

Thermal spraying — Recommendations for thermal spraying

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British Standard

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National foreword

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Foreword

This document (EN 14616:2004) has been prepared by Technical Committee CEN/TC 240 “Thermal spraying and thermally sprayed coatings”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard : Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

Thermal spraying encompasses processes used in the production of coatings and free standing bodies in for which spray materials are surface melted, melted off or melted and then propelled onto suitably prepared workpiece surfaces. The workpiece surfaces are not surface melted. In order to achieve specific coating properties, the spray coating can undergo additional post-treatment, either thermal or otherwise, for example, sealing.

Thermally sprayed coatings serve to improve the surface properties of a workpiece by manufacturing or repair operations. This can be done, for example, in relation to wear, corrosion, heat transfer or heat insulation, electrical conductivity or insulation, appearance and/or for restoring the part to working order. In certain cases, a spray coating can render a surface being solderable.

Chiefly due to their bonding mechanism, thermally sprayed coatings without thermal post-treatment can be distinguished from coatings applied with other processes such as deposition welding, brazing, physical vapour deposition (PVD) or chemical vapour deposition (CVD).

The advantages of thermal spraying are:

- the workpieces to be coated are only slightly heated so that distortion and any other undesired structural changes to the parent material are avoided. This does not apply if the coatings are thermally treated during or after the spray process;
- the application is not dependent on the size of the workpiece or component. The operation can be stationary or mobile depending on the spray process;
- even geometrical complex components can be coated using the appropriate spray set-up;
- the untreated surface of spray coatings generally provides a good bond coat for paintings;
- depending on the spray process and spray material, different coating thickness can be applied, although a coating thickness of approximately 10 µm is currently considered to be the lower limit.

Process-related disadvantages are as follows:

- the bond strength of thermally sprayed coatings without thermal post-treatment derives from adhesive forces only;
- the bond strength can be influenced due to expansion mismatch between coating and substrate material, especially in case of high operation temperature;
- spray coatings are micro porous;
- the thicker the spray coating, the higher the residual stresses in the coating; and the degree of multi-axial stress thus increases;
- spray coatings without additional thermal post-treatment are sensitive to edge pressure, localised and linear loads and to impact stresses;
- there are restrictions in relation to the geometric dimensions, e.g. for the inner coatings of workpieces whose inner diameter is too small.

1 Scope

This document includes general guidelines for the workmanlike production of metallic, metal-ceramic, oxide-ceramic and plastic coatings by means of thermal spraying on metallic and non-metallic parent materials.

It offers recommendations for an appropriate and practical spray set-up, faultless manufacturing, monitoring, quality assurance and for non-destructive and destructive tests on the component and accompanying specimen. It describes details about negative effects which can occur. It gives advice on how to prevent such effects. Permissible coating loads and evaluation categories for quality are not the subject of this standard, as they are dependent on the operating conditions.

This document can be used for contract purposes.

2 Normative references

Not applicable.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

shot-peening effect

pressure strengthening by grit-blasting

3.2

sound pressure level

mean value of emitted sound, measured in dB

3.3

etching

removing of surface material

NOTE Etching can be applied using liquid agents (wet chemical etching) or using gases in a recipient (dry etching, plasma etching). The etching agent reacts chemically with the substrate.

3.4

ion-etching

material removed by shooting the surface with high energetic particles like ions

NOTE The ions cut off material at the impact point. The procedure is used in plasma technology application (vacuum coating technology).

3.5

corona discharge

dielectric discharge in air after exceeding the break down field intensity; air molecules will be ionized by generating of short living ozone

4 Parent material

Virtually every kind of solid-state material can be coated by means of thermal spraying, provided its surface is suitably prepared. The achievable bond strength of the coating to the substrate is dependent on the spray material, spray process and the physical and technological properties of the parent material used. The bond strength, amongst other things, is particularly influenced by the thermal conductivity of the parent material in comparison to the conductivity of the spray coating and the state of the parent material's surface. In general