

UNOFFICIAL TRANSLATION

In the event of any doubt or misunderstanding arising from this translation, the standard in Thai will be held to be authoritative

**TIS 1884-2542 (1999)**  
**Thai Industrial Standard**  
**For**  
**Hot – rolled high strength steel coil strip plate and sheet**  
**with improved formability for automobile structural uses**

### 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 high strength steel coil strip plate and sheet with improved formability for automobile structural uses.
- 1.2 This standard covers the hot – rolled high strength steel coil strip plate and sheet with improved formability to be used for automobile structure.
- 1.3 This standard does not cover :
  - 1.3.1 hot – rolled high strength steel coil strip plate and sheet with improved formability for other purposes which have been specified by the particular standard.
  - 1.3.2 hot – rolled high strength steel coil strip plate and sheet with improved formability which will be finished by cold rolling.

### 2. Definitions

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

- 2.1 hot – rolled high strength steel coil strip plate and sheet with improved formability for automobile structural uses which shall be referred to hereinafter as steel : steel obtained by the process of hot rolling and having mechanical properties as specified in 6.2.
- 2.2 hot – rolled high strength 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 or roll forming.
- 2.3 skin pass or temper rolling: cold-rolling and annealed sheet, the purpose of skin passing 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 6.00 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 6.00 mm.
  - 3.1.3 Steel plate i.e. steel of 3.15 to 6.00 mm in nominal thickness (for grades SPFH 490 SPFH 540 and SPFH 590) and 3.15 mm to 4.00 mm in nominal thickness (for grades SPFH 540Y and SPFH 590Y) and having the width as agreed between manufacturer and purchaser.
  - 3.1.4 Steel sheet i.e. steel sheet having nominal thickness less than 3.15 mm and the width as agreed between manufacturer and purchaser.

- 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 5 grades as follows:
- 3.3.1 Grade SPFH 490
  - 3.3.2 Grade SPFH 540
  - 3.3.3 Grade SPFH 590
  - 3.3.4 Grade SPFH 540Y, improved yield strength for suitable forming quality.
  - 3.3.5 Grade SPFH 590Y, improved yield strength for suitable forming quality.

#### 4. Basic mass, dimension and tolerance

- 4.1 Basic mass of steel shall be 7.85 kg per mm thickness per m<sup>2</sup> 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.
    - 4.2.2.2 Width shall be in as given in table 3.
    - 4.2.2.3 Length shall be as given in table 4
 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 plate and sheet shall be not exceed the values given in table 5
  - 4.3.2 Tolerances on camber for cut edge steel coil and strip shall be not exceed 5 mm in any length of 2000 mm. Compliance is checked by 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 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 6.  
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 (for grades SPFH490 SPFH 540 and SPFH 590)	Not over 6.00	Not over 6.00	3.15 to 6.00	Less than 3.15
Thickness (for grades SPFH 540Y and SPFH 590Y)	Not over 4.00	Not over 4.00	3.15 to 4.00	Less than 3.15
Width	600 and above	Less than 600	As the agreement between manufacturer and purchaser	As the agreement between manufacturer and purchaser
Length	Not specified	Not specified	As the agreement between manufacturer and purchaser	As the agreement between manufacturer and purchaser

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

**Table 2 Tolerances on thickness**  
(clause 4.2.2.1)

unit : mm

Thickness	Tolerance on thickness			
	Width of 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 2 160
less than 2.00	± 0.16	± 0.19	± 0.20 <sup>(1)</sup>	-
2.00 to less than 2.50	± 0.18	± 0.22	± 0.23 <sup>(1)</sup>	-
2.50 to less than 3.15	± 0.20	± 0.24	± 0.26 <sup>(1)</sup>	-
3.15 to less than 4.00	± 0.23	± 0.26	± 0.28	± 0.30
4.00 to less than 5.00	± 0.26	± 0.29	± 0.31	± 0.32
5.00 to less than 6.00	± 0.29	± 0.31	± 0.32	± 0.34
6.00	± 0.32	± 0.33	± 0.34	± 0.38

Note <sup>(1)</sup> for steel of less than 1 600 mm in width.

**Table 3 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	
400 to less than 630	less than 3.15	-	+ 20 0	+ 10 0
	3.15 to less than 6.00	+ Not specified 0		+ 10 0
	6.00			+ 10 0
630 to less than 1000	less than 3.15	-	+25 0	+ 10 0
	3.15 to less than 6.00	+ Not specified 0		+ 10 0
	6.00			+ 10 0
1000 to less than 1250	less than 3.15	-	+30 0	+ 10 0
	3.15 to less than 6.00	+ Not specified 0		+ 10 0
	6.00			+ 15 0
1250 to less than 1600	less than 3.15	-	+35 0	+ 10 0
	3.15 to less than 6.00	+ Not specified 0		+ 10 0
	6.00			+ 15 0
1600 and over	less than 3.15	-	+40 0	+ 10 0
	3.15 to less than 6.00	+ Not specified 0		+ 10 0
	6.00			+ 1.2% 0

**Table 4 Tolerance on length**  
(clause 4.2.2.3)

unit : mm

Length	Tolerance on length
Under 6 300	+ 25 0
6 300 and over	+ 0.5% 0

**Table 5 Tolerances on camber for cut edge steel plate and sheet**  
(clause 4.3.1)

unit : mm

Length	Tolerances on camber		
	Width of 400 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

**Table 6 Tolerances on flatness for steel plate and sheet**  
(clause 4.5)

unit : mm

Grade	Thickness	Tolerances on flatness			
		Width of less than 1 250	Width of 1250 to less than 1600	Width of 1600 to less than 2000	Width of 2000 and over
SPFH490 and SPFH540	Less than 4.00	16	18	20	-
	4.00 to 6.00	14	16	18	22
SPFH590	1.60 to less than 4.00	20	22	24	-
	4.00 to 6.00	18	20	22	26
SPFH540Y and SPFH590Y	Not more than 4.00	22	-	-	-

- Note 1 The values given in Table 6 shall be applied to any 4000 mm length.  
 2 Steel plate and sheet of less than 4000 mm in length, the values shall be applied to the full length.

## 5. Chemical composition

- 5.1 Chemical composition shall be as the agreement between manufacturer and purchaser.

## 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 7.

Testing shall be in accordance with JIS Z 2241. The No.5 test piece shall be taken in perpendicular to the rolling direction as specified in JIS Z 2201.

### 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 7 Tensile strength and elongation**  
(clause 6.2.1)

Grade	Yield strength, min MPa	Tensile strength, min MPa	Elongation, min %			
			Thickness mm			
			Less than 2.00	2.00 to less than 2.50	2.50 to less than 3.25	3.25 to 6.00
SPFH 490	325	490	22	23	24	25
SPFH 540	355	540	21	22	23	24
SPFH 590	420	590	19	20	21	22
SPFH 540Y	295	540	-	24	25	26 <sup>1)</sup>
SPFH 590Y	325	590	-	22	23	24 <sup>1)</sup>

Note <sup>1)</sup> for steel of 3.25 to 4.00 mm in thickness.

## 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 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 following sampling plan 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 8

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 8, that lot shall be deemed as conforming to the requirements.

**Table 8 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 not less than 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 9.

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 9, that lot shall be deemed as conforming to the requirements.

**Table 9 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 mechanical properties

8.2.3.1 Three samples shall be taken at random 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.

8.2.3.2 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, and 8.2.3.2, 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.

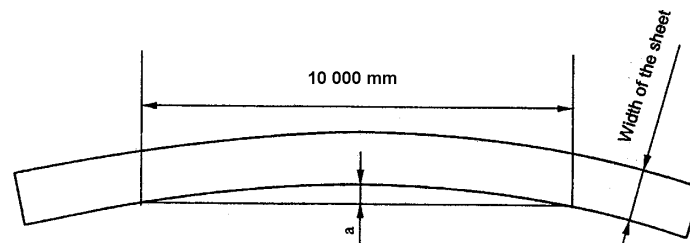
## 9.2 Camber tolerance

## 9.2.1 Cut edge steel plate and sheet

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 10 000 mm in cord length, the measurement being taken as shown in Figure 1. As for cut edge steel plate and sheet of less than 10 000 mm in length, the full length shall be applied.

## 9.2.2 Cut edge steel coil and strip

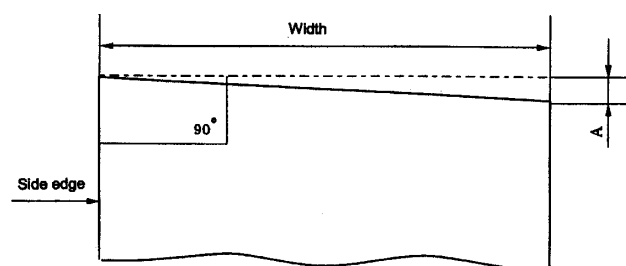
The test shall be as same as clause 9.2.1 with 2000 mm in cord length.



**Figure 1 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 from a straight line at right angle to a side and touching one corner, the measurement being taken as shown in Figure 2.



**Figure 2 Measurement of Out-of-square**  
(clause 9.3)

#### 9.4 Flatness for steel plate and sheet

Place the sample under its own mass 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.3 test piece as specified in JIS Z 2204 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 10.

**Table 10 Bending**  
(clause 9.5)

Unit : mm

Grade	Thickness	Diameter of mandrel
SPFH 490	Less than 3.25	1 times test piece thickness
	3.25 to 6.00	2 times test piece thickness
SPFH 540	Less than 3.25	2 times test piece thickness
	3.25 to 6.00	3 times test piece thickness
SPFH 590	Less than 3.25	3 times test piece thickness
	3.25 to 6.00	3 times test piece thickness
SPFH 540Y	Less than 3.25	2 times test piece thickness
	3.25 to 4.00	3 times test piece thickness
SPFH 590Y	Less than 3.25	3 times test piece thickness
	3.25 to 4.00	3 times test piece thickness