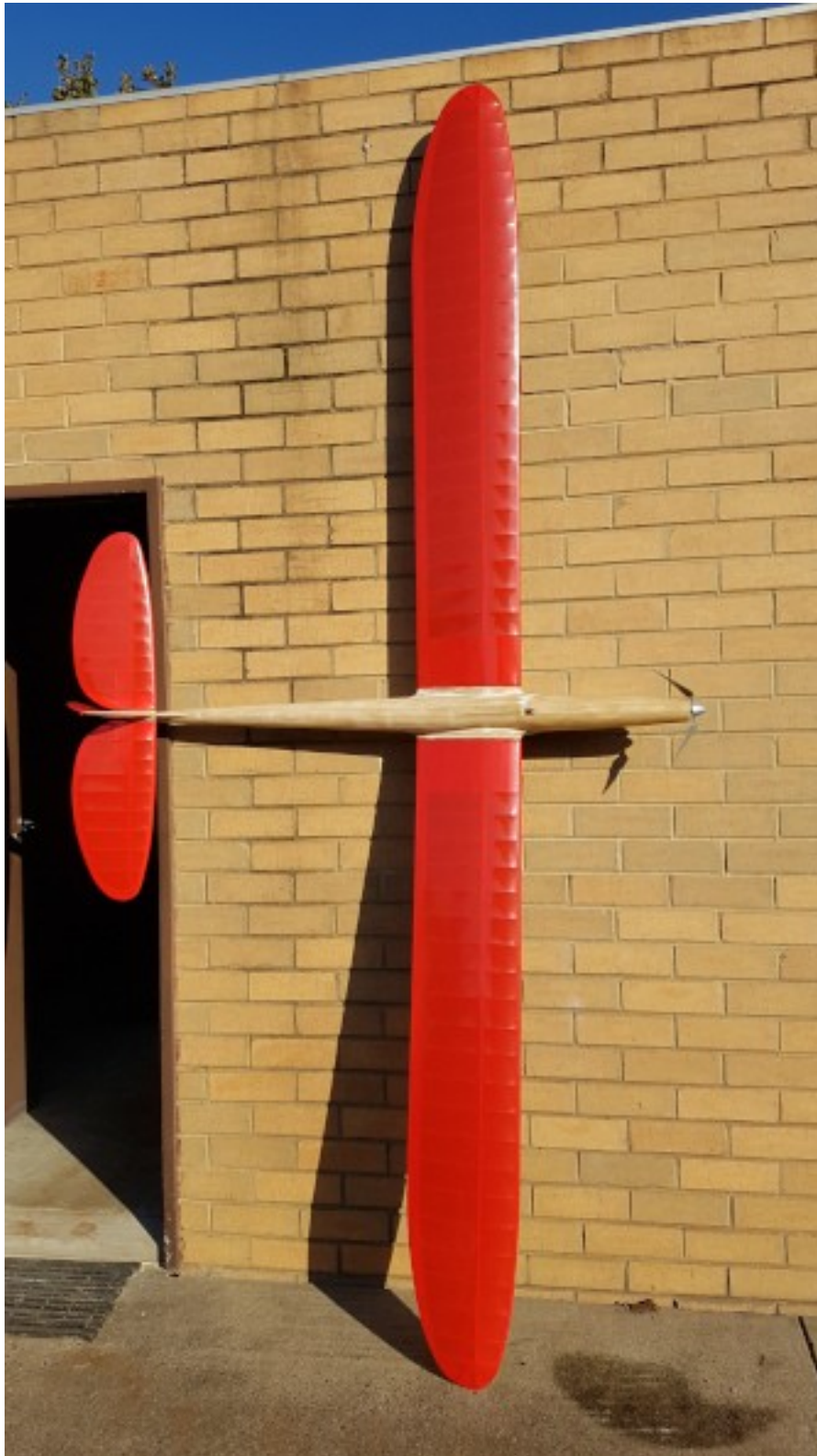# K40 Laser Cutter and the 1947 AM40 Powered Glider

December 2020

K40 Laser Cutter and the 1947 AM40 Powered Glider

On contacting my friend Tiziano Bortolai Secretary SAM-62 Italia, about a powered glider I saw in their language News Letter, He told me that the plan was available online at Outerzone and was designed by Aldo Montanari in 1947 for a 40 motor and a span was 3.5m, I decided to scale down to 3.0m considering my transport situation.

One of the difficulty of construction was cutting out the 18 different oval body formers from 1.5 ply.
For some time I have been interested in Laser Cutters. And this powered glider project provided me with the excuse to purchase of a Chinese k40 Laser cutter.

The Cutter
To give some idea of the items involved, including some extra items listed below:-
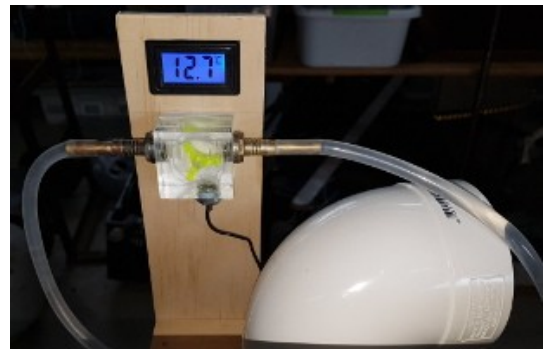
K40 40W CO2 Engraving Machine
$550.00 AU including delivery.
Ebay here

Added Water Cooling 3 Way Flow Meter and Digital thermometer to give a physical indication of water flow and temperature at a cost of under $20.00 AU
Ebay here

Some sort of alternate **Fume Extraction** system is needed because the one provided, was not, in my estimation powerful enough, I used an old Dyson Vacuum cleaner and a viable motor controller, 90mm storm water fittings, together with 90mm flexible domestic ducting and placed close the exit point to outside.

Addition of an **Air Assist** nozzle (read air blast to reduce the burn marks), which I 3d printed from www.thingiverse.com, and some sort of compressor to supply the air at a very low pressure.

Some other things to consider are :-
- Water Cooler and Additives.
- The installation of a mA meter (not provided in my buy).
- Checking wiring for good connections and proper earthing
- Making an height adjustable bed.

General layout of equipment. My cutter is driven by a LapTop using software called "K40 Whisperer see description here".

I chose to design the shapes in "Inkscape about here", a professional quality vector graphics software which runs on Linux, Mac OS X and Windows desktop computers, and the output is saved to the computer in the format .SVG file, and processed by K40 Whisperer and fed to the cutter via a USB link.

It was a steep learning curve and took time to learn, and there are plenty of tutes on YouTube to help.

Nov. 2022 update
The "free Inkscape" and "K40 Whisperer" Software, have been replaced by a commercial software product called "Lightburn" which talks directly to the laser, without the use of additional S/W Inkscape interface.
Lightburn enables the design complex shapes and has library facility's for different Materials and Artwork.

Here are the former's I have cut for the AM-40, they are going to be assembled on a mandrel which can be withdrawn later.

On the far left are the corrugated cardboard cutouts to check the final cuts in plywood.

he air extraction unit that came with the cutter was used to cool the small air compressor, and a new, better fitting air extraction duct was fitted to the rear of the machine. --->

Air extraction is a very important part of the system as some of the plywood glues give off nasty fumes on burning, that need to be extracted to the out side.
I made the exhaust chamber from chip board and 90mm storm water fittings.
The new chamber was screwed to the back of the machine with a soft gasket.

General layout showing:----->
L/top Laptop and
R/top right K40 Cutter.

B/left, Small air compressor in ventilated foam box
B/centre plastic bin for Cooling Water and water pump and
B/right Air supply unit.

Because I was only working from a small plan, and the expectation that large blow ups would not be relied on, I digitised the 18 former dimensions and put them into a LibreOffice Calc spread sheet, part of which is shown below…

AM-40 powered glider formers for 3000mm w/s Scale▸ 1.5625

F	#	t	T	h	H	w	W	R	hd	Hd	hdd	Hdd	wd	Wd	wdd	Wdd
1	↔	47.00	73.44	63.00	101.44	35.84	56.00	28.00	26.00	40.63	42.00	65.63	30.00	46.88	18.00	28.13
2	↔	60.00	93.75	78.50	125.78	41.00	64.06	32.03	33.00	51.56	52.00	81.25	35.00	54.69	21.50	33.59
3	↔	70.00	109.38	92.50	145.31	46.00	71.88	35.94	39.00	60.94	62.00	96.88	40.00	62.50	25.00	39.06
4	↔	77.00	120.31	102.00	160.94	52.00	81.25	40.63	43.00	67.19	68.00	106.25	44.00	68.75	27.00	42.19
5*	↔	80.00	125.00	105.00	167.58	54.50	85.16	42.58	44.00	68.75	70.00	109.38	46.00	71.88	28.00	43.75
6*	↔	78.00	121.88	106.00	166.41	57.00	89.06	44.53	44.00	68.75	70.00	109.38	47.00	73.44	29.00	45.31
7*	↔	75.50	117.97	103.00	162.50	57.00	89.06	44.53	43.00	67.19	66.50	103.91	48.00	75.00	29.00	45.31
8*	↔	70.00	109.38	96.50	153.52	56.50	88.28	44.14	41.00	64.06	62.00	96.88	47.00	73.44	28.00	43.75
9*	9	65.50	102.34	90.00	144.53	54.00	84.38	42.19	38.00	59.38	58.00	90.63	45.00	70.31	27.00	42.19

and then made a spreadsheet chart of the 6 important points of each former so that interactively I could make small alterations to the data to smooth the curves see next page.
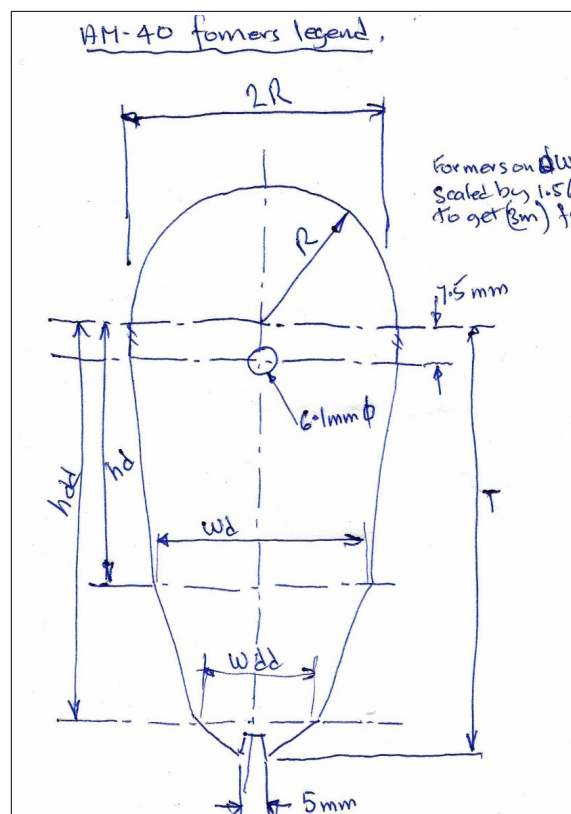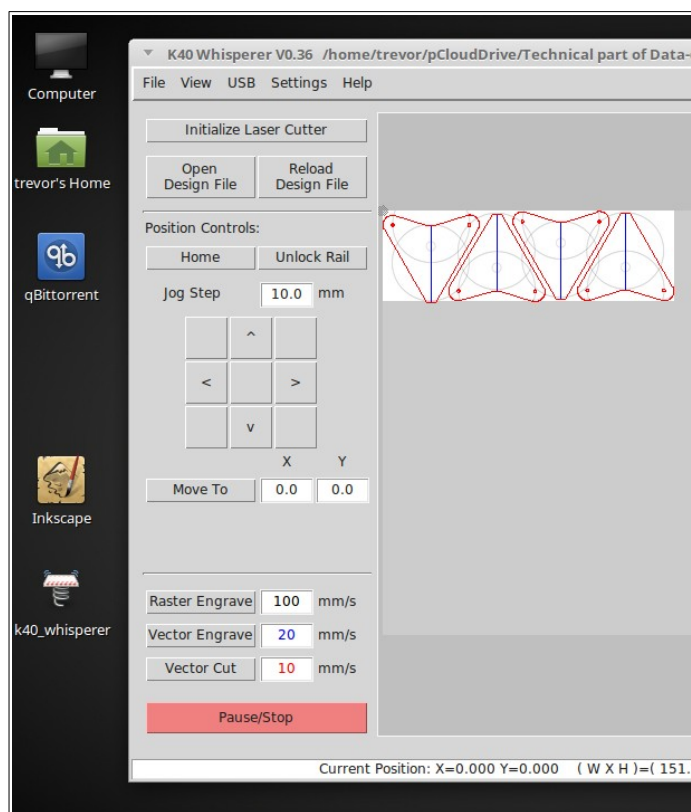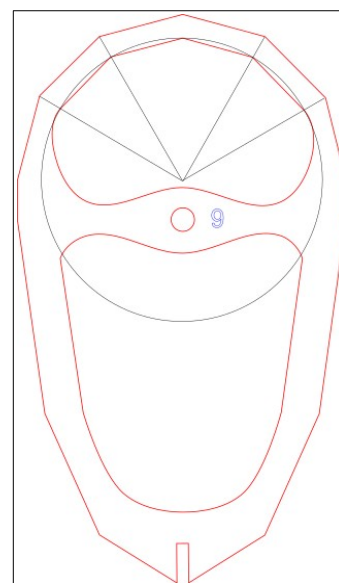
Here is the legend for the digitised data---->

Finished Calc Chart showing the smoothed contour lines:-
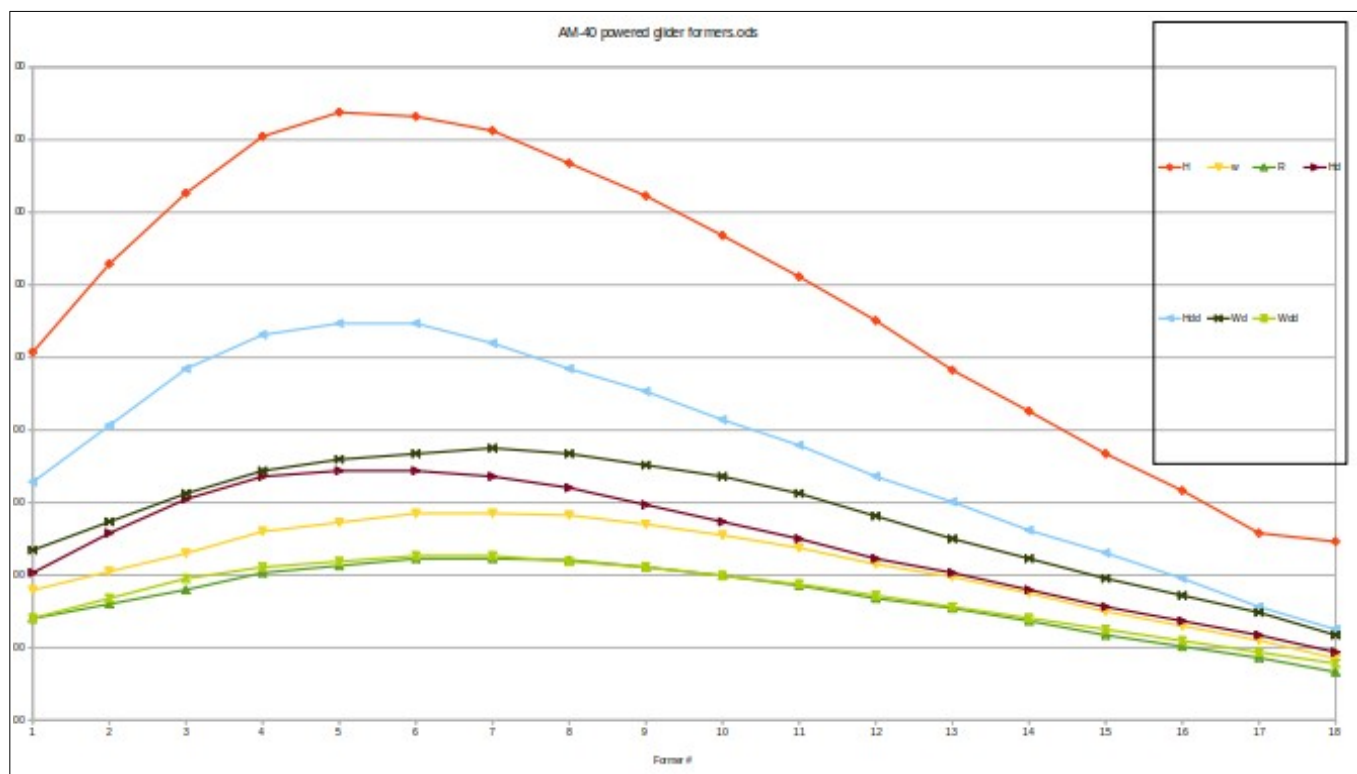
Here is is a copy of the .SVG file for former #9 (Hoop Pine Ply), as generated in Inkscape.
The blue lines Vector Engrave (VE) and is set at 0.05mm wide, and the Red lines are Vector Cut (VC) and are set at 0.20mm wide.

<--Here is a screen shot of the K40 Whisperer Software, for the 4 control horns, showing the control options ie:-

- Jog button in x and y directions to your start position, jog travel is changeable.
- Control over the 3 modes in mm/sec The Laser % Power is made on the the actual cutter.

Screen Shots – Lightburn S/W - Layout of Cuts and Materials Library's

Cuts / Layers

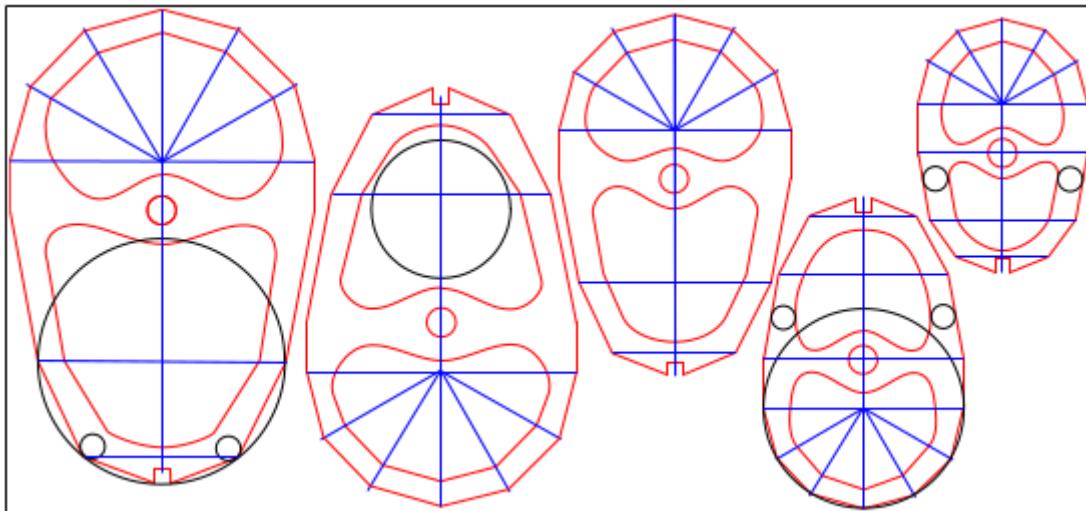| #	Layer	Mode	Spd/Pwr	Output	S
Former Cut O/S	02	Line ▾	10.0 / 80.0	▣	
Hole 6mm	03	Line ▾	10.0 / 80.0	▣	
Former Cut I/S	05	Line ▾	10.0 / 80.0	▣	

Library

K40 Materials Library

- ▾ Balsa
  - ▸ 1.60mm
- ▸ Baltic Birch
- ▸ Card Board Grey
- ▾ Cardboard Corragated
  - ▾ 2.00mm
    - ⬠ Former Cut
    - ⬠ Former Guides
- ▸ Markout on paper
- ▾ Ply Hoop Pine
  - ▾ 1.60mm
    - ⬠ Former Cut 15%_copy
    - ⬠ Former Guides 15%
  - ▾ 3.00mm
    - ⬠ Former Cut
    - ⬠ Former Guides
- ▸ Ply Hoop Pine 15%

Material

- Assign
- Link
- Create new from layer
- Edit Cut
- Edit Desc
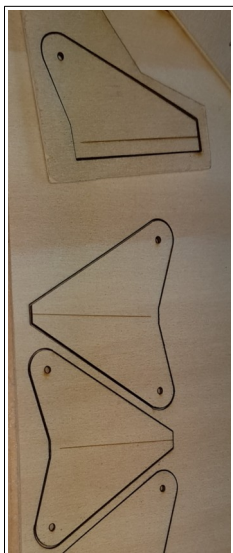- Duplicate
- Delete

Library

Below shows the layout for multiple cute in 1.6mm Hoop Pine to minimise wastage.

Regarding the cutting of the 48 x 2.5mm balsa ribs, I was pleasantly surprised by the accuracy and the minimum of burn marks on the edges

Once again savings on wastage can be made by making a mirror image and putting multiple images to suit the sheet width.--->

I was able to cut some nice control horns complete with 1.5mm hole for clevis. <---

The picture on the right shows file wall #1 1.5mmx2 and the motor mounts 1.5mmx3, also shows the complexity of the airways cuts made possible with the laser without distressing the ply too much..

And below are the body formers on the mandrill in a more advanced stage

Here are some of the settings I used for Vector Cutting and Engraving, different materials

Material	Ve (mm/sec) %power	Vc mm/sec %power
1.6mm Plywood	20 @ 9%	8 @ 40%
1.60mm Hoop Ply	20 @ 9%	8 @ 20%
2.00mm Corrugated Cardboard	40 @ 10%	10 @ 20%
1.80mm Corrugated Cardboard	40 @ 9%	10 @ 20%
0.30mm Card Stock	70 @ 8%	40 @ 9%
2.50mm Balsa	50 @ 9%	40 @ 20%
3.00mm Ply	40 @ 9%	8 @ 25%

It was a big task and a steep learning curve, but for me, it worked well.

Trevor Boundy Dec 2020

Reference Links:-

K40 Whisperer Manual

Adding-a-Analog-Milliamp-for-Your-Laser-Cutter
Using alternative software to control the laser cutter (Scorchworks Whisperer)
PC Water Cooling Cooler 3 Way Flow Meter w/ Digital Thermometer G1/4 Fitting
K40 Chinese Laser Cutter - Setup and Usage
Buyers guide to the Chinese K40 laser cutter