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4<sup>th</sup> Edition

# Thread Cutting On a Lathe

Safely Working with Benchtop Machines - Booklet I  
**Sherline / UNIMAT / Craftsman / China lathes**



U. Burghaus

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Safely Working with Benchtop Systems – Booklet I

Featuring Sherline, UNIMAT, SIEG, Craftsman

## **Booklet 1 – Thread Cutting on a Lathe**

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The author is not a professional machinist or engineer. He is a hobby machinist as you probably are. In fact, the author holds a PhD in physics and teaches physical chemistry at a college. Therefore, no information provided herein represents professional advice or best practices in machining. All information is provided to help hobbyists and other non-professionals gain a better understanding of using a miniature benchtop (tabletop) lathe for hobby type work.

This book features in particular Sherline, UNIMAT, SIEG, and Craftsman lathes and accessories. However, none of the statements or procedures may coincide with the manufacturers opinion or interests. The author is not an employee of, or agent for any of the vendors referenced in the text and does not sell or represent any of the third party products discussed.

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Acknowledgement

# Generic list of pictograms used in LatheCity books



Object of a given Chapter/brief introduction. Start of a project. The Chapter numbers are given in the content list.



Internet addresses of potentially useful sites. However, web sites may be infected by computer viruses. Use them at your own risk.



Safety notes. It is not my intention to bother you, and this book is meant for adults with advanced machining skills, not for children. Therefore, whether you read the safety notes or not is your decision. However, don't blame me if you do not take the few minutes to do this and end up in the hospital. All procedures are performed at your own risk.



Engineering terms or topics are described here. You may skip these if you are only interested in the operation of the tool. Remember, though, that knowledge also always provides protection (safety). If you know what you're doing... right.



Projects: engineering/artwork projects



Comparison of lathe and mill operations. Most of us started with lathe work, that is, these comparisons can help gaining a deeper understanding (even of lathe work).



Summary of the Chapters. See content list for Chapter numbers.



## Preface – why learning this?

**Why learning thread cutting?** When finalizing the current edition of this book, I contacted a few LatheCity customers for photos of vintage lathes or simply other lathe models to include in the book. Unfortunately, I often got a responds similar to this one:

*“My Lathe has all the gears for cutting threads but I've not tried it ... it seems confusing to me on how to set up the proper gears ... Instructions were hard for me to understand...”*

Well, guys, first, you have now hopefully easy to understand instructions. Second, much of the machinery on your lathe is devoted to cutting threads. Not using it would be like purchasing a BMW and driving 55 miles on a highway. In that case, save the money and get a Volkswagen. (Germans, which I am, have that “car thing” in the genes – using one of the common misconceptions for making a clear point. By the way, I don’t like “Sauerkraut” ...)

Seriously, cutting threads is one of the main advantages of having a lathe at hand. Try, at least, to learn how this works – it is fun. And, it is rather simple. I will discuss below what all the advantages really are.

**Why using the Sherline lathe as an example?** First of all, in the US, it is one of the most popular and most widely circulated small lathes. Secondly, it is an “open” system, i.e., you can really see and learn how thread cutting works. It’s a simple lathe and therefore ideal for learning thread cutting. By the way, we got orders for Sherline accessories made by LatheCity from around the world including Australia, Brazil, Dubai, Guatemala, Japan, New Zealand , Thailand, Venezuela, Vietnam, and many European countries.

**Vintage lathes.** The UNIMAT SL DB is featured in some detail since its design is quite similar to a Sherline lathe and a large number of UNIMATs are still in circulation. In addition, thread cutting on UNIMAT 3 and Craftsman 109 lathes is described. We got some photos from customers since we don’t have all these lathes in the shop either. Many thanks for the support.

**Larger lathes.** Nevertheless, how thread cutting works on a larger China import lathe is also discussed in this book. Perhaps you have one of these already or want to upgrade. Thus, even if you have a Grizzly, Harbor Freight, Craftsman, Sears, Rockwell, UNIMAT, Bolton, SIEG or whatever lathe, this book will include relevant information.

There are probably 10,000 bicycle or car models on the market, but if you learned how to operate one of these, you can manage most other models. Same thing happens with thread cutting. Anyway, the following lathe models are specifically discussed in the book. I do focus on the Sherline and SIEG systems, however.

Featured lathe models:

- Sherline (long/short version)
- UNIMAT SL DB
- UNIMAT 3
- 3536 HiTorque 8.5x16 (“China lathe”)
- SIEG SC4 (“China lathe”)
- Rockwell
- Craftsman 109

## Brief summary and glossary

This book is too short to provide a meaningful index. Instead, this glossary is added.

<b>ACME threads</b>	See Chapter 2.6.
<b>Left handed screws</b>	See Chapter 3.4. These can be cut basically in the same way as right handed screws. The gear train determines the handiness of the threads rather than the thread cutting operation on its own.
<b>Half nut, split nut</b>	Devise to synchronize the cross-slide and lead screw of a larger lathe. Fig. 4.4
<b>Threading die holder</b>	Mounting fixture for dies, see Fig. 4.10, which can replace a thread hand cutting machine.
<b>Threading tap holder</b>	Just use a Jacobs chuck, see Fig. 6.1., special fixtures are not really required.
<b>Runout</b>	Miss-alignment of e.g. the thread axis and work piece axis. See Fig. 6.9
<b>Dial indicator</b>	Mechanical DRO, so to say. Can be used to measure e.g. the runout. See Fig. 6.9
<b>DRO</b>	Digital readout. Gives the position of the lathe cutter.
<b>Tapping machine</b>	Fig. 2.9, hand tapping machine.
<b>Boring square holes</b>	See Vol. 1.
<b>Clutch</b>	Engagement mechanism used on some thread cutting machines. Prevents to build up too large torque while cutting threads (safety clutch, friction clutch). See Chapter 6.6.
<b>Bench block</b>	Fig. 6.2
<b>Threading leader</b>	Template for thread cutting, see Fig. 5.2
<b>Threading to a shoulder</b>	No special trick is here required, but cut the thread from the shoulder, i.e., start at the shoulder, see Chapter 4.5.

<b>Metric threads</b>	The gear train determines if a Metric or English thread is cut. See Chapter 3.5.
<b>Double lead screws</b>	Double start screws would be the correct term. A screw can have only one lead.
<b>Double start screws</b>	Chapter 3.8. Two helixes are cut in a bolt.
<b>Change gears</b>	The gears of the gear train. On a small lathe one has to change these gears a lot in order to change the TPI machined. I guess that's where the term is coming from.
<b>Threading dial</b>	Fig. 4.5, used to synchronize the lathe chuck and cross-slide.
<b>Tapered threads</b>	Chapter 3.9, threads cut in a taper. Can be done by turning between centers and off-setting the tailstock.
<b>Lead</b>	The linear or axial distance a nut moves in one revolution of a screw.
<b>29°</b>	That magic angle, right, see Fig. 3.12.
<b>Pitch</b>	One over TPI. Example 20 TPI threads have a pitch of $1/20=0.05''$
<b>¼-20</b>	¼ is the nominal diameter, 20 are the TPI
<b>M8-1.25</b>	8 mm is the nominal diameter, 1.25 mm is the pitch. For Metric screws the pitch is given rather than threads per mm.
<b>TPI</b>	Thread per inch, or turns (of a nut) per inch.
<b>Gear train</b>	See Chapter 2.4, assembly of gears.
<b>Center gauge</b>	See Fig. 3.2. Used to square a thread cutter. You will never need it, save the money.
<b>Thread cutting tools</b>	see Fig. 3.1.
<b>HSS</b>	High speed steel, preferred material for low budget hobby type cutting tools. Better are carbide inserts.
<b>HCS</b>	High carbon steel. Often misleadingly printed on cheapo tools. HSS, HCS all the same? Nope. HCS taps are good for cutting threads in drywall besides that use HSS tools.

<b>Hand tapping machine</b>	See Fig. 2.9, helps to square threads and provides enough torque.
<b>Wire gauges</b>	See Fig. 2.5, used to measure the depth of threads. Thread wire gauges.
<b>Thread repair</b>	See Chapter 4.5, no big trick, just readjust the cutter as good as possible with existing thread helix.
<b>Thread gauge</b>	See Fig. 2.5, measures the pitch of threads.
<b>UTS, UNC, UNEF</b>	See Chapter 2.3, thread standards.
<b>Major, minor radius</b>	See Fig. 2.3.
<b>Buddy system:</b>	See Chapter 1.
<b>ANSI Z87</b>	If you don't know what that is, PLEASE read Chapter 1.
<b>Thread repair dies</b>	Hex dies are often labeled as such which is basically bogus. A HSS hex die can be used to cut threads as any other die, assuming you have a die holder that does fit it and the die is compatible with a standard thread form (usually they are). Round dies can be better centered, however.



## Acknowledgements and notes to the 1<sup>st</sup> Edition

Proofreading of this Booklet by Scribendi (Canada) is acknowledged. Writing a book about metal working typically does not improve the reputation of a scientist and chemistry college teacher (some prefer not to get dirty fingers...). Therefore, many thanks in advance to open-minded colleagues. However, in the UK, there is apparently a “tradition” to write your own book about “gardening” – the LatheCity books would be my version of this, I guess.

## Acknowledgements and notes to the 2<sup>nd</sup> Edition

I added two Chapters and a few more images. Because thread cutting on Sherline’s system is not really practical, most home shop machinist think at some point about upgrading to a larger benchtop (“China type”) lathe. Therefore, I added a Chapter about thread cutting procedures on a lathe which actually allows for using the lathe motor for that purpose. In addition, a brief Chapter about thread cutting on an UNIMAT is added. This may for most of us be a historic note. The add-on Chapters were again proofread professionally by Scribendi (Canada). Also, the booklet was reformatted using pictograms and wider page margins.

**Updated 3<sup>rd</sup> Edition** One usually adds something; it’s hard to remove a Chapter. The drawback, the costs increase, but the product price usually does not. Anyway, I did add a “Tips and Tricks” Chapter and some more practical notes. Desktop publishing has the advantage that it is simple to come up with new editions and updates.

**Updated 4<sup>th</sup> Edition** This is probably now the last edition for a while, I hope. A more significant change, I started to offer the 4<sup>th</sup> edition as a professional paperback and changed the format from letter size to 9”x3” book format. This edition also features some more vintage lathes in more detail. The entire book was originally a 30 pages or so Chapter in one of our lathe books and grew over time in a separate book.

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Vol. 1: Basic Lathe Operations<sup>S</sup>

Vol. 2: Working with Lathe Accessories<sup>S</sup>

Vol. 3: Poor Man's CNC Lathe<sup>\*</sup>

Vol. 4: Tabletop Milling<sup>S,G</sup>

Booklet 1: Thread Cutting on a Lathe<sup>S</sup>

Booklet 2: Working with Exotic Materials on a Lathe and Mill<sup>\*</sup>

Booklet 3: Summary of Basic Metal Lathe Operations<sup>\*</sup>

Booklet 4: Artwork Projects on Benchtop Lathes and Mills<sup>\*</sup>

Some project booklets/manuals are also available.

Volumes in preparation:

*Vol. 5: Tabletop Lathes<sup>\*</sup>*

*Vol. 6: The CNC Benchtop Lathe – an Introduction<sup>S</sup>*

<sup>S</sup>: Featuring Sherline systems

<sup>G</sup>: Featuring Grizzly systems

<sup>\*</sup>: Completely model independent

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Uwe Burghaus, born in West Berlin, Germany, obtained his education in Physics and Physical Chemistry at the Free University of Berlin.\*) He obtained a PhD in 1995, after conducting his graduate studies in surface science at the Fritz-Haber Institute of the Max Planck Society in Berlin. After postdoctoral positions in Genoa (Italy) and Santa Barbara (USA), he went back to Germany to complete a habilitation/tenure in Physical Chemistry. Now at North Dakota State University, he started to establish a surface chemistry group in 2003 and obtained tenure in 2009. His group is currently focusing on studies about nanostructured catalysts.

His hobbies include machining furniture from metal and glass. He is not a professional machinist by training. However, his hobby metal work developed into a small part-time business in 2012. LatheCity currently sells books about metal working, software tools, and accessories: everything that's fun to make and may find customers. The strength of the business is custom-designed tools.

*\*) It's (still) called "Free University", not because we don't need to pay tuition in Germany (education is indeed free!), but because it was located in the western part of Berlin (West Germany), as opposed to East Berlin the "Russian sector". The FU Berlin was founded with the help of the US after the end of the 2<sup>nd</sup> world war – Google the details, please. (I got a few funny e-mails and did add this explanation ...) LatheCity books are unfortunately not for free, sorry – I also live in the US now ... ☺*

Cutting threads on a metal lathe is described in detail, including curiosities such as cutting double start screws or left hand screws. The author focuses here on practical procedures and troubleshooting (tips & tricks) and shows how all of this can be done on a benchtop lathe. We have not seen this type of information presented as concisely as it is here anywhere else in a hobby type machining book. The descriptions focus on practical and doable procedures, but also include the engineering background.

In particular, details are provided for the thread cutting accessory of the popular Sherline metal lathe, giving a fair but critical and independent opinion about often pricy accessories. The author is a hobby machinist, as you probably are.

Other sections describe thread cutting on UNIMAT SL DB / 3 lathes, which are similar in design to Sherline. In addition, thread cutting on a vintage Craftsman lathe and on larger benchtop lathes are discussed in detail.

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Safely Working with Benchtop Systems – Booklet I

Featuring Sherline / UNIMAT / Craftsman / China Lathes

Booklet 1 – **Thread Cutting on a Lathe**

4<sup>th</sup> Edition