



HVOF spray solutions

Praxair Surface Technologies, Inc. is a **world leader** in thermal spray equipment, materials, and coatings technology. As a primary contributor to the development and applications of High Pressure, High Velocity Oxygen-Fuel spraying, Praxair has designed a complete family of TAFE 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 representative or contact our U.S. equipment headquarters:

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Our JP-8000 HP/HVOF systems is designed for easy integration with the advanced Model 7780 Universal Process Control Center (UPCC), a sophisticated multi-process thermal spray controller. 7780 UPCC technology allows a single work station to control (left to right) a 5220 HP/HVOF gun, a 2700 Plasma ID gun, a 9935 Arc Spray gun, and virtually any other thermal spray device you need.

Highly productive systems Productivity

Whether you need HVOF equipment, powders, automated coating systems, or technical support and assistance, Praxair Surface Technologies has a solution you can rely on. With over 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 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 touchscreen 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, Praxair offers the advanced 7780 Universal Process Control Center (UPCC) computerized controller. Thermal spray processes, including the JP-8000-PC system, can be controlled from a robust human machine interface (HMI) PC/PLC-based control console. The PC HMI provides a user-friendly, touchscreen 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™ system (above) and JP-5000® system (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.

Enhanced technology and value Premium

JP-5000®

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

Key benefits afforded by the JP-5000 system's high particle velocities include extremely high coating density and low oxide content. Density is achieved by particles packing tightly and uniformly to reduce porosity. Low oxide content results from reduced powder particle dwell time in the flame due to the higher flame velocity. These two features are especially beneficial in applications requiring resistance to corrosive attack.



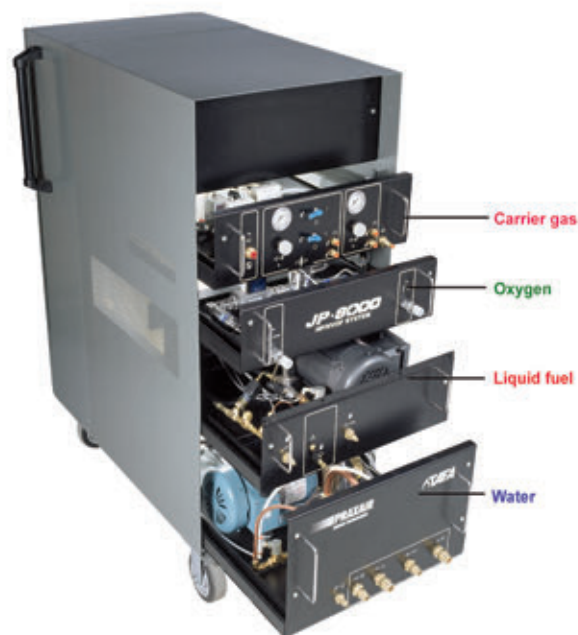
The sophisticated JP-8000™ system incorporates everything that made the JP-5000® system so successful in challenging applications such as Pelton wheels (above) for the hydro-power industry. In addition, we have engineered numerous advances, including the 8100 console (right) that features easy-access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

In addition to outstanding coating quality, the JP-5000 system delivers a significant productivity advantage, with spray rates up to two times higher than conventional gaseous-fueled 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.

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.



Elevated HVOF performance Performance

The TAFA JP-5000® and JP-8000™ systems use an elegantly simple and effective gun design to produce 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 up to 1/2" in. (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, faster with reduced maintenance and labor costs.

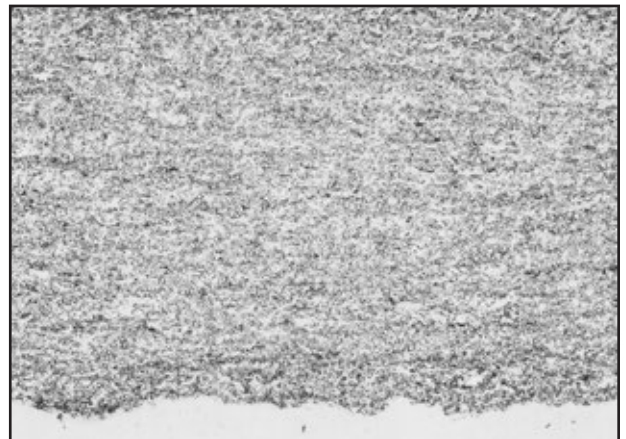


Perhaps the most striking advantage of the Model 5220 gun is its ability to apply coatings up to 1/2 in. (12.7 mm) thick (above) while maintaining superior bond strengths and high density (right). Thick coatings are possible because exceptionally high particle velocities produce coatings in compression, 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 the absolute best 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 consistent heating 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 gaseous-fueled 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. Competing gaseous-fueled processes have not been able to equal this unique property. The powder heating consistency also improves bond strength and overall coating quality.



Typical Tungsten Carbide – 17% Cobalt Coating Microstructure

HVOF processes for Equipment Solutions

JP-5000®

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

Features:

- Control over coating density and hardness
- Unparalleled ultimate hardness and density
- High interface bond strength
- Thickness capability up to 12.7 mm (1/2 in.)
- Smooth as-sprayed finish
- CE compliant

JP-5000 HP/HVOF system components:

- Model 5220 Gun
- Model 5120 Semi-Automatic Control Console
- Model 1264 Powder Feeder(s)
- Optional 1280 Feed Rate Controller(s)
- Optional Portable Kerosene Spill Cart



JP-8000™

Advanced next generation HP/HVOF® 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-8000 HP/HVOF system components:

- Model 5220 Gun
- 8100 Fully-Automatic MF Control Console
- Model 1264 Powder Feeder(s)
- Optional Remote Touchscreen Terminals
- Optional Data Acquisition
- Optional PC Touchscreen Version



5220 Gun

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

Features:

- Simple, proven, robust design
- Gas velocities up to 2195 M/sec (7200 Ft/sec)
- Monitored combustion pressure
- Radial powder injection
- Variable barrel lengths
- Ease of maintenance

5220 gun components:

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



Safety is not an option

Praxair takes thermal spray safety very seriously. All of our HP/HVOF® systems are engineered and built for productive and safe operation. Each system includes some or all of the following safety features, depending on operating characteristics:

Use of non-volatile liquid fuel (kerosene)

Separation of electrical components from the oxygen, fuel, and water modules by either a solid metal panel, adequate space/ventilation, or both

Interlocked alarm circuits to monitor fuel, oxygen flows and pressures, combustion pressure, and water supplies and flows that are designed to prevent conditions that could be hazardous to the operator or the equipment

Consoles are designed for stability, employing large wheels/casters, a low center of gravity, and even-weight distribution

Electrical safety is enhanced through the use of intrinsically safe components and separation of electrical voltage sources into discrete wire-ways

Kerosene is (a) prevented from entering the gun until the combustion sequence is activated; and (b) shuts off immediately if combustion does not occur

Combustion pressure is monitored and if combustion does not occur or stops, the entire system shuts down

Powerful Powerful

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, 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

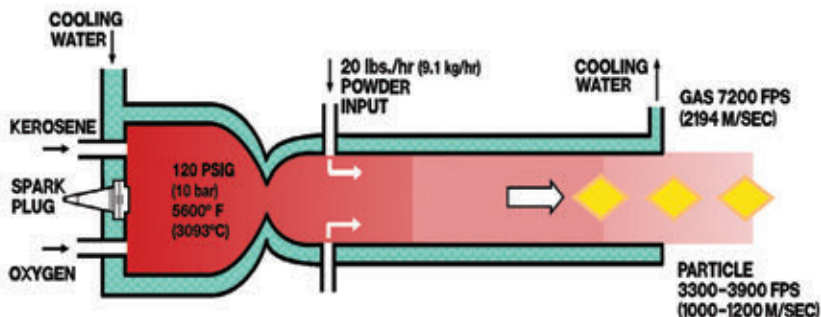
The Model 8100 Control Console for the JP-8000™ system is a closed-loop, fully automated console with an easy to read and follow touchscreen Operator Interface Terminal (OIT). The operator merely selects the required spray recipe from memory and pushes the gun "RUN" symbol on the screen to start the 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 Model 8100 console's modular circuits have been designed into individual drawers that slide out. When combined with the maintenance functionality built into the OIT 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. Almost 20 years of extensive engineering effort has gone into the development, testing and refinement of this unit. The result is a unique 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 lower 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 an exceptionally high combustion pressure of up to 120 PSIG (8.2 bar) and superior gas velocities (7,200 fps [2,194 m/sec.]). This translates into higher coating hardness and better coating integrity.



Proven, robust and economical Proven

The Economical Solution

A big plus for the JP-5000[®] and JP-8000[™] HP/HVOF[®] systems is operating economy. It saves money in several ways. Fuel costs are lower, as kerosene is generally available and less expensive than propylene or hydrogen.

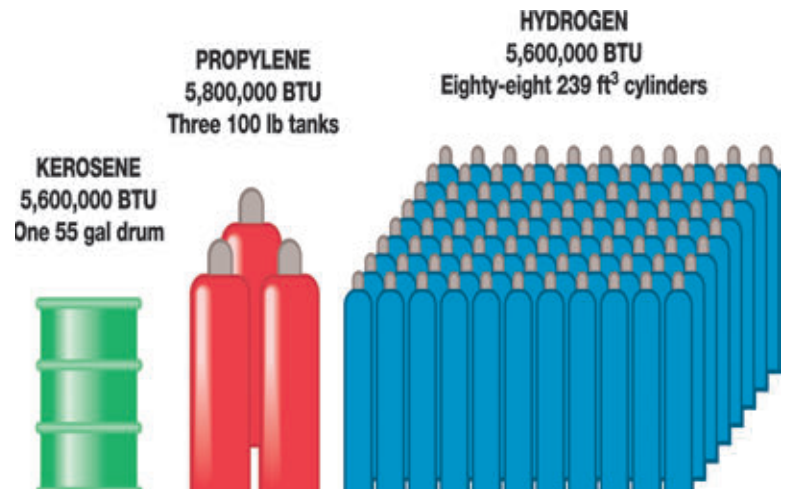
The spray rate of the Model 5220 gun can be as high as 20 lbs/hr (151 g/min), so you put down more coating in less time. Importantly, coating quality is not affected at the higher spray rates. Typical deposition rates of 0.001 in. (25.4 μ m) per pass build up your coating at rates up to two times those of gaseous-fueled HVOF systems. That helps you turn around parts more quickly, with less labor and waste.

The JP-5000[®] and JP-8000[™] systems' simplicity of design and robustness along with the Model 5220 gun's efficient water-cooling allows operation for extended periods, increasing up time. These features help you coat more parts in less time while spending less money and time maintaining your system.

The converging/diverging combustion nozzle design in the Model 5220 gun allows powders with a larger average particle size to be used. In many cases, this can decrease powder cost when compared with systems that require smaller particle sizes.



A key benefit to using larger particle sizes is that the larger particles have less surface area. This reduces oxidation and produces less oxygen in the coating thus producing a better coating for high temperature oxidation like the CoNiCrAlY coating shown above.



The use of kerosene as a fuel results in lower operating costs for the JP-5000[®] and JP-8000[™] systems and has the added benefit of increased safety.

Precision powder feeding

Precision

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 HVOF and other thermal spray applications. 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.



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 that 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 a higher pressure rating 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 effects 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

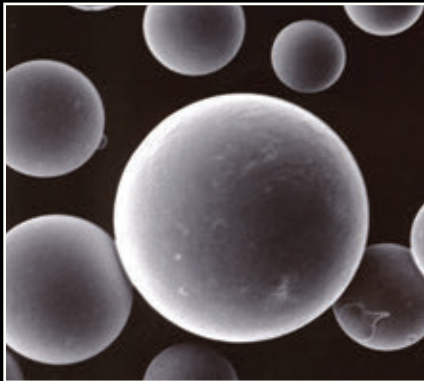


The 1264 powder feeder is a paragon of performance and versatility. Whether it is feeding fine oxides or coarse, dense alloys, the 1264 feeder delivers powder accurately and consistently. Decades of precision feeding are proof positive of the reliability of the 1264 powder feeder.

Powders that perform Powders

Praxair Surface Technologies is a leading supplier of HVOF powders specifically designed for use with the JP-5000®, JP-8000™ HP/HVOF®, and other HVOF systems.

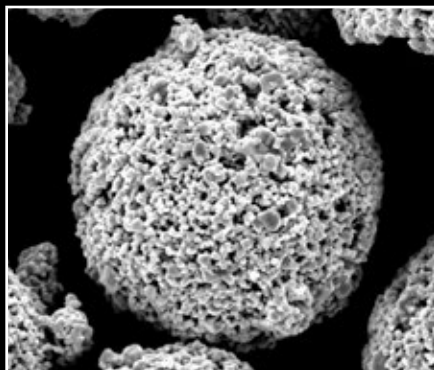
A solid commitment to research and development, linked with state-of-the-art manufacturing facilities, allow us to meet both small and large production requirements. We manufacture extensive lines of carbides, metal alloys, and ceramic powders designed for high deposition efficiency and unsurpassed coating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



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.

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 featuring 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 capability due to their higher deposition 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, Praxair 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.



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