

JIS

JAPANESE INDUSTRIAL STANDARD

Rails

Ⓔ JIS E 1101—1993

Translated and Published

by

Japanese Standards Association

**In the event of any doubt arising,
the original Standard in Japanese is to be final authority.**



JAPANESE INDUSTRIAL STANDARD

J I S

Rails

E 1101-1993

1. Scope This Japanese Industrial Standard specifies rails used for permanent ways.

Remarks 1. The standards cited in this Standard and the International standard corresponding to this Standard are shown in the Attached Table 1.

2. The units and numerical values given in { } in this Standard are based on the traditional units and are currently the values in force.

The traditional units and values are scheduled to be converted to the units and values shown in Annex 3 on and after April 1, 1995.

2. Definitions For the purposes of this Standard, the following definitions apply. Other terms and the definitions are given in JIS G 0202 and JIS G 0203.

- (1) continuous casting Manufacture of a long and large steel casting billet by continuously solidifying molten steel while it is being casted.
- (2) sequential continuous casting Continuous casting in which two or more molten steels are casted successively without any gap.
- (3) strand A generic name for a complete set of a mold, a billet supporting roll, a cooling zone, a withdrawal roll, and a cutter in continuous casting.

3. Classification The rails shall be classified as given in Table 1.

Table 1. Classification of rails

Type of rail	Notation	Summary	
		Calculated mass kg/m	With fish-bolt holes or without them
30 kg rail	30 A	30.1	With fish-bolt holes
			None
37 kg rail	37 A	37.2	With fish-bolt holes
			None
40 kgN rail	40 N	40.9	With fish-bolt holes
			None
50 kg rail	50 PS	50.4	With fish-bolt holes
			None
50 kgN rail	50 N	50.4	With fish-bolt holes
			None
60 kg rail	60	60.8	With fish-bolt holes
			None

Remarks: "N rail" is a generic name for 40 kgN rail and 50 kgN rail.

4. Chemical composition and mechanical properties

4.1 Chemical composition The chemical composition of the rails shall be as specified in Table 2 when subjected to the tests given in 9.1.

Table 2. Chemical composition

Unit: %

Type of rail	Chemical composition				
	C	Si	Mn	P	S
30 kg rail	0.50 to 0.70	0.10 to 0.35	0.60 to 0.95	0.045 max.	0.050 max.
37 kg rail	0.55 to 0.70				
50 kg rail	0.60 to 0.75				
40 kgN rail	0.63 to 0.75	0.15 to 0.30	0.70 to 1.10	0.030 max.	0.025 max.
50 kgN rail					
60 kg rail					

4.2 Mechanical properties The mechanical properties of the rails shall be as specified in Table 3 when subjected to the tests given in 9.2 and 9.3.

Table 3. Mechanical properties

Type of rail	Tensile strength N/mm ² (kgf/mm ²)	Elongation %	Brinell hardness
30 kg rail	690 (70) min.	9 min.	—
37 kg rail			
50 kg rail	740 (75) min.	8 min.	
40 kgN rail	800 (82) min.	10 min.	HB 235 min.
50 kgN rail			
60 kg rail			

Remarks: Value 1 N/mm² is equal to 1 MPa.

5. Shape, dimensions, dimensional deviation and geometrical tolerance The shape, dimensions, dimensional deviation and geometrical tolerance of the rails shall be as follows:

- (1) The shape and dimensions shall be as specified in Attached Fig. 1 to Attached Fig. 6.
- (2) The standard length of the rails shall be as specified in Table 4.

Table 4. Standard length

Unit: m	
Type of rail	Standard length
30 kg rail	10
37 kg rail	25
50 kg rail	
40 kgN rail	
50 kgN rail	25, 50
60 kg rail	

- (3) The dimensional deviation and geometrical tolerances referred to at 20°C of the rails shall be as specified in Table 5.

Table 5. Dimensional deviation and geometrical tolerance of rails

		Unit: mm			
Items		Type of rail			
		30 kg rail	37 kg rail 50 kg rail	40 kgN rail 50 kgN rail	60 kg rail
Length	Rail of 12.5 m or under	± 7.0		—	—
	Rail of over 12.5 m to and excl. 25 m	—	± 10.0	—	—
	Rail of 25 m	—	± 10.0	+ 10.0 - 5.0	+ 10.0 - 3.0
	Rail of 50 m	—		+ 25.0 0.0	+ 25.0 0.0
Height		+ 1.0 - 0.5			
Width of head		+ 1.0 - 0.5			+ 0.8 - 0.5
Width of web		+ 1.0 - 0.5			
Overall width and side width of base		± 1.0			± 0.8
Deviation of verticality at rail head to base		1.0			0.5
Out of square by cutting at end		1.0			0.5
Diameter of fish-bolt hole		± 0.5			

Table 5. (continued)

Unit: mm

Items		Type of rail			
		30 kg rail	37 kg rail 50 kg rail	40 kgN rail 50 kgN rail	60 kg rail
Location of fish-bolt hole		± 0.8		± 0.5	
Clearance between rail and standard fish-plate when the latter is fixed to the former	Outside ⁽¹⁾	2.0		1.5	
	Inside ⁽¹⁾	1.0		0.5	
Deviation of straightness (per 10 m)	Upward ⁽²⁾ lateral	15.0	10.0		
	Down-ward ⁽²⁾	—	10.0		
Deviation of straightness measured at end part (per 1.5 m)	Lateral	1.0			0.5
	Upward ⁽²⁾	1.2		1.0	0.7
	Down-ward ⁽²⁾	0.8		0.3	0.0
Twist of rail		—		2.0	1.0
Discrepancy of curvature R 19 at upper fillet from shape plate		—			0.3
Flatness of base bottom of rail		—			0.4

Notes (1) The outside herein means positioning outside the normal place and the inside means positioning inside the normal place.

(2) The upward herein means a state in which the rail head is bent in a depressed form and the downward means a state in which the rail head is bent in a projected form.

6. Appearance The rails shall have the appearance specified below:

- (1) The rails shall be of uniform shape throughout the whole length, and shall be free from any harmful twist.
- (2) The rails shall have no harmful defects such as cracks and flaws on the surfaces.
- (3) Permissible levels of surface defects shall be as given in Table 6. However, depth of surface defects and height of fin of 30 kg rail shall be under 0.6 mm.

Table 6. Permissible levels of surface defects

Type	Position	Permissible level
Seam	Head and base	$D < 0.4 \text{ mm}$
	Others	$D < 0.6 \text{ mm}$
Spills and rolled-in material	Head	$D < 0.4 \text{ mm}$ However, when $0.4 \leq D < 0.6 \text{ mm}$, permissible if $S < 150 \text{ mm}^2$.
	Others	$D < 0.4 \text{ mm}$ However, when $0.4 \leq D < 0.6 \text{ mm}$, permissible if $S < 200 \text{ mm}^2$.
Overlap and scratch	Head and base	$D < 0.4 \text{ mm}$
	Others	$D < 0.6 \text{ mm}$
Roll mark	Head and base	$H < 0.4 \text{ mm}$
	Upper fillet and lower fillet	$H < 0.6 \text{ mm}$

Remarks: The symbol D in this table means depth, S means surface area, and H means height of fin.

- (4) When there are surface defects harmful to service on the surfaces of the rails, the defects may be removed by repairing with a grinder by the manufacturer. However, conditions in this case shall be as described below.
- (a) The dimensions after repairing the rails shall be within the ranges specified in Table 5.
- (b) The repaired part of rails shall be finished clearly and the boundary between the repaired part and the surface as rolled shall be smooth.

7. Internal defects The internal defects of rails shall be as described below:

- (1) The rails without fish-bolt holes shall be free from pipe flaws.
- (2) The rails with fish-bolt holes shall be free from harmful pipe flaws. However, when pipe flaws are dotted inside the web of a rail, their lengths are $\frac{2}{15}$ or under to the rail height for the sawing cut section, $\frac{4}{15}$ or under for the polished surface and the pipe flaws are not opened, such pipe flaws are not considered harmful.
- (3) When subjected to the test specified in 9.5, the rails shall be free from internal defects likely to cause abnormalities such as a break, a crack, a deficiency, etc.

Further, when subjected to the test specified in 9.6, the rails shall be free from internal defects such as segregation of harmful impurities or the like.

8. Methods of manufacture and process of work

8.1 Methods of manufacture The rails shall be manufactured as described below:

- (1) Steel ingot and continuously cast steel billet (hereafter referred to as "cast billet") for the manufacture of the rails shall be produced either by pure oxygen converter or by electric furnace.
- (2) For sequential continuous casting, melt of the same steel shall be charged.
- (3) Steel ingot shall be rolled after its completion of solidification, which is not allowed while the ingot is tumbled.
- (4) The area of initial cross section of steel ingot shall be 25 times or over the sectional area of the rail to be rolled.
- (5) The area of initial cross section of cast billet shall be 8 times or over the sectional area of the rail to be rolled. For 30 kg rails the area of initial cross section, however, may be 7 times or over.
- (6) Ends of the steel ingot and the cast billet shall be discarded by cutting to the length sufficient to ensure freedom from internal harmful defects.
- (7) The rails shall be subjected to adequate treatment such as degassing of molten steel, slow cooling of rails, etc. to prevent them from the appearance of shatter crack.

8.2 Process of work The process of work to be applied to the rails shall be as described below:

- (1) The camber of the rails after rolling and cooling shall be as little as possible.
Both ends of the rails shall not deviate downwards.
- (2) When the rails is subjected to straightening of the camber, such treatment shall not be applied that may affect adversely the material of the rails.
- (3) Both ends of the rails shall be cut at a right angle to the lengthwise direction, and the burrs remaining at the ends shall be removed.
- (4) Fish-bolt holes shall be drilled accurately. The rails with the holes shall be chamfered at the end face and at the periphery of the holes, as shown in Attached Fig. 1 to Attached Fig. 6.

9. Tests

9.1 Analysis of chemical composition Analysis of chemical composition of the rails shall be made as described below:

- (1) Samples for analysis of chemical composition shall be taken in accordance with JIS G 0303.
- (2) Analysis shall follow the appropriate standard method of the following:
JIS G 1211

JIS G 1212
JIS G 1213
JIS G 1214
JIS G 1215
JIS G 1252
JIS G 1253
JIS G 1256
JIS G 1257
JIS G 1258
JIS K 0116

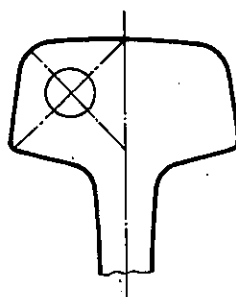
9.2 Tensile test Tensile test of the rails shall be made as described below:

(1) Taking test specimen for tensile test

- (a) For rails rolled from steel ingot Make up one lot of all steel ingots obtained from the same one heat, and select one rail rolled from an ingot which is selected at random out of the lot above-mentioned. Take one test specimen from the rear end of top-end crop of the rail sampled above.
- (b) For rails rolled from cast billet Make up one lot of all cast billets of all strands obtained from the same one heat. Select one strand randomly out of the lot, and then select one billet randomly out of the strand thus selected. Take one test specimen from any one portion of one rail taken randomly out of the rails rolled from the strand selected as above. The test specimen, however, shall not be sampled out of the portion which consists of mixture of two different heats, when the rails are obtained by the sequential continuous casting.

- (2) Tensile test piece shall be of No.4 type specified in JIS Z 2201, and it shall be machined from the portion shown in Fig. 1 below:

Fig. 1. Sampling position of tensile test piece



- (3) The test shall follow the method prescribed in JIS Z 2241.

9.3 Hardness test The hardness test of the rails shall be made as described below:

- (1) The test for hardness of a rail shall be carried out by making up one lot of the same molten steel at a position adjacent to a tensile test specimen.
- (2) The testing method shall be in accordance with JIS Z 2243.

9.4 Shape and dimensions test The shape and dimensions test shall be carried out by direct measurement, limit gauges, and other methods.

Further, the test for bend and twist of a rail shall be as described below:

- (1) For the test for bend in the vertical direction of a rail, bring down the rail side ways, stretch a string of 10 m at the center of the head when bent upward or at the top of the foot of the base when bent downward, and measure the maximum value of a clearance between the head or the top of the foot of the base of the rail and the string.
- (2) For the test in the lateral direction of a rail, make the head of the rail up, stretch a string of 10 m on the head side surface to a side wherein the rail is bent, and measure the maximum value of a clearance between the head side surface of the rail and the string.
- (3) The test for bend of the end part of a rail shall be carried out as follows in accordance with the measuring method specified in Annex 2.
 - (a) For the test for bend in the vertical direction at the end part of a rail, make the rail head up, apply a ruler of 1.5 m in length to the upper face of the rail end part, and measure the maximum value of a clearance between the upper face of the rail head and the ruler.
 - (b) For the test for bend in the lateral direction at the end part of a rail, make the rail head up, apply a ruler of 1.5 m in length to the head side face to a side wherein the rail end part is bent, and measure the maximum value of a clearance between the head side face of the rail and the ruler.
- (4) For the test for twist of a rail, make the rail head up, and measure the maximum value of a warped amount of the base rear face.

9.5 Drop hammer test Drop hammer test shall be made as described below:

- (1) **Taking test specimen for drop hammer test**
 - (a) **For rails rolled from steel ingot** Make up one lot of all steel ingots obtained from the same one heat, and select one rail randomly out of the rails rolled from any one ingot other than that from which the tensile test piece have been taken. Take one test specimen from the rear end of top-end crop of the rail thus sampled.
 - (b) **For rails rolled from cast billet** Make up one lot of all cast billets of all strands obtained from the same one heat. Select one strand, generally other than that from which the tensile test piece has been taken, randomly out of the lot, and then select one billet randomly out of the strand thus selected. Take one test specimen from any one portion of one rail taken randomly out of the rails rolled from the strand selected as above. The test specimen, however, shall not be sampled out of the portion which consists of mixture of two different heats, when the rails are obtained by the sequential continuous casting.

- (2) Test piece shall be a rail section as it is, and it shall be cut to the length of about 1.5 m out of the test specimen.
- (3) Drop hammer test shall be made by employment of the test machine specified in Annex 1 under the conditions specified in Table 7.

Table 7. Drop hammer test

Unit: m				
Type of rail	Supporting method	Height of falling	Distance between supports	Number of impacts (time)
30 kg rail	With head facing upward	4.0	0.914	1
37 kg rail		5.0		
40 kgN rail	With head facing downward	5.1		
50 kg rail	With head facing upward	5.8		
50 kgN rail	With head facing downward	7.0		
60 kg rail		10.6		

- (4) For the rails rolled from a billet, the drop hammer test may be omitted as agreed upon by the parties concerned with delivery.

9.6 Sulfur print test The sulfur print test of a rail shall be carried out for N rail and 60 kg rail as follows:

- (1) **Sampling of test specimen of sulfur print test**
- (a) **For rails rolled from steel ingot** Make up one lot of steel ingots produced from the same molten steel, and sample one test specimen from the rear end of the steel ingot head side crop part of a rail rolled from an optional steel ingot other than steel ingots from which a tensile test piece and a drop hammer test piece are sampled for each lot.
- (b) **For rails rolled from cast billet** Make up one lot of cast billets produced from the same molten steel, and sample each one test specimen from an optional part of a rail rolled from an optional cast billet produced from a strand, as a rule, other than billets from which a tensile test piece and a drop hammer test piece are sampled for each lot.
- (2) The test piece shall be a rail section as it is and shall be cut to the length of 10 mm or over out of the test specimen.
- (3) The test method shall be in accordance with JIS G 0560.

10. Inspection

10.1 Analytical inspection on chemical composition The analytical inspection on chemical composition of a rail shall be tested in accordance with 9.1 and the results shall meet the requirements specified in 4.1.

10.2 Inspection on mechanical property

10.2.1 Tensile inspection The tensile inspection of the rails shall be as follows:

- (1) When the tensile inspection of the rails is carried out in accordance with 9.2 and the results meet the requirements specified in 4.2, all rails rolled from the steel ingot or cast billet for the rails of the lot represented by the said test piece are accepted.
- (2) When the results of tensile inspection fail to meet the requirements specified in 4.2, a reinspect can be performed by sampling a test specimen again by the following methods:
 - (a) When a test piece breaks at a point beyond $\frac{1}{4}$ gage length from the center between the gage marks and the result fails to meet the requirements specified in Table 3, the said inspection shall be invalidated and further the inspection shall be made for the rail from which the initial test piece has been taken.
 - (b) For rails rolled from steel ingot Reject the portions of length, which are equal to 300 kg in rail mass, from the top end of steel ingot of all rails of the lot represented by the failure test piece. For the rest, take a test piece from the rear end of the rejected rail in accordance with 9.2. Reinspect the test piece thus obtained, and if the result meets the requirement, accept the rest. If the result of reinspection fails to meet the requirement, make further inspection for a test piece taken in the way described above.
 - (c) For rails rolled from cast billet Take one test piece from the portion neighbouring to the place, from which the initial test piece has been taken, of the test specimen. Further, take one test piece from any one portion of the rail which is rolled from any one cast billet of any one strand other than that from which the initial test piece has been taken. Reinspect the two test pieces taken as above, and if the two pieces succeed to meet the requirement, accept all rails of the lot which is represented by the above two pieces. However, the action described below shall be taken for the rails produced from cast billets made by sequential continuous casting, if the result of reinspection fails to satisfy the requirement. Reject the rails which are made of the mixture with the melt of the failure lot, in addition to the rails of the rejected lot.

10.2.2 Inspection on hardness The inspection on hardness of the rails shall be as follows:

- (1) The inspection on hardness of the rails shall be carried out in accordance with 9.3, and the results shall meet the requirements specified in 4.2.

- (2) The results of inspection shall be treated in accordance with 10.2.1 (1) and (2).

10.3 Inspection on shape and dimensions Shape and dimensions of the rails shall satisfy the requirements specified in 5. by testing in accordance with 9.4.

10.4 Appearance inspection Appearance of the rails shall meet the requirements specified in 6.

10.5 Inspection on internal defects

10.5.1 Inspection on internal defects The inspection on internal defects of the rails shall meet the requirements specified in 7. (1) and (2).

10.5.2 Inspection by drop hammer test The inspection by the drop hammer test of the rails shall be made as follows:

- (1) The inspection by the drop hammer test of the rails shall be tested in accordance with 9.5, and the results shall meet the requirements specified in 7. (3).
- (2) The results of the inspection shall be treated in accordance with 10.2.1 (1) and (2).

10.5.3 Inspection by sulfur print test The inspection by the sulfur print test of the rails shall be made as follows:

- (1) The inspection by the sulfur print test of the rails shall be tested in accordance with 9.6, and the judgment on the requirements specified in 7. (3) shall be carried out by the limit samples.
- (2) The results of the inspection shall be treated in accordance with 10.2.1 (1) and (2).

Informative reference: The limit samples herein are held by Railway Technical Research Institute.

11. Record The manufacturer of the rails shall prepare the results of the tests which have been made in accordance with 9. and shall report them.

12. Designation The rails shall be designated in the order of the number or title of this Standard, the type or symbol, and the discrimination of the presence of fish-bolt holes.

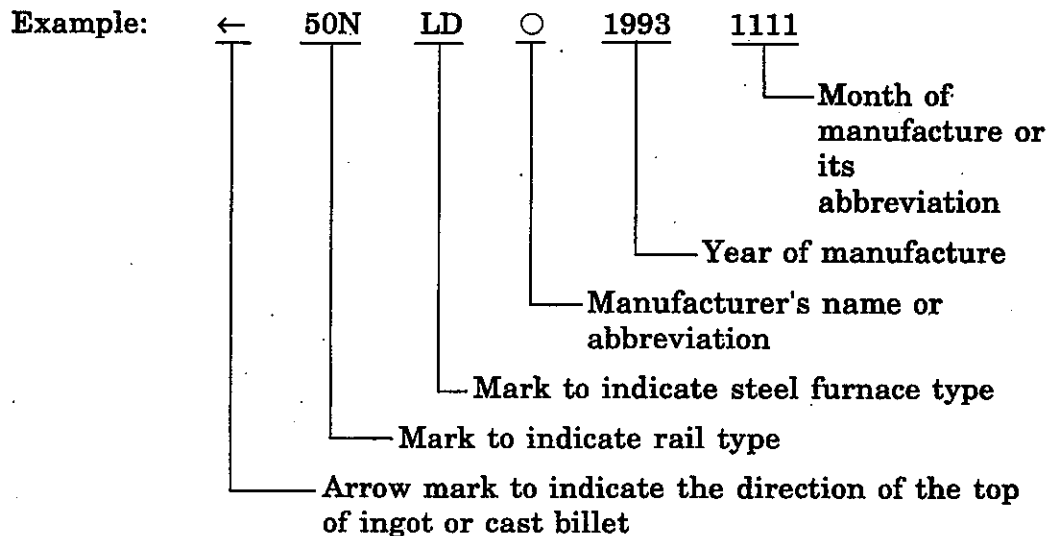
Example 1: JIS E 1101 40 N With fish-bolt holes

Example 2: Rails 40 kgN rail Without fish-bolt holes

13. Marking The rails shall be marked as described below:

- (1) The web of the rail shall bear, on its one side, the following particulars, as exemplified below, embossed legibly during the term of use. 30 kg, 37 kg and 50 kg rails may be exempted from marking of steel furnace type.

- (a) Arrow mark to indicate direction of top of ingot or cast billet ⁽³⁾
- (b) Mark to indicate rail type
- (c) Mark ⁽⁴⁾ to indicate steel furnace type
- (d) Manufacturer's name or abbreviation
- (e) Year and month of manufacture or its abbreviation



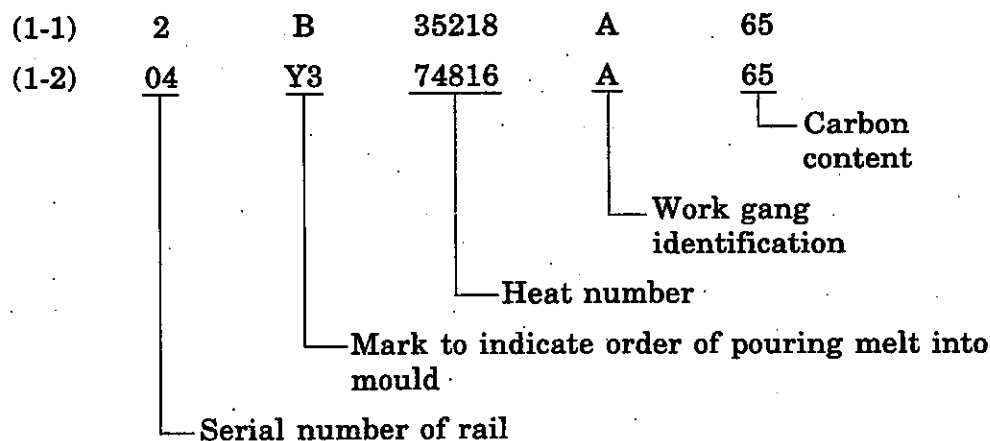
Notes ⁽³⁾ For cast billet, its terminal at the time of casting shall be taken as the top above-mentioned.

⁽⁴⁾ The marks to indicate steel furnace type are LD for a pure oxygen converter and E for an electric furnace.

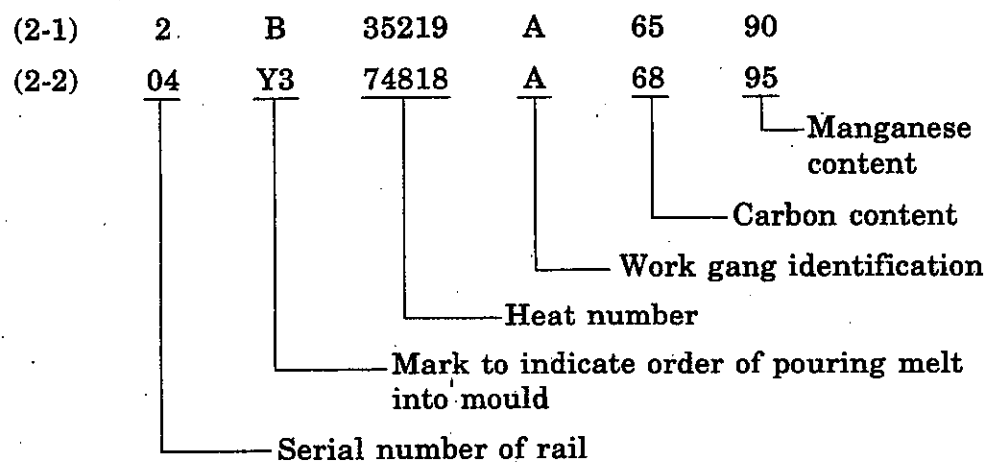
- (2) The web of the rail shall bear, on its other side, the following particulars, as exemplified below, stamped at a place which is not covered with fish-plate. However, 30 kg rails rolled from cast billets may be exempted from marking of serial number of the rail. In this case, letter "R" shall be marked, at the place for the serial number, to indicate that the rail is different from the rails produced from steel ingots.

- (a) Serial number ⁽⁵⁾ to indicate order of rails rolled from an ingot or an billet
- (b) Mark to indicate order of pouring melt into mould. For cast billet strand number and mark of cast billet order number.
- (c) Heat number
- (d) Work gang identification
- (e) Carbon content
- (f) Manganese content (only for 60 kg rails)

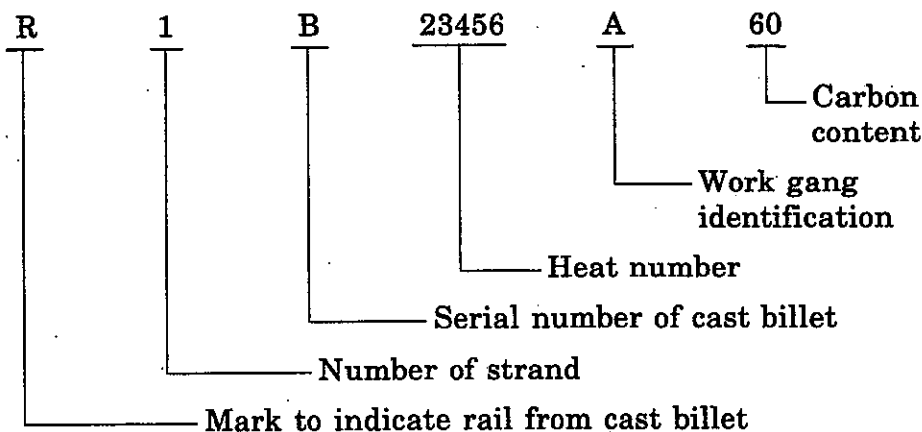
Example 1: For 30 kg, 37 kg, 40 kgN, 50 kg and 50 kgN rails rolled from steel ingots



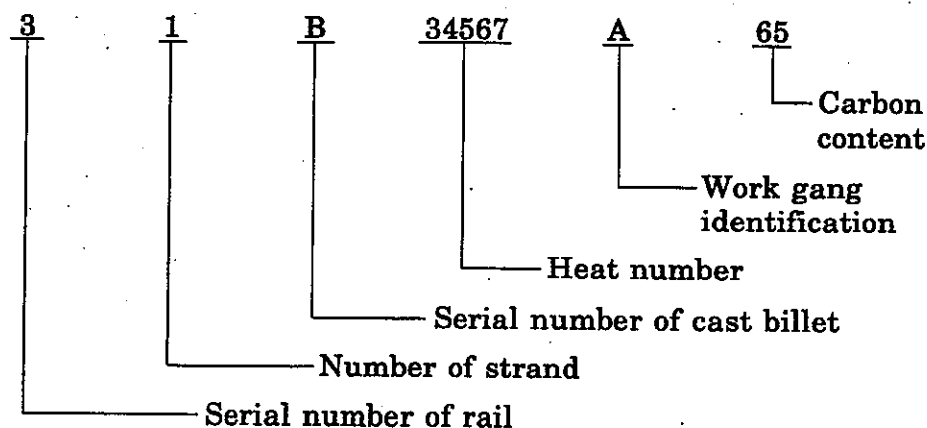
Example 2: For 60 kg rails rolled from steel ingots



Example 3: For 30 kg rails rolled from cast billets (omission of serial number of rail)



Example 4: For 37 kg, 40 kgN, 50 kg and 50 kgN rails rolled from cast billets

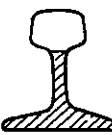
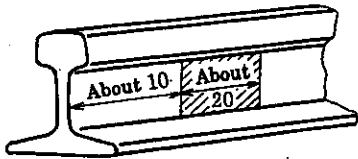


Note (5) In the case where 50 m rails are taken, stamping for the order of rails shall be expressed from its top side as follows:

- | | |
|------------------------|--------------------------------------|
| (1) 50 m + 50 m | (5) 50 m + 50 m + 50 m |
| | |
| (2) 50 m + 25 m + 25 m | (6) 25 m + 25 m + 50 m + 50 m |
| | |
| (3) 25 m + 50 m + 25 m | (7) 25 m + 25 m + 25 m + 25 m + 50 m |
| | |
| (4) 25 m + 25 m + 50 m | |
| | |

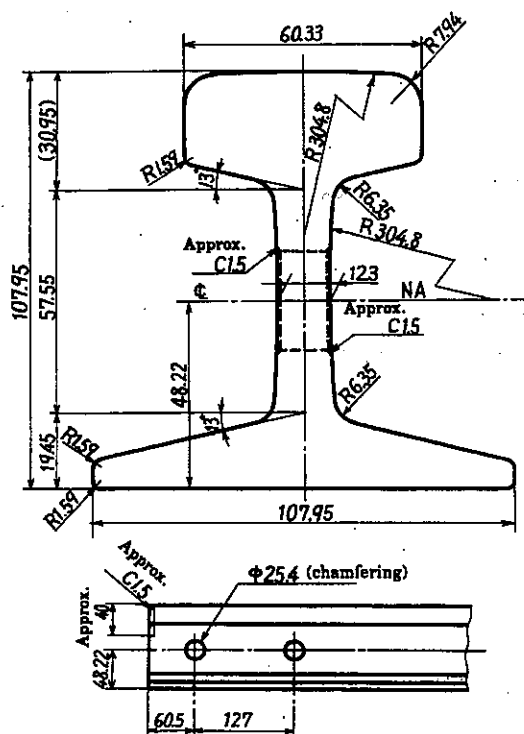
- (3) Both ends of a rail shall be painted by coating color given in Table 8. However, color painting may be omitted as agreed upon between the parties concerned with delivery.

Table 8. Marking by coating color of rails

Unit: mm	
Fish-bolt hole	Discrimination of color
With fish-bolt holes	 Blue on the web and base at both end faces
Without fish-bolt holes	 White on the side face of one side of web at both ends

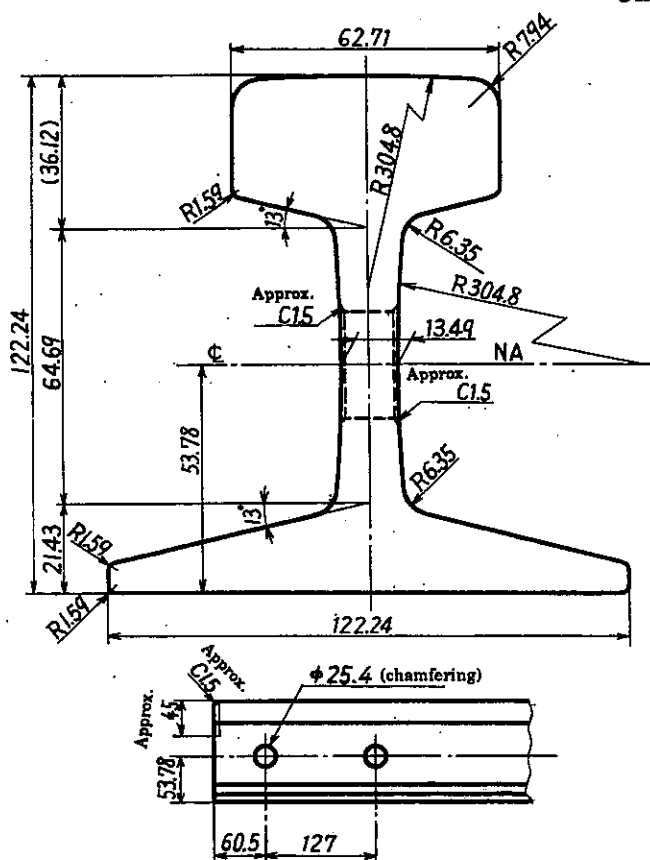
Attached Fig. 1. 30 kg Rail

Unit: mm



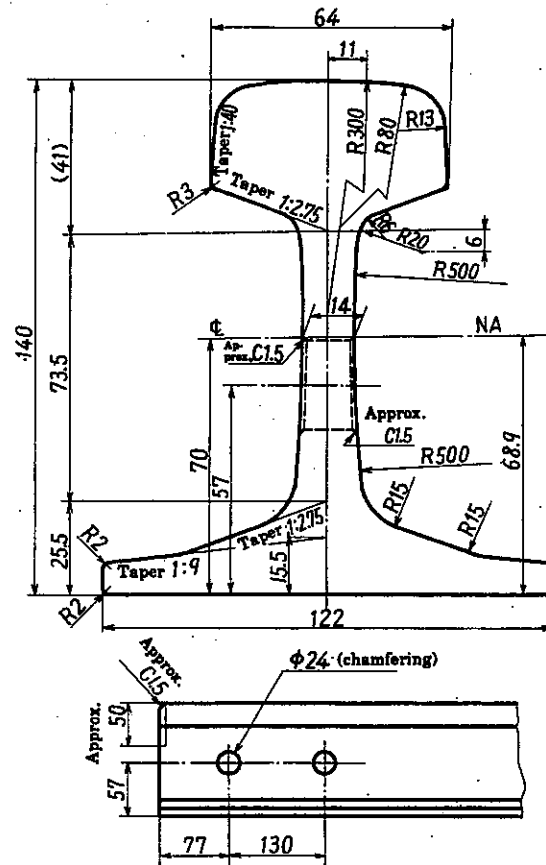
Attached Fig. 2. 37 kg Rail

Unit: mm



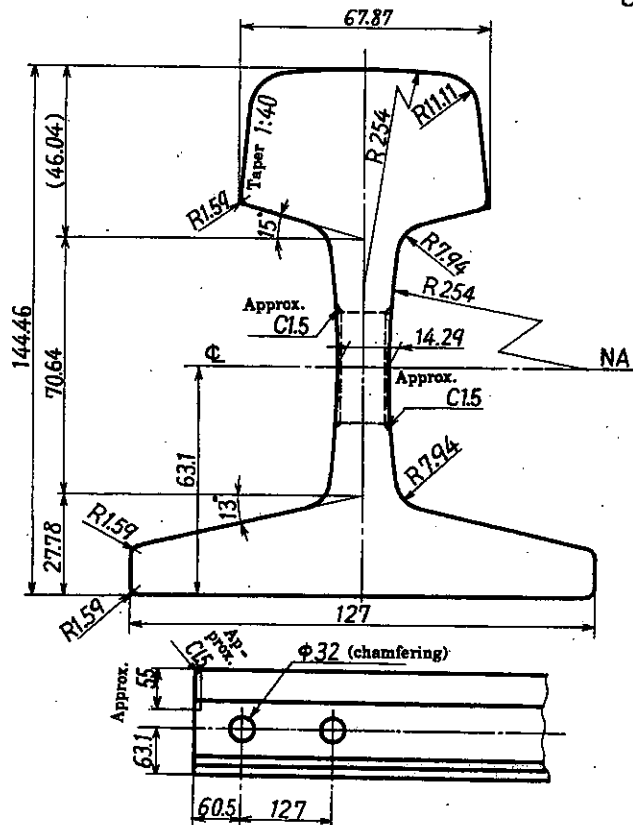
Attached Fig. 3. 40 kgN Rail

Unit: mm



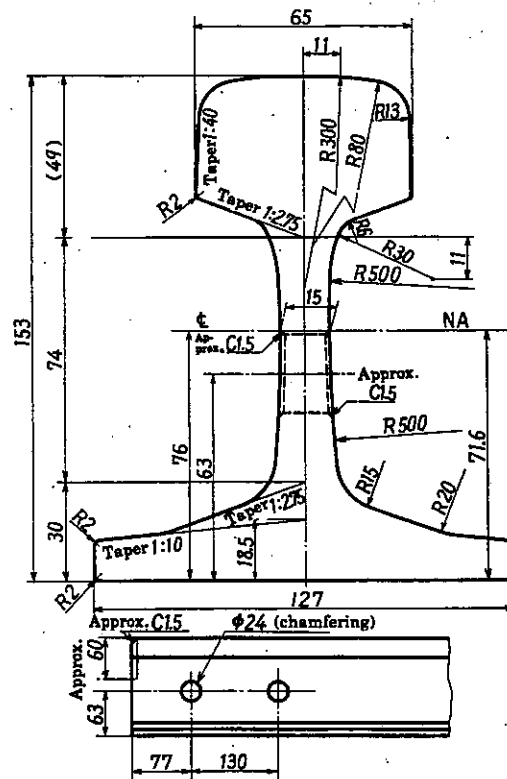
Attached Fig. 4. 50 kg Rail

Unit: mm



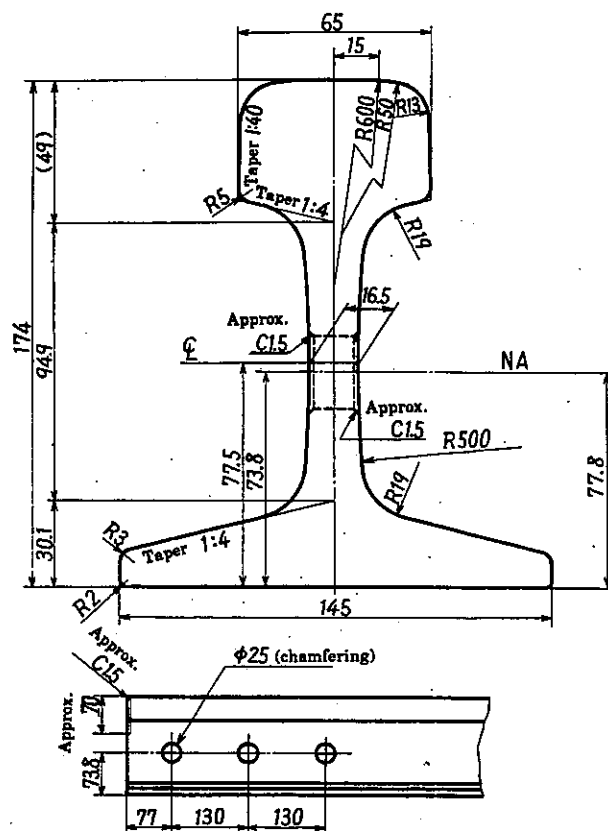
Attached Fig. 5. 50 kgN Rail

Unit: mm



Attached Fig. 6. 60 kg Rail

Unit: mm



Attached Table 1. Cited standards and corresponding International standard

JIS G 0202	Glossary of terms used in iron and steel (testing)
JIS G 0203	Glossary of terms used in iron and steel (products and quality)
JIS G 0303	General rules for inspection of steel
JIS G 0560	Method of sulphur print test for steel
JIS G 1211	Methods for determination of carbon in iron and steel
JIS G 1212	Methods for determination of silicon in iron and steel
JIS G 1213	Methods for determination of manganese in iron and steel
JIS G 1214	Methods for determination of phosphorus in iron and steel
JIS G 1215	Methods for determination of sulfur in iron and steel
JIS G 1252	Emission-spectroscopic analysis for carbon steel and low alloy steel
JIS G 1253	Method for photoelectric emission spectrochemical analysis of iron and steel
JIS G 1256	Method for X-ray fluorescence spectrometric analysis of iron and steel
JIS G 1257	Methods for atomic absorption spectrochemical analysis of iron and steel
JIS G 1258	Methods for inductively coupled plasma emission spectrochemical analysis of steel
JIS G 4801	Spring steels
JIS K 0116	General rules for emission spectrochemical analysis
JIS Z 2201	Test pieces for tensile test for metallic materials
JIS Z 2241	Method of tensile test for metallic materials
JIS Z 2243	Method of Brinell hardness test
ISO 5003	Flat bottom railway rails and special rail sections for switches and crossings of non-treated steel — Technical delivery requirements

Annex 1 Drop hammer test machine

1. The drop hammer test machine (hereafter referred to as "tester") shall be capable of mounting a rail on two supports of which span is adjustable from 914 mm to 1422 mm and also capable of dropping a tup of 907 kg in mass freely from at least the same height as that specified in the text of this Standard.
2. The anvil shall be such that of one solid casting, weighing 9072 kg inclusive of the attachments movable together with the anvil proper, and shall be supported in four corners each with five springs so as to be capable of being moved freely in the vertical direction along the columns. These springs shall be 210 mm in free height and 138 mm in outside diameter, and shall be made of 30 mm diameter steel bars of SUP 4 spring steel specified in JIS G 4801.
3. The base plate shall be made of 200 mm thick cast iron or cast steel to the same area as that of the anvil, and shall be fixed to the sub-structure with 50 mm diameter bolts.
4. The sub-structure shall consist of a timber grillage made of creosoted 300 mm square hard wood such as oak into one layer on masonry foundation fixed together by the use of bolts. The dimension of the sub-structure shall be 230 mm longer than the base plate.

The masonry foundation shall be made of concrete to thickness of 1.5 m or over, and shall be fixed onto foundation ground.

5. The pedestals to support the test rail shall be made of robust castings. The shape of the anvil positioning between these pedestals shall be formed so as to withstand the shock from breaking test piece.

The test rail support shall be of steel boom capable of being detached, and its upper surface shall be of semi-circular cylindrical form with a radius of 127 mm. The centre to centre distance of the supporting pedestals shall be adjustable from 914 mm to 1422 mm. The centre of the span shall always meet the centre of two faces which are to guide the drop tup.

6. The guide face shall be fixed to the column base and shall be kept firmly. It shall have such length sufficient to allow the tup to drop freely, and shall have its zero point at the point 133 mm above the top of the rail support and the scales of accurate 100 mm graduation on itself.

One of the guide faces shall be detachable so as to allow the tup to be taken out.

7. The drop tup inclusive of the attachments which are to drop together with the tup proper shall weigh 907 kg. Its striking surface shall be made of steel to semi-cylindrical form with a radius of 127 mm and a length of 300 mm. The portion of the tup which is to be contact with the guide face shall be not as manufactured but machine finished.

The dropping device shall be accurately released at any specified height, but shall be capable of being so locked that it may not begin to work while the test piece is being moved.

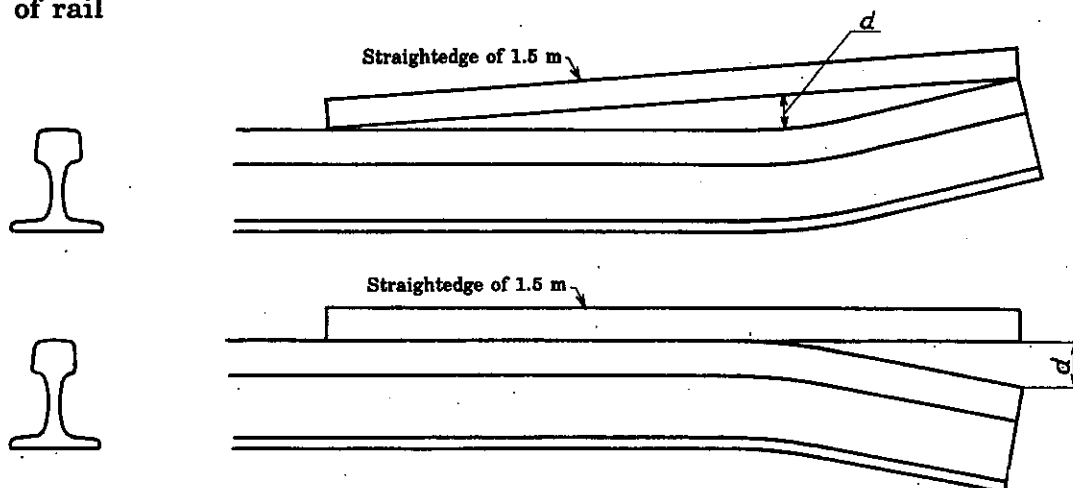
8. Release of the dropping device shall be automatic at any specified height.

The dropping device shall be capable of adjusting its height of falling accurately at intervals of 100 mm.

Annex 2 Measuring method for bend at end part of rail

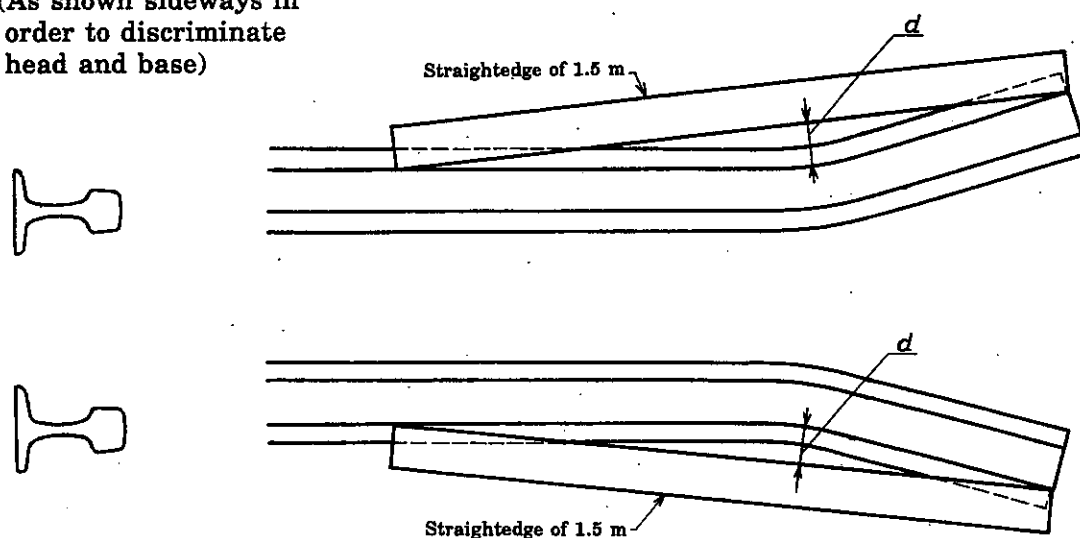
(1) Measuring method for vertical bend at end part of rail

Sectional view
of rail



(2) Measuring method for lateral bend at end part of rail

Sectional view of rail
(As shown sideways in
order to discriminate
head and base)



Remarks: The (d) in the figure indicates the maximum value of a clearance.

Annex 3

The standard values of tensile strength based on the traditional units specified in 4.2 in the body text of this Standard is scheduled to be converted to the values based on the SI units described in this Annex on and after April 1st, 1995.

4.2 Mechanical properties The mechanical properties of the rails shall conform to the specification in Table 3 when tested in accordance with 9.2 and 9.3.

Table 3. Mechanical properties

Type of rail	Tensile strength N/mm ²	Elongation %	Brinell hardness
30 kg rail	690 min.	9 min.	—
37 kg rail			
50 kg rail	740 min.	8 min.	
40 kgN rail	800 min.	10 min.	HB235 min.
50 kgN rail			
60 kg rail			

Remarks: 1 N/mm² = 1 MPa.

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