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Foreword

This standard was drafted in accordance with the rules given in the GB/T 1.1-2009.

This standard was proposed by Research Institute of Standards and Norms, Ministry of Housing and Urban-Rural Development of the People's Republic of China.

This standard is under the jurisdiction of Professional Technical Committee of Urban Rail Transit, Ministry of Housing and Urban-Rural Development of the People's Republic of China.

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Technical specification for low and medium speed maglev train transport rail row

1 Scope

This standard specifies the service conditions, requirements, test methods, inspection rules, safety and environmental protection, marking, packaging, transportation, storage, warranty period for medium and low speed maglev transit track panels.

This standard is applicable to the manufacture and acceptance of medium and low speed maglev transit track panels for maglev vehicles with running speed not more than 120km/h.

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 191 *Packaging—Pictorial Marking for Handling of Goods*
- GB/T 699 *Quality Carbon Structure Steels*
- GB/T 700 *Carbon Structural Steels*
- GB/T 1184 *Geometrical Tolerancing—Geometrical Tolerance for Features Without Individual Tolerance Indications*
- GB/T 1591 *High Strength Low Alloy Structural Steels*
- GB/T 1764 *Method of Test for Measurement of Dry Film Thickness of Paints*
- GB/T 1804 *General Tolerances—Tolerances for Linear and Angular Dimensions without Individual Tolerance Indications*
- GB/T 3190 *Chemical Composition of Wrought Aluminium and Aluminium Alloys*
- GB/T 3880 *Wrought Aluminium and Aluminium Alloy Plates, Sheets and Strips for General Engineering*
- GB/T 5117 *Carbon Steel Covered Electrodes*
- GB/T 5118 *Low Alloy Steel Covered Electrodes*
- GB/T 5237 *Aluminium Alloy Extruded Profiles for Architecture*
- GB/T 6892 *Wrought Aluminium and Aluminium Alloys Extruded Profiles for General Engineering*
- GB/T 8923 *Rust Grades and Preparation Grades of Steel Surfaces Before Application of Paints and Related Products*
- GB/T 11263 *Hot Rolled H and Cut T Section Steel*
- GB/T 13306 *Plates*
- GB/T 18684 *Specifications of Zinc/Chromate Coatings*
- JGJ 82 *Technical Specification for High Strength Bolt Connections of Steel Structures*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

F-shaped steel

The special steel for medium and low speed maglev track with the section of shape F which consists of inner magnetic pole, outer magnetic pole, induction section and fastening section.

3.2

induction plate

The secondary part of linear induction motor used for train traction, which adopts non-magnetic conductive material and is installed on F-shaped steel.

3.3

F-shaped rail

A kind of fundamental component bearing the suspension force, guiding force and tractive force of maglev vehicle, which consists of F-shaped steel and induction plate.

The parts of F-shaped steel on the opposite of both magnetic pole plates of maglev electromagnet are respectively named as inner magnetic pole and outer magnetic pole of F-shaped rail. The two end faces of inner magnetic pole and outer magnetic pole are named as magnetic pole face. The lower surface of F-shaped steel induction section is named as levitation detection surface.

3.4

sleeper

Fundamental components used for connecting F-shaped rails and keeping relative position of F-shaped rails and beam body fixed and transferring load.

3.5

track panel

Basic function unit of medium and low speed maglev line which has the function of supporting maglev vehicles, bearing vehicles' levitation force, guiding force and tractive force.

Track panel consists of F-shaped rails, sleepers, fasteners, etc. which may includes:

- a) Straight track panel, of which the centre line is straight;
- b) Circular curve track panel, of which the centre line is a circular curve;
- c) Transition curve track panel, of which the centre line is a transition curve.

Note 1: Track panel length refers to its centre line length.

Note 2: Centre line of track panel refers to the symmetry centre line of the two F-shaped rails.

3.6

sleeper spacing

The distance between two adjacent sleepers.

3.7

joints

Connecting device between adjacent track panels.

4 Service conditions

4.1 Environmental conditions

4.1.1 Altitude: $\leq 1\ 400\text{m}$.

4.1.2 Ambient temperature: -25°C to $+45\text{°C}$.

4.1.3 Relative humidity: $\leq 90\%$ (the monthly average minimum temperature of this month is 25°C).

4.1.4 Track panel shall be able to withstand the erosion of wind, sand, rain and snow and the corrosion of cleaning agent.

4.1.5 Due to different climatic conditions of different region of each city, the user and the manufacturer may stipulate application environmental conditions separately in the contract.

4.2 Line conditions

4.2.1 Track gauge: 2 000mm.

4.2.2 Sleeper spacing the value of 1 200mm is preferred, 800mm, 400mm may be adopted under special circumstances.

4.2.3 Length of track panel: length of centre line measured in horizontal plane is viewed as the length of track panel. An integral multiple of 1 200mm is preferred as the length value, such as 12 000mm, 6 000mm, 3 600mm, etc. It should be an integral multiple of 400mm under special circumstances.

4.2.4 The minimum radius of curve: main line: 100m, auxiliary lines: 75m.

4.2.5 The minimum radius of vertical curve: 1 000m.

4.2.6 The maximum longitudinal gradient: 70‰.

5 Requirements

5.1 General requirements

5.1.1 The track panel shall be manufactured and accepted in accordance with the design drawings and technical specifications approved via the specified procedures. For the unmarked geometrical tolerance in drawing and this document, the tolerance of linear and angular dimensions shall meet the requirements of Grade C given in GB/T 1804, shape-position tolerance without tolerance grade indication shall meet the requirements of Grade K given in GB/T 1184.

5.1.2 New type of track panel for different line shall follow the rules of new product for in-plant pilot production and acceptance.

5.1.3 Saturation magnetic flux density of F-shaped steel shall not be less than 1.4T.

5.1.4 Section of F-shaped steel shall comply with the requirements of magnetic flux and structural strength.

5.1.5 The materials of track panel, weldment, etc., shall meet the requirements of GB/T 699, GB/T 700 and GB/T 1591.

5.1.6 Welding material of track panel shall meet the requirements of GB/T 5117, GB/T 5118, etc.

5.2 F-shaped steel

5.2.1 Service life of F-shaped steel shall not be less than 30 years.

5.2.2 F-shaped steel should be weathering steel or carbon structural steel. The dimensions, cross-sectional area, mass and limit deviation of F-shaped steel shall be in accordance with those specified in Table 1. The sectional shape and dimension symbols are shown in Figure 1.

5.2.3 Requirements, test methods, inspection rules, packaging, marking, quality certificate, etc., shall meet the requirements of GB/T 11263 and current relevant standard of the nation.

Table 1 Parameters of F-shaped steel

Reference dimension (mm)		Limit deviation (mm)	Cross-sectional area (mm ²)	Theoretical weight (kg/m)
h	94.5	± 0.3	15 562	122.2
h_1	60	± 0.3		
h_2	50	± 0.3		
d_1	28	+1.5 0		
d_2	34.5	-		
d_3	28.5	+0.5 0		
b	372	-		
b_1	220	± 0.3		
b_2	220	± 0.5		

5.3 Induction plate

5.3.1 Induction plate should be made of aluminum alloy sheet which should meet the requirements of GB/T 3880. Copper alloy sheet may be adopted under special circumstances.

5.3.2 Mechanical property of induction plate is shown in Table 2.

5.3.3 The section view of induction plate is shown in Figure 2. Dimensions shall be in accordance with those specified in Table 3 and dimensions without tolerance grade indication shall meet the requirements of ordinary grade of GB/T 6892.

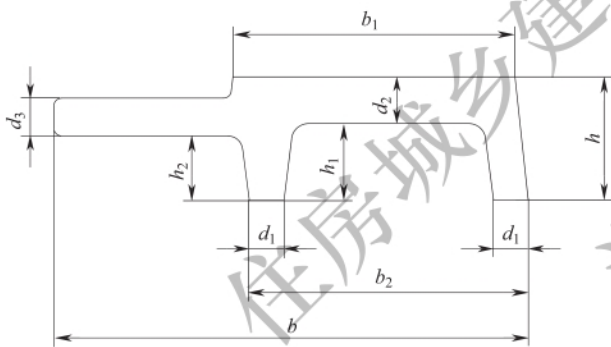


Figure 1 F-shaped steel

Table 2 Mechanical property of induction plate

Tensile strength (MPa)	Yield strength (MPa)	Elongation (%)
≥ 110	≥ 80	≥ 8

5.3.4 Conductivity should be larger than or equal to 0.57 S/m.

5.3.5 Density shall be $2.69 \times 10^3 \text{kg/m}^3$ at 20°C .

5.3.6 Thermal expansion coefficient is $23.5 \times 10^{-6} \text{K}^{-1}$ at 20°C to 100°C .

5.3.7 Surface of aluminum induction plate shall be treated by using anodic oxidation process. Oxide layer surface treatment shall comply with Grade AA15 of GB/T 5237, the thickness of oxide film shall be greater than or equal to 15 μm .

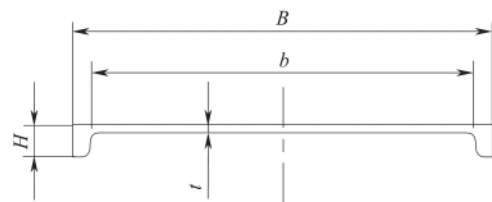


Figure 2 Induction plate

Table 3 Dimensions of induction plate

Unit:mm

Items	Reference dimension	Limit deviation
B	242	-
b	220	+1.5 -0.5
H	17	± 0.5
t	4	± 0.2

5.4 F-shaped rail

Dimension limit deviation and requirements of F-shaped rail shall be in accordance with those specified in Table 4.

Table 4 Dimension limit deviation of F-shaped rail

Unit:mm

No.	Inspection items	F-shaped straight rail	
		$\leq 6\ 000$	6\ 001-12\ 000
1	Length limit deviation	± 2	
2	Straightness limit deviation	$\pm 1/1\ 000$	$\pm 1/1\ 000$
3	Flatness	$\leq 0.5/\text{total length}$	$\leq 0.5/\text{total length}$
4	Installation height limit deviation of induction plate of the same rail	± 1	± 1.5

5.5 Sleeper

5.5.1 Service life of steel sleeper shall not be less than 30 years.

5.5.2 Sleeper should adopt hot rolling H-shaped steel of weathering steel or carbon structural steel. Its dimension, appearance, weight and limit deviation should be in accordance with those specified in Figure 3 and Table 5.

5.5.3 Hot rolling H-shaped steel shall meet the requirements of GB/T 11263.

5.5.4 H-shaped sleeper dimension limit deviation and requirements shall be in accordance with those specified in Table 6.

5.6 Track panel

5.6.1 The dimension limit deviation of F-shaped rail and H-shaped sleeper mounting hole shall be in accordance with those specified in Table 7. The hole wall surface roughness shall not be inferior to MRR Ra 12.5.

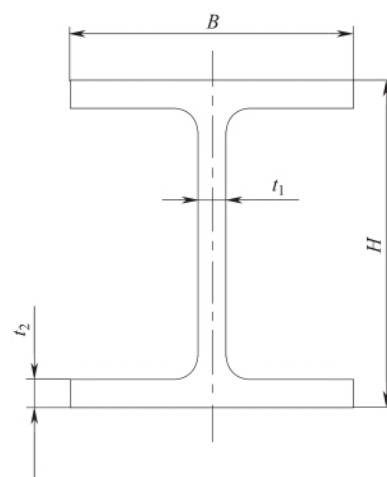
**Figure 3 H-shaped steel**

Table 5 Parameters of H-shaped steel

Code	Dimension (mm)				Cross-sectional area (mm ²)	Theoretical mass (kg/m)
	<i>H</i>	<i>B</i>	<i>t</i> ₁	<i>t</i> ₂		
Reference dimension	230	200	20	20	11 993	94.15
Limit deviation	± 2.0	± 3.0	± 1.0	± 1.5		

Table 6 H-shaped steel sleeper dimensional requirements

Unit:mm

No.	Inspection items	Requirements
1	Length of H-shaped sleeper	± 1
2	Straightness of H-shaped sleeper	1/1 000
3	Flatness of upper and lower surface of H-shaped sleeper	≤ 0.5

Table 7 Bolt hole limit deviation

Unit:mm

No.	Installation diameter (slotted hole)	Limit deviation of installation diameter
1	10-18	+0.18 0
2	18-30	+0.21 0
3	30-50	+0.45 0

5.6.2 The hole distance of F-shaped rail, H-shaped sleeper bolt holes shall be in accordance with those specified in Table 8.

Table 8 Bolt hole distance limit deviation

Unit:mm

Items	Range of hole distance			
	≤ 300	301-1 200	1 201-6 000	≥ 6 000
Bolt hole distance	≤ 300	301-1 200	1 201-6 000	≥ 6 000
Distance between any two holes of the same group	± 0.5	± 1.5	-	-
Distance between end holes of two adjacent groups	± 1	± 1.5	± 2	± 2.5

Note 1: Bolt hole distance refers to the distance of bolt holes of F-shaped steel rail, sleeper of the same track panel.
Note 2: At the joint of F-shaped rail and H-shaped sleeper, four bolt holes are in one group.
Note 3: At each end of F-shaped rail for track panel connection, two bolt holes are in one group.

5.6.3 Track panel assembling

Track panel assembling requirements and its dimension limit deviation shall be in accordance with those specified in Table 9.

Table 9 Dimension limit deviation of track panel

No.	Inspection items	Unit:mm	
		Length of track panel	
		≤ 6 000	6 001-12 000
1	Track gauge	± 1	
2	Length	± 2	
3	Coplanarity of four magnetic pole faces of the same cross section	≤ 1	
4	Flatness of track panel magnetic pole face	≤ 1/3 000, ≤ 2/total length	
5	Vertical dislocation of F-shaped rail of adjacent two track panels	± 1	
6	Horizontal dislocation of F-shaped rail of adjacent two track panels	± 1	
7	Distance between two adjacent sleepers	± 2	
8	Space between induction plate and F-shaped steel	≤ 1	

5.7 Track panel joints

5.7.1 Joints may be classified into type I, type II and type III according to joint expansion:

- a) Type I joint is used for the joint expansion within 10mm;
- b) Type II joint is used for the joint expansion of 10mm to 20mm;
- c) Type III joint is used for the joint expansion of 20mm to 40mm.

5.7.2 F-shaped steel of track panel joints shall meet the requirements of Article 5.2.

5.7.3 Induction plate of track panel joints shall meet the requirements of Article 5.3.

5.8 Track panel fasteners

High strength standard bolt pair for the track panel connection shall meet the requirements of JGJ 82.

5.9 Anti-corrosion painting

5.9.1 Steel materials, joints, fasteners shall be de-rusted to Sa 2 $\frac{1}{2}$ before being painted as specified in GB/T 8923.

5.9.2 Unless otherwise specified by the designer, the total dry film thickness of the steel and joint coating shall be 150 μm, of which the allowable deviation is -25 μm, the deviation of dry film thickness of each coating is -5 μm. The total dry film thickness of fastener coating shall be 20 μm, of which the allowable deviation is -5 μm. The deviation of dry film thickness of each coating is -2 μm.

5.9.3 The technical specifications of the coating shall meet the requirements of GB/T 18684. The measurement of paint film thickness shall meet the requirements of GB 1764.

5.10 Downward deflection of track panel under static load test shall be less than or equal to 0.6mm.

6 Test methods

6.1 Static load test of track panel

Test load is applied to the position of rail equidistant from two adjacent sleepers, test load is 1.25 times of the

rated load (1.75t is taken as rated load), there shall be no impact when loading.

- a) Inspect whether there is obvious deformation and crack on rail and two adjacent sleepers visually;
- b) Measure downward deflection value of two magnetic pole faces of rail under load.

6.2 Dimension measurement

Put three adjacent track panels of the same group on inspection bench and connect them with fasteners for measuring various dimensions, requirements are shown in Table 9.

6.2.1 Measurement of installation dimension of F-shaped steel of track panel

Measure the height, the distance to the center, the gauge of two F-shaped rails of track panel, requirements are shown in Table 9.

6.2.2 Measurement of pole face of track panel

Measure the coplanarity of four magnetic pole faces of the same cross section, the flatness of track panel magnetic pole face, requirements are shown in Table 9.

6.2.3 Space measurement

Measure the space between induction plate and F-shaped steel, requirements are shown in Table 9.

6.2.4 Moment measurement

Check the moment of fastener, which shall conform to the design requirements or technical specifications.

7 Inspection rules

7.1 Delivery inspection

Each group of track panel shall undergo the delivery inspection and the content of delivery inspection includes all the items of Article 5.4 to Article 5.9 and the requirements of design drawing.

7.2 Type inspection

Type inspection includes all the items of Chapter 5.

7.3 Acceptance

Measurement and acceptance shall be carried out in accordance with product drawing and this document, certificate of conformity shall be issued to users.

8 Safety and environmental protection

8.1 Safety

8.1.1 Hoisting, transport and storage shall be carried out strictly in accordance with the corresponding requirements.

8.1.2 After installation and adjustment of track panel, reinspection shall be carried out to confirm that fasteners are firmly and reliably connected.

8.1.3 Joints of track panel shall work normally and reliably after installation.

8.1.4 It is prohibited to erect and operate vehicles and equipment that are not special for maglev track panel.

8.1.5 During installation, commissioning and maintenance of track panel, strict safety precautions shall be adopted.

8.2 Environmental protection

8.2.1 Specific preventive measures shall be proposed and implemented for possible environmental destruction and adverse impacts due to construction activities.

8.2.2 Temporary storage site, pioneer road, etc., shall be built in accordance with the requirements of environmental protection.

9 Marking, packaging, transportation and storage

9.1 Marking

9.1.1 Markings shall be sprayed obviously on hoisting point of track panel.

9.1.2 Product plates shall be pasted on track panel, plates shall be produced in accordance with GB/T 13306.

9.1.3 Plate content shall include at least:

- a) Designation, factory logo;
- b) Specification and type;
- c) Mileage in the line of track panel;
- d) Length of track panel;
- e) Production date or serial number;
- f) Manufacturer name.

9.2 Packaging

Track panel is delivered without being packed, induction plates shall be protected carefully.

9.3 Transportation

9.3.1 Hoisting

Magnetic chuck or nylon lifting belts shall be adopted for hoisting track panel, force shall not be applied to F-shaped steel rail during hoisting, track panel scratch or distortion shall be avoided. Hoisting position shall be used, when there are several hoisting positions, force shall be uniformly distributed. During hoisting, keep track panel horizontal. When the lifting appliance is not special lifting slings for multi-layer lifting, only single layer can be lifted.

9.3.2 Transportation of track panel

During transport of track panel, force shall not be applied to F-shaped steel rail, fixing shall be firm. The stacks of track panel shall not exceed 6 stacks.

9.4 Storage

After passing inspection, track panel assembling shall be put in dry and ventilated workshop before installation. Cushion block shall be put between sleepers of two track panels during storage and F-shaped steel rail shall not bear force. Track panels shall not exceed 8 stacks for storage.

9.5 Accompanying documentation

Accompanying documentation include:

- a) Certificate of conformity;
- b) Packing list.

10 Warranty period

The warranty period is 12 months starting from the day of putting into service after transport rail installation provided that the product is stored, installed and used correctly, and shall not exceed 18 months starting from the day of delivery.

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