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# HP/HVOF | Equipment Solutions.



Making our world  
more productive

# HVOF Spray Solutions.

Praxair Surface Technologies, a Linde Company, is a world leader in thermal spray equipment, materials, and coatings technology. As a primary contributor to the development and application of High Pressure, High Velocity Oxygen-Fuel spraying, Praxair has designed a complete family of TAFE brand HP/HVOF® products reflecting years of equipment engineering and coatings expertise. Our HP/HVOF product line includes a system that matches your specific quality, productivity, robustness, and versatility needs.

The selection of HVOF spray equipment is a starting point. At Praxair we believe that the development of new HVOF powders and high density coatings will accelerate the growth of wear, oxidation, and corrosion-resistant applications. We dedicate teams of engineers to work with you to develop solutions that expand the markets for cost-effective thermal spray applications.

We'd like to work with you to select the best HVOF spray system, and then direct energy to maximize your output and rewards. For more information, please contact your local Praxair and TAFE representative or contact our U.S. equipment headquarters:

Phone: 1-603-223-2100

Fax: 1-603-225-4342

E-mail: <http://www.praxairsurfacetechologies.com>



Our JP-8000 HP/HVOF system is designed for easy integration with the advanced 7780 Universal Process Control Center (UPCC), a sophisticated multi-process thermal spray controller. 7780 UPCC technology allows a single workstation to control multiple thermal spray systems such as plasma, HE plasma, GF-HVOF, HP/HVOF, combustion powder and wire, and Arc Spray.

# Productivity. Highly Productive Systems.

Whether you need HVOF equipment, powders, automated coating systems, or technical support and assistance, Praxair Surface Technologies (PST) has a solution you can rely on. With more than 60 years of coatings experience, we apply hardware, materials, and technical expertise as well as hands on, practical operating and production experience, to HVOF products that produce the industry's most advanced and workable coating solutions.

Our HP/HVOF® systems are refined and optimized to produce the best coatings possible at exceptional production rates. By generating extremely high particle velocity, our equipment yields coatings recognized throughout the Thermal Spray industry for their density and superior performance. Application to application, we have a complete HVOF system that delivers outstanding value



Every once in a while, a product is developed that elevates performance expectations. The JP-5000® system is an example of one such product, and the JP-8000™ system “raises the bar” even higher for HVOF equipment. With mass flow controls and PLC management, the JP-8000 system sets a new standard of excellence for the thermal spray industry.

## JP-5000®

The renowned, original JP-5000® HP/HVOF® system, introduced in 1992, utilizes liquid fuel. The semi-automatic, rotometer-controlled console has proven itself to be unequalled in coating reproducibility and robustness for long-term use.

## JP-8000™

This is the next-generation of the JP-5000 system. This premium equipment features advanced controls, exceptional throughput and unparalleled coating quality. A JP-8000-PC version offers a touch-screen PC human machine interface (HMI) console with data acquisition software that provides comprehensive statistical data collection for thorough post-process analysis of the coating operation.

## 7780 UPCC

For unparalleled control of multiple thermal spray processes, PST offers the advanced 7780 Universal Process Control Center (UPCC) computerized controller. Multiple thermal spray processes including the JP-8000-PC system, can be controlled from a robust HMI PC/PLC-based control console. The PC HMI provides a user-friendly, touch-screen interface for the operator with closed-loop, mass-flow control of the spray process, while providing sophisticated data-acquisition, system diagnostics, and maintenance management.



Everything you need is provided in each of our complete HP/HVOF equipment packages, including the JP-8000 (above) and JP-5000 systems (left). And since HVOF systems should ideally be automated for safety and productivity purposes, our ancillary engineers are ready and able to assist you in developing the perfect cell to meet your production and economic requirements.

# Premium. Enhanced technology and value.

## JP-5000®

The JP-5000 is the original liquid-fueled HP/HVOF® system. It is engineered for ease-of-use, consistency and longevity.

The introduction of the Model JP-5000® High Pressure/High Velocity Oxygen Fuel (HP/HVOF®) system changed the HVOF thermal spray market over twenty-five years ago. By using liquid fuel instead of gaseous, the Model JP-5000 provides superior HVOF coating quality by combining higher combustion flame temperatures and pressures, improved powder injection, better barrel powder mixing and higher particle velocities; the result was, and still is, higher performance coatings.

In addition to outstanding coating quality, the JP-5000 system delivers a significant productivity advantage, with spray rates up to three times higher than conventional HVOF systems. The ability to apply more coating in less time reduces coating costs and increases the range of competitive coating solutions.

The JP-5000 system is also safe and economical to run. It operates on kerosene, which is easier to handle safely when compared to volatile gases such as hydrogen, natural gas, or propylene. Kerosene also is less expensive than most other HVOF fuel gases.



The sophisticated JP-8000 system incorporates everything that made the JP-5000 system so successful in challenging applications such as Pelton wheels (above) for the hydro-power industry. In addition, we have engineered numerous advances, including the 8100 console (right) that features easy-access utility drawers for fast and effective maintenance.

## JP-8000™

An ultra-high performance coating system, the JP-8000, is the next generation in the evolution of HP/HVOF® systems. Incorporating an array of desirable new features, including a touch-screen personal computer (PC) option that includes data acquisition software, the JP-8000 system is even more user friendly and reliable than its predecessor, the legendary JP-5000 system. Improvements include a sophisticated PLC-based, mass flow controlled gas/fuel management system that provides more precise control of flame characteristics. The result is increased system up-time and coatings that are more consistent and ultimately better than those previously achievable.





# Performance. Elevated HVOF performance.

The TAFE JP-5000® and JP-8000™ systems use a simple and effective gun design to produce High Pressure HVOF (HP/HVOF®) coatings of the highest quality. Coating benefits include:

- High and controllable coating density and hardness
- High bond strength (test adhesive fails before coating)
- Coating thickness exceeding 1/2" (12.7 mm)

In addition to the outstanding coating quality, the Model 5220 gun delivers spray rates up to two times higher than gaseous-fueled HVOF systems. This superior spray rate and productivity place the JP-5000® and JP-8000™ HP/HVOF® systems in a unique category of HVOF equipment: High Pressure HVOF. It also permits the job to be done with less equipment, while improving the turnaround time with reduced maintenance and labor costs.



Perhaps the most striking advantage of the Model 5220 gun is its ability to apply coatings up to 1/2 in. (12.7 mm) thick (above) while maintaining superior bond strengths and high density (right). Thick coatings are possible because exceptionally high particle velocities produce coatings in compression, in contrast with other HVOF systems that produce coatings in tension.

## Coating Quality is #1

Nothing is more important in an HVOF system than the quality of the coating it produces. The JP-5000 and JP-8000 systems have been developed and refined to produce outstanding coating quality. A basic rule for coating quality is: High Combustion Pressure = High Gas Velocity = High Particle Velocity = High Coating Quality. The Model 5220 gun is the embodiment of this rule; it has an exceptionally high combustion pressure, so it delivers consistently high quality coatings. A key benefit to the high particle velocities generated by the Model 5220 gun is the extremely high coating density and low oxide content. Low oxide content is simply due to the particles having less time in the atmosphere to oxidize. The high velocity also packs the particles more tightly, reducing porosity and creating a denser coating. This is especially beneficial in corrosion resistance applications where a denser barrier is needed and when grinding where high density coatings produce a finer finish.

One of the key factors in the Model 5220 gun's coating quality is the heating consistency of the powder as it exits the gun. The radial powder injection design of the Model 5220 gun heats the powder uniformly. Independent laboratory tests have shown the WC-Co (tungsten carbide cobalt) and CrC - NiCr (chromium carbide - nickel chromium) coatings have superior wear resistance - in some cases one-third the wear of coatings from other HVOF guns. This is due to uniform powder heating and the lower flame temperature, which allows a much higher percentage of carbides to remain in their original, less brittle state.

With the additional gun choices of the Model 8200 gun, with its ability to spray enhanced coatings, and the Model 825 JPid extension, with its ability to spray inside diameters and tight coating areas, the application versatility of the JP-5000 and JP-8000 systems is unmatched.



Typical 5220 gun Tungsten Carbide - 17% Cobalt Coating Microstructure

# Equipment Solutions. HVOF processes.

## JP-5000<sup>®</sup>

Elegantly simple, proven HP/HVOF<sup>®</sup> system for coatings of incomparable quality.

### Features

Large, accurate, easy to read rotameters

Single point, semi-automatic operation

Easy parameter setup

Monitored combustion pressure

Dual powder feeder capability

CE compliant

## JP-8000<sup>™</sup>

Advanced next generation HP/HVOF<sup>®</sup> system for consistent production of exceptional coatings.

### Features

Closed-loop controls

User-friendly, intuitive touchscreen

Modular drawer design

Password protection

Maintenance management

Recipe storage

CE compliant

### JP-5000 HP/HVOF system components:

Model 5220, 8200, 5250 ST or 825 JPid Guns

Model 5120 Semi-Automatic Control Console

Model 1264, 1264i or 1264WL Powder Feeder(s)

Optional Remote Operation Pendant

Optional Portable Kerosene Spill Cart

### JP-8000 HP/HVOF system components:

Model 5220, 8200, 5250 ST or 825 JPid Guns

8100 Fully-Automatic MFC Control Console

Model 1264, 1264i or 1264WL Powder Feeder(s)

Optional Data Acquisition

Optional PC Touch-screen Version



## 5220 Gun

The gun that is robust and rugged with years of proven reliability.

### Features

- Simple, proven, robust design
- Converging/diverging combustion nozzle
- Supersonic gas velocities
- Low pressure, radial powder injection
- Variable barrel lengths
- Ease of maintenance

### 5220 gun components:

- Factory Machined and Tested Stabilizers
- Combustion Chamber
- Dual- or Optional Tri-Port Powder Feed Interconnector
- Optional 8" & 12" Barrel Lengths
- Optional Longer Hose & Cable Lengths



## 8200 Gun

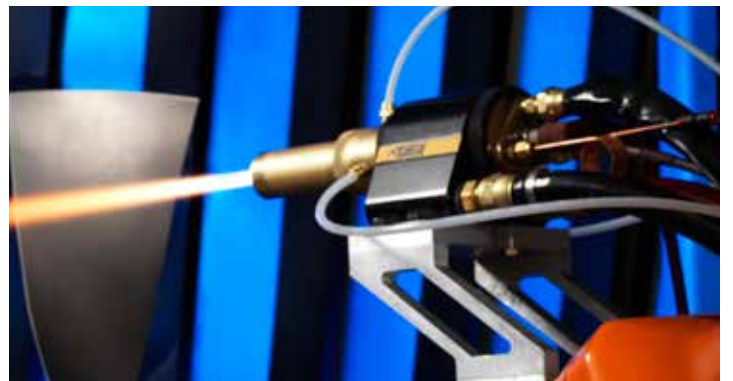
Improved and more efficient gun design with the ability to spray enhanced coatings.

### Features

- Simple, robust design
- Improved fuel atomization
- Enhanced powder injection
- Reduced barrel loading
- Higher powder particle velocities
- Enhanced coating capability

### 8200 gun components:

- 3-Port Powder Feed Interconnector
- 3 Combustion Chambers for varying pressure
- Unique 3-way Powder Splitter
- Optional 8" Barrel Length
- Optional Longer Hose & Cable Lengths



# Powerful. Powerful versatility.

## Model 5120 Control Console

The Model 5120 Control Console for the JP-5000® system is a semi-automatic, rotometer-controlled console that is engineered for ease of use and consistency. This single unit controls all the operating parameters including cooling water, powder on/off, carrier gas, oxygen, and fuel flows. Clear, easily readable gauges, rotometers, and digital meters let you set consistent spray parameters that yield repeatable results.

Automatic start-up and shut-down sequences ensure safe operation of the system. Once the flows are set on the rotometers, one-button operation lets you start the system and spray consistent coatings every time. The console can be controlled through a pendant or another part manipulator controller.

## Model 8100 Control Console

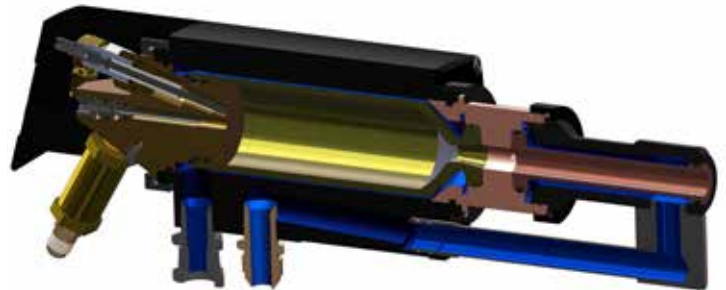
The Model 8100 Control Console for the JP-8000™ system is a closed-loop, fully-automated console with an easy to read and follow touch-screen Human Machine Interface (HMI). The operator merely selects the required spray recipe from memory and pushes the gun "RUN" symbol on the screen to start the spray process. The direct correlation between combustion pressure and gas velocity means that maintaining the same combustion pressure from one spray run to the next is critical to the system reproducing the same high quality coating time after time. A unique feature to the recipe and control screens is a combustion pressure alarm which helps ensure repeatable coating quality.

The 8100 console's modular circuits have been designed into individual drawers that slide out. When combined with the maintenance functionality built into the HMI software, maintenance troubleshooting and servicing becomes easy and hassle free.

## Model 5220 Gun

The Model 5220 gun is the heart of the JP-5000® and JP-8000™ systems. More than 25 years of extensive engineering effort has gone into the development, testing, and refinement of this unit. The result is a unique, simple and robust design that delivers significantly better coatings than conventional HVOF guns. Central to the design is its converging/diverging combustion nozzle and radial powder injection. The powder is injected downstream of the combustion nozzle. Injection into this low pressure area promotes better powder mixing, more even heating, less oxidizing, and more uniform, higher particle velocities. The particles impact with a kinetic energy and have a lower, but more consistent, temperature compared to other HVOF guns.

The 5220 gun's combustion chamber design generates a high combustion pressure of up to 120 PSIG (8.2 bar) and superior gas velocities (7,200 fps [2,190 m/sec.]). This translates into higher coating hardness and better coating integrity.



The Model 5220 HP/HVOF gun cross-sectional view.



# Potential. Application versatility.

## Model 8200 Gun

The Model 8200 Advanced High Pressure (HP)/HVOF® spray gun is an improved and more efficient design than the robust and proven Model 5220 standard gun. The 8200 gun exceeds its illustrious predecessor's already high standards by offering improved coating characteristics at dramatic operating cost savings.

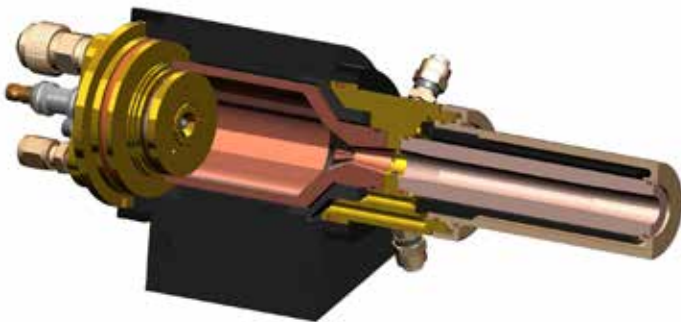
The design features in the 8200 gun, combined with a unique powder injection system, reduces, if not eliminates, the powder buildup and wear in the barrel. These design features allow a better balanced and easier introduction of the powder into the supersonic gas stream, resulting in an improved powder distribution throughout the flame. This leads to a more concentrated, centralized spray "spot" compared to the Model 5220 "standard" gun. These advancements reduce maintenance downtime, deliver greater coating consistency and provide longer component life.

Other 8200 Gun benefits include:

- reduced fuel and oxygen consumption
- reduced barrel loading and wear
- improved coatings with:
  - lower porosity
  - higher hardness
  - smoother as-sprayed surface finishes
- ability to spray impervious, thinner coatings to save powder costs

With multiple combustion chamber designs available, combustion pressures can be increased to as high as 200 psi (1380 kPa), thus improving coating quality without increasing fuel and oxygen consumption.

The Model 8200 gun sets a new standard for the HVOF market.

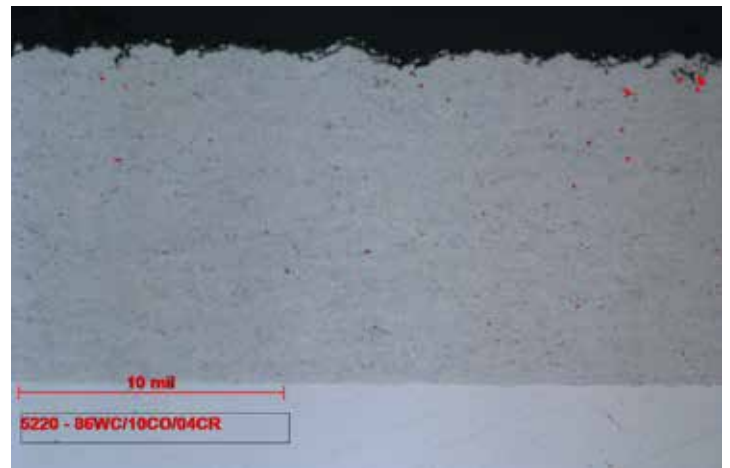


The Model 8200 Advanced HP/HVOF gun's efficient design incorporates knowledge gained over 27 years of HVOF experience. A few of these improvements encompass improved fuel atomization, lower fuel and oxygen consumption, better powder injection, reduced barrel loading, higher combustion pressures (thus velocities), and smoother as-sprayed surface finishes.

## Model 825 JPid Extension

The Model 825 JPid Extension is a versatile production gun designed to apply high quality coatings to inside diameters and hard to reach each applications.

The 825 JPid can spray internal bore diameters of at least 8 inches (203 mm) at an 80 degree spray angle. The 825 has spray rates of carbide powders up to 76 g/min (10 lbs/hr) with a DE of approximately 40%.



Typical 8200 Gun 86WC - 10Co - 4 Cr Coating. A key benefit to using finer particle sizes is that the finer particles can be accelerated to higher velocities which results in coatings with dramatically less porosity. The finer particle size powder and increased density leads to higher coating hardnesses, smoother as-sprayed surface finishes (less finishing required), and improved permeability resulting in the ability to use thinner coatings for further cost savings.

# Precision. Precision powder feeding.

## Model 1264 Powder Feeder

Praxair's unique, time-tested 1264 feeder operates on a volumetric principle that directly controls the powder feed rate by speed of a pick-up wheel. When the powder feeder is in operation, holes in the variable-speed wheel fill with powder. Gravity, carrier gas, and the rotation of the wheel work in concert to deliver powder to the gun. One advantage of this type of powder feeder is that it is not sensitive to gun back-pressure.

The Model 1264 Powder Feeder is an open-loop, pressurized unit specifically designed for thermal spray applications, but also well-suited for lesser cladding and additive manufacturing. The 1264 feeder is economical, easy to operate, and requires very little maintenance. Its proven design has become the standard for thermal spray powder feeding in industrial environments, offering unparalleled precision and repeatability of powder delivery. Recent design improvements further enhance the 1264 feeder's consistency and compatibility with HVOF systems such as the JP-5000® and JP-8000™ equipment.



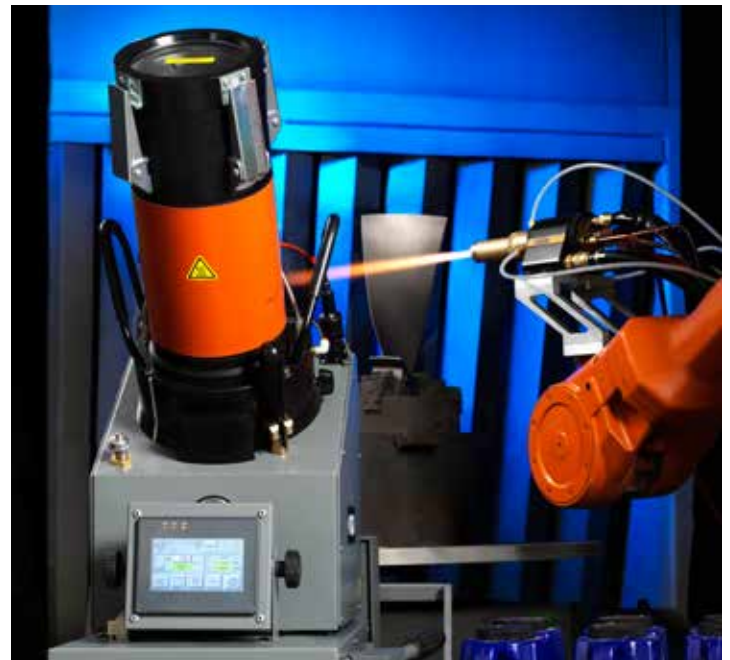
The Model 1264 Powder Feeder is a paragon of performance and versatility. Whether it is feeding fine oxides or coarse, dense alloys, the Model 1264 feeder delivers powder accurately and consistently. Decades of precision feeding are proof positive of the reliability of the 1264 powder feeder.

## Model 1264i Powder Feeder

Based on the proven Model 1264 design, the Model 1264i increases powder feed reliability and consistency by offering state-of-the-art controls technology such as a PLC for process control and an easy-to-use touch-screen operator interface which can be remotely mounted. Closed-loop RPM control with high/low warnings and alarms increases powder feedrate control to improve coating reproducibility. Additional enhancements include a 50 percent larger, removable, quick-change powder hopper to improve productivity and provide a higher pressure rating up to 125 psi (862 kPa).

## Model 1264WL Powder Feeder

The Model 1264WL powder feeder includes all the features of the Model 1264i feeder and improves powder feedrate stability with reliable closed-loop weight-loss control. Through rapid weight-loss over time calculations, the powder feeder is automatically and quickly brought to the pre-programmed powder feedrate and maintains that feedrate for the duration of the spray run. Features, such as a user-friendly touchscreen control, rapid response time, user-programmable filters, which reduce the affects of random noise (air movement and vibration) on the weight scale, recipe storage, user-settable low powder warning, and maintenance screens, all contribute to improved productivity, consistency, and ease-of-use.



With features such as high/low feedrate warnings and alarms, low powder warning and an automated powder profile set-up, the 1264WL powder feeder offers a new level of ease-of-use and reliability in weight-loss control capability that provides the precision and accuracy needed in critical production applications.

# Powders. Powders that perform.

In addition to producing powders specifically designed for use with the JP-5000®, JP-8000™ HP/HVOF® guns, Praxair Surface Technologies is a leading supplier of powders for all other thermal spray processes, as well as for additive manufacturing.

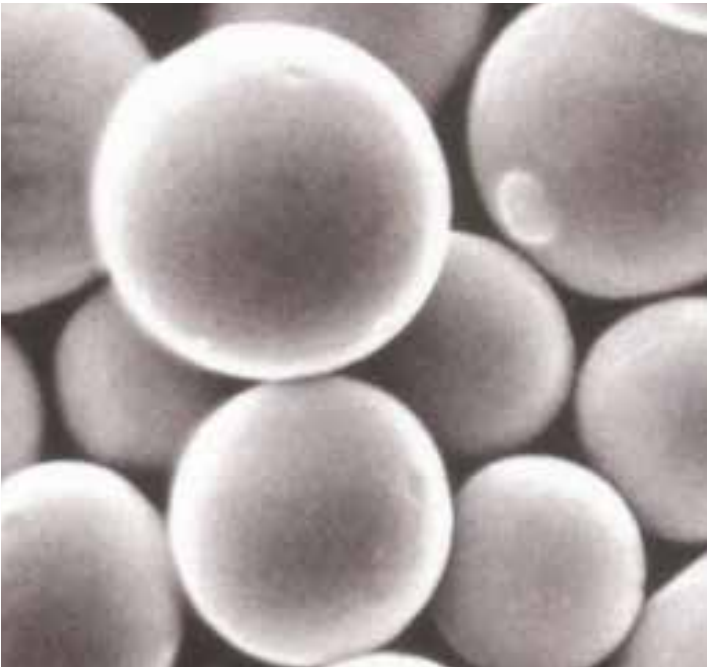
A solid commitment to research and development, linked with state-of-the-art manufacturing facilities, allow us to meet both small and large production requirements. We manufacture extensive lines of carbides, metal alloys, and ceramic powders designed for high deposition efficiency and unsurpassed coating quality.

## HVOF Powders

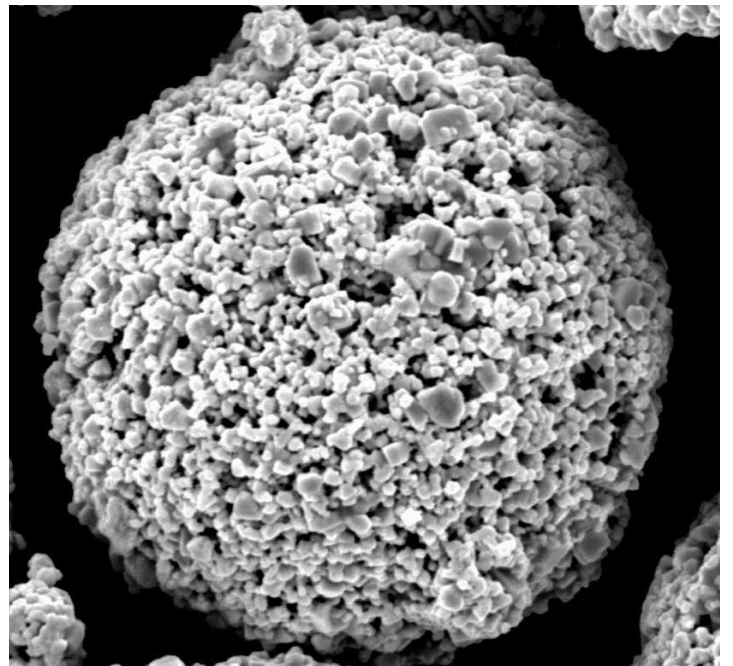
- Spherical carbides of all types, including WC-Co, WC-Co-Cr, WC-Ni, and CrC-NiCr powders.
- High purity gas-atomized metals and alloys, featuring Superalloys and MCrAlY powders of all types.
- Cast/crushed and sintered/crushed carbide powders, including WC-Co, WC-Co-Cr, and WC-Ni compositions.
- Proprietary, patent-protected Advanced Powder Technology (APT) powders features complete families in CrCr-NiCr and WC-Co compositions. These powders contain a fine carbide dispersion in a metal matrix that balances wear and corrosion properties and also provides a good balance between wear and ductility. They provide attractive cost savings due to their higher deposit efficiencies compared to conventional carbide powders.

An ISO 9001:2008 approved quality system assures that our powders are produced to the highest quality standards and comply with the demanding requirements of the aerospace, medical, gas turbine, petrochemical, and automotive industries, among others.

With global service, sales, and support networks and inventory stocking points strategically located around the world, PST stands ready to meet your most critical powder and application needs. Our experienced team of engineers, metallurgists, and coating specialists has one goal – to help you produce the best coatings possible. If you could benefit from applications assistance, please let us apply our experience. Call us today to discuss how we can help you produce the highest quality HVOF coatings.



Our Indianapolis, IN powder facility manufactures quality carbide and alloy powders specifically designed to produce exceptional HVOF coatings. Five separate powder processes generate materials with the precise characteristics to allow HVOF systems to produce the hardest, thickest, most dense coatings possible.



A Linde company



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