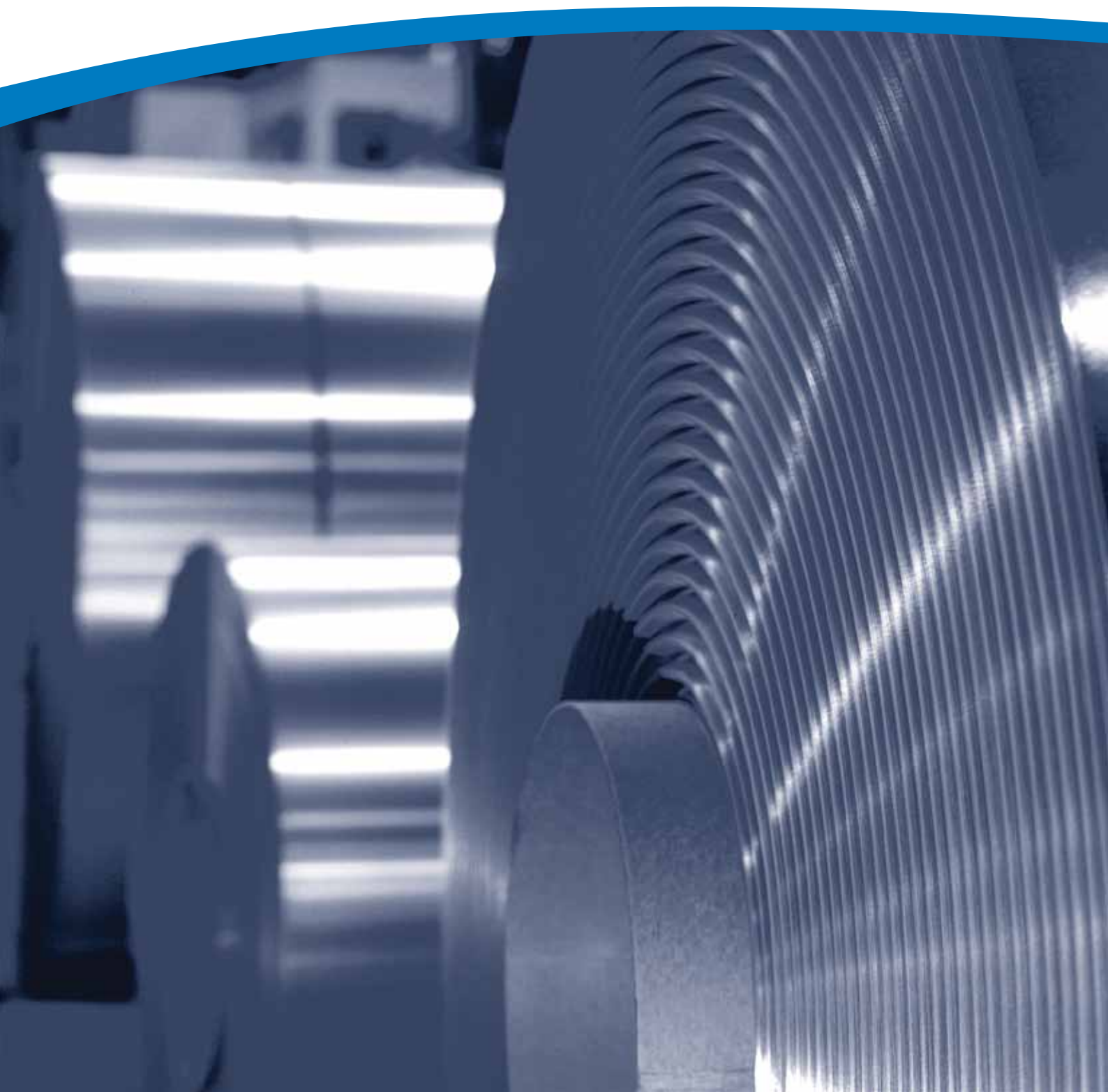


**TATA STEEL**



## **Tata Steel Strip Products**

Product catalogue



HOT-ROLLED,  
COLD-ROLLED AND  
METALLIC-COATED  
STRIP STEELS FROM  
TATA STEEL

# Tata Steel

We aim to deliver outstanding value to our customers and to be a leading corporate citizen – goals that we shall achieve through a passionate workforce.

Using research and development, the power of technology and our expertise, we shall deliver the best products and services while respecting people and continuously improving our environmental performance.

Seeking the earliest possible involvement with our customers, we shall ensure that they get the most suitable steel for their application and use the best design and processing technologies to produce their end product. The result is innovative steel solutions that help our customers compete.

## This catalogue

This catalogue is divided into four main sections, each colour-coded for easy recognition.

- Hot-rolled products
- Cold-rolled products
- Galvatite hot-dip galvanised products
- General information

Symbols used in the catalogue are defined in the glossary on page 55.

Some combinations of product specifications in this catalogue may be subject to conditions. In addition, specifications not shown here may have become available since this catalogue was published. Please consult us about your needs.

If you have questions about the information in this catalogue, please call us at the appropriate office listed on page 54.

## Contents

### Hot-rolled products

Page	
5	General
9	Steel for forming
11	Tenform high-strength low-alloy steel
15	DP600 dual-phase advanced high-strength steel
16	Tenform carbon-manganese steel
17	Structural steel
20	Durbar floor plate
22	High-Carbon Steel

### Cold-rolled products

Page	
24	General
30	Steel for forming
32	High-strength steel
34	Advanced high-strength steel
35	Structural steel

### Galvatite hot-dip galvanised products

Page	
38	General
44	Galvatite for forming
46	Galvatite high-strength steel
49	Galvatite structural steel

### General information

Page	
52	Quality
52	Finishing touches
53	Service and support
53	Tata Steel Service Centres
53	Health and safety
53	The environment
54	Contacting us
55	Glossary of symbols

# HOT-ROLLED PRODUCTS

Hot rolling at Tata Steel produces primary strip steel products in a range that offers extensive performance characteristics, versatility and economy, as well as steels for specific applications.



# General

The hot-rolled strip steel products offered in this section are listed below.

## Page

5	General
9	Steel for forming
11	Tenform high-strength low-alloy steel
15	DP600 dual-phase advanced high-strength steel
16	Tenform carbon-manganese steel
17	Structural steel
20	Durbar floor plate
22	High-Carbon steel

## Grades

This section of the catalogue shows the standard grades of hot-rolled steel offered by Tata Steel.

## Typical applications

- automotive components
- tubes and sections
- ship plate
- bridge components
- pressure vessels and boilers
- domestic appliances
- industrial furniture
- components for building and construction
- feed stock for cold-rolled, galvanised and packaging steels
- construction and earth moving equipment

## Coil condition

Tata Steel can supply hot-rolled steel in the following conditions:

### Hot-rolled coil:

Mill edges

Skin-passed (on request); available in thicknesses  $\leq 6.25\text{mm}$

### Pickled and oiled coil: (available in thicknesses $\leq 5\text{mm}$ )

Mill edges

Trimmed edges

### Pickled dry (on request): (available in thicknesses $\leq 5\text{mm}$ )

Mill edges

Trimmed edges

### Overall thickness and width limits

The overall thickness and width limits for hot-rolled products are shown in table 1 below. The limits for specific products are shown under individual product headings throughout the hot-rolled section.

### Coil diameters

The coil diameters that apply to hot-rolled coil are shown in table 2 below.

### Coil weight

The maximum weight of hot-rolled coils offered by Tata Steel is determined by three factors:

- Manufacturing limit: Maximum 21kg/mm of width up to 34 tonnes
- Maximum safe outside diameter of coil (mm): 10/7 x coil width (limit of 2200mm)
- Maximum weight allowed by road/rail transport

Tata Steel will discuss these factors with the customer to ensure compatibility with the quantity ordered.

Particular hot-rolled products may have maximum coil weights that differ from the range as a whole.

### Tolerances on dimensions and shape

Tolerances for continuously hot-rolled uncoated plate, sheet and strip of non-alloy and alloy steels are given in EN 10051 : 2010.

#### Tolerances for wide strip and slit wide strip

The values in EN 10051 : 2010 do not apply to the uncropped ends of the coil, i.e. the 'head' and 'tail'. The maximum length (in metres) of these ends can be equal to 90/nominal thickness (mm), but will not exceed 20 metres in total.

#### Thickness

The thickness tolerances shown in tables 3a and 3b on page 7 are from EN 10051 : 2010 and are for hot-rolled steel with normal deformation resistance. The tolerances for grades with yield strengths greater than 350N/mm<sup>2</sup> are shown in tables 3c and 3d.

**Table 1: Thickness and width limits**

Product	Product form	Thickness		Width	
		Min	Max	Min	Max
Hot-rolled dry	Mill finish	1.40	16.50	700	1830
Hot-rolled pickled	Pickled & oiled, mill edge	1.40	5.00	735	1550
Hot-rolled pickled	Pickled & oiled, trimmed edges	1.40	5.00	735	1525

**Note:** Dimensions are in millimetres

Tata Steel can supply hot-rolled coil to tighter tolerances than those in EN 10051 : 2010. If improved tolerances are required, they must be agreed with Tata Steel before ordering.

For cold-forming steels supplied to EN 10111 : 2008, the thickness tolerances are shown in table 4 on page 8.

#### Crown values

Maximum crown value can be agreed between the customer and Tata Steel when the material is ordered.

#### Coil width

The coil width tolerances in table 5 on page 8 are from EN 10051 : 2010.

#### Edge camber

The deviation over a length of 5metres will not exceed 20mm for mill edges and 15mm for trimmed edges as specified in EN 10051 : 2010.

### Surface

Hot-rolled steel is available in mill finish or pickled condition.

Pickled material can be supplied with rolling oil or preservative oil, normally from 1.0g/m<sup>2</sup> to 1.8g/m<sup>2</sup>, or with more or less oil on request.

If the level of oiling required is not specified in the order, a normal amount of oil will be applied.

### Health and safety

Tata Steel publishes the health and safety information for its hot-rolled steels at [www.tatasteeleurope.com/en/](http://www.tatasteeleurope.com/en/). *Product health and safety data sheet 16* covers all the hot-rolled products in this section except for DP600, which is covered by *Product health and safety data sheet 2*.

**Table 2: Diameter of hot-rolled coil**

Inside diameter, mill finish	762mm
Inside diameter, pickled and oiled	610mm
Tolerance on inside diameter	+0/-50mm
Outside diameter	Max 10/7 x width (limit 2200mm)

**Table 3a: Thickness tolerances**

Normal deformation resistance. EN 10051 : 2010  
Specified minimum yield strength  $Re \leq 300 \text{ N/mm}^2$  (category A)

Nominal thickness		Tolerances for a nominal width of			
		$\leq 1200$	$>1200$ $\leq 1500$	$>1500$ $\leq 1800$	$>1800$
>	$\leq$	$\pm$	$\pm$	$\pm$	$\pm$
1.40	2.00	0.17	0.19	0.21	–
2.00	2.50	0.18	0.21	0.23	0.25
2.50	3.00	0.20	0.22	0.24	0.26
3.00	4.00	0.22	0.24	0.26	0.27
4.00	5.00	0.24	0.26	0.28	0.29
5.00	6.00	0.26	0.28	0.29	0.31
6.00	8.00	0.29	0.30	0.31	0.35
8.00	10.00	0.32	0.33	0.34	0.40
10.00	12.50	0.35	0.36	0.37	0.43
12.50	15.00	0.37	0.38	0.40	0.46
15.00	16.50	0.40	0.42	0.45	0.50

Note: Dimensions are in millimetres.

**Table 3b: Thickness tolerances**

Normal deformation resistance. EN 10051 : 2010  
Specified minimum yield strength  $300 \text{ N/mm}^2 < Re \leq 360 \text{ N/mm}^2$  (category B)

Nominal thickness		Tolerances for a nominal width of			
		$\leq 1200$	$>1200$ $\leq 1500$	$>1500$ $\leq 1800$	$>1800$
>	$\leq$	$\pm$	$\pm$	$\pm$	$\pm$
1.40	2.00	0.20	0.22	0.24	–
2.00	2.50	0.21	0.24	0.26	0.29
2.50	3.00	0.23	0.25	0.28	0.30
3.00	4.00	0.25	0.28	0.30	0.31
4.00	5.00	0.28	0.30	0.32	0.33
5.00	6.00	0.30	0.32	0.33	0.36
6.00	8.00	0.33	0.35	0.36	0.40
8.00	10.00	0.37	0.38	0.39	0.46
10.00	12.50	0.40	0.41	0.43	0.49
12.50	15.00	0.43	0.44	0.46	0.53
15.00	16.50	0.46	0.48	0.52	0.58

Note: Dimensions are in millimetres.

**Table 3c: Thickness tolerances**

Normal deformation resistance. EN 10051 : 2010  
Specified minimum yield strength  $360 \text{ N/mm}^2 < Re \leq 420 \text{ N/mm}^2$  (category C)

Nominal thickness		Tolerances for a nominal width of			
		$\leq 1200$	$>1200$ $\leq 1500$	$>1500$ $\leq 1800$	$>1800$
>	$\leq$	$\pm$	$\pm$	$\pm$	$\pm$
1.40	2.00	0.22	0.25	0.27	–
2.00	2.50	0.23	0.27	0.30	0.33
2.50	3.00	0.26	0.29	0.31	0.34
3.00	4.00	0.29	0.31	0.34	0.35
4.00	5.00	0.31	0.34	0.36	0.38
5.00	6.00	0.34	0.36	0.38	0.40
6.00	8.00	0.38	0.39	0.34	0.46
8.00	10.00	0.42	0.43	0.44	0.52
10.00	12.50	0.46	0.47	0.48	0.56
12.50	15.00	0.48	0.49	0.52	0.60
15.00	16.50	0.52	0.55	0.59	0.65

Note: Dimensions are in millimetres.

**Table 3d: Thickness tolerances**

Normal deformation resistance. EN 10051 : 2010  
Specified minimum yield strength  $420 \text{ N/mm}^2 < Re \leq 900 \text{ N/mm}^2$  (category D)

Nominal thickness		Tolerances for a nominal width of			
		$\leq 1200$	$>1200$ $\leq 1500$	$>1500$ $\leq 1800$	$>1800$
>	$\leq$	$\pm$	$\pm$	$\pm$	$\pm$
1.40	2.00	0.24	0.27	0.29	–
2.00	2.50	0.25	0.29	0.32	0.35
2.50	3.00	0.28	0.31	0.34	0.36
3.00	4.00	0.31	0.34	0.36	0.38
4.00	5.00	0.34	0.36	0.39	0.41
5.00	6.00	0.36	0.39	0.41	0.43
6.00	8.00	0.41	0.42	0.43	0.49
8.00	10.00	0.45	0.46	0.48	0.56
10.00	12.50	0.49	0.50	0.52	0.60
12.50	15.00	0.52	0.53	0.56	0.64
15.00	16.50	0.56	0.59	0.63	0.70

Note: Dimensions are in millimetres.

**Table 4: Thickness tolerances**

**Cold forming steels**

**EN 10111 : 2008**

Nominal thickness		Tolerances for a nominal width of			
		≤1200	>1200 ≤1500	>1500 ≤1800	>1800
>	≤	±	±	±	±
1.40	2.00	0.13	0.14	0.16	–
2.00	2.50	0.14	0.16	0.17	0.19
2.50	3.00	0.15	0.17	0.18	0.20
3.00	4.00	0.17	0.18	0.20	0.20
4.00	5.00	0.18	0.20	0.21	0.22
5.00	6.00	0.20	0.21	0.22	0.22
6.00	8.00	0.22	0.23	0.23	0.26
8.00	11.00	0.24	0.25	0.25	0.28

**Note:** Dimensions are in millimetres

**Table 5: Tolerances on coil width**

**EN 10051 : 2010**

Nominal width		Mill edge		Trimmed edge	
		lower –	upper +	lower –	upper +
≥700	≤1200	0	20	0	3
>1200	≤1830	0	20	0	5

**Notes:**

1. Side trimming is available on thicknesses ≤ 5mm, and widths ≤ 1525mm in pickled and oiled state only.
2. Dimensions are in millimetres.

## Steel for forming

Hot-rolled steel for cold forming is used for bending and deep drawing and is suitable for pickling and welding. It has good properties for moderately deep-drawn parts.

### Typical applications

- car components
- tubes and sections
- components for domestic appliances
- industrial furniture
- garden furniture

### Standards

Tata Steel offers hot-rolled steel for forming in grades that comply with EN 10111 : 2008 and in a special Tata Steel grade, as shown (right). All grades are available in qualities suitable for galvanising. As the standard only applies to steel  $\leq 11$ mm thick, please consult Tata Steel about the properties of steel thicker than this.

### EN 10111 : 2008

- DD11
- DD12
- DD13
- DD14

### Tata Steel

DD14+ (HR1 improved)

### Mechanical properties

The values shown for the mechanical properties in table 6 below are for test pieces taken transverse to the rolling direction.

### Chemical composition

Hot-rolled steel for forming meets the requirements of the cast analysis in the standard, as shown in table 7 on page 10.

### Dimensions

The width and thickness limits are shown in tables 8 and 9 on page 10.

**Table 6: Mechanical properties**

Grade radius	R <sub>eL</sub> (N/mm <sup>2</sup> )		R <sub>m</sub> (N/mm <sup>2</sup> )	A (%)		Bend test
	Min-max		Max	Min		
				L <sub>0</sub> = 80mm	L <sub>0</sub> = 5.65√S <sub>0</sub>	Min
	1.5≤t<2	2≤t≤8		1.5≤t<2	2≤t<3	3≤t<8
<b>EN 10111 : 2008</b>						
DD11	170-360	170-340	440	23	24	28
DD12	170-340	170-320	420	25	26	30
DD13	170-330	170-310	400	28	29	33
DD14	170-310	170-290	380	31	32	36
<b>Tata Steel</b>						
DD14+ (HR1 improved)	170-250	170-250	340	36	36	36

### Notes:

1. The mechanical properties in this table apply to hot-rolled dry and to hot-rolled pickled and oiled, whether skin-passed or not.
2. The mechanical properties for the grades in the table are unchanged when those grades are supplied in qualities guaranteed suitable for galvanising.
3. Material thickness, t, is in millimetres.
4. DD11 products should be formed within 1 month of their availability.

**Table 7: Chemical composition**

Grade	C	Mn	P	S
	Max	Max	Max	Max
<b>EN 10111 : 2008</b>				
DD11	0.12	0.60	0.045	0.045
DD12	0.10	0.45	0.035	0.035
DD13	0.08	0.40	0.030	0.030
DD14	0.08	0.35	0.025	0.025
<b>Tata Steel</b>				
DD14+	0.055	0.25	0.020	0.020

Note: Values are in weight percentages.

**Table 8: Dimensions: Mill finish**

Thickness		Width		
		Min	Max	
≥	<		DD11 DD12	DD13, DD14 DD14+
1.40	1.50	700	1125	1125
1.50	1.60	700	1260	1275
1.60	1.70	700	1325	1360
1.70	1.80	700	1375	1425
1.80	1.90	700	1425	1500
1.90	2.00	700	1500	1550
2.00	2.50	700	1525	1650
2.50	3.00	700	1725	1830
3.00	16.50	700	1830	1830

**Notes:**

1. Dimensions are in millimetres.
2. EN10111:2008 only specifies material up to 11mm thick. Above 11mm thick material is supplied to Tata Steel Standard.

**Table 9: Dimensions: Pickled**

Thickness		Width		
		Min	Max	Max
≥	<		DD11 DD12	DD13 DD14
1.40	1.50	735	1125	1125
1.50	1.60	735	1260	1275
1.60	1.70	735	1325	1360
1.70	1.80	735	1375	1425
1.80	1.90	735	1425	1500
1.90	2.00	735	1500	1550
2.00	2.50	735	1525	1550
2.50	5.00	735	1550	1550

**Notes:**

1. For trimmed edges, reduce the maximum widths shown by 25mm.
2. Dimensions are in millimetres.

## Tenform high-strength low-alloy steel

Tenform is hot-rolled high-strength steel with enhanced properties for forming and welding. It has been specially developed to combine high strength with good formability.

The products in this section are Tenform XK and Tenform XF (reduced level of sulphur).

### Typical applications

- longitudinal members for chassis parts
- wheels
- seats
- airbag parts
- headrests
- safety belts
- clutch plates
- carriages for conventional and high-speed trains
- light towers
- warehouse shelving
- silos and containers
- earth moving and agricultural machines

### Standards

Tenform is available in the Tata Steel grades shown in table 10 below. Tata Steel can also supply steels to the exact specifications of EN 10149-2 : 1996, as shown in the same table.

### Mechanical properties

The values shown for strength and elongation in table 11 on page 12 are for test pieces taken in the rolling direction; those for the bend test are for test pieces taken transverse to the rolling direction. For reference, table 12 on page 12 shows the values for steels to EN 10149-2 : 1996.

### Chemical composition

Table 13 on page 12 shows the chemical composition of Tenform steels. For reference, table 14 on page 13 shows the chemical composition of steels to EN 10149-2 : 1996.

### Dimensions

The width and thickness limits for Tenform and for the nearest equivalent grades from EN 10149-2 : 1996 are shown in tables 15 and 16 on pages 13 and 14 respectively.

**Table 10: Standards: Tenform XK/XF**

Tata Steel	European EN 10149-2 : 1996
Grade	
XK300	–
XF300	S315MC
XK350	–
XF350	S355MC
XK400	–
XF400	–
XF420	S420MC
XK450	–
XF450	–
XF460	S460MC
XF500	S500MC

**Table 11: Mechanical properties: Tenform XK/XF**

Grade	R <sub>eL</sub> (N/mm <sup>2</sup> )	R <sub>m</sub> (N/mm <sup>2</sup> )	A (%)	Bending at 180° Mandrel diameter
	Min	Min	Min	Min
			L <sub>0</sub> = 80mm	
XK300	300	400	24	2t
XF300	300	400	26	0t
XK350	350	430	21	2t
XF350	350	430	23	0.5t
XK400	400	460	18	3t
XF400	400	460	20	0.5t
XF420	420	480	20	0.5t
XK450	450	500	18	3t
XF450	450	500	20	1t
XF460	460	520	18	1t
XF500	500	550	18	1t

Note: Material thickness, t, is in millimetres.

**Table 12: Mechanical properties: EN 10149-2 : 1996**

Grade	R <sub>eH</sub> (N/mm <sup>2</sup> )	R <sub>m</sub> (N/mm <sup>2</sup> )	A (%)	Bending at 180° Mandrel diameter <sup>2</sup>	
	Min	Min-max	Min		Min
			L <sub>0</sub> = 80mm	L <sub>0</sub> = 5.65√S <sub>0</sub>	
			t < 3	t ≥ 3	
S315MC	315	390-510	20	24	0t
S355MC	355	430-550	19	23	0.5t
S420MC	420	480-620	16	19	0.5t
S460MC	460	520-670	14	17	1t
S500MC	500	550-700	12	14	1t

Notes:

1. Material thickness, t, is in millimetres.
2. The values shown for the bend test apply to transverse test pieces.

**Table 13: Chemical composition: Tenform XK/XF**

Grade	C	Mn	P	S	Si	Micro-alloying elements (e.g. Nb)
	Max	Max	Max	Max	Max	Max
XK300/350/400	0.10	1.20	0.030	0.020	0.03	0.300
XK450	0.10	1.50	0.025	0.020	0.35	0.300
XF300/350/400/420	0.10	1.20	0.025	0.010	0.03	0.300
XF450/460/500	0.10	1.50	0.025	0.010	0.35	0.300

Note: Values are in weight percentages.

**Table 14: Chemical composition: EN 10149-2 : 1996**

Grade	C	Mn	P	S	Si	Al-total	V	Nb	Ti
	Max	Max	Max	Max	Max	Min	Max	Max	Max
S315MC	0.12	1.30	0.025	0.020	0.50	0.015	0.20	0.09	0.15
S355MC	0.12	1.50	0.025	0.020	0.50	0.015	0.20	0.09	0.15
S420MC	0.12	1.60	0.025	0.015	0.50	0.015	0.20	0.09	0.15
S460MC	0.12	1.60	0.025	0.015	0.50	0.015	0.20	0.09	0.15
S500MC	0.12	1.70	0.025	0.015	0.50	0.015	0.20	0.09	0.15

**Notes:**

1. Values are in weight percentages.
2. The sum of Nb, V and Ti shall be max 0.22%

**Table 15: Dimensions: Mill finish**

Thickness	Width							
	Min	Max			XF420	XF450	XF500	
≥	<		XF300	XF350	XF400	S420MC	S460	S500MC (min width 710)
1.40	1.50	700	1005	950	950	950	950	–
1.50	1.60	700	1100	1100	1080	950	950	–
1.60	1.70	700	1215	1260	1120	1000	1000	–
1.70	1.80	700	1225	1260	1160	1075	1075	–
1.80	1.90	700	1250	1260	1200	1125	1175	–
1.90	2.00	700	1350	1260	1240	1175	1330	1235
2.00	2.10	700	1409	1360	1260	1330	1330	1235
2.10	2.20	700	1409	1360	1280	1330	1330	1235
2.20	2.30	700	1409	1360	1300	1330	1330	1235
2.30	2.40	700	1409	1360	1320	1330	1330	1235
2.40	2.50	700	1409	1530	1340	1330	1400	1235
2.50	2.60	700	1560	1530	1360	1400	1400	1235
2.60	2.70	700	1560	1530	1380	1400	1400	1235
2.70	3.00	700	1560	1530	1400	1400	1400	1280
3.00	4.00	700	1830	1560	1400	1400	1830	1480
4.00	5.00	700	1830	1680	1560	1560	1560	1550
5.00	6.00	700	1830	1830	1600	1600	1600	1600
6.00	7.00	700	1830	1830	1750	1750	–	1600
7.00	8.00	700	1830	1830	1830	1830	–	1600
8.00	9.00	700	–	1830	–	1830	–	1600
8.00	12.00	700	–	1830	–	1830	–	–
12.00	15.00	700	–	1830	–	–	–	–

**Notes:**

1. For thicknesses from 2.00mm to 9.00mm, in S500MC/XF500, the minimum width is 710mm.
2. Dimensions are in millimetres.

**Table 16: Dimensions: Pickled**

Thickness	Width							
	Min	Max			XF420	XF450	XF500	
			XF300	XF350	XF400	S420 MC	S460	S500MC
≥	<							
1.40	1.50	735	1005	950	950	950	950	–
1.50	1.60	735	1100	1100	1080	950	950	–
1.60	1.70	735	1215	1260	1120	1000	1000	–
1.70	1.80	735	1225	1260	1160	1075	1075	–
1.80	1.90	735	1250	1260	1200	1125	1125	–
1.90	2.00	735	1350	1260	1240	1175	1175	–
2.00	2.10	735	1409	1360	1260	1330	1330	1235
2.10	2.20	735	1409	1360	1280	1330	1330	1235
2.20	2.30	735	1409	1360	1300	1330	1330	1235
2.30	2.40	735	1409	1360	1320	1330	1330	1235
2.40	2.50	735	1409	1530	1340	1330	1330	1235
2.50	2.60	735	1540	1530	1360	1400	1400	1235
2.60	2.70	735	1540	1530	1380	1400	1400	1235
2.70	3.00	735	1540	1530	1400	1400	1400	1235
3.00	4.00	735	1540	1550	1400	1400	1400	1280
4.00	5.00	735	1540	1550	1550	1550	1550	1480
5.00	5.01	735	–	–	–	–	–	1550

**Notes:**

1. For thicknesses from 1.80mm to 2.20mm, in S500MC/XF500, the minimum width is 810mm.
2. Dimensions are in millimetres.
3. For trimmed dimensions reduce max width by 25mm.

## DP600 dual-phase advanced high-strength steel

Hot-rolled DP600 is advanced high-strength steel for the automotive industry. It allows the user to increase the strength of the finished component or to reduce the thickness of the steel, or both. This can increase the output from each tonne of steel and produce products that are strong, light and safe under load. Its high strain-hardening capacity gives it good formability.

### Typical applications

- suspension components
- chassis components for cars and trucks
- wheel discs
- precision tubes

### Standard and grade

Draft European standard prEN 10338 : 2007 covers hot-rolled multiphase steels with higher yield strength for cold forming. We have used this standard to develop DP600, which not only meets the properties in the standard for HDT580X, but also in many cases exceeds them. Please consult us for more information about the typical properties of DP600.

### Mechanical properties

The values shown for the mechanical properties in table 17 below are for test pieces taken in the rolling direction.

### Chemical composition

Table 18 below shows the chemical composition of HDT580X to Draft prEN 10338 : 2007.

### Dimensions

Width and thickness limits are shown in tables 19 and 20 below.

**Table 17: Mechanical properties: prEN 10338 : 2007**

Grade	R <sub>p0.2</sub> (N/mm <sup>2</sup> )	R <sub>m</sub> (N/mm <sup>2</sup> )	A <sub>80</sub> (%)
HDT580X	330-460	580	≥19

**Table 18: Chemical composition: prEN 10338 : 2007**

Grade	C	Si	Mn	P	S	Al <sub>tot</sub>	Cr+Mo	Nb+Ti	V	B
HDT580X	≤0.17	≤0.80	≤2.20	≤0.08	≤0.015	≤2.00	≤1.00	≤0.15	≤0.20	≤0.005

Note: Values are in weight percentages.

**Table 19: Dimensions: Mill finish**

Thickness	Width	
	<	Max
≥		
2.50	3.00	1400
3.00	4.50	1500

#### Notes:

1. Widths refer to mill edge material.
2. For dimensions outside those shown in the table, please consult Tata Steel.
3. Dimensions are in millimetres.

**Table 20: Dimensions: Pickled**

Thickness	Width	
	<	Max
≥		
2.50	3.00	1400
3.00	4.50	1500

#### Notes:

1. Widths refer to mill edge material. Side-trimmed material is available from Tata Steel.
2. For dimensions outside those shown in the table, please consult Tata Steel.
3. Dimensions are in millimetres.

## Tenform carbon-manganese steel

Tenform carbon-manganese steel is high-strength formable steel with enhanced fatigue performance for the automotive industry. It allows the user to increase the strength of the finished component or to reduce the thickness of the steel, or both. The product in this section is Tenform CMN.

### Typical applications

- wheel rims
- wheel discs
- chassis parts for passenger cars and trucks
- suspension housings
- transverse links

### Grades

CMN250 and CMN300.

### Mechanical properties

The values shown for strength and elongation in table 21 below are for test pieces taken in the rolling direction; those for the bend test are for test pieces taken transverse to the rolling direction.

### Chemical composition

Tenform carbon-manganese steel meets the requirements of the cast analysis shown in table 22 below.

### Dimensions

The width and thickness limits are shown in tables 23 and 24 below.

**Table 21: Mechanical properties: Tenform CMN**

Grade	R <sub>eL</sub> (N/mm <sup>2</sup> )	R <sub>m</sub> (N/mm <sup>2</sup> )	A (%)	Bend test Mandrel diameter
	Min	Min	Min	Min
			L <sub>0</sub> = 80mm	
CMN250	250	360	28	0t
CMN300	300	440	26	0t

Note: Material thickness, t, is in millimetres.

**Table 22: Chemical composition: Tenform CMN**

Grade	C	Mn	P	S	Si
	Max	Max	Max	Max	Max
CMN250	0.12	0.90	0.035	0.010	0.03
CMN300	0.16	1.10	0.035	0.006	0.10

Note: Values are in weight percentages.

**Table 23: Dimensions: Mill finish**

Thickness	Width				
	CMN 250		CMN 300		
≥	<	Min	Max	Min	Max
1.40	1.50	700	1103	700	1005
1.50	1.60	700	1250	700	1100
1.60	1.70	700	1275	700	1200
1.70	1.80	700	1315	700	1225
1.80	1.90	700	1350	700	1250
1.90	2.00	700	1450	700	1350
2.00	2.50	700	1525	700	1405
2.50	3.00	700	1600	700	1560
3.00	16.50	700	1830	700	1830

Note: Dimensions are in millimetres.

**Table 24: Dimensions: Pickled**

Thickness	Width				
	CMN 250		CMN 300		
≥	<	Min	Max	Min	Max
1.50	1.60	735	1250	710	1250
1.60	1.90	735	1425	710	1425
1.90	2.10	735	1525	710	1525
2.10	5.00	735	1540	710	1540

Note: Dimensions are in millimetres.

## Structural steel

The good welding properties and guaranteed strength of hot-rolled structural steel make it suitable for many applications.

### Typical applications

- yellow goods
- building and construction
- tubes and pipes
- transport
- chassis parts
- sections and warehouse shelving
- simple pressure vessels

### Standards

Hot-rolled structural steel complies with European standard EN 10025 : 2004 and is available in the grades shown below.

#### EN 10025-2 : 2004

- S185+AR
- S235JR+AR
- S235J0+AR
- S235J2+AR
- S275JR+AR
- S275J0+AR
- S275J2+AR
- S355JR+AR
- S355J0+AR
- S355J2+AR

### The CE mark

The CE mark is a symbol devised by the European Council to signify that a product meets the conditions of the applicable Council directives. These conditions aim to ensure that the product is reliable and safe. Products that are “produced for incorporation in a permanent manner in construction works” fall under the Construction Products Directive. Hot-rolled steels covered by EN 10025 : 2004 are used in such “works” and are therefore covered by the directive. For these products, Tata Steel’s test certificates bear the CE mark and Tata Steel has issued a certified Declaration of Conformity.

### Mechanical properties

The values shown for strength and elongation in table 25 on page 18 are for test pieces taken transverse to the rolling direction; those for the impact test are for test pieces taken in the rolling direction.

### Chemical composition

Structural steel meets the requirements of the cast analysis in the standard, as shown in table 26 on page 18.

Tata Steel does not supply steel with increased copper content.

### Suitability for cold forming

If chemistry suitable for cold forming is required, this must be specified when the material is ordered.

When ordering qualities EN 10025-2 : 2004 suitable for cold forming, add the letter “C” to the end of the grade, e.g. S355J0C.

Cold forming cannot be guaranteed for structural steel that is not specified as cold formable.

### Suitability for galvanising

If chemistry suitable for post-galvanising is required, this must be specified when the material is ordered.

### Dimensions

The width and thickness limits are shown in tables 27 and 28 on page 19.

**Table 25: Mechanical properties: EN 10025-2 : 2004**

Grade	R <sub>eL</sub> (N/mm <sup>2</sup> )		R <sub>m</sub> (N/mm <sup>2</sup> )		A (%)			Impact test	
	Min	Min-Max	Min	Min-Max	Min	Temp	Min energy		
					L0 = 80mm		L0 = 5.65√S0	°C	J
	t ≤ 16.2	t ≤ 3	3 < t ≤ 16.5		1.5 < t ≤ 2	2 < t ≤ 2.5	2.5 < t < 3		
S185+AR	185	310-540	290-510		10	11	12	16	-
S235JR+AR	235	360-510	360-510		17	18	19	24	20
S235J0+AR	235	360-510	360-510		17	18	19	24	0
S235J2+AR	235	360-510	360-510		17	18	19	24	-20
S275JR+AR	275	430-580	410-560		15	16	17	21	20
S275J0+AR	275	430-580	410-560		15	16	17	21	0
S275J2+AR	275	430-580	410-560		15	16	17	21	-20
S355JR+AR	355	510-680	470-630		14	15	16	20	20
S355J0+AR	355	510-680	470-630		14	15	16	20	0
S355J2+AR	355	510-680	470-630		14	15	16	20	-20

**Notes:**

1. Material thickness, t, is in millimetres.
2. For thicknesses >16mm, the R<sub>eL</sub> value is decreased by 10N/mm<sup>2</sup>.
3. The impact properties of quality JR products are verified only when specified at the time of enquiry or order.
4. Impact strengths apply to thicknesses ≥6mm and are for standard test pieces only.
5. For the mechanical properties of cold forming qualities, please consult Tata Steel.

**Table 26: Chemical composition: EN 10025-2 : 2004**

Grade	C	Mn	P	S	Si	N <sup>1</sup>	Cu
	Max	Max	Max	Max	Max	Max	
S185+AR	-	-	-	-	-	-	0.55
S235JR+AR	0.17	1.40	0.035	0.035	-	0.014	0.55
S235J0+AR	0.17	1.40	0.030	0.030	-	0.014	0.55
S235J2+AR	0.17	1.40	0.025	0.025	-	-	0.55
S275JR+AR	0.21	1.50	0.035	0.035	-	0.014	0.55
S275J0+AR	0.18	1.50	0.030	0.030	-	0.014	0.55
S275J2+AR	0.18	1.50	0.025	0.025	-	-	0.55
S355JR+AR	0.24	1.60	0.035	0.035	0.55	0.014	0.55
S355J0+AR	0.20	1.60	0.030	0.030	0.55	0.014	0.55
S355J2+AR	0.20	1.60	0.025	0.025	0.55	-	0.55

**Notes:**

1. The maximum value for nitrogen does not apply if the chemical composition shows a minimum total aluminium content of 0.020% or if sufficient other nitrogen-binding elements are present. The nitrogen-binding elements shall be mentioned in the inspection document.
2. For the chemical composition of cold forming qualities, please consult Tata Steel.
3. The chemical composition of steels suitable for galvanising complies with EN 10025-2 : 2004.
4. Values are in weight percentages.

**Table 27: Dimensions: Mill finish**

Thickness		Width								
		S185+AR		S275JR+AR	S275J0+AR	S235JR+AR	S235J0+AR	S355JR+AR	S355J0+AR	S355J2+AR
≥	<	Min	Max	Max	Max	Max	Max	Max	Max	Max
1.40	1.50	700	1250	1005	1103	1160	1005	1005	1005	1005
1.50	1.60	700	1300	1255	1250	1250	1100	1100	1100	1100
1.60	1.70	700	1325	1255	1275	1275	1215	1215	1215	1215
1.70	1.80	700	1375	1255	1315	1315	1225	1225	1225	1225
1.80	1.90	700	1475	1255	1350	1350	1250	1250	1250	1250
1.90	2.00	700	1500	1350	1450	1450	1350	1350	1350	1350
2.00	2.50	700	1600	1405	1525	1525	1405	1405	1405	1405
2.50	3.00	700	1725	1560	1600	1600	1560	1560	1560	1560
3.00	16.00	700	1830	1830	1830	1830	1830	1830	1830	1830
16.00	16.50	700	1830	1830	1830	1830	1830	1830	1830	–

**Notes:**

1. The maximum thickness for these grades in cold-forming quality is 12.5mm.
2. Dimensions are in millimetres.

**Table 28: Dimensions: Pickled**

Thickness		Width								
		S185+AR		S275JR+AR	S275J0+AR	S235JR+AR	S235J0+AR	S355JR+AR	S355J0+AR	S355J2+AR
≥	<	Min	Max	Max	Max	Max	Max	Max	Max	Max
1.40	1.50	735	1250	1005	1003	1160	1005	1005	1005	1005
1.50	1.60	735	1300	1255	1250	1250	1100	1100	1100	1100
1.60	1.70	735	1325	1255	1275	1275	1215	1215	1215	1215
1.70	1.80	735	1375	1255	1315	1315	1225	1225	1225	1225
1.80	1.90	735	1475	1255	1350	1350	1250	1250	1250	1250
1.90	2.00	735	1500	1350	1450	1450	1350	1350	1350	1350
2.00	2.50	735	1550	1405	1525	1525	1405	1405	1405	1405
2.50	5.00	735	1550	1550	1550	1550	1550	1550	1550	1550

**Note:** Dimensions are in millimetres.

## Durbar floor plate

Durbar is hot-rolled structural steel floor plate with an evenly distributed, raised pattern that is integral to the product. It has excellent welding properties and can be used as a structural component.

### Standards and grades

Durbar meets the mechanical and chemical properties of EN 10025-2 : 2004 and is available in grades S275JR+AR and S355JR+AR.

### Mechanical properties

The mechanical properties of Durbar comply with EN 10025-2 : 2004 and are shown in table 29 below. The values shown for strength and elongation in table 29 are for test pieces taken transverse to the rolling direction; those for the impact test are for test pieces taken in the rolling direction.

### Chemical composition

The chemical composition of Durbar complies with EN 10025-2 : 2004 and is shown in table 30 below.

### Dimensions

Tata Steel manufactures Durbar S275JR+AR in standard sizes, which are shown in table 31 on page 21.

Other combinations of thickness and width will be considered, based upon the volume required.

Please consult Tata Steel about the dimensional range of S355JR+AR.

The thickness of Durbar is that of the plain plate, exclusive of the raised pattern. The studs in the pattern are typically between 1.5mm and 2.2mm.

### Surface aspects

Durbar has an evenly distributed, raised pattern that is integral to the product and which allows plates to be used in any direction. An independent research establishment tested Durbar both wet (clean water) and dry in accordance with BS7976 and the guidelines of the UK Slip Resistance Group. Durbar improves slip-resistance at all angles.

**Table 29: Mechanical properties: Durbar: EN 10025-2 : 2004**

Grade	R <sub>eL</sub> (N/mm <sup>2</sup> )	R <sub>m</sub> (N/mm <sup>2</sup> )	A (%)	Impact test	
	Min	Min-max	Min	Temp	Min energy
			$L_0 = 5.65\sqrt{S_0}$ $3 \leq t \leq 12.5$	°C	J
S275JR+AR	275	410-560	21	20	27
S355JR+AR	355	470-630	20	20	27

**Notes:**

1. Material thickness, t, is in millimetres.
2. Impact properties of quality JR products are verified only when specified at the time of the enquiry and order.
3. Impact strengths apply to thicknesses  $\geq 6$ mm and are for standard test pieces only.

**Table 30: Chemical composition: Durbar: EN 10025-2 : 2004**

Grade	C	Mn	P	S	Si	N
	Max	Max	Max	Max	Max	Max
S275JR+AR	0.21	1.50	0.035	0.035	–	0.012
S355JR+AR	0.24	1.60	0.035	0.035	0.55	0.012

**Note:** Values are in weight percentages.

**Table 31: Dimensions: Durbar coil**

Standard thickness	Standard widths
	S275JR+AR
3.00	1000/1250
4.50	1000/1250/1500
6.00	1000/1250/1500
8.00	1000/1250/1500
10.00	1000/1250/1500
12.50	1000/1250/1500

**Notes:**

1. Dimensions are in millimetres.
2. Please consult Tata Steel for 1750mm and 1830 requirements and non standard dimensions.

## High-carbon steel

Hot-rolled high-carbon steel, supplied in the 'as rolled', untreated condition, is suitable for cold rolling to thinner gauges. It is often heat treated to give the final mechanical properties required for the intended application.

### Typical applications

Typical applications are often machine parts and components that require high hardness and wear resistance from thin strip material.

These include:

- saw blades
- safety-shoe toe caps
- clips and buckles for seatbelts
- fastenings
- automotive clutch components

**Table 32: Chemical composition: EN 10132-4 : 2000**

Grade	C	Mn	P	S	Si	Cr	Mo	Ni
	Min-max	Min-max	Max	Max	Min-max	Max	Max	Max
C67S	0.65-0.73	0.60-0.90	0.025	0.025	0.15-0.35	0.4	0.1	0.4
C75S	0.70-0.80	0.60-0.90	0.025	0.025	0.15-0.35	0.4	0.1	0.4

**Notes:**

1. Values are in weight percentages.
2. Tighter than standard values are available. Please contact us for more information.

**Table 33: Dimensions: C67S and C75S: EN 10083-2**

Thickness	<	Width	
		Min	Max
≥			
2.00	4.00	1000	1150
4.00	5.00	1000	1250

**Notes:** Dimensions are in millimetres.

# COLD-ROLLED PRODUCTS

Cold rolling at Tata Steel produces processed strip steel products in a range that offers reduced thicknesses, enhanced surface finishes and forming characteristics, and high-strength grades. Many of these products are specially developed for demanding applications.



# General

The cold-rolled strip steel products offered in this section are listed below.

**Page**

24	General
30	Steel for forming
32	High-strength steel
34	Advanced high-strength steel
35	Structural steel

## Grades

This section of the catalogue shows the standard grades of cold-rolled steel offered by Tata Steel.

Specific material requirements should be stated in the order, since any parameters not specified then will be supplied according to the most appropriate values in the standard.

## Typical applications

- automotive components and body panels
- components for building and construction
- tubes and sections
- drums and boilers
- radiators
- furniture
- domestic appliances
- electrical goods

Most cold-rolled steel grades are suitable for:

- electrolytic coating
- hot-dip coating
- post-galvanising
- organic coating
- powder coating

## Coil condition

Tata Steel can supply cold-rolled steel in the following conditions:

**Annealed and skin-passed**

**Full hard (on request)**

### Overall thickness and width limits

The overall thickness and width limits for cold-rolled products are shown in table 1 below. The limits for specific products are shown under individual product headings throughout the cold-rolled section.

### Coil diameters

The coil diameters that apply to cold-rolled coil are shown in table 2 below.

### Coil weight

The maximum weight of cold-rolled coils offered by Tata Steel is determined by three factors:

- Manufacturing limit: Maximum 21kg/mm of width up to 34 tonnes
- Maximum safe outside diameter of coil (mm): 10/7 x coil width (limit of 2250mm)
- Maximum weight allowed by road/rail transport

Tata Steel will discuss these factors with the customer to ensure compatibility with the quantity ordered.

Particular cold-rolled products may have maximum coil weights that differ from the range as a whole.

### Tolerances on dimensions and shape

#### Thickness

The thickness tolerances from EN 10131 : 2006 for the four ranges of yield strength are shown in tables 3-6 on pages 26 and 27. Tata Steel can offer tolerances closer than the special tolerances (S) shown in the table. They must be agreed with Tata Steel before ordering.

#### Coil width

The coil width tolerances in table 7 on page 28 are from EN 10131 : 2006.

#### Flatness

Flatness complies with EN 10131 : 2006 as shown in table 8 for steel grades with  $R_{eL} < 260\text{N/mm}^2$  and table 9 for steel grades with  $R_{eL} \geq 260\text{N/mm}^2$  and  $< 340\text{N/mm}^2$ , both on page 28. Flatness tolerances in EN 10131 : 2006 apply to sheet only.

If there is a dispute about the flatness of material that was ordered to the Special tolerances shown in table 8, then the minimum acceptable standards of flatness described in table 10 on page 29 must be verified.

#### Edge camber

The deviation over a length of 2 metres will not exceed 5mm as specified in EN 10131 : 2006.

### Health and safety

Tata Steel publishes the health and safety information for its cold-rolled steels at [www.tatasteeleurope.com/en](http://www.tatasteeleurope.com/en). Product health and safety data sheet 16 covers all the cold-rolled products in this section except for DP600, which is covered by Product health and safety data sheet 2.

**Table 1: Thickness and width limits**

Product form	Thickness		Width	
	Min	Max	Min	Max
Mill edges <sup>1</sup>	0.35	3.00	710	1815
Trimmed edges <sup>2</sup>	0.35	2.00	900	1803

**Notes:**

1. Batch annealed.
2. Continuously annealed.
3. Dimensions are in millimetres.

**Table 2: Diameter of cold-rolled coil**

Inside diameter	610mm standard
Outside diameter	Max 10/7 x width (limit 2250mm)

**Table 3: Thickness tolerances: EN 10131 : 2006 :  $R_{eL} < 260N/mm^2$**

Nominal thickness		Normal tolerances for a nominal width of			Special tolerances (S) <sup>2</sup> for a nominal width of		
		≤1200	>1200 ≤1500	>1500	≤1200	>1200 ≤1500	>1500
>	≤	±	±	±	±	±	±
0.35	0.40	0.03	0.04	0.05	0.020	0.025	0.030
0.40	0.60	0.03	0.04	0.05	0.025	0.030	0.035
0.60	0.80	0.04	0.05	0.06	0.030	0.035	0.040
0.80	1.00	0.05	0.06	0.07	0.035	0.040	0.050
1.00	1.20	0.06	0.07	0.08	0.040	0.050	0.060
1.20	1.60	0.08	0.09	0.10	0.050	0.060	0.070
1.60	2.00	0.10	0.11	0.12	0.060	0.070	0.080
2.00	2.50	0.12	0.13	0.14	0.080	0.090	0.100
2.50	3.00	0.15	0.15	0.16	0.100	0.110	0.120

**Notes:**

1.  $1N/mm^2 = 1MPa$
2. For special tolerances, not all combinations of thickness and width are available in every product. Please consult Tata Steel.
3. Dimensions are in millimetres.

**Table 4: Thickness tolerances: EN 10131 : 2006 :  $R_{eL} \geq 260N/mm^2$  and  $< 340N/mm^2$**

Nominal thickness		Normal tolerances for a nominal width of			Special tolerances (S) <sup>2</sup> for a nominal width of		
		≤1200	>1200 ≤1500	>1500	≤1200	>1200 ≤1500	>1500
>	≤	±	±	±	±	±	±
0.35	0.40	0.04	0.05	0.06	0.025	0.030	0.035
0.40	0.60	0.04	0.05	0.06	0.030	0.035	0.040
0.60	0.80	0.05	0.06	0.07	0.035	0.040	0.050
0.80	1.00	0.06	0.07	0.08	0.040	0.050	0.060
1.00	1.20	0.07	0.08	0.10	0.050	0.060	0.070
1.20	1.60	0.09	0.11	0.12	0.060	0.070	0.080
1.60	2.00	0.12	0.13	0.14	0.070	0.080	0.100
2.00	2.50	0.14	0.15	0.16	0.100	0.110	0.120
2.50	3.00	0.17	0.18	0.18	0.120	0.130	0.140

**Notes:**

1.  $1N/mm^2 = 1MPa$
2. For special tolerances, not all combinations of thickness and width are available in every product. Please consult Tata Steel.
3. Dimensions are in millimetres.

**Table 5: Thickness tolerances: EN 10131 : 2006 :  $R_{eL} \geq 340N/mm^2$  and  $\leq 420N/mm^2$**

Nominal thickness		Normal tolerances for a nominal width of			Special tolerances (S) <sup>2</sup> for a nominal width of		
		≤1200	>1200 ≤1500	>1500	≤1200	>1200 ≤1500	>1500
>	≤	±	±	±	±	±	±
0.35	0.40	0.04	0.05	0.06	0.030	0.035	0.040
0.40	0.60	0.05	0.06	0.07	0.035	0.040	0.050
0.60	0.80	0.06	0.07	0.08	0.040	0.050	0.060
0.80	1.00	0.07	0.08	0.10	0.050	0.060	0.070
1.00	1.20	0.09	0.10	0.11	0.060	0.070	0.080
1.20	1.60	0.11	0.12	0.14	0.070	0.080	0.100
1.60	2.00	0.14	0.15	0.17	0.080	0.100	0.110
2.00	2.50	0.16	0.18	0.19	0.110	0.120	0.130
2.50	3.00	0.20	0.20	0.21	0.130	0.140	0.150

**Notes:**

1.  $1N/mm^2 = 1MPa$
2. For special tolerances, not all combinations of thickness and width are available in every product. Please consult Tata Steel.
3. Dimensions are in millimetres.

**Table 6: Thickness tolerances: EN 10131 : 2006 :  $R_{eL} > 420N/mm^2$**

Nominal thickness		Normal tolerances for a nominal width of			Special tolerances (S) <sup>2</sup> for a nominal width of		
		≤1200	>1200 ≤1500	>1500	≤1200	>1200 ≤1500	>1500
>	≤	±	±	±	±	±	±
0.35	0.40	0.05	0.06	0.07	0.035	0.040	0.050
0.40	0.60	0.05	0.07	0.08	0.040	0.050	0.060
0.60	0.80	0.06	0.08	0.10	0.050	0.060	0.070
0.80	1.00	0.08	0.10	0.11	0.060	0.070	0.080
1.00	1.20	0.10	0.11	0.13	0.070	0.080	0.100
1.20	1.60	0.13	0.14	0.16	0.080	0.100	0.110
1.60	2.00	0.16	0.17	0.19	0.100	0.110	0.130
2.00	2.50	0.19	0.20	0.22	0.130	0.140	0.160
2.50	3.00	0.22	0.23	0.24	0.160	0.170	0.180

**Notes:**

1.  $1N/mm^2 = 1MPa$
2. For special tolerances, not all combinations of thickness and width are available in every product. Please consult Tata Steel.
3. Dimensions are in millimetres.

**Table 7: Tolerances on coil width: EN 10131 : 2006**

Nominal width	Normal tolerances		Special tolerances (S)	
	lower	upper	lower	upper
	-	+	-	+
≤1200	0	4	0	2
>1200 ≤1500	0	5	0	2
>1500	0	6	0	3

Note: Dimensions are in millimetres.

**Table 8: Flatness tolerances  $R_{eL} < 260N/mm^2$**

EN 10131 : 2006

Tolerance class	Nominal width	Nominal thickness		
		<0.7	≥0.7<1.2	≥1.2
Normal	<1200	10	8	7
	≥1200 <1500	12	10	8
	≥1500	17	15	13
Special (FS)	<1200	5	4	3
	≥1200 <1500	6	5	4
	≥1500	8	7	6

Notes:

1. If sheet is ordered non skin-passed, only the normal tolerances are applicable.
2. The tolerances in this table represent maximum deviation from flatness when the sheet is placed on a horizontal surface.
3. Dimensions are in millimetres.

**Table 9: Flatness tolerances  $R_{eL} \geq 260N/mm^2$  and  $< 340N/mm^2$**

EN 10131 : 2006

Tolerance class	Nominal width	Nominal thickness		
		<0.7	≥0.7<1.2	≥1.2
Normal	<1200	13	10	8
	≥1200 <1500	15	13	11
	≥1500	20	19	17
Special (FS)	<1200	8	6	5
	≥1200 <1500	9	8	6
	≥1500	12	10	9

Notes:

1. If sheet is ordered non skin-passed, only the normal tolerances are applicable.
2. The tolerances in this table represent maximum deviation from flatness when the sheet is placed on a horizontal surface.
3. Flatness tolerances for material with an  $R_{eL} \geq 340N/mm^2$  must be specified when the material is ordered.
4. Dimensions are in millimetres.

## Surface

### Surface Quality

Cold-rolled steels are available in surface quality A or B to EN 10130 : 2006.

#### Surface quality A

Defects that do not influence the formability or the application of surface coatings are permitted. They are defects such as pores, minor scratches, slight indentations, small grooves or slight discoloration.

#### Surface quality B

The better side must be free of defects that can spoil the uniform appearance of a high-quality paint or of an electrolytic coating. The other side must at least conform to surface quality A.

Not all combinations of thickness and width are available in surface quality B. Please consult Tata Steel.

### Inspected side

As a rule, the upper side of the strip is inspected; on request, the strip can be turned over so that the underside is the inspected side.

### Surface texture

Cold-rolled steel is available in several surface textures. Unless specified otherwise, Tata Steel will supply normal roughness. Surface texture cannot be guaranteed for steel that has not been skin passed. Table 11 below shows the range of surface textures according to EN 10130 : 2006. Other surface textures may be available depending upon your requirement.

### Preservative oil

The standard oil applied by Tata Steel acts as a protective coating. Other kinds of oil may be available depending upon your requirement.

Tata Steel offers a range of oiling levels from 0.4-1.7g/m<sup>2</sup> per side. Other levels are available on request.

Tata Steel is not responsible for the risk of corrosion if material is ordered in the un-oiled condition.

**Table 10: EN 10131 : 2006**

#### Criteria in case of disputes over Special (FS) flatness tolerances ( $R_{eL} < 260 \text{ N/mm}^2$ )

Nominal width	Edge-wave length	Maximum acceptable wave height
<1500	>200	<1% of edge-wave length
≥1500	>200	<1.5% of edge-wave length
–	<200	≤2mm

#### Notes:

1.  $1 \text{ N/mm}^2 = 1 \text{ MPa}$
2. Dimensions are in millimetres.

**Table 11: Roughness: EN 10130 : 2006**

Grade	Symbol	Ra (µm) cut off 0.8mm
bright	b	≤0.4
semi-bright	g	≤0.9
normal	m	0.6-1.9
rough	r	>1.6

## Steel for forming

Cold-rolled steel for cold forming and deep drawing is available in a range of qualities, each designed for particular applications.

### Typical applications

- automotive components and body panels
- components for building
- domestic appliances
- electrical goods
- furniture
- radiators
- tubes

### Standards

Cold-rolled steel for forming complies with European standard EN 10130 : 2006 and is available in the grades shown below.

#### EN 10130 : 2006

- DC01
- DC03
- DC04
- DC05
- DC06

### Mechanical properties

The values shown for the mechanical properties in table 12 below are for skin-passed material and are for test pieces taken transverse to the rolling direction.

### Chemical composition

Cold-rolled steel for forming meets the requirements of the cast analysis in the standard, as shown in table 13 on page 31.

### Dimensions

The width and thickness limits are shown in table 14 on page 31. The minimum width is 710mm.

**Table 12: Mechanical properties: EN 10130 : 2006**

Grade	$R_e$ (N/mm <sup>2</sup> ) <sup>1</sup>	$R_m$ (N/mm <sup>2</sup> )	$A_{80}$ (%) <sup>2</sup>	$r_{90}$ <sup>3,4</sup>	$n_{90}$ <sup>3</sup>
	Max	Min-max	Min	Min	Min
DC01	280 <sup>5,7</sup>	270-410	28	–	–
DC03	240 <sup>5</sup>	270-370	34	1.3	–
DC04	210 <sup>5</sup>	270-350	38	1.6	0.18
DC05	180 <sup>5</sup>	270-330	40	1.9	0.20
DC06	170 <sup>6</sup>	270-330	41	2.1	0.22

#### Notes:

1. The values of yield strength are 0.2% proof strength for products that do not present a definite yield point, and lower yield strength ( $R_{eL}$ ) for other products. For thicknesses >0.5mm and ≤0.7mm, the value for yield strength is increased by 20N/mm<sup>2</sup>. For thicknesses ≤0.5mm, the value is increased by 40N/mm<sup>2</sup>.
2. For thicknesses >0.5mm and ≤0.7mm, the minimum value for elongation is reduced by 2 units. For thicknesses ≤0.5mm, the minimum value is reduced by 4 units.
3. The values of  $r_{90}$  and  $n_{90}$  apply only to products with a thickness ≥0.5mm.
4. For thicknesses greater than 2mm, the value for  $r_{90}$  is reduced by 0.2.
5. For design purposes, the lower yield strength ( $R_e$ ) may be assumed to be 140N/mm<sup>2</sup>.
6. For design purposes, the lower yield strength ( $R_e$ ) may be assumed to be 120N/mm<sup>2</sup>.
7. This upper limit is only valid for 8 days from the day the material is available.

**Table 13: Chemical composition: EN 10130 : 2006**

Grade	C	Mn	P	S	Ti
	Max	Max	Max	Max	Max
DC01	0.12	0.60	0.045	0.045	–
DC03	0.10	0.45	0.035	0.035	–
DC04	0.08	0.40	0.030	0.030	–
DC05	0.06	0.35	0.025	0.025	–
DC06	0.02	0.25	0.020	0.020	0.30 <sup>1</sup>

**Notes:**

1. Titanium may be replaced by niobium.
2. Carbon and nitrogen will be completely bound.
3. Values are in weight percentages.

**Table 14: Dimensions**

Thickness	Width				
		DC01	DC03 DC04	DC05	DC06
≥	<	Max	Max	Max	Max
0.35	0.38	1250	1250	1250	–
0.38	0.40	1322	1250	1250	–
0.40	0.43	1330	1275	1275	–
0.43	0.45	1390	1275	1275	–
0.45	0.50	1390	1300	1300	1350
0.50	0.53	1532	1350	1350	1350
0.53	0.55	1532	1400	1400	1350
0.55	0.58	1532	1475	1475	1350
0.58	0.60	1532	1525	1525	1425
0.60	0.65	1532	1532	1580	1580
0.65	0.70	1632	1632	1655	1650
0.70	0.75	1672	1672	1680	1680
0.75	0.95	1820	1815	1680	1680
0.95	1.20	1820	1815	1655	1650
1.20	1.60	1820	1815	1525	1560
1.60	2.00	1537	1525	1525	1525
2.00	2.50	1350	1350	1350	–
2.50	2.90	1300	1300	1300	–
2.90	3.00	1295	1295	1295	–

**Notes:**

1. The minimum width is 710mm.
2. Dimensions are in millimetres.

## High-strength steel

Cold-rolled high-strength steel is available in Tata Steel's own Tenform grade and to a European standard.

High-strength steel allows the user to increase the strength of the finished component or reduce the steel thickness, or both.

### Tenform CMN

Tenform CMN is a carbon-manganese grade and combines high strength with excellent formability for the most difficult cold-forming applications.

### Other high-strength steel grades

Tata Steel can also supply cold-rolled high-strength low-alloy steel grades to comply with EN 10268 : 2006.

### Typical applications

- automotive suspension components
- internal structural parts
- welded tube

### Standards

#### Tenform grade

Tenform CMN is available in the grade shown in table 15 below.

#### High-strength low-alloy steel

Tata Steel offers cold-rolled high-strength low-alloy steel to EN 10268 : 2006 as shown in table 16 below. The former European standard grades are shown for reference.

**Table 15: Tata Steel**

#### Tenform CMN

Grade
CMN300

### Mechanical properties

#### Tenform CMN

The values shown for the mechanical properties in table 17 below are for skin-passed material and are for test pieces taken in the rolling direction.

#### High-strength low-alloy steel

The values shown for the mechanical properties in table 18 on page 33 are for skin-passed material and are for test pieces taken in the rolling direction.

### Chemical composition

#### Tenform CMN

Tenform CMN meets the requirements of the cast analysis shown in table 19 on page 33.

#### High-strength low-alloy steel

Cold-rolled high-strength low-alloy steel meets the requirements of the cast analysis in the standard, as shown in table 20 on page 33.

### Dimensions

The width and thickness limits are shown in table 21 on page 33.

The minimum width is 900mm for all products.

**Table 16: Standards**

#### European

EN 10268 : 2006	EN 10268 : 1999
Grade	
HC260LA	H240LA
HC300LA	H280LA
HC340LA	H320LA
HC380LA	H360LA

**Table 17: Mechanical properties: Tenform CMN**

Grade	R <sub>p</sub> (N/mm <sup>2</sup> )	R <sub>m</sub> (N/mm <sup>2</sup> )	A <sub>80</sub> (%)
	Min-max	Min-max	Min
CMN300	300-360	440-500	26

**Table 18: Mechanical properties: EN 10268 : 2006**

Grade	R <sub>p0.2</sub> <sup>1</sup> (N/mm <sup>2</sup> )	R <sub>m</sub> (N/mm <sup>2</sup> )	A <sub>80</sub> <sup>2</sup> (%)
	Min-max	Min	Min
HC260LA	240-310	340	27
HC300LA	280-360	370	24
HC340LA	320-410	400	22
HC380LA	360-460	430	20

**Notes:**

1. If the yield strength is pronounced, the values apply to the lower yield point (R<sub>eL</sub>).
2. For thicknesses >0.5mm and ≤0.7mm, the minimum value for elongation is reduced by 2 units.

**Table 19: Chemical composition: Tenform CMN**

Grade	C	Mn	Si	P	S
	Max	Max	Max	Max	Max
CMN300	0.18	1.40	0.03	0.025	0.012

**Note:** Values are in weight percentages.

**Table 20: Chemical composition: EN 10268 : 2006**

Grade	C	Si	Mn	P	S	Al	Ti <sup>1</sup>	Nb <sup>1</sup>
	Max	Min	Max	Max	Max	Min	Max	Max
HC260LA	0.1	0.5	0.6	0.025	0.025	0.015	0.15	–
HC300LA	0.1	0.5	1.0	0.025	0.025	0.015	0.15	0.09
HC340LA	0.1	0.5	1.1	0.025	0.025	0.015	0.15	0.09
HC380LA	0.1	0.5	1.6	0.025	0.025	0.015	0.15	0.09

**Notes:**

1. These additional elements may be used individually or in combination where they appear in the definition of the steel within the composition limits indicated. Vanadium and boron may also be added. However, the sum of the contents of these four dispersoidal elements shall not exceed 0.22%.
2. Values are in weight percentages.

**Table 21: Dimensions**

Thickness		Width				
		CMN300	HC260LA	HC300LA	HC340LA	HC380LA
≥	<	Max	Max	Max	Max	Max
0.40	0.43	–	1330	–	–	–
0.43	0.50	–	1390	–	–	–
0.50	0.60	–	1525	–	–	–
0.60	0.65	–	1525	1405	1360	1258
0.65	0.70	–	1725	1405	1360	1258
0.70	0.90	1400	1725	1405	1360	1258
0.90	0.94	1400	1725	1405	1360	1298
0.94	1.00	1400	1725	1405	1530	1338
1.00	1.20	1400	1815	1560	1530	1378
1.20	1.27	1400	1815	1475	1530	1378
1.27	1.50	1400	1815	1475	1530	1398
1.50	1.60	1400	1815	1450	1450	1398
1.60	1.85	–	1450	1450	1450	1398
1.85	2.00	–	1450	1450	1450	1450

**Notes:**

1. The minimum width is 900mm for all products.
2. Dimensions are in millimetres.

## Advanced high-strength steel

Cold-rolled DP600 is advanced high-strength steel for the automotive industry. It allows the user to increase the strength of the finished component or to reduce the thickness of the steel, or both. This can increase the output from each tonne of steel and produce products that are strong, light and safe under load. Its high strain-hardening capacity gives it good formability.

For body-in-white applications, DP600 offers the opportunity to switch from hot-dip galvanised steels.

### Typical applications

- automotive body-in-white
- automotive superstructure components
- precision tubes

### Standard and grade

Draft European standard prEN 10338 : 2007 covers cold-rolled multiphase steels with higher yield strengths for cold forming. We have used this standard to develop DP600, which not only meets the properties in the standard for HCT600X but also in many cases exceeds them. Please consult Tata Steel for more information about the typical properties of DP600.

### Mechanical properties

The values shown for the mechanical properties in table 22 below are for test pieces taken in the rolling direction.

### Chemical composition

Table 23 below shows the chemical composition of HCT600X to Draft prEN 10338 : 2007.

### Dimensions

Width and thickness limits are shown in table 24 below.

**Table 22: Mechanical properties: prEN 10338 : 2007**

Grade	R <sub>p0.2</sub> (N/mm <sup>2</sup> )	R <sub>m</sub> (N/mm <sup>2</sup> )		A <sub>80</sub> (%)
		Min	Max	Min
HCT600X	340-420	600		20

**Notes:**

1. 1N/mm<sup>2</sup>=1MPa
2. Yield strength refers to the 0.2% proof strength for the product.
3. Tata Steel DP600 comfortably meets the 'n' and BH2 requirements.

**Table 23: Chemical composition: prEN 10338 : 2007**

Grade	C	Si	Mn	P	S	Al <sub>tot</sub>	Cr + Mo	Nb + Ti	V	B
	Max	Max	Max	Max	Max		Max	Max	Max	Max
HCT600X	0.17	0.80	2.20	0.08	0.015	≤2.00	1.00	0.15	0.20	0.005

**Note:** Values are in weight percentages.

**Table 24: Dimensions**

Thickness		Width	
>	≤	Min	Max
0.8	1.1	900	1330
1.1	1.2	900	1350
1.2	1.6	900	1400
1.6	1.8	900	1330

**Notes:**

1. Minimum width is 900mm.
2. Widths refer to untrimmed material. Mill edge or side-trimmed material is also available.
3. Dimensions are in millimetres.

## Structural steel

Cold-rolled structural steel has guaranteed minimum strength and good welding properties.

### Typical applications

- tubing
- domestic appliances
- steel furniture
- warehouse shelving

### Standards

Cold-rolled structural steel is available in two grades from Tata Steel.

CA200

CA240

### Mechanical properties

The values shown for the mechanical properties in table 25 below are for skin-passed material and are for test pieces taken transverse to the rolling direction.

### Chemical composition

Cold-rolled structural steel meets the requirements of the cast analysis as shown in table 26 below.

### Dimensions

The width and thickness limits are shown in table 27 below. The minimum width for all products is 900mm.

**Table 25: Mechanical properties: Tata Steel**

Grade	R <sub>p</sub> (N/mm <sup>2</sup> )	R <sub>m</sub> (N/mm <sup>2</sup> )	A <sub>80</sub> (%)
	Min-max	Min-max	Min
CA200	200-260	320-380	30
CA240	240-300	340-400	28

**Table 26: Chemical composition: Tata Steel**

Grade	C	Mn	P	S	SoI. Al
	Max	Max	Max	Max	Min-max
CA200	0.085	0.55	0.03	0.03	0.015-0.080
CA240	0.085	0.55	0.03	0.03	0.020-0.080

**Note:** Values are in weight percentages.

**Table 27: Dimensions**

Thickness	Width	
	CA200	CA240
≥	<	Max
0.38	0.40	1260
0.40	0.43	1330
0.43	0.50	1390
0.50	0.65	1532
0.65	0.70	1632
0.70	0.75	1672
0.75	0.99	1815
0.99	1.60	1815
1.60	2.00	–
		1450

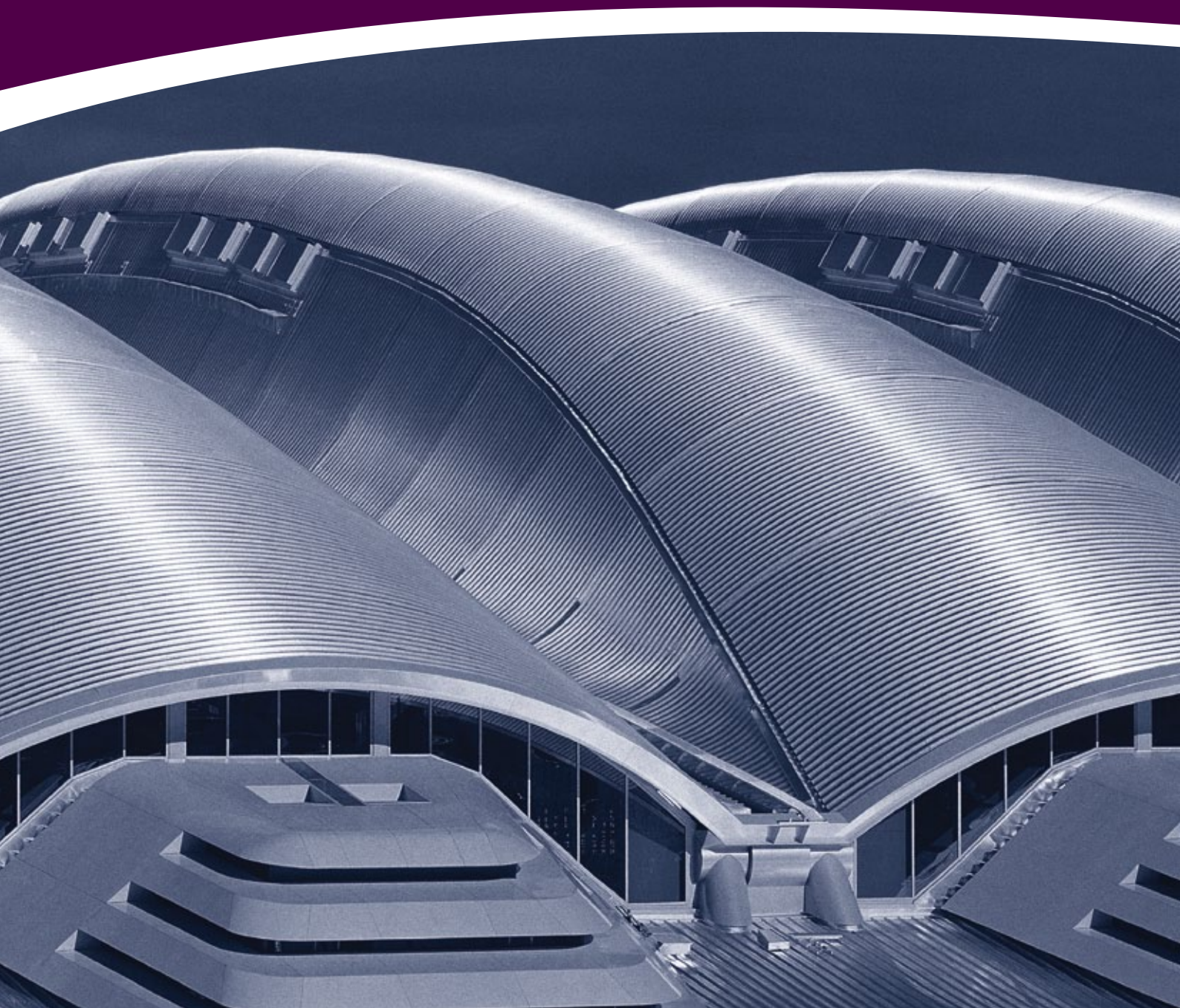
**Notes:**

1. The minimum width for all products is 900mm.
2. Dimensions are in millimetres.



# GALVATITE HOT-DIP GALVANISED PRODUCTS

Tata Steel Strip Products UK manufactures Galvatite with a pure zinc coating, offering corrosion resistance and a variety of characteristics for fabrication and performance.



# General

The hot-dip galvanised strip steel products offered in this section are listed below.

## Page

38	General
44	Galvatite for forming
46	Galvatite high-strength steel
49	Galvatite structural steel

## Grades

This section of the catalogue shows the standard grades of hot-dip galvanised steels offered by Tata Steel.

## Typical applications

- automotive components and body panels
- steel framing
- roof and wall cladding (when painted or pre-finished)
- components for building and construction
- rainwater goods (when painted/coated)
- tubes and sections
- engineering components
- domestic appliances
- electrical goods
- components for agricultural machinery

## Zinc coatings

Galvatite is available in the combinations of coating mass and surface finish shown in table 1 on page 39. For coating masses not shown in the table, please consult Tata Steel.

## Overall thickness and width limits

The overall thickness and width limits for Galvatite are shown in table 2 on page 39. The limits for specific Galvatite products are shown under the individual headings for each product.

## Coil diameters

The coil diameters that apply to Galvatite coils are shown in table 3 on page 39.

## Coil weights

The maximum weight of Galvatite coils offered by Tata Steel is determined by three factors:

- Manufacturing limit: Maximum 21kg/mm of width up to 30 tonnes
- Maximum safe outside diameter of coil (mm):  $10/7 \times$  coil width (limit of 2135mm)
- Maximum weight allowed by road/rail transport

Tata Steel will discuss these factors with the customer to ensure compatibility with the quantity ordered.

Particular products may have maximum coil weights that differ from the range as a whole.

## Tolerances on dimensions and shape

### Thickness

The thickness tolerances from EN 10143 : 2006 for the four ranges of yield strength – and for specific grades in the case of table 5 – are shown in tables 4-7 on pages 40 and 41.

Thickness refers to the total thickness (including the coating), measured at least 40mm from either edge.

For the zinc coatings Z450 and Z600, the tolerances on thickness shown in the tables should be increased by 0.01mm.

The thickness tolerances in the region of coil welds may be increased by a maximum of 50% over a length of 10 metres.

### Coil width

The coil width tolerances in table 8 on page 42 are from EN 10143 : 2006.

### Flatness

Flatness complies with EN 10143 : 2006. Table 9 on page 42 shows the flatness tolerances for steel grades with  $R_{eL} < 260\text{N/mm}^2$ . Table 10 on page 42 shows the flatness tolerances for steel grades with  $R_{p0.2} \geq 260\text{N/mm}^2$  and  $< 360\text{N/mm}^2$  and for grades DX51D and S550GD.

### Edge camber

The deviation over a length of 2 metres will not exceed 5mm as specified in EN 10143 : 2006.

## Health and safety

Tata Steel publishes the health and safety information for its Galvatite hot-dip galvanised steels in *Product health and safety data sheet 18*, which is available at [www.tatasteeleurope.com/en](http://www.tatasteeleurope.com/en).

**Table 1: Coating type, finish and designation**

Coating type	Coating finish	Description	Coating designation <sup>Note</sup>								
			Z100	Z120	Z140	Z200	Z225	Z275	Z350	Z450	Z600
Zinc (Z)	MA	Minimised spangle, as coated surface	•	•	•	•	•	•	•	•	•
	MB	Minimised spangle, improved surface	•	•	•	•	•	•	•	–	–
	MC	Minimised spangle, best quality surface	•	•	•	•	•	•	•	–	–

#### Notes:

- The number contained in the coating designation indicates the coating mass in g/m<sup>2</sup>, which includes both surfaces. Consult Tata Steel about the availability of coating masses other than those shown here, including coating masses between those shown.
- = Available  
– = Consult Tata Steel

**Table 2: Thickness and width limits**

Condition	Thickness		Width	
	Min	Max	Min	Max
Mill edge	0.40	2.5	700	1820
Side trimmed	0.40	2.5	700	1810

**Note:** Dimensions are in millimetres.

**Table 3: Diameter of Galvatite coil**

Inside diameter	610mm standard, 508mm on request
Outside diameter	Max 10/7 x width (limit 2135mm)

**Table 4: Thickness tolerances: EN 10143 : 2006 :  $R_{p0.2}$  or  $R_{eL} < 260N/mm^2$**

Nominal thickness		Normal tolerances for a nominal width of			Special tolerances (S) for a nominal width of		
		≤1200	>1200 ≤1500	>1500	≤1200	>1200 ≤1500	>1500
>	≤	±	±	±	±	±	±
0.20	0.40	0.04	0.05	0.06	0.030	0.035	0.040
0.40	0.60	0.04	0.05	0.06	0.035	0.040	0.045
0.60	0.80	0.05	0.06	0.07	0.040	0.045	0.050
0.80	1.00	0.06	0.07	0.08	0.045	0.050	0.060
1.00	1.20	0.07	0.08	0.09	0.050	0.060	0.070
1.20	1.60	0.10	0.11	0.12	0.060	0.070	0.080
1.60	2.00	0.12	0.13	0.14	0.070	0.080	0.090
2.00	2.50	0.14	0.15	0.16	0.090	0.100	0.110

**Notes:**

1.  $1N/mm^2 = 1MPa$
2. Dimensions are in millimetres.

**Table 5: Thickness tolerances: EN 10143 : 2006 :  $R_{p0.2} \geq 260N/mm^2$  and  $< 360N/mm^2$  and grades DX51D and S550GD**

Nominal thickness		Normal tolerances for a nominal width of			Special tolerances (S) for a nominal width of		
		≤1200	>1200 ≤1500	>1500	≤1200	>1200 ≤1500	>1500
>	≤	±	±	±	±	±	±
0.20	0.40	0.05	0.06	0.07	0.035	0.040	0.045
0.40	0.60	0.05	0.06	0.07	0.040	0.045	0.050
0.60	0.80	0.06	0.07	0.08	0.045	0.050	0.060
0.80	1.00	0.07	0.08	0.09	0.050	0.060	0.070
1.00	1.20	0.08	0.09	0.11	0.060	0.070	0.080
1.20	1.60	0.11	0.13	0.14	0.070	0.080	0.090
1.60	2.00	0.14	0.15	0.16	0.080	0.090	0.110
2.00	2.50	0.16	0.17	0.18	0.110	0.120	0.130

**Notes:**

1.  $1N/mm^2 = 1MPa$
2. Dimensions are in millimetres.

**Table 6: Thickness tolerances: EN 10143 : 2006 :  $R_{p0.2} \geq 360\text{N/mm}^2$  and  $\leq 420\text{N/mm}^2$**

Nominal thickness		Normal tolerances for a nominal width of			Special tolerances (S) for a nominal width of		
		$\leq 1200$	$> 1200$ $\leq 1500$	$> 1500$	$\leq 1200$	$> 1200$ $\leq 1500$	$> 1500$
>	$\leq$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$
0.35	0.40	0.05	0.06	0.07	0.040	0.045	0.050
0.40	0.60	0.06	0.07	0.08	0.045	0.050	0.060
0.60	0.80	0.07	0.08	0.09	0.050	0.060	0.070
0.80	1.00	0.08	0.09	0.11	0.060	0.070	0.080
1.00	1.20	0.10	0.11	0.12	0.070	0.080	0.090
1.20	1.60	0.13	0.14	0.16	0.080	0.090	0.110
1.60	2.00	0.16	0.17	0.19	0.090	0.110	0.120
2.00	2.50	0.18	0.20	0.21	0.120	0.130	0.140

**Notes:**

1.  $1\text{N/mm}^2 = 1\text{MPa}$
2. Dimensions are in millimetres.

**Table 7: Thickness tolerances: EN 10143 : 2006 :  $R_{p0.2} > 420\text{N/mm}^2$  and  $\leq 900\text{N/mm}^2$**

Nominal thickness		Normal tolerances for a nominal width of			Special tolerances (S) for a nominal width of		
		$\leq 1200$	$> 1200$ $\leq 1500$	$> 1500$	$\leq 1200$	$> 1200$ $\leq 1500$	$> 1500$
>	$\leq$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$
0.35	0.40	0.06	0.07	0.08	0.045	0.050	0.060
0.40	0.60	0.06	0.08	0.09	0.050	0.060	0.070
0.60	0.80	0.07	0.09	0.11	0.060	0.070	0.080
0.80	1.00	0.09	0.11	0.12	0.070	0.080	0.090
1.00	1.20	0.11	0.13	0.14	0.080	0.090	0.110
1.20	1.60	0.15	0.16	0.18	0.090	0.110	0.120
1.60	2.00	0.18	0.19	0.21	0.110	0.120	0.140
2.00	2.50	0.21	0.22	0.24	0.140	0.150	0.170

**Notes:**

1.  $1\text{N/mm}^2 = 1\text{MPa}$
2. Dimensions are in millimetres.

**Table 8: Tolerances on coil width: EN 10143 : 2006**

Nominal width	Normal tolerances		Special tolerances (S)	
	lower	upper	lower	upper
	-	+	-	+
≤1200	0	5	0	2
>1200 ≤1500	0	6	0	2
>1500 ≤1800	0	7	0	3
>1800	0	8	0	3

Note: Dimensions are in millimetres.

**Table 9: Flatness tolerances : EN 10143 : 2006 : R<sub>eL</sub> or R<sub>p0.2</sub><260N/mm<sup>2</sup>**

Tolerance class	Nominal width	Nominal thickness		
		<0.7	≥0.7<1.6	≥1.6
Normal	<1200	10	8	8
	≥1200 <1500	12	10	10
	≥1500	17	15	15
Special (FS)	<1200	5	4	3
	≥1200 <1500	6	5	4
	≥1500	8	7	6

Notes:

1. The tolerances in this table represent maximum deviation from flatness when the sheet is placed on a horizontal surface.
2. Dimensions are in millimetres.

**Table 10: Flatness tolerances : EN 10143 : 2006 : R<sub>p0.2</sub>≥260N/mm<sup>2</sup> and <360N/mm<sup>2</sup> and grades DX51D and S550GD**

Tolerance class	Nominal width	Nominal thickness		
		< 0.7	≥0.7<1.6	≥1.6
Normal	<1200	13	10	10
	≥1200 <1500	15	13	13
	≥1500	20	19	19
Special (FS)	<1200	8	6	5
	≥1200 <1500	9	8	6
	≥1500	12	10	9

Notes:

1. The tolerances in this table represent maximum deviation from flatness when the sheet is placed on a horizontal surface.
2. For R<sub>p0.2</sub>>360N/mm<sup>2</sup>, please specify flatness tolerances at the time of the enquiry or order.
3. Dimensions are in millimetres.

## Surface

### Surface quality

Galvatite is available in surface quality A, B or C to EN 10346 : 2009.

The surface qualities shown below are not necessarily available in every dimensional combination for this product. Please consult Tata Steel for more information.

#### Surface quality A: As coated surface

Imperfections such as small pits, differences in spangle size, dark spots, stripes and light passivation from the chemical treatment are permissible.

#### Surface quality B: Improved surface

This surface quality is obtained by temper rolling. To a small extent, imperfections are permissible, such as stretch-levelling breaks, skin-pass marks, scratches, indentations, spangle structure, zinc run-off marks and light passivation from chemical treatment. The surface has no pits.

#### Surface quality C: Best quality surface

This surface quality is obtained by temper rolling. The better side is suitable for the uniform appearance of a high-quality paint finish. The other side must at least conform to surface quality B.

#### Inspected side

As a rule, the upper side of the strip is inspected; on request, the strip can be turned over so that the underside is the inspected side.

### Surface texture

All Galvatite products are available in several surface textures. Unless the customer specifies otherwise, Tata Steel will supply a matt surface texture.

Table 11 below shows the range of surface textures available from Tata Steel.

**Table 11: Roughness**

	R <sub>a</sub> (µm) cut off 2.5mm	R <sub>a</sub> (µm) cut off 0.8mm
Matt	0.9-1.5	0.70-1.30
Middle rough	1.2-1.8	1.00-1.55

### Surface treatment

Galvatite is available oiled, chemically passivated, or both.

#### Oiling (O)

The material surface can be oiled with preservative oil. Other kinds of oil may be available, depending upon your requirement.

Table 12 below shows the levels of oiling available. If no particular level of oiling is specified by the customer, a normal level will be applied.

#### Chemical passivation (C)

Chemical passivation, which includes chromium-free treatment, protects against the effects of humidity and thereby reduces the risk of white rust formation during shipment and storage.

Chromium-free passivation (NCP) is available in coating finishes MA and MB. Please consult Tata Steel for more information on product range and compliance to environmental legislation.

#### Chemical passivation and oiling (CO)

This combination of surface treatments increases the degree of protection against white rust.

#### Untreated (U)

Tata Steel does not recommend that Galvatite be ordered in the untreated condition (dry) owing to the risk of white rust formation during shipment and storage. However, if untreated material is specified, it is supplied on the condition that the purchaser is responsible for any corrosion arising from material ordered in the untreated condition.

**Table 12: Levels of oiling**

Level of oiling	Approximately g/m <sup>2</sup> /side
Light	0.7
Medium/Normal	1.1
Heavy	1.8

## Galvatite for forming

Galvatite for cold forming offers a range that extends from bending and profiling qualities to extra deep drawing qualities.

### Typical applications

- automotive components and body panels
- tubes
- domestic appliances
- steel furniture
- electrical goods
- domestic heating
- drums
- building components
- components for agricultural machinery

### Standards

Galvatite for cold forming complies with European standard EN 10346 : 2009 and is available in the grades shown below.

#### EN 10346 : 2009

- DX51D+Z            • DX54D+Z
- DX52D+Z            • DX56D+Z
- DX53D+Z            • DX57D+Z

### Mechanical Properties

The values shown for the mechanical properties in table 13 below are for test pieces taken transverse to the rolling direction.

### Chemical composition

Galvatite for cold forming meets the requirements of the cast analysis shown in table 14 below.

### Dimensions

The width and thickness limits are shown in table 15 on page 45. The minimum width is 900mm. Widths below this may be available after consultation.

The surface finishes, treatments and coating weights shown in the general section for Galvatite are not necessarily available in all the dimensional combinations for this product. Please consult Tata Steel about your specific requirements.

**Table 13: Mechanical properties : EN 10346 : 2009**

	$R_{eL}$ <sup>5</sup> (N/mm <sup>2</sup> )	$R_m$ (N/mm <sup>2</sup> )	$A_{80}$ (%) <sup>2</sup>	$r_{90}$ <sup>3,4</sup>	$n_{90}$ <sup>4</sup>
Grade	Min-Max	Min-Max	Min	Min	Min
DX51D+Z	–	270-500	22	–	–
DX52D+Z	140-300 <sup>1</sup>	270-420	26	–	–
DX53D+Z	140-260	270-380	30	–	–
DX54D+Z	120-220	260-350	36	1.6	0.18
DX56D+Z	120-180	260-350	39	1.9	0.21
DX57D+Z	120-170	260-350	41	2.1	0.22

#### Notes:

1. This range of values applies to skin-passed products only.
2. For thicknesses >0.5mm and ≤0.7mm (including coating), the minimum elongation after fracture is decreased by 2 units. For thicknesses ≤0.5mm, the reduction is 4 units.
3. For thicknesses greater than 1.5mm, the  $r_{90}$  value is decreased by 0.2 units.
4. For thicknesses less than or equal to 0.7mm (including coating), the  $r_{90}$  value is decreased by 0.2 units and the  $n_{90}$  value is decreased by 0.01 units.
5. If the yield point is not pronounced, values apply to the 0.2% proof strength ( $R_{p0.2}$ ). If the yield strength is pronounced, values apply to the lower yield point ( $R_{eL}$ ).

**Table 14: Chemical composition: EN 10346 : 2009**

Grade	C	Si	Mn	P	S	Ti
	Max	Max	Max	Max	Max	Max
All grades	0.12	0.50	0.60	0.10	0.045	0.30

**Note:** Values are in weight percentages.

**Table 15: Dimensions**

**Coating type Z : Finishes MA, MB, MC**

Thickness		Width					
		Max					
≥	<	DX51D+Z	DX52D+Z	DX53D+Z	DX54D+Z	DX56D+Z	DX57D+Z
0.40	0.50	1375	1375	–	–	–	–
0.50	0.55	1375	1375	1250	1250	1250	1250
0.55	0.65	1520	1570	1570	1570	1570	1570
0.65	0.70	1650	1640	1640	1630	1630	1640
0.70	0.80	1750	1670	1670	1670	1670	1670
0.75	0.80	1750	1670	1670	1820	1670	1670
0.80	0.90	1800	1670	1670	1820	1820	1670
0.90	0.95	1830	1670	1670	1820	1820	1670
0.95	1.00	1830	1650	1650	1820	1820	1650
1.00	1.25	1830	1650	1650	1820	1820	–
1.25	1.45	1830	1640	1650	1720	1720	–
1.45	1.50	1830	1640	1640	1720	1720	–
1.50	1.60	1750	1640	1640	1720	1720	–
1.60	1.65	1650	1640	1640	1720	1720	–
1.65	1.70	1650	1380	1380	1380	1380	–
1.70	1.80	1560	1380	1380	1380	1380	–
1.80	1.90	1450	1380	1380	1380	1380	–
1.90	2.00	1400	1380	1380	1380	1380	–
2.00	2.50	1375	–	–	–	–	–

**Notes:**

1. Please consult Tata Steel about the availability of specific coating weights and surface finishes.
2. Dimensions are in millimetres.

## Galvatite high-strength steel

Galvatite high-strength steel allows the user to increase the strength of the finished component or reduce the steel thickness, or both. It also offers corrosion resistance and good forming properties.

### Typical applications

- automotive components
- automotive closures
- automotive body in white
- automotive re-inforcements

### Standard

Galvatite high-strength steel complies with EN 10346 : 2009 and is available in the grades and coatings shown in table 16 below.

Tata Steel supplies three types of Galvatite high-strength steel.

#### Interstitial free

This is a re-phosphorised, interstitial-free steel that gains its strength by solid solution hardening. Its extremely low and tightly-controlled carbon content gives it excellent flexibility. Other elements such as nitrogen, sulphur and manganese are also tightly controlled. With its combination of high-strength and excellent formability, this steel is suitable for the most difficult automotive applications such as bodysides and exterior panels. It is available in the grades and coating type shown in table 16.

#### Bake hardening

Bake hardening steel gains its strength by solid solution hardening. It starts with good ductility, allowing it to be pressed into complex shapes. It then increases in strength after being heated in the automotive paint stoving process, giving it improved dent resistance and a higher strength in the final part. The improved dent resistance of bake hardening steel makes it particularly suitable for automotive body panels. It is available in the grades and coating type shown in table 16.

#### Low alloy (micro-alloyed)

Low alloy steel gains its strength by precipitation strengthening and grain refinement. This product combines high strength with good formability for automotive structural applications including side-members, cross-members, pillars and sills. The construction industry also uses this product. It is available in the grades and coating type shown in table 16.

### Mechanical properties

The values shown for the mechanical properties in table 17 on page 47 are for temper-rolled material and are for test pieces taken transverse to the rolling direction.

### Chemical composition

Galvatite high-strength steel meets the requirements of the cast analysis in the standard, as shown in table 18 on page 47.

### Dimensions

The width and thickness limits are shown in table 19 on page 48. The minimum width for all products is 900mm. Widths below this may be available after consultation.

**Table 16: Standard: EN 10346 : 2009**

Grade	Symbol for coating type
<b>Interstitial free</b>	
HX180YD	Z
HX220YD	Z
<b>Bake hardening</b>	
HX180BD	Z
HX220BD	Z
HX260BD	Z
HX300BD	Z
<b>Low alloy (micro-alloyed)</b>	
HX260LAD	Z
HX300LAD	Z
HX340LAD	Z

**Table 17: Mechanical properties: EN 10346 : 2009**

Grade	R <sub>p0.2</sub> (N/mm <sup>2</sup> )	BH <sub>2</sub> (N/mm <sup>2</sup> )	R <sub>m</sub> (N/mm <sup>2</sup> )	A <sub>80</sub> (%)	r <sub>90</sub>	n <sub>90</sub>
	Min-Max	Min	Min-Max	Min	Min	Min
<b>Interstitial free</b>						
HX180YD	180-240	–	340-400	34	1.7	0.18
HX220YD	220-280	–	340-420	32	1.5	0.17
<b>Bake hardening</b>						
HX180BD	180-240	35	290-360	34	1.5	0.16
HX220BD	220-280	35	320-400	32	1.2	0.15
HX260BD	260-320	35	360-440	28	–	–
HX300BD	300-360	35	400-480	26	–	–
<b>Low alloy (micro-alloyed)</b>						
HX260LAD	260-330	–	350-430	26	–	–
HX300LAD	300-380	–	380-480	23	–	–
HX340LAD	340-420	–	410-510	21	–	–

**Note:** These values apply for three months for bake-hardening grades and six months for all other grades, from the date the works makes the material available.

**Table 18: Chemical composition: EN 10346 : 2009**

Grade	C	Mn	Si	Al	P	S	Ti <sup>1</sup>	Nb <sup>1</sup>
	Max	Max	Max	Min	Max	Max	Max	Max
<b>Interstitial free</b>								
HX180YD	0.01	0.70	0.50	–	0.060	0.025	0.120	0.09
HX220YD	0.01	0.90	0.20	–	0.080	0.025	0.120	0.09
<b>Bake hardening</b>								
HX180BD	0.10	0.70	0.15	–	0.060	0.025	0.12	0.09
HX220BD	0.10	0.70	0.50	0.015	0.080	0.025	0.12	0.09
HX260BD	0.10	0.80	0.50	0.015	0.100	0.025	0.12	0.09
HX300BD	0.10	0.80	0.50	0.015	0.120	0.025	0.12	0.09
<b>Low alloy (micro-alloyed)</b>								
HX260LAD	0.12	0.60	0.50	0.015	0.030	0.025	0.120	0.09
HX300LAD	0.11	1.00	0.50	0.015	0.030	0.025	0.150	0.09
HX340LAD	0.11	1.00	0.50	0.015	0.030	0.025	0.150	0.09

**Notes:**

1. These elements may be used individually or in combination. Vanadium and boron may also be added, but the combined level of Ti+Nb+V shall not exceed 0.22% by weight.
2. Values are in weight percentages.

**Table 19: Dimensions: Zinc coatings**

Thickness	Width	Max								
		Interstitial free		Bake Hardening				Low alloy		
≥	<	HX180 YD+Z	HX220 YD+Z	HX180 BD+Z	HX220 BD+Z	HX260 BD+Z	HX300 BD+Z	HX260 LAD+Z	HX300 LAD+Z	HX340 LAD+Z
0.55	0.65	–	–	1490	–	–	–	–	–	–
0.65	0.70	1270	1270	1500	–	–	–	–	–	–
0.70	0.75	1445	1445	1630	1289	–	–	1400	–	–
0.75	0.80	1467	1467	1760	1289	–	–	1400	–	–
0.80	0.90	1482	1482	1800	1482	–	–	1400	–	1510
0.90	1.10	1389	1389	1800	1389	1400	–	1400	1300	1510
1.10	1.20	1389	1389	1800	1389	1400	1300	1400	1300	1510
1.20	1.50	1400	1400	1800	1400	1400	1300	1400	1300	1510
1.50	1.60	1400	1400	1620	1400	1400	1300	1400	1300	1510
1.60	1.70	1400	1400	1620	1400	–	1300	–	1300	1510
1.70	1.80	1400	1400	1530	1400	–	1300	–	1300	1510
1.80	1.90	1400	1400	1450	1400	–	1300	–	1300	1510
1.90	2.00	1400	1400	1380	1400	–	1300	–	1300	1510

**Note:** Dimensions are in millimetres.

## Galvatite structural steel

Galvatite structural steel has guaranteed minimum strength.

### Typical applications

- Roof decking
- Domestic appliances
- Steel furniture
- Agricultural applications
- Building components including:
  - Steel framing
  - Infills
  - Dry lining
  - Purlins
  - Mezzanine flooring
  - Composite floor decking
  - HEVAC
  - Nail plates
  - Lintels
  - Angle bead
  - Access flooring

### Standards

Galvatite structural steel complies with European standard EN 10346 : 2009 and is available in the grades shown below. Tata Steel also offers S390GD+Z and S450GD+Z, which are not in EN 10346 : 2009.

#### EN 10346 : 2009

- S220GD+Z
- S250GD+Z
- S280GD+Z
- S320GD+Z
- S350GD+Z
- S550GD+Z

#### Tata Steel

- S390GD+Z
- S450GD+Z

### Mechanical properties

The values shown for the mechanical properties in table 20 below are for test pieces taken in the rolling direction.

### Chemical composition

Galvatite structural steel meets the requirements of the cast analysis shown in table 21 below.

### Dimensions

The width and thickness limits are shown in table 22 on page 50. This table includes dimensions for S390GD+Z and S450GD+Z, which are grades not included in EN 10346 : 2009. The minimum width is 900mm. Widths below this may be available after consultation.

**Table 20: Mechanical properties**

EN 10346 : 2009	R <sub>p0.2</sub> (N/mm <sup>2</sup> )	R <sub>m</sub> (N/mm <sup>2</sup> )	A <sub>80</sub> (%)
Grade	Min	Min	Min
S220GD+Z	220	300	20
S250GD+Z	250	330	19
S280GD+Z	280	360	18
S320GD+Z	320	390	17
S350GD+Z	350	420	16
S550GD+Z	550	560	–
<b>Tata Steel</b>			
S390GD+Z	390	470	14
S450GD+Z	450	500	14

**Note:** For thicknesses less than or equal to 0.7mm (including coating), the minimum elongation after fracture is decreased by 2 units.

**Table 21: Chemical composition: EN 10346 : 2009**

Grade	C	Mn	P	S	Si
	Max	Max	Max	Max	Max
All grades	0.2	1.7	0.1	0.045	0.6

#### Notes:

1. The chemical composition shown in this table also applies to S390GD+Z and S450GD+Z.
2. Values are in weight percentages.

**Table 22: Dimensions**

Thickness		Width							
		Max							
≥	<	S220GD+Z	S250GD+Z	S280GD+Z	S320GD+Z	S350GD+Z	S390GD+Z	S450GD+Z	S550GD+Z
0.40	0.45	1375	1375	1375	1375	1375	–	–	1070
0.45	0.55	1375	1375	1375	1375	1375	–	–	1220
0.55	0.60	1520	1520	1520	1520	1520	–	–	1220
0.60	0.65	1525	1525	1525	1525	1525	–	–	1220
0.65	0.70	1650	1650	1650	1650	1650	–	–	1220
0.70	0.75	1700	1700	1650	1650	1650	1325	1250	1220
0.75	0.80	1800	1700	1650	1650	1650	1325	1250	1220
0.80	1.00	1800	1800	1650	1650	1650	1325	1324	1220
1.00	1.10	1800	1800	1650	1650	1650	1325	1324	–
1.10	1.25	1800	1800	1650	1650	1650	1345	1324	–
1.25	1.30	1800	1800	1520	1520	1520	1345	1324	–
1.30	1.50	1800	1800	1520	1520	1520	1500	1324	–
1.50	1.60	1750	1750	1520	1520	1520	1500	1324	–
1.60	1.70	1650	1650	1520	1520	1520	1500	1324	–
1.70	1.80	1550	1550	1520	1520	1520	1500	1324	–
1.80	1.85	1450	1450	1520	1520	1520	1400	1324	–
1.85	1.90	1450	1450	1465	1465	1465	1400	1324	–
1.90	1.95	1400	1400	1465	1465	1465	1400	1324	–
1.95	2.00	1400	1400	1395	1395	1395	1400	1324	–
2.00	2.05	1375	1375	1375	1375	1375	1250	1275	–
2.05	2.50	1375	1375	1375	1375	1375	1275	1275	–

**Note:** Dimensions are in millimetres.

# GENERAL INFORMATION

This section provides information about further aspects of Tata Steel's products and services.

## Quality

We are third-party approved to ISO/TS 16949 : 2009, the global automotive standard for quality management systems.

## Finishing touches

### Labels

Products bear an ODETTE transport label, which contains information about the product and its destination, both in printed characters and bar code.

### Packing

We can adapt packing to suit your needs.

The standard packs described below are designed to suit the method of transport and the destination.

#### *Hot-rolled and pickled & oiled coils*

– Plain banded

The coil has at least two circumferential bands and one radial band. We can add additional banding on request.

– Pickled and oiled

The coil is banded as above, but offers edge protection and paper wrapping on request.

– Fully protected

The coil is secured with internal bands and is paper-wrapped, fully metal-wrapped with galvanised sheets, and supplied with fluted metal edge protection and a plastic bore protector. This pack is externally banded with three circumferential and four radial bands.

#### *Cold-rolled and coated coils*

– Plain banded

The coil has one circumferential band, at least two radial bands and can be supplied with edge protection on request.

– Paper wrapped

The coil has one circumferential band and four radial bands, plus bore protection and crane protection.

– Film wrapped

The coil is machine-wrapped and has one circumferential band, bore protection and crane protection.

– Fully protected

The coil is secured with one circumferential band and is paper or film-wrapped. It is then fully metal-wrapped and secured with three circumferential bands and six radial bands.

## Transport

We are highly experienced in arranging appropriate transport, including the necessary documentation.

Based on the modes of transport acceptable to you and on the coil weights in your order, we calculate the most suitable arrangements. The mode of transport is an important consideration in determining coil weight. The maximum weight of coils transported by road is limited by the maximum load weight for each vehicle.

### Order item weights

If an order weighs less than 100 tonnes, the total weight for that order must be a multiple of the feasible coil weight. The weight tolerances for any item on an order are shown below.

50 tonnes and over:  $\pm 10\%$

20 tonnes to under 50 tonnes:  $\pm 15\%$

Under 20 tonnes:  $\pm 25\%$

### Inspection documents

We provide inspection documents to EN 10204 : 2004. The criteria for the more common certificates are shown below.

#### 2.1 Certificate of compliance with order

This document certifies that the products supplied comply with the specification ordered.

#### 2.2 Test report with cast analysis only or with mechanical properties and cast analysis

This document certifies that the product supplied complies with the specification ordered. It provides non-specific test results, i.e. based upon Tata Steel's procedures for determining that the manufacturing process produces the product specified in the order.

#### 2.3 Inspection certificate

Tata Steel's authorised representative reports the test results based upon the specific product supplied.

## Service and support

We are focused on delivering world-class customer service and support.

### Service

Close relationships with our customers are at the heart of our business.

### Delivery

We carefully manage the supply chain to deliver your material when you want it. Under our Speedstock service, we can offer certain popular specifications in less than normal lead time.

To link with trading partners, we use UN/EDIFACT EDI messages, which cater for delivery schedules, Advanced Shipping Notification, invoices and other services.

Customers can manage many aspects of their orders using our e-SURE on-line order management system.

### Technical support

Our highly-trained support engineers can work with you on concept validation, material selection and vetting of parts, all to ensure you make optimum use of the material's properties and produce the best possible product.

This technical support carries on after delivery. It ensures that the material continues to meet your requirements. We offer a rapid problem-solving resource and look for ways to improve the in-service performance of the product. We also ensure that the material complies with all applicable legislative requirements and environmental directives.

Our technical helpline can supply information about specifications, applications, performance, health and safety and much more.

Meanwhile, our product and market development programmes help anticipate future market requirements that will help you compete. Our research and development is creating new and better products and ways of using them.

### Information

Information about our business, its products and services, useful contacts and product literature is available on our web site at: [www.tatasteeleurope.com/en/](http://www.tatasteeleurope.com/en/).

## Tata Steel service centres

Our extensive European service centre network provides innovative material solutions to all sectors of industry. These service centres create bespoke packages of products using the latest processing technologies, including laser cutting and welding, multi-strand, trapezoidal and press blanking, powder coating, slitting, sawing and profiling. The products are supplied cut and finished to exact size and specification, ready for immediate fabrication or assembly. The service is supported by the latest e-commerce, stock management and logistics facilities, which ensure the efficient operation of the supply chain, from initial order to delivery.

## Health and safety

Product health and safety data sheets for the products in this catalogue are available from our web site. They comply with the Chemicals (Hazard Information and Packaging for Supply) Regulations, which ensure compliance with the EU Dangerous Substances and Dangerous Preparations Directives.

## The environment

We recognise our environmental responsibilities.

Our commitment is to minimise the environmental impact of our operations and products by adopting sustainable practices and by continuously improving our environmental performance. For more information about Tata Steel Strip Products and the environment, see the section entitled *The environment* on our web site at: [www.tatasteeleurope.com/en/responsibility](http://www.tatasteeleurope.com/en/responsibility).

## Contacting us

We have offices in many countries around the world, each with in-depth knowledge of the local markets and access to all our commercial, technical and distributive resources.

For full details of our offices and agents worldwide, visit: [www.tatasteel.com](http://www.tatasteel.com).

### Sales to service centres

Tata Steel Strip Products  
Tri Gate Business Centre  
210-222 Hagley Road West  
Birmingham  
West Midlands  
B68 0NP  
UK  
T: +44 (0)1633 290022  
F: +44 (0)121 222 5180

### Sales to the sectors shown below

Tata Steel Strip Products  
PO Box 10  
Newport  
South Wales  
NP19 4XN  
UK

### Automotive sector

T: +44 (0)1633 755233  
F: +44 (0)1633 755287

### Tube, re-roller and general engineering sectors

T: +44 (0)1633 755369  
F: +44 (0)1633 755002

### Drum and radiator sectors

T: +44 (0)1633 755180  
F: +44 (0)1633 755002

### Export sales

T: +44 (0)1633 755138  
F: +44 (0)1633 755002

### Technical enquiries for all sectors

Technical enquiries  
Tata Steel Strip Products  
PO Box 10  
Newport  
South Wales  
NP19 4XN  
UK  
T: +44 (0)1633 755171  
F: +44 (0)1633 755064  
[strip.enquiries@tatasteel.com](mailto:strip.enquiries@tatasteel.com)

### Publications

This catalogue and other publications are available in the publications section of our web site at: [www.tatasteeleurope.com/en/](http://www.tatasteeleurope.com/en/)

### Tata Steel Service Centres

UK and Ireland  
T: +44 (0)1902 484000  
F: +44 (0)1902 484049  
[customer-services@tatasteel.com](mailto:customer-services@tatasteel.com)

## Glossary of symbols

Symbol	Definition	Symbol	Definition
≤	Less than or equal to	r	Plastic strain ratio
<	Less than		<b>Note:</b> The symbol r shall be completed by index figure x giving the orientation of the test piece relative to the rolling direction.
≥	Greater than or equal to	$\bar{r}$	The weighted average
>	Greater than		<b>Note:</b> The weighted average value is calculated using the formula:
R <sub>eL</sub>	Lower yield strength: lowest value of stress during plastic yielding, ignoring any initial transient effects.		$\bar{r} = \frac{(r_0+r_{90}+2r_{45})}{4}$
R <sub>eH</sub>	Upper yield strength: value of stress at the moment when the first decrease in force is observed.	n	Strain hardening exponent
R <sub>p</sub>	Proof strength, non-proportional extension: stress at which a non-proportional extension is equal to a specified percentage of the extensometer gauge length.  <b>Note:</b> The symbol used is followed by a suffix, giving the prescribed percentage, e.g. R <sub>p0.2</sub>		<b>Note:</b> the symbol shall be completed by an index figure x giving the orientation of the test piece relative to the rolling direction.
R <sub>m</sub>	Tensile strength: stress corresponding to the maximum force (F <sub>m</sub> ).	$\bar{n}$	The weighted average
A	Percentage elongation after fracture: permanent elongation of the gauge length after fracture, expressed as a percentage of the original gauge length.  <b>Note:</b> In the case of proportional test pieces, only if the original gauge length is other than $5.65\sqrt{S_0}$ , where $S_0$ is the original cross-sectional area of the parallel length, the symbol A should be supplemented by an index indicating the coefficient of proportionality used. In the case of non-proportional test pieces, the symbol A should be supplemented by an index indicating the original gauge length used, expressed in millimetres, e.g.:		<b>Note:</b> the weighted average is calculated using the formula:
A <sub>80</sub>	Percentage elongation of a gauge length of 80mm		$\bar{n} = \frac{(n_0+n_{90}+2n_{45})}{4}$
L <sub>0</sub>	Original gauge length	BH	Bake hardening
L <sub>0</sub> =5.65√S <sub>0</sub>	Proportional test piece		Steels that demonstrate an increase in proof strength following heating in the region of 170°C for 20 minutes.
L <sub>0</sub> =80mm	Non-proportional test piece	LA	Low-alloy/micro-alloyed
R <sub>a</sub>	Surface roughness measured in micrometres  <b>Note:</b> In the symbol R <sub>a0.8</sub> , the suffix represents the cut-off point used when measuring the surface roughness.	Y	Interstitial free
		D	Intended for hot-dip coating
		JR	A longitudinal Charpy V-notch impact of 27J at 20°C.
		J2	A longitudinal Charpy V-notch impact of 27J at -20°C.
		J0	A longitudinal Charpy V-notch impact of 27J at 0°C.
		+AR	Supply condition as rolled
		+N	Normalised

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## **Tata Steel UK Ltd**

PO Box 10  
Newport  
South Wales  
NP19 4XN  
UK  
T: +44 (0) 1633 290022  
F: +44 (0) 1633 755104  
[strip.enquiries@tatasteel.com](mailto:strip.enquiries@tatasteel.com)

## **Sales enquiries**

Tata Steel UK Ltd  
PO Box 10  
Newport  
South Wales  
NP19 4XN  
UK  
T: +44 (0)1633 755195  
F: +44 (0)1633 755002

## **Technical enquiries**

Tata Steel UK Ltd  
PO Box 10  
Newport  
South Wales  
NP19 4XN  
UK  
T: +44 (0)1633 755171  
[strip.enquiries@tatasteel.com](mailto:strip.enquiries@tatasteel.com)

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