INTERNATIONAL STANDARD

ISO 14920

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Thermal spraying — Spraying and fusing of self-fluxing alloys

Projection thermique — Projection et fusion des revêtements obtenus par projection thermique des alliages autofondants

ISO 14920:199 (E)

Foreword

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Draft International Standards adopted by the Technical Committees are circulated to member bodies for voting. Publication as an International Standard requires approval by at least 75 % of member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14920 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 107, *Metallic and other coatings*, Subcommittee SC 5, *Thermal spraying*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read "...this European Standard..." to mean "...this International Standard...".

Annex A of this International Standard is for information only.

Annex ZA provides a list of corresponding International and European Standards for which equivalents are not given in the text.

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Contents

Foreword

The text of EN ISO 14920:1999 has been prepared by Technical Committee CEN/TC 240 "Thermal spraying and thermally sprayed coatings", the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 107 "Metallic and other inorganic coatings".

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of an identical text or by endorsement, at the latest by August 1999, and conflicting national standards shall be withdrawn at the latest by August 1999.

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

1 Scope

This standard covers thermal spraying of self fluxing alloys that are simultaneously or subsequently fused to create a homogeneous, diffusion bonded coating.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

EN 1274 : 1996
Thermal spraying – Powders – Composition – Technical supply conditions

EN 10109-1
Metallic materials – Hardness test – Part 1: Rockwell test (scales A, B, C, D, E, F, G, H, K) and rockwell superficial test (scales 15N, 30N, 45N, 15T, 30T and 45T)

3 Design considerations

To ascertain whether sprayed and fused alloy coatings are suitable for the intended engineering application, consideration shall be given to the factors in the following sub-clauses.

3.1 Substrate (base metal)

3.1.1 As the process requires the application of heat to fuse the coating to the substrate, consideration shall be given to the possible effects of such heating on the substrate, including:

a) distortion;

b) scaling;

c) the need to stress relieve;

d) an irreversible transformation of the mechanical and/or metallurgical properties.

Martensitic steels are susceptible to stress cracking and alloys containing significant amounts of C, Al, Ti, Mg, S, sulfides, P, and Nitrogen can create porosity in the coating and may render the substrate liable to stress cracking.

3.1.2 The preparation of the component for a sprayed and fused coating usually includes a reduction of the design dimensions. Consideration shall be given to the effect of such reduction on the required physical properties and the fact that the resultant sprayed and fused coating may have differing physical properties.

3.1.3 The fatigue strength, shock resistance and other properties of the component may be affected by the application of the coating.

4 Self-fluxing alloy selection

4.1 Choice

The choice of coating alloy will determine the properties of the final deposit. e.g.

a) hardness;

b) resistance to wear and corrosion;

c) machinability;

d) suitability for the application.

4.2 Composition

The composition of the coating will determine the properties of the final deposit. Consideration shall be given to the effects of the stresses anticipated in service.

Substrate alloys which are subject to a martensitic change require a coating alloy with a high ductility. Consideration should also be given to the need for post heat treatment.

Guide to approximate hardness of the fused deposit see annex A.

4.3 Final machining

4.3.1 When selecting a suitable self-fluxing alloy, consideration should be given to the machining properties.

4.3.2 Many of the self-fluxing alloys are not machinable with standard tipped tools and can only be finished by using suitable grinding wheels. Manufacturers advice should be sought on suitable machining tools.

4.3.3 As the process involves heating the component to a high temperature, it is recommended that the coating process be completed before final machining of other areas which may be affected by the heat treatment.

5 Preparation of the component

5.1 Preliminary

5.1.1 All components to be treated shall be free from surface contamination such as oil or grease. Particular attention shall be paid to porous components where oil and grease in the pores may exude during the preheating or coating process.

5.1.2 Any prior surface treatments, for example nitriding, electroplating or protective coatings shall be removed before the preparation of the surface to be coated.

5.1.3 When the surface of the component is machined as part of the surface preparation, the machined surface and the form of the ends and/or edges of the prepared area shall be suitable for the coating process.

Where the coating is required to terminate at a point other than the end or edge of the component, the edge of the recess shall be machined to provide angle of 30 to 40 degrees, blending smoothly with the adjoining surface.

Where the coating shall finish to a square edge, the relevant edge shall be left longer than the proposed finished overall size and machined to the final dimension when the coating process is completed.

5.2 Method of surface preparation

5.2.1 The surface should be prepared using standard angular grit.

5.2.2 The grit blasting operation shall be confined to the area to be prepared for coating only, and the adjacent areas shall be masked in a manner best suited to the particular component. Masking materials used shall resist the impact of the grit and shall not contaminate the adjacent prepared surface.

5.2.3 Masking materials used to prevent the adherence of sprayed metal shall withstand the temperature of spraying and, where necessary, the fusing process, without contaminating the surface to be sprayed.

5.2.4 Drilled holes and other orifices which are required to be kept free from foreign matter shall be plugged. Plugs of steel or rubber are recommended for this purpose and should be shaped and positioned in such a manner as not to mask any part of the surface to be prepared. After grit blasting the plugs shall be removed and replaced with pieces of carbon suitably shaped to prevent ingress of the coating material and protruding sufficiently for their top surfaces to be exposed during the subsequent machining operation.

5.3 Cleanliness

After preparation, it is essential that the surface to be coated is not contaminated. Care shall be taken to ensure that the prepared surface is not contaminated with oil, grease, water or fingermarks. In the event of contamination the surface shall be re-prepared.

6 Processes

This is a manual process using an oxy/acetylene torch fitted with a hopper.

A suitable self-fluxing powder is fed via the hopper into the gas stream, through the flame and on to the component where it is simultaneously fused. The continuous process of pre-heating the workpiece with the flame through which the powder is fed and fused produces a coating with properties dependant on the choice of self-fluxing powder.

6.1.1 Powder particle size range

This is determined by the powder feed parameters selected and designed by the torch manufacturer. To avoid powder feed restrictions and blockages powders shall be purchased to the screen analysis recommended by the torch manufacturer.

6.1.2 Coating thickness

The limitation on deposit thickness is dependant on the chosen alloy, the required coating quality and due consideration to acceptable residual stresses which will increase with deposit thickness. Thicker coatings are more demanding on operator skill.

6.2 Spray and subsequently fuse

A manual or mechanised process using a powder flame spray gun to apply the required thickness of coating material to the component. This sprayed coating is subsequently fused.

A selected self-fluxing alloy powder is fed via a powder hopper into the carrier gas, through the flame, on to the workpiece until the desired thickness is achieved.

Fusing of the deposit is a separate operation performed as soon as possible after spraying using the following methods:

a) manually, using an oxy/acetylene torch;

b) induction coil;

c) furnace fusing (vacuum or inert gas);

d) laser beam;

e) other heating processes.

6.1 Spraying with simultaneous fusion

6.2.1 Powder particle size range

This is determined by the powder feed parameters selected and designed by the manufacturer of the flame spray gun. To avoid powder feed restrictions and blockages, powders shall be purchased to the screen analysis recommended by the manufacturer.

6.2.2 Thickness of deposit

Generally limited to 1,6 mm with 1 mm being preferred. Deposits in the "as sprayed" state may be 25 % thicker to allow for contraction/shrinkage during fusion.

6.3 Spraying technique

6.3.1 General

The sprayed coating should be applied as soon as possible after surface preparation and before any visible deterioration of the surface.

6.3.2 Pre-heating

The surface to be sprayed shall be pre-heated immediately before spraying. The temperature of the pre-heat is dependent upon composition of the substrate. This shall be performed in such a manner as to avoid contamination, or local overheating of the surface.

6.3.3 Spraying

Spraying shall be continuous until the coating is of adequate thickness, allowing for shrinkage during fusion. Note that shrinkage may be as much as 25 %. After spraying there shall be no visible evidence of lifting of the deposit from the base, or cracking of the deposit. If defects are found, the coating shall be removed and the preparation and spraying procedures repeated.

6.3.4 Fusing the deposit

The deposit shall be fused by heating it to a temperature within the melting range of the selected self-fluxing alloy. Heating to this temperature shall penetrate to the interface with the base metal to ensure that diffusion takes place. Fusing may be performed using an oxy/fuel torch, for example oxy/acetylene, induction heating, laser or vacuum/furnace fusing.

The rate and duration of heating and the temperature range is critical and will vary according to the composition of the coating alloy and the size and complexity of the component. Prolonged heating within the fusion range shall be avoided to prevent excessive diffusion between the coating and the base metal and to prevent deformation of the deposit.

The correct temperature is indicated by a change in the appearance of the coating which exhibits a marked increase in reflectivity, generally known as a "glaze". All parts of the sprayed surface shall exhibit this "glaze", progressively if heated by torch or induction coil, simultaneously if furnace fused. The appearance of a local "hot-spot" during fusing is evidence of a local loss of adhesion and shall be reason for rejection of the coating.

6.3.5 Cooling

After fusing, to avoid undue stresses, creating cracks, and/or distortion, cooling shall be retarded either by packing the component in an insulating material or by maintaining it in a hot chamber with a controlled cooling rate.

When substrate metals subject to a martensitic change have been coated, specialised cooling procedures will be necessary. Subsequent heat treatment may be necessary to maintain the base metal design properties. When such materials are being coated, powders with a low coefficient of expansion or high ductility shall be used.

7 Powder supply conditions and quality requirements

7.1 Chemical composition

The chemical composition shall be defined by any suitable testing method e.g. atomic absorbtion spectrometry, flame emission spectroscopy, X-ray fluorescent analysis etc.

7.2 Powder particle size range (see 6.2.1)

Typical size ranges (see 3.3 of EN 1274 : 1996) cover equipment specifications suitable for the application of self-fluxing powders. When determined, the particle size distribution (PSD) may exceed the upper limit by 2 % max. up to the next standard screen size and 5 mass % below the lower limit.

7.3 Conditions of supply

7.4 Certification

The manufacturer shall certify that every batch of his products meets the requirements of the specification, documented by a test certificate.

7.5 Hardness

Compliance with a specific hardness range is generally regarded as more important than the exact chemical composition of the self-fluxing nickel based alloys. The exact purchasing specification will be agreed between the customer and the supplier. Where possible hardness tests shall be carried out on a test deposit applied to a representative sample of the base metal to be coated. Where this is not possible, powders selected to a specific hardness range shall be tested using a standard hardness test procedure.

7.5.1 Standard hardness test

Test coupon size:

– 50 x 50 x 6,0 - 6,5 mm carbon steel.

Test coupon preparation:

– Sprayed and fused coating to be prepared in accordance with EN 10109-1;

– Edges of coupon should have a 2 mm chamfer.

Powder sample shall be representative of chosen batch.

Spray technique:

– Use standard settings for spray gun and spray a deposit of uniform thickness 1,0 mm to 2,0 mm.

Powders shall be dry and free from impurities.

Powders are to be delivered in airtight and damp-proof sealed containers. Special packaging is to be agreed with the powder manufacturer.

The powder containers shall be labelled "Mix before Use" with appropriate reference to safety regulations, well defined