SVENSK STANDARD
SS-EN ISO 12679:2015

Fastställd/Approved: 2015-10-19
Publicerad/Published: 2015-10-28
Utgåva/Edition: 1
Språk/Language: engelska/English
ICS: 25.220.20

Termisk sprutning – Rekommendationer för termisk sprutning (ISO 12679:2011)

Thermal spraying – Recommendations for thermal spraying (ISO 12679:2011)

Standarder får världen att fungera

SIS (Swedish Standards Institute) är en fristående ideell förening med medlemmar från både privat och offentlig sektor. Vi är en del av det europeiska och globala nätverk som utarbetar internationella standarder. Standarder är dokumenterad kunskap utvecklad av framstående aktörer inom industri, näringsliv och samhälle och befrämjar handel över gränser, bidrar till att processer och produkter blir säkrare samt effektiviserar din verksamhet.

Delta och påverka
Som medlem i SIS har du möjlighet att påverka framtida standarder inom ditt område på nationell, europeisk och global nivå. Du får samtidigt tillgång till tidig information om utvecklingen inom din bransch.

Ta del av det färdiga arbetet
Vi erbjuder våra kunder allt som rör standarder och deras tillämpning. Hos oss kan du köpa alla publikationer du behöver – allt från enskilda standarder, tekniska rapporter och standard-paket till handböcker och onlinetjänster. Genom vår webbtjänst e-nav får du tillgång till ett lättnavigerat bibliotek där alla standarder som är aktuella för ditt företag finns tillgängliga. Standarder och handböcker är källor till kunskap. Vi säljer dem.

Utveckla din kompetens och lyckas bättre i ditt arbete
Hos SIS kan du gå öppna eller företagsinterna utbildningar kring innehåll och tillämpning av standarder. Genom vår närhet till den internationella utvecklingen och ISO får du rätt kunskap i rätt tid, direkt från källan. Med vår kunskap om standarders möjligheter hjälper vi våra kunder att skapa verklig nytta och lönsamhet i sina verksamheter.

Vill du veta mer om SIS eller hur standarder kan effektivisera din verksamhet är du välkommen in på www.sis.se eller ta kontakt med oss på tel 08-555 523 00.

Standards make the world go round

SIS (Swedish Standards Institute) is an independent non-profit organisation with members from both the private and public sectors. We are part of the European and global network that draws up international standards. Standards consist of documented knowledge developed by prominent actors within the industry, business world and society. They promote cross-border trade, they help to make processes and products safer and they streamline your organisation.

Take part and have influence
As a member of SIS you will have the possibility to participate in standardization activities on national, European and global level. The membership in SIS will give you the opportunity to influence future standards and gain access to early stage information about developments within your field.

Get to know the finished work
We offer our customers everything in connection with standards and their application. You can purchase all the publications you need from us - everything from individual standards, technical reports and standard packages through to manuals and online services. Our web service e-nav gives you access to an easy-to-navigate library where all standards that are relevant to your company are available. Standards and manuals are sources of knowledge. We sell them.

Increase understanding and improve perception
With SIS you can undergo either shared or in-house training in the content and application of standards. Thanks to our proximity to international development and ISO you receive the right knowledge at the right time, direct from the source. With our knowledge about the potential of standards, we assist our customers in creating tangible benefit and profitability in their organisations.

If you want to know more about SIS, or how standards can streamline your organisation, please visit www.sis.se or contact us on phone +46 (0)8-555 523 00

Europastandarden EN ISO 12679:2015 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN ISO 12679:2015.

Denna standard ersätter SS-EN 14616:2005, utgåva 1.

The European Standard EN ISO 12679:2015 has the status of a Swedish Standard. This document contains the official English version of EN ISO 12679:2015.

This standard supersedes the Swedish Standard SS-EN 14616:2005, edition 1.

Upplysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS Förlag AB som även lämnar allmänna upplysningar om svensk och utländsk standard.

Information about the content of the standard is available from the Swedish Standards Institute (SIS), telephone +46 8 555 520 00. Standards may be ordered from SIS Förlag AB, who can also provide general information about Swedish and foreign standards.

Denna standard är framtagen av kommittén för Termisk sprutning, SIS/TK 134/AG 448.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på www.sis.se - där hittar du mer information.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 12679

October 2015

ICS 25.220.20

Supersedes EN 14616:2004

English Version

Thermal spraying - Recommendations for thermal spraying (ISO 12679:2011)

Projection thermique - Recommandations pour la projection thermique (ISO 12679:2011)

Thermisches Spritzen - Empfehlungen für das thermische Spritzen (ISO 12679:2011)

This European Standard was approved by CEN on 27 September 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN ISO 12679:2015 E

Contents

Page

European foreword

The text of ISO 12679:2011 has been prepared by Technical Committee ISO/TC 107 “Metallic and other inorganic coatings” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 12679:2015 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 April 2016, and conflicting national standards shall be withdrawn at the latest by April 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 14616:2004.

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

Endorsement notice

The text of ISO 12679:2011 has been approved by CEN as EN ISO 12679:2015 without any modification.

Introduction

Thermal spraying encompasses processes used in the production of coatings and free-standing bodies 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 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 following.

— 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 spraying process.

— The application is not dependent on the size of the workpiece or component. The operation can be stationary or mobile depending on the spraying process.

— Even geometrically complex components can be coated using the appropriate spray set-up.

— The untreated surface of spray coatings generally provides a good bond coat for painting.

— Depending on the spraying process and spray material, different coating thicknesses 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 an expansion mismatch between the coating and substrate material, especially in the case of a 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, localized and linear loads and to impact stresses;

— there are restrictions in relation to the geometric dimensions, for example, for the inner coatings of workpieces whose inner diameter is too small.

Thermal spraying — Recommendations for thermal spraying

1 Scope

This International Standard 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.

This International Standard provides 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 also gives advice on how to prevent such effects.

Permissible coating loads and evaluation categories for quality are not the subject of this International Standard, as they are dependent on the operating conditions.

This International Standard can be used for contract purposes.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles*

ISO 14231, *Thermal spraying — Acceptance inspection of thermal spraying equipment*

ISO 14232, *Thermal spraying — Powders — Composition and technical supply conditions*

ISO 14918, *Thermal spraying — Approval testing of thermal sprayers*

ISO 14919, *Thermal spraying — Wires, rods and cords for flame and arc spraying — Classification — Technical supply conditions*

ISO 14920, *Thermal spraying — Spraying and fusing of self-fluxing alloys*

ISO 14921, *Thermal spraying — Procedures for the application of thermally sprayed coatings for engineering components*

ISO 14922-1, *Thermal spraying — Quality requirements of thermally sprayed structures — Part 1: Guidance for selection and use*

ISO 14922-2, *Thermal spraying — Quality requirements of thermally sprayed structures — Part 2: Comprehensive quality requirements*

ISO 14922-3, *Thermal spraying — Quality requirements of thermally sprayed structures — Part 3: Standard quality requirements*

ISO 14922-4, *Thermal spraying — Quality requirements of thermally sprayed structures — Part 4: Elementary quality requirements*

ISO 14923, *Thermal spraying — Characterization and testing of thermally sprayed coatings*

ISO 14924, *Thermal spraying — Post-treatment and finishing of thermally sprayed coatings*

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

NOTE Sound pressure level is measured in decibels (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 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, spraying 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, hardened materials need a bond coat to give adequate bond strength. The possible coating thickness may be limited, depending on the bonding material being used. Certain surface-hardening processes, e.g. "nitriding", may leave gaseous inclusions which would prevent proper bonding.

A variety of plastics, as well as glass and paper, can be thermally sprayed when using the appropriate spraying process and a surface treatment method adapted for the respective material.

As the workpieces to be coated by means of thermal spraying are generally only slightly heated, undesired structural changes to the parent material and changes to the component's geometry due to distortion are avoided to the greatest possible extent. However, distortions resulting from intensive grit-blasting during surface preparation, especially with thin-walled parts or as a result of residual compressive stresses on the surface of the substrate caused by process-related shot-peening effects, can occur. If coatings are thermally treated during spraying (processes with simultaneous fusing) or subsequently, undesired structural changes and significant geometric changes can occur.

For purposes of quality assurance during the manufacturing process, the parent materials and components to be coated should be stored in such a way that damage and/or undesired changes to the shape or surface are avoided.

5 Component geometry

The application of thermal spraying is independent, to the greatest possible extent, of the size of the workpiece or component to be coated. This is mainly true for flame and arc spraying. For plasma and HVOF (high-velocity oxygen fuel) spraying, closed-off spray booths are normally required due to the high noise and dust emissions. As a result, there may be restrictions to size of the component.

Certain prerequisites concerning the practical set-up shall be considered when using thermal spraying. If these rules are followed, even complex geometric parts can be coated with expertise. The most important rules can be summarized as follows:

— the area to be coated shall be accessible to the spray gun with all its electrical and/or gas connections, and the necessary spray distance and spray angle shall be maintained;

— sharp edges should be avoided; they cannot be covered with a spray coating;

— narrow radii should be avoided, otherwise turbulence in the spray jet can occur, which can lead to unsatisfactory coatings in terms of bond strength and density;

— problems with turbulence and undesired, loose particles sticking to the walls occur especially when spraying in narrow bores or blind holes;

— to prevent the coating from spalling, it has proved advantageous to pull the coating around rounded or chamfered edges;

— the arguments listed for thermal spraying, i.e. accessibility, sharp edges, narrow radii, bores and blind holes, also apply to grit-blasting when preparing the surface to be sprayed.

6 Spray materials

6.1 General

The spray materials used for thermal spraying cover a wide range of very different materials. It is virtually possible to spray any material which can be produced as a solid wire, cored wire, rod, cord or powder, and which does not sublimate in the arc or plasma or decompose when passing through the flame. In the special case of molten-bath spraying, the material is processed in its liquid state.

Generally, the following spray materials can be used for thermal spraying:

— metals and metal alloys;

— metal ceramics;

— hard phases embedded in a matrix material;

— oxide ceramics, plastics, as well as various hybrid materials.

6.2 Selection of spray materials

An important task for the designer and/or person responsible for the spray technology is the selection of the spray material which is most suited to the application. Fundamental to the selection are the demand's profile of the coating, the subsequent operating conditions and the most suitable spraying process. Corrosion and/or wear loads, for example, can determine the demand's profile. The operating conditions in a tribological system can be determined by an increased operating temperature or by operating temperatures which fluctuate in level and, in some cases, also in speed. The most suitable spraying process distinguishes itself in terms of its ability to fulfil coating requirements, such as density, bond strength, porosity, purity, etc. Here, the relevant process data, such as temperature level in the flame, in the arc or in the plasma, the dwell time of the spray particles in the hot zone and the particle velocity in flight and on impact on the substrate, play a decisive role.