COLD ROLLED PRODUCTS

USIMINAS

USIMINAS

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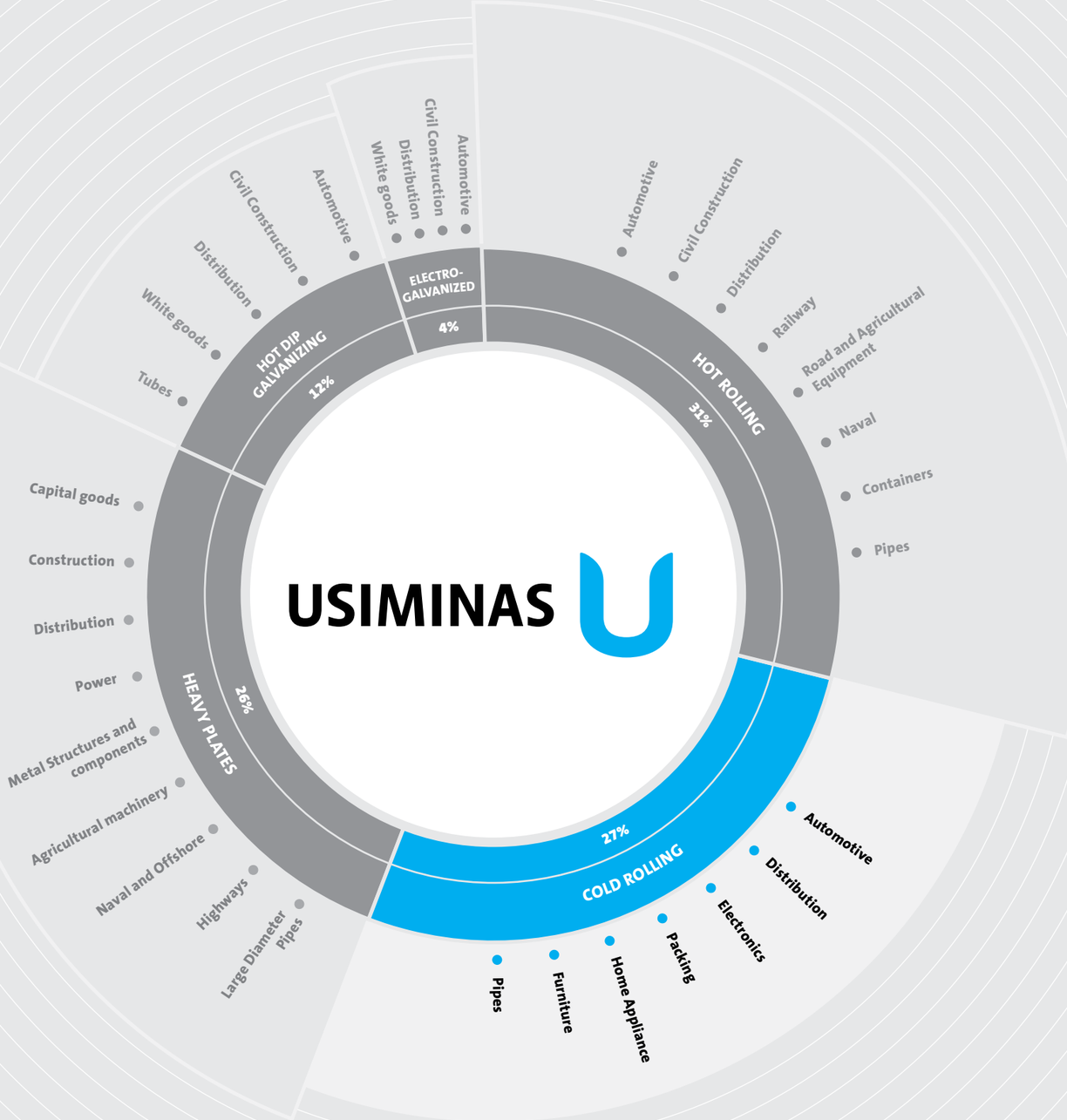


COMPLETE **SOLUTIONS IN STEEL**

WHEN THE STEEL IS FROM USIMINAS, QUALITY COMES FIRST.

Usiminas is a leading producer of flat steel in the Americas. There are units in six states of the country working on an integrated basis to deliver differentiated products and services.

A broad portfolio – from plates to coated steel - adds value to various strategic sectors of the economy, such as automotive, marine, oil and gas, civil construction, machinery and equipment, home appliance, distribution, among others.

They are innovative steels, developed in line with market trends, from Usiminas' historical vocation to technological research.

In the segment of **Cold Rolled Steel**, Usiminas offers a wide range of products to its customers, which cover from the simplest to last generation of Advanced High Strength Steels, AHSS, having the phase transformation as its main mechanism of hardening.

As the base of everything, a team trained to make steel more than a product, a solution.

COLD ROLLED STEEL

Cold rolled steel is generated by cold reduction applied to hot rolled product, followed by subsequent annealing (heat treatment).

The resulting products obtained present dimensions ranging from 0.20 to 3.00 mm in thickness and 700 to 1,830 mm in width, supplied as coils or sheets. The heat treatment, which gives the main mechanical properties to the product, can be optionally performed through two technologies:

- BAF- batch annealing furnace
- CAPL- continuous annealing and processing line

The association between specific chemical composition and adequate thermo-mechanical routes allows the production of different steel grades, from commercial to high strength ones.

Testing is performed on the material to verify properties specified in the standards, with the most common being the tensile test. Cold rolled products are supplied with temporary protective oils applied on the sheet surface to ensure atmospheric corrosion protection during the period the product is not used by the customer.

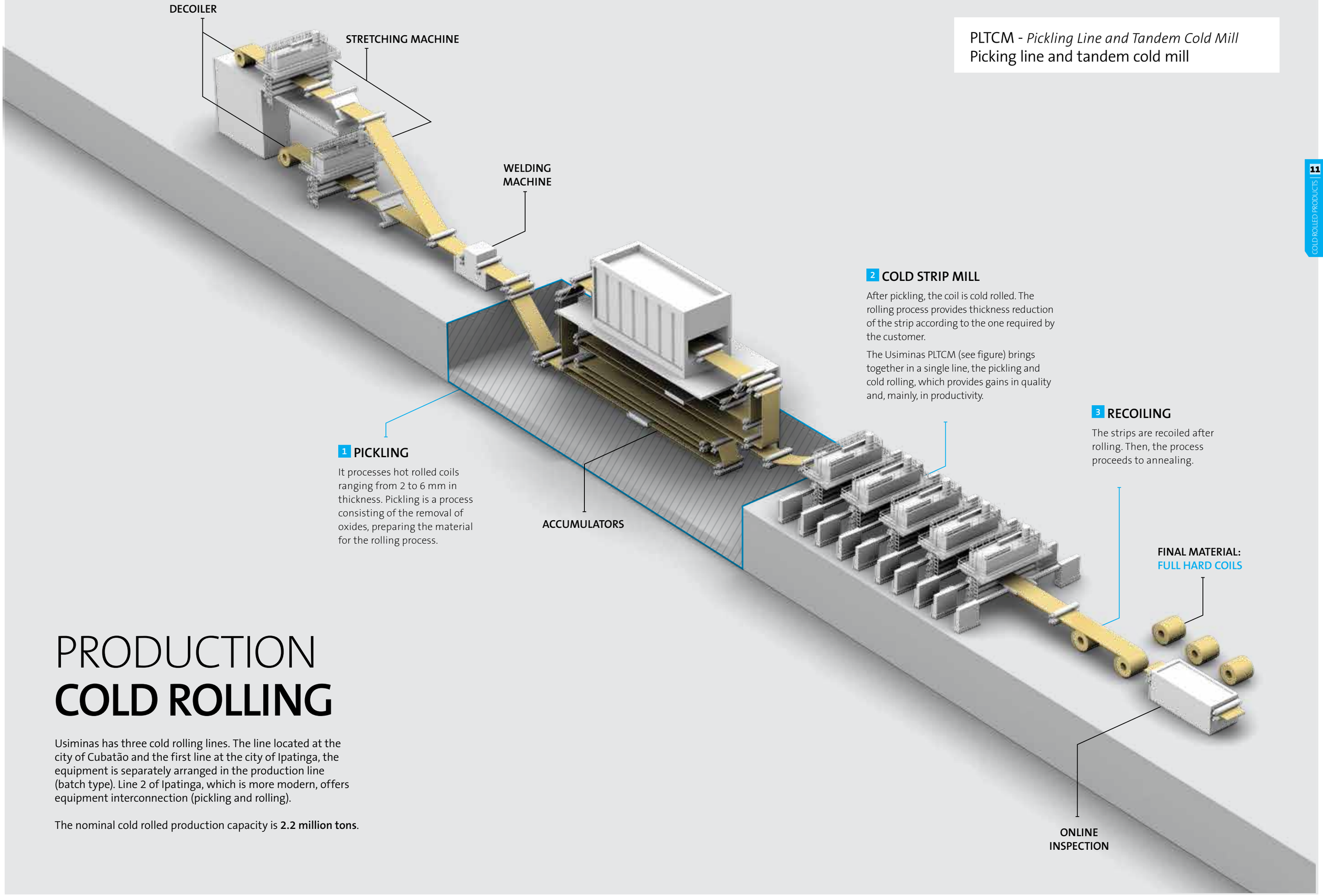
STANDARDS AND SPECIFICATIONS

Usiminas supplies materials with specifications or specific standards of each customer, with the most common ones being:

Usiminas	USI
American Society for Testing and Materials	ASTM
European Standard	EN
Japanese Industrial Standard	JIS
Brazilian Standard	NBR
Society of Automotive Engineers	SAE

This catalogue describes cold rolled steels, with their chemical and mechanical characteristics, produced according to Usiminas specifications, or the standards mentioned. It is important to highlight that this catalog indicates only basic information about these standards.

PLTCM - *Pickling Line and Tandem Cold Mill*
Picking line and tandem cold mill



1 PICKLING

It processes hot rolled coils ranging from 2 to 6 mm in thickness. Pickling is a process consisting of the removal of oxides, preparing the material for the rolling process.

2 COLD STRIP MILL

After pickling, the coil is cold rolled. The rolling process provides thickness reduction of the strip according to the one required by the customer.

The Usiminas PLTCM (see figure) brings together in a single line, the pickling and cold rolling, which provides gains in quality and, mainly, in productivity.

3 RECOILING

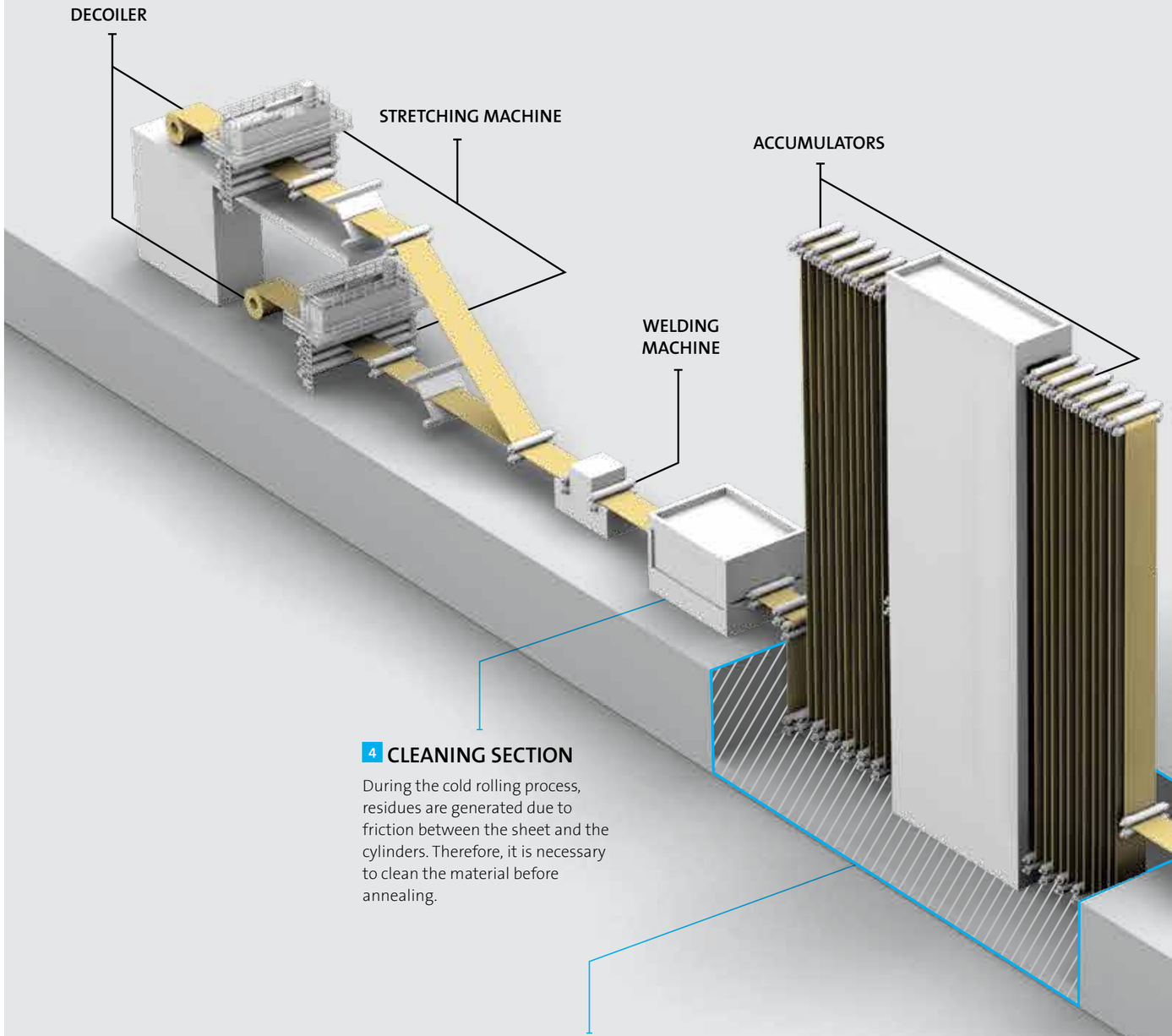
The strips are recoiled after rolling. Then, the process proceeds to annealing.

PRODUCTION **COLD ROLLING**

Usiminas has three cold rolling lines. The line located at the city of Cubatão and the first line at the city of Ipatinga, the equipment is separately arranged in the production line (batch type). Line 2 of Ipatinga, which is more modern, offers equipment interconnection (pickling and rolling).

The nominal cold rolled production capacity is **2.2 million tons**.

CAPL - *Continuous Annealing and Processing Line*
Electrolytic Cleaning + Continuous Annealing + Temper Rolling



4 CLEANING SECTION

During the cold rolling process, residues are generated due to friction between the sheet and the cylinders. Therefore, it is necessary to clean the material before annealing.

5 ANNEALING

After rolling, the material becomes extremely hard. The annealing process consists of heat treatment for restoring the mechanical properties of the material, making it adequate for application in several segments.

Annealing can occur through two technologies: “box” or “continuous”. In box annealing, the coils are placed in piles of three or four and undergo heating cycles. The material stays in these containers for 2 to 3 days, being annealed. On the other hand, in Continuous Annealing, the material is uncoiled at the entrance of the line and passes opened through the annealing line (in strip form), which provides quicker annealing and makes the process last only a few minutes.

6 TEMPER ROLLING

The process adjusts the mechanical properties, shape and surface roughness of the final product.

7 CUTTING LINE

It cuts the edges and sections the coils to meet the width and weight requested by the customer.

FINAL MATERIAL:
COLD ROLLED SHEETS

FINAL MATERIAL:
COLD ROLLED COILS

8 RECOILER

In this process, the strips are oiled and cut to meet the weight requested by the customer. Finally, they are packed.

ONLINE INSPECTION STATION

COMMERCIAL GRADE STEEL

Products with guarantee of chemical composition and without restriction of mechanical properties. Its use is indicated for bending processes in general, and applied in structural parts with low drawing requirement in the segments of civil construction, pipes, white goods and general use. Hardness range can be ensured if specified.

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)						Mechanical Properties (7)				
			C	Mn	Al	P	S	Other	Tensile Test Direction	YS (MPa)	Elongation		Hardness (HRB)
											GL (mm)	% mín	
Usiminas	USI-QC	0.38 ~ 3.00	0.15 max.	0.60 max.	-	0.040 max.	0.040 max.	-	-	-	-	-	-
	USI-QC-40												40 ~ 55
	USI-QC-45												45 ~ 60
	USI-QC-50												50 ~ 65
ASTMA1008 (2013)	CS-A (1) (7)		0.10 max.	0.60 max.	(2)	0.030 max.	0.035 max.	Cu: 0.20 (3) Ni: 0.20 max. Cr: 0.15 max. (4) Mo: 0.06 max. V: 0.008 max. Nb: 0.008 max. Ti: 0.025 max. (5)	Longitudinal	140 ~ 275	50	30	-
	CS-B (1) (7)		0.02 ~ 0.15										
	CS-C (1) (7)		0.08 max.			0.10 max.							
JISG3141 (2011)	SPCC		0.15 max.	0.60 max.	-	0.10 max.	0.035 max.	-	-	-	-	-	-
SAEJ403 (2014)	1006		0.08 max.	0.45 max. (8)	-	0.030 max.	0.035 max.	(6)	-	-	-	-	-
	1008		0.10 max.	0.50 max. (8)									
	1010		0.08 ~ 0.13	0.30 ~ 0.60									
NBR6658 (2009)	-		0.15 max.	0.60 max.	-	0.040 max.	0.040 max.	-	-	-	-	-	-

(1) There is no specification for the Al, Si, N, and B elements; however, their contents must be reported.
(2) When the application requires aluminum-killed steel, the grade has to be manufactured with a minimum 0.01% Al content.
(3) If the Cu content is specified, this is the minimum value allowed. If Cu is not specified, this is the maximum value allowed.
(4) At the manufacturer's discretion, the maximum 0.025% Cr is optional, provided that C < 0.05%.
(5) For steels with C > 0.02%, at the manufacturer's discretion, the maximum Ti can be 0.025% or calculated by the formula 3.4N + 1.5S.
(6) When the Cu content is required, a 0.20% minimum is usually specified.
(7) For the ASTMA 1008 standard, the mechanical properties shown are not mandatory. The values are provided to assist the buyer in specifying the suitable steel for a given application. Values outside these ranges may occur.

DRAWING STEEL

They may be supplied with low carbon (without alloying elements added) or as ultra-low carbon (with addition of titanium and/or niobium for fixing carbon and nitrogen). These steels are supplied with guarantee of mechanical properties, being limited, in most cases, the maximum value of yield strength (YS) and tensile strength (TS) and the minimum elongation (E). For steel with greater drawing capability requirement, anisotropy (r) and strain hardening (n) coefficients can be guaranteed. Their use is indicated for medium to extra-critical deep drawing processes, where strength, rigidity and ductility are required. They are applied in the automotive industry, as well as white goods, civil construction and general use.

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)						Mechanical Properties								
			C	Mn	Al	P	S	Other	Tensile Test Direction	Thickness (mm)	YS (MPa)	TS (MPa)	Elongation: Thickness (mm)	Elongation: GL (mm)	Elongation: % min.	r	n	Hardness (HRB)
Usiminas	USI-EM	0.40 ~ 3.00	0.12 max.	0.50 max.	-	0.040 max.	0.040 max.	-	Transversal	-	-	390 max.	≤ 0.60	50	30	-	-	65 max. (11)
													> 0.60		31			
	USI-EP		0.10 max.	0.45 max.		0.030 max.	0.030 max.			< 0.90	280 max.	370 max.	≤ 0.60		34			57 max. (11)
										≥ 0.90	260 max.		> 0.60		35			
	USI-EEP	0.45 ~ 3.00	0.08 max.	0.45 max.	0.020 min.	0.030 max.	0.030 max.			-	130 ~ 230	350 max.	≤ 0.60		36			50 max. (11)
													> 0.60		37			
	USI-EEP-PC		0.06 max.	0.35 max.	0.020 ~ 0.090	0.025 max.	0.025 max.				130 ~ 200	250 ~ 350	-		37			50 max. (11)
	USI-IF	0.60 ~ 2.30	0.02 max.	0.35 max.	0.010 min.	0.020 max.	0.020 max.	Ti: 0.300 max.			140 ~ 180	270 ~ 350	-		39	2.1 min. (7)	0.22 min. (7)	-
ASTMA1008 (2013)	DS-A (2) (12)	0.38 ~ 3.00	0.08 max.	0.50 max.	0.010 min.	0.020 max.	0.030 max.	Cu: 0.20 min. Ni: 0.20 max. Cr: 0.15 max. (3) Mo: 0.06 max. V: 0.008 max. Nb: 0.008 max. Ti: 0.025 max. (4)	Longitudinal	-	150 ~ 240	-	-	50	36	1.3 ~ 1.7 (1)	0.17 ~ 0.22 (1)	-
	DS-B (2) (12)		0.02 ~ 0.08		0.020 min.													
	DDS (2) (12)		0.06 max.		0.010 min.		0.025 max.				115 ~ 200				38	1.4 ~ 1.8 (1)	0.20 ~ 0.25 (1)	
	EDDS (2) (12)	0.60 ~ 2.30	0.02 max.	0.40 max.			0.020 max.	(5)			105 ~ 170				40	1.7 ~ 2.1 (1)	0.23 ~ 0.27 (1)	

CONTINUED

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)						Mechanical Properties									
			C	Mn	Al	P	S	Other	Tensile Test Direction	Thickness (mm)	YS (MPa)	TS (MPa)	Elongation			r	n	Hardness (HRB)
													Thickness (mm)	GL (mm)	% min.			
EN10130 (2006)	DC 01	0.38 ~ 3.00	0.12 max.	0.60 max.	-	0.045 max.	0.045 max.	-	Transversal	≤ 0.50	140 ~ 320	270 ~ 410	≤ 0.50	80	24	-	-	-
										0.50 < E ≤ 0.70	140 ~ 300		0.50 < E ≤ 0.70		26			
										> 0.70	140 ~ 280		> 0.70		28			
	DC 03		0.10 max.	0.45 max.		0.035 max.	0.035 max.			≤ 0.50	140 ~ 280	270 ~ 370	≤ 0.50		30	1.3 min. (7) (8)	-	
										0.50 < E ≤ 0.70	140 ~ 260		0.50 < E ≤ 0.70		32			
										> 0.70	140 ~ 240		> 0.70		34			
	DC 04		0.08 max.	0.40 max.		0.030 max.	0.030 max.			≤ 0.50	140 ~ 250	270 ~ 350	≤ 0.50		34	1.6 min. (7) (8)	0.18 min. (7)	
										0.50 < E ≤ 0.70	140 ~ 230		0.50 < E ≤ 0.70		36			
										> 0.70	140 ~ 210		> 0.70		38			
	DC 05	0.60 ~ 3.00	0.06 max.	0.35 max.		0.025 max.	0.025 max.			≤ 0.50	140 ~ 220	270 ~ 330	≤ 0.50		36	1.9 min. (7) (8)	0.20 min. (7)	
										0.50 < E ≤ 0.70	140 ~ 200		0.50 < E ≤ 0.70		38			
										> 0.70	140 ~ 180		> 0.70		40			
	DC 06		0.02 max.	0.25 max.		0.020 max.	0.020 max.	Ti: 0.300 max. (6)		≤ 0.50	120 ~ 210	270 ~ 330	≤ 0.50		37	2.1 min. (7) (8)	0.22 min. (7)	
										0.50 < E ≤ 0.70	120 ~ 190		0.50 < E ≤ 0.70		39			
										> 0.70	120 ~ 170		> 0.70		41			
JISG3141 (2011)	SPCCT	0.38 ~ 3.00	0.15 max.	0.60 max.	-	0.100 max.	0.035 max	-	Longitudinal	-	-	270 min.	0.38 ≤ E < 0.40	50	31	-	-	-
													0.40 ≤ E < 0.60		34			
													0.60 ≤ E < 1.00		36			
													1.00 ≤ E < 1.60		37			
													1.60 ≤ E < 2.50		38			
													≥ 2.50		39			
	SPCD		0.12 max.	0.50 max.		0.040 max.	0.035 max.				240 max.		0.38 ≤ E < 0.40		33			
													0.40 ≤ E < 0.60		36			
													0.60 ≤ E < 1.00		38			
													1.00 ≤ E < 1.60		39			
													1.60 ≤ E < 2.50		40			
													≥ 2.50		41			
	SPCE		0.10 max.	0.45 max.		0.030 max.	0.030 max.				220 max.		0.38 ≤ E < 0.40		35			
													0.40 ≤ E < 0.60		38			
													0.60 ≤ E < 100		40			
													100 ≤ E < 160		41			
													1.60 ≤ E < 2.50		42			
													≥ 2.50		43			

CONTINUED

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)						Mechanical Properties									
			C	Mn	Al	P	S	Other	Tensile Test Direction	Thickness (mm)	YS (MPa)	TS (MPa)	Elongation			r	n	Hardness (HRB)
													Thickness (mm)	GL (mm)	% mín.			
NBR5915 (2013)	EM	0.38 ~ 3.00	0.12 max.	0.60 max.	0.010 min.	0.040 max.	0.040 max.	-	Transversal	≤ 0.50	140 ~ 320	270 ~ 390	≤ 0.50	50	26	-	-	65 max. (11)
										0.50 < E ≤ 0.70	140 ~ 300		0.50 < E ≤ 0.70		28			
										> 0.70	140 ~ 280		> 0.70		30			
	EP		0.10 max.				0.030 max.			≤ 0.50	140 ~ 300	270 ~ 370	≤ 0.50		31	1.3 min. (7) (10)	0.16 min. (7) (10)	57 max. (11)
										0.50 < E ≤ 0.70	140 ~ 280		0.50 < E ≤ 0.70		33			
										> 0.70	140 ~ 260		> 0.70		35			
	EEP Grau 1		0.08 max.	0.45 max.		0.030 max.				≤ 0.50	140 ~ 270	270 ~ 350	≤ 0.50		34	1.7 min. (7) (10)	0.19 min. (7) (10)	50 max. (11)
										0.50 < E ≤ 0.70	140 ~ 250		0.50 < E ≤ 0.70		36			
										> 0.70	140 ~ 230		> 0.70		38			
	EEP Grau 2		0.06 max.				0.020 max.			≤ 0.50	140 ~ 250	270 ~ 350	≤ 0.50		35	1.9 min. (7) (10)	0.20 min. (7) (10)	50 max. (11)
										0.50< E ≤0.70	140 ~ 230		0.50 < E ≤ 0.70		37			
										> 0.70	140 ~ 210		> 0.70		39			
	EEP Grau 3	0.60 ~ 3.00	0.007 max.	0.35 max.		0.020 max.		Ti: 0.300 max. (9)		0.60 < E ≤ 0.70	140 ~ 200	270 min.	0.60 < E ≤ 0.70		38	2.1 min. (7) (10)	0.22 min. (7) (10)	48 max. (11)
										> 0.70	140 ~ 180		> 0.70		40			

(1) Average value of test performed in three directions.
(2) There is no specification for the Si, N, and B elements; however, their contents must be reported.
(3) At Usiminas' discretion, the maximum 0.025% Cr is optional, provided that C is < 0.05%.
(4) For steels with C > 0.02%, at Usiminas' discretion, the maximum Ti can be 0.025% or calculated by the formula 3.4N + 1.5S.
(5) Maximum specified values: Cu: 0.10% / Ni: 0.10% / Cr: 0.15% / Mo: 0.03% / V: 0.10% / Cb: 0.10% / Ti: 0,150%.
(6) Ti may be replaced by Nb. C and N should be completely stabilized.
(7) Value measured in the transverse direction.
(8) For thicknesses greater than 2.00mm, the r value is reduced by 0.2.
(9) Nb can also be used to replace Ti, totally or in part. In this case, the maximum allowed value for the Ti and Nb contents will be 0.30%.
(10) The r and n values are only valid for product thickness > 0.50mm and < 2.00mm. For thickness > 2.00mm, when specified in the sales order, the r value should be reduced by 0.2.
(11) The hardness values are for guidance only.
(12) For the ASTMA 1008 standard, the mechanical properties shown are not mandatory. The values are provided to assist the buyer in specifying the suitable steel for a given order. Values outside these ranges may occur."

BAKE HARDENING STEEL

The main characteristic of these steels are increased mechanical strength observed after paint baking treatment of the parts where they are applied. It has great strain aging capacity at temperatures ranging from 100°C to 200°C. These products also show moderate to deep drawing properties, associated to high mechanical strength. They are applied by the automotive industry, mainly in closing panels, such as hoods, trunk lids, doors and fenders, providing good denting resistance in the final parts, even with light drawing, a trait of this type of part.

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)						Mechanical Properties							
			C	Mn	Al	P	S	Other	Tensile Test Direction	YS (MPa)	TS (MPa)	Elongation			r	n	Min. value BH (MPa)
												Thickness (mm)	GL (mm)	% mín.			
Usiminas	USI-BH-180	0.70 ~ 1.00	0.04 max.	0.70 max.	0.020 min.	≤ 0.060	0.030 max.	Si: 0.50 max.	Transversal	180 ~ 240	300 ~ 360	-	50	34	1.6 min. (5)	0.15 min. (5)	30
	USI-BH-220	0.60 ~ 2.30	0.06 max.			≤ 0.080				220 ~ 280	340 ~ 400			32	1.5 min. (5)	0.15 min. (5)	
ASTMA1008 (2013)	BHS180 (1)	0.60 ~ 2.30	0.12 max.	1.50 max.	-	0.120 max.	0.030 max.	Cu: 0.20 (2) Ni: 0.20 max. Cr: 0.15 max. Mo: 0.06 max. V: 0.008 max. (3) Nb: 0.008 max. (3) Ti: 0.008 max. (3)	Longitudinal	180 min.	300 min.	-	50	30	-	-	25
	BHS210 (1)									210 min.	320 min.			28			
EN10268 (2006)	HC180B		0.05 max.	0.70 max.	0.015 min.	0.060 max.	0.025 max.	Si: 0.50 max.	Transversal	180 ~ 230	300 ~ 360	0.60 ≤ E ≤ 0.70	80	32	1.6 min. (4) (5)	0.17 min. (5)	35
												> 0.70		34			
	HC220B		0.06 max.			0.080 max.				220 ~ 270	320 ~ 400	0.60 ≤ E ≤ 0.70		30	1.5 min. (4) (5)	0.16 min. (5)	
												> 0.70		32			
SAEJ2340 (1999)	180B	-	-	-	-	0.050 max.	0.015 max.	Cu: 0.200 max. Ni: 0.200 max. Cr: 0.150 max. Mo: 0.060 max.	Transversal	180 min.	300 min.	-	50	-	-	0.19 min. (6)	30
	210B					0.100 max.				210 min.	320 min.					0.17 min. (6)	

(1) There is no specification for the Al, Si and N elements; however, their contents must be reported.
(2) If the Cu content is specified, this is the minimum value allowed. If Cu is not specified, this is the maximum value allowed.
(3) For C levels < 0.02%, V, Nb, or Ti, or a combination of these, is allowed for element stabilization, at Usiminas' discretion. In these cases, the maximum limits for V and Nb shall be 0.10% and for Ti, 0.15%.

(4) For thicknesses greater than 2.00mm, the r value is reduced by 0.2.
(5) Average value in the transverse direction.
(6) Average value in the longitudinal direction.

ISOTROPIC STEEL

These are titanium and/or boron micro-alloyed steels, which have excellent drawability with elevated strength. The isotropic characteristic of this steel makes possible to have uniform material flow during drawing, regardless of the direction of rolling, reducing the occurrence of earing in the drawn part and allowing optimization of the blank dimensions. They have a high denting resistance. These steels are applied in the automobile industry in outer panels, such as doors, hood, roof, etc.

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)						Mechanical Properties								
			C	Mn	Al	P	S	Other	Tensile Test Direction	YS (MPa)	TS (MPa)	Elongation			r_{90}	n_{90}	R
												Thickness (mm)	GL (mm)	% min.			
Usiminas	USI-220-I	0.60 ~ 2.30	0.07 max.	0.50 max.	0.015 min.	0.050 max.	0.025 max.	Ti: 0.05 max. (1)	Transversal	220 ~ 280	300 ~ 400	-	80	32	0.8 ~ 1.4	0.18 min.	±/- 0.15
	USI-260-I									260 ~ 320	320 ~ 420			30		0.17 min.	

(1) B can replace Ti, totally or in part.

MEDIUM AND HIGH STRENGTH STEEL

This series consists of products that conciliate the attributes of good drawability and high mechanical strength, especially obtained through the hardening mechanism by solid solution, by the presence of manganese and/or phosphorus.

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)						Mechanical Properties							
			C	Mn	Al	P	S	Other	Tensile Test Direction	YS (MPa)	TS (MPa)	Elongation			r_{90} min.	n_{90} min.
												Thickness (mm)	GL (mm)	% min.		
Usiminas	USI-STAR-400		0.07 max.	0.70 max.	0.020 min.	0.11 max.	0.035 max.	-	Transversal	260 ~ 360	380 ~ 500	-	50	28	-	-
ASTMA1008 (2013)	SHS 180 (1)		0.12 max.	1.50 max.	-	0.120 max.	0.030 max.	Cu: 0.20 (2) Ni: 0.20 max. Cr: 0.15 max. Mo: 0.06 max. V: 0.008 max. (3) Nb: 0.008 max. (3) Ti: 0.008 max. (3)	Longitudinal	180 min.	300 min.	-	50	32	-	-
	SHS 210 (1)									210 min.	320 min.			30		
	SHS 240 (1)									240 min.	340 min.			26		
	SHS 280 (1)									280 min.	370 min.			24		
	SHS 300 (1)									300 min.	390 min.			22		
EN10268 (2006)	HC180Y	0.60 ~ 2.30	0.01 max.	0.70 max.	0.010 max.	0.060 max.	0.025 max.	Si: 0.3 max. Ti: 0.12 max. (4)	Transversal	180 ~ 230	340 ~ 400	0.60 ≤ E ≤ 0.70	80	34	1.7 (5)	0.19
												> 0.70		36		
	HC180P		0.05 max.	0.60 max.	0.015 max.	0.080 max.		Si: 0.4 max.		180 ~ 230	280 ~ 360	0.60 ≤ E ≤ 0.70		32	1.6 (5)	0.17
												> 0.70		34		
	HC220Y		0.01 max.	0.90 max.	0.010 max.	0.080 max.		Si: 0.3 max. Ti: 0.12max. (4)		220 ~ 270	350 ~ 420	0.60 ≤ E ≤ 0.70		32	1.6 (5)	0.18
												> 0.70		34		
	HC220P		0.07 max.	0.70 max.	0.015 max.	0.080 max.		Si: 0.5 max.	Transversal	220 ~ 270	320 ~ 400	0.60 ≤ E ≤ 0.70		30	1.3 (5)	0.16
												> 0.70		32		
	HC260Y		0.01 max.	1.60 max.	0.010 max.	0.100 max.		Si: 0.3 max. Ti: 0.12max. (4)		260 ~ 320	380 ~ 440	0.60 ≤ E ≤ 0.70		30	1.4 (5)	0.17
												> 0.70		32		
	HC260P		0.08 max.	0.70 max.	0.015 max.	0.100 max.		Si: 0.5 max.		260 ~ 320	360 ~ 440	0.60 ≤ E ≤ 0.70		27	-	-
												> 0.70		29		
	HC300P		0.10 max.	0.70 max.	0.015 max.	0.120 max.		Si: 0.5 max.		300 ~ 360	400 ~ 480	0.60 ≤ E ≤ 0.70		24	-	-
												> 0.70		26		
JISG3135 (2010)	SPFC340		-	-	-	-	-	-	Longitudinal	175 min.	340 min.	0.60 ≤ E < 1.00	50	34	-	-
												1.00 ≤ E ≤ 2.30		35		
	SPFC370									205 min.	370 min.	0.60 ≤ E < 1.00		32		
												1.00 ≤ E ≤ 2.30		33		
SAEJ2340 (1999)	300S		0.13max.	-	-	0.100 max.	0.020 max.	-	Transversal	300 ~ 400	390 min.	-	50	24	-	-
	340S									340 ~ 440	440 min.			22		

(1) There is no specification for the Al, Si, and N elements; however, their contents must be reported.
(2) If the Cu content is specified, this is the minimum value allowed. If Cu is not specified, this is the maximum value allowed.
(3) For C levels < 0.02%, V, Nb, or Ti, or a combination of these, is allowed for element stabilization, at Usiminas' discretion. In these cases, the maximum limits for V and Nb shall be 0.10% and for Ti, 0.15%.
(4) Ti can be used alone or in combination with Nb. V and B may also be added. However, the sum of these four elements shall not exceed 0.22%.
(5) For thicknesses > 2.00mm, the specified r value should be reduced by 0.2.

MEDIUM AND HIGH STRENGTH MICROALLOYED STEEL

These are steels that show high mechanical strength associated to adequate ductility. Their characteristics are obtained by the addition of alloy elements, such as titanium and niobium, which, together with controlled thermo-mechanical process, promote hardening of the steel structure due to the formation of fine precipitates and by ferrite grain refinement. This group of steel is suitable for vehicle parts that do not require high drawability, such as structural or reinforcement parts. The high mechanical strength allows mass reduction of vehicles if small thickness higher strength steels were introduced in substitution of low strength steels.

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)						Mechanical Properties					
												Elongation		
			C	Mn	Al	P	S	Other	Tensile Test Direction	YS (MPa)	TS (MPa)	Thickness (mm)	GL (mm)	% min.
Usiminas	USI-STAR-450	0.60 ~ 2.30	0.10 max.	1.30 max.	0.010 min.	0.03 max.	0.030 max.	Nb 0.02 ~ 0.06 Si 0.6 max.	Transversal	300 ~ 450	450 ~ 650	-	50	24
	USI-STAR-470		0.10 max.	1.30 max.	0.010 min.	0.03 max.	0.030 max.	Nb 0.02 ~ 0.06 Si 0.7 max.	Transversal	355 ~ 555	420 ~ 540			20
ASTMA1008 (2013)	HSLAS310 (1) (3)		0.22 max.	1.65 max.	-	0.040 max.	0.040 max.	Cu: 0.20 (2) Ni: 0.20 max. Cr: 0.15 max. Mo: 0.06/0.16 max. (3) V: 0.005 min. (4) Nb: 0.005 min. Ti: 0.005 min.	Longitudinal	310 min.	410 min.	-	50	22
	HSLAS340 (1) (3)		0.23 max.							340 min.	450 min.			20
	HSLAS380 (1) (3)		0.25 max.							380 min.	480 min.			18
	HSLAS410 (1) (3)		0.26 max.							410 min.	520 min.			16
EN10268 (2006)	HC260LA	0.60 ~ 2.30	0.10 max.	0.60 max.	0.015 min.	0.025 max.	0.025 max.	Si: 0.5 max. Ti: 0.015 max. (4) Nb: 0.09 max. (4) (5)	Transversal	260 ~ 330	350 ~ 430	(6)	80	26
	HC300LA			1.00 max.						300 ~ 380	380 ~ 480			23
	HC340LA			1.10 max.						340 ~ 420	410 ~ 510			21
	HC380LA	0.70 ~ 2.30		1.60 max.						380 ~ 480	440 ~ 560			19
	HC420LA			1.60 max.						420 ~ 520	470 ~ 590			17
JISG3135 (2010)	SPFC440	0.60 ~ 2.30	-	-	-	-	-	-	Longitudinal	265 min.	440 min.	0.60 ≤ E < 1.00	50	26
												1.00 ≤ E ≤2.30		27
	SPFC490									295 min.	490 min.	0.60 ≤ E < 100		23
												1.00 ≤ E ≤ 2.30		24
	SPFC540									325 min.	540 min.	0.60 ≤ E < 100		20
												1.00 ≤ E ≤ 2.30		21
SAEJ2340 (1999)	300Y		0.13 max.	0.060 max.	-	0.060 max.	0.015 max.	V: 0.005 min. Nb: 0.005 min. Ti: 0.005 min.	Longitudinal	300 ~ 400	400 min.	-	50	21
	340Y									340 ~ 440	440 min.			20
	380Y									380 ~ 480	480 min.			18
	420Y									420 ~ 520	520 min.			16

(1) There is no specification for the Al, Si, and N elements; however, their results must be reported.
(2) If the Cu content is specified, this is the minimum value allowed. If Cu is not specified, this is the maximum value allowed.
(3) Class 1.
(4) Ti and Nb may be used alone or in combination, within the aforementioned limit. V and B may also be added. However, the sum of these four elements shall not exceed 0.22%.
(5) The max. 0.09 Nb specification is not valid for the HC260LA grade.
(6) For a thickness from 0.60mm to 0.70mm inclusive, the minimum elongation value shall be reduced by 2%.

DUAL PHASE STEEL

The term dual phase is related to steel microstructure, which is predominantly formed by islands of a hard martensitic phase, dispersed in a ferrite matrix. The presence of these constituents and their respective volumetric fractions in the microstructure directly influence the mechanical properties of these steels. This structure provides excellent ductility, high strain hardening, (WH effect – work hardening) and painting cure (BH effect – bake hardening effect).

They are especially recommended in the automotive industry for structural and reinforcement parts, providing weight reduction through thickness reduction. They have exceptional impact absorption capacity due to their high ductility/resilience.

However, the lower mechanical grades can be applied in cover panels of vehicles with noteworthy denting resistance.

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)					Mechanical Properties				
			C	Mn	Si	P	S	Tensile Test Direction	YS (MPa	TS (MPa)	Elongation	
											Thickness (mm)	GL (mm)	% min.
Usiminas	USI-DP-450	0.80 ~ 2.00	0.15 max.	2.50 max.	2.00 max.	0.09 max.	0.040 max.	Transversal	250 ~ 330	450 min.	-	80	27
	USI-DP-590								305 ~ 450	590 min.			20
	USI-DP-780 (1)	0.80 ~ 1.80	0.18 max.	3.30 max.					380 ~ 580	780 min.			13
	USI-DP-980 (2)		0.23 max.						550 ~ 730	980 min.			8

(1) Available on request.

TRIP STEEL – **TRANSFORMATION INDUCED PLASTITCITY**

TRIP steel is a product that combines high mechanical strength and great formability capacity. Its characteristics are assigned to a typical microstructure consisting of a ferritic matrix containing a distribution of bainite, martensite, and some retained austenite. When deformed retained austenite transforms into martensite, increasing material formability the. Another characteristic of this material, besides excellent ductility, is the increased strength due to bake hardening effect.

The high elongation and the homogeneous strain hardening coefficient, n, in the sheet plane allow the blank be positioned in any direction of sheet without adversely affecting application.

They are especially suitable for the automotive industry, for structural and reinforcement parts, providing reduction in weight through the reduction in thickness, as well as remarkable ability for impact absorption, due to its high ductility.

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)					Mechanical Properties					
			C	Mn	Si	P	S	Tensile Test Direction	YS (MPa	TS (MPa)	Elongation		
											Thickness (mm)	GL (mm)	% min.
Usiminas	USI-TRIP-780 (1)	1.00 ~ 1.80	0.30 max.	2.50 max.	2.20 max.	0.090 max.	0.015 max.	Longitudinal	440 ~ 560	780 min.	-	80	20

(1) Available on request.

ATMOSPHERIC CORROSION **RESISTANT** STEEL

These are steels whose substrate presents good atmospheric corrosion resistance when compared to common carbon steels. Elements such as Copper and Chromium, added to these steels, form a highly protective oxide coating during contact with the environment, resulting in an increase in useful life of structures and equipment. Atmospheric corrosion resistant steel is indicated for bending processes, deep drawing or extra-critical drawing processes in which, besides atmospheric corrosion resistance, rigidity and ductility are required. They are mainly applied in the white goods and civil construction industries.

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)							Mechanical Properties							
			C	Mn	Al	P	S	Cu	Cr	Tensile Test Direction	Thickness (mm)	YS (MPa)	TS (MPa)	Elongation			Hardness (HRB)
														Thickness (mm)	GL (mm)	% min.	
Usiminas	USI-R-COR-III-QC	0.38 ~ 3.00	0.15 max.	0.60 max.	-	0.040 max.	0.045 max.	0.05 min.	0.05 min.	Transversal	-	-	-	-	-	-	-
	USI-R-COR-III-EM		0.12 max.	0.50 max.			0.040 max.				-	-	390 max.	≤ 0.60	50	30	65 max.
														> 0.60		31	
	USI-R-COR-III-EP	0.45 ~ 3.00	0.10 max.	0.45 max.							< 0.90	275 max.	370 max.	≤ 0.60		34	57 max.
						0.030 max.	0.030 max.				≥ 0.90	260 max.		> 0.60		35	
	USI-R-COR-III-EEP		0.08 max.	0.45 max.	0.020 min.						-	130 ~ 230	350 max.	≤ 0.60		36	50 max.
														> 0.60		37	
	USI-R-COR-III-EEPPC	0.60 ~ 3.00	0.06 max.	0.35 max.	0.020 ~ 0.090	0.025 max.	0.025 max.				-	130 ~ 200	250 ~ 350	-		37	50 max.
	USI-R-COR-III-IF	0.70 ~ 1.80	0.02 max.	0.35 max.	0.010 min.	0.020 max.	0.020 max.				-	140 ~ 180	270 ~ 350	-		39	-

STRUCTURAL ATMOSPHERIC CORROSION RESISTANT STEEL

These are steels that have excellent atmospheric corrosion resistance compared to common carbon steel. They have greater atmospheric corrosion resistance than steels of class USI-R-COR-III, due to higher copper and chromium content. Structural atmospheric corrosion resistant steel has high mechanical strength and rigidity and is indicated for production of roofing, silos, siding in civil works, linings and structural parts.

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)					Mechanical Properties					
			C	Mn	Si	P	S	Tensile Test Direction	YS (MPa	TS (MPa)	Elongation		
											Thickness (mm)	GL (mm)	% min.
Usiminas	USI-AR-COR250	0.70 ~ 2.25	1.20 max.	0.35 max.	0.20 ~ 0.50	0.40 ~ 0.65	-	Transversal	250 min.	370 min.	-	50	22
	USI-AR-COR350		1.40 max.	0.15 ~ 0.55			Ti: 0.15 min.		350 min.	460 min.			

VITREOUS ENAMELING STEEL

Recommended for the conventional enameling process with one or two layers of enamel. The vitreous enameling process provides excellent atmospheric corrosion, thermal shock and abrasion resistance, in addition to good insulation capacity, and excellent decorative effect. They are specified according to their drawing capacity. They are generally applied in domestic appliances, mainly in burners and stove ovens.

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)					Propriedades Mecânicas						
			C	Mn	P	S	B	Tensile Test Direction	Thickness (mm)	YS (MPa)	TS (MPa)	Elongation		Hardness (HRB)
												Thickness (mm)	GL (mm) / % min.	
Usiminas	USI-EV-QC	0.38 ~ 3.00	0.15max.	0.60 max.	0.040 max.	0.040 max.	0.0008 min.	Transversal	-	-	-	-	-	-
	USI-EV-EP		0.10 max.	0.45 max.						280 max.	370 max.	≤ 0.60	34	57 max. (1)
												> 0.60	35	
	USI-EV-EEP		0.08 max.	0.45 max.						230 max.	350 max.	≤ 0.60	36	50 max. (1)
												> 0.60	37	
NBR6651 (2013)	QCV		0.08 max.	0.50 max.	0.040 max.	0.030 max.	-	Transversal	-	-	-	-	-	65 max. (1)
	EPV			0.45 max.	0.030 max.				< 0.90	275 max.	370 max.	≤ 0.60	34	57 max. (1)
									≥ 0.90	260 max.		> 0.60	35	
	EEV			0.40 max.	0.030 max.				-	230	350 max.	≤ 0.60	36	50 max. (1)
												> 0.60	37	

(1) The hardness values are for guidance only.

PACKAGING STEEL

These steels are supplied with thickness lower than 0.37 mm, and are classified according to their hardness. Coils and plates for packaging are only supplied without coating. The main advantages of steel recipients in relation to other metals, glass and polymers are their greater reflective capacity, facility of storage and recycling (able to be separated by magnets).

They are used in the production of packaging of edible oils, vegetable lubricants, chemicals, pesticides, batteries, solvents, waxes, greases, dehydrated products such as powdered milk and flour, among others. The packaging produced with these steels has fundamental characteristics inherent to this segment, such as: tightness, impermeability, mechanical resistance, and atoxicity. These steels, when applied in health, i.e. cans coated with sanitary varnish protection, prevent oxidation of oils and fats contained in food products, because they are opaque packaging.

Standard	Grade	Thickness Range (mm)	Chemical Composition (% p/p)				Hardness (HRB/HR - 30T)
			C	Mn	P	S	
Usiminas	USI-BNR-46 USI-BNR-52	0.20 ~ 0.37	0.12 max.	0.60 max. 0.80 max.	0.030 max. 0.080 max.	0.050 max.	46 ~ 64 52 ~ 70

SEMI-PROCESSED ELECTRICAL STEEL

The magnetic properties of non-oriented grain semi-processed steels (NOG-SP) are optimized during heat treatment made by the customers, which reduces magnetic loss and improves permeability. These steels have excellent flatness and dimensional homogeneity, especially in the sheared edge supply condition, which are characteristics required for punching of the strips. These steels are supplied for electromagnetic applications in small industrial motor nuclei, domestic appliances, transformers and hermetic compressors for refrigeration. .

Standard	Grade	Thicknesses (mm)	Chemical Composition (% p/p)						Hardness (HV-5)	Maximum Core Loss (W/Kg) (1)			
			C	Mn	Al	P	S	Si		Thickness (mm)	1.0T/50Hz	1.0T/60Hz	1.5T/60Hz
Usiminas	USI-CORE-550	0.50 / 0.60 / 0.80 / 0.90 / 1.00 / 1.20	0.08 max.	0.60 max.	0.010 max.	0.040 max.	0.030 max.	0.60 max.	100 ~ 190	0.50 / 0.60	5.50	6.80	12.70
										0.80 / 0.90	8.25	10.20	19.10
										1.00 / 1.20	11.00	17.60	25.40
	USI-CORE-450	0.50 / 0.60	0.10 max.	0.50 max.	-		0.020 max.	0.10 max.	110 ~ 150	0.50	4.50	5.20	11.30
										0.60	5.50	6.80	14.50
	USI-CORE-260	0.50 / 0.60 / 0.80	0.10 max.	0.70 max.	-		0.020 max.	0.50 min.	150 ~ 200	0.50	2.60	3.20	6.90
										0.60	3.10	3.80	8.20
										0.80	4.10	5.10	10.90
	USI-CORE-230	0.50	0.10 max.	0.70 max.	0.30 min.		0.020 max.	1.50 max.	150 ~ 205	0.50	2.30	2.80	5.40

(1) Calculated core loss after heat treatment in a N atmosphere at 760 °C/2h.

FINISHING AND SUPPLY CONDITIONS

SURFACE FINISHING

The surface aspect of the products should be defined according to the options below, as per standard NBR11888.

Grade A Surface: adequate for very demanding applications, for example, in exposed parts.

Grade B Surface: adequate for less demanding applications, also for exposed parts.

Grade C Surface: normally recommended for applications with lesser demand of surface aspect of the steel plate, such as in non-exposed parts and general applications.

TYPE OF OILING

Cold rolled products are supplied oiled to avoid atmospheric corrosion. Protective oils used are: Solvent Base, Oil Base or Prelube, which aids in the drawing/stamping process and DOS, that can be painted after baking with no need for degreasing. According to the customer's need, different amounts of oil can be applied. Please consult Usiminas for further clarifications.

EDGE FINISHING

Products can be supplied with or without sheared edges in the finishing lines.

TYPES OF PACKING AND IDENTIFICATION

Usiminas has diverse types of packing, either for products supplied as plates or coils. Consult Usiminas for further information.

DIMENSIONAL TOLERANCES

Usiminas guarantees dimensional limits under several specifications, such as Standards NBR11888, ASTMA568/A924 and EN10131. Consult Usiminas for further information. s.

OTHER

Dimensional precision, shape and other specifications not contained in the standards adopted should also be mentioned in the order.

USEFUL INFORMATION
ON USAGE

STOCKING AND SHIPPING

- Storage of steel coils or plate bundles should be made in the appropriate place, with use of supports or pallets in good condition, avoiding denting which may damage the coil or sheet surface. Piling is not recommended when the surface condition is A or B.

- Contact with water during storage or shipping can cause white and/or red rust in cold rolled products. Thus, handling of these products in the rain, under conditions where condensation may occur should be avoided, and when there is a possibility of contact with water, especially seawater.

- Preferentially, the storage place should be of low relative humidity (lower than 60% is recommended), with good air circulation and with low particulate/hygroscopic/acid substances in the air)

- Damaged packaging should immediately be repaired.

- If contact with water occurs, the material should be immediately dried and used.

- Very long storage time associated with high ambient temperatures may, for certain products, alter mechanical properties.

DEGREASING OPERATIONS

The use of neutral or slightly alkaline degreasing agents is recommended.

HANDLING DURING DRAWING OPERATIONS

- Plates should be carefully handled in such a way as to avoid surface damage that impedes their intended application. .

- The presence of sweat or fingerprints may alter the surface of drawn parts, making painting difficult. Thus, the use of gloves for plate handling is recommended. s.

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