TB

RAILWAY STANDARD OF THE

PEOPLE'S REPUBLIC OF CHINA

ICS 45.120

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TB/T 1632.2-2014

Replacing TB/T 1632.2-2005

Welding of rails Part 2: Flash butt welding

钢轨焊接 第 2 部分：闪光焊接

Issued on: October 30, 2014 **Implemented on: May 01, 2015**

Issued by: National Railway Administration

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Welding of rails Part 2: Flash butt welding

1 Scope

This Part of TB/T 1632 specifies the requirements, inspection methods, inspection rules for rail fixed and mobile flash butt welding.

This section applies to flash butt welding of 50 kg/m ~ 75 kg/m new rails.

2 Normative references

The following documents are essential to the application of 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 standard.

GB/T 230.1-2009 Metallic materials - Rockwell hardness test - Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)

GB/T 231.1-2009 Metallic materials - Brinell hardness test - Part 1: Test method

GB/T 4340.1-2009 Metallic materials - Vickers hardness test - Part 1: Test method

GB/T 6394 Metal - Methods for estimating the average grain size

GB/T 8170 Rules of rounding off for numerical values & expression and judgement of limiting values

GB/T 13298 Inspection methods of microstructure for metals

TB/T 1632.1-2014 Welding of rails - Part 1: General specification

TB/T 2622.2 Movable gas pressure welding equipment of steel rail - Technical specification for heater

TB/T 2622.3 Movable gas pressure welding equipment of steel rail - Technical specification for gas control box

3 Requirements

3.1 Requirements for welding rails

Rails used for flash butt welding shall comply with the provisions in Chapter 4 of TB/T 1632.1-2014.

3.2 Equipment requirements

3.2.1 Basic configuration

It shall be equipped with equipment or device, for track gauge and end slope treatment, rail end de-rusting, rail flash butt welding, welding rod shaping, joint heat treatment, joint straightening, joint shape finishing, flatness inspection, ultrasonic flaw detection, etc.

3.2.2 Basic requirements

Rail flash butt welding equipment shall be able to automatically record and store the process of pressure, current and displacement changing with time during the welding process. The joint heat treatment equipment shall be able to automatically record and store the process of joint temperature changing with time during heating and cooling.

3.3 Personnel requirements

Welding personnel shall hold a post training certificate, which is issued by a technical institution, as recognized by the competent railway authority.

3.4 Process requirements

3.4.1 Basic process

The basic process of rail flash butt welding includes:

- Selection of rails;
- Inspection and treatment of rails before welding;
- Rust removal before welding;
- Welding and pushing;
- Welding rod shaping (coarse grinding);
- Post-weld heat treatment;
- Aging (suitable for stationary flash butt welding);
- Straightening of welded joints;
- Shape finishing and straightness inspection;
- Flaw detection.

3.4.2 Inspection and treatment of rails before welding

3.4.2.1 Check the main geometric dimensions of the rail: Rail height (H), rail head width (WH), rail bottom width (WF), section asymmetry (A), rail crown fullness (C), end slope (vertical, horizontal direction), end twist, end and rail straightness.

3.4.2.2 The surface quality of the rails shall be inspected. The mirror inspection of the bottom surface of the rails shall be carried out, for fixed flash butt welding.

3.4.2.3 The straightening method can be used, to correct the bending of the end of the rail. For the bending of the end of the rail that cannot be straightened, the end of the curved rail shall be sawed off. The end slope of the rail after sawing shall meet the requirements of the corresponding rail standard.

3.4.3 Rust removal before welding

3.4.3.1 The end faces of the rails to be welded AND the contact parts between the rails and the electrodes of the flash butt welding machine shall be de-rusted.

3.4.3.2 If the rust-removed surface of the rail is to be welded for more than 24 hours OR if it is polluted by water, oil or dirt after grinding, it shall be de-rusted again.

3.4.3.3 If the rail waist is in contact with the electrode, the protruding rolling mark on the contact part shall be ground to be level with the parent metal.

3.4.4 Welding and pushing

3.4.4.1 The rail temperature before welding should not be lower than 10 °C.

3.4.4.2 The pushing and embossing process shall be completed automatically. The pushing and embossing process shall not damage the welded joint and the rail base metal. The surface after pushing and embossing shall have no visible cracks or welding slag intrusion. The maximum allowable pushing and embossing margin of each part of joint (the height of the welding rod after pushing the embossing) is 2 mm for the rail head, 2.5 mm for the bottom of the rail head, 2 mm for the rail waist, 1.5 mm for the rail bottom.

3.4.4.3 After the welding head is pushed and embossed and before grinding, use a detection ruler (L_0 = 1 m) to check the joint misalignment; measure and calculate the joint misalignment at 15 mm ~ 25 mm on both sides of the weld center line, as shown in Figure 1 and Figure 2. The amount of misalignment of joints shall not exceed the value specified in Table 1. For welded joints whose misalignment exceeds the maximum allowable value, the joints shall be cut off and re-welded. The sawing position shall not be less than 50 mm from the center line of the weld. Before re-welding, the end of the rail shall be at room temperature.

3.4.4.6 The welded joints (finished products) of each rail shall be marked. The mark shall be located on the same side of the welded long rail waist, at 1 m ~ 6 m away from the weld. The marking shall be clear and upright, which shall be identifiable within at least 5 years (or 1 overhaul period). The marking method shall ensure that each rail welded joint (finished product) can trace the records and relevant information of the production process.

3.4.5 Welding rod shaping (rough grinding)

3.4.5.1 Milling or grinding can be used to shape the welding rod. The base metal of the rail shall not be damaged, when the welding rods are shaped.

3.4.5.2 After welding rod shaping (coarse grinding), the surface roughness of welded joints shall meet the requirements of flaw detection and scanning.

3.4.5.3 The rails shall be ground longitudinally, not transversely; there shall be no grinding burns on the rail surface.

3.4.5.4 The vertical and horizontal misalignment of the non-working face of the welded joint shall transition smoothly.

3.4.5.5 When the line design speed v > 160 km/h, the height of the welding rods on the lower surface of the rail bottom of the rail flash butt welding joints shall not be greater than 0.5 mm (except for joints welded by tension locking); the edges and corners of the welding rods at the bottom of the rails shall transition smoothly.

3.4.6 Post-weld heat treatment

3.4.6.1 Post-weld heat treatment includes normalizing and post-weld under-speed quenching, to restore the hardness of the rail head.

3.4.6.2 The welding joints of fixed flash butt welding shall be heated by medium frequency electric induction. The welding joints of mobile flash butt welding should be heated by medium frequency electric induction, OR by flame swing of gas pressure welding heater. The equipment shall meet the requirements of TB/T 2622.2 and TB/T 2622.3.

3.4.6.3 When medium-frequency electric induction heating is used, the initial heating temperature shall be lower than 500 °C (rail head surface); the heating temperature of the rail head should be 900 °C ± 20 °C; the heating temperature of the rail foot should be 800 °C ~ 850 °C (the temperature measurement position of the rail foot is within the range of 10 mm inward from the edge of the rail foot). When the flame swing method of gas pressure welding heater is used for heating, the starting temperature of the heating shall be lower than 500 °C (the surface of the rail head); the heating width is 50 mm ± 10 mm; the heating temperature should be 850 °C ~ 950 °C. Under-speed quenching of the rail head shall be cooled by spraying compressed air.

3.4.6.4 After heat treatment, the rail-fixed flash welded joints shall be aged for no less than 24 h, before being straightened and shape finished.

3.4.7 Straightening of welded joints

The straightening method shall be used to correct the deviation of the straightness of the welded joint. It should carry out the straightening work, when the welded joint is at room temperature.

3.4.8 Shape finishing and straightness inspection

3.4.8.1 The shape of the top surface of the rail of the welded joint and the side working edge of the rail head shall be finished, by using a fine grinder or profiling grinder. After finishing the shape, the shape of the rail head shall be consistent with that of the base metal.

3.4.8.2 The length of profile finishing is not to exceed the range of 400 mm, on both sides of the center line of the weld. Contour finishing shall not cause any mechanical or thermal damage to welded joints or rails. Excessive flatness deviations and excessive joint misalignment shall not be corrected by contour finishing methods.

3.4.8.3 After the welded joint has been straightened and finished, it shall be checked for straightness and surface quality, in accordance with the provisions of TB/T 1632.1-2014.

3.4.9 Flaw detection

It shall be implemented, in accordance with Chapter 5 of TB/T 1632.1-2014.

3.5 Quality requirements

See Table 2 for the quality requirements of rail flash butt welding joints.

4.2 Flaw detection inspection

The flaw detection method shall be carried out, according to the provisions in Chapter 8 of TB/T 1632.1-2014.

4.3 Drop hammer test

Specimen requirements and test methods shall be carried out, in accordance with the provisions in Chapter 9 of TB/T 1632.1-2014.

4.4 Static bending test

Specimen requirements and test methods shall be in accordance with Chapter 10 of TB/T 1632.1-2014.

4.5 Fatigue test

Specimen requirements and test methods shall be in accordance with Chapter 11 of TB/T 1632.1-2014.

4.6 Tensile test

Specimen requirements and test methods shall be carried out, in accordance with the provisions in Chapter 12 of TB/T 1632.1-2014.

4.7 Impact test

Specimen requirements and test methods shall be carried out, in accordance with the provisions in Chapter 13 of TB/T 1632.1-2014.

4.8 Hardness test

4.8.1 Brinell hardness of rail top surface

The sampling position and measuring point distribution of the hardness specimen on the rail top surface are as shown in Figure 3. The weld seam is located at the center of the specimen length. After removing 1 mm from the top surface of the welded joint rail, test the Brinell hardness. The Brinell hardness's test method is carried out, in accordance with the provisions of GB/T 231.1-2009; the test condition is HBW10/3000.

4.8.2 Longitudinal section hardness

The sampling position of the specimen for longitudinal section hardness is as shown in Figure 4; the weld seam is located in the center of the specimen length. Test the hardness value of the rail head (test line 1) on the longitudinal section. The measuring points are arranged symmetrically to the left and right sides, with the weld as the center; the distance between the measuring points is 5 mm. The longitudinal section of the welded joint is tested for Rockwell hardness or Vickers hardness. The Rockwell hardness test

the broken welded joint with the naked eye or with the help of a magnifying glass. According to the requirements of Appendix A, check and record the test and the defect details of each fracture.

For joints broken by static bending and fatigue tests, it shall also check and record the details of test and each fracture defect, in accordance with the requirements of Appendix A.

5 Inspection rules

5.1 Finished product inspection

5.1.1 A finished product inspection shall be carried out for each welded joint (finished product).

5.1.2 The items of finished product inspection include appearance and flaw detection.

5.2 Type inspection

5.2.1 Type inspection shall be carried out, when one of the following situations occurs:

a) The rail welding organization welds the railway rail for the first time;

b) Change of welding process after normal production;

c) When replacing the rail welding machine, or before resuming production after the welding machine has been out of service for one year;

d) It has been 5 years since the type inspection report was obtained;

e) The production inspection result is unqualified;

f) When welding for the first time, after one of the rail steel type, rail production plant, rail delivery status, rail type is changed.

If two rails of the same steel type but different manufacturers, OR two rails of the same steel type but in different delivery states have passed the welding type inspection, respectively, the welding between the two rails:

- Welding production is allowed, if all production inspection items are qualified;

- In case of failure of the production inspection, a type inspection of the weld between the two rails shall be carried out.

5.2.2 See Table 3 for the items of type inspection and the number of tested welded joint samples.

production. The additional welded test pieces for production inspection shall adopt the process welding test piece inspected which has the same welding production. The production inspection results shall comply with the relevant provisions in Chapter 3; production may continue only after passing the inspection.

5.3.4 The production inspection (appearance, flaw detection, drop hammer, fracture, hardness, macrostructure inspection items), which is carried out in the year, shall include all kinds of steel rails welded in this year; the frequency of production inspection shall be increased if necessary.

5.3.5 The production inspection report shall include the following contents: Welding rail organization name, welding machine model and serial number, heat treatment equipment model and exit-factory number, rail manufacturer, rail type, rail steel designation, rail delivery status, inspection equipment, reasons for production inspection, detailed inspection results, etc.

5.3.6 When one or more test pieces are unqualified in the production inspection, re-inspection shall be carried out.

The first re-inspection: Re-inspect the unqualified test pieces with double sampling. If the test is qualified, the production inspection result is qualified; if one or more of the test pieces is unqualified, it shall be re-inspected.

The second re-inspection: Re-inspect the unqualified test pieces with double sampling. If the test is qualified, the production inspection result is qualified; if one or more of the test pieces is unqualified, the production inspection result shall be judged as unqualified.

5.4 Numerical rounding off

When it is necessary to evaluate whether the test result meets the specified value, it can be compared, according to the principle in the specified test method or the rounding off value specified in GB/T 8170.

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