Stainless Steel
Grade Description Summary

Introduction
All standard grades of stainless steel contain iron, carbon and a minimum of 11.5% chromium, the element responsible for the inherent corrosion resistance of the alloy. All stainless steels resist corrosion, although the degree of resistance to attack by many common chemicals, food products and other materials is variable. To enhance or supplement the effect of chromium, other alloying elements are added to straight chromium stainless steels as follows:

1. **Nickel—**to stabilize the austenitic structure, improve forming properties, increase ductility, high temperature strength and corrosion resistance (particularly in industrial and marine atmospheres, chemical, food and textile processing industries).

2. **Silicon**—to increase scaling resistance and resist carburizing at high temperatures.

3. **Manganese**—to improve hot-working properties, increase yield and tensile strengths (above 2%), partially replace nickel and stabilize the austenitic structure.

4. **Molybdenum—**to increase corrosion resistance (particularly in sulfite, sulfate, acetic acid and acetate solutions and salt water atmosphere), increase creep resistance, increase strength at elevated temperatures, expand range of passivity and counteract tendency to pit.

5. **Titanium, Columbium-Tantalum—**to prevent intergranular corrosion by stabilizing the carbon as titanium or columbium carbides instead of chromium carbides, produce finer grain size, reduce stretcher strains from drawing and forming in Type 430.

6. **Sulphur, Phosphorus** and **Selenium—**to improve machinability.

7. **Additional Chromium—**to increase scaling, wear and corrosion resistance and increase tensile strength.

Austenitic Grades
The 300 Series stainless steels are the most important members of the Austenitic family and are the most widely used of stainless steels. The Austenitic grades are non-magnetic* and hardenable only by cold working.

* (Note: Austenitic stainless steels may become slightly magnetic after cold working.)

Type 301 contains less chromium and nickel than 302 for more work hardening.

Type 302 is the basic type of the 300 series, 18% chromium—8% nickel group. It is the renowned 18-8 Stainless and is the most widely used of the chromium-nickel stainless and heat resisting steels.

Type 303 contains added phosphorus and sulphur for better machining characteristics. Corrosion resistance is slightly less than 302/304.

Type 303Se contains Se and P added to improve machinability.

Type 304-304L chromium and nickel increased and carbon lowered to reduce carbide precipitation and increase corrosion resistance. Carbon is lowest in 304L for welding applications.

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Type 305 has increased nickel to lower work hardening properties.

Type 309-309S have added chromium and nickel for more corrosion resistance and high temperature scaling resistance. 309S contains less carbon to minimize carbide precipitation.

Type 310-310S have higher nickel content than 309-309S to further increase scaling resistance. 310S contains less carbon than 310 to minimize carbide precipitation.

Type 316-316L contain substantial molybdenum additions for improved corrosion resistance (particularly pit-type corrosion), creep resistance and high temperature strength. Carbon content 316L is low for welding purposes.

Type 321 contains titanium to tie up the carbon and avoid chromium carbide precipitation in welding.

Type 330 ultra high nickel content provides best corrosion resistance to most furnace atmospheres. This grade has low coefficient of expansion, excellent ductility and high strength.

Type 347 – 348 have columbium-tantalum added to tie up the carbon and avoid chromium carbide precipitation in welding. Use for temperatures from 800to 1650 degrees F.

Ferritic Grades

Steels of the ferritic group, because of their low carbon (.08 to .20%) and high chromium contents, do not harden to any appreciable extent when quenched from high temperatures. They have a low coefficient of expansion and are highly resistant to atmospheric oxidation and strongly oxidizing solutions. This group is adaptable to high temperature, chemical plant and outdoor applications. An outstanding example of the latter is automotive trim. The ferritic grades are magnetic and non-hardenable.

Type 405 contains 12% chromium with aluminum added to prevent hardening.

Type 430 is the basic type in the ferritic group, possessing good ductility and excellent resistance to atmospheric corrosion. Its scaling resistance is higher than 302 in intermittent service, somewhat lower in continuous use.

Type 430F-430Se have sulphur and selenium (respectively) added for increased machinability.

Type 442 has added chromium for improved resistance to scaling.

Type 446 has still higher chromium content (27%) for added scaling resistance and is highest of the standard straight chromium types. Alloys with over 30% chromium become too brittle to process.

Martensitic Grades

The balance of the 400 series stainless steels belong to the Martensitic Group, are hardenable by heat treatment and are magnetic. Varieties such as Types 403, 410, 420 and 440 find major applications as products that must resist atmospheric oxidation, mildly corrosive chemicals and wet or dry corrosion, such as in steam and gas turbine parts, bearings and cutlery.

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Type 410 is the basic Martensitic type. It is the general purpose corrosion and heat resisting chromium stainless steel. It can be hardened by thermal treatment to a wide range of mechanical properties. It can be annealed soft for cold drawing and forming. This grade is always magnetic.

Type 403 is a special high quality steel made for blades and buckets for steam turbine and jet engine compressors. This grade is eminently suited for very highly stressed parts. This material is magnetic in all conditions.

Type 416-416Se are modifications of Type 410, being the free-machining, non-seizing, non-galling alloys. These properties are obtained by the addition of sulphur or selenium to Type 410. This is a heat-treatable grade with corrosion resistance and other characteristics closely approaching those of Type 410.

Type 420 is a chromium stainless steel capable of heat treatment to a maximum hardness of approximately 500 Brinell. It has a maximum corrosion resistance only in the fully hardened condition. Type 420 is magnetic in all conditions.

Type 431 is a nickel bearing (1.25-2.00%) chromium stainless steel which may be heat treated to high mechanical properties. It is magnetic in all conditions of use. It has superior corrosion resistance to Types 410, 416, 420, 430 and 440 stainless steels.

Type 440C is the stainless steel that can be heat treated to the highest hardness of any of the corrosion resistant steels. Its best corrosion resisting properties are obtained when it is in the fully hardened condition. It is recommended where high hardness, wear and corrosion resistance are paramount. This type is magnetic in all conditions.

"SM" Stainless Steels

"Sm" means Super Machinability. When you see "SM" used in conjunction with a standard type number, such as 304SM, it means that the machinability of this J&L Stainless Steel is maximum for its type. The same holds true for 303SM, 316 SM, 416SM and any other grade bearing this designation.

All metal machinists are familiar with the usual wide variation in the machinability of each type of carbon, alloy or stainless steel ranging from poor to excellent for the specific grade involved. Since there must be a reason for everything, including better machinability, J&L metallurgists proceeded to find it and now makes stainless that way, hence "SM".