List of internet links included in this book

Disclaimer

Web addresses are given without any warranty or guarantee, web sites may be infected by a computer virus and/or may not provide the best servise. **Neither the author nor publisher shall be liable for damage arising herefrom.** The content of web sites may have changed since the author looked at it and you read it.

LatheCity
Safely Working with Benchtop Systems IV

Volume 4 – Tabletop Milling

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Fargo, ND 58104
USA

Book 4

Part A: First steps

1. How is this book structured - introduction
2. What is a milling machine? - how to decide which one to purchase ?
3. What hardware will I need to get started with milling?
4. First things first - required safety notes – how to work safely?
5. The very first project on the mill - how can I get started?
6. Simple cross-slide lock - how to reduce vibrations?

1” = 25.4 mm

1 mm = 0.0394”

http://mdmetric.com/tech/cvtcht.htm
http://industrial-enclosures.com/html/conversion-mm-inch.html
http://www.engineeringtoolbox.com/inches-mm-conversion-

1. How is this book structured? - introduction

http://www.lathecity.com/CustomerCornerMain.php
http://www.lathecity.com/CustomerFeedback.html
http://www.lathecity.com/CustomerSurvey.html

2. What is a milling machine? – how to decide which one to purchase ?

Internet resources – sites providing general information about milling

http://awtarlab3.engin.umich.edu/wiki/index.php/How_to_edge_mill | Milling in general
http://awtarlab3.engin.umich.edu/wiki/index.php/How_to_face_mill | Milling in general
http://www.eng.mu.edu/~dlc/machineshop/contents.html | University site
http://www.robbjack.com/html/calc.html | Speed and feed calculations
http://www.americanmachinetools.com/how_to_use_a_milling_machine.htm | Quite extensive
http://its.fvtc.edu/MachShop3/basicmill/default.htm | Quite extensive
http://its.fvtc.edu/MachShop3/basicmill/Construction.htm | Naming all components of a mill
http://www.smithy.com/machining-handbook/Chapter-1 | Smithy mill/lathe
http://www.grizzly.com/products/category/480000|700002 | Large Benchtop mills
http://www.sherline.com/millinst.htm | Sherline's mill site
http://www.glacern.com/ | List of movies

Free access electronic book: Basic milling operations have not changed dramatically since 1910. You can find a number of free books listed here:

De Vries, D. (1910), *Milling machines and milling practice: a practical manual for the use of manufacturers, engineering students and practical men*, London: E. & F.N. Spon; New York: Spon & Chamberlain.
http://books.google.com/books?id=d0rOAAAAMAAJ&pg=PR3#v=onepage&q&f=false

3. What hardware do I need to get started with milling?

http://stores.ebay.com/Bklyn-Hobbies/_i.html?_fsub=469947419 | bare mill table for Sherline
http://www.youtube.com/watch?v=anxkL8bPLUw
http://www.cdcotools.com/ | DRO systems
www.metalworking.com
http://its.fvtc.edu/MachShop3/basicmill/default.htm
http://en.wikipedia.org/wiki/Milling_machine

4. First things first – required safety notes – how to work safely?

http://blog.makezine.com/archive/2011/04/yale-student-killed-in-lathe-accident.html
http://www.nature.com/nature/journal/v472/n7343/full/472259a.html

Safety notes can also be found on various web sites, a few links are given here:

http://www.mini-lathe.com/Mini_lathe/lathe_safety.htm
http://www.zeraware.com/
http://www.americanmachinetools.com/how_to_use_a_lathe.htm
http://www.fricknet.com/lp/safety_posters.php?gclid=CPTW6ZfFhaYCFQTNKgodFQoIpA

Safety products can also be purchased on-line, for example, perhaps look at:

http://www.envirosafetyproducts.com/product/magnifying_safety_glasses_magnifying_safety_glass

5. The very first project on the mill - how can I get started?

http://www.robbjack.com/html/calc.html | Speed and feed calculations

6. Simple cross-slide lock: How to reduce vibrations

http://en.wikipedia.org/wiki/Backlash_%28engineering%29 | what is a backlash?
http://www.sherline.com /4417Zinst.htm
http://news.thomasnet.com/ fullstory/Anti-Backlash-Nut-helps-eliminate-lock-up-issues-486674
http://www.sherline.com/MillExPN.pdf

Book 4

Part B:

A bit “theory”

7. Peeling an onion – cut and feed on a mill
8. Up and down milling
9. Work holding – clamping work safely for milling operations
10. Tool holding
11. Tooling
12. Working precisely with a mill

7. Peeling an onion – cut and feed on a mill

http://awtarlab3.engin.umich.edu/wiki/ index.php/Climb_vs._Conventional_Cutting,
http://www.cnccookbook.com/ img/MillStuff/ ClimbMilling.jpg,
http://cnccookbook.com/CCCNCMillFeeds SpeedsClimbConventional.htm
http://www.sherline.com/millinst.htm

http://en.wikipedia.org/wiki/Milling_cutter | Milling cutting tools and up/down milling
http://awtarlab3.engin.umich.edu/wiki/index.php/Climb_vs._Conventional_Cutting | More detailed
http://www.thetoolanddieguy.com/2011/10/03/conventional-milling-vs-climb-milling/ | Shop notes
http://cnccookbook.com/CCCNCMillFeedsSpeedsClimbConventional.htm | CNC site
http://www.cnccookbook.com/

9. Work holding – clamping work safely for milling operations

http://en.wikipedia.org/wiki/Vise,
http://www.fastenersuperstore.com/nuts
http://www.boltdepot.com/
http://www.littlemachineshop.com/Projects/Drawings/ScrewlessViseClamps.pdf
http://its.fvtc.edu/MachShop3/BasicMill/WorkHold.htm | Great site
http://www.littlemachineshop.com/info/vise_compare.php | Mill vise varieties
http://www.youtube.com/watch?v=nlLVEXXlFnY | How to use parallels
http://www.micro-machine-shop.com/sine_bars_vises.htm | Nice images of sine vises
Movie http://www.youtube.com/watch?v=4mhT1a28qO0 | Movie

http://www.morsecuttingtools.com/cgi/CGPTHOME
http://mdmetric.com/tech/ cvtcht.htm
http://www.lathecity.com/Freebees.html
http://www.lathecity.com/Tools/LASERProtractorSide.html | Morse Taper Cutter
http://www.loganact.com/tips/r8.htm | Professional drawing
http://www.oldengine.org/members/diesel/Tables/Clarkson3.htm
http://www.tools-n-gizmos.com/specs/Tapers.html#R8 | R8 specs

11. Tooling

11.3 Internet resources

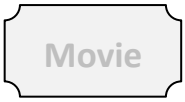
http://en.wikipedia.org/wiki/Milling_cutter | Milling cutting tools
http://nethelper.com/article/Milling_cutter | Milling cutting tools
http://www.websters-online-dictionary.org/definitions/Milling%20Cutter | Milling cutting tools
Movie http://www.youtube.com/watch?v=ckzK-LbeZmY | Smithy mill, nice movie

12. Working precisely on a mill

Movie http://www.youtube.com/watch?v=f0od-cp_9dg

12.4 Zero-budget edge finder made in your home shop

http://www.sherline.com/tip29.htm | home-made, zero-budget edge finder



http://www.youtube.com/watch?v=OrRsNToVhD0
http://www.youtube.com/watch?v=TGmaIIlVA9c
http://www.youtube.com/watch?v=wWXRPL5FamI
http://www.youtube.com/watch?v=XdEM77NDejE

12.7 Further Internet resources

http://www.lasercenteredgefinder.com/ | Laser pointer-based edge finder
http://www.lasercenteredgefinder.com/buynow.html | Expensive >$150 in 2012
http://www.youtube.com/watch?v=f0od-cp_9dg | Movie
http://shdesigns.org/Craftsman-12x36/tooling.shtml | Notes about machining an edge finder
http://its.fvtc.edu/MachShop3/BasicMill/squaring1.htm | Squaring parts on a mill
http://en.wikipedia.org/wiki/Edge_finder | The usual source, but not a good site this time

Book 4

Part C: Working with accessories on projects

14. End mills – finishing the tool posts

Movie

http://www.youtube.com/watch?v=XcU0LTavzDM | Keyway cutting on a lathe
http://www.youtube.com/watch?v=eAkU8BXlA5Q | With an arbor press
http://www.vwbroaching.com/keyseating.php | Key seating, vertical slotter
http://www.millerbroach.com/broach_tools.html | Broaches

18. The mill as a drill press – machining indexing equipment

http://www.tools-n-gizmos.com/specs/Tapers.html#B-Taper
www.graytex.com
http://www.mcmaster.com/#protractors/ =imito7

19. Dovetail cutter

http://www1.mscdirect.com/cgi/nnsrh
http://www.tap-die.com/contents/en-uk/d255_Dovetail_Cutters_Inch.html
http://www.tap-die.com/index.html
http://www.machinist-calculator.com/Dovetails-Eng.html
http://www.homemetalshopclub.org/news/dec02/dec02.html
http://en.wikipedia.org/wiki/Tangens
www.A2Zcorp.us/store
http://neme-s.org/Model_Engineer_Files/Gauging%20Dovetail%20Slides.pdf
http://www.homemetalshopclub.org/news/dec02/dec02.html | Equations
http://www.machinist-calculator.com/Dovetails-Eng.html | Dovetail calculator
http://www.brownells.com/.aspx/pid=14/Product/DOVETAIL-MEASURING-TOOL | Dovetail measuring tool
http://woodgears.ca/dovetail/index.html | Dovetails in wood work
http://en.wikipedia.org/wiki/Dovetail_joint

Designs of fast tool change systems based on dovetail joints:

http://homepage3.nifty.com/amigos/qctp/qctp-e.htm
http://homepage3.nifty.com/amigos/index-e.html

There are probably 100 YouTube videos about cutting dovetails; a few for metal work would be these:

Movie

http://www.youtube.com/watch?v=nAFBMBQ8e2g
http://www.youtube.com/watch?v=6S_iOU0C-Ug | Bridgeport mill
http://www.youtube.com/watch?v=xT2oACFlB0c | Bridgeport mill
http://www.youtube.com/watch?v=WbvscN7YVUs | Dovetail milling on a lathe
http://www.youtube.com/watch?v=KcNoz8dXNd | Woodwork
http://bbs.homeshopmachinist.net/showthread.php?t=48141

21. Fly cutter – cutting flat surfaces; lathe stop / mill lock

http://www.youtube.com/watch?v=lepvntEd3Jk | Making a fly cutter

Watch one of the movies before you start.

http://www.youtube.com/watch?v=PJmrZVeN4k8 | Fly cutter operation Sherline

http://www.youtube.com/watch?v=dsJ2o2BI4LE | Fly cutter operation Sherline
http://www.youtube.com/watch?v=Lql30RDYN_s | Fly cutter operation Bridgeport
http://www.youtube.com/watch?v=Ecs3OpHrfOg | Boring fly cutter

22. Boring on a mill – machining indexing attachment

http://www.jjjtrain.com/vms/mill_boring/mill_boring_00.html | Very detailed including animations.
http://www.youtube.com/watch?v=mHna6I-RfAs | Movie, Bridgeport mill.
http://www.youtube.com/watch?v=c6hDmC9Cpas | Specialty boring head for Sherline mill.

23. Rotary table – machining a tilt table and swiveled base

http://www.youtube.com/watch?v=am5774rnjtU | Simple design
http://www.deansphotographica.com/machining/projects/mill/rotary/rotary1.html
http://www.sherline.com/3700inst.pdf

23.5 Project example – machining a swiveled base

http://www.lathecity.com/Tools/LASERProtractorSide.html
http://email.villagepress.com/pub/HSM/20120806/20120806.html | chain drilling

23.8 Machining a wheel with spokes

http://www.sherline.com/3700inst.pdf for a very detailed example.

23.9 Note: cutting gears with a rotary table - mounting rotary table vertically

http://www.sherline.com/3700inst.pdf
http://www.dragonworks.info/CAD-CAM-CNC/xyzr%20table/XYZR%20Table%20R%20Axis.htm
http://www.hobby-machinist.com/showthread.php/1955-Which-is-better-for-cutting-small-gears-rotary-table-or-dividing-head
http://bbs.homeshopmachinist.net/archive/index.php/t-15155.html

23.10 Internet resources

General info:

http://en.wikipedia.org/wiki/Rotary_table
http://www.jjjtrain.com/vms/mill_rotary/mill_rotary_00.html
http://igor.chudov.com/manuals/Troyke-Rotary-Tables/UsingARotaryTable.pdf | Gear cutting
http://www.mini-lathe.com/Mini_mill/Accessories/Rotary_tables/rotary_tables.htm | Rotary table models.
http://www.jjjtrain.com/vms/mill_rotary/mill_rotary_00.html | Virtual machine shop

Rotary table vendors (2012 prices as seen on the web), just examples:

http://littlemachineshop.com/products/product_focus.php?Focus=Rotary+Tables | $230 -$800
http://www.grizzly.com/products/3-Rotary-Table Clamps/H6195?utm_source=google&utm_medium=productlisting&utm_campaign=google%2Bproducts | $85 for 3” table
http://www.sherline.com/3700pg.htm | $270

Movies - How to use a rotary table?:

http://www.youtube.com/watch?v=vckIQE5JWo8
http://www.youtube.com/watch?v=k4OUlxaAFio&feature=bf_next&list=PLA4CA98666CFADB8B

27. Tapping attachment

http://auto.howstuffworks.com/clutch.htm
http://en.wikipedia.org/wiki/Clutch
http://www.youtube.com/watch?v=r1rZ_M1Qnys | Movie

Book 4

Appendix and Endnotes

Web links and software

Disclaimer

Web addresses are given without any warranty or guarantee, web sites may be infected by a computer virus and/or may not provide the best servise. **Neither the author nor publisher shall be liable for damage arising herefrom.** The content of web sites may have changed since the author looked at it and you read it.

Interesting web sites about milling operations

These are website with general information about milling. More specific sites are included in most of the Chapters.

http://web.mit.edu/2.670/www/Tutorials/Machining/mill/Description.html
http://awtarlab3.engin.umich.edu/wiki/index.php/How_to_edge_mill | Milling in general
http://awtarlab3.engin.umich.edu/wiki/index.php/How_to_face_mill | Milling in general
http://www.eng.mu.edu/~dlc/machineshop/contents.html | University site
http://www.robbjack.com/html/calc.html | Speed and feed calculations
http://www.americanmachinetools.com/how_to_use_a_milling_machine.htm | Quite extensive
http://its.fvtc.edu/MachShop3/basicmill/default.htm | Quite extensive
http://its.fvtc.edu/MachShop3/basicmill/Construction.htm | Naming all components of a mill

Where is metal stock purchased?

http://www.metalsdepot.com/
http://www.industrialmetalsales.com/
http://kmac-distribution.com/
http://www.smallparts.com/
http://www.onlinemetals.com/
http://sherline.com/online.htm
http://www.mcmaster.com/

Purchasing plastics is more difficult. Perhaps try out the following sources:

www.online.metals.com
www.eplastics.com
http://www.professionalplastics.com/

For machinable wax, try this:

http://MSCdirect.com
http://www.machinablewax.com/
http://www.flexbar.com/

Too lazy for typing all of these addresses? A list of all links (and more) can also be found in the customer corner of our on-line shop.

As always, comparing prices may save a lot of money since sometimes rather astronomical and artificial pricing can be found, particularly in the hobby / amateur sector. Knowhow always equals money… Searching the web regularly by utilizing typical search engines such as

http://www.yahoo.com/
http://www.google.com/
http://en.wikipedia.org/wiki/List_of_search_engines

may be a good idea even for $10 products.

Sources for Sherline accessories

None-Sherline made accessories for Sherline systems:

www.LatheCity.com | You know that one, we hope.

www.omwmetal.com | Radius cutter

https://id3490.securedata.net/omwcorp.com/merchantmanager/product_info.php?products_id=1 | Radius cutter – direct link

http://www.discountcampus.com/dpp.htm | e.g. Morse type adapters

Modified Sherline systems:

http://www.computersculpture.com/Pages/Index_Production.html#sherlineProducts

CNC accessories:

http://www.flashcutcnc.com/Tabletop-CNC-Retrofit-accessories.php

CNC tool changer

http://www.cadcamcadcam.com/ | Main page, Jacked-up / tuned Sherline CNC systems

http://www.imsrv.com/sherlinemachines/?gclid=CJfeve3Sha8CFQZ_hwodhT9x2w | Jacked-up / tuned Sherline CNC systems, e.g. CNC thread cutting

http://www.youtube.com/watch?v=WMGsl9atr3Q | Video, Automatic tool changer for Sherline CNC

Sherline genuine (?) parts / vendors:

http://sherlinemachinetools.com/
http://www.lacywest.com/09mlathe.htm
http://www.dgrdesigns.co.uk/sherline.html | UK
http://www.blueridgeshoponline.com/category.sc?categoryId=25
http://precisiontools.shopping.officelive.com/SherlineToolsAccessories.aspx
http://www.mikestools.com/sherline-machine-tool-accessories_1209.aspx
http://www.shopwiki.com/l/sherline-lathe | that appears to be a sales platform for different vendors
http://www.weldershop.info/219/sherline-lathes-and-accessories/ | that appears to be a sales platform
http://www.discountcampus.com/dpp.htm
http://www.discountcampus.com/store/sherlineonline.htm
http://www.blueridgeshoponline.com/category.sc?categoryId=25
blueridgemachine@att.net

Interesting links to try out:

http://www.craftsmanshipmuseum.com/
http://en.wikipedia.org/wiki/Sherline

On-line tool shops – hand tools / standard accessories:

http://kittstools.com/ | They mentioned reduced shipping costs in their ad which they did not grant to me – be careful. Less expensive standard hand tools, etc.
http://www.harborfreight.com/ | You know that one I guess.
http://www.mcmaster.com/# | They have everything (nuts, bolts, cutting tools, specialty hand tool, taps, dies, etc.), but often rather expensive – in my opinion.
http://www.grainger.com/Grainger/wwg/start.shtml | They sell also to private customers.

Benchtop systems:

http://vcshobbies.com/home.php?cat=278 | Proxxon
http://www.sherline.com/ | Sherline
http://www.taigtools.com/ | TAIG
http://www.harborfreight.com/# | Haber freight
http://www.benchtop-lathes.com/

Lathes / mills – larger "benchtop" systems:

These may be the most well know brands.
http://www.grizzly.com/home.aspx | manufacturer site - Grizzly
http://www.jettools.com/us/manufacturing/en/home.html | manufacturer site - Jet
http://www.smithy.com/ | manufacturer site - Smithy
http://machinerydistributors.com/milling.htm | Shop Fox distributor, apparently no factory web site available – Shop Fox
http://stores.ebay.com/Bolton-Hardware?_trksid=p2047675.l2563 | Bolton hardware, E-bay store