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Thermal spraying — Quality requirements for manufacturers of thermal sprayed coatings

Projection thermique — Exigences qualité pour les fabricants de revêtement projeté thermiquement

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 240, *Thermal spraying and thermally sprayed coatings*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition of ISO 14922 cancels and replaces ISO 14922-1:1999, ISO 14922-2:1999, ISO 14922-3:1999 and ISO 14922-4:1999, which have been technically revised. The main changes compared with the previous editions are as follows:

— the four parts have been consolidated into one document;

— the requirements for the manufacturer now correspond to those of the parts;

— the weighting of requirements with +++ / ++ / + have been updated and are now requirements;

— the requirements have been separated: the quality assurance requirements former classified in 1, 2, 3 now clear as QRC and QAL C, S, E, the three assessment groups as comprehensive requirements, standard (normal) requirements, elementary requirements titled and presented in direct comparison in three columns in Annex C;

— the dependence on ISO 9001 has been removed;

— decision on QAL C, S, E by customer or manufacturer itself.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Thermal spraying processes are widely applied for producing industrial products and are mainly applied for preventive protection of surfaces. The application can take place both within the workshop as well as on site. Measures for the maintenance of worn coatings or of surfaces on components are also in the field of use. Thermal spraying can be found in all industries, but especially in the aerospace, stationary gas turbine, automotive, machinery construction, printing and chemical, and oil extraction and refining fluid control industries, as well as for medical purposes and for steel construction in the field of off-shore and on-shore, etc. Usually coatings are applied for anticorrosive and/or anti-wear purposes, high temperature protection and against chemical attack, as well as for aesthetic or electrical reasons.

Thermal spraying belongs to the so-called "special processes", where the quality of the coating cannot be unambiguously determined by testing without damaging the component. For an adequate use of thermal sprayed coatings and in order to avoid quality or cost-intensive problems when manufacturing and during service time, conditions and processes must be controlled. Therefore, a functional quality assurance system is made available for the coating factory, if necessary, in additional to a quality management system (e.g. ISO 9001).

This document provides three different levels of quality requirements (comprehensive level C, standard level S and elementary level E). These requirements can be defined by the customer's design engineering relating to the thermal sprayed coating or to the component.

The main elements of the quality assurance of the entire thermal spraying process for different applications in accordance with quality assurance levels C, S and E are listed in Annex B or Annex C. They can be used to check the proper function of the quality assurance system when applying a quality audit.

This document specifies requirements, tests and the scope of tests when qualifying the manufacturer. The specific requirements of the qualifying procedure in accordance with the quality assurance level C, S or E can be given by the general requirements of the quality management system of the company or a contract.

This document together with the relevant quality level can be stipulated by the customer/designer in order to require a minimum of quality assurance measures for the manufacturing of his or her component.

The requirements specified in this document can be helpful when a quality assurance system is being established.

Thermal spraying — Quality requirements for manufacturers of thermal sprayed coatings

1 Scope

This document specifies quality requirements for manufacturers of thermal sprayed coatings to ensure quality assurance for activities in the field of production.

NOTE It is independent of the availability of a quality management system, e.g. ISO 9001, ISO 14001 and ISO 45001, which concern the concept and organization of the quality management.

This document defines the quality requirements that are of importance for the manufacturing route.

This document is applicable to thermal spraying including all the pre- and post-treatments of the whole coating process for new parts, for repairs and maintenance (e.g. after service) at the workshop or on site.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

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

ISO 14917, *Thermal spraying — Terminology, classification*

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

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

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 ISO 14917 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
contract
requirements for the coating or for the component to be coated agreed between the contracting parties, e.g. by specification, drawing, manufacturing instructions.

Note 1 to entry: In order to avoid coordination problems between the contracting parties, it is essential to indicate a reference to the standard, including the publication date, according to which a contract was defined

3.2
special process
manufacturing process, including surface preparation and certain post-treatments, where the results of manufacturing cannot be confirmed entirely by subsequent quality and product tests and where, for example, manufacturing faults might only be shown after putting the product into service

Note 1 to entry: For this document, "special process" refers to thermal spraying.

3.3
coating manufacturer
person or organization responsible for thermal spraying production

3.4
thermal spraying coordinator
person who is trained and qualified, e.g. in accordance with ISO 12690 or equivalent

Note 1 to entry: Such training may be the ETSS (European Thermal Spraying Specialist) in accordance with the EWF Guideline 459.

3.5
thermal sprayer
person who is trained and qualified in accordance with ISO 14918 or equivalent or qualified by job reference specimens for a particular application

Note 1 to entry: Such a training may be the ETS (European Thermal Sprayer) in accordance with the EWF Guideline 507.

3.6
component
part, structure or construction that is partially or entirely covered by a thermal sprayed coating

3.7
quality assurance level
QAL
systematic measures in the field of production/manufacturing, for maintaining the internally or externally required quality of the production/manufacturing processes with regard to the *components* (3.6)

3.8
quality requirement class
QRC
classification that defines requirements for the coating and relates to its importance for the proper function and safety of the *components* (3.6)

3.9
factory quality control
FQC
internal functioning unit of a company that is independent of the production unit and that is responsible for keeping the intended or required quality guidelines

Note 1 to entry: FQC can be ensured by quality audits.

3.10
thermal spray procedure specification
TSPS
instructions for thermal spraying including any necessary parameters

Note 1 to entry: Instructions for pre- and post-treatment can be part of the TSPS.

4 Quality requirements for manufacturers and thermal sprayed coatings

4.1 General

Using this document, the quality requirements for the manufacturer for thermal spraying can be selected in such a way that they fulfil the requirements for the component to be coated. In accordance with 4.2 to 4.5, the appropriate level shall be selected in accordance with the importance of the thermal spray coating for the function and safety of the component.

4.2 Quality requirements for the manufacturer

4.2.1 General

Planned manufacturing, an adequate control, and testing of the manufacturing are sufficient measures in order to ensure the required function of components with thermal sprayed coatings. The establishing of an adequate quality assurance system is an appropriate measure for a successful production and completion in the time schedule and serves to avoid reworks or other additional measures.

In general, the manufacturer establishes the quality assurance system in accordance with the components to be coated and the requirements of the coatings.

Different requirements, which form the basis of establishing and defining a quality assurance system for thermal spraying, are listed in Annex C in accordance with the levels C, S and E.

Audits, which can be executed by an external test organization or internally by a department (FQC) independent from the production, shall safeguard the functionality of the system and shall check that the stipulated conditions are maintained.

It is a task and responsibility of the company's executive officers to establish a regular cycle for carrying out external or internal quality assurance audits in accordance with the rules.

4.2.2 Requirements for the quality assurance — Selection of the quality assurance level

The appropriate quality assurance level (QAL) C, S or E can be selected in relation to the quality requirement class (QRC), which is given by the required properties of the sprayed coating and its importance for the proper function and safety of the component. For details, see 4.4.

The requirements of the factory related to the QAL are:

— quality requirements for the manufacturer in accordance with QAL-C: comprehensive quality requirements;

— quality requirements for the manufacturer in accordance with QAL-S: standard quality requirements;

— quality requirements for the manufacturer in accordance with QAL-E: elementary quality requirements.

4.3 Selection of the quality requirements for the thermal sprayed coating — quality requirement classes

4.3.1 General

The QRC depends on the requirements of the sprayed coating and its importance for the proper function and safety of the component. It can be required by the customer, by an agreement between the contracting parties or by a general determination of the executing company itself. The specific level of the requirements is specified as given in 4.3.2 to 4.3.4.

4.3.2 Quality requirement class QRC1

Coatings of QRC1 are those where the function of the coating performs a main element of the design and has a decisive influence on the function of the component. In the case of its failure under service conditions, the function of the component or of a main part of it will be lost.

4.3.3 Quality requirement class QRC2

Coatings of QRC2 are those that support the function of a component. In the case of its failure under service conditions, the function of the component or of a main part of it will be impaired. However, a safe service is safeguarded for a certain but limited time.

4.3.4 Quality requirement class QRC3

Coatings of QRC3 are those where the function of a component does not depend on the functionality of the coating. In the case of its failure under service conditions, the function of the component or of a main part of it will not be impaired.

4.4 Selection of the quality requirements for thermal spraying

In general, components which have a QRC of 1 are likely to require the manufacturer to use a QAL of C, whereas those with a QRC of 2 or 3 can require a QAL of S or E. However, this shall be decided by an assessment of the function of the coatings and the complexity of their production. The QAL may, for instance, be upgraded where repair is very difficult or downgraded if the required coating is very insensitive to process variations. Annex A, Figure A.1, presents a flow chart for defining the requirements.

The instructions given in Table B.1 regarding the importance of different elements for the quality assurance for the different systems C, S and E shall be followed.

The requirements specified in Table C.1 regarding the quality assurance elements for the quality assurance system comprehensive requirements, standard (normal) requirements and elementary requirements shall be followed.

4.5 Designation of the quality assurance level

The designation of the required quality assurance system shall include a reference to this document and the status of the requirements. The requirements shall be specified as follows:

— in the case of comprehensive requirements: ISO 14922-C:2021;

— in the case of standard (normal) requirements: ISO 14922-S:2021;

— in the case of elementary requirements: ISO 14922-E:2021.

Annex A
(informative)

Flow diagram for selection of thermal spraying quality requirements