AUSTRALIAN WELDING INSTITUTE

WeldED

world skills Australia

WORLDSKILLS 2014.

WHAT IS IT & WHY IS IT SUCH A BIG HIT?

AS A MAJOR SPONSOR, CIGWELD HAVE THE WINNERS & SUM IT UP FOR YOU...

Sponsors

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Cover Page

CIGWELD are a major sponsor of Worldskills, Australia. The cover identifies one of the welding testpieces.

Worldskills Australia

WorldSkills is an international initiative that identifies and nurtures "Trade" and "Skill" talent around the globe. It's about selecting the best up and coming young talent across a range of skills, and having them compete against one another in their chosen event. They first compete at a regional level, then at the national level, and in the final stage they are sent abroad to step up to the plate on a world scale, and represent their country at the International Competitions which are run every second year

This year there were 44 Trade and Skill Categories being represented at WorldSkills in Australia.The Skills and Trades ranged from heavy industrial work like Welding or Construction Steel Work,to Plumbing, Auto Body Repair or Landscaping. At the other end of the spectrum, the competition also encompassed Skills such as Jewellery, Cookery, Hairdressing and Web Design.

The WorldSkills 2014 National Competition was held in Perth – and ran officially from the 18th – 20th September. The day before the competition began, all of the competitors had an official welcome ceremony, and were brought into their respective skill stations where they were given a couple of hours to get accustomed to their workstations and equipment.

The competitors were given 8 hours a day, over 3 days, to complete a given task. Each competitor worked on their own to build, repair or create their project from scratch. To help them along, a number of high profile companies chipped in to provide all of the relevant equipment, utilities and consumables that were required to complete the set task.

CIGWELD is a major Sponsor of WorldSkills Australia, and have supported this years event with a generous range of Professional Level Welding Machines, Safety Equipment and Consumables. The range of CIGWELD equipment assisted competitors with the welding, cutting and gas control, which was required within a number of the Skills and Trades.

These categories included: Welding, Sheetmetal Work, Construction Steel Work, Auto Body Repair, Plumbing and Jewellery.

CIGWELDs Comet Edge Regulators featured heavily throughout the event, as the solution for all gas control.The Comet Edge Blow Pipe and Cutting Attachment, Transmig 175i, Transmig 250i and Professional 220ACDC Inverter are just a few of the CIGWELD products that you would have seen in the Skillaroos workstations.

For a smooth transition into the workforce, gearing competitors with Professional CIGWELD machines provided them with the confidence and knowledge required to enhance their skills to use industry level equipment.

With safety being paramount at CIGWELD, machines are equipped with the latest in welding safety technology – **VRD, Voltage Reduction Device**, virtually eliminating electric shocks when not welding.

CIGWELD was an initial founder of Worldskills in Australia some years ago, and will continue to support this important program which assists with the development and education of our younger up and coming welding professionals, enhancing both their skills and experience. CIGWELD does more than donate funds and equipment to Worldskills; as a Major Sponsor, staff are involved nationally, and when required, devote time to judging competitions.

CIGWELD Marketing Manager, Laura Carrazza, explains that the WorldSkills sponsorship is just as important to CIGWELD, as it is to the WorldSkills organisation and the Competitors. “The exposure we get from being involved with such an important competition is immeasurable, as it is really about establishing a relationship and loyalty with our young, talented future professionals. The main aim is to have presence at the events, and we believe that through our sponsorship we are able to establish significant brand awareness, and as a result be instrumental in the growth and development at a grass roots level.”

The Welding category was where the largest range of CIGWELD welding equipment was located. The contestants used CIGWELD Transmig 250i Multi Process Welding Inverters, along with 220ACDC Welding Inverters and a range of CIGWELD wires, electrodes and TIG rods. All contestants were decked out in CIGWELD safety gear (Gauntlet or TIG gloves and high impact ProLite Auto Darkening Welding Helmets).

TRANSMIG 250i:

The CIGWELD TRANSMIG 250i is a self contained single phase multiprocess welding inverter that is capable of performing GMAW/FCAW (MIG),MMAW (Stick) and GTAW (Lift TIG) welding processes. The unit is equipped with an integrated wire feed unit, voltage reduction device (VRD applicable in stick mode only), PFC (power factor correction), digital voltage and amperage meters, and a host of other features in order to fully satisfy the broad operating needs of the modern welding professional.

TRANSTIG 220 AC/DC:

Great for the highest quality aluminium weld, the Transtig 220AC/DC combines the finest hardware with the latest digital software control systems, producing outstanding seam quality on even the thinnest materials. With DC stick, AC/DC Lift TIG and AC/DC HF TIG and jam packed with safety features, the Transtig 220 AC/DC is ideal for a range of industries, from boat building and panel beating to precision work in chemistry, wine or water tank installations. Whilst in TIG mode the Transtig 220AC/DC is capable of Pulse Welding, Spot Welding, 2T (Normal) and 4T (Latch) modes.

Welding competitors were asked to perform a number of welding tasks, demonstrating various welding positions, across a range of processes (MIG, TIG and Stick) and also on a range of metals (Mild Steel, Stainless Steel and Aluminium).

The main project was to construct a fully assembled pressure vessel that was visually assessed, as well as pressure tested by judges. Once a winner was selected, that individual then had the opportunity to take on the challenge at the International Worldskills competition in Brazil next year.

A world-class competition which has hundreds of millions of government and industry money poured into it, to make it the renowned event that it is today. We look forward to seeing our Skillaroo competitor's progress to this next level, and are thrilled that CIGWELD has been a part of this gateway to success and instrumental in their careers.

Winners from CIGWELD Supported categories:-

METALS & ENGINEERING CATEGORIES

WELDING

GOLD - KALLON McVICAR, ILLAWARRA NSW (WOLLONGONG)

SILVER - NATHAN KELLY, MACQUARIE - NSW (ORANGE)

BRONZE - ELTON STEWART-MURRAY, TASMANIA – TAS

CONSTRUCTION STEEL WORK

GOLD - JED SPARKES, SOUTHERN QUEENSLAND - QLD

SILVER - SCOTT BROWN ILLAWARRA - NSW (WOLLONGONG)

BRONZE - MICHAEL JAMES, RIVERINA MURRAY, NSW

ENGINEERING EXCELLENCE TEAM CHALLENGE

GOLD - TODD FITZSIMMONS & BROCK GOODWIN, HUNTER NSW

SILVER - BRADLEY CLARKE & MATTHEW LUTTRELL, TASMANIA - TAS

BRONZE - SHARI HUNT & MATTHEW KING, SPENCER GULF – SA

SHEET METAL WORK

GOLD - THOMAS CRITTENDEN, HUNTER - NSW

SILVER - HARRISON DENFORD, SYDNEY- NSW

BRONZE - HAMISH CHAMLEY, TASMANIA – TAS

JEWELLERY

GOLD - JYOTHI FORMAN, MELBOURNE - VIC

SILVER - DOUGLAS ELY, SYDNEY WEST - NSW

BRONZE - SAMANTHA KELLY, ADELAIDE - SA

BUILDING & CONSTRUCTION CATEGORIES

PLUMBING

GOLD - DYLAN Di MARTINO, MELBOURNE - VIC

SILVER - SAM GLISSON, BALLARAT/WIMMERA - VIC

BRONZE - SAM GIFFORD, RIVERINA MURRAY - NSW

REFRIGERATION

GOLD - BEAU KUPRIS, SYDNEY WEST - NSW

SILVER - JORDAN WALLWORTH, MELBOURNE - VIC

BRONZE - MARK YOUNG, TASMANIA- TAS

AUTOMOTIVE SERVICES

AUTOBODY REPAIR

GOLD - TRENT YEO, MELBOURNE - VIC

SILVER - KARL DAVIES, BALLARAT/WIMMERA - VIC

BRONZE - BLAKE HOLDEN, SYDNEY - NSW

INTERNATIONAL EXPERT OF THE YEAR AWARD

PAUL CONDRAN – WELDING

worldskills Australia

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CIGWELD

VICTOR TECHNOLOGIES

INNOVATION TO SHAPE THE WORLD

AUSTRALIAN WELDING INSTITUTE

NEWS FROM SMENCO PTY LTD

Made-in-Melbourne MiCut continues to lead CNC cutting industry

Mi-Cut AUSTRALIA PTY. LTD.

Since launching onto the local Australian market last year MiCut has gained a solid reputation in the industry for precision cutting ability, competitive pricing and a myriad of high-quality technical features.

Coupled with the added customer benefit of being able to talk directly with the developers and manufacturers of the machine, has made MiCut a welcome addition with CNC-cutting customers indicating they support the return of a home-grown product after years of foreign imports.

Australian distributor SMENCO, has also announced sharper pricing across the MiCut range to ensure they stay at the forefront of this competitive section of the industry.

Managing Director SMENCO, Anthony England: ' The MiCut is an all in one solution and our customers really appreciate that – no hassles about fume extraction or cable tracks or having to put it together yourself, it's a one-stop shop approach.'

The Micut profile cutting machine range has unmatched accuracy and robustness in its class. All machines are designed and built in Melbourne with many parts sourced locally.

MiCut believes simplicity is the key to producing products that are easy to install, operate and maintain. MiCut spokesperson: '
"We looked at existing CNC cutters on the market and came to the conclusion they were too complex and could be simplified".

The result of that thinking is today's MiCut which combines a simplified approach to CNC cutting with quality componentry. The end result is a cutting machine designed and built to deliver ongoing reliability, speed, accuracy and long life,

MiCut: The Facts:

MiCut 1212 – Cutting area 1230mm x 1230mm

MiCut 1224 – Cutting Area 1230mm x 2460mm

- 12×12 can be easily upgraded to 12×24.
- All Modules have plug in looms.
- Frame Constructed from powder coated Steel Heavy Box Section
- Small Machine Foot Print
- Speed Range – 75 to 6000 mm per min
- Hardened Linear Guides (X and Y Axis Z Axis)
- Rack and Pinion Drive – hardened and precision ground gears with precision rack
- All Sensors connected by IP67 plugs
- Heat shield
- Adjustable Front, Rear and Side Proximity sensing full travel limits
- MiCut “Quick Shield” – Remote lift and lower shield for increased protection
- Oxy Kit Available with Quick changeover
- Water Table – for dust and fume reduction

About MiCut

www.micut.com.au

3 Tower Court

Noble Park Vic 3174

+ 61 3 9798 1012

About SMENCO

SMENCO is one of Australia’s leading distributors of welding equipment, consumables and associated welding technology from around the world.

Among other leading international brands, SMENCO is the national distributor for Fronius welding equipment and Castolin Eutectic – both recognised as leaders in Welding Technology and Wear Solutions, also Bohler Welding Consumables, Kemper Fume Extraction, Bug-O Automated Welding Systems as well as BOA Bore Repair Systems.

Based in Melbourne with offices in all states, SMENCO personnel have an enviable reputation for knowledge, experience and commitment to their customers and their industry.

SMENCO company trained and experienced field staff are backed by a comprehensive national Distributor Network to provide customers with service that’s never far away.

SMENCO Pty Ltd

I Longview Court

Thomastown

Victoria 3074

1300 728 422

www.smenco.com.au

PAK 200i Manual Air-Plasma Cutting and Gouging System

CIGWELD Victor Technologies is excited to announce the introduction of the new PAK 200i Manual Air-Plasma Cutting & Gouging System.

Features of the new Pak 200i include:

- 200 Amps of Cutting Power
- Capable of hand cutting at 200 Amps with the ability to cut up to 70mm on mild steel. At full output will cut 254mm/min (10ipm) on 51mm mild steel.
- 100% Duty Cycle
- 100% duty cycle at full output
- Dual Gas Capability
- The dual gas system ensures superior quality and performance on ferrous and non-ferrous materials
- High Gouging Removal Rate
- Ability to remove up to 11.3kg of mild steel per hour
- Tip Saver for Optimal Tip Life
- This ensures that any accidental contact between the tip and work at high power levels will not damage the tip

The new PAK 200i has been intelligently designed to be used with the former PAK 200 Torches, Leads and Consumables.

With stock available in mid October, the PAK 200i is now available for ordering through your local CIGWELD Area Manager.

If you require any further information please contact your local CIGWELD Area Manager or call Customer Care on 1300 654 674.

CIGWELD

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TWI Training and Examination Services

The AWI and TWI are joining forces

Courses to be run near you

Appreciation of Engineering Quality Documentation Review Course

Course Code: WIS 21

The AWI and TWI are joining forces to bring relevant course material to the industry. A course designed to assist those involved with welding quality but do not require the detailed knowledge of the welding coordinators course..

Dates / Venue	20th October SA
Duration	3 days
Cost	$990 AUD

The Appreciation of Engineering Quality Documentation Review program will be rolled out again as a series of workshops which will be run around the country again in 2015

Course is suitable for:
Personnel involved in compiling and reviewing mechanical / engineering quality documentation for client acceptance. Inspectors, engineers, document controllers looking to expend their current knowledge of Quality Control activities.

Course content:
Analytical review of engineering documentation: material test certificates; Post Weld Heat Treatment; Visual, weld audit and weld history reports; fundamental knowledge requirements for QC personnel to carry out document review; in-depth assessment of documentation.

Course Objectives:
To be able to identify and quantify fabrication or procedural non-compliances against specified procedures.

Additional information:
Course entry is not restricted, however it is recommended that students have some knowledge / experience of the engineering / construction industry.

To register your interest contact AWI or TWI admin@austwelding.com.au, mark.grogan@twi-australia.com

admin@austwelding.com.au,
mark.grogan@twi-australia.com

NOTE: Courses are run subject to numbers

Get qualified in 2014 - Eddy Current Testing (ET) now covers testing of tubes and aerospace

Kuala Lumpur 3 – 14 November 2014

The course is ideal for all NDT personnel, inspectors and technicians responsible for, or engaged in, practical application of eddy current testing and writing techniques and instructions for detection of flaws in cast and wrought product, material identification/determination of properties, coating thickness measurement, tube testing and weld inspections. Also suitable to personnel engaged in inspection of aerospace materials, components and structure.

Course Objectives:
To detect cracks, surface and near-surface, in aircraft components, structures, tubes and welds

- To detect corrosion and thinning in non-magnetic materials
- To grade and sort materials on the basis of conductivity and permeability
- To write clear and concise inspection instructions and test reports
- To meet the syllabus requirements of CSWIP/PCN Level 2

Examination of cast forged and wrought products or tubing such as that found in condensers, heat exchangers and air conditioning units. This course covers the techniques of surface inspection and/or internal bore inspection and is supported by examinations complying with BS EN ISO 9712. The course ends with the certification examination. Training in accordance with the requirements of ISO 9712.

TWI Technology (S.E.Asia) Sdn. Bhd., Malaysia
Tel: +603 61573526
Email: inquiry@twisea.com

VERNON TOOL™ - A LINCOLN ELECTRIC COMPANY

Air Tractor achieves high flying productivity with VERNON Tool™

Air Tractor, Inc. of Olney, Texas produces the world's most extensive product line of aircraft for agricultural spraying, seeding, fertilizing or firefighting.

CHALLENGE

Improve the efficiency of manufacturing the over 120 tube sections that comprise a fuselage frame.

SOLUTION

MasterTube™ Cutting Machine (MTC) from VERNON Tool™, a Lincoln Electric Company.

RESULTS

• Fuselage frame tubes are cut and profiled in half the time.

• End profile is more accurate and requires less fine trimming.

On any day in Olney, Texas, you are bound to see a dusty cowboy walking through town or in sharp contrast; you will more than likely also see a brightly coloured, state-of-art firefighting plane soaring through the sky. Olney is a rural, relaxed town on the outskirts of Wichita Falls with a few surprises up its sleeve. The local landing strip seems to be a hotspot of activity for this unique, small town.

Recently renovated, this WWII-era airport has three long runways and serves as home to Air Tractor, Inc. A 100% employee owned company, Air Tractor is the world's leading manufacturer of agricultural spraying and firefighting aircraft. Producing more than 2,400 aircraft since 1974, this motivated team of employees is quality driven and productivity conscious.

With more than 50 years associated with the design and manufacture of agricultural and aerial firefighting planes, the Air Tractor team continually proves they know their customers and they know their business. Being a global supplier and a results driven company, Air Tractor strives to improve productivity by repeatedly looking for new efficiencies in their manufacturing operation.

The Air Tractor plane design is an all tubular fuselage frame, with more than 120 different tube sections in each frame. Finding a method to produce tubes with profiled ends efficiently was a bottleneck the team needed to overcome. After several years of searching, the Air Tractor team determined that there were few affordable ways to profile small diameter tubes in an automated, effective manner.

TWI Welding Job Knowledge

Welding of austenitic stainless steel - Part 1

There are a number of different types of steels that may be referred to as 'stainless'; previous articles have considered ferritic and precipitation hardening steels for example. It is therefore advisable to be specific and to refer to the group to which the steel belongs in order to avoid confusion.

Although commonly referred to as 'stainless steel', the steels covered in this article should be more correctly referred to as austenitic, 18/8 or chromium-nickel stainless steels. As with the other types of stainless steels, the austenitic stainless steels are corrosion and oxidation resistant due to the presence of chromium that forms a self-healing protective film on the surface of the steel. They also have very good toughness at extremely low temperatures so are used extensively in cryogenic applications. They can be hardened and their strength increased by cold working but not by heat treatment.

They are the most easily weldable of the stainless steel family and can be welded by all welding processes, the main problems being avoidance of hot cracking and the preservation of corrosion resistance.

A convenient and commonly used shorthand identifying the individual alloy within the austenitic stainless steel group is the ASTM system. This uses a three digit number '3XX', the '3' identifying the steel as an austenitic stainless, and with additional letters to identify the composition and certain characteristics of the alloy eg type 304H, type 316L etc; this ASTM method will be used in this article.

Typical compositions of some of the alloys are given in Table 1. The type 304 grade may be regarded as the archetypal austenitic stainless steel from which the other grades are derived and changes in composition away from that of type 304 result in a change in the identification number and are highlighted in red.

ASTM No. (type)	Composition wt%							Microstructure
	C (max)	Si (max)	Mn (max)	Cr	Ni	Mo	Others	Austenite - A Ferrite - F
304	0.08	0.75	2.0	18/20	8/11	-	-	A+2/8%F
304L	0.035	0.75	2.0	18/20	8/11	-	-	A + 2/8%F
304H	0.04 - 0.10	0.75	2.0	18/20	8/11	-	-	A + 2/8%F
304N	0.08	0.75	2.0	18/20	8/11	-	0.1/0.16N	A + 2/8%F
316	0.08	0.75	2.0	16/18	11/14	2/3	-	A + 3/10%F
347	0.08	0.75	2.0	17/20	9/13	-	Nb : 10xC	A + 4/12%F
321	0.08	0.75	2.0	17/19	9/12	-	Ti: 5xC	A + 4/12%F
310	0.15	0.75	2.0	24/26	19/22	-	-	100% A
309	0.08	1.0	2.0	22/24	12/15	-	-	A + 8/15%F
308L (generally filler metal only)	0.03	1.0	2.0	19/21	10/12			A + 4/12%F

Table 1 Typical compositions of some austenitic stainless steel alloys

The 3XX may followed by a letter that gives more information about the specific alloy as shown in the Table. 'L' is for a low carbon austenitic stainless steel for use in an aggressive corrosive environment ; 'H' for a high carbon steel with improved high temperature strength for use in creep applications; 'N' for a nitrogen bearing steel where a higher tensile strength than a conventional steel is required.

These suffixes are used with most of the alloy designations eg type 316L, type 316LN, type 347H, where the composition has been modified from that of the base alloy.

Austenitic stainless steels are metallurgically simple alloys. They are either 100% austenite or austenite with a small amount of ferrite (see Table 1). This is not the ferrite to be found in carbon steel but a high temperature form known as delta (δ) -ferrite. Unlike carbon and low alloy steels the austenitic stainless steels undergo no phase changes as they cool from high temperatures. They cannot therefore be quench hardened to form martensite and their mechanical properties to a great extent are unaffected by welding. Cold (hydrogen induced) cracking (Job Knowledge No. 45) is therefore not a problem and preheat is not necessary irrespective of component thickness.

Alloying elements in an austenitic stainless steel can be divided into two groups; those that promote the formation of austenite and those that favour the formation of ferrite. The main austenite formers are nickel, carbon, manganese and nitrogen; the important ferrite formers are chromium, silicon, molybdenum and niobium. By varying the amounts of these elements, the steel can be made to be fully austenitic or can be designed to contain a small amount of ferrite; the importance of this will be discussed later.

In 1949 Anton Schaeffler published a constitutional or phase diagram that illustrates the effects of composition on the microstructure. In the diagram Schaeffler assigned a factor to the various elements, the factor reflecting the strength of the effect on the formation of ferrite or austenite; these factors can be seen in the diagram.

The elements are then combined into two groups to give chromium and nickel 'equivalents'. These form the x and y axes of the diagram and, knowing the composition of an austenitic stainless steel, enables the proportions of the phases to be determined.

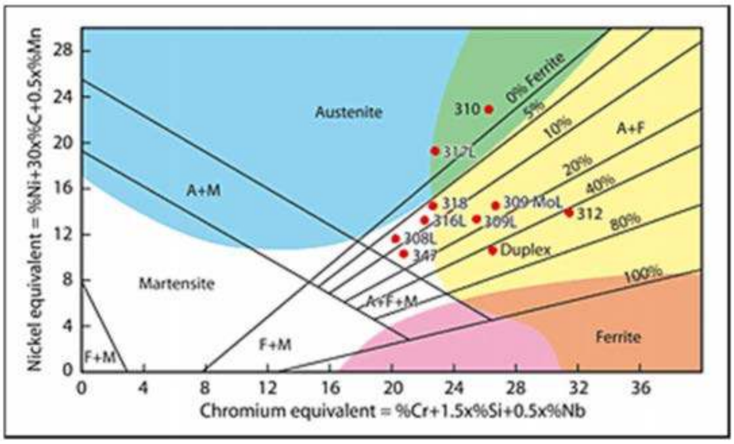


Fig 1. Shaeffler diagram (A-austenite; M - martensite; F - ferrite)

Typical positions of some of the commoner alloys are given in Fig.1. Also superimposed on this diagram are coloured areas identifying some of the fabrication problems that may be encountered with austenitic stainless steels.

Although all the austenitic stainless steels are sensitive to hot cracking (see the Job Knowledge article on Solidification Cracking), the fully austenitic steels falling within the vertically blue area in Fig.1 such as type 310 are particularly sensitive.

The main culprits are sulphur and phosphorus. To this end, these tramp elements have been progressively reduced such that steels with less than 0.010% sulphur and phosphorus less than 0.020% are now readily available. Ideally a type 310 or type 317 alloy should have sulphur and phosphorus levels below some 0.003%.

Cleanliness is also most important and thorough degreasing must be carried out immediately prior to welding.

The steels such as type 304, type 316, type 347 that fall within, or close to, the small uncoloured triangular region in the centre of the diagram contain a small amount of delta-ferrite and, whilst not being immune to hot cracking, have improved resistance to the formation of sulphur-containing liquid films. The reasons for this are that a) ferrite can dissolve more sulphur and phosphorus than austenite so they are retained in solution rather than being available to form liquid films along the grain boundaries and b) the presence of quite a small amount of ferrite increases the grain boundary area such that any liquid films must spread over a greater area and can no longer form a continuous liquid film. The 100% austenitic steels do not have this advantage.

One problem that has arisen with very low sulphur steels is a phenomenon known as 'cast to cast variation' or 'variable penetration'. The weld pool in a low sulphur steel (<0.005%) tends to be wide with shallow penetration; a steel with sulphur over some 0.010% has a narrower, more deeply penetrating weld bead.
This is generally only a problem with the use of the fully automated TIG welding process, a manual welder being capable of coping with the variations in penetration due to the differences in sulphur content in different casts of steel. However, automated TIG welding procedures developed on a 'high' sulphur steel, when used to weld a low sulphur steel may result in lack of penetration type defects; the reverse situation may result in excessive penetration. Changes to the procedure that have mitigated, but never eliminated, this problem have included slow travel speed, pulsed current, use of Ar/H2 shield gas mixtures.

Other methods include specifying a minimum sulphur of, say, 0.010% or segregating the steels into batches with known penetration characteristics and developing welding procedures to suit. The A-TIG activated flux process has also been found to be of benefit.

The problems of welding the fully ferritic steels that fall into the pink area, where grain growth and embrittlement is a problem, have already been dealt with in Job Knowledge - Welding of ferritic/martensitic stainless steels

The austenitic stainless steels falling into the yellow area will also embrittle but this is as a result of the formation of hard brittle phases called 'sigma' (σ) and 'chi' (χ). This embrittlement takes place in the temperature range of approximately 500 to 900°C. It is a sluggish process and is not a problem during welding of the austenitic stainless steels, but can occur in elevated temperature service or if the welded component is stress relieved.

Welding of austenitic stainless steel - Part 2

Welding of austenitic stainless steel - Part 1, dealt with the metallurgy of austenitic stainless steels and some of the welding problems that may be encountered.

Austenitic stainless steels can be welded with all the commercially available welding processes. There are matching filler metals available for most of the austenitic range of alloys, the exceptions being that there is no type 304 filler metal available (this alloy is generally welded with type 308 filler metal) and no type 321 filler due to the problems of transferring titanium across the arc. Type 321 steels are usually welded with a type 347 filler.

Also mentioned in Part 1 was that the austenitic stainless steels are metallurgically simple alloys and room temperature mechanical properties are not significantly affected by variations in the welding procedure. However, increasing the oxygen and ferrite levels will reduce the toughness at cryogenic (~-196°C) temperatures.

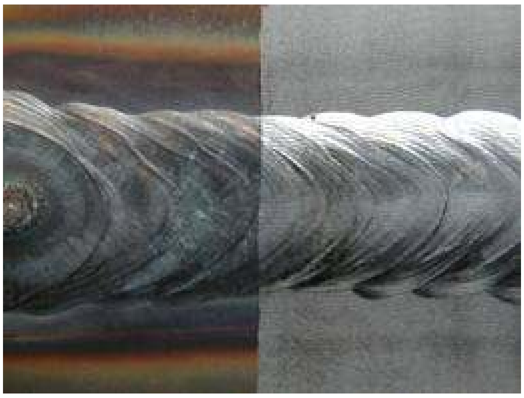
Basic coated manual metal arc electrodes with a controlled short arc length and basic agglomerated submerged arc fluxes are required for best toughness if arc welding processes are used. The steel and filler metal should be selected with as low a ferrite content as possible, say 1 to 3% for best Charpy-V test results.

Conversely, for best creep resistance an 'H' grade steel should be selected and rutile or acid/rutile electrodes and acid submerged arc fluxes should be used. These improve the creep strength by increasing the titanium and niobium content of the weld metal, forming a greater concentration of grain strengthening carbides.

TIG (GTAW) welding of the root pass must always be carried out with an inert gas back purge to prevent loss of chromium (and hence of corrosion resistance), argon being the gas generally used for this purpose. Nitrogen may be used but there is a risk of the weld deposit absorbing nitrogen, thereby becoming fully austenitic and hot crack sensitive.

Two characteristics of austenitic stainless steels that differentiate them from ferritic steels are the coefficients of thermal conductivity and expansion. Austenitic stainless steels have a low coefficient of thermal conductivity, approximately 1/3rd that of ferritic steel at room temperature and a coefficient of thermal expansion some 30% more than that of a ferritic steel.

Higher expansions in a narrower HAZ result in higher residual stresses and more distortion. This is a particular problem with thin sheet fabrications where the achievement of the desired dimensional tolerances can be extremely difficult and costly to achieve. The use of accelerated cooling techniques such as copper chills or a freezing gas (the liquid CO_2 low stress-no distortion technique typifies this approach) have been used to reduce distortion to acceptable levels.



One of the main reasons for using an austenitic stainless steel is its corrosion resistance. Whilst this is primarily a function of the chromium content of the steel, carbon also has a major but adverse effect resulting in a form of corrosion known as intergranular or inter-crystalline corrosion (ICC) or weld decay, a localised effect confined to the HAZ.

Carbides present in the HAZ of an austenitic stainless steel dissolve on heating and reform on cooling during the welding heat cycle. Unfortunately, these new precipitates form preferentially as chromium carbides on the grain boundaries, depleting chromium from the region immediately adjacent to the boundary, resulting in a local loss of chromium and a reduction in corrosion resistance. If sufficient chromium carbides are formed this results in a network of steel along the grain boundaries sensitive to corrosion; the steel has been sensitised. This sensitisation occurs in the HAZ region that has seen temperatures between 600 and 900°C and times that may be as short as 50 seconds.

There are several methods that may be used to overcome this difficulty. A solution heat treatment (1050°C followed by a water quench) will re-dissolve the carbides and these will be retained in solution on rapid cooling. Whilst this will eliminate the chromium depleted regions it is rarely practical to solution-treat complex welded structures.

The most obvious alternative technique is to reduce the carbon content. This has two beneficial effects:

The lower the carbon content, the longer the time required to form the carbides. At 0.08% carbon this time is around 50 seconds; at 0.03% carbon the time required is about eight hours, most unlikely to be achieved during welding!

The lower the carbon content then the fewer carbides there are to form a continuous chromium depleted network. Hence the 'L' grades, type 304L, or 316L, are preferred where best corrosion resistance is required.

One other method is the addition of alloying elements that will form carbides in preference to chromium; thus the stabilised type 321 and 347 grades containing titanium and niobium respectively were developed.

Titanium and niobium are very strong carbide formers that precipitate carbides at higher temperatures than those at which chromium carbides will form so there is no carbon available to react with the chromium. However, even these stabilised grades may corrode in a very narrow band close to the fusion line (the so-called knife-line attack) in the presence of hot acids. This is due to the higher and more restricted temperature range at which the niobium or titanium carbides dissolve. The solution, as above, is to limit the carbon to 0.03% maximum.

Welding consumables must also be selected with low carbon content if best corrosion resistance is required. Most arc welding consumables contain less than 0.03% carbon but there are filler metals available with carbon contents of up to 0.10%; these should only be used to weld the 'H' grades of steel where good creep resistance is required.

Although MAG (GMAW) welding is often used it should be remembered that carbon pick-up is possible when argon/CO2 mixtures are used, particularly if the welding is carried out in the dip transfer mode. Argon/2% oxygen mixtures are therefore generally preferred where best corrosion resistance is required but argon/10% CO2/2% oxygen is a good compromise that can be used for a broad range of applications.

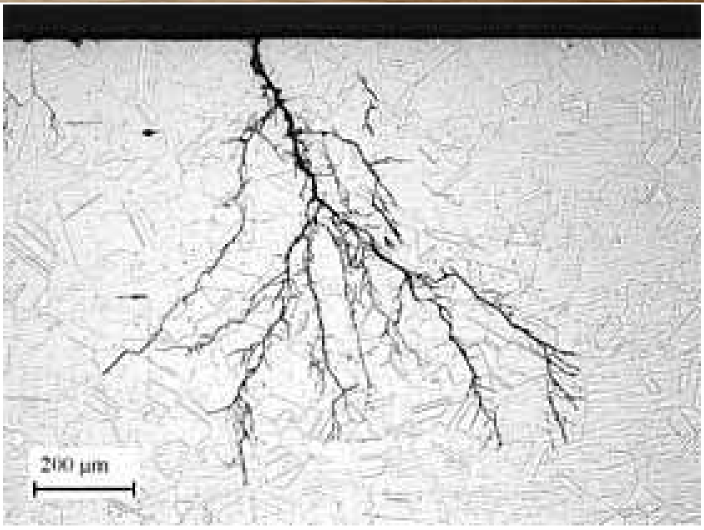
The other major service problem encountered with the austenitic stainless steels is that of stress corrosion cracking. This may be caused by strong alkali solutions but it is the halides (chlorides, fluorides and bromides) that are primarily responsible. Cracking takes place in areas of high stress, as the name suggests, and is not therefore confined solely to welds, but it is at and adjacent to welds that stresses approaching the yield point of the metal are found and these present a particular problem.

The cracking is transgranular and propagation rates can be extremely rapid given the ideal conditions. In hot concentrated chloride solutions, for example, penetration can occur in thin, sheet components within a few minutes. However, the lower the temperature and/or the acid concentration then the rate of crack propagation is correspondingly slower. Austenitic stainless steels are therefore not generally used where halides are present. Even here, stress corrosion cracking (SCC)may occur due to contamination, either of the product in the pipe or vessel or externally from sea water, particularly where the liquid is able to concentrate in crevices.

To eliminate any chance of SCC, the only solution is to stress relieve the weld at a temperature of around 700 to 900°C. It should be remembered that:

this may sensitise the steel so only low carbon grades should be used and

the steel may embrittle due to sigma phase formation (see Part 1) at the lower heat treatment temperatures.



Stress corrosion cracking (SCC) in Type 316L stainless steel

Local stress relief should be approached with caution as the temperature gradients may result in stresses developing outside the heated band; wider heated bands and more stringent control of temperature gradients than required by specifications or codes may therefore be necessary. Solution treatment (1050°C soak followed by very rapid cooling, ideally a water quench) will eliminate all residual stresses whilst avoiding both sensitisation and embrittlement but is rarely practical on a welded assembly.

The alternative is to select a steel that is more resistant; the molybdenum bearing grade type 316 is better than 304 or 321. The ferritic stainless steels are not susceptible to chloride SCC.

These articles were written by *Gene Mathers*.

AWI™ Welding Supervision qualifications

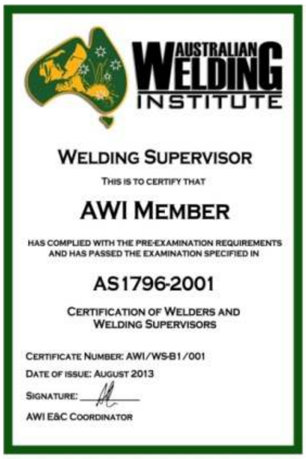
Given the initial success of our offering of exams to date, the AWI™ is rolling out the next few round of examinations for certification for Welding Supervisors for

- AS1796 – Certificate 10 and
- AS2214 – Welding Supervisors – Structural Steel Welding.

Feedback from running the initial round of examinations support that we are on track:

'they are based much more on what we need to know in the workshop' and
'it was a very detailed exam but based on practical application of being a supervisor'.

The AWI™ has listened to key stakeholders - Industry, but more importantly -YOU - and have provided a certification system that measures the skills and knowledge of welding supervisors. For example, there will not be questions on MIAB or Laser welding in the exam. Instead, we have elected to use the examination period to focus on the more 'relevant skills'.



Examinations will be held in capital cities around the country based on demand on the following dates

- **November 28th and 29th**

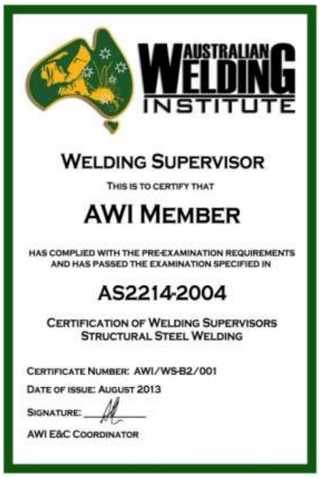
To apply for these examinations contact your local AWI™ contact or email admin@austwelding.com.au

The appropriate forms will be forwarded so you can complete them ready for the exams.

For those that have an existing welding supervision qualification through TAFE, another RTO's or the WTIA we are offering you the opportunity to convert your qualifications into the AWI™ qualification. by sitting the examination at 50% cost.

It is easy to do, if you have evidence of the qualification, satisfy the requirements of AWI™ and are willing to sit the exam all you do is apply to the AWI™ and sit the exam/s.

So if you would like to take this opportunity and prove to the industry your worth as a Welding Supervisor, here is your chance.



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Watch this space for the roll out of Welding inspection qualifications.

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