INTERNATIONAL STANDARD

ISO 12670

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

Projection thermique — Éléments traités par projection thermique — Conditions techniques de livraison

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 12670 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*.

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

1 Scope

This International Standard specifies technical supply conditions for parts with thermally sprayed coatings for the manufacturing or repair of components.

This International Standard applies to applications where quality requirements according to ISO 14922-2 (comprehensive requirements) or ISO 14922-3 (standard requirements) are required.

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 2063, *Thermal spraying — Metallic and other inorganic coatings — Zinc, aluminium and their alloys*

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

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 12690, *Metallic and other inorganic coatings — Thermal spray coordination — Tasks and responsibilities*

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

ISO 14916, *Thermal spraying — Determination of tensile adhesive strength*

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

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

EN 657, *Thermal spraying — Terminology, classification*

EN 1395-1, *Thermal spraying — Acceptance inspection of thermal spraying equipment — Part 1: General requirements*

3 Terms and definitions

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

4 Requirements

4.1 General requirements

4.1.1 Specifying the general requirements

This International Standard, which specifies the general requirements for supply, shall be indicated in the list of parts or in other manufacturing or delivery instructions.

4.1.2 Qualification of the manufacturer

The manufacturer of the thermally sprayed coating shall possess a quality management system, shall fulfil all requirements stipulated in the coating specification for the part, shall employ qualified personnel and is responsible for keeping the spraying equipment in a functional and safe condition.

Considering the following standards can help to fulfil the quality requirements for the coating:

a) spraying coordinator (supervisor): qualified according to ISO 12690;

b) thermal sprayer: qualified according to ISO 14918 or qualified by appropriate skill and knowledge;

c) non-destructive testing personnel: qualification according to EN 473;

d) spraying equipment: checked according to the relevant part of EN 1395 or qualified by the unobjectionable and unchanged function of the spraying equipment documented by test reports or coating results.

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

The manufacturer is responsible for preparing the spray procedure specification in written form.

The spray procedure specification shall refer to the coating specification and the manufacturing instructions, such as the list of parts, instructions of substrate and spraying material, drawings and tests.

If required, the spray procedure specification can be qualified by a component-related spray procedure qualification according to EN 15648.

4.2 Technical requirements

4.2.1 Spraying materials

Only spraying materials which are required in the coating specification and indicated in the spray procedure specification shall be applied. The spraying material shall comply with the technical supply conditions indicated in ISO 14232 for spraying powders and ISO 14919 for spraying wires, rods and cords.

The conformity of the delivered with the required spraying material shall be safeguarded, for example by comparing the composition indicated on the test certificate with the required one.

All spraying materials shall be stored in suitable packages.

The processing instructions of the manufacturer/supplier of the spraying material shall be considered.

4.2.2 Spray procedure specification

The spray procedure specification shall contain all parameters, including, for the relative motion between the gun and the part or the identification number of the motion programme, those which are necessary for the spraying process of the relevant part. The necessary parameters are to be determined by spraying tests or taken from an appropriate similar application.

The spray procedure specification may be qualified by a procedure qualification, for example according to EN 15648, if required.

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

Post-treatments, like machining, sealing of the coating or heat treatment of the part, shall be specified in the spray procedure specification or in the operation sequence plan (see ISO 14924). A test may be required to ensure that the sprayed coating and/or the part will not be damaged by the post-treatment process.

ISO 14920 contains instructions if fusing of self-fluxing alloys is required.

Any modification of parameters, spraying and/or auxiliary materials, design of the part, spraying procedure or spraying equipment requires a check of the coating's quality. A revision of the spray procedure specification or preparation of a new one is 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 in the interface, non-melted particles, time limit between surface preparation and spraying, etc. If applicable, reference samples for bend and cupping tests, or test procedures for wear, corrosion or thermal cycling tests can be agreed upon between the contracting parties.

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

Acceptance criteria and admissible imperfections which are not specified in the coating specification or in the manufacturing or testing instructions shall be agreed between the contracting parties.

5 Quality tests

5.1 General

Usually, tests and their scope are specified in the coating specification. If they are not indicated there, test instructions are to be prepared by the coating manufacturer. This can be done in agreement with the customer, if required.

Tables 1 and 2 will help to select and specify the appropriate tests and their scope.

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

In the case of mass production or series production of thermally coated parts and when tests indicated in Table 1 are applied, the actual number of parts within a batch shall be considered. Accompanying test specimens for certain tests are mentioned in Table 2.

Where a single part is to be coated, the percentage of the surface for random testing shall be calculated according to the size of the coated area. The influence of the process stability (process carried out manually, completely mechanized, or controlled in closed-loop form) shall be considered when random tests are specified.

Table 1 — Tests on the part

Coating condition	Visual inspection	Measuring the coating thickness[a]	Measuring the geometry	Penetration test[b]	Measuring the roughness[c]	Hardness test[d]
Coating as 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: the coating of any single part, or of each single part within a batch, shall be tested.

rt: random test.

[a] If geometric, technological or physical conditions enable this measurement.

[b] Measurement is practicable only if the coating is not porous.

[c] Roughness in the as-sprayed condition can be compared with reference samples according to ISO 8503-1, visually or by scanning. Measuring the roughness after machining shall be carried out according to ISO 4288.

[d] A hardness test carried out on the part itself can be accepted only if the coating or the part will not be damaged.

Table 2 — Requirements 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 as sprayed	Y/B	Y/B	Y/B	X	X
Coating sprayed and thermally post-treated	—	Y/E	Y/E	X	X

Y/B: required per batch.

Y/E: required in the case of a procedure evaluation or qualification.

X: Usually, the test is applied as a shop test only. Tests can be required, if reference samples are agreed between the contracting parties.

—: The test is senseless or not practicable.

[a] The determination shall be carried out according to ISO 14916. Results, the adhesive used and the bonding procedure shall be documented in the test report.

[b] The preparation method for the test specimen shall be agreed upon between contracting parties. The examination can also be used to measure the coating thickness.

[c] The hardness test shall be carried out according to ISO 6507-1 if the test on the part is not acceptable.

[d] The number and design of the test specimen, test procedure and admissible crack structures in the coating shall be agreed upon between the contracting parties.

[e] Can be applied according to ISO 20482. The test procedure and admissible crack structures in the coating shall be agreed upon between the contracting parties.

5.3 Test on the part

The surface characteristics described in ISO 14923 shall be assessed by visual inspection carried out by a skilled and qualified person. Wherever possible, required tests shall be carried out on the part.

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×.

5.4 Test on accompanying test specimens

Accompanying test specimens shall undergo the same operation steps of the spraying procedure as the part itself. The test specimen's material shall correspond to the material of the part in its mechanical and physical properties.

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

5.5 Rejection of a defective thermally sprayed coating

Where a sprayed coating or the accompanying test specimen did not pass the required tests, the defective thermally sprayed coating shall be removed. After cleaning and preparation, the part and the test specimen can be coated again according to the qualified spray procedure specification. However, if the defects show that the specification will not fulfil the requirements of the coating specification, the spray procedure specification shall be revised and qualified again.

Testing shall be carried out according to the original instructions and scope.

5.6 Documentation

The manufacturer/supplier is responsible for fulfilling all requirements of the coating specification and, if applicable, any agreements between the contracting parties. The test results shall be documented.