UNIVERSAL THREAD CUTTING ON A MINI LATHE

Neil Wyatt looks at screwcutting on a modern lathe.

Sooner or later, all model engineers need to cut threads on their lathe. Either the thread is simply too large for a tap or die, it is an awkward size, or a degree of accuracy is required that cannot be achieved by other methods in the home workshop.

On lathes, screwcutting is typically achieved by gearing the mandrel to the leadscrew. If the gearing is 1:1, the thread cut will be the same pitch as the leadscrew (though not necessarily the same form or diameter). By varying the ratio of the gears, via a gearbox or using a set of change gears, screws of various pitches can be cut easily and accurately. This method of screw production was devised by Henry Maudsley around 200 years ago. Following Sir Joseph Whitworth's standardisation of screw threads, this technique for screwcutting played a critical part in the advent of mass production in the nineteenth century.

If we need to produce threads that will only mesh with others we have made, standardisation is not an issue, and we can use any convenient pitch for the work in hand. In many cases, however, we will want to use bought in fixings or mate parts with threads cut using standard taps or dies. In these cases we need to cut threads to standard sizes.

The 'mini-lathes' available from several UK sources are generally available in either 'metric' or 'imperial' leadscrew versions. The supplied changewheels allow the cutting of most of the usually encountered metric series threads with a 2mm pitch leadscrew. Similarly, imperial sizes are easily cut with the 16tpi leadscrew. In each case the various sizes are simple ratios to the leadscrew, and the required changewheels are given on tables on the machine and in the manual.

What if we want to cut metric threads on an imperial machine, or vice versa? One can change over the leadscrew, but this takes time, as the apron must be removed and the clasp nuts replaced and adjusted as well. Is there an easier way?

One inch equals precisely 25.4 millimetres – though in the recent past the conversion wasn't quite so neat! If we introduce a 254-tooth changewheel into our set-up, we can now convert precisely between the two systems. There is a problem though; a 1-module 254-tooth gear is 254mm in diameter! A 127 tooth gear could be used, as it is exactly half of 254, but it would still be about 5 inches across. You could accommodate such a gear by making a new mounting banjo but you might also need to add further idler gears. The whole set-up would be rather clumsy.

The answer is a 63-tooth gear (**photo 1**). It may seem that 63 is 'close enough' to

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The 63 tooth wheel (aluminium) next to a 60 tooth plastic wheel.

half of 127 to do the job, but it isn't – it would produce errors of around 2%, acceptable for some purposes, but not for many others. The 63 tooth gear arises from another, fortuitous bit of maths.

1mm pitch is 25.4 threads per inch. To cut 25.4 tpi on a 16 tpi leadscrew we need a ratio of 16:25.4, this works out at 0.62992:1, or almost exactly 63:100. If we introduce the ratio 63:100 into our gear train then a 16tpi leadscrew will cut a 1mm pitch thread – actually 1.00125mm pitch – well within the tolerance of any other aspect of the process. To translate this into standard change wheels we can use:

63/100 = 63/50 *1/2=63/50 x 30/60

This means a 63-tooth gear on the fixed stud, driving a 50T joined to a 30T on the intermediate pair, and finally a 60T on the leadscrew itself (**photo 2**).

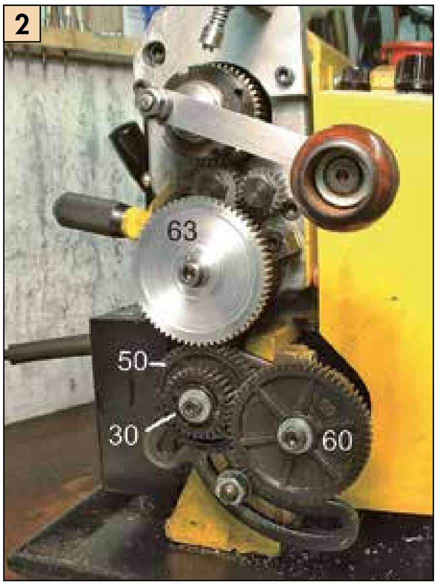
Conversely, a ratio of 100:63 allows a 1mm metric leadscrew to cut a 16tpi thread with the same accuracy. In fact, the standard metric leadscrew for mini lathes has a pitch of 1.5mm, so the 100:63 ratio would therefore cut 16 x 1.5 = 24 tpi, but this is dealt with by putting the ratios 2/3 and 100:63 in series. To get standard changewheels:

100/63 x 2/3 = 50/63 x 4/3 =
50/63 x 4/3 = 50/63 x 40/30

Just for clarity, this is a 50-tooth gear on the fixed stud, driving the 63T joined to a 40T on the intermediate pair, and finally a 30T on the leadscrew itself.

From these basic ratios, it is possible to derive a ratio for any other metric or imperial thread. Armed with a 63-tooth wheel and the right changewheel ratios you can cut almost any standard metric or imperial thread.

Aided by a spreadsheet, I have produced tables showing suggested combinations of changewheels for the three common thread families for both metric and imperial leadscrews. For the sake of my own sanity I have excluded many 'round' pitches which are achievable, but instead



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Annotated 1mm pitch leadscrew chain.

focused on 'standard' threads. The tables only use the changewheels supplied with the lathe plus the 63-tooth gear. Owners of metric lathes may find they do not have as great a selection of change gears, limiting the range of threads that can be cut. It is possible to obtain the gears as spares, or even to purchase a full 'imperial' set of metal gears.

Because of the limitations in the change gears available, not all conversions can be absolutely precise, especially for the BA series. There are also a few issues with 'odd' imperial sizes and the smallest metric threads. Even so, in the worst cases the ratios given should still allow you to cut threads that will mate with standard threads. In a few cases better results could be achieved by doubling up gears not duplicated in the standard gear set.

The metric tables cover every preferred value from 0.2 up to 6mm pitch. The 63-tooth gear allows the imperial machine to produce every thread, with no error

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Unsharpened module cutter.

greater than 0.8%. The imperial table covers all standard BSW, BSF, BSP, UNF, UNC and Model Engineer pitches. With the 63-tooth gear the metric machine can produce all these threads up to 4TPI to better than 0.1%, and up to 2.5TPI to less than 1% error. The 63-tooth gear allows the otherwise elusive 3.25 TPI to be achieved on the imperial machine. The 63 tooth gear also allows both metric and imperial machines to produce all British Association threads from 0BA to 16BA, accurate to better than 1%.

Do not attempt to screw cut threads coarser than about 8 tpi directly – the load on the gears with the leadscrew geared up this much is inviting disaster. Such threads can be produced by thread milling while driving the mandrel by turning the leadscrew. You will need, however, to make the simple modification of fitting a leadscrew handle.

All you need now is a 63-tooth changewheel, 1-module, 20 degree pressure-angle, 5⁄16 inch thick and bored 12mm with a ⅛ inch keyway. I will explain how you can make such a gear. If you would prefer to buy a suitable gear, 63-teeth are not a standard production number and they are normally expensive and would also need to be adapted to fit the lathe. Fortunately, Arc Euro Trade is planning to have a batch of suitable gears made up ready to fit to mini-lathes.

I made my gear in a few hours, but had the advantage of a milling machine and rotary table. It is possible to make the gear on a mini lathe alone, but if so you will need some form of cross-slide dividing attachment and a little ingenuity.

The supplied change gears are made of plastic (nylon or acetal), except the 20-tooth gears, which are steel. I decided to make a gear of aluminium alloy, partly because I had material of suitable size, but also because it would be compatible with all the existing gears. Most aluminium alloys are also easy materials to work, an advantage when using a single point form cutter. I face a blank to 8mm thick and mounted it in the four-jaw chuck, bored an accurate 12mm hole in the middle and relieved the face slightly for appearance sake. I then mounted the blank on a stub mandrel. This was turned from a short section of hex bar, held in the three-jaw chuck. I then drilled and tapped the end of the stub M6 using the tip of a taper tap. Finally I slit the stub and cleaned up the edges of the slot. With the blank on the mandrel and a suitable screw screwed home tight, it opened up just enough to hold the blank securely. Alternatively, you could put an M8 thread on the end of the mandrel and use a nut to hold it all secure.

I mounted the blank and turned it to size at 65mm. In fact it was slightly small at 64.98 millimetres. This meant I had to reduce the cutter infeed by 0.01mm.

Now I needed a number 2, 20 degrees pressure angle, 1-module cutter for a 63-tooth gear. Bought cutters are expensive but home-made cutters can give good results. There are many ways of making gear cutters. I have made cutters using the 'button' method described in Ivan Law's *Gears and Gearcutting* (Workshop Practice Series No 17), which describes all aspects of the process with detail and clarity. As I was only planning to make one gear in a fairly soft material, I decided that a complex cutter was not needed. Tubal Cain declared that the only time he made a flycutter to make a gear wheel, he filed it up using a similar size gear as a template, so I did the same. I used a ½ inch by ¾ inch piece of ⅛ inch gauge plate and the 65-tooth changewheel as a template. I started by angling the end to provide relief and then roughed out a wedge shape with a smooth file (**photo 3**). A half-round needle file made hollowing the sides of the cutter easy. Gauge plate is quite tough and files slowly, so it's easy to approach an accurate shape gradually. Once I had a good fit, I drilled the plate so that it could be fitted to a holder. My cutter holder is a MT2 arbor with two M6 holes in it – one for the fixing screw and one for a second screw as a stop (**photos 4** and **5**).

I hardened the gauge plate by heating to red hot and dropping it in sunflower oil. I then tempered it at 150 degrees in a thermostatic fryer, the right temperature for mushrooms, apparently. Once cool I used a diamond slip to polish the front face of the cutter.

I transferred the blank, still in the three-jaw chuck, to a rotary table on my milling machine (**photo 6** shows a smaller pinion being cut, but the setup is the same). The critical issues for cutting any gear are getting the cutter dead on the centreline of the blank and the correct cutting depth for the cutter. As the blank was undersize, I reduced the infeed appropriately. There was some 'extrusion' of metal at the crest of the teeth so I took a skimming cut off the crown of the teeth, but still decided to tidy up the 'edge' of each tooth with a needle file.

If you don't have a suitable dividing device, you will need to make a simple spindle of some kind to support the gear and allow it to be indexed and clamped for cutting each tooth. Various designs for both simple and complex indexing and dividing heads have featured in *MEW* over the years. If you fit a wooden disk with a suitably marked paper scale on the other end, you can then use a simple pointer and index by hand. A 101mm diameter disk is almost perfectly sized for a paper scale with 63 divisions 5mm apart to wrap around it.

The final task was slotting the ⅛ inch keyway. I used a toolpost held 'ram' type device as described by Stan Bray (*Useful Workshop Tools*, Workshop Practice Series No. 34). Slotting the light alloy was a

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Cutter on 2 Morse taper arbor.

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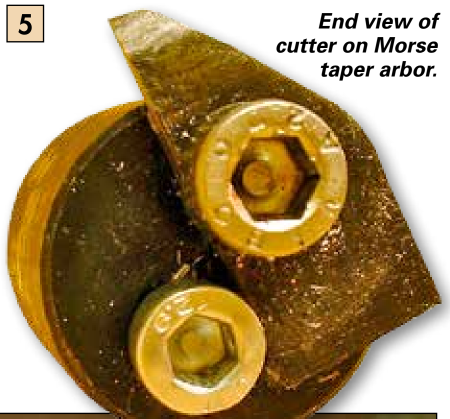

End view of cutter on Morse taper arbor.

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Cutting a gear.

Change Wheel Tables for Mini-Lathes

The following tables give changewheel combinations for all standard BSW, BSF, BSP, BA, UNC, UNF and Metric threads within the capacity of a mini lathe.

They use only the changewheels supplied with the lathe plus a 63-tooth gear, which allows the cutting of metric gears on an imperial machine, and vice versa. Such a gear also allows closer approximations to be made to some of the more difficult thread sizes.

There is no guarantee that the cutting of either the smallest or the largest threads is possible with a standard set-up. The ratios given will be useful to anyone wishing to employ special techniques to produce such threads.

Standard Thread per Inch sizes			
Size	Whitworth	BS Fine	Model Engineer
60	1/16		
48	3/32		
40	1/8		1/8 - 1/2
32	5/32	1/16	5/16 - 1/2
28		7/32	
26		1/4	
24	3/16 & 7/32		
22		5/16	
20	1/4	3/8	
18	5/16	7/16	
16	3/8	1/2 & 9/16	
14	7/16	5/8	
12	1/2 & 9/16	3/4	
11	5/8	7/8	
10	3/4	1	
9	7/8		
8	1		

Standard Thread per Inch sizes			
Size	Whitworth	BS Fine	Model Engineer
1/16	60		
3/32	48		
1/8	40		40
5/32	32		40
3/16	24	32	40
7/32	24	28	40
1/4	20	26	40
5/16	18	22	40 & 32
3/8	16	20	41 & 32
7/16	14	18	42 & 32
1/2	12	16	43 & 32
9/16	12	16	
5/8	11	14	
3/4	10	12	
7/8	9	11	
1	8	10	

IMPERIAL LEADSCREW 16TPI							
British Association threads from 0-16BA							
Thread Size	Change Wheels				Wheel Set-up	Actual Pitch	Error
	A	B	C	D			
0BA	63	50	30	60	B	1.00	0.0%
1BA	63	60	35	65	B	0.90	0.3%
2BA	63	57	30	65	B	0.81	0.0%
4BA	63	55	20	55	B	0.66	-0.2%
5BA	63	57	20	60	B	0.58	0.9%
6BA	60	55	20	65	B	0.53	-0.5%
7BA	50	55	20	60	B	0.48	-0.2%
8BA	60	55	20	80	B	0.43	-0.7%
9BA	35	45	20	63	B	0.39	-0.5%
10BA	35	60	30	80	B	0.35	0.8%
11BA	63	80	20	80	B	0.31	-0.8%
12BA	20	40	20	57	B	0.28	0.5%
13BA	40	63	20	80	B	0.25	-0.8%
14BA	20	50	20	55	B	0.23	-0.4%
15BA	30	57	20	80	B	0.21	0.5%
16BA	30	63	20	80	B	0.19	0.5%

IMPERIAL LEADSCREW 16TPI							
British Standard Metric Fasteners* up to 6mm							
PITCH	Change Wheels				Wheel Set-up	Actual Pitch	Error
	A	B	C	D			
6mm	63	50	60	20	B	6.001	0.0%
5mm	63			20	A	5.001	0.0%
4.5mm	63	20	45	50	B	4.501	0.0%
4mm	63	50	60	30	B	4.001	0.0%
3.5mm	63	20	35	50	B	3.500	0.0%
3mm	63	40	60	50	B	3.000	0.0%
2.5mm	63	60	45	30	B	2.500	0.0%
2mm	63			50	A	2.000	0.0%
1.75mm	63	50	35	40	B	1.750	0.0%
1.5mm	63	60	45	50	B	1.500	0.0%
1.25mm	63	40	30	60	B	1.250	0.0%
1mm	63	50	30	60	B	1.000	0.0%

IMPERIAL LEADSCREW 16TPI							
British Standard Metric Fasteners* up to 6mm							
PITCH	Change Wheels				Wheel Set-up	Actual Pitch	Error
	A	B	C	D			
0.8mm	63	50	20	50	B	0.800	0.0%
0.75mm	63	50	30	80	B	0.750	0.0%
0.7mm	63	50	20	57	B	0.702	0.3%
0.6mm	65	57	20	60	B	0.603	0.6%
0.5mm	63	50	20	80	B	0.500	0.0%
0.45mm	65	57	20	80	B	0.453	0.6%
0.4mm	20			80	A	0.397	-0.8%
0.35mm	20	63	45	65	B	0.349	-0.3%
0.3mm	30	80	40	80	B	0.298	-0.8%
0.25mm	40	63	20	80	B	0.252	0.8%
0.2mm	30	60	20	80	B	0.198	-0.8%

IMPERIAL LEADSCREW 16TPI							
Imperial Thread per Inch values from 60 to 2.5							
TPI	Change Wheels A	B	C	D	Wheel Set-up	Actual TPI	Error
2.5	80	20	80	50	B	2.500	0.0%
2.625	80	35	80	30	B	2.625	0.0%
2.75	80	20	80	55	B	2.750	0.0%
2.875	60	35	65	20	B	2.872	0.1%
3	40	20	80	30	B	3.000	0.0%
3.25	63	35	55	20	B	3.232	0.5%
3.5	40	20	80	35	B	3.500	0.0%
4	40	20	80	40	B	4.000	0.0%
4.5	40	20	80	45	B	4.500	0.0%
5	40	20	80	50	B	5.000	0.0%
6	80			30	A	6.000	0.0%
7	80			35	A	7.000	0.0%
8	80			40	A	8.000	0.0%
9	80			45	A	9.000	0.0%
10	80			50	A	10.000	0.0%
11	80			55	A	11.000	0.0%
12	40			30	A	12.000	0.0%
14	40			35	A	14.000	0.0%
16	80			80	A	16.000	0.0%
18	40			45	A	18.000	0.0%
19	40	50	60	57	B	19.000	0.0%
20	40			50	A	20.000	0.0%
22	40			55	A	22.000	0.0%
24	40			60	A	24.000	0.0%
26	40			65	A	26.000	0.0%
28	20			35	A	28.000	0.0%
32	20			40	A	32.000	0.0%
36	20			45	A	36.000	0.0%
40	20			50	A	40.000	0.0%
48	20			60	A	48.000	0.0%
56	20	60	30	35	B	56.000	0.0%
60	20	50	40	60	B	60.000	0.0%
64	20	40	20	40	B	64.000	0.0%
80	20	50	30	60	B	80.000	0.0%

Standard Metric Thread Pitches					
Size	Pitch	Size	Pitch	Size	Pitch
M0.8	0.2	M2	0.4	M4.5	0.75
M1	0.25	M2.2	0.45	M5	0.8
M1.2	0.25	M2.5	0.45	M6	1
M1.4	0.3	M3	0.5	M8	1.25
M1.6	0.35	M3.5	0.6	M10	1.5
M1.8	0.35	M4	0.7	M12	1.75

METRIC LEADSCREW 1.5mm PITCH							
British Association threads from 0-16BA							
Thread Size	Change Wheels A	B	C	D	Wheel Set-up	Actual Pitch	Error
0BA	40			60	A	1.000	0.0%
1BA	60	35	20	57	B	0.902	-0.3%
2BA	65	57	30	63	B	0.815	-0.6%
3BA	55	35	20	65	B	0.725	0.6%
4BA	30	60	57	65	B	0.658	0.3%
5BA	40	57	45	80	B	0.592	-0.4%
6BA	30	57	40	60	B	0.526	0.7%
7BA	35	55	30	60	B	0.477	0.6%
8BA	20	50	45	63	B	0.429	0.3%
9BA	20	60	35	45	B	0.389	0.3%
10BA	40	57	20	60	B	0.351	-0.3%
11BA	20	30	20	65	B	0.308	0.7%
12BA	20	60	45	80	B	0.281	-0.4%
13BA	20	40	20	60	B	0.250	0.0%
14BA	20	40	20	65	B	0.231	-0.3%
15BA	20	45	20	63	B	0.212	-0.8%
16BA	20	63	20	50	B	0.190	-0.3%
18BA	20	50	20	80	B	0.150	0.0%

METRIC LEADSCREW 2mm PITCH							
British Standard Metric Fasteners* up to 6mm							
Thread Size	Change Wheels A	B	C	D	Wheel Set-up	Actual Pitch	Error
6mm	60			20	A	6.000	0.0%
5mm	50			20	A	5.000	0.0%
4.5mm	45			20	A	4.500	0.0%
4mm	40			20	A	4.000	0.0%
3.5mm	35			20	A	3.500	0.0%
3mm	60			40	A	3.000	0.0%
2.5mm	50			40	A	2.500	0.0%
2mm	40			40	A	2.000	0.0%
1.75mm	35			40	A	1.750	0.0%
1.5mm	30			40	A	1.500	0.0%
1.25mm	50			80	A	1.250	0.0%
1mm	30			60	A	1.000	0.0%
0.8mm	40	50	20	40	B	0.800	0.0%
0.75mm	30			80	A	0.750	0.0%
0.7mm	35	50	20	40	B	0.700	0.0%
0.6mm	60	50	20	80	B	0.600	0.0%
0.5mm	20			80	A	0.500	0.0%
0.45mm	45	50	20	80	B	0.450	0.0%
0.4mm	40	50	20	80	B	0.400	0.0%
0.35mm	35	50	20	80	B	0.350	0.0%
0.3mm	30	50	20	80	B	0.300	0.0%
0.25mm	40	80	20	80	B	0.250	0.0%
0.2mm	20	50	20	80	B	0.200	0.0%

METRIC LEADSCREW 1.5mm PITCH							
British Standard Metric Fasteners* up to 6mm							
PITCH	Change Wheels				Wheel Set-up	Actual Pitch	Error
	A	B	C	D			
6mm	60	20	40	30	A	6.000	0.0%
5mm	50	20	40	30	A	5.000	0.0%
4.5mm	45	20	40	30	A	4.500	0.0%
4mm	40	20	40	30	A	4.000	0.0%
3.5mm	35	20	40	30	A	3.500	0.0%
3mm	60			30	A	3.000	0.0%
2.5mm	50			30	A	2.500	0.0%
2mm	40			30	A	2.000	0.0%
1.75mm	35			30	A	1.750	0.0%
1.5mm	60			60	A	1.500	0.0%
1.25mm	50			60	A	1.250	0.0%
1mm	40			60	A	1.000	0.0%
0.8mm	40	30	20	50	B	0.800	0.0%
0.75mm	30			60	A	0.750	0.0%
0.7mm	35	30	20	50	B	0.700	0.0%
0.6mm	60	50	20	60	B	0.600	0.0%
0.5mm	50	50	20	60	A	0.500	0.0%
0.45mm	45	50	20	60	B	0.450	0.0%
0.4mm	40	50	20	60	B	0.400	0.0%
0.35mm	35	50	20	60	B	0.350	0.0%
0.3mm	20	50	20	40	B	0.300	0.0%
0.25mm	20	60	20	40	B	0.250	0.0%
0.2mm	20	50	20	60	B	0.200	0.0%

METRIC LEADSCREW 2mm PITCH							
British Association threads from 0-16BA							
Thread Size	Change Wheels				Wheel Set-up	Actual Pitch	Error
	A	B	C	D			
0BA	30			60	A	1.000	0.0%
1BA	45	35	20	57	B	0.902	-0.3%
2BA	55	60	20	45	B	0.815	-0.6%
3BA	40	35	20	63	B	0.726	0.6%
4BA	20	55	57	63	B	0.658	0.3%
5BA	30	57	45	80	B	0.592	0.4%
6BA	50	60	20	63	B	0.529	-0.2%
7BA	35	55	30	80	B	0.477	0.6%
8BA	20	65	35	50	B	0.431	-0.2%
9BA	35	65	20	55	B	0.392	-0.4%
10BA	30	57	20	60	B	0.351	-0.3%
11BA	20	40	20	65	B	0.308	0.7%
12BA	20	57	20	50	B	0.281	-0.3%
13BA	20	40	20	80	B	0.250	0.0%
14BA	20	55	20	63	B	0.231	-0.4%
15BA	20	60	20	63	B	0.212	-0.8%
16BA	20	65	20	65	B	0.189	0.3%

METRIC LEADSCREW 2mm PITCH							
Imperial Thread per Inch values from 60 to 2.5							
Thread TPI	Change Wheels				Wheel Set-up	Actual Pitch	Error
	A	B	C	D			
2.5	80	20	80	63	B	2.500	0.0%
2.625	80	20	60	50	B	2.646	-0.8%
2.75	80	20	63	55	B	2.772	-0.8%
2.875	80	20	63	57	B	2.873	0.1%
3.25	80	30	80	55	B	3.274	-0.7%
3	80	20	60	57	B	3.016	-0.5%
3.5	80	20	57	63	B	3.509	-0.3%
4	80	20	50	63	B	4.001	0.0%
4.5	65	20	55	63	B	4.476	0.5%
5	80	30	60	63	B	5.001	0.0%
6	80	30	50	63	B	6.001	0.0%
7	80	35	50	63	B	7.001	0.0%
8	60	30	50	63	B	8.001	0.0%
9	80	45	50	63	B	9.001	0.0%
10	60	30	40	63	B	10.001	0.0%
11	80	55	50	63	B	11.001	0.0%
12	50	45	60	63	B	12.002	0.0%
14	50	35	40	63	B	14.002	0.0%
16	50			63	A	16.002	0.0%
18	50	45	40	63	B	18.002	0.0%
19	80	57	30	63	B	19.002	0.0%
20	40			63	A	20.003	0.0%
22	40	55	50	63	B	22.003	0.0%
24	50	45	30	63	B	24.003	0.0%
26	50	65	40	63	B	26.003	0.0%
28	50	35	20	63	B	28.004	0.0%
32	50	60	30	63	B	32.004	0.0%
36	50	45	20	63	B	36.005	0.0%
40	20			63	A	40.005	0.0%
48	50	60	20	63	B	48.006	0.0%
56	50	55	20	80	B	55.880	0.2%
60	40	60	20	63	B	60.008	0.0%
64	45	80	20	57	B	64.347	-0.5%
80	20	60	30	63	B	80.010	0.0%

Standard Metric Thread Pitches					
Size	Pitch	Size	Pitch	Size	Pitch
M0.8	0.2	M2	0.4	M4.5	0.75
M1	0.25	M2.2	0.45	M5	0.8
M1.2	0.25	M2.5	0.45	M6	1
M1.4	0.3	M3	0.5	M8	1.25
M1.6	0.35	M3.5	0.6	M10	1.5
M1.8	0.35	M4	0.7	M12	1.75

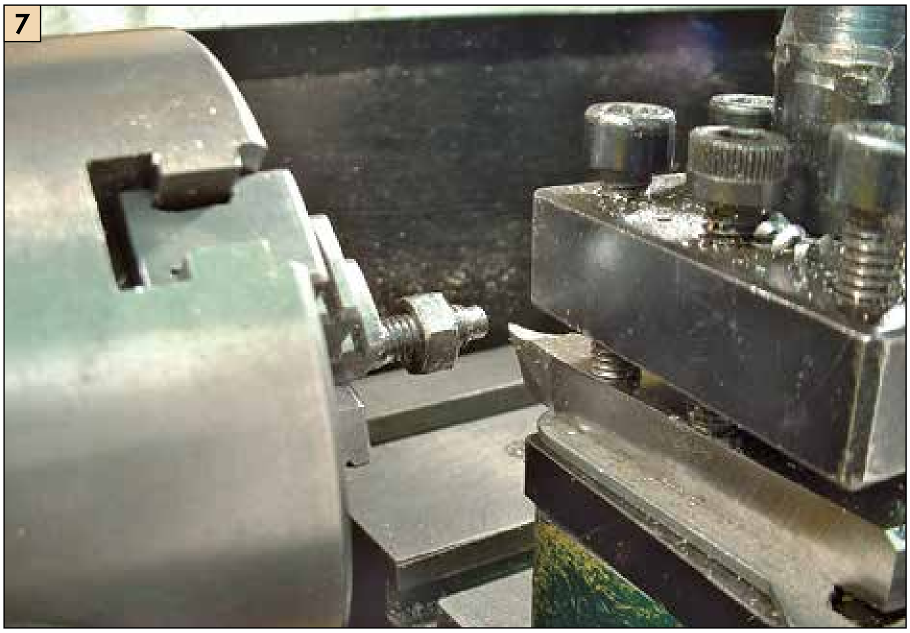
pleasure compared to using the ram on steel! To test both the gearwheel and the tables I cut an M6 test piece on my imperial machine, using a mandrel handle to turn the lathe. I'm proud to say that an M6 nut went straight on without slop or tightness (**photo 7**). I can now, in theory, cut almost any type of thread to a good standard of accuracy. I have since cut various metric threads, including an M32 by 1.5mm pitch thread for an ER25 collet nut, using this gear.

Before finishing I must make a few caveats. Cutting very fine threads to a good form is a challenge, if not impossible. Making BA threads down to about 8BA is possible using a very sharp tool dead on centre height – noting that the thread angle for BA is 47½ degrees. With smaller threads the cutting forces tend to bend the work.

At the other extreme, cutting the large pitch threads (those where the leadscrew is turning faster than the mandrel) may impose a damaging strain on the gear train. These should be cut by thread milling, using the leadscrew to turn the mandrel with the lathe switched off. To do this a toolpost milling spindle and a leadscrew handwheel such as that described by Alastair Sinclair (*Model Engineer's Workshop*, issue 91, July 2003) will be needed.

You should also bear in mind that you will not be able to use the leadscrew dial indicator when cutting non-standard threads. There are other ways, but the simplest and most reliable (if tedious) technique is to keep the clasp nuts engaged, and wind the cutter back between each cut. Again, a leadscrew handwheel is essential.

7



Cutting a 1mm pitch test thread.

Users of other lathes may find these tables useful. The 2mm pitch tables will suit some of the slightly larger metric lathes. The ML7, Super 7 and many other older British lathes have 8TPI leadscrews, so the imperial tables can be used with simple modifications. By doubling the teeth on an input gear or halving the teeth on an output gear to increase the overall ratio by 2:1 the same threads can be cut. Alternatively, simply select the set-up for the thread with half the pitch of the one you require. For example, the 0.5mm pitch set-up will give 1mm on a Myford.

There are nearly 33,000 theoretical combinations of the standard mini-lathe changewheels, though many are trivial duplications or impossible to set up. I am sure there are still a few improvements to be made to the tables, and though the formulae used ought to have eliminated significant errors, some of the ratios may prove hard to set up due to overlapping gears. I would be pleased to hear from any reader who discovers any improvements or errors. ■