

# SASMEE Locomotive Efficiency Trials Day 2005

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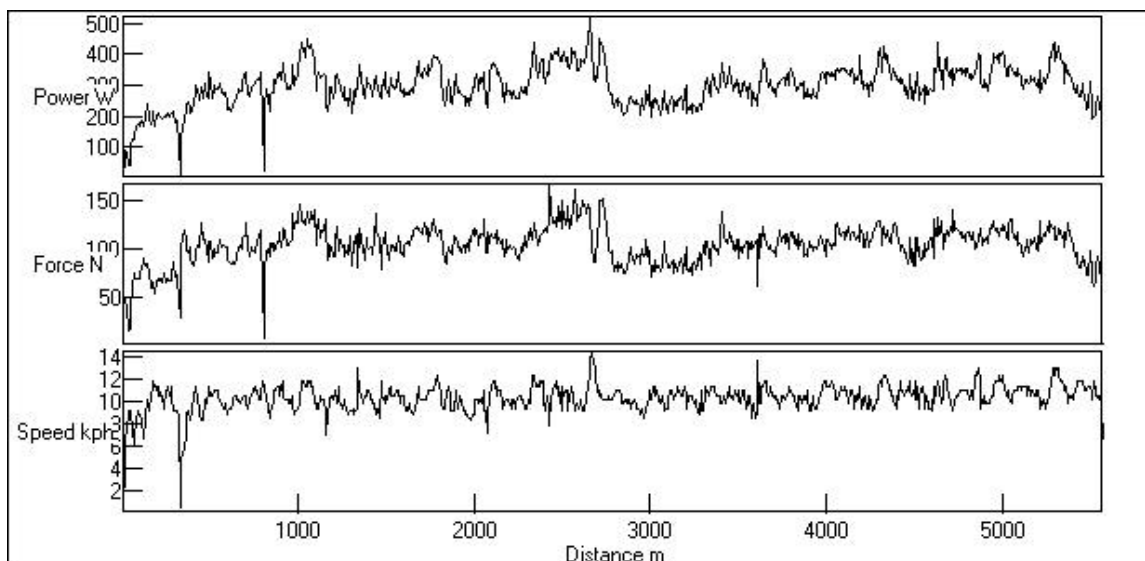
On 27/8/2005 we ran the third SASMEE steam locomotive efficiency trial. Engines haul a train of the driver's choosing for about 30 minutes. A computerised dynamometer car records the work done at the drawbar and the coal consumed is carefully measured. The overall thermal efficiency is the proportion of useful work done at the drawbar, relative to the energy released by the coal.

The dynamometer car, built by John Lyas and myself, is a close 5" gauge replica of the prototype in its early livery. Internally, it is very modern. The front drawbar is linked to an electronic load cell, and the wheels drive a DC tachometer and an optical revolution counter. A box of electronics conditions the signals, converts them to digital format, and transmits them to a laptop computer carried on a conventional passenger truck behind the car.

The laptop computer displays a scrolling "paper" chart, like the original instrument table, but it reads data every second and stores the information on disk for subsequent display or printing.

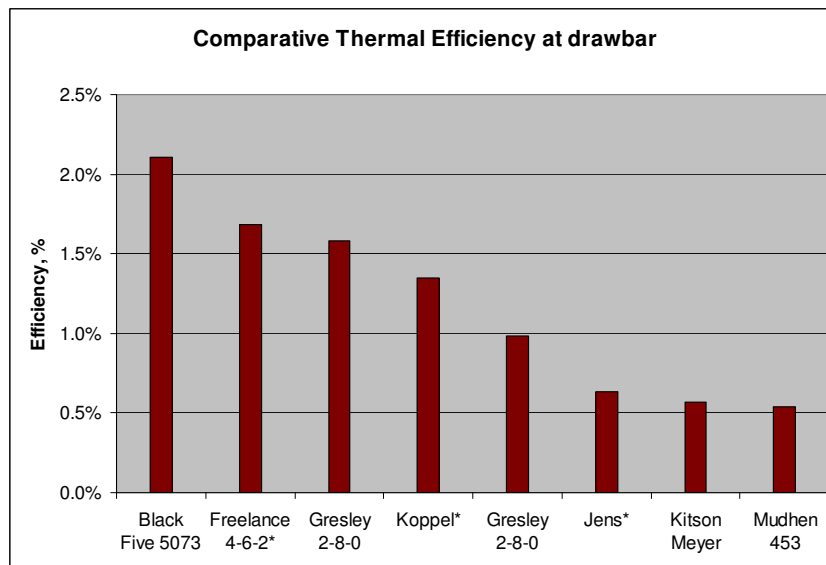
A full technical description of the dynamometer car, and the detailed results from the last three years of trials, can be downloaded from my website, at [www.avocetconsulting.com.au/modeleng](http://www.avocetconsulting.com.au/modeleng).

Figure 1 is a typical display.



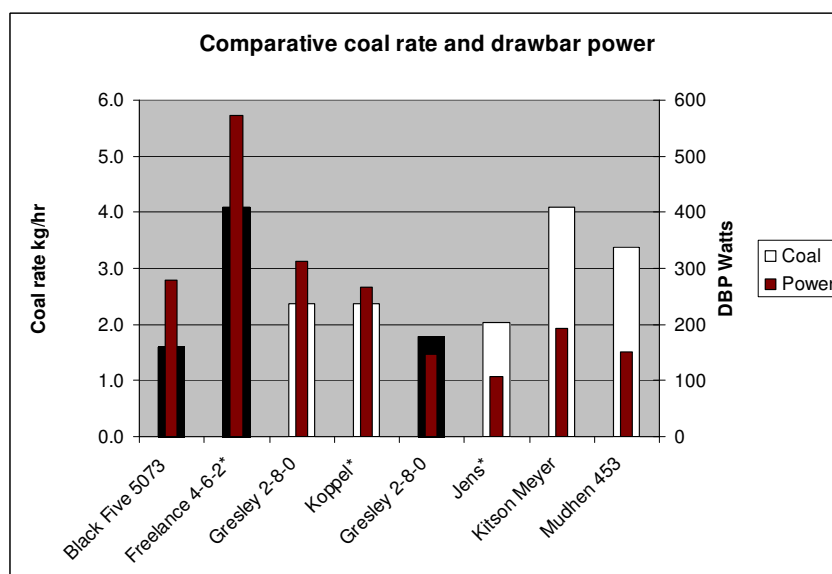
**Figure 1 Chart from Black Five 5073**

Figure 2 shows the relative thermal efficiencies in rank order. Locomotives marked with an asterisk (\*) are 7.25" gauge, otherwise they are 5" gauge.



**Figure 2 Efficiencies**

Figure 3 breaks the efficiency into its two components for each engine, where drawbar power is the Output, and coal rate is a measure of Input.



**Figure 3 Coal rate and average drawbar power**

Figure 4 provides tabular data for the day.

Owner/Driver	Loco.	Wheels	Time	Distance	Av Speed	Coal Rate	Av DB Power	Efficiency
	(* = 7.25" g, else 5" g)		Min	metres	kph	kg/hr	Watts	
Allan Wallace	Black Five 5073	4-6-0	34.6	5572	9.7	1.6	280	2.1%
Ian Thomas	Freelance 4-6-2*	4-6-2	31.6	5346	10.2	4.1	573	1.7%
Bryan Homann	Gresley 2-8-0	2-8-0	31.4	5564	10.6	2.4	312	1.6%
Bob Nash/Glen	Koppel*	0-6-0	30.6	4268	8.4	2.4	267	1.3%
Peter Homann	Gresley 2-8-0	2-8-0	30.3	5248	10.4	1.8	146	1.0%
Bill Coles	Jens*	0-4-0	31.8	4592	8.7	2.0	108	0.6%
Graeme Driscoll	Kitson Meyer	0-6-0+0-6-	31.3	3936	7.5	4.1	193	0.6%
Peter Hoye	Mudhen 453	2-8-2	31.5	4260	8.1	3.4	152	0.5%

**Figure 4 Results table**

One message from these results is that the engines that work harder also achieve the higher efficiencies. An excellent illustration is provided by Bryan Homann's Gresley, which did two trials at two levels of power output. Increasing the mean drawbar power from 146 to 312 watts increased the efficiency from 1.0 to 1.6%. This is consistent with measurements on Barry Dunstan's Dolgotch, which in the previous two years returned 0.8% at 190 watts, and 1.7% at 290 watts. It seems likely that most engines would return over 1% if they were worked harder. Black Five had a relatively light train but the brakes were dragged to create more load.

The prize for the most spectacular run must surely go to Ian Thomas and his large Pacific, which hauled a very heavy train including a "dead" diesel locomotive. The drawbar power peaked at over 1100 watts (1.5 horsepower) and the sound was magnificent.

To my humble embarrassment (and delight), my new Black Five was the winner this year, and as usual I provide a few technical details. I started building 5073 four years ago and spent about 1000 hours in the workshop. It is based on Don Young's design for the British class 5MT, with a few ideas borrowed from LBSC's "Doris" which I built in my twenties. The cylinders are bronze and fitted with plain bobbin type stainless steel piston valves. The main piston seals are Oring-energised PTFE rings. Needle rollers are used on all axles, and the boiler has the maximum superheat possible with four coaxial radiant elements in thin wall stainless steel tubes. Boiler feed is provided by an axle pump and one injector, which I use only rarely. The grate has 2mm gaps and 3.2 mm bars, giving an open area of 39%. There is no arch in the firebox. I think that its success is partly due to being driven at very short cutoff: the regulator was fully open and the expansion gear notched back until the engine would not quite slip at full boiler pressure.



**Figure 5 Black Five 5073 with the Dynamometer Car**

Thanks to the committee, the helpers and the drivers for helping make this an enjoyable and instructive day.