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Quality Requirements for Post Welding Heat Treatment

(ISO 17663:2009, Welding – Quality Requirements for Heat Treatment in Connection with Welding and Allied Processes, MOD)

焊后热处理质量要求

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1 Scope

This Document specifies the quality requirements for post weld heat treatment and provides guidelines for manufacturers to implement post weld heat treatment.

This Document applies to various post weld heat treatment methods for metallic materials and can also be used as a basis for evaluating the manufacturer's heat treatment capability.

2 Normative References

The provisions in following documents become the essential provisions of this Document through reference in this Document. For the dated documents, only the versions with the dates indicated are applicable to this Document; for the undated documents, only the latest version (including all the amendments) is applicable to this Document.

GB/T 3375 Welding Terminology

GB/T 7232 Terminology of Metal Heat Treatment

GB 15735 Requirements for the Safety and Health in Production Process of Metal Heat Treatment

GB/T 16839.1 Thermocouples - Part 1: EMF Specifications and Tolerances (GB/T 16839.1-2018, IEC 60584-1:2013, IDT)

3 Terms and Definitions

For the purposes of this Document, the terms and definitions given in GB/T 3375, GB/T 7232 and the following apply.

3.1 Manufacturer

Organizations and personnel that are engaged in heat treatment of welded products or components.

3.2 Loading temperature

The furnace temperature at which the product or component is loaded into the furnace.

3.3 Holding temperature

The process temperature at which the product or component is held constant in order to obtain special properties.

NOTE 1: The holding temperature depends on the type of heat treatment, the type of material and the thickness of the material.

NOTE 2: The holding temperature is usually expressed by a certain temperature range.

3.4 Holding time

The holding time of the product or component at the holding temperature.

NOTE 1: The calculation of the holding time starts when all the temperature measurement points reach the lower limit of the holding temperature, and ends when a temperature measurement point is lower than the temperature.

NOTE 2: The holding time depends on the type of heat treatment, the material and its thickness.

3.5 Section temperature range

The temperature variation range between two adjacent temperature measurement points within the specified straight-line distance.

3.6 Post weld heat treatment

After welding, heat treatment measures to improve the structure and properties of welded joints or to eliminate residual stress.

4 Requirement Review and Technical Review

4.1 General

The manufacturer shall review the contract requirements, all other requirements and relevant technical data to ensure that all information necessary to carry out the heat treatment operation is obtained before the work begins. Manufacturers shall confirm that their capabilities meet the requirements to ensure that all quality-related activity plans are feasible and comply with the provisions of GB 15735.

The review is carried out by the manufacturer; and it shall be confirmed that the content of the work is within the scope of its ability; that it has sufficient resources to ensure timely delivery, and that the documents are clear and unobjectionable. Manufacturers shall ensure that major

n) Quality requirements and heat treatment test (if necessary);

o) Heat treatment sequence/order;

p) Whether there is sufficient energy;

q) Other special agreements, such as product or component support.

5 Subcontractor

All subcontractors shall work in accordance with the manufacturer's agreement and shall fully meet the relevant requirements of this Document. The manufacturer shall ensure that subcontractors meet the specified quality requirements.

The information that the manufacturer provides to subcontractors shall include all relevant data involved in the technical review (see 4.3).

Manufacturers employing heat treatment subcontracting shall provide subcontractors with specifications and requirements for all relevant work. Subcontractors shall provide reports and documents of their related work as required by the manufacturer.

6 Personnel

The manufacturer shall assign a sufficient number of competent personnel to plan, implement and supervise the heat treatment work according to the specified requirements.

The competence of heat treatment operators shall be assessed and confirmed by the manufacturer.

Heat treatment operators shall receive necessary training and be able to read, understand and execute heat treatment process documents, such as adjustment procedures, installation of thermocouples, maintenance of temperature measuring instruments, etc.

7 Tests and Inspections

7.1 General

The manufacturer shall assign a sufficient number of competent personnel to carry out the planning, implementation, testing, inspection and evaluation of heat treatment work in accordance with the specified requirements.

7.2 Non-destructive testing

Non-destructive testing shall be carried out in accordance with product standards or relevant technical requirements.

7.3 Destructive test

Destructive test after heat treatment may be required in the following cases:

a) Application standards or contractual requirements;

b) The manufacturer decides to verify the performance of the product or component.

A separate test piece shall be used for the destructive test. The test piece is made of the same material as the product; and its production conditions and heat treatment process are also the same as the product.

8 Heat Treatment Equipment

8.1 Production, test and related equipment

The following equipment shall be configured if necessary:

a) Heat treatment furnaces or heating equipment;

b) Heat treatment program control device;

c) Temperature measuring instruments and recording instruments;

d) Cooling equipment;

e) Lifting and transporting equipment;

f) Personal protective equipment and other safety equipment.

8.2 Equipment list

In order to assess the capacity and ability of the workshop, the manufacturer and/or subcontractor shall maintain a list of necessary equipment for heat treatment. Such list shall include various information on the main equipment, such as:

a) Equipment name, heat source type and capability;

b) Furnace size, maximum loading and temperature range;

c) Program-controlled devices and their capabilities;

d) Temperature measuring equipment and its capacity, measuring method, reading range,

8.5 New Equipment

After new equipment is installed or after overhaul to the equipment, relevant equipment tests shall be carried out. The test shall evaluate the normal function of the device. Test contents include:

a) Metrological calibration of instruments and meters;

b) Functional testing;

c) Determination of furnace temperature uniformity;

d) Empty furnace, full load test verification;

e) Welding test piece evaluation test, including appearance, metallography, hardness.

These test reports shall be archived.

8.6 Maintenance

The manufacturer shall have a written plan for equipment maintenance. The maintenance plan shall include equipment inspection items that have an impact on the parameters listed in the relevant heat treatment process specification. Maintenance plans shall include inspections of safety issues.

9 Implementation of Heat Treatment

9.1 General

Heat treatment shall be based on specific circumstances, select the appropriate process method, heat source and place.

9.2 Heat treatment parameters

The manufacturer of the product or component is responsible for determining the heat treatment parameters, which are related to the material type and thickness.

Depending on different types of heat treatment, the following parameters shall be specified if necessary:

a) Loading temperature;

b) Heating rate;

c) Holding temperature (if necessary, the temperature range);

d) Holding time (if necessary, the time range);

e) Cooling rate;

f) Unloading temperature.

NOTE: The unloading temperature refers to the furnace temperature when the product or component is released from the furnace.

9.3 Heat treatment process specification

The manufacturer shall formulate the heat treatment process specification. The heat treatment procedure specification may be included in the welding procedure specification or directly referenced by the welding procedure specification.

The heat treatment process specification shall include the following:

a) Type of heat treatment, such as tempering, annealing, normalizing, etc.;

b) Heat treatment methods, such as inside furnace, induction, resistance, annular burners;

c) The location and number of temperature measurement points;

d) Protective atmosphere;

e) Heat treatment parameters;

f) Support and loading of products or components;

g) Cooling type;

h) The identification, marking or number of the product or component;

i) Environmental conditions, such as wind and rain protection measures;

j) The extent of the heating area and the isolation area.

The heat treatment process specification shall be evaluated according to product standards or contract requirements.

9.4 Work instructions

The heat treatment procedure specification or welding procedure specification can be used in the form of work instructions; or special work instructions can also be used. The work instructions shall be prepared according to the evaluation of qualified heat treatment process specification; and no separate evaluation is required.

9.5 The number of temperature measurement points

b) Material information (material model/designation, size specification);

c) Heat treatment equipment (identification);

d) Type of heat treatment (tempering, annealing, normalizing, etc.);

e) Heat treatment method (inside furnace, induction, resistance, annular burner, etc.);

f) The time of entering the furnace/the temperature of entering the furnace;

g) Heating rate;

h) Holding temperature;

i) Holding time;

j) Cooling rate;

k) Cooling method;

l) Furnace exit time;

m) Temperature measurement method, number and location of measurement points;

n) Time and location of heat treatment;

o) Appearance quality results after heat treatment of the product or component.

The heat treatment report shall be accompanied by the heat treatment record curve and signed by the designated person.

11 Nonconformities and Corrective Actions

When the heat treatment does not meet the specified requirements, the product or component shall not be evaluated for acceptance. In this case, the user shall be notified. Corrective action shall be taken as necessary. A non-conformance record report shall be prepared and filed with the quality record file.

Acceptable results of heat treatment corrective actions shall be documented.

Corrective actions shall be carried out in accordance with the prepared procedures. When preparing a corrective procedure, it is necessary to confirm that the corrective action shall not adversely affect the product or component. A report on corrective action shall be prepared and the product or component shall be tested, inspected and inspected again as originally required.

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