

REFINERY

REFINERY AND FCCU APPLICATIONS



Refinery And FCCU Applications

Kennametal Stellite is a global provider of solutions to wear, heat, and corrosion problems and is a world-class manufacturer of Cobalt and Nickel based materials and components.

Kennametal Stellite offers proven heat, wear and corrosion 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

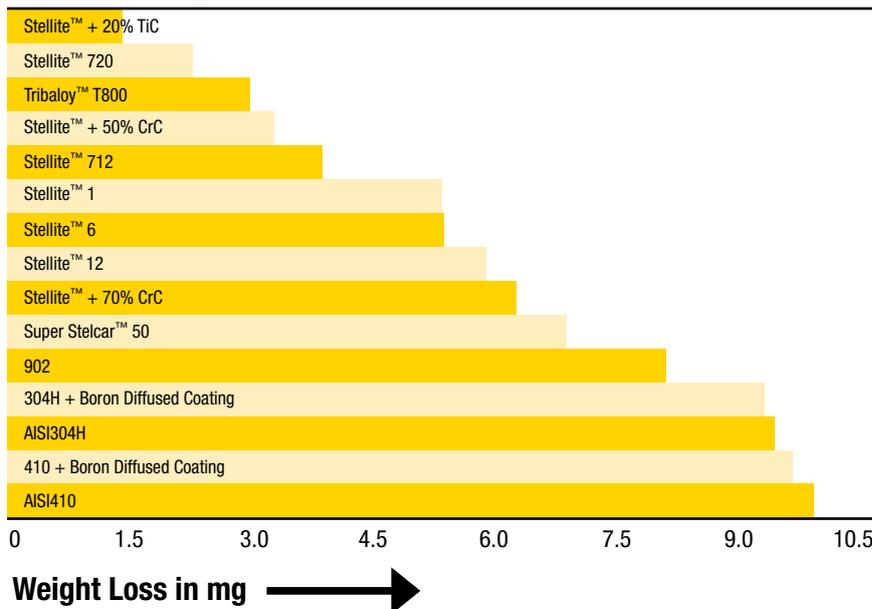
Kennametal Stellite manufactures solutions that extend component life, reduce unplanned down time, and decrease maintenance expenditures. Typical applications in the refinery industry include nozzles, thermowells, valves, and pump components. To meet customer needs, Kennametal Stellite rapidly develops 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 and 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™ T-800™ and Molybdenum-containing alloy Stellite™ 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™ TiC20 are candidate materials.

Erosion Testing 700°C



Test Conditions

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

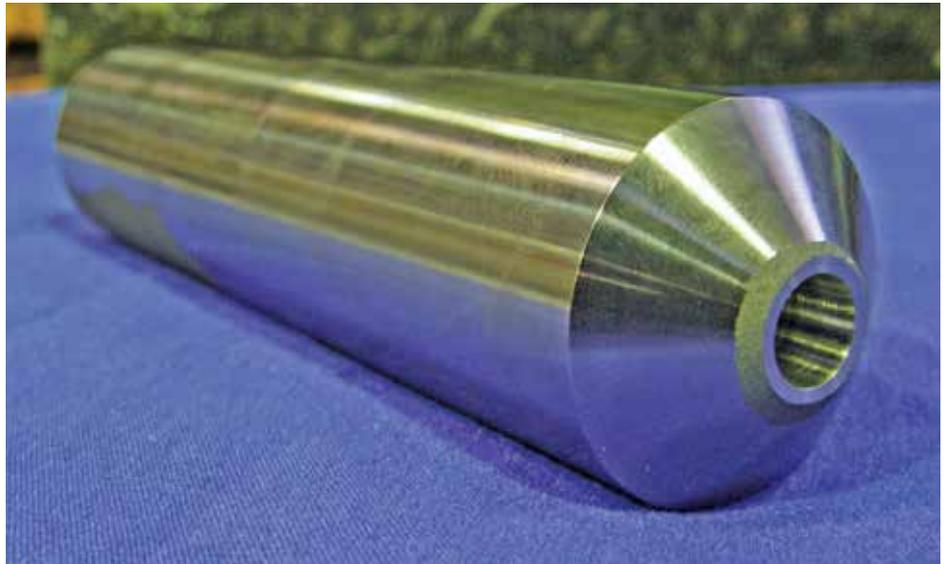
Tests carried out at the Chemical & Metallurgical Engineering Department of the University of Alberta, Edmonton, Canada.

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 various other chemicals. Nozzles must be designed to retain their 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).



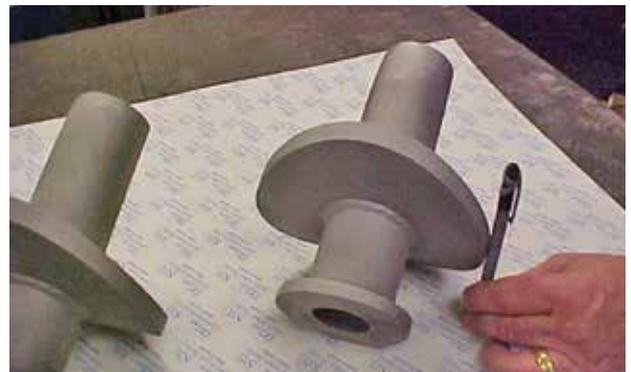
Thermowells

Of all metallic components in the refining and chemical processing industry, thermowells are exposed to the most severe of environments and, as such, require special attention. Flame spray or welded coatings of Stellite™ 6, 12, or 1 are often employed as a first line of defense in extending service life. Further enhancements to service life are achieved by utilizing Stellite™ 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 naphthanic acid corrosion in vacuum distillation and hydrochloric acid corrosion in catalytic reformers.

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 that exhibit good hot hardness to resist the effects of high-temperature softening. A variety of solutions are available, ranging 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 for years on large control valve seats and slides. While these alloys continue to work well, Tribaloy™ alloys and composites such as Stellite™ CrC50 and Stellite™ TiC20 are designed to resist even higher temperatures. Tribaloy™ T-800 is used for valves operating in MTBE service.



Pump Components

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

Pump impellers that experience high levels of cavitation (such as boiler feed pumps) may 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 Stellite™ 6 or Deloro™ 60 (in HF service). In severe wear environments, wear rings are thermally sprayed with Stelcar™ alloys that incorporate carbides of tungsten (JK117) or chromium (JK135). Mechanical seal faces may be thermally sprayed with Stelcar™ alloys containing tungsten carbide.



Stellite™ Refinery Products are Manufactured By:

Sand Casting

The sand casting process is typically used for larger parts with thick cross sections. A sand mould 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 mould. 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.

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.

UltraFlex™ Cladding

UltraFlex™, a wear-resistant, metallurgically-bonded surface treatment, brings industry-leading performance to components with complex geometries in the refining industry. UltraFlex™ is a proven process for extending component life and increasing productivity. Kennametal's 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	—	—	—



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