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SHERLINE Lathe and Mill Setup Instructions

Getting answers to your questions about machining

Over the years we have found that the majority of our customers are both highly intelligent and skilled craftsmen. Often they are also new to machining. The instructions we have included in this book, while far more extensive than anything included with other machine tools, even ones costing thousands of dollars, still only scratch the surface when it comes to machining. We have tried to anticipate the most common problems and questions asked by a new machinist. What we have provided in this book and with each accessory, when combined with a liberal amount of common sense, is more than enough to get you started. If you apply what you learn here, you will be well on your way to making good parts. No doubt you will also have many questions specific to your project that simply can't be addressed in a booklet of this type.

Answers to questions beyond the scope of this booklet will have to come from your own research. Book stores and libraries are full of excellent books on machining, and the Internet is forming some great user groups that can put you in direct contact with others who share your specific interests. Our own World Wide Web site is a great source of information as well, as we have published there all the instructions for all our tools and accessories for you to read and print out for free. We feel we have written the best book available on miniature machining with Sherline tools. It is called *Tabletop Machining* by Sherline's owner and long-time toolmaker Joe Martin. We also sell Doug Briney's *Home Machinist's Handbook* as well as a very informative steam engine project video by Rudy Kouhoupt, both of which are packed with knowledge for new machinists. For the past 35 years I have found *Machinery's Handbook* to be the source I turn to for answers to my own questions. May your journey toward becoming a skilled machinist be an enjoyable one.

An introduction to the world of miniature machining

What new machinists like most and least

If you are new to machining, you may find it to be either one of the most rewarding skills one can learn or the most frustrating thing you have ever attempted. What makes machining fun for some is the complexity and challenge. The same thing will drive others up the wall. One customer may be overjoyed because he can now make parts that were not available for purchase. Another may wonder why he just spent all day making a part that is similar to one he could have purchased for two dollars. (The difference is that it is not the same as the two dollar part-it is exactly the part needed.)

There are no shortcuts

Machining is a slow process if parts are made one at a time. The interesting thing is, a skilled machinist may take almost as long to make the same part as a novice. Shortcuts usually end in failure. Unlike some other trades, mistakes cannot be covered up. There are no erasers, white-out or "putting-on tools" for machinists; you simply start over. To expand a little on an old rule: *"Think three times, measure twice and cut once!"*

Anticipation of a tool's limitations is the craftsman's strength

The skill in machining isn't just "moving the dials". It is a combination of engineering and craftsmanship. A file is just as useful a tool to a good machinist as a multi-thousand dollar machine tool. Tools "deflect" or bend under load, and anticipating this bend is what it is all about. Sharp tools deflect less than dull tools, but with each pass the tool dulls a little and the deflection becomes greater. If you try to machine a long shaft with a small diameter, the center will always have a larger diameter than the ends because the part deflects away from the tool where it has less support. You can go crazy trying to machine it straight, or you can simply pick up a good flat mill file and file it straight in a few moments. Machine tools will never replace the "craftsman's touch", and machining is a combination of both good tools and good technique.

You don't become a machinist by buying a machine

You should strive from the beginning to make better and more accurate parts than you think you need. Work to closer tolerances than the job demands. Be on the lookout for ways to make a job easier or better. Having a selection of appropriate materials on hand and a good cutoff saw to get them to rough size is a good start. Take some time and read through this instruction book before you try machining anything. We want you to enjoy the process of creating accurate parts from raw metal. Buying a machine didn't make you a machinist, but using it along with the skill and knowledge you acquire along the way eventually will. With the purchase of SHERLINE equipment, you have taken your first step toward many years of machining satisfaction. We at SHERLINE thank you for letting us be a part of that.

Joe Martin, President and Owner

SAFETY RULES FOR POWER TOOLS

- 1. KNOW YOUR POWER TOOL**-Read the owner's manual carefully. Learn its application and limitations as well as the specific potential hazards peculiar to this tool.
- 2. GROUND ALL TOOLS**-If tool is equipped with a three-prong plug, it should be plugged into a three-hole receptacle. If an adapter is used to accommodate a two-prong receptacle, the adapter wire must be attached to a KNOWN GROUND. Never remove third the prong. (See Figure 1.)
- 3. KEEP GUARDS IN PLACE**-and in working order.
- 4. REMOVE ADJUSTING KEYS AND WRENCHES**-Form a habit of checking to see that keys and adjusting wrenches are removed from tool before turning on machine.
- 5. KEEP WORK AREA CLEAN**-Cluttered areas and benches invite accidents.
- 6. AVOID DANGEROUS ENVIRONMENT**-Do not use power tools in damp or wet locations. Keep work area well illuminated.
- 7. KEEP CHILDREN AWAY**-All visitors should be kept a safe distance from the work area.
- 8. MAKE WORKSHOP KID PROOF**-with padlocks, master switches or by removing starter keys.
- 9. DO NOT FORCE TOOL**-Do not force tool or attachment to do a job for which it was not designed. Use the proper tool for the job.
- 10. WEAR PROPER APPAREL**-Avoid loose clothing, neckties, gloves or jewelry that could become caught in moving parts. Wear protective head gear to keep long hair styles away from moving parts.
- 11. USE SAFETY GLASSES**-Also use face or dust mask if cutting operation is dusty.
- 12. SECURE WORK**-Use clamps or a vise to hold work when practicable. It is safer than using your hand and frees both hands to operate the tool.
- 13. DO NOT OVERREACH**-Keep your proper footing and balance at all times.
- 14. MAINTAIN TOOLS IN TOP CONDITION**-Keep tools sharp and clean for best and safest performance. Follow instructions for lubrication and changing accessories.
- 15. DISCONNECT TOOLS**-Unplug tool before servicing and when changing accessories such as blades, bits or cutters.
- 16. AVOID ACCIDENTAL STARTING**-Make sure switch is "OFF" before plugging in power cord.
- 17. USE RECOMMENDED ACCESSORIES**-Consult the owner's manual. Use of improper accessories may be hazardous.
- 18. TURN SPINDLE BY HAND BEFORE SWITCHING ON MOTOR**-This ensures that the workpiece or chuck jaws will not hit the lathe bed, saddle or crossslide, and also ensures that they clear the cutting tool.
- 19. CHECK THAT ALL HOLDING, LOCKING AND DRIVING DEVICES ARE TIGHTENED**-At the same time, be careful not to overtighten these adjustments. They should be just tight enough to do the job. Overtightening may damage threads or warp parts, thereby reducing accuracy and effectiveness.

20. **It is not recommended that the lathe be used for grinding.** The fine dust that results from the grinding operation is extremely hard on bearings and other moving parts of your tool. For the same reason, if the lathe or any other precision tool is kept near an operating grinder, it should be kept covered when not in use.
21. **DON'T LET LONG, THIN STOCK PROTRUDE FROM THE BACK OF THE SPINDLE**—Long, thin stock that is unsupported and turned at high RPM can suddenly bend and whip around.
22. **WEAR YOUR SAFETY GLASSES**-*Foresight is better than NO SIGHT!* The operation of any power tool can result in foreign objects being thrown into the eyes, which can result in severe eye damage. Always wear safety glasses or eye shields before commencing power tool operation. We recommend a Wide Vision Safety Mask for use over spectacles or standard safety glasses.

Electrical connections

The power cord used is equipped with a 3-prong grounding plug which should only be connected to a properly grounded receptacle for your safety. Should an electrical failure occur in the motor, the grounded plug and receptacle will protect the user from electrical shock. If a properly grounded receptacle is not available, use a grounding adapter to adapt the 3-prong plug to a properly grounded receptacle by attaching the grounding lead from the adapter to the receptacle cover screw.

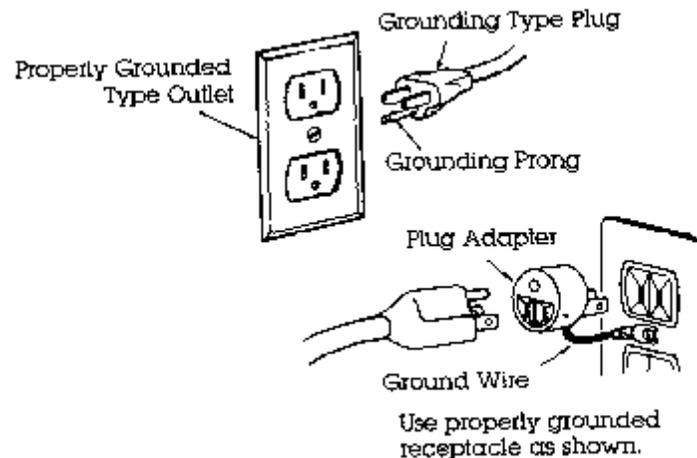


FIGURE 1-Always use a properly grounded receptacle.

NOTE: The electrical circuits designed into the speed control of your lathe or mill reads incoming current from 100 to 240 volts AC and 50 or 60 Hz. and automatically adapts to supply the correct 90 volts DC to the motor. As long as you have a properly wired, grounded connector cord for your source, the machine will operate anywhere in the world without a transformer. This has been true for all SHERLINE machines built since 1994. Prior to that, we used an AC/DC motor. Use that motor **ONLY** with the power source for which it was intended. It will not automatically adapt to any other current and using it

with an improper power source will burn out the motor or speed control. Also, the first few DC units built did not include the circuits to adapt to other currents. If you have an early DC model, remove the plastic speed control housing and look for a label on the aluminum speed control frame. If it has a small metallic label on top of the frame that lists input voltage as 120VAC, DO NOT ATTEMPT TO CONVERT TO OTHER CURRENTS. Models that can be used with any current have a paper label on the end of the speed control frame which lists the model number as KBLC-240DS.

The machines are normally supplied with a USA type plug but can be easily rewired to accept a European or U.K. type plug by attaching the wires using the color codes provided below.

| WIRE | USA | EUROPE |
|----------------|-------|----------------|
| 100/240 V | BLACK | BROWN |
| COMMON | WHITE | BLUE |
| GROUND (EARTH) | GREEN | GREEN W/YELLOW |

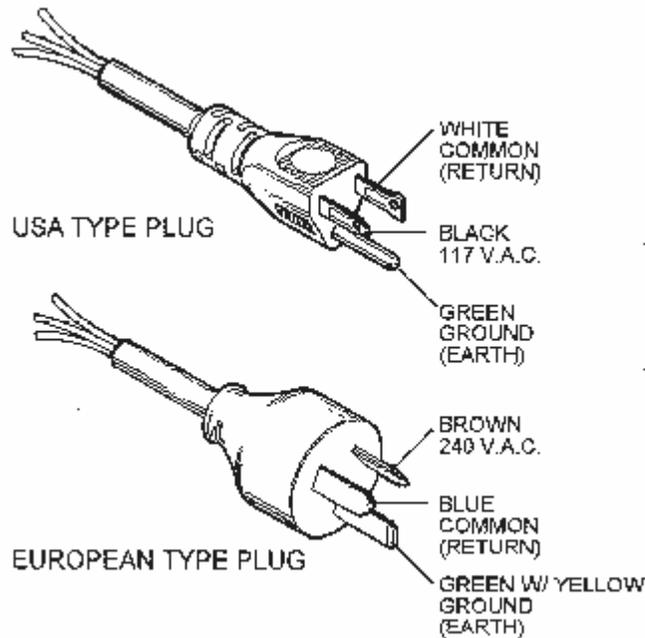


FIGURE1a-Wire color codes for USA and European connectors.

General precautions

- DO NOT attempt to operate the lathe or mill without first mounting them to a secure base. (See page 6.)
- DO NOT turn on the motor with a 3-jaw chuck mounted if the jaws are not tightened on themselves or on a part.

- A chip guard (P/N 4360) is now available that offers additional protection from flying chips when working near the spindle. It is not a substitute for wearing proper eye protection but is an excellent level of additional protection. It will also contain cutting oil to help keep your work area cleaner.

Avoid overtightening!

One of the problems with designing and manufacturing metal cutting equipment of this size is that the operator can physically be stronger than the machine, which is not normally the case with larger tools. For example, a 10-pound force applied a couple of inches out on a hex key becomes a 650-pound force at the tip of the screw. If you tighten both screws on the tool post this tight, it becomes approximately 1300 pounds of force on relatively small parts! Tools and/or parts can become distorted and accuracy will be lost. **Overtightening hold down screws and T-nuts in their slots can distort the crossslide or mill table.** It is not necessary to overtighten parts and tools because loads are smaller on equipment of this size. Save your equipment and increase accuracy by not overtightening and by taking light cuts.

Don't overstress the motor!

It is also important to realize that you can overload the motor supplied with this lathe or mill.* The many variables involved in machining, such as materials being machined, size of cutter, shape of cutter, diameter of stock, etc., can leave but one rule to follow...**COMMON SENSE!**

*The motor is thermally protected, so if it is overloaded it will simply shut down until it cools. See section on thermal protection.

CAUTION!

Read all operating instructions and safety rules carefully before attempting any machining operations.

Customer's responsibilities

Always use care when operating the lathe and mill. Follow safety rules for power tools. Turn off motor before attempting adjustments or maintenance. (Do not simply turn the speed control down to zero RPM but leave the motor switch on.) Be sure the work piece is firmly supported on the lathe or mill. Accessories should be mounted and operated following instructions carefully. Keep your machine clean, lubricated and adjusted as instructed. Do not leave cleaning rags, tools or other materials on the lathe bed or around moving parts of the machine.

Learning more about machining

Many fine books have been written on machining techniques and are available at your local library or book store. Although these books will be referring to machines many times larger than Sherline's tools, the principle remains the same. For the best reference that is specific to Sherline tools, see Joe Martin's book, [Tabletop Machining](#).

Lubrication

- **MACHINE SLIDES**-Use a light oil such as sewing machine oil on all points where there is sliding contact. This should be done immediately after each cleanup. (We grease the slides at the factory to ensure the lubrication stays in place during shipping, but light oil will work fine once you begin using the machine.)
- **LEAD SCREW, TAILSTOCK SCREW, CROSSLIDE SCREW**-Sewing machine oil should be placed along all threads regularly. At the same time, check that the threads are free from any metal chips. Use an air hose or paint brush to keep them clean.
- **TAILSTOCK SPINDLE**-Wind out the spindle as far as it will go and lightly oil it with sewing machine oil.
- **HANDWHEEL**-A few drops of light oil behind the handwheel will reduce friction between the surfaces and make operation easier and smoother.
- **HEADSTOCK BEARINGS**-These bearings are lubricated at the factory for the lifetime of the machine and should not need further lubrication. DO NOT break the seals.
- **MOTOR**-Sealed ball bearings require no maintenance.

Initial assembly of a new machine

Your new lathe or mill will come packed in a box with some items disassembled for shipping purposes. On the lathe you will install the crossslide table onto the saddle. On the mill you will install the "Z" axis column onto the base. On both machines you will need to install the motor and speed control. The machines are completely assembled and tested for fit at the factory prior to shipping. They are then disassembled and packaged, so everything should go together easily when you reassemble it. The motors are "run in" for approximately one hour to assure proper function and seating of the brushes.

Before you call us and say a part is missing, please look carefully through the packaging. Some parts are in bags taped to the bottom of cardboard flaps or spacers and you may not notice them when you open the box and remove the major components.

Lathe-crossslide mounting procedure

Installation of the crossslide requires no tools. First, make sure the bottom of the crossslide has a light coat of grease on all the sliding surfaces. This will have been applied at the factory, just make sure it has not been wiped off and that it is evenly distributed.

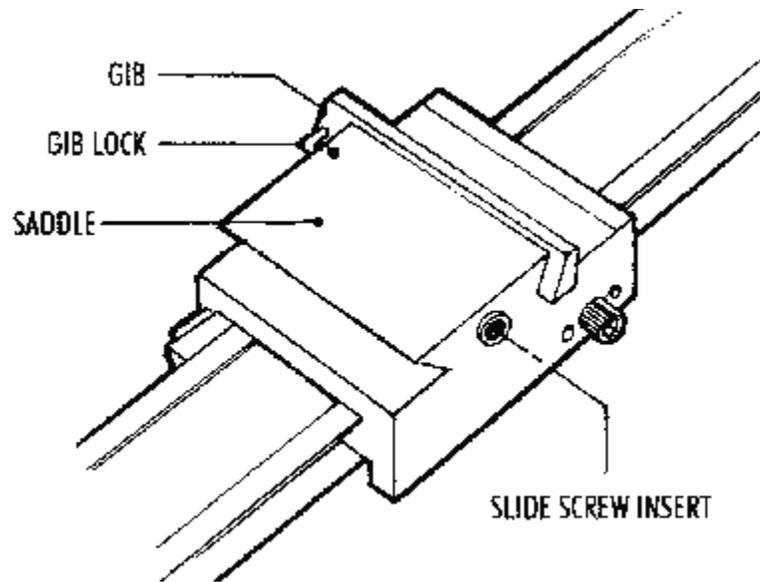


FIGURE 2

Next, see that the gib is in the proper position on the saddle. (See Figure 2.) It is taped into position for shipping. Remove the tape holding it in place. If the gib has come off, position it on the gib lock as shown.

Set the dovetail of the crossslide over the gib and matching dovetail on the saddle. Slide it onto the saddle about 1/4" (6-7mm) until it stops. (See Figure 3.)

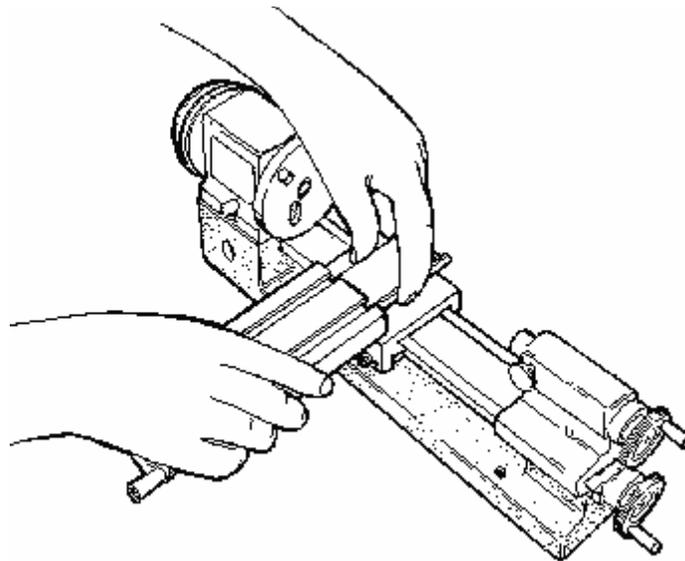


FIGURE 3

Look underneath and align the slide screw with the threads on the brass slide screw insert on the side of the saddle. (See Figure 4.) Turn the crossslide handwheel clockwise to

engage the threads. Continue to crank the handwheel clockwise until the crossslide is in the desired position on the saddle.

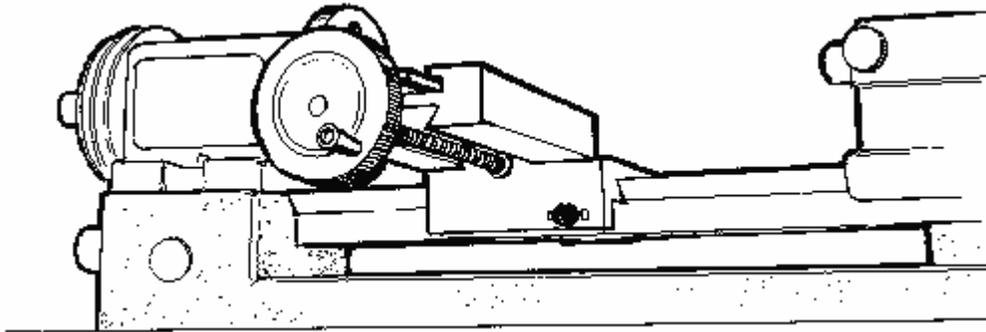


FIGURE 4

Mill-column mounting procedure

The mill is shipped attached to a piece of plywood to keep it from moving in the box. Before you begin, remove the screws holding the mill base to the plywood. It was installed strictly for packing purposes and will need to be removed so that the column can be installed.

The "Z" axis column is mounted to the base with two 1-3/4" long 1/4-20 socket head screws. These screws and the hex key tool you will need to tighten them are packaged in the bag with the motor mounting bracket and drive belt. It is much easier to mount the column to the base before you mount the motor and speed control to the saddle.

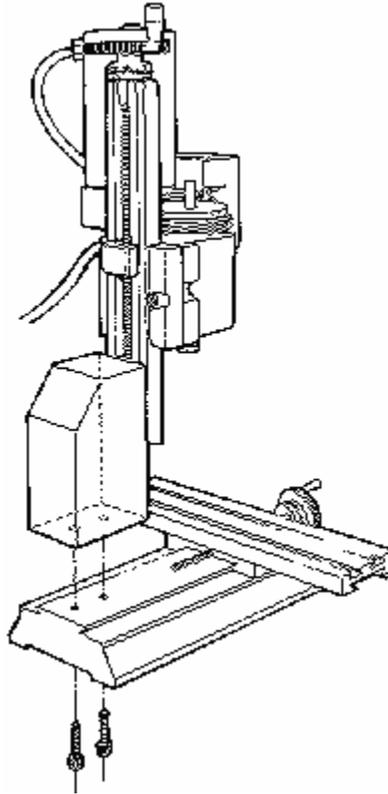


FIGURE 5

Set the column on the base aligned with the mounting holes and hold it in position while you insert the first screw up from the bottom of the base. Hand turn the first screw part way in and then start the second screw. This can be done with the machine upright by letting the base hang over the edge of your table or bench just far enough to expose the first hole. Using the hex key, snug up both screws lightly first, and then tighten evenly.

Assembly of the model 2000 and related model 8-direction mill columns

For specific directions on assembly of the various 8-direction columns and upgrades introduced in August, 1998, [click here](#). The Model 2000 mill and the related upgrades that convert standard mills into 8-direction mills offer the ability to drill holes or do machining operations from an almost infinite number of angles on parts mounted square to the table.

Check tightness of all bolts

Vibration in shipping can cause some bolts or screws to loosen up. Before using your new machine, check the tightness of all fasteners. It is also a good idea to check tightness

periodically when using the machine, as vibration from operation may cause some fasteners to loosen up.

Mounting the motor and speed control unit to the headstock

(Refer to the exploded views and number list for part number references.)

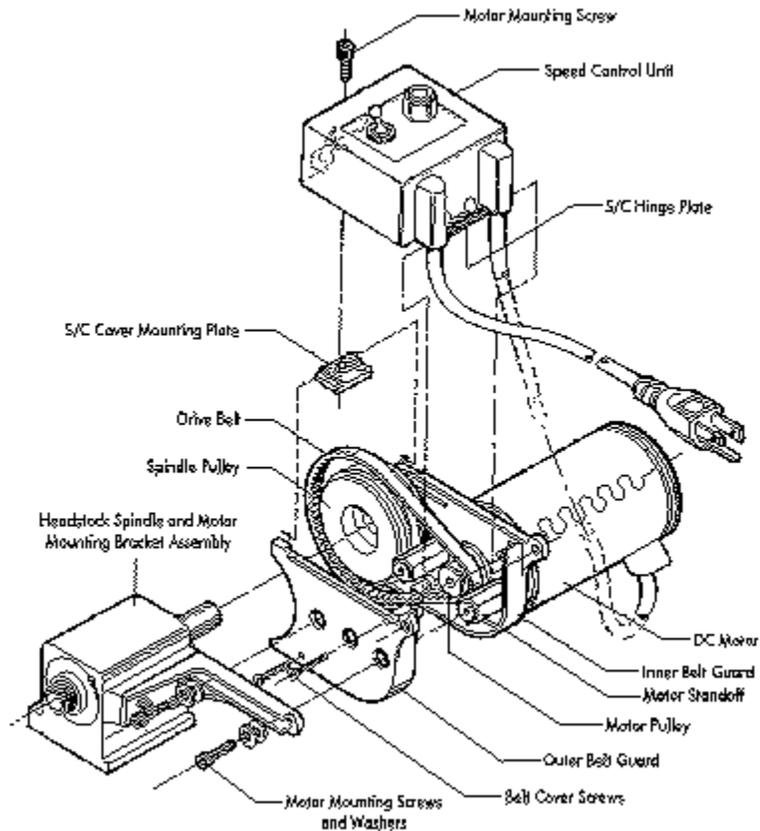


FIGURE 6-DC Motor and Speed Control Assembly

1. Remove motor pulley from motor shaft. Mount the inner belt guard to the motor using the two standoffs (P/N 4310). Next install the motor pulley (P/N 4336) to the motor shaft and tighten the set screw. The end of the pulley should be just about even with the end of the motor shaft with the smaller pulley toward the end of the shaft.
2. Place drive belt over motor pulley.
3. Place round post on speed control hinge plate in hole on inner belt guard.
4. Set outer belt guard in place locating other post of hinge plate in its pivot hole. Motor standoff ends will register in holes in outer belt guard. Make sure the drive

- belt is routed properly. Then secure the cover with (2) 1-3/8" pan head screws which go into nuts pressed into the back of the inner belt guard.
5. Attach motor mounting bracket to rear of headstock with two 10-32 x 3/8" socket head screws. There is enough "play" in the mounting holes to allow you to ensure the motor is visually mounted parallel with the spindle axis. (Note: If chip guard is to be mounted, its attachment screw replaces one of these mounting screws. It can be mounted at this time or after the headstock is in place. See instructions that come with the chip guard.)
 6. Place drive belt over spindle pulley and insert 10-32 x 3/4" socket head screws (with 2 washers on each) through motor mount slot and into holes in the ends of the motor standoffs. (These standoff ends should be exposed through locating holes in the outer belt guard.) NOTE: The normal operating position for the drive belt is on the large diameter groove on the motor pulley and the small diameter groove on the spindle pulley. Use of the other (low RPM) position is discussed elsewhere in these instructions. (See Figure 11.)
 7. Tighten motor mount screws, tilt speed control unit out of the way and check the alignment of the drive belt. It should be perpendicular to the drive pulleys. If it is not, loosen the set screw on the motor pulley and adjust it in or out on its shaft until the drive belt is square with the motor.
 8. Pull desired tension into drive belt by sliding the motor unit out in the bracket slot. Tighten mounting screws to hold the motor/speed control unit in place. NOTE: Do not overtension the drive belt. Just make sure it has enough tension to drive the spindle pulley without slipping under normal load. By not overtightening the belt you will not only extend its life, but will also provide a margin of safety for belt slippage should a tool jam in a part or an accident occur. The belt must be a little tighter when used in the low speed range because small diameter pulleys are not as efficient.
 9. Set mounting plate into top of belt guard housing so it rests on rails molded onto inside surfaces of housing. (The pressed-in nut goes down and to the outside.) Slide the plate toward the outside (toward the spindle pulley) until it stops. NOTE: The mounting plate was designed to be easily removable so it is out of the way when changing the drive belt position.
 10. Rotate speed control unit into place and insert the single 10-32 x 1/2"* socket head screw through hole in speed control housing and into nut in mounting plate. Tighten enough to hold in place. Do not overtighten.

*Changed from 3/8" long screws 1/5/05 for stronger engagement.

NOTE: Those of you who machine a lot of wood or brass may want to purchase and install a switch cover (P/N 3015) to keep the fine dust out of the power switch. The wood dust can gum up the switch causing intermittent operation. Brass dust can short out the switch or cause a risk of electric shock to the operator.

The advantages of Sherline's DC motor and electronic speed control

Sherline's 90 volt DC motor is very smooth and powerful, particularly at low RPM. The specially designed electronics package also provides some unique advantages in addition to smooth speed control with a usable speed range of 70 to 2800 RPM. A special circuit compensates for load, helping to keep RPM constant. The machines can also be used on any current world wide from 100 VAC to 240 VAC, 50 or 60 Hz without any further adjustment other than seeing that the proper wall plug is used. The control reads the incoming current and automatically adjusts to the proper settings.

We offer the motor and speed control along with the headstock and spindle as a package to builders of special machinery at a very reasonable price. They are especially popular for custom tooling in small industrial applications because of the large number of Sherline accessories that fit the spindle. We use them in our own production facility for a number of operations.

Motor is thermally protected

Thermal protection means there is a built-in circuit breaker that will shut down the motor if it gets too hot. This keeps the motor from burning out. The breaker will automatically reset as soon as the motor cools and you can go back to cutting, but you should be aware of how it works and what to do if the machine suddenly shuts itself down. If your motor is shutting down from overheating on a regular basis, it means you are taking too heavy a cut or operating at too high an RPM for long periods. Slow your speed down, reduce your cut or feed rate and you should have no further problems.

Due to the nature of miniature machining, overloading the machine is a common problem. It is often tempting to try to speed up the process by working faster. Keep in mind this is a small machine and work with patience and precision-don't be in a hurry. Your parts will come out better and your machine will last much longer if it is not overstressed.

What to do if the motor shuts down

If your thermal protection circuit shuts down the motor while work is in progress, immediately shut off the power switch and then back the tool out of the work. It should only take 10 seconds or less for the circuit breaker to reset, then you can turn the motor on and start the cut again, this time putting a little less stress on the motor. If you leave the tool engaged in the part and the power on, when the circuit breaker kicks back on, the motor must start under load. This can be very hard on your motor.

Remember that the circuit breaker turns the speed control off which turns off the motor. If power were to be applied to the speed control with the motor disconnected, it could damage the speed control.

Thermal protection is built into your motor to make sure it is not damaged by overloading. Use good common sense when operating the motor, and it will provide many years of trouble free operation.

Operation of the motor and electronic speed control

The lathe is supplied with an electronic speed control that produces a comprehensive range of speeds suitable for all operations. Special circuitry designed into the DC motor speed control automatically compensates for speed changes due to increased load. If the spindle RPM drops noticeably when cutting, you are taking too heavy a cut. The speed range of the spindle using the speed control is from 70 to 2800 RPM. This is achieved without the inconvenience of changing belt positions or gear ratios as is often the case with other designs. A second belt position is offered as an additional feature to provide extra torque at low RPM for larger diameter parts should your job require it.

To operate the motor, turn the speed control knob counter-clockwise as far as it will go. Then turn the toggle switch to "ON" and select the speed by turning the speed control knob clockwise.

Motors are pre-tested at the factory

Your new motor should run smoothly the first time you use it as it has been "run in" for about an hour before being shipped to you. Despite our secure packaging, there have been cases where extremely rough handling by a shipper has damaged the magnets in the motor. If the motor does not run when plugged in, turn the motor by hand. If it does not turn smoothly, it may have been damaged in shipment. Call Sherline for instructions on making a damage claim with the shipper. Do not attempt to repair the motor yourself.

Mounting the headstock to the lathe or mill

You may notice that the post onto which the headstock mounts is a loose fit where it projects from the lathe bed or column saddle. This is normal, and the diagram below will help you understand how it works.

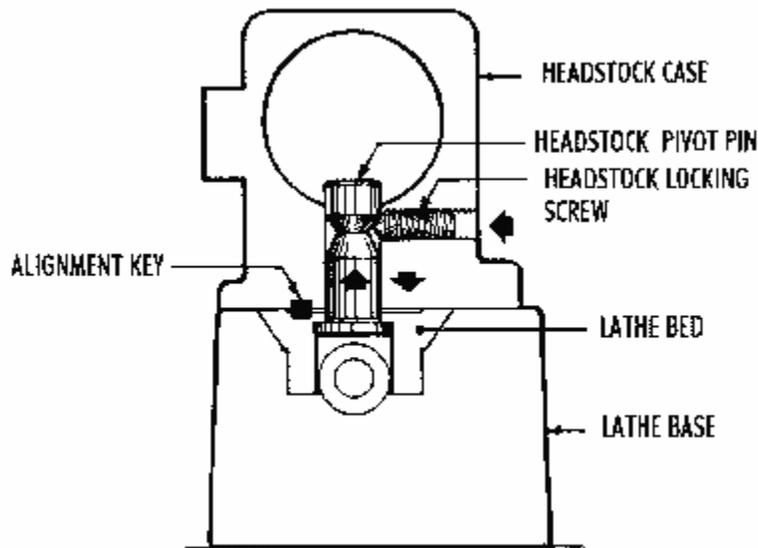


FIGURE 7-Cross section of headstock showing locking screw.

The screw in the front center of the headstock has a cone point. The pivot pin has a tapered slot with a corresponding angle. When the screw is tightened, its angled face engages the groove and, because the pivot pin can not come up, it draws the headstock down into position, clamping it into place. If the pin were rigid, it could keep the headstock from pulling down squarely.

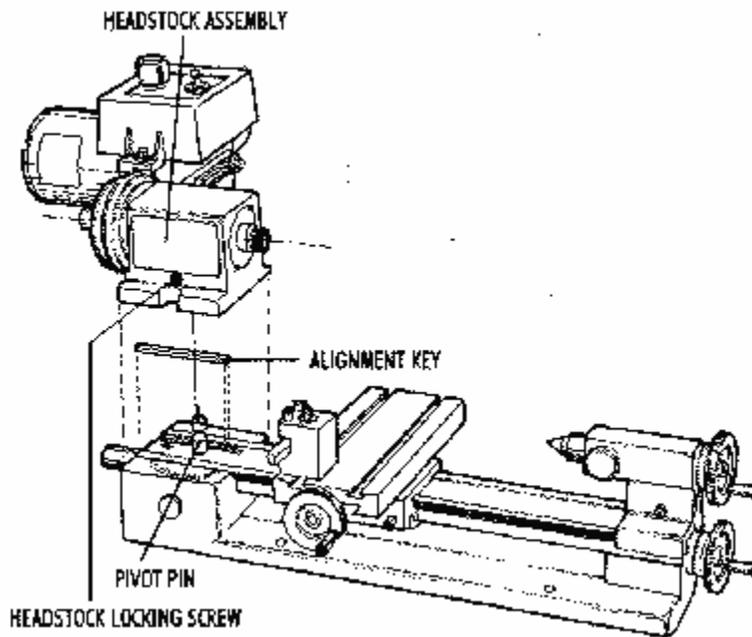


FIGURE 8-Headstock and alignment key in position over lathe.

The headstock is aligned with the lathe bed or column saddle with a precision ground key that fits into keyways in both parts. It is not square in cross section so it will fit in only one direction. Push the headstock firmly against it as you tighten the hold down screw. The mill headstock has two keyways milled into it so it can be mounted in conventional fashion or at a 90° angle for horizontal milling.

CAUTION! Always make sure the key, slot and mating surfaces are free from dirt and chips before locking down the headstock.

Removing the headstock alignment key allows the headstock to be mounted in positions other than square. This allows you to mill parts at an angle or turn tapers on the lathe. When using the lathe or mill without the alignment key, keep cutting loads light.

Mounting the mill and lathe to a board

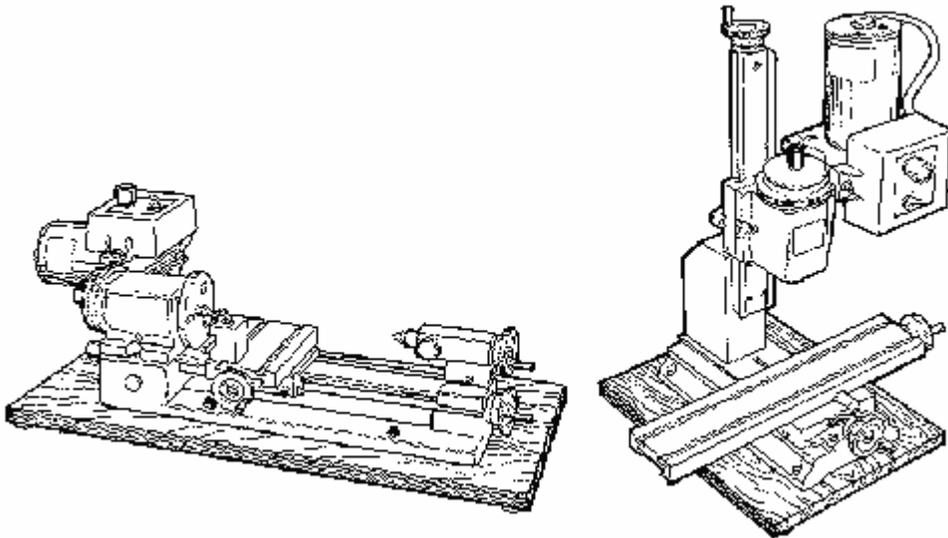


FIGURE 9-Machines mounted to a base board for stability.

Mounting the lathe to a board is necessary because of the narrow base. This keeps the machine from tipping. We recommend mounting the lathe on a piece of pre-finished shelf material which should be available from your local hardware store. (See below for sizes.) The machine can be secured to the board using four 10-32 screws with washers and nuts. Lengths should be 1-1/2" for short bed lathes and 1-7/8" for long bed lathes. Rubber feet should be attached at each corner on the bottom of the mounting boards. They are also readily available in hardware stores.

This arrangement gives the machines a stable platform for operation yet still allows for easy storage. The rubber feet help minimize the noise and vibration from the motor. Mounting the tool directly to the workbench can cause vibration of the bench itself which acts as a "speaker" and actually amplifies the motor noise. Bench mounting also

eliminates one of the best features of Sherline machines...the ability to easily be put away for storage.

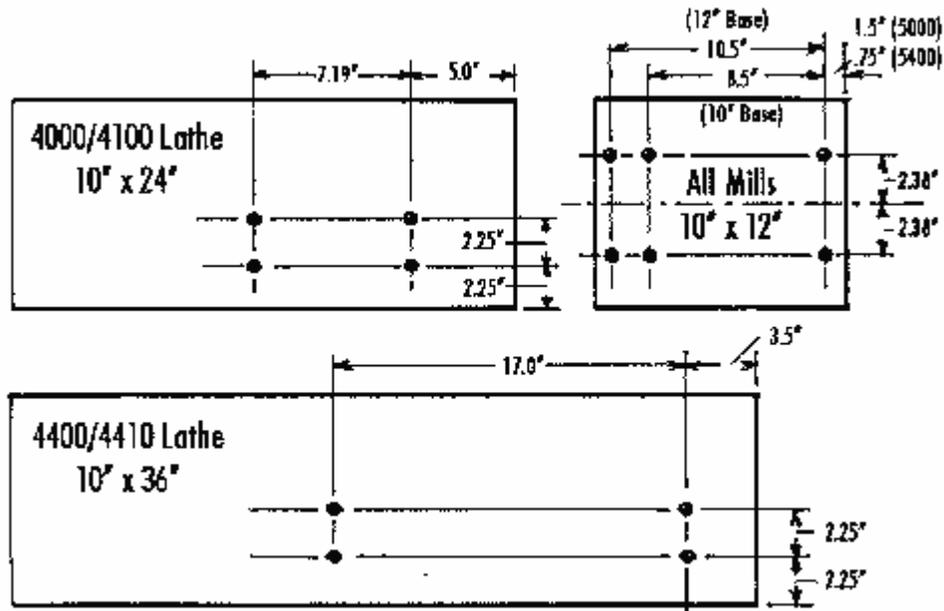


FIGURE 10-Plans for mounting board hole patterns. Confirm actual dimensions from your lathe or mill before drilling. The newly added model 2000 multi-direction mill can be mounted to a board 12" x 18" in a similar fashion.

The mill may be mounted in a similar manner on a 10" x 12" to 12" x 24" pre-finished shelf board with rubber feet using 10-32 x 1" screws to attach the mill to the board.

To keep your Sherline tools clean, soft plastic dust covers are available. The lathe cover is P/N 4150 for the Model 4000/4100 and 4500/4530 short bed lathes and P/N 4151 for the Model 4400/4410 long bed lathe. A mill dust cover is available as P/N 5150.

Converting machines from inch to metric or vice versa

All Sherline tools and accessories are manufactured in your choice of inch or metric calibrations. Converting a lathe or mill from one measurement system to the other is possible, but it takes more than changing the handwheels. The leadscrews, nuts and inserts must also be changed. A look at the exploded views of the machines on pages 27 and 28 will show which parts need to be purchased. (Look for parts that have both a metric and inch version in the parts listing.) Conversion kits with all the necessary parts are available. If you are a good mechanic, you can do the conversion yourself, or you can return your machine to the factory for conversion.

ADJUSTMENTS

Two-speed pulley

The normal pulley position, which is placing the belt on the larger motor pulley and smaller headstock pulley, will suffice for most of your machining work. Moving the belt to the other position (smaller motor pulley, larger headstock pulley) will provide additional torque at lower RPM. It is particularly useful when turning larger diameter parts with the optional riser block in place.

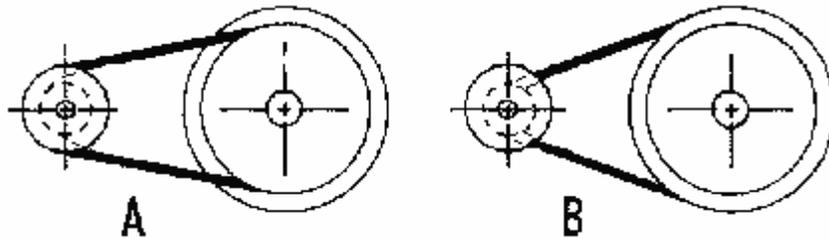


FIGURE 11-The two pulley positions. Position A is the conventional setting, position B offers more torque at low RPM. (Seen from pulley end of headstock.)

To change the pulley position, remove the speed control hold down screw and pivot the speed control housing up out of the way. Remove the mounting plate from its position on the rails of the two halves of the belt guard housing. Loosen the two nuts that hold the motor to the motor mounting bracket and take the tension off the belt. With your finger, push the belt off the larger groove of the pulley and into the smaller one. (Depending on which way you are changing it, this could be either the motor or spindle pulley.) Then move the belt to the larger diameter groove on the other pulley and rotate the headstock by hand to get it to seat. Push the motor outward on the motor mounting bracket to put the proper tension on the belt and retighten the two motor mounting screws. Now you can

replace the mounting plate, pivot the speed control back down and refasten it. Moving the belt back to the other position is simply a reverse of the above procedure.

Preload adjustment

SPINDLE ADJUSTMENT-If any end play develops in the main spindle, it can be easily eliminated by readjusting the preload nut. (See part number 4016 in the exploded view.) When the headstocks are assembled at the factory, the preload nut is adjusted to .0002" (.005mm) of end play. This is controlled by the outer races of the bearing being held apart by the headstock case and the inner races being pulled together by the preload nut. This setting was determined through experience and, like everything in engineering, it is a compromise. If the machine is only to be run at high speed, this setting may be too "tight". The headstock will run fairly warm to the touch normally, but extended periods of high speed operation may bring about excessive temperature. If this is your case, the preload may be reduced slightly.

To change the adjustment, remove the spindle pulley, loosen the set screw in the preload nut and back the preload nut off four degrees of rotation (counter clockwise). The bearings are lightly pressed into the case, so the inner race will not move without a sharp tap with a plastic mallet to the end of the spindle where the pulley is attached.

If you find your bearings are set too loose, you may want to take up on the end play. You can check them with an indicator or by spinning the spindle without the motor belt engaged. If the spindle spins freely with a chuck or faceplate on it, it is too loose for normal work. Adjust the preload nut until it turns approximately one and a half revolutions when spun by hand.

Gib adjustment

Gibs (tapered synthetic adjustment shims) are fitted to the mill headstock, saddle and table and to the lathe saddle and crossslide. Correct adjustment of the gibs will ensure smooth and steady operation of the slides. The gib is effectively a taper with an angle corresponding to the one machined into the saddle. It is held in place by an "L" wire gib lock which is secured with a locking screw. It is adjusted by loosening the gib locking screw and pushing the gib in until "play" is removed. After adjusting, retighten the locking screw. Milling operations require a tighter adjustment of the gibs than lathe operations.

Backlash adjustment

Backlash is the amount the handwheel can turn before the slide starts to move when changing directions. This is a fact of life on any machine tool and on machines of this type it should be about .003" to .005" (.08mm to .12mm).

Backlash must be allowed for by feeding in one direction only. Example: You are turning a bar to .600" diameter. The bar now measures .622" which requires a cut of .011" to bring it to a finished diameter of .600". If the user inadvertently turns the handwheel .012" instead of .011", he couldn't reverse the handwheel just .001" to correct the error. The handwheel would have to be reversed for an amount greater than the backlash in the feed screws before resetting the handwheel to its proper position.

Backlash on the "X" and "Y" axes of the mill may be reduced to a minimum by adjustment on the anti-backlash nuts. These nuts are located on the handwheel ends of the mill saddle. The nuts are secured by slotted pan head screws which hold a pointed locking plate that interlocks with teeth on the nut.

To adjust backlash, simply loosen the pan head screw and slide the locking plate to one side. Rotate the anti-backlash nut clockwise on the "X" axis and counterclockwise on the "Y" axis until snug. Replace the locking plate and tighten the pan head screw. With the anti-backlash nuts properly adjusted, the lead screws will turn smoothly and have no more than the proper .003" to .005" of backlash.

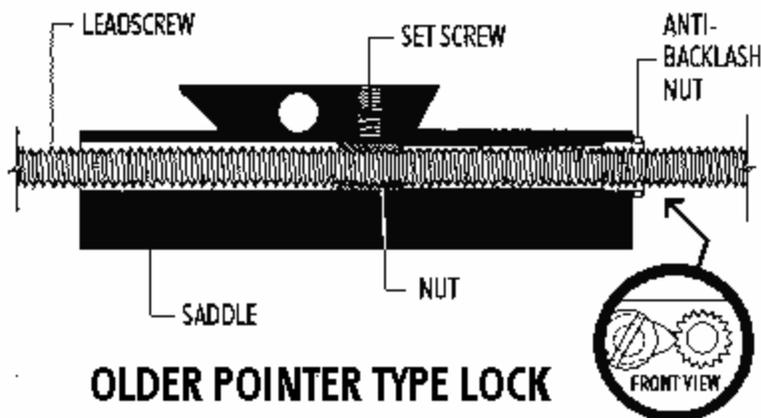


FIGURE 12-Backlash Adjustment. NOTE: A new lock now uses a star gear rather than the pointer to locate the anti-backlash nut, and a button head socket screw locks it in place. This system is easier to use, but the function is essentially the same. (The hole centers are different, which means the star gear cannot be used to replace the pointer on older models.)

Handwheel adjustment

The handwheels are secured to their corresponding leadscrew shafts by a small set screw in the side of the handwheel base. Check them periodically to make sure they have not been loosened by vibration. On the "zero" adjustable handwheels, you must first release the rotating collar by loosening the locking wheel. Then rotate the collar until you can see the set screw through the small hole in the side of the collar and adjust the screw as necessary.

If excessive backlash develops at the handwheel and thrust collar junctions, adjust by first loosening the handwheel set screw. Index (rotate) the handwheel so the set screw tightens on a different part of the shaft. (If you don't, it may tend to keep picking up the previous tightening indentation and returning to the same spot.) Push the handwheel in tightly while holding the mill saddle and retighten the handwheel set screw.

Movement of the handwheels

Turning the appropriate handwheel moves the saddle, crossslide and tailstock spindle. For the inch version, one complete turn of the handwheel gives a movement of .050". For the metric model, one complete turn of the handwheel gives a movement of 1mm. Handwheels are calibrated in .001" (1/1000") for inch models and .01mm (1/100mm) for metric models. Keep the screws clean, oiled and free from chips. The handwheels are quite accurate and should be used accordingly.

Aligning the head and tailstock

The versatile feature of Sherline machines that allows the headstock to be removed or rotated for taper turning and angle milling keeps us from being able to lock the headstock in perfect alignment. Precision ground alignment keys and accurate adjustment at the factory, however, make the machines highly accurate. In standard form, alignment should be within .003" (.08mm). This should be more than acceptable for most jobs you will attempt.

Only someone new to machining would talk about "perfect" alignment. Machinists speak instead in terms of "tolerances", because no method of measurement is totally without error. We believe the tolerances of your machine are close enough for the work for which it was intended, however, for those searching for maximum accuracy, here are some tips for maximizing the accuracy of your machine.

Loosen the headstock, push it back evenly against the alignment key and retighten. This will maximize the accuracy of the factory setting. To achieve greater accuracy, you will have to be willing to sacrifice one of the better features of your lathe or mill; that is, its ability to turn tapers and mill angles in such a simple manner.

HEADSTOCK-If you choose total accuracy over versatility or need it for a particular job, proceed as follows. Remove the headstock and clean any oil from the alignment key and slot and from the area of contact between bed and headstock. Replace the headstock, pushing squarely against the key and retighten. Take a light test cut on a piece of 1/2" to 3/4" diameter by 3" long aluminum stock held in a 3-jaw chuck. Use a sharp pointed tool to keep cutting loads low so as not to cause any deflection of the part. Measure the diameter of both machined ends. If there is a difference, the headstock is not perfectly square. Now, without removing the key, tap the headstock on the left front side if the part is larger at the outer end. (Tap on the right side if the part is larger at the headstock end.) You are trying to rotate the headstock ever so slightly when viewed from the top until the

machine cuts as straight as you can measure. There should be enough movement available without removing the key, as its factory placement is quite accurate.

Take another test cut and remeasure. Repeat this procedure until you have achieved the level of perfection you seek. Then stand the lathe on end with the alignment key pointing up and put a few drops of LocTite™ on the joint between key and headstock. Capillary action will draw the sealant in, and when it hardens, the key will be locked in place. We prefer this method to "pinning" the head with 1/8" dowel pins, because it offers you the option to change your mind. The headstock can be removed by prying with a screwdriver blade in the slot between the bottom of the headstock and the lathe bed to break the LocTite™ loose should you wish to be able to rotate the headstock again.

TAILSTOCK-To maximize the machine's tailstock alignment, first make sure that there are no chips caught in the dovetail of the bed and no chips or dents in the taper of your tailstock center. Now put a 6" long piece between centers and take a long, light test cut. Measurements at either end will tell you if you need to use an adjustable tailstock tool holder in the tailstock to achieve better tailstock alignment. We manufacture adjustable tailstock tool holders (P/N 1202 & 1203) and an adjustable live center (P/N 1201) which can help you attain near perfect alignment at the tailstock should your job require it. Instructions for their use are included with each item.

Remember that unless you drill very small holes (less than 1/64") or turn a lot of long shafts, you are giving up a very useful feature to solve a problem which can usually be handled with a few passes of a good mill file. The inaccuracy inherent in any drill chuck is such that perfect machine alignment is meaningless unless you use adjustable tailstock tool holders.

Use of cutting oils and lubricants

Much can be written about the use of lubricants, but they may usually be dispensed with where production rates are not very important. A small amount of any kind of oil applied with a small brush will be sufficient. Aluminum and its alloys may require the use of cutting oils to prevent the chips from welding to the tool's point. Do not use oils with a low flash point or a bad smell. If desired, a mixture of one part soluble oil to six parts water may be used on steel to assist in producing a smoother finish and reduce tool chatter when parting off. Brass and cast iron are always turned dry. Cutting lubricants should be cleaned off the tools after use.

Cutting oils can be purchased at an industrial supply store. We used to sell cutting oil, but dropped it from the line because we received so few orders. We assume our customers prefer to purchase their cutting oil from local sources. Do not use high sulfur pipe thread cutting oil. It is good for hard to machine materials, but is so dirty to work with we do not recommend it. We also find some of the tap cutting fluids are too smelly and unpleasant to use for general machining.

The main purpose of using lubricants is to keep the chips from sticking to the cutting tool. When used properly, modern high speed tool bits are not likely to be affected by heat on the type of work usually done on Sherline tools.

General machining terms

Two terms frequently used in machining are "Feed" and "Cut". Reference to the diagrams below will show what is meant by these terms. Normal turning on a lathe, when used to reduce the diameter of a work piece, involves advancing the cutting tool **perpendicular** to the lathe bed by an appropriate amount (depth of **cut**) and **feeding** the tool along parallel to the lathe bed to remove material over the desired length. (See Figure 13A below.)

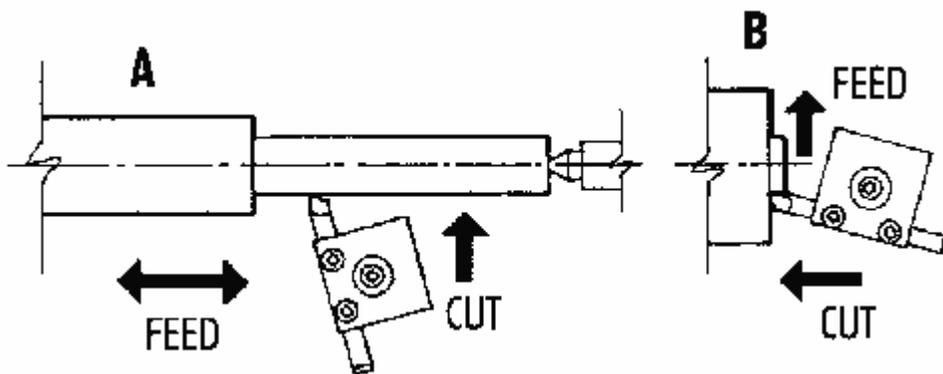


FIGURE 13-Directions of Feed and Cut showing (A) Turning work between centers and (B) Facing off a work piece.

In normal machining, the depth of **cut** is set by the crossslide handwheel, and the **feed** is provided by the handwheel on the end of the bed. When facing off the end of a work piece held in a chuck or faceplate, the depth of **cut** is set by the handwheel on the end of the bed, and the **feed** is provided by the crossslide handwheel. (See Figure 13B above.)

When using a mill, **cut** is determined by the amount of depth the cutter is set to by the "Z" axis handwheel. **Feed** is supplied by either or both the "X" or "Y" axis handwheels depending on the desired direction of the cut.

General rules for feed rates and cutting speeds

Before attempting to machine any metal, please try to remember this simple rule about machining: "If the tool chatters, decrease speed and increase feed."

Understanding this simple rule can save you many hours of grief. When the tool "chatters", it is not cutting in a continuous fashion. Metal likes to be machined in a way that allows the material to come off in a continuous strip while the tool is in contact with the metal. If the tool is not fed at a rate that is fast enough, the tool skips along the

surface, occasionally digging in. The surface of the tool that is doing the most cutting will find a frequency of vibration that is a product of all the variables involved. This can cause anything from a high pitched whine on light, high speed cuts to a resonating racket that can rip the work out of the chuck on heavy cuts. If you maintain the same feed rate and reduce the RPM, the feed will increase because chip will be thicker. (If that sounds wrong at first, think of it this way: At the same feed rate, if you cut the RPM in half, twice as much metal must be removed with each rotation to get to the end of the cut in the same amount of time. The chip is twice as thick, so the feed is GREATER at lower RPM if the feed RATE stays constant.)

When a tool chatters it gets dull faster because it must keep cutting through the previously machined surface that has been "work hardened" by machining. As you can imagine, there are limits to how much you can increase feed rate, so the answer lies in adjusting both speed and feed to achieve the proper cut.

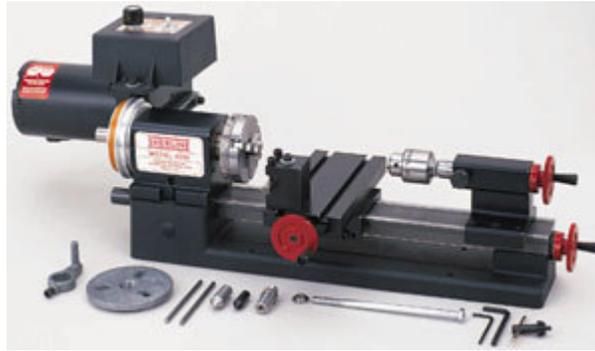
Proper cutting speed is the rate a particular material can be machined without damaging the cutting edge of the tool that is machining it. It is based on the surface speed of the material in relation to the cutter. This speed is a function of both the RPM of the spindle as well as the diameter of the part or size of the cutter, because, as the part diameter or cutter size increases, the surface moves a greater distance in a single rotation. If you exceed this ideal speed, you can damage the cutting tool. In the lathe and mill instructions, we give some examples of suggested cutting speeds, but what I wanted to get across here is that it isn't a slow process. A tool can be destroyed in just a few seconds. It isn't a case of getting only one hour of use instead of two. The cutting edge actually melts. If you machine tough materials like stainless steel, you will ruin more tools than you care to buy if you don't pay a lot of attention to cutting speeds. Charts showing suggested cutting speeds for various materials are included in both the lathe and mill sections that follow.

Lathe Specifications

| FEATURE | 4000(4100) | 4400(4410) |
|--------------------------|---|------------------|
| Swing over bed | 3.50" (90 mm) | 3.50" (90 mm) |
| Swing over carriage | 1.75" (45 mm) | 1.75" (45 mm) |
| Distance between centers | 8.00" (200 mm) | 17.00" (430 mm) |
| Hole through spindle | .405" (10 mm) | .405" (10 mm) |
| Spindle nose thread | 3/4"-16 T.P.I. | 3/4"-16 T.P.I . |
| Spindle nose taper | #1 Morse | #1 Morse |
| Travel of crossslide | 4.25" (110 mm) | 4.25" (110 mm) |
| Tailstock spindle taper | #0 Morse | #0 Morse. |
| Protractor graduations | 0° to 45° by 5° | 0° to 45° by 5° |
| Handwheel graduations | .001" (.01 mm) | .001" (.01 mm) |
| Length overall | 24" (610 mm) | 32.25" (820 mm) |
| Width overall | 7.5" (190 mm) | 8.75" (220 mm) |
| Height overall | 6" (150 mm) | 8" (200 mm) |
| Shipping weight | 24 lb. (10.9 kg) | 30 lb. (13.6 kg) |
| Motor | 90 volt DC with electronic speed control that accepts any incoming current from 100VAC to 240 VAC, 50 Hz or 60 Hz. Click here for motor specifications. | |
| Spindle speed range | 70-2800 RPM continuously variable by electronic speed control | |

SHERLINE PRODUCTS

INCORPORATED 1974



SHERLINE Lathe Operating Instructions

(Reprinted from the Sherline Assembly and Instruction Guide, Fourth Edition (1997))

CAUTION!
Read all operating instructions carefully
before attempting any machining operations!

Review Safety Rules for Power Tools before beginning.

Lathe Operating Instructions

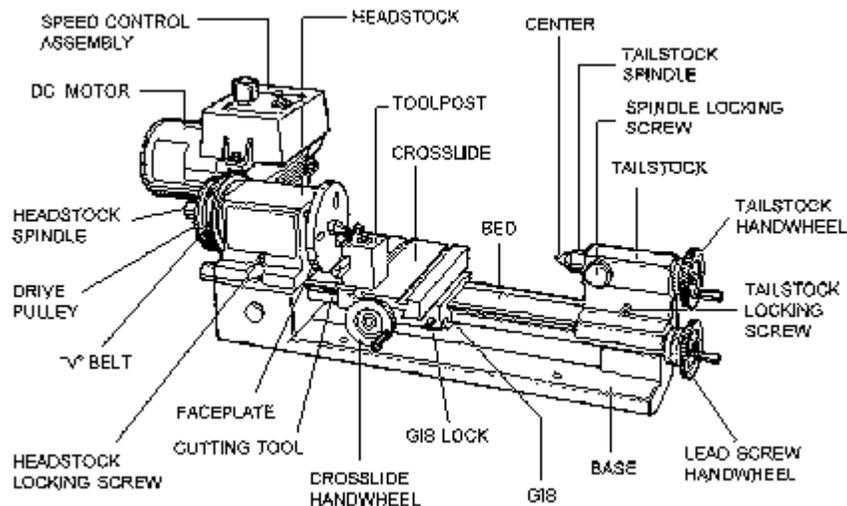


FIGURE 1--Parts of a Sherline lathe (Note: Tailstock locking screw is now relocated to a vertical position on the newer tailstocks. This drawing shows an older style tailstock without gib or cutout front face.)

Leveling the Cutting tool

Each type of turning work requires the correct tool for the job. It is important that the cutting tool is sharp and correctly set up in the tool post. The cutting edge of the tool should be exactly level with the center height of the lathe. Check this against either the headstock center or tailstock center. We also manufacture a simple tool height adjustment gauge (P/N 3009) which allows you to check tool height at any time by measuring from the table surface.

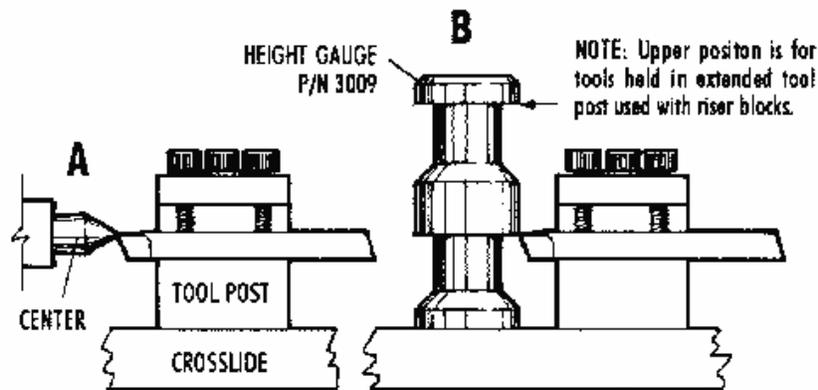


FIGURE 2—Leveling the tool using (A) the tip of a head- or tailstock center or (B) Sherline's tool height gauge P/N 3009. The standard tool post shown comes with 4000-series lathes. The 4400-series lathes come with an upgraded rocker tool post that allows the tip of the tool to be adjusted up or down without shimming.

The standard Sherline tool post is designed to hold common 1/4" square tool bits which have had a few thousandths of an inch (.1mm) ground off the top edge for sharpening. Loosen the hold-down bolt and slide the tool post as close to the center as possible. The tip of the tool bit may be raised or lowered by sliding a shim* underneath it. The cutting edge must be on center or just below center (0.004" or .01mm maximum). Ensure that the tool is fixed securely in position by firmly tightening the socket head screws. Try not to have the tool cutting edge protruding more than 3/8" (10mm) from the tool post.

*NOTE: Thin metal shim stock can be used for this purpose. If you don't have any metal thin enough, a single thickness of paper business card stock will usually do the job. Do not use more than one thickness as it will compress too much. Our optional rocker tool post (P/N 3057) allows this adjustment to be made without shims. It comes standard with the Model 4400/4410 long bed lathe.

Initial Test Cutting

If you have never operated a lathe before, we suggest that you make a trial cut on a scrap of material to learn the operation of the machine. In a 3- or 4-jaw chuck, secure a piece of round aluminum stock approximately 3/4" (19mm) diameter and 1-1/2" (38mm) long. Secure the presharpener 1/4" square cutting tool supplied with the lathe in the tool post, making sure that it is properly positioned. Turn the speed control all the way counterclockwise, and then turn the motor on. Bring the speed up to approximately 1000 RPM (about 1/3 speed). To establish tool position in relation to the work, bring the tool in slowly until it just starts to scribe a line on the work. Crank the tool towards the tailstock until it clears the end of the work. Advance the tool .010" (.25mm) using the crossslide handwheel (10 divisions on the inch handwheel scale). Using the bed handwheel, move the tool slowly across the work toward the headstock.

Cutting tools used on lathes are designed to remove metal much as paper is removed from a roll. It takes a positive feed rate to accomplish this. If the feed rate isn't fast enough, it would be similar to tearing an individual sheet of paper off the roll. The results when cutting metal would be shorter tool life, a poor finish and tool "chatter". Chatter is a function of rigidity, but it is controlled by speed (RPM) and feed rate.

Since you already have a piece of aluminum chucked up, experiment with speed and feed rate. You just took a cut of .010" (.25mm) and probably noticed that the machine didn't even slow down in the slightest. Now take a 1/2 inch long cut .050" or 1mm deep, which is 1 revolution of the handwheel. If you used the sharpened cutting tool that came with your machine it should have made the cut easily. If the tool "squealed", reduce the RPM a little and take another .050" cut while feeding the tool faster. You will probably be surprised at how easily your machine takes cuts this heavy.

We will now purposely try to make the machine "chatter". Make sure the stock you are cutting is sticking out of the chuck no more than 1 inch (25mm). Crank the handwheel two turns further in from the last setting which will give you a .100" (100 thousandths of an inch) or 2mm cut. Set the spindle speed to about 1000 RPM (1/3 speed) and feed the tool slowly into the material. Vary speed and feed until you get a substantial chatter. Without changing the depth of the cut, drop the speed to about 200 RPM and feed the tool into the work with more force. The chatter should disappear. Once you have learned to control chatter by adjusting speed and feed, you will be on your way to becoming a machinist.

Holding the Workpiece

Work can be held between centers, in three- or four-jaw chucks, on the faceplate or with a collet. Sometimes it is necessary to use a chuck and center, and, if the work is spinning fast, a live center should be used. (See Figures 3 and 4.)

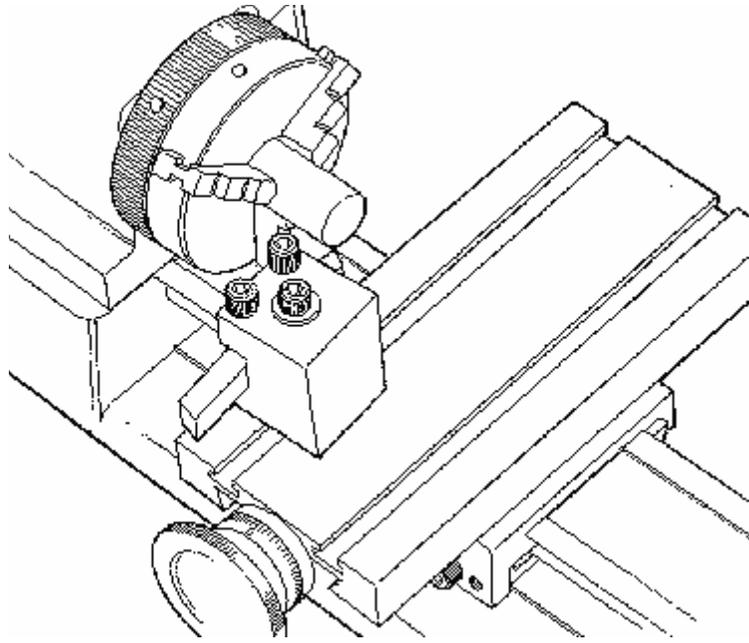


FIGURE 3—Holding a round work piece in a 3-jaw chuck.

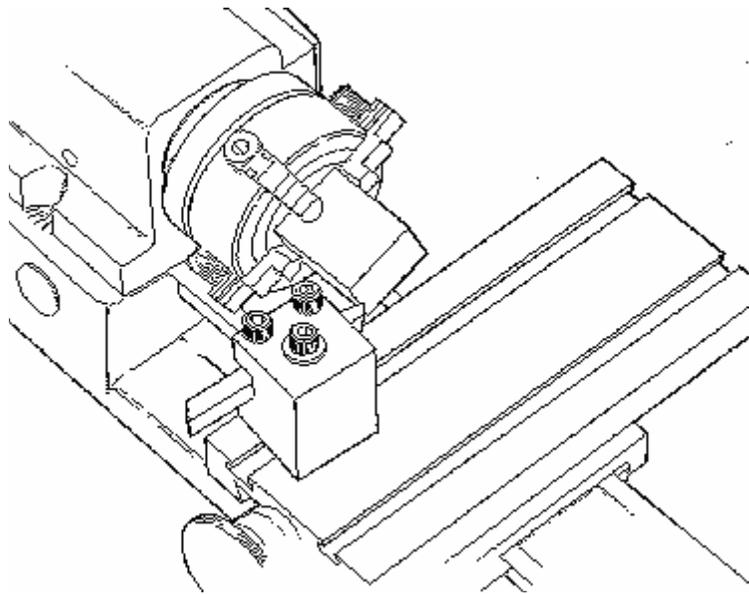


FIGURE 4—Holding a square work piece in a 4-jaw chuck.

Turning Between Centers

This is done by fitting the dog to the work that is to be turned and placing the work and dog between the centers in the headstock and tailstock. The maximum diameter that can be held with the dog is 5/8" (15mm). (See Figure 5.)

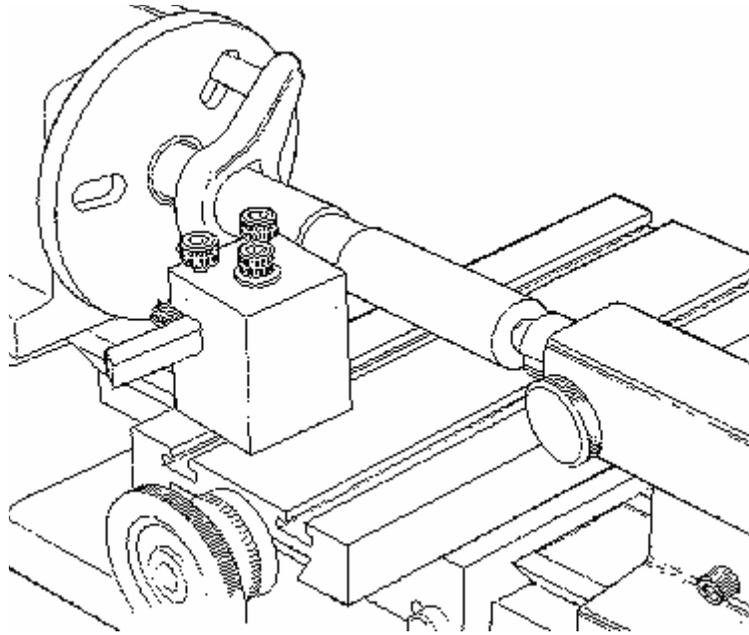


FIGURE 5—Turning between centers with a faceplate and drive dog.

The dog is driven by fitting it into one of the faceplate holes. This method of turning is ideal for bar work or turning of steps on a bar. The tailstock center must be greased to prevent overheating. (An optional "live center"—such as P/N 1191—turning on ball bearings is the solution preferred by most machinists.) The headstock spindle has a Morse No. 1 taper in the spindle nose. The spindle thread is 3/4-16 TPI. Accessories held in the spindle using the Morse No. 1 taper can be removed with the use of a knockout rod (not supplied) approximately 3/8" diameter and 6" long. The bar is inserted through the back of the spindle, and accessories, such as centers, can be removed with a few taps. The tailstock spindle is equipped with a Morse No. 0 taper and accessories such as drill chucks and centers can be removed by turning the handwheel counterclockwise until the accessory is ejected.

Center Drilling

Because the work turns and the drill does not on a lathe, it is necessary to use a center drill before a standard drill can be used. Due to the flexibility of a standard drill bit, it will tend to wander on the surface of the rotating work whereas a center drill is designed to seek the center and begin drilling. Cutting oil is recommended for all drilling operations. A center drill should be withdrawn, cleared of chips and oiled several times during the drilling of a hole to keep the tip from breaking off.

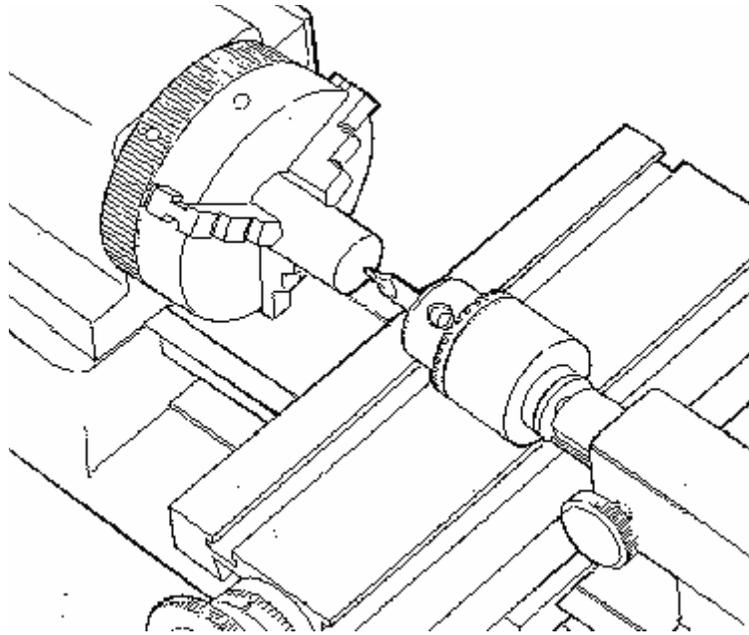


FIGURE 6—Center drilling. The work turns while the drill is stationary.

See chart of commonly available center drill sizes.

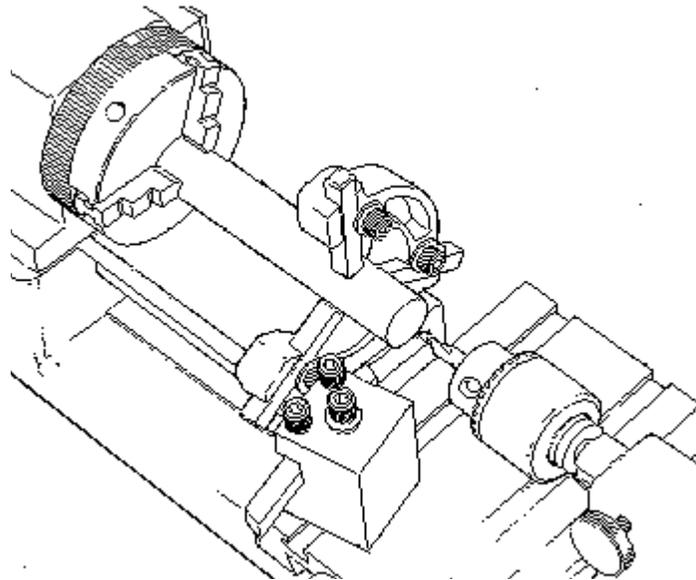


FIGURE 7--Center drilling a long work piece held in a steady rest.

Tailstock Drilling

Hold the work in a 3- or 4-jaw chuck. If the work is longer than approximately 3" (76mm), support the free end with a steady rest. Fit the drill chuck to the tailstock with a No. 0 Morse arbor and secure a center drill in the chuck. Adjust the tailstock to bring the

center drill close to the work and lock in position. Turn the tailstock handwheel to bring the center drill forward. After the hole is started with the center drill, switch to a standard drill bit of the desired size to drill the hole.

Headstock Drilling

The drill chuck comes fitted with a #0 Morse arbor that fits in the tailstock spindle. To use it in the headstock you will need to first change to the #1 Morse arbor which is included with your lathe. To change arbors, put the drill chuck key in its hole to give you better purchase to grip the chuck while using a wrench to remove the #0 arbor and replace it with the larger #1 arbor. Put the drill chuck in the headstock. Then put the drawbolt with its washer through the spindle hole from the other end of the headstock and tighten the drawbolt. **DO NOT OVERTIGHTEN!** (To remove, loosen the drawbolt a little and give it a light tap with a plastic mallet to break the chuck loose from the taper before completely removing the drawbolt.)

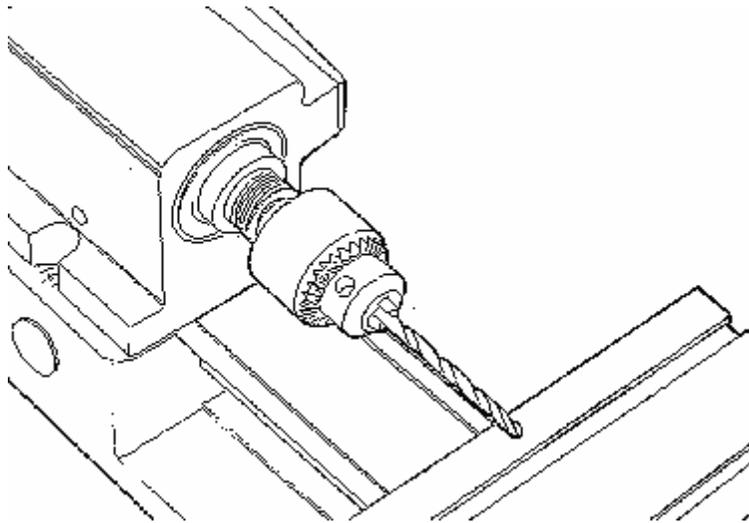


FIGURE 8—Headstock Drilling. The drill turns while the work is held stationary.

The easiest way to center drill the end of a round shaft which has a diameter too large to be put through the spindle is to support it with a steady rest (P/N 1074) while the end is being drilled. If this isn't possible, find the center with a centering square, prick punch a mark and center drill by hand. (See accessories, page 16. See also our *Tools and Accessories Catalog* for a photo of the steady rest in use.)

Reaming

Twist drills will generally not drill perfectly accurate sizes, and very small boring tools are not satisfactory in deep holes because of their flexibility. Therefore, reaming is used for holes requiring accuracy within .0005" (.013mm). Reamers are available in any standard size but are rather expensive and are generally not purchased to do one-of-a-

kind type work. Use them only when a boring tool cannot be used because of the depth of the hole. Because of their length, they cannot always be used on a small lathe.

Reamers are used only to "clean up" the hole. To make an accurate hole, the work is drilled approximately .010" (.25mm) smaller than the reamer size. The work should be slowly rotated and the reamer slowly fed into the hole while applying plenty of cutting oil. The reamer should be frequently removed and cleared of chips. Never rotate a reamer backwards in the work as this can dull the cutting edges.

Faceplate Turning

The faceplate has three slots which allow work to be bolted to its surface. Flat work can be screwed directly to the faceplate. Extra holes can be drilled to suit odd shaped work unsuitable for a chuck. If the work is mounted off center, be sure to counter balance the faceplate and use very low RPM. Don't hesitate to drill holes in or modify the faceplate as needed to do a particular job. That's what they are for. They are inexpensive and you can have several on hand modified for special jobs.

Taper Turning

On most lathes a taper can be cut by offsetting the tailstock. On the Sherline lathe it is done by removing the headstock key and turning the headstock to any angle away from dead center. To rotate the headstock, the alignment key must first be removed. Loosen the set screw in the front of the headstock and lift the headstock and motor unit off the locating pin. Tap the alignment key out of its slot on the bottom of the headstock and replace the headstock unit on the pin. While pressing down on the headstock, rotate it to the angle you desire by referring to the angle scale on the bed. The base is calibrated in 5° increments up to 45° both left and right of dead center. When set to the proper angle, retighten the set screw against the pin to lock the headstock into position. The compound slide ([P/N 1080](#)) is another tool that makes taper tuning easy. (See Figure 6, Pages 11/12 in Sherline's Tools and Accessories Catalog for a photo.)

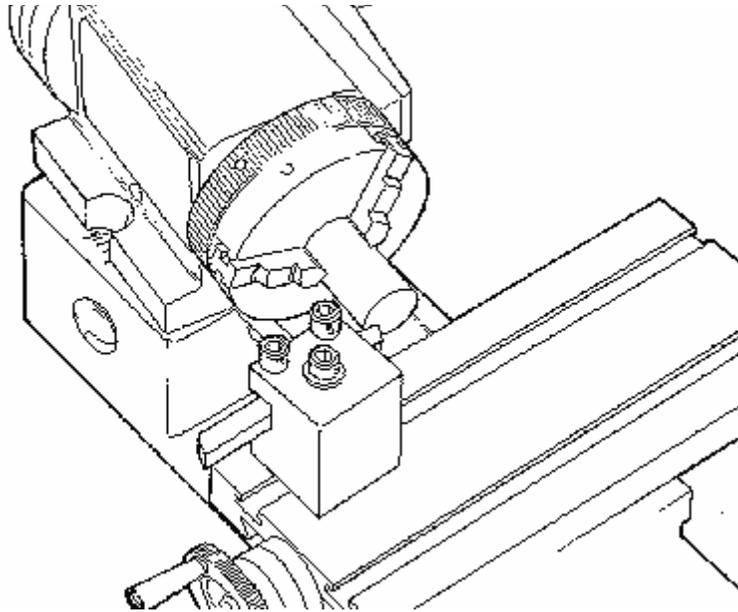


FIGURE 9--Turning a taper with the Headstock rotated.

Short work can be inserted in a 3- or 4-jaw chuck and turned as shown in Figure 9. If the headstock is angled towards the lathe front, the taper will cut smaller at the right. Tapers can also be bored in work held in the 3- or 4- jaw chuck. To machine a taper in longer stock, center drill both ends of the bar, set the headstock angle and mount the part between centers. (See Fig. 10.)

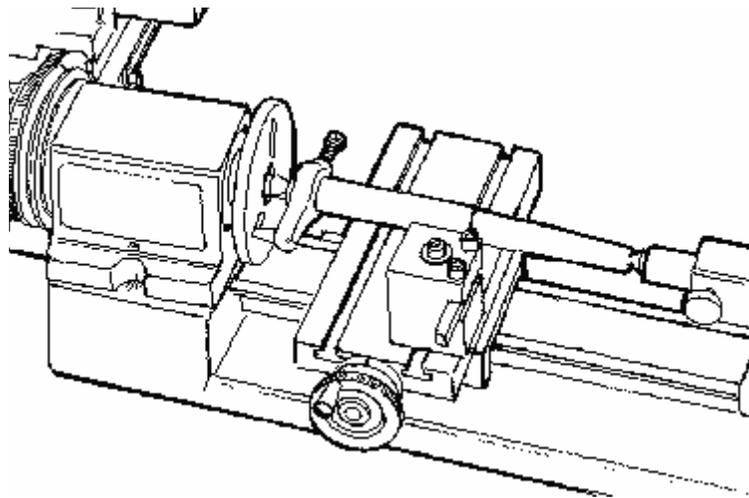


FIGURE 10—Long, shallow tapers can be cut in a continuous pass by pivoting the headstock to the proper offset while supporting the other end with the tailstock. The work is driven by using a drive dog in the faceplate. The dog acts like a "universal joint" as the drive pin slides in the faceplate slot.

Tool Shapes and Grinding Your Own Tools

The shaping of cutting tools to suitable angles for the type of material and nature of work being performed can be very important to satisfactory work. When tools become dull, gently re-grind and preserve the original angles and shapes. Do not grind the top face of the tools, but confine sharpening to the end and/or sides except form tools which are ground on the top surface.

Remember that heavy cuts and rapid feed will cause greater strain on the chuck and lathe. This may induce "spring" or binding of work and tools which can produce a poor finish.

NOTE: Because of the importance of a sharp and properly ground tool to the cutting process, Sherline has prepared a special instruction sheet on Grinding Your Own Lathe Tools. There are a few tips that can make the process a simple one. The instructions are included with each lathe and with cutting tool sets when you order them from us, or you may call us and request a copy. (Cost is \$5.00 postage paid.) They are also available from our World Wide Web site by clicking on the highlighted words above.

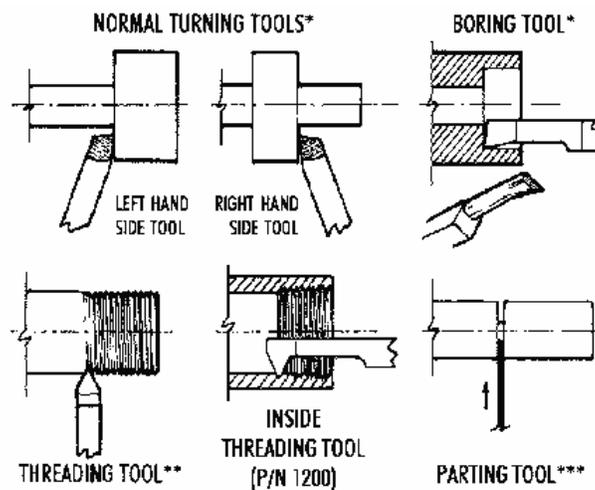


FIGURE 11—Tool Shapes.

*These shapes are available in high speed steel tool set, P/N 3007.

**The 60° threading tool is included as part of the carbide tool set, P/N 3006 and also comes with the thread cutting attachment, P/N 3100.

***The parting tool comes with the cutoff tool holder, P/N 3002. Other shapes are custom ground to accomplish special purposes as needed.

Cutting tools are ground to various shapes according to their usage. Tools are usually ground to shape as needed by the operator. Some standard tools are described below:

Normal Turning Tool—This feeds from right to left, is used to reduce work to the desired diameter and is the most frequently used of all tools.

Side Tools—These are used to face off the ends of shoulders and may also be used as normal turning tools. Note that a tool which is fed from LEFT to RIGHT is called a LEFT side tool.

Parting —The conventional parting tool is shaped like a dovetail when viewed from above and is used to cut off work pieces by feeding the end of the tool across the lathe bed and through the work piece. The Sherline parting tool instead uses a thin .040" (1mm) blade which has a slightly thicker ridge at the top to accomplish the same job of providing clearance for the tool while cutting. Parting tools thicker than .040" (1mm) will be too thick for use on your Sherline lathe.

Boring Tool—Used in the tool post on a lathe or in an offsettable boring head on a mill to enlarge holes in a work piece.

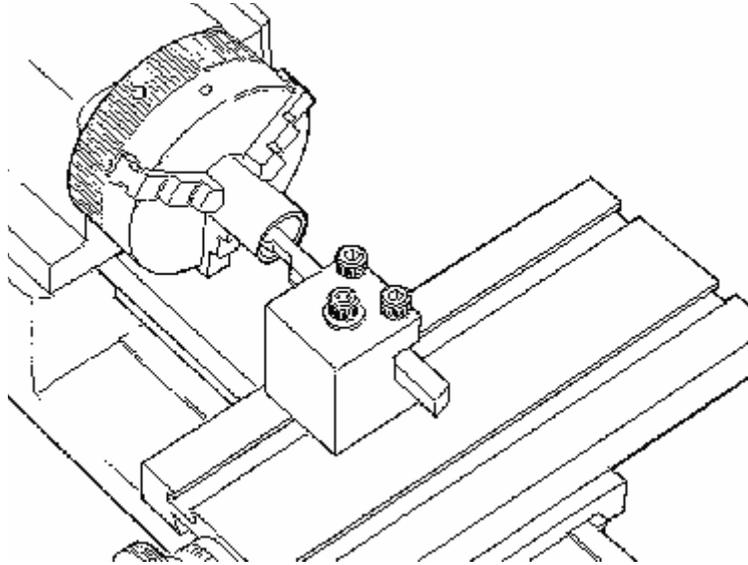


FIGURE 12—A Boring Tool in use.

Form Tool—A custom contour can be ground into a tool to produce a special shape like a radius in a part. The width of the cutting edge must be less than 2-1/2 times the smallest diameter. Cutting speed must be slow to prevent chatter.

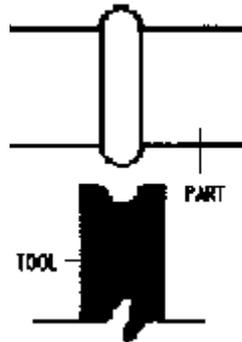


FIGURE 13—Form tool and the part it shapes.

The clearances ground behind the cutting edges indicate the type of material for which the tool may be used and the direction in which it is fed along the work. When grinding

tool bits, correct clearances are essential or "rubbing" can occur.

Turning Tools (left and right hand)—Reference to Figure 11 will illustrate the lateral positioning of this tool. Note the clearance behind the point between the end of the tool and the work. Insufficient clearance will cause the tool to "rub" and excessive clearance will produce a ridged or wavy finish due to the small length of tool edge in contact with the work. This ridging becomes more pronounced with rapid feed. To provide a smooth finish, the sharp cutting point may be slightly rounded with an oilstone, taking care to preserve the side clearance underneath this corner.

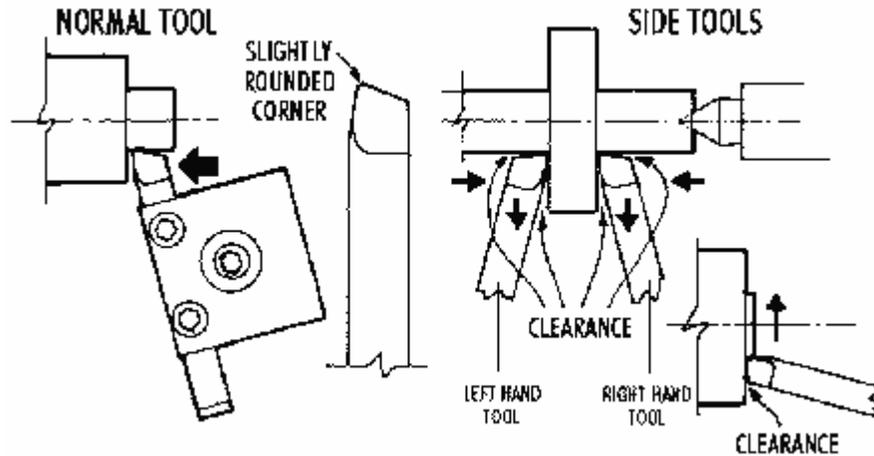


FIGURE 14—Arrows show direction of tool feed in all diagrams.

This tool should not be advanced directly endwise into the work. The depth of cut is set while the tool is clear of the end of the work. The starting procedure is to advance the tool until the point just touches the work. Note the reading on the crossslide handwheel, withdraw the tool slightly and move along until clear of the end of the work. Now advance the crossslide to the above reading, add desired depth of cut and then feed the tool along the work piece the desired distance. Withdraw the tool clear of the work, having noted the reading on the crossslide handwheel, mentally note the reading on the lead screw handwheel, return the tool to starting position and advance to the previous reading plus the desired cut.

(Note: Sherline offers optional adjustable "zero" handwheels which allow you to reset the handwheel to zero...a handy feature often found only on expensive full size machine tools.)

The second feed is now commenced, ceasing at the same previous reading of the lead screw handwheel. This procedure enables turning to accurate length.

Repeat the procedure until the work has been reduced to within about .010" (0.25mm) of desired diameter, noting that each .015" (0.4mm) increase in depth of cut will reduce the work diameter by twice this amount; that is, .030" (0.8mm). For the finishing pass, advance the tool by the required amount and feed along the work just far enough to gauge

the finished diameter. Adjust depth of cut if necessary and complete the final pass using a SLOW feed to obtain a smooth finish and exact size.

Cutoff or Parting Tool

After completing a part in the lathe it is frequently necessary to separate the part from the excess material used for chucking. This operation is best accomplished with the use of a cutoff tool or "parting tool" as it is sometimes called. The Sherline cutoff tool and holder (P/N 3002) utilizes a very slender, high speed tool steel cutting blade mounted in a special tool holder. The thinness of the blade (.040") enables it to feed into the part quite easily and at the same time minimizes the amount of waste material. One word of caution; never use a parting tool on a part mounted between centers. The part may bind on the cutter and result in a scrapped part or a broken cutting tool.

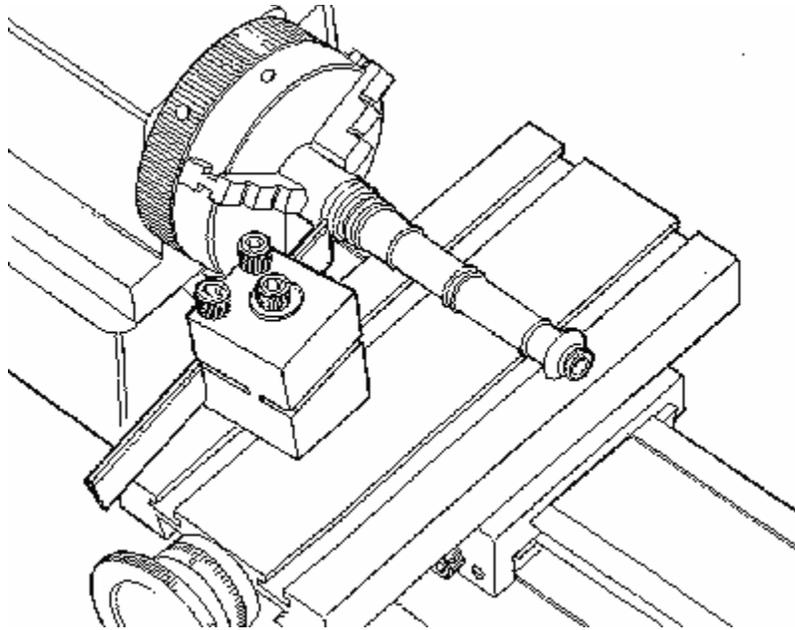


FIGURE 15—A parting tool used to separate a part from it's workpiece.

Always try to lay work out so the cutoff tool is used as close to the spindle as possible. Set blade height by sliding the blade in its slot in the tool holder. It should be set so the tip is aligned with the centerline of the part being cut. An unusual diameter may require a shim under the front or rear of the holder to accomplish this. The tool can also be mounted on the back side of the table by using the rear mounting block, P/N 3016.

NOTE: A rear mount cutoff tool is now available that allows the parting tool to be left in place on the rear side of the part for quick use. The parting tool is held upside down in the holder. See P/N 3018.

NOTE: ALWAYS USE CUTTING OIL WHEN USING THE CUTOFF TOOL. The cut will be made much smoother, easier and cooler.

The turning speed for parting should be about one half the normal turning speed and feed rate should be a little heavy so the chip will not break up in the slot. If speed and feed are correct, there will not be any chatter, and the chip will come out as if it were being unrolled. Cutting oil plays a major roll in this occurring properly.

If the tool chatters, first check to see if the work is being held properly. Then decrease speed (RPM) or increase feed rate or both. Once the blade has chattered, it leaves a serrated finish that causes more chatter. Sometimes a serrated finish can be eliminated by stopping the spindle, adding a liberal amount of cutting oil, bringing the blade up so there is a slight pressure on it without the spindle turning, and then turning by hand or as slowly as possible with the speed control.

Very small work may be completely cut off when held in a chuck and allowed to fall onto the crossslide. It is too small and light to cause any damage. Hollow articles, such as rings, may be caught on a piece of wire whose end is held in a suitable position.

Side Tools

While these may be, and often are, used as general purpose turning tools, their specific use is for facing the sides of collars and shoulders; that is, finishing these to correct dimension and with a smooth, flat surface. They are also for facing work held on a faceplate or in a chuck. The facing of work in this manner is very useful for the production of truly flat surfaces and for producing articles to an exact thickness. The two uses of the side tools are illustrated in Figure 11 and 14. The sharp corner at the cutting point should not be slightly rounded, as may be done with the normal turning tool, as knife tools may be required to produce sharp corners.

Boring Tool

The use of this tool requires the existence of a drilled or cored hole, or it may be used to enlarge the bore of a tube. The work must be mounted in a chuck or on a faceplate and the boring tool set as shown in Figure 24. Note the clearance behind the cutting point as shown in Figure 16 below.

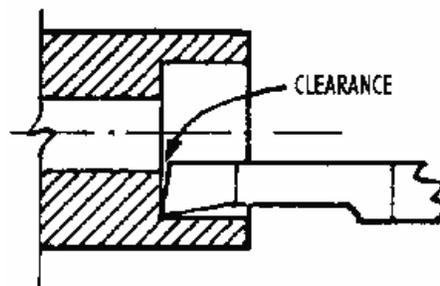


FIGURE 16--Boring tool clearance.

A slow rate of feed should be used as the turnings are not able to escape freely from the hole. Frequent withdrawal of the tool to allow turnings to escape may be necessary. Care should be taken not to feed the tool beyond the depth required or to feed so deeply as to damage the chuck or faceplate.

Where a hole must be bored right through the work, it should be shimmed out from the faceplate to provide clearance for the tool to feed through. The lead screw handwheel graduations can be used to indicate the correct depth at which to stop the feed. Notice that with boring, the depth of cut is increased by moving the tool and crossslide towards the operator and not away as with normal turning.

The boring of holes often necessitates greater than normal overhang of the tool from the tool post, so the depth of cut and rate of feed should be reduced from normal.

Inserted Tip Carbide Tools

Sherline brings the home shop machinist into the space age with cutting tools that add a new dimension to small lathes. When working with tough metals, high speed steel tools need constant sharpening and have a relatively short life. Brazed carbide tools cut great but chip easily. Inserted carbide cutting tools are the answer and have replaced those other tools in the modern machine shop. Carbide inserts have the ability to consistently give good finishes and long tool life at a much higher cutting speed. This is especially important with small lathes because they do not have excessive power at low RPM. With inserted carbide tools you can cut stainless steel at the same RPM you were formerly using to cut aluminum with high speed steel tools without any sacrifice in quality in surface finish.

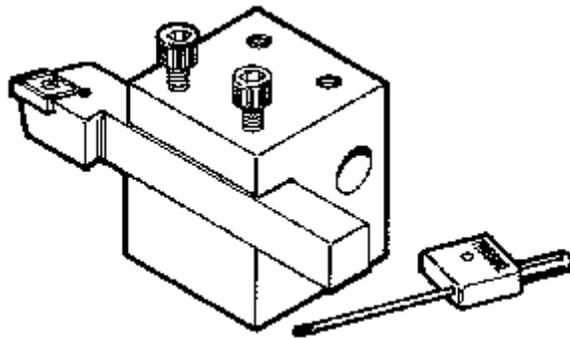


FIGURE 17--A Carbide Inserted Tip Cutter installed on the tip of a special tool designed to hold them.

These tools are more expensive than high speed steel; however, they are worth every penny if you have problems grinding your own steel tools or are cutting exotic materials like stainless steel. Sherline offers a tool post (P/N 7600) which holds the larger 3/8" diameter tool shanks used to hold carbide or diamond inserted tips. It also has a 3/8" round hole for boring tools. A good starting point for a tool is the P/N 7615 right hand

holder that uses the P/N 7605 insert. This is a 55° insert good for turning, facing and profiling. Also available are 80° inserts which are slightly less versatile but offer longer tool life because of their stronger, more square shape. These tools should not be used to cut hardened steels or piano wire. Materials such as those should be ground to shape, not cut. Abrasive materials such as glass reinforced plastics can be easily cut with these tools.

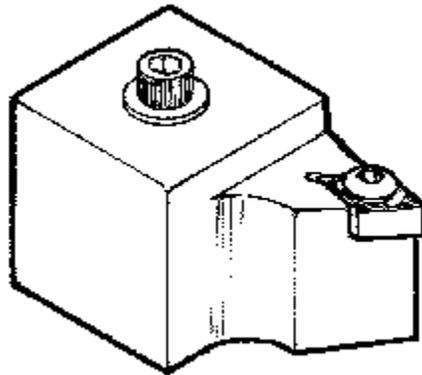


FIGURE 18—3/8" Negative rake insert tool holder (P/N 7610).

Another tool available to Sherline machinists which holds carbide inserts is the 3/8" IC 55° negative rake insert tool holder (P/N 7610). The indexable carbide insert sits on the tool holder at a 5° negative angle. This gives the sides of the cutter clearance even though the insert has square sides. By having square sides, both top and bottom of the insert can be used as cutting edges, giving a total of four cutting edges on each insert. Because of its design, it cuts like a positive rake cutter which requires less rigidity than a negative rake cutter. It gives you the best of both worlds—the four cutting edges of a negative rake tool along with the lower stress loading of a positive rake cutter which is appropriate for a lathe of this type.

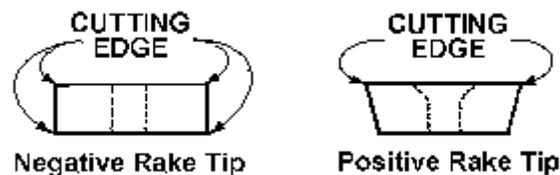


FIGURE 19—Negative and Positive Rake Carbide Cutting Tips. Negative Rake tips can be held upside down giving 4 cutting edges. Positive Rake tips cut from one side only, but cut better.

When searching for a mirrorlike finish on copper or aluminum, a four-sided diamond insert (P/N 7609) and a tool holder (P/N 7619) are also available. Though expensive, the four cutting edges of the diamond insert mean you are really getting four tools in one, making it a better deal than it may first appear.

NOTE: Never attempt to cut steel with a diamond cutter.

While inserted tip carbide and diamond cutting tools will improve the performance of the Sherline Lathe, they will not correct poor machining technique. Rigid setups are a must for tools such as these.

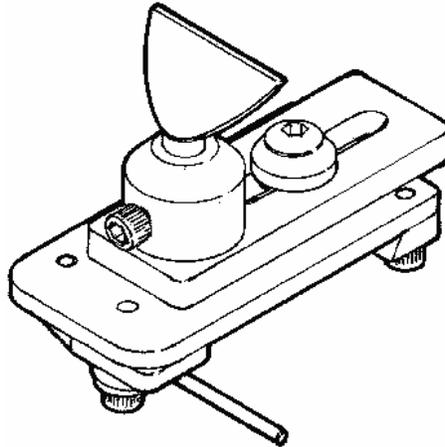


FIGURE 20—The Sherline W.R. Smith T-Rest

T-Rest (P/N 2110) and Gravers

Another method of removing metal is with a hand held cutting tool called a "graver". It is rested on and moved along a repositionable rest called a T-Rest. It is traditionally associated with clock and watch makers using jeweler's lathes, but can be a useful skill to anyone turning small, custom parts because of its freehand versatility. World renowned watch and clock maker, William R. Smith designed Sherline's T-Rest, and with it, your Sherline lathe becomes a first class jeweler's lathe. Complete instructions on use of the T-Rest as well as 3 additional pages by W.R. Smith on how to make your own high quality gravers are included with purchase of the rest. (They can also be found here on our World Wide Web site.)

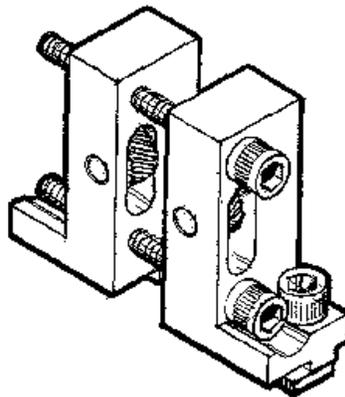


FIGURE 21—The Sherline knurling tool holder.

Knurling Tool (P/N 3004)

Sherline's knurling system is designed to be used only with the Sherline Lathe. The knurling holder mounts directly to the crossslide. A good knurl is produced by embossing, not by cutting, and this creates high tool loads. Using two knurls opposing each other equalizes these loads allowing successful knurling on a small machine. A number of patterns can be achieved by changing the knurls. A 25 thread per inch medium diamond pattern set comes with the tool. A number of additional straight and spiral knurls can be ordered.

Guide to Approximate Turning Speeds

| MATERIAL | CUT SPEED, S.F.M. | 1/4" (6mm) Dia. | 1/2" (13mm) Dia. | 1" (25mm) Dia. |
|-------------------|----------------------|-----------------|------------------|----------------|
| Stainless, 303 | 67 | 1000 RPM | 500 RPM | 250 RPM |
| Stainless, 304 | 50 | 800 RPM | 400 RPM | 200 RPM |
| Stainless, 316 | 47 | 700 RPM | 350 RPM | 175 RPM |
| Steel, 12L14 | 174 | 2600 RPM | 2300 RPM | 650 RPM |
| Steel, 1018 | 87 | 1300 RPM | 650 RPM | 300 RPM |
| Steel, 4130 | 82 | 1250 RPM | 650 RPM | 300 RPM |
| Grey Cast Iron | 57 | 900 RPM | 450 RPM | 225 RPM |
| Aluminum, 7075 | 400 | 2800 RPM | 2800 RPM | 1400 RPM |
| Aluminum, 6061 | 375 | 2800 RPM | 2800 RPM | 1400 RPM |
| Aluminum, 2024 | 268 | 2800 RPM | 2000 RPM | 1000 RPM |
| Brass | 400 | 2800 RPM | 2800 RPM | 1400 RPM |

FIGURE 22—Turning speeds for high speed steel cutting tools

TURNING SPEEDS

The chart above provides a guide to approximate speeds at which work of differing materials should be rotated. Note that the turning speed is inversely proportional to the diameter of the work; that is, the larger the diameter, the slower the turning speed. Material often differs in its hardness, so these figures may have to be varied. The harder the material, the slower the turning speed should be.

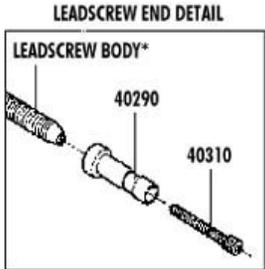
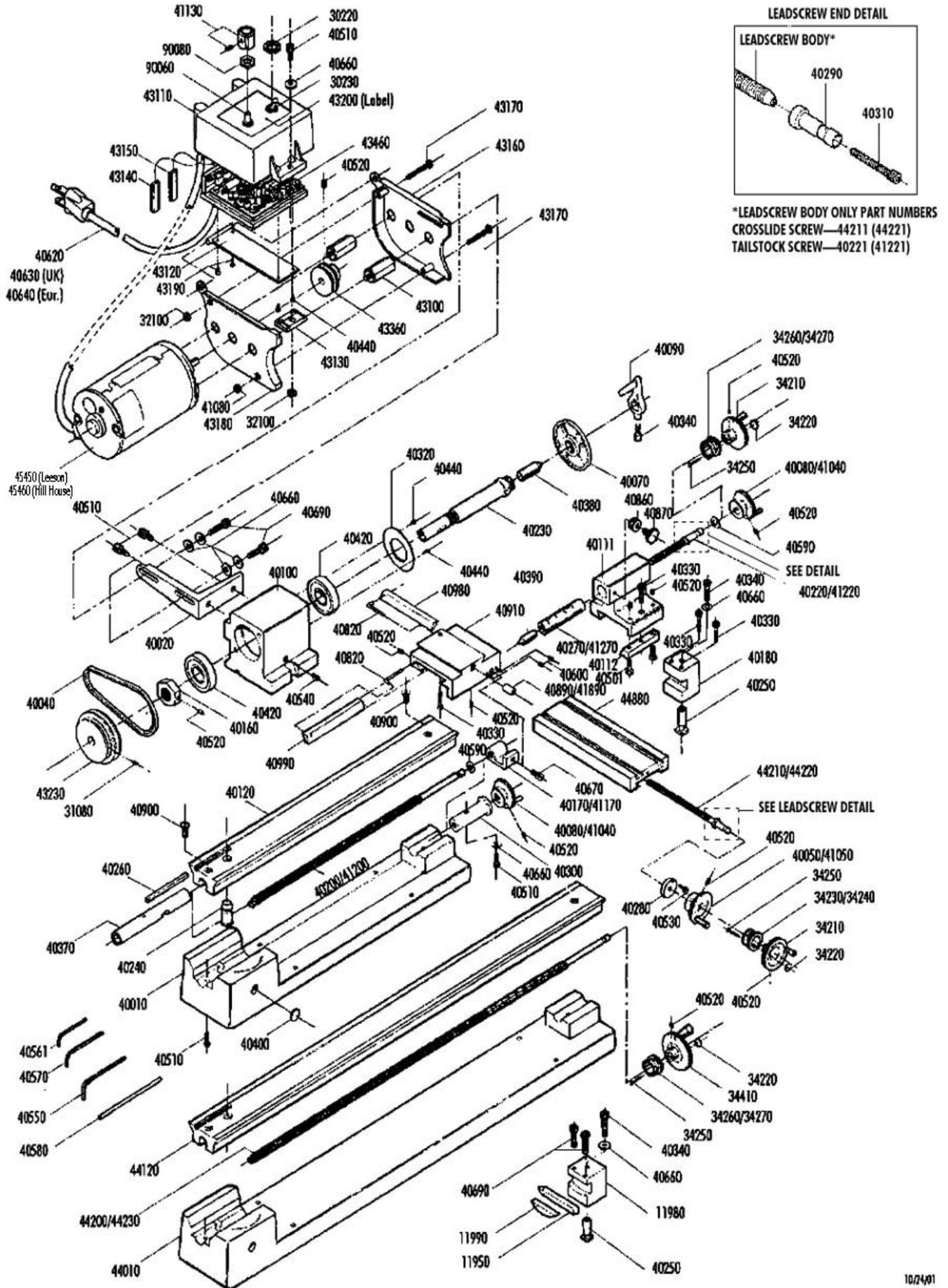
Keep in mind that, apart from possible production of excessive heat and the fact that excessive speed may damage the cutting edge or cause it to "rub" instead of cutting, turning speeds are not too critical. Slower speeds than normal cause no harm, except by increasing the time involved. Aluminum, however, usually gives a better finish turned at high speed and lubricated.

Use of Accessories and Attachments

Your lathe can be made more versatile with the addition of suitable attachments and accessories. These include various chucks and collets, a thread cutting attachment, vertical milling column, knurling tool, a live center and many others. Remember that accessories and attachments must be cared for in the same way as the lathe. Always make sure that threads are free from metal chips and dirt. Chucks should be lightly oiled frequently so that they continue to function smoothly and accurately. Gears in the thread cutting attachment should be lightly greased when in operation. Some attachments have moving slides and these should be lubricated in the same way as the slides in your lathe. Each accessory comes with complete instructions for its use when it is purchased.

Lathe Exploded View and Parts Diagram

Refer to part number list below drawing for description and material.



*LEADSCREW BODY ONLY PART NUMBERS
 CROSSSLIDE SCREW—44211 (44221)
 TAILSTOCK SCREW—40221 (41221)

Part Numbers and Descriptions, SHERLINE Lathes and Mills

KEY TO MATERIALS: A=Aluminum, B=Brass, C=Composite, DC=Die Cast,
P=Plastic, U=Urethane, S=Steel

(Updated 10/24/01)

| PART NO. | DESCRIPTION | MATERIAL |
|-------------------|---|----------|
| 11950 | 1/4" HSS cutting tool (RH) | S |
| 11980 | Rocker Tool Post Body | A |
| 11990 | Rocker Tool Post Rocker | S |
| 30220 | Toggle Switch Retaining Ring | S |
| 30230 | Toggle Switch | -- |
| 31080 | 10-32 x 3/8" Flat Pt. Set Screw | S |
| 34000 (34100) | Oversize Handwheel, Inch (Metric) | A |
| 34060 | Thrust Bearing Washer Set | Ball |
| 34210 | 2" handwheel Body | A |
| 34220 | Handwheel Locking Nut | S |
| 34230 (34240) | Y Axis/Crosslide Collar, Inch (Metric) | A |
| 34250 | 6-32 x 7/8" Pan Hd. Screw | S |
| 34260 (34270) | X, Z Axis and Leadscrew Collar, Inch (Metric) | A |
| 34410 | 2-1/2" Handwheel Body | A |
| 40020 | Motor Bracket | DC |
| 40040 | Drive Belt | U |
| 40050 (41050) | 1-5/8" Handwheel, Y Axis/Crosslide, Inch (Metric) | A |
| 40070 | Faceplate | DC |
| 40080 (410400) | 1-5/8" Handwheel, X Axis/Leadscrew, Inch (Metric) | A |
| 40090 | Drive Dog | DC |
| 40100 | Headstock Casing | A |
| 40111 | Tailstock Casing (Gib style) | A |
| 40112 | Tailstock Gib | B |
| 40120 | 15" Lathe Bed | DC |
| 40160 | Preload Nut | S |
| 40170 (41170) | Saddle Nut, Inch (Metric) | B |
| 40180 | Tool Post | A |
| 40200 (41200) | Tailstock Feed Screw (complete), Inch (Metric) | S |

| | | |
|---------------|---|------|
| 40221 (41221) | Tailstock Feed Screw body only, Inch (Metric) | S |
| 40220 (41220) | Feed Screw, Inch (Metric) | S |
| 40230 | Headstock Spindle | A |
| 40240 | Headstock Pivot Pin, Lathe | S |
| 40250 | Tool Post Tee Nut | S |
| 40260 | Head Key | S |
| 40270 (41270) | Tailstock Spindle, Inch (Metric) | S |
| 40280 | Thrust Collar | S |
| 40290 | Leadscrew end | S |
| 40300 | Leadscrew Thrust | S |
| 40310 | 5-40 x 1" SHCS | S |
| 40320 | Bearing Washer | S |
| 40330 | 10-32 x 5/8" Skt. Hd. Cap Screw | S |
| 40340 | 10-32 x 1" Skt. Hd. Cap Screw | S |
| 40345 | (See 45450) | -- |
| 40370 | Leadscrew Support | S |
| 40380 | #1 Morse Center | S |
| 40390 | #0 Morse Center | S |
| 40400 | Plug Button | P |
| 40420 | Headstock Bearing | Ball |
| 40440 | Self Tapping Screw | S |
| 40500 | 10-24 x 7/8" Skt. hd. Cap Screw | S |
| 40501 | 10-32 x 1/2" Button Head Hex Screw | S |
| 40510 | 10-32 x 3/8" Skt. Hd. Cap Screw | S |
| 40520 | 10-32 x 3/16" Cup Pt. Set Screw | S |
| 40530 | 5-40 x 3/8" Skt. Hd. Cap Screw | S |
| 40540 | 5/16-18 x 3/4" Cone Pt. Set Screw | S |
| 40550 | 5/32" Hex Key | S |
| 40560 | 3/16" Hex Key | S |
| 40570 | 3/32" Hex Key | S |
| 40580 | Spindle Bar | S |
| 40590 | 1/4" I.D. Washer | S |
| 40600 | 10-32 x 1/4" Flat Pt. Set Screw | S |
| 40620 | Power Cord, USA | -- |
| 40630 | Power Cord, UK | -- |
| 40640 | Power Cord, Europe | -- |

| | | |
|---------------|---------------------------------------|-------|
| 40660 | 3/16" I.D. Washer | S |
| 40670 | 10-32 x 1/2" Skt. Hd. Cap Screw | S |
| 40690 | 10-32 x 3/4" Skt. Hd. Cap Screw | S |
| 40760 | 10-32 x 5/8" Thumbscrew | S |
| 40820 | Gib Lock | S |
| 40860 | Tailstock Locking Screw Grommet | P |
| 40870 | Tailstock Spindle Locking Screw | S |
| 40890 (41890) | Slide Screw Insert, Inch (Metric) | B |
| 40900 | 10-32 x 3/8" Flat Hd. Skt. Screw | S |
| 40910 | Saddle | A |
| 40980 | Crossslide Gib | C |
| 40990 | Saddle Gib | C |
| 41080 | 6-32 Hex Nut | S |
| 41110 | Tailstock Casing | A |
| 41130 | DC Speed Control Knob and Set Screw | P/S |
| 43100 | DC Motor Standoff | A |
| 43110 | DC Speed Control Case | P |
| 43120 | DC Speed Control Hinge Plate | P |
| 43130 | DC Speed Control Cover Mounting Plate | P |
| 43140 | DC Speed Control Tab, Small | P |
| 43150 | DC Speed Control Tab, Large | P |
| 43160 | Belt Guard, Outer | P |
| 43170 | 6-32 x 1-3/8" Pan Hd. Screw | S |
| 43180 | Belt Guard, Inner | P |
| 43190 | #2 x 1/4" Flat Hd. Sheet Metal Screw | S |
| 43200 | DC Speed Control Foil Label | Foil |
| 43230 | Stepped Main Spindle Pulley | A |
| 43360 | Stepped Motor Pulley | A |
| 43450 | (See P/N 45450) | Motor |
| 43460 | DC Speed Control Electronics | -- |
| 44010 | 24" Lathe Base | DC |
| 44120 | 24" Lathe Bed | S |
| 44200 (44230) | 24" Leadscrew, Inch (Metric) | S |
| 44210 (44220) | Slide Screw, Inch (Metric) | S |
| 44211 (44221) | Slide Screw body only, Inch (Metric) | S |
| 44880 | Crossslide | A |

| | | |
|----------------------|--|-------|
| 45010 (45160) | Leadscrew, Z Axis, Inch (Metric) | S |
| 45040 | Saddle, Z Axis | A |
| 45170 | Column Saddle Lock | P |
| 45180 | 3/16" Ball Bearing | S |
| 45190 | #10 Type B Washer | S |
| 45450 or 45460 | 45450=DC Motor with externally replaceable brushes (Leeson) 45460=DC Motor with externally replaceable brushes (Hill House) (NOTE: We purchase motors from two different manufacturers to keep pricing competitive. Specifications on both are the same, but replacement motors should be ordered with the same part number as the original. Part number is printed on motor.) | Motor |
| 90060 | DC Speed Control 5K Potentiometer | -- |
| 90080 | 3/8-32 Hex Nut | S |

SHERLINE
PRODUCTS
INCORPORATED 1974



This double rotary table setup by Bob Breslauer of Ft. Lauderdale, Florida, is an example of the type of special setups Sherline tool owners sometimes develop.

Standard Dimensions of Sherline Tools

If you are making special tooling or a custom accessory for your Sherline tools, this will save you the trouble of measuring your particular machine to find a dimension, some of which are actually quite difficult to measure. If you need a dimension not listed here, please call or write with your request.

Most of the regular specifications can be found by looking at the Lathe and Mill descriptive pages which have a Specifications List at the end of each.

| LOCATION | DIMENSION |
|--|---------------|
| Bed dovetail angle | 55.5 degrees* |
| Lathe bed to spindle centerline | 1.75" |
| Lathe table surface to spindle centerline (calculated) | .940" |
| Headstock spindle nose internal taper | #1 Morse |
| Lathe tailstock internal taper | #0 Morse |
| Headstock spindle external thread | 3/4-16 |

| | |
|---|---|
| Pulley groove side angle | 19° |
| Table T-slot centerline distance (lathe and mill) | 1.5" |
| T-slot nominal dimensions** **Note: The T-slots are extruded into the material. Table surfaces are machined for flatness, but the slots themselves require no additional finishing processes. | Slot width, top: .25" T width, bottom: .40" Upper slot depth: .10" T Slot depth: .10" (Total depth: .20") |
| Leadscrew thread pitch, inch (Lathe, mill X and Y axes = 1/4-20, Mill Z axis = 3/8-20) | 20 threads per inch or .050" travel per revolution (handwheels divided into 50 increments of .001") |
| Leadscrew thread pitch, metric (Lathe, mill X and Y axes = 6.3 x 1 mm, Mill Z = 10 x 1 mm) | 1 mm travel per revolution (handwheels divided into 100 increments of .01mm) |
| Leadscrew thread directions | Right-hand: Lathe crossslide, Mill X-axis Left-hand: Lathe leadscrew and tailstock screw, Mill Y-axis and Z-axis |
| *NOTE: This dimension was determined by measuring the extruded bases that were supplied when we first took over production in the USA from the former Australian manufacturer. The base and several other parts were cast to match this angle and it was not economically feasible at the time to change it to an easier-to-manufacture 60 degrees. The original 55-degree angle was determined by a reference to <i>Machinery's Handbook, Vol. 17</i> as the ideal angle to cut a dovetail. When we took over production, a fixture was produced in-house to duplicate the existing angle which had changed slightly from the original 55° to an actual 55.5°. This fixture became the "standard", and every machine built since the early 1970's has been measured against this same fixture. The older brass beds and the current steel beds as well as the parts that fit them are all ground to this same angle. | |
| ALLOWABLE TOLERANCES | |
| Spindle Runout (at spindle nose), Maximum allowable (Most are within .0002-.0003") | 0.0005" |
| Spindle End Play (adjustable with preload nut), Factory Settings | with 2800 RPM Pulleys: 0.0002" with 10,000 RPM Pulleys: 0.0003" |
| Self-Centering 3-jaw and 4-jaw chuck runout | 0.003" or less |

| | |
|---|----------------------------|
| Leadscrew thread pitch accuracy | ±0.001" per inch of travel |
| COLLETS | |
| Sherline WW Collet body diameter | 0.312" to 0.313" |
| 8 mm WW collets (by others), body diameter | 0.314" to 0.315" |
| WW and 8 mm collet thread | .275-40 |
| HEADSTOCK BEARINGS | |
| Designation/stock number (ZZ refers to "double shielded") | 6004ZZ |
| Size of bore | 20 mm (0.7874") |
| Tolerance of bore | 0.0004" |
| Outside Diameter | 42 mm (1.6535") |
| Tolerance of OD | 0.0005" |
| Width | 12 mm (0.4724") |
| Bearings | 9 balls, 1/4" dia. |

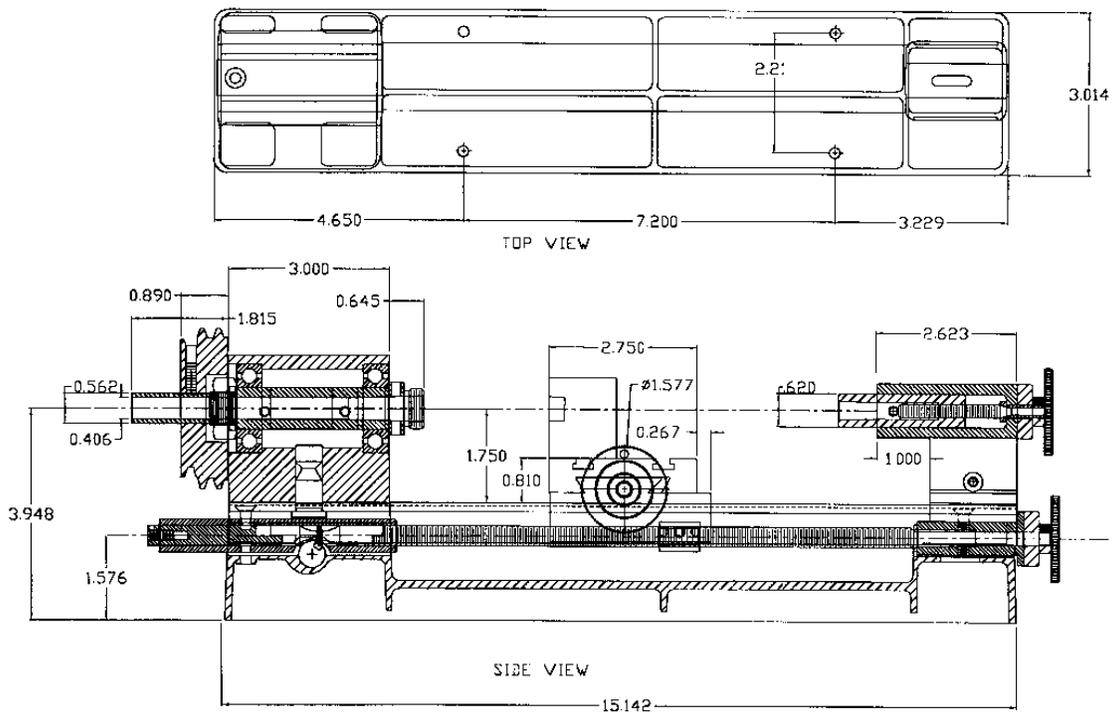
HISTORICAL NOTE

You might find it interesting to note that a problem similar to the one mentioned above is probably why Morse tapers are not perfectly consistent to this day. A Morse taper is listed as "about 5/8" per foot". Standard fixtures were probably made years ago and machines and tools over the years were made to match these fixtures. Modern measurement techniques were able to establish that these fixtures were not all perfectly consistent in angle. Changing the angle, however, would make it impossible for new parts to fit the old machines. Therefore, today we have Morse tapers that each vary slightly from a taper of 5/8" (.6250") per foot. The actual tapers for each number Morse taper are as follows:

| MORSE TAPER # | TAPER PER FT. | TAPER PER IN. |
|---------------|---------------|---------------|
| 0 | .62460 | .05205 |
| 1 | .59858 | .04988 |
| 2 | .59941 | .04995 |
| 3 | .60235 | .05019 |
| 4 | .62326 | .05193 |
| 5 | .63151 | .05262 |
| 6 | .62565 | .05213 |
| 7 | .62400 | .05200 |

Sherline Lathe Dimensions

The drawing below shows the key dimensions on a Sherline Model 4000 lathe. It is provided to help those who wish to make special equipment to fit to your lathe. If you wish to download a higher quality version of the drawing, it is also available as a .pdf file.



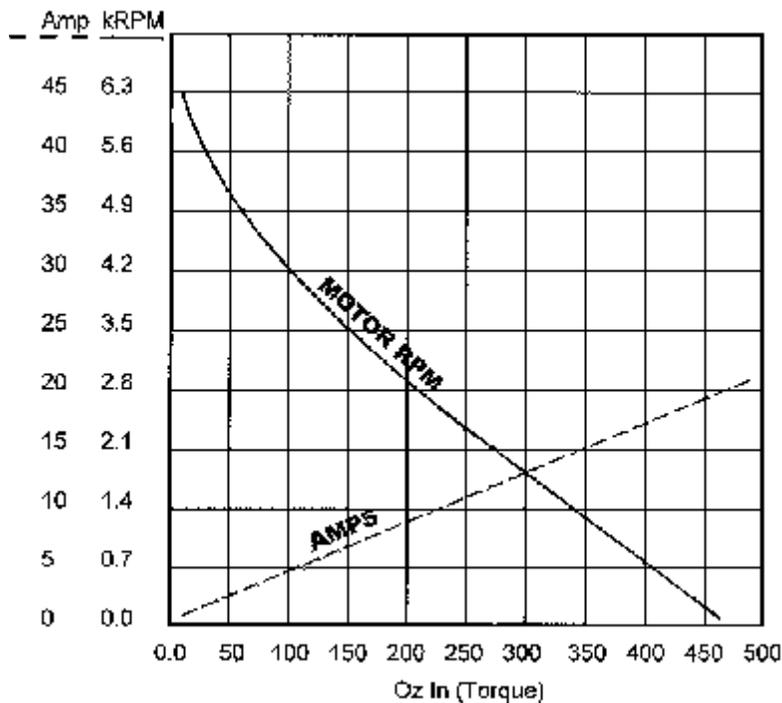
Motor and Speed Control

ELECTRIC MOTOR SPECIFICATIONS FROM MANUFACTURER

- **Type of enclosure:** Totally enclosed, non-vented
- **Duty rating:** Continuous--10 oz. in. at 6100 rpm, .85 amperes;
Intermittent--30 oz. in. at 5500 rpm, 1.75 amperes (5 minutes on / 15 minutes off)
- **Output horsepower:** .06 KW (60 W) at 10 oz. in. / 6100 rpm
- **AC voltage (input):** Normally 115 VAC, 60 Hz, Single Phase to rectifier (Sherline electronic speed control converts any input from 100 VAC to 240 VAC, 50-60 Hz.)
- **DC voltage:** 90 VDC to motor (60 Hz)

- Speed in rpm: 6100 rpm continuous
- Class of insulation: Class A, 105° (C.) insulation system
- Normal full load current: .85 amperes
- Starting current: 17 amperes instantaneous starting current (<100 milliamperes). This is also stall current in True RMS
- Max current at time of changeover from lower speed to higher speed: Depends on load
- Type of motor: 3.00 inch (outer diameter) sub-fractional horsepower brush-type permanent magnet motor
- Temperature rise at ambient 50° C.: Less than or equal to 45° C.
- Motor frame size: 3 inches
- End use of motor: Drive unit for lathe or mill

MOTOR TORQUE CURVE



NOTE: Electronic circuitry built into the speed control supplies a constant 90 VDC output to the motor regardless of the input current from 100VAC to 240VAC, 50 or 60

Hz, so Sherline machines can be plugged in and used in any country in the world without a transformer as long as you have the correct wall plug converter..

USE WITH AN INVERTER: This motor and speed control can be used with an inverter that produces a sine wave. It cannot be used with an inverter that produces a square wave.