

What is Stainless Steel?

Stainless steel is a generic term for a family of corrosion resistant alloy steels containing 10.5% or more chromium.



Photo: High purity (99.98 %) Iron

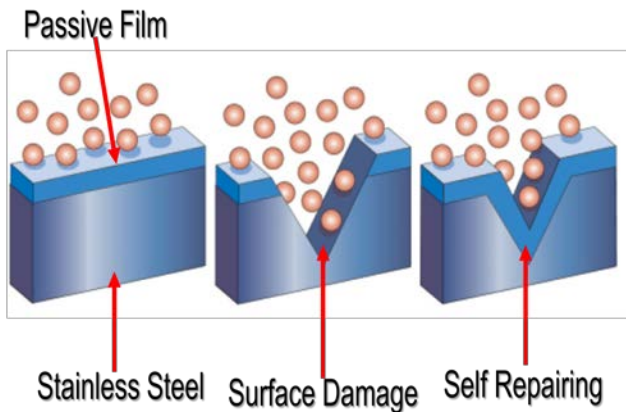


Photo: High purity (99.999 %) chromium crystals

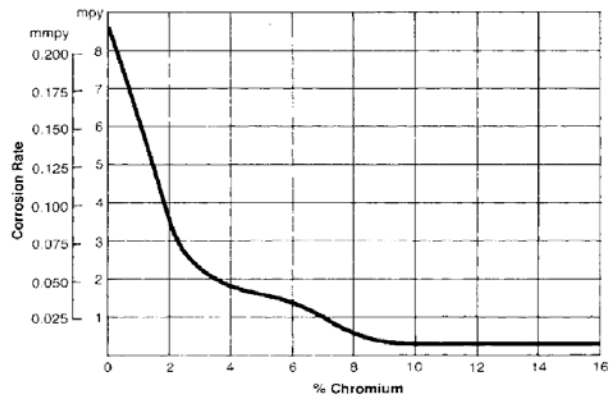
Source: wikipedia.org



All stainless steels have a high resistance to corrosion. This resistance to attack is due to the naturally occurring chromium-rich oxide film formed on the surface of the steel. Although extremely thin, this invisible, inert film is tightly adherent to the metal and extremely protective in a wide range of corrosive media. The film is rapidly self repairing in the presence of oxygen, and damage by abrasion, cutting or machining is quickly repaired.



Effect of Chromium Content on Corrosion Rate (2)



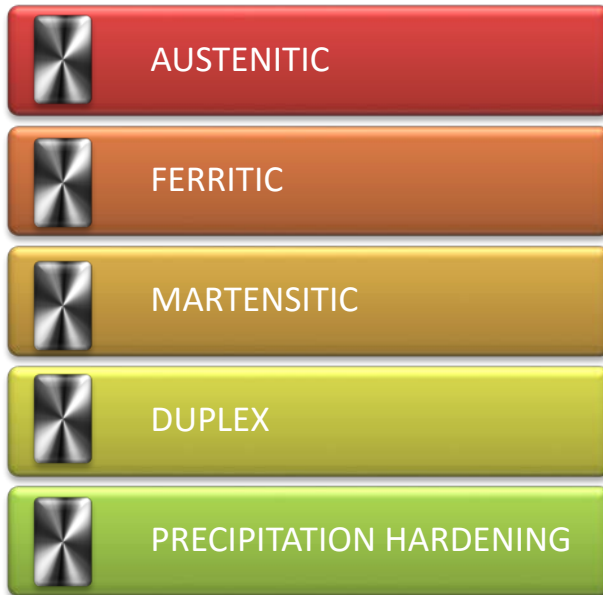


METALLIC ADDITIONS IN STAINLESS STEEL

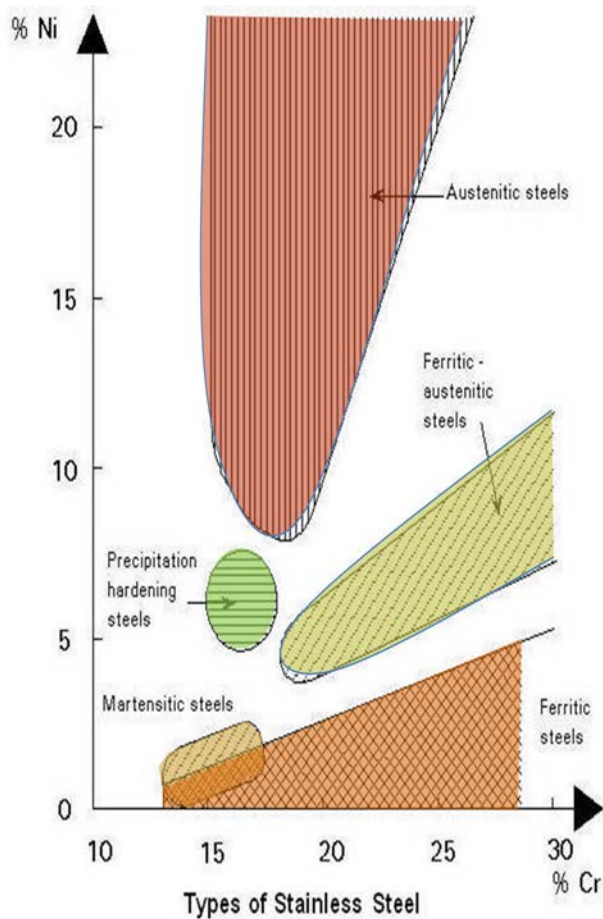


NON METALS IN STAINLESS STEEL

Types of Stainless Steel



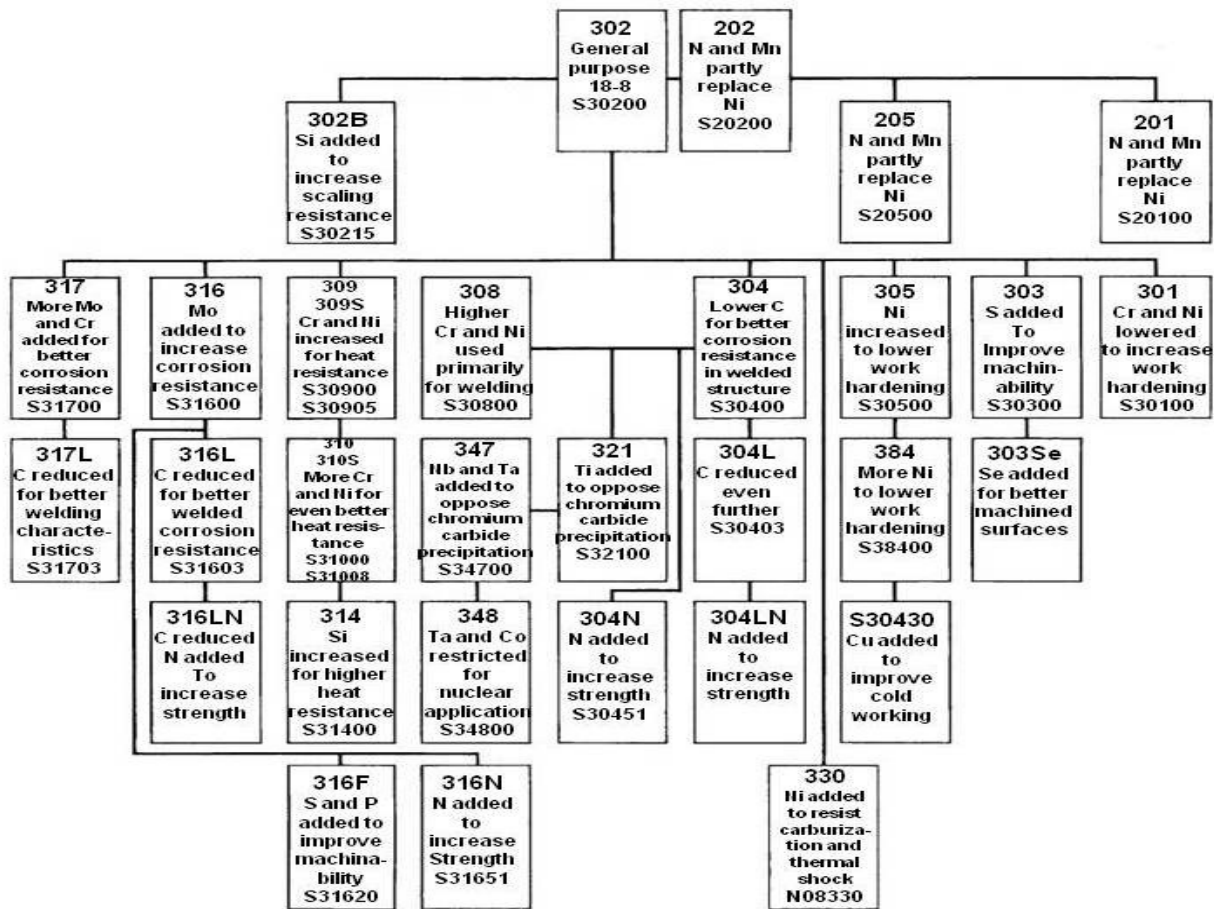
These are named according to the microstructure inherent in each steel group (a function of the primary alloying elements). Austenitic and ferritic grades account for approximately 95% of stainless steel applications.



Austenitic

When nickel is added to stainless steel in sufficient amounts the crystal structure changes to "austenite". The basic composition of austenitic stainless steels is 18% chromium and 8% nickel. Austenitic grades are the most commonly used stainless steels accounting for more than 70% of production (type 304 is the most commonly specified grade by far).

- Cr-Ni (3XX) / Cr-Mn-Ni (2XX) Stainless Steel
- Non magnetic
- Cannot be hardened by heat-treatment
- Can be hardened only through work hardening
- Very good formability
- Excellent corrosion resistance
- Increase in strength as a result of work-hardening



Common uses

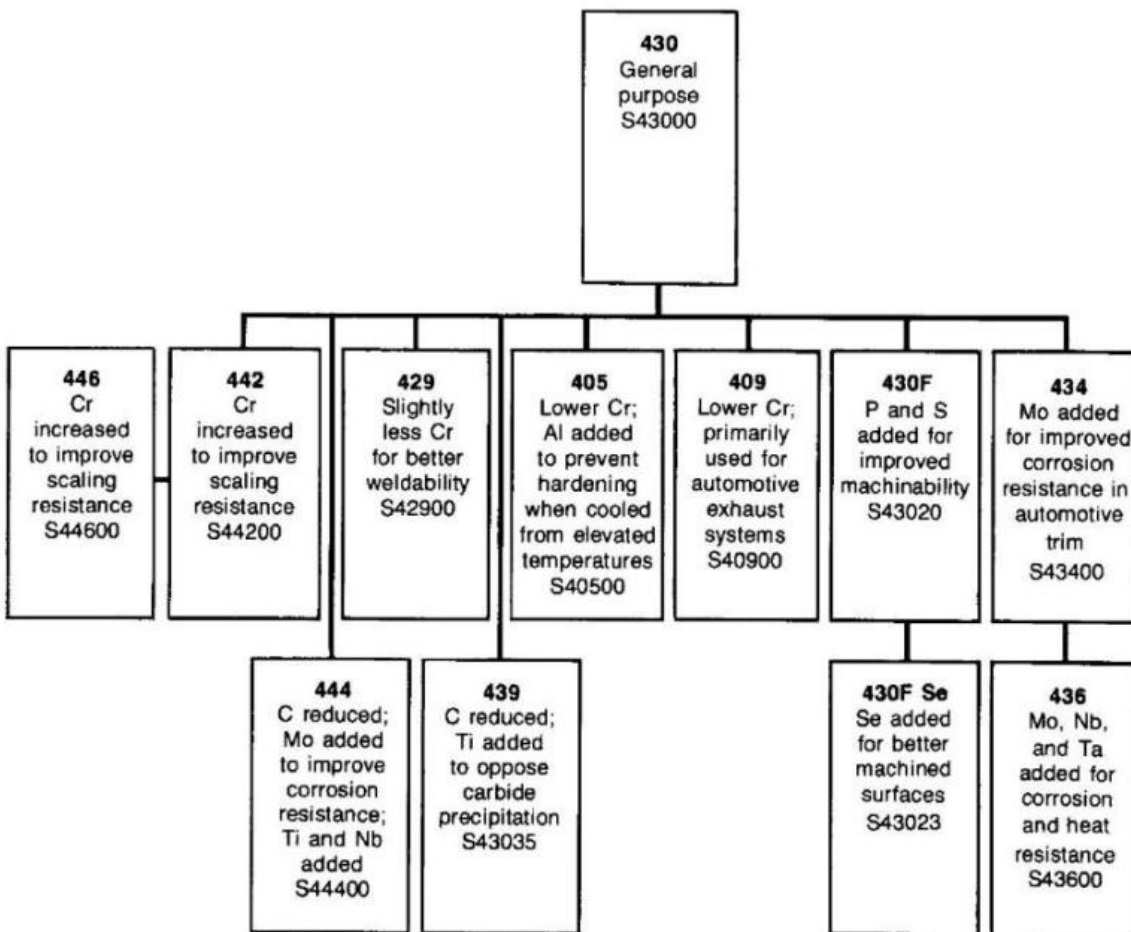
- computer floppy disk shutters (304)

- computer keyboard key springs (301)
- kitchen sinks (304D)
- food processing equipment
- architectural applications
- chemical plant and equipment

Ferritic

These are nickel-free stainless steels. They have a varying chromium (Cr) content of 12- 18%, but a lower carbon (C) content than the martensitics. (A special heat resistant grade contains 26% Cr.) The common specifications are 430, 409 and weldable 12% Cr steels.

- Fe-Cr Stainless Steel
- Magnetic
- Cannot be hardened by heat-treatment
- Can be Moderately hardened through work hardening
- Very good formability
- Very good corrosion resistance



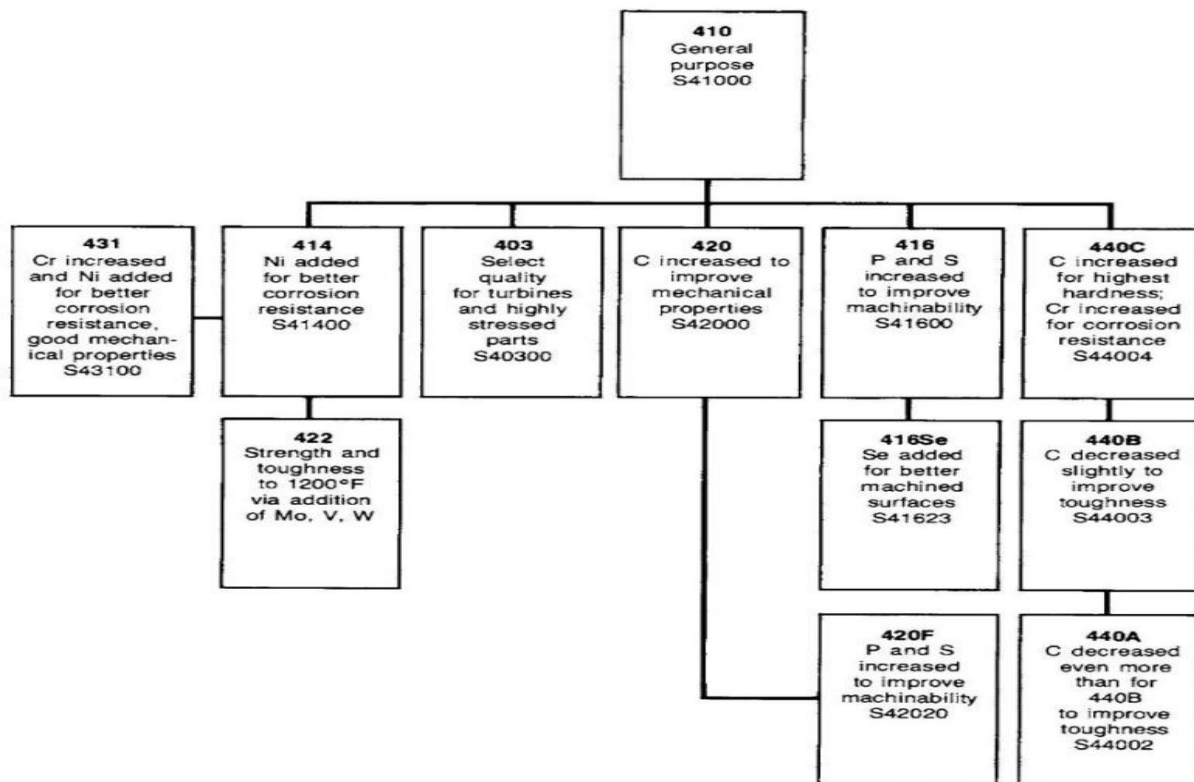
Common uses

- computer floppy disk hubs (430)
- automotive trim (430)
- automotive exhausts (409)
- colliery equipment (3CR12)
- hot water tanks (444)

Martensitic

Martensitic stainless steels are the first branch of the plain chromium stainless steels. These were the first stainless steels industrially developed (as stainless steel cutlery). They have a relatively high carbon (C) content and a chromium content of 12- 18% Cr. The common specifications are 410, 420, 431.

- Fe-Cr Stainless Steel
- Magnetic
- CAN be hardened by heat-treatment
- Can be hardened only through work hardening
- Good corrosion resistance in mild environments
- Fairly good ductility
- Some can be Heat-Treated to UTS exceeding 2,00,000 psi



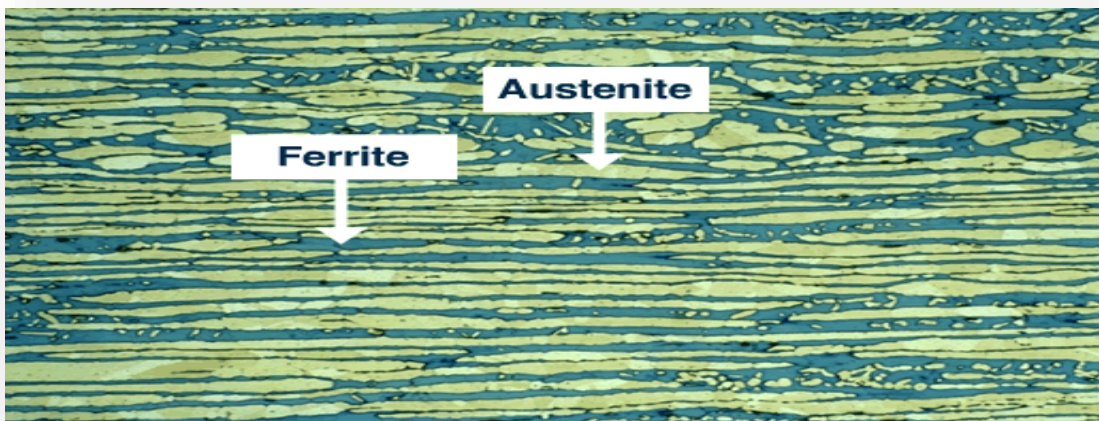
Common uses

- *knife blades*
- *surgical instruments*
- *shafts*
- *spindles*
- *pins*

Duplex

Duplex stainless steels have a structure of approximately equal amounts of ferrite and austenite and, therefore, may be referred to as ferritic-austenitic stainless steels. The chromium content varies from 18-28%. The nickel content of 4.5-8% is insufficient to develop a fully austenitic crystal structure. Most grades contain molybdenum in the range 2.5-4% plus a small nitrogen addition which enhances both strength and pitting resistance.

- **Annealed structure**
- **Austenite-Ferrite (min 30-70)**
- **Highly resistant to Chloride stress corrosion cracking**
- **Excellent pitting and crevice corrosion resistance**
- **Have about twice the strength as conventional SS**



Common uses

- *marine applications, particularly at slightly elevated temperatures*
- *desalination plant*
- *heat exchangers*
- *petrochemical plant*

Precipitation Hardening

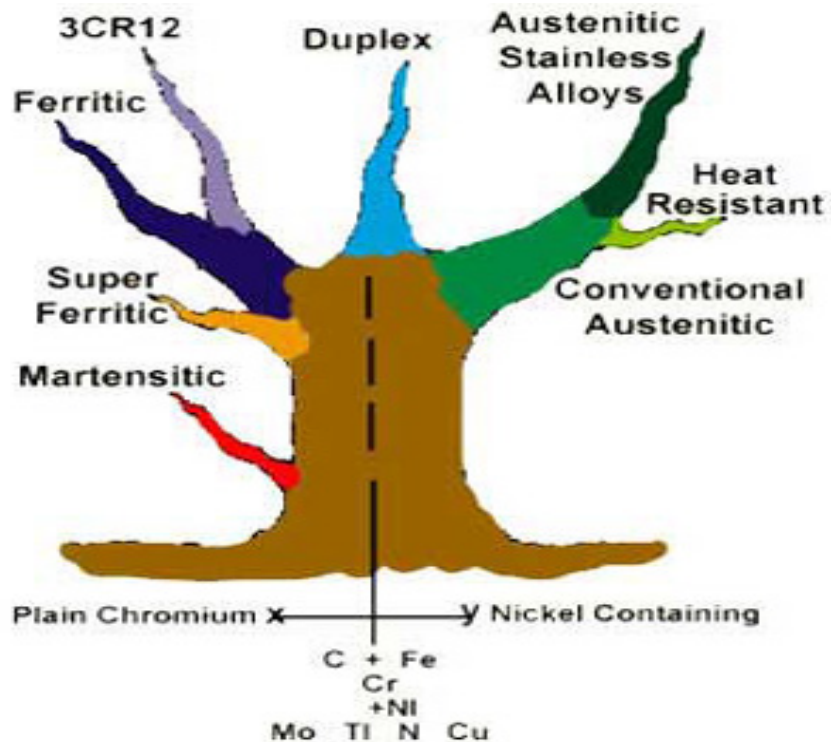
Precipitation hardening stainless steels have been formulated so that they can be supplied in a solution treated condition, (in which they are machineable) and can be hardened, after fabrication, in a single low temperature "ageing" process.

- Cr-Ni Stainless Steels
- Designed to be formable in the solution annealed condition and can subsequently be hardened by heat treating to strength levels several times that of 3XX Series
- Corrosion resistance is better than straight Ferritic 4XX

Common uses

- *Shafts for pumps and valves*

SS Family Tree



WHAT IS GREAT ABOUT STAINLESS STEEL?

- Corrosion resistance
- Wear Resistance
- Fire and heat resistance
- Hygiene
- Aesthetic appearance
- Strength-to-weight advantage
- Ease of fabrication
- Impact resistance
- Recyclability
- Long term value
- Low carbon foot-print

