STAINLESS STEELS
CORROSION RESISTANCE & GRADE SELECTION GUIDELINES(*)

I. Introduction

Stainless steels constitute a very specific class of steels : their Chromium content exceeding 11 % generates a very good resistance to corrosion in a very large array of environments. This is due to the so-called « passive layer » phenomenon whereby a superficial layer enriched in Chromium oxides is present at their surface and regenerates itself in a natural way. Certain alloying elements , primarily Nickel and Molybdenum, strenghten further this self-protecting mechanism , as follows :

- Nickel (and Copper to a lesser extent) decrease considerably the dissolution in acidic media
- Molybdenum protects the passive layer against the halide ions, particularly chloride ions very detrimental to the integrity of the passive layer

Stainless steels also exhibit a good resistance to high temperature oxidation, due to the presence of Chromium. When compared to coated steels, stainless steels have clearly a strong advantage due to their permanent and continuously regenerated protective surface layer. This so-called « in-depth » stainless characteristics is indeed a most valuable & important safety factor vis à vis the limited protection offered by thin surface coatings. Such coatings only provide time-limited protection and are by nature highly sensitive to denting and any form of mechanical surface damage. It thus comes as no surprise to find a very large array of useage of stalnless sreels in household appliances, hospitals, food processing industry and a very wide range of basic industries (chemical, petrochemical, oil & gas, metallurgy, etc..)

We provide herebelow a simplified description of the corrosion resistance of the main types/grades of stainless steels, as a guideline concerning their proper selection and utilization.

One must also emphasize the importance of regular surface cleaning and proper decontamination and passivation of stainless steel equipments for their optimum resistance to corrosion.

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Types	Main grades	Corrosion resistance	Preferred usage domains
FERRITICS			
with 12 % Cr	Grade 409 12 % Cr + Ti	Entry stainless grades with minimum Chromium Limited corrosion resistance	Automotive exhaust - Heat exchangers
MARTENSITICS			
with 12 / 14 % Cr	Grade 420 13 % Cr + 0,2 %C	Heat treatable (quenching + tempering) stainless steel grades. Limited corrosion resistance.	Grades for cutlery, blades and mechanical parts such as axles, pistons, etc..Also used in certain oil & gas drilling pipes.
FERRITICS			
With 17- 18% Cr	Grade 430 with 17 % Cr	Moderate corrosion resistance but sufficient for many applications ; Ferritic grades are not adapted to extensive contact with acidic media . Usage strongly prohibited in marine environments.	Wide range of usage in domestic applications such as household appliances, flatware, interior decoration,flue liners. The corrosion resistance can be improved by : • Molybenum addition : automobile trim, etc.. • Ti/Nb stabilization: appliances, heating units
AUSTENITICS			
• with Mn - Cr	Grade 204Cu 8%Mn- 2%Cu- 2%Ni	Moderate/intermediate corrosion resistance. Grade not suitable for most acidic media nor in the presence of chlorides such as brine and marine environments ,	« Low cost « austenitic stainless steel. Many domains of usage in household appliances, décoration, ventilation. Suitable for bakery equipment.
• With Ni - Cr	Grade 304 18%Cr- 8%Ni mostly 304L with low C < 0,03%	Good corrosion resistance in many environments (except in presence of halides). Low carbon grade 304L suppresses the risk of intergranular corrosion. Uneven resistance to corrosion in chemical industries media. Not suitable for marine environments.	Widely used multi-purpose grade : household appliances, flatware, silverware, architecture, hospitals, restaurants , schools kitchens, etc. Large usage in food & beverage processing industries ,except in the presence of chlorides. 304 L is the dominant grade across the board.
	Grade 302 17%Cr- 8%Ni	Good corrosion resistance, close to 304	Mostly used for spring applications .
	Grade 321 18%Cr- 8%Ni Stabilized with Ti	Corrosion resistance similar to 304L (stabilization wiyh Titanium suppresses the occurrence of intergranular corrosion)	Titanium stabilization also improves creep resistance at high temperatures.
	Grade 310 25%Cr- 20%Ni	Good corrosion resistance and resistance to high temperature oxidation (high Chromium content)	Grade mostly used for its very good resistance to high temperature: furnace components, hooks, conveyors, etc.. Also note grade 314 with higher Silicon content
• with Ni - Cr - Mo	Grade 316 18%Cr-10% Ni-2,5Mo Mostly 316L With low C < 0,03%	Very good resistance to corrosion, in many environments. Key grade for: chemical, petrochemical, food processing industries. Molybdenum provides a good resistance to localized corrosion (pitting, crevice corrosion). Recommended for marine environments.	Improved grade over 304 due to Molybdenum addition : very wide range of applications in corrosive media such as those encountered in chemical industry processes. Low carbon 316L is the dominant grade. Also note related grades: • 317 L with Mo ~ 3,5 % for more severe corrosive environments • 316Ti, stabilized with Titanium, for high temperatures usage..
	Grade 904L 20%Cr-25%Ni-4,5Mo (Uranus B6)	Improved corrosion resistance vis-à-vis 316L /317L Recommended for difficult marine applications such as desalination units, etc..	Top of the line « super stainless « grade. Used for most highly corrosive environments, in alternate choice with Inconels in some cases.
DUPLEX			
Austeno-ferritics	Grade 2209 22%Cr-5%Ni-3 Mo	Grade with mixed austenitic-ferritic structure. Good overall corrosion resistance and to stress corrosion cracking, particularly in the presence of H2S.	Numerous applications in chemical & petrochemical processes (tubes, pressure vessels, exchangers, etc...)

(*) This technical information serves as indicative guidelines which are not warranted by SADEV.

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