Training Modules.

Overview.

The choice and scope of each module should cover the range of tasks that one may undertake on, in this particular case, centre lathes along with any relevant support skills that would be necessary.

Identifying these modules and the extent of the cover should take into account the need to keep them brief for easy assimilation.

The excellent series of YouTube videos published by Blondihacks is a mine of information for the beginner wishing to use a metal turning centre lathe.

So the modules suggested have a substantial number of videos identified. The support document has some listings of the Blondihacks links.

An initial, though incomplete, proposed module set.

1. Machine shop safety
2. Understanding engineering drawings
3. Identification of lathe components and controls
4. Accurate measuring using calipers and micrometers
5. Simple overview of model engineering materials
6. Work holding
7. Blondihacks Lathe Tutorial:- Lathe Tool Shapes, What are they all for
8. Blondihacks Lathe Tutorial:- Side & Face cutting Metal Lathe Tutorial (MLT) 3 & 5
9. Blondihacks Lathe Tutorial:- Using parting tools MLT 15
10. Blondihacks Lathe Tutorial:- Drilling and boring MLT 10 & 22
11. The Harrison 250
12. Using the Newall DP700 Digital Readout
13. Tool Calibration

D. J. Tompkins

12/9/24 14/12/24
19/9/24
6/10/24
29/10/24
25/11/24

Module 1. General Safety Notice.

Overview.

Safety at the ESSMEE site is a priority consideration.

ESSMEE endeavours to provide a safe environment for all members and visitors.

However, each member and visitor also have the responsibility to act in a safe manner.

In the context of this training programme, comments apply to the machine shop area and to the fitting shop. (But can apply to any area of ESSMEE.)

Understand ! All powered machinery and tools have the speed, power and stored energy to inflict injury to a greater or lesser extent so they must be treated with respect.

It is recommended that safety glasses be worn, these are to be found in the yellow bag hanging in the machine shop. For those persons that normally wear corrective lenses, low cost safety glasses with corrective lenses are available, at modest price, on the net. If you wish, your optician would be happy to supply prescription safety glasses .

Appropriate clothing is necessary, loose flappy ends etc. that may be drawn into running machines will cause accidents.

The most important control on any powered machinery is the **STOP** switch, familiarise yourself with this control before using the machinery.

ESSMEE have a continuing programme of upgrading machinery by fitting with appropriate guards. These should be used.

Do not use any machine without adequate knowledge of its operation and how it should be operated. It is hoped that this training programme will allow for safer following of your hobby.

D. J. Tompkins.
13/9/24.
14/9/24.
6/10/24.
4/11/24.
25/11/24.

Module 2. Understanding Engineering Drawings.

Overview.

One must have an understanding of engineering drawings when endeavouring produce component parts, either in the machine shop or any other engineering manufacturing area.

An engineering drawing aims to provide all the information necessary to make the component (or put together an assembly) without the necessity for any calculations on the shop floor. The information should all be generated in the design office and the shop floor does the manufacturing.

The process of generating a drawing starts right back at the usually most difficult stage of achieving something, that is to decide what is to be made.

In the era prior to complete computer designing, the period most model engineering is presently residing, it is most likely that the apocryphal back of the envelope is the first visual description of a design. From that a layout, to scale, is drawn up based on materials chosen, stress calculations as necessary, aesthetic considerations etc. etc..

From the layout all the detailed component parts may be designed and drawn up.

These component drawings are taken and a general assembly drawing is constructed in order to check that the component parts will actually fit together as intended. At this stage the detailed drawings may be corrected as required before passing them out for manufacture.

In pre-computer days modelling large projects, such as aircraft, would have scale or life size models made to check original layouts and also allow easier design of tortuous components such as pipes etc. etc.. The enormous cost of these mock-ups led to the rapid development of 3D CAD where model could be produced in virtual space. It is telling that one of the leading 3D CAD programmes, Solidworks, is the product of the Dassault Aircraft Company.

A logical extension of the computer models is machining parts without the need to produce detailed drawings, i.e. CADCAM.

But us model engineers, harking back to the steam age, primarily use detailed drawings and so we need to understand their details.

Whilst there are several world standards such as ISO, JSO and ANSI we also need to navigate the peculiarities of typical Model Engineer drawings where economic use of drawing sheet space comes to the fore.

Internet Tutorials.

For training at one's own pace the next stage is to carry out a Google and YouTube search for 'Understanding Engineering Drawings'. From the suggestion find ones that you find easy to understand. e.g.

https://fractory.com/engineering-drawing-basics/

A separate document titled : Information Resources will, hopefully, be updated as further YouTube videos are identified.

Club Tutorials.

There is limited ability for the club to carry out formal tutorials but one-to-one or very small groups can be carried out on and ad hoc basis.

D. J. Tompkins.
19/9/24
6/10/24
4/11/24
25/11/24

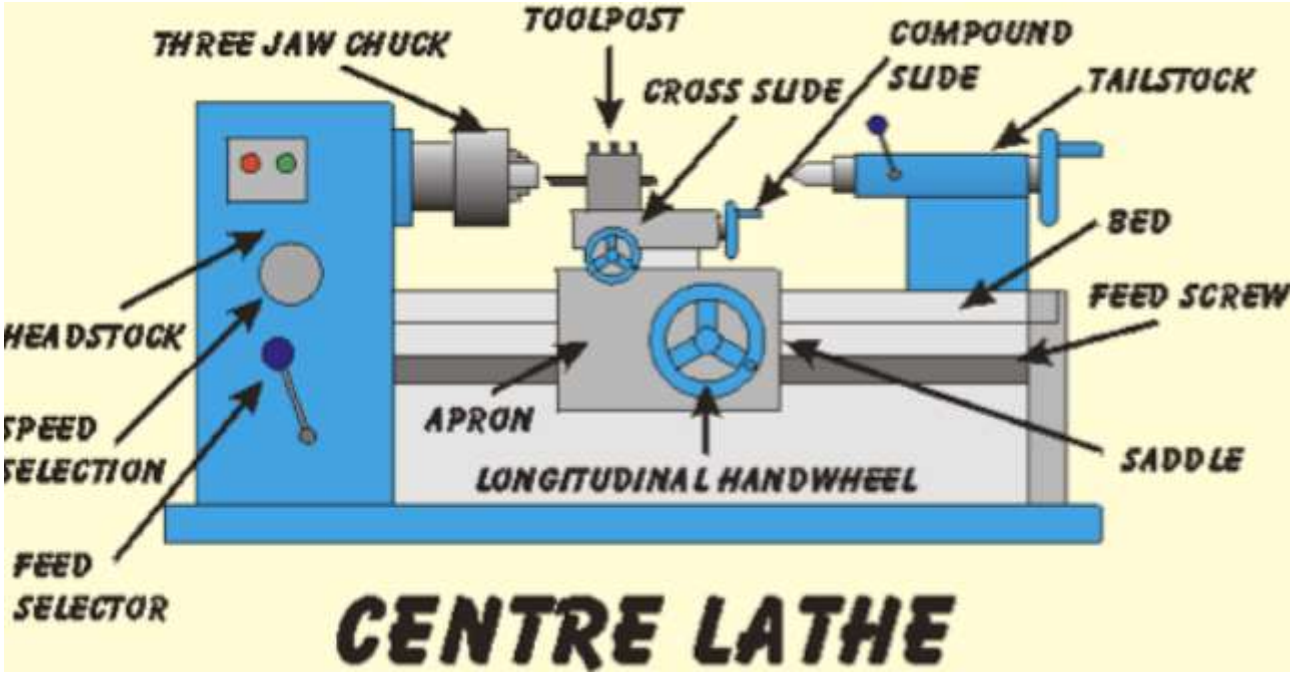
Module 3. Lathe Components.

Overview.

Lathes have a long history in the production of cylindrical parts. Their operation is based on the concept of rotating the component and removing material by a nominally stationary tool being applied to it.

We moved on from the pole lathes for woodwork to our modern lathes usually powered by individual electric motors.

ESSMEE is fortunate in owning 3 lathes of varying capabilities and capacities.



In the illustration all the typical components may be seen. All of the ESSMEE lathes have different positioning of their controls along with further secondary controls that are not shown in the illustration.

With all machinery the most important control is the OFF switch.

Make sure you know where it is and how it is operated.

Internet Tutorials.

On the internet search for such subject as :- Lathe Components & Controls.

Some YouTube links are shown in the 'Information Resources' document.

Mentoring.

Understand that all machinery has the potential to cause considerable injury.

The power of the drive motor combined with cutting tools and catch points such as the rotating jaws of chucks give the ability to cause these injury.

KEEP HANDS AND LOOSE CLOTHING AWAY FROM THE ROTATING PARTS.

Until you are very familiar with the operation of the lathe always ensure a suitably knowledgeable member is on hand to monitor your progress.

D. J. Tompkins.

13/10/24
4/12/24

Module 4. Accurate Measuring Using Micrometers and Calipers.

Overview.

The driving force for accuracy in traceable measurement was mass production, taking manufacturing from bespoke to mass production.

The earliest examples of the need for accuracy allowing part interchangeability was in the production of firearms in the U.S..

In our arena we wish to machine components that will assemble without excessive precise fitting.

To achieve this it is necessary to be able to measure accurately using equipment such as micrometers and calipers. These device require knowledge and practice to give the levels of confidence and precision.

In addition to correct usage, an understanding of the basic accuracy limitations will inform in the selection measurement method used.

A review of techniques can be found in the large numbers of videos that may be accessed on YouTube and Google.

Search for 'Use of micrometers and Calipers (Vernier and Digital)'.

Further links may be found in the document 'Information Resources'.

Following the videos practical experience can be gained at the club house where known test lengths may be found. No doubt club members that already familiar with accurate measurement will answer any questions.

D. J. Tompkins.
20/9/24
6/10/24
4/11/24
4/12/24

Module 5. Simple Overview of Model Engineering Materials

Overview.

The conservative outlook for most steam railway modellers leads to a 'traditional' range of materials for jobs machined on the lathe.

The range discussed is limited, with a huge range of sub-types, so this, as the title infers, is a simple excursion into the subject.

Most mainly used materials for model steam railway components.

Copper and some of its alloys.

Copper being a ductile and malleable metal has found its place for tubing, boilers and components like rivets.

It has a wide range of alloys used in our hobby:

14. Brass, found in sheet and bar forms. As a sheet it is easily formed, in its annealed state, and may be easily machined. A typical lathe tool will have low top rake as the chip formation is of a brittle failure type.
15. Bronze, usually found in bar form and used for bearings. Be aware that the aluminium bronze form is a difficult material to machine as it is prone to rapid work hardening.
16. Phosphor bronze, as its name implies it has a phosphorous component in its make up. A strong alloy that machines quite well but care must be taken when drilling in the lathe as it tends to 'close in' on the drill in deeper holes.

Ferrous materials.

Ferrous materials have iron as the main component of the alloys. There is a wide range of alloys available. Materials can be described in some details in such publications such as the Macreadys stock range catologue.

- Mild steel, are usually low alloy carbon containing alloys and have varying machinability. For secondary treatments such as case hardening or hardening specific alloys can be found.
- High alloy steels can provide particular characteristics, usually after an appropriate heat treatment regime.
- Stainless steels and rust resistant irons may be non-magnetic or magnetic dependent on the alloy and its crystal structure. If it is of the austenitic form then it will be non magnetic. The ferritic and martensitic forms are magnetic. When machining one must be aware that stainless steels display a notable amount of work hardening thus sharp tools and avoidance of very small depths of cut is necessary.
- Cast iron is a material that is sensitive to cooling conditions when cast. This controls the hardness due to the high carbon content. Some alloy elements can be added to produce what is known as a spheroidal graph form. The graphite content provides lubrication that gives easy machining.

Plastics.

Not quite a 'real' traditional ME material, but, there are benefits in using plastics in some areas.

- PTFE, sometime known as Teflon. This soft plastic, with a low coefficient of friction, has great chemical stability and a typical use of in gland and pipe joint sealing.
- UPVC is a stable rigid plastic but not too temperature resistant.
- Acetal, a trade name for one version is Delrin. A strong plastic that is a treat to machine to close tolerances. Available in a range of colours.
- Acrylics, such as Perpex and Plexiglass, are usually employed because it is available as water clear. There are two forms available the first is extruded and the second is cast. Beware that machining can easily cause overheating that will lead to problems with the tools. In addition one should steer clear of machining the extruded form as it will stress crack a a short time after machining. Also acrylics are very sensitive to solvents etc. etc. that will lead to surface crazing or bodily cracking.

Aluminium.

A lesser used material in model steam locomotive building but it has its uses.

There are 2 main bar stock types, alloys with and without zinc.

Without zinc the alloy, such as a type 6082, is weldable but when it comes to machining it produces stringy swarf and tends to weld material to the tool tip compromising the cutting action.

Zinc containing alloys are commonly known as free machining and produce swarf similar to brass. Build up on the tool tip is minimal.

Tutoring.

No doubt a whole raft of YouTube videos can add to ones knowledge base.

Mentoring.

Most drawings will specify the material to be used and how it should be post machining treated. Because of the range of strengths and hardnesses advice about work-holding should be sort.

D. J. Tompkins

4/11/24.
7/11/24.
25/11/24.

Module 6. Work Holding

Overview

When machining any component one of the first points to consider is how the job is to be held during the machining operation. This consideration applies to all machining operations.

The three club lathes are reasonably provided with holding devices but have differing mounting methods.

The Harrison lathes have what is known as Camlock noses and the Myford has a screwed nose.

With any mounting system the golden rule is that the mating faces of both the nose and the removable job mounting device should be spotlessly clean. Failure to observe this will lead to job imprecision and damage to lathe and mounting device.

Please note that some of the descriptions below may not be clear without a complete understanding of a centre lathe build and operation. This module should be read when next to a lathe in order that a mental picture may be built up of the holding operation.

Simple Holders

The turning operation involves rotating the job and then applying a nominally stationary tool to cut off material.

Early lathes spun the job between two sharp points, this turning between centres is still a useful method. Mounting the job on a faceplate also was an early option.
A precursor to modern chucks was the bell chuck where a cup shape had screws through the sides that held the job, a forerunner of the modern 4 jaw chuck.

Modern Work Holders

Moving from the basic we have the mounting of the job between centres. Hardened centre points, usually a 60° cone angle, are fitted to the lathe nose and the tailstock. The tailstock centre may be a rotating centre removing the wear point on the job caused by a fixed centre.

The job, between centres, is driven by means of the pin protruding from a drive plate connecting to a drive dog clamped to the job. Balancing should be considered as drive dogs may be very unbalanced.

To turn large or irregular shaped components the faceplate comes into its own. The job is held on the faceplate by clamps of various types. Care must be taken to balance the load on the faceplate to prevent vibration.

There are a variety of modern chucks with three main types, 4 jaw, 3 jaw and collet.

4 jaw chucks, in the main, have independent clamping jaws.
Typically the jaws of a 4 jaw chuck may be reversed to enable a variety of job sizes to be held.

The 4 jaw chuck can provide a very high holding capability.

A self centring variety of chuck is available and is usually associated with wood turning but my be used for metal turning.

3 jaw self centring chucks are probably the most widely used chuck on a metal turning lathe. Its ability to hold a round job very close to concentric with the lathe spindle is very useful but cannot be relied on for perfect concentricity should a job need to be reversed in the chuck for a second operation.

To move the jaws a spiral plate engages with teeth on the rear of the chuck jaws to move them in simultaneously. The jaws fit into the chuck in slots that are normally numbered to match the mating jaw. This matching must be adhered to as the teeth on the jaws are 120° out of phase with each other thus ensuring the spiral brings the jaws together at the centre of the chuck.

Two points arise from this spiral arrangement, the first is that the clamping load that may be exerted is limited by the friction forces on the spiral/jaw contact points and the second is that the jaws may not be reversed.

Therefore 3 jaw chucks are normally supplied with internal and external jaw sets. In addition soft jaws are available.

To match a particular job soft jaws may be used by machining out an appropriate recess (or shoulder set for gripping on a large bore). This will improve the concentricity of holding plus minimum marking of the job by the jaws.

The third work holder is the collet chuck. These come in a variety of types, the Harrison 250 is equipped with two forms. The first is a lever operated Burnard multi-size collet chuck. DO NOT REMOVE THE COLLET RETAINING CAP IF THE CHUCK IS NOT MOUNTED ON THE LATHE.

The second is a set of draw-bar collets that include internal and external washer holding collets. Some forms of collets may have a range of internal shapes such as squares, hexagons et. etc..

Work Holding Various Materials

The last thing one wants is for a job to come flying out of the work holder so adequate holding is vital.

There are several factors to be considered when holding a job and these include size of the job, how difficult the material is to machine, the amount of length that may be gripped, the cutting load, the friction between the job and the chuck. This list is not exhaustive but it will give an indication of what holder should be used.

In making a judgement of a turning job the diameter to length ratio should be considered. A long thin job will easily flex so support from a tail-stock centre and steadies may be called for.

As one's experience builds then the holding decisions become easier but asking for a second opinion is always a good idea.

Internet Tutorials

A start YouTube search should be something like 'Centre Lathe Chucks'. For here one can dig further into the subject.

Mentoring

As usual 'If in Doubt Ask' is relevant here, so don't be inhibited in asking for advice.

Keeping you and the machine safe should be to the forefront.

D. J. Tompkins

3/11/24
25/11/24
22/2/25

Module 7, 8, 9, & 10. Blondihacks Videos Covering Most Lathe Operations

Overview.

The YouTube videos presented by Blondihacks give very concise demonstrations of the various basic lathe operations. Familiarity of these videos prior to actually standing in the front of a lathe will be most beneficial.

Information.

Links for the Blondihacks channel and other useful videos are contained in the appendices.

Tutorials.

Getting the feel of turning is best learned with an experienced turner at ones elbow. Knowing the sounds and feel of the lathe when turning.

There are club members that have the experience and are likely to act as mentors.

D. J. Tompkins

4/12/24

Module 11. The Club Harrison 250 Lathe.

Description.

The Harrison M250 is the smaller brother of the M350 that the club owns and as such bridges the gap between the Myford and the M350.

The H250 was originally purchased from a machine dealing company who had bought it from a model engineering supply shop that closed. As such the machine was unused and quite a rare beast in so much as having single phase electrics and an imperial scaling.

Imperial Machine.

Being an imperial machine the dials are calibrated in 'thous' and the thread cutting arrangements are nominally in T.P.I. although with the correct change wheels metric threads may be cut.

The centre height is 145mm (5.7"), the tailstock has a #3 Morse taper whereas the spindle has a #5 Morse taper and a Ø35mm through bore.

The cross slide is fitted with a Dickson T2 tool post and the bed slide has a micrometer adjustable saddle stop.

Along with the full set of original tool kit spanners and the manual there is a complete change wheel set that includes those needed for metric pitch threads. For imperial threads there is a thread indicator dial attached to the saddle.

Drive Motor.

A 3 phase motor was retro fitted to provide more power and a smoother lower noise drive. It is possible to vary the spindle speed from 0% to 200% the nominal gearbox selected speed but as the motor is a standard 3 phase unit it should be run for the majority of its working cycle at the 100% nominal speed. This means that the motor is being driven by a 50 Hz supply. Away from the 50 Hz, when the speed is varied, the losses within the motor will cause excessive heating.

Thus for normal machining always select your required speed by using the gearbox settings not the variable speed knob on the control panel. (The use of the variable speed control will be explained later in this module.)

Digital Readout.

The digital readout is a Newall DP 700 unit that employs magnetic measuring scales. One is fitted on the cross slide and the other is connected to the saddle thus giving the ability to measure the movements of both the saddle and the cross slide.

The display has 2 readouts, the upper one indicating the job diameter (note not radius) and the lower one the movement of the saddle. The display may be switched between inches and millimetres, the conversion is automatic.

For operation and use of the digital readout see Module 13: Newall DP70 Readout.

Chucks.

The lathe has a D1-3 spindle nose and on to this can be mounted the various chucks etc. that are available.

These include a 3 jaw self centring unit, a 4 independent jaw unit and a lever operated adjustable collet chuck.

A series of collets along with their associated draw bar is also available.

And, of course, a face plate.

Tail Stock.

As noted above the tailstock has a #3 Morse taper into this may be fitted various accessories that include a dead centre, a rotating centre, a drill chuck, a sensitive drill and die holder.

Use Of Variable Speed Control.

For occasional use when thread tapping, single point tool thread cutting or die thread cutting the variable motor speed can be used for short periods. When approaching the end of cuts of these noted operations one can slow the spindle speed right down to zero for accurate end point determination.

At other times, when undertaking normal turning operations, the spindle speed may be altered slightly to stop chatter.

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26/01/25

Module 12. Using the Newall DP700 Digital Readout.

Overview

As previously noted the digital readout is a 2 channel unit measuring the diameter direction (X axis) and the axial direction (Y axis) employing magnetic encoders.

The unit is capable of working in the simple mode, where either axis may be reset to zero at any time, or using stored zero set points for up to 50 different tools.

The method of operation is different for each mode because of the treatment of the memorised absolute zero point within the unit.

Simple mode

Club Members who have used the digital readouts on the Harrison 350 and the large milling machine will be used to resetting axes to zero for use in continuation of the machining operations.

What is VERY IMPORTANT when in this mode tool number 50 MUST be selected. This is achieved by entering 50 on the numeric pad and then pressing ENTER.

After this operation one may press the left arrows adjacent to the two axis displays as required.

Using Tool Remembered Zero Setting Mode

It is assumed that the variously numbered tool holders have been calibrated. (Most tool holders have a number engraved on the end.)

To be sure that the Readout absolute zero is correct for the calibrated tools one must:

17. Select tool number 50 (see above).
18. Place the Zero setting gauge between the cross slide and the back of the cross slide dial holder.
19. Lightly nip up the setting gauge, ensuring it is square between the two faces.
20. Press the left arrow button next to the X axis (diameter) display.

Now the absolute zero for the X axis is returned to the zero used by the various tool calibrations.

Assuming the tool selected for use has been calibrated, one should select it by entering the tool number with the numeric pad and then pressing ENTER.

Now the tool should cut the diameter close to that displayed on the upper display.

HOWEVER: As the cut may vary due to such factors as tool wear, job deflection, depth of cut taken etc. etc..

My experience of good accurate cutting found that one should rough cut down to within about 0.5 mm (0.020") followed by a cut of about 0.25 mm (0.010"). Now a measurement taken will allow the calculation of the exact amount to be removed. With this process, accuracies down to 10 microns (0.0005") may be achieved.

Tool Calibration

See Module 13 for the process of calibrating a cutting tool.

D. J. Tompkins
26/1/25

Module 13. Tool Calibration

Overview

As noted before the DP700 Digital Readout is able to calibrate the zero of up to 50 tools. The process is shown on the instruction set hanging above and to the right of the H250.

The method I have found to be reliable is :

21. Mount a suitable test piece in the lathe.
22. Take a 'clean-up' cut.
23. Start the calibration process.
24. Take a further cut of approximately 0.25 mm (0.010").
25. Note the X axis reading.
26. Follow the instructions.
27. Carefully withdraw the saddle to take a measurement, making sure the cross slide is not disturbed. (The X axis reading should remain the same.)
28. Follow the instructions and enter the measured figure when requested by the indicator.
29. Complete the instruction set.

The tool zero is now set.

You may wish to make another small cut to check the accuracy of the calibration.

D. J. Tompkins

26/1/25

Appendix1.

Information Resources.

General Note.

In reviewing many YouTube videos it has become obvious that one YouTube contributor has an excellent range of videos associated with the operation of a centre lathe.

The contributor is Blondihacks and it is suggested that subscribing to this person will bring you many super videos.

A collection of these blondihacks is:

https://www.youtube.com/watch?v=H6Dnmd3lDzA&list=PLqXDyb9PP_G8H-rS8J_MRepF1CeEcSIW8

Engineering drawings.

https://www.youtube.com/watch?v=ht9GwXQMgpo (Very Good)
https://www.youtube.com/watch?v=1roPfzjHXnM (Good)
https://www.youtube.com/watch?v=jj4mUHzTSYc (Good)
https://www.youtube.com/watch?v=0HZKCx6dcJ0 (Good)

Accurate measurement.

https://www.youtube.com/watch?v=jJfu35JDXOs (Basic)
https://www.youtube.com/watch?v=7u0PIz7deu8 (Good)

Lathe components & controls.

https://www.youtube.com/watch?v=jJfu35JDXOs (Good)
https://www.youtube.com/watch?v=sbbwJ5p6irc (Has interesting points)
https://www.youtube.com/watch?v=9-YF79xGies&ab_channel=SmithyIndustries

Introduction to cutting tools.

https://www.youtube.com/watch?v=KlNAVlgpShU (Good)
https://www.youtube.com/watch?v=J63dZsw7Ia4

Side & Face cutting.

https://www.youtube.com/watch?v=H6Dnmd3lDzA (First in a series, good)

https://www.youtube.com/watch?v=_Vw48i30SN8&t=13s (A little wordy but the first episode of a series)

https://www.youtube.com/watch?v=fDSLWYHuj4g (Simple turning on Myford)

https://www.youtube.com/watch?v=SOnPEwP9bCA (Turning with some safety points)

https://www.youtube.com/watch?v=wvYQdi68074 (Screw-cutting)

Using parting tools.

https://www.youtube.com/watch?v=fZlWJ_JqQtA (Slightly long)

Discussing job materials.

https://www.youtube.com/watch?v=ysInnHOoouc (Copper and alloys)

Drilling and boring in the lathe.

https://www.youtube.com/watch?v=lHquZSsM_k0 (Good)

The Harrison 250 digital readout.

A pdf copy of the DP 700 manual is available.

Calibrating tools on the Harrison 250.

The instructions for calibrating tools are attached to the back board of the lathe.

Appendix 2.

Support Videos from Blondihacks.

This YouTube contributor has published a range of videos including a set specifically aimed at centre lathe use. Below are a sample of the videos available and it is suggested that a YouTube search for:

Blondihack metal lathe tutorial

will bring up an extensive range of individual subjects oon lathe use in a format that can easily be digested.

Below are some sample links, in no particular order, for consideration.

Lathe Tool Shapes - What Are They All For?

https://www.youtube.com/watch?v=KlNAVIgpShU

Metal Lathe Tutorial 19 : Calipers & Micrometers

https://www.youtube.com/watch?v=v8U_gg6Qz6c

Metal Lathe Tutorial 1 : Theory

https://www.youtube.com/watch?v=H6Dnmd3lDzA&list=PLY67-4BrEae9Ad91LPRlhcLJM9fO-HJyN

Metal Lathe Tutorial 3: Facing

https://www.youtube.com/watch?v=r9AqbENiLOQ&t=61s

Metal Lathe Tutorial 5: Turning

https://www.youtube.com/watch?v=1IsG8vIXA8k

Metal Lathe Tutorial 15: Parting

https://www.youtube.com/watch?v=PeHmee4tvYc&t=308s

Metal Lathe Tutorial 10: Drilling

https://www.youtube.com/watch?v=lHquZSsM_k0&t=24s

Metal Lathe Tutorial 22 : Boring! Boring BARS, that is!

https://www.youtube.com/watch?v=8-ySTD5b7Dw&t=593s

D. J. Tompkins

17/11/24.

Appendix 3.
Some of the Books in the Club's Library.

How to read engineering drawings.

The amateur's lathe.

Using the small lathe.

Know your lathe.

Practical lessons in metal turning and screw-cutting.

D. J. Tompkins
17/10/24