INTERNATIONAL STANDARD

ISO 14922-3

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Thermal spraying — Quality requirements of thermally sprayed structures —

Part 3: Standard quality requirements

Projection thermique — Exigences qualité des constructions obtenues par projection thermique —

Partie 3: Exigences qualité standard

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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 3.

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 part of ISO 14922 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14922-3 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 107, *Metallic and other inorganic 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...".

ISO 14922 consists of the following parts, under the general title *Thermal spraying — Quality requirements of thermally sprayed structures*:

— *Part 1: Guidance for selection and use*

— *Part 2: Comprehensive quality requirements*

— *Part 3: Standard quality requirements*

— *Part 4: Elementary quality requirements*

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

Contents

Foreword

The text of EN ISO 14922-3:1999 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 December 1999, and conflicting national standards shall be withdrawn at the latest by December 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 specifies requirements so that:

– It is independent of the type of the thermally sprayed structure.

– It defines quality requirements for thermal spraying both in workshops and on site.

– It provides guidance for describing a manufacturer's capability to produce thermally sprayed constructions to meet specified requirements.

– It may also be used as a basis for assessing the manufacturer in respect to his thermal spraying capability.

This standard is appropriate when demonstration of a manufacturer's capability to produce thermally sprayed construction, fulfilling specified quality requirements, are specified in one or more of the following:

– a contract between involved parties;

– an application standard;

– a regulatory requirement.

The requirements contained within this standard may be adopted in full or may be selectively deleted by the manufacturer if not applicable to the construction concerned. They provide a flexible framework for the control of thermal spraying in the following cases:

– Case 1

To provide specific requirements for thermal spraying in contracts which require the manufacturer to have a quality system other than EN ISO 9001 or EN ISO 9002.

– Case 2

To provide specific requirements for thermal spraying in contracts which require the manufacturer developing a quality system.

– Case 3

To provide specific requirements for thermal spraying in application standards which uses thermal spraying as part of its requirements or in a contract between relevant parties. It may however be more appropriate for EN ISO 14922-4 to be used in such cases.

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 473
Non-destructive testing – Qualification and certification of personnel

EN 582
Thermal spraying – Determination of the adhesive tensile strength

EN 657
Thermal spraying – terminology – Classification

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

prEN 13214
Thermal spraying – Thermal spray coordination – Tasks and responsibilities

EN ISO 9001
Quality systems – Model for quality assurance in design/development, productuion, installation and servicing (ISO 9001 : 1994)

EN ISO 9002
Quality systems – Model for quality assurance in production, installation and servicing (ISO 9002 : 1994)

EN ISO 14918
Thermal spraying – Approval testing for thermal sprayers

prEN ISO 14919
Thermal spraying – Wires, rods and cords for flame and arc spraying – Classification – Technical supply conditions

EN ISO 14922-1
Thermal spraying – Quality requirements of thermally sprayed structures – Part 1: Guidelines for selection and use

ISO 8402 : 1994
Quality management and management assurance – Vocabularity

3 Definitions

For the purposes of this standard definitions given in EN 657 and listed in part 1 of this standard apply.

4 Contract and design review

4.1 General

The manufacturer shall review the contractual requirements and the design data provided by the purchaser or in-house data for construction designed by the manufacturer. This is to ensure that all information necessary to carry out the fabrication operations is available prior to the commencement of the work. The manufacturer shall affirm his capability to meet all thermal spraying contract requirements and ensure adequate planning of all quality related activities.

The items in 4.2 are typically considered at or before time of the contract review. The items in 4.3 usually form part of the design review and should be taken into account during the contract review if the design is not carried out by the manufacturer. It shall be ensured that all relevant information has been supplied by the purchaser.

When a contract does not exist, e.g. items made for stock, the manufacturer is required to take into consideration the requirements of 4.2, whilst carrying out his design review (4.3).

4.2 Application – Contract review

Contractual requirements to be considered should include:

a) the application standard to be used, together with any supplementary requirements;

b) the specification of thermal spraying procedures, non-destructive testing procedures and heat treatment procedures;

c) the approval of personnel, if contractual agreed;

d) inspection and testing;

e) quality control arrangements, including any involvement of an independent inspection body;

f) identification;

g) environmental conditions relevant to thermal spraying on site;

h) sub-contracting;

i) handling of non-conformance.

4.3 Application – Design review

Design requirements to be considered should include:

a) location, accessibility and sequence of all coatings;

b) surface finish of the coating;

c) substrate material specification and coating properties;

d) dimensions and details of prepared substrate surfaces and sprayed coatings, masking;

e) quality and acceptance requirements for coatings;

f) other special requirements, e.g. acceptability of shotpeening, heat treatment, cooling.

5 Sub-contracting

When a manufacturer intends to use sub-contracted services (e.g. inspection, non-destructive testing, post treatment) all relevant specifications and requirements shall be supplied by the manufacturer to the sub-contractor. The subcontractor shall provide such records and documentation of his work as may be specified by the manufacturer.

Any sub-contractor shall work under the order and responsibility of the manufacturer and shall fully comply with the relevant requirements of this standard.

The information to be provided by the manufacturer to the sub-contractor shall include all relevant data from the contract review (see 4.2) and the design review (see 4.3). Additional requirements may need to be specified, if the design of a structure is to be sub-contracted.

6 Personnel for thermal spraying

6.1 General

The manufacturer shall have at his disposal sufficient and competent personnel for the planning, performing, supervising and examining of the thermal spraying production according to specified requirements.

6.2 Qualified thermal sprayer

All thermal sprayers must be approved by a suitable qualification test according to EN ISO 14918. All records of approval shall be maintained up to date.

6.3 Thermal spraying coordinator

The manufacturer shall have at his disposal appropriate thermal spraying coordination personnel who controls the correct performing of the work. Such persons having responsibility for quality activities shall have sufficient authority to enable any necessary action to be taken. The duties, inter-relationships and limits of responsibility of such persons should be clearly defined, see prEN 13214.

7 Personnel for quality testing

7.1 General

The manufacturer shall have at his disposal sufficient and competent personnel for planning and performing, supervising and inspection, testing and examination of the thermal spraying production according to specified requirements.

7.2 Non-destructive testing

The non-destructive testing personnel shall be approved according to EN 473.

8 Equipment

8.1 Equipment for manufacturing

The following equipment shall be available when necessary:

– workshops, generally as roofed working sites;

– stores for correct storage of substrate materials (to be coated components), consumables and other additives for thermal spraying;

– equipment for drying spray powders;

– equipment and machines to prepare and machine the components for thermal spraying (e.g. degreasing equipment, sand blasting cabins);

– spraying equipment, including equipment for supply, setting and control;

– handling systems (e.g. turntables, turning machines, robot systems);

– exaust systems, dust filters, protective means against noise and radiation;

– equipment for thermal treatment of the components before and after spraying;

– cooling equipment;

– machines, tools and equipment for post treatment of thermal sprayed coatings (e.g. grinding, turning);

– equipment and means for testing and measuring materials and thermal sprayed coatings;

– for spraying on site, appropriate conditions have to be installed.

8.2 Description of equipment

The manufacturer shall maintain a list of essential equipment, used for thermal spraying production. This list shall identify items of major equipment, essential for an evaluation of workshop capacity and capability. The list includes for instance:

– capacity of the biggest crane;

– size of the components, that may be sprayed;

– capacity of blasting chambers and for spraying.

8.3 Suitability of equipment

The equipment shall be adequate for the application concerned. Approval of thermal spraying and pre- and post treatment equipment is not usually required unless specified in the contract.

8.4 Maintenance

The manufacturer shall ensure maintenance of the equipment.

Examples for such features are:

– conditions of guides in equipment for mechanised thermal spraying fixtures;

– conditions of equipment for measuring current and voltage, flow meters etc. used for the operation of the thermal spraying machines;

– conditions of cables, hoses, connectors etc;

– conditions of control system in mechanised and/or automatic thermal spraying;

– conditions of thermocouples and other temperature measurement instruments;

– condition of powder and wire feeders and conduits.

8.5 Health and safety and environmental aspects

Equipment necessary for health and safety and environmental protection must be available. All necessary activities to assure standards of health and safety and of emission have to be conducted.

9 Thermal spraying activities

9.1 Production plan

The manufacturer shall carry out adequate production planing, compatible with facilities as in 8.1. This shall include at least:

– specification of the sequence by which the construction shall be manufactured, e.g. as a single part or sub-assembly, and the order of subsequent final assembly;

– identification of the individual processes required to manufacture the construction;

– reference to the appropriate procedure specification for thermal spraying and allied processes;

– specification for inspection and testing, including the involvement of any independent inspection body;

– environment conditions, e.g. protection against wind and rain;

9.2 Thermal spraying procedure specification

The manufacturer shall prepare thermal spraying procedure specification and shall ensure that these are used correctly in production.

9.3 Work instructions

The manufacturer may use the thermal spraying procedure specification directly in the workshop for instruction purposes to the sprayer. Alternatively, he may use dedicated work instructions. Such dedicated work instructions shall be prepared from an approved thermal spraying procedure specification and do not require seperate approval.

9.4 Pre- and post-treatment

The manufacturer shall be fully responsible for the specification and the performance of any pre- and post-treatment. The procedure shall be compatible with the substrate material, the coating construction etc. A record of the treatments shall be made during the processes, if necessary. The record shall demonstrate that the specification has been followed and shall be traceable to the particular treatment operation.

9.5 Documentation

The manufacturer shall establish and maintain procedures for control of relevant quality documents, e.g. thermal spraying procedure specification, thermal sprayer certificate.

10 Consumables for thermal spraying

10.1 General

Responsibilities and procedures involved in the control of thermal spraying consumables shall be specified by the manufacturer.

10.2 Batch testing

Batch testing of consumables will be required only if stated in the contract.

10.3 Storage and handling

The manufacturer shall produce and implement procedures for storage, handling and use of consumables which avoid moisture pick-up, oxidation and damage etc. The procedure shall be in accordance with the supplier's specifications.

11 Storage and handling of substrate materials

Storage shall be such that the material will not be adversely affected. Identification shall be maintained during storage.

12 Thermal spraying related inspection and testing

12.1 General

Inspection and testing shall be implemented at appropriate points in the manufacturing process to assure conformity with contract requirements. Location and frequency of such inspection and/or testing will depend on the contract and/or application standard, the thermal spraying process and the type of construction (see 4.2 and 4.3).

The manufacturer may carry out informal tests without restrictions. Reporting of such tests is not required.

12.2 Inspection and testing before thermal spraying

Before the start of thermal spraying, the following shall be checked, when necessary:

– suitability and validity of the thermal sprayer's certificate, see EN ISO 14918;

– suitability of thermal spraying procedure specification;

– identity of the substrate material;

– identity of the consumables, e.g. according to EN 1274;

– surface preparation, also shape and dimension;

– spraying should be done as soon as possible after preparation;

– fit-up, jigging and tacking;

– any special requirements in thermal spraying procedure specification, e.g. prevention of distortion;

– arrangement of any production test;

– suitability of working conditions for thermal spraying, including environment.

12.3 Inspection and testing during thermal spraying

During thermal spraying, the following shall be checked at suitable intervals or by continuous parameter, when necessary:

– essential thermal spraying parameters (e.g. gas flow, spraying current, spraying voltage, travel speed);

– substrate temperature;

– correct use and handling of consumables;

– control of distortion;

– any intermediate examination, e.g. checking dimensions.

12.4 Inspection and testing after thermal spraying

After thermal spraying, compliance with relevant acceptance criteria shall be checked, when necessary:

– by visual testing;

– by nondestructive testing;

– by destructive testing, e.g. according to EN 582;

– shape structure and geometrical dimensions of the sprayed component;

– results and reports of pre and post treatment, e.g. grinding, thermal post treatment.

12.5 Inspection and test status

Measures shall be taken as appropriate to indicate e.g. by marking of the item or a routing card, the status of inspection and test of the sprayed construction.

13 Non-conformance and corrective actions

Measures shall be implemented to control items which do not conform to specified requirements in order to prevent their inadvertent use. When repair and/or thermal re-spraying is undertaken by the manufacturer, appropriate procedures shall be available at all workstations where these activities are performed. When repair or thermal re-spraying is performed, the items shall be re-inspected, tested and examined in accordance with the original requirements. Measures shall also be implemented to ensure that conditions adverse to quality of the thermally sprayed construction are promptly identified and corrected.

14 Calibration

The manufacturer shall be responsible for the appropriate calibration of the inspection, measuring and testing equipment. All equipment used to assess the quality of the sprayed construction shall be suitably controlled and shall be calibrated at specified intervals.

15 Identification and traceability

Identification and traceability shall be maintained throughout the manufacturing process, where appropriate. Documented systems to ensure identification and traceability of thermal spraying operations should include, when necessary:

– production plans;

– records of coating locations in structure;

– coating marking, labels etc;

– traceability (for fully mechanised and automatic spray-equipment including sprayer) to specific coatings;

– sprayer and procedure approval;

– non-destructive testing procedures and personnel;

– spraying consumables, e.g type, batch etc;

– substrate material.

16 Quality records

Quality records according to the contract requirements should include, when necessary:

– record of contract/design review;

– material certification;

– consumable certification;

– thermal spraying procedure specification;

– thermal spraying procedure approval test records;

– thermal sprayer approval certification;

– non-destructive testing personnel certificates;

– pre- and post-treatment and procedures specification records;

– non-destructive and destructive testing procedures and reports;

– dimensional reports;

– records of repairs or new thermal spraying.

Quality records shall be retained for a minimum period of 5 years in the absence of any other specified requirements.

Annex ZA (informative)

Bibliography

Table ZA.1: List of ISO standards conforming to the EN standards quoted in clause 2

EN standards quoted in clause 2	Corresponding ISO standards	Title of the ISO standard
EN 473	–	
EN 582	ISO 14916	Thermal spraying – Determination of tensile adhesive strength
EN 657	ISO 14917	Thermal spraying – Terminology, classification
EN 1274	ISO/DIS 14232	Thermal spraying – Powders – Composition – Technical supply conditions

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