

# COMPONENTS

## WEAR SOLUTIONS COMPONENTS



# Wear Solutions Components

Kennametal Stellite is a global provider of solutions for wear, heat, and corrosion problems, and is a world-class manufacturer of cobalt- and nickel-based materials and components.

Decades of experience and knowledge with cobalt and nickel alloys have produced a comprehensive portfolio of materials that have become industry-standard in many critical applications. We utilize a broad range of processes to transform our materials into application-specific solutions for our customers' challenging high-heat, erosion, and corrosion problems.

## **Industries Served**

Kennametal Stellite offers its proven heat, wear, and corrosion experience and customized solutions to a broad range of industries, including:

- **Aerospace**
- **Oil & Gas**
- **Automotive**
- **Power Generation**
- **Steel**
- **Lumber**
- **Glass**
- **Other Process Industries**



# Wear Solutions Components

Kennametal Stellite manufactures solutions that extend component life, reduce unplanned equipment downtime, and decrease maintenance expenditures. Solid components manufacturing starts with one of several casting, powder metallurgy, or wrought material processes. In addition to solid components, we utilize several hardfacing, coating, or cladding processes when a solid component is not required, or when the selected surface alloy cannot be reliably cast.

## Alloys & Custom Engineering

**Combining proprietary metal alloys and advanced materials expertise with specialized engineering design and fabrication.**

Everything we do begins with the identification of your high-temperature wear or corrosion problems in operating environments where equipment downtime or failure is costly to your operations. This identification, coupled with a thorough understanding of the wear mechanisms and operating environment, will lead to the component design, alloy selection, and manufacturing process selection that are best suited for your problem.

Our support is highly present in numerous industries that are negatively affected by wear, corrosion, and high temperatures. We deliver tailored wear solutions for customers in many industries, including: oil and gas, power generation, automotive, aerospace and defense, glass, pulp and paper, steel, galvanizing, wood cutting, food, and other process industries. To best serve these industries, Kennametal Stellite has developed more than 200 alloys with unique characteristics and properties. Our development engineers can also create a custom alloy specifically for you and your needs.

## Alloy Families

### Stellite™ Alloys

Stellite™ cobalt-based alloys are noted for their resistance to corrosion, erosion, and abrasion at elevated temperatures (up to 800°C). There are more than 20 Stellite™ alloys in this family.

A special Stellite™ alloy: Stellite™ 6B is a custom wrought (hot forged) material with outstanding resistance to most types of wear, and is extremely resistant to seizing or galling. High temperatures have little effect on the toughness and dimensional stability of this alloy.

### Deloro™ & Nistelle™ Alloys

Deloro™ nickel-based alloys exhibit excellent corrosion, abrasion, and wear resistance (up to 600°C), and have a wide melting range allowing them to be applied by the spray and fuse, and powder-weld processes. Nistelle™ nickel-based castings are noted for their outstanding corrosion resistance and are offered in a full range of ASTM, AMS, and ACI specifications.

### Tribaloy™ Alloys

These cobalt- and nickel-based alloys feature a hard inter-metallic laves phase, dispersed in a tough matrix of eutectic or solid solution. Tribaloy™ alloys exhibit outstanding resistance to high-temperature wear, galling, and corrosion, and are particularly suitable for use where lubrication is a problem.

### 700 Series™ Alloys

This family of cobalt-based alloys uses chromium and molybdenum as major alloying elements. These offer good wear resistance with superior corrosion resistance in reducing environments of hydrochloric, phosphoric, and naphthanic acid.

### Additional Materials

Stelcar™ and Super Stelcar™ composites have varying percentages of carbide in cobalt- and nickel-based matrices. These hardfacing materials are designed for extremely abrasive and erosive environments. Delcrome™ iron-based alloys provide excellent wear resistance where heat and corrosion are not factors.

***Industry-leading wear-resistant solutions in alloys-based science, hardfacing consumables, and components that excel in wear resistance in extreme temperatures and applications.***

*Stellite™, Nistelle™, Tribaloy™, Stelcar™, Super Stelcar™, and Delcrome™ are registered trademarks of Kennametal Inc.*

## ■ Alloy Characteristics

Alloy	Typical H.R.C.	Typical U.T.S. KSI	Typical ELONG. %	Typical Applications
<b>Cobalt-Based Alloys</b>				
Stellite™ 1	50–54	80	<1	Valve seat inserts, bearings, cutter edges
Stellite™ 3	51–58	80	<1	High-temperature with severe abrasion
Stellite™ 4	45–49	136	<1	Corrosion with erosion on pump parts
Stellite™ 6	39–43	121	1	Some wear and corrosion with ductility
Stellite™ 6B	33–43	140	11	Stock product with wear and corrosion resistance, excellent ductility
Stellite™ 6K	40–50	176	4	Excellent wear and corrosion resistance for knives and scrapers
Stellite™ 12	47–51	100	<1	High-temperature with wear resistance
Stellite™ 19	51–53	105	<1	High-temperature with abrasion
Stellite™ 20	53–59	80	<1	Pump sleeves, rotary seal rings, bearing sleeves
Stellite™ 21	25–30	105	9	Good ductility and corrosion resistance
Stellite™ 25	<20	134	5	High-temperature nitric acid
Stellite™ 31	28–35	107	10	Aerospace engine parts
Stellite™ 33	53–58	55	<1	High-temperature with severe wear and abrasion
Stellite™ 250	19–29	80	8	High-temperature oxidation resistance
Stellite™ Star J	53–60	62	<1	Severe high-temperature wear
Stellite™ 694	48–54	120	1	Gas turbine parts, such as turbine blade interlocks
Stellite™ 706	39–43	116	1	Wear and corrosion with ductility
Stellite™ 712	47–51	121	<1	High temperature with wear and corrosion resistance
Stellite™ 720	53–60	62	<1	High-temperature corrosion, severe wear and abrasion
Tribaloy™ T-400	51–58	100	<1	Good wear and corrosion resistance
Tribaloy™ T-400C	48–56	95	<1	Improved oxidation corrosion and abrasion resistance
Tribaloy™ T-401	45–50	94	1	Enhanced ductility with superior corrosion and wear resistance
Tribaloy™ T-800	50–58	100	<1	High-temperature with severe corrosion, wear, and abrasion
ULTIMET®	<25	105	15	Valve parts, forging dies, incinerator nozzles
<b>Nickel-Based Alloys</b>				
Deloro™ 50	42–58	77	<1	Wear and corrosion resistance
Deloro™ 60	57–62	70	<1	Extrusion press, screw barrel, pump impeller, plunger
Nistelle™ B-2C	20–25	90	20	Resists hot hydrochloric acid
Nistelle™ C	17–27	80	4	Hot metal stamping, piercing points, drop forging dies
Nistelle™ Super C	17–27	100	15	Similar to Nistelle™ C with improved wear and corrosion resistance
Nistelle™ X	90 HRB	55	8	High-temperature and corrosion resistance
Tribaloy™ T-700	42–48	NA	<1	High-temperature, wear, and corrosion resistance
Tribaloy™ T-745	37–46	87	<1	Similar to T-700 with better corrosion resistance
<b>Nickel-Based Super Alloys</b>				
INCONEL® 713	30–42	110	3	Vacuum melted high-temperature Ni-based superalloy
INCONEL® 718	25 max.	110	5	Vacuum melted high-temperature Ni-based superalloy
INCONEL® 625	90 HRB	85	25	Vacuum melted high-temperature Ni-based superalloy
<b>Iron-Based Alloys</b>				
Delcrome™ 90	51–55	65	<1	Severe cold abrasion
NoCo™ 02	40–44	150	8	Nuclear valve trim
Tribaloy™ T-506	31–38	94	2	High-temperature oxidation and wear resistance

ULTIMET® is a registered trademark of Haynes International.  
INCONEL® is a registered trademark of Huntington Alloys Corporation.

## Solid Component Processes

Solid components benefit from wear properties that are consistent throughout the component, particularly in shapes and configurations that would be difficult or impossible to protect otherwise. Solid components are produced by: casting, powder metallurgy, or wrought material processes. With our in-house, fully equipped and staffed machine shops, we are able to finish machine solid components to your surface and dimensional requirements.

### Investment Casting

Precision investment casting is ideal for intricately shaped components. The lost wax, ceramic shell process produces high near net-shape components with good as-cast surface finishes, minimizing machining requirements.

Alloys are melted in high-frequency induction furnaces, offering complete flexibility and metallurgical dependability. A wide range of cobalt, nickel, and stainless steel alloys can be poured in our investment foundries. All castings poured can be produced to print in our well-equipped machine shops.



### Vacuum Investment Casting

Similar to air-poured investment casting, this process utilizes a vacuum to remove air from the ceramic mold, allowing the pressure differential to fill the mold while eliminating oxidation during the pouring process. (This is particularly important when alloys include elements such as aluminum or titanium). This casting method is used most often to pour aerospace and industrial gas turbine components.

### Centrifugal Casting

Centrifugal casting is ideal for pouring high-quality cylindrical blanks that will be machined into ring or tubular-shaped components. As the name implies, a centrifugal force is employed by spinning a cylindrical mold around its long axis. This exerts pressure on the molten metal, pushing it against the outside walls of the mold, resulting in a very dense blank with a fine, uniform grain structure. These centrifugal casting blanks are subsequently finish machined into components.



## Sand Casting

The sand casting process is typically used for larger parts with thick cross sections. A sand mold is created using a relatively inexpensive pattern (often wood) in two halves. The halves are assembled, along with any cores required, to form the pouring mold. Sand castings can be poured in a wide range of cobalt, nickel, and stainless steel alloys. As required by your application; these castings can be machined to your print.

## Powder Metallurgy

Powder metallurgy is a process for making fully dense components with uniform microstructures from metal powder, which are free of non-metallic inclusions and defects.

A mixture of metal powder and a binder is formed to shape through either a pressing or extrusion process. This pre-form is heated to a temperature just below the melting point of the alloy. During this sintering process, the diffusion of metal atoms between the alloy particles produces strong bonds between the particles.

This process is particularly efficient for the production of large quantities of small parts with a simple shape, such as balls and saw teeth.

## Wrought Material

Stellite™ alloy 6B (AMS 5894) and Stellite™ alloy 6K are wrought materials whose physical properties are enhanced as the grain structure of the metal changes during plastic deformation. During this forming process, the wrought material achieves higher strength than cast material of the same chemistry.

Stellite™ alloy 6B (AMS 5894) is produced in both bar and sheet form while Stellite™ alloy 6K is produced only in sheet form.

These materials are then cut to shape (laser or water jet) and machined into components to a customer's drawing.

- AMS 5894
- PWA 1196 & BMS7-338 certified
- DFARS compliant
- Ultrasonically inspected
- Guaranteed mechanical properties



STELLITE ALLOY 6B SIZE RANGE		
Round Bar	Diameter	.312–6.000" (22 standard sizes)
	Length	Up to 160"
Flat Stock	Thickness	.031–1.000" (10 standard sizes)
	Sheet Size	Up to 36"x 96"

\*Custom sizes upon request



## Hardfaced Components

Hardfacing of components may provide the best solution in situations where wear is localized or where the best material is difficult to cast. Our wide range of materials enables us to take a targeted coatings approach to solve your difficult wear problems.

### High Velocity Oxygen Fuel (Jet Kote™ HVOF)

- Very dense coatings, excellent bonding, minimal metallurgical changes, and minimal temperature effects to the substrate.

### Plasma Spraying

- High-quality and dense coating, ideal for high melting-point materials.

### Flame Spraying

- Widely applicable, relatively low cost, if fused — metallurgical bond with substrate, liquid and gas tight.

### Plasma Transferred Arc (PTA)

- Highly automated, high powder utilization, low dilution, wide range of hardfacing materials available.

### Manual Metal Arc Welding

- Flexible, low cost, mobile, ideal for repairs.

### TIG Welding

- Manual operation, can be mechanized, low dilution.

### UltraFlex™ and Conforma Clad™ Processes

- Proprietary cladding processes well suited to complex geometries.
- Non-line-of-sight applications, such as inside diameters, strong metallurgical bonds with substrate, no Fe-dilution or heat-affected zones.

### Hardfacing Equipment and Materials Solution

Kennametal Stellite designs and manufactures state-of-the-art PTA and HVOF equipment, customized to work with our materials on your shop floor. Consider the added operational control you achieve with a turn-key equipment and materials solution.

*Jet Kote™, UltraFlex™, and Conforma Clad™ are registered trademarks of Kennametal Inc.*





## Industries Served

### Oil & Gas — Exploration and Production

Stellite™ components are found in MWD and LWD tools, tri-cone bits, mud pulser units, auto chokes, pressure pumps, artificial lift equipment, and severe service and safety valves.

### Automotive & Diesel

Solid Stellite™ components are found in turbo-chargers and EGRs while Stellite™ coating materials are used to protect the sealing surface of engine valves.

### Power Generation

Stellite™ materials are used in steam handling valves, IGT combustor and hot gas path components (including blades and vanes), IGT frame components, steam turbine erosion shields, and nuclear control rod mechanisms.

### Food Processing

Kennametal Stellite provides components fabricated from FDA-approved alloys, which are utilized in food handling, processing, bottling, and canning equipment.

### Aerospace

We specialize in small to medium-sized structural components such as those found in combustor and hot gas path engine applications or in rod-end bearing applications.

### Petrochemical/Chemical

Solid Stellite™ and bimetallic components (for field assembly), as well as UltraFlex™ clad components, are utilized in a range of refinery applications such as nozzles, thermowells, spargers, valve trim and bodies, pump components, and return bends.

### Severe Service Valves

Our materials and components are found in severe service metal-seated ball, butterfly, and gate control valves.

### Other Processing Machines and Equipment

Many OEMs use our alloy components within their equipment to ensure longer life and reliability for their machines. You will find Stellite™ materials in virtually all process industries.





## Finish Machining of Components

Kennametal Stellite component production facilities offer full finish-machining capability, providing customers with a one-stop, ready-to-use component.

We are the experts in machining the alloys we pour or apply. Our highly skilled machine shop staff with years of experience, along with our state-of-the-art CNC equipment, enable us to produce components to your drawing.

Our extensive finishing capabilities include:

- Turning
- Milling
- Drilling
- Grinding (cylindrical, centerless, knife, double disc)
- Lapping
- Balancing
- Wire/Die Sink EDM
- Cutting (laser, water jet)





## Quality Systems & Certification



Extensive quality systems assure that our components and process control meet your high expectations. Our facilities maintain **ISO 9001:2015** and **AS9100D** certifications, as well as **NADCAP** for **NDT**. In addition, we hold numerous customer-specific and industry-specific qualifications in segments such as aerospace, power generation, and nuclear.

## Inspection Capability

In accordance with customer requirements, we verify and document a wide variety of features through measurement, chemical analysis, radiography, and fluorescent penetrant crack detection. We perform destructive tests as required, and also work with independent testing firms capable of performing third-party inspections and over-checks.

Our certification, qualification, and testing capabilities are continuously expanding. Feel free to discuss your requirements with our staff.

# WEAR SOLUTIONS COMPONENTS

For customer service or to place an order contact:

**AMERICAS SALES OFFICE**  
North America: +1 800 267 2886  
Phone: 1.613.968.3481  
Fax: 1.613.966.8269  
E-mail: [k-bvl.service@kennametal.com](mailto:k-bvl.service@kennametal.com)

[stellite.com](http://stellite.com)



**WORLD HEADQUARTERS**

**Kennametal Inc.**

1600 Technology Way  
Latrobe, PA 15650

USA

Tel: 1 800 446 7738

E-mail: [ftmill.service@kennametal.com](mailto:ftmill.service@kennametal.com)

**EUROPEAN HEADQUARTERS**

**Kennametal Europe GmbH**

Rheingoldstrasse 50

CH 8212 Neuhausen am Rheinfall

Switzerland

Tel: +41 52 6750 100

E-mail: [neuhausen.info@kennametal.com](mailto:neuhausen.info@kennametal.com)

**ASIA-PACIFIC HEADQUARTERS**

**Kennametal Singapore Pte. Ltd.**

3A International Business Park

Unit #01-02/03/05, ICON@IBP

Singapore 609935

Tel: +65 6265 9222

E-mail: [k-sg.sales@kennametal.com](mailto:k-sg.sales@kennametal.com)

**INDIA HEADQUARTERS**

**Kennametal India Limited**

CIN: L27109KA1964PLC001546

8/9th Mile, Tumkur Road

Bangalore - 560 073

Tel: +91 080 22198444 or +91 080 43281444

E-mail: [bangalore.information@kennametal.com](mailto:bangalore.information@kennametal.com)

**[kennametal.com](http://kennametal.com)**