Cryogenic treatment of Engines and parts.

Cryogenic treatment of machine parts is used to reduce friction and wear, and increase service life.

It has been used successfully in motorsport applications on a range of drivetrain components where these effects have been found to assist in extending part life from hours to many months.

Researchers have found that the effects of shallow cryogenic tempering (-110 degF) is minimal unless it is performed as part of the initial heat treat cycle. Heat treating is what gives steel it's hardness as well as it's toughness, wear resistance and ductility. Even performed properly, heat treating cannot remove all of the retained austenite (large unstable particles of carbon carbide) from a steel. Proper heat treating is a key part in increasing a part's toughness, durability, wear resistance, strength and Rockwell hardness.

The beneficial changes that occur as a result of the heat treat process do not actually take place during the heating, but rather from the cooling or "quenching" from the high temperature. The benefits of the quench do not stop at room temperature, as many alloys will continue to show significant improvements as the quench temperature nears absolute zero. While it is impossible to actually achieve –459.67 degF (a molecular zero movement state that eliminates all stress), deep cryogenic tempering temperatures are very efficient and cost effective in increasing dimensional stability, increasing wear resistance and performance of most alloys.

The main benefits are found in the treatment of steels, and inside most engines this includes the cylinder, piston ring and the entire crankshaft. To perform the ultimate test on all of these components, we even treated a complete engine. It was dyno tested before and after cryogenic treatment to see what performance gains could be found - if any !!

In this 'ultimate' test a standard Yamaha KT100S kart engine was used, and after a complete rebuild and normal running-in period, it was dyno tested to give an output as in the following chart named #AJS.101. For peace of mind the carby was removed from the engine before the all-in cryogenic treatment, and the crankshaft seals were replaced after the treatment. The treated engine was then dyno tested and the results obtained are named #AJS.111.

As can be seen from the results, the before and after versions of the engine produced near identical maximum HP at the same RPM's. However both below and above this peak, the engine showed an increase in power after treatment. There was also an increase in the peak torque after treatment.

Another test included is from Ian Williams own personal KT100S kart engine, used to place 3rd at the 2001 SA state championships (while still wearing a brace and recovering from a broken left ankle !!). The dyno output prior to any cryogenic treatment is #Grunt.041, and following the treatment of just the cylinder and the piston ring, the output is #Grunt.044.

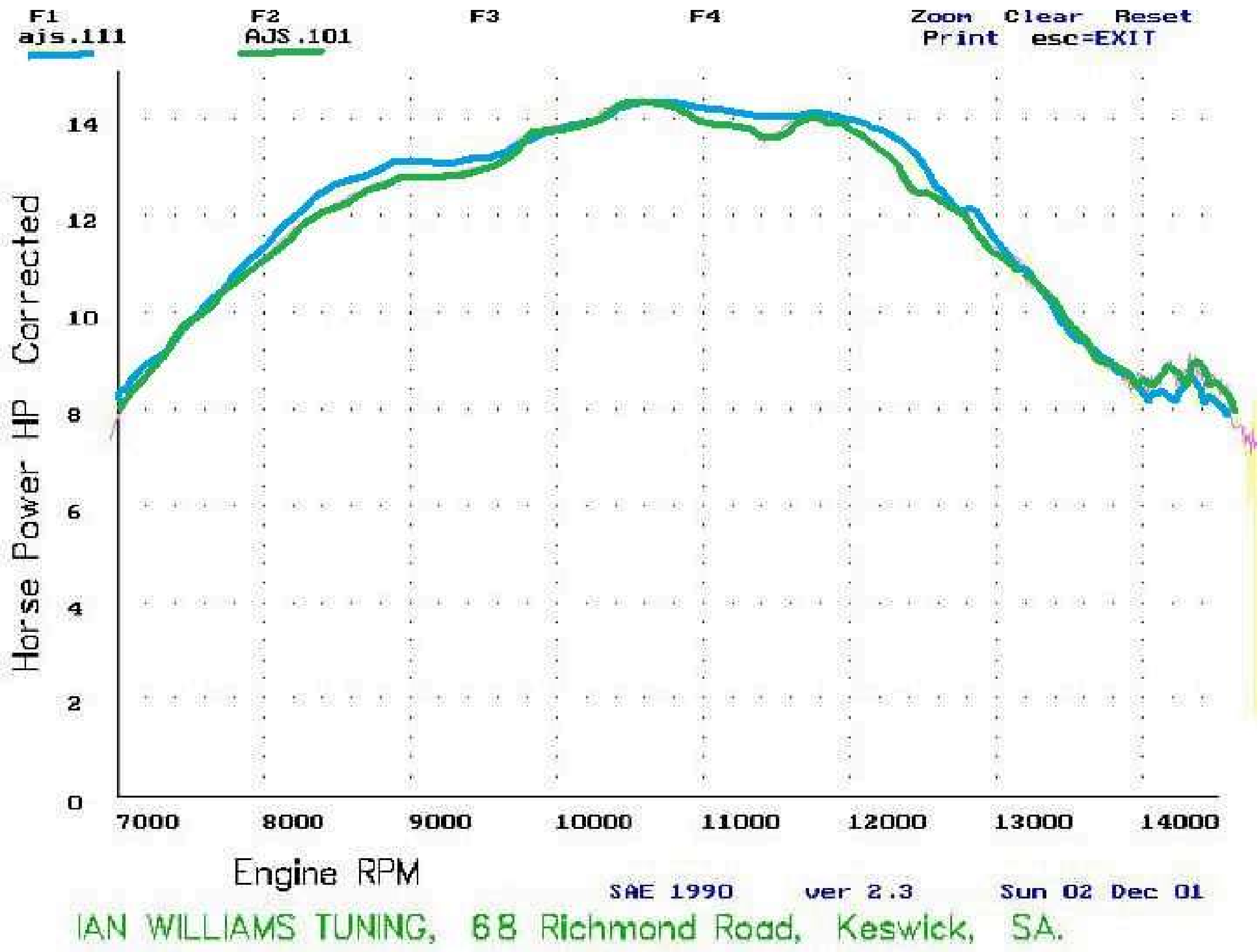
As can be seen, this gave a very dramatic increase in horsepower from 10,000 to 13,000 rpm, in the order of a third to a half horsepower all across this rpm range. The increase seen after cryogenic treatment has been consistent across all blueprinted kart engines.

Similar results have been gained with most 2 stroke engines, and we are now just starting to treat and test the various components of the 125cc Rotax Max kart engine - and so far the treatment of the cylinder and piston and ring has shown much improved component life, and a lap record at Mallala Motorsport Park in our home town for Brad Fox.

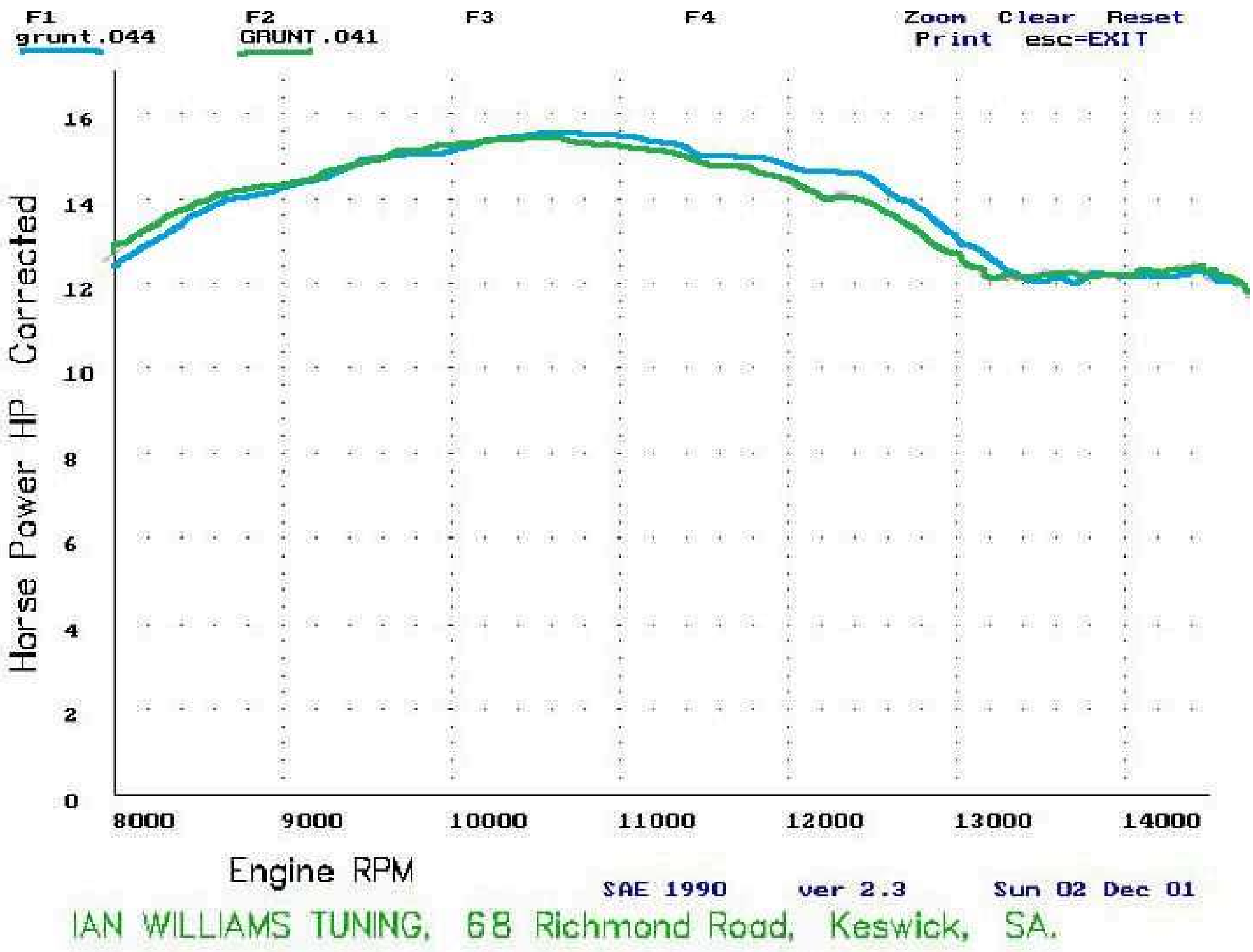
In 2020 we have continued development and testing with the cryogenic treatment, and now with more data logging capabilities we can see the changes in better detail. The FR125 Max Rotax engines are gaining 200 to 300rpm more on top end for the same application, which is not a lot but it is a very real gain on the track !!

We will have this service available right here in Adelaide again soon, so turnaround times will be much quicker.... and prices lower.

The dyno outputs from the stock KT100S as #AJS101 (green line) 'before' and #AJS111 (blue line) 'after' treatment.



Below are curves for a blueprinted KT100S as #Grunt041 (green line) 'before' and #Grunt044 (blue line) 'after' treatment.



Below is a table showing the horsepower of both engines at the same 200 rpm steps up through the rev range,
where the improvement is clearly evident in both the standard and blueprinted engines.

RPM	AJS101	AJS111	Grunt041	Grunt044	RPM	AJS101	AJS111	Grunt041	Grunt044
8000	11.16hp	11.40hp	12.69	12.42	11200	13.89	14.19	15.15	15.42
8200	11.72	11.99	13.33	12.99	11400	13.57	14.01	14.94	15.12
8400	12.08	12.43	13.79	13.51	11600	13.94	14.18	14.76	15.09
8600	12.43	12.71	14.04	13.91	11800	13.95	14.12	14.74	15.00
8800	12.67	13.03	14.23	14.11	12000	13.83	13.95	14.38	14.76
9000	12.81	13.12	14.35	14.27	12200	13.38	13.76	14.07	14.72
9200	12.74	13.07	14.51	14.49	12400	12.49	13.20	14.05	14.52
9400	12.95	13.15	14.84	14.78	12600	12.39	12.44	13.62	14.18
9600	13.16	13.27	15.00	14.96	12800	12.08	12.21	13.10	13.58
9800	13.68	13.6	15.10	15.08	13000	11.38	11.53	12.71	13.16
10000	13.84	13.79	15.28	15.13	13200	10.73	11.11	12.16	12.51
10200	13.87	13.89	15.36	15.29	13400	10.23	10.17	12.15	12.09
10400	14.29	14.17	15.42	15.52	13600	9.35	9.47	12.23	12.13
10600	14.39	14.38	15.42	15.58	13800	8.75	8.83	12.28	12.10
10800	14.22	14.33	15.34	15.61	14000	8.58	8.03	12.23	12.20
11000	14.03	14.24	15.23	15.51					