

AUSTRALIAN STAINLESS

SPECIALISING IN STAINLESS STEEL AND ITS APPLICATIONS

#42
SUMMER
2008



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EDITED AND PUBLISHED BY THE AUSTRALIAN STAINLESS STEEL DEVELOPMENT ASSOCIATION
PRINT POST APPROVED PP451207/00205

ASSDA

STAINLESS SPIRIT OUT OF THIS WORLD



The grand scale of *Rings of Saturn* at Melbourne's Heide Museum of Modern Art takes on even more significance when you learn about the artist.

Renowned Australian sculptor Inge King AM was born in Germany in 1918, moving to Australia in 1951 and forging her career despite a culturally conservative landscape at the time.

The 89-year-old artist created the 400cm x 600cm x 500cm *Rings of Saturn* in 2005-2006 as part of her Celestial Series, using stainless steel to create the sense of floating, lightness and reflection that prevails in outerspace.

"Stainless steel is not suitable for every work, but these pieces were inspired by a story on space research I saw on TV and they needed a certain spirit," Ms King said.

"By using stainless steel with a sanded finish, the piece is very durable and it breaks and reflects the light, so at any time of the day it looks different."

Ms King makes scale models of her sculptures, but the physical demands of creating the final work requires her to contract out the fabrication.

Using Ms King's 50cm model of *Rings of Saturn*, Melbourne fabricator Robert Hook coordinated the laser cutting of about 3 tonnes of 5mm grade 316 stainless steel, then welded the two full circles and two semi-circles.

He took the welds down with a 5 inch grinder, then used a polifan disc to smooth them out. He created the finished look with Poly-PTX flap wheels and used a 9 inch, 100 grit sanding disk on the larger surfaces.

Rings of Saturn was commissioned through the Heide Foundation, with support from Lindsay and Paula Fox, and sits in Heide's Sir Rupert Hamer Garden.

Inge King will hold an exhibition of mostly stainless steel works at Australian Galleries, 35 Derby Street, Collingwood, Victoria in April-May 2008. Visit www.australiangalleries.com.au for more information.

Photo acknowledgement including cover:

Inge King

Rings of Saturn 2005-06

Heide Museum of Modern Art Collection

Commissioned through the Heide Foundation with

significant assistance from Lindsay and Paula Fox 2005

Photographer: John Gollings 2007 (and front cover 2006)

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CURVED SPINE LEAVES STRONG IMPRESSION

If you're investing in a home overlooking the water at Noosa, Queensland, you will almost certainly want the fittings to be impressive.

Sunshine Coast ASSDA Accredited Fabricator Bell Stainless rose to the challenge at this Noosa property by designing and building a single stringer staircase and balustrade that leaves a lasting impression.

The curved staircase features 15 timber treads which are bolted onto 6mm grade 316 stainless steel plates, which are then welded onto the stringer.

The handrail is made from grade 316 with a No 4 finish and the balustrade in-fills are made from 10mm solid rod.

Bell Stainless General Manager David Vine said the more than 90 degree curve of the staircase created some design challenges.

"Because you can't roll the pipe in a corkscrew for the stringer we started with a curve on a flat plane then used a series of cuts to corkscrew it," Mr Vine said.

"Of course, we also had to be careful not to distort the angle when the tread plates were welded on. It was an interesting challenge."

Mr Vine said even though the staircase was indoors, the salty coastal environment meant

grade 316 stainless was the logical choice for this upmarket home.

"We steered away from stainless steel wire for the balustrades because of the inherent difficulties with teastaining in the crevices, and because we needed to maintain an even curve to match the top rail," Mr Vine said.

The stringer was fabricated in two halves and assembled on-site.

Mr Vine said because of the high tensile strength of stainless, there was very little flexing as people move up and down the staircase.

"The owners were really happy with the final outcome and we've had a number of enquiries from people who've seen it."

The stainless steel was supplied by Fagersta, Brisbane.

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STAINLESS CLEANS UP UNIVERSITY GROUNDS



The thought of public rubbish bins usually attracts images of black smelly wheelie bins with broken lids and flies. However, if you walked through the University of Queensland in Brisbane's St Lucia, you would be greeted, instead, with clean stainless steel and lovely bright colours.

The installation of between 30-50 new double-bin enclosures has added splashes of colour and flair to the university grounds. Designers Street and Garden Furniture Co enlisted the services of long time contractors and ASSDA Accredited Fabricators Rocklea Pressed Metal to manufacture the pieces.

Featuring laser cut patterns, bright colour spray painting (to distinguish general rubbish from recycling) and a unique shape, the bins were designed with the surrounding art deco buildings in mind.

Street and Garden Furniture Co Director David Shaw says he often uses stainless steel for outdoor use because of its robustness and he found it particularly useful for the bins.

He says students tended to decorate large surface areas with posters, so using stainless steel meant they could be easily cleaned.

"Much of the damage is often caused by people emptying the bins," Mr Shaw also says.

"So we tried to design them to make them easily accessible. If the surface gets damaged, they can be simply re-surfaced."

Manufacture of the bins involved 12.24 square metres of 1.6mm grade 304 sheet with a number 4 finish and 18 lineal metres of 25 x 1.6mm grade 304 square tube. A considerable amount of laser cutting was done to adopt the academic shield and to break the large surface area with an aesthetic pattern. A floating top was also designed to minimise the dominance of the wheelie bin size and to provide a shield against weather.

The designs were done by Street and Garden Furniture Co and then sent to Rocklea Pressed Metal as a CAD file.



David Shaw says his longstanding relationship with Rocklea Pressed Metal has been built through a history of confidence and delivery.

"An awful lot of the things we do, those guys are involved in," he says. "I am totally confident they'll provide me with what I've drawn."

The University of Queensland project is a longstanding one, dating back to 1997. The project also incorporates the installation of light poles, tree grates, signage and seats, much of which Rocklea Pressed Metal has contributed to.

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Testing for grade confirmation



FOLLOWING A SERIES OF ALTERNATIVE GRADE SELECTION, THIS ARTICLE DEALS WITH TESTING FOR GRADE CONFIRMATION

Testing for grade confirmation

Raw material price fluctuations and increasing demand for stainless steels have driven demand for lower cost alloys as alternatives to the traditional "300" series steels. This has been met through a range of existing and new, innovative steels with different properties, performance and availability broadening the range of alloys that might be found in the market. But as with the traditional stainless steels you can't tell what they are by looking at them. This article describes most of the range of test methods available for grade confirmation. The method used depends on the budget, size of job and the potential consequences of having the wrong alloy.

Why test?

Contract documents may require formal test certificates. Usually these are issued by the mill and unless there is reason to doubt them this is sufficient. However, sometimes a positive material identification (PMI) is required for safety critical items such as LPG valves. Legal cases also tend to be very demanding about precise documentation. Some products may also be lacking in documentation and traceability.

Unexpected poor performance often prompts calls for material testing. Such testing removes one variable in things that might have gone wrong but the cause is more frequently inadequate surface finish or errors in design or fabrication.

Finally, reverse engineering of an existing product from a competitor or overseas supplier often requires detailed materials' information.

What level of testing is required?

General or intermediate level guidance could cover differentiation between carbon and stainless steel or between 304 and 316 or between 300 series and 200 series or ferritic grades.

Full laboratory chemical analysis will be needed

for some cases (such as determining low carbon grades) or when it has become a legal rather than a technical issue.

Full mechanical and metallurgical analyses may also be required if strength or hardness are essential design elements. If the material has undergone subsequent surface modification then the required investigation could be extensive – and expensive.

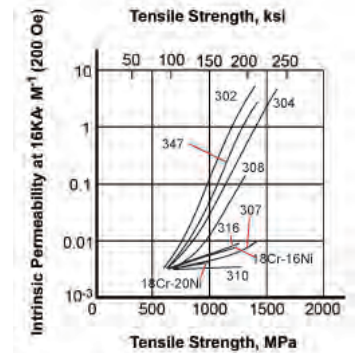
Simple physical tests

Appearance is not a reliable indicator of the grade of stainless steel as the differences are determined more by surface treatments than alloy composition. Even the differences between mirror polished surfaces are fairly subtle. The table below shows slight differences in density of some stainless steel alloys but density determination is not a convenient method.

Alloy	Density (g/cc)
430, 3Cr12/5Cr12	7.7
2205	7.8
304, 310	7.9
316	7.98

A widely accepted test is a magnet. Duplex, super duplex, martensitic and ferritic stainless steels are strongly attracted to a magnet while annealed austenitic stainless steels are not. However, cold worked austenitic stainless steels are weakly attracted to a magnet so cold formed ends to a vessel, cold rolled bolts and bent corners will be affected by a magnet. This applies to both the conventional chromium-nickel 300 grades and the chromium-manganese 200 series austenitic grades. The strength of the effect that a magnet has on a material can be related to the relative permeability and the graph shows the different effect of the same level of cold work (bending) on various austenitic alloys. The grades with higher nickel or austenitising elements (310 or 316) show much lower magnetic properties. In comparison, mild steel

has a relative permeability somewhere between a few hundred and 2000. Relative permeability of duplex and ferritic alloys is in the hundreds. Precipitation hardening alloys are magnetic but the degree depends on whether the alloy is martensitic or semi-austenitic.



Chemical tests

The proprietary kits are designed to test for a specific element and have a limited shelf life. If you have a project requiring multiple tests then they are very useful. However, if you only require a couple of tests a year, then it may be cheaper and more thorough to run a full laboratory test.

Molybdenum

The most common test uses a single drop of solution to distinguish between low and high molybdenum content. The "Moly Drop" test will distinguish between 304/304L and 316/316L but the test will also give a positive result with 317/317L, 904L, the 6% Mo grades, 444, 2205 and the super duplex grades. The test requires a clean, dry, grease free surface and it sometimes helps to lightly abrade the surface.

The yellow drop (as shown) will darken after a few minutes but the reaction speed is slower if the surface is cold. It is a comparative test and scrap additions during production may give enough molybdenum to give a slight colouration.

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The test is therefore most reliable if a known 304 and 316 are tested with the unknown. If the sample is to be used in service, then the chemicals should be washed away immediately after the test.



There is another chemical test using ethyl xanthogenate to form a red or pink complex when molybdenum ions are dissolved in solution. The molybdenum is dissolved from the surface either by using a hydrochloric or sulphuric acid. The strength of the colour depends on the level on molybdenum in the alloy.

Manganese

The increasing use of high manganese stainless steels has led to several manganese test kits operating on the same principal as the electrochemical test for molybdenum. The semi-quantitative results of a kit test for manganese are shown in the photographs below.

Mn checker coloring sample					
Aln content	Mn8.7%	Mn5.9%	Mn3%	Mn1.7%	Mn0.8%
Coloring					
Coloring immediately after electrolysis					

Apart from the recent low nickel, high manganese stainless grades, there have been specialist 200 series grades used in generators, higher strength (pre duplex) marine alloys and for anti-galling applications.

Sulphur

A practical and rapid test for a high sulphur (free machining) stainless steel (303 and 430F are the most common) is to prepare sulphur prints using photographic paper soaked in 3% sulphuric acid for several minutes. The treated paper is pressed onto a cleaned surface for about 5 seconds. High sulphur levels are shown by a brown colour. Once again, this is a comparative test so low and high sulphur samples should be compared to the test piece.

Instrumental techniques

There are two basic techniques each with two variants.

The automated instruments are expensive and would normally be used for large projects, or by scrap metal merchants, manufacturers or specialist NDT contractors.

Spark spectroscopy requires a flat surface preferably about 20mm in diameter. An electrical spark is generated and the colour of the spark is determined by the elements present. The elemental concentration is controlled by the intensity of the specific colours. In automated instruments, the spectrum is compared to a library of data and percentage composition is calculated for each element. Calibration is required against materials with similar composition. A sparking mark is left on the surface and must be removed if appearance or fatigue resistance is important. The instrument's accuracy tends to be lower than a laboratory instrument and exposure to air excludes measuring nitrogen.

The older "Metascopes" were also spark spectroscopes but relied on visual comparisons of line brightness so their accuracy was very operator dependant.

Grinding spark identification using a hard, high speed grinding wheel is even older technology. It will cause a grinding burr and is extremely dependent on the operator skill. Spark bursts are related to the carbon content and characteristic sparks/carrier lines are related to the alloying metals. Chromium in steel produces a spark stream that is orange-red in colour. A yellow colouration caused by nickel persists all along the spark whereas the orange specks of chromium appear only near the origin of the spark stream, in close contact with the grinding wheel. Relatively narrow and short spark streams, white-yellow in colour, are produced in type 304 stainless steels.

The second broad method is X-ray fluorescence. Older instruments used one or more radioactive sources although more recent miniaturisation of X-ray tubes means that some instruments generate X-rays directly. Regardless of their source, the X-rays excite electrons from the inner shells of the elements and when outer electrons fall into the newly vacant shell, a characteristic spectrum of light – generally with a number of lines – is emitted. The instrument measures the intensity of counts in each line and compares it to an internal databank. Provided that the surface is clean and smooth and the measurement is for long enough to give good statistics (typically between 20 and 60 seconds), then the alloy can be identified. However, because

The assistance of ASSDA colleagues is gratefully acknowledged – in particular Peter Moore from Atlas Specialty Metals.



of the physics of X-ray fluorescence, it cannot analyse for light elements, especially carbon or nitrogen. The units are light and easy to use as seen in the picture. One advantage for reporting is that results can be directly downloaded into a computer records system



Laboratory measurements

Atomic Absorption (AA) or Inductively Coupled Plasma Spectroscopy (ICP) techniques use laboratory instruments after a sample has been digested in (usually) a mixture of acids. This is slow and may be more expensive than a spark test but it will give a more complete and reliable result. Carbon requires a separate (LECO ignition) test and detecting silicon by either method requires aggressive chemicals to get the silicon into solution.

Which test?

Is it 430/2205 or 304/316?

A magnet will be strongly attracted to 430 and 2205 but only weakly to deformed parts of 304 or 316.

Is it 430 or 2205?

Both are strongly magnetic but only duplex 2205 will give a positive moly drop test result.

Is it 304 or 316?

A moly drop test will give a positive result with 316.

Is it a low carbon grade?

Only a spark spectrometer can distinguish between low and standard carbon grades.

In all these cases a full laboratory analysis will answer the question and provide a full composition for about \$100.

STAINLESS UPGRADE ON TRACK FOR RAIL STATIONS



When ASSDA Accredited Fabricator Bridgeman Stainless won a tender to supply stainless steel balustrades for Queensland Rail, supplying quality materials with excellent fabrication techniques was at the forefront of their mind.

The upgrade of Oxford Park and Grovely rail stations in Brisbane's North West was a 12-month project, headed by Arup and Moggill Constructions, and included significant use of stainless steel for the hand rails and balustrades.

Director Len Webb says the job was an excellent opportunity to showcase stainless steel at its best, rather than reverting to cheaper, less reliable materials and fabrication techniques.

"The project manager, Allan Bolt, and I had a number of meetings with Arup and Moggill to discuss how best to use stainless steel to its advantage," he says.

Bridgeman Stainless supplied a prototype of the balustrades before any work began, to ensure issues such as tea-staining were addressed.

"By doing ASSDA's Stainless Steel Specialist Course, we were able to confidently discuss the importance of using certain finishes to help prevent issues such as tea-staining," Len said.

The project used 54 square metres of plate, and almost 5400 metres of 1.6mm tube in diameters of 50.0mm, 38.1mm and 15.88mm.

All stainless steel supplied by Bridgeman was in grade 304 and was polished to a #600 grit. The tube materials were supplied by Tubesales in Yatala, Queensland and the plate was supplied by Atlas Specialty Metals in Wacol. The plate was polished by an external contractor.

The balustrades were largely made offsite but then transported to the stations where they were welded together. The joints were then passivated, re-polished back to the #600 finish and then, finally, cleaned.

A maintenance prevention schedule will be delivered on completion of the job, paying particular attention to those areas where the stainless steel is undercover and not regularly cleaned by rain.

Bridgeman Stainless Project Manager Allan Bolt says the company's commitment to ongoing education about stainless steel and their dedication to quality workmanship had secured their reputation in the industry.

Moggill Constructions Senior Project Manager Marc Kuypers says the emphasis Bridgeman Stainless took on quality showed in their results.

"We hadn't worked with Bridgeman Stainless before and we are quite impressed with their work," Marc says.

Arup Superintendent Representative John Rutherford said he was particularly impressed

by the quality of the work Bridgeman carried out on site.

John, Marc, Len and Allan agreed that the success of the project was due largely to the excellent communication between all parties involved.

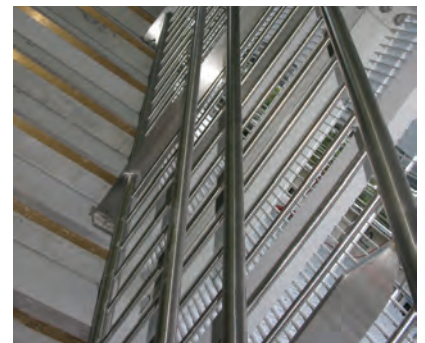
Len said, as one of the first ASSDA Accredited Fabricators, Bridgeman Stainless thoroughly endorses the ASSDA Accreditation program as it distinguishes fabricators with quality practices within the industry.

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STAINLESS INTEGRAL TO BRIDGE'S 300 YEAR DESIGN LIFE



Artist's impression of the completed bridge. Image courtesy of Queensland Motorways.

Queensland's largest ever road and bridge project will rely, in part, on innovation within the stainless steel industry to meet its design life of 300 years.

The Gateway Upgrade Project in Brisbane, which includes construction of a second Gateway Bridge and is being delivered by Queensland Motorways with design, construction and maintenance by the Leighton Abigroup Joint Venture (LAJV), will use reinforcement bar made for the first time from Outokumpu Group's LDX 2101@ duplex stainless steel.

A total of 130 tonnes of duplex stainless steel will be used in the bridge's most critical structures: the splash zones of the two main river piers (28 tonnes of LDX 2101@ have already been supplied and some Duplex 2205 will be used due to availability of dimensions for certain components).

Gateway Bridge Alliance Manager Gerry van der Wal said LDX2101@ was chosen due to its high level of corrosion resistance (close to 316L) and low nickel content, which made it more cost effective and less susceptible to rapidly escalating worldwide nickel prices.

Outokumpu's Qld and NT Manager Ken Hayes said that in bridge construction, stainless steel should be specified for parts where it makes a positive contribution, such as splash zones and the bridge deck.

"If carbon steel rebar is used, the bridge deck needs a water-proof membrane and the concrete must be of high quality, whereas if stainless rebar is used, reduced concrete cover can be specified, and it is also possible to relax the design criteria with respect to maximum crack width," he said.

"As a result, with stainless rebar, bridges

can be built either with no extra cost or for a lower cost than by using carbon steel reinforcement."

Mr Hayes said LDX2101@ offered the most cost-effective alternative for durable reinforced concrete structures and, due to its good price stability, it offered construction projects vitally important predictability.

"The win-win outcome from the use of LDX2101@ is much improved sustainability in our constructed environment," he said.

Because LDX2101@ had never been used for rebar before this project, Outokumpu's metallurgists carried out extensive tests to ensure it would withstand a high corrosion environment if the concrete were permeated by seawater.

A trial rebar coil was also sent to Atlas Specialty Metals' Durinox facility in Melbourne to ensure it could be easily straightened.

Durinox Manager Colin McGill said they had to decoil the material, cut it to length and bend it to the appropriate shape.

"This was the first time we had processed the material and there were some challenges we had to overcome because of its very high strength," Mr McGill said.

Once Outokumpu's quality system and external testing criteria were approved by LAJV, the initial 28 tonnes of the hot rolled, ribbed, 16mm LDX2101@ were delivered to Atlas Specialty Metals in Melbourne in 750kg coils for processing between October and December 2007.

The \$1.88 billion Gateway Upgrade Project will be completed in 2011. It includes duplication



of the original Gateway Bridge (which was completed in 1986), upgrade to 12km of the Gateway Motorway and construction of a new 7km deviation providing better access to Brisbane Airport.

Just over 20 years after it was constructed, the original Gateway Bridge is now exceeding capacity, carrying more than 100,000 vehicles each day.

When the duplication project is complete, the original bridge will carry six lanes of traffic north and the new bridge will carry six lanes of traffic south.

The new bridge is a 1.6km long balanced cantilever motorway bridge with the main span measuring 260 metres.

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Photos courtesy Leighton Abigroup Joint Venture



SMART MANUFACTURING, SECURE FUTURE



Access to quality materials and becoming smarter in the way we use and add value to these materials are essential if stainless steel-related businesses in Australia and other Pacific Rim nations are to excel in a world with many new grades of stainless steel on the market.

PacRim Stainless 2008 delegates will hear from a dynamic range of speakers showing us how innovation will help meet these new challenges.

Speaker and paper highlights include:

- Juha Rantanen, President & CEO, Outokumpu Group (Finland): global trends in trade mix and factors influencing price
- Nirmal Mathur, Director - Corporate & International Marketing, Jindal Stainless Steel (India): the global outlook and leadership on the move to Asia



- Dave Stewart, Deputy Coordinator-General (Infrastructure Delivery), Queensland Government: opportunities in the SE Qld Water Grid
- John Doolan, Manager, Tankhouse Technology and Chief Financial Officer, Xstrata Technology: stainless steel in the minerals processing sector
- product durability in the tropics
- fabrication clusters and a fabrication forum
- workplace health and safety

PacRim Stainless 2008 is also an excellent opportunity to showcase your business with a trade booth or through sponsorship. For more information visit www.assda.asn.au, call (07) 3220 0722 or email Siri Grabski on siri_g@assda.asn.au

2008 REFERENCE MANUAL

Production of the 2008 *Reference Manual* is underway, with distribution expected towards the end of March.

ASSDA's *Reference Manual* is an indispensable guide for the stainless steel industry with 8,000 copies distributed to specifiers and end users of stainless steel in Australia and overseas.

The book contains information on:

Properties and Performance
Grade Selection
Surface Finishes
Design and Fabrication
Product Specifications
Conversion Tables
and more.

It is also a quick reference guide for locating ASSDA members, including a comprehensive buyer's guide.

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