Russ Sadler's Video journey trying to learn about Chinese laser Cutting Technology

Introduction

This technically is a video diary of my mistakes and successes as I gradually come to terms with the mysteries of owning one of this little Chinese dragons. It seems illogical that a diary should have an index. That is something done by historians (after my passing) who have too much time on their hands waiting for history to happen!!!

However, after being put into a pschycological headlock, I have relented and with the help of Gene Uselman who has carefully created the skeleton of this index, I have added pertinent bullet points to each video to help others find elements of interest.

This bullet point index has been made a year into my learning journey when I am older and wiser. It must be remembered at all times that this is a video record of me learning about a technology that is very poorly documented and in my naivety I make (what I can now see as) lots of silly mistakes. Where it is appropriate, I warn of my error BUT in the spirit of leaving the work as an unedited record of discovery I leave you to watch ahead to that point where I begin to realize and correct those errors
Thanks for your interest.
Russ July 2016

Chinese laser cutter tutorial

part 1... Intro and unpacking machine

https://youtu.be/YvrMeUUzaBo

- Introduction to the machine
- A look at what you get for your money
- The DIY water tank
- Tour of the machine
- A look at the engineering quality
- Doubts about the aluminium table

part 2... laser theory

https://www.youtube.com/watch?v=zF9nQHlvGkc

- Laser light theory
- Laser head description
- Laser focus point
- Absorptivity table for metals
- 3 main cutting mechanisms with the laser
- Hazardous fumes from cutting plastics and some woods
- Warning about VERY high voltage

part 3... Load RDworks

https://www.youtube.com/watch?v=SGD8BPZntxY

- Loading RDWorks
- Useless stuff on the CD.
- Not the latest version of RDWorks That can be found at http://en.rd-acs.com/down_complex.aspx?FId=n14:14:14
- But a better source for a good stable well tried version with added items in the cutting parameter library can be found at http://www.thunderlaser.com/laser-download Download at least items 1,3 and 4
- Install the USB driver but put a USB stick into a USB port first or it may complain (in Chinese that you wont understand). THEN press install to load RDWorks.
- Configuring your work area to match your table size
- Quick first look at drawing a figure
- Use of Control key.
- Simple use of coordinates to align objects
- Quick look at layers and cutting parameters
- Cutting power…you are witnessing my ignorance. DO NOT FOLLOW IT. Set your max/min power at 60% /60%
- UNTICK THROUGH POWER.
- Layer order.. regardless of order, SCAN always takes precedence over cut layers

part 4... Early pin bed and laser setup

https://www.youtube.com/watch?v=fA1jM9hTk6s

- Nail bed mark1
- Fitting the water pump and tubing
- Powering up the machine in stages
- Using the focusing tool
- Red dot pointer
- Finding out where machine 0,0 is
- First test pulse
- Seeing the invisible laser beam
- First power down

part 5... cut, engrave tests, Display panel

https://www.youtube.com/watch?v=Zcze9B0BmpA

- Dangerous materials you should not cut
- Places to go and find out about plastic materials
- Loading your first test program
- On machine parameter editing
- Exploring the machine keyboard
- Running first test program
- The effect of air assist……not a good idea to turn off air assist as there will be a chance of fogging the lens.
- Note I am using 80 and 85% power BAD NEWS. I should not be using more than 60%
- Why you need to set the focus correctly.

part 6... Focus guage and early mode burn depth tests

https://www.youtube.com/watch?v=ybnT3lECAqs

- Making a focus setting gauge
- Testing beam power and size of beam with different focus distances in a block of acrylic
- Depth of cut tests with different speeds and no air assist (not recommended as there is a risk of fogging the lens)
- Depth of cut tests with different air assist pressures
- Beam penetration results (more air assist pressure=shallower cut) True for acrylic but not all materials
- In my ignorance I mention using 100% power. I didn't know at this point that 100% power was there but NOT to be used!!!!

RDworks Learning Lab

01... Basic vector tools

https://www.youtube.com/watch?v=fLSI-z-TdNQ

- Setting Config file to give a page size the same as your machine table
- Setting the blue arrows to match your machine 0,0
- Setting head position (the green square) At this point I did not understand the datum scheme. See https://youtu.be/CWZvQXxbR_E
- Setting node menu
- Drawing a line and using the Ctrl key to fix ordinate positions
- Drawing Poly lines
- Drawing Circles and ovals
- Drawing squares and rectangles
- Using the Text tool
- Quick look at Bezier curve tool

02... Sizing and positioning

https://www.youtube.com/watch?v=SlUFg42u5xQ

- Drawing a marquee round objects
- The X and Y coordinate position of object centres
- The X and Y dimensions of an object
- Using the padlock tool
- Using the % scale windows
- Using the rotation tool
- Getting to rotation handles with a double click

03... Positioning and alignment

https://www.youtube.com/watch?v=ns8b28g80vk

- Move your object to work area corners
- Last drawn or selected object become the “anchor” object
- Use of EDGE alignment tools
- Last selected (using shift key)object become the “anchor” object
- Using mouse key to zoom in and out.
- Resizing and spacing objects tools.
- Moving an object’s location coordinate

04... First program setup

https://www.youtube.com/watch?v=p8npuHUO5sw

- Draw simple test object
- Use of layers to separate scan and cut functions
- Setting layer parameters for cutting/etching
- Assessing depth of cut to guess cutting speed.
- Is Blowing? Is actually not relevant to our simple machine. It's a feature of the controller that allows you to program the extractor on and off so that it only extracts when you are cutting if you answer Yes. You fan is NOT connected to this system so the question and the answer are meaningless
- Through mode. I now know this to be not very important for our machine Through Power should be used in conjunction with OPEN DELAY. Normally the program starts cutting immediately. If you tick Through Power, specify a Through Power % and set the OPEN delay to say 10ms. The head moves to the start point, turns on the Through power % for 10ms. After 10ms the normal power and program begins NOTE!!! Make sure you set OPEN DELAY back to zero if you untick Through Power
- Error Don't set power to 85% limit yourself to 65%
- Layer cut order. You can select cut order BUT machine will a ALWAYS do scanning layers first
- Preview your program
- Save your drawing as a .RLD file
- Save your machine program via Ufile button as a .RD file.
- Load .RD file via a USB stick into the laser machine

05... First Cut

https://www.youtube.com/watch?v=MLBY8z_nRWw

- Look at different plastics you can and cannot cut
- Hammer test to identify safe ones
- Places to go to find out about material hazards
- How to edit parameters on the machine
- How to run your first program

06... Graphics Intro

https://www.youtube.com/watch?v=ybnT3lECAqs

- First attempt at graphics in Photoshop (failed)
- Importing graphic from internet
- Building a picture away from RDWorks
- Import into RDWorks
- Create final object
- Break object into 2 layers. One for cut and one for scan
- I set power to 85% power WRONG!!!!
- Use preview screen
- Connect PC to machine to transfer program
- Use of Track button
- Examine finished project

07... effect of dirty lens, method of testing

https://www.youtube.com/watch?v=yEtgIfFhIek

- Designing a cut test program
- Copy and paste duplicate objects
- Use even spacing tool
- Use horizontal alignment tool
- Put all objects on different layers
- Assign parameters to each layer
- Run the cut test to show results are now worse
- Some ignoramus mistreating a lens!!!!
- This is how to remove the anti-reflective coating. Ignorance is bliss. DON'T do it this way.
- Despite my attempt at wrecking the lens, alls well that ends well

08... bitmap discussion

https://www.youtube.com/watch?v=DXPQw--q19A

- Import a BMP picture
- Using the bitmap handle
- Examine the picture in the Bitmap Handle window
- Experiment with lots of settings
- Add text to picture
- Add layers and assign parameters for each layer.
- Cutting at 90%??? WRONG!!!

09... Cutting a dithered bitmap grapic

https://www.youtube.com/watch?v=Hq2A_2JVXvo

- Producing the horse graphic on acrylic using NET GRAPHIC.
- Set the focus a little into the material
- Not the most successful graphics test

10...Bitmap Handle Dot graphics

https://www.youtube.com/watch?v=Z9xR4hujtB4

- Reworking the horse picture as DOT GRAPHIC
- Produce 2 copies
- Zooming the screen to examine the finished dot picture
- Invert image to a negative for the second picture
- Examine both with preview.
- Cut both pictures and compare end results
- Examine pictures close up to look at the dotting
- Modify resolution to improve picture?

11p1...Rotary

https://www.youtube.com/watch?v=wyevrQXaGRo

- Disconnect Y axis plug and plug in rotary device
- Orienting the rotary device onto the machine table
- Discover direction of keyboard arrows
- Understanding 90 degree rotation of program
- Designing and programming a test program with 150mm reference lines
- Set rotary device true to table
- Power machine on and find the roller 0,0

11p2...Rotary ….Create a scaling factor

https://www.youtube.com/watch?v=sIlXSZhgbe4

- Align Head to work centre
- Understanding slippage
- Align work by using track test
- Cut test program and measure reference distance (162mm)
- Don't mess with vendor settings
- The maths off calculating a correction factor
- Designing another calibration check program
- Verifying Calibration number with a smaller tube.

12... early mirror adj (see session 51 for best method)

https://www.youtube.com/watch?v=R55qu_lCdKk

- Designing acrylic targets to aid with beam alignment
- Quick check of beam alignment at each mirror
- Check beam centre through nozzle in two axes

13... rotary glass engrave

https://www.youtube.com/watch?v=X2OnCcx9qZM

- Prepare bitmap for rotary engraving
- Set to negative and also modify y axis to 92.6%
- Someone suggested engraving through wet kitchen roll
- Repeat test with NO kitchen roll
- Be careful of glass shards
- Clean off glass shards

14p1... Design and cut Puzzle

https://www.youtube.com/watch?v=3pMHKLT8oDU

- Preparing a photo by mounting it to backboard
- Method of cut design
- Programming the cuts
- Cut optimise
- Preview cuts
- Order cuts by layer order.
- Test cuts to see how corrugated card does not cut well
- On-machine editing caution. Only one layer at a time
- Looks like cut success but in reality rubbish.

14p2...

https://www.youtube.com/watch?v=HbvMs0sM16Q

- Picture remounted on 2mm acrylic for 2nd attempt
- Maybe substitute tri wall card for honeycomb
- 3rd attempt 95% power (NO!!!!!!!)
- Finally success
- Stupid test…… engraving sliced bread!!!

15... Design light sculpture

https://www.youtube.com/watch?v=xSu8jGLWJVk

- Preparing program
- Setting paramerets 95% power (NO!!!!!)
- Cutting the parts
- Assembling the sculpture (click together)
- Add some led illumination
- Final success

16... tests of tube power (failing tube)

https://www.youtube.com/watch?v=JfRpa9Y5Woc

- Create some power loss test programs
- Run the test program
- Note. At the end of each sweep the beam cuts a groove in the piece of vertical white acrylic
- Conclusion that power loss if from the laser itself.
- MODE burn tests prove varying laser output

17... more mode burns at tube- bad tube

https://www.youtube.com/watch?v=DJBRZ2J0Q9A

- Running program to produce test strips
- Finding out that power recovers quickly when beam switched off
- Mode burns at 1 minute intervals
- Examination of mode burns to show magnitude and speed of power loss

18... set cut properties

https://www.youtube.com/watch?v=BXna2oBp-gE

- Realization that RDWorks is an INTERFACE program NOT a CAD or DRAWING program.
- A drawing with multiple parts that need cutting in a specified order.
- Discovery of the cut optimise list
- This is the tedious LONG way to order cuts (Its not until session 29 that I discover the BEST way to use this tool)
- Assembling the acrylic construction
- This jig was a great vehicle for learning about cut control, sadly the jig itself was useless

19... Xmas cards

https://www.youtube.com/watch?v=C7Su7RZvKdQ

- General design of card.
- Edit cut property examination
- Cut optimse set up
- Struggle to find the correct order
- Cut optimise set as “inside to out”
- Examination of original nail bed. Binned
- Mk 2 pin bed…fully adjustable
- Cutting the Xmas card
- Assembling the finished card

20... cut optimise

https://www.youtube.com/watch?v=9wVGHLWHirM

- Explanation of the cut order I am looking for
- Cut optimise setting
- A different approach to SET CUTTING PROPERTY.
- Reversing the list
- Test with preview to check order….wrong.
- MUST remove tick from Path Optimise to allow ME to take control.
- Fix the Sue problem
- Further refinement of ordering the Set Cutting Property list
- Setting pin positions for good paper support
- The final personalised Christmas card

21... Fitting new tube prelude (DIY power meter ?)

https://www.youtube.com/watch?v=eAWaqHFvRqk

* An attempt to use conventional calorimetry to measure tube output power

21p1... Fitting new 50w tube

https://www.youtube.com/watch?v=NzbqN8m7hGM

- Final testing of original rubbish tube prior to changing it.
- Introduction to my crude calorimeter
- Calorimeter calculations to establish power absorbed
- Results show lower average output form higher % power setting
- Conclusion. Yes, a rubbish tube. Needs to be replaced

21p2... Fitting new 50w tube

https://www.youtube.com/watch?v=_hysBCC_ZwE

- Emptying the water from the old tube
- Removing the old tube
- Remove the HV connection. (Wire wrap connection!!!!)
- Modifying the brackets to suit new larger tube
- DO NOT ATTEMPT TO SOLDER THE WIRE ONTO THE POST like this. It will NEVER work and will invalidate any warranty that may be on the tube. Stay with the wire wrap method.
- Connect water and check air bubbles move out
- Mode burns to verify better output
- Quick check the beam is thro centre of nozzle
- New beam cut quality
- Quantitative assessment of power with mode tests
- Results hint at 65% power being max power output
- Calorimeter results assessment of power.
- No Power supply issues
- Grapical confirmation that you don't run at more than 60% power setting

22... 50w fraud

https://www.youtube.com/watch?v=KQDCy-mPNqA

- Chinese laser advertising fraud
- Benchmark tests
- Design test program
- Run perfectly timed mode burns to see power characteristic of your tube.
- Confirmation that 60% power setting should not be exceeded.

23... Fine detail import issue

https://www.youtube.com/watch?v=zG376fzLHMI

- Import artefacts as RDWorks brings in fine detail
- Solution is to export at 10 times full size
- Import and then scale down to 10%

24... Adding Ammeter and winterize

https://www.youtube.com/watch?v=xDZmuxq5BEM

- A suitable temperature relay (with sensor) can be found at http://www.ebay.co.uk/itm/220V-Temperature-Controller-Sensor-2-Relay-Output-STC-1000-BT/281979653286?_trksid=p2045573.c100033.m2042&_trkparms=aid%3D111001%26algo%3DREC.SEED%26ao%3D1%26asc%3D35377%26meid%3Ddc2e9c371d8543e2bbdb11f35fe629ee%26pid%3D100033%26rk%3D4%26rkt%3D8%26sd%3D330769086309

  and the ammeter at http://www.ebay.co.uk/itm/91C4-DC-0-30mA-Class-2-5-Accuracy-Analog-Ammeter-Amperemeter-Gauge-/351749565079?hash=item51e5e86a97:g:HjsAAOSwmtJXUVFu.
- Wire in the ammeter and check polarity
- Check what %power is the allowed max drive current (75%)
- See efficiency of extraction system
- Test cut with 4mm plywood
- Fitting NTC probes to measure temperature of return water into the tank
- Revised max power is now 65%power
- Test cut in 4mm
- Demonstration of how the excess power puts marks on the acrylic base plate

25 Convert photo to sketch for engraving

https://www.youtube.com/watch?v=x_EyCqNzVjk

- Bit maps revisited
- Photograph onto wood ….a failure
- Convert photo into a line drawing sketch
- Import as bitmap
- Use BitMap Handle to modify picture even further.
- Add a cut out feature
- Cut/engrave the coasters
- Finish them off with a wax polish

4 Month Review

https://www.youtube.com/watch?v=g5k6YhNqfSw

- My experiences and modifications so far

26... project- build acrylic knife holder

https://www.youtube.com/watch?v=8Gv-mEM2qMI

- Order the parts with reversing method
- 65% power cutting for 10mm acrylic at 2mm/sec
- Cutting 10mm acrylic with a 1.5” focal length lens
- Cutting 3mm acrylic
- Assembly of knife block
- Squareness of edge ……. A problem?

27... Simplified mode burn- disable Y axis

https://www.youtube.com/watch?v=8Jgf0fPsPH0

- Draw a test program
- Remove the Y axis plug
- Auto run mode burn test
- Turn off power to reconnect Y axis

28... Cartesian co-ordinates explaination, plus datums and origin

https://www.youtube.com/watch?v=CWZvQXxbR_E

- Simple look at the CARTESIAN co-ordinate system
- Explain machine 0.0
- Explain program 0,0
- Explain position of OBJECT 0,0
- Explain machine ORIGIN button allows you to fix the program 0,0 at a position of your choice in the workspace.

29... cut optimise- (best method) with butterfly card project

https://www.youtube.com/watch?v=_3oUQ9gKjCk

- A radically simple approach to controlling cut order
- Clear the CUT OPTIMIZE window
- Turn off PATH OPTIMISE
- Use of the SHIFT key to help with SELECTING separate elements into a GROUP
- Press the GROUP button
- Review and order the SIMPLIFIED Edit Cut Property list
- Cutting the program
- Assembly of the finished card

30... cutting 10mm ply, tips tricks

https://www.youtube.com/watch?v=dt5R04vJPMc

- Cutting 10mm plywood…..very cleanly
- Keyboard wear observed
- Keyboard cover
- Fire hazard note
- Note about edge squareness

31p1... Mk1 laser polnter

https://www.youtube.com/watch?v=-RgbmAWgWxU

- Constructing a compact laser pointer
- Collimating the beam

31p2 Mk1 laser polnter

https://www.youtube.com/watch?v=XRizHrFSCwc

- Examine the positional error of the focus point when the laser beam is off centre to the lens or off angle to the lens
- Fixing the laser pointer to the water jacket
- Steering the mirrors accurately
- Out of squareness found?
- REMOVE the laser pointer and check with the real beam
- Test cut to show resetting head to perpendicular has fixed the squareness issue with cutting.

31p3 Mk1 laser polnter

https://www.youtube.com/watch?v=KectEimG4jg

- Using the laser pointer to set the mirrors
- Checking the dimensional accuracy of the CUT
- Understanding diagonal errors

31 p4 Mk1 laser polnter

https://www.youtube.com/watch?v=TUJgBcb2xnQ

- Making a target holder and targets for checking that beam is coming out of the nozzle perpendicular to the table.
- Remove mirror 3 and modify holes to allow more float
- Move the head ONTO the beam centre and reset it square and true.
- Discovery that lens is fitted “wrong” way
- Now easier to get beam vertical

32... using laser power meter,

https://www.youtube.com/watch?v=DrbQdIAQl4s

- My power meter arrives!!!!
- Examination of what I got for my money
- Do I trust it? Yes
- Designing a test program to set the beam on for an EXACT period to fire at the power meter
- Quick check of laser output …..37 watts!!!!!
- Check power after 3 mirrors …..31 watt !!!!
- Check after lens 30.5 watts !!!

33p1... LED edge lit sign(solar powered)

https://www.youtube.com/watch?v=Mfk317JZE-w

- Design of edge lit sign….but solar powered
- Scanning ALWAYS happens first regardless of layer order.
- Engraving and cutting sign
- Quick test of “look” with temporary LEDs

33p2... LED edge lit sign

https://www.youtube.com/watch?v=n0kk4umA0BA

- Making the aluminium base tube
- Fitting the sign to the base tube
- Testing the solar lights…..rubbish
- Testing a much higher price LED set…Looking good
- Fitting LEDs to sign
- Test of durability and "look" ……seems successful

33p3... LED edge lit sign

https://www.youtube.com/watch?v=di1nmMHMTOI

- Last minute modification to make a mount for the solar collector integrated into the sign mounting post

34… Mk1 fixed tube clamps

https://www.youtube.com/watch?v=LsVGSm1DkqQ

- Design a set of clamps for my 2nd laser tube to replace the dodgy modified original clamps.
- Cutting the clamps
- Assembling the clamps
- Check clamps fit the tube

35p1... understanding a sealed CO2 laser tube

https://www.youtube.com/watch?v=6onXMU08GzQ

- How does my laser tube work?
- Simple atomic stuff
- Pictorial description of how the tube works.

https://www.youtube.com/watch?v=mN7_4h3nCZM

- Description of how the carbon dioxide depletes inn your tube.
- Final proof graph of why your tube dies.
- Parallax confirms “dissociation” as the cause of death for a tube.
- Examination of my old tube to try and find out why it was so bad.
- Fit original tube back into machine for testing
- Add heat transfer grease to gap on mirror
- Did it improve its performance? Is it worth keeping?

35p3... Comparison of old and new tubes

https://www.youtube.com/watch?v=5GQQdHFgrLQ

- Fit 2nd tube back into machine
- Must seal HV terminal to prevent coronal leakage
- Fitting temperature probes to protect tube against freezing.
- Powering up the tube again
- Example of my new tube trying to strike at low current
- Example of my tube struggling to strike properly at full/mid range current
- Power characteristic for my 2nd tube
- Laser through mode ….possible work around?

36 Mk2 laser pointer

https://www.youtube.com/watch?v=GQJRNbf1NbE

- Revised version of the laser pointer
- Different registration system
- Reference scorch mark
- Elastic band fixing method
- Checking mirror settings
- Cutting 10mm acrylic with 30 watts

37... Adjustable tube clamps

https://www.youtube.com/watch?v=Iqwft4dmGos

- Assembly of Mk2 adjustable clamps.

38p1...-Mk3 laser adustable pointer

https://www.youtube.com/watch?v=-w9f8fZujlw

- Another attempt at making a laser pointer
- Assembly of the pointer
- No collimation required
- Rubber band fix ….again
- Sausage shaped mark (not a sharp dot)
- The Y axis beam instability problem we noticed with the mk1 pointer is still there

38p2...

https://www.youtube.com/watch?v=AcCBPiQXFrI

- Examination of the wandering beam and the effect it could have on the cutting accuracy
- Mirror 2 mount seemed to be the root cause…very flimsy and being twisted by torque from the cable guide chain
- Stiffen the bracket with additional screw
- Discovery that mirror mount limits bracket adjustment.
- 10mm plywood test cut at 6mm/sec.
- Check on power at cutting surface 27 watts!!!
- Quick look at the heating / anti-freeze system

39... tests on 1.5 ,2 ,2.5 lenses for cutting

https://www.youtube.com/watch?v=WbBPps42iHc

- Realization that my machine is fitted with a 1.5” focal length lens
- Comparing 3 lenses that we can fit to our machines
- Spot diameter is very important (energy density
- Longer focal length puts the nozzle further off the work. That degrades the airflow into the cut area.
- For acrylic you do not need much airflow but for wood you need lots.
- Depth of cut changes with focal length
- Depth of cut in acrylic can be shown to decrease with excess air assist.

40... discuss cooling- not chiller

https://www.youtube.com/watch?v=asM0s7wm4AM

- How does temperature affect the power output of the tube.?
- Discussion of how my tank and tube are protected against sub zero weather and how the DISTILLED water in the tank has remained pristine
- Examination of graph to verify the winterisation of the machine was a success
- Look at the graph to see the overall result. No significant loss with temperature increase.

41p1...What is IR and how is it reflected off metals

https://www.youtube.com/watch?v=kJe16YQlIM0

- Infra Red ….what is it?
- Laser beam is IR “light” that we cannot see but we can feel it.
- How dangerous is IR
- How various metals react to IR light
- The dangers of reflectance
- Steel bed plate advantages
- Phenomenal copper reflectance
- Laser beam danger assessment
- Materials that absorb IR including human tissue.
- Safety glasses http://www.hivis.net/132/Personal-Protection-Equipment/Safety-Spectacles/Clear-Lens/

41p2... discuss mirrors and measure losses,

https://www.youtube.com/watch?v=hSDRQAkcPO0

- Power tests to check power losses across mirrors
- Important to set the power meter back to ROOM TEMPERATURE
- Summary of results for mirror losses
- Discussion of results
- Examination of my mirrors
- Difficulty getting access to mirror 2
- Mirror 2 needs a dramatic clean
- Recheck power losses
- Improvement after cleaning mirrors? NO.
- Decision to make copper mirrors.

41p3... Making Prototype Copper Mirror

https://www.youtube.com/watch?v=JZApIOwIpeU

- Check power loss with copper mirror and original mirror
- Making of a prototype set of copper mirrors
- Significant reduction in mirror losses by using copper mirrors
- Discovery that my mirrors are molybdenum

42... Power Loss Between mirrors

https://www.youtube.com/watch?v=2gUjlExQI64

- More mode burns to check power after each mirror
- A few hiccups with my “bipolar” tube performance.
- Understanding that mirrors are oval when the beam arrives/leaves. Must be very accurate with beam alignment
- Modifications to mirror 2 screws
- Using the red beam pointer to aid mirror adjustment.
- Hacking the machine to access the mirror adjusting screws
- Relative power of mode burns A good checking method
- Decision to make better copper mirrors.
- Final test demo of cutting 15mm acrylic

43 Making improved Copper Mirrors

https://www.youtube.com/watch?v=HHagynL4zqs

- Death of the hard disk mirror myth
- Make a hard disk mirror
- Compare the hard disk mirror with the copper mirror
- Make a new mirror that also shows better performance.
- Further hacksaw work on the machine case.

44p1... line of sight mirror adj

https://www.youtube.com/watch?v=5YvOqH44n6c

- Look at changes I have made to make beam setting simple
- Case changes
- Mirror 2 modifications
- Make an adjustable bracket for the head mount
- Modify mirror 2 mounting bracket
- Remove mirror 3 and set up a line of sight back to the laser.

44p2...

https://www.youtube.com/watch?v=pl6dAWOkksM

- Burn mark misses mirror 3 Why?
- Adjust laser tube alignment, NOT a mirror
- Pulse test and align the mirrors
- Move the head onto beam centre, you may have to make your own bracket.

45... Pin Bed Mk2

https://www.youtube.com/watch?v=kMDRzBZTW9c

- Pin Bed manufacture (8mm acrylic)
- Setting pins to give edge location
- Setting a typical pin arrangement
- Cutting demo of a gift box using the pin bed 2mm stainless dowels http://www.pts-uk.com/Products/Pins_Dowel_Pins_Metric_A2/A70232

46... Make and Test Ultimate Copper Mirrors & HQ lens

https://www.youtube.com/watch?v=ELeqP3tHlp0

- Even more copper mirrors!!! A different manufacturing method
- Making 3 mirrors at once
- Change the lens for a new HQ lens
- Do a scorch mark on mirror 3
- Turn the laser and add the laser pointer to the tube
- Replace 1 mirror at a time and use the laser pointer to reset each as you go
- Power checks good until mirror 3
- Mirror 3 has always been a problem Why?
- Detail drawing of the head shows mirror is not central to the entry hole
- Adjust the HEAD to catch the beam in the correct place.
- With all the new mirrors and HQ lens Examination and discussion of results

47... 8 month review of machine

https://www.youtube.com/watch?v=4qy5cPZWGj4

- Quick tour of the machine to look at all the changes I have made
- Ammeter essential to maintain good tube life
- Look at the way I have winterised the machine against freezing
- Distilled water still pristine
- Importance of my power meter in developing the machine.
- Head mount special adjustable bracket
- Mirror mount and adjustment modification
- Laser pointer.
- Dangers of the laser beam
- Hard disk mirror myth
- DIY copper mirrors …very, very good.
- Bad design of mirror 3 position.
- Demonstration of my “laser KISS” to get the machine run properly
- Run out of patience and have ordered a new 60watt tube and PSU
- Look at the new pin bed

48... Mk4 laser pointer

https://www.youtube.com/watch?v=GU3XxbT5hwc

- Yet another variation of the laser pointer to suit different machines
- This version s magnetically mounted on it’s own bracket and stands free of the laser tube.
- Design. Cutting and assembly of parts
- Testing

49... Design case extension for 60w tube

https://www.youtube.com/watch?v=9JqYUZ9wPp4

- Cutting and building the extension box parts

50... Fitting 60w tube

https://www.youtube.com/watch?v=zCTrRT1C_eY

- Unpacking
- Removing the old tube and power supply
- Fitting the new 60 watt tube and power supply
- Move the position of the HV end end tube clamp to reduce unsupported length
- Powering up the tube
- Checking the power output. WOW 73watts!!!

51p1... Beam Alignment A Definitive Procedure

https://www.youtube.com/watch?v=Vl6QKlwRKlk

- Must ensure that mirror mounts 1 and 2 are true 45 degrees and same distance off the Y axis rail
- Must set the laser tube parallel to the back and bottom face of the enclosure by using packing blocks.
- Check entry into mirror 1 is central.
- These tedious setting will only need to be done once.

51p2... best align procedure(IMHO)- no led,

https://www.youtube.com/watch?v=w9v3Vs0Nbkw

- Check the beam onto mirror 2 until it is parallel to the Y axis rail
- Adjust the laser tube packing block to bring the beam to mirror 2 centre.
- Adjust the beam into mirror 3 until it is parallel to the Xaxis rail
- Adjust the head to put the beam into the correct centre position on mirror 3
- With mirror 3 steer the beam so that it is central and perpendicular to the table.
- Add the nozzle/lens and carry out test on 15mm acrylic using a 1.5" focal length lens.

52... Checking table for flat, level

https://www.youtube.com/watch?v=gLWa7GdbkQ8

- Examine the play in the table in all planes
- Adjust to remove the slack
- Measure the corner errors
- Set all corners to the same height
- Check the centre.

53... Power meters and doHICKY

https://www.youtube.com/watch?v=lO9rWlobLZU

- How does a power meter work? Why is it so useful?
- Demonstration of exactly how the meter works
- It is a comparator not an absolute device
- It has to be calibrated against a known standard.
- Can you make your own DIY power meter?
- Add a digital thermometer to a doHICky and with a calibration chart you can make your own power meter
- How well does it work?
- Demonstration of its use and its accuracy.
- Opportunity to make one for yourself

54... beam drag & flame polish

https://www.youtube.com/watch?v=pYmT9yIjC4Q

- Explanation of and demonstration of Through Hole Power
- What is beam drag?
- How do I get rid of it?
- Set focus onto surface and close air assist to almost off
- Modify the focus depth to 3mm below surface
- Great flame burnished edge
- Increase speed…….cut success
- Examination of cut characteristic
- Non-square faces explained.

55p1...MAX-MIN POWER-

https://www.youtube.com/watch?v=38fBha5rqxI

- Observation of power overload at corners and finish of cut

55p2

https://www.youtube.com/watch?v=bsY1Ul7fBn0

- Rerun of test to examine effects by cutting acrylic with equal max/min power
- Change power to 65%/10%. No effect on corner depth

55p3

https://www.youtube.com/watch?v=i5iHjA7Hef8

- Review of my edit capabilities.
- This is what happens when I make a stupid mistake

55p4... summation

https://www.youtube.com/watch?v=vqQyhW4uSsM

- Narrowing the search area for a good setting
- Examination of results
- Very narrow zone of settings that work
- Test of observations
- Finding the “needle in the haystack”

56... Engraving History lesson and Greyscale

https://www.youtube.com/watch?v=85gl9GadV8A

- Engraving…definition of and origins
- Designing a greyscale test patch
- Investigating to see if we can see the machine changing power in response to different shades of grey

57... 3D laser carving is it possible

https://www.youtube.com/watch?v=ctgvoLKWowA

- Can this grey scale capability be used to get 3D carving?
- Develop a picture using Photoshop
- Get picture to 10 levels of grey
- Import to RDWorks and set parameters
- First attempt at greyscale cutting
- Photo conversion is NOT the way to get 3D pictures

58... More 3D carving

https://www.youtube.com/watch?v=3xO1hiBQzBg

- Creating a “special” grey scale test picture with Photoshp
- Failure
- Special files that have been specifically prepared for 3D carving
- Test work with another picture and different cut parameters
- Modified picture in maple wood
- Modified picture in bamboo wood
- Modified picture in acrylic …….edge illuminated

59… Hi and Lo Cost Marking of Metal

https://www.youtube.com/watch?v=b_06laAjMPc

- Cannot etch or engrave metal with our low power
- Marking metal by heat bonding a chemical into the surface
- Quick test and scratching to show durability
- High cost of Cermark
- Low cost of Molybdenum Disulphide spray lubricant
- Breaking all the safety rules
- Running a matrix of tests
- Looking at hazards of using these products.
- Comparison of results

60...Explore lens orientation

https://www.youtube.com/watch?v=1yMAr75h5O8

- Is there a right and wrong way to mount a lens?
- Design and cut a focus checking ramp
- Set the manual speeds and power
- Run tests with lens up and down
- Examination of results

61... Mk5 laser pointer

https://www.youtube.com/watch?v=WzcBapYhYuQ

- Very cheap and compact laser diode
- Yet another iteration of the laser pointer to suit my 60 watt tube
- Cutting the parts
- Assembling the parts
- Carry out a ref scorch mark to start with
- Fitting to the machine
- Laser switch safety precaution.
- Aligning the pointer to the reference scorch mark
- Using the pointer to readjust the laser tube

62... Energy density study

https://www.youtube.com/watch?v=61bGzWicRRk

- Can I use a longer focal length lens to cut thicker materials?
- Yes, provide you have a high enough power to maintain sufficient energy density for the material / thickness being cut.
- Demonstration of various lenses, thicknesses and materials.

63... Design- coffee pod dispenser

https://www.youtube.com/watch?v=muABTr04WjE

- Many requests to see how the process of designing something from just an idea happens. A difficult subject because so much is happening in the mind and only can be seen as it gets transferred into “lines on paper” Here is an attempt at showing how I go about this simple task.

63(duplicated number….sorry)... 3D- Hi Freq Impact Engraving

https://www.youtube.com/watch?v=mXIDwQxhX3k

- Examination of the 3D carving, taking note of the VERTICAL lines. What's causing it
- Testing the High Frequency Impulse Engraving region
- The High Frequency measures at 3.5kHz
- At 14% and above trace is dead smooth
- Examination of the beam during the tests (slow mo video)
- Look at straight cut and the edge marks that exist

Suspecting stepper motor causes these marks

64... Hi Speed video camera

https://www.youtube.com/watch?v=2A2gVmH9wuk

- Quick look at my Chinese camera (a NoPro?)
- Capable of 240 frames per second
- Hopefully may be useful in solving laser machine questions

65... Rough Engraving study

https://www.youtube.com/watch?v=BXJTSBeywHQ

- Still on the hunt for vertical engraving lines
- Is it the stepper motor or is it a pulsing laser beam?
- Review of how laser beam works
- Effect of too much current through your tube
- Pink beam does not mean output power
- Proof that laser will not produce visible pulsemarks
- Design of test program to compare the surface finish difference between normal scan and grey scale scan
- Very unexpected results
- Stepper motor under suspicion
- However, 1 finally arrive a logical (but incorrect) deduction that the laser power variation is to blame for the strange marks.

66... Stepper motor Causing Marks…Proved

https://www.youtube.com/watch?v=aOi8Mxg85vQ

- Many more tests to try and track down cause of surface finish marks
- Although stepper motor has always been a suspect, I now go hunting for dimensional facts to squarely prove that the stepper motor IS the culprit
- Explanation of how the strange tooth profile is generated by multi step acceleration of the stepper
- Adding extra mass to the head to see how the stepper struggles to accelerate it.

67 Etching on Slate

https://www.youtube.com/watch?v=LC26tA2D4J4

- Change of subject while I think more about what action to take on the stepper issue
- Testing the engraving capability on SLATE
- Preparing a photo ready to engrave
- Import into RDWorks and set parameters
- Calculate the ideal INTERVAL
- Change to 2” focal length lens
- Test scan on substitute slate
- Finish design
- Leave outside shape and set cut to low %power so that it does not cut. This is so that I can line up slate with image
- Change lens to 1.5” focal length
- Second test at higher speed 300mm/s

68... Keith forum advert :]-

https://www.youtube.com/watch?v=9Xq95wM0C_k

- www.rdworkslab.com

69... Rotary jig design and marking glass-

https://www.youtube.com/watch?v=bu7xtKdXU90

- Making a jig to help etch tapered objects on the rotary device
- Fitting the rotary table onto the machine
- Power the machine OFF and disconnect the Y axis and plug in the rotary device
- Power ON and help the machine find a datum position
- Quick review of arrow movements
- Anti slip device
- Test etch
- Be careful of glass shards
- Does washing up liquid help the engraving quality? Maybe.
- Testing CERMARK “Tile and Glass
- Clean excess Cermark off with acetone
- Silly test with molybdenum disulphide
- Set tapered tumbler into support jig
- Test etching, again with washing up liquid.

70... Setting up Template for Repeat Engraving-

https://www.youtube.com/watch?v=NrTvxtaLNaw

- Repeat engraving, with accurate repeat pattern location
- Cut blank parts first
- Preparing the etch drawing in RDWorks
- Config head position to CENTRAL position.
- Make a nozzle location jig
- Material location against a reference
- Locate the head position by getting nozzle aligned with the setting piece
- A question about multiple origins
- My machine anti-shake system
- Test etch to prove registration

71 Glass etching…An in Depth Look

https://www.youtube.com/watch?v=9Dqg4pchfTw

- New USB microscope
- Close up pictures of previous etching results
- RDWorks V8.01.18 download
- Immediate impressions of new version parameters and layers
- Etching of moly coated, Cermark coated and plain glass
- Immediate impressions
- Close examination of microscope pictures
- Summary of results

72 Is DOT mode Useful? https://www.youtube.com/watch?v=6J6CxGd4Hkw

- Creating a simple program to Test dot function
- Explaining the dotting parameters
- Testing it on tri-wall cardboard
- Adjusting parameters to get a good cut
- Use for tri-wall as an alternative to honeycomb
- DON'T set fire to your machine!!!!
- Testing dotting on 1mm polyester sheet
- Testing dotting on 1,5mm polycarbonate sheet

73 Defining a programmed START position for the Laser Head

https://www.youtube.com/watch?v=y9AYkPq-0AM

- Defining head START position
- Drawing a simple reference object
- Understanding difference between centre-of-object marker, program datum (the green square) and the object reference handle.
- 4 programmable start positions for the laser head.
- CURRENT position works from MACINE stored data for the ORIGIN
- MACHINE ZERO works from machine datum 0,0
- ANCHOR work from an ORIGIN position stored in the PROGRAM
- ABSOLUTE works from the coordinates of the green as drawn on your RDWorks work area.
- Tests to prove the 4 program positioning options
- OOPS!!!!
- ABSOLUTE and CURRENT work as described
- MACHINE ZERO and ANCHOR do NOT work as described
- Modifying USER settings to change the PARKING position for the head.

74 Disaster Recovery https://www.youtube.com/watch?v=h9NCqTT3Sh8

- You CANNOT copy the Factory Default file
- China did not populate my recovery file with GOOD data
- Machine settings all messed up!!!
- Problems loading MY copies of recovery files
- Strange manner of loading the recovery files
- Successful restore
- How to save the USER and VENDOR settings files.

75 What have I learned from 1 year of owning a Chinese Laser Engraver

https://www.youtube.com/watch?v=GNV0JUJXdvk

- My early mistakes with ebay tubes
- My great experience of buying a new tube and power supply
- Chart of tube power characteristic sowing 70watt output.
- Non linearity of tube output.
- Understand your tube current limits and fit an ammeter to monitor it
- Summary explanation of how tube works
- Don't use 100% power EVER. If no ammeter then stop at 65%
- Discussion of axis speeds
- Converting the machine into a "dream machine"
- Cheap temperature control relays
- Look at my ONE YEAR OLD distilled water. Still pristine.
- Look at the water temperature control system.
- Failed bouncy castle fan….motor burn out
- New fan very noisy. Needed a silencer.
- New air higher volume assist pump for future fitting
- Quick look at my home made copper mirrors
- I would not have learnt as much if the machine had been perfect

76 Laser Etched Tshirt Logo

https://www.youtube.com/watch?v=hA3wEGtYfFc

- Can we "scorch" a pattern on a flimsy T shirt?
- Programming the pattern
- Getting theT shirt onto a flat surface for "etching"
- Set the beam out of focus
- Failure 1
- Attempt 2 with different settings
- A quick trial on plywood
- And set the focus point to get the ideal power density
- Test 2…….sort of success
- Modelling the end result!!!!!

77 Vendor and User Files https://www.youtube.com/watch?v=Y-tva0CSJao

- Have you messed up your machine settings?
- Call up the Default Factory parameters with code HF8888
- All may not be good if your vendor has not saved the good settings!
- How do we start getting back to normal
- Must be done via a connected PC
- Vendor settings password is RD8888
- Deciding on a logical strategy for setting the parameters
- Must set the distances correct to start with
- Proving just how critical it is to have the dimensions calibrated correctly
- Experiment with other parameters to see what has been fixed
- Stepping through all the parameters to make sure they are realistic.
- Experimenting with the user parameters
- Saving the Vendor parameters out to a file and also storing your good settings into the Set Factory Parameters with code CC8888
- Test the machine with a demanding program
- Go to www.rdworkslab.com to down load some typical vendor and user files.
- Quick look at air assist control valve modification.

78 How to Justify Text https://www.youtube.com/watch?v=_NluzdiikNg

- Standard text input appears to be only LEFT justified
- Text is actually GROUPED
- If you UNGROUP a block of text all letters and parts of letters become moveable.
- Careful regrouping allows you to do positional control to get centre or right justified control

79 Machine Health Check part 1

https://www.youtube.com/watch?v=wupSN8mXlus

- Using the laser world's anal thermometer to quickly check your machine's health
- Using the dohicky to check power out f the tube.
- Discussion of what "tube life" might mean
- Rerun the tube characterization tests to check for power loss after 6 months
- How to check mirror power losses
- Using the red dot pointer to set a reference beam BEFORE removing any mirrors
- .Removing , polishing and resetting the copper mirrors.
- Finding serious mirror problems and lens issues.

79 Machine Health Check part 2

https://www.youtube.com/watch?v=hJahkB0zrms

- Doing some mode burn tests to discover that the beam shape and power is changing between mirrors
- Explanation of why the problem exists (curved edge mirrors)
- Forced to change back to original Molybdenum mirrors to gte beam shape back
- Mode burns again to check beam shape remains constant
- Machine back to reasonable whilst awaiting proper copper mirrors and new lens from China.
- Run a demanding test program to check performance.
- Final use of the anal thermometer to prove machine is back in good beam condition even though not as good as it could/should be.

80 My Chinese Pizza Oven!!

https://www.youtube.com/watch?v=cVuYyfJmfTs

- Experiments to look at the RAMP feature that is only available when SCAN is selected.
- Examination of the results an comparing with 3 D engraving and standard engraving.
- Observation of the “curtain effect”
- Discovering a FIRE in the machine.
- Examination of the damage caused by the fire.
- Look at the wood that caught fire.

81 My Chinese Pizza Oven!!

https://www.youtube.com/watch?v=fA7_-F0deLw

- New belt examination
- Cleaning the slide with abrasive 3M pad
- Re-greasing the slides
- Removing the head to discover belt fixing system
- Releasing the belt tension
- Fitting new belt through the cross beam
- Making new belt clamp plates
- Fitting new belt
- Discovering the drive pulley to be eccentric
- Cleaning mirrors to remove smoke damage
- Refitting the head
- Quick health check with anal thermometer

82 Intagilo and Rilievi ***https://www.youtube.com/watch?v=ivnlXq_ZXAU***

- Setting up the test program in RDWorks
- Discussion of what the expectations may be
- Discussion of the results and trying to discover why both results look the same
- Investigation into the CURTAIN effect
- Linking the effect to the belt pitch
- Observing that the pattern comes and goes cyclically and tie in with eccentric pulley
- Concluding that the curtain effect may be caused by incorrect belt tension
- Tests to investigate effects of varying tension
- Setting tension to medium and testing the head stiffness with a complex detailed pattern
- A demonstration of what INDEPENDENT OUTPUT does and how it’s not a fix for all issues

83 Is this Curtains forEver?

https://www.youtube.com/watch?v=QFLq14vY2zQ

- A more in depth analysis of what the root cause of the curtain effect might be
- Lookat fundementals of toothed belts and pulleys
- Analysis of non-linear motion BETWEEN tooth pitches
- Proving that belt stretches every pitch
- 16 teeth is not really enough for smooth motion
- Conclusion is to live with the problem but mitigate it by finding an ideal medium tension.

84 My New Adventure

https://www.youtube.com/watch?v=MTUJUkT9cxo

- A new addition to the learning lab “team” arrives
- Why a second machine?
- A quick look at what you get to make you jealous
- Waiting for the tube and engineer to arrive and commission the machine, all we can do is look around it
- Some first impressions (and critical observations)
- Poking into all the corners
- A opportunity to compare stepper technology with servos is a real possibility.

85 Acrylic Cut Marks Nailed

https://www.youtube.com/watch?v=hpjTGrtnru0

- Using the new Lightblade machine to do a real job
- Not a honeycomb table fan but will use it for this job
- Marks on back of acrylic not as bad as expected
- Zero,zero in opposite corner
- Demo of auto focus……mixed initial impressions
- Despite the safety interlocked main lid.it IS a pass-through machine
- Removed the red dot pointer…..my choice
- Fighting with the focus tube nut!!!
- Note small nozzle hole…a great benefit
- Lenses not marked. Checking to establish focal length
- Using the machine manually to chop up some over length free material
- Cutting striations on the egde of acrylic DESPITE using a servo system.
- Comaparison of the cutting striations witnessed in laser cut mild steel with the same patterns we see on acrylic edges.
- A diagrammatic explanation of how the striations are formed
- Modification to add a flow regulator to the air assist.
- Comparison of low air assist and high flow air assist on the edge finish of acrylic

86 Acrylic Cutting Slo Mo

https://www.youtube.com/watch?v=29L-3TpL8ws

- Attempting to view acrylic striations actually happening.
- Using my crude No-Pro camera at 200 frames per second plus some special Russ cheapskate modifications we go for the burn!!
- Viewing the slow mo footage
- Look at the reference material for steel laser cutting.
- Microscope pictures of the edge finishes
- Mapping the energy density systems (cutting)
- The effect of speed on the bottom finish of closed systems (engraving) as opposed to through systems (cutting)
- Fast cutting smooths the bottom (so does anti-wrinkle cream)
- Does any of this read over to wood cutting?

87 Maximizing Air Assist Efficiency

https://www.youtube.com/watch?v=OCVsMXw6yh4

- A new air assist pump (double the output). Is there any benefit to having it?
- Using a 2” FL lens to cut 10mm plywood
- 1.5” lens cuts at 15mm.sec That’s a starting benchmark
- 2” lens will NOT match that speed so drop speed right back to 5mm/sec
- Demonstration of the “tissue test” to check edge charring
- Analysis of the current air assist flow path.
- Identifying CHOKE points and fixing them
- Seeing the benefit of improved air FLOW
- Does the new pump provide better cutting? Yes 50% better.
- Make an extension nozzle to reduce the air gap
- Testing to show a 70% improvement with new pump
- Testing the small pump but with a reduced air gap gives 50% increase
- 1.5” lens shows no benefit from the large capacity pump.

88 Mk6 Pointer and Other Tools

https://www.youtube.com/watch?v=Mqv2nPm8QzU

- An apology for breaking two promises
- Work carried out as preparation for evaluating the Lightblade machine could benefit many “red and black” machine owners.
- Detailed instructions for building the target holders
- Mk6 laser pointer. A set of detailed assembly instructions
- Demonstration of using the pointer in conjunction with the targets and holders
- Cutting a hands-free beam health checker and targets
- Observations of out of focus on Light blade machine?
- Assembly of the beam health checker.
- Demonstration of the old beam checker, and how the new design is hands-free
- All drawings are available but may need modification to suit your machine