

200 Series Stainless Steels an overview by BSSA

1. Introduction

The chromium-manganese (5-9% Mn) stainless steels with low nickel (about 5%) content have been with us for a long time. The 201 and 202 types are perhaps the best known in Europe. However, these steels as grades 1.4372 and 1.4373 in EN 10088-2 are sufficiently unusual to be designated "special grades" in this standard. They do not appear at all in the pressure vessel standard EN 10028-7. However, in the ASTM standards, there is no such distinction and whilst undoubtedly less common than 300 series, the US and Asian mills are more prominent in their promotion of the 200 series.

There has always been an interest in the possible substitution of the common 300 nickel-bearing steels by the 200 series particularly in times of high nickel prices. This interest has resulted in the International Stainless Steel Forum (ISSF) taking a lead in examining the technical and marketing issues surrounding these steels.

A detailed report is publicly available on the ISSF website, "New 200-series" steels: An opportunity or a threat to the image of stainless steel?"¹ This report is particularly concerned with the new generation of steels with ultra-low nickel levels which as yet have no recognised national or international standards. This article refers frequently to this report but also uses other publicly available data, notably from the US mills.

2. Comparison of 200 Series with 300 Series

Chemical Composition – Indicative

Steel Type	C	Mn	Cr	Ni	N	Cu
1.4372 (201)	0.15 max	6	17	4.5	0.25 max	-
201L (Allegany Brand)	0.03 max	6	17	4.5	0.25 max	-
1.4373 (202)	0.15 max	8.5	18	5	0.25 max	-
1.4597 (204Cu)	0.15 max	7	16	2	0.15	2.5
Cr-Mn 1% nickel*	0.10 max	9	16	1.5	0.20 max	1.7
1.4301 (304)	0.07 max	2.00 max	18	8	0.11 max	-

Note The AISI grades in brackets are the nearest equivalents

*Proprietary grade



Left: A Carbon steel lighting column and Right: A 200 series column, in a coastal location

Mechanical Properties

In general, the 200 series are somewhat higher in strength than the 300 series. In some applications this is beneficial, allowing reduced section thicknesses and weight saving in applications such as freight containers, freight truck frames and lighting columns.

The higher work hardening rate allows very high strengths to be developed in the cold-worked condition, for example up to 1500 MPa for grade 1.4372 in EN 10088-2. However, this factor also means that processes such as deep drawing are more difficult to carry out on the 200 series and with the ultra-low nickel types it is possible to get cracking after the article has been drawn.

Weldability

The 200 series are generally weldable by the same processes as the 300 series. Although matching consumables are available, they are often welded using the same filler metals as 300 series such as type 308. Low carbon grades such as 201L have been developed for welding thick section plate.

Some problems have been reported with the new ultra-low nickel steels concerning intergranular corrosion in welded components. However, these problems are caused by excessive carbon contents which are not typical of modern steelmaking practices.

Corrosion Resistance

A clear distinction must be made between the established 200 series (with nickel at 4-5%) and the "new" ultra-low nickel grades with respect to corrosion resistance.

It is well established that for grades such as 201 there is a broad similarity with 304 in standard tests such as pitting, salt spray testing and long term exposure tests.² In contrast, the ultra-low nickel grades have performed markedly poorly compared to 304 in these tests.¹

This reduces the scope for the direct substitution of the



300 series by the ultra-low Ni 200 series. Nevertheless, there will be many environments where they have adequate corrosion resistance, particularly in comparison to for example the 11-13 Cr ferritic and martensitic types. It should also be recognised that the 200 series are of limited value in relatively low chloride waters at temperatures higher than normal ambient, where higher alloy steels such as 316 are required for pitting and crevice corrosion resistance.

3. Applications

The established 200 series grades have been used successfully in many applications over the years, notably in freight containers, lighting columns, hoseclips and banding.

It also appears that there is a significant difference between the US and Europe in the use of 200 series. In the US they have been used for railcars, cookware, catering equipment and washing machine drums. These applications are rare or unknown in Europe.

For the 200 series, the most successful applications are likely to be in relatively mild corrosive environments where the degree of forming is moderate to low. The limited corrosion resistance of the 200 series makes the part of the market where 316 is considered a minimum immune to substitution. Clearly, there will need to be improvements in some aspects of the new ultra-low nickel steels, for example corrosion resistance, to allow them to be more widely considered..

Possible applications include:

cutlery, cookware, water tanks, indoor architectural, automotive trim, rebar, bus bodies and frameworks and fuel tanks (although these would be susceptible to at-

tack by de-icing salts).

However, growth is likely to be inhibited in Europe due to:

- difficulty in switching grades in established process lines, presses etc.
- the importance of sectors such as chemical, pharmaceutical, offshore where corrosion resistance of the 200 series is inadequate.
- the lack of standards required to cover the newer Asian grades.

4. Steelmaking

There are some issues concerned with the steelmaking of the 200 series steels:

- The high manganese content causes higher refractory erosion rates than for the 300 series.
- Quoting from the ISSF paper ¹ "Potential users of 200-series grades are strongly recommended to separate 200-series scrap from other stainless steel types of scrap. Good traceability in the recycling process is imperative in order not to jeopardize the high overall recyclability of stainless steel".

5. Summary

The 200 series both established and new grades are a useful part of the range of stainless steels available to engineers and specifiers in a range of benign applications. There are a number of factors which will affect their substitution of 300 series applications:

Steelmaking – increased process costs partially offset saving in raw materials. Scrap segregation.

Formability – poorer deep drawing ability compared to 304. Change to established process lines where formability is acceptable.

Corrosion resistance – some questions over the new ultra-low nickel grades and limited pitting corrosion and crevice corrosion resistance in all but low chloride, low temperature conditions

Standards – inclusion of new grades into EN standards would take some time.

6. References

New 200-series" steels: An opportunity or a threat to the image of stainless steel? ISSF Paper November 2005

AL 201HP™ (UNS S20100) alloy: a high-performance, lower-nickel alternative to 300 series alloys - David S. Bergstrom and Cheryl A. Botti.