

## DUPLEX SAF 2205 ALLOY STEEL TEST BOILER

### CARBON STEEL BOILERS –

There are many of these boilers operating on the larger miniature locomotives around Australia and New Zealand. They have worked very well for many years in service on the larger 7 ¼" gauge locomotives. Boiler inspectors are finding that once the boilers are about 10 - 12 years old due to low Ph in the feed water, corrosion and general decay of surfaces inside, they require extensive repairs or complete replacement. Les Irwin General manager from Penfield miniature Railway near Sydney decided to find an alternative material for boilers in the 25 - 50 litre range.

### WHY NOT USE STAINLESS STEEL?

There are different grades of stainless steel which can resist corrosion or grades that can resist variations of pressure however they are not suitable to operate under both conditions at the same time. The expansion rate of the 300 series grade of Stainless steel is almost twice that of carbon steel. Time has proven over the years 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. For this reason conventional 300 series stainless steel is not a recommended material from which to manufacture our miniature steam boilers.

### DUPLEX 2205 ALLOY STEEL HISTORY –

In 2006 Les Irwin from the PENWOOD RAILWAY south of Sydney contacted several metallurgists for advice. They all recommended that he use the SANDVIK Duplex SAF 2205 steel alloy. This alloy was developed in Sweden to fill the need for a metal alloy with a low expansion rate that would resist cyclic stress cracking at the welds, resist corrosion, and be suitable for a huge variety of other assorted pressure vessels. 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. The seeds were sown; Les was on a development mission to bring the live steam hobby and its boilers into the next century.

### DUPLEX 2205 TEST BOILER

We have been following developments in Australia with the Duplex alloy for the past 2 ½ years and during this time I have attended meetings run by the Australian Miniature Boiler and Safety Committee, AMBSC. In March 2010 at a AALS convention in Brisbane, Dave Giles, Dennis Collins, Paul Newton and John Heald, were invited to build a test boiler using the codes that had been developed by Les Irwin, chairman of the Duplex 2205 development committee and his advisers for the SAF 2205 alloy steel. Dave Giles attended another code review meeting at Penwood Railway in September 2010. It was agreed that the Kiwi 2205 test boiler group conduct a series of cyclic tests on the Kiwi

built test boiler from cold to 7 bar pressure and back to cold again. This would be repeated about 50 times and the welds would then be tested for cracks. The boiler is now completed and the cyclic test program is completed. We are pleased to advise that the final result shows no sign of any cracks. We hope the new AMBSC Part 4 code for SAF 2205 Duplex alloy steel for use in boilers will be sent to print very soon.

#### WHAT HAPPENS NEXT

Once the AMBSC codes part 4 for the Duplex SAF 2205 alloy steel materials are sanctioned in Australia we will be presenting AMBSC Part 4 of the codes to our NZ authorities for review and to have it added to Section A6 in the NZ Miniature Boiler Standards giving exemptions for boilers not covered by the full size boiler codes in New Zealand.

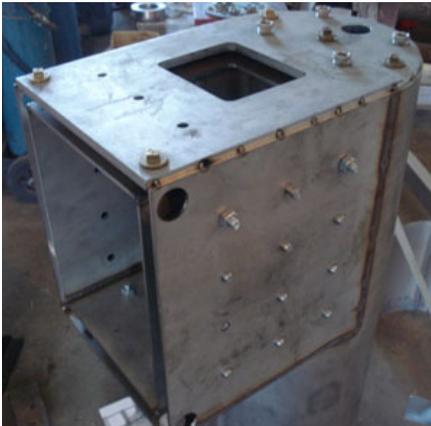
#### HOW DID IT ALL HAPPEN -

John Heald had a narrow gauge loco that needed a boiler - The NZ 2205 committee decided if we were going to design and build a test boiler it needed to fit onto something at the end of the test program to see how it really performed. The test boiler was designed to fit Johns loco.



Les Irwin agreed that the test boiler be built in NZ and after some fine tuning sent Dave Giles the draft codes - Dave spent several days on design and cad drawings for the test boiler. The drawings were sent to Les to verify that the design complied with codes. The drawings on a disk were then given to

SANDVIK in Auckland and a few days later the computer controlled laser cut kitset 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 all within 1/10th of a mm. We were all very impressed. All pieces of the certified plate kitset were engraved with SAF 2205 before delivery and material certificates supplied. Dennis rolled and cold formed the various plates and tack welded the parts together. Dave and Paul inspected all the assembly fits and checked and recorded progress on a regular basis. John spent several evenings machining the 2205 round bar making the stays for around the firebox and the crown sheet. Dennis continued to use his 25 years experience in business welding Duplex 2205 alloy to good use welding the test boiler kitset components in logical order until the boiler was completed. Paul and John conducted the hydraulic test and as expected, not a weep appeared anywhere. Paul has now conducting the cyclic tests and the crack testing has been completed.



*DUPLEX 2205 BOILER COMMITTEE CHAIRMAN,  
AMBSC Codes Part 4 - Research & Design*

*Les Irwin Penwood Railway  
Les Irwin & several others*

*DUPLEX SAF 2205 TEST BOILER - NZ DESIGN AND MANUFACTURING TEAM  
CERTIFIED MATERIALS SUPPLIERS  
PROJECT MANAGER - Design & Drawings  
METAL FORMING & WELDING  
CYCLIC TEST PROGRAM*

*SANDVIK, Auckland Branch  
Dave Giles  
Dennis Collins  
Paul Newton*

*BOILER INSPECTOR  
TEST BOILER - OWNER / WITNESS*

*Paul Newton  
John Heald*

I see the Duplex SAF 2205 material replacing carbon steel as a material to manufacture boilers in the 25 - 50 litre volume range in the future. I still think copper is best for boilers up to 175 mm dia and volumes less than 20 litres. The life expectancy of the Duplex material SAF 2205 alloy steel should be similar to a copper boiler.



**Dave Giles** Project Manager.

**IKON ENGINEERING DEVELOPMENT LTD**

Incorporating - IKON LOCOMOTIVE WORKS - Established 1980

Manufacturer of more than 50 steam locomotive Boilers to the AMBSC boiler codes Pt 1 and Pt 2 Ranging in volume from 10 litres up to 49 litres..

**In Memoriam**

*Les Merritt whose death was announced in the last edition with his 31/2" 'Black Five'. 1991*

*Thanks to Steve Reece for the photo.*

