



# KERMETICO



**Multi-Purpose HVAF AK Systems**

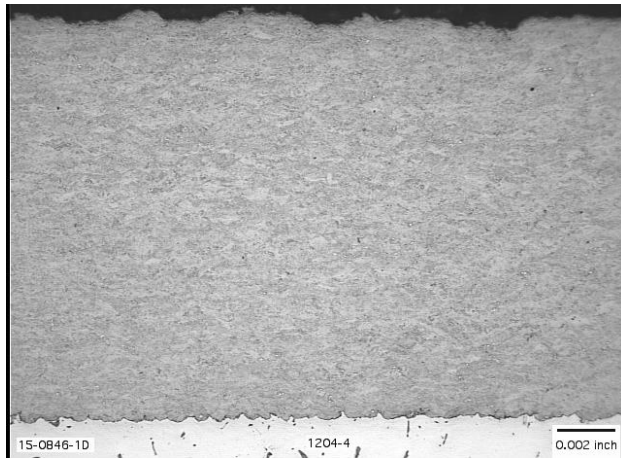
2017

# What is Kermetico HVAF?

High Velocity Air Fuel (HVAF) – a thermal spray process characterized by a low combustion temperature (1,960-2,010°C | 3,560-3,650°F), high particle velocities (800 to over 1,000 m/s | 2,625-3,281 ft./sec.), resulting in low-oxidized, ductile, non-porous high-bond carbide and metal coatings.

Spray rate up to 550 g/min (73 lbs./hr.) makes the process much faster, providing a significant advantage over HVOF:

- A fraction of capital investment
- A half of HVOF operating costs



# HVAF vs HVOF Coating Quality Comparison

WC-10Co-4Cr Coating Features	Typical HVOF	Kermetico HVAF AK Mode		
		Economy	Balanced	Ultra
Deposition efficiency, %	40-55	60-65	48-58	36-42
Hardness, HV <sub>300</sub>	1,050-1,250	1,050-1,250	1,250-1,350	1,350-1,600+
Young's Modulus E, GPa	300	400	450	450
Apparent metallographic porosity	<0.8	<0.8	<0.5	<0.3
Bond strength, Mpa (PSI)	80+ (12,000+)			
Range of as-sprayed roughness, μm (μ in.)	3.5-4.5 (150-180)	1-3.2 (40-130)		

Sources: VTT, Finland, CPRI, India, In-house research

# Kermetico HVAF AK, a Multi-Purpose System



Axial powder injection. Air cooled. Gas fuel: propane, propane-butane, propylene, natural gas. Blast & spray with the same gun.

We supply one or all of our spray guns with a system:

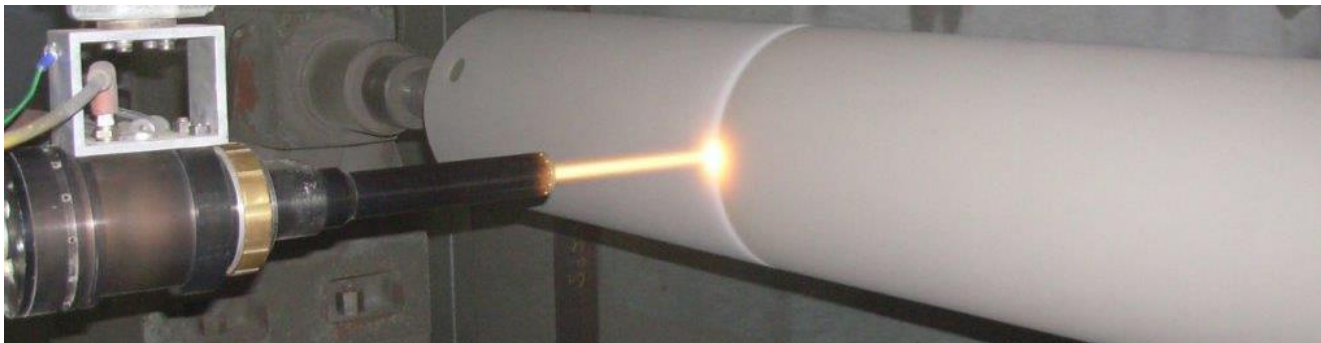
- [AK7](#) – all materials for large parts
- [AK6](#) – carbide coatings for all parts
- [AK5](#) – for smaller parts and complex geometry
- [AK-HH](#) – for manual coating deposition
- [AK-ID](#) – for internal diameters 80 mm (3.15”) and larger
- [AK-IDR](#) – rotating internal diameter torch for bores 100 mm (4”) and larger



# Kermetico HVAF AK7

A spray gun to deposit metals, alloys and carbides onto large surfaces.

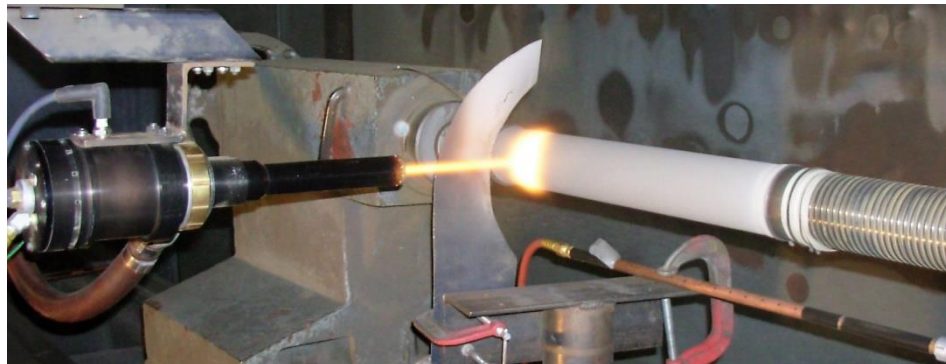
- ✓ Spray rate – 33+ kg/h (73+ lbs./hour)
- ✓ Economy, Balanced or Ultra modes to achieve the best cost for the coating quality needed
- ✓ Deposits WCCoCr 50 microns per pass, 1,600+ HV<sub>300</sub> in Ultra mode
- ✓ Widest selection of materials: from stainless steel to MCrAlY
- ✓ 5-20 to 20-45  $\mu\text{m}$  powder sizes
- ✓ Easy to tune, hard to break – works 100 hours or more with one nozzle
- ✓ The best choice for massive flat parts as well as for parts with 200 mm (8") and bigger diameter: paper rolls, sink rolls, hydro turbines, vessels, cyclones, massive tubes, large ball valves, gate valves, pump plungers, etc.



# Kermetico HVAF AK6

A gun optimized to deposit cemented carbides onto a variety of parts

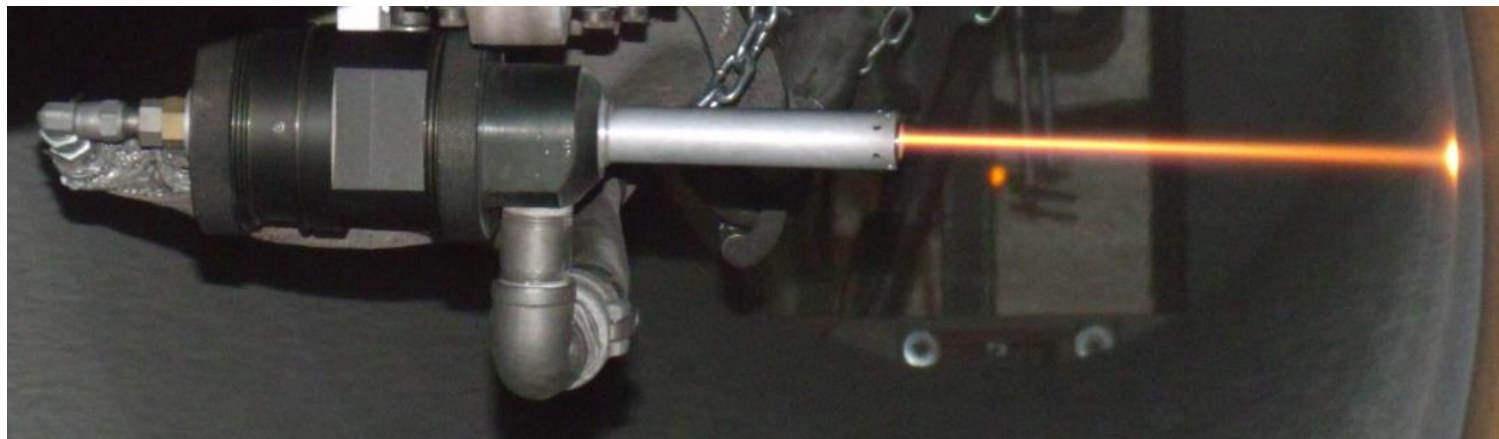
- ✓ Maximum spray rate - 28kg/h (62 lbs./hour)
- ✓ Works best on medium parts, well on big and small parts
- ✓ Fine-tuned to spray Tungsten and Chromium Carbides
- ✓ Balanced or Ultra modes to achieve the best cost for the coating quality needed
- ✓ 50 microns WCCoCr per pass for rolls, 30 microns per pass for flat surfaces
- ✓ 5-20 to 10-38  $\mu\text{m}$  powder sizes
- ✓ Used in manufacturing and repair of mud motor rotors, valves, shafts, rods, sleeves, vessels, etc.



# Kermetico HVAF AK5

Our compact spray gun to spray versatile powders and surfaces

- ✓ 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  $\mu\text{m}$  powder sizes
- ✓ Used to spray WC-10Co-4Cr, CR<sub>3</sub>C<sub>2</sub>-NiCr, Hastelloy-type, super-stainless onto sleeves, flanges, valves, shafts, spindles, rods 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 (5.5 lbs.)
- ✓ 3-10 to 15-30  $\mu\text{m}$  powders
- ✓ Designed to make perfect coatings with slow movement along a surface
- ✓ Gun Base Station with built-in ignition and remote pendant
- ✓ Used to deposit WCCo, WCCoCr, Cr<sub>3</sub>C<sub>2</sub>-NiCr, Hastelloy, Super-Stainless coatings onto boiler tubes, vessels, flanges, nozzles, elbows, etc.
- ✓ Good for manual blasting or coating stripping



# Kermetico HVAF AK-ID and AK-IDR

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

- ✓ AK-ID – a gun to spray internal diameters 80 mm (3.15”) and larger, reach up to 1.5 m (5’)
- ✓ AK-IDR - a rotating gun to spray bores 100 mm (4”) and larger up to 600 mm (2’) deep
- ✓ Maximum spray rate for either gun – 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  $\mu\text{m}$  powder sizes
- ✓ Spray WCCoCr and Hastelloy-type



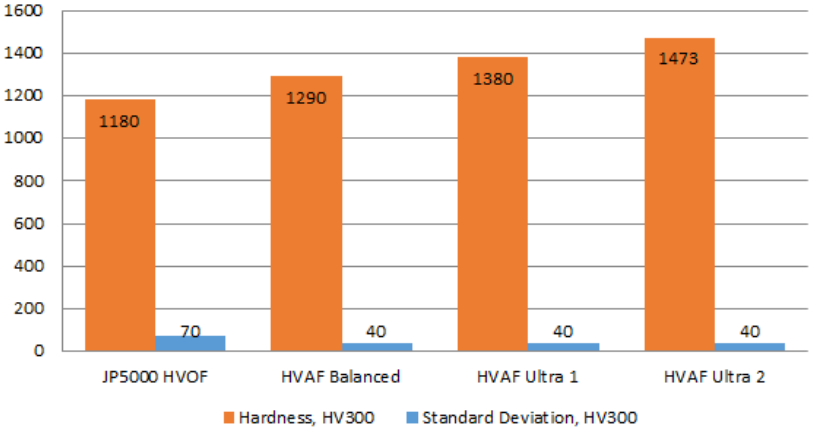
# System Control

- PLC-based, mass-flow controlled system
- Industrial IP67 rated tablet is the basic operator control of 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 interface to monitor and troubleshoot equipment at any authorized internet-connected device

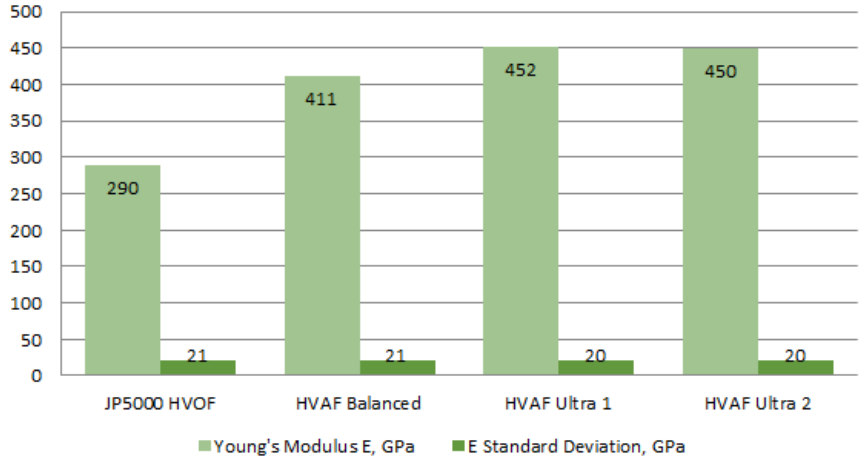


# HVAF Coating Quality

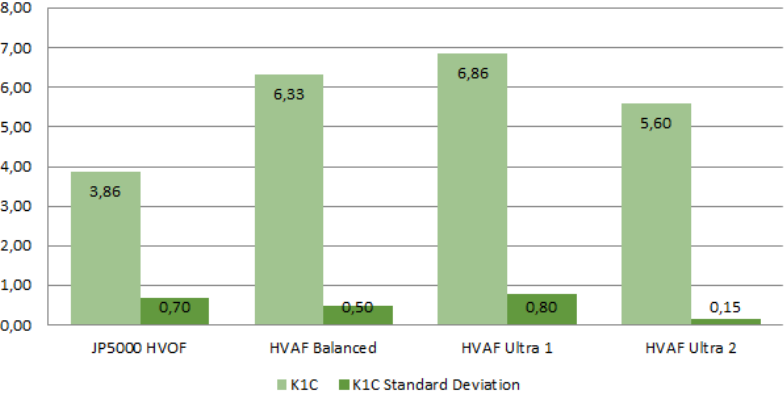
Vickers Hardness of WC-10Co-4Cr Coatings



Young's Modulus E of WC-10Co-4Cr Coatings

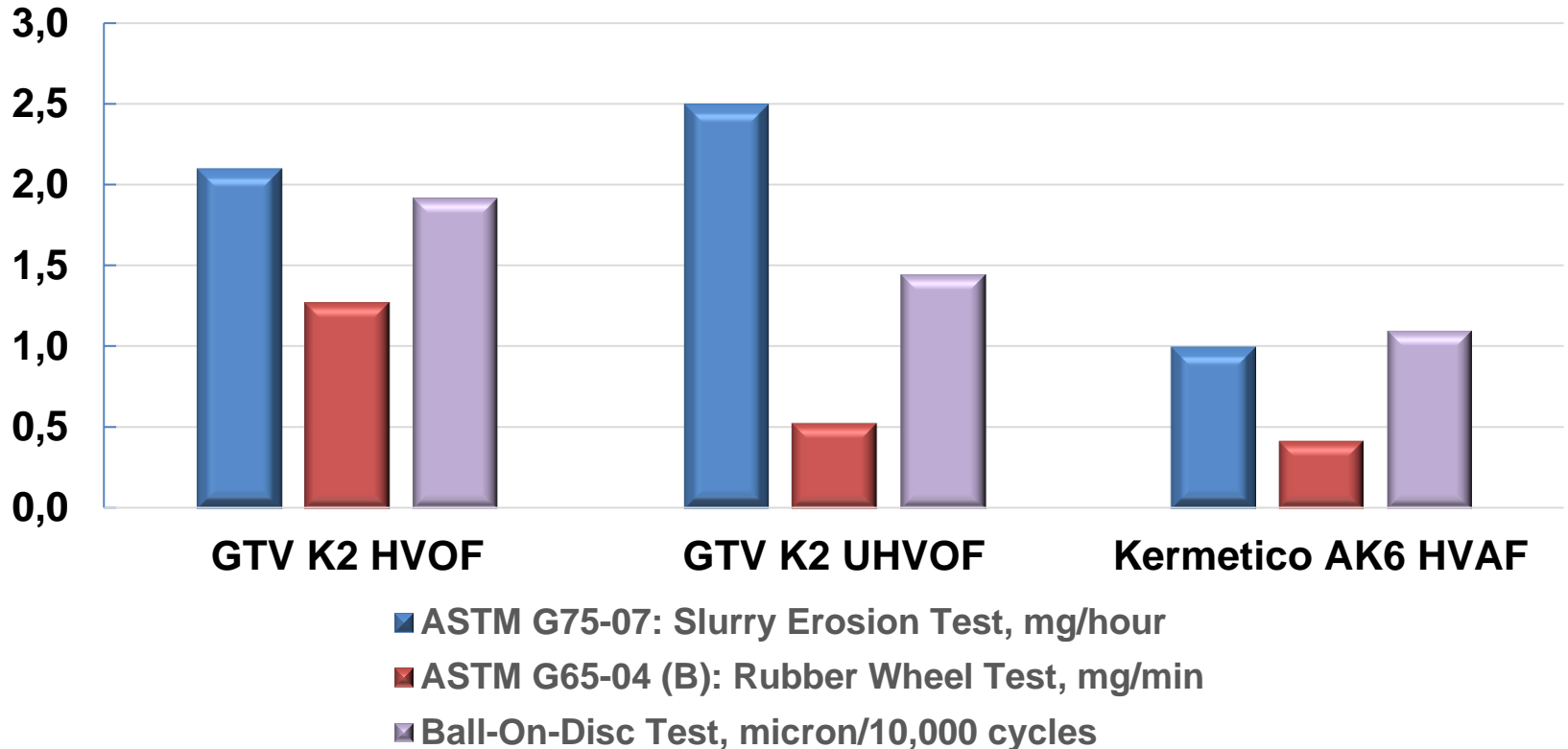


Fracture Toughness K1C of WC-10Co-4Cr Coatings, MPa\*m<sup>1/2</sup>



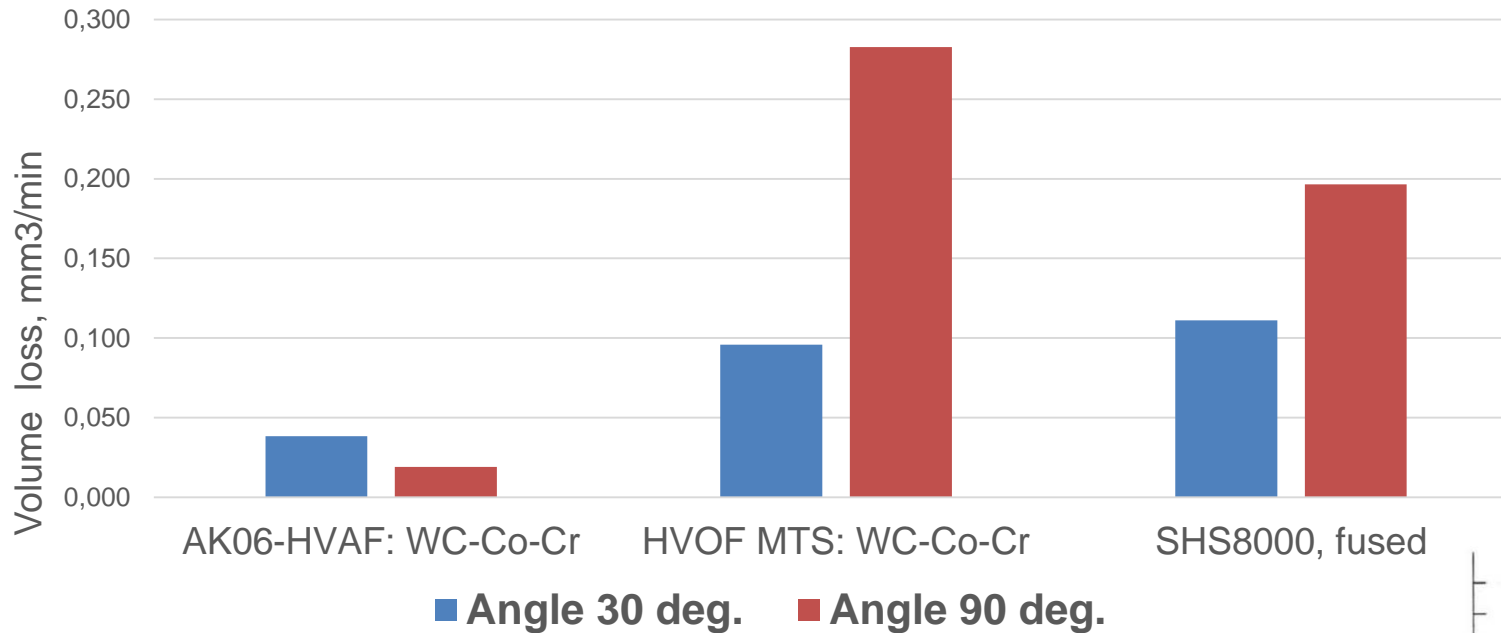
HVAF tungsten carbide coatings are **harder** and **stronger** than HVOF ones, yet they are **ductile**. These are the reasons why they **resist wear and cavitation combined**.

## InnoMat GmbH Report on WCCoCr coatings for Stellba AG (2016)

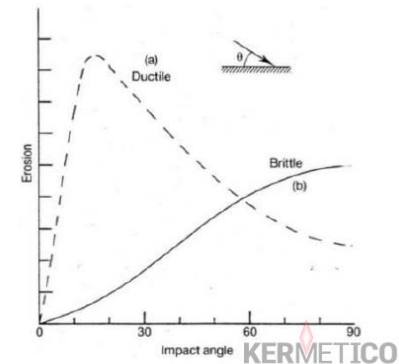


# Our HVAF Coating Resists Erosion as a Ductile Material

Dry erosion rate of hard coatings

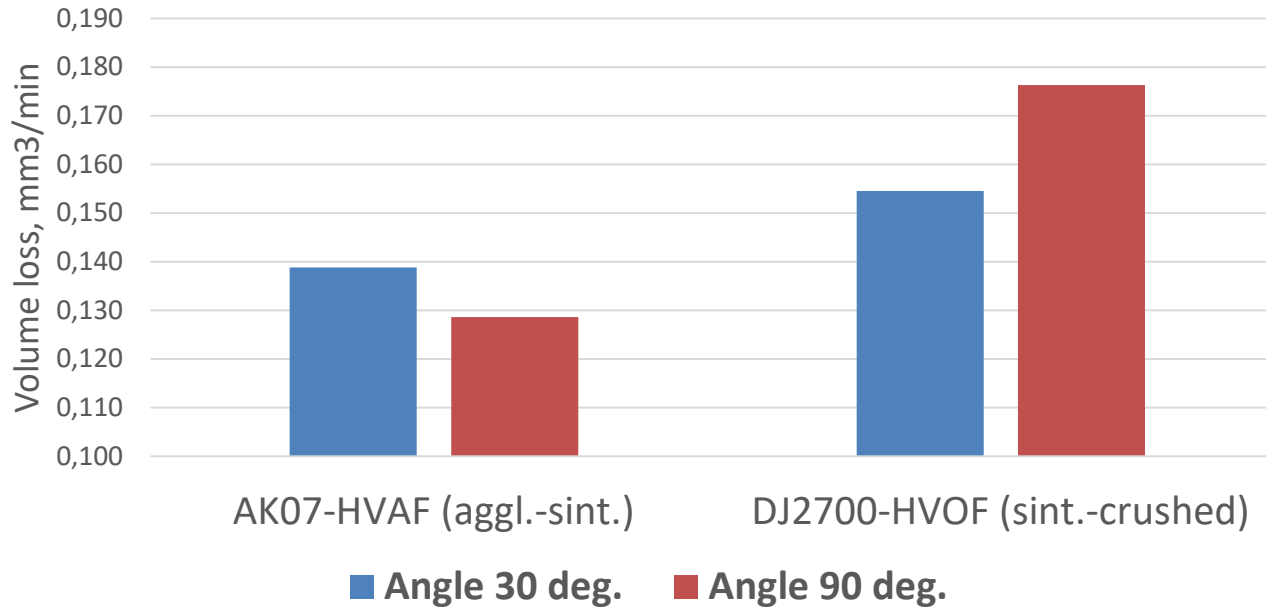


Courtesy of Midwest Thermal Spray



# Our HVAF Coating Resists Erosion as a Ductile Material

Slurry erosion rate of WC-10Co4Cr coatings

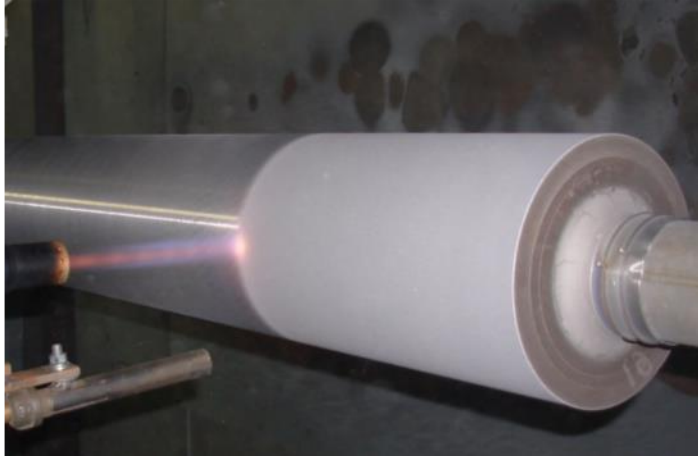


Q. Wang, Mat. Engineering and Performance, 24(4), 2015

# Made for Manufacturing

Our systems are designed by sprayers for sprayers:

- ✓ Use an existing HVOF infrastructure
- ✓ User-friendly controls, different guns with same system → easy to learn
- ✓ High technological efficiency → it is really hard to make a poor coating
- ✓ Axial powder feed + simple design → long-lasting, easy to change spare parts
- ✓ Hardness deviation 6% → fewer QC issues
- ✓ No vapors of the sprayed powder → less health hazards



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



A Double Elbow Sprayed with  
our Rotating ID Gun

# An HVAF Blasting Grit Feeder

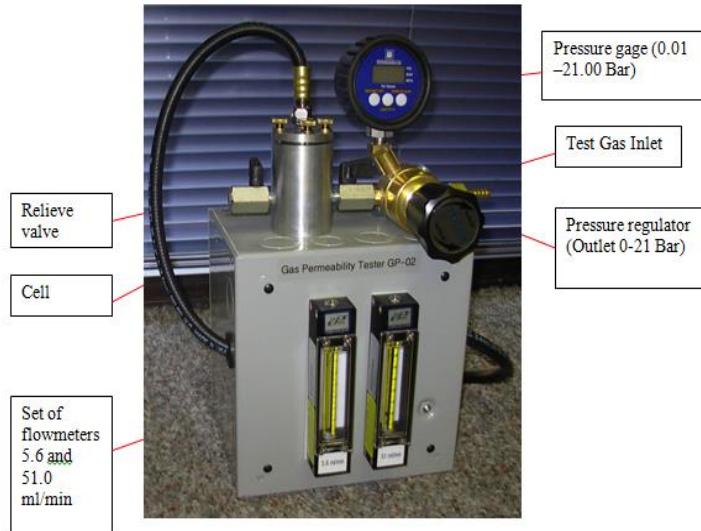


Kermetico HVAF Grit Feeder for part blasting

- Grit particle velocity - 1,000 m/s, temperature - over 1,200°C (2,200°F)
- Compared to conventional grit blasting with compressed air:
  - ✓ Blasting rate is 5+ fold faster
  - ✓ Grit consumption over 100-fold less
- The same gun setup is used for blasting and spraying that results in further reductions of time for applying the thermal spray coating.
- An efficient tool for hard coating stripping.
- Grit: Aluminum Oxide, Silicone Carbide
- Grit particle size: #220 to #24 mesh
- Grit consumption: 1-8 kg/hour
- Blasting rate: 5-20 m<sup>2</sup>/ hour

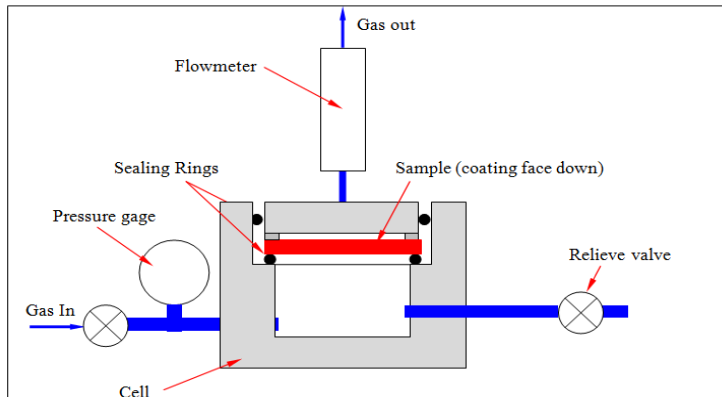


# An Instant Coating Quality Test



## Gas Permeability Tester:

- The easiest way to evaluate coating porosity level
- 1,000-times more sensitive than metallography
- Nitrogen, coating sample, 5 minutes → numerical result



# Business Benefits

1. Buy and use fewer systems, investing four times less in a new Job Shop. Each Kermetico HVAF gun sprays 5x faster than any HVOF gun, and there is an option to switch to an ID or a hand-held gun with the same system.
2. Return your HVAF investment spraying second ton of WCCoCr. How?
  - ✓ The spray rate is up to 33 kg/hour with the deposition efficiency higher than 60%. Fewer work hours means fewer hours to pay for. And with our system your spray time is just a fraction of the HVOF spray time
  - ✓ No oxygen – just compressed air, which costs 10 times less
  - ✓ Easy-to-change specialized guns allow spraying each part in the most efficient way
  - ✓ Cost of spare parts is 1/10 of HVOF for the same work
3. Eliminate the blasting room – blast and spray with one setup to reduce manufacturing time, improve quality and minimize blast media consumption by a factor of 100.
4. You can reduce your as-sprayed coating thickness and grinding time due to the low roughness of our HVAF as-sprayed coatings.

# Economic Aspects of Kermetico HVAF

Mode	Coating Hardness , HV <sub>300</sub>	Coating Porosity, %	Deposition Efficiency, %
Economy (E)	1,050-1,250	<0.8	60 - 70
Balanced (B)	1,250-1,350	<0.5	48 - 58
Ultra (U)	1,350-1,600+	<0.3	36 - 42

High spray rates are applicable for large and small parts



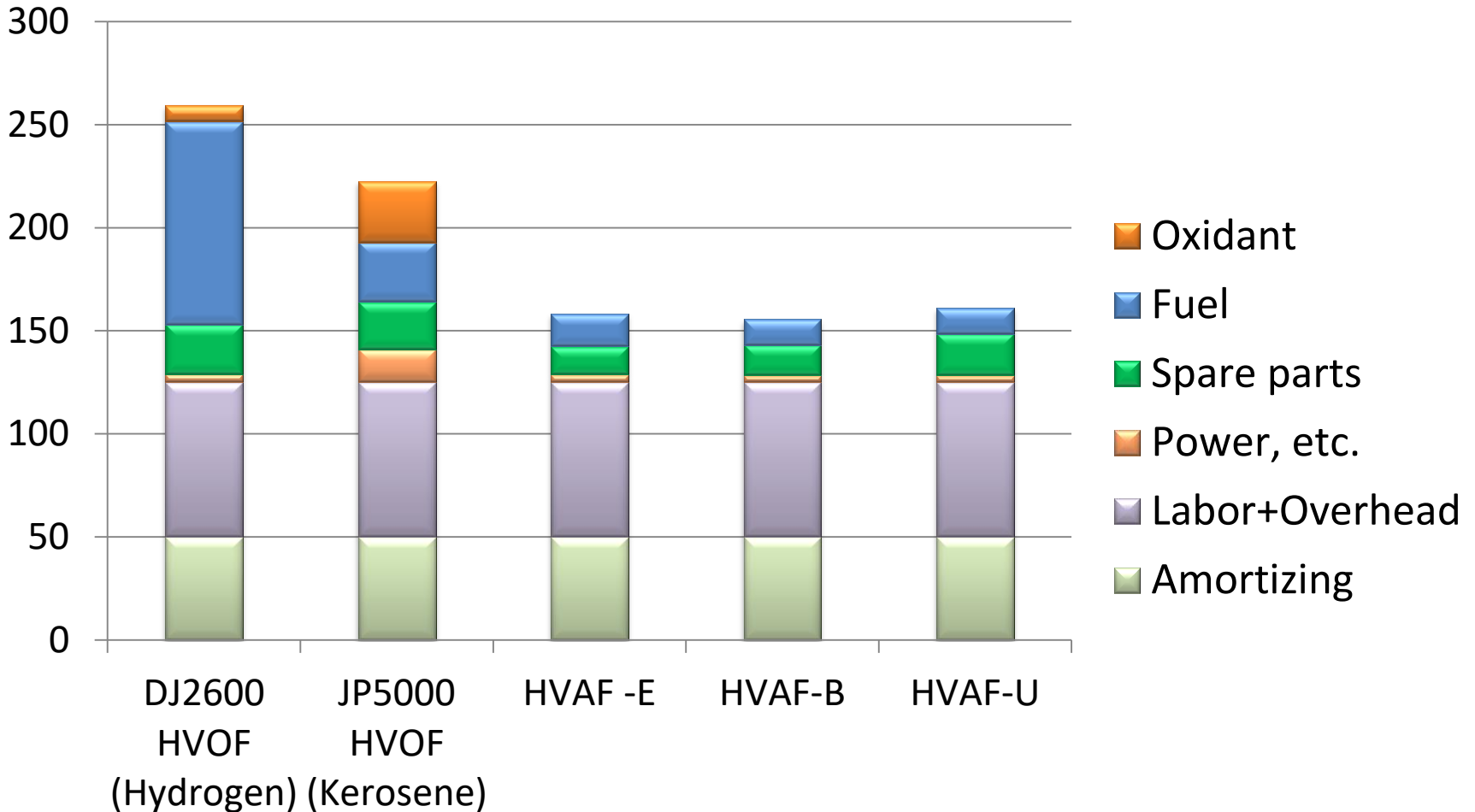
O.D. 38 mm: Rate 25 kg/hour



O.D. 330 mm: Rate 32 kg/hour

The Data for WC-10Co-4Cr, agglomerated & sintered powder

# HVOF vs HVAF WC-10Co-4Cr Costs

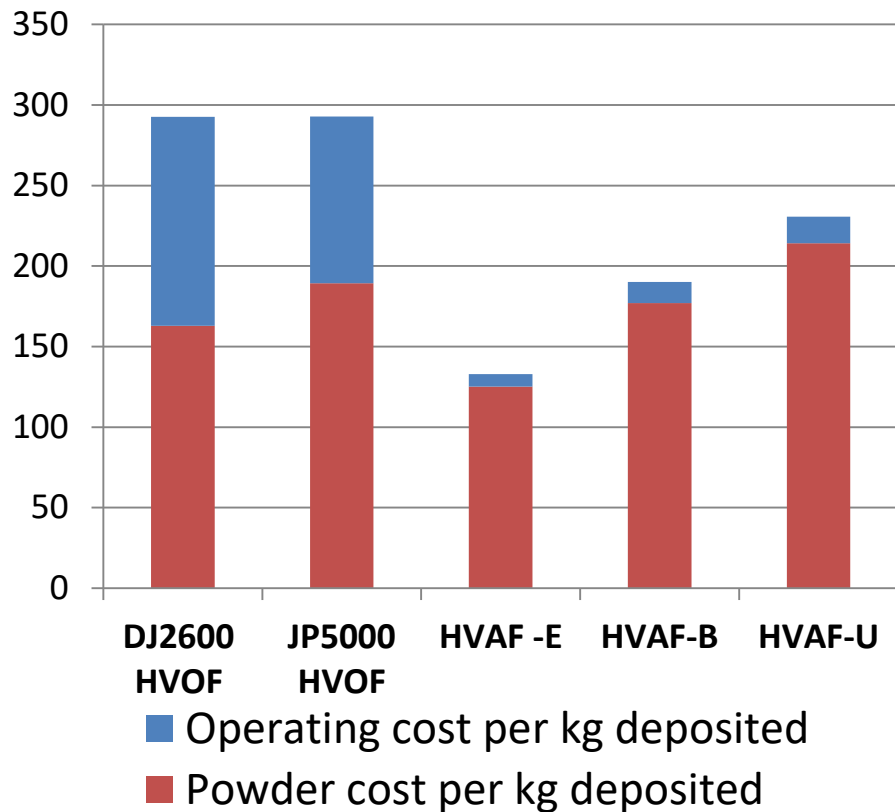


Comparison of HVAF and HVOF Operating Costs, USD per Hour  
(Prices in Texas, USA)

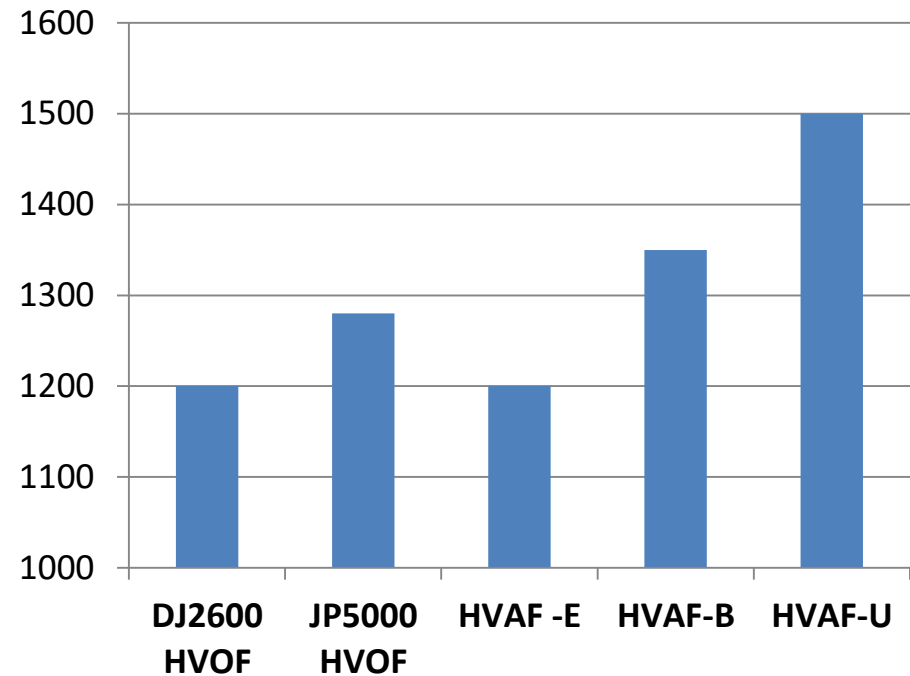
# A Comparison of HVAF and HVOF Costs



Cost per WCCoCr kg Deposited, USD



WCCoCr Coating Hardness, HV<sub>300</sub>



Note: All prices are in US Dollars, for Texas, USA

# HVOF vs HVAF WCCoCr Costs



Feature	DJ2600 HVOF	JP5000 HVOF	AK7 HVAF (E)
Total operating cost, USD/hour	\$260	\$223	\$160
Spray rate, kg/hour	4	5	32
Deposition efficiency	50%	43%	65%
Deposition rate, kg/hour	2.2	2.2	20.8
Cost per KG of sprayed coating, USD	\$293	\$293	\$133
AK7 savings per KG of deposited coating, USD	\$160	\$160	

**Change your HVOF system to Kermetico HVAF and gain **\$160,000 USD per each metric ton** of deposited tungsten carbide coating**

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 National 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, meet the designers 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](#)

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