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 2060-2543
Thai Industrial Standard
For
Hot – rolled steel coil strip plate and sheet for gas cylinders

1. Scope

1.1 This standard specifies types, types of edge and grades, basic mass, size 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 gas cylinders

1.2 This standard covers the hot – rolled steel coil strip plate and sheet to be used for welded gas cylinders with a capacity of 500 liters or under which contain such high – pressure gasses as LP gas acetylene and various kinds of freon gas.

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

1.3.3 hot – rolled steel coil strip plate and sheet for gas cylinders for internal combustion engine.

2. Definitions

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

2.1 hot – rolled steel coil strip plate and sheet for gas cylinders which shall be referred to hereinafter as steel : steel obtained by the process of hot rolling and having chemical composition as specified in table 9

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.

2.9 liquefied petroleum gas : a fluid which is composed predominantly of any of the following liquefied hydrocarbons or mixture of all or any of them :

Propane
Propene
Butane
Butene

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 less than 1.20 mm and 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 less than 1.20 mm and not exceed 6.00 mm.
- 3.2.3 Steel plate i.e. steel of 3.15 to 6.00 mm in thickness.
- 3.1.4 Steel sheet i.e. steel sheet having thickness not less than 1.20 to 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 grade into 3 grades as follow:
- 3.3.1 Grade 1
- 3.3.2 Grade 2
- 3.3.3 Grade 3

4. Basic mass, dimension and tolerance

4.1 Basic mass of steel shall be 7.85 kg per mm thickness per m^2 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 and 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 plate and sheet
  shall be not exceed the values given in table 6
- 4.3.2 Tolerances on camber for cut edge steel coil and strip
  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 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	1.20 to 6.00	1.20 to 6.00	3.15 to 6.00	1.20 to 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 seller and purchaser.

Table 2 Tolerances on thickness for steel of grade 1 and 2
(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
1.20 to less than 1.60	± 0.14	± 0.15	± 0.16	-
1.60 to less than 2.00	± 0.16	± 0.17	± 0.18	± 0.21
2.00 to less than 2.50	± 0.17	± 0.19	± 0.21	± 0.25
2.50 to less than 3.15	± 0.19	± 0.21	± 0.24	± 0.26
3.15 to less than 4.00	± 0.21	± 0.23	± 0.25	± 0.27
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	± 0.29	± 0.30	± 0.31	± 0.35

Note Tolerances for steel of 2 000 mm or more in width shall be agreed between the seller and purchaser.

Table 3 Tolerances on thickness for steel of grade 3
(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
1.20 to less than 2.00	± 0.16	± 0.19	± 0.20	-
2.00 to less than 2.50	± 0.18	± 0.22	± 0.23	± 0.25
2.50 to less than 3.15	± 0.20	± 0.24	± 0.26	± 0.29
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 Tolerances for steel of 2 000 mm or more in width shall be agreed between the seller and purchaser.

Table 4 Tolerance on width
(clause 4.2.2.2)

unit : mm

Width	Thickness	Tolerance				
		Mill edge		Cut edge		
		Steel plate and sheet	Steel strip and cut lengths therefrom	Normal cut edge	Resheared or fine cut edge	Slitted edge
Under 160	1.20 to 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			+10 0	+4 0	-
160 to less than 250	1.20 to 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			+10 0	+4 0	-
250 to less than 400	1.20 to 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			+10 0	+4 0	-
400 to less than 630	1.20 to 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			+10 0	+5 0	-
600 to less than 1000	1.20 to 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			+10 0	+6 0	
1000 to less than 1250	1.20 to 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			+15 0	+6 0	
1250 to less than 1600	1.20 to 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			+15 0	+6 0	
1600 and over	1.20 to 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			+1.2% 0	+6 0	

Table 5 Tolerance on length
(clause 4.2.2.3)

unit : mm

Length	Thickness	Normal cut edge	Resheared or fine cut edge
Under 6300	1.20 to less than 6.00	+25 0	+5 0
	6.00	+25 0	+10 0
6300 or over	1.20 to less than 6.00	+0.5% 0	+10 0
	6.00	+0.5% 0	+15 0

Note For the resheared or fine cut edge steel of 20 mm and over in width, tolerance on length for normal cut edge steel shall be applied.

Table 6 Tolerances on camber for cut edge steel plate and sheet
(clause 4.3.1)

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 7 shall be applied.

Table 7 Tolerances on camber for cut edge steel coil and steel strip
(clause 4.3.2)

unit : mm

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

Table 8 Tolerances on flatness for 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 over 3000
1.20 to less than 1.60	18	20	-	-	-
1.60 to less than 3.15	16	18	20	-	-
3.15 to less than 4.00	16	16	16	-	-
4.00 to less than 6.00	14	14	14	24	25
6.00	13	13	13	21	22

Note 1. The values given in Table 8 shall be applied to any 2000 mm length.
2. 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 shall be in accordance with Table 9, and when determined by product analysis, the values given in Table 9 may be varied by Table 10.

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

Table 9 Chemical analysis determined by cast analysis
(clauses 2.1 and 5.1)

Grade	Chemical composition, %					
	Carbon	Silicon	Manganese	Phosphorus	Sulfur	Niobium (Columbium)
1	0.20 max.	0.30 max.	0.60 max.	0.05 max.	0.05 max.	-
2	0.20 max.	0.35 max.	1.20 max.	0.04 max.	0.04 max.	-
3	0.20 max.	0.30 max.	1.50 max.	0.04 max.	0.04 max.	0.01 to 0.04

Table 10 Tolerances on chemical composition determined by product analysis
(clause 5.1)

Chemical composition	Values as given in Table 9 %	Tolerances %
Carbon	0.20 max.	+ 0.03
Silicon	0.30 max.	+ 0.03
	Over 0.30 up to 0.35	+ 0.05
Manganese	Not over 0.60	+ 0.03
	Over 0.60 up to 1.50	+ 0.04
Phosphorus	All values	+ 0.01
Sulfur	All values	+ 0.01
Niobium(Columbium)	All values	+ 0.01(for maximum value)
	All values	- 0.01(for minimum value)

6. Requirements

6.1 General characteristics

Steel shall be of killed steel with 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 11.

Testing shall be in accordance with TIS 244 Part 4 or Part 5. The test piece shall be taken in perpendicular to the rolling direction.

6.2.2 Bending

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

Table 11 Tensile strength and elongation
(clause 6.2.1)

Grades	Yield strength, min MPa	Tensile strength, min MPa	Elongation, min %
1	255	402	28
2	300	440	24
3	340	490	20

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) Cast 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 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 100 101 and over	3 13	0 1

8.2.3 Sampling and acceptance for testing on chemical composition

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

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

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 requirement of clause 6.2, that lot shall be deemed to comply with the requirement.

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. As for test piece having 30 mm or over 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 0.1 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 made by measurement device having an accuracy of 0.1 mm with 2000 mm in cord length, the measurement being taken as shown in Figure 1.

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.

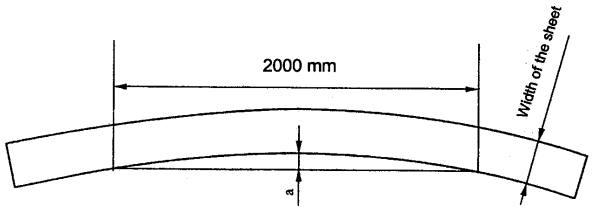

Figure 1 Measurement of camber tolerance
(clause 9.2.1)

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.

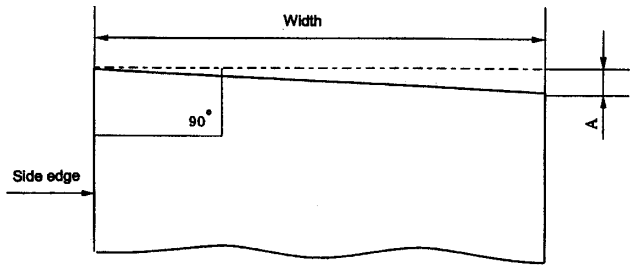

Figure 2 Measurement of Out-of-square
(clause 9.3)

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 0.1 mm

9.5 Bending

The test piece shall be taken in perpendicular to the rolling direction. The testing shall be in accordance with TIS 244 Part 11 and 12, 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.

Table 14 Bending

(clause 9.5)

Unit : mm

Grade	Diameter of mandrel
1	2 times test piece thickness
2	3 times test piece thickness
3	3 times test piece thickness