

	MAXION STRUCTURAL COMPONENTS HOT-ROLLED STEELS FOR COLD FORMING DIMENSIONAL AND SHAPE TOLERANCES	Standard: HR 002
		Edition: 12-2022

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1. Scope

This standard specifies tolerances on dimensions and shape for ordering, manufacturing, and supplying hot-rolled steel coil, plates, and sheets for cold forming with thicknesses range from 1.50 mm to 25.00 mm. The steels purchased by Maxion have special requirements of dimensional and shape stability for high performance in the process and in the final application. Therefore, this standard shall be considered for steels of the Maxion standard or not.

2. Normative references

ABNT NBR 11888 - Sheet and coils of carbon and high strength alloy steel - General requirements.

ABNT NBR 11889 - Heavy thickness coils and plates of carbon and high strength low alloy steels - General requirements.

ASTM A568/A568M - Standard specification for steel, sheet, carbon, structural, and high-strength, low-alloy, hot-rolled and cold-rolled, general requirements for.

DIN EN 10051 - Continuously hot-rolled strip and plate/sheet cut from wide strip of non-alloy and alloy steels - Tolerances on dimensions and shape.

DIN EN 10058 - Hot rolled flat steel bars and steel wide flats for general purposes - Dimensions and tolerances on shape and dimensions.

GMW3224 - Nominal sheet steel thicknesses and thickness tolerances.

ISO 16160 - Hot-rolled steel sheet products - Dimensional and shape tolerances.

ISO 7452 - Hot-rolled steel plates - Tolerances on dimensions and shape.

JIS G 3193 - Dimensions, shape, mass and permissible variations of hot rolled steel plates, sheets and strips.

JIS G 3194 - Dimensions, shape, mass and permissible variations of hot rolled flat steel.

INMETRO N° 248.

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3. Terms and definitions

3.1 Acronyms, abbreviations, designation, and symbols

Thickness measurement

The thickness may be measured at any point across the width not less than 10 mm from a cut edge and not less than 20 mm from a mill edge. For measurement of thickness shall be used micrometers constructed with anvils and spindles that having minimum diameters of 4.80 mm. The tip of the spindle shall be flat, and the tip of the anvil shall be flat or rounded with a minimum radius of curvature of 2.55 mm. Micrometers with pointed tips are not suitable for thickness measurements. Thickness and thickness tolerances shall be rounded to two decimal places.

Flatness measurement

Deviations from flatness should be measured with the aid of a ruler long enough to be positioned between peaks of ripple or distortion. In addition to the height of the deviations, it is also essential to measure their repetitive distances to analyze the causes.

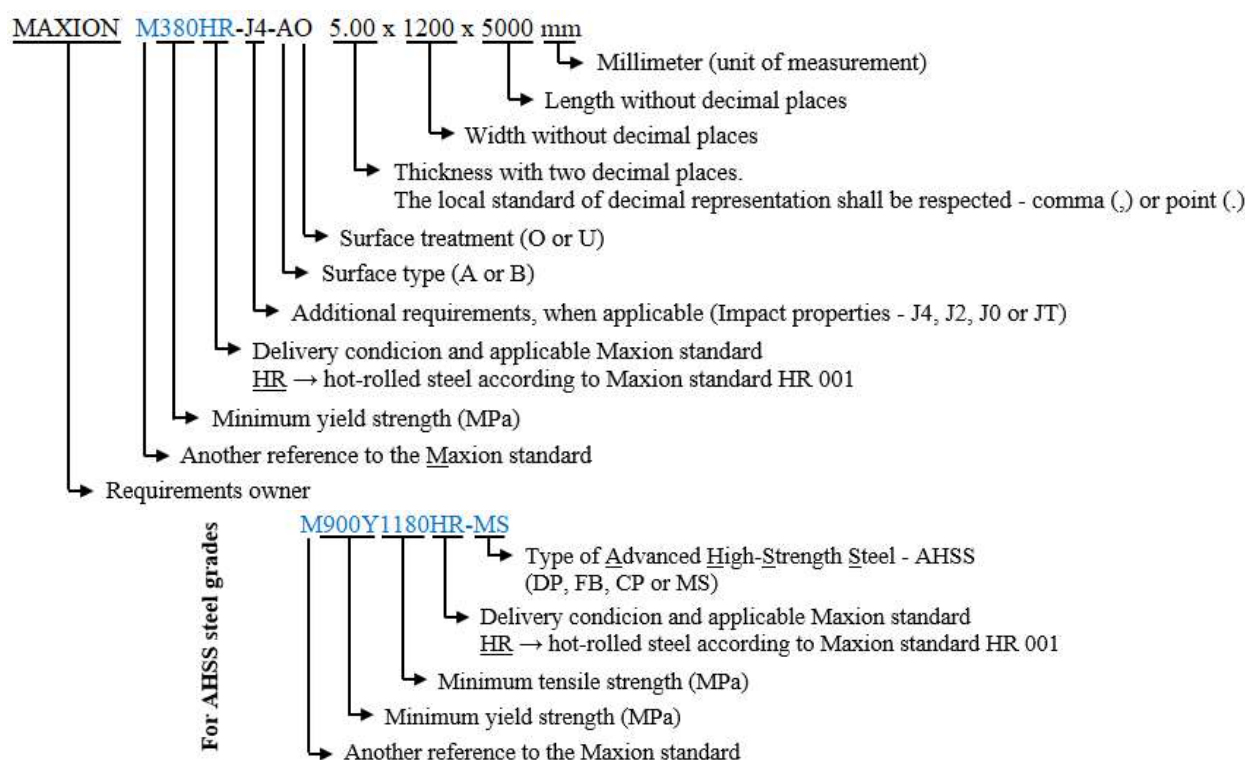
Edge camber measurement

Edge camber is the deviation of a side edge from a straight line. Such a deviation is measured by placing a straightedge (or line) on the concave side and measuring the greatest distance between the sheet/plate edge and the straightedge.

Out-of-squareness measurement

Out-of-squareness is used to control the geometric regularity of the plates or sheet through the measurement of the diagonals to avoid significant deviations from perpendicularity.

For Maxion standard steels the designation shall be referenced in other documents, drawing, etc., as follows example:



Minimum information must be described for each application or product:

Drawing	Steel grade + Thickness
Coil	Steel grade + Thickness + Width
Plates/Sheets	Steel grade + Thickness + Width + Length

E.g.: Coil M380HR-J4-AO 5.00 x 1200 x 3000 mm

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4. Requirements

4.1 Tolerances for thickness

The tolerances on thickness are given in Tables 1 to 6. Eventual asymmetrical tolerances must respect the thickness range.

**Table 1 - Normal tolerances on thickness for steel grades with a specified minimum yield strength
YS ≤ 280 MPa**

Width - w [mm]	Thickness - t [mm]									
	t ≤ 2.00	2.00 < t ≤ 3.00	3.00 < t ≤ 4.00	4.00 < t ≤ 5.00	5.00 < t ≤ 6.00	6.00 < t ≤ 8.00	8.00 < t ≤ 10.00	10.00 < t ≤ 12.50	12.50 < t ≤ 16.00	16.00 < t ≤ 25.00
w ≤ 1200	+ 0.18 - 0.18	+ 0.20 - 0.20	+ 0.20 - 0.20	+ 0.22 - 0.22	+ 0.24 - 0.24	+ 0.27 - 0.27	+ 0.29 - 0.29	+ 0.31 - 0.31	+ 0.34 - 0.34	+ 0.36 - 0.36
1200 < w ≤ 1500	+ 0.20 - 0.20	+ 0.20 - 0.20	+ 0.23 - 0.23	+ 0.25 - 0.25	+ 0.27 - 0.27	+ 0.27 - 0.27	+ 0.31 - 0.31	+ 0.34 - 0.34	+ 0.36 - 0.36	+ 0.38 - 0.38
1500 < w ≤ 1800	+ 0.20 - 0.20	+ 0.23 - 0.23	+ 0.23 - 0.23	+ 0.27 - 0.27	+ 0.29 - 0.29	+ 0.29 - 0.29	+ 0.34 - 0.34	+ 0.36 - 0.36	+ 0.41 - 0.41	+ 0.43 - 0.43
w > 1800	+ 0.20 - 0.20	+ 0.23 - 0.23	+ 0.25 - 0.25	+ 0.29 - 0.29	+ 0.32 - 0.32	+ 0.32 - 0.32	+ 0.36 - 0.36	+ 0.41 - 0.41	+ 0.43 - 0.43	+ 0.45 - 0.45
YS - Yield strength										

**Table 2 - Special tolerances on thickness for steel grades with a specified minimum yield strength
YS ≤ 280 MPa**

Width - w [mm]	Thickness - t [mm]									
	t ≤ 2.00	2.00 < t ≤ 3.00	3.00 < t ≤ 4.00	4.00 < t ≤ 5.00	5.00 < t ≤ 6.00	6.00 < t ≤ 8.00	8.00 < t ≤ 10.00	10.00 < t ≤ 12.50	12.50 < t ≤ 16.00	16.00 < t ≤ 25.00
w ≤ 1200	+ 0.09 - 0.09	+ 0.10 - 0.10	+ 0.10 - 0.10	+ 0.11 - 0.11	+ 0.12 - 0.12	+ 0.14 - 0.14	+ 0.15 - 0.15	+ 0.16 - 0.16	+ 0.17 - 0.17	+ 0.18 - 0.18
1200 < w ≤ 1500	+ 0.10 - 0.10	+ 0.10 - 0.10	+ 0.10 - 0.10	+ 0.13 - 0.13	+ 0.13 - 0.13	+ 0.14 - 0.14	+ 0.16 - 0.16	+ 0.17 - 0.17	+ 0.18 - 0.18	+ 0.19 - 0.19
1500 < w ≤ 1800	+ 0.10 - 0.10	+ 0.12 - 0.12	+ 0.12 - 0.12	+ 0.14 - 0.14	+ 0.14 - 0.14	+ 0.15 - 0.15	+ 0.17 - 0.17	+ 0.18 - 0.18	+ 0.21 - 0.21	+ 0.22 - 0.22
w > 1800	+ 0.10 - 0.10	+ 0.12 - 0.12	+ 0.12 - 0.12	+ 0.15 - 0.15	+ 0.15 - 0.15	+ 0.16 - 0.16	+ 0.18 - 0.18	+ 0.21 - 0.21	+ 0.22 - 0.22	+ 0.23 - 0.23
YS - Yield strength										

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Table 3 - Normal tolerances on thickness for steel grades with a specified minimum yield strength
280 MPa < YS ≤ 500 MPa

Width - w [mm]	Thickness - t [mm]									
	t ≤ 2.00	2.00 < t ≤ 3.00	3.00 < t ≤ 4.00	4.00 < t ≤ 5.00	5.00 < t ≤ 6.00	6.00 < t ≤ 8.00	8.00 < t ≤ 10.00	10.00 < t ≤ 12.50	12.50 < t ≤ 16.00	16.00 < t ≤ 25.00
w ≤ 1200	+ 0.20	+ 0.23	+ 0.26	+ 0.29	+ 0.30	+ 0.30	+ 0.31	+ 0.34	+ 0.37	+ 0.39
	- 0.20	- 0.23	- 0.26	- 0.29	- 0.30	- 0.30	- 0.31	- 0.34	- 0.37	- 0.39
1200 < w ≤ 1500	+ 0.20	+ 0.23	+ 0.29	+ 0.29	+ 0.33	+ 0.33	+ 0.34	+ 0.37	+ 0.39	+ 0.41
	- 0.20	- 0.23	- 0.29	- 0.29	- 0.33	- 0.33	- 0.34	- 0.37	- 0.39	- 0.41
1500 < w ≤ 1800	+ 0.23	+ 0.26	+ 0.31	+ 0.32	+ 0.34	+ 0.34	+ 0.37	+ 0.39	+ 0.44	+ 0.47
	- 0.23	- 0.26	- 0.31	- 0.32	- 0.34	- 0.34	- 0.37	- 0.39	- 0.44	- 0.47
w > 1800	+ 0.23	+ 0.26	+ 0.34	+ 0.34	+ 0.35	+ 0.35	+ 0.39	+ 0.44	+ 0.47	+ 0.49
	- 0.23	- 0.26	- 0.34	- 0.34	- 0.35	- 0.35	- 0.39	- 0.44	- 0.47	- 0.49
YS - Yield strength										

Table 4 - Special tolerances on thickness for steel grades with a specified minimum yield strength
280 MPa < YS ≤ 500 MPa

Width - w [mm]	Thickness - t [mm]									
	t ≤ 2.00	2.00 < t ≤ 3.00	3.00 < t ≤ 4.00	4.00 < t ≤ 5.00	5.00 < t ≤ 6.00	6.00 < t ≤ 8.00	8.00 < t ≤ 10.00	10.00 < t ≤ 12.50	12.50 < t ≤ 16.00	16.00 < t ≤ 25.00
w ≤ 1200	+ 0.10	+ 0.12	+ 0.13	+ 0.15	+ 0.15	+ 0.15	+ 0.16	+ 0.17	+ 0.19	+ 0.20
	- 0.10	- 0.12	- 0.13	- 0.15	- 0.15	- 0.15	- 0.16	- 0.17	- 0.19	- 0.20
1200 < w ≤ 1500	+ 0.10	+ 0.12	+ 0.14	+ 0.15	+ 0.15	+ 0.15	+ 0.17	+ 0.19	+ 0.20	+ 0.21
	- 0.10	- 0.12	- 0.14	- 0.15	- 0.15	- 0.15	- 0.17	- 0.19	- 0.20	- 0.21
1500 < w ≤ 1800	+ 0.12	+ 0.13	+ 0.16	+ 0.16	+ 0.16	+ 0.16	+ 0.19	+ 0.20	+ 0.22	+ 0.24
	- 0.12	- 0.13	- 0.16	- 0.16	- 0.16	- 0.16	- 0.19	- 0.20	- 0.22	- 0.24
w > 1800	+ 0.12	+ 0.13	+ 0.17	+ 0.17	+ 0.17	+ 0.18	+ 0.20	+ 0.22	+ 0.24	+ 0.25
	- 0.12	- 0.13	- 0.17	- 0.17	- 0.17	- 0.18	- 0.20	- 0.22	- 0.24	- 0.25
YS - Yield strength										

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**Table 5 - Normal tolerances on thickness for steel grades with a specified minimum yield strength
YS > 500 MPa**

Width - w [mm]	Thickness - t [mm]									
	t ≤ 2.00	2.00 < t ≤ 3.00	3.00 < t ≤ 4.00	4.00 < t ≤ 5.00	5.00 < t ≤ 6.00	6.00 < t ≤ 8.00	8.00 < t ≤ 10.00	10.00 < t ≤ 12.50	12.50 < t ≤ 16.00	16.00 < t ≤ 25.00
w ≤ 1200	+ 0.22	+ 0.25	+ 0.28	+ 0.31	+ 0.32	+ 0.32	+ 0.33	+ 0.36	+ 0.39	+ 0.41
	- 0.22	- 0.25	- 0.28	- 0.31	- 0.32	- 0.32	- 0.33	- 0.36	- 0.39	- 0.41
1200 < w ≤ 1500	+ 0.22	+ 0.25	+ 0.31	+ 0.31	+ 0.35	+ 0.35	+ 0.36	+ 0.39	+ 0.41	+ 0.43
	- 0.22	- 0.25	- 0.31	- 0.31	- 0.35	- 0.35	- 0.36	- 0.39	- 0.41	- 0.43
1500 < w ≤ 1800	+ 0.25	+ 0.28	+ 0.33	+ 0.34	+ 0.36	+ 0.36	+ 0.39	+ 0.41	+ 0.46	+ 0.49
	- 0.25	- 0.28	- 0.33	- 0.34	- 0.36	- 0.36	- 0.39	- 0.41	- 0.46	- 0.49
w > 1800	+ 0.25	+ 0.28	+ 0.36	+ 0.36	+ 0.37	+ 0.37	+ 0.41	+ 0.46	+ 0.49	+ 0.50
	- 0.25	- 0.28	- 0.36	- 0.36	- 0.37	- 0.37	- 0.41	- 0.46	- 0.49	- 0.50
YS - Yield strength										

**Table 6 - Special tolerances on thickness for steel grades with a specified minimum yield strength
YS > 500 MPa**

Width - w [mm]	Thickness - t [mm]									
	t ≤ 2.00	2.00 < t ≤ 3.00	3.00 < t ≤ 4.00	4.00 < t ≤ 5.00	5.00 < t ≤ 6.00	6.00 < t ≤ 8.00	8.00 < t ≤ 10.00	10.00 < t ≤ 12.50	12.50 < t ≤ 16.00	16.00 < t ≤ 25.00
w ≤ 1200	+ 0.12	+ 0.14	+ 0.14	+ 0.17	+ 0.17	+ 0.17	+ 0.18	+ 0.19	+ 0.21	+ 0.22
	- 0.12	- 0.14	- 0.14	- 0.17	- 0.17	- 0.17	- 0.18	- 0.19	- 0.21	- 0.22
1200 < w ≤ 1500	+ 0.12	+ 0.14	+ 0.17	+ 0.17	+ 0.17	+ 0.17	+ 0.19	+ 0.21	+ 0.22	+ 0.23
	- 0.12	- 0.14	- 0.17	- 0.17	- 0.17	- 0.17	- 0.19	- 0.21	- 0.22	- 0.23
1500 < w ≤ 1800	+ 0.14	+ 0.15	+ 0.18	+ 0.18	+ 0.18	+ 0.18	+ 0.21	+ 0.22	+ 0.24	+ 0.26
	- 0.14	- 0.15	- 0.18	- 0.18	- 0.18	- 0.18	- 0.21	- 0.22	- 0.24	- 0.26
w > 1800	+ 0.14	+ 0.15	+ 0.19	+ 0.19	+ 0.19	+ 0.20	+ 0.22	+ 0.24	+ 0.26	+ 0.27
	- 0.14	- 0.15	- 0.19	- 0.19	- 0.19	- 0.20	- 0.22	- 0.24	- 0.26	- 0.27
YS - Yield strength										

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4.2 Tolerances for width

Width is measured perpendicularly to the longitudinal axis of the product, which in coils is the rolling direction. The tolerances on width are given in Table 7.

Table 7 - Tolerances on width for all steel grades and length

Width - w [mm]	Width tolerance [mm]		
	Cut edge	Mill edge	Slitting
$w \leq 1200$	+ 7 - 0	+ 22 - 0	+ 0.50 - 0.50
$1200 < w \leq 1500$	+ 7 - 0	+ 25 - 0	+ 0.50 - 0.50
$1500 < w \leq 1800$	+ 8 - 0	+ 30 - 0	+ 0.50 - 0.50
$w > 1800$	+ 8 - 0	+ 30 - 0	+ 0.50 - 0.50

4.3 Tolerances for length

Length tolerances are shown in Table 8, which in the case of plates and sheets corresponds to the dimension in rolling direction.

Table 8 - Tolerances on length for all steel grades

Width - w [mm]	Lengths tolerance [mm]
$w \leq 1200$	+ 10 - 0
$1200 < w \leq 1500$	+ 10 - 0
$1500 < w \leq 1800$	+ 10 - 0
$w > 1800$	+ 10 - 0

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4.4 Tolerances for flatness

The deviation from flatness shall not exceed the tolerances given in Table 9.

Table 9 - Normal and special tolerances on flatness for all steel grades

		Flatness tolerances [mm]								
Thickness - t [mm]		t ≤ 5.00			5.00 < t ≤ 12.50			12.50 < t ≤ 25.00		
Width - w [mm]	Type of tolerance	YS ≤ 280	280 < YS ≤ 500	YS > 500	YS ≤ 280	280 < YS ≤ 500	YS > 500	YS ≤ 280	280 < YS ≤ 500	YS > 500
w ≤ 1200	NT	15	18	20	15	20	23	15	20	20
	ST	8	8	10	8	12	12	8	10	10
1200 < w ≤ 1500	NT	18	20	22	20	20	25	17	20	20
	ST	10	10	13	10	12	15	10	10	10
1500 < w ≤ 1800	NT	18	22	25	20	20	25	17	20	25
	ST	10	12	15	10	12	15	10	10	12
w > 1800	NT	24	30	30	22	24	30	20	22	25
	ST	12	15	17	10	12	15	10	12	12
NT - Normal tolerances / ST - Special tolerances / YS - Yield strength										

The main flatness deviations for plates or sheets that must be avoided and controlled are highlighted in Figure 1 to 4.



Figure 1 - Wavy edges in hot-rolled steel plates or sheets and its measurement



Figure 2 - Wavy central in hot-rolled steel plates or sheets and its measurement



Figure 3 - Cross bow in hot-rolled steel plates or sheets and its measurement



Figure 4 - Coil set in hot-rolled steel plates or sheets and its measurement

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Additionally, Figures 5 and 6 show the most common flatness problems in steel coils. These also need to be avoided and controlled.



Figure 5 - Wavy edges in steel coils



Figure 6 - Central buckles in steel coils

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4.5 Tolerances for edge camber

In case of plates and sheets the edge camber shall not exceed 10 mm for any length ≤ 5000 mm. For lengths greater than 5000 mm, the edge camber shall not exceed 0.25% of the actual length. Figure 7 schematically shows the measurement methodology.

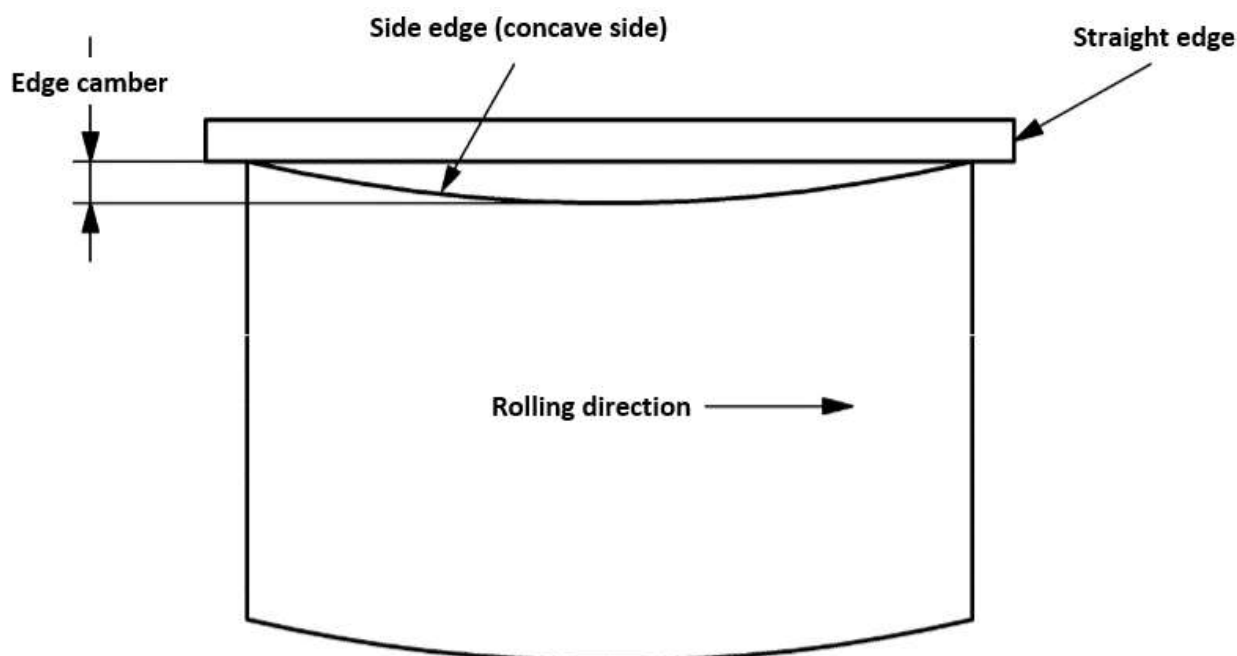


Figure 7 - Schematic drawing of steel plates and sheets edge camber measurement

4.6 Tolerances for out-of-squareness

The out-of-squareness is obtained by the difference between the measured diagonals (D_1 e D_2), as shown in Figure 8. The out-of-squareness shall not exceed 5 mm.

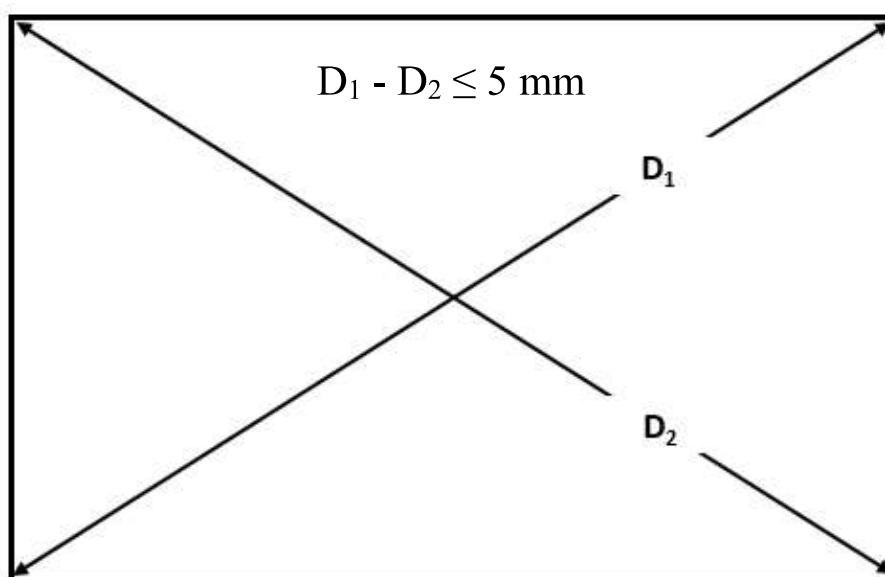


Figure 8 - Schematic drawing of steel plates and sheets out-of-squareness measurement

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4.7 Tolerances for coils

The variation allowed for the mass reported on the invoice and measured upon receipt of the coil, plates and sheets is $\pm 1\%$. Additionally, irregular winding cannot exceed 50 mm, measured relative to the correctly wound region of the circumferential plane of the coil. Loose winding is also not allowed, even if there is no irregular winding, as shown in Figure 9.



Figure 9 - Typical irregular winding problems not permitted. **a)** Telescope effect in the first outer turns; **b)** Telescope effect in the first inner turns; **c)** Irregular winding in all circumferential plane; and **d)** Loose winding

For logistical, operational and safety reasons, the maximum weight allowed for coils and the maximum external diameter must be clearly determined for each product.

4.8 Quality document

An inspection document, inspection certificate or quality certificate shall be supplied to prove the conformity of the supplied product. This document must include the methodology of tests and analysis, as well as the results obtained for the fundamental specifications, according to EN 10204.

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4.9 Delivery

4.9.1 Information to be supplied by the purchaser

In order to allow the manufacture to supply conform products, the following information shall be provided by the purchaser at the time of enquiry and order:

- Part number;
- Full designation of the material as given in item 3.1;
- Nominal dimensions and its tolerances, or normative reference related to dimensions;
- Application of the products;
- Surface type and treatment;
- Type of edge;
- Oil type and quantity (when applicable);
- Package;
- Limits on the mass and the sizes of the coils, plates, and sheets;
- Additional requirements;
- Additional inspection documents.

Note: The producer must develop and supply the material in order to meet the performance and application desired by the purchaser. Tolerances more severe than special tolerances and/or other specifications may be available upon agreement between purchase and producer.

4.9.2 Identification of batches

The batches supplied shall be identified from the labels containing at least the following information:

- Client name;
- Full designation of the material as given in item 3.1;
- Invoice number;
- Batch identification;
- Mass.

Additional information must be negotiated by the purchaser at the time of enquiry and order.

5. Rules and regulations

The products shall be produced and supplied in accordance with applicable international and local legislations. The supplier shall create the Material Data Sheets (MDS) and/or Conflict Minerals Declarations (CMD) and send them to their customer at no cost. If requested by the customer, this registration must be done through platforms that collect, maintain, analyze, and archive information about the materials across all levels of your supply chain (e.g. IMDS and/or CDX). The producer must supply products according to initial approvment or equivalent. Any changes in material or manufacturing process is not permitted without prior notification and approval. Lack of notification by the supplier constitutes grounds for rejection of any shipment.

6. Equivalences

Not applicable.

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7. Release and revisions

Issue	Edition	Date	Description	Responsible
0	12-2022	12/27/2022	Initial publication	Dr. Paulo H. O. M. Alves Quality Dept.