JIS G3131 Hot-roll mild steel plates, sheet and strip

1. Scope

The Japanese Industrial Standard specifies the hot-rolled mild steel plates, sheets and strip (hereafter referred to as "steel sheet and coil")intended for general fabrication purposes and drawing.

Remarks

1. The standards cited in this Standard are given in Attached Table 1.

2. The corresponding International Standard of this Standard is given in the following:

ISO 3573: 1986 Hot-rolled carbon steel sheet of commercial and drawing qualities

3. A part of the corresponding International Standard listed in this Standard is given in the Annex. This Annex may be applied instead of the requirements specified in 1.,2.,3.,4. and 7. of this text.

4. The steel sheet and coil from which the scale has been removed after the hot-rolling operation by picking or grit blasting may be shipped on request by the purchaser.

2. Grade and symbol

The steel and coil shall be classified into 3 categories, and their symbols shall be as given in Table 1.

Table 1. Symbol of grade

Symbol of grade	Applicable thickness mm	Remarks
SPHC	1.2 or over, up to and incl. 14	Commercial quality
SPHD	1.2 or over, up to and incl. 14	Drawing quality
SPHE	1.2 or over, up to and incl. 6	Deep drawing quality

3. Chemical composition

The steel sheet and coil shall be tested in accordance with 7.1. and their cast analysis values shall be as given in Table 2.

Table 2. Chemical composition (Unit: %)

Symbol of grade	C	Mn	P	S
SPHC	0.15 max.	0.60 max.	0.050 max.	0.050 max.
SPHD	0.10 max	0.50 max.	0.040 max.	0.040 max.
SPHE	0.10 max.	0.50 max.	0.030 max.	0.035 max.

4. Mechanical properties

The steel sheet and coil shall be tested in accordance with 7.2 and their tensile strength, elongation and bendability shall be as specified in Table 3.

In the case of bend test, it shall bent without crack on the outside of the bent portion.

In addition, the drawability of SPHE may be agreed between the purchaser and supplier.

Table 3. Mechanical properties

Symbol of grade	Tensile strength N/mm	Elongation %						Tensile test piece	Bendability			
		Thickness 1.2 mm or over to and excl 1.6 mm	Thickness 1.6 mm or over to and excl 2.0mm	Thickness 2.0 mm or over to and excl 2.5 mm	Thickness 2.5 mm or over to and excl 3.2 mm	Thickness 3.2 mm or over to and excl 4.0 mm	Thickness 4.0 mm or over		Bending angle	Inside radius		Test piece
										Thickness up to and 3.2 mm	Thickness 3.2 mm or over	
SPHC	270 min.	27 min.	29 min.	29 min.	29 min.	31 min.	31 min.	No. 5, in rolling direction	180	Flat on itself	Thickness 0.5	No. 3, rolling direction
SPHD	270 min.	30 min.	32 min.	33 min.	35 min.	37 min.	39 min.		-	-	-	
SPHE	270 min.	31 min.	33 min.	35 min.	37 min.	39 min.	41 min.		-	-	-	

5. Shape, dimensions, mass and tolerances

The shape, dimensions, mass and their tolerances of the steel and coil shall conform to JIS G 3793

With this, respect, tolerances on length for the steel sheet and those on width for the cut edged steel sheet shall, unless otherwise specified, be in accordance with the tolerance A, and tolerances on thickness for the steel sheet and coil shall be as specified in Table 4.

Table 4. Tolerances on thickness

Thickness	Width			
	Up to and excl. 1200	1200 or over to and excl. 1500	1500 or over to and excl. 1800	1800 or over up to and incl. 2000
Up to and excl. 1.60	【 0.14	【 0.15	【 0.16	-
1.60 or over to and excl. 2.00	【 0.16	【 0.17	【 0.18	【 0.21
2.00 or over to and excl. 2.50	【 0.17	【 0.19	【 0.21	【 0.25
2.50 or over to and excl. 3.15	【 0.19	【 0.21	【 0.24	【 0.26
3.15 or over to and excl. 4.00	【 0.21	【 0.23	【 0.26	【 0.27
4.00 or over to and excl. 5.00	【 0.24	【 0.26	【 0.28	【 0.29

5.00 or over to and excl. 6.00	【 0.26	【 0.28	【 0.29	【 0.31
6.00 or over to and excl. 8.00	【 0.29	【 0.30	【 0.31	【 0.35
8.00 or over to and excl. 10.0	【 0.32	【 0.33	【 0.34	【 0.40
10.0 or over to and excl. 12.5	【 0.35	【 0.36	【 0.37	【 0.45
12.5 or over to and incl. 14.0	【 0.37	【 0.39	【 0.40	【 0.50

Note

(1) The vale shall be applied to the steel sheet and coil up to and excluding 1600 mm in width.

(2) The vale shall be applied to the steel sheet and coil up to and excluding 2000 mm in width.

Remarks

1. The thickness shall be measured at any point on the steel sheet and coil not less than 20 mm from a side edge. For the steel sheet and coil under 40 mm in width, measurement shall be made at the mid-width thereof.

2. The value specified in Table 4 shall not be applied to the irregular portions of both ends of the steel coil.

3. The tolerances on thickness of the steel sheet which is not manufactured from the steel coil may be agreed between the purchaser and supplier.

6. Appearance

The appearance of the steel sheet and coil shall conform to 6. (Appearance) of JIS G 3193

7. Test

7.1 Chemical analysis

7.1.1 General requirements and sampling method for chemical analysis

The chemical composition of the steel sheet and coil shall be determined by cast analysis, and the general requirements for chemical analysis and the sampling method of specimen for analysis shall be as specified in 3. (Chemical composition) of JIS G 0303

7.1.2 Test method The method for chemical analysis shall be in accordance with any one the following standard:

JIS G 1211, JIS G 1213, JIS G 1214, JIS G 1215, JIS G 1253, JIS G 1256, JIS G 1257, JIS G 1258

7.2 Mechanical test

7.2.1 Test in general The general requirements for mechanical testing shall be in accordance with the specifications in 4. (Mechanical properties) of JIS G 0303. With this respects, the sampling method of specimen shall conform to Class A, and the number of test pieces and the sampling position shall be as following:

(1) Number of test piece for tensile test and bend test

(a) For steel coil and cut lengths there from

Each one test piece for tensile and bend tests shall be taken from each test lot of the same heat rolled to the same thickness. When the mass of one test lot exceeds 50 t, however,

two sets of test pieces shall be taken from the lot.

(b) For steel sheet (excluding cut lengths there from)

Each on test piece for tensile and bend tests shall be taken from each test lot of the same heat where the maximum thickness of the steel sheet is within twice the minimum thickness thereof. When the mass of one test lot exceeds 50 t, however, two sets of test piece shall be taken from the lot.

(2) Sampling position and direction of tensile test and bend test piece

The test piece shall be taken parallel to the rolling direction and the center of the test piece shall be at a quarter-width from a side edge. When it is infeasible to alloy the center of the test piece to be at a quarter-width from a side edge, however, the sampling should be performed as close to the aforementioned position as possible.

7.2.2 Tensile test The tensile test shall be carried out as given in the following:

(1) As to a test piece, No. 5 test piece specified in JIS Z 2201 shall used.

(2) The test method shall be as specified in JIS Z 2241.

7.2.3 Bend test The bend test shall be carried out as given in the following:

(1) As to a test piece, No. 3 test piece specified in JIS Z 2204 shall be used.

(2) The test method shall be as specified in JIS Z 2248.

8. Inspection

8.1 Inspection

The inspection shall be carried out as follows:

(1) The general requirements for inspection shall be as specified in JIS G 0303.

(2) The chemical composition shall conform to the requirements specified in 3.

(3) The mechanical properties shall conform tot he requirements specified in 4.

(4) The shape, dimensions and mass shall conform tot he requirements specified in 5.

(5) The appearance shall conform to the requirements specified in 6.

8.2 Reinspection

The steel sheet and coil having failed to meet the requirements of the tensile test and/or the bend test may be subjected to a retest for final acceptance according to the specifications of 4.4 (Retest) in JIS G 0303.

9. Marking

The steel sheet and coil having passed the inspection shall be marked with the following details for each bundle by suitable means. The steel sheets which are not bundled shall be marked for each sheet.

(1) Symbol of grade

(2) Heat number or inspection number

(3) Dimensions
(4) The number of sheets for each bundle or mass
(5) Manufacturer's name or its identifying brand

10. Report

The manufacturer shall submit to the purchaser a report in accordance with the requirements of 8. (Report) in JIS G 0303 when required by the purchaser in advance.

Attached Table 1. Cited standards

JIS G 0303 General rules for inspection of steel
JIS G 1211 Iron and steel-Method for determination of carbon content
JIS G 1213 Method for determination of manganese in iron and steel
JIS G 1214 Method for determination of phosphorus in iron and steel
JIS G 1215 Iron and steel-Method for determination of sulfur content
JIS G 1253 Iron and steel-Method for spark discharge atomic emission spectrometric analysis
JIS G 1256 Method for X-ray fluorescence spectrometric analysis of iron and steel
JIS G 1257 Iron and steel-Methods for atomic absorption spectrometric analysis
JIS G 1258 Method for inductively coupled plasma emission petrochemical analysis of steel
JIS G 3193 Dimensions, mass and permissible variations of hot rolled steel plats, sheets and strip
JIS Z 2201 Test piece for tensile test for metallic materials
JIS Z 2204 Bend test piece for metallic materials
JIS Z 2241 Method of tensile test for metallic materials
JIS Z 2248 Method of bend test for metallic materials
ISO 6892 Metallic materials-Tensile testing
ISO 7438 Metallic material-bend test

Annex Hot-rolled carbon steel sheet of commercial and drawing qualities

Foreword

This Annex has been made out based on the scope, chemical composition, mechanical properties and mechanical property tests specified in ISO 3573: 1986 (Hot-rolled carbon steel sheet of commercial and drawing qualities which correspond to the text of this Standard.

It is not allowed to apply only a part of this Annex instead of the requirements specified in this text.

1. Scope and field of application

1.1 This Annex applies to hot-rolled carbon steel of commercial and drawing qualities.

Note (1) Hot-Rolled sheet up to but not including 3 mm in thickness is commonly known as "sheet". Hot-rolled sheet 3 mm and over is thickness in commonly known as either "sheet" or "plate".

(2) Steel that is to be subjected to subsequent rerolling is not covered by this Standard.

Hot-rolled steel sheet is suitable for many applications where the presence of oxide or scale, or normal surface imperfections disclosed after removal of oxide or scale, are not objectionable. It is not suitable for applications where surface is of prime importance.

1.2 Commercial quality sheet (HR1) is intended for general abricating purposes where sheet is used in the flat or for bending, moderate forming, and welding operations. It is commonly produced in the range of thickness 1.2mm to 12.5mm inclusive, and in widths of 600 mm and over and over, in coil and cut lengths.

1.3 Drawing quality sheet (HR2, HR3, HR4) is intended for drawing or severe forming, including welding. It is commonly produced in the range of thickness 1.6 mm to 12.5 mm inclusive, and in widths of 600 mm and over, in coil and cut lengths.

Drawing qualities quality

HR2 - drawing quality

HR3 -deep drawing quality

HR4 - deep drawing quality special killed

1.4 Hot-rolled sheet less than 600 mm wide may be slit from wide sheet and will be considered as sheet.

2. References

ISO 6892 Metallic materials - Tensile testing

ISO 7438 Metallic materials - Bend test

3. Chemical composition

The chemical composition (cast analysis) shall not exceed the value given in Annex Table 1.

Annex Table 1. Chemical composition (cast analysis)

Values as percentages by mass

Quality		C	Mn	P	S
Designation	Name				
HR1	Commercial	0.15 max.	0.60 max.	0.05 max.	0.05 max.
HR2	Drawing	0.12 max.	0.50 max.	0.04 max.	0.04 max.
HR3	Deep Drawing	0.10	0.45 max.	0.03 max.	0.03 max.

HR4	Deep Drawing special killed	0.08 max.	0.45 max.	0.03 max.	0.03 max.

4. Mechanical properties

At the time that the steel is made available for shipment, the mechanical properties shall be as given in Annex Table 2, when they are determined on test pieces obtained in accordance with the requirements of 6.

Prolonged storage of the sheet can cause a change in the mechanical properties (increase in hardness and a decrease in elongation), leading to a decrease in drawability. To minimize this effect, quality HR4 should be specified.

Annex Table 2. Mechanical property requirements for hot-rolled carbon steel sheet

Quality		Tensile strength (1) N/mm	Elongation (2)(3) %				180 x bend (3)	
Designation	Name		Up to and excl. 3 mm in thickness		3 mm or over, up to and incl. 6 mm in thickness		Inside radius	
			Gauge length		Gauge length		Up to and excl. 3 mm in thickness	3 mm or over up to and incl. 6 mm in thickness
			80 mm	50 mm	5.65	50 mm		
HR1	Commercial	-	-	-	-	-	Thickness 】 0.5	Thickness 】 1.0
HR2	Drawing	430 max.	25 min.	26 min.	28 min.	29 min.	-	-
HR3	Deep Drawing	370 max.	28 min.	29 min.	32 min.	33 min.	-	-
HR4	Deep Drawing special killed	390 max.	28 min.	29 min.	32 min.	33 min.	-	-

Note (1) Minimum tensile strength for qualities HR2, HR3 and HR4 would normally be expected to be 270 N/mm

All tensile strength values are determined to the nearest 10 N/mm

(2) The non-proportional test piece with a fixed original gauge length (50mm) up to 6 mm inclusive thick sheet can be used in conjunction with a conversion table (Informative Reference of This Annex). In case of dispute, however only the result obtained on a proportional test piece will be valid for material 3 mm and over on thickness.

(3) For materials over 6 mm in thickness, values for bend and elongation are subject to agreement between the manufacturer and purchaser.

(4) So: original cross-sectional area of gauge length

5. Sampling

5.1 Tensile test

One representative sample for the tensile test required in Annex Table 2 shall be taken from each lot of sheet for shipment. A lot consist of 50 t or less of sheet of the same designation rolled to the same thickness and condition.

5.2 Bend test

One representative sample for the bend test (application only to HR1) shall be taken from each lot of sheet for shipment. A lot consists of all sheet of the same designation rolled to the same thickness and condition.

6. Mechanical property tests

6.1 Tensile test

The tensile test shall be carried out in accordance with ISO 6892. Transverse test piece shall be taken midway between the center and edge of the sheet as rolled.

6.2 Bend test (applicable only for HR1)

The transverse bend test piece shall withstand being bent through 180 x , in the direction shown in Annex Figure 1 and outside of the bent portion. The bent test shall be carried out at ambient temperature and in accordance with ISO 7438.

Small cracks on the edges of test piece, and cracks not visible to the naked eye shall be disregarded.

Annex Figure 1. transverse bend test piece (after bending)

Informative reference Conversion of elongation values for various profiles of test pieces

This Informative reference supplements relating specified matters to the text and the Annex, but does but does not from a part of this Standard.

The conversion of elongation value from a proportional test piece (gauge length = 5.65()) to non-proportional gauge length is given in ISO 2566-1 (Steel-Conversion of elongation value-Part 1: Carbon and low alloy steels). A part of them is presented as given in Informative reference Table 1, accordingly. The relationship between each elongation value and the conversion factor is as follows:

Elongation value (on non-proportional test piece) = conversion factor 】 elongation value (on proportional test piece)

Informative reference Table 1. Conversion factor of elongation value from a proportional test piece (gauge length = 5.65 ()) to that of a nonproportional test piece

(So: orignal cross-sectional area)

Original cross-sectional area of test piece mm	Gauge length of non-proportional test piece		original cross-sectional area of test piece mm	Gauge length of non-proportional test piece	
	80 mm	50 mm		80 mm	50 mm
5	-	0.577	180	0.979	1.182
10	-	0.663	190	0.990	1.195
15	0.596	0.719	200	1.000	1.207
20	0.631	0.761	210	1.010	1.219
25	0.660	0.796	220	1.019	1.230

30	0.674	0.826	230	1.028	1.241
35	0.706	0.852	240	1.037	1.252
40	0.725	0.875	250	1.046	1.262
45	0.742	0.896	260	1.054	1.272
50	0.758	0.915	270	1.062	1.281
55	0.772	0.932	280	1.070	1.291
60	0.786	0.949	290	1.077	1.300
70	0.811	0.978	300	1.084	1.309
80	0.833	1.005	310	1.092	1.317
90	0.852	1.029	320	1.009	1.326
100	0.871	1.051	330	1.105	1.334
110	0.887	1.071	340	1.112	1.342
120	0.903	1.090	350	1.118	1.350
130	0.917	1.107	360	1.125	1.357
140	0.931	1.124	370	1.131	1.365
150	0.944	1.139	380	1.137	1.372
160	0.956	1.154	390	1.143	1.379
170	0.968	1.168	400	1.149	1.386

Remarks

1. For steels other than the mild steel plate, sheet and strip, ISO2566-1 should be referred.

2. Where either "gauge length/original cross-sectional area" exceeds table is not applicable.

3. For the steel sheet or plate up to and excluding 4 mm in thickness, the reliability of the conversion will become worse, so that agreement reliability of the conversion will become worse, so that agreement between the purchaser and supplier is necessary when this table is applied.