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

<table>
<thead>
<tr>
<th>Features</th>
<th>Gen IV™</th>
<th>VRC®Raptor™</th>
<th>VRC®Dragonfly™</th>
</tr>
</thead>
</table>
| **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)  
                    | Gas 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** | 900°C Robotic  
                    | 650°-700°C Hand-Held             | 650°-700°C                        | 650°-700°C                        |
| **Compatible with Applicator Heater** | X                                | X                               | X                                |
| **Multi-Powder Feeder Standard** | X                              | X                               | X                                |
| **System Pressure up to 1000 PSI** | X                                | X                               | X                                |
| (69 Bar)           |                                   |                                 |                                  |
| **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                                |                                  | 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.

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

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™**

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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

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

Field Portable Cold Spray Systems

Brolga-002

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

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

Aerospace

Automotive

Maritime

Oil & Gas
Cold Spray Repairs

Aircraft Skin Panel Fastener Hole Repair

SS Shaft Defect Repair

Corrosion Resistant Layers

Bronze Corrosion Repair

Pipe Joint Leak Repair

Navy Valve Actuator Repair

Pipe Repair without High Temp

Hard Coatings


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 Sprayed with 410SS/CrC—48 HRC

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

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

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

- 7075 Al on PEEK Thermoplastic Shaft

- CP Al on PEEK Thermoplastic

- CP Ti on PEEK Thermoplastic

- Tin Based Alloy on Carbon Fiber Filled Plastic

Infrared Energy Reflective

- Stainless Steel Blend on A36 Steel

Acid Resistance

- Tantalum Coating

Antimicrobial

- Antimicrobial Copper Coating

High Heat Resistance

- Niobium Coating
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.

<table>
<thead>
<tr>
<th>Aluminum</th>
<th>Copper</th>
<th>Titanium</th>
<th>Steel &amp; SS</th>
<th>Nickel</th>
</tr>
</thead>
<tbody>
<tr>
<td>- CP Al</td>
<td>- CP Cu</td>
<td>- CP Ti (all grds)</td>
<td>- 1018</td>
<td>- CP Ni</td>
</tr>
<tr>
<td>- 2024</td>
<td>- Bronze</td>
<td>- Ti-6Al-4V</td>
<td>- 4340</td>
<td>- Inco 625</td>
</tr>
<tr>
<td>- 6061</td>
<td>90Cu-10Sn</td>
<td>And more</td>
<td>- 17-7 SS</td>
<td>- Inco 718</td>
</tr>
<tr>
<td>- 7050</td>
<td>Cu-Ni-Inco</td>
<td></td>
<td>- 316 SS</td>
<td>- Ni/CrC</td>
</tr>
<tr>
<td>- 7075</td>
<td>Ni-Al-Cu</td>
<td></td>
<td>- 410 SS</td>
<td>- NiCr/CrC</td>
</tr>
<tr>
<td>And more</td>
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</tbody>
</table>

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.
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!

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