ROTTLER

EM103/4/5 SERIES HEAVY DUTY CNC MACHINING CENTER

OPERATION AND MAINTENANCE MANUAL

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18.02.2020

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ORDERING PROCEDURE

Contact your regional Rottler sales rep for assistance in ordering optional equipment, replacement parts, or tooling.

If you are unable to contact your regional Rottler sales rep, call the factory at 253-872-7050 and ask to speak to the parts sales specialist.

Have the following information handy to expedite the ordering process:

1. Your name, business name, and contact number
2. Customer number
3. If you don't have a customer number, your billing address
4. Shipping address if different from billing address
5. Machine model and serial number
6. Part number and description of what you want to order
7. Preferred method of shipment
8. You may also contact us via e-mail with the above information. Send e-mail requests to: parts@rottlermfg.com or intlpart@rottlermfg.com

In some cases you may be requested to send a photo of the part you are ordering if it is a replacement part, or doesn't appear in the database.

If you are unsure which part you need to order, contact our service department and ask to speak to one of our service consultants. They will assist you in determining which part you require.

THERE IS A MINIMUM ORDER OF $25.00

INTRODUCTION

Contents

Introduction

READ THE SAFETY CHAPTER BEFORE INSTALLING MACHINE. THOROUGHLY UNDERSTAND ALL SAFETY ISSUES BEFORE OPERATING MACHINE.

ATTENTION OWNER/BUSINESS MANAGER

To validate the warranty on your new Rottler machine, please be sure to sign and complete the "Installation Report" located in the Installation Chapter of this manual.

We suggest that the new user of the EM103/4/5 read the CONTROL DEFINITIONS to get an idea how the machine operates.

The Operating Instructions chapter should be read in order to familiarize the user with the actual button pushing sequences required to carry out a job. These chapters in the manual should be considered an introduction. As the operators of the EM103/4/5 series machines gain experience with using the different functions of the machine, complicated setups and programs will make more sense.

The rest of the manual contains information and part number reference on fixtures, cutting tools, and machine maintenance. The operator should read and become familiar with these areas as well.

Description

The model EM103/4/5 machine is a precision, single point boring, and high-speed surfacing unit. The machine can be equipped with tooling and accessories for surfacing and re-boring most American passenger car and truck engines, In-lines, as well as 90 and 60 degree V-types.

EM103/4/5 machines can be easily tooled, to machine a wide range of engines, including European and Asian engines, also, the machine can be easily adapted to perform other boring and surfacing operations.

The machine is designed, to maintain alignment of cylinder bores, and cylinder head, deck surfaces to the pan rails and main bearing bore locations, as was done in the original factory machining. This overcomes the many inaccuracies and out-of-alignment problems associated with clamping portable boring bars to the cylinder head surface of blocks.

Convenient controls, fast block clamping, precise 3 axis CNC positioning and clamping, means considerable savings in floor to floor time, and operator involvement.

Change over or resetting time required to set up V-type or in-line engines is a minimum, making this machine highly suited to the jobber shop where engines cannot be run through in model lots.

All feeds and rapid travels are power operated and controlled form the control panel.

Disclaimer

The EM103/4/5 Manual (henceforth to be referred to as the “Manual”) is proprietary to Rottler Manufacturing LLC. (“Rottler Manufacturing”) and no ownership rights are hereby transferred. No part of the Manual shall be used, reproduced, translated, converted, adapted, stored in a retrieval system, communicated or transmitted by any means, for any commercial purpose, including without limitation, sale, resale, license, rental or lease, without the prior express written consent of Rottler Manufacturing.

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Rottler Manufacturing and its employees or representatives are not responsible for any information regarding final specifications of any workpiece that is created as a final product when using Rottler equipment. It is the responsibility of the end user of Rottler equipment to determine the final dimensions and finishes of the workpiece that they are working on. Any information regarding final dimensions and finishes that appears in any Rottler literature or that is expressed by anyone representing Rottler is to be regarded as general information to help with the demonstration of or for operator training of Rottler equipment.

Limited Warranty

Rottler Manufacturing Company Model EM103/4/5 parts and equipment is warranted as to materials and workmanship. This limited warranty remains in effect for one year from the date of installation or two years from the date of the original shipment from Rottler or whichever date occurs first. This only applies is the machine is owned and operated by the original purchaser and is operated and maintained as per the instructions in the manual. A machine is warranted only if the Installation Report has been properly executed by a certified installation person and received by Rottler at the time of actual installation.

The products are warranted upon delivery to conform to their published specifications and to be free from defects in material and workmanship under normal use for a period of one year from shipment. Should a product not be as warranted, Rottler sole obligation shall be, at its option, to repair, correct or replace the product or to refund the amounts paid for the Product upon its return to a location designated by Rottler. No warranty shall extend to rapid wear Products (including tooling) or to Products which have been subject to misuse (including any use contrary to Rottler instructions), neglect, accident (including during shipment), improper handling or installation, or subject to any modification, repair or service not certified by Rottler. Rottler shall not be liable for any consequential, direct or indirect damages or for any other injury or loss. Buyer waives any right, beyond the foregoing warranty, to make a claim against Rottler. No warranty is provided for any Products not paid in full.

Merchandise cannot be returned to Rottler without prior approval. Customer must contact the Parts Department to get approval and to be issued a Return Goods Authorization number **(RGR#).** Merchandise authorized for return must be returned prepaid. If merchandise is returned with shipping charges collect, the actual amount of these charges may be deducted from any credit which may be due the customer. The **RGR #** assigned by the Parts Department should be written on the shipping label and must appear on a copy of the invoice(s) covering the original shipment. This invoice copy must be included in the box with the parts. Shipment must contain ONLY those items on the **RGR** as approved for return. Merchandise must be received within 10 days of the date of **RGR** or the **RGR** will be canceled. All returned merchandise may be subject to a 20% restocking fee on under $1,000.00 amount or 10% on any items over $1,000.00. Parts or tooling over 30 days old are considered as customer property and can only be returned with prior approval from Rottler Corporation Management.

The issuance of a **RGR DOES NOT** guarantee credit - it is only authorization for the return of the goods. Credit for return merchandise is at the sole discretion of Rottler. Credit will be issued only after inspection of returned goods.

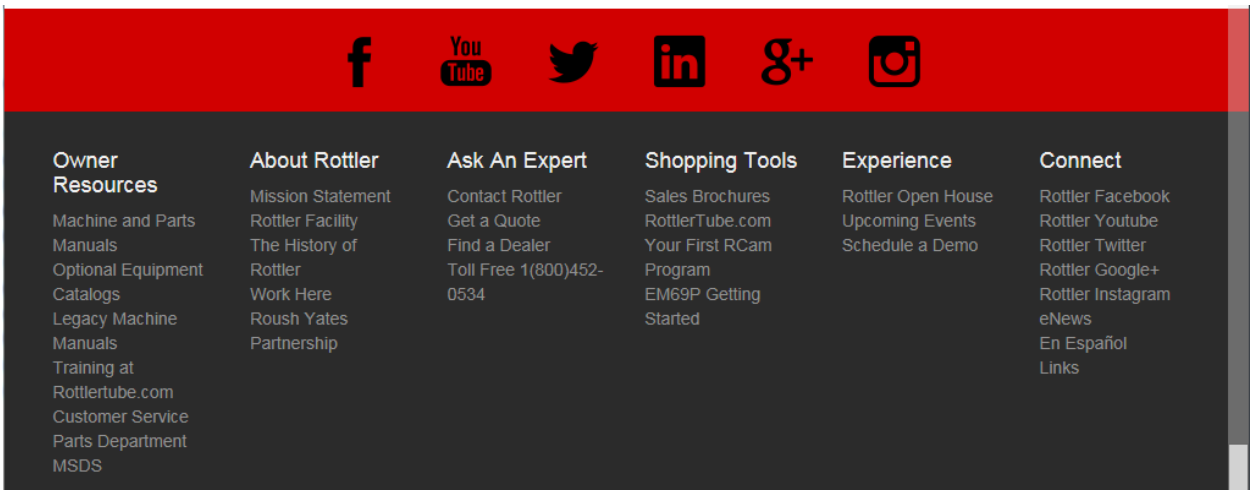
Tools proven to be defective within the warranty period will be repaired or replaced at the factory's option.

We accept no responsibility for defects caused by external damage, wear, abuse, or misuse, nor do we accept any obligation to provide compensation for direct or indirect costs in connection with cases covered by the warranty.

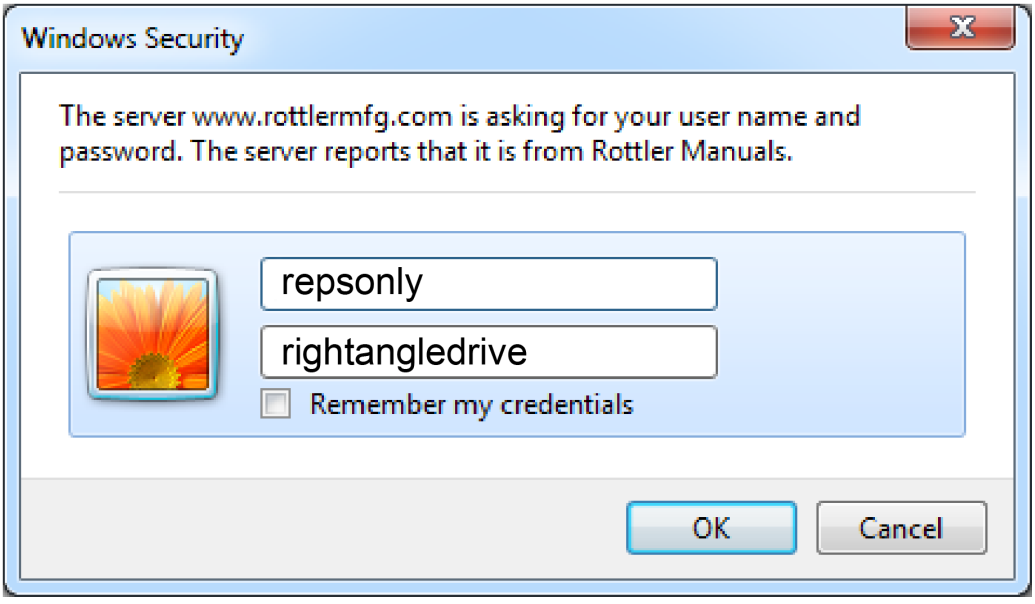
Online Documentation Access

Online documentation for machines and optional equipment can be accessed at the Rottler website. To access documentation open your browser and navigate to https://www.rottlermfg.com.

Scroll to the bottom of the page and under the Owner Resources title click the type of documentation you want to access.



If a log in window pops up asking for user name and password fill in the blanks as shown.



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INSTALLATION

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EM103/4/5 INSTALLATION PREPARATION REQUIREMENTS

1. Floor needs to be prepared with anchor bolts installed. Rottler highly recommends the Hilti system.

2. Machine needs to be set in place with a leveling pad under each leveling bolt. After setting the machine in place, check that each anchor bolt nut turns freely and that there is no damage to the anchor bolt threads.

3. Rough level the machine.

4. Electrical connection made to the machine. Provide 208-240 VAC 3 phase power. 60 amp service is required.

5. Ground rod installed and connected.

6. Air supply to the machine. Minimum 100 PSI of clean, dry air.

7. Fixtures removed from the machine bed, and cleaned of rust preventative.

8. Machine cleaned of rust preventative.

9. Machine requires an Internet connection. Preferably wireless.

10. Have a scrap block available for operator training. Preferably a block commonly repaired at your facility.

ATTENTION OWNER/BUSINESS MANAGER

To validate the warranty on your new Rottler machine, please be sure to sign the installation report after the installation technician has installed the machine and verified the machine is operating correctly and given the operators operation and maintenance training.

Thank you for your cooperation and the opportunity to be of service to you.

ROTTLER MANUFACTURING

ROTTLER

INSTALLATION REPORT
EM100 SERIES
REV 112719

OFFICE USE ONLY

Route to:
Parts _____ Service Mgr _____ Assem Mgr _____ Eng Mgr_____Parts _____ Andy _____ Parts _____
Warranty Exp Date _____

ROTTLER MANUFACTURING MUST HAVE THIS REPORT RETURNED TO PROPERLY QUALIFY WARRANTY ON EQUIPMENT

Customer:_____ Address:_____
City:_____ State:_____ Zip:_____ Phone:_____
Country:_____
Machine Model:_____ Serial Number:_____ Representative:_____

MACHINE INSTALLATION: Electrical information MUST be complete to validate this report.

_____Customer has read and fully understands importance of machine location as explained in the installation section of the manual.

The following is the customer's responsibility prior to the arrival of Rottler technician. Please initial each item when it is completed.

Customer must provide foundation and hold down bolt system, see following attached drawing and document "F70 and F100 Series Foundation and Hold Down Requirements"

⚠ CAUTION

VERY IMPORTANT: Modern design machines contain electronic low voltage circuitry that provides great advantages and a better machine life. BUT, you must have an excellent, stable power supply along with a good earth ground. If not, electrical noise problems are likely to interfere with machine operation unexpectedly.

Customer is responsible for providing electricity to machine in a manner that meets the local electrical code requirements.

_____Remove machine from truck. Weight: EM103 14,000 lbs (6,350 kg) EM104 16,000 lbs (7257 kg) EM105 18,000 lbs (8165 kg) EM107 45,000 lbs (20,412 kg) EM109 50,000 lbs (22680 kg).
_____If the machine was shipped in a container follow the removal procedure in the installation section of the manual. (EM103, EM104, EM105 only)
_____Remove fixturing and misc. parts from machine and clean.
_____Install machine on foundation with supplied jack pads under jacking bolts.
_____Install hold down nuts and bolts, see attached document. – This must e done first.
_____Rough Level the machine using a precision level so there is equal tension on all bolts.
_____This machine requires between 208 and 240 Volts AC, Three Phase, 50/60 Hz power supply. For voltages above 240 or below 208 VAC, a 30kva transformer will be required. Measure the incoming voltage between L1 and L2, L2 and L3, and L1 and L3. Current requirements for this machine is 60 amps. Measure the incoming AC voltage at least twice during installation.
1. L1to L2 _____VAC, L2 to L3 _____ VAC, L1 to L3 _____
2. L1to L2 _____VAC, L2 to L3 _____ VAC, L1 to L3 _____

_____Measure each leg of the incoming supply to ground. Sometimes you may find a "high" leg to ground. When this happens make sure the high leg is running to L3.
L1 to ground _____VAC L2 to ground _____VAC L3 to ground _____VAC

⚠ CAUTION Neutral and machine ground are not the same thing. You should measure an open circuit between Neutral and ground.

⚠ CAUTION **IF VOLTAGE IS OUTSIDE THE CORRECT RANGE AT ANY TIME THE MACHINE WILL NOT OPERATE PROPERLY AND MAY BE DAMAGED.**

_____Air of the proper pressure and capacity connected to the machine. Air supply must be free from oil and water. Oil or water will damage electrical and air components.
_____Customer should attempt to have junk work piece available.
_____Have the operator read through the operation manual before training begins. This will help him be familiar with the button pushing sequences. Have the operator read through the manual again after training and some of the sequences will make more sense.
_____Have Internet connection available for the machine. Either via Ethernet cable or Wireless. The machine comes equipped with a wireless USB adapter.

The following is the Rottler technician's responsibility

_____Check column top and spindle base bottom for rust and nicks if spindle must be installed. Clean and stone as required.
_____When lifting spindle unit, keep in mind the front to back center of gravity is located approximately 12 inches from the front end and has a tendency to lean forward.
_____Each main system is protected internally by circuit breakers. Green indicates the breaker is "tripped" and red indicates the breaker is "Hot" (conducting electricity).
_____Clean any rust inhibitor from the machine surfaces. Move the column from side to side continually cleaning the machine base until all inhibitor is removed.
_____Install spindle unit on column, if required, using one of the approved methods described in the operation manual. (Spindle unit weighs 6,000 lbs, 2,800 Kgs.)

Using fork lift angle iron brackets

_____Bolt brackets to each side of the spindle base.
_____Use large C-clamps to clamp the fork lift forks to the angle iron brackets. This will prevent any accidental slips. Loosen 1/2 13 x 3 1/2 Inch bolts on pendent arm to allow it to be moved out of the way.
_____Use a forklift to lift the spindle unit onto the column. Be careful to watch clearance of all items.
_____Install the Right (Fixed Side Rail) and removable dowel pins. Torque Side Rail bolts to 80 Ft/lbs.
_____Lift spindle unit into place. Push spindle base up against Right Side Rail.
_____Install left side rail (9202A) with 2 Belleville's (9024E) opposing each other () on each set screw (9202D), torque side rail bolts to 80 Ft/lbs.
_____Adjust the adjustable screws (9202D) on SIDE rails by tightening them until they bottom out, then unscrewing them 1/8 turn.
_____Measure the protrusion of the Sides Rails above the spindle base and record.
Right: Front _____ Rear _____
Left Front _____ Rear _____
_____Install the Right and Left Top Rails.
_____Install top rails (9202B) with 2 Belleville's opposing each other () on each adjustable set screw (9202D). Torque to 80 lbs.

_____Adjust the adjustable screws (9202D) on TOP rails by tightening them until they bottom out, then unscrewing them 3/4 turn.
_____Remove angle iron brackets form spindle base.
_____Connect air and oil lines per air logic diagram.
_____Remind customer of the proper air pressure and capacity connected to the machine. Air supply must be free from oil and water. Oil or water will damage electrical and air components.
_____Connect electrical wires in main rear enclosure if required using machine wiring diagram.

MACHINE START-UP

⚠ CAUTION When starting the machine for the first time, it may move out of control. Make sure all hands are clear of machine parts. Be ready to press the Emergency Stop button if needed.

_____**BEFORE** turning power on to the machine. Check all wires for security by using the correct screw driver and turning CW until movement stops. Stranded wire can “spread” slightly from vibration during transport.
_____Install electrical component covers inside the electrical enclosure with fasteners provided.
_____Turn main power on at the main disconnect switch located on the rear enclosure.
_____If machine moves out of control, turn power off and contact factory for help in trouble shooting.
_____If any of the circuit breakers “trip”, reset and call factory for possible trouble shooting.
_____Install and test the Internet connection to the machine. DO NOT download any updates unless instructed to do so by Rottler.
_____Check the computer control options and make sure that you turn on z-axis bit 2 and spindle bit 3.

MACHINE MOVEMENTS

_____Make sure there is nothing obstructing the full vertical, horizontal or In/Out travel of the machine taking special notice of the rear enclosure, way travel and top of the spindle unit.
_____Put the machine in hand wheel mode and verify Vertical operation. Put an indicator on the cutter head and verify .001” movement per detent in course mode and .0001” in fine mode. If the indicator is jumpy the outer spindle adjustment may be too tight. Refer to manual and re-adjust.
_____Put the machine in hand wheel mode and verify Horizontal operation. Put an indicator on the cutter head and verify .001” movement per detent in course mode and .0001” in fine mode
_____Use the rapid buttons and verify proper vertical, horizontal and In/out travel.
_____Check limit switch operation with handwheel before using the power feed.
_____Move the machine to its vertical limits to verify proper operation.
_____Move the machine to its horizontal limits to verify proper operation.
_____Move the machine to its In/Out limits to verify proper operation.
_____Start the spindle and verify operation at all speeds.
_____Use the spindle creep buttons and verify proper operation.
_____Prime the oiling system. (See maintenance section of manual for complete details.)
_____Use a precision level and level the machine:

Record machine level readings below (must be within .0005). Back Way:

Back Way:
P1 _____ P2 _____ P3 _____ P4 _____ P5 _____ P6 _____ P7 _____ P8 _____
Back to Front Way:
P1 _____ P2 _____ P3 _____ P4 _____ P5 _____ P6 _____ P7 _____ P8 _____

Record Dial Indicator readings:

Spindle to Back Table:
P1 _____ P2 _____ P3 _____ P4 _____ P5 _____ P6 _____ P7 _____ P8 _____
Spindle to Front Table:
P1 _____ P2 _____ P3 _____ P4 _____ P5 _____ P6 _____ P7 _____ P8 _____

_____Check mill tilt, and lift amounts with Y axis in the middle of travel, and record
Amount of tilt _____ Amount of tilt _____
(See Section 6 of the manual for specification)

The following procedures should be shown to personal involved in machine maintenance.
See maintenance section of manual for complete details. Video of procedure can be viewed at:
www.rottlertube.com

_____Adjust outer spindle bushings. (See maintenance section of manual for further instructions)
_____Adjust inner spindle bearings. (See maintenance section of manual for further instructions)
_____Perform spindle sweep adjustment. (See Rottlertube.com for walk through)
_____Verify ALL axis backlash comp is operating properly, adjust if needed. Record actual readings after verification.

	Auto	Handwheel
X-Axis	_____	_____
Y-Axis	_____	_____
Z-Axis	_____	_____

_____Install way cover brackets and way covers. Way Cover support brackets should be flush with way surface.

INSTRUCTING THE OPERATOR

Note: Rotter employees and representatives per company policy are not permitted to provide end user of Rottler equipment with any OEM specifications for the workpiece that is created by end user using Rottler equipment.

⚠ WARNING

_____ Explain to the customer and operator that at NO time is there to be any software or hardware other than Windows Auto Update and Rottler installed on this machine. This includes screen savers, anti-virus software, and any hardware device that installs software on the machine. Installation of screen savers and anti-virus software can cause dangerous control problems. Any installation of software or hardware will void the warranty on the machine.
_____Explain to the customer and operator that the machine should be hooked up to the Internet anytime it is on. The software on the machine will automatically connect to our server to send back useful information on machine status.
_____Connect customer supplied Internet to the machine. Verify that the Internet is accessible from the machine.
_____Once the machine has been fully setup and is ready for operation create a Skype account for the machine following the instructions in the Installation Section of the manual.
_____Explain to the customer and the operator how the to log onto Skype and communicate with Rottler when needed.

⚠ WARNING

_____ Computer Viruses will cause the machine control system to become unstable. This may cause the machine to make uncontrolled moves which could create a dangerous environment for the machine operator.

IMPORTANT

_____Refer to Chapter 4, Control Definitions of the Machine Manual, Section: Computer and Controller System Safety. Explain and discuss this section carefully with Owner/Manager/Operator and have them sign off. Failure to do so will result in the machine warranty being Null and Void.

_____

Signature / Title

_____Explain to the customer the importance of backing up the block profiles to a separate device. Any computer failure or possible operator input error can result in the loss of all block profiles that were created for the machine. Refer to Chapter 5 of the machine manual for detailed instructions on backing up and restoring block profiles.

_____Explain to the customer the proper way to turn the machine off when it is not in use. Do not leave the machine on overnight. It is important to close all programs followed by shutting down Windows before turning the main power switch off. Do not turn the main power switch off before shutting down Windows.

_____Using the operating manual as a guide explain the function of all buttons.

_____Cycle all machine movements and supervise the handling of same by operator.

_____Demonstrate the differences of Manual and Auto operation.

_____Fully explain the entire Auto Cycle from Centering to Auto Retract.

_____Explain machine parameters and error messages. It is very important that the customer does not change parameter settings without first checking with Rottler Manufacturing. If certain parameters are changed the machine may make uncontrolled moves or not operate at all.

_____Point out safety features to customer and operator. Do not push any buttons without thinking of safety first.

⚠ CAUTION Do not assume the cutterhead micrometer has been calibrated.

_____Install a work piece in the machine and perform an undersize test bore to qualify the micrometer setting to the customers measuring tools.

Note adjustments: + _____, - _____.

_____Explain precision reset of tool in cutterhead.

_____The following is a checklist to go through every time the machine is started to begin a cut or automatic cycle.

- Work piece secure
- RPM set
- Feed Rate set
- Correct program in use
- Program oriented correctly (vertical zero at correct place) Centering range adequate
- Guards in place
- Cutterhead secure
- Tool holder adjusted to the correct size
- Tool holder locked in place

_____Proceed to have operator bore block to size.

_____Demonstrate and explain boring with the electronic hand wheel.
_____Explain the correct Feed rates and speeds from Cutting Insert Bulletin.
_____Cutter head change and expected stub bar performance.
_____Parts ordering, refer the to the operating manual for part numbers and description.
_____Offset tool bits, calibration of micrometer and anvil setting.
_____Train on ALL Rottler programs even if they need to be run in the air.
_____If Rottler CAM was provided to the customer train on any programs supplied by Rottler.
_____Review Emergency stop procedure with operator per operating manual.

MAINTENANCE SECTION

_____Use the manual as a reference when explaining routine maintenance and lubrication.
_____Overload devices, There are no mechanical overload devices on this machine. The machine is protected from overload by the motor controllers. If the system is overloaded the controllers shut the motors off. The controllers can be reset by turning the main power off for at least 1 minute, then turning it back on.
_____Explain again the proper Inner and Outer spindle adjustment to the operator.
_____Dampener cleaning.
_____Micrometer and anvil thread adjustment.
_____Inspection of tool bit hole in tool holders (deformation due to accidental impact).

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Note: Rotter employees and representatives per company policy are not permitted to provide end user of Rottler equipment with any OEM specifications for the workpiece that is created by end user using Rottler equipment.

General remarks on machine performance, adjustments as received and any further organization or parts required to complete the installation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Instructions given to:_____

Sales/Service Engineer: _____ Date_____

Shop Foreman/Superintendent or Owner: _____ Date_____

Once completed send this form to:
Rottler Manufacturing
attn: Parts Department
8029 S 200 St
Kent, WA 98032 USA

Alternately you may send this form via fax or e-mail:
fax: [+1] 253-395-0230
e-mail: parts@rottlermfg.com

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Removing Machine from Shipping Container

All EM100 machines that are shipped in a container must be unloaded using the following method.

Machines will be loaded into containers at the factory mounted on metal tubes. These tubes will facilitate the sliding of the machine out of the container.

If the machine is to be removed from the container for transfer to its final destination the seal must not be broken.

Use lifting straps or chains placed through the tubes to pull the machine from the container. Make certain that the machine is clear of the container before attempting to lift machine.

The photo below shows the machine packed and sealed for placement into a container.

The photos below show the tubes that the machine sits on. Place straps or chains through these tubes to pull the machine out of the container. Take care not to damage the threads of the bolts holding the tubes to the machine.

WARNING

Using an alternative method to remove the machine from the container that results in damage to the foil packaging seal or to the machine itself could result in the warranty being voided.

Installation Procedure

Rottler EM103/4/5 Series Foundation and Hold Down Requirements

Rottler machines require a good concrete foundation and hold down system. It is not recommended to install a machine on a cracked floor or over an expansion joint. The layout/position of the hold down holes can be found on the foundation drawings below.

There are two methods commonly used by customers:

1. Drill the concrete floor as per drawing layout before arrival of machine.
2. Place machine, mark floor through holes in machine base, move machine away then drill the floor.

The machine is provided with jacking bolts and steel pads to place between the jacking bolts and floor. For shipping, the steel pads are packed in a separate box and marked with yellow/black tape so the box is clearly visible. This allows the machine to be unpacked and removed from the shipping crate, placed on the floor on these steel pads without opening the accessory crates. When placing the machine on the jacking bolts, ALWAYS rough level to be sure that the weight of the machine is evenly distributed over all the jacking bolts.

Rottler recommends Hilti products as per attached list. 3/4” (20mm) diameter X 12” (300mm) long studs are recommended. Drill floor approx 7” (180mm) deep with 1” (25mm) drill. As it is difficult to drill concrete exactly on center, it is recommended to drill a pilot hole. After drilling and before injecting epoxy, it is also recommended to move the machine into place and make sure all studs fit through the holes in the base and travel all the way down into the holes so that approx 5” (130mm) protrude out of the floor. The machine may have to be moved a small amount to allow all studs to fit. Once this is checked, the studs can be removed then the epoxy injected into the bottom of the holes. Make sure all dust is vacuumed out of the holes before the epoxy is injected. Ensure that the epoxy is injected starting at the bottom of the holes to be sure the stud has maximum contact with the epoxy. The size of the holes will determine how much epoxy to inject into the holes before fitting the studs. On average, 1/2 to 2/3 of the hole should be filled with epoxy before the stud is installed. Be sure when the stud is installed, that the epoxy fills the hole to the top. Fit the washer and nut and tighten lightly to align the stud then allow the epoxy 24 hours to harden ready for leveling and final anchoring.

The column is tied down with chains for transport, if it is required to move the column to help with installation of the hold down system, the column tie downs can be removed and manually turn the horizontal ball screw nut by hand to move the column sideways. Be sure that the rails are clean and lubed under the column before moving.

The following is a ***MINIMUM*** recommendation for safe reliable operation.

4000 PSI concrete

Slab thickness of 12” (30cm)

Any slab that is thinner than this may require monitoring of levelness of the machine.

Lifting Machine with Provided Lift Eyes

⚠ WARNING

Lifting a machine using the following method is a dangerous and demanding procedure. Therefore Rottler recommends that the customer hire a licensed and bonded material handling specialists. Rottler will not be held liable for and consequences resulting from mishandling of the machine using this method.

Observe the following precautions:

1. Check the machine invoice to see what the shipping weight was and be certain that the hoists to be used ratings exceed that weight.
2. Be certain that all rigging used is rated for the weight that will be lifted.
3. Check lift eyes for damage and for secure attachment.
4. Nylon straps are preferred over cable and chain in order to prevent damage to machine.


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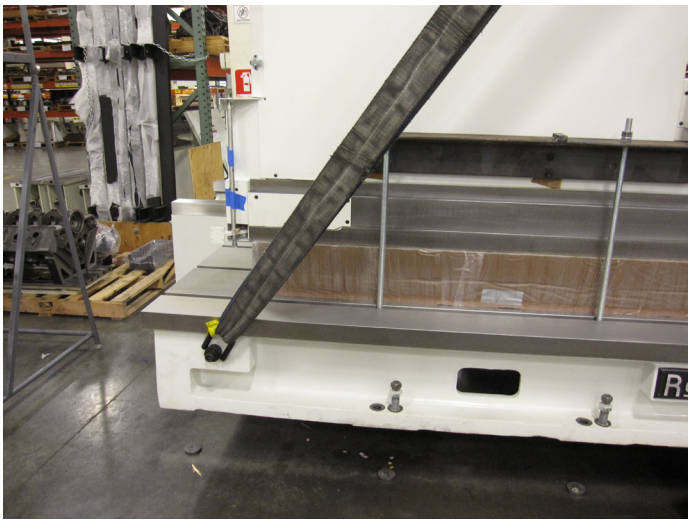


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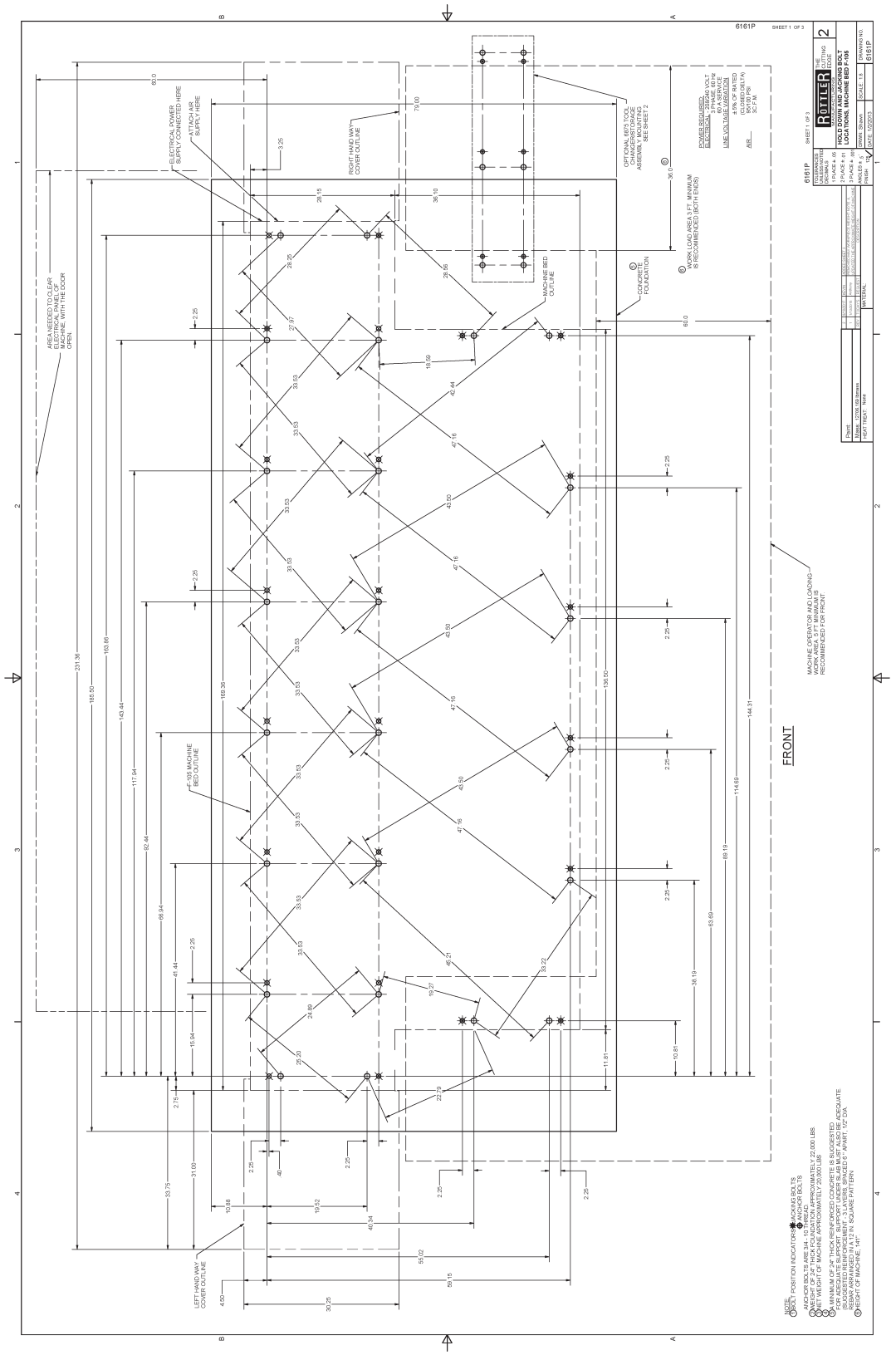
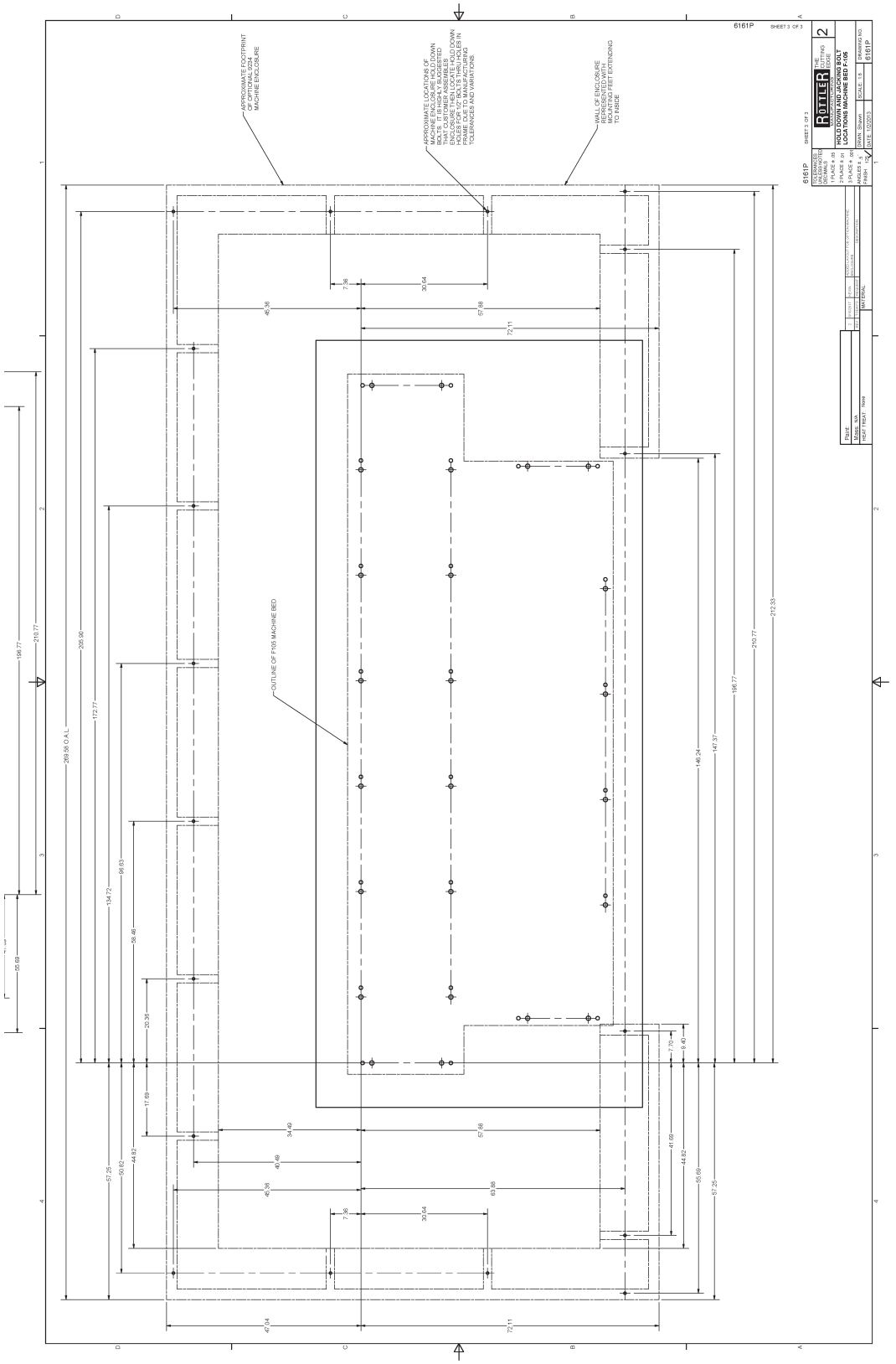
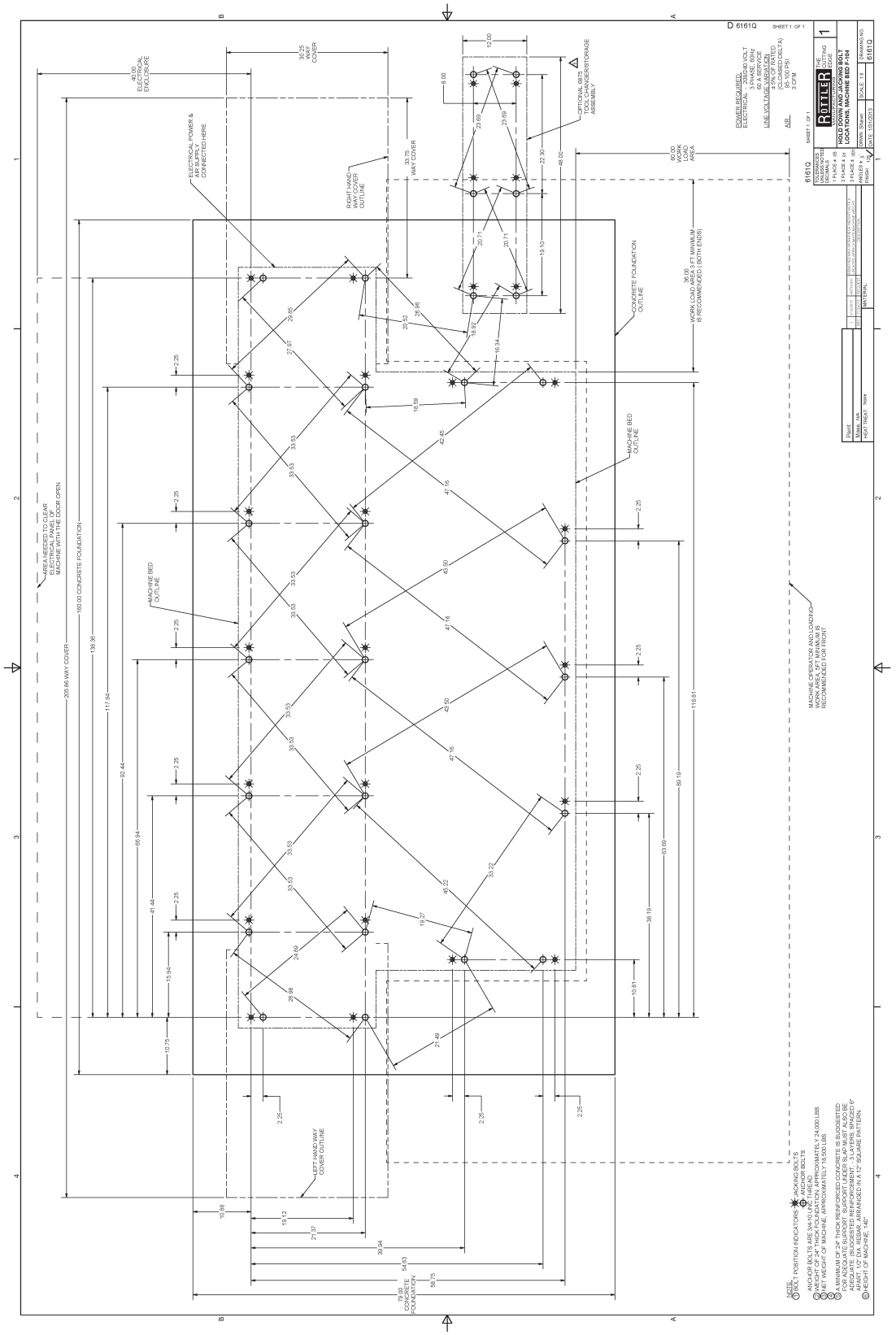
EM105 Hold Down and Jacking Bolt Locations



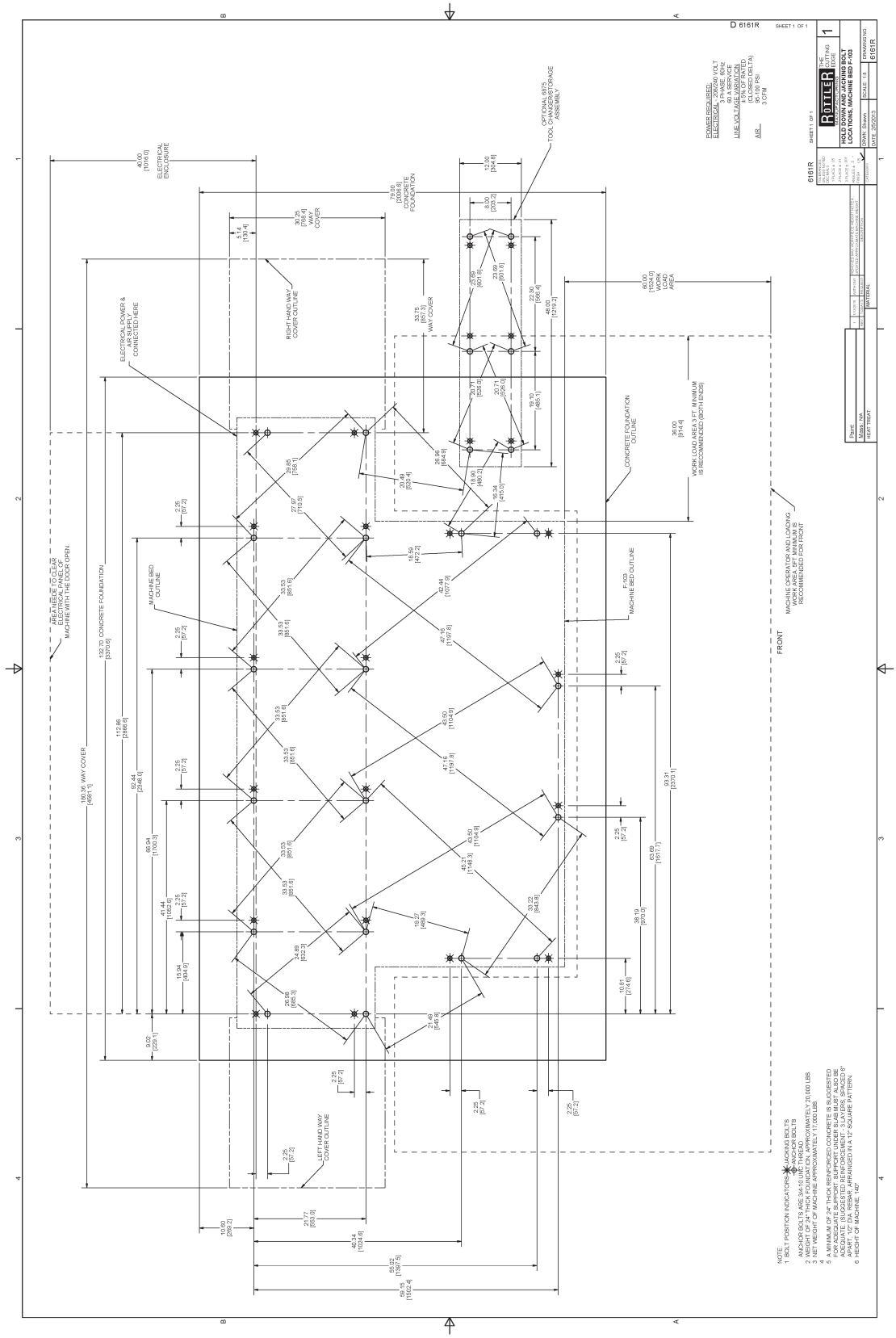
EM105 Optional Enclosure Mounting Bolt Locations



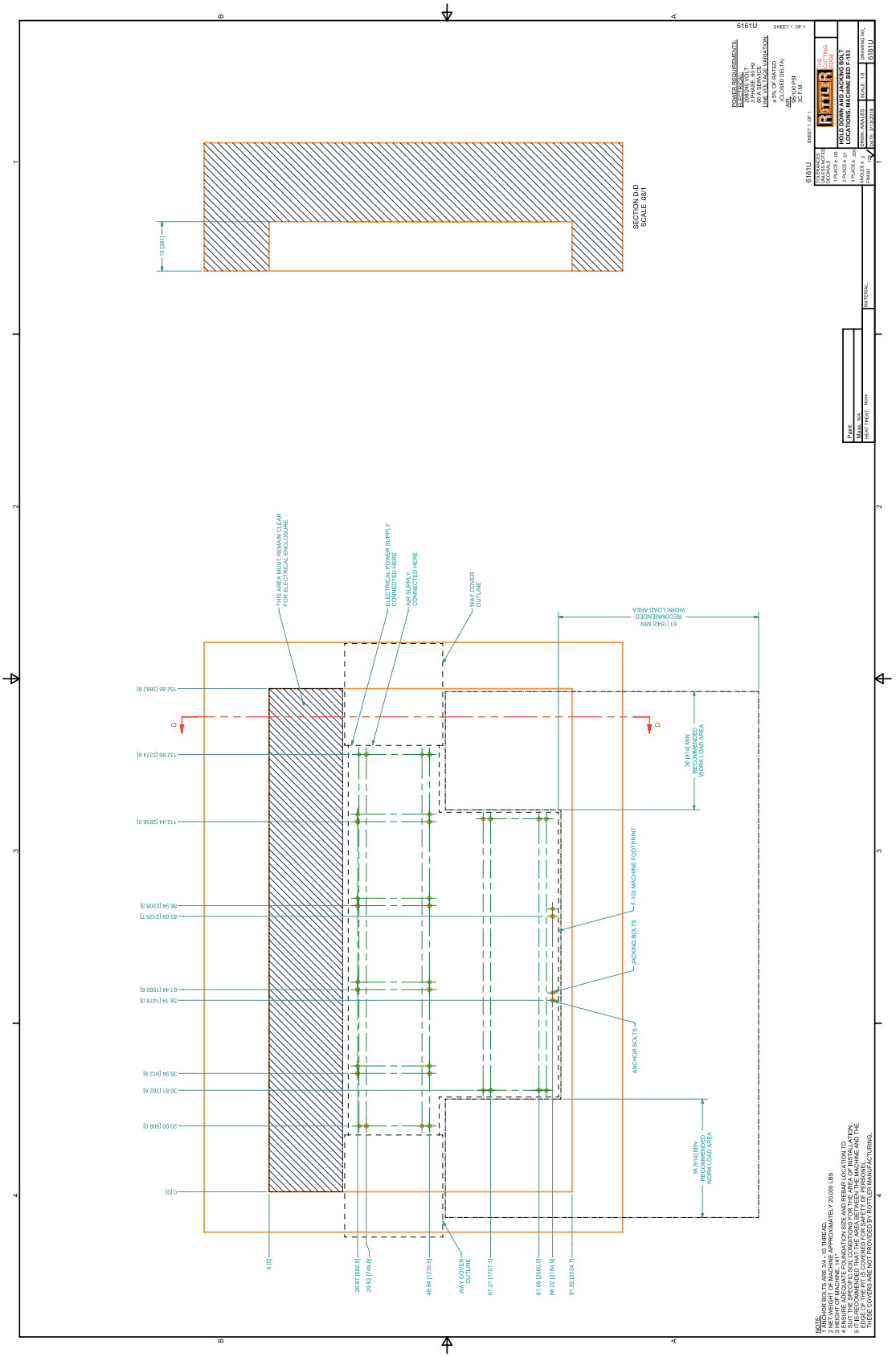
EM104 Hold Down / Jacking Bolt Locations



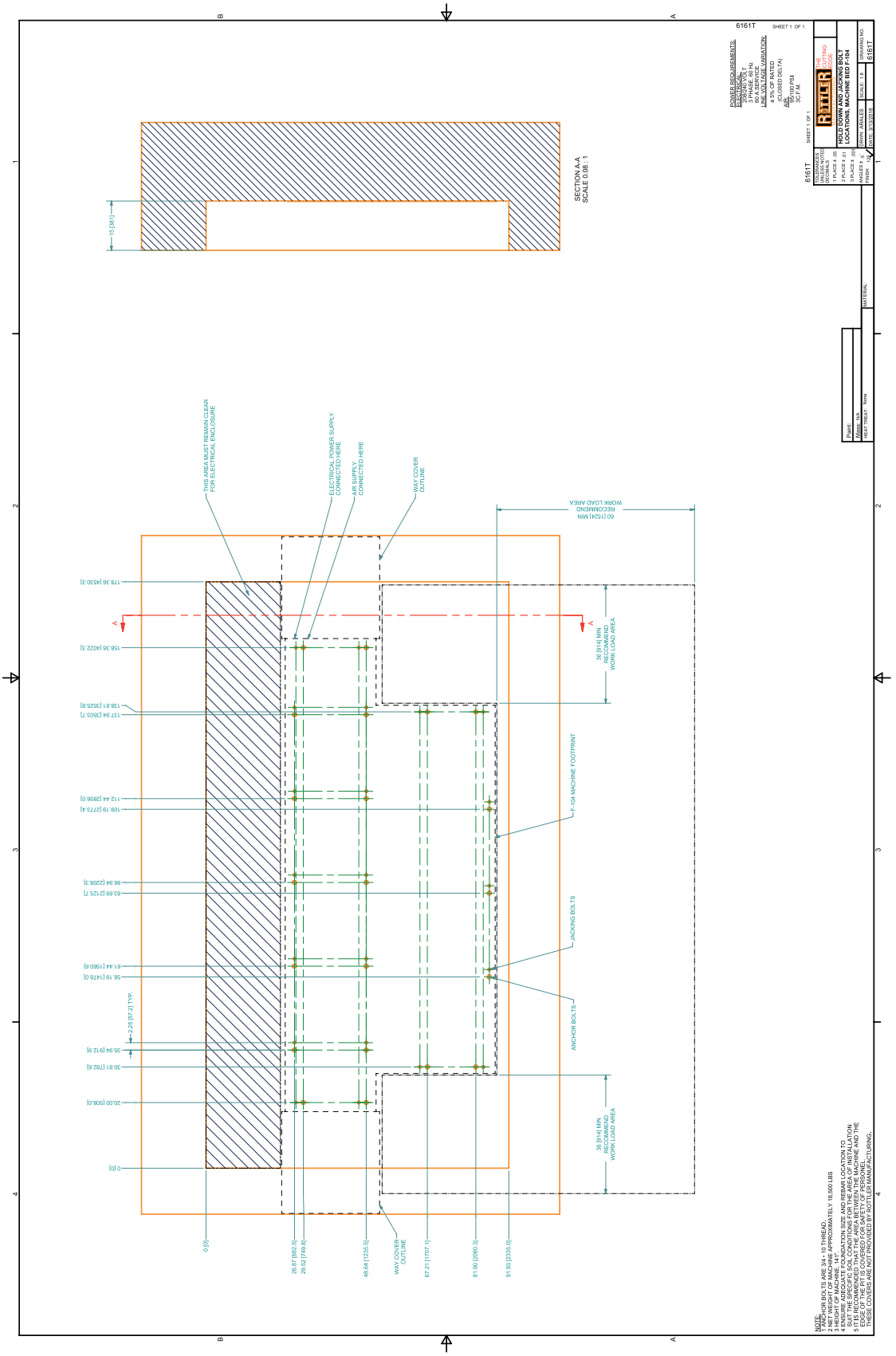
EM103 Hold Down / Jacking Bolt Locations



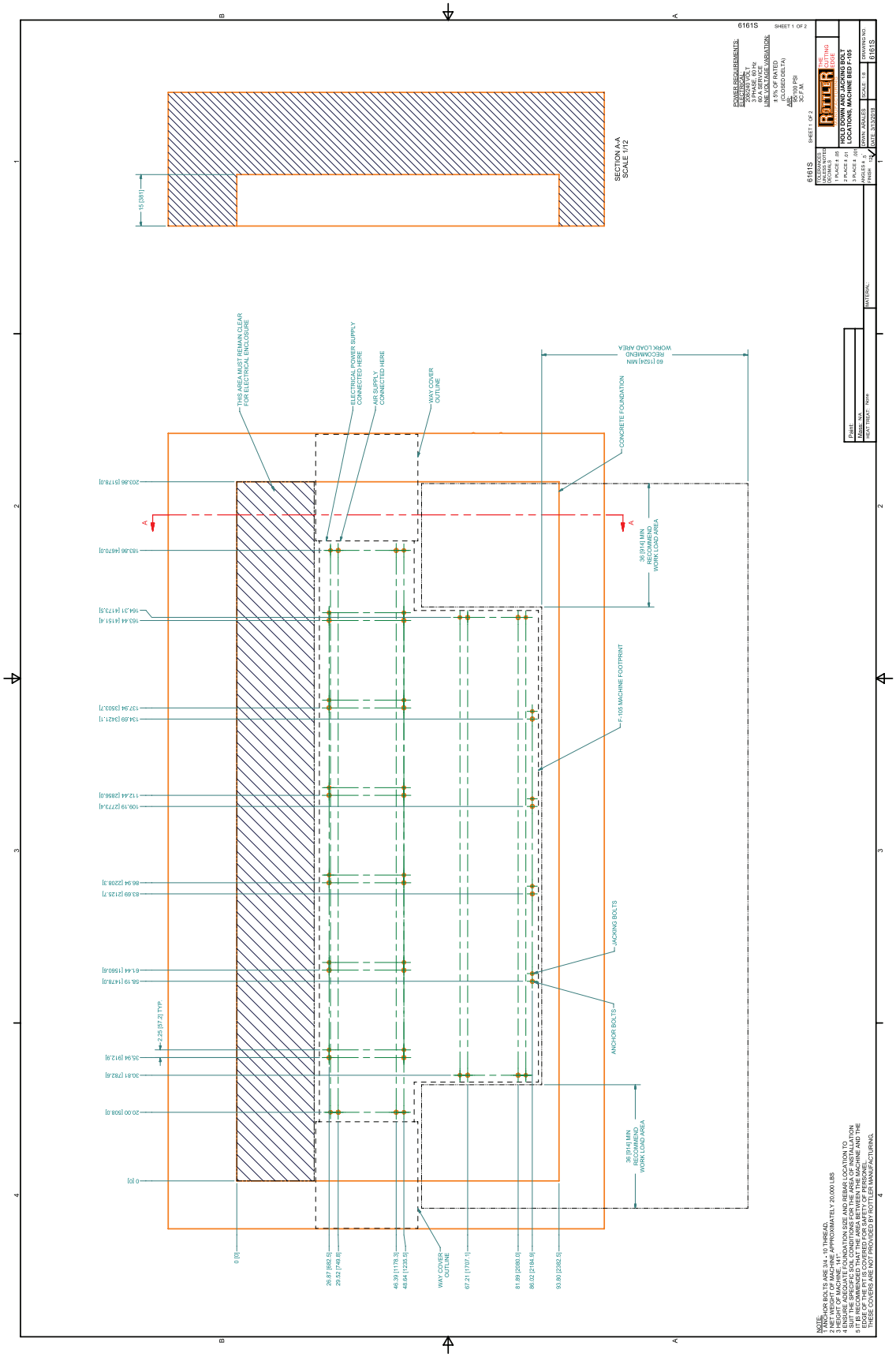
EM103 Hold Down / Jacking Bolt Locations Sunken Foundation



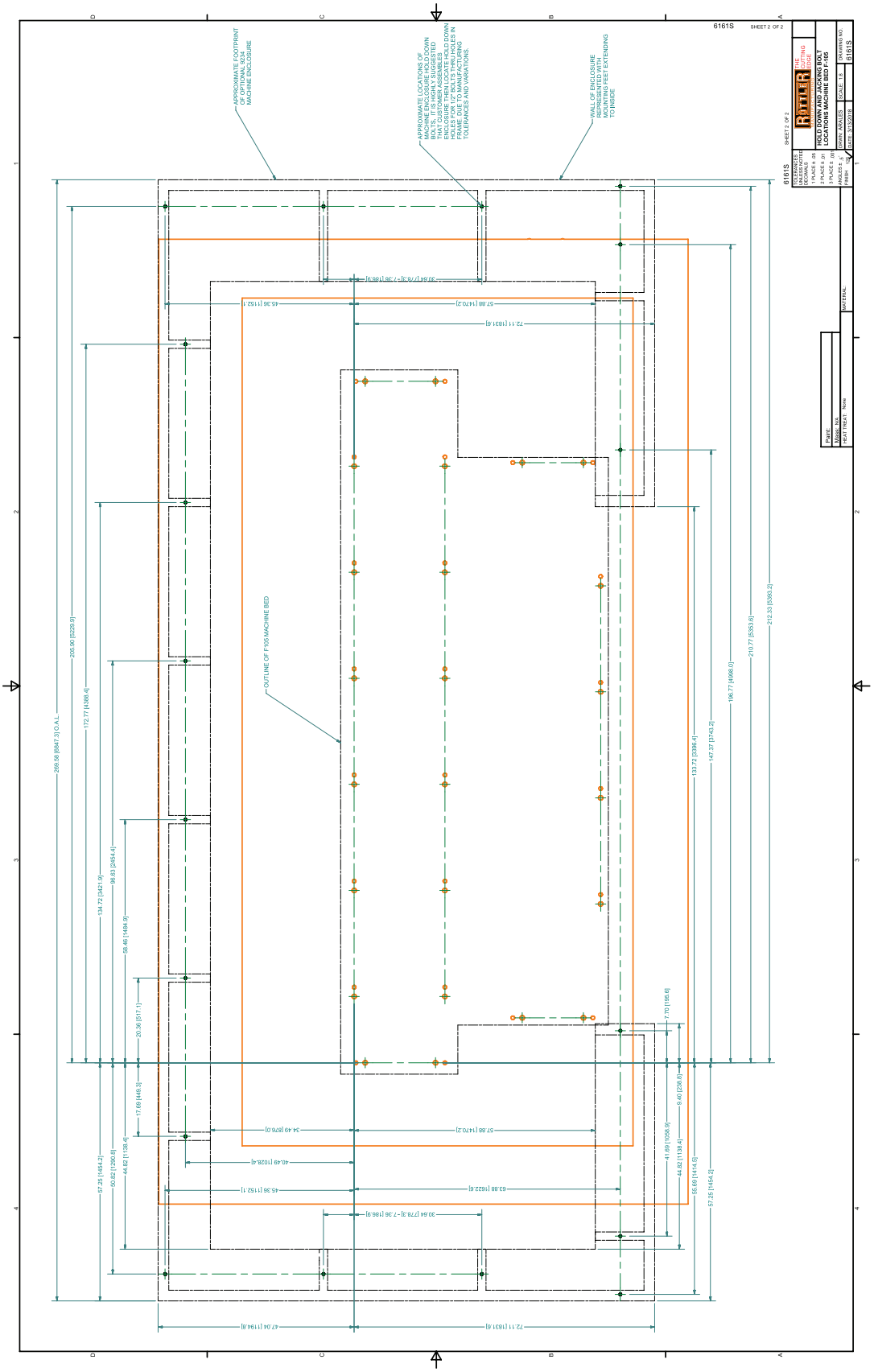
EM104 Hold Down / Jacking Bolt Locations Sunken Foundation



EM105 Hold Down / Jacking Bolt Locations Sunken Foundation

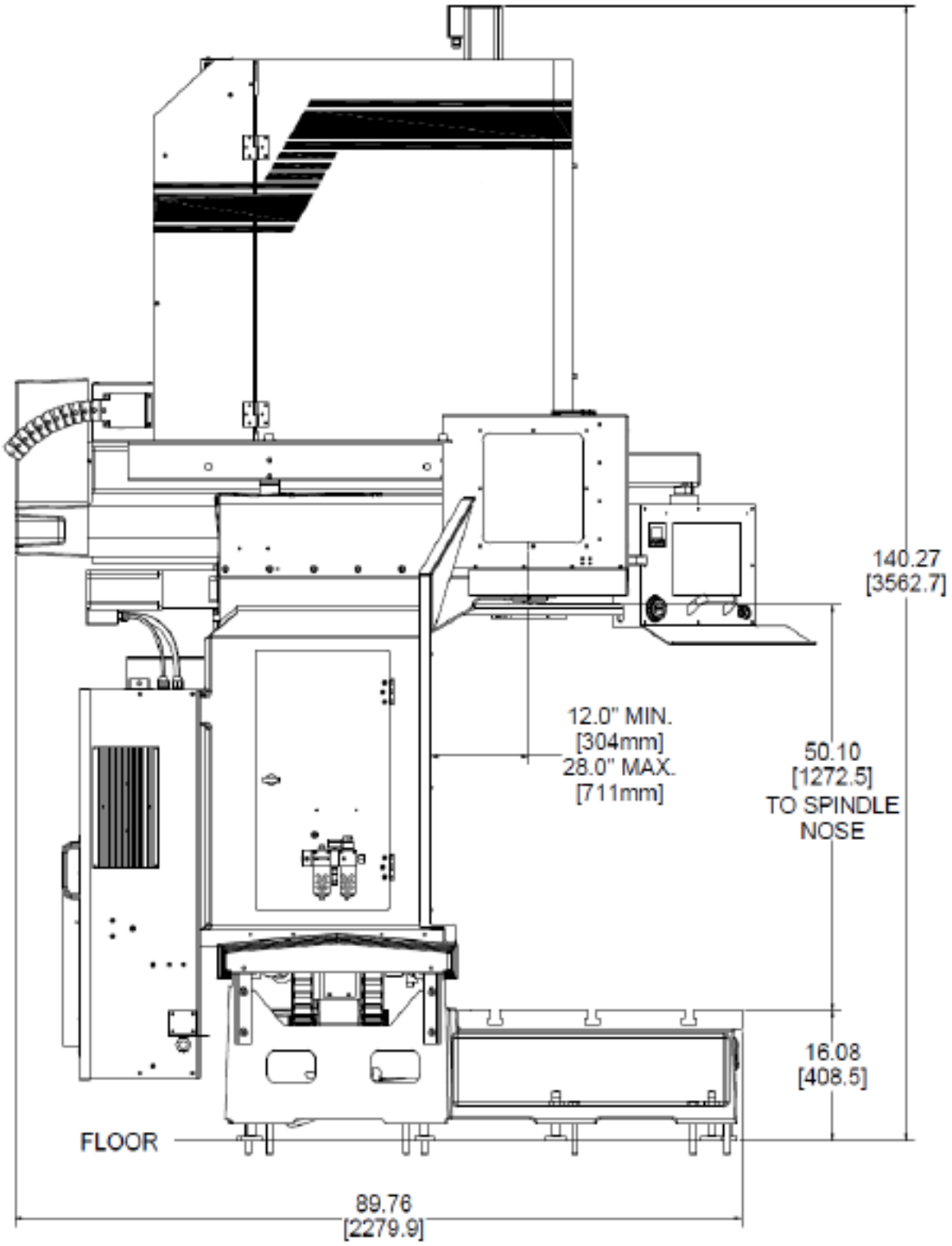


EM105 Hold Down / Jacking Bolt Locations Sunken Foundation



Machine Dimensions

Left Side View



IMPORTANT! Placement of Machine

It is critical that the machine be placed in an area of the facility that has a stable thermal environment. The machine should be kept away from direct sunlight, large heating units, and doorways that would allow outside air direct contact on the machine.

Exposure to the above and other extremes in temperature will cause thermal drift to occur in the machines which could have a detrimental effect on machining accuracy. A number of unrepeatable errors in machine performance have been linked to this condition.

Location

The productivity of this machine will depend a great deal on its proper initial installation. Pay particular attention to the means by which work pieces are lifted into the machine as well as the material handling to and from other operations in your shop.

The proper loading arrangement and area location for your EM103/4/5 machine is extremely important.

A slow travel (6’ to 10’ per minute) power hoist, operated from either a bridge crane or a jib crane arrangement works very well. Verify the hoist has a rating that exceeds the load being lifted.

For shops where large production runs are anticipated, the work pieces should be directly loaded and unloaded from a conveyor. If this is not the case we recommend considerable attention be given to the crane so that it covers an adequate area, to allow the operator to back up and remove work pieces without creating a dangerous, cluttered work area.

Unpacking

Use care in removing the crate materials from the machine. Be careful not to use force on any part of the machine.

Remove the toolbox, parallels and optional equipment from the machine. Completely clean these articles as well as the rest of the machine with solvent. Rust inhibitor was applied at the time of shipment. Any of this left on the machine, will allow cast iron dust to collect in that area, which could cause premature wear.

Column Hold Down

The machine was shipped with the column held in place with chains and turnbuckles to the Main bed. Do not attempt to move the machine under power until these restraints have been removed.

Leveling

Located in the bottom of the main base are the leveling and tie down screws. If care is taken, the main base can be leveled extremely accurately. Start by placing the jacking pads under the jacking screws. Adjust the jacking screws so the lowest point of the main base is at least 1/4” off the jacking pad. Make sure all the jacking screws are touching their jacking pads. Use a precision machinist’s level, and check the base at several points to get an idea where the high and low spots are, adjust evenly where necessary. Start with the back linear rail. With your precision level, level the back linear rail in the lengthwise direction to .0005” per foot. Take the readings approximately mid way between the jacking points.

Use a precision metal support to span the distance between the front and rear linear rails. (Support must be parallel within .0005” in its length). Take readings over every jacking bolt and level within .0005” over the length of the base. Be sure to use the jacking points down the middle of the main base.

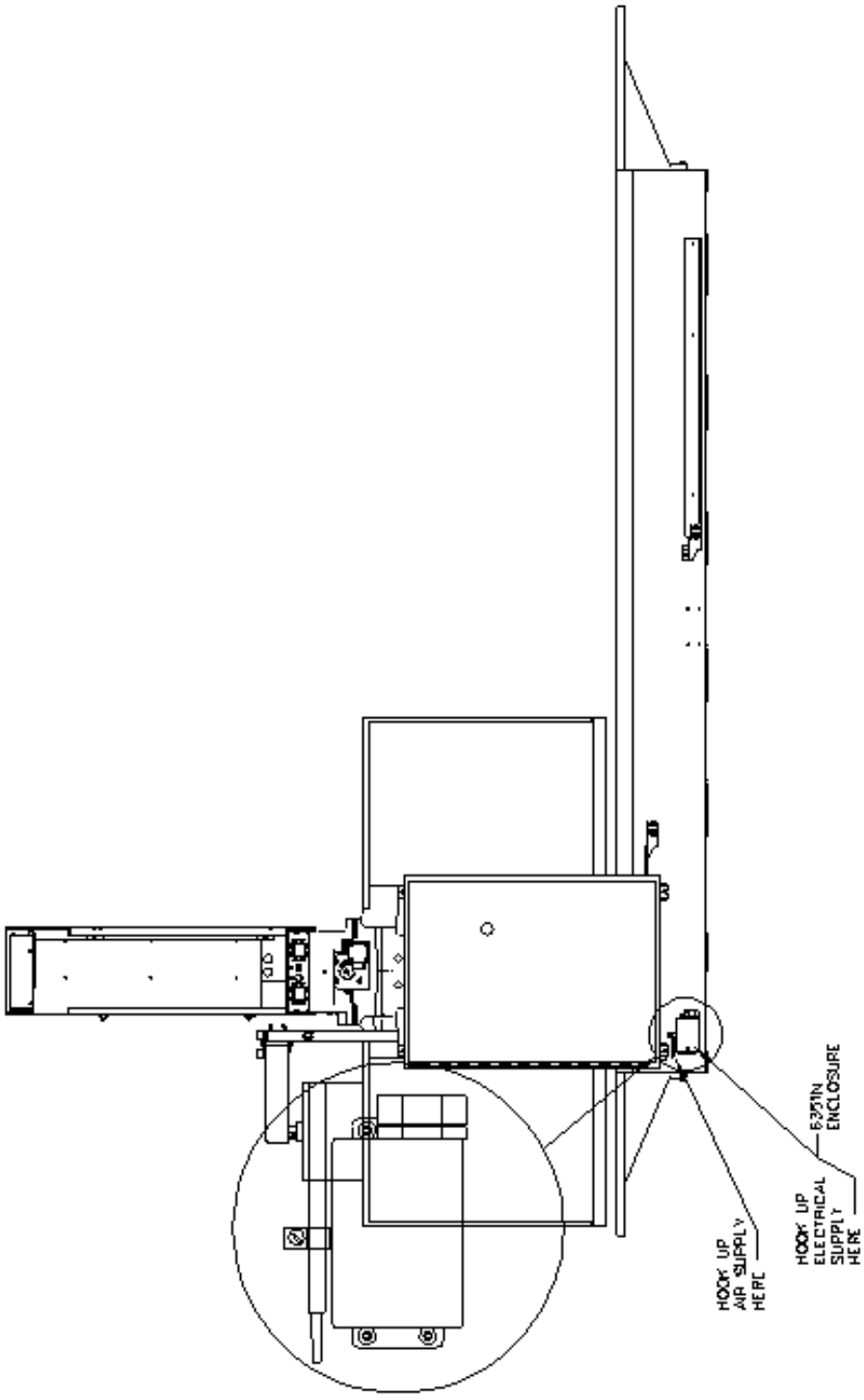
Recheck the linear rails for level. Now check the machine table. Using the front jacking screws level the table within .0005” in both directions.

Be sure that all jacking bolts have approximately equal weight on them. As you level the base, snug the anchor bolts to help hold the main base in place. Recheck all areas of the main base for level.

Air Supply

It is very important that the air source for the EM103/4/5 machine be moisture free. Water and oil in the line will result in early cylinder and valve failure. The factory recommends installing a water trap at the machine.

Attach a 100 PSI air source to the appropriate intake in the small enclosure located on the left rear of the machine near the bottom.



Power Supply

This machine has the following power requirements:

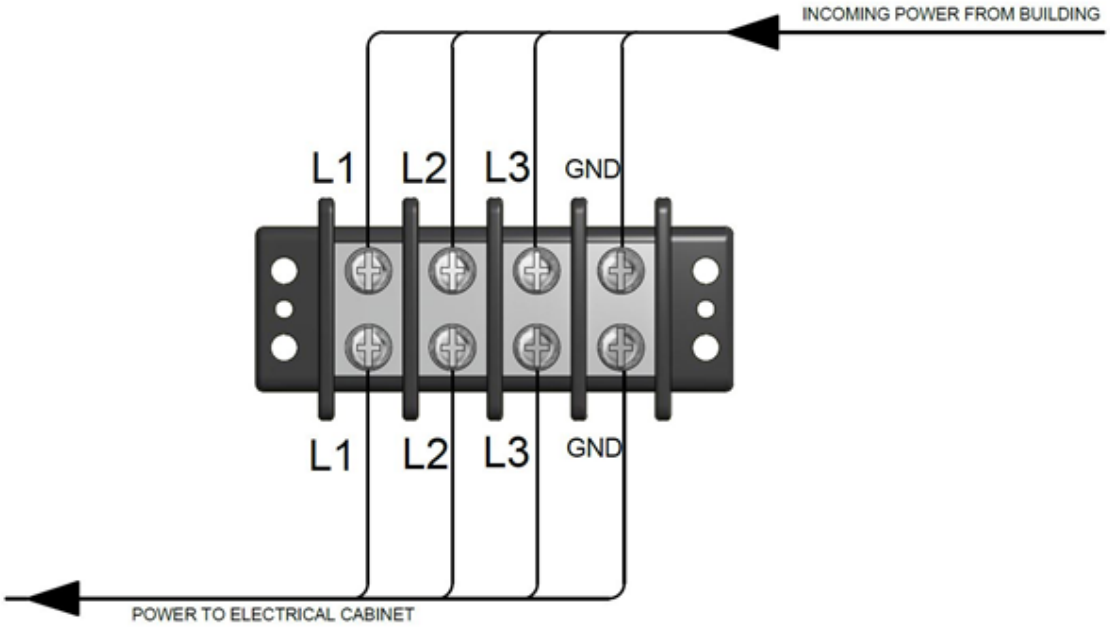
- 208 to 240 VAC
- Three Phase
- 50 or 60 Hertz
- 60 amps

See illustration below for correct connection of incoming power. Measured power at the machine's main breaker must be within the required range listed above. If incoming power is not within range, a transformer must be used. Failure to do so will cause the machine to function abnormally and cause permanent damage to the electronic control system.

Some electrical services contain a "Hot Leg, High Leg, or Wild Leg", where one leg measures 208VAC to Ground instead of 120VAC. It is required to use the "Hot Leg" for L3 when connecting the machine. Voltage measured between the phases must be between 208VAC and 240VAC, while phases 1 and 2 to ground must be ~120VAC. Phase 3 to ground is allowed to measure up to 208VAC.

IMPORTANT ***Electrically connect in accordance with national and local electrical codes.***

⚠ CAUTION ***Do not attempt to connect more than 240 VAC to this machine.***
Do not attempt to connect to Single Phase Power.



Grounding

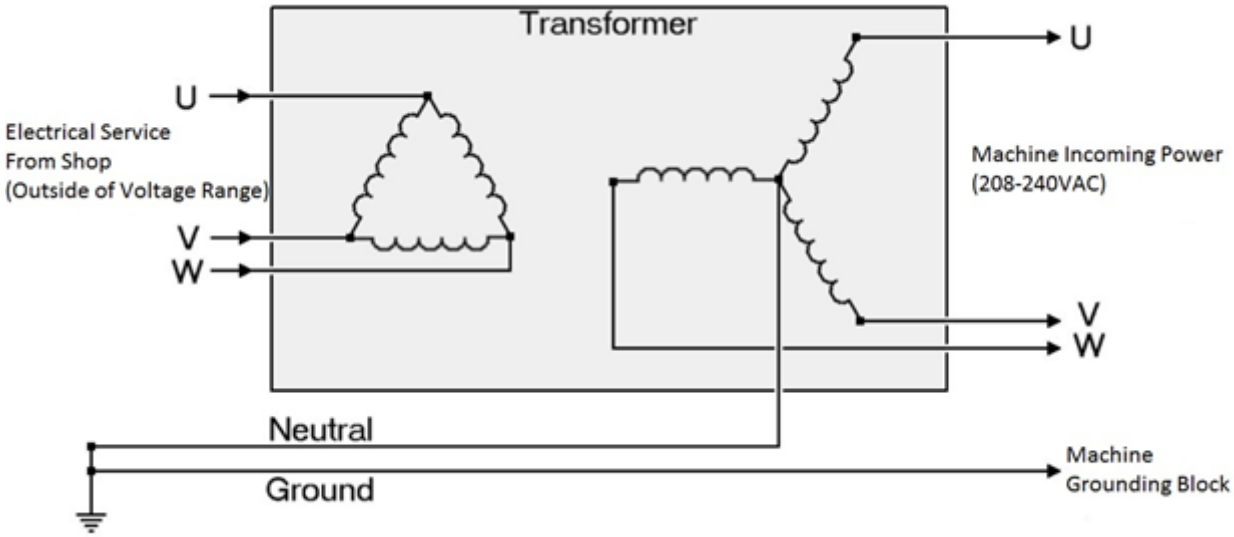
The machine requires a good earth ground. The grounding conductor from the incoming power source must be connected to the grounding block located inside of the electrical cabinet. A ground rod installed in addition to the electrical service grounding conductor is permitted, but must be connected directly to the grounding block inside of the electrical cabinet. Connecting the ground rod to the machine base is not permitted. Consult a Licensed Electrician in your area to assess the installation, and install the appropriate ground rod if necessary. Failure to do so may lead to an installation that is unsafe and does not meet national and local electric codes.

Transformer Connections

This machine has the following minimum transformer size requirement:

- 30 kVA

If a transformer is necessary for machine installation, please refer to the diagram below for connection information. Transformers must be sized to meet the minimum power requirements listed above. Consult a Licensed Electrician in your area for transformer selection and installation.

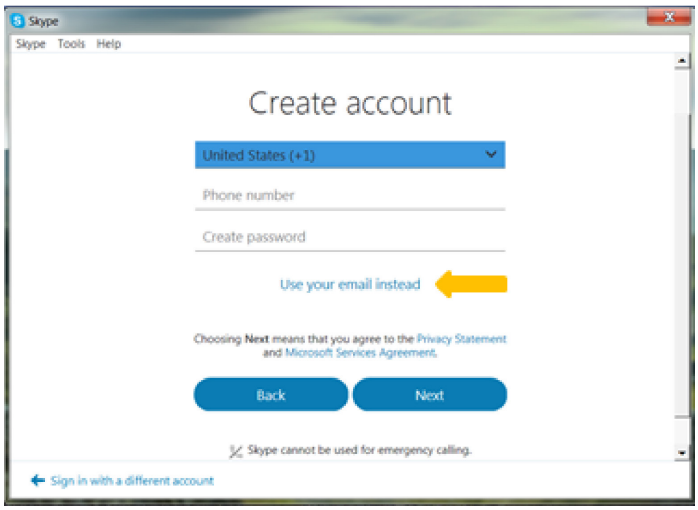


Phase Converters

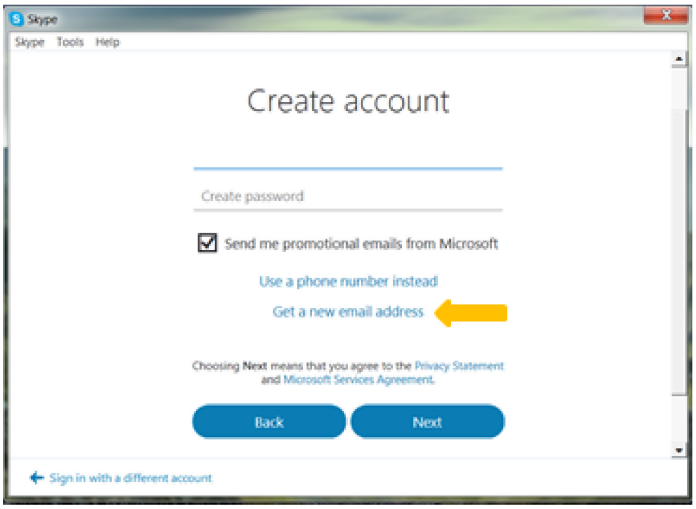
It is always preferred to provide Three Phase Power directly from the electrical service to the machine. If Three Phase Power is not available in the required installation location, a phase converter may be used to power the machine. A CNC rated phase converter is required for correct operation of the machine. Consult a Licensed Electrician for proper sizing and installation.

Creating a Skype Account

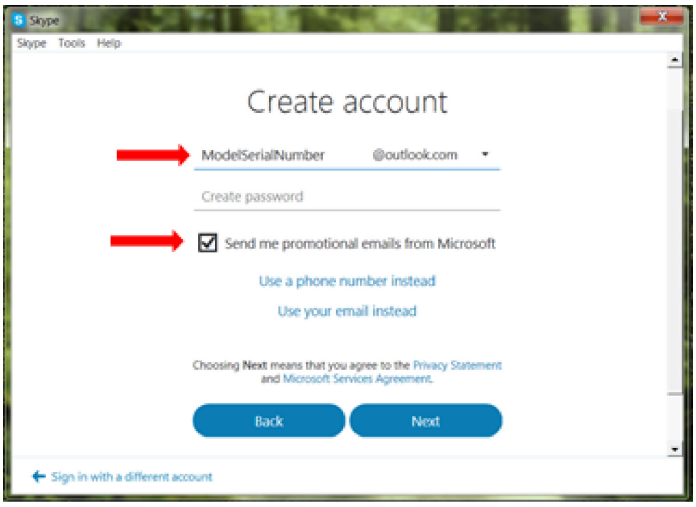
Click on create an account



Click on: Use your email instead



Click on: Get new email address

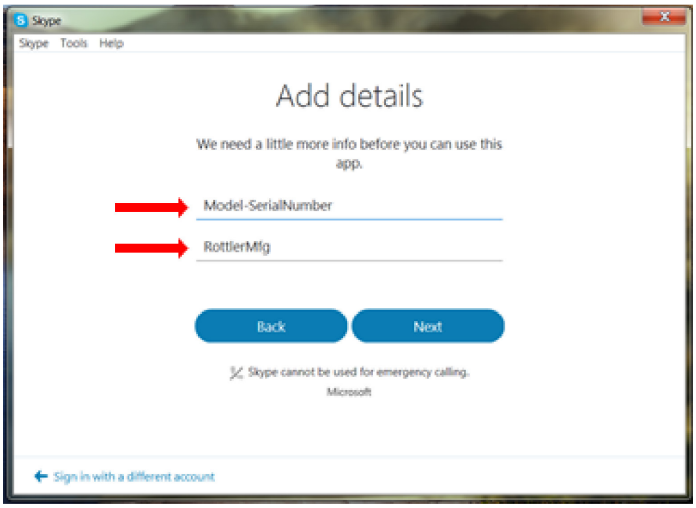


Name the email account using the Rottler machine Model and Serial number.

Ex: H85A111, EM69P001

Create a password that is easy to remember.

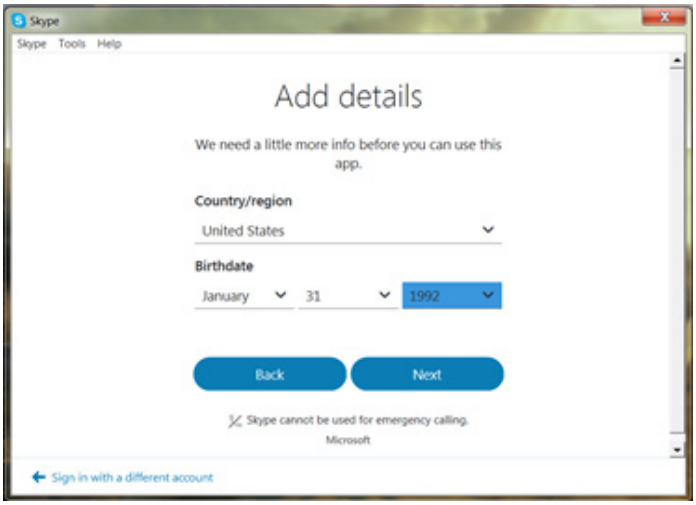
Uncheck the box to receive emails from Microsoft.



First Name: Model-Serial Number

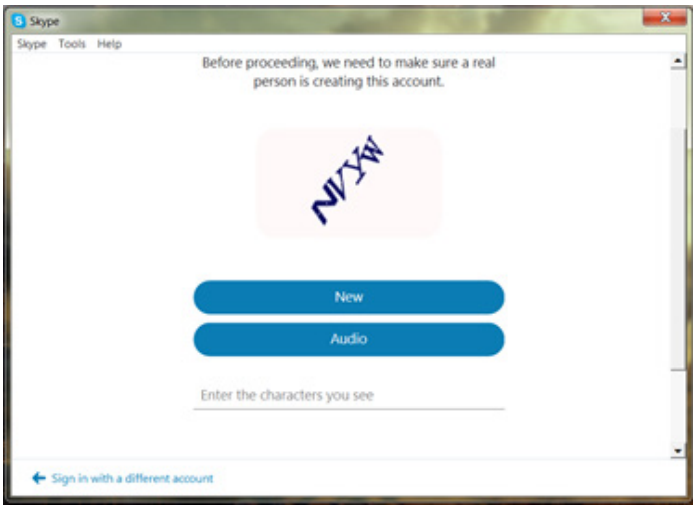
Ex: EM105A-113

Last Name: RottlerMfg



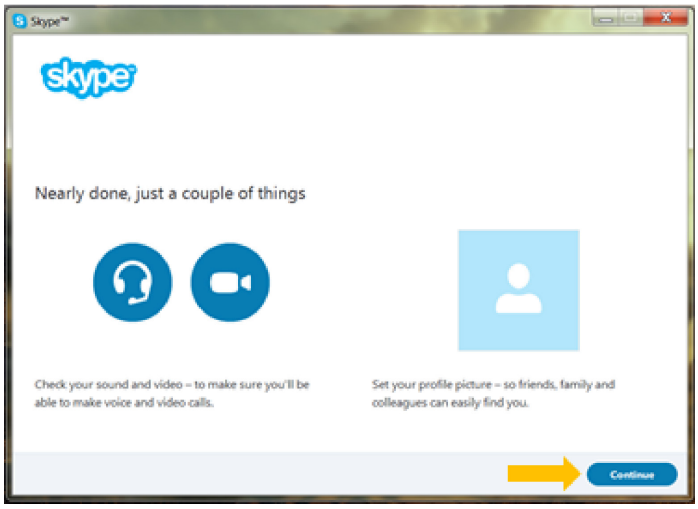
Select your Country/region

Birthday: Today's date, year 1992

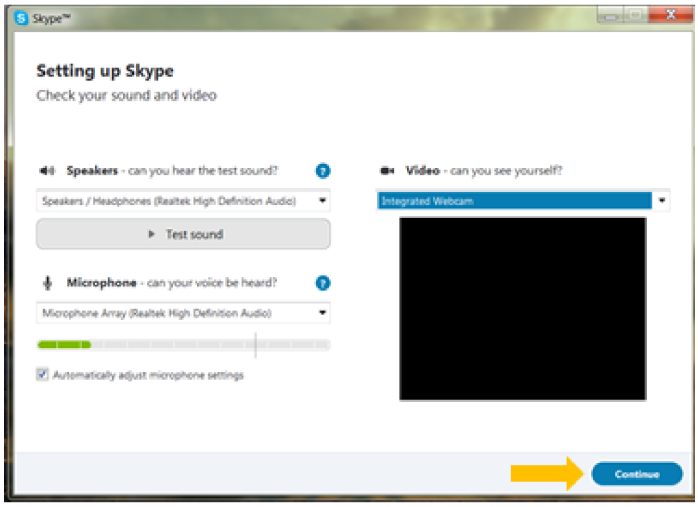


Type the code exactly as it appears.

Click “Next”

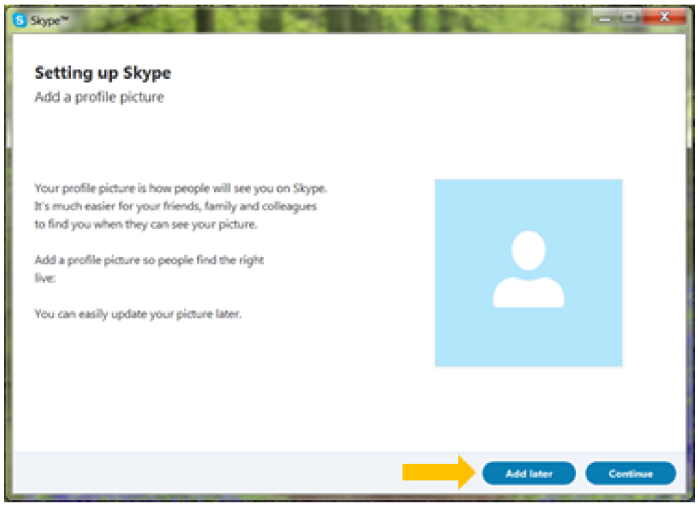


Click “Continue”



If your headset and/or web camera are hooked up you can verify that they are working here.

Otherwise, click “Continue”



Click “Add later” to skip this part.

Your Skype account is set up and ready for use.

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SAFETY

Contents

Safety Information

For Your Own Safety Read This Instruction Manual Before Operating This Machine.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in serious injury.

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

Safety Instructions for Machine Use

WARNING **This machine is capable of causing severe bodily injury**

ONLY A QUALIFIED, EXPERIENCED OPERATOR SHOULD OPERATE THIS MACHINE. NEVER ALLOW UNSUPERVISED OR UNTRAINED PERSONNEL TO OPERATE THE MACHINE. Make sure any instructions you give in regards to machine operation are approved, correct, safe, and clearly understood. Untrained personnel present a hazard to themselves and the machine. Improper operation will void the warranty.

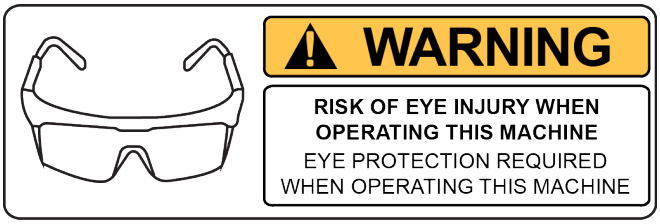
KEEP GUARDS IN PLACE and in proper working order. If equipped with doors, they must be in the closed position when the machine is in operation.

KEEP WORK AREA CLEAN. Cluttered areas and benches invite accidents.

KEEP CHILDREN AND VISITORS AWAY. All children and visitors should be kept a safe distance from work area.

WEAR THE PROPER APPAREL. DO NOT wear loose clothing, gloves, rings, bracelets, or other jewelry which may get caught in moving parts. Non-Slip foot wear is recommended. Wear protective hair covering to contain long hair.

ALWAYS USE SAFETY GLASSES. Also use face or dust mask if cutting operation is dusty. Everyday eye glasses only have impact resistant lenses, they are NOT safety glasses.



DO NOT OVER-REACH. Keep proper footing and balance at all times.

USE THE RECOMMENDED ACCESSORIES. Consult the manual for recommended accessories. The use of improper accessories may cause risk of injury.

CHECK DAMAGED PARTS. Before further use of the machine, a guard or other part that is damaged should be checked to determine that it will operate properly and perform its intended function. Check for alignment of moving parts, breakage of parts, mounting, and other conditions that may affect its operation. A guard or other part that is damaged should be properly repaired or replaced.

NEVER OPERATE A MACHINE WHEN TIRED, OR UNDER THE INFLUENCE OF DRUGS OR ALCOHOL. Full mental alertness is required at all times when running a machine.

IF AT ANY TIME YOU ARE EXPERIENCING DIFFICULTIES performing the intended operation, stop using the machine! Then contact our service department or ask a qualified expert how the operation should be performed.

DO NOT MODIFY OR ALTER THIS EQUIPMENT in any way. If modifications are deemed necessary, all such requests must be approved and/or handled by Rottler Manufacturing. Unauthorized modifications could cause injury and/or damage to machine and will void the warranty.

SAFETY DECALS SHOULD NEVER BE REMOVED. They are there to convey important safety information and warn of potential hazards.

ALL LOCAL SAFETY CODES AND REGULATIONS should be followed when installing this machine.

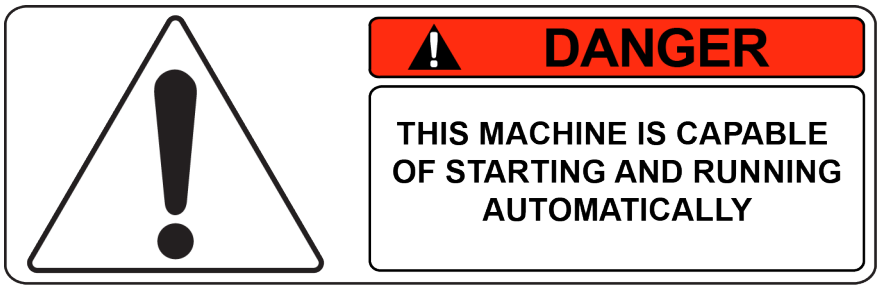
ONLY QUALIFIED PERSONAL should perform service on the electrical and control systems.

When boring the machine is capable of throwing metal chips over 10- feet from the cutting area. Always use the guards. Eye protection must be worn at all times by the operator and all other personnel in the area of the machine.

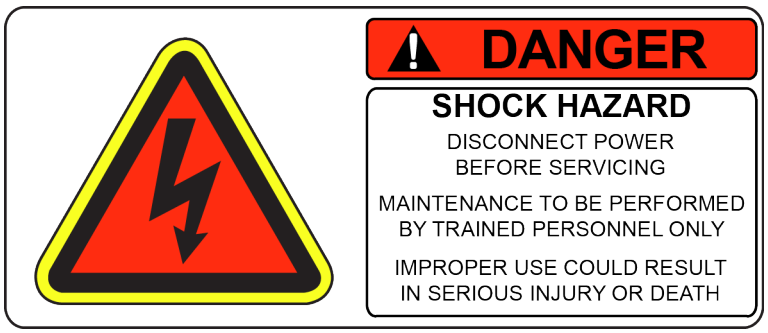
CAUTION No list of safety guidelines can be complete. Every piece of shop equipment is different. Always consider safety first, as it applies to your individual working conditions. Use this and other machinery with caution and respect. Failure to follow guidelines could result in serious personal injury, damage to equipment or poor work results.

Electrical Power

THIS MACHINE IS AUTOMATICALLY CONTROLLED AND MAY START AT ANYTIME

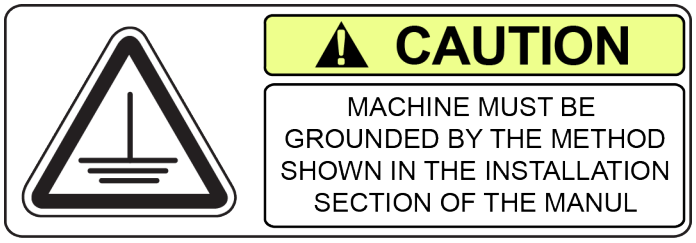


All electrical power should be removed from the machine before opening the rear electrical enclosure.



In the event of an electrical short, grounding reduces the risk of electric shock by providing a path of least resistance to disperse electric current.

Electrocution or a fire can result if the machine is not grounded correctly. Make sure the ground is connected in accordance with this manual. **DO NOT** operate the machine if it is not grounded.



CAUTION No single list of electrical guidelines can be comprehensive for all shop environments. Operating this machinery may require additional electrical upgrades specific to your shop environment. It is your responsibility to make sure your electrical system complies with all local codes and ordinances.

WARNING This machine operates under computerized control and, like all computerized equipment, is susceptible to extraneous electrical impulses internally or externally produced. The machine may make moves out of the operator's control at any time. The operator should work in and around the machine with caution at all times.

The operator and nearby personnel should be familiar with the location and operation of the Emergency Stop Button.

Make sure all electrical equipment has the proper overload protection. ***This machine should have a fully isolated power supply*** to prevent damage and uncontrolled movement of the machine. If this machine is on the same power lines that are running to other electrical equipment (grinders, welders, and other AC motors) electrical noise can be induced into this machine's electrical system. Electrical noise can cause the controller to see false signals to move. Not supplying a fully isolated supply to the machine may void factory warranty. Refer to the Power Supply section located in the Installation section for voltage and amperage requirements of this machine.

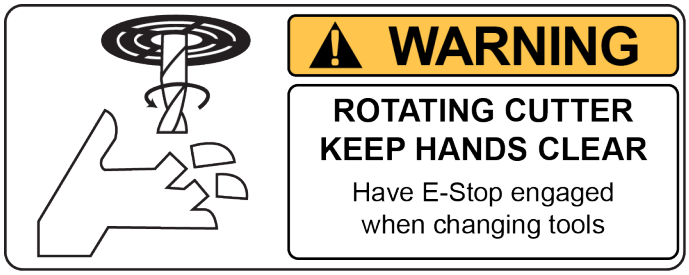
Machine Operator

The operator of this machine should be a skilled machinist craftsman who is well versed in the caution, care, and knowledge required to safely operate metal cutting tools.

If the operator is not a skilled machinist he/she must pay strict attention to the Operating Instructions outlined in this manual, and get instruction from a qualified machinist in both production and operation of this machine.

This machine has the following areas of exposed moving parts that you must train yourself to respect and stay away from when they are in motion:

Cutting Tool Area – Any operation involving hands in the cutter head area, such as inspection or alignment of the cutter head or tools, tool insertion and removal, cutter head changes, and size checking etc. requires the machine to be in Neutral.



Machining – Eye protection must be worn during all operations of the machine. Hands must be kept completely away from the cutter head. All chip guards must be in position during machine operations.

CAUTION Work Loading and Unloading – Carefully develop handling methods of loading and unloading work pieces so that no injury can result if hoist equipment or lift connection should fail. Periodically check lift components for damage that may cause failure.

CAUTION **Machine Maintenance** – Any machine adjustment, maintenance or parts replacement absolutely requires a complete power disconnection from the machine.

Emergency Procedure

Assuming one of the following has occurred: tool bit set completely off size, work piece not clamped, spindle is not properly centered, and these mistakes will become obvious the minute the cut starts

PRESS THE EMERGENCY STOP BUTTON (on the front control panel) ***IMMEDIATELY!***

Find out what the problem is, return the spindle to its up position without causing more damage. To restart the machine, turn the Emergency Stop Button CW until the button pops out

Be alert to quickly stop the machine in the event of a serious disruption of the boring process either at the top or bottom of the bores.

REMEMBER, metal cutting tools have the speed and torque to severely injure any part of the human body exposed to them.

Computer and Controller System Safety

The computer and controller are located in the main rear electrical enclosure. This unit is a full computer, running Windows 7 64 Bit operating system. Contact the factory if more information on the computer system is required.

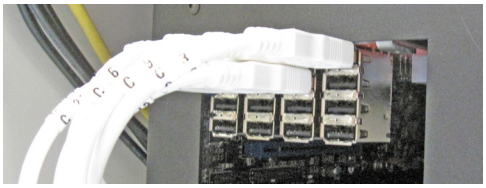
IMPORTANT The computer in this machine has the ability to connect to the Internet via Ethernet or Wireless using a USB wireless (Wi-Fi) adapter. Updating the Rottler software should ONLY be done when directed to do so by a Rottler service technician. Updating Rottler Software when not directed by Rottler personnel will result in a non-operational machine.

The machine should be hooked up to the Internet anytime it is on. The software on the machine will automatically connect to our server to send back useful information on machine status.

Any IT personnel should ***ALWAYS*** get approval from Rottler before doing ANYTHING on the computer.

⚠ DANGER This machine is capable of causing severe injury or death. Doing any of the following without Rottler's direct consent may cause severe injury or death.

⚠ WARNING Do not attempt to install USB devices in the PCI ports. These ports have high voltage and any attempt to connect a USB device in these ports will result in destruction of that device. There is also the possibility of damage to the computer system of the machine.



IMPORTANT Downloading any program or changing any Rottler or Computer settings may cause the machine and/or software to become unstable. DO NOT install ANY screen saver, Anti-Virus, Spyware or any type of Security software on the computer. This could create a hazardous environment for the operator and personnel around the machine. Performing any of the above will also result in the machine warranty being NULL and VOID.

IMPORTANT DO NOT connect any type of external hardware to the computer via USB or any other means. Do not install any type of Device Driver. This could create a hazardous environment for the operator and personnel around the machine. Performing any of the above will also result in the machine warranty being NULL and VOID.

Electrical Safety Features Of Rottler DM Controlled Machines

All Rottler machines that use the DM operational control system are designed to comply with all applicable safety standards. This includes but is not limited to the following systems:

1. Current sensors in all motor control panels.
2. Thermal sensors in all motors and motor controls.
3. Electrical breakers to prevent voltage surges and spikes from reaching electrical system.
4. Electrical lockout on main electrical enclosure.
5. E-Stop that shuts down all operational systems in an event of an emergency.

All thermal and current limits for motors and motor controls are preset at the factory. In the event that any of those parameters are exceeded during operation of the machine, the machine control system will shut down the machine and a warning of the specific fault will appear on the control screen.

CONTROL DEFINITIONS

Contents

Control Definitions

The purpose of this chapter is to define the function of the buttons throughout the various screens. Certain button functions may not make sense right away in this chapter. As the operator reads through the Operating Instructions chapter of this manual, the function of these buttons will become clear.

Computer and Controller System Safety for DM Controlled Machines

The computer and controller are located in the main rear electrical enclosure. This unit is a full computer, running Windows operating system. Contact the factory if more information on the computer system is required.

IMPORTANT: The computer in this machine has the ability to connect to the Internet via Ethernet or Wireless using a USB wireless (Wi-Fi) adapter. Updating the Rottler software should ONLY be done when directed to do so by a Rottler service technician. Updating Rottler Software when not directed by Rottler personnel could result in a non-operational machine.

It is recommended that the machine be hooked up to the Internet anytime it is on. The software on the machine will automatically connect to our server to send back useful information on machine status. It will also record performance parameters that will be used to evaluate any occurrence of a malfunction.

The Auto Update for the Windows Firewall (Security) and Windows Defender (Anti-Virus) is turned on. The computer will automatically download the updates and then install them when the computer is shut down every Friday night.

Any IT personnel should ALWAYS get approval from Rottler before doing ANYTHING on the computer.

⚠ WARNING Downloading ANY program from the Internet or by other means when not directed by Rottler is prohibited and will result in the machine warranty being NULL and VOID.

⚠ WARNING Downloading any program or changing any Rottler or Computer settings may cause the machine and/or software to become unstable. DO NOT install ANY screen saver, Anti-Virus, Spyware or any type of Security software on the computer. This could create a hazardous environment for the operator and personnel around the machine. Performing any of the above will also result in the machine warranty being NULL and VOID.

Master Power On/Off Switch

This switch is located on the main electrical control enclosure on the right hand side of the machine.

When first applying power to the machine the computer will need to boot up. Be patient, it will take several minutes to complete booting. The Rottler program will not automatically start. Double tap the Rottler_WPF icon on the screen to start Rottler.

When turning the main power to the machine off there is a specific procedure to follow so as not to damage the computer. The computer must shut down its internal systems before main power is removed from it.

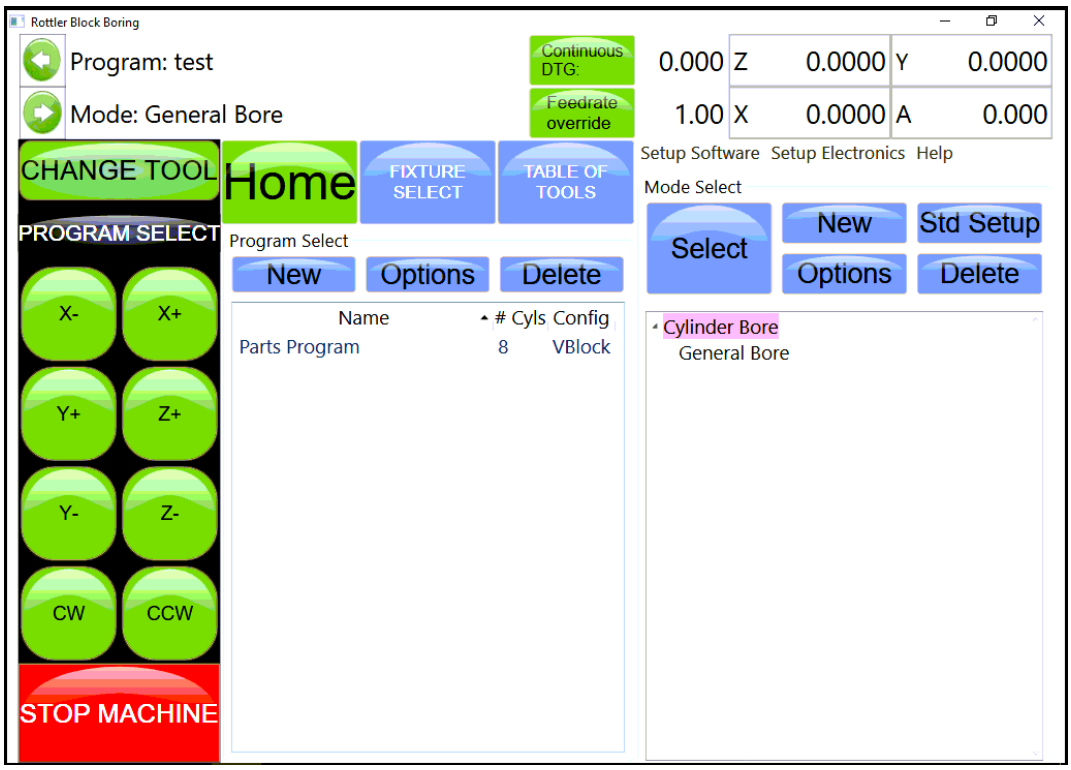
Press the “Start” button in the left-hand side of the Start Bar. This will bring up the “Start Menu”. Press the “Shutdown” line at the bottom of the Start Menu. This will bring up a Pop Up menu, make sure that “shut down computer” is selected and press “OK”.

This will shut down the computer. It is now OK to turn Main Power off to the machine.

Initialization Screen

When the EM103/4/5 is powered up, the Rottler program will not automatically start. It may take several minutes for the computer to power. Start the Rottler program by double tapping the Rottler_WPF icon on the desktop Once the program is started, the Rottler Program Select will appear.

NOTE: Do not push any buttons or icons on the screen before the Rottler program starts or an error may be caused on the computer.



General Information

The Rottler software operates on a Block Model format. You select or create the block you are working with. Then select or create an operation to be performed on that block.

Home

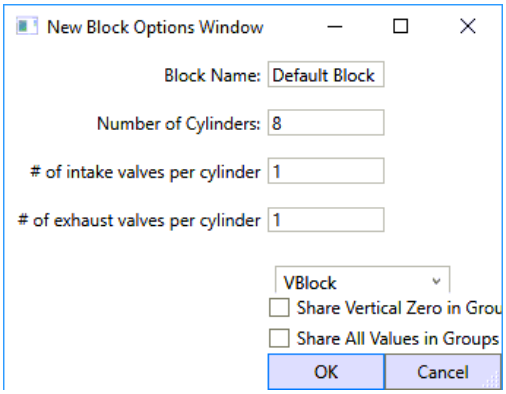
Pressing this button will cause the machine to run a self check on the electronics. The machine MUST be homed after it is turned on.

Program Select

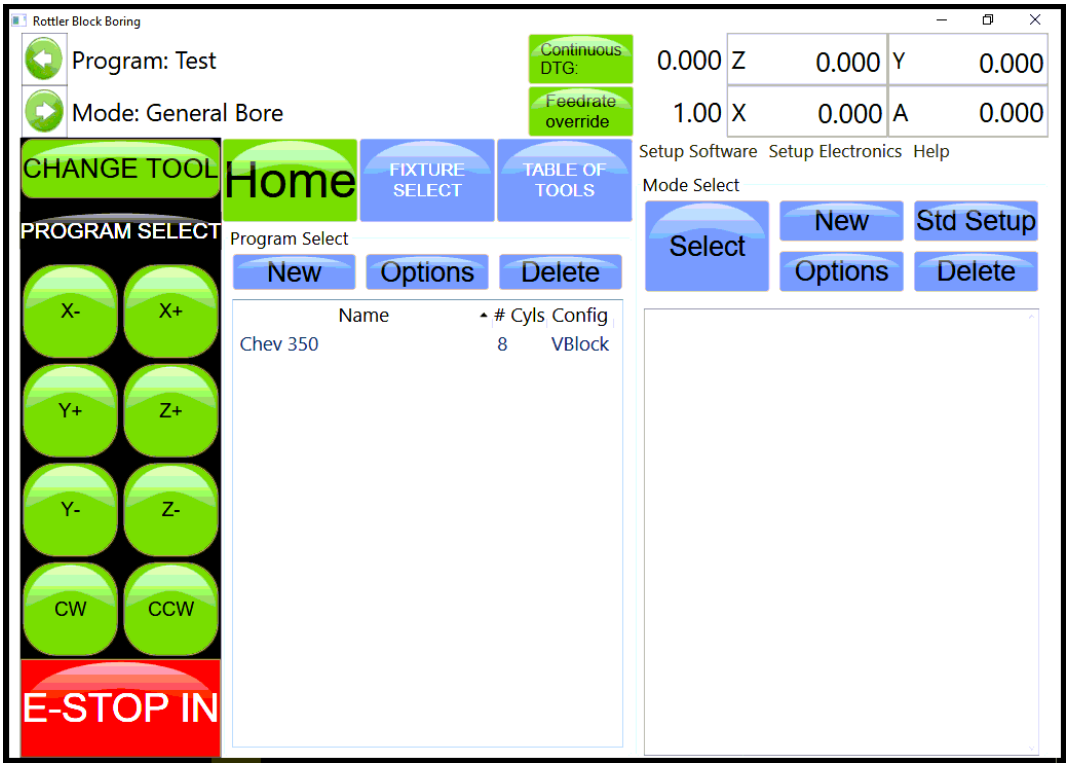
This is the left section of the screen. This is where you create and select blocks you will be working with.

New

Pressing this in the Upper level will cause a dialog box to appear. Here is where you name and configure the block, the number of cylinders and Inline or V Block.



Pressing OK will result in the Block Model being inserted into the left hand side of the screen.



Options

This will bring up the same dialog box as described above if any of the information needs to be changed.

Delete

This will delete whatever block program is selected. A dialog box will appear to ask you if you want that program deleted.

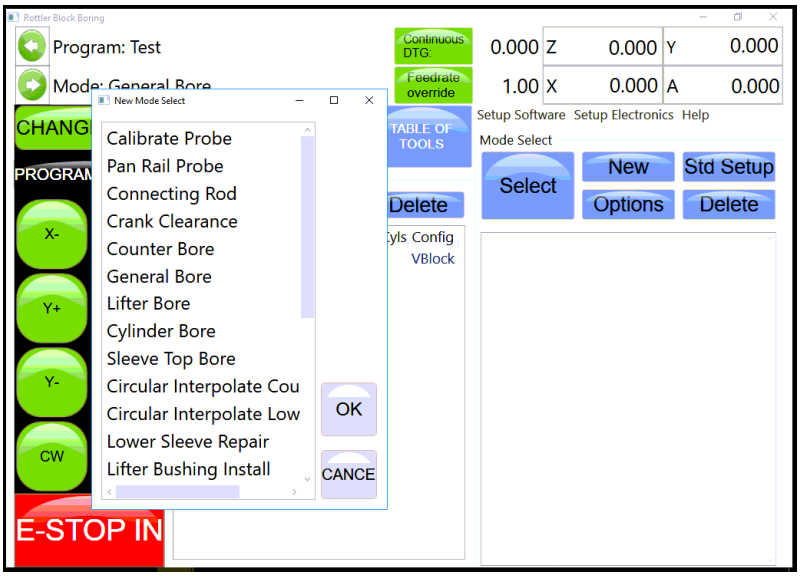
Mode Select

This is the right section of the screen. This is where you create or select operations to be performed on the selected Block. This area will be blank when you first create a block.

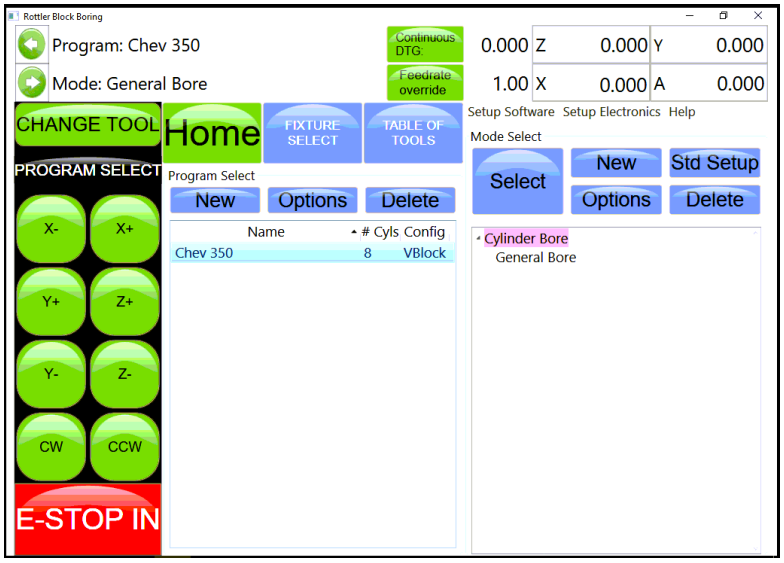
You can create only certain modes you will use on a block or use a standard set up that inserts all modes available. You can also create a new mode and rename if for a specific use.

New

Pressing this button will bring up a dialog box with Rottler standard operations.



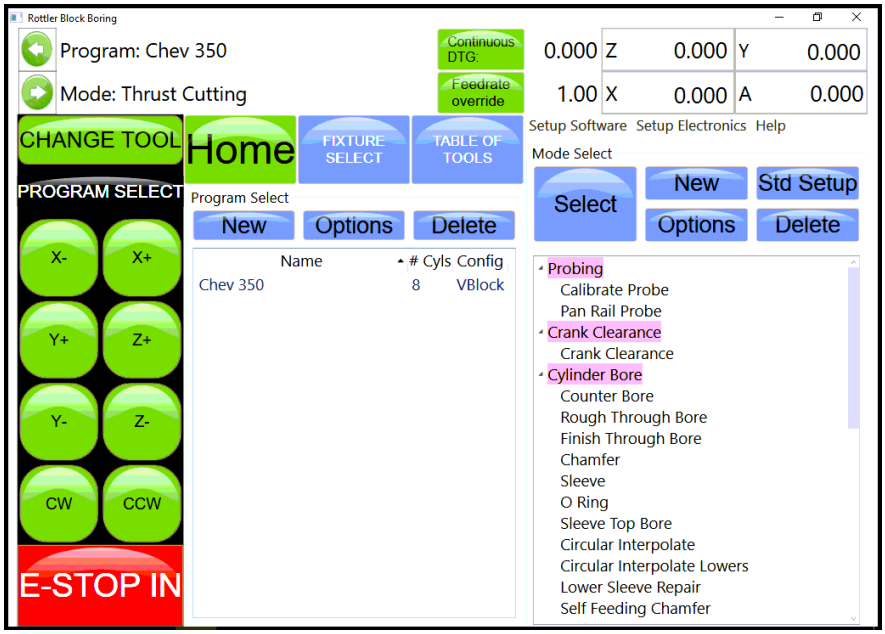
Select the operation you want to create and then press OK. This will place a general Bore operation under the Cylinder bore mode in the right hand section.



To enter General Bore mode highlight it and then press Select. This will take you to the operation screens that will be described later.

Std (Standard) Setup

Pressing this button will insert all the Rottler operations into the right hand section automatically.



Use the slide bar on the right hand side to scroll through all the operations.

Options

Press this button to bring up a dialog box to allow positive numbers to be entered in the horizontal stops. Most all programs are from left to right, the farther right you go the larger the negative number. However if a different zero point is used a positive number may be needed. For example, if you zero on the first cylinder on the left bank of a block and then “roll it over” the first cylinder is farther to the right than the zero position. Which would be a positive number.

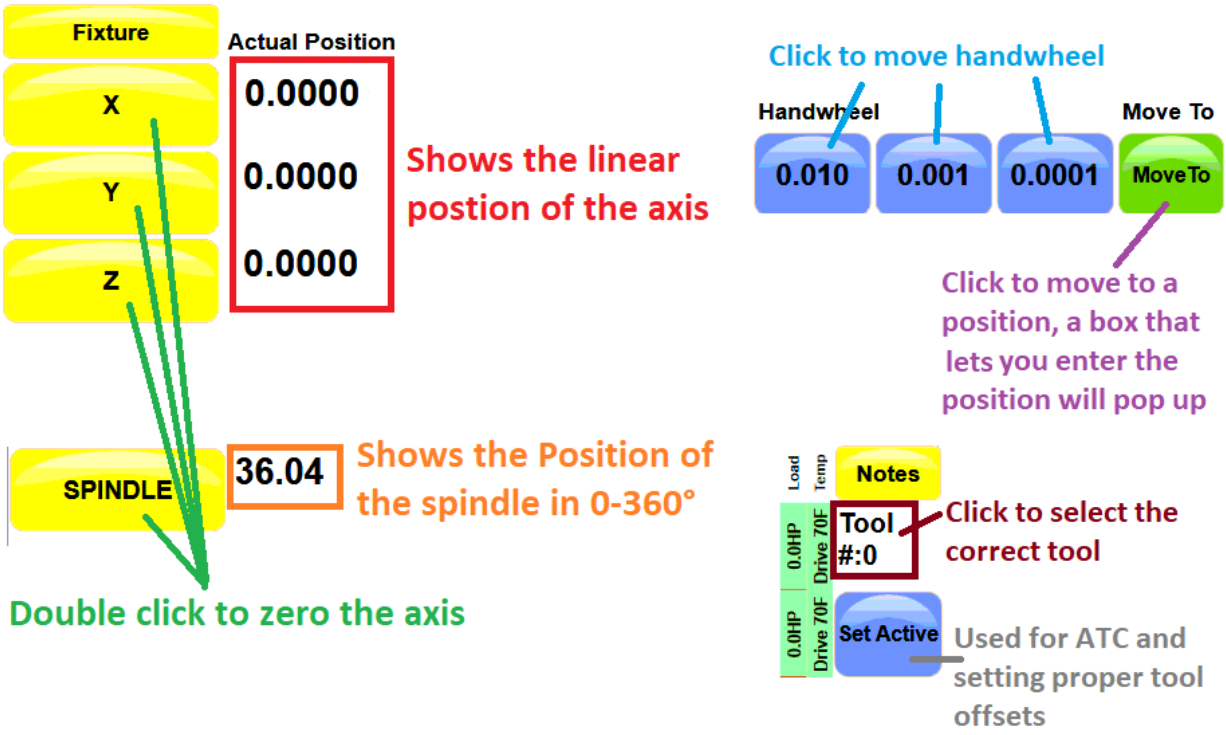
Delete

This will delete the selected Mode. It will ask you if you want this mode deleted before deleting it.

NOTE: Once the control definition for a particular button has been discussed it will not be repeated in the different modes of operation. Only new buttons or buttons with a different function will be discussed in different modes.

For these descriptions the Tool# and Probe # are not being used. They will be described later in this chapter.

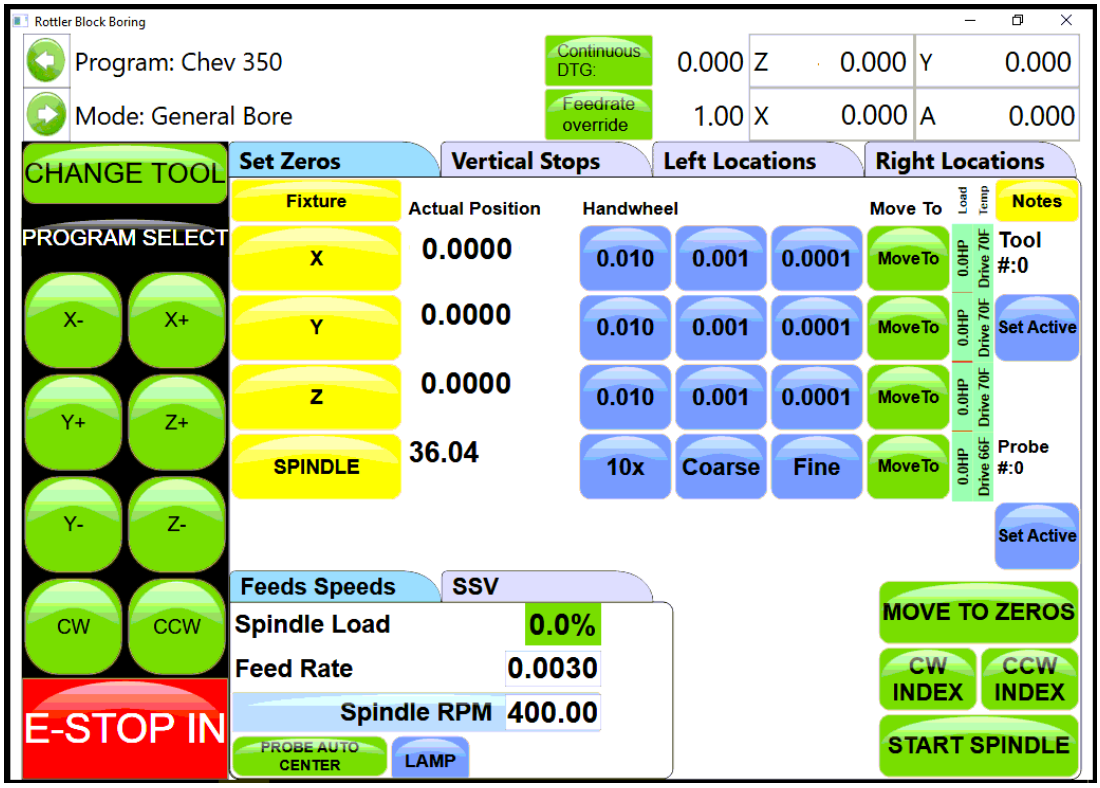
Basic Machine Controls



Cylinder Bore, General Bore 3 Axis (without Tool Changer)

Each buttons function will be described in this section. In the different MODES, the same buttons will not be described again.

Set Zero Tab



Actual Position

These are a numerical display showing the actual distance the axis are away from where they have been zeroed.

Velocity Override

The Velocity override is displayed in the upper left of the Actual Position display. The default is 100% of the programmed Feed Rate. When operating… turning the handwheel Counter Clockwise will override the axis rapid travel and feed rate 100 and 0% when in an automatic cycle.

Zero Buttons

These buttons will erase the actual position display of their associated axis and reset the displayed value to zero.

Handwheel Buttons

These buttons will activate their associated axis for use with the handwheel. The left button of each axis will move the machine in .010” per detent, the middle button .010” per detent and the right .0001” per detent of the handwheel. Pressing any of the axis Jog buttons will disengage the handwheel.

Spindle Start

This button will start the spindle at the RPM that is specified on the Auto Bore Cycle tab. Once the button has been pressed and the spindle is running the button will turn red and read Spindle Stop. Pressing the button again will stop the spindle and cause the button to go back to green.

CW and CCW Creep

These buttons will cause the spindle to rotate slowly CW or CCW direction. The spindle will continue to rotate as long as the button is pressed. The speed at which the spindle will rotate is set in the Machine Parameters and should not be changed unless instructed to do so by the factory.

Jog Buttons

These buttons control the rapid travel of the Vertical, Horizontal and In/Out axis. Pressing these buttons will allow you to move the machine through all ranges of its travel unobstructed. If the spindle is turned on these buttons become feed buttons and the machine will feed in whatever direction you have pressed. The rate at which the machine will feed is determined by the value set in the Auto Bore Cycle tab. When in rapid travel, these buttons are momentary contact and you will have to keep them pressed to keep the machine moving. When the spindle is on, they are latching buttons and once they are pressed the travel will continue until they are pressed again.

Move to

Pressing these buttons will bring up a dialog box for the associated axis. Enter a value that you want the axis to move to and press ENTER. That axis will then move to that position. You can do multiple “Move To” at the same time. One after another.

Move To Zeros

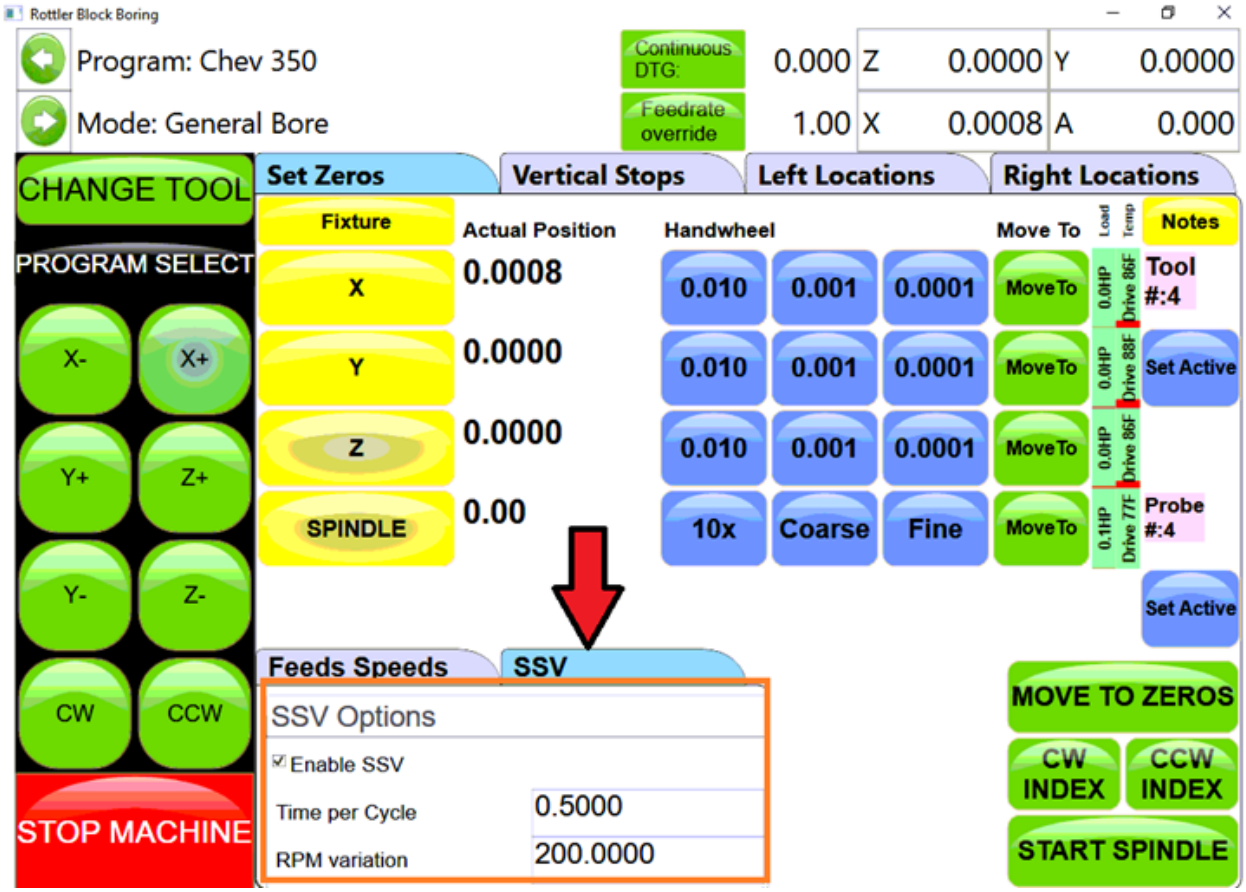
Pressing this button will cause the vertical to move the zero position first. The in/out and horizontal will move after the vertical has moved to zeros.

CW and CCW Index

Pressing either of these buttons will cause the spindle to rotate to the index position. Index position is with the tool to the right as you are facing the machine.

Using SSV (Spindle Speed Variance)

Spindle Speed Variation (SSV) allows you to modify the spindle speed within a range causing it to continuously change. This changes the harmonic frequency of the machining, which can help in the appearance of chatter. Various issues can cause chatter: spindle speed, incorrect feeds, depth of cut, part rigidity, the type of part being machined, thin walls, or diameter-length ratio.



Checking enable SSV- will engage it for the machining process you are doing

Time per Cycle- each cycle is measured as a second.

RPM Variation- How much the rpm can vary up and down from what you set in the program

(NOTE: setting this too extreme can cause Spindle errors and spindle crashes.)

IMPORTANT

Setting Spindle Index

Any time the machine has been turned off the spindle index position must be set. Turn the spindle to the index position (tool holder facing to the right at 90 degrees from the operator). Then press the Zero button net to the spindle position read out. This will put a zero value in the display box.

This screen also shows the Spindle Load, programmed Feed Rate and Spindle RPM.

Probe Auto Center

The Probe is an option on the EM103/4/5 machine. When this button is pressed a single Probing routine will be run in the position the machine is currently at.

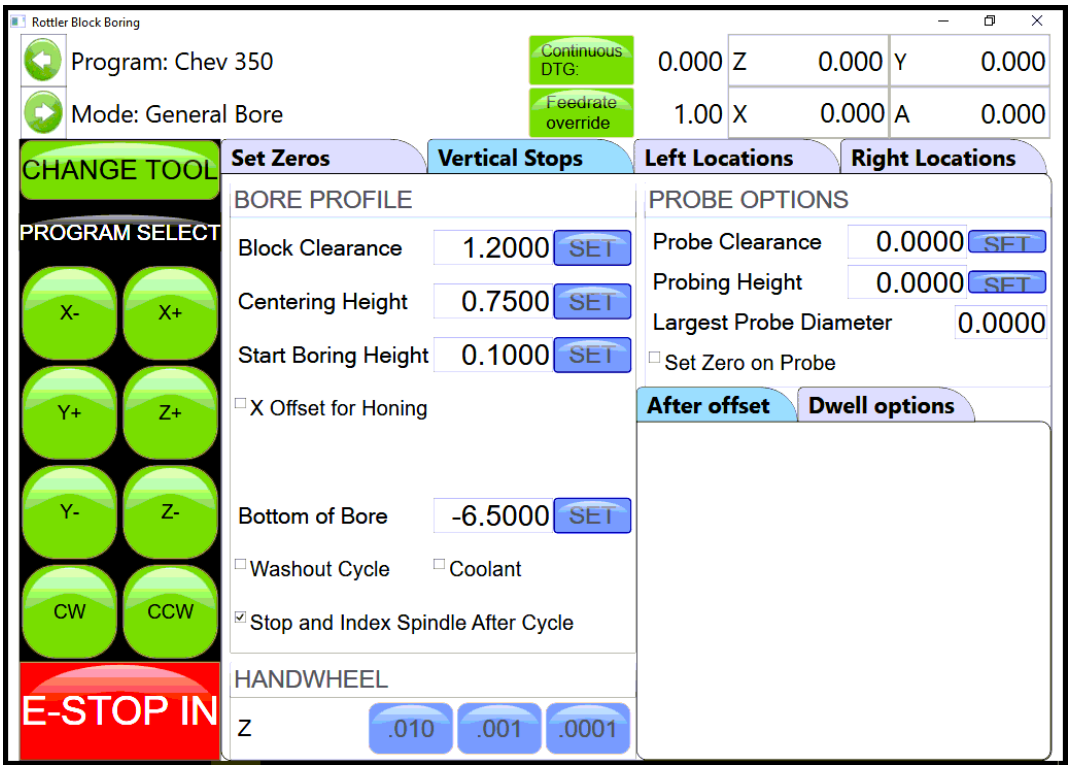
Vertical Stops Tab

This screen is used to set the Vertical stops the machine will use to bore a cylinder. There are four Vertical stops used on this screen plus two optional Lower Clearance stops.

If the machine is equipped with a probe there are two (2) additional stops, Probe Clearance and Probe Height.

The function of the Vertical stops will be defined in the Operating Instructions chapter in this manual.

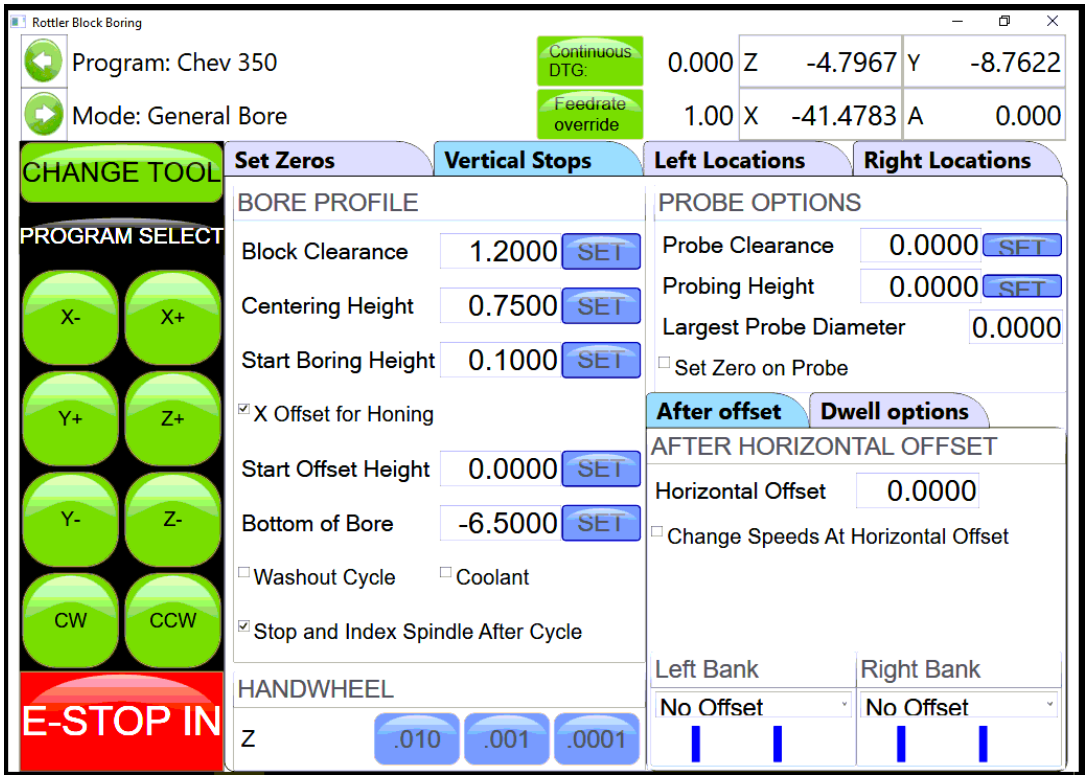
To enter any of the Vertical Stops press the Data box next to the Vertical stop you want to enter. A pop-up menu will appear. Press the desired numerical value and then press ENTER. The numerical data will then appear in the data box. You can also move the Vertical physically to the location you want the stop to be at and press the “SET” button next to the Data Box. This will take the current position from the Digital read out and insert it into the associated Data Box.



Horizontal Offset for Honing

There is often the need to machine out the “webbing” at the bottom of a cylinder to get the correct honing clearance. Checking the box next to “Horizontal Offset for Honing” will bring up an additional screen section on the lower right.

This is where you will set the amount, direction and speed the offset will cut.



Left and Right Locations Tab

This screen is used to set the Horizontal and In/Out stops the machine will use to bore a block. The number of In/Out and horizontal stop on this page will change with the block configuration i.e V6, V8 or inline.

The function of the Horizontal and In/Out stops will be defined in the Operating Instructions chapter of this manual.

To enter any of the Horizontal and In/Out stops press the Data box next to the Horizontal or In/Out stop you want to enter. A pop-up menu will appear. Press the desired numerical value and then press OK. The numerical data will then appear in the data box

Cylinder Bore – Bore Locations

There are three (3) different modes you can operate the machine in on these screens, Blueprint, Indicated and Probing.

Blueprint

This mode of operation allows you to enter specific values for the bore locations from a blueprint type document.

It is helpful to have the blue print numbers entered on this screen even if you are not going to bore to the blueprint locations on a particular block. They help to set the general area of the bore if you are manually centering (indicating) or probing the block.

Move Buttons

When pressed, these buttons will move the machine, under power, to the Horizontal and In/Out positions shown in the data boxes below the Move button. The Vertical will move to the Clearance height before it makes the Horizontal or In/Out moves. After it has moved to the Horizontal and In/Out positions the Vertical will move to the Centering Height. After this, all motion stops.

Bore Buttons

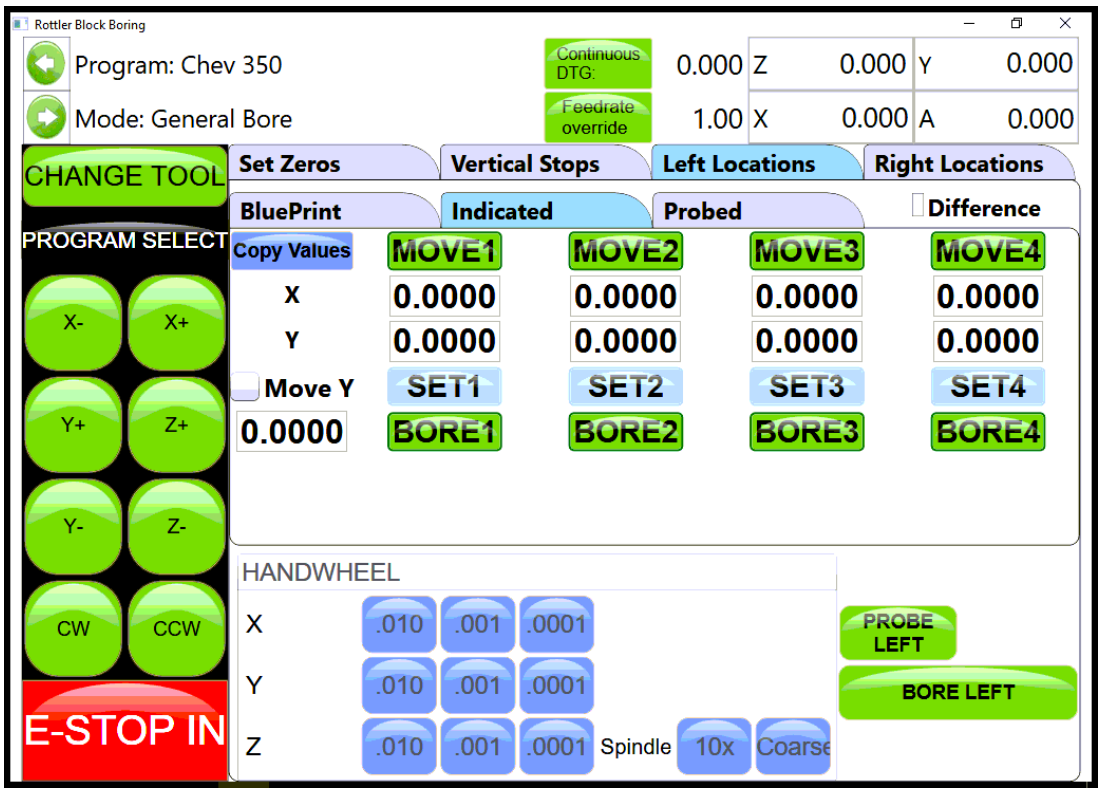
Pressing this button once will cause it to turn yellow. This indicates when the “Bore Left” button is pressed this cylinder will not be bored.

Touching this button again (with a pause in between touches) will turn the button back to green. All green bores will be bored if the “Bore Left” button is pressed. The control will ask you if you sure you want to bore the selected bores.

Double Clicking a Bore button will keep it green and turn all other bore buttons yellow.

Indicated

This screen is designed to manually indicate each cylinder in for it’s specific location.



Set Buttons

Once a cylinder has been indicate, pressing the associated Set Button will take the current machine position and place the values in the Data Box associated with that cylinder.

Copy Values

Pressing this button will bring up another window where you can select to copy the In/Out and Horizontal values from Blueprint, Indicated or Probed screen.

Difference

Checking this Box will cause a green check mark to be placed in the box. The Data Boxes will then display the difference in values from the blueprint screen to the indicated screen. This is helpful to know how far the cylinders actual location is from blueprint values.

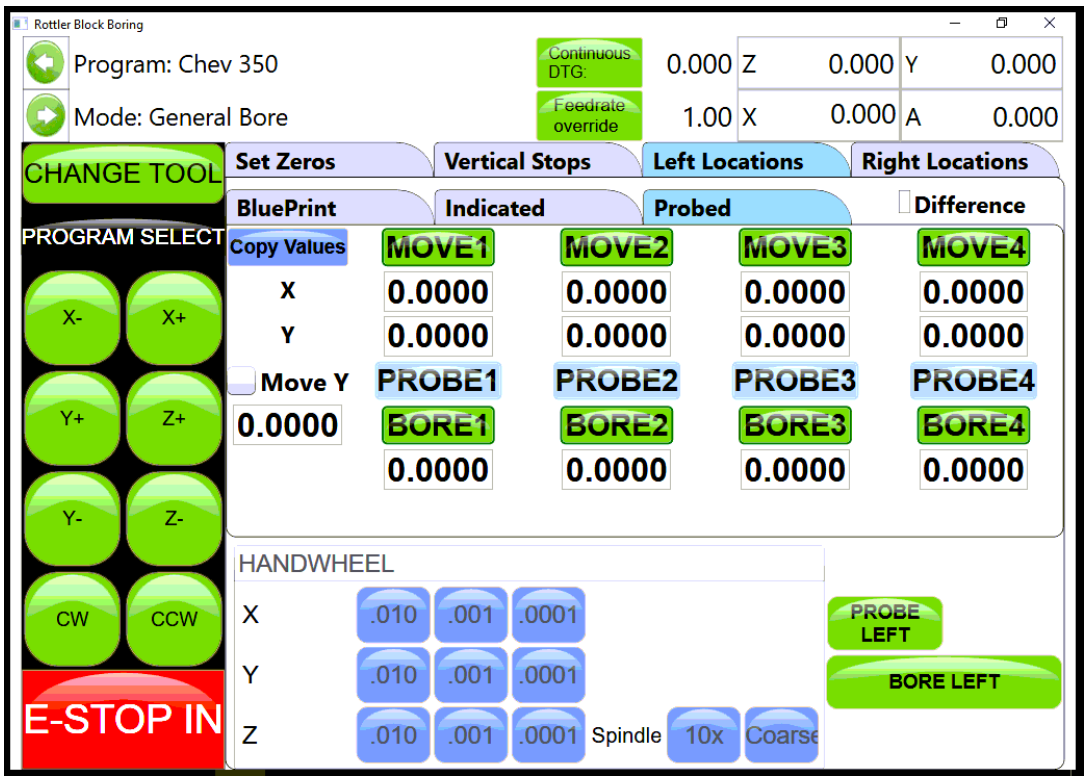
Bore Left and Right

Pressing this button will cause the entire Left or Right bank to be bored automatically. The Bore buttons that are yellow will not be bored though.

Probing

The probe is an option on the EM103/4/5 machine.

This screen is designed to automatically probe one or all of the cylinders.



Probe Buttons

Pressing this button will cause a probing routine to be run on the associated cylinder.

Probe Left or Right

Pressing this button will cause the entire Left or Right banks to be probed automatically.

Probed Diameter

This Data Box will display the diameter of the cylinders as they are probed.

LOWER SLEEVE REPAIR

Lower Sleeve repair is meant to be used when the Upper Bore is smaller in Diameter than the Lower Bore. Therefore the spindle has to offset in the Horizontal to clear the Upper Bore.

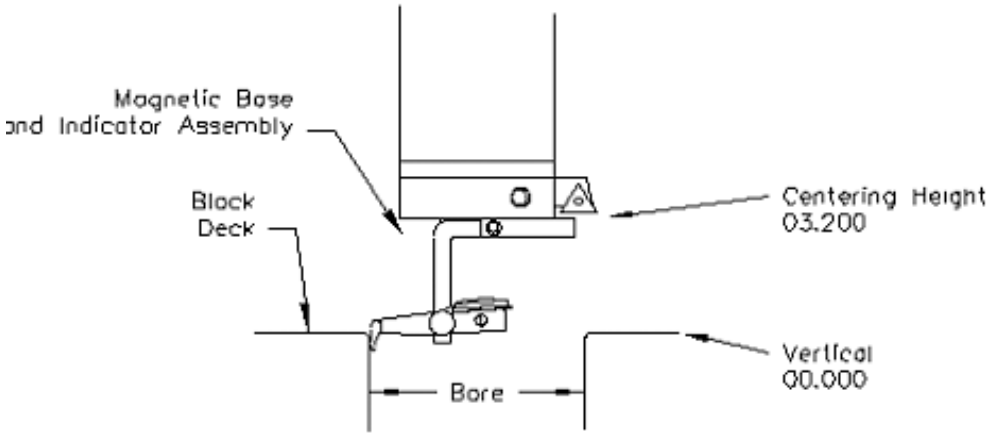
The Lower Sleeve Repair mode operates the same as the Cylinder Bore Mode with the exception of additional parameters in the Vertical Stops Tab.

Block Clearance

This is the distance above the zero position or block deck allowing the cutter head to move to the next bore unobstructed. If you are blueprinting a block the number will be just enough to allow the tool in the cutter head to clear the block deck.

Centering Height

This is a distance above the vertical zero where you will be manually centering the block. The drawing Below is a typical set up for manual centering or indicting a cylinder.

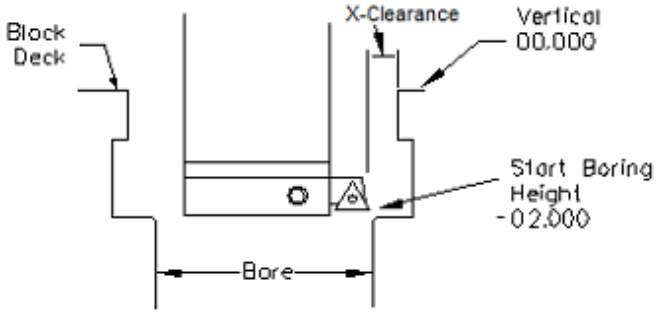


X-Clearance

This is the parameter will index the cutter pointing in the x+ direction, (right) three O'clock position. The amount you set will allow the tool to move so it clears the block deck of the upper bore does not contact the block or upper bore. See drawing below. Machine moves in the X axis, and can be set to positive or negative movement. Should be set to negative value ex... -.200 (-5mm)

180 index (check box)

This will make the spindle index with the tool pointing in the (X-) direction, (left) nine O'clock position. Should set X-clearance to a positive value, ex... .200 (5mm)



X-Overshoot

This refers to the amount that it will overshoot the machine to help eliminate any backlash. IMPORTANT- If your X-clearance is negative (-) the overshoot should be a positive value, if the X-clearance is positive the overshoot should be negative (-)

Start Boring Height

This is the distance above zero or the block deck where you want the cutter head to start rotating and the downward feed to start. Generally this is just a short distance above the lower sleeve to minimize the amount of time the machine bores through air.

Bottom of the Bore

This is the distance below zero or the Block deck where you want the machine to stop boring and retract out of the cylinder. When the spindle retracts it will then go to the Block Clearance position.

This is an example of what the above program would look like on the vertical stops.

Stop and Index Spindle after Cycle

Checking this box will cause the spindle to be indexed to the three O'clock position after the cylinder has been bored but before it retracts. It will also offset to the left before the tool is retracted. This is the default setting. You would not want this check in an operation such as Lifter Boring.

Probing For The Mill Cycle

The Rottler Milling program is set up to Automatically Probe the Deck height of a block and then Mill it to a set Deck Height. This can be done on a 3 or 4 axis machine. This will also cover Setting Tool Offsets.

Table of Tools for Milling

You ***MUST*** use the Table of Tools if you want to Automatically Probe the deck height and cut it to a set height. Once done the Table of Tools Should look similar to the below picture. The 100mm Probe is Tool 1. The 10" Fly Cutter is Tool 2.

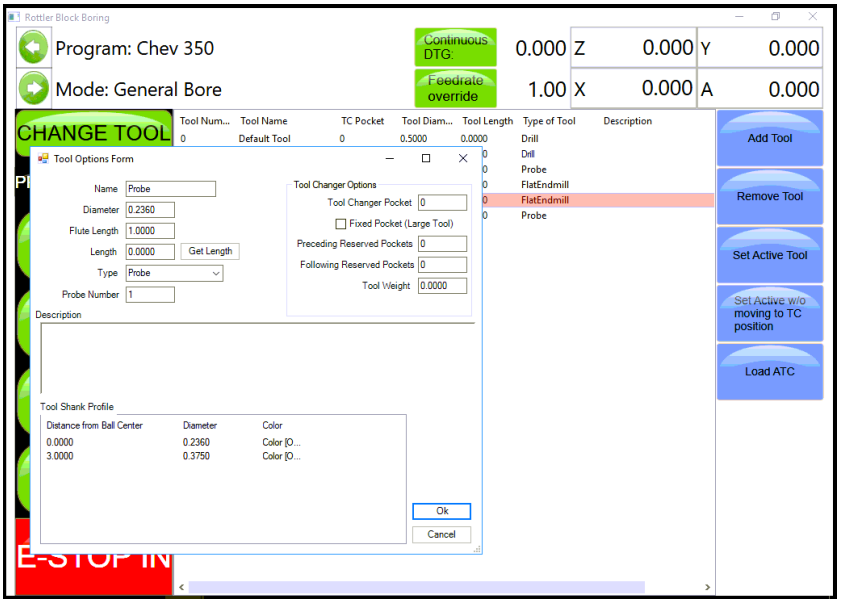
Go to Program Select, and then select the block you are working with and then Mill Mode.
Install the Probe physically into the spindle. If you have a 4th axis rotate it to Zero degrees. Indicate the Middle flat on the head stock to be sure it is zero all the way across. There should be a number stamped into the headstock.

This is the distance from the Flat to the center of the Crank. Bring the probe down until it just touches the middle flat.

Open the Table of Tools and double click on Tool1 100 mm Probe. Enter the Measured diameter of your probe. This is not used in the Milling Program but *needs* to be entered accurately for Probing in the Bore mode.

On the open window select Get Length. This will open another Window. There will be a value, that you cannot edit, in the "Z Location from Zero" this is the distance the Vertical Axis is from home when the Probe touches the Middle flat.

In the Data box for "Z Touch off Height" enter the number that is stamped on the Head Stock. This is the distance from the flat to the center line of the Crank.



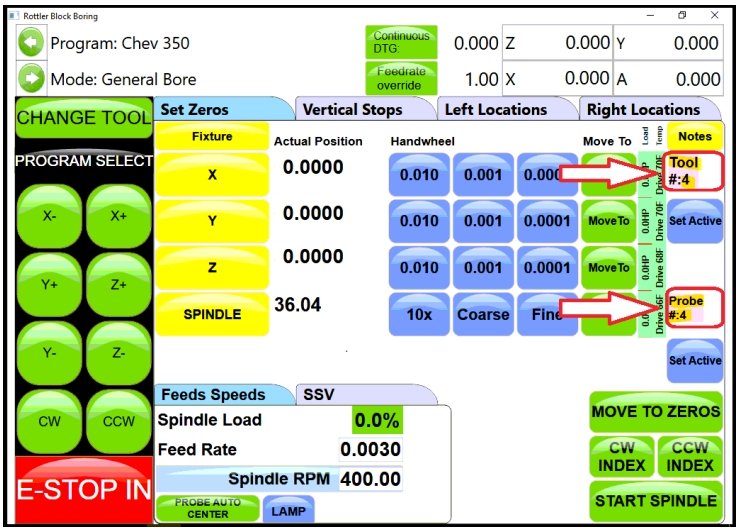
Select OK on both windows. This will put the Total tool length into the Table of Tools.
The Vertical Digital Read Out will now consider the center of the Crank bore to be the Vertical Zero position. When the Probe tip or Cutting insert touches the Deck the Vertical DRO will be reading out the distance from the center of the Crank bore (Actual Deck Height).

Assigning Tools

From the Set Zero Tab, select Probe#. This will open the Tools Select Form. Select Tool 1, 50 mm Probe and click OK.

Select the Tool#.

This will open The Tool Select Form. Select Tool 2, 10 inch Fly Cutter and click OK.



The tools to be used have now been assigned to the program.

Left Deck Probe

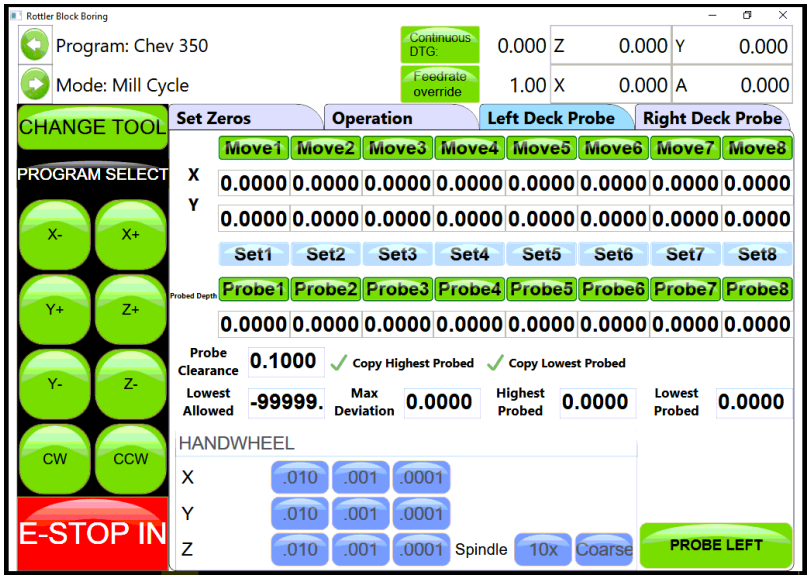
Enter the positions you want the Probe to probe here. You can physically move the probe to the locations on the bank you want to probe and hit the set button also.

Right Deck Probe

Roll the block over to the Right Bank. Enter the positions you want the Probe to probe here. You can Physically move the probe to the locations on the bank you want to probe and hit the set button also.

Auto Probing

Press the Start Probing button. The machine will first probe each programmed location on the left bank and record the height. The spindle will move to Vertical Clearance height and the block will roll over to the right bank and probe the programmed locations and record them. If you have a 4th axis The block will then roll back over to the Left bank and the spindle will move to the first Left location and stop.



Lifter Bore

The Lifter Bore Mode and its buttons operate identical to the Bore Mode with a couple of exceptions.

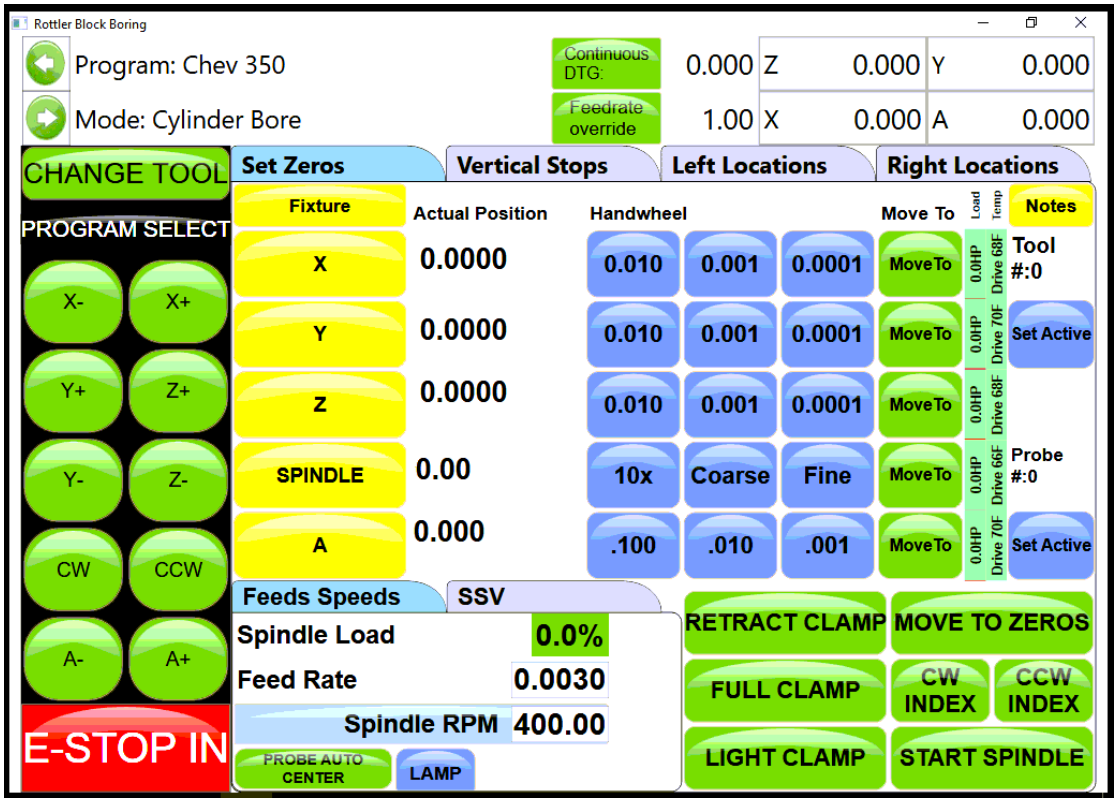
On the Program Vertical Stops screen, lower Clearance Offset is not an option.

After a bore is complete the spindle will not offset .020” for tool clearance unless the “Horizontal Offset after Cycle” box is checked. This is used when a single point boring tool is used for lifter boring.

Cylinder Bore 4 Axis

Most of the Control Definition in the 4th axis is the same as the 3 axis version of software. Only the differences or new features will be discussed in this section.

Set Zero Tab



Jog Controls

4Th-

Pressing this button will cause the 4th axis to rotate in a negative direction while held.

4Th+

Pressing this button will cause the 4th axis to rotate in a positive direction while held.

4th Axis Degree and Move

Touching the 4th Axis Degree Data Box will bring up a Pop-Up Menu so a degree can be entered. Once a value is entered (even zero), pressing the Move button will move the 4th axis to that position.

4th axis Brake

This shows the status of the 4th axis brake a well as manually turning the brake on and off. When the 4th axis is rotated using the jog controls the fixture will automatically switch the brake On and Off.

Light Clamp

Pressing this button will cause light pressure to be exerted from the Tail Stock towards the Head stock. When the 4th axis is rotated using the jog controls the fixture will automatically switch from Full to Light clamp and back.

Full Clamp

Pressing this button will cause full pressure to be exerted from the Tail Stock towards the Head stock.

Retract

Pressing this button will cause the tail stock to fully retract. A dialog box will appear when this button is pressed to assure you want to retract the tail stock. This is to prevent an accidental retraction when a block is in the fixture.

Table Of Tools

The Table Of Tools is a very powerful feature in this software. Most of the Rottler programs are designed to be used without interacting with the Table Of Tools.

Only the program specific uses will be described here.

Table Of Tools General Information

The Table Of Tools is used to set different tool lengths so multiple tools can be used in one program and reference the same vertical zero position.

For Example, if you were to use two boring bars in one program. One boring bar is 8” long and the other is 4” long. There is then a 4” difference in where the cutter of each bar will come into contact with the part to be machined. Using the Table of Tools you can set the 4” difference for one of the boring bars so that both of the cutting tools will come into contact with the material at the same vertical position.

Accessing Table Of Tools

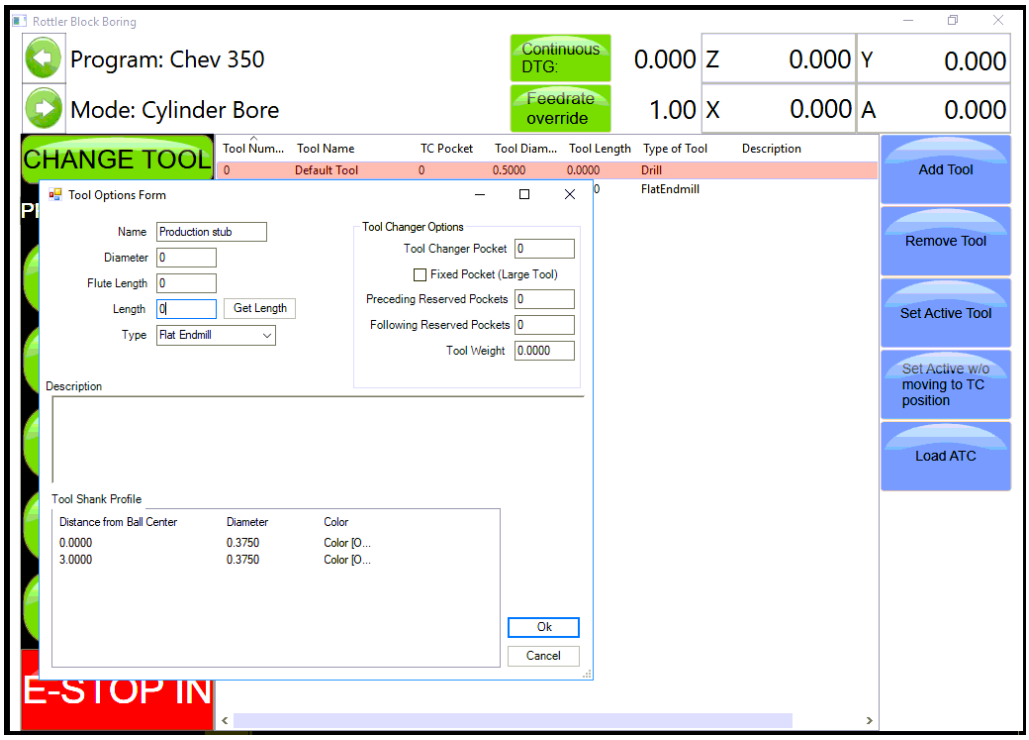
Select TABLE OF TOOLS from any screen in the upper left hand corner. This will open up the Table Of Tools.

On this screen you will be able to Add, Remove or Set that tool Active (installed in spindle and being used).

The Table of Tools comes with Tool 0 installed with no offset amount. Tool 0 will remain tool 0 with no offset always. Tool 0 will be set active when you are using programs that do not require tool offsets.

Add Tool

To add a tool to the Table of Tools press Add Tool. This will open another window. Here you will name the Tool you are adding. Such as 2.9 production Stub. It is important to give an accurate name to the tool. You want the tool easily identifiable by its name. The only other data box the Rottler software uses is the Length Data Box. This will be discussed later. Press OK.



The Added tool will now show in the Table of Tools.

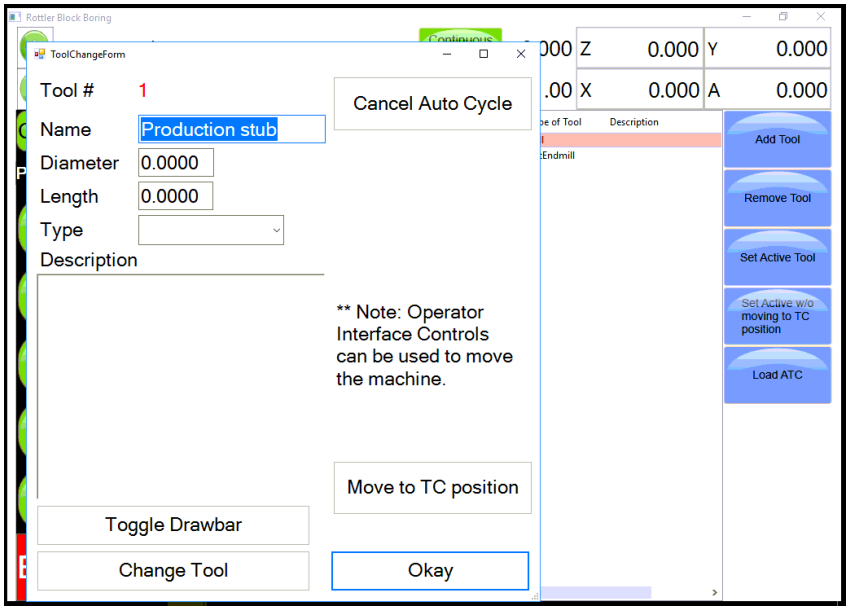
Remove Tool

Pressing this button will remove the highlighted tool from the Table of Tools.

Set Active Tool

Pressing this button will set the highlighted tool to an Active Status (tool installed and will be used) Any Vertical offset associated with that tool will be used when a program is run. You can tell which tool is active because it is highlighted in Red. When no offset is required in a program Tool 0, Default Tool should be active.

When setting a tool active another window will open. This is the Tool Change Form. It is basically there to verify the tool information before it is set to an active status. Verify the information and press OK.



This window will open when the machine does an automatic tool change. This will be discussed in Chapter 5 Operating Instructions. After you press OK another window will open. This is a Warning Dialog box to inform the operator of the possibility of the spindle start if the tool change is done in an automatic program. Press OK.

Setting Tool Offsets

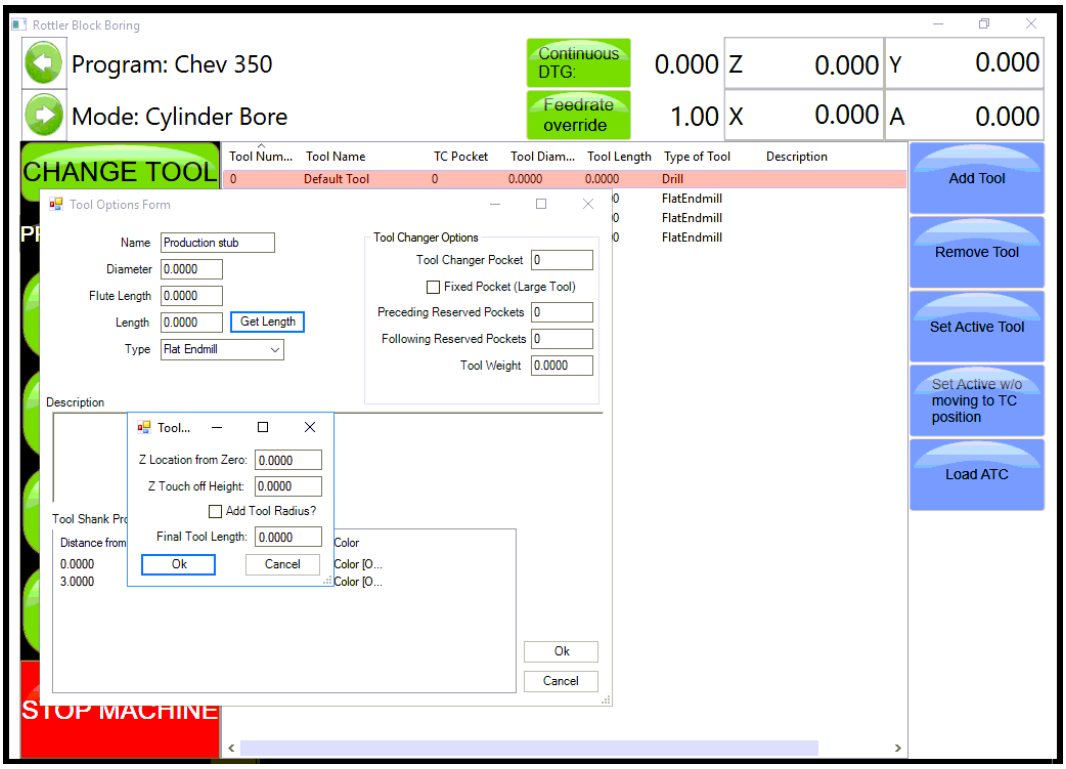
Add all the tools that will need offsets into the table of tools. Leave the Length value at 00.00 when you first enter them.

For this example we will be setting offsets for a 2.9 Production Stub, 100mm Probe and a 10 inch Fly cutter. Add these tools to the table of Tools.

NOTE: Only the Probe will use the Tool Diameter. The Probe will use the Tool Diameter when probing a cylinder, it will not use the Tool Diameter when touch off a surface such as a block deck. Changing this setting will be discussed in later in this Chapter.

To set Tool Offsets you will need a fixed vertical reference point on the machine that does not change such as the head stock of the 4th axis or Performance Fixture.

Install the first tool such as the 2.9 Production Stub with Cutting insert installed. Bring the cutting insert down until it just touches the flat on the head stock of the 4th axis fixture. Go to the TABLE OF TOOLS and double click the 2.9 Production Stub tool. Select Get Length from that window. This will bring up the Tool Length window.



Z Location from Zero

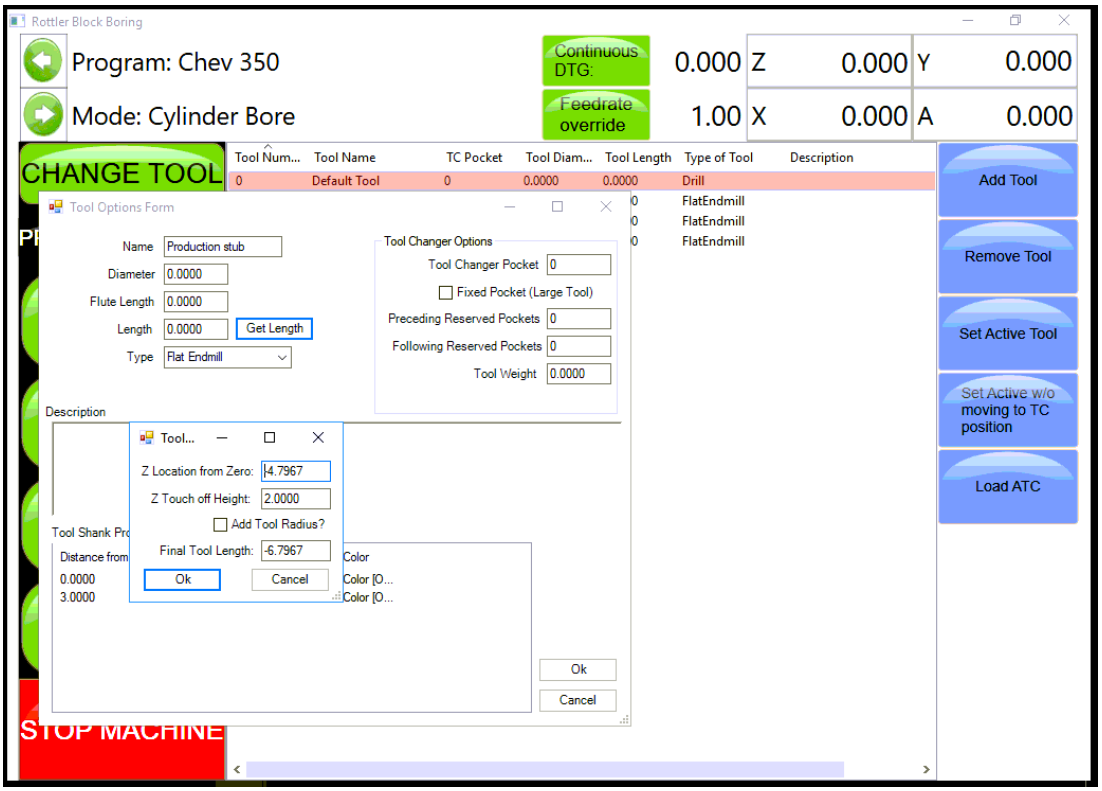
This is the distance the Vertical Axis is from the home position. NOT where the operator has set the Vertical Zero in the program. This value is set by the computer automatically. In this example the tool just touched the flat at 8.0000.

Z Touch Off Height

This value is an additional value you want added to the Z location from zero. For example, if you wanted to use the center of the Crankshaft as the vertical reference point, but you are touching the tool off of the flat of that head stock, you would enter the distance from where you are touching off to the center of the Crank (this value is stamped into the headstock by Rottler). The values from Z Location from Zero and Z Touch off Height are added together by the computer to get the Final tool Length value. If you are not referencing another vertical position then this value will remain 00.000.

Add Tool Radius?

Checking this box will add the Tool Radius to the Final Tool Length. This is not used in the Rottler programs and should remain unchecked for all tools.



Repeat this procedure for each tool. Touch ALL of them off from the same point.

When running a Rottler program the cutting insert for each tool will reference the Vertical Zero the operator set in the program and come into contact with the surface to be machined at the same vertical value.

Applying Table of Tools to Rottler Programs

The use of the Table of Tools to specific Rottler programs such as Bore and Mill will be defined in Chapter 5 Operating Instructions.

Fixture Select

This is also a very powerful tool. It is not generally used in the Rottler Programs. It's basic function is to offset a program and table of tools a set distance on each axis (if desired) and run the same program without resetting axis zero points.

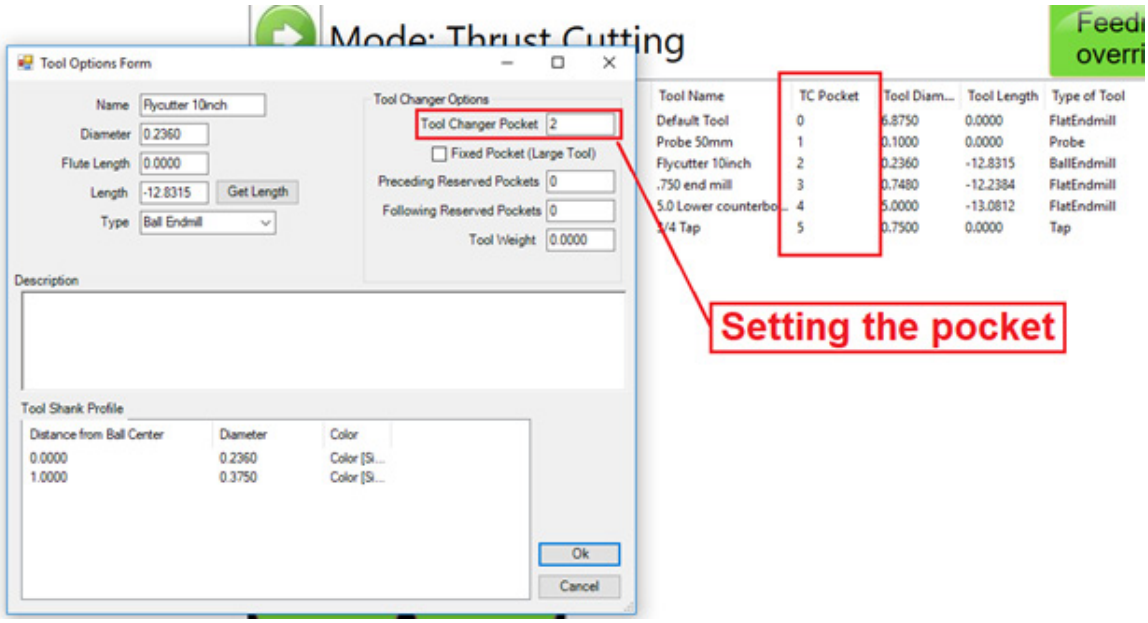
For example, if you have to fixtures that are identical but are set at a different location on the table you can set the difference values in the table of fixtures and run the program.

It is recommended this is not used unless you are a very experienced operator.

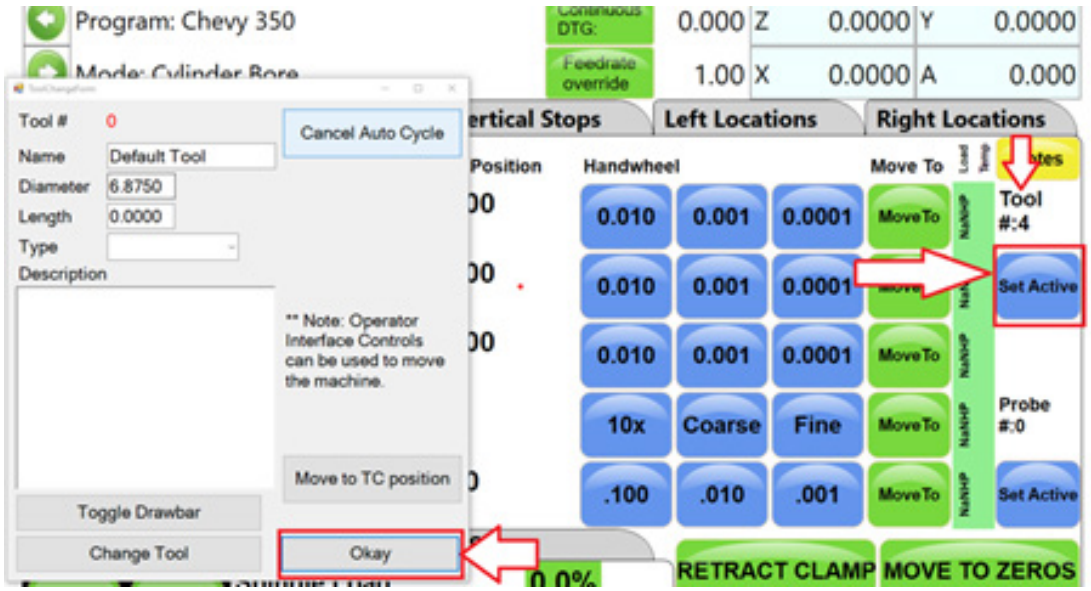
Tool Changer On A EM103/4/5

This will cover setting EM tool changer operation. Using the ATC the machine will be making automatic moves, be aware of pinch points. This requires knowledge of machine setup, program setup and access to the software setup.

1. It is important to give an accurate name to the tool. You want the tool easily identifiable by its name
2. There is a box that you can check on labeled Fixed Pocket (Large Tool). This is for cutters that have a greater diameter than 3.0”(75mm). As an example a typical flycutters used for surfacing decks is 10.0”(255mm) diameter. In this case you would want to select the Fixed Pocket box and leave the two pockets before and after the large diameter.



Pressing the Set Active button will set the highlighted tool to an Active Status which triggers the tool changer to perform a tool change to that specific tool.



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OPERATING INSTRUCTIONS

Contents

Operating Instructions

The purpose of this chapter is to explain and guide the operator from loading a block through running an automatic cycle.

All modes of operation will be discussed in this chapter.

Note: We recommend, particularly for operators unfamiliar with this machine, to practice on a junk block in order to become familiar with the controls and procedures of the boring machine.

Loading Blocks

Small Gas and Diesel

Manual V6/V8 Combination Fixture 502-1-72H

⚠ WARNING Handle the block and fixture with EXTREME care and guidance. A block hoist is REQUIRED. Mishandling of a heavy engine block and fixture may result in the dropping of parts and personal injury.

The Model 502-1-72H manual V6/V8 combination fixture is a fast, simple and universal system to properly and accurately hold most 60 degree V-type engine blocks for either cylinder boring or deck surfacing.

See illustration on the following page.

Boring Application

NOTE: The block must have the main bearing caps in place and torqued.

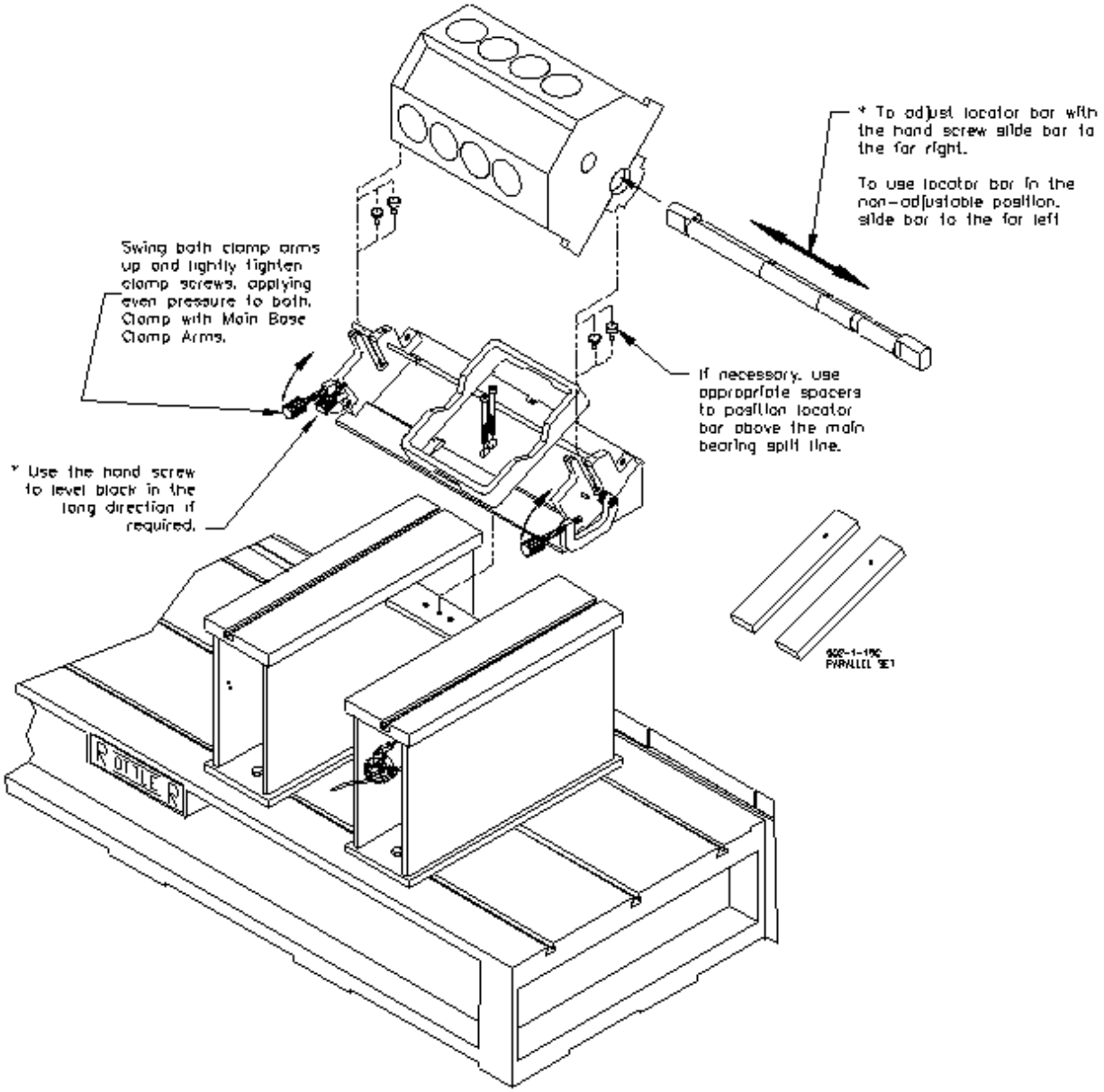
Care must be taken to assure the contact edges of the locator bar are near the cap split line. A pair of 3/8” and 1/2” spacers are provided for blocks with large main bearing bores, to enable the bar to locate near the main bearing split line. (See figure 2)

V-blocks: (blocks with main bearing center lines no more than 1/2” higher than the pan rail plane) are mounted with the 502-3-8B V-block frame in place. Select the 90-degree option placement of the frame to suit block length, or main bearing caps will interfere with frame. Rotate frame 90 degrees by moving its shoulder screws to alternate set of holes.

Y-Blocks: (blocks with main bearing center lines 2-3/8” to 3-1/2” higher than the pan rail plane) are mounted directly on the fixture. Some Y-blocks (GM 60 degree) have too narrow pan rails and some have too low main bearing location which will require the use of the 502-1-15C precision 1-1/4” x 3” parallel set to raise and or support the block. Use the shoulder screw from the V-block frame and hook the parallels over the back of the V-fixture.

This fixture may be easily repositioned on the support parallels (without a block in place) to shift from the 60 degree support surface to the 90 degree support surface or vice versa.

⚠ WARNING Extreme care must be taken by the operator whenever handling large blocks. Large blocks may cause fixture to tip when floated too far outward. We recommend leaving the hoist attached when moving these blocks. Large blocks should be lifted from the block bank surface.



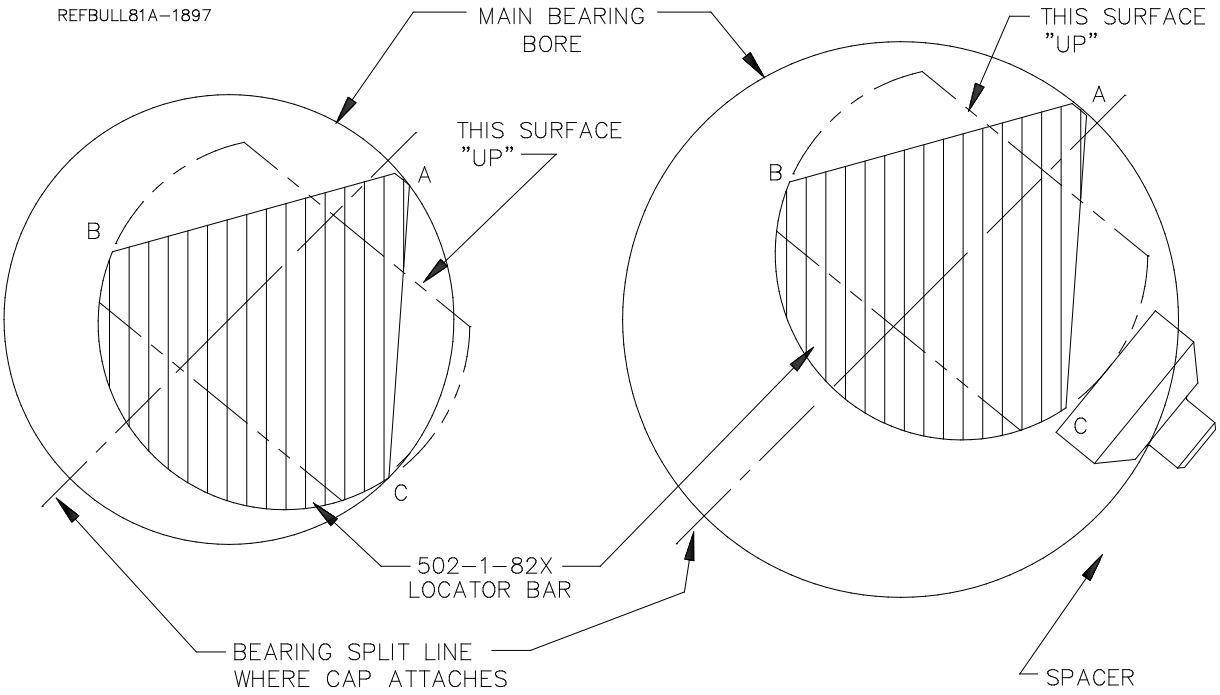


FIGURE 1 FIGURE 2

Normal Operating Procedure

The normal operating procedure on smaller V-blocks is to first pick up the block. Place the 502-1-82X locator bar through the main bearings and hoist the block into the fixture. Pulling the block towards you, with the locator against the positioners, will prevent jamming in the slot of the guides during the loading and unloading operations. The locator bar is positioned with the word ‘UP’ that is on the end of the bar facing up and away from the operator. (see figure 1) After the locator bar is engaged in the positioners, pivot the block outwards as you lower it. Slide the block to the far left (this is the non adjustable position).

Make sure the block is firmly seated in place and not resting on the pan-rail, burrs or other interference points. Accurate seating can also be a problem with extremely warped or distorted blocks. Another cause of problems is failure to remove main bearing inserts. The locator bar has a relief for blocks with a small main bearing or seal. Rotate locator bar clamps into position & lightly tighten the hand screws, applying even pressure to both. Clamp the block securely with the main base clamp arms.

Warped or distorted blocks may require leveling of the deck surface in the long direction. This is possible with the hand-screw assembly in the left-hand bar positioner. Loosen both clamp hand-screws and slide the locator bar to the far right position. Retighten both clamp hand-screws. Raise or lower the adjusting hand-screw as required. For the non-adjustable position slide locator bar to the far left.

Push the fixture back into bore position. There is a guide block (502-1-105) attached to the bottom of the fixture to aid in guiding the fixture along the support ways.

Operate the block clamp arms, bore, and pull fixture back to the load position.

Loosen locator bar hand screws and rotate clamps out of the way. Lift the block, either from the deck surface or with the optional 502-1-95 block handler. Turn the block 180 degrees & reload to duplicate the operation on the other bank.

After turning the engine block 180 degrees the locator bar must be twisted 180 degrees also. Again the word ’UP’ must enter into the positioners facing up and away from the operator. (See figure 1).

Figure 1

502-1-82X main bearing locator bar indexes at point A. When bank is reversed and the bar is twisted 180 degrees, point A still indexes the main bearing.

Point C holds the block down. When bank is reversed and the bar is twisted 180 degrees, point B holds the block down.

Figure 2

502-1-82X main bearing locator bar indexes near bearing split line. Point C does not contact the bearing cap but rests on matched spacers that are provided to fit in the bar positioners slot. If there is a means of holding the block down such as block clamp towers, this method may be used in large bores in order to properly index near the bearing split line. If extreme care is used this method may be used to index blocks without bearing caps attached. (Optional clamp down must be provided).

Surfacing Application

NOTE: The block must have the main bearing caps in place and torqued.

Care must be taken to assure the contact edges of the locator bar are near the cap split line. A pair of 3/8” and 1/2” spacers are provided for blocks with large main bearing bores, to enable the bar to locate near the main bearing split line. (See figure 2)

V-blocks:

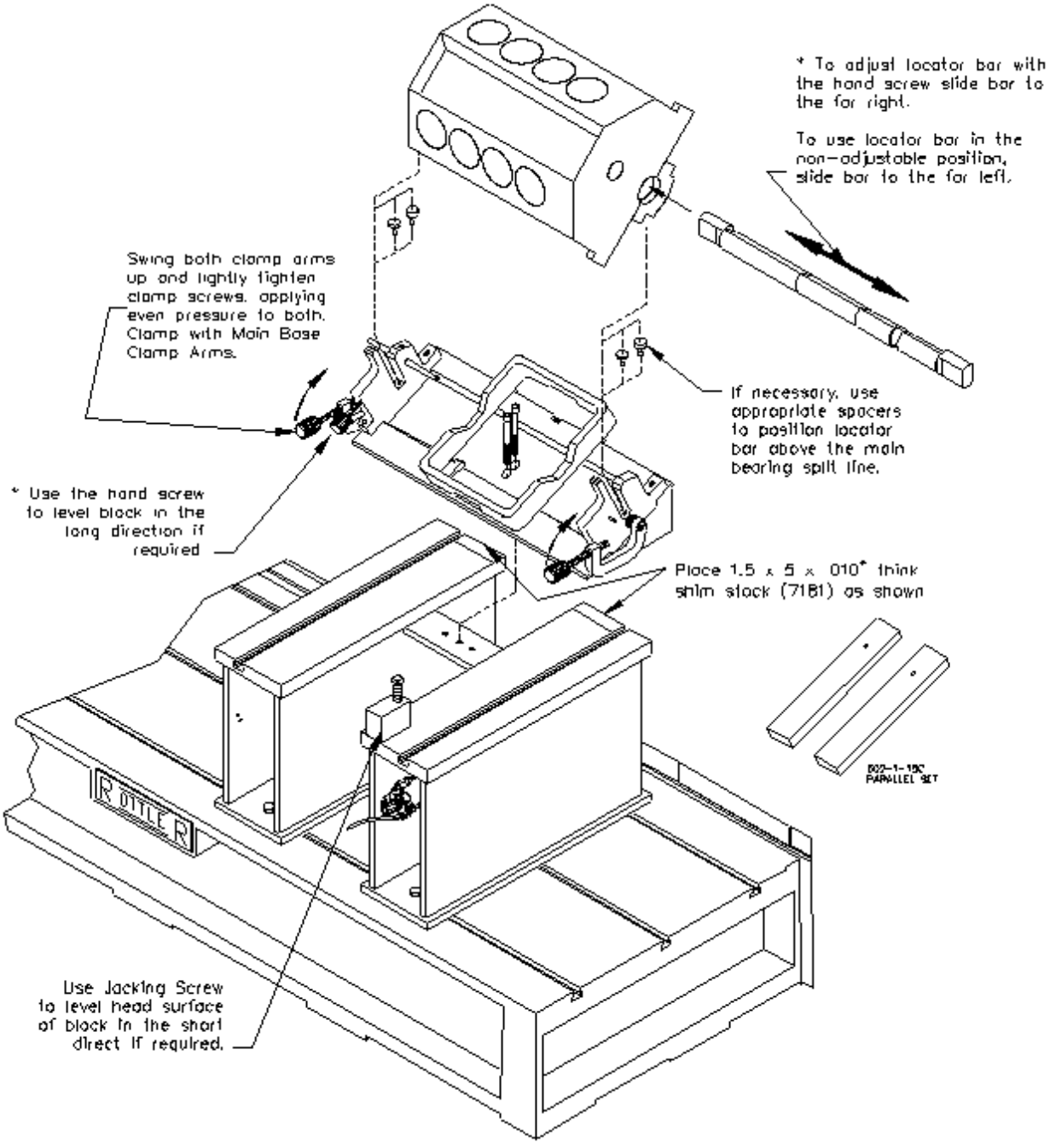
(blocks with main bearing center lines no more than 1/2” higher than the pan rail plane) are mounted with the 502-3-8B V-block frame in place. Select the 90-degree option placement of the frame to suit block length, or main bearing caps will interfere with frame. Rotate frame 90 degrees by moving its shoulder screws to alternate set of holes.

Y-Blocks:

(blocks with main bearing center lines 2-3/8” to 3-1/2” higher than the pan rail plane) are mounted directly on the fixture. Some Y-blocks (GM 60 degree) have too narrow pan rails and some have too low main bearing location which will require the use of the 502-1-15C precision 1-1/4” x 3” parallel set to raise and or support the block. Use the shoulder screw from the V-block frame and hook the parallels over the back of the V-fixture.

This fixture may be easily repositioned on the support parallels (without a block in place) to shift from the 60 degree support surface to the 90 degree support surface or vice versa.

⚠ WARNING Extreme care must be taken by operator whenever handling large blocks. Large blocks may cause fixture to tip when floated too far outward. We recommend leaving hoist attached when moving these blocks. Large blocks should be lifted from the block bank surface.



Normal Operating Procedure

The normal operating procedure on smaller V-blocks is to first pick up the block. Place the 502-1-82X locator bar through the main bearings and hoist the block into the fixture. Pulling the block towards you, with the locator against the positioners, will prevent jamming in the slot of the guides during the loading and unloading operations. The locator bar is positioned with the word 'UP' that is on the end of the bar facing up and away from the operator. (see figure 1) After the locator bar is engaged in the positioners, pivot block outwards as you lower it. Slide block to the far left (this is the non adjustable position).

Make sure the block is firmly seated in place and not resting on pan-rail, burrs or other interference points. Accurate seating can also be a problem with extremely warped or distorted blocks. Another cause of problems is failure to remove main bearing inserts. The locator bar has a relief for blocks with a small main bearing or seal. Rotate locator bar clamps into position & lightly tighten the hand screws, applying even pressure to both. Clamp the block securely with the main base clamp arms.

Warped or distorted blocks may require leveling of the deck surface in the long direction. This is possible with the hand-screw assembly in the left-hand bar positioner. Loosen both clamp hand-screws and slide the locator bar to the far right position. Retighten both clamp hand-screws. Raise or lower the adjusting hand-screw as required. For the non-adjustable position, slide locator bar to the far left.

Push fixture back into surfacing position with the back of the fixture on the shim stock. The shim stock is put in place to raise the back side of the block, you can then use the Jacking Screw to raise and lower the front of the block. There is a guide block (502-1-105) attached to the bottom of the fixture to aid in guiding the fixture along the support ways.

Operate the block clamp arms, surface, and pull fixture back to the load position.

Loosen locator bar hand screws and rotate clamps out of the way. Lift the block, either from the deck surface. Turn the block 180 degrees & reload to duplicate the operation on the other bank.

After turning the engine block 180 degrees the locator bar must be twisted 180 degrees also. Again the word 'UP' must enter into the positioners facing up and away from the operator. (See figure 1).

Figure 1

502-1-82X main bearing locator bar indexes at point A. When bank is reversed and the bar is twisted 180 degrees, point A still indexes the main bearing.

Point C holds the block down. When bank is reversed and the bar is twisted 180 degrees, point B holds the block down.

Figure 2

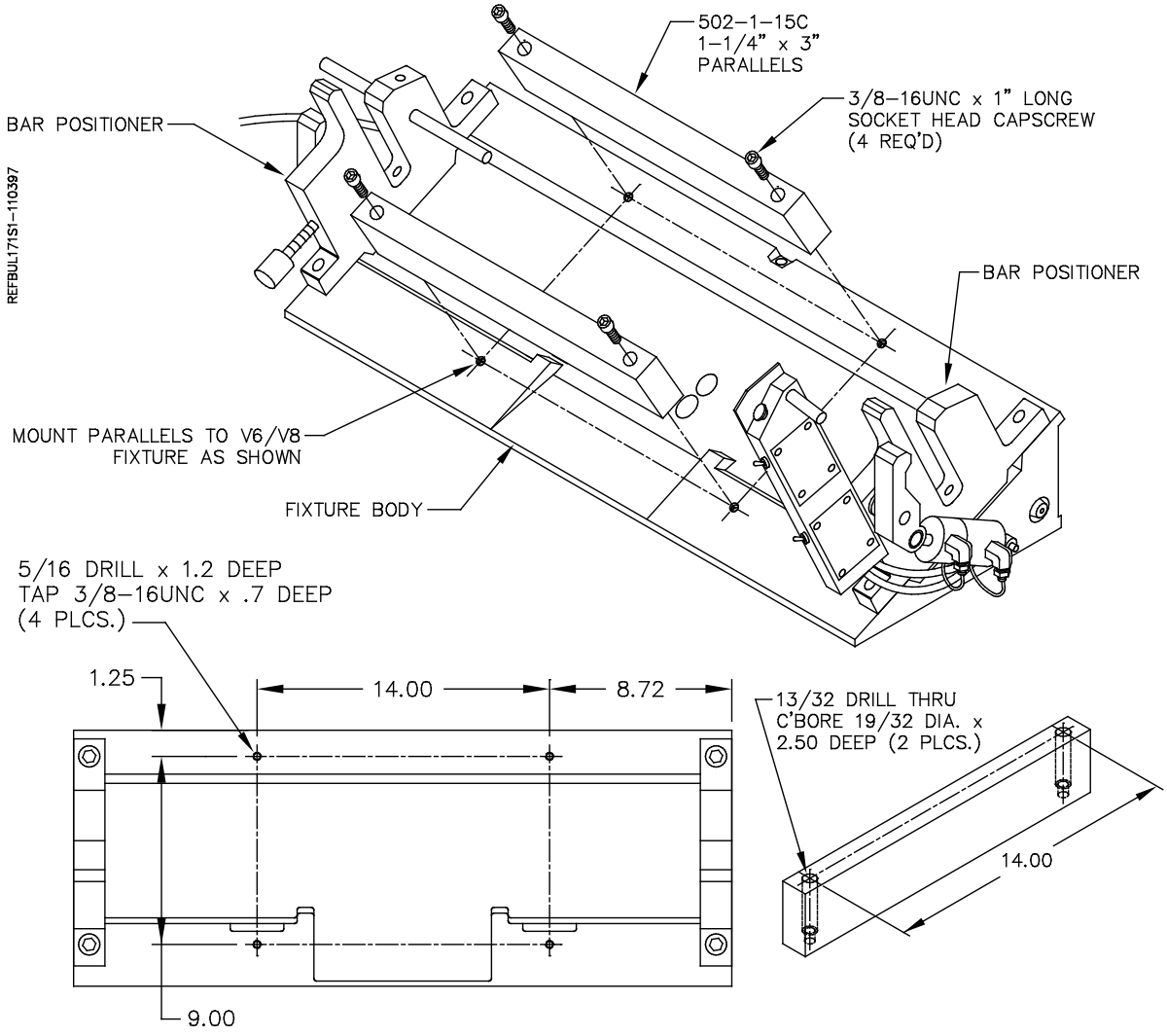
502-1-82X main bearing locator bar indexes near bearing split line. Point C does not contact the bearing cap but rests on matched spacers that are provided to fit in the bar positioners slot. If there is a means of holding the block down such as block clamp towers, this method may be used in large bores in order to properly index near the bearing split line. If extreme care is used this method may be used to index blocks without bearing caps attached. (Optional clamp down must be provided).

Retrofitting 502-1-15C Parallels to V6/V8 Combination Fixture

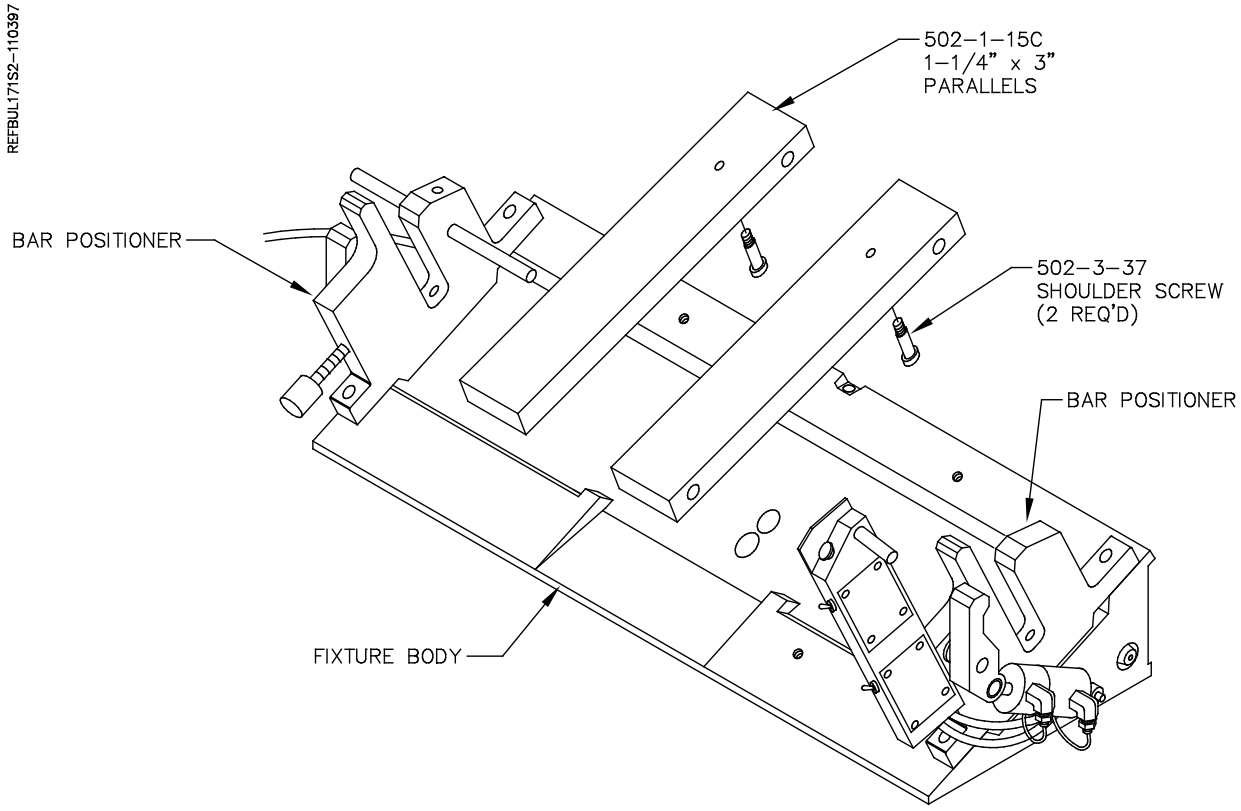
(Special Applications)

Some engine blocks with large main bores (3-1/8” and larger) cause the locator bar to bottom out in the bar positioners and/or the V-shaped relief’s of the 502-3-8B V-block frame before clamping the block properly. Mounting the 502-1-15C parallel set as shown below in place of the V-block frame will provide proper clearance for clamping. Older style fixtures and parallels can be modified to this configuration using illustrations below.

V-6 blocks with one-piece ‘caged’ main bearing caps (all caps are connected) can interfere with 502-3-8B V-block frame. The parallel arrangement shown below will allow proper support and clamping of these blocks.



Some V-6 engine blocks (for example Buick V-6) have main bearing bores that are too low in respect to the pan rails. This causes the locator bar to bottom out in the bar positioners before the block is properly clamped. Positioning the 502-1-15C parallel set as shown below will raise the block enough to provide proper clamping.



Diesel Blocks

6725 Diesel Fixture

Small Diesel V Blocks

On these blocks it will be necessary to install the 6370Z, 10” parallels or 6794E, 8” parallels onto the bed of the machine. These parallels are keyed, place them onto the deck surface and then push them toward the rear of the machine. This will located them evenly on the middle keyway of the machine bed. Place the two 6553F main bearing supports onto the parallels, these are also keyed and fit into the machined slots on the parallels. This will put the two main bearing supports in line with each other. Tighten all bolts to lock the parallels and main bearing support into place. Select the correct size main bearing locators and install them into the mains of the block..

Note: Make sure there are no burrs or debris in the main bearing bores where they will contact the main bearing locators. This can cause the block not to clamp properly and may cause tipping or rocking of the block.

⚠ WARNING Handle these large blocks with extreme care and guidance. A block hoist is required when handling these blocks. These blocks should be lifted from the block bank surface.

Install the main bearing locators into the mains of the engine block. Lower the block so that the locators go into the main bearing support.

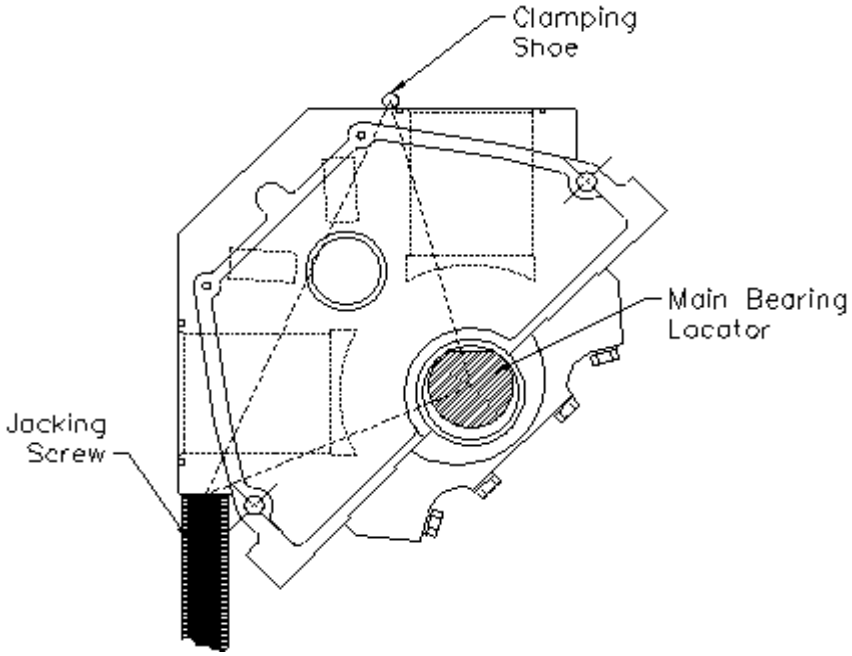
⚠ DANGER The hoist must remain attached to the block until it is firmly clamped into position. The blocks will have a tendency to tip forward until they are properly supported and clamp. When not properly supported and attached to a hoist these blocks will roll forward and out of the fixture. This will cause severe injury or death to operator.

Select the correct jacking screw to reach the block. Place the jacking screws into the jack bodies and place on the parallels in a location they will support the block from rolling forward.

Position the block clamps so the front of the shoe will clamp the block in the middle on both ends. The following illustration shows the correct triangle clamping system that should be used.

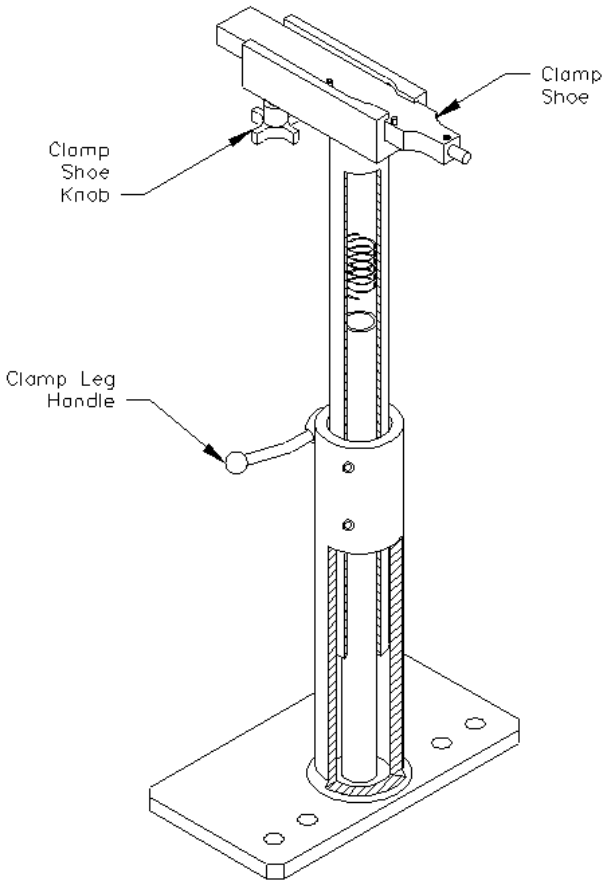
You can raise and lower the ends of the block by rotating the Hex nut located on the ends of the main bearing locators.

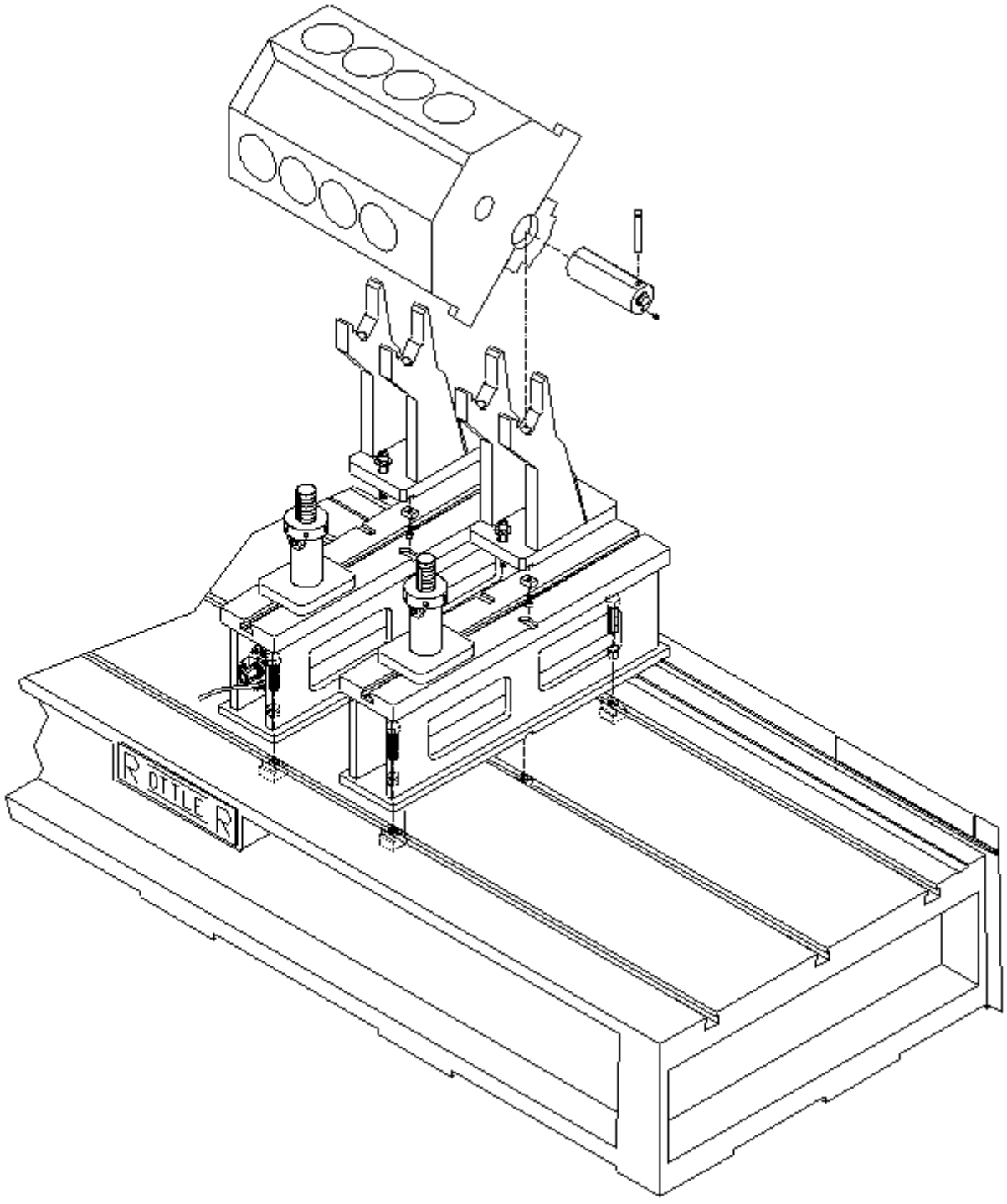
Triangle Clamping



Adjust the height so the shoes rest on the clamp points. Tighten the clamp leg handles. Actuate the clamp shoes by turning their knobs. Apply pressure to the two clamps as evenly as possible to avoid tipping the block up on one side.

Block Clamp Arm




R OTTLE R

Small Diesel In Line Blocks

On these blocks it will be necessary to install the 6370Z, 10” parallels onto the bed of the machine. These parallels are keyed, place them onto the deck surface and then push them toward the rear of the machine. This will located them evenly on the middle keyway of the machine bed. Place the two 6553F main bearing supports onto the parallels, these are also keyed and fit into the machined slots on the parallels. Use the forward machined slots. This will put the two main bearing supports in line with each other, and on centerline of the machine bed.

Position the fixtures at a distance apart equal to the outboard main journals. Tighten all bolts to lock the parallels and main bearing support into place. Select the correct size main bearing locators, and install them into the mains of the block. Notice the locators have a flat area. Installing with the flat side up will allow end to end height adjustment of the block by rotating the locator. Installing with the round side up will position the block so all machining operations are parallel and perpendicular to the main bore centerline. This simply requires leveling the block in the front to rear direction.

Note: Make sure there are no burrs or debris in the main bearing bores where they will contact the main bearing locators. This can cause the block not to clamp properly and may cause tipping or rocking of the block.

⚠ WARNING Handle these large blocks with extreme care and guidance. A block hoist is required when handling these blocks. These blocks should be lifted from the block bank surface.

Lower the block so that the locators go into the main bearing support. A clevis pin is provided to keep the locator in position on the main bearing support.

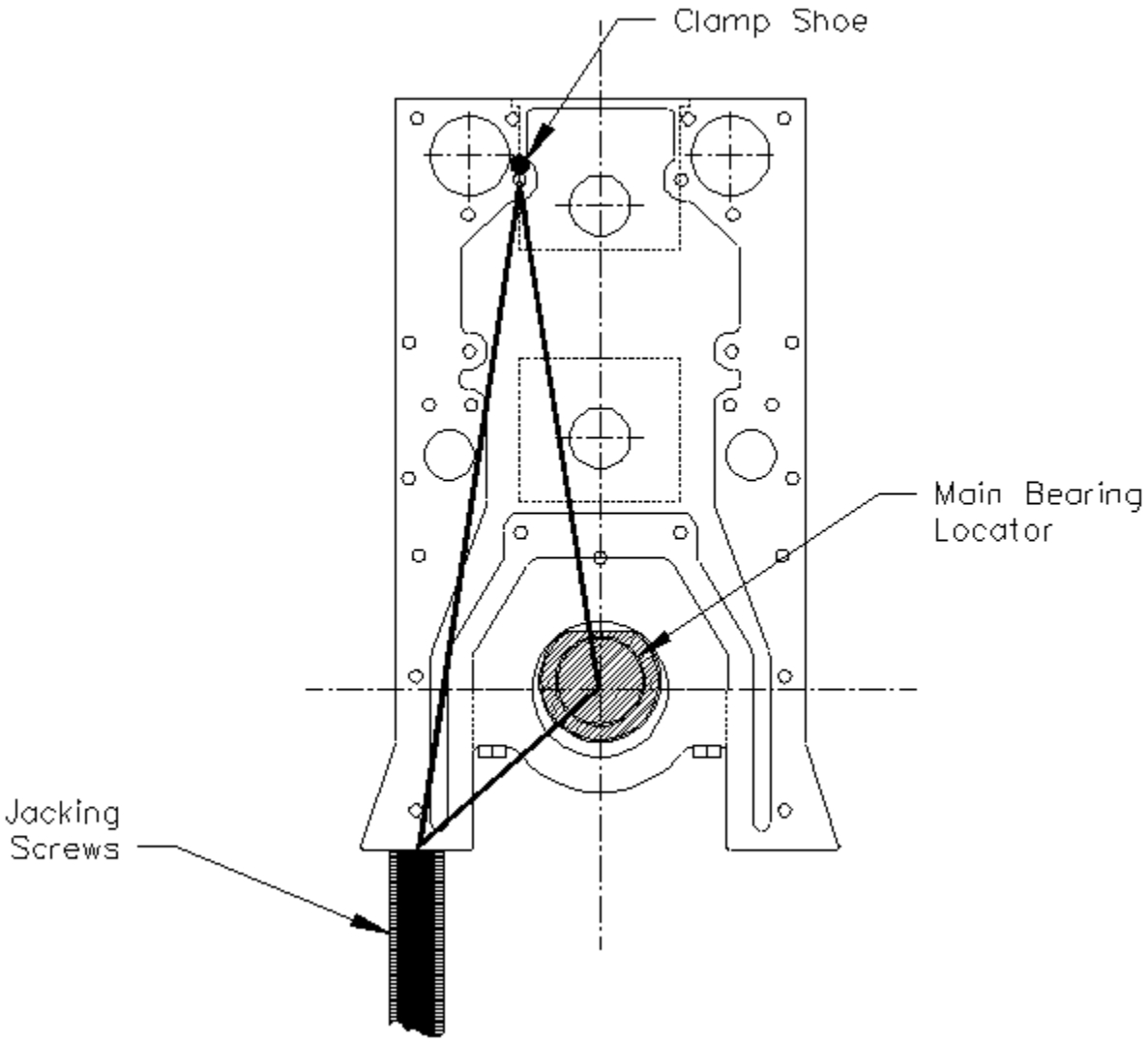
For in-line blocks, load the block with the heavier side towards the front.

⚠ DANGER The hoist must remain attached to the block until it is firmly clamped into position. The blocks will have a tendency to tip until they are properly supported and clamp. When not properly supported and attached to a hoist these blocks will roll forward or backwards and out of the fixture. This will cause severe injury or death to operator.

Select the correct jacking screws to reach the block. Place the jacking screws into the jack bodies and place on the machine bed in a location they will support the block from rolling forwards. Rough level the block using a spirit level.

The following illustration shows the correct triangle clamping system that should be used.

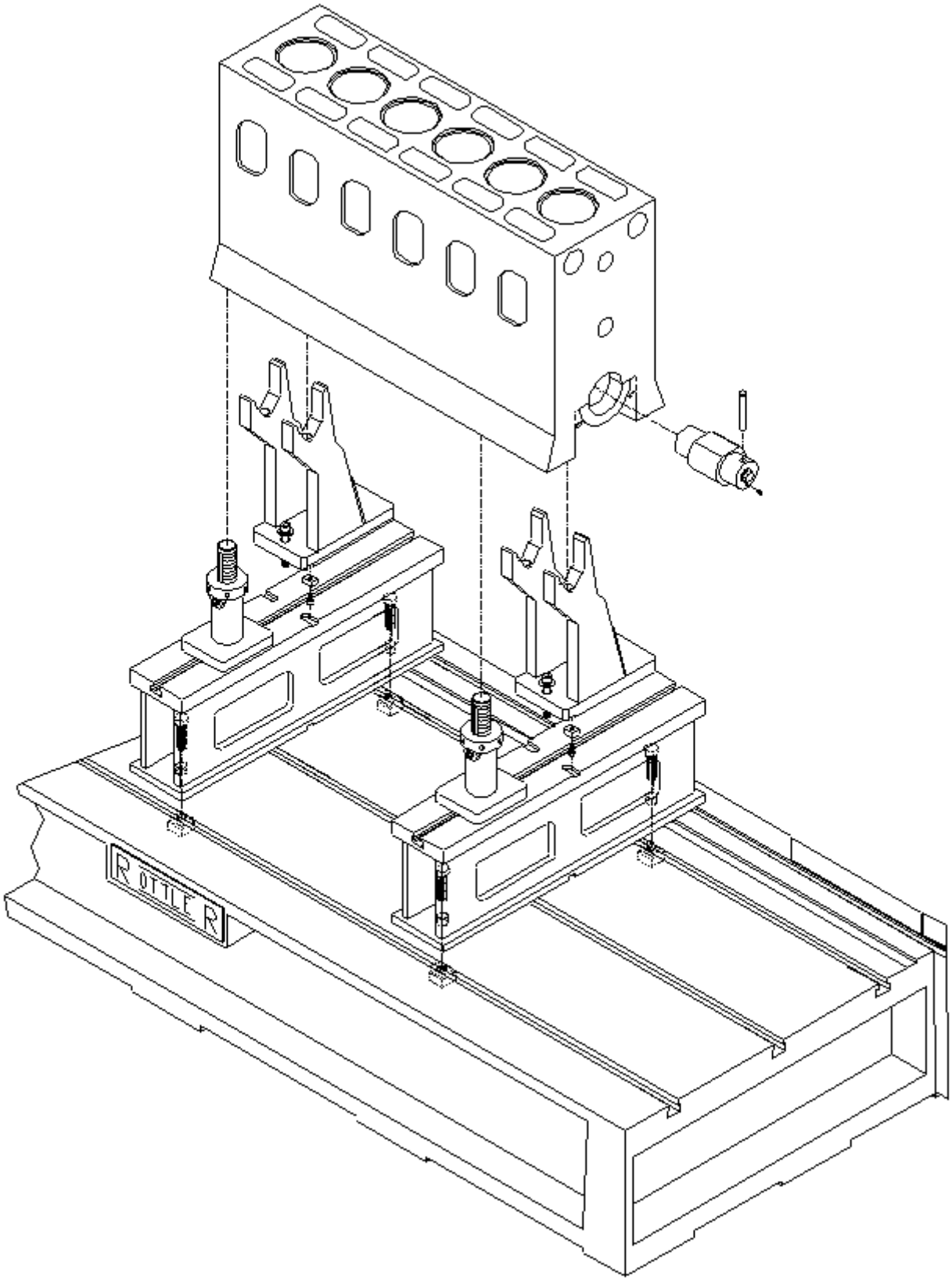
Triangle Clamping



Adjust the height so the shoes rest on the clamp points. Tighten the clamp leg handles. Actuate the clamp shoes by turning their knobs. Apply pressure to the two clamps as evenly as possible to avoid tipping the block up on one side.

Be sure the clamp is below the deck surface if you to resurface the block.

⚠ WARNING Do not release the hoist or lifting device from the block until the clamping is secure.


R DITTE R

6405F Large V-Block

Place the 6405 supports on the machine bed. Make sure there is no debris or burrs on the mating surfaced. The supports should be placed on the machine bed with the two dowels on the bottom of the supports into the middle keyway. Place the supports the same distance apart as the mains you will be using. On long blocks, it is recommended to use main bearing locations inward from the ends, to more equally balance the block and avoid sag. Push the supports back toward the rear of the machine against the dowel pins. This will line the supports up with each other. Tighten the four (4) mounting bolts on each support.

Install the correct size locators into the main bores that will be used.

⚠ WARNING Handle these large blocks with extreme care and guidance. A block hoist is required when handling these blocks. These blocks should be lifted from the block bank surface.

⚠ DANGER The hoist must remain attached to the block until it is firmly clamped into position. The blocks will have a tendency to tip until they are properly supported and clamp. When not properly supported and attached to a hoist these blocks will roll forward or backwards and out of the fixture. This will cause severe injury or death to operator.

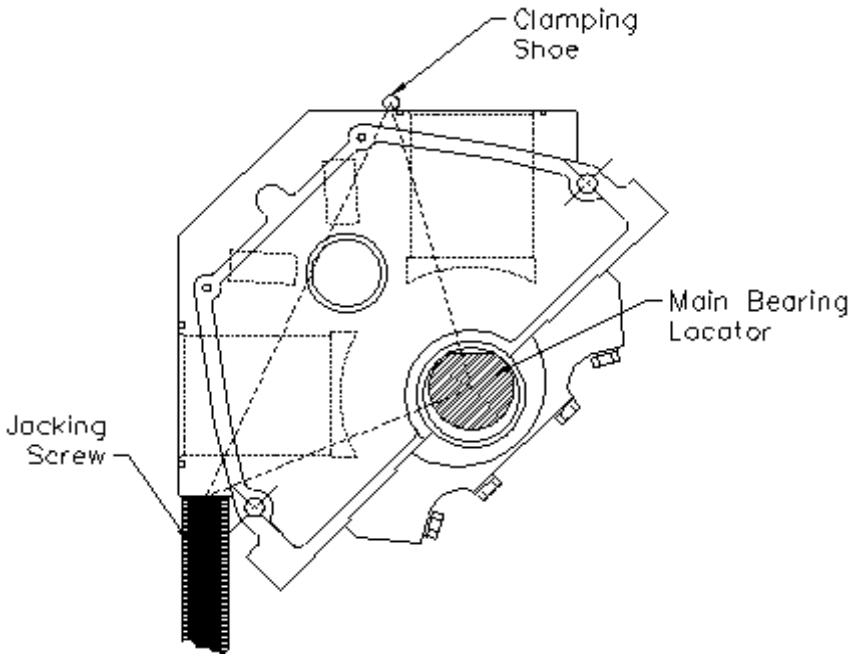
The main bearing bores being used should be on centerline of each support. Set the jacking bodies, with the proper length jack screw installed onto the machine base. These should be located in the general area of the supports. Temporarily secure to the deck with at least one bolt.

Lower the block down onto the supports. Place a level on the deck of the engine block and check the level front to back. Position the jack stands in a location to properly support the block and secure. To level, use the jacking screws to raise or lower the front of the engine block.

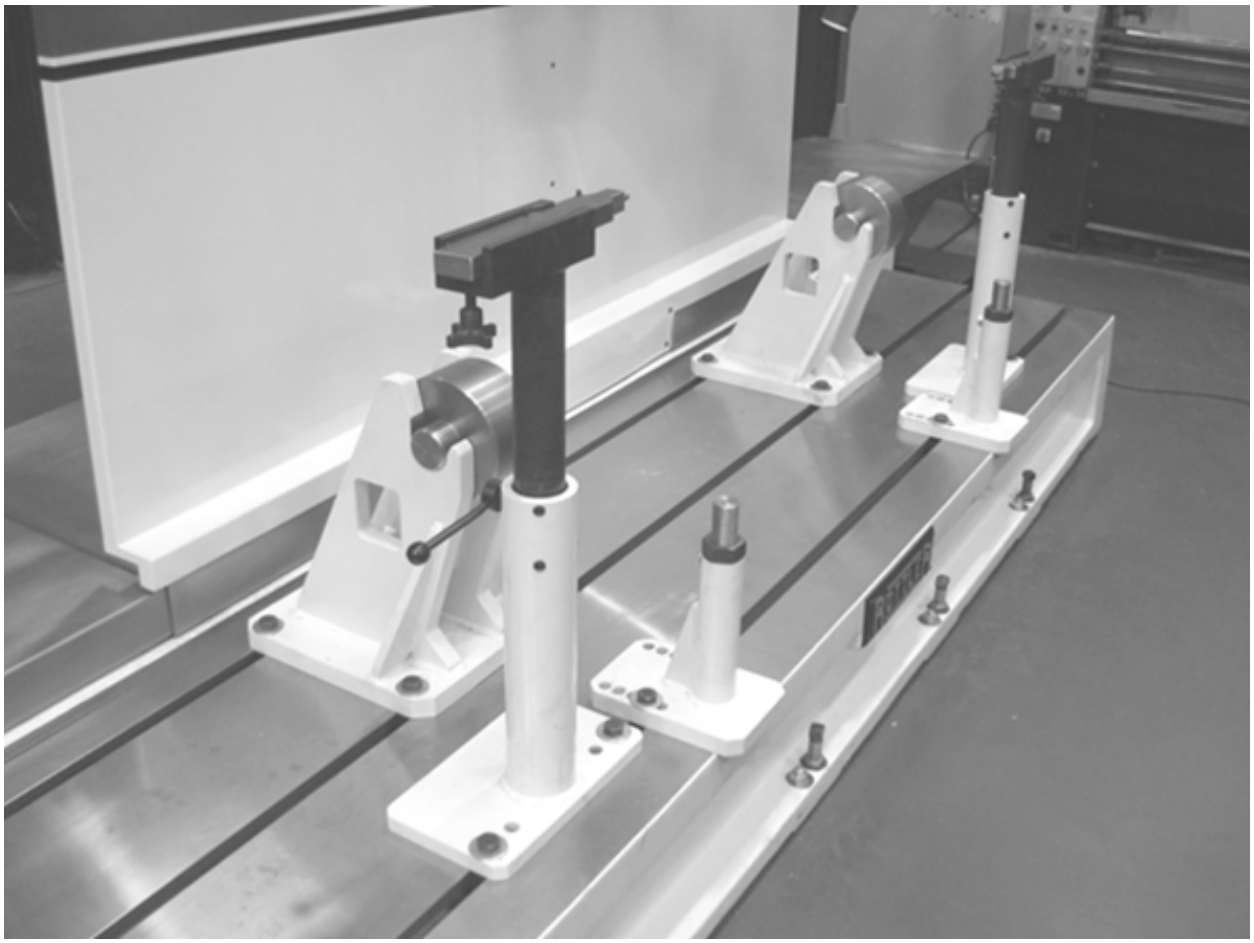
Position the block clamps on the machine bed and secure in a location to allow proper clamping.

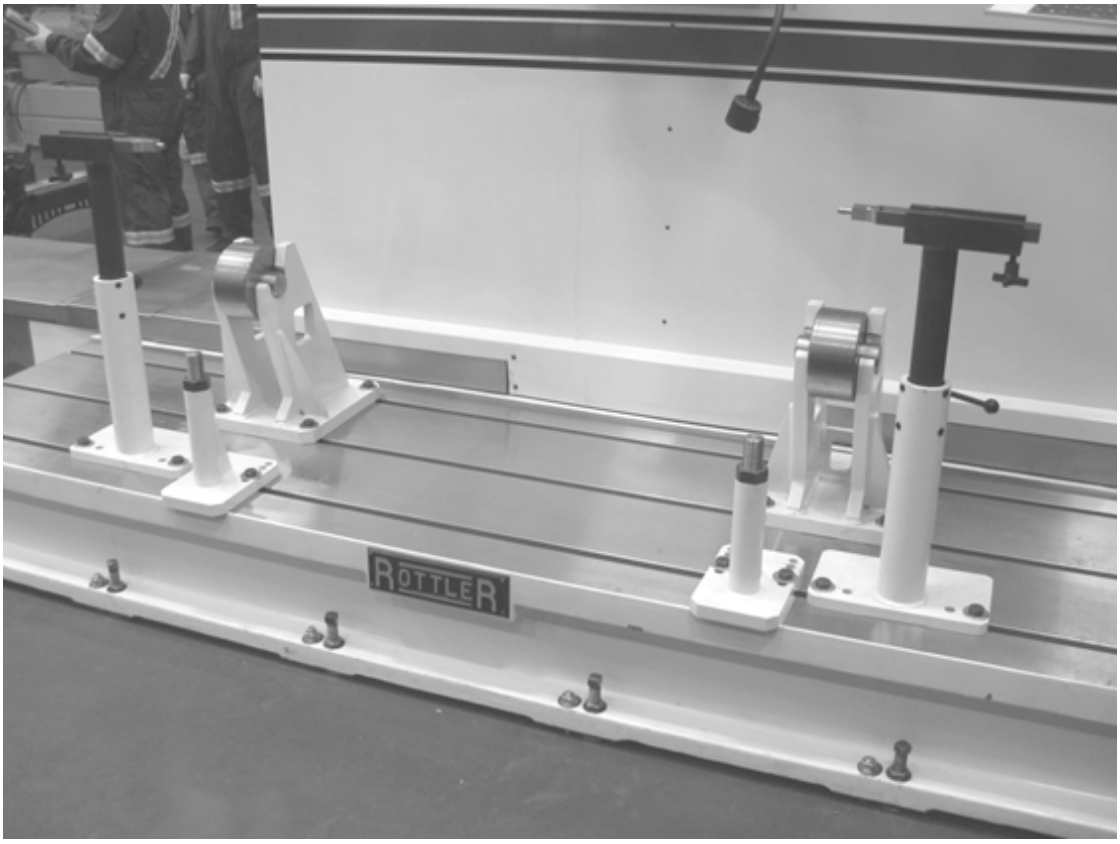
The following illustration shows the correct triangle clamping system that should be used.

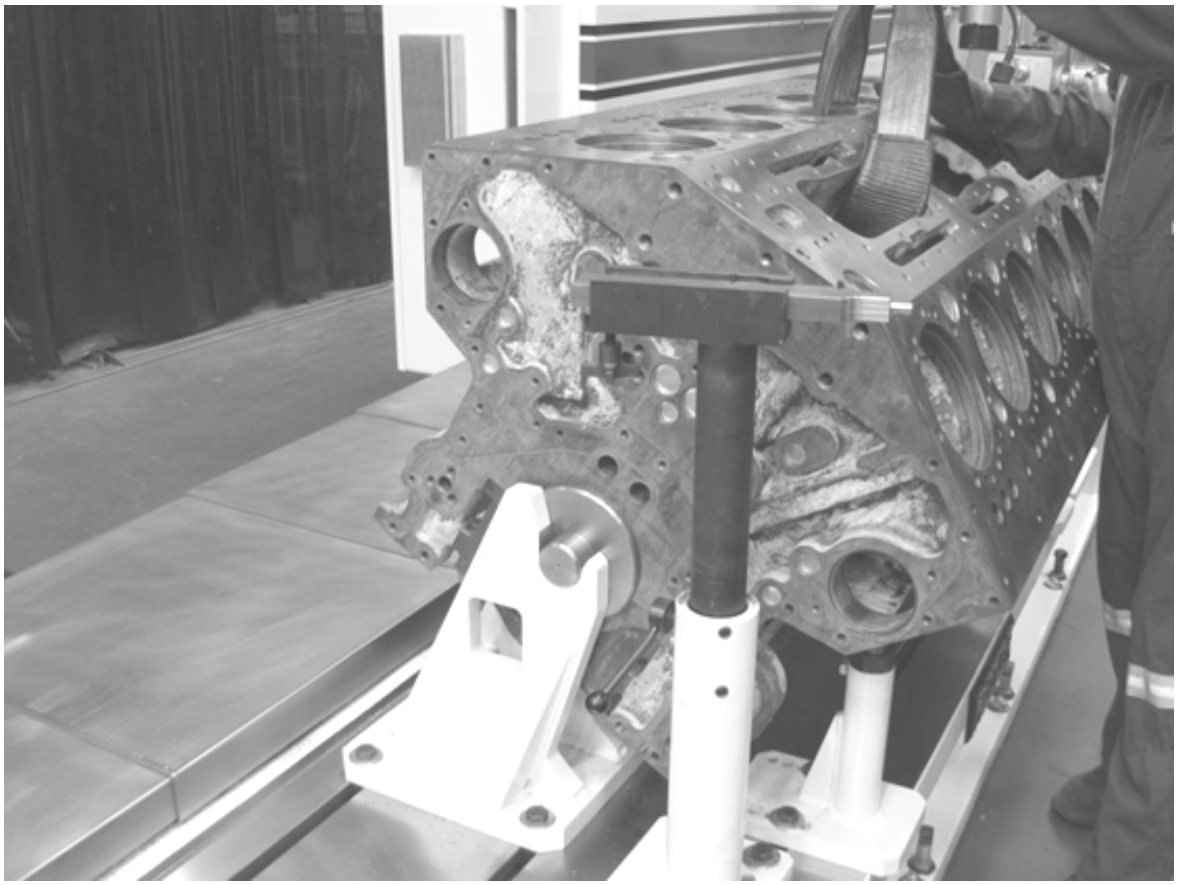
Triangle Clamping



Adjust the height so the shoes rest on the clamp points. Tighten the clamp leg handles. Actuate the clamp shoes by turning their knobs. Apply pressure to the two clamps as evenly as possible to avoid tipping the block up on one side.




ROTTLER

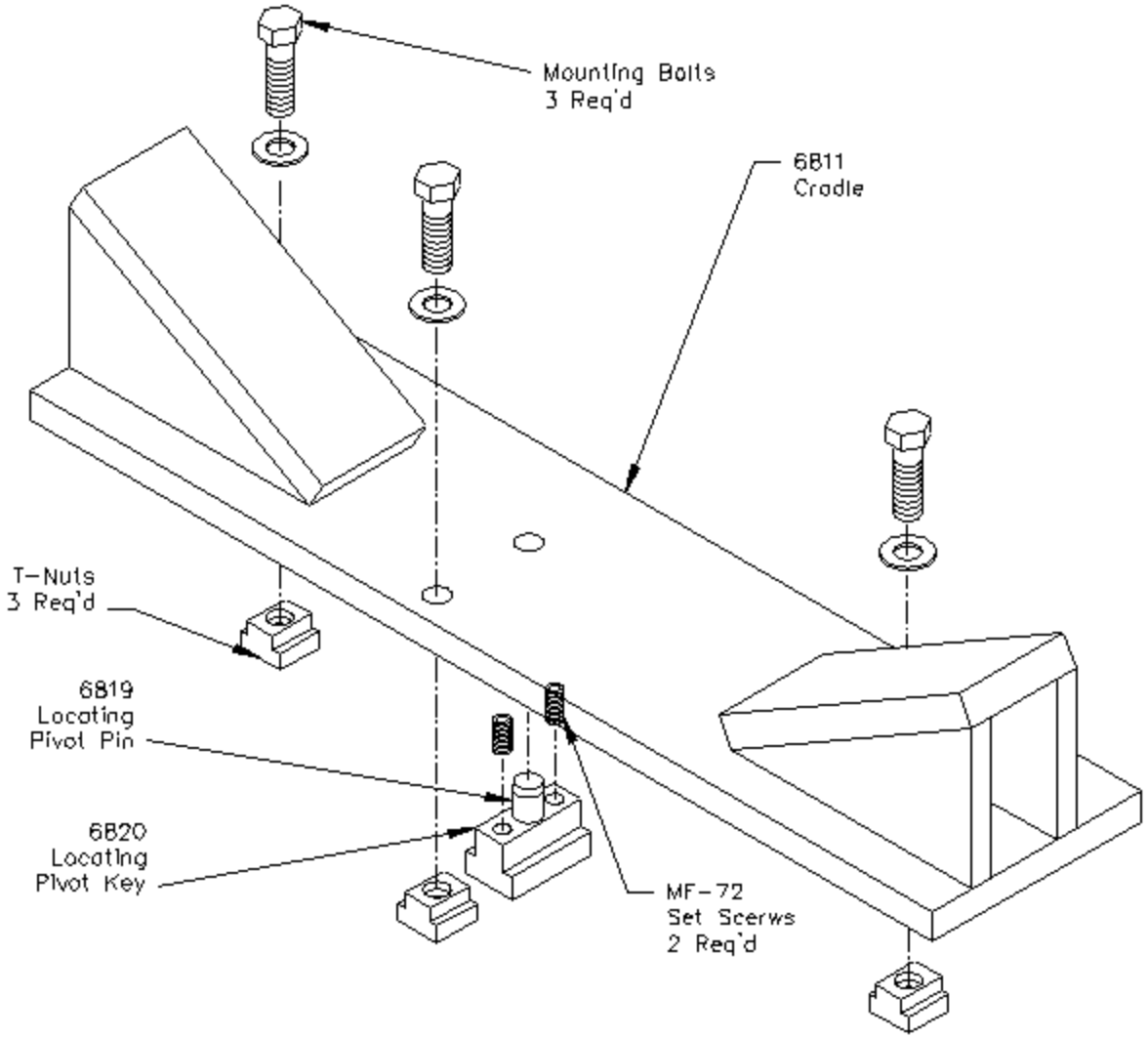


6810 Waukesha 7042, 9390 and CAT 379, 398, 399 Block Line Bore Fixture

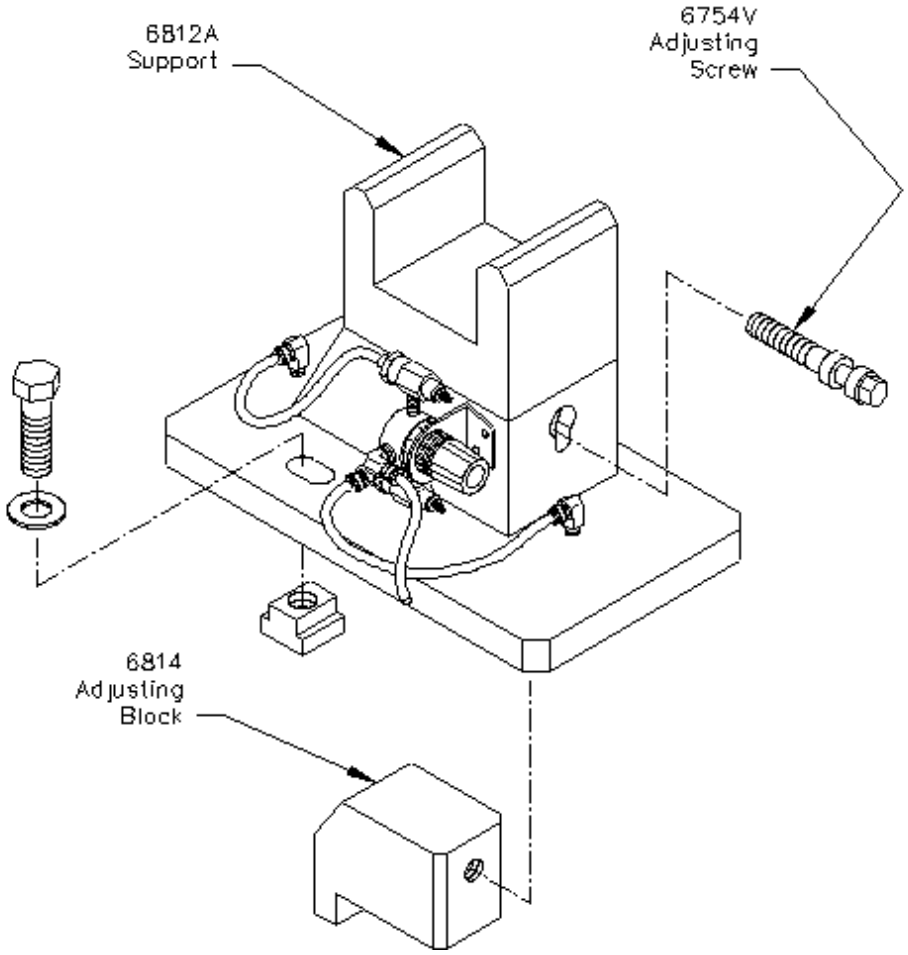
This fixture is designed to be mounted directly on the bed of an EM100 Series machine. Due to the large size of the Waukesha 7042 block, care must be taken when loading and unloading to avoid bumping the block into the block into the column or spindle unit.

⚠ WARNING Handle these large blocks with extreme care and guidance. A block hoist is required when handling these blocks.

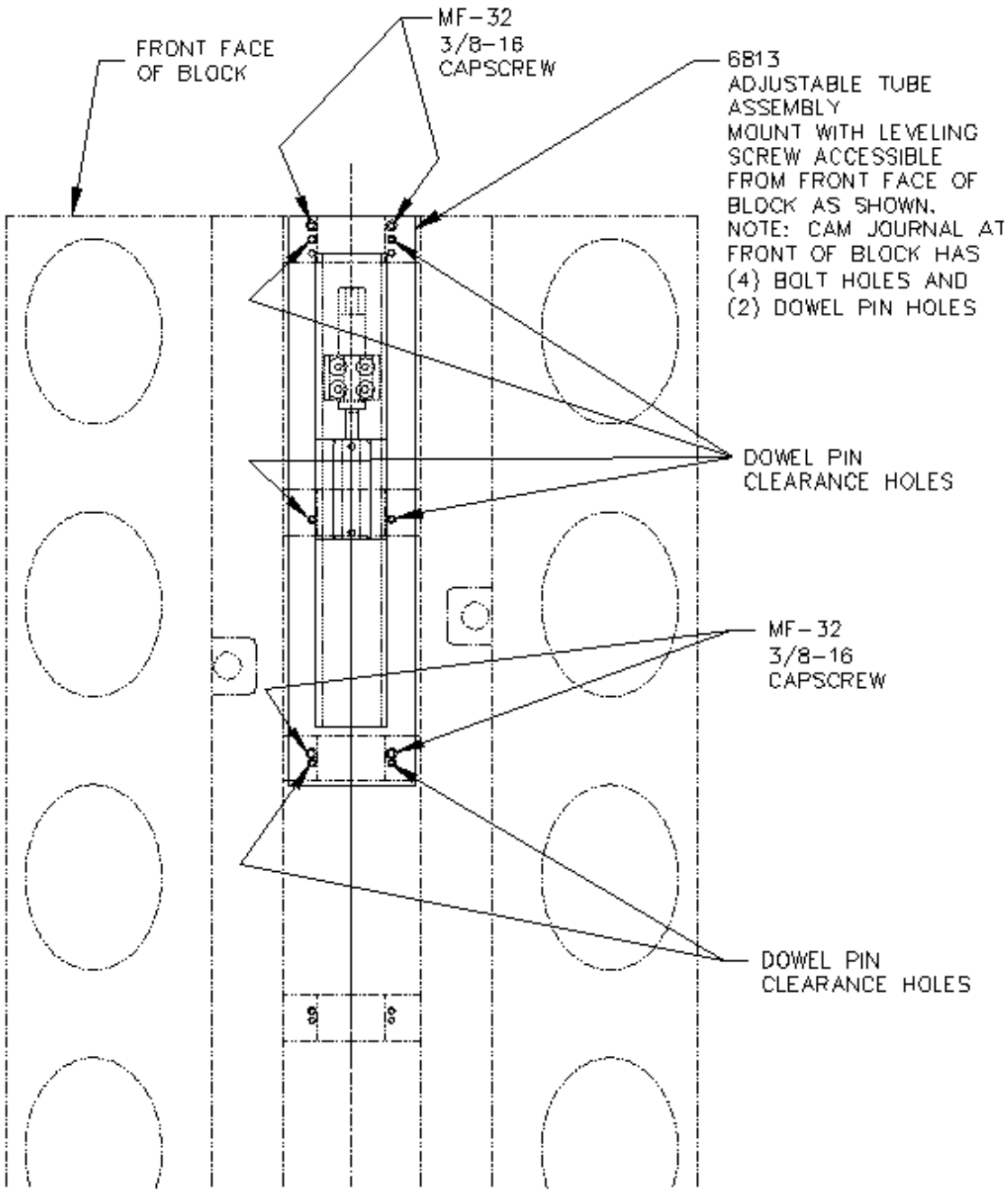
Use the diagram on the following pages when referring to part numbers listed below. This Line Bore fixture consists of a stationary cradle and a adjustable support. The Cradle (6811A) is mounted to the machine bed over the locating pivot key and pin assembly. The locating pivot pin (6819) is pressed into the locating pivot key (6820). This assembly is positioned in the center keyway of the machine bed and the (2) set screws (MF-72) are tightened to lock the key in place. The Cradle is positioned over the pin and mounted to the machine bed. With the mounting bolts installed but not tight this provides a standard pivot point for the Cradle.



The support (6812A) is assembled with the adjusting screw (6754V) and the adjusting block (6814). This assembly is mounted to the machine bed with the lower tab of the adjusting block in the center keyway. ***Be sure to install the special ratchet adjusting wrench prior to setting this assembly on the machine bed***

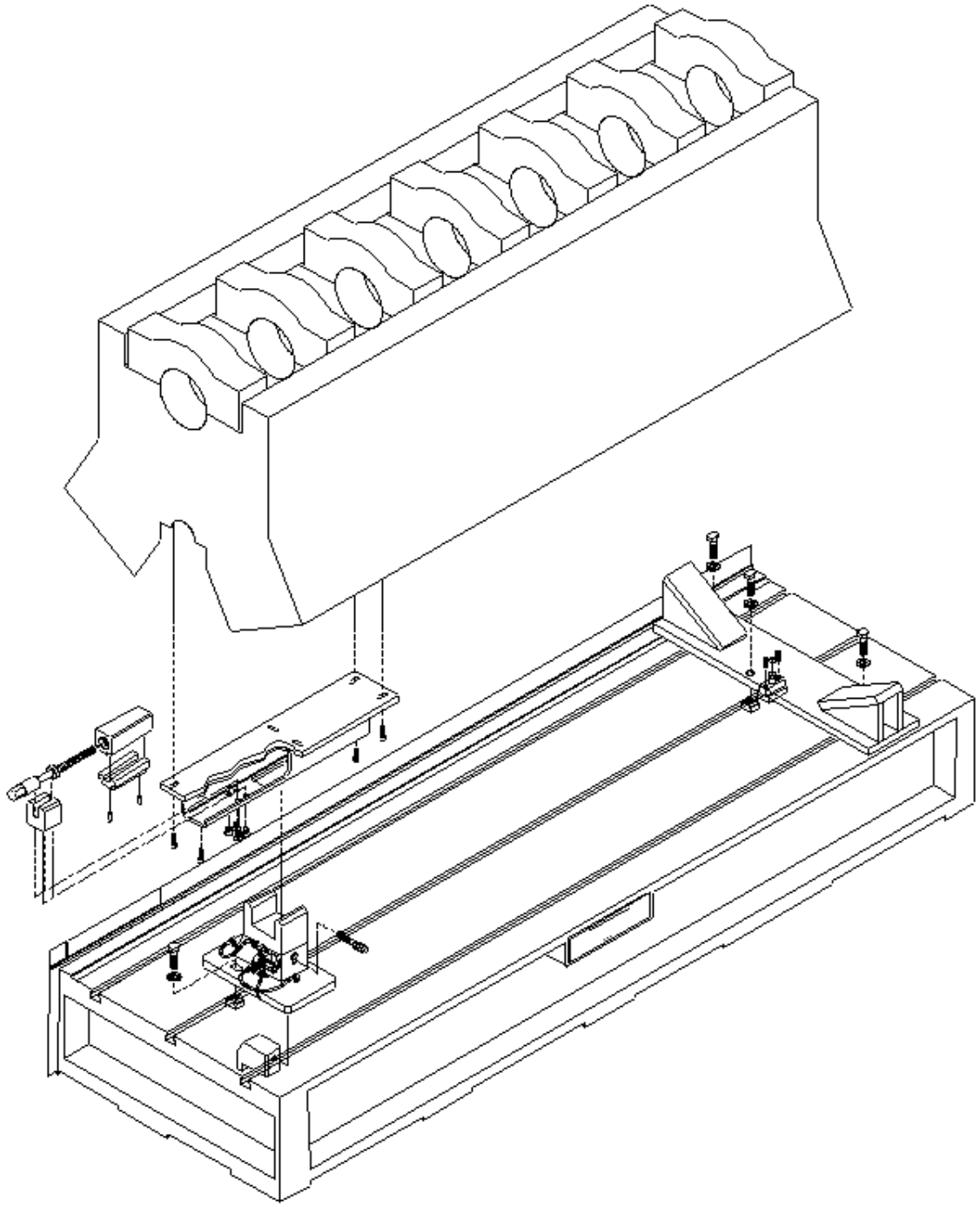


The adjustable tube (6813) is bolted to the Waukesha Block using the Cam Bearing Cap mounting holes. The adjustable tube has ten (10) holes drilled in it. Four (4) of the holes are used to bolt the adjustable tube to the engine block, the remaining six (6) holes are clearance for the cap alignment dowel pins in the engine block. Since the Cam Bearing Caps are not evenly spaced along the block, the adjustable tube must be mounted on the front end of the block as shown in the following illustration.



The upper and lower leveling pads, bracket and screw are already installed in the adjustable tube.

With the adjustable tube installed, the block is ready to be lowered into the Cradle and Support. Use caution to locate the adjustable tube correctly on the support. The two roll pins (MF-229B) installed in the lower leveling pad (6411) are designed to locate the leveling pads properly.



All mounting bolts should be loose to start with. Due to the design of this fixture, the Cradle end of the block is stationary both in relationship to the machine bed key way and in height. This end is not adjustable. The adjustable end of the fixture is located on the same machine bed keyway as the cradle. Once the block is loaded into the fixture it is ready to be aligned for the line boring operation. Up and down adjustment is accomplished using the leveling screw (6408) inside the adjustable tube. The block is adjusted in and out by activating the air float on the support, and turning the adjustment screw using the previously installed ratchet wrench. Once the block is located in and out deactivate the air float and tighten the support end mounting bolt to lock into place. Tighten the three (3) mounting bolts on the Cradle end of the fixture now. The alignment of the block should be checked again at this time. Repeat alignment adjustments as needed.

6821 Adjustable, Universal Line Bore Parallel Assembly

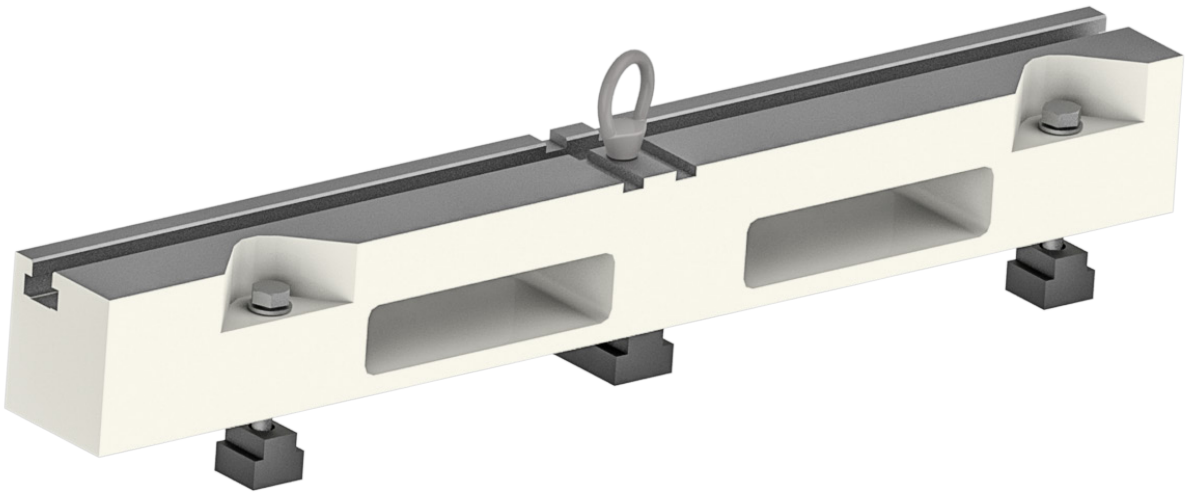
This fixture is designed to be mounted directly on the bed of the F90 series machine.

Due to the large size of the these blocks, care must be taken when loading and unloading to avoid bumping the block into the column or spindle unit.

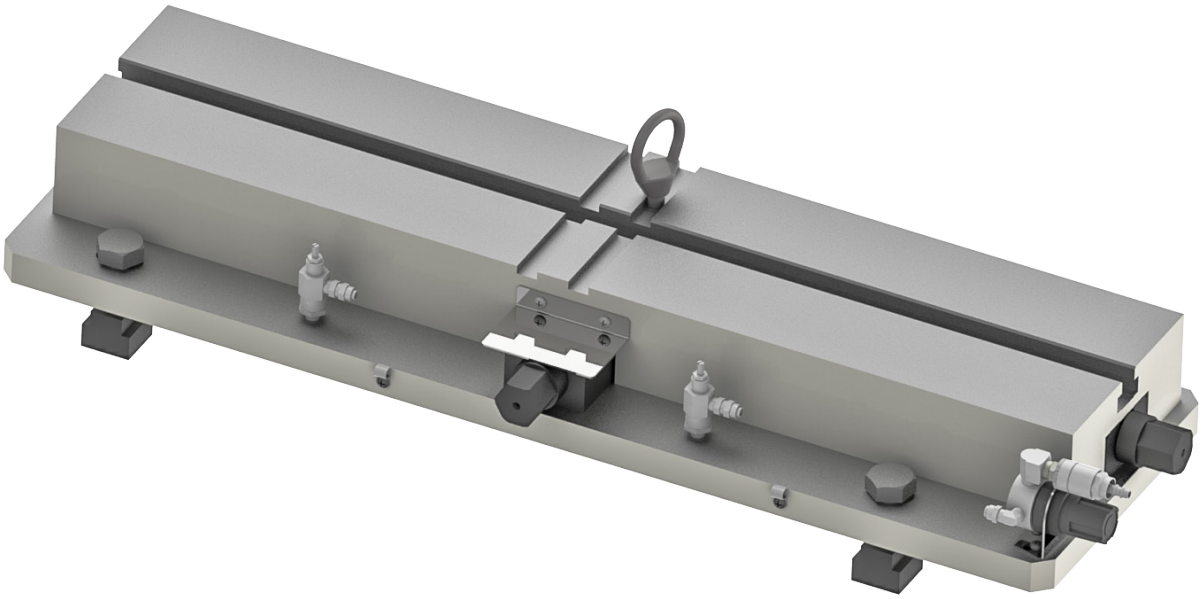
⚠ WARNING Handle these large blocks with extreme care and guidance. A block hoist is required when handling these blocks.

Use diagrams on the following pages when referring to part numbers listed below. This Line Bore fixture consists of a stationary parallel and an adjustable parallel used in conjunction with a cradle that fits the block to be machined.

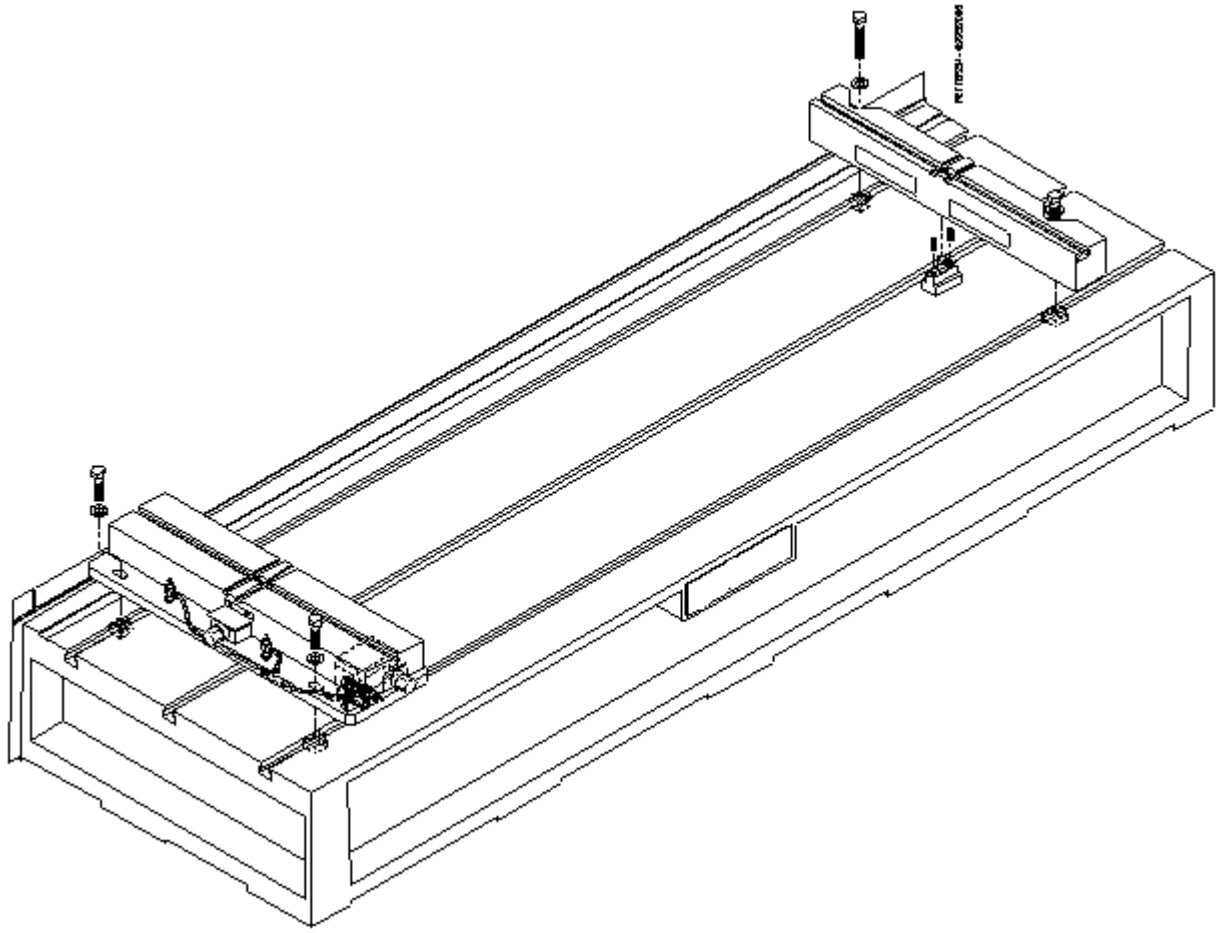
Install the 6820 Pivot Key (with Pivot Pin already pressed in) into the center keyway on the right hand side of the F90 bed. Tighten the two MF-72 set screws down. This will hold the Pivot key in place while the parallel pivots on the Pivot Pin (6819).Place the parallel onto the pivot pin, install the mounting bolts and washers but do not tighten down.



Install the adjustable parallel onto the left hand side of the machine bed with the In/Out adjusting block (6830) located in the front keyway. Install the mounting bolts and washers but do not tighten down.



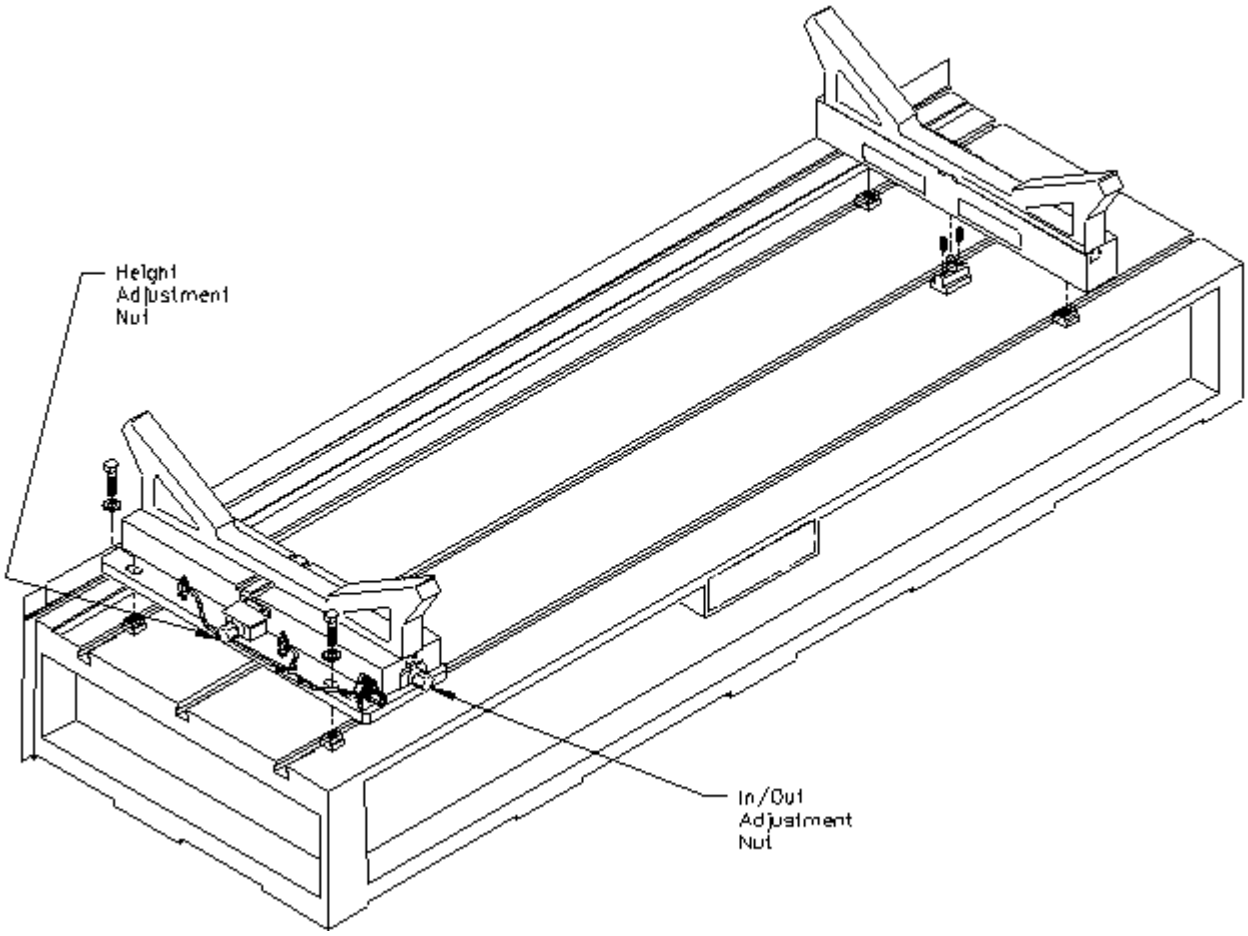
Once both parallels are installed on the machine bed, place a magnetic indicator on the spindle towards the main bed. Indicate the adjustable parallel into the stationary parallel to within .002” on the In/Out and height. This lines the fixture up close so the block can be loaded and then use minor adjustments on the fixture to line the block up.



Select the set of V cradles for the block you are going to be machining. There are various types of cradles that can be used on this fixture. There are risers available also that can be mounted to the cradles to accommodate certain blocks. For cradle and riser selection refer to the Options section of this manual. The CAT 3500 series cradle is shown in this example.

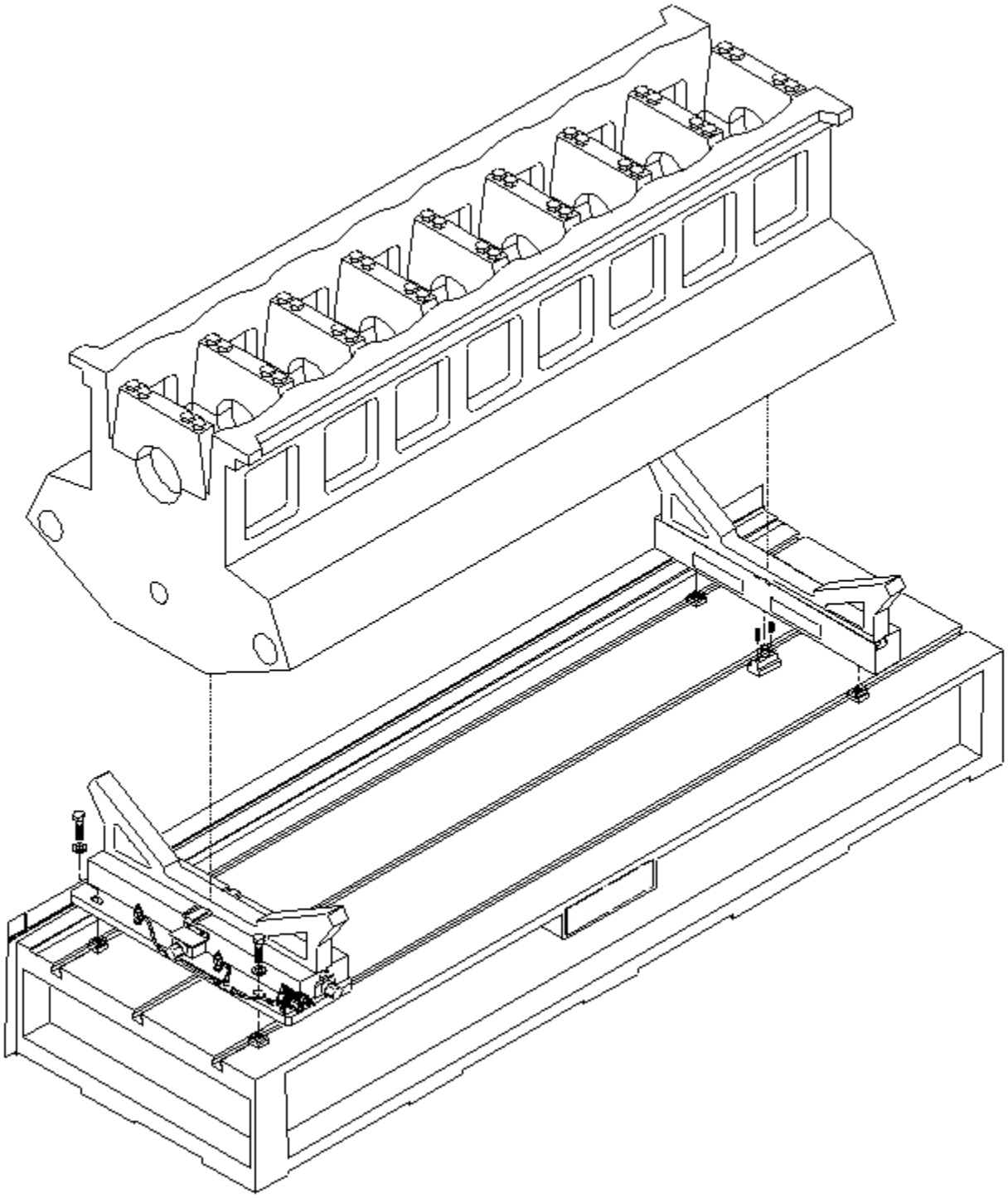
Place the cradles on the parallel. Line up the horizontal key on the cradles with the key slot on the parallels. Generally, the rearward key slot is used, but on large blocks such as the CAT 3500, it is necessary to use the front key slot to allow clearance between the machine column, and engine block. Install mounting bolts and lock the cradles down. Due to the extreme weight of these blocks, clamping is usually not required. Threaded rods and clamp bars bridged across the cylinder bore, and threaded into the cradles is a way to secure the block if desired.

For in-line blocks, cradles are not used. In this case, round locators are bolted directly to the parallels. Lower the block with the end cylinders over the locators and push the block towards the front or rear. This will position the block in a straight line with the machine travel. Secure with threaded rods and clamp bars bridged across the cylinder bore, and threaded into the locators.

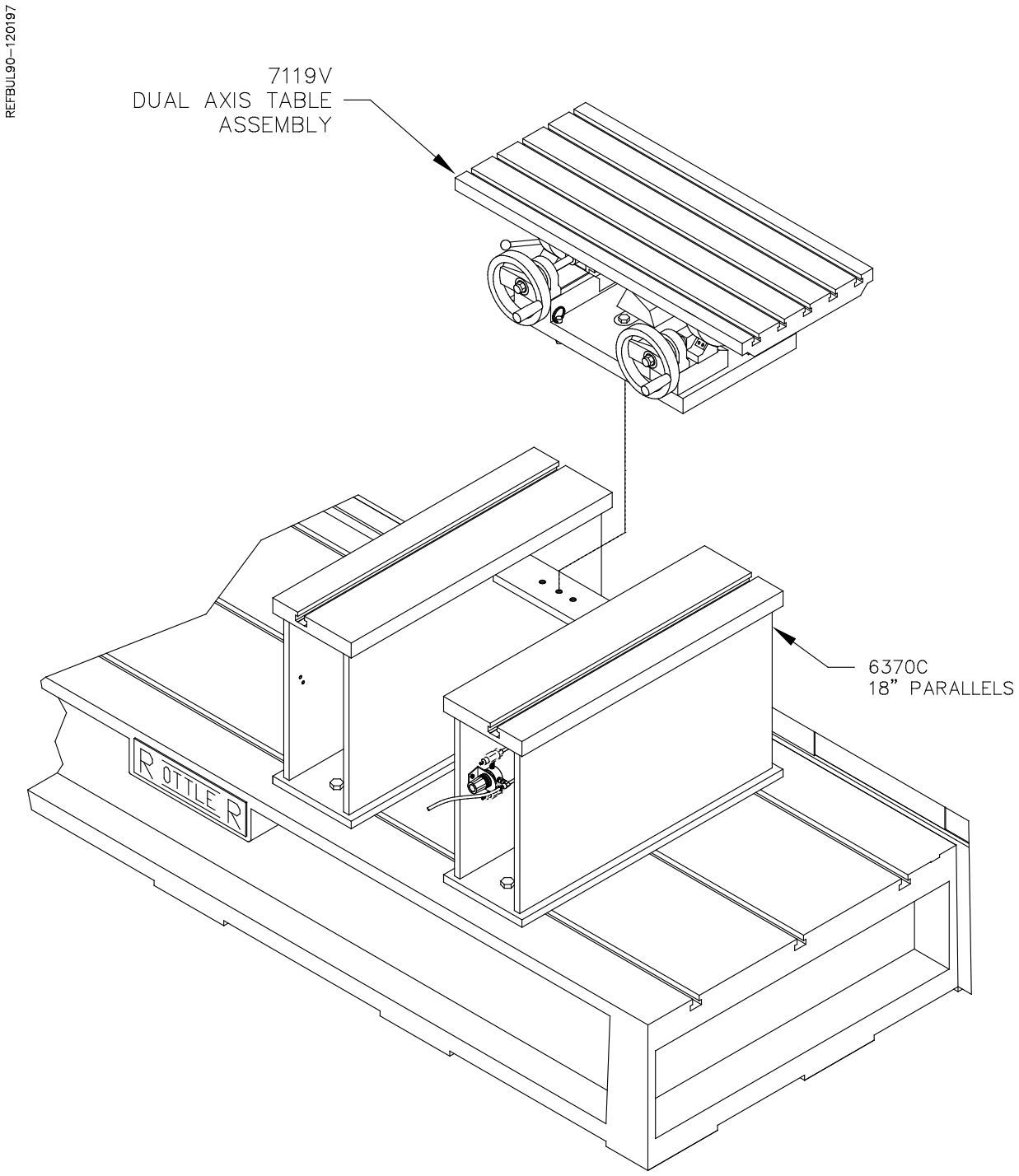


Lower the block slowly down into the cradles. Using a heavy soft mallet, tap the sides of the cradles to allow the block to settle into position. The block is now ready for alignment.

Up and down adjustment is accomplished by turning the screw on the side of the adjustable parallel. The in/out direction is adjusted by turning screw at the front of the adjustable parallel. Apply air pressure to the fixture while adjusting the in/out direction. Once the block is aligned, tighten down the fixture bolts and recheck alignment. Readjust as necessary.



7119V Dual Axis Table Assembly



Instructions for Small In-Line Blocks

The Dual Axis Table has the capability of holding small (less than 13 ½" from pan rail to head surface) in-line cylinder blocks for resurfacing. This will require the use of parts from the 7119P Universal Head Fixturing package.

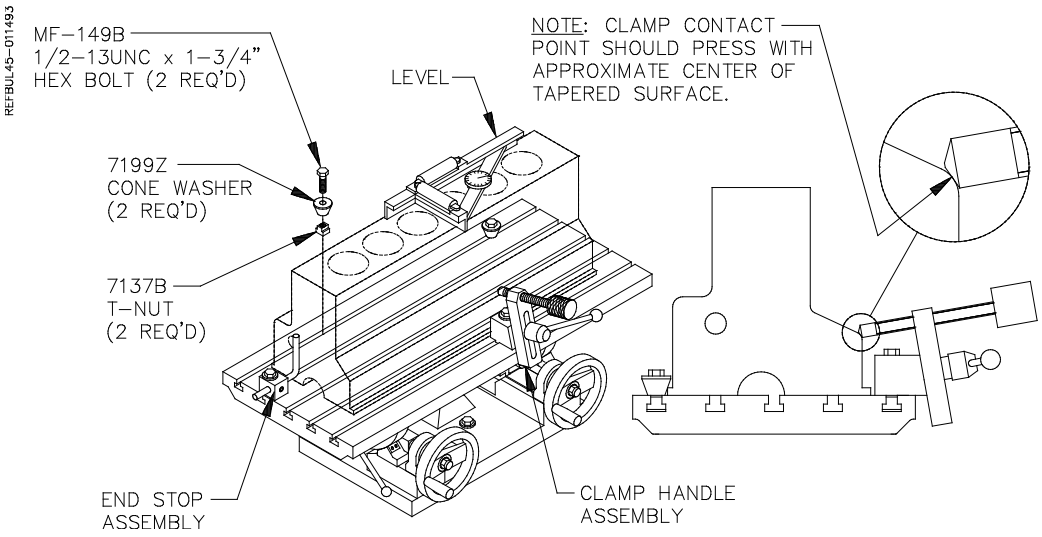
Mounting Block to Table

There are two (2) methods for mounting blocks to the Table. Blocks with the main caps removed or with the raised main bearings can be mounted directly to the table surface. Block with the main bearing caps installed which are lower than the pan rail surface must be mounted using support blocks from the Universal Fixturing package.

Blocks with Main Caps Removed or Raised Main Bearings

Remove any burrs from pan rails of block.

Locate cone washers on table to approximately center block in path of cutter-head and 'hook' the edge of the pan rail in the rear. Clamp the block using clamp handle assembly. We suggest you install the stop rod assembly on the left hand end of the block. This is an added safety precaution.



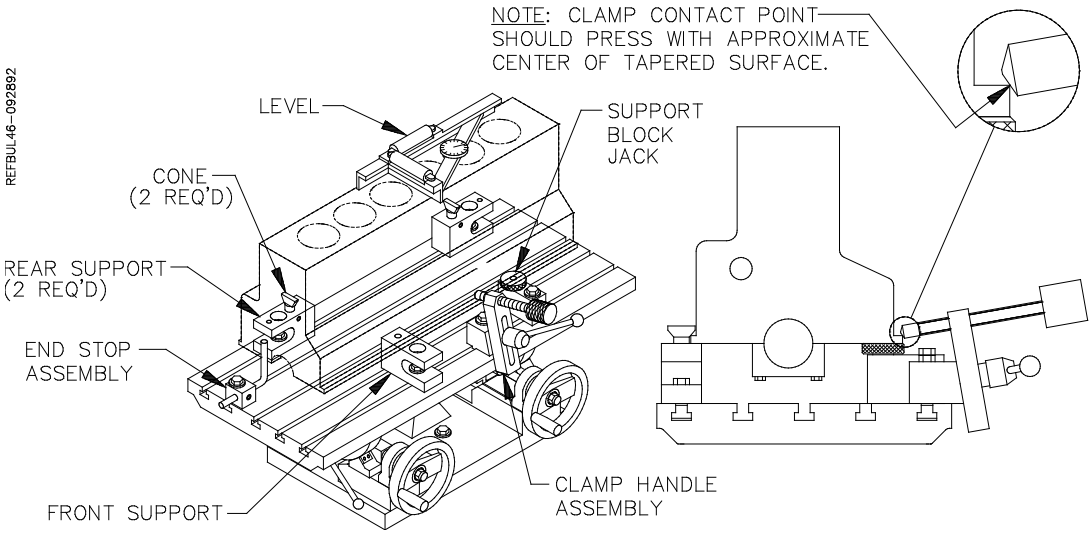
Check that all bolts and hold downs are tight. Loosen table clamp and level head surface of block in both directions. Lock table clamp and recheck block for level.

Blocks with Main Caps Installed

Remove any burrs from pan rails of block.

Position rear supports and front supports to hold block approximately centered in path of cutter-head. Generally, place the front supports closer together than the rear supports.

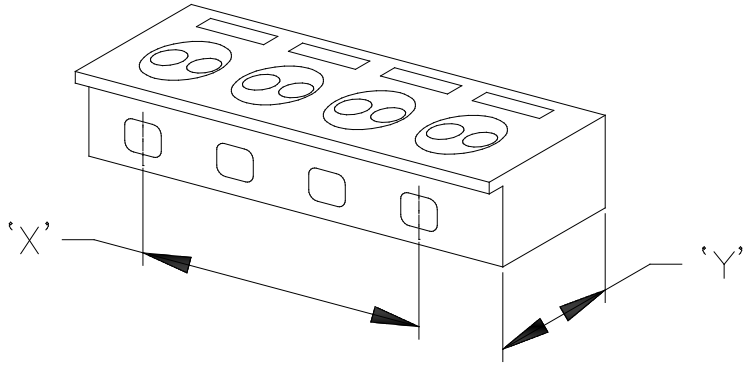
Place the block on the supports. Reposition the supports if necessary to clear main caps. Etc. Elevate the cones to hook the pan rail in the rear. Tighten set screws to lock cones in place. Tighten the hex bolts on the supports. Adjust the support block jack to eliminate any rocking. Lightly apply the clamp handle assembly.



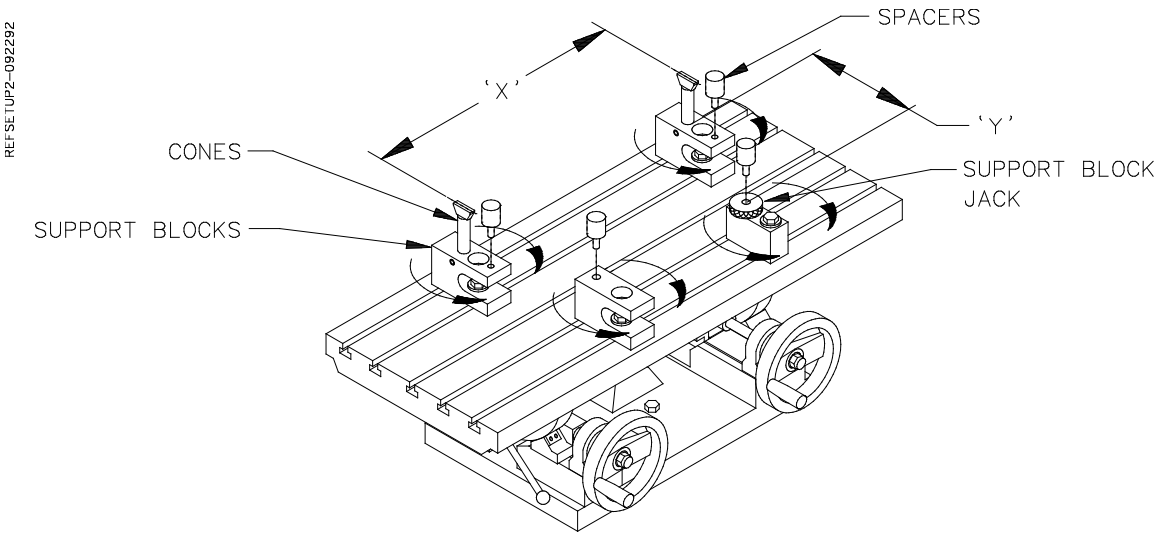
Loosen table clamp and level head surface of block in both directions. Lock table clamp. With the level still on the block tighten clamp handle assembly with appropriate clamp nose on the lower portion of a port or indent near the middle of the block. Tighten the clamp 1/8 to1/4 turn after contacting the block. Do not over-tighten. Watch the level as you tighten to check for movement or warping. If the block moves or warps, repositioning the front supports inward will generally solve the problem. Check to see that the block cannot be moved in the fixture. We suggest that you install the stop rod assembly on the left hand end of the block. This is an added safety precaution.

Typical Head Set Up Procedure

Find the desired ports or bosses, in the head, to position cones (long or short) on rear support blocks. Measure the distance between the centerlines of these ports (bosses) within 1/16” (1mm – 5mm). Measure the distance from rear support points to front support points on the head.



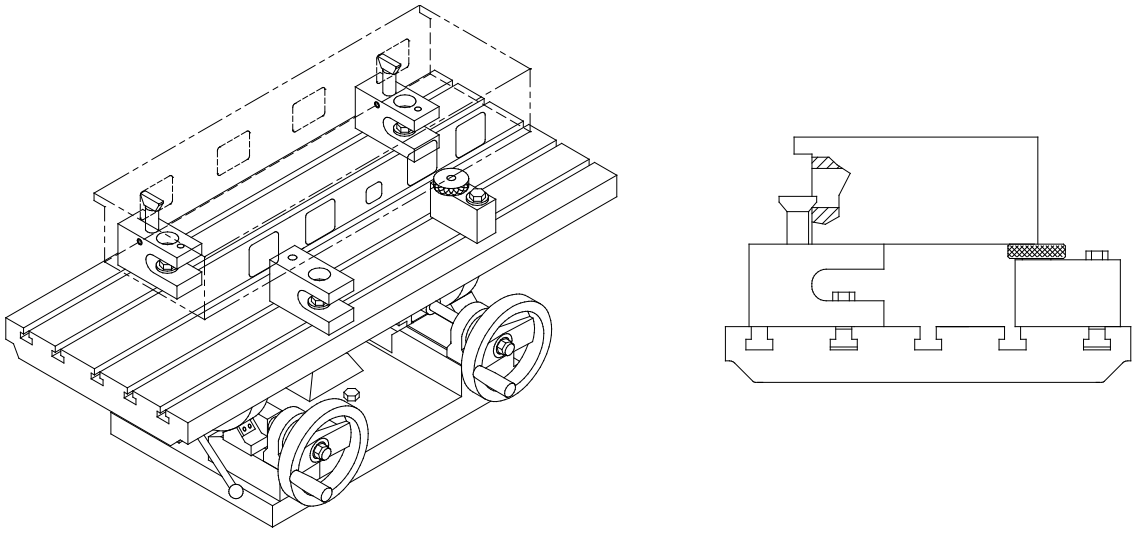
Position rear support blocks and front support blocks to hold the head approximately centered on the table top and spaced apart per dimensions measured in step ‘1’ above. Generally, place the front blocks closer together than the rear blocks. If necessary, use either 2 or 4 spacers to raise the head for clearing studs or to angle the head so the cutterhead clears the head clamp handle assembly.



Place the head on the support blocks. Elevate the cones to ‘hook’ the two ports (bosses) on the head and tighten their set-screws. Adjust the position of the front support blocks if necessary. Tighten the hex bolts on the support blocks. Push the head back firmly into the cones. Adjust the support block jack to eliminate any rocking of the head. Do not tighten the head clamp handle assembly yet.

Unlock the table. Using the two hand-wheels, level the head surface to be cut. Lock the table in this position.

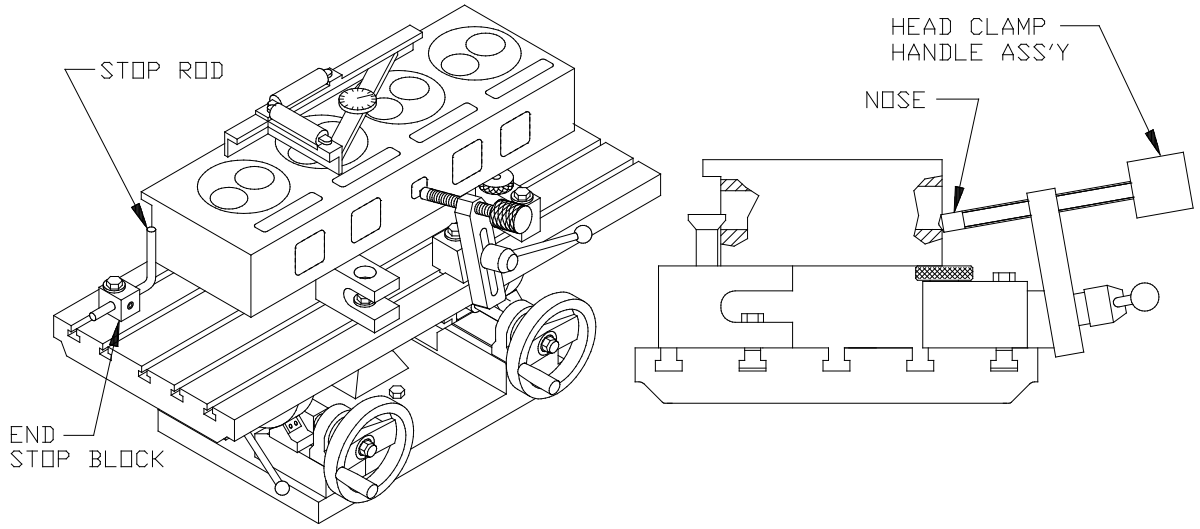
REFSETUP3-092292



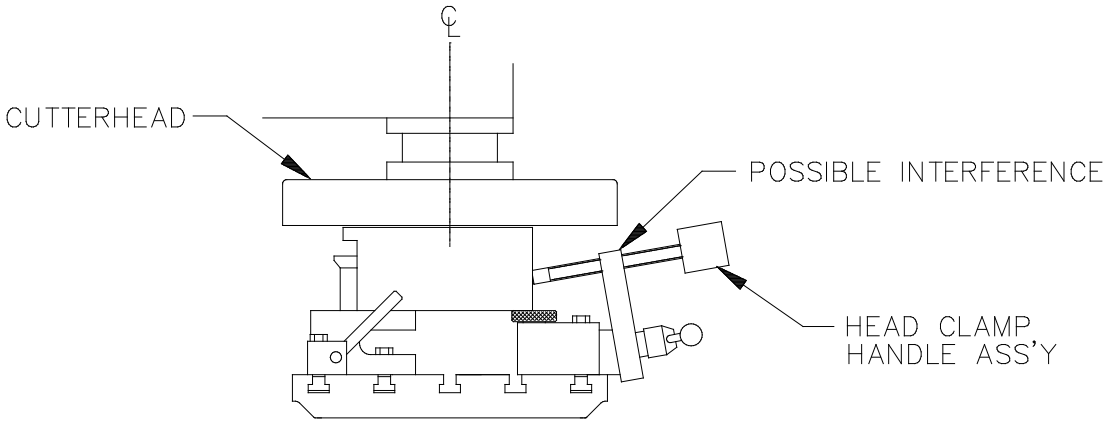
The head clamp handle assembly has a replaceable nose that pushes on the head. With the level still on the head surface, tighten the head clamp handle assembly on the lower edge of a port or indent near the middle of the head. Tighten the clamp 1/8 to 1/4 turn after contacting the head. Do not over tighten. Watch the level as you tighten to check for movement or warping. Some heads are very sensitive to support block placement, and the front support blocks may have to be moved slightly inward to prevent this warping. Check to see that the head cannot be moved in the fixture.

Slide the end stop block up against the left end of the head towards the rear. If possible, rotate the stop rod to contact a machined area on the end of the head. This will aid in loading a run of similar heads.

REFSETUP4-123192

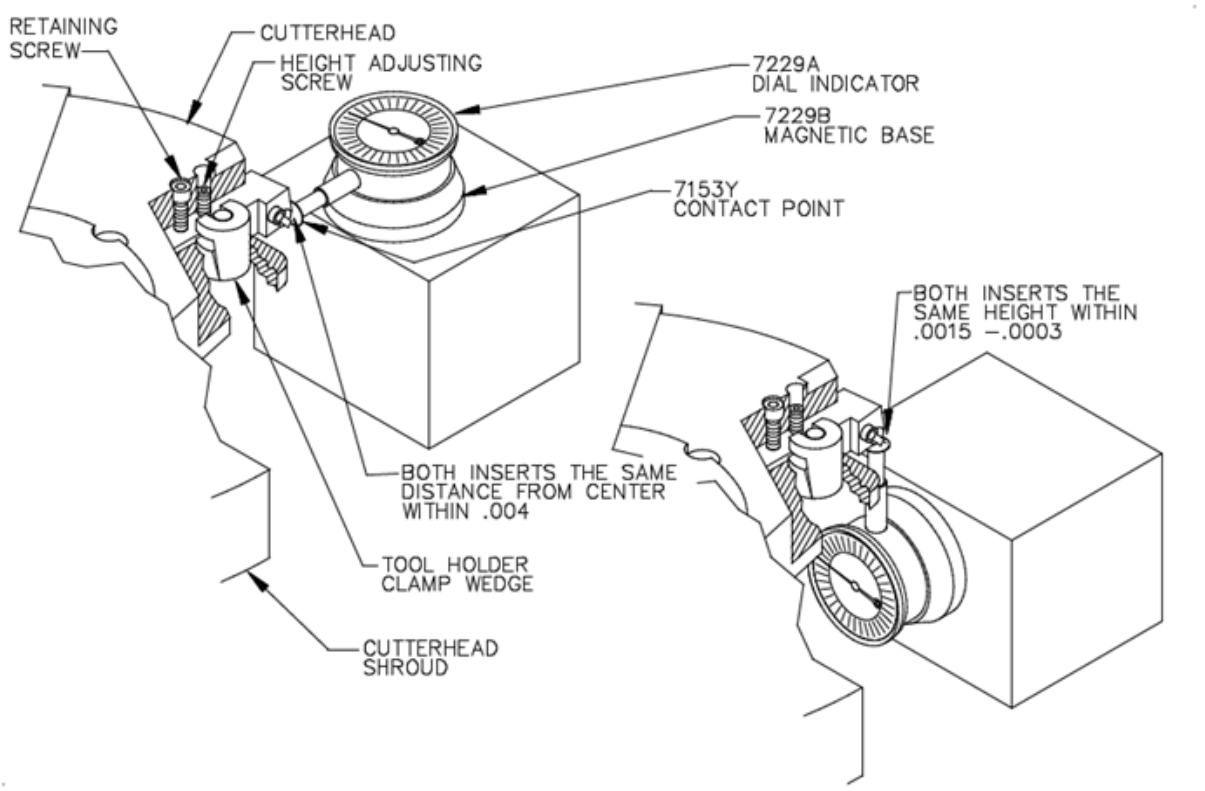


Visually check for clearance between the cutterhead and head fixture tooling pieces, especially the head clamp handle, assembly. The head should be approximately centered in the path of the cutterhead.



Setting Up Rottler Fly Cutting Tool With Two Inserts

- Travel the spindle to the center of the machine bed.
- Go to the Rottler home screen on the machine before proceeding.
- Remove the cutter head shroud from the fly cutter. Attach a dial runout indicator to a cylinder head or engine block, etc.
- Rotate cutter head and check to see that both inserts are the same distance from the center of the spindle, within .004.
- If adjustment is necessary loosen the tool holder clamp wedge, and the height adjustment screw. Move tool in or out the required distance. Tighten the clamp wedge. Snug up the height adjustment screw. There is a set screw located at the bottom of the tool holder; it locks a dowel pin in place.
- When the in-out adjustment is set, loosen the set screw, the pin will pop out and hit the back of the slot. Tighten the set screw. This way, when a tool holder is removed and then replaced, it will be located very nearly where it was.
- Insert height will still need to be adjusted.
- Rotate cutter head and check to see that both inserts are the same height within .0015-.0003 The closer you get it the more accurate your surface will be.
- If adjustment is necessary loosen the tool holder clamp wedge, then alternately loosen and tighten the height adjusting screw and the retaining screw, until both inserts are set as desired.
- Retighten the tool holder clamp wedge, and recheck both inserts.



12” Multi Tooth Milling Head - 6865

This milling head holds 14 insert cartridges. Each insert has 10 cutting edges, 5 on each side. The inserts need to be adjusted to be at equal height of each other to within .0004” (.01mm). To set the height of the inserts, install the milling head into the machine spindle. Install the inserts. Back off the small set screw above each tool cartridge. Loosen each tool cartridge, push up, and re-tighten.

Using an indicator with a large diameter convex tip, find the insert that is at the lowest setting. Now, adjust the remaining inserts to equal height by turning the small set screw above each tool cartridge.

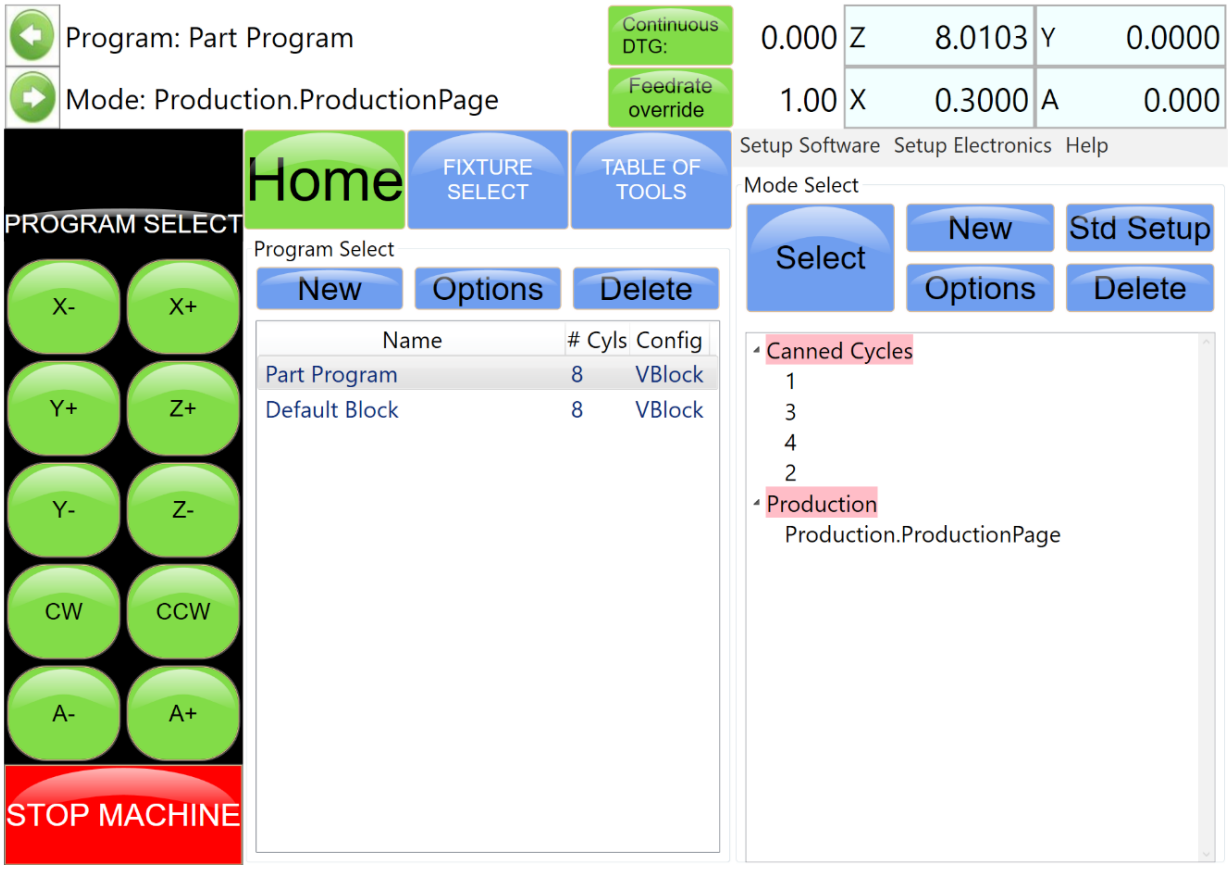
18” Multi Tooth Milling Head 6864

This milling head holds 9 insert cartridges. Each insert has 10 cutting edges, 5 on each side. The inserts need to be adjusted to be at equal height of each other to within .0004” (.01mm). To set the height of the inserts, install the milling head into the machine spindle. Install the inserts. Back off the small set screw above each tool cartridge. Loosen each tool cartridge, push up, and re-tighten.

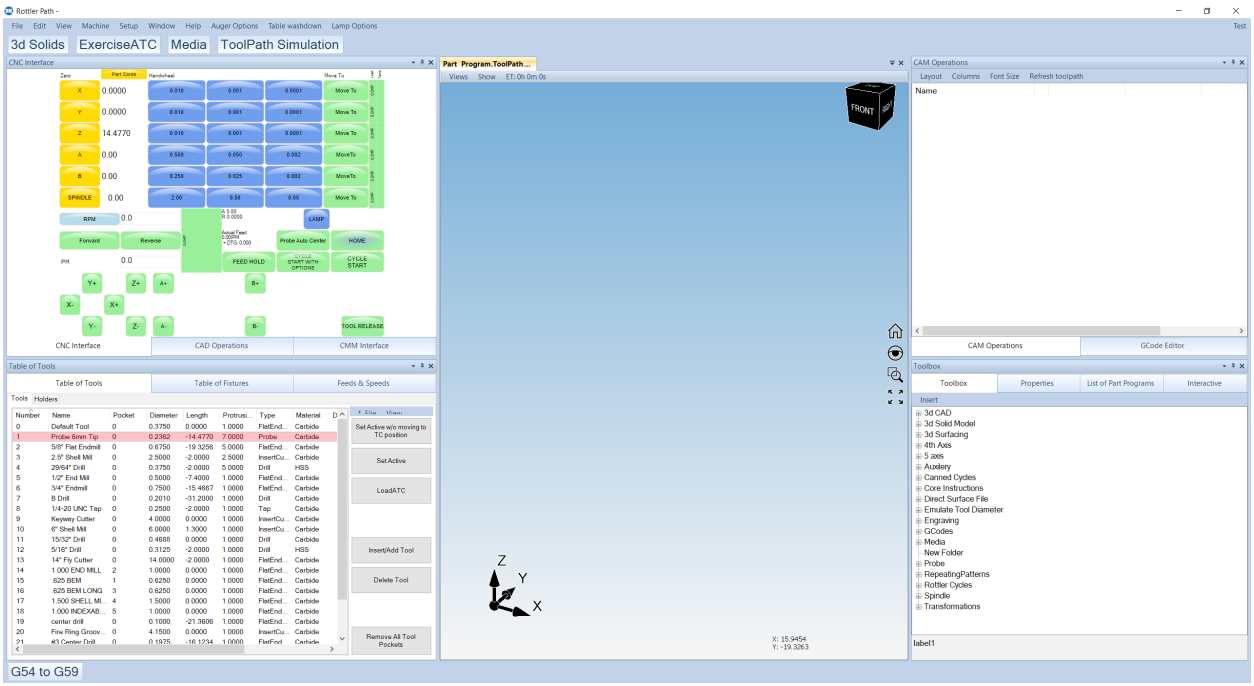
Using an indicator with a large diameter convex tip, find the insert that is at the lowest setting. Now, adjust the remaining inserts to equal height by turning the small set screw above each tool cartridge. Install the dampener band around the perimeter of the milling head.

General Machine Information

The Rottler EM103/4/5 utilizes Computerized Numeric Control (CNC). From within any of the Rottler software packages the CNC control interface can be used to move the machines axis in any of the labeled directions. Below are images of the main user interfaces found in the RPATH/4C software and the Rottler Block Software program packages.



Rottler Block Software User Interface



Rottler RPATH/4C User Interface

Homing

The EM69ATC ***MUST*** be homed anytime it is restarted after it has been shut down. The machine will automatically prompt the user to home the machine before being able to program and run any cycles. Homing is required so that the axes reference their current locations so that parts can be machined correctly in their respective coordinate locations.

Building Programs

NOTE: The instructions within this operator manual will cover the creation and use of block machining programs in the Rottler Block Software. For information regarding the creation and use of Rottler's Rpath/4C software packages consult the Rottler Introduction to Rpath/4C training manual that is supplied with the purchase of that software package.

Create a Block Program

Within the Block Software's main screen under the program select tab, select the "NEW" button to create a new engine block file. Enter the engine block information for name, number of cylinders and block configuration and press OK when finished. On the Right side of the screen under the mode select tab, press new and select the type of operation you wish to perform to create the operation program within the engine block file. For this example we will create a cylinder bore program.

Options

If you need to change the block configuration or name of a block that has already been created, use the Options button. This will bring up the same window as when the block was created.

Std (Standard) Setup

Pressing Std Setup will cause all of the available Modes to be inserted into the Modes area on the right hand side.

Select

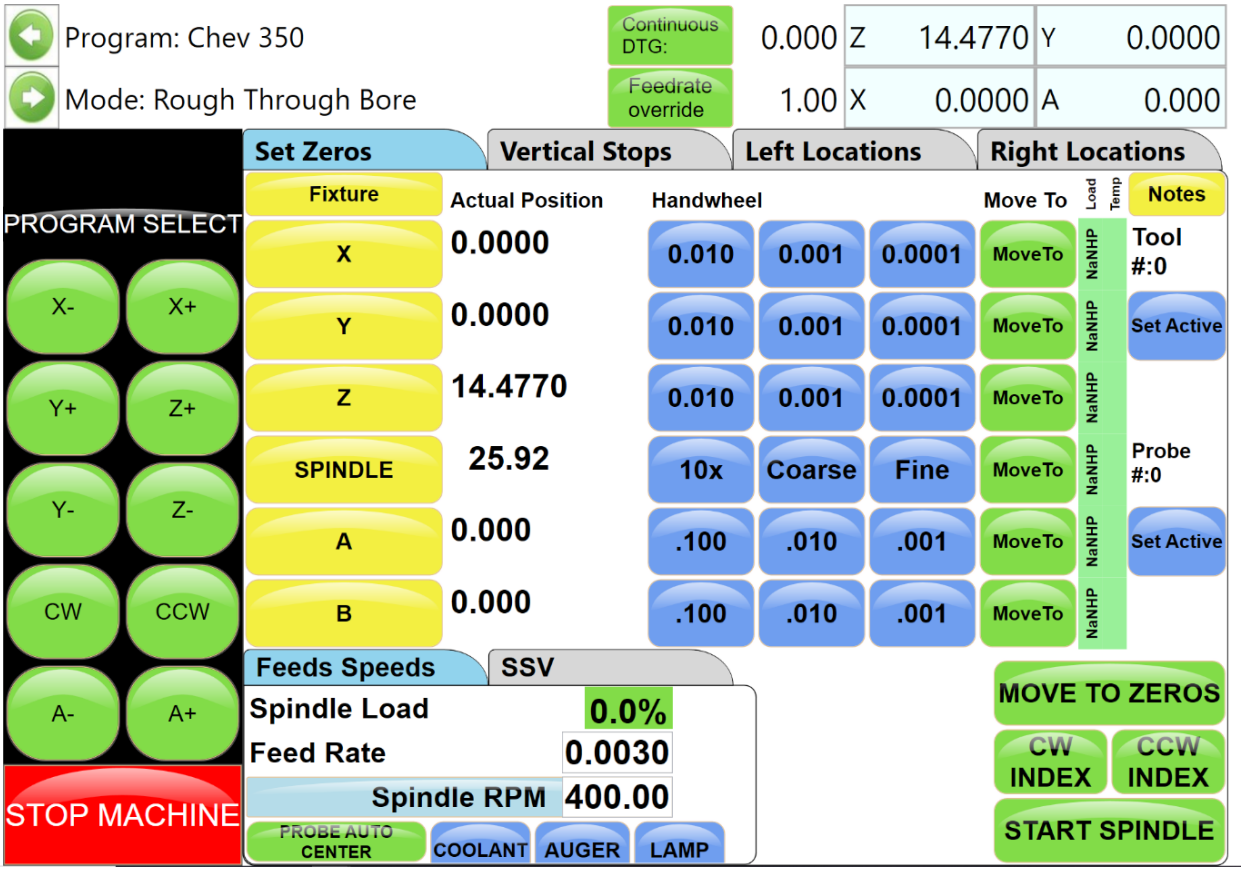
Pressing Select with a Mode highlighted will open the operations screens for using the program.

Options

Resetting the Options button with a Mode highlighted will open a window where you can change the mode name. There is also a check box to allow positive number to be entered into the program where they are normally forced to a negative value.

Cylinder Bore Mode 3 Axis

Select Cylinder Bore and then Rough Through Bore on the screen. This will bring up the boring program with the Set Zeros tab shown.

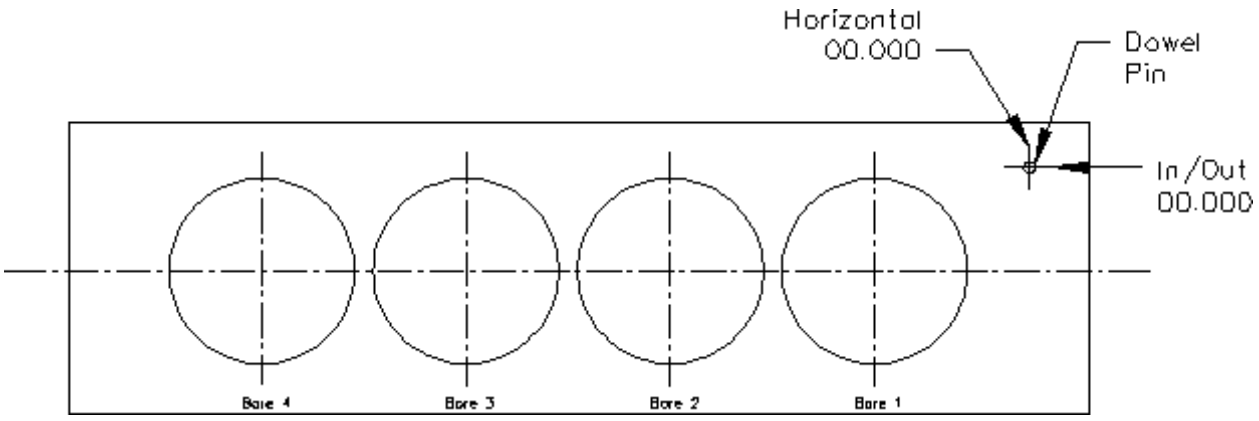


Setting Zeros

The purpose of setting zero points is to give the operator a specific point to build programs from. The machine also uses these zero points to run the operation. The zero points can be set at any point in the machines' travel. Every program will save it's individual zero positions, once the zero positions are set for an individual program then the operator need only to position the block in to be worked on in the same position each time to successfully run the operations.

X and Y Axis Zero's

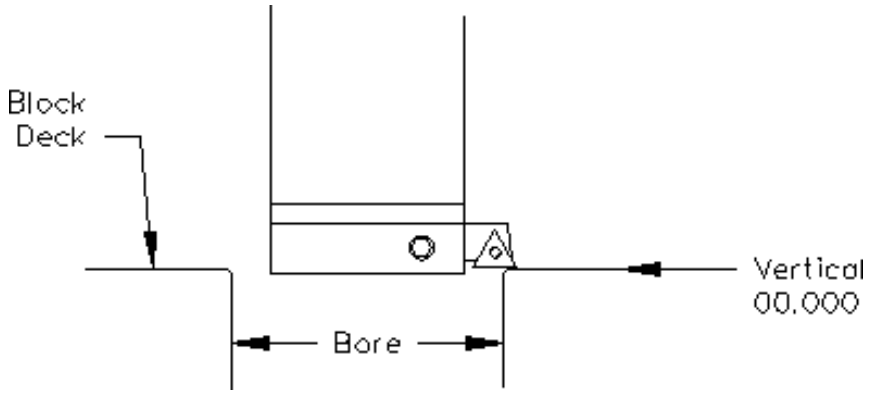
For this example, the Engine Block Dowel Pin will be our zero point for the **X-Axis** (Horizontal) and **Y-Axis** (In/Out) axis. Using either the touch trigger probe or a test indicator, find the center of the dowel pin. Without moving the machine, **double tap** on the **X and Y buttons** directly beneath the **Fixture button** on the **Set Zeros** screen. A window will pop up asking if you want to set the selected axis, **press yes to zero the axis.**



Vertical Zero

There are two different methods for setting the Z-axis zero for block machining

For this example, we will be using the block deck to zero our Z-axis (vertical axis). Insert a tool holder into the cutterhead you will be using to bore the block. Center the cutterhead over a cylinder. Using the Vertical Handwheel, bring the cutterhead down until the tool just touches the deck and press the Vertical Zero button. The display next to this button will go to zero. The Vertical zero has now been set.



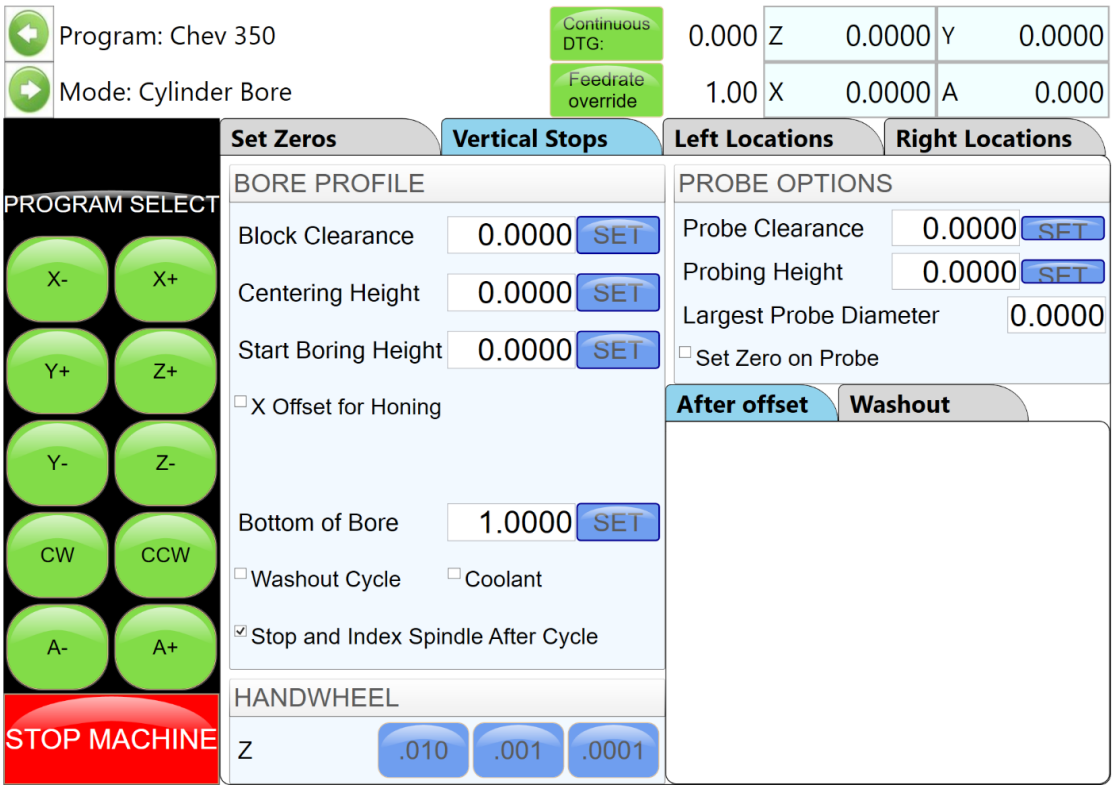
The zeros points for all axis have now been set. All the numbers entered from this point on will reference these zero positions. You are finished with the Set Zeros screen, select the next Tab to the Right, Vertical Stops.

Blueprinting Method

Even if you are not going to be boring a block to the blue print specifications it is recommended to have the Blueprint values entered. It will speed up the process of indicating and probing a block by giving the operator a close estimate of bore location.

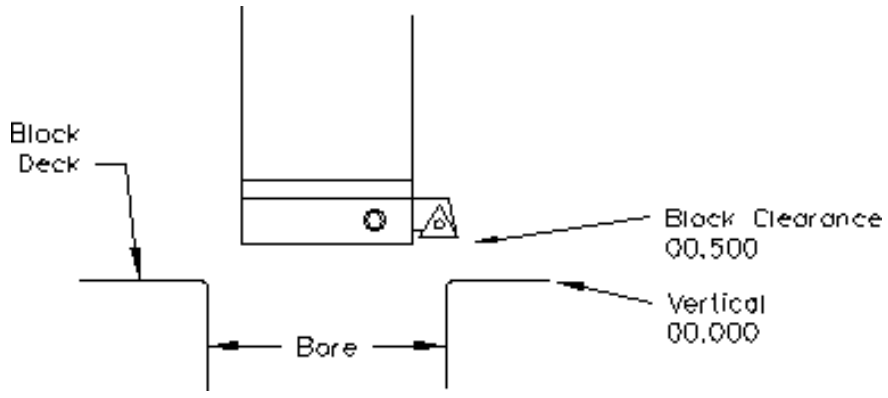
Programming Vertical Stops

To build a program you must set the Vertical Stops for the program. This is done by filling out the boxes in the Vertical Stops Tab.



Block Clearance

This is the distance above the zero position or block deck allowing the cutterhead to move to the next bore unobstructed. If you are Blueprinting a block the number will be just enough to allow the cutterhead to clear the block deck. We recommend a .100” to .500” range for this value.

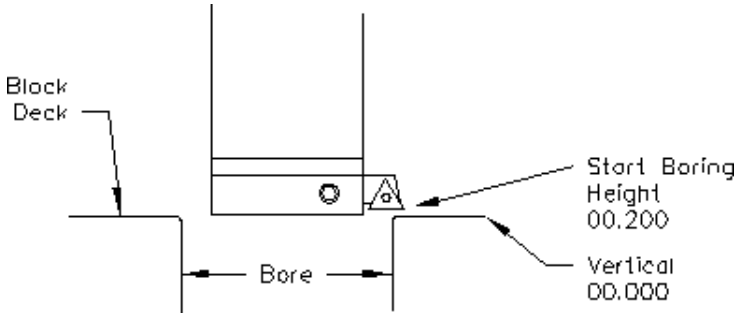


Centering Height

When Blueprinting this stop is not needed. It should be the same as the block Clearance Height.

Start Boring Height

This is the distance above zero or the block deck where you want the cutterhead to start rotating and the downward feed to start. Generally, this is just a short distance above the block deck to minimize the amount of time the machine bores through air. We recommend .030” to .200” range for this value



Bottom of the Bore

This is the distance below zero or the Block deck where you want the machine to stop boring and retract out of the cylinder. When the spindle retracts it will then go back to the Block Clearance position. For blue printing you can use a OEM bore length specification.

X Offset for Honing

This feature is designed to offset the cutter at a certain height in the lower bore to cut out block web intrusions to make room for the honing process. Checking this box will add the offset parameters options to the Vertical Stops Tab.

Start Offset Height

This is the vertical depth at which the cutter will shift to the side to start cutting.

Horizontal Offset

This is the distance the cutter will offset from the bore center.

Change Speeds at Horizontal Offset

Often the clearance cut is much larger that the cut for the rest of the bore. For this you can check this box and enter a different RPM and Feed Rate. If a different speed and feed are not need do not check this box and the same feed and speed will be used that was used to bore the cylinder.

For each bank (of a V Block) you can select the direction required for the offset routine.

Washout Cycle

Checking this box will open another window on the right hand side of the screen. Here you can enter the RPM and number of revolutions that will be performed when the cutter reaches the Bottom of Bore position. This is used when a certain type of finish is required on a counter bore or the bottom of a sleeve cut. Typically the RPM is reduced during a washout cycle.

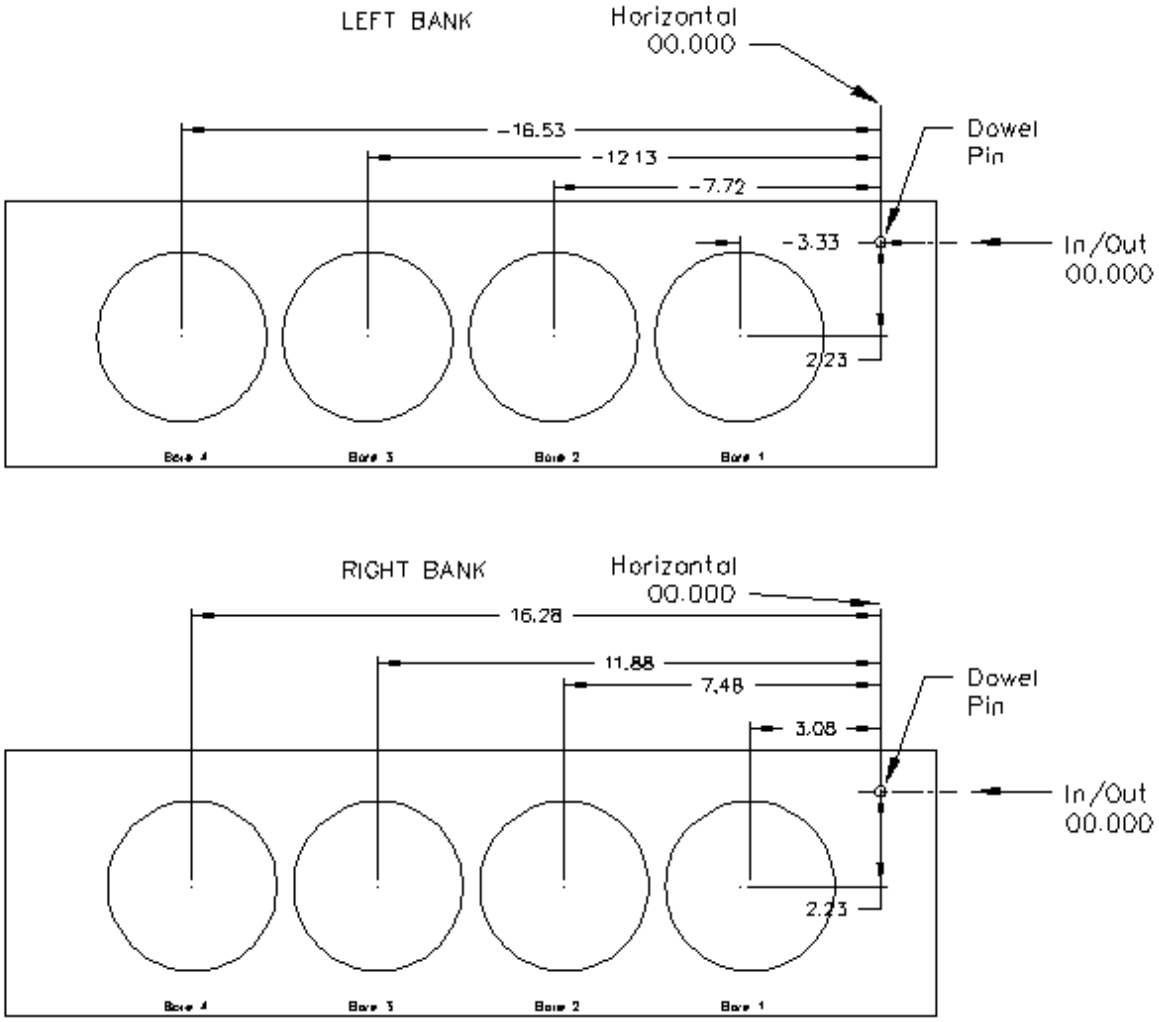
Stop and Index Spindle after Cycle

Checking this box will cause the spindle to be indexed to the three O'clock position after the cylinder has been bored but before it retracts. It will also offset to the left before the tool is retracted. This is the default setting. You would not want this check in an operation such as Lifter Boring.


Program: Chev 350
Mode: Cylinder Bore
Continuous DTG:
Feedrate override
0.000
1.00
Z 0.0000
X 0.0000
Y 0.0000
A 0.000
PROGRAM SELECT
X-
X+
Y+
Z+
Y-
Z-
CW
CCW
A-
A+
STOP MACHINE
Set Zeros
Vertical Stops
Left Locations
Right Locations
BORE PROFILE
Block Clearance 0.5000 SET
Centering Height 0.2000 SET
Start Boring Height 0.2000 SET
X Offset for Honing
Start Offset Height -5.2000 SET
Bottom of Bore -5.4000 SET
Washout Cycle
Coolant
Stop and Index Spindle After Cycle
HANDWHEEL
Z .010 .001 .0001
PROBE OPTIONS
Probe Clearance 0.0000 SET
Probing Height 0.0000 SET
Largest Probe Diameter 0.0000
Set Zero on Probe
After offset
Washout
WASHOUT OPTIONS
Finish RPMS 60.00
Finish Revolutions 2.00

Bore Locations

To build a program you must set the X and Y axis locations for the individual cylinder bores. Since we previous set the program zero at the dowel pin location, we may now use the block blueprint dimensions to program the X and Y locations for the cylinders in reference to the dowel pin location.



Left Locations

Right Locations

Boring a Block

Once the Vertical Stops and Left/Right location stops have all been entered the Spindle RPM and Feed Rate need to be entered. This is done on the Set Zeros screen. Once this is done you can go to the Left and/ or Right Bore location screens and bore the cylinders.

Pressing the Bore Left for Bore Right buttons Will Bore all the cylinders that have Green bore button below them.

Pressing a Bore button once will turn that button Yellow. Any Yellow button will not be bored when the

Bore Left or Right button is pressed.

Double clicking any Bore button will turn all the Bore button yellow EXCEPT the one that was double click.

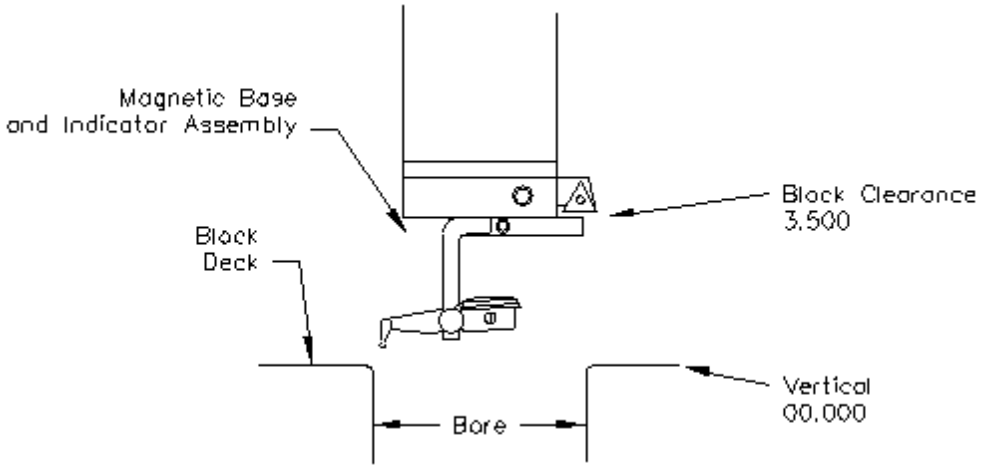
If your machine is equipped with a 4th axis fixture then the Start auto cycle button will bore both the left and right banks automatically and roll the 4th axis over in between the two banks.

Indicator Method

Sometimes it is necessary to us a dial indicator to find the bore locations of an engine block when creating the program. When this is required the programming is identical to the blueprinting method, with the only exception being that we will now take advantage of the centering height option. When using this method we want to program the machine so that it goes to the rough location of the bore, where we then can use a dial indicator to find the true center of the bore to be machined before saving the X,Y location.

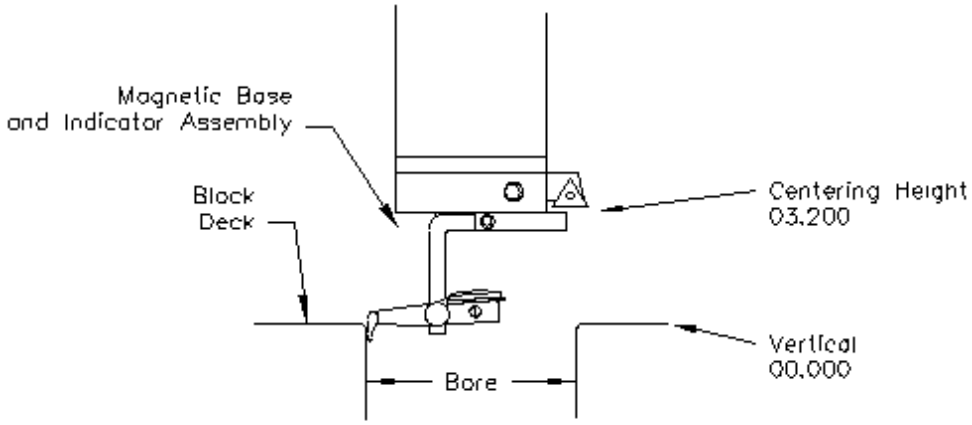
Block Clearance

This is the distance above the zero position or block deck allowing the cutterhead to move to the next bore unobstructed. When you are indicating the cylinders in you must have this stop set so the indicator will clear the block surface when traveling to the next cylinder.



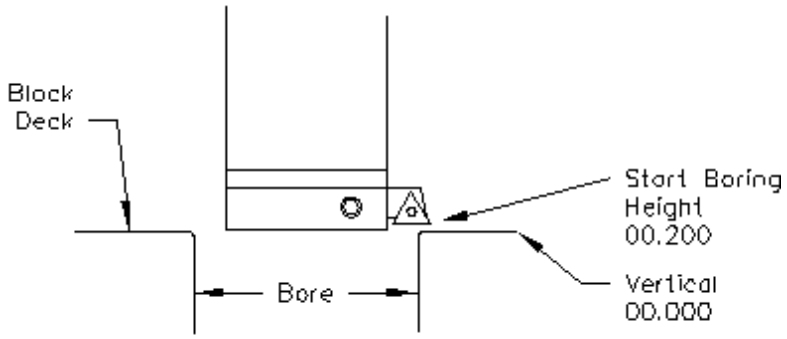
Centering Height

This is a distance above the vertical zero where you will be manually centering the block. The drawing below is a typical set up for manual centering or indicting a cylinder.



Start Boring Height

This is the distance above zero or the block deck where you want the cutterhead to start rotating and the downward feed to start. Generally this is just a short distance above the block deck to minimize the amount of time the machine bores through air.



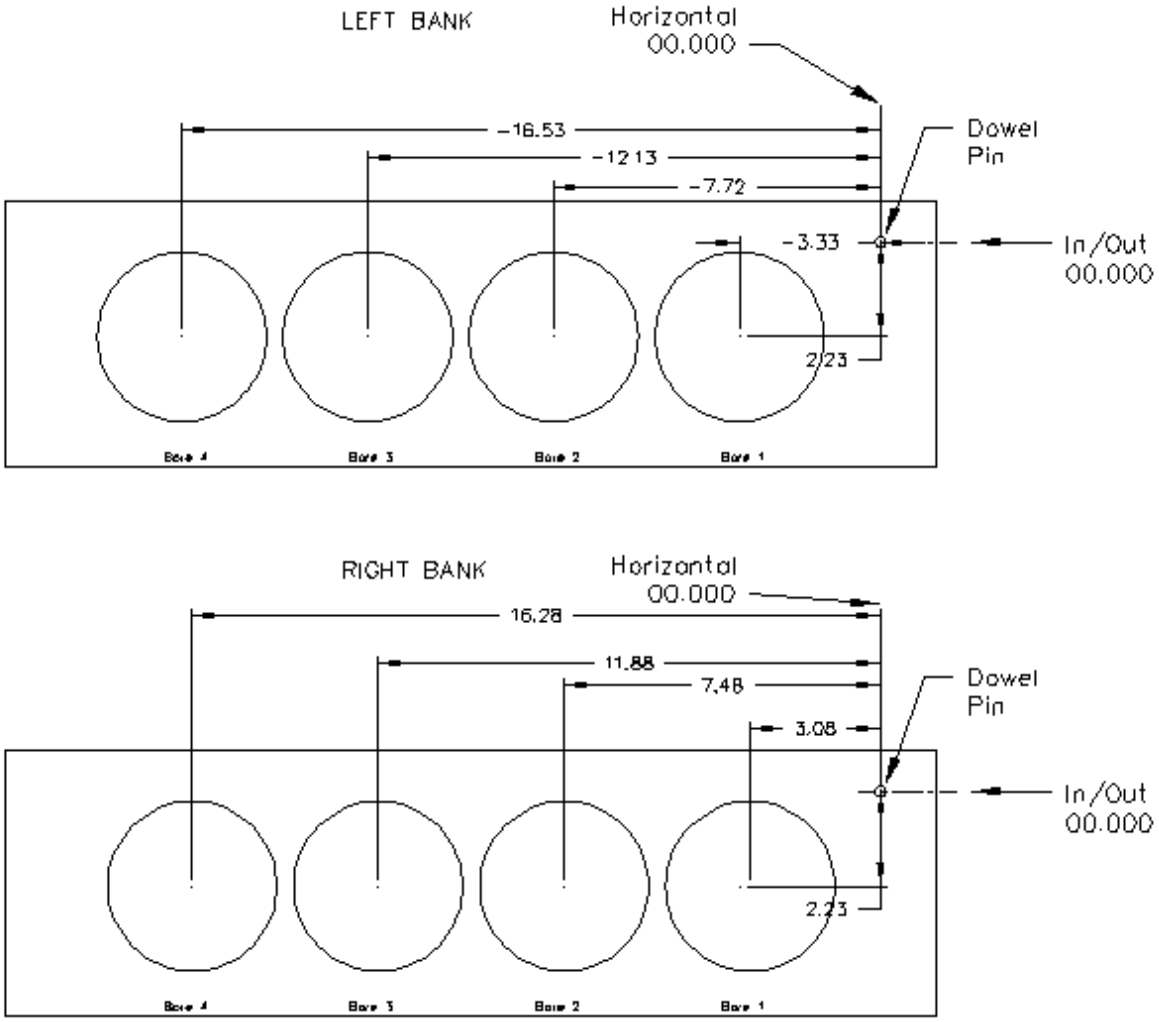
Bottom of the Bore

This is the distance below zero or the Block deck where you want the machine to stop boring and retract out of the cylinder. When the spindle retracts it will then go to the block Clearance position.

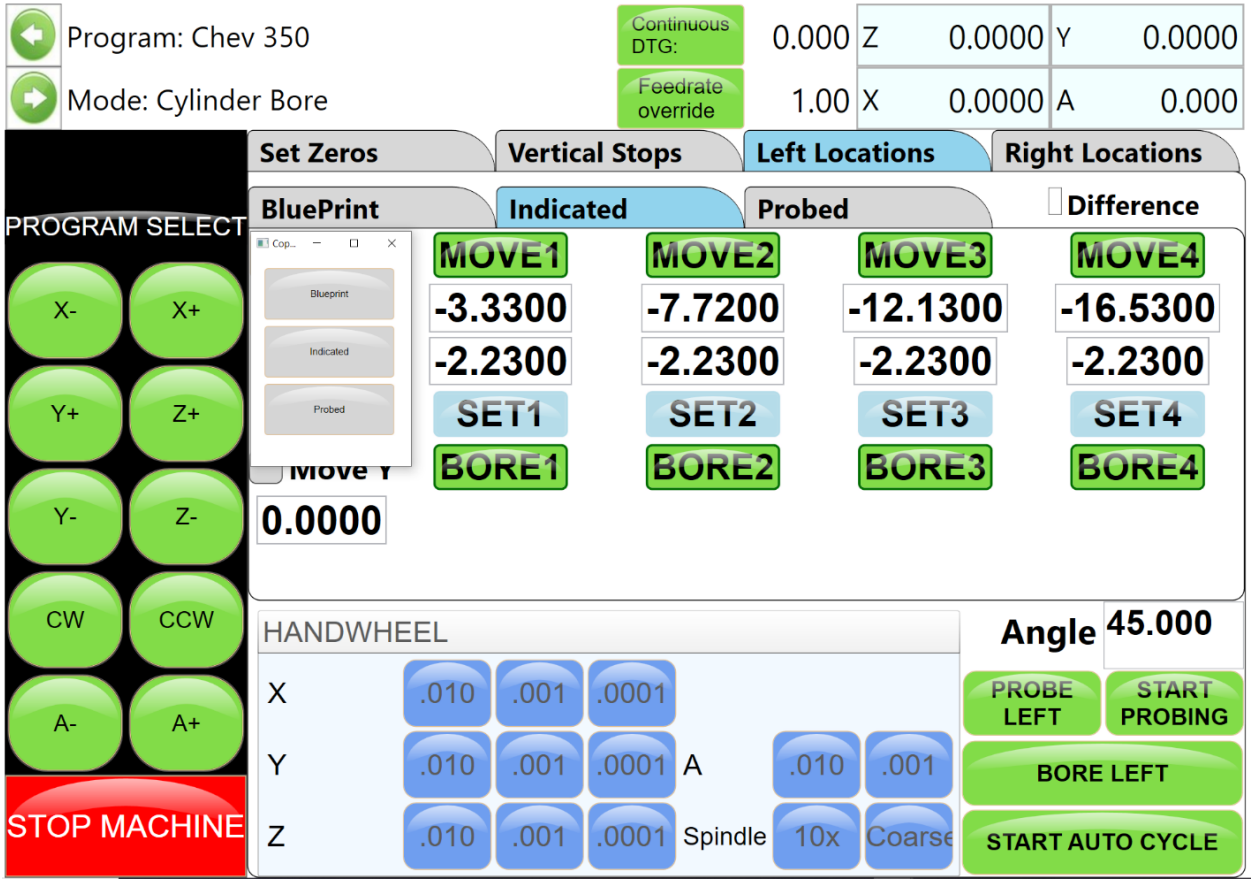
The Vertical stops have now been set. You are finished with the Vertical Stops screen, select Left and/or Right Locations.

Bore Locations

To build a program you must set the X and Y axis locations for the individual cylinder bores. Since we previous set the program zero at the dowel pin location, we may now use the block blueprint dimensions to program the rough X and Y locations for the cylinders in reference to the dowel pin location.



Select the left locations tab and then navigate to the indicated. If you have programmed the blueprint locations into this program, then press copy values and then blueprint. This will cause the values from the Blueprint page to be copied into the indicated page. This give you a starting point to indicate the individual cylinder from.



Press the Move 1 button. The machine will move to the first cylinder and stop at the centering position. Manually indicate the cylinder in using the X and Y axis handwheel options. Once the cylinder is centered press the Set 1 button. This will transfer the current position of the machine into the first set of Data Boxes. Repeat this process for all the cylinders that need to be indicated. Once the Left Locations have been indicated the same steps can be used to set the right locations.

Boring a Block

Once the Vertical Stops and Left/Right location stops have all been entered the Spindle RPM and Feed Rate need to be entered. This is done on the Set Zeros screen. Once this is done you can go to the Left and/ or Right Bore location screens and bore the cylinders.

Pressing the Bore Left for Bore Right buttons Will Bore all the cylinders that have Green bore button below them.

Pressing a Bore button once will turn that button Yellow. Any Yellow button will not be bored when the Bore Left or Right button is pressed.

Double clicking any Bore button will turn all the Bore button yellow EXCEPT the one that was double click.

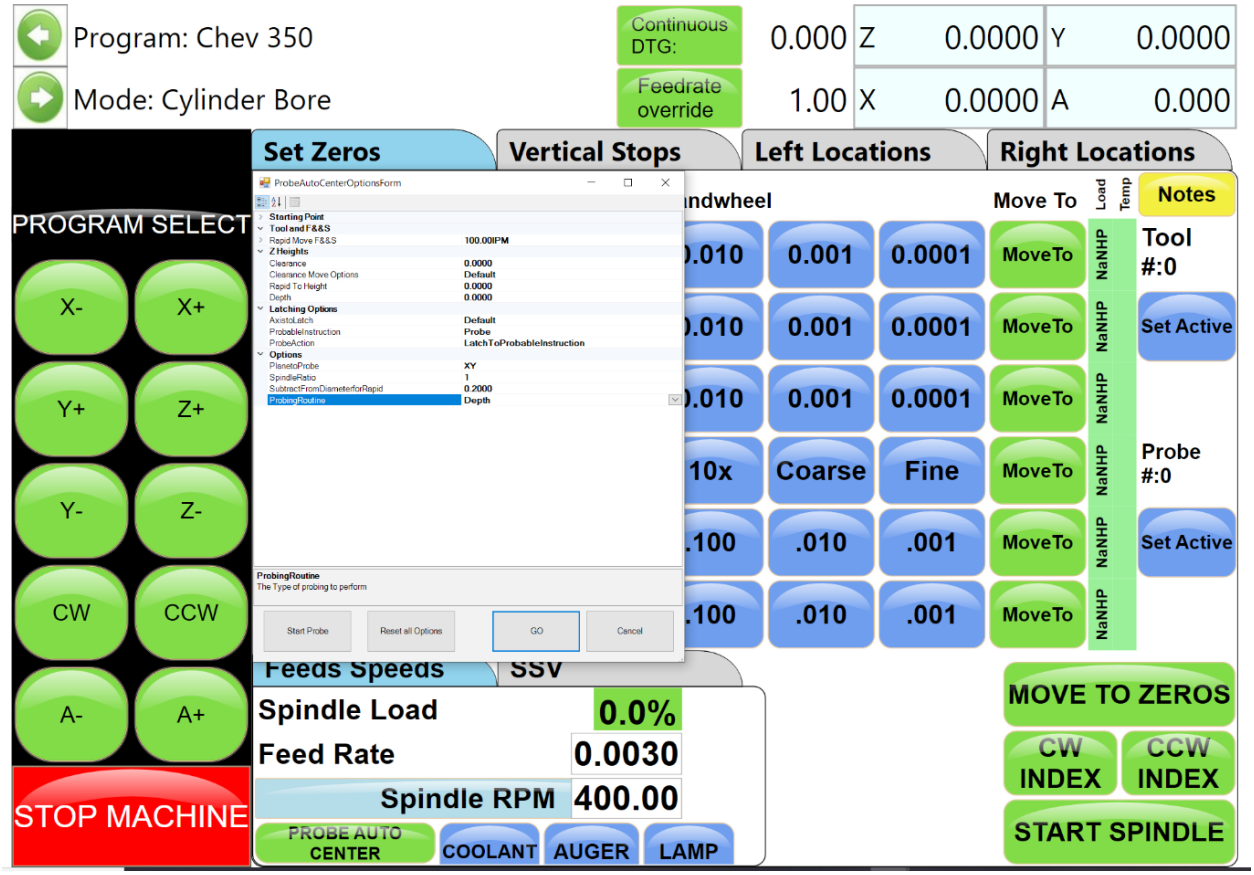
If your machine is equipped with a 4th axis fixture then the Start auto cycle button will bore both the left and right banks automatically and roll the 4th axis over in between the two banks.

Probing Method

If your machine is equipped with a Renishaw touch trigger probe then we can use the machines probing routines to locate the block deck, cylinder locations, and set zero's automatically. When using this method we want to program the machine so that it goes to the rough location of the bore, where we then call the probing routine to probe the bore and record the calculated X,Y locations of the bore automatically.

Vertical Zero

If you have setup the table of tools and recorded tool length compensations values, then instead you can used the Probe Auto Center command and select the depth routine from within the pop up window to probe he block deck. This will feed the z-axis with down with the probe in the spindle until the probe finds the deck surface. After the cycle is complete the probe tip will be just touching the surface and you can double click the z axis button to set the vertical zero.



If you have not setup the table of tools then use the blueprinting methods strategy for setting you vertical zero by touching the cutter off of the top of the block deck surface.

Programming Vertical Stops

Block Clearance

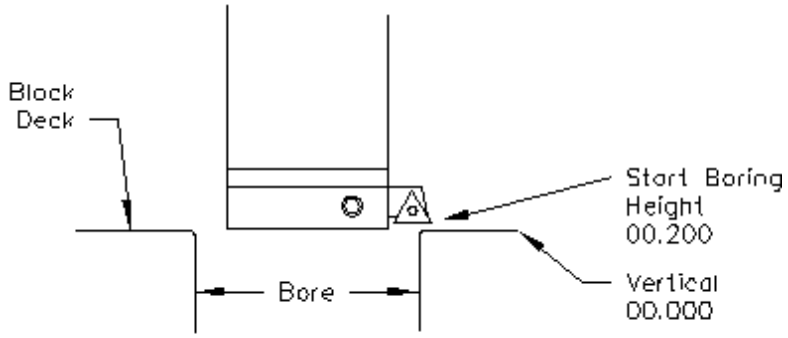
This is the distance above the zero position or block deck allowing the probe to move to the next bore unobstructed.

Centering Height

This stop is not used when you are using the probing feature. It is recommended that it be set to the same value as the Block Clearance.

Start Boring Height

This is the distance above zero or the block deck where you want the cutterhead to start rotating and the downward feed to start. Generally this is just a short distance above the block deck to minimize the amount of time the machine bores through air.



Bottom of the Bore

This is the distance below zero or the Block deck where you want the machine to stop boring and retract out of the cylinder. When the spindle retracts it will then go to the block Clearance position.

Probe Height

Using the handwheel bring the Probe down to the location in the cylinder you will be probing. Press the SET button next to Probe height. This will set the probing height position.

Using the handwheel move the probe up until it can safely move horizontal to the next cylinder. Press the SET button next to Probe Clearance. This will set the clearance height.

The Vertical stops have now been set. You are finished with the Vertical Stops screen, select Left and/or Right Locations.

Bore Locations

To build a program you must set the rough X,Y locations for the individual cylinder bores.

Select Left Locations and the Blueprint. Program the blueprint values (or close approximation) into the Horizontal and In/Out stops. Do the same for the Right Locations.

Select the Left Locations tab and then the probed tab. You can probe each cylinder individual by pressing the associated Probe button or you can probe the entire bank by pressing the Probe Left Button.

Probe Auto Center

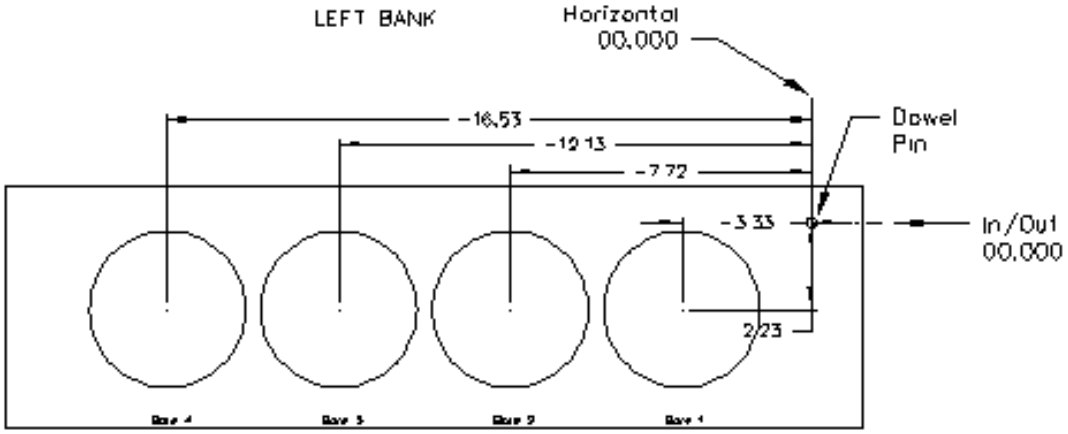
This feature is located on the Set Zero page. This allows easily find the center of a hole or cylinder. Roughly place the probe in the center of a cylinder. Press Probe Auto Center. The cylinder will be probed in 4 places, when finished the probe will move to the center of the probed cylinder. Pressing Horizontal and In/Out zero will then establish the center of that hole.

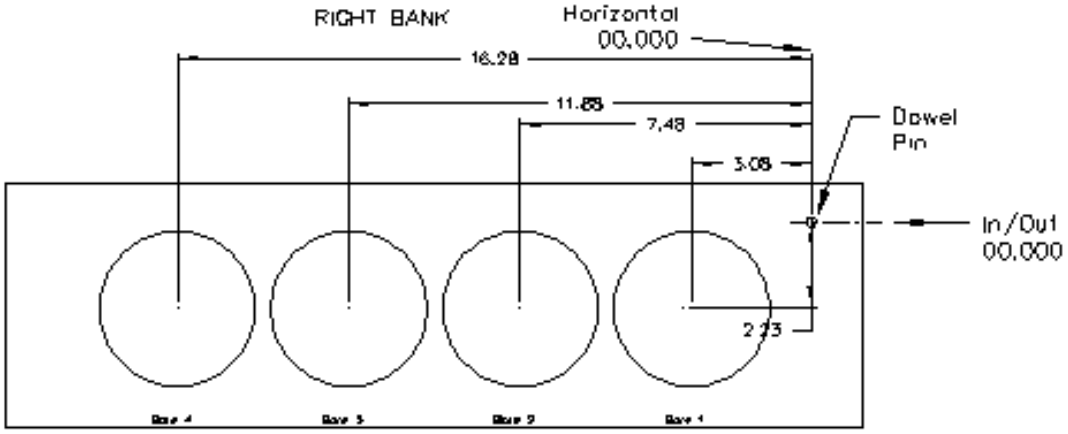
Automatic Probing Procedure

The probe will move to the center of the cylinder to be probed. It will then move to the right at a slow rate until the side of the cylinder is touched, it will then back off slightly and touch the same spot again to confirm position. The probe will then touch off the cylinder in three more spots and retract from cylinder.

As each cylinder is probed the Probed Diameter, Horizontal and In/Out positions will be placed into the Data Boxes for the corresponding cylinder.

Press the Right Locations tab and repeat the above procedure for the cylinders to be probed on the right bank..





Boring a Block

Once the Vertical, Horizontal and In/Out stops have all been entered the Spindle RPM and Feed Rate need to be entered. This is done on the Set Zeros screen. Once this is done you can go to the Left and/ or Right Bore location screens and bore the cylinders.

Pressing the Bore Left for Bore Right buttons Will Bore all the cylinders that have Green bore button below them.

Pressing a Bore button once will turn that button Yellow. Any Yellow button will not be bored when the Bore Left or Right button is pressed.

Double clicking any Bore button will turn all the Bore button yellow EXCEPT the one that was double click.

Cylinder Bore Mode 4th Axis

NOTE: The program with the 4th axis installed works basically the same as the 3 axis mode. ONLY the differences in operation and screens will be discussed here. Carefully read through the 3 Axis mode and then the 4th axis mode for operation and building programs.

Select Cylinder Bore and then Through Bore on the control panel. This will bring up the boring program with the Set Zeros tab shown.

Setting Zeros

The purpose of setting zero points is to give the operator a specific point to build programs from. The machine also uses these zero points to run the program from. The zero points can be set at any point in the machines' travel. Each axis (except the Spindle rotation) will need to have a zero point set for the machine to operate from.

4th Axis (Rotational) Zero

The Zero position for the 4th (Rotational) Axis should be preset from the factory. If the zero needs to be reset use the following procedure.

There are three (3) flats cut onto the Head Stock Plate. Use the middle flat to set the rotational zero. Using an indicator off of the spindle indicate the middle flat to Zero all the way along it. Use the 4th Axis hand wheel to do this. When the middle flat is indicated in press the 4th Axis Zero button. You 4th (Rotational) Zero is set.

Finding the In/Out (Y) Axis Zero with 4th Axis

The Head Stock Plate has a hole in it next to the Middle Flat. This hole is centered on the center of the Main and Cam locator shafts.

Building Programs with the 4th Axis

Program are built the same as in the 3 Axis mode with the exception of setting the Angle for each Bank. The Left and the Right Locations page each have an Angle Data Box. Here you enter the angle of each bank from the 4th Axis (Rotational) zero position. The zero position is with the Cam and Crank Locators lined up vertically.

Example: On a Chevy 350 the Left bank would be positive 45 Degrees and the Right Bank would be a negative -45 Degrees.

Setting Vertical Clearance with 4th Axis

It is very important when setting your Vertical and Probe Clearance height that you be sure to account for the Roll Over of the block from bank to bank. When in an automatic program the block will roll from the Left Bank to the Right bank at the Left Bank Bore1 position. It will also rotate from the Bore1 position when going from Right Bank to Left.

Table of Tools for 3 and 4th Axis Bore Mode

NOTE: The Table of Tools is not needed to run the Rottler automatic programs. It is recommended that it not be used except by the advanced operator.

Building a Program with Table of Tools

Build the program as described above for 3 and 4 Axis programs using the same vertical zero locations.

Put the tools to be used into the Table of Tools as described in Chapter 2. In Bore mode you are not referencing another vertical location such as the Crank centerline so the Z Touch off Location will remain at zero.

Assigning Tools

Tools to be used in the boring operations are set on the Set Zeros page. To select a Tool, double click on Tool # on the right side of the screen. This will bring up the Table of Tools window. Highlight the tool you will be using, such as 2.9 Production Stub and select OK.

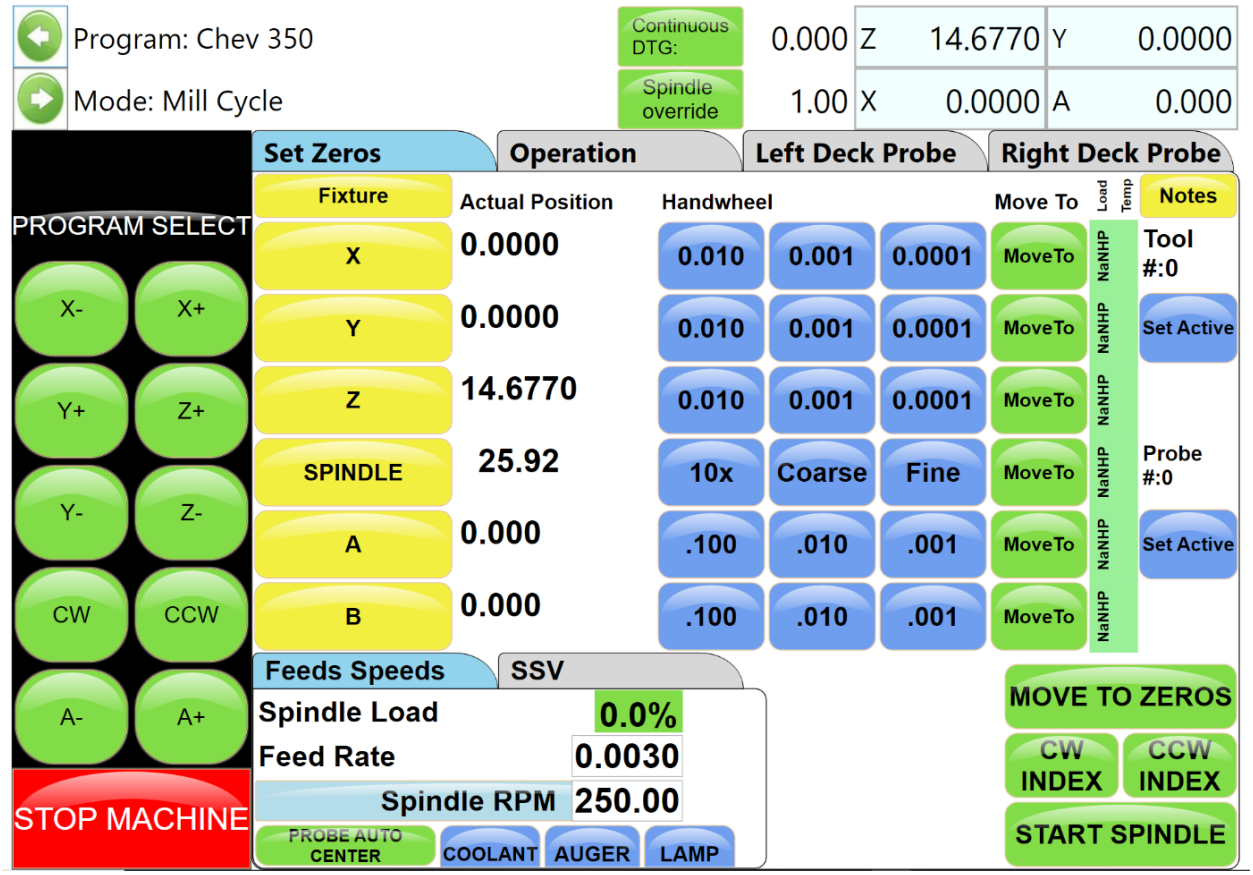
Do the Same to select the Probe you will be using, such as 100mm Probe.

NOTE: The Tool highlighted in red is the currently Active tool.

Mill Cycle 3 Axis

Mill Cycle

The mill cycle can be used for programming straight line toolpaths such as what is required for creating a surfacing/decking routine. From the mode select are in the main screen, select new and then select the mill cycle operation from the pop-up window. Once created, enter the mill cycle operations by selecting it in the mode select box.



Setting Zeros

The purpose of setting zero points is to give the operator a specific point to build programs from. The machine also uses these zero points to run the program from. The zero points can be set at any point in the machines' travel. Each axis will need to have a zero point set for the machine to operate from.

Horizontal Zero (X-axis)

For this example, we are going to set the Horizontal Zero (X-axis) at the point where the selected fly cutter is approximately ¼" passed the right hand side of the block to be machined.

In/Out Zero (Y-axis)

For this example we are going to set the In/Out Zero at the center line of the work piece.

Vertical Zero (Z-axis)

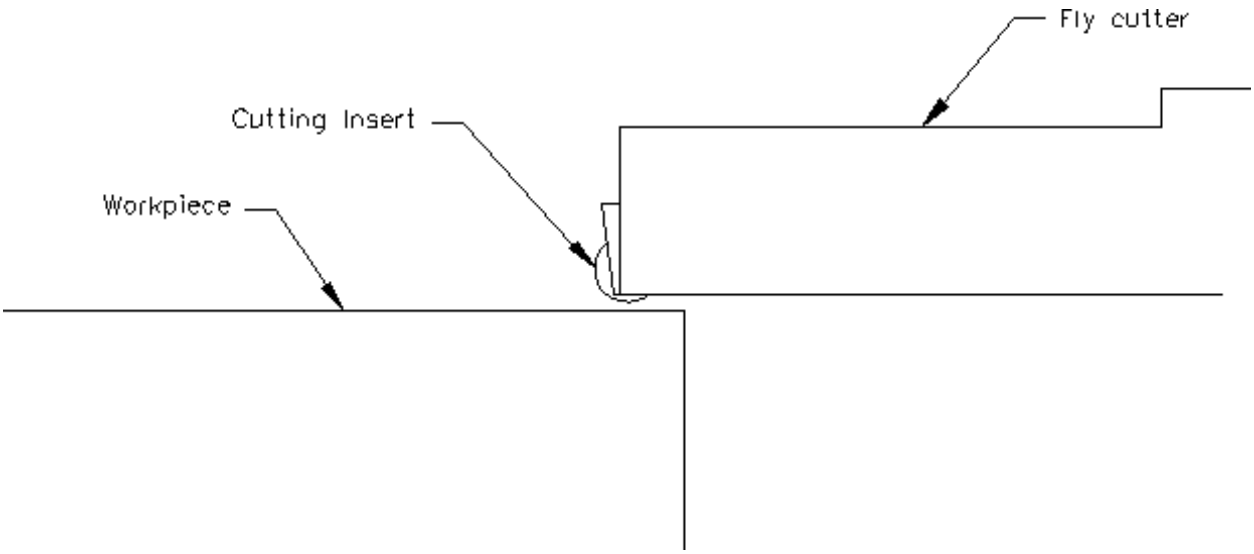
For this example the Vertical Zero will be at the deck height of the work piece.

Feeds and Speeds (IPR/RPM)

The spindle RPM and Feed rate in IPR can be set in the lower left corner of the Set Zeros tab under the Feeds Speeds box. The RPM should be set based on the recommend SFM range for the insert being used, based on the material of the block being machined. Feed rate should be set based on the insert geometry, and surface finish requirements of the block to be machined.

Manual Procedure for Setting Vertical and Horizontal Zero's (Z-axis/X-axis)

Start the spindle. Select the .001" increment for the Z-axis handwheel and move the spindle down until you can hear or see the cutter just touching the block. Double tap the Z button to zero the Z-axis here. Feed the cutter in the +X direction. When the cutter has cleared the block by approximately ¼" double tap the X button to zero the X axis.



Operation

Horizontal End

This is the programs ending location in the X axis. Since we are setting up on the right-hand side of the machine this number will be negative. To set this value the operator can either jog the machine to the left end of the block so the cutter to be used is passed the end of the block and then press SET to save the current location. Or if the length of the block is known then the operator can click the box next to the SET button and type in the length of the block plus the radius of the cutter to be used for the end location.

Amount Per Pass

This is the maximum depth of cut to be performed each time the cutter makes a pass across the block surface. This is used to set the depth for any roughing cuts that will be performed.

Vertical Start

This is the Vertical Position the machine will start cutting at. This value is usually Zero which is usually the starting Deck Height.

Vertical End

This is the Vertical Position the machine will stop cutting at. It is the Total amount of material you want to remove in the Milling process.

Copy Lowest/Copy Highest

These buttons are used in conjunction with the probe with mill for probing

Rough Settings

These values are used when taking multiple passes are necessary to remove material before finishing the block surface. Typically the rough settings will use more aggressive cutting parameters to remove material efficiently.

Rough Feed Rate

The desired roughing feed rate in IPR

Rough Spindle RPM

The desired roughing spindle speed in RPM

Finish Cut Settings

These are the cut parameters that the machine will automatically switch to when performing the final pass

Finish Amount

The amount to be removed on the last pass.

Finish Feed Rate

The desired Finish Feed Rate in IPR.

Finish RPM

The desired Finish Spindle RPM.

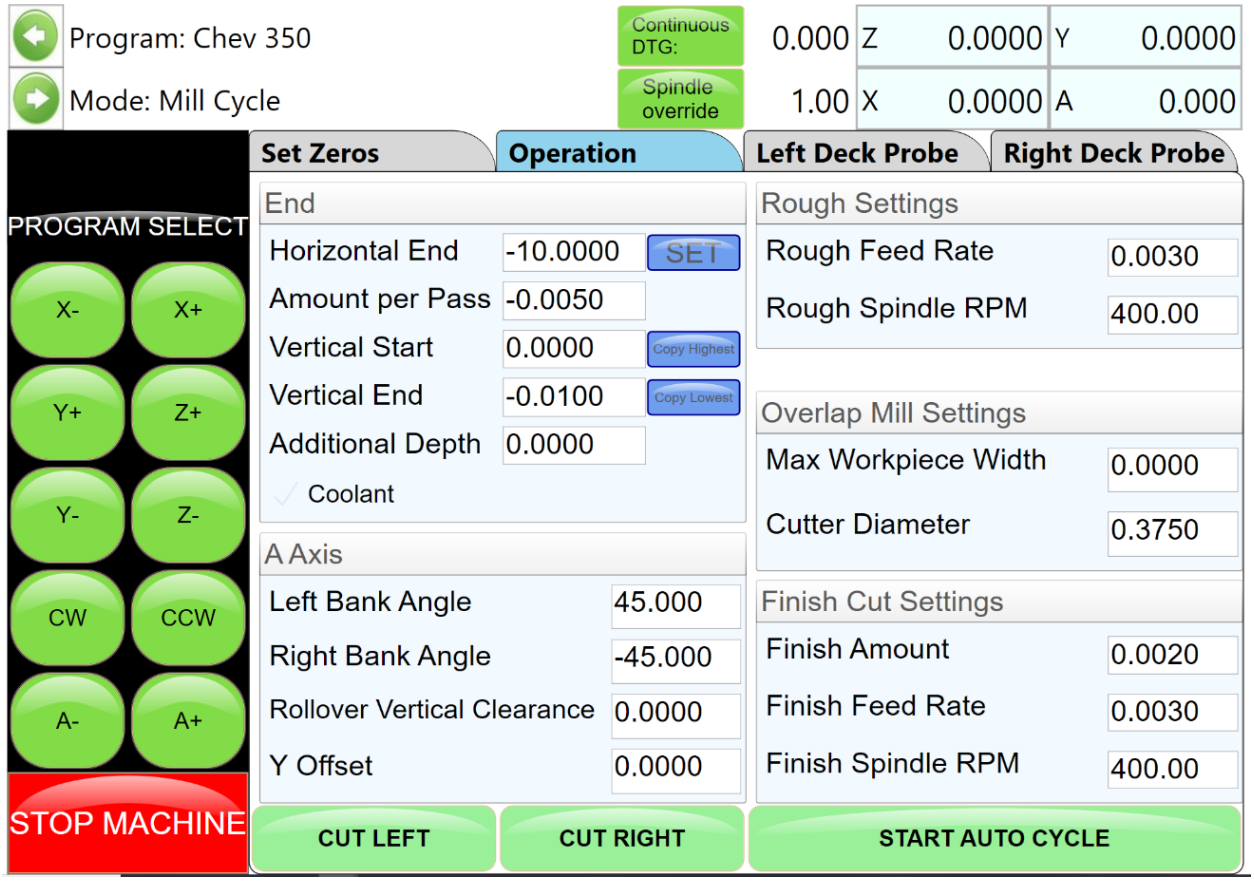
A-Axis

This is controls the 4th axis if machining a V-block.

Overlap Mill Settings

This is used if the cutter to be used cannot machine the entire width of the block in one pass.

NOTE: You do not need to have evenly divisible numbers in these sections. The computer will do the math to remove the maximum allowable material each pass while still using the specified finish cut settings.



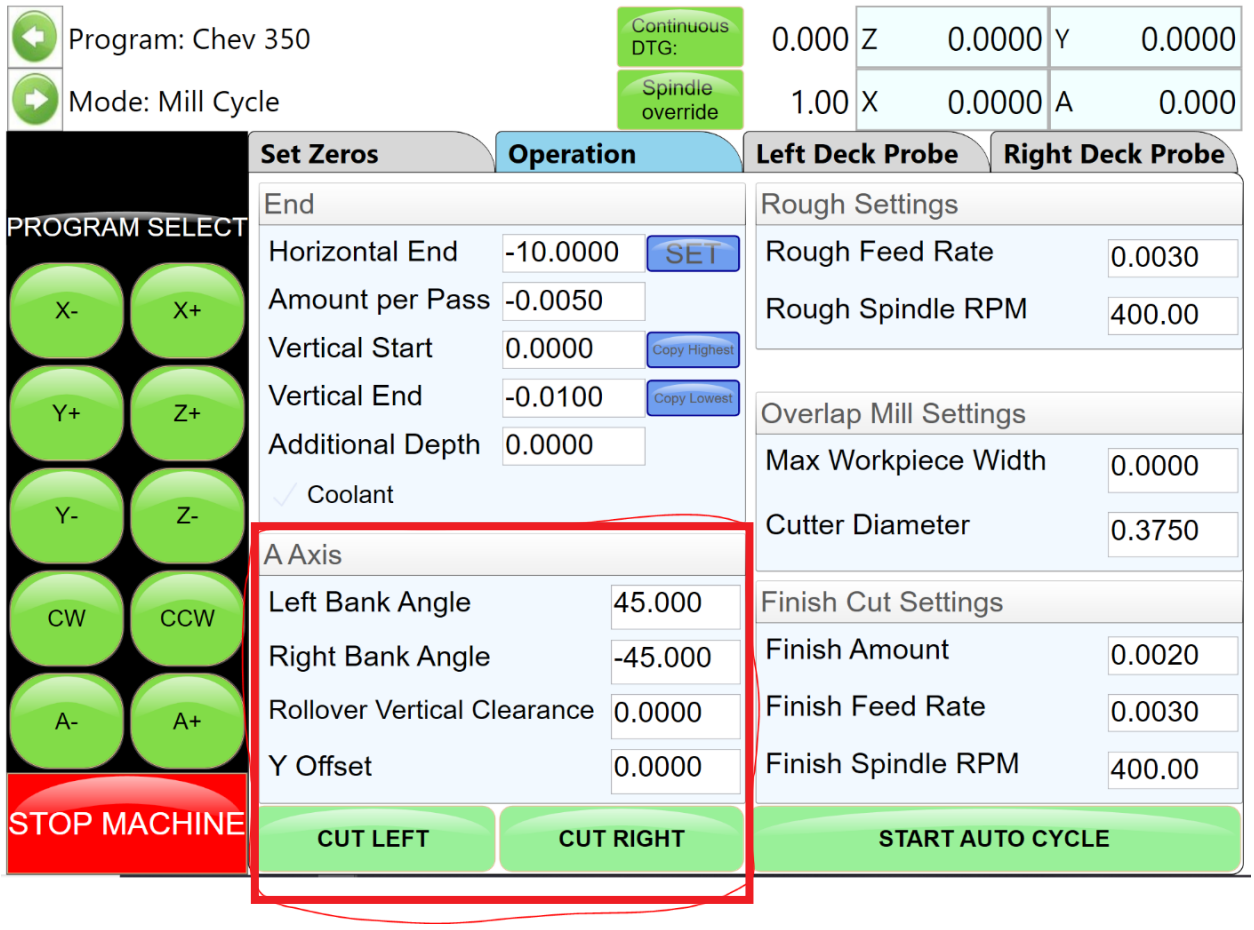
Start Auto Cycle

Pressing this button will start the machines automatic cycle. The cycle to be run is determined by the setting on this page. If you only require one pass to be made, do not enter any values into the Rough Setting, only the Finish Cut Settings.

Mill Mode 4th Axis

Program Additions to 3-axis Operation

The Program setup for a 4th Axis operation is largely the same as the programming for a 3-axis operation. The only difference is the addition of the A-Axis settings. When surfacing a V-block we first setup the surfacing operation on one deck and then fill out the A-axis settings to have the program repeat on the second deck.



4h Axis Angles

Left Bank Angle

Enter the angle of the Left Deck. This is the angle of the block in reference to the Cam and Crank bore being lined up Vertically.

Right Bank Angle

Enter the angle of the Right Deck. This is the angle of the block in reference to the Cam and Crank bore being lined up Vertically.

Rollover Vertical Clearance

Enter the value the Fly Cutter will have to move up vertically to clear the block when it rolls over from bank to bank. Make sure the block can completely rollover when in this position for safety

Cut Left and Cut Right

Pressing these buttons will cause the machine to run an automatic cycle (per the parameter defined in the Operations page) on the associated bank.

Start Auto Cycle

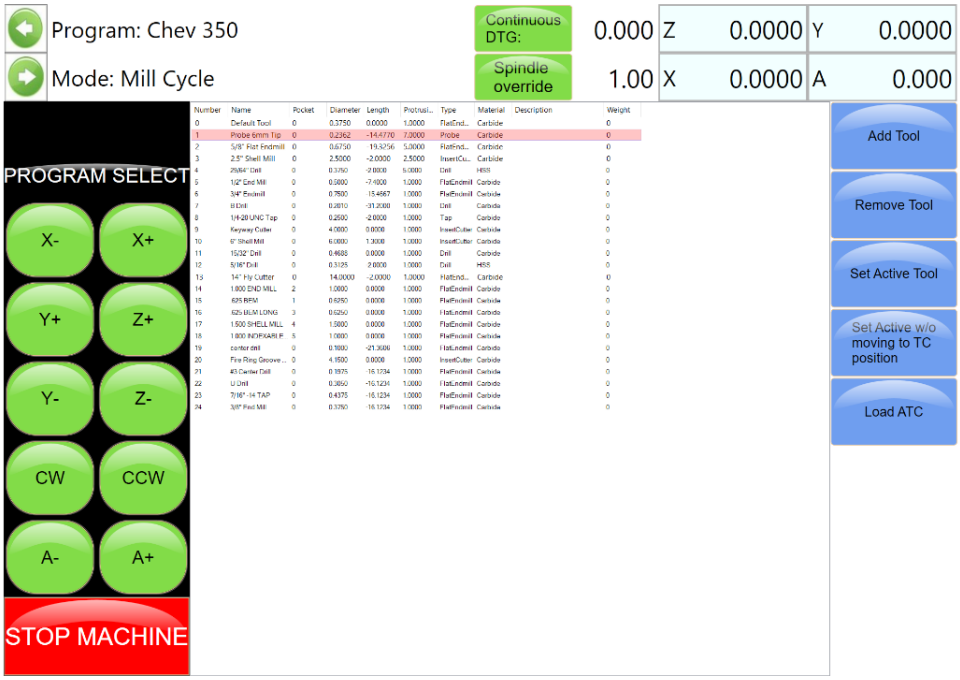
Pressing this button will start the machines automatic cycle. The cycle to be run is determined by the setting on this page. If you only require one pass to be made, do not enter any values into the Rough Setting, only the Finish Cut Settings.

Milling Using Automatic Deck Probing

The Rottler Milling program is set up to Automatically Probe the Deck height of a block and then Mill it to a set Deck Height. This can be done with both 3 and 4 axis operations.

Table of Tools for Milling

You MUST use the Table of Tools if you want to Automatically Probe the deck height and cut it to a set height. If you are unsure about how to setup the table of tools and set tool length compensation, then consult the Table of Tools section of the operator's manual before proceeding further in this section.

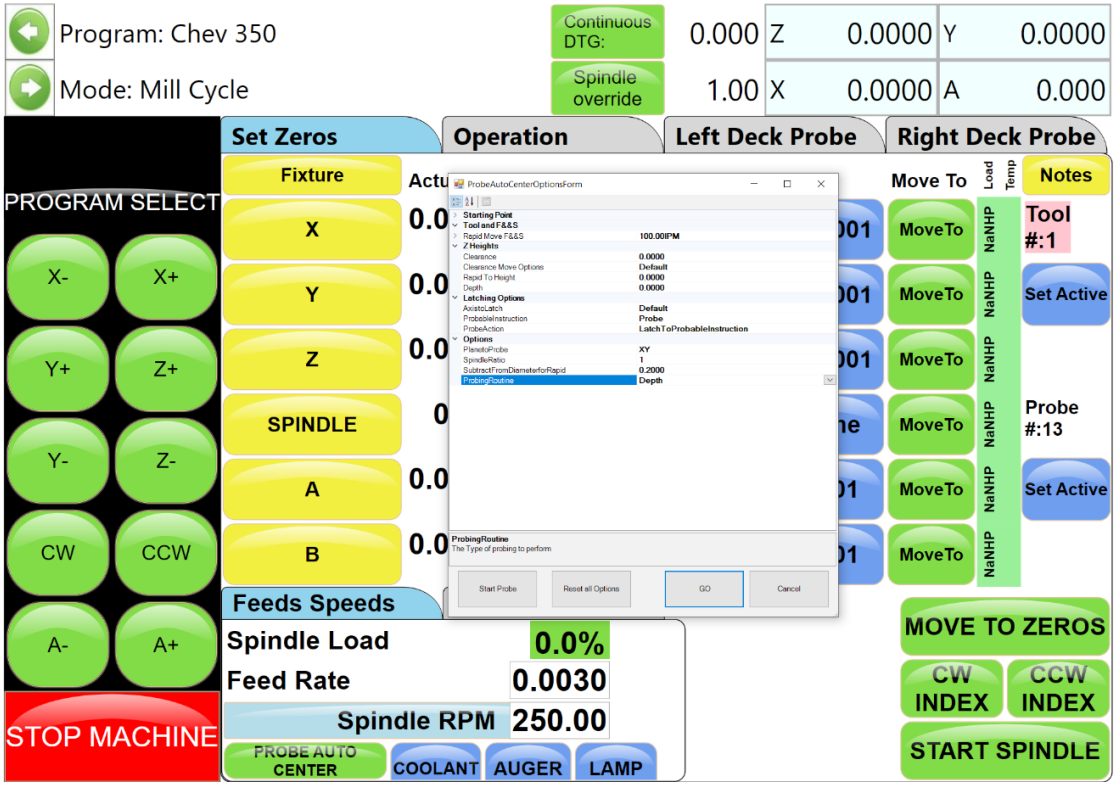


Building a Program Using the Probe and Table of Tools

Using the probe allows the programmer to setup different blocks that may require different tooling using only the probe to find locations and set zeros. Using the probe speeds up the setup time while also increasing the accuracy and precision of the blocks being processed. When surfacing we can use the probe to automatically find the lowest relative point of the surface and then use that gathered data to let the machine figure out how much material to remove.

Probe Auto Center

The probe auto center button can be found in the feeds and speeds tab within the set zeros page. Clicking this button will open the probe auto center form where the various probing routines can be called upon while jogging the machine. The Depth, Inside Diameter, and Outside diameter routines are the most used routines for performing engine work.



Probe Depth

Probes a surface in one point by moving down in the z-axis and stopping with the probe tip just touching the surface. When setting up a probing routine, you must run this operation and zero the z-axis while the probe tip is touching the surface to give the probe a starting reference.

Probe Inside Diameter

Probes 4 points 90 degrees offset from each other to find the center line of a circle in one plane.

Probe Outside Diameter

Probes 4 points 90 degrees offset from each other on the circumference of a circle to find the centerline in one plane.

Probing Engine Block Surfaces

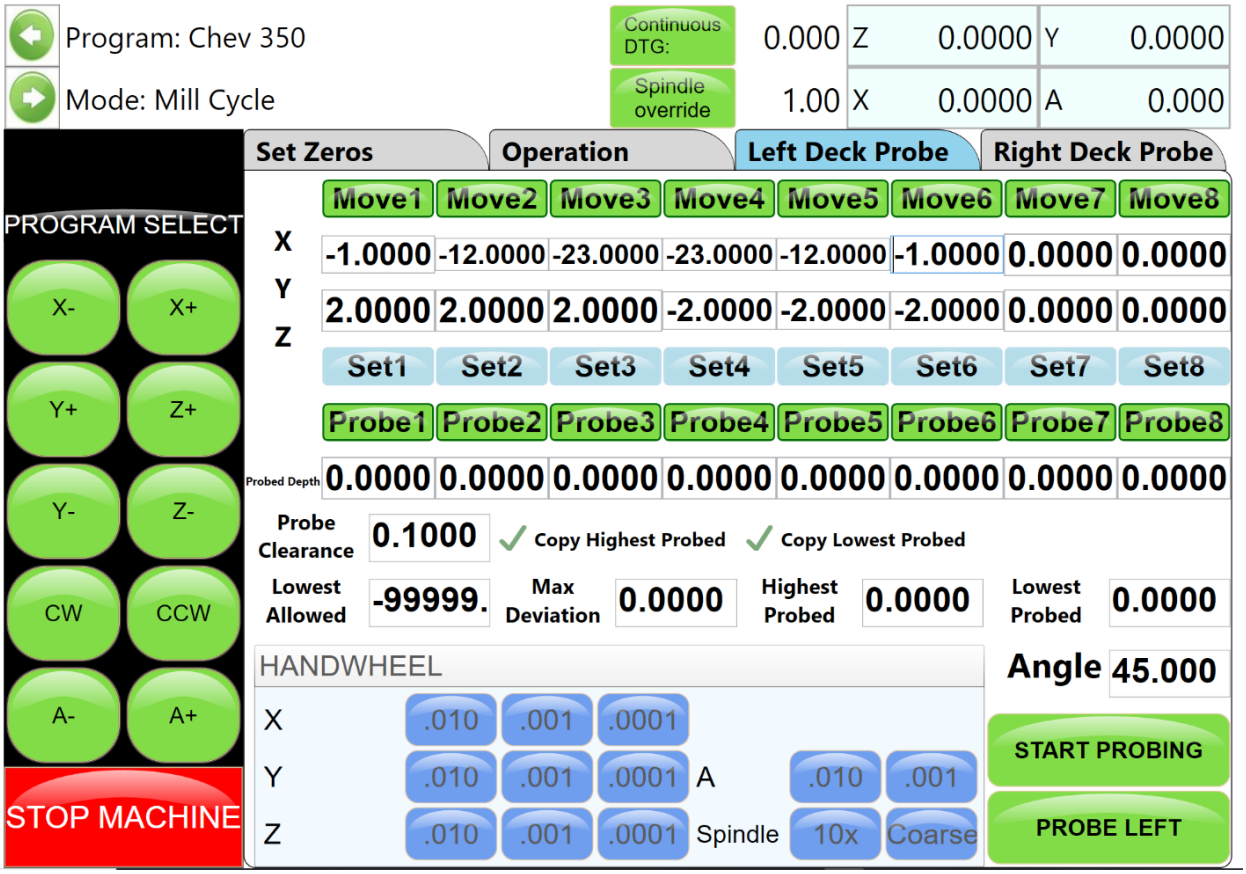
To probe the engine block deck surfaces we can use the left deck probe and right deck probe tabs from within the block software to define locations for the probe to move to and then run the depth probing routine

Left Deck Probe

Enter the positions you want the Probe to probe here. You can physically move the probe to the locations on the bank you want to probe and hit the set button also.

Right Deck Probe

Roll the block over to the Right Bank. Enter the positions you want the Probe to probe here. You can physically move the probe to the locations on the bank you want to probe and hit the set button also.



Probe Clearance

Position in the z-axis that the probe will return to when moving between points.

Lowest Allowed

Lowest Z-axis position that the machine will lower the probe to before stopping if it doesn't contact a surface.

Auto Probing

Press the Start Probing button. The machine will first probe each programmed location on the left bank and record the height. The spindle will move to Vertical Clearance height and the block will roll over to the right bank and probe the programmed locations and record them. The block will then roll back over to the Left bank and the spindle will move to the first Left location and stop.

Auto Milling

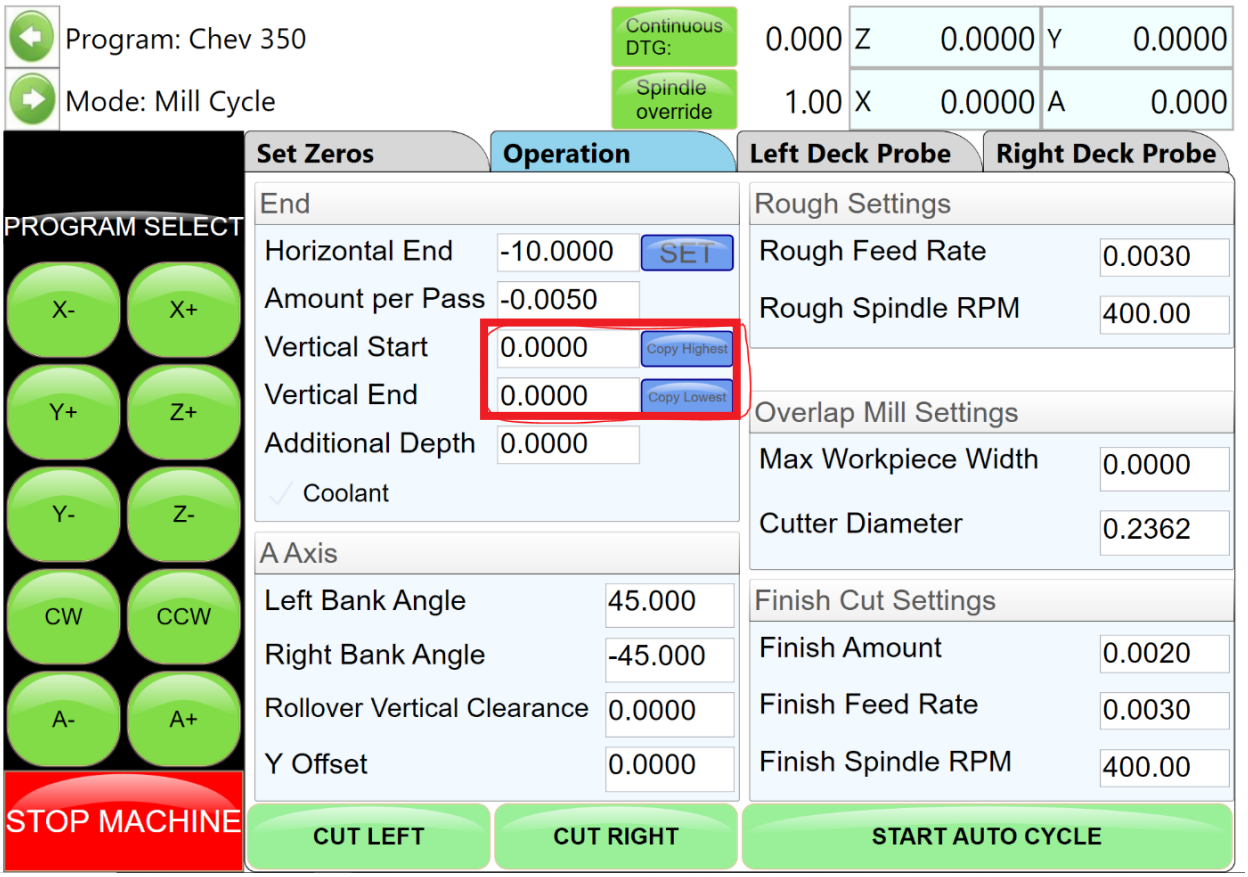
After the points have been probed the values gathered from the probe can be copied into the depth to cut within the operation tab.

Vertical Start

Press Copy Highest next to Vertical Start. This will copy the Highest Probed point of either bank. This is the Height at which the Start Auto Cycle would start the first cutting pass.

Vertical End

Press copy lowest to copy the lowest point from the probed data into this box. This can be used to perform a minimum cleanup on the block, as the finish cut will end at the lowest probed points height. If more material is to be removed, then the amount below the lowest point that the operator would like to cut can be entered manually in the box as done in previous methods.



Start Auto Cycle

Pressing this button will start the Auto Cycle for Both Banks. First the Left bank will be cut to the set parameters. The spindle will go to the Clearance Height and Roll over to the Right bank and cut it to the set parameters. The Spindle will again go to the Clearance Height and roll over to the Left bank. The machine will go idle at this point.

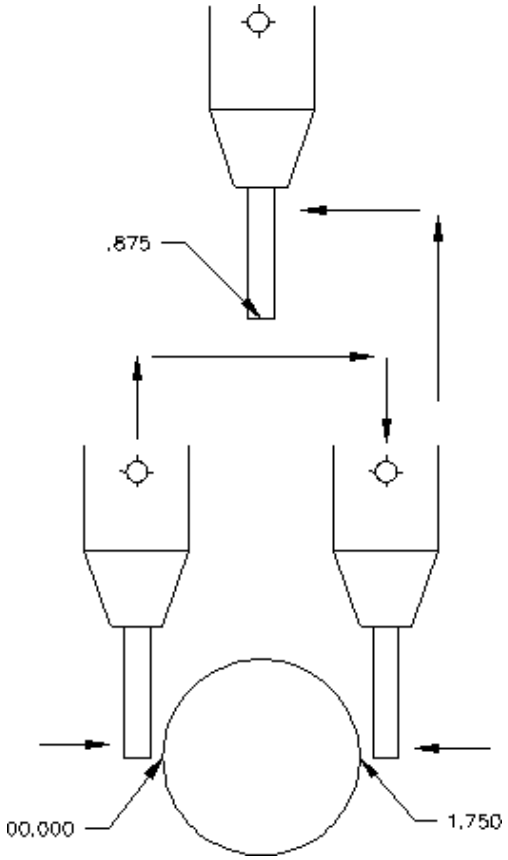
Lifter Bore Mode 3 Axis

Lifter Bore programs are built the same as described in the Bore Mode 3 Axis. The differences in locating the bores and tooling will be discussed in this section.

Y-axis Zero (In/Out)

The Y-axis zero position for lifters is the center line of the Cam Bore. An easy way to find the center of the cam line is to use the electronic probe. The following is an example of this procedure. Install the probe into the holder and the holder into the spindle. Bring the probe down until it is in the approximate center of the cam Bar Vertically. Press the Vertical Zero button now (this is only a temporary Vertical Zero position). Jog the Y-axis with the handwheel to bring the probe up to the Cam Bar until it lights. Press the Y-axis zero button here. Move the spindle up enough to clear the Cam Bar, move the probe to the other side of the Cam Bar. Bring the vertical down to the zero position. Hand wheel the probe into the Cam Bar until the light comes on. Note the Y-axis position reading. Divide this reading by two. Bring the spindle up until it can clear the Cam Bar. Use the Y-axis handwheel and move the Y-axis position until it matches the divided number. This is the center line of the Cam Bar. Press the Y-axis Zero button now. The Y-axis zero position has been set. The following illustration visual shows the above description.

Start Boring Height



Pay attention when setting this height, there are often protrusions in the casting that will not allow the end mill to travel unobstructed all the way to the start of the lifter bore. It is safest to set the Start Boring Height above the Deck.

Lifter Bore Angle

Rottler has specific Lifter Bore spacers that are installed on the Cam bar to set the correct angle for lifter boring when using the Performance Fixture.

Lifter Bore 4th Axis

Lifter Bore programs are built the same as described in the Bore Mode 4th Axis. Only the differences will be discussed in this section.

Start Boring Height

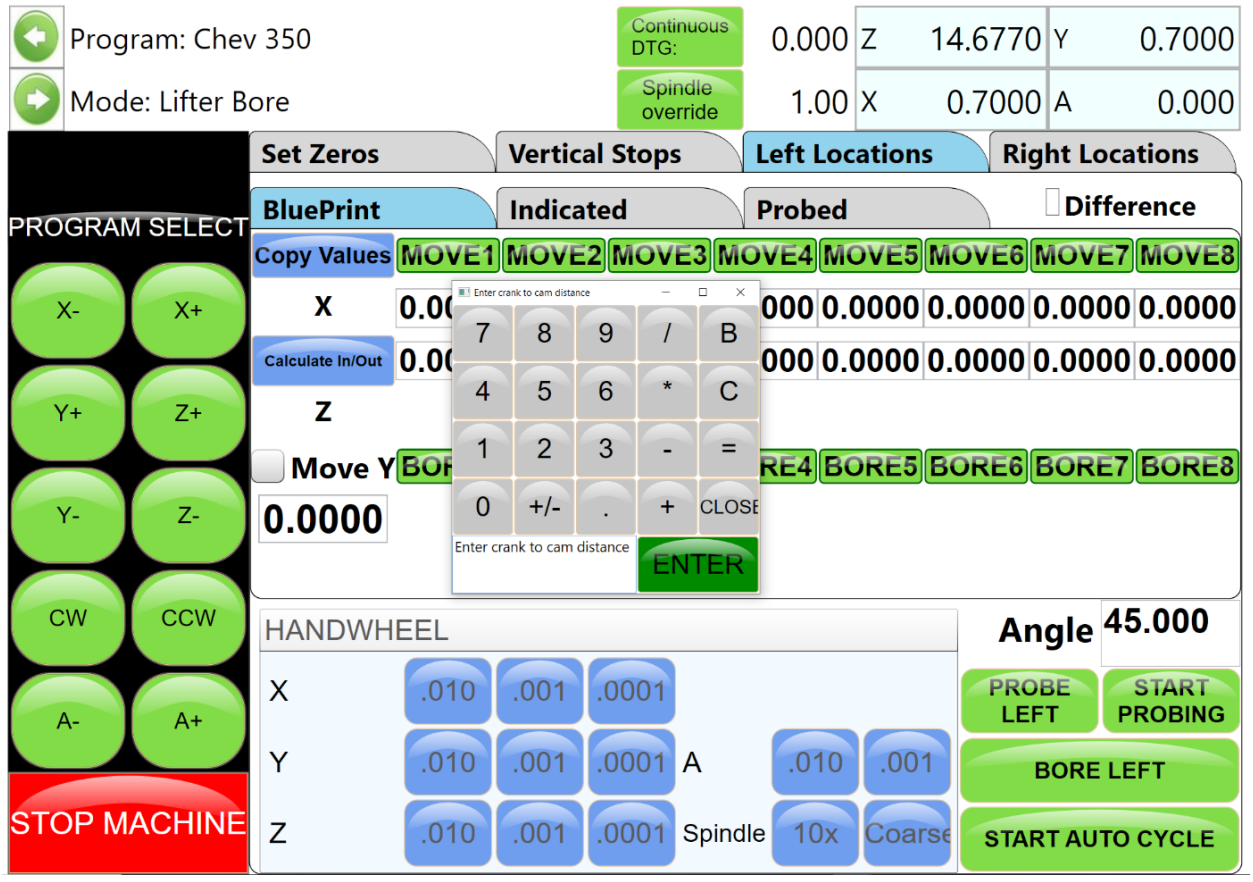
Pay particular attention when setting this height, there are often protrusions in the casting that will not allow the End Mill to travel unobstructed all the way to the start of the lifter bore. It is safest to set the Start Boring Height above the Deck.

Lifter Bore Angle

The angle for each bank is located on the associated Locations page. Press the angle numerical value and a pop-up will open so you can type in the Lifter Bore angle.

Calculate Y-axis zero

This button is located next to the Y-axis locations for each Bank. You must first have the correct angle entered in the angle data box. Then press the calculate In/Out button. A window will open where you enter the center to center distance of the Cam to Crank bores. The In/Out locations will automatically be filled in.

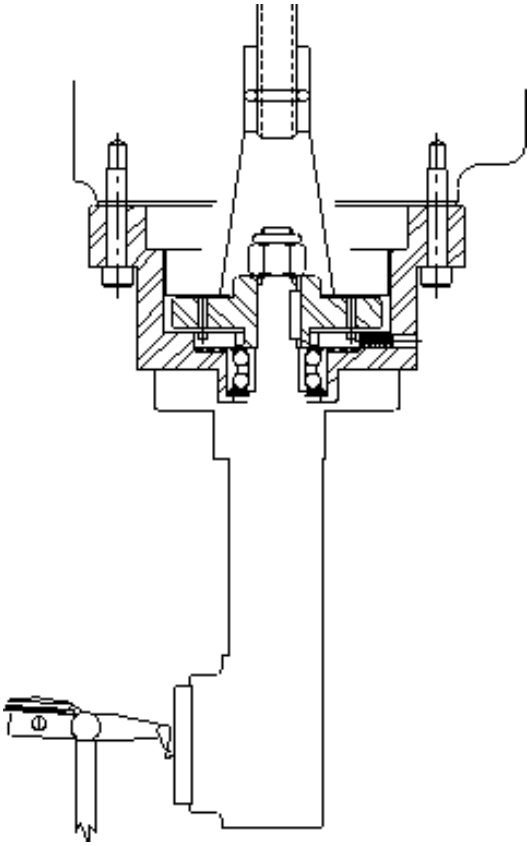


Line Bore Mode

Create a Line Bore Operation in the mode select box from the main screen.

Mounting and Aligning the 90 Degree Head

Mount the 90-degree head onto the spindle and just snug mounting bolts. Use the following instructions to align the head. Mount a test indicator to the machine table or block. Align the indicator needle as shown in the figure below on the tool mounting surface.



Using the Y-axis handwheel increment move the indicator from one side to the other noting the amount of difference. Adjust the 90-degree drive until the variance across the face is less than .0005”. Tighten the mounting bolts for the head and check the surface again to be sure it did not shift when tightening the head.

Setting Zeros

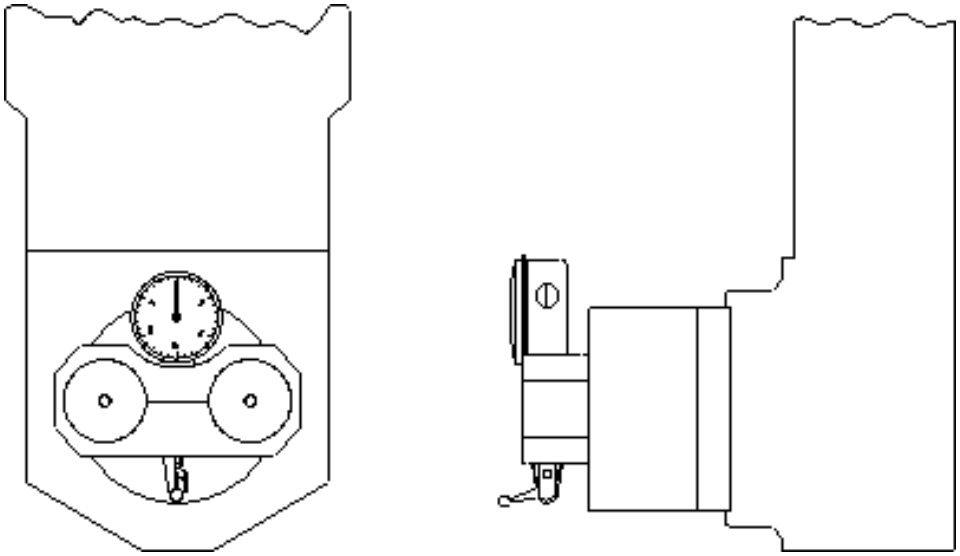
The purpose of setting zero points is to give the operator a specific point to build programs from. The machine also uses these zero points to run the program from. The zero points can be set at any point in the machines' travel. Each axis (except the Spindle rotation) will need to have a zero point set for the machine to operate from.

X-axis (Horizontal Zero)

The Horizontal should be set about .050" offset from the front of the first main to be bored, making sure that, that position will allow the head to travel up without interference. Bring the head down and roughly center it in front of the first main. It does not need to be perfectly centered to set the horizontal zero. Double tap the X button from the set zeros tab to set the horizontal zero.

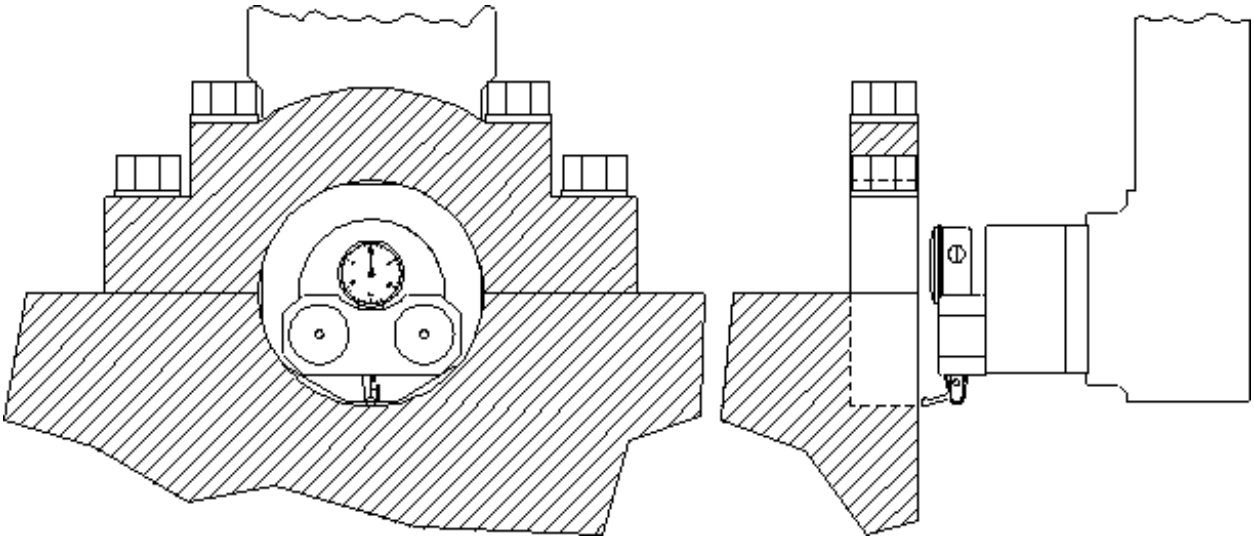
Y-axis (In/Out Zero)

Locate the supplied indicator and small magnetic base. Mount on cutterhead as shown below.



Using the X-axis handwheel increment option move the indicator inside the main bore, making sure the indicator is not touching the main bore at this point. You will be indicating both sides and the bottom of the saddle, generally the cap is not used while indicating the bore.

Physically move the indicator and mag base on the cutterhead until there is about .010” pressure on it. Start rotating the spindle CW and CCW watching he indicator. Move the machine in the Y-axis (In/Out) with the handwheel increment until the indicator readings are the same on both the sides and the saddle locations of the main. Once equal double tap the Y and Z buttons on the set zeros tab to set the zero locations for the program



Programming Vertical Stops

There are two (2) vertical stops used in the Line bore mode. These are Bore Centerline and Block Clearance.

Bore Centerline

The first vertical stop is on the main bore centerline. This is the same as the vertical zero that is set when indicating the block main in the previous section

Block Clearance

The block clearance height is the height that the spindle will retract up to before moving to the next main bore location. This height should be set somewhere above the block where the 90-degree head will not interfere with the block during horizontal movements.

Programming Horizontal Stops

The Horizontal Zero was set .050” before the first Main Bore. The first Horizontal stop will be 00.000. Measure the distance between each main and enter it into the corresponding stop number.

Programming Bore Length

Measure the length of each Main Bore and enter that value into the corresponding length box.

Running the Auto Cycle

You will need to set a Feed Rate and Spindle RPM on this screen to run an auto cycle. After this is done press the “Move to Zeros” button. The spindle will move up the Vertical Block Clearance distance if it is not already there. It will then move to the Horizontal and In/Out axis to the zero position. The vertical will then move down to the zero position and stop.

CAUTION: If you press the MOVE buttons or the Cycle Start button the machine will not move the In/Out axis to the zero position. You need to move the In/Out axis to the zero position manually before you press Cycle Start the machine will go idle at this time. Pressing the “Start Auto Cycle” button will cause the entire cycle to run. After a program has been completed the machine will move the spindle over to the first Main Bore at the Clearance Distance.

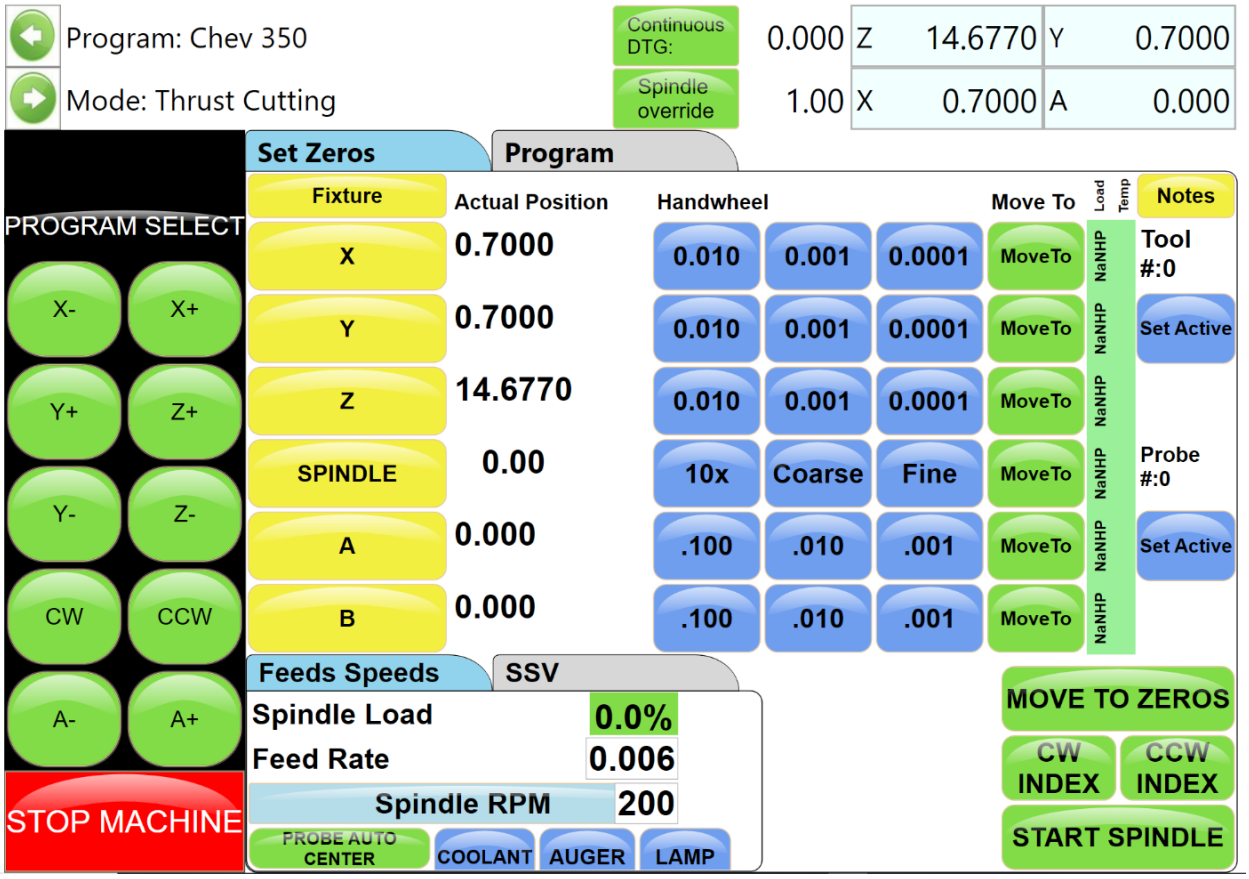
Thrust Cutting

Refer to Line Bore in this section for mounting the block and aligning the 90-degree head.

Note: It is important to read through the entire Thrust Bearing Cutting section before entering any values or starting the Auto Cycle. You will better understand how the program operates and how the values effect the operation of the Auto Cycle.

The Thrust Cutting program can cut a single or double thrust face using circular interpolation.

Select the Thrust Bearing Cutting button from the Main Menu. This will bring up the Thrust Bearing Cutting Bore Mode with the Set Zeros tab shown.



Setting Zeros

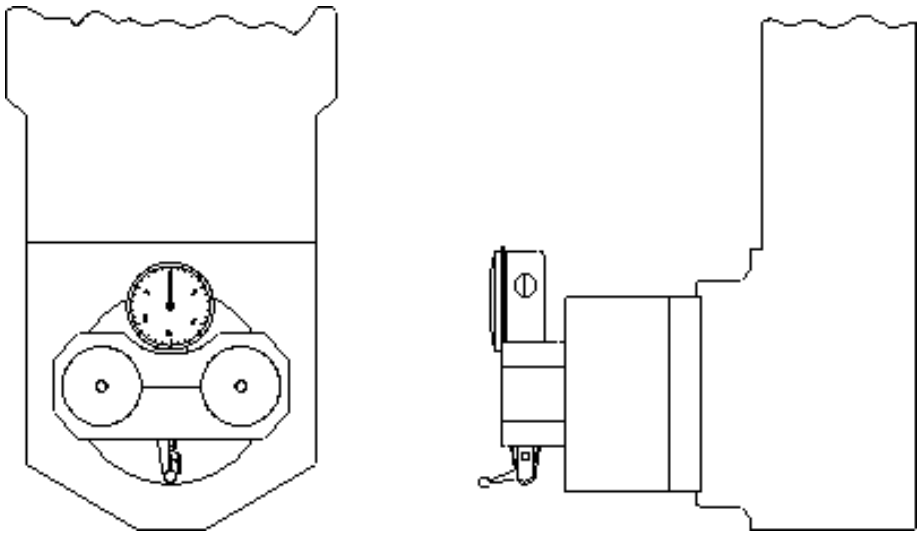
The purpose of setting zero points is to give the operator a specific point to build programs from. The machine also uses these zero points to run the program from. The zero points can be set at any point in the machines' travel. Each axis (except the Spindle rotation) will need to have a zero point set for the machine to operate from.

X-Axis (Horizontal Zero)

The Horizontal should be set with the cutter to be used just touching the thrust face. Use the handwheel increment buttons to jog the cutter into this locations and then double tap the X button to set the program zero.

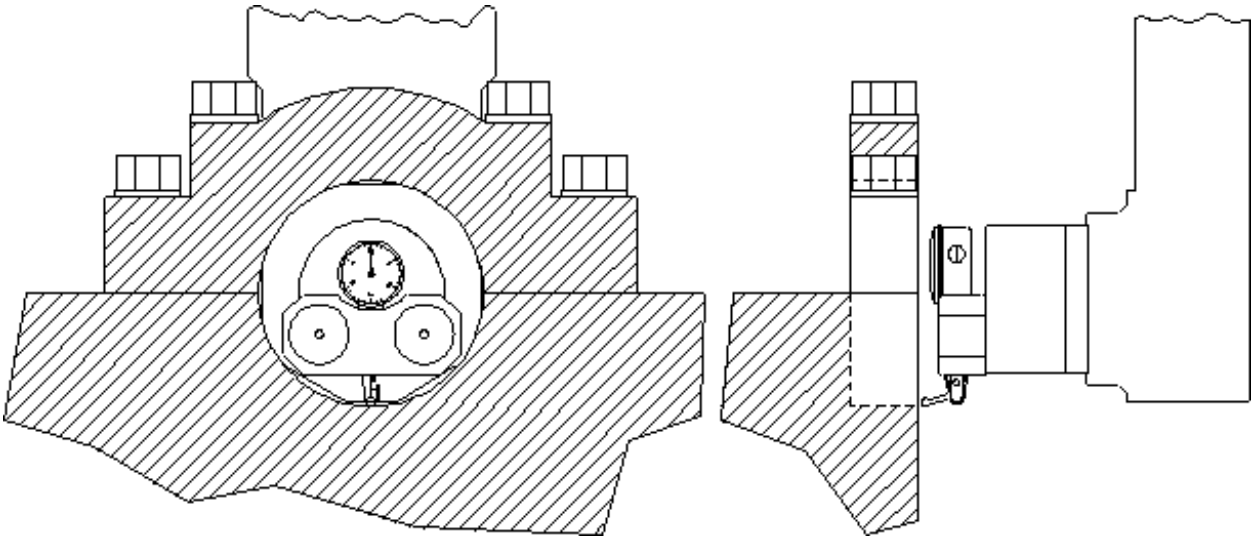
Y-axis (In/Out Zero)

Locate the supplied indicator and small magnetic base. Mount on cutterhead as shown below.



Using the X-axis handwheel increment option move the indicator inside the main bore, making sure the indicator is not touching the main bore at this point. You will be indicating both sides and the bottom of the saddle, generally the cap is not used while indicating the bore.

Physically move the indicator and mag base on the cutterhead until there is about .010” pressure on it. Start rotating the spindle CW and CCW watching he indicator. Move the machine in the Y-axis (In/Out) with the handwheel increment until the indicator readings are the same on both the sides and the saddle locations of the main. Once equal double tap the Y and Z buttons on the set zeros tab to set the zero locations for the program.



Dimensions & Auto Cycle

The program tab is where the critical dimensions are set for the thrust cutting process. Switch to this tab to enter the cutting dimensions and parameters.

Thrust Dimensions

Outside

This is the outside diameter of the thrust face to be machined.

Inside

This is the Inside diameter of the thrust face to be machined.

Cutter

This is the diameter of the cutting tool to be used.

Clearances

Z (Vertical)

This is the distance, from zero, the 90-degree head will have to travel up to clear the main caps on the block.

X (Horizontal)

This is the distance, from zero, the 90-degree head will have to travel to clear the main for the next vertical move.

Dimensions

Main Width

Width of the thrust face to be cut, this is the outside diameter minus the inside diameter.

Insert Width

This is the width of the cutting surface of the insert being used. This is used to calculate the step over required for interpolation.

Left Depth of Cut

This is the Inside diameter of the thrust face to be machined.

Right Depth of Cut

This is the diameter of the cutting tool to be used.

Cut Left Side

Cuts the left side thrust faces

Cut Right Side

Cuts the right side thrust faces

Cut Both Sides

Cuts both thrust faces.

Description and Running of the Auto Cycle

You will need to enter the Feed Rate and Spindle RPM the program will run at. There are no Move to buttons in this program. You **MUST** be at the zero positions when the Auto Cycle is started.

Start Auto Cycle

When you are at the corresponding zero positions press the Auto Cycle. The vertical feed will start at the programmed rate in an upward direction until the correct Outside diameter is reached. The circular interpolation will start at this point and go 360 degrees. It will then continue the circular interpolation back towards the center of the Main to clear the cutting tool from the thrust face. When the cutterhead is back at the center point (zero positions) of the Main, all motion will stop. The cutterhead will then rapid travel to the left taking the main width and the cutter diameter into account to reach the correct depth on the second thrust face. The same circular interpolation process will then be repeated for the second face. The cutterhead will then retract horizontally to the clearance distance then vertically to the block clearance distance.

When the program is running the “Start Auto Cycle” button will change to “Press to Pause”. If this button is pressed the machine will pause the program right where it is. At this point the screens are locked out from changing anything. The button will the change to “Press to Resume”. If you want to resume press the button and the program will continue from that point on. If you do not wish to continue press the “Stop” button. This will put the machine back in idle mode and changes can be made to the program.

Cam End Tunnel Boring

To bore the end tunnels on a Block refer to Block End Truing Fixture 650-3-30 when used with Cam Boring for setting up the block. Select a Cam bushing that will fit the existing Cam bore and place it in the Cam Spacer. Place the distributor end of the block facing up. You will need to be in the Bore Mode on the control panel. The Cam spacer placed in the center T-Slot should put the Cam tunnel in line with the Main bore.

Center the spindle over the Main bore using the electronic probe or magnetic base with indicator. Zero the X and Y axes.

Move the table the specified blue-print distance toward the Cam Tunnel. This distance should in the blue printing specifications for the block you are working with.

Check that you are on center of the cam bore with the electronic probe or indicator.

⚠ CAUTION ***Be very careful when correcting the existing Cam bore on the y-axis. This could cause the distributor gears to be damaged.***

Install the 650-2-3F cutterhead into the spindle.

Refer to the Bore Mode, programming Vertical Stops section earlier in this guide for guidance on setting up the vertical stops for this operation.

Note: It is important to bore the Cam End bores the full length of the cutterhead on both ends. If you do not you may have trouble getting the Cam Bar to bore the full length between Cam End Bores. Run the operation before proceeding.

Hint: It is helpful and more efficient to have three (3) tool holders set up for this procedure, two (2) of them for large material removal and one for a finish pass of .020” to .030”.

Note: To bore the oil groove in the Cam Bore, refer to the Cam Bore Oil Groove section in this chapter. This is a CNC operation.

Remove the block from the fixture, select a Cam bushing that will fit the bore that was made on the distributor end of the block.

Rotate the block so that the distributor end is now facing down. Tighten the block into the fixture. The Cam spacer will put the end bores in line.

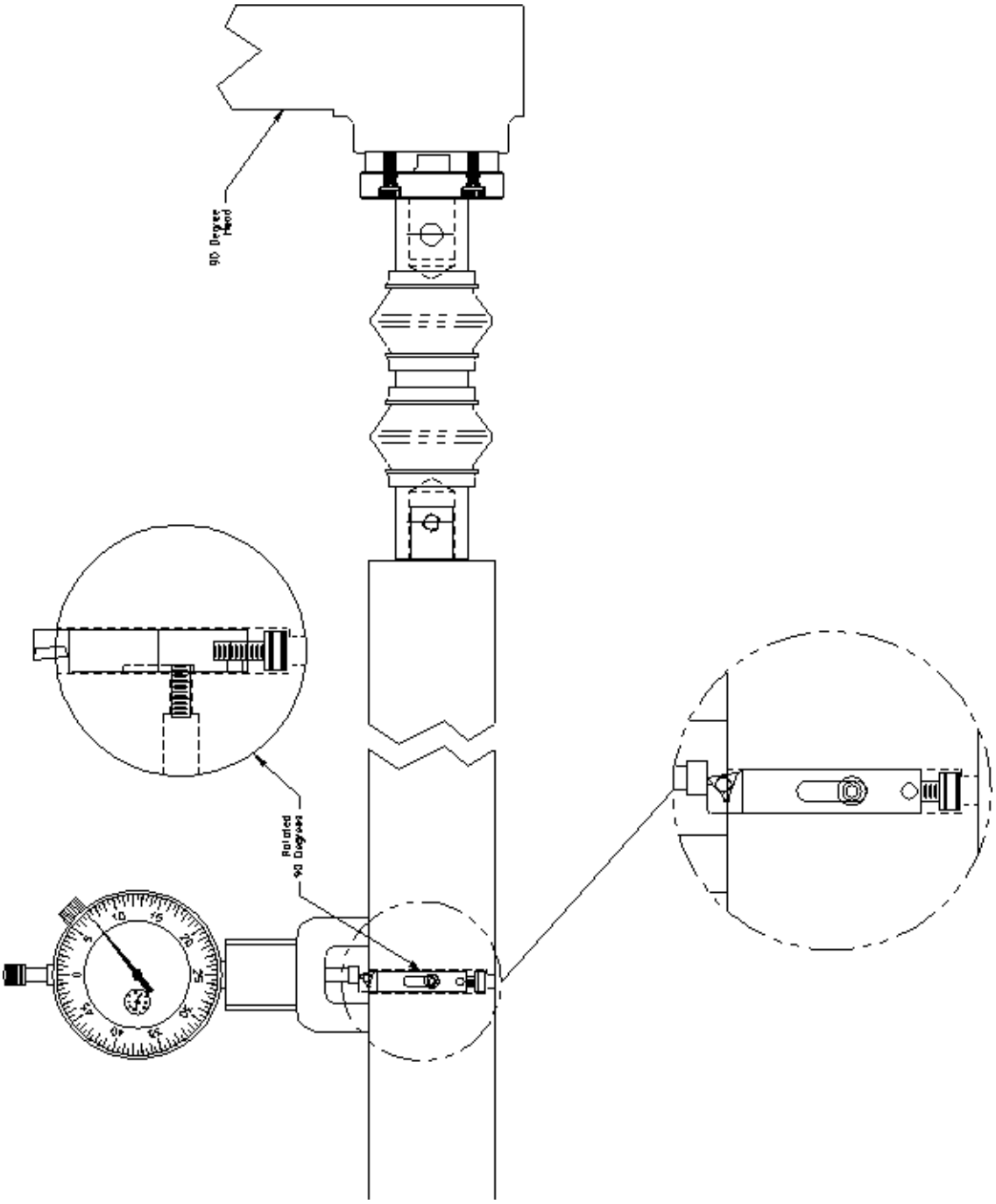
Press the move to zeros button.

Repeat the above process on this end of the block to finish boring the Cam End Bores.

Cam Tunnel Boring

To bore the center of the Cam tunnel, refer to Cam Tunnel Boring in the Block Mounting section of this chapter. Mount the block as shown.

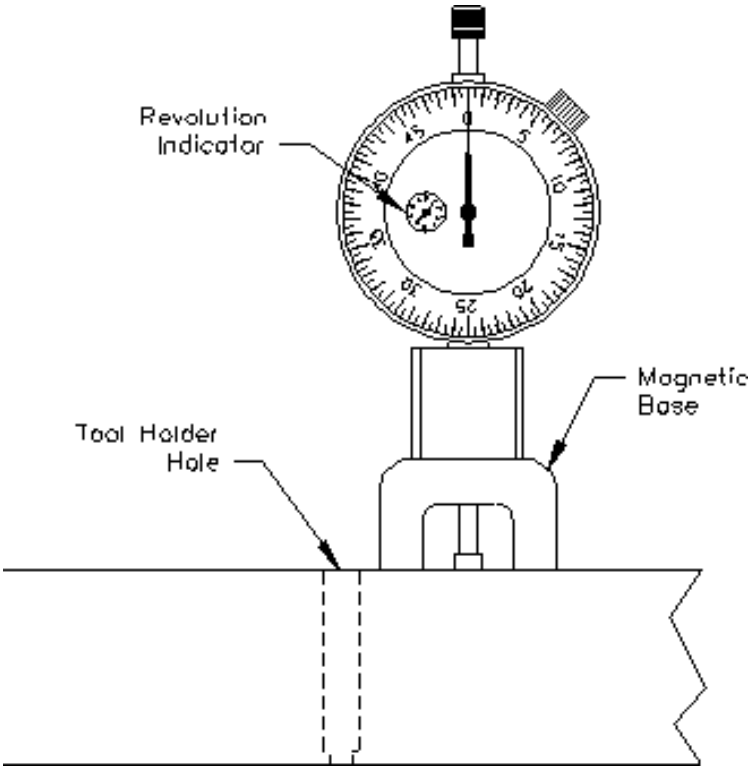
The following illustration shows the cutting tool and holder and how they are set inside the Cam Boring Bar.



Zeroing the Micrometer

Remove the magnet keepers from the bottom of the indicators magnetic base. These should be put back on when the magnet is not in use to keep the magnet strong.

Place the magnet on the smooth portion of the bar next to the tool holder hole. Set the zero on the indicators dial, noting the number of revolutions the dial has made.



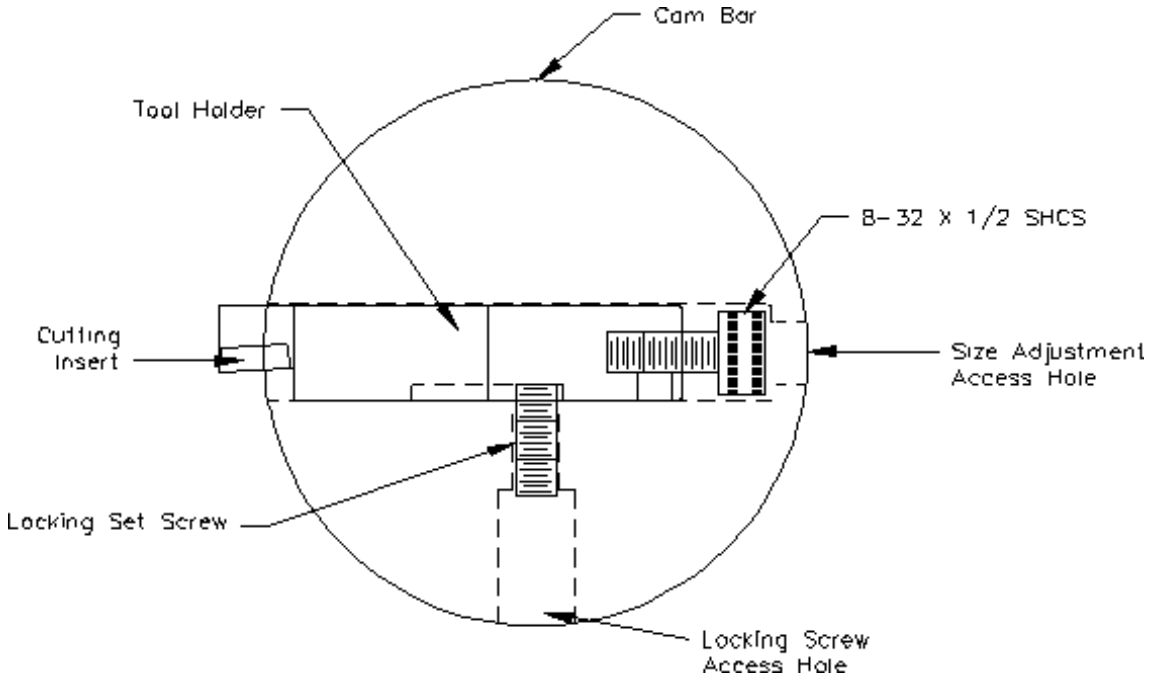
Setting Cutting Size

The diameter of the Cam Bar 650-2-32D is 1.7500". The 8-32 X ½" socket head cap screw on the back of tool holder is used to adjust size. When the tool holder is inserted into the Cam Bar the cap screw goes against a ledge inside the Cam Bar. When the cap screw is turned in the size will get smaller. When the cap screw is turned out the size will get bigger.

⚠ CAUTION ***When adjusting the size on the tool holder, you must remember that the amount that will be taken off the diameter will be twice the reading on the dial indicator.***

When the dial indicator reads zero the bar will cut 1.7500". Double the amount past zero on the dial indicator and add that to 1.7500" to determine the cut diameter.

Once the size has been set, lock the set screw in the Cam Bar to secure the tool.



Refer to the Line boring section of this chapter for mounting and alignment of the 90 degree head.

Select Line Bore Mode of operation.

Mount the dual flex coupling to the 90 degree head with the two (2) supplied socket head cap screws. Install one Cam Bearing Locator into the left side of the block.

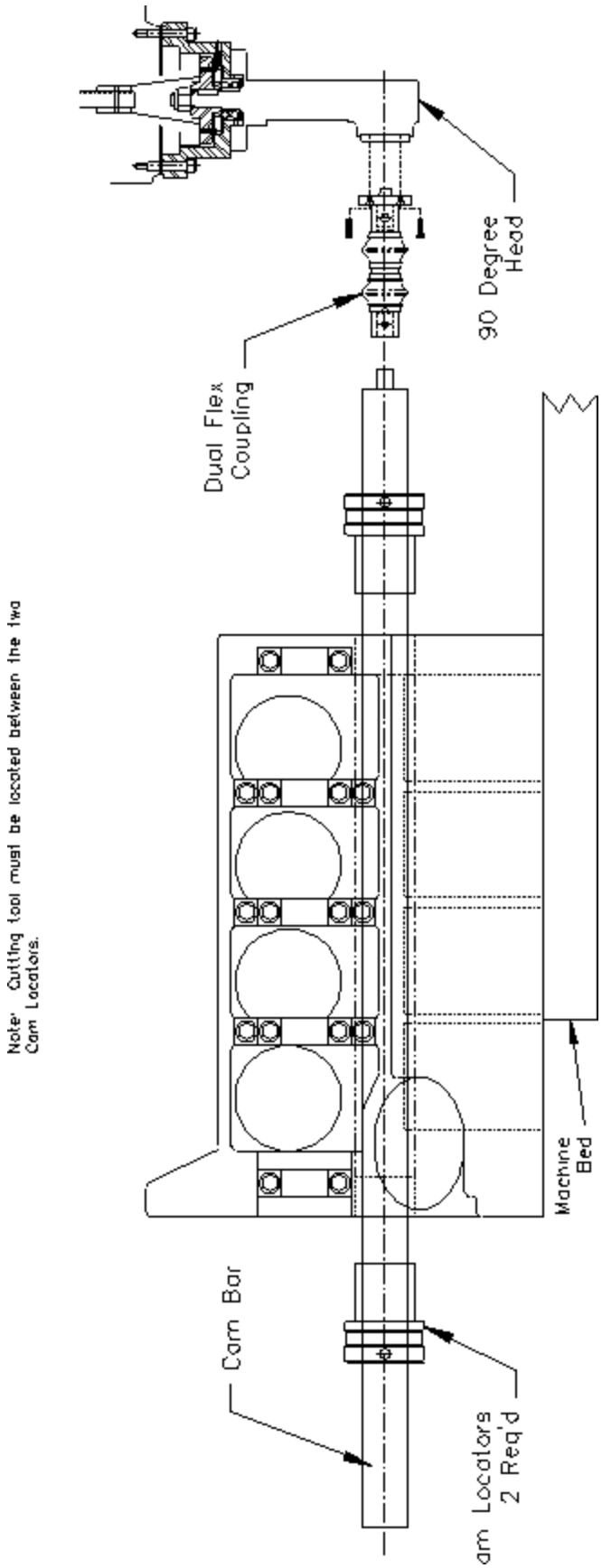
Slide the Cam Bar into the Cam Tunnel and then into the right side locator. Keep the end of the Cam Bar with the adapter on it to the right.

Slide the second locator onto the Cam Bar, then the locator into the Cam Bore. The cutting tool needs to be between the two (2) locators.

Bring the 90 degree head down and line up the end of the dual flex coupling with the adapter on the Cam Bar. This does not have to be a precise line up, the dual flex coupling will take care of any alignment variance. Tighten the socket head cap screw on the dual flex coupling on to the adapter on the Cam Bar.

Press the Vertical, Horizontal and In/Out zero buttons.

Final set up should look line the drawing on the following page. The mounting components are not shown on this drawing. Refer to the block mounting section of this chapter.


90 Degree Head
Dual Flex Coupling
Machine Bed
Cam Bar
am Locators 2 Req'd
Note: Cutting tool must be located between the two Cam Locators.

Setting Vertical Stops

Make sure the machine is at the zero positions as described previously.

When using the Line Bore Mode to do the Cam Tunnel boring the vertical stops described here will never change. They must be used to run the cycle without damaging parts.

Block Clearance: -.001

Block Center Line: 00.000

Setting Horizontal Stops

All of the Horizontal stops are to remain at 00.000 when using the Line Bore Mode to do Cam Tunnel boring. The only setting that gets changed on this screen is the Bore Length for Horizontal stop 1. This will be the distance between the two (2) end Cam bores that needs to be bored out.

Auto Cycle

You **DO NOT USE** the Auto Cycle when Cam Tunnel boring. The only items that get used on this screen are the Feed Rate and Spindle RPM.

Recommended feeds and speeds will be discussed later in this chapter.

Manual Bore

This screen is used to bore the Cam Tunnel. With the Horizontal and the In/Out axis at the zero position and the Vertical at or above the Block Clearance Height, Press the BORE1 button.

The spindle will do a rapid move down to the Block Center Line position (this is only .001 so will not notice the move). The spindle and Horizontal feed will start at the programmed speed. The machine will continue boring horizontally until the horizontal position set in the Bore Length is reached. The Vertical will retract .001 and the horizontal will retract back to the zero position.

Recommended Boring Procedure

The three (3) tool holders included in this package should be used as dedicated holders. Two of them set for roughing passes and the third set for a final finish pass.

It is recommended to set the first two tool holders for a .100” pass each, then set the third tool for the finish size.

Size is not critical on the first two passes, these tools can be set and not adjusted for each use. The third tool should be checked with the dial indicator for final size each time you use it.

Recommended Feed Rate: .001 - .003

Recommended Spindle RPM: 300 – 500

IMPORTANT: You should put a light coating of light weight oil on the Cam Bar to prevent it from seizing up as it goes through the Cam Locators. At higher spindle speeds the bar heats up more.

Circular Interpolation Tool Paths

Circular Interpolation is a common tool path that refers to using a tool smaller in diameter than the desired bore size and programming the machine to move in a circular move to mill the bore to the desired final diameter. Common applications include circular pockets, counter bores or semi-circular profiles such as internal or external radii or fillets. Both the RPATH and Rottler Block software's feature operations which can perform these various circular interpolation movements. The 2 main options for circular interpolation are as follows: Pocket, and Circular Move. Each of these are discussed in more detail below. For this lesson, the Rottler Block Software will be used in the sample images.

Objectives of this lesson:

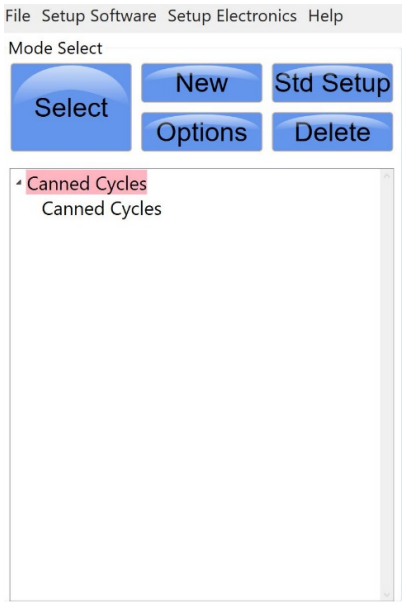
- Learn how to setup and program the 2 options for circular interpolation operations and the benefits for each method
    - Canned Cycle – Pocket
    - Canned Cycle – Circular Move

*Note: All feeds, speeds, depth of cuts, and tool paths are for demonstration purposes only. The operator can change these to suit the machining philosophy of the shop and the tooling available. *

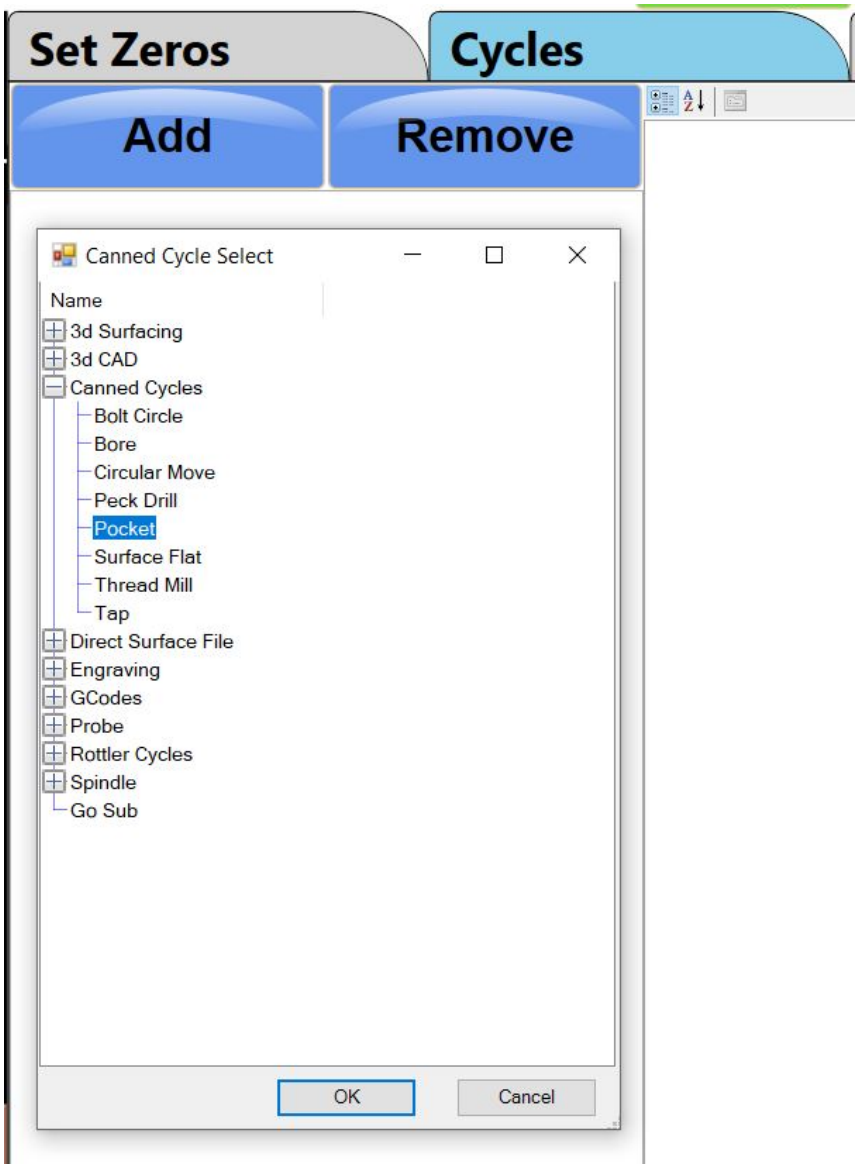
Canned Cycle – POCKET

The Pocket operation is a standard operation which can be used to remove material in a rectangular or circular recessed area such as a counter bore. This is typically used when the center of the area to be machined requires a significant amount of material removal.

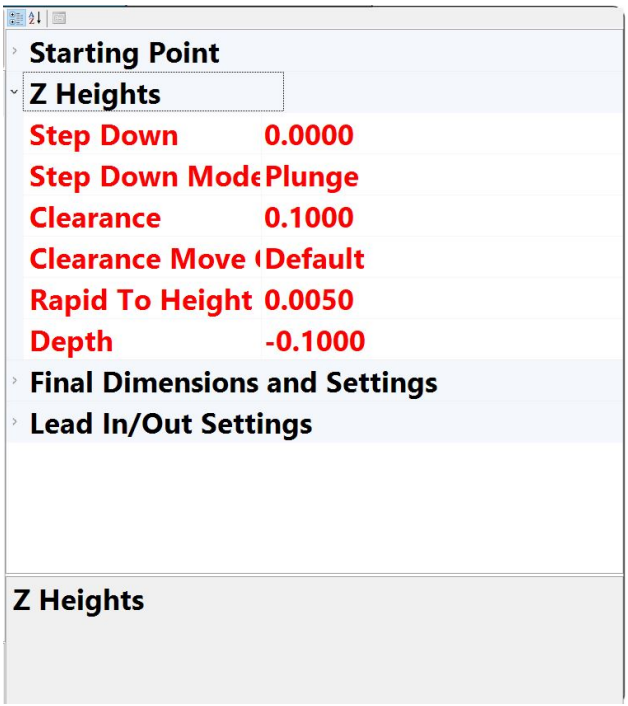
To add a canned cycle operation in the block software, select the program you wish to work form in the program selection area and then press NEW in the Mode Select area from the main screen. A pop-up window will appear, find and select canned cycle to create the mode in the block file.



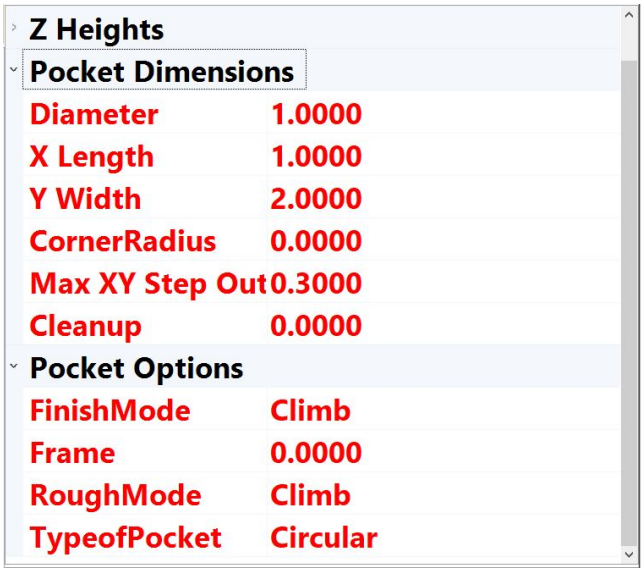
Once created click on the Canned Cycles label to open the programming interface. Select the Cycles tab and you should see add and remove buttons on the left of the screen. From here select the add button and a window will appear where you can select the canned cycles drop down option which will allow you to select POCKET.



Press okay to confirm the selection. The pocket cycle will be added to the list and the properties for the pocket operation will appear in the right column of the screen in red text. These properties can be used to edit the type, size, and location for the pocket operation.



The Z Heights refer to the depth of the pocket and control where the cutter will start cutting as well as how much material to be removed per pass in the z-axis. You may also change the step-down mode from plunge to ramp. Typically for pockets ramp is preferred.

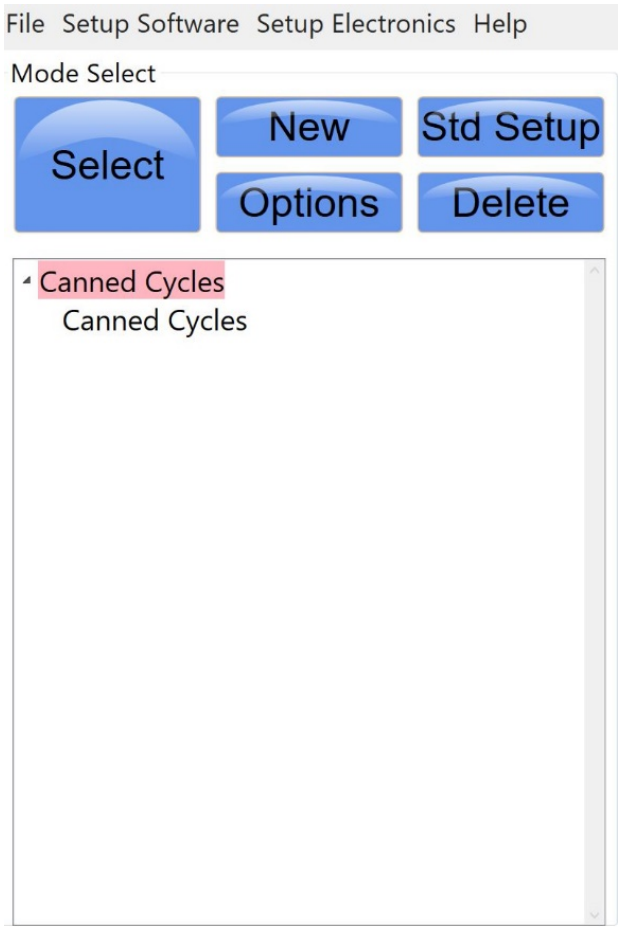


The pocket dimensions and Pocket options are used to edit the dimensions of the pocket as well as the type. For circular interpolation change the Type of Pocket to Circular this will then use the Diameter setting for the pocket dimension. You may also change the max step out which controls the amount of material to be removed per pass radially. The cleanup option can be used to create a finish pass of a smaller amount than the standard step out.

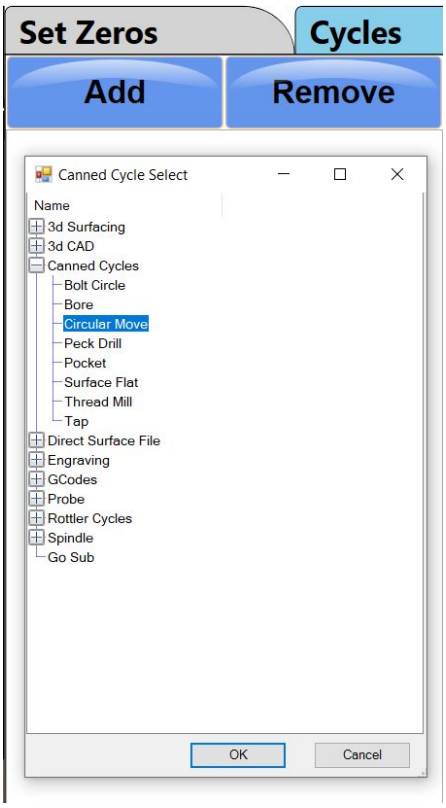
Canned Cycle – CIRCULAR MOVE

Circular move is a fixed diameter move that can be used to profile the ID or OD of a circular object. Circular move may also be used for creating a circular grove of a specific width. This is typically used to contour a single profile and clean up a surface or to create an o-ring groove.

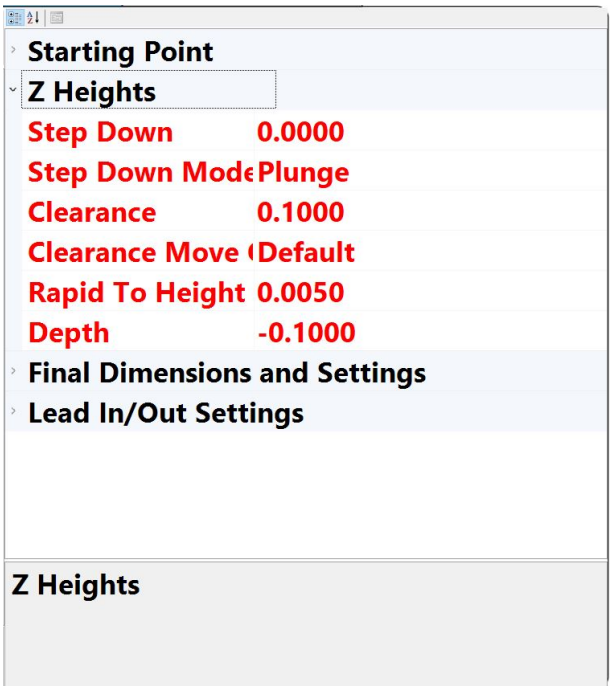
To add a canned cycle operation in the block software, select the program you wish to work form in the program selection area and then press NEW in the Mode Select area from the main screen. A pop-up window will appear, find and select canned cycle to create the mode in the block file.



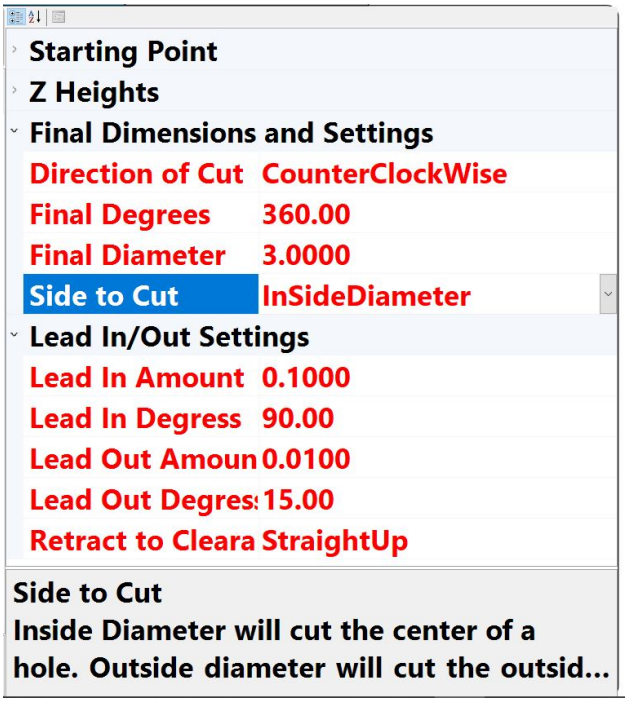
Once created click on the Canned Cycles label to open the programming interface. Select the Cycles tab and you should see add and remove buttons on the left of the screen. From here select the add button and a window will appear where you can select the canned cycles drop down option which will allow you to select CIRCULAR MOVE.



Press okay to confirm the selection. The circular move cycle will be added to the list and the properties for the circular move operation will appear in the right column of the screen in red text. These properties can be used to edit the type, size, and location for the circular move operation.



The Z Heights refer to the depth of the circular move and control where the cutter will start cutting as well as how much material to be removed per pass in the z-axis. You may also change the step-down mode from plunge to ramp. Typically for circular move plunge is preferred.

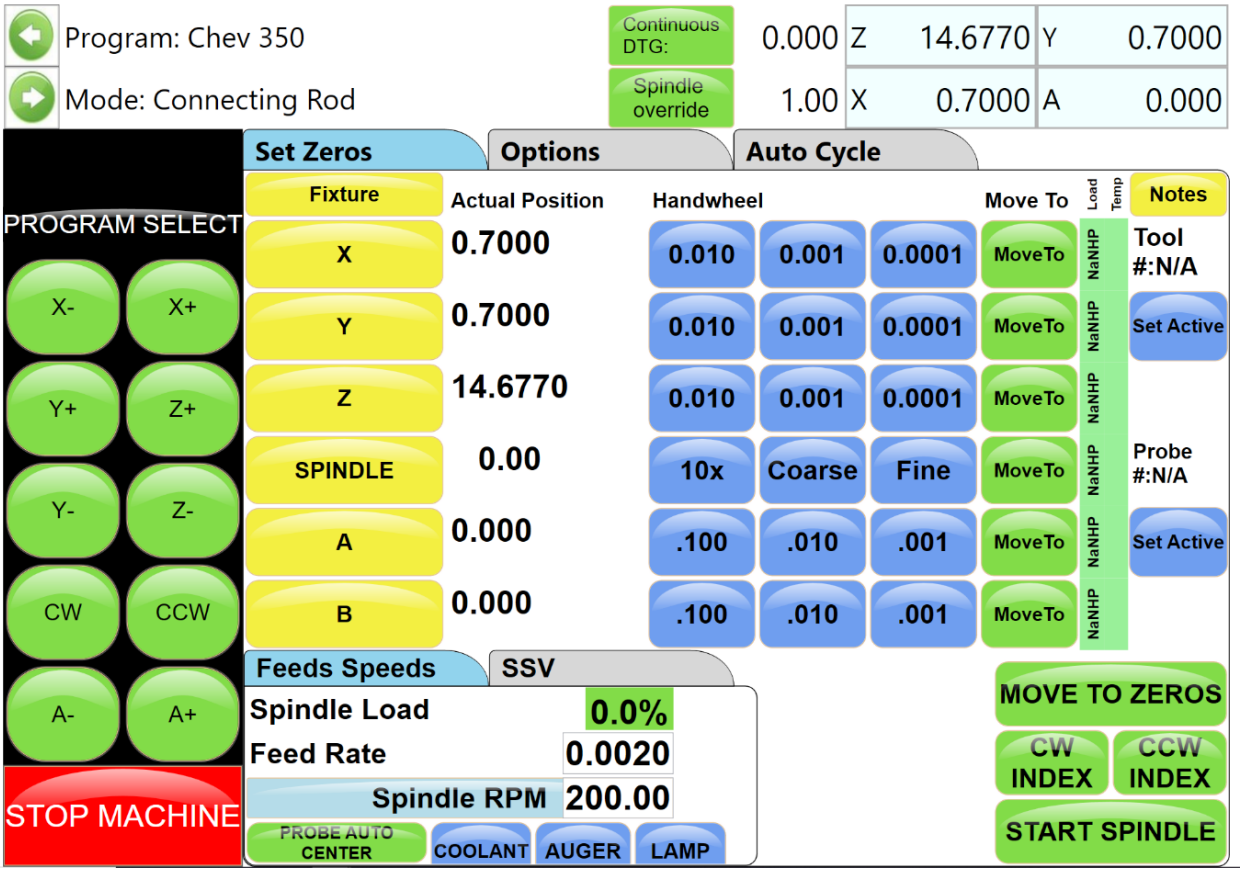


The Final dimensions and Settings are used to edit the dimensions of the operation as well as the type. For a full circle the final degrees will default to 360, this can be modified if less is to be cut. The side to cut may also be changed to inside diameter, outside diameter, or no tool comp for grooving operations. The program will automatically account for the tool diameter so the final diameter should be set to the intended final dimension. Lead In/Out settings control the approach and exit of the cutter and can be modified should clearance be an issue.

Connecting Rod Boring

Main Screen

Select the Connecting Rod operation from within the mode select tab. This will add the operation and you may then open the connecting rod operation to bring up the standard set zeros page.



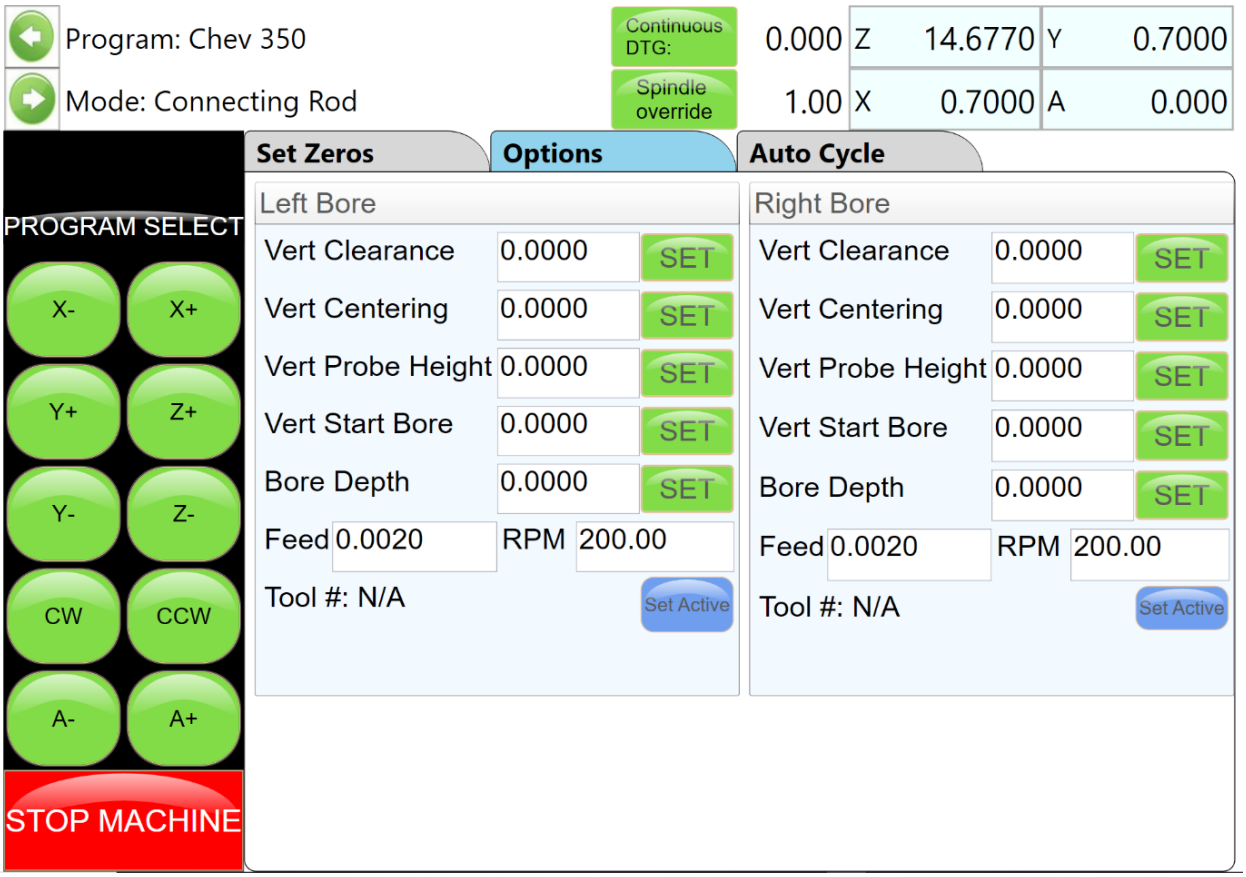
Setting Zeros

Using a dial indicator or the touch probe, find the center of the connecting rod large bore, typically this is done only on the connecting rod body side and not the cap side. Double tap the X and Y buttons to set the program zeros once the center is found.

Setting Vertical Zero

Using the electronic probe with the depth probing routine or the tool to be used. Touch off the top surface of the large bore on the connecting rod. Double tap the Z button to set the program vertical zero.

Program Options



This screen is used to input all the parameters for boring both the big and small end of the rod plus setting positions for centering and measuring.

Vert Clearance: This is the vertical height of the cutterhead with reference to vertical zero to where the cutterhead will move before any horizontal movements take place.

Vert Centering: This is the vertical height of the cutterhead with reference to vertical zero to where the cutterhead will move to allow the operator to center the machine with a dial indicator.

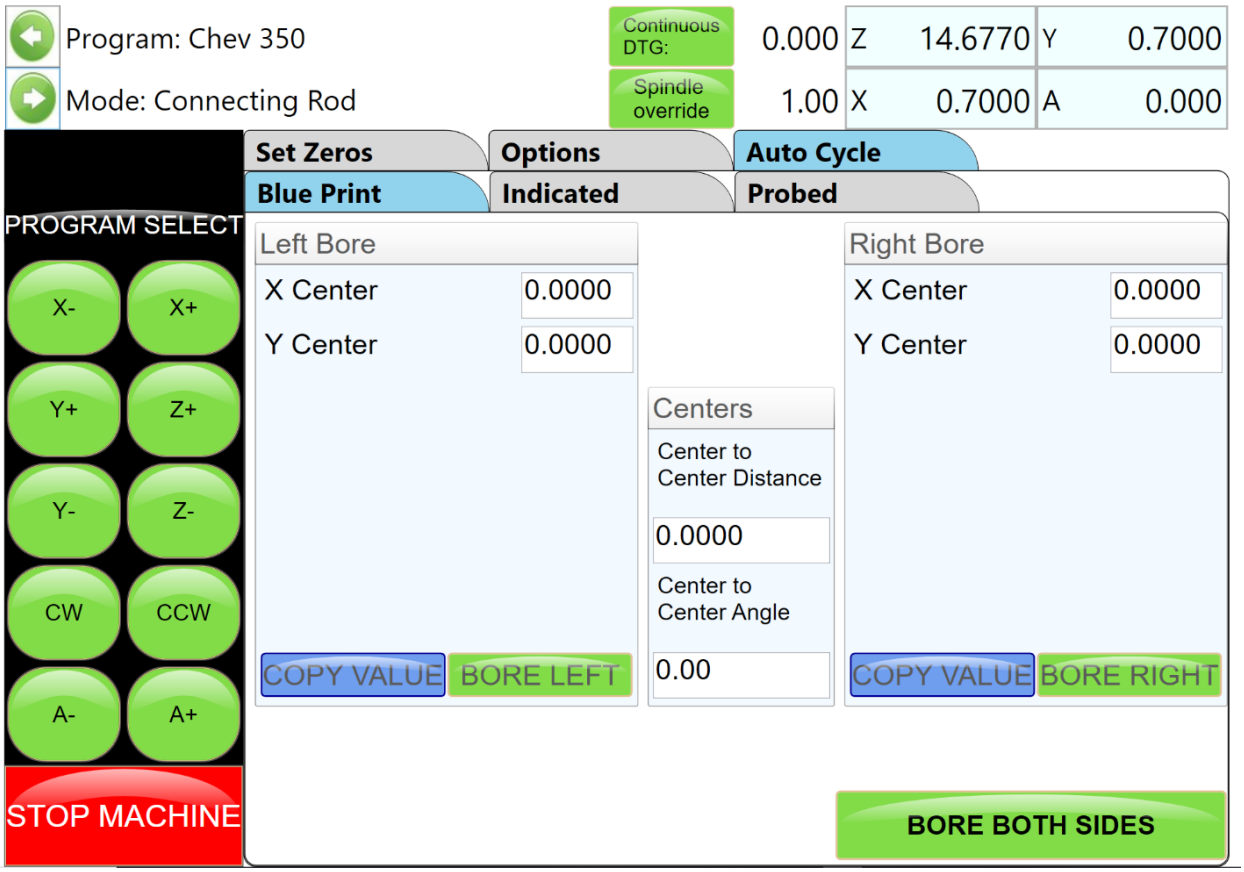
Vert Probe Height: This is the vertical height that the machine will move to before probing the bore to re-center the machine using the three-point probe routine.

Vert Start Bore: This is the vertical height of the cutterhead with reference to vertical zero to where the cutterhead will move to start boring the conrod. This is set about .040” (1mm) above the side of the connecting rod bore

Bore Depth: This is the vertical height of the cutterhead with reference to vertical zero to where the cutterhead will stop boring, index the boring tool and retract back to the clearance position after it’s finished cutting.

Tool #: Click the Tool word to bring up the tool select form and define the tool to be used for the individual bores.

Auto Cycle

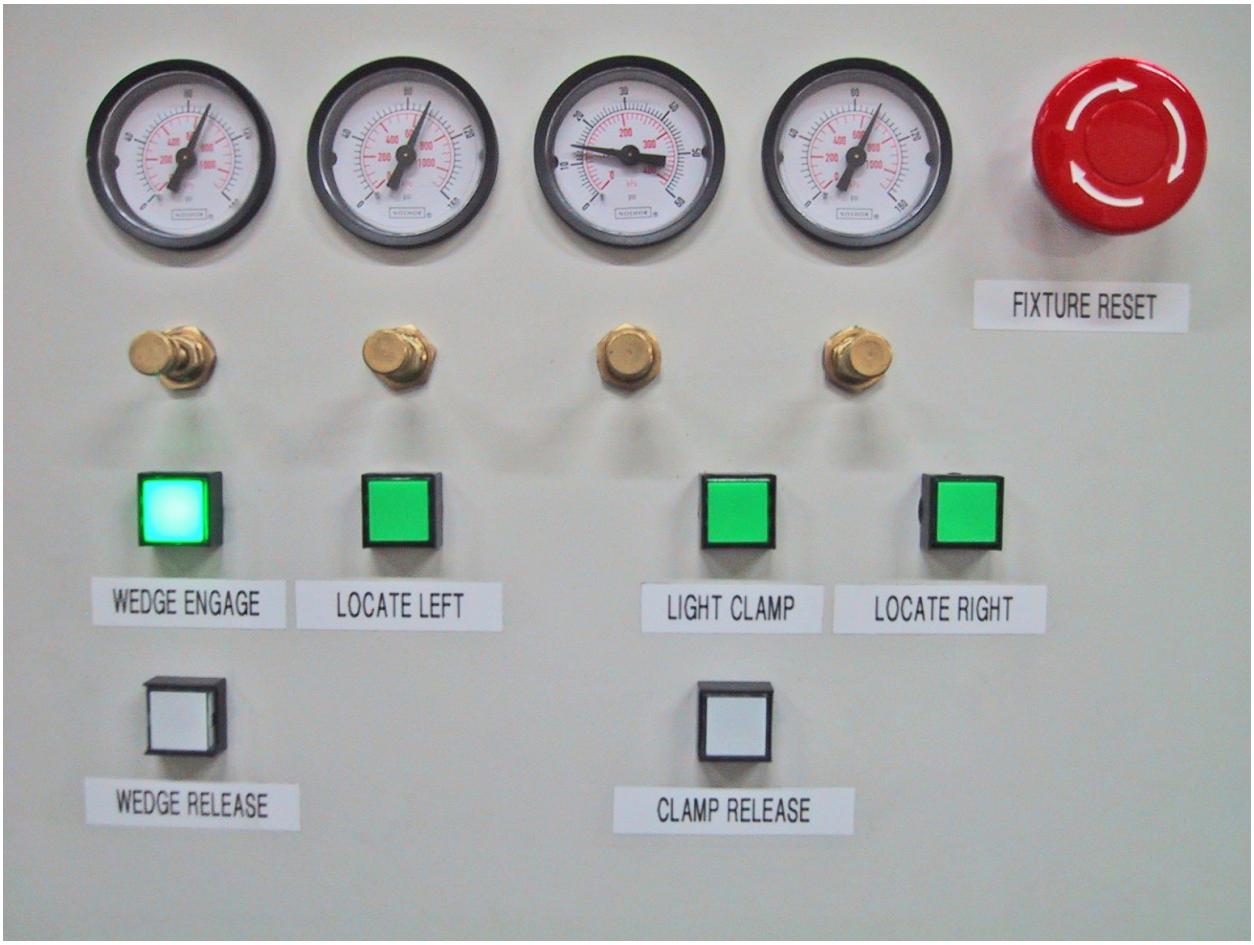


This screen is used to the connecting rod program. From the Auto Cycle tab the operator can use the Blueprint, Indicated or Probed tabs to machine using the respective methods as described in the 3 Axis Block Boring section.

Bore Both: If special cutterheads with big and small end tooling in one are being used, the block can be checked so that the machine will bore both big and small end in one cycle. Normally the big and small ends are bored with different cutterheads and this block will be unchecked.

Note: Do not stop an automatic cycle in mid cycle and then try to start it again. The CNC code running behind the Rottler screens use offsets in the controller. If the machine is stopped during an automatic cycle the machine must be shut down and restarted to clear the offsets. Otherwise the displayed position and actual position of the machine will not be correct.

Fixture Control Panel



Set Up Procedure For Conrod Fixture

Select the widest big and small end ball locators that will fit inside the conrod big and small end bores.

Press Locate Right and the right hand ball locator will move up and stop against it's end stop, then remove the air pressure supply to the conrod fixture so that the ball locator pivot arms may be moved manually.

Fit the selected ball locators to the right and left hand mounting positions. Be sure there are no chips and that the locators fix exactly in their mounting positions. Connect the air pressure to the fixture.

Press Locate Right Button, the right hand ball locator will move up and stop against it's end stop. Select the correct conrod support and place across the conrod fixture.

Place the conrod to be bored into the fixture so that the big end bore touches both the balls of the right hand ball locators.

Adjust the conrod rest so that the rod lies approximately horizontal.

Adjust the 3 big end support pads so that each support pad locates on the side of the big end and does not protrude into the big end bore. This will require removing and refitting the conrod to be sure the 3 support pads are correctly located and their hold down cap screws are tight.

Readjust the conrod support to allow the conrod to lie horizontal with no rock or tilt of the conrod on the 3 big end support pads.

Remove the conrod from the fixture.

Press locate left and the left hand small end ball locating device will lift up.

When the left hand ball locating device is at it's end of travel, place the conrod back in the fixture and adjust the left hand slide assembly so that both the left hand locating balls contact the bore inside the conrod small end.

Remove the conrod from the fixture.

Slide the left hand locating assembly approx 1/2" (12.7mm) to the right and lock both hold down handles securely, this will ensure that the small end ball locators contact the small end with some preload. Place the conrod in the fixture.

Position the clamp arms so that their feet are approx 1/8" (3mm) above the side of the big end, be sure that hey do nor protrude into the big end bore to be machined and adjust their travel limit stops and lock the lock nuts.

Press the Light Clamp button, this will places light clamping pressure on the clamp arms and lightly hold the conrod down against the 3 support pads under the big end of the conrod.

Press the Locate Left button, the small end ball locator will move up and contact the bore of the small end of the conrod and firmly press it against the big end and straighten the conrod along the center of the fixture.

Select a set of wedges that will allow the outside of the small end of the conrod to be supported during boring so that there is no chatter or vibration during boring.

Press Wedge Engage button, the wedges will be pressed against the outside of the small end.

The conrod is now ready to be bored.

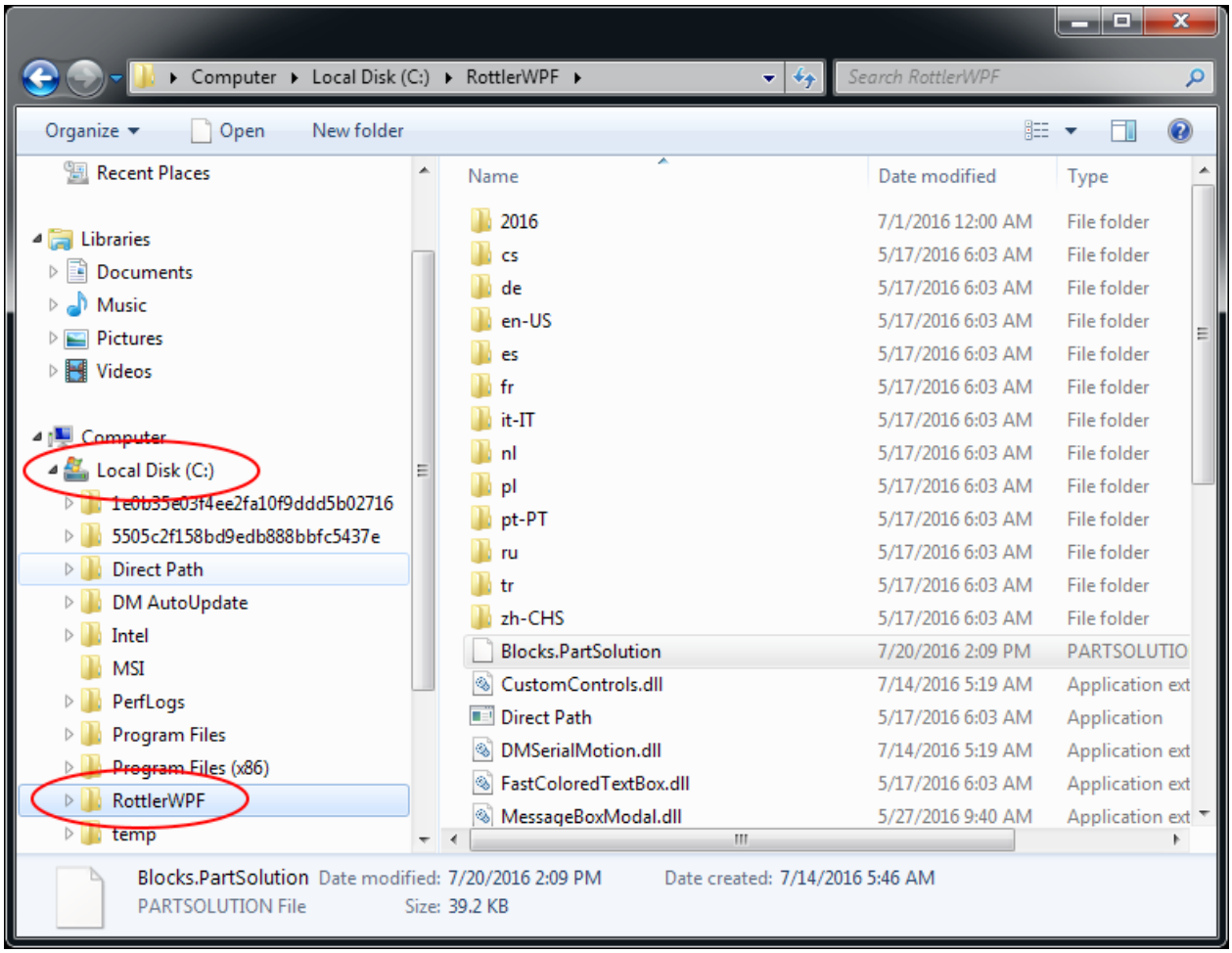
Air Pressure Settings

Right Hand Side Air Gage:	Locate Right	100psi (6.5Bar)
Second from Right Hand Side:	Light Clamp	15psi (1.0Bar)
Second from Left Hand Side:	Locate Left	30psi (2.0Bar)
Left Hand Side Air Gage:	Wedge Engage	30psi (2.0Bar)

Backing Up and Restoring Block Profiles

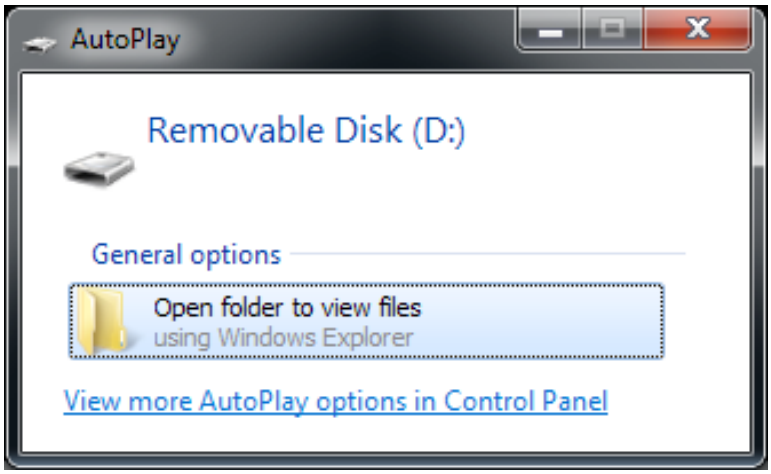
This section will explain how to back up and restore the operator created block profiles for DM controlled machines for archival purposes or to transfer to a different machine.

First step is to open your file bowser and locate the RottlerWPF file on the C disk drive.

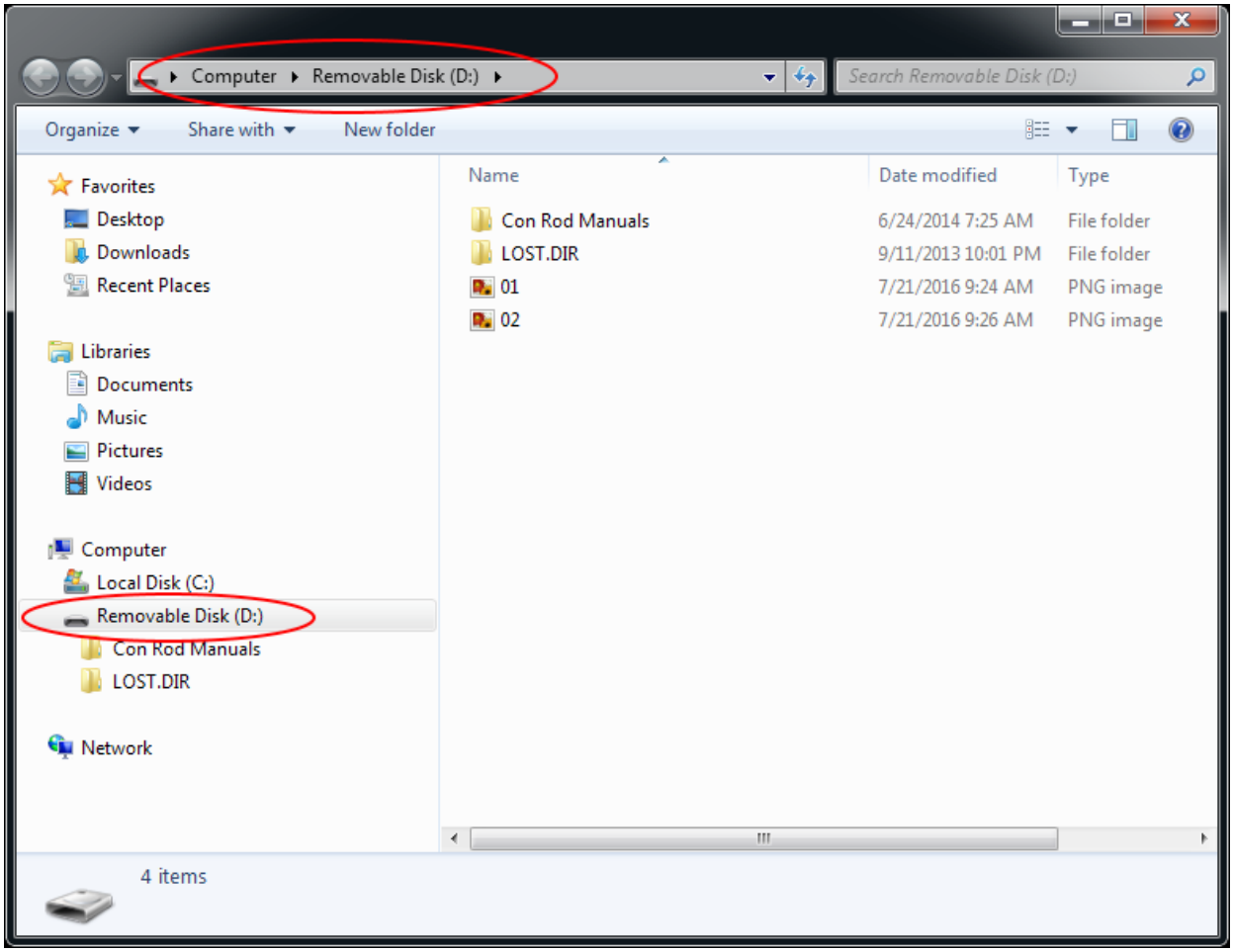


The next step is to plug in a flash drive to an open USB port

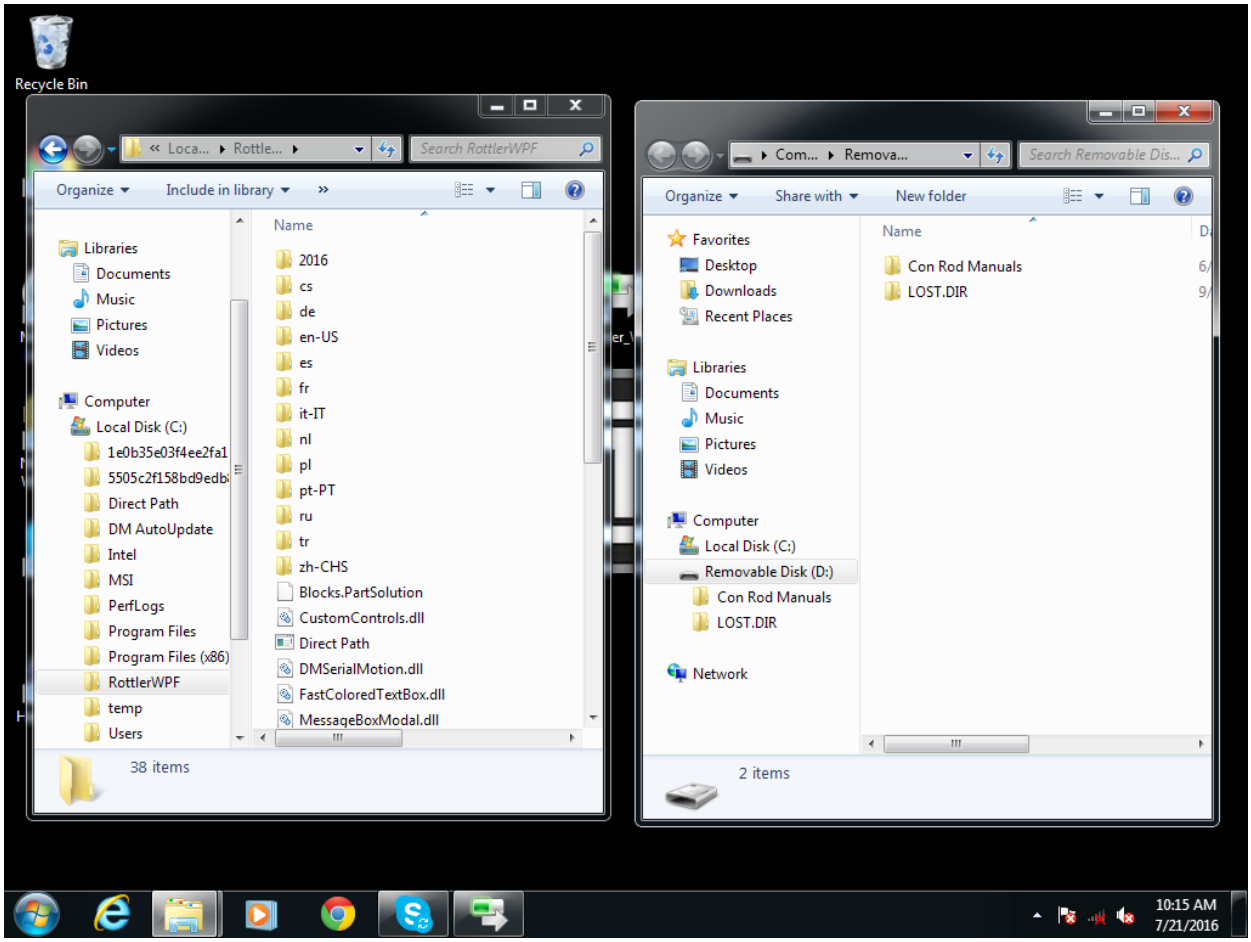
The following pop up box will appear on your screen.



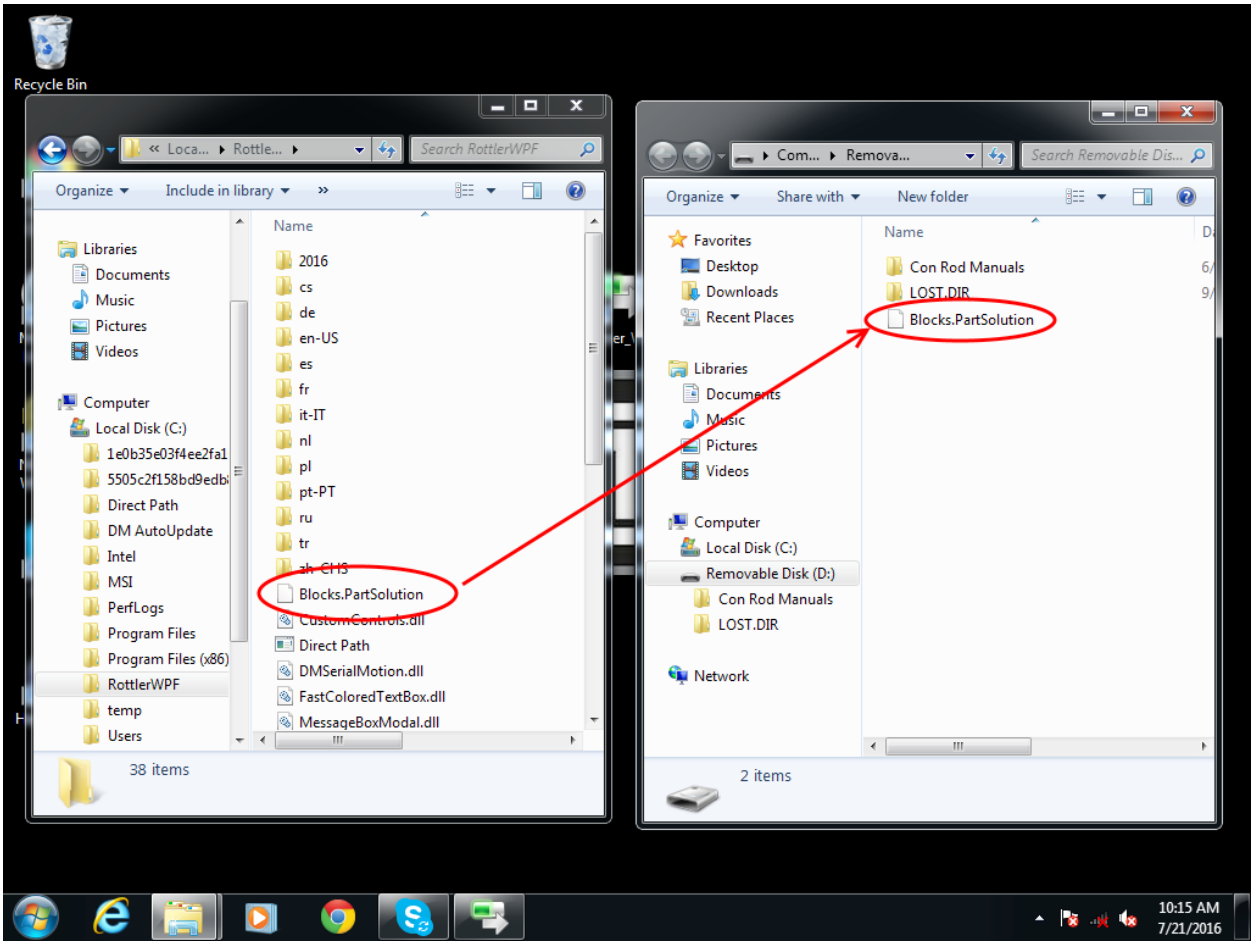
Click on the Open folder to view files option and the following screen will appear. This is the contents of the flash drive you just plugged in.



Next resize and arrange both file browsers so that they are side by side.



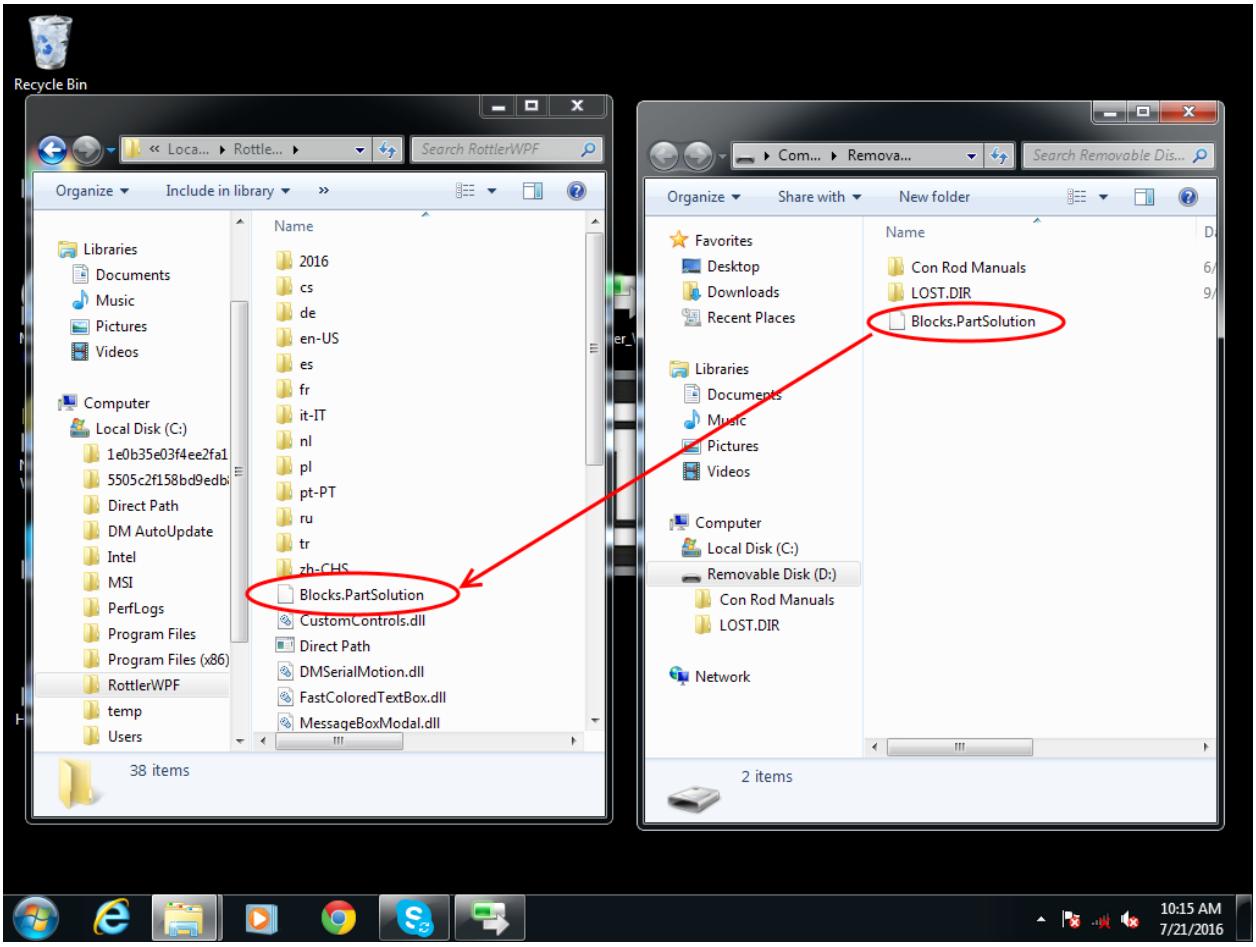
Block profiles are backed up each time the machine is run with the current profiles being shown in the RottlerWPF folder. All that needs to be done to back up the current profile is to simply drag it from the RottlerWPF folder to the flash drive folder. A copy of the file will be placed on the flash drive.



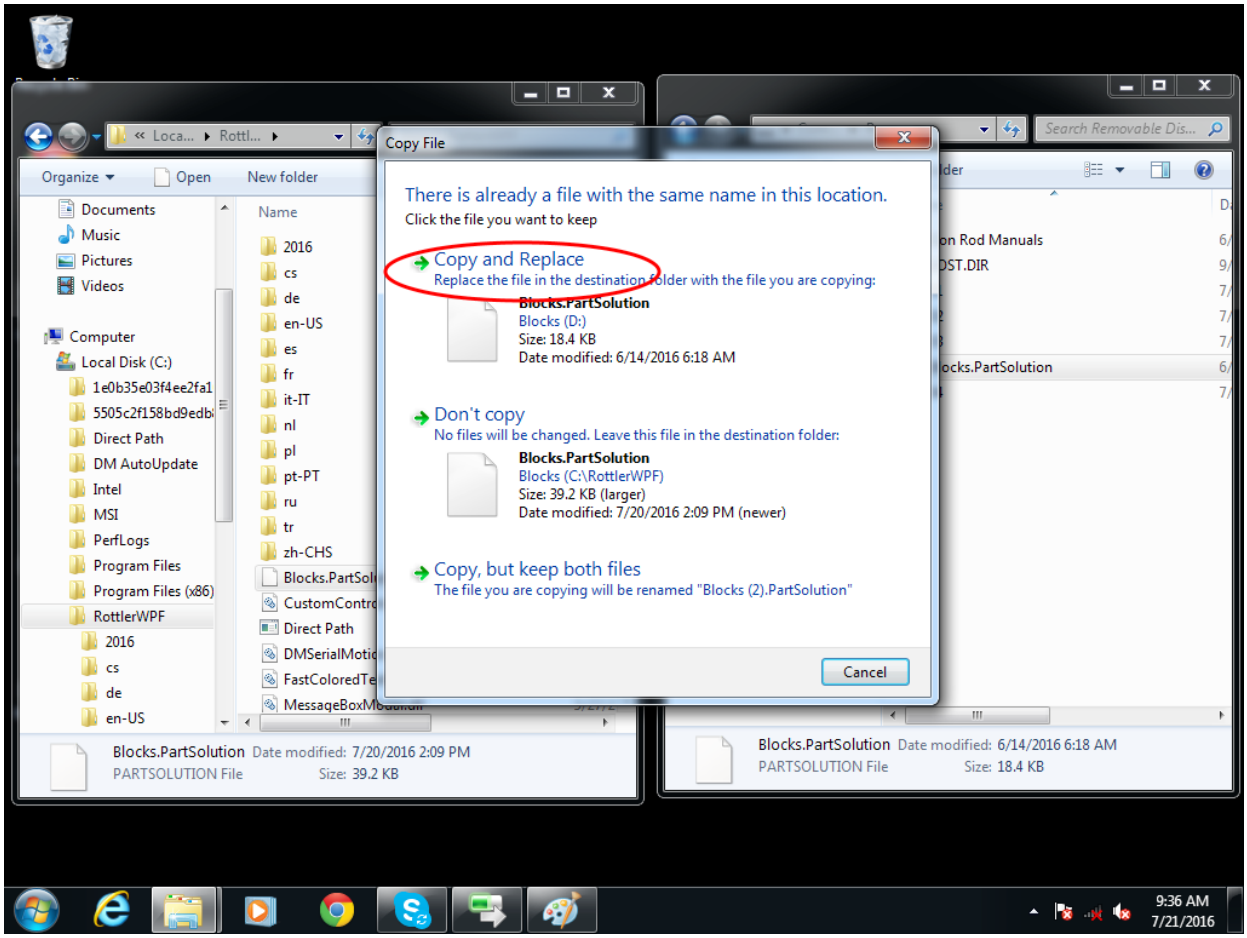
Backup is now complete. Close both file browser windows and remove the flash drive.

To restore or add block profiles go through the first 5 steps explained previously.

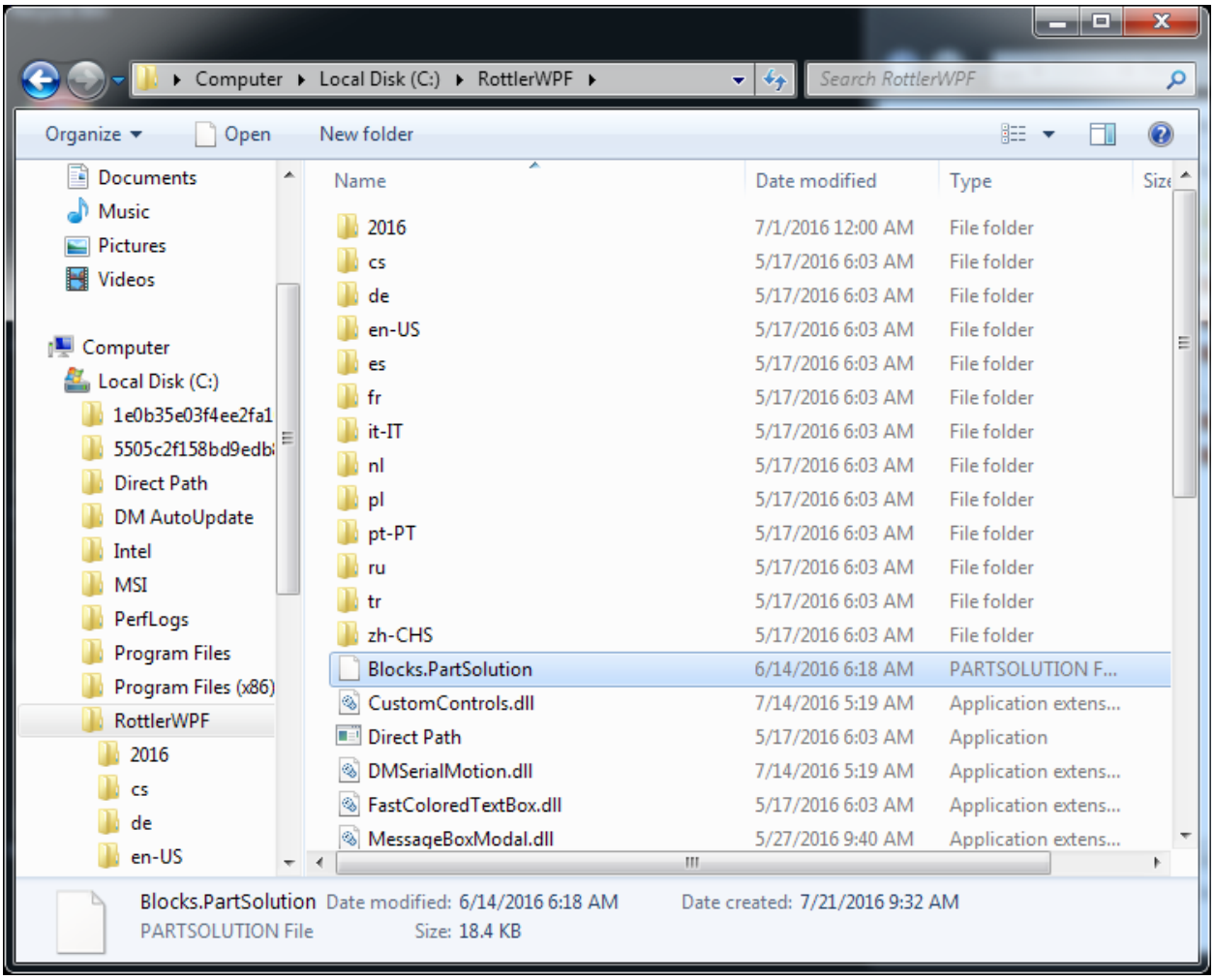
Highlight the block profiles file in the flash drive and drag it into the RottlerWPF folder on the local hard drive.



You will get a pop up window about there being a file of the same name in the destination folder. Click on the Copy and Replace option.



The archived block profiles will now be installed.



Close both browser windows and remove the flash drive. The restore process is now complete.

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MAINTENANCE

Contents

Quick Reference Lubrication Chart: EM103/4/5

Refer to the maintenance section in the manual for lubrication location points and instruction.

Assembly	Frequency	Lube Operation	Recommended Lubricant	Date Serviced
Outer Spindle	8 Hours 1000 Hours	Wipe with oil Soak felt wiper with oil	ISO VG 68 Way Oil	
Oil Reservoir System	8 Hours 175 Hours	Check upper oil lines are full Fill reservoir with oil if needed	ISO VG 68 Way Oil	
Upper Vertical Ballscrew Pillow Block Bearing	175 Hours	Grease	NLGI 2 White Lithium Grease	
Lower Vertical Ballscrew Bearing Pack	175 Hours	Grease	NLGI 2 White Lithium Grease	
Rear Y Axis Bearing Housing Grease Fitting	175 Hours	Grease	NLGI 2 White Lithium Grease	
Column Feed Gear Housing	1000 Hours	Fill with oil	GL-5 or MT-1 80W-90 Gear Oil	
X-Axis Rail Trucks	175 Hours	Grease	Showa Shell Alvania S2 or equivalent	

Quick Reference Preventative Maintenance Chart: EM103/4/5

Refer to the procedures in the maintenance section of the manual to make or check these adjustments. Not all of the items listed in the table below have adjustment. The information should be recorded and the amount of wear tracked so the part can be replaced before down time on the machine occurs.

Procedure	Frequency	Date Serviced/Comments
Spindle Sweep Adjustment	150 Hours	
X-Axis Rail Trucks	175 Hours	
Outer Spindle Bushing Adjustment	500 Hours	
Spindle Tilt Measurement	500 Hours	
Inner Spindle Bearing Adjustment	1000 Hours	
Horizontal Gib(s) Adjustment	1000 Hours	
X,Y,Z Auto Mode Backlash Adjustment	1000 Hours	
X,Y,Z Handwheel Backlash Adjustment	1000 Hours	
Electrical Enclosure Air Filter Replacement	1000 Hours	
Machine Level Adjustment	1000 Hours	
Spindle Drive Belt Adjustment	1000 Hours	
Vertical Drive Belt Adjustment	1000 Hours	
Horizontal Ballscrew Inspection	2000 Hours	
Spindle Wear Measurement	2000 Hours	

Oil Cross Reference Chart

ISO AND UNI SYMBOLS	APPLICATION FIELD	Agip	api	ARAL	ARCO	barelli	bellini	BERGOLINE	BP	BRYTOL	Castrol	Chevron
AN 68	LUBRIFICAT. LOSS	RAGULA 68 ACER 68	API MF-68	ARAL DURAL MR 68	GASCON 68	MIN 68	TRASMISSION 68	ACCA 68	OI 68	CM 68	MAGNA 68	CIRCULATING OIL 68 GST OIL 68
CB 32	GEARS MODERATELY CHARGED CB 150	ACER 32 ACER 68 ACER 150	API MF-32 API CB-32 API MF-68 API CB-68 API MF-150 API CB-150	ARAL DURAL MR 46 ARAL VITAM GF 32 ARAL DURAL MR 68 ARAL VITAM GF 68 ARAL DURAL MR 150 ARAL DEGOL TU 150	RUBELERE 32 RUBELERE 68 RUBELERE 150	MT/40S 32 MT/40S 68 MT/40S 150	SPRINTER AS 32 SPRINTER AS 68 SPRINTER AS 150	BERGOFLUID 32 PARATER S 32 BERGOFLUID 68 PARATER S 68 BERGOFLUID 150 PARATER S 150	ENERGOL CS 32 ENERGOL CS 68 ENERGOL CS 150	CMC 32 CMC 68 CMC 150	MAGNA 32 PERFECTO T32 MAGNA 68 PERFECTO T68 MAGNA 150	CIRCULATING OIL 46 GST OIL 46 CIRCULATING OIL 68 GST OIL 68 CIRCULATING OIL 150 GST OIL 150
CC 150 CC 320 CC 460	GEARS VERY CHARGED	BLASIA 150 BLASIA 320 BLASIA 460	API DT-150 API DT-320 API DT-460	ARAL DEGOL BG 150 ARAL DEGOL BG 320 ARAL DEGOL BG 460	PENNANT ML 150 PENNANT ML 320 PENNANT ML 460	G.E.P. 150 G.E.P. 320 G.E.P. 460	RED FH4 150 RED FH4 320 RED FH4 460	BERGOPLEX EP 150 BERGOPLEX EP 320 BERGOPLEX EP 460	ENERGOL GR-XP 150 ENERGOL GR-XP 320 ENERGOL GR-XP 460	CENTOL EP 150 CENTOL EP 320 CENTOL EP 460	ALPHA SP 150 ALPHA SP 220 ALPHA SP 460	NL GEAR COMPOUND 150 NL GEAR COMPOUND 320 NL GEAR COMPOUND 460
FD 5 FD 10 FD 22	SPHERICAL BEARINGS AND COUPLED CLUTCHES	OSO 10 OSO 15 OSO 22	API DB-10 API DB-32	ARAL DURAL SR 5 ARAL DURAL SR 10 ARAL DURAL SR 22	DURO OIL 10 DURO OIL 22	VELOS A 10 TIARO 22	SPRINTER ADP 5 SPRINTER ADP 10 SPRINTER ADP 22	BERGOSPIN 5 ENERGOL 10 BERGOSPIN 22	ENERGOL HP 5 ENERGOL HP 10 ENERGOL HLP-Z 22	ARGS 5 NOVOIL 10 NOVOIL 22	MAGNA AB 5 HYSPIN AWS 10 HYSPIN AWS 22	MECHANISM LPS 15
G 32		EXODIA 32	API MG-32		TRUSJIDE 32	TIARO BK 32	WAY 32	ENGINE K 32	ENERGOL GHL 32	VARTAK 32 AS 32	MAGNA DS 32	VISTAC OIL 32X
G 68	GUIDES	EXODIA 68	API MG-68	ARAL DEGAN T B 68	TRUSJIDE 68	M.P. 68	WAY 68	ENGINE K 68	MIDCURAT 68 ENERGOL GHL 68	VARTAK 68 AS 68	MAGNA BD 68 MAGNA BD F 68	VISTAC OIL 68X
G 220		EXODIA 220	API MG-220	ARAL DEGAN T B 220	TRUSJIDE 220	M.P. 220	WAY 220	ENGINE K 220	MIDCURAT 220 ENERGOL GHL 220	VARTAK 220 AS 220	MAGNA CF 220 MAGNA CF X 220	VISTAC OIL 220X
HM 32 HM 46 HM 68	HYDROSTATIC SYSTEMS	OSO 32 OSO 46 OSO 68	API CB-32 API CB-46 API CB-68	ARAL VITAM GF 32 ARAL VITAM GF 46 ARAL VITAM GF 68	DURO OIL AW 32 DURO OIL AW 46 DURO OIL AW 68	TIARO 32 TIARO 46 TIARO 68	SPRINTER ADP 32 SPRINTER ADP 46 SPRINTER ADP 68	PARATER S 32 PARAVIS HLP 32 PARATER S 46 PARAVIS HLP 46 PARATER S 68 PARATER HLP 68	ENERGOL HLP-Z 32 ENERGOL HLP 32 ENERGOL HLP-Z 46 ENERGOL HLP 46 ENERGOL HLP-Z 68 ENERGOL HLP 68	ARGS 32 HYDROIL 32 ARGS 46 HYDROIL 46 ARGS 68 HYDROIL 68	HYSPIN AWS 32 HYSPIN AWS 46 HYSPIN AWS 68	MECHANISM LPS 32 MECHANISM LPS 46 MECHANISM LPS 68
HG 32 HG 68	HYDRAULIC SYSTEMS AND GUIDES	EXODIA 32 EXODIA 68	API CB-68 EP API CB-68 EP	ARAL DEGAN T B 68	TRUSJIDE OGF TRUSJIDE 68	TIARO BK 32 TIARO BK 68	WAY SI 32 WAYGUIT N 32 WAY SI 68 WAYGUIT N 68	ENGINE K 32 ENGINE HY 68	ENERGOL GHL 32 ENERGOL GHL 68	VARTAK OGF VARTAK 68	MAGNA DC 32 MAGNA AX 68	VISTAC OIL 32X
G 32 G 68 G 220	MULTI FUNCTIONING GREASES	GR MU EP 1 GR MU EP 2 GR MU EP 3	API GREASE NGI-1 API GREASE LT-3 API GREASE NGI-2 API GREASE GR-B API GREASE NGI-3	ARAL ARALUB HL 1 ARAL ARALUB HL 2 ARAL ARALUB LF 3	LITHOLINE HEPG 1 LITHOLINE HEPG 2 LITHOLINE HEPG 3	LITIO EP 1 LITIO EP 2 PALMUT 3	GREASE U EP 1 GREASE U EP 2 GREASE U EP 3	RULTEN 900 EP 1 RULTEN 900 N2-EP 2 RULTEN 900 N 3	GREASE LTX1 GREASE LTX1-EP GREASE LTX2 GREASE LTX2-EP GREASE LTX3	BRYGREASE LT 1 BRYGREASE LTEP1 BRYGREASE LT 2 BRYGREASE LTEP2 BRYGREASE LT 3 BRYGREASE LTEP3	SPHEEROL APT 1 SPHEEROL EPL 1 SPHEEROL APT 2 SPHEEROL EPL 2 SPHEEROL APT 3 SPHEEROL EPL 3	DURAUTH GREASE EP 1 DURAUTH GREASE EP 2 DURAUTH GREASE EP 3

ISO AND UNI SYMBOLS	APPLICATION FIELD	COMLUBE	elf	Esso	EURAL	FINA	FUCHS	IGLEA	ITALIANA PETROLI	KLÜBER LUBRICATION	LEVENIT CHEMICAL LUBRICANTS	LUBRA
AN 68	LUBRIFICAT. LOSS	LG AN 68	MOVIXA 68	NURAY 68	ERAL 68	ARIAN 68	RENOLIN 68	BEARING 68	IP ARIULA OIL 68	CRUCOLAN 68	BETA 52/68	INDUSTRIAL 68
CB 32	GEARS MODERATELY CHARGED	OLEOL HH CB 32	POLYTELIS 32	TERESSO 32 NUTO 32	BRIGHT 32	SOLNA 32	RENOLIN 32	FILETE V 32 PRESTAN 32	IP HERMEA OIL 32 IP HYDRUS OIL 32	CRUCOLAN 32	BETA 30/32	OLNEO 32
CB 68		OLEOL HH CB 68	POLYTELIS 68	TERESSO 68 NUTO 68	BRIGHT 68	SOLNA 68	RENOLIN 68	FILETE V 68 PRESTAN 68	IP HERMEA OIL 68 IP HYDRUS OIL 68	CRUCOLAN 68	BETA 52/68	OLNEO 68
CB 150		OLEOL HH CB 150	POLYTELIS 150	NUTO 150	BRIGHT 150	SOLNA 150	RENOLIN 150	FILETE V 150 PRESTAN 150	IP HERMEA OIL 150 IP HYDRUS OIL 150	CRUCOLAN 150	BETA 120/150	OLNEO 150
CC 150	GEARS VERY CHARGED	OLGEAR EP CC 150	REDUCTELF SP 150	SPARTAN EP 150	ELTON EP 150	GIRAN 150	RENEP COMPOUND 104	RILEN EP 150	IP MELLANA OIL 150	LAMORA 150	DELTA EP 118/150	DACTA EP 150
CC 320		OLGEAR EP CC 320	REDUCTELF SP 320	SPARTAN EP 320	ELTON EP 320	GIRAN 320	RENEP COMPOUND 103 RENEP SUPER 6	RILEN EP 320	IP MELLANA OIL 320	LAMORA 320	DELTA EP 230/320	DACTA EP 320
CC 460		OLGEAR EP CC 460	REDUCTELF SP 460	SPARTAN FP 460	ELTON EP 460	GIRAN 460	RENEP COMPOUND 110 RENEP SUPER 10	RILEN EP 460	IP MELLANA OIL 460	LAMORA 460	DELTA EP 320/460	DACTA EP 460
FD 5	SPINDLES, BEARINGS AND COUPLED CLUTCHES	OLEOL HM FD 5	SPINELF 5	NUTO H 5	NEDEL 5	HYDRAN 10	RENOLIN MR 1	FILETE V 5	IP HYDRUS OIL 05	CRUCOLAN 5	VELOX 13/05	OLEODIN 5 OLNEO HLP 5
FD 10		OLEOL HM FD 10	SPINELF 10	SPINESSO 10	NEDEL 10	HYDRAN 10	RENOLIN MR 3	FILETE V 10	IP HYDRUS OIL 10	CRUCOLAN 10	VELOX 15/10	OLEODIN 10 OLNEO HLP 10
FD 22		OLEOL HM FD 22	SPINELF 22	SPINESSO 22	NEDEL 22	HYDRAN 22	RENOLIN MR 5	FILETE V 22	IP HYDRUS OIL 22	CRUCOLAN 22	VELOX 20/15	OLEODIN 22 OLNEO HLP 22
G 32		WAY LUBE EP G 32	MOGLIA 32	FEBIS K 32	ARIF T 32	HYDRAN G 32	RENOLIN 1	NODROP V 32	IP BANTIA OIL HG 32	LAMORA SUPER POLADD 32	ALPHA 29/32	SLEDOL 32
G 68	GUIDES	WAY LUBE EP G 68	MOGLIA 68	FEBIS K 68	ARIF T 68	HYDRAN G 68	RENEP 2	NODROP V 68	IP BANTIA OIL HG 32	LAMORA SUPER POLADD 68	ALPHA 52/68	SLEDOL 68
G 220		WAY LUBE EP G 220	MOGLIA 220	FEBIS K 220	ARIF T 220	HYDRAN G 220	RENEP 5	NODROP V 220	IP BANTIA OIL G 220	LAMORA SUPER POLADD 220	ALPHA 150/220	SLEDOL 220
HM 32	HYDROSTATIC SYSTEMS	OLEOL HM 32	ELFOLNA 32	NUTO H 32 NUTO HP 32	HYDER 32	HYDRAN 32	RENOLIN B 32	FILETE V 32	IP HYDRUS OIL 32 IP HYDRUS OIL X 32	LAMORA 32	HYDROLUBE 30/32	OLEODIN 32 OLNEO HLP 32
HM 46		OLEOL HM 46	ELFOLNA 46	NUTO H 46 NUTO H 68	HYDER 46	HYDRAN 46	RENOLIN B 46	FILETE V 46	IP HYDRUS OIL 46 IP HYDRUS OIL X 46	LAMORA 46	HYDROLUBE 40/46	OLEODIN 46 OLNEO HLP 46
HM 68		OLEOL HM 68	ELFOLNA 68	NUTO HP 68	HYDER 68	HYDRAN 68	RENOLIN B 68	FILETE V 68	IP HYDRUS OIL 68 IP HYDRUS OIL X 68	LAMORA 68	HYDROLUBE 52/68	OLEODIN 68 OLNEO HLP 68
HG 32	HYDRAULIC SYSTEMS AND GUIDES	OLEOL HG 32	HYGLISS 32	FEBIS K 32	TERCAL 32	HYDRAN G 32	RENOLIN 1	FILETE VE 32	IP BANTIA OIL HG 32	LAMORA 32	HYDROLUBE EP 30/32	SLEDOL GC 32
HG 68		OLEOL HG 68	HYGLISS 68	FEBIS K 68	TERCAL 68	HYDRAN G 68	RENOLIN 3	FILETE VE 68	IP BANTIA OIL HG 68	LAMORA 68	HYDROLUBE EP 52/68	SLEDOL GC 68
G 32	MULTI FUNCTIONING GREASES	LHITGREASE XM 1	ROLEXA 1 EPEXA 1	BEACON EP 1	LITNER EP 1	MARSON EPL 1	RENOLIT 1	VEGA 1	IP ATHESIA GR 1 IP ATHESIA GR EP 1	CENTOPLEX 1 CENTOPLEX 1 EP	LITGREASE EP 1	ROLLER EP 1
G 68		LHITGREASE XM 2	ROLEXA 2 EPEXA 2	BEACON 2 ESSO GP GREASE	LITNER EP 2	MARSON EPL 2	RENOLIT 2 RENOLIT FEP 2	VEGA 2	IP ATHESIA GR 2 IP ATHESIA GR EP 2	CENTOPLEX 2 CENTOPLEX 2 EP	LITGREASE EP 2	ROLLER EP 2
G 220		LHITGREASE XM 3	ROLEXA 3	BEACON 3	LITNER EP 3	MARSON EPL 3	RENOLIT 3 RENOLIT FEP 3	VEGA 3	IP ATHESIA GR 3	CENTOPLEX 3 CENTOPLEX 3 EP	LITGREASE EP 3	ROLLER EP 3

ISO AND UNI SYMBOLS	APPLICATION FIELD		Mobil	oleotecnica	Persian Oil	PETROL CALTEX	Q8	REINACH	ROLOIL	Shell		SPRINGOIL
AN 68	LUBRIFICAT. LOSS	MACHINERY 68	RUBREX 400	MILPAR 68	TECNOL 68	CASTOR 68	VERDI 68	OLIO VER 15	LEMANIA 68	VITREA OIL 68	SINLUBE 68	NURAX 68
CB 32	GEARS MODERATELY CHARGED	TELEDINAX 32	MOBIL VACTRA OIL LIGHT	TURBO 32	VITROL 32	REGULUS 32 LAMBISH HY 32	VERDI 32	OLIO EHT 13	ARM 32-V	VITREA OIL 32 TELLUS OIL C32	SINLUBE GR 32	ENGINE SPECIAL 32
CB 68		TELEDINAX 68	MOBIL VACTRA OIL HEAVY MEDIUM	TURBO 68	VITROL 68	REGULUS 68 LAMBISH HY 68	VERDI 68	OLIO EHT 15	ARM 68-V	VITREA OIL 68 TELLUS OIL C68	SINLUBE GR 68	ENGINE SPECIAL 68
CB 150		TELEDINAX 150	MOBIL VACTRA OIL EXTRA HEAVY	TURBO 150	VITROL 150	REGULUS 150	VERDI 150	OLIO BYSCOLINA 120	ARM 150-V	VITREA OIL 150 TELLUS OIL C150	SINLUBE GR 150	ENGINE SPECIAL 150
CC 150	GEARS VERY CHARGED	GEAR OIL EP 150	MOBILGEAR 629	ROTO EP 150	REDOIL EP 150	TAURUS WRP 150	GOYA 150	OLIO EPPOL EP 150	EP 150	OMALA OIL 150	SINLUBE GRS 150	GEAR 150/EP
CC 320		GEAR OIL EP 320	MOBILGEAR 632	ROTO EP 320	REDOIL EP 320	TAURUS WRP 320	GOYA 320	OLIO EPPOL EP 300	EP 320	OMALA OIL 220	SINLUBE GRS 320	GEAR 320/EP
CC 460		GEAR OIL EP 460	MOBILGEAR 634	ROTO EP 460	REDOIL EP 460	TAURUS WRP 400	GOYA 460	OLIO EPPOL EP 400	EP 460	OMALA OIL 460	SINLUBE GRS 460	GEAR 460/EP
FD 5	SPINDLES, BEARINGS AND COUPLED CLUTCHES	TELEDINAX 5	MOBIL VELOCITE OIL No. 4	VELOX 5	IDROL 10	ORION 5	PUCCINI 4P	OLIO EHT 10		TELLUS OIL C5	SINLUBE 5	FUSING HD 10
FD 10		TELEDINAX 10	MOBIL VELOCITE OIL DTE 21	VELOX 10	IDROL 10	ORION 10	HAYDN 10	OLIO EHT 10	LR 10	TELLUS OIL C10	SINLUBE 10	FUSING HD 10
FD 22		TELEDINAX 22	MOBIL VELOCITE OIL DTE 22	VELOX 22	IDROL 22	SIRIUS H 22	HAYDN 22	OLIO EHT 12	LR 22	TELLUS OIL C22 TELLUS OIL 22	SINLUBE 22	FUSING HD 22
G 32		OLG 32	MOBILVACUOLINE 406	LUBEX K 32	AROIL S 32	GEMINI CS 32	WAGNER 32	OLIO TRAX 13		TONNA OIL T 32	SINLUBE SL 32	SLIDE 32/K
G 68	GUIDES	OLG 68	MOBIL VACTRA OIL No. 2	LUBEX K 68	AROIL S 68	GEMINI SW 68	WAGNER 68	OLIO TRAX 15	ARM 68 EP	TONNA OIL T 68 TONNA OIL TX 68	SINLUBE SL 68	SLIDE 68/K
G 220		OLG 220	MOBIL VACTRA OIL No. 4	LUBEX K 220	AROIL S 220	GEMINI SW 220	WAGNER 220	OLIO ANTIGOCCIA 1450	ARM 220-EP	TONNA OIL T 220 TONNA OIL TX 220	SINLUBE SL 220	SLIDE 220/K
HM 32	HYDROSTATIC SYSTEMS	TELEDINAX 32	MOBIL DTE 24	MOVO H 32	IDROL 32	SIRIUS H 32 SIRIUS HOD 32	HAYDN 32	OLIO EHT 13 H	LI 32	TELLUS OIL 32 HYDRAULIC OIL 32	SINYDRO 32	ENGINE SPECIAL 32
HM 46		TELEDINAX HVI 32 TELEDINAX 46	MOBIL DTE 25	MOVO H 46	IDROL 46	SIRIUS H 46 SIRIUS HOD 46	HAYDN 46	OLIO EHT 14 H	LI 46	TELLUS OIL 46 HYDRAULIC OIL 46	SINYDRO 46	ENGINE SPECIAL 46
HM 68		TELEDINAX HVI 46 TELEDINAX 68 TELEDINAX HVI 68	MOBIL DTE 26	MOVO H 68	IDROL 68	SIRIUS H 68 SIRIUS HOD 68	HAYDN 68	OLIO EHT 15 H	LI 68	TELLUS OIL 68 HYDRAULIC OIL 68	SINYDRO 68	ENGINE SPECIAL 68
HG 32	HYDRAULIC SYSTEMS AND GUIDES	TELEDINAX EP 32	MOBIL VAQUOLINE OIL 1405	LUBEX K 32	AROIL S 22	GEMINI CS 32	WAGNER 32	OLIO DYN 32	LI 32-EP	TONNA OIL T 32 TONNA OIL TX 32	SINLUBE SL 32	SLIDE 32/K
HG 68		TELEDINAX EP 68	MOBIL VAQUOLINE OIL 1409	LUBEX K 68	AROIL S 32	GEMINI CS 68	WAGNER 68	OLIO DYN 68	LI 68-EP	TONNA OIL T 68 TONNA OIL TX 68	SINLUBE SL 68	SLIDE 68/K
G 32	MULTI FUNCTIONING GREASES	UNIVERSAL GREASE 1 UNIVERSAL GREASE EP1	MOBILPLEX 46	LITEX EP 1	LT GREASE 1	LIBRA GREASE 1 LIBRA GREASE EP1	REMBRANDT EP 1	GRASSO SFERULLF	LITEX/EP 1	ALVANIA EP GREASE1 SUPER GREASE EP1	G/EP 1	UNIVERSAL EP/1
G 68		UNIVERSAL GREASE 2 UNIVERSAL GREASE EP2	MOBILPLEX 47	LITEX EP 2	LT GREASE 2	LIBRA GREASE 2 LIBRA GREASE EP2	REMBRANDT EP 2	GRASSO SFERULLC	LITEX/EP 2	ALVANIA GREASE P2 SUPER GREASE P2	G/EP 2	UNIVERSAL EP/2 SERVICE/2
G 220		UNIVERSAL GREASE 3 UNIVERSAL GREASE EP3	MOBILPLEX 48	LITEX EP 3	LT GREASE 3	LIBRA GREASE 3 LIBRA GREASE EP3	REMBRANDT EP 3	GRASSO SFERULLD	MERCURY 3	ALVANIA GREASE P3 SUPER GREASE P3	G/EP 3	SERVICE/3

ISO AND UNI SYMBOLS	APPLICATION FIELD	Synecco	TAMOIL	TENNECO	TEXACO	TOTAL	Vabriol	VALVOLINE	Vanguard	VISCOL	WEBER	WLADOIL
AN 68	LUBRIFICAT. LOSS	HYDRAULIC N 68	TAMLUBE OIL 68	VERTEX 68	OMNIS 68 ALCAID OIL 60	CORTIS 68	METIX 68	CIR 68	KOMOL ST 68	SIGNAL TR 68 (5)	WEBER WEBCOM 68	ENGINE 68
CB 32	GEARS MODERATELY CHARGED	PACEMAKER RODI 3	INDUSTRIAL OIL 32	CONTEX 32 VERTEX 32	OMNIS 32 RANDO OIL HD 32	CORTIS 32 AZOLLA ZS 32	METRA 32	CIR 32	KOMOL ST 32	SIGNAL VL 32 (3) SIGNAL NO 32 (3)	WEBER WA 32	ENGINE RE 32
CB 68		PACEMAKER RODI 5	INDUSTRIAL OIL 68	CONTEX 68 VERTEX 68	OMNIS 68 RANDO OIL HD 68	CORTIS 68 AZOLLA ZS 68	METRA 68	CIR 68	KOMOL ST 68	SIGNAL VL 68 (5) SIGNAL NO 68 (5)	WEBER WA 68	ENGINE RE 68
CB 150		PACEMAKER RODI 12	INDUSTRIAL OIL 150	CONTEX 150 VERTEX 150	OMNIS 150 RANDO OIL HD 150	CORTIS 150 AZOLLA ZS 150	METRA 150	CIR 150	KOMOL ST 150	SIGNAL VL 150 (10) SIGNAL NO 150 (10)	WEBER WA 150	ENGINE RE 150
CC 150	GEARS VERY CHARGED	PACEMAKER RODI 12	CARTER EP LUBR 150	FACTOR 150	MEROPA 150	CARTER EP 150	GEARLUBE EP 150	GEAR EP 150	GEARING EP 150	SIGNAL VL/EP 150(10)	WEBER FARGO EP 150	ENGINE E P 150
CC 320		PACEMAKER RODI 24	CARTER EP LUBR 320	FACTOR 320	MEROPA 320	CARTER EP 320	GEARLUBE EP 320	GEAR EP 320	GEARING EP 320	SIGNAL VL/EP 320(22)	WEBER FARGO EP 320	ENGINE E P 320
CC 460		PACEMAKER RODI 32	CARTER EP LUBR 460	FACTOR 460	MEROPA 460	CARTER EP 460	GEARLUBE EP 460	GEAR EP 460	GEARING EP 460	SIGNAL VL/EP 460(31)	WEBER FARGO EP 460	ENGINE E P 460
FD 5	SPINDLES, BEARINGS AND COUPLED CLUTCHES	PACEMAKER RODI 016		ECTON 5	300 OIL 5		RINOL 5	ETC 5	KOMOL SVR 5	SIGNAL ELROS 5(12)	WEBER W.L. 10	ENGINE HY SY 05/B
FD 10			TAMSPINDLE OIL 10	ECTON 10	SPRINTEX OIL 10	AZOLLA ZS 15	RINOL 10	ETC 10	KOMOL SVR 10	SIGNAL CO 10 (1)	WEBER W.L. 15	ENGINE HY SY 10/B
FD 22			TAMSPINDLE OIL 22	ECTON 22	SPRINTEX OIL 22	AZOLLA ZS 15	RINOL 22	ETC 22	KOMOL SVR 22	SIGNAL CO 22 (2)	WEBER W.L. 22	ENGINE HY SY 22/B
G 32		PACEMAKER RODI 3	TAMWAY OIL 32	BARTON 11		DROSERA MS 32	METRA K 32	GES 32	C.O. SPECIAL 32	SIGNAL VL/U 32 (3)	WEBER WAY 32	ENGINE HDT/32
G 68	GUIDES	PACEMAKER 55	TAMWAY OIL 68	BARTON 20	WAY LUBRICANT 68	DROSERA MS 68	METRA K 68	GES 68	STOL 68	SIGNAL VL/SG 68 (5)	WEBER WAY 68	ENGINE HDT/68
G 220		PACEMAKER 80	TAMWAY OIL 220	BARTON 44	WAY LUBRICANT 220	DROSERA MS 220	METRA K 220	GES 220	STOL 220	SIGNAL VL/SG 220(12)	WEBER WAY 220	ENGINE HDT/220
HM 32	HYDROSTATIC SYSTEMS	PACEMAKER 32	HYDRAULIC OIL 32	ECTON 32 ECTON X 32	RANDO OIL HD 32	AZOLLA ZS 32	GAMMA X 32	HYDRAULIC HLP 32	HYDRAULIC 32	SIGNAL CO 32 (3)	WEBER WL 32 WEBER WL HP 32	ENGINE HY SY 32/B
HM 46		PACEMAKER 46	HYDRAULIC OIL 46	ECTON 46 ECTON X 46	RANDO OIL HD 46	AZOLLA ZS 46	GAMMA X 46	HYDRAULIC HLP 46	HYDRAULIC 46	SIGNAL CO 46 (4)	WEBER WL 46	ENGINE HY SY 46/B
HM 68		PACEMAKER 68	HYDRAULIC OIL 68	ECTON 68 ECTON X 68	RANDO OIL HD 68	AZOLLA ZS 68	GAMMA X 68	HYDRAULIC HLP 68	HYDRAULIC 68	SIGNAL CO 68 (5)	WEBER WL 68 WEBER WL HP 68	ENGINE HY SY 68/B
HG 32	HYDRAULIC SYSTEMS AND GUIDES	PACEMAKER RODI 3	TAMWAY OIL 32	BARTON 11	CLEARTEX D RANDO OIL HD 32	DROSERA MS 32	METRA K 32 METRA T 32	GES 32	C.O. SPECIAL 32	SIGNAL VL/U 32 (3)	WEBER WEBSTICK 32	ENGINE HDT/32 ENGINE HDT 32/A
HG 68		PACEMAKER 55	TAMWAY OIL 68	BARTON 18	CLEARTEX F RANDO OIL HD 68	DROSERA MS 68	METRA K 68 METRA T 68	GES 68	C.O. SPECIAL 68	SIGNAL VL/U 68 (5)	WEBER WEBSTICK 68	ENGINE HDT/68 ENGINE HDT 68/A
G 32	MULTI FUNCTIONING GREASES	SINT GREASE EP 1	TAMLITHGREASE 1 EP	GRASSO C-1 SPECIAL GRASSO MR 1001	MULTIFAK EP 1 MARFAK 1	MULTIS EP 1 MULTIS 1	CS/MPL 1 GREASE CS/EP 1 GREASE	L 1 EP GREASE	LIKO 1 LIKO EP 1	SIGNAL ROLSFER EP 1	WEBER GREASE MP EP 1	GOLD 200 F1 GOLD 200 EP 1
G 68		SINT GREASE EP 2	TAMLITHGREASE 2 TAMLITHGREASE 1 EP	GRASSO C-2 SPECIAL GRASSO MR 1002	MULTIFAK EP 2 MULTIFAK MP 2	MULTIS EP 2 MULTIS 2	CS/MPL 2 GREASE CS/EP 2 GREASE	L 2 EP GREASE	LIKO 2 LIKO EP 2	SIGNAL ROLSFER EP 2	WEBER GREASE MP EP 2	GOLD 200 F2 GOLD 200 EP 2
G 220		SINT GREASE EP 3	TAMLITHGREASE 3	GRASSO C-3 SPECIAL GRASSO MR 1003	MARFAK HD 3	MULTIS EP 3 MULTIS 3	CS/MPL 3 GREASE CS/EP 3 GREASE	L 3 EP GREASE	LIKO 3 LIKO EP 3	SIGNAL ROLSFER EP 3	WEBER GREASE MP 3	GOLD 200 F3 GOLD 200 EP 3

Maintenance

Lubrication

Refer to images following these written instructions:

Below are the directions that explain how and where to add oil to the different systems:

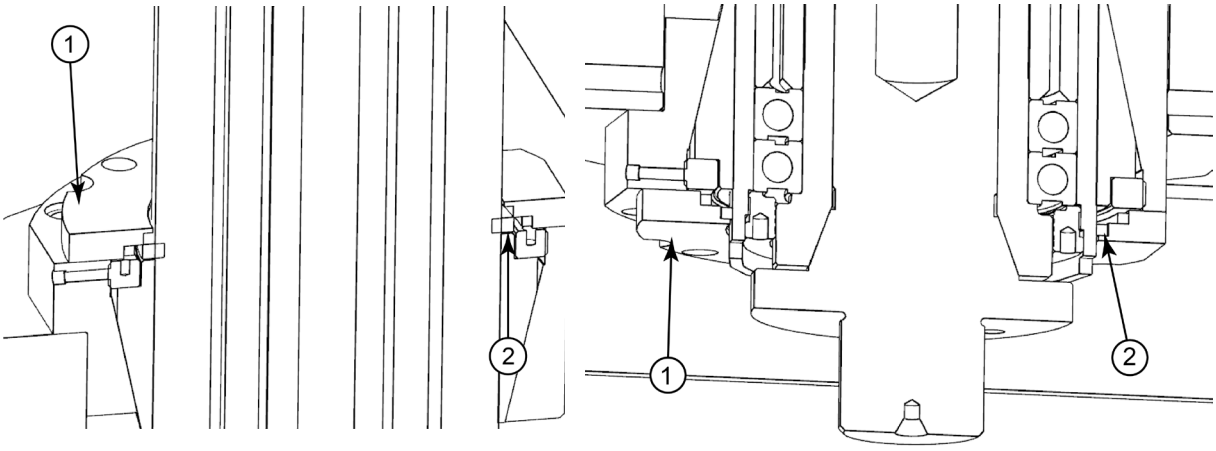
⚠ CAUTION Do not overfill any of the lubrication points, serious electrical damage may result.

Outer Spindle
The Outer Spindle is hard chromed and is supported in tapered, cast iron spindle bushings. The Outer Spindle supports the Inner Spindle, bearings, seals etc. and maintains the boring rigidity.

Every 8 hours:
The Outer Spindle needs to be moved down to the lower limit, wiped clean, and then lightly coated with a ISO VG 68 Way Oil. This is very important, if the spindle is allowed to operate dirty the cast iron dust will act as an abrasive on the spindle chrome. This will cause the spindle to wear prematurely.

Every 1000 Hours:
Open the sheet metal cover from the front of the spindle unit. Remove the 4 flat head bolts holding the felt wiper retainers (1) in place. Lift or drop the retainer to access the felt wiper.(2) Soak the felt wipers (2) with ISO VG 68 Way Oil. Reinstall the felt wiper retainers.(1)

Note: Do not adjust the nut below the felt wiper (see the mechanical section for correct adjustment of this nut).



Refer to page 8-25 for exploded view and parts call out.

Oil Reservoir System

Every 8 hours check the oil supply lines to the upper spindle to be sure they are full of oil.

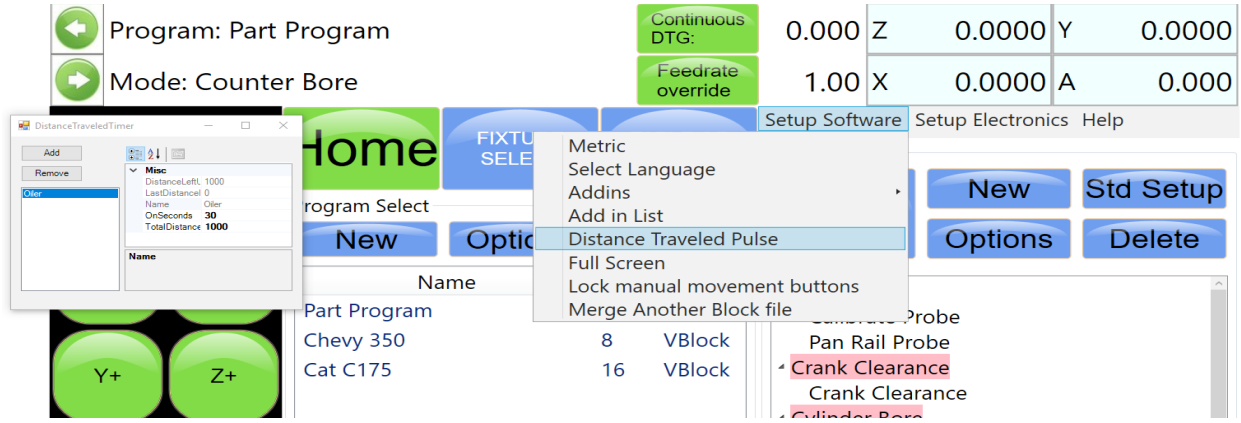
IMPORTANT The oil reservoir system is located inside the lower portion of the column. This system lubricates the following:

Ways
Inner Spindle Bearings (Upper and Lower)
Horizontal Ballscrew
Outer Spindle

Every 175 Hours:
The oil level of the reservoir should be checked, and filled with ***ISO VG 68 WAY OIL.***

When the oil reservoir is low or empty on the EM103/4/5 machine, the control panel will show “LOW OIL” and will not run until the reservoir has been filled.

The oil system is set for automatic oiling after 1,000 feet of travel. The setting can be changed by clicking the Setup Software tab, then the Distance Traveled Pulse in the drop down box. A pop up box will appear where you can change the amount of travel before the oiler activates.



Inner Spindle Bearings

The Inner Spindle Bearings are lubricated from the oil reservoir system. It is normal for a small amount of this oil to seep through the spindle bearings and onto the cutterhead.

Vertical Ballscrew Bearings

The Upper Pillow Block bearing is located on the top plate just below the driven sprocket. The lower bearing set is located at the bottom of the ballscrew in the spindle base.

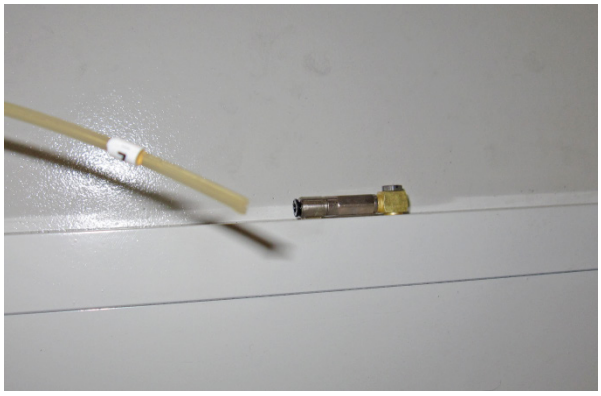
Every 175 Hours:
These bearings should be greased with NLGI 2 White Lithium Grease.

X-Axis Rail Trucks

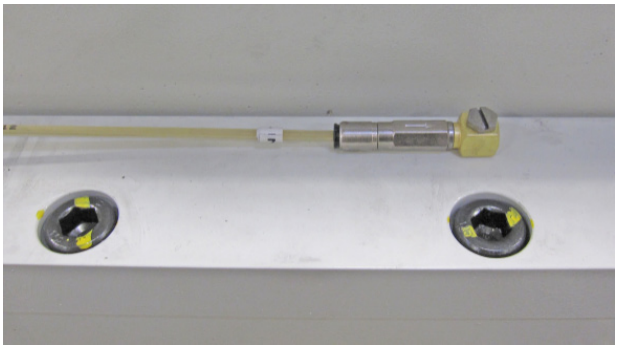
Every 1000 Hours:
Grease all 4 linear rail trucks with 4-6 pumps of grease, then move the column 3 feet in the positive and negative directions and give it 4-6 more pumps of grease.
These bearings should be greased with NLGI 2 White Lithium Grease.

Priming Spindle Base Oil Lines

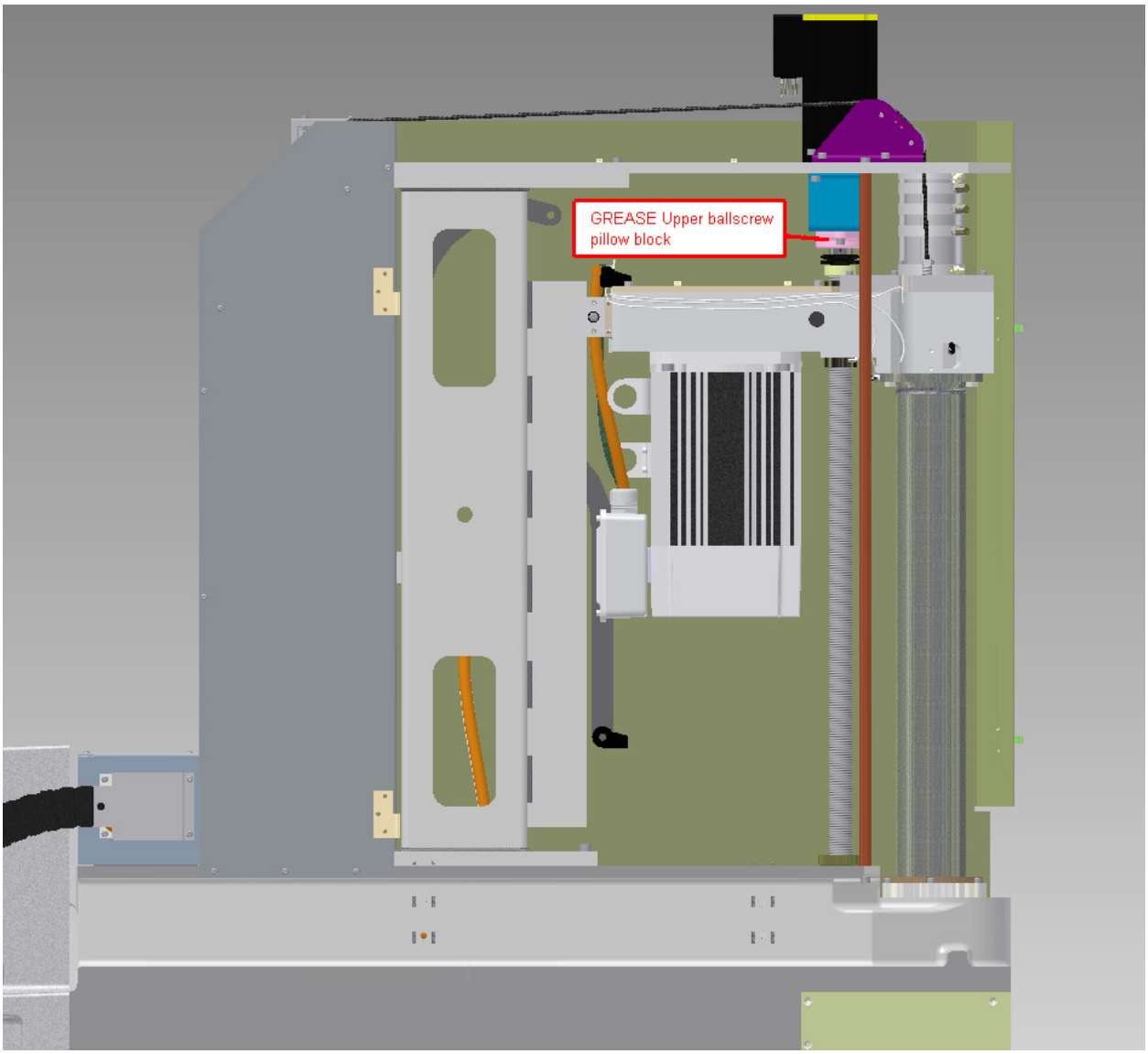
1. After the spindle base has been placed on the column the oil lines must be purged of air.
2. Remove the oil lines located on the spindle base guide rails.



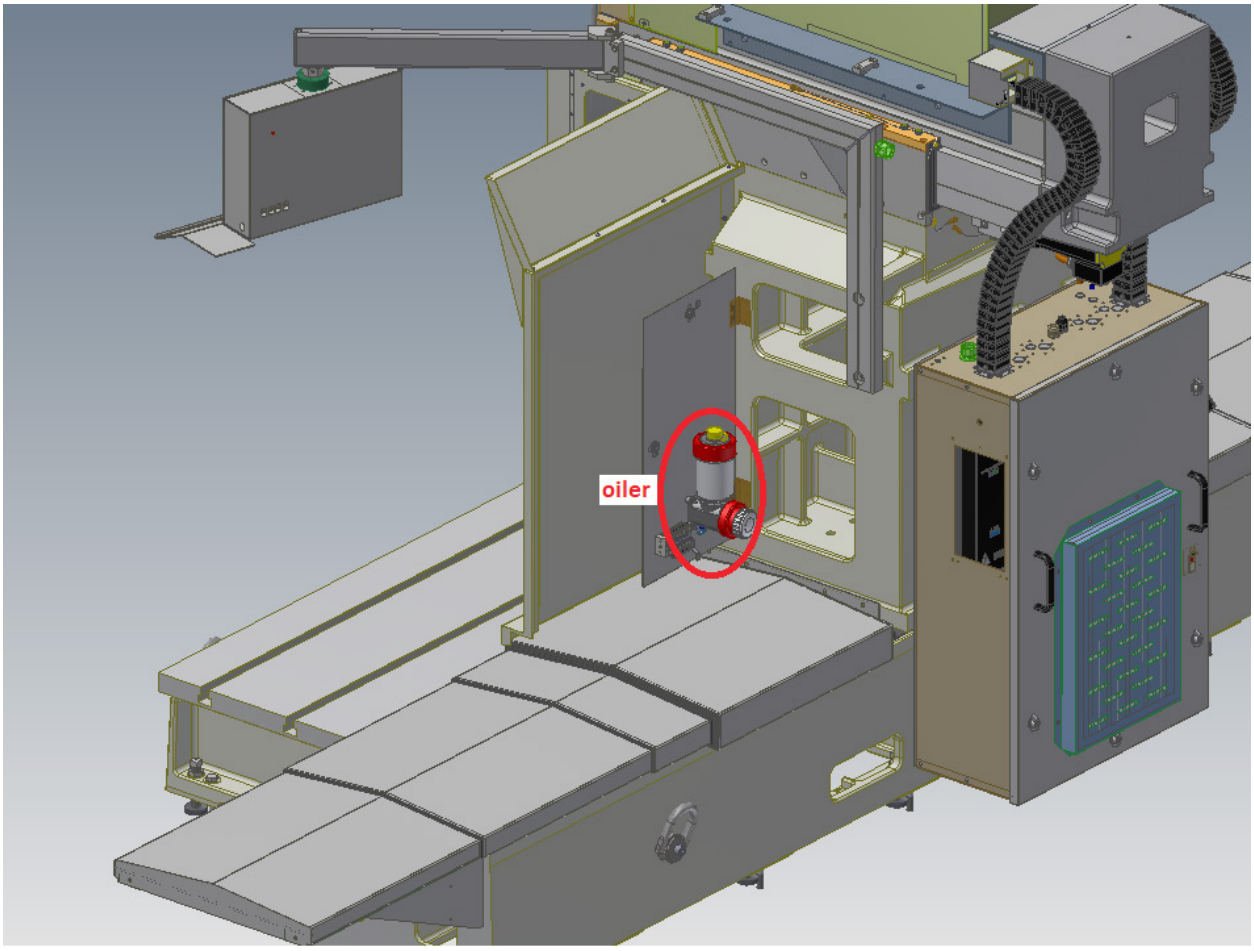
3. Energize the IO bit for the oiler on the computer and wait for oil to flow out of the line.
4. Reattach oil lines.



Lubrication Locations



Lubrication Locations cont:



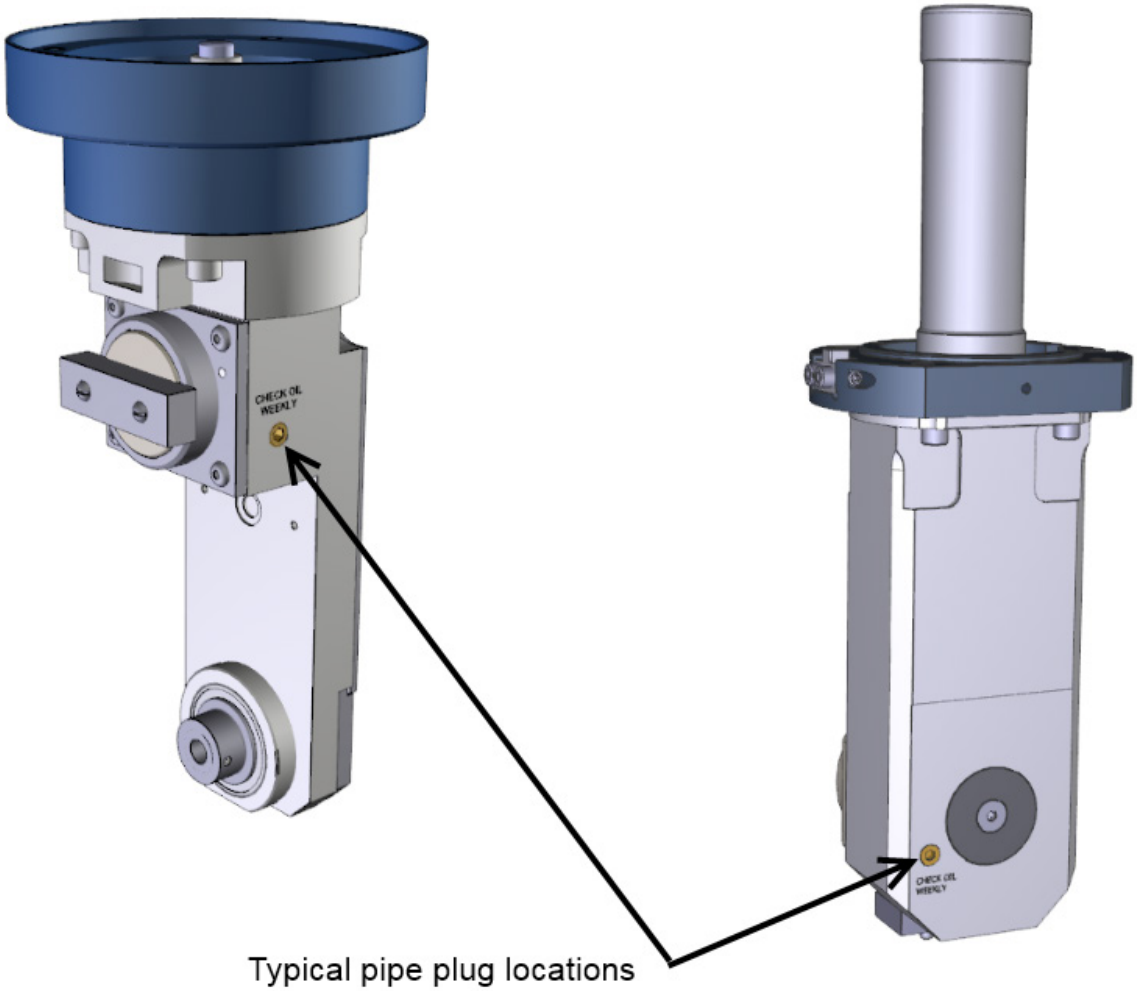
Right Angle Drive Lubrication Information

All right angle drives require lubrication at the point where the pinion drive intersects with the drive gear. This is generally in the area where the cutterhead is attached, except for the units that have belt drive. There will be a small pipe plug that is removed to check oil level and add oil if needed. See illustration below for general locations.

With the drive mounted on the machine spindle the oil level should be even with the bottom of the pipe plug threads.

All Rottler Right Angle Drives are filled with Union 76 Turbine Oil 68 prior to shipment. Use this or an equivalent ISO VG68 oil if the need to add or change oil arises.

When adding oil, fill until oil starts to run out of fill hole. Allow excess oil to drain, then coat pipe plug threads with anti-seize compound and replace it.

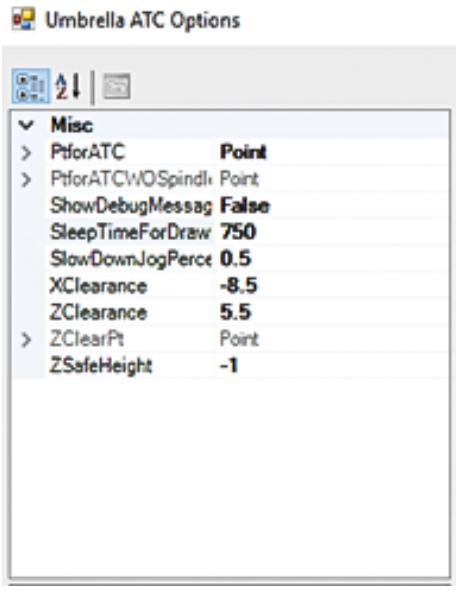


Typical pipe plug locations

Tool Changer Setup

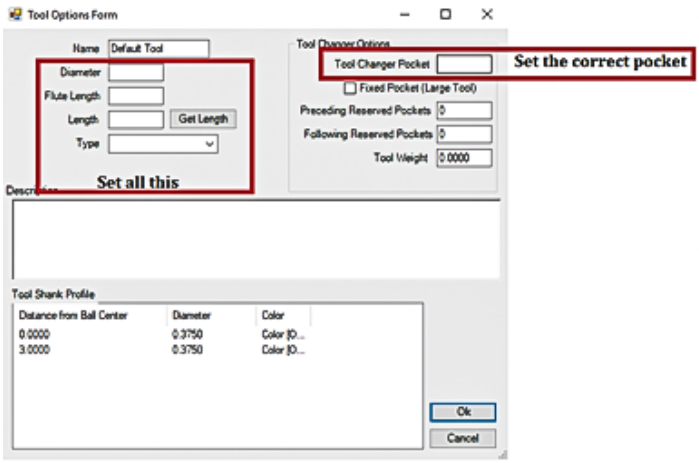
This will cover tool changer set up. This procedure should be done only by skilled personnel. In this procedure the machine will be making automatic moves, this requires knowledge of other item setup and access to the software setup.

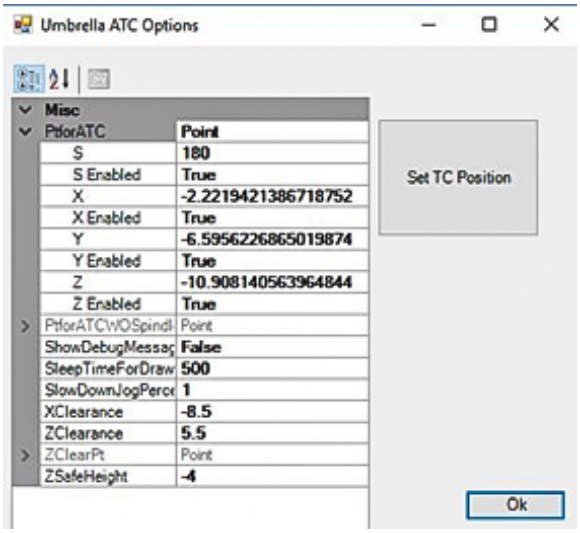
1. Add the Umbrella ATC into the software thru the addin list.
2. Reboot the software for it to take effect
3. Home the machine
4. Create a new Block program, we will refer to ours are “TC1”
5. Add a general bore program to the block program
6. Bring up the “Control” options screen under setup electronics
7. Access the x-y-z-s axis’s and under status tab use the GOTO button and move them all to “dro” 0
8. Go into general bore Mode
9. Zero the axis in the the general bore mode on the actual dro soft limit Axis zeros. See Bulletin 318 (may help you when setting up the tool changer)
10. Move the changer with the control options screen to the 1st tool spot. (Make sure you protect against falling tools with plywood/rags)



11. Access the addins Umbrella ATC setup set the numbers as shown, for a starting point.
12. Install a tool in the spindle.
13. Use the hand wheel and move the tool into the fingers, make sure the tool pick up/drop off is correct. (Make sure the spindle is oriented correctly May need to change in the PtforATC in options.)
14. Use the Set TC position button to set the spot. (Verify that the settings changed in the PtforATC tab)
15. Release the tool and move the spindle up to verify the distance needed to clear the retention knob but keep the access door open, if there is a chip door. Verify your Z-clearance, standard is ~ 5.5
16. Move the machine z-axis back down onto the tool. Verify your settings for the tool pickup are correct.
17. While gripping the tool move the machine away from the ATC until the chip door closes. Verify your X-clearance, standard is ~ -8.5 (- mounted on the right hand side + for the left hand side.)

18. Set the Z Safe height. This is height that it knows it can go to before it resumes a program before or after a tool change. (Suggest using 0 until you're comfortable with the changer.)
19. SlowDownJogPercent 0.5 is 50% speed 1 is 100% speed 1.5 is 150% speed
20. Sleeptimefordrawbar in milliseconds 1000 is one second standard is 750ms of dwell time.
21. Enter in 2-3 tools in table of tools, click add a tool.





22. Try a tool change with a light tool.

Magnescale Indicator Set Up

--Turn off power to Magnescale by unplugging the connector on the back of the unit. Or having someone else shut off the power while you stay in front of the unit.
-- Plug it back in while you are holding down the reset button. You will see either “mm” or “in”
-- While the still holding the reset button down, press the mode button and both the “mm” or “in” will start blinking, you are now in edit mode.
-- You can now release the reset button, use the up arrow to switch between “mm” and “in”.
hit the set button to lock in the selection

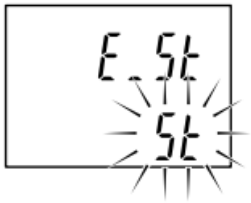
Setting Up Sensor Stroke Depth.

Press and hold set and mode until options menu starts blinking. Push mode once to switch to rSLP and then press up arrow to set +.0005.

-- Push set once, and then mode ONE time, then rSL should be blinking
-- Press and hold set and mode until options menu starts blinking. Push mode once to switch to rSL and then press up arrow to set +.0002.

-- Push set once, and then mode button.

-- should be set to rEF > OFF
-- Push mode button once.



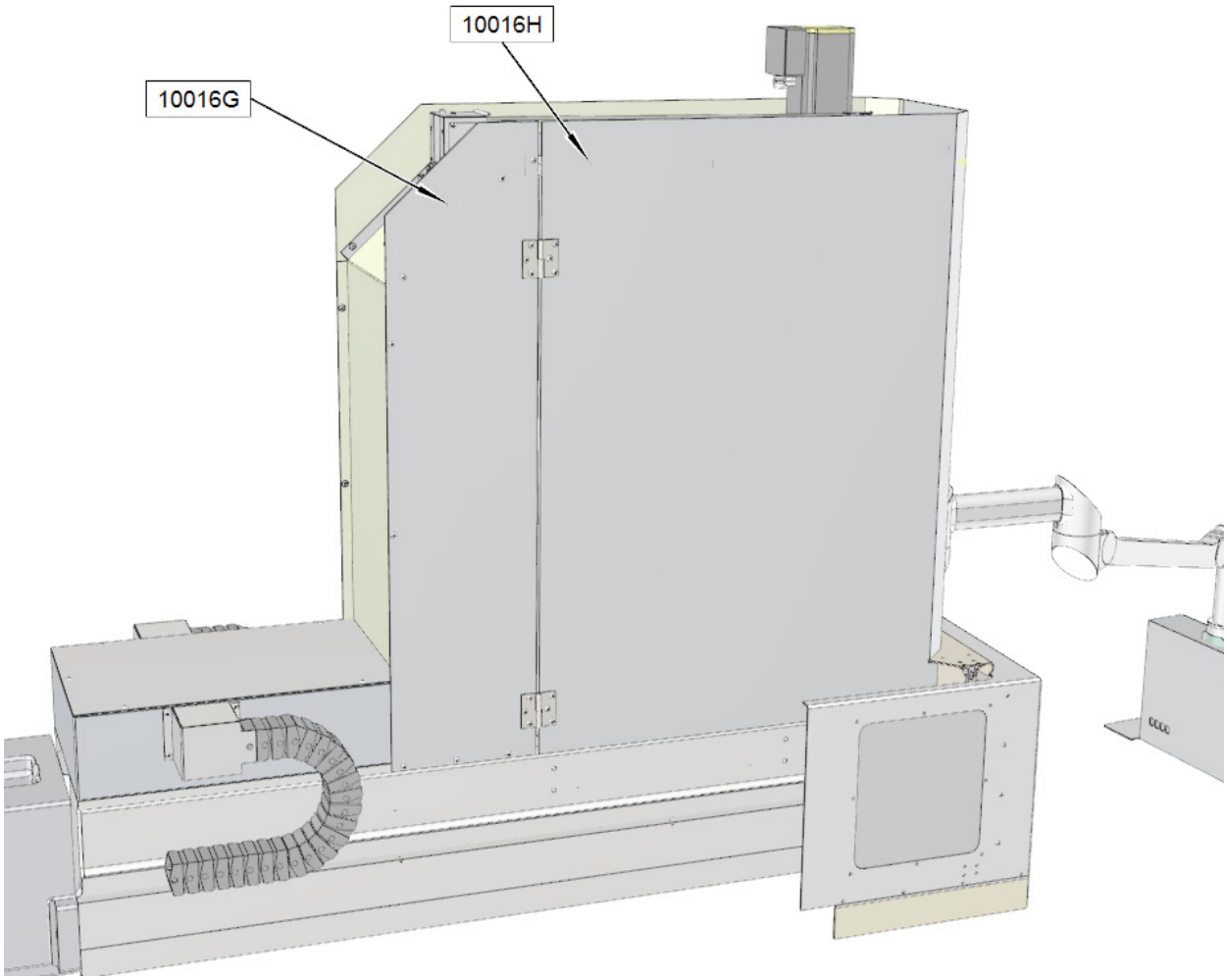
-- Should be set to E_St > St
-- Push mode button once. You should be back to the main readout screen
--Depress the plunger it should go from zero to max of .2000-2500

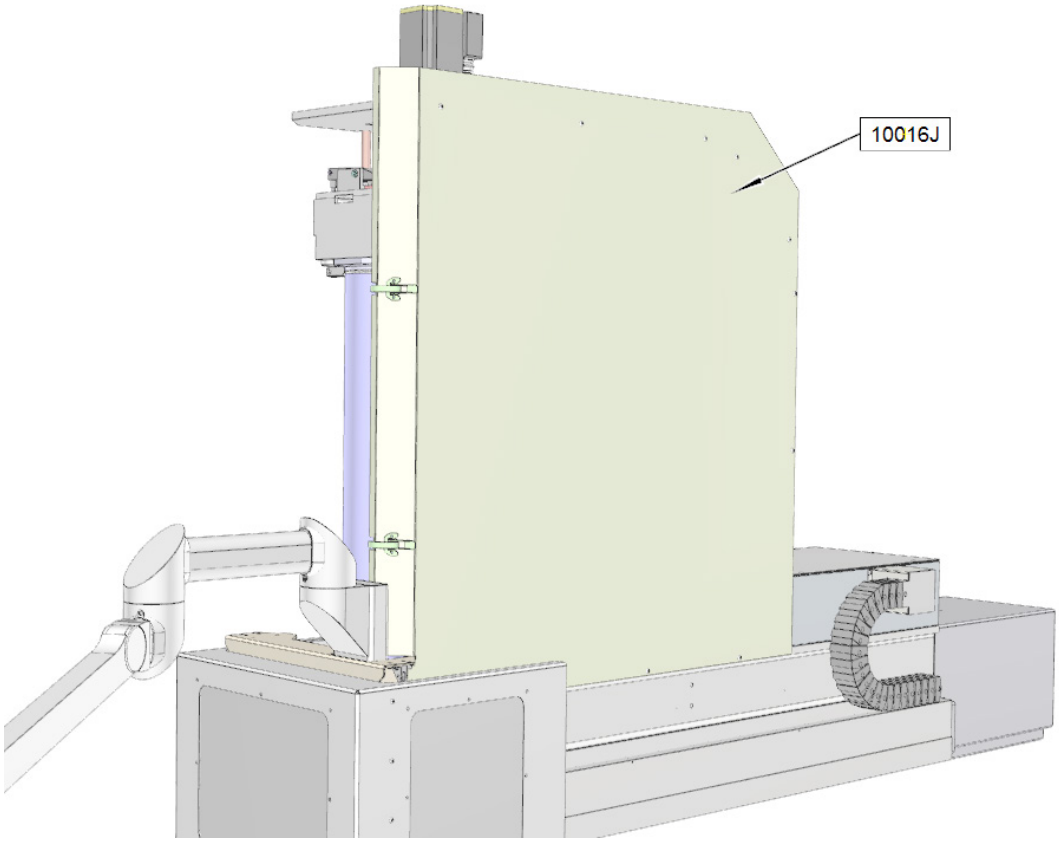
Spindle Drive Belt Replacement / Adjustment

CAUTION ***Turn off power to machine before proceeding with this procedure.***

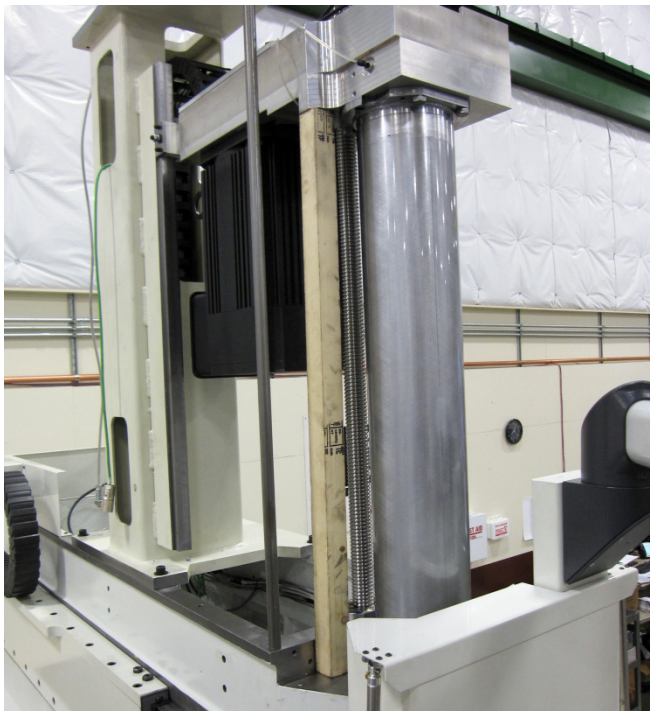
The spindle drive belt is located in the upper spindle housing.

Remove the spindle door and covers.

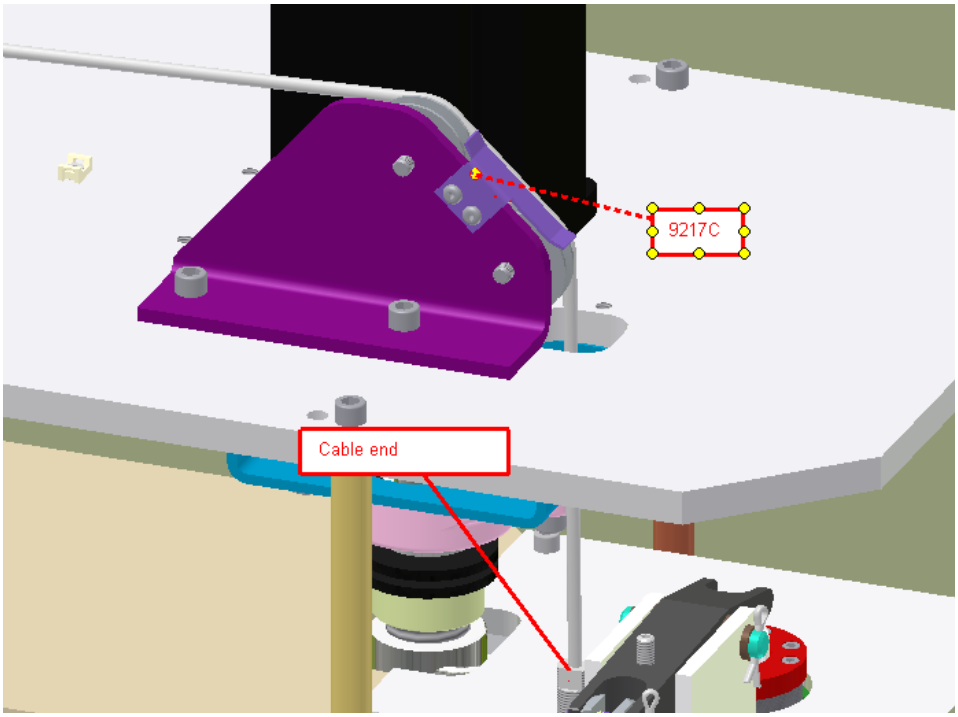




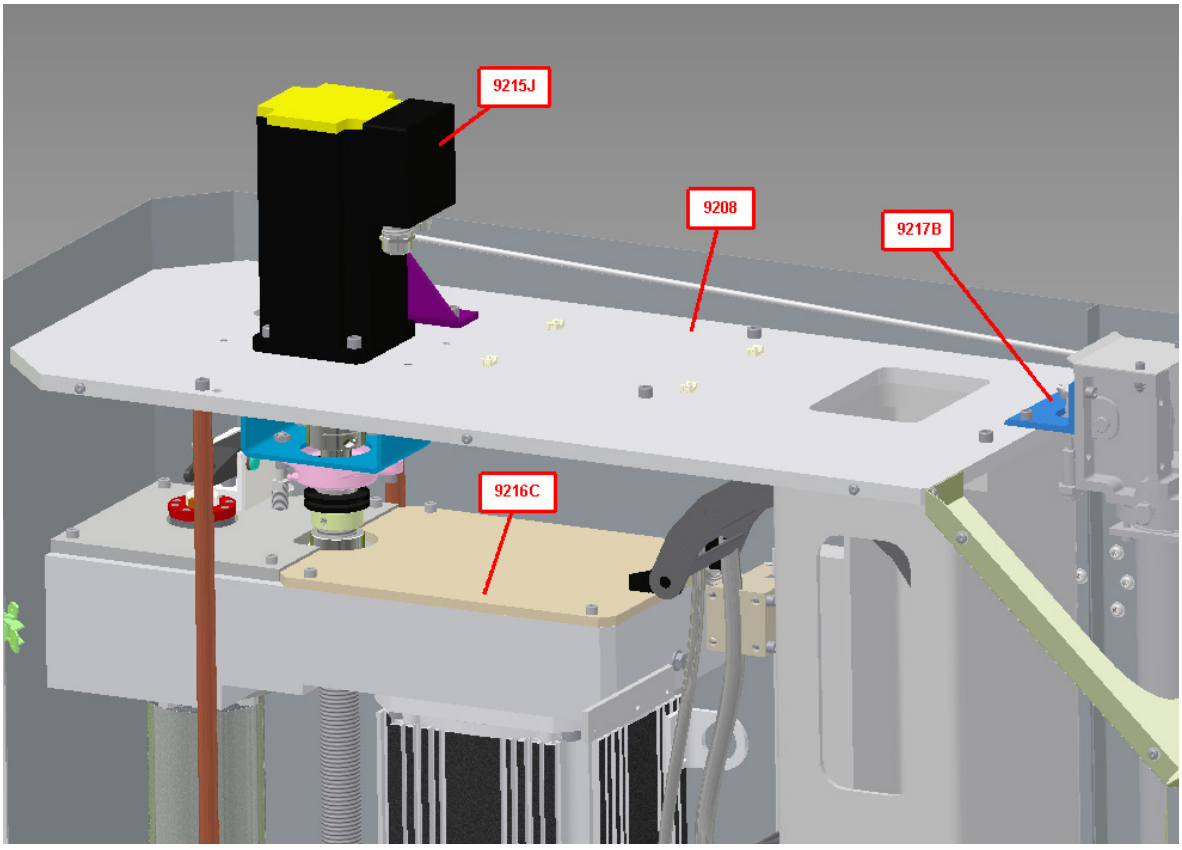
Lower spindle down onto a piece of wood to prevent the motor from falling.



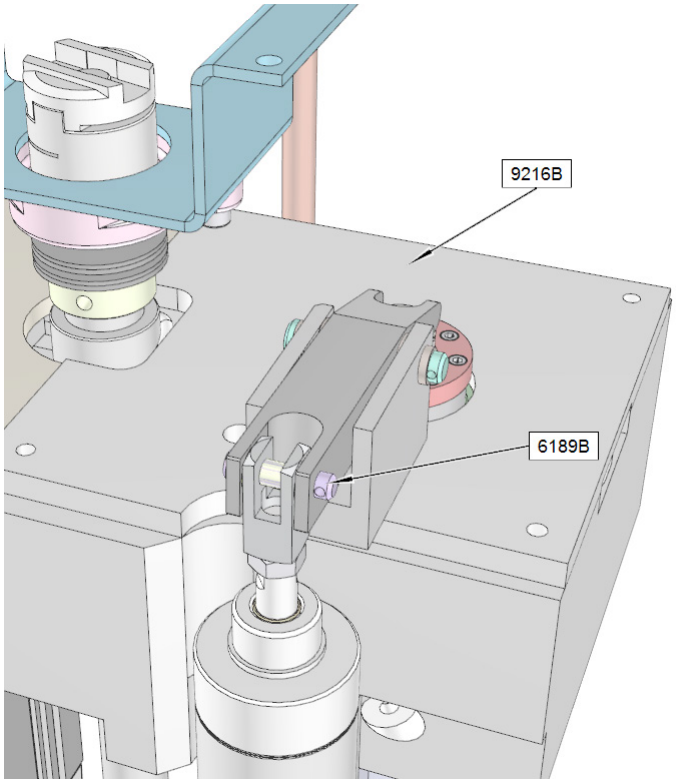
Remove the counter weight cable end from the upper housing.



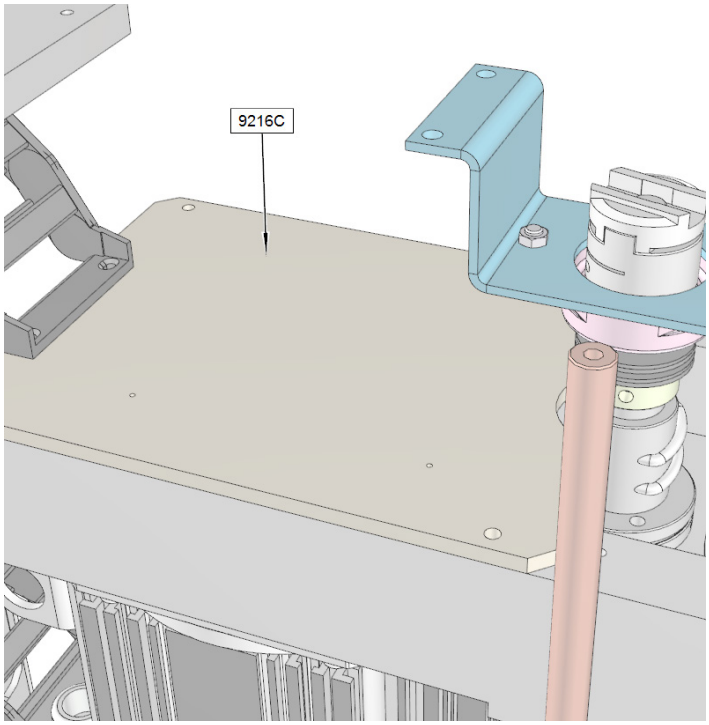
Remove Z-Axis motor, mount plate, and bracket.



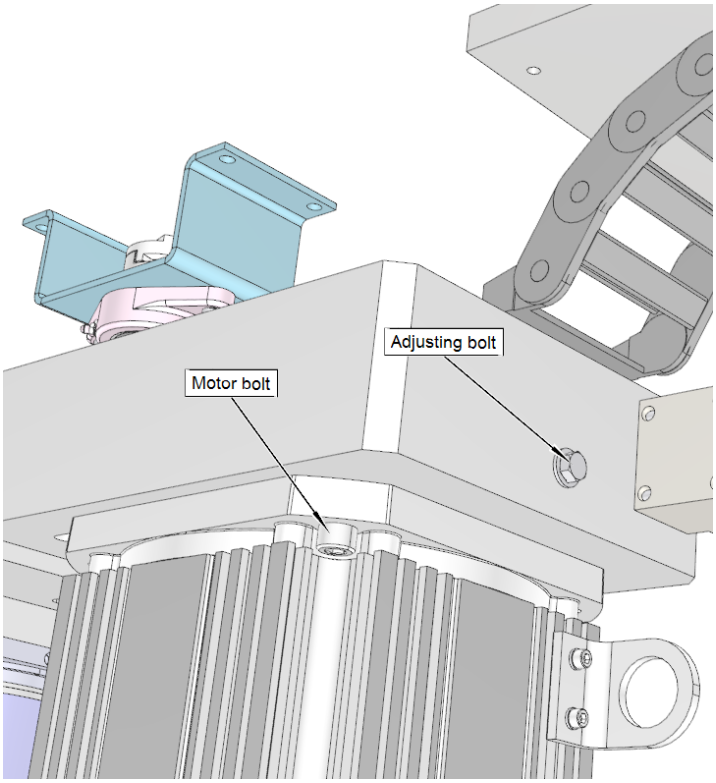
Remove drawbar bracket assembly and front housing cover plate.



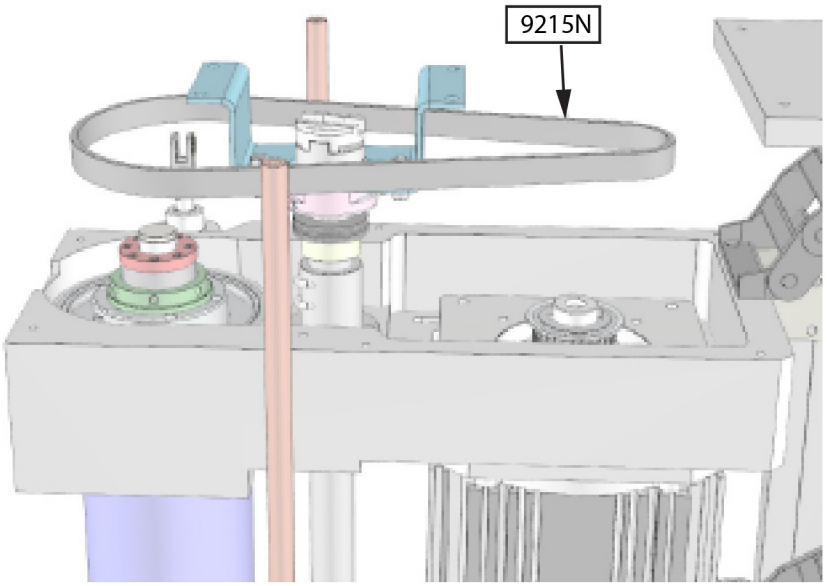
Remove rear housing cover plate.



Loosen motor mount bolts and belt tension adjusting bolt.



Remove and replace bolt.

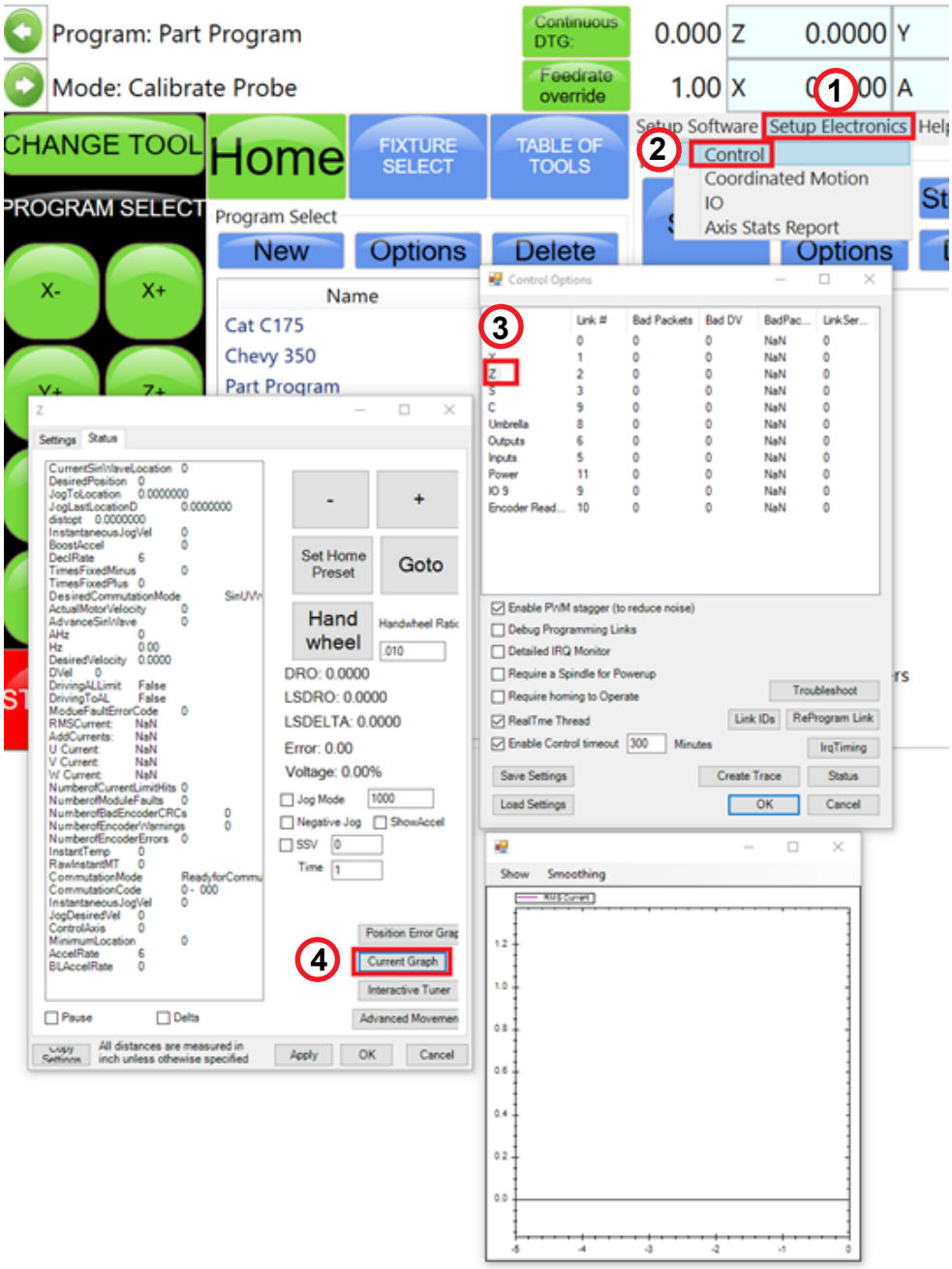


When the new belt is in place use the adjusting bolt to set the belt tension. Proper tension is when there is 5/16” of deflection when 2-4 lbs. of force is applied between the 2 pulleys.

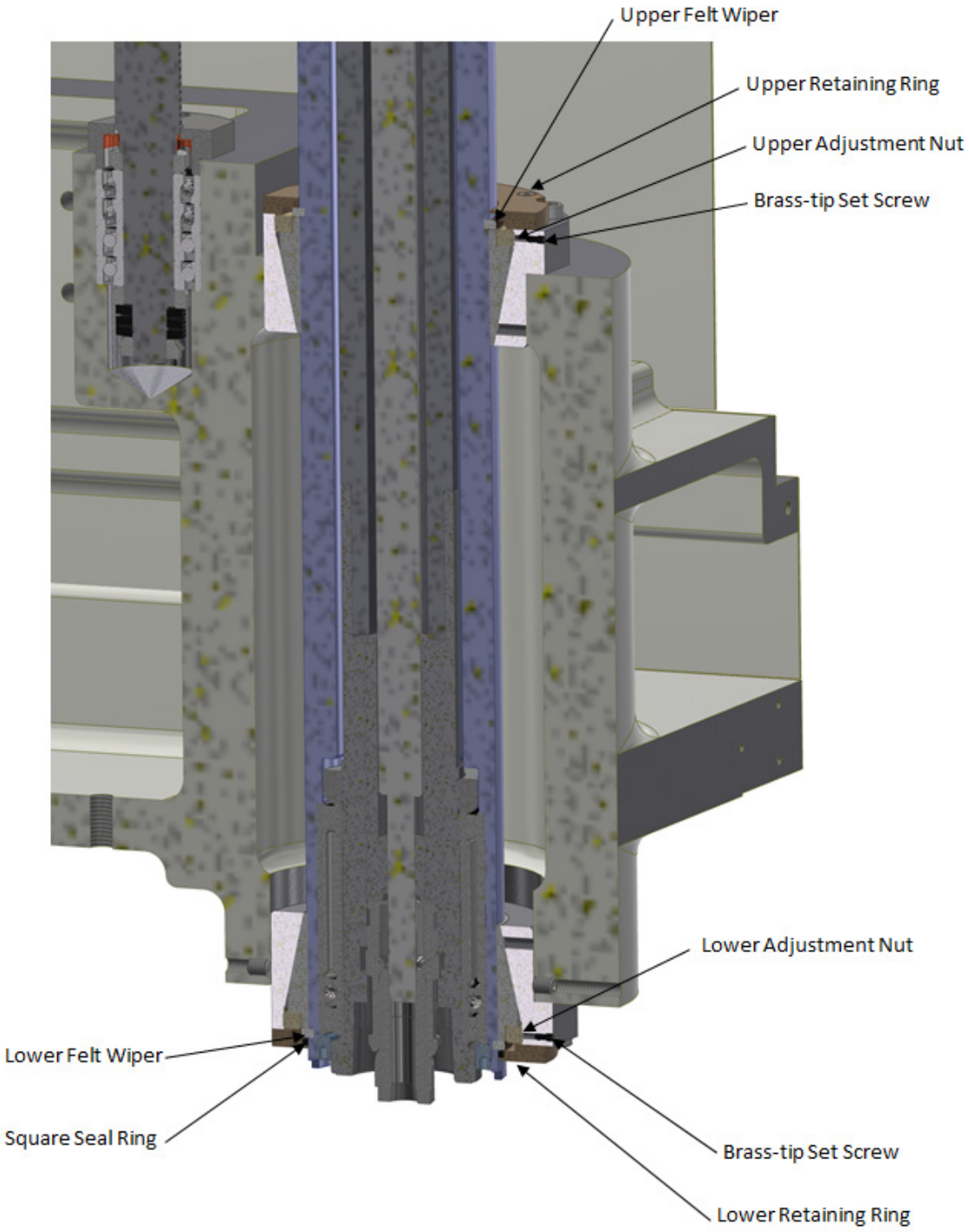
Outer Spindle Bushing Adjustment

NOTE Do the spindle sweep procedure before tightening the outer spindle bushings. Refer to spindle sweep for details.*

1. Start the Rottler software.
2. Pull up the graph by selecting Setup Electronics (1), then select Control (2), which will bring up the Control Options box.
3. In the Control Options box select Z (3) which will bring up the Z Status box.
4. Select Current Graph (4).



5. Before adjusting be sure that the spindle is well lubricated.
6. Move the spindle to middle of its travel in the Z-axis.



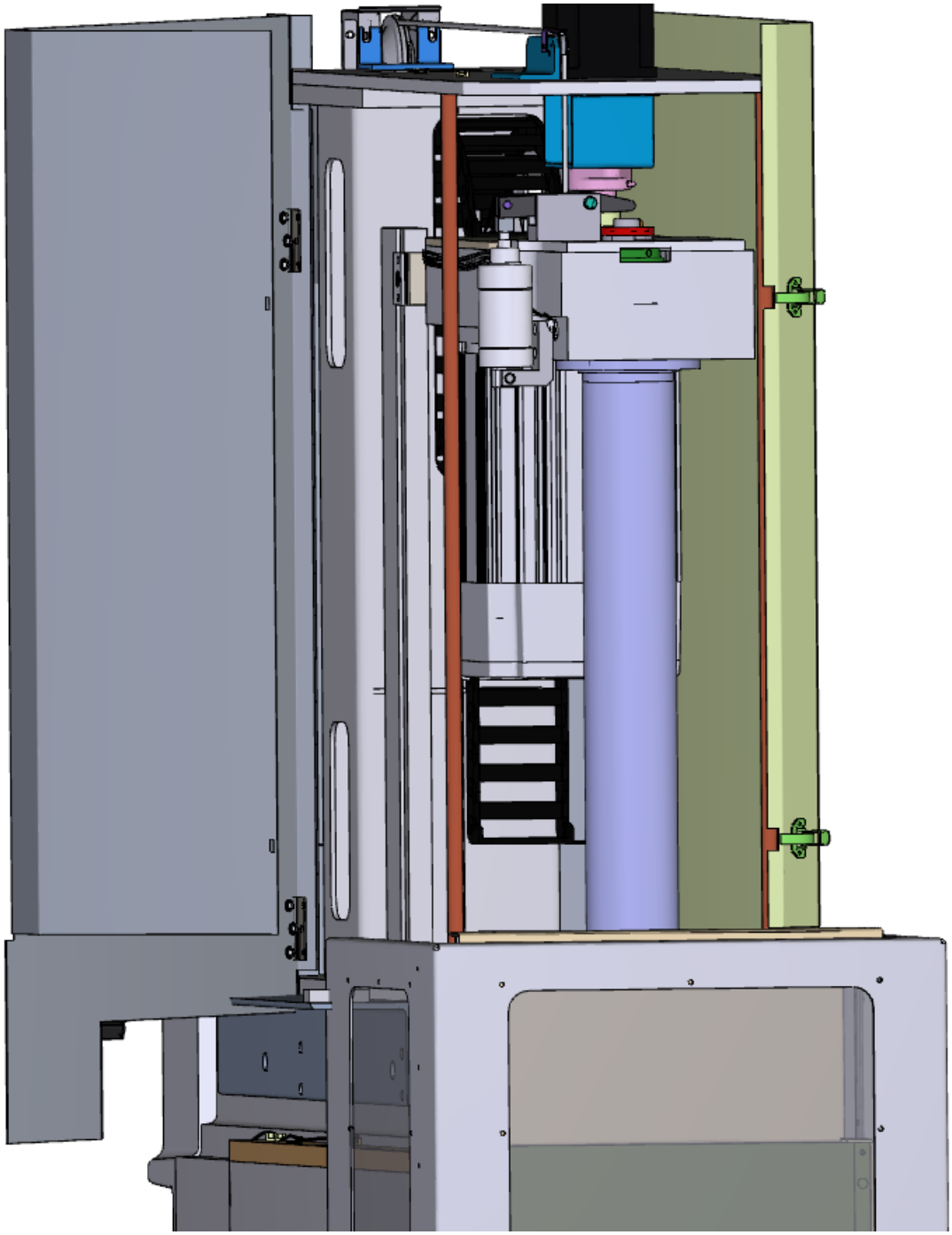
7. Unscrew the (4) 10-24 X 5/8 FHCS in the upper retaining ring, and move the ring/felt aside
8. Unscrew the (4) 10-24 X 5/8 FHCS in the lower retaining ring, and remove the retaining ring, Square ring, felt.
9. Loosen the brass-tip set screws in both the upper and lower bearing retainers

10. Loosen both upper adjustment nut and lower adjustment nut ¼ turn, move up and down 5” 5 times. Note the loosened amperage_____(.5-1.5)
11. Move the spindle to middle of its travel in the Z-axis
12. Move the spindle up 5”, then using a 3/16 pin punch and a 24oz metal hammer, tighten the lower adjustment nut (6223) until an increase of .25amps on the graph is noted.
13. Move the spindle to middle of its travel in the Z-axis
14. Move the spindle down 5”, then using a 3/16 pin punch and a 24oz metal hammer, tighten the upper adjustment nut (6223) until another increase of .25amps on the graph is noted.
15. With both adjustment nuts tightened a total of .5 amp should show on the graph
16. Tighten the (2) brass-tip set screws in the upper and lower bearing retainers
17. Reinstall the upper felt and the upper retaining ring (4) 10-24 X 5/8 FHCS
18. Reinstall the lower felt, and square ring then upper retaining ring (4) 10-24 X 5/8 FHCS. Replace felt or square ring if worn out.

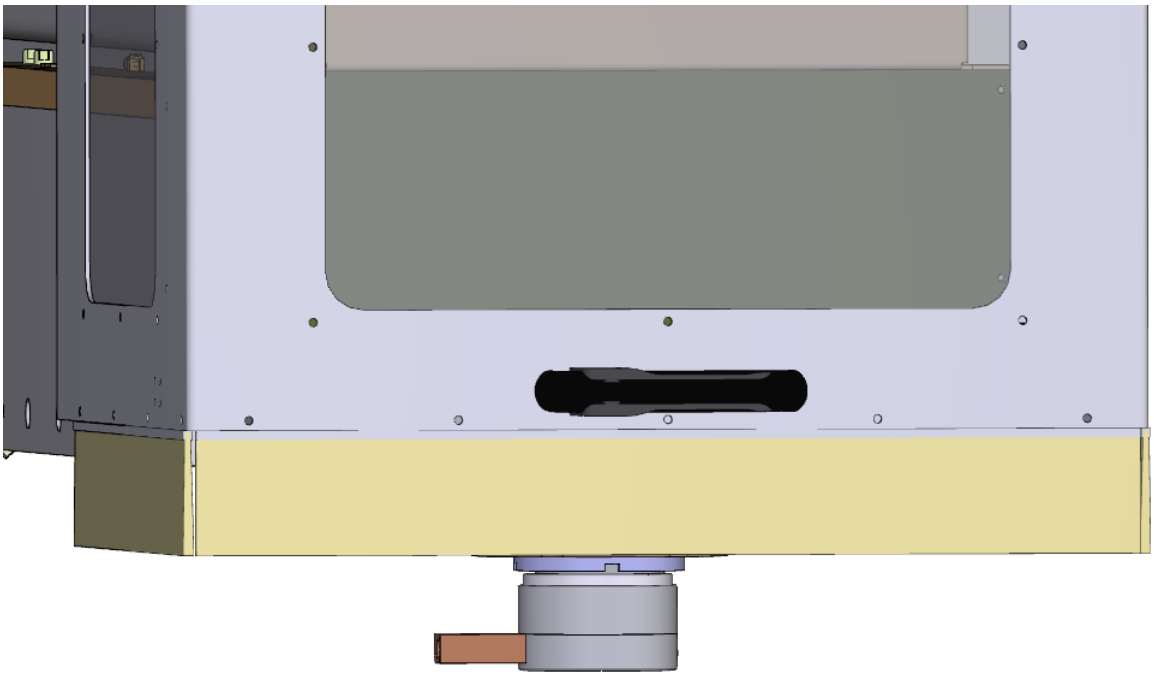
Inner Spindle Adjustment

⚠ WARNING **FOLLOW ALL SAFETY PROCEDURES LISTED IN THE SAFETY SECTION OF THIS MANUAL BEFORE STARTING THIS PROCEDURE**

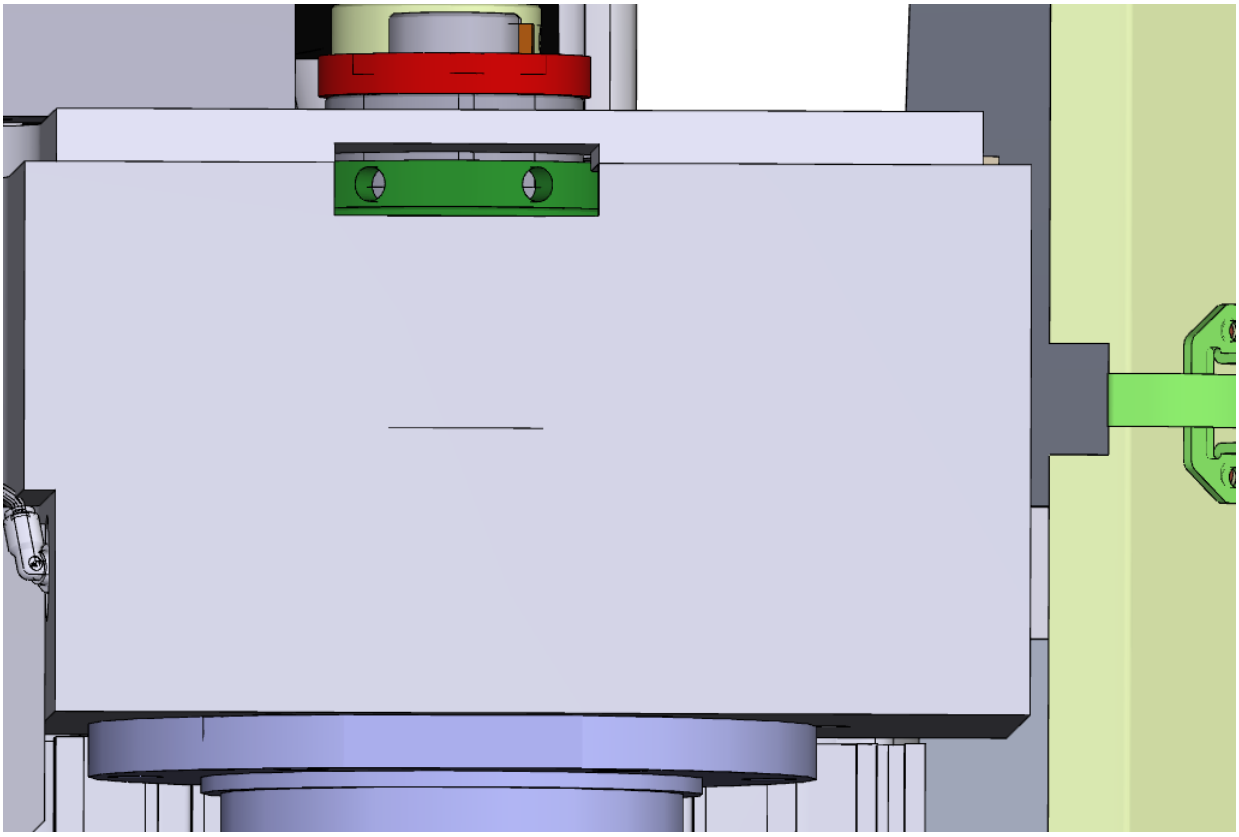
Open the spindle base door.



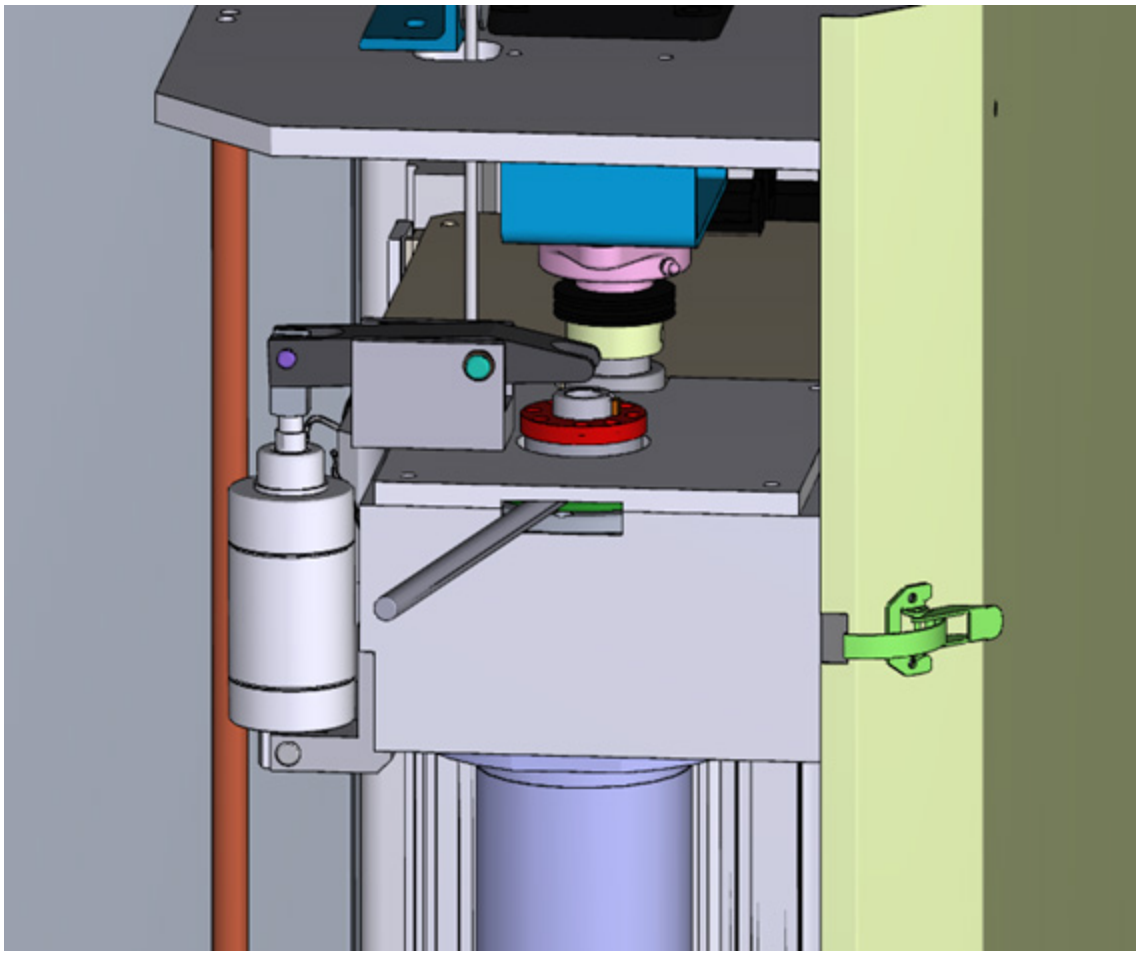
Install surfacing cutterhead or boring cutterhead with long tool holder onto spindle.



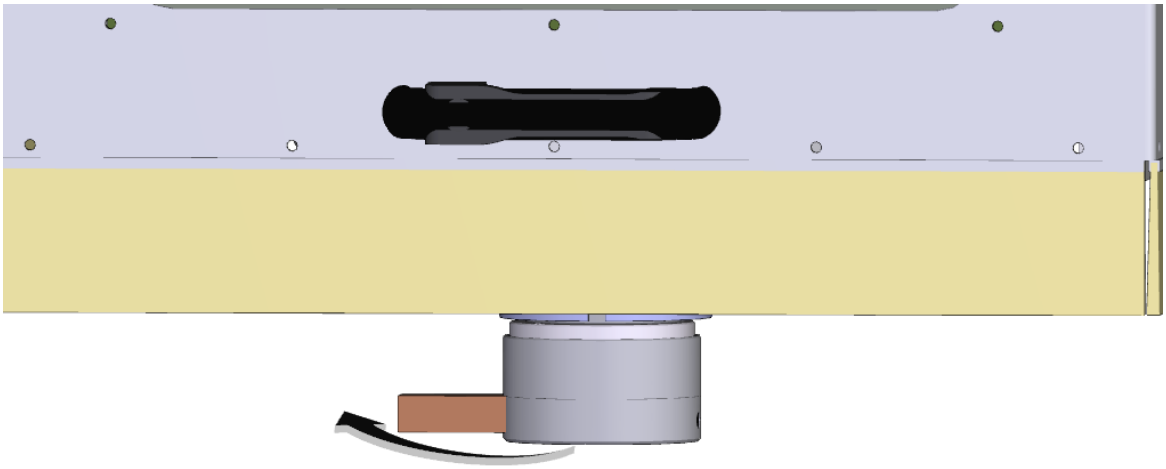
Locate opening in the belt housing.



Insert a rod into one of the drilled holes of the adjustment nut. This is used to lock the adjustment nut in place so that the nut won't turn while inner spindle is turned.

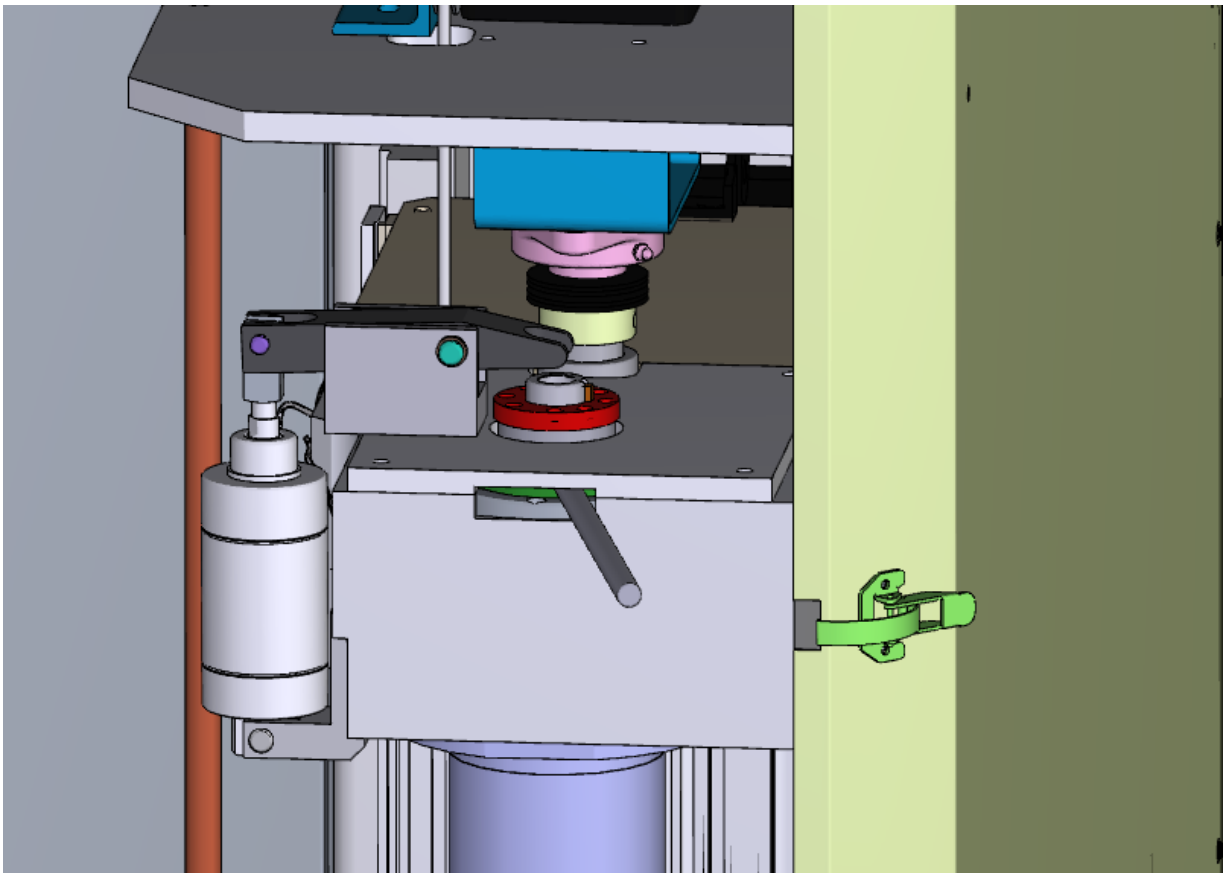


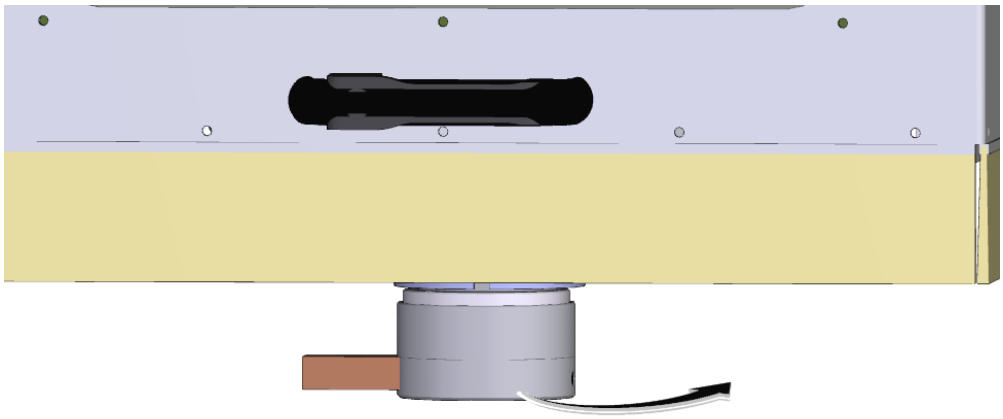
Grab hold of the cutterhead and turn it one turn clockwise to loosen the inner spindle adjustment.



Now turn the cutterhead counterclockwise. You will feel an increase of resistance as the spring load of the inner spindle increases. Continue to tighten until there is a sudden increase in effort to turn the cutterhead. At this point the inner spindle washers are fully compressed.

⚠ CAUTION ***IMPORTANT: DO NOT OVER TIGHTEN, SEVERE BEARING DAMAGE WILL OCCUR AND REPLACEMENT WILL BE NECESSARY***





Now turn the cutterhead clockwise until you feel the detent ball on the adjusting nut lock into place. The inner spindle is now adjusted.
Remove the rod from the adjustment nut and close the spindle cover door.

EM103/4/5 Upper Housing Disassembly

Travel the machine to the right Home position.
Remove the spindle base door and right side cover.
Place a board across the spindle base directly below the spindle motor (6790K or 6790U). Lower the spindle until the motor just touches the board.

⚠ CAUTION Disconnect all power and air to the machine before continuing, severe bodily injury may occur.

Remove the four (4) bolts securing the motor the belt housing. Remove the two (2) bolts that secure the cable carrier (6314K) to the upper housing. Remove the oil and air lines from the upper housing.

Note: It is not necessary to disconnect the spindle motor wiring.

Rotate the vertical ballscrew by hand until it is about eight (8) inches from the top plate.
Place a board, of proper length, between the bottom of the upper housing and the top of the spindle base to prevent it from falling.

Remove the two bolts that secure the centering gear housing (6168H) to the belt housing. Work the centering housing up off the centering shaft. Tie it up to the top plate.

IMPORTANT!!: Do not attempt to move the vertical under power when the centering housing is not bolted to the belt housing or the upper plate. Severe damage will result to the centering shaft!!

Remove the Clevis Pin (7210B) from the draw bar actuator bracket (6174B). Lift the actuator arm (6173B), move the arm and cylinder off to the side. Remove the air cylinder (6204A), clevis pin (6189A) and mount bracket (6188C) from the side of the belt housing. Remove the two (2) bolts that attach the draw bar actuator bracket (6174B) to the to belt housing cover.

Remove the counter weight cable (6453 F or 6453G) from the upper housing by loosening the lock nut and unscrewing the cable nut.

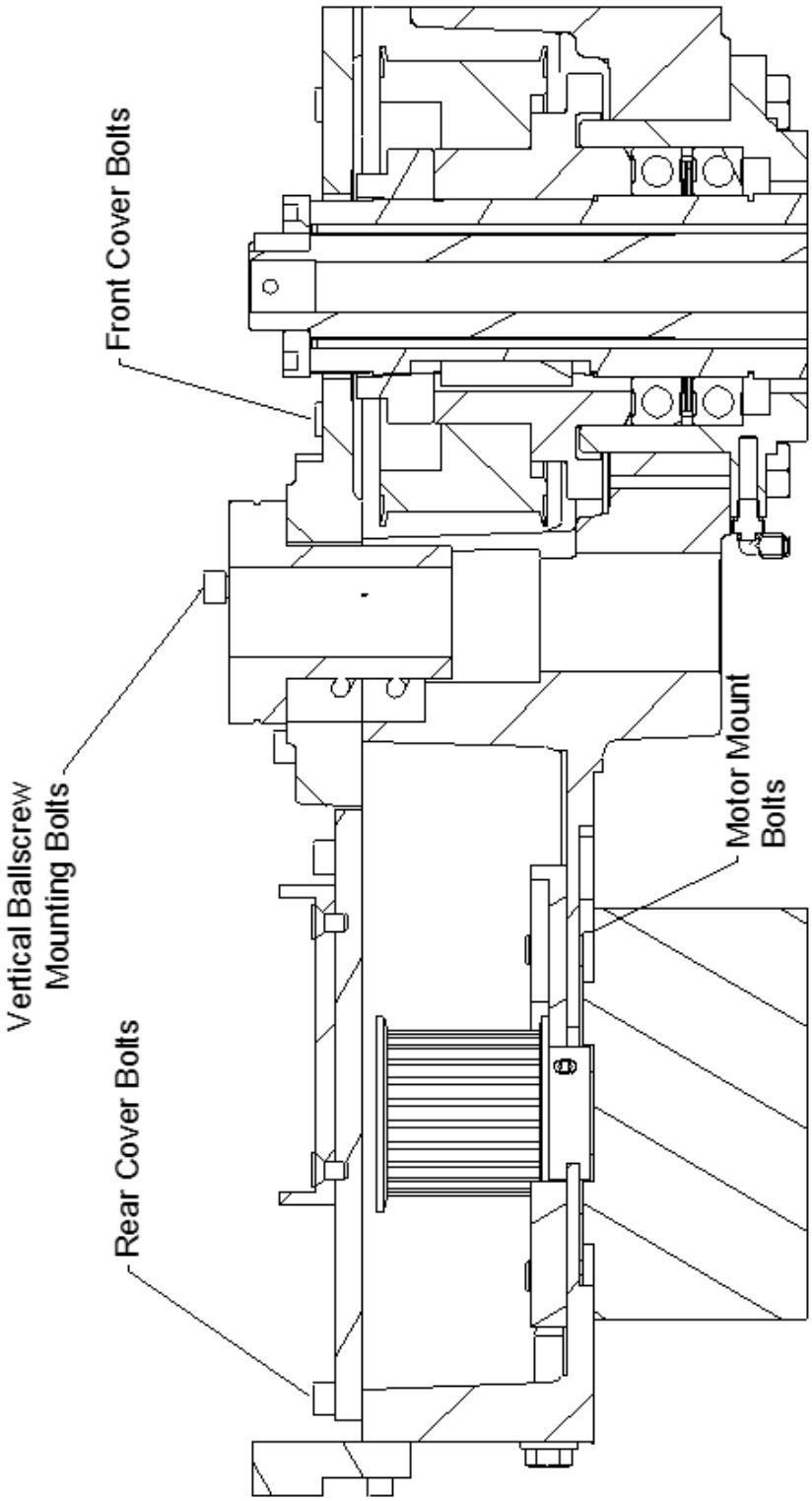
Note: When reassembling, be sure not to thread the cable nut in too far as it may come in contact with the driven pulley.

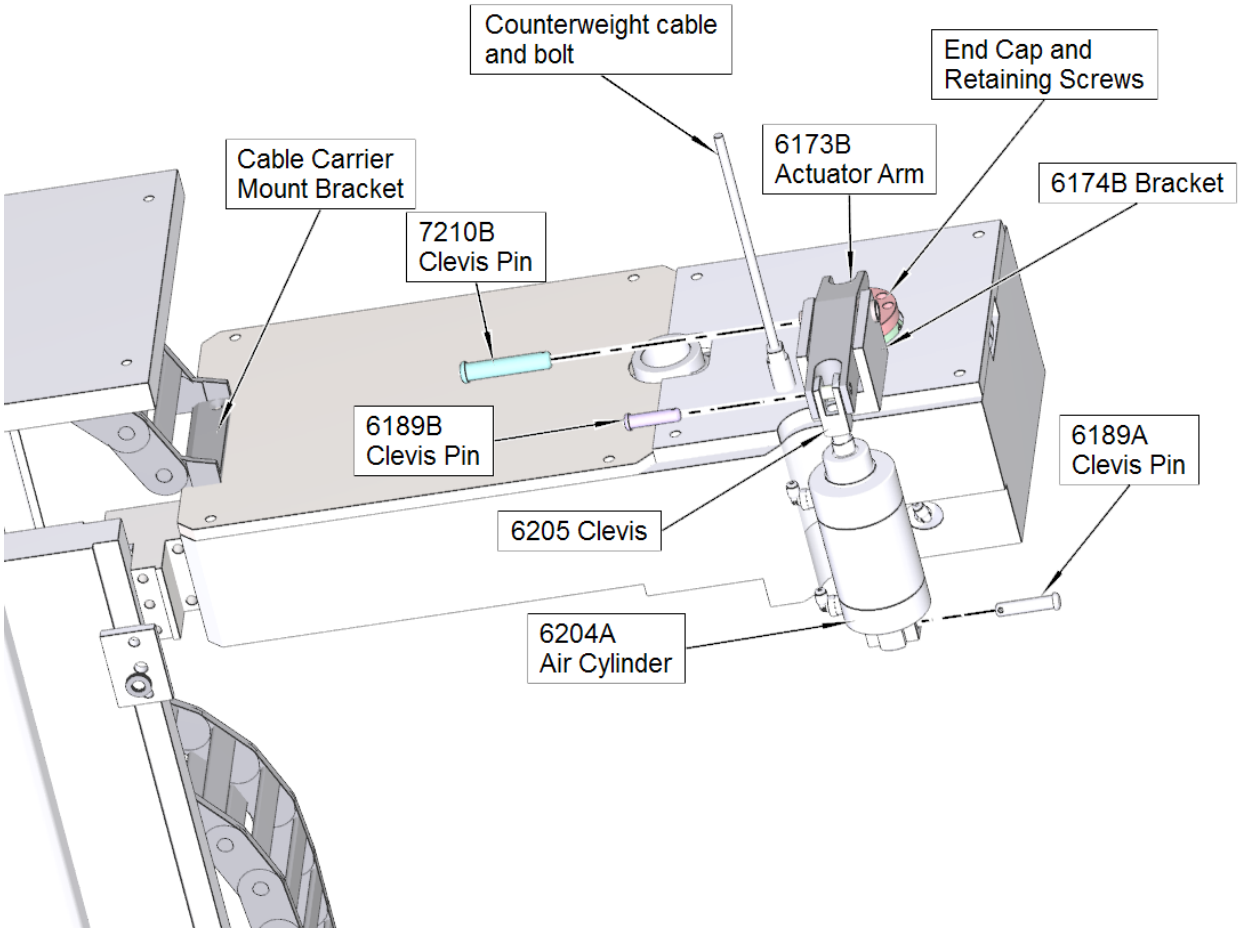
Remove the eight (8) screws holding the inner spindle end cap (6180A). Unscrew these bolts slowly around the diameter of the end cap as they are under spring pressure from the draw bar. Remove the cap by pulling straight up.

Note: When reinstalling, the end cap must be aligned concentric to the draw bar.

Remove the three (3) screws that secure the vertical ballscrew nut to the belt housing. Holding the nut with one hand, turn the ballscrew with the other to move it up and out of the way so the belt housing lid can be removed.

Remove the bolts securing the belt housing covers. The covers are pinned to the belt housing. Use a soft face mallet to carefully remove the covers.
From this position you can remove and/or replace pulleys and belts.


Front Cover Bolts
Vertical Ballscrew
Mounting Bolts
Motor Mount
Bolts
Rear Cover Bolts


Counterweight cable and bolt
End Cap and Retaining Screws
6173B Actuator Arm
Cable Carrier Mount Bracket
6174B Bracket
7210B Clevis Pin
6189B Clevis Pin
6189A Clevis Pin
6205 Clevis
6204A Air Cylinder

EM103/4/5 Inner Spindle Removal

Prior to following these instruction, perform the steps in Upper Housing Disassembly.

IMPORTANT: When removing bearings, bellevilles and spacers, not the direction they come off for correct reassembly.

The driven pulley and inner spindle adjustment nut must be in place before continuing. Remove the LEFT HAND THREAD throwback ring (6305D) from the bottom of the outer spindle.

Note: If the driven pulley and inner spindle adjustment nut are not in place the inner spindle will be able to fall out of the outer spindle.

While supporting the inner spindle from the bottom, remove the inner spindle adjustment nut and driven pulley from the top.
The inner spindle is now free to be removed from the bottom. This spindle is precision fit into the outer spindle, it may be necessary to tap the top of the inner spindle with a soft face mallet to get the spindle to drop out.

Note: Be sure of the thrust direction of the bearings on reassembly.

Reassemble in the reverse order.

Inner Spindle Angular Contact Bearing Replacement

Prior to following these instruction, perform the steps in Upper Housing Disassembly and Inner Spindle Removal.

Loosen the three (3) Allen head set screws on the shoelock nut (6116F).
Loosen the shoelock nut and slide off of the top of the spindle.

Note: Be very careful not to damage the threads when sliding nuts, bearings and sleeves off the top of the inner spindle. These are very fine threads used for the inner spindle adjustment nut.

Remove the top bearing by tapping lightly and evenly on both sides of the bearing. After the bearing is moved slightly off of the spacer set (6172E) tap the inner race.

Note: Tapping on the outer race can cause it to roll off of the bearings. Generally after removing the bearings from the inner spindle they are not suitable for re-use.

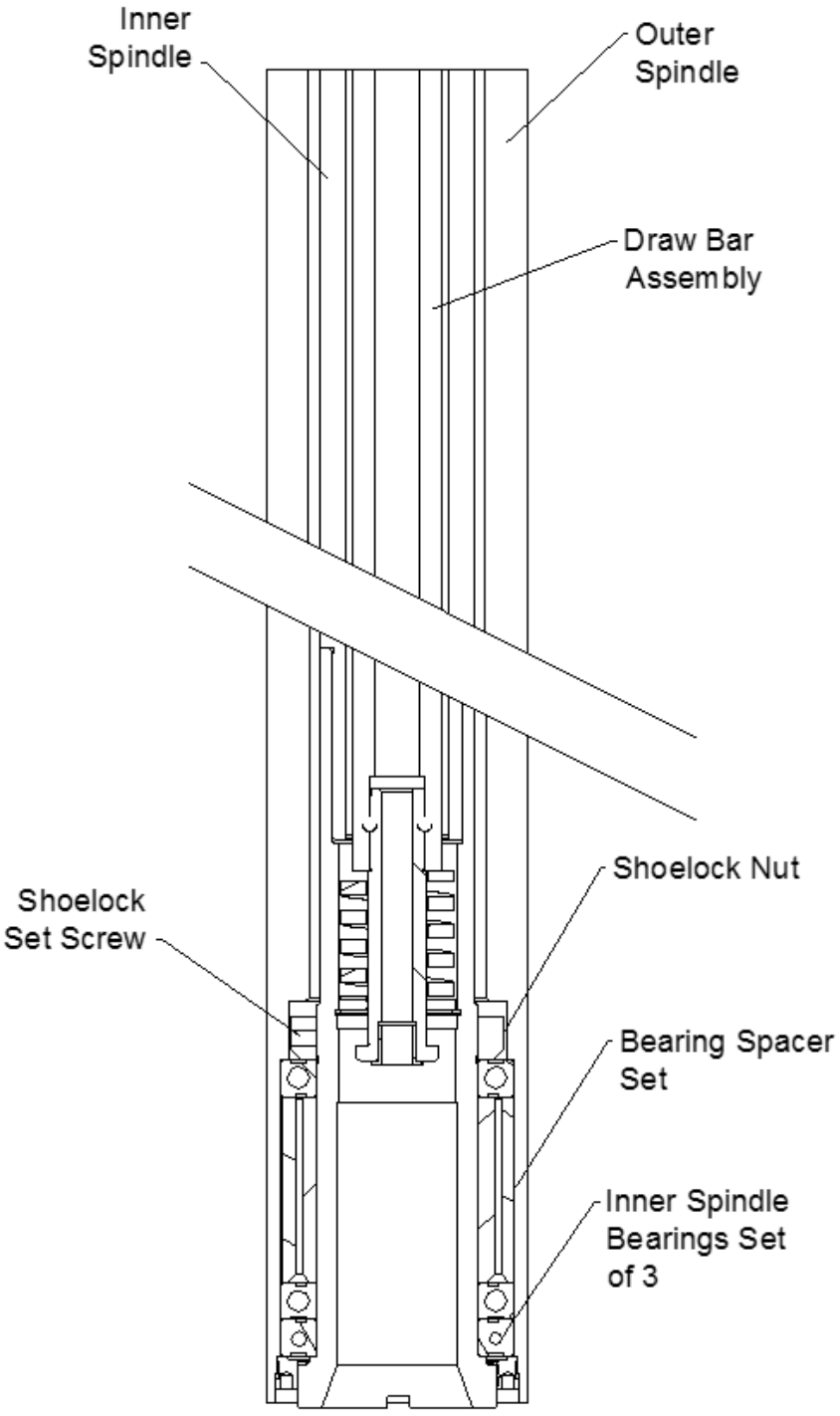
Remove the spacer set.
Remove the two lower bearings (6116E) set of three (3) the same way as the top bearing.
Stand the spindle on end so that the bearing pack is nearest the floor.
Make sure inner spindle is free of all dirt and debris.
Lightly coat the lower bearing pack area with a light weight #10 oil.

If you have a bearing heater available to you, it is the preferred method of bearing installation. If not, follow the instructions below.

Slide the two (2) lower bearings onto the inner spindle with the correct bearing thrust direction until they stop. Use a small brass punch to lightly tap each side of the bearing on the inner race until both bearings are seated at the bottom of the spindle.
Install the spacer set.

Install the top bearing using the same procedure as the lower bearings until it is seated against the spacer set.

Install the shoelock nut and tighten with a spanner wrench until the inner races of the bearings and spacer set are fully seated together.
Tighten the three (3) set screws on the shoelock nut.
Place the inner spindle in a vise near the bearing pack and lock the vise.
Indicate the bearing set to within .0005” all the way around. Adjust the spacer set by tapping the high side lightly with a brass drift.



Spindle Sweep

The outer spindle must be swept into the main bed of the machine to achieve accurate bores.

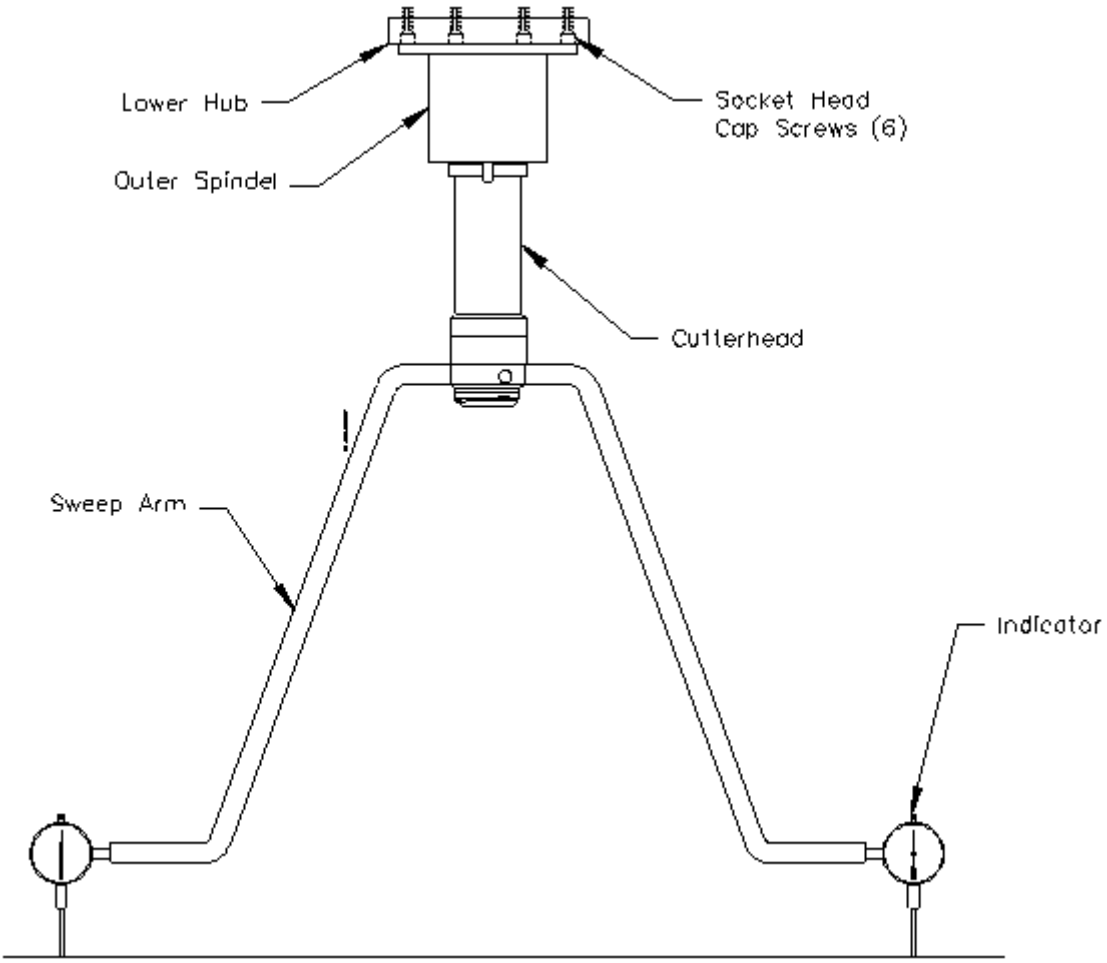
Remove all fixturing from the machine bed, clean and stone if needed.
Install a boring cutterhead into the machine.
Install the sweep are into the cutterhead.
Bring the machine down until you have about .005” pressure on the indicator.

⚠ CAUTION Disconnect all power and air to the machine before continuing, severe bodily injury may occur.

Turn the sweep arm to the 9 O’clock position. Zero the indicator here.
Loosen the 6 socket head cap screws on the lower spindle hub. You do not want them all the way loose, just snug.
Use the four (4) set screws in the spindle base to move the spindle until the indicator reads within .0005” with a full 360 degree sweep of the indicator.

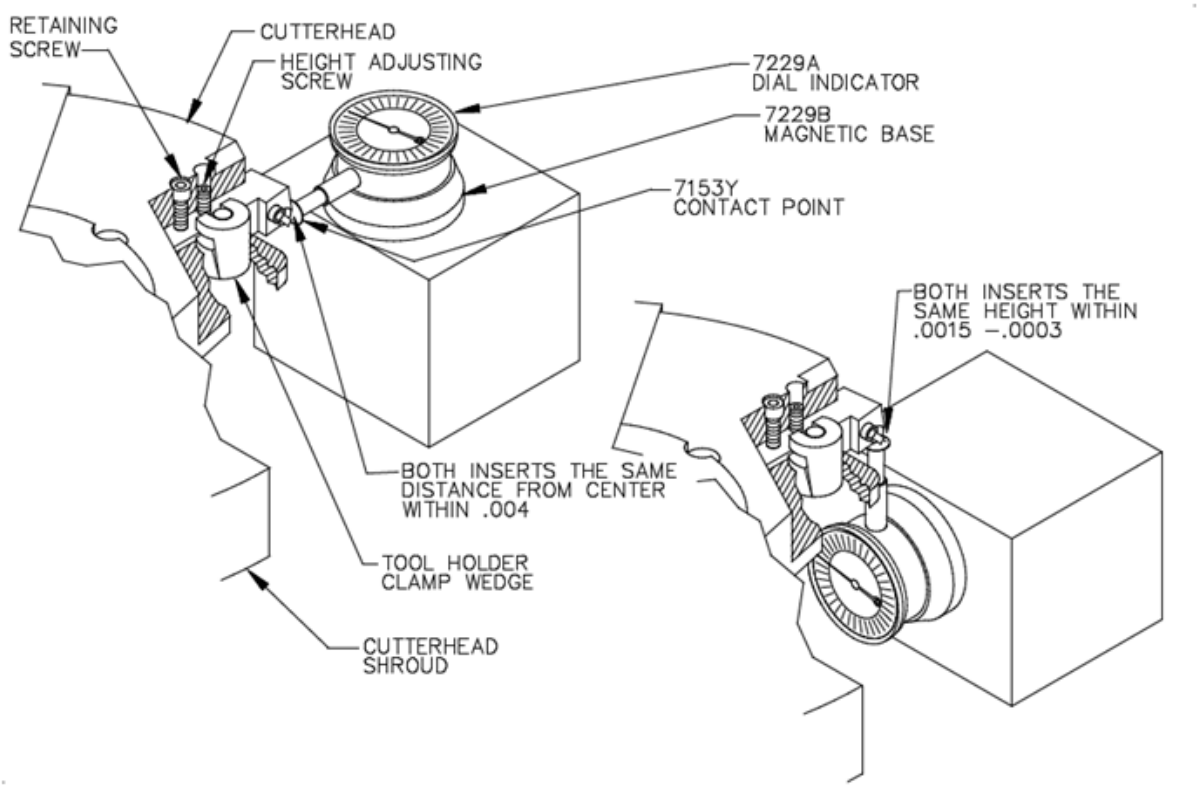
Note: You do not want the right hand side of the spindle to be more positive than the left, it will interfere with the automatic tilt of the machine when in Mill mode.

Once the spindle is swept in tighten the six (6) socket head cap screws and double check that the sweep did not move.



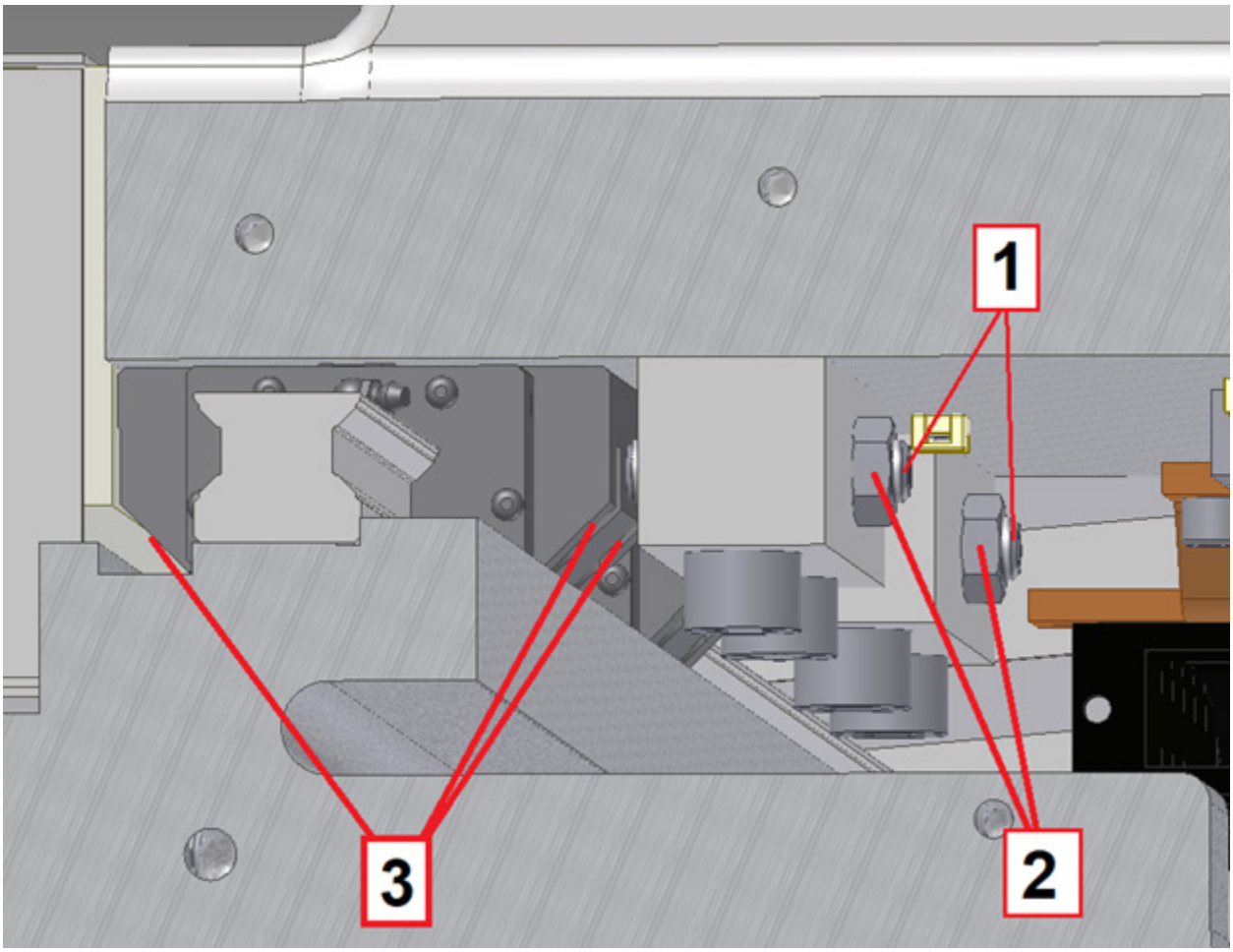
Setting Up Rottler Fly Cutting Tool With Two Inserts

1. Travel the spindle to the center of the machine bed.
2. Go to the Rottler home screen on the machine before proceeding.
3. Remove the cutter head shroud from the fly cutter. Attach a dial runout indicator to a cylinder head or engine block, etc.
4. Rotate cutter head and check to see that both inserts are the same distance from the center of the spindle, within .004.
5. If adjustment is necessary loosen the tool holder clamp wedge, and the height adjustment screw. Move tool in or out the required distance. Tighten the clamp wedge. Snug up the height adjustment screw. There is a set screw located at the bottom of the tool holder; it locks a dowel pin in place.
6. When the in-out adjustment is set, loosen the set screw, the pin will pop out and hit the back of the slot. Tighten the set screw. This way, when a tool holder is removed and then replaced, it will be located very nearly where it was.
7. Insert height will still need to be adjusted.
8. Rotate cutter head and check to see that both inserts are the same height within .0010-.0003. If adjustment is necessary loosen the tool holder clamp wedge, then alternately loosen and tighten the height adjusting screw and the retaining screw, until both inserts are set as desired.
9. Retighten the tool holder clamp wedge, and recheck both inserts.



Adjusting Horizontal Gibs

The Horizontal gibs are located under the main column, on the back side of the front way. These gibs keep the column from “cocking” when the direction of travel is changed. This adjustment becomes more critical when line boring. If the gibs are too loose the column will turn slightly sideways when traveling. This will cause the alignment of the right angle drive to be off. The cutter head will then cut heavier on one side of the bore.



To adjust:

- Remove the front metal chip cover.
- Loosen the linear rail truck bolt (3) (four per truck)
- Loosen the Lock Nut (2) on the set screw.
- Tighten the set screw (1) to 35 ft. lbs. using a correct size Allen; this will pull the Front Way bearing up against the front way while pressing the gib up against the Front Way.
- Loosen the Set Screw.(1)
- Tighten the set screw (1) to 10 ft. lbs. (120 in. lbs.)
- Lock the Lock nuts. To 35Ft. Lbs. (2)
- Tighten the linear rail truck bolt (3) (four per truck)

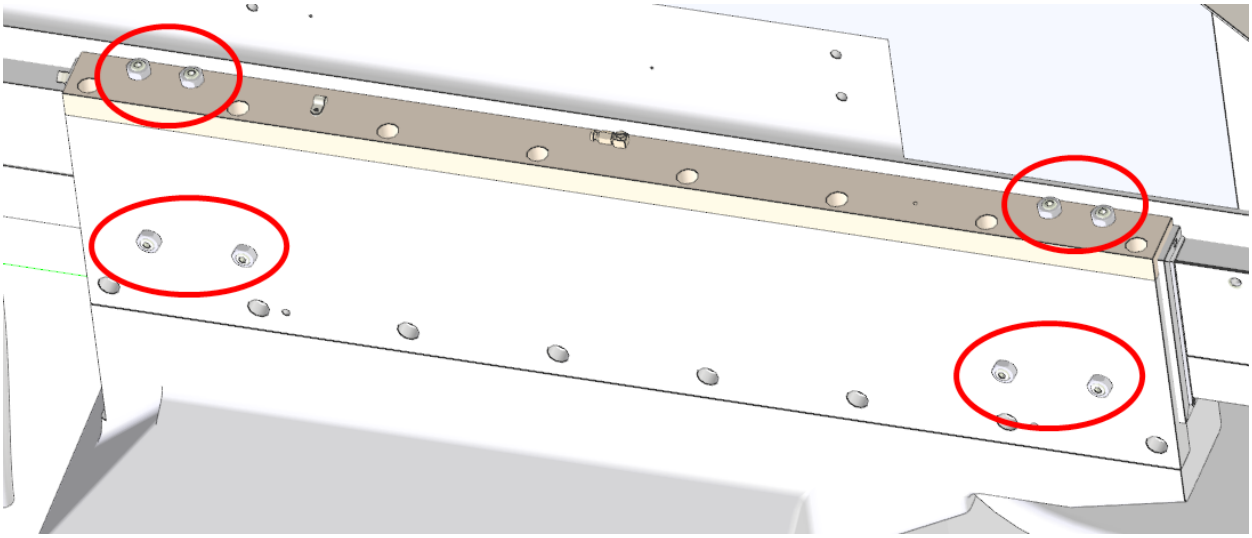
Run the machine back and forth to let the gibs adjustment to seat in.

Another way to check for correct adjustment is to attach a magnetic base dial indicator (.0001 resolutions) to the column with the indicator tip contacting the machine way surface.

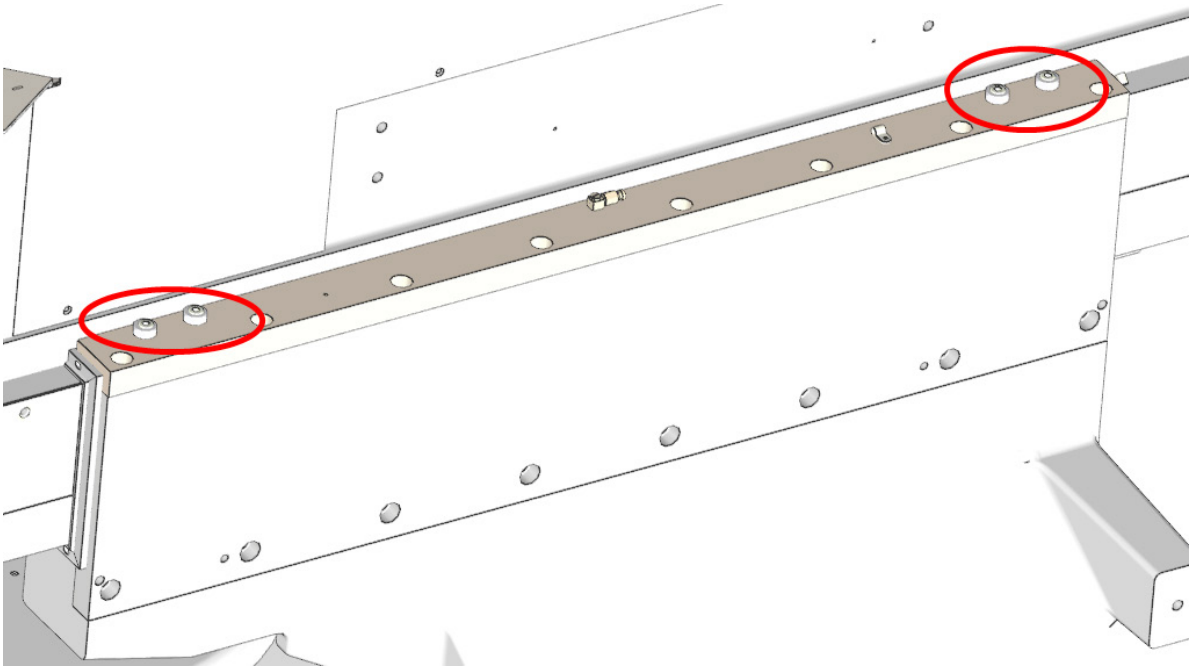
Now using the handwheel in .010” per click mode, move the column back and forth, about two turns on the handwheel in each direction at a rapid rate.
Note the amount of movement on the dial indicator.
The acceptable amount of movement on the dial indicator is between .0000 -.0002”
Adjust as necessary. This procedure must be performed on both, the right, and left, side of the column.

Adjusting Y-Axis Gibs

The Y-Axis adjusting gibs are located at the top of the machine column that the spindle base is mounted on. There are gibs located on the top and side rails on the left side of the column. Two are located on the top rail and two are located on the side rail.



On the right side of the column there are gibs located on the top rail.



Adjustment Procedure

1. On the left side rail loosen the jam nuts.
2. Tighten the set screws until they bottom out and can’t be turned further.
3. Loosen each set screw 1/8 turn.
4. Tighten jam nuts.
5. On both top rails loosen jam nuts.
6. Tighten the set screws until they bottom out and can’t be turned further.
7. Loosen each set screw 3/4 turn.
8. Tighten jam nuts.

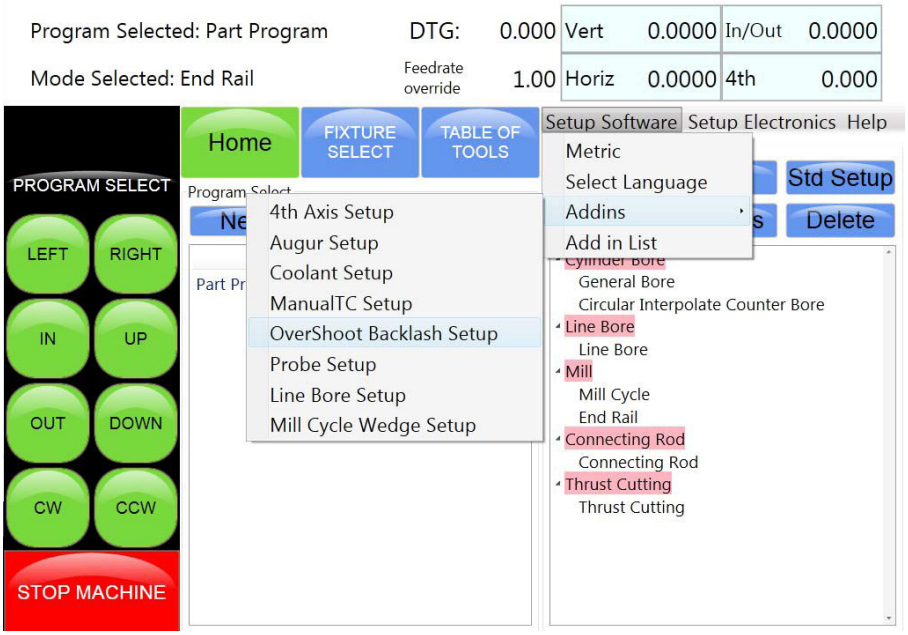
Backlash Setting .NET Software

The Screens depicted below are for setting Backlash compensation values only. DO NOT use any other information on these screens to change information on the machine.

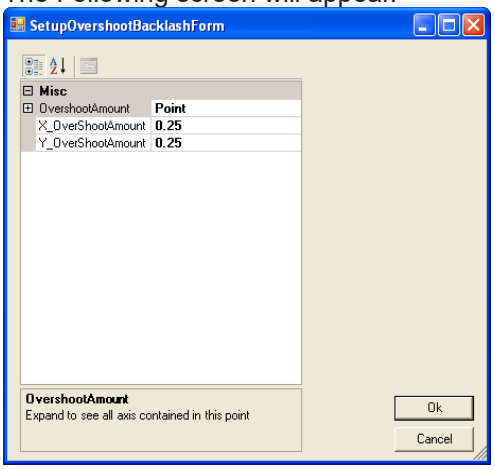
Turn off “Overshoot Backlash Setup”

Note: Only the F70-90 and 100 machines use the overshoot feature.

Go to Setup Software>Addins>Overshoot Backlash Setup



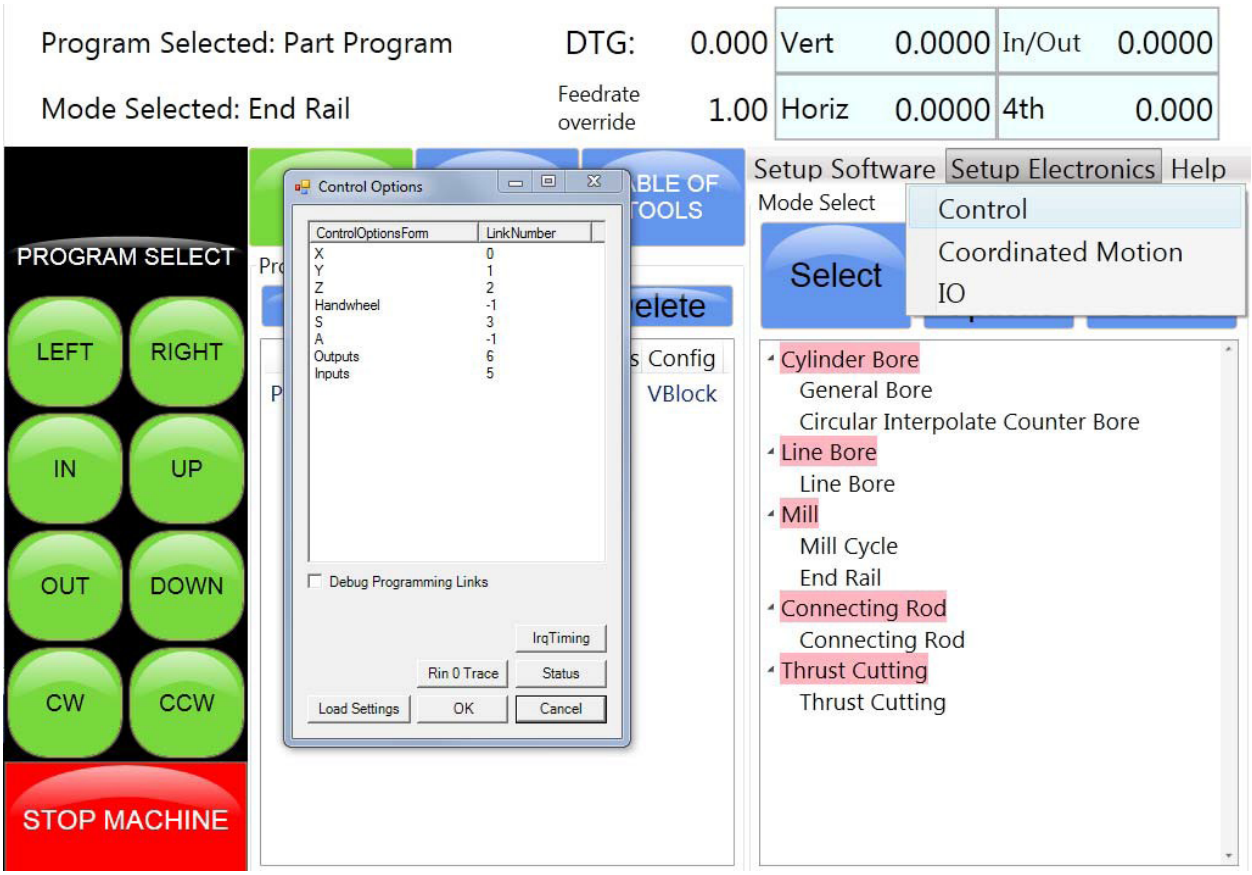
The Following screen will appear.



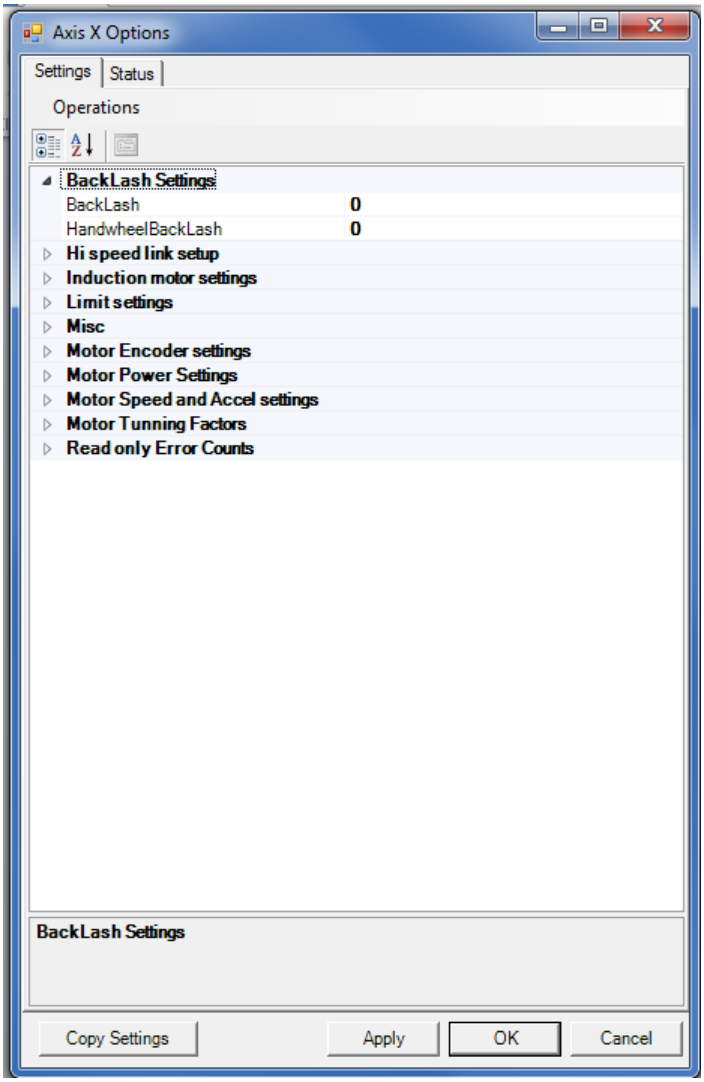
1. Record the existing X and Y “Overshoot Amount”. Generally .250

2. Use the “On Screen Keyboard”, or plug in the full size keyboard, and change the amounts to 0.00, and click on OK. Close the “Setup” screen.

3. Go to Setup Electronics>Control



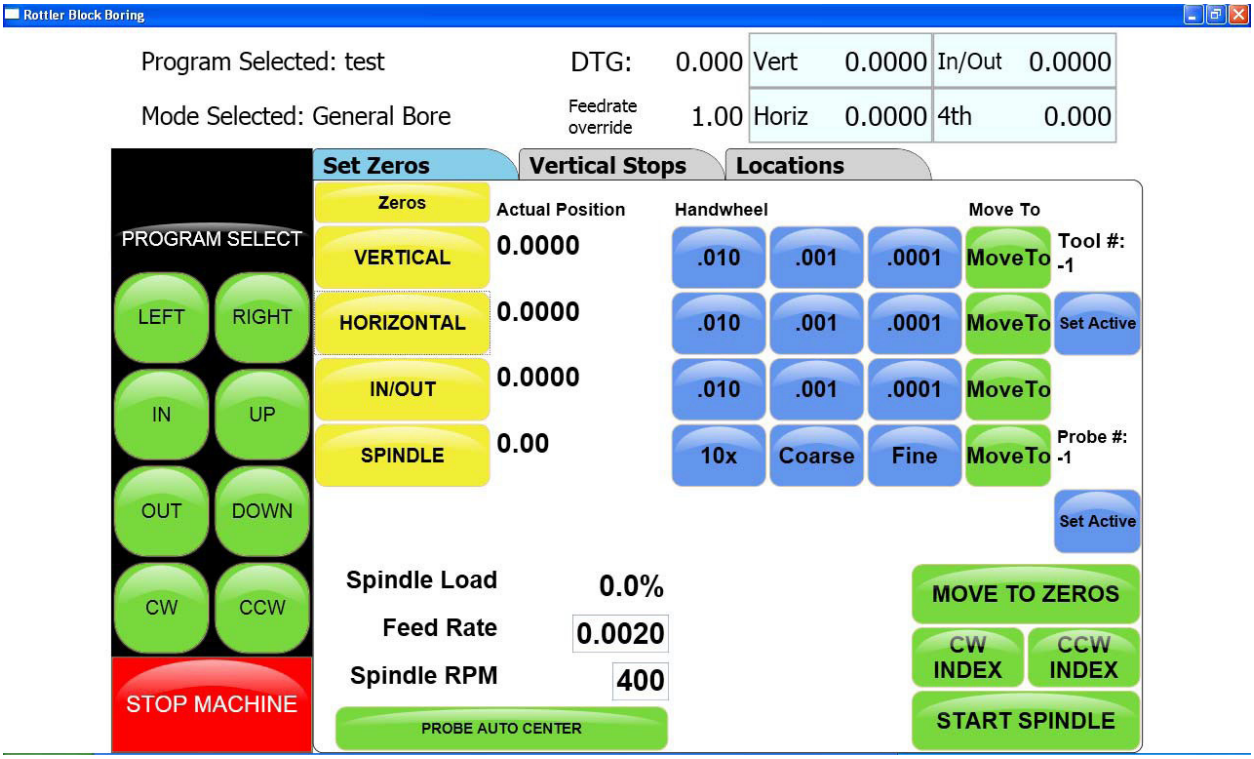
4. On the “Control Options” screen, double click the X to bring up the “X Options” screen.



Now minimize the screen.

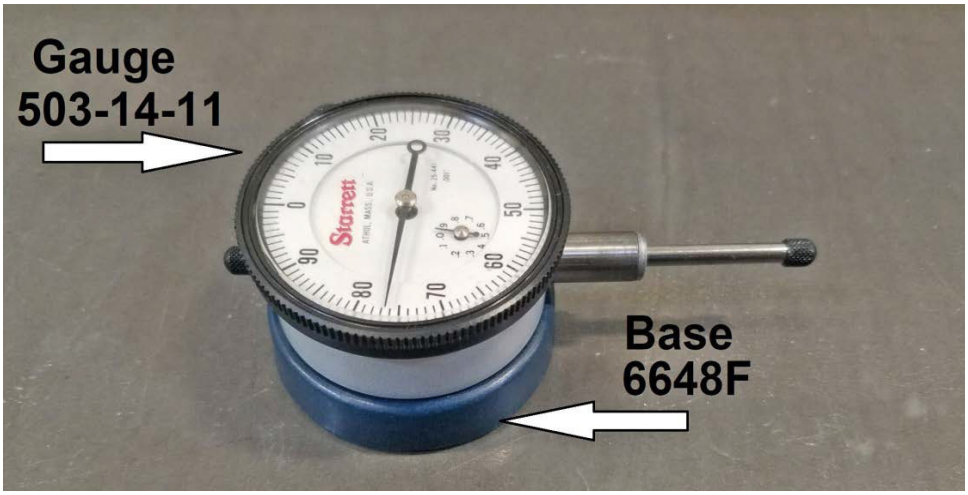
5. Repeat step 5 for the Y and Z axis.
6. Close the “Control Options “screen.

7. Select a program (block), then select any cylinder bore mode.



Notes:
******The photos shown are demonstrating the X axis (horizontal) backlash adjustment. The Y and Z axis are adjusted following the same steps.***
******The direction of machine travel to put the initial load on the dial indicator, are as follows: X (horizontal), from the right toward the left.***
Y (in/out), from back toward the front. Z (vertical) from top toward the bottom.

A Dial Indicator with 1.0” to 1.5” of travel should be used for several reasons.

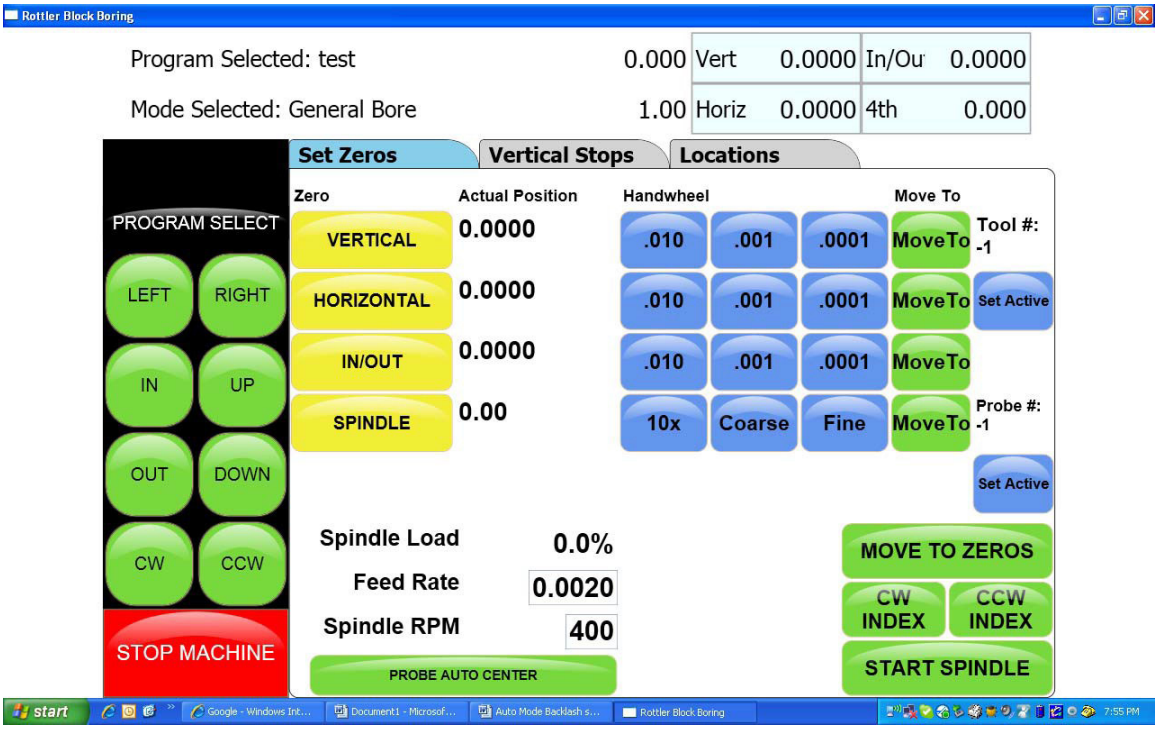


If the axis is overshooting or coming to position slowly you will be able to see it with a dial indicator. With Digital indicator you will only see the end position. The Magnascale indicator should be used to dial or tram in. The automatic moves of the machine can “Shock” the sensitive plunger of the Magnascale.

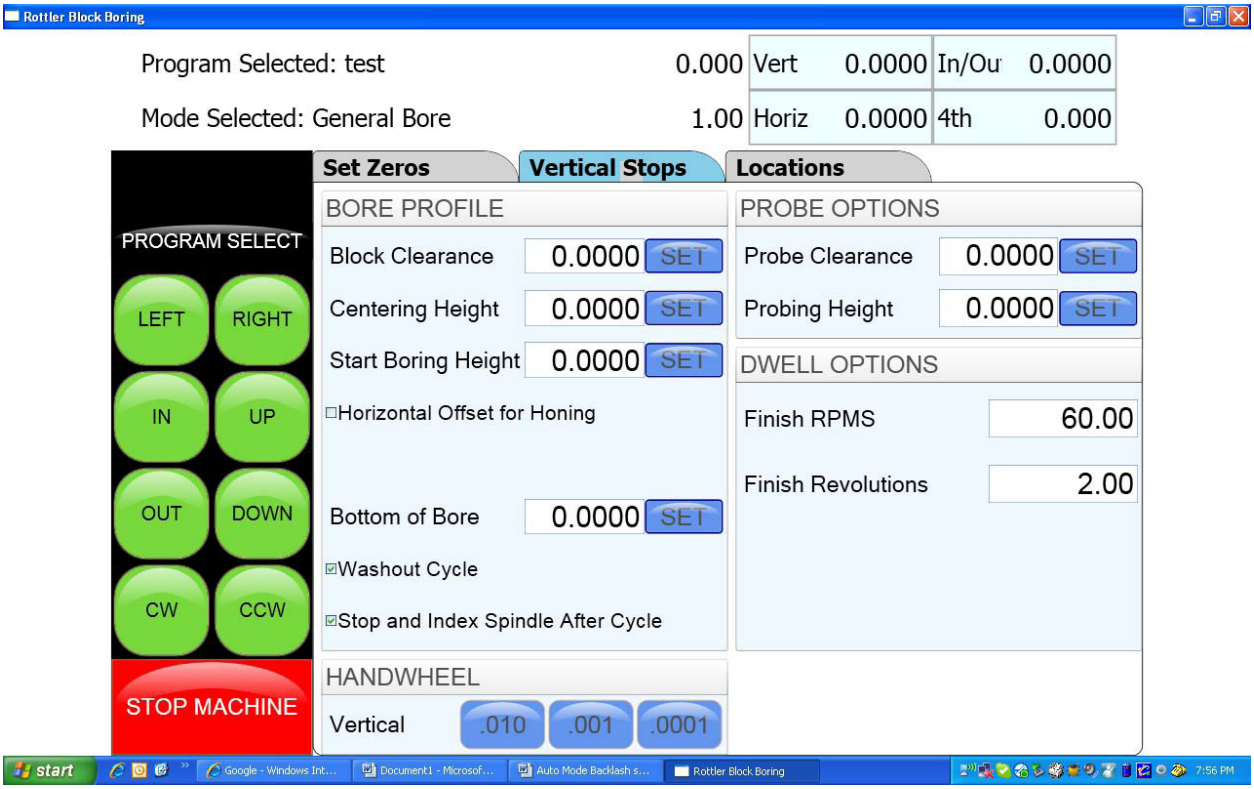
8. Attach the magnetic base and dial indicator to a stationary stand, parallel, or engine block fixed to the machine bed.

9. Bring the spindle of the machine in position to put a slight load on the Plunger, about .020”.

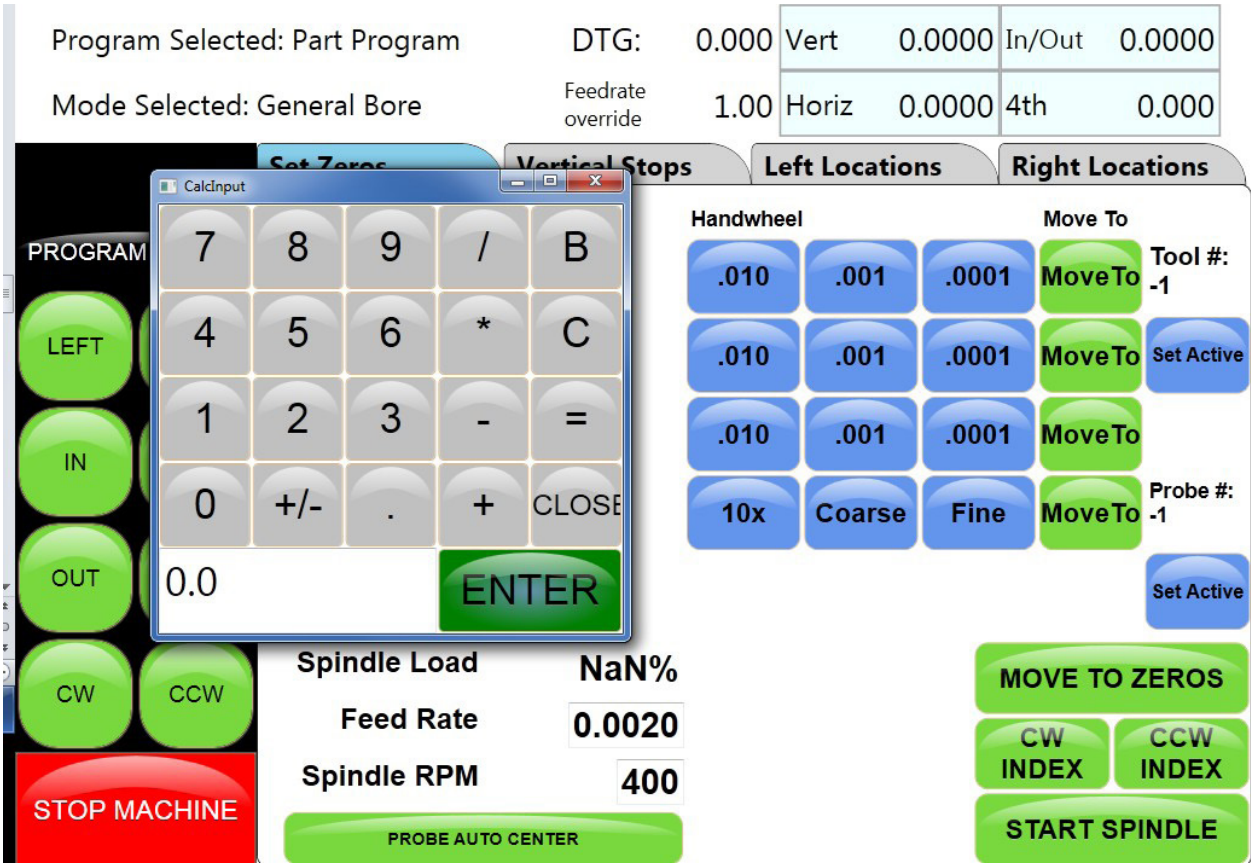
10. Set “Vertical, Horizontal, In/Out” zero.



11. Set all vertical stops to “zero”.



12. Move the machine spindle away from the Plunger a few inches, and press ”Move to” and then 0 and Enter from the pop up keypad for the axis that is being measured..



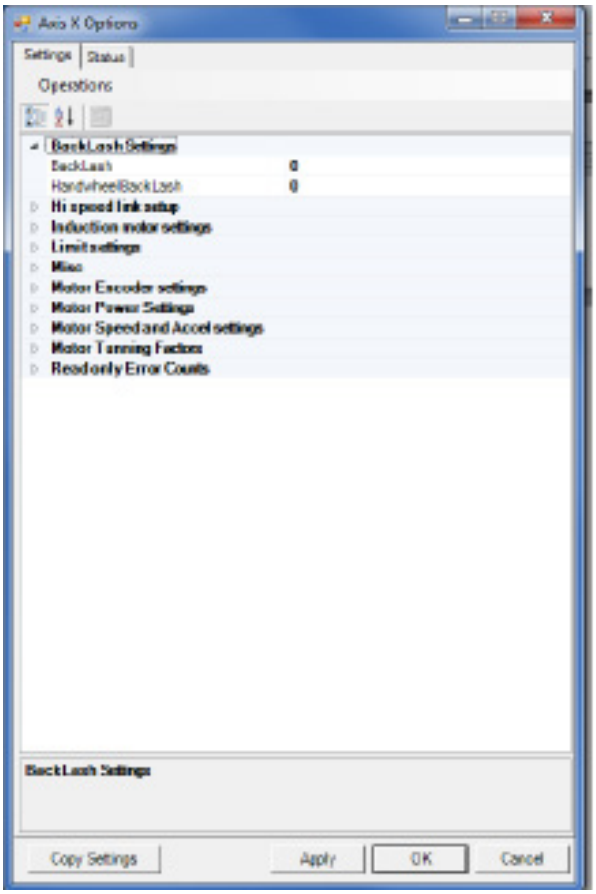
13. Repeat the movement to verify the machine will repeatedly position itself at zero.

14. Now, use the “Move To” button and then -.200 to move the spindle -.200” in the opposite direction.

15. Press “Move to” and then 0 and Enter from the pop up keypad for the axis that is being measured.

If the machine did not position itself to bring the digital readout to zero, a backlash compensation adjustment is needed.

16. To adjust, maximize the “Axis X Options” screen. Go to Backlash Setting>Backlash.



17. Use the “On Screen Keyboard”, or plug in the full size keyboard to enter the amount of correction in the Backlash area. After entering a value, click “Apply”, for the new setting to take effect.

18. Repeat steps 13 through 17 and adjust as necessary until the machine positions itself to “Zero” on the digital readout from both directions.

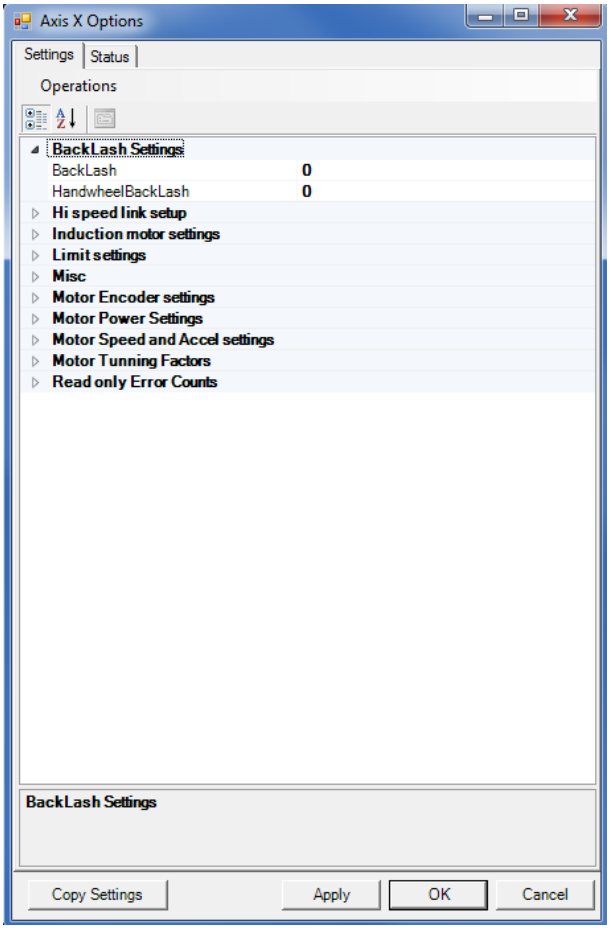
Handwheel Backlash is measured in a similar way to Backlash but the axes is moved by the Handwheel – the Move To buttons are NOT used.

19. Set up the Dial Indicator as described in #8 and #9.

20. Touch the .001” Handwheel button and move the axis to away. Turn the handwheel at a **constant speed** and move the axis back until the control panel displays zero. If the axis travels past zero, start again - move back again and turn the Handwheel at **constant speed** until the axis stops on zero on the machine display. Check that the Dial Indicator is zero, if not, move away and back again until both the machine control and Dial Indicator both read zero.

21. Now move the axis in the opposite direction and be sure to stop about.020” less that total plunger travel before compressing the plunger all the way. Now move the axis back by turning the Handwheel at a **constant speed** until the machine display reads zero. Check the reading on the Dial Indicator.

22. Use the “On Screen Keyboard”, or plug in the full size keyboard to enter the amount of correction into Handwheel Backlash. Press Apply when you are done.



23. Follow steps 9 through 22 for the Y and Z axis.

24. When finished, re-enter the “Overshoot Backlash Amounts”, as recorded in step 2 and click OK and close the window.

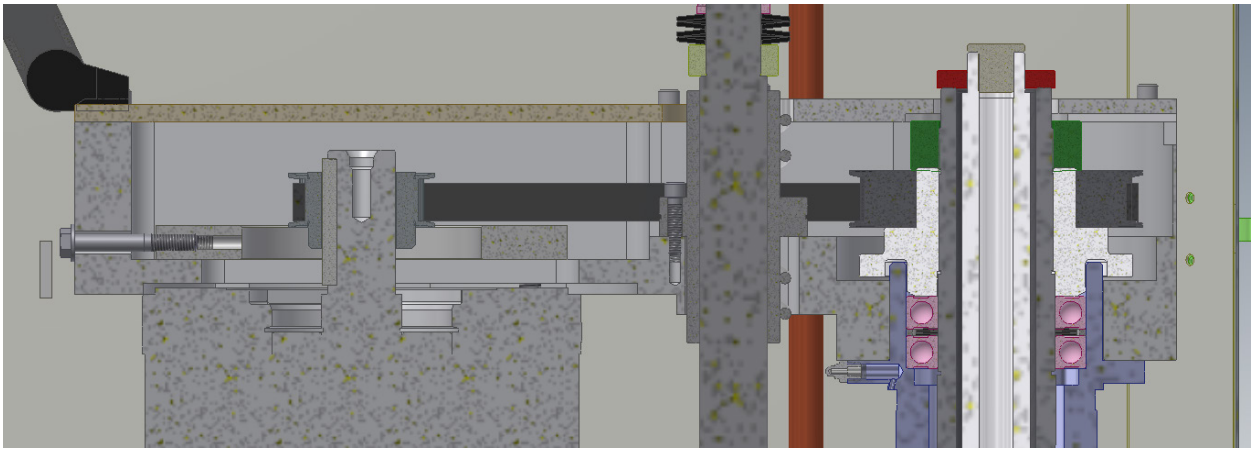
Spindle Belt Adjustment

The spindle belt should not require adjustment very often, but if required use the following instructions.

Open the Spindle Base shroud.
Loosen the four Motor mounting bolts on the spindle motor.
Tighten or loosen the Tension adjustment bolt on the rear of the belt housing until 5 pounds of pressure causes the spindle belt to deflect 1/4”.

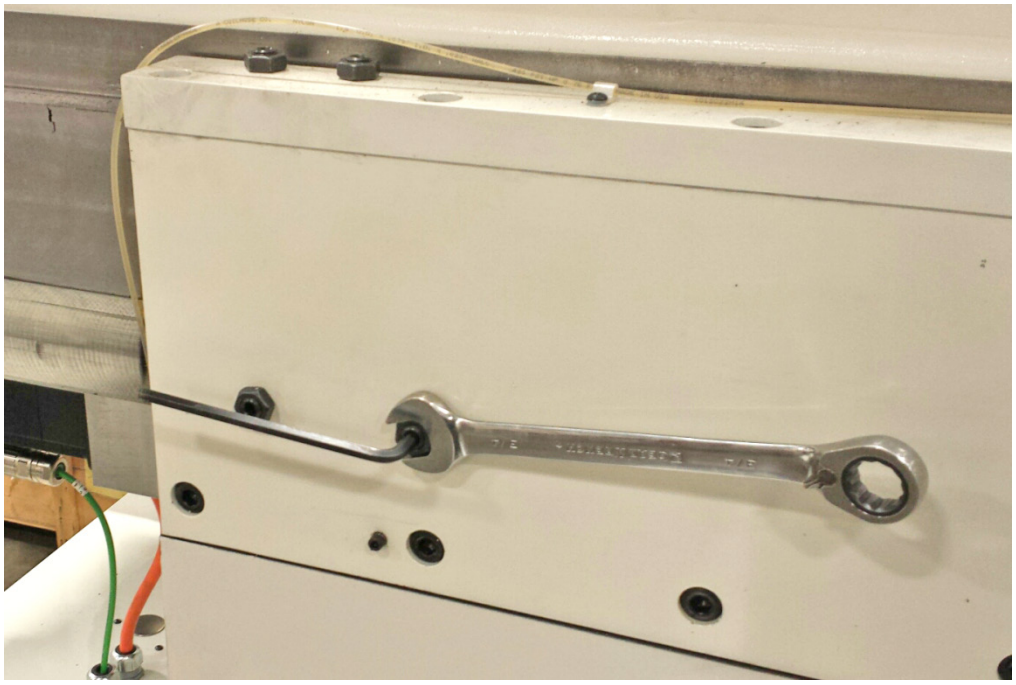
If the spindle motor is run at high speed and a high pitched wining is heard from the belt housing area the belt adjustment is probably too tight.

If you can visually see the belt jumping around while running the belt is too loose.



Top and Side Rail Adjustment

1. Loosen jam nuts on side rail adjustment screws
2. Tighten adjustment screws until they bottom out
3. Back adjustment screws out 1/8 of a turn
4. Tighten jam nuts

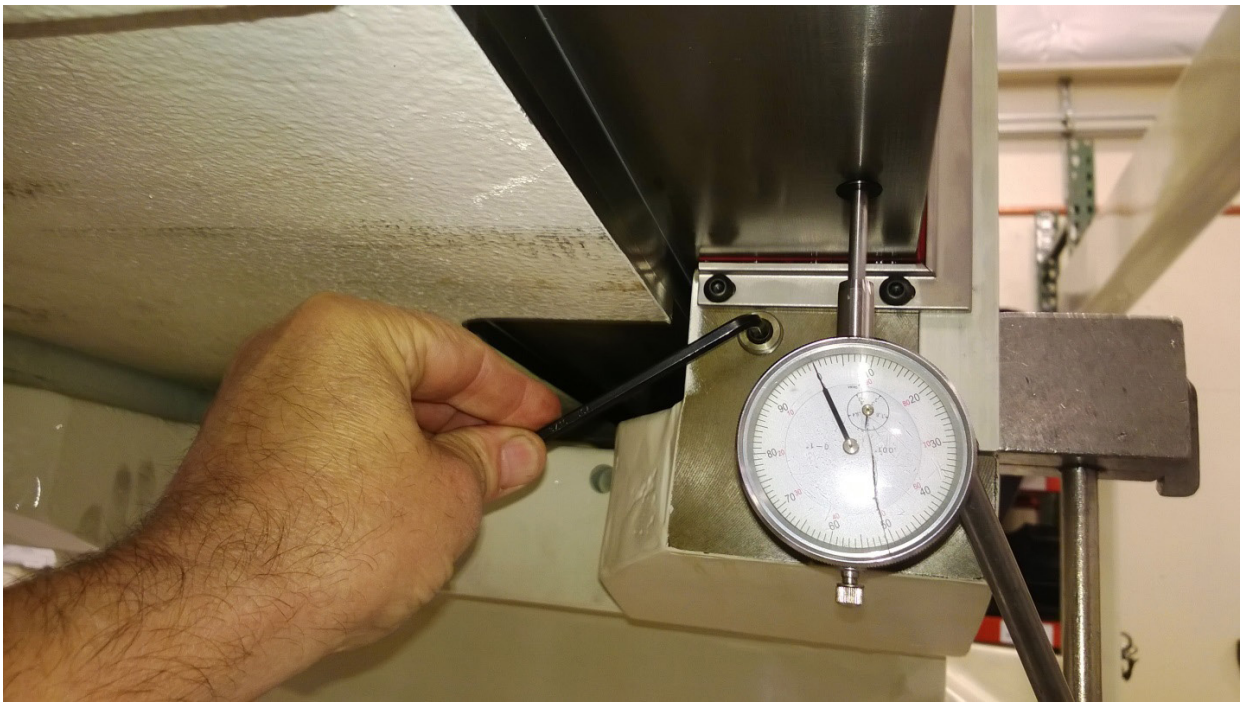


5. Loosen jam nuts on top rail adjustment screws
6. Tighten adjustment screws until they bottom out
7. Back adjustment screws out 3/4 of a turn
8. Tighten jam nuts

Mill Tilt Adjustment Procedure

1. Position the Y axis in the middle of its travel. Using a 5/32” hex key, loosen the locking set screw through the access hole in the right side guide rail

2. Put the machine in “Mill Cycle” mode, with the wedge turned off. Attach an indicator as shown in the following photo, and set to zero position.

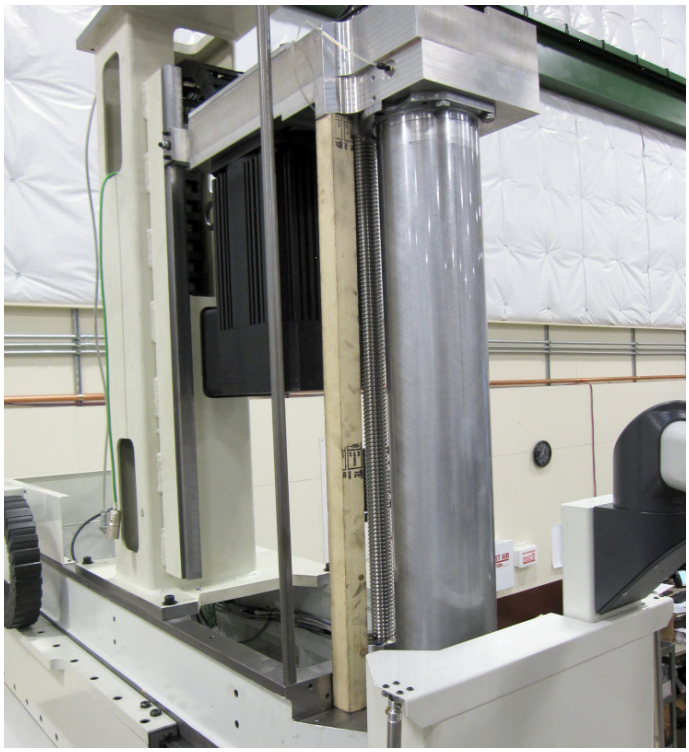


3. Using a 3/16” hex key, turn the adjustment screw in or out to increase, or decrease, the amount of mill tilt. Turn the screw CCW to increase, or turn CW to decrease the amount as shown in the photo at step #2. After each adjustment, turn the “Wedge On”, to check the amount. Set to .002”- .004” (.05mm - .1mm) of lift with the wedge turned on. Turn the wedge off to readjust, and then turn the wedge on to check the amount.
4. When finished, tighten the locking set screw as shown in the photo in step #1.
5. Repeat the procedure for the rear wedge.

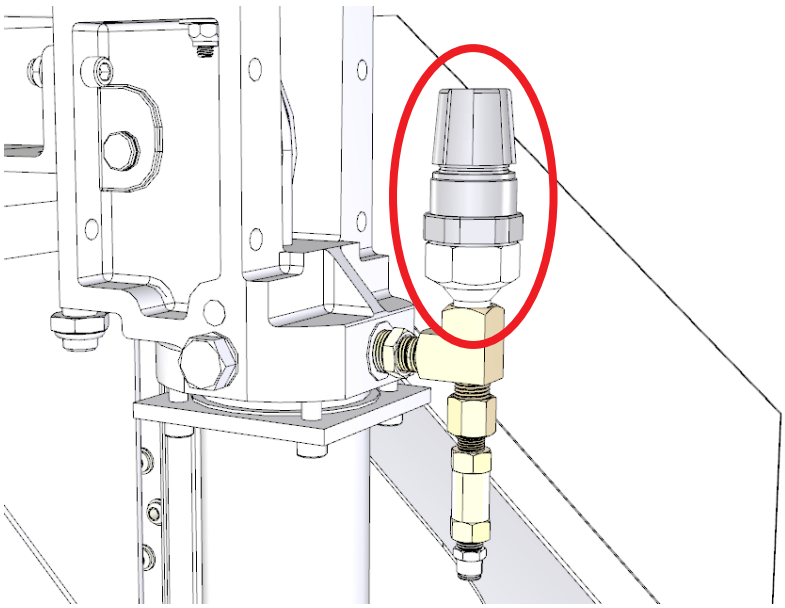
6. After adjusting the rear wedge, re-check the front, to make sure it did not change.

Replacing the Counterbalance Cylinder

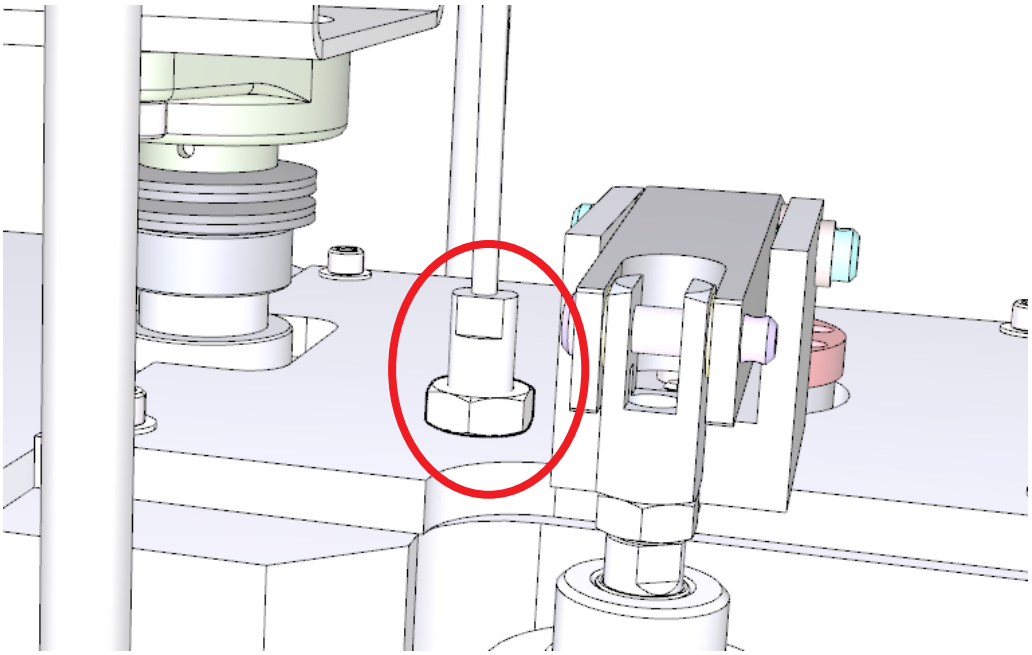
- Move the spindle to its full up position. Cut a piece of wood and place it under the spindle housing as shown below to prevent the spindle housing from dropping when air is removed from machine.



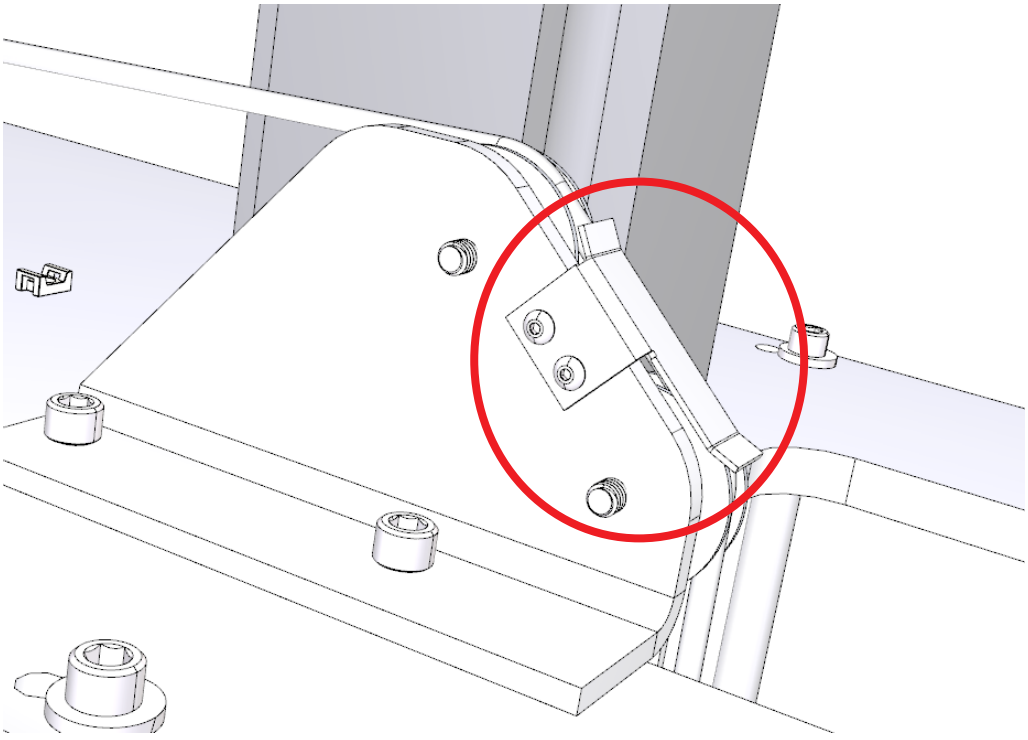
- Shut down the machine at the electrical panel and lock out in accordance with safety regulations and or shop safety policy.
- Unplug air from machine and remove the pop off valve to bleed air from the counterbalance cylinder.
- Remove air line from fitting and cut off any zip ties that hold the line to the cylinder.
- Remove pop off valve assembly for reuse on new cylinder.



Remove the cable end from the top plate.

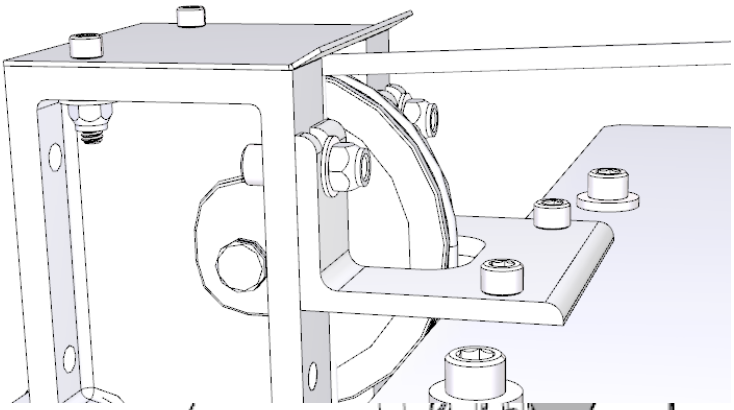


Remove cable guide from double pulley assembly.

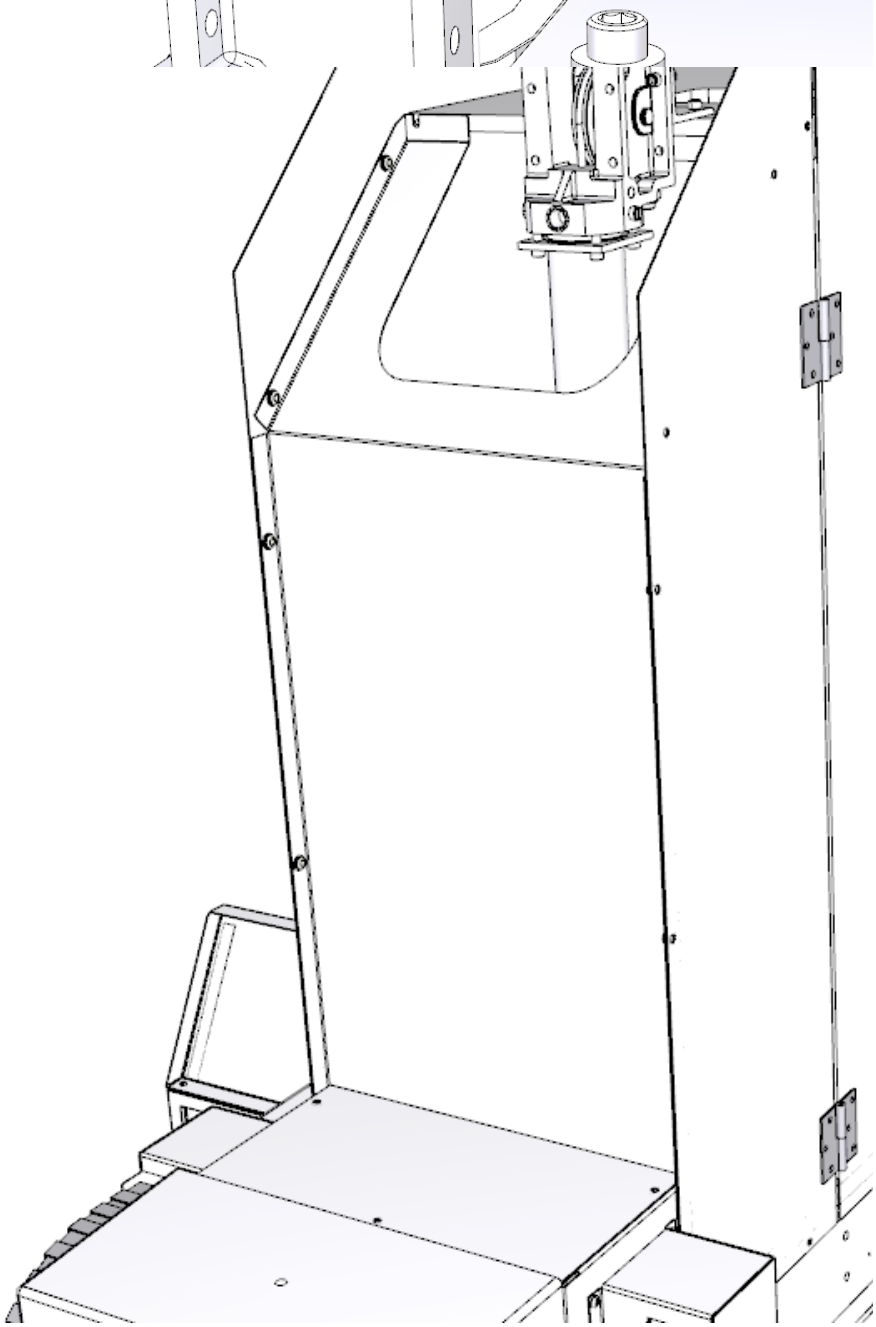


Remove the top cover from the cylinder and save for reuse.

Unbolt the top of the cylinder from the bracket holding it to the top plate.



Remove the sheet metal covers at the back to access the counterbalance cylinder.



- Unbolt the cylinder assembly from the tower base plate and install new cylinder.

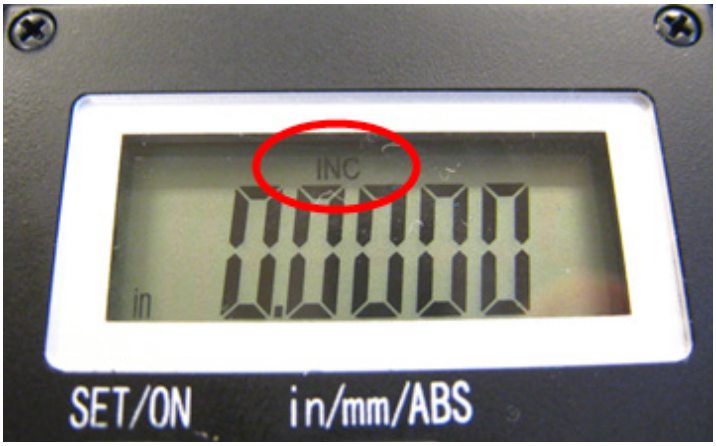
- Bolt top of cylinder to top plate bracket and reinstall top cover.
- Install pop off valve assembly to the top of the cylinder and attach air line.
- Replace the sheet metal covers.
- Run the cable over the double pulley assembly and screw the end into the top plate.
- Replace the cable guide on the double pulley assembly.
- Reattach air to the machine.
- Turn the power back on, run the spindle up, and remove piece of wood that supported the spindle housing.

Digital Micrometer setting instructions

Turn the thimble until the ‘0’ line on the thimble lines up with the vertical line nearest the spindle lock ring.

Determine which cutter head bore range the micrometer is going to be used on. (example; 2.9 – 6.0)
We want to initially set the micrometer to the minimum bore diameter of this cutterhead.

NOTE: MICROMETER CAN NOT BE PROGRAMMED IF THE LETTERS INC APPEAR IN THE DISPLAY. To get rid of INC, quickly press the in/mm/ABS button.



To set or edit micrometer

Press and hold the set/on button and the + or – button at the same time. “Set” will flash in the display. This places the micrometer in edit mode. (CAUTION: use a pencil tip or something similar to gently push the small round buttons - they are quite small and a bit delicate.)

Press and hold the + or – buttons to change the display number to the minimum bore diameter determined earlier (example; 2.9). Caution: Pushing the + or – buttons and holding in place will cause the numbers to scroll automatically. The numbers will count slowly at first and once 0.010” has been counted off the scrolling speed will pick dramatically.

After you have reached the desired number in the display, press the set/on button twice quickly to exit the edit mode. “Set” should no longer be flashing in the display. The micrometer is now ready for use.

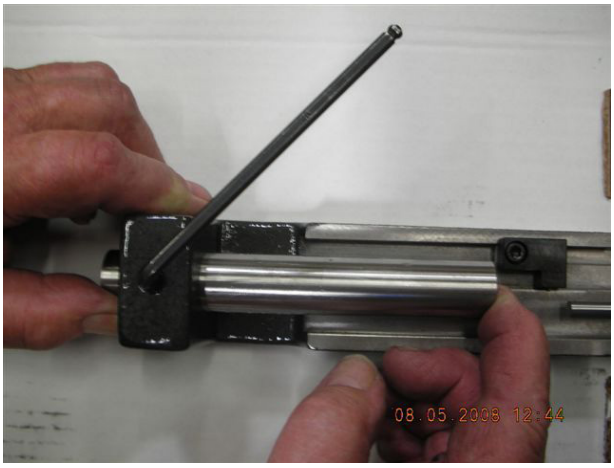
CAUTION: AFTER MICROMETER SET-UP IS COMPLETE, DO NOT PUSH SET/ON BUTTON AGAIN. PUSHING THE SET/ON BUTTON DURING USE WILL RETURN THE DISPLAY TO THE ORIGINAL MINIMUM BORE DIAMETER. THE ONLY TIME YOU SHOULD USE THE SET/ON BUTTON AGAIN IS TO- A. To shut micrometer off at which time you push and hold the button or B. to turn micrometer display back on at which time you push button one time. The display will then show the last reading before micrometer was shut off.

CAUTION: DO NOT BACK THE THIMBLE ALL THE WAY OUT TO THE END OF IT’S TRAVEL. ONCE THE THIMBLE IS BACKED ALL THE WAY OUT, IT WILL NO LONGER ROTATE PROPERLY AND THE DIGITAL HEAD WILL NEED TO BE REPLACED.

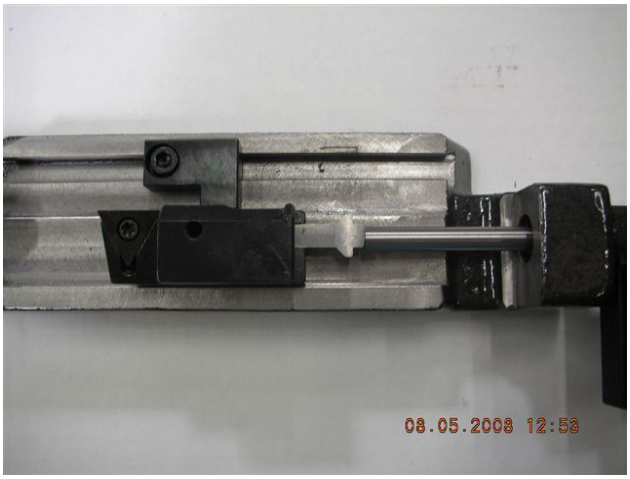
Micrometer is calibrated in inch mode. If metric is desired, press and hold in/mm/ABS button until mode changes to metric (approximately 3-4 seconds). A quick press of the in/mm/ABS button will put micrometer in ABS mode: 0.000, with another quick press returning it to initial setting.

Set up the cutter head and bore a set up hole. Measure the bore accurately. Set the digital display to this bore dimension and then -

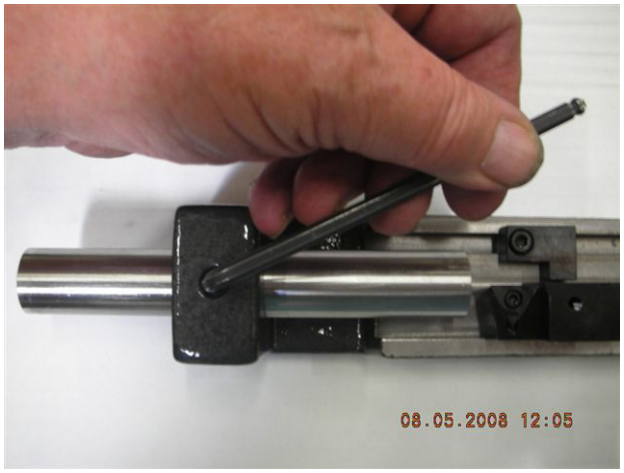
Loosen the set screw holding the large diameter anvil. Slide the anvil back out of the way.



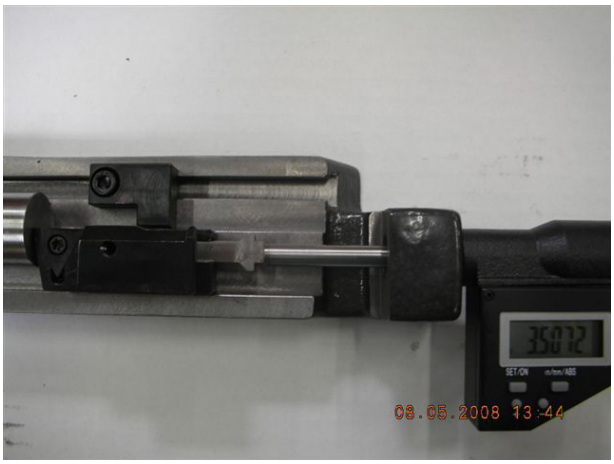
Place the tool holder used to bore the hole into the micrometer frame. Slide the location nub on the back of the tool holder gently up against the end of the digital micrometer shaft.



Slide the large diameter anvil up until it touches the end of the cutting tip of the tool holder. Tighten the set screw.



Back the digital micrometer shaft off, then bring it up to touch the tool holder and recheck that the numbers in the display are the same as the numbers previously shown.



The micrometer is now set up for use with this cutter head.

Note: this procedure must be repeated to set the micrometer to a different cutter head. The micrometer can only be set to one cutter head at a time.

To shut off micrometer press and hold set/on button until screen goes blank or let micrometer set until display disappears.

With initial setting of micrometer it is recommended that you use the procedure detailed below in the event you think you have size problems.

Procedure:
The short vertical lines that cross the horizontal scale on the micrometer sleeve are reference marks. Set the zero on the micrometer thimble even with the first vertical line and note the size shown in the digital display. Record this size for future reference. Now follow the same procedure for each line and record the sizes. At any time you feel your micrometer is reading incorrectly, you can quickly refer to the recorded size of the line closest to the range you are using and check that the micrometer is still accurate.

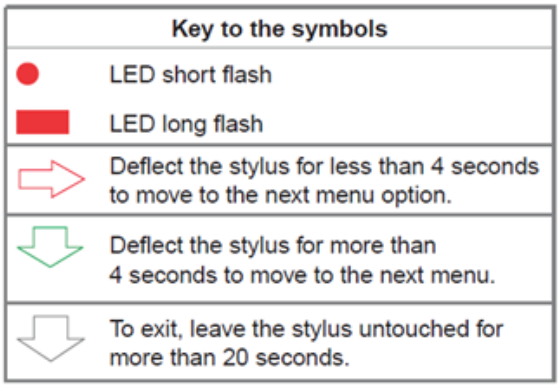
Probe “On-Center” Adjustment

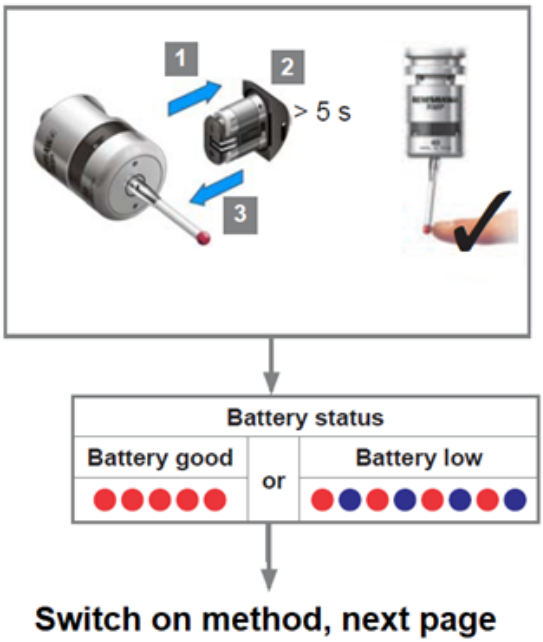
This covers setup and calibration of the probe, so it will accurately position your machine.

- Verify that the four adjusting screws and two locking screws are installed in the probe tool holder.
- Assemble probe on either CAT 40 Shank or Rottler Taper
- With the machine breaker that supplies power to the probe receiver turned off;
- Install batteries in the probe WITH stylus deflected.

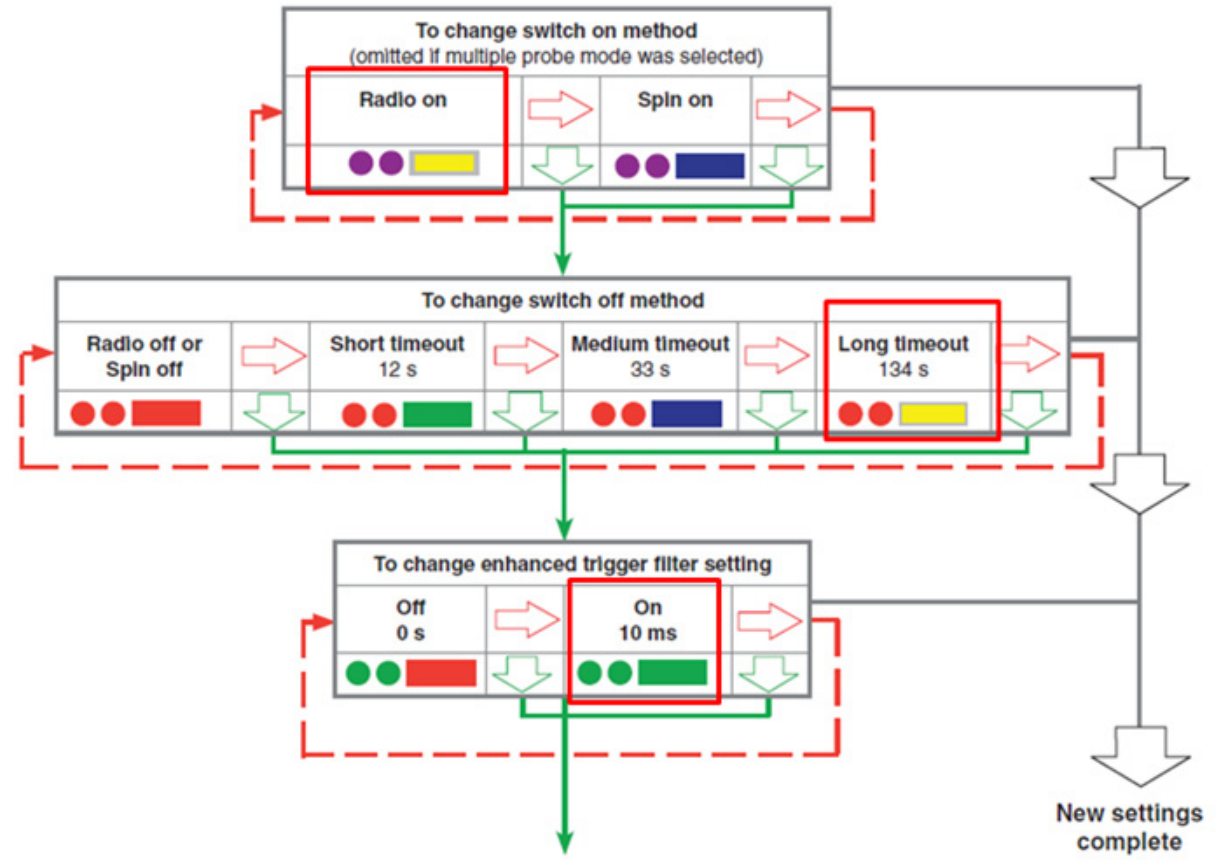
Probe LED check will run.

- Release stylus after battery check this will put you in edit mode.
- First will be Switch off method, you want this at purple, purple, yellow (Radio On). If it is not, deflect and release stylus quickly to change the mode.
- Hold the stylus deflected until the colors change to move to the next setting.
- You should be at Switch Off method; it should be red, red, yellow (134 seconds). If it is not, deflect and release stylus quickly to change the mode.
- Hold the stylus deflected until the colors change to move to the next setting.
- You should be at Enhanced trigger filter; it should be green, green, green (on). If it is not, deflect and release stylus quickly to change the mode.
- Hold the stylus deflected until the colors change again to move to the next setting.
- You should be at Acquisition mode, light blue, light blue, light blue.
- Turn on machine and quickly deflect and release the stylus. This must be done within 10 seconds of turning on the power breaker to the probe. If you are watching the RMI-Q (located ON the machine) you will see the right light turn red, yellow, red, yellow, red, yellow is shows the partnership has been acquired.
- Go into the software and do a probe auto center and hit start probe to verify that it works correctly.





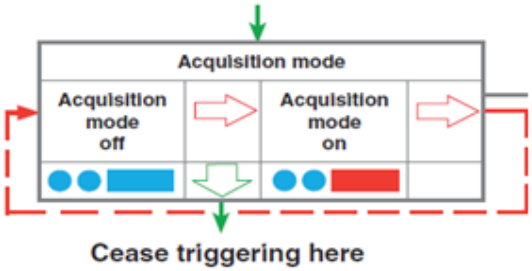
Switch on method, next page



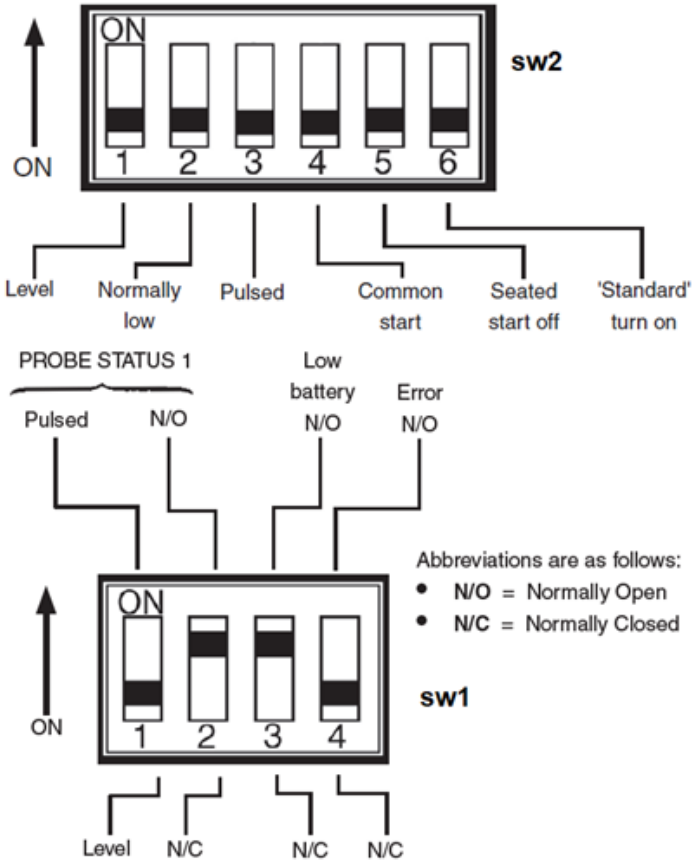
Changing the probe settings (continued)

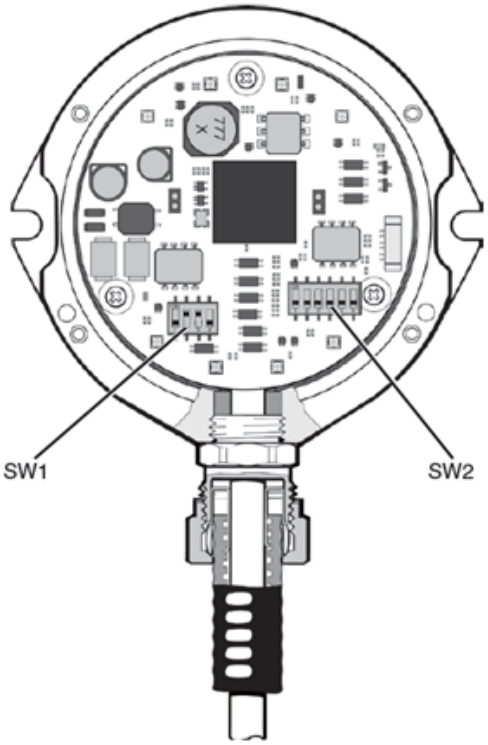
Note: After the RMI has been acquired, the RMP40 will only show Acquisition mode off.

See RMP40 - RMI partnership.



If the Probe does not turn off after 137 seconds you will need to make sure that the RMI-Q switches are shown in the following positions:





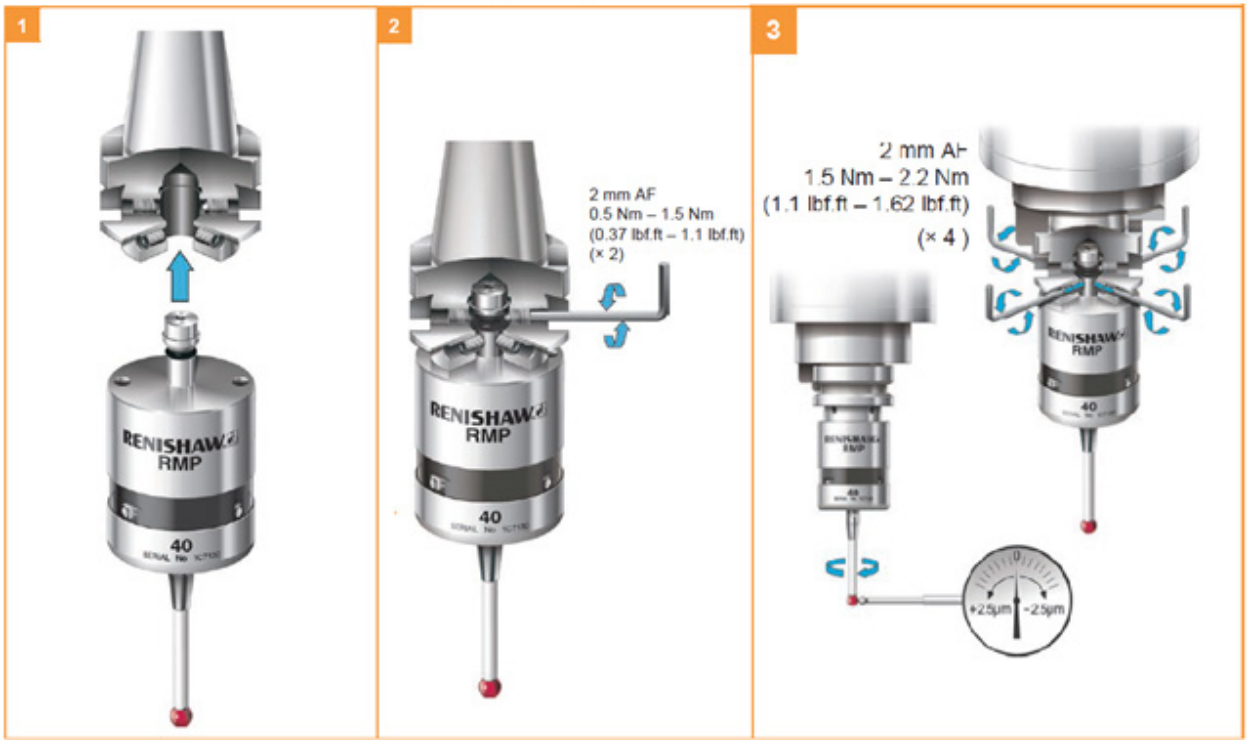
During normal use, the difference between the touch position and the reported position does not change, but it is important that the probe is calibrated in the following circumstances:

- when a probe system is to be used for the first time;
- when a new stylus is fitted to the probe;
- when it is suspected that the stylus has become distorted or that the probe has crashed;
- at regular intervals to compensate for mechanical changes of your machine tool;
- if repeatability of relocation of the probe shank is poor. In this case, the probe may need to be recalibrated each time it is selected.

It is good practice to set the tip of the stylus on center, because this reduces the effect of any variation in spindle and tool orientation. A small amount of run-out is acceptable, and can be compensated for as part of the normal calibration process.

- calibrating either in a bored hole of know size, a ring gauge, or on a datum sphere.

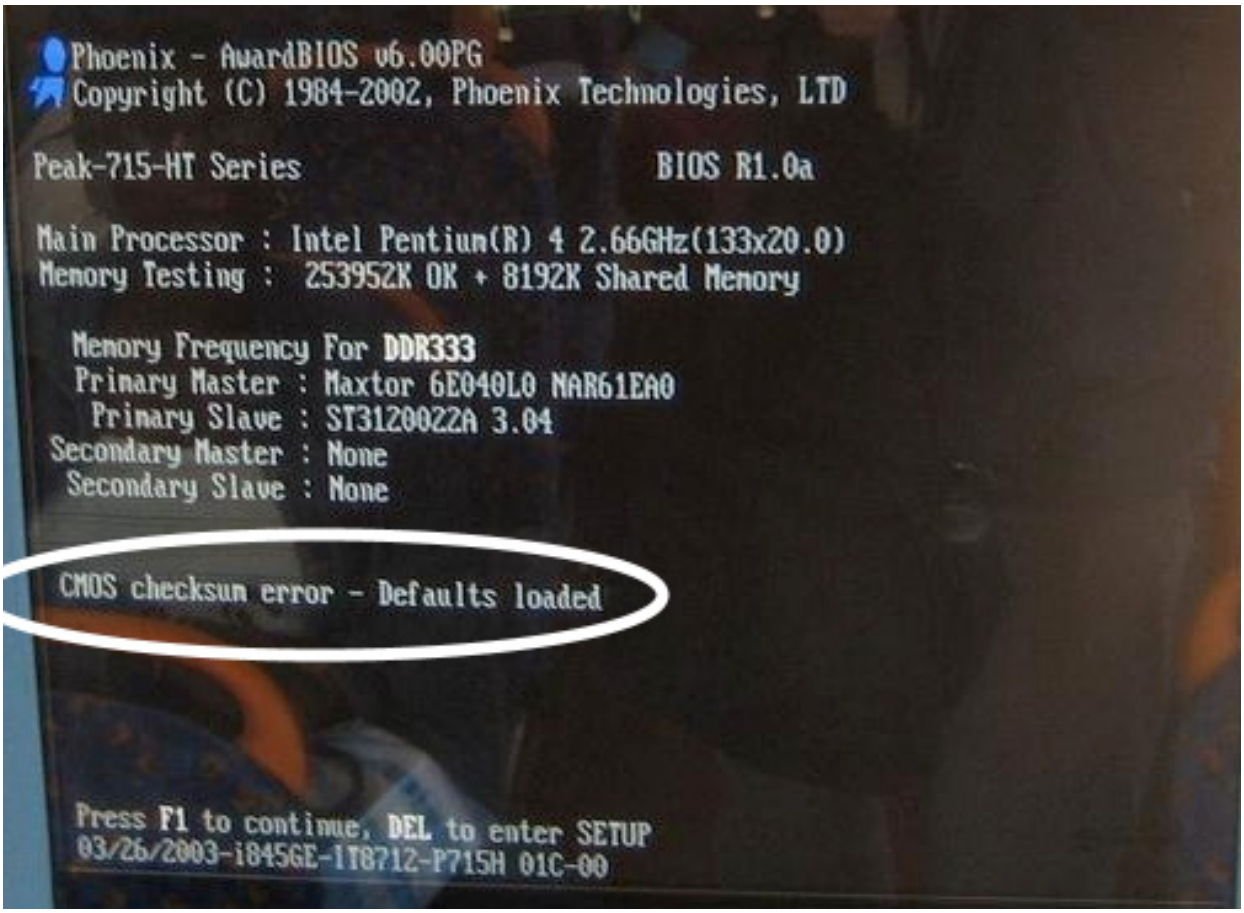
Mounting the probe on a shank



- Dial the probe stylus into center using a .0001” indicator to within .0005” the tighter tolerance you hold the more accurate the machine will be. You must use an indicator that takes very little pressure to get a reading. Excessive pressure on the stylus will deflect the probe and you will not be able to dial it in correctly.
- Go to the Main/Block Model screen and select the Table of Tools. You may only have a Default Tool #0 listed.
- Press Add Tool. This will bring up a dialog box. Change the name from default tool to probe style that you are installing i.e. 50mm stylus, 100mm stylus. Set the diameter to .2360” this is default probe tip on a 50mm,100mm, and 17.5mm.
- Install a block, or parallels onto the machine and secure it solidly to the machine table.
- Place the Ring Gauge onto the top of the block, use Probe Auto Center to find center zero your X and Y axis here. Make sure you use a ring gauge or a hole of a known diameter. This will set the correct probe timing.
- Adjust the probed diameter by going to the IO under Setup Electronics and changing the Probe MS. You will need to increase or decrease the MS of the probe to achieve correct Probe Diameter.
- Repeat until the correct diameter is displayed.
- Probe Auto Center the ring gauge, without moving X or Y, remove the probe up in Z and Install the cutter head. Put a magnet base with the Last Word indicator on the cutter head and sweep the cylinder/ring gauge.
- The variation in X and Y Should be less than .0005.
- If not add compensation to ProbeOffSet under > Setup Eletronics-Addins-ProbeSetup

Replacing the Motherboard Battery

If computer fails to boot up and you get a CMOS error message on the screen, then the battery on the computer motherboard has failed and needs to be replaced.



The following is the procedure for replacing the motherboard battery.

Turn off the power on the electrical enclosure and remove the enclosure cover.

Locate the computer and check to see that the power light is not on. If it is on turn off the power switch.
Note: On some machines it may be necessary to unbolt the computer from the enclosure in order to gain access to the cover screws.

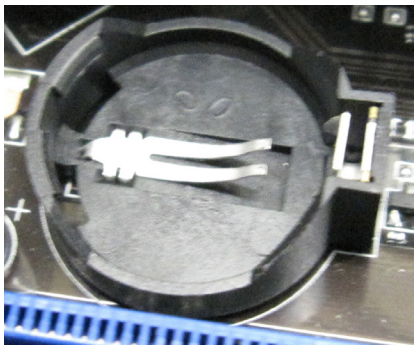
Remove the 6 screws indicated by the arrows from the cover.

Remove the cover.

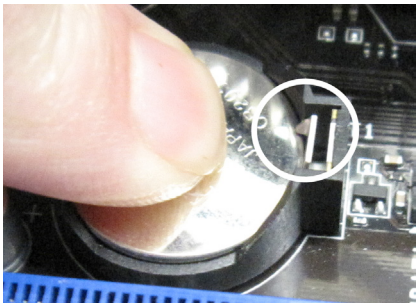
Locate the battery on the motherboard.

Push the battery retention clip away from the battery. When the clip is released the battery will pop up.

Remove the battery and place new battery in the battery holder.



Using your finger tip push down on the battery until the retention clip is in its lock position.



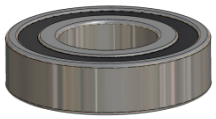
Replace computer cover and make sure that power switch on the computer is on.

Replace the enclosure cover and switch power back on.

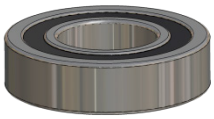
Ballscrew Assemblies Reference

Alignment Definitions for Angular Bearings and Belleville Washers

Bearing Alignment



VIEW OPEN END UP



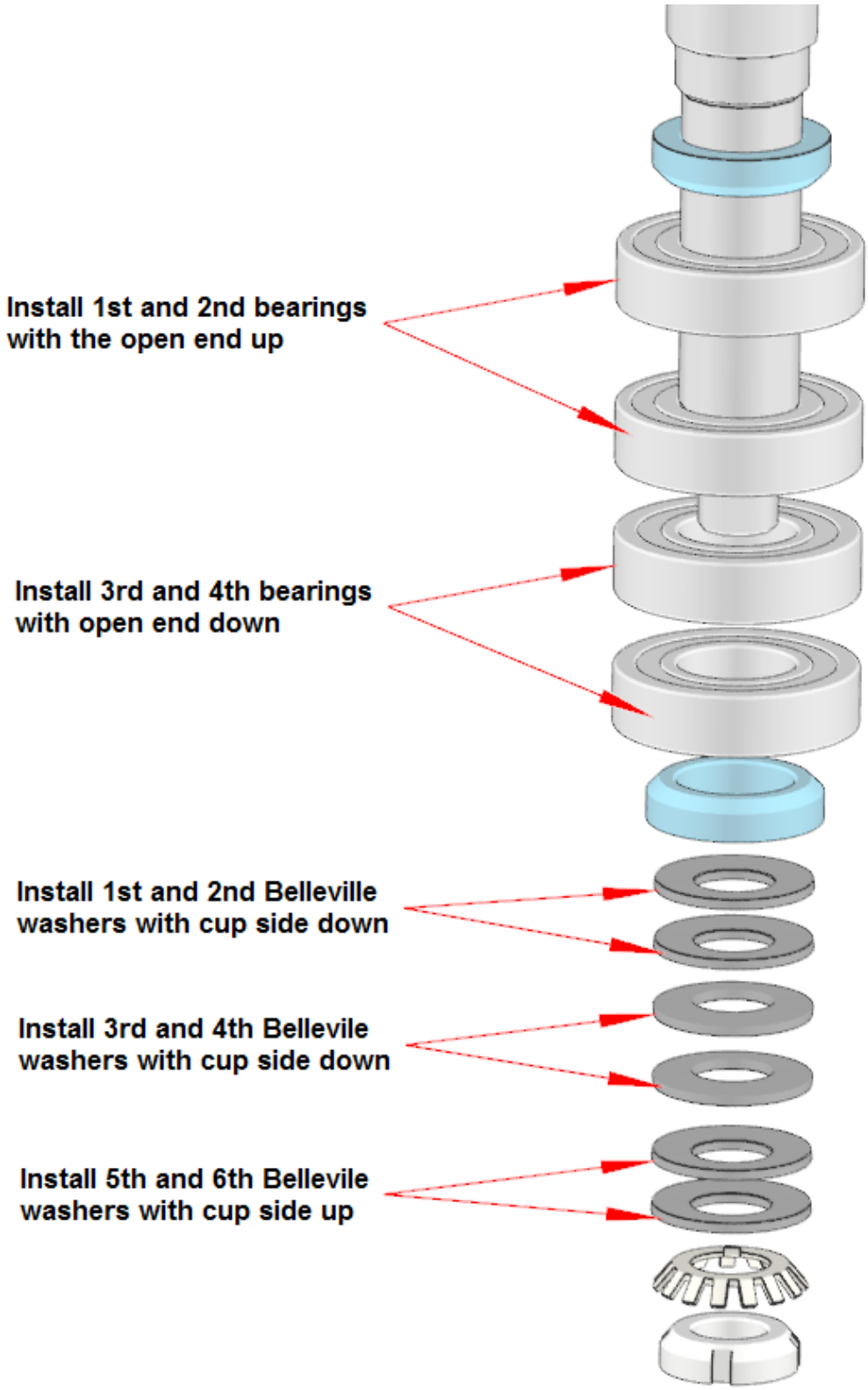
VIEW CLOSED END UP

Belleville Washer Alignment

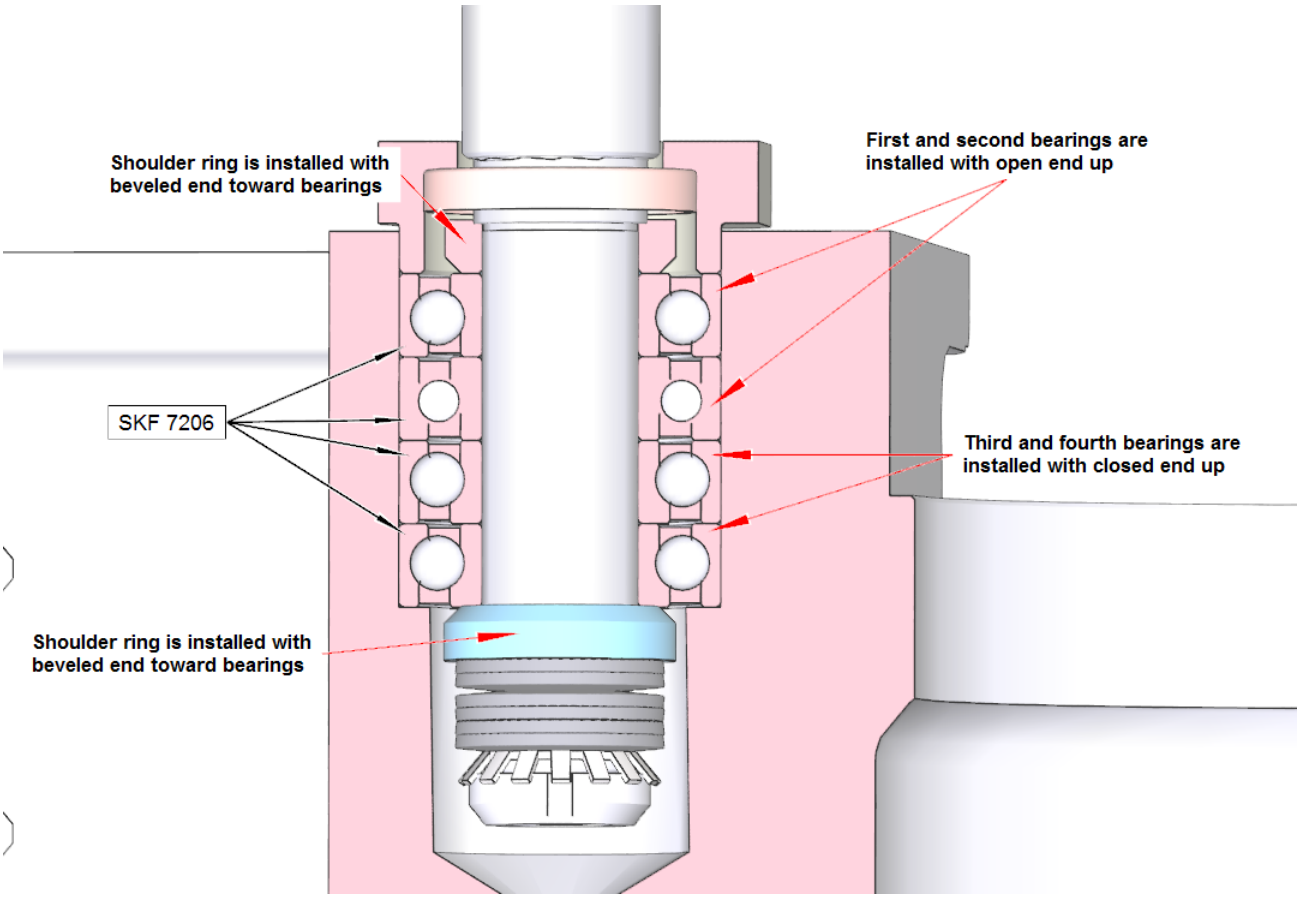
VIEW CUP UP

VIEW CUP DOWN

Z-Axis Lower Bearing and Belleville Washer Stacking Order

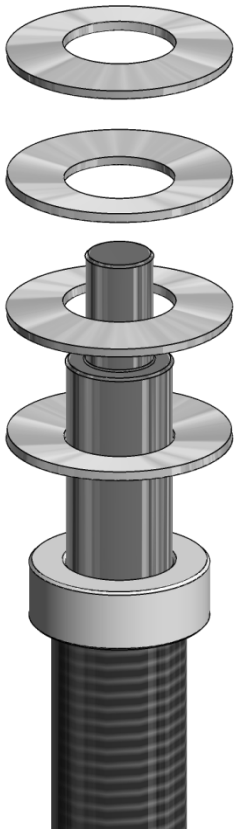


Z-Axis Lower Bearing and Belleville Washer Section View

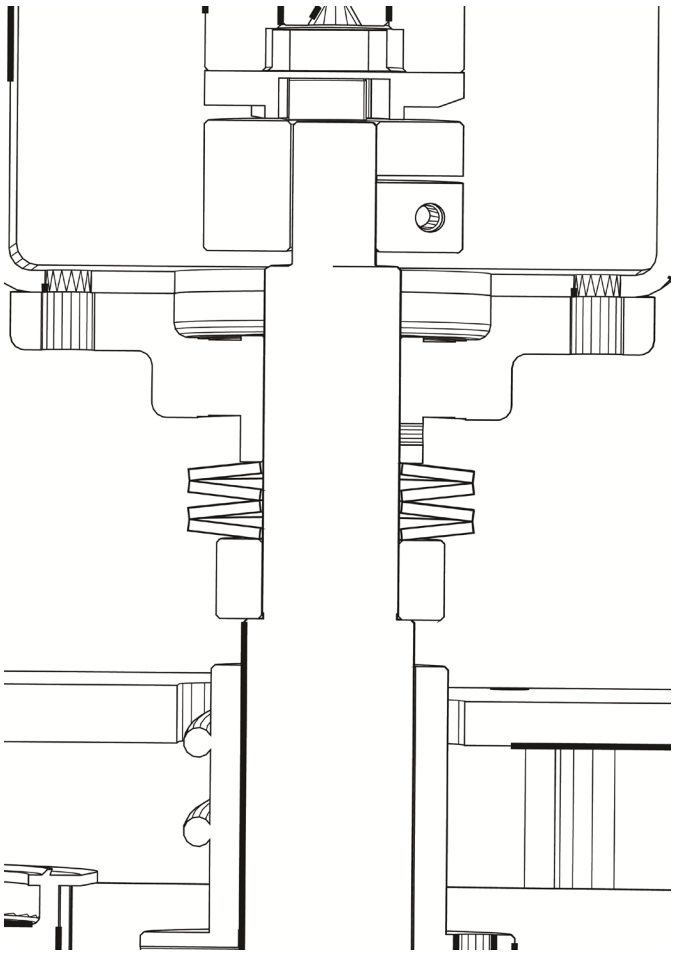


Z-Axis Upper Belleville Washer Stacking Order

Install 1st washer with cup side facing out, then alternate next 3 washers.

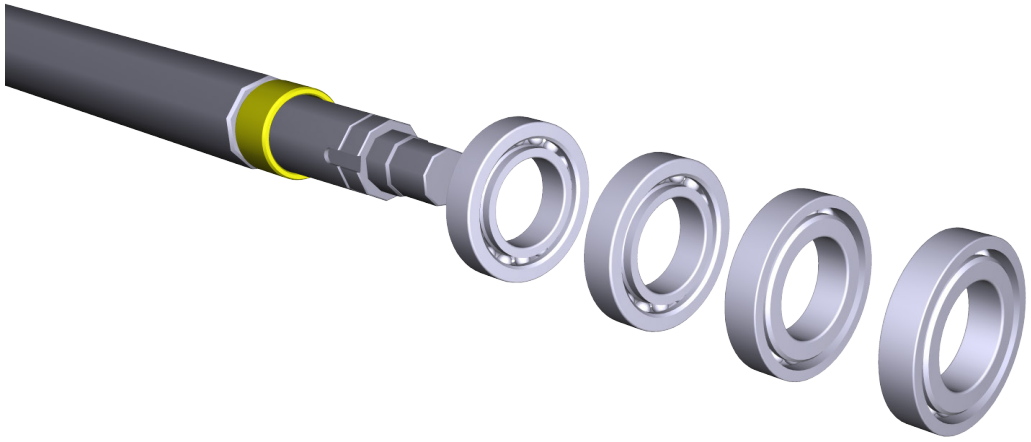


Z-Axis Upper Belleville Washer Section View

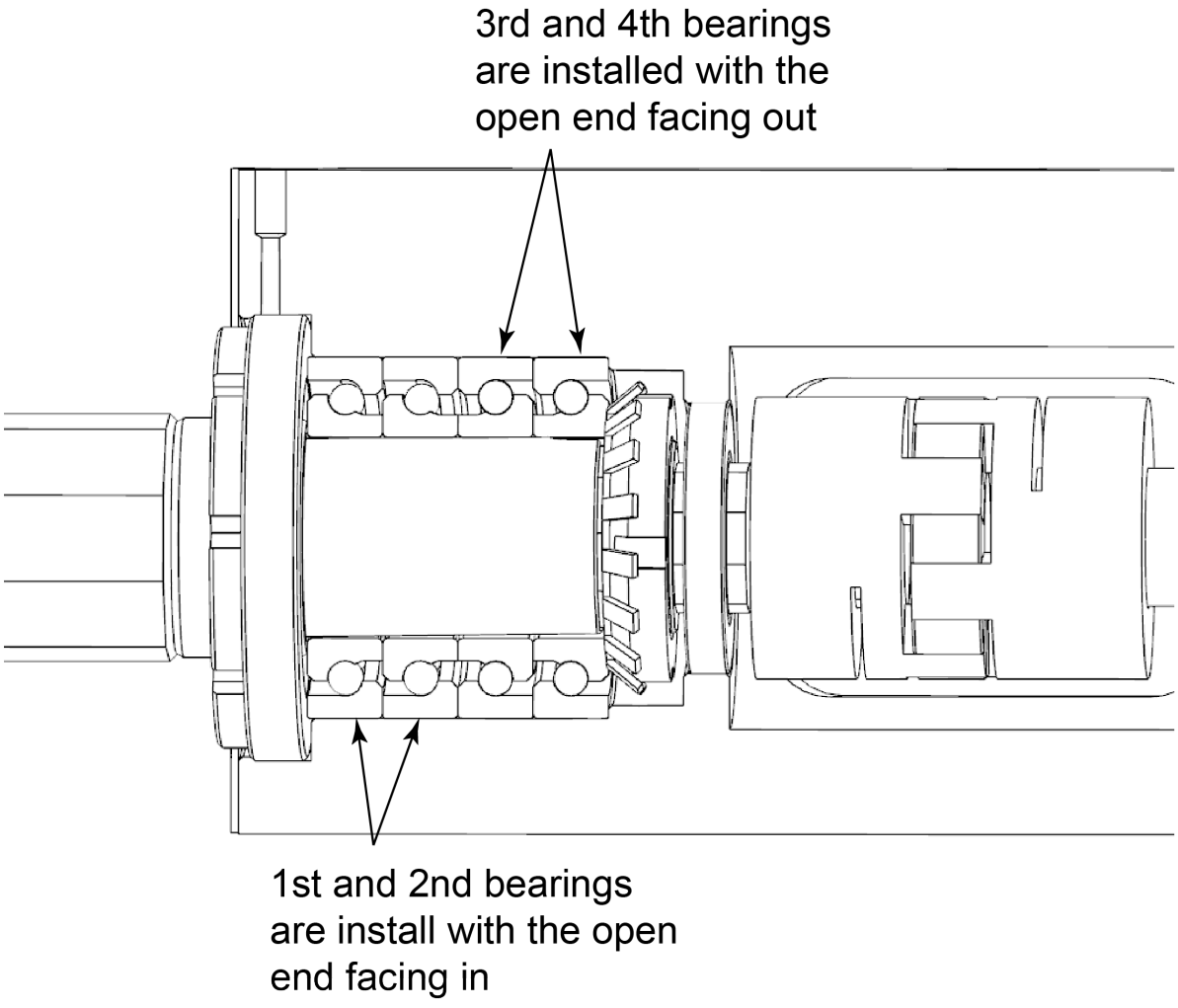


X-Axis Drive Side Bearing Stacking Order

Install 1st and 2nd bearings with open side facing in. Install 3rd and 4th bearings with open end facing out.

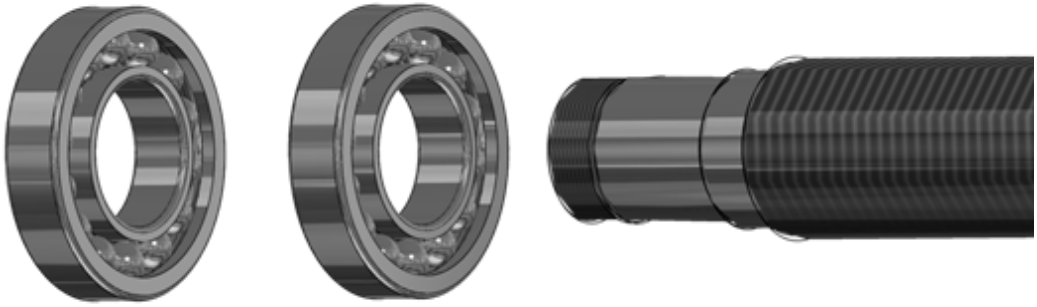


X-Axis Drive Side Bearing Section View

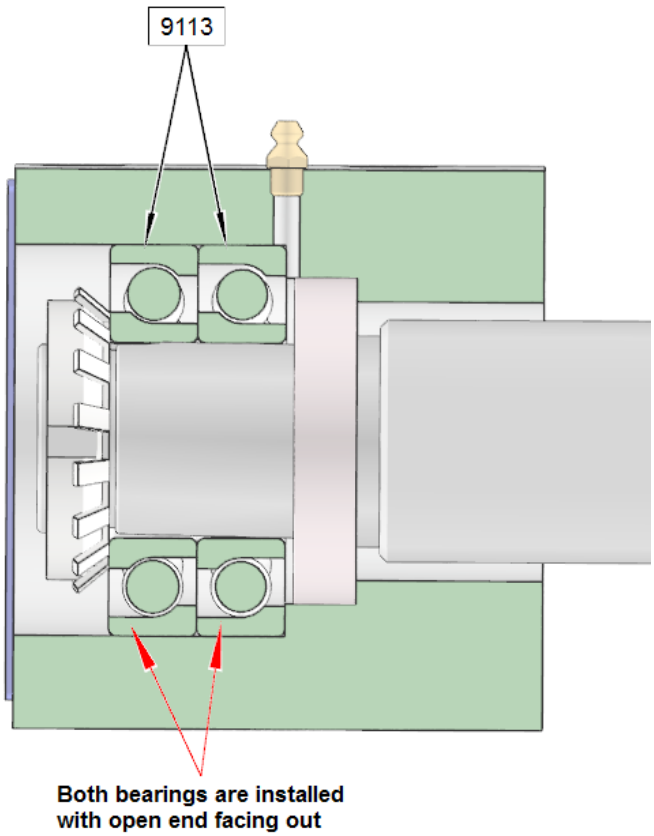


X-Axis Idle Side Bearing Stacking Order

Install both bearings with open side facing out.

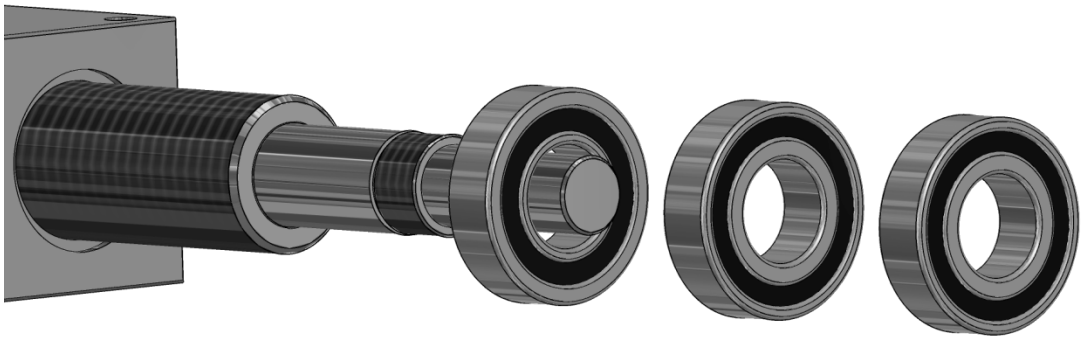


X-Axis Idle Side Bearing Section View

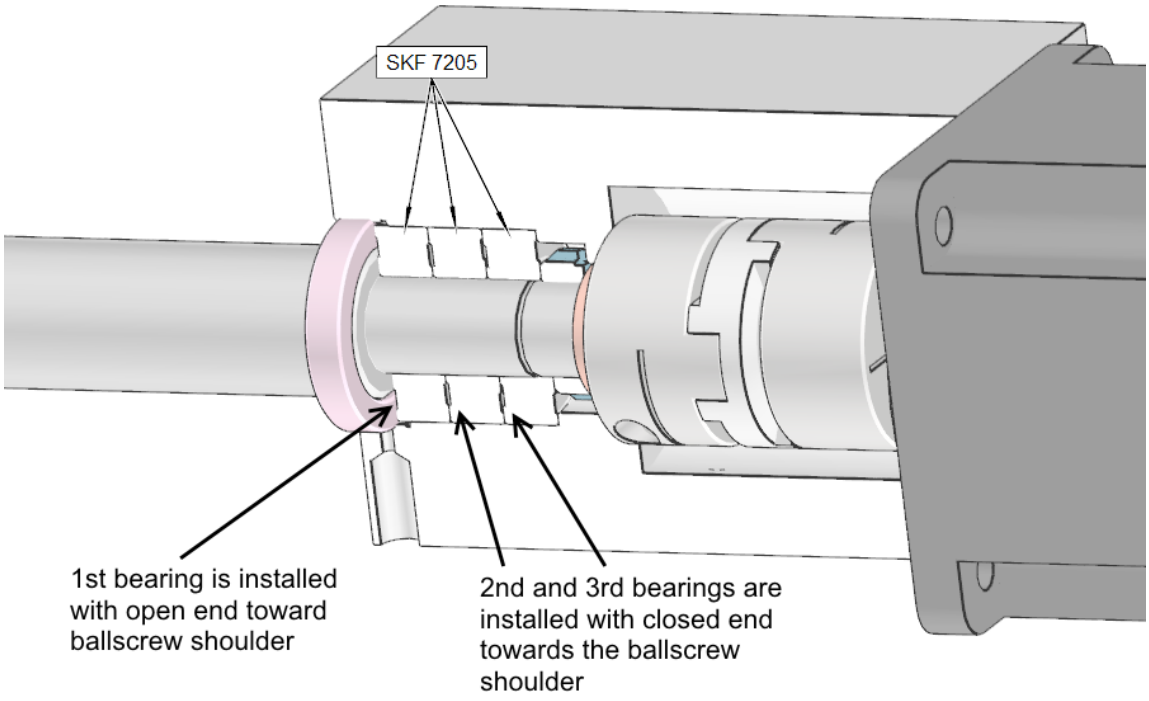


Y-Axis Bearing Stacking Order

Install 1st bearing with open end toward ballscrew shoulder. Install 2nd and 3rd bearings with closed end toward 1st bearing.

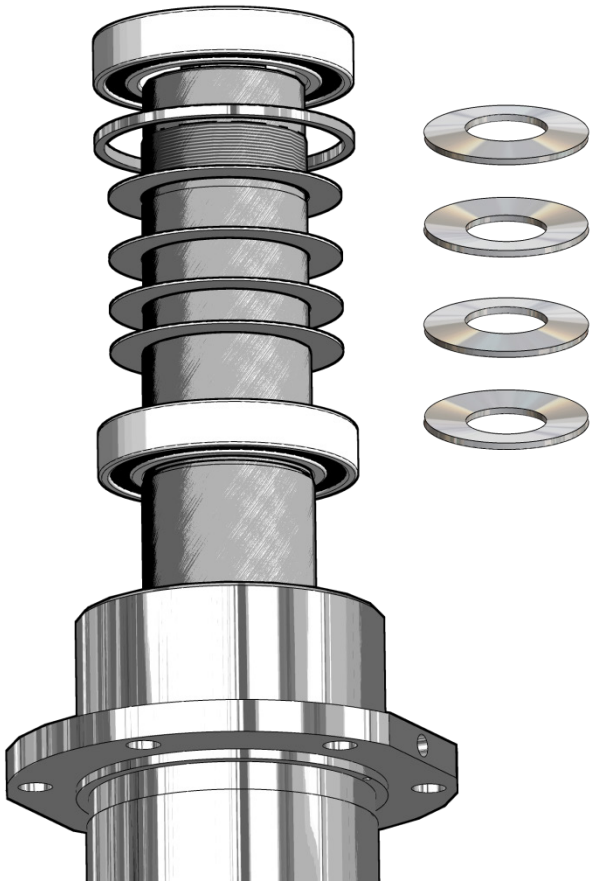


Y-Axis Bearing Section View

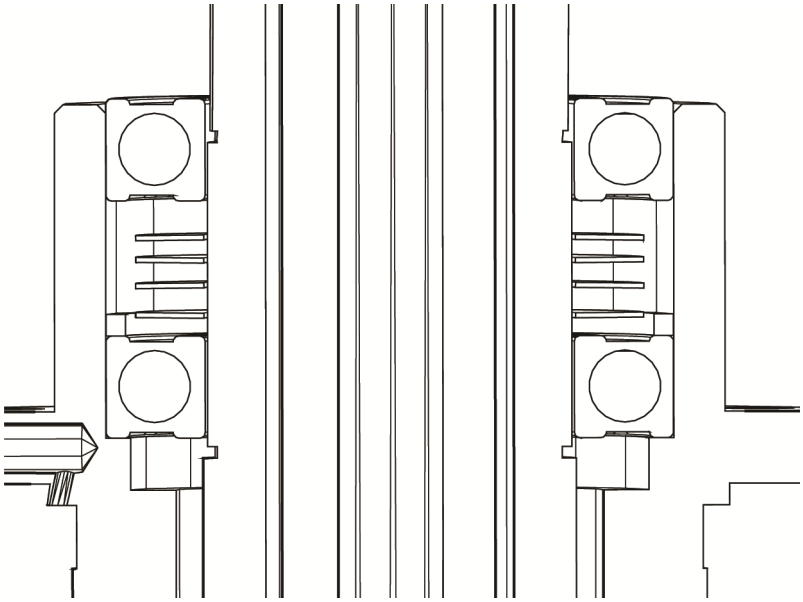


Inner Spindle Upper Section Belleville Washer Stacking Order

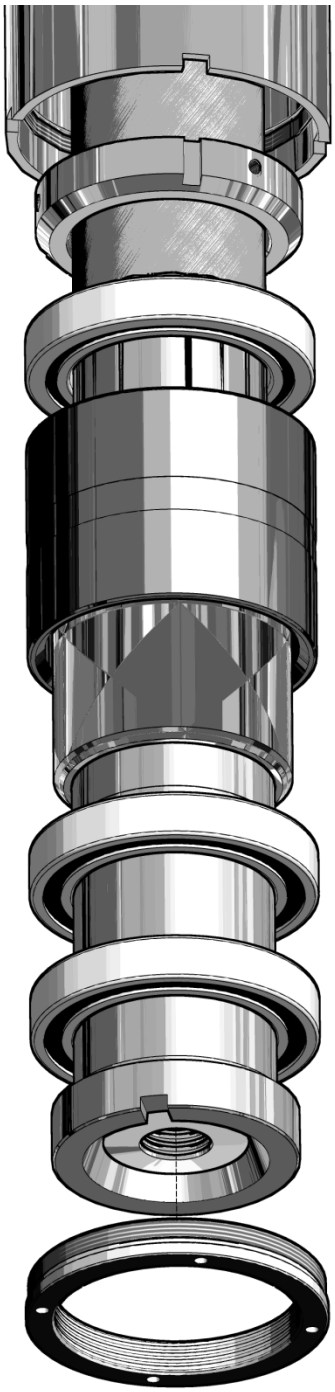
6113 Belleville washers are stacked in an alternating pattern with the bottom washer installed cup face up. (see illustration on right side)



Inner Spindle Upper Section Belleville Washer Section View



Inner Spindle Lower Section Bearing Stacking Order



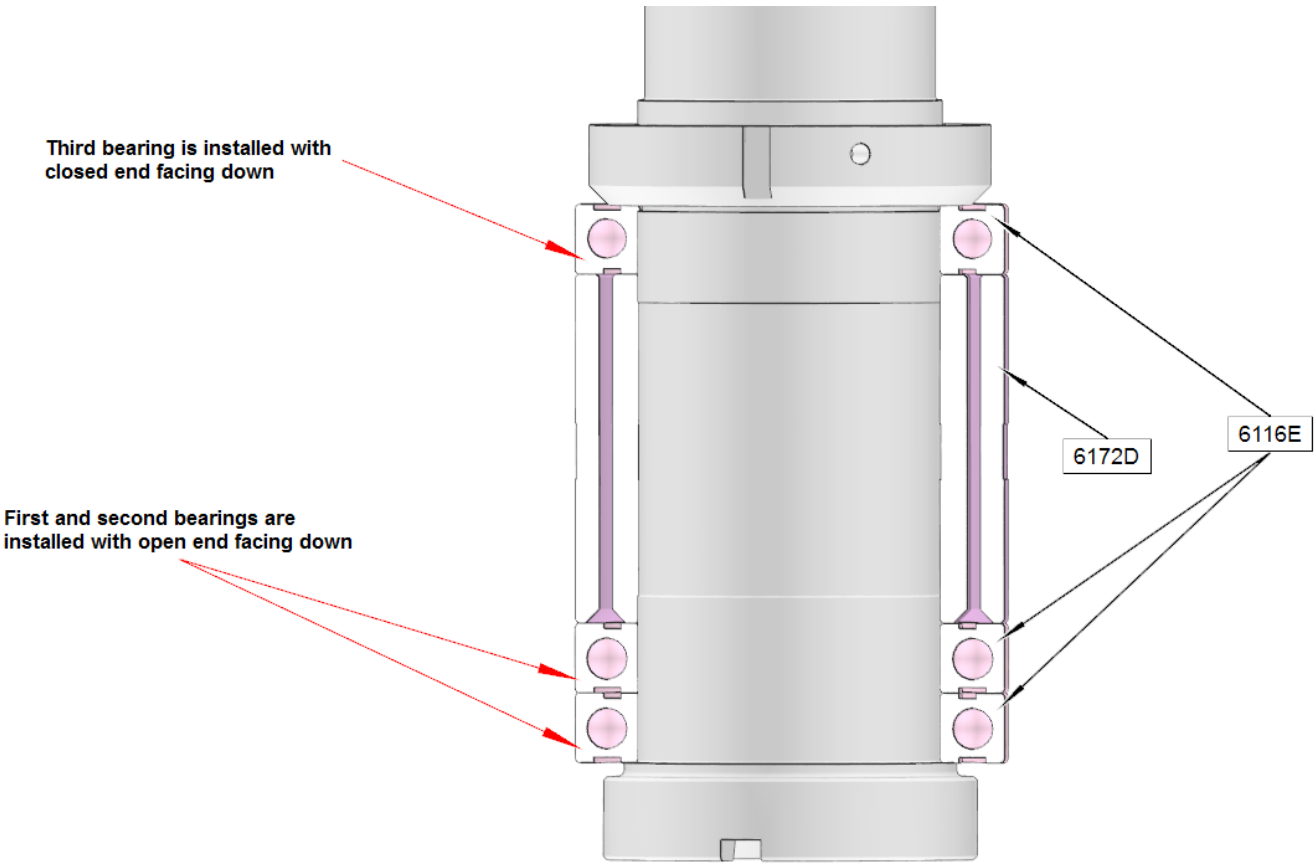
Install 3rd bearing with the closed side down.

Install inner and outer spacer assembly with beveled end facing up.

Install 2nd bearing with the open side down.

Install 1st bearing with the open side down.

Inner Spindle Lower Section Bearing Section View



Wiring, Air and Oil Line Diagrams

Wiring Diagrams, Air Line Diagrams, Oil Line Diagrams

Please visit the service tab of our web page www.rottlermfg.com and Send a Service Request. Or contact the Rottler Factory Service at service@rottlermfg.com for assistance.

You may also call Rottler at 1-800-452-0534 or 1-253-872-7050

Please ensure you have the Machine Model and Serial Number available when contacting Rottler for Service

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TROUBLESHOOTING

Problem:

Icon on screen does not move to area touched.

Solution:

Follow the procedure below to recalibrate the touchscreen.

1. Get to the Alignment screen.
    1. If an Elo icon is available in the tool tray at the lower right side of the desktop, click it, then click Align.
    2. Otherwise, go to the Windows Control Panel, double-click Elo Touchscreen and click the Align button on the General tab.
        1. If Windows XP and no Elo icon, click the “Switch to Classic View” button on the left
        2. If Windows 7 and no Elo icon, look for “View by: Category” text toward the upper right; click it and select “Small icons”
2. Touch and release the upper left target; the target should jump to the lower right.
3. Touch and release the lower right target; the target should jump to the upper right.
4. Touch and release the upper right target; a check screen should appear.
5. Touch and release the green check mark; the check screen should disappear.
6. The cursor should now jump to the point of touch.
7. If the Elo Control Panel is open, close it and the Windows Control Panel.

Problem:

Tool change was interrupted and not completed

Solution:

If a tool change is interrupted and not completed, the machine must be shut down. Disconnect the power supply and remove the air supply from the machine. Remove the tool by hand.

Chatter Problems

If you are having chatter problems when you are boring you should do the following steps;

1. Replace the insert, Make sure you use Rottler RT321 inserts it is strongly advised.

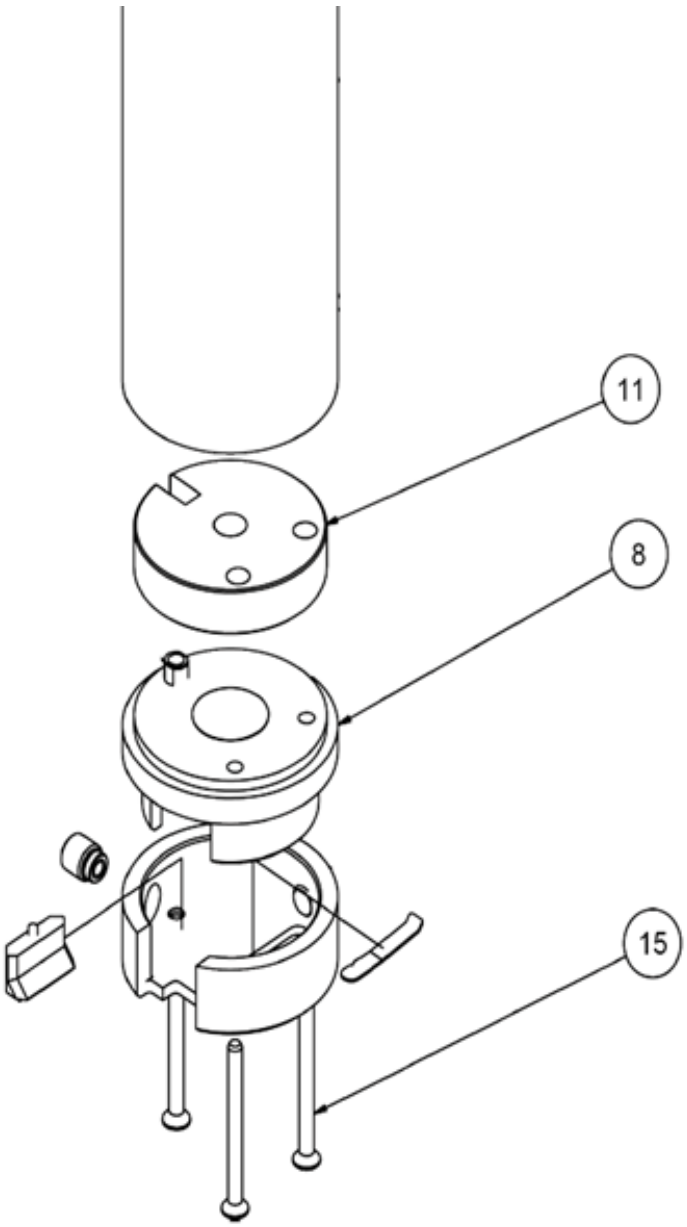
2. Clean the inside of the bore head. Oil will build up if you leave the boring head in the machine overnight or have the oiler turned up. You will need to clean any oil off of the counterweight (11), also clean the cavity that the counterweight sits in. This is done by removing the bolts (15). This procedure is the same with other Rottler cutter heads. See the optional equipment parts catalogue for breakdowns of the cutter heads.

3. Check Inner Spindle Adjustment, see maintenance section.

4. Check outer spindle adjustment/bushings, see maintenance section.

5. Newer models we recommend the use of the SSV system, if you are having chatter issues.

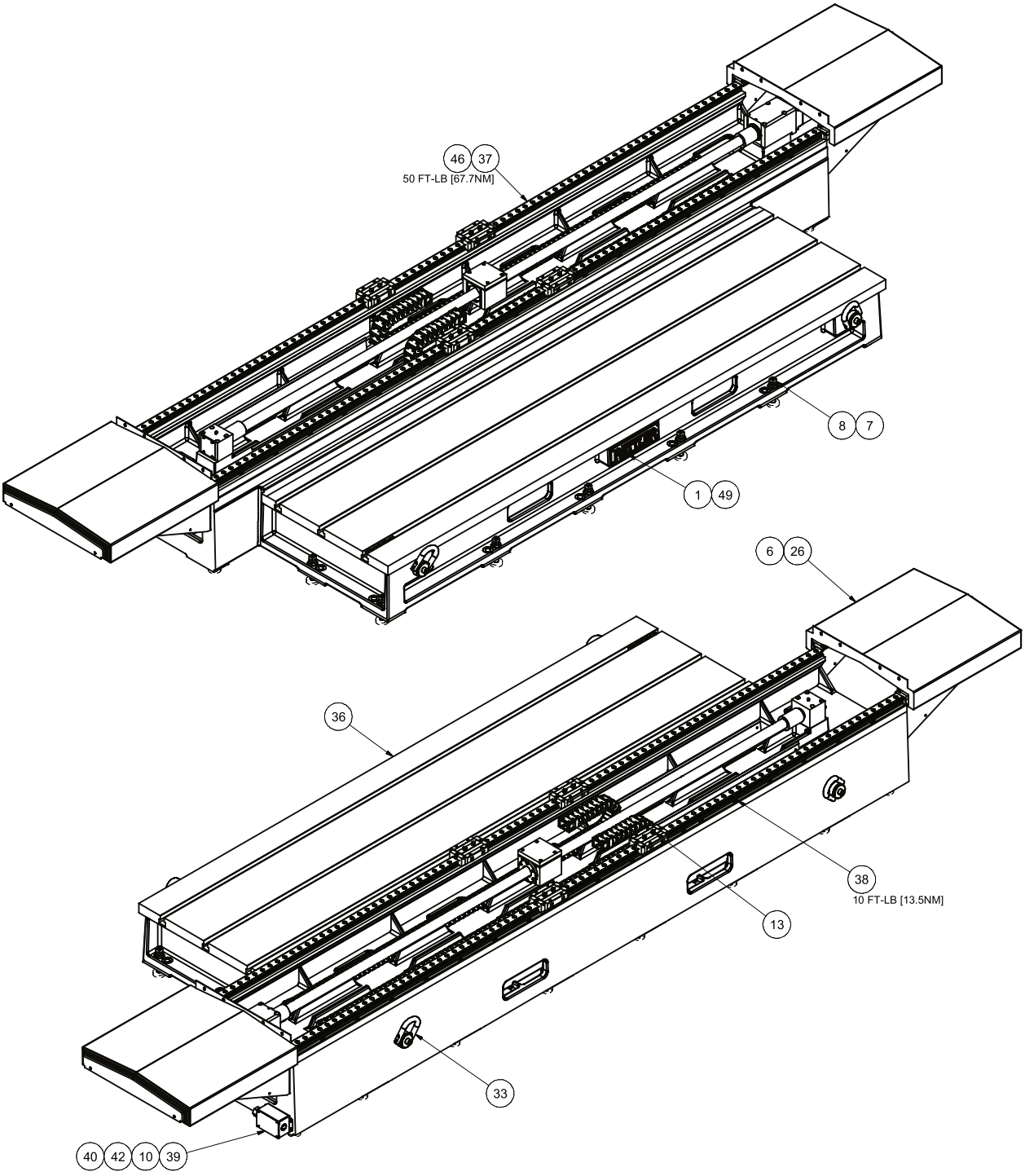
6. Counter balance cable pressure; verify that it is in service and unbroken. See maintenance section.

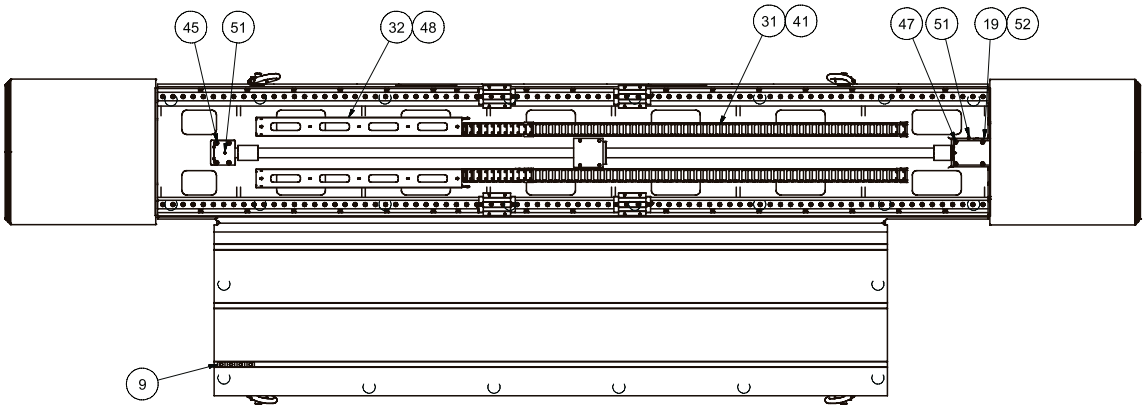


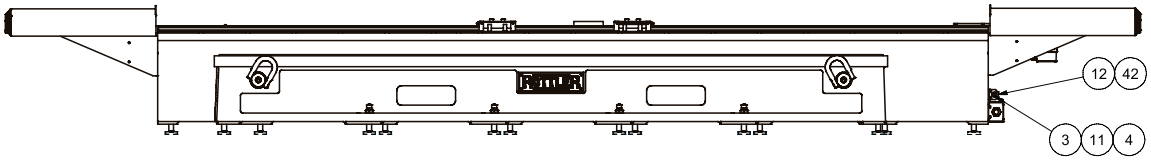
MACHINE PARTS

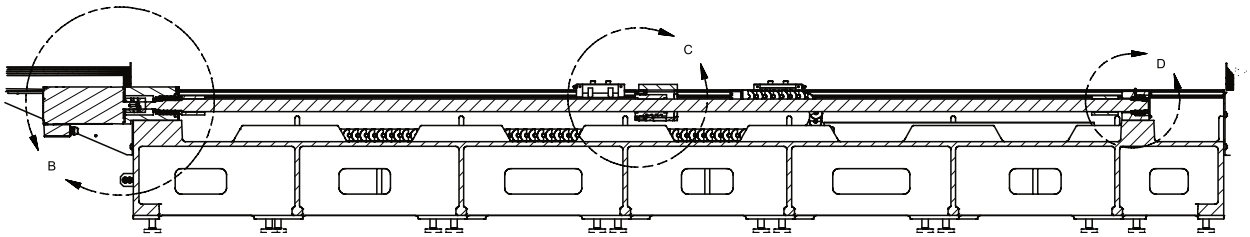
Contents

Bed Assembly Parts

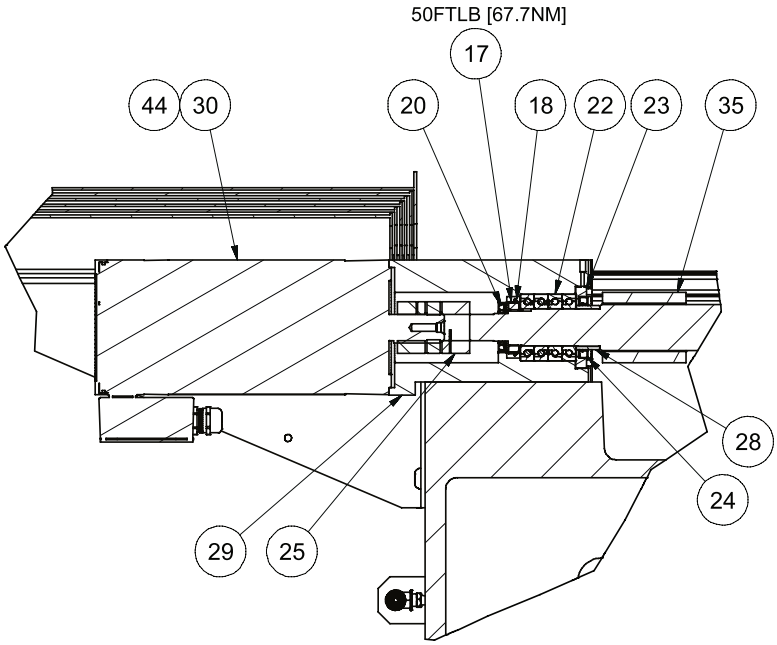




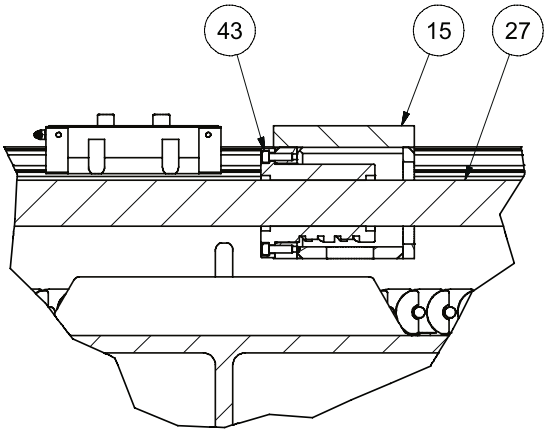




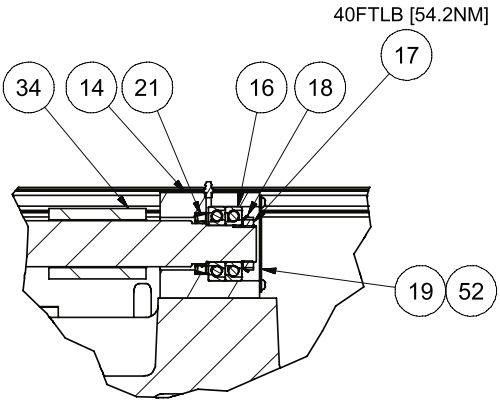
Enlarged Section Views on Next Page



DETAIL B



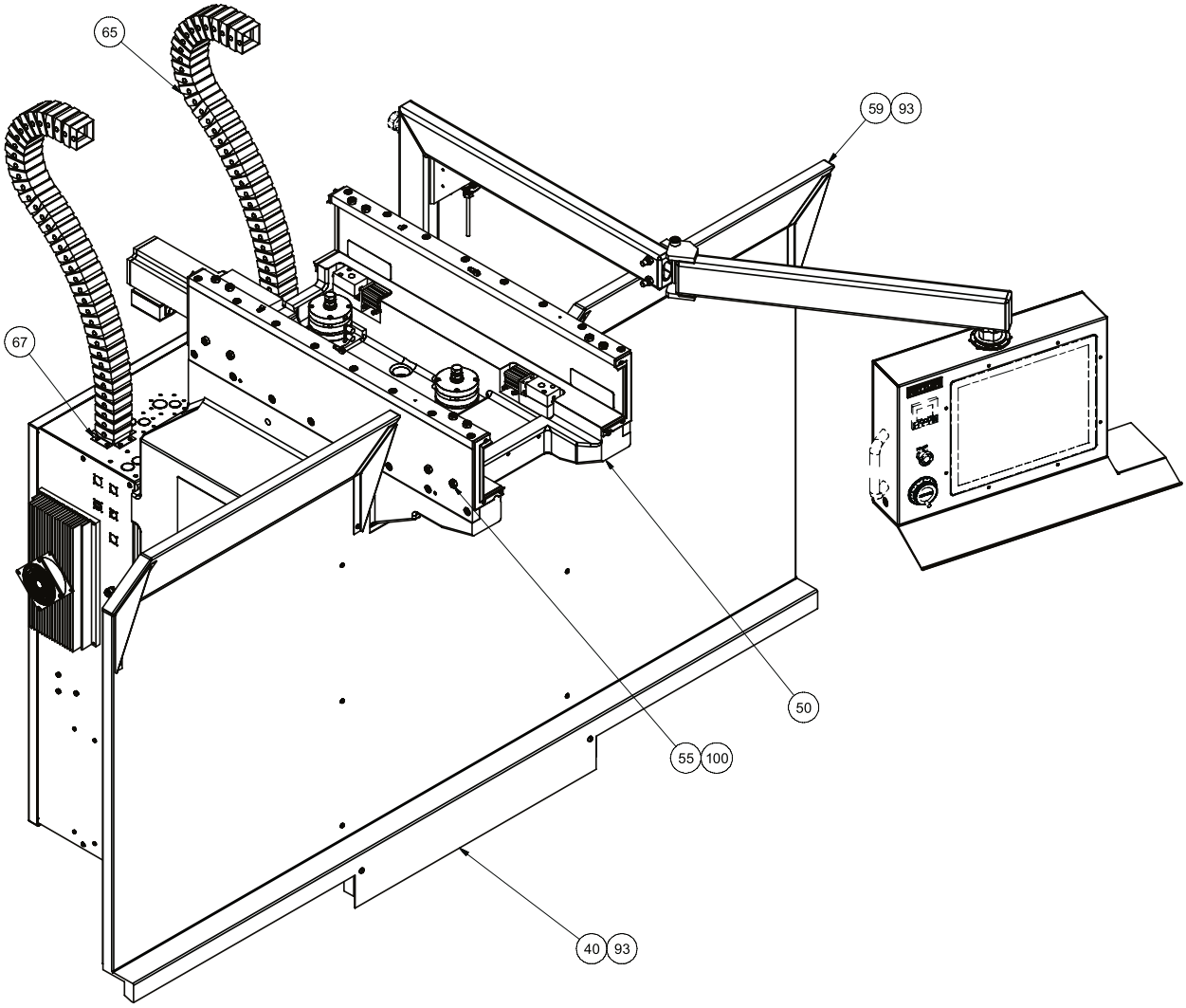
DETAIL C

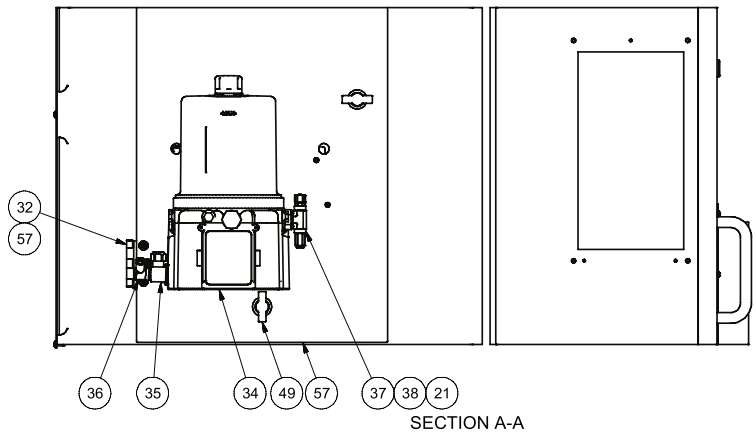


DETAIL D

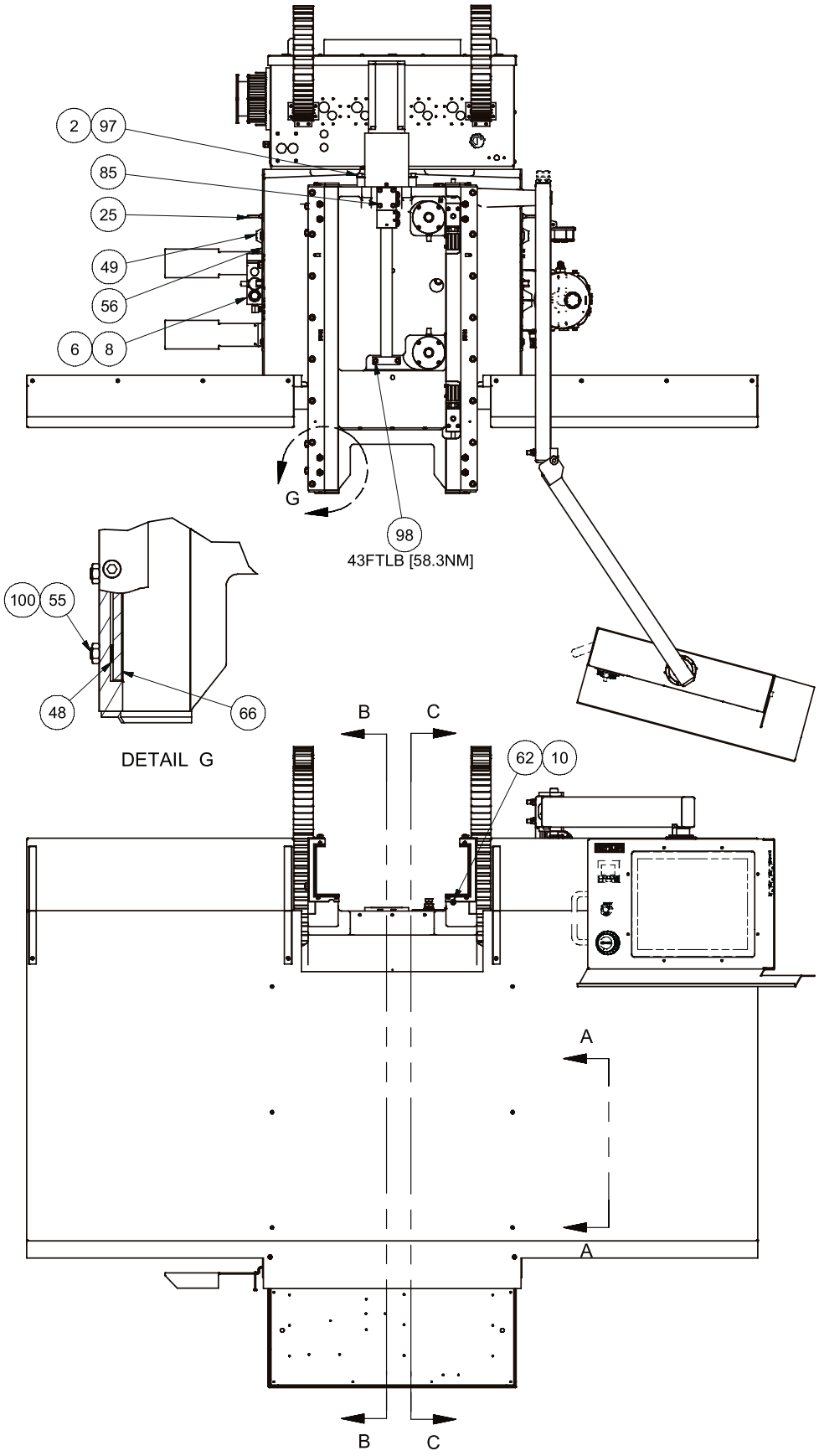
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-1-19	NAMEPLATE, ROTTLER
2	1	502-11-16X	CONNECTOR, MALE THREAD 1/4 NPTF V6/V8 FIXTURE
3	1	502-11-16Z	CONNECTOR, MALE THREAD AIR FITTING
4	1	502-11-17B	TEE, 1/4 X 1/4"
5	1	502-11-17E	COUPLING 1/4 NPT
6	8	650-3-61S	SCREW, SOCKET BUTTON HEAD 1/2-13 X 5/8"
7	24	6150C	NUT,JACKING SCREW--1-12 UNF-F100
8	24	6150E	JACKING SCREW--1-12 UNF X 5" LONG-FLAT TIP--F100
9	4	6160	NUT, "T"-HARDENED
10	1	6334	STRAIN RELIEF -1" ELECTRONIC ENCLOSURE
11	3	6345	FITTING,MALE BARBED INSERT (AIR HOSE)
12	1	6345B	BRACKET, F80 AIR
13	8	7664N	CAPSCREW, SOCKET HEAD M12x1.75 X 20MM
14	1	9112F	BALLSCREW SUPPORT-X-AXIS -F103,F104,F105
15	1	9112H	X-AXIS BALLSCREW MOUNT (MACHINING) -F103,F104,F105 COLUMN
16	2	9113	BEARING, ANGULAR CONTACT-F103,F104,F105
17	2	9113A	LOCK NUT-F103,F104,F105
18	2	9113B	LOCK WASHER-F103,F104,F105
19	2	9113D	COVER, SUPPORT HOUSING-F103,F104,F105
20	1	9113F	SEAL-F103,F104,F105
21	1	9113G	SEAL-F103,F104,F105
22	4	9113H	BEARING, X-AXIS BALLSCREW
23	1	9113J	NUT, BEARING RETAINING
24	1	9113K	CRS1/CRS11/CRW1/HMS4-Radial shaft seals
25	1	9113M	COUPLING ASSEMBLY-F103,F104,F105
26	2	9114	WAY COVER ASSEMBLY, F-103/104/105
27	1	9201H	X AXIS BALLSCREW - F100
28	1	9201J	SPACER, SEAL X-AXIS BALLSCREW - F100
29	1	9212C	HOUSING, BALLSCREW DRIVE - X-AXIS F107/9 (QUAD BEARING)
30	1	9215F	X-AXIS MOTOR , F103,F104,F105
31	2	9219	CABLE CARRIER, COLUMN TRAVEL-F105
32	2	9219D	TRACK, CABLE CARRIER - F107/9
33	4	9227C	RING, HOIST OR LIFTING EYE - F100
34	1	9232	BALLSCREW OVER TRAVEL SPRING - F103/4/5 - LEFT 4.13" LONG
35	1	9232A	BALLSCREW OVER TRAVEL SPRING - F103/4/5 - RIGHT 3.56" LONG
36	1	9238B	MACHINE BED - F-105AL (MACHINING)
37	1	9241	RAIL, LINEAR (X-AXIS) - F105AL
38	36	10043A	CLAMP, LINEAR RAIL - F106
39	1	10075	BOX, ELECTRICAL JUNCTION - EM100
40	1	10075A	CONNECTOR, BLOCK - EM79 - 109
41	4	MF-8	S.H.C.S.10 - 24 UNC - 2 1/4
42	6	MF-12	SOCKET HEAD CAPSCREW 1/4-20 X 1/2"
43	6	MF-23	SOCKET HEAD CAPSCREW 5/16-18 X 1"
44	4	MF-40	SOCKET HEAD CAPSCREW 7/16-14 X 1 3/4"
45	4	MF-41A	SOCKET HEAD CAPSCREW 1/2-13 X 3 1/2"
46	164	MF-44	S.H.C.S.1/2 - 13 UNC - 1 1/2
47	4	MF-44A	S.H.C.S.1/2 - 13 UNC - 1 3/4
48	4	MF-90	Socket Button Head1/4 - 20 x 1/2
49	4	Mf-92	Socket Button Head1/4 - 20 x 3/4
51	2	MF-191A	Grease Fitting 5/16-18
52	8	MF-248	Socket Button Head1/4 - 20 x 3/8

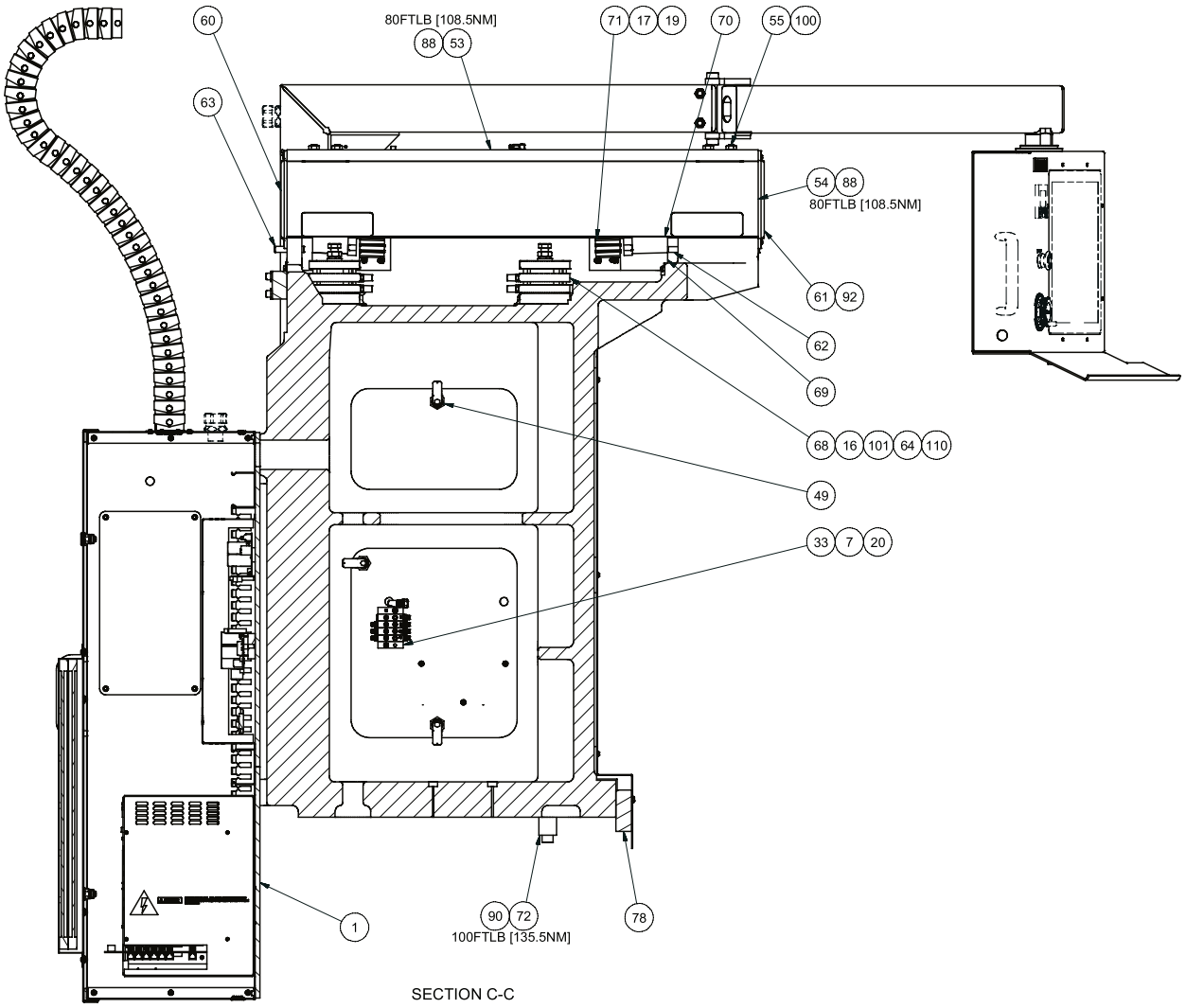
Column Assembly Parts

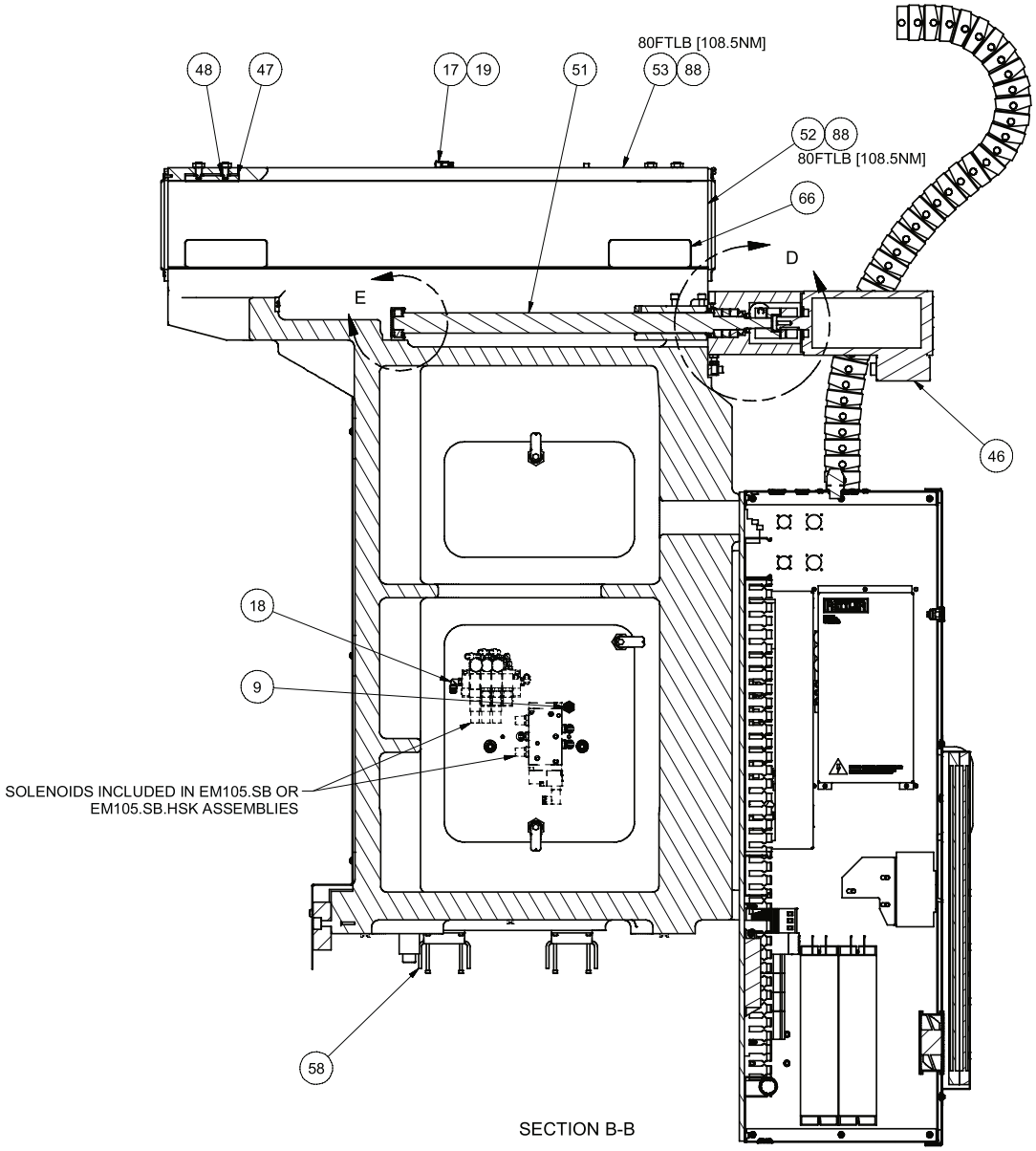


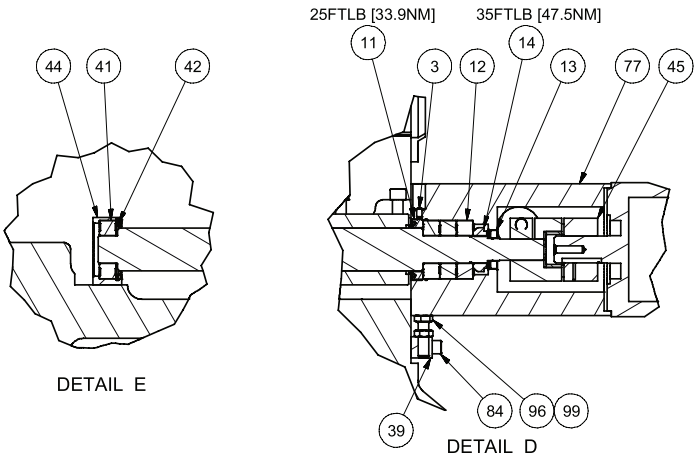


SECTION A-A


2
97
85
25
49
56
6
8
G
98
43FTLB [58.3NM]
100
55
48
66
DETAIL G
B
C
62
10
A
A
B
C


60
63
80FTLB [108.5NM]
88
53
71
17
19
70
55
100
54
88
80FTLB [108.5NM]
61
92
62
69
68
16
101
64
110
49
33
7
20
1
90
72
100FTLB [135.5NM]
78
SECTION C-C


80FTLB [108.5NM]
48
47
17
19
51
53
88
52
88
80FTLB [108.5NM]
66
D
E
46
18
9
SOLENOIDS INCLUDED IN EM105.SB OR
EM105.SB.HSK ASSEMBLIES
58
SECTION B-B


25FTLB [33.9NM]
35FTLB [47.5NM]
11
14
44
41
42
3
12
13
77
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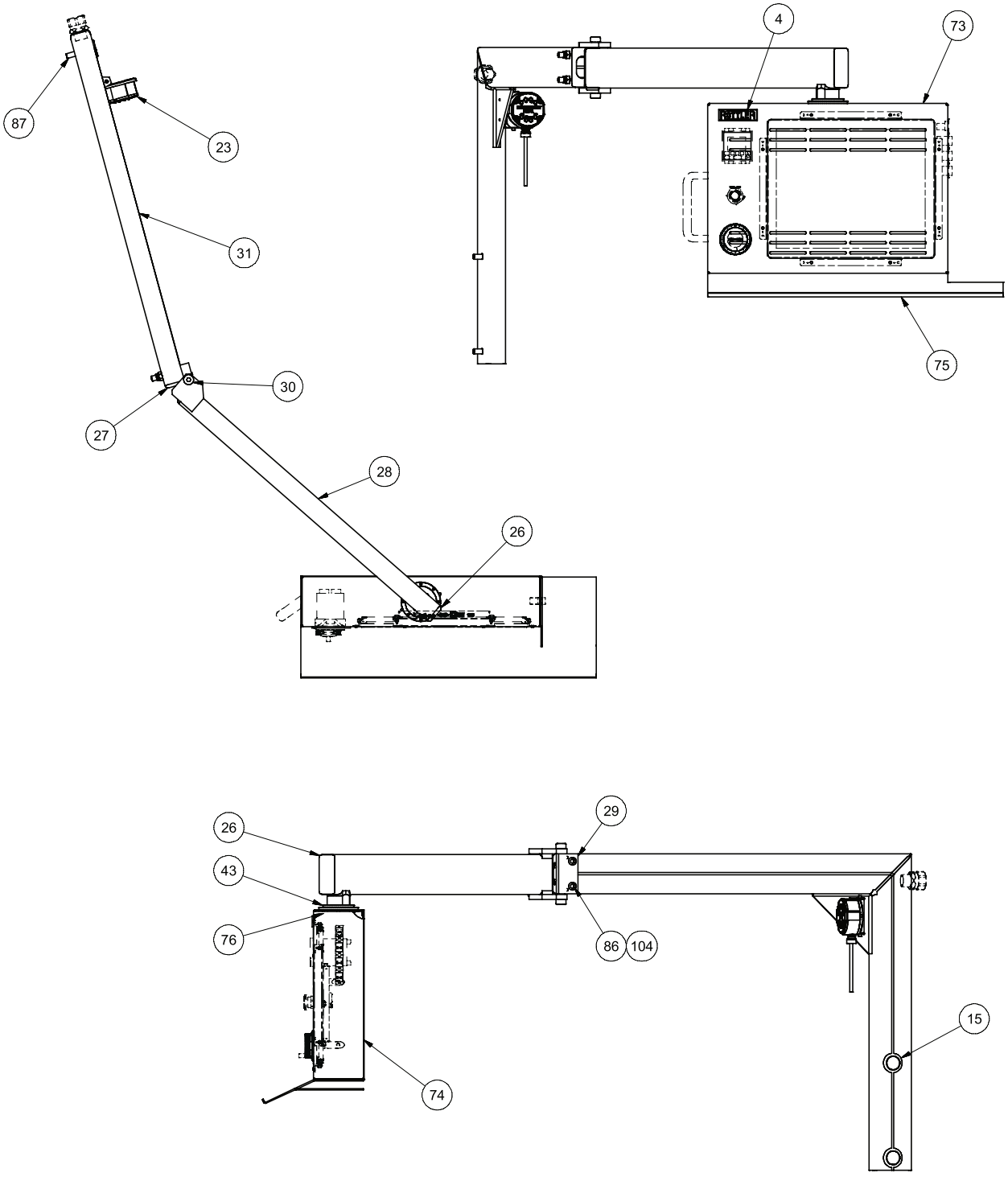
84
96
99
39
DETAIL E
DETAIL D


87
23
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4
73
75
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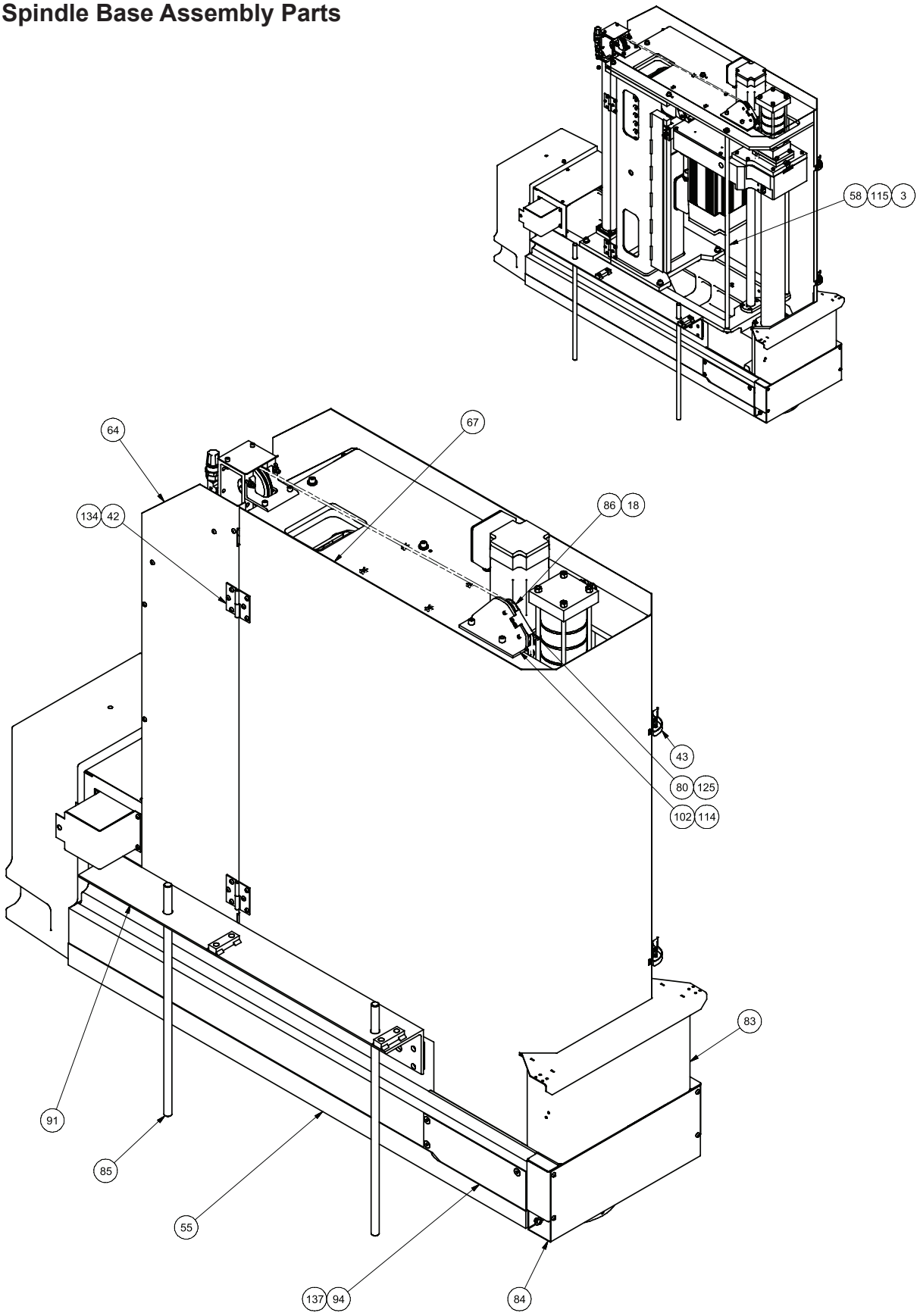
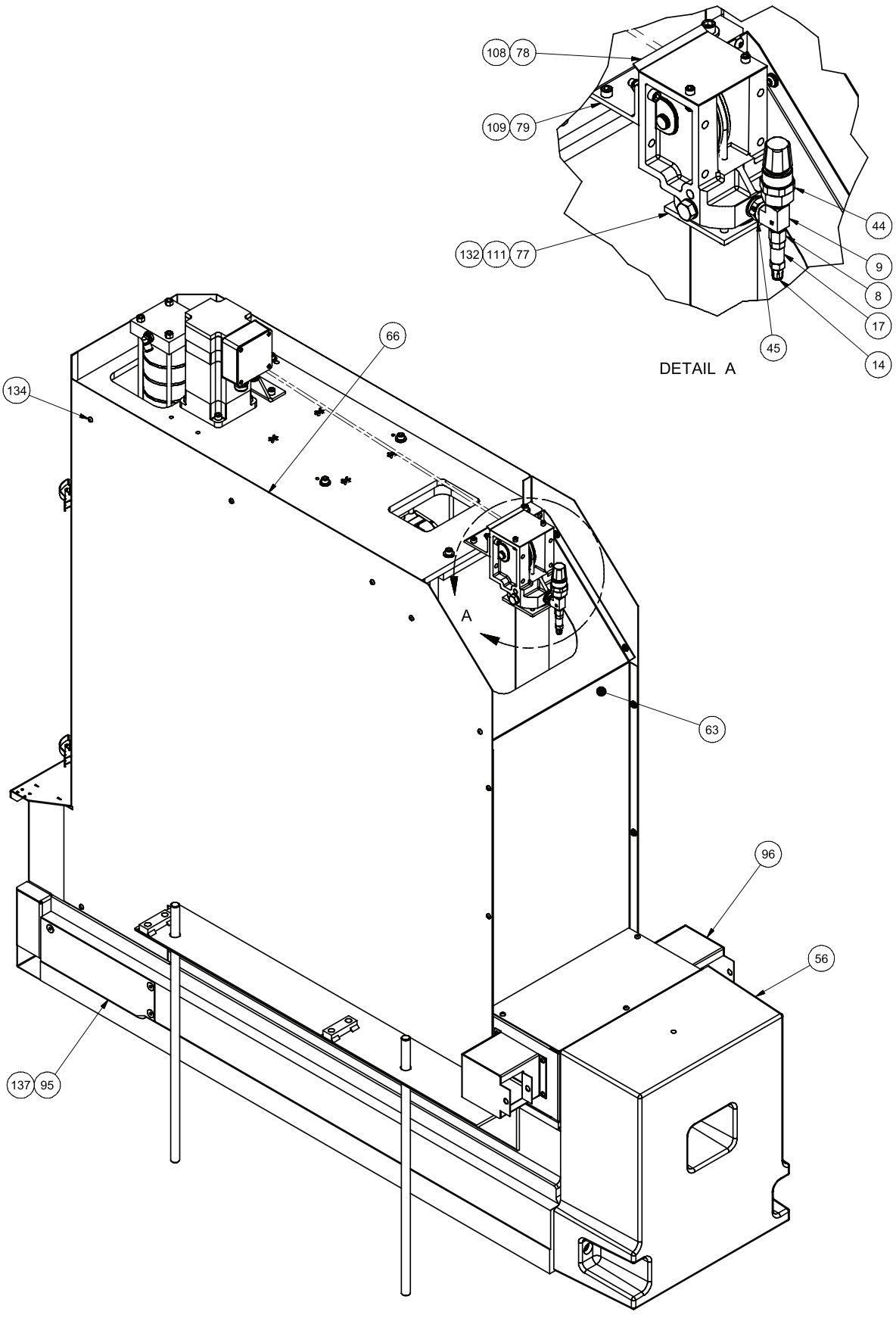
43
76
29
86
104
74
15

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	EM100.ELE	ELECTRCIAL (FOR EM103/104/105)
2	4	100-28-18	WASHER, FLAT - CLAMP ARM & WEAR PADS
3	1	100-82-2A	SCREW,SET-BRASS GIB - 3/8" LONG
4	2	502-1-19E	BOLT ON NAME PLATE
5	2	502-3-17	WASHER, HOLD DOWN & CLAMP HANDLE
6	1	502-11-17H	BUSHING, PIPE, 1/4NPT x 1/8NPT
7	1	502-11-17R	ELBOW, ST, 1/8 FPT X 1/8 MPT
8	1	502-37-71H	FILTER REGULATOR ASSEMBLY F80e/F79A/F109
9	1	502-37-71N	STRAIN RELIEF F80E SERIES
10	2	504-29-36	BRASS TIPPED SET SCREW 5/16-18UNC x 5/16" LG.
11	1	504-34-15A	NUT, THRUST BEARING SPINDLE FEED F5 SERIES
12	3	504-34-52	BEARING, ANGULAR CONTACT BALL (25 MM) F5 SERIES
13	1	504-34-53	OIL SEAL (.781 ID) F5 SERIES
14	1	504-34-54	LOCKNUT BEARING (BH-05) F5 SERIES
15	2	506-6-8	PLUG, RUBBER 39MM
16	4	514-3-99	MUFFLER, AIR EXHAUST (1/4")
17	8	514-4-16A	FITTING, ADJUSTABLE "L"
18	1	514-4-17E	ELBOW, 90 DEGREE MALE - 1/4" POLY X 1/8" NPT
19	10	514-4-17J	CONNECTOR, MALE - 1/8" OD TO 10-32
20	1	514-4-18J	FITTING 1/8 NPT X 3/8 TUBE-STRAIGHT HYDRAULIC RESEVOIR
21	1	514-4-18K	FITTING 1/4 NPT X 3/8 TUBE STRAIGHT COOLER BRACKET AND BALL VALVE
22	4	514-7-58	VALVE, CHECK (SHORT STROKE)
23	1	650-3-59U	RMP 40 RADIO PROBE HARDWARE KIT
24	6	6147Y	CLAMP, NYLON--3/16"-F90 SERIES
25	4	6190P	EYE BOLT(MACHINING)-3/8" X 1 14" -F79A
26	1	6200J	PLUG-TUBING- PENDANT SWING ARM F80 SERIES
27	2	6200L	PLUG-TUBING- PENDANT SWING ARM F80 SERIES (REWORK OF 6200J)
28	1	6200P	ARM, SWING - PENDANT HOUSING - EM79 & EM103/4/5
29	1	6201H	HINGE BLOCK, PENDANT F80 SERIES
30	2	6201J	BOLT, PIVOT-PENDANT F80 SERIES
31	1	6201V	SWING ARM SUPPORT F70/100 (MACHINING)
32	4	6340P	HINGE, AIR ACCESS DOOR F80E
33	1	6349K	FEEDER, FLO-OILER - EM79/103/104/105
34	1	6363	PUMP, OIL DISTRIBUTION - EM70/100
35	1	6363A	CONNECTOR, OILER POWER - EM70/100
36	1	6363B	CONNECTOR, LOW LEVEL OILER - EM70/100
37	1	6363C	ADAPTER, OILER OUTPUT - EM70/100
38	1	6363D	VALVE, OILER RELIEF - EM70/100
39	1	6451Q	BLOCK, ADJUSTING-BELT-SERVO MOTOR
40	1	6584K	PANEL, SHIELD F99Y
41	1	6778D	BEARING,MIDDLE-VERTICAL SHAFT HEAVY DUTY LINE BORE HEAD F88
42	1	7245E	RETAINING RING-SF
43	1	7322C	BEARING, SLEWING RING
44	1	9001A	BALLSCREW SUPPORT-Y AXIS (F90 SERIES)
45	1	9001Q	COUPLING ASSEMBLY - EM79/100 FOR Z & Y AXIS
46	1	9020H	MOTOR WITH BISS ENCODER-XYZ AXIS-F60/P60 AND Y AXIS ON F103,F104,F105,F109
47	4	9024A	GIB ASSEMBLY-SPRING-F90 COLUMN WITH SOLID Y-AXIS WAYS
48	24	9024E	SPRING,BELLEVILLE-GIB F90 SERIES
49	6	9030E	DOOR LATCH ,COLUMN AND AIR ACCESS-F100
50	1	9200F	COLUMN, (TURCITE ASSEMBLY) - F103/104/105AL
51	1	9201A	BALL SCREW ASSY, Y-AXIS -DIRECT DRIVE (IN--0UT TRAVEL) -F103/104/105
52	1	9202A	GIB BAR,- COLUMN -F103,F104,F105
53	2	9202B	GIB BAR,-TOP- COLUMN -F103,F104,F105
54	1	9202C	BAR ASSEMBLY, FIXED GIB- COLUMN -F103,F104,F105
55	12	9202D	SCREW,GIB ADJUSTING-SPINDLE BASE
56	1	9205	SIDE COVER, AIR CONTROL -COLUMN -F103,F104,F105
57	1	9205A	SIDE COVER, OILER CONTROL -COLUMN -F103,F104,F105
58	2	9219C	BRACE, CABLE TRACK - F103/4/5
59	2	9223A	CHIP DEFLECTOR, F103,F104,F105
60	2	9224	WAY WIPER,LEFT SIDE-SPINDLE BASE-F103/F104/F105
61	2	9224A	WAY WIPER,RIGHT SIDE-SPINDLE BASE-F103/F104/F105
62	1	9225	ADJUSTING SCREW, SPINDLE BASE TILT-F103/F104/F105
63	1	9225A	HEXAGON SOCKET SET SCREW-FLAT POINT, SPINDLE BASE TILT-F103/F104/F105
64	2	9228A	BOLT,TILT LIFT CYLINDER-F103,F104,F105
65	2	9231C	WIRING TRACK-SPINDLE F103/104/105
66	2	10003L	GIB ASSEMBLY, SPRING F-100 SPINDLE BASE
67	2	10015F	CABLE CARRIER BRACKET(SET OF 2 EACH),SPINDLE BASE-F100
68	2	10018E	CYLINDER TILT/LIFT-F100 SERIES
69	2	10018G	BASE WEDGE, SPINDLE BASE TILT -F70/F109/F105/F104/F103
70	2	10018H	TILT WEDGE, SPINDLE BASE-F70/F109/F105/F104/F103
71	2	10018J	CYLINDER -SPINDLE BASE TILT-F100 SERIES
72	2	10043C	PUSH BLOCK, LINEAR RAIL CARRIAGE - F106
73	1	10410	ENCLOSURE, PENDANT - F60/F70/F100
74	1	10411	COVER, PENDANT ENCLOSURE REAR - F60/F70/F100

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
75	1	10412	TRAY, PENDANT ENCLOSURE KEYBOARD - F60/F70/F100
76	1	10413	SPIN STOP, PENDANT - EM79/103/104/105
77	1	11008A	DIRECT DRIVE HOUSING BALLSCREW SUPPORT-X AND Y AXIS-F70
78	2	11010G	STOP, FRONT BEARING - EM79
79	4	MF-5A	S.H.C.S.10 - 24 UNC - 1/2
80	2	MF-7	S.H.C.S.10 - 24 UNC - 1 3/4
81	8	MF-7A	S.H.C.S.10 - 24 UNC - 2
82	4	MF-8	S.H.C.S.10 - 24 UNC - 2 1/4
83	8	MF-16	S.H.C.S.1/4 - 20 UNC - 1 1/4
84	2	MF-25	SOCKET HEAD CAPSCREW 5/16-18 X 1 1/2"
85	4	MF-31	S.H.C.S.3/8 - 16 UNC - 1
86	2	MF-41A	SOCKET HEAD CAPSCREW 1/2-13 X 3 1/2"
87	2	MF-44	S.H.C.S.1/2 - 13 UNC - 1 1/2
88	32	MF-44	SOCKET HEAD CAPSCREW 1/2-13 X 1 1/2"
89	6	MF-46A	S.H.C.S.5/8 - 11 UNC - 1 1/2
90	4	MF-46G	SOCKET HEAD CAPSCREW 5/8-11 X 2 1/2"
91	3	MF-76	Socket Flat Head 8-32 UNC x 0.375
92	6	MF-88A	Socket Button Head10 - 24 x 1/2
93	21	MF-90	Socket Button Head1/4 - 20 x 1/2
94	2	MF-93A	Socket Button Head 5/16 - 18 x 1/2
95	4	MF-143	HEX BOLT 3/8-16 X 1"
96	1	MF-143A	HEX BOLT 3/8-16 X 1 1/4"
97	4	MF-144	HEX BOLT 3/8-16 X 1 1/2"
98	2	MF-147	HEX BOLT 3/8-16 X 2 1/4"
99	1	MF-164	HEX NUTS 3/8-16 NC
100	12	MF-172	HEX JAM NUTS 1/2-20 NF
101	2	MF-173	JAM NUT5/8 - 11
102	3	MF-179	FLAT WASHERS 1/4"
103	2	MF-180	FLAT WASHERS 1/2"
104	2	MF-186	NYLOCK NUTS 1/2-13 NC
105	15	MF-186A	NYLOCK NUT 1/4-20
106	2	MF-186B	NYLOCK NUTS 10-24
107	1	MF-191A	5/16-32 STRAIGHT LUBE GREASE FITTINGS
108	2	MF-204	DOWEL PINS 1/4 X 1"
109	3	-	SOCKET BUTTON HEAD 1/4-20 X 1 1/4"
110	8	-	S.H.C.S.1/4 - 20 UNC - 4 1/4

Spindle Base Assembly Parts




108
78
109
79
132
111
77
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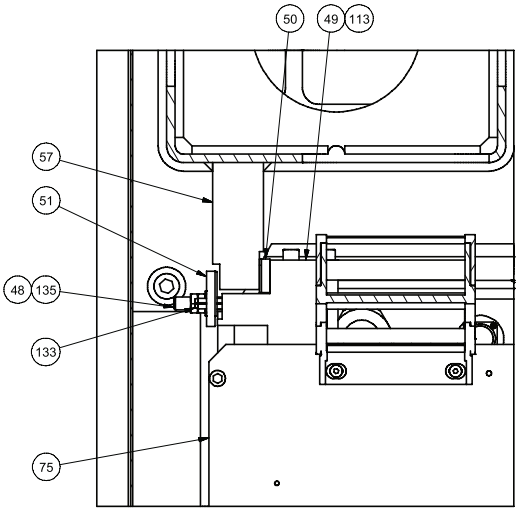
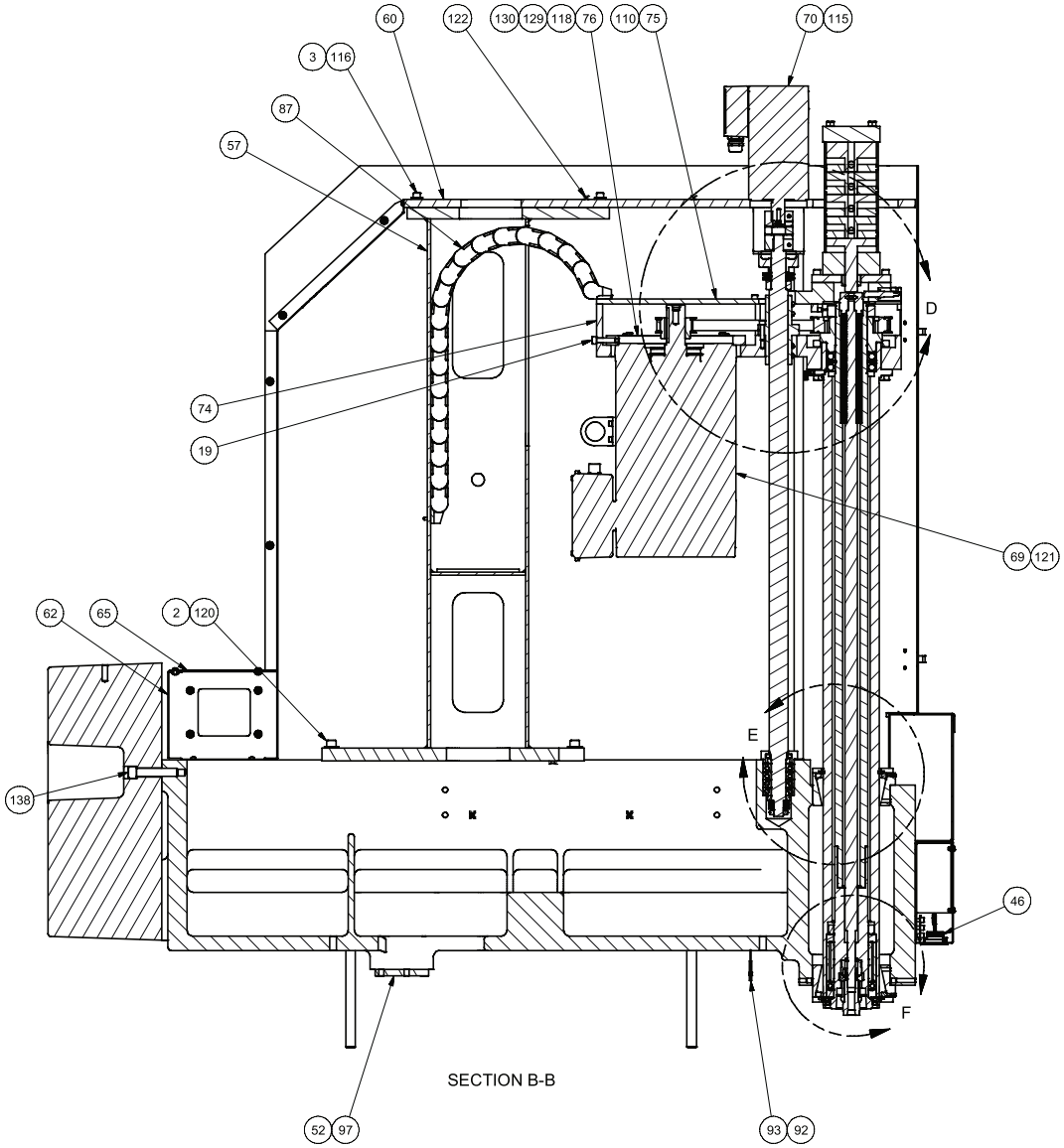
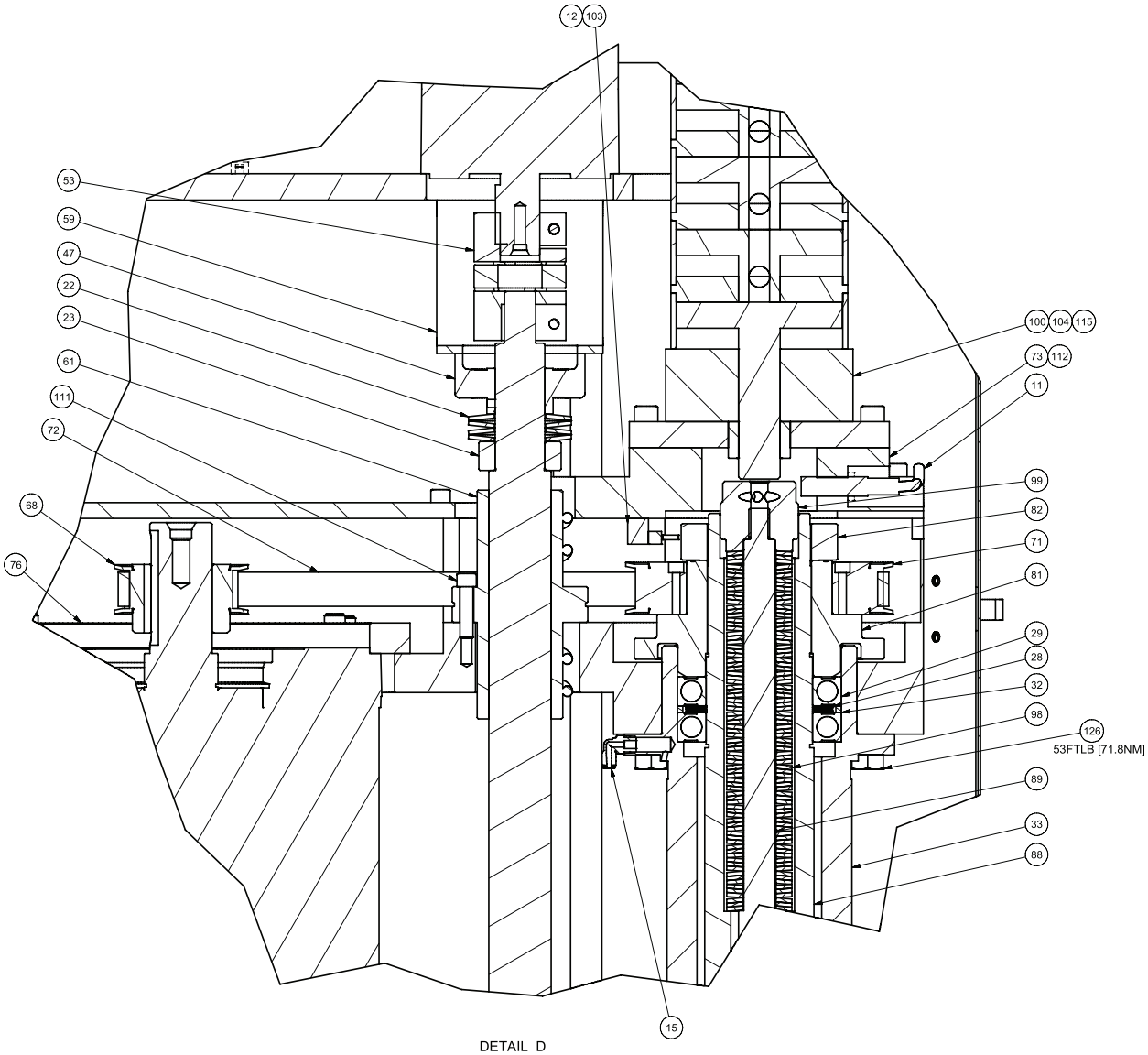
9
8
17
14
45
DETAIL A
66
134
A
63
96
56
137
95



SECTION C-C



SECTION B-B


12
103
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111
72
68
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100
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73
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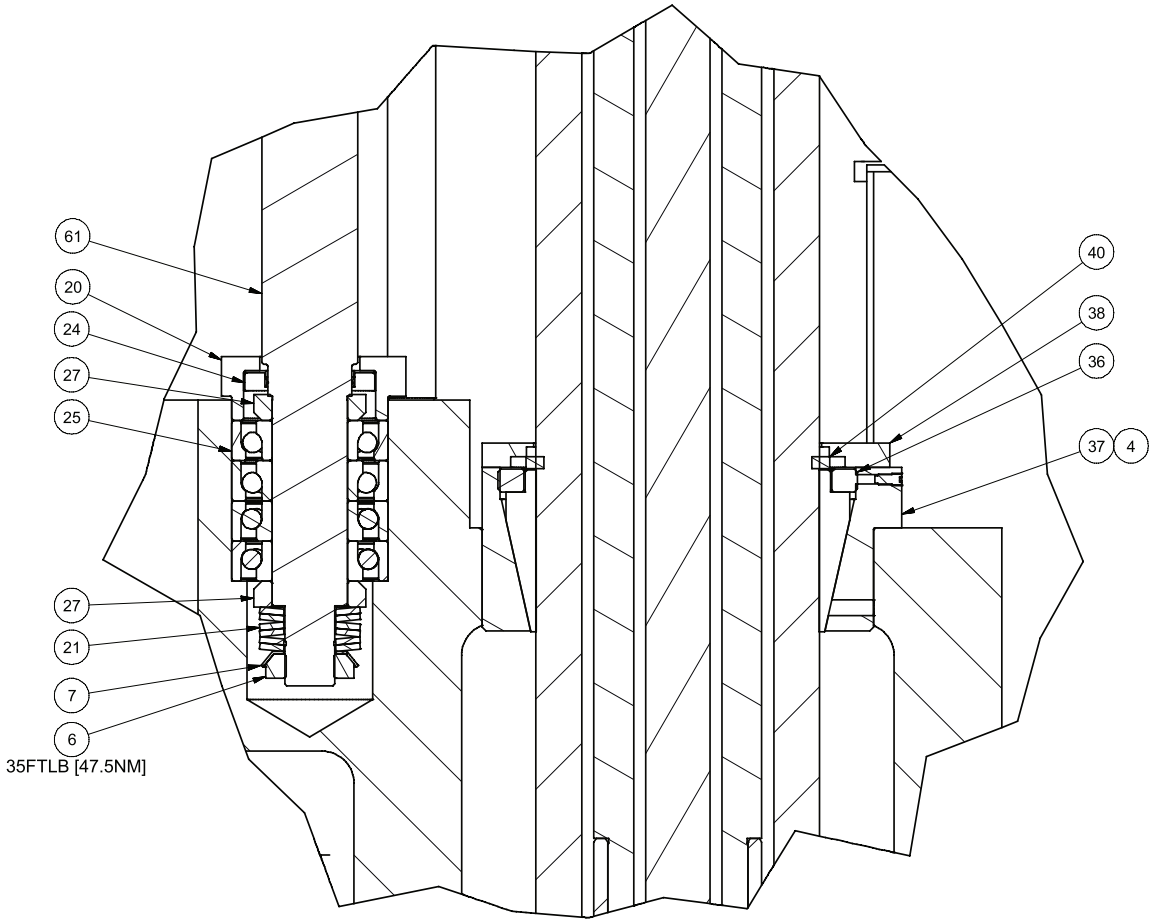
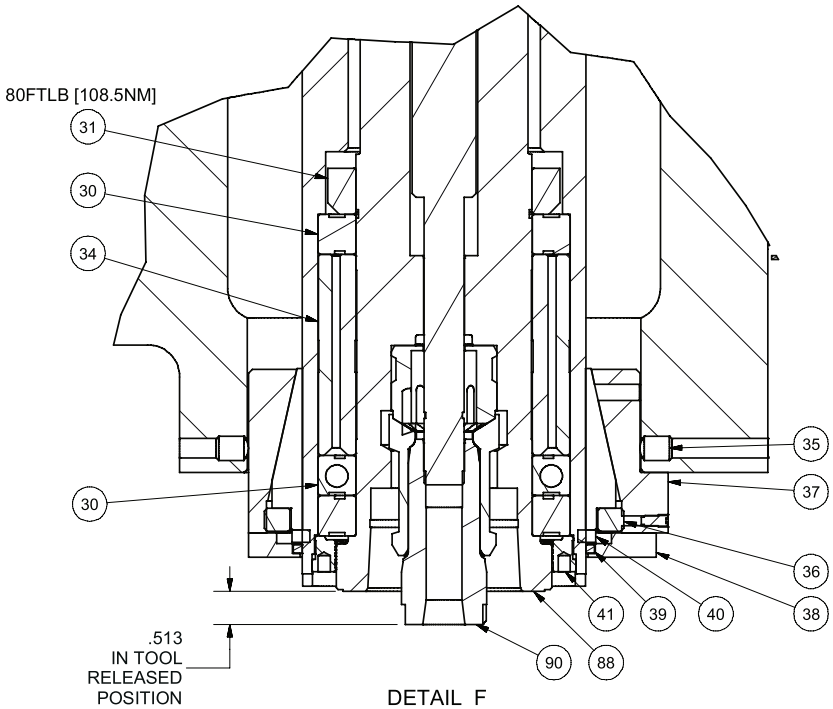
71
81
29
28
32
98
126
53FTLB [71.8NM]
89
33
88
15

DETAIL D



DETAIL E

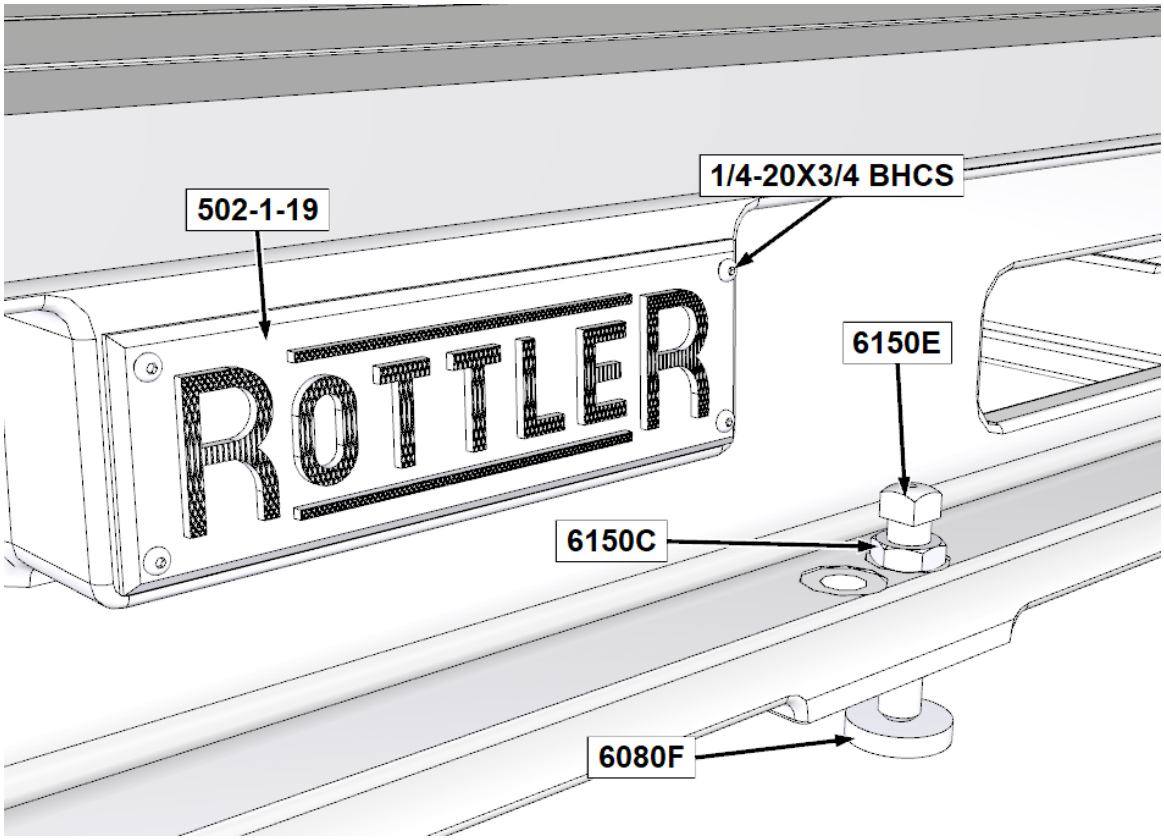


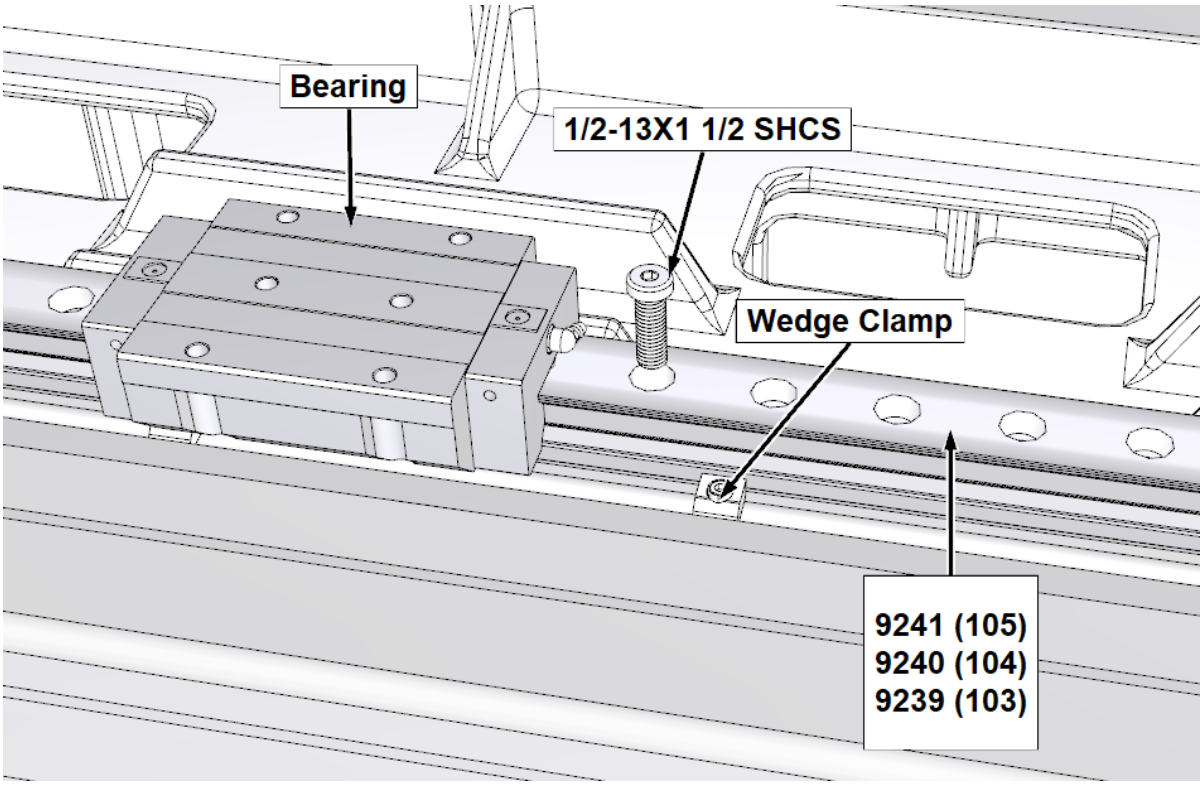
DETAIL F

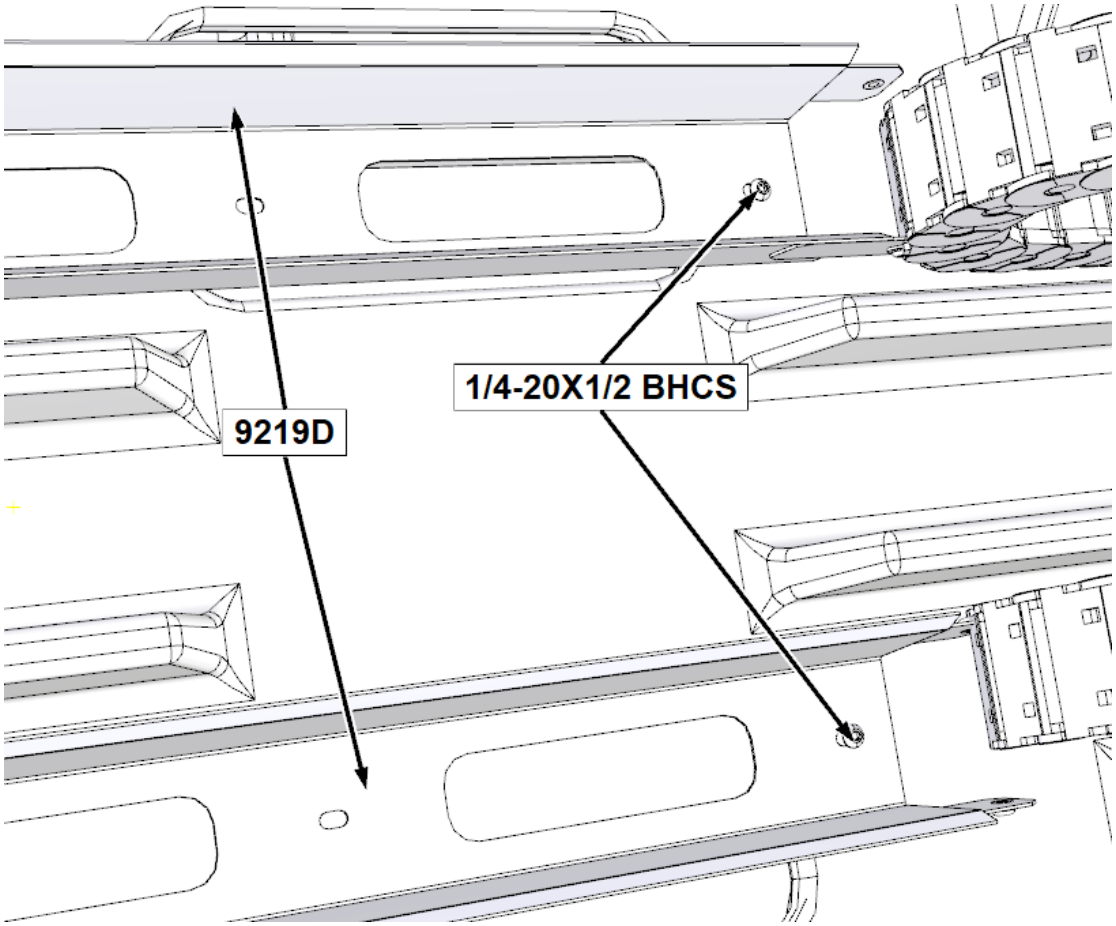
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	100-19	WASHER, THRUST
2	4	100-19A	WASHER, HARDENED 17/32" ID
3	7	100-28-18	WASHER, FLAT - CLAMP ARM & WEAR PADS
4	2	100-82-2B	SCREW, SET-BRASS TIPPED (8-32 X 3/8")
5	1	501-27	CAP, OIL TUBE FITTING
6	1	502-10-17	NUT,LOCK
7	1	502-10-18	WASHER,LOCK
8	1	502-11-17L	ADAPTER, #120-B 1/4 TO 1/8" MALE PIPE FITTING
9	1	502-11-17W	TEE, 1/4 FPT X 1/4 MPT
10	1	502-11-59A	TEE, 1/4" NPT X 3/8" TUBE - HSK MACHINES
11	1	502-37-81	SENSOR, PROXIMITY
12	1	514-2-65C	PROXIMITY SWITCH ASSEMBLY- LOWER LIMIT
13	1	514-4-17E	ELBOW, 90 DEGREE MALE - 1/4" POLY X 1/8" NPT
14	1	514-4-17W	FITTING 1/8NPT x 1/4" POLY STRAIGHT
15	2	514-4-18	ELBOW-90 DEGREE 1/8 POLY TO 1/8NPT
16	1	514-4-18A	ELBOW 3/8" TUBE X 1/4" NPT INJECTION OILER
17	1	514-7-58	VALVE, CHECK (SHORT STROKE)
18	2	650-3-66R	SHOULDER SCREW CONROD CAP FIXTURE ASSEMBLY F88S
19	1	650-3-92Y	SCREW, SOCKET HEAD CAP-(3/8-24 X 1 1/2")
20	1	6032E	RETAINER,THRUST BEARING- SPINDLE FEED
21	6	6037A	SPRING,FEED SHAFT & COLUMN BUMPER
22	4	6037C	SPRING, BELLEVILLE VERTICAL BALLSCREW STOP
23	1	6037D	COLLAR, SPACER-VERTICAL BALL SCREW STOP
24	1	6052	SEAL,OIL-UPPER BALLSCREW
25	4	6063	BEARING, ANGULAR CONTACT BALL
26	1	6090B	KEY, SQUARE SPINDLE DRIVE
27	2	6107	RING, SHOULDER-SPINDLE FEED
28	4	6113	SPRING,BELLEVILLE-UPPER BEARING-INNER SPINDLE TAKEUP
29	2	6115A	BEARING,UPPER SPINDLE (BELT DRIVEN F80)
30	1	6116E	BEARING,PRECISION- SPINDLE (SET OF 3)
31	1	6116F	NUT,BEARING-LOWER INNER SPINDLE (SHOELOK)
32	1	6123F	SPACER,OUTER SPINDLE-UPPER HOUSING F80
33	1	6166N	SPINDLE,OUTER-PRECISION BEARING STYLE F88E WITH BELT DRIVE - F100 SERIES
34	1	6172E	SPACER(SET)-PRECISION BEARING SPINDLE
35	4	6219M	SCREW, ADJUSTING-SPINDLE BEARING RETAINER
36	2	6223	NUT,SPINDLE-OUTER
37	2	6225A	CARRIER,LOWER BEARING
38	2	6247A	RETAINER,WIPER-SPINDLE
39	1	6248	WIPER (SQUARE CROSS SECTION "O" RING)
40	2	6249	OILER,FELT-LOWER
41	1	6305D	NUT,THROW BACK RING-PRECISION BEARING SPINDLE
42	2	6320J	HINGE,SPINDLE COVER
43	2	6320M	CLAMP, SPINDLE COVER
44	1	6449	VALVE,RELIEF-COUNTERWEIGHT
45	1	6449A	ADAPTER, BRASS - F106/7/9
46	2	6457N	LED light and Housing
47	1	6759F	BLOCK,FLANGE-SERVO MOTOR
48	2	6760F	SPRING,BELLEVILLE-LINEAR BEARING
49	1	6760J	BRACKET,MOUNTING-LINEAR BEARING
50	1	6760K	BEARING, INNER-LINEAR GUIDE
51	1	6760L	BEARING, OUTER-LINEAR GUIDE
52	4	7242J	THREAD INSERT, CLAMP SHOE
53	1	9001Q	COUPLING ASSEMBLY - EM79/100 FOR Z & Y AXIS
54	1	9005T	VALVE, TOOL RELEASE - F100 HSK MACHINES
55	1	9206B	BASE,SPINDLE (MACHINING) F103,F104,F105
56	1	9206D	COUNTERWEIGHT(MACHINING), SPINDLE BASE ,F103.F104.F105
57	1	9207A	TOWER(MACHINING)F103,F104,F105
58	2	9208B	SUPPORT BAR, TOP PLATE -F103.F104,F105
59	1	9208C	VERTICAL BEARING SUPPORT BRACKET - F103/104/105
60	1	9208E	PLATE, TOWER TOP HSK (MACHINING) - F100 SERIES
61	1	9209	BALL SCREW ASSY, Z-AXIS -DIRECT DRIVE (VERTICAL) -F103/104/105
62	1	9213	COVER,BOX-SPINDLE BASE -F103.F104,F105
63	1	9213A	REAR COVER, TOWER -F103.F104,F105
64	1	9213B	COVER, LEFT SIDE REAR -TOWER -F103.F104,F105
65	1	9213C	COVER, LOWER REAR SPINDLE BASE -F103,F104,F105
66	1	9213D	COVER, RIGHT SIDE- TOWER -F103.F104,F105
67	1	9213F	COVER, DOOR-TOWER -F103.F104,F105
68	1	9215B	SPROCKET,DRIVE SPINDLE DRIVE -F103.F104,F105
69	1	9215G	MOTOR, SPINDLE - BISS ENCODER - F100 SERIES
70	1	9215J	Z-AXIS OR EVAC MOTOR (WITH BRAKE) - EM100 & EM69
71	1	9215M	SPROCKET, DRIVEN 60 TOOTH SPINDLE DRIVE (MACHINING) - F103 TO F109
72	1	9215N	BELT, SPINDLE DRIVE - F103 - F109
73	1	9216H	COVER, FRONT UPPER HOUSING (MACHINING) - F100 SERIES WITH HSK SPINDLE
74	1	9216J	HOUSING, UPPER SPINDLE (MACHINING) - EM100
75	1	9216L	COVER, REAR - UPPER HOUSING (MACHINING) EM100
76	1	9216M	PLATE, SPINDLE DRIVE MOTOR MOUNT (MACHINING) - EM100
77	1	9217	COUNTER BALANCE CYLINDER -F103.F104,F105

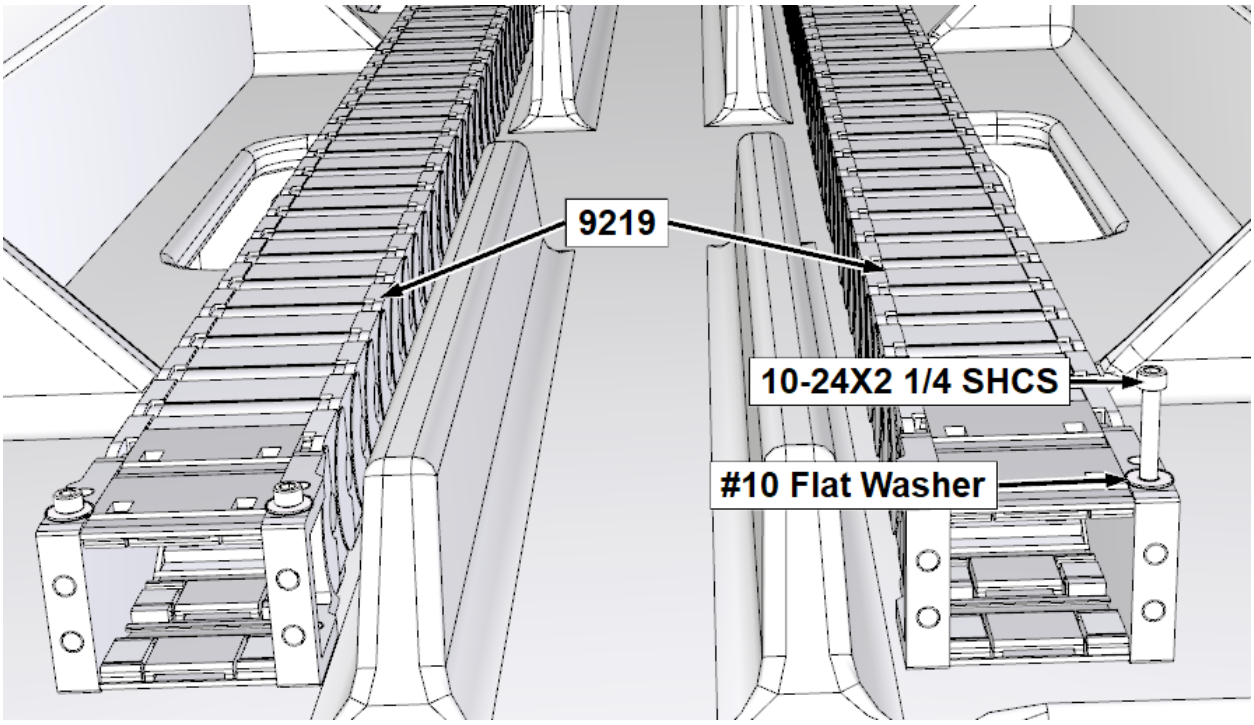
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
78	1	9217A	GUIDE/COVER, COUNTERBALANCE CYLINDER -F103.F104,F105
79	1	9217B	SUPPORT BRACKET, UPPER CABLE CYLINCER -F103.F104,F105
80	1	9217C	CABLE GUIDE, COUNTERWEIGHT CABLE-F70/F103/F104/F105
81	1	9218	INDEX BUSHING-DRIVEN SPROCKET F103,F104,F105
82	1	9218A	NUT,SPINDLE ADJUSTMENT ,F103.F104.F105
83	1	9222B	FRONT PLATE, SPINDLE BASE -F103,F104,F105
84	1	9222C	LIGHT MOUNT-COVER, SPINDLE BASE -F103,F104,F105
85	4	9227A	HOLD DOWN ROD, SPINDLE BASE - SHIPPING F103/4/5
86	2	9230	PULLEY, CABLE CYLINDER-F103,F104,F105
87	1	9231B	CARRIER,CABLE ASSEMBLY (VERTICAL) -F103/F104/F105
88	1	9233	SPINDLE ASSEMBLY, INNER - F103/4/5 HSK SPINDLE
89	1	9233C	SHAFT, DRAWBAR - F103/4/5 HSK SPINDLE
90	1	10001T	GRIPPER, HSK SPINDLE ASSEMBLY - F107/F109
91	2	10003J	ANGLE PLATE, SPINDLE BASE-F90/F100
92	2	10013C	WIPER PLATE, Y-AXIS-F100 SPINDLE BASE
93	1	10013D	RUBBER WIPER, Y-AXIS-F100 SPINDLE BASE
94	1	10013E	LEFT SIDE COVER, LOWER-SPINDLE BASE-F100
95	1	10013F	RIGHT SIDE COVER, LOWER-SPINDLE BASE-F100
96	2	10015G	BOX ASSEMBLY, CABLE CARRIER MOUNT-F100
97	1	10019	BALLSCREW NUT MOUNT-F100
98	81	10041	BELLEVILLE SPRING, DRAWBAR - HSK SPINDLE
99	1	10041B	NUT, HSK DRAWBAR TOP - F100
100	1	10042B	CYLINDER, DRAWBAR RELEASE - HSK SPINDLE 5 STAGE
101	1	10042F	PACK, VALVE - F106/7/9 HSK
102	1	11017G	BRACKET, DUAL PULLEY COUNTER BALANCE - F79
103	1	11019	BRACKET,SENSOR MOUNT-TOWER-F70
104	2	11042G	CYLINDER, DRAWBAR RELEASE - F100 HSK
105	2	MF-2A	SOCKET HEAD CAPSCRW 8-32 X 3/4"
106	1	MF-11	SOCKET HEAD CAPSCREW 1/4-20 X 3/8"
107	6	MF-12	SOCKET HEAD CAPSCREW 1/4-20 X 1/2"
108	2	MF-15A	S.H.C.S.1/4 - 20 UNC - 7/8
109	2	MF-21	S.H.C.S.5/16 - 18 UNC - 5/8
110	4	MF-22	SOCKET HEAD CAPSCREW 5/16-18 X 3/4"
111	5	MF-24	S.H.C.S.5/16 - 18 UNC - 1 1/4
112	6	MF-25	S.H.C.S.5/16 - 18 UNC - 1 1/2
113	4	MF-28E	SOCKET HEAD CAPSCREW 5/16-18 X 3"
114	6	MF-29	S.H.C.S. 3/8 - 16 UNC - 1/2
115	12	MF-31	S.H.C.S.3/8 - 16 UNC - 1
116	6	MF-32	S.H.C.S.3/8 - 16 UNC - 1 1/4
117	12	MF-33	SOCKET HEAD CAPSCREW 3/8-16 X 1 1/2"
118	4	MF-34	SOCKET HEAD CAPSCREW 3/8-16 X 2"
119	1	MF-39C	SOCKET HEAD CAPSCREW 7/16-14 X 1 1/4"
120	4	MF-44	S.H.C.S.1/2 - 13 UNC - 1 1/2
121	4	MF-44A	SOCKET HEAD CAPSCREW 1/2-13 X 1 3/4"
122	10	MF-76	Socket Flat Head 8-32 UNC x 0.375
123	4	MF-79	SOCKET FLAT HEAD SCREW 10-24 X 1/2"
124	8	MF-79A	SOCKET FLAT HEAD SCREW 10-24 X 5/8"
125	2	MF-87	Socket Button Head10 - 24 x 1/4
126	5	MF-149	HEX BOLT 1/2-13 X 1 1/4"
127	4	MF-164	HEX JAM NUTS 3/8-16
128	6	MF-179	FLAT WASHERS 1/4"
129	4	MF-179A	FLAT WASHERS 3/8"
130	4	MF-184A	LOCK WASHERS 3/8"
131	2	MF-186A	NYLOCK NUTS 1/4-20
132	2	MF-187	NYLOCK NUTS 5/16-18 NC
133	2	MF-228	ROLL PINS 5/16 X 1 1/2"
134	52	MF-248	Socket Button Head1/4 - 20 x 3/8
135	1	MF-1000	SOCKET SET SCREW CUP POINT 3/8-16 X 2"
136	2	-	SOCKET FLAT HEAD SCREW 5/16-18 X 3/4"
137	6	-	SOCKET FLAT HEAD SCREW 3/8-16 X 5/8"
138	3	-	S.H.C.S.5/8 - 11 UNC - 3 1/4

Machine Base Parts

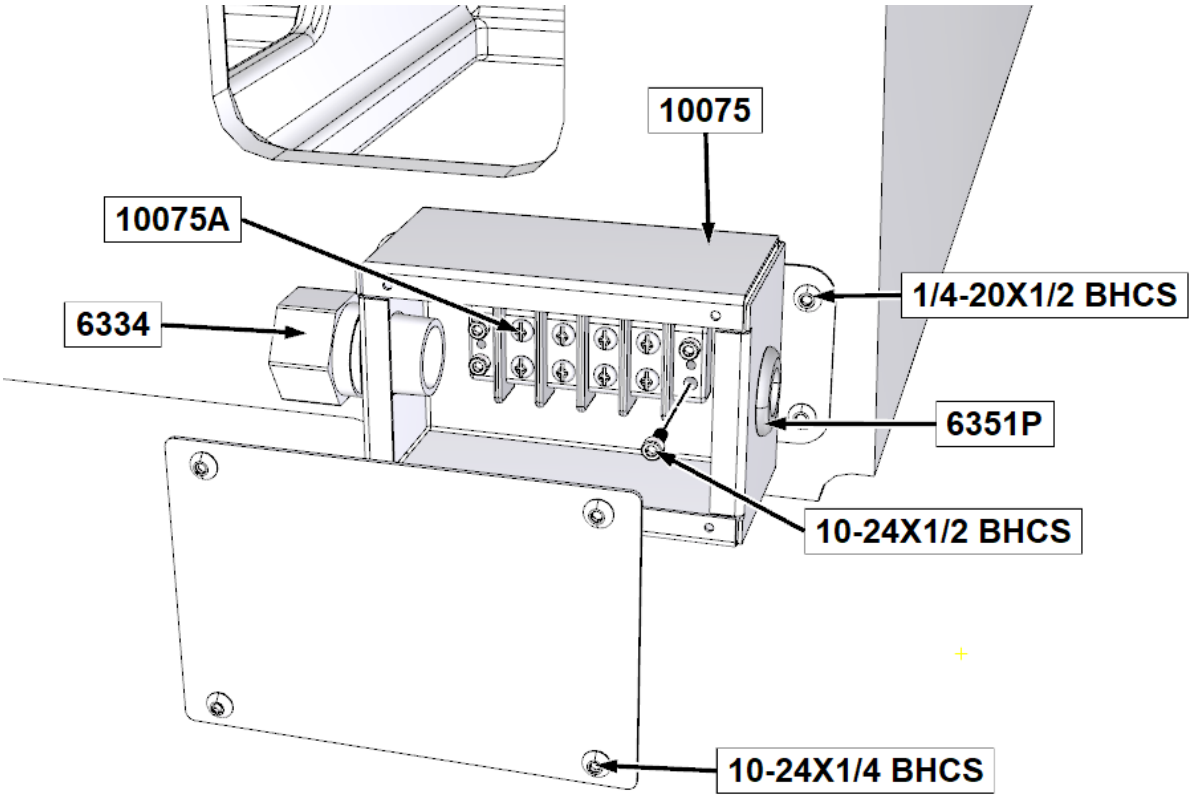




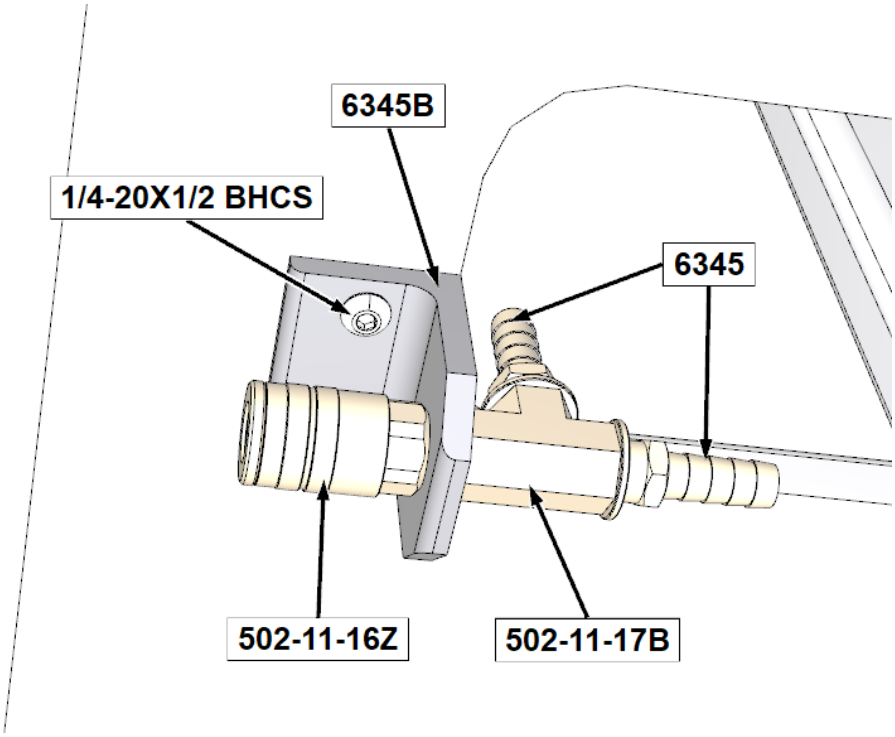

9219D
1/4-20X1/2 BHCS


9219
10-24X2 1/4 SHCS
#10 Flat Washer

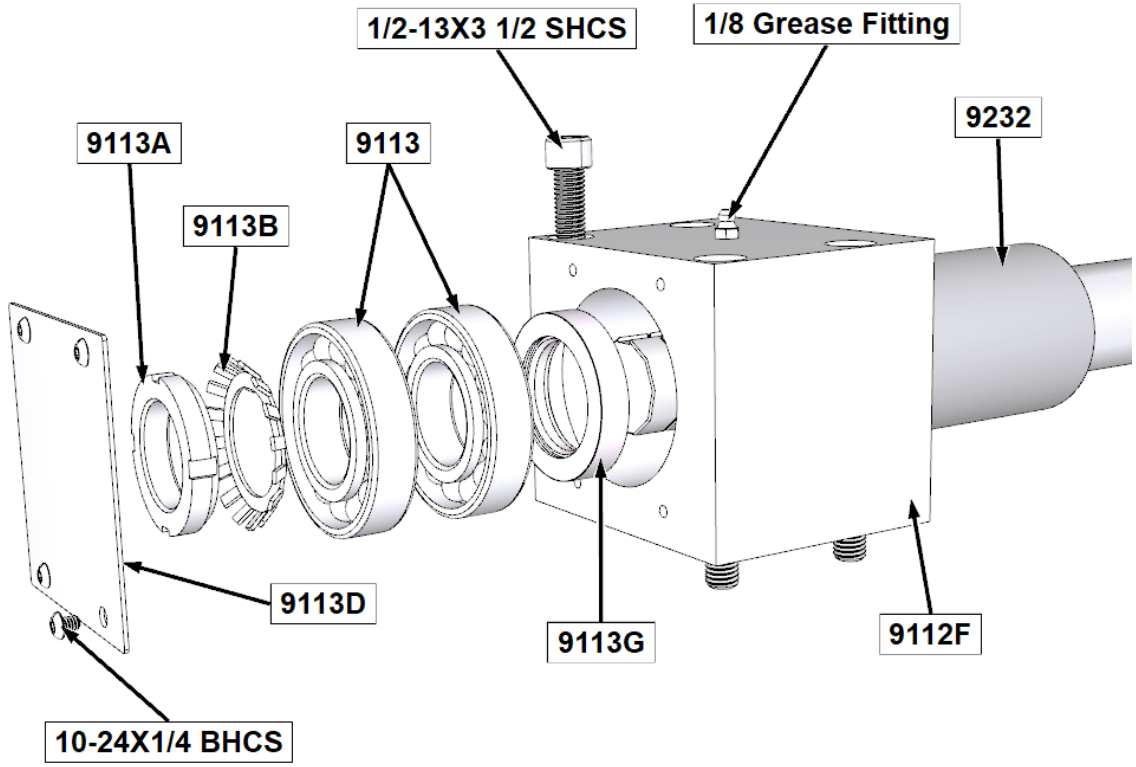
Incoming Power Box Parts

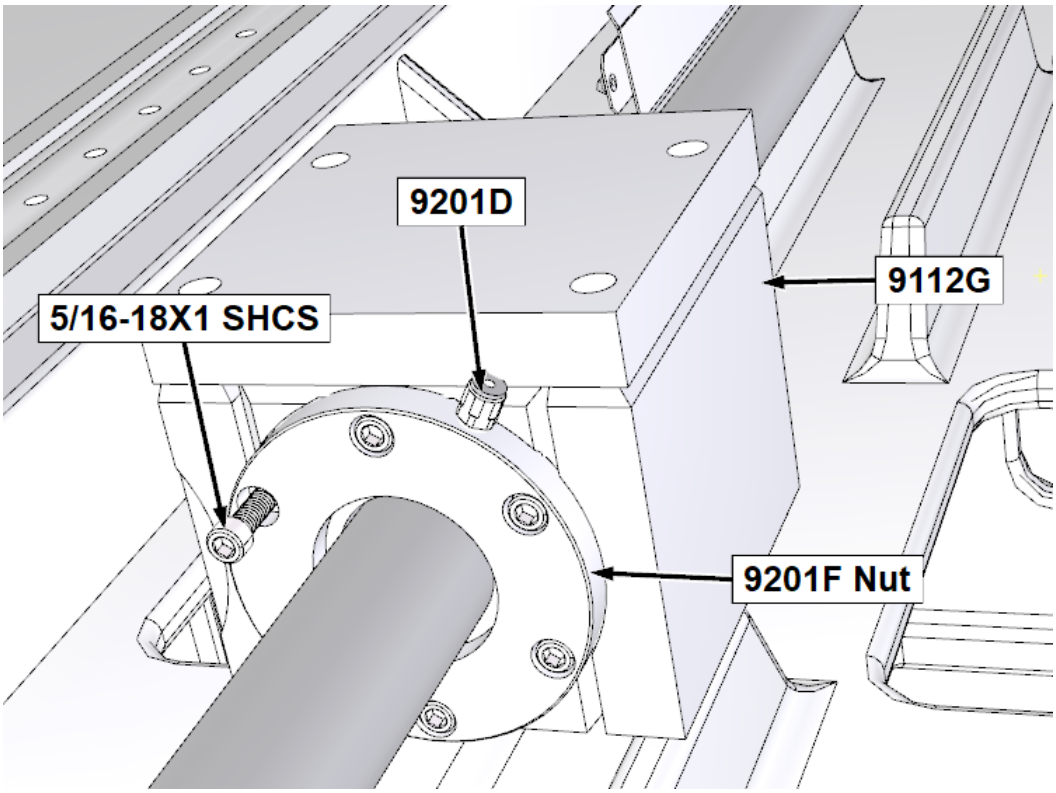


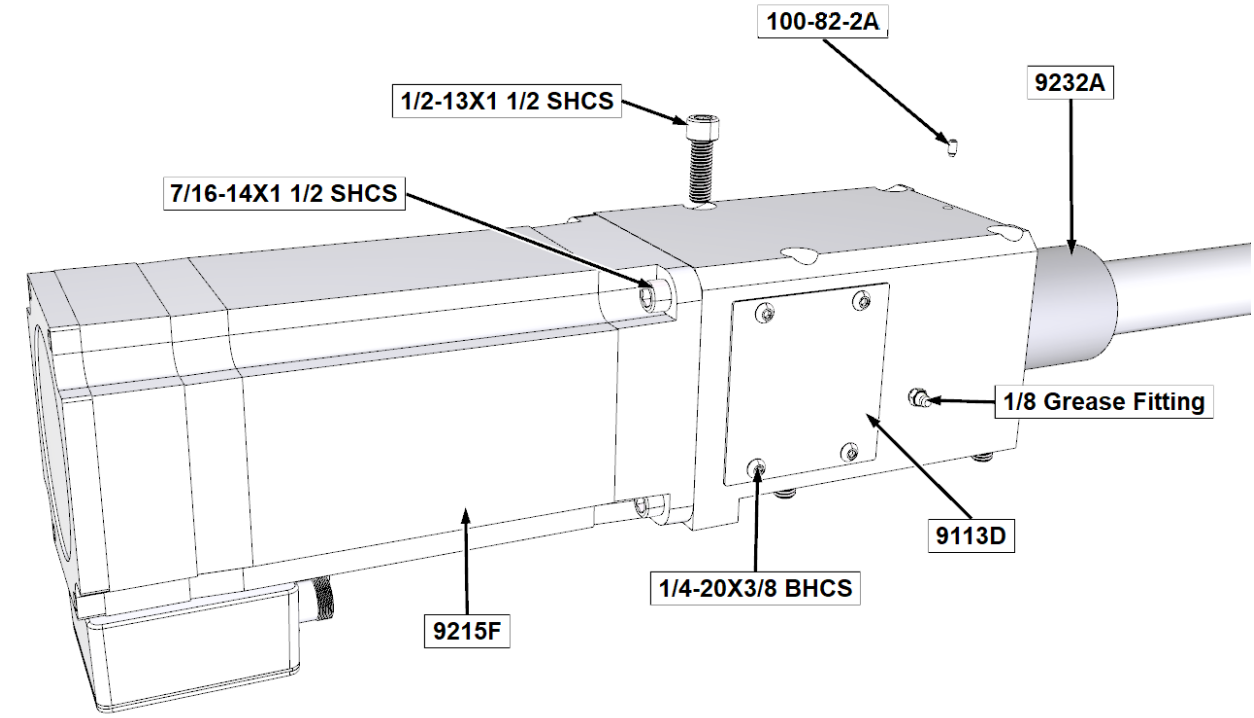
Incoming Air Supply Distribution Parts

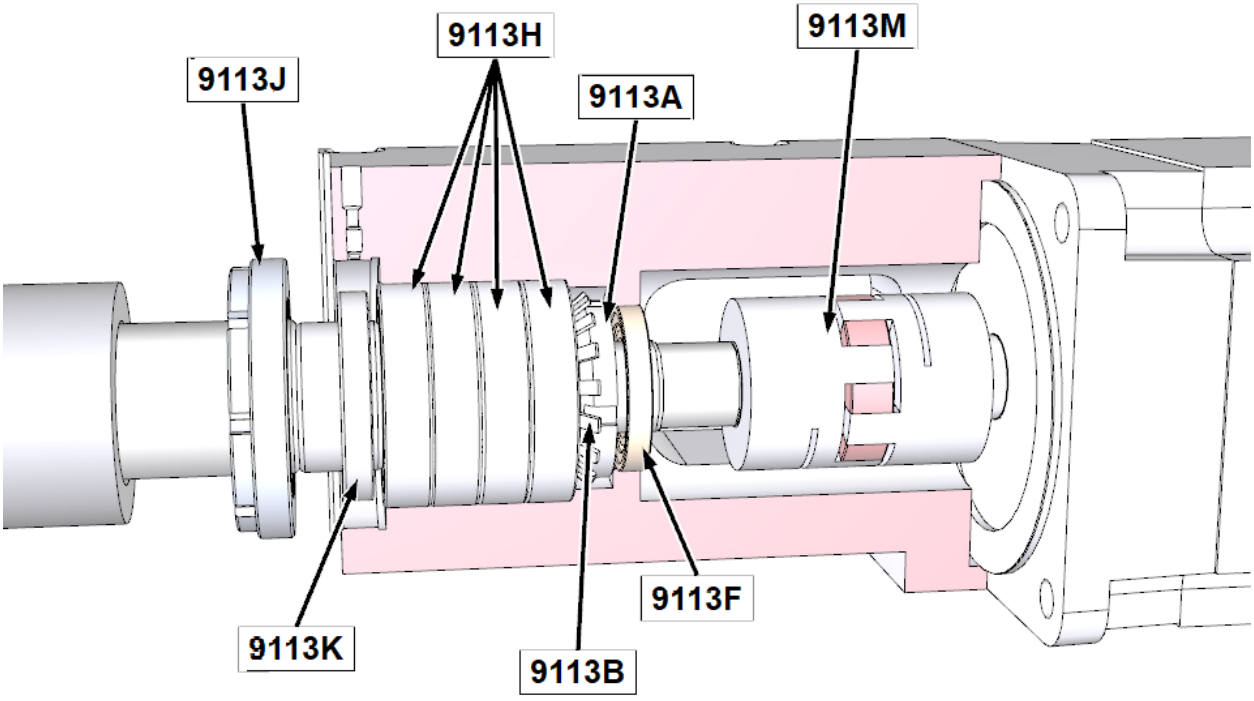


X-Axis Assembly Parts

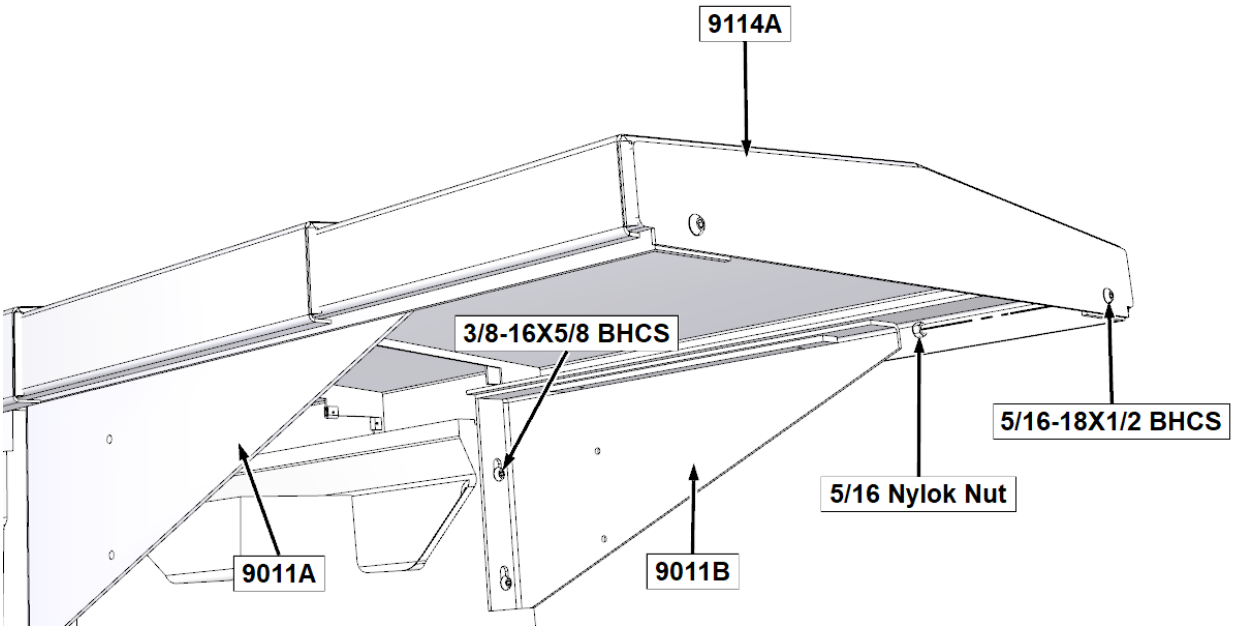




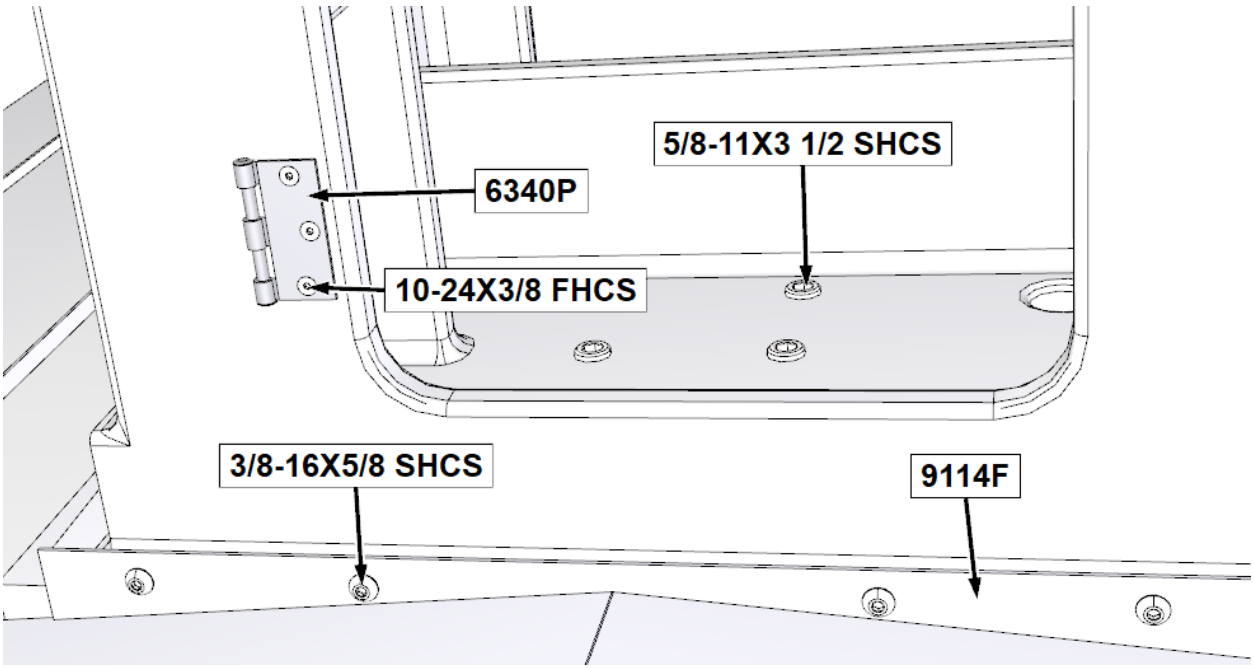

100-82-2A
9232A
1/2-13X1 1/2 SHCS
7/16-14X1 1/2 SHCS
1/8 Grease Fitting
9113D
1/4-20X3/8 BHCS
9215F

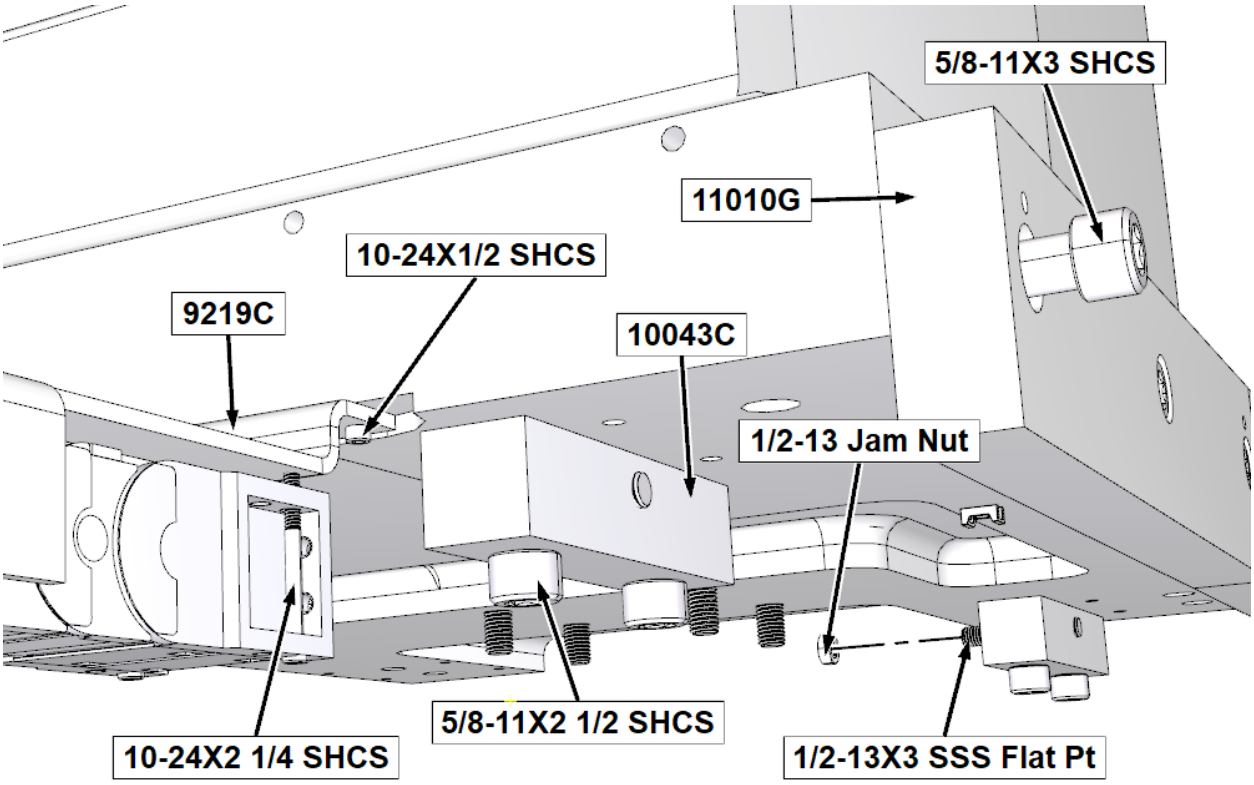

9113H
9113M
9113J
9113A
9113F
9113K
9113B

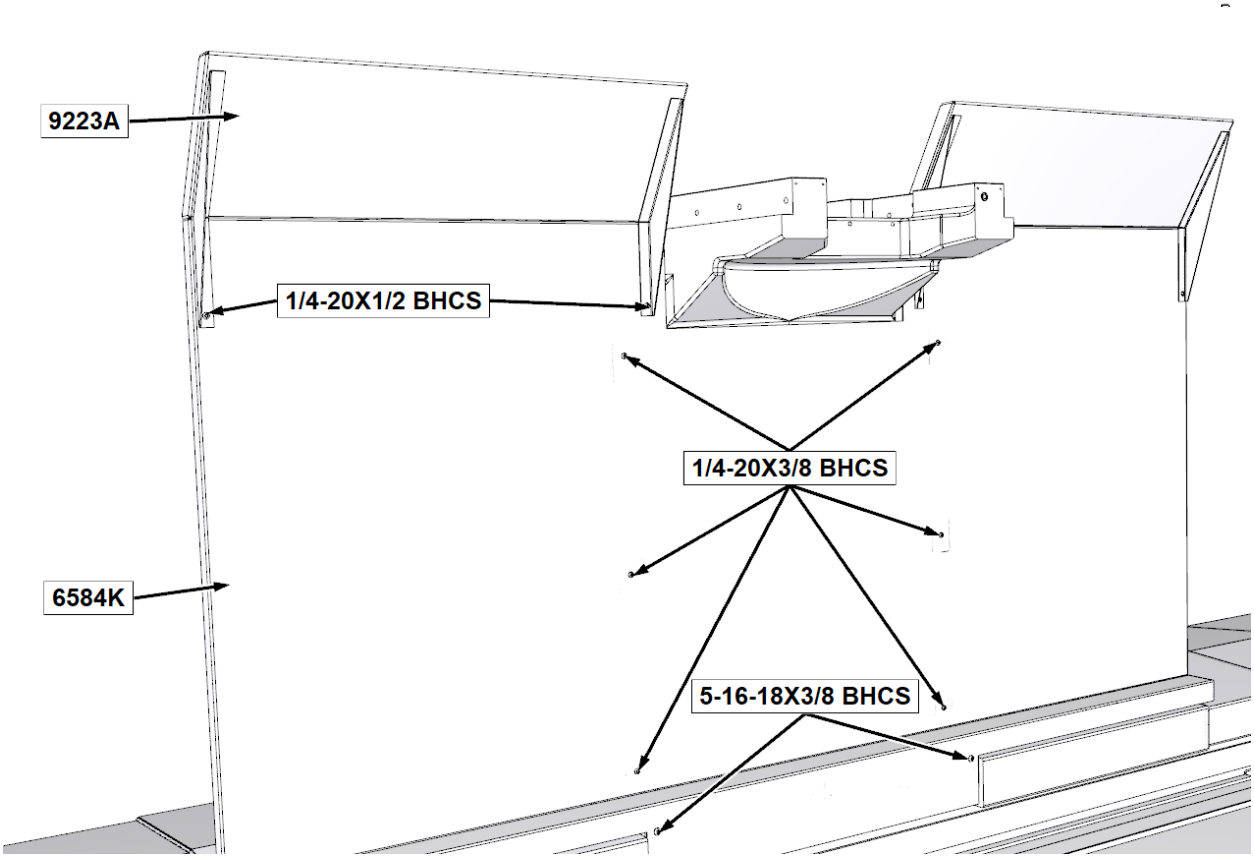
Rail Cover Parts



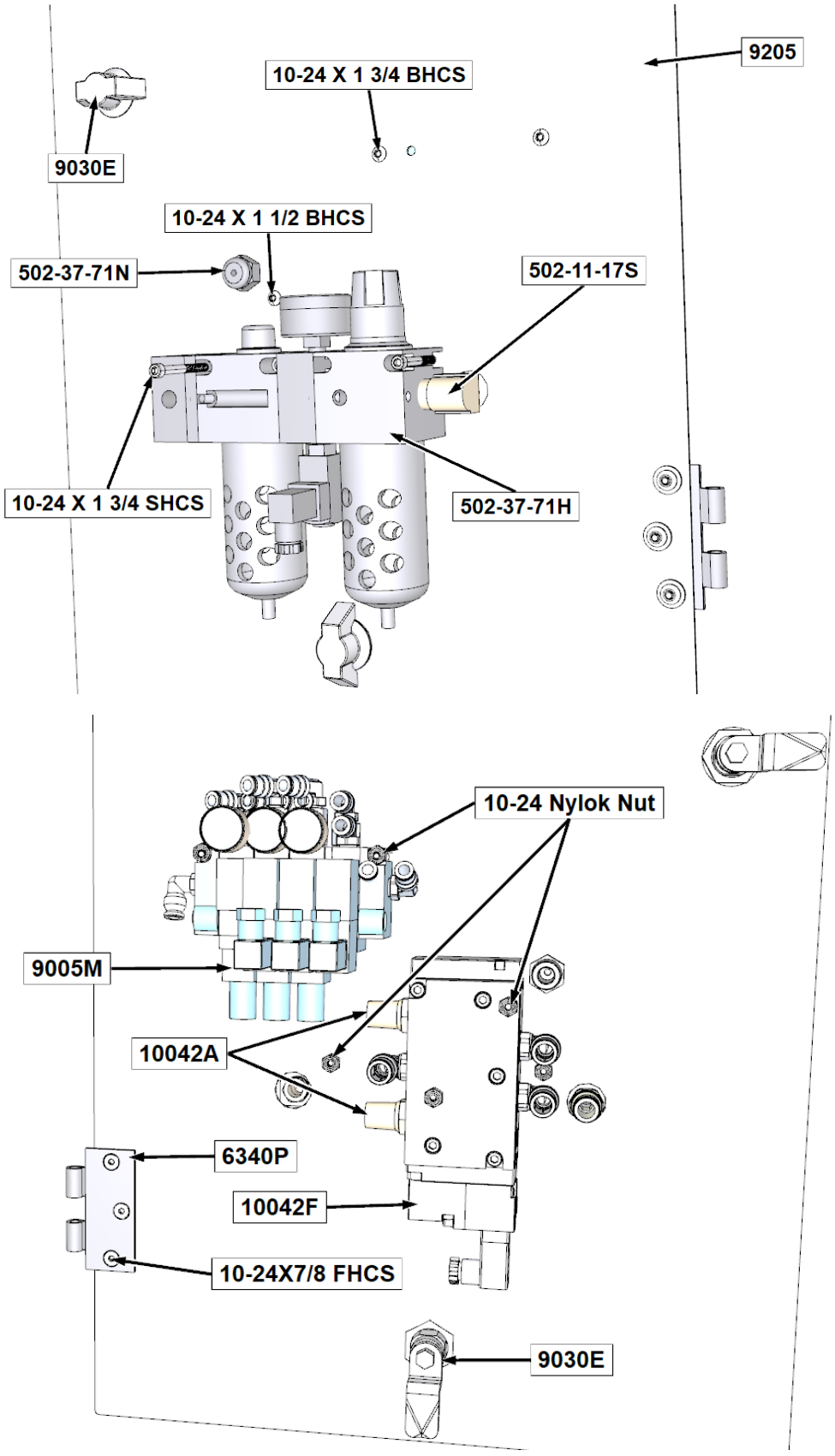
Column Assembly Parts



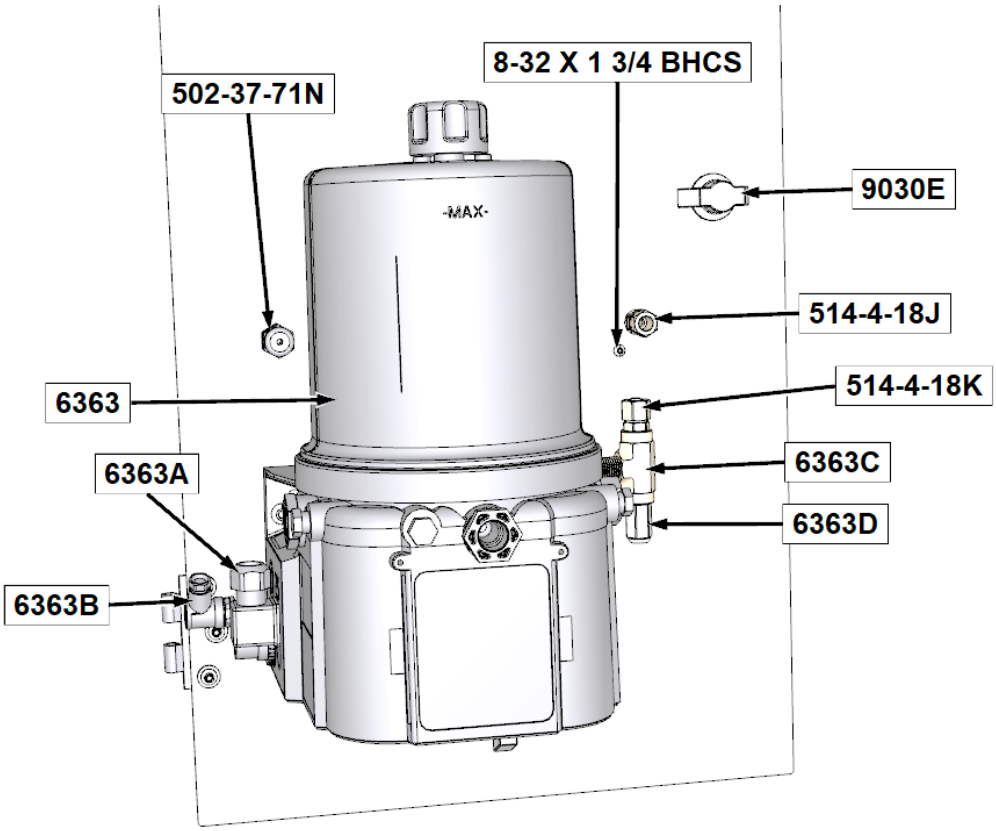

5/8-11X3 SHCS
11010G
10-24X1/2 SHCS
9219C
10043C
1/2-13 Jam Nut
10-24X2 1/4 SHCS
5/8-11X2 1/2 SHCS
1/2-13X3 SSS Flat Pt

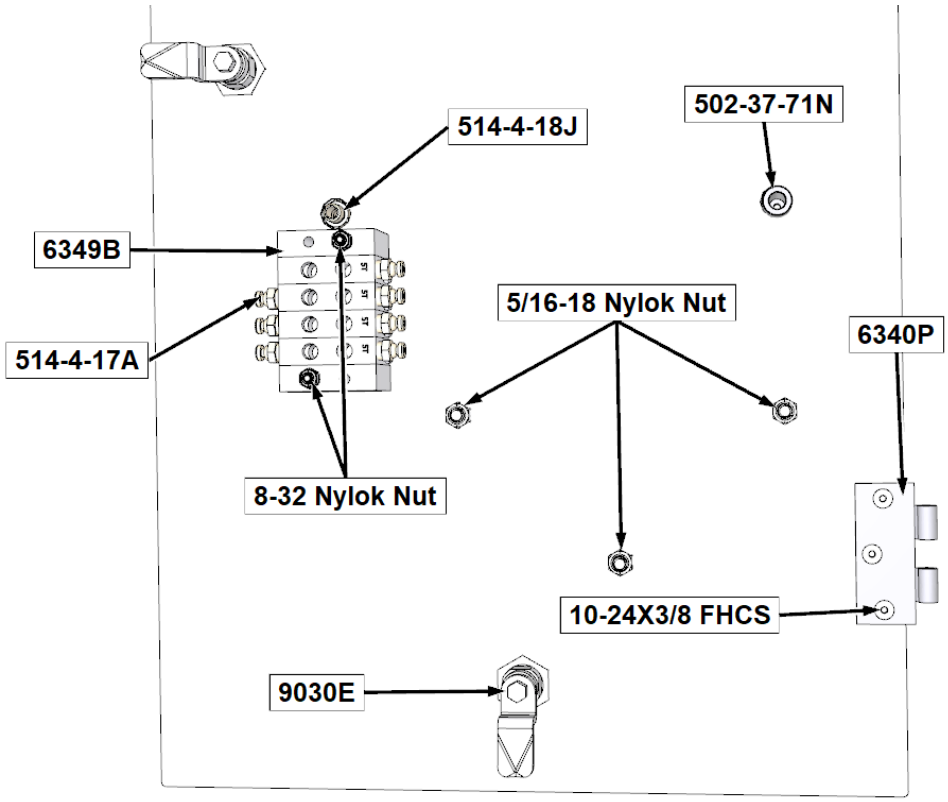

9223A
1/4-20X1/2 BHCS
1/4-20X3/8 BHCS
6584K
5-16-18X3/8 BHCS

Air Door Parts

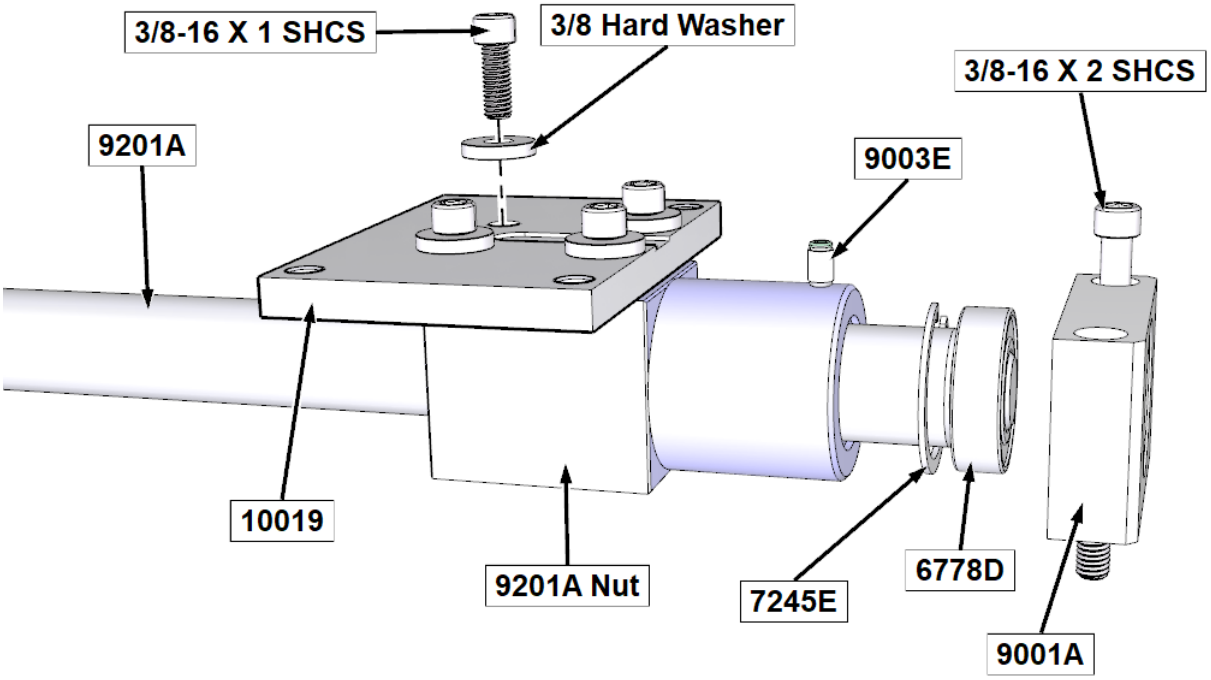


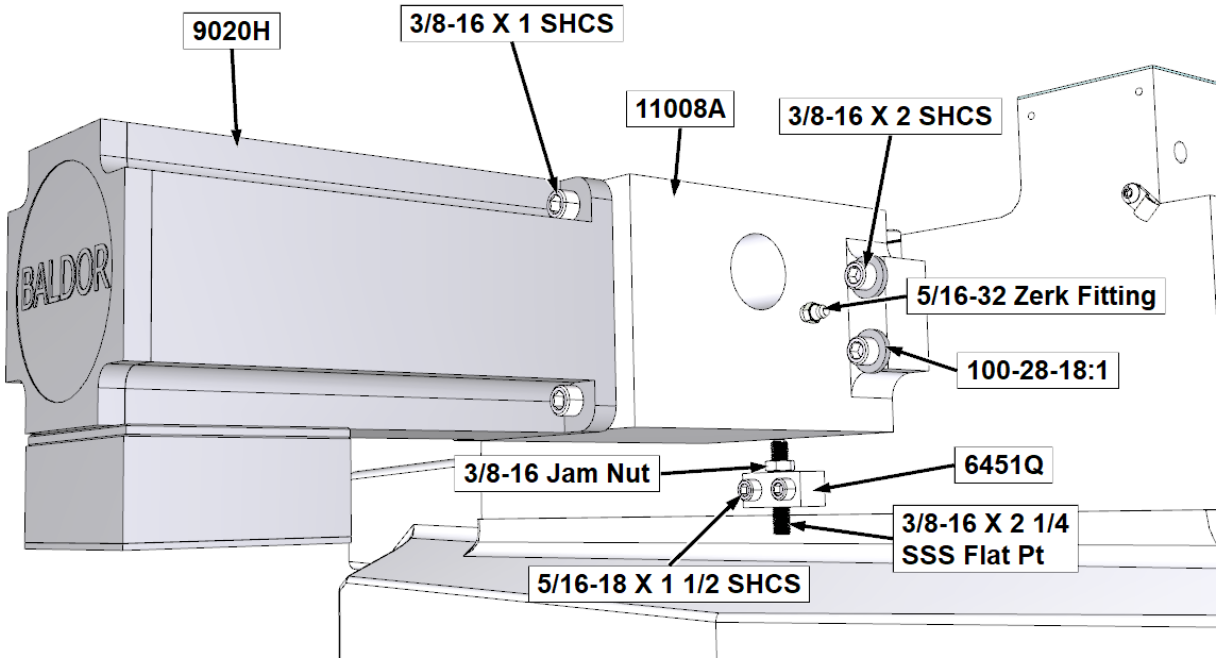
Oiler Door Parts

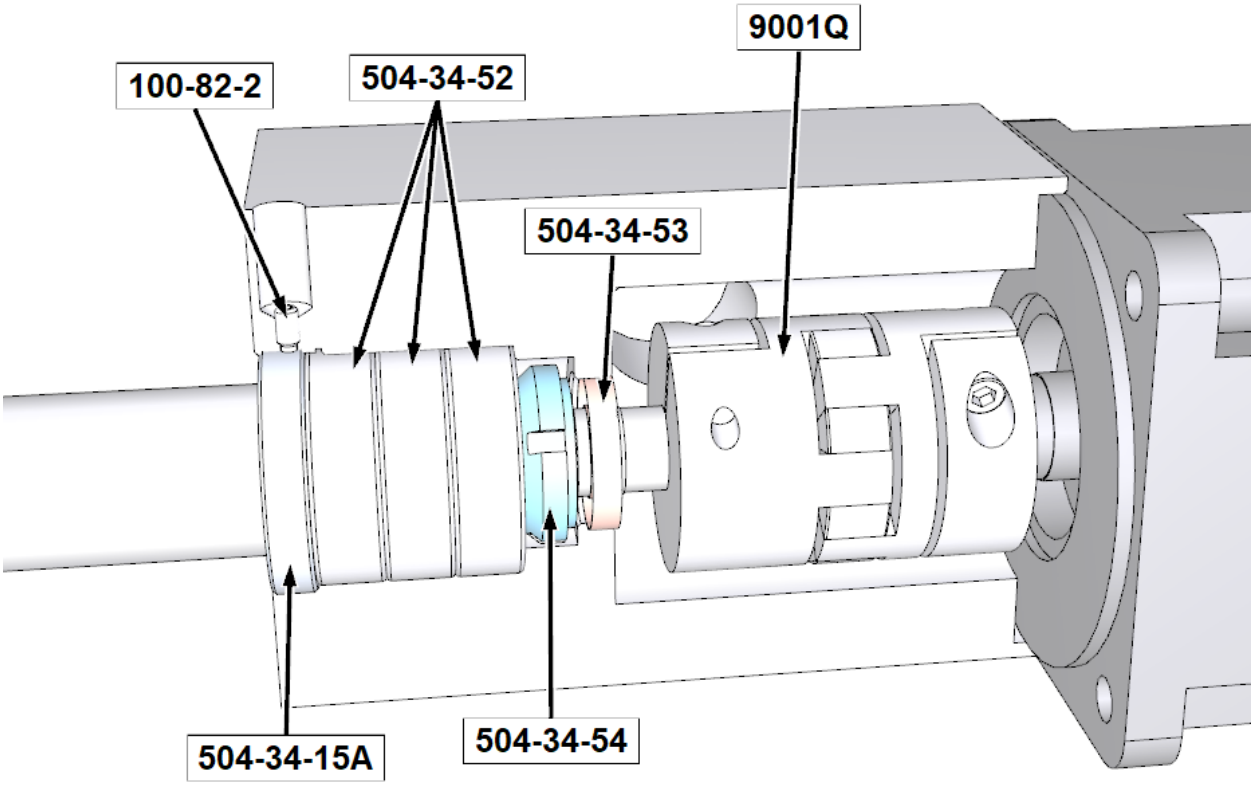




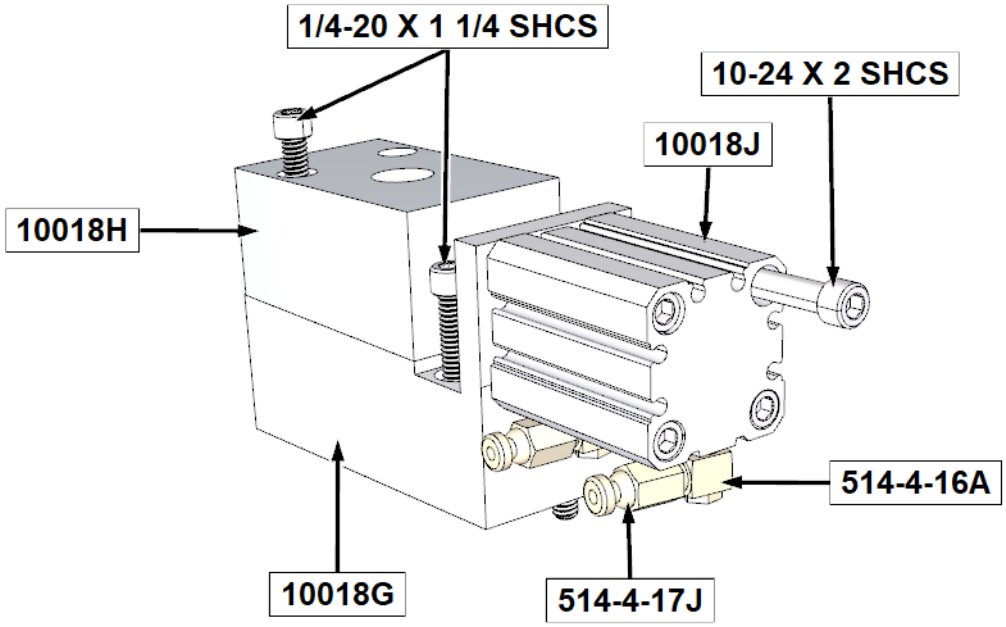
Y-Axis Assembly Parts



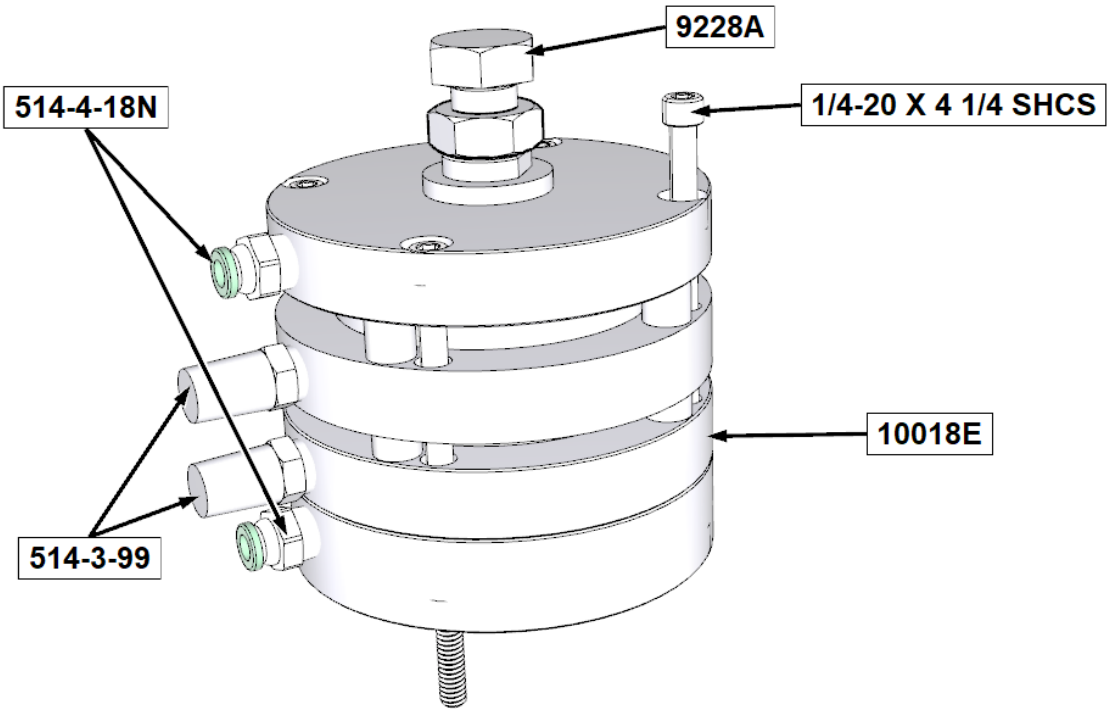


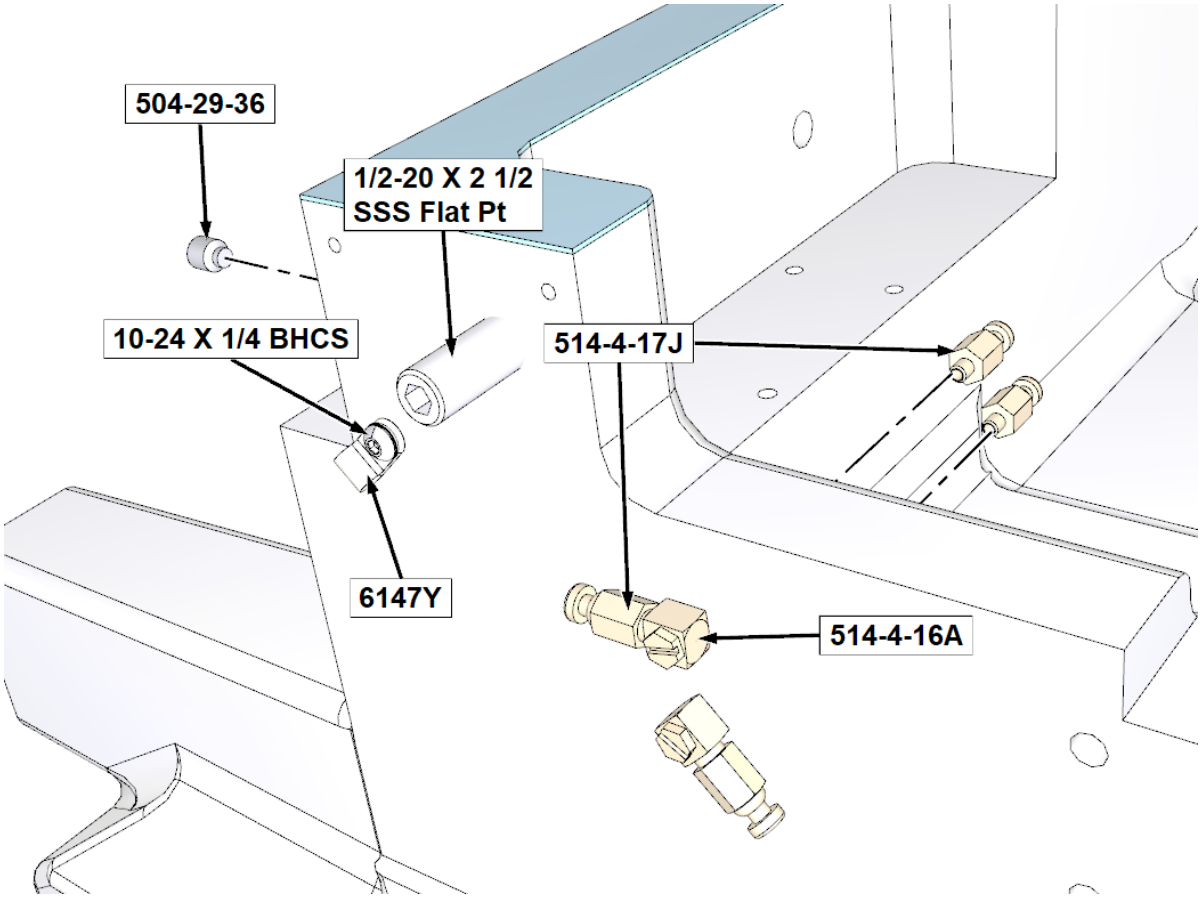


Tilt Wedge Assembly Parts

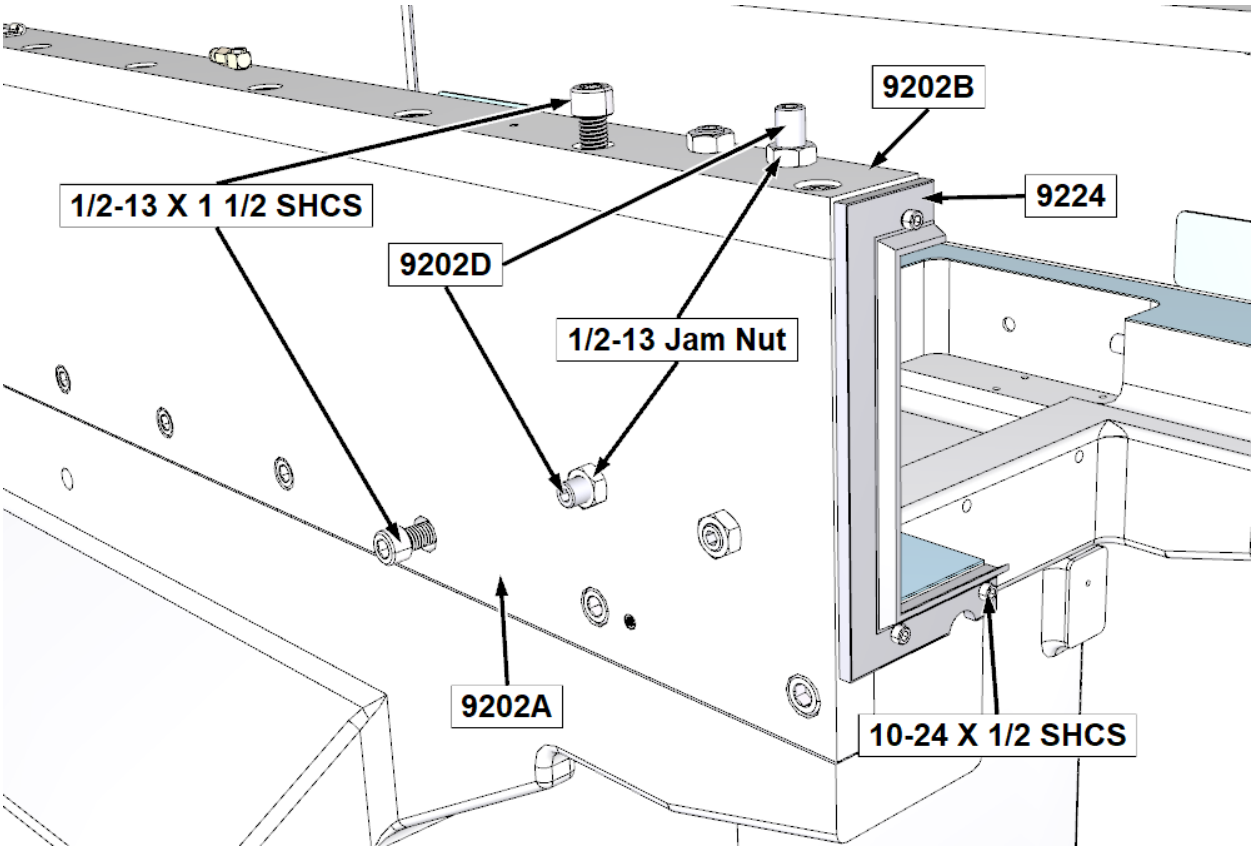


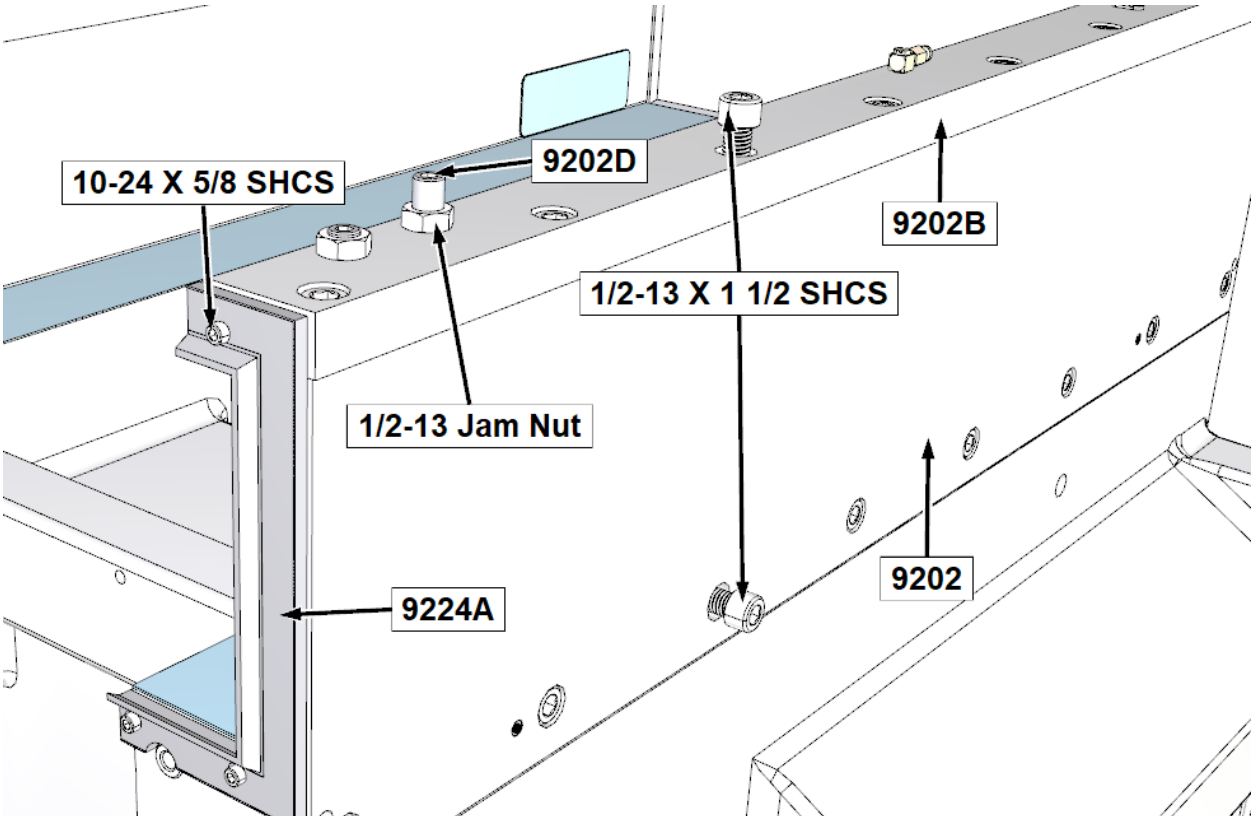
Lift Cylinder Assembly Parts

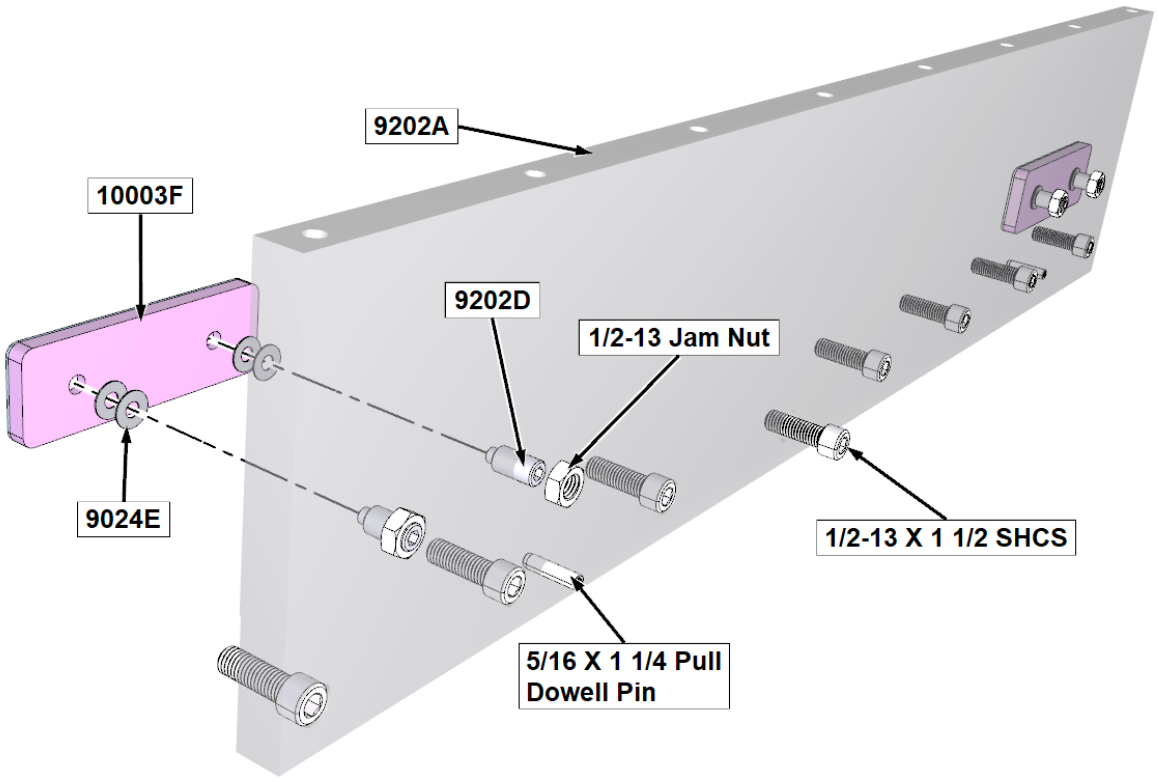


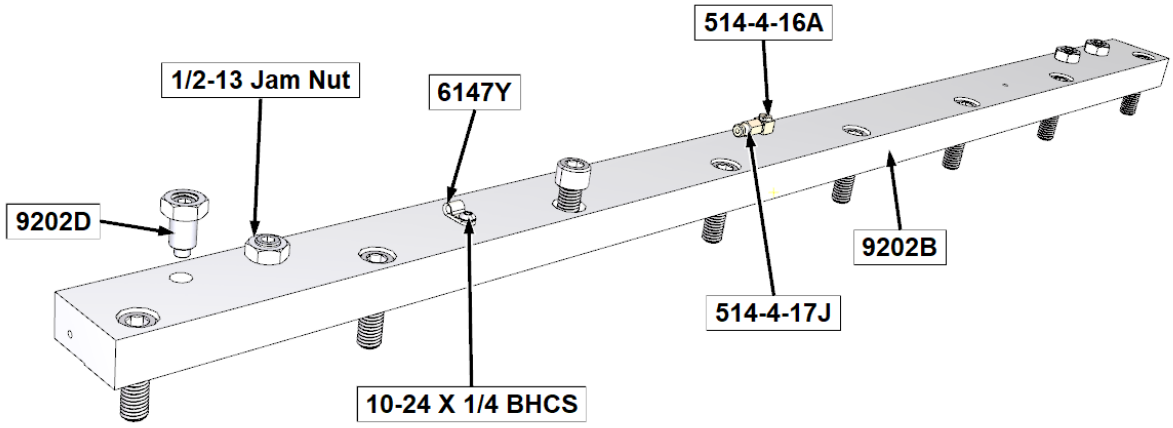


Gib Assembly Parts

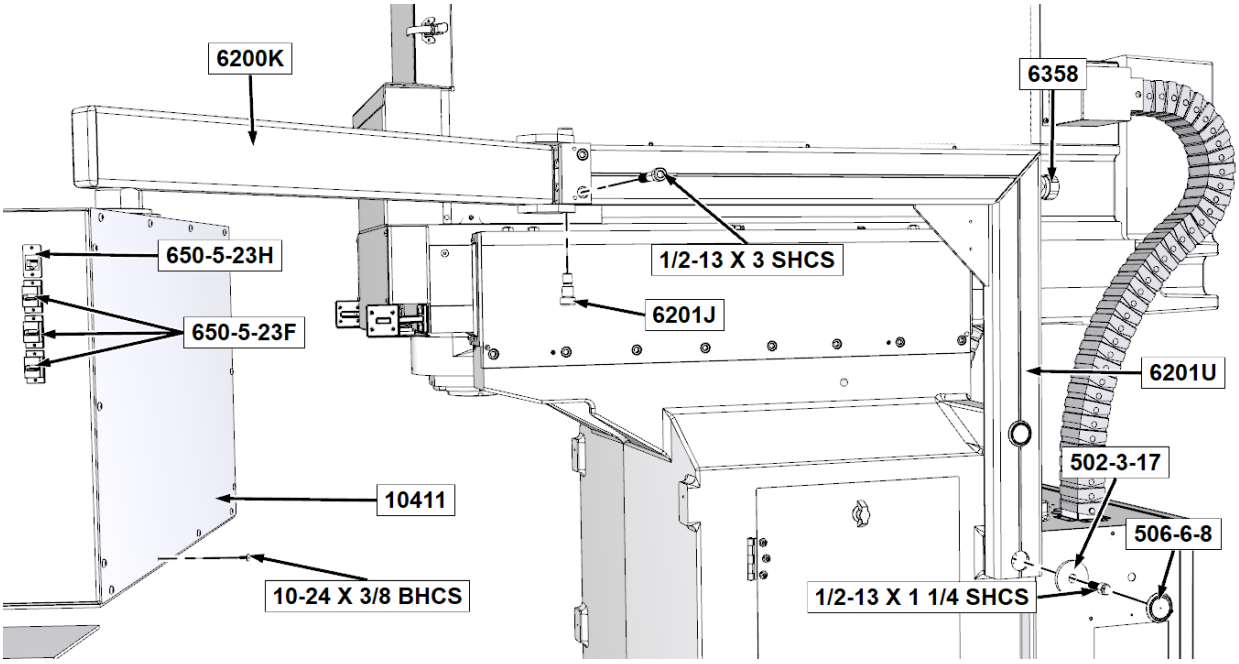


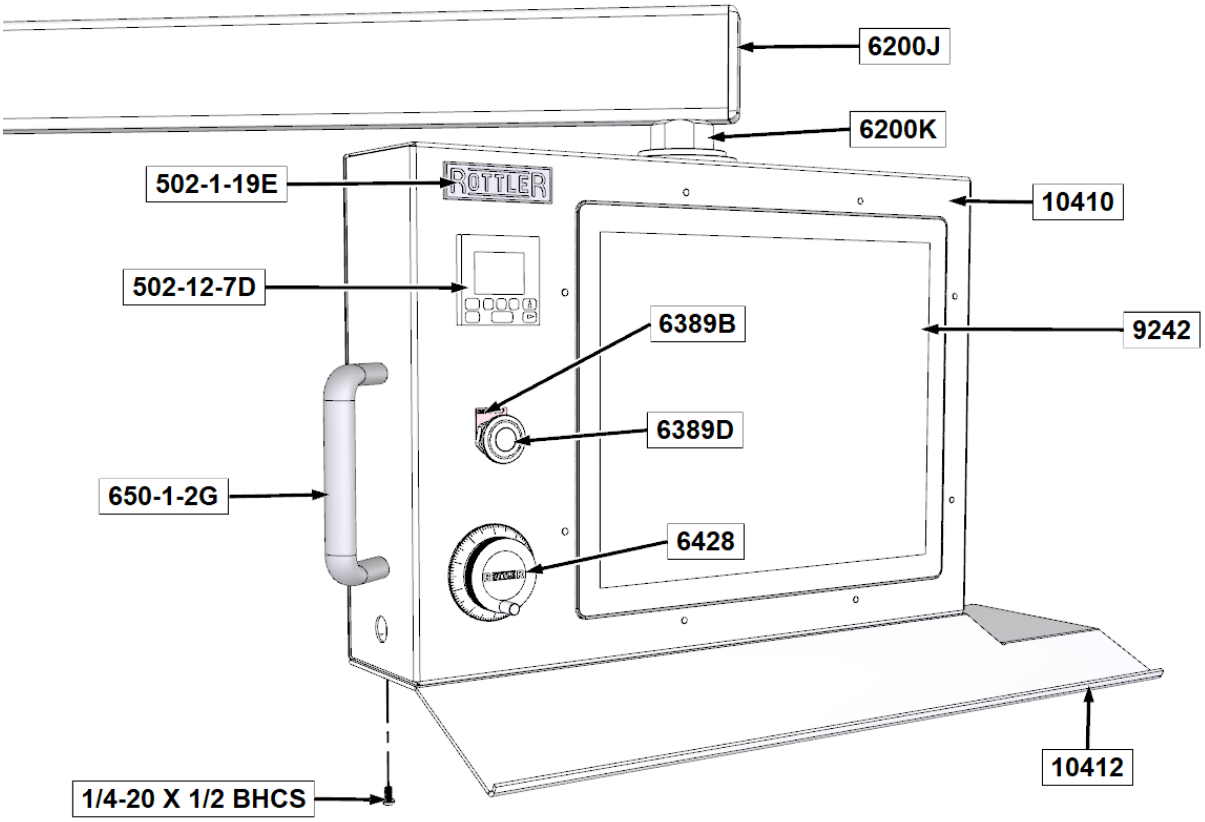



9202A
10003F
9202D
1/2-13 Jam Nut
9024E
1/2-13 X 1 1/2 SHCS
5/16 X 1 1/4 Pull
Dowell Pin

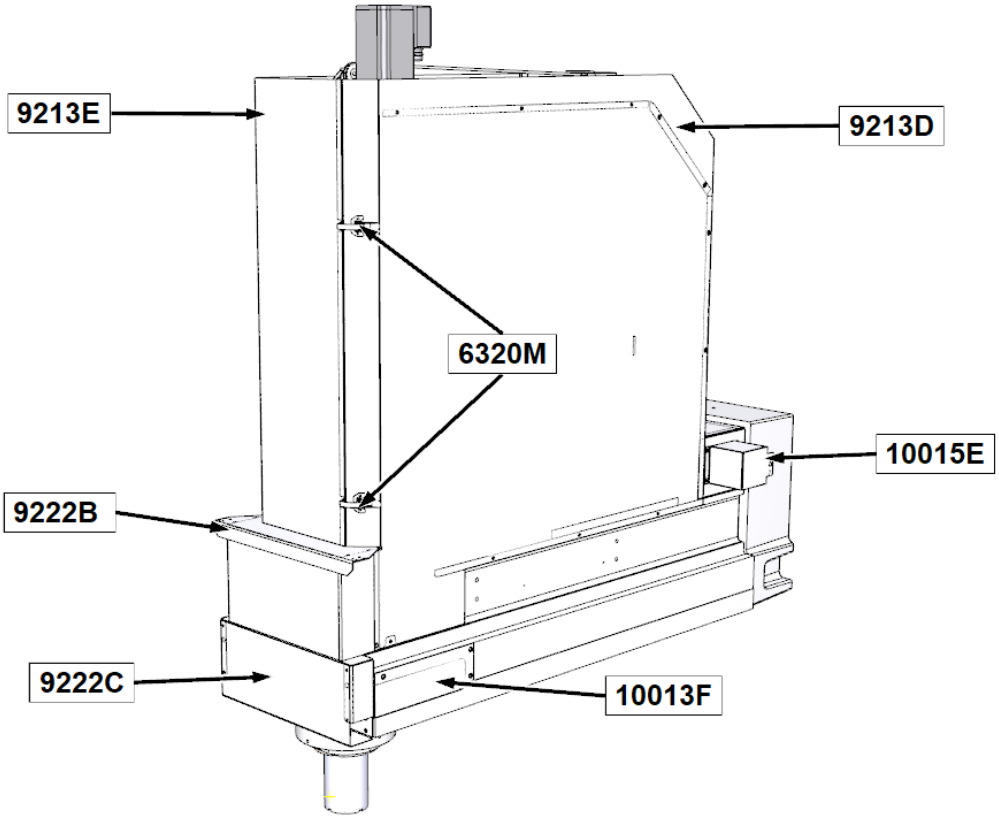

514-4-16A
1/2-13 Jam Nut
6147Y
9202D
9202B
514-4-17J
10-24 X 1/4 BHCS

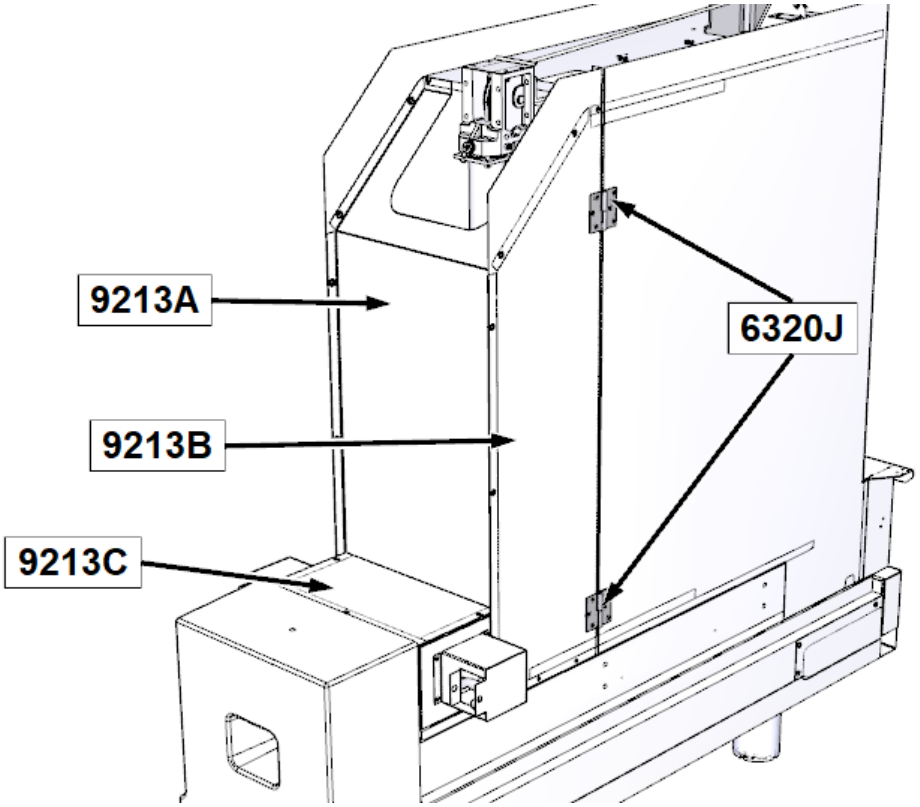
Pendent Assembly Parts

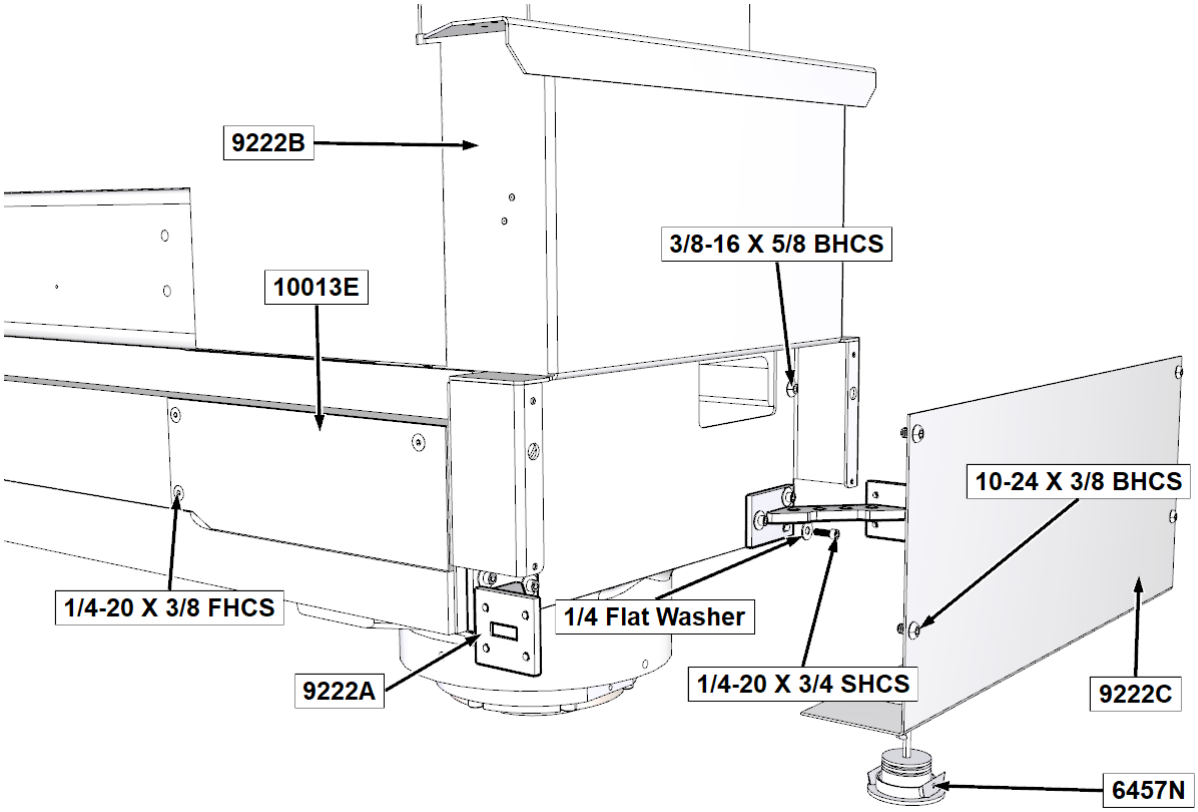


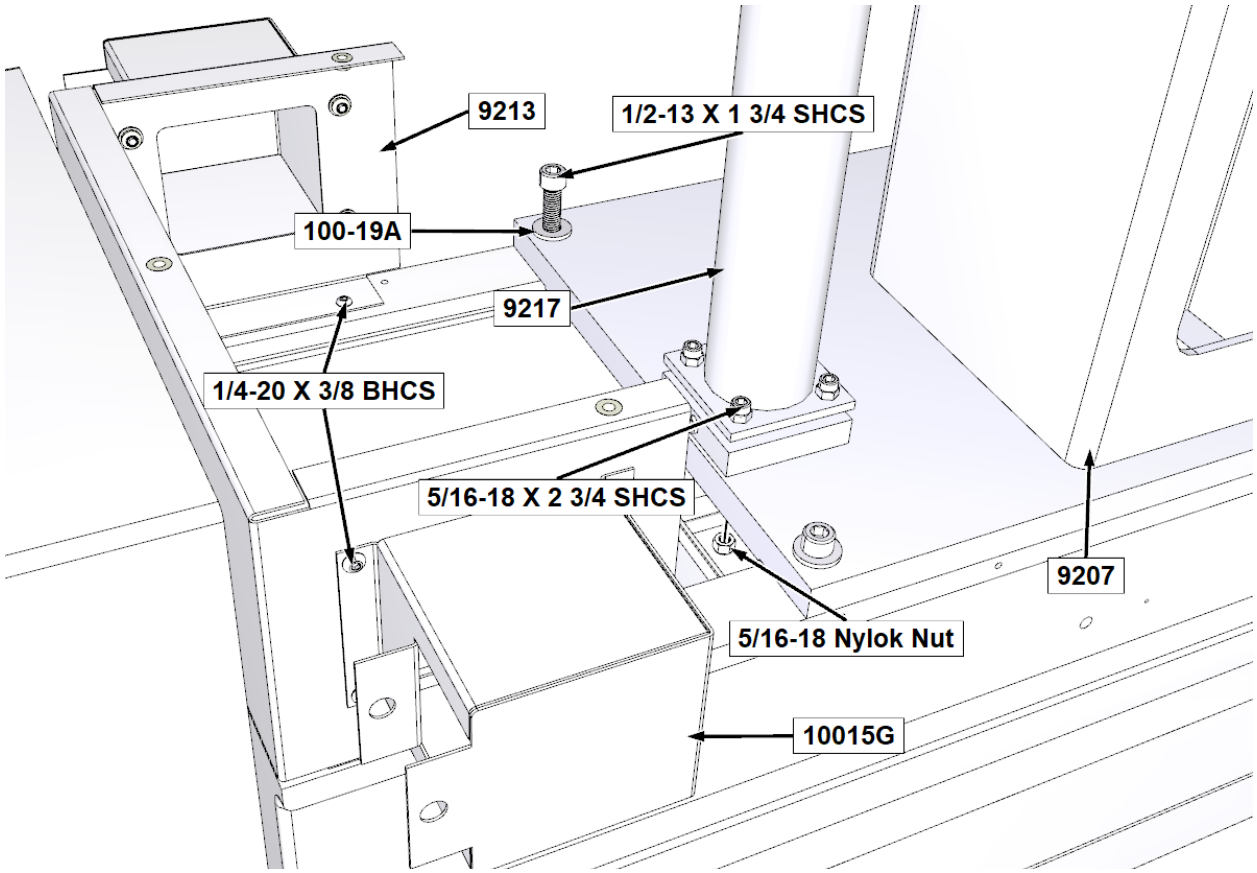


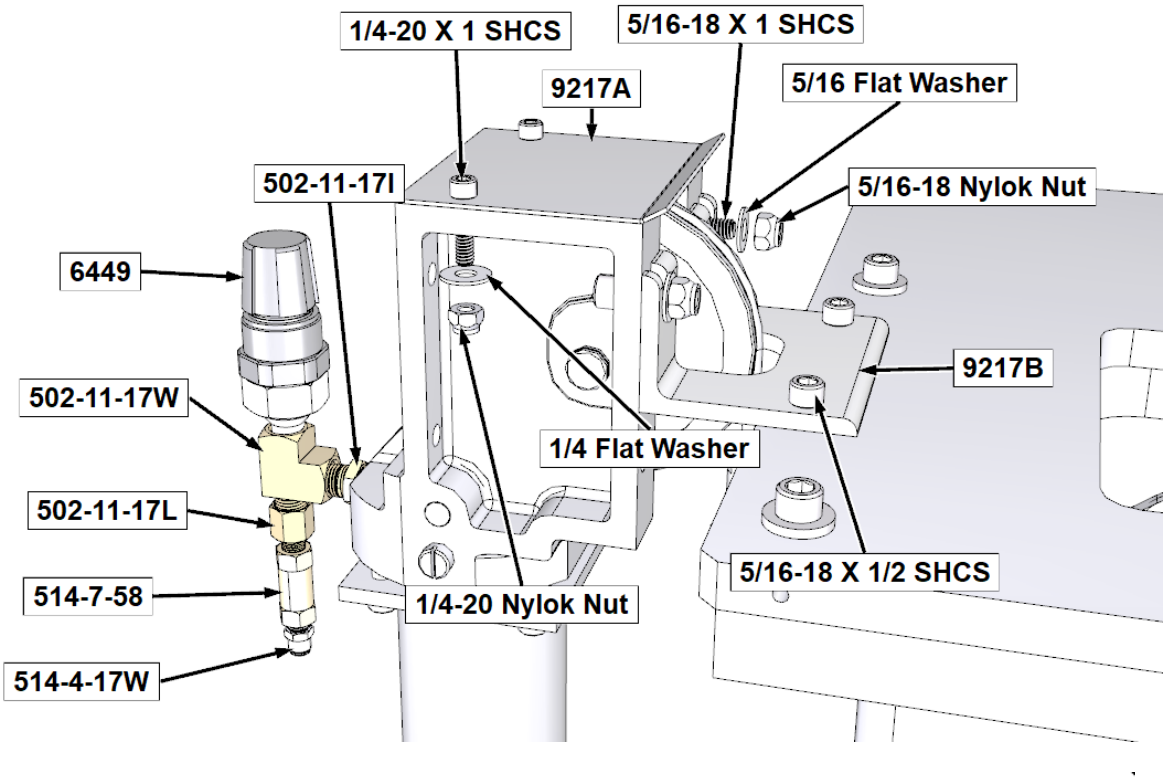
Spindle Base Parts

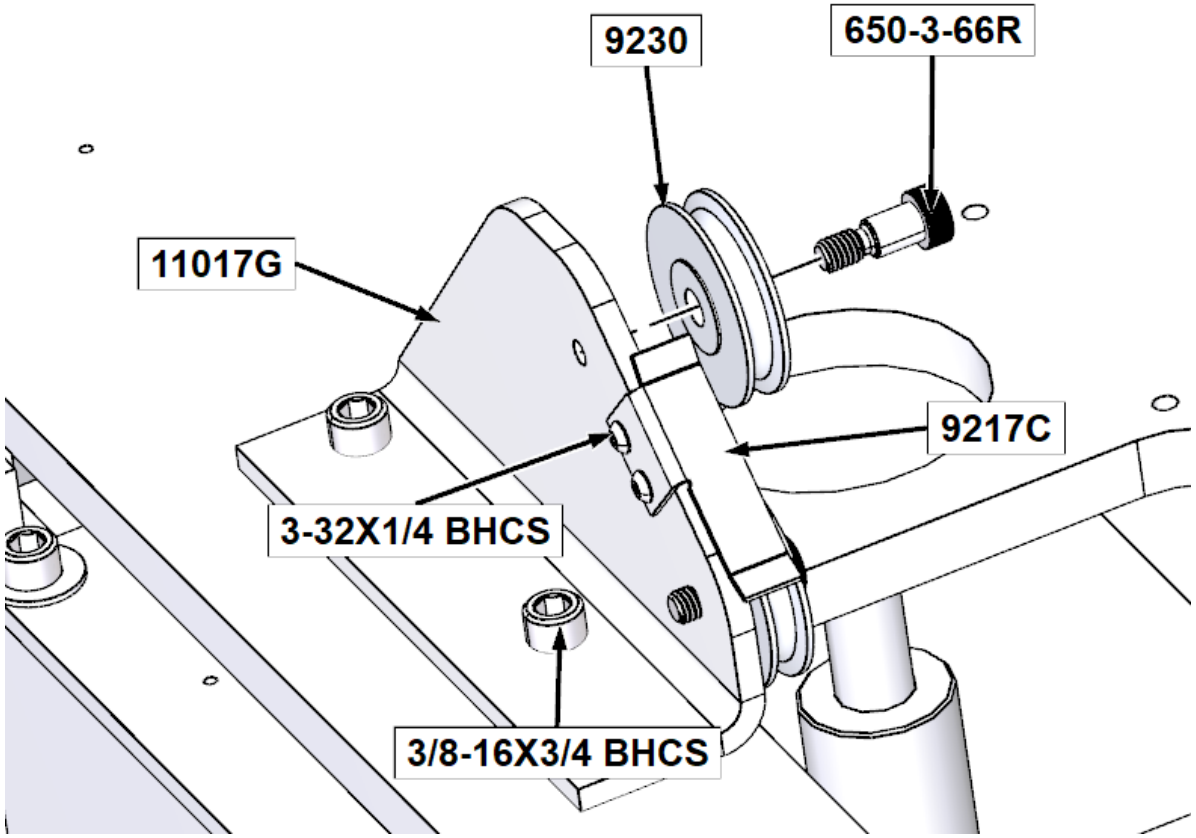


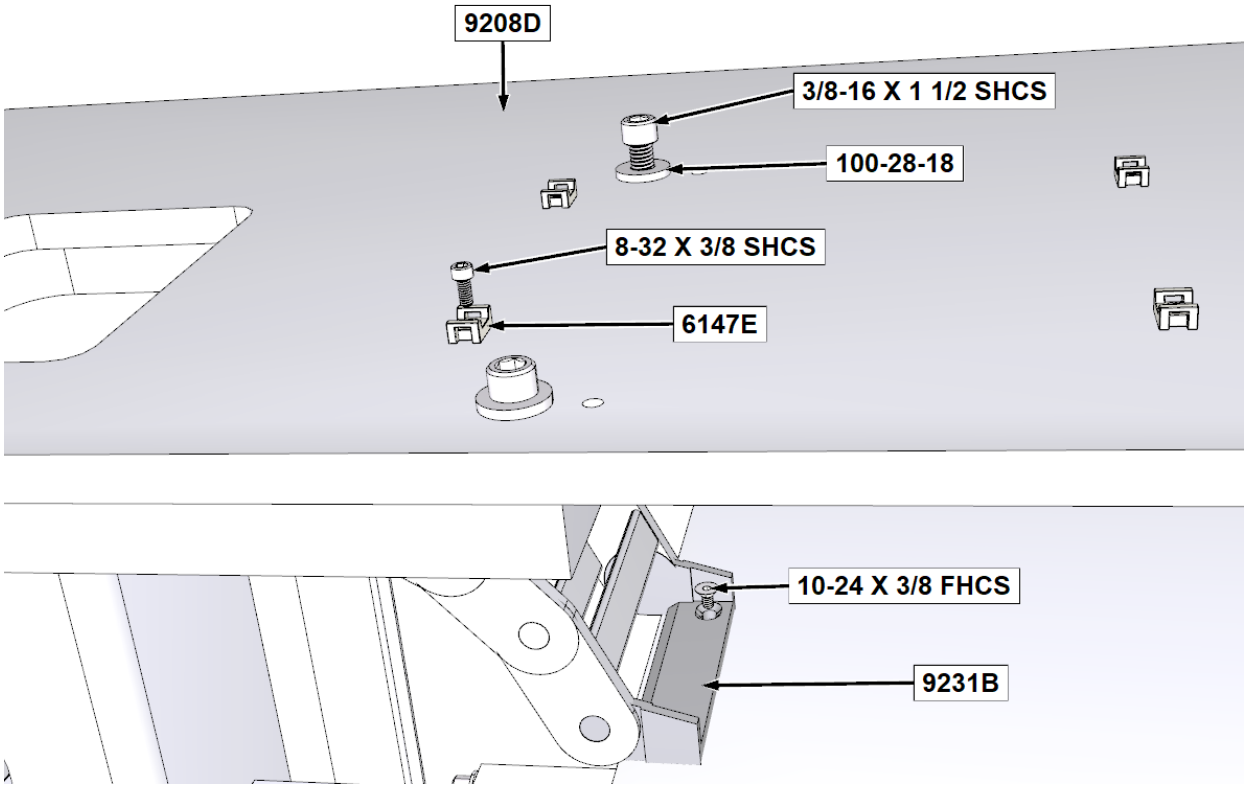


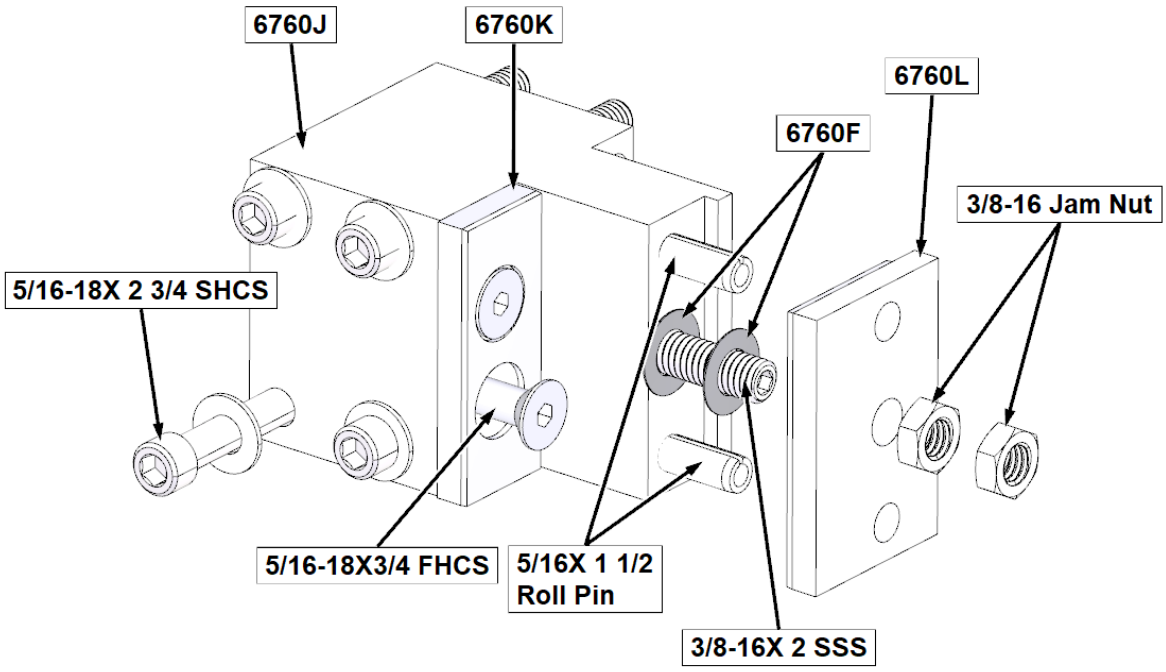

9222B
3/8-16 X 5/8 BHCS
10013E
10-24 X 3/8 BHCS
1/4-20 X 3/8 FHCS
1/4 Flat Washer
1/4-20 X 3/4 SHCS
9222C
9222A
6457N


9213
1/2-13 X 1 3/4 SHCS
100-19A
9217
1/4-20 X 3/8 BHCS
5/16-18 X 2 3/4 SHCS
9207
5/16-18 Nylok Nut
10015G

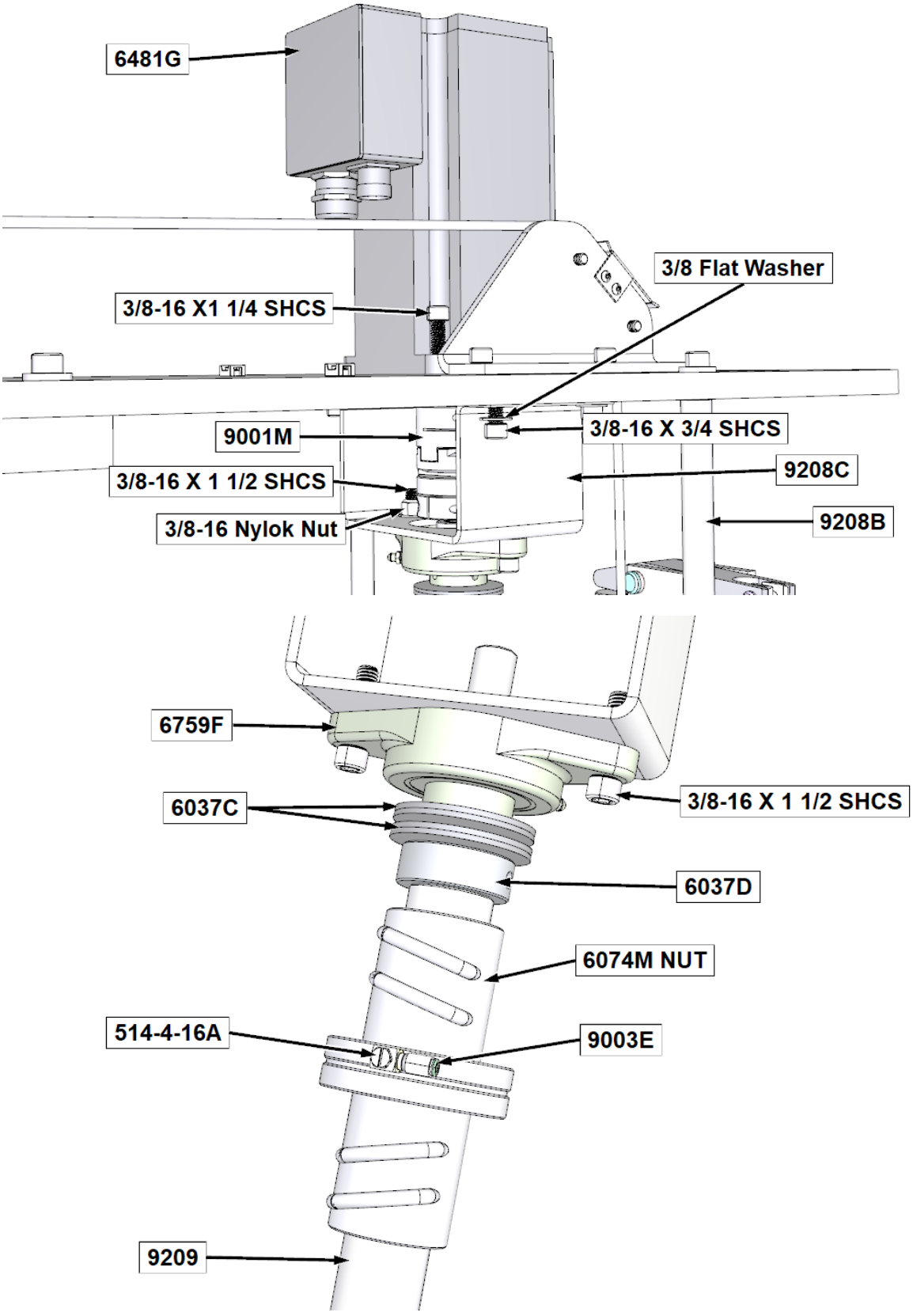

1/4-20 X 1 SHCS
5/16-18 X 1 SHCS
9217A
5/16 Flat Washer
502-11-17I
5/16-18 Nylok Nut
6449
9217B
502-11-17W
1/4 Flat Washer
502-11-17L
5/16-18 X 1/2 SHCS
514-7-58
1/4-20 Nylok Nut
514-4-17W

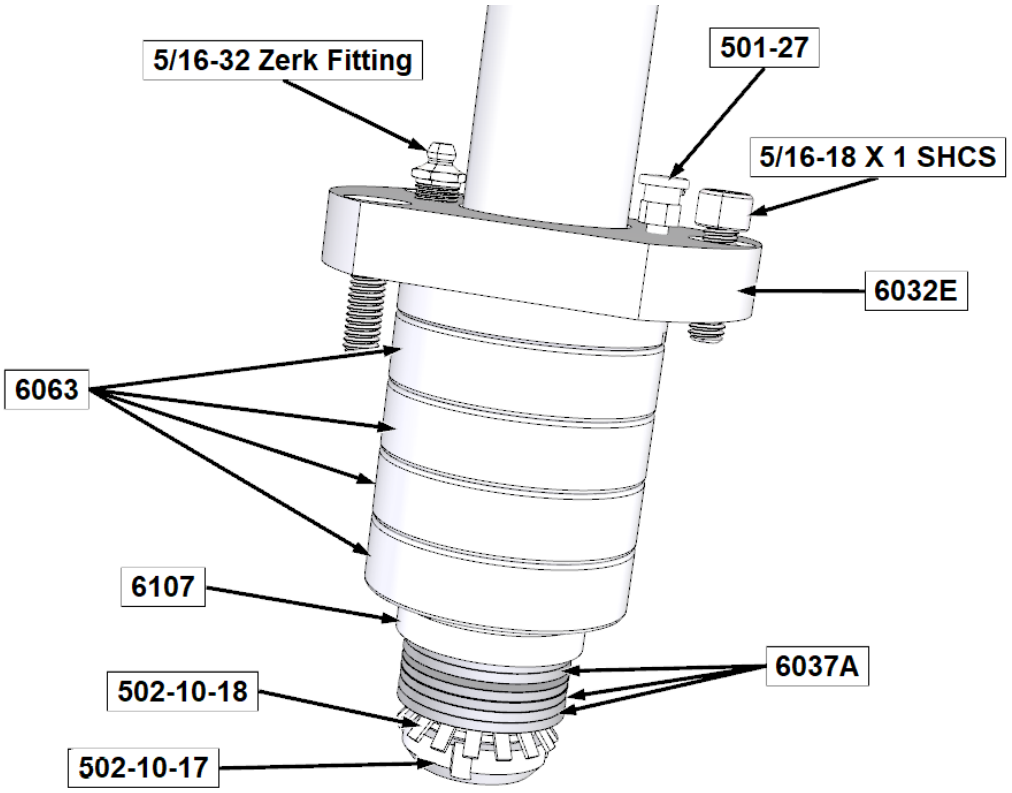

9230
650-3-66R
11017G
9217C
3-32X1/4 BHCS
3/8-16X3/4 BHCS


9208D
3/8-16 X 1 1/2 SHCS
100-28-18
8-32 X 3/8 SHCS
6147E
10-24 X 3/8 FHCS
9231B

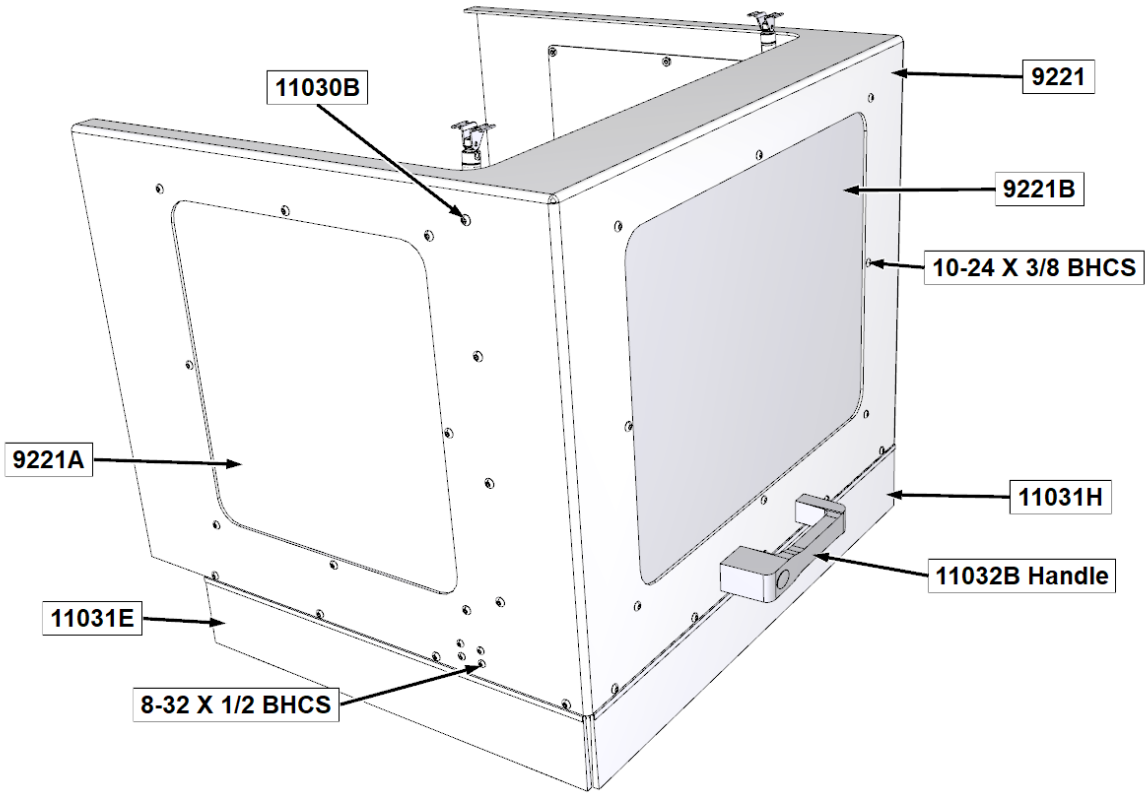

6760J
6760K
6760L
6760F
3/8-16 Jam Nut
5/16-18X 2 3/4 SHCS
5/16-18X3/4 FHCS
5/16X 1 1/2
Roll Pin
3/8-16X 2 SSS

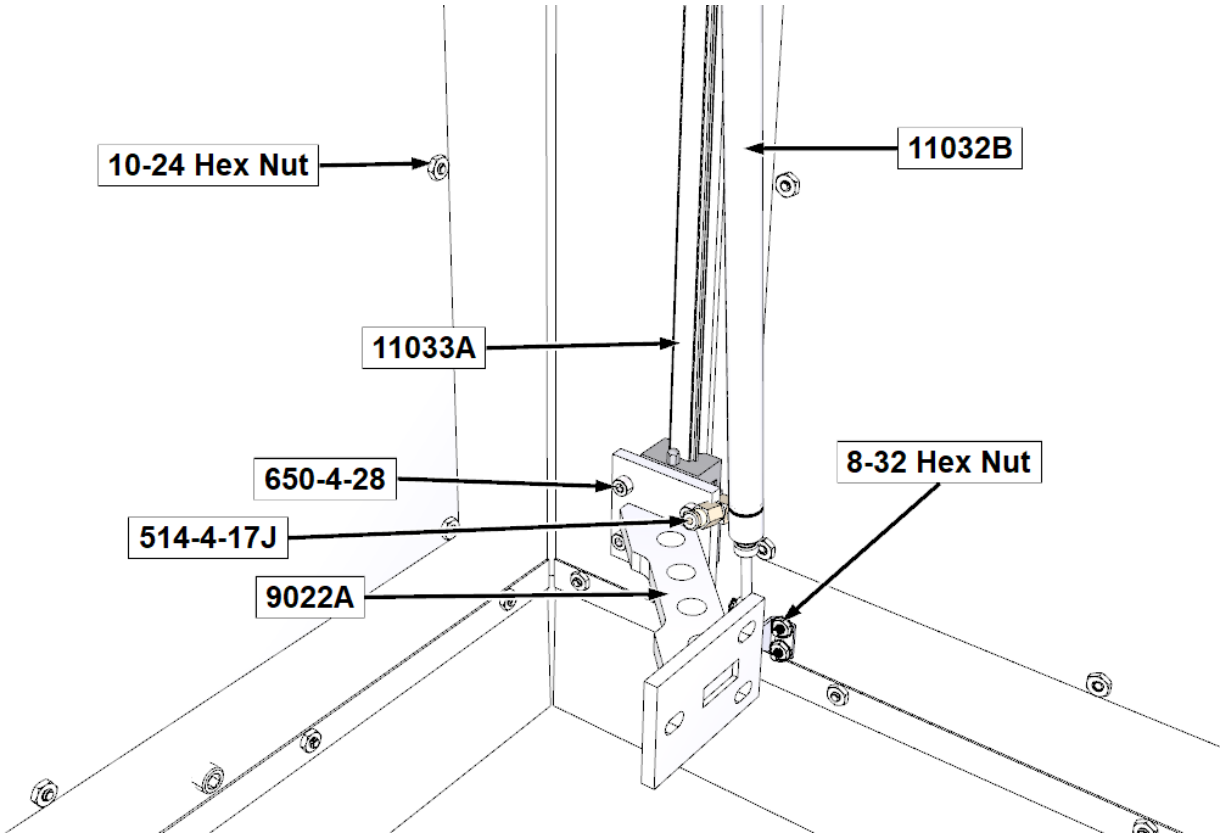
Z-Axis Assembly Parts



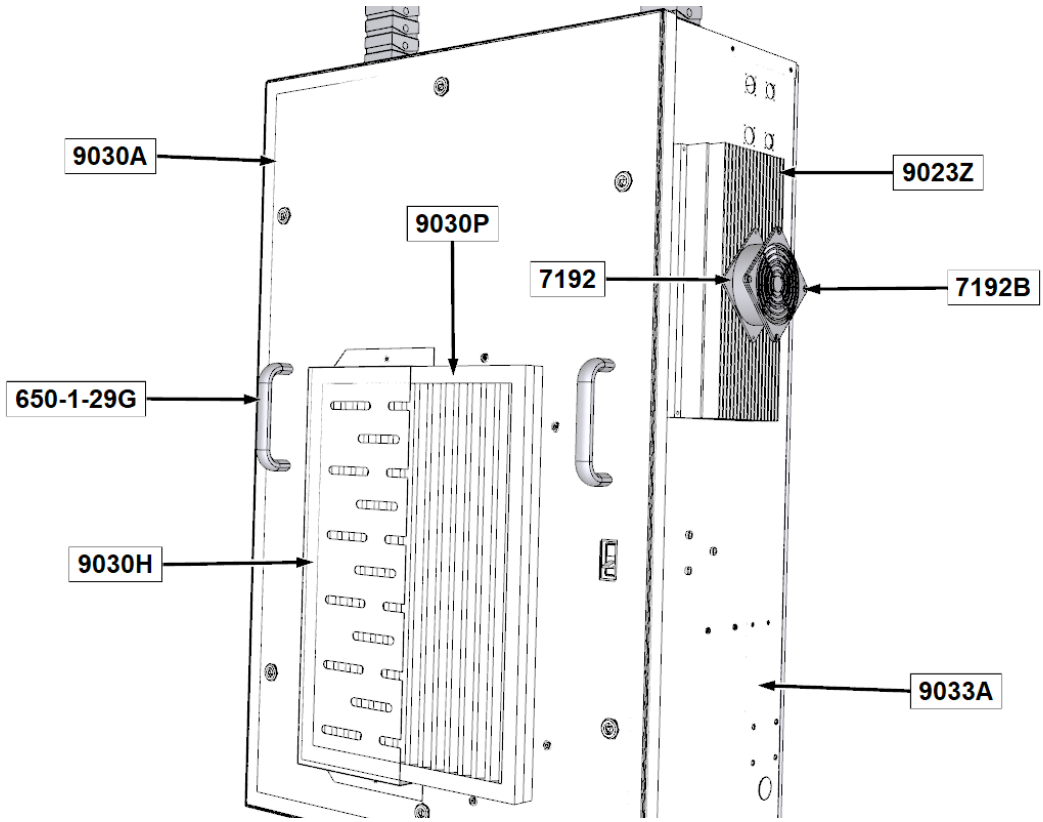


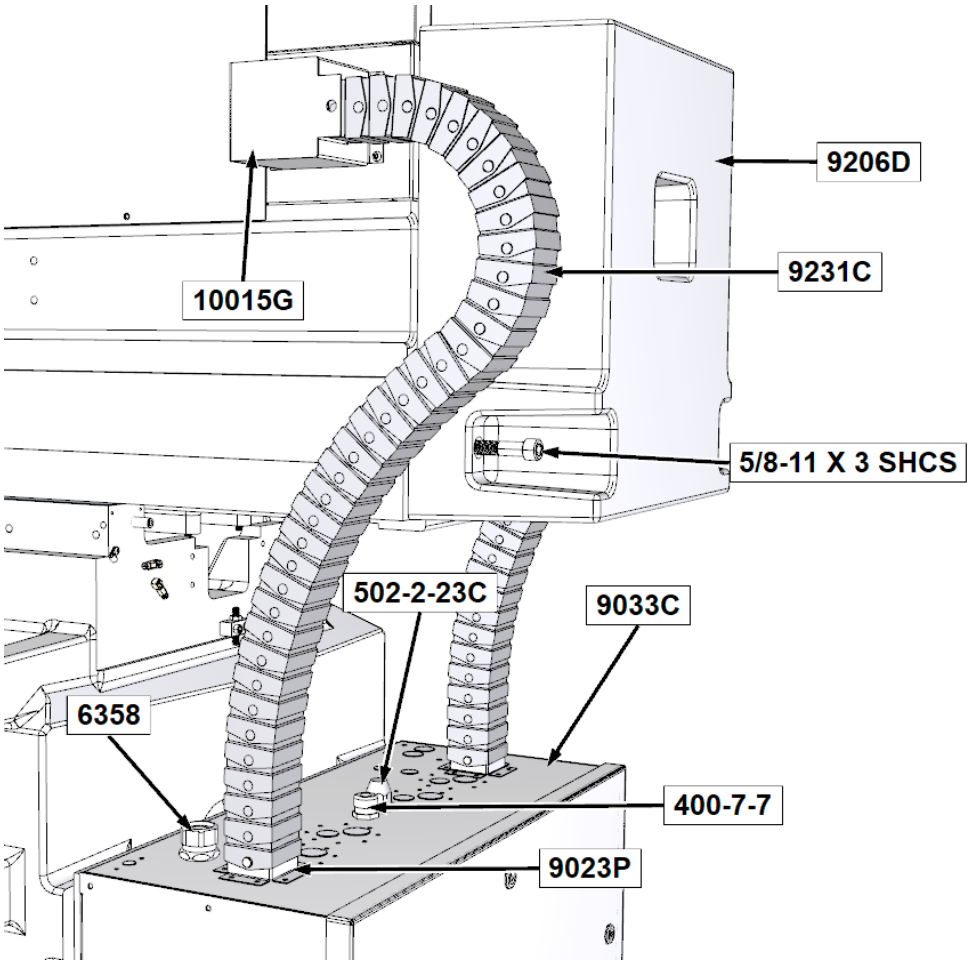
Chip Shield Parts

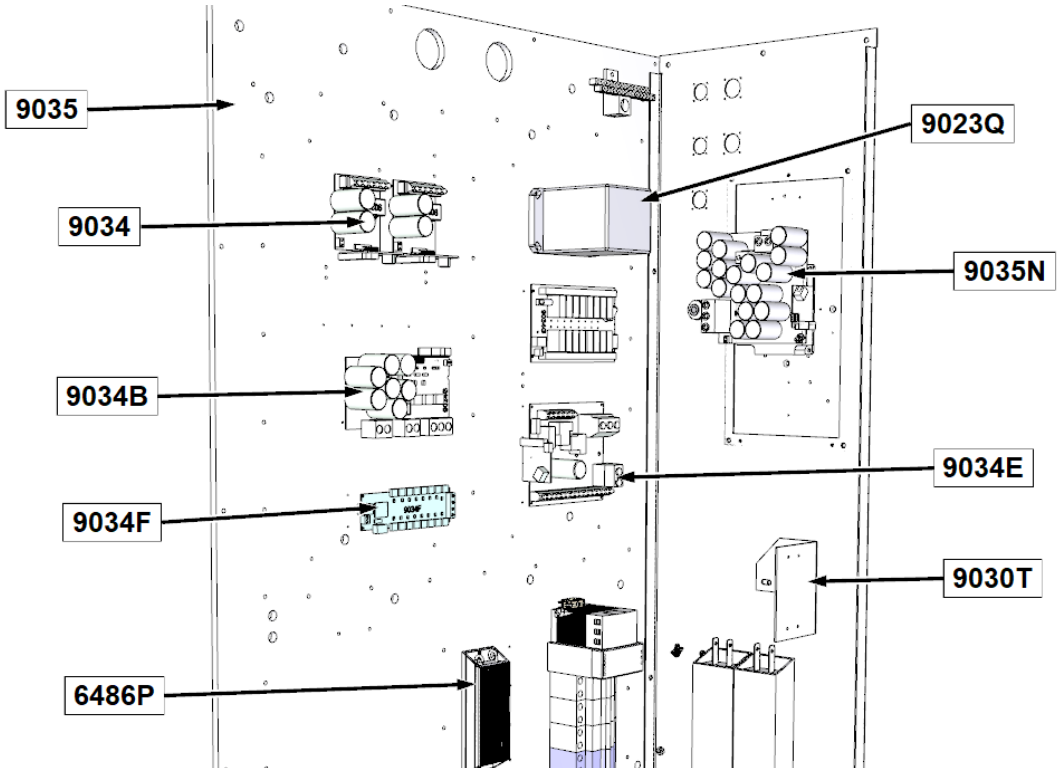


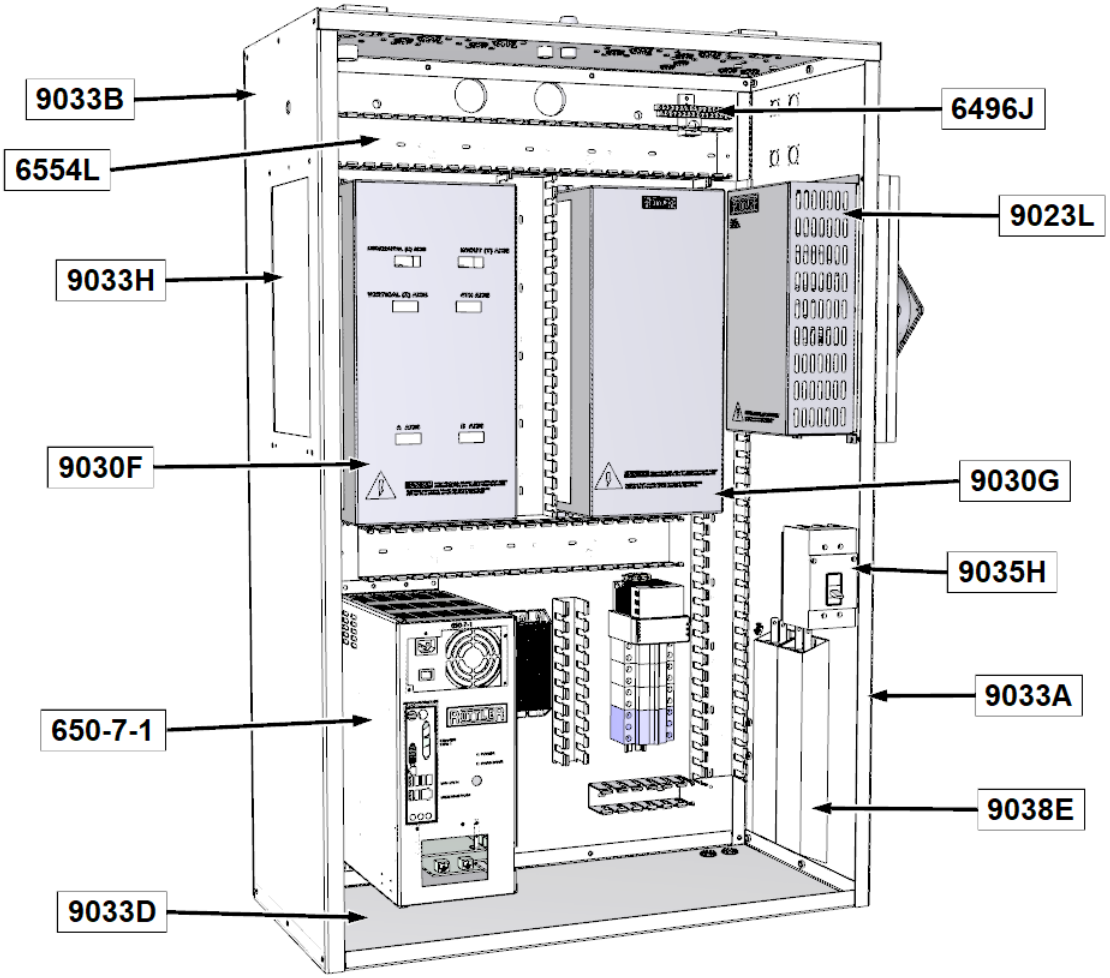


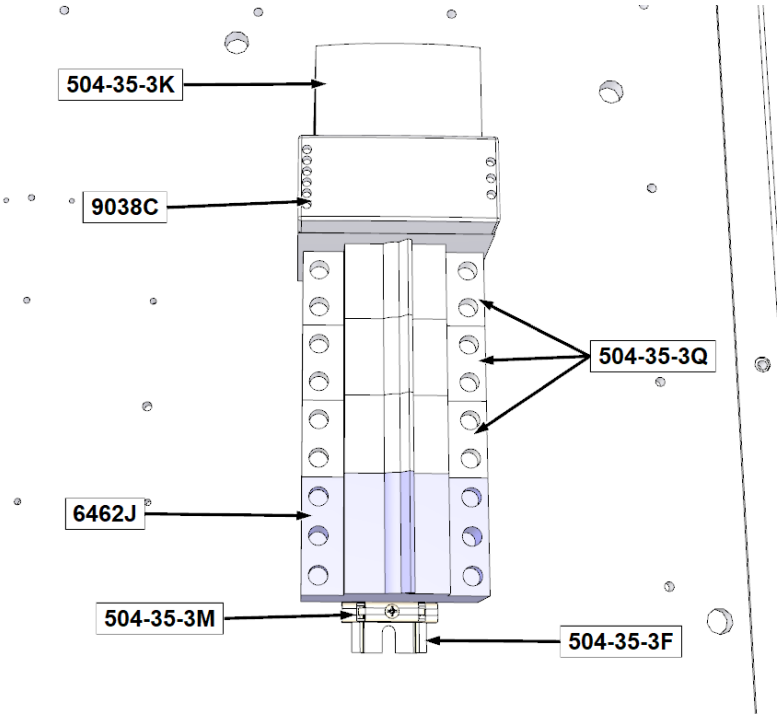
Electrical Enclosure Parts



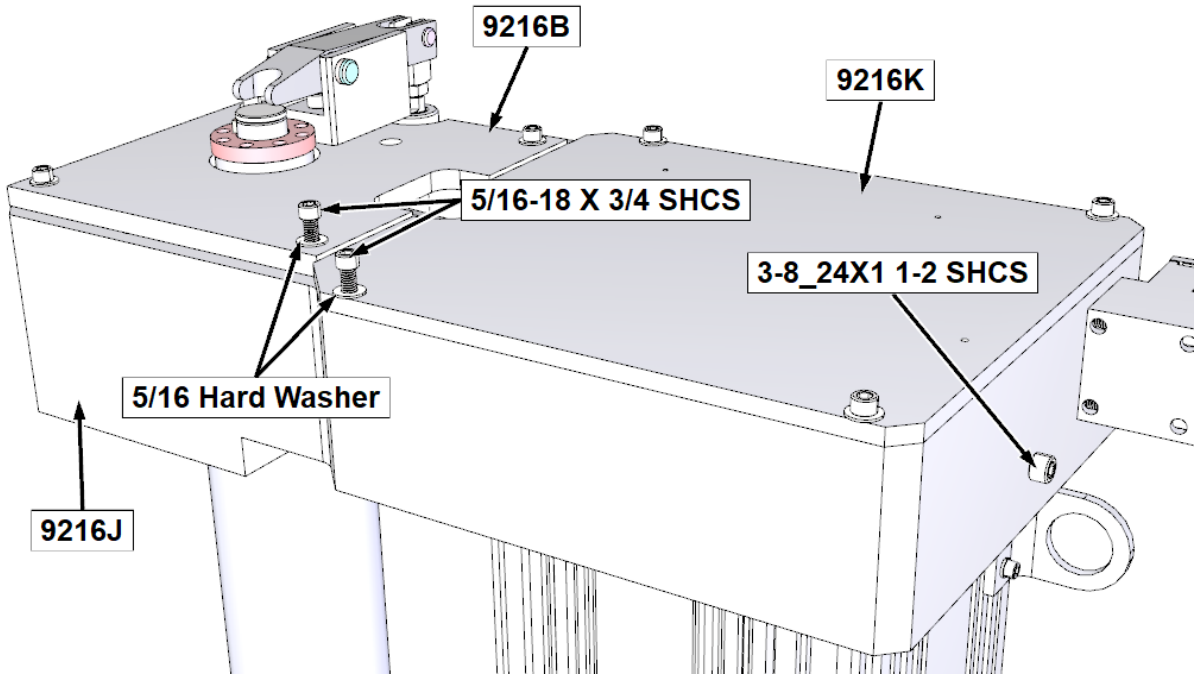

9206D
9231C
10015G
5/8-11 X 3 SHCS
502-2-23C
9033C
6358
400-7-7
9023P

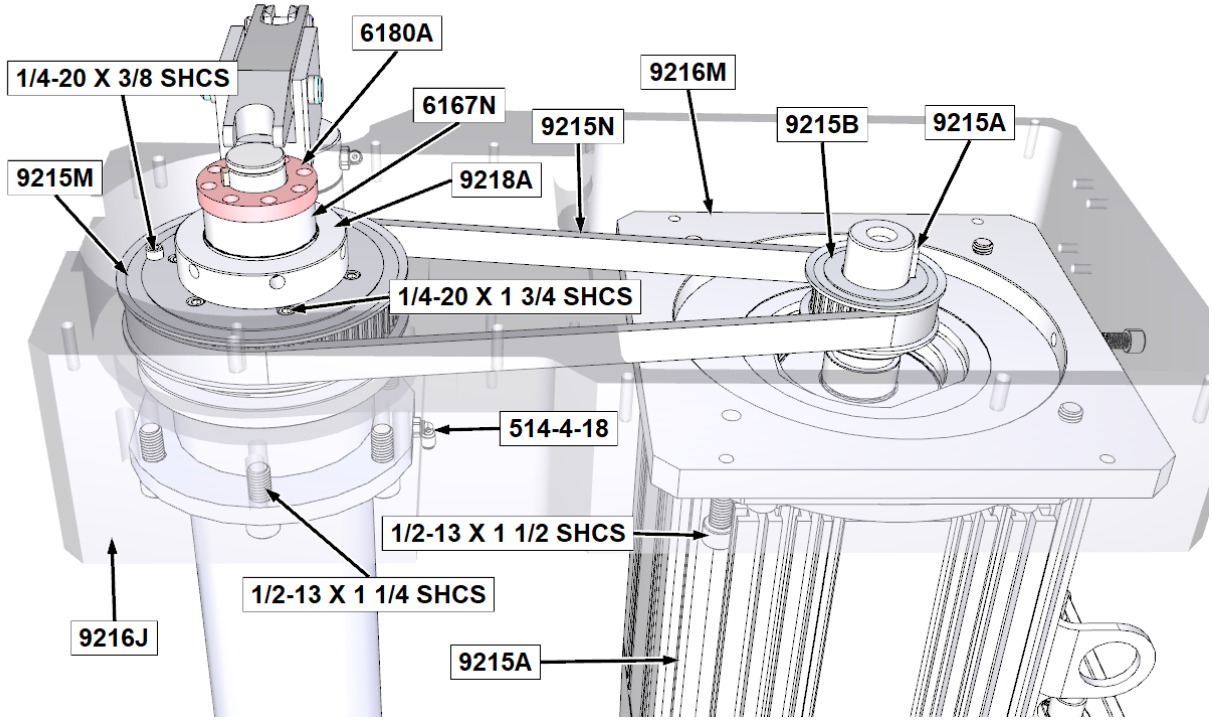

9035
9023Q
9034
9035N
9034B
9034E
9034F
9030T
6486P

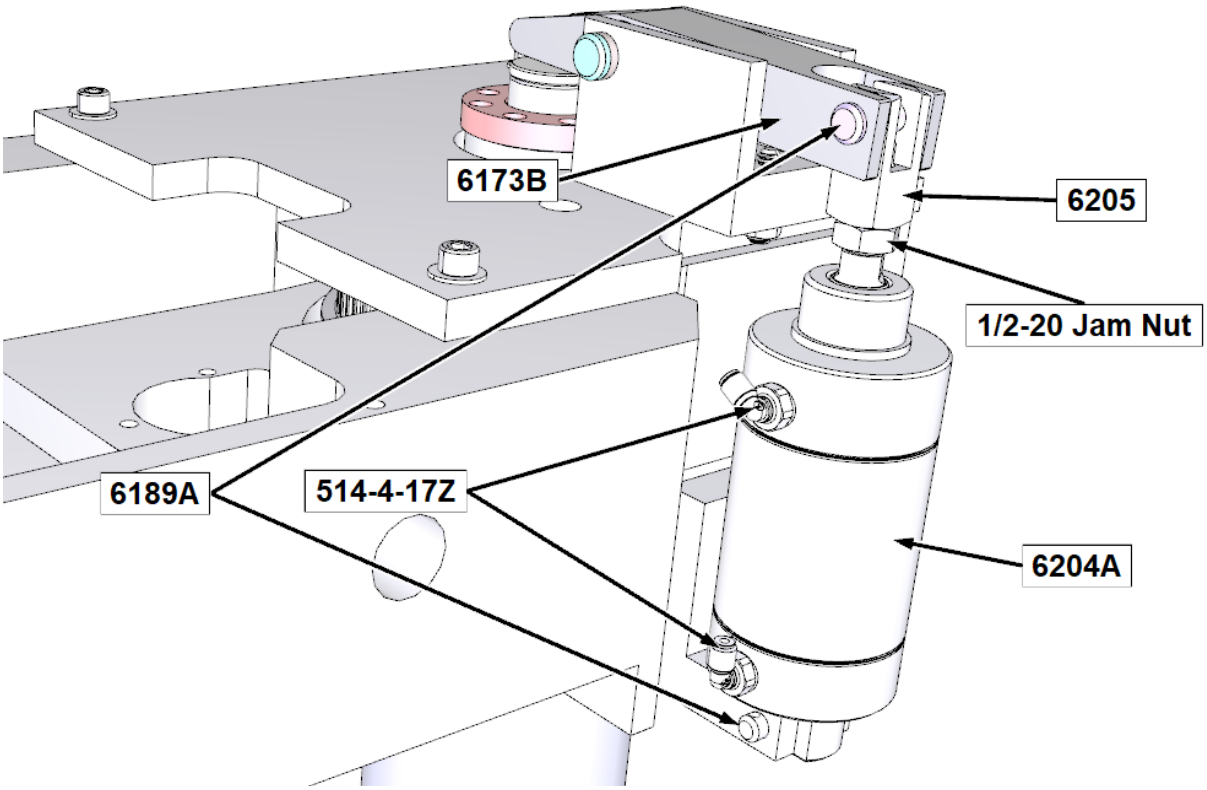

9033B
6554L
9033H
9030F
650-7-1
9033D
6496J
9023L
9030G
9035H
9033A
9038E

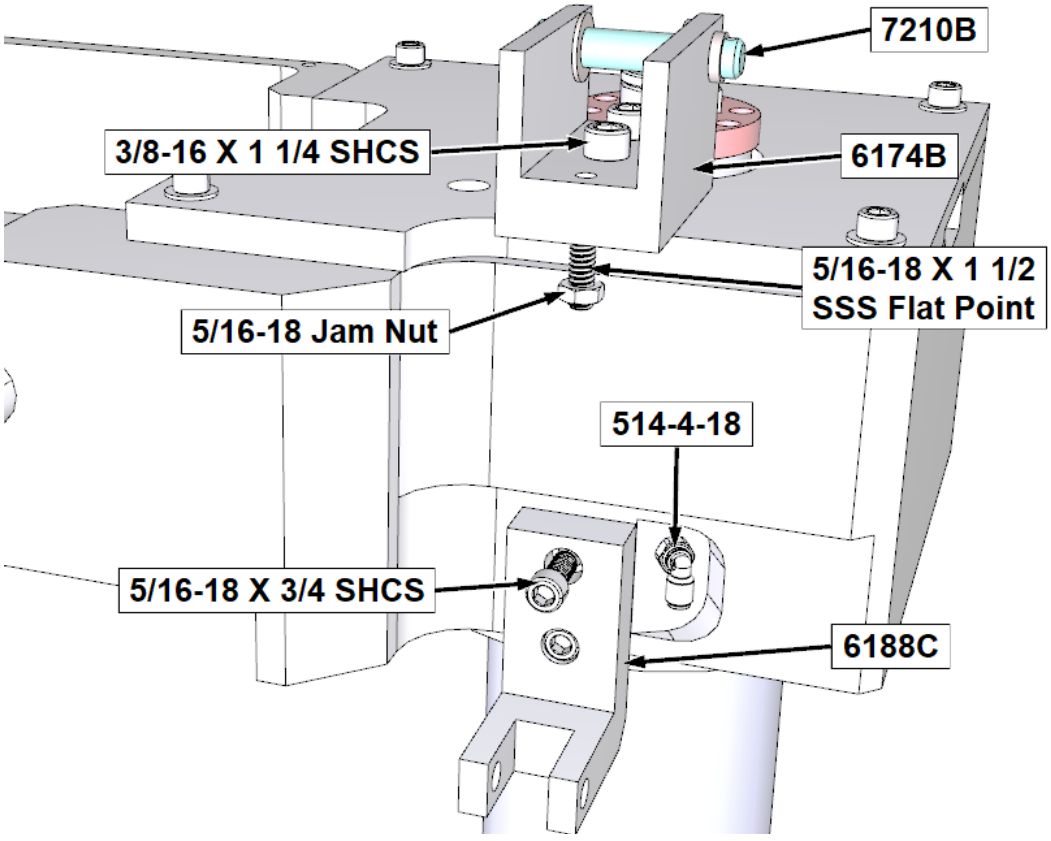

504-35-3K
9038C
504-35-3Q
6462J
504-35-3M
504-35-3F

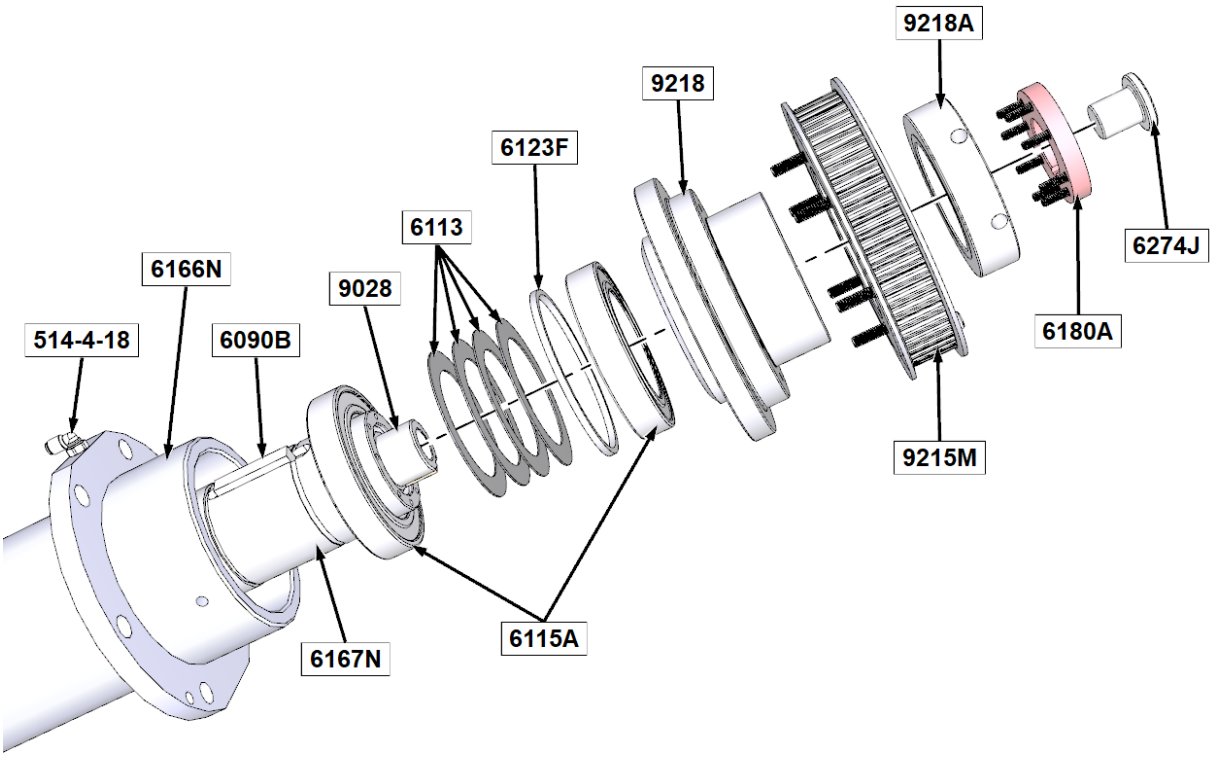
Spindle Housing Assembly Parts Rottler Spindle

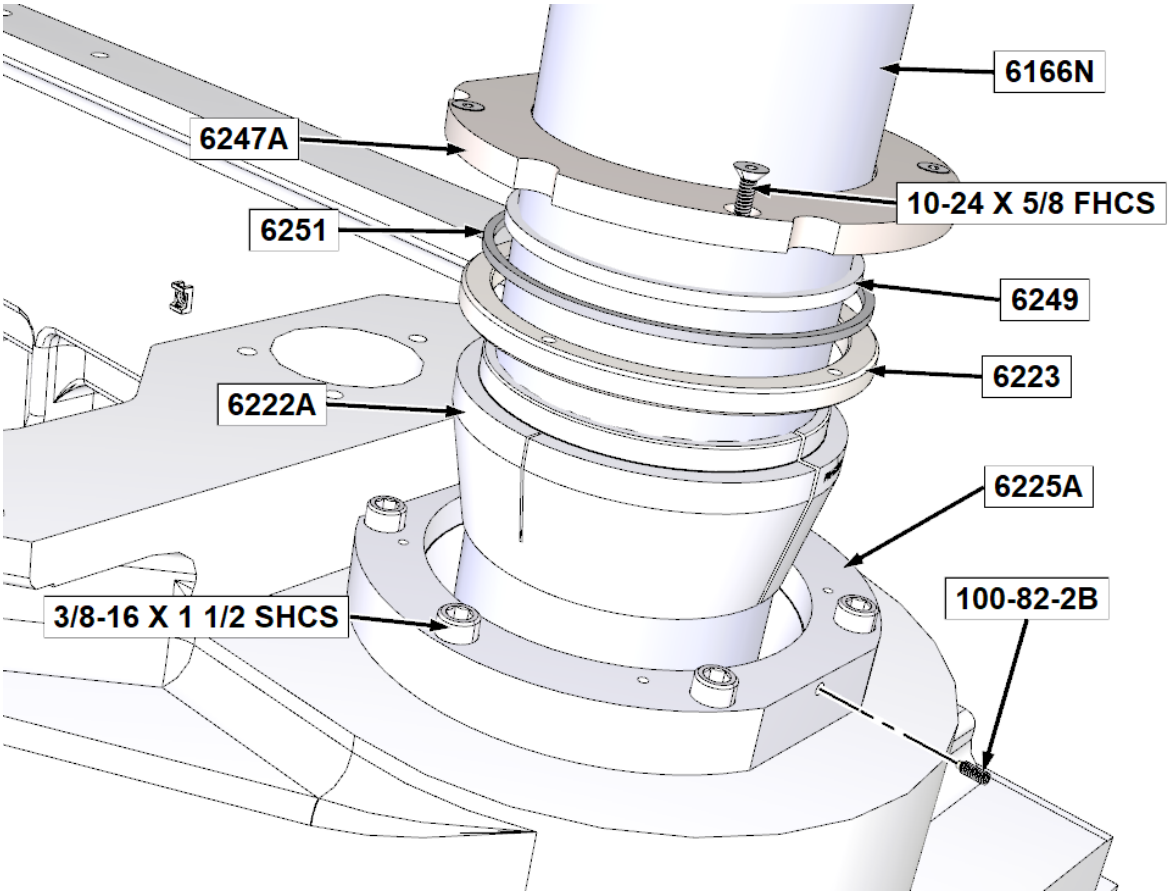


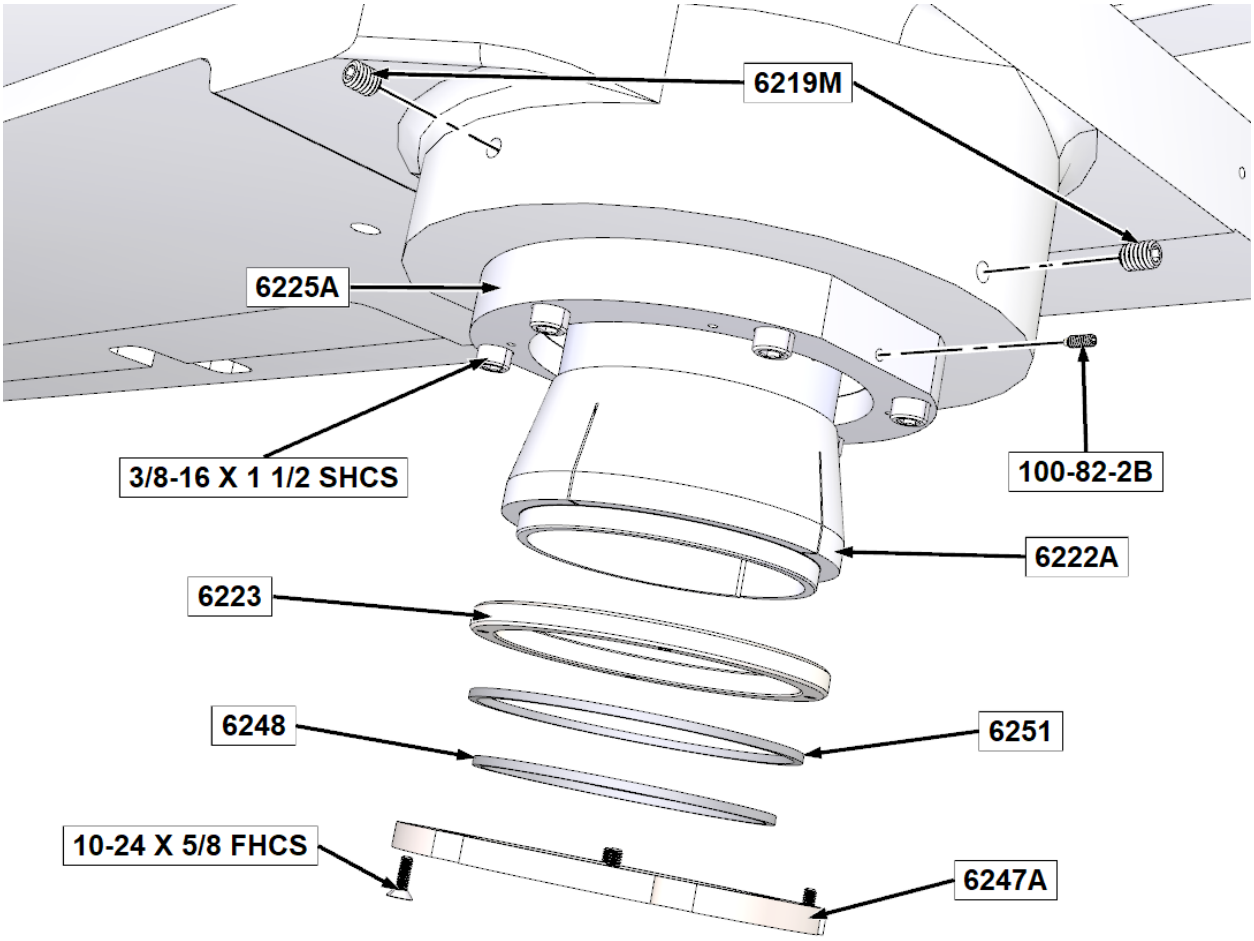


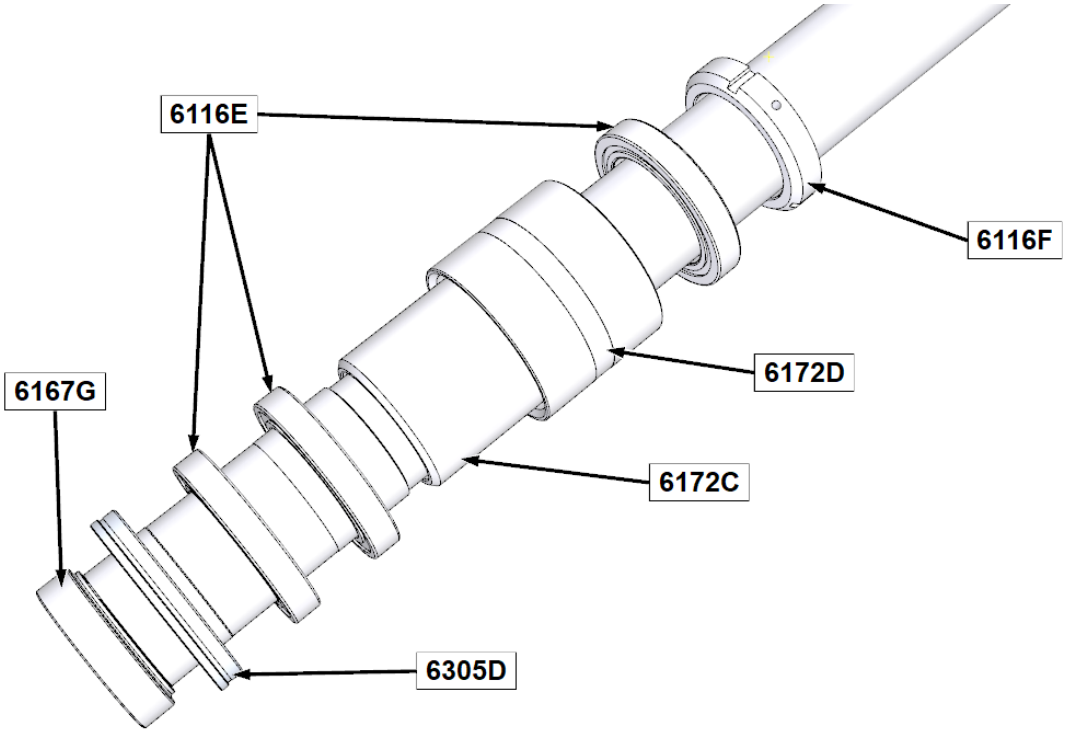

6173B
6205
1/2-20 Jam Nut
6189A
514-4-17Z
6204A

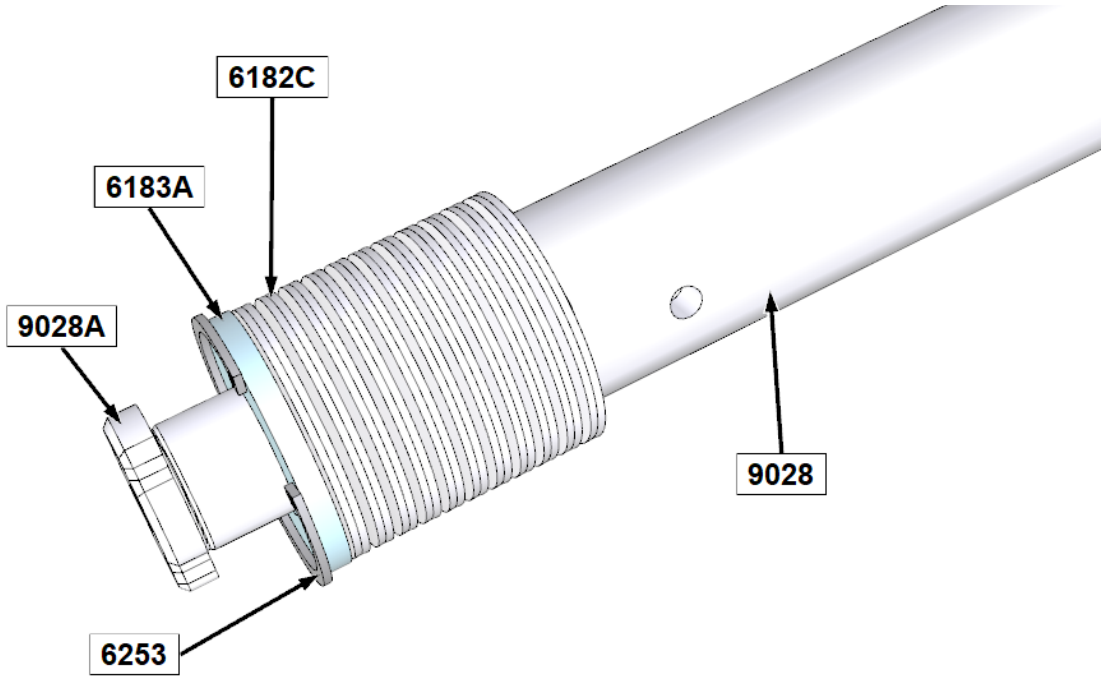

7210B
3/8-16 X 1 1/4 SHCS
6174B
5/16-18 X 1 1/2
SSS Flat Point
5/16-18 Jam Nut
514-4-18
5/16-18 X 3/4 SHCS
6188C


9218A
9218
6123F
6113
6166N
9028
514-4-18
6090B
6274J
6180A
9215M
6167N
6115A

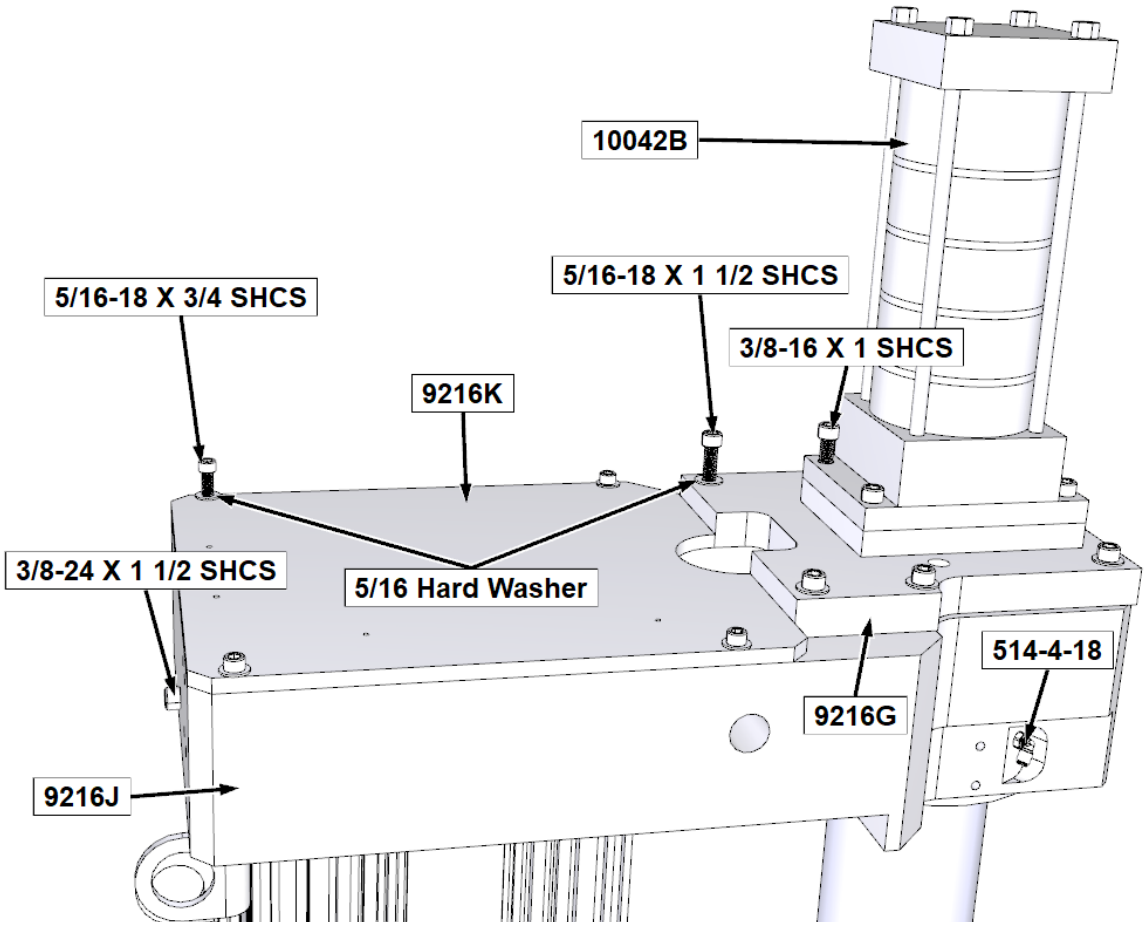

6166N
6247A
10-24 X 5/8 FHCS
6251
6249
6223
6222A
6225A
3/8-16 X 1 1/2 SHCS
100-82-2B

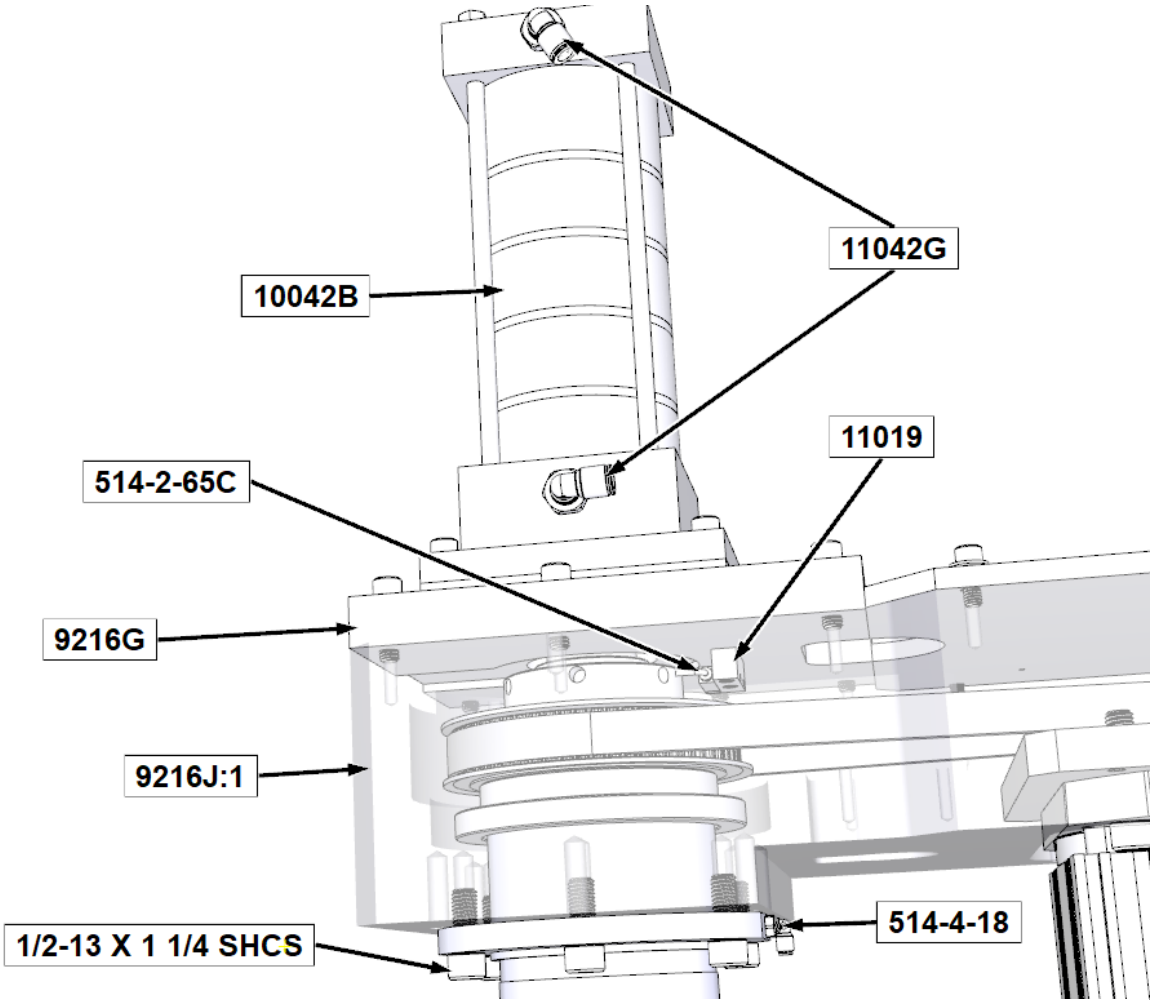

6219M
6225A
3/8-16 X 1 1/2 SHCS
100-82-2B
6222A
6223
6248
6251
10-24 X 5/8 FHCS
6247A

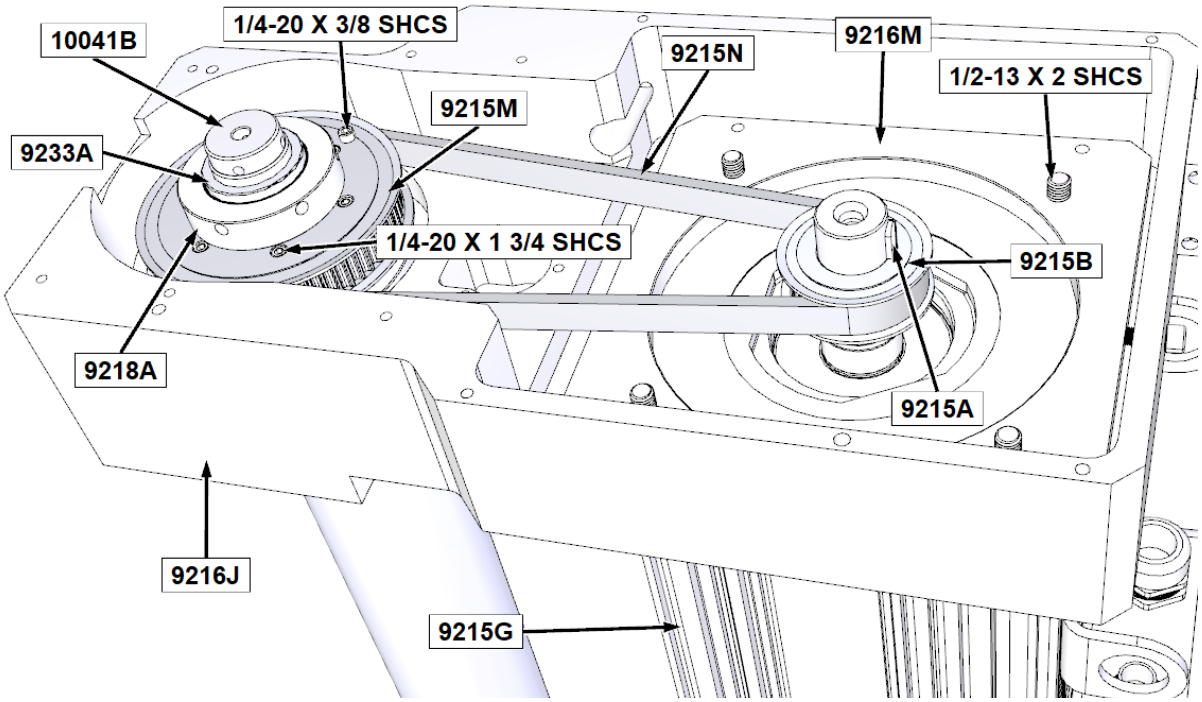

6116E
6116F
6172D
6167G
6172C
6305D

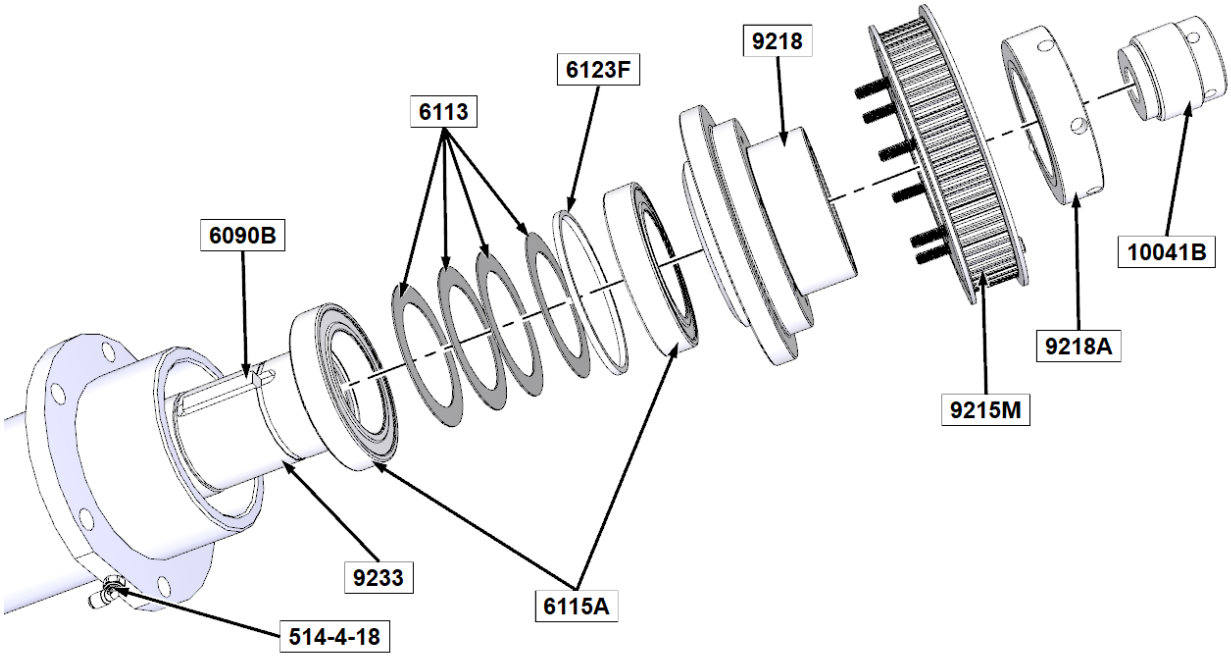


Spindle Housing Assembly Parts HSK Spindle




11042G
10042B
11019
514-2-65C
9216G
9216J:1
514-4-18
1/2-13 X 1 1/4 SHCS


10041B
1/4-20 X 3/8 SHCS
9215N
9216M
1/2-13 X 2 SHCS
9215M
9233A
1/4-20 X 1 3/4 SHCS
9215B
9218A
9215A
9216J
9215G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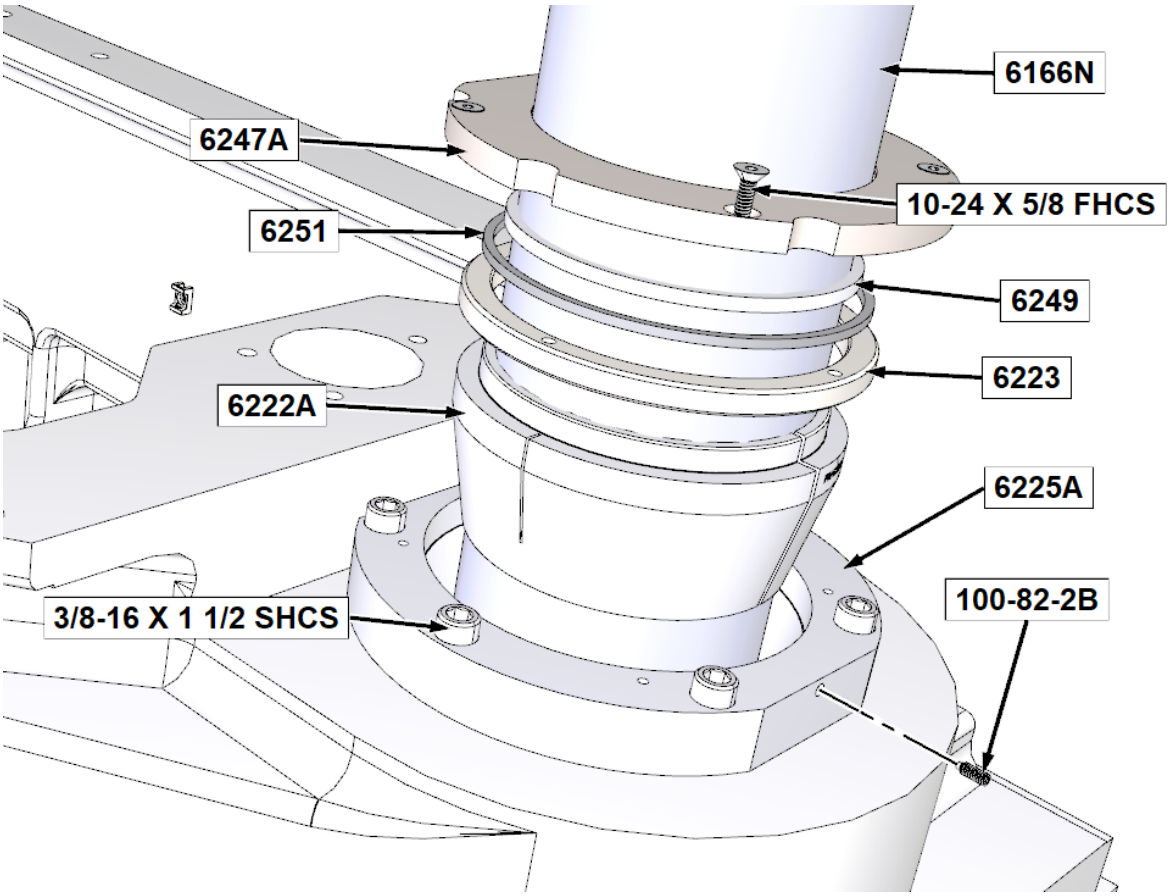
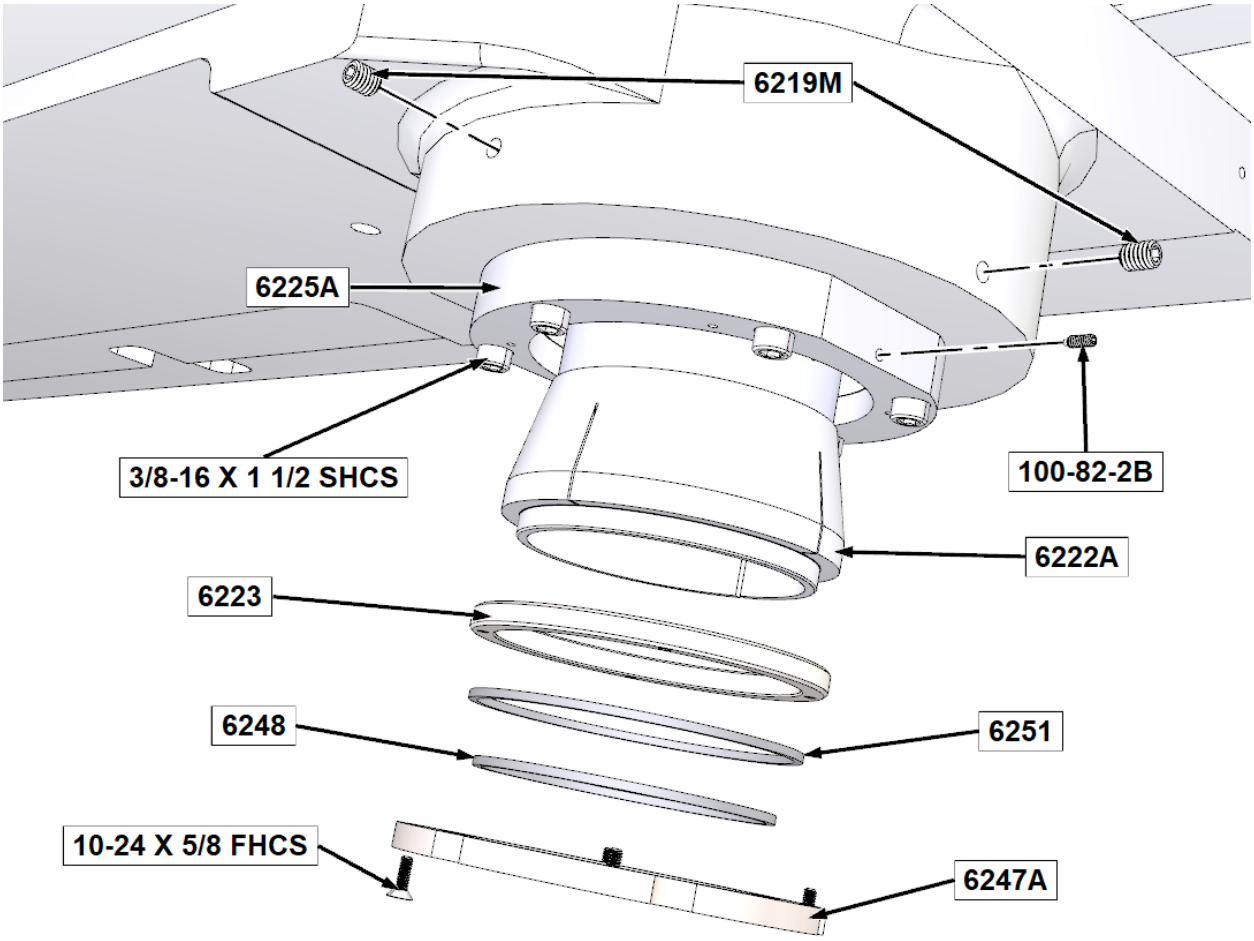
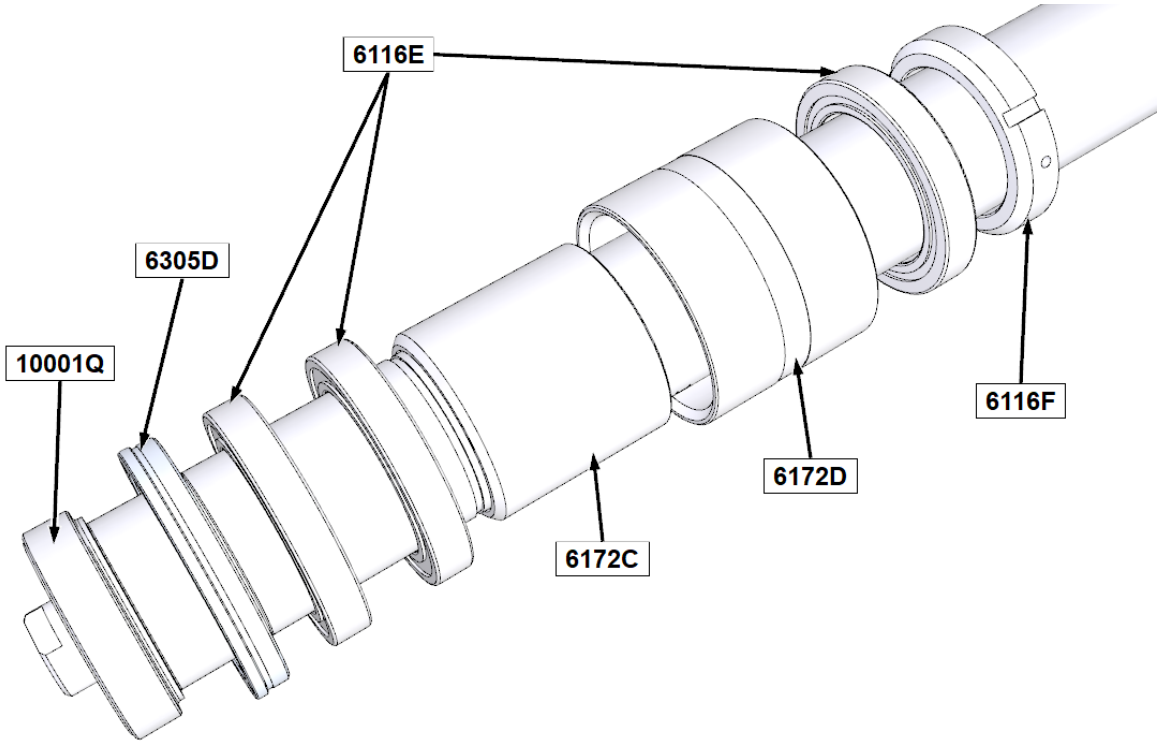
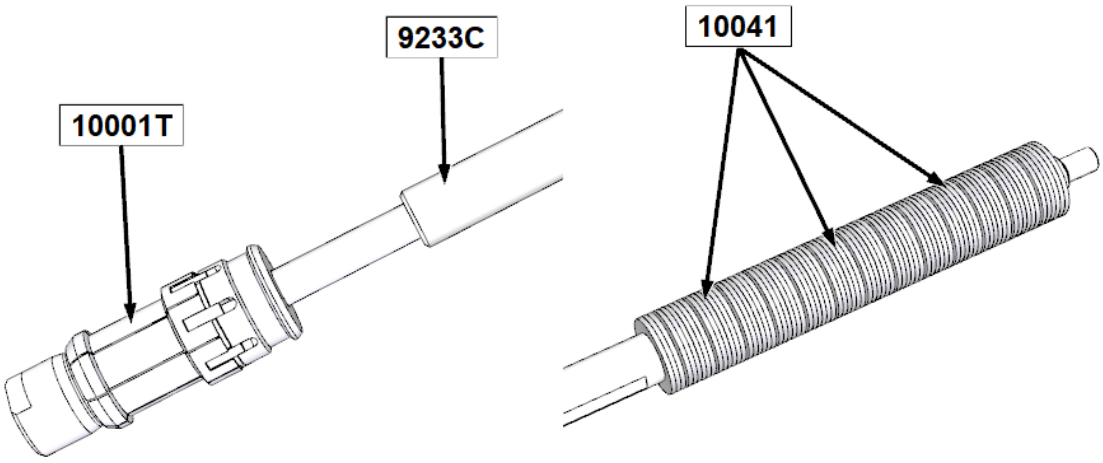
6090B
10041B
9218A
9215M
9233
6115A
514-4-18


6166N
6247A
10-24 X 5/8 FHCS
6251
6249
6223
6222A
6225A
3/8-16 X 1 1/2 SHCS
100-82-2B


6219M
6225A
3/8-16 X 1 1/2 SHCS
100-82-2B
6222A
6223
6248
6251
10-24 X 5/8 FHCS
6247A


6116E
6305D
10001Q
6116F
6172D
6172C


9233C
10001T
10041

OPTIONS

Optional Equipment

Optional Equipment Catalog and Parts Manual are located on the Manual CD shipped with machine.

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SDS

The Safety Data Sheets list shown in this section are the substances and materials that an operator is most likely to come in contact with while using this machine.

Other substances and materials are used in the manufacture, testing, and shipping of this machine. A complete list of the Safety Data Sheets of substances and materials used by Rottler Manufacturing during manufacturing, testing, and shipping is located on the Manual flash drive shipped with the machine. Safety Data Sheets are also located on the company web site: http://www.rottlermfg.com/documentation.php

1) Mobil Vactra Oil #2

2) Mobil Polyrex EP2

Product Name: MOBIL VACTRA OIL NO. 2
Revision Date: 30 Aug 2018

SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: **MOBIL VACTRA OIL NO. 2**
Product Description: Base Oil and Additives
Product Code: 201560901015, 600494-85
Intended Use: Lubricant

COMPANY IDENTIFICATION

Supplier: **East Coast Lubes Pty Ltd (Queensland and Northern Territory)**
A.B.N. 37 117 203 611
Cnr North and Mort Streets
Toowoomba, Queensland 4350 Australia

24 Hour Emergency Telephone 1300 131 001
Supplier General Contact 1800 069 019

Supplier: **Southern Cross Lubes (Victoria and Tasmania, New South Wales and Australian Capital Territory)**
58-66 Ajax Road
Altona, Victoria 3018, Australia

24 Hour Emergency Telephone 1300 131 001
Product Technical Information 1300 466 245
Supplier General Contact 1300 552 861

Supplier: **Perkal Pty Ltd Trading as Statewide Oil (Western Australia)**
A.B.N. 43 009 283 363
14 Beete Street
Welshpool, Western Australia 6106 Australia

24 Hour Emergency Telephone (8:00am to 4:30pm Mon to Fri) 1300 919 904
Product Technical Information
Supplier General Contact (08) 9350 6777
(08) 9350 6777

Supplier: **Perkal Pty Ltd Trading as Statewide Oil (South Australia)**
A.B.N. 43 009 283 363
6-10 Streiff Rd
Wingfield, South Australia 5013 Australia

24 Hour Emergency Telephone (8:00am to 4:30pm Mon to Fri) 1300 919 904
Product Technical Information
Supplier General Contact (08) 8359 8995
(08) 8359 8995

SECTION 2 HAZARDS IDENTIFICATION

This material is not hazardous according to regulatory guidelines (see (M)SDS Section 15).

Contains: PHOSPHORIC ACID ESTERS, AMINE SALT May produce an allergic reaction.

Other hazard information:

Physical / Chemical Hazards:
No significant hazards.

Health Hazards:
High-pressure injection under skin may cause serious damage. Excessive exposure may result in eye, skin, or respiratory irritation.

Environmental Hazards:
No significant hazards.

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

This material is defined as a mixture.

Reportable Hazardous Substance(s) or Complex Substance(s)

Name	CAS#	Concentration*	GHS Hazard Codes
2,6-DI-TERT-BUTYL-P-CRESOL	128-37-0	0.1 - < 1%	H400(M factor 1), H410(M factor 1)
PHOSPHORIC ACID ESTERS, AMINE SALT	Confidential	0.1 - < 1%	H227, H302, H317, H318, H401, H411

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume. Other ingredients determined not to be hazardous up to 100%.

SECTION 4 FIRST AID MEASURES

INHALATION
Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT
Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by

a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

NOTE TO PHYSICIAN

None

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

Hazardous Combustion Products: Aldehydes, Incomplete combustion products, Oxides of carbon, Smoke, Fume, Sulphur oxides

FLAMMABILITY PROPERTIES

Flash Point [Method]: >205°C (401°F) [ASTM D-92]
Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0
Autoignition Temperature: N/D

SECTION 6 ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

PROTECTIVE MEASURES

Avoid contact with spilled material. See Section 5 for fire fighting information. See the Hazard Identification Section for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for advice on the minimum requirements for personal protective equipment. Additional protective measures may be necessary, depending on the specific circumstances and/or the expert judgment of the emergency responders.

For emergency responders: Respiratory protection: respiratory protection will be necessary only in special cases, e.g., formation of mists. Half-face or full-face respirator with filter(s) for dust/organic vapor or Self

Contained Breathing Apparatus (SCBA) can be used depending on the size of spill and potential level of exposure. If the exposure cannot be completely characterized or an oxygen deficient atmosphere is possible or anticipated, SCBA is recommended. Work gloves that are resistant to hydrocarbons are recommended. Gloves made of polyvinyl acetate (PVA) are not water-resistant and are not suitable for emergency use. Chemical goggles are recommended if splashes or contact with eyes is possible. Small spills: normal antistatic work clothes are usually adequate. Large spills: full body suit of chemical resistant, antistatic material is recommended.

SPILL MANAGEMENT

Land Spill: Stop leak if you can do so without risk. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do so without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7 HANDLING AND STORAGE

HANDLING

Prevent small spills and leakage to avoid slip hazard. Material can accumulate static charges which may cause an electrical spark (ignition source). When the material is handled in bulk, an electrical spark could ignite any flammable vapors from liquids or residues that may be present (e.g., during switch-loading operations). Use proper bonding and/or earthing procedures. However, bonding and earthing may not eliminate the hazard from static accumulation. Consult local applicable standards for guidance. Additional references include American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practice on Static Electricity) or CENELEC CLC/TR 50404 (Electrostatics - Code of practice for the avoidance of hazards due to static electricity).

Static Accumulator: This material is a static accumulator.

STORAGE

The type of container used to store the material may affect static accumulation and dissipation. Do not store in open or unlabelled containers. Keep away from incompatible materials.

Material is defined under the National Standard [NOHSC:1015] Storage and Handling of Workplace Dangerous Goods.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMIT VALUES

Exposure limits/standards (Note: Exposure limits are not additive)

Substance Name	Form	Limit/Standard			Note	Source
2,6-DI-TERT-BUTYL-P-CRESOL		TWA	10 mg/m3			Australia OELs

2,6-DI-TERT-BUTYL-P-CRESOL	Inhalable fraction and vapour	TWA	2 mg/m3			ACGIH

Exposure limits/standards for materials that can be formed when handling this product:

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

Biological limits

No biological limits allocated.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:
No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:
Particulate
No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:
Nitrile,Viton
No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:
No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS

Comply with applicable environmental regulations limiting discharge to air, water and soil. Protect the environment by applying appropriate control measures to prevent or limit emissions.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Note: Physical and chemical properties are provided for safety, health and environmental considerations only and may not fully represent product specifications. Contact the Supplier for additional information.

GENERAL INFORMATION

Physical State: Liquid
Colour: Amber
Odour: Characteristic
Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 °C): 0.883
Flammability (Solid, Gas): N/A
Flash Point [Method]: >205°C (401°F) [ASTM D-92]
Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0
Autoignition Temperature: N/D
Boiling Point / Range: > 316°C (600°F)
Decomposition Temperature: N/D
Vapour Density (Air = 1): > 2 at 101 kPa
Vapour Pressure: < 0.013 kPa (0.1 mm Hg) at 20 ºC
Evaporation Rate (n-butyl acetate = 1): N/D
pH: N/A
Log Pow (n-Octanol/Water Partition Coefficient): > 3.5
Solubility in Water: Negligible
Viscosity: 68 cSt (68 mm2/sec) at 40 ºC | 8.6 cSt (8.6 mm2/sec) at 100°C
Oxidizing Properties: See Hazards Identification Section.

OTHER INFORMATION

Freezing Point: N/D
Melting Point: N/A
Pour Point: -6°C (21°F)
DMSO Extract (mineral oil only), IP-346: < 3 %wt

SECTION 10 STABILITY AND REACTIVITY

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.

INCOMPATIBLE MATERIALS: Strong oxidisers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

POSSIBILITY OF HAZARDOUS REACTIONS: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

INFORMATION ON TOXICOLOGICAL EFFECTS

Hazard Class	Conclusion / Remarks
Inhalation	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Irritation: No end point data for material.	Negligible hazard at ambient/normal handling temperatures.
Ingestion	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Skin	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Skin Corrosion/Irritation: No end point data for material.	Negligible irritation to skin at ambient temperatures. Based on assessment of the components.
Eye	
Serious Eye Damage/Irritation: No end point data for material.	May cause mild, short-lasting discomfort to eyes. Based on assessment of the components.
Sensitisation	
Respiratory Sensitization: No end point data for material.	Not expected to be a respiratory sensitizer.
Skin Sensitization: No end point data for material.	Not expected to be a skin sensitizer. Based on assessment of the components.
Aspiration: Data available.	Not expected to be an aspiration hazard. Based on physico-chemical properties of the material.
Germ Cell Mutagenicity: No end point data for material.	Not expected to be a germ cell mutagen. Based on assessment of the components.
Carcinogenicity: No end point data for material.	Not expected to cause cancer. Based on assessment of the components.
Reproductive Toxicity: No end point data for material.	Not expected to be a reproductive toxicant. Based on assessment of the components.
Lactation: No end point data for material.	Not expected to cause harm to breast-fed children.
Specific Target Organ Toxicity (STOT)	
Single Exposure: No end point data for material.	Not expected to cause organ damage from a single exposure.
Repeated Exposure: No end point data for material.	Not expected to cause organ damage from prolonged or repeated exposure. Based on assessment of the components.

OTHER INFORMATION

For the product itself:

Component concentrations in this formulation would not be expected to cause skin sensitization, based on tests of the components, this formulation, or similar formulations.

Contains:

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames

test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitising in test animals.

IARC Classification:
The following ingredients are cited on the lists below: None.

--REGULATORY LISTS SEARCHED--
1 = IARC 1 2 = IARC 2A 3 = IARC 2B

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data for the material, components of the material, or for similar materials, through the application of bridging principals.

ECOTOXICITY
Material -- Not expected to be harmful to aquatic organisms.

MOBILITY
Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY
Biodegradation:
Base oil component -- Expected to be inherently biodegradable

BIOACCUMULATION POTENTIAL
Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

SECTION 13 DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS
Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products. Protect the environment. Dispose of used oil at designated sites. Minimize skin contact. Do not mix used oils with solvents, brake fluids or coolants.

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14 TRANSPORT INFORMATION

LAND (ADG) : Not Regulated for Land Transport

SEA (IMDG): Not Regulated for Sea Transport according to IMDG-Code

Marine Pollutant: No

AIR (IATA): Not Regulated for Air Transport

SECTION 15 REGULATORY INFORMATION

This material is not considered hazardous according to Australia Model Work Health and Safety Regulations.

Product is not regulated according to Australian Dangerous Goods Code.

No Poison Schedule number allocated by the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) established under the Therapeutic Goods Act.

AS1940 COMBUSTIBLE CLASS: C2

REGULATORY STATUS AND APPLICABLE LAWS AND REGULATIONS

Listed or exempt from listing/notification on the following chemical inventories (May contain substance(s) subject to notification to the EPA Active TSCA inventory prior to import to USA): AICS, DSL, ENCS, IECSC, KECI, PICCS, TCSI, TSCA

SECTION 16 OTHER INFORMATION

KEY TO ABBREVIATIONS AND ACRONYMS:

N/D = Not determined, N/A = Not applicable, STEL = Short-Term Exposure Limit, TWA = Time-Weighted Average

KEY TO THE H-CODES CONTAINED IN SECTION 3 OF THIS DOCUMENT (for information only):
H227: Combustible liquid; Flammable Liquid, Cat 4
H302: Harmful if swallowed; Acute Tox Oral, Cat 4
H317: May cause allergic skin reaction; Skin Sensitization, Cat 1

H318: Causes serious eye damage; Serious Eye Damage/Irr, Cat 1
H400: Very toxic to aquatic life; Acute Env Tox, Cat 1
H401: Toxic to aquatic life; Acute Env Tox, Cat 2
H410: Very toxic to aquatic life with long lasting effects; Chronic Env Tox, Cat 1
H411: Toxic to aquatic life with long lasting effects; Chronic Env Tox, Cat 2

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:
Southern Cross Lubes (Victoria and Tasmania): Section 01: Supplier Mailing Address information was deleted.
Southern Cross Lubes (Victoria and Tasmania, New South Wales and Australian Capital Territory): Section 01: Supplier Mailing Address information was added.
Section 11 Acute Toxicity data - Header information was deleted.
Section 11 Substance Name - Header information was deleted.
Section 11 Substance Toxicity table - Header information was deleted.
Section 11 Substance Toxicology table information was deleted.
Section 12: information was modified.

DGN: 7053124DAU (1014681)

Prepared by: Exxon Mobil Corporation
EMBSI, Clinton NJ USA
Contact Point: See Section 1 for Local Contact number

End of (M)SDS

Product Name: MOBIL POLYREX EP 2
Revision Date: 25 Jul 2018

SAFETY DATA SHEET

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT

Product Name: **MOBIL POLYREX EP 2**
Product Description: Base Oil and Additives
Product Code: 2015A020G020, 641696-00, 97Y279
Intended Use: Grease

COMPANY IDENTIFICATION

Supplier: **EXXON MOBIL CORPORATION**
22777 Springwoods Village Parkway
Spring, TX 77389 USA

24 Hour Health Emergency	609-737-4411
Transportation Emergency Phone	800-424-9300 or 703-527-3887 CHEMTREC
Product Technical Information	800-662-4525
MSDS Internet Address	www.exxon.com, www.mobil.com

SECTION 2 HAZARDS IDENTIFICATION

This material is not hazardous according to regulatory guidelines (see (M)SDS Section 15).

Other hazard information:

HAZARD NOT OTHERWISE CLASSIFIED (HNOC): None as defined under 29 CFR 1910.1200.

PHYSICAL / CHEMICAL HAZARDS

No significant hazards.

HEALTH HAZARDS

High-pressure injection under skin may cause serious damage. Excessive exposure may result in eye, skin, or respiratory irritation.

ENVIRONMENTAL HAZARDS

No significant hazards.

NFPA Hazard ID:	Health:	0	Flammability:	1	Reactivity:	0
HMIS Hazard ID:	Health:	0	Flammability:	1	Reactivity:	0

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary

from person to person.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

This material is defined as a mixture.

Hazardous Substance(s) or Complex Substance(s) required for disclosure

Name	CAS#	Concentration*	GHS Hazard Codes
CARBONIC ACID, CALCIUM SALT (1:1)	471-34-1	5 - < 10%	None

* All concentrations are percent by weight unless material is a gas. Gas concentrations are in percent by volume.

As per paragraph (i) of 29 CFR 1910.1200, formulation is considered a trade secret and specific chemical identity and exact percentage (concentration) of composition may have been withheld. Specific chemical identity and exact percentage composition will be provided to health professionals, employees, or designated representatives in accordance with applicable provisions of paragraph (i).

SECTION 4 FIRST AID MEASURES

INHALATION

Under normal conditions of intended use, this material is not expected to be an inhalation hazard.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

SECTION 5 FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

Inappropriate Extinguishing Media: Straight Streams of Water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply. Firefighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces

and to protect personnel.

Hazardous Combustion Products: Aldehydes, Incomplete combustion products, Oxides of carbon, Smoke, Fume, Sulfur oxides

FLAMMABILITY PROPERTIES

Flash Point [Method]: >168°C (334°F) [EST. FOR OIL, ASTM D-92 (COC)]
Flammable Limits (Approximate volume % in air): LEL: N/D UEL: N/D
Autoignition Temperature: N/A

SECTION 6 ACCIDENTAL RELEASE MEASURES

NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations. US regulations require reporting releases of this material to the environment which exceed the applicable reportable quantity or oil spills which could reach any waterway including intermittent dry creeks. The National Response Center can be reached at (800)424-8802.

PROTECTIVE MEASURES

Avoid contact with spilled material. See Section 5 for fire fighting information. See the Hazard Identification Section for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for advice on the minimum requirements for personal protective equipment. Additional protective measures may be necessary, depending on the specific circumstances and/or the expert judgment of the emergency responders.

For emergency responders: Respiratory protection: respiratory protection will be necessary only in special cases, e.g., formation of mists. Half-face or full-face respirator with filter(s) for dust/organic vapor or Self Contained Breathing Apparatus (SCBA) can be used depending on the size of spill and potential level of exposure. If the exposure cannot be completely characterized or an oxygen deficient atmosphere is possible or anticipated, SCBA is recommended. Work gloves that are resistant to hydrocarbons are recommended. Gloves made of polyvinyl acetate (PVA) are not water-resistant and are not suitable for emergency use. Chemical goggles are recommended if splashes or contact with eyes is possible. Small spills: normal antistatic work clothes are usually adequate. Large spills: full body suit of chemical resistant, antistatic material is recommended.

SPILL MANAGEMENT

Land Spill: Scrape up spilled material with shovels into a suitable container for recycle or disposal.

Water Spill: Stop leak if you can do it without risk. Confine the spill immediately with booms. Warn other shipping. Skim from surface.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS

Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7 HANDLING AND STORAGE

HANDLING

Prevent small spills and leakage to avoid slip hazard.

Static Accumulator: This material is not a static accumulator.

STORAGE

Do not store in open or unlabelled containers.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMIT VALUES

Exposure limits/standards (Note: Exposure limits are not additive)

Substance Name	Form	Limit / Standard			NOTE	Source
CARBONIC ACID, CALCIUM SALT (1:1)	Respirable fraction.	TWA	5 mg/m3		N/A	OSHA Z1
CARBONIC ACID, CALCIUM SALT (1:1)	Total dust.	TWA	15 mg/m3		N/A	OSHA Z1

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

No biological limits allocated.

ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

No protection is ordinarily required under normal conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapor warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use

conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping.

ENVIRONMENTAL CONTROLS

Comply with applicable environmental regulations limiting discharge to air, water and soil. Protect the environment by applying appropriate control measures to prevent or limit emissions.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Note: Physical and chemical properties are provided for safety, health and environmental considerations only and may not fully represent product specifications. Contact the Supplier for additional information.

GENERAL INFORMATION

Physical State: Solid
Form: Semi-fluid
Color: Blue-Green
Odor: Characteristic
Odor Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 °C): 0.9
Flammability (Solid, Gas): N/A
Flash Point [Method]: >168°C (334°F) [EST. FOR OIL, ASTM D-92 (COC)]
Flammable Limits (Approximate volume % in air): LEL: N/D UEL: N/D
Autoignition Temperature: N/A
Boiling Point / Range: > 330°C (626°F)
Decomposition Temperature: N/D
Vapor Density (Air = 1): N/D
Vapor Pressure: < 0.013 kPa (0.1 mm Hg) at 20 °C
Evaporation Rate (n-butyl acetate = 1): N/D
pH: N/A
Log Pow (n-Octanol/Water Partition Coefficient): > 3.5
Solubility in Water: Negligible
Viscosity: >211 cSt (211 mm2/sec) at 40 °C | >16.6 cSt (16.6 mm2/sec) at 100°C
Oxidizing Properties: See Hazards Identification Section.

OTHER INFORMATION

Freezing Point: N/D
Melting Point: 265°C (509°F)
DMSO Extract (mineral oil only), IP-346: < 3 %wt

NOTE: Most physical properties above are for the oil component in the material.

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY: See sub-sections below.

STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.

MATERIALS TO AVOID: Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

POSSIBILITY OF HAZARDOUS REACTIONS: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

INFORMATION ON TOXICOLOGICAL EFFECTS

Hazard Class	Conclusion / Remarks
Inhalation	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Irritation: No end point data for material.	Negligible hazard at ambient/normal handling temperatures.
Ingestion	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Skin	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Skin Corrosion/Irritation: No end point data for material.	Negligible irritation to skin at ambient temperatures. Based on assessment of the components.
Eye	
Serious Eye Damage/Irritation: No end point data for material.	May cause mild, short-lasting discomfort to eyes. Based on assessment of the components.
Sensitization	
Respiratory Sensitization: No end point data for material.	Not expected to be a respiratory sensitizer.
Skin Sensitization: No end point data for material.	Not expected to be a skin sensitizer. Based on assessment of the components.
Aspiration: Data available.	Not expected to be an aspiration hazard. Based on physico-chemical properties of the material.
Germ Cell Mutagenicity: No end point data for material.	Not expected to be a germ cell mutagen. Based on assessment of the components.
Carcinogenicity: No end point data for material.	Not expected to cause cancer. Based on assessment of the components.

Reproductive Toxicity: No end point data for material.	Not expected to be a reproductive toxicant. Based on assessment of the components.
Lactation: No end point data for material.	Not expected to cause harm to breast-fed children.
Specific Target Organ Toxicity (STOT)	
Single Exposure: No end point data for material.	Not expected to cause organ damage from a single exposure.
Repeated Exposure: No end point data for material.	Not expected to cause organ damage from prolonged or repeated exposure. Based on assessment of the components.

OTHER INFORMATION

Contains:
Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitizing in test animals.

The following ingredients are cited on the lists below: None.

--REGULATORY LISTS SEARCHED--

1 = NTP CARC	3 = IARC 1	5 = IARC 2B
2 = NTP SUS	4 = IARC 2A	6 = OSHA CARC

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data for the material, components of the material, or for similar materials, through the application of bridging principals.

ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

MOBILITY

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY
Biodegradation:

Base oil component -- Expected to be inherently biodegradable

BIOACCUMULATION POTENTIAL

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

SECTION 13 DISPOSAL CONSIDERATIONS

Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products.

REGULATORY DISPOSAL INFORMATION

RCRA Information: The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, Part 261D), nor is it formulated to contain materials which are listed as hazardous wastes. It does not exhibit the hazardous characteristics of ignitability, corrosivity or reactivity and is not formulated with contaminants as determined by the Toxicity Characteristic Leaching Procedure (TCLP). However, used product may be regulated.

Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14 TRANSPORT INFORMATION

LAND (DOT): Not Regulated for Land Transport

LAND (TDG): Not Regulated for Land Transport

SEA (IMDG): Not Regulated for Sea Transport according to IMDG-Code

Marine Pollutant: No

AIR (IATA): Not Regulated for Air Transport

SECTION 15 REGULATORY INFORMATION

OSHA HAZARD COMMUNICATION STANDARD: This material is not considered hazardous in accordance with OSHA HazCom 2012, 29 CFR 1910.1200.

Listed or exempt from listing/notification on the following chemical inventories: IECSC, TCSI, TSCA

SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302

SARA (311/312) REPORTABLE GHS HAZARD CLASSES: None.

SARA (313) TOXIC RELEASE INVENTORY: This material contains no chemicals subject to the supplier notification requirements of the SARA 313 Toxic Release Program.

The following ingredients are cited on the lists below:

Chemical Name	CAS Number	List Citations
CARBONIC ACID, CALCIUM SALT (1:1)	471-34-1	4, 16, 17, 18
DIPHENYLAMINE	122-39-4	18
HYDROTREATED HEAVY NAPHTHENIC DISTILLATE	64742-52-5	13, 17, 18
NAPHTHALENE	91-20-3	10

--REGULATORY LISTS SEARCHED--

1 = ACGIH ALL	6 = TSCA 5a2	11 = CA P65 REPRO	16 = MN RTK
2 = ACGIH A1	7 = TSCA 5e	12 = CA RTK	17 = NJ RTK
3 = ACGIH A2	8 = TSCA 6	13 = IL RTK	18 = PA RTK
4 = OSHA Z	9 = TSCA 12b	14 = LA RTK	19 = RI RTK
5 = TSCA 4	10 = CA P65 CARC	15 = MI 293	

Code key: CARC=Carcinogen; REPRO=Reproductive

SECTION 16 OTHER INFORMATION

WARNING: Cancer - www.P65Warnings.ca.gov.

This warning is given to comply with California Health and Safety Code 25249.6 and does not constitute an admission or a waiver of rights.

N/D = Not determined, N/A = Not applicable

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:
Section 12: information was modified.
Section 15: SARA (311/312) REPORTABLE GHS HAZARD CLASSES information was added.
Section 15: SARA (311/312) REPORTABLE HAZARD CATEGORIES information was deleted.
Section 16: Standard phrases for California Proposition 65 information was modified.

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Internal Use Only

MHC: 0B, 0B, 0, 0, 0, 0 PPEC: A

DGN: 2031524XUS (550332)
