SLOVENSKI STANDARD
SIST EN 15520:2007
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Vroļ e brizganje - Priporoļ ila za konstrukcijsko oblikovanje komponent s prevlekami, nanesenimi z vroļ im brizganjem

Thermal spraying - Recommendations for constructional design of components with thermally sprayed coatings

Thermisches Spritzen - Empfehlungen zum konstruktiven Gestalten von Bauteilen mit thermisch gespritzten Schichten

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Projection thermique - Recommandations sur la conception des assemblages d'éléments comportant un revetement déposé par projection thermique

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25.220.20	Površinska obdelava	Surface treatment

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EUROPEAN STANDARD

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Thermal spraying - Recommendations for constructional design of components with thermally sprayed coatings

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Foreword

This document (EN 15520:2007) 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of an identical text or by endorsement, at the latest by February 2008, and conflicting national standards shall be withdrawn at the latest by February 2008.

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Introduction

Thermal spraying is applied to improve the surface properties of work pieces in order to increase the wear resistance, the electrical conductivity or the electrical resistance, to achieve corrosion resistance for the pertinent service conditions, to improve sliding behaviour or, to provide heat insulation. Recommendations for thermal spraying are contained in EN 14616.

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1 Scope

This European Standard applies for thermal sprayed coatings. It contains basic recommendations for the design of components, which have to be completely or partially coated. The recommendations apply for new manufacturing as well as for repair of worn components. The coating may be of metallic, metal-ceramic, oxide-ceramic materials or polymers.

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.

EN 14665, *Thermal spraying — Thermally sprayed coatings — Symbolic representation on drawings*

3 Applications and specific properties of thermally sprayed coatings

Due to their structure, thermal sprayed coatings possess properties which markedly distinguish them from bulk materials. An appropriate basic structural design and a suitable parent metal have to bear any mechanical loading. Usually, thermal sprayed coatings do not increase the strength of the parent work piece.

Some process related features and specific properties of thermal sprayed coatings are summarised in Table 1.

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Table 1 — Process related features and specific properties of thermal sprayed coatings

Process related features	Specific properties of thermal sprayed coating
Components made of almost every material can be coated by thermal spraying.	Not every spraying procedure is appropriate for all applications.
Coatings with properties completely different from the parent material are possible.	—
Coatings can be sprayed with different spraying materials side by side, one upon another, or mixing into one another (graded coatings).	Usually the effect of the residual stress in the coating rises with increasing coating thickness.
Usually the heat input caused by spraying is so low, that it is possible to avoid structural transformation or deformation. The heat input by fusing self-fluxing alloys or diffusion annealing may cause structural transformation or deformation.	If the coating is not post heat treated the bond strength mainly depends on mechanical adhesive properties. If the coating is post heat treated the bond strength depends on diffusion and the coating is densified.
The ability to apply the spraying process is practically independent of the size of the component.	Some geometric dimensions e.g. internal bores with too small a diameter may limit the spray ability.
Components with complicated shapes can be coated, if appropriate spraying equipment is used.	Sprayed coatings are susceptible to edge loading, point and line loading and impact stresses.
Areas of a component, which shall be free of sprayed material can be protected, e. g. by masking.	—
The untreated surface of the coating provides a good basis for painting or sealing.	—
Several thermal spraying processes can be applied on site as well as in a workshop.	—
Coating properties e.g. porosity can be varied to suit particular applications.	Sprayed coatings are micro porous except for post heat treated self-fluxing alloy coatings.

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4 Basic rules for design of components with thermal sprayed coatings

Without proper consideration of the constructional design for thermal sprayed coatings, it may not be possible to achieve the desired properties of the coating.

Designs which are suitable for thermal spraying will be suitable for pre-treatment, blasting and visual inspection.

Further design instructions for specific applications are contained in EN ISO 14921 and EN ISO 17834 and for the protection of steel structures against corrosion in EN ISO 12944-3, EN ISO 14713 and EN ISO 2063, which deal with the evaluation of coating material, processing and testing and give recommendations for coating thicknesses for several corrosive conditions.

The most important rules for the design are summarised in Table 2.

Table 2 — Basic rules and arguments

Basic rules	Arguments — Explanations
Sufficient accessibility of the area to be coated.	The procedure, spray gun with its electrical and/or gas connections, required spray distance and spray angle shall all be considered.
Area to be coated shall be visible and attainable.	Visible and within reach for the spray jet or tool moved by an operator or a manipulator.
Sharp edges are to be avoided.	Usually they cannot be coated, with a sufficient and uniform coating thickness. Coatings may be damaged on sharp edges. Sharp edges on holes and along cut edges shall be chamfered or rounded.
Small internal radii are to be avoided.	Turbulence of the spray jet, unfavourable angles of incidence, and irregular rebounding spray particles will occur which will lead to insufficient bond strength and density.
Sprayed coatings in narrow holes, slots or in blind holes are to be avoided.	Turbulence and spray particles which are insufficiently adherent to the wall may occur.
Dust inclusions when coating internal surfaces shall be minimised, see Figure 4.	Special care to remove dust and heat.
The spray jet should hit the surface at right-angles. The angle of incidence shall not be less than 45°.	Insufficient spray angles impair bond strength, efficiency, and coating structure. See Figures 4a) and 4b).
The risk of spalling of the coating has to be minimised.	The coating shall be continued around rounded or chamfered edges. See Figures 5a) and 5b).
The risk of damaging the coating has to be minimised.	A support edge or pocket (e. g. per Figure 8 detail X) may be employed.
Welds to be coated shall be free of splatters, undercuts and pores.	Smoothing of such irregularities shall be required.
Heat affected zone from thermally cut edges has to be minimised.	Remove the hardened sharp edge of the cut.

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5 Design for preparation of components and work pieces for thermal spraying

When components or work pieces shall be only partially coated, the final machining to finished size of the whole component shall be carried out after spraying the coating. When manufacturing rotationally symmetrical components the blank should be pre-machined only in the area to be sprayed to the diameter appropriate for the coating thickness. One example is shown in Figure 7.

In case of thermal spraying of finish-machined parts or repair of parts by coating, areas which shall not be coated may be protected by appropriate measures (e. g. masking) for blasting and thermal spraying.

6 Machining and post-treatment of thermal sprayed coatings

The different properties of thermal sprayed coatings compared to bulk materials shall be considered in machining processes. Procedures for machining, thermal post-treatment, or sealing of sprayed coatings are indicated in EN ISO 14924 and in EN ISO 14920. Impairment of the parent metal by any thermal post-treatment shall be considered. For details see EN ISO 14920.

7 Instructions for design - Symbolic representation of the sprayed coating on drawings - Test instructions in the parts list

The symbolic representation of a sprayed coating on a drawing shall be according to EN 14665. If the symbolic representation does not cover the requirements for the coating, the coating specification shall be indicated in the pertinent parts list or by a note on the drawing.

The coating specification shall contain the type of coating, pre-treatments, test procedures, required values for e.g. tensile adhesive strength, hardness, etc. relevant for this component, and if applicable, the spraying procedure and post treatments.

An example is given in Clause 8 of this standard in Table 4 and Figure 8.

Instructions that define tests and the scope of tests shall be indicated in the parts list. Tests on component and tests on accompanying test specimens have to be indicated separately, see Figure 8 and Table 4.

If further tests like corrosion or wear tests are required, test procedures and required results have to be agreed between the contracting parties.

It is recommended to indicate the general supply conditions as per EN 15311 in the pertinent parts list to specify requirements concerning quality management of the manufacturer and specific instructions for manufacturing and testing.

8 Examples for design suitable for spraying

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8.1 Plane surfaces

Examples are shown in Figure 1. Further examples for coatings for protection against corrosion of welded structures are presented in EN ISO 12944-3.

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8.2 Rotationally symmetrical parts

Restrictions of geometrical dimensions exist when coating inner surfaces. Specific conditions of the spray procedure such as spray distance and the size of spray spot have to be considered. Customary minimum dimensions for thermal spraying are contained in Table 3 (see also Figures 2 and 3). The actual dimensions depend on the procedure, equipment, and spray material. Examples of how to round or chamfer edges or carry out support edges or pockets are shown in Figure 5 and Figure 8.

Table 3 — Customary minimum dimensions for internal spraying

Procedure and spray equipment		Minimum inner diameter d_{min} mm	Maximum length of coating L mm
Case a	Standard equipment (for external spraying, see Figure 4a)	5	L/d < 1
Case b	Extra equipment (special internal spraying gun, see Figure 4b)	40 to 60	up to 2 000

8.3 Special shape

Details of work pieces which require particular attention are:

— key-ways, profiled key-seats, edges, end faces, support edges and flanges.

To avoid excessive edge pressure, edges have to be chamfered or rounded, see Figure 6. Spray coatings shall not be exposed to point and line stress (with the exception of fused self-fluxing alloys which are not susceptible).

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