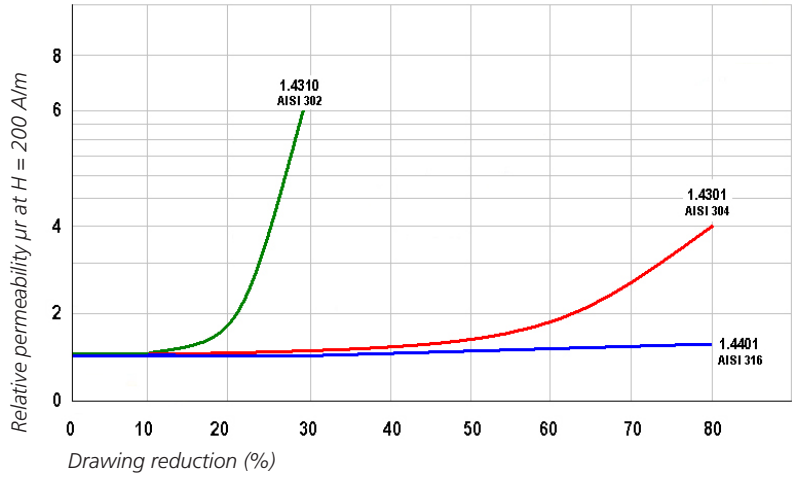
MAGNETIC PERMEABILITY

PERMEABILITY (μo)
It is the ease of magnetic flux propagation in vacuum, μo = 1.26 • 10-6 • H/m

INITIAL PERMEABILITY
Is the ratio between the field B (induction) and the field H (A/m during magnetization) measured when the field H is towards zero. More useful is the relative permeability or the quotient produced by the permeability of the material and the permeability of empty space (air). It is used to indicate weak ferromagnetic steels employed for the nuclei of transformers.

ABSOLUTE MAGNETIC PERMEABILITY
Characteristic parameter of every material, obtained from the ratio between magnetic induction B produced inside the material by a magnetic field and the intensity H of the applied field (symbol: m). The inverse 1/m of permeability is called specific reluctance.

RELATIVE MAGNETIC PERMEABILITY
Physical quantity expressing the attitude of a substance to be magnetized by a magnetic field in which it is immersed. Its symbol is μr and is the ratio between the absolute permeability μ of a given material and the permeability μo of empty space.
Ferritic and martensitic stainless steels are defined as magnetic (the magnet attracts them) when they are at room temperature and lose this characteristic when are heated above 769°C. Austenitic steels are classified as non-magnetic and their permeability is around 1.02 μr.
They can be slightly magnetised when cold-drawn, but a successive re-crystallization would re-establish the state of non-magnetism.



The graph shows the indicative trend of relative permeability in function of the percentage of drawing work hardening for three austenitic steels. Permeability is reduced by increasing the percentage of Nickel, Manganese, Carbon, Copper, and Nitrogen, which are elements capable of stabilizing austenite and limit the formation of martensite during the cold work hardening.
For example, in steel 1.4401 having C% = 0.06; Cr% = 17.70; Ni% = 10.50 permeability remains very low (μr 1.08) with a 10% reduction, and even when reduction is so strong to reach 80% permeability does not exceed 1.30.
In solubilised state, austenitic steel is "non magnetic" whist dissolved but, as said above, they develop magnetic properties when they are cold deformed, because this operation is capable of transforming a part of austenite into martensite.
Relative magnetic permeability (μr) and resistance to traction (Rm) of some types of austenitic stainless steel in function of cold reduction (%).
(G. Di Caprio - Gli acciai inossidabili)

EN 10088-1	AISI	Reduct. %	Permeability μr at intensity H		Resistance to traction N/mm²
			4000 A/m	16000 A/m	
1.4310 ~	301	0	1	1	668
		19,5	1,15	1,26	989
		55,0	14,8	19,0	1564
1.4310	302	0	1	1	670
		20,0	1,01	1,01	915
		44,0	1,05	1,12	1202
		68,0	1,59	2,70	1505
		84,0	2,15	6,65	1659
1.4301	304	0	1	1,0040	569
		18,5	1	1,01	711
		32,0	1,04	1,06	1026
		65,0	1,54	2,12	12,68
		84,5	2,20	4,75	1426
1.4303	305	0	1	1	620
		18,5	1	1,01	908
		34,5	1,02	1,020	1088
		52,5	1,05	1,06	1237
		84,0	1,09	1,14	1391

EN 10088-1	AISI	Reduct. %	Permeability μr at intensity H		Resistance to traction N/mm²
			4000 A/m	16000 A/m	
1.4842 ~	310	0	1	1,0035	758
		14,7	1	1	901
		26,8	1	1	1090
		64,2	1	1	1354
1.4401	316	0	1,0030	1,0040	588
		20,8	1	1	828
		45,0	1	1,01	1124
		60,8	1,01	1,01	1252
		81,0	1,01	1,01	1365
1.4541	321	0	1	1	617
		16,5	1,02	1,02	866
		41,5	1,40	1,61	1140
		53,5	2,44	3,34	1226
		70,5	6,76	9,40	1451
1.4550	347	0	1	1	667
		13,5	1,01	1,01	831
		40,0	1,06	1,09	1168
		60,0	1,25	1,45	1264
		90,0	1,97	4,12	1522