

REFINERY

REFINERY AND FCCU APPLICATIONS



Refinery And FCCU Applications

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

Kennametal Stellite offers proven solutions in solid cast or coated form to the refinery and FCCU market segments. Typical applications include:

- **Nozzles**
- **Thermowells**
- **Valve Trim & Bodies**
- **Pump Components**
- **Return Bends**



Kennametal Stellite™ Refinery and FCCU Applications

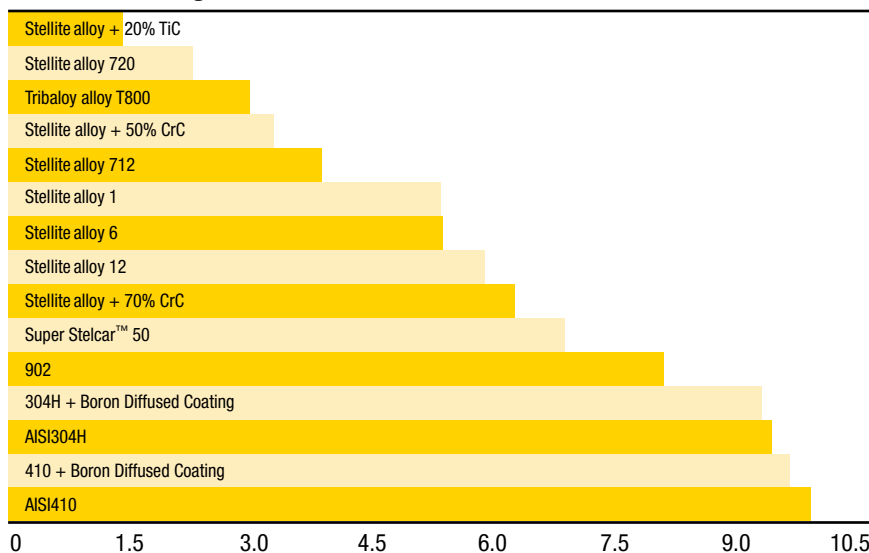
Kennametal Stellite manufactures solutions to extend component life, reduce unplanned down time, and decrease maintenance expenditures. Typical applications in the refinery industry include nozzles, thermowells, valves, and pump components. To meet customer needs, Kennametal Stellite rapidly develops and supplies a finish-machined component utilizing one or more of the following processes:

- Investment Casting
- Vacuum Casting
- Sand Casting
- Centrifugal Casting
- Powder Metallurgy
- Wrought Material & Processing
- Coatings/Claddings
- Finish Machining

High-Temperature Erosion Resistance

Stellite alloys are noted for their high-temperature erosion resistance in a multitude of industries. In petroleum refining, the reactor and regenerator sections of the FCCU's pose severe erosion problems. During an accelerated wear test at regenerator temperatures (700°C), using an FCCU catalyst as the erosive media, cobalt-based alloys such as Tribaloy™ alloy T-800 and Molybdenum-containing Stellite alloy 720, showed a significant engineering advantage over 304, 410, and boron diffused 410. These cobalt and molybdenum alloys provide an exceptional blend of high-temperature sulfidation, oxidation, and erosion resistance. In even more demanding situations, alloy matrix composites such as Stellite alloy TiC20 are candidate materials.

Erosion Testing 700°C



Weight Loss in mg →

Test Conditions

- Temperature 700°C • Erodant FCCU catalyst
- Angle 60° • Velocity 100 m/s • Particle flux

Tests carried out at the Chemical & Metallurgical Engineering Department of the University of Alberta, Edmonton, Canada.

Refinery Applications

Nozzles

A variety of nozzle configurations are used in refining and petrochemical processing to handle the injection and introduction of steam, air, hydrocarbon feed, coke, and other chemicals. Nozzles must be designed to retain dimensional and structural integrity from turnaround to turnaround. Abnormal erosion or fracture can seriously jeopardize process safety and the economics of the operation. Typical examples of wear-resistant nozzles that Kennametal Stellite manufactures include riser/reactor feed nozzles, regenerator air nozzles, steam stripping nozzles, orifice chamber nozzles, and fluid coker nozzles.

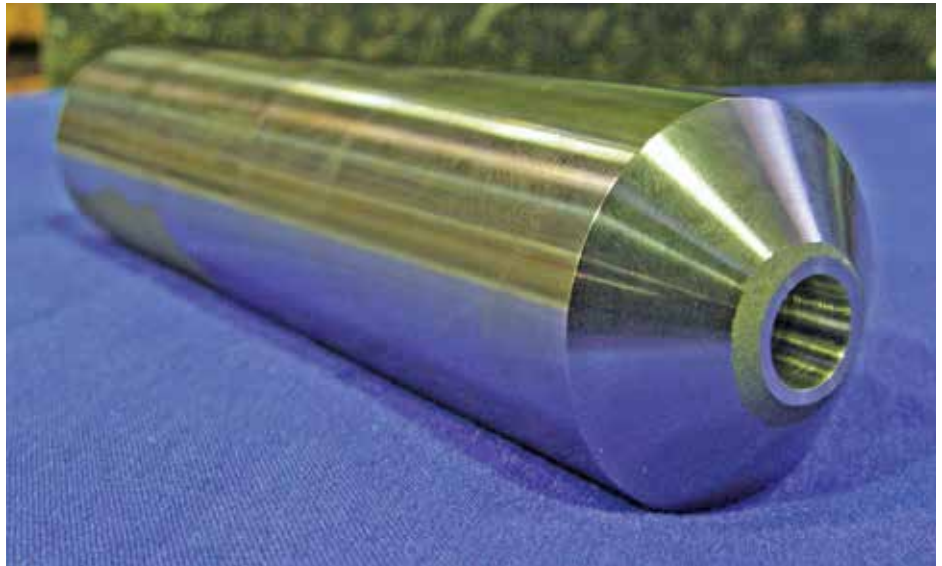
To facilitate field installation, nozzles may be supplied as bimetallic cast components (the nozzle itself is a Stellite™ casting and the saddle is 304 SS).

Thermowells

Of all metallic components in the refining and chemical processing industry, thermowells are exposed to the most severe environments and require special attention. Flame spray or welded coatings of Stellite alloy 6, 12, or 1 are often used as a first line of defense in extending service life. Further enhancements to service life are achieved utilizing Stellite alloy 6 or 12 cast components. Maximum life is realized from a combination of Stellite castings overlaid with Stelcar™ coatings such as T-800 (Tribaloy™), JK125 (chromium carbide) or JK117 (tungsten carbide). Thermowells, UltraFlex™ coated with the Mo-containing Stellite 700 series alloys, combat naphthenic acid corrosion in vacuum distillation and hydrochloric acid corrosion in catalytic reformers.



Refinery nozzles



Thermowell

Valves

As metal-to-metal wear is accelerated at high temperatures, valve trim, such as plugs, balls, gates, seats, stems and slides, must be manufactured or repaired with alloys exhibiting good hot hardness to resist the effects of high-temperature softening. Available solutions range from UltraFlex™ cladding and coatings, to castings and powder metallurgy parts for smaller components.

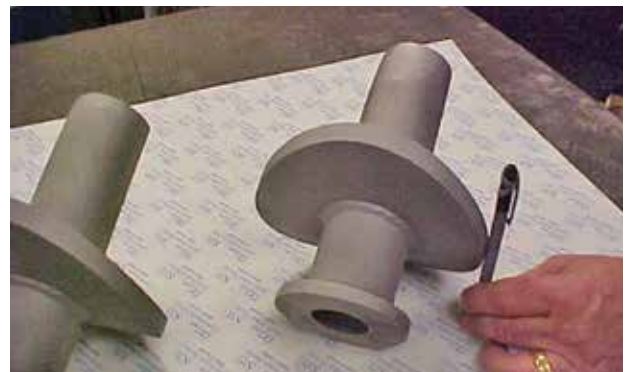
Cobalt alloys, such as Stellite™ 6, 12, and 1, have been used extensively on large control valve seats and slides. While these alloys perform well, Tribaloy™ alloys and composites, such as Stellite CrC50 and Stellite TiC20, are designed to resist even higher temperatures. Tribaloy alloy T-800 is used for valves operating in MTBE service.

Pump Components

Pump casings can be cast or selectively thermally sprayed with various Stellite alloys. Extend casing life even further with the use of replaceable pump liners manufactured from Delcrome™ alloys (for low-temperature service) or Stellite 6 (for more corrosive or high-temperature service).

Pump impellers experiencing high levels of cavitation (such as boiler feed pumps) can be cast from cavitation-resistant alloys Stellite 6 and Stellite 21. Both open and closed impellers may be cast from Stellite alloys with further enhancements in wear and corrosion protection being provided by selectively thermally spraying high-wear areas.

Wear rings are generally hardfaced with alloys such as Stellite 6 or Deloro™ 60 (in HF service). In severe wear environments, wear rings are thermally sprayed with Stelcar™ composites that incorporate carbides of tungsten (JK117) or chromium (JK135). Mechanical seal faces may be thermally sprayed with Stelcar composites containing tungsten carbide.



Pump and valve components

Manufacturing Processes

Stellite™ refinery products are manufactured by:

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.

Sand Casting

Sand casting 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. These castings can be machined to your print.

UltraFlex™ Cladding

The UltraFlex process offers a wear-resistant, metallurgically-bonded surface treatment and brings industry-leading performance to components with complex geometries. UltraFlex cladding has been proven as a successful technology in applications such as return bends in DCU fired heaters, thermowells, nozzles, and many other applications where longer life and reliability are critical. Kennametal UltraFlex cladding is available in a broad array of materials, ensuring the optimum solution for the wear environment in your refinery application.

HVOF Coating

The High Velocity Oxygen Fuel (JetKote™ HVOF) coatings systems applies very dense, well-bonded coatings with minimal metallurgical changes and minimal temperature effects to the substrate. A gas flame burns under high pressure in a chamber and powder is introduced coaxially into the high velocity gas stream. The powder is transferred by the gas stream, with high kinetic energy, to the surface of the workpiece.

■ Alloy Information

ALLOY	Ni	Co	Cr	W	Mo	Fe	C	Si	Re/Vickers, Room Temp.	Vickers, 800°F	Vickers, 1200°F	Vickers, 1400°F
COBALT-BASED ALLOYS												
Stellite 6	—	bal	28	5	—	—	1.2	—	41 / 410	300	260	185
Stellite 706	—	bal	29	—	5	—	1.2	—	41 / 410	290	241	212
Stellite 12	—	bal	29	9	—	—	1.8	—	45 / 440	345	275	245
Stellite 712	—	bal	29	—	8.5	—	1.8	—	46 / 455	390	340	284
Stellite 1	—	bal	31	13	—	—	2.3	—	52 / 547	475	380	260
Stellite 720	—	bal	33	—	18	—	2.5	—	60 / 697	530	330	250
Tribaloy T900	16	bal	18	—	23	—	<0.08	2.7	54 / 577	620	440	270
Tribaloy™ T800	—	bal	17.5	—	28.5	—	<0.08	3.4	58 / 653	660	485	310
NICKEL-BASED ALLOYS												
Deloro 40	bal	—	7.5	—	—	2.5	0.25	3.5	45 / 440	327	215	90
Deloro™ 50	bal	—	11	—	—	2.6	0.4	3.8	55 / 597	413	230	110
Nistelle™ C4C	bal	—	17	—	17	—	<0.02	—	22 / 248	—	—	—
Nistelle X	bal	1.5	22	0.6	9	19	<0.2	—	90(Rb) / 192	—	—	—

Stellite™, Tribaloy™, Nistelle™, UltraFlex™, and JetKote™ are registered trademarks of Kennametal Inc. Deloro™ is a registered trademark of Madison Industrial Solutions Corporation.



Refinery and FCCU Applications

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