

UNOFFICIAL TRANSLATION

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**Thai Industrial Standard
For
Hot – rolled steel coil strip plate and sheet for automobile structural uses
TIS 1999-2543(2000)**

1. Scope

- 1.1 This standard specifies types, types of edge and grades, basic mass, dimension and tolerances, chemical composition, requirements, marking and labeling, sampling and criteria for conformity and testing for hot – rolled steel coil strip plate and sheet for automobile structural uses.
- 1.2 This standard covers hot – rolled steel coil strip plate and sheet with press drawability to be used for automobile frames, wheels, etc.
- 1.3 This standard does not cover:
 - 1.3.1 hot – rolled steel coil strip plate and sheet for other purposes which have been specified by the particular standard.
 - 1.3.2 hot – rolled steel coil strip plate and sheet which will be finished by cold rolling

2. Definitions

For the purpose of this standard, the following definitions apply:

- 2.1 hot – rolled steel coil strip plate and sheet for automobile structural uses which shall be referred to hereinafter as steel : steel having chemical composition as specified in clause 5.1 and mechanical property as specified in table 9 or table 10 and table 11.
- 2.2 hot – rolled steel coil strip plate and sheet finished by cold rolling: hot – rolled steel coil strip plate and sheet which will be finished by such an un-heat rolling process that does not include skin pass or temper rolling.
- 2.3 skin pass: rolling after hot-rolling, the purpose of skin pass is one or more of the following: to control shape, hardness, flatness, surface finish and to minimize the appearance of stretcher strains or coil breaks.
- 2.4 mill edge: edge of steel generated by hot rolling as it is, not to be cut and possibly containing some irregularities such as cracked or torn edges or thin edges.
- 2.5 cut edge: edge of steel generated by cutting after hot rolling.
- 2.6 normal cut edge: edge of steel generated by first cutting to the required width and length.
- 2.7 resheared or fine cut edge: edge of steel generated by re-cutting after the first cutting.
- 2.8 slitted edge: edge of steel generated by cutting to the delivery required dimension.

3. Types, types of edge and grade

- 3.1 Steel are classified into 4 types as follows:
 - 3.1.1 Steel coil i.e. steel in coil form with the width equal and above 600 mm and the thickness not exceed 14.00 mm.
 - 3.1.2 Steel strip i.e. steel strip in coil form, the width is less than 600 mm, the thickness is not exceed 14.00 mm.
 - 3.2.3 Steel plate i.e. steel of 3.15 to 14.00 mm in thickness.
 - 3.1.4 Steel sheet i.e. steel sheet having thickness less than 3.15 mm.
- 3.2 Steel are classified according to types of edge into 2 types as follows:
 - 3.2.1 Mill edge
 - 3.2.2 Cut edge

3.3 Steel are classified according to mechanical properties into 4 grades as follow:

- 3.3.1 SAPH 310
- 3.3.2 SAPH 370
- 3.3.3 SAPH 400
- 3.3.4 SAPH 440

4. Basic mass, dimension and tolerance

4.1 Basic mass of steel shall be 7.85 kg per mm thickness per m² area and given as the recommendation.

4.2 Dimension and tolerance

4.2.1 Dimension

shall be as given in table 1

4.2.2 Tolerance

4.2.2.1 Thickness shall be as given in table 2. Restricted thickness tolerances for steel are given in table 3

4.2.2.2 Width shall be in as given in table 4

4.2.2.3 Length shall be as given in table 5

Compliance is checked by the test of clause 9.1.

4.3 Tolerances on camber

4.3.1 Tolerances on camber for cut edge steel coil and strip shall be not exceed the values given in table 6

4.3.2 Tolerances on camber for cut edge steel plate and sheet shall be not exceed the values given in table 7

Compliance is checked the test of clause 9.2.

4.4 Out-of-square of cut edge steel plate and sheet

After the test of clause 9.3, the out-of-square at the angle shall be not exceed 1% of width.

4.5 Flatness of cut edge steel plate and sheet

Place the steel plate and sheet under its own weight on flat surface, deviation of flatness shall be not exceed the values given in table 8.

Compliance is checked by the test of clause 9.4.

Table 1 Dimension of steel

(Clause 4.2.1)

unit : mm

Dimension	Steel coil	Steel strip	Steel plate	Steel sheet
Thickness	Not over 14.00	Not over 14.00	3.15 to 14.00	Less than 3.15
Width	600 and above	Less than 600	As the agreement between supplier and purchaser	As the agreement between supplier and purchaser
Length	Not specified	Not specified	As the agreement between supplier and purchaser	As the agreement between supplier and purchaser

Note For steel coil and strip, the inside and outside diameter of the coil shall be agreed between the supplier and purchaser.

Table 2 Tolerances on thickness
(Clause 4.2.2.1)

unit : mm

Thickness	Tolerance on thickness				
	Width of less than 1 600	Width of 1 600 to less than 2 000	Width of 2 000 to less than 2 500	Width of 2 500 to less than 3 150	Width of 3 150 to less than 4 000
less than 1.25	± 0.16	-	-	-	-
1.25 to less than 1.60	± 0.18	-	-	-	-
1.60 to less than 2.00	± 0.19	± 0.23	-	-	-
2.00 to less than 2.50	± 0.20	± 0.25	-	-	-
2.50 to less than 3.15	± 0.22	± 0.29	+ 0.29	-	-
3.15 to less than 4.00	± 0.24	± 0.34	± 0.34	-	-
4.00 to less than 5.00	± 0.45	± 0.55	± 0.55	± 0.65	-
5.00 to less than 6.30	± 0.50	± 0.60	± 0.60	± 0.75	± 0.75
6.30 to 14.00	± 0.55	± 0.65	± 0.65	± 0.80	± 0.80

Table 3 Tolerances on restricted thickness for steel
(Clause 4.2.2.1)

unit : mm

Thickness	Tolerance on thickness			
	Width of 600 to less than 1 200	Width of 1 200 to less than 1 500	Width of 1 500 to less than 1 800	Width of 1 800 to less than 2 000
1.60 to less than 2.00	± 0.16	± 0.17	± 0.18	-
2.00 to less than 2.50	± 0.17	± 0.19	± 0.21	-
2.50 to less than 3.15	± 0.19	± 0.21	± 0.24	-
3.15 to less than 4.00	± 0.21	± 0.23	± 0.26	-
4.00 to less than 5.00	± 0.24	± 0.26	± 0.28	± 0.29
5.00 to less than 6.00	± 0.26	± 0.28	± 0.29	± 0.31
6.00 to less than 8.00	± 0.29	± 0.30	± 0.31	± 0.35
8.00 to less than 10.00	± 0.32	± 0.33	± 0.34	± 0.40
1.00 to less than 12.50	± 0.35	± 0.36	± 0.37	± 0.45
12.50 to 14.00	± 0.38	± 0.39	± 0.40	± 0.50

Note Tolerances on restricted thickness for steel plate and sheet which are not manufactured from steel coil and sheet shall be agreed between the purchaser and the supplier.

Table 4 Tolerance on width
(Clause 4.2.2.2)

unit : mm

Width	Thickness	Tolerance				
		Mill edge		Cut edge		
		Steel plate and sheet	Steel coil and cut lengths therefrom	Normal cut edge	Resheared or fine cut edge	Slitted edge
Under 160	less than 3.15	-	-	+5 0	+2 0	± 0.3
	3.15 to less than 6.00			+5 0	+3 0	± 0.5
	6.00 to 14.00			+10 0	+4 0	-
160 to less than 250	less than 3.15	-	-	+5 0	+2 0	± 0.4
	3.15 to less than 6.00			+5 0	+3 0	± 0.5
	6.00 to 14.00			+10 0	+4 0	-
250 to less than 400	less than 3.15	+ Not specified 0	-	+5 0	+2 0	± 0.5
	3.15 to less than 6.00			+5 0	+3 0	± 0.5
	6.00 to 14.00			+10 0	+4 0	-
400 to less than 630	less than 3.15	+ Not specified 0	+ 20 0	+10 0	+3 0	± 0.5
	3.15 to less than 6.00			+10 0	+3 0	± 0.5
	6.00 to 14.00			+10 0	+5 0	-
600 to less than 1000	less than 3.15	+ Not specified 0	+25 0	+10 0	+4 0	-
	3.15 to less than 6.00			+10 0	+4 0	
	6.00 to 14.00			+10 0	+6 0	
1000 to less than 1250	less than 3.15	+ Not specified 0	+30 0	+10 0	+4 0	-
	3.15 to less than 6.00			+10 0	+4 0	
	6.00 to 14.00			+15 0	+6 0	
1250 to less than 1600	less than 3.15	+ Not specified 0	+35 0	+10 0	+4 0	-
	3.15 to less than 6.00			+10 0	+4 0	
	6.00 to 14.00			+15 0	+6 0	
1600 and over	less than 3.15	+ Not specified 0	+40 0	+10 0	+4 0	-
	3.15 to less than 6.00			+10 0	+4 0	
	6.00 to 14.00			+1.2% 0	+6 0	

Table 5 Tolerance on length
(Clause 4.2.4)

unit : mm

Length	Thickness	Normal cut edge	Resheared or fine cut edge
Under 6300	less than 6.00	+25 0	+5 0
	6.00 to 14.00	+25 0	+10 0
6300 or over	less than 6.00	+0.5% 0	+10 0
	6.00 to 14.00	+0.5% 0	+15 0

Table 6 Tolerances on camber for cut edge steel coil and steel strip
(Clause 4.3.1)

unit : mm

Width	Tolerances on camber in any 2000 length
Under 250	8
Over 250	5

Table 7 Tolerances on camber for cut edge steel plate and sheet
(Clause 4.3.2)

unit : mm

Length	Tolerances on camber		
	Width of 250 to less than 630	Width of 630 to less than 1000	Width of 1000 and over
Under 2500	5	4	3
2500 to less than 4000	8	6	5
4000 to less than 6300	12	10	8
6300 to less than 10000	20	16	12
10000 or over	20 in any 10000 length	16 in any 10000 length	12 in any 10000 length

Note For cut edge steel plate and sheet of less than 250 mm in width, tolerances on camber as given in Table 6 shall be applied.

Table 8 Tolerances on flatness for cut edge steel plate and sheet
(Clause 4.5)

unit : mm

Thickness	Tolerances on flatness				
	Width of less than 1250	Width of 1250 to less than 1600	Width of 1600 to less than 2000	Width of 2000 to less than 3000	Width of 3000 and over
Less than 3.15	16	18	20	-	-
3.15 to less than 4.00	16			-	-
4.00 to less than 6.00	14			24	25
6.00 to less than 10.00	13			21	22
10.00 to 14.00	12			16	17

Note The values given in Table 8 shall be applied to any 2000 mm length, and for cut edge steel plate and sheet of less than 2000 mm in length, the values shall be applied to the full length.

5. Chemical composition

5.1 Chemical composition

Chemical composition determined by means of cast analysis, phosphorus shall not exceed 0.040% and sulfur shall not exceed 0.040%, or when determined by product analysis, the values may be higher than maximum values by not exceed 0.01%.

The testing shall be carried out by general chemical analysis or other equivalent method.

6. Requirements

6.1 General characteristics

Steel shall have smooth surface and free from such defects as rolled-in scale, lamination, seam or crack that are detrimental to practical use.

Compliance is checked by visual inspection or other equivalent method.

6.2 Mechanical properties

6.2.1 Tensile strength and elongation

shall be as given in Table 9. Restricted tensile strength and elongation shall be as given in table 10 and 11

Testing shall be in accordance with JIS Z 2241. The test piece shall be taken in parallel to the rolling direction. The form and dimension of test piece shall conform to Fig. 1 or Fig.2.

6.2.2 Bending

After the test of clause 9.5, no cracks shall be generated on the outside surface of the bend portion of the test piece.

Table 9 Tensile strength and elongation
(Clause 6.2.1)

Grades	Tensile strength min. MPa	Yield strength min MPa			Elongation, min %						
					No.5 test piece						No.1A test piece
		Thickness of less than 6 mm	Thickness of 6 mm to less than 8 mm	Thickness of 8 mm to 14 mm	Thickness of less than 2.0 mm	Thickness of 2.0 mm to less than 2.5 mm	Thickness of 2.5 mm to less than 3.15 mm	Thickness of 3.15 mm to less than 4.0 mm	Thickness of 4.0 mm to less than 6.3 mm	Thickness of 6.3 and over	
SAPH 310	310	185*	185*	175*	33	34	36	38	40	26	
SAPH 370	370	225	225	215	32	33	35	36	37	25	
SAPH 400	400	255	235	235	31	32	34	35	36	24	
SAPH 440	440	305	295	275	29	30	32	33	34	22	

Note * Given as the recommendation.

Table 10 Restricted tensile strength
(Clause 6.2.1)

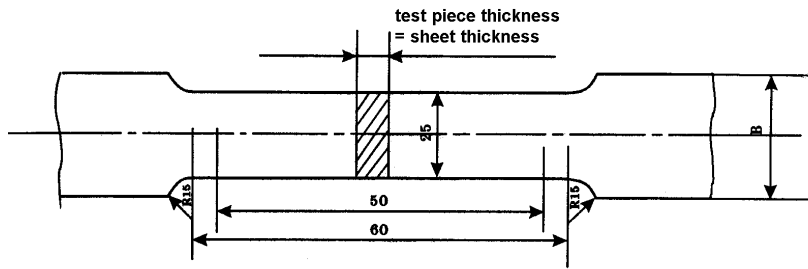
Grades	Tensile strength, min Mpa	Yield strength MPa							
		Thickness of less than 1.60 mm	Thickness of 1.60 mm to less than 2.00 mm	Thickness of 2.00 mm to less than 2.50 mm	Thickness of 2.50 mm to less than 3.20 mm	Thickness of 3.20 mm to less than 4.00 mm	Thickness of 4.00 mm to less than 6.30 mm	Thickness of 6.30 mm to less than 8.00 mm	Thickness of 8.00 mm to less than 14.00 mm
SAPH 370	370	235 to 355	225 to 345	215 to 335	215 to 335	205 to 325	205 to 325	195 to 315	195 to 315
SAPH 400	400	255 to 375	245 to 365	235 to 355	235 to 355	225 to 345	225 to 345	215 to 335	215 to 335
SAPH 440	440	295 to 410	285 to 400	275 to 390	275 to 390	265 to 380	265 to 380	225 to 370	255 to 370

- Note 1 The values are applied to the 3 grades only.
2 No. 5 test piece shall be prepared.

Table 11 Restricted elongation
(Clause 6.2.1)

Grades	Tensile strength, min Mpa	Elongation %							
		Thickness of less than 1.60 mm	Thickness of 1.60 mm to less than 2.00 mm	Thickness of 2.00 mm to less than 2.50 mm	Thickness of 2.50 mm to less than 3.20 mm	Thickness of 3.20 mm to less than 4.00 mm	Thickness of 4.00 mm to less than 6.30 mm	Thickness of 6.30 mm to less than 8.00 mm	Thickness of 8.00 mm to less than 14.00 mm
SAPH 370	370	33 to 46	34 to 47	35 to 48	35 to 48	36 to 49	37 to 50	Not less than 40	Not less than 40
SAPH 400	400	31 to 44	32 to 45	33 to 46	34 to 47	35 to 48	36 to 49	Not less than 38	Not less than 38
SAPH 440	440	28 to 41	29 to 42	30 to 43	32 to 45	33 to 46	34 to 47	Not less than 35	Not less than 35

- Note 1 The values are applied to the 3 grades only.
2 No. 5 test piece shall be prepared.



Note In the case of steel sheet not more than 3 mm in thick, the radius R of fillet shall be 20 mm to 30 mm, and the width B shall be 30 mm or over.

Figure 1 No.5 test piece
(Clause 6.2.1)

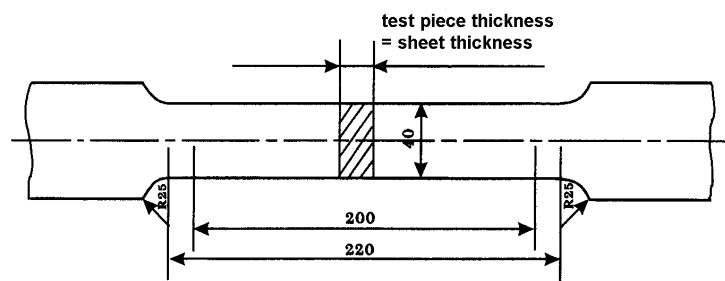


Figure 2 No. 1A test piece
(Clause 6.2.1)

7. Marking and labeling

7.1 Each end of coil of steel coil and strip and each bundle of steel plate and sheet shall bear at least number letter or mark indicating legibly and clearly the following information:

- (1) Type, the type of edge and grade;
- (2) Thickness x width x length expressed in mm x mm x mm (in case of steel coil and strip, the length does not required);
- (3) Mass expressed in kg;
- (4) Melting number or the lot number;
- (5) Name of manufacturer, factory or registered trade mark;
- (6) Country of manufacture

In case foreign language is used, the meaning shall correspond to that in Thai specified above.

8. Sampling and criteria for conformity

8.1 Lot : Steel of the same type grade and dimension manufacture by the same process which are manufactured or delivered or purchased at the same period of time.

8.2 Sampling and acceptance shall comply with the sampling plan below or other technically equivalent sampling plan.

8.2.1 Sampling and acceptance for testing on dimension, camber tolerance and general characteristic for steel coil and strip.

8.2.1.1 Samples shall be taken at random from the same lot. Number of samples shall be as specified in Table 12

8.2.1.2 Provided that samples failing to comply with each of the requirements of clause 4.2, 4.3 and 6.1 does not exceed the acceptance number specified in Table 12, that lot shall be deemed as conforming to the requirements.

Table 12 Sampling plan for testing on dimension, camber tolerance and general characteristics for steel coil and strip
(Clause 8.2.1)

Lot size coil	Sample size coil	Acceptance number
Not over 50	3	0
51 and over	13	1

Note For testing on dimension, sample of 2 m in length shall be cut at approximately 500 mm from either end of a coil.

8.2.2 Sampling and acceptance for testing on dimension, camber tolerance, out of square, flatness and general characteristic for steel plate and sheet.

8.2.2.1 Samples shall be taken at random from the same lot. Number of samples shall be as specified in Table 13.

8.2.2.2 Provided that samples failing to comply with each of the requirements of clause 4.2, 4.3, 4.4, 4.5 and 6.1 does not exceed the acceptance number specified in Table 13, that lot shall be deemed as conforming to the requirements.

Table 13 Sampling plan for testing on dimension, camber tolerance, out of square, flatness and general characteristics for steel plate and sheet
(Clause 8.2.2)

Lot size plate	Sample size plate	Acceptance number
Not over 100	3	0
101 and over	13	1

8.2.3 Sampling and acceptance for testing on chemical composition

8.2.3.1 Three samples complying with clause 8.2.1.2 or 8.2.2.2 shall be taken at random.

8.2.3.2 Provided that all samples meet the requirements of clause 5.1, that lot shall be deemed to comply with the requirements.

8.2.4 Sampling and acceptance for testing on mechanical properties

8.2.4.1 Three samples shall be randomly taken from the same lot of the mass not exceed 1000 tons, when the mass of the lot exceeds 1000 tons, additional three sample shall be taken. All samples shall each be of adequate size for making the test piece for testing on tensile strength, elongation and bending.

8.2.4.2 Provided that all samples meet the requirements of clause 6.2, that lot shall be deemed to comply with the requirements.

8.3 Criteria for conformity

Provided that all samples meet the requirements of clauses 8.2.1.2, 8.2.2.2, 8.2.3.2 and 8.2.4.2, that lot shall be deemed to comply with this standard.

9. Testing

9.1 Dimension

9.1.1 Thickness

9.1.1.1 Apparatus

A measuring device having an accuracy of 0.005 mm.

9.1.1.2 Measurement

(1) Steel coil and strip

In case of mill edge, the measurement shall be carried out at the position not less than 25 mm from the both edges.

In case of cut edge, the measurement shall be carried out at the position not less than 15 mm from the both edges for test piece having 30 mm or over in width. As for test piece having less than 30 mm in width, the measurement shall be carried out at least three points of each edge at the center of the test piece.

(2) Steel plate and sheet

In case of mill edge, the measurement shall be carried out at least three points at the position not less than 25 mm from all edges.

In case of cut edge, the measurement shall be carried out at least three points at the position not less than 15 mm from all edges.

9.1.1.3 Report

The average value shall be reported.

9.1.2 Width

9.1.2.1 The width shall be measured by a measurement device having an accuracy of 0.5 mm at the position approximately 100 mm from the both ends for steel plate and sheet, and 1000 mm from both ends for steel coil and strip. The average value shall be reported.

9.1.2.2 For slitted edge steel, the measurement shall be carried out by a measurement device having an accuracy of 0.05 mm.

9.1.3 Length for steel plate and sheet

The length shall be measured by a measurement device having an accuracy of 1 mm at the position approximately 100 mm from the both edges. The average value shall be reported.

9.2 Camber tolerance

9.2.1 Cut edge steel coil and steel strip

Place the test piece on a flat surface, maximum deviation of camber (a) shall be measured by measurement device having an accuracy of 0.5 mm with 2000 mm in cord length, the measurement being taken as shown in Figure 3.

9.2.2 Cut edge steel plate and sheet

The test shall be as same as clause 9.2.1 with 10000 mm in cord length.

Cut edge steel plate and sheet of less than 10000 mm in length, the full length shall be applied.

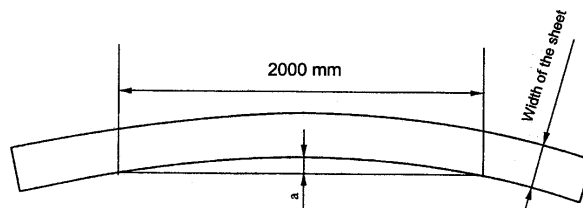


Figure 3 Measurement of camber tolerance
(Clause 9.2.1)

9.3 Out-of-square of cut edge steel plate and sheet

The deviation (A) of an end edge shall be measured by measurement device having an accuracy of 0.5 mm from a straight line at right angle to a side and touching one corner, the measurement being taken as shown in Figure 4.

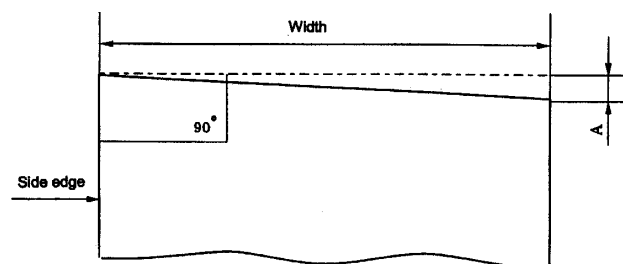


Figure 4 Measurement of Out-of-square
(Clause 9.3)

9.4 Flatness for steel plate and sheet

Place the sample on the flat surface, the flatness tolerance is the maximum distance between the lower surface of the sheet and the flat horizontal surface which be measured by measurement device having an accuracy of 0.5 mm

9.5 Bending

The No.5 test piece as Fig.5 shall be taken in perpendicular to the rolling direction. The test piece shall withstand being bent through 180°, and the legs of test piece are parallel to each other, the diameter of mandrel shall be as given in Table 14.

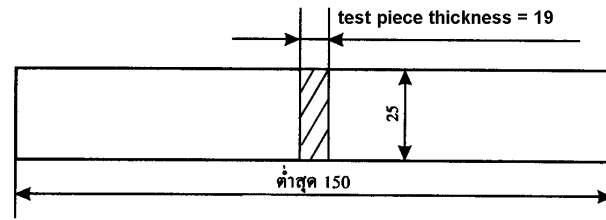


Figure 5 Bending test piece
(Clause 9.5)

Table 14 Bending
(Clause 9.5)

Unit : mm

Grade	Thickness	Diameter of mandrel
SAPH 310	Less than 2.00	Close contact, the mandrel is not required
	Not less than 2.00	2 times test piece thickness
SAPH 370	Less than 2.00	Test piece thickness
	Not less than 2.00	2 times test piece thickness
SAPH 400	Less than 2.00	2 times test piece thickness
	Not less than 2.00	2 times test piece thickness
SAPH 440	Less than 2.00	2 times test piece thickness
	Not less than 2.00	3 times test piece thickness