Thermal Spraying—Practice, Theory, and Application

American Welding Society

Thermal Spraying

Practice, Theory, and Application

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Chapter 1

Fundamentals of the Process

1.1 General

The thermal spraying processes are specialized, yet have a wide ranging utilization in both manufacturing and maintenance. The nature of the processes is truly synergistic. That is, there are many components and variables involved, which, when working together and properly applied, produce an effect far greater than indicated when they are considered individually. Yet each component and variable must be understood to permit the proper selection and operation of a particular process. With this background, the user is then in a position to tailor the process to a particular application.

1.2 Definition

Thermal spraying is a group of processes in which finely divided metallic or nonmetallic surfacing materials are deposited in a molten or semimolten condition on a prepared substrate to form a spray deposit. (Also, see the terms *arc spraying, flame spraying,* and *plasma spraying* in the Glossary.) The surfacing material may be in the form of powder, rod, cord or wire. The thermal spraying gun generates the necessary heat by using combustible gases or an electric arc. As the materials are heated, they change to a plastic or molten state, and are accelerated by a compressed gas. The confined stream of particles are conveyed to the substrate. The particles strike the surface, flatten, and form thin platelets (splats) that conform and adhere to the irregularities of the prepared surface and to each other. As the sprayed particles impinge upon the substrate, they cool and build up, particle by particle, into a lamellar structure, thus a coating is formed.

1.3 Process Variations

The basic variations of the thermal spraying processes occur in the spray materials used, the method of heating, and the method of propelling the materials to the substrate.

1.3.1 Spraying Materials. The spray materials are used in the form of wire, rod, cord (a continuous length of plastic tubing), or powder. Cord spraying is primarily used in Europe. Many metals, oxides, cermets, and intermetallic compounds, some organic plastics, and certain glasses can be deposited by one or more of the various processes.

1.3.2 Processes. Thermal spraying processes may be categorized into two basic groups according to the method of heat generation.

Group I Combustion	Group II Electrical
Flame	Plasma (nontransferred arc)
Detonation	Plasma (transferred arc)
	Wire arc
	Induction plasma

The first group uses combustible gases as the heat source. Processes using electrical power as the heat source such as plasma (transferred and nontransferred arc), electric arc, and induction plasma comprise the second group. Consumables used in this group are in powder or wire form.

1.4 Nature of Sprayed Coatings

Success in the use of thermally sprayed coatings relies on careful adherence to specific process procedures. A basic rule of thermal spraying is that any deviation from the standards for a particular application or inattention to detail will produce unreliable results. Succeeding chapters will discuss the process procedures in detail. The sprayed coating has three basic aspects, as follows:

1.4.1 Substrates. Substrates onto which the thermal sprayed coatings are applied include metals, oxides, ceramics, glass, most plastics, and wood. All spray materials cannot be applied to all substrates; some require special techniques.

Substrate preparation prior to spraying is required for every thermal spraying process, and is virtually the same for each process. Two important steps are as follows: