





X9TM

TECHNICAL MANUAL

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OUR MISSION

Pro-Cut International is dedicated to providing our customers with the most advanced, precise, and profitable tools for brake repair. We have worked with, learned from and solved problems for people at all levels of the brake repair business - from the largest auto manufacturers and national service chains to one-bay, one-man operations. It is a business our entire staff lives, eats, and breathes. We welcome you to our table and look forward to working with you to improve your brake service business.

Limited Warranty

This warranty extends to the original owner of the the equipment. Pro-Cut International warrants this equipment against defects in materials or workmanship as follows.

Labor

For the period of two (2) years from the original date of purchase, if we determine that the equipment is defective subject to the limitations of this warranty, we will replace it at no charge for labor. Pro-Cut International warrants any such work done against defects in materials or workmanship for the remaining portion of the original warranty period.

Parts

For the period of two (2) years from the original date of purchase, we will supply, at no charge, new or rebuilt replacement parts in exchange for parts we determine are defective subject to the limitations of this warranty. Pro-Cut International warrants any such replacement parts against defects in materials or workmanship for the remaining portion of the original warranty period.

What Your Warranty Does Not Cover

This warranty does not apply to damage due directly to misuse, abuse, negligence or lack of maintenance.

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IMPORTANT SAFETY INSTRUCTIONS

The X9 Rotor Matching System is a precision instrument which requires close attention while in operation. It will provide many years of service if it is operated safely. Basic Safety precautions should always be followed, including the following:

1. Read all instructions
2. Care must be taken as burns can occur from touching hot parts.
3. Do not operate equipment with a damaged cord or if the equipment has been dropped or damaged - until it has been examined by a qualified service person.
4. Do not let a cord hang over the edge of the table, bench, counter or come in contact with hot manifolds or moving fan blades.
5. If an extension cord is necessary, a cord with a current rating equal to or more than that of the equipment should be used. Cords rated for less current than the equipment may overheat. Care should be taken to arrange the cord so that it will not be tripped over or pulled
6. Always unplug equipment from electrical outlets when not in use. Never use the cord to pull the plug from the outlet. Grasp the plug and pull to disconnect.
7. Let equipment cool completely before putting away. Loop cord loosely around equipment when storing.
8. To reduce the risk of fire, do not operate equipment in the vicinity of open containers of flammable liquids (gasoline).
9. Adequate ventilation should be provided when working on operating internal combustion engines.
10. Keep hair, loose clothing, fingers, and all parts of the body away from moving parts.
11. To reduce the risk of electric shock, do not use on wet surfaces or expose to rain.
12. Use only as described in this manual. Use only manufacturer's recommended attachments.
13. **ALWAYS WEAR SAFETY GLASSES.** Everyday eyeglasses only have impact resistant lenses. *THEY ARE NOT SAFETY GLASSES.*

SAVE THESE INSTRUCTIONS

INTRODUCTION

WELCOME TO THE PRO-CUT TEAM.

Congratulations on your purchase of the **PFM X9**, the world's fastest and most accurate computerized on-car brake lathe.

For many years, on-car lathes were used only for rotors that were difficult to remove. Due to current trends, virtually all auto manufacturers now require or recommend the use of on-car technology to match every rotor to every hub. By matching a rotor to the hub, the chance of a vehicle returning for a lateral run-out induced brake pedal pulsation is virtually eliminated. There is simply no better way to refinish and match a rotor than with the patented X9 ROTOR MATCHING SYSTEM.

The following pages are designed to guide you through set-up, operation, and maintenance of your lathe.

If you have any questions along the way, please call us. Our technical support team is standing by from 8 a.m. to 5 p.m. Eastern time. Or browse our website for technical information and tips: www.procutusa.com.

YOUR LATHE PACKAGE

Every Pro-Cut PFM X9 Lathe Package comes complete, ready to assemble and use. Setup and on-site training is included by a local, certified Pro-Cut Rep. Please contact Pro-Cut at 800-543-6618 immediately if you have not already made arrangements for on-site training. In order for your shop to appreciate the benefits of this machine as soon as possible after the lathe is installed, it is **CRITICAL** that technicians take the on-line training **PRIOR** to the Pro-Cut Rep arriving to set up the lathe.

TrainSMART is Pro-Cut's nationwide training and certification program in rotor matching. The two-part program begins with an online class where the basics of rotor matching and lathe use are covered, and is a prerequisite Level 2. Techs will take an online quiz and print a certificate to be signed later by the trainer after part 2 is completed successfully. The second part of the program is a hands-on training class offered by an expert Pro-Cut representative or college instructor.



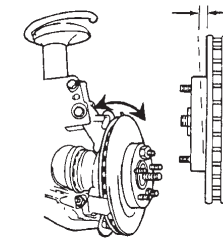
LATERAL Run-out leads to ... THICKNESS VARIATION which results in ... BRAKE PEDAL PULSATION.

Brake pedal pulsation is most often the result of thickness variation in the brake rotor. Thickness variation is the technical term for a rotor that is not uniformly thick. New rotors are uniformly thick, and stop the vehicle smoothly. But thickness variation can develop over time and eventually lead to brake pedal pulsation.

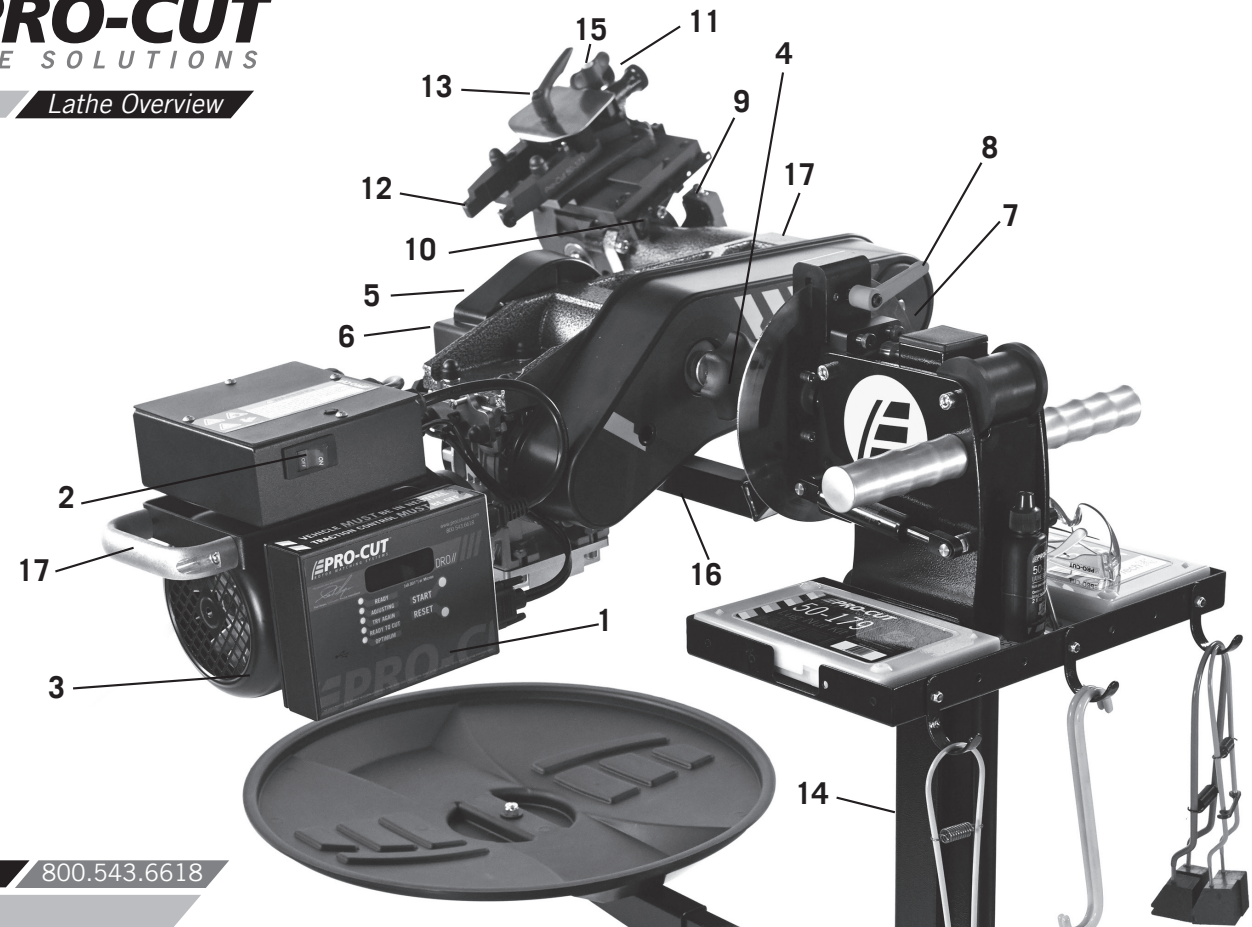
How does thickness variation develop? Through lateral run-out in the face of the rotor. Lateral run-out is the technical term for “wobble”, and is a measurement of how much the surface of the disc wobbles from side to side as it rotates .

A rotor with lateral run-out will not wear evenly, and uneven wear increases over time. As the vehicle moves down the road with the brakes relaxed, the rotor will brush each pad once per revolution, resulting in a thin spot on the rotor.

Since vehicle hubs often have lateral run-out due to stacked component tolerances, a new or newly bench machined rotor will often exhibit excessive lateral run-out as it turns on the hub. Most manufacturers require rotor run-out to be below 0.002”. The X9 Rotor Matching System allows you to match every rotor to the hub on which it turns. The on-board PFM computer compensation system delivers a precise alignment between the lathe axis and the hub axis, thereby guaranteeing that a Pro-Cut machined rotor will have less than 0.001” lateral run-out every time.



By match-machining the rotor to the hub assembly on which it resides, lateral run-out will be reduced to below OEM specs every time!



COMPONENTS

- | | | | |
|----|---------------------------------------|-----|--------------------------------|
| 1. | X9 Computer Box | 10. | Automatic Shut-off Cam |
| 2. | On/Off Switch | 11. | Cut Depth Adjustment Dials |
| 3. | 1 hp Motor | 12. | Cutting Tips/Inserts |
| 4. | Draw Bar Knob | 13. | Tool Arm Lock Lever |
| 5. | Adjustment Flange (<i>obscured</i>) | 14. | Trolley |
| 6. | Adjustment Solenoid | 15. | Cutting Head lateral Lock Knob |
| 7. | Feed Engagement Knob | 16. | Lathe Trolley Arm |
| 8. | Disc-Lock Lever | 17. | Lathe Handles |
| 9. | Automatic Shut-off Switch | | |

Before you begin setting up, check contents against the parts diagram enclosed in the lathe package. If you are missing any parts, call Pro-Cut immediately.

ASSEMBLE THE TROLLEY

Open the trolley box and check contents against the parts diagram . If you are missing any parts, call Pro-Cut immediately. Proceed with assembly, following the instructions enclosed in the box.

MOUNT THE LATHE TO THE TROLLEY

Once the trolley is assembled you will need to mount the lathe to the trolley. Locate lathe arm on trolley so that lathe will be in upright horizontal position when it is installed, then lock the disc-lock lever firmly.

1) Remove the lathe body from the shipping pallet and install mounting studs under lathe in two threaded holes that correspond with the lathe trolley arm holes.

2) Find another person to help lift the lathe using the handles on either end, and insert the lathe mounting studs into trolley arm. Secure with two nuts (36-001B) and flat washers (37-108).

Cutting Edge Tip

Assemble the trolley completely then get assistance from another person to mount the lathe on the trolley.

VEHICLE PREPARATION

Before lifting the vehicle, the front wheels should be straight and the parking brake should be off, with the transmission in neutral, and the traction control turned off.

1. Raise the vehicle according to the lift manufacturer's instructions. Raise until the wheel hub is about belt level.
2. Check wheel bearings for damage or excessive play. If this or any other wheel service is required, it should be performed before match-machining the rotors as loose or damaged bearings will keep the lathe from doing the most accurate job possible.
3. Remove the wheels. Remove the brake calipers and suspend them out of the way of moving parts such as half shafts and CV joints using the yellow S-hooks provided (pn 37-034). Be sure to remove all wheels that may turn when the lathe is turned on.
4. Use Pro-Cut part number 37-996 wheel hub cleaning kit, or other suitable wheel hub cleaning tool to remove rust or debris. Clean all material from the mounting area.
5. The rotor on the side of the vehicle that is not to be machined should be marked and removed if it is free on the hub or secured with at least 2 lug nuts. Match marking the rotors to the hub is very important.
6. Use a micrometer to measure rotor thickness and determine how much material may be removed from the rotor by comparing to brake spec guide provided. Visually inspect for deep rust or grooves. This inspection will help determine the depth of the cut.

NOTE: Remember to index mark rotors before removing them so you can be sure they are returned to the same positions on the hub.

It is important to start on the proper side. The Pro-Cut mounts directly to the hub of the vehicle. With the lathe right-side up (FIG:1) the cutting head is to the right of the hub as you face the vehicle wheel well. When machining a rotor, the cutting head is most often positioned where the caliper rides. On a vehicle where the calipers ride in front of the hub, always start on the passenger side. If the caliper rides to the rear of the hub, begin on the driver's side.

When you flip the lathe to machine the opposite side of the vehicle (FIG:2), no inboard / outboard cutting head adjustments are required since they were made in the upright position.

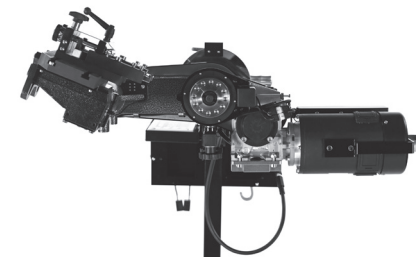


FIG:1 Lathe in upright position. Note that adjustments to cutting head are made in this position.

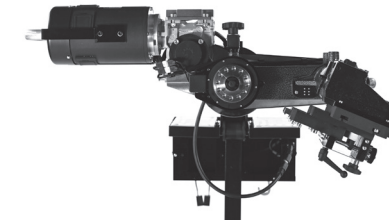


FIG:2 Lathe in upside-down position. You will need to flip the lathe over into this position to machine one side of the vehicle if there is a dust shield, or other interference behind the rotor.

NOTE

The Pro-Cut X9 machines both front and rear rotors. The lathe's operations do not change at all in the rear of the vehicle.

LATHE PREPARATION CHECK CUTTING TIPS

Before mounting the lathe, check the cutting tips and make sure they are ready for use. The cutting tips are one of the most critical components of the machine. It is vital that they are Pro-Cut brand tips in good condition and properly mounted. Each cutting tip has three corners which may be used. The correctly installed tip is wider on the top and has a groove, or dots, facing up. A tip mounted upside down will produce a surface finish that looks like a record.

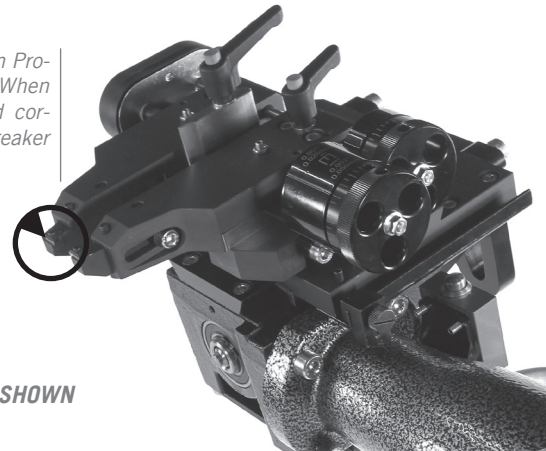
You should get at least 7 cuts per corner. However, tip life is affected by variables such as rust or ridges. In order to determine when to rotate tips, monitor rotor finish. If the rotor finish begins to look inconsistent, or feels rough to the touch, tips should be rotated. Tips that are chipped or cracked should never be used.

Be sure that the tip pocket is clean before positioning the tip. Any foreign material pinched under the tip will cause problems.

NOTE 1: The lathe has a powerful 1 hp motor which requires 20 amp service. All extension cords must be at least 12 gage and less than 25 feet; drop light cords are not recommended.

NOTE 2: Use only Pro-Cut Cutting Tips (50-742 or 50-778). Although other tips may fit the machine, only Pro-Cut tips have been specifically engineered in tandem with the Pro-Cut lathe. Using a non-Pro-Cut tip may compromise lathe performance and result in poor surface finish.

This is the premium Pro-Cut tip (50-778). When the tip is mounted correctly, the chip breaker and dots face up.



*OPTIONAL 50-1250 CUTTING HEAD SHOWN

MACHINING ROTORS

In just 4 steps in about 7-9 minutes, any tech can perform top-quality brake work.

- Step 1:** Mount the Adapter (2 mins.)
- Step 2:** Set up the Lathe (1-2 mins.)
- Step 3:** Adjust for Lateral Run-out (1 mins.)
- Step 4:** Make the Cut (3-4 mins.)

If the four steps are followed properly on each brake job, the Pro-Cut X9 RMS will operate accurately and efficiently.

STEP 1: MOUNT THE ADAPTER (2 Minutes)

The First step is to choose the proper adapter. Most passenger cars require either the four (50-687) or five lug (50-688) Direct Fit® adapter. Some larger passenger cars and smaller trucks use the (50-693) adapter. For most trucks and vans, use the larger adapter (50-681) or the 50-694. See the adapter guide on pages 70-71 of this manual, or use the adapter search on the Pro-Cut website or SuperTech app for more specific information.

Once you've selected the correct size adapter, place it over the studs or threaded holes (European vehicles) in the correct position indicated by the adapter guide. When possible, use the nuts provided with the machine. Tighten nuts with an open box end wrench or a torque wrench in a star pattern. Do not use high torque impact guns to mount adapters. Nuts should be tightened to 25-30 ft. lbs. Excess torque may damage the adapter.

Some vehicles require the use of a spacer (30-791 or 50-246) which are provided in the lathe package. If the adapter doesn't fit flush and square, use the spacer. Sometimes the holes in the spacer are not needed as the entire bolt pattern will fit in the center of the spacer.

WARNING

The adapters are made of case iron, not aluminum or steel like wheels. They are not designed to withstand the use of impact tools. **DO NOT USE IMPACT GUNS TO ATTACH THESE ADAPTERS!** Twenty to thirty ft.-lbs. applied by hand is plenty to secure the adapter to the vehicle. Excess torque applied with an impact wrench will damage the adapters. **Warranty does not cover this misuse.**

STEP 2: SET UP THE LATHE (2 Minutes)



Step 2: Technician mounts the lathe to the adapter

SECURING THE CUTTING HEAD

Vibration is the root cause of most surface finish problems. Be sure the cutting head is securely locked in place. Tight connections here reduce the chance of vibration.

A. Mount the Lathe to the Adapter

Move the cutting head out so that the tips will not strike the rotor as you mount the lathe.

Next, roll the machine into place and match it up with the adapter. Note that the trolley moves up and down to accommodate different heights. The small dowel pin on the face of the adapter will fit into any of holes on the run-out adjustment flange. Turn the draw bar knob to thread into the adapter securely connecting the lathe to the vehicle.

NOTE: It is very important that the machine be mounted smoothly on the adapter without prying or forcing. Take the time to align the machine properly in order to avoid damage to the run-out adjustment flange. The large draw bar knob will spin on very easily when the machine is properly aligned, much like installing an oil filter. Tighten it by hand only.

B. Position the Lathe for Cutting

Loosen the trolley lock lever so that the machine is free to rotate. Rotate the machine so that the cutting head is in a position where there is clearance to make the cut. Be sure to check the back side of the rotor for obstacles. Make sure there will be clearance for the chip deflector as well. **Lock the trolley lever so the machine will not rotate when the motor is started.**

STEP 2: SET UP THE LATHE (2 Minutes) (CONTINUED)

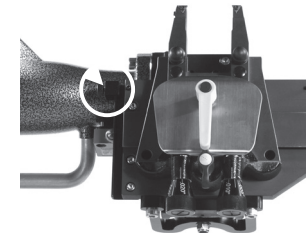
C. Position Cutting Head and Set Shut-off Cam

The Speed-Lock Cutting Head has two lock levers, one closer to the brake rotor (Forward) to release the tool arms, and one farther from the brake rotor (rear) that allows you to lock the cutting head in position once centered over the rotor. The cutting head can slide laterally but is limited by two roll pins; one on either side of the leading edge of the slide plate.

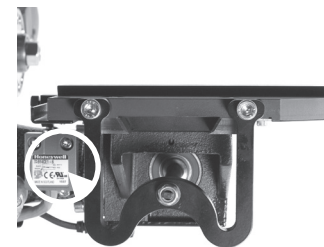
Loosen the forward lever and the rear knob. Slide the cutting head laterally and adjust the tool arm depth knobs (at the rear of the cutting head) so the tool arms are evenly spaced and will clear the rotor. Once centered over the rotor, tighten the rear lock knob to secure the cutting head. If the cutting-head lock knob is not secure, a poor surface finish will result; over-tightening is not required.

NOTE: The Pro-Cut will mount cutting head up on one side and cutting head down on the other. Always start right-side up; this way, when you proceed to the other side of the vehicle, the offset of the cutting head, and the shut-off cam will already be set.

Next you will set the shut-off cam. Crank the feed knob in until the tips clear the outside edge of the rotor. Loosen the cam screw and slide the cam back until it contacts the automatic shut-off switch plunger. Tighten the cam screw. The cam will press the shut-off switch when the tips clear the rotor.



Set the shut-off cam (circled) by loosening the thumbscrew and positioning on the rail so that the cam will depress the stop button when the cutting tips clear the rotor.



Note the Automatic Shut-Off Switch Above. The shut-off cam will depress the stop button when the cutting tips clear the rotor.

MACHINING ROTORS

STEP 3: ADJUST FOR LATERAL Run-out (1 Minute)

You must adjust for lateral run-out to eliminate wobble (run-out) from the machine before cutting. This procedure ensures the resulting machined rotor will have minimal run-out after cutting. The PFM X9 Rotor Matching System has been calibrated to reduce run-out to less than 0.001" [25.4 micron] or less as measured on the rotor face.

COMPENSATE FOR Run-out

The PFM X9 Rotor Matching System compensates for run-out automatically. With the machine mounted securely to the adapter and all potential interfering items clear of the rotating assemblies, press the motor on switch. With the machine running smoothly, wait approximately 8 seconds, then press and hold the start button on the DRO computer board for 2 seconds. The lateral movement of the lathe as measured at a 12" / 305mm diameter (6" / 152mm from the center of hub) will be displayed on the Digital Read Out (DRO) screen. A clicking sound will be heard throughout the adjustment process, which is the adjustment solenoid changing the angle (at the adjustment flange face) until run-out is reduced to within vehicle specification or less.

This procedure will usually take between 10 to 45 seconds. Total adjustment time depends on a number of factors including initial run-out and the resistance in the hub. Average adjustment time is less than 30 seconds, but may take up to 120 seconds depending on vehicle set-up. When the machine is done adjusting, green lights and a displayed lateral run-out value on the digital display will give feedback on the compensated status of the lathe.

When the machine is done adjusting, a displayed value on the DRO will give feedback on the status of the lathe. To make the DRO easier to read at a glance, we removed leading zeros and set the output to show whole thousandths to the left of the decimal point and tenths of a thousandth to the right of the decimal point. For example, a measurement of 0.0015" [38 micron] will be displayed on the DRO as 1.5 [38 micron], or one and a half thousandths or thirty eight microns. Green lights for "READY TO CUT" and "OPTIMUM" will also be illuminated as a backup to the DRO.

MACHINING ROTORS

STEP 3: ADJUST FOR LATERAL Run-out (1 Minute) CONTINUED

If the TRY AGAIN light is illuminated, the machine is unable to fully adjust for run-out. This difficulty could be due to looseness of fittings, irregular run-out, damage to wheel bearings or other components, or other factors relating to set-up. The best procedure is to loosen the machine from the adapter, check adapter and vehicle setup, rotate the adapter locator pin 180 degrees, and attach the machine again. Make sure that the machine is adequately supported by the trolley. Run the adjustment procedure and the machine will again adjust for run-out. If TRY AGAIN appears repeatedly, there is most often a problem with the vehicle. You should dismount the machine and check for a damaged wheel bearing or CV joint. Such problems will have to be addressed before match-machining is possible.

If the machine seems to be having excessive difficulty in adjusting for lateral run-out, consult the troubleshooting section on Page 33.

NOTE



DRO computer in READY mode.



DRO computer compensated for lateral run-out to 0.0006" and ready to cut.



STEP 4.
Technician sets cut depth.

WARNING

It is extremely important not to touch the hat of the rotor with the outer tool holder. This will damage or break the tool holder plate. This type of damage is **NOT COVERED BY THE WARRANTY.**

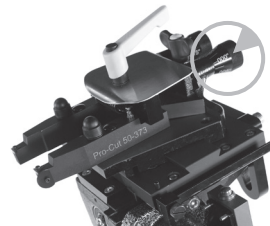
Step 4: MAKE THE CUT (4 Minutes)

1. With the motor still running, loosen the forward lock lever on the cutting head to allow cutting depth adjustment.
2. Turn cut-depth knobs counter-clockwise until the tips can clear both sides of the rotor. Crank the cutting head in to 1/2" from the outer edge of the braking surface of the rotor.
3. Start with the inside (behind the rotor) tool arm. Turn the depth knob clockwise (tighten) until the tool tip just barely makes contact (scratches) with the rotor surface. You can listen for the contact. Next move the outside tool arm in until it also makes contact.
4. If there is a large ridge on the outer edge of the rotor, you may remove that as well by depressing the feed clutch and allowing the lathe to cut off the ridge. Now you may zero set the knobs, back off the tool arms, and wind the cutting head back in to 1/8th of an inch from the inside starting point of the cut. Be careful not to crank the cutting arms into the "hat" of the rotor. **Damage caused by advancing the cutting arm into the hat of the rotor is not covered by warranty.**
5. When you are at the inside edge of the pad contact surface, you may adjust for depth by turning the depth knobs clockwise until you reach zero on each knob, which should be the original scratch point from the test scratch on the outer edge. If the cutting tips are not touching the rotor at the zero set mark, then you must turn the knob(s) clockwise until they do - this is your start point to add the depth of cut. Each line of the knob represents cutting tip movement of 0.0025" / 0.064mm. Cut at least 0.005" / 0.13mm (or two lines) on each side with each pass. The maximum depth is 0.020" / 0.51mm per side, per pass. The exceptions to this rule would be extremely large and thick rotors such as on a Medium Duty truck like the Ford F550 or larger, or very thin solid rotors such as on the rear of a Cadillac DeVille. In these applications, the depth rule is reversed and the minimum cut can be reduced to 0.0025" / 0.13mm per side per pass, and the maximum cut depth should be limited to 0.005" per side per pass. Other specialty rotors, such as cross-drilled or slotted, may also require a reduced cut depth. **Note: See our web site for tech-tips on cutting larger and specialty rotors.**

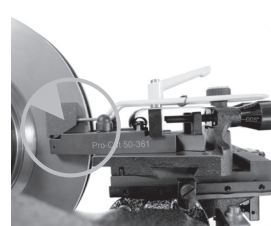
MACHINING ROTORS

Step 4: MAKE THE CUT (4 Minutes) CONTINUED

6. Now that you have adjusted for depth, tighten the forward lock lever (over the tool arms). This lever must be tight to minimize vibration. **For safety, it is advised at this time that you turn the motor off. Place the chip deflector/silencer around the rotor and over the cutting tips.** Grooves in the chip deflector/silencer will fit snugly over the cutting tip screw heads when installed correctly. There are several types of chip deflector/silencers. The first, the 50-703 standard version, is used in most smaller vented rotor applications. The second, the 50-754, has double thick silencer blocks and a lock clip to increase pressure on the rotor. The 50-754 chip deflector/silencer works well on the thin solid rear rotors. The third, the 50-744, has thicker wire and a stronger spring for larger vented rotors on larger cars and trucks. For 1250/1299 style cutting heads, use the 50-773 chip deflector
7. Once cut depth is set, tool arms are locked down, silencer is secure, and draw bar tightness is double checked, you may turn the motor back on. Press the feed engagement knob to engage the automatic feed. Provided that you previously set the shut-off cam correctly, the lathe will shut off when the cut is complete. The cut will take two to four minutes depending on the size of the rotor.



Turn the dials clockwise to advance the cutting tip depth. Each line on the dial indicates 0.0025"



The chip deflector rides over the cutting arms as shown above. The chip deflector should be used every time.



Move the cutting head by turning the knob shown above, clockwise for away from the rotor, counter-clockwise for towards the rotor.



Pictured above is the 50-754, which has double thick silencer heads and a lock clip to increase pressure on solid thin rear rotors.

Step 4: MAKE THE CUT (4 Minutes) *CONTINUED*

- When you are finished cutting, loosen the cutting arm lock lever, and turn the dials counter clockwise so they will clear the larger thickness of the second rotor. Loosen the draw bar knob and remove the lathe from the adapter. Be careful not to bump either the rotor or the wheel with the cutting head as you dismount the lathe. Take special care not to bump the tips into the rotor.
- Before removing the adapter from the first side, measure and record the lateral run-out on the rotor. Also measure and record the thickness to ensure that it is above “machine to” specification. You may compare to factory specifications in the Pro-Cut Brake Spec Guide provided, or other reliable certified source. When you have finished your measurements, be sure to clear the hub, caliper bracket, and speed sensors of any brake chips, dust or debris. **Optional but recommended:** With the motor running, finish sanding with a 150 grit sandpaper on a sanding block on each side of the rotor for 1 minute will serve to improve the surface roughness average (Ra) by up to 25%. Excellent surface finishes provide the least amount of initial brake noise and the best customer satisfaction.
- Cleaning the rotor surface after machining to remove all dust and debris is very important in the overall quality of the brake job. Pro-Cut recommends using liberal amounts of warm water with a mild detergent and drying thoroughly with clean towels to be certain all loose material is removed.

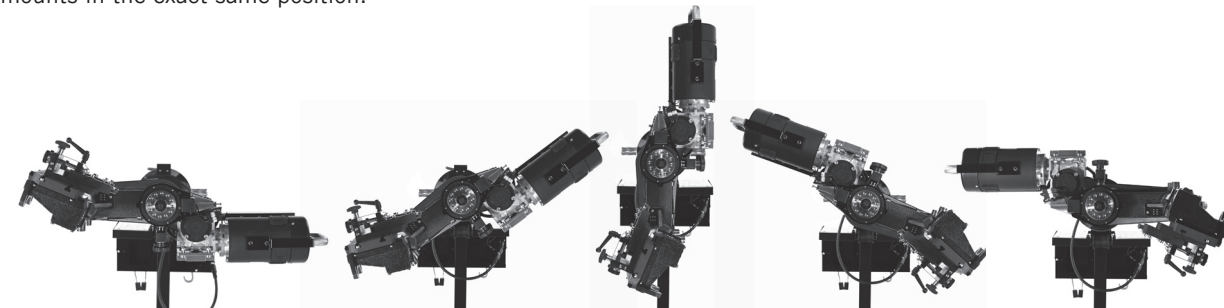
MACHINING ROTORS

MACHINING THE OPPOSITE SIDE

- Loosen the trolley disc lock lever and rotate the machine into the upside-down position.
- The procedure for cutting in the upside-down position is the same, though fewer steps are needed as the lateral position of the cutting head relative to the rotor is already set. The lathe mounts in the same manner. Often, the shut-off switch will still be depressed from the previous cut, so the machine will not turn on until you advance the cutting head slightly. The cutting arms will also still be advanced in from the last cut, so be sure to loosen the forward lock lever and spread the tool arms before feeding the head towards the center of the rotor. Measuring and adjusting for run-out is exactly the same as in the upright position. The entire cutting process is also the same, right down to the chip deflector/silencer which mounts in the exact same position.

NOTE

Be sure the auto shut-off is not still engaged from your first cut!



After loosening the trolley handle, the lathe can be flipped over to machine the opposite side of the vehicle.

MACHINING ROTORS

VEHICLE REASSEMBLY

Be sure to torque all lug nuts to manufacturer's specification with a torque wrench or other calibrated tool. Excess or uneven torque can deflect the rotor and actually induce additional run-out, destroying the accuracy of the rotor matching process.

When machining (and any optional sanding) is complete on both sides, all debris must be removed and rotor surfaces completely cleaned with soap and water. Cast iron dust left on the rotor can cause brake noise. All surfaces should be cleaned of chips and dust. Special care should be used in making sure that ABS sensors are free of debris. Reassemble the brakes and wheels to the manufacturer's specifications.

HELPFUL HINTS FOR CUTTING ROTORS USING A PRO-CUT LATHE

- Inspect cutting tip edge for wear and damage.
- Be sure that the vehicle is in neutral.
- Remove the wheel and caliper on both sides of the vehicle and stabilize the opposing rotor so it does not rock.
- Be sure that the Emergency Brake is released.
- If ambient temperature is well below freezing and the vehicle is all-wheel drive, warm vehicle up by driving for 5 minutes.
- If cutting a vehicle with limited slip, disconnect the drive shaft if resistance is too great.
- If there is an electronic traction control control switch, turn it to 'off'.

MACHINE CARE

HELPFUL HINTS FOR CUTTING ROTORS USING A PRO-CUT LATHE

- If the vehicle has a floating locking rear axle, remove the axle prior to attaching lathe.
- If AWD vehicle and all 4 wheels turn, remove all 4 wheels and calipers.
- **Optional:** After cutting rotors, sand each side for 1 minute with 150 grit sandpaper, then wash with soap and water until all residue is removed. This will improve surface finish even further than using cutting tips alone.

MAINTENANCE

The Pro-Cut lathe is simple and rugged. With just a few maintenance tips you can ensure a long and profitable life for your machine.

Check cutting tip edges. If there are chips or dings, turn or replace the tip. Be sure they are right-side up so that the groove and dots are visible. Each tip has three cutting points. When worn out, replace them using a 2mm allen wrench as the one provided with the tool kit. Although the tips must be securely tightened, do not over-tighten them either. When changing tool tips, clean the threads and put a spot of Vaseline ® (or thick grease) in the bottom of the screw hole before tightening the tool bit screw. The Vaseline / grease will stop chips from accumulating in the hole and rusting in place. If chips do rust in place, they can often be dislodged by poking a needle through the hole.

Clean the slide plate and tool holder plate, taking special care that there are not chips or dirt wedged in the dovetails or under the tool arms. Clean loose cast-iron chips from the magnetic tip on the adjustment flange to maintain a clear signal to the computer. Check the electrical connections and cord for cuts in the insulation or for wear.

WEEKLY MAINTENANCE

Lubricate the cut depth adjustment wedge threads with a thin coat of light machine oil.

Check the slide plate for lateral play. Lateral play often causes ridges and machining grooves when a rotor is resurfaced. To check for lateral play, grab the slide plate assembly and try to wiggle it side to side.

TROUBLESHOOTING ASSURING A SMOOTH FINISH

NOTE

The Pro-Cut X9 should provide a smooth surface finish on every cut, free of chatter, tone, or roughness. If your machine leaves a standard, “chatter” or rough finish, you need to find the problem. The following pages are the common sources of poor surface finish and ways to remedy the problem.

Brake performance is dependent upon rotor surface finish as well as minimizing lateral run-out. The Pro-Cut lathe is designed to give you a superior surface finish on any rotor as long as proper maintenance is followed.

Minimizing vibration during machining is the key to high-quality surface finish. It is critical that all contact points between the rotor and the lathe are secure – specifically, the connections between lathe and adapter; the slide plate and the lathe; the cutting head and the plate; and the tips and the tool holders. Looseness in any of these areas will compromise lathe performance and surface finish.

TROUBLESHOOTING

CHECK CUTTING TIPS

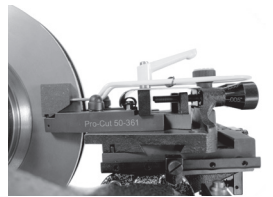
The cutting tips must be right-side up. Dots face up. The cutting tips should not have chips or dings in the surface of the points. Do not take cuts of less than 5 thousandths of an inch / 0.13mm unless necessary for non-vented, drilled, or rear of dual wheel trucks. Cuts of 5 to 10 thousandths / 0.13-0.25mm will provide the best surface finish and the longest tip life for vented rotors of normal size.

MAKE SURE THE CUTTING HEAD IS SNUG

On each brake job, the technician must center the cutting head. Once the head is centered, it is vital that the technician tighten the cutting head lateral lock lever securely. Failure to do this may result in chatter.

USE THE CHIP DEFLECTOR

The chip deflector included with the lathe is a critical component. The pressure of its pads provides dampening that reduces the chance of vibration while cutting. New chip deflectors can be purchased directly from Pro-Cut.



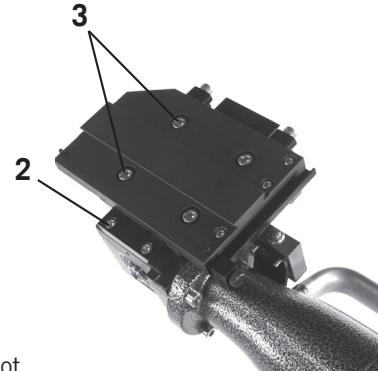
The chip deflector reduces vibration.

CHECK FOR BENT TOOL HOLDER PLATE

Check the tool holder plate for damage. Slide a 0.003" / 0.08mm feeler gage between the tool holder plate (50-293) and the tool arms. If it can be inserted freely your tool holder plate is damaged. A damaged tool holder plate will often cause a vibration during the cut. This will leave a poor surface finish on the rotor.

Slide Plate Resistance Adjustment

1. Remove the Cutting Head from the Slide Plate.
2. Center the Slide Plate on the Gear Box between the screws that are through the dove tail plate.
3. Locate and loosen the 2 wedge locating screws on the slide plate.
4. Be sure that the runners of the slide plate are clean and free of debris.
5. Grasping the slide plate on the side opposite of the slide rail, wiggle it back and forth at the same time push on the side where the rail is located.
4. Tighten the 2 wedge locating screws.
4. Test the resistance of the slide plate by turning the clutch knob. There should not be any sideward movement or looseness in the slide plate.



| Detail of the 50-1650 Slide Plate

TROUBLESHOOTING

LATERAL Run-out ADJUSTMENT

If the machine is having difficulty adjusting for lateral run-out, first assess the vehicle being serviced. If lateral movement is rough or uneven due to damaged vehicle components, these components must be repaired or replaced before rotors are match-machined. It is also important that the machine be supported by the trolley during adjustment.

CALIBRATION PROCEDURE

The Pro-Cut PFM X9 Rotor Matching System is calibrated with an acceptance number from the factory. Normally, this will never need to be changed. **Please call Pro-Cut Service Department before attempting calibration procedure to confirm that this is the problem.**

DRO COMPENSATION INSTRUCTIONS

Your new PFM X9 On-Vehicle Lathe is equipped with DRO. DRO, which stands for "Digital Run Out," combines several features to offer you increased accuracy as well as lathe diagnostics and efficiency tracking. By checking these values on a monthly basis, managers can track their ROI based on the machine usage. Pro-Cut Service Technicians can also check the accuracy of the machine over time.

The first screen that you will see when the machine is plugged in (after the computer "boots up") is the Ready Mode.

Once you initiate the run-out compensation process by pressing the START button, the "live" lateral run-out will be displayed. In this mode, the lathe will display actual run-out, or how much the lathe is moving laterally, as recorded in thousandths and tenths of a thousandths of an inch. To make the display easier to read at a glance, we've removed the leading zeros from the display and simply have one digit to the left of the decimal, or the whole thousandths, and one digit to the right of the decimal, or the tenths of a thousandth. Once the compensation cycle is complete, the final run-out will be displayed on the screen for four minutes, or about the duration of one cut cycle. After four minutes the screen will revert back to the READY screen.



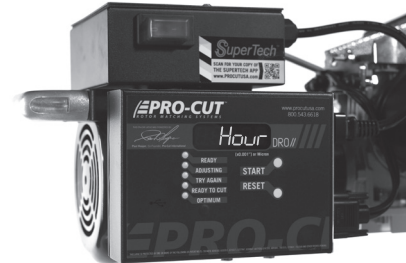
| Ready Mode.



| This display of final compensation equals .0006"

DRO EFFICIENCY TRACKING

The remaining screens are accessed through the START button and are scrolled through by continued pressing of the START button. The machine first must be in the Ready mode and the **motor must be off**. Press and hold the START button until all of the lights come on, then release and the Hour screen will be displayed. Then, press the START button again and the number of hours that the motor has run will be displayed in hours and tenths of an hour.



| The first diagnostic screen



| This value represents hours and tenths of an hour that the motor has run.

DRO EFFICIENCY TRACKING

Press the START button again and the word "Total" will be displayed. Press the START button once more and the total number of times the machine has compensated will be displayed.



This value represents the total number of completed compensation cycles. Estimating one cycle per cut, we can begin to establish ROI.

DRO DIAGNOSTICS

Press the START button once more and the "A.Adj." will be displayed. Press the START button once again and the average adjustment (compensation) time over the course of the total number of compensations the machine has completed will be displayed in seconds.



This value represents the average compensation time recorded in seconds over the life of the lathe.

DRO DIAGNOSTICS CONTINUED

Press the START button again and the word "5 Adj." screen will be displayed. Press the START button once more and the last five adjustment cycle times will be displayed in seconds.

Press the START button once more and you will reach the units display toggle. Pressing the 'calibration button' will toggle between inch and metric (mm for thickness and microns for runout) display modes.



Display of average compensation time of the last 5 successful compensation cycles.



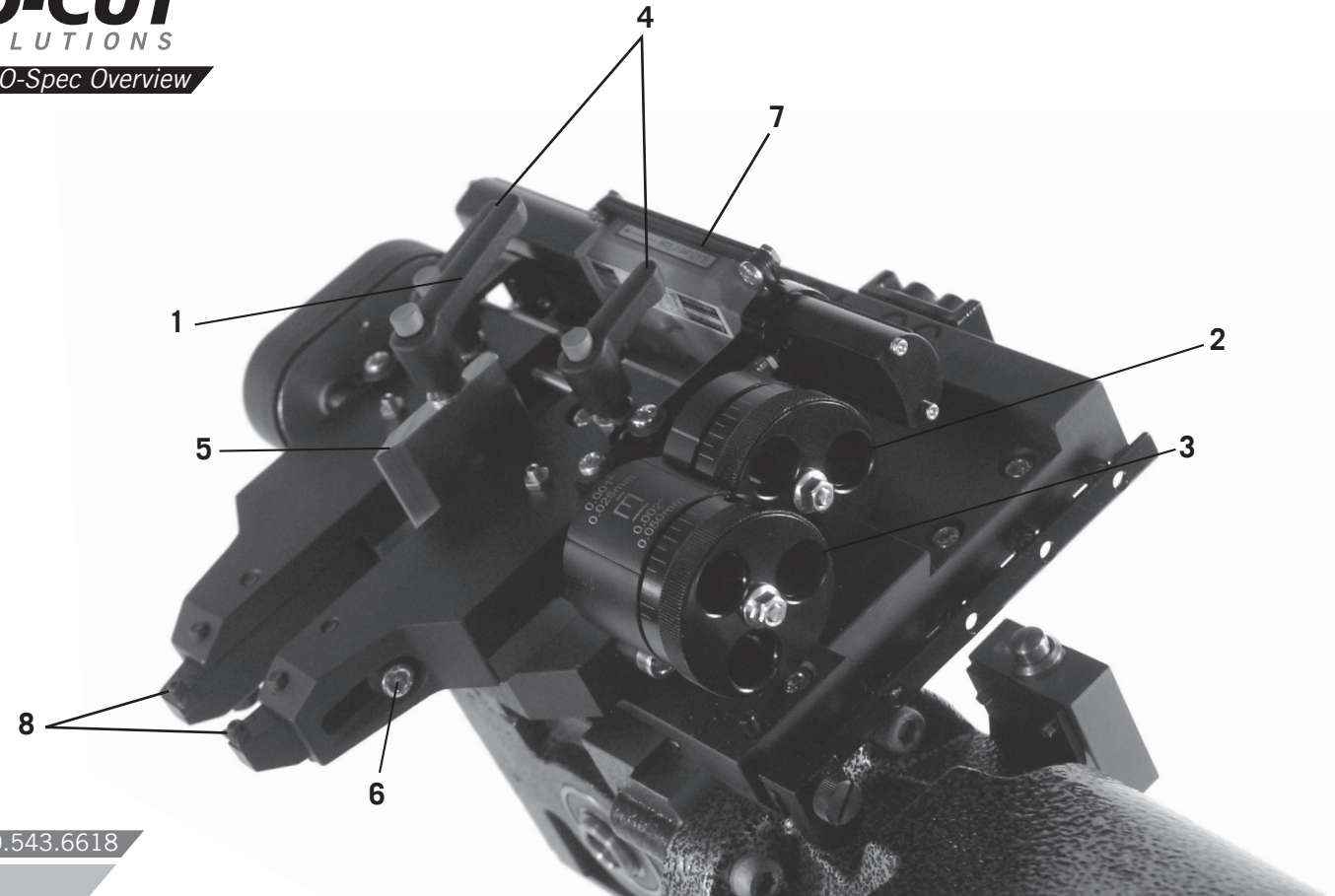
PRO-Spec TECHNICAL SUPPLEMENT



YOUR LATHE PACKAGE

The **PRO-Spec upgrade package** allows for live display of rotor thickness on the DRO screen. The 50-1250 Lateral cutting head replaces the 50-220 cutting head. This new cutting head allows us to use a single sensor to measure the distance between the arms, and thus the distance between the carbide insert tips.

- | | |
|----------------|-----------------------|
| 50-1250 | Lateral Cutting Head |
| 50-1206 | Slide Sensor Assembly |
| 50-1148 | Gauge Pickup Module |
| 37-1210 | Gauge Block |



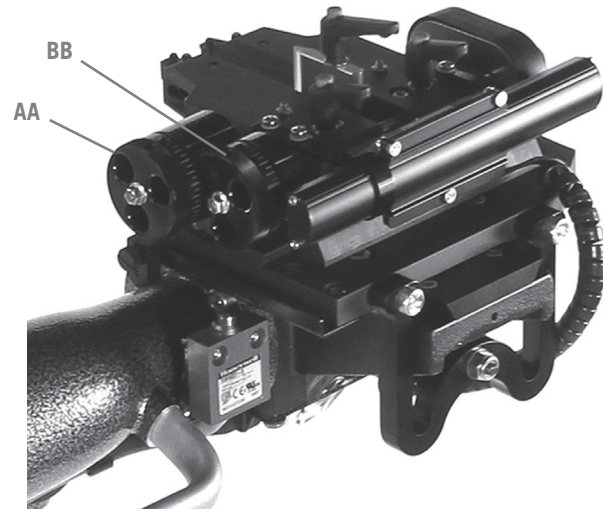
PRO-Spec COMPONE

With 50-1250 Cutting Head

- | | | | |
|----|------------------------------|----|--------------------------|
| 1. | Position lock lever | 5. | Rotor centering pointer |
| 2. | Adjustment dial - inboard | 6. | Throat depth lock screws |
| 3. | Adjustment dial - outboard | 7. | Slide Sensor Assembly |
| 4. | Tool arm position lock knobs | 8. | Carbide cutting inserts |

THE 50-1250 CUTTING HEAD

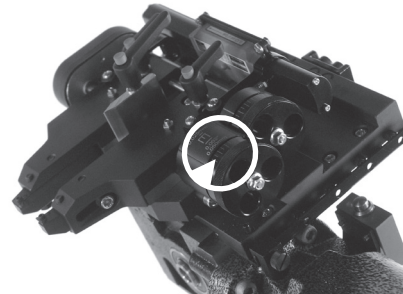
Unlike Pro-Cut's earlier designs, this cutting head's arms move from side to side. The adjustment knobs face the user. The depth adjustment dials are offset; as a reminder - the one nearest you (**AA**) adjusts the outboard (away from vehicle) depth of cut and the one farther from you (**BB**) adjusts the inboard (nearest to vehicle) depth of cut.



Detail of outboard adjustment knob (AA) and inboard adjustment knob (BB)

The dial knobs have small and large lines. Each small line is 0.001"[0.025mm] depth and each large line is 0.002"[0.050mm] depth. Each full turn of these knobs moves the arm almost 0.050"[1.25mm] - nearly twice what the older style cutting heads removed per turn. Please take care not to cut too deeply by accident.

Detail of small adjustment lines 0.001" / 0.025mm depth and each large line of 0.002" / 0.050mm depth.



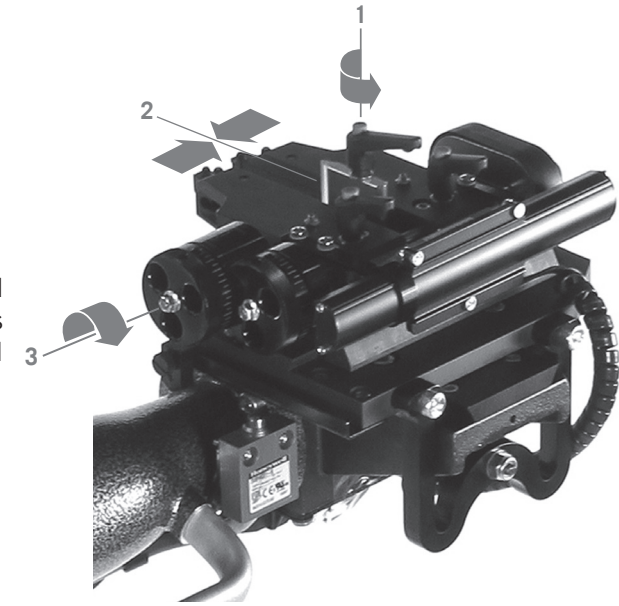
50-1250 CUTTING HEAD

TO USE THIS CUTTING HEAD:

1. Loosen the position lock knob.
2. Using the rotor centering pointer as a guide, center the cutting head over the rotor. Tighten position lock knob.
3. Adjust each arm's depth of cut as desired and then lock each arm with its' lock knob. It is not necessary to use much force on the tool arm lock knobs. Finger snug is plenty.

Turn off the lathe to stop the rotor from spinning and then fit the silencer/deflector over the rotor, and secure the back end of it under the lock lever. This will help prevent it falling away prematurely.

NOTE: Use only Pro-Cut Cutting Tips (50-742 or 50-743). Although other tips will fit the machine, only Pro-Cut tips have been specifically engineered in tandem with the Pro-Cut lathe. Using a non-Pro-Cut tip may compromise lathe performance and result in poor surface finish.



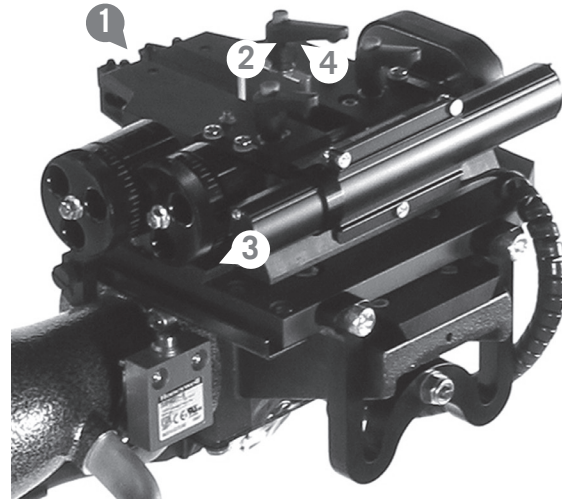
USING THE 50-1250 CUTTING HEAD CONTINUED

If a rotor has an extra wide face width, or if the inboard face is wider than the outboard face, the inserts may be adjusted to allow for staggered cheeks by loosening the throat depth lock screws, moving the insert holder to the desired position and then re-tightening the throat depth lock screws.

50-1250 CUTTING HEAD ASSEMBLY

TO FIT THE TOOL HOLDER PLATE TO THE SLIDE PLATE:

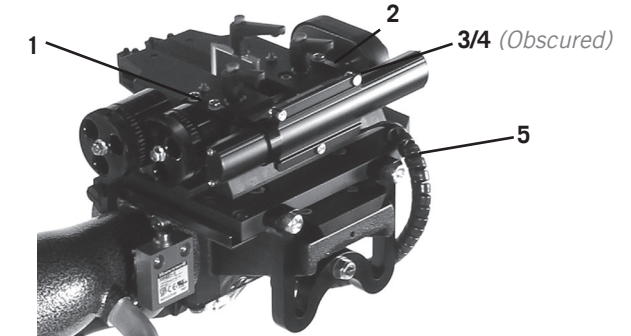
1. Loosen the travel limit screw until it no longer crosses the slot on the bottom surface of the tool holder plate.
2. Carefully loosen the position lock lever until the cam on the bottom surface is just below flush with the bottom surface of the tool holder plate.
3. Slide the cutting head over the male dovetail on the slide plate.
4. Once in place re-tighten the position lock lever (4) and the travel limit screw (1).

**THE SLIDE SENSOR 50-1206**

THE SLIDE SENSOR is an absolute encoder device, nearly identical to those used in digital calipers. When mounted to a correctly adjusted cutting head and properly calibrated it should give an accuracy of $\pm .004"$ [0.102 mm]. The sensor itself is enclosed in a case to prevent dust contamination. This is a precise instrument, please take care. Its housing will prevent most damage, but it is not intended to take large loads or impacts nor be used as a handle.

50-1206 COMPONENTS

1. Inboard mounting bracket
2. Outboard mounting bracket
3. Slide pin
4. Slide pin clamp screw
5. Data cable

**THE SLIDE SENSOR 50-1206 ASSEMBLY**

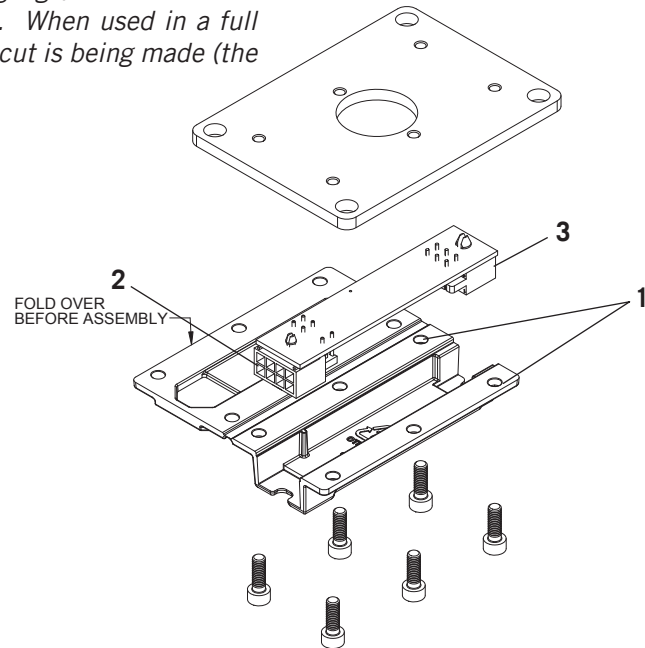
Loosen, but do not remove, the slide pin clamp screw. Using the four screws provided mount the inboard and outboard mounting brackets to the holes tapped in the top surface of the tool arms. You will likely need to adjust the slide side to side, or move the arms to match the separation of the brackets. Before tightening the bracket screws, please make sure the slide sensor is parallel to the rail on which the arms move. Once you're sure this is parallel, tighten the four mounting bracket screws and the slide pin clamp screw.

THE GAUGE PICK UP MODULE 50-1148

The Gauge Pickup module has two jobs. It decodes the data from the slide sensor (aka the gauge) and sends it to the main lathe computer for display. When used in a full GYR package, it also detects when a cut is being made (the pickup).

FEATURES:

1. Mounting holes
2. 8 pin connector
3. 6 pin connector



THE GAUGE PICK UP MODULE 50-1148 ASSEMBLY

Remove the cover on the bottom of the bevel gearbox assembly. Replace it with the 50-1148 assembly, taking care to aim the eight pin connector towards the lathe body. With the lathe unplugged from AC power, seat the 6 pin connector from the slide sensor, and the 8 pin connector from the lathe's harness. These are waterproof connectors and they seat firmly. Please make sure the small catch latches over the post on the top of each connector to ensure a complete connection. Re-power the lathe.

***NOTE:** The Gauge Pickup module also performs cutting detection, but this feature is not used unless you upgrade to a full GYR package.

ELECTRONIC READOUT:

When the lathe is plugged in you will see three letter/number combinations if you have connected everything properly:

LA### Lathe Adjustment Module & Version Number *(You will see digits, not the # symbol)*

DC### Display Control Module & Version Number

GP### Gauge Pickup Module & Version Number

If the Gauge Pickup Module is not connected you will see E.GPM instead of GP###. Always unplug the lathe when connecting or disconnecting lathe electronics. It is unlikely that doing so while the lathe is powered will cause any harm, but the electronics work best when they are all powered on and off simultaneously.

PRO-Spec CALIBRATION

Before the lathe may be used to cut rotors, the slide scale and cutting head assembly must be calibrated. This calibration procedure should be performed at least monthly, or any time the slide scale is removed from the cutting head. It is not necessary to re-calibrate every time an insert is rotated, the inserts are very precise and do not vary much. You should, however take care that the insert has not shifted or rotated in its' pocket after tightening the tip screw.

CALIBRATION STEP 1:

Set the calibration block with 0.800" / 20.32mm side between the tool arm carbides. It should be as square as possible and just barely touching each carbide. If you have it set correctly, you will not be able to rotate it except along the line formed by the two carbide inserts touching it. Be careful not to over-tighten the carbides - they are harder than the calibration block and will damage it if carelessly tightened, also over tightening may chip the carbide itself. When properly seated the calibration block will 'hang' between the carbides. Please note that the gauge block has one pair of sides which is NOT 0.800". If you are unsure, check with a digital caliper to make sure you use the correct faces when calibrating.

CALIBRATION STEP 2:

To calibrate the thickness you must enter the same menu as you use to read the DRO Efficiency numbers (see pages 35-37). With the motor off, press and hold the Start button on until all of the lights come on and then release it. Press the Start button multiple times until you see a screen that says 'H0.800' or 'H20.32' if in mm mode.

PRO-Spec CALIBRATION CONTINUED

CALIBRATION STEP 3:

With the display in 'H' mode, and the 0.800" / 20.32mm thick calibration block in place, press the CALIBRATION button, the same one used to set the LRO Acceptance number. You will hear a beep. When you have done this, you can press the Reset button to exit the H mode or use the Start button again if you wish to read the DRO numbers out or switch between inch and mm display mode.

CALIBRATION STEP 4:

The cutting head and slide sensor are now calibrated to read thickness correctly. To check calibration you can put the gage block between the inserts again and re-tighten. If you read between 0.796" / 20.22mm and 0.804" / 20.42mm you are properly calibrated.

USING THE PRO-Spec

If you rotate the adjustment knobs, you will see the DRO display transition to thickness display. After 8 seconds of inactivity the display will alternate between the thickness reading and whatever else had been on screen. Operation of the DRO remains unchanged. You turn on the motor and press the Start button.

PRO-Spec SERVICE CONSIDERATIONS

A properly set up and adjusted 50-1250 cutting head will provide smooth yet firm arm motion with minimal knob backlash. If you are having difficulty turning the dials when the arm knobs are backed off, or if the dials turn very easily then adjustments need to be made to the assembly. A poorly adjusted cutting head can cause poor rotor surface finish.

The most common cause of poor dial feel is mis-adjustment of the tool arm ways. This procedure is for adjusting the 50-1250 Lateral Cutting Head. The cutting head may need to be adjusted if there is excessive play in the cutting arms. Another indication of needing adjustment is when a cutting arm is locked down the thickness reading changes. With a 4mm Allen Wrench (full size, high quality, no T-handle) and 37-1220 (2) Lock down levers, first install 37-1220 Lock Down Levers:

- If the 50-1250 does not have the 37-1220 lock down levers, install them at this time.
- Remove the current arm lock down knobs (37-1200). Install the 37-1220 hold down levers.

The Adjustment:

1. Rotate the Adjustment dials so that the cutting arms move back and forth.
2. Grasp the front of the cutting arm and wiggle it back and forth while turning the lock down lever to lock the wedge in place. Do this for both arms.
3. With the arms locked down, loosen the 2 wedge locating screws. This requires the use of a 4mm, high quality, full size Allen wrench.
 - Do Not use a “T” Handle Allen Wrench.
 - Do Not loosen and then tighten one at a time, **both screws must be loose at the same time.**
4. Tighten the 2 wedge locating screws. Do this for both cutting arms.
5. Loosen the lock down levers and check the arms for movement.

PRO-Spec TROUBLE SHOOTING

ISSUE No Thickness Measurement Data.

TROUBLESHOOT One of the white rectangular cables connect to the device under the feed mechanism are partially or not fully connected. To solve this:

1. Power off the lathe by unplugging it.
2. Re-seat these cables firmly.
3. Power the lathe on.

6 8 ADAPTER PACKAGES



50-687

4-HOLE ADAPTER

Fits most 4-lug vehicles.



50-688

5-HOLE ADAPTER

Fits most smaller 5-lug vehicles.



50-693

5-LUG ADAPTER - LARGE

Fits larger 5 lug cars and smaller SUVs and trucks such as Toyota Camry, most BMW models, and Chevy Equinox.



50-946

LIGHT DUTY 6 LUG ADAPTER

6 lug adapter fits newer Colorado/Canyon, some Cadillacs, and 6 lug single rear wheel Sprinters.



50-681

TOYOTA SPECIALTY & ALTERNATE TRUCK ADAPTER

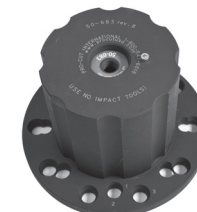
Fits most pickups and SUVs including the Toyota Land Cruiser and VW Touareg (does NOT have older common Ford pattern found on the 50-691 adaptor).



50-694

TALL HUB TRUCK ADAPTER

Primarily used to fit the 2003+ Expedition and 2004+F150, this adapter shares patterns with other common trucks that have tall hubs which may interfere with the 50-691 adapter.



50-683

3/4 TON TRUCK ADAPTER/COMMON

Fits most 3/4 ton single wheel trucks front and rear.



50-935

DUAL WHEEL TRUCK ADAPTER

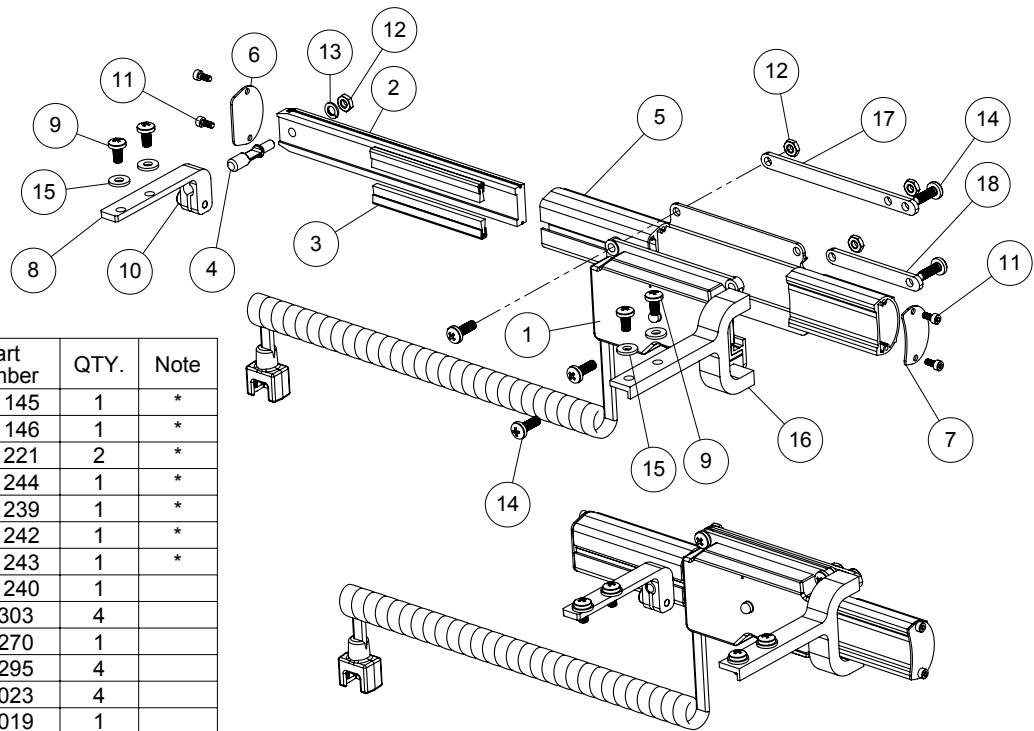
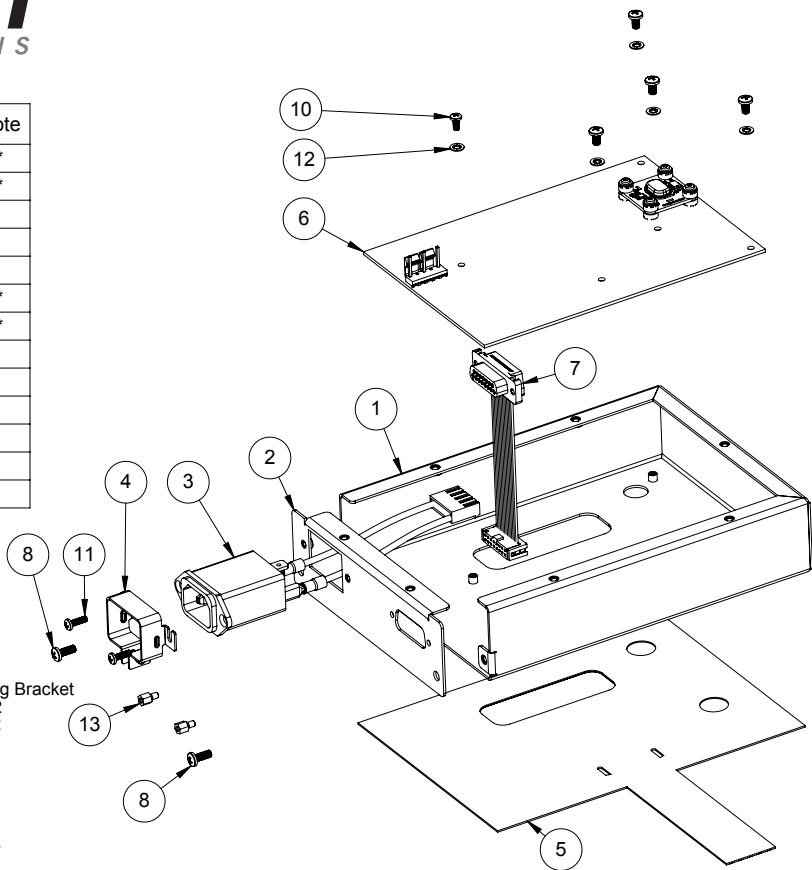
Fits 1-ton Ford, Dodge, and Chevy trucks and vans with dual wheels.

ITEM NO.	PART NUMBER	QTY.	Note
1	50-1128	1	*
2	50-1125	1	*
3	50-457	1	
4	37-628	1	
5	50-1135	1	
6	50-1154	1	*
7	50-1144	1	*
8	35-806	2	
9	35-311	4	
10	35-803	1	
11	35-802	2	
12	37-016	5	
13	35-418	2	

LEGEND:

- * Not available for sale
- † Assembly diagram available
- ± Part of larger assembly
- ⌋ Comes with hardware
- ‡ Not shown
- @ Special Order

Motor Brand | Mounting Bracket
Leeson 50-2212
Elprom (120& 230 VAC) 50-2222
Elprom 230VAC only after 12/2024 50-2227

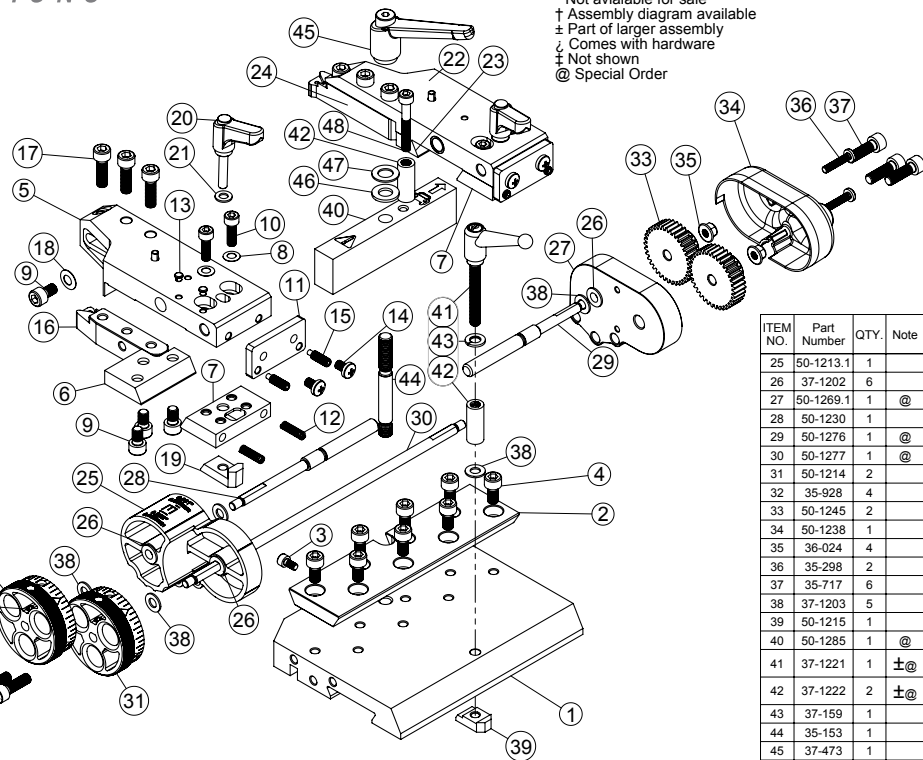


ITEM NO.	Part Number	QTY.	Note
1	50-1145	1	*
2	50-1146	1	*
3	50-1221	2	*
4	50-1244	1	*
5	50-1239	1	*
6	50-1242	1	*
7	50-1243	1	*
8	50-1240	1	
9	35-303	4	
10	35-270	1	
11	35-295	4	
12	36-023	4	
13	37-019	1	
14	35-322	5	
15	37-1206	4	
16	50-1225	1	±
17	50-1226	1	±
18	50-1227	1	±

LEGEND:

- * Not available for sale
- † Assembly diagram available
- ± Part of larger assembly
- ⌋ Comes with hardware
- ‡ Not shown
- @ Special Order

ITEM NO.	Part Number	QTY.	Note
1	50-1281	1	*
2	50-1282	1	*
3	35-257	1	
4	35-284	8	
5	50-1296	1	@
6	50-1258	1	@
7	50-1261	2	@
8	37-076	4	
9	35-291	8	
10	35-815	4	
11	50-1268	2	@
12	37-1250	4	
13	37-614	4	
14	35-926	4	
15	50-1208	4	@
16	50-1288	1	
17	35-366	6	
18	37-087	2	
19	50-1254	2	@
20	37-1220	2	
21	37-025	2	
22	50-1297	1	@
23	50-1259	1	@
24	50-1289	1	

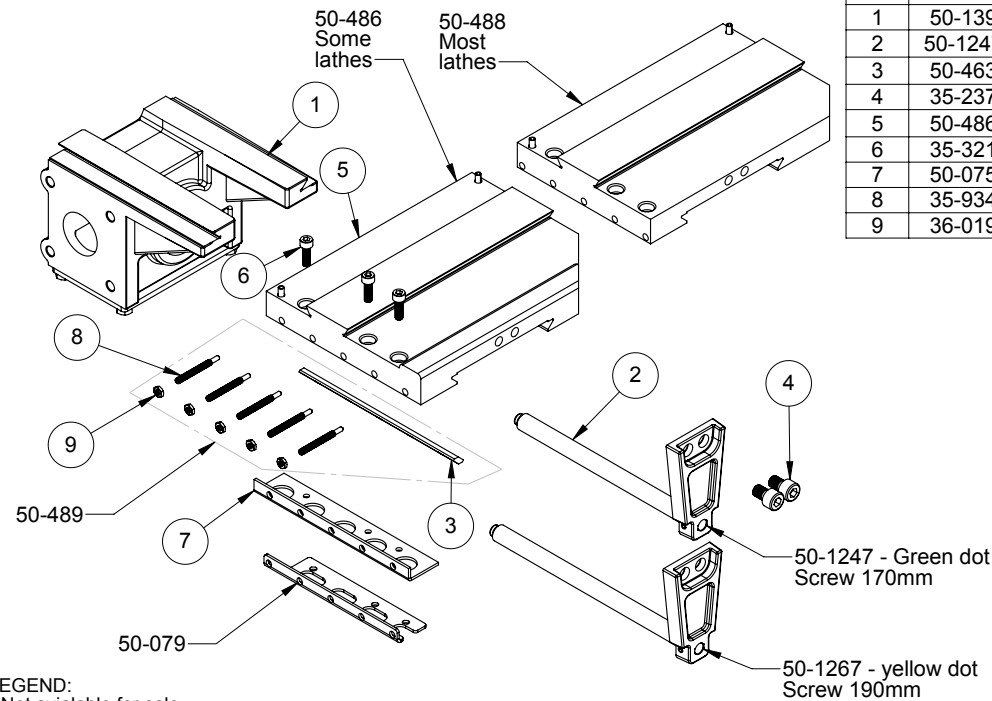


LEGEND:
* Not available for sale
† Assembly diagram available
± Part of larger assembly
∠ Comes with hardware
‡ Not shown
@ Special Order

ITEM NO.	Part Number	QTY.	Note
25	50-1213.1	1	
26	37-1202	6	
27	50-1269.1	1	@
28	50-1230	1	
29	50-1276	1	@
30	50-1277	1	@
31	50-1214	2	
32	35-928	4	
33	50-1245	2	
34	50-1238	1	
35	36-024	4	
36	35-298	2	
37	35-717	6	
38	37-1203	5	
39	50-1215	1	
40	50-1285	1	@
41	37-1221	1	±@
42	37-1222	2	±@
43	37-159	1	
44	35-153	1	
45	37-473	1	
46	37-003	1	
47	37-077	1	
48	35-324	1	@

Disassembly of 50-1281 and 50-1282 is not recommended.

ITEM NO.	PART NUMBER	Qty.	Note
1	50-139	1	
2	50-1247	1	†
3	50-463	1	†
4	35-237	2	
5	50-486	1	†
6	35-321	3	
7	50-075	1	
8	35-934	5	
9	36-019	5	

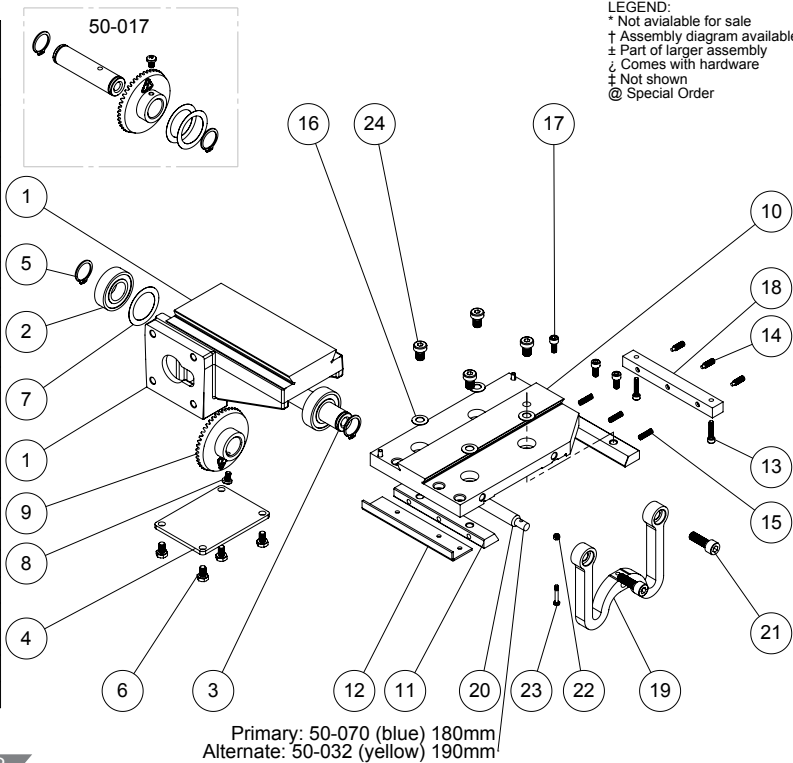


LEGEND:
* Not available for sale
† Assembly diagram available
± Part of larger assembly
∠ Comes with hardware
‡ Not shown
@ Special Order

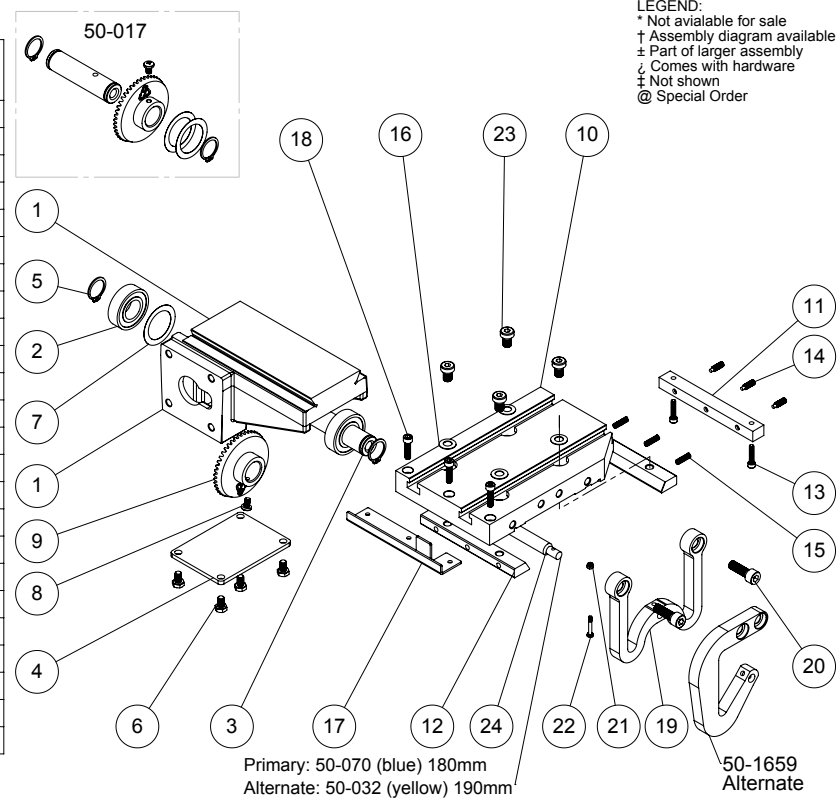
50-1247 - Green dot
Screw 170mm

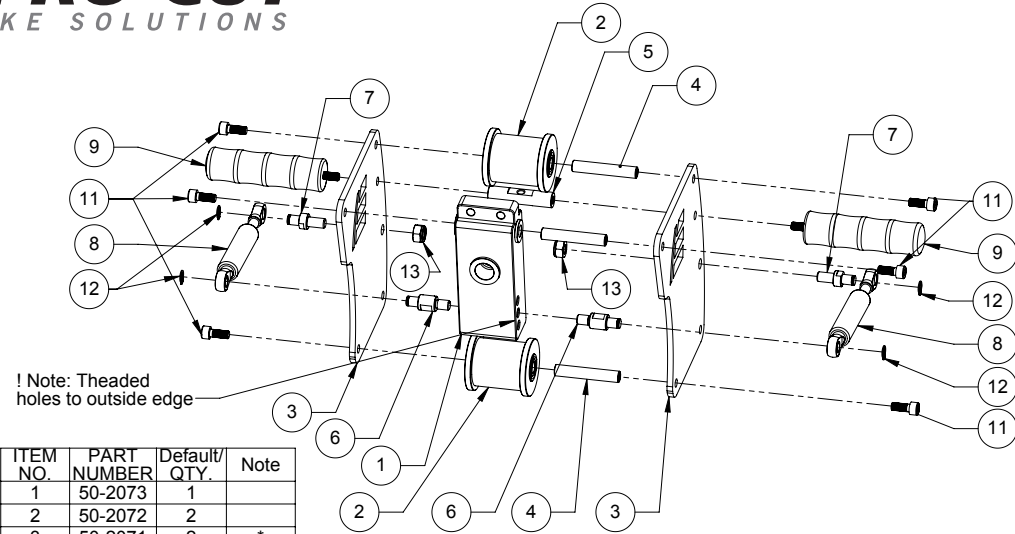
50-1267 - yellow dot
Screw 190mm

ITEM NO.	PART NUMBER	QTY.	Note
1	50-1651	1	
2	37-056	2	
3	50-016	1	*±
4	50-1668	1	
5	37-057	2	±
6	35-927	4	
7	50-018	1	±
8	35-926	1	
9	50-021	1	*±
10	50-1658	1	∩
11	50-1657	2	*
12	50-1664	1	
13	35-951	2	
14	50-1208	3	
15	37-1250	3	
16	37-077	4	
17	35-292	3	
18	50-1667	1	*
19	50-1661	1	∩
20	50-070	1	
21	35-236	2	
22	36-015	1	
23	50-1672	1	
24	35-255	4	



ITEM NO.	PART NUMBER	QTY.	Note
1	50-1651	1	
2	37-056	2	
3	50-016	1	*±
4	50-1668	1	
5	37-057	2	
6	35-927	4	
7	50-018	1	±
8	35-926	1	
9	50-021	1	*±
10	50-1342	1	
11	50-1667	1	*
12	50-1657	2	*
13	35-951	2	
14	50-1208	3	
15	37-1250	3	
16	37-077	4	
17	50-1665	1	
18	35-271	3	
19	50-1661	1	∩
20	35-236	2	
21	36-015	1	
22	50-1672	1	
23	35-255	4	
24	50-070	1	

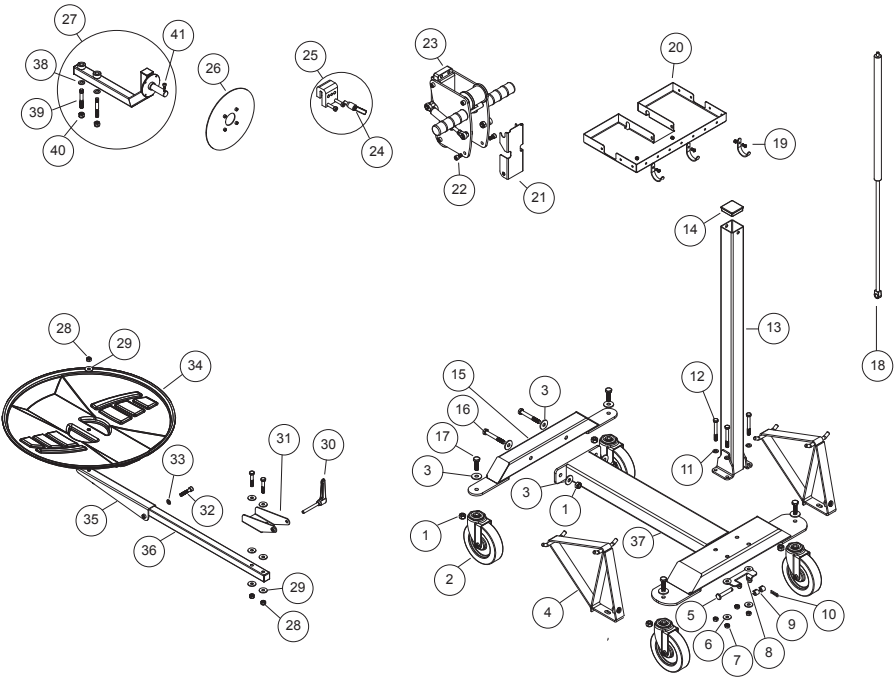




ITEM NO.	PART NUMBER	Default/ QTY.	Note
1	50-2073	1	
2	50-2072	2	
3	50-2071	2	*
4	50-2076	3	*
5	50-2016	1	
6	50-2074	2	*
7	50-2075	2	
8	37-485	2	
9	50-1038	2	
10	37-721	2	
11	35-239	6	
12	37-498	4	
13	36-001B	2	

LEGEND:
* Not available for sale
† Assembly diagram available
± Part of larger assembly
⌋ Comes with hardware
‡ Not shown
@ Special Order

ITEM	PART	QTY
1	36-001B	6
2	37-038	4
3	37-993	8
4	50-2030	2
5	37-046	1
6	37-110	4
7	36-009	4
8	50-2019	1
9	50-2046	2
10	37-496	1
11	37-003	4
12	35-360	4
13	50-2048	1
14	37-618	1
15	50-2029	1
16	35-998	2
17	35-304	4
18	37-489	1
19	50-2018	3
20	50-2077	1
21	50-2078	1
22	35-414	2
23	50-2070	1
24	37-1065	1
25	50-1065	1
26	50-2034	1
27	50-2235	1
28	36-002	3
29	37-111	7
30	37-484	1
31	50-2041	1
32	35-293	1
33	37-011	1
34	50-2044	1
35	50-2043	1
36	50-2042	1
37	50-2047	1
38	37-108	2
39	35-159	2
40	35-285	1
41	36-001B	1

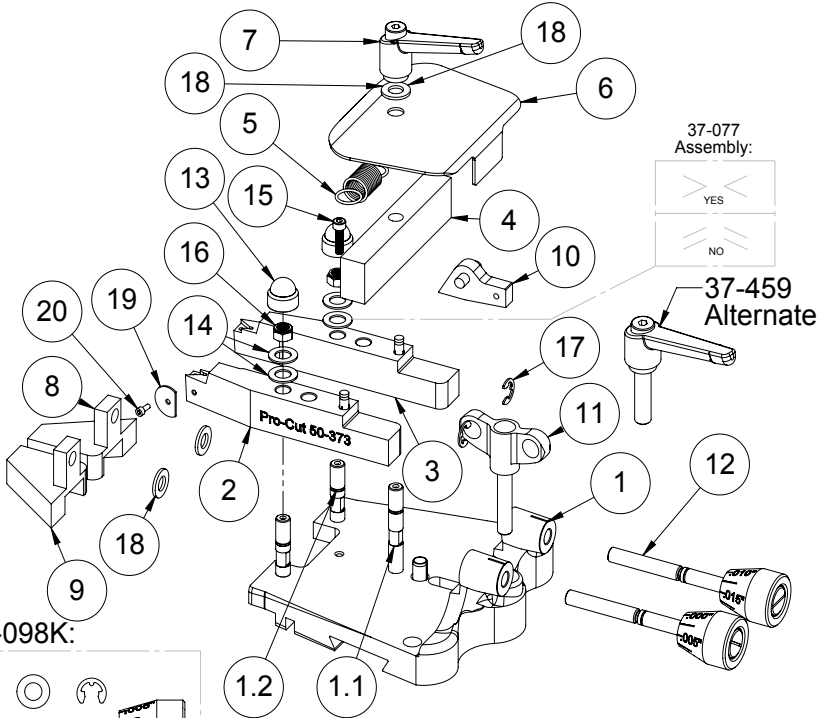
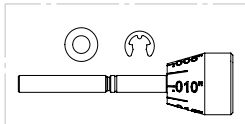


LEGEND:
* Not available for sale
† Assembly diagram available
± Part of larger assembly
⌋ Comes with hardware
‡ Not shown
@ Special Order

ITEM NO.	PART NUMBER	QTY.	NOTE
1	50-293	1	
1.1	50-065	1	
1.2	50-063	2	
2	50-373	1	
3	50-374	1	
4	50-252	1	
5	50-053	1	
6	50-260	1	
7	37-473	1	
8	50-253	1	
9	50-254	1	
10	50-249	1	
11	37-812	1	
12	50-098	2	
13	36-010	2	
14	37-077	4	
15	35-259	1	
16	36-020	2	
17	37-082	2	
18	37-003	3	
19	50-365	1	
20	50-364	1	

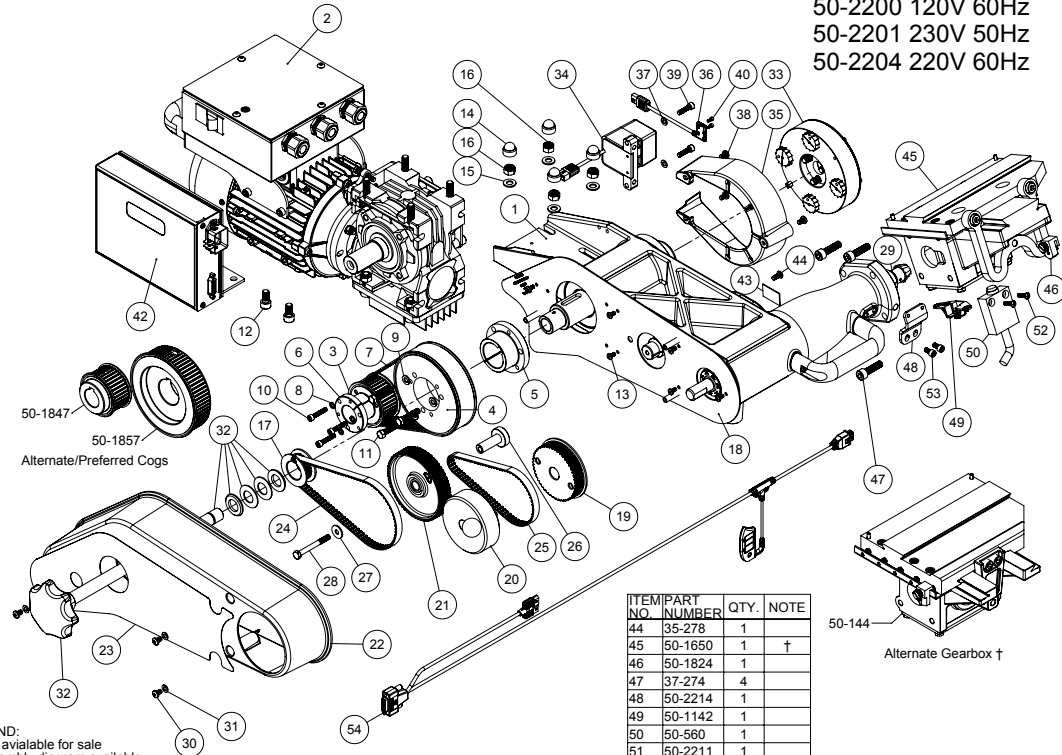
LEGEND:
* Not available for sale
† Assembly diagram available
‡ Part of larger assembly
⌋ Comes with hardware
‡ Not shown
@ Special Order

50-098K:



ITEM NO.	PART NUMBER	QTY.	NOTE
1	50-2201	1	*
2	50-2221	1	†
3	50-1845	1	
4	50-1846	1	
5	37-1854	1	
6	37-1805	1	⌋
7	37-1845	1	
8	37-156	3	
9	37-157	3	
10	35-800	3	
11	35-838	3	
12	35-414	2	
13	35-280	6	
14	36-010	4	
15	37-003	4	
16	36-002	4	
17	50-1831	1	
18	50-2218	1	
19	50-566	1	
20	50-570	1	
21	50-565	1	
22	50-2242	1	
23	50-861	1	
24	37-1808	1	
25	50-567	1	
26	50-2217	1	
27	37-117	1	
28	35-251	1	
29	50-2220	1	†
30	35-834	3	
31	37-025	3	
32	50-2239	1	⌋
33	50-2400	1	†
34	50-1840	1	
35	50-2208	1	
36	50-1826	1	
37	37-025	2	
38	35-926	3	
39	35-835	2	
40	50-364	2	
42	50-1184	1	†
43	37-2208	1	

LEGEND:
* Not available for sale
† Assembly diagram available
‡ Part of larger assembly
⌋ Comes with hardware
‡ Not shown
@ Special Order

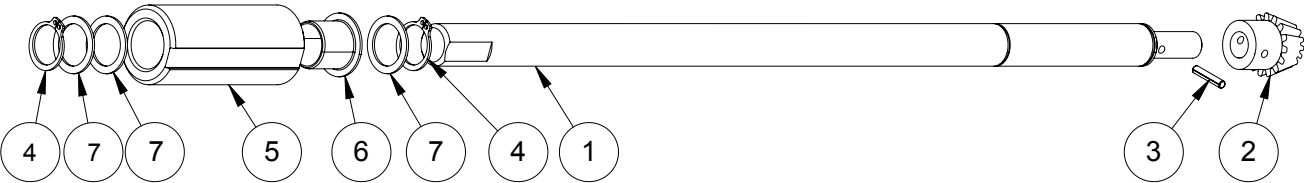


ITEM NO.	PART NUMBER	QTY.	NOTE
44	35-278	1	†
45	50-1650	1	†
46	50-1824	1	
47	37-274	4	
48	50-2214	1	
49	50-1142	1	
50	50-560	1	
51	50-2211	1	
52	35-281	2	
53	35-811	2	
54	50-2223	1	

50-2200 120V 60Hz
50-2201 230V 50Hz
50-2204 220V 60Hz

ITEM NO.	PART NUMBER	QTY.
1	50-2220.1	1
2	50-022	1
3	37-054	1
4	37-495	2
5	50-649.2	1
6	37-1920	1
7	37-503	3

Only 50-022 available for sale separately.

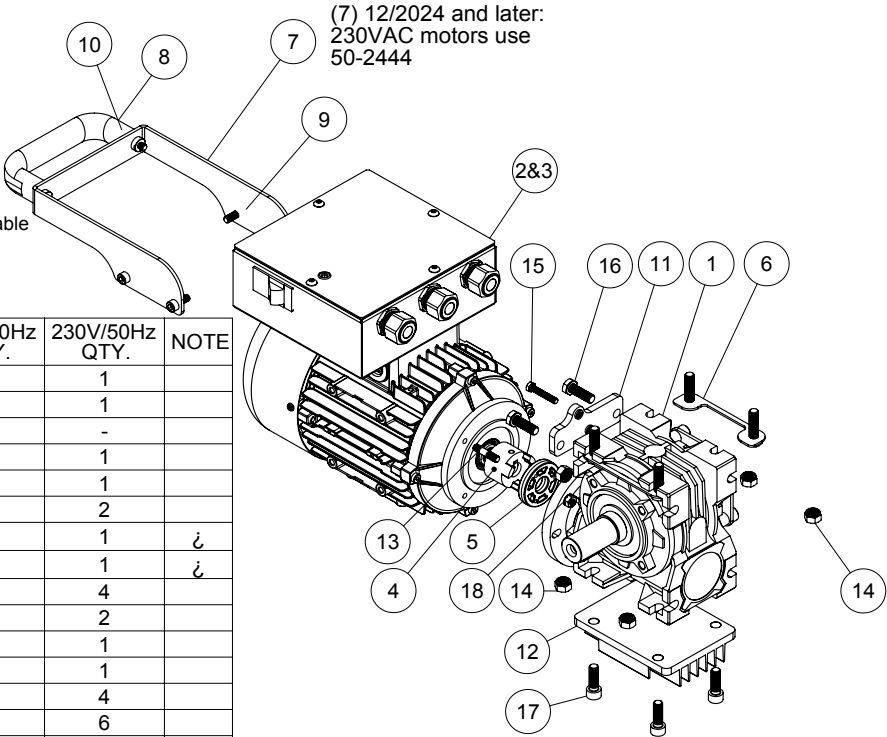


Earlier versions may vary.

LEGEND:
* Not available for sale
† Assembly diagram available
± Part of larger assembly
¿ Comes with hardware
‡ Not shown
@ Special Order

LEGEND:
* Not available for sale
† Assembly diagram available
± Part of larger assembly
¿ Comes with hardware
‡ Not shown
@ Special Order

ITEM NO.	PART NUMBER	120V/60Hz QTY.	230V/50Hz QTY.	NOTE
1	37-2200	1	1	
2	50-1528	-	1	
3	50-1526	1	-	
4	50-2260	1	1	
5	50-2263	1	1	
6	50-2210	2	2	
7	50-1844	1	1	¿
8	37-813	1	1	¿
9	35-718	4	4	
10	35-229	2	2	
11	50-2207	1	1	
12	50-2209	1	1	
13	35-4057	4	4	
14	36-002	6	6	
15	35-320	1	1	
16	35-317	2	2	
17	35-236	6	6	
18	36-4017	1	1	



(7) 12/2024 and later:
230VAC motors use
50-2444

DATE	NOTES	DRO READINGS			
MONTH / DAY / YEAR		HOURS	TOTAL	AVERAGE	LAST 5

MAINTENANCE SCHEDULE

DATE	NOTES	DRO READINGS			
MONTH / DAY / YEAR		HOURS	TOTAL	AVERAGE	LAST 5



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R9/2025

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