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Safety glass for railway rolling stock

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. Consequently **JIS R 3213:1992** is replaced with **JIS R 3213:1998**.

This revision has been published in order to amend partial quality and to conform with **JIS Z 8301:1996** *Rules for the drafting and presentation of Japanese Industrial Standards* which has been revised in July 1, 1996.

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Safety glass for railway rolling stock

1 Scope This Japanese Industrial Standard specifies the safety glass mainly used for the windows of the railway rolling stock.

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. If the indication of the year of coming into effect is given to these referred standards, only the edition of indicated year constitutes the provision of this Standard but the revision and amendment made thereafter are not applied. The normative references without the indication of the year of coming into effect apply limiting only to the most recent edition (including the amendment).

JIS A 1414	<i>Methods of performance test of panels for building construction</i>
JIS B 1501	<i>Steel balls for ball bearings</i>
JIS B 7502	<i>Micrometer callipers</i>
JIS B 7512	<i>Steel tape measures</i>
JIS B 7516	<i>Metal rules</i>
JIS K 6301	<i>Physical testing methods for vulcanized rubber</i>
JIS R 3106 :1985	<i>Testing method on transmittance and reflectance for daylight and solar radiation and solar heat gain coefficient of flat glass</i>
JIS Z 8401	<i>Rules for rounding off of numerical values</i>
JIS Z 8701	<i>Colour specification—The CIE 1931 standard colorimetric system and the CIE 1964 supplementary standard colorimetric system</i>
JIS Z 8703	<i>Standard atmospheric conditions for testing</i>
JIS Z 8722	<i>Methods of colour measurement—Reflecting or transmitting objects</i>

3 Definitions For the main terms used in this Standard the following definitions apply.

- a) **safety glass** The processed products of plate glass for the purpose of reducing the human injuries caused by broken window glass due to an accident or the like of the railway rolling stock, and the generic term of the tempered glass, laminated glass and sealed insulating safety glass.
- b) **tempered glass** That has been so processed as to increase the strength against the function of external force and the temperature change, forming a strong compressive stress layer on the glass surface by heat treatment of the plate glass, as well as, the tempered glass by heat treatment becomes fine fragments when it breaks.
- c) **laminated glass** That has been so bonded on all over surface, inserting an intermediate membrane between the two sheets or more of plate glass, that the larger part of fragments may not be scattered, even if it has been broken due to the function of external force.

Further, that has been replaced at least one sheet or more by the tempered glass, among

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the two sheets or more of constituting plate glass is called tempered laminated glass.

- d) **sealed insulating safety glass** That has been bonded on its periphery, placing two sheets or more of laminated glass or tempered glass in parallel with uniform gaps, and filling dry air nearly equal to the external atmospheric pressure into gaps.
- e) **intermediate membrane** That layer of synthetic resin being interposed between the material plate glasses composing the laminated.

When an adhesive, plasticizer and the like are used jointly, these are also included in the intermediate membrane.

4 **Types and symbols** The types and symbols of the safety glass shall be as given in Table 1.

Table 1 Types and symbols of safety glass

Type	Symbol	English equivalent (informative)
Tempered glass	TR	Tempered glass for railway rolling stock
Laminated glass	LR	Laminated glass for railway rolling stock
Sealed insulating safety glass	SR	Sealed insulating safety glass for railway rolling stock

Remarks : The types of the safety glass are subclassified according to the thicknesses, shapes, areas, portions to be used, tone of colour, etc., however, when the test items, standard values or test methods to be applied are different according to the classification, the difference shall be indicated by clearly specifying in 5 and 6.

5 **Quality** The quality of the safety glass shall conform to the requirements of 5.1 to 5.3, carrying out the tests by the test methods specified in 6 on the test items of Table 2.

Table 2 Test items and subclauses of test methods for safety glass

Test item		Quality subclause of respective types for safety glass			Subclause of test method
Classification	Subclassification	Tempered glass	Laminated glass	Sealed insulating safety glass	
1. Shapes and dimensions	1) Thickness	5.1.1	5.2.1	5.3.1	6.1.1
	2) Dimensions	5.1.2	5.2.2	5.3.2	6.1.2
	3) Warp (plane)	5.1.3	5.2.3	5.3.3	6.1.3
	4) Bent error (curved surface)	5.1.4	5.2.4	5.3.4	6.1.4
2. Appearance	1) Length and permissible number of appearance defect	5.1.5	5.2.5	5.3.5	6.2
3. Basic characteristic	1) Visible light transmittance	—	5.2.6	—	6.3.1
	2) Optical distortion	—	5.2.7	—	6.3.2
	3) Heat resistance	—	5.2.8	—	6.3.3
	4) Impact resistance	5.1.6	5.2.9	—	6.3.4
	5) Condition of fragments	5.1.7	—	—	6.3.5
	6) Dew point	—	—	5.3.6	6.3.6
	7) Acceleration durability	—	—	5.3.7	6.3.7
					6.3.7 c)
					6.3.7 d)
	8) Thermal characteristics	—	—	5.3.8	—

- Remarks 1 The visible light transmittance and optical distortion shall be applied to the window which has a field of view required for driving.
- 2 8) Thermal characteristics shall be classified as the thermal insulation characteristic specified in 5.3.8 b) and sunlight thermal screening characteristic specified in 5.3.8 c).

5.1 Quality of tempered glass

5.1.1 Thickness and its tolerances The nominal thickness, thickness and its tolerances of tempered glass shall be as given in Table 3.

Table 3 Nominal thickness, thickness and its tolerances of tempered glass

Unit : mm

Nominal thickness	Thickness and its tolerances		Classification by shape
3.2	3.2	± 0.3	Plane
4	4.0		Plane or curved surface
5	5.0		
6	6.0		
8	8.0	± 0.6	
10	10.0		
12	12.0	± 0.8	Plane
15	15.0		
19	19.0	± 1.2	

5.1.2 Shapes, dimensions and tolerances thereof The shapes, dimensions (except thickness) and tolerances thereof of the tempered glass shall be as follows:

- a) The shapes and dimensions of the tempered glass shall be as agreed between the parties concerned (the values of dimensions in accordance with agreement shall be called as agreed values).
- b) The dimensional tolerances of rectangular or square tempered glass shall be as given in Table 4 for the agreed values. However, when it corresponds to any of the following, it shall be as agreed between the parties concerned.
 - 1) In the case of 3.2 in nominal thickness, if it is 0.9 m² or over in the area of one sheet, or it exceeds 1 200 mm in the length of one side.
 - 2) In the case of 4 in nominal thickness, if it is 1.8 m² or over in the area of one sheet, or it exceeds 1 800 mm in the length of one side.
 - 3) In the case of 5 and 6 in nominal thickness, if it is 3.6 m² or over in the area of one sheet, or it exceeds 2 400 mm in the length of one side.
 - 4) In the case of 8, 10 and 12 in nominal thickness, when it is 7.2 m² or over in the area of one sheet, or it exceeds 3 000 mm in the length of one side.
 - 5) When 15 and 19 in nominal thickness.
- c) The dimensional tolerances of the plane tempered glass and curved surface tempered glass other than rectangular and square shall be as given in Table 5. However, when it corresponds to any one of the following, it shall be as agreed between the parties concerned.
 - 1) When the shape is plane, and corresponds to 1), 2), 3) and 4) of 5.1.2 b).
 - 2) When the shape is curved surface, 4, 5 and 6 in nominal thickness and over 1 600 mm in side length, or 1.2 m² or over in area.

3) When the shape is curved surface, 8 in nominal thickness, and over 2 200 mm in side length or 2.0 m² in area.

Table 4 Dimensional tolerances of rectangular and square plane tempered glass
Unit : mm

Nominal thickness	Area of one sheet (m ²)	Length of side	Dimensional tolerances	
			Length and width	Difference of both diagonal lines
3.2	Under 0.3	Under 600	± 1.0	3.5 or under
4		600 or over	± 1.5	
5	0.3 or over to and excluding 0.8	Under 1 000	± 2.0	4.5 or under
6		1 000 or over		
	0.8 or over to and excluding 1.0	Under 1 200	± 2.5	5.5 or under
		1 200 or over		
	1.0 or over to and excluding 1.2	Under 1 500	± 3.0	6.5 or under
		1 500 or over		
	1.2 or over	Under 1 800	± 3.0	6.5 or under
		1 800 or over		
8	Under 1.0	Under 1 000	± 2.5	7.5 or under
10		1 000 or over	± 3.0	
12	1.0 or over to and excluding 1.5	Under 1 500	± 3.5	7.5 or under
		1 500 or over		
	1.5 or over	Under 2 000	± 4.0	8.5 or under
		2 000 or over		

Table 5 Dimensional tolerances of plane tempered glass and curved surface tempered glass other than rectangular or square shape
Unit : mm

Shape	Classification of nominal thickness	Tolerances on straight line part			Tolerances on curved line part		Tolerances of reference side (¹)
		Length of side			Area of product		
		Under 1 200	1 200 or over to and excl. 1 800	1 800 or over	Under 1 m ²	1 m ² or over	
Plane	6 or under	± 1.5	± 2.0	± 2.5	± 2.0	± 2.5	± 0.5
	8 or over up to and incl. 12	± 2.0	± 2.5	± 3.0	± 3.0	± 3.5	
Curved surface	6 or under	± 1.5	± 2.0	—	± 2.5	± 3.0	
	8	± 2.0	± 2.5	± 3.0	± 3.0	± 3.5	

Note (1) The reference side is generally considered to be that side which is located at the under side when a glass is fitted to the rolling stock.

5.1.3 Warp The warp of the plane tempered glass shall not exceed 0.5 % in the case of the bow shape and 0.3 % in the case of the corrugated shape respectively. However, the bow shape warp of the tempered glass for sashless descending window shall be 0.35 % or under.

5.1.4 Bent error (2) The bent error tolerances of the curved surface tempered glass shall be as given in Table 6.

Note (2) When a product has been put on an inspecting gauge having a standard bent shape, that gap which is caused between the inspecting gauge and the product at its peripheral part.

Table 6 Bent error tolerances of curved surface tempered glass

Unit : mm

Nominal thickness	Length of side			
	Under 600	600 or over to and excl. 1200	1200 or over to and excl. 1800	1800 or over
4, 5, 6 and 8	3.0 max.	3.5 max. However, sum of the gaps at the symmetrical positions shall be 5.0 or under.	4.0 max. However, sum of the gaps at the symmetrical positions shall be 6.0 or under.	5.0 max. However, sum of the gaps at the symmetrical positions shall be 8.0 or under.

5.1.5 Appearance The appearance quality of the tempered glass shall comply with Table 7.

Table 7 Appearance quality of tempered glass

Type of defect	Length (or diameter) of defect and permissible number of pieces
Transparent void	0.5 to 3.0 mm: within 2 pieces per 300 mm square
Foreign substance (4)	0.5 to 1.5 mm: within 1 piece per 300 mm square
Heavy scratch (5)	Central part (3) 5.0 to 10.0 mm: within 3 pieces per 300 mm square Surrounding part (3) 5.0 to 20.0 mm: within 5 pieces per 300 mm square
Medium scratch (6)	Central part (3) 10.0 to 30.0 mm: within 3 pieces per 300 mm square Surrounding part (3) 10.0 to 30.0 mm: within 5 pieces per 300 mm square
Permissible number of pieces when defects mentioned above (void, foreign substance, heavy scratch, medium scratch) have been mixed	(1) In an arbitrary 30 cm square, up to 3 pieces in central part and up to 5 pieces in surrounding part may be permissible. (2) That defect exceeding the maximum length shall be zero piece. (3) That defect under the minimum length may be permissible. However, that crowd which is impedimental to seeing through shall not exist.
Stripe, wave, swell and unevenness on original surface	In the seeing through from the direction of 45° in angle to the glass plane, no distortion shall be seen on the object of within 5 m.
Cracking	None.
Chipping	There shall be no chipping of which width or length at the peripheral part (3) is not less than the thickness of the material plate glass.

- Notes ⁽³⁾ The central part, surrounding part and peripheral part are as given in Fig. 1. However, when the central part overlaps the peripheral part, that portion shall be considered to be the peripheral part.
- ⁽⁴⁾ The colored void is included in the foreign substance.
- ⁽⁵⁾ That scratch which is easily be caught by a nail.
- ⁽⁶⁾ That scratch which is not easily be caught by a nail.

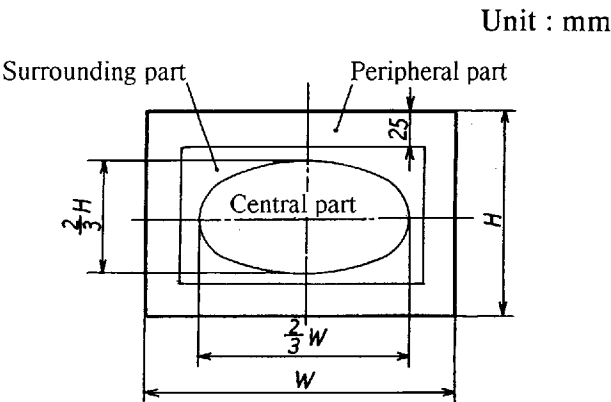


Fig. 1

5.1.6 Impact resistance The impact resistance of the tempered glass shall be subjected to the test on 6 sheets of specimens, and when the following conditions have been satisfied, it shall be judged as acceptable.

- a) One sheet or less of broken number of sheets.
- b) When the broken number of sheets is two sheets, carry out an additional test on other six specimens from the same lot, and the broken number of sheets is zero.

5.1.7 Condition of fragments The condition of the fragments of the tempered glass shall satisfy the conditions of Table 8.

Table 8 Condition of fragment of tempered glass

Classification of nominal thickness	Number of fragments
3.2	The number of fragments in the area of 100 mm × 100 mm square shall be 10 pieces or more. Furthermore, when the portion of less than 10 pieces in number of fragments has occurred, the number of fragments in the area of 200 mm × 200 mm square including that portion shall be 40 pieces or more.
4 or over	The number of fragments in the area of 50 mm × 50 mm square shall be 40 pieces or more. Furthermore, when the portion of less than 40 pieces in number of fragments has occurred, the number of fragments in the area of 100 mm × 100 mm square including that portion shall be 160 pieces or more.

5.2 Quality of laminated glass

5.2.1 Thickness and its tolerances The nominal thickness ⁽⁷⁾ and its tolerances of the

laminated glass shall be as given in Table 9. However, for the curved surface laminated glass, laminated glass of 3 sheets or more of material plate glass, tempered laminated glass and laminated glass of 13 mm or over in nominal thickness, the thickness and its tolerances shall be as agreed between the parties concerned.

Note (7) The nominal thickness of the laminated glass shall be the sum of the nominal thickness of the material plate glass.

Table 9 Tolerances on thickness of laminated glass

Unit : mm

Classification of nominal thickness	Tolerances
Under 7	± 0.6
7 or over to and excl. 10	± 0.8
10 or over to and excl. 13	± 1.0

5.2.2 Shapes, dimensions and tolerances thereof The shapes, dimensions (except thickness) and tolerances thereof of the plane laminated glass and curved surface laminated glass shall be in accordance with the following:

- a) The shapes and dimensions of the plane laminated glass and curved surface laminated glass shall be as agreed between the parties concerned (the values of dimensions by agreement shall be called as the agreed values.).
- b) The dimensional tolerances of the rectangular and square plane laminated glass shall be as given in Table 10 for the agreed values. However, as to those of the laminated glass, tempered laminated glass of 3 sheets or more in material plate glass, laminated glass of 13 mm or over in nominal thickness, and that of exceeding 2 400 mm in the length of one side, the dimensional tolerances shall be as agreed between the parties concerned.

Table 10 Dimensional tolerances of rectangular or square laminated glass

Unit : mm

Classification of nominal thickness	Length of side		
	Under 1 200	1 200 or over to and excl. 1 800	1 800 or over up to and incl. 2 400
Under 10	± 1.5	± 2.0	± 2.5
10 or over to and excl. 13	± 2.0	± 2.5	± 3.0

- c) The dimensional tolerances of the plane laminated glass and curved surface laminated glass other than rectangular or square shape shall be as given in Table 11. However, as to those of the laminated glass of 3 sheets or more of material plate glass, laminated glass of 13 mm or over in nominal thickness and exceeding 2 400 mm in the length of one side, the dimensional tolerances shall be as agreed between the parties concerned.

Table 11 Dimensional tolerances of laminated glass and curved surface laminated glass other than rectangular or square shape

Unit : mm

Shape	Classification of nominal thickness	Dimensional tolerances on straight line part			Dimensional tolerances on curved line part		Tolerances on reference side (1)
		Length of side			Area of product		
		Under 1 200	1 200 or over to and excl. 1 800	1 800 or over	Under 1 m ²	1 m ² or over	
Plane	Under 10	± 1.5	± 2.0	± 2.5	± 2.0	± 2.5	± 1.0
	10 or over to and excl. 13	± 2.0	± 2.5	± 3.0	± 3.0	± 3.5	
Curved surface	Under 10	± 1.5	± 2.0	± 2.5	± 2.5	± 3.0	
	10 or over to and excl. 13	± 2.0	± 2.5	± 3.0	± 3.0	± 3.5	

5.2.3 Warp The warp of the plane laminated glass shall not exceed 0.3 %. However, for the tempered laminated glass it shall be 0.35 % or under.

5.2.4 Bent error ⁽²⁾ The bent error of the curved surface laminated glass shall be as given in Table 12. However, as to those of the laminated glass of 3 sheets or more of material plate glass, laminated glass of 13 mm or over in nominal thickness, and exceeding 2 400 mm in the length of one side, it shall be as agreed between the parties concerned.

Table 12 Tolerances on bent error of curved surface tempered glass

Unit : mm

Classification of nominal thickness	Length of side		
	Under 1200	1200 or over to and excl. 1800	1800 or over
Under 13	3.5 max. However, the sum of the gaps at the symmetrical positions shall be 5.0 or under.	4.0 max. However, the sum of the gaps at the symmetrical positions shall be 6.0 or under.	5.0 max. However, the sum of the gaps at the symmetrical positions shall be 8.0 or under.

5.2.5 Appearance The appearance quality of the laminated glass shall comply with Table 13, other than the appearance quality specified in 5.1.5.