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**Cold-reduced carbon steel sheet and  
strip**

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In the event of any doubts arising as to the contents,  
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## Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by the Japan Iron and Steel Federation (JISF) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS G 3141: 2009** is replaced with this Standard.

However, **JIS G 3141 : 2009** may be applied in the **JIS** mark certification based on the relevant provisions of Article 19 Clause 1, etc. of the Industrial Standardization Law until September 19th, 2012.

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Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public or utility model right which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public or utility model right which have the said technical properties.

# Cold-reduced carbon steel sheet and strip

## Introduction

This Japanese Industrial Standard has been prepared based on the fourth edition of ISO 3574 published in 2008 with some modifications of the technical contents.

The portions given sidelines or dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with the explanations is given in Annex JB.

## 1 Scope

This Standard specifies the cold-reduced carbon steel sheet and strip (hereafter referred to as "steel sheet and strip"). The cold-rolled steel strip in coil (that of under 600 mm in width) and the steel sheet cut from the cold-rolled steel strip in coil are included in the steel sheet and strip.

NOTE: The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 3574 : 2008 *Cold-reduced carbon steel sheet of commercial and drawing qualities* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according to ISO/IEC Guide 21-1.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS G 0320 Standard test method for heat analysis of steel products

JIS G 0404 Steel and steel products—General technical delivery requirements

JIS G 0415 Steel and steel products—Inspection documents

JIS Z 2241 Metallic materials—Tensile testing—Method of test at room temperature

JIS Z 2244 Vickers hardness test—Test method

JIS Z 2245 Rockwell hardness test—Test method

JIS Z 2254 Metallic materials—Sheet and strip—Determination of plastic strain ratio

JIS Z 8401 Guide to the rounding of numbers

### 3 Classification and symbol

The steel sheet and strip shall be classified into 5 types, and the symbols thereof shall be as given in table 1. They shall be divided according to the temper grade and the surface finish as given in table 2 and table 3, respectively.

Upon the agreement between the purchaser and the manufacturer, the intermediate temper grade or the subdivided surface finish not specified in table 2 or table 3 may be applicable.

**Table 1 Symbol of grade**

Symbol of grade	Application
SPCC <sup>a)</sup>	Commercial quality
SPCD	Drawing quality
SPCE	Deep drawing quality
SPCF	Non-ageing deep drawing quality
SPCG	Non-ageing extra deep drawing quality
Note <sup>a)</sup> When the SPCC steel sheet and strip of the standard temper grade and as-annealed are guaranteed for their tensile strength upon the request by the purchaser, T shall be suffixed to the symbol of grade so that it reads SPCCT.	

**Table 2 Temper grade**

Temper grade	Symbol of temper grade
As-annealed	A
Standard temper grade	S
$\frac{1}{8}$ hard	8
$\frac{1}{4}$ hard	4
$\frac{1}{2}$ hard	2
Full hard	1
$\frac{1}{8}$ hard, $\frac{1}{4}$ hard, $\frac{1}{2}$ hard and full hard are only applicable to SPCC.	

**Table 3 Surface finish**

Surface finish	Symbol of surface finish	Remarks
Dull finish	D	A matt finish produced with a roll of which the surface is roughened mechanically or chemically
Bright finish	B	A smooth finish produced with a roll of which the surface is finished smoothly
This table is not applicable to the steel sheet and strip as-annealed.		

### 4 Chemical composition

The steel sheet and strip shall be tested in accordance with 13.1, and the heat analysis value thereof shall be as given in table 4. The specification in table 4 is not applicable to the steel sheet and strip of  $\frac{1}{8}$  hard,  $\frac{1}{4}$  hard,  $\frac{1}{2}$  hard and full hard.

**Table 4 Chemical composition**

Unit : %				
Symbol of grade	C	Mn	P	S
SPCC	0.15 max.	0.60 max.	<u>0.100 max.</u>	0.035 max.
SPCD	0.10 max.	0.50 max.	0.040 max.	0.035 max.
SPCE	0.08 max.	0.45 max.	0.030 max.	0.030 max.
SPCF	0.06 max.	0.45 max.	0.030 max.	0.030 max.
SPCG <sup>a)</sup>	0.02 max.	0.25 max.	0.020 max.	0.020 max.
Alloying elements other than those in this table may be added as necessary.				
Note <sup>a)</sup> The upper limit value of Mn, P or S may be altered upon the agreement between the purchaser and the manufacturer.				

## 5 Mechanical properties

### 5.1 Yield point or proof stress, tensile strength and elongation

The steel sheet and strip of standard temper grade and as-annealed shall be tested in accordance with 13.2, and the yield point or proof stress, tensile strength and elongation thereof shall be as given in table 5. The specification in table 5 is applicable only to the steel sheet and strip of 30 mm or over in width.



**Table 5 Yield point or proof stress, tensile strength and elongation**

Symbol of grade	Yield point or proof stress <sup>a)</sup>	Tensile strength	Elongation							Tensile test piece
	N/mm <sup>2</sup>	N/mm <sup>2</sup>	%							
	Thickness mm		Thickness mm							
	0.25 or over	0.25 or over	0.25 or over to and excl. 0.30	0.30 or over to and excl. 0.40	0.40 or over to and excl. 0.60	0.60 or over to and excl. 1.0	1.0 or over to and excl. 1.6	1.6 or over to and excl. 2.5	2.5 or over	
SPCC	—	—	—	—	—	—	—	—	—	No. 5 test piece, rolling direction
SPCCT <sup>b)</sup>	—	270 min.	28 min.	31 min.	34 min.	36 min.	37 min.	38 min.	39 min.	
SPCD	(240 max.)	270 min.	30 min.	33 min.	36 min.	38 min.	39 min.	40 min.	41 min.	
SPCE	(220 max.)	270 min.	32 min.	35 min.	38 min.	40 min.	41 min.	42 min.	43 min.	
SPCF <sup>c)</sup>	(210 max.)	270 min.	—	—	40 min.	42 min.	43 min.	44 min.	45 min.	
SPCG <sup>c)</sup>	(190 max.)	270 min.	—	—	42 min.	44 min.	45 min.	46 min.	—	
For those under 0.60 mm in thickness, the tensile test shall generally be omitted. The elongation of the steel sheet and strip of standard temper grade that have been bright finished shall be the value so as that 2 is subtracted from the value of this table.										
NOTE: 1 N/mm <sup>2</sup> = 1 MPa										
Notes <sup>a)</sup> The upper limit value of yield point or proof stress in parentheses is informative and may be applied upon the agreement between the purchaser and the manufacturer.										
<sup>b)</sup> The tensile test value is guaranteed for those among SPCC.										
<sup>c)</sup> The non-ageing property of SPCF and SPCG shall be guaranteed for six months after the shipment from the manufacturer's factory. When the shipment is delayed due to the request from the purchaser, the term shall be six months from the original shipment date. The non-aging property is the characteristic that does not grow the stretcher-strain at the time of working.										

## 5.2 Average plastic strain ratio

The steel sheet and strip of SPCG shall be tested in accordance with 13.2, and the average plastic strain ratio  $\bar{r}$  shall be as given in table 6.

**Table 6 Average plastic strain ratio  $\bar{r}$** 

Symbol of grade	Thickness mm			
	Under 0.50	0.50 or over to and incl. 1.0	Over 1.0 to and incl. 1.6	Over 1.6
SPCG	—	1.5 min.	1.4 min.	—

## 5.3 Hardness

The steel sheet and strip of  $\frac{1}{8}$  hard,  $\frac{1}{4}$  hard,  $\frac{1}{2}$  hard and full hard (hereafter referred to as "hard material") shall be tested in accordance with 13.2, and their hardness shall be as given in table 7 or table 8. However, the hardness shall be in accordance with table 7 unless otherwise specified. For the material so thin in thickness that Rockwell hardness scale B (hereafter referred to as "HRB") cannot be measured, the hardness may be measured by Rockwell superficial hardness scale 30T (hereafter referred to as "HR30T"), Rockwell superficial hardness scale 15T (hereafter referred to as "HR15T") or Vickers hardness

(hereafter referred to as "HV"), and converted to HRB by the conversion table as given in table 9 to table 11. An example of HRB and the minimum applicable thickness is given in table 12.

When the diamond anvil is used at the time of measuring the hardness of HR30T or HR15T, the test allows the appearance of the indentation on the back of a test piece. In this case, the hardness is converted to HRB by using table 9 and table 10.

The hardness value which is not in the hardness conversion table shall be calculated by interpolation.

NOTE: JIS Z 2245 specifies so that "After the test, no deformation shall be visible on the surface of the test piece opposite the indentation.", and the equation to calculate the minimum thickness of the test piece where spherical indenter is used is shown in table 13 for informative.

**Table 7 Rockwell hardness of hard material (HRB)**

Temper grade	Symbol of temper grade	HRBS or HRBW <sup>a)</sup>
$\frac{1}{8}$ hard	8	50 to 71
$\frac{1}{4}$ hard	4	65 to 80
$\frac{1}{2}$ hard	2	74 to 89
Full hard	1	85 or over
Note <sup>a)</sup> The measurement shall be either by HRBS or HRBW. However in case of any doubt arising, HRBS shall be applied.		

**Table 8 Vickers hardness of hard material (HV)**

Temper grade	Symbol of temper grade	HV
$\frac{1}{8}$ hard	8	95 to 130
$\frac{1}{4}$ hard	4	115 to 150
$\frac{1}{2}$ hard	2	135 to 185
Full hard	1	170 or over

**Table 9 Conversion table from HR30TS to HRBS**

HR30TS	Converted HRBS	HR30TS	Converted HRBS	HR30TS	Converted HRBS	HR30TS	Converted HRBS
35.0	28.1	47.0	46.0	59.0	63.9	71.0	81.9
36.0	29.6	48.0	47.5	60.0	65.4	72.0	83.4
37.0	31.1	49.0	49.0	61.0	66.9	73.0	84.9
38.0	32.5	50.0	50.5	62.0	68.4	74.0	86.4
39.0	34.0	51.0	52.0	63.0	69.9	75.0	87.9
40.0	35.5	52.0	53.5	64.0	71.4	76.0	89.4
41.0	37.0	53.0	55.0	65.0	72.9	77.0	90.8
42.0	38.5	54.0	56.5	66.0	74.4	78.0	92.3
43.0	40.0	55.0	58.0	67.0	75.9	79.0	93.8
44.0	41.5	56.0	59.5	68.0	77.4	80.0	95.3
45.0	43.0	57.0	60.9	69.0	78.9	81.0	96.8
46.0	44.5	58.0	62.4	70.0	80.4	82.0 <sup>a)</sup>	98.3

This table may be applicable to the conversion from HR30TW to HRBW. However in case of any doubt arising, HR30TS shall be applied.

NOTE This conversion table shall be in accordance with table 2 [1] of **ASTM E140**. Hardness not in the table of **ASTM** is obtained by interpolation.

Note <sup>a)</sup> When HR30TS exceeds 82.0, the converted value of HRBS shall be expressed as "over 98.3". However, the converted value of HRBS obtained by extrapolation may be reported by the round number, instead.

**Table 10 Conversion table from HR15TS to HRBS**

HR15TS	Converted HRBS	HR15TS	Converted HRBS	HR15TS	Converted HRBS	HR15TS	Converted HRBS
70.0	28.8	76.0	47.3	82.0	65.8	88.0	84.3
70.5	30.3	76.5	48.8	82.5	67.3	88.5	85.8
71.0	31.9	77.0	50.4	83.0	68.8	89.0	87.3
71.5	33.4	77.5	51.9	83.5	70.4	89.5	88.9
72.0	35.0	78.0	53.4	84.0	71.9	90.0	90.4
72.5	36.5	78.5	55.0	84.5	73.5	90.5	92.0
73.0	38.0	79.0	56.5	85.0	75.0	91.0	93.5
73.5	39.6	79.5	58.1	85.5	76.6	91.5	95.0
74.0	41.1	80.0	59.6	86.0	78.1	92.0	96.6
74.5	42.7	80.5	61.1	86.5	79.6	92.5	98.1
75.0	44.2	81.0	62.7	87.0	81.2	93.0 <sup>a)</sup>	99.7
75.5	45.7	81.5	64.2	87.5	82.7		

This table may be applicable to the conversion from HR15TW to HRBW. However in case of any doubt arising, HR15TS shall be applied.

NOTE This conversion table shall be in accordance with table 2 of **ASTM E140**. Hardness not in the table of **ASTM** is obtained by interpolation.

Note <sup>a)</sup> When HR15TS exceeds 93.0, the converted value of HRBS shall be expressed as "over 99.7". However, the converted value of HRBS obtained by extrapolation may be reported by the round number, instead.

**Table 11 Conversion table from HV to HRBS**

HV	Converted HRBS	HV	Converted HRBS	HV	Converted HRBS	HV	Converted HRBS
85	41.0	145	76.6	210	93.4	330	—
90	48.0	150	78.7	220	95.0	340	(108.0)
95	52.0	155	79.9	230	96.7	350	—
100	56.2	160	81.7	240	98.1	360	(109.0)
105	59.4	165	83.1	250	99.5	370	—
110	62.3	170	85.0	260	(101.0)	380	(110.0)
115	65.0	175	86.1	270	(102.0)		
120	66.7	180	87.1	280	(103.5)		
125	69.5	185	88.8	290	(104.5)		
130	71.2	190	89.5	300	(105.5)		
135	73.2	195	90.7	310	—		
140	75.0	200	91.5	320	(107.0)		

NOTE 1 This conversion table shall be in accordance with table 1 [2] of **SAE J417**. Hardness not in the table of **SAE** is obtained by interpolation.

NOTE 2 The value in parentheses is out of the scope of HRBS and for reference. It may be reported as the round number.

**Table 12 Example of HRB and minimum thickness**

HRBS or HRBW	50	65	74	85
Minimum thickness mm	2.40	1.95	1.68	1.35

**Table 13 Equation to calculate minimum thickness of test piece**

Indenter	Rockwell hardness	Rockwell superficial hardness
Spherical indenter	$15h$ or $0.03 (130-H)$	$15h$ or $0.015 (100-H)$
NOTE: $h$ : Depth of permanent indentation		$H$ : Hardness value

## 5.4 Bendability

The steel sheet and strip of SPCC shall be tested in accordance with 13.2 under the test conditions as given in table 14, and the outside surface of the test piece shall not show the cracking.

NOTE: For the bend test, see 13.2.5.

**Table 14 Bendability**

Temper grade	Symbol of temper grade	Bend angle	Inside clearance <sup>a)</sup>
As-annealed	A	180°	0 (flat on itself)
Standard temper grade	S	180°	0 (flat on itself)
$\frac{1}{8}$ hard	8	180°	0 (flat on itself)
$\frac{1}{4}$ hard	4	180°	1
$\frac{1}{2}$ hard	2	180°	2
Full hard	1	—	—
Note <sup>a)</sup> Maximum number of sheets of nominal thickness.			

## 6 Expression of dimensions

The dimensions of the steel sheet and strip shall be expressed as follows.

- a) The dimensions of the steel sheet shall be expressed by thickness, width and length in millimetre.
- b) The dimensions of the steel strip shall be expressed by thickness and width in millimetre.

## 7 Standard thickness

The standard thickness of the cold-reduced carbon steel sheet and strip of 600 mm or over in width shall be as given in table 15.

**Table 15 Standard thickness**

Unit : mm									
Standard thickness	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4
	1.6	1.8	2.0	2.3	2.5	(2.6)	2.8	(2.9)	3.2
The standard thickness not in parentheses should preferably be used.									

## 8 Dimensional tolerances

### 8.1 Measuring positions of dimensions

The measuring positions of dimensions shall be as follows.

- a) Thickness shall be measured at a normal portion for steel strip and at any point not less than 15 mm inward from each edge (end part in the width direction) for steel sheet. For that whose width is less than 30 mm, the measurement shall be made at a mid-width position.
- b) Width shall be measured at a normal portion for steel strip and at any position for steel sheet.
- c) Length shall be measured at any position for steel sheet.

### 8.2 Tolerances on thickness

The tolerances on thickness shall be as follows.

- a) The tolerances on thickness shall be applied to the nominal thickness.
- b) The tolerances on thickness shall be divided into A and B as given in table 16 and table 17, respectively. The tolerances on thickness A shall generally be applied. However, B may be applied upon the agreement between the purchaser and the manufacturer.

**Table 16 Tolerances on thickness A**

Unit: mm

Thickness	Width				
	Under 630	630 or over to and excl. 1 000	1 000 or over to and excl. 1 250	1 250 or over to and excl. 1 600	1 600 or over
Under 0.25	±0.03	±0.03	±0.03	—	—
0.25 or over to and excl. 0.40	±0.04	±0.04	±0.04	—	—
0.40 or over to and excl. 0.60	±0.05	±0.05	±0.05	±0.06	—
0.60 or over to and excl. 0.80	±0.06	±0.06	±0.06	±0.06	±0.07
0.80 or over to and excl. 1.00	±0.06	±0.06	±0.07	±0.08	±0.09
1.00 or over to and excl. 1.25	±0.07	±0.07	±0.08	±0.09	±0.11
1.25 or over to and excl. 1.60	±0.08	±0.09	±0.10	±0.11	±0.13
1.60 or over to and excl. 2.00	±0.10	±0.11	±0.12	±0.13	±0.15
2.00 or over to and excl. 2.50	±0.12	±0.13	±0.14	±0.15	±0.17
2.50 or over to and excl. 3.15	±0.14	±0.15	±0.16	±0.17	±0.20
3.15 or over	±0.16	±0.17	±0.19	±0.20	—

**Table 17 Tolerances on thickness B**

Unit: mm

Thickness	Width			
	Under 160	160 or over to and excl. 250	250 or over to and excl. 400	400 or over to and excl. 630
Under 0.10	±0.010	±0.020	—	—
0.10 or over to and excl. 0.16	±0.015	±0.020	—	—
0.16 or over to and excl. 0.25	±0.020	±0.025	±0.030	±0.030
0.25 or over to and excl. 0.40	±0.025	±0.030	±0.035	±0.035
0.40 or over to and excl. 0.60	±0.035	±0.040	±0.040	±0.040
0.60 or over to and excl. 0.80	±0.040	±0.045	±0.045	±0.045
0.80 or over to and excl. 1.00	±0.04	±0.05	±0.05	±0.05
1.00 or over to and excl. 1.25	±0.05	±0.05	±0.05	±0.06
1.25 or over to and excl. 1.60	±0.05	±0.06	±0.06	±0.06
1.60 or over to and excl. 2.00	±0.06	±0.07	±0.08	±0.08
2.00 or over to and excl. 2.50	±0.07	±0.08	±0.08	±0.09
2.50 or over to and excl. 3.15	±0.08	±0.09	±0.09	±0.10
3.15 or over	±0.09	±0.10	±0.10	±0.11

### 8.3 Tolerances on width

The tolerances on width shall be as follows.

- The tolerances on width shall be applied to the nominal width.
- The tolerances on width shall be divided into A, B and C as given in table 18, table 19 and table 20, respectively. Table 18 shall be applied to those by ordinary cutting method, table 19 shall be applied to those by re-cut or precision cut and table 20 shall be applied to those by slit.

**Table 18 Tolerances on width A**

Unit: mm	
Width	
Under 1 250	1 250 or over
+7	+10
0	0
The plus side tolerances shall not be specified to the stretcher-levelled steel sheet.	

**Table 19 Tolerances on width B**

Unit: mm	
Width	
1 250 Under	1 250 or over
+3	+4
0	0

**Table 20 Tolerances on width C**

Unit: mm				
Thickness	Width			
	Under 160	160 or over to and excl. 250	250 or over to and excl. 400	400 or over to and excl. 630
Under 0.60	±0.15	±0.20	±0.25	±0.30
0.60 or over to and excl. 1.00	±0.20	±0.25	±0.25	±0.30
1.00 or over to and excl. 1.60	±0.20	±0.30	±0.30	±0.40
1.60 or over to and excl. 2.50	±0.25	±0.35	±0.40	±0.50
2.50 or over to and excl. 4.00	±0.30	±0.40	±0.45	±0.50
4.00 or over to and excl. 5.00	±0.40	±0.50	±0.55	±0.65

## 8.4 Tolerances on length

The tolerances on length shall be as follows.

- The tolerances on length shall be applied to the nominal length of the steel sheet.
- The tolerances on length shall be divided into A and B as given in table 21 and table 22, respectively. Table 21 shall be applied to those by ordinary cutting method and table 22 shall be applied to those by re-cut or precision cut.

**Table 21 Tolerances on length A**

Unit: mm	
Length	Tolerances
Under 2 000	+10 0
2 000 or over to and excl. 4 000	+15 0
4 000 or over to and excl. 6 000	+20 0
The plus side tolerances shall not be specified to the stretcher-levelled steel sheet.	

**Table 22 Tolerances on length B**

Unit: mm	
Length	Tolerances
1 000 Under	+3 0
1 000 or over to and excl. 2 000	+4 0
2 000 or over to and excl. 3 000	+6 0
3 000 or over to and excl. 4 000	+8 0

## 9 Shape

### 9.1 Flatness

The flatness of the steel sheet and strip shall be as follows.

- Flatness of steel sheet** The flatness of steel sheet shall be divided into A and B as given in table 23 and table 24, respectively. Table 24 shall generally be applied to

the stretcher-levelled steel sheet. The flatness shall be applied only to the steel sheet cut from the cold-reduced carbon steel strip of the standard temper grade of 600 mm or over in width. The flatness shall be measured by laying a steel sheet on a flat surface plate, and the value shall be determined by subtracting the thickness of the steel sheet from the maximum strain <sup>1)</sup> from the upper side of the flat surface of the steel sheet.

Note <sup>1)</sup> According to its shape and location of occurrence, the strain is categorized as follows.

Bow: curving of the whole steel sheet, either in the rolling direction or in the direction transverse to the rolling direction

Wave: rippling in rolling direction of the steel sheet

Edge wave: wave appearing on the edge of steel sheet (end part in the width direction)

Centre buckle: wave appearing on the centre part of the steel sheet

**Table 23 Maximum value of flatness A**

Unit : mm

Width	Type of strain		
	Bow, wave	Edge wave	Centre buckle
Under 1 000	12	8	6
1 000 or over to and excl. 1 250	15	9	8
1 250 or over to and excl. 1 600	15	11	8
1 600 or over	20	13	9

**Table 24 Maximum value of flatness B**

Unit : mm

Width	Type of strain		
	Bow, wave	Edge wave	Centre buckle
Under 1 000	2	2	2
1 000 or over to and excl. 1 250	3	2	2
1 250 or over to and excl. 1 600	4	3	2
1 600 or over	5	4	2

- b) **Flatness of steel strip** The flatness of the steel strip shall be as given in table 23; however it shall not be applied to the bow. Also, it shall be applied to the steel strip of standard temper grade and not to the irregular portions of the steel strip. The flatness of steel strip shall be inspected on the inspection station installed on the production line. When the measurement value is necessary, the measurement including the measurement method shall be reported upon the agreement between the purchaser and the manufacturer.

The measurement of flatness of steel strip may be omitted <sup>2)</sup>.



Note <sup>2)</sup> The omission of the measurement of flatness based on the judgment of the manufacturer is permissible on the precondition that the flatness shall satisfy the specified value.

## 9.2 Camber

The application of camber to the steel sheet and strip shall be as given in figure 1. The camber of steel sheet and strip shall be divided into A and B as given in table 25 and table 26, respectively. Table 26 shall be applied upon the agreement between the purchaser and the manufacturer, and when applied, the purport shall be indicated. The camber shall not be applied to the irregular portions of steel strip.

The measurement of camber may be omitted <sup>3)</sup>. However, when designated by the purchaser, the measurement shall be performed.

Note <sup>3)</sup> The omission of the measurement of camber based on the judgment of the manufacturer is permissible on the precondition that the camber shall satisfy the specified value.

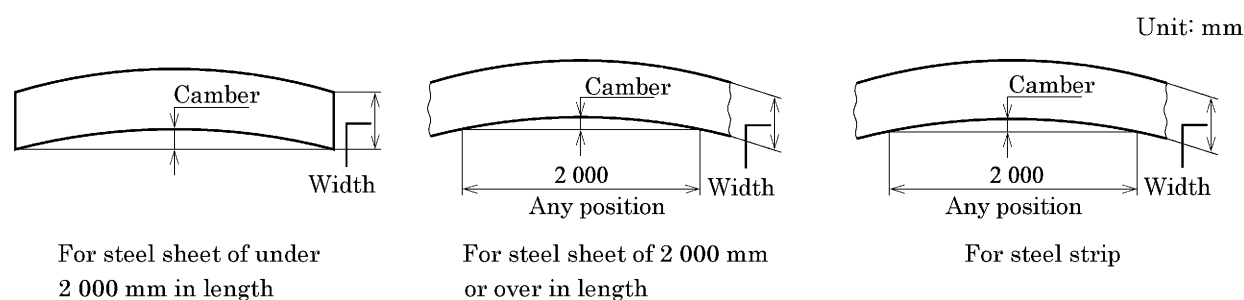


Figure 1 Application of camber to steel sheet and steel strip

Table 25 Maximum value of camber A

Unit : mm

Width	Division of steel sheet and steel strip		
	Steel sheet		Steel strip
	Under 2 000 in length	2 000 or over in length	
30 or over to and excl. 40	8	8 in any 2 000 in length	
40 or over to and excl. 630	4	4 in any 2 000 in length	
630 or over	2	2 in any 2 000 in length	

**Table 26 Maximum value of camber B**

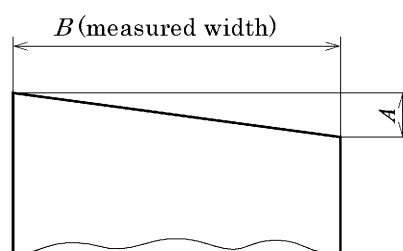
Unit : mm

Width	Division of steel sheet and steel strip		
	Steel sheet		Steel strip
	Under 2 000 in length	2 000 or over in length	
30 or over to and excl.40	25	25 in any 2 000 in length	
40 or over to and excl. 630	10	10 in any 2 000 in length	

### 9.3 Squareness

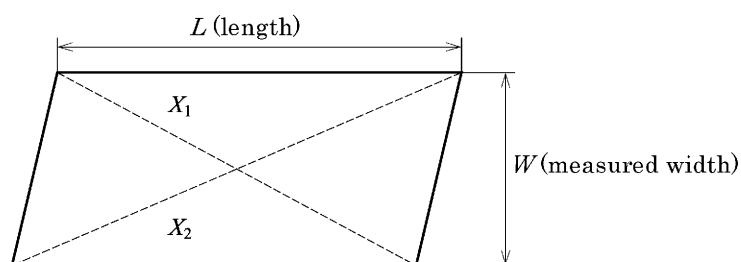
The squareness of steel sheet shall be in accordance with either of the following. However, in case of any doubt arising, the method a) shall be applied.

- a) **Method using perpendicular line** The squareness of steel sheet shall be expressed by the ratio  $(A/B)$ , where  $A$  indicates the distance between a perpendicular line from an edge drawn at a corner point and the corner point of the opposite edge, and  $B$  indicates the length of the perpendicular line (measured width), as shown in table 2, and this value shall not exceed 1.0 %.



**Figure 2 Squareness of steel sheet (method using perpendicular line)**

- b) **Method using diagonal lines** Half of the absolute value of the difference  $(|X_1 - X_2|/2)$  between each length of two diagonal lines ( $X_1$  and  $X_2$  in figure 3) of the steel sheet shall be obtained, and this value shall not exceed 0.7 % of the measured width  $W$  of the steel sheet.



**Figure 3 Squareness of steel sheet (method using diagonal lines)**

## 10 Mass

### 10.1 Mass of steel sheet

The mass of steel sheet shall be as follows.

- a) The mass of steel sheet shall be given in kilograms. Generally, for the steel sheet cut from the cold-reduced carbon steel strip of 600 mm or over in width, the theoretical mass shall be applied; and for the cold-reduced steel sheet of under 600 mm in width, the measured mass shall be applied.
- b) The calculation method of mass of steel sheet shall be as given in table 27.
- c) The standard mass of single bundle of steel sheet of 600 mm or over in width shall be 2 000 kg, 3 000 kg or 4 000 kg.

**Table 27 Calculation method of mass**

Calculation order	Calculation method	Number of digits in resultant <sup>b)</sup>
Basic mass                      kg/mm·m <sup>2</sup>	7.85 (mass of 1 mm in thickness per 1 m <sup>2</sup> in area)	—
Unit mass                      kg/m <sup>2</sup>	Basic mass (kg/mm · m <sup>2</sup> ) × thickness (mm)	Rounded off to 4 significant figures
Area of steel sheet              m <sup>2</sup>	Width (mm) × length (mm) × 10 <sup>-6</sup>	Rounded off to 4 significant figures
Mass of single sheet            kg	Unit mass (kg/ m <sup>2</sup> ) × area (m <sup>2</sup> )	Rounded off to 3 significant figures
Mass of single bundle          kg	Mass of single sheet (kg) × number of sheets in single bundle of same dimensions	Rounded off to integral number in kg
Total mass <sup>a)</sup> kg	Sum of the mass of each bundle	Integral number in kg
Notes <sup>a)</sup> The total mass may be calculated as mass of a single sheet (kg) × total number of sheets. <sup>b)</sup> The rounding off of numerical values shall be in accordance with the rule A of JIS Z 8401.		

## 10.2 Mass of steel strip

The mass of steel strip shall be as follows.

- a) The mass of steel strip shall be given as the measured mass in kilograms.
- b) For the mass of steel strip, the maximum mass shall generally be designated upon the agreement between the purchaser and the manufacturer, and the designated maximum mass shall generally be the following value or over.
  - 1) For the steel strip of 600 mm or over in width, 3 kg per 1 mm in width
  - 2) For the steel strip of under 600 mm in width, 1 kg per 1 mm in width

## 11 Oiling

The steel sheet and strip shall be oiled unless otherwise designated.

## 12 Appearance

The appearance shall be as follows.

- a) The steel sheet and strip shall be free from defects to the extent of detrimental to practical use. The defects on the surface shall generally be applied to one-side surface <sup>4)</sup> of the steel sheet and strip.

The steel strip may contain some irregular portions and welds, since the inspec-

tion thereof generally does not afford the manufacturer the opportunity to remove the defective portions.

NOTE: Defects are such as holes, laminations and surface flaws.

Note<sup>4)</sup> The one-sided surface generally refers to the surface of the upper side in packaging for the steel sheet and an outside surface for the steel strip.

- b) For the steel sheet and strip of as-annealed, the coil break, edge wave, etc. caused by the omission of temper rolling shall not be regarded as detrimental defects.
- c) For the steel sheet and strip for which "uncoil" is specified, rust, scratches and other defects likely to occur due to uncoiling shall not be regarded as the detrimental defects.

## 13 Tests

### 13.1 Chemical analysis test

#### 13.1.1 General matters and sampling method of chemical analysis test

The chemical composition of the steel sheet and strip shall be determined by heat analysis, and the general matters for chemical analysis test and the sampling method for analysis shall be as specified in clause 8 of JIS G 0404.

#### 13.1.2 Analytical method

The analytical method shall be as specified in JIS G 0320.

### 13.2 Mechanical test

#### 13.2.1 General matters of mechanical test

General matters of the mechanical test shall be as specified in clause 7 and clause 9 of JIS G 0404. In this case, the sampling method shall be Class A of 7.6 of JIS G 0404 and the number and the sampling position of test pieces shall be as follows.

- a) **Number of test pieces** Take one test piece from each coil while in cold rolling (hereafter referred to as the "coil").

When the mass of coil is under 3 000 kg, one test piece shall be taken from those of the same heat, same thickness, same rolling condition and same heat treatment, respectively.

- b) **Sampling position of test piece** The centre of a test piece shall be in the position 1/4 inward in the width direction or the position close to it. The tensile test piece and the bend test piece shall be taken parallel to the rolling direction.

#### 13.2.2 Tensile test

The tensile test shall be as follows.

- a) The test piece to be used shall be No. 5 test piece specified in JIS Z 2241. When sampling of No. 5 test piece is infeasible, the test piece shall be upon the agreement between the purchaser and the manufacturer.
- b) The test method shall be as specified in JIS Z 2241.

#### 13.2.3 Plastic strain ratio test

The test piece and the test method shall be as specified in JIS Z 2254.

#### 13.2.4 Hardness test

The test piece and the test method shall be as specified in JIS Z 2244 or JIS Z 2245.

#### 13.2.5 Bend test

The bend test shall be as follows.

The test for bendability may be omitted <sup>5)</sup>. However, when designated by the purchaser, the test shall be performed.

Note <sup>5)</sup> The test for bendability may be omitted by the judgment of the manufacturer on the precondition that the bendability shall satisfy the specified value.

- a) **Test piece** The test piece shall have a width of 15 mm to 50 mm and a suitable length of about twice the width. Unless otherwise specified, one test piece shall be taken from the sample parallel to the rolling direction.
- b) **Bending of test piece** The test piece shall be bent manually with a hand vise at 180° in the longitudinal direction of the test piece as shown in figure 4 with sandwiching the number of sheets specified in table 14 as the internal spacing. When a hand vise is not available, other suitable means of testing may be adopted.

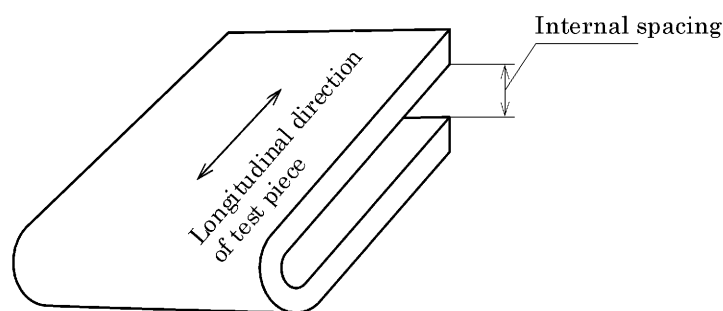


Figure 4 Direction of bend test

### 14 Inspection and re-inspection

#### 14.1 Inspection

The inspection shall be as follows.

- a) General requirements of inspection shall be as specified in JIS G 0404.
- b) The chemical composition shall comply with clause 4.
- c) The mechanical properties shall comply with clause 5.
- d) The dimensional tolerances shall comply with clause 8.
- e) The shape shall comply with clause 9.
- f) The mass shall comply with clause 10.
- g) The appearance shall comply with clause 12.

#### 14.2 Re-inspection

The steel sheet and strip which have failed in the mechanical test may be subjected

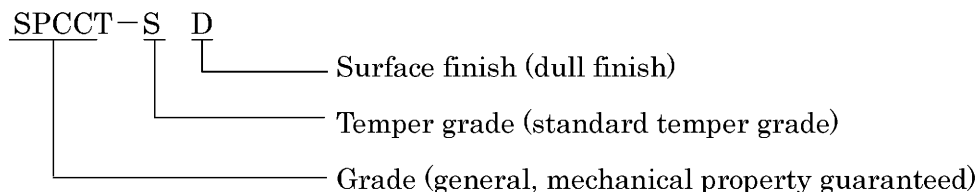
to a retest as specified in **9.8 of JIS G 0404** for final acceptance.

## 15 Packaging and marking

The steel sheet and strip which have passed the inspection shall generally be packaged and marked with the following items by suitable means. However, according to the agreement between the purchaser and the manufacturer, a part of them except **h)** may be omitted.

- a) Symbol of grade
- b) Symbol of temper grade
- c) Symbol of surface finish
- d) Serial number or inspection number
- e) Dimensions (see clause 6)
- f) Number of sheets or mass (omissible for the cold-reduced carbon steel sheet and strip of under 600 mm in width)
- g) Manufacturer's name or its identifying brand
- h) Symbol which denotes camber B : B (when applied)

Example: Expression of symbol of grade, symbol of temper grade and symbol of surface finish



## 16 Report

When there is a request from the purchaser beforehand, the manufacturer shall submit the inspection document to the purchaser. In this case, the report shall comply with the requirements in clause **13 of JIS G 0404**. However, the carbon in chemical composition may be reported by three decimal places. Unless otherwise designated, the type of inspection document shall comply with either standard designation 2.3 or 3.1.B in table 1 of **JIS G 0415**.

## Annex JA (informative)

### Additional information

#### Introduction

This Annex describes the reference values for the agreement between the purchaser and the manufacturer concerning the hardness of the standard temper grade and as-annealed, tensile strength and elongation of hard materials, as well as the notes on the contract, and is not to constitute the provisions of this Standard.

#### JA.1 Hardness of standard temper grade and as-annealed

The hardness of the standard temper grade and as-annealed is as given in either table JA.1 or table JA.2. However, the hardness values of HR30T, HR15T and HV may be converted to HRB hardness values according to the conversion table of table 9 to table 11 of the text. The test method is in accordance with 13.2 of the text.

NOTE 1 JIS Z 2245 specifies so that "After the test, no deformation shall be visible on the surface of the test piece opposite the indentation." Since the influence of the test can be detected on the backside of the test piece of the standard temper grade and as-annealed easier than of the hard materials, sufficient attention is required in selecting the scales for Rockwell hardness.

NOTE 2 When the diamond anvil is used at the time of measuring the hardness of HR30T or HR15T, the test allows the appearance of the indentation on the back of a test piece.

NOTE 3 HRB should not be used because the deformation of the test can easily be observed on the backside of the test piece.

**Table JA.1 Rockwell hardness of standard temper grade and as-annealed**

Temper grade	Symbol	Hardness		
		HRB	HR30T	HR15T
As-annealed	A	57 max.	54 max.	79 max.
Standard temper grade	S	65 max.	60 max.	82 max.

**Table JA.2 Vickers hardness of standard temper grade and as-annealed**

Temper grade	Symbol	HV
As-annealed	A	105 max.
Standard temper grade	S	115 max.

#### JA.2 Tensile strength and elongation of hard materials

The tensile strength and the elongation of hard materials are as given in table JA.3. The test method is in accordance with 13.2 of the text.

**Table JA.3 Tensile strength and elongation of hard materials**

Temper grade	Symbol	Tensile strength N/mm <sup>2</sup>	Elongation %	Tensile test piece
$\frac{1}{8}$ hard	8	290 to 410	25 min.	No. 5 test piece, rolling direction
$\frac{1}{4}$ hard	4	370 to 490	10 min.	
$\frac{1}{2}$ hard	2	440 to 590	—	
Full hard	1	550 min.	—	
NOTE: This table is applied to the steel sheet and strip of 0.25 mm or over in thickness and 30 mm or over in width.				

### JA.3 Notes on contract

It is recommended that the purchaser designates the following items on the contract.

#### a) General matters to be specified on ordering

- 1) Distinction of steel sheet and steel strip <sup>6)</sup>
- 2) Symbol of grade
- 3) Symbol of temper grade
- 4) Symbol of surface finish
- 5) Dimensions
- 6) Quantity
- 7) Mass of bundled steel sheets (if required)
- 8) Allowable range of total quantity of shipment to ordered quantity
- 9) Delivery date, delivery method and destination
- 10) Maximum mass for steel strip
- 11) Inside diameter for steel strip (if required)
- 12) Designation of uncoiling (if required)
- 13) Use

Note <sup>6)</sup> When ordering the cold-reduced carbon steel sheet and strip of under 600 mm in width, they should be designated as the "cold-rolled steel strip" at the time of ordering.

#### b) Temper grade and surface finish The steel sheet and strip are shipped with the following conditions, unless otherwise designated.

- 1) The cold-reduced carbon steel sheet and strip of 600 mm or over in width  
Standard temper grade and dull finish
- 2) The cold-reduced carbon steel sheet and strip of under 600 mm in width  
Standard temper grade and bright finish

#### c) Dimensional tolerances and flatness Unless otherwise designated, the following dimensional tolerances and flatness are applied. In other cases, the purport should be indicated.



- 1) The cold-reduced carbon steel sheet and strip of 600 mm or over in width  
Tolerances on thickness A, tolerances on width A, tolerances on length A and flatness A
- 2) The cold-reduced carbon steel sheet and strip of under 600 mm in width  
Tolerances on thickness B, tolerances on width B, and tolerances on length B
- d) **Others** Where the marking of the date of temper rolling for the standard temper grade is required, the purport should be indicated.

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## Bibliography

- [1] ASTM E140 *Standard Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, and Scleroscope Hardness*
- [2] SAE J417 *Hardness tests and hardness number conversions*

**Annex JB (informative)**  
**Comparison table between JIS and corresponding International Standard**

<b>JIS G 3141: 2011</b> <i>Cold-reduced carbon steel sheet and strip</i>	<b>ISO 3574 : 2008</b> <i>Cold-reduced carbon steel sheet of commercial and drawing qualities</i>
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(I) Requirements in <b>JIS</b>		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
1 Scope	The cold-reduced carbon steel sheet and strip are specified.		1		Identical		—
2 Normative references							
3 Classification and symbol	Five types of steel grade, temper grade division and surface finish division are specified.		1	Five types of steel grade are specified.	Addition	In <b>JIS</b> , temper grade division and surface finish division are added.	Wider range of cold-reduced carbon steel sheets are specified in <b>JIS</b> than those in <b>ISO</b> Standard.
4 Chemical composition	Chemical compositions of four elements, C, Mn, P and S are specified for five types of steel grade.		5.2	Chemical compositions of five elements, C, Mn, P, S and Ti are specified for five types of steel grade.	Alteration	P in SPCC is higher than that in <b>ISO</b> Standard. Ti is not specified for SPCG, while specified in <b>ISO</b> Standard.	SPCC requires higher composition of P than that in <b>ISO</b> Standard because it is often applied to the hard materials which are not specified in <b>ISO</b> Standard. It is specified in <b>JIS</b> that other alloying elements may be added as necessary .

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
5 Mechanical properties	The yield point or proof stress, tensile strength, elongation, average plastic strain ratio, hardness and bendability are specified.		5.6	Yield point or proof stress, tensile strength and elongation are specified.	Addition  Alteration	In ISO Standard, hardness and bendability are deleted at the time of revision.  JIS and ISO Standard differ in tensile strength and elongation. ISO Standard specifies tensile strength by the upper limit contrary to the lower limit in JIS.	Although bendability is deleted in ISO Standard, JIS specifies do that it shall be applied when requested. Provision of hardness is necessary for the hard materials of JIS. JIS and ISO Standard differ in the shape of the test piece and the tensile direction. Further, the lower limit of the tensile strength in JIS is the same as the value for reference in ISO Standard.
6 Expression of dimensions	The expression of dimensions is specified.		15		Identical		—
7 Standard thickness	The standard thickness is specified.		—		Addition	In JIS, the thickness used normally is specified as the standard thickness.	In JIS, the standard thickness is necessary for products of general use.
8 Dimensional tolerances	Dimensional tolerances on thickness, width and length are specified.		6	Tolerances on thickness, width, length, flatness, squareness and camber are specified.	Alteration	In JIS, the dimensional tolerances are severer than those of ISO Standard.	Proposal of tolerances of JIS will be submitted to ISO Standard.
9 Shape	The flatness, camber and squareness are specified.		6	Tolerances on thickness, width, length, flatness, squareness and camber are specified.	Alteration	In JIS, the dimensional tolerances are severer than those of ISO Standard.	Proposal of tolerances of JIS will be submitted to ISO Standard.

(I) Requirements in <b>JIS</b>		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
10 Mass	The mass is specified.		—		Addition	In <b>JIS</b> , the theoretical mass and the measured mass are specified.	Two types of mass are required according to the custom on business, and specified in <b>JIS</b> .
11 Oiling	The oiling is specified.		4.6		Identical		—
12 Appearance	The appearance is specified.		4.4 11		Identical		—
13 Tests	Chemical analysis test, tensile test, hardness test, bend test and plastic strain ratio test are specified.		5.3 7 8	Chemical analysis and tensile test are specified.	Addition	In <b>JIS</b> , hardness test, bend test and plastic strain ratio test are added.	In <b>JIS</b> , provisions for hardness test, bend test and plastic strain ratio test are added.
14.1 Inspection	The inspection is specified.		—	—	Addition	In <b>JIS</b> , inspection is specified in one clause, while it is specified in each clause in <b>ISO Standard</b> .	This is the unique configuration of <b>JIS</b> and is kept as it is.
14.2 Re-inspection	The re-inspection and the judgment are specified.		9 10		Identical		—
15 Packaging and marking	Packaging and eight items to be marked are specified.		14	Seven items to be marked are specified.	Addition	In <b>JIS</b> , the packaging is added.	Since packaging is required according to the custom on business, it is specified in <b>JIS</b> .
16 Report	Items to be reported according to the request by the purchaser are specified.		15	Report is submitted on the items requested by the purchaser.	Addition	In <b>JIS</b> , the decimal places of carbon in chemical composition to be reported is added as the specification.	Since carbon in chemical composition is required to be reported by 3 decimal places according to the custom on business in some cases, it is specified in <b>JIS</b> .

(I) Requirements in <b>JIS</b>		(II) Inter- national Standard number	(III) Requirements in Interna- tional Standard		(IV) Classification and details of technical deviation between <b>JIS</b> and the International Standard by clause		(V) Justification for the technical deviation and future measures
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
Annex JA (informative)	Hardness of the standard temper grade and as-annealed, tensile strength of the hard materials as well as the notes on the contract are described for reference.		13	The determination of the inside diameter, outside diameter of the coil and the maximum mass is specified.	Addition	In <b>JIS</b> , the hardness of standard temper grade and as-annealed, and the tensile strength of hard materials are added.	Since the hardness of standard temper grade and as-annealed and the tensile strength of hard materials may be used according to the custom on business, they are added in <b>JIS</b> .
—	—		15	Matters to be supplied by the purchaser are specified.			
—	—		3	Terms and definitions are specified.	Deletion	In <b>JIS</b> , terms and definitions are deleted.	Since terms are defined in <b>JIS G 0203</b> , it is kept as it is.
—	—		12	Acceptance inspection prior to shipment is specified.	Deletion	In <b>JIS</b> , acceptance inspection is deleted.	Since products of <b>JIS</b> are for general use and acceptance inspection prior to shipment is not carried out normally, it is deleted.

Overall degree of correspondence between **JIS** and International Standard (**ISO 3574** : 2008) : MOD

NOTE 1 Symbols in sub-columns of classification by clause in the above table indicate as follows:

- Identical: Identical in technical contents.
- Deletion: Deletes the specification item(s) or content(s) of International Standard.
- Addition: Adds the specification item(s) or content(s) which are not included in International Standard.
- Alteration: Alters the specification content(s) which are included in International Standard.

NOTE 2 Symbol in column of overall degree of correspondence between **JIS** and International Standard in the above table indicates as follows:

- MOD: Modifies International Standard.

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