

# AUSTRALIAN STAINLESS

SPECIALISING IN STAINLESS STEEL AND ITS APPLICATIONS

#40  
WINTER  
2007

## PacRim Stainless 2007

Stainless Evolution: Prices•Products•Prosperity

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FOCUSING ON THE ASIA-PACIFIC REGION

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ALSO IN THIS EDITION:



STAINLESS REVAMP FOR SUNSHINE COAST BEACH **2**



SCHOOL GETS A SPLASH OF STAINLESS COLOUR **3**



MIRROR MIRROR ON THE LAKE **6**



INAUGURAL STAINLESS STEEL ART EXHIBITION **7**

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ASSDA

## STAINLESS REVAMP FOR SUNSHINE COAST BEACH

A revamp of Kings Beach in Caloundra, QLD, has had a gleaming response, with stainless steel a major contributor to the brand new look.

Initial stages included new seats, hand railing and some draining, but the most recent instalment focussed on the beach-side swimming pool and recreational area with balustrades all around. Although 2 or 3 different builders have been used during the project to date, ASSDA Accredited Fabricator Paige Stainless was involved with all stages.



Kilometres of stainless steel tube was used to fence the 98 metre pool circumference with top and bottom rails and railings.

"There was also some peripheral work, such as seats and railings that lead into the pool area," says Kevin Finn of Paige Stainless.

Kevin says that whilst the end result of stainless steel looks great, the builders had little choice but to use the material.

"They did look at aluminium for the pool fencing. Stainless steel was certainly the most expensive but with the corrosive environment and longevity required, it was imperative that they use stainless steel."

The project used only grade 316, supplied by ASSDA members Atlas Specialty Metals and Tube Sales at both 600 and 800 grit polishes to help prevent tea staining.

The unique setting of the pool (located on the beach), meant fabrication was largely done onsite.

"Because of the different shapes of the pool and the way we had to configure the posts for the fencing, we couldn't manufacture panels in the workshop," says Kevin. "It would have been too disjointed so, instead, we rolled the shapes to the outline, cut them to length and then physically made it on site to ensure the most accurate fit."

Some work had to be scheduled around tide times as the pool sits 10 feet from sea level with the fence right on the edge. To get around this, Kevin said every second post was welded from the inside with the remaining posts completed on the outside.

To further help protect the job from tea staining, the welds were hand passivated with a gel and then coated with three different coatings from the Cyndan Rapelle range. These coatings were "Stainless Steel Cleaner", "Cleans All" and "Stainless Steel Sentry".



Following installation, the council was provided with a maintenance schedule, including recommendations for the use of these products.

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## SCHOOL BUILDING GETS A SPLASH OF STAINLESS COLOUR



SHOWCASING THE USE OF LONG LASTING POWDER COATED ARCHITECTURAL FINISHES



This school building in South Australia used AN6 PCL powder coated stainless steel from Stainless Sections

The materials used for the Assembly Hall and Music Department of the Sacred Heart School of Performing Arts have set a new benchmark of possibility for the fusion between decorative and functional design.

The custom produced cladding panels used a 0.6mm base material, which was rigidised to a 1.2mm finish. The material was installed as interlocking panels, complementing the linear building components.

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ASSDA member Stainless Sections provided the stainless steel cladding for the Adelaide school building, for its hard wearing and low maintenance properties. However, keeping to the creative nature of the activities to be performed within the building, a strong focus on the aesthetics was adopted.

The face side of the stainless steel was powder coated and then polished to produce a warm and coloured background.

Roy Carter of Stainless Sections says the product gives users the best of both worlds.

"The material allows the colour to be added without compromising wearability of the metal surface," he says. Roy also says the material facilitates ease of cleaning and graffiti removal.



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# Alternative stainless steel grades



**THIS ARTICLE IS THE FIRST OF A TWO PART SERIES OUTLINING NEW AND EMERGING STAINLESS STEEL GRADES WHICH MAY BE CONSIDERED AS ALTERNATIVES TO THE MORE TRADITIONAL AND WIDELY KNOWN VARIETIES**

The growing demand from China and the rest of the developing world has driven up the price of alloying elements added to stainless steels. Over the last five years nickel prices have risen to ten times what they were. Chromium and molybdenum have also risen strongly, and the price of stainless steel scrap – which steelmakers use extensively – has soared. Inevitably, stainless steels have also seen large price increases, with little relief in sight. Growing demand and the time required to develop new supply sources mean that nickel and other alloy prices are unlikely to drop to the levels seen a few years ago.

Higher prices are driving stainless steel users to seek more cost effective solutions: the optimum choice of grade is a blend of engineering and economic factors, and the choice may be different in a new cost environment. The most common stainless steel grade, 304, is used in about 60% of applications for stainless steel around the world. Grade 304 contains about 8% of nickel, which is used to form the ductile austenite crystal structure. Grade 316, with 10% of nickel and higher corrosion resistance given by an addition of 2% molybdenum, is also very common. It is used in marine environments. Users are seeking more cost effective alternatives to both these austenitic 300 series grades.

Austenitic 200 series, duplex stainless steels and ferritic grades can all be used instead of 304 and 316, if they are selected, designed, fabricated and used appropriately. This article and the next in the series describe the alternatives to the more traditional grades, with their abilities and limitations.

The alloying elements in stainless steel contributing most to corrosion resistance are chromium and molybdenum. Within each of the alternative groups there are grades with different corrosion resistance resulting from the

chromium and molybdenum contents.

The well known austenitic 300 series grades contain the highest levels of nickel. The austenitic 200 series grades contain less nickel, and manganese is added to make the austenite crystal structure form. Because the 200 series grades have the austenitic crystal structure their mechanical and fabrication properties are similar to the familiar 300 series.

Ferritic grades have the same crystal structure as carbon steel, and have similar mechanical and fabrication properties and do not contain a nickel addition.

Duplex grades are not fully austenitic. They are formulated to be a mixture of equal amounts of austenitic and ferritic grains in the microstructure, which generally means the nickel content is about half of that in an austenitic grade of the same chromium content.

### Austenitic 200 Series

These grades are austenitic despite their lower nickel because they have more manganese. Manganese is about half as effective in forming austenite as nickel, so for every 1% of nickel left out, about 2% of manganese has to be added – at the same level of chromium, which suppresses the formation of austenite. Half the nickel in these grades has been replaced by manganese and the price of manganese is also rising strongly.

First developed in the 1930s, most of the common 200 series grades have corrosion resistance similar to the ferritic grade 430, lower than grade 304, because the chromium content is lower. Newer Indian developments (grades J1 & J4 in the table) have centered on grades with significantly lower corrosion resistance. There are other proprietary 200 series grades with

higher chromium contents used in marine and anti-galling applications.

The austenitic 200 series are the closest in behaviour to the 300 series of the alternative groups. Hence they are the easiest to convert to.

### Mechanical and Physical Properties

The tensile strength of common 200 grades exceeds 600MPa, i.e. about 20% higher than 304. The 0.2% proof stress is more than 20% greater than that of 304 but the elongation at fracture is similar. In contrast with carbon steel, all the austenitic stainless steel grades have tensile strengths at least double the 0.2% proof stress, a consequence of their high rate of work hardening. Some newer grades include copper to reduce this. Because of the austenitic microstructure of annealed 200 series grades they are ductile down to cryogenic temperatures and do not suffer brittle fracture

In comparison with the physical properties of 304, the 200 series have very similar density, elastic modulus, electrical and thermal properties.

Some 200 series grades in comparison to 304

Grade		Carbon (Max)	Manganese	Chromium	Nickel	Copper
201	16/4	0.15	5.5-7.5	16.0-18.0	3.5-5.5	-
202	17/4	0.15	7.5-10.0	17.0-19.0	4.0-6.0	-
J1	15/4	0.08	7.0-8.0	15.0-17.0	4.0-4.5	1.5-2.0
J4	15/1	0.10	8.5-10.0	15.0-17.0	0.8-1.2	1.5-2.0
304	18/8	0.07	2.0max	17.5-19.5	8.0-10.5	-

### Attributes

The ductility and formability are similar to the 300 grades although the lower nickel gives a greater risk of delayed cracking after heavy cold forming. Welding is similar to the 300 series grades although the 200 grades may

have higher carbon and may suffer sensitisation (loss of intergranular corrosion resistance) if welded in sections thicker than 5 mm. Stress corrosion cracking resistance is similar to the 300 series. Like 304 and 316, 200 series grades do not respond to a magnet when in the annealed condition, but become magnetic after cold work.

### Limitations

The lower chromium levels mean that the 15% chromium grades have lower corrosion resistance than ferritic grade 430. Even the 16 & 17% chromium grades are somewhat inferior to 304 in corrosion resistance, since it appears that a 200 series grade has slightly less corrosion resistance than a 300 series grade with the same chromium level. This may be due to the high levels of sulphur present in 200 series grades from some sources.

Steelmakers do not want 200 series scrap mixed with 300 series scrap as the high manganese levels reduce the life of steelmaking refractories. Batches of 300 series scrap suspected of being contaminated with 200 series are likely to attract only the much lower 200 series scrap price. Hence strict segregation of off-cuts is required.

At present none of the 200 series grades are routinely stocked in Australia.

### Applications

As with all grade groups, it is important to choose a grade with corrosion resistance adequate for the application. The lower chromium 200 series grades detailed in the table are generally suitable for use with mild acids and alkalis including most foods (pH not less than 3). They are satisfactory with 20°C potable water and are suitable for indoor exposure – furniture, bins, etc. They are used extensively for cookware and serving bowls – applications where the corrosion conditions are not severe since the utensils are washed and dried. The formability and deep drawability of the 200 series are especially useful for these applications.



## CHLORINE AND CHLORIDE: SAME ELEMENT, VERY DIFFERENT EFFECT

Choosing the correct grade of stainless steel for a tank, pipe or process vessel requires (at the very least) information about the temperature, pH and chemical composition of the contents. One of the most important items of the chemical composition is how much chloride (salt) is present. Analysis reports often give the concentration as milligrams per litre (mg/L) or sometimes as parts per million (ppm) of Cl. However, Cl is also the symbol used for the element chlorine.

So what is the difference?

Chlorine is a poisonous, yellowish green gas which readily dissolves in water to give a strong disinfectant or bleach. The strength of a bleach solution is sometimes measured by the "available chlorine". Swimming pools are usually treated with dilute hypochlorite solutions which produce a few parts per million (ppm) of chlorine. This acts as a strong, oxidising biocide. Drinking water is normally treated to give a residual of 0.2 to 0.5 mg/L of chlorine. (There are also other disinfection methods such as chloramine or ozone.)

Chlorine is very aggressive to stainless steels. The Nickel Institute guidelines for continuous exposure at ambient temperatures (~20°C) and neutral pH (~pH7), are that 304 can cope with 2ppm chlorine and 316 ~5ppm chlorine. In alkaline solutions (pH>7) higher concentrations are possible but this does not help much in swimming pools or drinking water. Chlorine frequently causes corrosion problems. Chlorine attack can occur with bleach laden washdown water if pools form in drains which are usually empty. Chlorine concentrations in droplets or water films immediately above a still pool or water tank can be higher than the chlorine level in the bulk water. When dosing concentrated chlorine into pipes or tanks, it must be well mixed otherwise concentrated streams will eat out downstream elbows or tank walls near the chlorine inlet.

Much higher concentrations can be used for short periods as the attack on the stainless steel must initiate and form a stable pit for failure to occur. The American Water and Wastewater Association permits 25ppm for 24 hours in cases of emergency disinfection. The food industry can use up to 100ppm in hot water for minutes followed by rinsing and/or passivation. It is an effective biocide because the kill rate depends on (exposure time) \* (concentration of biocide) but the stainless steel is resistant to the chlorine for the relatively short, high concentration exposure.

And what about chlorides?

Chloride occurs naturally in drinking water and ranges from less than 10mg/L in Melbourne to more than 200mg/L in Adelaide. Chloride is not oxidizing and is not a biocide. The most common form is sodium chloride. Seawater is about 3% sodium chloride although there are other compounds. Nickel Institute guidelines for continuous exposure at neutral pH and ambient temperatures permit chloride levels of 200ppm for 304, 1000ppm for 316 and 3600 ppm for 2205 duplex. The guidelines allow for the presence of crevices (such as bolt heads, flanges or deposits) but assume that the surface has been passivated. In alkaline environments (pH>7) higher chloride levels can be tolerated. Higher temperatures reduce the permissible chloride level. Temperatures over 60°C are not recommended for 304 or 316 as they are at risk of sudden failure from chloride stress corrosion cracking.

The message

Chlorine and chloride are different forms of the same element but with vastly different effects on stainless steel. Chlorine is bleach and stainless steels can only tolerate exposure to a few ppm continuously. Chloride is part of the salt in natural waters and even 304 can cope with a few hundred ppm at ambient temperatures and pH~7.

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## MIRROR MIRROR ON THE LAKE



A new Stockland housing development on the Gold Coast has incorporated the use of art to promote outdoor living and community engagement. And, with a public lake the intended destination, artists Lubi Thomas and Adrian Davis knew stainless steel would best fit the bill.

The Highland Reserve development in Upper Coomera, 40 minutes south of Brisbane, boasts a mountainous backdrop and sprawling native bushland. The additional inclusion of a lake within the development prompted Stocklands to commission a public artwork for the area. Following a process of concept pitches from various artists, Lubi Thomas and Adrian Davis of Davis-Thomas were successful in securing the project.

"They (Stockland) have always, until now, bought artwork off the shelf," Lubi Thomas says. "This time though, they wanted to do something site-specific."

After spending time in the area the artists discovered the most evident thing about the lake was its mirror-like quality. They were inspired by the lake's rippling responses to wind changes and wanted to convey this relationship to the general public.

The result was a series of nine stainless steel floating wind 'petals', each with their own anchor point and dispersed across the lake. The use of mirrored stainless steel meant the original concept delivery was met.

"We needed to find a material that was robust enough, as well as something that would reflect the lake itself," says Lubi. "That is what inevitably drew us towards mirrored stainless."



A series of nine stainless steel floating petals on the lake provide a point of interest for residents.

The pieces are made entirely of grade 316 in sheet, tube and flat bar to cater to the environment, and to ensure a life of 20-25 years. The added benefit is that ongoing maintenance is limited to removing the marks of nature.

ASSDA member and Accredited Fabricator Rocklea Pressed Metal supplied materials for the works, and was further engaged for part of the fabrication.

Troy Olive of Rocklea Pressed Metal said the CAD drawings were sent to them, enabling them to laser cut and roll the petals to the desired radius. In total, 12-15 sheets of stainless steel was used.

The use of mirrored stainless meant an additional relationship was explored between the lake and the sun. In the right conditions, the pieces react to the sunshine hitting the water, beaming light between the pieces.

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## INAUGURAL STAINLESS STEEL ART EXHIBITION

An exhibition showcasing the use of stainless steel in an artistic sense will, for the first time ever, coincide with ASSDA's annual conference in October.

Sponsored by ASSDA member ELG and presented in partnership with Cooks Hill Galleries, the exhibition entitled Stainless Evolution, will be on display in the main auditorium at the PacRim 2007 Conference in Newcastle this October. The pieces created will use various types of stainless steel, for the exclusive viewing of PacRim delegates.

Warrick Timmins of Newcastle is one such artist who has used stainless steel in his pieces to depict his love of water. Warrick says he enjoys designing forms that challenge his skills and pushes the dimensions of the materials he uses. He says he uses stainless steel for its 'strength, beauty and reflective qualities'.

Following on from the conference, the art exhibition will be moved to Cooks Hill Galleries in Newcastle, under the direction of Mr Mark Widdup.



These pieces by Warrick Timmins are just some of the examples we can expect to see at PacRim 2007



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The work of Anna Eggert is not new to ASSDA, or to those familiar with the 2005 Reference Manual where her pieces entitled "Belinda's dress" featured on the cover.

Two years on, Anna's love of stainless steel continues, as she begins work on a new project which has seen her nominated for the 2007 McClelland Award. The work, which will be put forward for a chance at the \$100,000 prize money, is similar to that shown, and again uses stainless steel mesh. "Mesmerized" is an eight piece artwork continuing an investigation into the female identity. In particular, Anna explores the inherent nature of those outside the Muslim religion, who become 'mesmerized' by their own curiosity of a women dressed in hijab.

The production of the pieces begin with a roll of stainless steel mesh. The material is rolled out and a pattern is penned before cutting with a nibble. All pieces are made with grade 316. The base layer of the pieces use quite

a coarse stainless steel with a 1.0mm aperture x 0.56mm wire diameter (known as 16/24). A softer layer is then used on top, with a mesh known as bolding cloth which has an aperture of 710 micron and wire diameter of 0.20mm.

Anna says all her stainless steel mesh is supplied by Metal Mesh in Sydney who have been very supportive of her work. Various pieces of Anna's repertoire of work will be displayed in NSW, Canberra and Noosa in the coming months, with the winner of the McClelland Award to be announced in November.

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# PACRIM STAINLESS 25-26 OCTOBER 2007 NEWCASTLE NSW



Some diverse national and international speakers will present papers at ASSDA's PacRim Stainless 2007, reflecting the conference's theme of Stainless Evolution: Prices-Products-Prosperity. Highlights will include:

- Prof Michael Cortie, Director of the Institute for Nanoscale Technology, University of Technology Sydney, who was part of the team that developed and patented several new ferritic and low-nickel austenitic stainless steels in South Africa;
- Former Queensland Premier Hon Mike Ahern AO, Special Representative for the Queensland Government promoting trade and investment with Africa, the Middle East and India, who will talk about competing with India and China;

- end-users from the food and beverage and defence/marine sectors;
- Mr Jan Christensen and Mr Sami Packalen from Stalatupe Oy who will talk about new material possibilities for structural hollow sections;
- a US representative from ATI Allegheny Ludlum who will talk about lean substitution options for 300 series alloys;
- Mr Darren Leeder from Furphy Engineering who will talk about plasma welding technology new to Australia.

Other topics to be covered will include a market and prices overview, skills shortages, and e-learning.

But PacRim won't be all work and no play: delegates will also have the opportunity to take part in a wine tasting tour of the renowned Hunter Valley or play golf at the Newcastle Golf Club (ranked 11th in Australia by Golf Australia magazine and rated in the World's Top 100 Courses by a panel of experts).

PacRim Stainless 2007 is not to be missed. To register for the conference, visit [www.assda.asn.au](http://www.assda.asn.au).



Photograph courtesy of Newcastle Tourism

**THE LATE GARY DRUMMOND** At the time of publication, ASSDA was saddened to hear of the passing of Gary Drummond of Sandvik. A vale will follow in the next edition of Australian Stainless.

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