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**NONFERROUS METALS INDUSTRY STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

YS/T 591-2017

Heat treatment of wrought aluminium and aluminium alloys

变形铝及铝合金热处理

(English Translation)

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1 Scope

This Standard specifies the equipment, heat treatment processes and quality assurance for heat treatment of wrought aluminum and aluminum alloys.

This Standard applies to the heat treatment of wrought aluminum and aluminum alloy processing products.

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

GB/T 231.1, Metallic materials -- Brinell hardness test -- Part 1. Test method

GB/T 3246.1, Inspection method for structure of wrought aluminum and aluminum alloy products -- Part 1. Inspection method for microstructure

GB/T 7998, Method for evaluating the susceptibility to intergranular corrosion of aluminum alloys

GB/T 9452, Test method for qualified work zone of heat treatment furnace

GB/T 12966, The methods for determining aluminum and aluminum alloys conductivity using eddy current

3.1 Basic requirements

3.1.1

All heat treatment equipment shall be equipped with temperature and time control devices and recorders that meet process control requirements. The recorder shall be able to

accurately reflect the temperature and time control conditions, and can be stored for reference.

3.2.1 Classification

Commonly used heat treatment furnaces can be divided into two types. periodic heat treatment furnaces and continuous heat treatment furnaces. The periodic heat treatment furnace is highly versatile and can meet a variety of heat treatment process requirements.

It is commonly used for heating and annealing of general products. But the production efficiency and thermal efficiency are low. The continuous heat treatment furnace has the characteristics of mechanization and high automation. It can meet the requirements of various heat treatment processes for large quantities of a single product. It has high productivity.

3.2.2.1 Air furnace

Air furnaces use air as the medium. Generally, a forced air circulation system is installed. It is the furnace type with the simplest structure.

3.2.4.1 The correspondence between the types of heat treatment furnaces and the

temperature uniformity of the effective heating zone is shown in Table 1. The temperature uniformity is tested according to the method specified in GB/T 9452.

3.2.4.2 Temperature uniformity shall be rechecked after all operations that alter the temperature uniformity or heat treatment performance of the heat treatment furnace, or after major overhauls.

3.3.1.1 Tank size

The quenching tank shall be of sufficient size to ensure that the product can be completely immersed in the quenching medium.

3.3.1.2 Cycle

The quenching tank shall have an internal or external circulation system to ensure the flow of quenching medium.

3.3.2 Spray quenching equipment

When using a spray system for quenching, the coolant released from the nozzle shall have sufficient volume (flow), pressure and temperature to ensure that all products can achieve a uniform quenching effect. The equipment shall be equipped with a recorder to monitor spray

quenching parameters.

4.1.1 General requirements

4.1.1.1

The heat treatment process shall match the heat treatment equipment. Product monitoring inspections shall be carried out regularly to monitor the operation of heat treatment equipment and the suitability of the process.

4.1.3 Product placement

4.1.3.1

Products shall be placed on racks and kept at a distance to ensure that the quenching medium fully enters all load areas.

4.1.4 Furnace capacity

Furnace installation shall be appropriately selected based on product and process requirements to ensure temperature uniformity. For salt bath quenching products with a thickness less than or equal to 2.5 mm, the furnace loading shall ensure that the time to reach the lowest temperature does not exceed 10 min. For salt bath quenching products with a thickness greater than 2.5 mm, the furnace loading shall ensure that the time to reach the minimum temperature does not exceed 20 min.

4.1.5 Fixtures

Fixtures shall be positioned to avoid steam interception and ensure free circulation of the quenching fluid and quenching effect.

4.2.1 Online solid solution heat treatment process

The extrusion online solution heat treatment process shall be carried out in accordance with the provisions of YS/T 876.

4.3.1 Quenching medium

The quenching medium is water, air, water polymer solution, liquefied gas or oil. There is the appropriate equipment for these medium. The spray quenching medium can use water or a mixture of water and ethylene glycol.

5.1 Process control

All important influencing factors of the heat treatment process shall be controlled within the scope specified in the work instruction document. During actual operation, control charts can be used for monitoring to ensure that each parameter is under control.

Corresponding data shall be recorded. The controlling factors are as follows.

5.2 Repeated solution heat treatment

5.2.2

The holding time for repeated solution heat treatment can be shortened to half of the time specified in Table 3.

5.2.3

If the heating speed of the continuous heat treatment furnace is fast enough, as long as there is no serious diffusion of the aluminum-cladding layer, it is allowed to add one repeated solution heat treatment on the basis of Table 9.

5.2.4

Without the consent of the supplier, the purchaser is not allowed to perform repeated solution heat treatment on products in the following conditions.

5.2.6

Unexpected failure handling. Products that have reached the solution heat treatment temperature but are out of the furnace due to failure shall be quenched, and shall be deemed to have undergone a solid solution heat treatment for the failed furnace batch. Products that have not reached the solution heat treatment temperature can be air cooled.

5.3.2.3 Aluminum alloy diffusion

Partial specimens cut from rolled products representing a batch or charge are subjected to microscopic examination in accordance with GB/T 3246.1. Examination shall be performed under a metallographic microscope at 100 to 1000 times magnification to determine the extent of diffusion of alloy components through the aluminum-cladding.

It also allows solution potential measurement methods to be used to analyze the diffusion of the aluminum-clad layer. It is a condition that documentation on the interrelationship between this method and optical methods be made available for inspection.

5.3.3 Handling of unqualified test results

5.3.3.1

When the test results are unqualified, the reasons shall be identified. If the test shows that the heat treatment equipment or process cannot be used for aluminum alloy heat treatment, the fault shall be eliminated and the process adjusted. Re-test until the tested items are qualified. Suspicious products that have been produced must be inspected. Handle according to qualified products and unqualified products.