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**Induction hardening and
tempering of iron and steel parts**

钢铁件的感应淬火与回火

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Induction hardening and tempering of iron and steel parts

1 Scope

This Standard specifies the basic requirements for quality control, safety and health and labor protection of induction hardening and tempering of the surface of iron and steel parts.

This Standard applies to induction hardening and tempering of the surface of iron and steel parts and the heat treatment process of induction hardening.

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.

GB/T 230.1 Metallic materials - Rockwell hardness test - Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)

GB/T 699 Quality carbon structure steels

GB/T 1182 Geometrical Product Specifications (GPS) - Geometrical tolerancing - Tolerances of form, orientation, location and run-out

GB/T 1220 Stainless steel bars

GB/T 1221 Heat-resistant steel bars

GB/T 1222 Spring steels

GB/T 1298 Carbon tool steels

GB/T 1299 Tool and mould steels

GB/T 1348 Spheroidal graphite iron castings

GB/T 3077 Alloy structure steels

GB/T 4340.1 Metallic materials - Vickers hardness test - Part 1: Test method

GB/T 4341.1 Metallic materials - Shore hardness test - Part 1: Test method

GB/T 5216 Structural steel with specified hardenability bands

GB/T 5617 Determination of effective depth of hardening after induction or flame hardening of steel

GB/T 6967 Martensitic stainless steel castings for general engineering application

GB/T 7232 Terminology of metal heat treatment

GB/T 8121 The terminology of technological materials of heat treatment

GB 8702 Controlling limits for electromagnetic environment

GB/T 9439 Grey iron castings

GB/T 9440 Malleable iron castings

GB/T 9452 Testing method for working zone of heat treatment furnace

GB/T 10201 Regulations of proper usage of electricity in heat treatment industry

GB/T 11352 Carbon steel castings for general engineering purpose

GB/T 12603 Classifications and designations for metal heat treatment

GB/T 13314 General specifications of forged steel work rolls for cold rolling

GB/T 13324 Terminology of heat treatment equipment

GB 15735 Requirements for the safety and health in production process of metal heat treatment

GB/T 15822.1 Non-destructive testing - Magnetic particle testing - Part 1: General principles

GB/T 16923 Normalizing and annealing of steel parts

GB/T 17358 Power consumption, measurement, and testing in heat treating production

GB/T 18254 High-carbon chromium bearing steel

GB/T 18449.1 Metallic materials - Knoop hardness test - Part 1: Test method

GB/Z 18718 Energy saving directives for heat treatment

GB/T 19944 Fuel consumption calculation and measurement method in heat treating production

GB/T 30822 Environmental protection technical requirements for heat treatment industry

GB/T 32541 Quality control system for heat treatment

JB/T 3593 Heat treated sintered iron-based structural materials

JB/T 4120 Heavy forged alloy steel backup rolls

JB/T 6955 The specification of quenching medium for heat treatment

JB/T 9204 Metallographic examination of induction hardened steel parts

JB/T 9205 Metallographic examination of pearlitic graphite cast iron parts induction hardened

JB/T 9218 Non-destructive testing - Test method for penetrant testing

3 Terms and definitions

For the purpose of this document, the terms and definitions defined in GB/T 7232, GB/T 8121, GB/T 13324, GB/T 9452, GB/T 16923 and the following apply.

3.1

induction hardening and tempering

For the purpose of all or part of surface hardening of iron and steel parts, it is heated by induction heating to a temperature above A_{c3} or A_{c1} point, and cooled with a suitable cooling medium (quenching); then to adjust the hardness and increase the toughness, it is heated in a tempering furnace or by induction heating to a suitable temperature below A_{c1} point and then cooled (tempering).

3.2

distortion

Relative to the workpiece to be processed, change in form or size of the workpiece after heat treatment.

4 Induction hardening and tempering process code

The surface induction hardening and tempering process code of iron and steel

7 Induction hardening and tempering process and operation

7.1 Workpiece to be processed

Check and confirm the material, status, form, size and appearance of the workpiece to be processed according to the requirements of 5.2. The surface of the workpiece to be processed shall have no scale, burrs or oil stains which may affect the induction heating quenching and tempering. Descaling, deburring and washing if necessary.

7.2 Induction hardening and tempering equipment

7.2.1 Check and confirm that the induction power supply is in the power-on state, no abnormal alarm, the cooling water flows normally, and it is in the heating standby state.

7.2.2 Set the temperature of the equipment's cooling water tank, confirm that the cooling water flow in each part is normal and no leakage. Set the temperature of the quenching liquid tank according to the established heat treatment process; the quenching liquid pipeline system shall be no leakage; confirm the no-load quenching liquid flow by manual switch or button.

7.2.3 Check that the control and operating system is in the power-on state, no abnormal alarm.

7.2.4 Check the operation of the operating mechanism of each part of the equipment in manual mode.

7.2.5 According to the established heat treatment process, through the control and operating system interface of the equipment, preset the program corresponding to the workpiece to be processed, including necessary parameters and steps such as quenching heating and tempering heating output power or output voltage value, quenching and tempering heating time, location or displacement parameters, quenching cooling time, tempering cooling time, each action step.

7.3 Sensors and coolers

7.3.1 Select appropriate sensor and cooler for the workpiece to be processed and install.

7.3.2 Check and confirm if the sensor is deformed, damaged, and the state of the magnetizer meets the processing requirements.

7.6.2 When selecting the induction heating tempering method, use the tempering sensor and cooler corresponding to the workpiece to be processed, select the corresponding program, and operate according to the same procedure as specified in 7.5.

7.6.3 When selecting the tempering furnace method, according to the established heat treatment process, set the tempering heating temperature and holding time before tempering.

7.6.4 According to the technical requirements of the workpiece, tempering is sometimes omitted. In the case of omitting tempering or using induction tempering, in order to avoid defects such as cracks in the workpiece, it shall be processed according to the material, form, processing conditions, etc. of the workpiece.

7.7 Straightening

After heat treatment, the workpiece to be straightened shall ensure that the residual stress generated by straightening does not hinder the subsequent machining and use, and if necessary, carry out the stress relief treatment. The stress relief treatment shall ensure the performance of the workpiece.

7.8 Record

Record the processing process according to the provisions and process requirements, and keep it in a safe place. This shall be recorded if tempering is omitted.

8 Quality requirements and inspection

8.1 Appearance

The surface of the processed workpiece shall not have microcracks, melts, burns caused by induction hardening, and scratches and bumps that affect use. The appearance inspection shall be carried out by visual inspection and the crack shall be inspected according to any method specified in GB/T 15822.1 or JB/T 9218.

8.2 Surface hardness

The inspection of the surface hardness of the processed workpiece may be carried out according to the provisions of GB/T 230.1, GB/T 4340.1, GB/T 4341.1, GB/T 18449.1, using appropriate hardness tester. The hardness deviation value shall comply with the allowable range listed in Table 9, Table 10 and Table 11. Table 11 shall comply with the provisions of JB/T 4120, and it is only applicable to certain large workpieces.

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