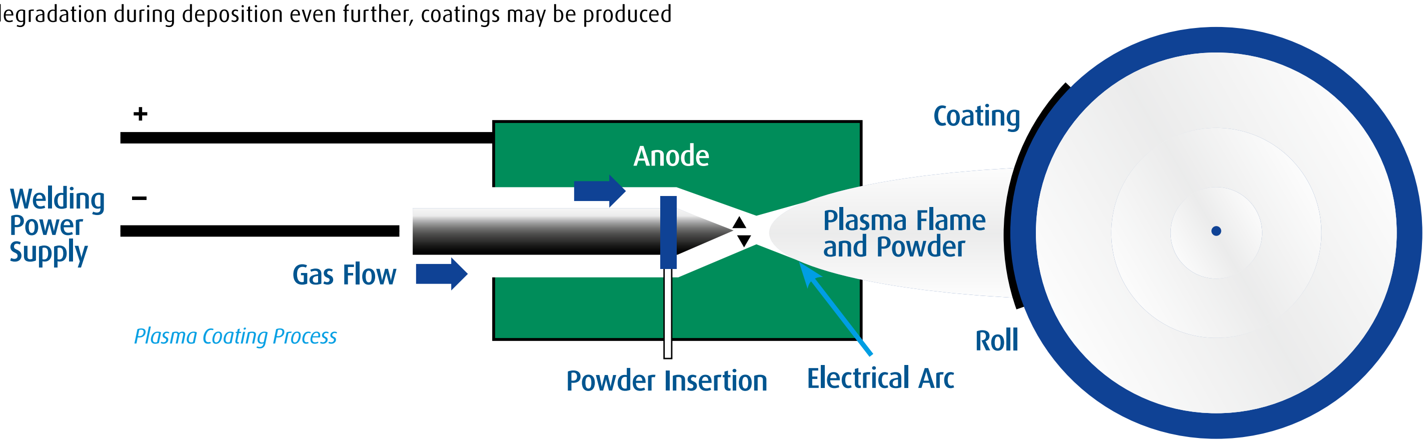
Thermal Spray Process | Plasma

A plasma torch is shown schematically in Figure 1. Gas, usually argon and/or nitrogen, with hydrogen or helium admixed in some cases, flows through a cylindrical copper anode that forms a constricting nozzle. A direct current arc is maintained between an axially placed tungsten cathode and the outer or expanding portion of the anode. A gas plasma (ionized gas) is generated with a core temperature of about 50,000°F (30,000°C). Powder, with a particle size ranging up to about 100 microns, is fed into the plasma stream in a variety of ways and locations. The powder is heated and accelerated by the plasma stream, usually to temperatures above its melting point, and to velocities ranging from 400 to almost 2,000 ft/sec. The actual powder temperature distribution and velocity are strongly a function of the torch design.

The gases chosen for plasma do not usually react significantly with the powder particles; however, reaction with the external environment, normally air, may lead to significant changes in the coating. The most significant reaction with metallic and carbide coatings is oxidation. The unique design of Praxair Surface Technologies torches results in less oxidation than occurs with most other plasma torches. To reduce degradation during deposition even further, coatings may be produced using either an inert gas shield surrounding the effluent or by spraying in a vacuum chamber under a low pressure of inert gas. Argon usually is used in both cases as the inert gas. A proprietary Praxair gas shroud is extremely efficient in inhibiting oxidation and is less costly than spraying in low-pressure chambers.

Plasma deposition is a line-of-sight process. However, because of the relatively small size of the torch, the inside surface of hollow cylinders (and certain other more complex shapes) can frequently be coated with appropriate traversing equipment. Torches have been produced that can coat inside cylinders to substantial depths. The as-deposited surface roughness of Praxair plasma coatings varies with the type of coating from about 60 to more than 300 microinch Ra. Although for many applications coatings are used as deposited, some coatings are ground or ground and lapped to 1 to 10 microinch Ra. Typical coating thicknesses range from about 0.002 to 0.020 inch, but both thicker and thinner coatings can be used.



Plasma Coating Process

Thermal Spray Process | Plasma

Almost any material that melts without decomposing can be used to make D-Gun or non-transferred arc plasma sprayed coatings. In both, the coating material in the form of powder is heated and accelerated in a high-temperature, high-velocity gas stream and projected against the surface to be coated. The molten or semi-molten droplets form thin, overlapping platelets that quickly solidify on the surface; many layers of such platelets form the coating.

A major attribute of this technology is the ability to apply coatings with very high melting points to substrates (workpiece or part) without significantly heating the substrate. Thus coatings can be applied to fully heat-treated, completely machined parts without danger of changing the metallurgical properties or strength of the part and without the risk of thermal distortion inherent in high-temperature coating processes.

Standard production coatings include pure metals and metallic alloys such as nickel or nichrome, ceramics such as alumina or alumina-titania, and cermets such as tungsten carbide cobalt. These coatings are used in many industries, including steel manufacturing, aviation, paper manufacturing and chemical processing. Their primary purpose is usually to combat wear (abrasive, erosive, fretting, or adhesive), often in very corrosive environments.

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