Fibre Draw Tower Alignment

Contents

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Introduction

The basic principal of draw tower alignment is to define the path the fibre will take between the molten preform tip and the bottom datum surface (see later for explanation) and then to ensure that all the process equipments are aligned in such a way that the fibre path (aka fibre line) passes centrally though the effective process centre of each device.

Step 1 Establishing the Fibre Line for the First Time

When the tower was first erected it is normal to use the furnace as the item which defines the fibre line simply because it is large, heavy and more awkward to move than other items. The furnace will have been located and set level in a position such that its centre coincides approximately with the centre of the preform holding chuck when it is approximately midway in its forward - back & left - right adjustment ranges.

1) With a spirit level on the top surface of the furnace body use the jacking points to ensure the body is set level

2) If the furnace is not fitted with a top and bottom irises then fit alignment jigs to the top and bottom of furnace if they are available.

3) For the first time setting of the fibre line any process equipment below the furnace that would otherwise restrict the movement of a free hanging plumb line should be moved out of the way. eg Open He cooling tube, open cane puller belts, open minicapstan, remove coating applicator but leave the resin delivery blocks in position, open UV lamp entry and exit doors.

4) On the two pulley tension monitor assembly the upper pulley is called the DATUM PULLEY. The other pulley is called the tension meter pulley. Set the unit so that the tension meter pulley is retracted. Move the block carrying the datum pulley to the right (assuming the tower handedness has the fibre is exiting the tower to the right when viewed from the front) by loosening the fixing screws and using the slots. The aim is to create a space between the two pulleys where a plumb line can hang without touching either pulley.

5) Take the pin chuck, fishing line and a plumb bob weight with pointed end. If the draw tower is fitted with a Vee clamp system then an adaptor will be needed to hold the pin chuck and the

adaptor is held in the vee clamp. If the tower is fitted with a chuck then no adaptor is needed and the pin chuck is held directly by the chuck. Attach the pin chuck to the preform clamp/chuck and move the preform carriage to around mid travel in its up/down direction.

6) Remove the brass screw assembly from the top of the plumb bob because it is not advisable to try to lower the fishing line with the weight attached. Attach the fishing line to the small brass adaptor and use it as a small weight to lower the plumb line through the furnace and down the tower. Hold the reel of fishing line level with the pin chuck and unwind sufficient so that the small drop weight hangs below the tension pulley just above the capstan but does not touch the floor. Put a mark on the line and then add 2 metres extra length and cut the line.

7) Now the fishing line is cut thread it through the pin chuck (which is hollow) and pull the 2 metres of excess line out of the top of the chuck . Clamp the line with the pin chuck jaws level with the mark that you made. At the other end of the line at the bottom of the tower screw the pointed plumb bob weight onto the brass adaptor which was used as the drop weight. Lower the weight gently until it hangs freely.

8) With the furnace irises set fully open move the X/Y position of the pin chuck until the line is hanging approximately in the centre of the furnace. If no top and bottom irises are available use a set of vernier gauges to judge when the line is centred.

9) Go down the tower and check that the fishing line is not touching anything. If it is touching things then move those things out of the way. Go back to the top of the tower and recheck if the line is still approximately centred in the furnace adjusting pin chuck X/Y position if needed.

10) You may find it helpful to immerse some of the plumb bob weight in a semi viscous liquid such as oil in order to make it settle in position more quickly but of course remember to clean the weight whenever you need to move it.

11) Now begin progressively closing the top furnace iris adjusting the X/Y position of the pin chuck to prevent it touching the iris. At the end of this step you should have the iris nearly closed but the plumb line not touching it but centred in the iris aperture.

12) Open the top iris and progressively close the bottom iris without moving the X/Y position of the fishing line. If the line touches the iris then the furnace is not level.

13) Fine tune the tilt of the furnace whilst repeating steps 11 and 12.

You should now have achieved a state where there is a free hanging plumb bob and both top and bottom irises can be virtually closed without disturbing the fishing line.

Note : In this state you have now set the top datum position ie the furnace position.
The next step is to set the bottom datum position. The bottom datum position is set by the position of the upper pulley of the pair of pulleys making the coated tension monitor assembly.

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14) Without disturbing the plumb line position set in the steps above move the datum pulley to the left until the plumb line is just kissing the bottom of the vee in the upper pulley. ie its position should not have caused the plumb line to move forward or backwards nor left or right but there should not be and gap between the plumb line and the point where it first encounters the pulley ie the vertical tangent point. Take care over this step. Lock down the fixing screws and recheck alignment. Loosen and readjust if necessary.

In this state you have now have a free hanging plumb line where the line passes through the middle of the furnace whilst the line is just kissing the root of the bottom datum pulley.

Note : You have now set the bottom datum position ie the datum pulley position.
Step 2 setting the capstan offset.

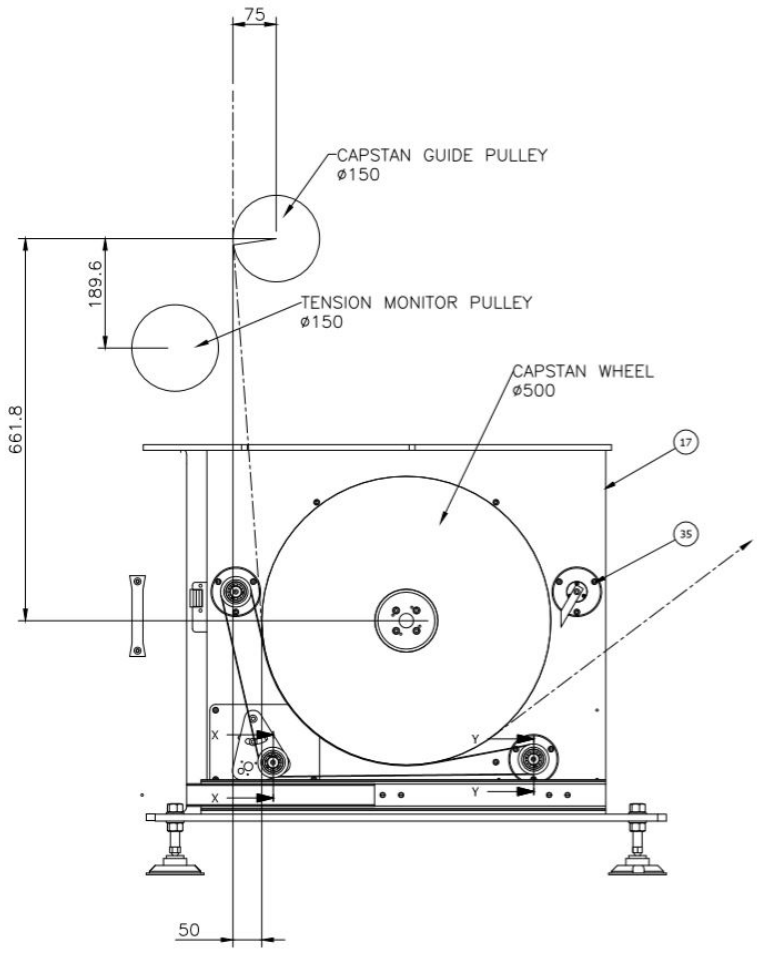
The purpose of the capstan offset is to ensure that even with the tension pulley disengaged there is always a positive wrap of the fibre around the datum pulley. The offset does not need to be set to the same level of precision as that used to establish the fibre line.

15) Remove the capstan belt.

16) If the plumb bob is sitting in oil remove the oil vessel and wipe the plumb bob.

17) Using the preform feed up/down controls slowly lower the feed mechanism watch to ensure the plumb bob does not hit the capstan. Lower until the plumb bob until it is just above the upper belt guide pulley..

18) The capstan offset is defined as the distance between the plumb line and a vertical tangent to the capstan surface running parallel to the plumb line(see diagram). The offset should be 50 mm nominal and for a tower with the fibre exiting to the right will require the whole capstan assembly to be offset to the right. It is not necessary to adjust the offset distance to any better than +/- 5 mm. Care should be taken however to ensure that the front/back alignment of the capstan is such that the centre of the capstan surface is in line with the plumb line ie if a vertical plane was drawn through the vee pulley on the datum pulley then that plane would pass through the middle of the capstan surface. Likewise, a ruler should be used to ensure the capstan pulley is set parallel to the tower face.



With the capstan now correctly position use the feet to mark the floor for future reference and ideally bolt the capstan to the floor.

Note : You have now set the capstan offset.
Having done this further alignment can be done without the need to have the plumb bob attached.

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19) Keep the tension pulley retracted to avoid any risk of damaging its load cell. Refit the capstan belt.

20) Remove the plumb bob weight and slacken the pin chuck to allow additional line to be pulled through so that the line can pass round the datum pulley and into the capstan under the belt following the path the fibre would take during normal fibre drawing.

21) Retighten the pin chuck and then use the capstan to tension the line enough to hold it straight. This is the line around which most of the equipment can be positioned.

Aligning the Bare Fibre Diameter Gauge

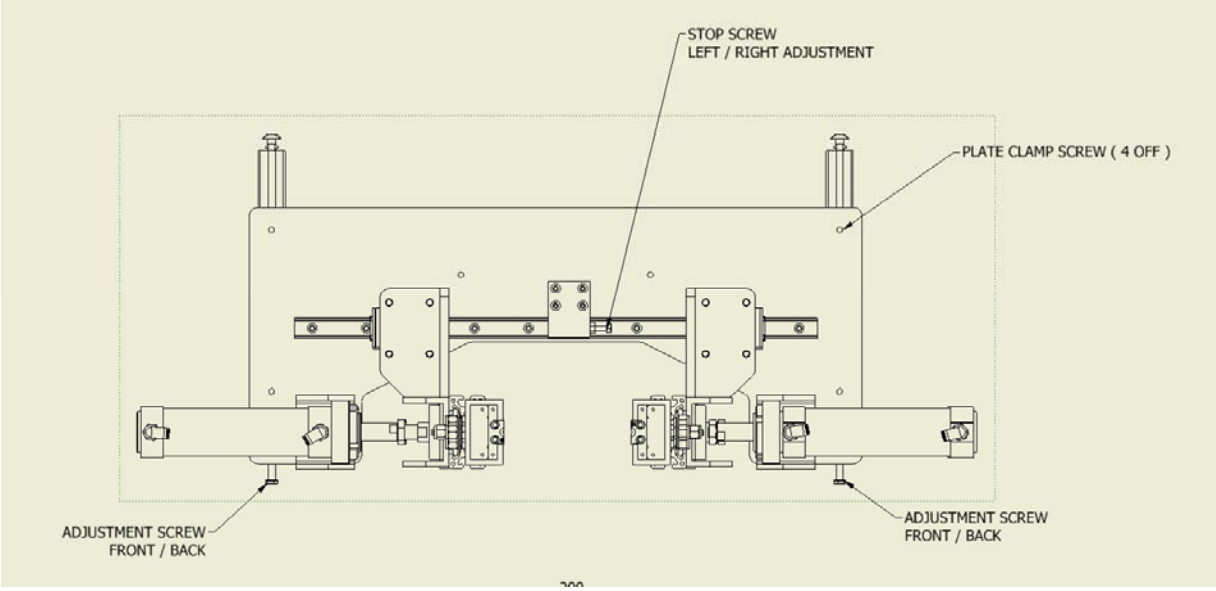
The tightened plumb line should register in the gauge as if it were a fibre. Move the gauge head whilst observing the position of the line within the optical sensing area of gauge head using the relevant display on the control system or diameter gauge processor unit. Move the head until the tight plumb line appears in the optical centre. The diameter gauge has now been centred around the fibre line.

Providing the gauge is not moved it provides a quick means of setting the X/Y position of the pin chuck for any future alignment checks in that with a free handing or tight line the pin chuck X/Y is position can be adjusted until the line shows in the optical centre of the gauge.

Aligning the He Cooling System

Close the He cooling tube around the tight plumb line. Assess whether the fibre is in the centre of the entry and exit orifices. Offsets that require the tube to be moved forwards or backwards are done by loosening the 4 off plate clamp screws and then adjusting the 2 off front/back adjusting screws (see diagram). The 4 plate clamp screws should be retightened after the adjustment is completed. This adjustment may require the clamps screws on each of the ram mounting plates to be loose at the same time.

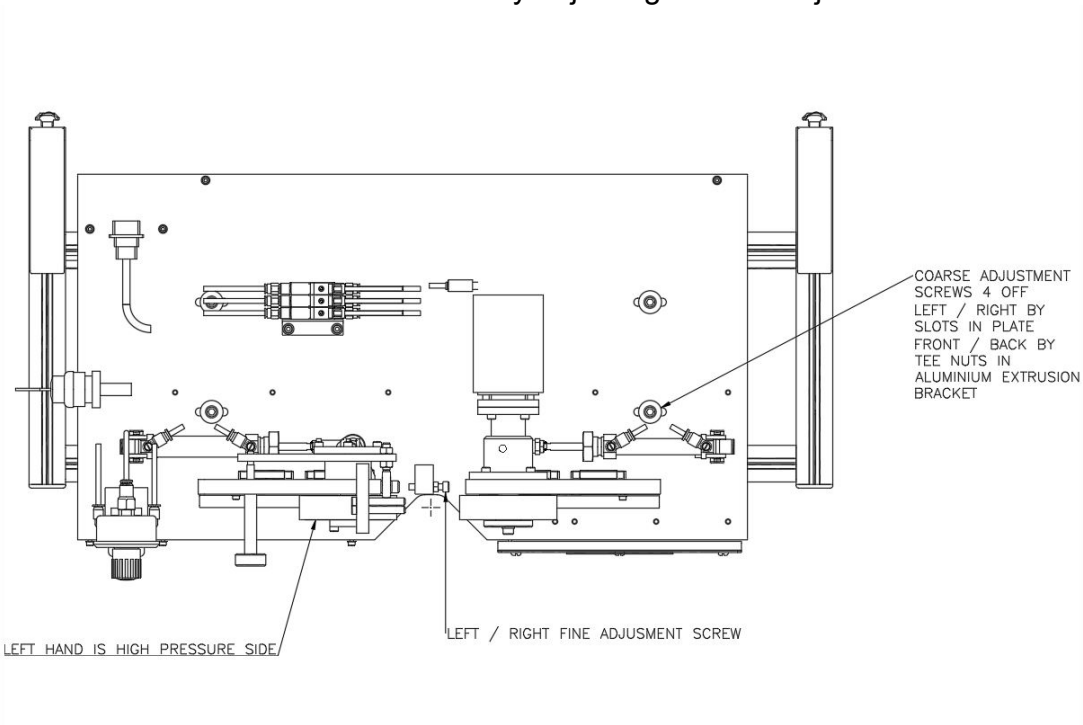
Offsets that require left right adjustment are achieved by moving the position of the mechanical set screw stop on each of the right hand high pressure rams (see diagram below). Be careful to adjust all the rams stops by a similar amount to ensure the tube continues to close smoothly



Aligning the Minicapstan

Using the tight plumb line close the minicapstan and then manually hold open the right hand lower pressure side. The aim is to adjust the position of the left hand pinch roller such that the plumb line passes down the middle of the gripping surface and the the plum line just kisses the surface of the left hand pulley when it is against its mechanical stop. Forward back adjustment and coarse left right adjustment is achieved by loosening the 4 coarse adjustment clamp screws (see diagram) which will enable the mounting plate to be moved left right in the slots in the plate and forward back by the tee nuts which are in the aluminium extrusions under the plate ie it should be possible to move the plate in two directions. Retighten the 4 clamp screws.

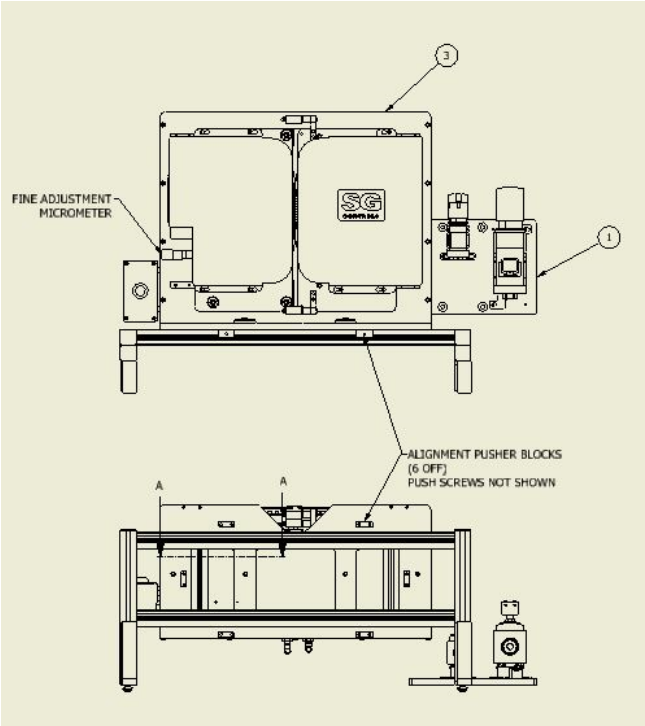
Fine adjustment of left right position of the left hand pinch roller is achieved by adjusting the fine adjustment screw as shown.



The minicapstan is now aligned.

Aligning the Cane Puller

The cane puller is aligned using a tight plumb line.



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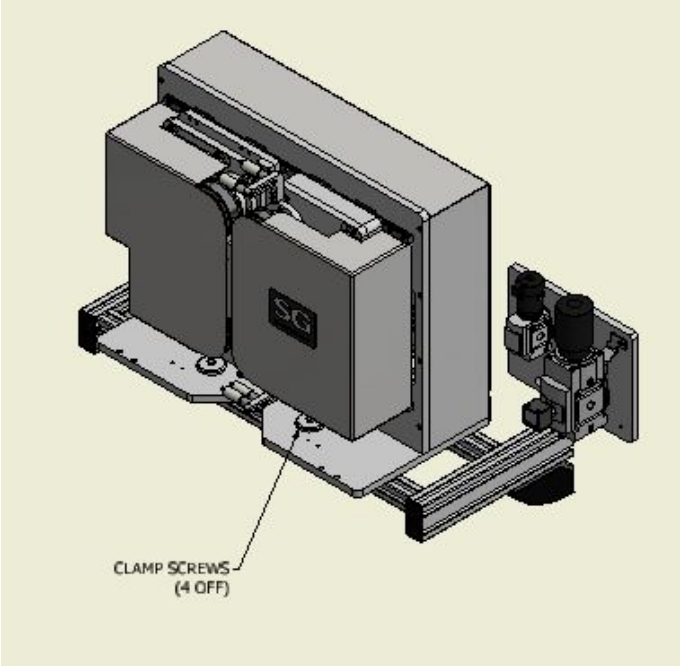

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Close the belts and then using the regulator controlling the low pressure belt (the right hand belt) set that pressure to zero. This should allow the right hand belt to be opened by hand whilst leaving the left hand belt held in position by pneumatics against its end stop.

Set the fine adjustment micrometer to mid travel (see diagram for location)

Loosen the four clamp screws (see diagram for location) and then use the pusher blocks (see diagram for location) to adjust the left right and forward back position until the plumb line is just touching the left hand belt and runs centrally down the middle of the gripping surface.

Retighten the 4 off clamp screws.

Now using the fine adjustment micrometer move the left had belt left/right and readjust if necessary to ensure that the plumb line is just kissing the belt surface.

Note : Record the reading on this micrometer for future reference.

The thickness of the fishing line is small but for drawing larger canes it is good practice to try to maintain the centre of the cane in the same position as the plumb line. This requires the left hand

belt to be offset to the left by half the nominal diameter of the cane being drawn. eg if the cane is 2 mm diameter then take the micrometer reading from step above and then use the micrometer to offset the belt 1 mm to the left.

7) Re-establish pressure on the right hand belt (low pressure side).

The cane puller is now aligned.

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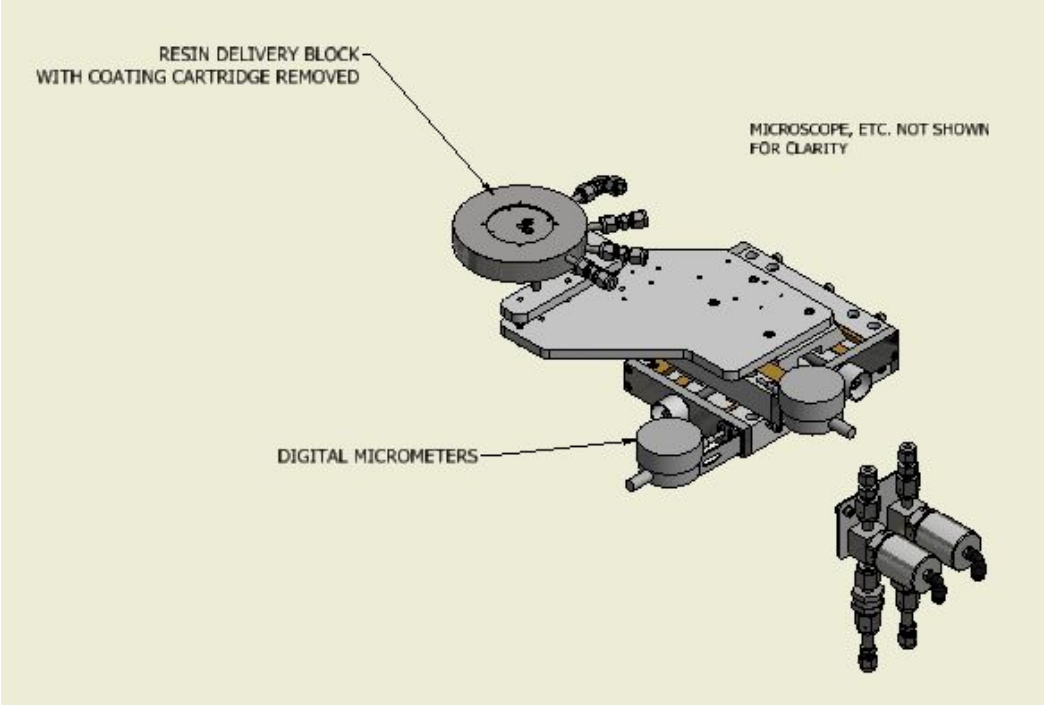
Aligning a Coating System

The coating system is aligned with a tight plumb line.

The coating cartridge assembly will need to have been removed in advance in order to have threaded the tight plumb line through the central aperture in the resin delivery block.



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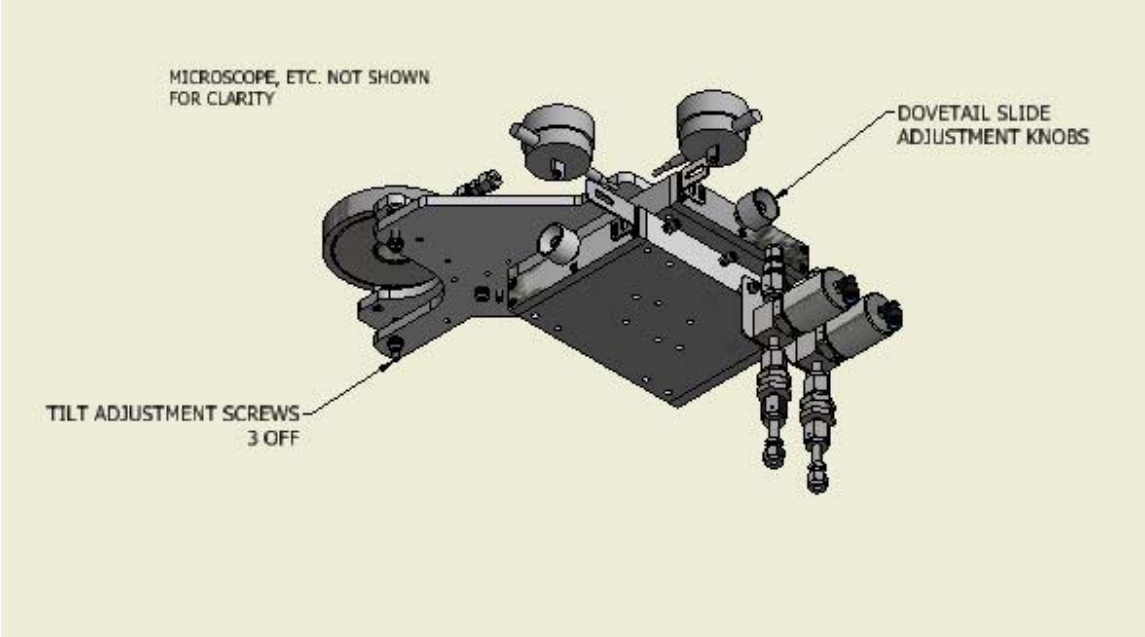

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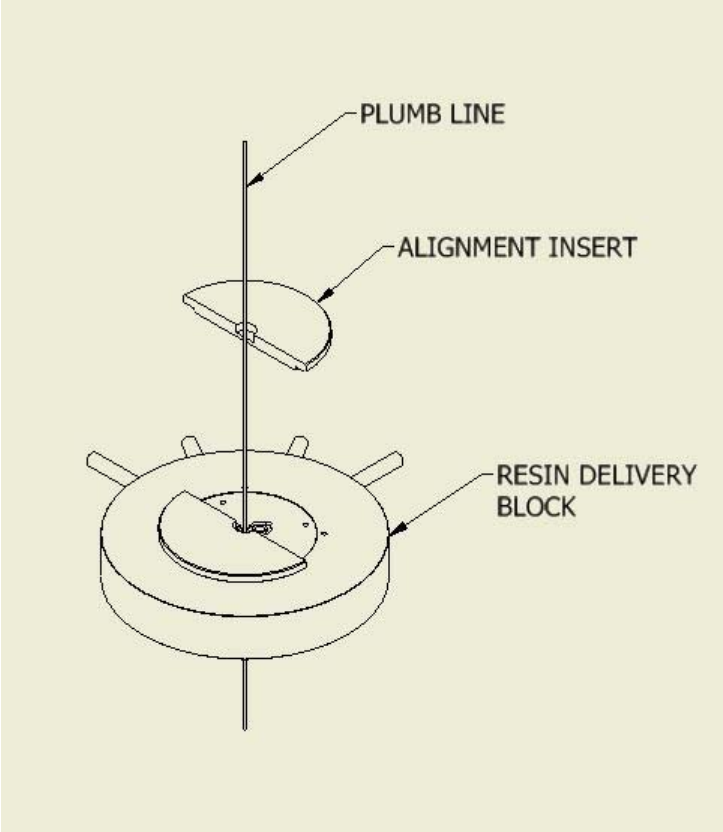
The figures shows the resin delivery block. The aperture through which the plumb line should be threaded is the central aperture not the resin feed aperture/s.

Level the resin delivery block using a spirit level and the 3 tilt adjusting screws shown in the figure.

Using the dovetail adjustment knobs adjust the X/Y position of the resin delivery block until the plumb line appear to be centred as best as one can judge by eye.

Insert the two semi-circular alignment inserts into the recess on the top of the resin delivery block and fine tune the X/Y position of the block using the dovetail adjustment blocks. You may fine it easier to make the adjustment by fitting one half only and making preliminary fine tuning before inserting the other half for final fine tuning.



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Note : Record the positions shown on the X and Y Micrometers. They allow the position of the coating applicator to be established quickly without need to realign.

The coating applicator is now aligned.

Aligning a Concentricity Monitor

The concentricity monitor is aligned with a tight plumb line.

Remove the cover and loosen the 4 clamp screws. Nudge the baseplate holding the screen and optics until the plumb line is centred in the circle around which the screen is partially wrapped. Use a Vernier gauge or similar for this task. Re- tighten the clamp screws.

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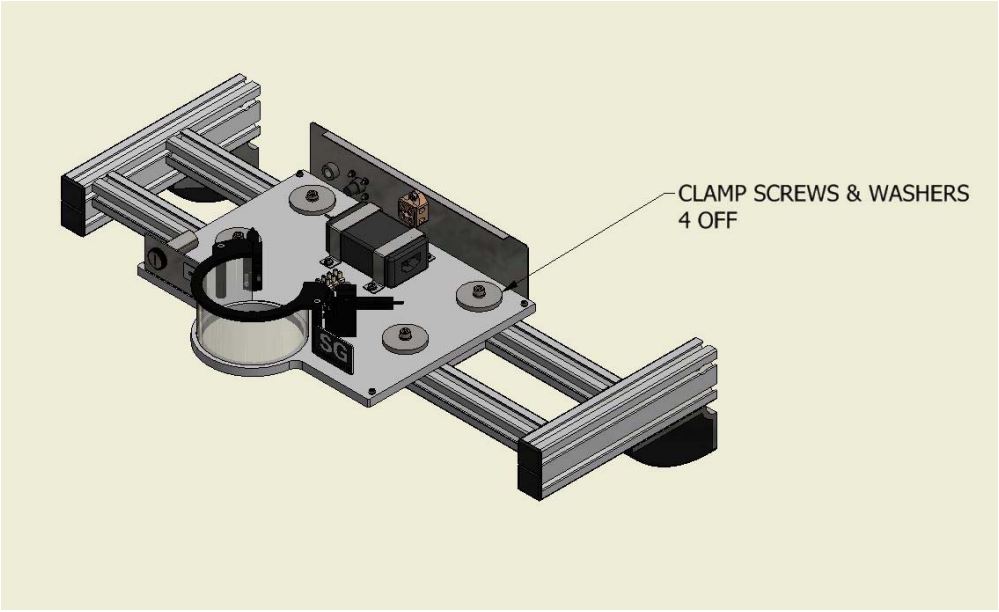

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Switch on the lasers and then turn the laser adjusting screws in turn until the beams from both lasers illuminate the plum line with maximum intensity.

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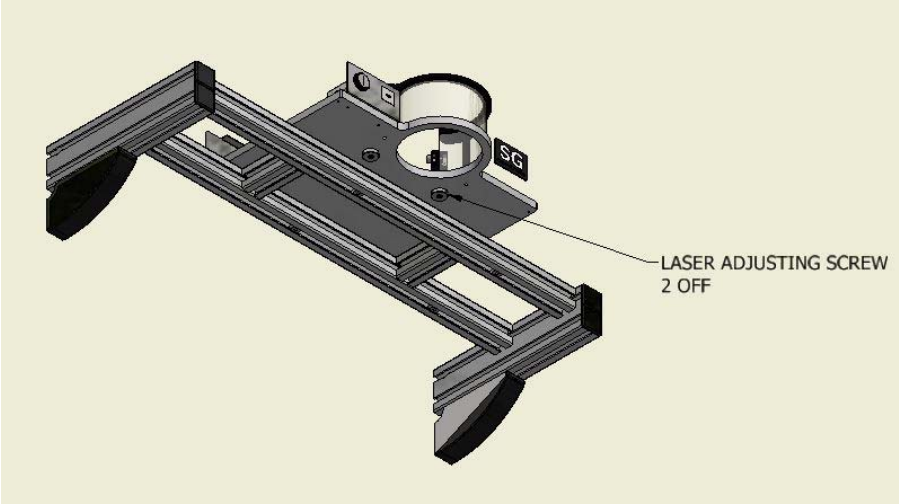

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Refit the covers.

Final fine tuning of the laser positions should be done during an actual draw of fibre by turning the laser adjusting screws whilst viewing the two interference patterns on the circular screen. Optimum setting is when each pattern shows maximum intensity and clarity.

The concentricity monitor is now aligned.

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Aligning UV Curing Lamps

A UV lamp is aligned with a tight plumb line.

Close the lamp entry and exit “irises” and adjust the lamp position until the plumb line is centred in both entry and exit apertures. Lamp position is adjusted by turn buckles on a hexapod mounting system (see figures below).

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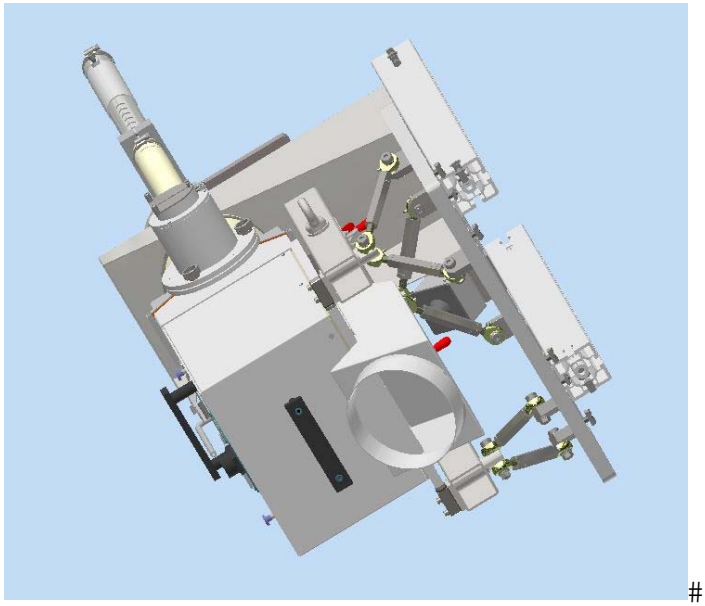

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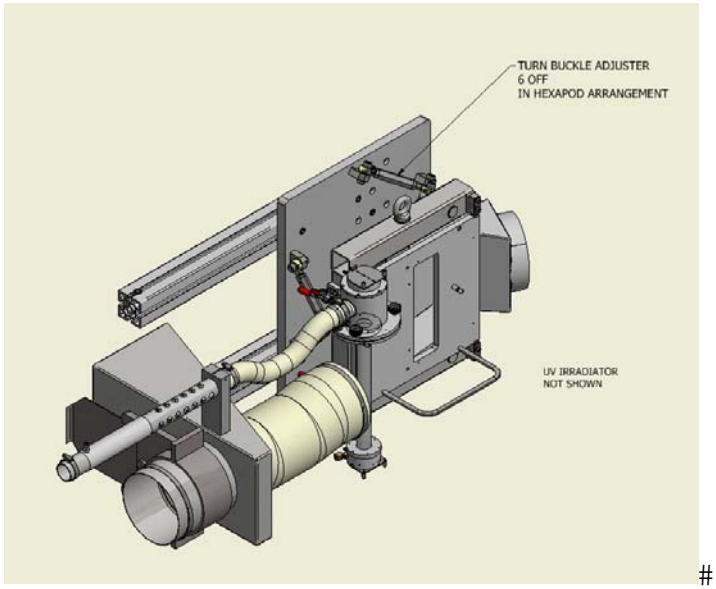

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Aligning a Coated Fibre Diameter Gauge

The gauge is aligned with a tightened plumb line and this should register in the gauge as if it were a fibre. Move the gauge head whilst observing the position of the line within the optical sensing area of gauge head using the relevant display on the diameter gauge processor unit. Move the head until the tight plumb line appears in the optical centre.

The diameter gauge has now been centred around the fibre line.

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