5C CNC Pneumatic Rotary Indexer
for 6” Angle Lock Vise—P/N 88000

Assembly and Use

Precautions
1. Do not carry or handle the unit by the electrical cable. The connections were not designed to support its weight and the fine motor wires can easily be damaged.
2. Do not apply pneumatic pressure to the spindle without a collet in the spindle and material of the proper size in the collet.
3. Operate with pneumatic pressure between 100 and 125 PSI. If source is of a higher pressure, install a pop-off valve in line.
4. Condensation inside the unit can cause rust and damage. Install and use the in-line oiler provided with this unit.
5. Read all instructions before attempting to use the indexer. Certain procedures done incorrectly can damage the unit and void the warranty.

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Patent No. US8,087,858B2
Installing, Maintaining and Operating the SherlineCNC 5C Indexer and Controller

By Joe Martin

Introduction

The 5C CNC indexer is primarily designed to be used with Bridgeport® type milling machines. Most mills of this type today are used in conjunction with an Angle Lock vise. I came up with the idea to design a 5C Indexer that would mount directly into a vise of this type after removing my vise, clamping and indicating a 5C manual indexer on to my mill to do a single machining operation. When it was completed I had to lift my heavy vise back on to the mill clamp and indicate it in before I could start producing work again. I wasted at least 45 minutes to accomplish this.

I knew my American made Kurt Angle Lock® vise was capable of clamping a plate precisely in place so my design criteria had to be to hold a plate of adequate rigidity in both the vertical and horizontal position with standard vise jaws. It also had to have a pneumatic collet closer to speed things up. I also knew it had to be a programmable device because the machine trades no longer will accept products that don’t speed up manual operations. I never thought it was going to be so hard to accomplish.

Joe Martin
President/Owner
Sherline Products Inc.
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 a 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 the third prong.

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 the tool before turning on any machine.

5. **Keep work area clear**—Cluttered work areas and benches invite accidents.

6. **Avoid a dangerous work environment**—Do not use power tools in damp or wet locations. Keep your work area well illuminated.

7. **Keep children away**—All visitors should be kept a safe distance from the work area.

8. **Make your workshop “kid-proof”**—with padlocks, master switches or by removing starter keys.

9. **Do not force a tool**—Do not force a 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 headgear to keep long hairstyles away from moving parts.

11. **Use safety glasses**—Also use a face or dust mask if a cutting operation is dusty.

12. **Secure the 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.


15. **Disconnect tools**—Unplug or turn off tools before servicing and when changing accessories such as blades, bits or cutters.

16. **Avoid accidental starting**—Make sure the switch is “OFF” before plugging in a power cord.

17. **Use only recommended accessories**—Consult the owner’s manual. Use of improper accessories may be hazardous.

18. **Turn the spindle by hand BEFORE switching on the motor**—This ensures that the workpiece or chuck jaws will not hit the lathe bed, saddle or crosslide, 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. Over-tightening may damage threads or warp parts, thereby reducing accuracy and effectiveness.

20. **Don’t use your machine 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 any other precision tool is kept near an operating grinder, it should be kept covered when not in use.

21. **Support long stock that protrudes through the back of the spindle**—5C collets were not designed for uneven loads.

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.

23. **Checking/changing computer power supply voltage settings**—The 24V power supply for the indexer can only be used with 110VAC current.

24. **Static electricity can damage your controller**—If the case must be opened, be sure you are properly grounded before touching any components on the circuit board. A spark of static electricity can damage delicate circuits in some components in your indexer. Either wear an approved static electricity grounding strap around your wrist or touch a grounded source with one hand before touching any components with your other hand.

25. **Be sure you know what will happen BEFORE pushing the [START] button**—Run your program in before running the actual part to make sure it will run the path your are expecting. Make sure your machine is in the proper home position before starting the operation. Always make written notes of these locations including the direction of backlash.

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**Voiding the Warranty**

Modification or disassembly of the indexer beyond normal maintenance procedures described in these instructions may void the warranty. Before attempting major repairs, call the factory for advice and instructions.
### Sherline 5C CNC Indexer Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center height in the vertical position</td>
<td>4.50”</td>
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<tr>
<td>Overall height in the vertical position</td>
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<tr>
<td>Overall length</td>
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<tr>
<td>Overall width of the body</td>
<td>6.0”</td>
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<tr>
<td>Overall width, body and stepper motor</td>
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<td>Overall height in the horizontal position</td>
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<tr>
<td>Controller cable length</td>
<td>48”</td>
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<tr>
<td>Worm Gear ratio</td>
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<td>Maximum rotating speed</td>
<td>41°/sec</td>
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<td>Positioning accuracy</td>
<td>± .006°</td>
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<tr>
<td>Spindle concentricity</td>
<td>0.0004”</td>
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<tr>
<td>Perpendicularity, body to spindle</td>
<td>0.0008”</td>
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<tr>
<td>Stepper Motor holding torque</td>
<td>198 ozf-in (1400 mNm)</td>
</tr>
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</table>

**5C Indexer Features**

- Controller uses “ramping” to accelerate and decelerate during each movement. You can enter the minimum and maximum speeds used to suit your work. (The amount of ramping becomes more noticeable when the slow feed is set below 5 in the Settings mode.)
- Controller allows a programmable amount of backlash compensation
- Indexer designed, patented, manufactured and assembled in the USA
- Body is 4140 steel, hardened and ground
- Spindle is case hardened steel
- Indexer has a precision hobbed gear and worm that are made from different metals to prevent galling and ensure long life
- T.I.R of spindle nose is .0004” or less
- Spindle zero collar on the spindle is easy to adjust and read with marks at 1° increments
- Manual adjustment knob is marked in 1/10° increments
- Red Emergency Stop button
- Green Cycle Start button
- In-line oiler for air included
- Can be held in a 6” Kurt angle lock® style vise in either vertical and horizontal position
- Stock up to 1-1/16” in diameter can be fed through spindle
• Uses the most popular collet in the world (5C)
• Pneumatic collet clamping system
• Stand-alone CNC controller is easy to operate and easy to program
• Rotational position verified by an encoder
• System will shut down if a positioning error occurs

The Importance of Reading the Instructions
It is impossible to make a product this complex “idiot proof.” The best rule I’ve ever come up with when dealing with any type of CNC equipment is this: “You have to know what the machine will do after you push the button BEFORE you push the button.” This can only be accomplished by reading, and re-reading if necessary, the instructions and “playing with the 5C Indexer” at the same time until you thoroughly understand how the features you plan to use work. The indexer is already programmed with factory defaults and ready to operate; but just to be safe, the defaults should be reset on the first start-up by pressing 9 on the keyboard and holding it down while turning on the power switch. This will restore factory defaults. Don’t mount this unit on a mill that has a cutter in the spindle until you truly understand how to control it. Over 50% of these instructions will require reading one time.

Proper Use of the 5C Indexer

NOTE: No water-based coolants should be used with this 5C Indexer unless it is only applied directly to the part with a brush. This unit was not designed to operate in a standard CNC enclosure being flooded with high pressure coolant.

1. You must use the inline oiler that is supplied with this unit. There are several internal O-rings that are located on moving parts. The inline oiler ensures that these internal parts are properly lubricated. Use only “Air Tool Oil” in the inline oiler to prevent rust.

2. You must use dry air with this indexer. If you don’t have an air dryer on your main air supply (which you should if you operate a CNC shop) we recommend that you use an inline air dryer (or two inline air dryers).

NOTE: If any water or mist comes out of the “air release hole” when you clamp or unclamp the collet, it’s a sign of water in air supply. The release hole is located at the top front of the body, directly above the serial number. Storing the system when the internal parts are exposed to moisture for long periods of time will damage the unit with rust and void its warranty.

3. Minimum air pressure for this indexer is whatever it takes to hold the work tight enough so it doesn’t move during machining but doesn’t damage the part. This might be the case machining thin wall tubing. Maximum air pressure is (125 psi) but 100 psi will put a little more than 1000# pull on the draw bar which should do the job.

4. Disconnect the controller cable and the air line prior to mounting the 5C Indexer, so you will have fewer components to handle. Once the 5C Indexer is mounted securely you can connect the air, controller cable, and power supply for the controller.

5. This Indexer was designed to fit in a 6” Kurt angle lock® style vise. It is not made to be clamped to the top of a table. If you’re determined to clamp it to the table, four 1-2-3 blocks should get the job done, but don’t ding it up with the hold-down clamps. Use the flat surfaces of the Indexer Body and the side slots to clamp the indexer in the vise.

A). When clamping the indexer in the horizontal position, use the two side slots to clamp and locate the indexer in the vise. There should be space between the bottom of the vise and the 5C cover. Do not rest the indexer on the 5C Cover and clamp it by the sides.

B). When clamping the indexer in the vertical position, clamp the body front-to-back sandwich style between the vise jaws. Do not clamp it by the side in a larger vise. There is not enough surface contact for proper rigidity.

6. Whenever you are clamping the indexer with the stepper motor housing on the back side of the spindle, be mindful that you have clearance between the motor housing and the column on the mill. It wasn’t designed for use in this manner, but you can do it if you are careful.

7. Don’t hang the controller cable in an area where it can be pinched by the machine when in use, and don’t lift the indexer by the flex cable.

8. The Controller Stand has a 17/32″ (13.5mm) hole in the base for easy mounting of the controller to the milling machine table so it moves with the indexer with a standard 1/2” hold down bolt or stud. Locate the controller away from hot chips.

9. Do Not activate the clamp unless there is a collet mounted in the indexer holding the appropriate size stock. If you activate the clamp without a collet or a collet without the proper size stock in the indexer it may damage the collet because it will force the 5C Draw Piston into the 5C Cover. This may damage internal parts and seals. The contact with the 5C Cover will also act as a break which will not allow the indexer to rotate.

10. Spindle Locking Lever—The 5C Indexer has a manual spindle locking lever on the front of the indexer body. You can lock the spindle by turning this lever clockwise. The locking lever is in the unlock position when it is pointing towards the bottom of the indexer. This lever should be engaged whenever you are changing the collet or applying a radial load on a part or fixture that is being held in the 5C collet (such as a mounting bolt on a fixture). You can also use the locking lever to lock in any given position. Be sure to unlock the lever prior to indexing the spindle to the next position. If you index the spindle with the locking lever on, it will stall the stepper motor and the screen will show a “position error.” This action should not result in

NOTE: In an air supply that exceeds 125psi is used, install a pop-off valve in the air supply line to the 5C Indexer to protect it.
1. The stepper motor can be turned manually by turning the red knurled 1/10° knob on the opposite end of the worm gear housing from the stepper motor. It can also be controlled from the keypad as explained in the “JOG” Mode section in the right-hand column and on page 7.

The stepper motor is difficult to manually turn when it is energized. Therefore, the controller must be either off or in the Jog mode when you turn the handwheel manually. For fine positioning of the indexer we suggest that you put the Jog mode when you turn the handwheel manually. For example, if you enter “4,” the spindle will move in 90 degree increments (360° / 4 = 90°). A typical application of this mode would be gear cutting and hole patterns. Gears produced with the Sherline Indexer will run smoothly as long as the proper single tooth hob is used.

10. If the collet is not adjusted properly, it may allow the Draw Piston to bottom out on the inside of the 5C Cover. This will cause a “brake effect” which will not allow the indexer to rotate. You must unclamp the collet, thread it to its proper location, and re-clamp the part. (Repeat step 11 above.)

11. We recommend that you apply an anti-seize lubricant such as Never-Seez® to the threads of the collet prior to extended use.

12. Collet installation and adjustments: This 5C Indexer has approximately 0.200” of total movement in the Draw Piston. First, connect a proper air supply and make sure that the indexer is in the unclamped position with a quick pull on the collet control valve. Using the collet wrench that is supplied with your indexer, thread the collet into the spindle until the tapers makes contact. Then thread the collet in until the stock or part will not fit in the collet. Then loosen the collet a quarter turn until it is open just enough to insert and remove your part. Place the part in the collet, then clamp and unclamp the part. Re-adjust the collet as needed with the collet wrench.

13. To close the collet, push the knob in all of the way. Be sure there is material of the proper size in the collet to close on. Leave the collet control knob in the clamped position while the work is being machined (not in the neutral position). As you may know, 5C collets have a tendency to stick closed. We eliminated this problem by allowing the operator to open the collet with a quick pull of the spring loaded pneumatic control valve knob. This directs compressed air to the backside of the collet closer piston which forces the collet open. Do not hold the knob open for more than a few seconds or you will waste compressed air and expose the cover to higher loads than needed to get the job done.

14. Stepper Motor—The stepper motor can be turned manually by turning the red knurled 1/10° knob on the opposite end of the worm gear housing from the stepper motor. It can also be controlled from the keypad as explained in the “JOG” Mode section in the right-hand column and on page 7.

The stepper motor is difficult to manually turn when it is energized. Therefore, the controller must be either off or in the Jog mode when you turn the handwheel manually. For fine positioning of the indexer we suggest that you put the controller in Jog mode and use the NXT and PRV buttons instead of turning it by hand.

15. Backlash—This indexer does have some mechanical backlash (.2°or less). After the worm has been run for several hours you can re-adjust the backlash and get it to a minimum. This backlash can be compensated for using the backlash compensation as described in the paragraph entitled “Setting the Electronic Backlash Compensation” further on in the instructions. However, we recommend that you make a 5 or 10 degree move in the opposite direction of that which you are going to rotate the work. Then move back 5 or 10 degrees to your starting point. This will load the worm and the spindle in the working direction and take up any mechanical backlash.

**Mounting Fixtures to the 5C Indexer**

If a fixture is mounted in a collet there is always the possibility of the fixture “spinning” in the collet or the collet moving in the spindle. The safest way to eliminate this problem is to design a fixture that clamps to the spindle nose without using setscrews that could damage the spindle nose. The fixture should also be balanced so the mechanical backlash will not change during rotation when the out of balance part goes over top dead center on close tolerance parts. Standard 5C collet stops will work with the indexer without modifications.

**Driving the Spindle**

There are four primary ways to move the spindle electronically:

- **DIVISION MODE** - you can enter a number of equal divisions in which to divide one rotation of the spindle. For example, if you enter “4,” the spindle will move in 90 degree increments (360° / 4 = 90°). A typical application of this mode would be gear cutting and hole patterns. Gears produced with the Sherline Indexer will run smoothly as long as the proper single tooth hob is used.

- **DEGREES MODE** - you can specify the exact number of degrees to move the spindle. For example, if you enter “132.130,” the spindle will rotate 132.130 degrees.

- **JOG MODE** - you can move the spindle clockwise or counter-clockwise with the keypad on the controller by pressing the #1 or #3 button on the keypad.

- **PROGRAM MODE** - you can program movements. For example, you can have the spindle move 90°, then 132°, then reverse rotation 20°, etc. You can increase the accuracy of moves which reverse the direction of the spindle by using the backlash compensation feature. You can enter up to 40 blocks in each of two separate programs. A block of information contains the speed of rotation (feed rate in degrees per second) for each block, and whether the spindle is to pause and wait after a block is taken or move continuously. A block of information contains: 1) Speed of rotation in degrees/sec, 2) Direction of rotation (clockwise or counter-clockwise), 3) How many degrees it will rotate and 4) whether it will pause or continue to the next block.

**Remember to:**

- Place a couple drops of Air Tool Oil in the air inlet prior to connecting the airline.
- Thread in a collet as described above (use anti-seize lubricant on threads).
- Place a part or piece of stock in the collet.
- Using the pneumatic clamp knob, clamp and unclamp the part.
• Make sure that the Locking Lever is in the unlock position.
• With the controller power OFF, turn the 1/10 degree knob several turns in each direction. This will ensure that the locking lever is unlocked and that all of the internal parts are moving freely.

Initial Test
1. While pressing and holding [9] on the keypad, turn the controller on. This will restore factory defaults.
2. Choose “Division” mode. Input “008.” Index 360 degrees using the [NXT] button.
5. Now choose “Division” Mode. Input “000.” Press [Enter] and the indexer will rotate continuously until you press the [Stop/Jog] button. Let it run for a few minutes. Then press the [Stop/Jog] button to stop the rotation.

The Sherline Controller
Even though the computer is a small 8 bit device, it is very complex. It computes and drives the stepper motor in micro steps. Like all electronic devices, the easier it is to operate, the harder it is to design and program. We believe the instructions are easy to read and shouldn’t give you any problems, but if they do, please notify us at Sherline, and we will attempt to improve them. We want our instructions to be the best in the business. The most important rule is to always work safely and accurately.

Power of the Motor
The stepper motor is rated at 198 ozf.in (1400 mNm) of holding torque, with the highest torque being achieved at low RPM. The maximum speed of 41°/sec provides high speed with less torque. To use that setting for positioning, the system must be completely free from drag. Remember that a heavy piece of stock as in a long bar should be considered...
drag. We’ll leave the supporting long pieces of stock up to you. A 5C collet was never designed for such loads.

We recommend considering these factors when setting the maximum positioning speed to avoid stalling the stepper motor and losing steps. If this happens, the controller will stop the operation and signal an error, and you’ll have to manually position the work at zero and restart the computer. (More about this later.) When cutting at a programmed speed, take advantage of the motor’s power by programming slower cutting feeds when necessary. The larger the diameter, the greater the cutting forces.

**Positioning Accuracy**

The first thing to understand about the 5C Indexer is the accuracy that can be obtained in real terms. The first thing to understand about the 5C Indexer is the accuracy that can be obtained in real terms. A full revolution with a 1.8° stepper motor is made up of 200 full steps and 200 half steps. Both full and half steps are quite precise. The Sherline driver for these motors incorporates a feature called micro stepping. This is a method of improving the accuracy by energizing both coils to each magnet. By varying the amount of current to each coil it will offset the rotational position slightly but with less torque. I believe its real benefit is smoothing out a stepper motor’s operation. It is also the recommended method of driving stepper motors today.

The motor driver circuitry also incorporates an encoder that checks each individual move to prove it is within tolerance. If it’s not, an error message will be displayed and you’ll have to correct the problem and start over from the beginning. A problem like this may occur because a crash or a heavy cut made on a large diameter. In normal use it will not happen.

**Mechanical Accuracy**

The gear that turns electronic signals into a real movement has been hobbed directly on to the spindle. This process eliminates any error associated with cutting each tooth individually or the tolerance buildup created when a separate gear is added to the spindle. As anyone associated with the machine trades realizes, “nothing is perfect.” This is also the case for this product; however, I seriously doubt that anyone buys the indexer could measure the mechanical indexing error of the worm and gear. The electronic system has no error in its calculations, but it does round off as explained later in “the degrees mode” section below.

The main source of mechanical accuracy is backlash between the worm and the worm gear. This can be easily adjusted, but you need a slight amount of clearance for lubrication and minimum wear. We set the clearance at the factory at 0.2°. After it has been run for several hours it may be reduced in some cases. See the section on “Proper maintenance and care of your 5C Indexer.”

**Operating Instructions for using the Controller**

From this point on you don’t need to memorize all the instructions before trying to operate the CNC indexer. The best way to learn how to use it is mount it vertically in a vise mounted on a milling machine and connect the controller to the indexer. Keep reading and try one feature at a time to see how the indexer works. It’s quite simple to operate even though we’ve included lengthy instructions.

Clamp the controller to the table. Connect the 5C Indexer by inserting the cannon plug into its outlet which is located on the back side of the connection box. Once the cannon plug is inserted lock it in place using the threaded locking collar. Now it’s safe to add power.

The power supply must be plugged into an 110V AC outlet. The power jack is located on the lower front side of the connection box that is mounted under the controller. It is a bayonet style plug with a “half-turn” locking collar. The controller is turned on using the toggle switch located on the right-hand side of the connection box.

**Notes:**

1. We recommend that you plug in the power and the motor cable after you have secured the indexer in its working position. The 24VDC supply is light duty and should be located where it will be free from stray hot chips.
2. Make sure that the motor cable is not in a position where it can be pinched once your machine starts to move if you have it mounted to a CNC machine. It’s now safe to turn the power on. There is no need to use the pneumatic collet closer at this time so don’t attach the air supply yet.

**The “Jog” Keys**

The Jog feature allows you to quickly move the spindle in clockwise and counter-clockwise directions using the keypad. To rotate the spindle using the Jog feature, first press the [STOP/Jog] key.

In Jog Mode the motor is not powered. This means you can turn the “manual 1/10° knob” by hand for fine positioning. You can also hold down the [1] or [3] keys for rapid, motorized motion. The “rapid” feed rate is controlled by the “fast setting” entered in the Settings mode. Holding the [1] key will move the spindle clockwise, [3] will move it counter-clockwise. The [7] and [9] keys will move the spindle in a similar manner, only in this case the feed rate will be controlled by the “slow” setting. (See the "Settings Mode" section on page 12 for how to set these speeds.) For setting up you can also make very fine, slow movements. [NXT] will move the spindle counter-clockwise, [PRV] will move it clockwise.

When you are finished Jogging, press the [MODE] key to deactivate the Jog function and enter another mode.

**NOTE:** In addition to using it in the Jog function, you can also press the [STOP/Jog] key at any time the spindle is moving, and it will serve as a PANIC STOP, immediately stopping the spindle in place. In any mode other than the Jog function if the spindle is in motion and you want to stop it immediately, simply press the [STOP/Jog] key. Doing so leaves the spindle in the JOG mode, so it will need to be reset to your previous mode before continuing.

**The Mode Settings**

The basic operation of the controller is to press the [MODE] key to advance from one mode of operation to the next.
This will cycle through the various modes of operation. When the mode you wish to use is displayed, press the [ENTER] key to start that mode and enter the parameters of operation. The four modes are:

- Division
- Degrees
- Program
- Settings

**“Division” Mode**

The Division Mode allows you to specify a fixed number of divisions per rotation of the 5C Indexer. For example, you might specify “4” divisions. Then, each time you press [NXT] the spindle will advance 90 degrees. The calculations are made for each individual index eliminating rounding error buildup. Even prime numbers will divide within the described tolerances.

When you first turn on the controller, it will display “Sherline 5C Indexer.” Press the [MODE] key once to advance to the first mode. The LCD (liquid crystal display) screen will display:

**Division Mode**
Press Enter

The LCD screen will then display:

**Divisions: 000**
Enter a number

You should now enter the number of divisions into which you wish to divide the rotation. When you press a number key, that number will appear on the LCD screen where the cursor is blinking. To move the cursor left, press the [PRV] (Previous) key. To move the cursor right, press the [NXT] (Next) key or type any digit. You can enter any value between zero and 999 divisions. (Zero is a special case. It will cause the spindle to run continuously until you stop it by pressing [JOG]).

When entering the number of divisions you must enter all three digits. For example if you want 30 divisions you must enter “030.” After you press the [ENTER] key, the LCD screen will display:

**Division # 1**
Press [NXT]

This means that the spindle is at position one (of 30), and it is waiting for you to press the [NXT] or [PRV] keys. If you press [NXT], the spindle will advance 12 degrees clockwise, and the LCD screen will display:

**Division # 2**
Press Nxt, Prv

If you had pressed the [PRV] key, the spindle would move 12 degrees counter-clockwise, and the LCD screen would display:

**Division # 30**
Press Nxt, Prv

It displays “Division # 30” because it turned counterclockwise one position, from one to 30.

There is a special function available in the Division Mode. After you have set the controller up to move with the [NXT] and [PRV] keys, you can press the [MINUS] key. This will cause the spindle to move one division with a one-second delay between movements. It will continue making the programmed movement with one-second delay between movements until you stop it with the [STOP] (JOG) key. (If the [STOP] key is hit between movements while the spindle is not rotating, it must be held down longer than one second to stop the movement.) This might be used for marking or lasering parts.

**PANIC STOP**—Any time the spindle is moving you can stop it immediately by hitting the red Emergency Stop switch. This will stop all motion and shut down power. You will lose your place in the program you were running and will have to start over. If you use the [STOP] key on the controller you’ll have to hold the key down until you’re sure the program has stopped. A momentary “blip” will not always shut the program down.

To exit the Division Mode, press the [MODE] key.

**The “Degrees” Mode**

The Degrees Mode allows you to specify the exact number of degrees the spindle will rotate every time you tell it to advance. Keep in mind that the resolution of the spindle is .0125 degrees. This means, for example, that it cannot move to a position like “0.010” degrees which is not an even multiple of “0.0125.” However, the spindle keeps track of exactly where it’s supposed to be and where it is actually able to go, and always gets as close to the correct location as possible (within .006 degrees). Note: The smallest single degree move that you can input is “.015.” This is by default.

When the LCD screen displays “Division Mode” you can press the [MODE] key once to advance to the Degrees Mode. The LCD screen will display:

**Degrees Mode**
Press Enter

The LCD screen will then display:

**Degrees: 000.000**
Enter a number

You can now enter the number of degrees you wish to travel at each movement. When you press a number key, that number will appear on the LCD screen where the cursor is blinking. To move the cursor left, press the [PRV] (Previous) key. To move the cursor right, press the [NXT] (Next) key or type any digit.

When entering the number of degrees you must enter all three digits. For example if you want 30 degrees you must enter “030.” After you press the [ENTER] key, the LCD screen will display:

**Division # 1**
Press [NXT]

This means that the spindle is at position one (of 30), and it is waiting for you to press the [NXT] or [PRV] keys. If you press [NXT], the spindle will advance 12 degrees clockwise, and the LCD screen will display:

**Division # 2**
Press Nxt, Prv

If you had pressed the [PRV] key, the spindle would move 12 degrees counter-clockwise, and the LCD screen would display:

**Division # 30**
Press Nxt, Prv

You can also specify whether the spindle is to move clockwise or counter-clockwise when you enter the number of degrees to move. The spindle default direction is counterclockwise. To enter a clockwise value, press the [MINUS] key. This will add a minus sign before the degree amount, indicating reverse travel. If the degree sign is negative, the
[NXT] key will move the spindle clockwise and [PRV] will move counter-clockwise. To make a negative value positive again, press the [MINUS] key again.

(Note that it is also possible to change the default direction of travel from clockwise to counter-clockwise. See the Settings mode for details.)

You can also tell the controller to move zero degrees. This is a special case. It will cause the spindle to run continuously until you stop it with the [STOP] key. See the section below labeled “Continuous Rotation” for an explanation of this action.

When the number you want is displayed, press [ENTER]. For example, suppose you typed “020.000” for the number of degrees. After you hit [ENTER], the LCD screen will display:

020.000 000.000
Press Nxt, Prv

The first number is the movement size you selected (20.000 degrees). The second number is the current position (000.000 degrees). The controller is waiting for you to press the [NXT] or [PRV] keys. If you press [NXT], the spindle will advance 20 degrees clockwise, and the LCD screen will display:

020.000 020.000
Press Nxt, Prv

The current position is now shown to be 20 degrees. If you press [NXT] again, the screen will show:

020.000 040.000
Press Nxt, Prv

The current position is now shown to be 040.000 degrees.

If you had pressed the [PRV] key the first time, the spindle would move 20 degrees counter-clockwise, and the LCD screen would display:

020.000 340.000
Press Nxt, Prv

The current movement is shown to be 20.000 degrees and the current position is 340 degrees (360 degrees minus 20 degrees).

Panic Stop—Any time the spindle is moving you can stop it by using the Red Emergency Stop button or immediately by hitting the [STOP] (Jog) key on the control pad. This will stop all motion and put you into the JOG mode. You will lose your place in the program you were running and will have to start over.

To exit from the Degrees Mode, press the [MODE] key.

The “Program” Mode
The Program Mode allows you to prepare a list of many movements to take one after another. For each block you will enter four parameters:

1) The number of degrees to move,
2) The direction of travel (clockwise or counter-clockwise),
3) The feed rate for that move, and
4) Whether or not the spindle should wait for you to hit the [NXT] key after each block of information is completed.

The program you enter will be remembered indefinitely (unless you change it), even if you turn the controller off. There is room for two separate programs of 40 blocks each.

Before you enter your program blocks, you’ll want to plan them carefully to be sure they’re correct before typing them all in. Write them down on paper and check for errors. (A form that you can copy is provided as the last page of these instructions.)

The Program Mode comes after the Degrees Mode. Press the [MODE] key until the screen displays:

Program Mode
Press Enter

When you press “Enter,” the screen will display:

Which program?
Press 1 or 2...

You can now select which program you will use. Use the keypad to select program number [1] or [2], and the screen will display something similar to:

Program 1
Run=NXT Edit=PRV

This indicates which program you’ve selected. Press the [NXT] key to run the program that was stored previously. Press the [PRV] key to enter a new program, or edit the existing program.

Entering a new Program
If you press the [PRV] key, the LCD screen will show you the degree setting for the first program block and allow you to change it. For example, the screen might show something similar to this:

Block 1:1
Degrees: 090.000

The “1:1” means you’re working on program one, block number one. The first movement in this example will move the spindle 90 degrees clockwise. To change this amount, type the number keys. You can press [NXT] to move the cursor to the right or [PRV] to move the cursor to the left.

You can indicate whether you want the spindle to move clockwise or counter-clockwise. To enter a counter-clockwise direction, press the [MINUS] key. This will place a minus sign before the degree amount, indicating reverse travel. If you press the [MINUS] key again, the minus sign will be removed and the direction will be clockwise.
When the screen shows the movement you wish, press the [ENTER] key to enter (and store) your selection. The screen will then display something similar to this:

**Block 1:1**
**Feed rate: 15**

This means that the feed rate for this programmed block is 15 degrees per second. The number you enter will be the fastest rate the spindle will reach during a move. The SLOW rate (the rate it starts at each time) depends on what you entered for SLOW in the Settings Mode. You can change the feed rate to anything between 1 and 41 degrees per second.

When the screen shows the feed rate you wish to use, press [ENTER] again. The LCD screen will then display something similar to:

**Block 1:1**
**No Pause**

You can tell the controller to pause after each block or continue to the next block. If you tell it to pause, you must hit the [NXT] key during program execution before it will advance. You would use this feature to drill a hole for example. To set the current program block to pause, press the [7] key (marked “slow”). To set the current program block to NOT pause, press the [9] key (marked “fast”). I really can’t anticipate a reason to use this feature other than changing feed rates.

After setting the PAUSE parameter the way you want it, hit the [ENTER] key. The LCD screen will then display something similar to:

**Block 1:2**
**Degrees: 000.000**

This indicates that you’re ready to program the movement for block number 2 in the first program. You can now define the block size, feed rate, and pause status just like you did for the first block.

When you’ve entered the entire program blocks you wish, terminate the program by entering a movement of “000.000” and a pause or no pause. This tells the controller to stop asking for new input and prepares to run the program you’ve just entered.

**Insert and Delete**

When entering a program you may make a mistake, or you may wish to modify a program after it has been entered. You can INSERT and DELETE program blocks to correct or modify an existing program. To access the INSERT and DELETE functions, press the [MODE] key while the controller is waiting for you to enter the number of degrees for any program movement. (You can’t use INSERT or DELETE after entering the degree size.) The LCD screen will then display something similar to:

**Block 1:5**
**Insert?**

You can now insert a new movement at this point in the program by hitting the [ENTER] key. The LCD screen will display something similar to:

**Block 1:5**
**Wait...**

After a few seconds the word “Wait...” will go away and you will be able to enter a movement for the new, inserted position.

If you do not INSERT a program block but rather press the [MODE] key a second time, the controller will display:

**Block 1:5**
**Delete?**

You can now delete the current program block by hitting the [ENTER] key. The LCD screen will display something similar to:

**Block 1:5**
**Wait...**

After a few seconds the word “Wait...” will go away and the previous settings for that program block will have been removed and replaced by the settings for the next program block.

If you do not INSERT or DELETE a program block, but rather press the [MODE] key a third time the controller will display:

**Block 1:5**
**Exit?**

You can now terminate the programming session entirely by pressing the [ENTER] key. Or, if you press the [MODE] key a fourth time, the controller will return to the editing mode.

**The Loop Command**

If you press the [MODE] key at the very start of a new block the display will read

**Block 1:1**
**Begin Loop?**

This means that the instructions entered from this point to the point that an “End Loop” is entered in the same manner will be repeated for as many times as entered after entering the command “End Loop.” The “End Loop” can only be entered after a “Begin Loop” has been entered. It is acceptable to have a “Pause” command entered in the loop program. This would require you to press [NXT] for each stage of the loop; however, keep track of the loops made. (The lower right corner of the display displays how many times the loop has left to cycle.) You could inadvertently start into another set of loops by pressing the [NXT] key one time too many. Remember that the only time you will be offered the loop command choice is when the mode key is pressed before entering a movement number.
The LOOP COMMAND allows you to easily program a series of identical movements.

**Running a Stored Program**

Enter the Program Mode using the [MODE] key and press the [ENTER] key. You now have a choice of program 1 or 2. Enter your choice using the [1] or [2] key. Then press the [NXT] key to run the program. The program will start. While the spindle is in motion, the display will read:

**Moving...**

**Controlling the Program while it is Running using the Stop, Mode and Pause Commands**

The [8] “Pause” key can be entered at anytime a program is running, with or without loops and put the program in a “Pause” mode. The program will stop running after the computer completes the block it was running when the command was entered; however the key must be held down until the program ends its present movement. The program can be restarted with the [NXT] key and will resume running the program from its last completed command.

You can terminate execution at any time by pressing the [MODE] key, which will allow you to go back and enter a new program or start running the same one over again. Again, the key must be held down until the move for that block was completed.

You can press the [STOP] key at any time to abort spindle motion and it will enter you into the Jog Mode. Remember that you will lose your place and have to manually move to your home position before running your program.

**Restarting the Program**

After all of the steps in the program are completed, the program will stop and wait for you to hit the [NXT] key if you stored a “Pause” at the end. If you stored “No Pause”, the program will start over again immediately.

NOTE: If the controller seems to refuse to run a program, it is probably because the first movement in the program has been defined as “000.000” degrees. If this happens, go to EDIT MODE and check the program if the first block has been edited to zero.

Old programs can be erased by holding down the [9] when the controller is turned off and turning it on. We recommend doing this occasionally so you can start with a “clean slate.” This will also reset factory defaults located in the “SETTINGS” section.

**Continuous Rotation**

You can put the spindle into continuous motion by entering zero for the number of divisions in the Division Mode, or zero for the number of degrees in the Degrees Mode. During continuous motion, the spindle will start moving at the SLOW speed setting, ramp up to the FAST speed setting, and keep turning until you stop it with the [STOP] key. When the spindle goes into Continuous Motion, the LCD screen will display something similar to:

*Hit JOG to stop*

**Feed rate: 40**

The first line serves to remind you how to stop the motion: by hitting the [JOG] key.

The second line shows you what the current setting of the FAST feed rate is. You can now change the speed of rotation with the keypad while the spindle is turning. If you press the [7] key (labeled “Slow”), the feed rate will decrease. If you press the [9] key (labeled “Fast”), the feed rate will increase. In this way, you can find the speed setting that works best for you. As the speed changes, the new rate is assigned to the FAST speed setting and shown on the LCD screen.

As you decrease the FAST feed rate, if the value goes lower than the current setting for the SLOW feed rate, the SLOW setting will also be reduced to the same value. (You can’t have the SLOW setting be faster than the FAST setting.)

The Sherline 5C Indexer Controller is a self-contained microprocessor-based controller that will automate the motion of the Sherline 5C Indexer. Though you can still move the indexer spindle with the small graduated knob when the controller is turned off, it’s a lot easier to take advantage of the jog feature for long moves. The controller is designed to drive it for you in precise, measured steps.

**Start-up Commands**

Note: You can skip over the Start-up and Settings commands if you are reading this for the first time. The factory default settings will work and these settings are only needed for advanced operations.

There are several utility commands that can be issued by holding down certain keys when the controller is first turned on. For example

The three start-up commands are:

- [7] — Show the revision date of the firmware.
- [9] — Erase all program memory locations.
- [MODE] — Erase all program memory locations and initialize all settings to factory defaults.

**The “Settings” Mode**

The next mode after the Program Mode is the Settings Mode. This allows you to enter some parameters of operation for the spindle. These settings are remembered even when you turn the controller off.

• **“Slow” Setting**

When the screen displays:

**Settings Mode**

**Press Enter**

Press the [ENTER] key. The screen will then display something similar to:

**Slow: 10 (default setting)**

**Enter a number**

The number after the word SLOW is the minimum feed rate of the 5C Indexer. This is the speed with which the spindle starts each movement. The units are degrees per second. Whenever the spindle moves, it starts at the SLOW
feed rate and ramps up to the FAST feed rate. It also ramps down to the SLOW rate before stopping.

When the screen shows the value you wish to use for SLOW, press the [ENTER] key. The value will be stored and remembered for all future operations and used with the JOG, DEGREES and DIVISION modes. The highest setting allowed for SLOW is (20).

• “Fast” Setting
The screen will then display something similar to:

Fast: 35 (default setting)
Enter a number

The number after the word FAST is the maximum feed rate of the spindle. This is the maximum speed the spindle reaches in each movement. The units are degrees per second. Whenever the spindle moves, it starts at the SLOW feed rate and ramps up to the FAST setting. If you set the FAST rate the same as the SLOW rate, the rate of motion will be constant during the move. The spindle does not have much power at the fastest settings, so very fast settings should only be used for positioning, not for cutting operations. Experience will teach you what speeds are appropriate for your own work. (The maximum speed that can be entered is 41 degrees/sec.)

When the screen shows the value you wish to use for FAST, press the [ENTER] key. The value will be stored and remembered for all future operations and used with the JOG, DEGREES and DIVISION modes.

• Direction Setting
Defining Direction: When we are stating “clockwise” (cw), or “counter-clockwise” (ccw) rotation of the indexer. It is the direction that the “spindle” will turn when you are looking directly at the collet end of the spindle. I believe you should leave this alone and use a minus input to change directions unless you have a particular reason.

The screen will then display something similar to:

Direction: 1 (default setting)
Press 1 or 3

This parameter allows you to enter the default direction of travel. When the direction is set to (1): The spindle will turn CCW in the division, degree, and program mode. The spindle will turn CW when you are in the Jog mode and you push the number [1] key (marked with a left arrow). When the direction is set to (3): The spindle will turn CW in the division, degree, and program mode. The spindle will turn CCW when you are in the Jog mode and you push the number [3] key (marked with a right arrow), and CCW when you push the [1] key.

• Setting the Electronic Backlash Compensation
The only time this feature would be useful is if you were running a program that switched rotational directions. The physical backlash in the worm gear can be minimized with proper adjustment (See “Maintenance” section later in these instructions); however, it cannot be totally eliminated. The controller supports electronic backlash correction to compensate for whatever actual backlash remains in the worm gear. It works in this way: Every time the spindle makes a motion in the “reverse” direction, it will overshoot the amount of travel by the backlash amount, and then move “forward” by the same amount. This takes up any backlash in the worm gear. You can set the backlash correction to any amount you like. If you set it to zero, it will not be used. If you set it to a small amount, it can just exactly take up the backlash in your 5C Indexer. If you set it to a relatively large value, you can see the spindle overshoot and then return to correct position.

The LCD screen will display something similar to:

Backlash: 01 (default setting)
Enter a number

The number represents the number of motor steps to overshoot by.* When you have typed the backlash setting you want, press the [ENTER] key to store it. The controller will then go back to the Division Mode.

*NOTE: 8 steps = 1 division line on the handwheel = 0.1°. We factory set each machine at (16) = 0.2°

You can determine the amount of backlash compensation to use by trial and error and your own preference. To evaluate the current backlash setting, go to the DIVISION mode. Enter something like 50 divisions. Hit the [PRV] key. The spindle will move in the reverse direction and overshoot the distance specified by the backlash amount, then change direction and move forward by the backlash amount. If the backlash setting is small, you won’t notice it. If it is large, it will be easy to see.

Additional Control Switches and Buttons
In addition to the key pad on the controller, there are control buttons and switches on the connection box that is mounted under the controller, on the control stand.

The toggle switch on the right-hand side is your power on/off switch.

The green button on the lower left side is a cycle start button. This button functions the same as the NXT key.

The big red push button on the top left side is an emergency stop button. If you push this button in, it will kill all power to the controller. To regain power to the controller, turn the emergency switch clockwise. The switch will pop out and the controller will turn back on.

How to Align the Handwheel Zero Point with an Energized Stepper Motor

The zero mark and the stepper motor on each 5C Indexer are aligned at the factory. These instructions are in the event that this relationship is lost (knob or stepper motor are moved or replaced). The first thing to understand is that every time you turn the 5C Indexer on, the electrical energizing of the stepper motor will cause the motor to turn slightly. The amount and direction that the motor turns depends on the position of the indexer when it was turned.
off and the relationship of the magnets and the coil in the stepper motor.

What we are going to do is to align the zero mark on the “manual 1/10° knob” with a “full step” position on the stepper motor (where the magnets are fully aligned with the coil). By doing this, you should be able to regain a true zero position (within .006°) every time you turn the power on. To align the zero mark:

• Turn the power on.

• In the “Degrees” Mode, make a move of 10,000°. This will energize the stepper motor and assure you the system is operating correctly.

• With the control still in the Degrees mode, we now want to over-ride the red knob with 1/10° by hand. Turn the knob 2 or 3 “full steps.” For each full step you will feel the stepper motor click into position solidly.

• Loosen the set screw on the 1/10° knob. Turn the knob until the Zero line on the knob lines up with the sight line on the worm housing and re-tighten the set screw.

Note: If the knob moves to the left or right when you tighten the set screw, the screw may be hitting a previous set screw indentation on the worm shaft. If this is the case, you will need to turn the worm shaft to a position where the set screw groove on the worm shaft is clean and free of indentations.

Turn the power off. Rotate the 1/10° knob so the zero line on the knob lines up with the sight line on the worm housing. Now turn the power on again. In the “Degrees” Mode, make a move of 5,000° or 10,000°. This will make the 1/10° knob turn one or two full revolutions. At the end of the move the Zero line on the 1/10° knob should be lined up with the sight line on the worm housing. If you over-ride the 1/10° knob, you will see that the stepper motor will click hard to each 1/10° line on the knob. Now you are set.

End of Instructions

You’ll have to admit that Bryan and I have squeezed about as many features out of an 8 bit microprocessor as possible. We realize that many will never be used for ordinary machining tasks, but we spent a lot of time adding them just in case.

I know I have repeated some information from section to section, as I realize some people don’t always read instructions from front to back. They search for the part that answers their immediate question. So, if my instructions seem somewhat redundant, please forgive me. I could be living on a 60-foot yacht in the South Pacific if I could recover the money in scrapped parts made by employees of mine who cut first and thought later!

Joe Martin
President and owner
Sherline Products Inc.

Electronic Design Credits

The Sherline CNC 5C Indexer controller was designed by Bryan Mumford at Mumford Micro Systems in conjunction with Sherline Products, Inc. Many thanks to John Wettroth for advice and suggestions.

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Care and Maintenance of your 5C CNC Indexer
by Karl Rohlin

1. Water inside the 5C Indexer will cause problems:

A. We strongly suggest that you put a few drops of “air tool oil” into the air fitting on the 5C Indexer before attaching the air line. Then activate the clamp and unclamp. Manually turn the spindle with the 1/10 degree knob to get everything moving and lubricated. Do this every time you use the 5C Indexer.

B. When finished using the 5C Indexer, remove the air line, put a few drops of “air tool oil” into the air fitting and repeat the process above. This will ensure that the inside of the indexer is lubricated before you store it.

2. Shipping Box: We strongly recommend that you keep the box in which the indexer was shipped. This sturdy wooden box is perfectly suited for shipping and storing your indexer. If, in the future, you need to ship your indexer anywhere, this box will help reduce shipping damage.

3. Oiler: There is a ball cap oiler on the back side of the 5C Cover. Add a few squirts of air tool oil or another light weight lubricating oil to the oiler cap every time you use the indexer. This will both lubricate and help prevent internal rust.

Figure 5—Red 1/10° Control knob and black Pneumatic Valve handle. The zero mark can be seen on top of the worm housing above the knurled red knob. In the background the spine locking lever can be seen in front of the 1° dial and 5C spindle.
4. **Inline Oiler**: Make sure the inline oiler supplied with your indexer is installed and used whenever you are using your indexer. This inline oiler is the first step in maintaining your indexer. It will both help prevent internal rust and lubricate internal moving parts.

5. **Drain hole**: If you don’t use water or water based coolants and your air is dry, you will have less chance of problems caused by moisture inside your indexer. However, if you suspect that there may be excessive moisture collecting inside your indexer, there is a drain hole on the back side of the 5C Cover. To inspect, remove the 10-32 set screw from the drain hole. Then set the indexer in the vertical position with the drain hole down. See if any water or oil contaminated with water (cloudy) comes out the drain hole. If your indexer has become contaminated with water, see section below “#10, Water Contamination.”

6. **Transporting the 5C Indexer**: Hold the 5C Indexer firmly by the main body and the spindle whenever you are moving it from one place to another. Do not use the flex cord or air line as a handle. Do not carry the indexer by the stepper motor housing.

7. **How to Adjust Mechanical backlash**: The worm housing is adjustable. This allows you to increase or decrease the amount of clearance between the worm and the worm gear. The factory backlash setting is 0.2° or less (two lines on the manual 1/10° knob). This amount of backlash gives an acceptable amount of clearance for lubrication, causes minimal wear and allows smoothest movement of the spindle. As you use your indexer, the worm and worm gear will wear in slightly. As they wear in, you can adjust the clearance amount by moving the worm housing closer to the worm gear.

   **A. Adjusting the worm housing:**

   1. When assembled at the factory, the worm housing and the 5C Cover have a bead of silicone applied to the mating surfaces as a dust and moisture seal. This silicone seal is soft and will allow some adjustment, but not much. For your initial adjustment, loosen the four 10-32 mounting screws in the worm housing that secure it to the indexer body. With the indexer in the vertical position (the worm housing at the top), push down on the worm housing. While applying pressure to the worm housing, retighten the four 10-32 mounting screws. The slight amount of movement that the soft silicone will allow is often enough to reduce the amount of mechanical backlash. Now lock the spindle using the locking lever. Turn the 1/10° manual knob back and forth to see how much backlash you have.

   Each line is 1/10°, and backlash should be two lines or 2/10° maximum. If you are satisfied with the amount of backlash, manually turn the spindle 360° to check for any tight spots. To do this, take note of which degree mark the 1° Dial is on, then, using the 1/10° knob, turn the spindle through one full revolution. You need to do this manually so you can feel any tight spots. Once you have rotated the spindle one full revolution without any tight spots, you can go to the division mode on the controller and input “000” for divisions. This will make the indexer run continuously until you hit the jog button. Let it run for 5 or 10 minutes, then check the backlash again.

   2. If the adjustment above was not sufficient you will need to remove the silicone sealant from between the worm housing and the 5C cover to achieve more adjustment.

   **B. Removing silicone sealant to achieve more backlash adjustment**: To remove the worm housing, loosen the four 10-32 worm housing mounting screws. Then apply pressure to the bottom of the worm housing with both of your thumbs to break it loose. (Applying alternating pressure rocking it from side to side may help.) Once the worm housing has been removed, use a hobby knife or razor blade to remove the silicone that remains stuck to the mating surfaces.

   Note: While the worm housing is off you may want to brush a thin coat of “Super Lube®” synthetic grease onto the teeth of the spindle gear. This is easily done with an acid brush or your finger while you turn the spindle by hand. You can buy a 3 oz. tube of this grease from Sherline Products. This is the same grease used during factory assembly of the indexer.
C. Apply a small bead of fresh silicone to both mating sides of the worm housing. Align the two worm housing mounting clamps with the two 3/8" holes in the indexer body. Slowly wiggle the worm housing into place. (This will be a tight fit, so take your time.) As you are assembling the worm housing, you will need to turn the 1/10° knob slightly left and right to allow the worm to align with the gear teeth and fall into place.

D. Once the worm housing is in place, adjust it so it is sitting square to the top of the indexer body. Look at the relationship between the two mounting clamps and the top of the indexer body. If the worm housing is sitting square, then both of the mounting clamps should be below the top surface of the indexer by the same amount. Gently push up and down on either side of the worm housing to square it.

E. Now comes the important part—how much pressure to exert on the worm housing in order to minimize backlash without causing too much friction between the worm and the gear teeth. It takes very little pressure on the worm housing to accomplish this. Place the indexer on a table in the vertical position with the spindle nose facing away from you. Lean the indexer forward so it is resting on both the bottom of the indexer and the spindle nose. Place your thumb inside the back side of the spindle and your forefinger on top of the worm housing. Gently pinch the worm housing between your thumb and forefinger. While pinching the worm housing, tighten the two lower 10-32 mounting screws. The pinching pressure is all you need. If you push down hard on the worm housing from the top, you will create too much force and the worm and gear will bind and lock up. Use the 1/10° knob as explained above and make the spindle rotate one full revolution while checking for tight spots. Then check the amount of backlash as previously described. If there is still more backlash than you desire loosen the two lower 10-32 mounting screws and pinch the worm housing a little tighter. You will never get rid of all the backlash, but you can tighten it up a bit as the worm and gear wear in. Once you are satisfied with the amount of backlash, tighten all four 10-32 mounting screws on the worm housing and run the spindle continuously as explained above. The indexer should run smoothly without any noticeable drop in speed or changes in stepper motor sound from one part of the spindle gear to another. If you notice any slowing in the rotation of the spindle or a sound change in the stepper motor you may need to back off on the worm housing pressure a little.

Note: If you applied new grease to the spindle gear it will take a couple revolutions of the spindle for the worm to squeeze out the excess grease. The excess grease will initially slow down the spindle rotation until it is properly distributed.

8. **Spindle removal:** If you have an internal air leak or other problem that requires the removal of the spindle you will need to send your indexer back to our factory. Loctite * is used in the assembly process. Without the proper tools and fixtures to remove the spindle, you can cause extensive damage to the indexer. To set up an RMA (Return Authorization) for your indexer call Sherline Products at (800)-541-0735. Please ship your indexer back to the factory carefully packed in the wooden shipping box it came in.

9. **Position Error:** There are a few reasons that the control might give you a position error. The most common is stalling the spindle. The spindle can be stalled by either leaving the locking lever on while attempting to rotate the spindle, or trying to take too large of a cut while the spindle is rotating. To fix this, take a lighter cut or slow down the feed rate.

The next most common reason for the position error is a communication loss between the encoder and the controller. This can be caused by a broken encoder wire, which is why we ask that you don’t use the power cable to carry the indexer. It could also be caused by an electrical power drop or spike. In this case we recommend that you go to the division or degree mode on the controller and make the indexer move to several positions in the course of one full revolution. See if you get another “position error” while the indexer is moving without any load. If so, call for technical support at Sherline Products.

10. **Water Contamination:** There are three areas in the indexer where water contamination can occur: 1) The clamping side of the 5C collet piston, 2) The unclamping side of the 5C collet piston or 3) The worm and gear area of the 5 indexer.

   A. If you suspect water contamination in either of the first two areas, remove the air line from the indexer. Add a few drops of air tool oil to the air line fitting. Reconnect the air line. Activate and deactivate the clamp several times. Repeat this process of adding oil and activating/deactivating the clamp a few times or until you begin to get “oil mist” coming out of the air release hole. (The release hole is located at the top front of the body, directly above the serial number.)

   B. To check for water contamination in the third area, remove the “drain screw” as described in the paragraph “#4 Drain Hole” above.

   C. If you have excessive water contamination that has led to internal rusting, your indexer will need to be disassembled, cleaned, and repaired by the factory if possible. To set up an RMA for your indexer call Sherline Products at (800)-541-0735, M-F, 8-5 (Pacific). Please ship your indexer back to us in the wooden box that it came in.
## Part Number List

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>20970 (4 Req.)</td>
<td>8-32 x ½&quot; SHCS (Stepper motor to stepper motor mount)</td>
</tr>
<tr>
<td>40520 (4 Req.)</td>
<td>10-32 SH Set Screw</td>
</tr>
<tr>
<td>40530</td>
<td>5-40 x 3/8&quot; SHCS</td>
</tr>
<tr>
<td>87041</td>
<td>Keypad control power supply</td>
</tr>
<tr>
<td>88100</td>
<td>5C Control valve</td>
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<tr>
<td>88101 (3 Req.)</td>
<td>-008 0.312&quot; OD x 1/16&quot; O-Ring</td>
</tr>
<tr>
<td>88105</td>
<td>5C indexer body</td>
</tr>
<tr>
<td>88107</td>
<td>Spring, 5/16&quot; OD x .035&quot; wire dia. x 1.5&quot; long compression spring, closed end</td>
</tr>
<tr>
<td>88109</td>
<td>Spindle bearing</td>
</tr>
<tr>
<td>88110</td>
<td>Washer, .130 ID</td>
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<tr>
<td>88111 (2 Req.)</td>
<td>-038 2.750&quot; OD 1/16&quot; O-Ring for 88115</td>
</tr>
<tr>
<td>88112</td>
<td>Spindle thrust bearing washer (Timken Torrington)</td>
</tr>
<tr>
<td>88113</td>
<td>Spindle thrust bearing (Timken Torrington needle bearing)</td>
</tr>
<tr>
<td>88115</td>
<td>Washer—.221&quot; ID</td>
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<tr>
<td>(88115L)</td>
<td>(Alternate washer—.221 ID x .170&quot; thk)</td>
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<tr>
<td>88116</td>
<td>Teflon Bearing</td>
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<tr>
<td>88117</td>
<td>Valve control knob</td>
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<td>88120</td>
<td>Locking lever handle</td>
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<tr>
<td>88121 (2 Req.)</td>
<td>-035 O-Ring</td>
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<tr>
<td>88122</td>
<td>Locking lever shoe</td>
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<tr>
<td>88123</td>
<td>Locking lever washer</td>
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<tr>
<td>88125</td>
<td>5C spindle</td>
</tr>
<tr>
<td>88127</td>
<td>198 ozf in NEMA 23 Stepper Motor w/ encoder</td>
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<tr>
<td>88130</td>
<td>Spindle preload nut</td>
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<tr>
<td>88135</td>
<td>Collet piston</td>
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<tr>
<td>88136</td>
<td>-222 1.75&quot; OD 1/8&quot; O-Ring</td>
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<tr>
<td>88137</td>
<td>-224 2.0 O.D. x 1/8&quot; O-Ring</td>
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<tr>
<td>88138</td>
<td>-239 3.875&quot; OD 1/8&quot; O-Ring</td>
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<tr>
<td>88140</td>
<td>Worm gear cover</td>
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<tr>
<td>88140D</td>
<td>Tapered insert (Glued in to P/N 44140)</td>
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<tr>
<td>88141 (7 Req.)</td>
<td>8-32 x 1.5&quot; SHCS (Worm gear cover to body)</td>
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<tr>
<td>88142</td>
<td>-155 4&quot; ID x 4-3/16&quot; OD O-Ring</td>
</tr>
<tr>
<td>88143</td>
<td>.074-.084&quot; wide x .016&quot; thick x 16.50&quot; long flat spring steel</td>
</tr>
<tr>
<td>88150</td>
<td>Dial collet</td>
</tr>
<tr>
<td>88155</td>
<td>5C Dial</td>
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<tr>
<td>88165</td>
<td>Worm Housing</td>
</tr>
<tr>
<td>88171</td>
<td>5C stepper motor cap nut</td>
</tr>
<tr>
<td>88172</td>
<td>5C stepper motor cap</td>
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<tr>
<td>88176 (4 Req.)</td>
<td>8-32x3/8&quot;SHCS (Stepper motor mount to worm housing)</td>
</tr>
<tr>
<td>88177</td>
<td>5C stepper motor mount</td>
</tr>
<tr>
<td>88178</td>
<td>5C stepper motor housing</td>
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<tr>
<td>88179</td>
<td>-041 3&quot; x 3-1/8&quot; x 1/16&quot; O-ring</td>
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<tr>
<td>88180</td>
<td>Motor to worm coupling</td>
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<tr>
<td>88181</td>
<td>5C motor sleeve coupling</td>
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<tr>
<td>88182</td>
<td>5C stepper motor housing extension</td>
</tr>
<tr>
<td>88183</td>
<td>35mm Bearing (Motor to worm cplng.)</td>
</tr>
<tr>
<td>88185</td>
<td>5C worm</td>
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<tr>
<td>88186</td>
<td>Worm backlash nut</td>
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<tr>
<td>88187</td>
<td>3/8&quot; flange bearing</td>
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<tr>
<td>88190</td>
<td>1/10 worm dial</td>
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<tr>
<td>88191</td>
<td>10-32 x ½&quot; locking SHCS</td>
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<tr>
<td>88195 (2 Req.)</td>
<td>Worm housing clamps</td>
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<tr>
<td>88196 (4 Req.)</td>
<td>10-32 x 1-3/8&quot; SHCS</td>
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<tr>
<td>88200</td>
<td>Stepper motor cable assembly with wiring and plugs</td>
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<tr>
<td>88201</td>
<td>90° street elbow, 1/8-27 x 1/8-27, MSC Part # 83295766</td>
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<tr>
<td>88203</td>
<td>1/8&quot; pipe thread plug, brass, slotted</td>
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<tr>
<td>88207</td>
<td>In-line oiler (not shown in exp. view)</td>
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<tr>
<td>88210</td>
<td>5C Collet wrench (not shown, exp. view)</td>
</tr>
<tr>
<td>88300</td>
<td>Electronic keypad assembly w/ stand, wiring box, buttons and switches</td>
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</tbody>
</table>

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Figure 8—Long, heavy stock extending from the 5C collet should be supported by a rest. The collet itself was not designed to support loads of this type.
(Make multiple copies of this page and use them for future program records)

**Program Sheet**

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