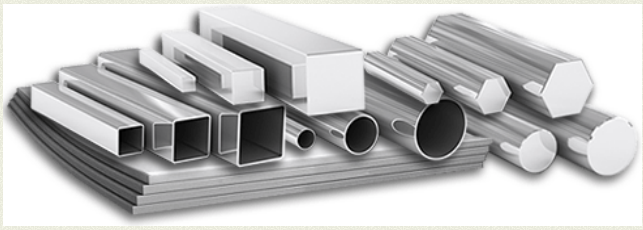
STAINLESS STEEL



The special characteristic of stainless steels is that they have a **resistance to corrosion** that is significantly higher with respect to other steels; some of them also have an excellent **resistance to high temperatures**.These characteristics of stainless steels are obtained thanks to the addition of chromium and other alloy elements, and allow use even in **particularly aggressive environments** such as **chemical plants, marine environments** and **offshore platforms**. These qualities of resistance to assaults makes them perfect materials to be used also in **architecture** to increase the durability of the objects created. Some of these steels, thanks to a chemical composition that is particularly rich in nickel and chromium, are called "refractory steels" and can withstand high temperatures with a limited loss of the mechanical characteristics.Stainless steels are commonly divided into five groups, depending on the specific amounts of alloying elements, which control the microstructure of the alloy.

Stainless steels martensitic *(corrosion-resistant, temperable steels):* Martensitic stainless steels, as is the case of quenched and tempered steels, **can be tempered**. For this reason the products can be provided in both the annealed state (a treatment that improves their machinability and deformability) and in the **quenched and tempered** state (which instead enhances their mechanical strength and corrosion resistance characteristics). In order to achieve high surface hardness values, it is finally possible to subject these steels also to induction hardening after chip removal machining. As with the other steels, the versions with the addition of sulfur lend themselves more easily to machining by chip removal.
Stainless steels ferritic *(corrosion-resistant, non-temperable steels):* The ferritic stainless steels, which are characterized by a ferritic structure, **cannot be tempered**, but the mechanical strength characteristics can in any case be improved thanks to cold deformation or drawing. The chromium content ensures a **good resistance to corrosion**, further increased in the variety with the addition of molybdenum, while the addition of sulfur allows the **machinability by chip removal** to be improved. The steels of this category are often used in the white (appliances) sector, for the production of grills, and whenever a generic resistance to corrosion is required without very accentuated characteristics.

Stainless steels austenitic (*corrosion-resistant, non-magnetic steels):* In addition to chromium — a basic element of all stainless steel — austenitic stainless steels also contain **high levels of nickel**, an element that significantly improves its resistance to corrosion, as well as the possible addition of other elements such as **molybdenum**, **titanium**, and **niobium**, present in some versions. The austenitic structure of these steels does not allow the execution of quenching and tempering treatments, but cold drawing deformations allow **very high mechanical characteristics** to be obtained, especially on small diameters. At the solubilized state they are completely non-magnetic, while in the drawn state they acquire a slight ferromagnetism. The versions with the addition of **copper**, instead, have a decidedly improved **cold deformability**, making them suitable for example for use in formed screws and in general for cold forming. The steels of the Plus series undergo special processing during casting and an analytical balancing that provides them with an excellent **machinability** in the tool in relation to this category of materials. The addition of sulfur, finally, allows an easy machinability of the material and makes it suitable for the production of turned parts with challenging machining; in contrast, the resistance to corrosion is slightly decreased.

Stainless steels austenitic-ferritic *(duplex steels, corrosion-resistant, non-temperable, suitable for aggressive environments):* The chemical composition of this category of steels, also called biphasic, allows a mixed structure of austenite and ferrite to be obtained with unique corrosion resistance characteristics, especially to corrosion under voltage and to marine corrosion. Thanks to these characteristics and to the high mechanical strength, which can be obtained with hardening and cold deformation, these steels are commonly used in offshore platforms, and in any case where the action of salt and corrosive agents is particularly accentuated. They are magnetic, can generally be welded and cannot be tempered. These are therefore products with a particularly high level of performance, whose development is still underway and whose applications have yet to be fully explored.

Stainless steels heat-resistant *(steels resistant to corrosion and high temperatures):* The specific needs of environments that have **very high temperatures** have led to the need to create stainless steels able to cope with these very particular conditions: this is, for example, the case with the steels designed to be used within **heat treatment ovens** or as resistors of radiating elements. Thanks to the addition of chromium and nickel in high quantities and to a balanced analysis, the steels in this category are particularly suitable for retaining good mechanical characteristics at high temperature; they can therefore remain in service for a long time in environments at high temperature and with chemical aggressiveness.

COMPARISON CHART WITH CORRESPONDENCES OF THE MOST IMPORTANT STAINLESS STEELS' FAMILIES

GROUP	PRODUCT TYPE	UNI CLASSIFICATION	AISI	MATERIAL Nr	PRODUCT CLASS	CHEMICAL ANALYSIS (%)										APPLICATIONS
						C	S	P	Si	Mn	Cr	NI	Mo	Cu	ALTRI	
SPRINGS	302 304 316	X10CrNi1809 X5CrNi1810 XCrNiMo1713	AISI 302 AISI 304 AISI 316	1.4310 1.4301 1.4401	AUSTENITIC AUSTENITIC AUSTENITIC	≤0.12 ≤0.07 ≤0.07	≤0.030 ≤0.020 ≤0.025	≤0.045 ≤0.040 ≤0.040	≤0.6 ≤1.0 ≤1.0	≤1.6 ≤2.0 ≤2.0	18 18.5 17.5	8.5 9.5 12	- - 2.25	- - -	- - -	FOR SPRINGS IN GENERAL
AUTOMATIC MACHINES PRODUCTION	303 430F	X10CrNiS1809 X10CrS17	AISI 303 AISI 430F	1.4305 1.4104	AUSTENITIC FERRITIC	≤0.15 ≤0.15	≤0.25 ≤0.25	≤0.030 ≤0.030	0.50 0.50	≤2.0 ≤1.25	18 17	9 -	≤0.60 ≤0.60	- -	- -	PARTICULARLY RECOMMENDED FOR WORKING,REMOVING THE BURRS
PRESS SCREWS	410 430 304 304C-u 310 316	X12Cr13 X8Cr17 X5CrNi1810 - X15CrNi2520 X5CrNiMo1713	AISI 410 AISI 430 AISI 304 AISI 304 Cu AISI 310 AISI 316	1.4006 1.4016 1.4301 1.4567 1.4842 1.4401	MARTENSITIC FERRITIC AUSTENITIC AUSTENITIC AUSTENITIC AUSTENITIC	≤0.12 ≤0.08 ≤0.07 ≤0.03 ≤0.08 ≤0.05	≤0.025 ≤0.025 ≤0.025 ≤0.025 ≤0.025 ≤0.025	≤0.040 ≤0.040 ≤0.040 ≤0.040 ≤0.040 ≤0.040	0.40 0.50 ≤1.0 ≤1.0 ≤1.5 ≤1.0	0.50 0.60 ≤2.0 ≤2.0 ≤2.0 ≤2.0	13 17 18 17.5 25 17.5	- - 10 10 20 12	- - - - - 2.25	- - - 3.5 - -	- - - - - -	FOR COLD-PRESS IN GENERAL
WIRE NETTINGS,CONVEYOR BELTS	304 304LC 316 316LC 321	X5CrNi1810 X2CrNi1811 X5CrNiMo1713 X2CrNiMo1712 X6CrNiTi1811	AISI 304 AISI 304LC AISI316 AISI 316LC AISI 321	1.4301 1.4306 1.4401 1.4435 1.4541	AUSTENITIC AUSTENITIC AUSTENITIC AUSTENITIC AUSTENITIC	≤0.07 ≤0.03 ≤0.06 ≤0.025 ≤0.08	≤0.025 ≤0.025 ≤0.025 ≤0.020 ≤0.015	≤0.040 ≤0.035 ≤0.040 ≤0.030 ≤0.030	≤1.0 ≤1.0 ≤1.0 0.60 0.50	≤2.0 ≤2.0 ≤2.0 1.70 1.60	18.5 19 17.5 18 18	9.5 10.5 12 12 10.5	- - 2.25 2.50 -	- - - - -	- - - - Ti=5xCmin	GENERAL PURPOSES
	309 310 310S 314 330 431	X16CrNi2314 X22CrNi2520 X6CrNi2520 X16CrNiSi2520 - 	AISI 309 AISI 310 AISI 310S AISI 314 AISI 330 	1.4828 1.4845 1.4841 1.4864 1.4057	AUSTENITIC AUSTENITIC AUSTENITIC AUSTENITIC AUSTENITIC 	≤0.11 ≤0.20 ≤0.08 ≤0.20 ≤0.08 	≤0.025 ≤0.025 ≤0.025 ≤0.020 ≤0.030 	≤0.040 ≤0.040 ≤0.040 ≤0.040 ≤0.030 	0.50 ≤1.50 ≤1.50 1.5÷3 2÷2.6 	≤2.0 ≤2.0 ≤2.0 ≤2.0 1.50 	23 25 25 25 18 	13 20 20 20 38 	- - - - - -	- - - - - -	- - - - - -	FIRE-RESISTANT MATERIALS
BLANK STATE FOR HOOKS,CHECKERS	304 316 430	X5CrNi1810 X5CrNiMo1713 X8Cr17	AISI 304 AISI 316 AISI 430	1.4301 1.4401 1.4016	AUSTENITIC AUSTENITIC FERRITIC	≤0.08 ≤0.07 ≤0.06	≤0.030 ≤0.030 ≤0.030	≤0.040 ≤0.040 ≤0.040	≤1 ≤1 ≤1	≤2.0 ≤2.0 ≤2.0	18 17.50 17	9.50 11.50 -	- 2.25 -	- - -	- - -	GENERAL PURPOSES

FINISHES (TYPES AND EQUIVALENTS)

DESCRIPTION	ASTM A480	EN 10088
HOT ROLLED,NOT HEAT TREATED, NOT DESCALED	(HR)	1U
HOT ROLLED,HEAT TREATED, PICKLED	1	1D
HOT ROLLED, ANNEALED,PICKLED AND COLD ROLLED, BRIGHT SURFACE FINISHING	1	2H
COLD ROLLED, HEAT TREATED, PICKLED, SMOOTH SURFACE FINISHING	2D	2D
COLD ROLLED,HEAT TREATED, PICKLED, SKIN PASSED (SMOOTHER SURFACE THAN 2D)	2B	2B
COLD ROLLED, BRIGHT ANNEALED. SMOOTH, BRIGHT, REFLECTIVE SURFACE	BA	2R
SATIN POLISHED	3	2K
SATIN POLISHED	4	2K
BRUSHED OR DULL POLISHED	6	2J
BRIGHT POLISHED	7	2P
MIRROR POLISHED	8	/
PATTERN ON ONE SIDE	/	2M

X5CrNi1810 (AISI 304)

The reference steel for the chromium-nickel austenitic stainless steel category, it has good resistance to corrosion, cold deformability, and polishability. Its versatility makes it widely used for cutlery, grills,urban fixtures, and appliances ,as well as in the automobile industry and in other application.

STANDARD REFERENCE EN 10088-3 : 2005 (HOT-ROLLED AND BRIGHT PRODUCTS)

REFERENCE AND COMPARABLE STANDARDS

EUROPE		ITALY	GERMANY		FRANCE	UK	USA
UNI 10088-3:2005		(UNI 6900:71)	(DIN 17440-85)		(NF A 35-574-90)	(BS 970 pt.3-91)	AISI
GRADE	N°		WERKSTOFF	N°			
X5CrNi18-10	1.4301	X 5 CrNi 18 10	X5CrNi18-10	1.4301	27 CN 18-09	304S15	304

CHEMICAL COMPOSITION (CAST ANALYSIS) (%)

C/max	Si/max	Mn/max	P/max	S/max	N/max	Cr	Ni
0.07	1.00	2.00	0.045	0.030	0.11	17.50÷19.50	8.0÷10.5

MECHANICAL PROPERTIES [ROUGH TURNED (1X) IN THE ANNEALED CONDITION]

SIZE max (mm)	HARDNESS HB max * **	$Rp_{0,2}$ (MPa) min	$Rp_{0,1}$(MPa) min. *	Rm (MPa) **	A5 (%) min. **	KV (J) min.	RESISTANCE TO INTERGRANULAR CORROSION	
							IN THE DELIVERY CONDITION	IN THE WELDED CONDITION
100	215	190	225	500÷700	45	100	SI	NO

* ONLY FOR GUIDANCE **THE MAXIMUM HB VALUES MAY BE RAISED BY 100HB OR THE TENSILE STRENGHT VALUE MAY BE RAISED BY 200MPa AND THE MINIMUM A% VALUE MAY BE LOWERED TO 20% FOR BARS OF ≤35 mm

MECHANICAL PROPERTIES (COLD DRAWN 2H,AND GROUND BARS 2G IN THE SOLUTION ANNEALED CONDITION)

SIZE max (mm)	$Rp_{0,2}$ (MPa) min	Rm (MPa)	A5 (%) min. *	KV (J) min
≤10	400	600÷950	25	-
>10 ≤16	400	600÷950	25	-
>16 ≤40	190	600÷850	30	100
>40 ≤63	190	580÷850	30	100
>63 ≤100	190	500÷700	45	100

* VALUES VALID ONLY FOR SIZE ≤5mm

MECHANICAL PROPERTIES (COLD DRAWN WIRE AND COILS 2H)									
TENSILE STRENGTH Rm (MPa)	+ C600	+C700	+C 800	+C 900	+C 1000	+C 1100	+C 1200	+C 1400	+C 1600
	600÷800	700÷900	800÷1000	900÷1100	1000÷1250	1100÷1350	1200÷1450	1400÷1700	1600÷1900
NOTE: THE DESIRED TENSILE STRENGHT LEVEL SHALL BE EVALUATED DEPENDING ON DIAMETER REQUIRED									
MECHANICAL PROPERTIES (COLD DRAWN WIRE AND COILS IN THE SOLUTION ANNEALED CONDITION 2D)									
SIZE	0.10 ≤ d ≤ 0.20		0.20 ≤d ≤0.50		0.50 ≤d ≤1.00		1.00 ≤d ≤3.00	3.00 ≤d ≤5.00	5.00 ≤d ≤16.00
Rm (MPa) max									
A (%) max	20		30		30		30	35	35
NOTE: IF SKIN PASSED, R_m MIGHT BE INCREASED BY UP TO 50 (MPa)									
WORKING TEMPERATURES RECOMMENDED									
OPERATION			HOT FORGINGS DEFORMATION				SOLUTION ANNEALING (WATER ,AIR)		
° C			900÷1200				1000÷1100		