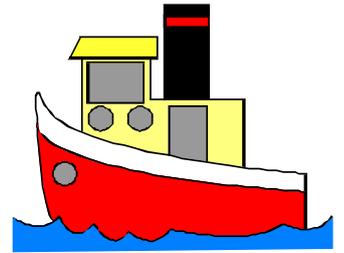




WHEELS and FLOATS



Newsletter No. 331 Feb / Mar 2014

TAURANGA MODEL MARINE AND ENGINEERING CLUB

The Secretary
c/o 3 Waipuna Grove
Tauranga 3112
Palmerville Station Phone 07 578 7293

Rail Track ; Memorial Park
Open to Public weather permitting.
Sundays 10.00am to 4.00pm
Website. www.taurangaminiaturerailway.org.nz
or www.tmmec.org.nz

NOTICE OF MEETING

The next general meeting will be on
Tuesday 4th March at 7pm,
At Palmerville Station

Patron:	Noel Pope
President:	Peter Jones (07) 543 2528
Vice President:	Ron Salisbury (07) 577 9403
Secretary:	Owen Bennett (07) 544 9807
Treasurer:	Clive Goodley (07) 5722959
Editor:	Clive Goodley (07) 5722959
Email:	goodley@clear.net.nz

Committee:	Warren Belk, Bruce Harvey, John Stent, Bruce Mckerras Peter Lindsay. John Nicol.
Boiler Committee:	Peter Jones, Paul Newton, Bob Batchelor. Bruce McKerras
Safety Committee	Warren Karlsson, Bruce Harvey Lloyd Breckon. Pete Lindsay

Next Committee Meeting, Thurs. 27th Feb.

Conveners:	Ron Salisbury, Bruce McKerras
Workshop:	Bruce Harvey
Track:	Warren Belk, Ken Fox
Marine:	John Nicol
Librarian:	Clive Goodley
Rolling Stock:	Owen Bennett
Small Metals Store:	Murray De Lues
Website by:	

Operators Jan/Feb 2014

16-02-14	W. Karlsson
23-02-14	B. Kinkaid
02-03-14	P. Lindsay
09-03-14	B. MacKerras
16-03-14	Rotorua
23-03-14	R. Salisbury
30-03-13	O. Bennett

Editors Notes

The working Bs on the new track are now a regular feature at the park. The members involved are doing a great job in hot and sticky conditions. There is now a work trolley (a converted ridecar) for most of the gear and tools and so the considerable amount required does not need to be returned to the workshop each day, but can be left stored in the tunnel meantime. This also helps to lessen the clutter in the workshop.

Sunday ride numbers have been good through the summer and the extra school holiday running meant we provided another two thousand eight hundred rides for the public and of course extra money for the club, thanks to all the guys who gave their time to assist.

Pete Lindsay has been having a run of bad health over the summer, we hope you come right soon Pete. There has been a few disgruntled members of the club because of the lack of information about other clubs open days. With the advent of newsletters by email, this is one area that has fallen through the cracks. I did try to galvanise other clubs into action last year by emailing their contact numbers and requesting that they send me details of their special weekends and I was willing to make up a calendar of clubs and their dates and

email it to all clubs. I had just one reply and so it is up to the other clubs to make known their special dates, not mine.

From the Committee Meeting

A new vacuum pump has been fitted to the vacuum tester and is working well, drawing 28 inches of vacuum. It's an Aussie piece of machinery, doesn't it make you proud to be a Kiwi, helping the economy of our neighbours across the ditch.

We had a visitor from Canberra a few weeks ago and he told us that passengers were warned before leaving the station that the use of cameras and tablets was banned. This had considerably reduced the derailment problem. We will change our recorded message to include that rule, as leaning out to take photographs is always likely to cause a derailment.

We will take part, (show exhibits) in the Tauranga Model Show on the 3rd 4th May

The school holiday running was again successful, with over 2,800 rides on the Tuesdays and Thursdays only. A Thank you to all the members giving their time.

Discussion on Duplex boilers, see John Heald's article.

The indefatigable workers on the trestle bridge hit a new snag with the bolt holes for the diagonal bracing not lining up with the bracing on the opposing side of the same pole. Not their fault, the designer never allowed for the curve of the bridge, but nevertheless they were lumbered with overcoming it. This they have done and to their credit, swiftly.

Following on from last year's Whakatane incident, discussions are still ongoing regards safety chains between ridecars. Co-incidentally, I was watching a train go past at the Bayfair underpass two days ago and I noticed that the log wagons towards the rear of the train had the old hook coupling, but without chains. Is there a particular reason for the discarding of chains on full size railways? I previously thought they were only done away with, where automatic couplers were in use: just goes to show how out of touch I am.

After retiring, I went to the Social Security office to apply for Social Security. The woman behind the counter asked me for my driver's License to verify my age. I looked in my pockets and realized I had left my wallet at home. I told the woman that I was very sorry, but I would have to go home and come back later. The woman said, 'Unbutton your shirt'. So I opened my shirt revealing my curly silver hair. She said, 'That silver hair on your chest is proof enough for me' and then processed my Social Security application. When I got home, I excitedly told my wife about my experience at the Social Security office. She said, 'You should have dropped your pants. You might have gotten disability too.'

John Heald brings us up to date on the Duplex boiler issue. The following article is up to date as at 12/1/14. The Australian coverage I believe is now complete, with Victoria ratifying the new code. Thanks John.

Duplex Steel: A New Material for Live Steam Boilers by Mike Masee and John Heald

In this great hobby of ours, we are often confronted with a choice of whether to build using traditional methods and materials, or to incorporate a few outwardly invisible changes to our engines which ease the maintenance and operation of a scaled down live steam locomotive.

Since the development of steam technology as pertaining to locomotion came to a standstill in the 1940s, there have been many advancements in the materials sciences that are applicable to our live steam models, and we shall discuss one of the latest and most useful advances here.

The problem with ordinary stainless steels for boilers

The use of ordinary stainless steels (200 through 400 series) in pressure vessels is not recommended due to a problem known as chloride stress corrosion. Tap water has trace amounts of sodium, calcium,

potassium and magnesium chlorides and others depending on the supply source. Chloride salts in solution greatly accelerate corrosion caused from internal stresses and thermal stresses, eventually causing microscopic cracks, which may lead to structural failure.

In addition, the expansion rate of the 300 series grade of stainless steel as an example is almost twice that of carbon steel. Time has proven that the cyclic heating and cooling of the 300 series grade of stainless steel can cause hairline cracks to develop beside or along the welded seams.

Enter 2205 duplex steel

In 2006, Les Irwin from the Penwood Railway near Sydney, Australia contacted several knowledgeable individuals for advice on an alternate to mild steel for boiler applications without the attendant problems of ordinary stainless steels discussed above.

This group included Dr. Ian Ward, metallurgist (Ex Sandvik Australia), Kurt Staub, welding engineer (Sandvik Australia) and Robert Brunton, BSc in Metallurgy.

The group all recommended that Les use the Duplex SAF 2205 steel alloy. This material was developed in Sweden by Sandvik Engineering Group to fill the need for a metal alloy with a low expansion rate that would also resist cyclic stress cracking at the welds, resist corrosion, and be suitable for a large variety of assorted pressure vessels. The microstructures of 2205 consist of a mixture of austenite and ferrite phases of stainless steel. As a result, duplex steels display properties characteristic of both types of steel without many of the downsides. While duplex steels have been around since the 1930s, the 2205 alloy is a nitrogen enhanced duplex stainless steel alloy first brought to market in the 1980s. The nitrogen serves to significantly improve the corrosion resistance properties of the alloy, which also exhibits a yield strength that is more than double that of conventional austenitic stainless steels; especially in the welded condition. Within the normal operating conditions and temperatures of a live steam boiler, no corrosion cracking is expected.

Duplex 2205 steel has yield strength of about 450 MPa (megapascals) compared with 250 MPa for mild steel. In addition, Duplex steel has an elongation factor of about 25% and good bending capabilities.

The Duplex SAF 2205 alloy steel quickly became the metal of choice in many industries for heat exchangers and vessels that were subjected to heat, corrosive contents and large variations in temperature and pressure in their normal daily operating environment. It is widely used in chemical, petrochemical, cellulose and nuclear plants around the world.

The seeds were sewn, Les was on a development mission to bring the live steam hobby and its boilers into the next century.

Building a test boiler

The idea was presented to the Australian Miniature Boiler and Safety Committee (AMBSC), which formed a Duplex 2205 committee headed up by Les Irwin, with technical contributions by Lyndsay Brack, Pressure Welding Instructor, Peter Glover, Engineering Company Director and Dr. Richard Stuart, Oil and Gas Line Engineer.

Further discussion took root at the AALS convention in Brisbane where Dave Giles, Dennis Collins, Paul

Newton and John Heald of New Zealand were invited to build a test boiler using the preliminary code developed by Les Irwin and the AMBSC committee.

Since John Heald had started on construction of a Darjeeling Himalayan Railway 'B- Class' engine for 7.25" gauge and needed a boiler, it was decided to build John's "B- Class" boiler as the first duplex steel test article.

Final CAD design was completed by Dave Giles, who fine tuned the drawings for the boiler to assure compliance with the preliminary 2205 code. The drawings were then given to Sandvik's Auckland, NZ location where a laser-cut kit of parts was produced. All tube holes including inspection and tapping holes were cut in the various plates by Sandvik's laser beam and the accuracy of the kitset was held within 1/10th of a millimeter. All bush and dome holes are to be clear of external line welds as would be done for copper and steel boilers.

Dennis Collins, utilizing 25 years of experience welding duplex 2205 steel and being a certified 2205 welder with an accepted procedure for welding the boiler, rolled and cold formed the various plates and tack welded the parts together. Dave Giles and Paul Newton inspected all of the assembly fits and recorded progress on a regular basis. Boiler owner John Heald spent several evenings machining the 2205 round bar making the stays for around the firebox and the crown sheet. Dennis then welded the test boiler kitset components in logical order until the boiler was completed. Although not required by the code, the firebox was not only welded on the water side of the firebox but also on the fire side.

Hydrostatic and stress testing

On completion of welding, 3 pot dye weld testing was undertaken with no problems found.

After an initial hydrostatic test to 200 PSI found no leaks or weeps, it was agreed that the 2205 boiler group conduct a series of cyclic tests on the new boiler from cold to 100 PSI (the working pressure limit in Australia and New Zealand for hobby boilers) and back to cold again via cooldown and then blowdown at 30 PSI. This would be repeated 48 times to simulate about 5 years of use on the boiler.

After the conclusion of the tests, the boiler was thoroughly cleaned, removing all soot and fire residue, and then crack tested using the dye penetrant method. No cracking of any kind was detected. Special attention was paid to the ligament area around the fire tube plates, and the throat area and foundation ring.

The length expansion of the boiler from ambient temperature to 165 C (329F) working temperature was only 4.5 mm over the 1 meter length of the boiler, the same amount as a carbon steel boiler of equivalent size.

No water treatment was used at all, and after 48 tests, no appreciable sludge was collected in the blowdown catch containers. As the local water was full of all sorts of minerals, it was expected that calcium could be a problem, but no buildup was detected on internal inspection of the boiler after the cyclic tests.

Initial Conclusions

The conclusions reached by the boiler test group are that a SAF 2205 Duplex boiler constructed to the AMBSC part 4 code for miniature boilers will be more than satisfactory provided the overall design and welding procedure is strictly adhered to. The life expectancy of the Duplex material SAF 2205 alloy steel should be similar to a copper boiler, and is suitable for boilers ranging from 20 – 50 litres (5 to 13 gallons).

The final ABMSC part 4 code for duplex boilers has now been approved for use in most states of Australia, with Victoria the last to be negotiated. About two years prior, the code was presented to the then New Zealand Labour Department by the MEANZ executive. As this department was downsized and its duties

changed, the code was handed back to MEANZ to obtain verification. As the verification required a cost, Manakau Live steamers put up money for an independent authority to obtain verification. Unfortunately it transpires that some or all of the technical paper work leading up to the code design may not have been included to support final acceptance.

Access to the test boiler has since been offered to any company wishing to verify Sandvik's claims on the integrity of the material. No one has taken up the offer to date. It has been noted that even the experts on metallurgy seem oblivious that there is a massive difference in chemical composition between ordinary stainless steels and Duplex 2205. This article has been put together to resolve this myth.

The difference in cost of building a duplex boiler vs. a mild steel boiler in Australia and New Zealand is small enough to make 2205 economically viable. The major benefit is the expected longevity of the SAF 2205 material as compared to carbon steel, plus cost and time savings realized from greatly reduced boiler maintenance and water treatment tasks. Two 250mm diameter Duplex boilers have been designed here in New Zealand with an all-up cost of \$4500 each, including the CAD design work, material and specialized welding procedures.

The duplex boiler in operation

As of the writing of this article, the boiler has been under steam for a cumulative 600 hours of operation, including above mentioned cyclic testing bringing an all-up number of firings to nearly 100. This equates to about 8 years use. An internal inspection was carried out recently that revealed the interior to be in 'as new' condition with no solid buildup or corrosion noted. Although it was not used during the testing phase to eliminate water solid variables, an inexpensive PolyFloc additive has been used since to prevent scale buildup over time. This same chemical can and should also be used in copper boilers to prevent solids build up on the internal surfaces. Only 2 years back, John was given a copper boiler to inspect due to poor firing qualities only to find the boiler had to be cut up due to the firebox water space being partially blocked with solids.

Issues raised and addressed

Phase change and embrittlement in duplex material under high temperature

An initial concern of the duplex boiler committee was the temperatures reached at the surfaces of the inner firebox. At higher temperatures, duplex steel can undergo a phase change in its crystalline structure resulting in progressive hardening and embrittlement of the material.

Because this reaction occurs more rapidly at 475 °C (887 °F), this process is also known as "475 °C embrittlement". However this phase separation may also slowly occur in temperatures as low as 300 °C (572 °F) after thousands of hours, or at 600 °C (1112 °F) in exposures of a few minutes, depending on the chemical composition of the steel.¹

During the cyclic testing of the duplex boiler, the highest temperature that could be achieved and measured on the firebox surfaces with a roaring coal fire at 100 PSI was 289 C°, averaging around 260 C° in standard operation.

The low temperature is due to the fact that the water / steam side of the boiler possesses a much higher heat transfer coefficient than the gas side; thus the temperature of the material throughout is much closer to the water side than the fire side.

According to retired technical manager for Sandvik Australia Dr. Ian Ward even if you were to achieve temperatures approaching or slightly surpassing 300 °C on the firebox side, one would not appreciably

harden the material over the standard working life of a hobby boiler, nor in that case cause the material to harden beyond a level acceptable for mild steel pressure vessels. At temperatures below 400 °C, the reduction in properties is relatively small and takes a very long time to form even with continuous service. At hobby usage levels, this would be very difficult to achieve. According to Les Irwin of the 2205 boiler committee, Sandvik engineers give the minimum life of the material at about 100,000 hours of operations under average steaming conditions.

Use of a fusible plug in the crown sheet, which is specified in the 2205 code, will prevent damage should a dry firing incident occur, as per copper and steel codes. The test boiler has been fitted with a 'certified' tin filled plug rated to 230C. To date there have been no problems. As with both copper and steel boilers, any dry fired boilers have to be ascertained by a club boiler committee as to the course of action to get a unit back into service. Both copper, steel and duplex have their own characteristics in this event. If severe over heating occurs on duplex boilers, which would be very rare, the whole unit can be removed from the engine chassis and annealed to bring the structure back to its original chemical form. It is not an end of life event for the boiler. Sandvik can supply details on the 2205 annealing process for boiler committees to adhere to.

In the AMBSC duplex steel boiler code, stay calculations were performed assuming the strength of only mild steel, offering an even larger factor of safety when using duplex steel. Even with a small amount of hardening over time, one would still be well above the tensile and yield strengths of mild steel.

Ease of welding 2005 Duplex Steel

Questions have been raised as to the ease of TIG welding duplex 2205 steel as compared to mild steel.

According to Dennis Collins, welder of the prototype 2205 boiler, the duplex boiler was easier and faster to weld than a mild steel boiler, for a professional welder with 2205 experience and qualifications. This was largely due to the close fit of the pre-cut kit of 2205 materials and the fact that it requires no big grinding preparation for the welds. Dennis estimates about 30 hours of labor for the large 10.7" round top boiler on the B- Class.

Conclusion

In closing, the authors believe that 2205 is a very viable alternative to mild steel and is already starting to see notable use in some parts of the world. The AMBSC Part 4 code containing all information needed to fabricate a 2205 boiler can be ordered through several outlets online, including directly from the AMBSC treasurer, the Australian Scale Model Exchange (SMEX) website as well as the Australian Model Engineering Magazine website.

At this point in time it is known that over 20 Duplex boilers are planned or under construction.

The authors wish to thank Les Irwin, Dave Giles, Dr. Ian Ward, Paul Newton and Dennis Collins for their invaluable help and assistance in putting this article together.

References: 1 - S.S.M. Tavaresa, R.F. de Noronha, M.R. da Silva, J.M. Neto, S. Pais, 475 °C Embrittlement in a Duplex Stainless Steel, Materials Research, tinyurl.com/7of8drk (September 22, 2001).
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Parts of this article were adapted with permission from:

Dave Giles, Duplex Boiler Development Report, December 2010 P.A. Newton, Report on cyclic tests on SAF 2205 Duplex Test Boiler, 15 December, 2010

On the web: AMBSC – Australian Miniature Boiler and Safety Committee

<http://www.pnc.com.au/~wallison/AALS/AMBSC/AMBSC.htm>



Photo below. The council mower did this





Boating News

Radio yacht sailing. Once again we are racing into the new year with our next special day the VTNZ day on the 15th February, where all types of sail boat are invited to come and sail. May the 2nd to the 5th will be the Nationals for one metre yachts, held at the Lakes in Tauranga. Sailors are coming from Australia, South Africa, the South Island as well as from North Island Clubs. Top NZ sailors will be there and we estimate possibly having 4 divisions with sailors moving up or down through these.

Our Wednesday and Saturday racing has been competitive with visits from sailors from out of Tauranga. We continue to hand our transmitters to people watching the sailing and enjoy seeing them sail our boats. Cheers, Ken Fox.

Photo of racing with No. 2 rigs on the 1st February.