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**NATIONAL STANDARD OF THE  
PEOPLE'S REPUBLIC OF CHINA**

**GB/T 43897-2024**

**Cast superalloy - Master alloy - Single crystal**

铸造高温合金 母合金 单晶

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### 3 Terms and definitions

Clause 3 states in a single line that this document has no terms and definitions that need to be defined.

### 4 Order content

A contract or an order placed under this document should include the number of this document, the alloy grade, the size specification, the quantity and total mass, and any other requirements agreed between supplier and purchaser.

### 5 Dimensions and mass

5.1 The nominal diameter of the master alloy is usually 70 mm to 90 mm; where the purchaser has particular requirements for the size, these are agreed between supplier and purchaser and noted in the contract. 5.2 The master alloy is delivered by actual mass.

### 6 Technical requirements

6.1 The raw material used to melt the master alloy shall meet HB/Z 131. Where other raw material or recycled material is to be used, supplier and purchaser agree on it and note it in the contract. 6.2 The master alloy shall be produced by vacuum induction melting, or by the melting process laid down in a dedicated process document; the melting method used shall be stated in the contract and in the quality certificate.

6.3.1 The alloy grades and their chemical composition shall meet Table 1, and any particular requirement of the purchaser shall be noted in the contract. Table 1 runs over two printed pages and covers nine single crystal grades, DD402, DD403, DD405, DD406, DD407, DD408, DD432 and DD499, with nickel as the balance in every grade; the first block fixes the mass fraction ranges or upper limits of the main alloying elements, and two further blocks fix the maximum contents of a long list of trace and tramp elements, while lettered footnotes add further limits for individual grades. The extractor did not keep the rows and the column headings aligned, so the figures of Table 1 are not reproduced here.

6.3.2 At the request of the purchaser, noted in the contract, the supplier may add inspection and control requirements for trace element contents.

6.4 The electron vacancy number of alloy DD406 shall be not greater than 2.30. For other grades the supplier may provide the electron vacancy number at the request of the purchaser, noted in the contract, the acceptance criterion being agreed between the two parties. 6.5 The master alloy is delivered in the as-cast condition.

6.6 Specimens for the mechanical property test are cut from single crystal test bars or test plates remelted and poured from the same heat of master alloy, and the deviation between the [001] single crystal growth direction of the bar or plate and the principal stress axis of

the specimen shall be not greater than 15°, unless a particular need is noted in the contract. The specimen blanks are heat treated to the schedules recommended in Table 2 and shall then meet the properties of Table 3. With the agreement of the purchaser the mechanical property test may be omitted.

Table 2 gives, grade by grade, a solution treatment and one to three ageing stages, each with its temperature, its holding time and air cooling or cooling at a rate equivalent to air cooling; DD408 and DD432 also carry a pre-treatment stage, and DD499 is heated in the furnace and cooled under argon at a rate equivalent to air cooling. Table 3 fixes tensile properties, namely test temperature, tensile strength, proof strength at 0.2 % plastic extension, elongation after fracture and reduction of area, and stress rupture properties, namely test condition, test temperature, stress, time to rupture and reduction of area after rupture; several grades carry more than one test condition inside a single row and the extractor merged those rows, so the values of Table 3 are not reproduced here.

6.7 At the request of the purchaser the supplier may carry out a dross test on the master alloy, the dross area being not greater than 2 %. 6.8 The surface shall be 100 % free of scale and shall carry no adhering iron, refractory, slag or other foreign inclusions and no honeycomb defects; the primary shrinkage cavity shall be cut off and any residual secondary shrinkage cavity shall be not more than 7 mm in diameter and free of residue and dirt; the surface shall be 100 % ground or machined to a metallic lustre.

6.9 Each bar shall be marked on its upper and its lower end face with the alloy grade and the melting heat number, the two ends being distinguished, and no marking method that is not permanent or that contaminates the material shall be used. The alloy grade and the melting heat number shall also be marked round the whole outside surface of each bar by a method that does not contaminate the material.

## 7 Test methods

7.1.1 The chemical composition is analysed by the methods of a long list of GB/T and HB standards, or by other general methods; arbitration analysis is carried out by a second, partly different list of GB/T and HB standards. In the list of routine methods HB 20241.7 appears twice, which is how the original is printed.

7.1.2 The analysis of lithium, potassium, rubidium, caesium, strontium, chlorine, bromine, iodine, ruthenium, rhodium, osmium, iridium, gold, mercury, praseodymium, neodymium, holmium, erbium, thulium, ytterbium, uranium and thorium is agreed between supplier and purchaser; ruthenium is named twice inside that list in the original. 7.2 The test methods for the other inspection items shall meet Table 4.

## 8 Inspection rules

8.1 Inspection and acceptance of the master alloy are carried out by the quality supervision

department of the supplier, and the purchaser has the right to inspect and accept the master alloy against this document. 8.2 The master alloy is submitted for inspection and acceptance in batches by heat, each batch being made up of material of one grade and one melting heat number.

8.3 The number of samples, the sampling positions and the test methods shall meet Table 4. That table has six columns and eight numbered rows and came out legible. Chemical composition: two samples per batch, one from the upper and one from the lower end of any bar, all elements analysed on the upper end sample and only aluminium and titanium on the lower end sample, tested to 7.1. Electron vacancy number: one per batch, upper end of any bar, to GB/T 31309. Mechanical properties: high temperature tensile, one specimen per batch for each temperature and stress, and high temperature stress rupture, one specimen per batch for each test condition, taken from any position of the single crystal test bar or test plate, to GB/T 228.2 and GB/T 2039. Dross test: one per batch, upper end of any bar, to HB 5406. Dimensions: every bar, whole bar, with a steel tape of 1 mm accuracy or another measuring tool of suitable accuracy. Surface quality and product marking: every bar, whole bar, by visual examination. A footnote requires the supplier to provide enough test bars or plates for the purchaser to retest.

8.4.1 Where the chemical analysis result is not acceptable, one further specimen may be taken from the upper and from the lower part of the same bar and the failing elements analysed again; if either of those specimens is still not acceptable, the heat is rejected.

8.4.2 Where a mechanical property test is not acceptable, twice the number of specimens may be taken from the same group and retested; if the retest is still not acceptable, a further group of specimens, of the same number as at the first inspection, may be taken from another set of specimens remelted and poured from the same heat batch, and that inspection shall be acceptable at the first attempt or the heat batch is rejected. Where a metallurgical defect inside a specimen has caused the result, the result is void and a new specimen is taken and tested.

8.4.3 An unacceptable electron vacancy number rejects the heat batch. 8.4.4 An unacceptable dross test rejects that bar; another bar of the same heat batch may be sampled and tested again, and a second failure rejects the heat. 8.4.5 Unacceptable dimensions or surface quality reject that bar. 8.4.6 Unacceptable product marking may be corrected by marking the bar again, and a bar that then passes may be delivered.

## 9 Packaging, marking, transport and storage, quality certificate

9.1 The master alloy is packed separately by alloy grade and melting heat number, or boxed in heat number order. 9.2 Each package or box carries a label giving the alloy grade and the melting heat number. 9.3 The master alloy is transported and stored in clean, dry, corrosion-protected conditions, loaded and unloaded steadily and stored tidily by heat batch.