

**DESIGNER**

**HANDBOOK**

**STAINLESS**

**STEEL**

**PRIMER**



## WHAT IS STAINLESS STEEL?

Stainless steel is an iron-based metal that has at least 10.5% chromium. Other alloying elements, such as nickel, molybdenum, manganese, can be added as well as additional amounts of chromium to achieve specific corrosion resistance and physical properties.

## WHY DOESN'T IT RUST?

Stainless steel does not RUST (red rust that one normally sees on carbon steel is iron oxide), because it contains chromium and has a very low carbon content (compared to mild steel). The chromium combines with oxygen in the air to form a very adherent surface film that resists further oxidation. No iron is oxidized; therefore, no red rust.

## THE MOST POPULAR KINDS OF STAINLESS STEEL

There are over 100 different kinds of stainless steel but only about 5 grades are the most popular. (For further information please refer to the SSINA publication: *"Design Guidelines for the Selection and Use of Stainless Steel"*)

### STAINLESS TYPE 304 (UNS S30400)

By far, the most popular grade of stainless steel is 304. The 300 series designation tells one that the grade is composed basically of 18% chromium and 8% nickel. It is *non-magnetic* and cannot be hardened by heat treatment. Sometimes referred to as 18-8.

### STAINLESS TYPE 316 (UNS S31600)

The next most popular stainless for general corrosion resistance is 316. It also consists of chromium (16%) and nickel (10%), but also contains 2% molybdenum. The additional alloying increases the resistance to salt corrosion.

## GENERAL CHARACTERISTICS

### MECHANICAL PROPERTIES:

	Hardness (Rb)	Tensile Strength (1000 Psi)	Yield Strength (0.2% 1000 Psi)	Elongation (% in 2 in.)
<b>304/316</b>	78-83	80-85	30-42	50-60
<b>430</b>	80-85	70-75	40-50	30-35
<b>410</b>	80-82	70-75	35-45	25-35
<b>409</b>	75	65	35	25

### STAINLESS TYPE 430 (UNS S43000)

430 is a straight chromium type stainless (no nickel) with 16% chromium. It has less corrosion resistance than the 300 series. Like the 300 series, 430 cannot be hardened by heat treatment but *it is magnetic*.

### STAINLESS TYPE 410 (UNS S41000)

410 is a straight chromium grade with less chromium than 430 (about 11.5%). Because it has less chromium, it has somewhat less corrosion resistance than 430, *but this grade can be hardened by heat treatment. It is also magnetic*.

### STAINLESS TYPE 409 (UNS S40900)

This grade contains the lowest level of chromium at 10.5%. It is also magnetic.

## SIZES AND SHAPES AVAILABLE

Stainless steel manufacturers produce many different sizes and shapes of stainless steel. Flat products called "sheets" are available in thickness from under 0.375 inches down to about 0.020 inches, either as cut sheets or as wrapped coils. Material under 0.020 inches is usually called "foil" and can be made down to 0.001 inches. Sheets are usually wider than 18 inches and can be made up to 60 inches wide. Widths under 18 inches are called "strip" and are generally available in the same thickness as sheet. Flat products with thickness of 0.375 inches and over are called "plates." They are available up to about 10 inches thick, and usually 96 or 120 inches wide. Long products are round, square, rectangular, hexagon or octagon from 0.1875 inches in thickness and up. Wire products are generally round in size from 0.703 to 0.003 inches. Tubular products from 0.1875 inches, pipes from 0.125 inches and angled products from 1.50 inches are also available.

## CORROSION RESISTANCE

Generally resists corrosion in the atmosphere and in water environments, most acids, alkaline solutions and some chlorine bearing environments.

## FIRE & HEAT RESISTANCE

Resistant to major deformation at temperatures up to 1000° F.

## HYGIENE

Extremely easy to clean with biodegradable soap and water. Does not alter the taste of foodstuffs.

## STANDARD FINISHES AVAILABLE

### SHEET & STRIP

No. 1 is a rough, dull finish that results from hot rolling.

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No. 2D is a dull finish generally used where the surface appearance is of little concern.

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No. 2B is a bright finish with some reflectivity. It is a general purpose finish used as is, or it is used as a basis for subsequent polished finishes.

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No. 4 is a polished bright surface with reasonable reflectivity, although it contains visible "grit lines" which prevent mirror reflection.

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No. 6 is a dull satin finish with less reflectivity than a No. 4.

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No. 7 is a highly reflective surface finish but still maintains some light "grit" lines.

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No. 8 is the most reflective standard finish with a mirror-like reflectivity.

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### PLATE

Hot Rolled is a rough surface with the annealing scale left on. Generally not recommended for use in this condition.

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Hot Rolled, Annealed & Pickled (or blast cleaned) is the commonly preferred finish with the scale removed from the hot rolled surface by acid etching or blasting.

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Hot Rolled, Annealed & Pickled and Cold Rolled is a smoother finish with less surface imperfections.

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### BAR

Hot Worked Only is a surface where the scale is left on after hot rolling.

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Hot Worked & Rough Turned is a surface where the scale has been removed by turning the surface in a lathe or grinding machine.

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Hot Rolled, Pickled, or blast cleaned & Pickled is where the surface has been cleaned of scale by acid etching or blasting.

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Annealed Only is a surface where the scale is left on after hot rolling and annealing.

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Annealed & Rough Turned is the same as hot worked and rough turned but the bar has been annealed to make the structure more ductile.

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Annealed & Pickled or blast cleaned & Pickled is where the surface has been cleaned of scale by acid etching or blasting after annealing.

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Annealed, Cold Drawn or Cold Rolled is where the surface is smooth because it has been drawn through a die or rolled through polished rolls.

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Annealed & Centerless Ground is where the surface has been ground to remove some of the surface area similar to ground flat sheet surface.

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Annealed & Polished is where the surface has been polished to bright finish.

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### WIRE

Cold Drawn is a smooth surface with the residual drawing lubricant left on.

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Cold Drawn and Clean has a smooth surface, free of residual drawing lubricants.

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Diamond Drawn is a bright smooth surface, produced with diamond drawing dies and wet drawing lubricants.

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Electropolish Quality (EPO) has a smooth surface for producing a bright finish after electropolishing.

## SUPERIOR STRENGTH-TO-WEIGHT RATIO

The strength of many stainless steels can be increased by work-hardening thereby providing higher strength at lower weight.

## IMPACT RESISTANT

The 300 series provides high toughness from elevated temperatures to far below freezing.

## RECYCLABLE

Stainless steel is 100% recyclable. Recycled material is used in over 65% of all new stainless products.

## "GREEN" MATERIAL

Stainless steel is a "Green" material as demonstrated by the evaluation of stainless steel using the following critical environmental guidelines:

### ENVIRONMENTAL PRINCIPLES

Developing an environmental policy is one of the most important components of environment management. Many of the North American producers of stainless steel have such a policy. SSINA member companies are committed to operating their facilities in compliance with applicable federal, state and local environmental laws and regulations.

### ENVIRONMENTAL MANAGEMENT SYSTEMS

SSINA member companies have established environmental affairs departments (analogous to the marketing and finance departments) that address environmental issues.

### MATERIALS, ENERGY AND WATER USAGE

The use of these vital resources is closely monitored. The major raw material for the production of stainless steel is "recycled" stainless steel scrap from within the plants themselves and from customers and fabricators after a long useful life in the marketplace. Furnace byproducts are collected and reclaimed. Electric furnaces that melt the stainless steel are state-of-the-art with computer controls to ensure efficient use of electric power. Water, which is mainly used as a cooling medium, is recycled up to 100 times prior to discharge.

### POLLUTION PREVENTION

The air emissions from the electric melting and refining furnaces are collected via a series of ducts and hoods then routed to a high efficiency filter where

solid particles are collected and the metals recovered. The air emissions from the cleaning operations are collected and routed to a fume scrubber to remove the acid mist.

*(For further information, please refer to the SSINA publication: "Stainless Steel: The Green Material")*

## GENERAL INFORMATION

### FABRICATION

Stainless steel can be fabricated by methods similar to those used for carbon steel and other common metals. However, changes may be necessary to the extent that they differ in yield strength and rate of work hardening. All stainless steels have a work hardening rate higher than carbon steel: the 300 series (304, 316) are characterized by large increases in strength and hardness when cold worked. For example: if one can cut or shear a piece of carbon steel 0.40 inches in thickness, then the equipment used to cut will only be able to shear a piece of stainless steel 0.20 inches in thickness. Every time a piece of stainless steel is bent or a saw blade passes over the surface, the material will increase in hardness and become stiffer. Stainless steels also tend to "springback" after being bent, to a much greater extent than mild steel. It is therefore necessary to over bend stainless to obtain the desired bend. Care in the shop is extremely important when fabricating stainless steel. Care should be taken to protect the surface of the material (plastic film is available on certain finishes and should be left on during processing). Contact with carbon tools or handling equipment should be prevented as the stainless steel can pickup carbon particles, which will lodge in the surface and subsequently will rust. If you see red rust on the surface of stainless steel, it is probably from some source of contamination, such as the use of a steel brush (steel wool) or the surface of the stainless steel was dragged over a carbon steel support member.

*(For further information, please refer to the SSINA publication: "Stainless Steel Fabrication")*

### WELDING

Stainless steel can be welded as easily as carbon steel but the process is different. Stainless steel electrodes must be used and currents and cooling techniques are not the same.

*(For detailed information on welding stainless steel, please contact the American Welding Society)*

### MACHINABILITY

Stainless steels can be machined; however, the "gummy" nature of the material makes the standard grades difficult. Several specially developed stainless grades exist that have been altered to provide excellent machining characteristics. Type 303 is the machining equivalent of type 304.

### SPECIAL FINISHES & COLOR

In addition to the standard finishes, there are several special finishes that are available for stainless steel. Finishes can be "rolled-on", embossed or etched in a wide variety of patterns and designs. Very different and remarkable finishes can be achieved by mechanical treatments to the surface to provide interesting textures and patterns including perforations, knitting, weaving and cutting and expanding the material. Stainless can be "colored" by electrochemical coloring, sputtering, plating and by using resin-based paints.

*(For further information, please refer to the SSINA publication: "Special Finishes for Stainless Steel")*

### AVAILABILITY

Stainless steel is produced in North America by several companies. A list, with Web sites, is provided on the back page.

Many Steel Service Centers stock and process stainless steel. For a partial list, refer to the Sponsors listing on the back page. For a complete listing of steel service centers, contact the Steel Service Center Institute at 773-867-1300 or ssci.org.

### PRICE COMPARISON

Pricing of stainless steel has generally been below the CPI index for other metals and, while dependent on the price of the main alloying elements such as nickel and chromium, has not significantly increased in the past few years.

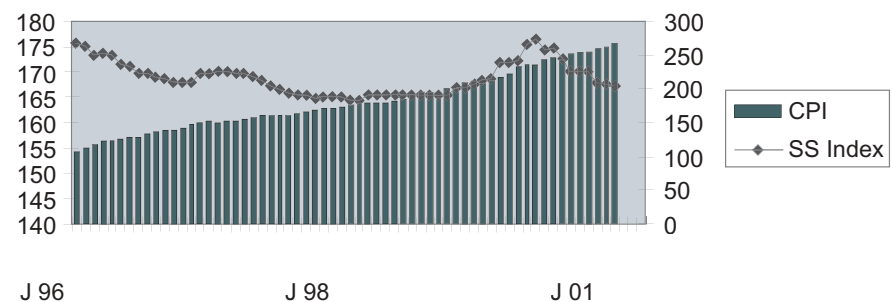
*\* Data provided by ERAMET*

## FOR MORE INFORMATION

You can contact us through our Web sites, [www.ssina.com](http://www.ssina.com) and [www.sensationalstainless.com](http://www.sensationalstainless.com). The following free SSINA publications can be ordered or downloaded by visiting the "Publications and What's New" section of the [ssina.com](http://ssina.com) web site.

- Stainless Steel Fabrication
- Stainless Steel for Machining
- Stainless Steel Architectural Facts
- Stainless Steel for: Wall Ties, Stone Anchors, Masonry Fastening Systems
- Specifications for Stainless Steel
- Stainless Steel Fasteners
- Standard Practices for Stainless Steel
- Stainless Steel for Handrails, Railings & Barrier Applications
- The Care and Cleaning of Stainless Steel
- Stainless Steel in Water Handling & Delivery Systems
- Stainless Steel for Structural Applications
- Stainless Steel for Superior Fire & Heat Resistance
- Stainless Steel Rebar for Construction Applications
- Stainless Steel The Green Material
- Why Stainless Steel
- Environmental Brochure on Stainless Steel
- Special Finishes for Stainless Steel
- Directory of Stainless Steel Products for Building & Construction
- Design Guidelines for the Selection and Use of Stainless Steel
- Stainless Steel for Residential Applications
- Standard Practices for Stainless Steel Roofing, Flashing, Copings

**Price for Stainless Steel vs CPI**



This primer has been developed by the Specialty Steel Industry of North America (SSINA) to help the novice or lay person understand some of the characteristics and uses of stainless steel. It is intended to be a “beginning” in learning about stainless steel and is not particularly comprehensive. SSINA has other publications that go into further detail on stainless steel. They are referenced throughout this primer and a complete listing is provided at the end of this publication.

## **SOME TYPICAL APPLICATIONS**

### **BUILDING & CONSTRUCTION**

Roofing

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Flashings

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Wall ties for masonry

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Doors & windows

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Entry ways

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Canopies

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Lobby walls & ceilings

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### **COMMERCIAL**

Food processing equipment

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Wine tanks

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Fast food equipment

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Hospital equipment

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Oil & Gas processing equipment

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Petro-chemical equipment

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### **INDUSTRIAL**

Farm equipment

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Animal feeding equipment

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Fertilizer manufacturing

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Aircraft parts

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Pumps and shafts

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Filters

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Chemical manufacturing

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Computer chip processing

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### **RESIDENTIAL**

Kitchen appliances

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Sinks & counter tops

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Fireplace fronts & liners

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BBO grills & outdoor kitchens

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Washer fronts and interior drums

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Furniture

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Cooking utensils

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Tableware

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### **MEDICAL**

Implants

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Hospital equipment

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Orthodontic fixtures

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Sutures

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Tools

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### **MARINE**

Boat hardware

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Propellers

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Safety lines

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Rigging

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Dock hardware

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