Micro Steam Turbine Car

Friday 2 Jan 2004

In 2003 I purchased a steam car kit at the annual Science Festival in Grahamstown, South Africa. This kit is produced by *The S.A. Institution of Mechanical Engineering* and *The University of Natal*.

The kit is a complete set of sheet metal parts, tubing, wheels etc and even some tools. Tools required are listed as 'kitchen scissors and pliers' though I recommend some nice tin snips, a hammer, a steel anvil block (I used an offcut of BMS) and an electric soldering iron.

Skills required are rudimentary, though following the instructions is a must. The better one follows the instructions and the more one attempts to produce good, neat and accurate work, the better the car will look and run.

This kit is aimed at school children as a means to encourage mechanical and scientific study in a practical way, however I found it a pleasant few hours work to assemble and it is fun to run too and it now stands on my mantlepiece. I will be converting mine to run on 5" gauge track since I'm really a railway nut at heart.

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The kit arrives very neatly packed. The plastic bag contains everything but the largest sheet metal plates, and the cooldrink can which will not fit. The cooldrink can supplied is empty but sealed, though the instructions do mention 'drinking the contents' after making the holes for the safety valve and the impulse jet pipes.

The sheet metal is donated by a packaging company and I guess must be rejects from the printing line, though I could not see any obvious faults.

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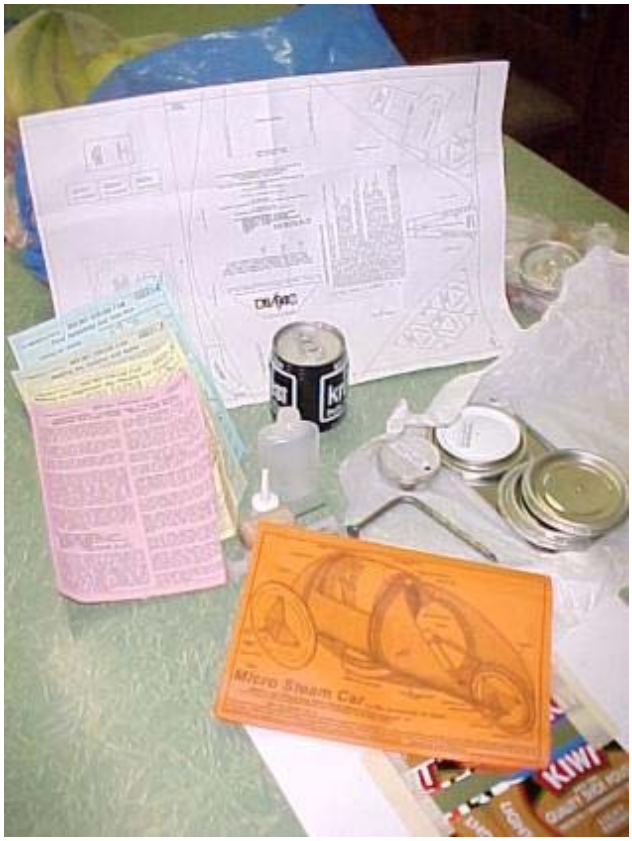

Partially unpacked one finds a number of interesting things, including the 4 sheets of instructions, a number of paint or oil tin lids, the full size template for the body and other sheet parts.

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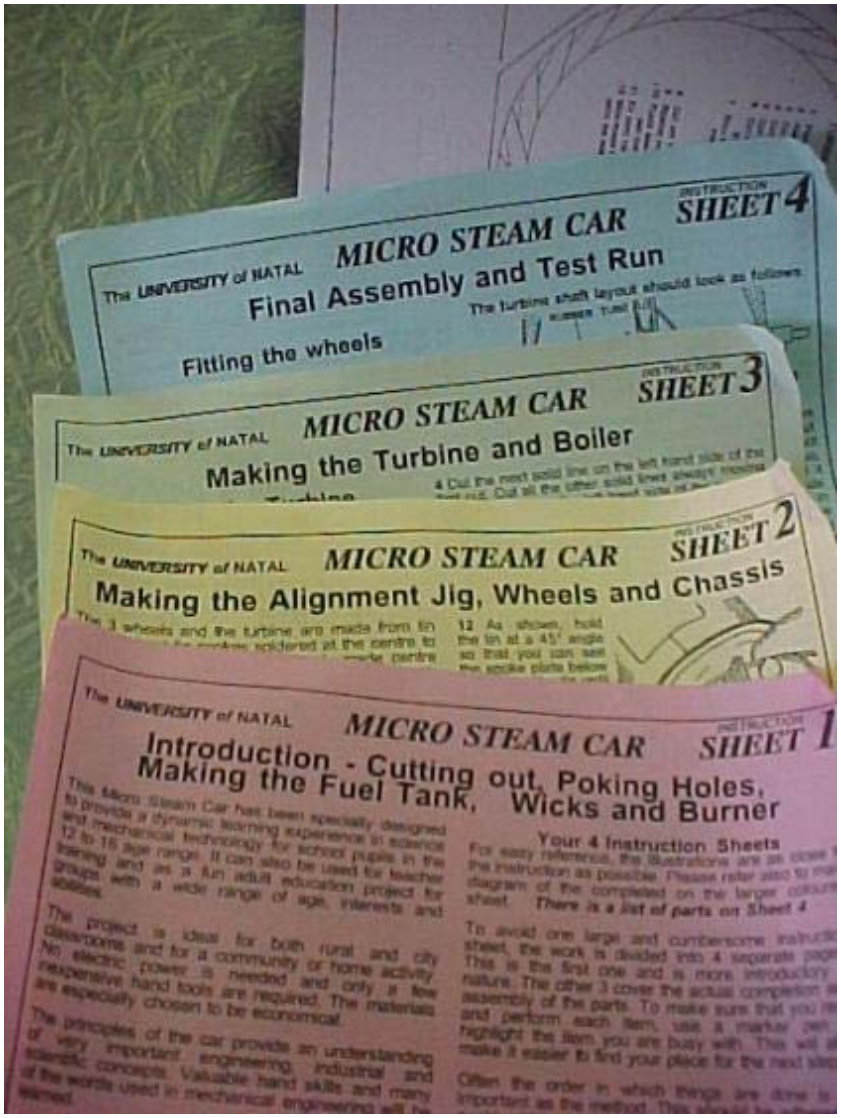

The instruction sheets are very well laid out with clear prose. It is as well to read through all of them before starting as I found a mention on the last page about not permanently assembling the body to make possible repairs in the future. This was too late for me though, since I elected to solder the body instead of using the wire provided to bind it together. It is much neater, and much stiffer, but very permanent.

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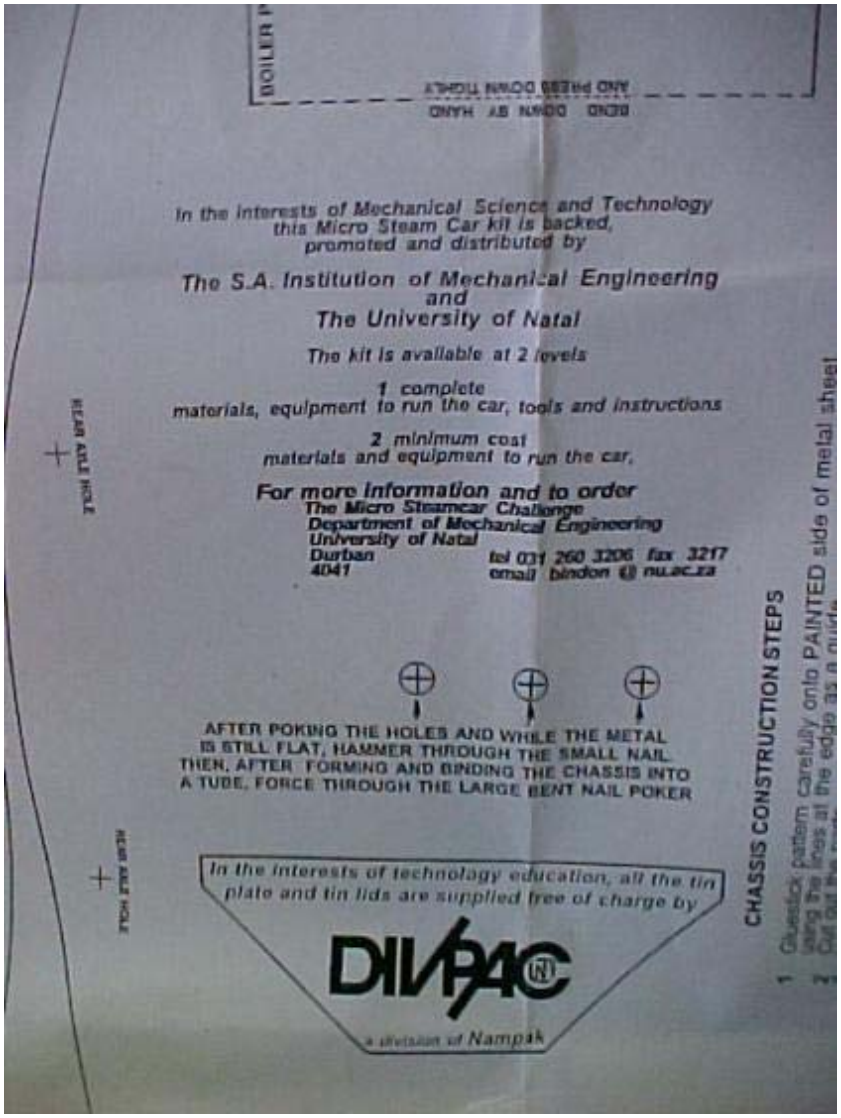

Part of the full size template for the body plate. This sheet is glued to the big metal plate and one simply follows the cutting lines, punch through on all the + markings with the awl provided, then roll it around a 50mm diameter 'something' to form the basic body. Though the instructions mention using kitchen scissors to cut this plate (in fact the listed tools needed are the scissors and a pair of pliers, and that is all. I guess one could build it with just those tools, but it is much easier to do it with a few more tools, notably the geared tin snips I used).

Last edited January 02 2004 10:58:48.

More unpacked parts. Top left is the water filling bottle, below that the awl made from a bicycle spoke and section of dowel, the fuel filling syringe, the smaller bag of parts, to the right of the the big bent nail for enlarging the burner holes, the burner fuel tank.

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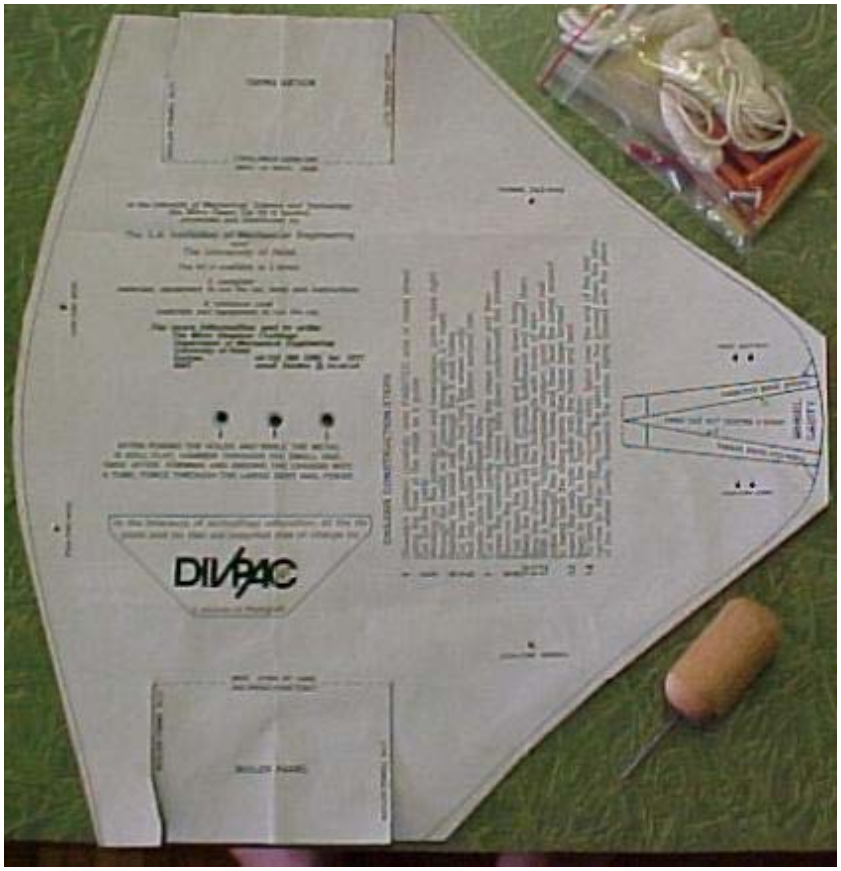
The collection of lids used for wheels etc. When I first unpacked it all I was confused by the 2 extra lids which later turned out to be for the wheel soldering jig. This is made by wrapping a strip of steel around the 2 lids to form a cylinder. This is held together by a sticky label. One of the axles is placed through the holes, the wheel on top, then the spoke plate on top of that. The cylinder ensures that the axle is perpendicular to the wheel surface, so that when the spoke plate is soldered on the wheel does not wobble. Well that's the theory anyway. I managed to get the turbine to wobble and will have to redo it sometime to get it to balance better.

Last edited February 16 2009 08:48:07.



The body sheet cut out, holes punched. The 3 burner holes will later be enlarged to clear the burners, and the V at the right end will be cut after bending and fixing to the bulkheads. Cutting it now would make wrapping it around the bulkheads and getting an even curve very difficult.

Last edited January 02 2004 11:14:00.

The small bag of parts. These include the syringe needle for fueling, various bits of rubber tube, the plastic tubes for the burners, the wick material (they claim it is a strand from a floor mop, a bit of string to make a lighter and the various sticky labels used for temporary workholding on the bulkhead assemblies.

Last edited January 02 2004 11:16:12.

After a pleasant hour's cutting with my geared tin snips I have a pile of scraps and 4 spoke plates (the triangular bits), the turbine blade wheel, and the body plate at left.

Last edited November 07 2004 21:49:02.

Making the burner is very simple as the burner fuel tank is already punched for the burner tubes. There are 3 holes, but 2 are covered with a sticker. The orange drinking straw tubes are covered with rectangles of the heavy aluminum foil. The mop string has 4 sub strings, but only 3 will fit so one must be removed.

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The initial stage of the burner completed. I have made all 3 burner tubes, and fitted one to the tank. The instructions say to do this, but only later does it become apparent that this is so that one can do the soldering with the single burner. Hence my ealrier mention of reading all the instructions first so one has an overview of what is planned.

Last edited January 02 2004 11:21:52.

A closeup of a spoke plate and the front wheel. The plate is bent as indicated then soldered to the lid using the jig previously described.

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The 3 main wheels. The one on the left was soldered using the meths burner and though it worked I felt that an electric soldering iron would be quicker and neater and MUCH less frustrating, so the other wheels are done using a 40 watt iron.

The lids all being new they tinned very easily and most of the work was done without prior tinning with the solder. The solder supplied, about 2mm thick, flows very nicely indeed.

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The completed body. Sadly I didn't think to image the bulkheads before I fitted them in the body. They are made from the 2 lids indicated earlier, and 2 strips of sheet steel about 2cm wide. These strips are wrapped around the lids and soldered in place to form collars that make it much easier to position the bulkheads in the body. The instructions say to wrap 2 pieces of wire around the body at each bulkhead and tighten with pliers. I did that with a single peice of wire only to hold the lot in place while I soldered the bulkheads in place as you can see here. The rear bulkhead has the hole in it so one can reach the burners to light them.

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A closeup of the soldered in rear bulkhead. You can also see the enlarged burner holes with the edges beaten down. Not necessary, but nicer.

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The front end bulkhead soldered in and showing the various axle holes. The top ones are for the turbine, whiel the bottom left set are for the front wheel. The plans show 4 holes which I guess for allowing some adjustment for different length rubber bands. I used the front holes and it works fine.

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The business end of the boiler. The cooldrink can is supplied empty and a little paper template

aids in placing the holes on the edge. The copper tubes are supplied drilled etc so very little work is required here. The cross drilled hole is the filler and safety valve. A small section of rubber tube is slipped over the hole to provide a safety release. The turbine nozzle (longer tube) is formed by placing a wire of the correct size in the end and crushing the copper in a vice. This has been done very neatly and works perfectly. For competition one might want to adjust the nozzle size to improve speed or efficiency, but for my purposes this one is just fine.

The can is actually steel and soldered very easily.

Last edited November 07 2004 21:51:12.

Again I omitted to take some photos of the turbine parts before assembling it. However, here you can see the turbine blades. The turbine is made in 3 parts, a can lid with a spoke plate to keep it straight on the shaft, and the blade disk. This disk is carefully cut out and each blade bent aroudn a nail. Then it is offered up to the lid and the blades regularized. The instructions don't specify exactly how the 2 are supposed to stay together besides being held by the rubber tubes on the axle, so I soldered it all together and did some rudimentary balancing with the solder too. I'll have to revisit the balancing though as it is not quite right.

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The other side of the turbine wheel.

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The completed car just before the first run. The wheels are fitted and held in place by slipping short bits of rubber tube over the axles. The burner is held in place by a long strip of metal that hooks in just behind the front wheel and hooks over the rear axle. This can be removed so that the wicks can be serviced.

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The first lighting up! A nice even burn from all 3 wicks and boil was achieved in about 3 minutes.

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There she goes! By not using the flash I managed to get the camera to capture the motion of the turbine and front wheel. You can see the safety valve at top left. I pointed the nozzle to the right side of the turbine wheel so that steam entering each blade is turned around to the left, giving (I hope) maximum energy transfer with minimum interference. The single peice of wire around the body holds the boiler in place.

I feel that the whole is much neater for having soldered the body together, otherwise there would be 3 bits of wire there, with attendant sharp ends.

I've been trying to think of a way to measure the RPM of this rig. The gear ratio is about 20 to 1 (rivet is about 3mm dia, front wheel is about 60mm. The turbine whines at about 4000 hertz at a guess. It goes too fast for my cycle speedos to measure. My 2nd idea is to use my computer to record the sound and then us a FFT analysis to find that frequency, then divide by the number of blades on the turbine. I'll fiddle around with it sometime and see.

Of course, now that it is built, I'm thinking of adapting it to 5" gauge rail usage. I'm figuring to get some more paint tin lids of the same size as used in the soldering jig, and mount them front and back. I suspect I'll need another stage of reduction to the drive wheels, and I'll need to adjust the front axle height anyway to keep it all level so this might accomodate the reduction stage at the same time. The paint tin lids have a pretty good approximation of a wheel tread and flange combination.

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For more information and to order kits.... (note that I, the web page creator, am not involved in this project other than as a satisfied builder)

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As thy days, so shall thy strength be
Deuteronomy 33:25

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