



Cold Spray

**Making metals work longer and harder
than ever before...**

The Leader in Complete Cold Spray Solutions

VRC leads the way in designing the most capable cold spray systems with specifications to meet or exceed our customer's expectations. We also specify and integrate complete turnkey solutions ranging from installation of the equipment into an existing space to integration of complete automation and enclosure solutions needed to do their job.

Each Customer Has Specific Requirements –VRC Designs Customized Solutions To Meet Those Needs



VRC Specializes in Fixture Design and Tooling, to Optimize Repair Cost and Time

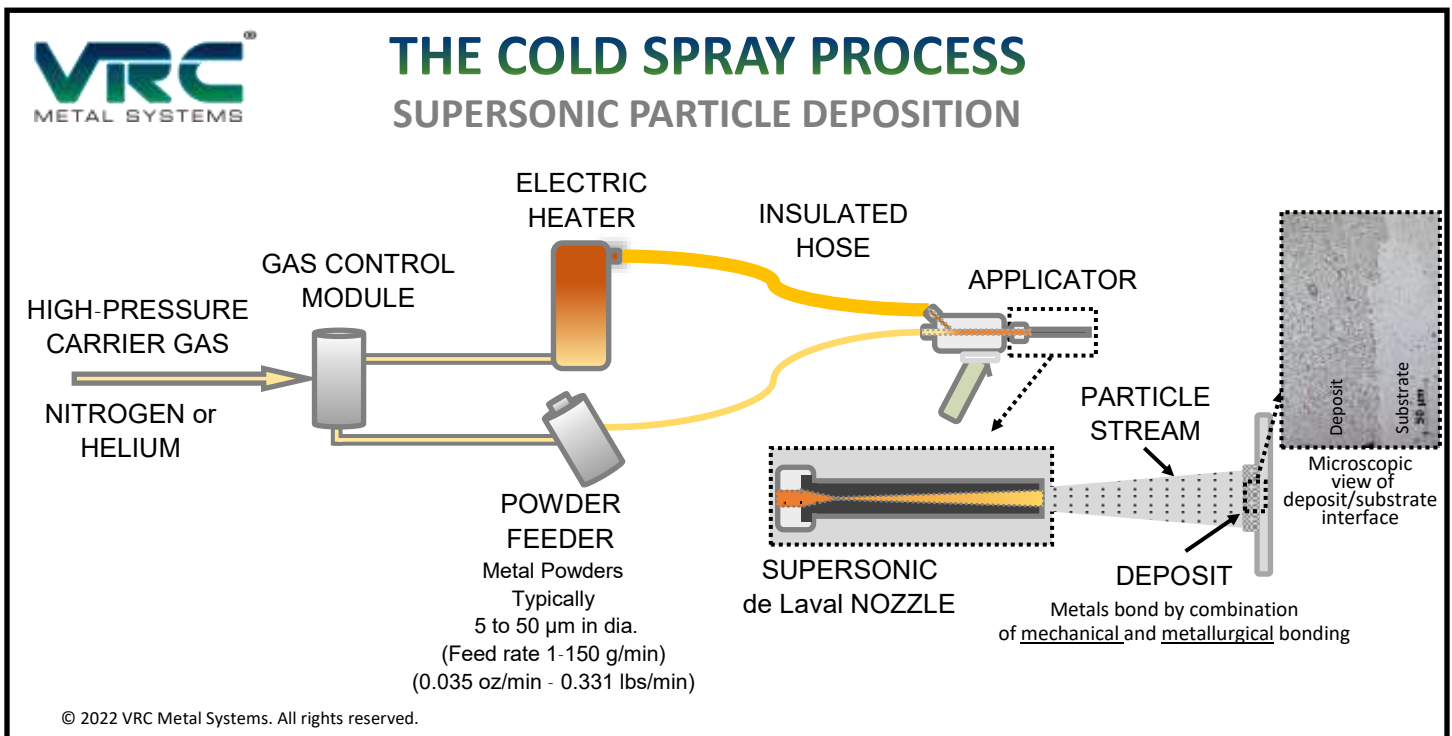


Cold Spray – The case for HIGH pressure

Cold spray, also referred to as supersonic particle deposition, is a solid-state coating process utilizing a heated high-pressure carrier gas, like nitrogen or helium, or air to accelerate metal powders through a supersonic de Laval nozzle to bond particles to a substrate. Low-pressure cold spray generates lower particle velocities, and primarily relies on mechanical interlocking with some metallurgical bonding. Low-pressure cold spray adhesion is comparable

with other traditional thermal spray processes, which operate at higher temperatures.

However, **high-pressure cold spray coatings** with higher particle velocities and primarily metallurgical bonding are anywhere from **2 to 10 times stronger than low-pressure** cold spray coatings, depending on the material deposited. High-pressure cold spray coatings can be structural, and approach wrought properties of the sprayed material.



VRC not only manufactures state-of-the-art high pressure Cold Spray equipment, but also develops Cold Spray applications for our customers in a variety of industries.

The VRC Cold Spray Systems



VRC Gen IV™ High-Pressure System with our new 23kW applicator heater and dual powder feeders



VRC® Raptor™ High-Pressure System with a Deployable 21kW Heater and Handheld Pendant



VRC® Dragonfly™ High-Pressure System with Modular Components, a 21kW Heater and Handheld Pendant



VRC Cold Spray Systems Capabilities

Features	Gen IV™	VRC®Raptor™	VRC®Dragonfly™
Dimensions	Electrical Module 20"x 20"x 55" (50.8cm x 50.8cm x 139.7cm) Gas Module 32"x 20"x 55" (81.28cm x 50.8cm x 139.7cm)	68"L x 32"W x 65"H (173cm L x 82cm W x 165cm H)	Electrical Module 41"L x 22"W x 12"H (104cm L x 56cm W x 30cm H) Gas Module 41"L x 22"W x 12"H (104cm L x 56cm W x 30cm H)
Weight for Portability	N/A Stationary System	900lbs (408kg)	Heaviest Component 94lbs (42.63kg)
Electrical	480 VAC, 3 PH, 60 Amps	480 VAC, 3 PH, 50 Amps	480 VAC, 3 PH, 50 Amps
Human Machine Interface	Full Touch Screen Controls	Tethered w/Full Touch Screen Controls	Tethered Pendant Parameter Readout
Heater Type	23kW Applicator Heater	21kW Remotable Floor Heater	21kW Remotable Floor Heater
Applicator Temp Range 1202°-1650° (650°-900°C)	900°C Robotic 650°-700°C Hand-Held	650°-700°C	650°-700°C
Compatible with Applicator Heater	X	X	
Multi-Powder Feeder Standard	X		
System Pressure up to 1000 PSI (69 Bar)	X	X	X
Gas Supply: Max Input Pressure	2175 PSI (150 Bar)	3000 PSI (206 Bar)	3000 PSI (206 Bar)
Max Gas Flow 88 CFM (2500 SLM)	X	X	X
Data Capture & Download	X	X	X
Single or Multiple Gas Capable	Two Gas System Nitrogen, Helium or Air	Two Gas System Nitrogen, Helium or Air	One Gas System Nitrogen, Helium or Air
Gas Blending	X		
Post Spray Printed Report	X		
Auxiliary Data Acquisition	4 external TC's standard, other sensors optional		
Integration with Robotics	X	X	
Configurable alarm package to alert operator of issues during use	X		

The VRC Additive & Subtractive Systems

VRC is the global leader in cold spray equipment manufacturing and experts at cold spray process development for both defense and commercial applications. We will match our customers with the right cold spray equipment, material, and process to make them successful.

Integrated Additive & Subtractive Systems:

- VRC's line of additive cold spray systems with integrated automation in an acoustical spray booth with dust collection.
- VRC's line of additive & subtractive systems with integrated CNC machining, automation, acoustical booth and dust collection.



Medium System



Large Manufacturing System

Compressed Gas Support Systems:

- Helium Recovery, Nitrogen Generation and Compressed Air solutions

We know Cold Spray. With the VRC Cold Spray Systems, we are able to spray the full range of materials depositable by both HIGH and LOW pressure systems. If it can be done with cold spray, we can do it!

Support Equipment & Consumables



Acoustical Booths



Vark™ Portable Dust Collector



VRC® Dragonfly™ Cart



Portable Spray Booth



Automation

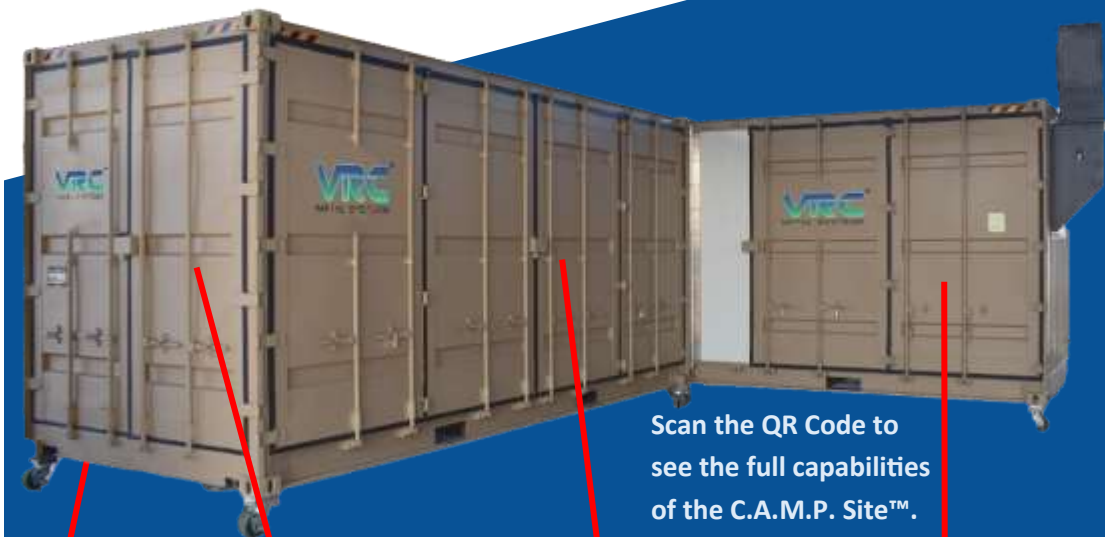


Liquid Cooled Applicator Heater

VRC supports all consumable products such as, powders, nozzles and hoses.

The C.A.M.P. Site™ Cold Spray Cell

Cold Spray
Advanced
Manufacturing
Portable
SITE™



Scan the QR Code to see the full capabilities of the C.A.M.P. Site™.



Gas Storage:

- Two 12-packs of high pressure rated (4500psi) DOT bottles of compressed air totaling 11,840 cubic feet



Generator:

- 125kVA output capacity
- Provides 3-phase 480VAC power
- “Power Balance” system to maintain sufficient load on the engine

Compressor:

- 4-Stage, air-cooled compressor
- 26.4 standard cubic feet per minute charge rate
- 20 HP 3-phase motor



Brolga Trailerized Systems

Field Portable Cold Spray Systems



Brolga-002



- Includes an on-board VRC®Raptor™ cold spray system, compressed air storage and a separate diesel generator.



Mobile Cold Spray Cart

- Fanuc 6-axis articulating arm robot with 10 lb. payload capacity
- Robot controller and pendant on-board
- Battery-powered, manually operated 2WD cart with built-in charger
- Deployable outriggers for in-process stability during rapid motion
- Hose and cable storage



BROLGA-003
FIELD PORTABLE COLDSPRAY SYSTEM

Together
ahead. **RUAG**

VRC®
METAL SYSTEMS

Industries Served

Aerospace



Automotive



Maritime



Oil & Gas



VRC[®]
METAL SYSTEMS

Cold Spray Repairs

Aircraft Skin Panel Fastener Hole Repair¹



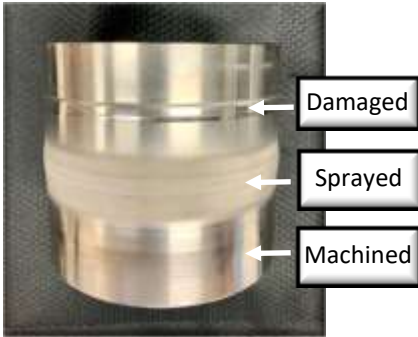
[1] Ch. 9 Cold Spray Applications: V.K. Champagne et al. Cold Spray Coatings, ASM International (2018) pp. 25-56.

Pipe Joint Leak Repair

Leaky pipe coupling can be sealed with cold spray on-site at temps low enough that most operations can remain running



SS Shaft Defect Repair



Corrosion Resistant Layers



Bronze Corrosion Repair



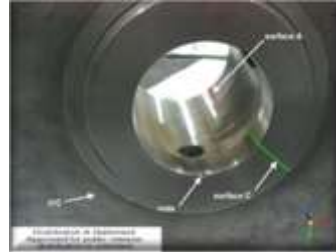
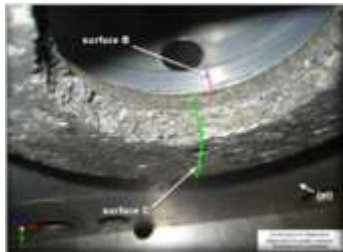
Pipe Repair without High Temp



Damaged steel pipe after tooling to remove defect

Steel pipe showing raw cold spray build-up before final machining

Navy Valve Actuator Repair²



Hard Coatings

Durable hard coating option and or Chrome replacement NiCr/CrC
(wear resistance specimen shown after abrasion test)



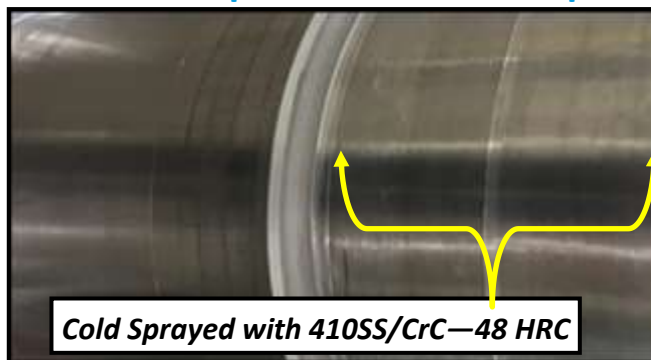
[2] Cold Spray Repair of a Navy Valve Actuator: Widener, C.A., Carter, M.J., Ozdemir, O.C. et al. Journal of Thermal Spray Technology (2016)25: 193.

And Many More...

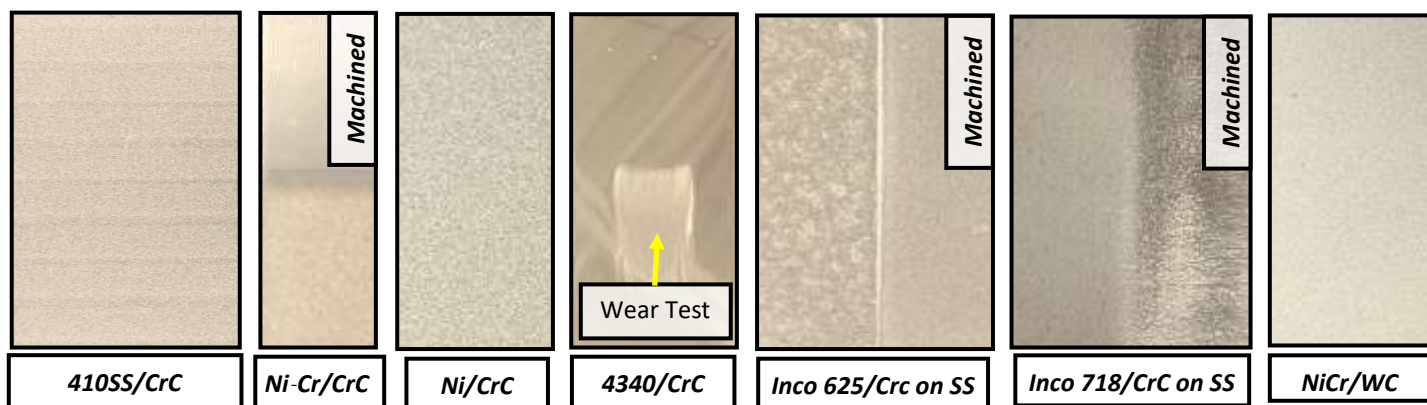
VRC cold spray equipment is saving our customers millions of dollars every year by repairing components for aircraft, ships, submarines, helicopters, missile systems, mining and industrial equipment, refineries, power plants, and many more.

Mechanical Wear Resistance

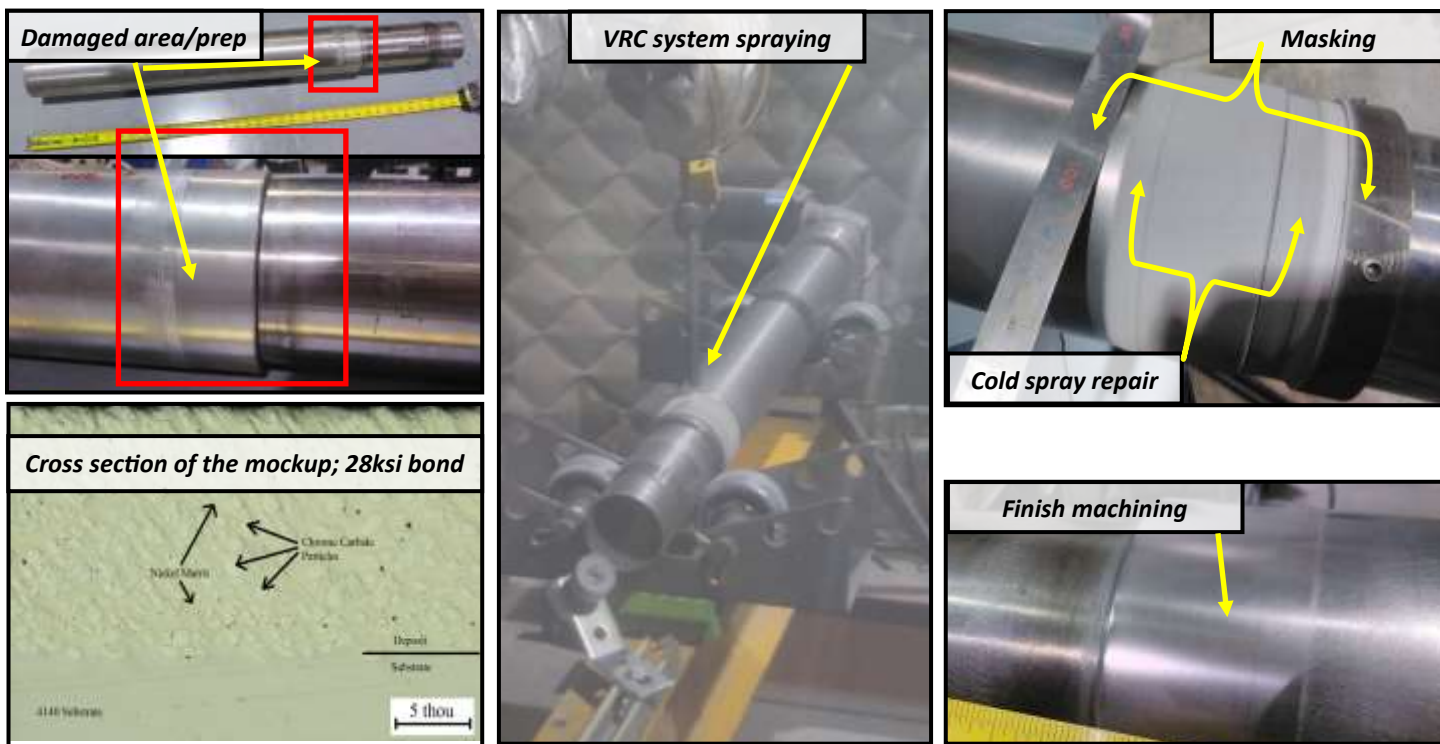
Chrome Replacement Shaft Repair



Family of Chrome Replacements / Hard Coating Options—Plus Many More



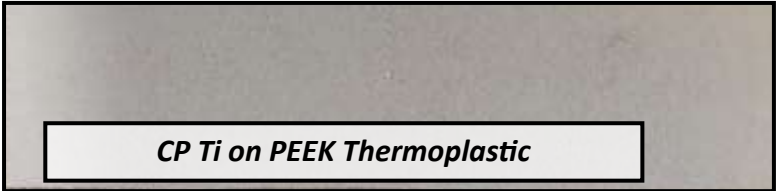
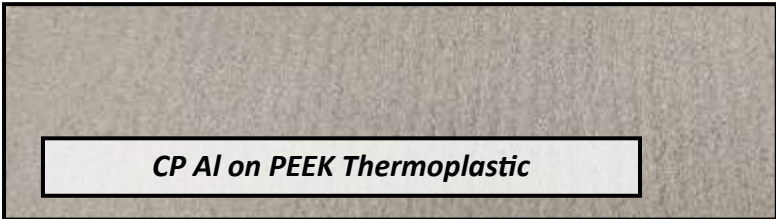
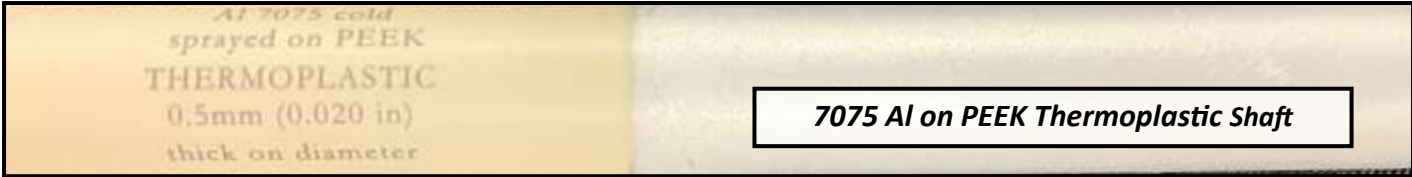
Cold Spray Shaft Repair Process—Ni/CrC on 4140 Steel*



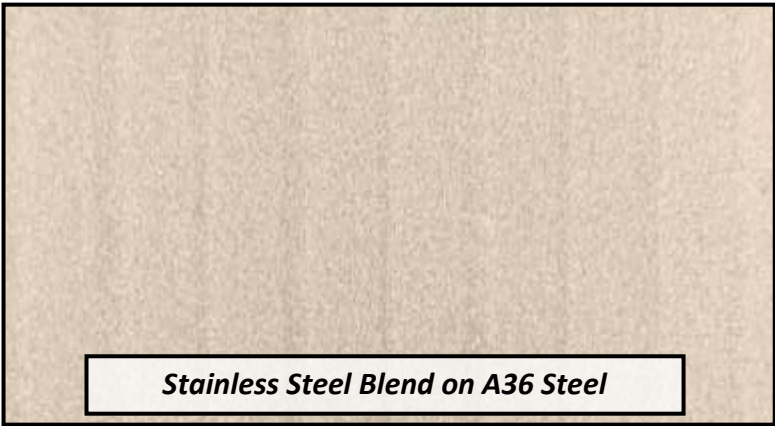
*Pictures courtesy of US Army Research Lab—Victor Champagne, Aaron Nardi, Gehr Ferguson, Isaac Nault, William Story, & Dan Nikolov

Enhancement & Specialty Coatings

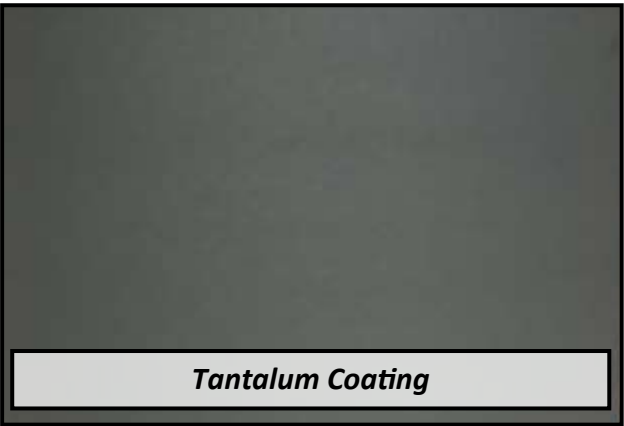
Cold Spraying Metal on Thermoplastic (wear resistance or RF shielding)



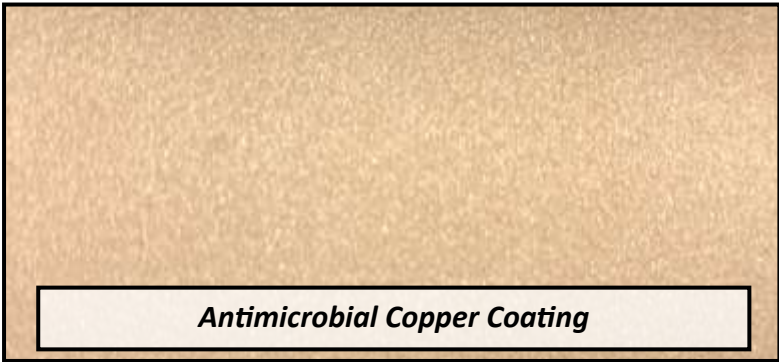
Infrared Energy Reflective



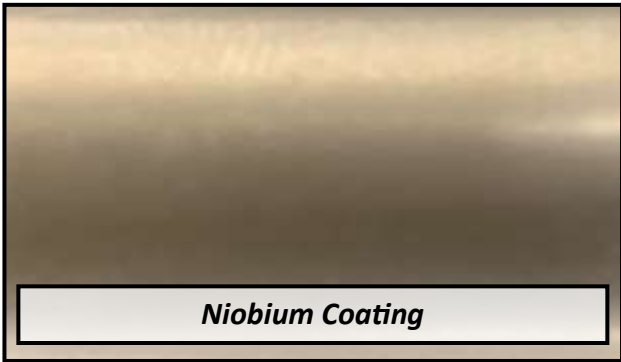
Acid Resistance



Antimicrobial



High Heat Resistance



Cold Spray Materials, Properties and Testing

Materials

Single or Mixed Powder Feeding

Unique tumbling drum powder feeder enables uniform coatings with mixed powders - does not separate heavier materials like competitors' vibratory feeders.

Aluminum

- CP Al
- 2024
- 6061
- 7050
- 7075
And more

Copper

- CP Cu
- Bronze
- 90Cu-10Sn
- Cu-Ni-Inco
- Ni-Al-Cu
And more

Titanium

- CP Ti (all grds)
- Ti-6Al-4V
And more

Steel & SS

- 1018
- 4340
- 17-7 SS
- 316 SS
- 410 SS
And more

Nickel

- CP Ni
- Inco 625
- Inco 718
- Ni/CrC
- NiCr/CrC
And more

Specialty Powders

Tantalum, Niobium, Chromium, MCrAlYs Blends, MMCs, Silver, Tin, Babbit, and more

Properties

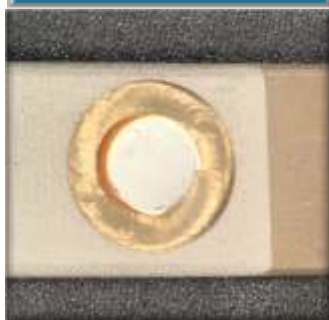
VRC high-pressure cold spray systems typically create deposits with bond strengths above 10 ksi (68.9 MPa) and can exceed 30 ksi (206 MPa) bond strength while maintaining less than 1% porosity, and hardness values ranging from 90 to 1300 Vickers (48 HRB - 72.5 HRC).

Testing

VRC can perform a wide range of material testing to ensure properties meet or exceed customer requirements.

Adhesion | Tensile | Micro Structure Analysis | Hardness |
Lug Shear | Abrasion | Corrosion | Sliding Wear

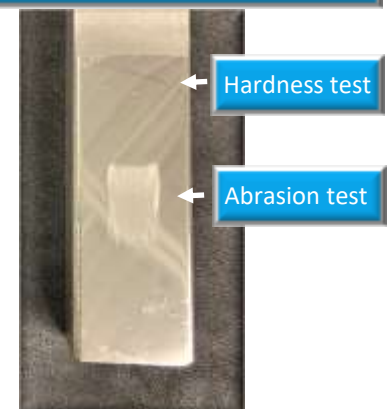
Adhesion Testing NiCr/CrC
sprayed on A-36 Steel



Microscopic analysis of CP Ti
deposit/substrate interface



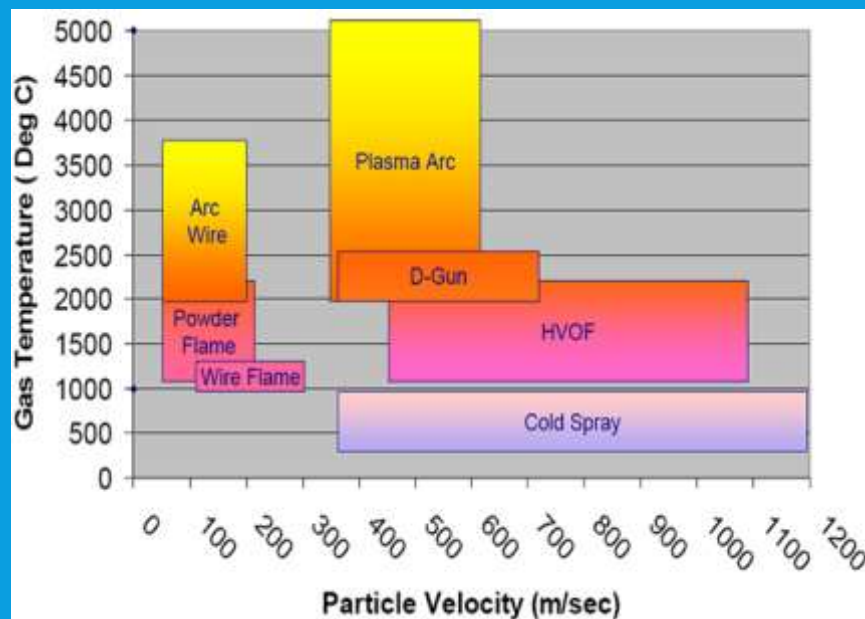
ASTM G65 Wear Test of a Cold
Spray Chrome Replacement Coating



High-Pressure Cold Spray is the only thermal spray process that offers structural properties

Benefits of Cold Spray vs. Traditional Thermal Spray

- No heat affected zone
- Negligible oxidation of cold spray materials
- Spot repairable - ability to reapply new cold spray over old coatings
- Superior coating adhesion, strength and toughness
- Fully-dense coatings
- Minimal distortion
- Deposition thickness - no limit
- Minimal masking requirement due to focused particle spray path
- Environmentally friendly - no toxic fumes
- Precise gas temperature control
- Compressive residual stresses rather than tensile



Cold spray operates at much lower temperatures than thermal spray and uses primarily kinetic energy to create solid-state bonded coatings, instead of melting and re-solidification.

VRC[®]

METAL SYSTEMS

Inc. 5000

2017, 2018, 2019, 2020



**Veteran Owned Business of
the Year 2020**

Certified AS9100D

**Large Business of the Year
2022**

**Your trusted partner for cold spray applications development,
equipment design and integration with the only portable,
high-pressure, hand-held capable machines.**

**DIMENSIONAL RESTORATION & REPAIR | CORROSION-RESISTANT COATINGS |
WEAR-RESISTANT COATINGS | ADDITIVE MANUFACTURING |
HIGH-STRENGTH DISSIMILAR MATERIAL COATINGS |
FIELD REPAIR | EMI SHIELDING**

Making Metals Work!

Learn more at vrcmetalsystems.com

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