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**General specifications of forged steel work rolls for cold
rolling**

锻钢冷轧工作辊 通用技术条件

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General specifications of forged steel work rolls for cold rolling

1 Scope

This Standard specifies technical requirements, test methods and inspection rules for forged alloy steel work rolls for cold rolled metal.

This Standard applies to integral forged alloy steel work rolls for cold rolling and intermediate rolls used in cold-rolling mills such as sheet metal (strip) (hereinafter referred to as the cold-rolling rolls). The cold-rolling rolls manufactured by other methods can also use this Standard as reference.

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrigendum) or revisions do not apply to this Standard, however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 223.5, *Steel and iron - Determination of acid-soluble silicon and total silicon content - Reduced molybdosilicate spectrophotometric method*

GB/T 223.11, *Iron, steel and alloy - Determination of chromium content - Visual titration or potentiometric titration method*

GB/T 223.14, *Methods for chemical analysis of iron, steel and alloy - The N-benzoyl-N-phenylhydroxylamine extraction photometric method for the determination of vanadium content*

GB/T 223.19, *Methods for chemical analysis of iron, steel and alloy - The neocuproine-chloroform extraction photometric method for the determination of copper content*

GB/T 223.23, *Iron, steel and alloy - Determination of nickel content - The dimethylglyoxime spectrophotometric method*

GB/T 223.26, *Iron, steel and alloy - Determination of molybdenum content - The thiocyanate spectrophotometric method*

4.4 The network carbide inspection shall be carried out in accordance with the provisions of GB/T 1299-2000.

4.5 The ultrasonic flaw detection shall be carried out in accordance with the provisions of Annex A.

4.6 The Shore hardness test method shall be carried out in accordance with the provisions of GB/T 13313.

4.7 For the test of the depth of the hardened layer of the cold-rolling roll body, it shall use the determination method of surface Shore hardness by layer-by-layer grinding of rolls or the method for determining surface Shore hardness values when using unit grinding.

4.8 The inspection method for the surface cracks of the cold-rolling roll body shall be determined by negotiation between the supplier and the purchaser.

5 Inspection rules

5.1 The quality of the cold-rolling rolls shall be inspected by the quality inspection department of the manufacturer according to this Standard and the agreement between the supplier and the purchaser.

5.2 The size and surface quality of each part of the cold-rolling roll shall be inspected piece by piece.

5.3 The chemical composition of the cold-rolling rolls is sampled and inspected during the pouring process of molten steel in each furnace. The electroslag steel shall be sampled and inspected at the upper end of the electroslag ingot. When the analysis fails, it is allowed to take samples from the cold-rolling roll body for reinspection. It shall be accepted if it passes the reinspection.

5.4 The inspection of macrostructure and reticulated carbide shall comply with the provisions of GB/T 15547.

5.5 The cold-rolling rolls shall be inspected by ultrasonic flaw detection one by one.

5.6 The surface hardness of the cold-rolling roll, the hardness uniformity of the roll body, and the width of the soft belt shall be inspected piece by piece.

5.7 The depth of the hardened layer of the roll body is guaranteed by the manufacturer's process. The hardened layer of the same material, heat treatment process, and diameter can be determined by dissection test, which is a representative test roll. If it is different from the grinding measurement value, the actual measurement value shall prevail.

5.8 The purchaser shall conduct reinspection within three months after the cold-rolling

rolls arrive. When the purchaser reinspects or confirms that the quality of the cold-rolling roll does not meet this Standard or the agreement between the supplier and purchaser, the manufacturer shall be notified to conduct a joint inspection. Eligibility is determined according to the results of the joint inspection or third-party arbitration.

6 Marking, packaging, transportation and storage

6.1 The cold-rolling rolls that have passed the inspection shall be marked with the manufacturer's mark and roll number on the end face of the non-transmission end (optional end of the symmetrical work roll). If the purchaser has special requirements for marking and roll number, it shall be indicated in the agreement between the supplier and the purchaser.

6.2 The anti-rust packaging of the cold-rolling rolls shall be carried out in accordance with the provisions of level 3 packaging in Table 1 of GB/T 4879-1999. The anti-rust period is 2 years.

6.3 Wooden crates or grids are used as the outer packaging of the cold-rolling rolls. The packaging quality shall meet the requirements of the transportation department for packaging.

6.4 Packaging marks and random documents

6.4.1 Packaging box marks generally include:

- a) Contract number, work roll model and exit-factory number;
- b) Weight;
- c) Packing date;
- d) Arrival (port) and receiver;
- e) Sending station (port) and deliverer.

6.4.2 For the cold-rolling rolls packed with grid plates, the content of the logo can be written on light-colored nylon fibers, cotton cloth or galvanized thin iron sheets that are not easy to fade and durable. Then securely fasten to the outer packaging.

6.4.3 Accompanying documents shall include quality certificate, packing list and so on. The accompanying documents shall be packed in plastic bags and placed in the box.

The content of the quality certificate generally includes:

- a) Model, name, specification and quantity of the cold-rolling roll;
- b) Contract number or exit-factory number;

Annex A

(normative)

Ultrasonic flaw detection method for forged steel work rolls for cold rolling

A.1 Scope

This method specifies the ultrasonic flaw detection method and grading of flaw detection results for forged steel work rolls for cold rolling (hereinafter referred to as the rolls, including work rolls for cold-rolling metal sheets, strips and foils; work rolls for levelling machine; intermediate rolls for multi-roll mills).

This method is applicable to the ultrasonic flaw detection of longitudinal wave contact method for roll forging billets and roll finished products with a diameter greater than or equal to 80mm using a type A pulse reflection ultrasonic flaw detector. For the rolls with a diameter less than 80mm, the flaw detection method shall be negotiated by both parties.

A.2 Terms and definitions

The terms and definitions defined in GB/T 12604.1 as well as the followings apply to this method.

A.2.1 reference height

Set a certain height of the oscilloscope screen as the reference. This height shall be the reference height (usually expressed as a percentage of the full screen of the oscilloscope screen).

A.2.2 single echo defects

When the probe moves from the highest position of the defect echo to any direction, the amplitude of the defect echo decreases normally, and the echo defect whose equivalent diameter is not less than $\Phi 2\text{mm}$ is called a single echo defect.

A.2.3 cluster echo defects

In a cube with a side length of 50mm, the number of defect echoes is not less than 5. The defect echoes of which the equivalent diameter is not less than $\Phi 2\text{mm}$ are called cluster echo defects.

A.2.4 continuous echo defects

When the probe moves at the detected part, the defect indication length shall not be less than 50mm. The defect echoes of which the equivalent diameter is not less than $\Phi 2\text{mm}$

are called continuous echo defects.

A.2.5 traveling echo defects

The defect echoes that, when the probe moves at the detected part, the moving distance of the defect echo front position is equivalent to the workpiece thickness of 25mm or more, are called traveling echo defects.

A.2.6 central grass defects

Under flaw detection sensitivity, grass-like echoes are reflected in the roll axis area. Use the DGS method to adjust the instrument to the position of the axis $\Phi 2\text{mm}$. When the wave height of the equivalent diameter is 20% of the full screen height, the grass echo wave height is lower than 20% of the full screen height. Such grass echo defects are called central grass defects.

A.3 General requirements

A.3.1 Instruments, probes

A.3.1.1 Adopt type A pulse reflection ultrasonic flaw detector. Its performance indicators shall comply with the provisions of JB/T 10061.

A.3.1.2 The test of the probe performance for ultrasonic flaw detection shall be carried out in accordance with the provisions of JB/T 10062.

A.3.2 Rolls

A.3.2.1 The shape of the roll for flaw detection shall be processed into a simple geometric shape as much as possible. That is, machining of holes, keyways, arc-shaped transition areas shall be arranged after flaw detection. Finished rolls are re-inspected as completely as possible according to their geometry.

A.3.2.2 The surface roughness R_a of the flaw detection surface of the roll shall not be greater than $6.3\mu\text{m}$.

A.3.2.3 There shall be no scratches and dirt on the flaw detection surface of the roll that will affect the flaw detection.

A.3.2.4 The roll shall be placed on a freely rotating support for flaw detection, so as to ensure that the entire roll is scanned.

A.3.2.5 Determination of roll material attenuation coefficient:

- a) The attenuation coefficient of the roll material shall not be greater than 0.004dB/mm . When the sound permeability of the roll is poor, it shall be re-heated and then tested for flaws;
- b) When measuring the attenuation coefficient of the roll material, select three parts

I - The surface area of the roller body; its scope is S_1 , mm;

II - The middle area;

III - The surface area of the center hole of the roller body; its scope is S_2 , mm;

IV - The roll neck.

Figure A.4 -- Schematic diagram of roll area division

A.7 Defect measurement and recording

A.7.1 Defect measurement

A.7.1.1 Measurement of a single echo defect

A.7.1.1.1 For a single echo defect smaller than the diameter of the sound beam of the probe, the equivalent diameter of the defect is measured by the DGS method.

A.7.1.1.2 For a single echo defect larger than the diameter of the sound beam of the probe, use the half-wave height method to measure the boundary size of the defect. Make geometry corrections according to the location of the defect.

A.7.1.2 Measurement of cluster echo defects

A.7.1.2.1 Measure the maximum equivalent diameter of the cluster echo according to A.7.1.1.1.

A.7.1.2.2 Use half-wave height method to measure the boundary indication size of cluster echo defects. Circumferential dimension shall be geometrically corrected according to the defect position.

A.7.1.3 Measurement of continuous echo defects

A.7.1.3.1 Measure the maximum equivalent diameter of a continuous echo according to A.7.1.1.1.

A.7.1.3.2 Use half-wave height method to measure the indicated axial length of the continuous echo defect.

A.7.1.4 Measurement of traveling echo defects

A.7.1.4.1 Measure the maximum equivalent diameter of a traveling echo according to A.7.1.1.1.

A.7.1.4.2 Use half-wave height method to measure the indicated axial length of the wandering echo defect.

A.7.1.4.3 Determine the depth range of a traveling echo defect in a roll according to the

traveling position of the traveling echo on the scanning line of the oscilloscope.

A.7.1.5 Measurement of central grass defects

Determine the extent of the central grass echo defect in the roll axis area (expressed as a percentage of the roll diameter) according to the position of the grass echo on the scan line of the oscilloscope.

A.7.2 Records of defects

A.7.2.1 The measurement results of defects shall be recorded in detail, including the equivalent diameter of the defect (for continuous echo defects, record the maximum equivalent diameter), boundary size, indicated length and depth, coordinate position in the roll, and the nature of the defect. Except for area I, the single defect smaller than the equivalent diameter of $\Phi 2\text{mm}$ in other areas may not be recorded.

A.7.2.2 The record can be described in words. Or it can be carried out with reference to the provisions of Annex B.

A.8 Evaluation of flaw detection results

A.8.1 Impermissible defects in rolls

A.8.1.1 Cracks, white spots, shrinkage cavities and wandering echo defects are not allowed.

A.8.1.2 The center of the solid roll is not allowed to have a central grass echo defect area larger than 12% of the outer diameter.

A.8.2 Grading of flaw detection results

When the rolls meet the requirements of 8.1, the flaw detection results are divided into level A and level B according to the regulations on defects in each area, see Table A.2.

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