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Thermal spraying — Components with thermally sprayed coatings — Technical supply conditions

The European Standard EN 15311:2007 has the status of a British Standard

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Thermisches Spritzen - Bauteile mit thermisch gespritzten Schichten - Technische Lieferbedingungen

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Contents

Foreword

This document (EN 15311:2007) 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of an identical text or by endorsement, at the latest by September 2007, and conflicting national standards shall be withdrawn at the latest by September 2007.

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1 Scope

This European Standard specifies technical supply conditions when using thermally sprayed coatings for manufacturing or repair of components.

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 473, *Non destructive testing — Qualification and certification of NDT personnel — General principles*

EN 582,, *Thermal spraying — Determination of tensile adhesive strength*

EN 657:2005, *Thermal spraying — Terminology, classification*

EN 1395, *Thermal spraying — Acceptance inspection of thermal spraying equipment*

EN 13214, *Thermal spraying — Thermal spray coordination — Tasks and responsibilities*

EN ISO 2063, *Thermal spraying — Metallic and other inorganic coatings — Zinc, aluminium and their alloys (ISO 2063:2005)*

EN ISO 4288, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture (ISO 4288:1996)*

EN ISO 8503-1, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces (ISO 8503-1:1988)*

EN ISO 14918, *Thermal spraying — Approval testing of thermal sprayers (ISO 14918:1998)*

EN ISO 14923, *Thermal spraying — Characterization and testing of thermally sprayed coatings (ISO 14923:2003)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 657:2005 apply.

4 Requirements

4.1 General requirements

4.1.1 Indication

This European Standard specifying the general requirements for supply conditions should be indicated in the parts list or in delivery instructions.

4.1.2 Qualification of the manufacturer

The manufacturer of the thermally sprayed coating for a component shall fulfil all requirements stipulated in the coating specification, should possess a quality management system, shall employ qualified personnel and is responsible to keep the spraying equipment in proper condition. The following standards shall be used to fulfil the requirements according to the quality requirements of the coated component:

1) spraying co-ordinator (supervisor): qualified according to EN 13214 or qualified by appropriate knowledge in case of subordinate applications;

2) thermal sprayer (manual manufacturing): qualified according to EN ISO 14918 or qualified by appropriate knowledge;

3) thermal sprayer as an operator: apprenticed qualified on theoretical knowledge according to EN ISO 14918 or adequate experience;

4) non destructive testing – personnel qualification, if applicable: according to EN 473 class 2 for penetrant test (PT);

5) spraying equipment: checked according to the relevant part of EN 1395 or qualified by a correct function of the spraying equipment by test reports or coating results.

4.1.3 Preparing the instructions for thermal spraying (spray procedure specification)

The manufacturer is responsible for preparing and ensuring the execution of instructions (see also EN ISO 14922).

The spray procedure specification has to refer to the coating specification and the manufacturing instruction documents, like parts list, material instructions of parent metal and spraying material, drawings and test instructions. The spray procedure specification should be prepared in written form; only in case of subordinate applications will a verbal form be accepted.

If required, the spray procedure specification may be qualified by a component related spray procedure qualification.

4.2 Technical requirements

4.2.1 Spraying materials

Only spraying materials which are indicated in the spray procedure specification shall be applied. Preferably, the spraying material should comply with the technical supply conditions of EN 1274 for spraying powders and EN ISO 14919 for spraying wires, rods and cords.

The conformity of the spraying material with the instructions in the spray procedure specification should be verified by comparison with the relevant test certificate from the manufacturer/supplier of the spraying material.

The manufacturer/supplier processing instructions shall be considered.

All spraying materials shall be stored in suitable packages. Marked spraying materials shall be used only.

EN 14616 gives instructions for supply and storage of spraying material.

4.2.2 Spray procedure specification

The spray procedure specification shall contain all parameters which are necessary for the spraying procedure. The required parameters are to be determined by spraying tests or to be taken from adequate prior knowledge.

The preparation of the substrate's surface shall be specified in the spray procedure specification. Further instructions may be taken from EN 13507.

Post treatments like machining, sealing the coating or heat treatment shall be specified in the spray procedure specification or in the operation sequence plan (see EN ISO 14924). If required, a test shall prove that the sprayed coating and/or the component will not be impaired by the post treatment process.

When fusing self-fluxing alloys EN ISO 14920 contains further instructions.

Any modification of parameters or the substrate material, spraying materials, auxiliary materials, design, spraying procedure, or spraying equipment will require a check of the coating's quality. A review of or a new preparation of the spraying procedure specification may be required.

4.2.3 Requirements for acceptance criteria for thermally sprayed coatings

Requirements for acceptance criteria shall be specified in the coating specification, e.g. maximum and/or minimum values of hardness, tensile adhesive strength, coating thickness, coating structure, porosity, roughness, grit residues at the interface, non-melted particles, time limit between surface preparation and spraying etc. If applicable, master pictures for bend and cupping tests, or test procedures for wear, corrosion or thermal cycling tests may be agreed upon between contracting parties.

Where acceptance criteria and admissible imperfections are not specified in the coating specification or in the manufacturing instructions they shall be agreed between the contracting parties.

In case of corrosion protection applications by zinc or aluminium EN ISO 2063 shall apply for testing and acceptance criteria.

5 Quality tests

5.1 General

Tests and their scope shall be contained in the coating specification and the spray procedure specification.

Test instructions are to be prepared by the coating manufacturer in agreement with the customer, if required.

Where quality tests are not specified in the coating specification or agreed between contracting parties,tests and their scope shall be applied according to this European Standard.

5.2 Tests, scope of tests and requirement for accompanying test specimens

Where mass or series production of coated components is carried out and when using tests indicated in Table 1 the actual number of components in a lot has to be considered. Accompanying test pieces for certain tests are shown in Table 2.

Where a single, component is to be sprayed the percentage of a random test shall be calculated according to the size of the coated area. The influence of process stability (completely mechanised, manual, or process controlled in closed loop form) shall be considered when calculating random tests.

Table 1 — Test on the component

Coating condition	Visual inspection	Measuring the coating thickness [a]	Measuring the geometry	Penetrant test [b]	Measuring the roughness [c]	Hardness test [d]
Coating sprayed	100	rt	rt	–	rt	rt
Coating sprayed and machined	100	rt	rt	–	rt	rt
Coating sprayed and thermally post treated	100	rt	rt	rt	rt	rt

100: each part respectively all parts of a lot are to be tested by 100 %

rt: random test

[a] If measuring is possible by geometric, technological or physical reasons.

[b] If the coating is not porous.

[c] Generally, comparison by visual inspection or by touch compared with reference samples EN ISO 8503-1. Measuring the roughness after machining shall be carried out according to EN ISO 4288, when required.

[d] If the component will not be impaired thereby and a certain hardness value of the coating is required. Measuring methods according to EN ISO 6508-1 should be preferred. In case of extremely soft coatings the Rockwell hardness test procedure according to EN ISO 6508-1 scale N should be applied.

Table 2 — Requirement for accompanying test pieces for certain tests

Coatings condition	Determination of tensile adhesive strength [a]	Materialographic examination [b]	Hardness test [c]	Bend test [d]	Cupping test [e]
Coating sprayed	Y/E	Y/L	Y/L	X	X
Coating sprayed and thermally post treated	–	Y/E	Y/E	X	X

[a] The determination shall be carried out according to EN 582. Results, the adhesive used and the bonding procedure have to be documented in the test report.

[b] The preparation method of the test specimens is to be agreed upon. The examination may also be used to measure the coating thickness.

[c] If hardness test at the component is not accepted, preferably according to EN ISO 6507-1.

[d] Test specimen, procedure and admissible crack structures in the coating have to be agreed upon.

[e] May be applied e.g. according to EN ISO 20482. Test specimen, procedure and admissible crack structures in the coating have to be agreed upon.

Y/L: required per lot

Y/E: required in case of procedure evaluation

X: usually, applied for shop tests only, or if comparative tests according to master series are agreed

–: senseless or not practicable

5.3 Test on the component

The surface characteristics described in EN ISO 14923 shall be assessed by visual inspection. Wherever possible, required tests shall be carried out on the component.

A 100 % visual inspection shall be carried out after finishing the coating, even if this is not specified in the manufacturing instructions. In case of doubt about the quality of the sprayed coating the test's sensitivity shall be raised by using a magnification of 6 to 10 times.

5.4 Test on accompanying test specimen

Accompanying test specimens shall go through all operation steps of the entire spraying procedure in the same way as the component itself. The test specimen's material shall correspond to the material of the component in its mechanical and physical properties.

Tests shall be carried out according to EN ISO 14923, if possible. Where procedures are not prescribed in the coating specification or in the test instructions the test method has to be agreed between the contracting parties.

5.5 Rejection of a defective sprayed coating

Where a sprayed coating or the accompanying test specimen did not pass the required tests the defective sprayed coating shall be removed. After cleaning and preparation the spray coating may be built up again according to the qualified spray procedure specification. Testing shall be applied with the original scope.

If the qualified procedure will not fulfil the requirements of the coating specification a new spray procedure specification shall be prepared and, if required be qualified by the customer.

5.6 Documentation

The manufacturer/supplier is responsible to fulfil all requirements of the coating specification. The results of tests shall be documented.

Bibliography

[1] EN 1274, *Thermal spraying — Powders — Composition, technical supply conditions*

[2] EN 13507, *Thermal spraying — Pre-treatment of surfaces of metallic parts and components for thermal spraying*

[3] EN 14616, *Thermal spraying — Recommendations for thermal spraying*

[4] EN ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method (ISO 6507-1:2005)*

[5] EN ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T) (ISO 6508-1:2005)*

[6] EN ISO 14919, *Thermal spraying — Wires, rods and cords for flame and arc spraying — Classification — Technical supply conditions (ISO 14919:2001)*

[7] EN ISO 14920, *Thermal spraying — Spraying and fusing of self-fluxing alloys (ISO 14920:1999)*

[8] EN ISO 14922-1, *Thermal spraying — Quality requirements of thermally sprayed structures — Part 1: Guidance for selection and use (ISO 14922-1:1999)*

[9] EN ISO 14922-2, *Thermal spraying — Quality requirements of thermally sprayed structures — Part 2: Comprehensive quality requirements (ISO 14922-2:1999)*

[10] EN ISO 14922-3, *Thermal spraying — Quality requirements of thermally sprayed structures — Part 3: Standard quality requirements (ISO 14922-3:1999)*

[11] EN ISO 14922-4, *Thermal spraying — Quality requirements of thermally sprayed structures — Part 4: Elementary quality requirements (ISO 14922-4:1999)*

[12] EN ISO 14924, *Thermal spraying — Post-treatment and finishing of thermally sprayed coatings (ISO 14924:2005)*

[13] EN ISO 20482, *Metallic materials — Sheet and strip — Erichsen cupping test (ISO 20482:2003)*

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