Thermal Spray Process | Detonation Gun

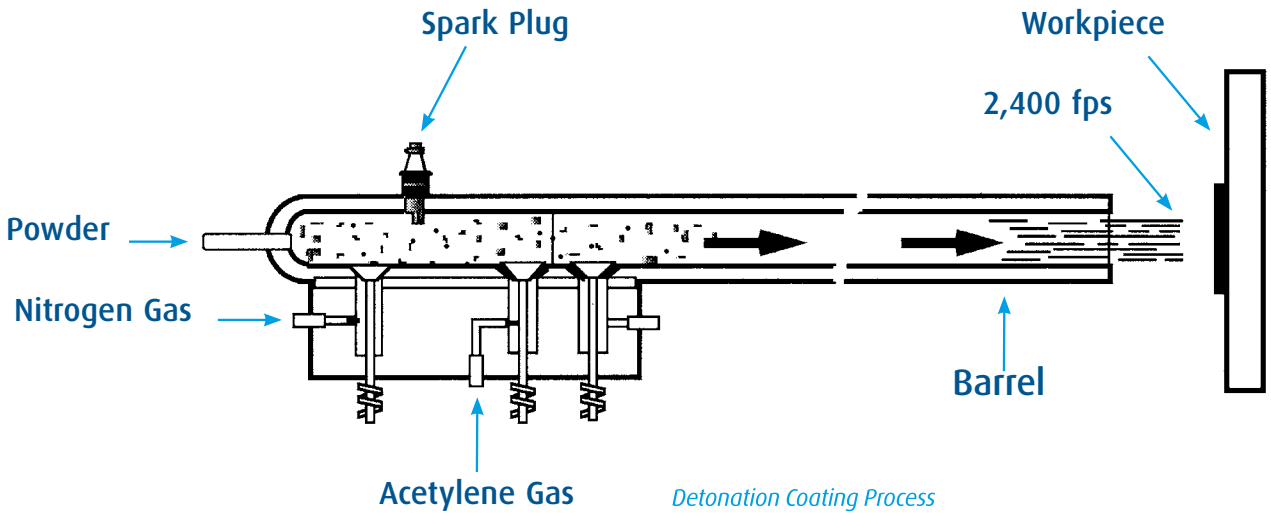
A detonation gun (D-Gun) consists of a water-cooled barrel several feet long and about one inch in diameter with some associated valving for gases and powder, as shown schematically in Figure 1. A carefully measured mixture of gases, usually oxygen and acetylene, is fed to the barrel along with a charge of powder (usually with a particle size less than 100 microns). A spark is used to ignite the gas, and the resulting detonation wave heats and accelerates the powder as it moves down the barrel. The gas is traveling at a supersonic velocity, and the powder is entrained for a sufficient distance for it to be accelerated to a supersonic velocity as well, typically about 760 m/sec (2400 ft/sec). A pulse of nitrogen gas is used to purge the barrel after each detonation. This process is repeated many times a second.

Each individual detonation results in the deposition of a circle (disk) of coating a few microns thick and about one inch in diameter. The coating is made of many overlapping disks. Careful, fully automated disk placement results in a very uniform coating thickness and a relatively smooth, planar surface. Detonation gun coatings thus consist of multiple layers of densely packed, thin lenticular particles tightly bonded to the surface. Primarily because of their high density and high bond strength, Praxair Surface Technologies D-Gun coatings have become the standard of excellence for thermal spray coatings.

The as-deposited surface roughnesses of D-Gun 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, most 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 depending on the specific application.

The detonation gun process is called line-of-sight because the end of the barrel must be able to see the area being coated. The best coating properties are achieved when the angle of deposition is close to 90 degrees to the surface. Because of the very high powder velocity, however, little degradation in properties is usually noted down to at least 60 degrees, and useful coatings can be made at angles as low as 45 degrees.

The size of the detonation gun makes it impractical to manipulate the gun itself inside cavities, thus cavities are coated only by firing into them at an angle. As a result, for example, the inside surface of a hollow, cylinder can be coated only to a depth equal to the diameter (an angle of deposition of 45 degrees).



Detonation Coating Process

Thermal Spray Process | Detonation Gun

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.

A Linde company

PRAXAIR SURFACE TECHNOLOGIES

Linde

Making our world more productive

Praxair Surface Technologies, a Linde company
1500 Polco Street, Indianapolis, IN 46222
Phone +1 317 240 2500, Fax +1 317 240 2255
www.praxairsurfacetechnologies.com, psti-info@praxair.com

P-9085, 02-2021