

# **ROTTLER**

## **H86AX CNC HONING MACHINE**

**OPERATION AND MAINTENANCE MANUAL**





# **MANUAL SECTIONS**

**INTRODUCTION**

**INSTALLATION**

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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](mailto:parts@rottlermfg.com)

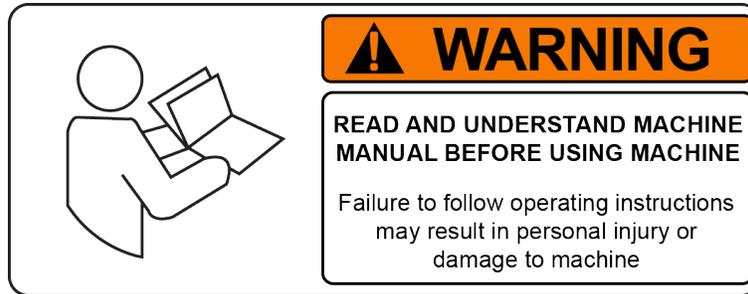
In some cases you may be requested to send a photo of the part you are ordering if it is a replacement part, or doesn't appear in the database.

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



**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 H86AX 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 H86AX 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.

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## Description

The model H86AX Honing Machine is a wet, complete cylinder block and general purpose-honing machine

A Windows based touch screen panel provides easy and convenient control of the H86AX. Block programs can be created and stored to memory for later recall, providing a quick set up for honing common blocks. All preferences such as dwell setting, cross hatch angle, and honing loads are automatically set up when a block program is selected at time of machine set-up.

The support carriage is mounted on linear rails and is powered by a direct drive motors to provide simple and easy hole-to-hole setup.

Convenient devices are provided to properly control honing operations and provide easy handling.

Fixtures are available for doing a large variety of engine types. Special fixtures and tooling for doing large industrial engine sleeves is also available.

A coolant tank is located under the main splash tank and a coolant pump is located behind the machine. A button is provided on the control panel to operate the coolant system.

## Disclaimer

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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 H86AX parts and equipment is warranted as to materials and workmanship. This limited warranty remains in effect for one year from the date of delivery, provided the

machine is owned and operated by the original purchaser and is operated and maintained as per the instructions in the manual.

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

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 Order Department or representative 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 Order 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 written approval from Rottler Corporation Management and/or Shipping Department.

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.

# INSTALLATION

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## **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***



OFFICE USE ONLY  
Route to: Servicer Mgr → Accounting → Andy → Accounting 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 responsibility prior to the arrival of Rottler Sales/Service technician. Please Initial each item when it is completed.**



**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, isolated power supply along with an isolated 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: 2,500 lbs.
- \_\_\_\_\_ Provide solid foundation for machine.
- \_\_\_\_\_ Remove fixturing and misc. from machine and clean.
- \_\_\_\_\_ Install machine on foundation with jack pads under jacking bolts.
- \_\_\_\_\_ Level machine. When level all leveling bolts should have equal pressure on them.
- \_\_\_\_\_ This machine requires between 208 and 240 Volts AC, Three Phase, 50/60 Hz, isolated power supply.



**If this machine is being installed in a location without 3 phase power, follow the single phase wiring hookup shown in this section**

- \_\_\_\_\_ Measure the incoming voltage between L1 and L2, L2 and L3, L1 and L3. Measure the incoming AC voltage at least twice during installation.  
L1 to L2 \_\_\_\_\_ VAC    L2 to L3 \_\_\_\_\_ VAC    L1 to L3 \_\_\_\_\_ VAC  
L1 to L2 \_\_\_\_\_ VAC    L2 to L3 \_\_\_\_\_ VAC    L1 to L3 \_\_\_\_\_ VAC
- \_\_\_\_\_ This machine should have an external breaker rated at 30 Amps, continuous draw.
- \_\_\_\_\_ 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



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.**

\_\_\_\_\_ Briefly describe the isolated ground connection to the machine you have made: (Instructions to make a correct isolated ground are included in the operating manual)

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\_\_\_\_\_ Customer should attempt to have junk work piece available.

\_\_\_\_\_ Make sure coolant will be available for set up.

\_\_\_\_\_ 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.

\_\_\_\_\_ Clean any rust inhibitor from the machine surfaces

\_\_\_\_\_ Make sure that an Internet connection is available at the machine.

### The following is the Rottler Sales/Service technician's responsibility

#### MACHINE START-UP

\_\_\_\_\_ **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.

\_\_\_\_\_ The system is protected by fuses and circuit breakers located in the electrical enclosure. Show customer where they are located and confirm that spare fuses were shipped with machine.

**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.

\_\_\_\_\_ Explain the coolant filtration system and necessity of maintenance to that system.

\_\_\_\_\_ Explain to the customer the injection oiler operation. The timer is controlled by the computer.

\_\_\_\_\_ Show the customer where the reservoir is located and explain what type of oil is required.

\_\_\_\_\_ Turn Main power on at the power switch located on the electrical enclosure.

\_\_\_\_\_ If any of the fuses blow, replace them, then call factory if further assistance is needed.

\_\_\_\_\_ If any of the circuit breakers "trip", reset and call factory for possible trouble shooting.

\_\_\_\_\_ If machine moves out of control, turn power off and contact factory for help in trouble shooting.

\_\_\_\_\_ Install and test the Internet connection to the machine. DO NOT download any updates unless instructed to do so by Rottler.

\_\_\_\_\_ Check oil lines to make sure they are fully primed. On machines with enclosure the back access panel will have to be removed. If oil lines are not fully primed with oil, run the manual priming procedure as described in maintenance section of the manual.

#### MACHINE MOVEMENTS

\_\_\_\_\_ Remove hone head from machine for the following procedures.

\_\_\_\_\_ Verify all machine movements are working correctly using the hand wheel.

\_\_\_\_\_ Verify all machine movements are working correctly using the jog buttons.

\_\_\_\_\_ Start spindle motor to verify correct direction of rotation.

**INSTRUCTING THE OPERATOR:**

**Note: Rottler 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.

\_\_\_\_\_ Explain to the customer and operator that 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.

\_\_\_\_\_ 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.

\_\_\_\_\_ Connect customer supplied Internet to the machine. Verify that the Internet is accessible from the machine.

**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.

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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.

\_\_\_\_\_ 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.

\_\_\_\_\_ If equipped with the auto rotate fixture explain how to set up and operate.

\_\_\_\_\_ Explain selecting correct riser blocks for the block to be honed.

\_\_\_\_\_ Fully explain the entire Auto Cycle.

\_\_\_\_\_ Explain the need to Home the machine each time the hone head is changed or removed and reinstalled on the spindle.

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

\_\_\_\_\_ 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

\_\_\_\_\_ The following is a checklist of information needed prior to setting up a job.

- Finish bore size, cross hatch angle, and finish.
- Bore length.
- Center to center dimension of cylinders.
- If the job is a V type block, the pan rail to crank line center dimension, and cylinder offset between cylinder banks.

\_\_\_\_\_ Demonstrate loading and roll over of V8 block.

\_\_\_\_\_ Demonstrate in-line block clamp system.

\_\_\_\_\_ Explain Optional block hold down arrangements.

\_\_\_\_\_ Supervise the operator loading, cycling and unloading the block.

\_\_\_\_\_ Develop the best block handling system you can for his shop.

\_\_\_\_\_ Consider a block coolant drain area.

\_\_\_\_\_ Examine several V8 blocks at the lower cylinder / bearing cap area and explain to the operator the necessity of setting the lower stop for maximum over stroke.

\_\_\_\_\_ Explain the ABSOLUTE requirement for complete relief below the cylinder, which may include hand grinding.

\_\_\_\_\_ Demonstrate removal and cleaning of cone in hone head.

\_\_\_\_\_ Explain all stone options as well as hone head options.

\_\_\_\_\_ Explain to the operator the methods for the fastest stock removal.

\_\_\_\_\_ Explain the cause and cure of bad geometry and improper stone cutting.

\_\_\_\_\_ Explain "breaking" the stones in.

\_\_\_\_\_ Demonstrate proper stone dressing (refer to manual).

\_\_\_\_\_ Explain the importance of maintaining the proper coolant mix.

\_\_\_\_\_ Explain the importance of keeping the coolant clean.

\_\_\_\_\_ Review the necessity of proper stone to coolant relationship.

\_\_\_\_\_ Again review the operator manual, including all safety and emergency stop procedures.

## **MAINTENANCE SECTION**

\_\_\_\_\_ Review machine lubrication per manual.

\_\_\_\_\_ Review coolant changing.

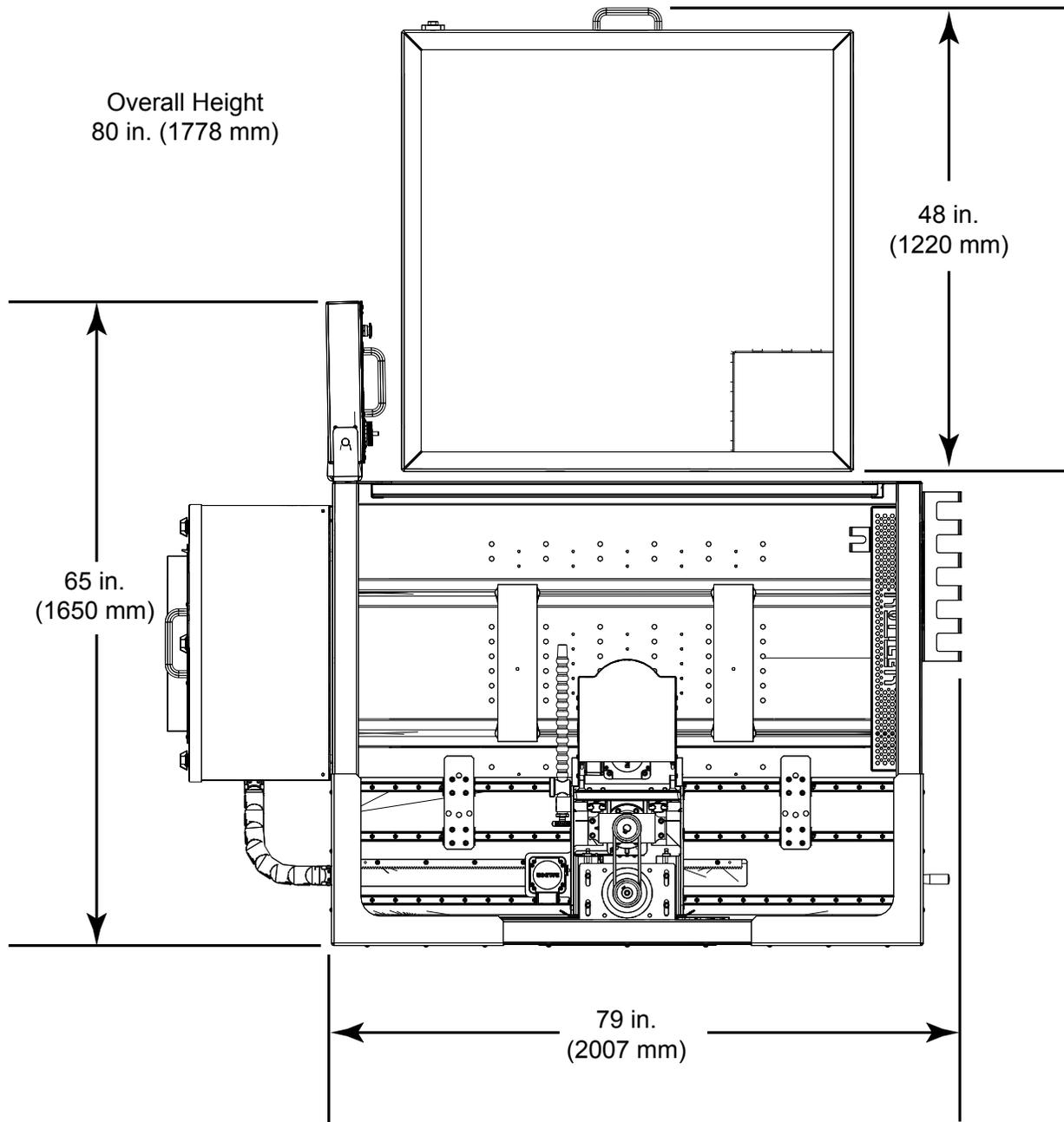
\_\_\_\_\_ Review filter paper changing.

\_\_\_\_\_ Review filling oil reservoir.

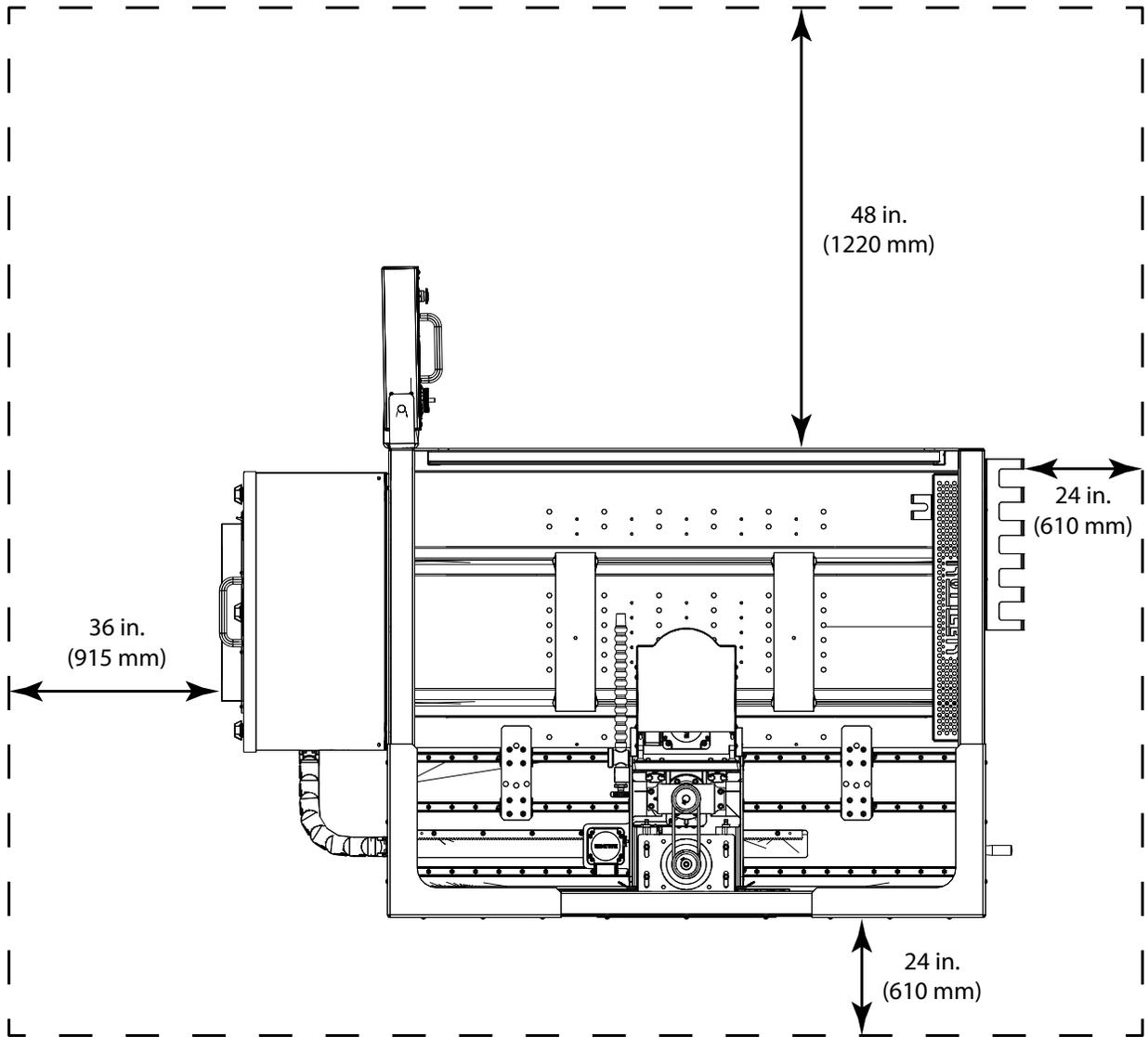


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### Machine Dimensions



### Machine Working Clearances



## Installation Procedure

### Location

The productivity of this machine will depend to a great extent on its proper initial installation, particularly the means by which cylinder blocks are lifted into the machine as well as the material handling to and from other operations in your shop.

The proper loading arrangement and location for your H85A machine is extremely important.

A slow travel (6' to 10' per min.) power hoist, operated from either a bridge crane or a jib crane arrangement works very well. A 1000-lb. hoist is generally adequate for lifting the engine block. An air hoist with speed control makes an ideal method for fast, convenient loading.

If some production honing with this machine is anticipated, and the cylinder blocks are not directly loaded and unloaded from a conveyor, we would recommend considerable attention be given to the crane so that it covers an adequate area to allow the operator to back up and remove cylinder blocks without cluttering up his own area. If two machines are to be operated by one operator, we recommend that the open faces be placed at right angles to each other, with the machines approximately three feet apart.

### Unpacking

Carefully uncrate the H85A Machine. Remove all equipment in splash tank.

Completely clean the machine exposed metal surfaces with solvent. Rust inhibitor is applied to the machine at the time of shipment and must be removed before operating the machine.

### Leveling

Four cap screws and jam nuts are provided with the machine for leveling. Insert the screws from the bottom of the base. Place the jam nuts on top of the threaded hole in the base.

Using a precision level, level the upper table within .002" per foot in both directions (Except favor the high setting to the front for best coolant return).

### Coolant



Refer to the Coolant section in Chapter 5 of this manual for proper coolant types and mixes. Be sure to read the MSDS section of this manual and exercise due caution concerning coolant hazard.

## Power Supply



**Disconnect all power before servicing this machine. Failure to do so could result in electrical shock.**

This machine has the following power requirements:

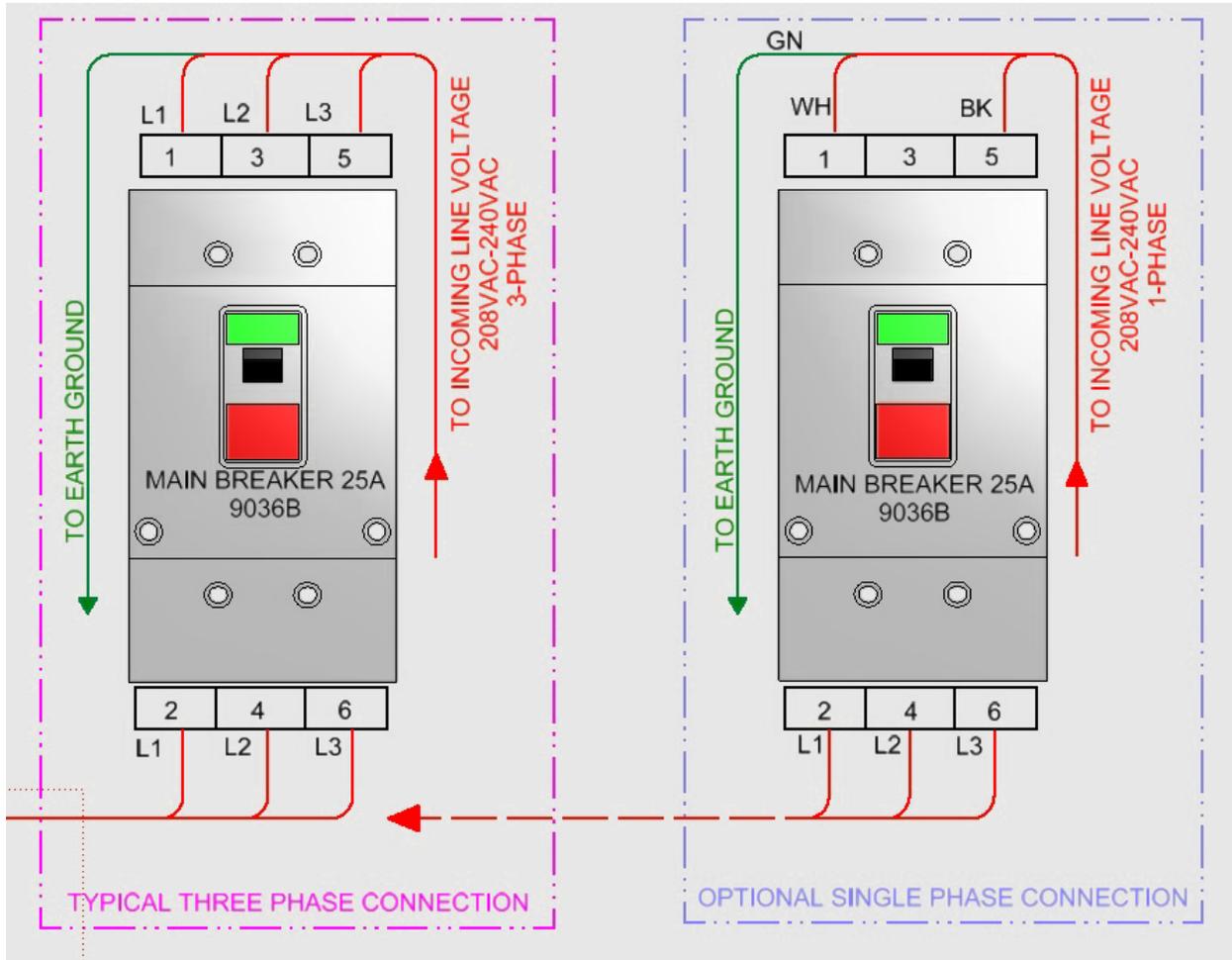
- 208 to 240 VAC
- Three Phase or Single Phase
- 50 or 60 Hertz
- 30 amps

**CAUTION** This machine cannot be run on 440 volts. A transformer must be installed if 440 volts must be used.

See illustration following for correct connection of “measured” incoming power  
See wiring diagram for more details.

### Electrical Hook-up

Incoming lines are attached to the power switch. Incoming supply ground wire goes to the ground block. See electrical diagram for more detail.

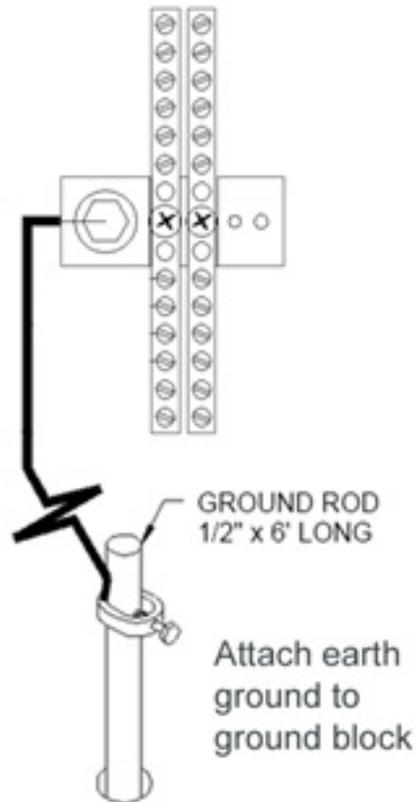


**Grounding**

This machine must be connected to a good earth ground rod. A 6 foot, 1/2" diameter, 15 OHM, Copper grounding rod driven into the earth next to the machines is preferred. **Not providing a grounding rod could void factory warranty.**

**IMPORTANT**

*Wire in accordance with local and national codes.*



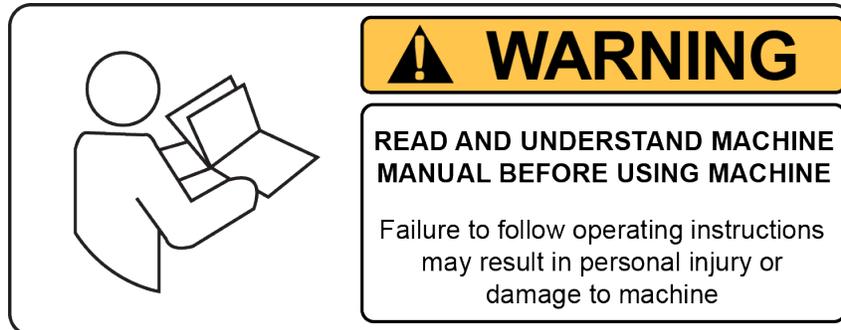
# **SAFETY**

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<b>Electrical Safety Features Of Rottler DM Controlled Machines .....</b>	<b>3-7</b>

## 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.



This machine is capable of causing severe bodily injury.

### Safety Instructions for Machine Use



**KEEP GUARDS IN PLACE** and in proper working order.



**KEEP WORK AREA CLEAN.** Clean spilled coolant from floor to avoid slipping hazard.

**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** 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.

**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.

**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.



**No list of safety guidelines can be complete. Every shop environment 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



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.



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 comply with all local codes and ordinances.

## Machine Operator

Operator of this H86AX Honing machine should be a skilled machinist craftsman: that is well versed in the caution, care, and knowledge required to safely operating a metal cutting tool.

If the operator is not a skilled machinist, the operator must pay strict attention to the operating procedure outlined in this manual, and must get instruction from a qualified machinist in both the productive and safe operation of this H86AX Honing Machine.

Rottler H86AX Honing equipment has the following areas of exposed moving parts that you must train yourself to respect and stay away from when they are in motion:



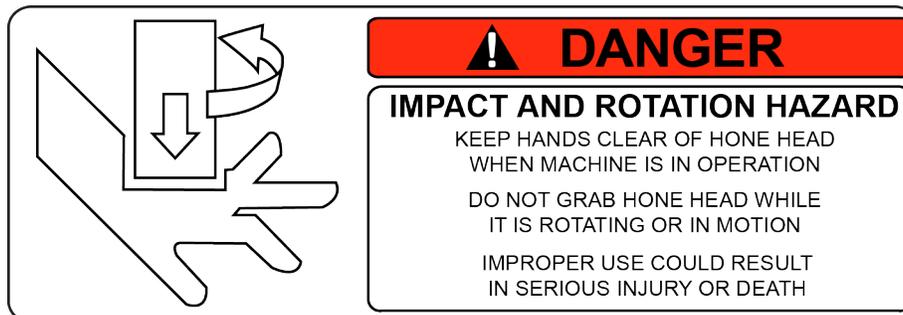
Safety glasses are recommended while machine is running.



**WARNING**

**Work Clamping** - Be sure work is clamped securely in accordance with the instructions.

**Hone Head Area** - Keep hands completely away from the rotating honing head at *ALL* times.

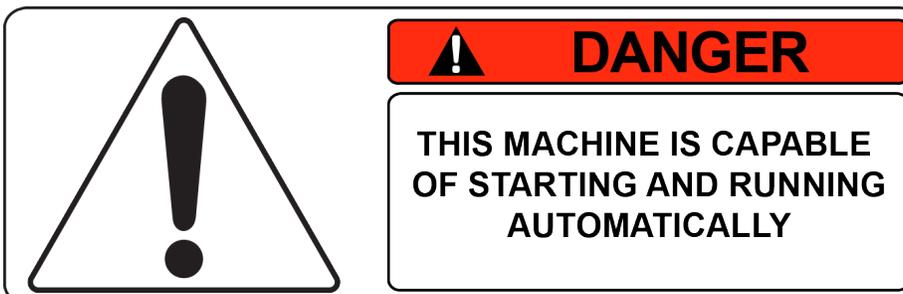


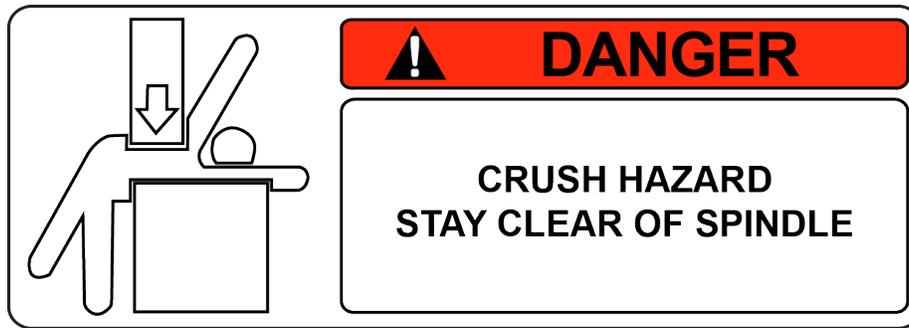
**Honing** - Do not engage rotation power when hone is out of a cylinder.



**CAUTION**

**Operator Controls** - Familiarize yourself with the exact location of the e-stop button so you can immediately react to an emergency.





*Keep clear of spindle when working in tank area. Spindle can drop if there is a failure in the machine. Move spindle out of work area when changing blocks or fixtures.*

## **IMPORTANT**

### **Remember**

Machine 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 World Wide Web 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.

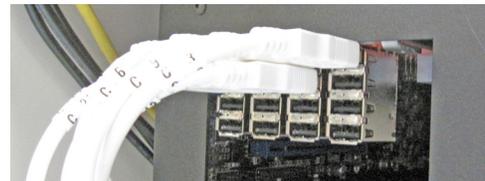
**Any "IT" personnel should ALWAYS get approval from Rottler before doing ANYTHING on the computer.**



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.



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.



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.



**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:

Thermal sensors in all motors and motor controls.

1. Current sensors in all motor control panels.
2. Electrical breakers to prevent voltage surges and spikes from reaching electrical system.
3. Electrical lockout on main electrical enclosure.
4. 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

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## Control Definitions

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

**NOTE:** Not all modes of operation will be discussed in this Section. The function of several buttons and actions are the same in many modes. The description of a function or button operation will not be repeated if it exists in another mode. All modes of operation will be discussed in the Operations Section of this manual.

### 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 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 World Wide Web 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.

## COMMON INTERFACE NOTICE

All Rottler machines using Direct Motion technology share a common control interface. This allows for a better environment for programming machine functions across a wide range of different machines. This also allows for easier deployment in shops already using Rottler Direct Motion machines.

Because of the common interface some machines may have buttons and menu tabs that may not be applicable to the machine that is being used. If the buttons or menu tabs are not mentioned in the control definitions section of the manual, they will not be used in machine operation.

### Definitions of terminology used in this section

**Screen:** This is what appears on the monitor. There are different screens for setting up the machine and to operate it.

**Icon:** A small graphic that is located on the screen. The Icon is used to activate various programs related to machine operation.

**Button:** A small graphic that is located on the screen as part of group of buttons that is used to set up or operate the machine. A button has two different possible functions. One is when it is used as switch. When it is used as switch the button will either be on or off after it has been pressed and must be pressed again to revert to start status. The second is as contact switch. This is also called a momentary contact button. This button is active only while it is being pressed by the operator.

**Click:** This is a method of activating an icon or button using a computer mouse. On a touch screen such as the one that this machine is equipped with you can use your finger tip or a stylus to activate the icon or button.

**Press or Touch:** Use your finger tip to activate a button on the screen.

**Activate:** A way of indicating that button, menu title, or tab has been clicked on or pressed.

**Tab:** A small box located near the top of the screen. A tab will be labeled with the function of a screen that will appear when the tab is clicked or touched.

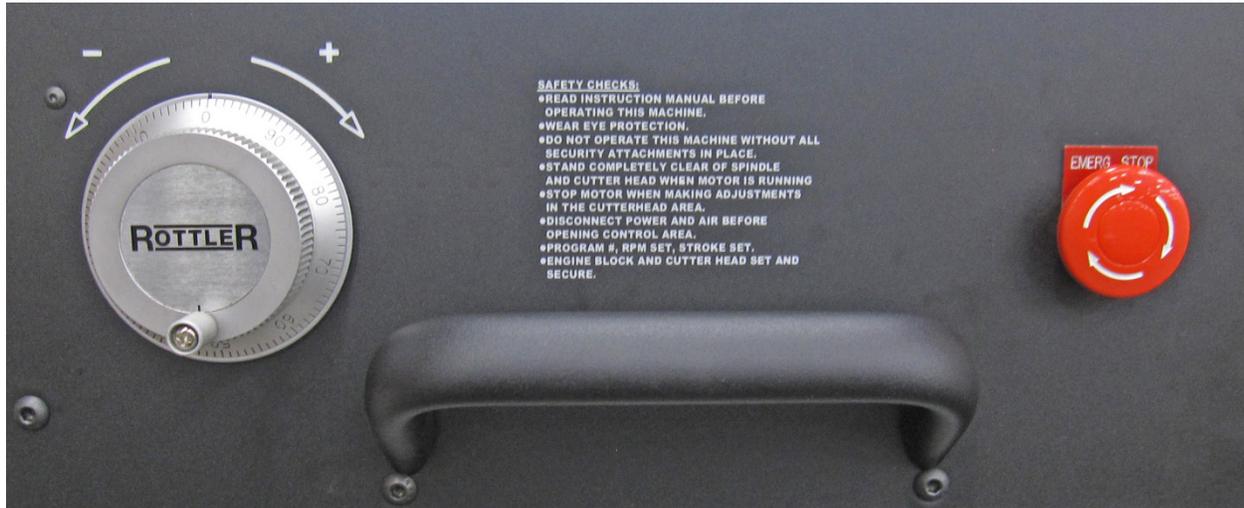
**Value Box:** This is where values that are needed to run a program are entered. Touching a value box will cause a number pad to appear so that the desired value can be input.

**Menu Title:** A one or two word title that describes the contents of a menu. Clicking or touching an Option Title will cause a menu to appear below it.

**Menu:** A box that appears below an Option Title when it is activated. A menu will contain a number of functions that can be activated or deactivated by clicking or pressing the title. Or when activated another menu will open up with more functions that can be activated.

**Pop Up Window:** This is a box that will appear when certain buttons, menu titles, or value boxes are activated. These Pop Up Windows can be warnings, requests for input, or confirmation requests.

## Hand Controls



### E-STOP Switch

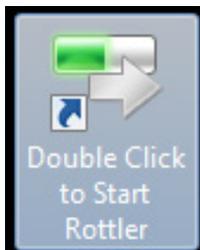
This switch is used in an emergency situation. Pushing the button in will disconnect the power to all the motors that run the machine except the coolant pump motor. The machine will stop dead in place when activated. To restore power to the machine turn the button clockwise until it pops out.

### Handwheel

The handwheel is used to manually move the machine in different directions according to which axis is activated. The handwheel is also used to manually feed the stones in or out.

### Boot Up Screen

This is the screen you will see when first turn on the power.



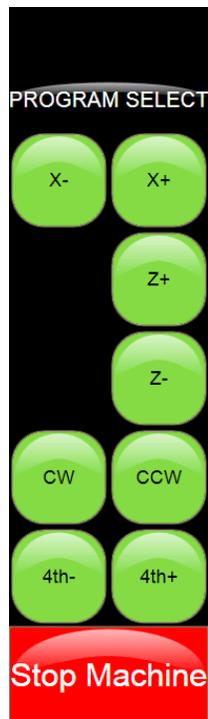
#### Start Icon

Double Click or double press to start the Rottler operating program

## Set Up Screen



### Jog Button Panel



The jog buttons are momentary contact buttons. They activate rapid travel for the axis indicated on the button.

The X- button will move the carriage to the left.  
The X+ button will move the carriage to the right.

The Z+ button will move the spindle up.

The Z- button will move the spindle down.

The CW button will rotate the spindle clockwise.  
The CCW button will rotate the spindle counter clockwise.

The Stop Machine button is used to stop the machine cycle before it has completed. The machine will complete a hone stroke and raise out of the cylinder.



When this icon replaces the Stop Machine button it indicates that the E-STOP switch is engaged and all motions buttons on the screen are disabled. The E-STOP switch must be released before any of the motion buttons on the display screen will respond.

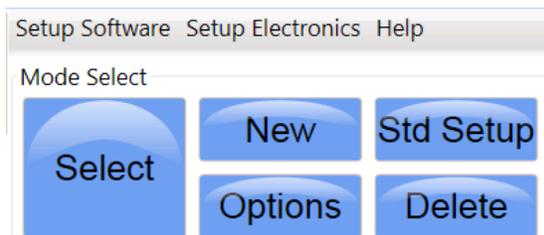
### Program Select Section Buttons



The Home button is use to index the hone head when it is installed on the machine. FIXTURE SELECT, and TABLE OF TOOLS buttons are not used on the H86AX.

The New and Options, buttons are used for creating new engine block profiles that will be saved for later use. The Delete button is used for removing a block profile from the Program Select list.

### Mode Select Sections Buttons and Menus.



Setup Software and Setup Electronics menu titles will open new options menus. These are mostly used for machine setup at the factory or for service. There are 2 options that an operator can select if needed and will be explained further on.

The Help menu title will open the help and instruction files for the machine.

**New Button:** This button is used to bring up a pop up screen where a machining process will be chosen for use. The process will appear below the Mode Select buttons.

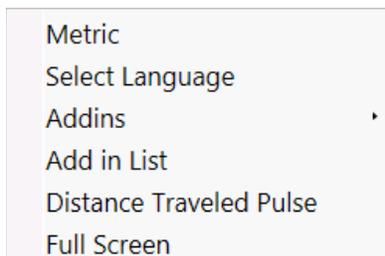
**Std Setup Button:** This button will insert all processes that are available for this machine in the area below the Mode Select buttons.

**Options Button:** This button will bring up a pop screen that will allow the operator to change the name of the process that was highlighted.

**Delete Button:** This button will delete any process that has been highlighted.

**Select Button:** This button will bring up the Operation Screen once a block program and a process have been highlighted.

### Software Setup Menu



This is the menu that appears when the Setup Software title is touched. Here the operator can choose to change to metric display readings by checking the Metric title. Inch display readings can be restored by unchecking the Metric title box.

A different language can be used by touching the Select Language title and choosing for the languages that appear.

## Operation Screen

At the top of the screen you will see the block and process that was selected. In the upper right section there is a readout of current location of the different axis's. **All readings are plus or minus from the zero set points.** ( The A axis readout in this case is the 4<sup>th</sup> axis and will only show a reading if the optional auto rotate fixture is installed )

**Screen Tabs:** When the Setup, Bore Locations, or Operation tab is touched the corresponding screen for that tab will appear. These different screens are used for programming and operation of the machine.

### Handwheel Buttons

At the bottom of the screen are 4 buttons. When a button is touched and activated the operator will be able to control the axis indicated on the button by using the handwheel. The active button will turn red after it is touched.

**Handwheel X Button:** When this button is activated the operator will be able to move the carriage to the right or left using the handwheel. Each notch or click of the handwheel will move the carriage 0.010 of an inch. Turning the handwheel clockwise or to the plus side will cause the carriage to move to the right. Turning the handwheel counter clockwise or to the minus side will cause the carriage to move to the left.

**Handwheel Z Button:** When this button is activated the operator will be able to move the spindle up or down using the handwheel. Each notch or click of the handwheel will move the spindle 0.010 of an inch. Turning the handwheel clockwise or to the plus side will cause the spindle to move up. Turning the handwheel counter clockwise or to the minus side will cause the spindle to move down.

**Handwheel Stones Button:** When this button is activated the operator will be able to feed the stones in or out using the handwheel. Each notch or click will increase or decrease the diameter of the stones by 0.001 of an inch. Turning the handwheel clockwise or to the plus side will cause the stones in increase in

diameter. Turning the handwheel counter clockwise or to the minus side will cause the stones to decrease in size.

### Operation Screen: Setup Tab

#### Set Zeros Buttons

These buttons will set the zero point for each axis that is indicated on the button. When touched a confirmation pop up screen will appear to confirm that the operator wants to set the zero point.

#### Z Stops

This section is where the clearance height for the hone head is set. A value can be entered by touching the value box and keying in the value on the pop up number pad. Or the hone head can be moved to the desired location using the Z Axis jog button or handwheel. When the hone head is in the desired position the operator can touch the set button to enter the value that is in the value box.

#### Cross Hatch Calculator

This section is where the operator will enter values into the appropriate boxes to set up the auto cross hatch function. After the values have been entered the operator will press the Calc button to determine the proper RPM to achieve the desired cross hatch angle.

#### Stones Load Setup

This is the section where the operator will enter the desired running loads for different processes. Values are entered by touching the proper value box and entering the desired value on the number pad that appears. The operator will also indicate which hone head will be used for the job.

**Stroke Setup**

This is the section where the operator will enter information to determine how far the spindle will travel while it is stroking up and down. The bottom value box is where the number of strokes to be used in the plateau mode is entered.

**Operation Screen: Bore Locations Tab**



This is the screen where the operator will enter the values for center to center bore dimensions. This will enable the machine to move automatically from bore to bore. Move 1 value will be 0.000 since this is the start point for the honing process. Each succeeding value box will add the center to center bore dimension to the previous value.

**Move Buttons**

If the operator touches one of the Move buttons the carriage will move to the position that is entered in the value box below the button.

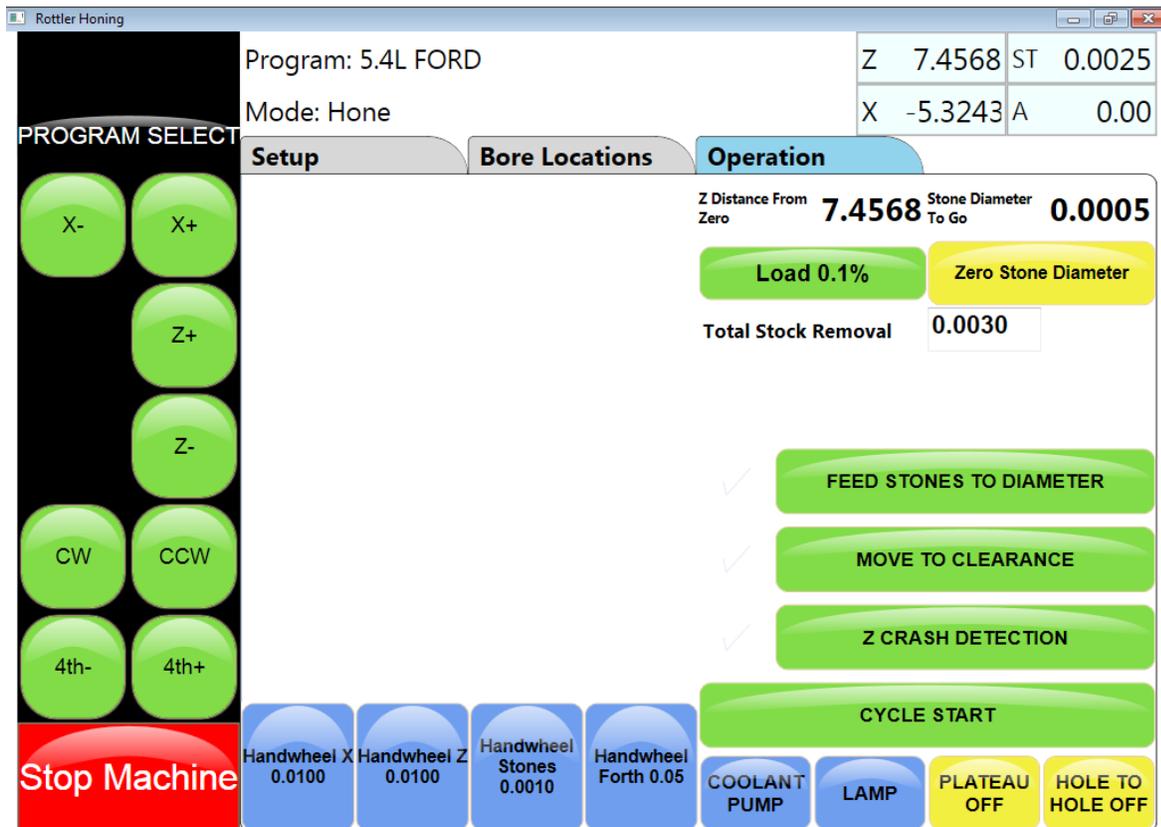
**Hone Buttons**

These buttons are used to determine if that cylinder will be honed during the auto honing process. When touched the button will turn yellow and indicated that the cylinder will not be honed during the auto honing process. Individual buttons can be deactivated if the operator wants to bypass honing a specific cylinder during the auto honing process.

**Left and Right Locations Tabs**

If a V Block is to be honed then it will be necessary to enter values for the right side bank after touching the Right Locations tab to bring up the screen. The values will be different than for the left side since there will be a need to account for the cylinder offset from bank to bank. This will be covered fully in the Operations Section.

## Operation Screen: Operation Tab



This is the screen where the honing operation will be run from. At the top under the Operation Tab are 2 readouts. The first is Z Distance From Zero. This reading shows the location of the spindle from the zero point. The second is Stone Diameter To Go. This readout shows how much the stones must still feed out to reach the Total Stock Removal setting.

### Load Reading Button

This is a non-functional button. This is where the spindle motor load reading is displayed. The button color will change as load increases. Green indicates that the motor load is in its optimal area. Yellow indicates that the motor load is slightly high. Red indicates that the motor load is excessive.

### Zero Stone Diameter Button

This button is used to set the zero setting for the stone diameter.

### Total Stock Removal Value Box

This is where the operator will enter a value for the amount of stock to be removed from a cylinder.

## Operation Buttons

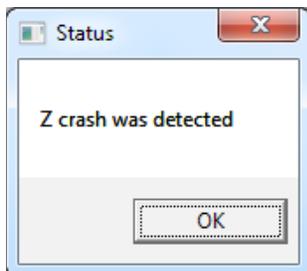


### FEED STONES TO DIAMETER Button

When this button is active touching it will cause the spindle motor to start and the stones to feed out until the finish load setting is reached. When that occurs the spindle motor will shut off. This is the zero point for the stone diameter. The operator will touch the Zero Stone Diameter button to set the zero point for the stones. This button is active only if the check mark is visible next to the button. The check can be turned on or off by touching the check mark box.

### Z CRASH DETECTION Button

When this button is active the machine will automatically detect and interference points that will come in contact with the bottom of the stones. When auto cycle is started the machine will run a test to determine if there is any interference points on each cylinder before honing begins. If an interference point is detected the machine will stop. When the machine is moving from cylinder to cylinder the machine will detect if the stones are not properly entering the bore and stop before damage can occur.



If there is an occurrence of an interference point being detected the machine will stop and a pop up screen will appear on the screen.

### CYCLE START Button

This is the button that is touched to begin the auto honing cycle process. The machine will complete the entire process of honing all the cylinders that have been tagged to hone. The machine can be stopped mid cycle by touching the Stop Machine button. If an emergency arises or if the screen does not respond to touch commands the E-STOP can be used to stop the machine.

**COOLANT PUMP and LAMP BUTTONS**

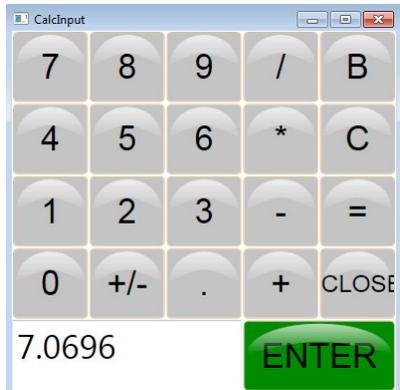
These buttons turn the coolant pump and lamps on or off. When they are on they will be red in color. The coolant pump and lamps have an independent power supply and will work even if the E-STOP is engaged.

**PLATEAU Button**

This button will turn the Plateau mode on or off. When it is on the button will turn red and the numbers of strokes to be used for the process is displayed on the button.

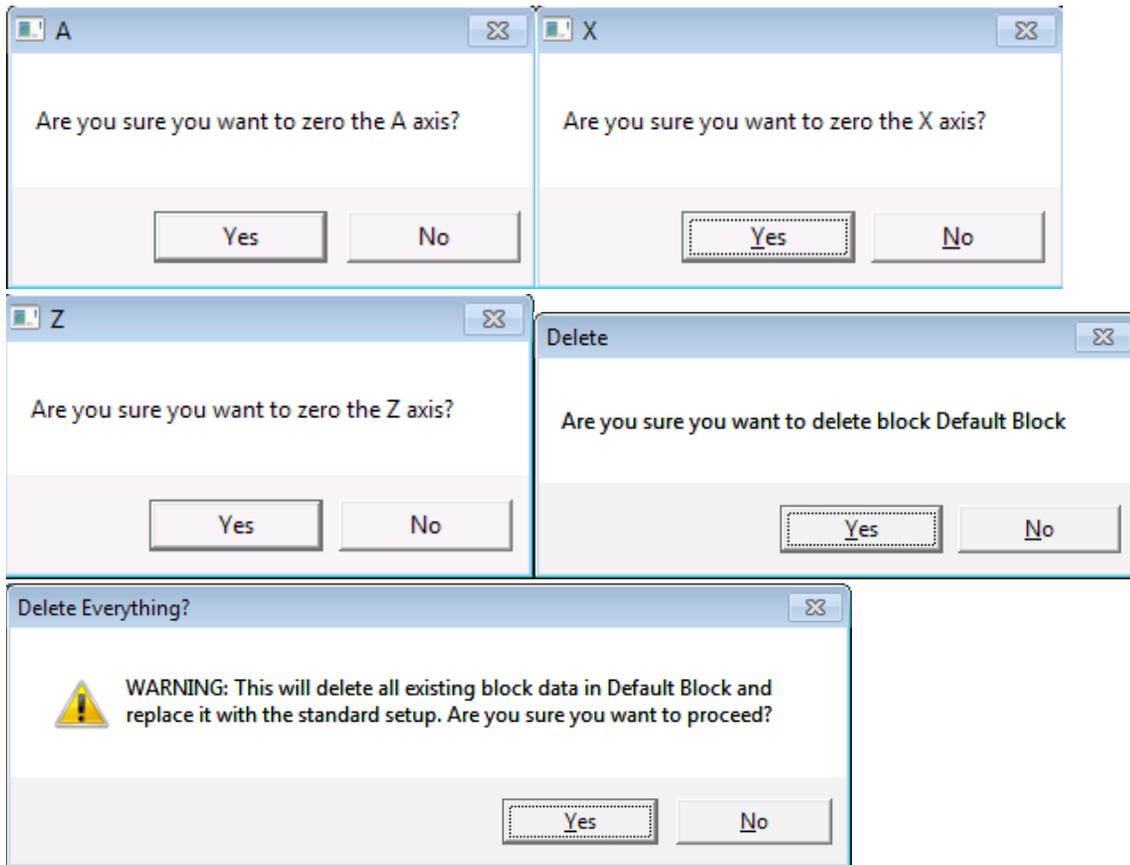
**HOLE TO HOLE Button**

This button will turn on the automatic hole to hole honing process. When the button is red and ON is displayed the machine will automatically move to each hole in the programmed process that is engaged by touching the CYCLE START button. When button is yellow and OFF is displayed on the button only the cylinder that is aligned with the stones will be honed.

**Pop Up Windows and Menus****Number Pad**

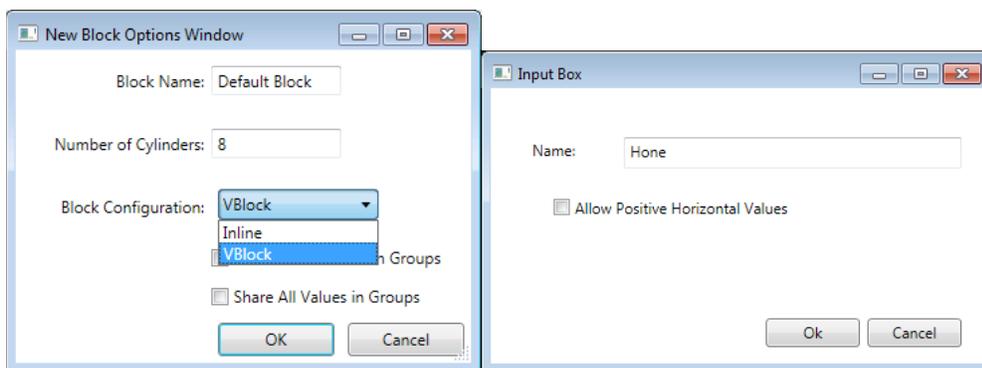
This window will pop up when the operator touches a value box. The operator will input the value desired and then touch ENTER to place the value in the value box.

### Conformation Windows

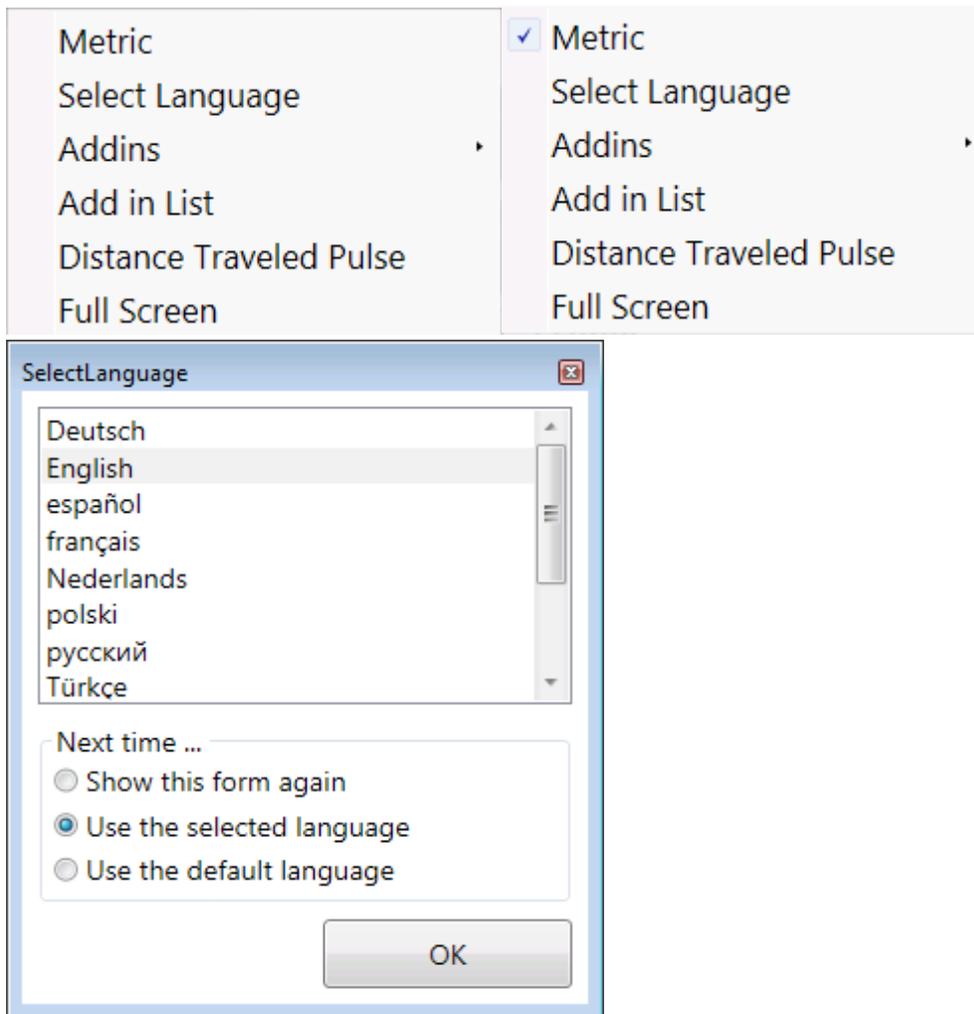


These windows will pop up to confirm that the operator wants complete an action.

### Change and Choose Windows

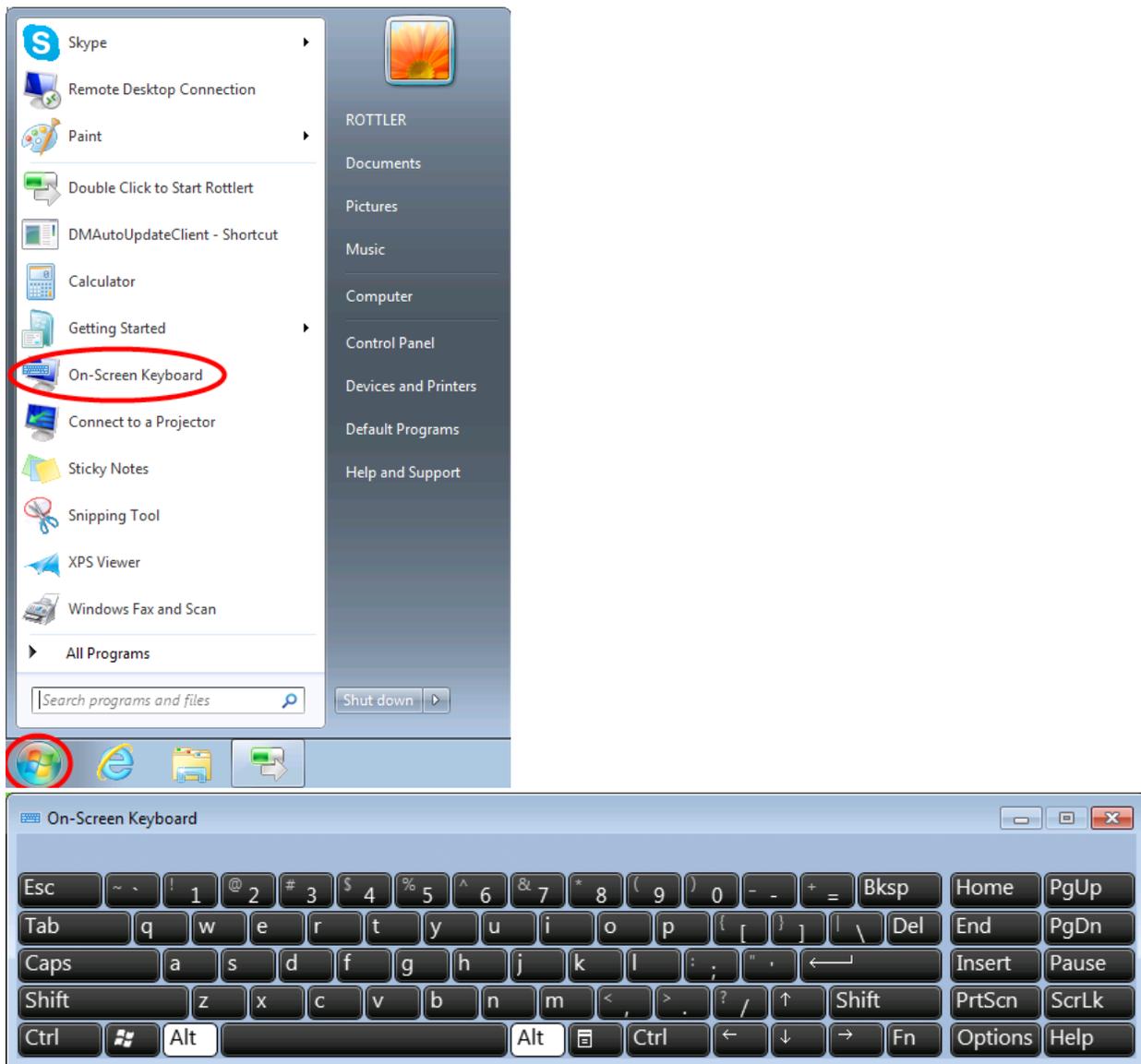


These windows will pop up when the operator wants to enter or change information.

**Software Set Menus**

These menus are for selecting the metric screen readouts and language.

## On Screen Keyboard



If a keyboard is not attached the machine an on screen keyboard can be used.  
To access the on screen keyboard touch the Start button and then touch the On-Screen Keyboard Icon.

**STONE HOLDER SIZE CHART H86AX****MEDIUM HONE HEAD**

Diameter (New Stones)

	0.312 Stones		0.200 Stones	
	Min	Max	Min	Max
514-10-13A	2.34	2.45	2.12	2.23
514-10-13F	2.44	2.55	2.22	2.33
514-10-13B	2.54	2.65	2.32	2.43
514-10-13G	2.64	2.75	2.42	2.53
514-10-13C	2.74	2.85	2.52	2.63
514-10-13H	2.84	2.95	2.62	2.73
514-10-13D	2.94	3.05	2.72	2.83

Diameter (New Stones) (Metric)

	7.925 Stones		5.08 Stones	
	Min	Max	Min	Max
514-10-13A	59.44	62.23	53.75	56.54
514-10-13F	61.98	64.77	56.29	59.08
514-10-13B	64.52	67.31	58.83	61.62
514-10-13G	67.06	69.85	61.37	64.16
514-10-13C	69.60	72.39	63.91	66.70
514-10-13H	72.14	74.93	66.45	69.24
514-10-13D	74.68	77.47	68.99	71.78

Diameter (New Brushes )

	0.550 Brushes		0.395 Brushes	
	Min	Max	Min	Max
514-10-13A	2.82	2.93	2.51	2.62
514-10-13F	2.92	3.03	2.61	2.72
514-10-13B	3.02	3.13	2.71	2.82
514-10-13G	3.12	3.23	2.81	2.92
514-10-13C	3.22	3.33	2.91	3.02
514-10-13H	3.32	3.43	3.01	3.12
514-10-13D	3.42	3.53	3.11	3.22

Diameter (New Brushes) (Metric)

	13.970 Brushes		10.033 Brushes	
	Min	Max	Min	Max
514-10-13A	71.53	74.32	63.65	66.45
514-10-13F	74.07	76.86	66.19	68.99
514-10-13B	76.61	79.40	68.73	71.53
514-10-13G	79.15	81.94	71.27	74.07
514-10-13C	81.69	84.48	73.81	76.61
514-10-13H	84.23	87.02	76.35	79.15
514-10-13D	86.77	89.56	78.89	81.69

**LARGE HONE HEAD**

Diameter (New Stones)

	0.312 Stones		0.200 Stones	
	Min	Max	Min	Max
514-9-5J	2.99	3.45	2.77	3.23
514-9-5A	3.17	3.63	2.94	3.41
514-9-5B	3.42	3.88	3.19	3.66
514-9-5C	3.67	4.13	3.44	3.91
514-9-5D	3.92	4.38	3.69	4.16
514-9-5E	4.17	4.63	3.94	4.41
514-9-5F	4.42	4.88	4.19	4.66
514-9-5G	4.67	5.13	4.44	4.91
514-9-5H	4.92	5.38	4.69	5.16
514-9-5K	5.17	5.63	4.94	5.41
514-9-5L	5.42	5.88	5.19	5.66
514-9-5M	5.67	6.13	5.44	5.91
514-9-5N	5.92	6.38	5.69	6.16
514-9-5P	6.17	6.63	5.94	6.41
514-9-5Q	6.42	6.88	6.19	6.66
514-9-5R	6.67	7.13	6.44	6.91
514-9-5S	6.92	7.38	6.69	7.16

Diameter (New Stones) (Metric)

	7.925 Stones		5.08 Stones	
	Min	Max	Min	Max
514-9-5J	75.92	87.73	70.23	82.04
514-9-5A	80.39	92.20	74.70	86.51
514-9-5B	86.74	98.55	81.05	92.86
514-9-5C	93.09	104.90	87.40	99.21
514-9-5D	99.44	111.25	93.75	105.56
514-9-5E	105.79	117.60	100.10	111.91
514-9-5F	112.14	123.95	106.45	118.26
514-9-5G	118.49	130.30	112.80	124.61
514-9-5H	124.84	136.65	119.15	130.96
514-9-5K	131.19	143.00	125.50	137.31
514-9-5L	137.54	149.35	131.85	143.66
514-9-5M	143.89	155.70	138.20	150.01
514-9-5N	150.24	162.05	144.55	156.36
514-9-5P	156.59	168.40	150.90	162.71
514-9-5Q	162.94	174.75	157.25	169.06
514-9-5R	169.29	181.10	163.60	175.41
514-9-5S	175.64	187.45	169.95	181.76

Diameter (New Brushes )

	0.550 Brushes		0.395 Brushes	
	Min	Max	Min	Max
514-9-5J	3.47	3.93	3.16	3.62
514-9-5A	3.64	4.11	3.33	3.80
514-9-5B	3.89	4.36	3.58	4.05
514-9-5C	4.14	4.61	3.83	4.30
514-9-5D	4.39	4.86	4.08	4.55
514-9-5E	4.64	5.11	4.33	4.80
514-9-5F	4.89	5.36	4.58	5.05
514-9-5G	5.14	5.61	4.83	5.30
514-9-5H	5.39	5.86	5.08	5.55
514-9-5K	5.64	6.11	5.33	5.80
514-9-5L	5.89	6.36	5.58	6.05
514-9-5M	6.14	6.61	5.83	6.30
514-9-5N	6.39	6.86	6.08	6.55
514-9-5P	6.64	7.11	6.33	6.80
514-9-5Q	6.89	7.36	6.58	7.05
514-9-5R	7.14	7.61	6.83	7.30
514-9-5S	7.39	7.86	7.08	7.55

Diameter (New Brushes) (Metric)

	13.970 Brushes		10.033 Brushes	
	Min	Max	Min	Max
514-9-5J	88.01	99.82	80.14	91.95
514-9-5A	92.48	104.29	84.61	96.42
514-9-5B	98.83	110.64	90.96	102.77
514-9-5C	105.18	116.99	97.31	109.12
514-9-5D	111.53	123.34	103.66	115.47
514-9-5E	117.88	129.69	110.01	121.82
514-9-5F	124.23	136.04	116.36	128.17
514-9-5G	130.58	142.39	122.71	134.52
514-9-5H	136.93	148.74	129.06	140.87
514-9-5K	143.28	155.09	135.41	147.22
514-9-5L	149.63	161.44	141.76	153.57
514-9-5M	155.98	167.79	148.11	159.92
514-9-5N	162.33	174.14	154.46	166.27
514-9-5P	168.68	180.49	160.81	172.62
514-9-5Q	175.03	186.84	167.16	178.97
514-9-5R	181.38	193.19	173.51	185.32
514-9-5S	187.73	199.54	179.86	191.67

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# OPERATING INSTRUCTIONS

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## Honing In General

The H86AX is capable of honing a cylinder very accurately with very little or no work from the operator. The goal of the operator should be to create or choose a block program for the engine being honed. And select the proper hone head, stone holders, and stone set that will allow the machine to hone the cylinder to size with the correct finish.

While the H86AX is running, the screen will show a representation of the hone head traveling up and down in the cylinder. Along the sides will be a line that represents the cylinder wall. While the machine is honing those lines will approximate the shape of the cylinder. If a section of the cylinder is tight then the lines will move toward the hone head. When the tight area exceeds a predetermined amount a red mark will appear in the area and the machine will dwell or short stroke in that area to remove the tight spot.

The H86AX uses a two-step process when a cylinder is honed. When the cycle is started the machine will run a high pressure roughing load that will allow for quick stock removal. When the cylinder is near finish size the machine will automatically switch to a finish mode that lowers the pressure to allow for truing of bore geometry and final sizing.

## Large Amount of Material Removal

When you have large amounts of material to remove from a cylinder (.005 and up) the following steps should be used to maintain size control.

For stock removal of .010 or more it is best to use a two step process. Start with 80 grit stones, (.004" removal per minute) use the Rough Hone process and bring all cylinders to within .005" of the final size. Switch to stones that will leave you the desired RA value and remove the final amount of material using the Finish Hone process.

When there is less that .010" to remove start with 270 grit stones and bring cylinders to within .002" of final size using the Rough Hone process. Switch to stones that will leave you the desired RA value and remove the final amount of material using the Finish Hone process. You can also use the 270 grit stones and bring the cylinder to final size. Then install finishing stones and activate the PLATEAU operation to bring the cylinder to your desired RA value.

## Common Surface Finishes

Today's modern engines are demanding smoother and more precise surface finishes. There are two commonly used plateau surface finishes in automotive engine cylinder bore finishing today. They are both described below. The single step, non-plateau finish is no longer recommended for engine cylinder bores. The processes described below are commonly used in the engine building industry. If the engine or ring manufacturer recommends a particular finish the engine manufacturers specifications or ring manufactures recommendation should be followed.

### Non-Plateau

The typical Ra finishes used for a Non-Plateau finish should be in the 16-24 range. A 16-24 Ra finish leaves adequate peaks to be knocked off during the engine break in period yet is not so rough as to cause oil burning problems before the cylinder walls have been plateaued by the rings. During initial start up of the engine the rings will create the plateau by knocking off the peaks of a non-plateau finish. Most modern ring manufacturers do not recommend using this type of finish.

**Plateau**

Plateau surface finishes are required to meet the demands of the modern engine designs and emissions whether the engine is a standard automotive engine or a performance engine. With today's ring specifications becoming much more defined the honing operation must be very precise to meet those specifications. Also the use of a surface measuring device able to measure the details of a plateau finish has become more important. These devices that enable you to measure RpK, RK, Rvk and the Mr1 and MR2 are readily available and reasonable in costs. Rottler has these devices and has done a tremendous amount of testing to determine the proper process to use in order to obtain the plateau finishes required by ring manufacturers. Today's ring manufacturers' specify the desired surface finishes more by applications than by ring materials. Therefore we have developed the following procedures for the following finishes required.

Blown and Turbo Charged applications:

RpK 8-14  
Rk 30-40  
Rvk 50+

Nascar and Prostock applications:

RpK 4-6  
Rk 18-22  
RvK 28-32

Performance Street and Track (longer life):

RpK 8-10  
Rk 25-30  
RvK 35-40

The plateau finish has become very popular. One of its purposes is to minimize the break-in or ring seating period. A plateau finish involves the use of a roughing abrasive to obtain the Rvk parameters followed by a finer grit finishing abrasive to obtain the proper RpK value. When the finishing abrasive is used, only a few strokes are required to create the plateau. If you were to continue honing with the fine abrasive you would eliminate the plateau effect and create a simple non-plateau finish equal in roughness to the finish abrasive.

***Plateau Caution***

In the past in order to obtain a good plateau finish and eliminate the torn and fragment metal left behind from the diamond abrasive you would use a three step process where you would use rough abrasive for base finish followed by a fine abrasive for the plateau effect then follow that up with plateau brush to remove torn and fragmented material from surface. When you use the plateau brushes you should never use more than 6 strokes. More honing time with plateau brushes will cause glazed cylinder walls!

## **New Method for Plateau Honing**

The new method to plateau honing uses a cubic boron nitride abrasive or what is known as CBN. This is a very sharp abrasive that cuts very cleanly and does not tear and fragment the surface of cylinder. This allows operator to eliminate the plateau brush step. We will define both processes for the customers still using fine diamond abrasive to plateau.

### **Method 1: 2 Step Using CBN Stones**

Common applications for general duty and performance and track applications. This application can use both cast iron rings and moly rings. We must further define this honing process by the hardness of material being honed. So as a rule standard OEM blocks use a softer cast iron than performance blocks and aftermarket cylinder sleeves. For this discussion we will use the terms OEM blocks and Dart blocks/ Darton Sleeves.

### **OEM Blocks And Other Standard Duty Applications**

#### **Step One:**

Use part number 514-9-14J (270/325 grit) Diamond abrasive. Use the Hone process with a roughing load of 50% and a finish load of 40%. Hone the cylinder to size. If you experience out of roundness in OE blocks due to cylinder wall thickness variations reduce the roughing load to 40% and the finish load to 30%.

#### **Step Two:**

Use part number 514-9-35B (600 grit) CBN abrasive for 4 strokes at 15% load. When plateau honing with fine abrasive, slow the rpm down to 80 rpm. The H85 machine will adjust the stroke speed to maintain the proper cross hatch angle during this process. Typical cross hatch angles range from 38 to 45 degrees included angle. The H85 has a ball screw for vertical stroke and is very accurate when setting cross hatch angles.

### **Dart Blocks And Darton Sleeves**

#### **Step One:**

Because these blocks are harder you will need to use a rougher abrasive for the base finish, part number 514-9-14K (170/200 grit) to maintain a high enough initial RvK number to allow for some drop in the RvK number when following with fine abrasive. Use 50% roughing load and 40% finishing load to size. Reduce load setting if there is a problem with maintaining proper bore geometry.

#### **Step Two:**

Use part number 514-9-35B (600 grit) CBN abrasive for 4 to 6 strokes at 15% load. When plateau honing with fine abrasive slow the RPM down to 80 rpm.

### **Method 2: 3 Step Using Plateau Brushes**

### **OEM Blocks And Other Standard Duty Applications**

#### **Step 1:**

Start with part number 514-9-14J (270/325 grit) Diamond abrasive and hone to size with roughing load of 50% and finish load of 40% unless cylinders become out of round then use 40% roughing and 30% finishing.

#### **Step 2:**

Use part number 514-9-14L (550 grit) diamond abrasive as the second step of a three step process by using plateau mode at 15% load and 80 rpm for 4 strokes.

Step 3:

Use part number 514-9-14H plateau brushes for 3 strokes at 15% load in the plateau mode at 80 rpm.

### **Dart Blocks And Darton Sleeves**

Step 1:

Start by using part number 514-9-14K (170/200 grit) and honing cylinder bore to size with 50% roughing load and 40% finishing load. Reduce load setting if there is a problem with maintaining proper bore geometry.

Step 2:

Next step is to follow-up in the plateau mode with a part number 514-9-14L (550 grit) diamond abrasive at 15% load for 4 strokes at 80 rpm.

Step3:

Final step is to use 514-9-14H plateau brushes at 15% load for 4 strokes at 80 rpm.

### **OEM Engines That Are Force Induction Race Applications Or Nitrous Powered**

#### **Method 1: 2 Step Using CBN Stones**

Step 1:

Start by honing the cylinders with part number 514-9-14K (170/200 grit) Diamond abrasive to size. Roughing load should be set at 50% and finish load at 40% unless cylinder become out of round. Then drop to 40% roughing and 30% finishing load. In this application most piston ring manufacturers want RvKs in the +50 category.

Step 2:

Use part number 514-9-35B (600 grit) CBN abrasive with a load of 15% for 4 to 6 strokes at 80 rpm.

### **Dart Blocks And Darton Sleeves That Are Force Induction Race Applications Or Nitrous Powered**

Step 1:

Start with part number 514-9-14W (140/170 grit) diamond abrasive and hone to size at 50% rough load and 40% finish load.

Step 2:

Follow -up with part number 514-9-35B (600 grit) CBN abrasive with load pressure of 15% with rpm of 80 for 4 to 6 strokes.

### **Oem Engines That Are Force Induction Race Applications Or Nitrous Powered**

#### **Method 2: 3 Step Using Plateau Brushes**

Step 1:

Start with part number 514-9-14K (170/200 grit) diamond abrasive and hone to size at 50% roughing load and 40% finishing load. Reduce load setting if there is a problem with maintaining proper bore geometry.

Step 2:

Follow-up with part number 514-9-14L (550 grit) diamond abrasive in the plateau mode at 15% load for 4 strokes at 80 rpm.

**Step 3:**

Continue with part number 514-9-14H plateau brush in plateau mode at 15% load for 4 strokes at 80 rpm.

**Method 1: 2 Step Using CBN Stones****Nascar/Prostock Applications****Step 1:**

In this form of racing only high performance materials are used so there is no need to discuss OE blocks. Start by honing block to size with part number 514-9-14J (270/325 grit) Diamond abrasive at rough load of 50% and finish load of 40%.

**Step 2:**

Follow-up by using part number 514-9-21G (800 grit) Diamond abrasive for 4 to 6 strokes at 15% load with rpm of 80.

**Special Procedure for Subaru Blocks****Step 1:**

Using 514-9-32E 80 grit stones, remove stock until .002" from finish size. Use 45% for the rough load and 35% for the finish load.

**Step 2:**

Hone to final size using 514-9-32E 325/400 grit stones using 45% for the rough load and 35% for the finish load.

**Step 3:**

Use 514-9-21H 1000 grit stones in plateau mode at 80 RPM and load set at 20% for 2 - 3 strokes.

**Step 4:**

Use 514-9-14H bushes in plateau mode at 80 RPM and the load set at 20% for 4 strokes.

**Single Step Honing Process**

There is still a call for a simple one step process where you may use one grit size abrasive and follow up with a plateau brush for a few strokes. Typically this is done with part number 514-9-14E (325/400 grit) diamond abrasive to size. Use 50% roughing load and 40% finishing load followed by 4 to 6 strokes in the plateau mode at 15% load with part number 514-9-14H plateau brushes. This won't allow for much plateau or RvK, but it does produce a 18 to 24 Ra finish.

### Using Vitrified Abrasives

Abrasive grades are available for most any finish you want to achieve. Two or three bond hardnesses are available with most grits. The right bond hardness will break down gradually depending on the grit used. Too soft a bond will lose abrasive excessively. Too hard a bond will chatter and start glazing the bore, with rapid heating and poor stock removal.

Finer grit stones generally break down much faster than coarse grit does. They must break down quickly to prevent the stone from loading or glazing.

Bond hardness will act differently with different cutting oils. Rottler abrasives were designed to be used with Rottler honing oils or equivalent. In general, Rottler honing oil is of low Sulfur content. Using other honing oils may have an adverse effect on the abrasive performance. Faster spindle rotation and light pressures will make abrasive act harder. Faster stroke speed and heavy pressures will make abrasive act softer.

Abrasive should wear relatively evenly and parallel to the shim support. If you encounter uneven abrasive wear, the cause may be damaged universal drive joint, unmatched stones, or misalignment of hone drive with cylinder bore.

Standard Vitrified abrasives can not be used in synthetic or water base coolants.

Generally, lighter honing pressures are required when using vitrified stones compared with diamond stones. The finer the grit the lighter the load should be as follows.

- 80 Grit40 – 60%
- 180 Grit40 – 60%
- 220 Grit30 – 50%
- 320 Grit20 – 40%
- 400 Grit10 – 30%
- 600 Grit05 – 25%

See Options section in the manual for list of available abrasives.

## Using Diamond Abrasives

### General

In the proper application, diamond abrasives are very effective for cylinder honing. The Rottler Precision Hone Head brings the cost of diamond honing down to a range that is much more affordable. Competitive hone heads require the purchase of multiple hone heads to cover the same size range as the Precision Head. The Rottler system is approximately 1/5 the cost.

Because of the long life of diamond abrasives the cost per hole of diamond abrasives is approximately 1/5 of the vitrified abrasives.

Diamond abrasives in combination with the Rottler Precision Honing Head make a very rigid honing head. The system will do an excellent job of truing tapered or out of round holes with little or no operator attention. An operator can set the roughing and finishing loads and expect the machine to hone the cylinder to size unattended with little or no attention. It is important to use proper stone pressure when using diamond abrasives. The roughing motor load setting should be in the 0 - 60% range. The finishing load should be set in the 15 – 25% area. Generally, the higher the roughing motor load reading the faster the stock removal. The lower the finishing load is set, the more accurate the bore will be.

### Using CBN Abrasives

Another type of Abrasive is known as CBN or Cubic Boron Nitride. This is a very sharp abrasive unlike diamond which is relatively dull but very tough abrasive. The CBN abrasive is a very clean cutting abrasive and doesn't leave the torn and fragmented metal in cylinder that diamond will leave. CBN is so sharp that it compares to standard abrasives for cutting action but has the life of diamond abrasive. CBN won't last quite as long as diamond or cut as fast so as a rule you would normally use diamond to do most of the work of stock removal followed by CBN to remove the torn and fragmented metal for a better surface for ring sealing. If plateau finishes are required we suggest using diamond to hone to size in the aforementioned grit sizes followed by a CBN abrasive. If you are only doing a one grit finish then we suggest again honing with diamond to within .0005 to .001 and then following up with a CBN abrasive in that same grit size. Typically for a finish like this we would recommend a 400 grit CBN abrasive.

The H86AX is capable of removing an unlimited amount of material from a cylinder with a high degree of accuracy. Generally, it is desirable for overall engine block geometry to use a boring machine to bore all material out except for .003 of hone stock.

It is important to use Rottler Synthetic Coolant, part number 514-4-71C, when using diamond stones. It must be mixed with water and maintained properly to give optimum honing results.

Note: When mounting new stones in holders it is recommended that you flat stone the back of the stones to remove any possibility of burrs causing misalignment of stones mounted in holders.

### Scratching

Scratching in the cylinder looks as though a single grit of a larger abrasive particle has lodged between the cylinder wall and the hone head. Often the scratch will be less than one revolution of the hone head and it will follow the cross hatch angle of the honing machine. Several things can cause this problem.

#### ***Improper coolant mix***

The ratio of water to synthetic additive to water will change after the initial mix is put in the coolant tank. A Refractometer can be purchased to accurately check the ratio. When the ratio is measured as a percentage it should be 5 – 8%. This corresponds to a reading of 3-5 on the Refractometer. It is important not to confuse the percentage with the true Refractometer reading.

#### ***Unacceptable synthetic coolant brand***

#### ***Lack of abrasive dressing***

#### ***Dirty Coolant***

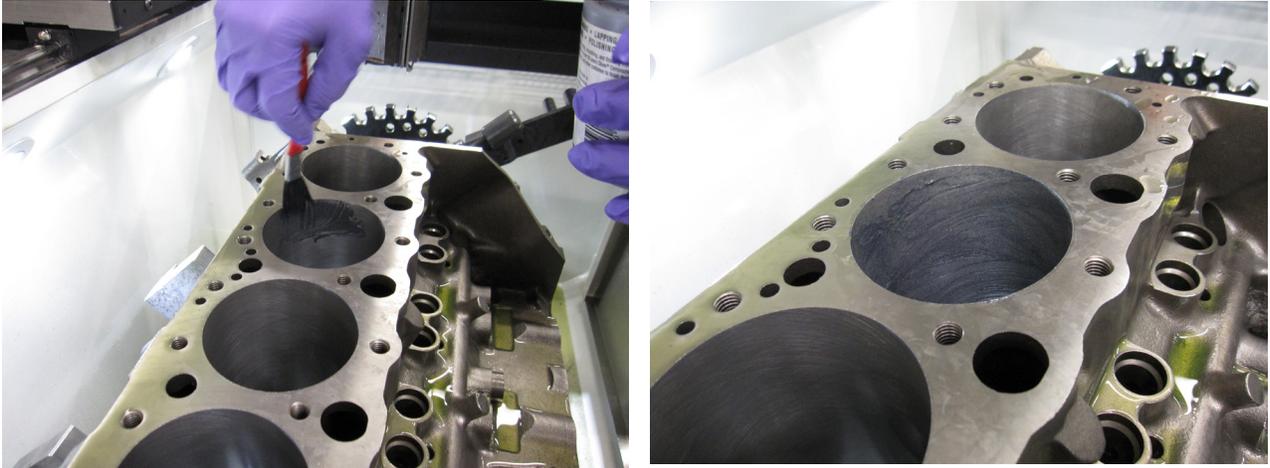
**Breaking In A New Set of Diamond Abrasives**

Rottler diamond abrasives are pre-radiused to minimize the breaking in period. When a new set of diamonds is installed the surface finish obtained on the first few blocks will be 5-10 Ra rougher than after the break in period. You must hone 2 - 5 blocks before the surface finish stabilizes.

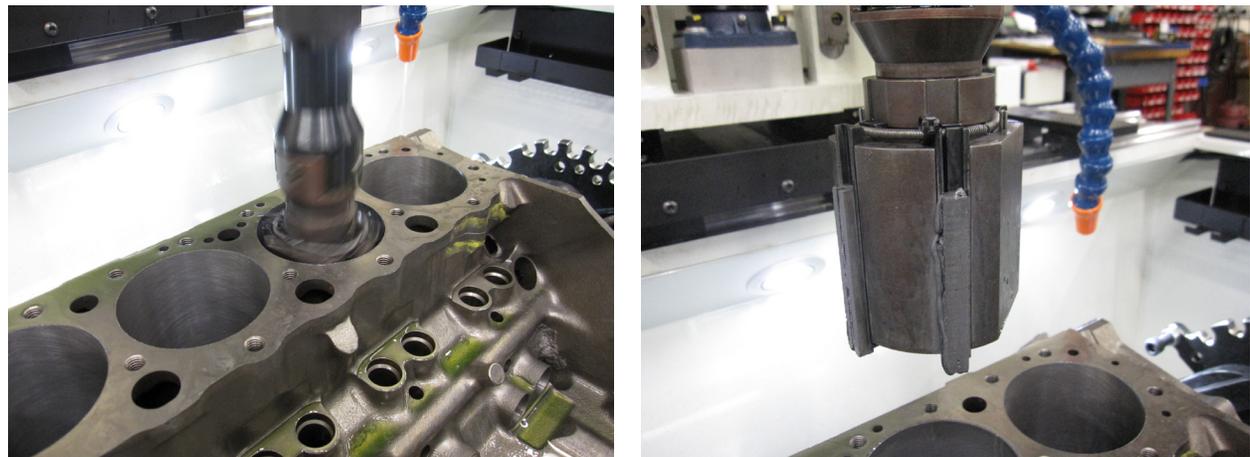
**Truing New Diamond Abrasives**

On grit sizes 500 and up to 1200 grit we recommend using the lapping compound that came with the machine to expedite the process.

To start take a small brush and apply the lapping compound into the cylinder.



Set the cutting pressure in roughing and finishing mode to 20%. Set RPM to 80 rpm. You will need to set the stock removal for .010 to .015 in the stock removal window as abrasive will wear quickly with lapping compound. Insert hone head into bore. Start the machine with the coolant nozzle pointed away from the cylinder. Do not use the flow valve to shut off flow from the pump as that will cause the motor to overheat and trip out. You can shut the pump motor off in the Operation screen if you want. Run machine until it either shuts off or the DRO for stock removal stalls or quits moving. This indicates grit has either worn down or been swept from between cylinder wall and abrasive.



Remove hone head and clean the abrasive. Closely look at abrasive to determine if there is a solid line of contact the entire length of abrasive. If there is not a solid line contact on either the leading or trailing edge of abrasive then repeat the process again.

Once you have achieved the desired contact area you must clean the abrasive from the cylinder that was honed, diamond stones, stone holders and hone head. We recommend removing the stone holders, hone body and feed out cone rod from hone head and cleaning thoroughly to remove any lapping compound. If not completely removed, remaining lapping compound could cause excessive wear to moving parts in the hone head.



### **Dressing Diamond Abrasives**

Diamond Abrasives use a metal bond to hold the individual diamond particles. Failing to dress the stones after honing 30 - 50 blocks will increase the pressure required to remove stock or the stock removal rate slows down significantly. This will result in finishes with excessive folded and torn metal. Undressed stones will also cause excess bore distortion and inaccuracies in the boring process. This is caused by the diamond abrasive dulling or the bond not breaking down. The edge of the stone will also become very sharp. This is a normal occurrence and is easily corrected by removing the holder/abrasive assembly, use a wire brush to dress the abrasive. A common method is to remove the stone holder from the hone head. Leave the stone in the stone holder and move the stone through a bench grinder wire wheel. The brush rotation should be across the narrow width of the stone. Turn the holder over and pass the stone through the wheel again. This process will return the abrasive to a like new cutting condition, and put a slight radius on the edge of the abrasive stick (approx. .005 inch.)

### **Torn Metal**

This is often caused by improper coolant mix, lack of dressing, or the use of high honing pressure during the finishing process. The Rottler hone head is capable of very high loads. If problems with torn metal are encountered verify the coolant mix, proper dressing of the abrasives, and reduce the finishing load during the final hone stage. If required make several strokes manually with minimum stone pressure (10-20%).

### **Stock Removal Rate**

The hardness of the cylinder you are honing will affect the stock removal rate. If you find the stock removal rate for a given cylinder is slower than normal check to make sure you have properly dressed the stones. Improperly dressed stones can increase honing time by as 50% or more. Improperly dressed stones will also produce an unacceptable finish.

### **Diameter Range**

Because the diamond abrasives break down very slowly, a single set of stones is limited in its diameter range. One set of diamonds should be used for each stone holder range. A set of diamonds can not be

constantly changed from one stone holder size to another. The stones would constantly be in the break-in process and very poor performance or finishes will result.

### **Cross Hatch Angle and Washout**

The ideal situation would be for a hone to change the direction it is traveling instantaneously. If this was possible the angle of the cross hatch would stay consistent through the entire cylinder. The Rottler H86AX uses high speed electronics in cooperation with a ballscrew drive to change the direction of travel. This reduces the amount of Cross Hatch wipeout considerably from a crank driven rocker arm. As a rocker arm changes direction, the rate of travel slows but the rotation speed of the hone head stays consistent. This is the cause of washout at the top and bottom of cylinders. Since the H86AX has a linear travel spindle this condition does not exist.

### **Coolant:**

#### **Coolant types and Selection:**

When using Vitrified honing stones you must use a petroleum based coolant. Such as Mobil Met 33 or Upsilon or any equivalent light honing oil. This is required since vitrified honing stones are not compatible with water based synthetic coolants.

Diamond stones will work with oil or water based synthetic coolants, but work most efficiently with the water based synthetic coolants. Rottler Manufacturing recommends the use of Rottler 514-4-71C water based, synthetic coolant for diamond only applications. This coolant works best when mixed to a 5% – 8% solution.

#### **Refractometer:**

A Refractometer is used to measure the amount of coolant to water ratio. A 5% to 8% ratio will read a 3 – 5 on the Refractometer. It is important not confuse the ratio with the actual Refractometer reading. Coolant to Water Ratio is 1:20 thus 1 gallon of coolant to 20 gallons of water.

#### **Coolant Pump System:**

The coolant tank on the H86AX will hold a maximum of 70 gallons of the selected coolant.

## Honing Alusil, Silitec, and Lokasil Cylinders in Synthetic Coolant Equipped Machines

These instructions are for honing Alusil, Silitec and Lokasil cylinders with Rottler honing machines that have water based synthetic coolant in the sump tank.

### Equipment And Parts Needed:

- **Machine:** Rottler HP6A, HP7A, H70 Series, H80 Series
- **Coolant:** Commercial honing oil with a low or medium viscosity.
- **Hone Head:** For HP6A and HP7A Rottler part # 514-9B, For H70 and H80 Series machines Rottler part # 514-9R.
- **Stone Holders:** Rottler parts determined by size of bore.
- **Abrasives:** Rottler 400 grit diamonds part # 514-9-14V (do not substitute different grit size)  
Rottler 600 grit diamonds part # 514-9-14G (do not substitute different grit size)  
KS finishing diamonds Rottler part# 514-9-18P (do not substitute different grit size)  
Rottler felt wipers part # 514-9-21E  
Rottler silicon compound part # 514-9-21F

### Instructions for Honing Alusil, Silitec, and Lokasil Cylinders

Cylinders should be bored to within .002 with a PCD insert. This is very important to prevent fracturing of silicon particles below the finish surface of bore. If PCD isn't used the exposure of the silicon will result in a defective sliding surface for piston and rings.

Turn off the coolant motor. Use a spray bottle with honing oil to spray the cylinders during the honing process. Place a drip tray under the block to catch the honing oil runoff to prevent contaminating machine coolant.

Cylinders should then be honed using Rottler 400 grit diamond stones (514-9-14V no substitutes) to size with tolerance of +.0002 -.0000. Machine parameters should be set as follows: RPM 170 to 180, Honing loads should be set at 20% to 25% for roughing and 15% finish load.

*\*NOTE: When using the diamond stones they should be trued in to diameter of cylinder by using them in cast iron cylinder the same diameter of aluminum cylinder being honed. This includes the KS finish diamonds also.*

Next install the Rottler 600 grit finishing diamonds (514-9-14G no substitutes) and run one cycle in the plateau mode. The plateau mode parameters are different in each type of hone machine. You will need to change these parameters (see operating instructions) to 10 strokes per cycle and a honing load of 15%. Cylinders should already be to size from previous step. You are not trying to remove much material with this operation. The need for this operation is to lower the surface finish for the next step.

Next install the KS finishing diamonds (514-9-18P no substitutes) and run one cycle in the plateau mode. This operation will prepare the surface finish for the final step.

*\*NOTE: Chamfer or break the edge of the exposing stones prior to using them in bore. This will help prevent chipping on stone edges.*

The last step in the process is to expose the silicon particles by eroding the surrounding metal away from the silicon particles using Rottler felt pads part # 514-9-21E. These are used with Rottler silicon compound paste part # 514-9-21F. Take a small paint brush and apply paste to felt wipers and the entire cylinder. Install hone head in bore and hone for approximately 45 to 60 seconds per cylinder. Machine settings for this operation should be RPM 160 to 170, strokes per minute of 60, shut-off automatic stone feed up. Start machine and feed stones up manually until load reaches 15%. Let machine run for 45 to 60 seconds per cylinder. Reapply silicon compound to felt pads and to each following cylinder. There is no need to over stroke cylinder during this process so shorten stroke length accordingly.

## Honing Alusil, Silitec, and Lokasil Cylinders in Hone Oil Equipped Machines

These instructions are for honing Alusil, Silitec and Lokasil cylinders with Rottler honing machines that have mineral based honing oil in the sump tank.

### Equipment And Parts Needed:

- **Machine:** Rottler HP6A, HP7A, H70 Series, H80 Series
- **Hone Head:** For HP6A and HP7A Rottler part # 514-9B, For H70 and H80 Series machines Rottler part # 514-9R.
- **Stone Holders:** Rottler parts determined by size of bore.
- **Abrasives:** Rottler 400 grit diamonds part # 514-9-14V (do not substitute different grit size)  
Rottler 600 grit diamonds part # 514-9-14G (do not substitute different grit size)  
KS finishing diamonds Rottler part# 514-9-18P (do not substitute different grit size)  
Rottler felt wipers part # 514-9-21E  
Rottler silicon compound part # 514-9-21F

### Instructions for Honing Alusil, Silitec, and Lokasil Cylinders

Cylinders should be bored to within .002 with a PCD insert. This is very important to prevent fracturing of silicon particles below the finish surface of bore. If PCD isn't used the exposure of the silicon will result in a defective sliding surface for piston and rings.

Cylinders should then be honed using Rottler 400 grit diamond stones (514-9-14V no substitutes) to size with tolerance of +.0002 -.0000. Machine parameters should be set as follows: RPM 170 to 180, Honing loads should be set at 20% to 25% for roughing and 15% finish load.

*\*NOTE: When using the diamond stones they should be trued in to diameter of cylinder by using them in cast iron cylinder the same diameter of aluminum cylinder being honed. This includes the KS finish diamonds also.*

Next install the Rottler 600 grit finishing diamonds (514-9-14G no substitutes) and run one cycle in the plateau mode. The plateau mode parameters are different in each type of hone machine. You will need to change these parameters (see operating instructions) to 10 strokes per cycle and a honing load of 15%. Cylinders should already be to size from previous step. You are not trying to remove much material with this operation. The need for this operation is to lower the surface finish for the next step.

Next install the KS finishing diamonds (514-9-18P no substitutes) and run one cycle in the plateau mode. This operation will prepare the surface finish for the final step.

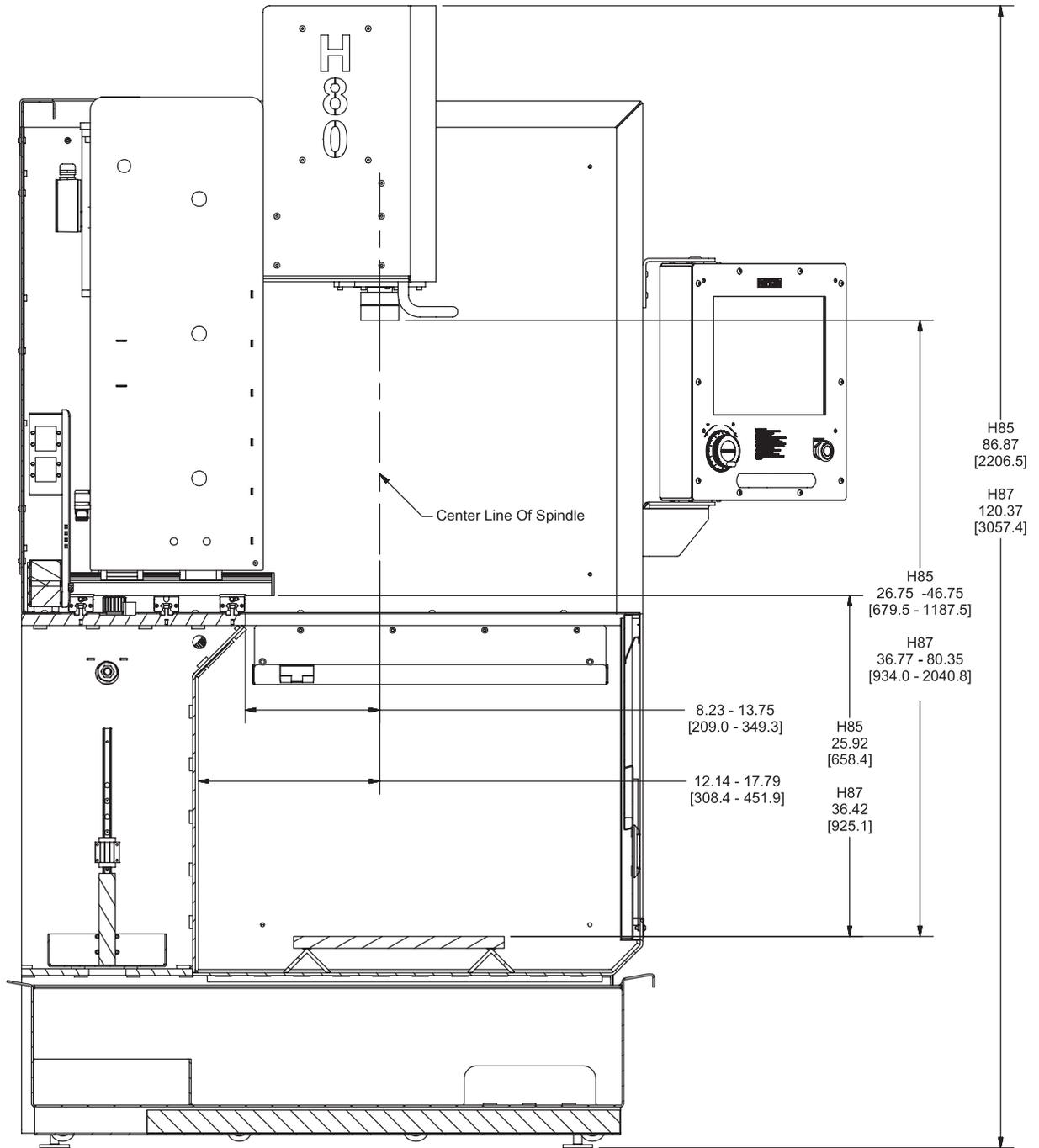
*\*NOTE: Chamfer or break the edge of the exposing stones prior to using them in bore. This will help prevent chipping on stone edges.*

Turn off the coolant motor for the final process.

The last step in the process is to expose the silicon particles by eroding the surrounding metal away from the silicon particles using Rottler felt pads part # 514-9-21E. These are used with Rottler silicon compound paste part # 514-9-21F. Take a small paint brush and apply paste to felt wipers and the entire cylinder. Install hone head in bore and hone for approximately 45 to 60 seconds per cylinder. Machine settings for this operation should be RPM 160 to 170, strokes per minute of 60, shut-off automatic stone feed up. Start machine and feed stones up manually until load reaches 15%. Let machine run for 45 to 60 seconds per cylinder. Reapply silicon compound to felt pads and to each following cylinder. There is no need to over stroke cylinder during this process so shorten stroke length accordingly.

### Work Envelope Dimensions

Refer to the dimensions in the illustration below to determine if the machine can handle the intended work piece.



## Honing a Cylinder Block

### Introduction

The purpose of this section is to familiarize the operator with various features of the H86AX.

The operator should have a working knowledge of honing and be familiar with using a power hone.

It is suggested that scrape block be used for the following walk-through.

### Definitions of terms used in this section:

**Button:** A labeled icon on the control display screen.

**Touch:** To activate an icon button we will use the term touch. ie: Touch CYCLE START button to start the programed honing process. Some buttons will stay active once they have been touched and must be touched a second time to deactivate.

**Touch and Hold:** Some buttons are momentary buttons and you must maintain contact with the button to keep it active. ie: When the Z- button is touched and contact maintained the hone head will travel downward until contact with the button is released.

**Value Box:** A small box section of the screen that contains a number that indicates a value for the function listed next to it.

### Safety Reminders:

When machine is idle the spindle should always be keep in the full up position and the E-STOP engaged. This deactivates touchscreen controls to prevent any accidental activation. The word E-STOP IN will be displayed on the red Stop Machine button at the lower left corner of the operation screen

The operator can stop the honing process at any time by touching the STOP MACHINE button. Touching the CYCLE START button again will restart the process.

If an emergency situation arises or if the touchscreen is not responding, pressing the E-STOP button will shut off power to all motors and solenoids and bring the hone to a stop. The word E-STOP IN will be displayed on the Stop Machine button. To release the E-STOP turn the button clockwise until it pops out.

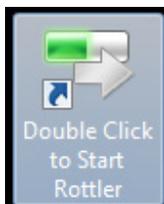
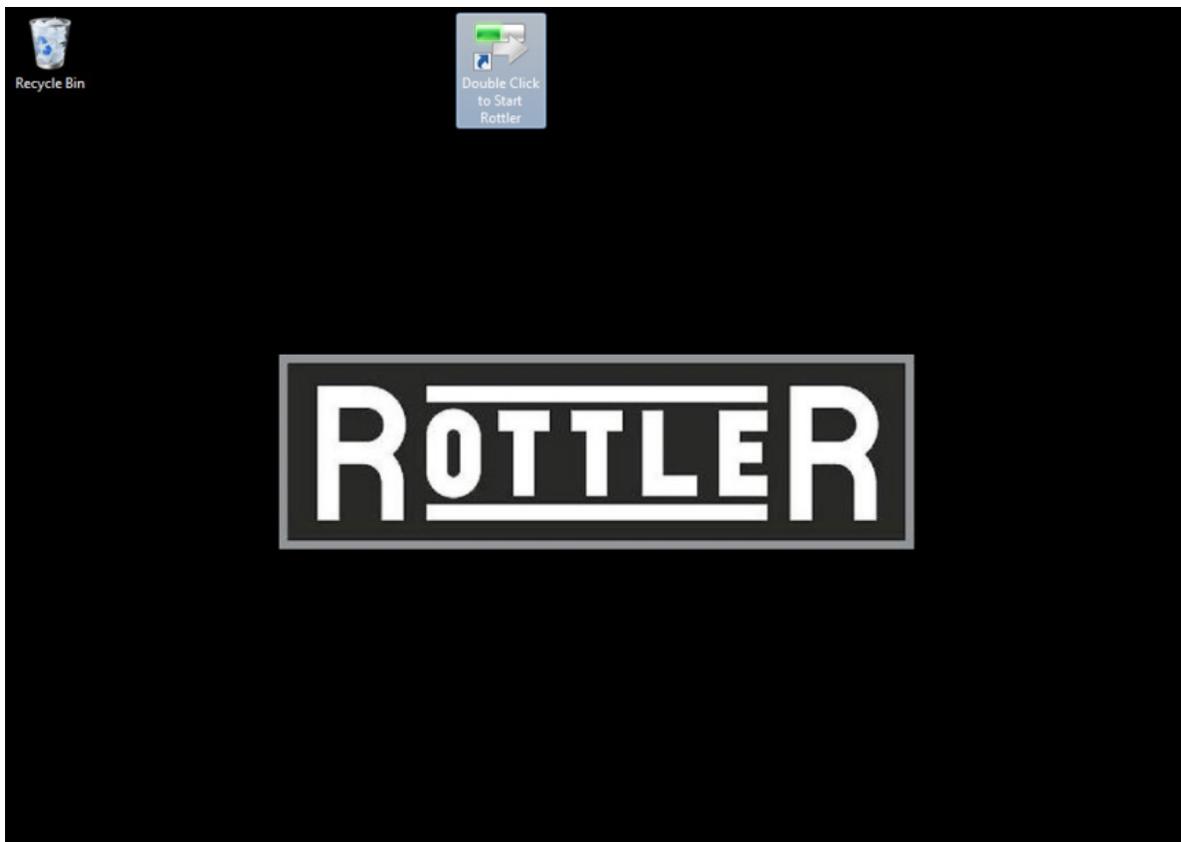
## Getting Started

Once the machine is set up and ready to run turn on power to machine by flipping the power switch to the on position.

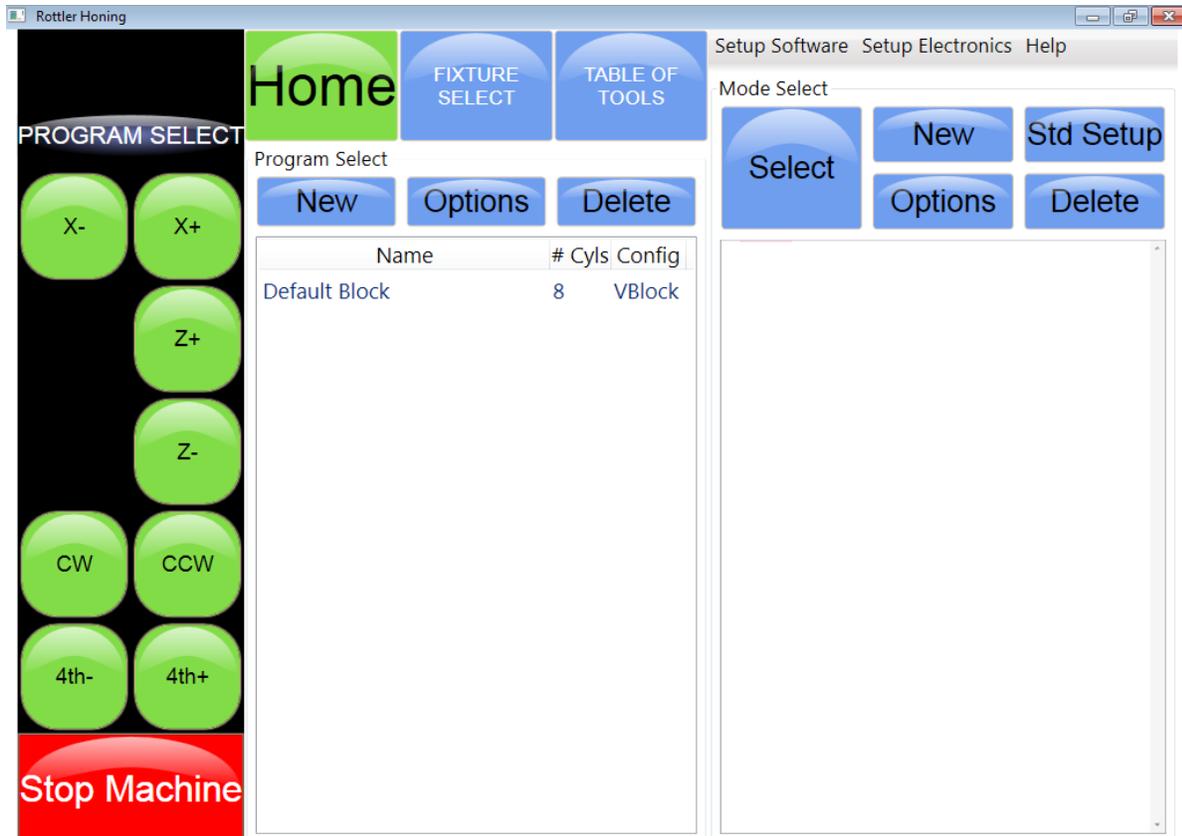


It will be assumed that the machine is being operated without a keyboard or mouse attached.

The computer will start up and boot screen will appear on the monitor. This may take a few minutes if operating system is doing an update.



Double Touch the Start Rottler icon. The HOME screen will appear on the monitor.



This is the Home screen. Using the jog buttons touch the X+ button to move the carriage to the right side of the machine. Touch the Z+ button to raise the spindle all the way to the top. Now the machine is in its block loading position. Engage the E-STOP by pressing the red E-STOP switch.



The Stop Machine button now reads E-STOP IN. It is now safe to work inside the tank area.

## Planning the Job

### Block Specifications

- You will need to know the following information for the job you are planning:
- Finish bore size, cross hatch angle, and finish.
- Bore length.
- Center to center dimension of cylinders.
- If the job is a V type block, the pan rail to crank line center dimension, and cylinder offset between cylinder banks.

### Tooling Selection

You will need to decide what honing process will be used and if there will be a final plateau process for the job. Based on that decision use the following charts to select which hone head, stone holders, stones, and if need brushes.

Now is also a good time to set your bore gauge to desired final size.

**STONE HOLDER SIZE CHART H86AX****MEDIUM HONE HEAD**

Diameter (New Stones)

	0.312 Stones		0.200 Stones	
	Min	Max	Min	Max
514-10-13A	2.34	2.45	2.12	2.23
514-10-13F	2.44	2.55	2.22	2.33
514-10-13B	2.54	2.65	2.32	2.43
514-10-13G	2.64	2.75	2.42	2.53
514-10-13C	2.74	2.85	2.52	2.63
514-10-13H	2.84	2.95	2.62	2.73
514-10-13D	2.94	3.05	2.72	2.83

Diameter (New Stones) (Metric)

	7.925 Stones		5.08 Stones	
	Min	Max	Min	Max
514-10-13A	59.44	62.23	53.75	56.54
514-10-13F	61.98	64.77	56.29	59.08
514-10-13B	64.52	67.31	58.83	61.62
514-10-13G	67.06	69.85	61.37	64.16
514-10-13C	69.60	72.39	63.91	66.70
514-10-13H	72.14	74.93	66.45	69.24
514-10-13D	74.68	77.47	68.99	71.78

Diameter (New Brushes )

	0.550 Brushes		0.395 Brushes	
	Min	Max	Min	Max
514-10-13A	2.82	2.93	2.51	2.62
514-10-13F	2.92	3.03	2.61	2.72
514-10-13B	3.02	3.13	2.71	2.82
514-10-13G	3.12	3.23	2.81	2.92
514-10-13C	3.22	3.33	2.91	3.02
514-10-13H	3.32	3.43	3.01	3.12
514-10-13D	3.42	3.53	3.11	3.22

Diameter (New Brushes) (Metric)

	13.970 Brushes		10.033 Brushes	
	Min	Max	Min	Max
514-10-13A	71.53	74.32	63.65	66.45
514-10-13F	74.07	76.86	66.19	68.99
514-10-13B	76.61	79.40	68.73	71.53
514-10-13G	79.15	81.94	71.27	74.07
514-10-13C	81.69	84.48	73.81	76.61
514-10-13H	84.23	87.02	76.35	79.15
514-10-13D	86.77	89.56	78.89	81.69

**LARGE HONE HEAD**

Diameter (New Stones)

	0.312 Stones		0.200 Stones	
	Min	Max	Min	Max
514-9-5J	2.99	3.45	2.77	3.23
514-9-5A	3.17	3.63	2.94	3.41
514-9-5B	3.42	3.88	3.19	3.66
514-9-5C	3.67	4.13	3.44	3.91
514-9-5D	3.92	4.38	3.69	4.16
514-9-5E	4.17	4.63	3.94	4.41
514-9-5F	4.42	4.88	4.19	4.66
514-9-5G	4.67	5.13	4.44	4.91
514-9-5H	4.92	5.38	4.69	5.16
514-9-5K	5.17	5.63	4.94	5.41
514-9-5L	5.42	5.88	5.19	5.66
514-9-5M	5.67	6.13	5.44	5.91
514-9-5N	5.92	6.38	5.69	6.16
514-9-5P	6.17	6.63	5.94	6.41
514-9-5Q	6.42	6.88	6.19	6.66
514-9-5R	6.67	7.13	6.44	6.91
514-9-5S	6.92	7.38	6.69	7.16

Diameter (New Stones) (Metric)

	7.925 Stones		5.08 Stones	
	Min	Max	Min	Max
514-9-5J	75.92	87.73	70.23	82.04
514-9-5A	80.39	92.20	74.70	86.51
514-9-5B	86.74	98.55	81.05	92.86
514-9-5C	93.09	104.90	87.40	99.21
514-9-5D	99.44	111.25	93.75	105.56
514-9-5E	105.79	117.60	100.10	111.91
514-9-5F	112.14	123.95	106.45	118.26
514-9-5G	118.49	130.30	112.80	124.61
514-9-5H	124.84	136.65	119.15	130.96
514-9-5K	131.19	143.00	125.50	137.31
514-9-5L	137.54	149.35	131.85	143.66
514-9-5M	143.89	155.70	138.20	150.01
514-9-5N	150.24	162.05	144.55	156.36
514-9-5P	156.59	168.40	150.90	162.71
514-9-5Q	162.94	174.75	157.25	169.06
514-9-5R	169.29	181.10	163.60	175.41
514-9-5S	175.64	187.45	169.95	181.76

Diameter (New Brushes )

	0.550 Brushes		0.395 Brushes	
	Min	Max	Min	Max
514-9-5J	3.47	3.93	3.16	3.62
514-9-5A	3.64	4.11	3.33	3.80
514-9-5B	3.89	4.36	3.58	4.05
514-9-5C	4.14	4.61	3.83	4.30
514-9-5D	4.39	4.86	4.08	4.55
514-9-5E	4.64	5.11	4.33	4.80
514-9-5F	4.89	5.36	4.58	5.05
514-9-5G	5.14	5.61	4.83	5.30
514-9-5H	5.39	5.86	5.08	5.55
514-9-5K	5.64	6.11	5.33	5.80
514-9-5L	5.89	6.36	5.58	6.05
514-9-5M	6.14	6.61	5.83	6.30
514-9-5N	6.39	6.86	6.08	6.55
514-9-5P	6.64	7.11	6.33	6.80
514-9-5Q	6.89	7.36	6.58	7.05
514-9-5R	7.14	7.61	6.83	7.30
514-9-5S	7.39	7.86	7.08	7.55

Diameter (New Brushes) (Metric)

	13.970 Brushes		10.033 Brushes	
	Min	Max	Min	Max
514-9-5J	88.01	99.82	80.14	91.95
514-9-5A	92.48	104.29	84.61	96.42
514-9-5B	98.83	110.64	90.96	102.77
514-9-5C	105.18	116.99	97.31	109.12
514-9-5D	111.53	123.34	103.66	115.47
514-9-5E	117.88	129.69	110.01	121.82
514-9-5F	124.23	136.04	116.36	128.17
514-9-5G	130.58	142.39	122.71	134.52
514-9-5H	136.93	148.74	129.06	140.87
514-9-5K	143.28	155.09	135.41	147.22
514-9-5L	149.63	161.44	141.76	153.57
514-9-5M	155.98	167.79	148.11	159.92
514-9-5N	162.33	174.14	154.46	166.27
514-9-5P	168.68	180.49	160.81	172.62
514-9-5Q	175.03	186.84	167.16	178.97
514-9-5R	181.38	193.19	173.51	185.32
514-9-5S	187.73	199.54	179.86	191.67

**Stone and Brush Selection**

Use the following charts to select the stones and brushes to obtain the desired finish

NOTE: Ra - Roughness Average. Value before Ra is in micro inches. Value in brackets um is micro meters. Long designates length of stone. Height designated thickness of stone.

<b>Set of 4</b>	<b>Set of 6</b>	<b>Diamond Stones, .312" (7.90mm) Height</b>
514-9-14F	514-9-32F	80 grit, 3" (76mm) long, 90Ra (2.25um)
514-9-14R	514-9-32R	80 grit, 3 1/2" (89mm) long, 90Ra (2.25um)
514-9-21R		80 grit, 4" (102mm) long, 90 Ra, (2.25um)
514-9-14W	514-9-32W	140/170 grit, 3" (76mm) long, 50-75Ra (1.25 - 1.875um)
514-9-21W		140/170 grit, 4" (102mm) long, 50-75 Ra, (1.25 - 1.875um)
514-9-14K	514-9-32K	170/200 grit, 3 (76mm) long, 45-60Ra (1.125 - 1.5um)
514-9-14M		170/200 grit, 3 1/2" (89mm) long, 45-60Ra (1.125 - 1.5um)
514-9-21M		170/200 grit, 4" (102mm) long, 45-60 Ra, (1.125 - 1.5um)
514-9-14J	514-9-32J	270/325 grit, 3" (76mm) long, 35-45Ra (.875 - 1.125um)
514-9-14T	514-9-33B	270/325 grit, 3 1/2" (89mm) long, 35-45Ra (.875 - 1.125um)
514-9-14Z		270/325 grit, 4" (102mm) long, 35-45Ra (.875 - 1.125um)
514-9-14E	514-9-32E	325/400 grit, 3" (76mm) long, 24-30Ra (.6 - .75um)
514-9-14Q		325/400 grit, 3 1/2" (89mm) long, 24-30Ra (.6 - .75um)
514-9-14X		325/400 grit, 4" (102mm) long, 24-30Ra (.6 - .75um)
514-9-14V		400 grit, 3" (76mm) long, 15-19Ra (.375 - .475um)
514-9-14C	514-9-32C	500 grit, 3" (76mm) long, 18-22Ra (.45 - .55um)
514-9-14P		500 grit, 3-1/2" (89mm) long, 18-22Ra (.45 - .55um)
514-9-14U		500 grit, 2 1/2" (64mm) long, 18-22Ra (.45 - .55um)
514-9-14L	514-9-32L	550 grit, 3" (76mm) long, 15-19Ra (.375 - .475um)
514-9-14N		550 grit, 3 1/2" (89mm) long, 15-19Ra (.375 - .475um)
514-9-14G	514-9-32G	600 grit, 3" (76mm) long, 8-12Ra (.2 - .3um)
514-9-14S		600 grit, 3 1/2" (89mm) long, 8-12Ra (.2 - .3um)
514-9-21G	514-9-33	800 grit, 3" (76mm)
	514-9-33A	800 grit, 3 1/2" (89mm)
	514-9-33C	800 grit, 4" (102mm)
514-9-21H		1000 grit, 3" (76mm)
514-9-21J	514-9-33J	1200 grit, 3" (76mm)
<b>Set of 4</b>	<b>Set of 6</b>	<b>Diamond Stones, .200" (5.10mm) Height</b>
514-9-14D	514-9-33B	325/400 grit, 3" (76mm) long, 18-22Ra (.45 - .55um)
<b>Set of 4</b>	<b>CBN Stones, .321" (7.90mm) Height</b>	
514-9-35C	CBN Stones, 320 grit, 3" (76mm) long	
514-9-35D	CBN Stones, 400 grit, 3" (76mm) long	
514-9-35B	CBN Stones, 600 grit, 3" (76mm) long	
<b>Set of 4</b>	<b>Brushes for Plateau Finishing</b>	
514-9-14H	Plateau Finishing, .550" (14mm) height, 3 1/2" (89mm) long, requires one or two size smaller stone holder compared to .312" (7.90mm) height diamond stone	
514-9-14Y	Plateau Finishing, .395" (10mm) height, 3 1/2" (89mm) long, requires same or one size smaller stone holder compared to .312" (7.90mm) height diamond stone	

### Loading the Block

The next step is to load the block that will be honed onto the fixture. In this tutorial the optional auto rotate fixture is shown. The block loading procedure is the same for the manual fixture. Select the block that will be used. In this tutorial a small block V-8 will be used.

Set the riser blocks on the fixture cradle so that the pan rails are sitting on the surface that was determined to be closest to ideal.



The main caps must be on when a V-Block is honed and on an Inline Block if the optional clamp arms are not used.

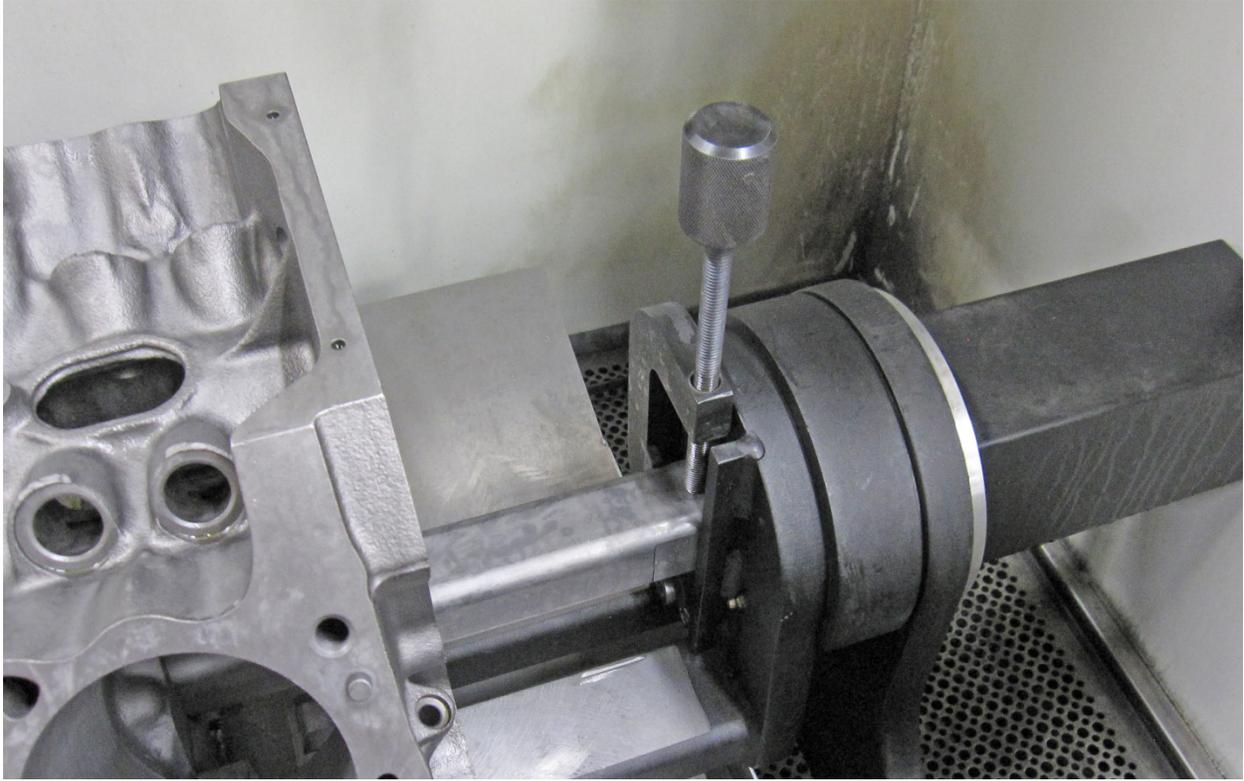


Place the clamp bar tube through the main bore of the block. Be certain that the machined flats at the end of the clamp bar tube are in a vertical position.



Use an appropriate method to place the block on the riser parallels with the front of the block facing left or away from the control pendent.

Take care to align the clamp tube with the receiver slots on the cradle. Once the block is sitting on the riser blocks place the clamp bar lock downs over the tube and turn the knobs until the clamp tube is secured.



### Programing Set Up

Now that the block has been placed on the fixture and tooling has been chosen, select the stones and holders to be used in the first process. Put holders and stones into the hone head and mount hone head on spindle of machine.

The H86AX machines use a standard Kwik Switch mount system for the hone heads.

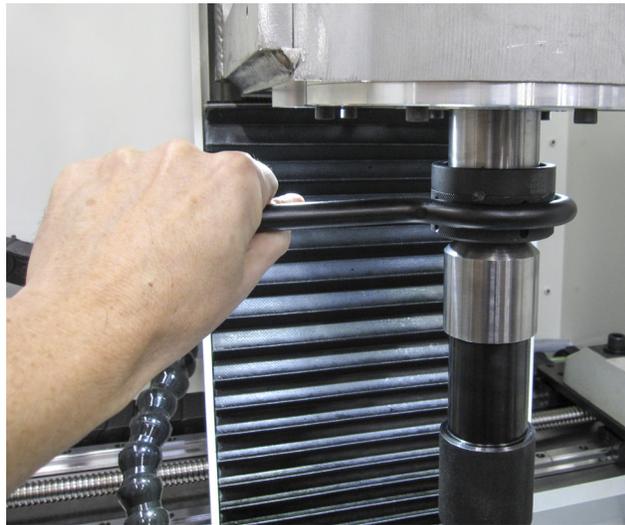
To mount a hone head confirm that the locknut is in the open position.



The hone head will have the standard locking tabs on the mounting adaptor and a drive coupler for adjusting the stones. When mounting the hone head it will be necessary to align the drive coupler with its receiver inside the drive spindle. Once they are aligned the adaptor tabs will fit into the receiver slots. The tabs will activate the release pin and the locknut will automatically turn to lock the hone head in place.



Due to design the nut will continue tighten during use. When it comes time to change or remove the hone head it may become so tight that the release wrench will be needed to loosen the locknut. Turn locknut clockwise to release the hone head.



Consult the tooling charts in the previous section to determine which hone head and stone holders will be needed for the job you are setting up for.

Prior to hone head installation confirm that the con rod is at least 1/4”(6mm) up inside the hone body. This will assure that the homing procedure will function correctly.

Once the hone head is attached release the E-STOP switch and touch the Home button to calibrate the hone head set up to the machine program.

Once homing is complete, check that cone rod is all the way up inside the hone head before proceeding.

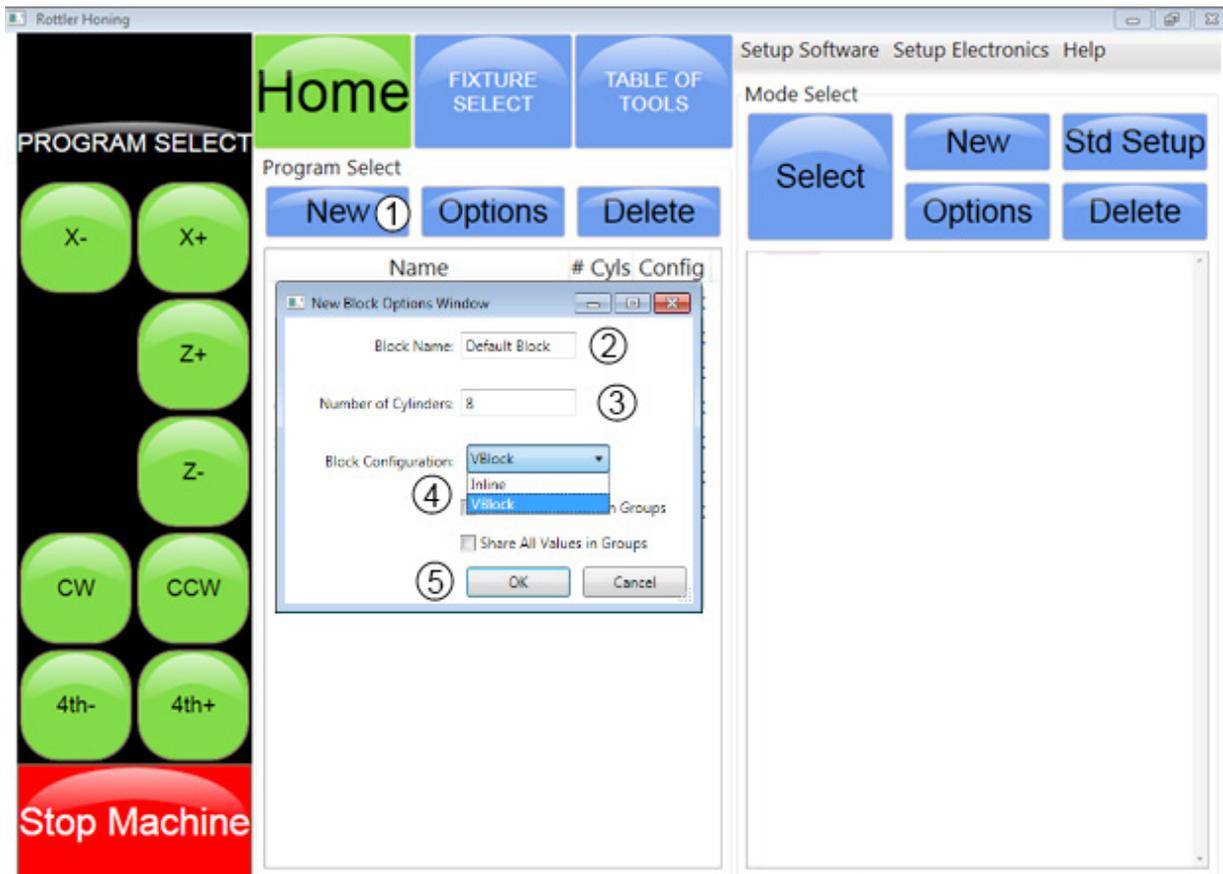
***THIS IS CRITICAL.*** If for some reason the cone rod doesn't reach it's upper most travel point when homing is completed, then the bore size range will not be properly calibrated. This could result in the cone rod coming out of the hone body during operation and could potentially cause damage.



**IMPORTANT: Whenever a hone head set up is changed the machine must be Homed.**

Now that the machine is set up for honing we will construct a program to hone the block.

## Creating a Program

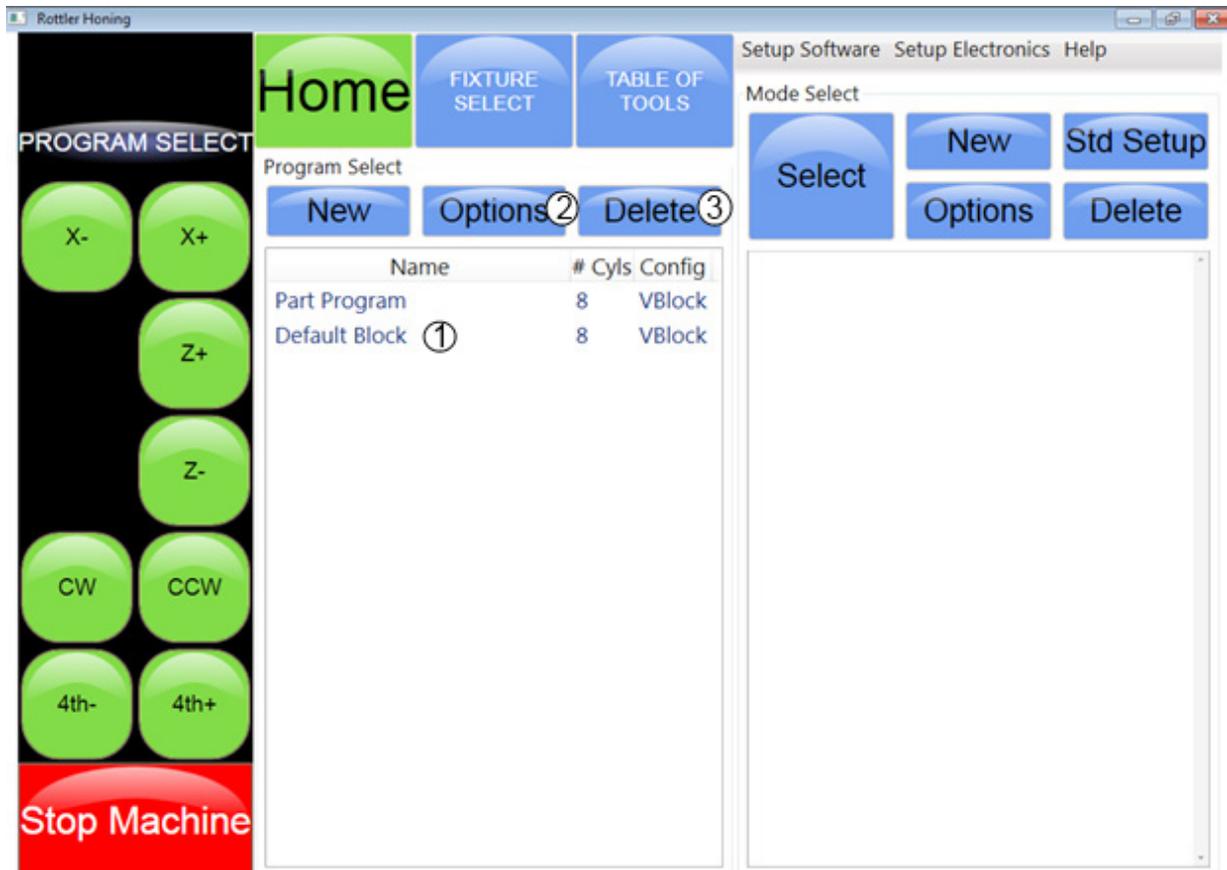


On the home screen under the Program Select touch the New button (1) and the New Block Options Window will appear.

Name the block,(2) input number of cylinders (3) and choose VBlock or Inline.(4) Touch OK (5) when finished.

The new block program title (1) will appear on the list.

For this tutorial we will use the standard Default Block and its settings.



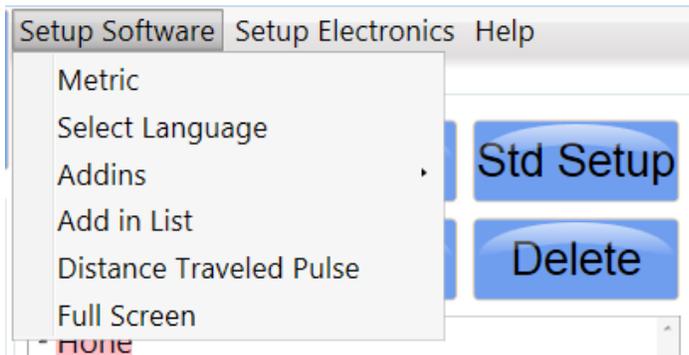
The Options button (2) will bring New Block Options Window back where you can edit information for the block that is highlighted. Highlight the block program you want to edit, then touch the Options button. The Delete button (3) will bring up the Delete Window. (4) Highlight a block program and touch the Delete button.



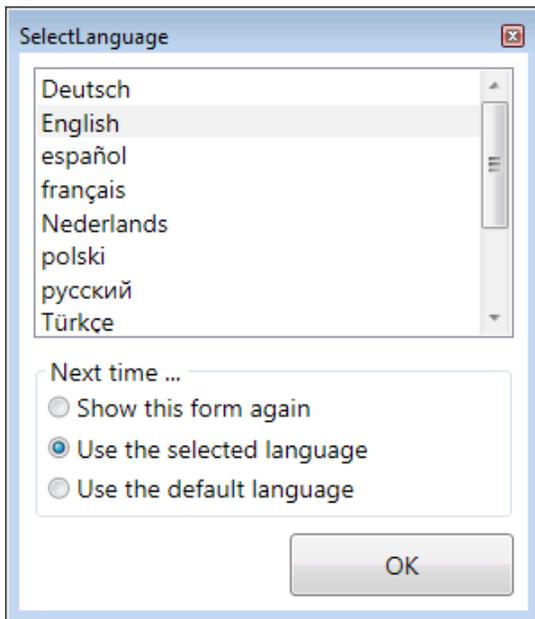
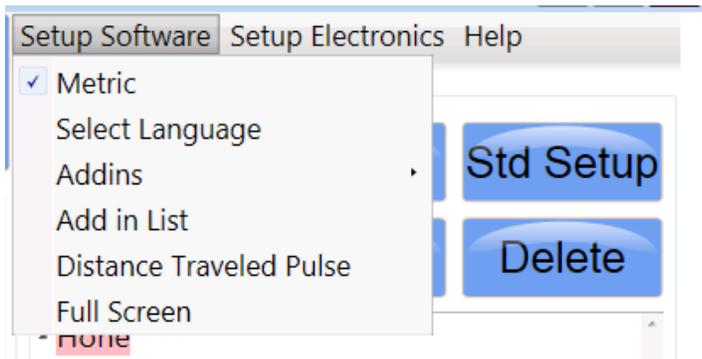
Touch the Yes button (5) if you want to delete the block that is highlighted.

**Mode Select Section of Home Screen.**

Click the Setup Software menu tab and this drop down menu will appear.

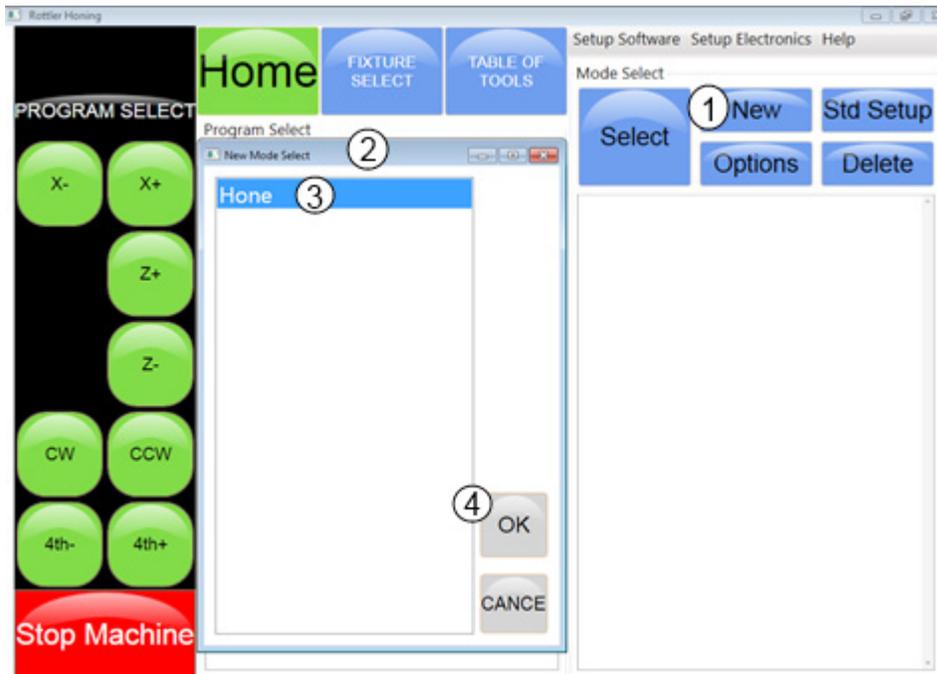


Operator should only concern themselves with the first two. Click on Metric and all readings and settings on the monitor will be metric. Uncheck Metric to return all readings and settings to inch. Click on Select Language to have everything on screen in a different language.



The rest of the menu items and those of the Setup Electronics tag are used only for machine setup at the factory or for use by qualified service person when needed.

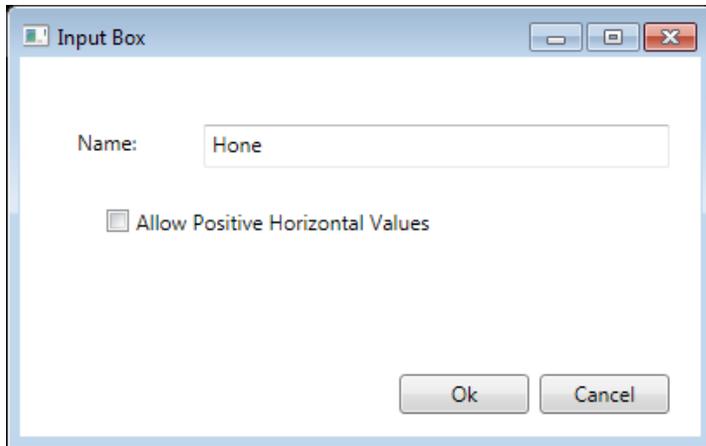
Touch the New Button (1) and the New Mode Select screen (2) will appear.



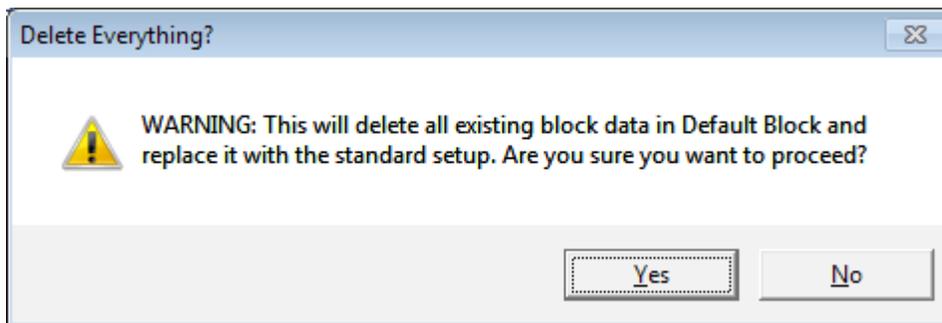
Highlight Hone (3) and touch OK.(4) The Hone program (5) will appear in the Mode Select section



Clicking the Options button (6) will bring the following window. Name of Hone process can be changed in this window.



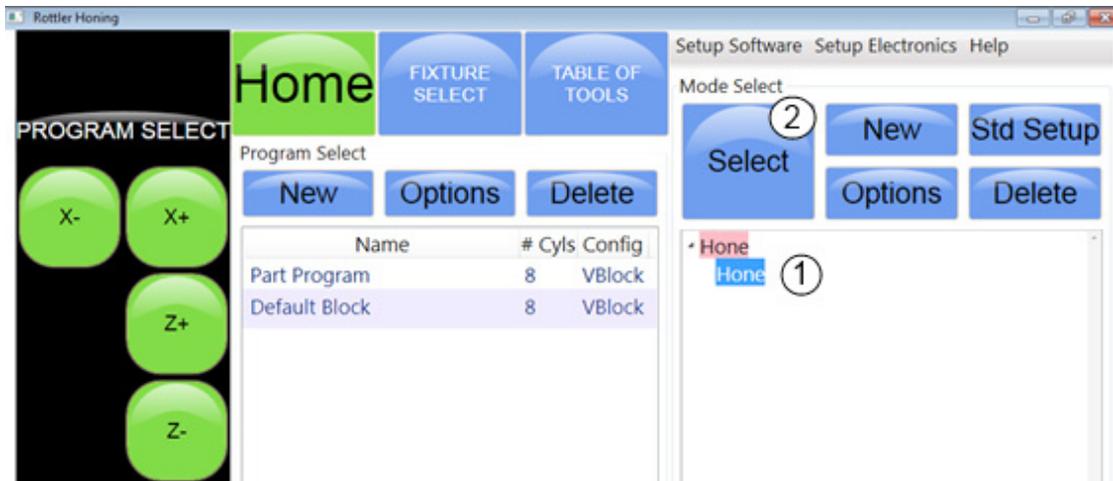
The Std Setup button (7) will bring up the following window. If you want to delete all settings in a block program that is highlighted and return the factory default setting click Yes.



If you choose the Std Setup the following Hone Modes will be loaded onto the Mode Select screen.

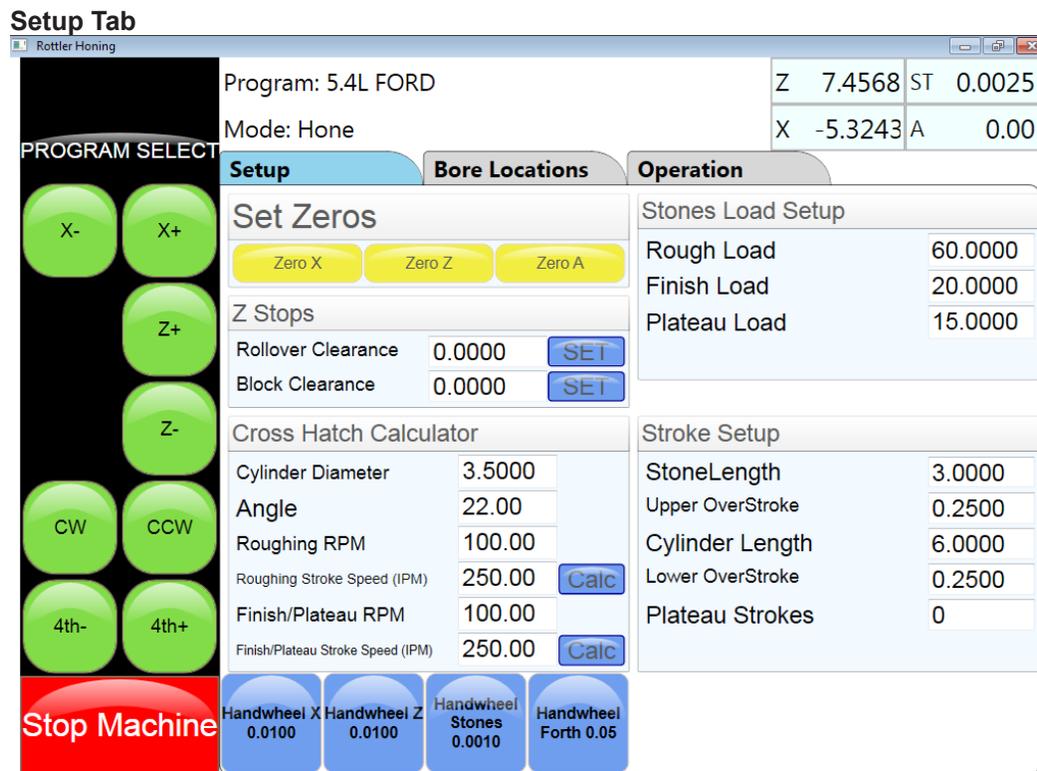


Highlight the Hone (1) process for the block program you just created. If the Std Setup was chosen select either Rough Hone or Finish Hone.



Click on the Select button (2) to bring up the Setup screen.

### Operations Setup Screen

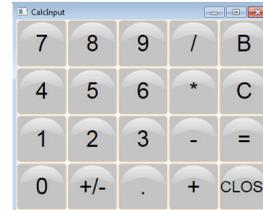


This is where machines setting are input.

Stones Load Setup	
Rough Load	60.0000
Finish Load	20.0000
Plateau Load	15.0000
<input type="text"/>	

Begin by going to the Stones Load Setup section and inputting the values that will be used for the block you are going to hone. Touching one of the value boxes will bring up the number pad that can be used to input the value you wish to use.

Select the hone head to be used by using the drop down menu.



Move down to the Stroke Setup section and input the values for this section. Cylinder Length is the measurement of the longest section of the cylinder. The amount of OverStroke is usually dictated by the clearance of bottom of the cylinder to the main web. When clearance is not an issue a setting of .250-.500 is a good place to start.

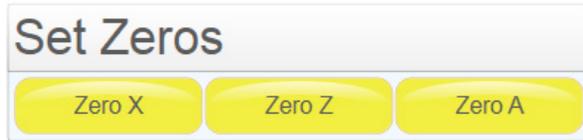
Stroke Setup	
StoneLength	3.0000
Upper OverStroke	0.2500
Cylinder Length	6.0000
Lower OverStroke	0.2500
Plateau Strokes	0

Cross Hatch Calculator		
Cylinder Diameter	3.5000	
Angle	22.00	
Roughing RPM	100.00	
Roughing Stroke Speed (IPM)	250.00	Calc
Finish/Plateau RPM	100.00	
Finish/Plateau Stroke Speed (IPM)	250.00	Calc

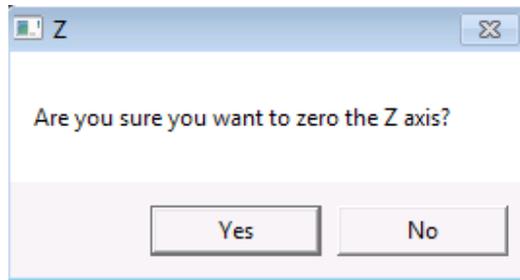
Move over to the Cross Hatch Calculator section and input the values for this section. Cylinder Diameter will be the finished size of the cylinders you are honing. Angle will be whatever angle specified by the ring manufacturer or requested by the customer. Roughing and Finish/Plateau RPM is generally set in the 120-200 range. Operator preference and experience will be the final determining factor. You can touch the Calc buttons to see what the stroke speed in IPM will be with the setting you have entered. Change the RPM setting if you think the IPM reading is either too high or too low.

**Setting Zeros**

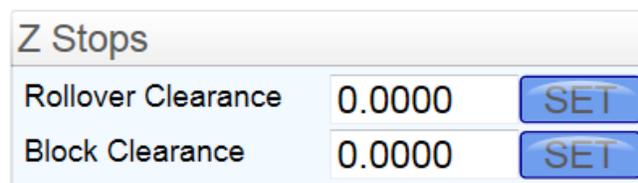
Touch the Setup tab to bring back the Setup screen.  
In the Set Zeros section touch the Zero Z button.



You will get a confirm pop up for that. Touch Yes to continue.



Using the handwheel raise the hone head out of the cylinder out of the bore until the bottom clears the deck by 1-2 inches. In the Z Stops section touch the SET button that is in the same line as the Block Clearance value.

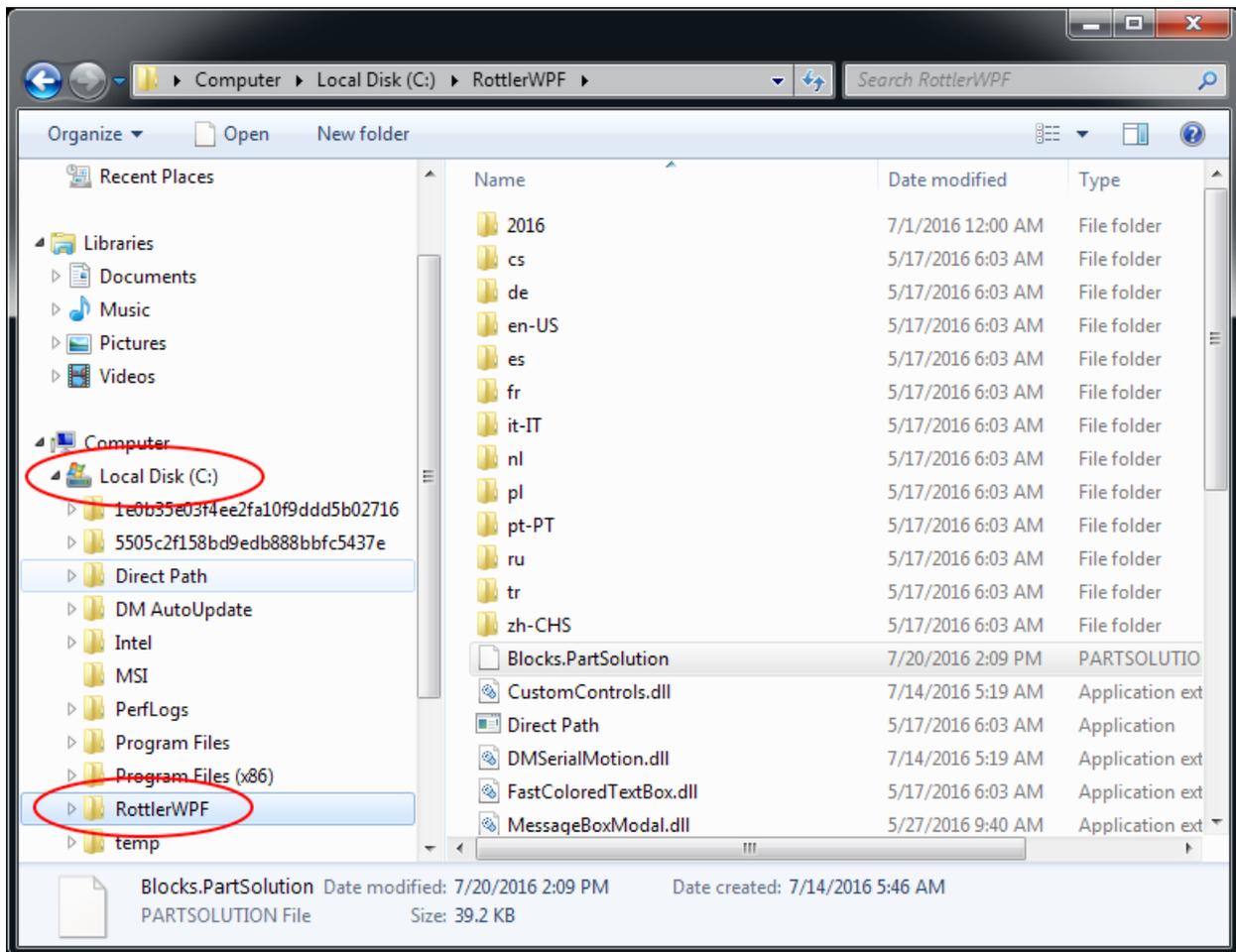


This will tell the machine how much to raise the hone head when it has completed honing a cylinder and will be moving to next. If you are honing a V type block then raise the hone head high enough to clear the block when the fixture is moved from one bank to the other.

## 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.

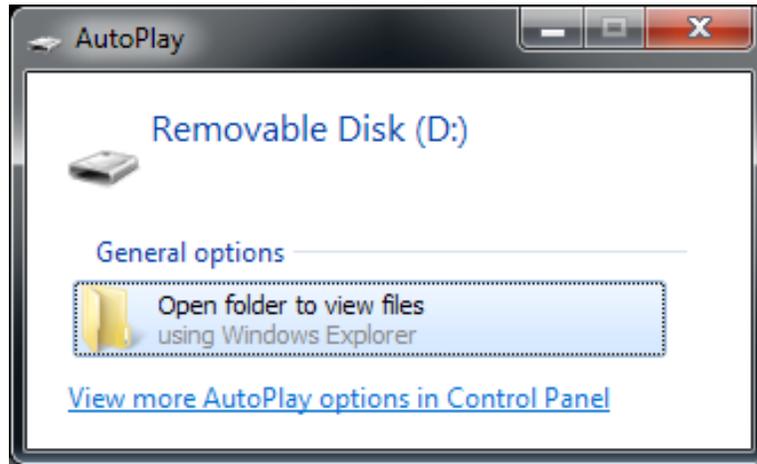
First step is to open your file browser locate the RottlerWPF file on the C disk drive.



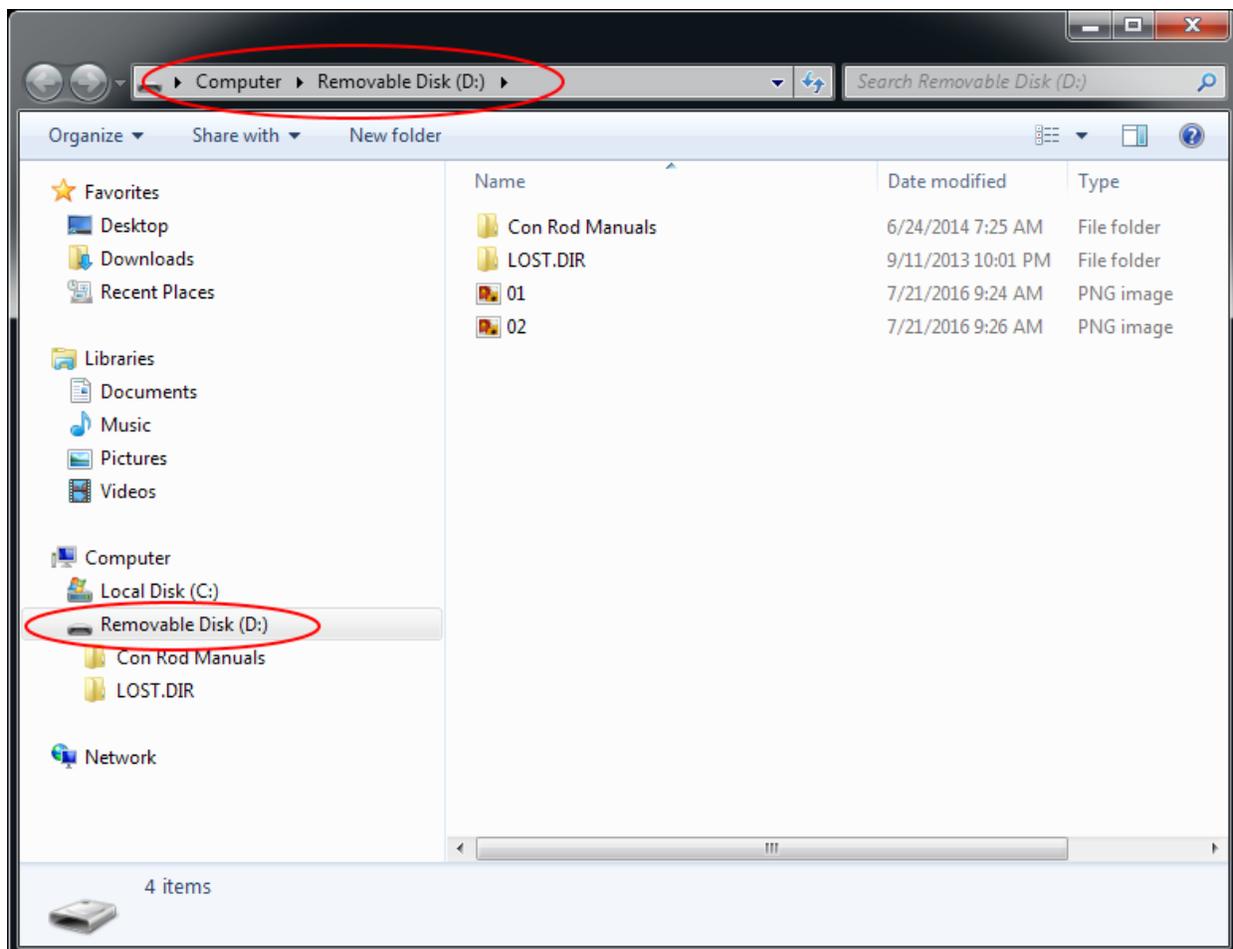
The next step is to plug in a flash drive to an open USB port



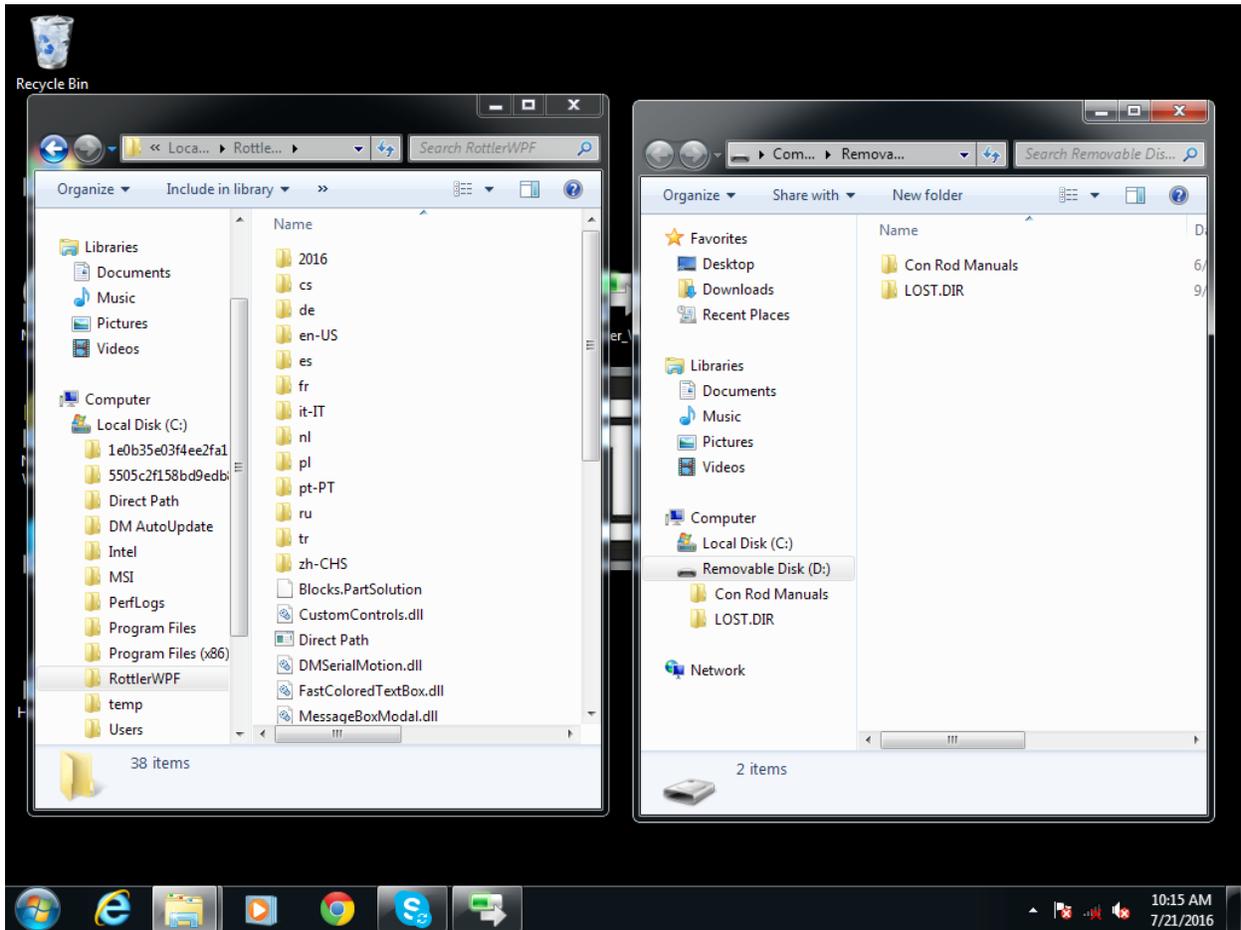
The following pop up box will appear on your screen.



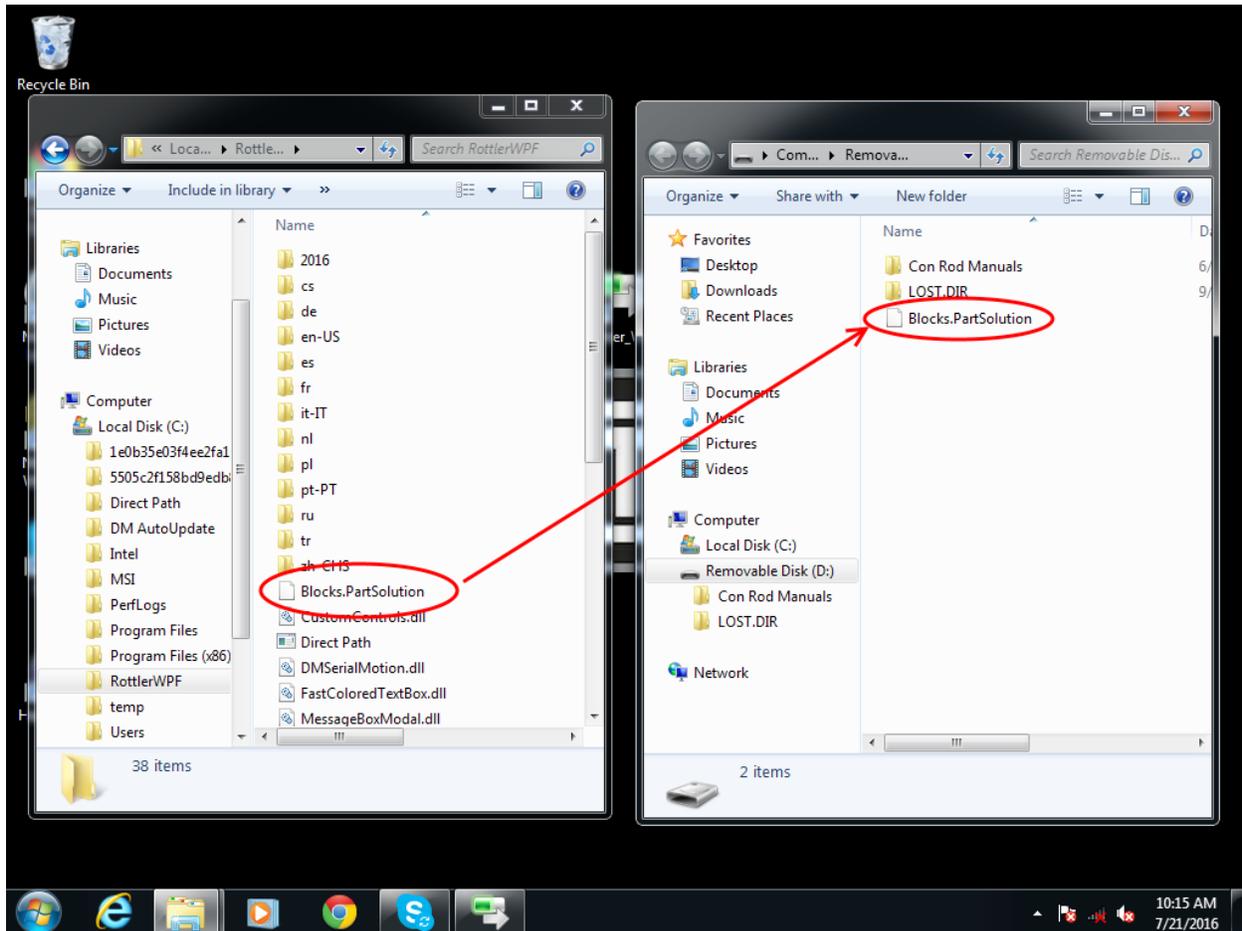
Click on the Open folder to view files option and the following screen will appear. This is the contents of the flash drive you just plugged in.



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



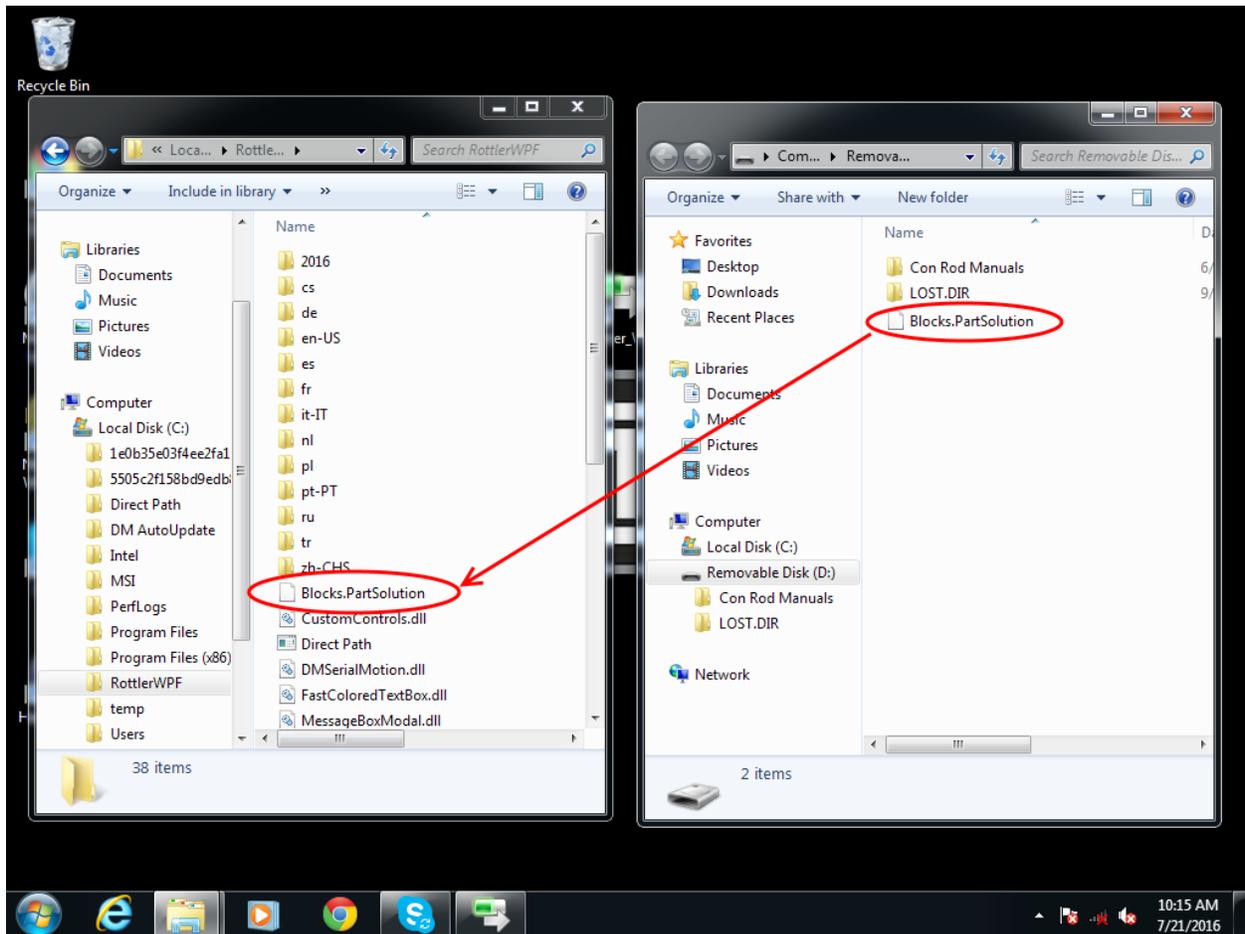
Block profiles are backed up each time the machine is run with the current profiles being shown in the RottlerWPF folder. All that needs to be done to back up the current profile is to simply drag it from the RottlerWPF folder to the flash drive folder. A copy of the file will be placed on the flash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



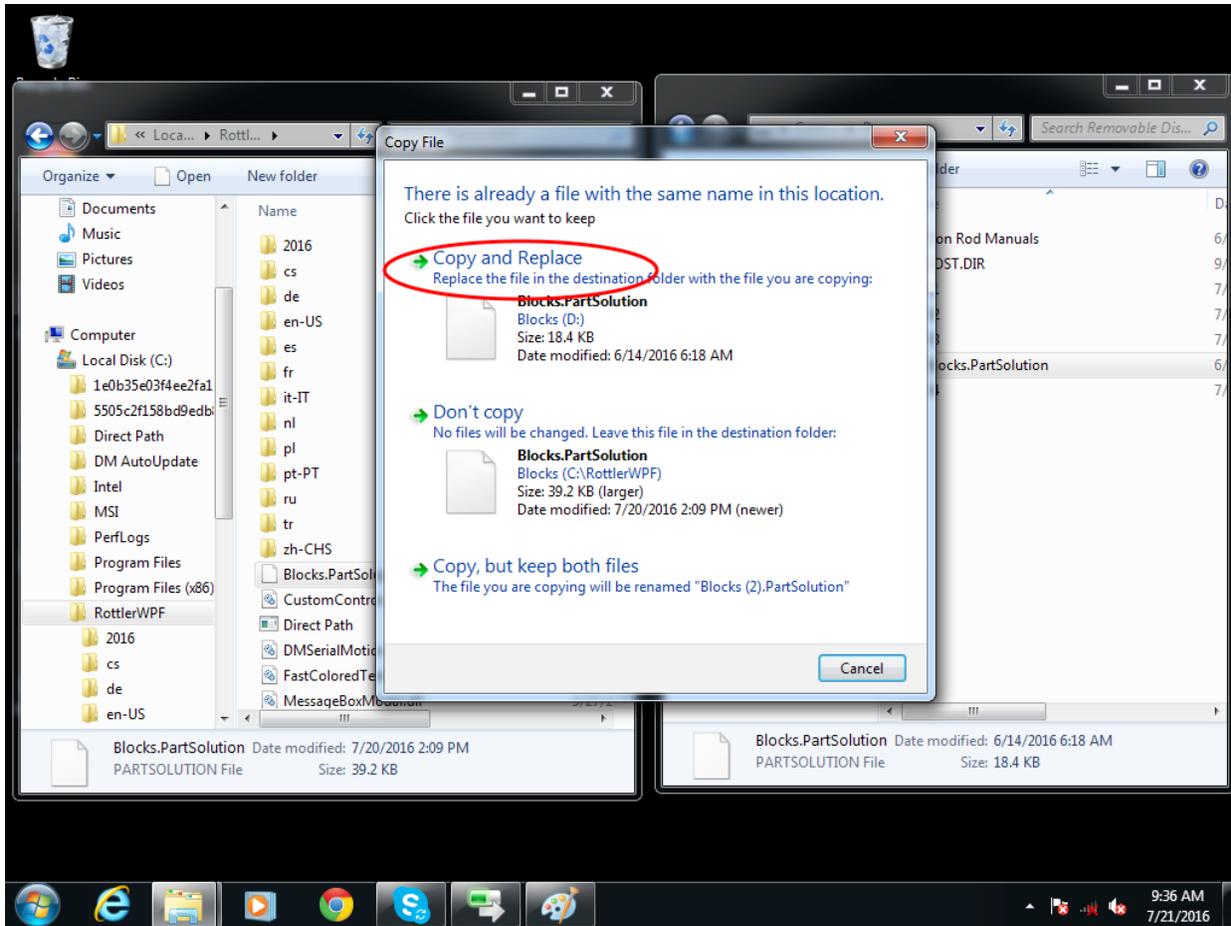
Backup is now complete. Close both file browser windows and remove the flash drive.

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

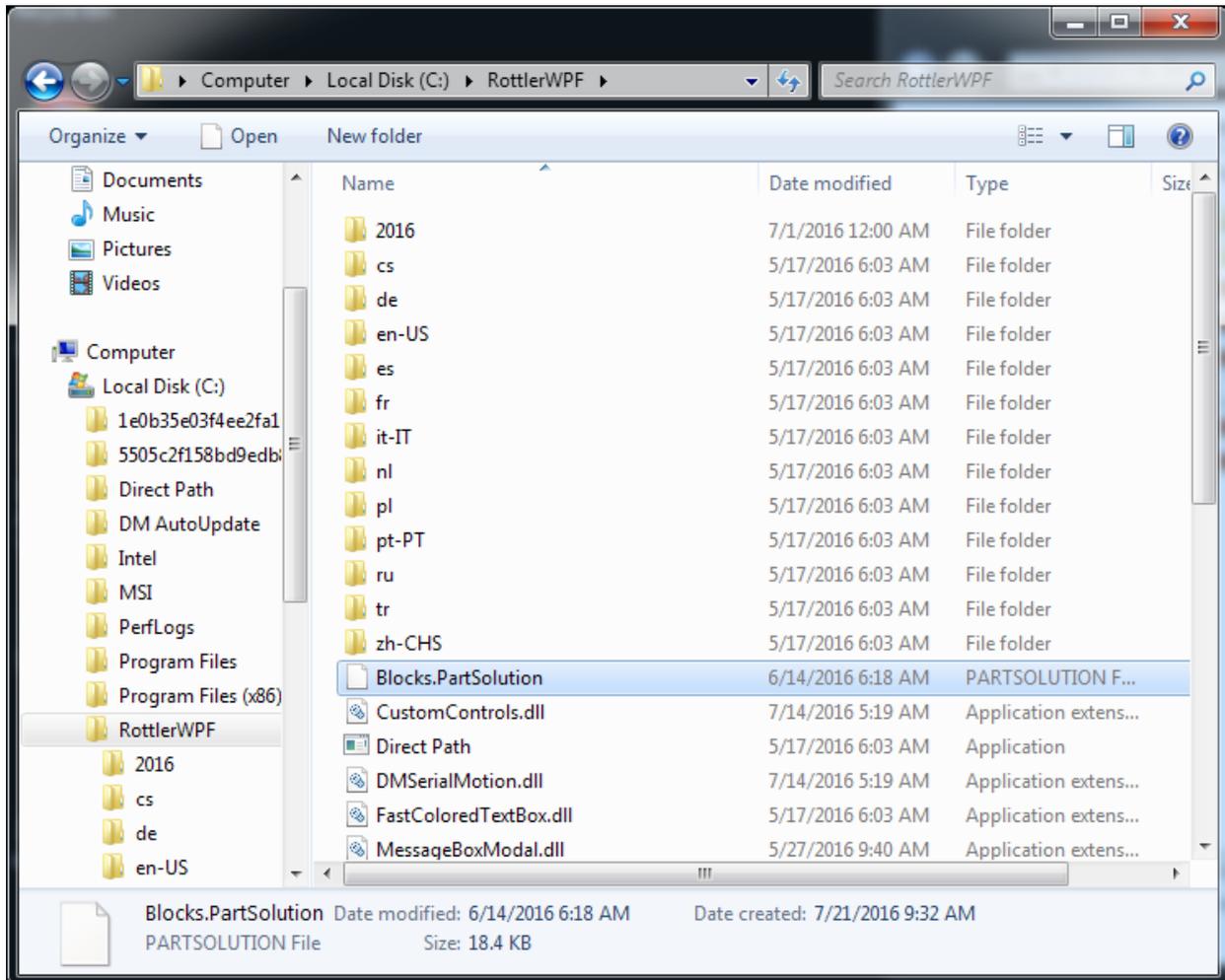
Highlight the block profiles file in the flash drive and drag it into the RottlerWPF folder on the local hard drive.



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

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## Maintenance



Follow all relevant safety procedures as described in Section 3 of this manual before performing any maintenance or repair procedure.

## Lubrication



Refer to the Material Safety Data Sheets on the manual CD for information on proper use and handling of lubricants mentioned in this maintenance section.

## Grease Fittings

There are grease fittings on the main carriage assembly, the optional clamp arm assemblies, and the optional Turn Over Fixture. See the following images for locations of grease fittings and intervals for adding grease.

***These grease fittings should be greased, using NLGI #2 White Lithium Grease.***

## Automatic Lubricator

The oil injection lubricator is located on the back of the main base. The oil injector lubricates the ballscrews. The automatic injection lubricator is controlled by the machine program. The controller will activate the injection lubricator at a predetermined time interval

***When needed***, add lubrication oil to the reservoir. ***Use ISO VG 68 Way Oil.***

## Electrical Enclosure

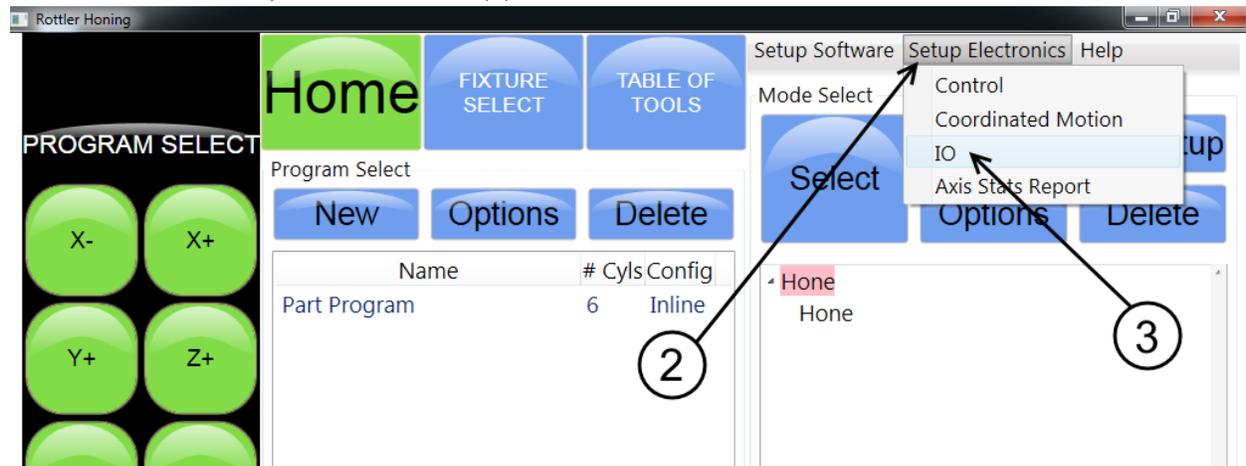
On a weekly basis check the door air filter and the aluminum finned heat sink and fan assembly. Replace the air filter when it becomes dirty. Blow off the heat sink and fan when it becomes covered in dust. Refer to the Machine Parts section of this manual for more details and for part number of the filter.

## Priming Oil Lines

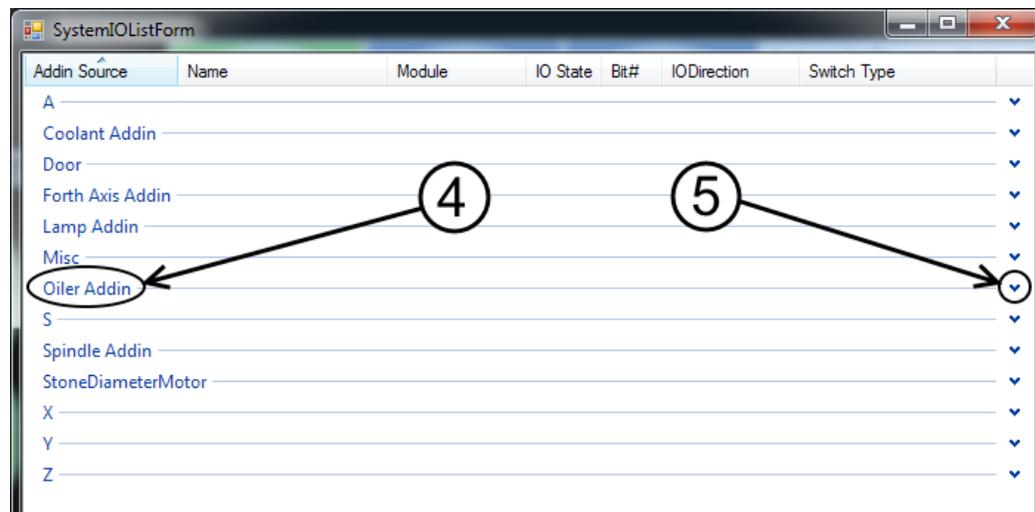
If there is ever the need to fill the oil lines that provide lubrication on the machine use the following procedure.

**CAUTION** Do this procedure with the E-STOP engaged to prevent any accidental activation of machine functions.

- 1 Go to the Home screen.
- 2 Click the Setup Electronics tab. (2)

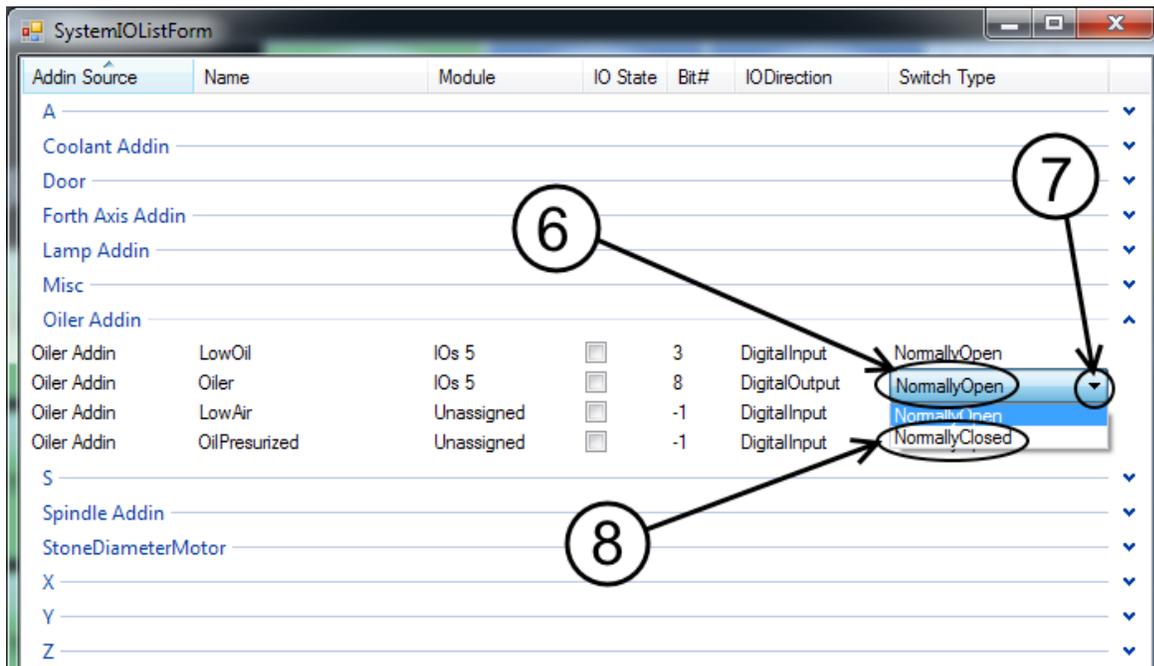


- 3 Select the IO tab (3) from the drop down menu. This will bring up the following screen.

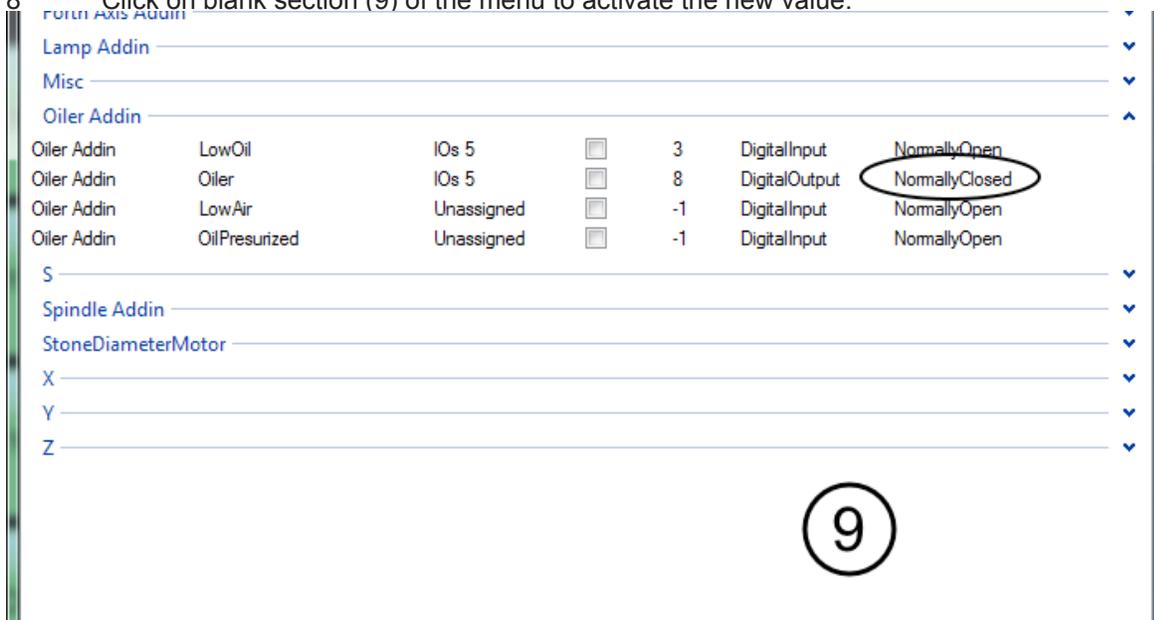


- 4 Go to the Oiler Addin line (4) and click the down arrow (5) to expand the section.

- The second item on the expanded list is the control for the oiler. Click on NormallyOpen (6) and value box will appear.

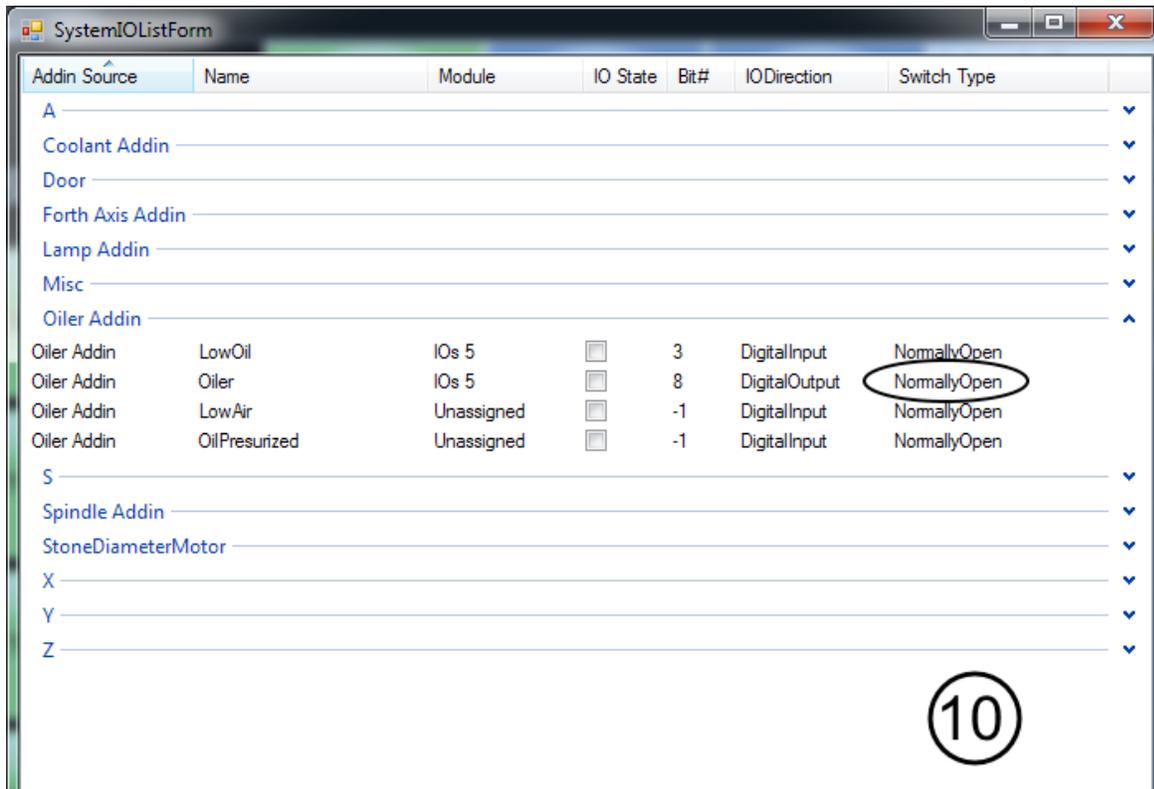


- Click on the down arrow (7) and the different values available will appear.
- Click on NormallyClosed (8) and it should appear on the second line in place of NormallyOpen.
- Click on blank section (9) of the menu to activate the new value.



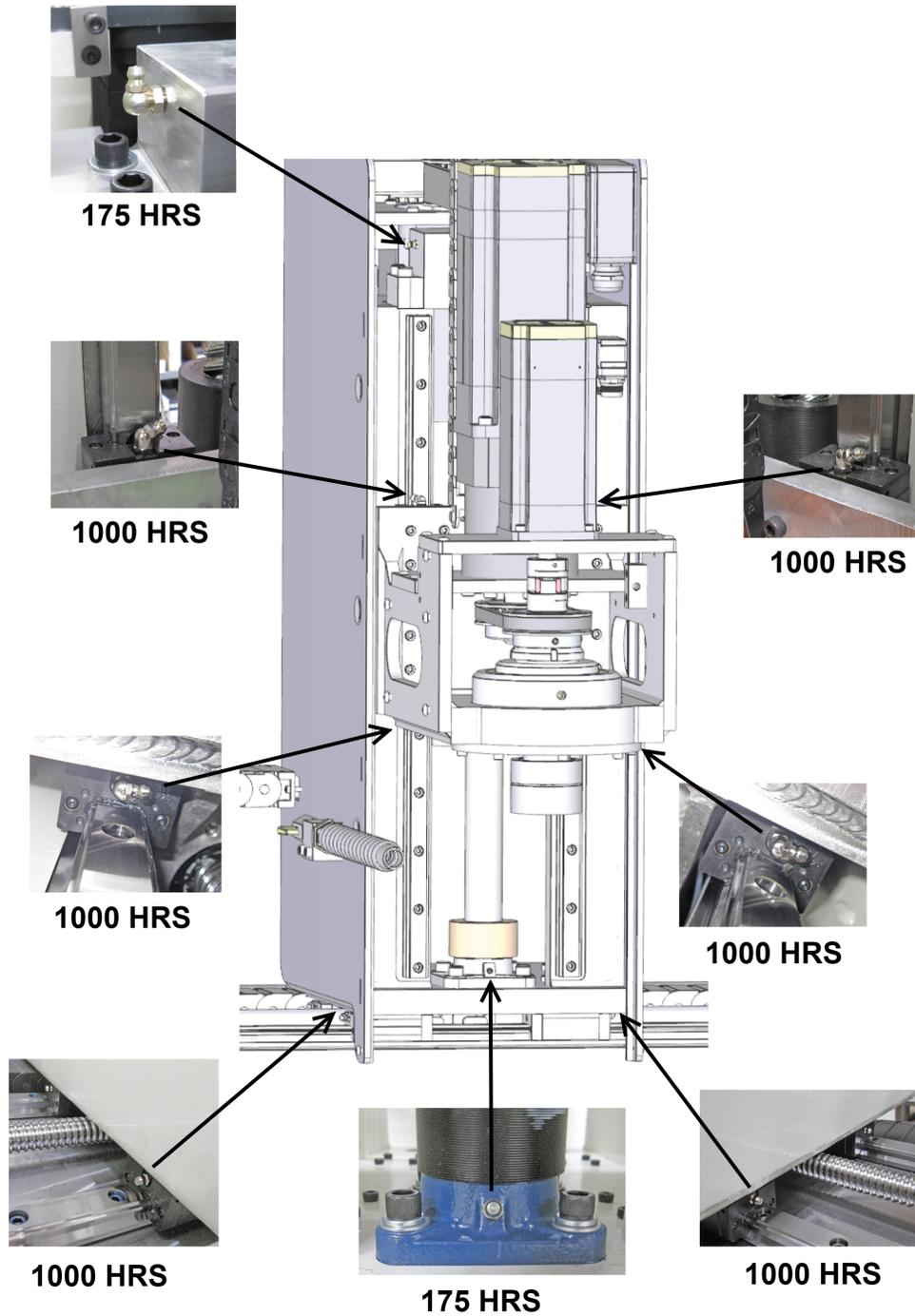
- Oiler should now be running. Observe the oil lines and wait for them to become filled with oil.
- Once they are filled go back to the setup window.

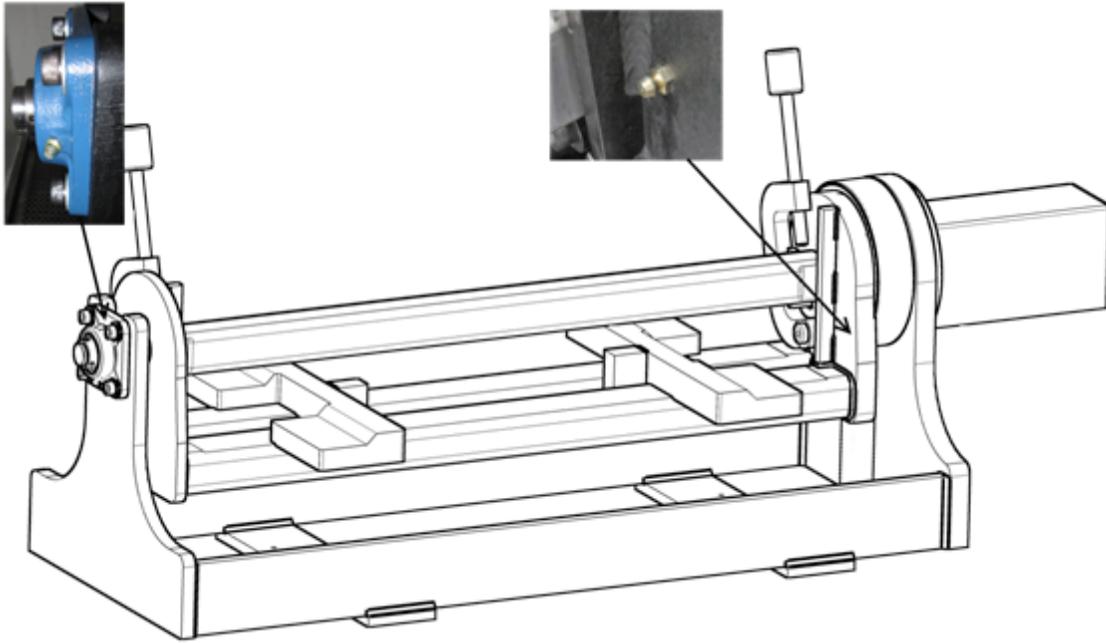
- 11 Click the NormallyClosed value, click the down arrow, then click NormallyOpen.



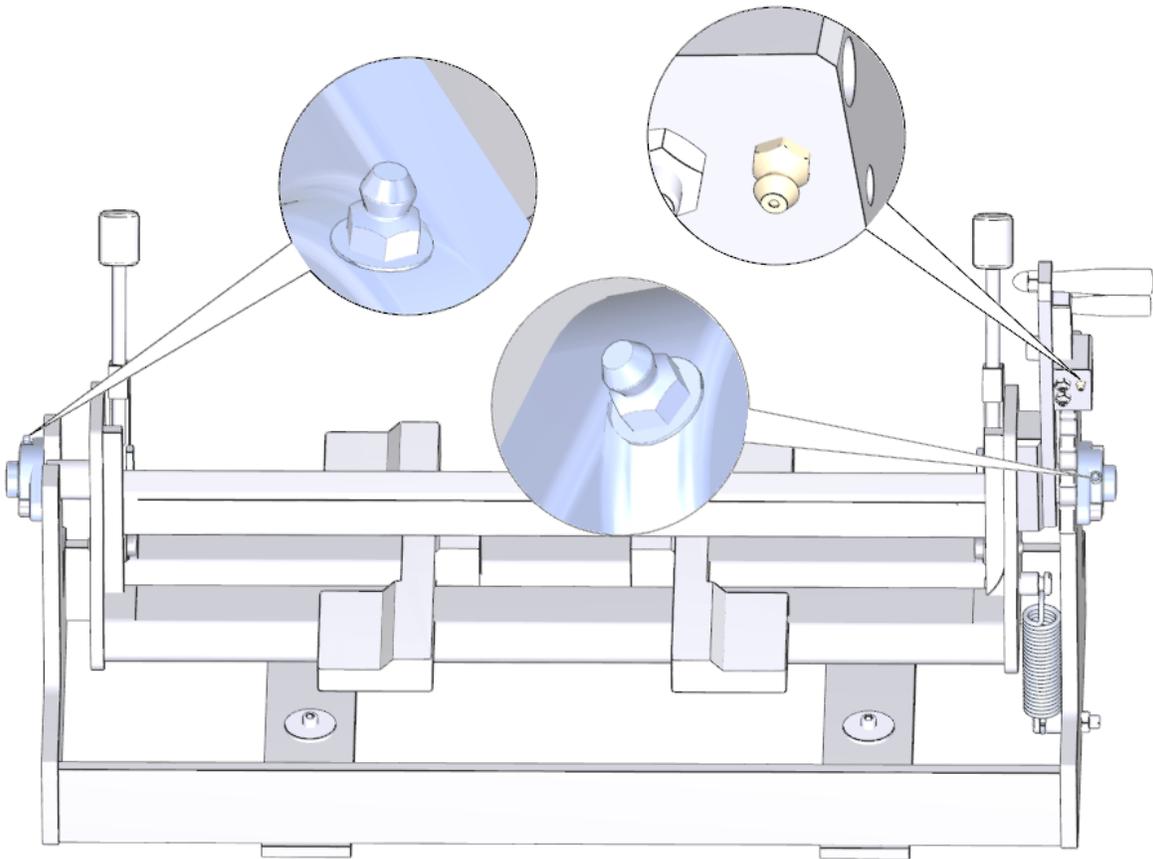
- 12 Click on a blank area (10) to set the NormallyOpen value.  
13 Close the window.  
14 Release the E-STOP.

### Grease Fitting Locations





***Grease should be added every 175 hours of service time.***



## Honing Coolant

The coolant pump is located in the back of the splash tank. The coolant drains under the block fixture into a sump under the machine.

Change the honing coolant when it gets dirty. When changing coolant, completely clean tank and filter screen. Refill with Rottler 514-4-71C coolant mixed with water to a reading of 3 – 5 on the Refractometer scale. If a Refractometer is not available then a static ratio of 5% - 8% is acceptable. Ratio of coolant to water will be approximately 1:20 or 1 gallon of coolant for each 20 gallons of water.

## Standard Coolant Filter Unit

Replace filter element in filter housing as needed.

Use the supplied 514-2-42D wrench to loosen the filter bowl from the housing. Remove old filter and replace with new filter (514-2-42C). Use wrench to retighten bowl onto housing. **Do not over tighten.**

## Magnetic Coolant Filter Unit

Clean unit when it becomes half full of honing particles.



Remove housing from base unit



Remove dirty magnetic element from housing



Place magnetic element on supplied stand

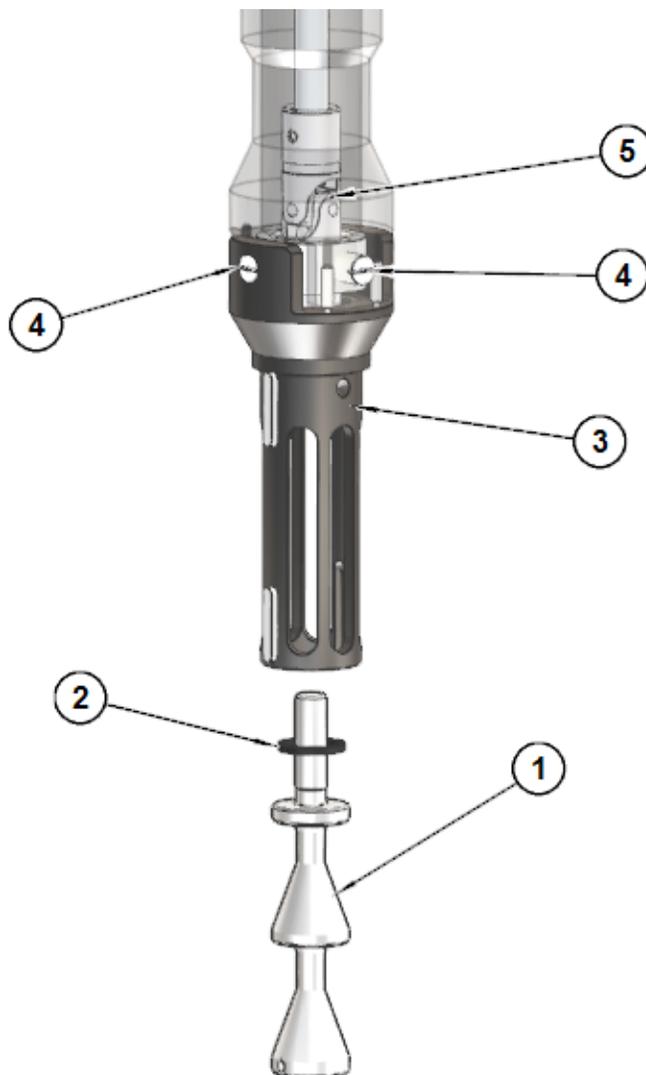
Using supplied scrapper, remove build up from magnetic element

Place cleaned magnetic element back into housing and reattach to base unit

### Hone Head Maintenance

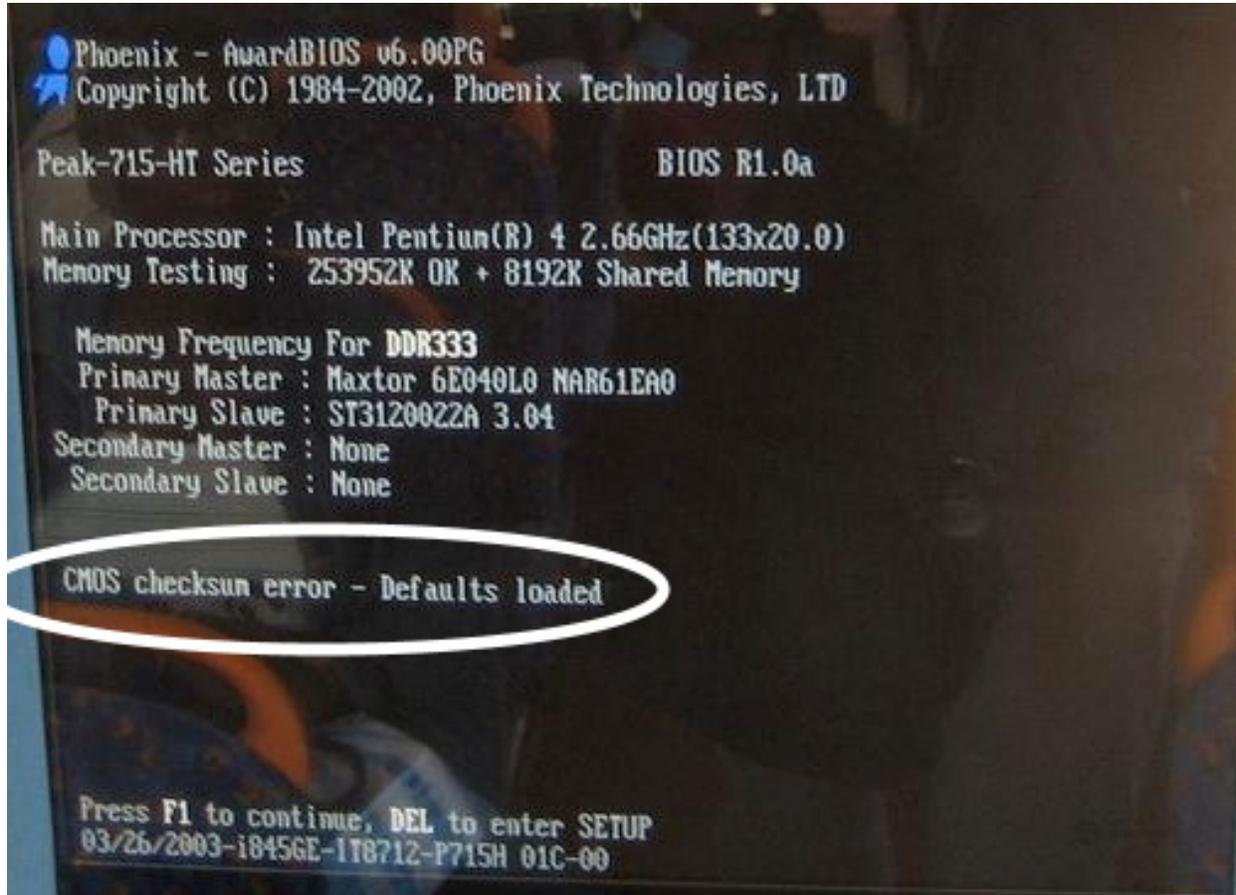
This procedure should be performed every 40 hours of machine operation or weekly, whichever comes first.

1. Remove cone rod (1) from body (3) and clean threads. Lubricate threads with high pressure grease.
2. Check rubber bumper (2) for damage. Replace if damaged.
3. Clean hone head body.(3)
4. Lubricate 4 pivot screws (4) with motor oil.
5. Lubricate feed nut universal (5) with motor oil.
6. Replace cone rod (1) and rubber bumper (2) into hone head body.(3)



## 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.



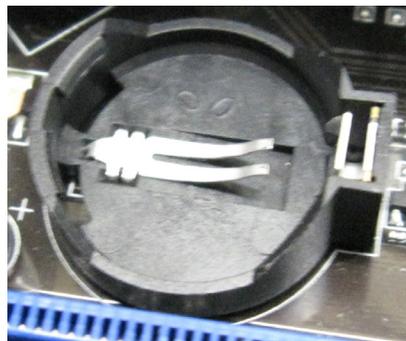
Locate the battery on the motherboard.



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.

## Belt Tension Adjustment

***Belt Tension settings for the Z-Axis motor and the spindle drive motor are critical and must be set properly for best performance and to avoid potential damage.***

Belt Tension Specifications are as follows:

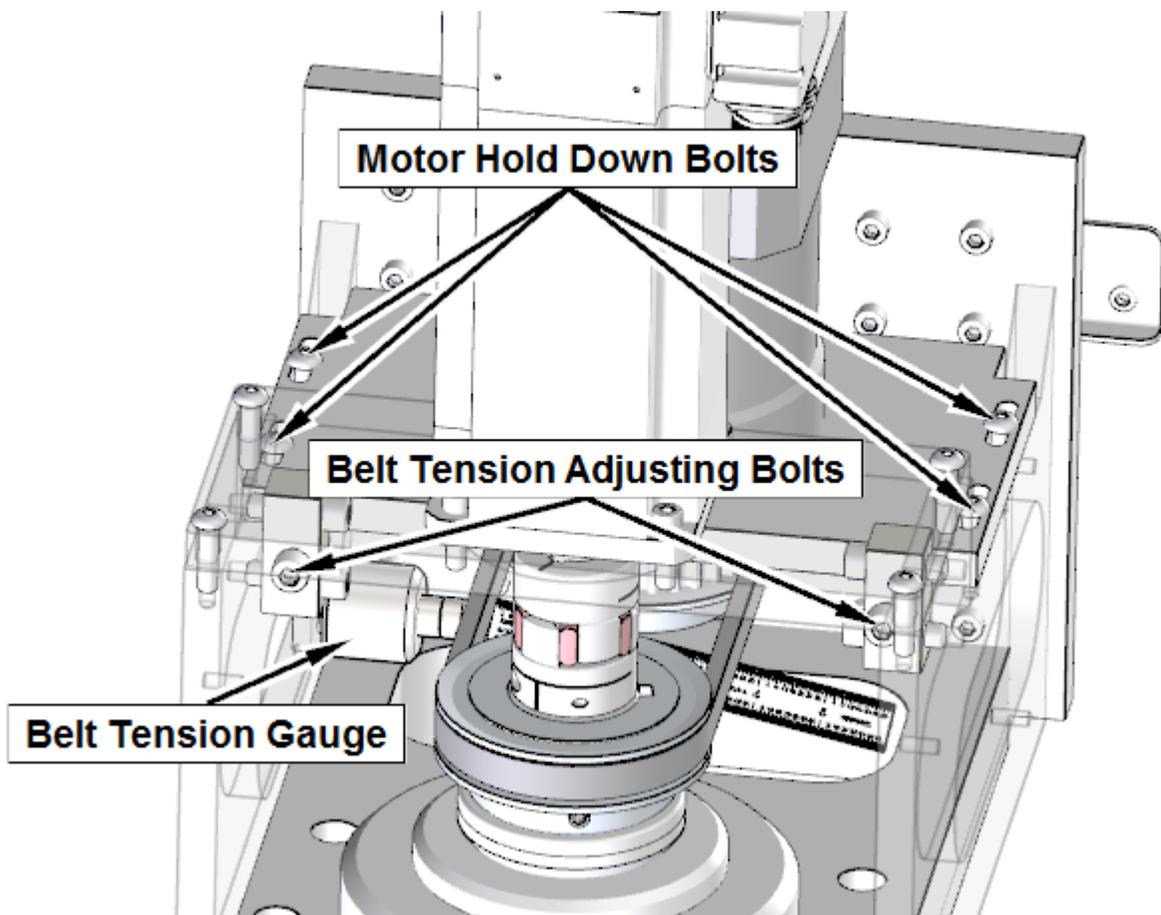
- Z-Axis motor belt tension, 5 lbs of tension should produce 1/2" of belt deflection.
- Spindle drive motor belt tension, 3 lbs of tension should produce 1/4" of belt deflection.

**⚠ CAUTION** *Be sure that power is turned off before adjusting belt tension.*

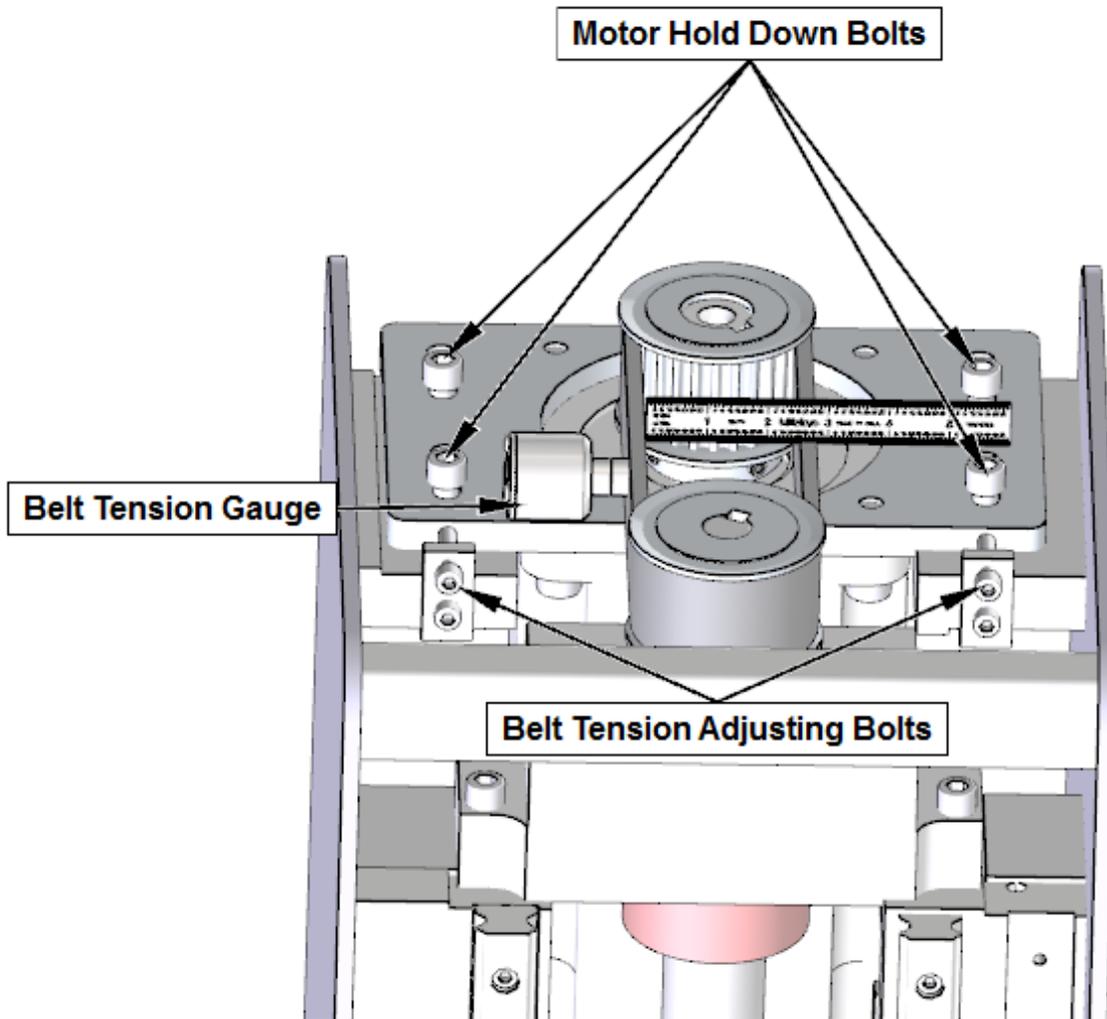
Adjustment on both motors is done by loosening the bolts that hold the motor in place and then tightening or loosening the belt tension adjusting bolts until the specification for that particular belt is reached.

Tighten motor hold down bolts after adjustment is completed.

## Spindle Motor Belt Adjustment



**Z-Axis Motor Belt Adjustment**



## 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



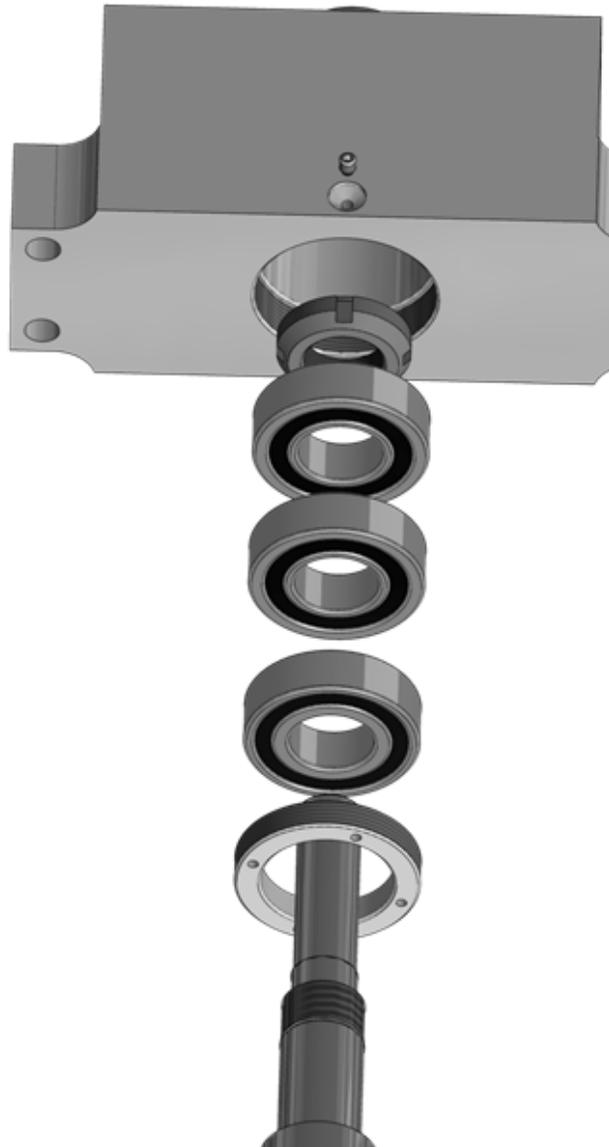
VIEW CUP DOWN

## Z-Axis Bearing Installation Stacking Order

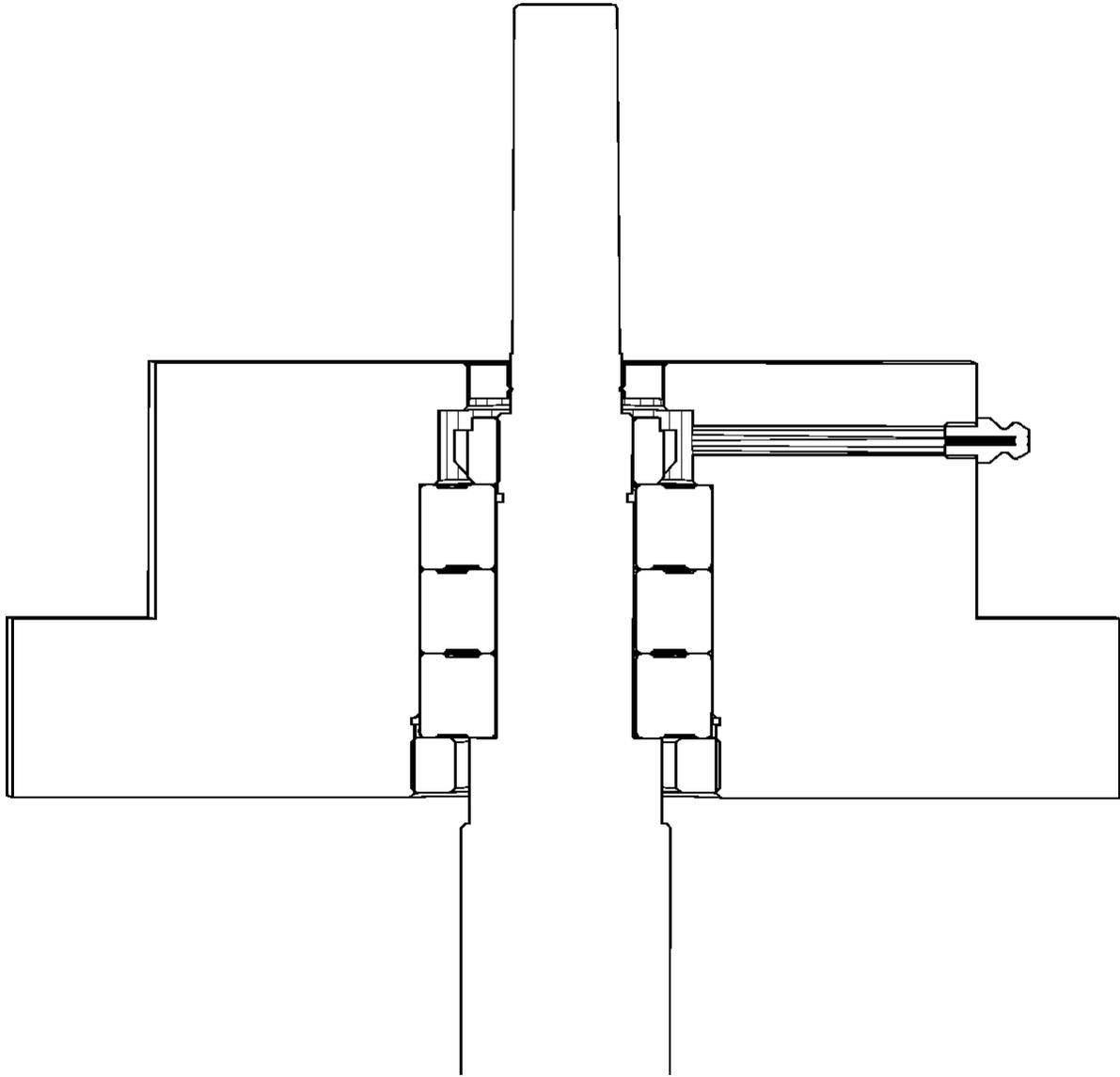
Z-Axis bearings have an asymmetrical inner race design. See illustration below for proper stacking order of bearings.

2<sup>nd</sup> and 3<sup>rd</sup> bearings are install with open end up towards locknut.

1<sup>st</sup> bearing is installed closed end up towards locknut.



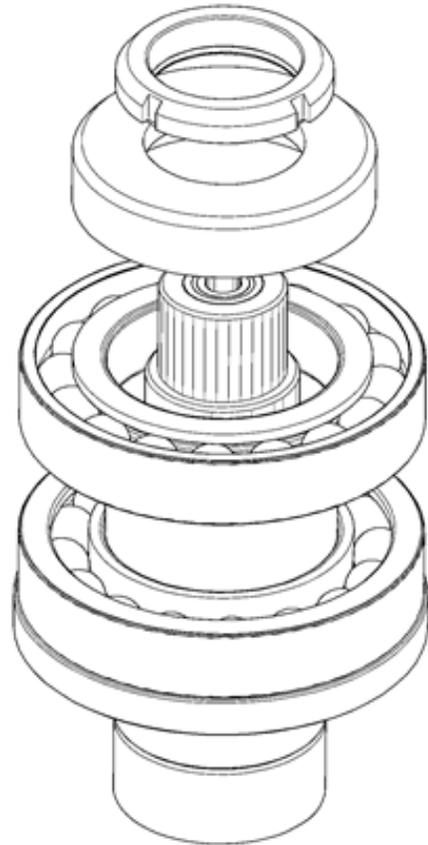
**Z-Axis Bearing Installation Section View**



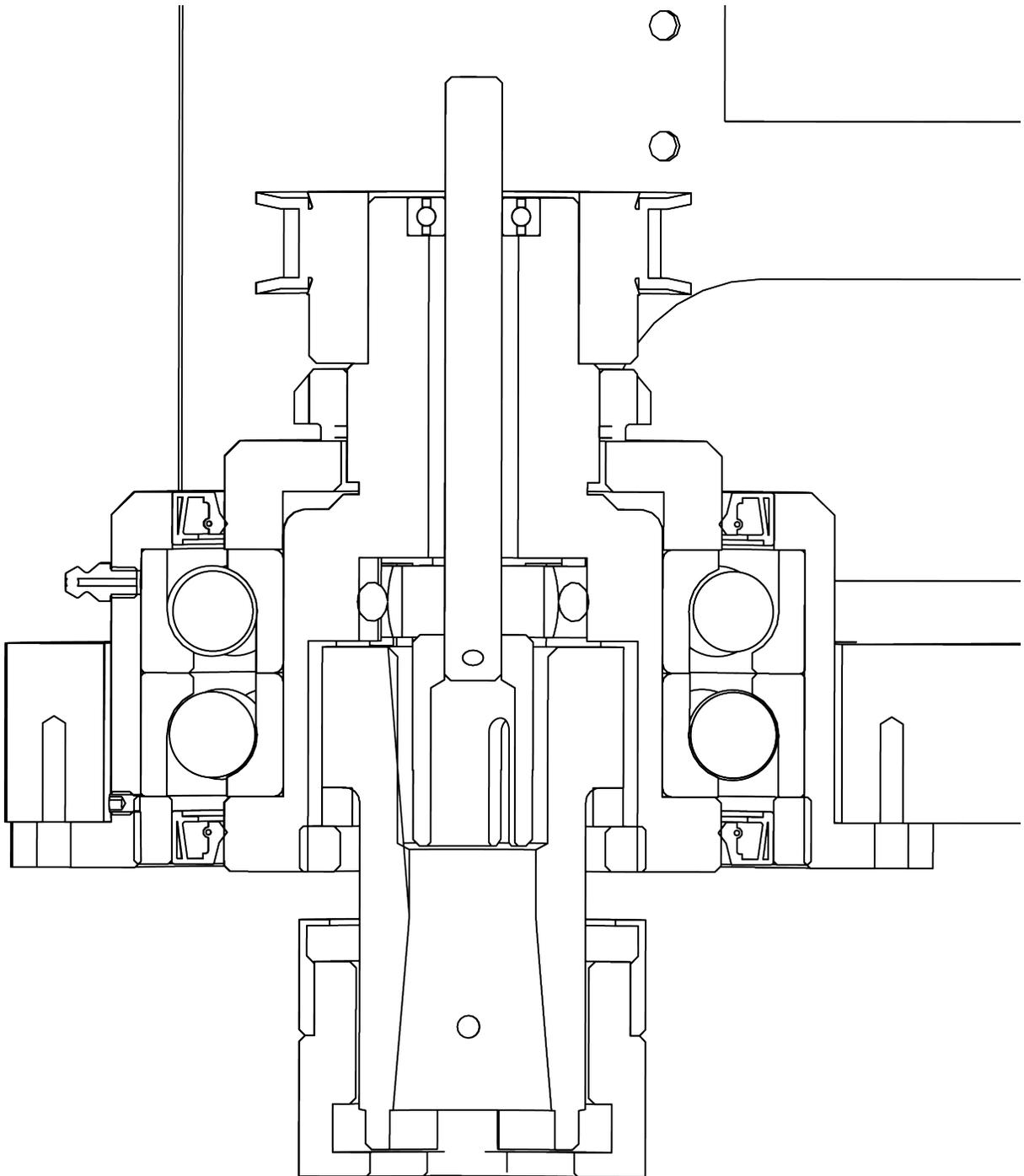
## Spindle Housing Bearing Installation Stacking Order

2<sup>nd</sup> bearing is installed with closed end down towards flange.

1<sup>st</sup> bearing is installed with open end down towards flange.



**Spindle Housing Bearing Installation Section View**



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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.

For further assistance in troubleshooting:

Please visit the service tab of our web page at Send a Service Request [www.rottlermfg.com](http://www.rottlermfg.com) or contact the Rottler Factory Service at [service@rottlermfg.com](mailto:service@rottlermfg.com) for assistance and your service request.

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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# MACHINE PARTS

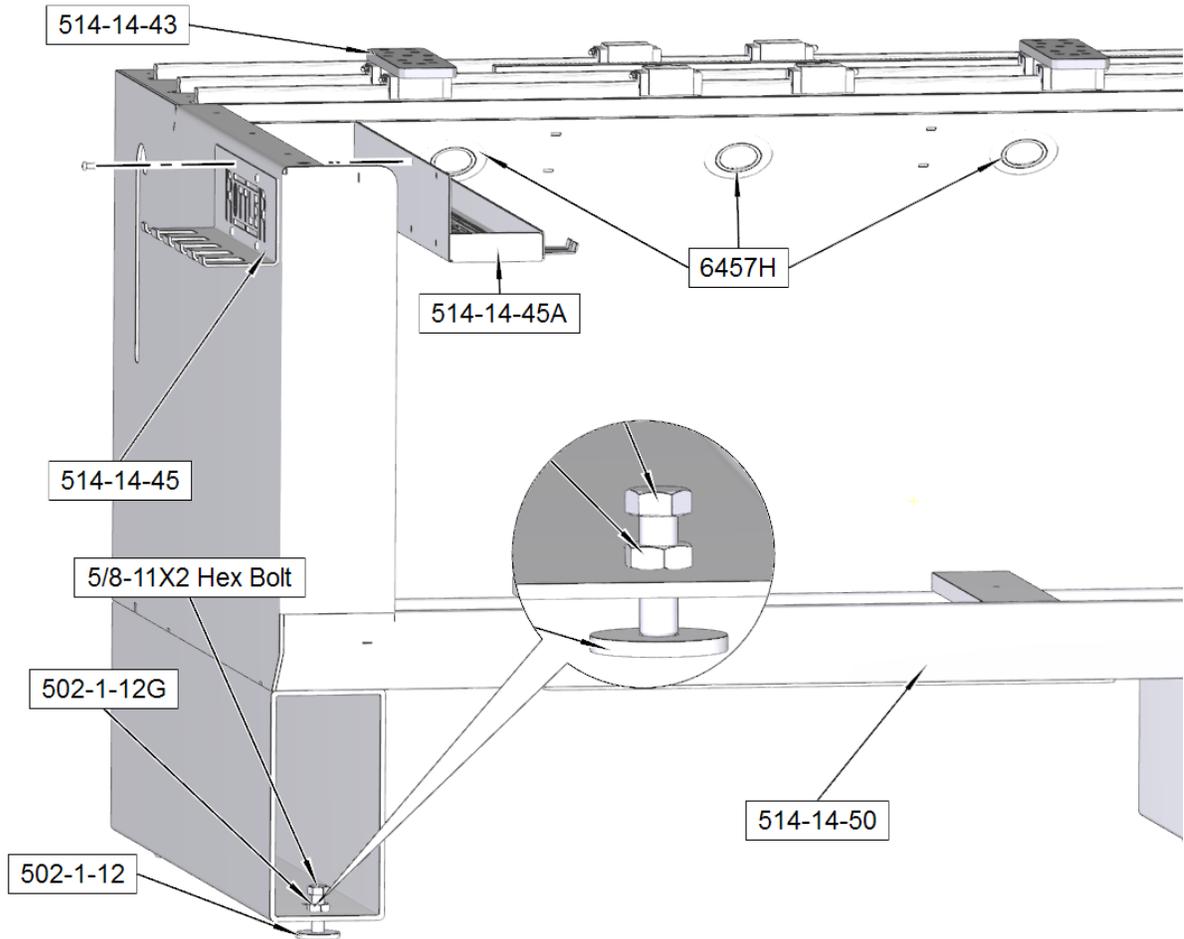
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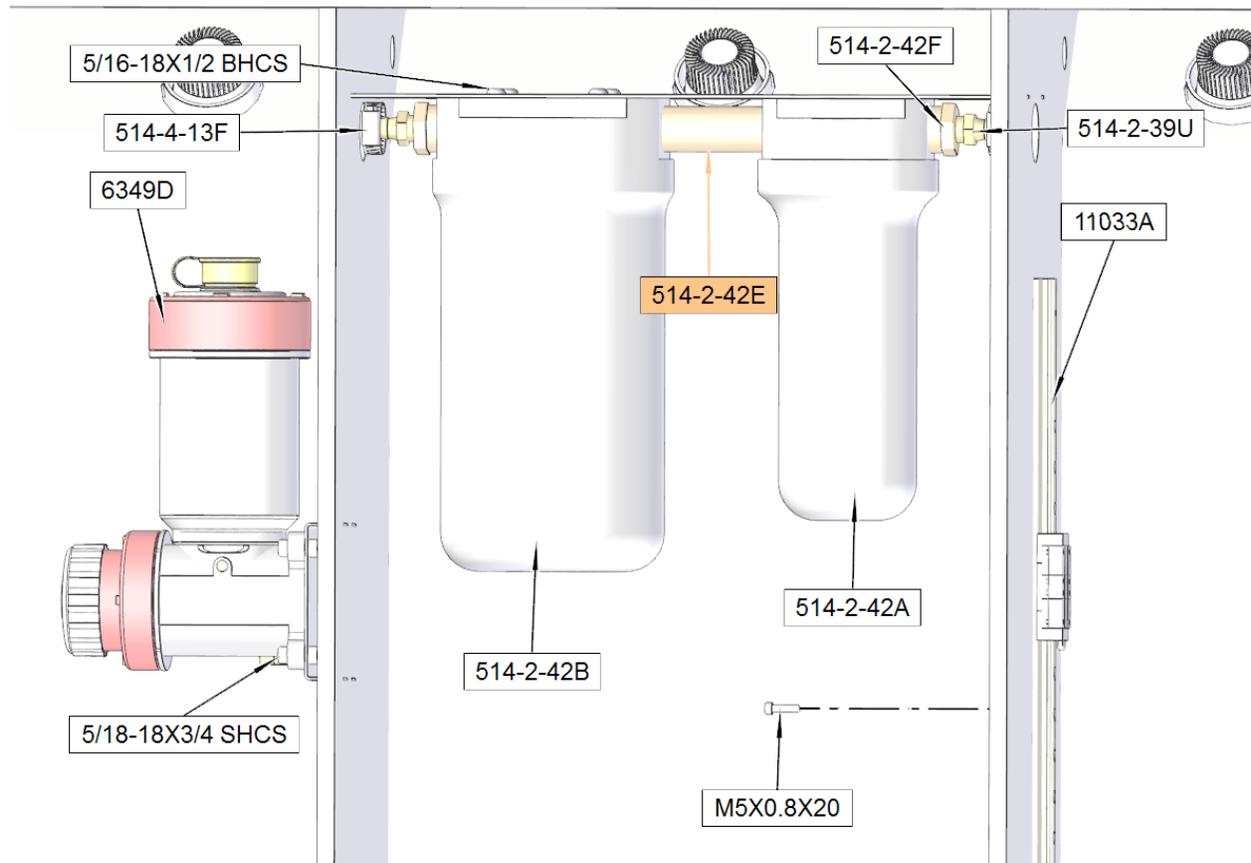
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## Machine Parts

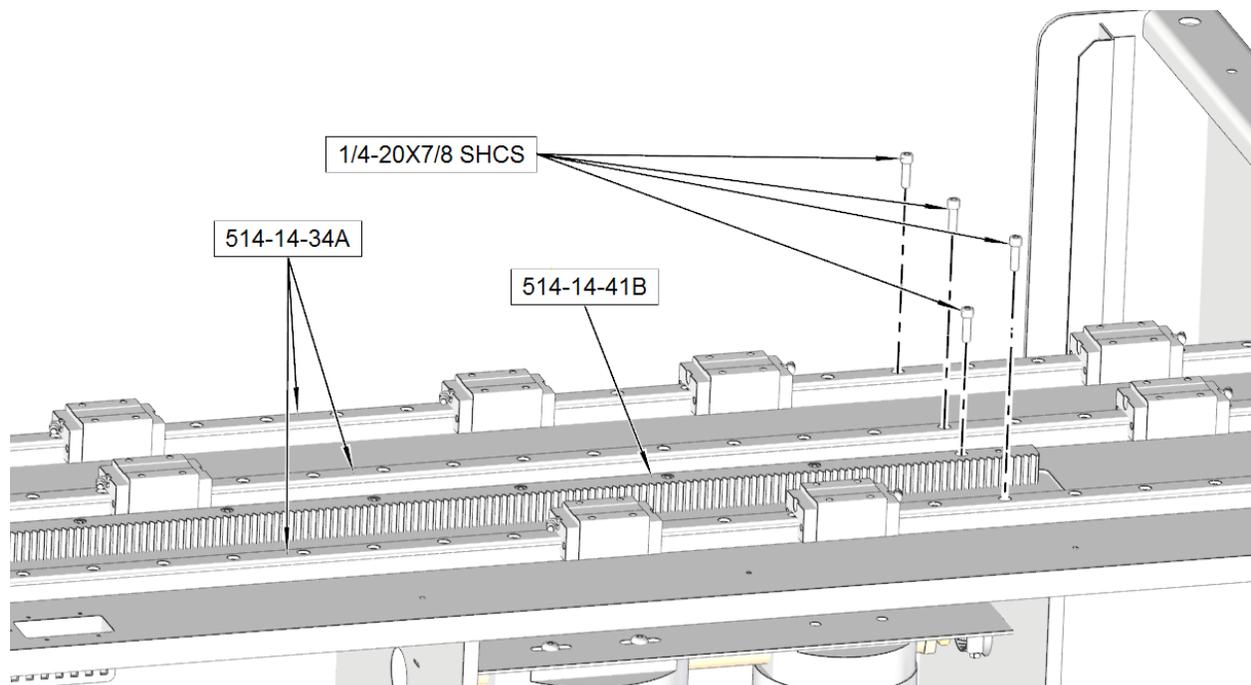
### Hone Tank and Components



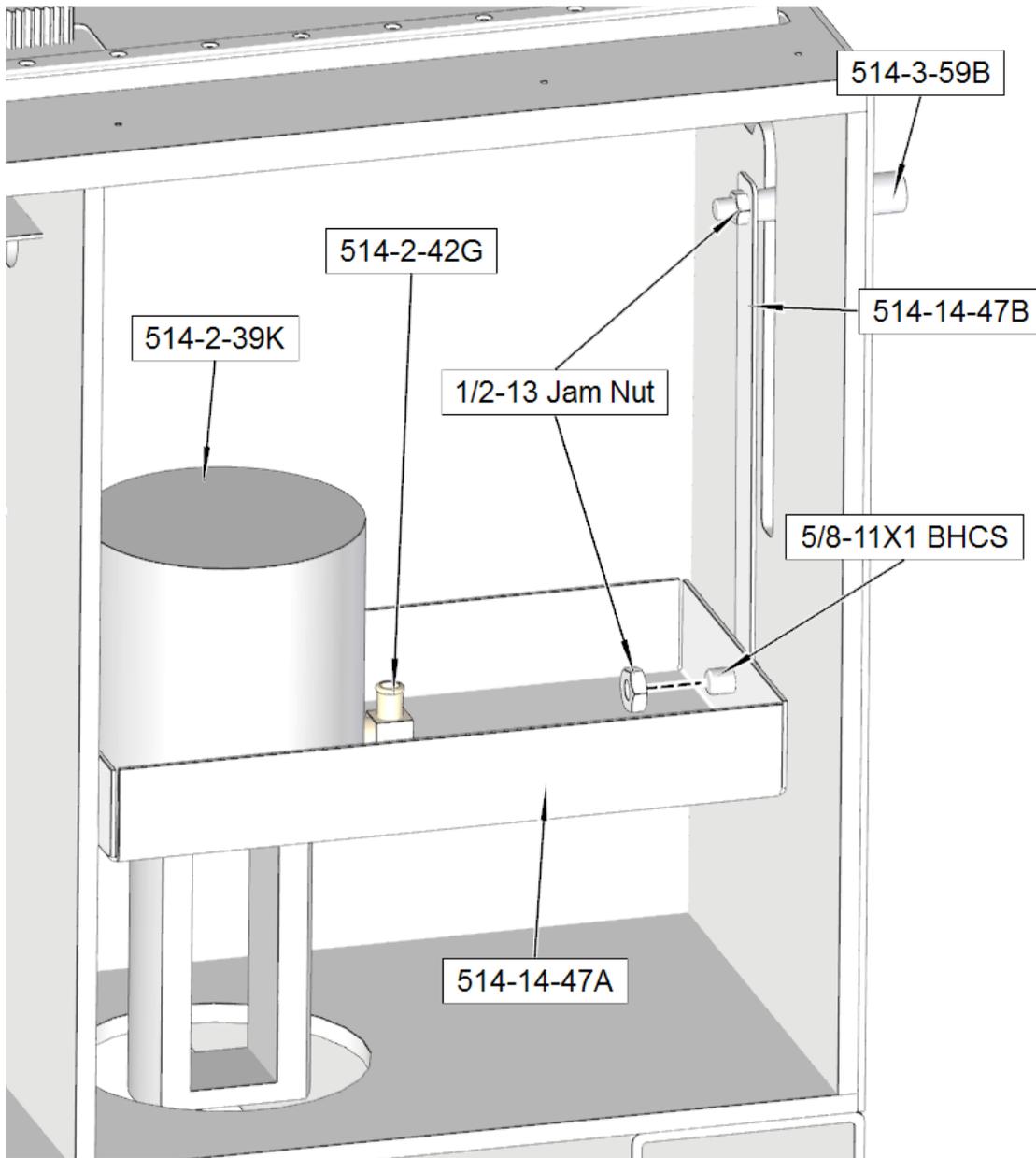
### Oiler and Filter Assembly



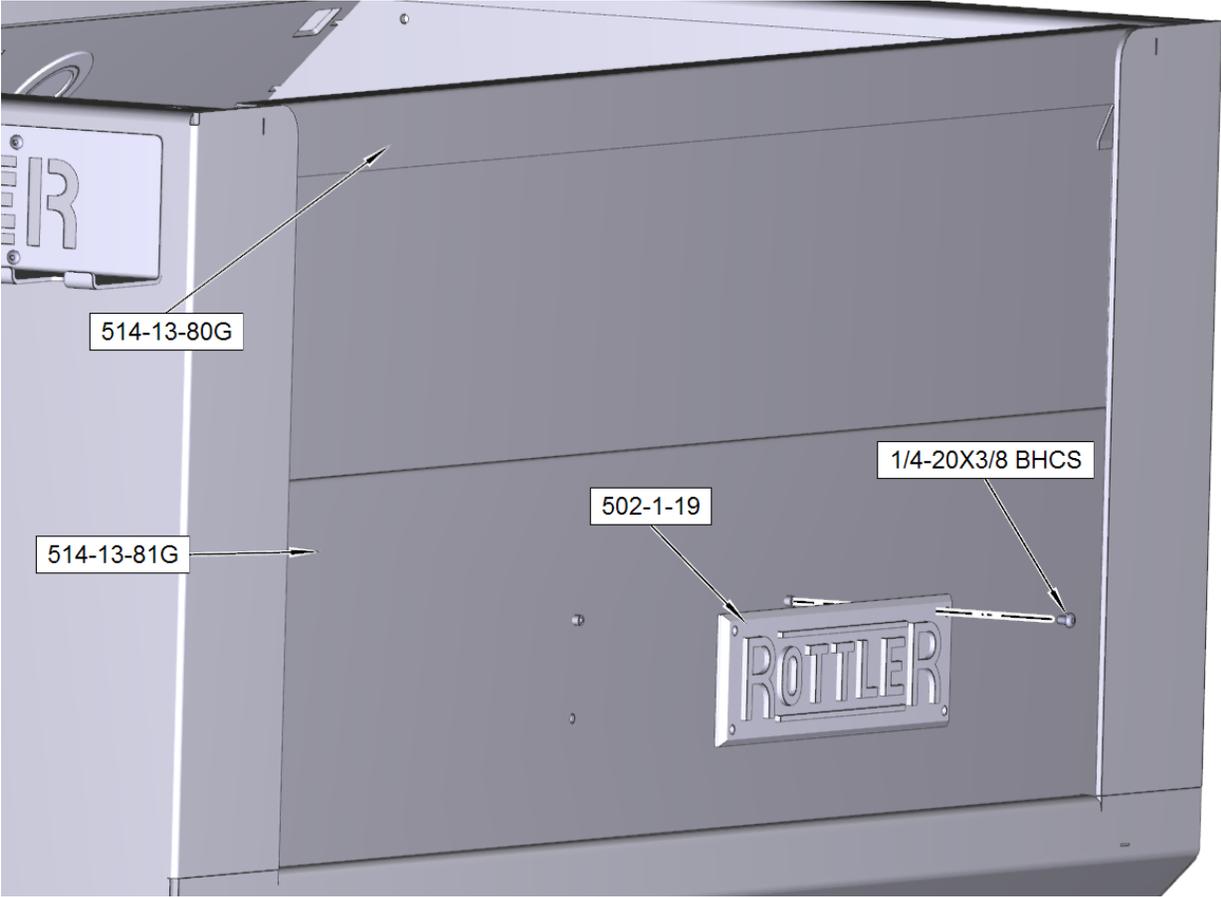
### Linear Rails and X-Axis Rack



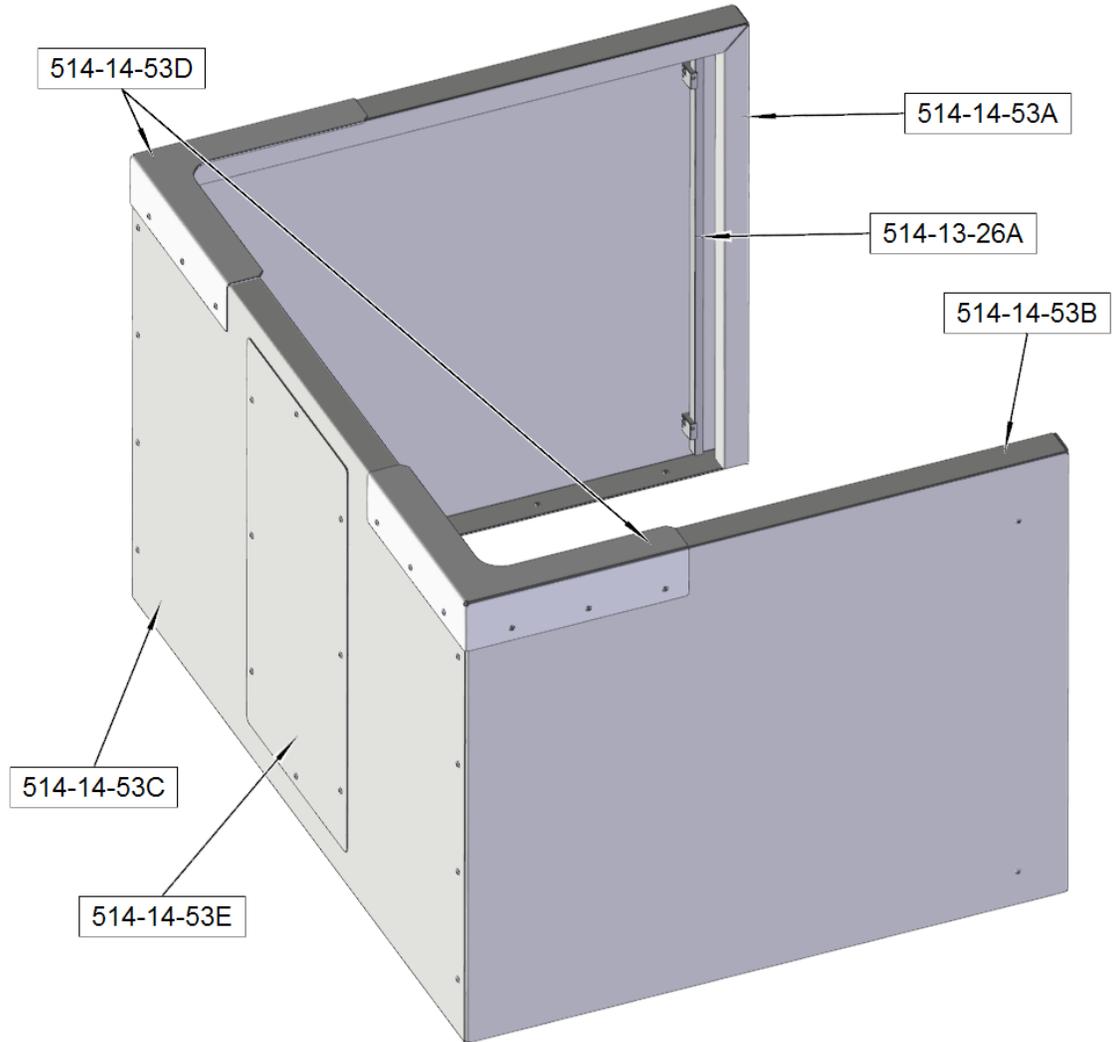
### Coolant Pump Assembly

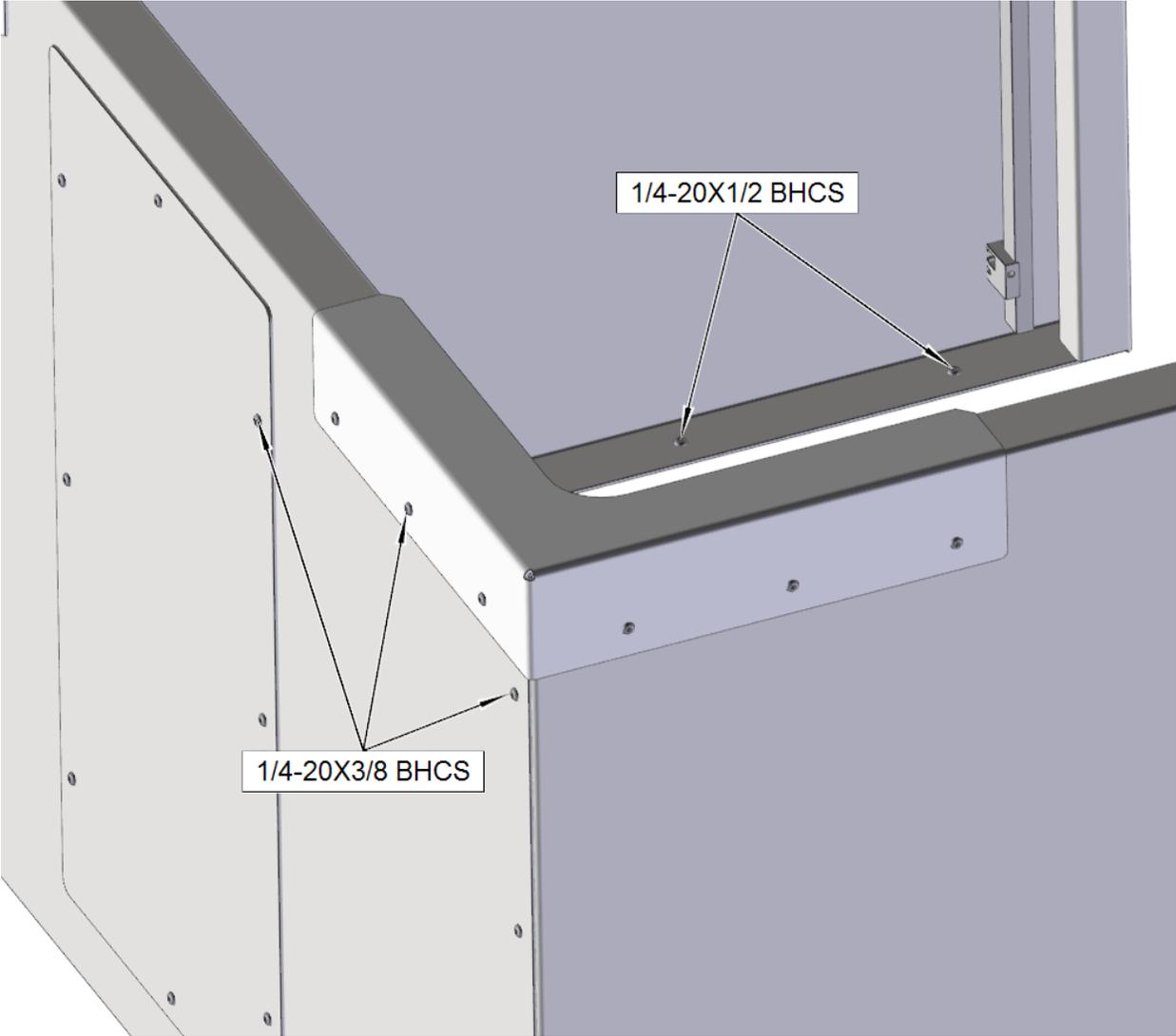


Doors

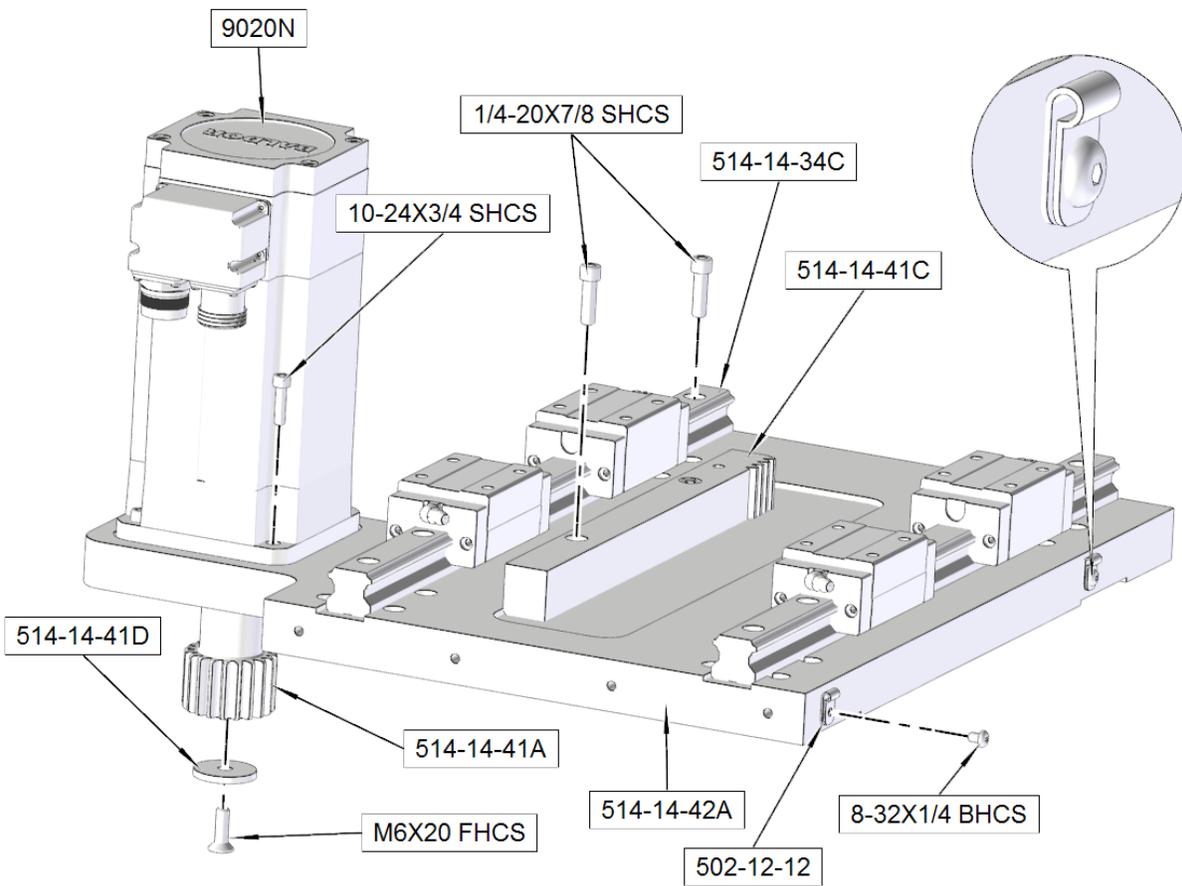


### Enclosure Parts



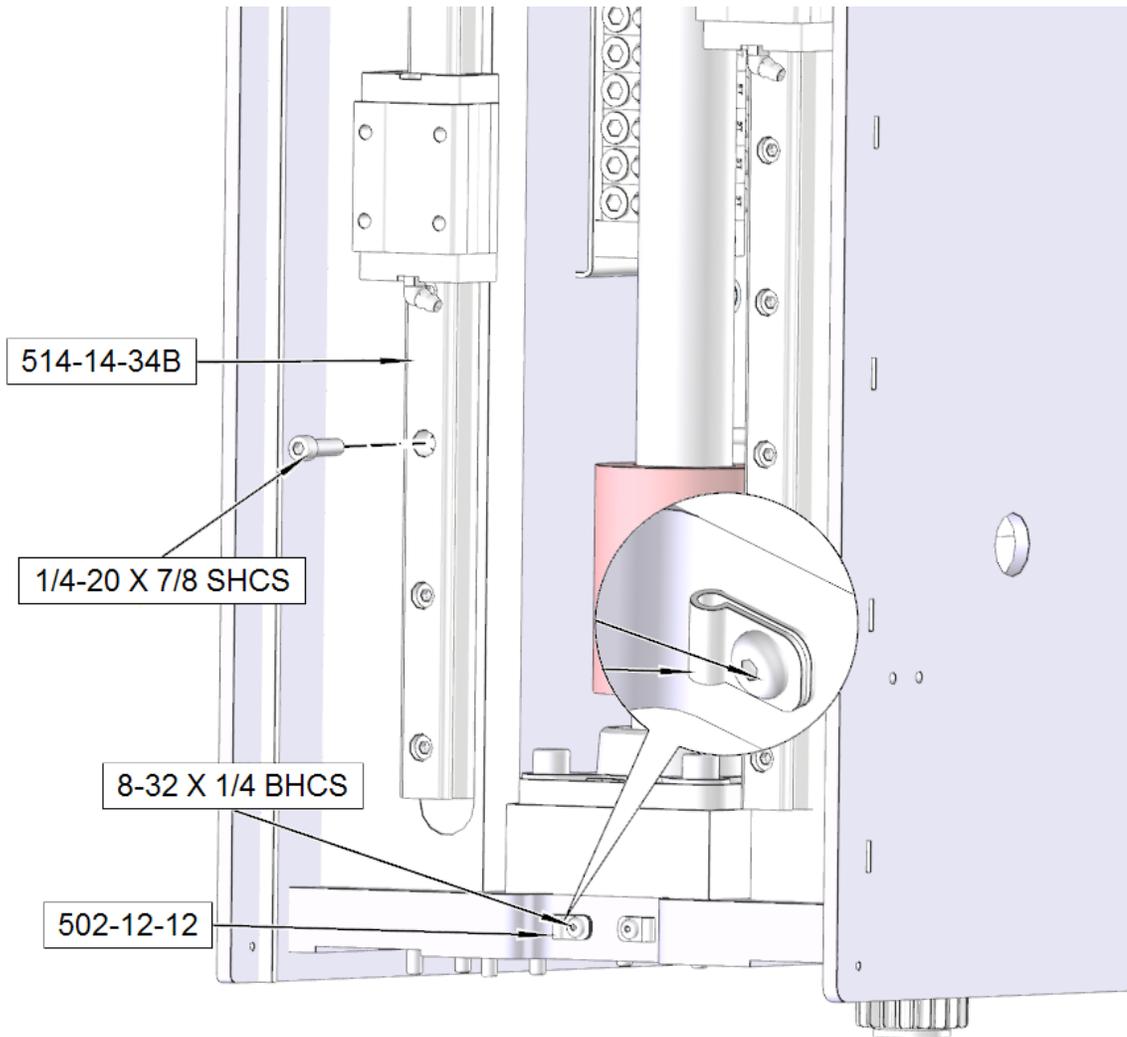


### Base Plate Assembly

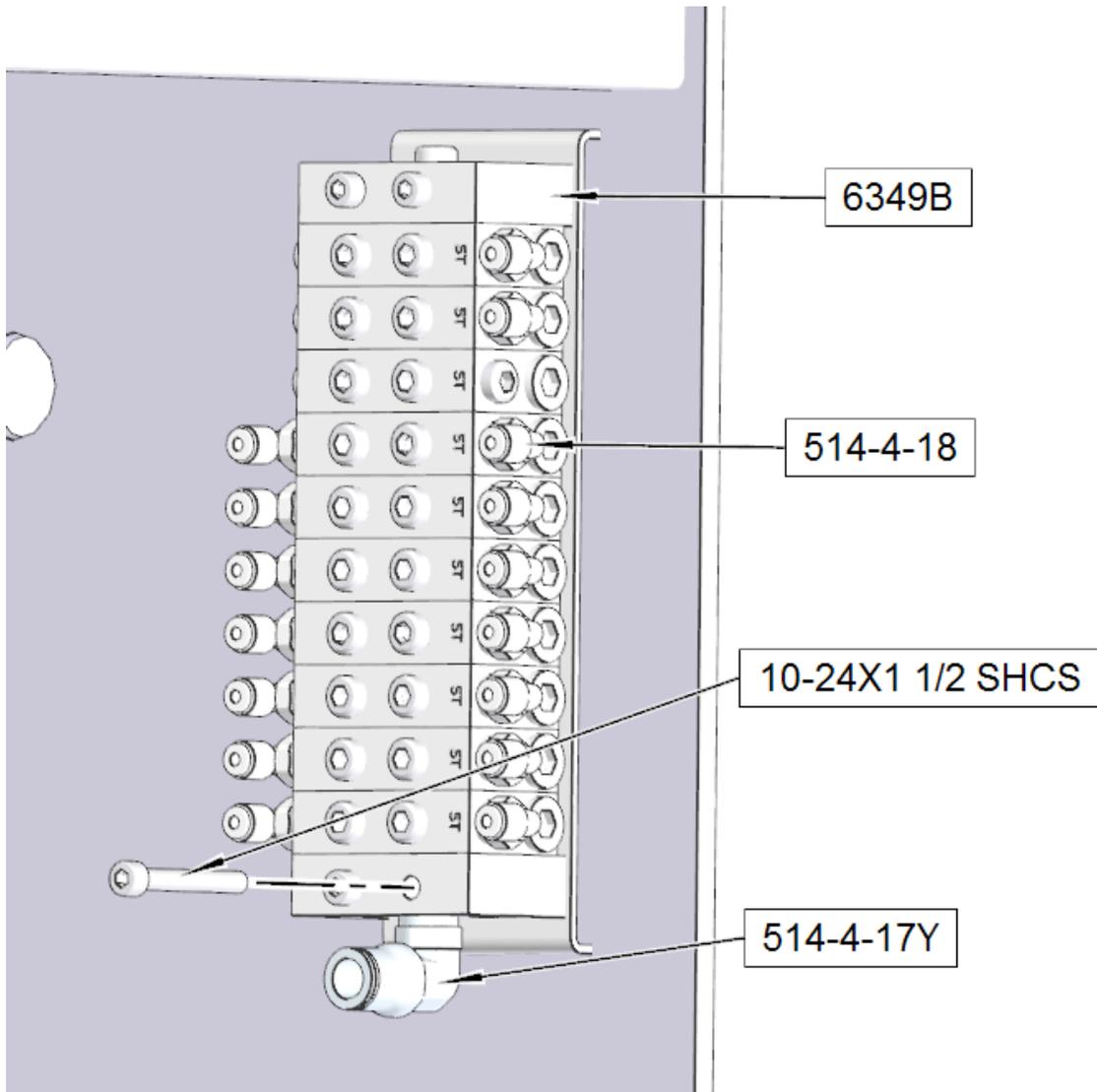




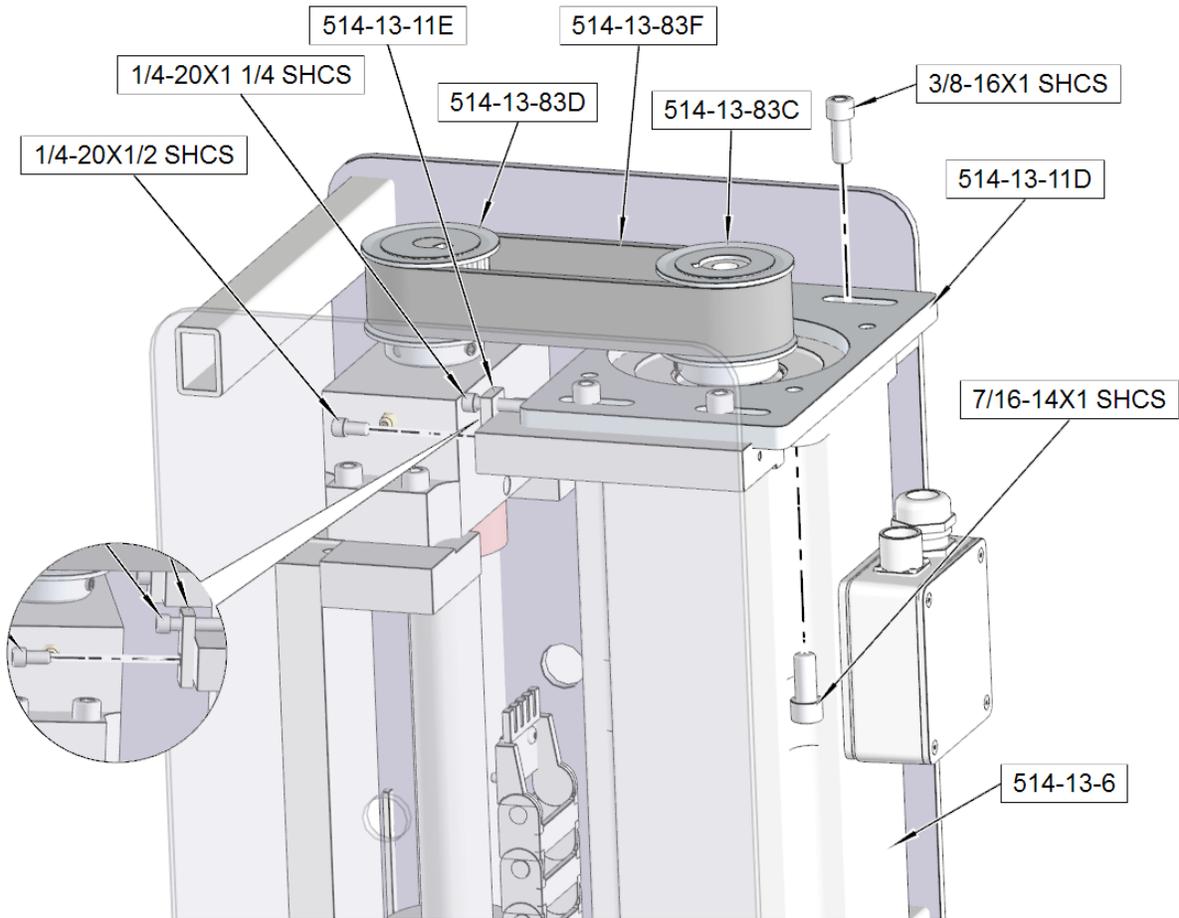
### Linear Rails



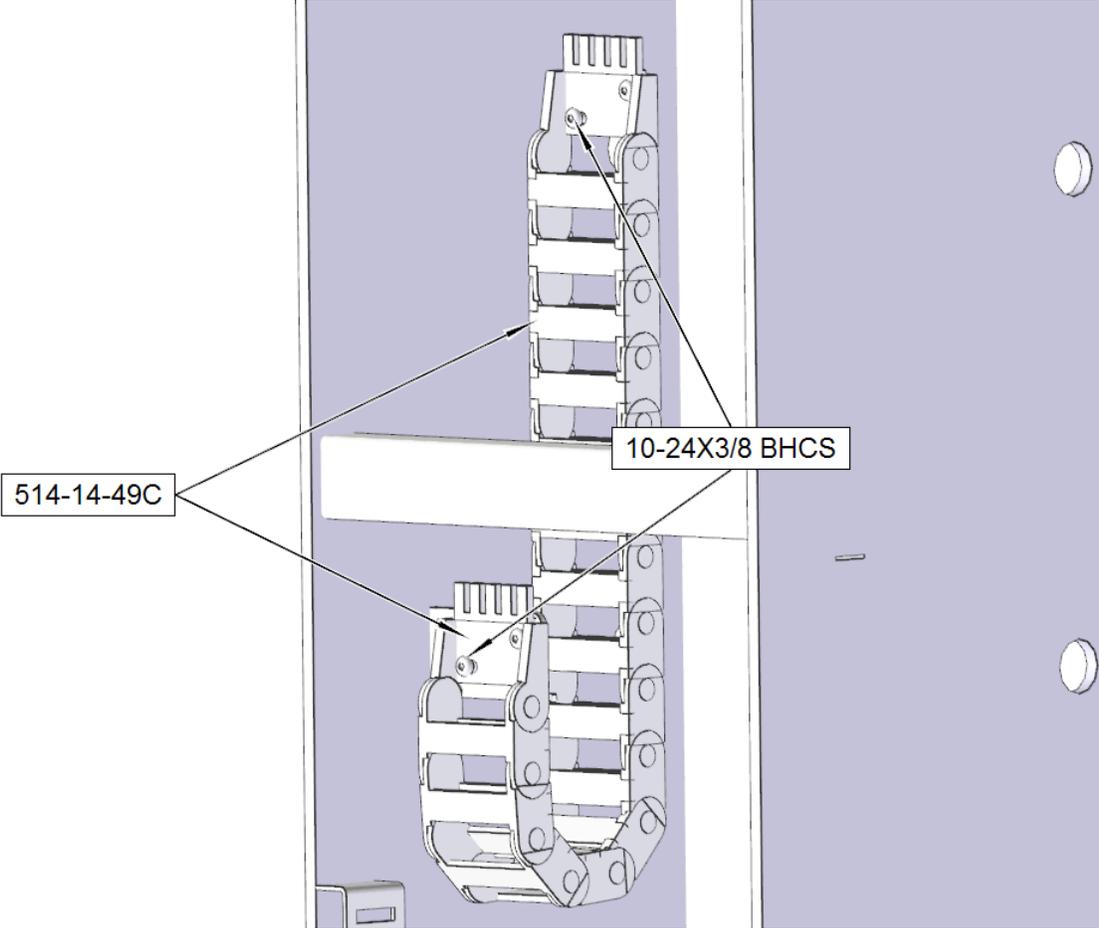
### Oiler Distribution Block



### Z-Axis Motor Assembly

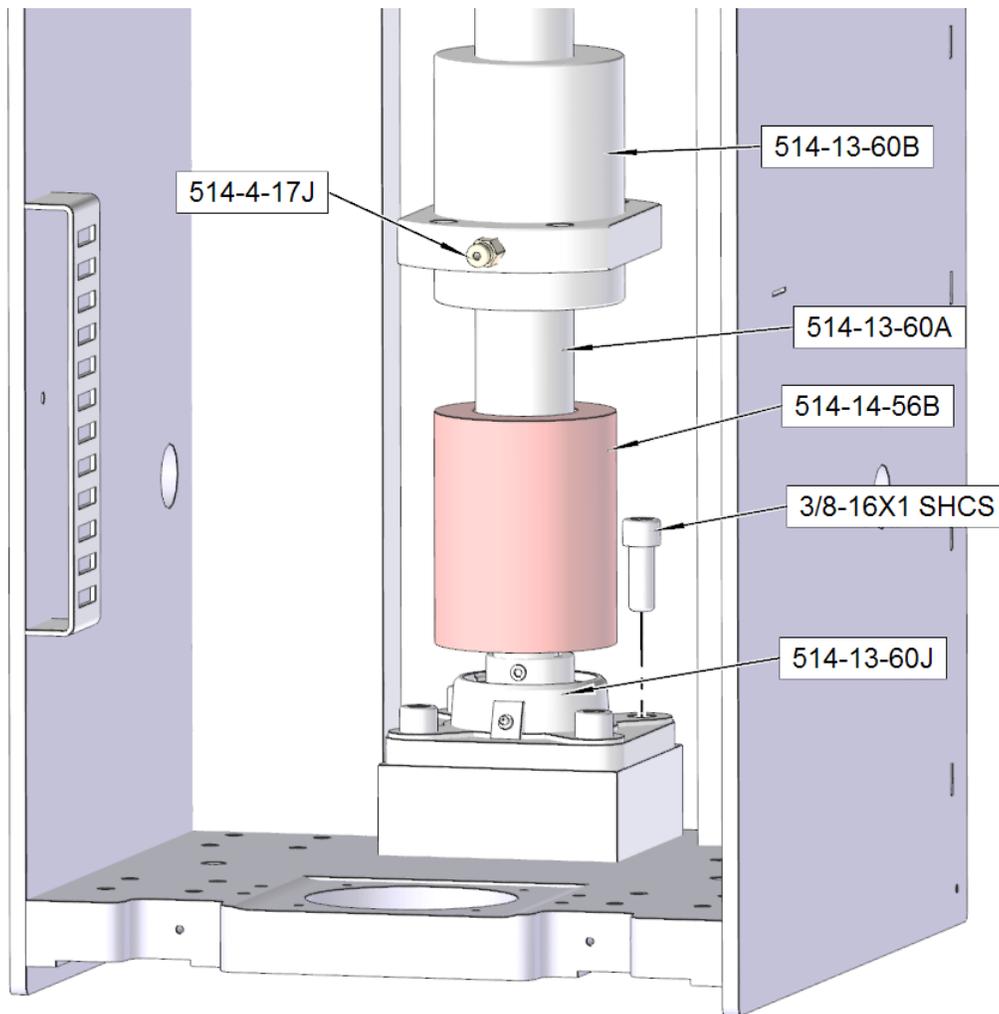


**Inner Wire Track Assembly**

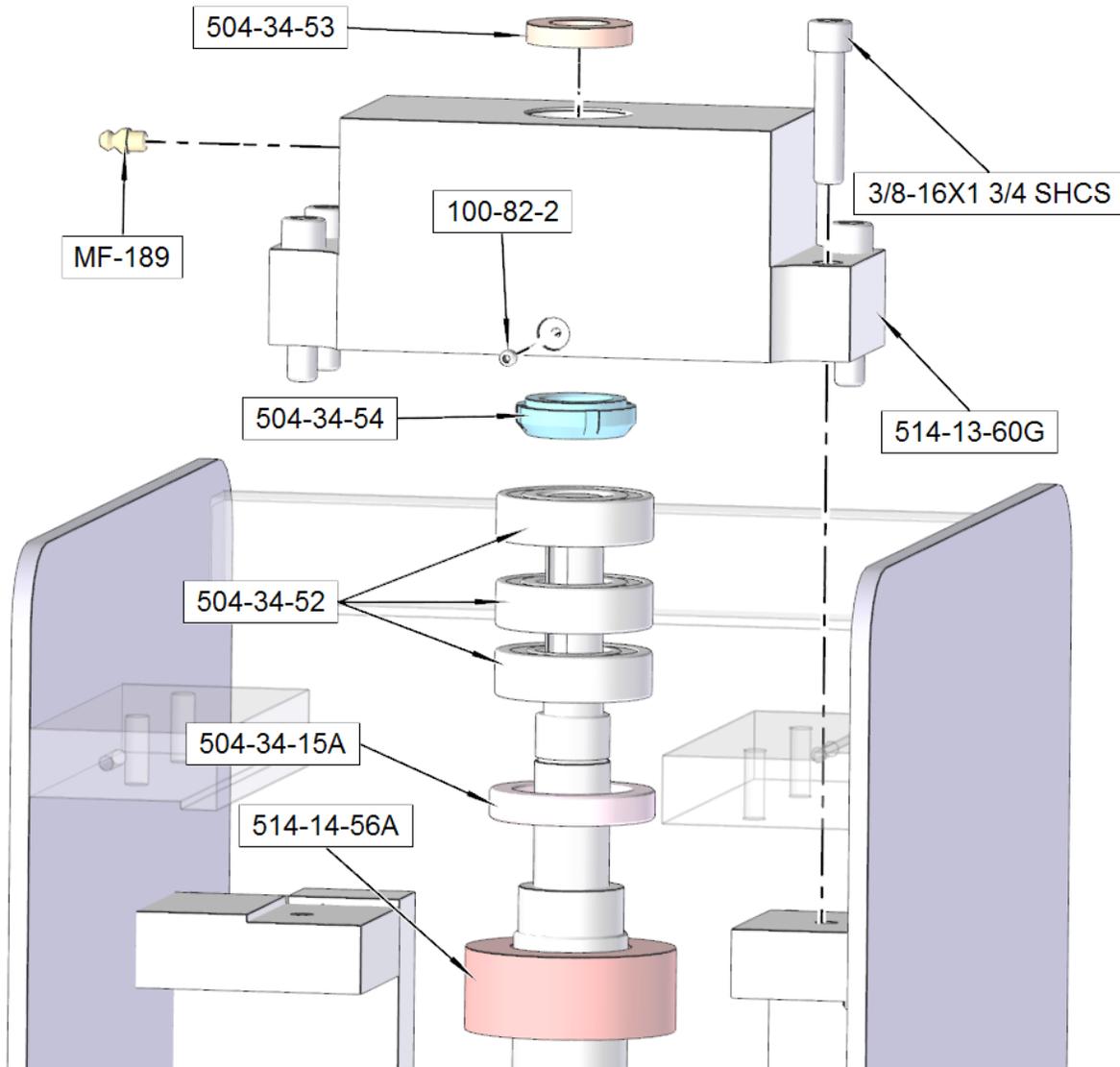


### Z-Axis Ballscrew Assembly

#### Lower Section

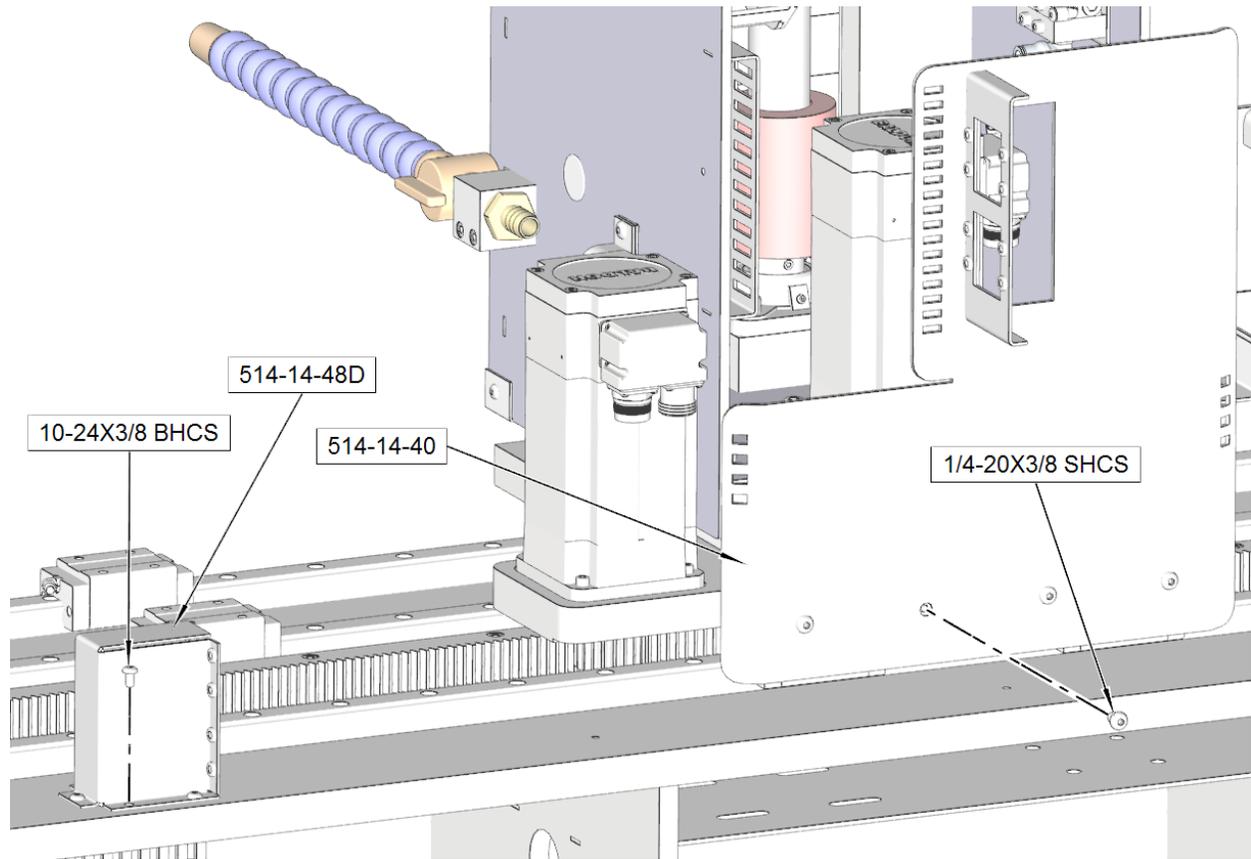


Upper Section

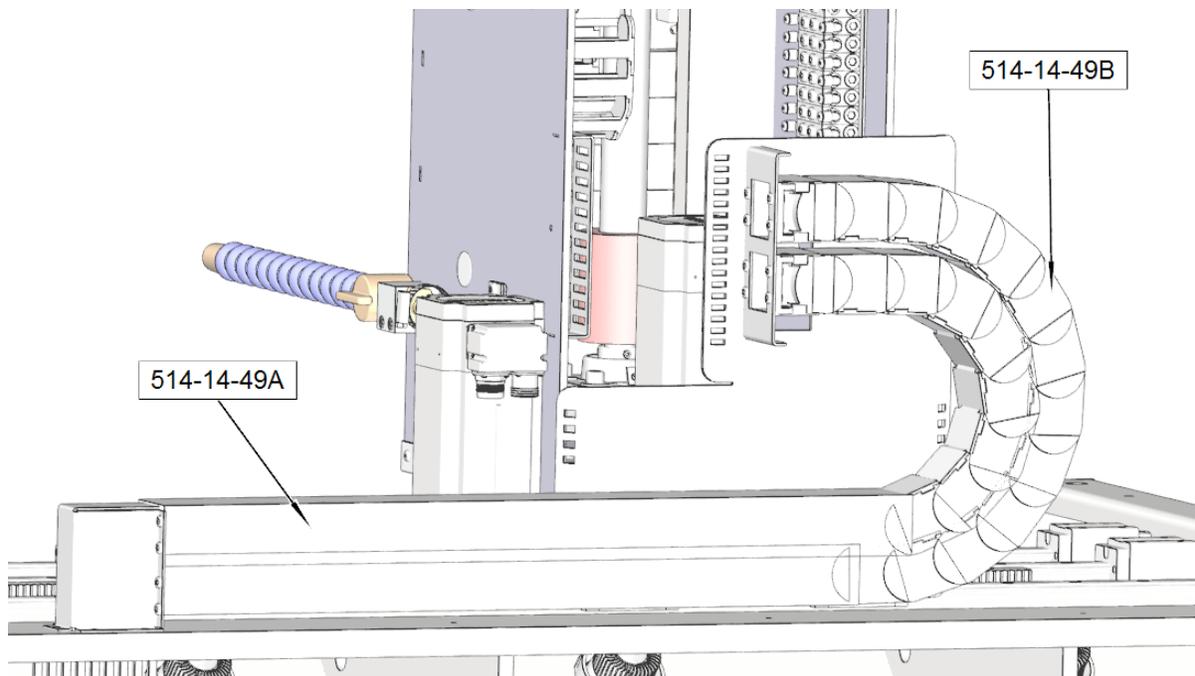


### Outer Wire Track Assembly

#### Mounts

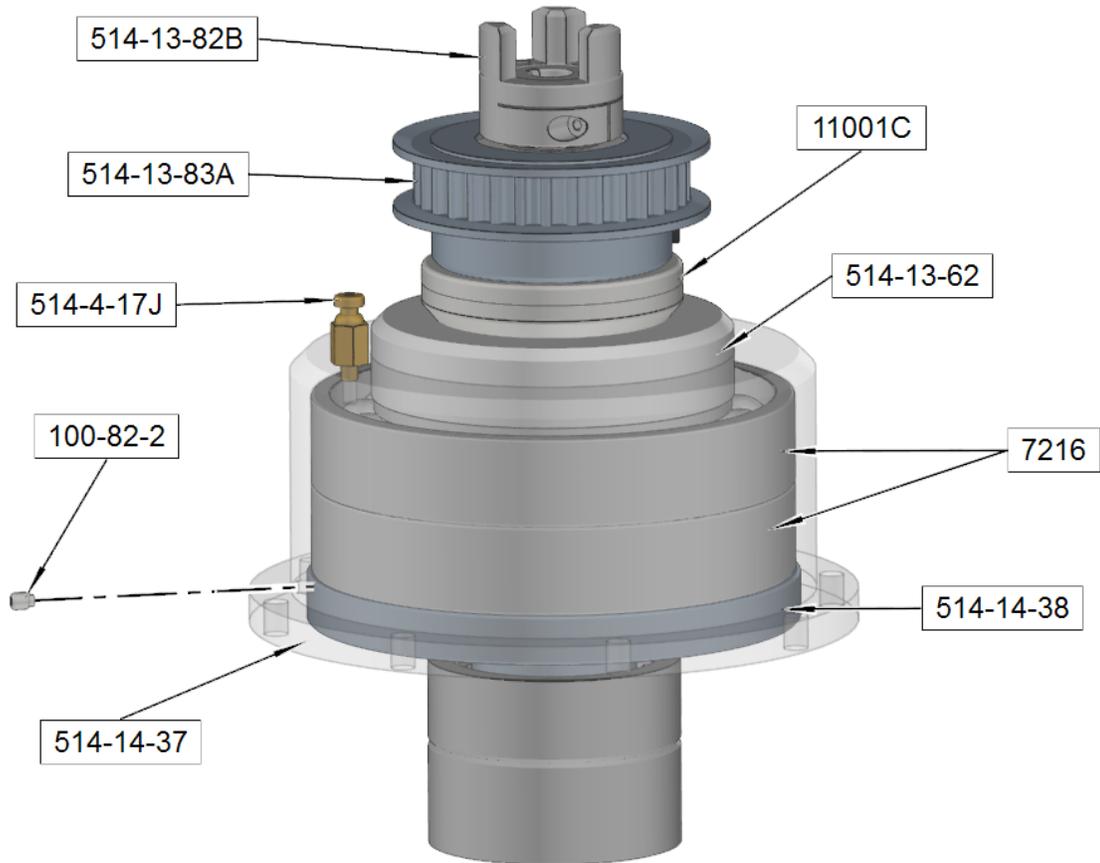


#### Wire Tracks

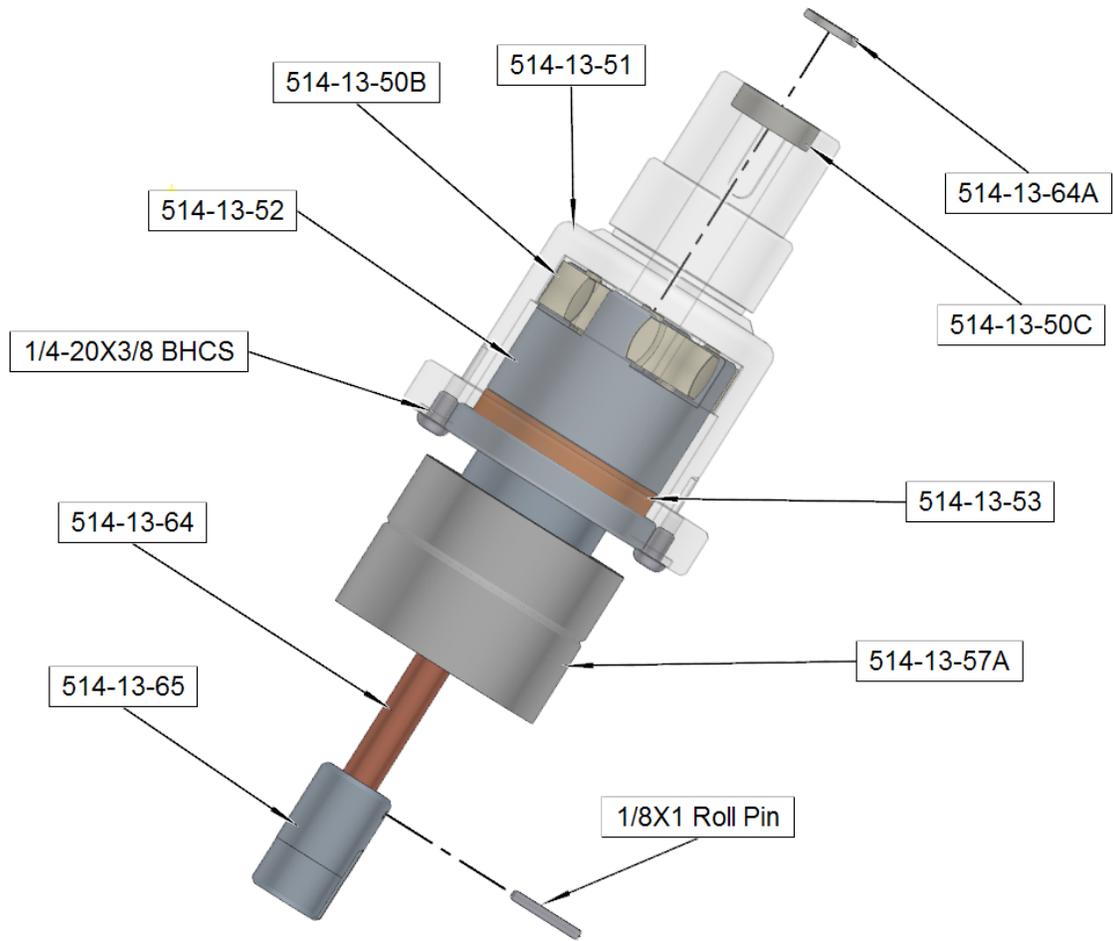


## Spindle Drive Assembly

### Outer Components

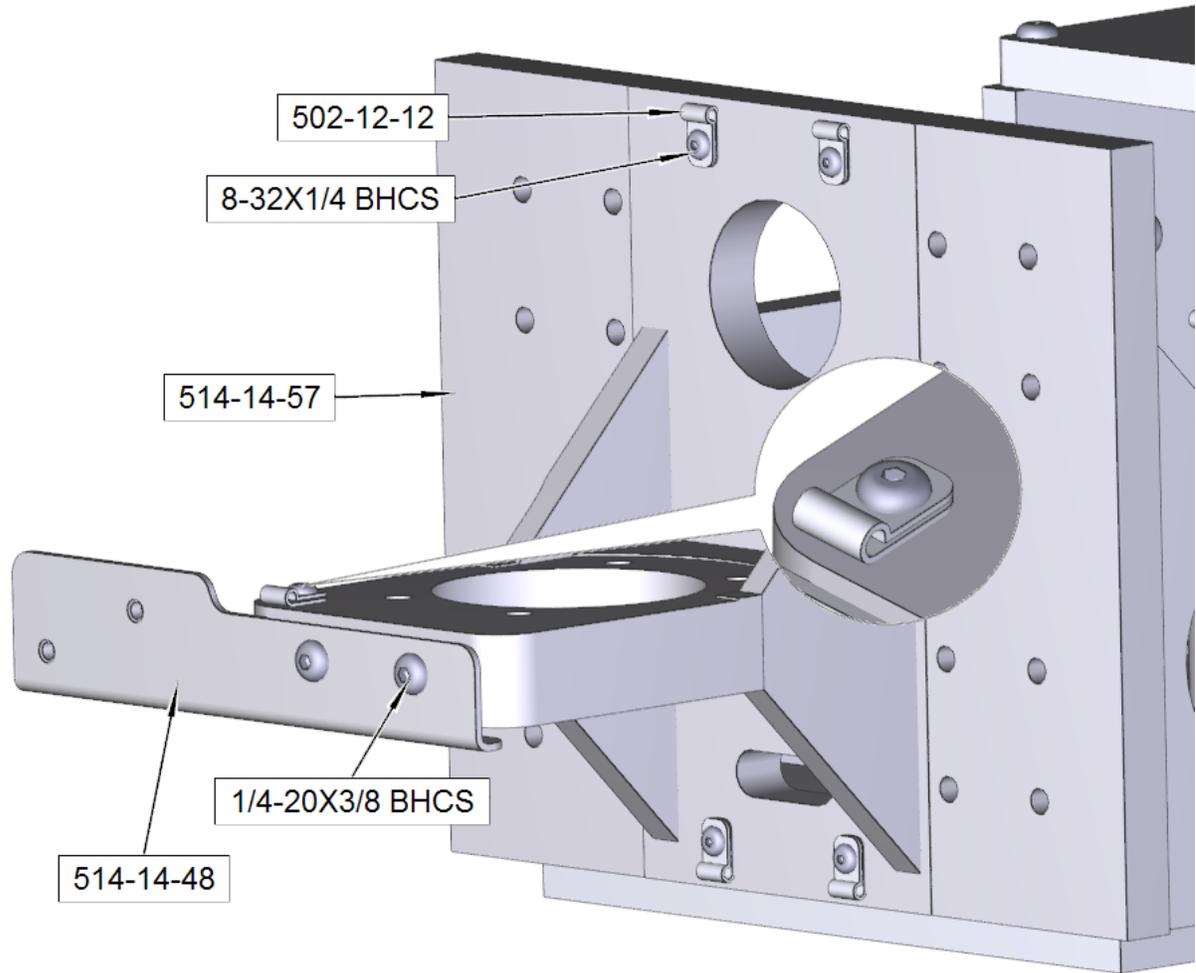


### Inner Components

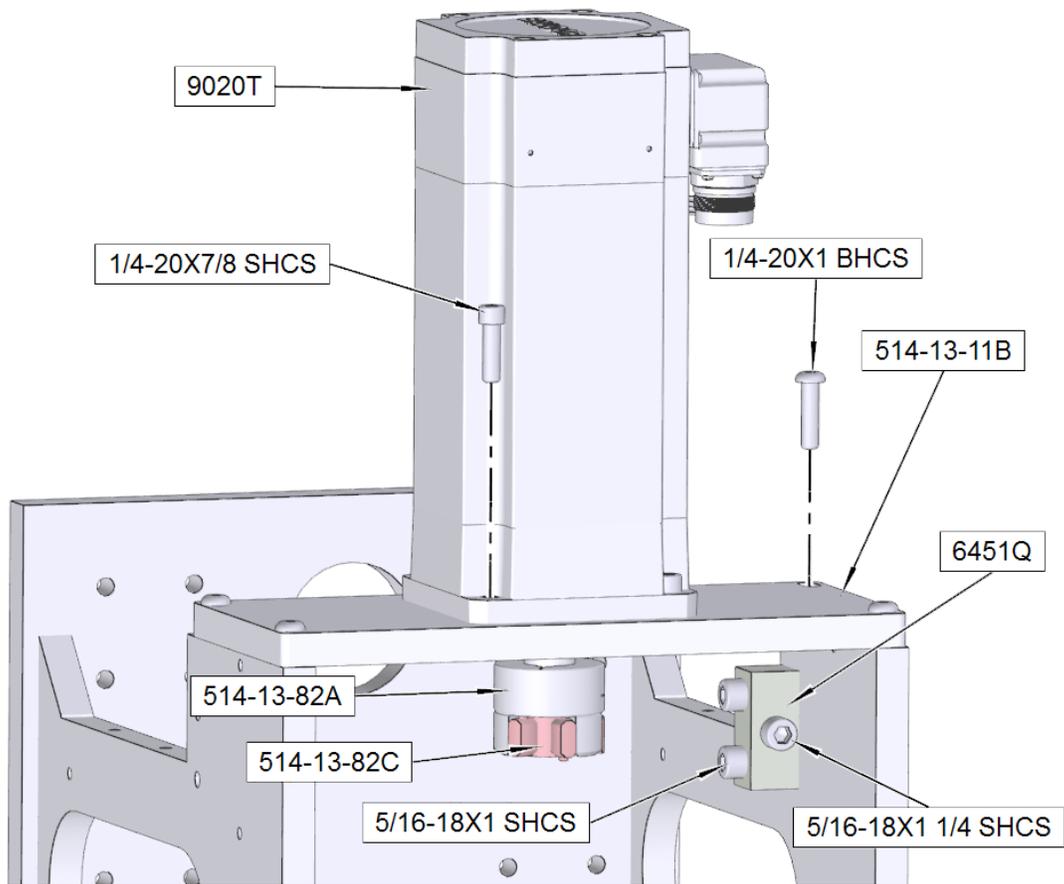


### Spindle Drive Carriage Assembly

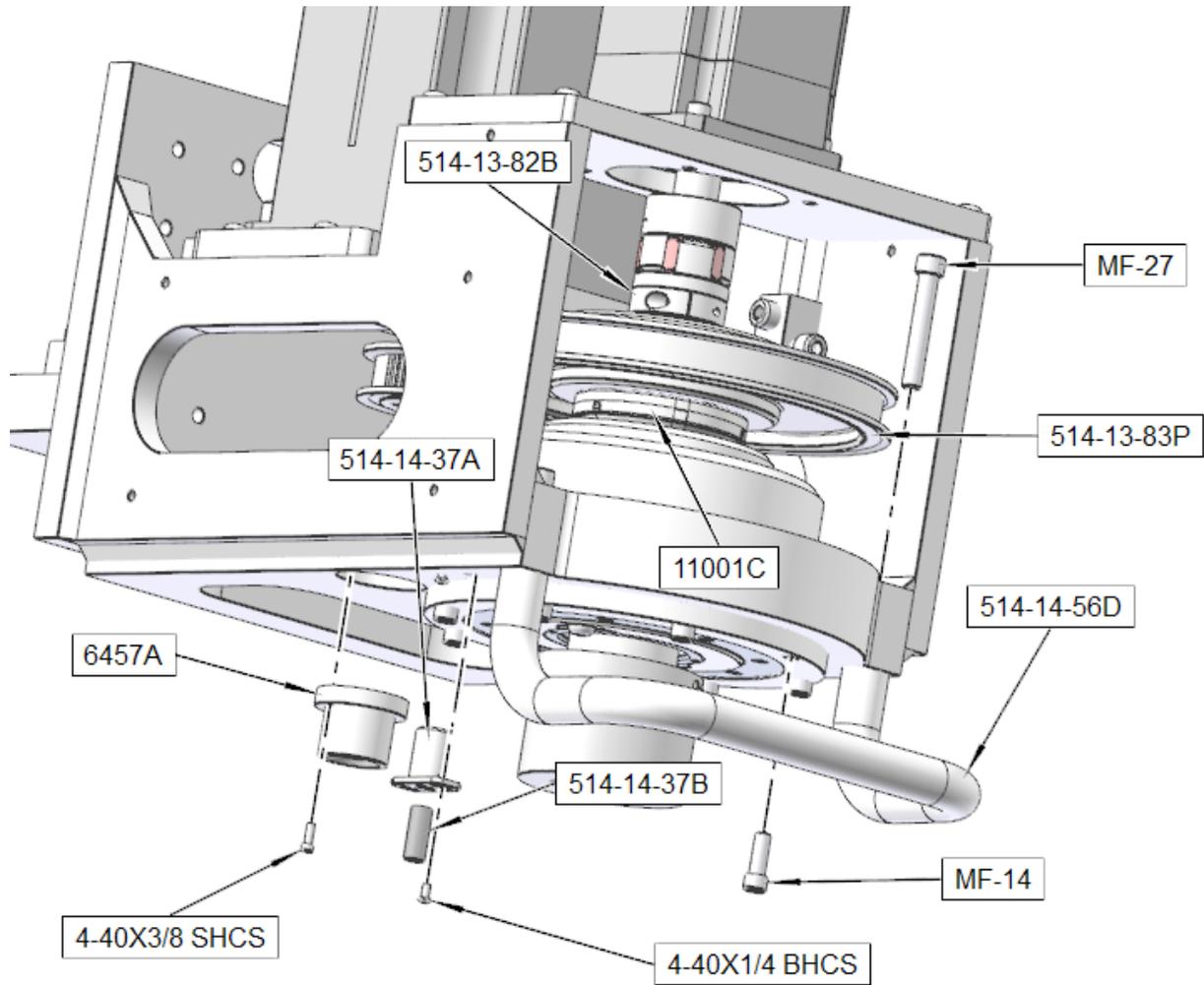
#### Oil Lines and Wire Track Attachments



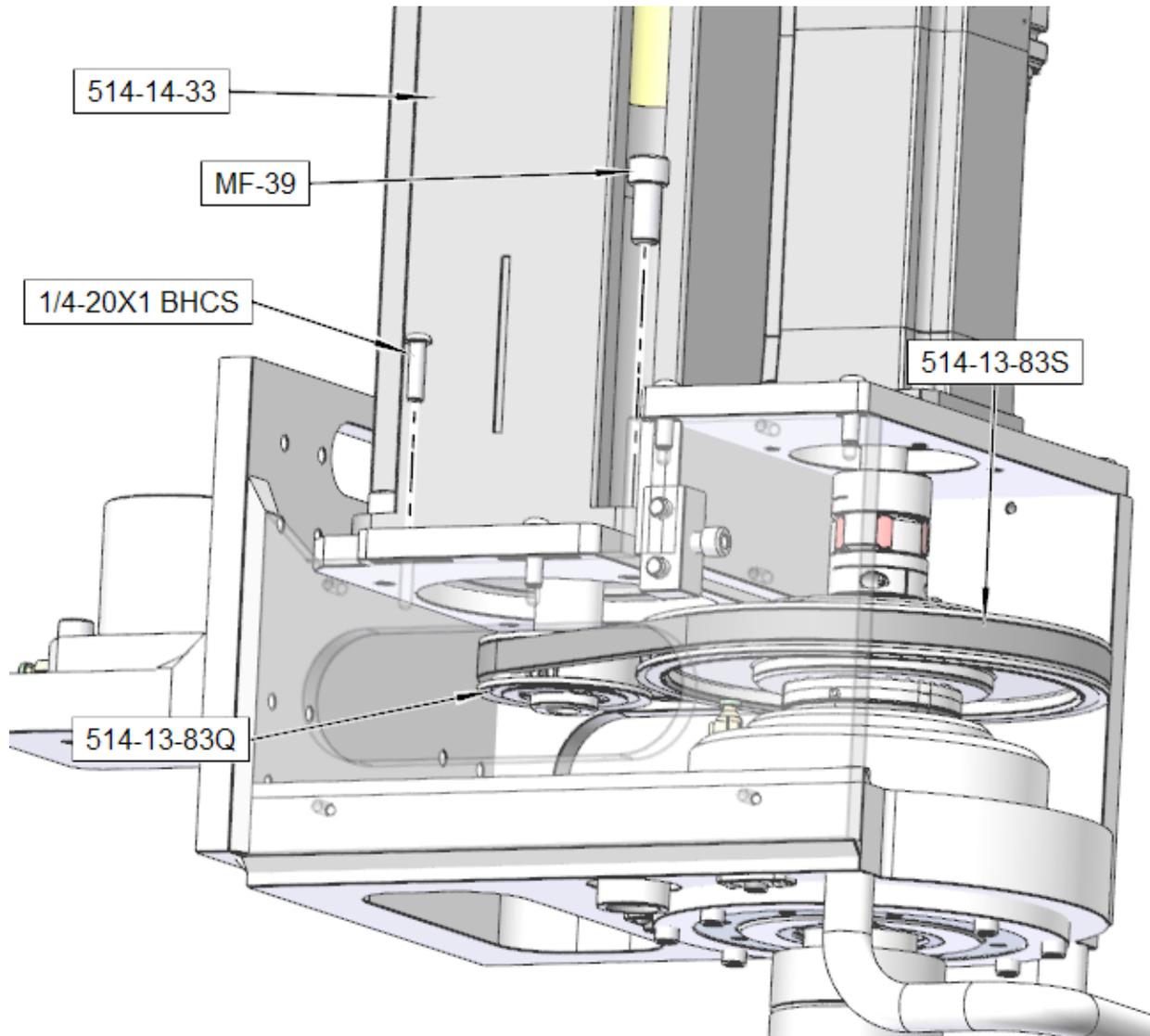
### Feed Motor Assembly



**Lower Section**



### Spindle Drive Motor Assembly



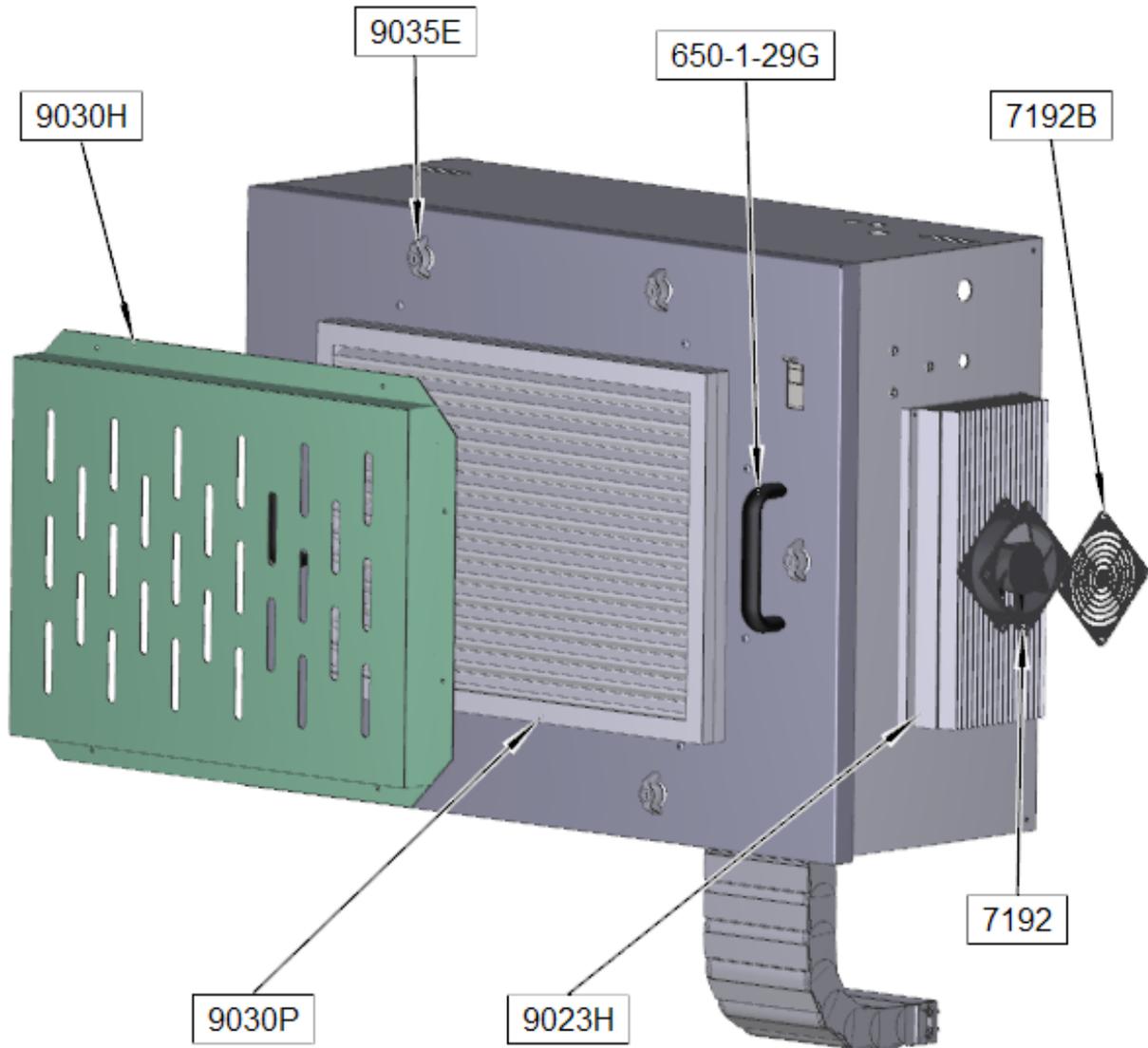
**Spindle Drive Cover**



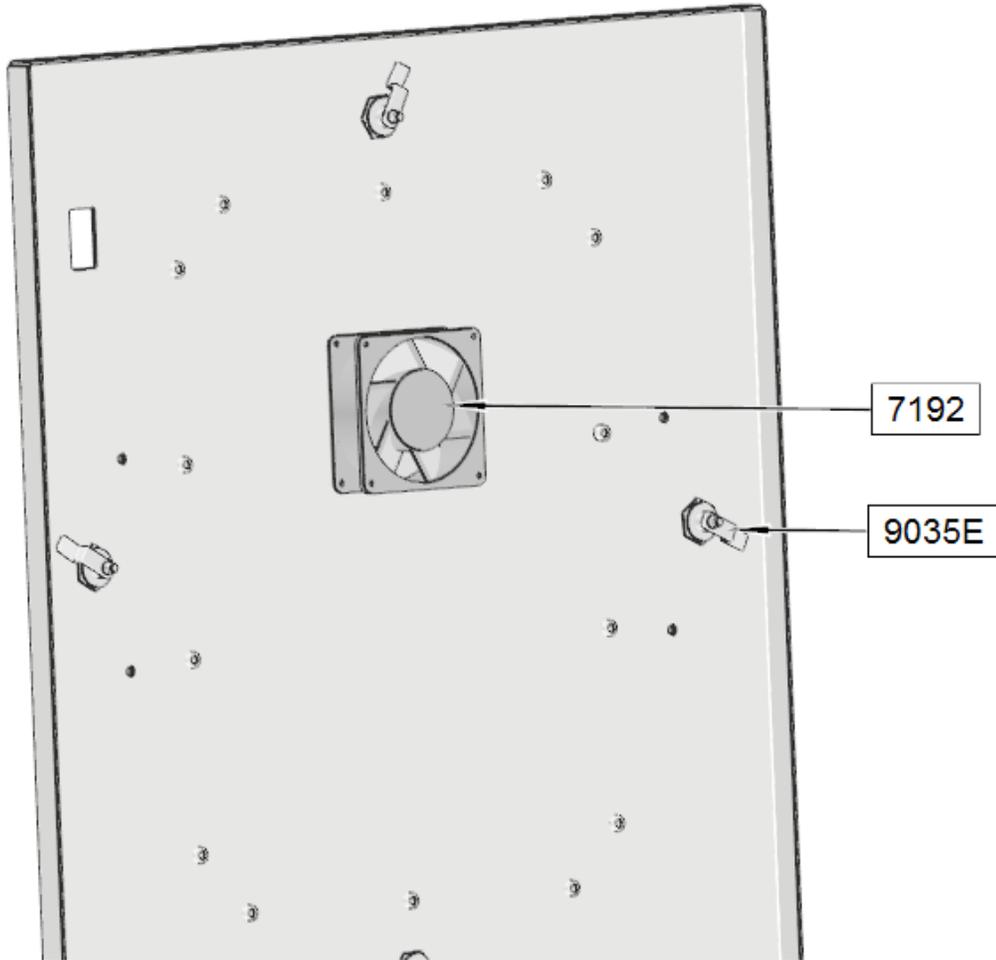
## Electrical Enclosure

### Door Assembly

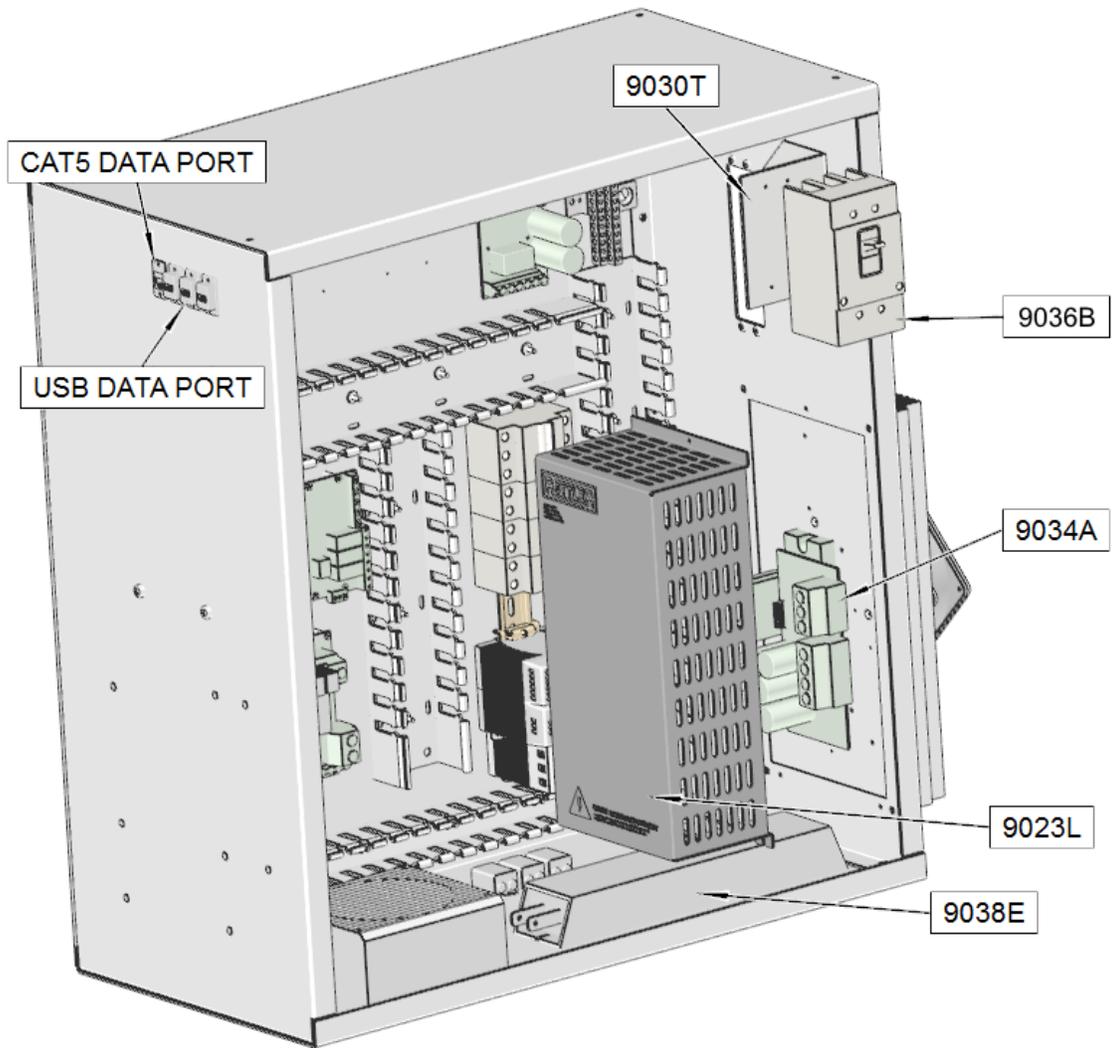
#### Outside Parts

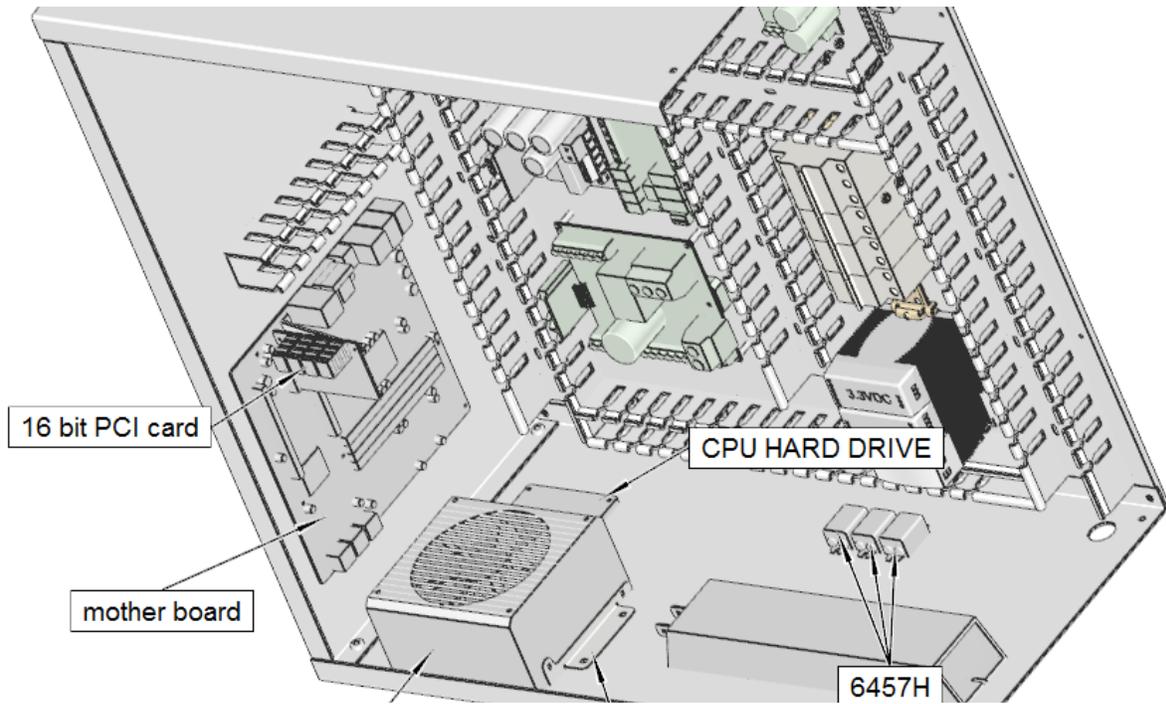


**Inside Parts**

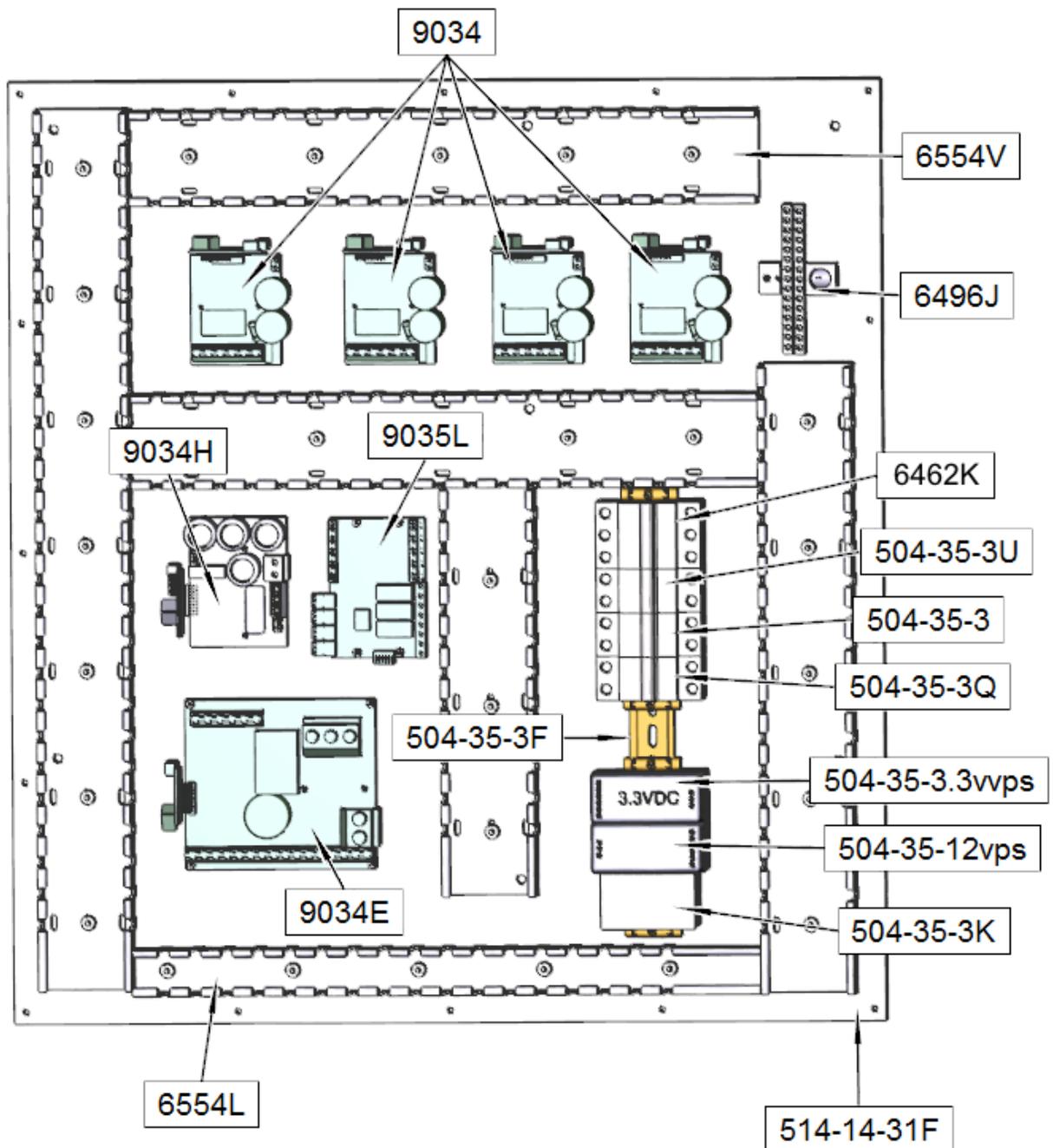


### Inside Components



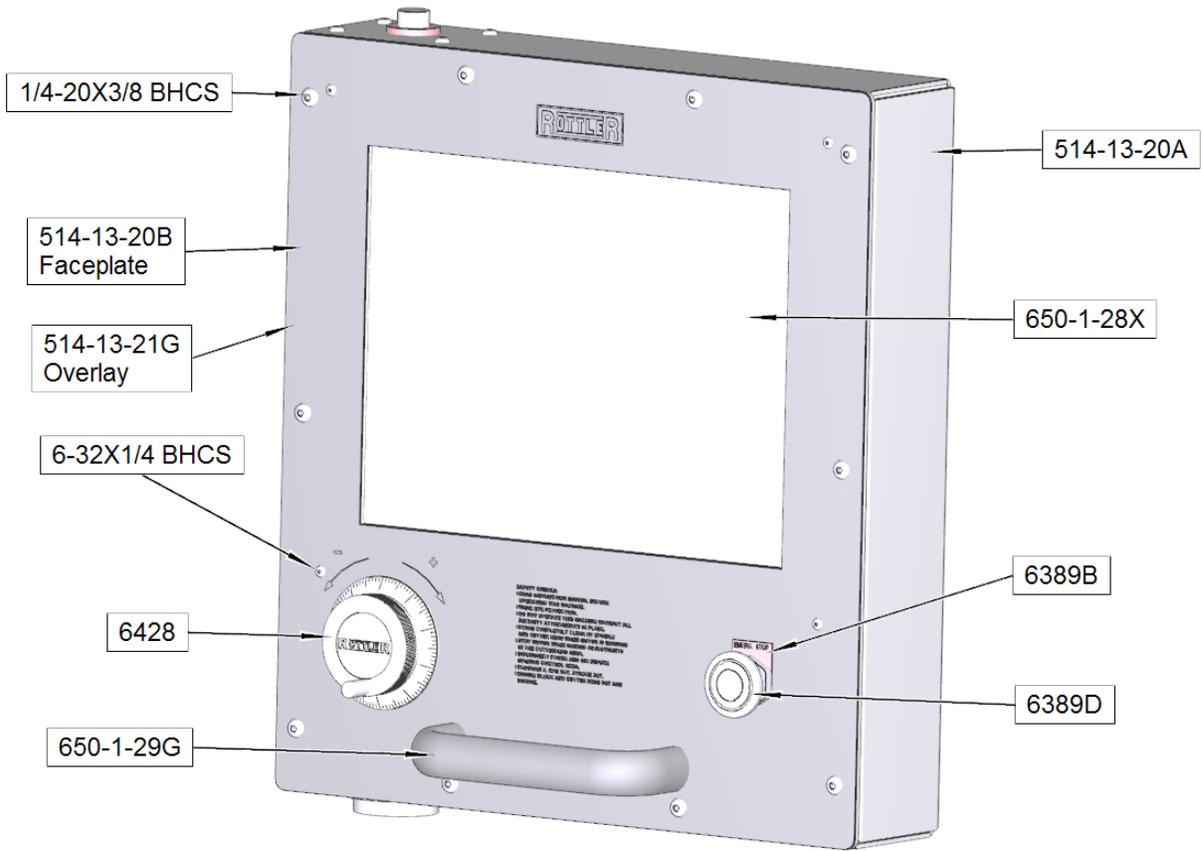


### Electrical Panel Assembly

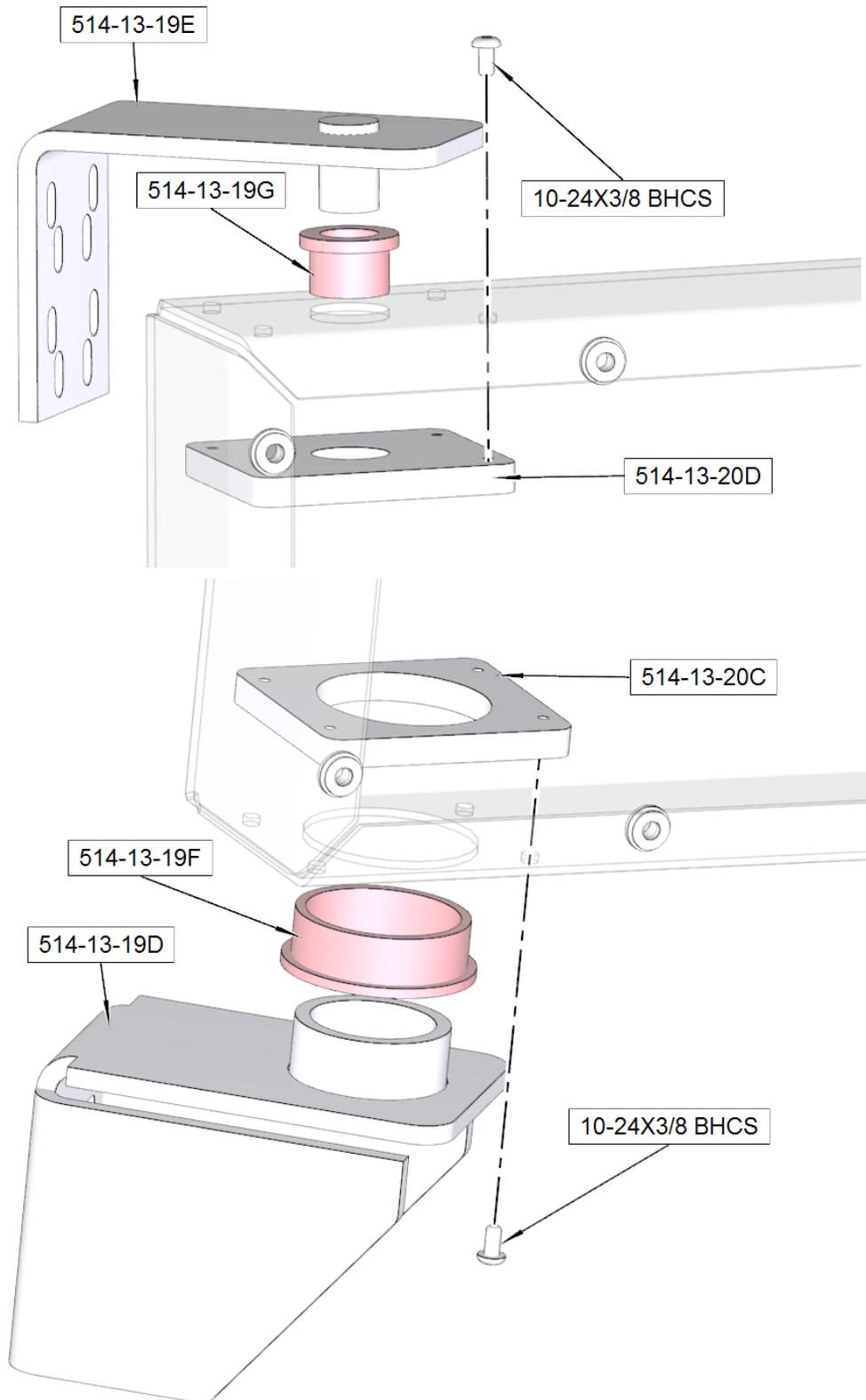


# Control Pendant Assembly

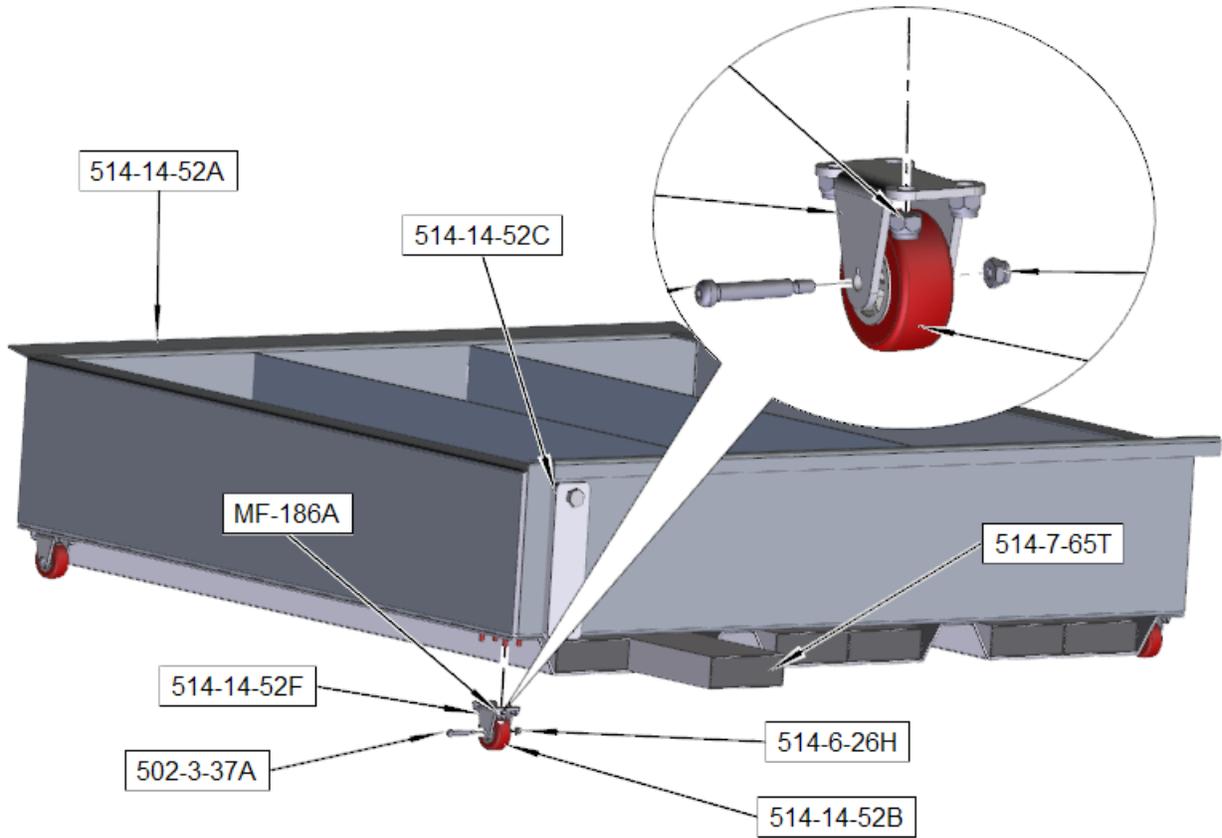
## Outer Components



### Pendant Mounts

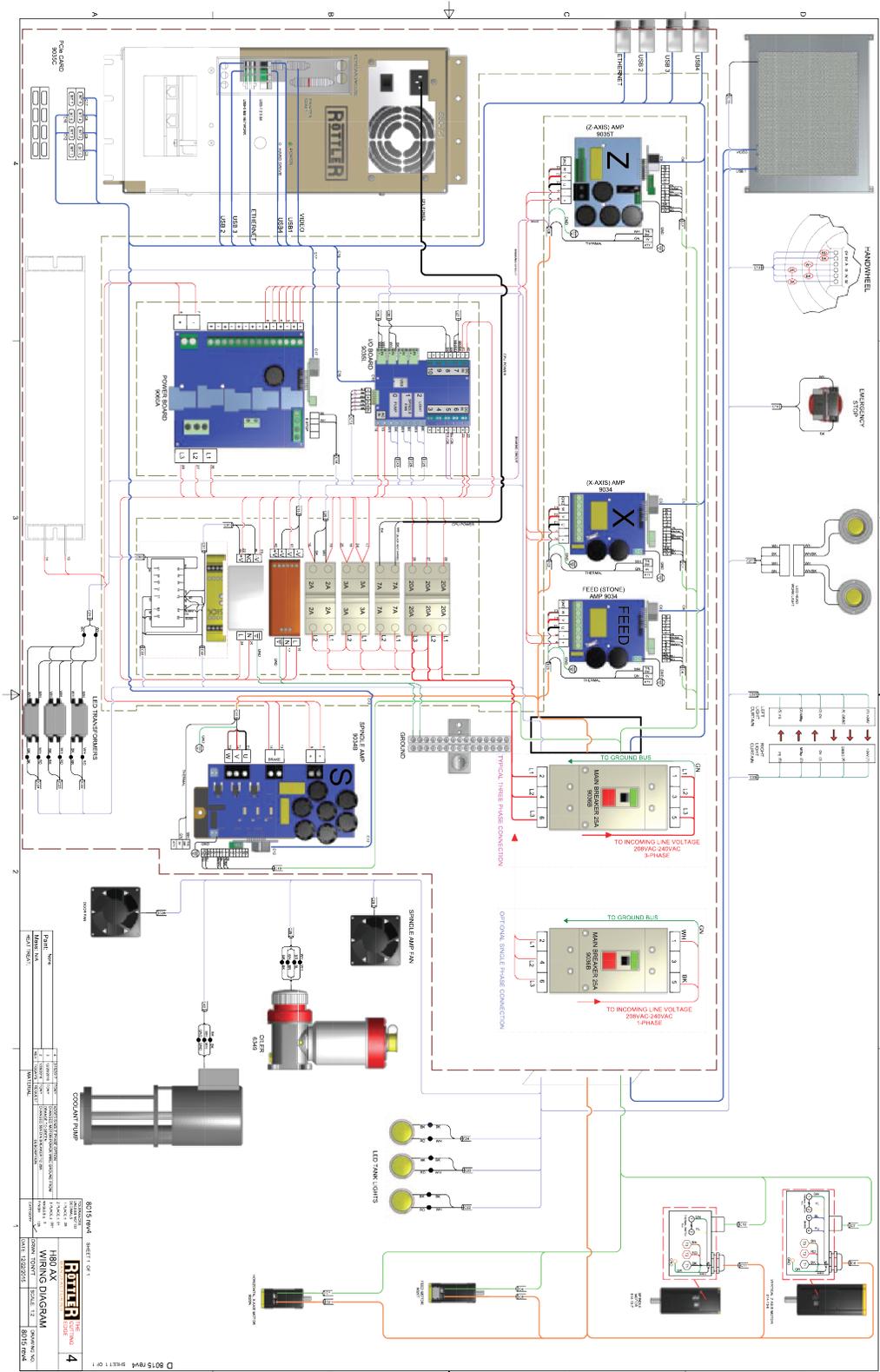


### Coolant Sump Tank



### Wire Diagram

A scalable version of this wire diagram is located on the manual CD.



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# OPTIONS

## Optional Equipment

Optional Equipment Catalog and Parts Manual are located on the Manual CD shipped with machine.



# MSDS

The Material Data Safety 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 Material Data Safety Sheets of substances and materials used by Rottler Manufacturing during manufacturing, testing, and shipping is located on the Manual CD shipped with the machine. Material Data Safety Sheets are also located on the company web site: <http://www.rottlermfg.com/documentation.php>

**1) Rottler Honing Coolant**

**2) 76 Multi-Way Oil**



## SAFETY DATA SHEET

Revision Date: 29-Apr-2016

### 1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION

**Product identifier**

**Product Name** YUMATE™ SC-870C

**Other means of identification**

**Product Code** YUMATE SC-870C

**Synonyms** None

**Recommended use of the chemical and restrictions on use**

**Recommended Use** Water soluble metalworking fluid.

**Uses advised against** No information available

**Details of the supplier of the safety data sheet**

**Manufacturer Address**

Yushiro Manufacturing America, Inc.

783 West Mausoleum Road

Shelbyville, IN 46176

Telephone: 317-398-9862

**Emergency telephone number**

**Emergency Telephone** Chemtrec 1-800-424-9300

### 2. HAZARDS IDENTIFICATION

**Classification**

**OSHA Regulatory Status**

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Serious eye damage/eye irritation	Category 1
Skin sensitization	Category 1B
Reproductive toxicity	Category 2
Specific target organ toxicity (repeated exposure)	Category 2

**Label elements**

**Emergency Overview**

**Danger**

**Hazard statements**

Causes serious eye damage

May cause an allergic skin reaction

Suspected of damaging fertility or the unborn child

May cause damage to organs through prolonged or repeated exposure

Harmful to aquatic life with long lasting effects



**YUMATE™ SC-870C**

Revision Date: 29-Apr-2016

<b>Appearance</b> No information available	<b>Physical state</b> liquid	<b>Odor</b> Amines
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**Precautionary Statements - Prevention**

Obtain special instructions before use  
 Do not handle until all safety precautions have been read and understood  
 Use personal protective equipment as required  
 Contaminated work clothing should not be allowed out of the workplace  
 Wear protective gloves  
 Do not breathe dust/fume/gas/mist/vapors/spray  
 Avoid release to the environment

**Precautionary Statements - Response**

IF exposed or concerned: Get medical advice/attention  
 Specific treatment (see .? on this label)  
 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
 Immediately call a POISON CENTER or doctor/physician  
 IF ON SKIN: Wash with plenty of soap and water  
 If skin irritation or rash occurs: Get medical advice/attention  
 Wash contaminated clothing before reuse

**Precautionary Statements - Storage**

Store locked up

**Precautionary Statements - Disposal**

Dispose of contents/container to an approved waste disposal plant

**Hazards not otherwise classified (HNOC)****Other Information**

- May be harmful if swallowed
- Unknown acute toxicity 1.9 % of the mixture consists of ingredient(s) of unknown toxicity

**3. COMPOSITION/INFORMATION ON INGREDIENTS**

Chemical Name	CAS No	weight-%	Trade Secret
Triethanolamine	102-71-6	10 - 30	*
Monoethanolamine	141-43-5	1 - 5	*
Boric acid	10043-35-3	1 - 5	*

Some specific chemical identities and the exact percentages of composition have been withheld as trade secrets.

**4. FIRST AID MEASURES****First aid measures**

**Eye contact** Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

**Skin Contact** Wash off immediately with soap and plenty of water. Wash contaminated clothing before reuse. If symptoms persist, call a physician.

**Inhalation** Remove to fresh air.

**Ingestion** Clean mouth with water and drink afterwards plenty of water.

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Most important symptoms and effects, both acute and delayed

Symptoms No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

**5. FIRE-FIGHTING MEASURES**Suitable extinguishing media

Dry chemical, foam, carbon dioxide, water spray or fog is recommended.

Unsuitable extinguishing media CAUTION: Use of water spray when fighting fire may be inefficient.

Specific hazards arising from the chemical

No information available.

**Hazardous combustion products** Incomplete combustion and thermolysis may produce gases of varying toxicity such as carbon monoxide, carbon dioxide, various hydrocarbons, aldehydes and soot. These may be highly dangerous if inhaled in confined spaces or at high concentration.

Explosion data

Sensitivity to Mechanical Impact None.

Sensitivity to Static Discharge None.

Protective equipment and precautions for firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

**6. ACCIDENTAL RELEASE MEASURES**Personal precautions, protective equipment and emergency procedures

Personal precautions Avoid contact with eyes and skin. Use personal protective equipment as required. Ensure adequate ventilation, especially in confined areas.

Environmental precautions

Environmental precautions Avoid release to the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional Ecological Information. Dispose of contents/container to an approved waste disposal plant.

Methods and material for containment and cleaning up

Methods for containment Prevent further leakage or spillage if safe to do so.

Methods for cleaning up Soak up with inert absorbent material.

**7. HANDLING AND STORAGE**Precautions for safe handling

Advice on safe handling Use personal protective equipment as required. Avoid contact with skin, eyes or clothing. Ensure adequate ventilation, especially in confined areas.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep from freezing. Protect from extremes of temperature and direct sunlight. Keep container tightly closed in a dry and well-ventilated place.

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Incompatible materials                      Acids. Strong oxidizing agents. Nitrites and nitrosating agents.

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

#### Control parameters

#### Exposure Guidelines

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Triethanolamine	TWA: 5 mg/m <sup>3</sup>	-	-
Monoethanolamine	STEL: 6 ppm TWA: 3 ppm	TWA: 3 ppm TWA: 6 mg/m <sup>3</sup> (vacated) TWA: 3 ppm (vacated) TWA: 8 mg/m <sup>3</sup> (vacated) STEL: 6 ppm (vacated) STEL: 15 mg/m <sup>3</sup>	IDLH: 30 ppm TWA: 3 ppm TWA: 8 mg/m <sup>3</sup> STEL: 6 ppm STEL: 15 mg/m <sup>3</sup>
Boric acid	STEL: 6 mg/m <sup>3</sup> inhalable fraction TWA: 2 mg/m <sup>3</sup> inhalable fraction	-	-

#### Appropriate engineering controls

**Engineering Controls**                      Showers  
    Eyewash stations  
    Ventilation systems.

#### Individual protection measures, such as personal protective equipment

**Eye/face protection**                      Wear safety glasses with side shields (or goggles). Avoid contact with eyes.

**Skin and body protection**                      Wear protective gloves and protective clothing. Avoid contact with skin and clothing. Selection of protective clothing depends on work conditions.

**Respiratory protection**                      If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

**General Hygiene Considerations**                      Handle in accordance with good industrial hygiene and safety practice.

### 9. PHYSICAL AND CHEMICAL PROPERTIES

#### Information on basic physical and chemical properties

Physical state	liquid	<b>Odor</b>	Amines
Appearance	No information available	<b>Odor threshold</b>	No information available
Color	light yellow		

<u>Property</u>	<u>Values</u>	<u>Remarks • Method</u>
pH	8.85	
Melting point / freezing point	No information available	
Boiling point / boiling range	No information available	
Flash point	No information available	
Evaporation rate	No information available	
Flammability (solid, gas)	No information available	
Flammability Limit in Air		
Upper flammability limit:	No information available	
Lower flammability limit	No information available	
Vapor pressure	No information available	
Vapor density	No information available	
Specific Gravity	1.059	@ 20°C
Water solubility	Miscible in water	

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<b>Solubility in other solvents</b>	No information available
<b>Partition coefficient</b>	No information available
<b>Autoignition temperature</b>	No information available
<b>Decomposition temperature</b>	No information available
<b>Kinematic viscosity</b>	No information available
<b>Dynamic viscosity</b>	No information available
<b>Explosive properties</b>	No information available
<b>Oxidizing properties</b>	No information available

**Other Information**

<b>Softening point</b>	No information available
<b>Molecular weight</b>	No information available
<b>VOC Content (%)</b>	No information available
<b>Density</b>	8.8 lbs/gal
<b>Bulk density</b>	No information available

**10. STABILITY AND REACTIVITY****Reactivity**

No data available

**Chemical stability**

Stable under recommended storage conditions.

**Possibility of Hazardous Reactions**

None under normal processing.

<b>Hazardous polymerization</b>	Hazardous polymerization does not occur.
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**Conditions to avoid**

Extremes of temperature and direct sunlight.

**Incompatible materials**

Acids. Strong oxidizing agents. Nitrites and nitrosating agents.

**Hazardous Decomposition Products**

No hazardous decomposition products if stored and handled under normal conditions.

**11. TOXICOLOGICAL INFORMATION****Information on likely routes of exposure**

<b>Product Information</b>	No data available
<b>Inhalation</b>	Inhalation of vapors at high concentration may cause mild irritation of respiratory system.
<b>Eye contact</b>	Contact with eyes may cause serious eye damage.
<b>Skin Contact</b>	Repeated or prolonged skin contact may result in dermatitis. May cause sensitization by skin contact.
<b>Ingestion</b>	May be harmful if swallowed.

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Triethanolamine	= 4190 mg/kg ( Rat )	> 20 mL/kg ( Rabbit ) > 16 mL/kg ( Rat )	-
Monoethanolamine	= 1720 mg/kg ( Rat )	= 1 mL/kg ( Rabbit ) = 1000 mg/kg ( Rabbit )	-
Boric acid	= 2660 mg/kg ( Rat )	> 2000 mg/kg ( Rabbit )	> 0.16 mg/L ( Rat ) 4 h

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Information on toxicological effects

Symptoms No information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

**Skin corrosion/irritation** Repeated exposure may cause skin dryness or cracking.  
**Serious eye damage/eye irritation** Risk of serious damage to eyes.  
**Sensitization** May cause sensitization by skin contact.  
**Germ cell mutagenicity** No information available.  
**Carcinogenicity** This product does not contain any components at concentrations at or above 0.1% that are listed as carcinogens or potential carcinogens by OSHA, IARC or NTP.  
**Reproductive toxicity** Product contains boric acid. Animal ingestion studies in several species indicate that, at high doses, boric acid may cause reproductive and developmental effects. Human epidemiological studies have not shown a negative effect on human fertility.  
**STOT - single exposure** No information available.  
**STOT - repeated exposure** May cause damage to kidneys and liver through prolonged or repeated exposure.  
**Aspiration hazard** No information available.

Numerical measures of toxicity - Product Information

**Unknown acute toxicity** 1.9 % of the mixture consists of ingredient(s) of unknown toxicity  
**The following values are calculated based on chapter 3.1 of the GHS document.**  
**ATEmix (oral)** >3,000 mg/kg

**12. ECOLOGICAL INFORMATION**Ecotoxicity

Harmful to aquatic life

Persistence and degradability

No information available.

Bioaccumulation

No information available.

Other adverse effects

No information available

**13. DISPOSAL CONSIDERATIONS**Waste treatment methods

**Disposal of wastes** Disposal should be in accordance with applicable regional, national and local laws and regulations.

**Contaminated packaging** Do not reuse container.

Chemical Name	California Hazardous Waste Status
Boric acid 10043-35-3	Toxic

**14. TRANSPORT INFORMATION**

DOT Not regulated

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**15. REGULATORY INFORMATION****International Inventories**

TSCA Complies  
 DSL/NDL Complies

**Legend:**

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory  
 DSL/NDL - Canadian Domestic Substances List/Non-Domestic Substances List

**US Federal Regulations****SARA 313**

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

**SARA 311/312 Hazard Categories**

Acute health hazard	Yes
Chronic Health Hazard	Yes
Fire hazard	No
Sudden release of pressure hazard	No
Reactive Hazard	No

**CWA (Clean Water Act)**

This product contains substances classified as oil under Section 311 of the Clean Water Act and the Oil Pollution Act of 1990. Discharge or spills which produce a visible sheen on surface water or waterways leading to surface water must be reported to the National Response Center at 800-424-8802.

**CERCLA**

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

**US State Regulations****California Proposition 65**

This product contains the following Proposition 65 chemicals (Trace impurities, <<0.1%)

Chemical Name	California Proposition 65
Diethanolamine - 111-42-2	Carcinogen
N, N-Diethanolamine - 111-42-2	Carcinogen
1,2-dichloroethane - 107-06-2	Carcinogen
1,4-dioxane - 123-91-1	Carcinogen
Ethylenimine - 151-56-4	Carcinogen
Ethylene oxide - 75-21-8	Carcinogen Developmental Female Reproductive Male Reproductive
Propylene oxide - 75-56-9	Carcinogen

**U.S. EPA Label information**

EPA Pesticide registration number Not Applicable

**16. OTHER INFORMATION**

Issue Date 17-Dec-2015

Revision Date: 29-Apr-2016

Revision Note

No information available

**Disclaimer**

The information provided in this Material Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing,

**YUMATE™ SC-870C****Revision Date:** 29-Apr-2016

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storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

**End of Safety Data Sheet**

# Safety Data Sheet



## Section 1: Identification of the substance or mixture and of the supplier

<b>Product Name:</b>	<b>Multi-Way Oil HD</b>
<b>SDS Number:</b>	817776
<b>Synonyms/Other Means of Identification:</b>	Multi-Way HD 32 Multi-Way HD 68 Multi-Way HD 220
<b>Intended Use:</b>	Way Oil
<b>Manufacturer:</b>	Phillips 66 Lubricants 600 N. Dairy Ashford, 2WL9072F Houston, Texas 77079-1175
<b>Emergency Health and Safety Number:</b>	Chemtrec: 800-424-9300 (24 Hours)
<b>Customer Service:</b>	U.S.: 1-800-822-6457 or International: +1-83-2486-3363
<b>Technical Information:</b>	1-877-445-9198
<b>SDS Information:</b>	Phone: 800-762-0942 Email: SDS@P66.com URL: www.Phillips66.com

## Section 2: Hazard(s) Identification

This material is not considered hazardous according to OSHA criteria.



## Section 3: Composition / Information on Ingredients

Component	CASRN	Concentration <sup>1</sup>
Lubricant Base Oil (Petroleum)	VARIOUS	>95
Additives	Proprietary	<5

<sup>1</sup>All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

## Section 4: First Aid Measures

**Eye Contact:** If irritation or redness develops from exposure, flush eyes with clean water. If symptoms persist, seek medical attention.

**Skin Contact:** Remove contaminated shoes and clothing and cleanse affected area(s) thoroughly by washing with mild soap and water or a waterless hand cleaner. If irritation or redness develops and persists, seek medical attention.

**Inhalation (Breathing):** First aid is not normally required. If breathing difficulties develop, move victim away from source of exposure and into fresh air in a position comfortable for breathing. Seek immediate medical attention.

**Ingestion (Swallowing):** First aid is not normally required; however, if swallowed and symptoms develop, seek medical attention.

817776 - Multi-Way Oil HD  
Date of Issue: 14-Jun-2012

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Status: FINAL

817776 - Multi-Way Oil HD  
Date of Issue: 14-Jun-2012

Page 2/7  
Status: FINAL

**Notes to Physician:** Acute aspirations of large amounts of oil-laden material may produce a serious aspiration pneumonia. Patients who aspirate these oils should be followed for the development of long-term sequelae. Inhalation exposure to oil mists below current workplace exposure limits is unlikely to cause pulmonary abnormalities.

**Medical Conditions Aggravated by Exposure:** Conditions which may be aggravated by exposure include skin disorders.

### Section 5: Fire-Fighting Measures

#### NFPA 704 Hazard Class

Health: 0 Flammability: 1 Instability: 0 (0-Minimal, 1-Slight, 2-Moderate, 3-Serious, 4-Severe)

**Unusual Fire & Explosion Hazards:** This material may burn, but will not ignite readily. If container is not properly cooled, it can rupture in the heat of a fire.

**Extinguishing Media:** Dry chemical, carbon dioxide, foam, or water spray is recommended. Water or foam may cause frothing of materials heated above 212°F / 100°C. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

**Fire Fighting Instructions:** For fires beyond the initial stage, emergency responders in the immediate hazard area should wear protective clothing. When the potential chemical hazard is unknown, in enclosed or confined spaces, a self contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8).

Isolate immediate hazard area and keep unauthorized personnel out. Stop spill/release if it can be done safely. Move undamaged containers from immediate hazard area if it can be done safely. Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done safely. Avoid spreading burning liquid with water used for cooling purposes.

**Hazardous Combustion Products:** Combustion may yield smoke, carbon monoxide, and other products of incomplete combustion. Oxides of sulfur, nitrogen or phosphorus may also be formed.

See Section 9 for Flammable Properties including Flash Point and Flammable (Explosive) Limits

### Section 6: Accidental Release Measures

**Personal Precautions:** This material may burn, but will not ignite readily. Keep all sources of ignition away from spill/release. Stay upwind and away from spill/release. Avoid direct contact with material. For large spillages, notify persons down wind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Wear appropriate protective equipment, including respiratory protection, as conditions warrant (see Section 8). See Sections 2 and 7 for additional information on hazards and precautionary measures.

**Environmental Precautions:** Stop spill/release if it can be done safely. Prevent spilled material from entering sewers, storm drains, other unauthorized drainage systems, and natural waterways. Use water sparingly to minimize environmental contamination and reduce disposal requirements. If spill occurs on water notify appropriate authorities and advise shipping of any hazard. Spills into or upon navigable waters, the contiguous zone, or adjoining shorelines that cause a sheen or discoloration on the surface of the water, may require notification of the National Response Center (phone number 800-424-8802). If spill/release in excess of EPA reportable quantity (see Section 15) is made into the environment, immediately notify the National Response Center (phone number 800-424-8802).

**Methods for Containment and Clean-Up:** Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended. Dike far ahead of spill for later recovery or disposal. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water remove with appropriate methods (e.g. skimming, booms or absorbents). In case of soil contamination, remove contaminated soil for remediation or disposal, in accordance with local regulations.

Recommended measures are based on the most likely spillage scenarios for this material; however local conditions and regulations may influence or limit the choice of appropriate actions to be taken. See Section 13 for information on appropriate disposal.

### Section 7: Handling and Storage

**Precautions for safe handling:** Keep away from flames and hot surfaces. Wash thoroughly after handling. Use good personal hygiene practices and wear appropriate personal protective equipment (see section 8).

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Spills will produce extremely slippery surfaces. Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. Do not wear contaminated clothing or shoes.

**Conditions for safe storage:** Keep container(s) tightly closed and properly labeled. Use and store this material in cool, dry, well-ventilated area away from heat and all sources of ignition. Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage.

"Empty" containers retain residue and may be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, or other sources of ignition. They may explode and cause injury or death. "Empty" drums should be completely drained, properly bunged, and promptly shipped to the supplier or a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations. Before working on or in tanks which contain or have contained this material, refer to OSHA regulations, ANSI Z49.1, and other references pertaining to cleaning, repairing, welding, or other contemplated operations.

### Section 8: Exposure Controls / Personal Protection

Component	ACGIH	OSHA	Other
Lubricant Base Oil (Petroleum)	TWA: 5mg/m <sup>3</sup> STEL: 10 mg/m <sup>3</sup> as oil mist, if generated	TWA: 5 mg/m <sup>3</sup> as Oil Mist, if generated	---

**Note:** State, local or other agencies or advisory groups may have established more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

**Engineering controls:** If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional engineering controls may be required.

**Eye/Face Protection:** The use of eye/face protection is not normally required; however, good industrial hygiene practice suggests the use of eye protection that meets or exceeds ANSI Z.87.1 whenever working with chemicals.

**Skin/Hand Protection:** The use of skin protection is not normally required; however, good industrial hygiene practice suggests the use of gloves or other appropriate skin protection whenever working with chemicals. Suggested protective materials: Nitrile

**Respiratory Protection:** Where there is potential for airborne exposure above the exposure limit a NIOSH certified air purifying respirator equipped with R or P95 filters may be used.

A respiratory protection program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant a respirator's use. Air purifying respirators provide limited protection and cannot be used in atmospheres that exceed the maximum use concentration (as directed by regulation or the manufacturer's instructions), in oxygen deficient (less than 19.5 percent oxygen) situations, or under conditions that are immediately dangerous to life and health (IDLH).

Suggestions provided in this section for exposure control and specific types of protective equipment are based on readily available information. Users should consult with the specific manufacturer to confirm the performance of their protective equipment. Specific situations may require consultation with industrial hygiene, safety, or engineering professionals.

### Section 9: Physical and Chemical Properties

**Note:** Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1 atm). Data represent typical values and are not intended to be specifications.

<b>Appearance:</b>	Dark amber
<b>Physical Form:</b>	Liquid
<b>Odor:</b>	Petroleum
<b>Odor Threshold:</b>	No data
<b>pH:</b>	Not applicable
<b>Vapor Pressure:</b>	<1 mm Hg
<b>Vapor Density (air=1):</b>	>1
<b>Initial Boiling Point/Range:</b>	No data
<b>Melting/Freezing Point:</b>	No data
<b>Pour Point:</b>	< 5 °F / < -15 °C
<b>Solubility in Water:</b>	Insoluble
<b>Partition Coefficient (n-octanol/water) (Kow):</b>	No data

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Specific Gravity (water=1):	0.865 - 0.884 @ 60°F (15.6°C)
Bulk Density:	7.20 - 7.37 lbs/gal
Viscosity:	5 - 20 cSt @ 100°C; 32 - 220 cSt @ 40°C
Evaporation Rate (nBuAc=1):	No data
Flash Point:	> 320 °F / > 160 °C
Test Method:	Pensky-Martens Closed Cup (PMCC), ASTM D93, EPA 1010
Lower Explosive Limits (vol % in air):	No data
Upper Explosive Limits (vol % in air):	No data
Auto-ignition Temperature:	No data

## Section 10: Stability and Reactivity

**Stability:** Stable under normal ambient and anticipated conditions of use.

**Conditions to Avoid:** Extended exposure to high temperatures can cause decomposition. Avoid all possible sources of ignition.

**Materials to Avoid (Incompatible Materials):** Avoid contact with strong oxidizing agents and strong reducing agents.

**Hazardous Decomposition Products:** Not anticipated under normal conditions of use.

**Hazardous Polymerization:** Not known to occur.

## Section 11: Toxicological Information

Information on Toxicological Effects of Substance/Mixture

Acute Toxicity	Hazard	Additional Information	LC50/LD50 Data
Inhalation	Unlikely to be harmful		>5 mg/L (mist, estimated)
Skin Absorption	Unlikely to be harmful		> 2 g/kg (estimated)
Ingestion (Swallowing)	Unlikely to be harmful		> 5 g/kg (estimated)

**Aspiration Hazard:** Not expected to be an aspiration hazard.

**Skin Corrosion/Irritation:** Not expected to be irritating. Repeated exposure may cause skin dryness or cracking.

**Serious Eye Damage/Irritation:** Not expected to be irritating.

**Signs and Symptoms:** Inhalation of oil mists or vapors generated at elevated temperatures may cause respiratory irritation. Accidental ingestion can result in minor irritation of the digestive tract, nausea and diarrhea.

**Skin Sensitization:** Not expected to be a skin sensitizer.

**Respiratory Sensitization:** No information available.

**Specific Target Organ Toxicity (Single Exposure):** No information available on the mixture, however none of the components have been classified for target organ toxicity (or are below the concentration threshold for classification).

**Specific Target Organ Toxicity (Repeated Exposure):** No information available on the mixture, however none of the components have been classified for target organ toxicity (or are below the concentration threshold for classification).

**Carcinogenicity:** No information available on the mixture, however none of the components have been classified for carcinogenicity (or are below the concentration threshold for classification). A mortality study sponsored by General Motors and the United Auto Workers suggested a link between cutting oils or machining fluids and various forms of cancer (e.g., esophageal, laryngeal, and rectal). The study evaluated workplace exposures from 1940-1984. Since the composition of these materials has changed substantially since 1940, and because the most notable effects were seen among those with work histories dating back to that time, the relevance of these findings to present-day exposures is uncertain. Cutting oils or machining fluids have not been identified as carcinogens by NTP, IARC, or OSHA.

**Germ Cell Mutagenicity:** No information available on the mixture, however none of the components have been classified for germ cell mutagenicity (or are below the concentration threshold for classification).

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**Reproductive Toxicity:** No information available on the mixture, however none of the components have been classified for reproductive toxicity (or are below the concentration threshold for classification).

#### Information on Toxicological Effects of Components

##### Lubricant Base Oil (Petroleum)

**Carcinogenicity:** The petroleum base oils contained in this product have been highly refined by a variety of processes including severe hydrocracking/hydroprocessing to reduce aromatics and improve performance characteristics. All of the oils meet the IP-346 criteria of less than 3 percent PAH's and are not considered carcinogens by NTP, IARC, or OSHA.

### Section 12: Ecological Information

**Toxicity:** All acute aquatic toxicity studies on samples of lubricant base oils show acute toxicity values greater than 100 mg/L for invertebrates, algae and fish. These tests were carried out on water accommodated fractions and the results are consistent with the predicted aquatic toxicity of these substances based on their hydrocarbon compositions. Classification: No classified hazards.

**Persistence and Degradability:** The hydrocarbons in this material are not readily biodegradable, but since they can be degraded by microorganisms, they are regarded as inherently biodegradable.

**Bioaccumulative Potential:** Log Kow values measured for the hydrocarbon components of this material are greater than 5.3, and therefore regarded as having the potential to bioaccumulate. In practice, metabolic processes may reduce bioconcentration.

**Mobility in Soil:** Volatilization to air is not expected to be a significant fate process due to the low vapor pressure of this material. In water, base oils will float and spread over the surface at a rate dependent upon viscosity. There will be significant removal of hydrocarbons from the water by sediment adsorption. In soil and sediment, hydrocarbon components will show low mobility with adsorption to sediments being the predominant physical process. The main fate process is expected to be slow biodegradation of the hydrocarbon constituents in soil and sediment.

**Other Adverse Effects:** None anticipated.

### Section 13: Disposal Considerations

The generator of a waste is always responsible for making proper hazardous waste determinations and needs to consider state and local requirements in addition to federal regulations.

This material, if discarded as produced, would not be a federally regulated RCRA "listed" hazardous waste and is not believed to exhibit characteristics of hazardous waste. See Sections 7 and 8 for information on handling, storage and personal protection and Section 9 for physical/chemical properties. It is possible that the material as produced contains constituents which are not required to be listed in the MSDS but could affect the hazardous waste determination. Additionally, use which results in chemical or physical change of this material could subject it to regulation as a hazardous waste.

This material under most intended uses would become "Used Oil" due to contamination by physical or chemical impurities. Whenever possible, Recycle used oil in accordance with applicable federal and state or local regulations. Container contents should be completely used and containers should be emptied prior to discard.

### Section 14: Transport Information

#### U.S. Department of Transportation (DOT)

Shipping Description: *Not regulated*  
Note: *If shipped by land in a packaging having a capacity of 3,500 gallons or more, the provisions of 49 CFR, Part 130 apply. (Contains oil)*

#### International Maritime Dangerous Goods (IMDG)

Shipping Description: *Not regulated*  
Note: *U.S. DOT compliance requirements may apply. See 49 CFR 171.22, 23 & 25.*

#### International Civil Aviation Org. / International Air Transport Assoc. (ICAO/IATA)

UN/ID #: *Not regulated*  
Note: *U.S. DOT compliance requirements may apply. See 49 CFR 171.22, 23 & 24.*

	LTD. QTY	Passenger Aircraft	Cargo Aircraft Only
Packaging Instruction #:	---	---	---
Max. Net Qty. Per Package:	---	---	---

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### Section 15: Regulatory Information

#### CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs (in pounds):

This material does not contain any chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372.

#### CERCLA/SARA - Section 311/312 (Title III Hazard Categories)

Acute Health:	No
Chronic Health:	No
Fire Hazard:	No
Pressure Hazard:	No
Reactive Hazard:	No

#### CERCLA/SARA - Section 313 and 40 CFR 372:

This material does not contain any chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372.

#### EPA (CERCLA) Reportable Quantity (in pounds):

This material does not contain any chemicals with CERCLA Reportable Quantities. This material contains the following chemicals subject to the reporting requirements of 40 CFR 302.4:

#### California Proposition 65:

This material does not contain any chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm at concentrations that trigger the warning requirements of California Proposition 65.

#### International Hazard Classification

**GHS Classification**  
None

#### Canada:

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the Regulations.

**WHMIS Hazard Class:**  
None

#### National Chemical Inventories

All components are either listed on the US TSCA Inventory, or are not regulated under TSCA  
All components are either on the DSL, or are exempt from DSL listing requirements

**U.S. Export Control Classification Number:** EAR99

### Section 16: Other Information

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#### Guide to Abbreviations:

ACGIH = American Conference of Governmental Industrial Hygienists; CASRN = Chemical Abstracts Service Registry Number; CEILING = Ceiling Limit (15 minutes); CERCLA = The Comprehensive Environmental Response, Compensation, and Liability Act; EPA = Environmental Protection Agency; GHS = Globally Harmonized System; IARC = International Agency for Research on Cancer; INSHT = National Institute for Health and Safety at Work; IOPC = International Oil Pollution Compensation; LEL = Lower Explosive Limit; NE = Not Established; NFPA = National Fire Protection Association; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PEL = Permissible Exposure Limit (OSHA); SARA = Superfund Amendments and Reauthorization Act; STEL = Short Term Exposure Limit (15 minutes); TLV = Threshold Limit Value (ACGIH); TWA = Time Weighted Average (8 hours); UEL = Upper Explosive Limit; WHMIS = Worker Hazardous Materials Information System (Canada)

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**Disclaimer of Expressed and implied Warranties:**

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