




KERMETICO

**Convertible HVAF+HVOF
Thermal Spray Equipment**

2017

HVOF WCCoCr Coatings

Rivalry: a Zero-Sum Game



- Tungsten carbide is the most widely sprayed wear-resistant coating. HVOF is currently the standard WC deposition method and WCCoCr accounts for the largest HVOF business segment.
- Many customers perceive HVOF WC coatings as prohibitively expensive, because:
 - Costs of powder, oxygen, and spare parts are high
 - Spray rates are low -> many expensive workhours to spray
 - Deposition efficiency is low
- HVOF WC quality does not justify the cost:
 - WC decomposes at high HVOF temperatures, making brittle coatings
 - Mechanical properties of HVOF WC are still far from theoretically possible
 - Process deviation is high -> quality is not consistent

Result 1: Tungsten carbide coating is too expensive for many applications.

- Substitutes are present, each of them having their own problems:
 - Hard chromium electroplating is carcinogenic
 - Laser clad and PVD/CVD coatings cannot reach WC performance, but growing

Result 2: Growing competition squeezes HVOF spray shops profits.

Kermetico C: Win-Win for an End-User and a Shop



- Kermetico Convertible HVAF/HVOF Systems

5+ times higher spray rates than conventional HVOF. Gas fuel: propane, propane-butane, propylene or natural gas. Axial powder injection. Minimized material decomposition and oxidation. One system – many guns. Blast & spray with one gun.

- A Job Shop Gets Competitive Edge

Exceptional HVAF deposition rate while meeting quality standards.

Unprecedented technological efficiency. Safe (no flashback possible).

Works with the existing HVOF infrastructure. Easy to operate and support.

Less than ½ of conventional HVOF WCCoCr coating cost @\$50/kg WCCoCr.

- An End-User Gets New Quality and Applications

Higher coating quality for existing materials: high density and strength, high hardness combined with ductility (no embrittlement), consistent results. Low roughness of as-sprayed coatings. New geometries and new applications are feasible for high velocity spray.

Kermetico Convertible Guns

Convertible equipment works in HVOF or HVAF mode.

- Meet-the-spec HVOF mode: same HVOF powder size, same process, high DE, higher spray rate, ½ of the cost of conventional HVOF
- Beyond the spec HVAF mode: fine powder, no Oxy. Higher-value, harder, less brittle, ductile, non-permeable, smooth as-sprayed coatings
- [C7](#) – a high power gun for spraying metals and carbides onto large parts with the best cost and quality.
- [C6](#) – a universal thermal spray gun to deposit metals, alloys, and cermets onto a variety of parts.
- [ID](#) – a gun to spray onto internal diameters 80 mm (3.15”) and larger

Additional HVAF-only guns you may use with the same system:

- [AK5](#) – a compact spray gun
- [AK-IDR](#) – a rotating gun to spray IDs 100 mm (4”) and larger
- [AK-HH](#) – a manual HVAF gun
- [Specialized](#) guns

All the equipment is controlled by the industrial IP67-rated tablet + PLC.



Kermetico C7

The most powerful HVOF/HVAF gun for massive parts, parts with diameter >200mm (8").

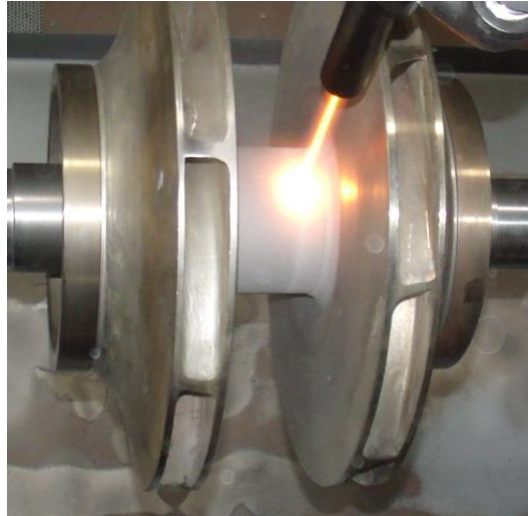
- ✓ Selectable HVAF or HVOF mode
- ✓ Ductile, high-hardness coatings with low hardness deviation
- ✓ Perfect combustion + optimal nozzle design
- ✓ The best protection against feedstock oxidation is in HVAF mode
- ✓ Most flexible hardware setup (a large selection of different chamber, injector and nozzle combinations to best fit your task)
- ✓ 5-20 to 20-53 μm powder sizes, suspension spray
- ✓ 33+ kg/hour (73+ lbs./hour) with 60% DE lets you spray 0.25 mm (0.001") thick 1 m² (11 ft²) WCCoCr coating in just 10 minutes!
- It is too powerful for small parts or IDs



Kermetico C6

Universal gun to deposit metals and carbides onto a variety of parts:

- ✓ With 2/3 of C7 gun power, maximum spray rate - 28kg/hour (62 lbs./hour)
- ✓ Works great on medium to small parts, well on larger parts
- ✓ Wide tuning range: HVOF + Economy, Balanced or Ultra HVOF modes
- ✓ 5-20 to 20-53 μm powder size ranges



Kermetico HVOF/HVAF ID Gun

High velocity combustion equipment to apply coatings onto internal diameters of pipes, nozzles, sleeves, elbows, etc.

- ✓ ID – a gun to spray internal diameters 80 mm (3.15”) and larger, reach up to 1.5 m (5’) deep
- ✓ Maximum spray rate – 5 kg/hour (11 lbs./hour)
- ✓ Spray angle - 90°
- ✓ Elegant design, axial powder feed + air cooling provide long life and high technological stability
- ✓ 1-10 to 3-15 μm powder sizes
- ✓ Sprays WCCoCr and Hastelloy-type powders



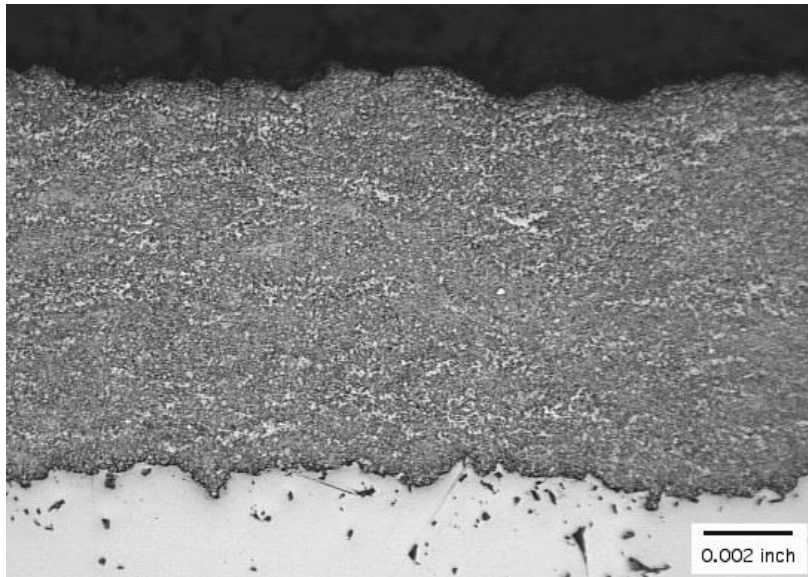
Tungsten Carbide Spray Modes



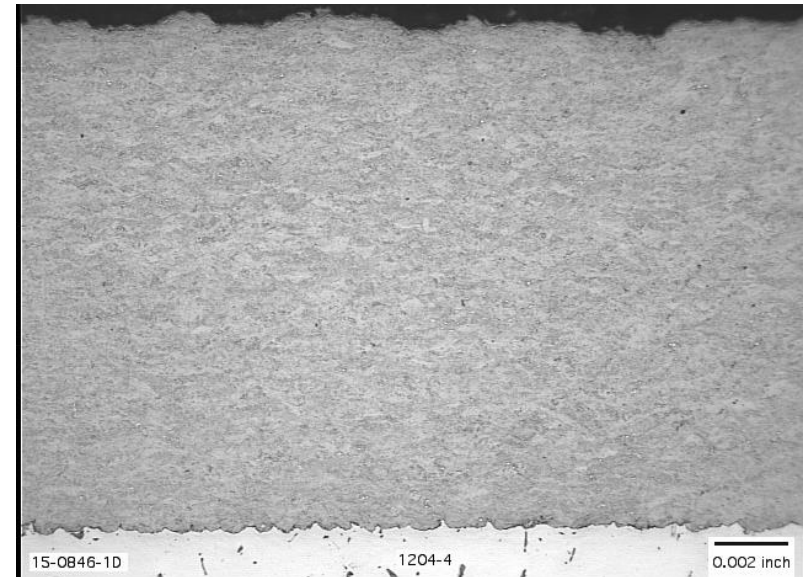
WC-10Co-4Cr Spray Mode	Coating Hardness , HV ₃₀₀	Coating Porosity, %	Deposition Efficiency, %
HVOF	1,050-1,250	<0.8	55
HVAF Economy (E)	1,050-1,250	<0.8	65+
HVAF Balanced (B)	1,250-1,350	<0.5	48 – 58
HVAF Ultra (U)	1,350-1,600+	<0.3	36 – 42

- spray AMS-specified powders in HVOF mode with HVAF spray rates
- save money in HVAF economy, getting HVOF quality with a lower cost
- use the highest quality HVAF U-mode to get high-hardness ductile coatings
- or choose HVAF Balanced mode to gain in both cost and quality

HVOF and HVAF Mode Micrographs WCCoCr



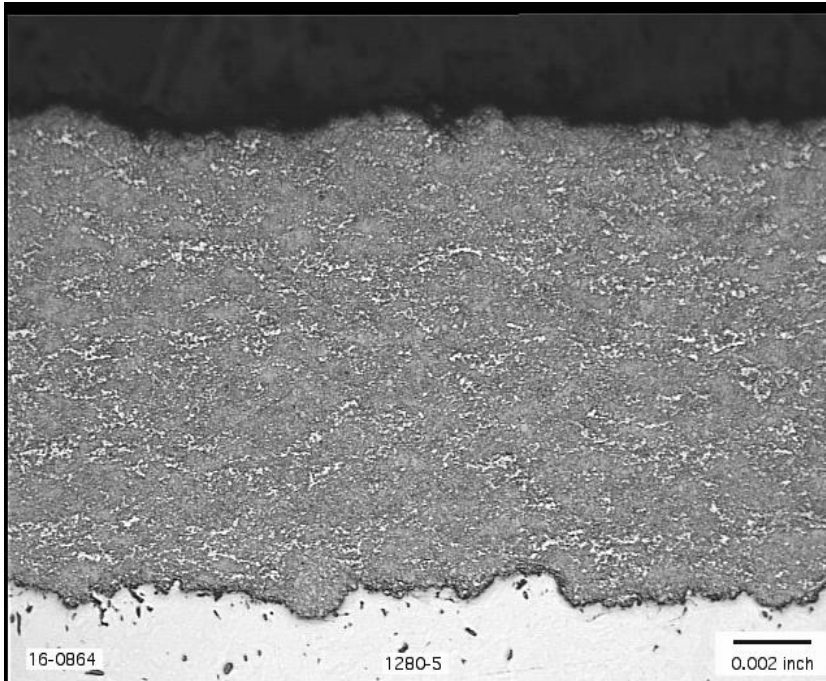
AMS 7882-specified WC-10Co-4Cr powder in HVOF mode, hardness 1,180 HV₃₀₀, DE 50%, porosity less than 0.5%



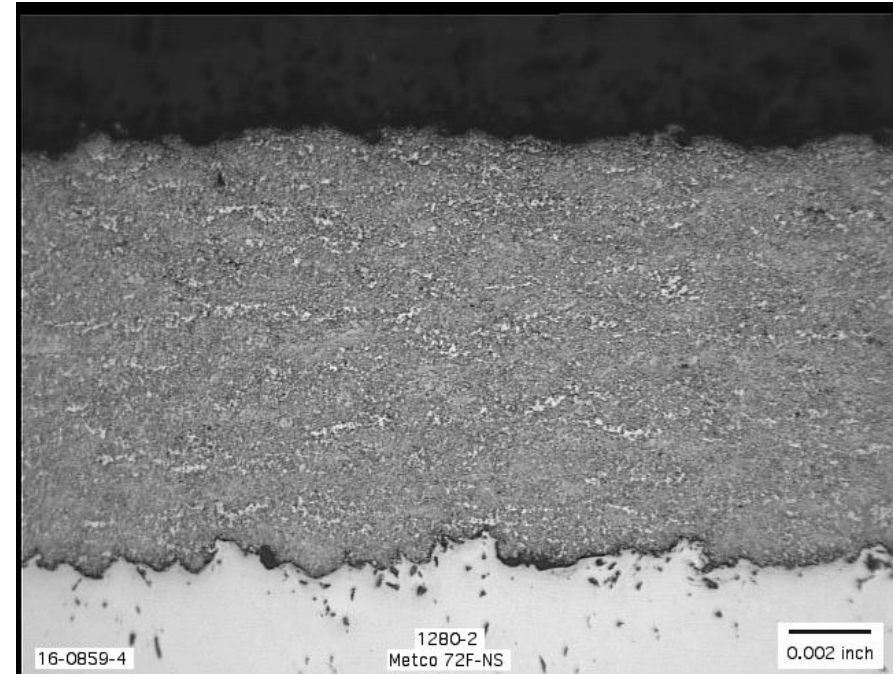
H.C. Starck Amperit WC-10Co-4Cr in HVAF U-mode. Hardness 1,450 HV₃₀₀, DE 45%, gas impermeable, porosity less than 0.5%

HVOF

Mode Micrographs WCCo

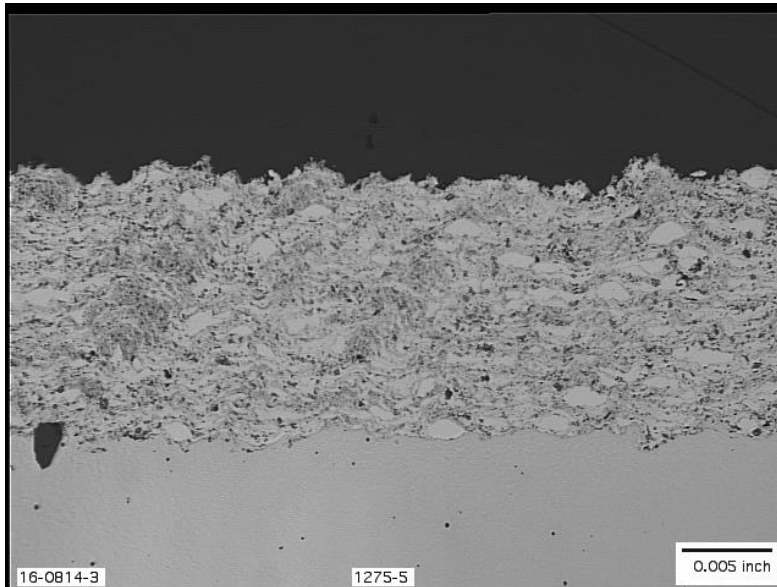


AMS 7880-specified sintered and crushed WC-12Co powder in HVOF mode, hardness 1,152 HV₃₀₀, DE 48%, porosity less than 0.5%

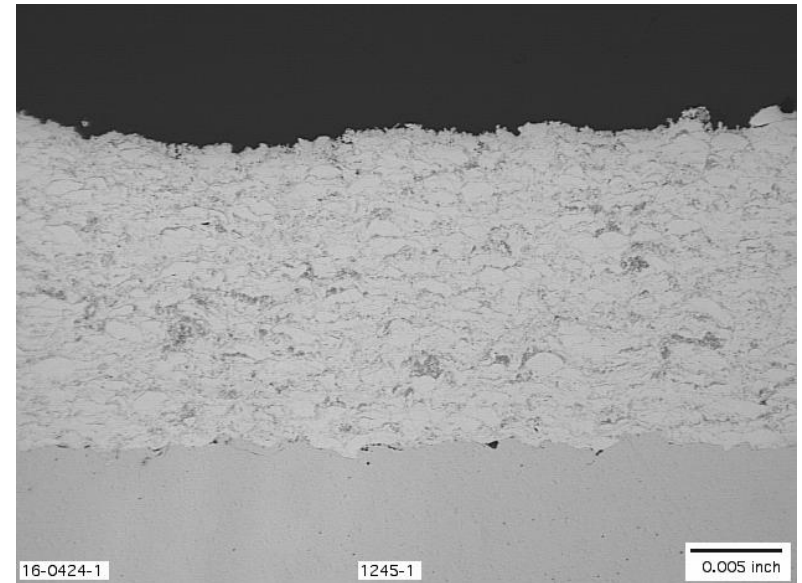


AMS 7880-specified sintered and crushed WC-12Co powder in HVOF mode, hardness 1,214 HV₃₀₀, DE 35%, porosity less than 0.5%

HVOF Mode Micrographs Steel



C6 HVOF mode Super-Stainless
coating, gas impermeable at 80
microns

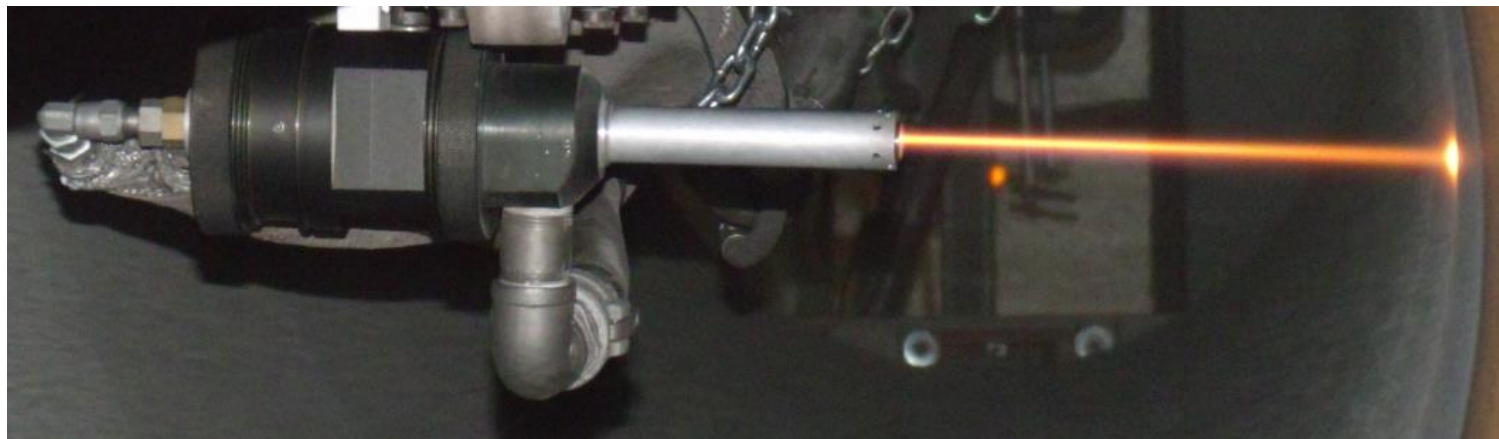


C6 HVOF mode SS 316 coating,
gas impermeable at 80 microns

Kermetico HVAF AK5

Our compact gun to spray versatile powders

- ✓ Maximum spray rate - 15kg/h (33 lbs./hour)
- ✓ Designed for spraying thin walls, internal surfaces or small parts
- ✓ Fits internal diameters 205 mm (8") and larger
- ✓ 3-15 to 5-30 μm powder sizes
- ✓ Sprays WC-10Co-4Cr, CR₃C₂-NiCr, Hastelloy-type, super stainless onto sleeves, flanges, valves, shafts, spindles, rods, shafts and tubes



Kermetico HVAF AK-HH



Built on the basis of our successful AK5, this gun provides impressive quality for manual coatings:

- ✓ Maximum spray rate - 15kg/h (33 lbs./hour)
- ✓ Gun weight 2.5 kg (5 lbs.)
- ✓ 1-10 to 15-30 μm powders
- ✓ Designed to make perfect coatings with slow movement along a surface
- ✓ Gun Base Station with built-in ignition and remote pendant
- ✓ Deposits WCCo, WCCoCr, Cr₃C₂-NiCr, Hastelloy-type, super-stainless coatings onto boiler tubes, vessels, flanges, nozzles, elbows, etc.
- ✓ Good for manual blasting or coating stripping

Kermetico HVAF AK-IDR

High velocity thermal spray equipment to apply coatings onto internal diameters of hard-to-rotate parts.

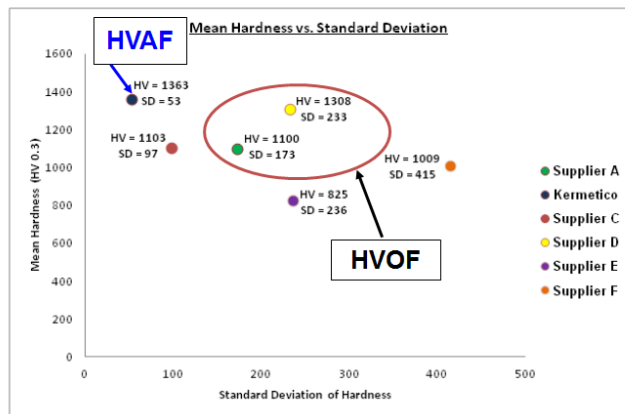
- ✓ a rotating gun to spray bores 100 mm (4") and larger up to 600 mm (2') deep
- ✓ Maximum spray rate – 5 kg/hour (11 lbs./hour)
- ✓ Spray angle - 90°
- ✓ Elegant design, axial powder feed + air cooling provide long life and high technological stability
- ✓ 1-10 to 3-15 μm powder sizes
- ✓ Sprays WCCoCr and Hastelloy-type powders



HVAF Coating Quality

Uniformity of HVAF Coatings Properties:

Hardness of HVOF and Kermetico HVAF WC-10Co-4Cr coatings (Schlumberger, UK)

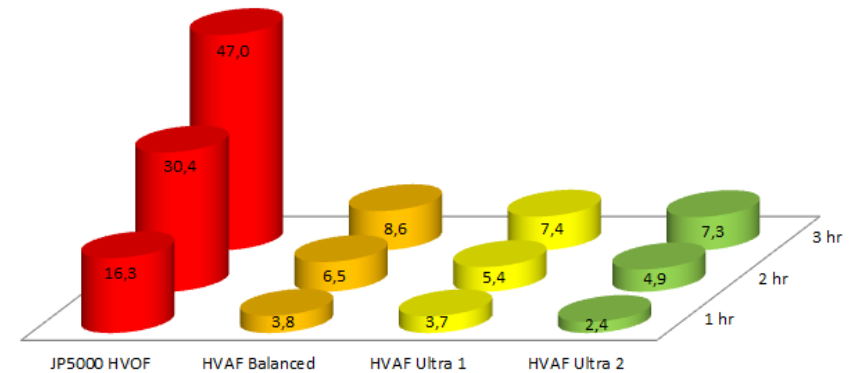


Relative standard deviation, %



HVAF: 3.9 %
HVOF: 15.7-17.8%

Cumulative Weight Loss of WC-10Co-4Cr Coatings During Silt Erosion Test, mg

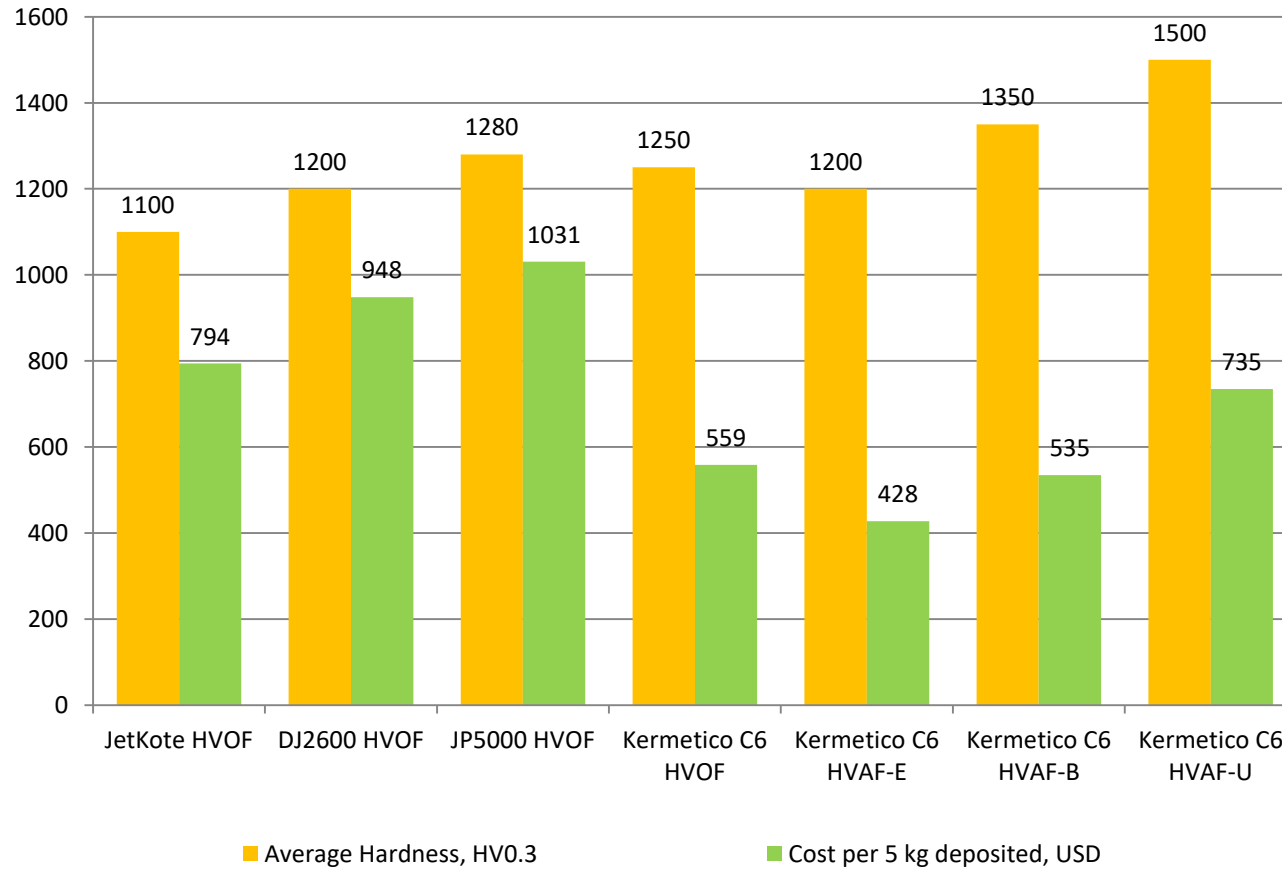


Charts are courtesy of Schlumberger (left) and CPRI, India (right)

HVOF and HVOF Cost vs Quality

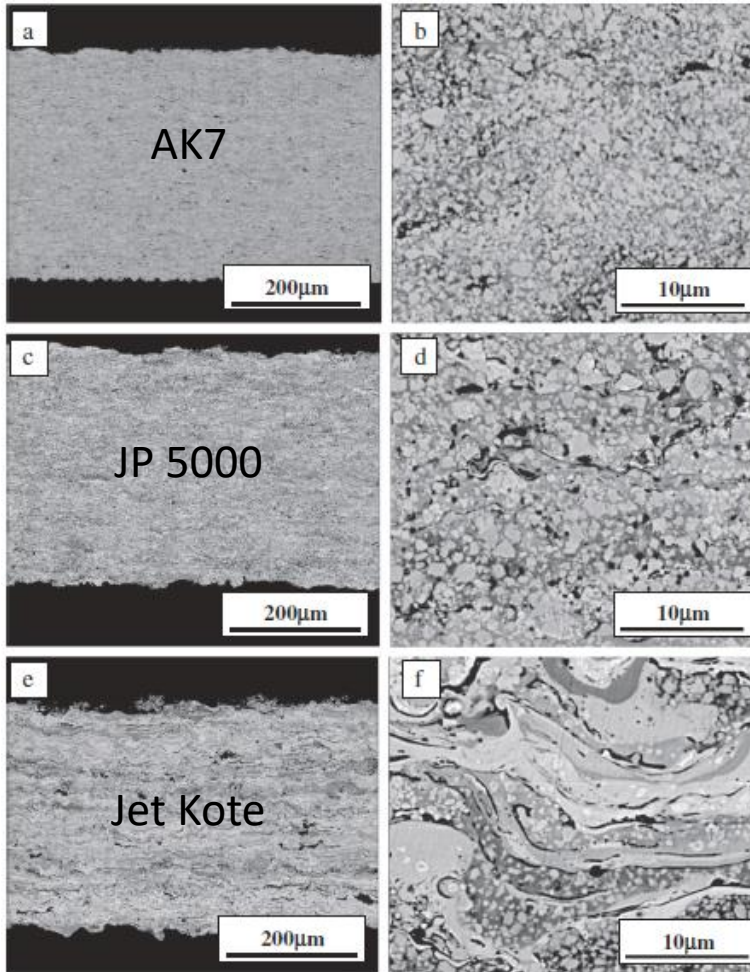


Kermetico Makes More for Less



The Data for the U.S. at Powder Price of \$50 per kg.

The Result



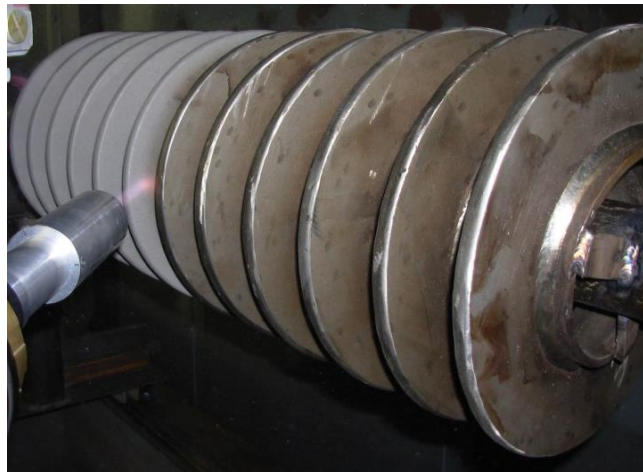
Gun	Hardness, HV ₃₀₀	Porosity, %	Fracture Toughness K1C	Ratio W ₂ C to WC
AK	1326 ± 98	0.3	5.97 ± 0.7	0
JP	1289 ± 108	0.6	4.87 ± 0.6	0.12
JK	1047 ± 112	1.7	3.01 ± 0.6	0.7

[Source](#): Wear and corrosion performance of WC-10Co4Cr coatings deposited by different HVOF and HVAF spraying processes
 Qun Wang etc., Hunan University, 2013

Designed for Manufacturing

Our systems are designed by sprayers for sprayers:

- ✓ Use existing HVOF infrastructure, powders and specs
- ✓ User-friendly controls, one system - several guns → easy to learn
- ✓ High technological efficiency → it is really hard to make a poor coating
- ✓ Axial powder + simple design → long-lasting, easy to change spare parts
- ✓ Hardness deviation <6% → fewer QC issues
- ✓ No fumes of sprayed powder → less health hazards



Blast & Spray with One Gun:
10x Faster, One Setup



We Spray Tons of Powder Each Year

Business Benefits

1. Buy and use fewer systems, investing four times less in a new Job Shop. Each Kermetico gun sprays 5x faster than a conventional HVOF gun, and there is an option to switch to an ID or a hand-held gun with the same system.
2. Return your investment spraying a second metric ton of WC-10Co-4Cr. How?
 - ✓ The spray rate is up to 33 kg/hour with deposition efficiency higher than 50%. Fewer work hours means fewer hours to pay for. And with our system you need to spray just a fraction of the HVOF spray time
 - ✓ No oxygen in HVAF mode – just compressed air, which costs 10 times less;
 - ✓ Easy-to-change specialized guns allow spraying each part in the most efficient way
 - ✓ The cost of our spare parts is 1/10 of the typical HVOF cost for the same work
 - ✓ You gain more than \$100 per deposited kilogram of E-mode HVAF WC-10Co-4Cr compared to a conventional HVOF system
3. Eliminate the blasting room – blast and spray with one setup to improve quality, cut manufacturing time and reduce blast media consumption by a factor of 100.
4. Reduce as-sprayed coating thickness and grinding time due to the low roughness of the as-sprayed coating.

System Control

- PLC-based, mass-flow controlled system
- Industrial IP67 rated tablet is the basic operator control device for a gun and all external devices
- Works consistently with propane, propane-butane, propylene, natural gas
- Variety of powder feeders with canisters from 3.3 to 10.4 liters, with a weight loss control option
- Gas control unit with fully isolated compartments
- Optional interfaces:
 - to a computer display(s)
 - to monitor and troubleshoot equipment at any authorized internet-connected device



Each of our developers has more than 30 years of coating experience. We have been designing and producing our equipment and technology in California, USA, since 2006.

More than 60 systems are at work worldwide, 20 of them are in universities and labs; there are numerous academic papers published showing HVOF superiority over HVOF. We and our partners have sprayed thousands of different customer parts with no rejection.

Visit our job shop and watch the process:

3900 Oregon Street, Suite 2, Benicia, CA 94510, USA,
+1 707-745-3862

Our distributors:

China: [Oriental Renpro](#)
EU(Italy): [Surface Coating Solutions](#)
EU (Poland): [TMC Poland](#)
India: [Spraymet](#)
Japan: [New Metals and Chemicals Co](#)
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