

Plasma 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 application of plasma spray with equipment and coatings routinely used by the aircraft engine industry for OEM and repair coatings for over 45 years, Praxair has designed a complete family of products reflecting years of equipment engineering and **coatings expertise**. Our plasma product line is certain to include a system that meets your specific quality, productivity, versatility and economic needs.

We recognize that the selection of a new plasma spray system is just the initial step. That's why Praxair continues to **develop and perfect** new plasma powders and coatings to help push thermal spray technology toward an exciting generation of wear, oxidation and corrosion-resistant applications. We dedicate talented engineers to team with you to develop materials, processes and **coating solutions** that expand the market for cost-effective thermal spray applications.

Let us work with you to select the **best plasma spray system** and put it to work to maximize your output and returns. For more information, please contact your local representative or contact our U.S. equipment headquarters:

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One of the key advantages of the Model SG-100 gun is its ability to adapt to the Model 2086A ID extension, shown applying a TBC on an aircraft burner can.



A systems approach Systems

Integrated Systems

In order to produce superb plasma-sprayed coatings with a wide variety of materials, plasma spray equipment must perform consistently, whether the energy level is 15 kW or 200 kW. To provide consistent control over the complete range of plasma spray systems and power levels, Praxair Surface Technologies offers four plasma system options: (1) manual, critical orifice controlled; (2) automatic, critical orifice controlled; (3) computerized, mass-flow controlled; and (4) high energy, computerized, mass-flow controlled.

Whether you need simple, reliable plasma spray equipment, a sophisticated, robust computerized system, or the high power PlazJet II plasma spray equipment, Praxair has a solution for you.

Committed Resources

The decades of excellent performance provided by our plasma systems, including critical aircraft engine applications, are a reflection of our commitment and expertise in the field of Thermal Spray.



We can offer a complete plasma system that fits most requirements. Importantly, we support our hardware with unparalleled technical service and applications assistance, along with one of the most capable powder operations in the thermal spray industry. Praxair's equipment options, powder quality and selection, and coatings know-how offer you the best value for a total plasma coating system.

Integrated Know-How

Our pioneering use of argon as the primary plasma gas gives:

- Easier/simpler ignition and startup
- An arc larger in diameter and "softer" than diatomic gas arc
- Less substrate heating due to shorter effluent plume
- Quieter operation; more stable arc region
- More consistent performance
- Cleaner coatings

Combine this with first-rate engineering backup, coating expertise and world-class powder and you can be assured of consistent reliable coatings.

Add it up and you will agree: Praxair has the right plasma solution to meet your needs.

Manual/Economical (Model 3710)

The economy unit, at either 40 kW or 100 kW power levels suitable for low to medium production rates.

Automatic Operation (Model 6600c)

This flexible, powerful plasma control console combines critical orifice gas flow control with PLC-based closed-loop control of process gas flows.

Advanced Closed-Loop (Model 7700AP UPC)

The computerized 100 kW power level, mass flow-based "universal" controller that operates most plasma guns.

High Energy (Model 7700PJ)

For unparalleled, low cost, highest quality coatings, the PlazJet II operating at power levels up to 200 kW offers up to a 300 percent improvement over conventional plasma guns.



Each plasma spray system includes everything you need to produce outstanding coatings, whether your applications require a simple unit with a Model SG-100 gun (left) or a more sophisticated system like the high powered PlazJet II (above).

Plasma processes for Equipment Solutions

3710

3710 Economy Plasma Spray System

Features:

Manual critical orifice gas flow control

Built-in PC-100 power supply controller with digital displays

Two powder feeder control capability (either/or)
NFPA Type "Z" purging with audio/visual alarms

Best combination of economy and performance

3710 System Components

Model 3710 Plasma Spray Control Console

40 kW or 100 kW Power Supplies

Plasma Spray Gun (e.g., SG-100, F4 and 9M, etc.)

Model HF-2210 High Frequency Arc Starter

Model 1264 Precision Powder Feeder



6600c

6600c Plasma Spray System

Features:

Critical orifice gas flow control with closed-loop control of plasma gases

Digital gas flow display in two user-configurable units

Two powder feeder control capability (simultaneously)

Soft-start and process gas flow ramping for reliable operation

Flexible I/O configuration simplifies integration with robots and automation.

6600c System Components

Model 6600c Plasma Spray Control Console

Plasma Spray Gun (e.g., SG-100, F4 and 9M, etc.)

Model HF-2210 High Frequency Arc Starter

Model 3621 Voltage Controls

100 kW Power Supply

Model 1264 Precision Power Feeder



7700AP UPC

7700 Computerized, Closed-Loop Plasma Spray System

Features:

- Mass flow control of plasma and carrier gas
- Manual and fully automatic, PLC-based process control
- Intuitive, touch-screen interface terminal
- Optional Model 7780 multi-process control capability
- Sophisticated data acquisition and maintenance software

7700AP UPC System Components

- Model 7701 Universal Plasma Controller HMI
- Main Control Panel (MCP)
- Primary and Secondary Gas Control Modules
- Carrier Gas Control Module(s)
- 100 kW Power Supply
- Plasma Spray Gun (e.g., SG-100, F4 and 9M, etc.)
- HF/PS Power Module
- Two Model 1264 Precision Powder Feeders



7700PJ

PlazJet II High Energy Plasma Spray System

Features:

- Computerized/PLC-based high energy plasma spray process control
- Mass flow control of plasma and carrier gases
- Large “recipe” storage capability with programmable process set points
- Power levels up to 200 kW
- Consistent, highest quality coatings at high spray rates

PlazJet II Components

- Model 7700PJ PlazJet Controller HMI
- Main Control Panel (MCP)
- Primary and Secondary Gas Control Modules
- Carrier Gas Control Module
- HPS-250 kW Power Supply
- PlazJet II High Energy Plasma Gun
- Model HF-2210 Power Module with HF-2100
- Two Model 1264WL Weight-Loss Powder Feeders



Powerful Powerful

Model 3710 Console

The economical Model 3710 Plasma Control Console is a compact, plasma controller designed for production environments. The Model 3710 features “jeweled” critical orifice gas flow control for consistent, highly accurate and repeatable gas control.

Decades of reliable performance stand testament to the benefits of critical orifice technology. Low maintenance critical orifice flow control reduces the need for periodic calibrations.

Features:

- Simple, manual operation
- Water flow and gas pressure interlocks to prevent torch damage
- Solid-state power control with current preset functionality

Model 6600c Console

The Model 6600c Plasma Control Console offers unsurpassed features at an affordable price. The 6600c features closed-loop control of plasma gases based upon the proven critical orifice flow control design.

The unique software of the 6600c provides for full integration with automated spray cells, including robots and ventilation controls.

Features:

- Closed-loop process gas flow control
- Digital flow readout
- User-configurable gas flow control units
- Simplified integration with automation

Model 7700AP UPC

The Model 7700AP Universal Plasma Controller is the ultimate in plasma spray process control. The Model 7700AP features mass flow control of process gases with a robust PC/PLC control architecture.

The use of mass flow controllers provides highly accurate, repeatable gas flow control that is relatively insensitive to supply pressures. Plasma energy can be controlled by either current, kW or Net Energy.

The Model 7700's color PC touch-screen OIT is simple and rugged.

The Model 7700 software is intuitive and easy to operate.

Features:

- Development (manual) or Production (full automatic control) mode
- Recipe storage with multi-layer part recipe capability
- Maintenance functionality
- Data acquisition
- Operates one to four powder feeders
- Robot Master or Robot Slave functionality
- Optional remote diagnostics

Model 7700PJ PlazJet II

The PlazJet II is a high power (200 kW) DC plasma spray system that provides superior quality coatings and dramatically improved throughput compared to competing high enthalpy plasma torches.

Based on the Model 7700AP UPC, the 7700PJ PlazJet II allows for operation of the original revolutionary long arc high energy plasma torches. All of the features of the 7700AP UPC are standard on the 7700PJ PlazJet II high energy plasma spray system.

The family of PlazJet torches, with either internal or external powder feed, allows for rapid coating deposition, with spray rates that exceed 300 grams per minute. For some materials, deposit efficiency may exceed 75% with the external feed torch.

The PlazJet II System equipped with any of the PlazJet torches produce gas velocities up to four times higher than conventional plasma guns. This high velocity allows for the deposition of hard, dense coatings with minimal porosity.

Features:

- Power up to 200 kW for higher spray rates
- Exceptional deposit efficiency
- Proven TAFA Model 7700 PC/PLC Control system

Advanced technology Technology

Model SG-100 Gun

Praxair's Model SG-100 plasma spray gun is regarded as one of the most flexible and durable plasma spray guns on the market today. The Model SG-100 is designed to produce exceptional plasma coatings, regardless of which system controls it.

Operating at energy levels up to 80 kW, the gun is suitable for a wide range of applications requiring metals, carbides or ceramics. The Model SG-100's unique design accepts internal and/or external powder injection at a variety of injection angles and features anodes and cathodes renowned for long service life.

Internal injection provides the most efficient spraying condition and generates the highest-quality coatings. By injecting the powder closer to the highest arc, heat and momentum transfer to powder particles is maximized for improved deposit efficiency compared to external injection.

The Model SG-100's small number of self-aligning parts makes assembly quick and accurate, saving time and money. Flexibility, efficiency and proven excellence have made the Model SG-100 plasma gun an industry favorite.

The Model SG-100 is compatible with plasma gases including argon, nitrogen, helium and hydrogen. Common torch configurations support Ar-H₂ and Ar-He plasma gas mixtures.

Under production operation conditions, anode life for some torch configurations may be as high as 300 hours of actual spray time.

Model SG-100 features:

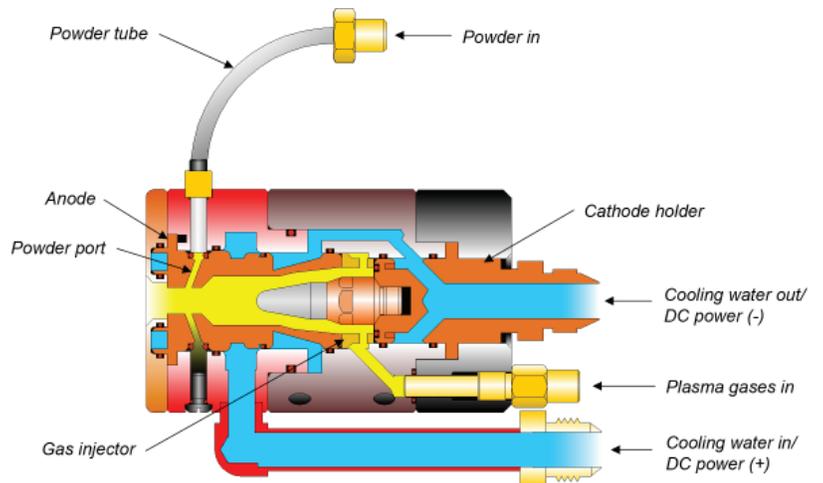
- Self-aligning components
- A range of hardware configurations
- Internal and/or external powder feed
- Extended life anodes and cathodes
- High deposit efficiencies
- Internal diameter capability

Model SG-200 Gun

The Model SG-200 plasma spray gun is a smaller version of the Model SG-100 designed for energy levels up to 40 kW. Specifically suited for machine-mounted applications, including true 90 degree ID coatings, the Model SG-200 works best in production environments requiring rapid, uniform and repeatable coatings.



Dual port external powder injection with variable port angles is available as an option for both the Model SG-100 and SG-200 (above). These external ports can be used in place of, or in conjunction with the internal ports.



Versatility and performance

Versatility

The versatility of the Model SG-100 gun extends the capability to coat internal diameters to as small as 38 mm (1.5"). The Model 2086A and Model 2700 extensions to the standard Model SG-100 produce quality ID coatings at energy levels up to 30 kW. Interchangeable components allow quick conversion from OD to ID operation, adding to the unmatched capability of the Model SG-100 gun. The Model 2086A extension can deposit coatings into diameters as small as 64 mm (2.5") and is supplied with 45° spray angle hardware while configurations for 60° and straight ahead are also available. The Model 2700 can coat diameters as small as 38 mm (1.5") and is supplied with 45° hardware.

ID Spray

The SG-100 plasma gun design is simple yet robust, producing excellent coatings of all types and allowing easy conversion to ID spraying (Model 2700-12 shown).



Model SG-100 Hardware

The Model SG-100 gun operates in a number of modes (subsonic, Mach I and Mach II) to allow for optimum user flexibility. The parts are designed to be self-aligning and assembled easily and quickly while maintaining concentricity, i.e., the center line of the electrode on the axis of the nozzle (anode). The more precise the alignment is, the more centered the arc is within the nozzle. Good concentricity and proper gas flow patterns produce:

- Minimum heat loss to the nozzle
- Long nozzle (anode) life
- Simpler, more reliable powder injection into the plasma stream
- Minimal nozzle powder buildup
- Improved coatings quality and reproducibility

Imitators just don't stack up

With tolerances specified to ensure gun operating consistency and long service life, our spare parts offer what poor imitations cannot; spray performance as designed and intended, resultant coatings of unsurpassed excellence and true value in every sense of the word. With all of that assurance and our unparalleled customer service and coatings development, why would anyone think of using out of spec facsimile parts?

Precise, Matching Spare Parts

Aftermarket suppliers typically do not design, manufacture or test equipment, and stack tolerances are overlooked or simply not considered. Individual parts are merely copied. As a plasma spray original equipment manufacturer, Praxair produces components with the understanding that 0.001" (25.4 μm) accuracy can dramatically improve or destroy performance.



Sophisticated process control Control

Flexible Process Control Option

Many complex thermal spray coatings demand precise control of the heating and acceleration of powder particles. The dynamic nature of DC arc plasma torches, along with strict requirements for process control verification and diagnostics, requires robust system design and sophisticated, closed-loop computer control.

Praxair covers the entire range of process control needs, from the manual Model 3710 control console, to the sophisticated PLC/PC controlled Model 7700AP UPC or PlazJet II systems.

The new Model 6600c Plasma Control Console is capable of fully automatic operation in both stand-alone and robot integrated installations. The 6600c features closed-loop control of primary and secondary gas, as well as power supply current with user-configurable dual digital gas flow displays.

The Model 6600c also features user-configurable warning and alarm tolerances for key process parameters. Alarm and warning ranges may also be configured for torch and power supply voltage to indicate degradation of torch components.

The Model 7700 systems offer configurable control modes including fixed current operation, constant power control, or Net Energy control.

The Net Energy function varies the electrical power supplied to the plasma torch, by automatically varying either secondary gas flow, or power supply current. This control mode permits the Model 7700AP UPC, 7780 UPCC or PlazJet II plasma control system to react to the changing physical condition of the plasma torch hardware.

By controlling the energy where the powder is heated, the controller maintains repeatability of the process from one production run to the next, despite normal gun component variations/wear and cable degradation.

Simply put, more stable and consistent plasma energy results in repeatable particle heating and reproducible plasma coatings.

Optional water conductivity monitoring is available for the 7700AP UPC, 7780 UPCC, 7700PJ PlazJet II, and 6600c plasma systems. This feature provides a visual warning when water conductivity exceeds specified limits, ensuring reliable starting and operation of the plasma torch.



Among the advanced plasma control options available with Net Energy are the integrated PC/PLC-based Model 7700AP UPC (above) and the unique PlazJet II, a high power plasma spray process controller.

The Model 7780 UPCC multi-process thermal spray system expands the precise control of the Model 7700-based plasma spray system to include TAFE Model JP-8000-PC HP/HVOF® system. This combination provides the ultimate multi-process thermal spray cell for the most demanding applications.

Precision powder feeding

Precision

Model 1264 Powder Feeder

Praxair's unique, time-tested TAFA Model 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 improvement further enhance the Model 1264 feeder's consistency and compatibility with plasma systems such as the Model 3710, Model 6600c, Model 7700AP UPC, Model 7780 UPCC and PlazJet II 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 delivers powder accurately and consistently. Decades of precision feeding are proof of the reliability of the Model 1264.

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 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% larger, removable, quick-change powder hopper to improve productivity and a higher pressure rating to 125 psi (862 kPa).

Model 1264WI Powder Feeder

The Model 1264WL powder feeder includes all the features of the Model 1264i feeder and improved powder feedrate stability with reliable closed-loop weight-loss control. Through rapid weight-loss over time calculations, the powder feeder is automatically brought to the pre-programmed powder feedrate and maintains that feedrate for the duration of the spray run. Features such as triple load-cell summing, rapid response time, user-programmable filters which reduce the affects of random noise (air movement and vibration) on the weight scale, a user-friendly touch-screen control, recipe storage, 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 trial profile set-up, the Model 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.



Perfecting the
application process

Know-how

As a company dedicated to providing exceptional coatings solutions, Praxair recognizes the added importance of providing thermal spray powders and applications assistance. We realize that your interest is the coatings you produce – their quality, consistency and cost, and the speed, efficiency and repeatability with which they are produced.

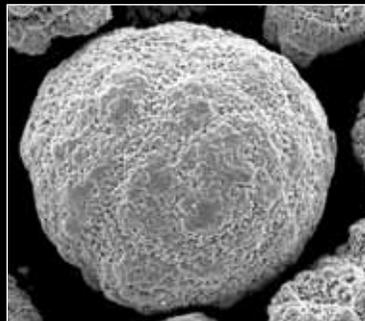
That's why we are proud to supply a family of thermal spray powders designed specifically for use with each type of plasma spray device. Yet we go one step further: The sole mission of Praxair's coating technology department is to perfect each of our processes. All day, every day, we work to refine coating parameters for our systems and powders. And we are never more effective than when working in tandem with you, helping solve coating problems, developing new innovative solutions, or increasing the deposit efficiency of proven coating solutions.



Plasma Powders

- High-purity gas-atomized metals and alloys, including MCrAlY powders of all types
- Spray-dried and sintered ceramic powders, including TBC stabilized zirconia
- Dense, metal-free chromium oxide powders produced by a proprietary process
- Spherical carbides of all types, including WC-Co-Cr and CrC-NiCr powders
- Cast/crushed and sintered/crushed carbide powders, including WC-Co and WC-Ni
- 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 deposit efficiencies compared to conventional carbide powders.

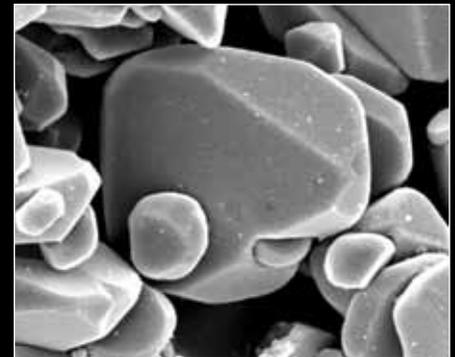
Utilizing multiple production methods, including argon gas atomization, spray-drying and sintering, and proprietary technologies, we make high-purity powders engineered to meet the exacting requirements of plasma spray systems.



In order to get the maximum output from your plasma system, proper selection and use of premium thermal spray powders is a must. Look no further than Praxair. Our state-of-the-art powder facility in Indianapolis, sets the new standard for world-class manufacture of thermal spray 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.

If required, we can customize a plasma powder, gun, complete system, or coating to meet the specifications of your unique application. Similarly, Praxair's powder engineering team can work to match specific material needs, whether a new alloy, powder morphology or particle size distribution is required.





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