HVAF Flash-Carbide: An Economical Alternative To Electroplated Hard Chrome

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Flash-Carbide:

Flash-Carbide is hard (over 1400 HV$_{300}$) and very dense coating of WC-10Co-4Cr composite material, applied with Kermetico High-Velocity Air-Fuel (HVAF) spray method onto various metallic parts and structures to improve their surface resistance to severe wear and corrosion.

The Flash-Carbide coating:

• **thickness is comparable to dimensional tolerances** of the treated parts (15-35 micron)
• **small thickness deviation**, about 1 micron,
• **as-sprayed surface roughness is similar to ground surface**, typically $R_a = 1.5$ micron or lower.

Thus, the Flash-Carbide surface does not require dimensional grinding. Final surface roughness is achieved with a simple polishing.
Cross-sectional micrographs of Electroplated Hard Chrome EHC (a) and Flash-Carbide (b) coatings

Micrograph images is a courtesy of GE Global Research, Niskayuna NY USA
Flash-Carbide (cont.)

• Coating is dense to meet industry specifications for corrosion resistance (typically set as duration without traces of corrosion during salt-spray corrosion testing).

• Mechanical properties, such as fatigue resistance, wear and erosion resistance, impact resistance, etc. exceed existing values for Electroplated Hard Chrome.

When coating cylindrical parts, such as hydraulic rods, pump plungers and shafts, the sprayed-and-finished Flash-Carbide cost drops below 0.04 USD per sq.cm (under 37 USD per sq. foot), which is 10…20 -times lower than typical HVOF carbide coating.
Flash-Carbide:
Survives 1000-hr salt spray corrosion test at as-sprayed thickness as low as 15 microns
Flash-Carbide: ASTM B117 Salt Spray Corrosion Test
AK06 HVAF WC-10Co4Cr: 25 µm (0.0010“) thickness as-sprayed

0 h 168 h 336 h 504 h 672 h 1008 h
Flash-Carbide: ASTM B117 Salt Spray Corrosion Test
AK06 HVAF WC-10Co4Cr: 15 µm (0.0006“) thickness as-sprayed

0 h  168 h  336 h  504 h  672 h  1008 h
Flash-Carbide:
Wear resistance exceeds electroplated chrome by 20+ fold
Flash-Carbide: ASTM G174 Loop Abrasion Test

Test results is a courtesy of GE Global Research, Niskayuna NY USA

Average Volume Loss (mm³)

- Flash Carbide: 0.015
- Chrome: 0.40

Kermetico
Flash-Carbide (FC): Abrasive Wear Test vs Electroplate Hard Chrome (EHC)

Test results is a courtesy of Prof. Li Changxin, Xian Jiatong University, China

Abrasive Wheel (400 $\mu$m Al$_2$O$_3$) Diameter 210 mm, rotation 97 RPM, Load 25N, duration 1 min

<table>
<thead>
<tr>
<th></th>
<th>EHC (1)</th>
<th>EHC (2)</th>
<th>EHC (3)</th>
<th>Flash Carbide (1)</th>
<th>Flash Carbide (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume Loss, mm$^3$</td>
<td>3.45</td>
<td>4.35</td>
<td>2.68</td>
<td>0.065</td>
<td>0.115</td>
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</tbody>
</table>
Flash-Carbide: Residual stresses
ASTM 2447 Rev. D: Almen strip (Type N-1S), Arc height measurements

Flash-carbide thickness coating (20-40 μm) matches the typical Almen strip requirements

Full-thickness coating (100-120 μm) is over-stressed

Typical industry requirement: 6-12 mils
Flash-Carbide
Cost Structure
Hydraulic rod, Diameter 38 mm x Length 550 mm (1.5” OD x 21.65” L)

Spraying: 8.50 USD  +  Polishing: 13.60 USD  +  Handling: 2.20 USD  =  TOTAL: 24.30 USD

As-received
Ground to lower dimensional tolerance

As-sprayed
30 micron, Ra 1.50 μm

Polished
21 micron, Ra 0.20 μm