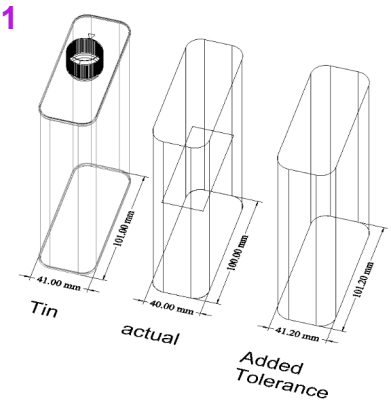
Feed screw using Animationlab.
Part 3.

First. I am not an engineer. I know nothing about metal strength, tolerances, feed rates etc. This doc is simply showing an alternative approach to the previous methods, which used multiple bottled and setting subtraction on every bottle. a time consuming process.

I have no idea, why I didn't think of this method, at the time I wrote the other methods (many years ago). But this greatly simplifies the process. Whilst feed screws can be used just for timing, Here we will rotate a tin by 90 degrees.

Fig 1

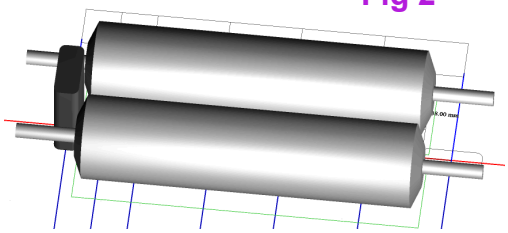


NOTE, everything here is guesswork. This is just to show the possibility, and not how to make a functional object.

First we have the tin can. We don't need to bother with the 'lips' we just need the centre section.

We do have to allow some tolerance, or the tin will jam in the screw. There are probably special tolerances one should follow. I just guessed at 0.6 mm each end / side. (adding 1.2mm to the length / width. Fig 1.

Fig 2



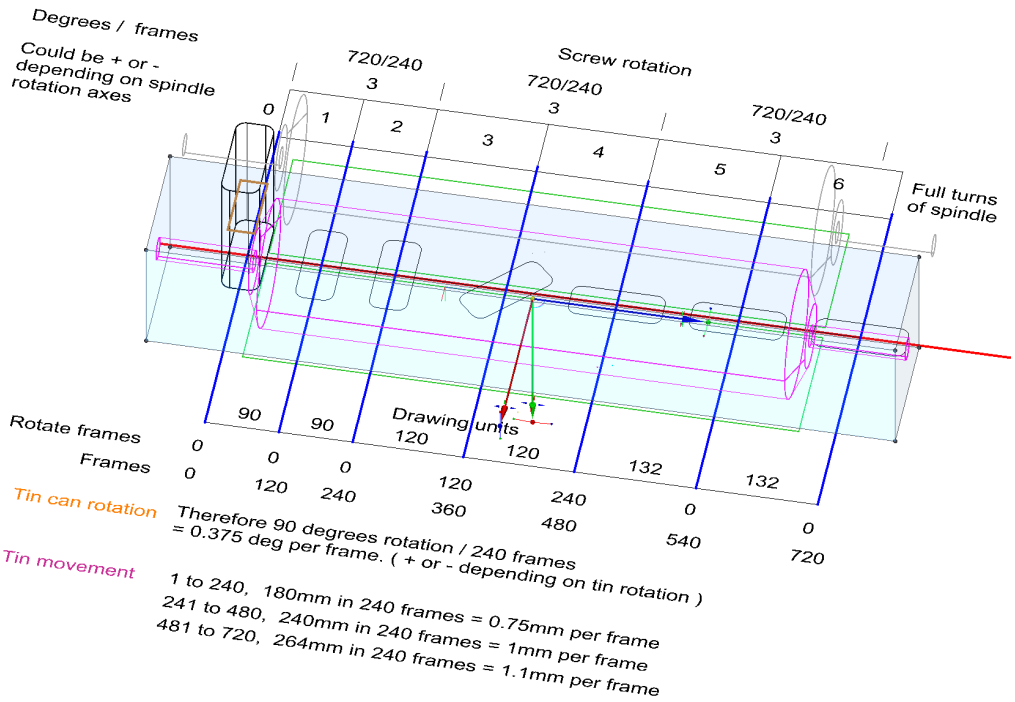
We also need two cylinders, which will eventually be the feed screws.

The diam is estimated for the tin to cut less than half of the diameter. The length, based on how many straight areas required before / after the tin rotation.

Fig 3. Shows the full setup, both 2d and 3d. The 2D setup, and text, is for reference, so I don't forget what I'm doing. I'll only briefly go through it, as I anyone using AnimationLab will already know most things about using TC.

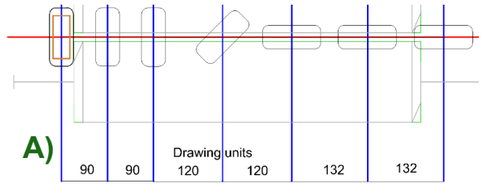
The 2D.

Fig 3



For the overall animation, we need the movement per rotation of the cylinders. In this case mm. (Blue lines), Fig 4.

Fig 4



The figures in A). Are as drawn full size units in mm between each cylinder rotation.

A) Drawing units: 90, 90, 120, 120, 132, 132

B) Rotate on frame: 0, 0, 0, 120, 240, 0, 0

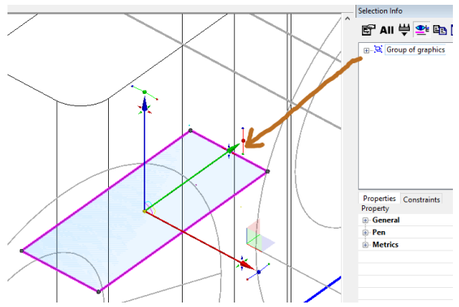
C) Frames: 0, 120, 240, 360, 480, 540, 720

B). Shows the rotation of the tin to reach 90 degrees, in amount of frames. Higher figures will make a smoother looking object, but require much longer animation time.

C). This is the number of frames, As with B, higher numbers will look smoother, at the expense of time. These are guesswork. And based simply on what I think will look OK.

For the tin, we need a few details.

Fig 5



The tin will be grouped with a rectangle, using add to group command. This is because it we rotate the tin, and apply movement to it, it will veer off course. Setting the tin to rotate and the rectangle to movement will keep the tin straight.

Fig 6

The Calculation for tin rotation, Fig 6 C). Is simply 90 (degrees) divided by the number of frames. Which, as seen in Fig 4 (B). Is 240 frames. Giving 0.375 per frame

C) Tin can rotation: Therefore 90 degrees rotation / 240 frames = 0.375 deg per frame. (+ or - depending on tin rotation)

D) Tin movement:
1 to 240, 180mm in 240 frames = 0.75mm per frame
241 to 480, 240mm in 240 frames = 1mm per frame
481 to 720, 264mm in 240 frames = 1.1mm per frame

Movement is dictated by the number of drawing units, divided by the number of frames. Although there are 6 sections, 1 and 2 are the same and can be combined. 3 and 4 can be combined. Lastly 5 and 6, can be combined.

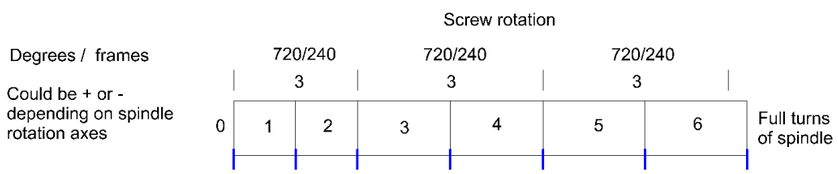
Looking at Fig 6 D). We can see that we only need three calculated figures, to span the whole animated frames.

If we had drawn all the sections equal units, we would have only needed one calculation for the lot. I drew the different to show the effect.

The remaining calculation is for the rotation of the cylinders. Looking at Fig 4 above. Although the drawing units size are different, we have used 120 frames for each of the six rotations

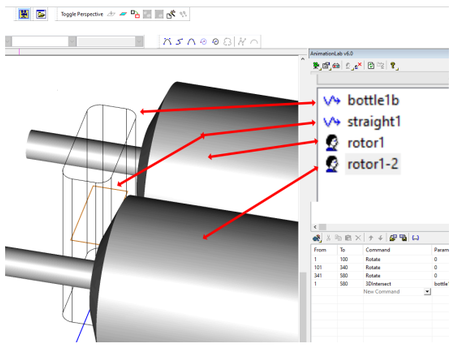
As can be seen in Fig 7. The six different section have the same rotation degrees. This is not necessarily the case in all circumstances, but in this case it simplifies the input as we only need one command for the whole rotation.

Fig 7



Now we have the figures, we can look at the animation side of things.

Fig 8



As with all animations, first we need actors. Fig 8.

IMPORTANT. Before making the rectangle (called straight). Into an actor, it must be made into a group. Even though it is a single object. This is so the add to group command will work.

The two spindles, I've called rotor 1 and 2).
The Tin, which I called a bottle originally.
The rectangle, I called straight, because all it does is move straight in the X direction.

Fig 9 **Bottle**

From	To	Command	Param-1	Param-2	Param-3
0	0	AttachToGroup	straight1		
241	480	Rotate	0	0	-0.375
		New Command			

The bottle Fig 9. has two commands.
The first 0 to 0. Attached the bottle to the rectangle (straight) group. This can be done because we have already set the rectangle as a single object group.

The second command rotates the bottle 90 degrees, starting at from 241. And ending at frame 480. We have already determined the rotation per frame to be 0.375. Therefore the only thing left is to determine + or - sigh.

For this we ensure the object coordinate system is set to entity and extents. Select the object, and manually rotate in the desired direction. Look at the inspection bar to determine + or -. One can simply look at he objects axes, and work it out. But manually checking eliminates errors.

Fig 10 **Rectangle (straight)**

From	To	Command	Param-1	Param-2	Param-3
1	240	Move	0.75	0	0
241	480	Move	1	0	0
481	720	Move	1.1	0	0
		New Command			

Next we have Movement of the rectangle (group). This is simply three move command, using the frames and figures derived earlier. (D on previous page).

We are moving in the positive X direction, so no need for a sign.

Fig 11 **Rotor 1**

From	To	Command	Param-1	Param-2	Param-3
1	720	Rotate	0	0	-3
1	720	3DSubtract	bottle1b	0	
		New Command			

For the spindles (rotors), they are identical, except. In this case, they way that they were drawn, resulted in opposite rotation axes.

Rotor 1 has a negative rotation Fig 11. And rotor 2 has a positive rotation. Fig 12.

Fig 12 **Rotor 2**

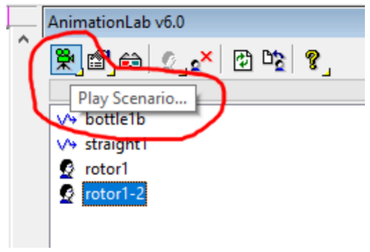
From	To	Command	Param-1	Param-2	Param-3
1	720	Rotate	0	0	3
1	720	3DSubtract	bottle1b	0	
		New Command			

As all rotations were 120 frames, we only need one rotate command. Had the frames be different we would simply add more rotate commands, spanning the relevant frame numbers.

The subtraction command, uses all frame (except frame 0). And subtracts the bottle from both cylinders.

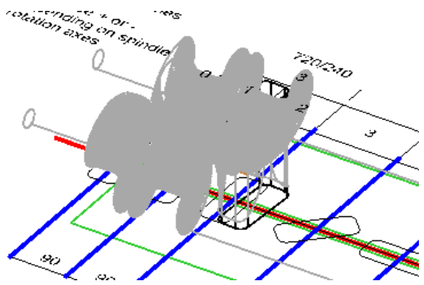
Lastly. If all looks OK, we need to 'play' the animation in wire frame. One can use draft or quality. But there is almost no advantage in doing so. And the animation render will take longer.

Fig 13



However. Personally. Once everything is set up. I save the file under a new name, before the first animation. This is just so I have a clean copy of the file, in case something goes wrong.

Fig 14



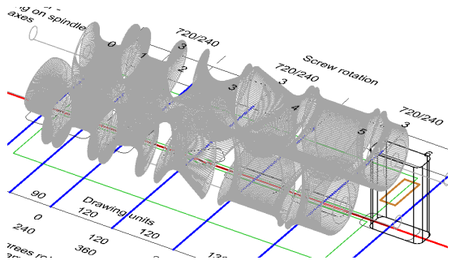
Once the animation starts, one should see it cutting into the cylinders. Fig 14. If this is not visible, then something is amiss.

Stop the recording and use 'undo' to reverse things. And Trace the problem.

Because we are dealing with 58 frames, which include subtractions. I will take quite a while to record / complete the animation.

In actual fact we are not bothered about the animation, it is simply used to automate the feed screw construction. As to manually move tin, rotate tin at frame 101, rotate spindle1, rotate spindle2, subtract. Etc. etc. 580 times, is definitely prone to errors creeping in.

Fig 15

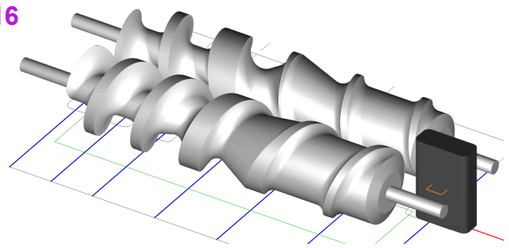


After possible 30 to 60 minutes. The animation is complete. Answer 'No' when asked if you want to play video. (this took 44 minutes).

At this stage we can turn on draft render, to see what our finished feed screw looks like.

If one is not happy with the results, for example, too few facets, causing a jagged appearance. Simply use 'undo'. Make the necessary adjustment, and remake the animation.

Fig 16



As can be seen in Fig . Draft render. I doesn't look bad. But it will never be perfect, as the subtractions creates a faceted appearance.

DO NOT save the file. If everything looks OK. Use the save-as (after switching to wire frame mode). This means one still have an unchanged version in case any errors are found on close inspection.

With commands, one normally needs to use edit menu - undo to set the file back to normal, if errors are found.

One problem that may be encountered with 'undo', in some versions of TC, is the creation of duplicate objects.

If Fig. After using undo, it looks reasonable in draft view.
What can happen, is the undo works, but has created a copy of the feed screw, instead of deleting it. As can be seen in wire frame view Fig.

Fig 17

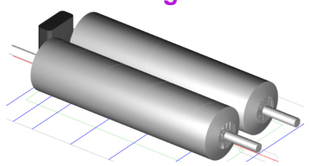
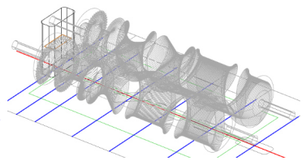


Fig 18



If this occurs, simply select the screw and delete, leaving the original spindles. Note, their entry as actors may be removed, this is normal. Simply select a spindle, and its entry as an actor will return, then select the second one.

ERROR.

Fig 19

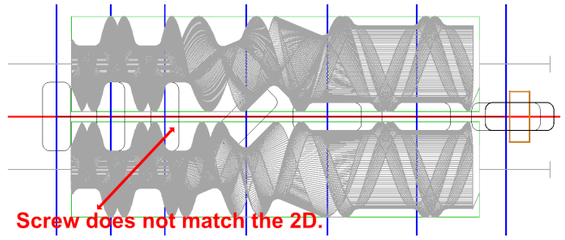


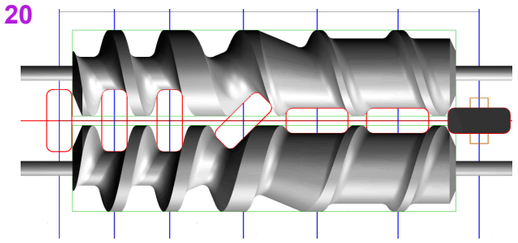
Fig . Shows an error / mismatch between the finished screw, and the 2D.

As can be seen, I made an error.

This was traced to the fact that, when drawing to 2D. I mistakenly made two reference points, 80mm apart, when they should have been 90mm apart.

This means, that for the first 240 frames, The tin movement distance should have been .6666 instead of 0.75. In actual fact, the screw will still work fine. But in the interest of getting it right, I adjusted the 2D, and thus the start point 'tin can'. So the original 0.75 movement, now applies.

Fig 20



After the changes were made. The Animation / subtractions were carried out again.

As can be seen in Fig . I highlighted the 2D to Red, so it shows up better, and the spindle now matches the 2d perfectly.

I mentioned previously about facets. As can be seen in Fig . The curvature is made of multiple flat surfaces, simulating a curve. With enough frames, these surfaces can me minimal. If the frames per rotation were reduced, which in tern causes higher degree value for the rotate command. It results in a bad finish, as in Fig . (which used 7.2 degrees)

Fig 21

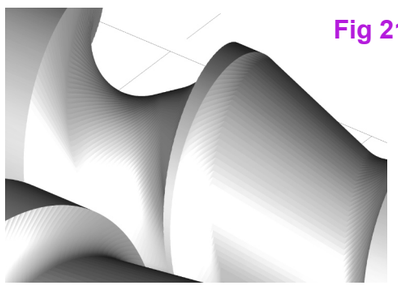
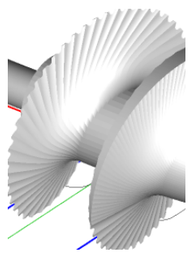


Fig 22



As with the previous (Excel) method. To get a very smooth finish, one would need to use lofting in the platinum version. But unless one is sending the file directly from TC to a CNC machine, then simply increasing the number of frames per section, which results in reducing the spindle rotation angle, would normally be all that is required for a good 3D printed screw.

Example, In the above screw. We used 120 frames for each of the six sections, resulting in a 3 degree spindle rotation per frame (360 / 120 = 3).

If we change it to 180 per section, the spindle rotation would be 360 degrees / 180 frames = 2 degrees per frame.

This would mean the whole animation will increase from 720 frames, to 1080 frames. Basically it will just take longer to animate the subtractions. But it will look better.

A word of caution. The more frames per spindle rotation, the slower TC will get. Even at the 3 degrees used here. When selecting the finished feed screw. It can take several seconds before TC will allow one to move it.

That is just the price you have to pay for drawing complex curved items in TC. Cure = buy a Super computer or a different software.

Example 2

If one required a more smoother rotation of the tin, one can increase the distance the tin travels with respect to the spindle rotations.

In this example, the spindle rotates four times to get the the tin 90 degrees, instead of two in the previous example. Coupled with a an increase in frames for the rotation from 240 to 360.

To keep the animation time low(ish). I reduced the frames per rotation from 120 to 90. This does make it look more faceted, but this is only an example. So I deemed it acceptable.

Fig 23

Previous example with two spindle turns to get the tin 90 degrees.

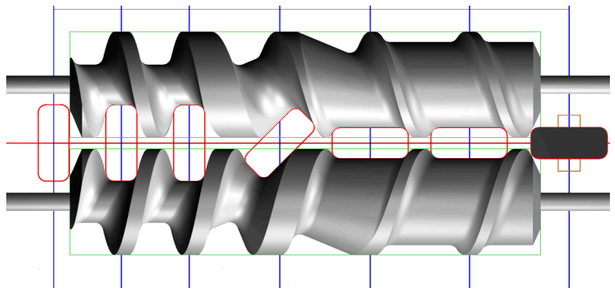
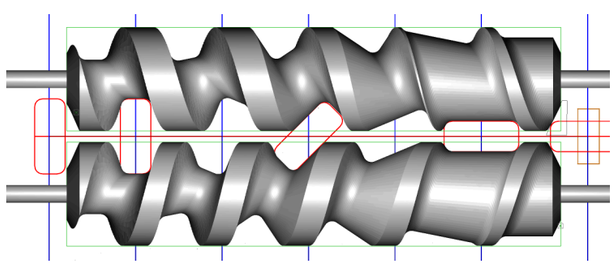


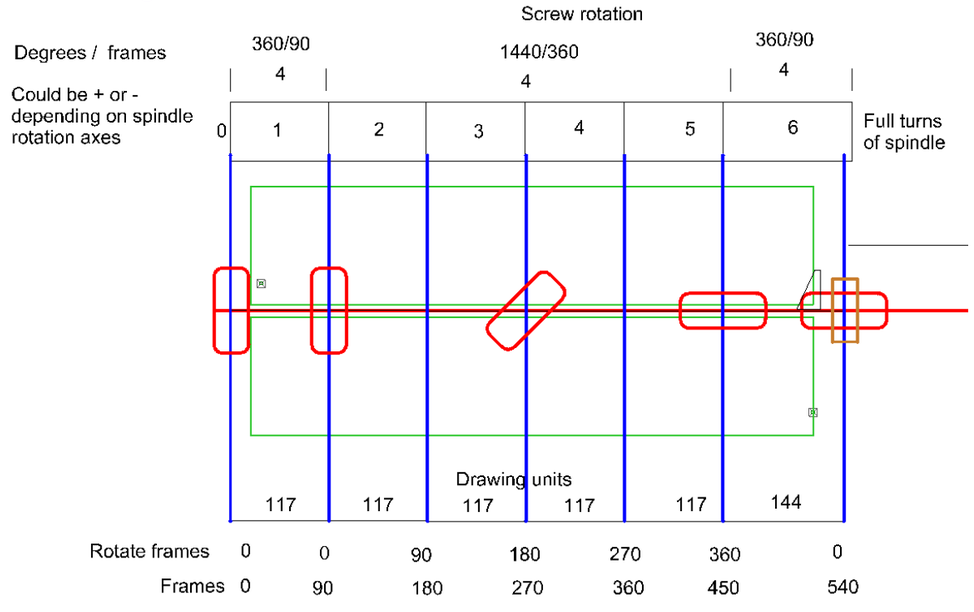
Fig 24

New example uses four spindle turns to get the tin 90 degrees.



The setup is similar to previous. The figures are change to reflect the fact that, the tin rotation is spread over more distance. The setup still uses 6 spindle rotations for the whole project.

Fig 25



Tin can rotation Therefore 90 degrees rotation / 360 frames
= 0.25 deg per frame. (+ or - depending on tin rotation)

Tin movement 1 to 90, 117mm in 90 frames = 1.3 mm per frame
91 to 450, 468mm in 360 frames = 1.3mm per frame
451 to 540, 144mm in 90 frames = 1.6mm per frame

The animation setup is shown in Fig .

Fig 26

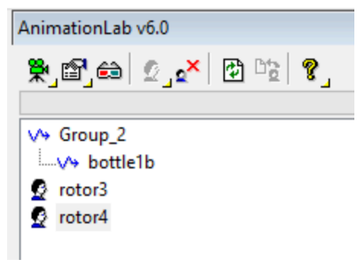


Fig 27

Group (straight) object

From	To	Command	Param-1	Param-2	Param-3
1	450	Move	1.3	0	0
451	540	Move	1.6	0	0
		New Command			

Fig 28

Tin can / Bottle

From	To	Command	Param-1	Param-2	Param-3
0	0	AttachToGroup	Group_2		
91	450	Rotate	0	0	-0.25
		New Command			

Fig 29

Rotor 3

From	To	Command	Param-1	Param-2	Param-3
1	540	Rotate	0	0	4
1	540	3DSubtract	bottle1b	0	
		New Command			

Fig 30

rotor 4

From	To	Command	Param-1	Param-2	Param-3
1	540	Rotate	0	0	4
1	540	3DSubtract	bottle1b	0	
		New Command			

The figures in both the examples were pretty straightforward. In that, I chose distance and rotation to keep to one decimal place. This helps avoid calculation errors. For example 130 mm over 110 frames would be 1.18181818 etc. mm per frame. Not a good figure.

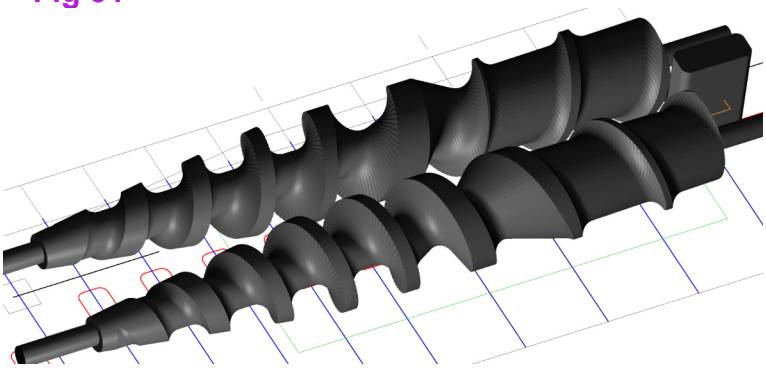
Always best to adjust things to get good figures to work with. Rather that insisting on specific figures. And risk errors.

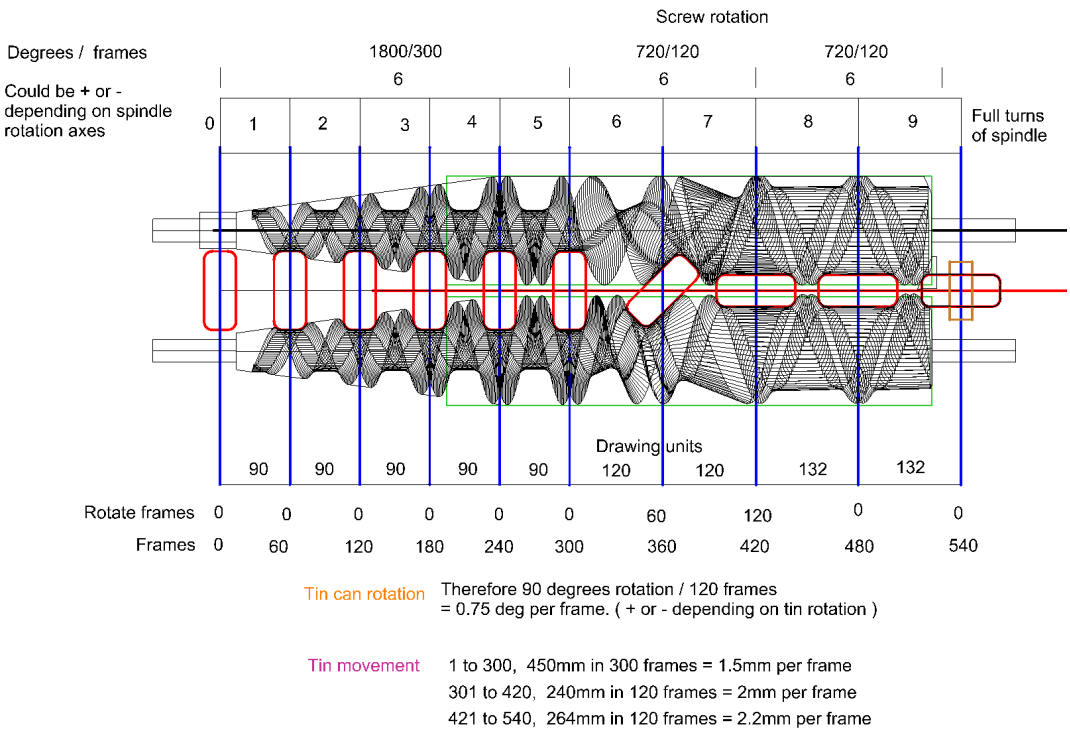
Variation.

There may be times when a tapered screw may be preferable. The setup is the same, except using a tapered spindle, to subtract from.

In this example I used a relatively low frame rate of 60 per rotation. This was simply done in this case, so the animation did not take too long.

Fig 31





The End.