TriCom-HT™

Overview

TriCom-HT is a proprietary electro-deposited coating developed to provide excellent wear and oxidation resistance for high temperature metal seals and sealing components. TriCom-HT comprises a unique cobalt-nickel alloy matrix co-deposited with chromium carbide (Cr_2C_3) and MCrAlY particles to provide a wear and oxidation resistant system for prolonged use at 1400°F (760°C) and limited exposure up to 1550°F (843°C).

TriCom-HT is designed to significantly reduce the wear of metallic sealing elements caused by thermal expansion and vibrational movement between mating surfaces.

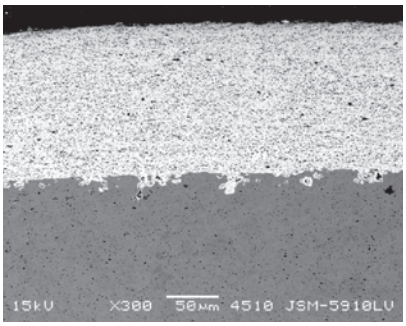

Figure 1: TriCom-HT is a composite coating consisting of a cobalt-nickel matrix with chromium carbide and MCrAlY reinforcing phases.

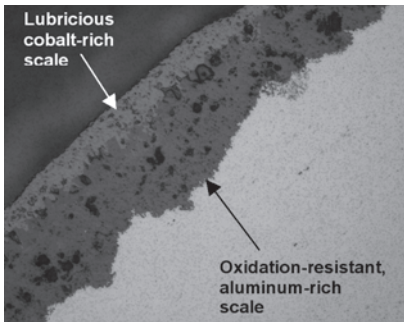

Figure 2: TriCom-HT forms a multi-layer oxide scale at service temperatures to simultaneously slow oxidation and wear.

Coating Structure:

TriCom-HT is a composite tribological coating containing finely dispersed reinforcing phases of chromium carbide and MCrAlY particles (Figure 1). Cobalt in the coating matrix provides high temperature lubricity while nickel provides ductility, oxidation resistance and increased hardness to prevent abrasive wear. Chromium carbide reduces the wear rate by acting as a solid lubricant when partially oxidized. MCrAlY is used as a vehicle to introduce strong oxide forming metals into the coating to increase oxidation resistance and coating adhesion to the substrate. Upon heating in air, chromium oxide, alumina and yttria form within the coating matrix, slowing further oxidation of the coating. Cobalt oxide and chromium oxide also form on the coating surface, providing a lubricious oxide glaze that decreases both the coating and counter face wear rates (Figure 2).

Coating Performance:

TriCom-HT is designed to balance wear resistance with oxidation resistance to provide a long lasting solution to high temperature wear. TriCom-HT was tested using a high temperature linear reciprocating wear tester to fully evaluate the coating at each stage of development.

The unique composition of TriCom-HT significantly improves oxidation and wear behavior compared to typical cobalt chromium carbide coatings (Figure 3), extending the service temperature and life of the coating. In high temperature, high frequency friction and wear tests (modified ASTM D 5707 method) TriCom-HT coated samples exhibited less wear than samples coated with a cobalt chromium carbide coating. The wear rate of TriCom-HT coated samples remained stable throughout the test temperature range of 1350°F to 1500°F (732°C to 816°C).

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Table 3 compares the oxidation behavior of TriCom-HT to competitive wear resistant coatings at 1350°F (732°C). The oxidation rate of TriCom-HT approximates that of nickel-based coatings, and is an order of magnitude better than typical cobalt chromium carbide coatings.

Applications:

TriCom-HT is typically applied to temperature resistant metals including stainless steels, nickel and cobalt superalloys. TriCom-HT works well in both oxidizing environments, such as air, and carburizing atmospheres including exhaust gases.

TriCom-HT is suitable for any high temperature static sealing application where differential thermal expansion or vibrational wear may occur. Typical applications include resilient metal seals, sealing components for land based and aviation gas turbines, and diesel exhaust components.

Figure 4: TriCom-HT prevents wear in high load metal to metal sealing applications such as these automotive exhaust manifold couplers.

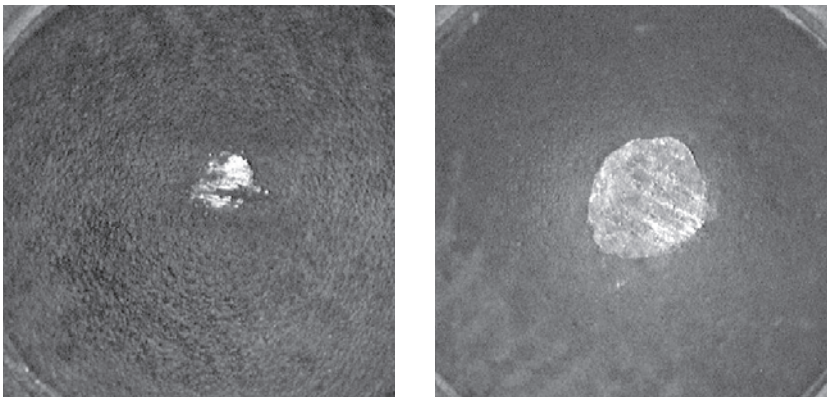

Figure 3: Wear scar on coated spheres from high temperature ball-on-flat wear tests. TriCom-HT (at left) exhibits significantly less wear after 72-hours at 1350°F (732°C) than a typical cobalt chromium carbide coating (right). Contact stress was 46 ksi (317 MPa) and total wear distance was 4.9 miles (7.9 km).

Table 1: TriCom-HT Characteristics	
Hardness	450-500 HVN 45 - 49 HRC
As-Coated Surface Finish	64 µin (1.6 µm) Ra or Better
Coating Thickness	As Specified .001 to .005 in. (0.025 to 0.127 mm) Typical
Service Temperature	1400°F (760°C) Continuous 1550°F (843°C) Maximum

Table 2: Test Parameters for High Temperature Wear Tests	
Test Laboratory	Parker Hannifin Advanced Products – North Haven, CT
Motion	Linear Reciprocating (0.25 inch stroke)
Frequency	145 cycles/min
Test Duration	622,500 cycles (72 hours)
Temperature	1350°F (732°C)
Contact	10 mm ball-on-flat
Contact Stress	46.0 ksi (317 MPa)

Table 3: Oxidation Testing at 1350°F for 72 Hours in Air	
Coating	**Scale Thickness**
TriCom-HT	5.8×10^{-4} in
Cobalt Chromium Carbide Coating	1.9×10^{-3} in
Nickel Chromium Carbide Coating	3.5×10^{-4} in

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