

## Calculating change gears for thread cutting on Weiss/Warco 280 F lathe

On the spindle there is a fixed 40T gear, this is a *driver* gear. **H** means there is no gear; use a spacer either from when you remove the feed ratios or in the box with the change gears.

**L** is the leadscrew gear (or input to gearbox) and is a *driven* gear.

The vertical dash between numbers in the threading table show that the gear above meshes with the one below.

Numbers side by side are on the same bolt e.g. Z1 & Z2 are on one stud, Z3 & Z4 on another.

This is the formula based on my Imperial 280 but assuming its got a metric leadscrew (3mm), the head/spindle and gearbox should be the same on both its just the leadscrew that would be different.

We know the leadscrew will move the carriage 3mm per revolution of the leadscrew but we want it to only move by 1.75mm per rev so:  $1.75 / 3.00 = 0.583333$

Now to get the same number with the gears.

Basically divide the driver by the driven so the 40T spindle drives the 50T, 50T drives the 80T, 70T drives the 60T, this gives us the fractions:  $40/50$ ,  $50/80$  &  $70/60$  or expressed as decimals: 0.8, 0.625 & 1.16666.

The gearbox ratios are A=1:1, B=2:1 & C=1:2 which give the decimals 1, 2 & 0.5.

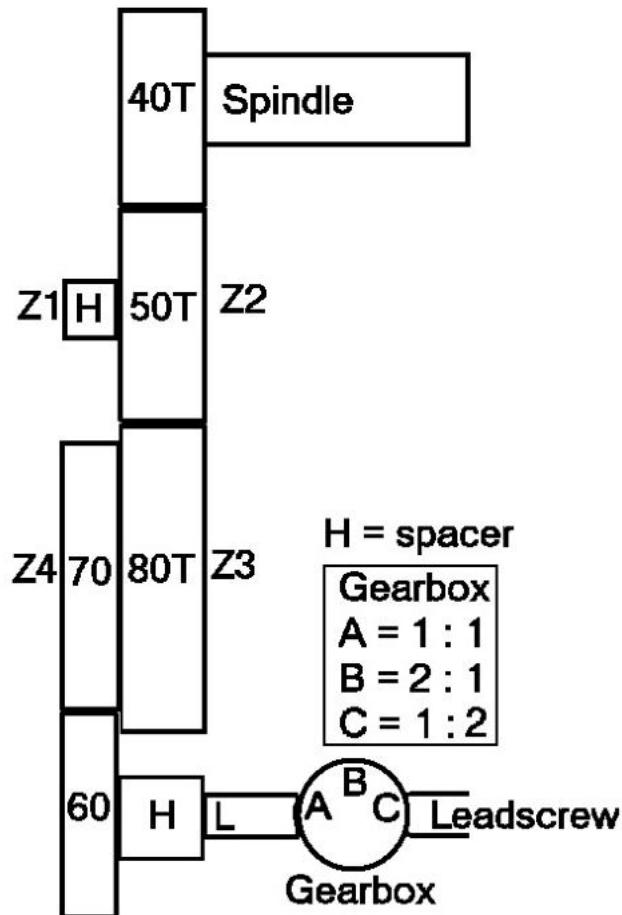
We assume gearbox selector in position A. You now multiply these decimals so:  $0.8 \times 0.625 \times 1.16666 \times 1 = 0.583333$

If the two numbers are the same you have got it right. In our case they both come out at **0.583333**.

The gears are module 1.5.

(From Jason B's post on Model Engineer forum:

<http://www.model-engineer.co.uk/forums/postings.asp?th=83460&p=5>)



## Calculating metric threads on lathe with metric leadscrew

The general formula is: 
$$\frac{\text{Pitch of work (mm)}}{\text{Pitch of leadscrew (mm)}} = \frac{\text{Driver gear}}{\text{Driven gear}}$$

The **Weiss 280/290 F** metric lathes have a 3mm pitch leadscrew and are as standard supplied with these change gears:

A fixed 40T on the spindle, in addition these change gears:

20, 30, 45, 50, 60, 60, 65, 70, 75, 80, 85

*Example 1:*

Let us calculate gear wheels needed to cut 1mm pitch on the work, gearbox selector in A:

Pitch of work (mm)	Driver gear	1	25
----- = ----- = --- = ---			
Pitch of leadscrew (mm)	Driven gear	3	75

A 25 gear wheel and a 75 gear wheel will give the needed ratio, but it will not span the quadrant, and since the 40T gear on the spindle is fixed, it must be included. So we add:

25	80	25	2 · 40	25 · 2	40	50	40
---	---	---	-----	-----	---	---	---
75	80	75	80	75	80	75	80

Now we have included a 40T gear wheel as a driver wheel – the spindle gear. 75 and 80 are driven gears. Now we just need gear wheels on Z1 & Z2, to span the quadrant (banjo). Here we use just one 60T gear wheel, it is both a driven gear (driven from spindle) and a driver gear, driving the 80 gear. So we get:

50	40	60
---	---	---
75	80	60

Spindle is 40T driving Z2 with a 60T gear (spacer on Z1). Z3 is a 80T gear (driven from the Z2 60T gear), Z4 is 50T driving the 75T gear on L (on gearbox) and a spacer closest to the gearbox. The easy way to get which gears for threading 1mm pitch would of course be to look at the table on the gear cover.

*Example 2.*

Let us calculate gears needed for a pitch not in the table – 4mm – and gearbox selector in A.

Pitch of work (mm)	Driver gear	4	4	10	40
----- = ----- = --- = --- . --- = ---					
Pitch of leadscrew (mm)	Driven gear	3	3	10	30

A 40T driver gear driving a 30T gear would give the ratio needed, but will not span the banjo. We will have to have gear wheels on the Z1 / Z2 stud and on the Z3 / Z4 stud. We can add:

40	80	60
---	---	---
30	80	60

The spindle 40T is driving a 80T gear on Z2 (spacer on Z1), this 80T gear is also a driver driving a 30T gear on Z3, with a 60T gear on Z4 driving a 60T gear on L (+ spacer).

Example 3.

Let us calculate the change gears needed for a pitch of 0.7mm, standard pitch for M4. This is not listed in the feed and thread table.

$$\begin{array}{rcccccccc} \text{Pitch of work (mm)} & \text{Driver gear} & 0.7 & 0.7 & 10 & 7 & 5 & 35 & 2 \cdot 40 \\ \hline & = & = & = & = & = & = & = & = \\ \text{Pitch of leadscrew (mm)} & \text{Driven gear} & 3 & 3 & 10 & 30 & 5 & 150 & 80 \end{array}$$

Now we can "move" 2 to multiply with 35 and get:

$$\begin{array}{rcccccccc} 70 & 40 & 20 & 70 & 20 & 40 & 70 & 20 & 40 \\ \hline 150 & 80 & 20 & 50 \cdot 3 & 20 & 80 & 50 & 60 & 80 \end{array}$$

Now the 40T driver gear (on spindle) will drive the 80T driven gear on Z2, Z1 has a 70T driver gear, driving a 50T gear on Z4. A 20T gear on Z3 drives a 60T gear on L (+spacer)

## Additional metric threads



$\begin{array}{cc} Z_1 & Z_2 \\   &   \\ Z_4 & Z_3 \\   &   \\ L & \end{array}$					$\begin{array}{cc} 70 & 80 \\   &   \\ 50 & 20 \\   &   \\ H & 60 \end{array}$	$\begin{array}{cc} H & 80 \\   &   \\ 60 & 30 \\   &   \\ 60 & H \end{array}$
C					0.35	2.0
A					0.7	4.0
B					1.4	N.R.

## Calculating module threads on 290F lathe with metric leadscrew

Module
Driver gear

The general formula is:  $\frac{\text{Pitch of leadscrew (mm)}}{\pi} = \frac{\text{Driven gear}}{\text{Driver gear}}$

Since  $\pi$  (Pi) is not a simple fraction we have to use an approximation; **25/8** or **22/7** (a better approximation). These approximations will only work if you have some additional change gears, if you use 25/8 for  $\pi$  : 21, 24 (or/and possibly 48), 32 and 55.

You need to cut a module thread if you want to make a worm for a worm wheel.

### Module 1.25

You'll need a 55T and a 21T gear in addition to the gears supplied. Gearbox selector position A.

$$\begin{array}{l}
 \text{Driver gear} \quad 22 \quad 1.25 \quad 11 \quad 2 \cdot 1.25 \quad 11 \quad 2.5 \quad 10 \quad 11 \quad 25 \quad 11 \quad 5 \cdot 5 \quad 55 \quad 5 \\
 \hline
 \text{Driven gear} \quad 7 \quad 3 \quad 7 \quad 3 \quad 7 \quad 3 \quad 10 \quad 7 \quad 30 \quad 7 \quad 3 \cdot 10 \quad 21 \quad 10 \\
 \\
 55 \quad 5 \quad 2 \cdot 40 \quad 55 \quad 10 \quad 40 \quad 55 \quad 60 \quad 40 \\
 \hline
 21 \quad 10 \quad 80 \quad 21 \quad 10 \quad 80 \quad 21 \quad 60 \quad 80
 \end{array}$$

40T driver gear is on spindle, driving a 80T gear on Z2. On Z1 a 55T driver gear, driving an 60T idler on Z4 (with spacer on Z3). 21T gear on L (+ spacer).

### Module 1.

You will need a 24T gear in addition to the gears supplied. Gearbox selector in position A.

$$\begin{array}{l}
 \text{Driver gear} \quad 25 \quad 1 \quad 5 \cdot 5 \quad 1 \quad 50 \quad 1 \quad 8 \quad 50 \quad 40 \quad 75 \\
 \hline
 \text{Driven gear} \quad 8 \quad 3 \quad 8 \quad 3 \quad 80 \quad 3 \quad 8 \quad 80 \quad 24 \quad 75
 \end{array}$$

40T driver gear is on spindle, driving a 80T gear on Z2. On Z1 a 50T driver gear, driving a 75T gear on Z4 (with spacer on Z3). The 75T gear is also a driver for the 24T gear on L (+ spacer). If you move the gearbox selector to position C you get module 0.5 (using position B is **Not Recommended**).

### Module 0.75.

You will need a 32T gear in addition to the gears supplied. Gearbox selector in position A.

$$\begin{array}{l}
 \text{Driver gear} \quad 25 \quad 0.75 \quad 25 \quad 7.5 \quad 25 \quad 7.5 \quad 50 \quad 15 \quad 50 \quad 30 \quad 40 \quad 50 \quad 30 \quad 40 \\
 \hline
 \text{Driven gear} \quad 8 \quad 3 \quad 8 \quad 30 \quad 8 \cdot 2 \quad 15 \quad 32 \quad 30 \quad 32 \quad 60 \quad 40 \quad 32 \quad 30 \quad 80
 \end{array}$$

The fraction 30/30 means you can use an idler – like 70T – to span the quadrant.

40T driver gear is on spindle, driving a 80T gear on Z2. On Z1 a 50T driver gear, driving a 70T gear on Z4 (spacer on Z3). The 70T gear is driving a 32T gear on L (+ spacer on L).

### Module 0.5.

You will need a 48T gear in addition to the gears supplied. Gearbox selector in position A.

$$\begin{array}{l}
 \text{Driver gear} \quad 25 \quad 0.5 \quad 5 \cdot 5 \quad 0.5 \quad 50 \quad 2.5 \quad 16 \quad 50 \quad 40 \quad 60 \\
 \hline
 \text{Driven gear} \quad 8 \quad 3 \quad 8 \quad 3 \quad 80 \quad 3 \quad 16 \quad 80 \quad 48 \quad 60
 \end{array}$$

40T driver gear is on spindle, driving a 80T gear on Z2. On Z1 a 50T driver gear, driving a 60T gear on Z4 (with spacer on Z3). The 60T gear is also a driver for the 48T gear on L (+ spacer). ). If you move the gearbox selector to position B you get module 1, in position C you get module 0.25.

#### Module 0.4

No additional change gears needed.

$$\begin{array}{r} \text{Driver gear} \quad 25 \quad 0.4 \quad 5 \quad 5 \cdot 0.4 \quad 50 \quad 2 \quad 20 \quad 50 \quad 40 \quad 60 \\ \hline \text{Driven gear} \quad 8 \quad 3 \quad 8 \quad 3 \quad 80 \quad 3 \quad 20 \quad 80 \quad 60 \quad 60 \end{array}$$

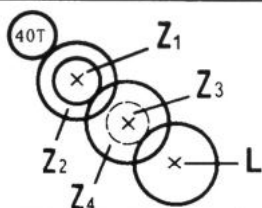
40T driver gear is on spindle, driving a 80T gear on Z2. On Z1 a 50T driver gear, driving a 60T gear on Z4 (spacer on Z3), this gear is also driving a 60T gear on L (+ spacer). This will work since there are two 60T gears supplied with the lathe.



Z <sub>1</sub>	Z <sub>2</sub>			50 80	50 80	50 80	50 80	55 80
Z <sub>4</sub>	Z <sub>3</sub>			60 H	65 H	70 H	75 H	60 H
L				60 H	48 H	32 H	24 H	21
C				0.2	0.25	0.375	0.5	0.625
A				0.4	0.5	0.75	1	1.25
B				0.8	1	1.5	N.R.	N.R.

# THREADING AND FEEDING TABLE FOR METRIC LATHE

CE



$Z_1$ $Z_4$	$Z_2$ $Z_3$ L	30 80 75 20 H 85	45 75 80 20 H 85	45 75 80 30 H 85	30 70 80 50 H 85	30 75 80 50 H 60	45 75 60 50 H 80
	C	0.05	0.07	0.10	0.12	0.16	0.25
	A	0.1	0.14	0.21	0.25	0.32	0.5
	B	0.2	0.28	0.42	0.5	0.65	/
	C	/	/	/	/	/	0.03
	A	0.015	0.017	0.026	0.03	0.036	0.06
	B	0.030	0.035	0.052	0.06	0.072	0.12



$Z_1$ $Z_4$ L	$Z_2$ $Z_3$	H 60 20 75 80 H	H 60 30 80 75 H	H 60 50 80 75 H	H 60 50 80 60 H	70 80 50 20 H 60	H 50 60 80 60 H	H 50 70 80 60 H	H 80 60 30 60 H
C		0.2	0.3	0.5	0.625	0.35	0.75	0.875	2.0
A		0.4	0.6	1.0	1.25	0.7	1.5	1.75	4.0
B		0.8	1.2	2.0	2.5	1.4	3.0	3.5	N.R.



$Z_1$ $Z_4$ L	$Z_2$ $Z_3$	H 60 60 70 65 H	H 65 50 60 70 H	H 60 50 75 60 H	H 60 45 50 85 H	H 60 50 80 65 H	H 70 45 60 85 H	H 60 65 80 50 H	H 60 60 85 45 H	H 50 45 85 70 H
C		8	9	9.5	10	11	12	6.5	6.75	14
A		16	18	19	20	22	24	13	13.5	28
B		32	36	38	40	44	48	26	27	56



$Z_1$ $Z_4$ L	$Z_2$ $Z_3$			50 80 60 H 60 H	50 80 65 H 48 H	50 80 70 H 32 H	50 80 75 H 24 H	55 80 60 H 21 H
C				0.2	0.25	0.375	0.5	0.625
A				0.4	0.5	0.75	1	1.25
B				0.8	1	1.5	N.R.	N.R.

## Calculating imperial (inch) threads on lathe with metric leadscrew

When cutting imperial threads on a lathe with metric leadscrew it is easiest to keep the half-nuts closed all the time and stop and back off the tool and then reverse the lathe (same for cutting module threads).

Imperial threads are measured as the number of threads per inch (TPI), and we must convert inch to mm, 5 inches is 127mm, so a 127T gearwheel will give a perfect translation. A 127 wheel is large and therefore other approximate translations are used (see table 1).

In the formula TPI is the number of threads per inch you want to cut, LS is the leadscrew pitch in mm, often 3 on smaller lathes, F is a conversion factor from table 1.

$$\text{Drivers} \quad 1 \quad 10$$

The general formula is:  $\frac{\text{Drivers}}{\text{Driven}} = \frac{1}{\text{TPI}} \cdot \frac{10}{\text{LS}} \cdot F$

Table 1, translation Factors		
F	Error	
28/11	-1 in 465	Traditional factor
13/33	1 in 1650	Traditional factor, small error
38/15	1 in 380	Traditional factor
40/7 · 40/9	1 in 8000	Traditional factor, very small error
27/17 · 8/5	-1 in 2160	
13/8 · 39/25	1 in 507	

### Example, 27 TPI

You want to cut a 27 TPI thread (Pipe thread in the US) on a lathe with a LS of 3mm pitch. By using a Factor that contain 27, this number then can be eliminated.

$$\begin{array}{cccccccccccccccc} \text{Drivers} & 1 & 10 & 27 & 8 & 2 \cdot 5 & 2 \cdot 4 & 4 & 10 & 4 & 5 & 40 & 20 \\ \hline & = & \frac{1}{27} \cdot \frac{10}{3} \cdot \frac{27}{17} \cdot \frac{8}{5} = \frac{2 \cdot 5}{3 \cdot 17} \cdot \frac{2 \cdot 4}{5} = \frac{4}{3} \cdot \frac{10}{17} \cdot \frac{4}{5} = \frac{40}{85} \\ \text{Driven} & 27 & 3 & 17 & 5 & 3 \cdot 17 & 5 & 3 & 10 & 17 & 5 & 30 & 85 \end{array}$$

40 is the Driver gear on the Spindle, driving a suitable idler gear (both driver and driven) on Z<sub>2</sub>, (with a spacer H on Z<sub>1</sub>), driving the 30 gear on Z<sub>3</sub>. The 30T gear is connected to the 20 T Driver on Z<sub>4</sub>, driving the 85 gear on LS.

### Example, 13 TPI

With gearbox lever in position A. This will require a 39 and a 48 wheel. By using a Factor that contain 13, this number can be eliminated.

$$\begin{array}{cccccccccccccccc} \text{Drivers} & 1 & 10 & 13 & 39 & 2 \cdot 5 & 39 & 40 & 2 \cdot 5 & 39 & 40 & 39 & 40 \\ \hline & = & \frac{1}{13} \cdot \frac{10}{3} \cdot \frac{13}{8} \cdot \frac{39}{25} = \frac{2 \cdot 5}{3 \cdot 8} \cdot \frac{39}{25} \cdot \frac{40}{2 \cdot 20} = \frac{2 \cdot 5}{3 \cdot 8} \cdot \frac{39}{25} \cdot \frac{40}{2 \cdot 12} = \frac{50}{5 \cdot 4} \cdot \frac{39}{50} = \frac{39}{48} \\ \text{Driven} & 13 & 3 & 8 & 25 & 3 \cdot 8 & 25 & 2 \cdot 20 & 2 \cdot 12 & 50 & 5 \cdot 4 & 50 & 48 \end{array}$$

40 is the Driver gear on the Spindle, driving an idler gear (both driver and driven) on Z<sub>2</sub>, (with a spacer H on Z<sub>1</sub>), driving the 50 gear on Z<sub>3</sub>. The 50 gear is connected to the 39 gear on Z<sub>4</sub>, driving the 48 gear on LS.

Here's another combination (13.026 TPI) that doesn't need extra gear wheels. 40 is the Driver gear on the Spindle, driving a 60T Idler gear (both driver and driven) on Z<sub>2</sub>, (with a spacer H on Z<sub>1</sub>), driving a 80 gear on Z<sub>3</sub>. The 80 gear is connected to a 65 gear on Z<sub>4</sub>, driving a 50 gear on LS. This is with gearbox lever in position A, with gearbox lever in position C you get 26 TPI.

*A few other inch combinations*

13.5 TPI (actually 13.494 TPI, will also give 27 TPI – actually 26.988 TPI – with gearbox lever in position C on 280/290). 40 is the Driver gear on the Spindle, driving a 50T Idler gear (both driver and driven) on  $Z_2$ , (with a spacer H on  $Z_1$ ), driving the 85 gear on  $Z_3$ . The 85 gear is connected to the 60 gear on  $Z_4$ , driving a 45 gear on LS.

26TPI (25.988 TPI). 40 is the Driver gear on spindle, driving a suitable Idler gear (both driver and driven) on  $Z_2$ , (with a spacer H on  $Z_1$ ), driving a 85 gear on  $Z_3$ . The 85 gear is connected to the 45 gear on  $Z_4$ , driving a 65 gear on LS.

On my HBM 290 lathe both the Change gear table on the machine and in the manual has an error for the 9, 18 and 36 TPI; spacer on  $Z_1$ , a 50T idler on  $Z_2$ , driving a 85T gear on  $Z_3$ . The 85T gear is connected to a 60T gear on  $Z_4$  that is driving a 65T gear on the leadscrew. The combination listed in the manual and on the machine will give 9.75, 19.5 and 39 TPI.

A 65T idler on  $Z_2$ , driving a 60T gear on  $Z_3$ , the 60T gear is connected to a 50T gear on  $Z_4$ , that is driving a 70T gear on the leadscrew (position A gives 17.78TPI).



## Thread Dial Indicator for metric 290F lathe

The metric 280/290 F lathes are equipped with a 3mm pitch leadscrew and a thread dial indicator with a **30T** worm gear (about module 1) and a dial with **6** divisions (sketch at right).

One revolution of the thread indicator will move the carriage :  $30 \times 3\text{mm} = 90\text{mm}$ .

If you are cutting a metric thread with 2mm pitch, 90 is evenly divisible with 2 ( $90 / 2 = 45$ ) giving no remainder. That means if you engage the half-nuts when the thread dial is in position 2 you can disengage the half-nuts when you reach the end of the thread, move the carriage and engage the half-nuts when the thread dial is at position 2 again. And you will pick up the previous cut thread correctly.

You can also use other positions on the thread dial, position 2, 4 and 6 are evenly spaced so the carriage will travel  $90\text{mm} / 3 = 30\text{mm}$ . You then get  $30 / 2 = 15$  (no remainder) so you can engage the half-nuts at position 2, 4 or 6 and still pick up a 2mm pitch thread correctly.

You can't use any division, the dial has 6 equally spaced divisions and  $90 / 6 = 15$ . However  $15 / 2 = 7.5$ , you get a remainder. So position 1, 3 and 5 can't be used for 2mm pitch thread cutting. If we do the same calculation for a 1.5 mm pitch thread we get :  $15 / 1.5 = 10$  (no remainder), that mean you can engage the half-nuts at any of the 6 positions and pick up a 1.5mm pitch thread correctly.

For 0.4mm and 2mm pitch threads you can use position 2, 4 and 6 and pick up the thread correctly.

For 0.2 – 0.25 – 0.3 – 0.5 – 0.6 – 0.75 – 1.0 – 1.25 – 1.5 – 2.5 and 3mm pitch thread you can engage the half-nuts at any of the 6 positions and pick up the thread correctly.

Some pitches are missing from the above listing, namely: 0.7mm, 0.8mm, 1.75mm, 3.5mm and 4.0mm. 90 cannot be evenly divided by any of these pitches, the solution is to use a worm gear with a different number of teeth – **28**. With a **28T worm gear** one revolution of the thread dial will move the carriage:  $28 \times 3\text{mm} = 84\text{mm}$ .

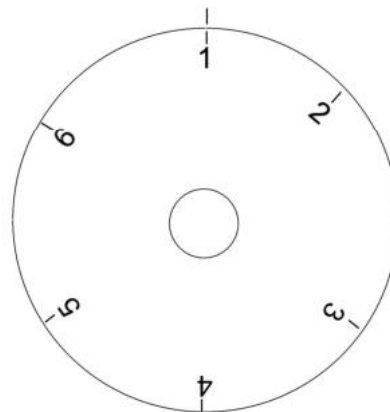
$84 / 1.75 = 48$ . You can use any of the dial positions 1 or 4 since  $84 / 2 = 42$  and  $42 / 1.75 = 24$  (no remainder). Using a thread dial and positions 1 and 4 and a 28T worm gear will let you correctly pick up not only 1.75mm pitch, but also many other pitches.

For pitches 0.3mm, 0.6mm, 0.75mm, 0.8mm, 1.5mm, 3.0mm and 4.0mm you can only use one position (1).

For pitches 0.2 – 0.35 – 0.4 – 0.5 – 0.7 – 1.0 – 1.75 – 2.0 and 3.5mm you can use any of position 1 or 4.

This table show which thread pitches that can be picked up using either a 30T worm wheel or a 28T worm wheel to connect the thread dial to the 3mm pitch leadscrew, and which thread dial positions that can be used.

Thread dial pos. (30T worm wheel)	Pitch in mm	Thread dial positions (28T worm wheel)	Pitch in mm
2, 4, 6	0.2	1	0.3, 0.6, 0.75, 0.8
2, 4, 6	0.4	1	1.5, 3.0, 4.0
2, 4, 6	2.0	1, 4	0.2, 0.35
1 - 6	0.3, 0.25	1, 4	0.4
1 - 6	0.5	1, 4	0.5
1 - 6	0.75	1, 4	0.7
1 - 6	1.0	1, 4	1.0
1 - 6	1.25	1, 4	1.75
1 - 6	1.5	1, 4	2.0
1 - 6	2.5	1, 4	3.5
1 - 6	3.0		



## Threading Dial for Metric Pitch Threads

By Martin Conelly

If you think about the pitch of an 11 TPI thread it is not hard to see that it has a pitch that cannot be written down exactly as a decimal number, but the same is also true for 3TPI, 6TPI, 12TPI and others.

Metric threads based on millimetre units (mm) use this as a system, threads are designated by their diameter and pitch such as M10 which is 10mm diameter and the standard course pitch is 1.5mm. From the smallest to a typical maximum pitch likely to be encountered in a small workshop of 6mm there are 24 pitch values that are metric standard pitches, I list them below in groups that are relevant to threading.

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
0.2mm	0.4mm	0.45mm	0.8mm	1.25mm	0.35mm
0.25mm	2mm	4.5mm	4mm	2.5mm	0.7mm
0.3mm	6mm			5mm	1.75mm
0.5mm					3.5mm
0.6mm					
0.75mm					
1mm					
1.5mm					
3mm					

And in a group of its own 5.5mm.

What is the relevance of these groups? Well a metric leadscrew equivalent to an 8 TPI leadscrew on an inch based lathe has a pitch of 3mm. All the threads in the *first group* can be fitted into 3 an exact number of times. This means that if you are cutting a thread with any of these pitches you would not need a threading dial, just re-engage anywhere to cut deeper or just take a polishing cut. *Group 2* requires 6mm or two leadscrew pitches to fit an exact number of pitches into, then three, four, five, seven and finally eleven leadscrew pitches for the 5.5mm pitch thread. So for any pitch after the first group a threading dial is needed for successful re-engagement of the half-nuts. So how many teeth do we need on the gear driving the dial? Well let's consider 16 like the inch version from earlier with a dial having 8 lines and four of them numbered. This will allow all of group 1 any point, all of group 2, any line and all of group 4, any numbered line, to be cut successfully with multiple passes. This only covers half the possible pitches, a different number of teeth on the gear will be required for the other pitches. If we replace the 16 tooth gear with one having 15 teeth we can now have 15 lines with every third line numbered 1 – 5 and every fifth line lettered A – C with one line being both 1 and A. With this we can do group 3 with numbers and group 5 with letters. A 14 tooth gear will do for group 6 with two lines on opposite sides and finally a similar dial with two lines and 22 teeth for 5.5mm if required. This is why metric lathes are supplied with a number of threading dials (or gears) and the correct one needs to be used for the pitch being cut. This complication is why the recommendations from many people is to leave the half-nuts engaged when cutting metric threads even on a lathe with a metric leadscrew. These gear tooth counts are not the only possibilities, you could have twice as many teeth on each gear to achieve the same result. You may also find metric leadscrews with different pitches. You could in theory have a gear with enough teeth to do all these different pitches but it would need a tooth count that was divisible by 2, 3, 5, 7 and 11 which means something that is probably ridiculously large and with complicated markings on the dial. If we decide not to include the 5.5mm pitch you could get away with 70 teeth which is still too large to be sensible. Multiple gears and threading dials is the preferred method as a result.

## Method of obtaining Register when threading – Using the Chasing dial

Most lathes have a chasing dial (Thread Dial Indicator), see Fig. 22, attached or built in as a part of the carriage. It comprises a bracket containing a gear, which is driven by meshing with the lead screw, and a graduated dial attached to the gear by a connecting spindle. The metric chasing dial is arranged so that any one of several gears (14, 16, 18, 20, 22 teeth – or some other number of teeth) can be assembled to engage the lead screw. The dial face has numbered graduations indicating turns of the lead screw.

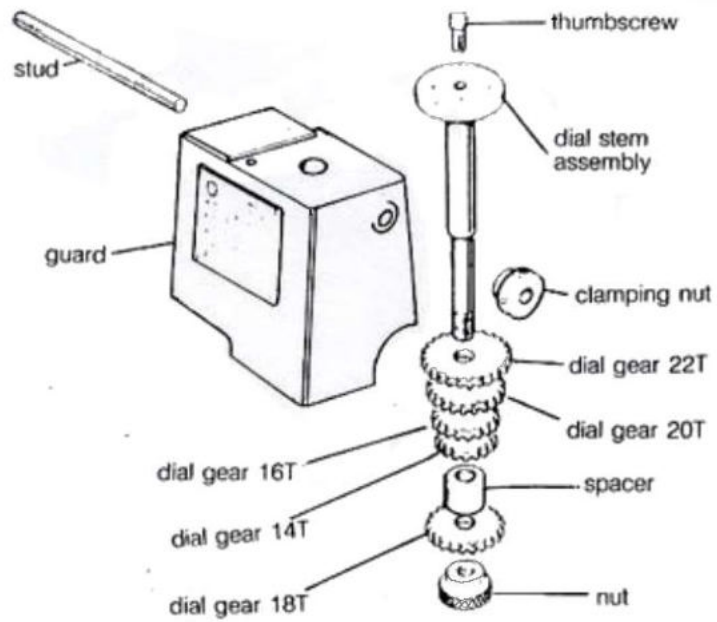


Figure 22 The chasing dial

### Principle of operation

Only at common length intervals spanning the leads of both the lead screw and the screw being cut can the screwing tool be engaged to register with the previous cut thread.

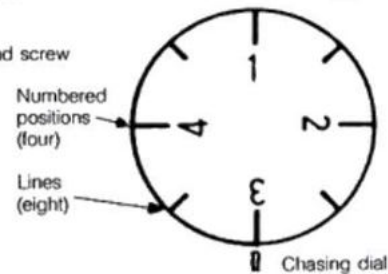
The numerator of the ratio obtained from work lead over lead screw lead, when used in its simple form, provides a number proportional to the smallest possible interval of length for register of the tool with the previous cut. Each tooth of the gear provides a count of the length of this interval as multiples of the lead of the lead screw. The number of teeth on the worm gear must be large enough to provide a practical gear. The dial face divides this larger-than-necessary number into time-saving parts – two or more per turn of the dial face. As many divisions of the dial face as possible should be used. This reduces waiting time for engagement of the half-nuts.

*Note:* The numerator must divide equally into the number of teeth of the worm gear in the chasing dial, for example the ratio is 5/12; the worm gear has 20 teeth; that is 20 divided by 5=4. Therefor the chasing dial may be used by engaging on number divisions 5 teeth apart – or 1, 2, 3 or 4.

Table 1 Engagement positions

For metric pitches

Using 6 mm lead screw



Pitches to be cut (mm)	Number of teeth on chasing dial gear	Position on dial for engaging correct register
0.35, 0.7, 1.75, 3.5, 7, 14	14	1 and 3 or 2 and 4
0.8, 4, 12	16	Any line
8	16	Any numbered line
0.2, 0.25, 0.3, 0.4, 0.5, 0.6, 0.75, 1, 1.5, 2, 3, 6	Chasing dial not required	Engage any position
0.45, 4.5, 9	18	1 and 3 or 2 and 4
1.25, 2.5, 5, 10	20	1, 2, 3 or 4
5.5, 11	22	1 and 3 or 2 and 4

### Engagement Positions

The following chart shows when the half-nuts can be engaged for cutting threads at various pitches, using the chasing dial (using a lathe with a 6mm lead screw).