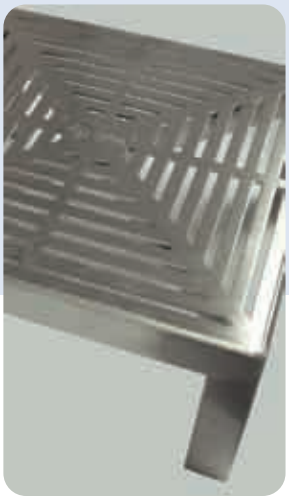
Introduction – stainless steels and special metals



1

www.atlassteels.com.au

Introduction

Welcome to Atlas Steels, the leading stockist and distributor of stainless steels and special metals for Australia and New Zealand.

This Reference Manual provides information on the range and grades of stainless and special metals we distribute. It also contains general technical information that may be of interest to users and outlines the processing facilities and services provided to our customers.

Atlas Steels The Company

In 1918 Atlas Steels began the manufacturing of tool steels in Canada and by 1938 was the major producer of tool and specialty steels in the country. In the years since 1918 many of the businesses that Atlas started world wide have been absorbed into other companies and today the only one still remaining and maintaining the Atlas name in the specialty metals industry is the Australasian offshoot, which evolved from the Canadian parent when they established operations in Australia in 1939.

In many respects the Atlas of today with operations in Australia and New Zealand, remains true to the vision of its forefathers and still retains its focus and strength in specialty metals but with a larger products base in stainless steels, alloy steels, aluminium and carbon steels in specialised applications.

The Atlas of today is a fully Australian owned private company, with a distribution warehousing and metals processing network that encompasses 19 major cities and towns across Australia and New Zealand.

For more information about Atlas, please visit our website at ***www.atlassteels.com.au***

Conducting business with Atlas Steels

Atlas, over many years of participation in the specialty metals industry, has built a level of knowledge and expertise that has helped to build the company to be the largest in its market and offer superior customer service. We do this by providing:

- a comprehensive range of specialty metal products;
- locations in all States of Australia and New Zealand;
- personnel who can readily understand the specific needs of product users;
- nationally integrated, computer-based stocking and inventory control systems;
- extensive global product sourcing network from reputable mills;
- warehouse facilities, systems and procedures that cater to the needs of processing and handling specialty metals;

- a company-wide quality system accredited to ISO9001;
- trained technical support personnel;
- project services dedicated to supplying products to major resource and infrastructure projects in any region of the world.

There is limited production of specialty metals in Australia and New Zealand, with the majority being imported from overseas mills. Because of this it is most important that users have a high level of confidence in the product and services supplied by specialty metals stockists/distributors.

Atlas has, through years of participation in the industry, established a network of reputable mill suppliers to service its customers. These mills have been chosen following a rigorous selection process based on Atlas criteria of mill adherence to strict product quality standards, history of reliable supply and support for product in the field.

Atlas supports its customers and suppliers with experienced technical personnel and sales personnel trained extensively to understand the product qualities and applications associated with specialty metals.

Terms and conditions of sale

Refer to ***www.atlassteels.com.au***

Limitation of liability

The information contained in this handbook is not intended to be an exhaustive statement of all relevant data applicable to special and general metal products. It has been designed as a guide for customers to the products and services Atlas Steels can offer. No responsibility is implied or accepted for or in conjunction with quality or standard of any product or its suitability for any purpose or use.

It is the responsibility of the user to ensure product specified is fit for the purpose intended.

All conditions, warranties, obligations and liabilities of any kind which are or may be implied or imposed to the contrary by any statute, rule or regulation or under the general law and whether arising from the negligence of the company, its servants or otherwise are hereby excluded except to the extent that the company may be prevented by any statute, rule or regulation from doing so.

The grades and properties of stainless steel

Introduction

The group of alloys which today make up the family of stainless steels had their beginnings in 1913 in Sheffield, England. Harry Brearley was testing a number of alloys for possible gun barrel steels and observed that samples cut from one of these trial heats did not rust. Upon investigation it was shown to contain 13% chromium and this discovery lead to the development of stainless for use in cutlery, for which Sheffield became famous. Coincidentally, at about the same time, development work was also being carried out in France and Germany, which resulted in the production of the first austenitic stainless steel.

The families of stainless steel

Stainless steels are iron-based alloys containing a minimum of about 10.5% chromium. The chromium forms a protective self-healing oxide film, which is the reason why this group of steels has its characteristic 'stainlessness' or corrosion resistance. The ability of the oxide layer to heal itself means that the steel is corrosion-resistant, no matter how much of the surface is removed.

Although all stainless steels depend on the presence of chromium, other alloying elements are often added to enhance their properties. The categorisation of stainless steels is unusual amongst metals in that it is based upon the nature of their metallurgical structure. Depending on the exact chemical composition of the steel the microstructure may be made up of the stable phases of austenite or ferrite, a 'duplex' mix of these two, the phase martensite created when some steels are rapidly quenched from a high temperature, or a structure hardened by precipitated micro-constituents.

The broader group of stainless steels can be viewed by comparison to the more familiar plain carbon 'mild' steels as having the following general characteristics:

- higher work hardening rate;
- higher ductility;
- higher strength and hardness;
- higher hot strength;
- higher corrosion resistance;
- higher cryogenic toughness; and
- lower magnetic response (for austenitic only).

These properties apply particularly to the austenitic grades and to varying degrees to other grades.

Austenitic stainless steels

This group contains at least 16% chromium and 6% nickel (the basic grade 304 is referred to as 18/8) and range through to the high alloys or 'super austenitics' such as 904L and 6% molybdenum grades.

Additional elements can be added such as molybdenum, titanium or copper, to modify or improve stainless properties, and making them suitable for many critical applications involving high temperature as well as corrosion resistance. This group of stainless steels is also suitable for cryogenic applications because the effect of the nickel content in making the steel austenitic avoids the problems of brittleness at low temperatures, which is a characteristic of other types of steel.

The characteristics of the austenitic stainless steels are:

- good corrosion resistance;
- weldable using standard methods and equipment;
- excellent ductility;
- stable austenite structure at all temperatures;
- cannot be hardened by heat treatment;
- harden rapidly when cold worked;
- good strength and scaling resistance at high temperatures;
- excellent cryogenic properties; and
- non-magnetic when annealed.

Ferritic stainless steels

These are plain chromium (10.5 to 30%) grades such as grade 430 and 409. Their moderate corrosion resistance is improved in the higher alloyed grades (such as 444) and poor fabrication properties improved in the proprietary grade AtlasCR12.

The characteristics of the ferritic grades are:

- good resistance to corrosion, but generally not as good as the austenitics;
- not as readily welded as austenitics;
- good ductility;
- cannot be hardened by heat treatment;
- can only be moderately hardened by cold work;
- fully magnetic;
- not suitable for use at very low temperatures;
- stable ferrite structure at all temperatures; and
- immune from chloride stress corrosion cracking.

Martensitic stainless steels

Martensitic stainless steels are also based on the addition of chromium as the major alloying element but with a higher carbon and generally lower chromium content than the ferritic type, e.g. 12% in grades 410 and 416. Grade 431 has a chromium content of about 16% but its microstructure is still martensite despite the chromium level due to the addition of 2% nickel in the composition. The martensitic grades are used in the hardened condition for high strength applications (eg pump shafts) and high hardness applications (eg knife blades).

The characteristics of martensitic stainless steels are:

- hardenable by heat treatment (quenching and tempering);
- magnetic; and
- have moderate corrosion resistance.

Precipitation hardening stainless steels

These are chromium and nickel containing steels, which can develop very high tensile strengths. The most common grade in this group is '17-4PH', also known as grade 630, with the composition of 17% chromium, 4% nickel, 4% copper and 0.3% niobium. The major advantage of these steels is that they can be supplied in the solution-treated condition, which is machinable. Following machining, forming, etc. the steel can be hardened by a single, fairly low temperature 'aging' heat treatment which does not cause distortion to the component. The most common applications are shafts and spindles.

The characteristics of the precipitation hardening steels are:

- hardenable by heat treatment (solution treatment and ageing);
- magnetic; and
- have moderate corrosion resistance.

Duplex stainless steels

Duplex stainless steels such as 2205 (designation indicates 22% chromium and 5% nickel but also contains 3% molybdenum and 0.15% nitrogen) have microstructures comprising a mixture of austenite and ferrite.

Duplex austenitic-ferritic steels combine some of the characteristics of each class.

- Resistant to stress corrosion cracking, albeit not quite as resistant as ferritic grades.
- Toughness is superior to ferritics but inferior to that of austenitics.
- Strength is greater than that of the annealed austenitic steels by a factor of two.
- Corrosion resistance is high for most grades.
- They do suffer from reduced toughness below -50°C and after exposure above 300°C, so are only used between these temperatures.
- Highly resistant to choloride stress corrosion cracking.

Standard classifications

There are many different grades of stainless steel and the American Iron and Steel Institute (AISI) in the past designated some as standard compositions, resulting in the commonly used three-digit numbering system, e.g. 304, 316, etc. This role has now been taken over by the SAE and ASTM who allocate UNS numbers to new grades. The full range of these standard stainless steel grades is contained in the Iron and Steel Society (ISS) *Steel Products Manual for Stainless Steels* and in the SAE/ASTM handbook of *Unified Numbering Systems*.

Although the majority of stainless steel products sold in Australia and New Zealand are supplied to American ASTM specifications, we see some references to European "Euronorms". These use different grade designations, both numbers and names.

ASTM Grade	304	304L	316	316L	430	2205
UNS No.	S30400	S30403	S31600	S31603	S43000	S32205
EN No.	1.4301	1.4306	1.4401	1.4404	1.4016	1.4462
EN Name	X5CrNi18010	X2CrNi19-11	X5CrNiMo17-12-2	X2CrNiMo17-12-2	X6Cr17	X2CrNiMoN22-5-3

Certain other grades do not have standard numbers but instead are covered by other national and international specifications for specialised products.