

ROTTLER

EM69P CNC 5 AXIS DIGITIZING & PORTING MACHINE OPERATIONS MANUAL



PARTS ORDERING

For optional equipment catalogs, please visit <https://www.rottlermfg.com/documentation.php>

For fastest service ordering parts or equipment, contact us via e-mail with the information below. For customers within the U.S., send emails to parts@rottlermfg.com, for customers outside of the U.S., use intlparts@rottlermfg.com

Have the following information on hand to expedite the ordering process:

1. Your name, business name, and contact number
2. Customer number, or your billing address if you do not have a customer number
3. Shipping address if different from the billing address
4. Machine model and serial number
5. Part number and description of the item(s) to order
6. Preferred method of shipment

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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(s) you require.

THERE IS A MINIMUM ORDER OF \$25.00

MANUAL SECTIONS

INTRODUCTION

INSTALLATION

SAFETY

CONTROL DEFINITIONS

OPERATING INSTRUCTIONS

MAINTENANCE

TROUBLESHOOTING

MACHINE PARTS

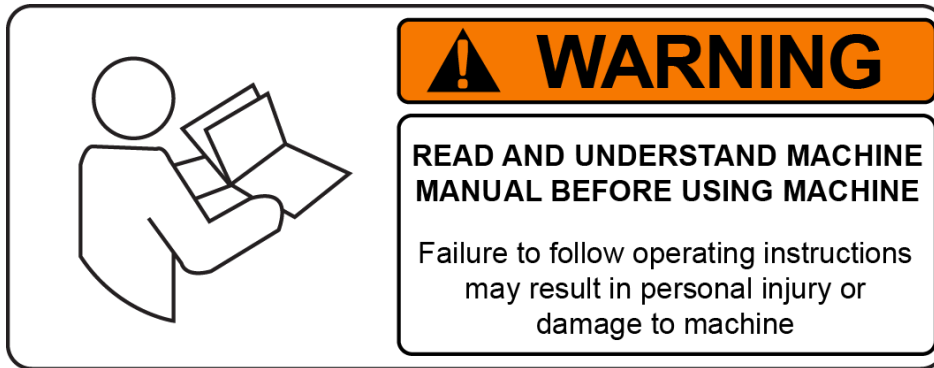
OPTIONS

SDS

INTRODUCTION

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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 EM69P 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 EM69P series machines gain experience with using the different functions of the machine, complicated setups and programs will make more sense.

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

Description

The Rottler EM69P is a 5-axis CNC machine designed and developed specially for porting cylinder heads. The design of the machine allows the center of the “ball shaped” cutting tool to rotate about its own center on the 5th axis.

This unique design has many benefits to a performance engine builder of which the most important are ease of programming and the fastest and most accurate method to port cylinder heads.

Disclaimer

The EM69P Manual (henceforth to be referred to as the “Manual”) is proprietary to Rottler Manufacturing LLC. (“Rottler Manufacturing”) and no ownership rights are hereby transferred. No part of the Manual shall be used, reproduced, translated, converted, adapted, stored in a retrieval system, communicated or transmitted by any means, for any commercial purpose, including without limitation, sale, resale, license, rental or lease, without the prior express written consent of Rottler Manufacturing.

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

Limited Warranty

Rottler Manufacturing Company Model EM69P parts and equipment is warranted as to materials and workmanship. This limited warranty remains in effect for one year from the date of installation or two years from the date of the original shipment from Rottler or whichever date occurs first. This only applies if the machine is owned and operated by the original purchaser and is operated and maintained as per the instructions in the manual. A machine is warranted only if the Installation Report has been properly executed by a certified installation person and received by Rottler at the time of actual installation.

The products are warranted upon delivery to conform to their published specifications and to be free from defects in material and workmanship under normal use for a period of one year from shipment. Should a product not be as warranted, Rottler sole obligation shall be, at its option, to repair, correct or replace the

product or to refund the amounts paid for the Product upon its return to a location designated by Rottler. No warranty shall extend to rapid wear Products (including tooling) or to Products which have been subject to misuse (including any use contrary to Rottler instructions), neglect, accident (including during shipment), improper handling or installation, or subject to any modification, repair or service not certified by Rottler. Rottler shall not be liable for any consequential, direct or indirect damages or for any other injury or loss. Buyer waives any right, beyond the foregoing warranty, to make a claim against Rottler. No warranty is provided for any Products not paid in full.

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

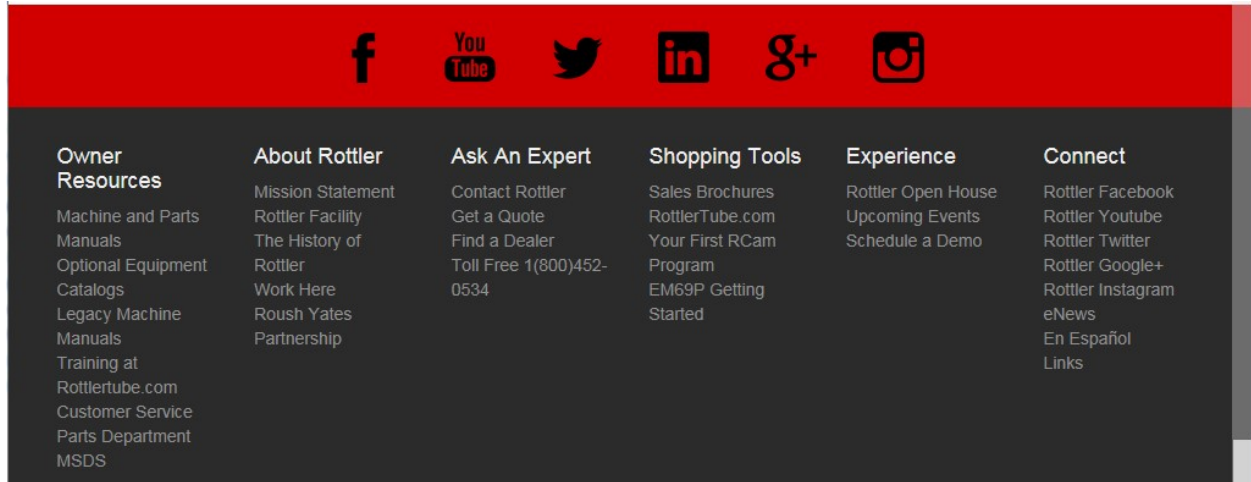
The issuance of a **RGR DOES NOT** guarantee credit - it is only authorization for the return of the goods. Credit for return merchandise is at the sole discretion of Rottler. Credit will be issued only after inspection of returned goods.

Tools proven to be defective within the warranty period will be repaired or replaced at the factory's option. We accept no responsibility for defects caused by external damage, wear, abuse, or misuse, nor do we accept any obligation to provide compensation for direct or indirect costs in connection with cases covered by the warranty.

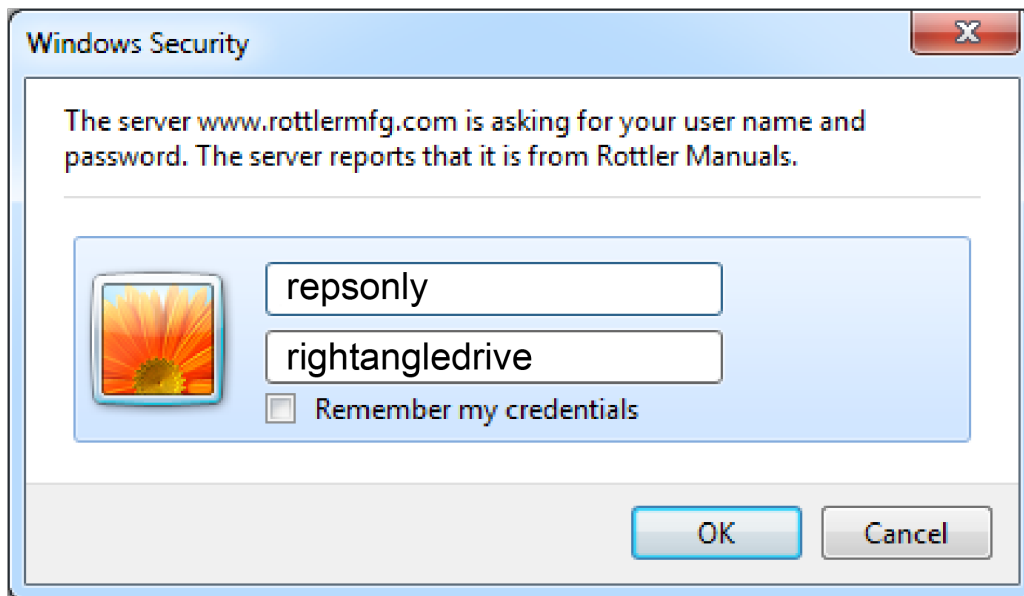
Online Documentation Access

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

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



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



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



INSTALLATION REPORT

EM69P

REV 110519

OFFICE USE ONLYRoute to:
Parts ____ Service Mgr ____ Assem Mgr ____ Eng Mgr ____ Parts ____ Andy ____ Parts ____
Warranty Exp Date _____

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

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

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

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

**Customer responsibility prior to the arrival of Rottler Sales/Service technician.
Please Initial each item when it is completed.**

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

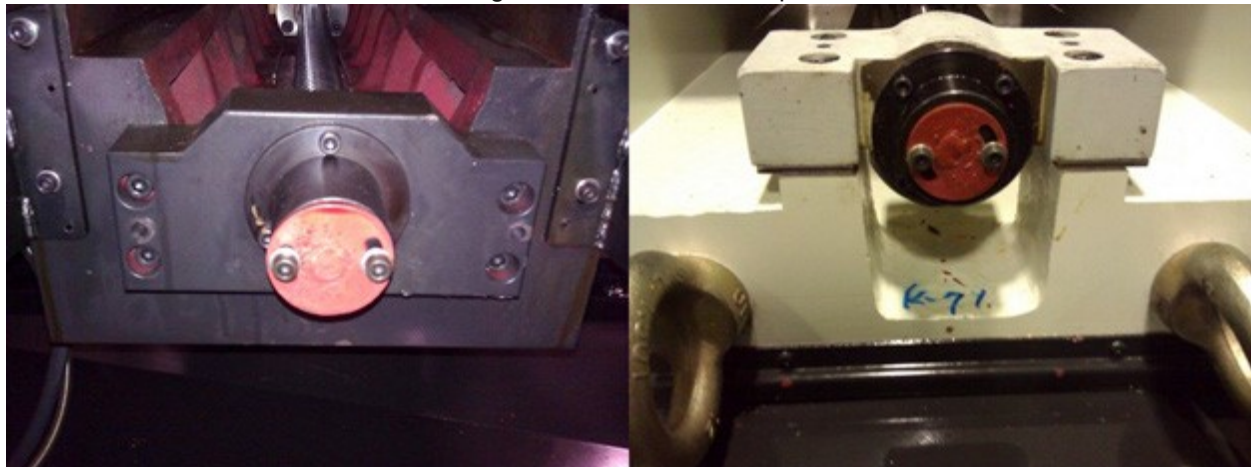
CAUTION **VERY IMPORTANT:** Modern design machines contain electronic low voltage circuitry that provides great advantages and a better machine life. BUT, you must have an excellent, stable power supply along with a good earth ground. If not, electrical noise problems are likely to interfere with machine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

- _____ Remove machine from truck.
- _____ Remove fixturing and misc. from machine and clean.
- _____ Install machine with jack pads under jacking bolts. Refer to the Machine Installation section in chapter 2 of the EM69P manual for proper uncrating and leveling instructions.
- _____ This machine requires between 208 and 240 Volts AC, Three Phase, 50/60 Hz power supply. For voltages above 240 or below 208 VAC, a 30kva transformer will be required. Measure the incoming voltage between L1 and L2, L2 and L3, and L1 and L3. Current requirements for this machine is 60 amps. Measure the incoming AC voltage at least twice during installation.
 1. L1to L2 _____ VAC, L2 to L3 _____ VAC, L1 to L3 _____
 2. L1to L2 _____ VAC, L2 to L3 _____ VAC, L1 to L3 _____
- _____ Measure each leg of the incoming supply to ground. Sometimes you may find a "high" leg to ground. When this happens make sure the high leg is running to L3.
L1 to ground _____ VAC L2 to ground _____ VAC L3 to ground _____ VAC

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

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

_____ Air of the proper pressure and capacity connected to the machine. Air supply must be free from oil and water. Oil or water will damage electrical and air components.



- _____ Remove the ball screw locks on the left side of the table for the X axis, and the front of the table for the Y axis. They may be covered up by the way covers.
- _____ Place a thin film of silicone on one side of the ball screw caps and install them in place of both the X and Y axis locks.
- _____ Air of the proper pressure and capacity connected to the machine. Air supply must be free from oil and water. Oil or water will damage electrical and air components.
- _____ Customer should attempt to have junk work piece available.
- _____ Have the operator read through the operation manual before training begins. This will help him be familiar with the button pushing sequences. Have the operator read through the manual again after training and some of the sequences will make more sense.
- _____ Have Internet connection available for the machine. Either via Ethernet cable or Wireless (Wi-Fi). The machine comes equipped with a wireless USB adapter.

Rottler technician Installation checklist:

- _____ **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.
- _____ Each main system is protected internally by circuit breakers. Green the breaker is “tripped” and red indicates the breaker is “Hot” (conducting electricity).

_____ Clean any rust inhibitor from the machine surfaces. Remove the way covers from the front and back of the Y (In/Out) Axis. Clean the rust inhibitor from exposed areas of the In/Out and Vertical axis. If the side trays for the Horizontal have been put on the machine, remove them. Use cleaner such as WD40 or Kerosene to clean the ways. Remove way wipers and clean each wiper. _____ Remove all rust inhibitor from the axis way surfaces.


 **CAUTION** *Do not attempt to move any axis until all rust inhibitor has been removed.*

_____ Reinstall way wipers. Confirm that all wipers make full contact with way surfaces.
 _____ Check the exterior of the limit switch for any shipping preservative and wipe clean if required.

Note: The positioning of the machine in small increments will be detrimentally affected if all rust inhibitor is not removed from the ways.

_____ Remind customer air of the proper pressure and capacity connected to the machine. Air supply must be free from oil and water. Oil or water will damage electrical and air components.
 _____ Connect electrical wires in main rear enclosure if required using machine wiring diagram.

MACHINE START-UP

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

_____ E-stop should be pushed in before turning the machine on for the first time.
 _____ Turn main power on at the main disconnect switch located on the rear enclosure.
 _____ If machine moves out of control, turn power off and contact factory for help in trouble shooting.
 _____ If any of the circuit breakers “trip”, reset and call factory for possible trouble shooting.

MACHINE MOVEMENTS

_____ Make sure there is nothing obstructing the full vertical or horizontal travel of the machine taking special notice of the rear enclosure, way travel and top of the spindle unit.
 _____ Put the machine in hand wheel mode and verify Vertical operation. Put an indicator on the cutter head and verify .001” movement per detent in course mode and .0001” in fine mode. If the indicator is jumpy the outer spindle adjustment may be too tight. Refer to manual and re-adjust.
 _____ Put the machine in hand wheel mode and verify Horizontal operation. Put an indicator on the cutter head and verify .001” movement per detent in course mode and .0001” in fine mode _____ Put the machine in hand wheel mode and verify Vertical operation.
 _____ Put the machine in hand wheel mode and verify Horizontal operation.
 _____ Put the machine in hand wheel mode and verify A axis operation.
 _____ Put the machine in hand wheel mode and verify B axis operation.
 _____ Use the rapid buttons and verify proper vertical, horizontal, A axis, and B axis travel.
 _____ Move the machine to its vertical, horizontal, A axis and B axis limits and verify Home and down limit operation.
 _____ Move the machine to its horizontal limits and verify operation of the left and right limit switches.
 _____ Start the spindle and verify operation at all speeds.
 _____ Use the spindle creep buttons and verify proper operation.
 _____ Level the machine:

INSTRUCTING THE OPERATOR:

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

! WARNING

_____ Explain to the customer and operator that at NO time is there to be any software or hardware other than Windows Auto Update and Rottler installed on this machine. This includes screen savers, anti-virus software, and any hardware device that installs software on the machine. Installation of screen savers and anti-virus software can cause dangerous control problems. Any installation of software or hardware will void the warranty on the machine.

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

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

_____ Once the machine has been fully setup and is ready for operation create a Skype account for the machine following the instructions in the Installation Section of the manual.

_____ Explain to the customer and the operator how the to log onto Skype and communicate with Rottler when needed.

! WARNING

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

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

Signature / Title

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

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

_____ Connect customer supplied Internet to the machine.

_____ Verify that the Internet is accessible from the machine.

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

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

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

_____ Demonstrate the differences of Manual and Auto operation.

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

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

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

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

_____ Parts ordering, refer the to the operating manual for part numbers and description.

_____ Review Emergency stop procedure with operator per operating manual.

MAINTENANCE SECTION

_____ Use the manual as a reference when explaining routine maintenance and lubrication.

_____ Overload devices, There are no mechanical overload devices on this machine. The machine is protected from overload by the motor controllers. If the system is overloaded the controllers shut the motors off. The controllers can be reset by turning the main power off for at least 1 minute, then turning it back on.

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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.

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

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Instructions given to: _____

Sales/Service Engineer: _____
Date _____

Shop Foreman/Superintendent or Owner: _____
Date _____

Once completed send this form to: Rottler Manufacturing attn: Parts Department
Alternately you may send this form via fax or e-mail:
8029 S 200 St fax: [+1] 253-395-0230
Kent, WA 98032 USA e-mail: parts@rottlermfg.com

Rottler EM69P Pre-Install Checklist

IMPORTANT

*Tool Changer Assembly must be Installed by Rottler Factory Trained Technician
Tool changer may have to be installed on machine before final position
If there are any clearance issues in final location contact your Rep*

*This checklist is to get you prepared to have the necessary equipment available and ready for the
Rottler Technician for use during install
Any questions please contact your Rottler Rep or Rottler Service Department*

Receiving Machine and Placing in Position _____ Remove
machine from truck.
_____ Remove the machine from the pallet
_____ Equipment to lift at least 12,000 lbs. / 5443.1084 kgs.

Machine Pick-up Points

- Lifting hooks located in the top of the back column and Front Lifting hooks located under the front way cover (Remove way cover).



- Lift machine evenly



Machine Height and Clearance

Vertical height of machine is 10 ft. / 3.048 m.

- Will need to be able to lift tool changer above the machine during assembly
- Using equipment able to lift 2700 lbs. / 1224.699 kgs.

Rigging Supply Required During Install

- _____ Need 4 straps or chains of even length of at least 3.5 ft. / 1.1m above from the lifting points.
_____ (If using straps it might need top be double length to loop around lifting points)





_____ Install machine with jack pads under jacking bolts. Refer to the Machine Installation section in the manual for proper uncrating and leveling instructions.



_____ Remove fixtures and misc. from machine and clean.

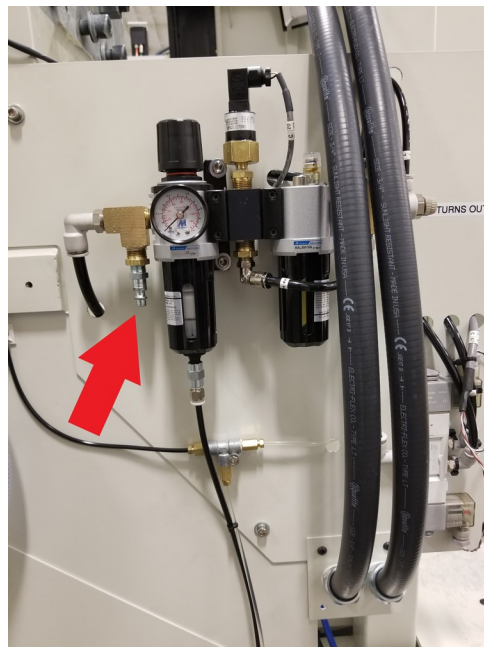
_____ Rough level the machine.

Air Supply to Machine

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

Connecting to the back of the column of the machine.

- Located on the column, back of machine.
- Connect line to quick disconnect



Connecting Power to the Machine

Power Supply

This machine has the following power requirements:

208 to 240 VAC

Three Phase

50 or 60 Hertz

60 amps

See illustration for correct connection of “measured” incoming power. Connect three phase wiring to the power terminals located in the main rear enclosure, located on the right rear of machine base. The connection terminals are located on the DIN rail. Connect high leg of 3 phase power to L3 blue terminal. Attach other 2 power lines to terminal blocks L1 and L 2. Attach wire from the grounding rod to the ground block.

IMPORTANT

Important: Electrically connect in accordance with national and local electrical codes.

_____ This machine requires between 208 and 240 Volts AC, Three Phase, 50/60 Hz power supply. For voltages above 240 or below 208 VAC, a 17kva transformer will be required. Measure the incoming voltage between L1 and L2, L2 and L3, and L1 and L3. Current requirements for this machine is 60 amps. Measure the incoming AC voltage at least twice during installation.

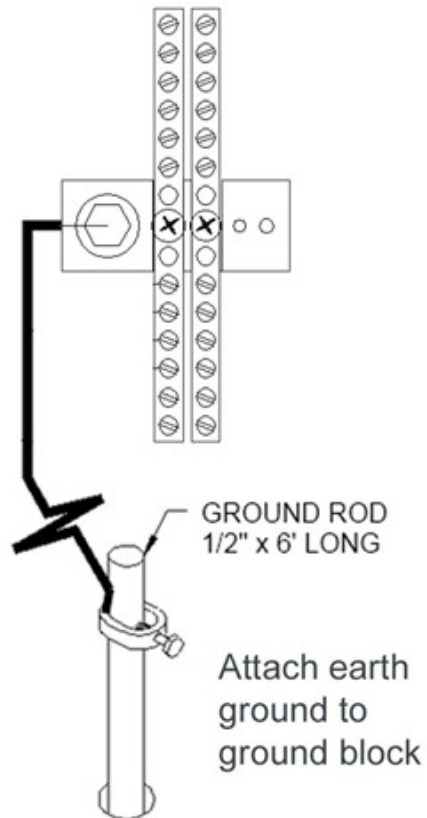
1. L1to L2 _____ VAC, L2 to L3 _____ VAC, L1 to L3 _____
2. L1to L2 _____ VAC, L2 to L3 _____ VAC, L1 to L3 _____

_____ Measure each leg of the incoming supply to ground. Sometimes you may find a “high” leg to ground. When this happens make sure the high leg is running to L3.

L1 to ground _____ VAC L2 to ground _____ VAC L3 to ground _____ VAC

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

Electrically connect in accordance with national and local electrical codes.

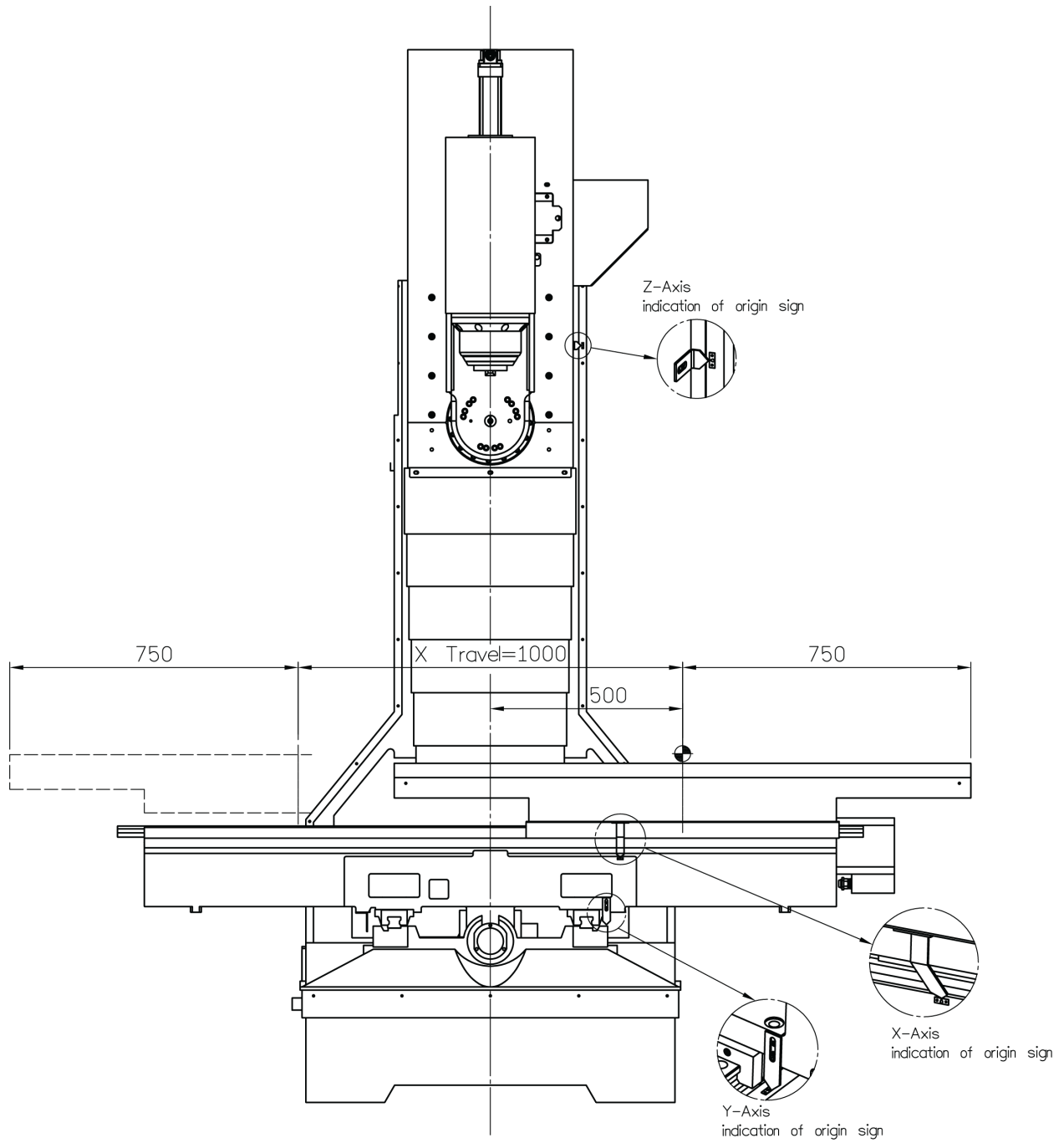
Digitizing Setup

Parts Required

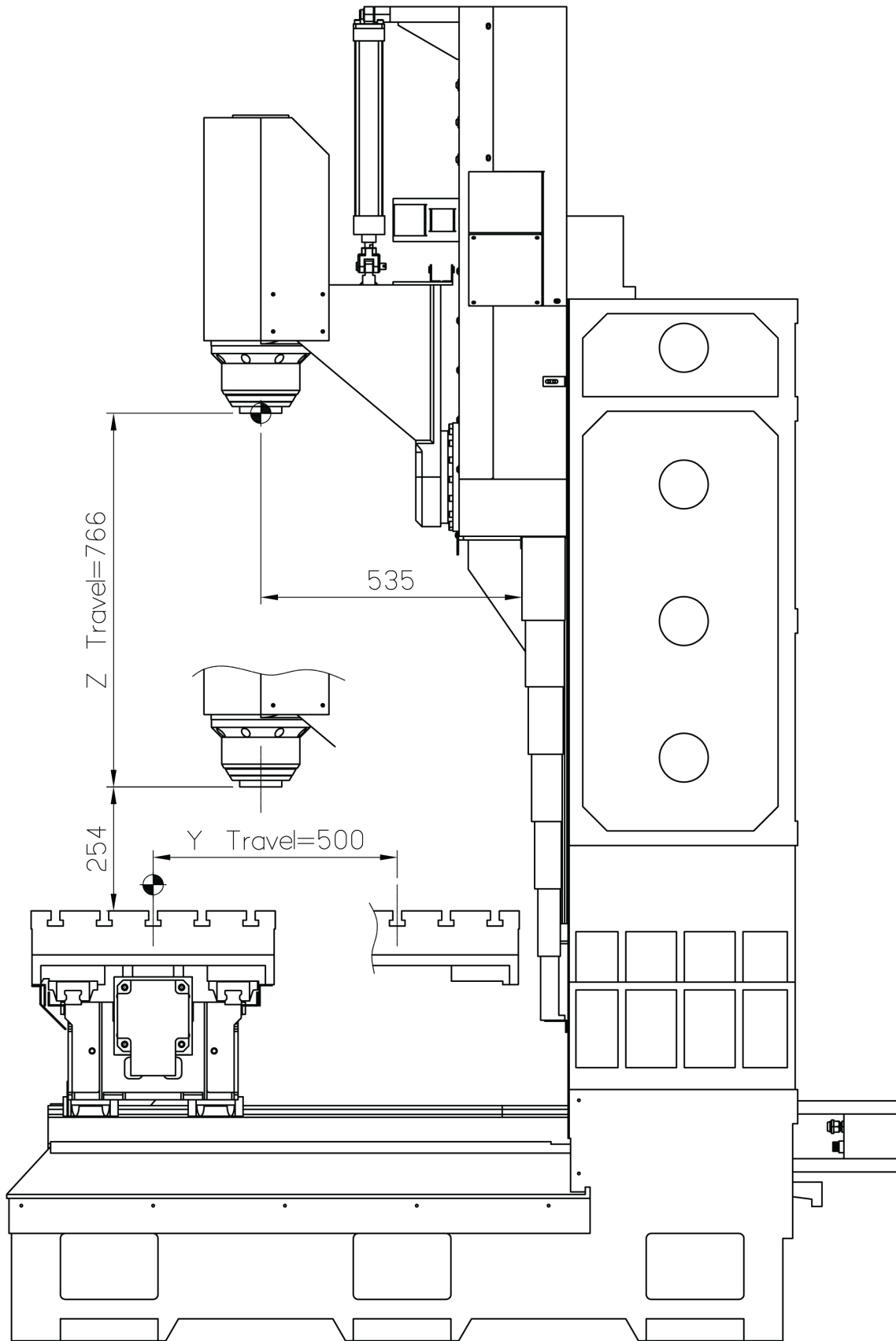
- _____ Have Cylinder head ready for Digitizing (Disassembled and Cleaned Bare Head)
- _____ Have Scrap Cylinder head ready for test cuts (Same as digitized head preferred)
- _____ Valves for the heads to be digitized (Intake & Exhaust)
 - _____ Valves need to be ground down to be flush with the surface of the chamber.
- _____ Molding Clay (used for Digitizing)

Machine Travel Dimensions

Front Dimensions



Side Dimensions



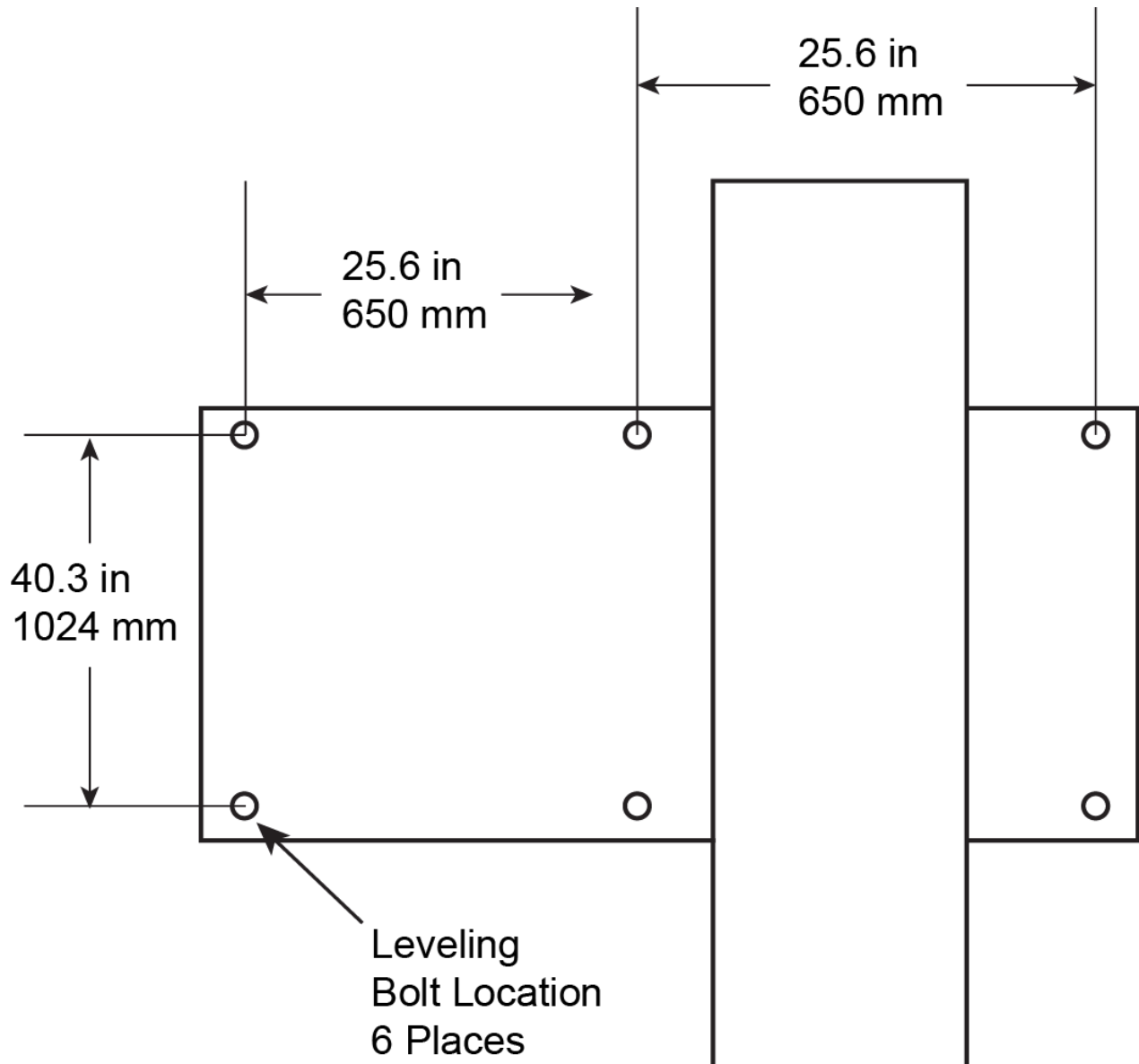
Clearance Dimensions

Clearance dimensions were not available at the time of this manual's publication. Contact Rottler Sales for clearance dimensions.



Image Currently Unavailable

Leveling Bolt Locations



Leveling and Alignment

Leveling the EM69P properly is very important if you are to use the EM69P to its full blue printing capabilities as well as maximizing the use of Rottler fixturing.

Use the following instructions to properly level the EM69P.

Six Hex head bolts, six jam nuts, and six purple leveling pads are provided with the machine for leveling. Refer to the following illustrations for leveling bolt locations. Screw the jam nuts all the way onto the bolts; insert the bolts at the base support points. Screw the bolts in until they are just protruding from the bottom of the base casting. Lower the machine onto the Leveling pads, making sure the bolts seat into the recessed area of the leveling pads.

Make sure there is equal pressure on each of the leveling bolts. Remove the protective rubber cover, located behind the table, from the Y-Axis (In/Out). Place the level on the Y-Axis ways, level the ways in both directions (Horizontal / In-Out) within .0005".

Check the level in both directions on the Table. If it does not match the alignment of the Y-Axis ways refer to the Maintenance Chapter of this manual for full alignment procedures.

Installation Procedure



IMPORTANT! *Placement of Machine*

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

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

Location

The productivity of the EM69P will depend a great deal on the proper initial installation. Pay particular attention to the means by which work pieces are lifted into and out of the machine as well as the material handling to and from other operations in your shop. The proper loading arrangements and work location for your EM69P is extremely important.

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

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

Unpacking and Lifting

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

Power Supply

This machine has the following power requirements:

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

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

Some electrical services contain a "Hot Leg, High Leg, or Wild Leg", where one leg measures 208VAC to Ground instead of 120VAC. It is required to use the "Hot Leg" for L3 when connecting the machine.

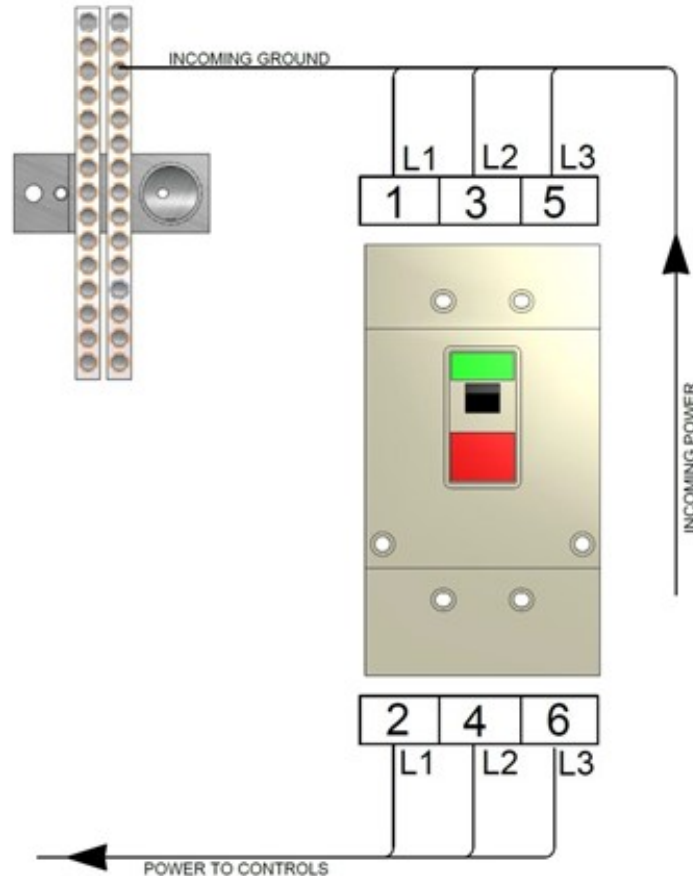
Voltage measured between the phases must be between 208VAC and 240VAC, while phases 1 and 2 to ground must be ~120VAC. Phase 3 to ground is allowed to measure up to 208VAC.

IMPORTANT

Electrically connect in accordance with national and local electrical codes.

CAUTION

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



Grounding

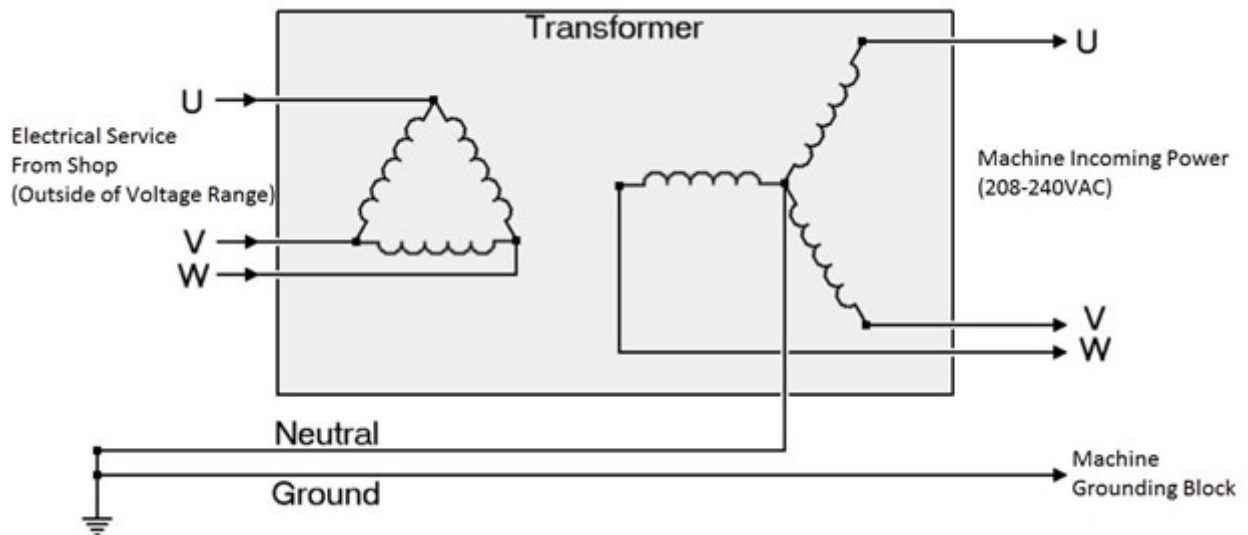
The machine requires a good earth ground. The grounding conductor from the incoming power source must be connected to the grounding block located inside of the electrical cabinet. A ground rod installed in addition to the electrical service grounding conductor is permitted, but must be connected directly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

Transformer Connections

This machine has the following minimum transformer size requirement:

- 30 kVA

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



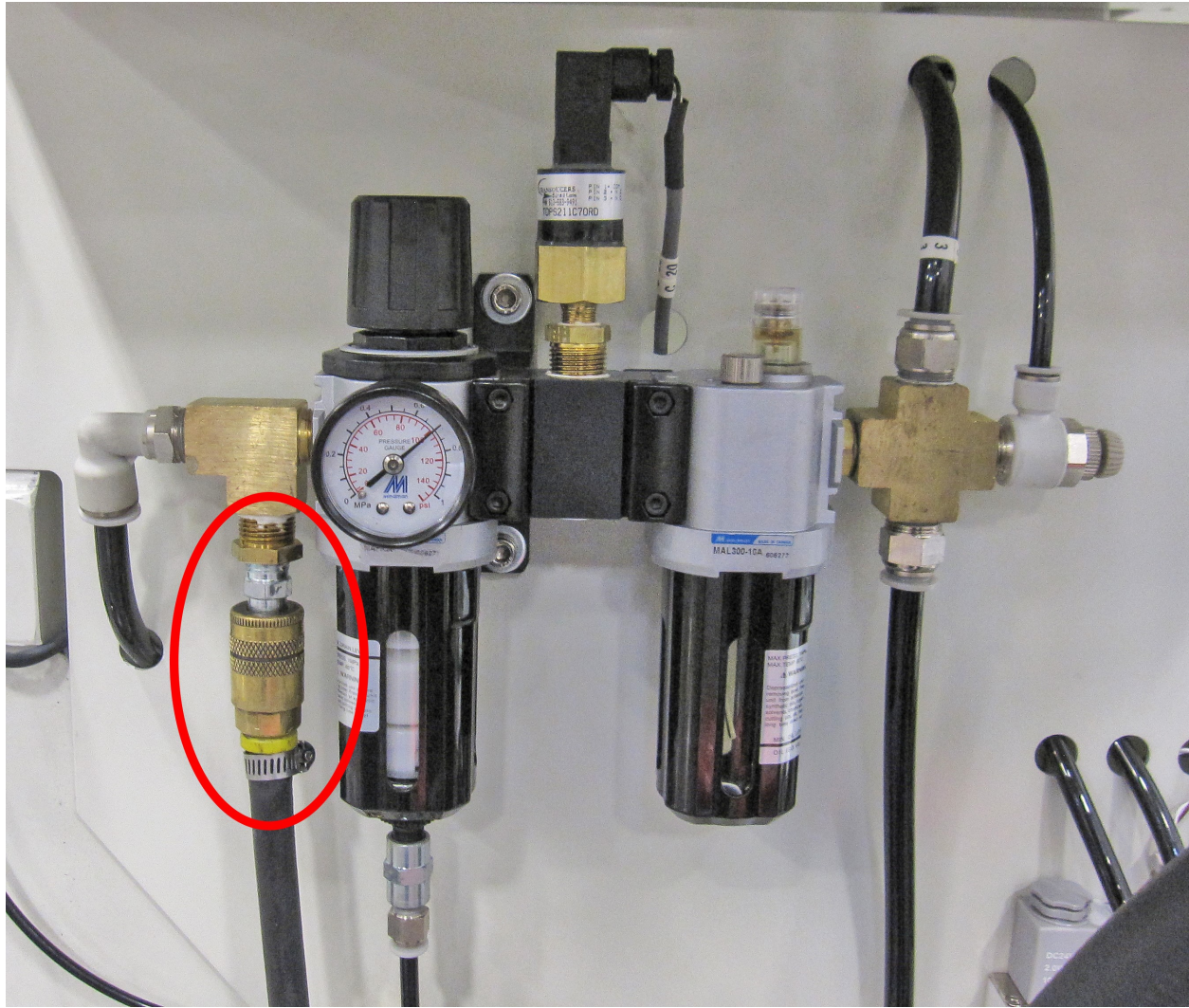
Phase Converters

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

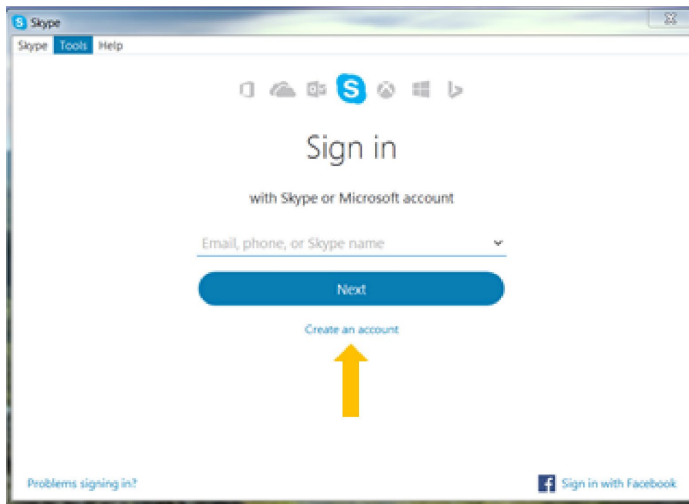
Air Supply

It is very important that the air source for the EM69P be moisture free. Water and oil in the air lines will result in early cylinder and valve failure as well as introducing moisture into the Inner spindle bearings. ***The factory recommends installing a water trap at the machine.***

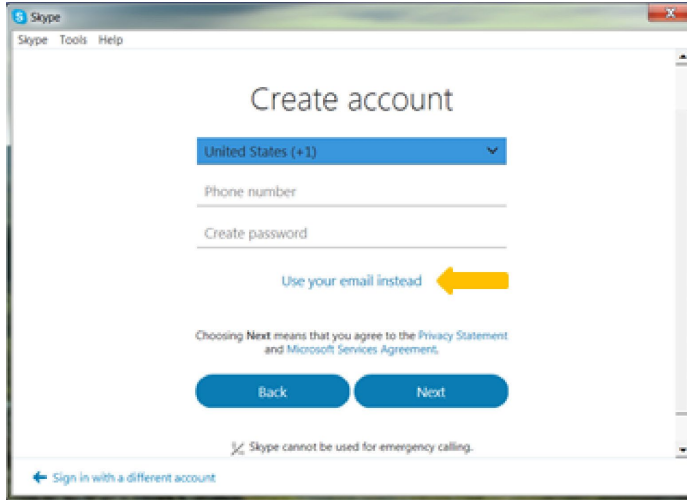
Attach a 100 P.S.I. air source to the main air intake located on the back of the machine.



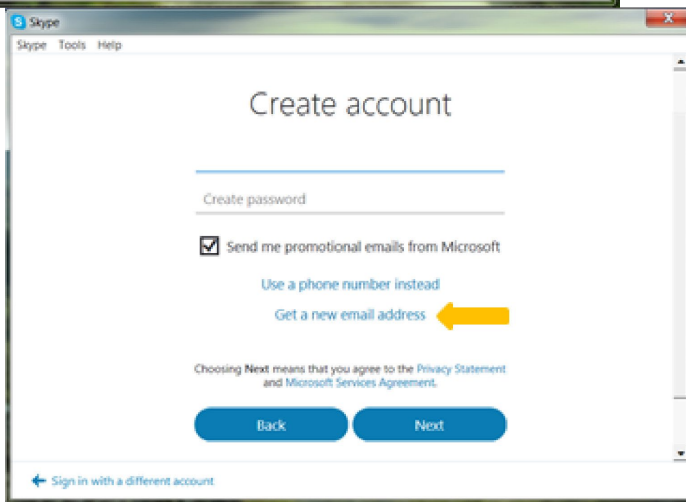
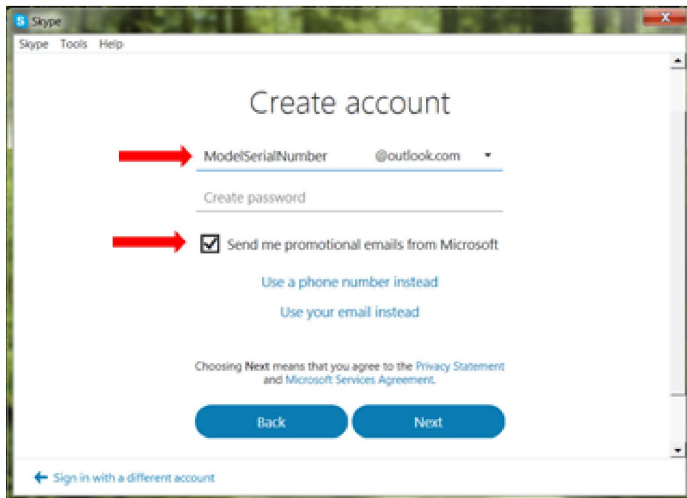
Creating a Skype Account



Click on create an account



Click on: Use your email instead



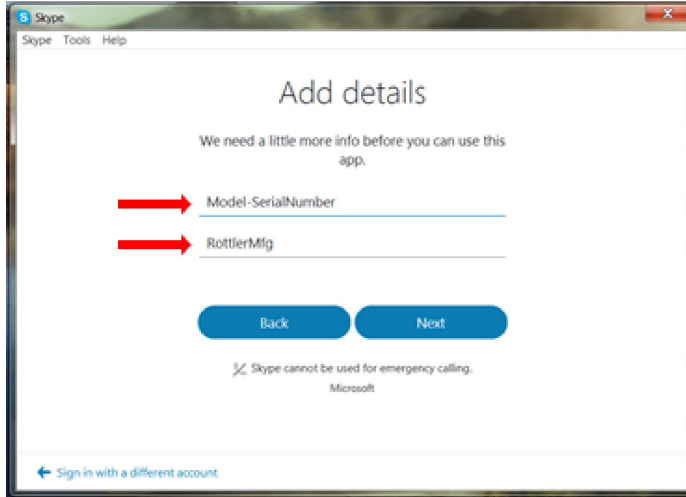
Click on: Get new email

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

H85A111, EM69P001

Create a password that is easy to remember.

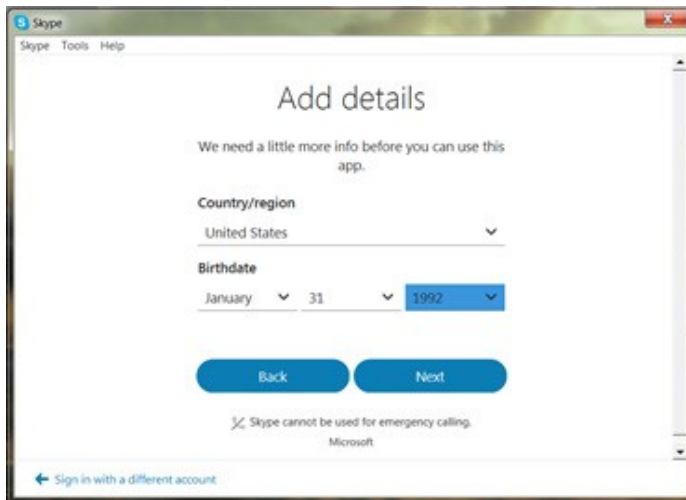
Uncheck the box to receive emails from Microsoft.



First Name: Model-Serial Number

Ex: H85A-111, EM69P-001

Last Name: RottlerMfg

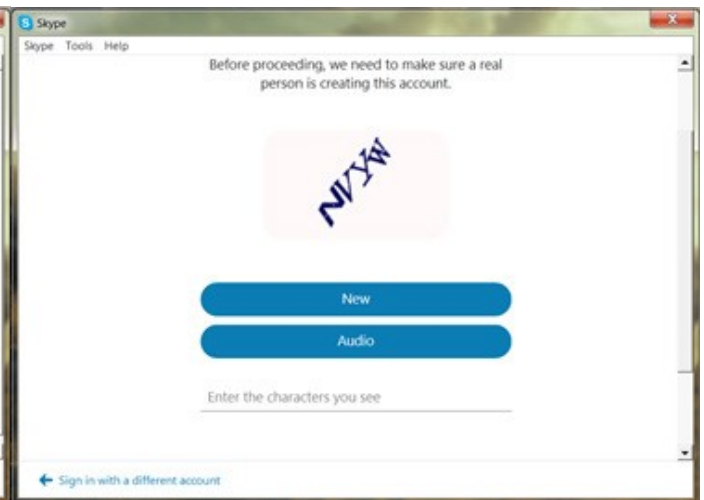


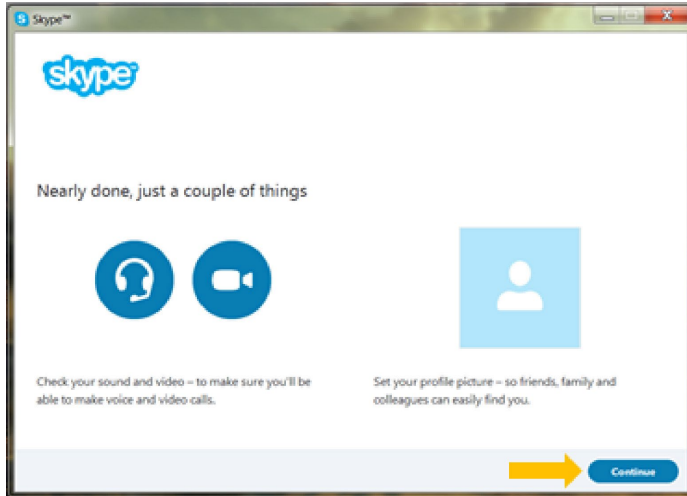
Select your Country/region

Birthdate: Today's date, year 1992

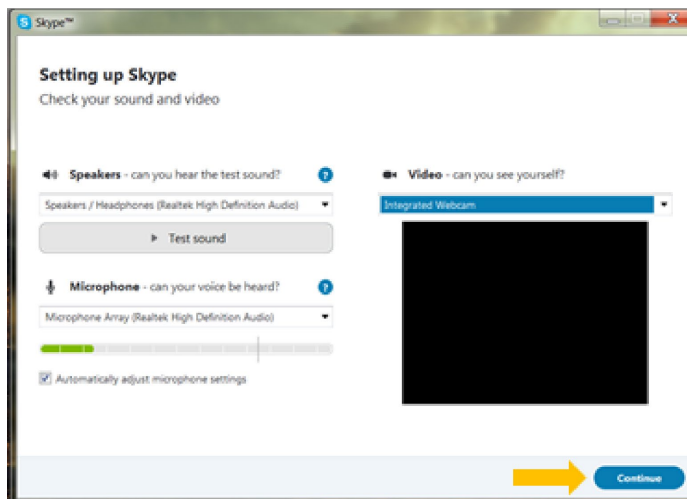
Type the code exactly as it appears.

Click "Next"



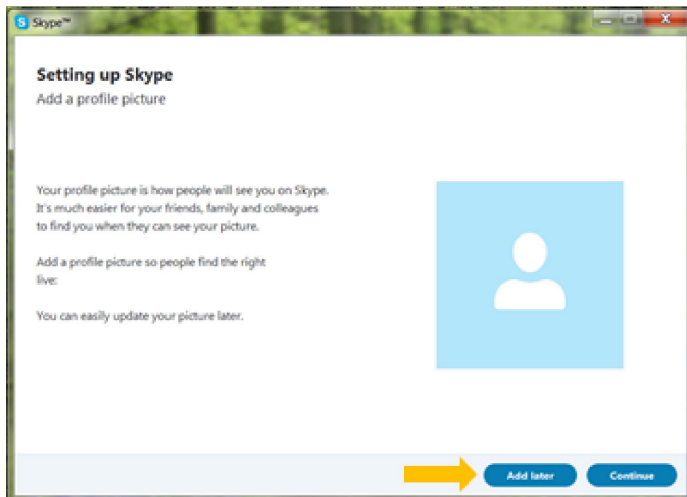


Click "Continue"



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

Otherwise, click "Continue"



Click "Add later" to skip this part.

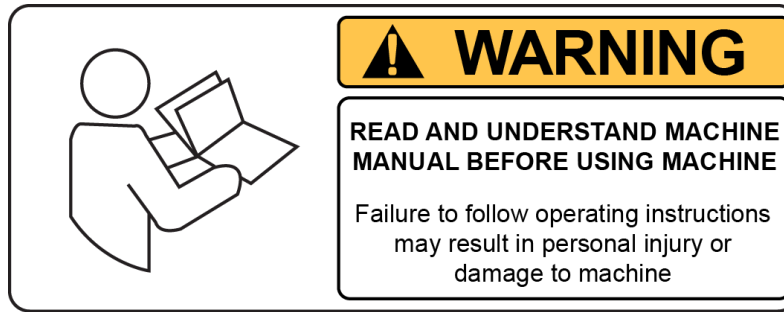
Your Skype account is set up and ready for use.

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



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



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



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



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



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

Safety Instructions for Machine Use



This machine is capable of causing severe bodily injury

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

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



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

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

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

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



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

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

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

NEVER OPERATE A MACHINE WHEN TIRED, OR UNDER THE INFLUENCE OF DRUGS OR ALCOHOL.

Full mental alertness is required at all times when running a machine.

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

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

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

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

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

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

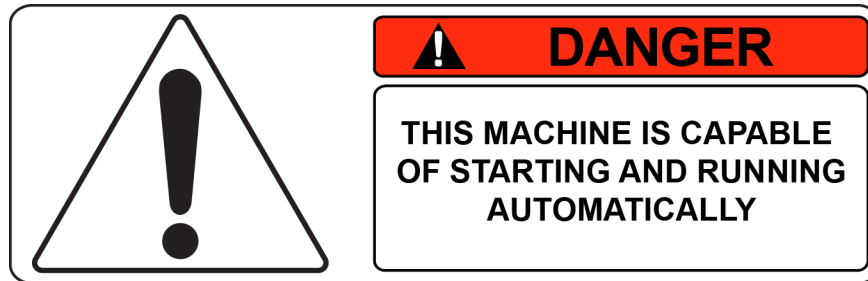




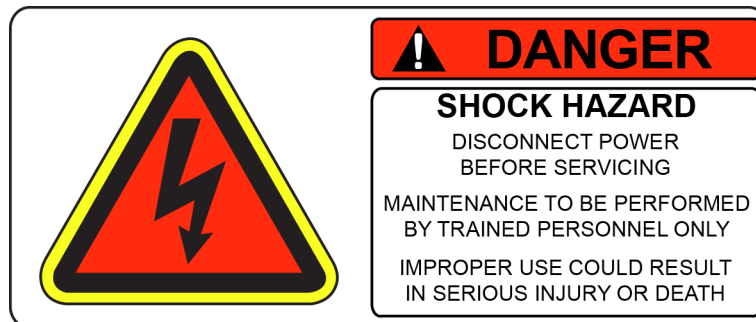
No list of safety guidelines can be complete. Every piece of shop environment is different. Always consider safety first, as it applies to your individual working conditions. Use this and other machinery with caution and respect. Failure to follow guidelines could result in serious personal injury, damage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

Electrical Power

THIS MACHINE IS AUTOMATICALLY CONTROLLED AND MAY START AT ANYTIME

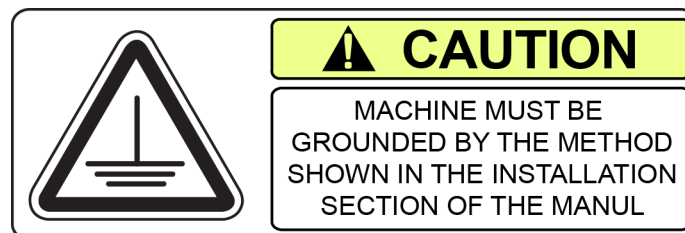


All electrical power should be removed from the machine before opening the rear electrical enclosure.




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

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



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.

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

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

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

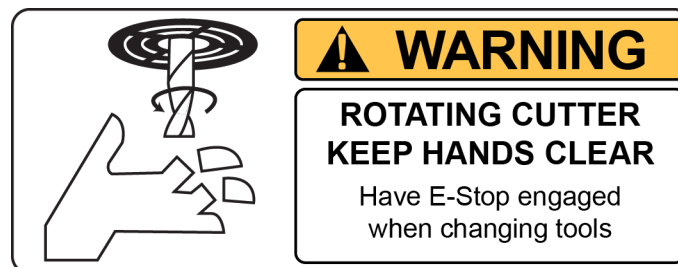
Machine Operator:

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

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

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

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



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



**CAUTION**

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

**CAUTION**

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

Emergency Procedure:

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

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

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

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

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

Computer and Controller System Safety:

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

**IMPORTANT**

The computer in this machine has the ability to connect to the 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.

**DANGER**

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

**WARNING**

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

**IMPORTANT**

Downloading any program or changing any Rottler or Computer settings may cause the machine and/or software to become unstable. **DO NOT** install ANY screen saver, Anti-Virus, Spyware or any type of Security software on the computer. This could create a hazardous

environment for the operator and personnel around the machine. Performing any of the above will also result in the machine warranty being NULL and VOID.

IMPORTANT DO NOT connect any type of external hardware to the computer via USB or any other means. Do not install any type of Device Driver. This could create a hazardous

environment for the operator and personnel around the machine. Performing any of the above will also result in the machine warranty being NULL and VOID.

Electrical Safety Features Of Rottler DM Controlled Machines

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

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.

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Control Definitions

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

Computer and Controller System Safety

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 adapter. This machine should NOT be connected to the Internet for any reason other than getting a software update. This 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.

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.



Connecting to the Internet for any other reason will leave the machine vulnerable to viruses which could create a safety hazard and/or leave the machine inoperable.



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.



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.

Master Power On/Off Switch

This switch is located on the main electrical control enclosure on the back of the machine. The switch must be in the off position before opening the rear enclosure door.

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

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

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

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

Machine Startup

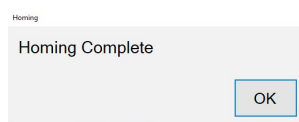
Start by double clicking the direct surface icon found on your desktop.

E-Stop

The E-stop is a safety tool that will prevent the machine from moving and allow you to immediately terminate any action that the machine is performing, in case there is an emergency. Once the Direct Surface program has opened, twist the red E-stop button until it pops out.

Homing the Machine

Every time a new session of Direct Surface has been opened the machine MUST be homed to ensure proper operation the machine. This allows the machine to accurately locate all travel limits and zeros. To home the machine you click the green “Home” button on the right side of the screen. The A and B axis will rotate to a specified ‘home’ location. Once this process is complete, a message saying “Homing Complete” will appear and you may click “OK.” If you receive a message that says “Error: Move Axis farther away from homing switch” The just use the green jog buttons to move the mentioned axis and press the “HOME” button again.



(You will see this message after all axes find their limits.)



Controls

Viewing the control there are several tabs to click on (A) which include Setup, Digitize, Program, Tool path, and Auto Cycle. Each of these tabs will be used in order to guide you through the programming process. The yellow X, Y, Z, A, B buttons (B) allow you to zero you fixture coordinates. The blue “HANDWHEEL” buttons (C) are to select the increments you would like to move each axis by the hand wheel. The “GOTO” buttons (D) allow you to quickly move to a designated fixture location. The “JOG CONTROLS” (E) allow you to quickly move the machine in less precise increments to a desired location.

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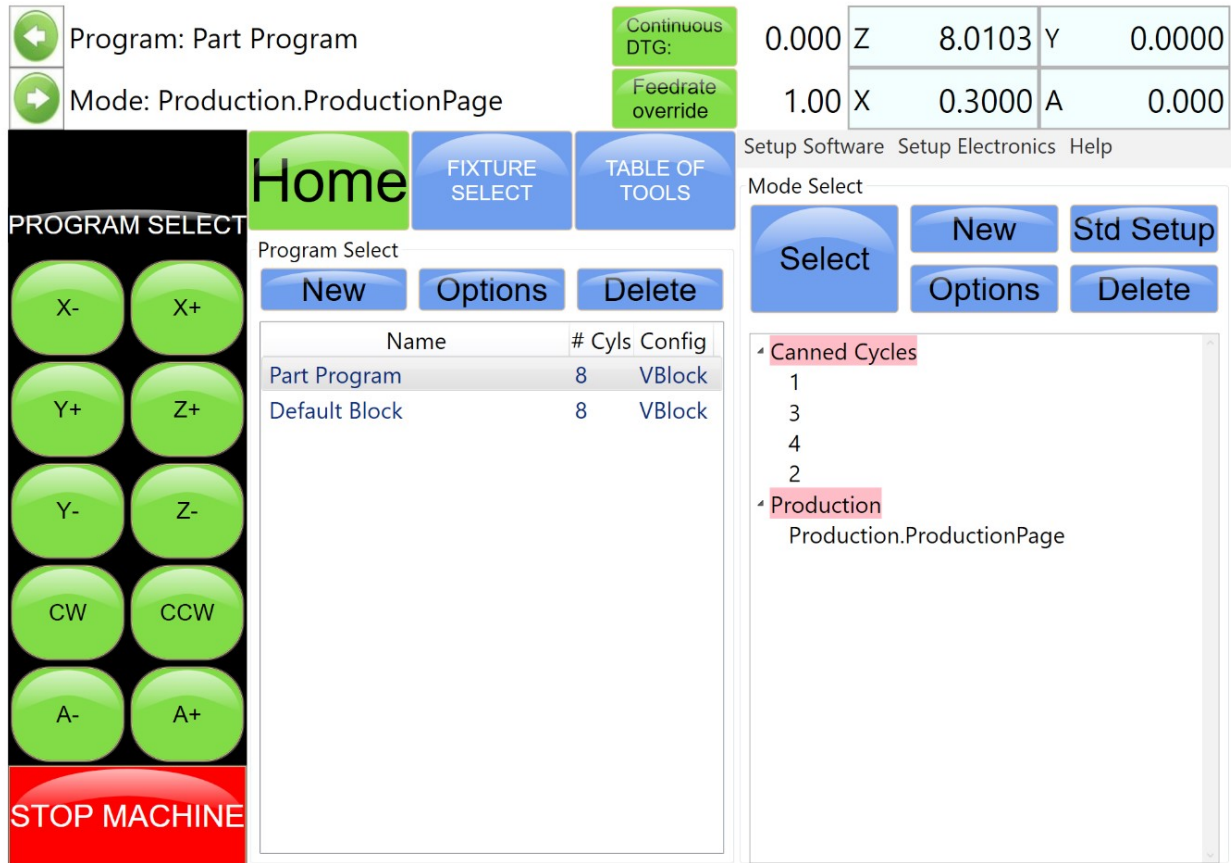
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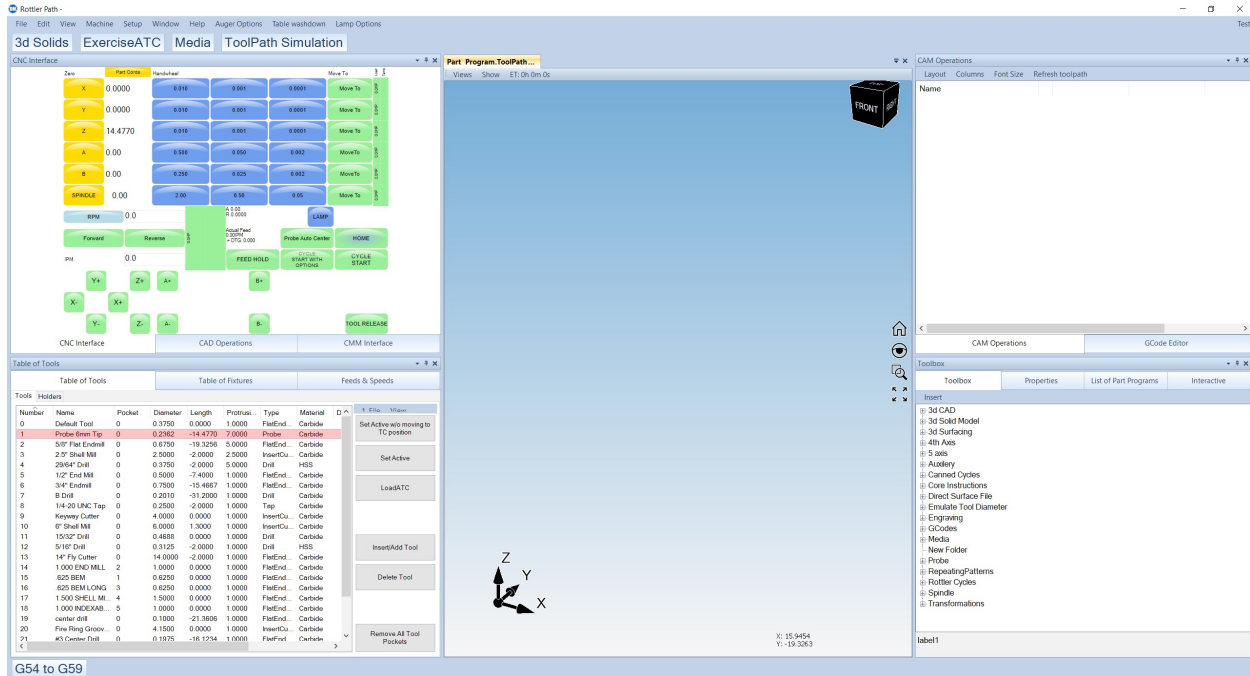
Using 3rd Party Tooling in Rottler Machines with CAT 40 Tooling.5-111

General Machine Information

The Rottler EM69P utilizes Computerized Numeric Control (CNC). From within any of the Rottler software packages the CNC control interface can be used to move the machines axis in any of the labeled directions. Below are images of the main user interfaces found in the RPATH/4C software and the Rottler Block Software program packages.



Rottler Block Software User Interface



Rottler RPATH/4C User Interface

Homing

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

Building Programs

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

Create a Block Program

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

Program: Chev 350
 Mode: Cylinder Bore

Continuous DTG:	0.000	Z	14.4770	Y	0.0000
Feedrate override	1.00	X	0.0000	A	0.000

Home FIXTURE SELECT TABLE OF TOOLS

Setup Software Setup Electronics Help

PROGRAM SELECT

X- X+
 Y+ Z+
 Y- Z-
 CW CCW
 A- A+

STOP MACHINE

Program Select

New Options Delete		
Name	# Cyls	Config
Part Program	8	VBlock
Default Block	8	VBlock
Chev 350	8	VBlock

Mode Select

Select New Std Setup
 Options Delete

◀ Cylinder Bore
 Cylinder Bore

Options

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

Std (Standard) Setup

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

Program: Chev 350
Mode: Thrust Cutting

Continuous DTG: 0.000 Z 14.4770 Y 0.0000
Feedrate override: 1.00 X 0.0000 A 0.000

Setup Software Setup Electronics Help

Home FIXTURE SELECT TABLE OF TOOLS

PROGRAM SELECT

X- X+
Y+ Z+
Y- Z-
CW CCW
A- A+

STOP MACHINE

Program Select

Name	# Cyls	Config
Part Program	8	VBlock
Default Block	8	VBlock
Chev 350	8	VBlock

Mode Select

Select New Std Setup
Options Delete

- ▾ Canned Cycles
 - Canned Cycles
- ▾ Probing
 - Calibrate Probe
 - Pan Rail Probe
- ▾ Crank Clearance
 - Crank Clearance
- ▾ Cylinder Bore
 - Counter Bore
 - Rough Through Bore
 - Finish Through Bore
 - Chamfer
 - Sleeve
 - O Ring
 - Sleeve Top Bore
 - Circular Interpolate
 - Circular Interpolate Lowers

Select

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

Options

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

Cylinder Bore Mode 3 Axis

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

Program: Chev 350
 Mode: Rough Through Bore

Continuous DTG: 0.000 Z 14.4770 Y 0.0000
 Feedrate override: 1.00 X 0.0000 A 0.000

Set Zeros	Vertical Stops	Left Locations	Right Locations
Fixture	Actual Position	Handwheel	Move To
X	0.0000	0.010 0.001 0.0001	MoveTo
Y	0.0000	0.010 0.001 0.0001	MoveTo
Z	14.4770	0.010 0.001 0.0001	MoveTo
SPINDLE	25.92	10x Coarse Fine	MoveTo
A	0.000	.100 .010 .001	MoveTo
B	0.000	.100 .010 .001	MoveTo

Feeds Speeds SSV

Spindle Load: 0.0%
 Feed Rate: 0.0030
 Spindle RPM: 400.00

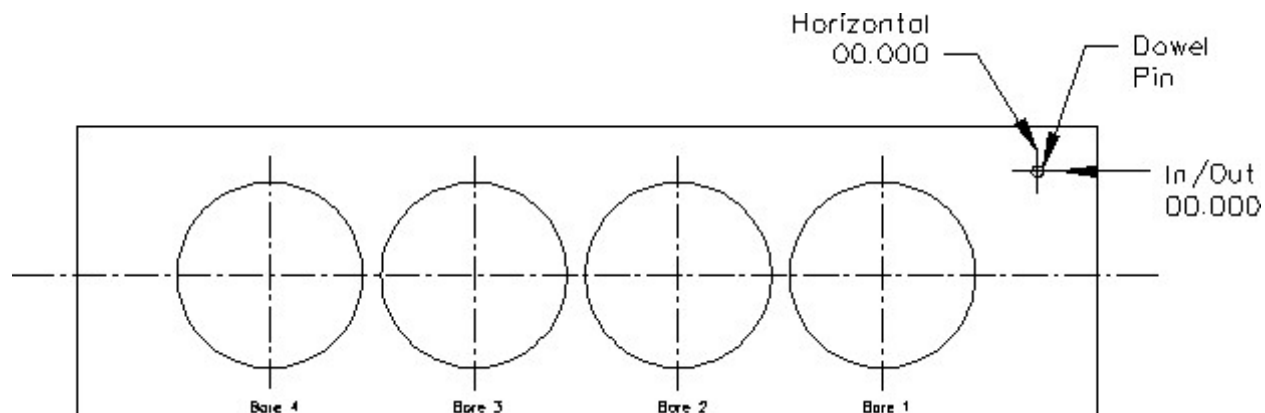
Buttons: PROBE AUTO CENTER, COOLANT, AUGER, LAMP, MOVE TO ZEROS, CW INDEX, CCW INDEX, START SPINDLE

Setting Zeros

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

X and Y Axis Zero's

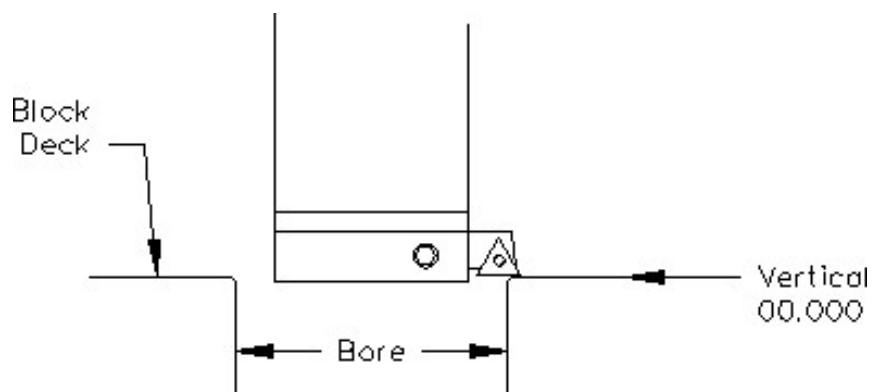
For this example, the Engine Block Dowel Pin will be our zero point for the **X-Axis** (Horizontal) and **Y-Axis** (In/Out) axis. Using either the touch trigger probe or a test indicator, find the center of the dowel pin. Without moving the machine, **double tap** on the **X and Y buttons** directly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



Vertical Zero

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

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



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

Blueprinting Method

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

Programming Vertical Stops

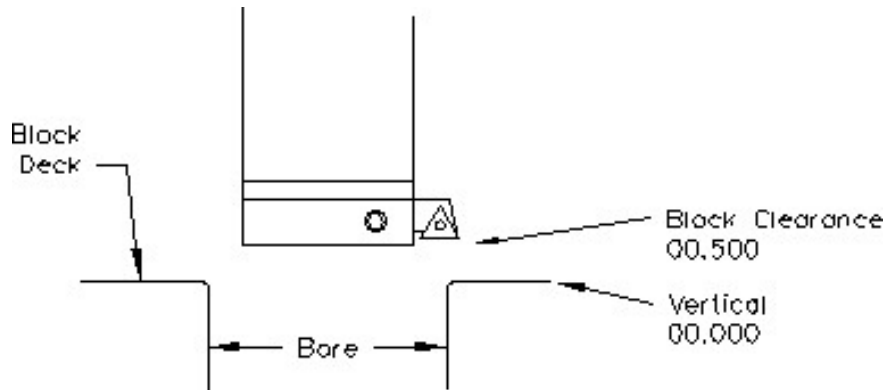
To build a program you must set the Vertical Stops for the program. This is done by filling out the boxes in the Vertical Stops Tab.

←	Program: Chev 350	Continuous DTG:	0.000	Z	0.0000	Y	0.0000
→	Mode: Cylinder Bore	Feedrate override	1.00	X	0.0000	A	0.000

Set Zeros	Vertical Stops	Left Locations	Right Locations
BORE PROFILE Block Clearance <input type="text" value="0.0000"/> <input type="button" value="SET"/> Centering Height <input type="text" value="0.0000"/> <input type="button" value="SET"/> Start Boring Height <input type="text" value="0.0000"/> <input type="button" value="SET"/> <input type="checkbox"/> X Offset for Honing Bottom of Bore <input type="text" value="1.0000"/> <input type="button" value="SET"/> <input type="checkbox"/> Washout Cycle <input type="checkbox"/> Coolant <input checked="" type="checkbox"/> Stop and Index Spindle After Cycle		PROBE OPTIONS Probe Clearance <input type="text" value="0.0000"/> <input type="button" value="SET"/> Probing Height <input type="text" value="0.0000"/> <input type="button" value="SET"/> Largest Probe Diameter <input type="text" value="0.0000"/> <input type="checkbox"/> Set Zero on Probe	
HANDWHEEL Z <input type="button" value=".010"/> <input type="button" value=".001"/> <input type="button" value=".0001"/>		After offset Washout	

Block Clearance

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

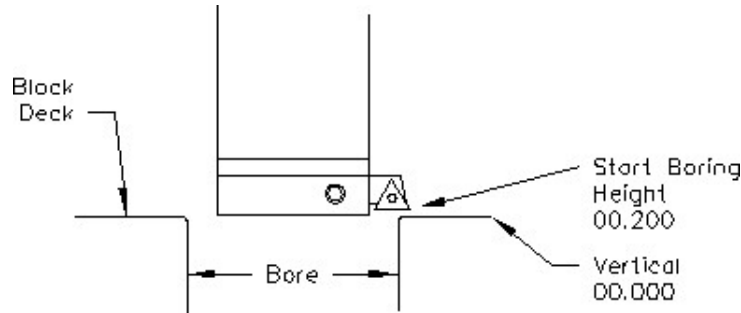


Centering Height

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

Start Boring Height

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



Bottom of the Bore

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

←	Program: Chev 350	Continuous DTG:	0.000	Z	0.0000	Y	0.0000
→	Mode: Cylinder Bore	Feedrate override	1.00	X	0.0000	A	0.000

PROGRAM SELECT

X- X+

Y+ Z+

Y- Z-

CW CCW

A- A+

STOP MACHINE

Set Zeros	Vertical Stops	Left Locations	Right Locations
BORE PROFILE		PROBE OPTIONS	
Block Clearance	0.5000 SET	Probe Clearance	0.0000 SET
Centering Height	0.2000 SET	Probing Height	0.0000 SET
Start Boring Height	0.2000 SET	Largest Probe Diameter	0.0000
<input type="checkbox"/> X Offset for Honing		<input type="checkbox"/> Set Zero on Probe	
Bottom of Bore	-5.4000 SET	After offset Washout	
<input type="checkbox"/> Washout Cycle	<input type="checkbox"/> Coolant		
<input checked="" type="checkbox"/> Stop and Index Spindle After Cycle			
HANDWHEEL			
Z	.010	.001	.0001

X Offset for Honing

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

←	Program: Chev 350	Continuous DTG:	0.000	Z	0.0000	Y	0.0000
→	Mode: Cylinder Bore	Feedrate override	1.00	X	0.0000	A	0.000

Set Zeros	Vertical Stops	Left Locations	Right Locations
BORE PROFILE		PROBE OPTIONS	
Block Clearance	0.5000 <input type="button" value="SET"/>	Probe Clearance	0.0000 <input type="button" value="SET"/>
Centering Height	0.2000 <input type="button" value="SET"/>	Probing Height	0.0000 <input type="button" value="SET"/>
Start Boring Height	0.2000 <input type="button" value="SET"/>	Largest Probe Diameter	0.0000
<input checked="" type="checkbox"/> X Offset for Honing		<input type="checkbox"/> Set Zero on Probe	
Start Offset Height	-5.2000 <input type="button" value="SET"/>	After offset Washout	
Bottom of Bore	-5.4000 <input type="button" value="SET"/>	AFTER HORIZONTAL OFFSET	
<input type="checkbox"/> Washout Cycle	<input type="checkbox"/> Coolant	Horizontal Offset	0.0200
<input checked="" type="checkbox"/> Stop and Index Spindle After Cycle		<input checked="" type="checkbox"/> Change Speeds At Horizontal Offset	
HANDWHEEL		Feed Rate	0.0020
Z	<input type="button" value=".010"/> <input type="button" value=".001"/> <input type="button" value=".0001"/>	Spindle RPM	300.00
		Left Bank	Right Bank
		Right Offset	No Offset
		<input type="button" value="L"/>	<input type="button" value="R"/>

Start Offset Height

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

Horizontal Offset

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

Change Speeds at Horizontal Offset

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

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

Washout Cycle

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

Stop and Index Spindle after Cycle

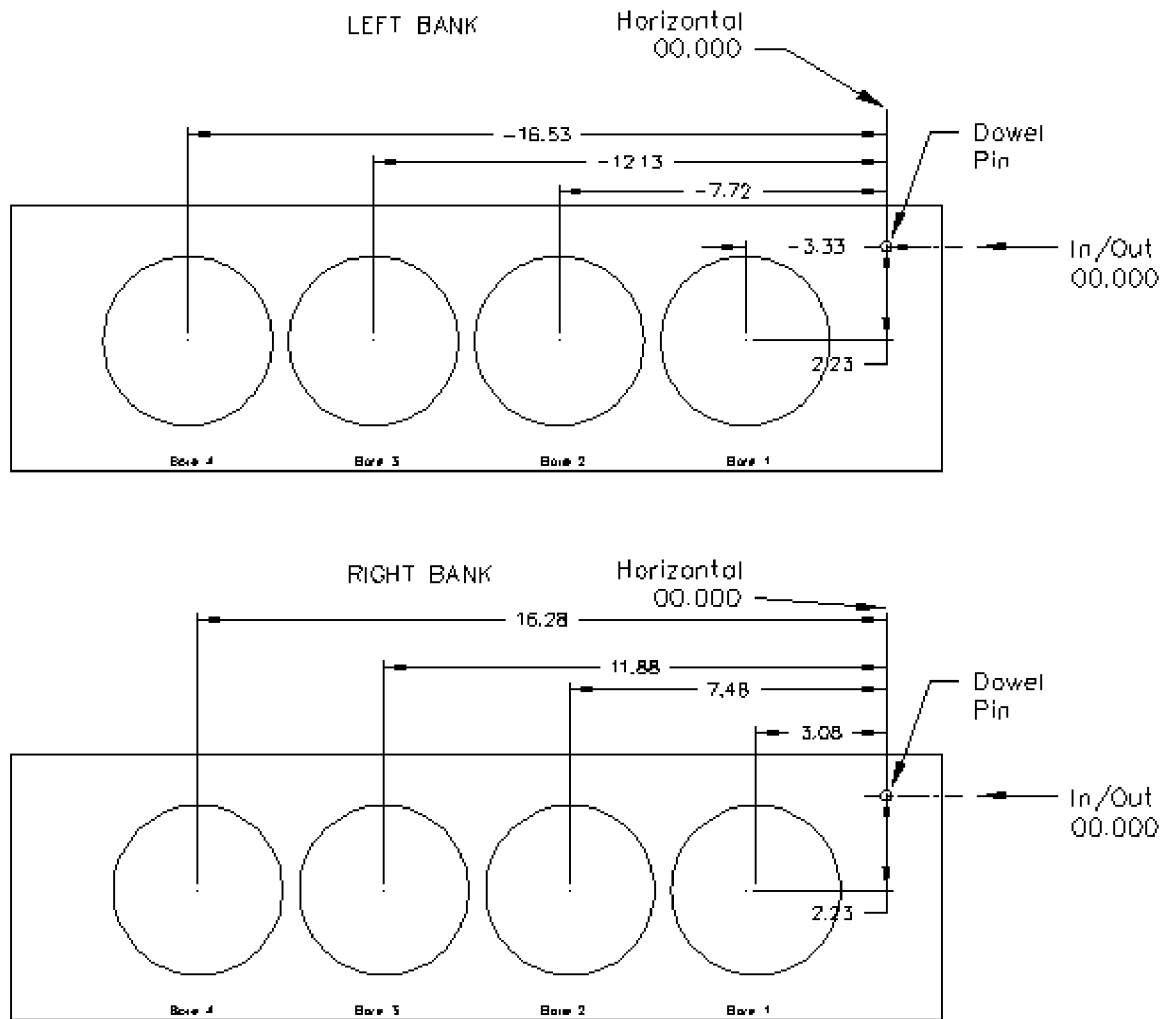
Checking this box will cause the spindle to be indexed to the three O'clock position after the cylinder has been bored but before it retracts. It will also offset to the left before the tool is retracted. This is the default setting. You would not want this check in an operation such as Lifter Boring.

←	Program: Chev 350	Continuous DTG:	0.000	Z	0.0000	Y	0.0000
→	Mode: Cylinder Bore	Feedrate override	1.00	X	0.0000	A	0.000

PROGRAM SELECT	Set Zeros	Vertical Stops	Left Locations	Right Locations
X- X+ Y+ Z+ Y- Z- CW CCW A- A+ STOP MACHINE	BORE PROFILE		PROBE OPTIONS	
	Block Clearance	0.5000 SET	Probe Clearance	0.0000 SET
	Centering Height	0.2000 SET	Probing Height	0.0000 SET
	Start Boring Height	0.2000 SET	Largest Probe Diameter	0.0000
	<input checked="" type="checkbox"/> X Offset for Honing		<input type="checkbox"/> Set Zero on Probe	
	Start Offset Height	-5.2000 SET	After offset Washout	
	Bottom of Bore	-5.4000 SET	WASHOUT OPTIONS	
	<input checked="" type="checkbox"/> Washout Cycle <input type="checkbox"/> Coolant		Finish RPMS	60.00
	<input checked="" type="checkbox"/> Stop and Index Spindle After Cycle		Finish Revolutions	2.00
	HANDWHEEL			
Z	.010 .001 .0001			

Bore Locations

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



Left Locations

Program: Chev 350 Continuous DTG: 0.000 Z 0.0000 Y 0.0000
 Mode: Cylinder Bore Feedrate override: 1.00 X 0.0000 A 0.0000

	Set Zeros	Vertical Stops	Left Locations	Right Locations	
PROGRAM SELECT X- X+ Y+ Z+ Y- Z- CW CCW A- A+ STOP MACHINE	BluePrint	Indicated	Probed	Difference	
	Copy Values	MOVE1	MOVE2	MOVE3	MOVE4
	X	-3.3300	-7.7200	-12.1300	-16.5300
	Y	-2.2300	-2.2300	-2.2300	-2.2300
	Z				
	Move Y	BORE1	BORE2	BORE3	BORE4
	0.0000				
HANDWHEEL				Angle 45.000	
X	.010 .001 .0001			PROBE LEFT START PROBING	
Y	.010 .001 .0001	A	.010 .001	BORE LEFT	
Z	.010 .001 .0001	Spindle	10x Coarse	START AUTO CYCLE	

Right Locations

Program: Chev 350 Continuous DTG: 0.000 Z 0.0000 Y 0.0000
 Mode: Cylinder Bore Feedrate override: 1.00 X 0.0000 A 0.0000

	Set Zeros	Vertical Stops	Left Locations	Right Locations	
PROGRAM SELECT X- X+ Y+ Z+ Y- Z- CW CCW A- A+ STOP MACHINE	BluePrint	Indicated	Probed	Difference	
	Copy Values	MOVE1	MOVE2	MOVE3	MOVE4
	X	-3.0800	-7.4800	-11.8800	-16.2800
	Y	-2.2300	-2.2300	-2.2300	-2.2300
	Z				
	Move Y	BORE1	BORE2	BORE3	BORE4
	0.0000				
HANDWHEEL				Angle -45.000	
X	.010 .001 .0001			PROBE RIGHT START PROBING	
Y	.010 .001 .0001	A	.010 .001	BORE RIGHT	
Z	.010 .001 .0001	Spindle	10x Coarse	START AUTO CYCLE	

Boring a Block

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

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

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

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

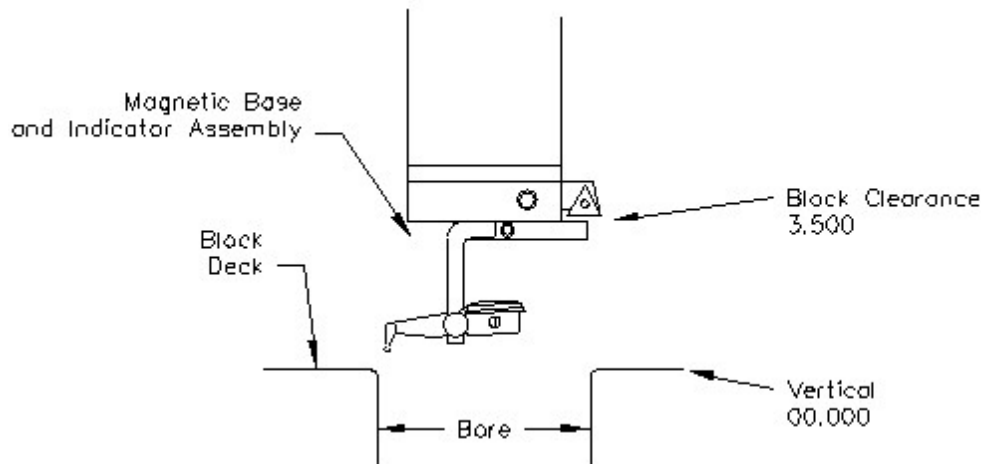
If your machine is equipped with a 4th axis fixture then the Start auto cycle button will bore both the left and right banks automatically and roll the 4th axis over in between the two banks.

Indicator Method

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

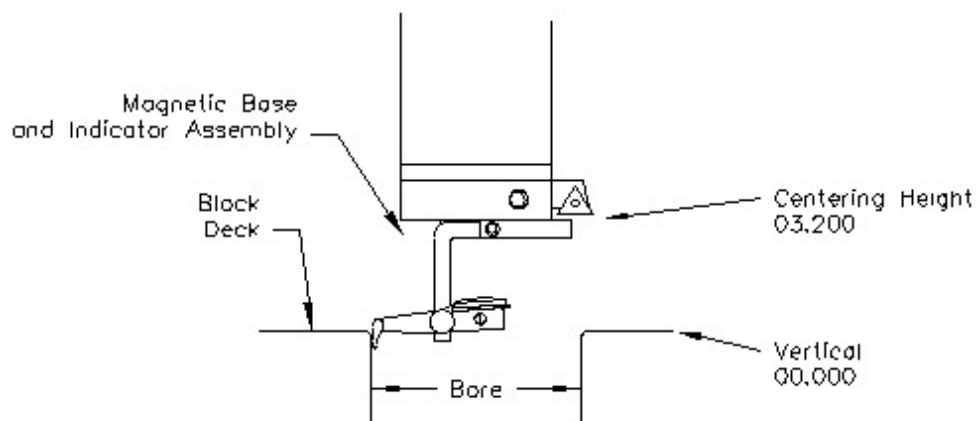
Block Clearance

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



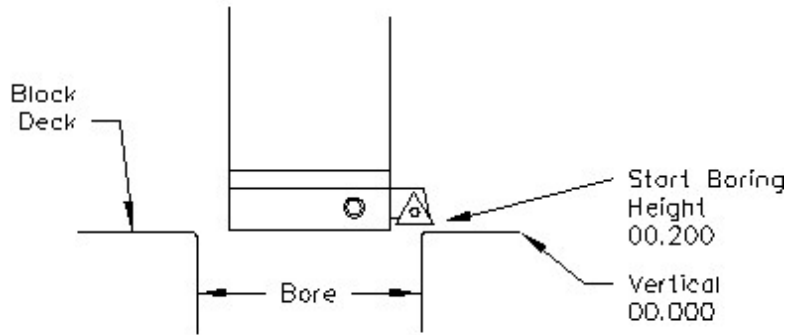
Centering Height

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



Start Boring Height

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



Bottom of the Bore

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

←	Program: Chev 350	Continuous DTG:	0.000	Z	0.0000	Y	0.0000
→	Mode: Cylinder Bore	Feedrate override	1.00	X	0.0000	A	0.000

PROGRAM SELECT

X- X+

Y+ Z+

Y- Z-

CW CCW

A- A+

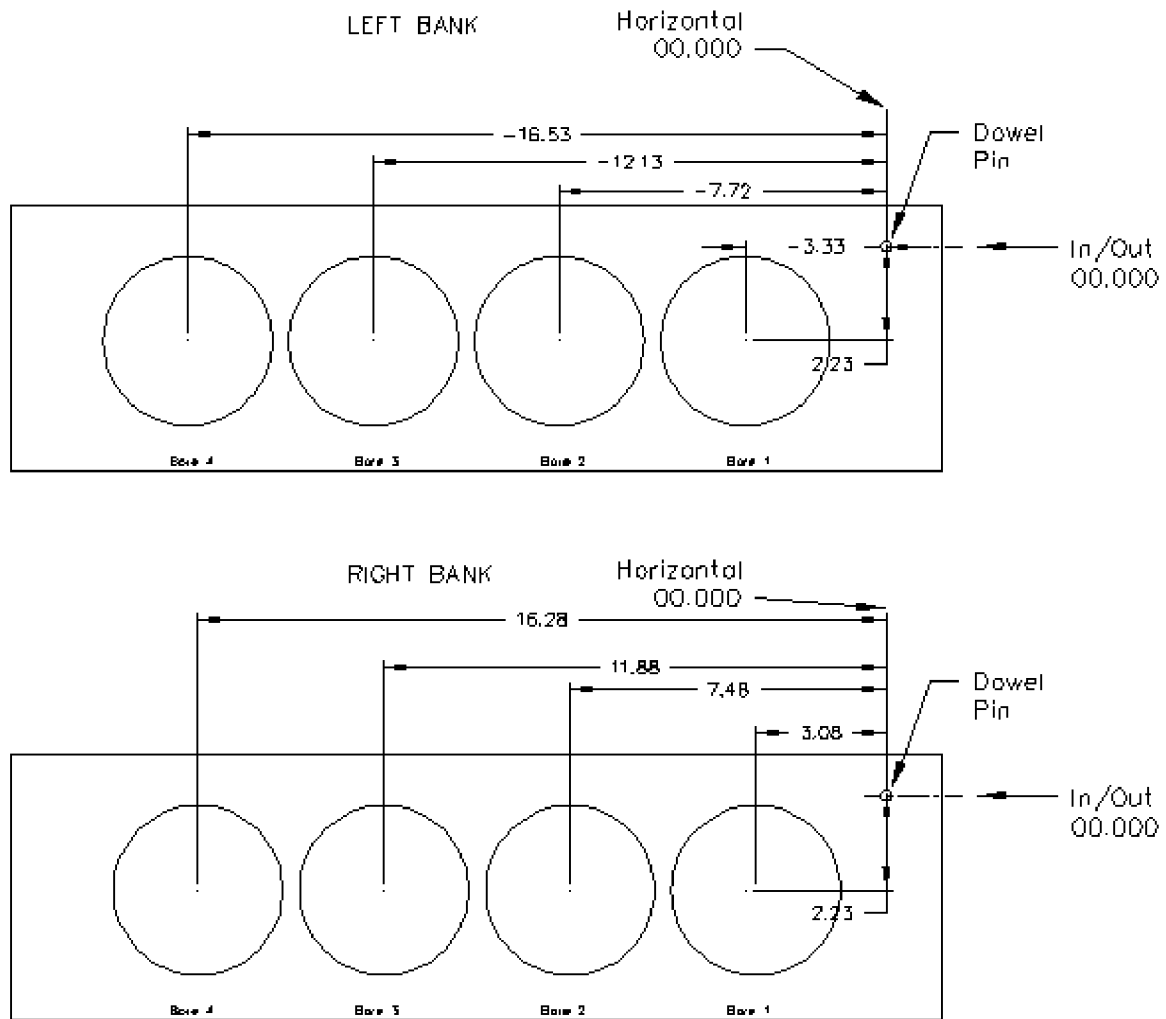
STOP MACHINE

Set Zeros	Vertical Stops	Left Locations	Right Locations
BORE PROFILE		PROBE OPTIONS	
Block Clearance	3.5000 SET	Probe Clearance	0.0000 SET
Centering Height	3.2000 SET	Probing Height	0.0000 SET
Start Boring Height	0.1000 SET	Largest Probe Diameter	0.0000
<input type="checkbox"/> X Offset for Honing		<input type="checkbox"/> Set Zero on Probe	
Bottom of Bore	-5.4000 SET	<div style="display: flex; justify-content: space-around;"> After offset Washout </div>	
<input checked="" type="checkbox"/> Washout Cycle	<input type="checkbox"/> Coolant	WASHOUT OPTIONS	
<input checked="" type="checkbox"/> Stop and Index Spindle After Cycle		Finish RPMS	60.00
HANDWHEEL		Finish Revolutions	2.00
Z	.010 .001 .0001		

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

Bore Locations

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



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

The screenshot displays the machine's control interface. At the top, it shows 'Program: Chev 350' and 'Mode: Cylinder Bore'. Below this are 'Continuous DTG:' (0.000) and 'Feedrate override' (1.00). A table shows coordinates for Z, X, Y, and A axes. The main interface is divided into several sections: 'Set Zeros', 'Vertical Stops', 'Left Locations', and 'Right Locations'. The 'Left Locations' section is active, showing a grid of 'MOVE' buttons (MOVE1 to MOVE4) with numerical values, 'SET' buttons (SET1 to SET4), and 'BORE' buttons (BORE1 to BORE4). A 'HANDWHEEL' section at the bottom left has buttons for X, Y, and Z axes with resolution options (.010, .001, .0001). On the right, there are buttons for 'PROBE LEFT', 'START PROBING', 'BORE LEFT', and 'START AUTO CYCLE'. A 'STOP MACHINE' button is located on the far left. A 'PROGRAM SELECT' panel on the left contains directional buttons (X-, X+, Y+, Z+, Y-, Z-, CW, CCW, A-, A+).

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

Boring a Block

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

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

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

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

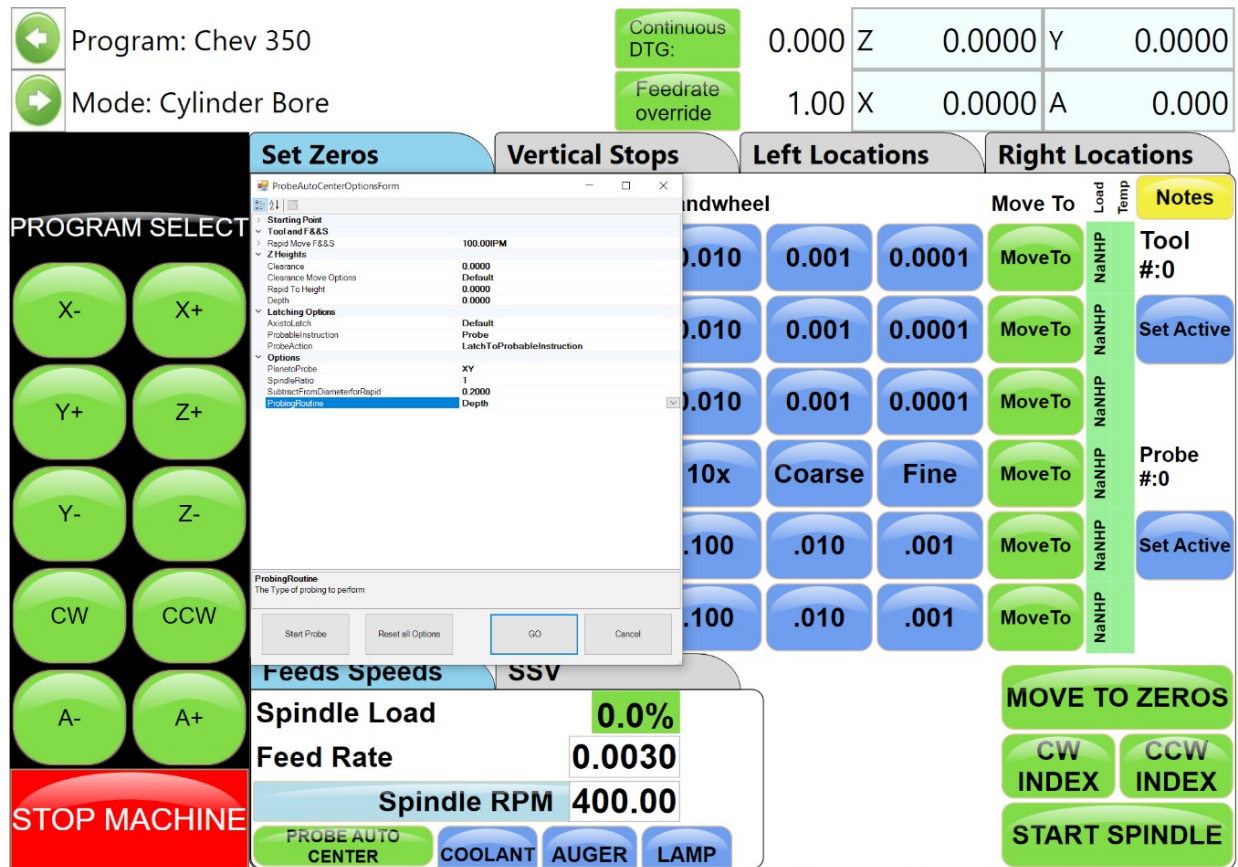
If your machine is equipped with a 4th axis fixture then the Start auto cycle button will bore both the left and right banks automatically and roll the 4th axis over in between the two banks.

Probing Method

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

Vertical Zero

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



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

Programming Vertical Stops

←	Program: Chev 350	Continuous DTG:	0.000	Z	0.0000	Y	0.0000
→	Mode: Cylinder Bore	Feedrate override	1.00	X	0.0000	A	0.0000

PROGRAM SELECT

X- X+

Y+ Z+

Y- Z-

CW CCW

A- A+

STOP MACHINE

Set Zeros	Vertical Stops	Left Locations	Right Locations
BORE PROFILE			
Block Clearance	0.2000 SET	PROBE OPTIONS	
Centering Height	0.1000 SET	Probe Clearance	0.0000 SET
Start Boring Height	0.1000 SET	Probing Height	0.0000 SET
<input type="checkbox"/> X Offset for Honing		Largest Probe Diameter	0.0000
		<input type="checkbox"/> Set Zero on Probe	
Bottom of Bore	-5.4000 SET	After offset Washout	
<input checked="" type="checkbox"/> Washout Cycle	<input type="checkbox"/> Coolant		
<input checked="" type="checkbox"/> Stop and Index Spindle After Cycle			
HANDWHEEL			
Z	.010	.001	.0001

Block Clearance

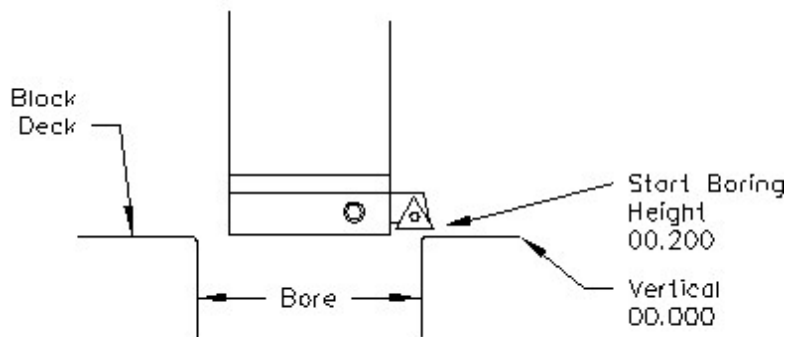
This is the distance above the zero position or block deck allowing the probe to move to the next bore unobstructed.

Centering Height

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

Start Boring Height

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



Bottom of the Bore

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

Probe Height

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

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

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

←	Program: Chev 350	Continuous DTG:	0.000	Z	0.2000	Y	0.0000
→	Mode: Cylinder Bore	Feedrate override	1.00	X	0.0000	A	0.000

PROGRAM SELECT	Set Zeros	Vertical Stops	Left Locations	Right Locations
X- X+ Y+ Z+ Y- Z- CW CCW A- A+ STOP MACHINE	BORE PROFILE		PROBE OPTIONS	
	Block Clearance	0.2000 SET	Probe Clearance	0.2000 SET
	Centering Height	0.1000 SET	Probing Height	-0.4667 SET
	Start Boring Height	0.1000 SET	Largest Probe Diameter	0.0000
	<input type="checkbox"/> X Offset for Honing		<input type="checkbox"/> Set Zero on Probe	
	Bottom of Bore	-5.4000 SET	<input checked="" type="checkbox"/> After offset <input type="checkbox"/> Washout	
	<input checked="" type="checkbox"/> Washout Cycle <input type="checkbox"/> Coolant			
	<input checked="" type="checkbox"/> Stop and Index Spindle After Cycle			
	HANDWHEEL			
	Z	.010 .001 .0001		

Bore Locations

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

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

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

This feature is located on the Set Zero page. This allows easily find the center of a hole or cylinder.

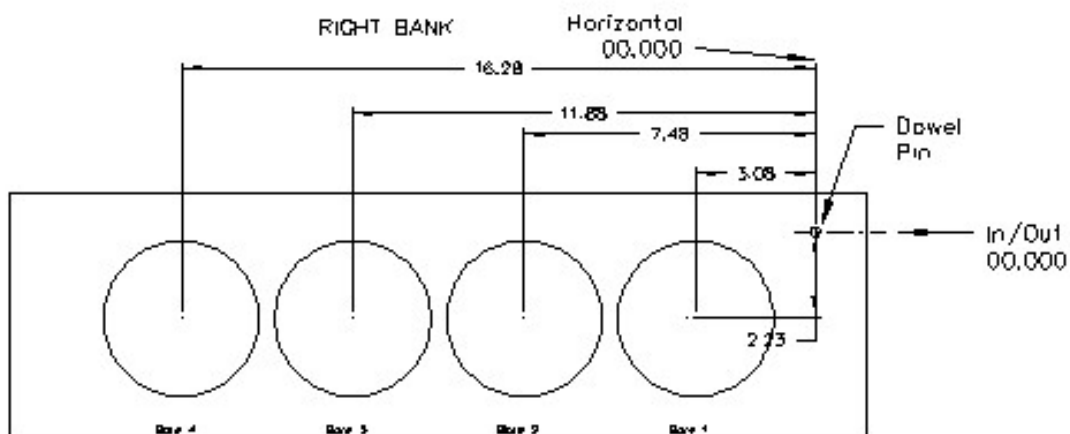
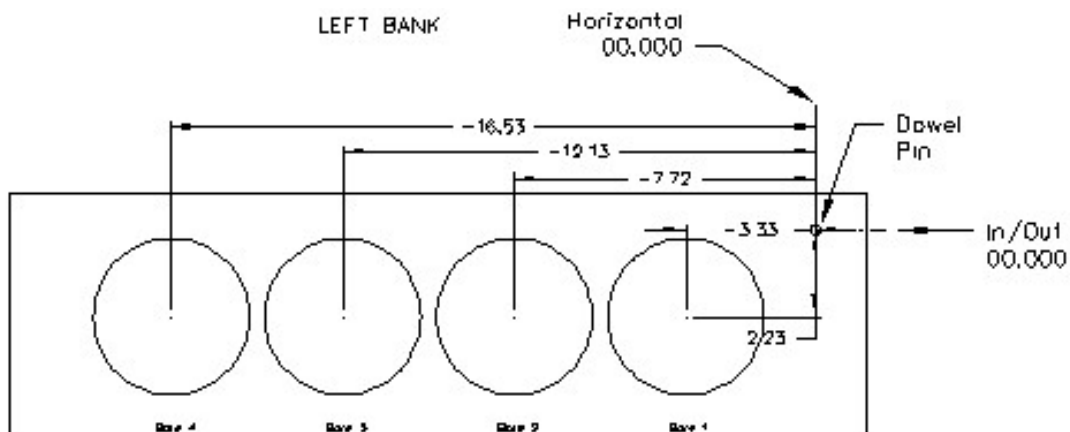
Roughly place the probe in the center of a cylinder. Press Probe Auto Center. The cylinder will be probed in 4 places, when finished the probe will move to the center of the probed cylinder. Pressing Horizontal and In/Out zero will then establish the center of that hole.

Automatic Probing Procedure

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

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

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



Boring a Block

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

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

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

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

Cylinder Bore Mode 4th Axis

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

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

Setting Zeros

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

4th Axis (Rotational) Zero

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

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

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

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

Building Programs with the 4th Axis

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

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

Setting Vertical Clearance with 4th Axis

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

Table of Tools for 3 and 4th Axis Bore Mode

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

Building a Program with Table of Tools

Build the program as described above for 3 and 4 Axis programs using the same vertical zero locations. Put the tools to be used into the Table of Tools as described in Chapter 2. In Bore mode you are not referencing another vertical location such as the Crank centerline so the Z Touch off Location will remain at zero.

Assigning Tools

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

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

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

Program: Chev 350

Mode: Cylinder Bore

Continuous DTG: 0.000 Z 0.2000 Y 0.0000

Feedrate override 1.00 X 0.0000 A 0.000

Set Zeros

Vertical Stops

Left Locations

Right Locations

Tool Select

Number	Name	Pocket	Diameter	Length	Protrus...	Type	Material	De
0	Default Tool	0	0.3750	0.0000	1.0000	FlatEnd...	Carbide	
1	Probe 6mm Tip	0	0.2362	-14.4770	7.0000	Probe	Carbide	
2	5/8" Flat Endmill	0	0.6750	-19.3256	5.0000	FlatEnd...	Carbide	
3	2.5" Shell Mill	0	2.5000	-2.0000	2.5000	InsertCu...	Carbide	
4	29/64" Drill	0	0.3750	-2.0000	5.0000	Drill	HSS	
5	1/2" End Mill	0	0.5000	-7.4000	1.0000	FlatEnd...	Carbide	
6	3/4" Endmill	0	0.7500	-15.4667	1.0000	FlatEnd...	Carbide	
7	B Drill	0	0.2010	-31.2000	1.0000	Drill	Carbide	
8	1/4-20 UNC Tap	0	0.2500	-2.0000	1.0000	Tap	Carbide	
9	Keyway Cutter	0	4.0000	0.0000	1.0000	InsertCu...	Carbide	
10	6" Shell Mill	0	6.0000	1.3000	1.0000	InsertCu...	Carbide	
11	15/32" Drill	0	0.4888	0.0000	1.0000	Drill	Carbide	
12	5/16" Drill	0	0.3125	-2.0000	1.0000	Drill	HSS	
13	14" Fly Cutter	0	14.0000	-2.0000	1.0000	FlatEnd...	Carbide	
14	1.000 END MILL	2	1.0000	0.0000	1.0000	FlatEnd...	Carbide	
15	.625 BEM	1	0.6250	0.0000	1.0000	FlatEnd...	Carbide	
16	.625 BEM LONG	3	0.6250	0.0000	1.0000	FlatEnd...	Carbide	
17	1.500 SHELL M...	4	1.5000	0.0000	1.0000	FlatEnd...	Carbide	
18	1.000 INDEKAB...	5	1.0000	0.0000	1.0000	FlatEnd...	Carbide	
19	center drill	0	0.1000	-21.3606	1.0000	FlatEnd...	Carbide	
20	Fire Ring Groov...	0	4.1500	0.0000	1.0000	InsertCu...	Carbide	
21	#3 Center Drill	0	0.1975	-16.1234	1.0000	FlatEnd...	Carbide	
22	U Drill	0	0.3050	-16.1234	1.0000	FlatEnd...	Carbide	
23	7/16" -14 TAP	0	0.4375	-16.1234	1.0000	FlatEnd...	Carbide	
24	3/8" End Mill	0	0.3750	-16.1234	1.0000	FlatEnd...	Carbide	

Handwheel

0.010	0.001	0.0001	MoveTo
0.010	0.001	0.0001	MoveTo
0.010	0.001	0.0001	MoveTo
10x	Coarse	Fine	MoveTo
.100	.010	.001	MoveTo
.100	.010	.001	MoveTo

Move To

Load Temp

NaNHP

NaNHP

NaNHP

NaNHP

NaNHP

NaNHP

Notes

Tool #:0

Set Active

Probe #:0

Set Active

Feeds Speeds SSV

Spindle Load **0.0%**

Feed Rate **0.0030**

Spindle RPM **400.00**

PROBE AUTO CENTER COOLANT AUGER LAMP

MOVE TO ZEROS

CW INDEX CCW INDEX

START SPINDLE

Mill Cycle 3 Axis

Mill Cycle

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

Program: Chev 350
Mode: Mill Cycle

Continuous DTG: 0.000 Z 14.6770 Y 0.0000
Spindle override: 1.00 X 0.0000 A 0.000

Set Zeros	Operation	Left Deck Probe	Right Deck Probe
Fixture	Actual Position	Handwheel	Move To
X	0.0000	0.010 0.001 0.0001	MoveTo
Y	0.0000	0.010 0.001 0.0001	MoveTo
Z	14.6770	0.010 0.001 0.0001	MoveTo
SPINDLE	25.92	10x Coarse Fine	MoveTo
A	0.000	.100 .010 .001	MoveTo
B	0.000	.100 .010 .001	MoveTo

Feeds Speeds SSV
Spindle Load 0.0%
Feed Rate 0.0030
Spindle RPM 250.00

STOP MACHINE

PROBE AUTO CENTER COOLANT AUGER LAMP

MOVE TO ZEROS
CW INDEX CCW INDEX
START SPINDLE

Setting Zeros

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

Horizontal Zero (X-axis)

For this example, we are going to set the Horizontal Zero (X-axis) at the point where the selected fly cutter is approximately $\frac{1}{4}$ " passed the right hand side of the block to be machined.

In/Out Zero (Y-axis)

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

Vertical Zero (Z-axis)

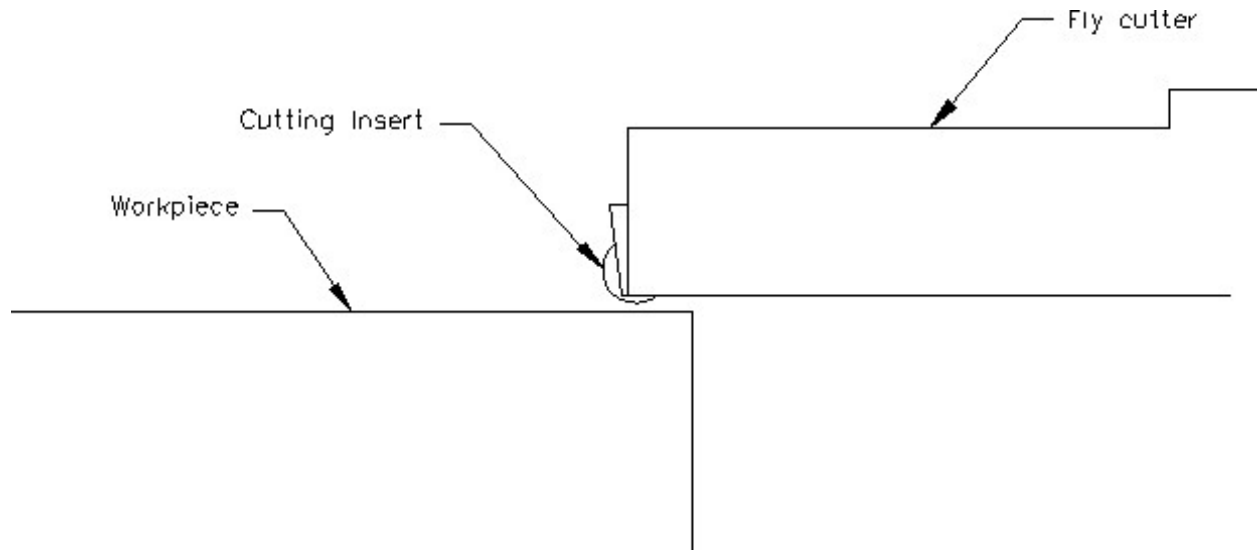
For this example the Vertical Zero will be at the deck height of the work piece.

Feeds and Speeds (IPR/RPM)

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

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

Start the spindle. Select the .001" increment for the Z-axis handwheel and move the spindle down until you can hear or see the cutter just touching the block. Double tap the Z button to zero the Z-axis here. Feed the cutter in the +X direction. When the cutter has cleared the block by approximately $\frac{1}{4}$ " double tap the X button to zero the X axis.



Operation

Horizontal End

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

Amount Per Pass

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

Vertical Start

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

Vertical End

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

Copy Lowest/Copy Highest

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

Rough Settings

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

Rough Feed Rate

The desired roughing feed rate in IPR

Rough Spindle RPM

The desired roughing spindle speed in RPM

Finish Cut Settings

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

Finish Amount

The amount to be removed on the last pass.

Finish Feed Rate

The desired Finish Feed Rate in IPR.

Finish RPM

The desired Finish Spindle RPM.

A-Axis

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

Overlap Mill Settings

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

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

←	Program: Chev 350	Continuous DTG:	0.000	Z	0.0000	Y	0.0000
→	Mode: Mill Cycle	Spindle override	1.00	X	0.0000	A	0.000

PROGRAM SELECT	Set Zeros	Operation	Left Deck Probe	Right Deck Probe
X- X+ Y+ Z+ Y- Z- CW CCW A- A+ STOP MACHINE	End			Rough Settings
	Horizontal End	-10.0000 <input type="button" value="SET"/>		Rough Feed Rate <input type="text" value="0.0030"/>
	Amount per Pass	-0.0050		Rough Spindle RPM <input type="text" value="400.00"/>
	Vertical Start	0.0000 <input type="button" value="Copy Highest"/>		
	Vertical End	-0.0100 <input type="button" value="Copy Lowest"/>		Overlap Mill Settings
	Additional Depth	0.0000		Max Workpiece Width <input type="text" value="0.0000"/>
	<input checked="" type="checkbox"/> Coolant			Cutter Diameter <input type="text" value="0.3750"/>
	A Axis			Finish Cut Settings
	Left Bank Angle	45.000		Finish Amount <input type="text" value="0.0020"/>
	Right Bank Angle	-45.000		Finish Feed Rate <input type="text" value="0.0030"/>
Rollover Vertical Clearance	0.0000		Finish Spindle RPM <input type="text" value="400.00"/>	
Y Offset	0.0000			
	<input type="button" value="CUT LEFT"/>	<input type="button" value="CUT RIGHT"/>	<input type="button" value="START AUTO CYCLE"/>	

Start Auto Cycle

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

Mill Mode 4th Axis

Program Additions to 3-axis Operation

The Program setup for a 4th Axis operation is largely the same as the programming for a 3-axis operation. The only difference is the addition of the A-Axis settings. When surfacing a V-block we first

setup the surfacing operation on one deck and then fill out the A-axis settings to have the program repeat on the second deck.

←	Program: Chev 350	Continuous DTG:	0.000	Z	0.0000	Y	0.0000
→	Mode: Mill Cycle	Spindle override	1.00	X	0.0000	A	0.000

PROGRAM SELECT	Set Zeros	Operation	Left Deck Probe	Right Deck Probe
X- X+ Y+ Z+ Y- Z- CW CCW A- A+ STOP MACHINE	End	Horizontal End	Rough Settings	
	-10.0000	Amount per Pass	Rough Feed Rate	0.0030
	SET	-0.0050	Rough Spindle RPM	400.00
	Vertical Start	0.0000	Overlap Mill Settings	
	Copy Highest	Vertical End	Max Workpiece Width	0.0000
	Copy Lowest	-0.0100	Cutter Diameter	0.3750
	Additional Depth	0.0000	Finish Cut Settings	
	✓ Coolant	Left Bank Angle		45.000
	A Axis		Right Bank Angle	-45.000
	Rollover Vertical Clearance		0.0000	Finish Amount
Y Offset		0.0000	Finish Feed Rate	0.0030
CUT LEFT		CUT RIGHT	Finish Spindle RPM	400.00
START AUTO CYCLE				

4h Axis Angles

Left Bank Angle

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

Right Bank Angle

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

Rollover Vertical Clearance

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

Cut Left and Cut Right

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

Start Auto Cycle

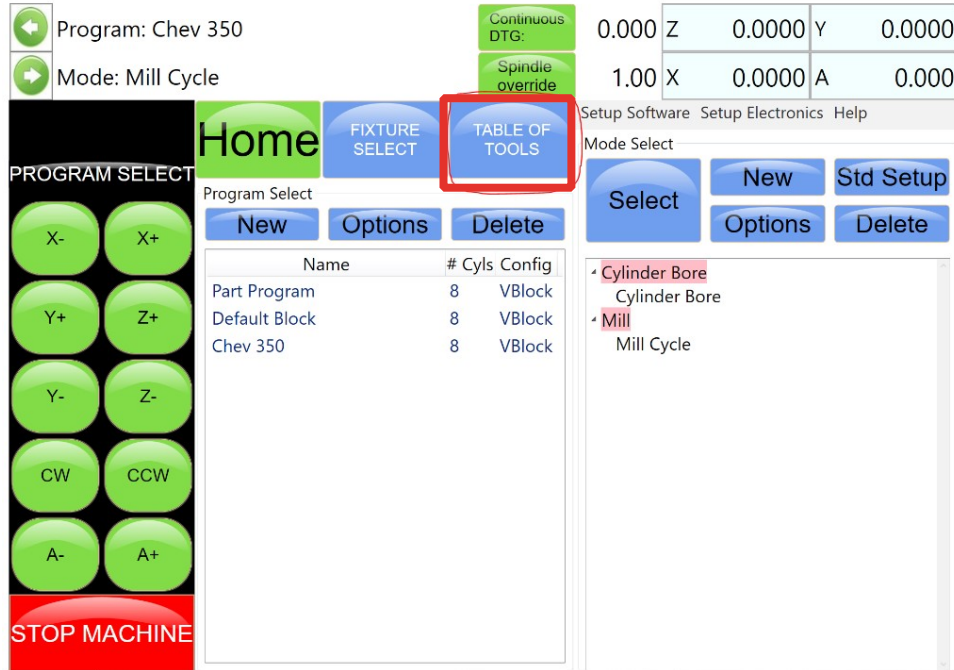
Pressing this button will start the machines automatic cycle. The cycle to be run is determined by the setting on this page. If you only require one pass to be made, do not enter any values into the Rough Setting, only the Finish Cut Settings.

Milling Using Automatic Deck Probing

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

Table of Tools for Milling

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

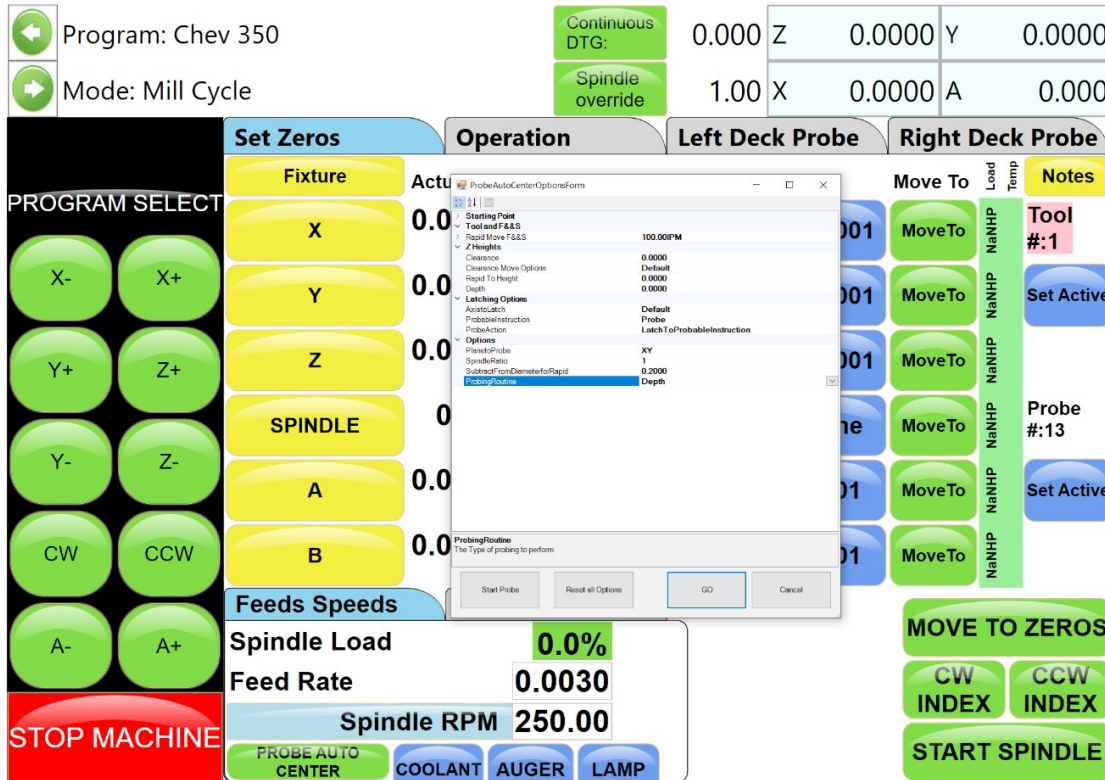


Building a Program Using the Probe and Table of Tools

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

Probe Auto Center

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



Probe Depth

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

Probe Inside Diameter

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

Probe Outside Diameter

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

Probing Engine Block Surfaces

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

Left Deck Probe

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

Right Deck Probe

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

Program: Chev 350
 Mode: Mill Cycle
 Continuous DTG: 0.000 Z 0.0000 Y 0.0000
 Spindle override 1.00 X 0.0000 A 0.0000

	Move1	Move2	Move3	Move4	Move5	Move6	Move7	Move8
X	-1.0000	-12.0000	-23.0000	-23.0000	-12.0000	-1.0000	0.0000	0.0000
Y	2.0000	2.0000	2.0000	-2.0000	-2.0000	-2.0000	0.0000	0.0000
Z								
	Set1	Set2	Set3	Set4	Set5	Set6	Set7	Set8
	Probe1	Probe2	Probe3	Probe4	Probe5	Probe6	Probe7	Probe8
Probed Depth	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Probe Clearance: 0.1000 Copy Highest Probed Copy Lowest Probed
 Lowest Allowed: -99999. Max Deviation: 0.0000 Highest Probed: 0.0000 Lowest Probed: 0.0000
 Angle: 45.000

HANDWHEEL
 X: .010 .001 .0001
 Y: .010 .001 .0001 A: .010 .001
 Z: .010 .001 .0001 Spindle: 10x Coarse

START PROBING
 PROBE LEFT

Probe Clearance

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

Lowest Allowed

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

Auto Probing

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

Auto Milling

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

Vertical Start

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

Vertical End

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

←	Program: Chev 350	Continuous DTG:	0.000	Z	0.0000	Y	0.0000
→	Mode: Mill Cycle	Spindle override	1.00	X	0.0000	A	0.000

PROGRAM SELECT	Set Zeros	Operation	Left Deck Probe	Right Deck Probe	
X- X+ Y+ Z+ Y- Z- CW CCW A- A+ STOP MACHINE	End	Horizontal End	-10.0000	SET	Rough Settings
	Amount per Pass	-0.0050			Rough Feed Rate
	Vertical Start	0.0000	Copy Highest		Rough Spindle RPM
	Vertical End	0.0000	Copy Lowest		400.00
	Additional Depth	0.0000			Overlap Mill Settings
	✓ Coolant				Max Workpiece Width
	A Axis	Left Bank Angle	45.000		Cutter Diameter
	Right Bank Angle	-45.000			0.2362
	Rollover Vertical Clearance	0.0000			Finish Cut Settings
	Y Offset	0.0000			Finish Amount
				Finish Feed Rate	
				Finish Spindle RPM	
				400.00	
	CUT LEFT	CUT RIGHT	START AUTO CYCLE		

Start Auto Cycle

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

Lifter Bore Mode 3 Axis

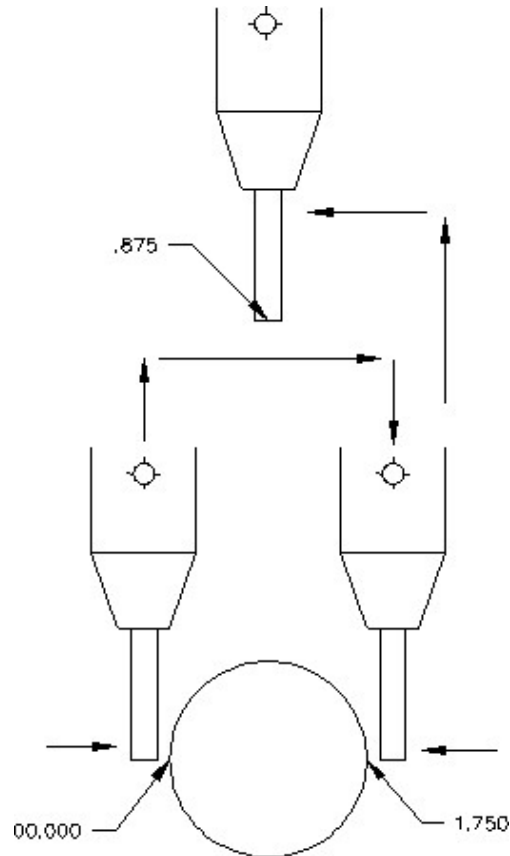
Lifter Bore programs are built the same as described in the Bore Mode 3 Axis. The differences in locating the bores and tooling will be discussed in this section.

Y-axis Zero (In/Out)

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

matches the divided number. This is the center line of the Cam Bar. Press the Y-axis Zero button now. The Y-axis zero position has been set. The following illustration visual shows the above description.

Start Boring Height



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

Lifter Bore Angle

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

Lifter Bore 4th Axis

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

Start Boring Height

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

Lifter Bore Angle

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

Calculate Y-axis zero

This button is located next to the Y-axis locations for each Bank. You must first have the correct angle entered in the angle data box. Then press the calculate In/Out button. A window will open where you

enter the center to center distance of the Cam to Crank bores. The In/Out locations will automatically be filled in.

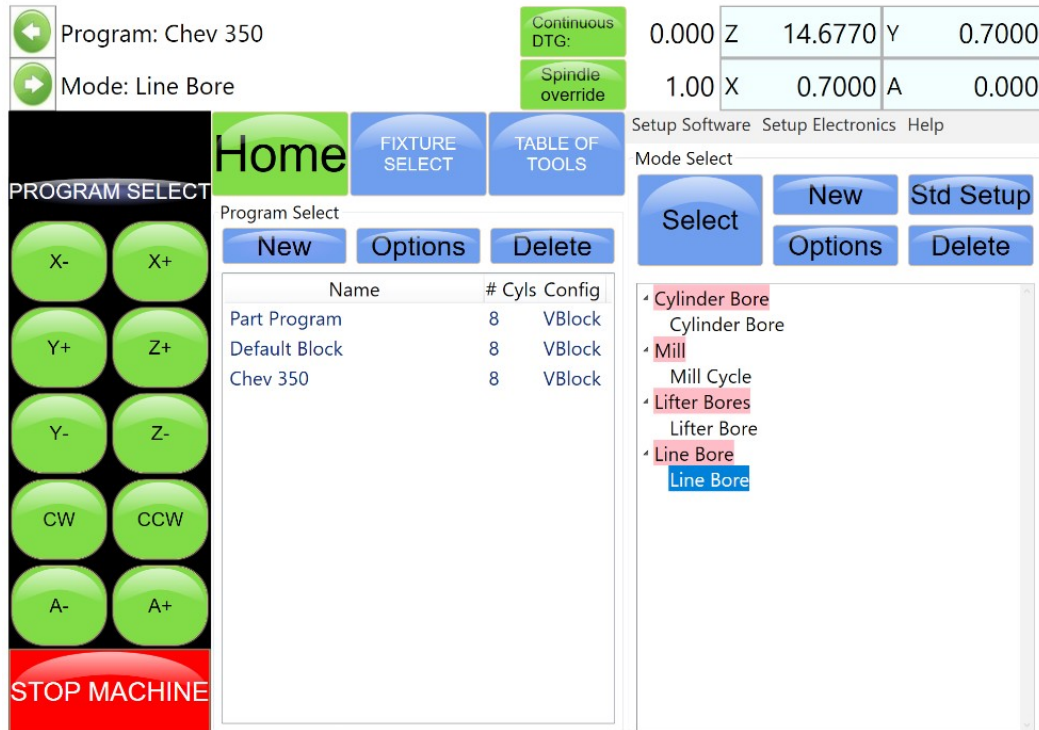
The screenshot displays the machine control interface with the following elements:

- Program Information:**
 - Program: Chev 350
 - Mode: Lifter Bore
 - Continuous DTG: 0.000
 - Spindle override: 1.00
- Coordinate Data:**

Z	14.6770	Y	0.7000
X	0.7000	A	0.000
- Navigation and Mode Selection:**
 - Buttons: Set Zeros, Vertical Stops, Left Locations, Right Locations
 - Mode Select: BluePrint, Indicated, Probed, Difference
 - Copy Values: MOVE1 through MOVE8
- Input Fields:**
 - X: 0.00
 - Z: 0.00
 - Move Y BORE: 0.0000
 - Handwheel: X (.010, .001, .0001), Y (.010, .001, .0001), Z (.010, .001, .0001)
 - Angle: 45.000
- Control Panel:**
 - Buttons: X-, X+, Y+, Z+, Y-, Z-, CW, CCW, A-, A+
 - STOP MACHINE (Red)
 - PROBE LEFT, START PROBING
 - BORE LEFT
 - START AUTO CYCLE
- Calculator Overlay:** A numeric keypad is open for entering the "crank to cam distance".

Line Bore Mode

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



Mounting and Aligning the 90 Degree Head

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

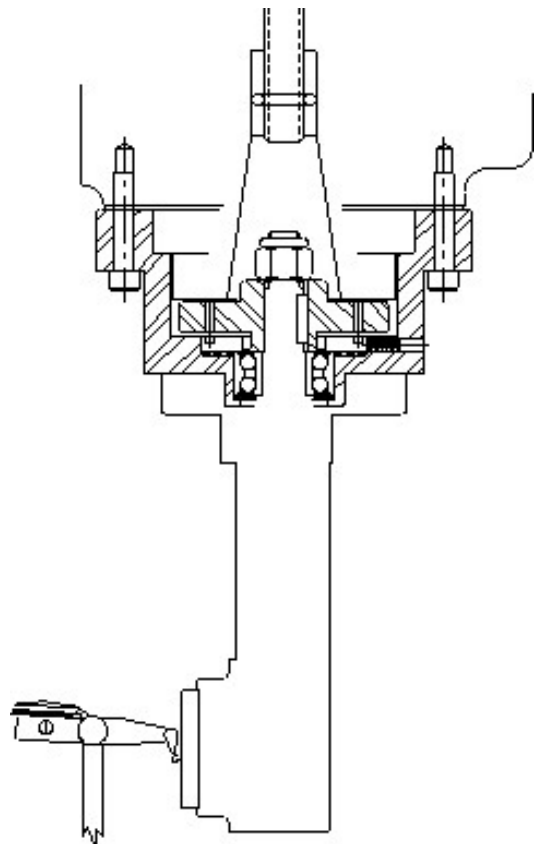
Using the Y-axis handwheel increment move the indicator from one side to the other noting the amount of difference. Adjust the 90-degree drive until the variance across the face is less than .0005". Tighten the mounting bolts for the head and check the surface again to be sure it did not shift when tightening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

Setting Zeros

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

X-axis (Horizontal Zero)

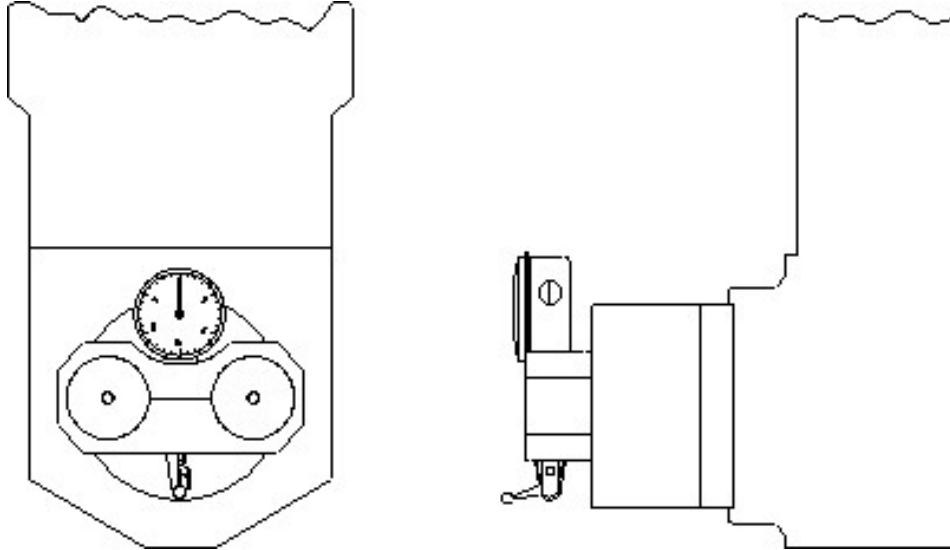
The Horizontal should be set about .050" offset from the front of the first main to be bored, making sure that, that position will allow the head to travel up without interference. Bring the head down and roughly center it in front of the first main. It does not need to be



perfectly centered to set the horizontal zero. Double tap the X button from the set zeros tab to set the horizontal zero.

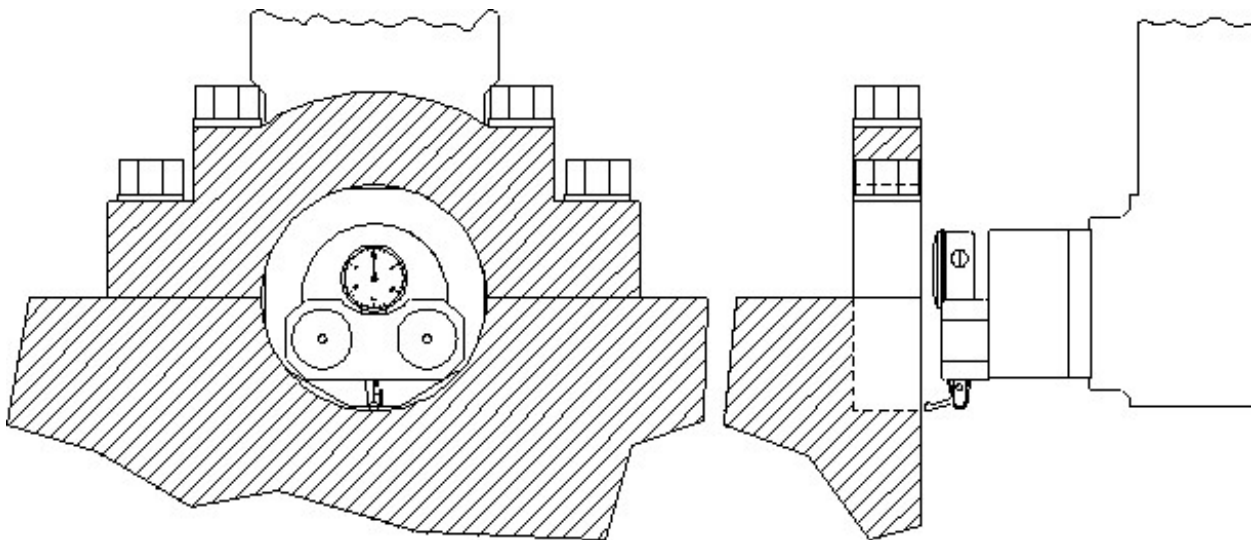
Y-axis (In/Out Zero)

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



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

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



Programming Vertical Stops

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

Bore Centerline

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

Block Clearance

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

Programming Horizontal Stops

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

Programming Bore Length

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

Running the Auto Cycle

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

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

Thrust Cutting

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

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

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

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

Program: Chev 350
 Mode: Thrust Cutting

Continuous DTG: 0.000 Z 14.6770 Y 0.7000
 Spindle override: 1.00 X 0.7000 A 0.000

Fixture	Actual Position	Handwheel	Move To	Load Temp	Notes
X	0.7000	0.010 0.001 0.0001	MoveTo	NaNHP	Tool #:0
Y	0.7000	0.010 0.001 0.0001	MoveTo	NaNHP	Set Active
Z	14.6770	0.010 0.001 0.0001	MoveTo	NaNHP	
SPINDLE	0.00	10x Coarse Fine	MoveTo	NaNHP	Probe #:0
A	0.000	.100 .010 .001	MoveTo	NaNHP	Set Active
B	0.000	.100 .010 .001	MoveTo	NaNHP	

Feeds Speeds SSV
 Spindle Load: 0.0%
 Feed Rate: 0.006
 Spindle RPM: 200

PROGRAM SELECT
 X- X+
 Y+ Z+
 Y- Z-
 CW CCW
 A- A+

STOP MACHINE

PROBE AUTO CENTER COOLANT AUGER LAMP

MOVE TO ZEROS
 CW INDEX CCW INDEX
 START SPINDLE

Setting Zeros

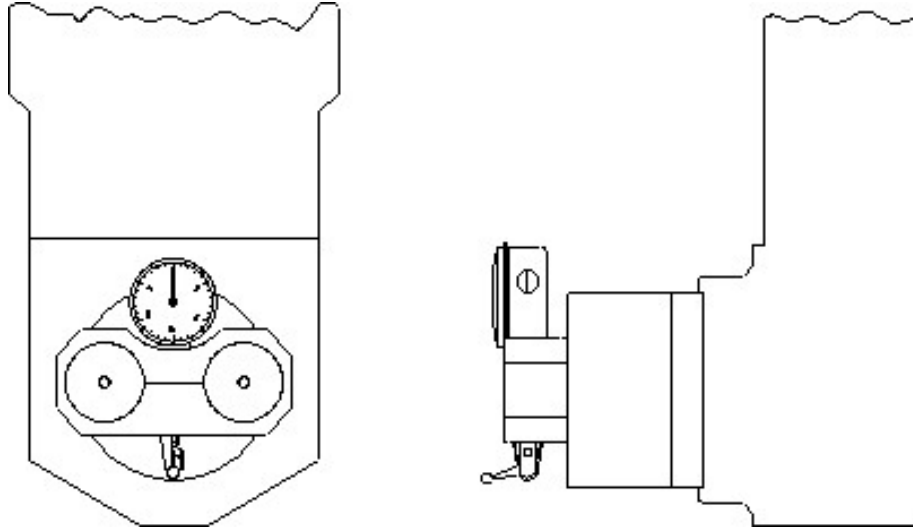
The purpose of setting zero points is to give the operator a specific point to build programs from. The machine also uses these zero points to run the program from. The zero points can be set at any point in the machines' travel. Each axis (except the Spindle rotation) will need to have a zero point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

X-Axis (Horizontal Zero)

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

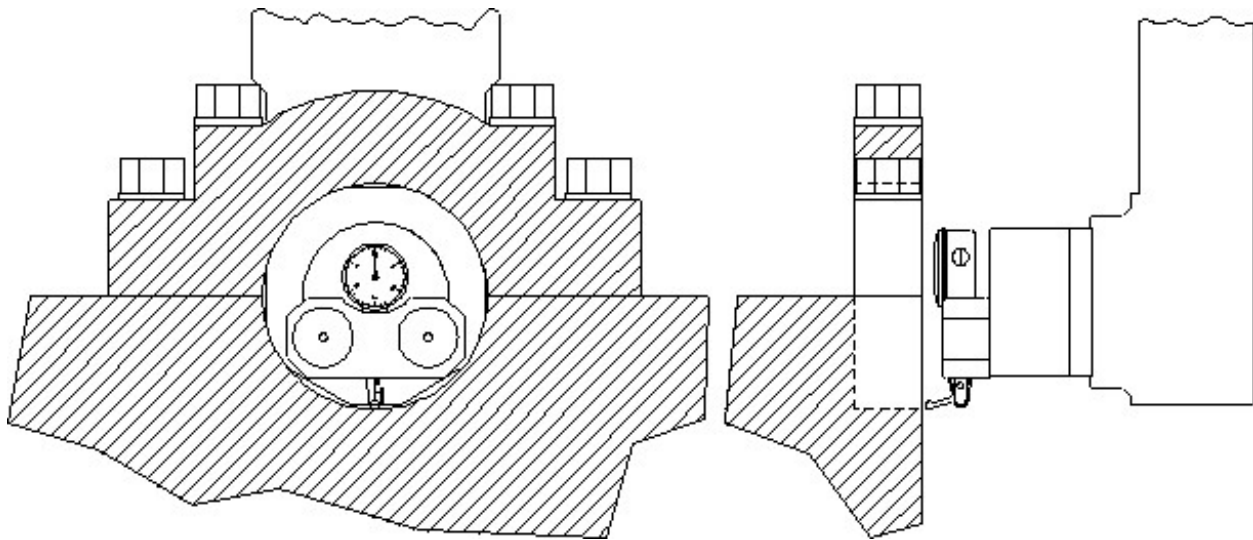
Y-axis (In/Out Zero)

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



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

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



Dimensions & Auto Cycle

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

←	Program: Chev 350	Continuous DTG:	0.000	Z	14.6770	Y	0.7000
→	Mode: Thrust Cutting	Spindle override	1.00	X	0.7000	A	0.000

Set Zeros		Program	
Thrust Diameters		Clearances	
Outside	<input type="text" value="3.0000"/>	Z	<input type="text" value="5.0000"/> SET
Inside	<input type="text" value="2.8000"/>	X	<input type="text" value="0.1000"/> SET
Cutter	<input type="text" value="0.3750"/>	Feed Through Rate	<input type="text" value="10.0000"/>
Dimensions			
Main Width	<input type="text" value="1.0000"/>		
Insert Width	<input type="text" value="0.2500"/>		
Left Depth of Cut	<input type="text" value="0.0010"/>		
Right Depth of Cut	<input type="text" value="0.0010"/>		

PROGRAM SELECT	
X-	X+
Y+	Z+
Y-	Z-
CW	CCW
A-	A+
STOP MACHINE	

CUT LEFT SIDE	
CUT RIGHT SIDE	
CUT BOTH SIDES	

Thrust Dimensions

Outside

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

Inside

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

Cutter

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

Clearances

Z (Vertical)

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

X (Horizontal)

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

Dimensions

Main Width

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

Insert Width

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

Left Depth of Cut

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

Right Depth of Cut

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

Cut Left Side

Cuts the left side thrust faces

Cut Right Side

Cuts the right side thrust faces

Cut Both Sides

Cuts both thrust faces.

Description and Running of the Auto Cycle

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

Start Auto Cycle

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

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

Cam End Tunnel Boring

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

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

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

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



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

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

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

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

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

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

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

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

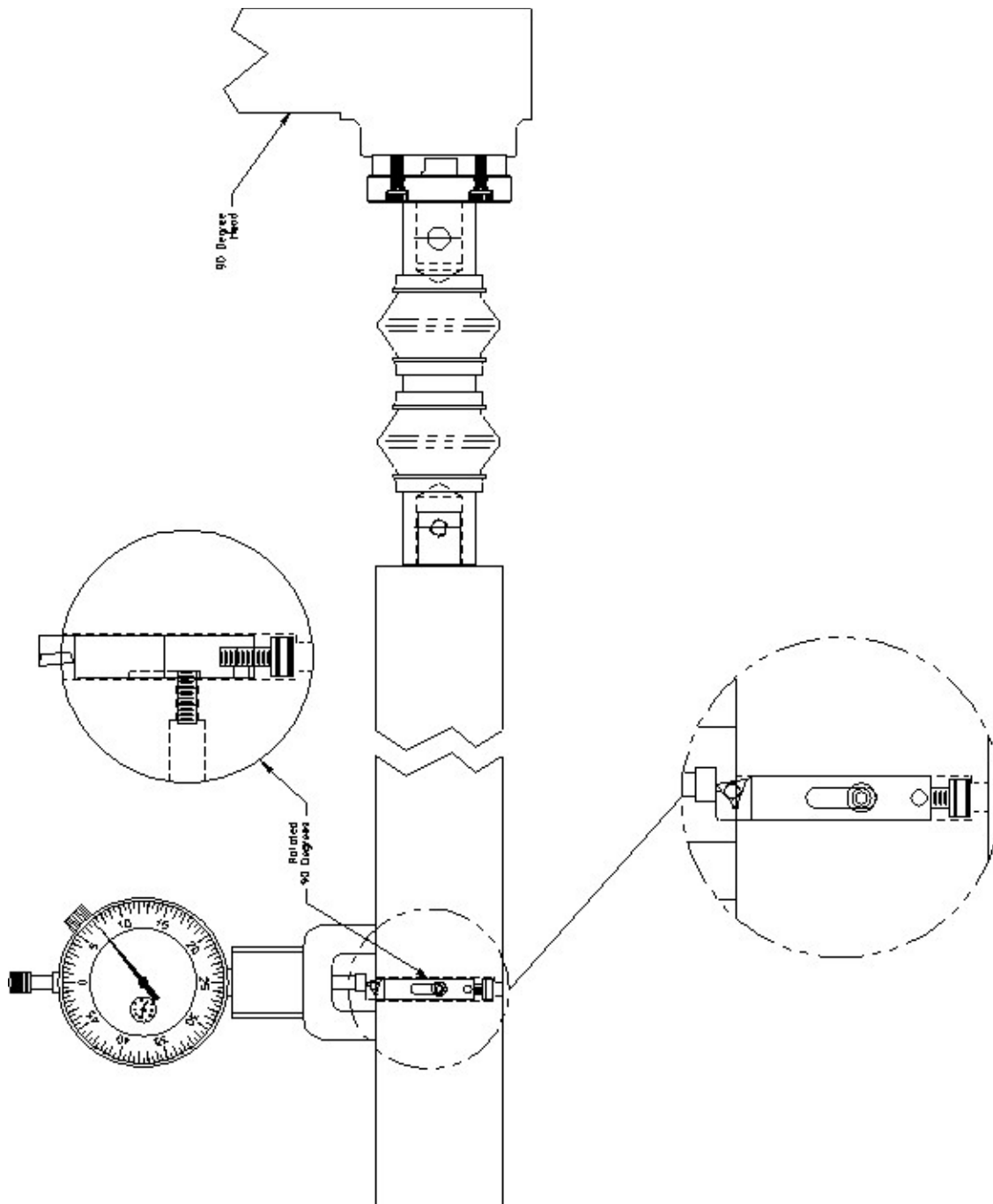
Press the move to zeros button.

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

Cam Tunnel Boring

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

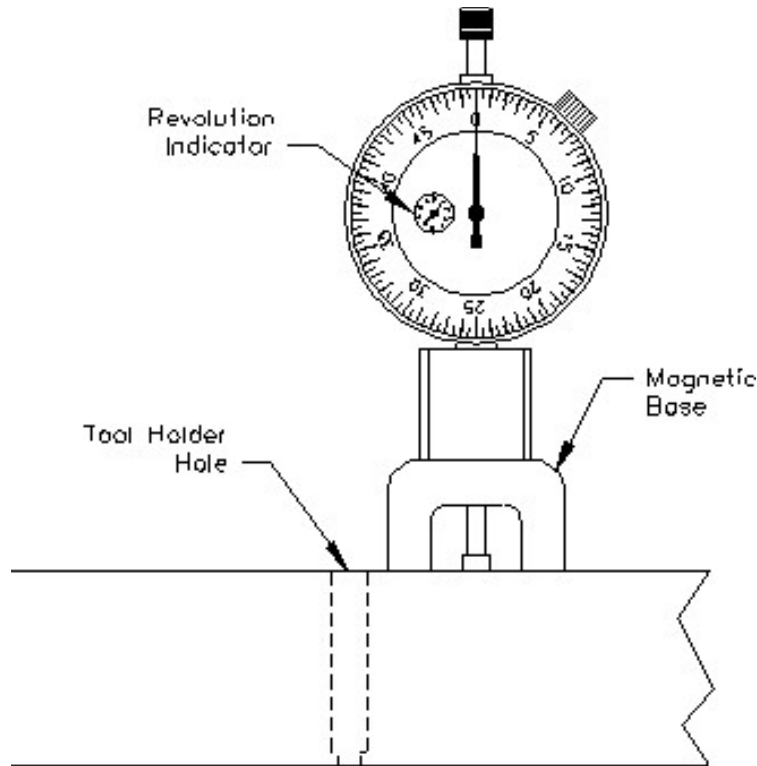
The following illustration shows the cutting tool and holder and how they are set inside the Cam Boring Bar.



Zeroing the Micrometer

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

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



Setting Cutting Size

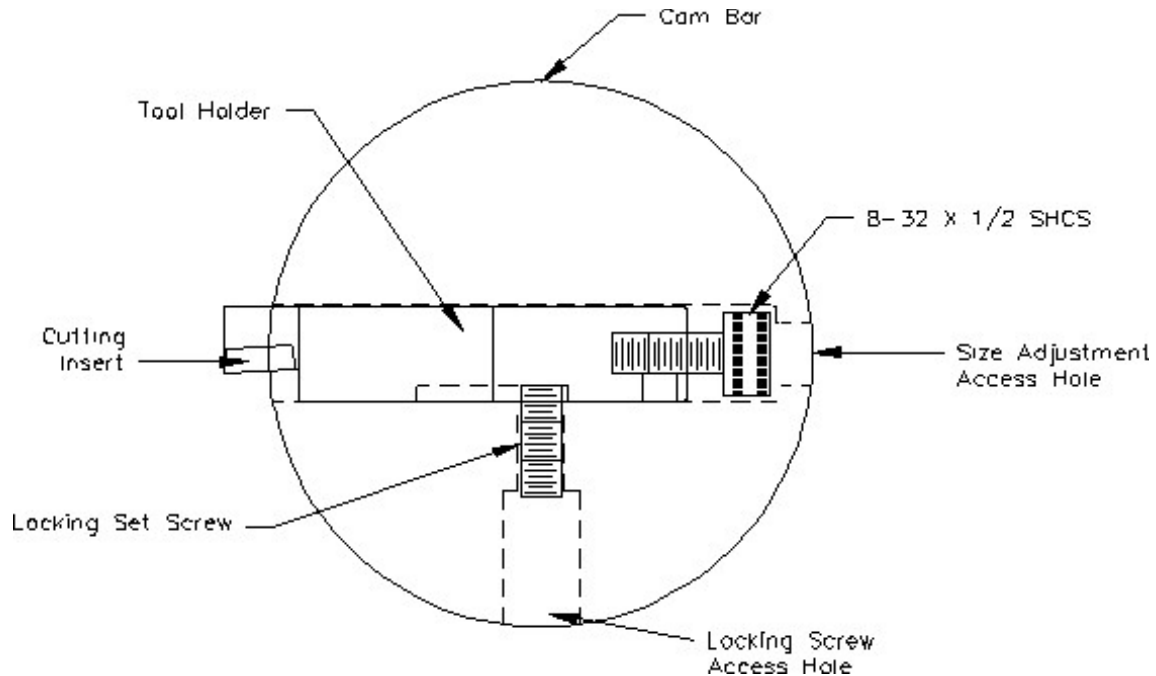
The diameter of the Cam Bar 650-2-32D is 1.7500". The 8-32 X 1/2" socket head cap screw on the back of tool holder is used to adjust size. When the tool holder is inserted into the Cam Bar the cap screw goes against a ledge inside the Cam Bar. When the cap screw is turned in the size will get smaller. When the cap screw is turned out the size will get bigger.



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

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

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



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

Select Line Bore Mode of operation.

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

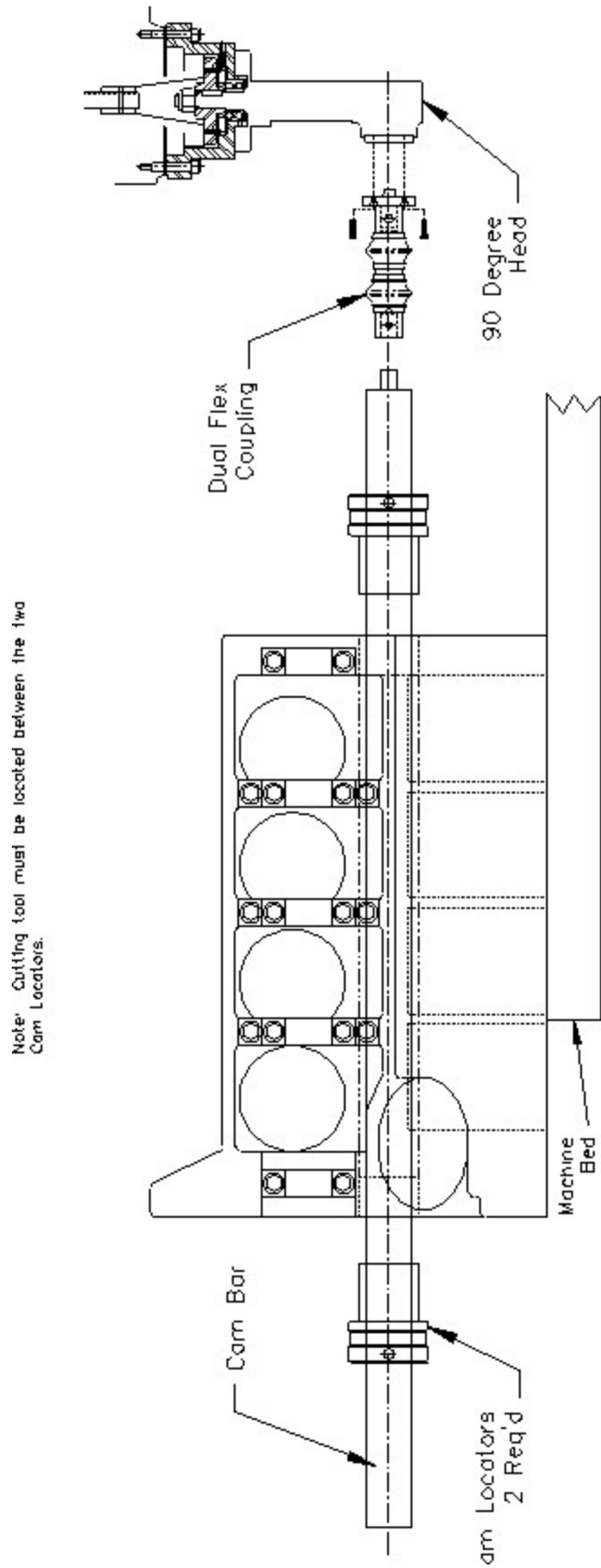
Slide the Cam Bar into the Cam Tunnel and then into the right side locator. Keep the end of the Cam Bar with the adapter on it to the right.

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

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

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

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



Setting Vertical Stops

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

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

Block Clearance: -.001
Block Center Line: 00.000

Setting Horizontal Stops

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

Auto Cycle

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

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

Manual Bore

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

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

Recommended Boring Procedure

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

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

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

Recommended Feed Rate: .001 - .003
Recommended Spindle RPM: 300 – 500

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

Circular Interpolation Tool Paths

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

Objectives of this lesson:

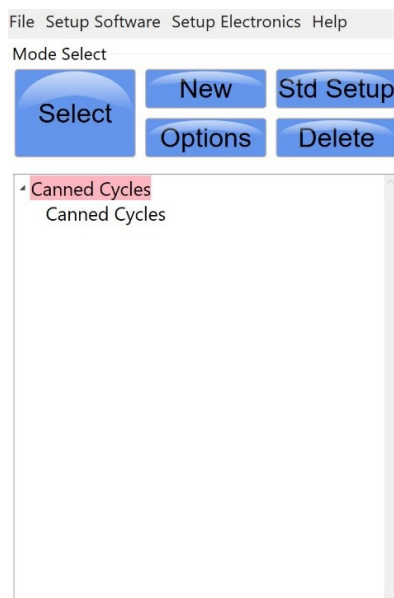
- Learn how to setup and program the 2 options for circular interpolation operations and the benefits for each method
 - Canned Cycle – Pocket
 - Canned Cycle – Circular Move

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

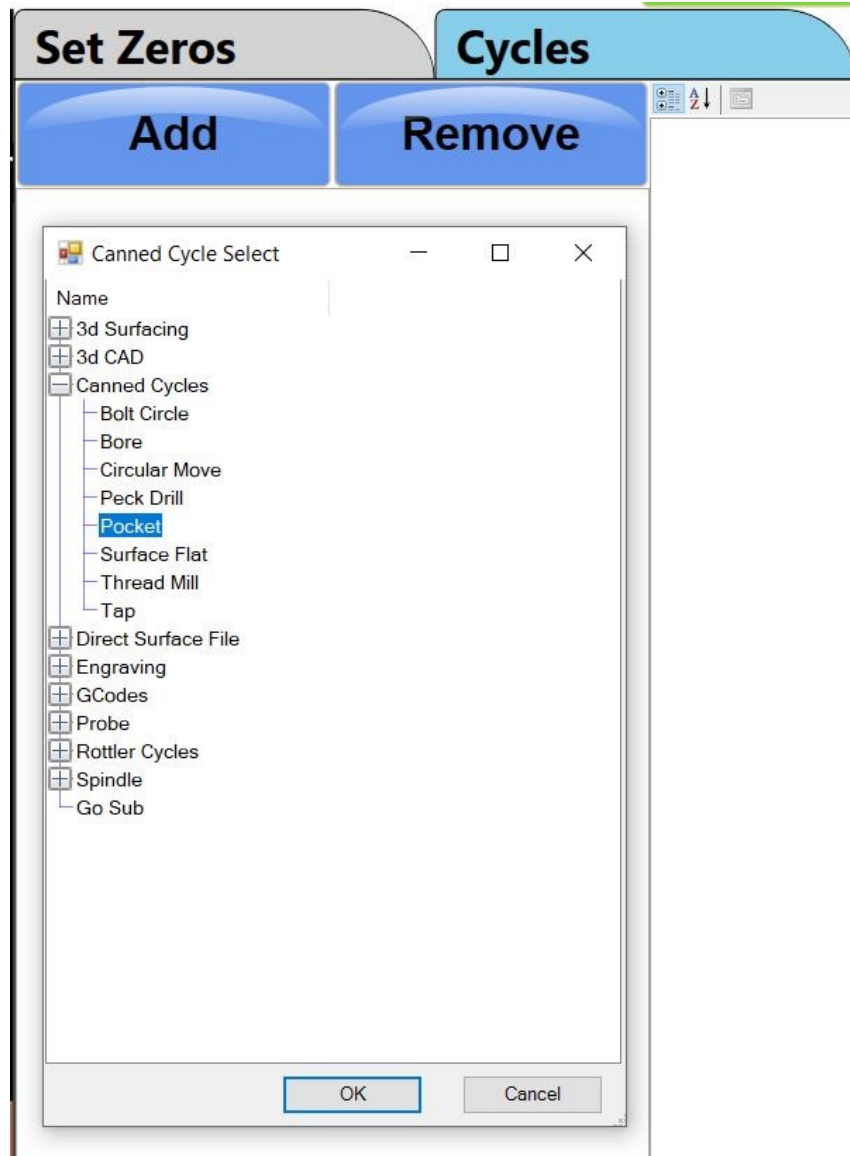
Canned Cycle – POCKET

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

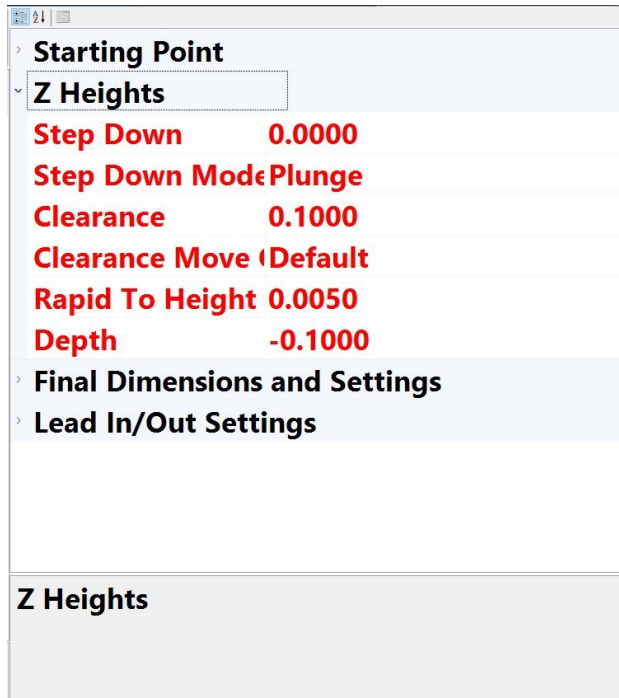
To add a canned cycle operation in the block software, select the program you wish to work form in the program selection area and then press NEW in the Mode Select area from the main screen. A pop-up window will appear, find and select canned cycle to create the mode in the block file.



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



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



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

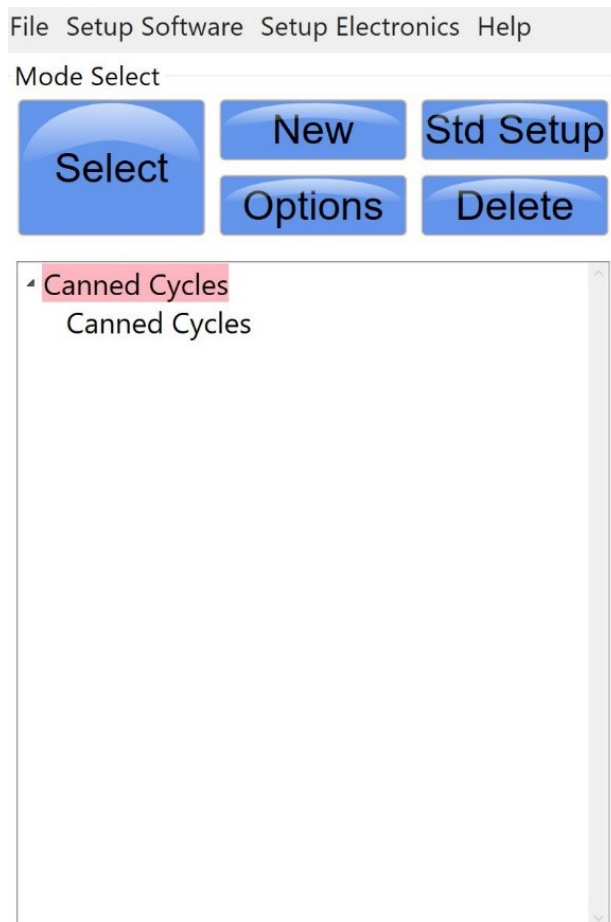


The pocket dimensions and Pocket options are used to edit the dimensions of the pocket as well as the type. For circular interpolation change the Type of Pocket to Circular this will then use the Diameter setting for the pocket dimension. You may also change the max step out which controls the amount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

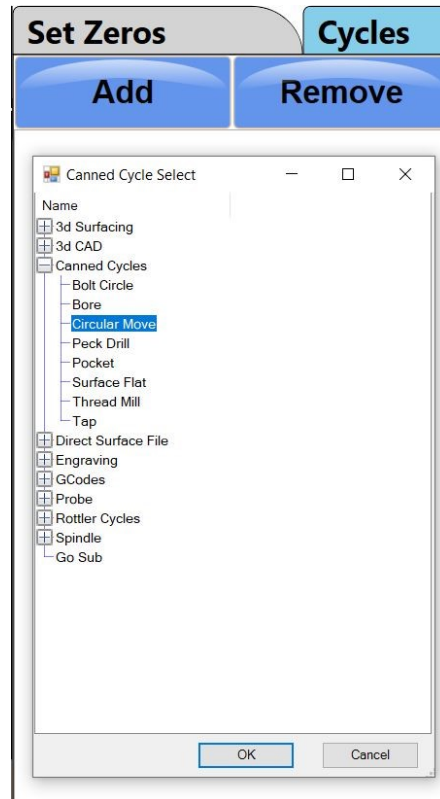
Canned Cycle – CIRCULAR MOVE

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

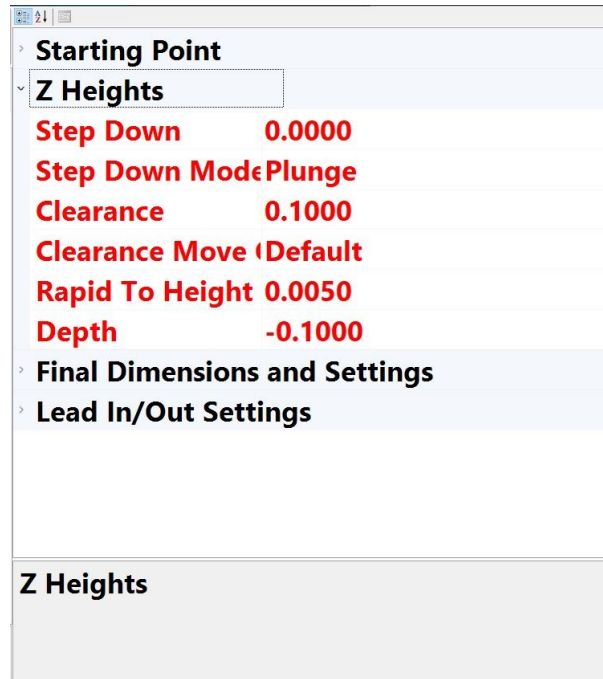
To add a canned cycle operation in the block software, select the program you wish to work from in the program selection area and then press NEW in the Mode Select area from the main screen. A pop-up window will appear, find and select canned cycle to create the mode in the block file.



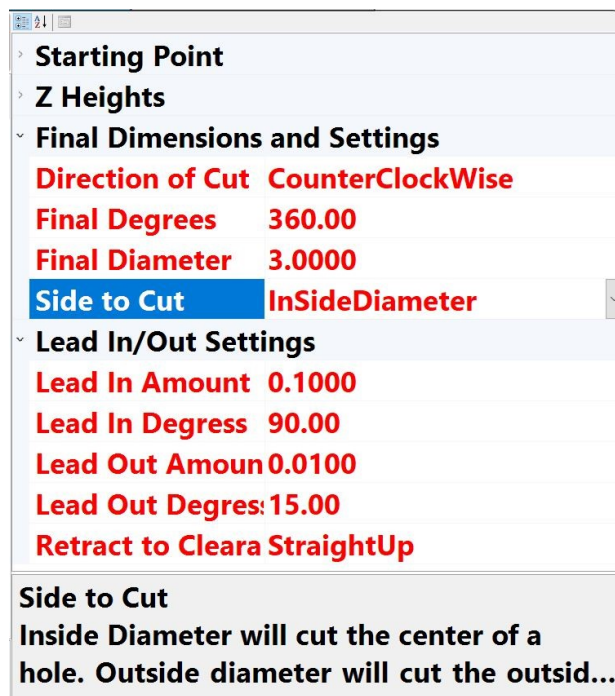
Once created click on the Canned Cycles label to open the programming interface. Select the Cycles tab and you should see add and remove buttons on the left of the screen. From here select the add button and a window will appear where you can select the canned cycles drop down option which will allow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



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



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



The Final dimensions and Settings are used to edit the dimensions of the operation as well as the type. For a full circle the final degrees will default to 360, this can be modified if less is to be

cut. The side to cut may also be changed to inside diameter, outside diameter, or no tool comp for grooving operations. The program will automatically account for the tool diameter so the final diameter should be set to the intended final dimension. Lead In/Out settings control the approach and exit of the cutter and can be modified should clearance be an issue.

Connecting Rod Boring

Main Screen

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

←	Program: Chev 350	Continuous DTG:	0.000	Z	14.6770	Y	0.7000
→	Mode: Connecting Rod	Spindle override	1.00	X	0.7000	A	0.000

PROGRAM SELECT		Set Zeros	Options	Auto Cycle	Notes
X-	X+	Fixture X	Actual Position 0.7000	Handwheel 0.010 0.001 0.0001	Move To NaNHP Tool #:N/A
Y+	Z+	Y	0.7000	0.010 0.001 0.0001	Move To NaNHP Set Active
Y-	Z-	Z	14.6770	0.010 0.001 0.0001	Move To NaNHP
CW	CCW	SPINDLE	0.00	10x Coarse Fine	Move To NaNHP Probe #:N/A
A-	A+	A	0.000	.100 .010 .001	Move To NaNHP Set Active
STOP MACHINE		B	0.000	.100 .010 .001	Move To NaNHP
Feeds Speeds		SSV		MOVE TO ZEROS	
Spindle Load		0.0%		CW INDEX CCW INDEX	
Feed Rate		0.0020		START SPINDLE	
Spindle RPM		200.00		PROBE AUTO CENTER COOLANT AUGER LAMP	

Setting Zeros

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

Setting Vertical Zero

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

Program Options

<div style="display: flex; justify-content: space-between;"> <div> <p>Program: Chev 350</p> <p>Mode: Connecting Rod</p> </div> <div> <p>Continuous DTG: 0.000</p> <p>Spindle override: 1.00</p> </div> <div> <table border="1"> <tr> <td>Z</td> <td>14.6770</td> <td>Y</td> <td>0.7000</td> </tr> <tr> <td>X</td> <td>0.7000</td> <td>A</td> <td>0.000</td> </tr> </table> </div> </div>	Z	14.6770	Y	0.7000	X	0.7000	A	0.000
Z	14.6770	Y	0.7000					
X	0.7000	A	0.000					
<div style="display: flex; justify-content: space-between;"> <div style="width: 20%;"> <p>PROGRAM SELECT</p> <p>X- X+</p> <p>Y+ Z+</p> <p>Y- Z-</p> <p>CW CCW</p> <p>A- A+</p> <p style="background-color: red; color: white; text-align: center; padding: 5px;">STOP MACHINE</p> </div> <div style="width: 80%;"> <table border="1"> <thead> <tr> <th style="background-color: #cccccc;">Set Zeros</th> <th style="background-color: #add8e6;">Options</th> <th style="background-color: #cccccc;">Auto Cycle</th> </tr> </thead> <tbody> <tr> <td colspan="2"> <p>Left Bore</p> <p>Vert Clearance 0.0000 SET</p> <p>Vert Centering 0.0000 SET</p> <p>Vert Probe Height 0.0000 SET</p> <p>Vert Start Bore 0.0000 SET</p> <p>Bore Depth 0.0000 SET</p> <p>Feed 0.0020 RPM 200.00</p> <p>Tool #: N/A Set Active</p> </td> <td> <p>Right Bore</p> <p>Vert Clearance 0.0000 SET</p> <p>Vert Centering 0.0000 SET</p> <p>Vert Probe Height 0.0000 SET</p> <p>Vert Start Bore 0.0000 SET</p> <p>Bore Depth 0.0000 SET</p> <p>Feed 0.0020 RPM 200.00</p> <p>Tool #: N/A Set Active</p> </td> </tr> </tbody> </table> </div> </div>	Set Zeros	Options	Auto Cycle	<p>Left Bore</p> <p>Vert Clearance 0.0000 SET</p> <p>Vert Centering 0.0000 SET</p> <p>Vert Probe Height 0.0000 SET</p> <p>Vert Start Bore 0.0000 SET</p> <p>Bore Depth 0.0000 SET</p> <p>Feed 0.0020 RPM 200.00</p> <p>Tool #: N/A Set Active</p>		<p>Right Bore</p> <p>Vert Clearance 0.0000 SET</p> <p>Vert Centering 0.0000 SET</p> <p>Vert Probe Height 0.0000 SET</p> <p>Vert Start Bore 0.0000 SET</p> <p>Bore Depth 0.0000 SET</p> <p>Feed 0.0020 RPM 200.00</p> <p>Tool #: N/A Set Active</p>		
Set Zeros	Options	Auto Cycle						
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This screen is used to input all the parameters for boring both the big and small end of the rod plus setting positions for centering and measuring.

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

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

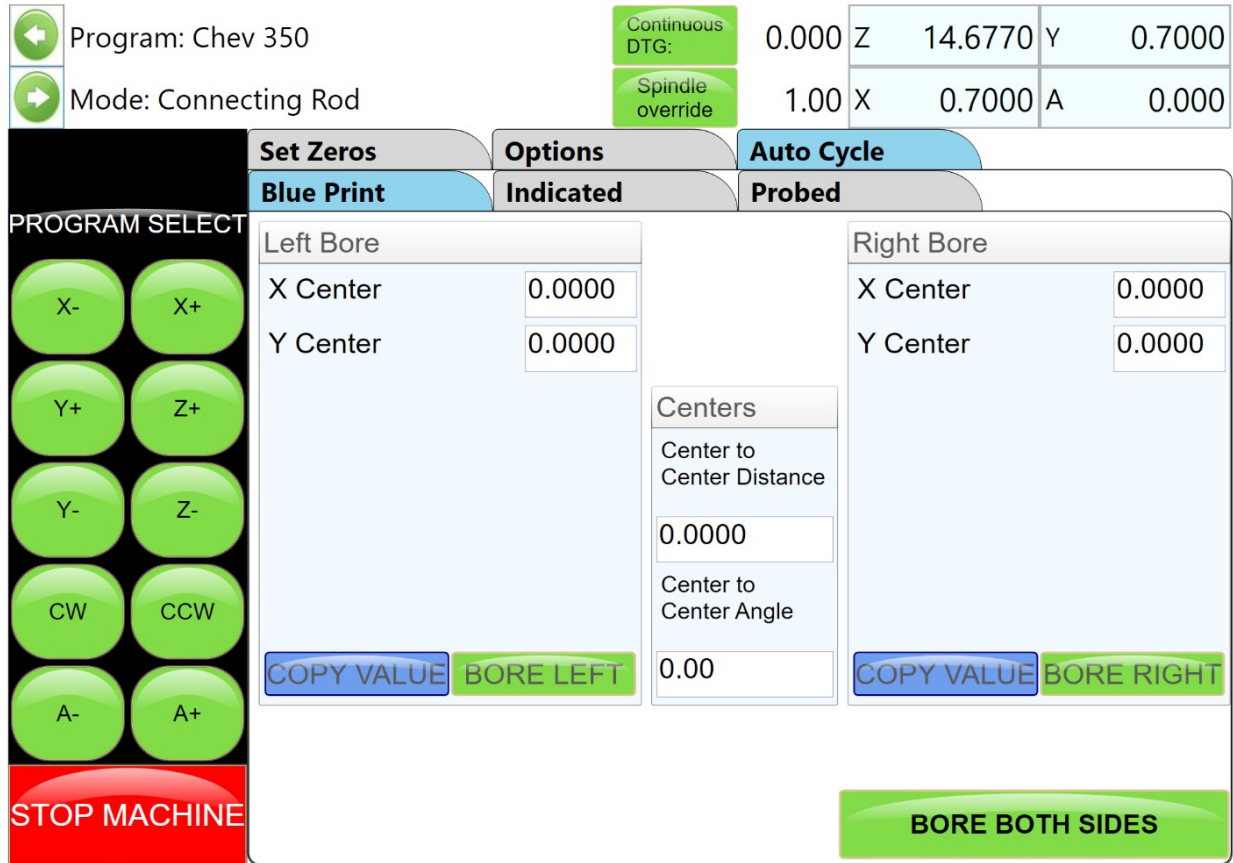
Vert Probe Height: This is the vertical height that the machine will move to before probing the bore to recenter the machine using the three-point probe routine.

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

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

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

Auto Cycle

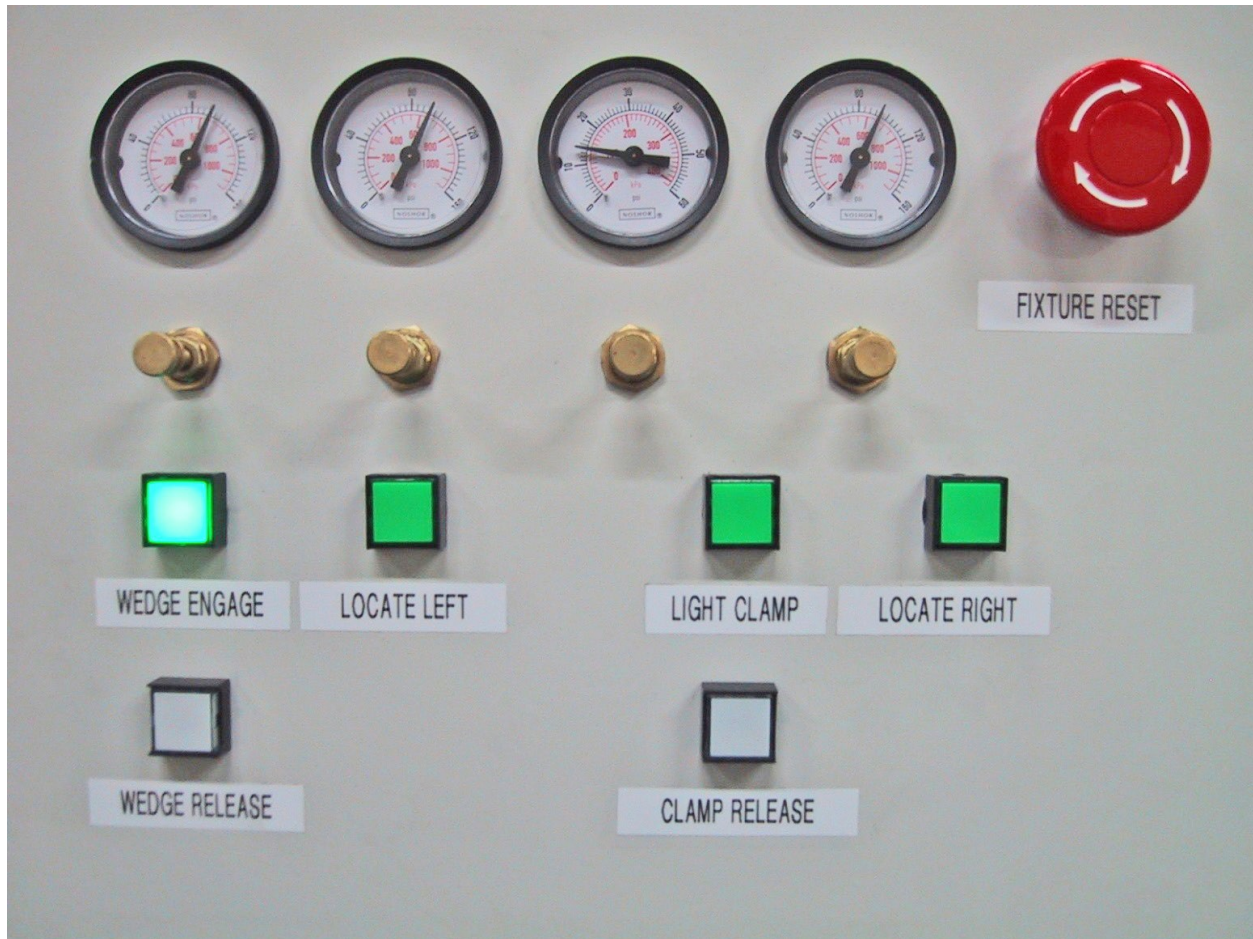


This screen is used to the connecting rod program. From the Auto Cycle tab the operator can use the Blueprint, Indicated or Probed tabs to machine using the respective methods as described in the 3 Axis Block Boring section.

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

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

Fixture Control Panel



Set Up Procedure For Conrod Fixture

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

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

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

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

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

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

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

Remove the conrod from the fixture.

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

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

Remove the conrod from the fixture.

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

Position the clamp arms so that their feet are approx 1/8" (3mm) above the side of the big end, be sure that they do not protrude into the big end bore to be machined and adjust their travel limit stops and lock the lock nuts.

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

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

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

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

The conrod is now ready to be bored.

Air Pressure Settings

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

OPERATING INSTRUCTIONS

Spindle Chiller System

The spindle chiller system MUST be on whenever the machine is operating. The chiller is turned on separately from the machine. Before proceeding you should check to make sure it is operating. The display should read a number representing a degree in Celsius. You can toggle between room and oil temperature by pressing the "ON/OFF" button.

To change the temperature settings of the chiller system, simply hold one of the "UP" or "DOWN" arrows on the control panel for 3 seconds. This will cause the number on the screen to change to a number "+15.0/-15.0." These numbers represent the desired temperature of the oil as compared to room temperature. The recommended settings are "-3.0" for room temperatures 20+ degrees Celsius and "+3.0" for room temperatures 19.5- degrees Celsius.

Chiller Control Panel

The green lights on the left hand side (A) indicate whether the number displayed is room or oil temperature. The number displayed (B) is a Celsius reading of temperature. The "UP" and "DOWN"

arrows (C) allow you to change temperature settings in the oil chiller. The “ON/OFF” button (D) will toggle the temperature selection between oil and room temperature.



Spindle Warm Up/Break In

It is imperative that the spindle motor is warmed up before any cutting is done to prevent permanent damage to the internal components. There are two cycles that can be run to accomplish this. The first and most common cycle is the “Quick Warm Up” cycle. This cycle takes approximately 30 minutes to complete. The Quick Warm Up should be done any time the machine has sat in without the spindle running for 8 hours or more. The second cycle is the “Long Break In” cycle. This should be used any time the machine has been transported, the spindle has been left at a high angle overnight, or the spindle has not been operated in 7 days or more. This cycle takes approximately 2.5 hours. Both processes should be completed with the B axis at 0 degrees. There is no need to supervise the machine while it is operating in either of these modes.



Do not perform the Warm Up/Break In procedure with any tooling attached to the spindle.

MACHINE STARTUP

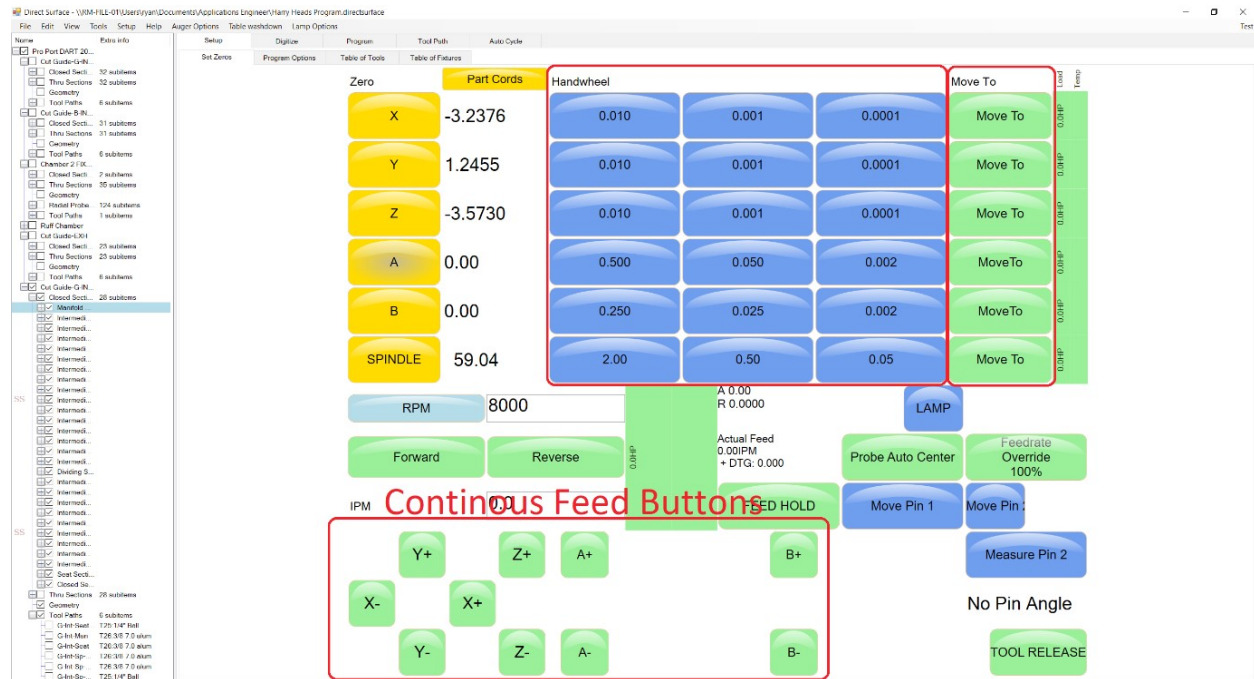
- Start by double clicking the direct surface icon found on your desktop.
- Before operating the check to see that the machine has the correct air pressure on the regulators
- Open the rear air controls enclosure to view regulator pressure.
- Manifold gauges should read; 100psi, 35psi, 12psi.

- Note the middle gauge is the one that regulates the pressure for the B axis. This setting is critical.
- Not having the specific air pressure to the machine will cause the B axis to fall when tilted at an angle and motor loses power, the support cylinder will not have the air to prevent from the motor from falling. If there is too much air in the system it will cause the head to rise up when the head is tilted and the motor loses power.
- If pressure is not to spec, follow the B-Axis air pressure adjustment procedure located in the maintenance section of this manual.
-

Home Machine

Once you are viewing the machine control interface Home the machine. Homing the machine makes the control reference the current machine position in order to complete future calculations for position movements. The machine will not run any auto cycles until this step is complete.

Once the machine has been homed the machine can be jogged around by using the axis control interface with either the feed buttons, move-to commands, or the handwheel increment selection buttons.



Control Interface

From the main screen we can see there are various tabs at the top of the control interface labeled **Setup**, **Digitize**, **Program**, **Tool path**, and **Auto Cycle**. Each of these tabs will be used in order to guide you through the programming process. You will start at the **Setup** tab and end with the **Auto Cycle** tab.

Setup Tab – Contains the Set Zeros, Program Options, Table of Tools, and Table of Fixtures Sub-tabs. This is where the operator can jog the machine, set program zeros, and record tool and fixture information.

Digitize Tab – Contains a small window for machine control. This is where the operator can position the machine with the probe equipped and perform digitization of chambers and ports.

Program Tab – Contains the digitized information. This is where the operator can edit the digitized cross sections to manipulate port geometry.

Tool Path Tab – Contains the automatically generated tool path that will be ran based on the port geometry from the program tab.

Auto Cycle Tab – This is where the operator selects which ports/chamber operations they wish to run and contains the cycle start button.



Each head will have its own specific offset or location within the machine work envelope. Notice the **“Table of Fixtures”** below. The table of fixtures stores the prescribed fixture name as well as it’s fixture zero locations.

To choose the fixture to be used select the fixture from within the table of fixtures and it will be highlighted, then click on the **‘Set Active’** button on the right side of the screen.

To add a new fixture simply click the ‘Add New” button, then you can double click on the fixture number to change the name for the fixture. To set the zeros for a new fixture you can jog the machine and use the touch trigger probe to find the location you would like to use for the fixture offset. By double clicking on the axis buttons from within the CNC interface screen the machine will save the current location as the zero for that axis. The numbers next to the axis button are the part coordinates as reference from the current fixtures zero locations.

Setup	Digitize	Program	Tool Path	Auto Cycle
Set Zeros	Program Options	Table of Tools	Table of Fixtures	
Fixture N...	Fixture N...	Fixture Off...	Fixture Off...	
0		0.0000	0.0000	0.0000
1	My Fixture	0.0000	0.0000	0.0000
2	Y8 Small	0.0000	0.0000	0.0000
3	BBC	3.2376	-1.2455	2.0000
4		0.0000	0.0000	0.0000

Add New

Move Up

Move Down

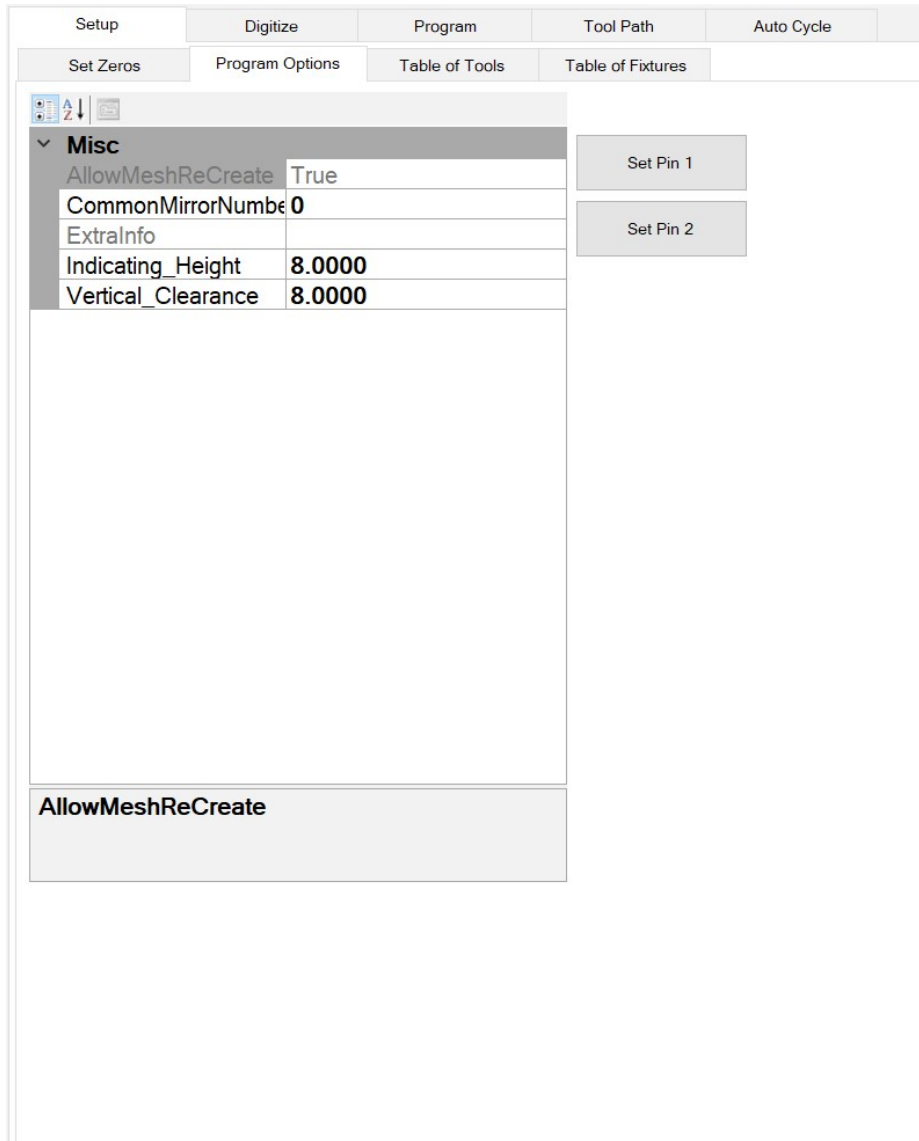
Delete

Set Active

Active Fixture Number:
2

Locating Fixture

To locate a cylinder head fixture, the pins that were used for alignment earlier need to be located individually and set as a location within the program. Starting with the left pin, use a dial indicator or the touch trigger probe to locate the center of the pin. Within the **program options** sub tab, locate the **Set Pin 1** button then press the button. A window will come up asking if you are sure you want to set pin location and verifying that the right fixture number is selected. Repeat the process to locate pin 2 and once the center of the pin is located press the **Set Pin 2** button.



Pin 1 which is the left pin will be used as the fixture offset zero location for the current fixture that is being setup.

After both pins are located, the Z axis needs to be changed to 2.0000" since it's the distance from what the fixture is rotating on the A axis. Go to the "Table of Fixtures" tab and click on the fixture number that is selected, there will be a window that come up indicating the position for the X, Y, and Z axis, double click on the Z axis and change it to 2.0000" when prompted to set the Z axis fixture offset.

Setup		Digitize	Program	Tool Path	Auto Cycle
Set Zeros		Program Options	Table of Tools	Table of Fixtures	
Fixture N...	Fixture N...	FixtureOff...	FixtureOff...	FixtureOff...	
0		0.0000	0.0000	0.0000	
1	My Fixture	0.0000	0.0000	0.0000	
2	V8 Small...	0.0000	0.0000	0.0000	
3	BBC	3.2376	-1.2455	2.0000	
4		0.0000	0.0000	0.0000	

FixtureOptionsForm

Name:

Description:

Fixture Offset Axis Values

Axis	Value
X	0.0000
Y	0.0000
Z	2.0000
A	0.0000
B	0.0000
S	0.0000

Important Locations:

Important Location Axis Values:

Defining Tool Length and Probe Length Offsets

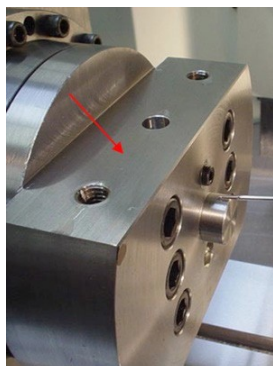
All tools will be touched off on the flat side of the 4th axis head stock, opposite to where the plate gets mounted. Note that the flats on the 4th axis have two different dimensions from the center of rotation. One flat is 2" from center the other flat is 2.5" from center. The 2" dimension will be positioned at A0.000. The 2.5" dimension will be positioned at A180.00. All tools and probes will be established from the 2.5" side.

Probe Length

To define probe height, position probe just over the flat of the 4th axis. Position the probe so its approximately 1 inch above the surface to be probed. From the Set Zeros sub tab press the Probe Auto Center button to bring up the probe options window. Make sure that the probing routine is set to depth and when ready press GO.



The probe will automatically move down until it touches the surface, move back up to a clearance plane, and then move back down until the probe tip is just touching the surface of the head stock.

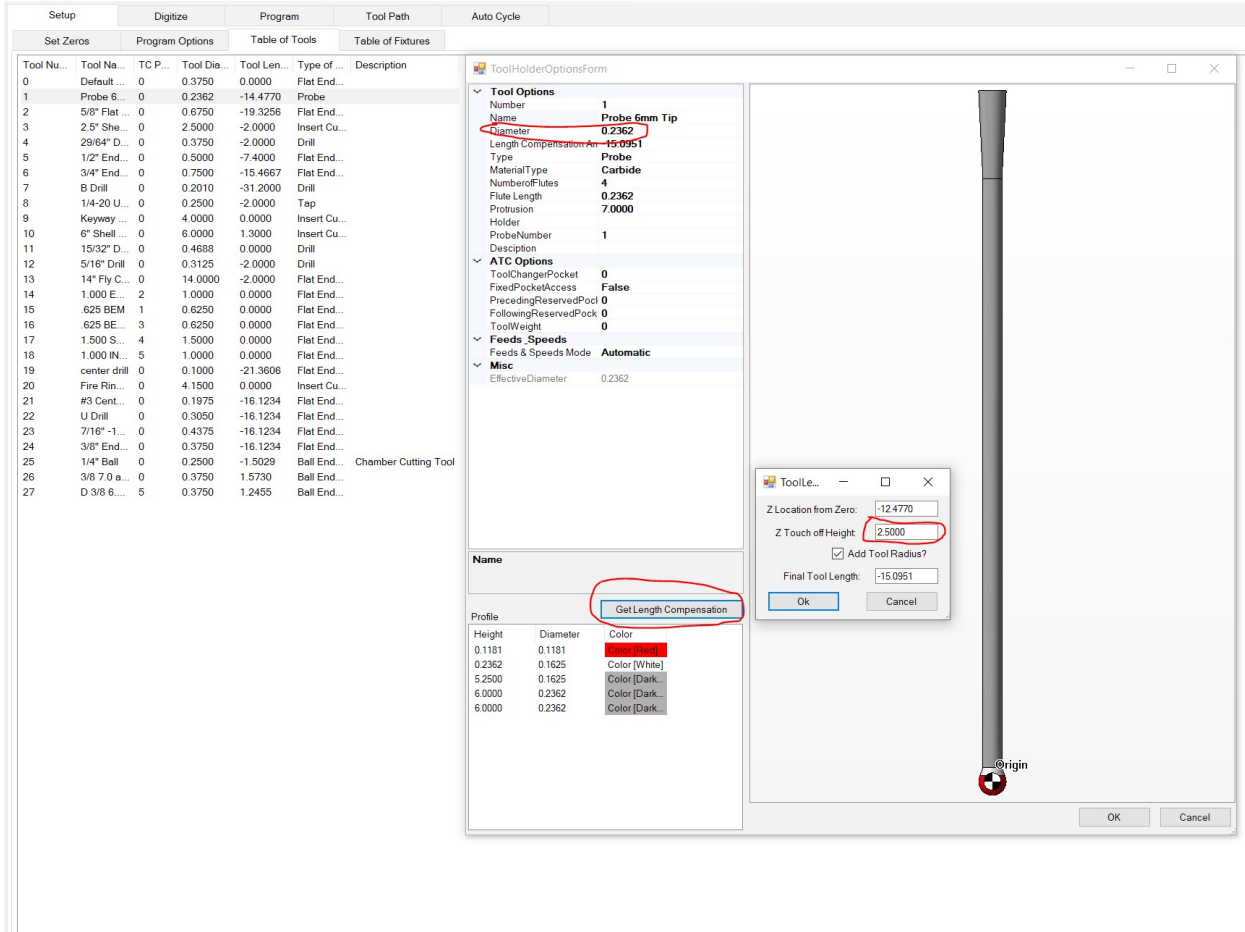


Touch all cutters and probe off on the head of 4th axis at position 180 degrees as shown by the red arrow above. The dimension from the center of rotation to the flat positioned at 180 degrees is 2.5000"

Table of Tools

Open the table of tools and double click on the probe to bring up the Tool Holder Options Form. From this window you can edit the information that defines the probe. The two critical boxes that must be filled out are the Diameter and Length Compensation values. If using the standard 6mm probe then the diameter is

.2362. This should be set from the factory. Pressing the get length compensation button will bring up the Tool Length Compensation Window.



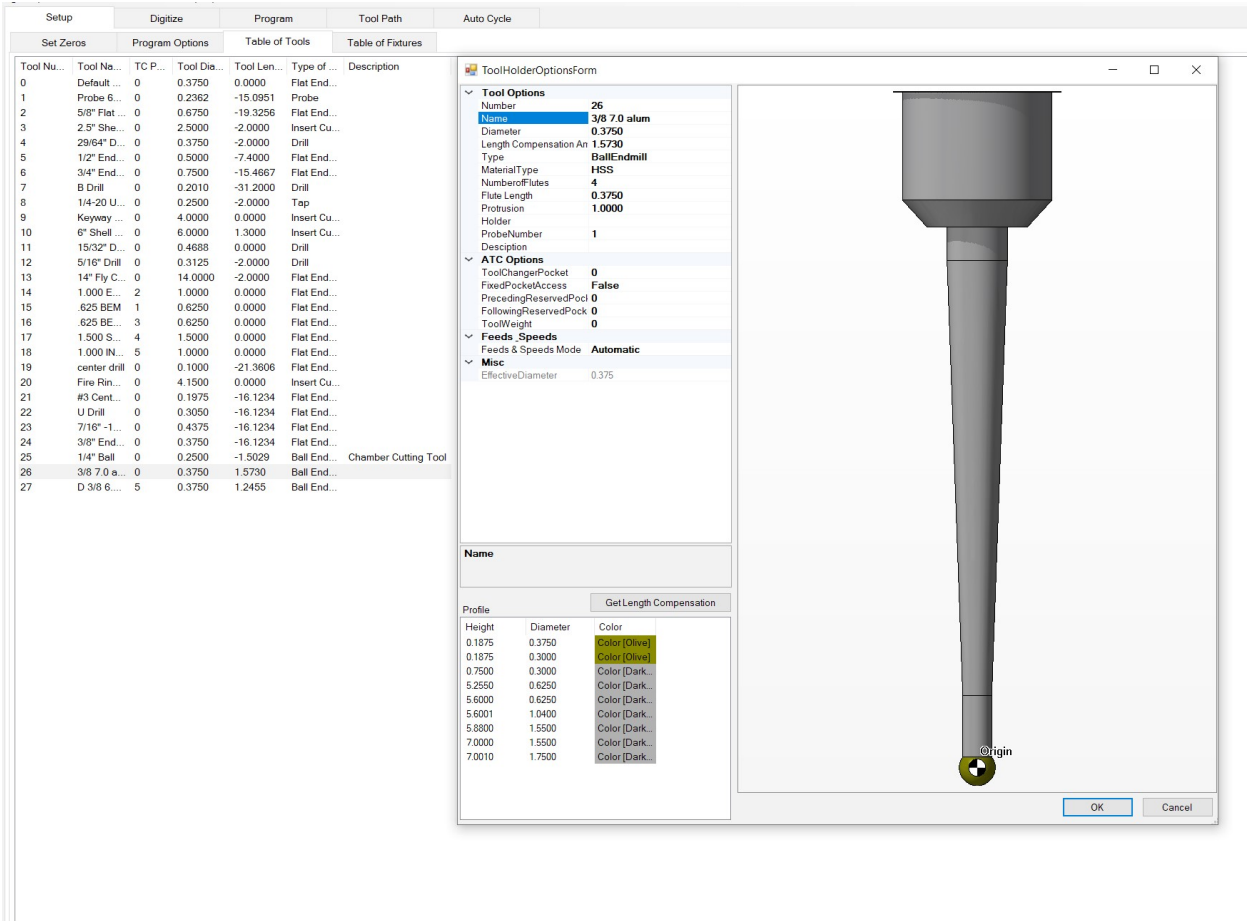
Note there is a value of 2.500" in the 'Z Touch off Height' field. Since we are using a probe and touching directly on the 4th axis flat to establish the height the value will be set at 2.500" to adjust the height offset number from the flat to the center of rotations (all probe and tool Z zeroes are established at the center of the 4th axis rotation).

Cutting tools are set up slightly different than the probe since we can't use the probe auto center command. A .100" gage block is supplied for touching off hard tools such as the porting tools and any other carbide endmills the operator may wish to use.

To setup a tool we still need to touch off the top of the 4th axis spot on the 2.5" offset face as we did with the probe. The difference is we now have to bring the tool down manually until we can just slide the .100" gage block between the tool tip and the 4th axis surface.

With the tool loaded into the spindle jog the machine down until it is close to the touch off surface. Using the .001" increment on the z-axis handwheel setting, continue to move the cutter down as you slide the .100" block back and forth underneath the tool. Continue to do this until the cutter just touches the gage block and you can no longer slide the block back and forth. Once the tool is touching the gage block switch to the .0001" handwheel increment setting and jog the spindle up in the z axis just a few clicks. Move the tool back down in the z axis as you continue to slide block back and forth underneath the cutter. Continue doing this click by click until you feel the cutter just drag across the surface of the block. At this point open the Table of Tools, Select the current tool or create a new tool if necessary. Open the get

length compensation tab for the tool. Press the Get length compensation, enter 2.5" for the Z touch off height and press OK.

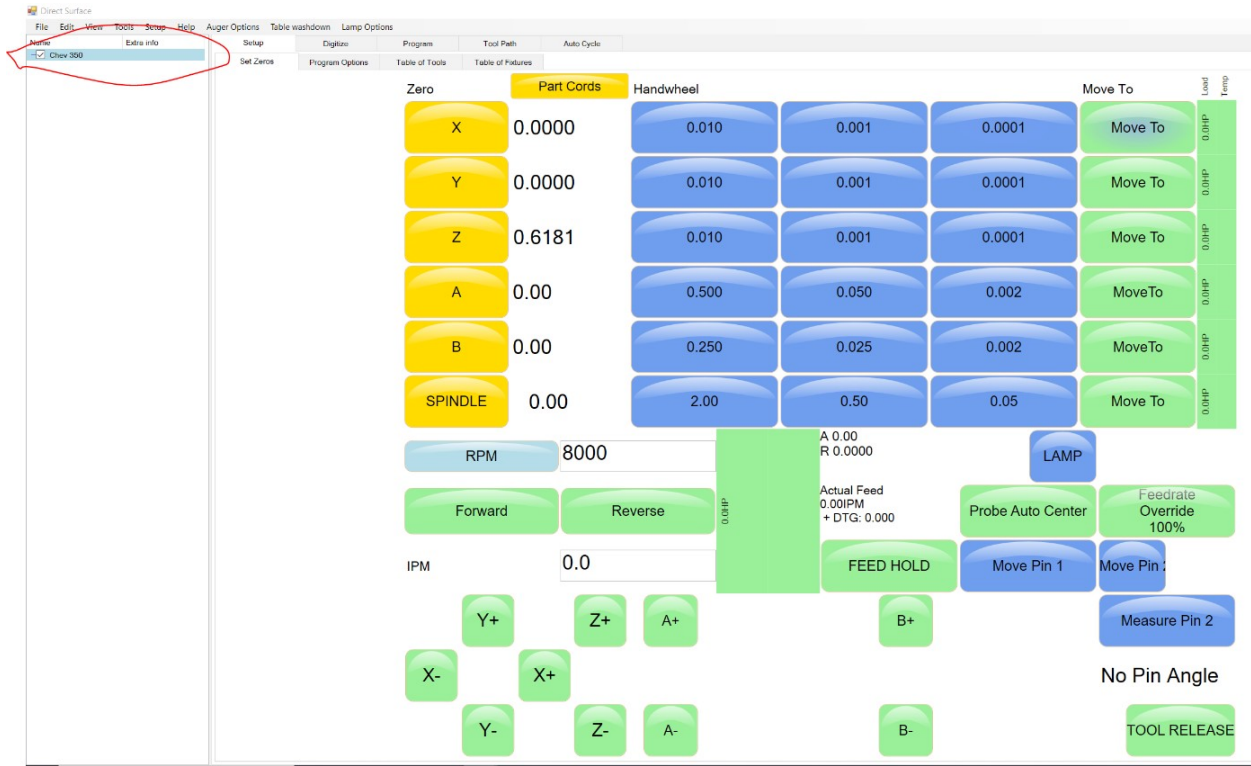


If you are setting up tools with ball ends such as the probe or porting tools then make sure that the Add Tool Radius box is clicked. This allows the machine to perform the correct position moves while cutting with multiple axes while making sure the tool doesn't overshoot the desired dimensions.

DIGITIZING

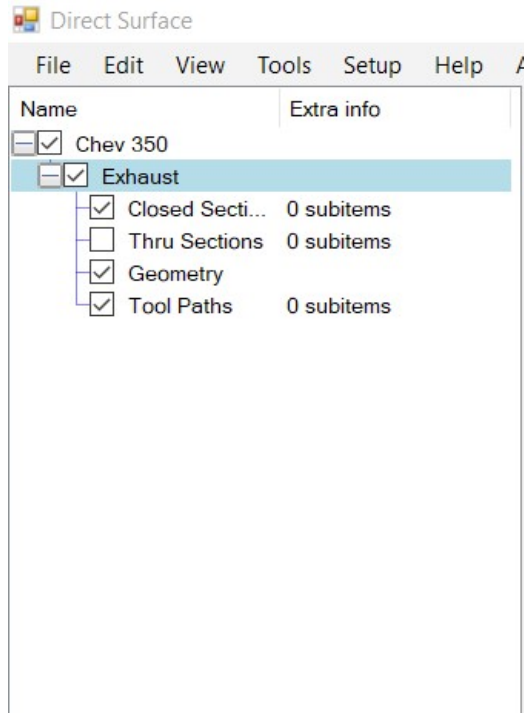
Starting a New Head

When you open a new file a new head program is automatically created. You can right click on the new head designation on the left side of the screen and press rename to name the head.



Creating a Port

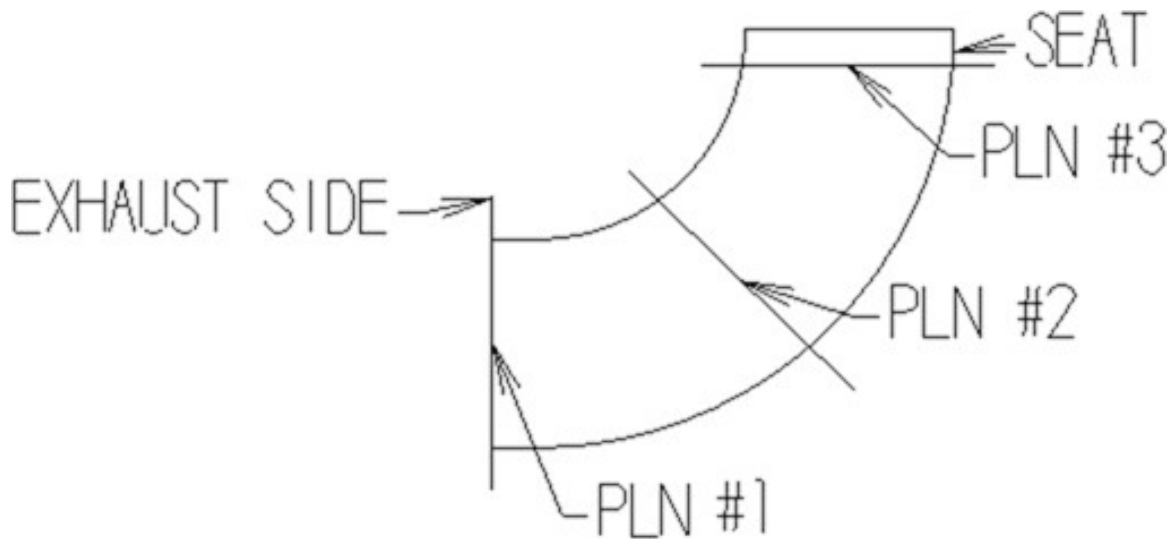
To add a port right-click on your newly named head and then click on 'Add A New Port'. Click the (+) icon to expand the port information tree. You may also right click on the new port name to rename the port.



Digitizing a Port

- There are three planes that need to be defined by using the hand-wheel in order to create a road map for the automated digitizing process. It takes three points to define a plane. We will be using X,Y,Z, A, and B axes in order to define each of the three planes. We will start off by focusing on the exhaust port. The intake port(s) will be done in the exact same fashion.

- With regards to the exhaust port the three planes that we need to define occur at the exhaust manifold side, the middle of the port (where the major transition takes place), and lastly the valve seat area.
- The planes that we define are simply approximate positions. We are simply defining where we need the probe to move so that it can begin its automatic digitizing process. See the diagram below.
- Plane #1 will be digitized from the Manifold side. With the A axis oriented so that the manifold side is facing upward.
- Plane #2 can be digitized from either seat or exhaust side, whichever is easiest. The clearance available for the probe to reach into the port before shanking out is usually what determines the transition plane.
- Plane #3 will be digitized from the seat side with the A axis oriented so that the seat side is facing upward.



Creating Planes

Set the probe to active tool from within the table of tools

Navigate back to the Set Zeros tab and then right click on the Closed Sections in the Cylinder head information drop down list.

PLANE #1

First rotate the A-axis to get the manifold side flat and facing upward. To define plane #1 we will use 3 points that are spaced at approximately 120 degrees apart. You will pick these points up using the handwheel. The hand wheel can be move in X, Y, or Z to find the three points.

POINT #1



POINT #2

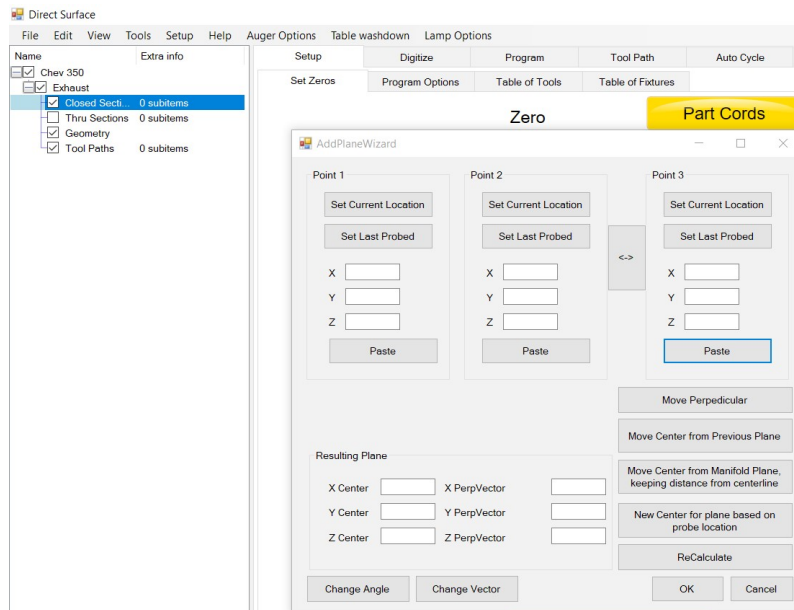


POINT #3



Right click on “Closed Sections” then click on **“Add New Plane for Probing”**. An ‘AddPlane Wizard’ will appear. Position your probe near where point #1 is from the above photos by using the hand-wheel. Using the .001” handwheel increments in the z-axis bring the probe down slowly until the lights on the probe change from **green** to **red**. Once the light turns red move the probe back up one handwheel click at a time until the light becomes green again.

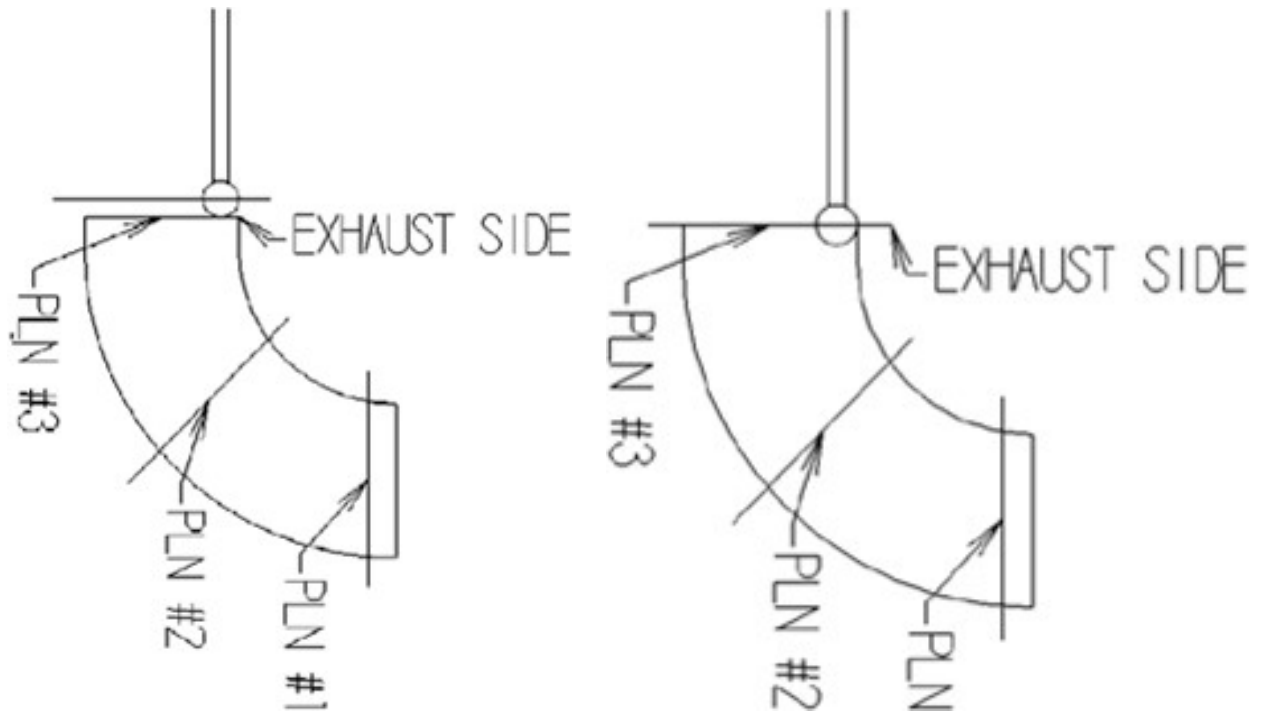
In the Add Plane Wizard where it says Point 1 click the Set Last Probed button. This will collect the last probed X,Y,Z axis location and store the coordinates in the respective boxes. Repeat the above process at points 2 and 3 and use the set last probed button to fill out the X,Y, and Z boxes for both points within the Add Plane Wizard.



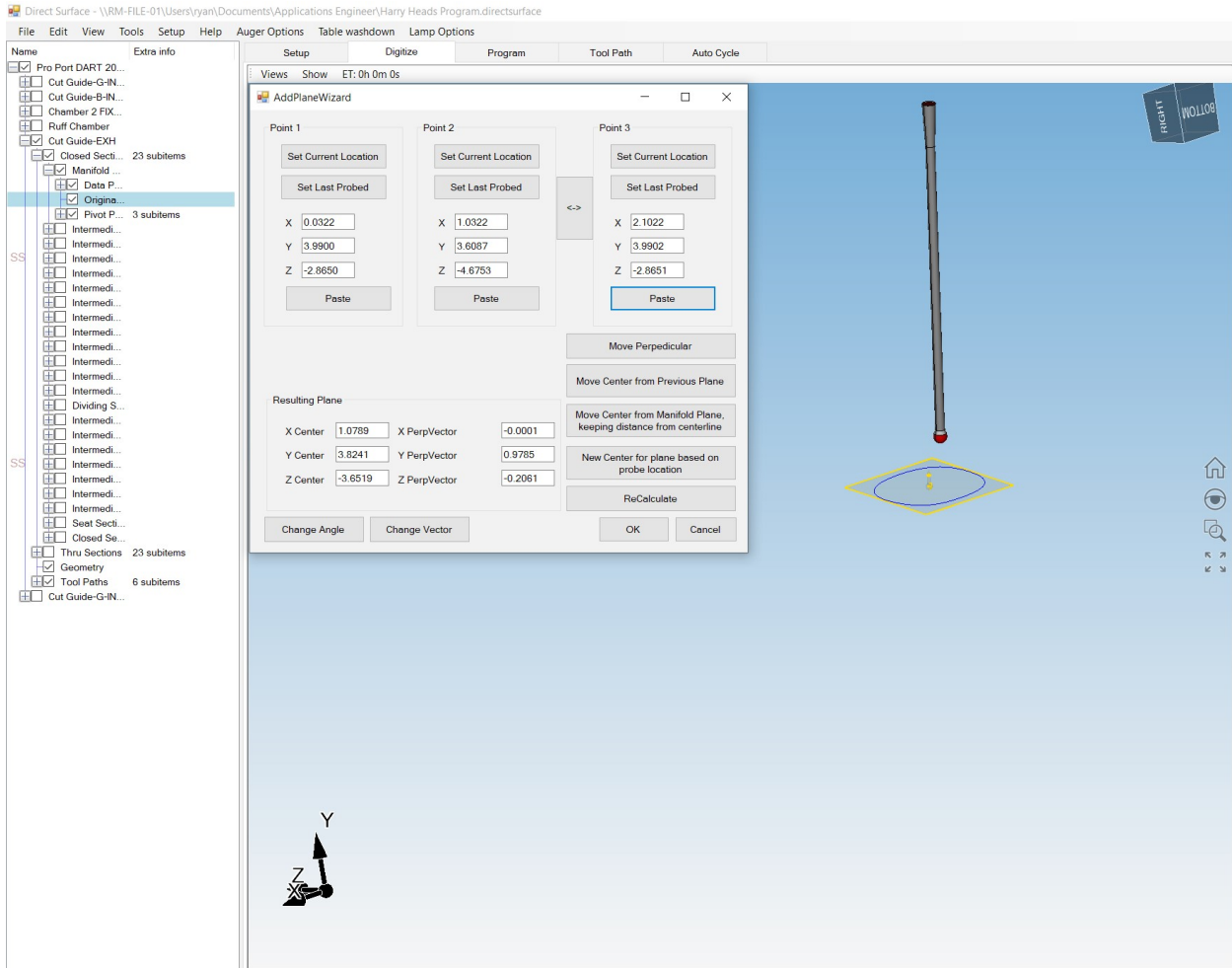
Once this plane has been created using the above method, we want to relocate the plane so that it's at the very edge of the port. This is accomplished by moving the plane down by the radius of the probe tip which if using the 6mm probe is .118”

Original Plane

Shifted Plane



To manipulate the plane, navigate to the digitize tab. Highlight the closed sections and in the viewing window click show and the planes to see the planes. Double click on the Original Plane in manifold plane tree to re-open the Add Plane Wizard.



Click on the Move Perpendicular button to open the Input Form. In the entry box type in $-.118$ and press OK to shift the plane down by the probe tip radius.

PLANE #2

To define plane #2 we will be using the side of the probe to pick up the three different points that will be making up the plane, instead of using the tip of the probe as used on the previous plane. So there will be no need to move the plane after it has been set. Right click on the closed sections option and select Add New Plane For Probing.

Hand wheel X, Y, Z, A, and B around until you can position the probe to the approximate points shown below. Points #1 and #2 can be picked up just to the left and to the right of the valve guide, being straight across from each other, as square as possible to the valve guide. (Make sure that only the ruby is touching the port and not the shank of the probe).



POINT #1

POINT #2

POINT #3

POINT #3 SIDE VIEW

Point #3 is the short turn radius point and can be the most difficult point of the 3 to define. It will need to be directly across from the 1st and 2nd point. We must be able to reach this point from both the manifold and seat sides so take some time and care when positioning this point.

The Figures below are shown as an example of how the probe must be able to reach Point #3 from both the manifold and seat side of the head. The pictures below show this plane being picked up from the seat side. As mentioned above you may choose which side you would like to first define this point. If the A-axis is not rotated enough you will not be able to get at this point from the other side. There has to be a "line of sight" to Point #3 from both directions.

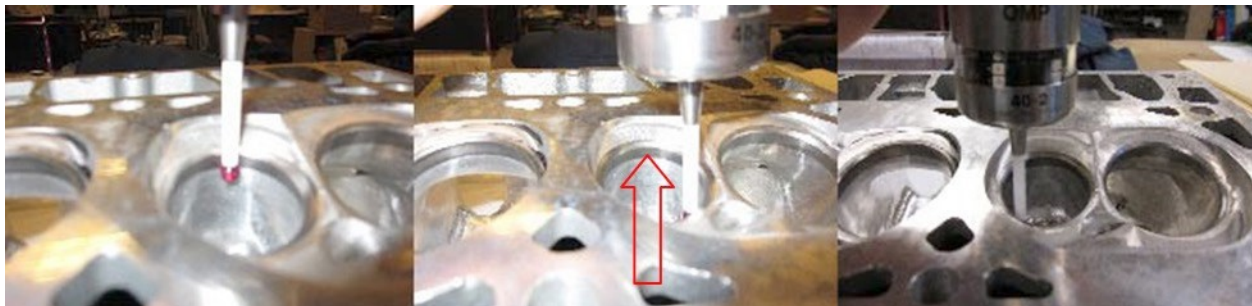
Sometimes it can take a couple of minutes to get your probe positioned where you like in which case the probe may shut off automatically. If this happens simply go into the table of tools and click on the 'Start Probe' button, then click on the 'Set Zeros' tab to get back to the control.

PLANE #3

Manually rotate the A-axis so that the seat side of the head is facing up. If you know the angle of the head then you can use the move-to command and enter the angle to have the deck of the head aligned with the horizontal plane.

Start by clicking on "Add New Plane for Probing" button, then use the "Add A Plane Wizard" to set plane #3. The three points to probe the plane will be as shown on the picture below, right after the valve seat insert finishes (see the red arrow in point 2 for clarity)

We will be using the side of the probe, and there will be no need to move the plane perpendicular when it's been set. Line up the center of the probe right between the end of the seat insert and the port. Set all three points as shown on the picture then click "OK" on the window to add the plane.



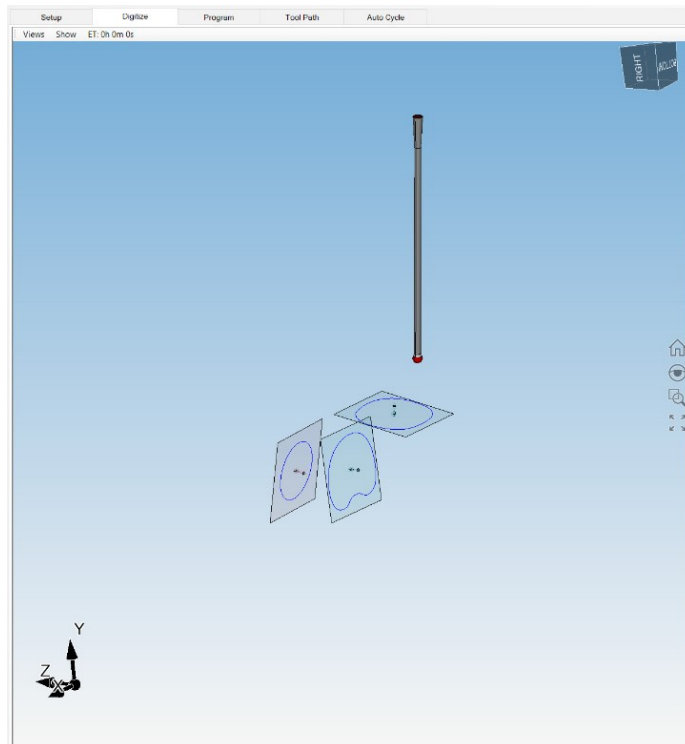
POINT #1

POINT #2

POINT #3

Use the methods learned for probing plane #2 to create plane #3 in the Add Plane Wizard. You may view the plane in the digitize tab to see that it's been created.

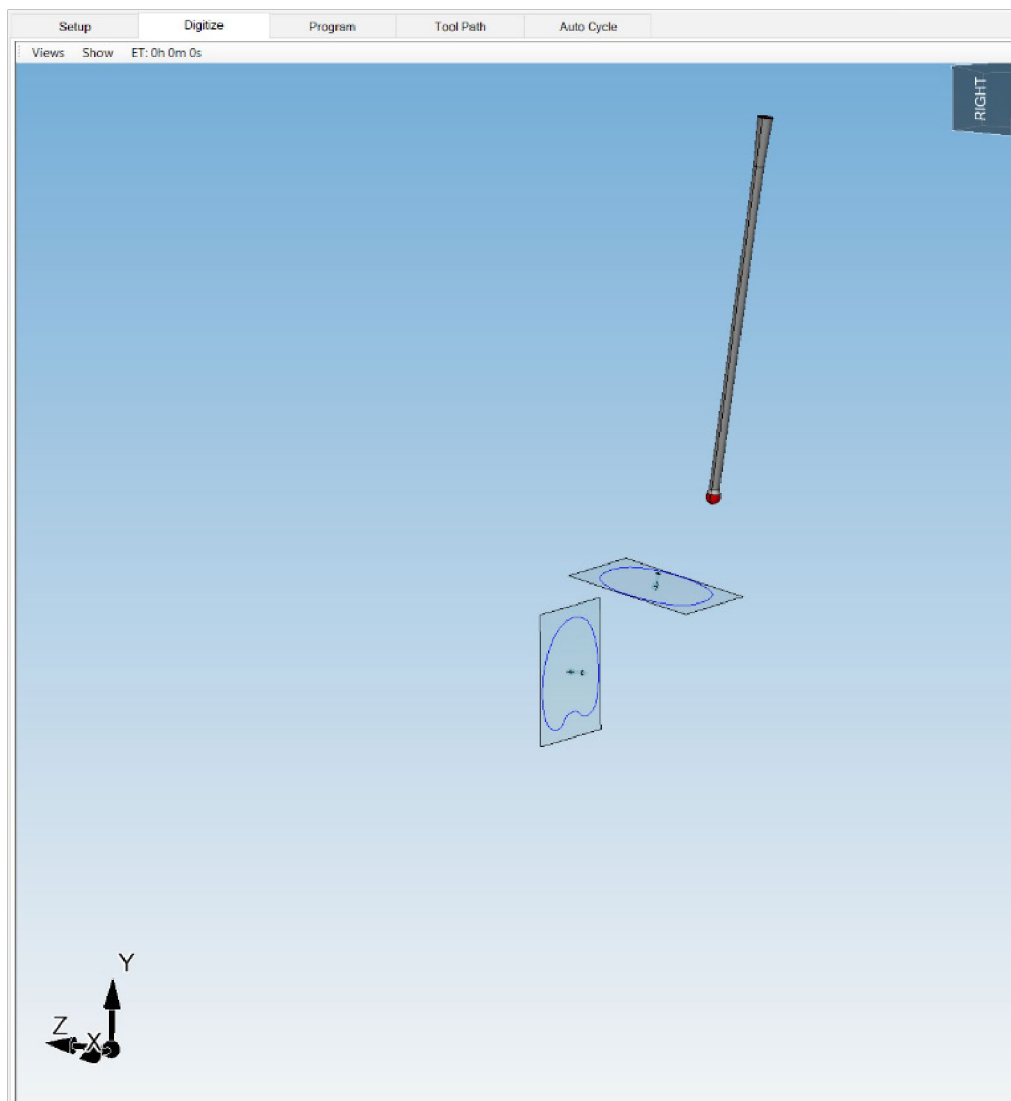
After Plane 3 has been created you should be able to view all three planes in the digitize tab by clicking the show planes option. The figure below shows an example of the three planes that were created for an exhaust port.



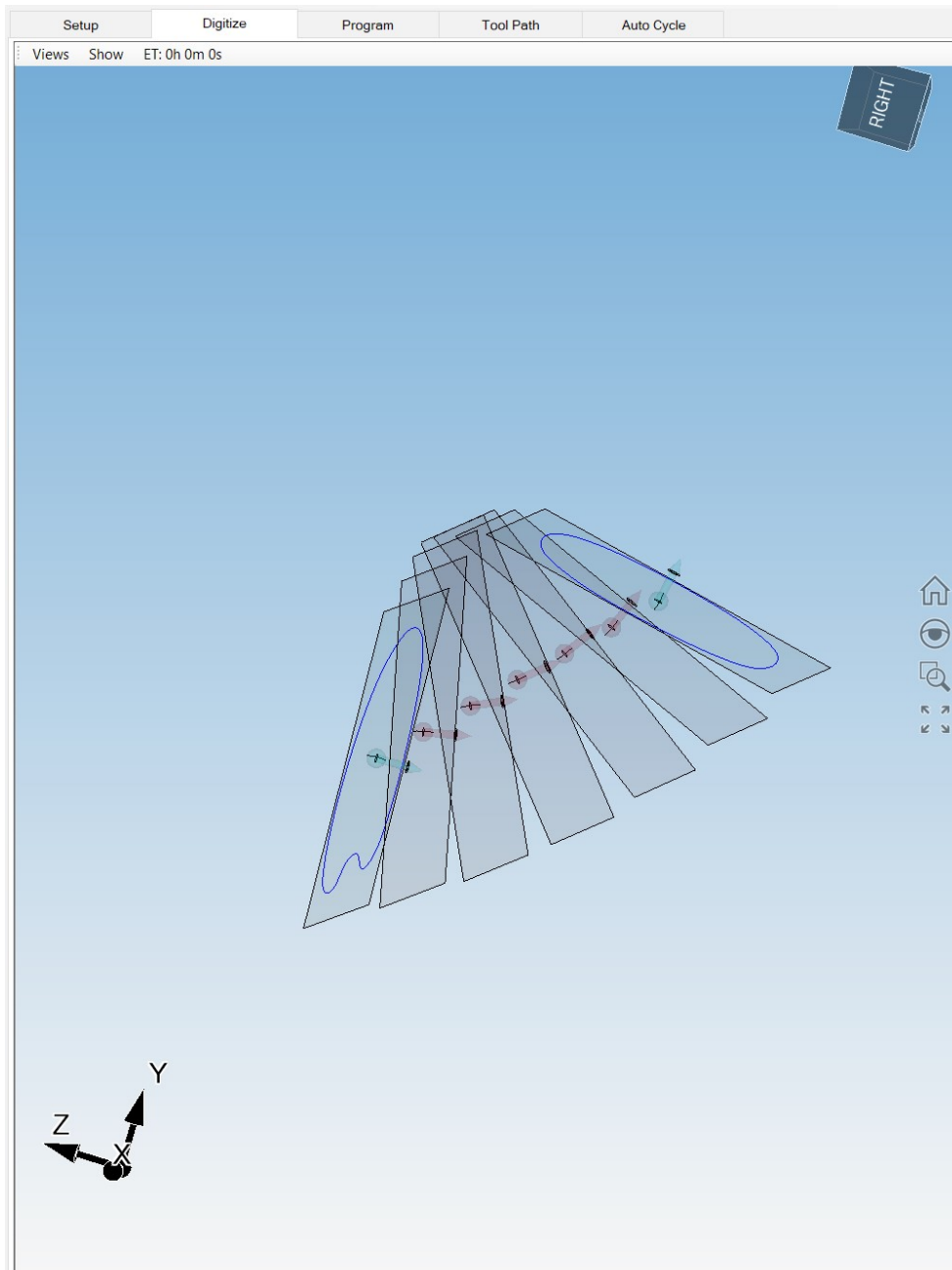
Creating Intersecting Planes

Now that we have all three planes defined for the port, it is now time to begin our automatic digitizing process. With the 'Digitize' tab still open make sure that all three of the planes have a check mark in each of the boxes. You should now be able to see the three planes that were created.

To create the intermediate planes, we need to isolate 2 of the 3 planes by unchecking one of the planes created. Uncheck Plane #3 in the cylinder head information tree on the left side of the screen so only the manifold plane and dividing line plane are shown in the graphics window.



Right click on the closed sections tab in the information tree and select create intermediate planes for probing. The system will then ask you to input the number of planes you wish to divide space between the manifold plane and dividing line plane into. This value will determine how many cross sections of the port the probe will digitize. Increasing the number of intermediate planes increases the resolution or accuracy of the digitized data. However, this has diminishing returns and the more intermediate planes that are used will increase the time it takes to digitize a port while only improving accuracy slightly. In the example below we are digitizing the exhaust port for a big block chevy head. We have chosen to use 5 additional planes between the manifold plane and dividing line plane. A typical rule of thumb is to choose a sufficient number of planes that will result in approximately a .500" step-down between the plane center lines.

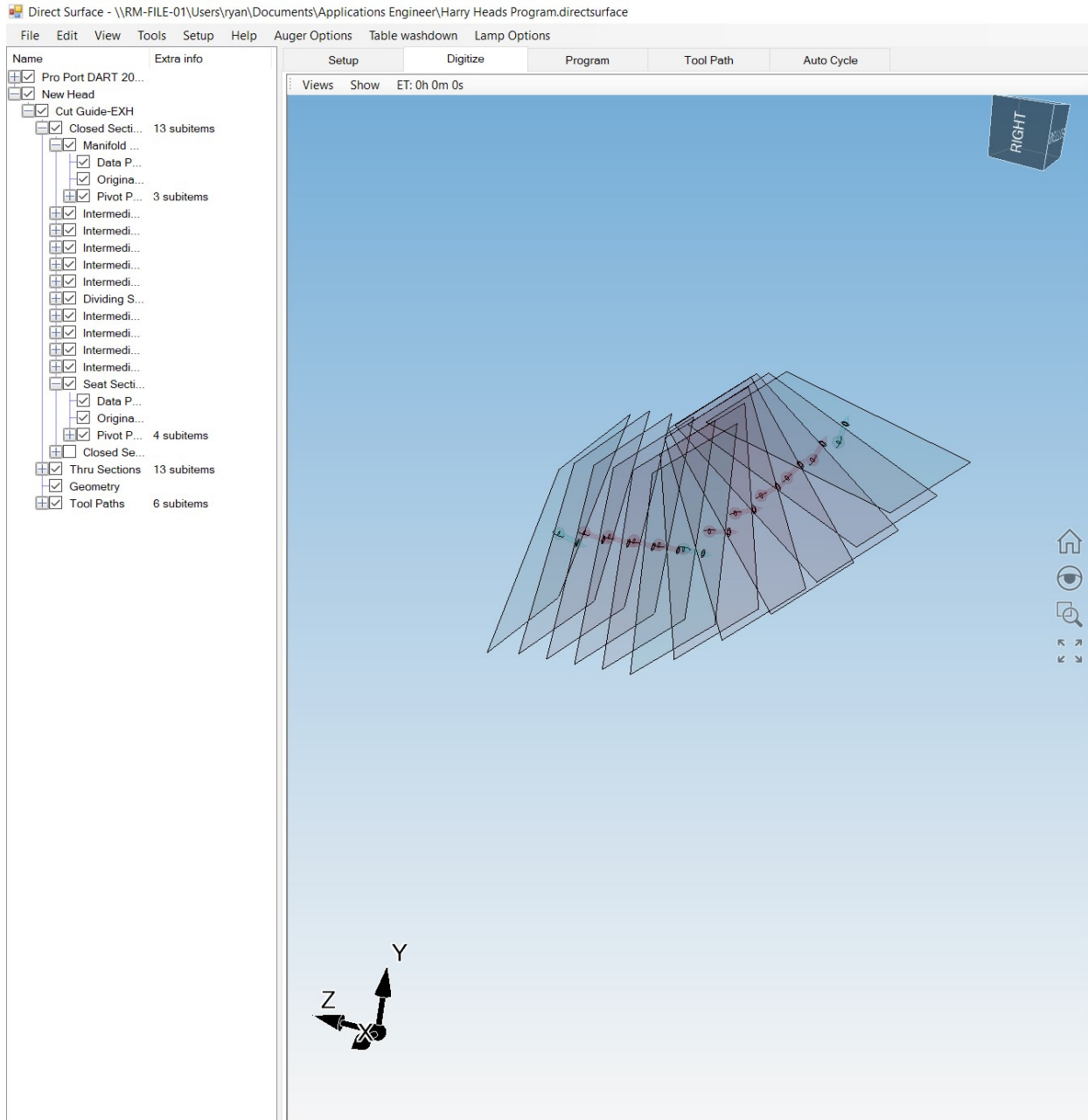


The figure above shows the manifold and divided plane being divided up by an additional 5 planes. Also note that there are 5 new closed sections listed. Each one of the closed sections represents a plane. You can turn these intermediate planes on and off by clicking the check mark box next to the closed section you wish to turn on or off.

Now we need to create planes for the divided line and the seat side planes. Repeat the process above by turning off all the closed sections except for the seat plane and dividing plane. Once complete right-click on the closed section line and select add intermediate planes. Once again for our example we are using 5 planes between the seat plane and dividing plane.

After creating intermediate planes between dividing plane and seat plane you will see that there are five new 'Closed Sections' in between the divided line plane and the seat side plane. Check all the

closed sections and select show planes in the graphics window to view all the planes for probing. When complete the graphics window should look like the figure below.



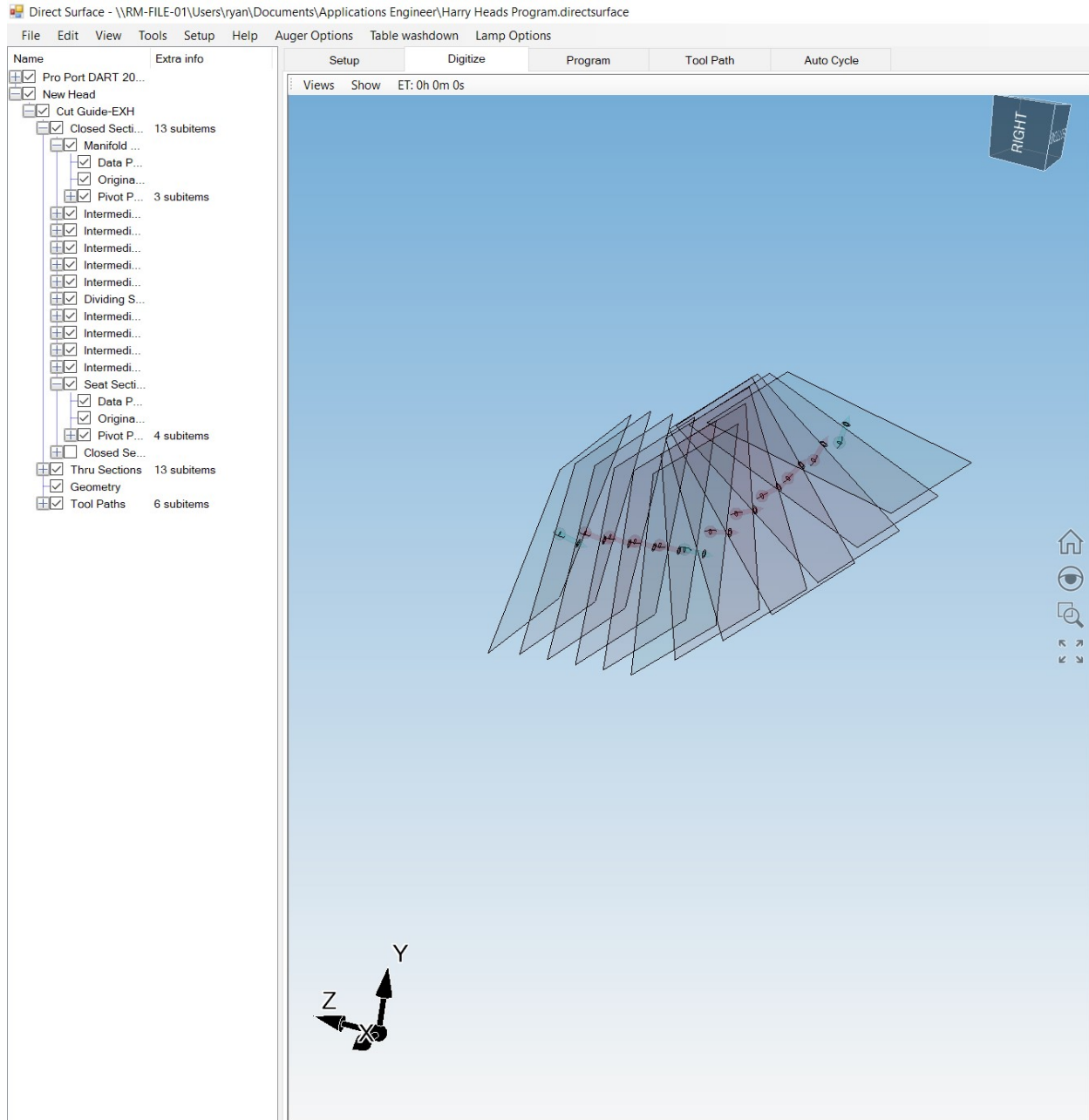
When we begin to digitize the probe will find the center of each of these planes. Then the probe will work its way to the wall of the port until it detects contact. Once contact has been made the probe will start finding points around the port within the plane in .065" increments. Once the probe has revolved around the port wall it will move back to center before proceeding down to the next plane and repeating the process. As the probe finds points it will populate them within the plane and draw a closed cross section representing the wall of the port.

Probing Defined Planes

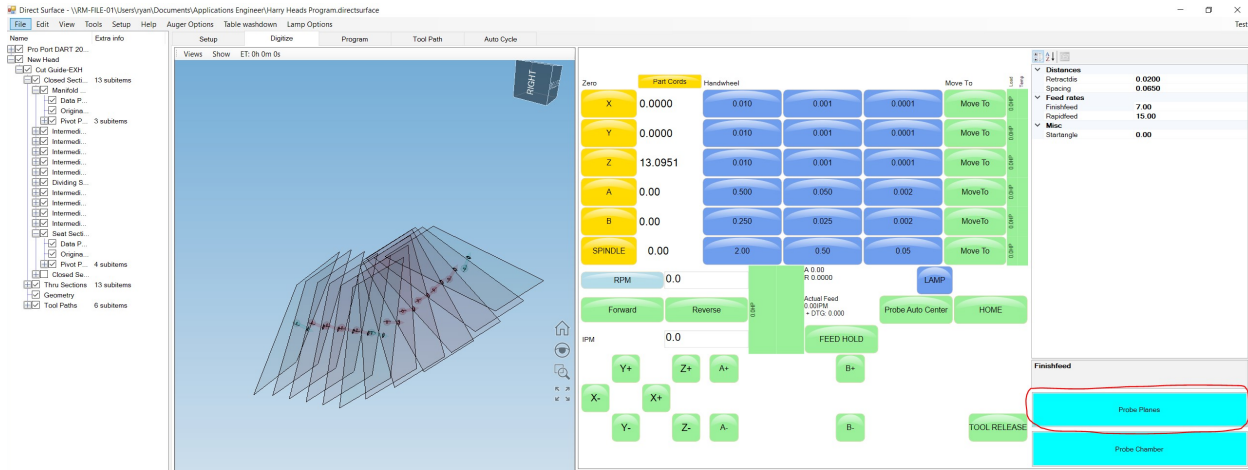
When you begin to digitize you will isolate each half of the port by checking the closed sections you wish to probe first. For example, you can start off by checking the 'manifold side' through the 'divided side'

sections first, as shown below. This will digitize at the prescribed plane locations from the manifold plane through to the dividing line plane. Note that if you probe the dividing line plane from this side then it does not need to be probed again when you digitize the remaining planes from the seat side.

Notice that the only planes visible on the screen are the “manifold side”, “divided line”, and “closed section” intermediate planes. The planes that represent the other half of the port have been shut off. The planes that we have defined below are simply a road map for the probe to move to begin its digitizing process. The probe will find its way to the middle of each plane then at that level will start moving out to find its way to the edge of the port.



Click on **'Probe Planes'** from the CNC interface on the right of the screen to begin the digitizing process. Initially you may have to click **'Probe Planes'** twice as the first time turns probe on. Click "OK" through the comment windows, the probe should move to the middle of the first plane and begin digitizing.

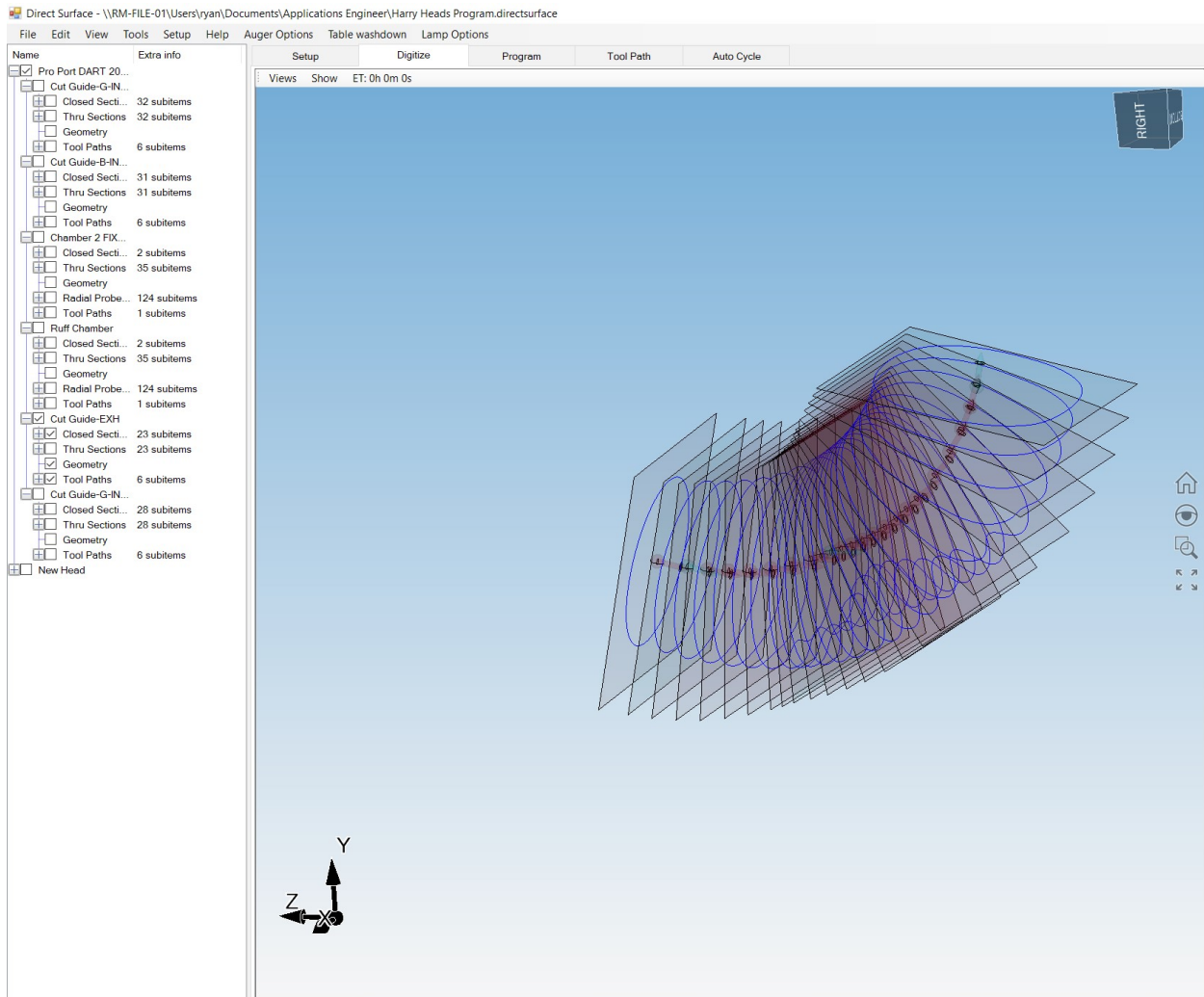


The software will tell you how much the 4th and 5th axis will rotate before it starts to move to the first Plane. This value is in absolute measurement scale from the origin location.

Once the machine finishes digitizing a single plane the software will again notify the operator of the next intended move to the proceeding plane. Check to make sure that the rotation seems reasonable and will not cause any collisions. Click OK to move to the next plane and to continue probing the port.

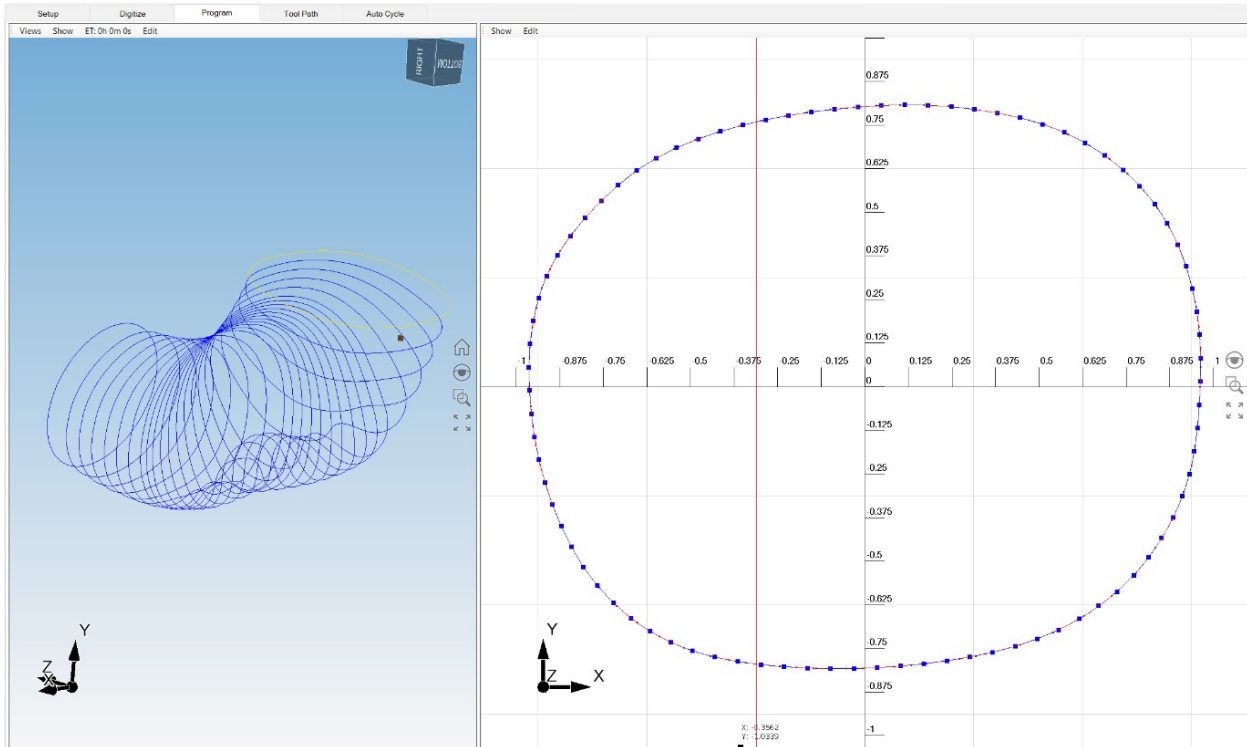
Repeat this process until you have made it through all the planes that you have checked. Once the machine has finished digitizing this section of the port, Rotate the head to the other side to be digitized and repeat the process above for the remaining planes.

After probing all the planes, you should now see all the cross sections at each plane have been defined. Check all the closed sections in the cylinder head information tree to view the probed sections in the graphics window. If done correctly then your graphics window should now look similar to the figure shown below.



Cross-Section Manipulation

Switching to the Program Tab will allow the operator to see the probe cross-sections in both the 3D graphics window as well as a 2D plot of the points probed within a selected plane. By clicking on a cross-section within the 3D graphics window the operator will see the corresponding shape drawn out in the 2D plot on the right of the screen. The square dots represent the probed data points and the connecting arcs between the parts are also shown.



The operator can click and drag on any of the individual square dots to move that point around on the 2D plot. The software will re-calculate the line of best fit to wherever the point is re-positioned. Furthermore, by holding down the CTRL key on the keyboard, the operator can select any two points on the 2D plot. With two points selected, you can then right click anywhere on the screen and a window with a various set of editing tools will pop up. The tools available are listed below, it is recommended to use the “make line” and “make arc” functions to smooth or edit the port as necessary. When selected the operator can use the same click and drag method as used with single points to move and re-position the set of points between the two selected points. This will make the software re-calculate the line or arc of best fit between the two selected points while keeping the cross-section geometry smooth and continuous.

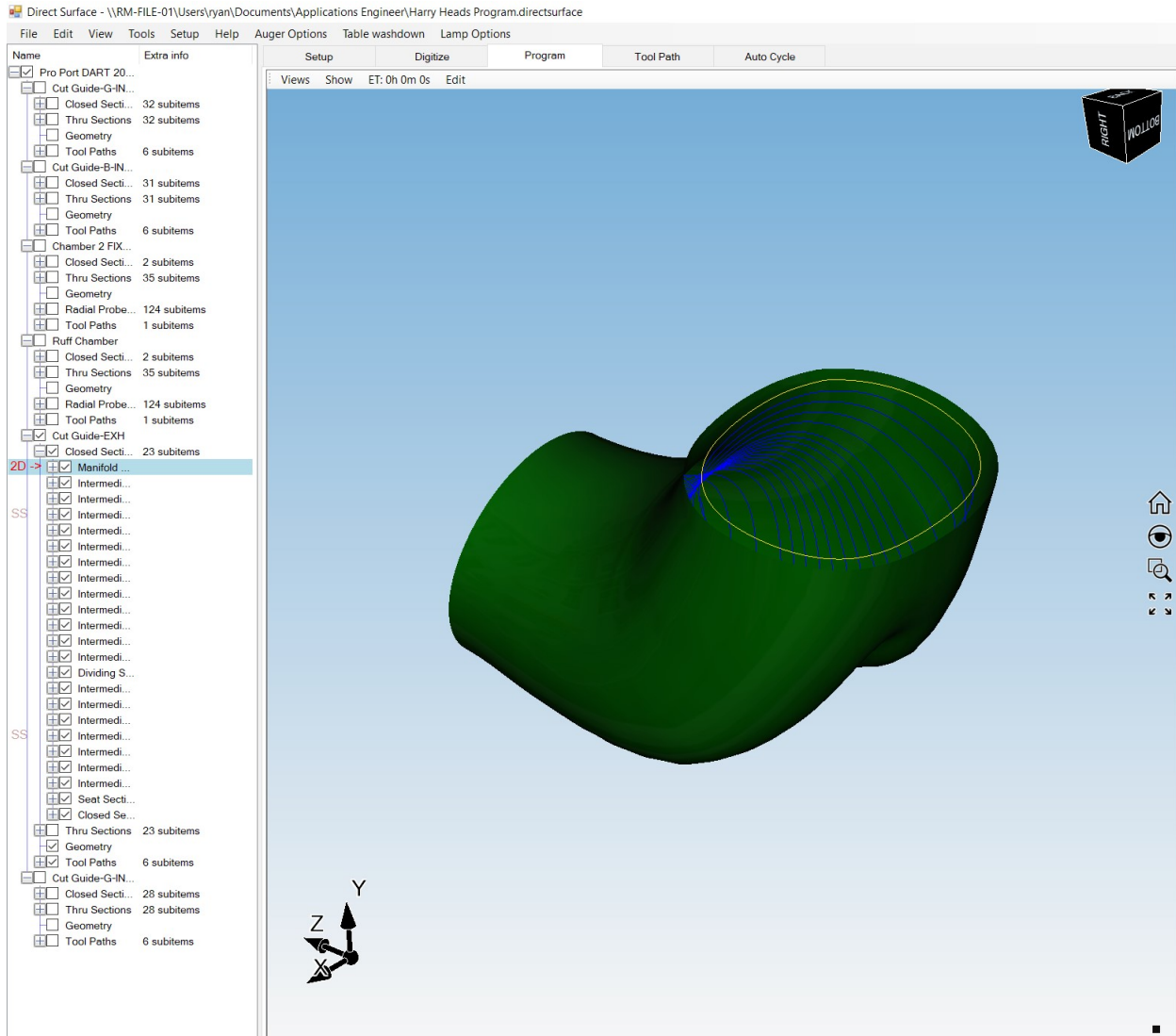
Make Straight Line: Re-arranges the points into a straight line between the two selected points with the location defined by where the operator clicks on the 2D plot.

Make Arc: Re-arranges the points into a smooth arc with a radius defined by where the operator clicks on the 2D plot.

Creating a Surface

After the digitized cross-sections have been manipulated to satisfactory geometry the next step is to create the port surface within the software. This process connects the cross-sections together to form a solid surface to which the program can then create tool path on. To accomplish this, right click on the port name in the cylinder information tree and select Create Surface. A series of windows will pop up, the first will ask the operator if a guide support exists, if it does then click “yes” if not click “no”. The second window will ask how many thru sections the program should use to “stitch” together the port surface, The default number is 72 and does not need to be changed so press “OK”.

The software will create a green surface that is offset from the blue cross-sections. The offset amount is the probe radius. This is because the cross-sections represent the probe center point when the tip contacted the port surface during digitizing.



Surface Manipulation

Before creating the toolpath, the operator should take some to inspecting the created surface to make sure it looks correct. If manipulation is required, then the previous method of editing the cross sections can still be used to manipulate any specific areas the operator desires. Editing the cross sections will automatically update the surface to the best fit available based on the edits. **Creating a Toolpath**

Once the surface has been manipulated to the operator's satisfaction, then the next step is to create the tool paths that will be used to machine the port. This is done by right clicking on the dividing line cross section in the cylinder head information tree and selecting one of the options for tool path creation that pop-up. The tool path options, and their descriptions are listed below;

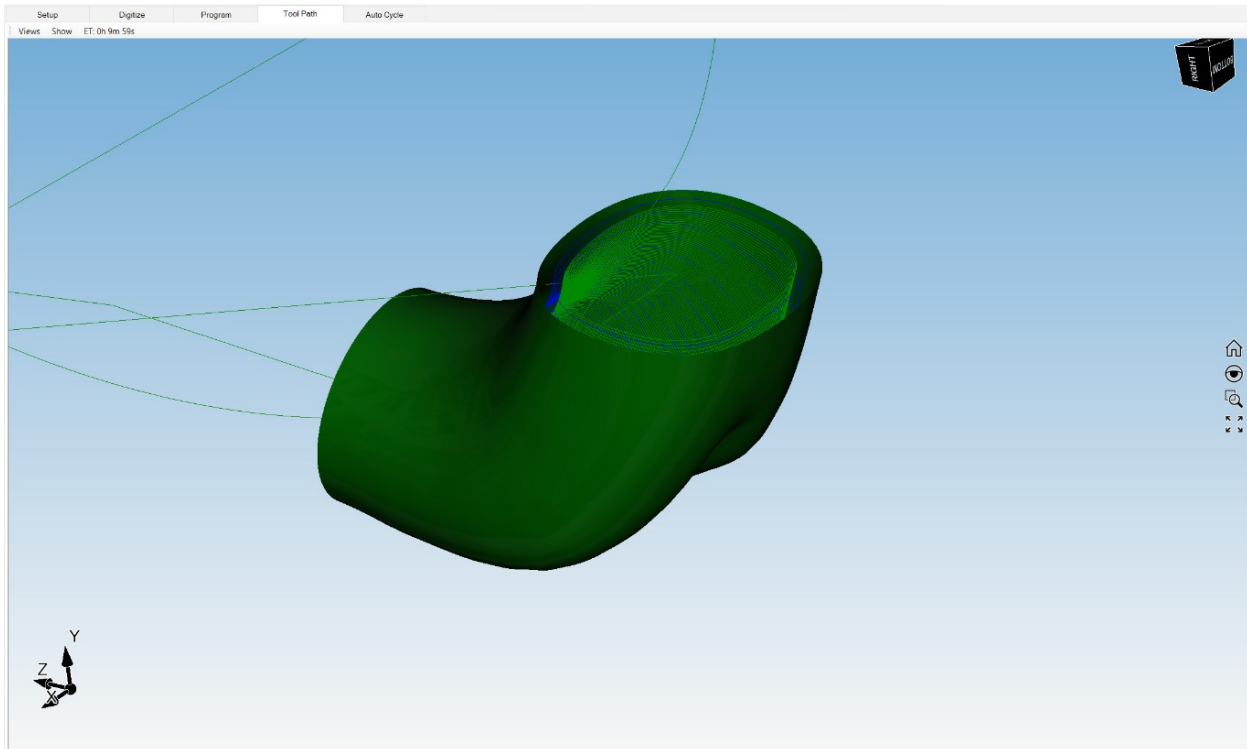
Make 2 Tool Paths: Creates two tool paths based on the two sections of planes above and below the dividing plane

Make 2 Dimple Tool Paths: Creates two dimpling operations on the two sections of planes above and below the dividing plane

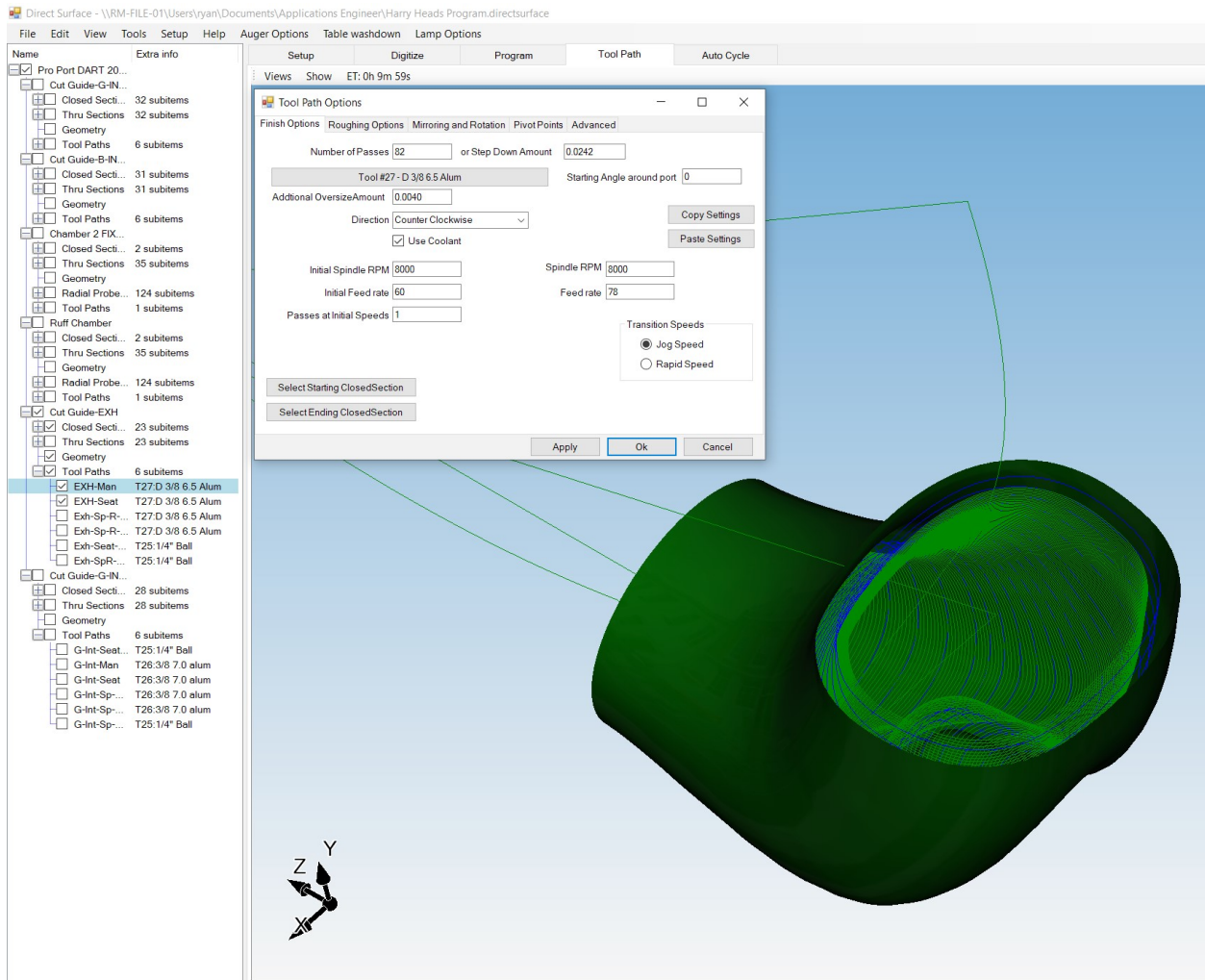
Make 2 Billet Roughing Tool Paths: Creates two roughing tool paths that are used to remove large amounts of material from the center of the port. This is used when creating billet heads or with original castings that are being significantly enlarged

Make 2 Spiral Roughing Tool Paths: Creates two roughing tool paths that are used to remove a relatively large amount of material from a port. This is used when significant enlargement of ports is to be done.

Once you select a tool path option, you can switch to the Tool Path tab and the software will automatically generate the toolpath. Once created you should see the toolpath in light green inside the port. The result should look like the figure below.

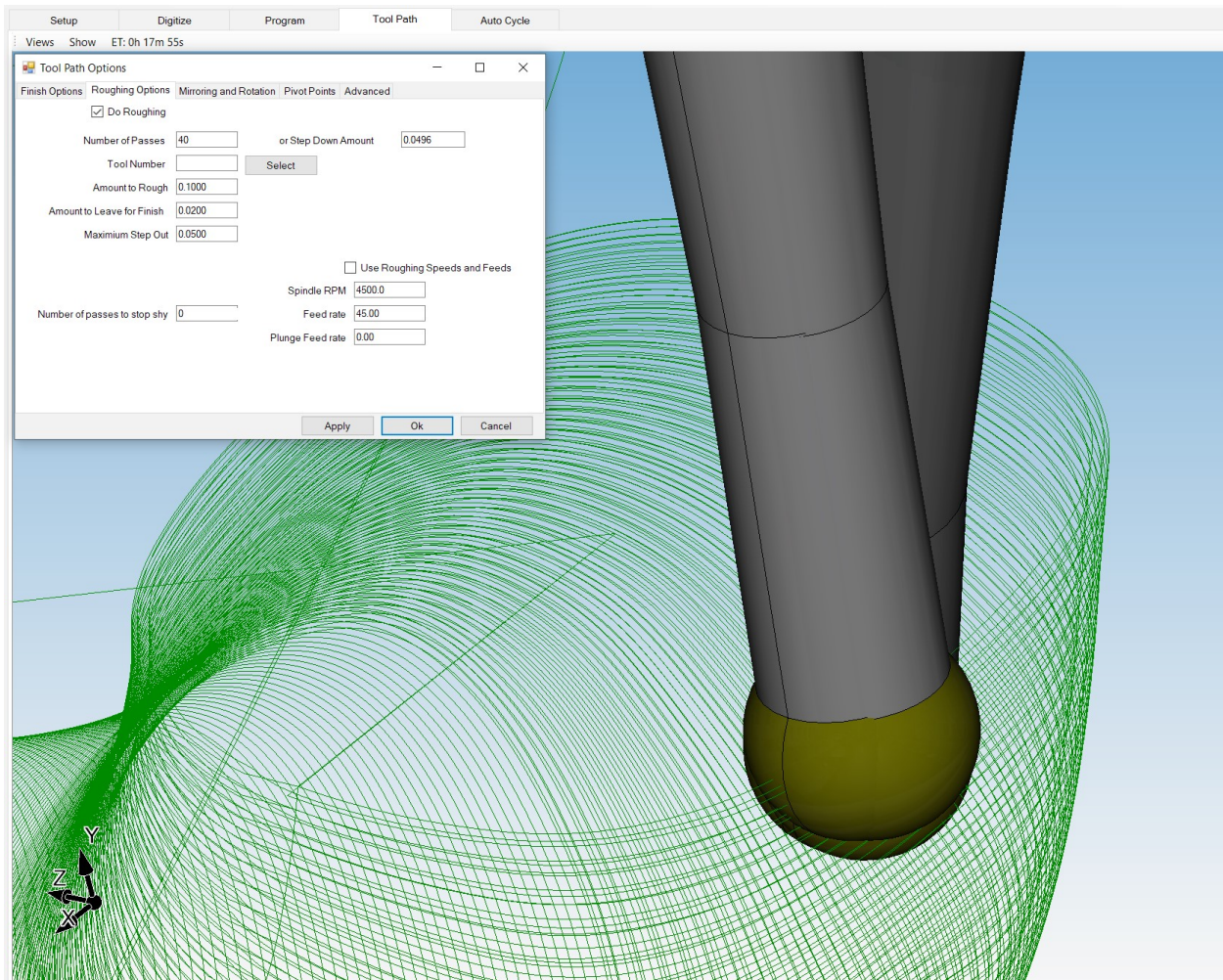


To edit the tool path parameters double click on the tool path you wish to edit from within the cylinder head information tree and the Tool Path Options window will pop-up. From this window you can change the number of passes, step-down increment, final port sizing, along with all other parameters that define the tool path. You may also edit the Feeds and Speeds for the tool path from this option window as well.



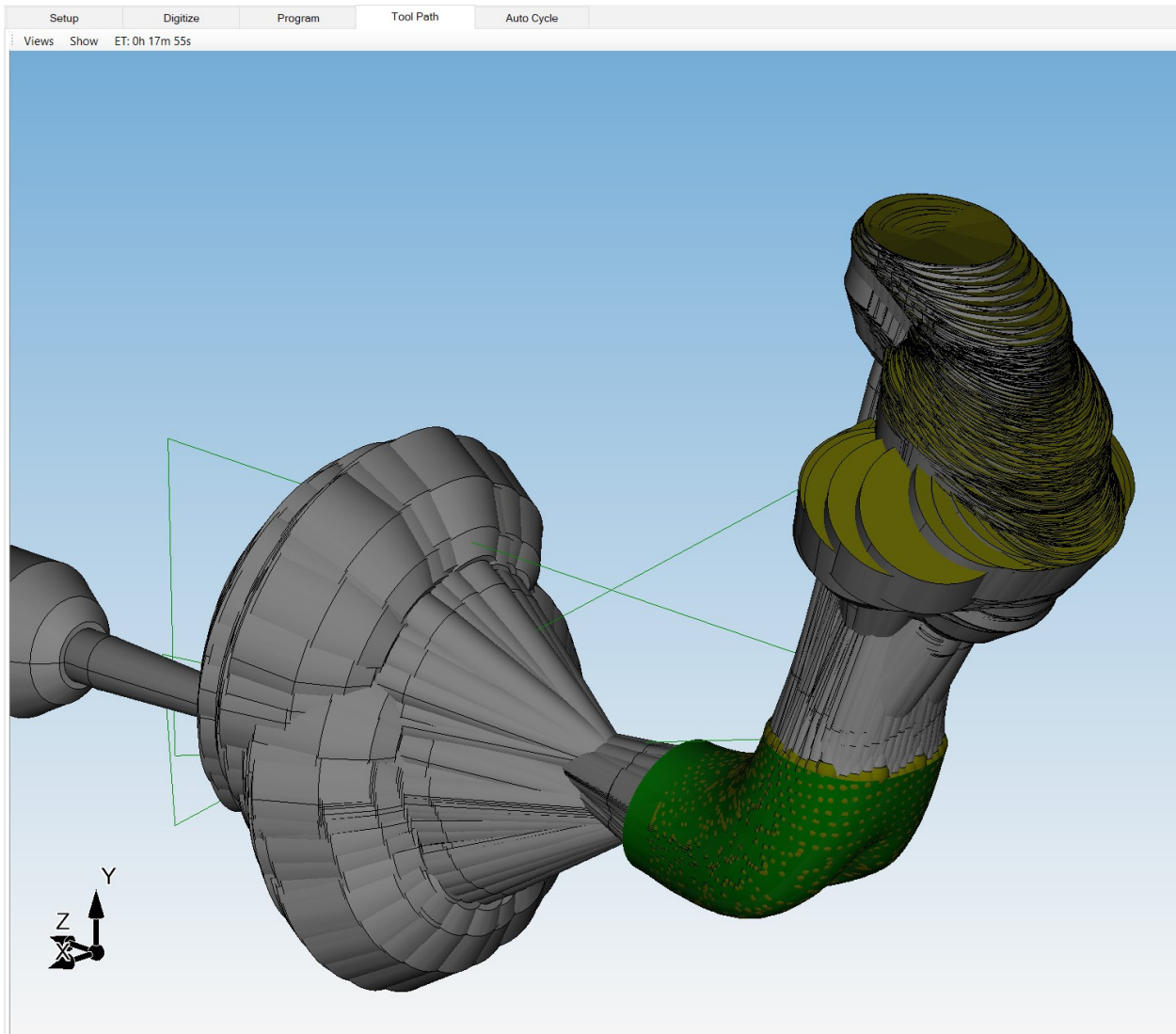
Creating a Roughing Routine for The Toolpath

To create a roughing routine, click on the Roughing Options tab within the tool path options window. Enter the number of roughing passes or a step-down amount that you would like the cutter to increment by as well as the amount to rough, amount to leave, and maximum step-out. Clicking apply will calculate a basic roughing tool path which will be offset inward from the original toolpath based on the parameters mentioned above.



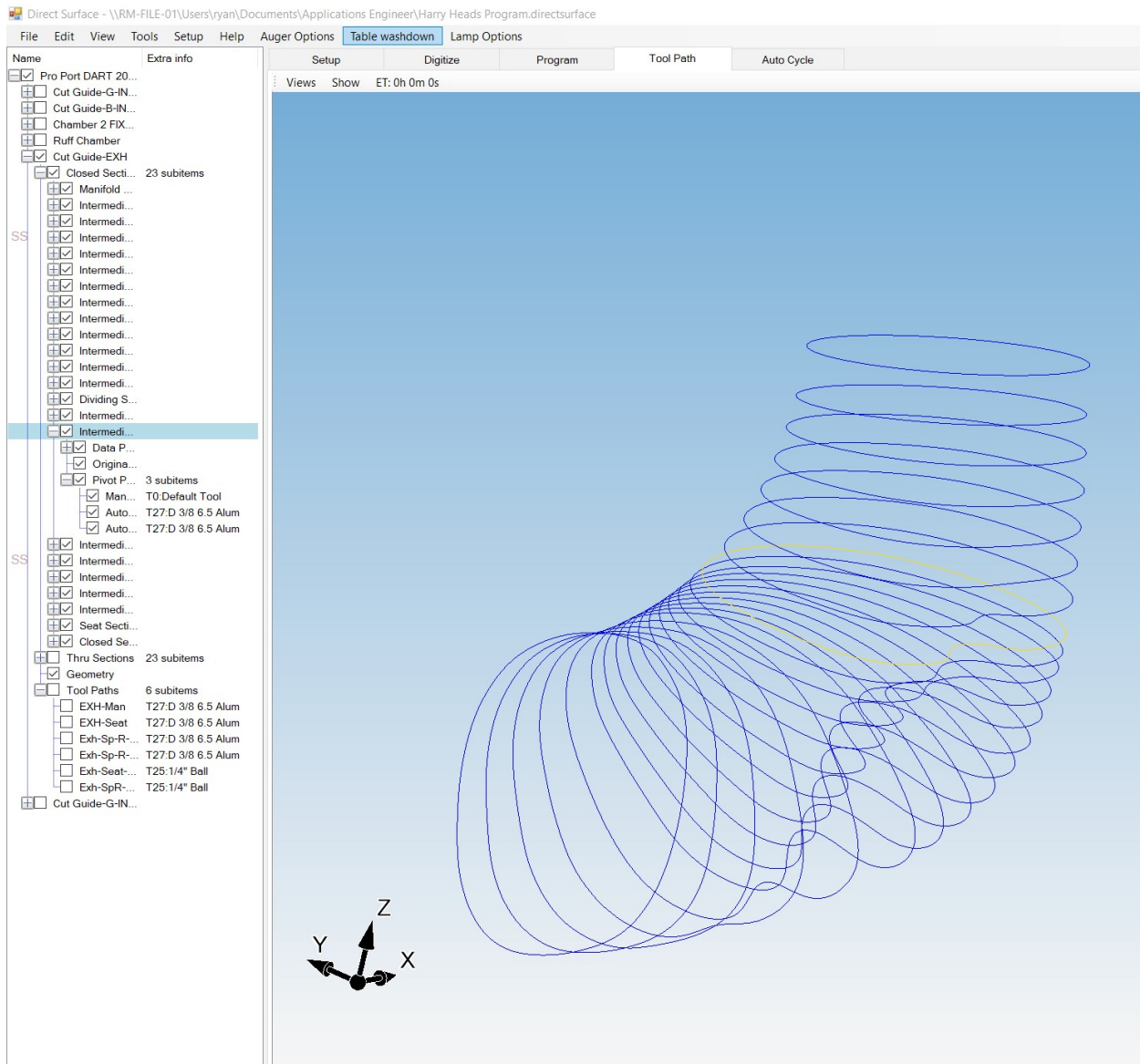
The roughing routine will appear in the 3D graphic window as shown in the figure above. You can hover over the tool path with the mouse to verify the tool positions to see where the cutter will be positioned during the process.

Next, click on 'Show' and be sure to have Solids and Tool checked. Next select the "Show toolpath on all points" option to present a simulation of all of the locations that the tool will be moved to during the porting process. Rotate the view to insure that at no point the tool will be outside of the port surfaces. This is a quick and effective way to verify that the program was written correctly.

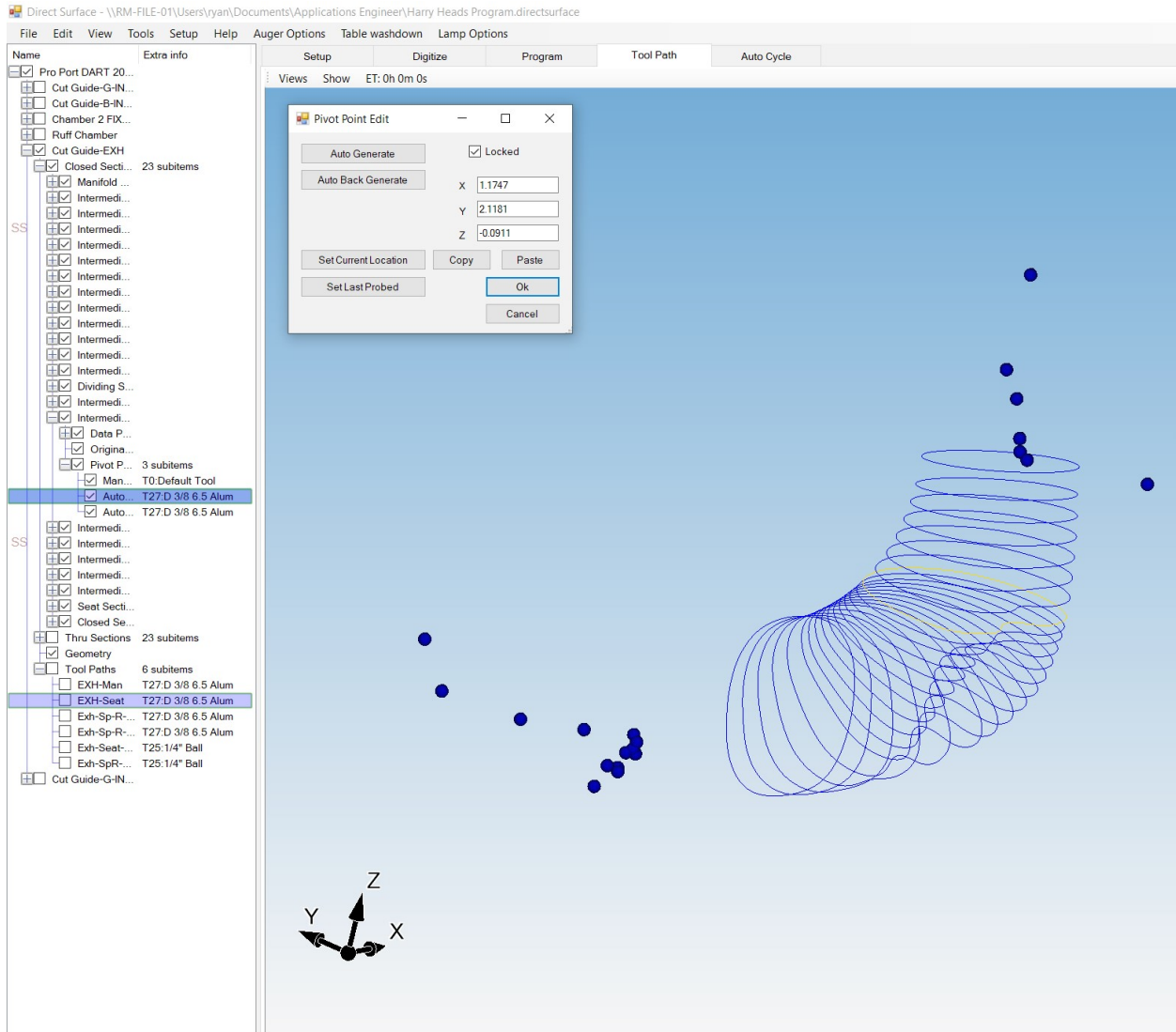


Moving Pivot Points

If during the tool path verification process, you notice the tool tip or shank are out of position at any moment, then it may be necessary to move pivot points for certain cross sections. This can be done by isolating the pivot point that corresponds to a specific cross-section, and then moving that pivot point to a different position in space to allow the tool a better angle to machine the port section at. To accomplish this task start by highlighting a cross section around the issue in the 3D graphics window.



Open the Closed Section that you want to manipulate the pivot point by clicking on the “+” sign. Then open the ‘Pivot Points’ for this cross section. Double click on ‘Automatically Create Pivot Point’. A box will pop up that will allow you to manipulate the X, Y, and Z points of this pivot point. After changing a pivot point be sure to put a check in the “Locked” box.

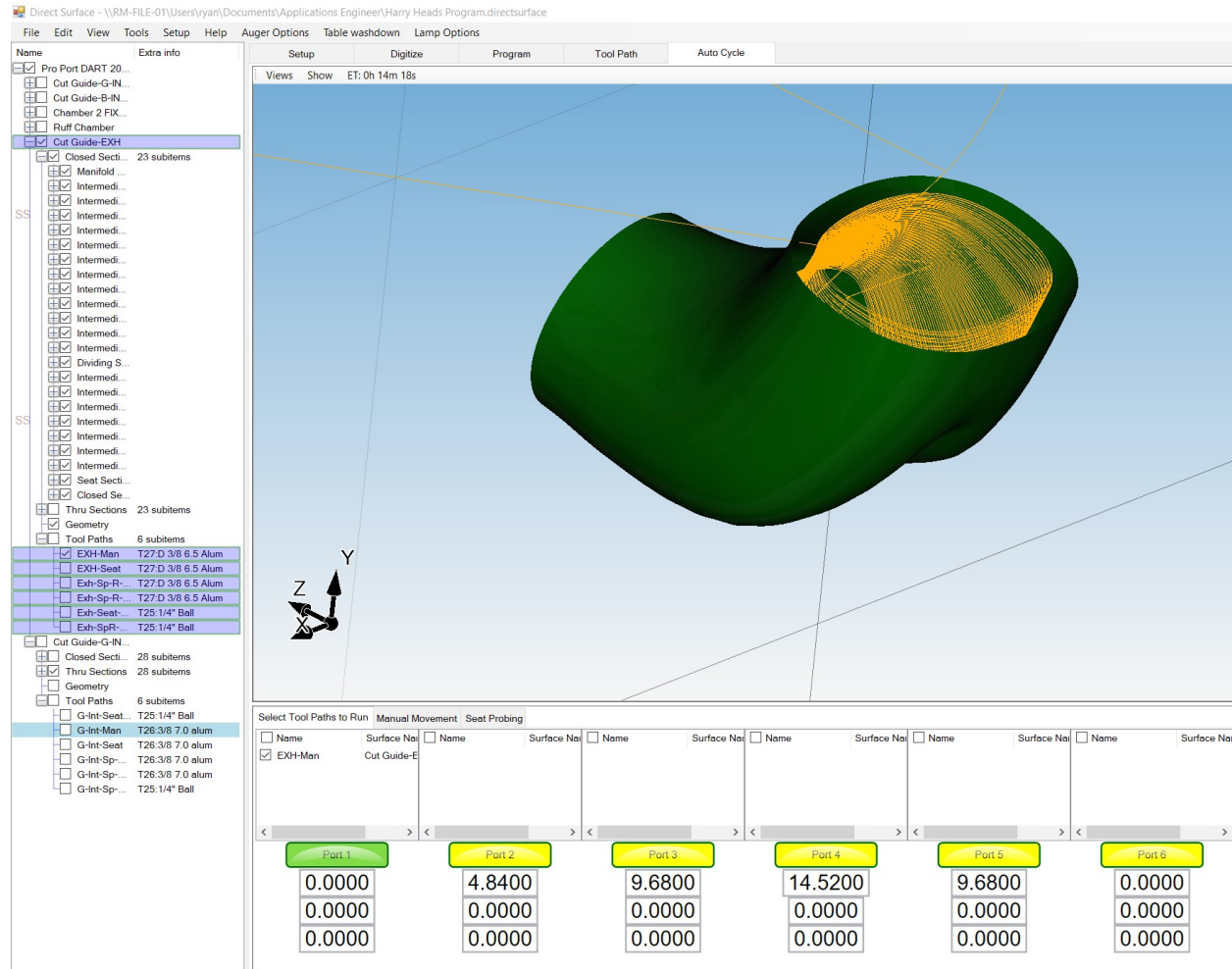


Make sure you click on 'Show' and ensure that the Pivot Points has a check by it. When you highlight the proper cross section you will see the pivot point show up as red. Depending on the direction(X, Y, or Z) you want to move the pivot point this will graphically show you where the pivot point is being moved to.

Keep in mind when moving pivot points that X,Y, and Z sit normally when the A axis is located at A zero. In other words when A is positioned at zero X positive is to the right, Y positive is facing to the back of the machine and Z positive is straight up. As the A axis rotates so do Y and Z. Let's say for example the A axis rotates 90 degrees so that now the combustion chambers and fixture plate are facing the back of the machine. The Y and Z have rotated along with the head. In this instance the Z positive is now facing the back of the machine and the Y positive is facing toward the table. Think of it as fastening an X,Y,Z symbol on the top of the fixture plate when A axis is at zero and combustion chambers are facing up. As the head rotates around the X,Y,Z symbol rotates with the head. Once the pivot point has been moved the tool path automatically regenerates and you can simulate the cutter path to ensure that you have addressed tool interference. If not, the pivot point may need to be moved again.

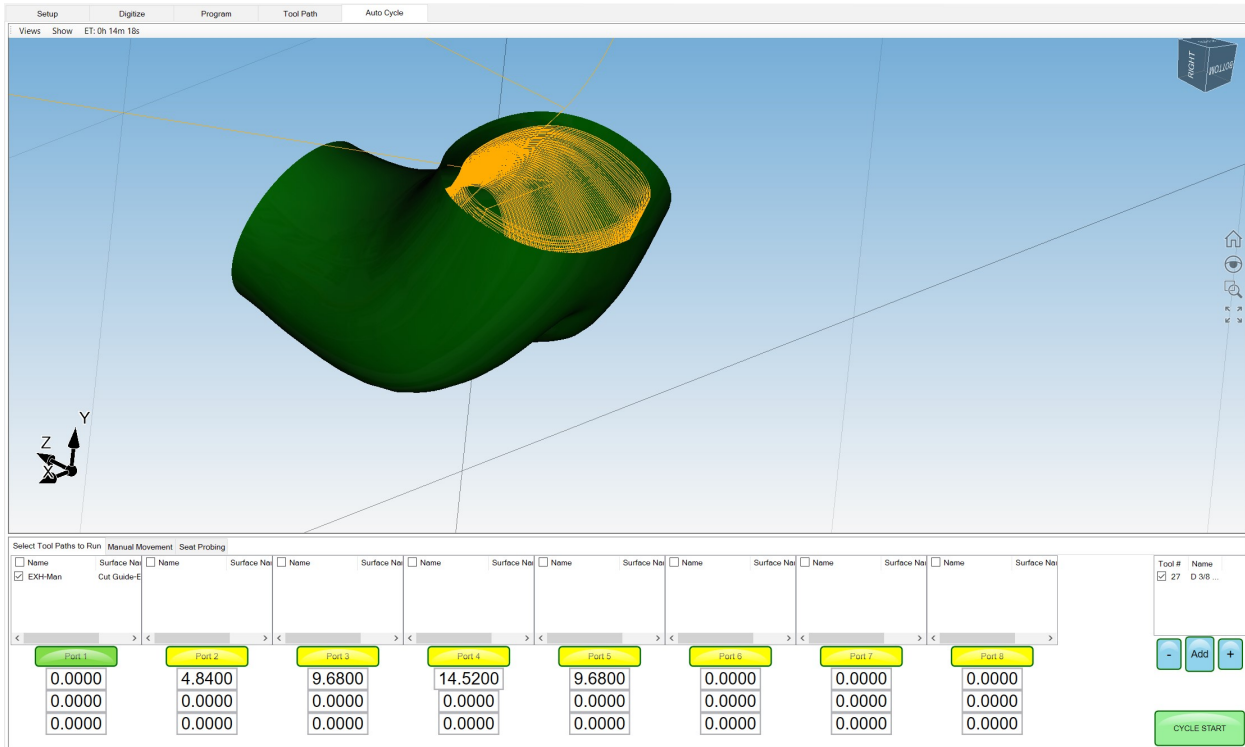
Loading and Running a Tool Path

Once you are satisfied with the simulation of the tool inside the port it is now time to run a tool path. Start off by clicking on the 'Auto Cycle' tab. Also, make sure that the 'Select Tool Paths to Run' tab is selected down at the bottom of the page.



Open the Tool Path in the cylinder head information tree. To add the tool-path you wish to run, drag and drop the tool path into the open box above the port number you want to perform the operation on. The tool path should appear in the graphics window, you can also select the show solid option to see the port surface in the 3D graphics window.

Notice that the port number is highlighted either green or yellow. Having the port lit up in green means that these are the ports that will be machined. In the example below Port 1 was used to digitize from. Whichever port was used to digitize will need to have the X, Y, Z location boxes set to zero. To set the location for the other ports you may type in the bore spacing in the top box.



The diagram below shows the actual tool path the cutter will follow. You will notice that there is a green arc that moves from the intake part of the port around to the seat side of the port. This represents the movement of the tool when it completes the first half of the port, then pulls out, then rotates around to the opposite side of the port to begin its operations where it will join in the middle of the port.

At this point to start the tool path cycle simply click on 'Cycle Start'. A message will come up verifying that you have the correct tool loaded up. If you do not have the correct tool click on 'Change Tool'. If you do simply click 'Okay', The Program will start and beginning cutting the cylinder head ports.

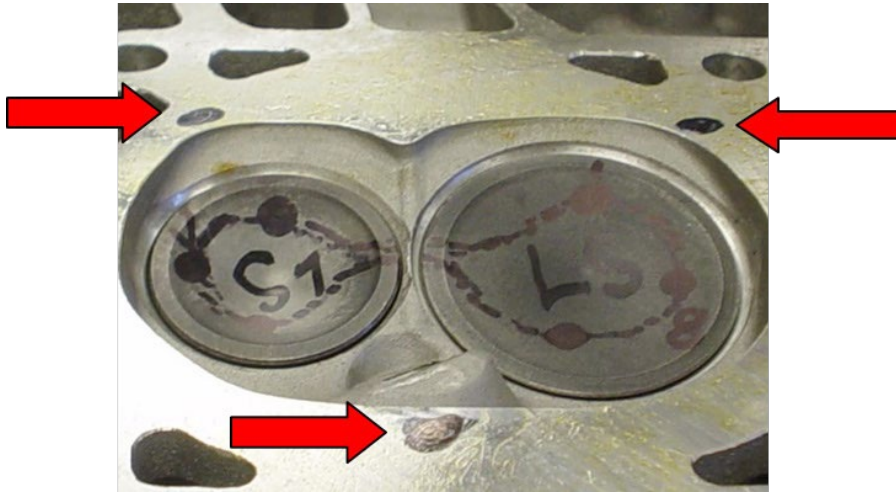
NOTE: It is very important to acknowledge that after clicking on OK that the machine will become active and will move quickly to its first position. Especially when you are first proving out a head the operator needs to keep their hand on the hand wheel and E-stop button. While the machine is in motion if you turn hand wheel counter clockwise it will slow the feed of the machine all the way down to zero inches per minute. This allows you to ease the cutter into the work and avoid potential crashing due to incorrect fixture or tooling offset or any other variable that could be overlooked.

Creating A Combustion Chamber

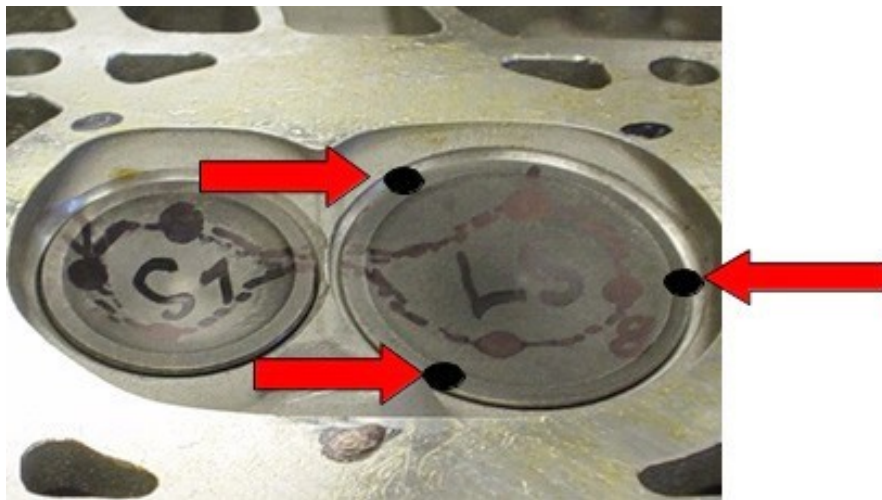
To create a combustion chamber right click on the head name then left click on 'Add a New Chamber' like shown below. You will see 'Chamber' appear just under the intake and exhaust ports. You can right click on chamber and rename the chamber if you desire. **Adding Planes**

The first step in creating a combustion chamber is to establish two planes. The first plane will be established at the deck surface of the head. You will pick up three points on the deck to define this plane. The second plane we will define is the angle of one of the valves. Note that it does not matter which valve you will use. To define a plane on the valve you will need to collect three points. In the photo below there are arrow showing approximate positions to establish the two planes.

The three points that need to be collected to define the deck plane surface:



The three points that need to be collected to define the valve plane surface:



Defining the Planes

To define the two planes in the software, start by right clicking on 'Add New Planes for Probing'. It will tell you that you are using a certain tool number to collect the points. Make sure that you have set the proper tool set as active. This can be found in the table of tools under the setup tab. Whatever probe you are using set this tool number to active.

Defining Deck Plane

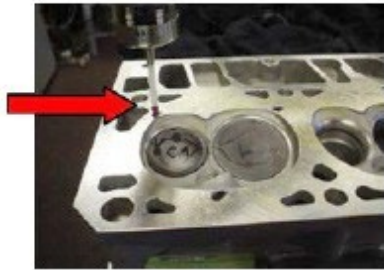
First Plane

After clicking on 'OK' an Add Plane Wizard will appear. You will enter three points into the wizard the same way we did when you defined the planes for the intake and exhaust ports. You will start by collecting 3 points on the deck surface like shown below.

Use the handwheel to bring the probe down in Z until the indicator light changes from green to red then move it back up in the positive Z direction until light changes back green. From within the Add Plane wizard click on 'Set Last Probed' to collect point's one, two, and three. Remember, it takes three points to

define a single plane. Note the position of the probe relative to the chamber's edge. The digitizing process begins in the center of the three points.

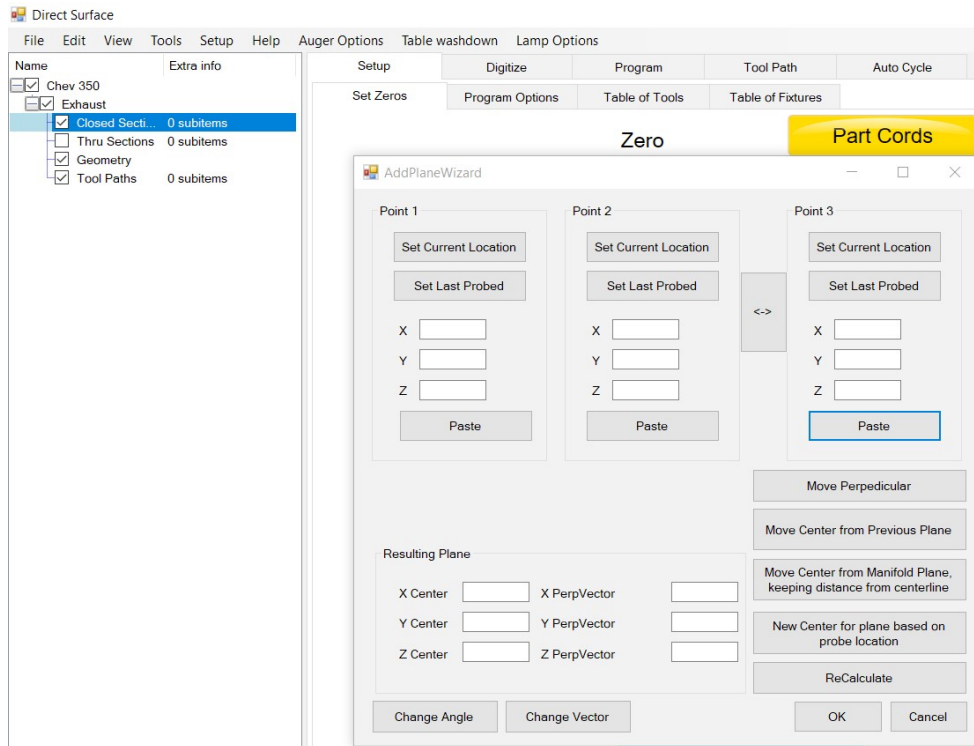
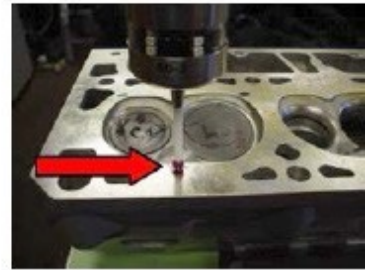
POINT 1



POINT 2



POINT 3



Second Plane

Just as you did with the deck plane you will again start by right clicking on 'Closed Sections Template' then left click on "Add New Planes for Probing." You should see a message appear that says "Adding new plane using tool #3" (If you are using tool #3 as the probe you want to use to digitize). You will repeat the same process that we used in creating the deck plane only this time you will use three points on the surface of the valve. See pictures below:

POINT 1



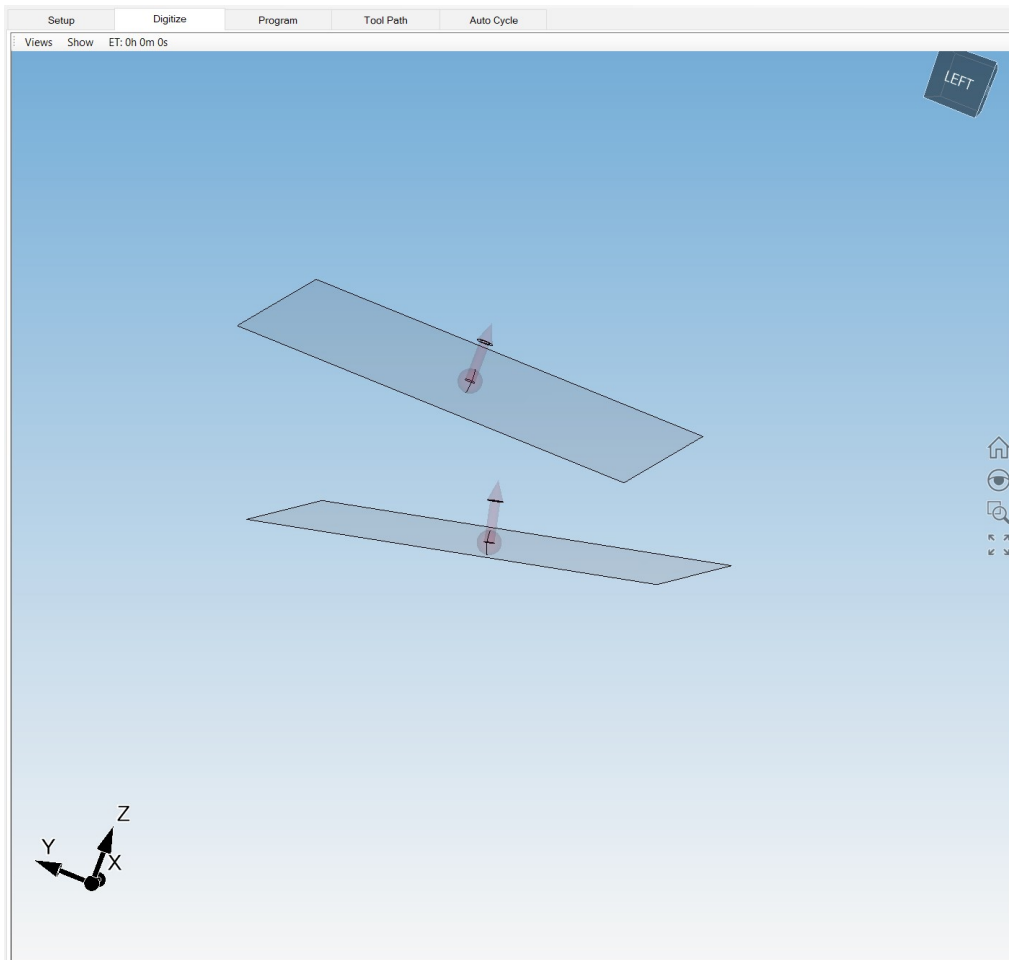
POINT 2



POINT 3



Once you have collected the three points you can verify that you have created the two planes by clicking on the 'Digitize' tab. If all you see is blank space ensure that you have clicked on 'Show' and that you have a check by 'Planes'. You should then see your newly created planes in the graphics view below.

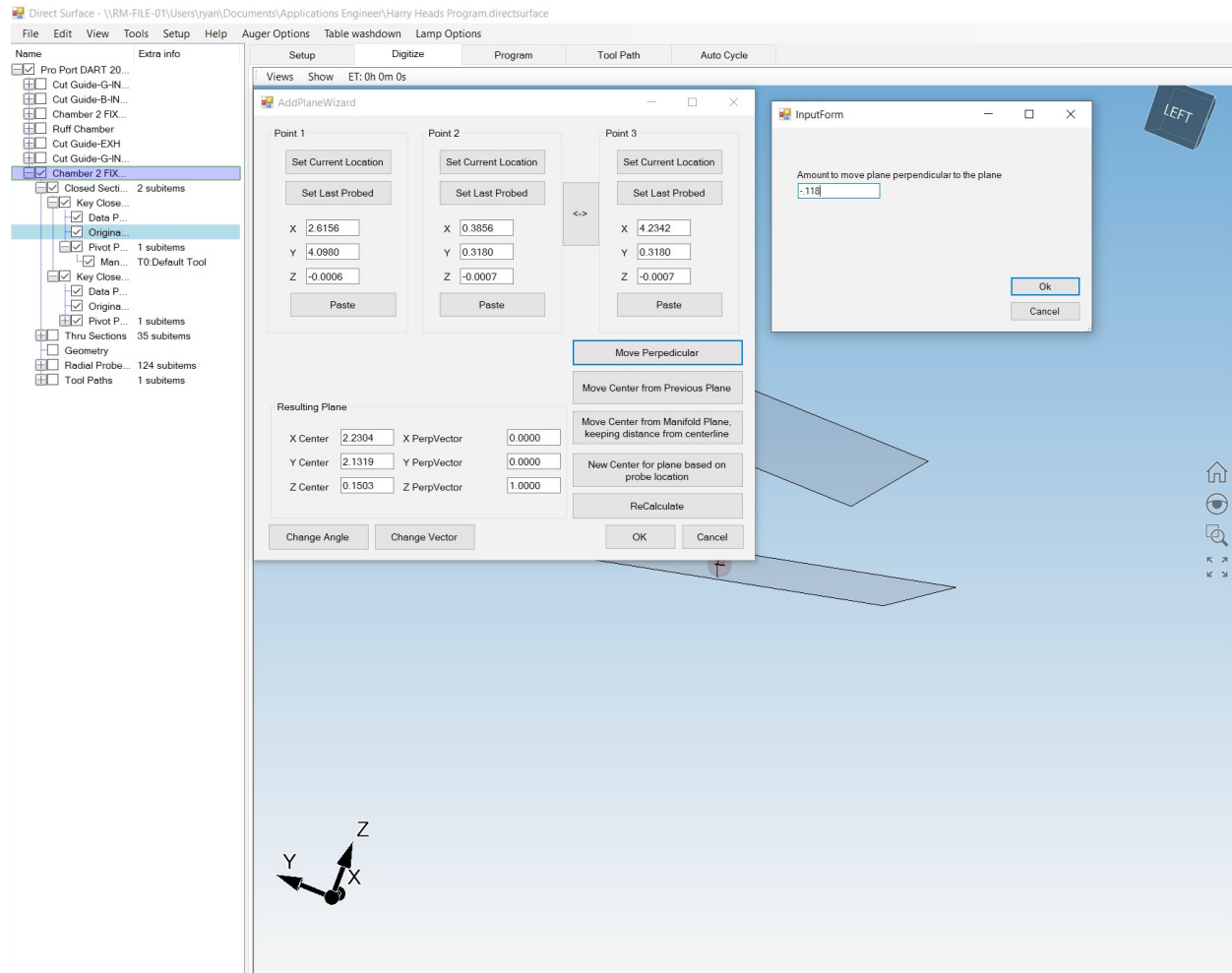


Moving Deck Surface

Before we begin digitizing for the cross section at the deck surface, we need to move the plane down toward the valves. You will notice that there is a red arrow at the center of the plane. This represents the positive direction. In the example above you will see the valve plane is on the opposite side of the red line. This means that you will move the plane negative (.118). Keep in mind that it will not always be a negative number. It can vary depending on how the software calculates the plane.

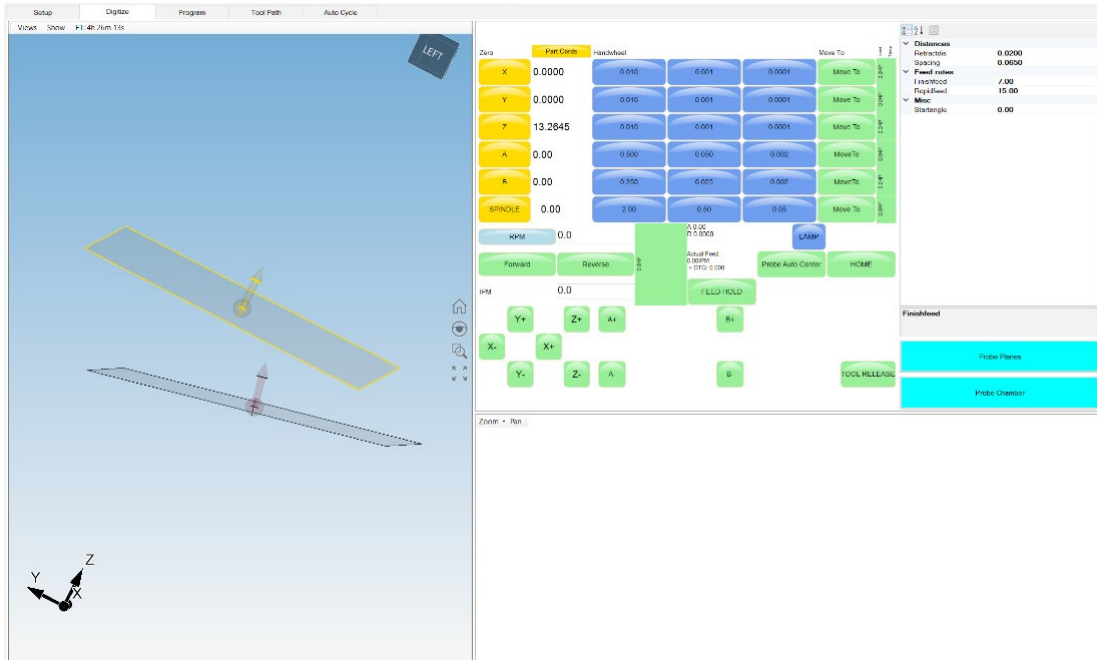
Another way to analyze the direction you want to move the plane is to click on show and check 'Tool' so that you can visually see the probe in the graphics view. Physically wheel your probe down so that the midpoint of the ruby is sitting at the deck surface. When you drop the plane down .118 you will see it move in the graphics. You can verify that the plane should be going through the tip of the probe exactly through the center of the ball. If it does not, you most likely moved the plane in the wrong direction. In this case you would have to double the .118 to .236 and change the sign.

To move the deck surface, open the deck surface plane that has been created. Next, double click on original plane. This will re-open the plane wizard. Next, click on move perpendicular. It is in this field where you will enter the value to move the plane. In this case it will have a value of (-) .118. This is approximately half the diameter of the probe tip. Actual tip size is .236 and half of that value is .118.

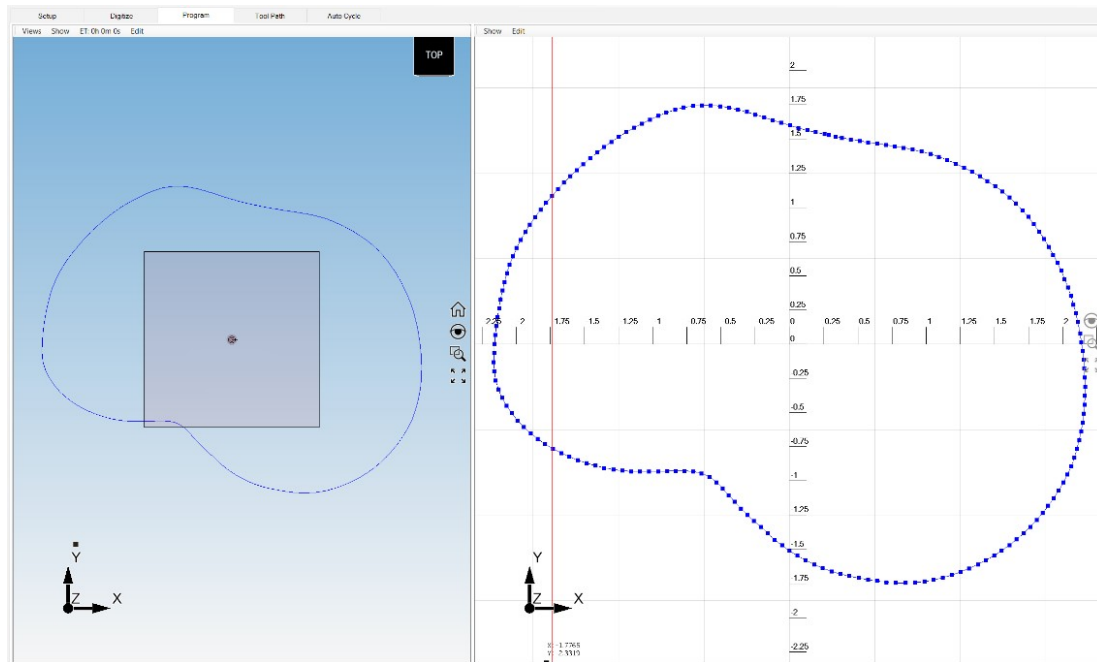


Create Cross Sections

After creating two planes you must now define the cross sections that are essentially the inner and outer borders in which the probe will be contained in. To define the cross section at the deck surface you will simply highlight the deck plane then click on probe planes.



Once the deck surface cross section has been probed automatically you should see something similar to what is shown below. Again, this is simply an outside border that the probe will move to when we begin digitizing the entire combustion chamber



Inside Border

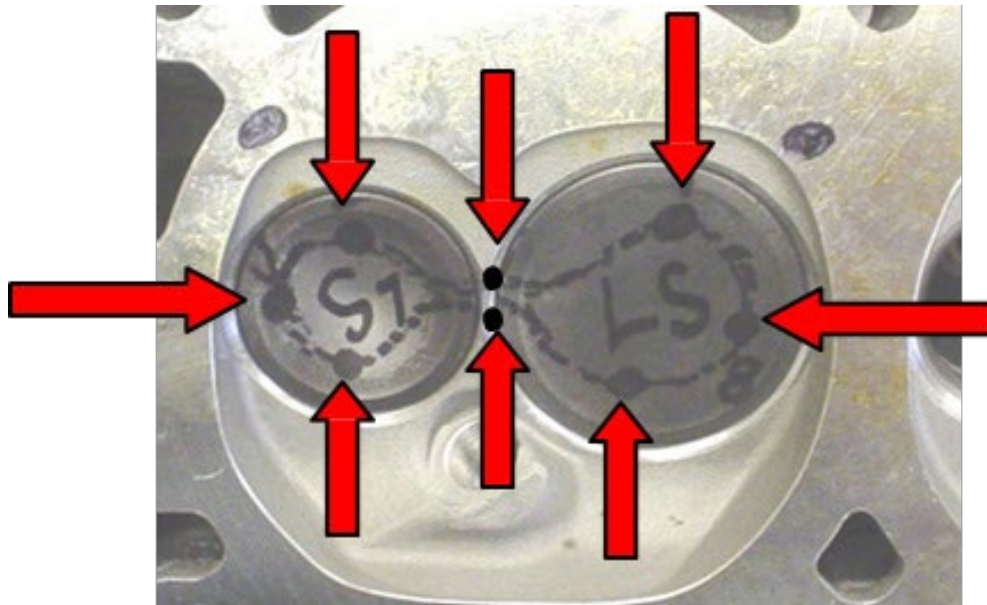
After the outside border is defined, the next step is to define the inside border for probing. The goal is to collect 8 data points in the bottom of the combustion chamber to define a rough shape that represents inner portion of the valves and chamber.

Due to the irregular shape of the combustion chamber and valves this process has to be done manually with the probe. Inside of the table of tools there is a button labeled 'Start Probe'. Click on this button and

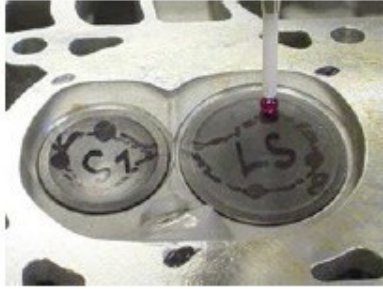
you will see the probe become activated. From the digitize tab we will jog the probe tip to the contact points as shown in the figure below. As we have done in previous procedures, you will move the probe to the point you would like to record, use the handwheel to move the probe down until the light on the probe turns red, and then back off until the probe light turns green using the .001" handwheel increment setting. The points shown in the figure below are arbitrary, you may select points in different locations for your application. The only requirement for the point selection is that the points should be offset from the edge of the valve and should be the rough representation of the combustion chamber outline.

NOTE: The example below shows a combustion chamber probing process for a 2 valve U.S. manufacturer V8 cylinder head. If you are attempting a chamber with multiple valves you will want to tweak the lower profile shape and points location to make a rough estimate of the outline of the cylinder heads combustion chamber, while still using points gathered from locations on the valves.

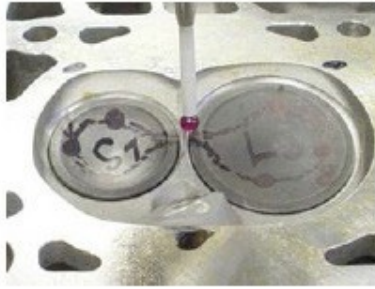
To record the points as you touch the probe to the individual locations click on 'Tools' label in the top right corner of the software screen by the 'File', 'Edit', and 'View' icons. From within the Tools drop down tab, select "Record Point" to store the current location of the probe. To speed up this process you may also use the "CTRL-R" keyboard shortcut to store the points as you go instead of navigating to the Tools tab each time.



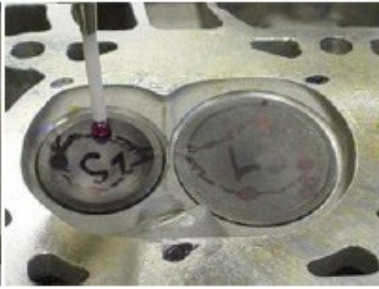
POINT 1



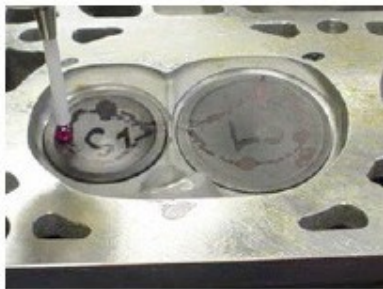
POINT 2



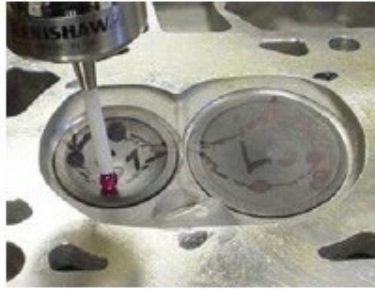
POINT 3



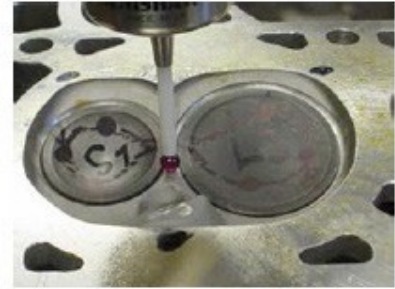
POINT 4



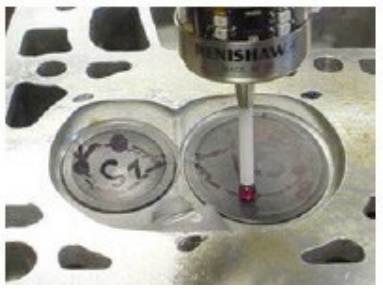
POINT 5



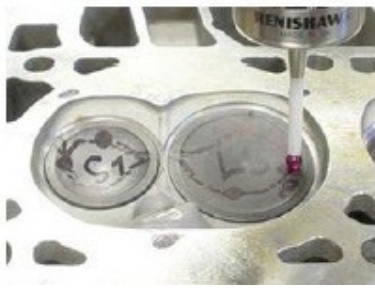
POINT 6



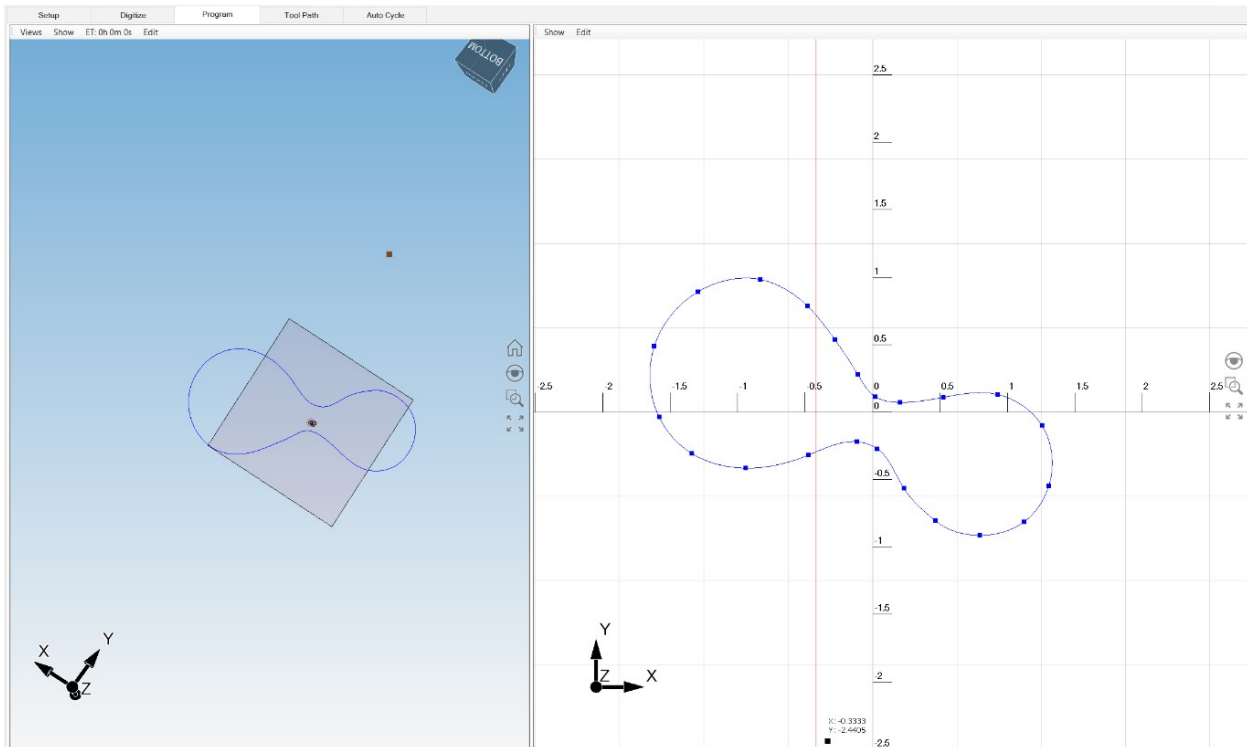
POINT 7



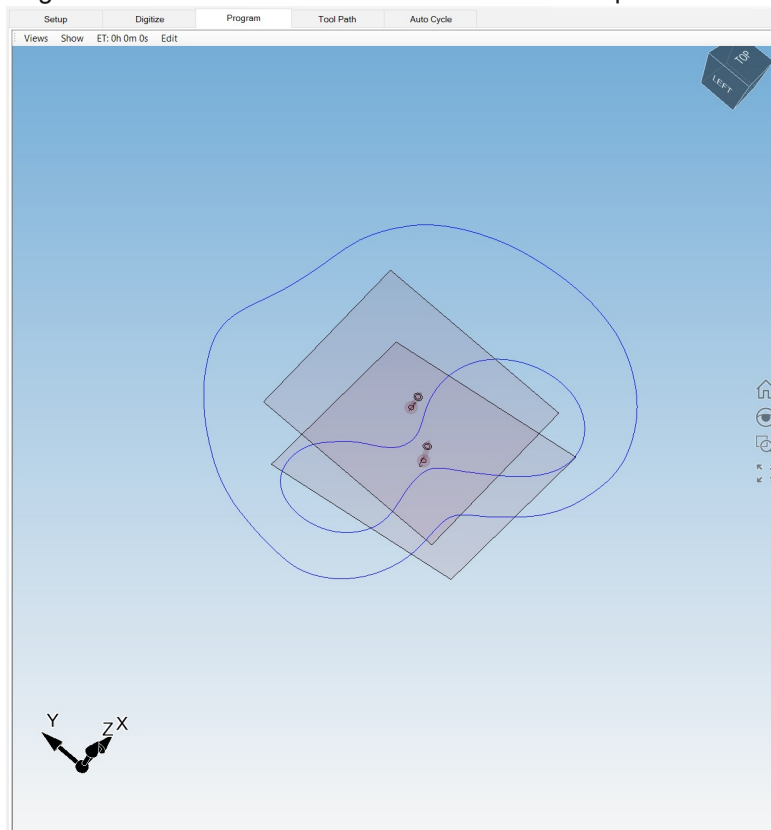
POINT 8



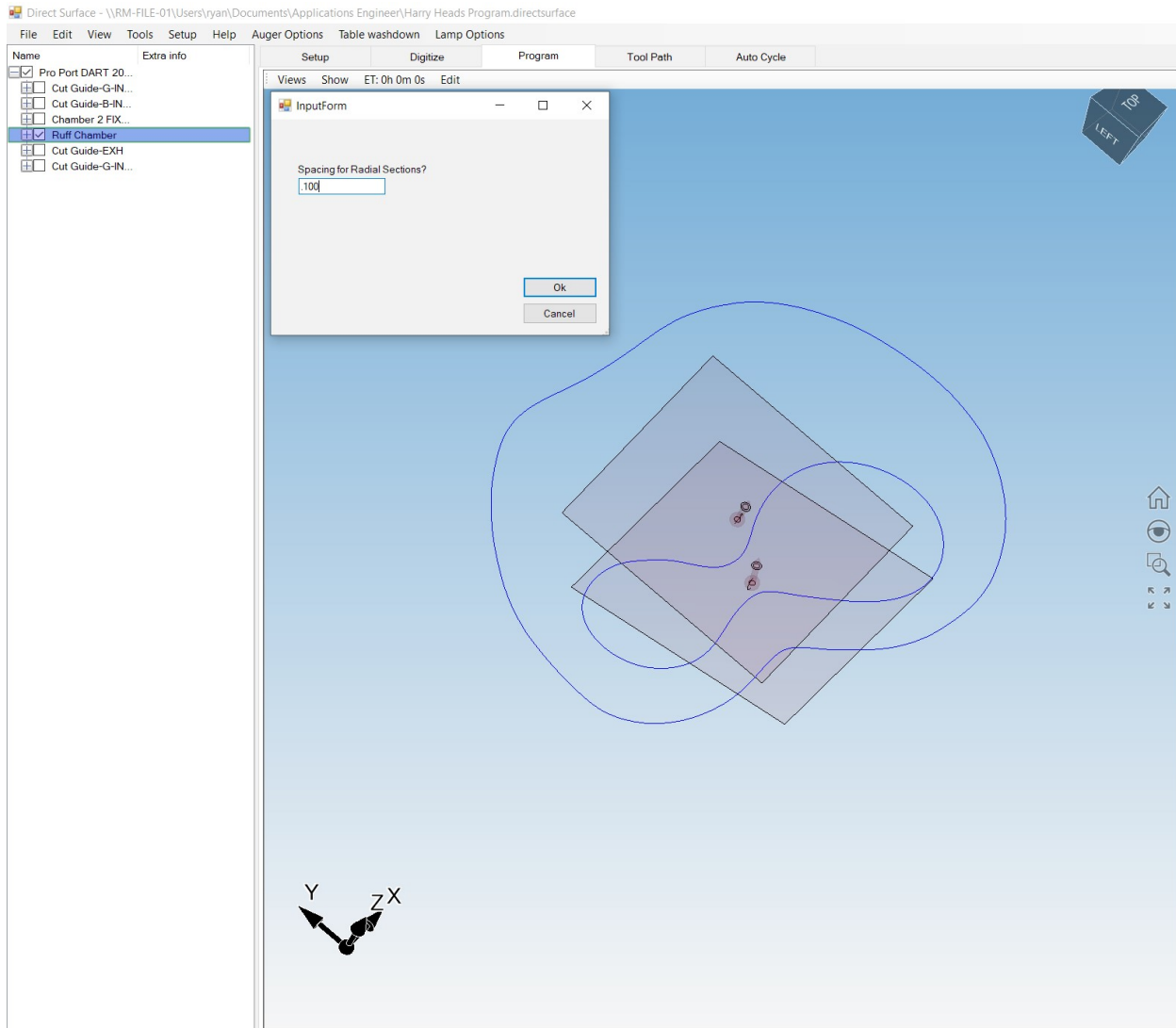
After you have recorded all eight points you should have something that looks like the picture below. To View the created lower boundary, switch to the Program Tab where you will see both the Plane and cross section in the 3D graphics window as well as the 2D Plot of the boundary.



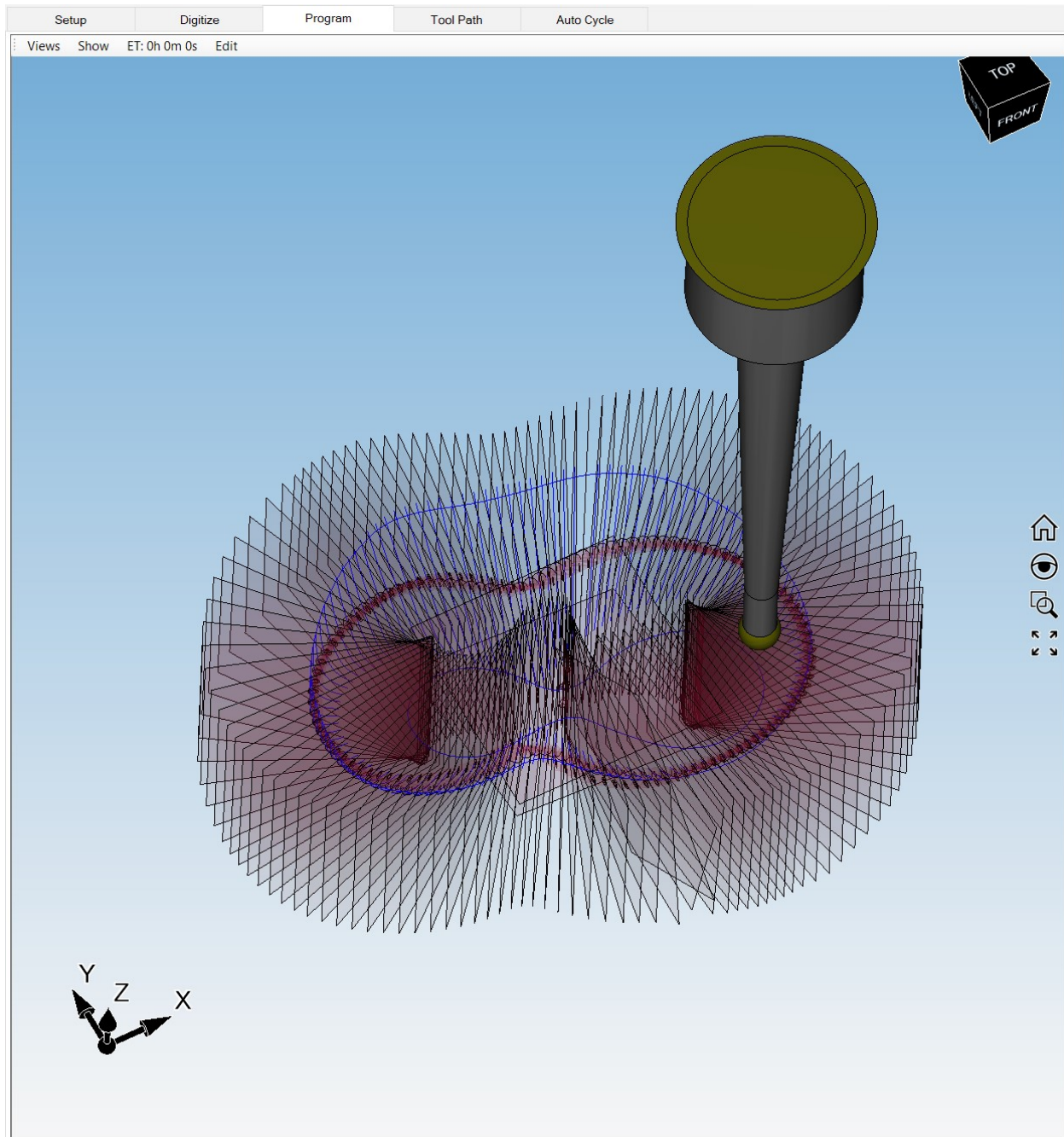
Now, check on the deck closed sections box so both the boundaries are displayed in the 3D graphics window. At this point we have created two boundaries. These containment boundaries define not only where the probe will digitize but also where the tool will cut when a tool path is created.



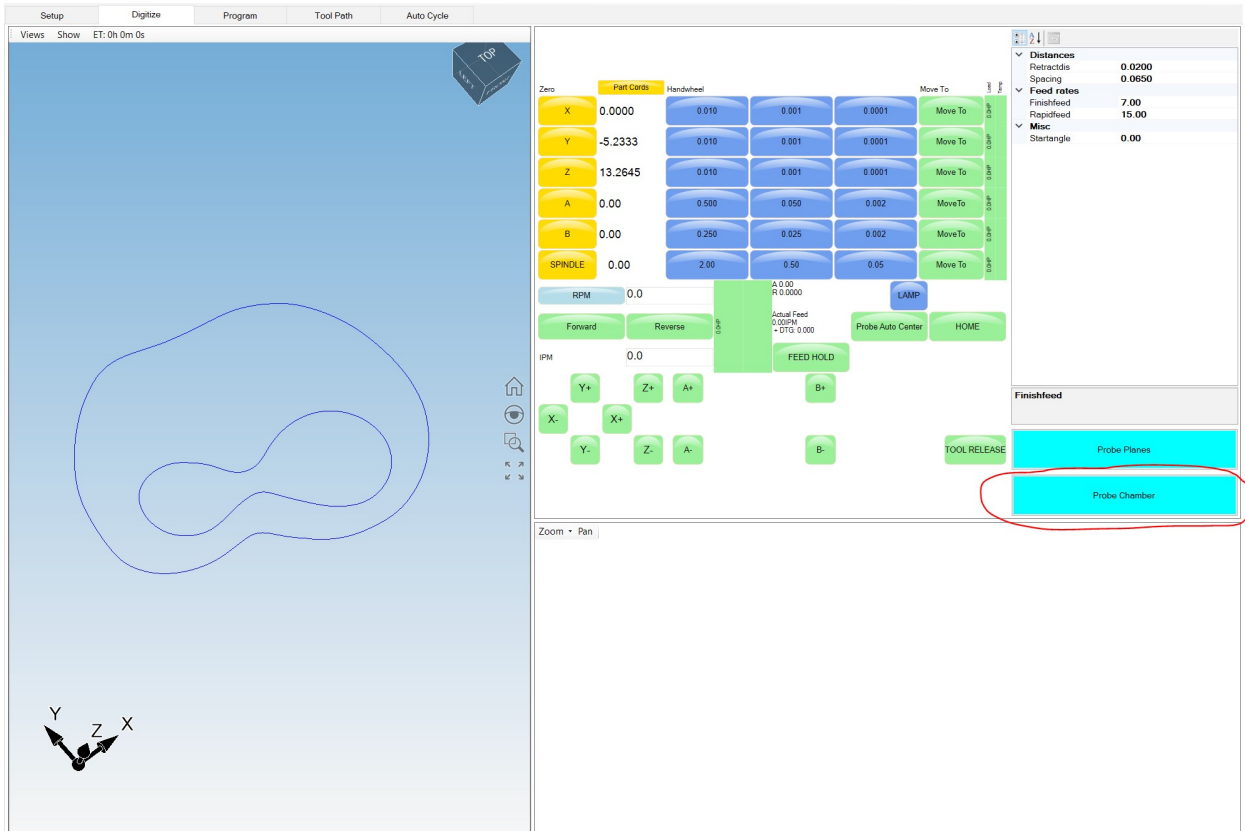
Now that the closed sections are complete and displayed. The next step is to create a set of radial lines that project out from the lower section to the upper section that the probe will use to follow and collect data points on. To accomplish this right click on the named chamber in the cylinder head information tree and select “Radial Operations” followed by “create radial template”. A window will pop up asking for a spacing for the radial sections, in this example we are using “.100” spacing.



To view the radial sections that we created make sure that the “show planes” option is selected from within the show tab in the 3D graphics window. Then make sure that the “Radial Probed Planes” box is checked under the Cylinder head information tree. If done correctly then the 3D graphics window should look something like the image show below with all the probe planes visible.

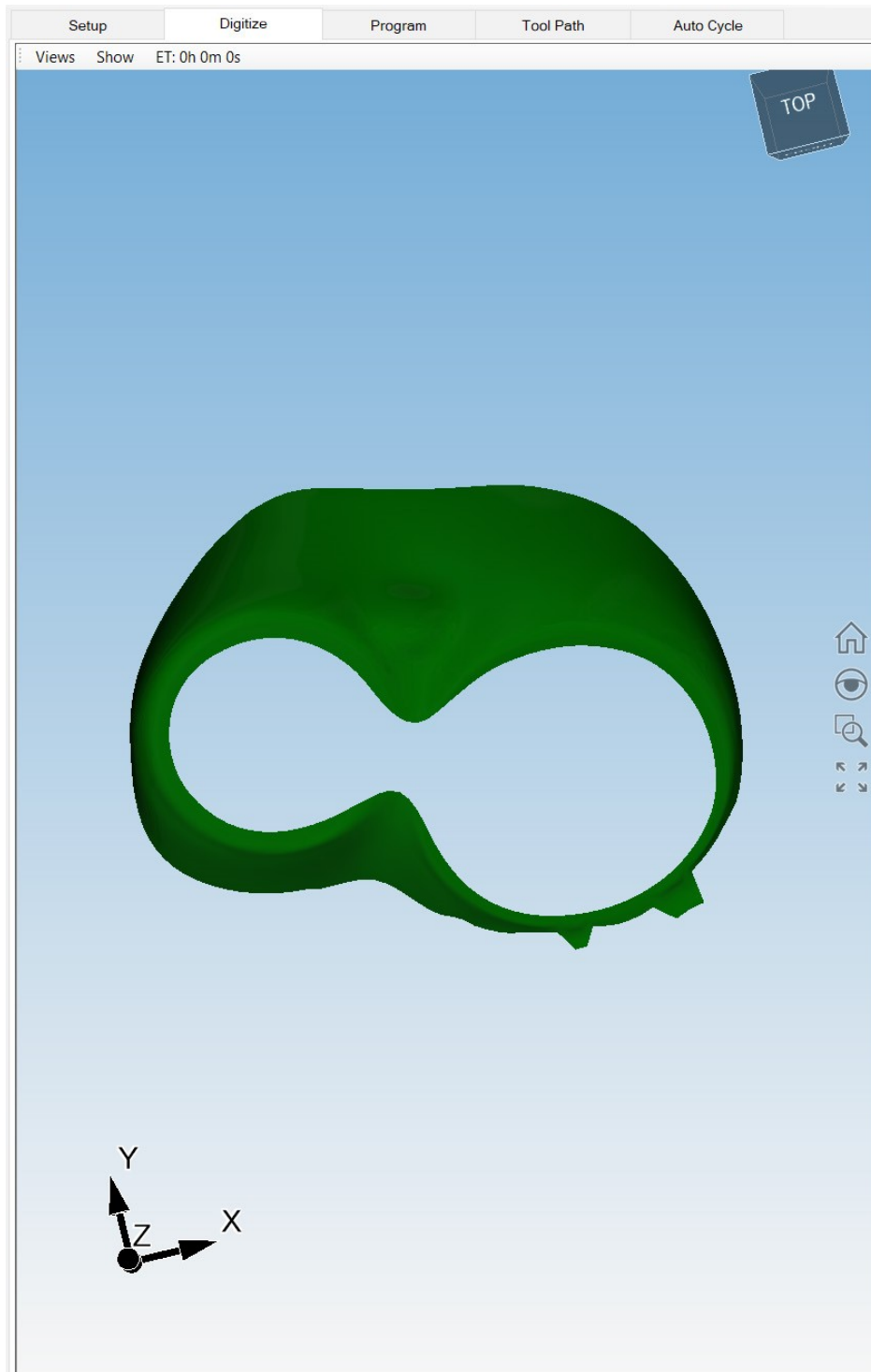


The next step is to activate the automatic probing cycle. Make sure that the "Digitize" tab has been selected. Jog the probe so that the tip is positioned approximately 3 inches above the combustion chamber. When ready, press the probe chamber button on the right of the screen to initiate the probing process.



The probe will start on the inside portion of the chamber and work its way up to the deck surface. The chamber will take some time to finish digitizing. If you choose to leave the machine unattended during this process, then make sure that the probe completes the first few radial lines and that the valves will stay secure during the whole process. Furthermore it is important that the spark plug holes have been plugged so that the probe tip will not error out inside of the hole.

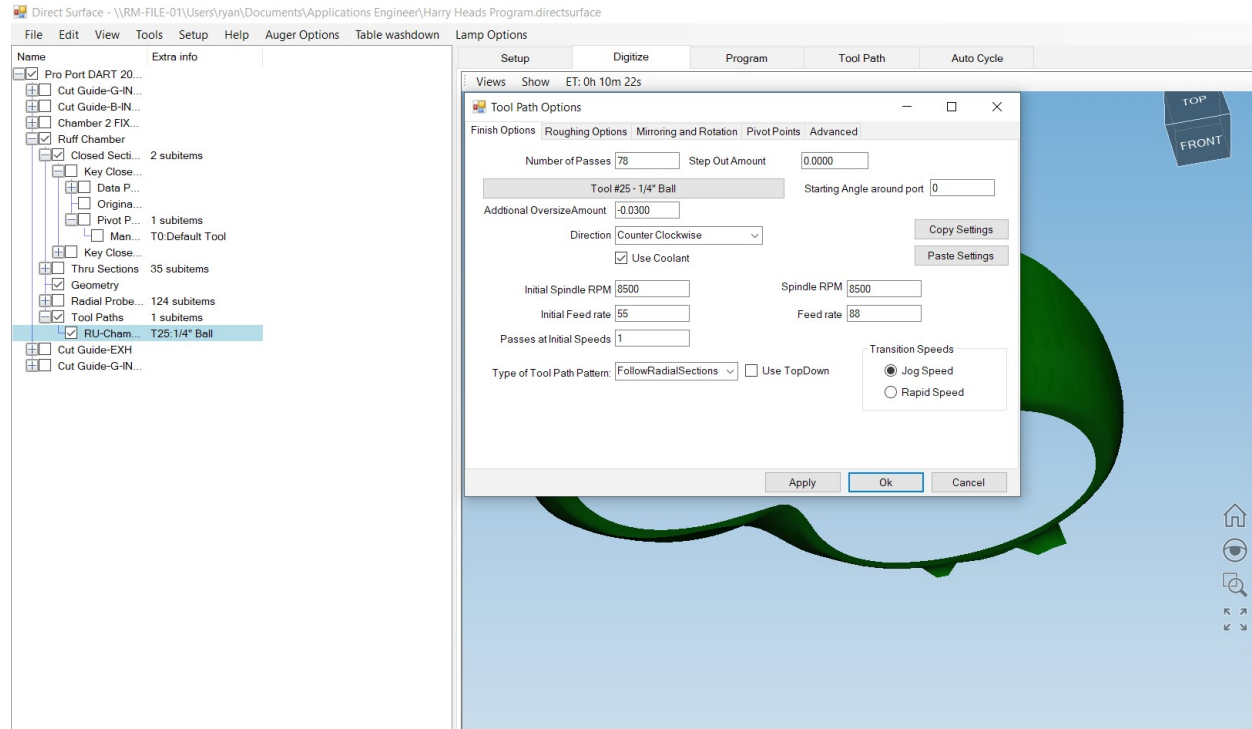
After probing completes, we can proceed to creating the surface. Similar to porting, we need to create this surface so that we can tell the machine where to create a toolpath. To create the surface, right click on the chamber name in the cylinder information tree and select "create surface". To then view the surface, select "show solids" from within the show drop down tab in the 3D graphics window. When done the 3D graphics window should look something like the figure below.



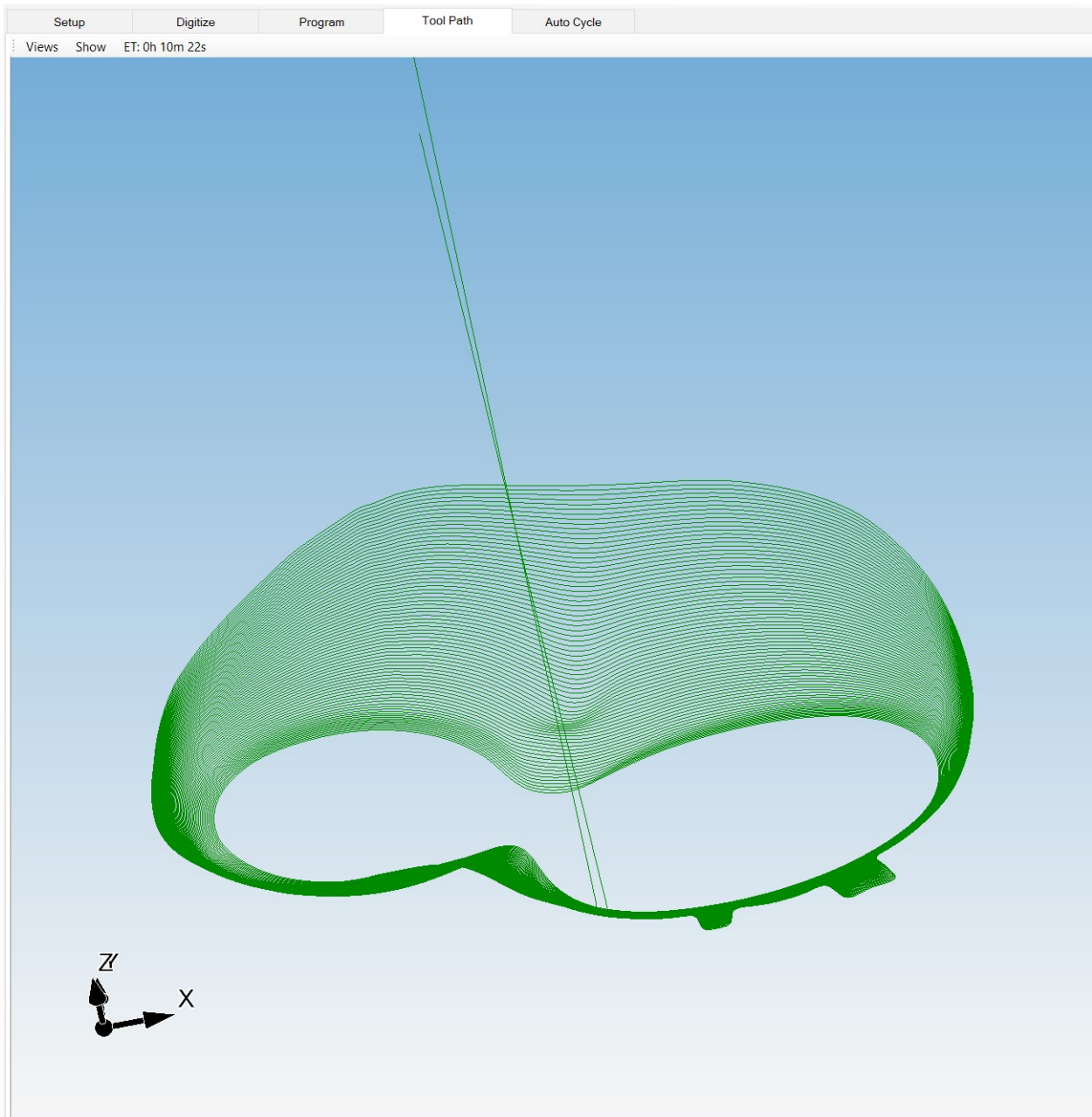
Creating a Tool Path

Once we have a surface created for the combustion chamber, it is then time to create the tool path to machine the combustion chamber surface. Under chamber in the cylinder open up “closed sections” and then open up the “key closed sections” which are two one for the top and the other for the bottom section. Under each of the “key closed sections” click and highlight the “pivot points” then press the delete key on the keyboard. It will ask if you are sure you want to delete it, chose “yes”.

To create a tool path for the chamber start by right clicking on 'Tool Paths' found under the chamber name as shown below. Double click on the Tool Path name that was created as shown below. A window will pop up which contains the machining parameters for the combustion chamber tool path. Enter your desired information here, an example is provided in the figure below.



Press "OK" when finished editing the machining parameters. To view the tool path after it generates, switch to the Tool Path tab. If done correctly the tool path should look something like the figure shown below.



The last step before running the tool path is to switch to the auto cycle tab and drag and drop the newly created tool path from the cylinder head information tree to the ports you wish to run the cycle on. After this is completed, make sure to turn the ports on by making them green as well as selecting the show tool path option in the 3D graphics window. Once complete the autocycle tab should look like the figure shown below. If everything looks correct then the operator may press the “cycle start” command to begin cutting the combustion chambers.



Mirroring

On some heads you will have to mirror the ports or chambers depending on the application that you are working on. If this is necessary then follow the instructions below to mirror the tool path to the correct location

Mirroring Tool Path

After you have all your tool paths created for the chamber and ports, with all feeds and speeds that you want to cut with, just simply right click on the "tool path" tab under either the port or chamber section and then click on "Duplicate All Tool paths as Mirrored Toolpath"

A window will come up and ask to input the offset to mirror around X, It's the distance to the center of the chamber, for example in a SBC head the center of the chamber is 2.4 around the X axis. Which X is located off of the left dowel pin.

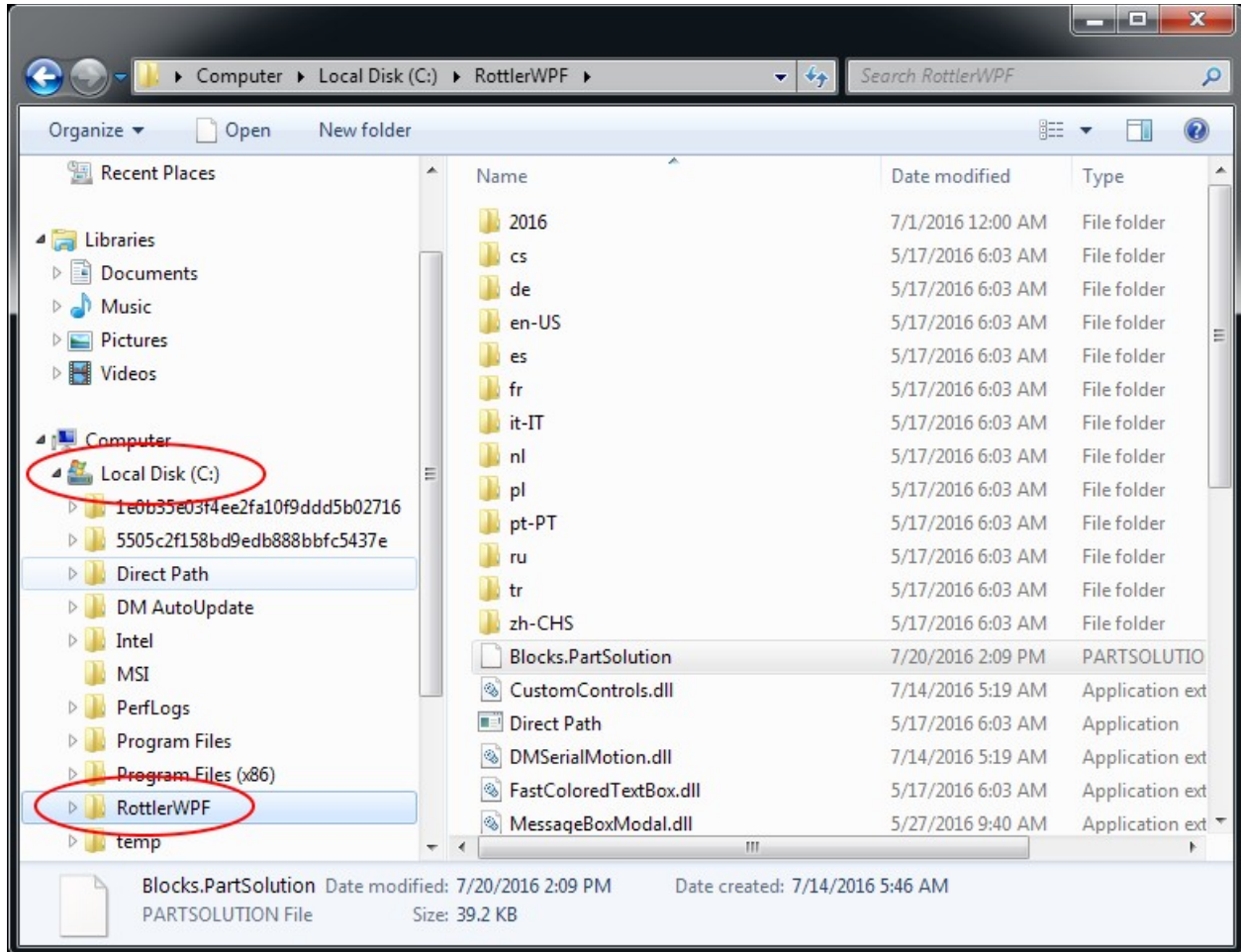
Do the same for the chamber tool path and then you will have the mirrored tool path created under your original tool path.

When setting up the tool paths on the desired cylinder, drag the mirrored tool path on the cylinders that are mirrored from the original digitized chamber and ports.

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.

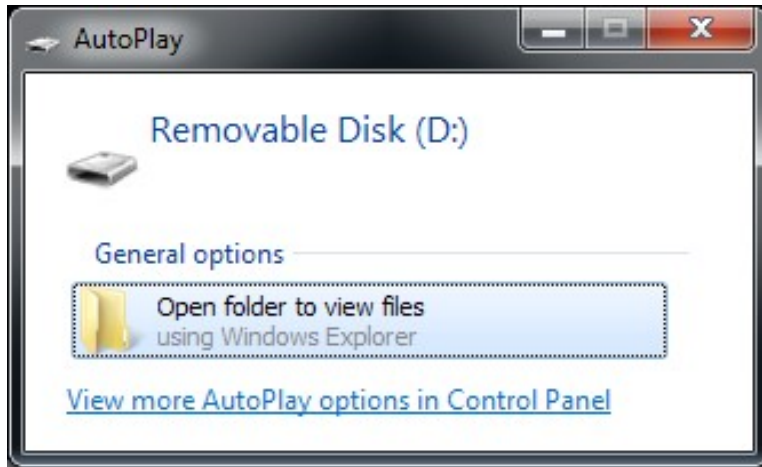
First step is to open your file browser and locate the RottlerWPF file on the C disk drive.



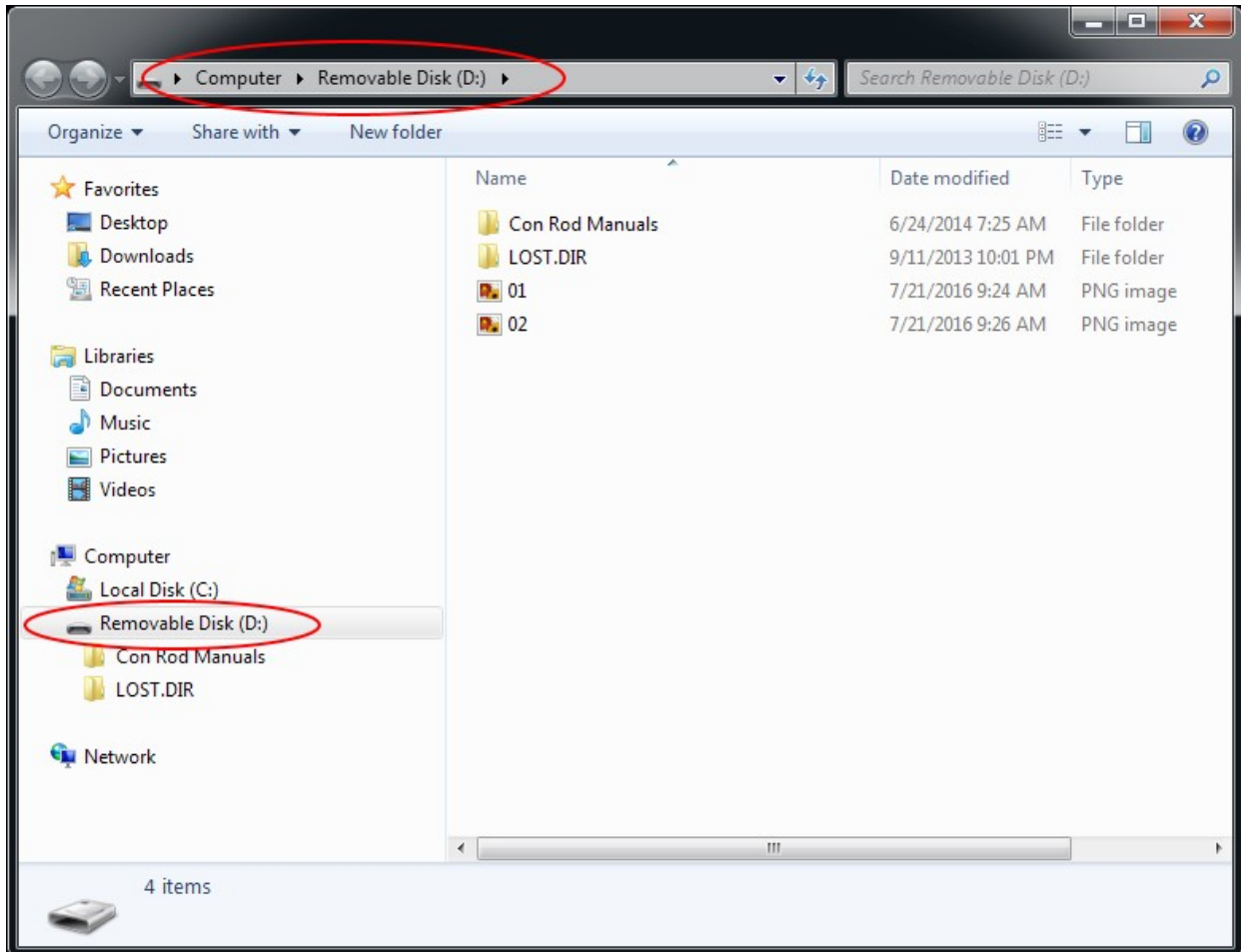
The next step is to plug in a flash drive to an open USB port



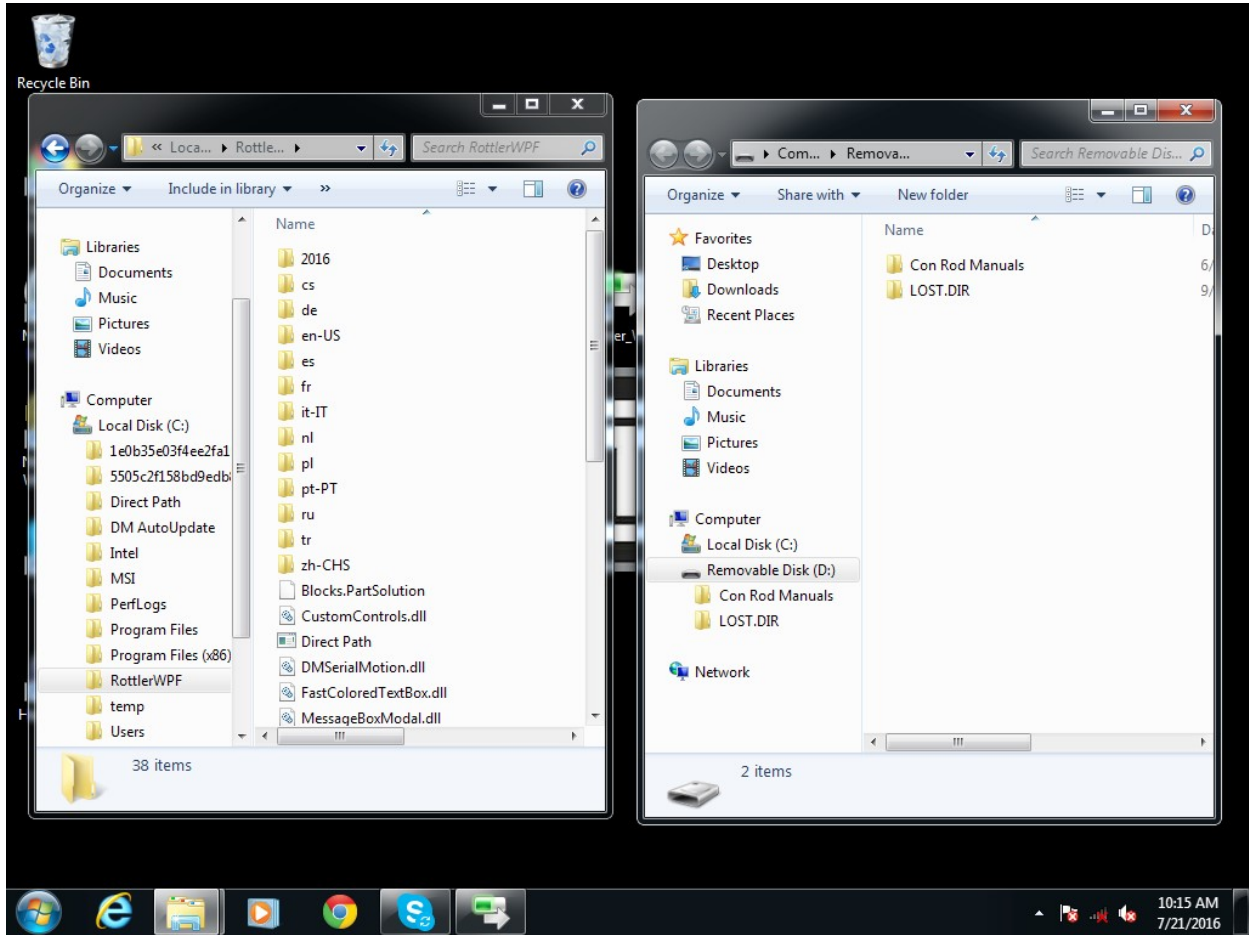
The following pop up box will appear on your screen.



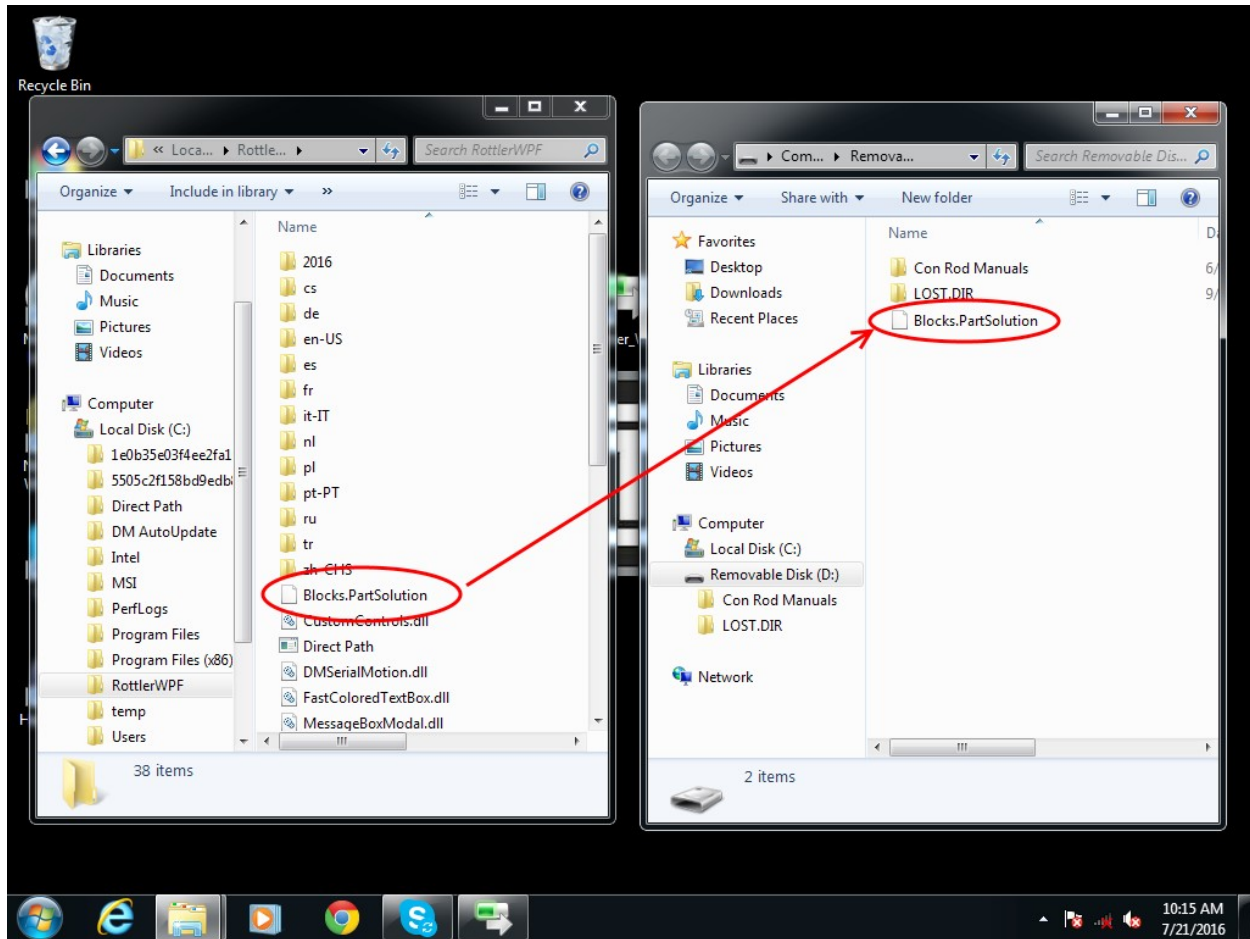
Click on the Open folder to view files option and the following screen will appear. This is the contents of the flash drive you just plugged in.



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



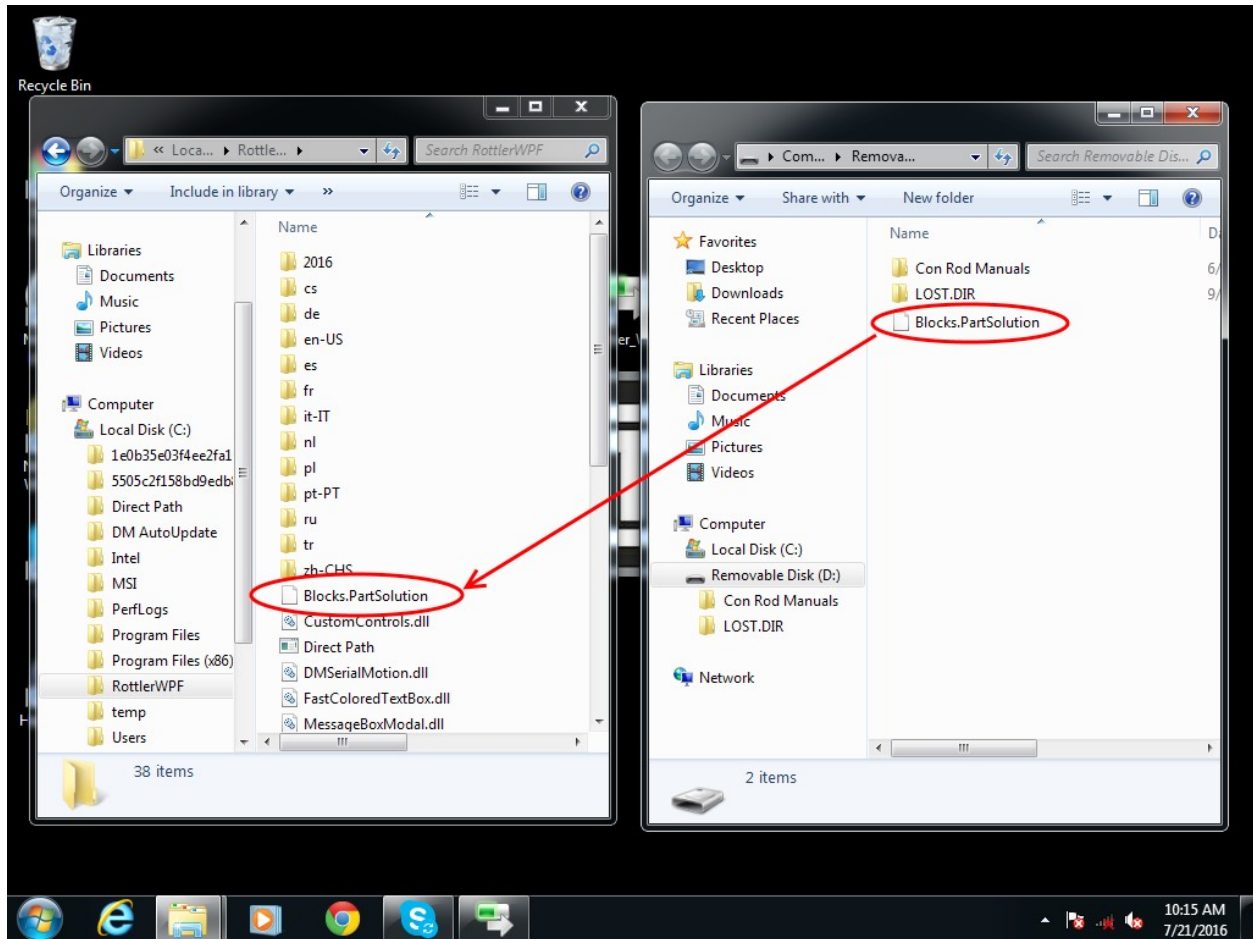
Block profiles are backed up each time the machine is run with the current profiles being shown in the RottlerWPF folder. All that needs to be done to back up the current profile is to simply drag it from the RottlerWPF folder to the flash drive folder. A copy of the file will be placed on the flash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



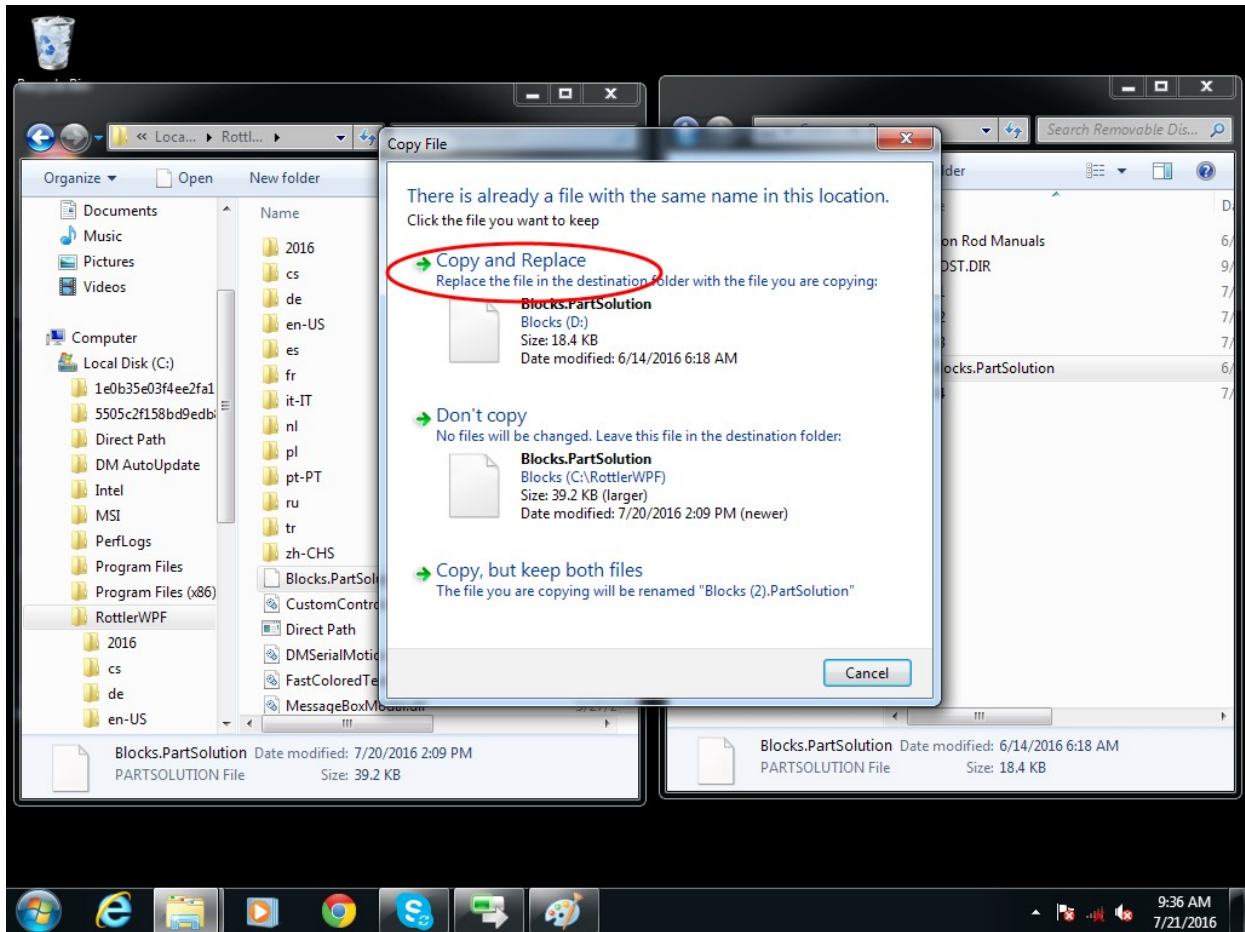
Backup is now complete. Close both file browser windows and remove the flash drive.

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

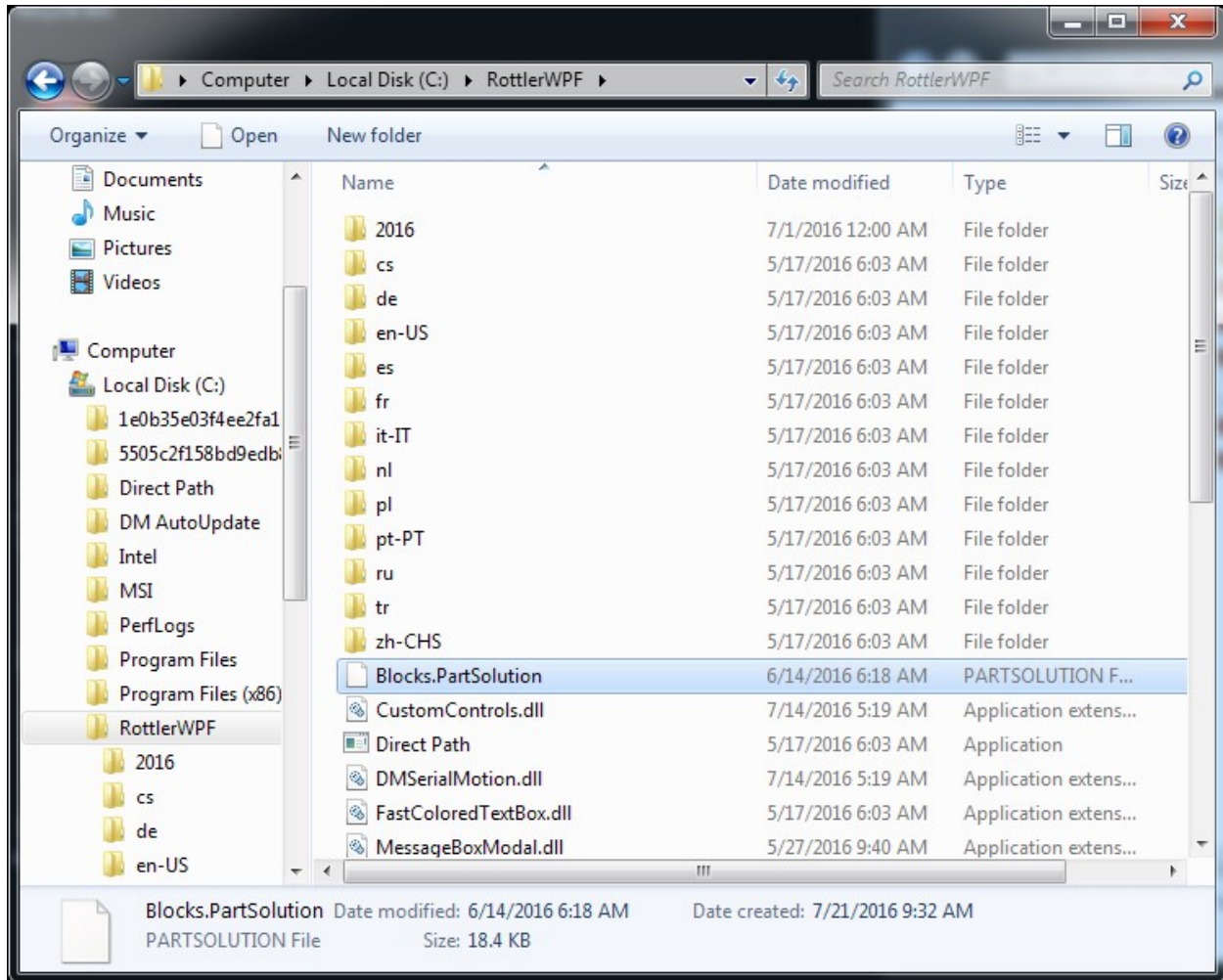
Highlight the block profiles file in the flash drive and drag it into the RottlerWPF folder on the local hard drive.



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



The archived block profiles will now be installed.



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

Using 3rd Party Tooling in Rottler Machines with CAT 40 Tooling.

When it is not convenient for the customer to order CAT 40 tooling from the factory or if the customer needs tooling that we don't stock, they may purchase tooling from 3rd party vendors such as MSC Metalworking.

Rottler uses a Parlec - A Style, CAT40 Taper, 5/8-11 Thread, 45 Degree Angle Radius, Standard Retention Knob with the following specifications: 1.68 Inch Overall Length, 0.281 Inch Coolant Hole Diameter, 0.74 Inch Knob Diameter, 0.12 Inch Flange Thickness, 0.64 Inch Knob to Flange Length, 0.635 Inch Pilot Diameter, Through Coolant.



The metric equivalent is a Parlec - A Style, BT40 Taper, M16 x 2 Thread, 45° Angle Radius, Standard Retention Knob 1.65 Inch Overall Length, 0.281 Inch Coolant Hole Diameter, 0.74 Inch Knob Diameter, 0.12 Inch Flange Thickness, 0.64 Inch Knob to Flange Length, 0.669 Inch Pilot Diameter, Through Coolant.



MAINTENANCE

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Maintenance

Quick Reference Lubrication Chart: EM69P

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

Assembly	Frequency Hours	Lube Operation	Recommended Lubricant	Date Serviced
Way Oil Level	40	Fill as needed	Conoco Brand 76 Way Oil HD 68 or ISO VG 68 equivalent	
Drawbar oil level	160	Fill as needed		

Quick Reference Preventative Maintenance: EM69P

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

Procedure	Frequency Hours	Date Serviced/Comments
Long Break-In Cycle	Variable	
Quick Warm-Up Cycle	Daily	
Empty Water Traps	40	
Clean Spindle Chiller Air Filter	40	
Check Way Oil Functionality	160	
Visually Inspect Way Covers	160	
Check Spindle Chiller Level and Settings	160	
Replace Coolant	480	
Check Air Pressure Regulators	480	
Check Backlash	960	
Check Gibbs	960	
Check Home Presets	960	
Check for Loose Bolts	960	
Check Machine Geometry	960	
Check Incoming Voltage	960	

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Removable copy

Quick Reference Lubrication Chart: EM69P

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

Assembly	Frequency Hours	Lube Operation	Recommended Lubricant	Date Serviced
Way Oil Level	40	Fill as needed	Conoco Brand 76 Way Oil HD 68 or ISO VG 68 equivalent	
Drawbar oil level	160	Fill as needed		

Quick Reference Preventative Maintenance: EM69P

Refer to the procedures in the maintenance section of the manual to make or check these adjustments.

Not all of the items listed in the table below have adjustment. The information should be recorded and the amount of wear tracked so the part can be replaced before down time on the machine occurs.

Procedure	Frequency Hours	Date Serviced/Comments
Long Break-In Cycle	Variable	
Quick Warm-Up Cycle	Daily	
Empty Water Traps	40	
Clean Spindle Chiller Air Filter	40	
Check Way Oil Functionality	160	
Visually Inspect Way Covers	160	
Check Spindle Chiller Level and Settings	160	
Replace Coolant	480	
Check Air Pressure Regulators	480	
Check Backlash	960	
Check Gibbs	960	
Check Home Presets	960	
Check for Loose Bolts	960	
Check Machine Geometry	960	
Check Incoming Voltage	960	

Flush Coolant System	1920	
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Scheduled Maintenance Procedures

Long Break-In Cycle

A Long Break-In Cycle should be completed whenever any of the following criteria has been met:

- The machine has been transported
- The Spindle has not been run for 7 or more consecutive days
- The spindle has been left out of position (more than 20 degrees from '0') for 8 or more consecutive hours

The Long Break-In Cycle is a process that takes approximately 3 hours and 55 minutes. During this cycle the spindle must be at the '0' position and clear of any objects. It is necessary that the spindle chiller is functioning and air pressure is supplied to the machine. The spindle will then cycle through a series of RPM changes and pauses to properly distribute grease throughout the bearings.

The Long Break-In Cycle can be located in the Direct Path or Direct Surface Programs in the Menu Bar at the top of the screen under; Spindle Warmup Cycles>Long Break In Cycle



Once the cycle has been completed, the machine can be operated normally.

Quick Warm-Up Cycle

The Quick Warm-Up Cycle must be completed every day before the machine is operated. The Quick Warm-Up Cycle lasts approximately 30 min. . During this cycle the spindle must be at the '0' position and clear of any objects. It is necessary that the spindle chiller is functioning and air pressure is supplied

to the machine. The spindle will then cycle through a series of RPM changes and pauses to properly distribute grease throughout the bearings and increase the internal temperature to an acceptable level.

The Quick Warm-Up Cycle can be located in the Direct Path or Direct Surface Programs in the Menu Bar at the top of the screen under; Spindle Warmup Cycles>Quick Warmup.



Once the cycle has been completed, the machine can be operated normally.

Setting the B-Axis Air Pressure

1. Rotate the spindle to 45 degrees.
2. Place something under the spindle so if it falls, it does not damage anything. A wood block is perfect.
3. Push the E-Stop.
4. If the spindle falls, it needs more pressure, if it rises, it needs less pressure
 - A. If it needs less air, you will need to release the pressure form the reservoir tank, as it has a one way check valve, then adjust the regulator pressure to where it need to be.
 - B. Older machines don't have the one way check valve, so previous step is not necessary.
5. Adjust the valve that controls the pressure to the B axis accordingly.
6. Repeat this process until the spindle does not move when pressing the E-Stop in



Image Currently Unavailable

Empty Water Traps

The EM69P is equipped with 2 water traps. The first water trap is located on the main pressure regulator. This water trap has a float that allows it to self-purge whenever water builds up inside of the trap.

The second water trap is located on the back of the machine. This trap should be emptied every week to prevent moisture buildup in the air system that could potentially cause rust accumulation and blockages. At the bottom of this black air reservoir there is a ball valve used to relieve air pressure and moisture.

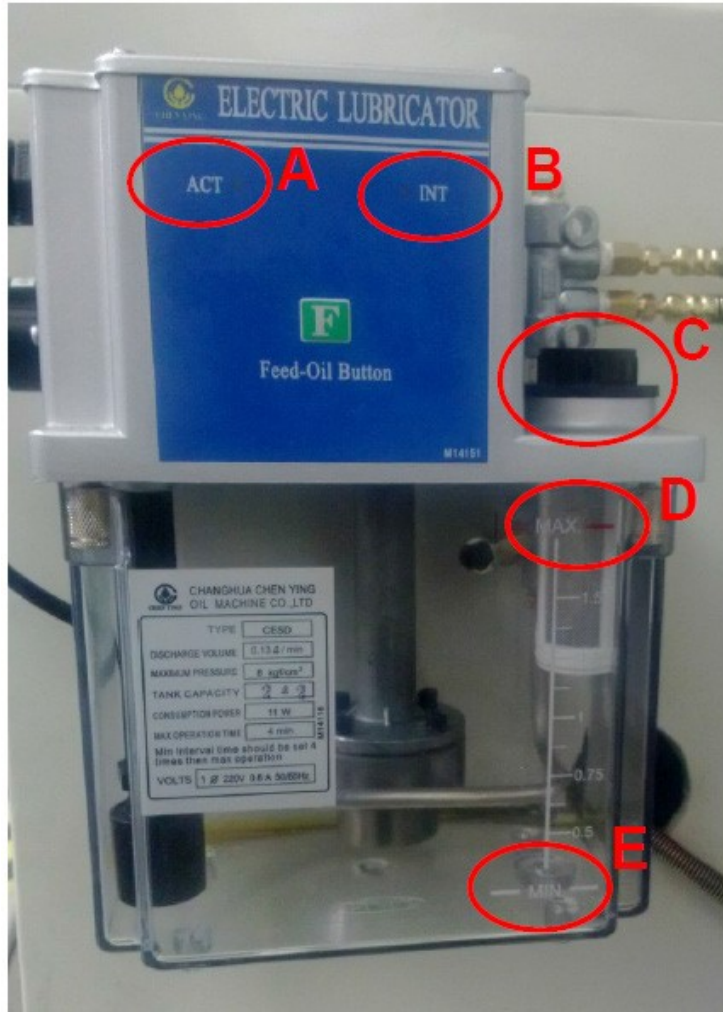
While emptying the water trap, the B axis must be in the '0' position. Failure to do this can cause a drop of air pressure in the system substantial enough to allow the spindle motor to fall to one side and overextend the tilt assist, causing permanent damage. With air pressure still applied to the machine; open the valve for at least 10 seconds then return it to the closed position.



Image Currently Unavailable

Check Way Oil (Level)

This machine uses **ISO VG 68 Way Oil** to lubricate all moving components. This way oil is contained in a reservoir on the rear of the machine. The reservoir also serves as a pump that is activated for a predetermined amount of time (approximately 30 seconds) after the machine has moved a designated distance (approximately 13,000 inches.) The level of the way oil should be checked weekly.



- A) An LED indicates that the oiler is being supplied power and is currently active.
- B) An LED indicates that the oiler is being supplied power but is not currently active.
- C) This is the fill cap for the oiler. Be sure the filter is in place while filling.
- D) This is the maximum amount of oil allowed in the oiler. DO NOT OVERFILL. Overfilling can cause permanent pump damage.
- E) This is the minimum amount of oil allowed in the oiler. DO NOT ALLOW TO EMPTY. An empty reservoir can cause permanent pump damage.

Clean Spindle Chiller Air Filter

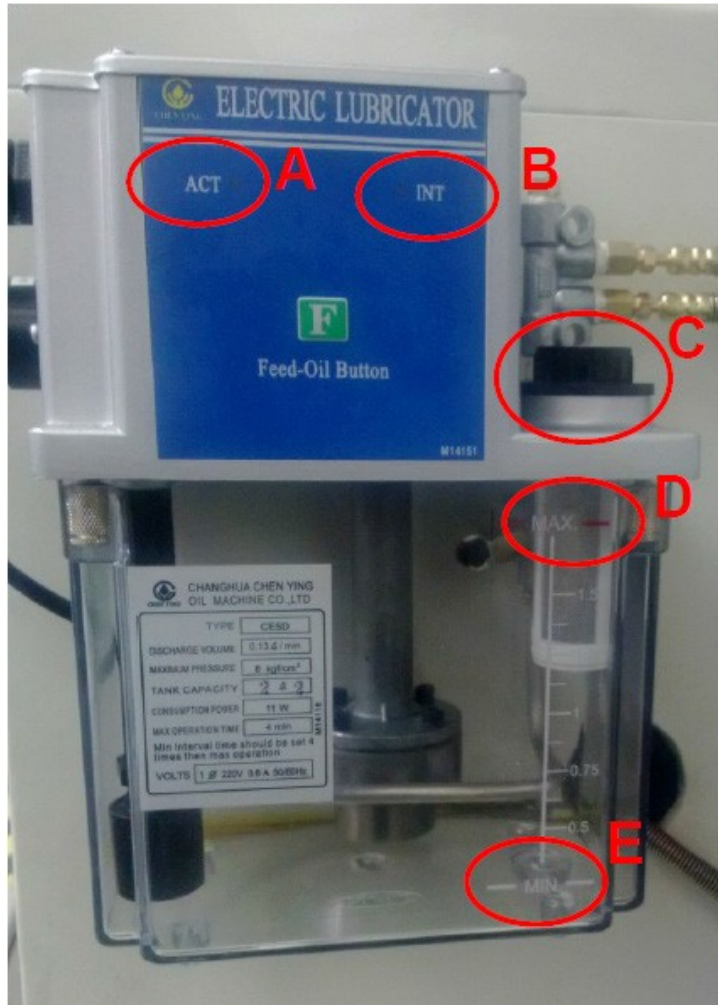
It is important to clean the air filter of the spindle chiller every week. Failure to do so could cause chiller failure.



- 1) Dismount the air filter.
- 2) Blow dust from the cooling fins using compressed air.
- 3) Clean dust from the air filter with water or compressed air in the reverse flow.
- 4) Remount air filter.

Check Way Oil (Functionality)

This machine uses Multipurpose Way Oil to lubricate all moving components. This way oil is contained in a reservoir on the rear of the machine. The reservoir also serves as a pump that is activated for a predetermined amount of time (approximately 30 seconds) after the machine has moved a designated distance (approximately 13,000 inches.) The functionality of the oil pump should be checked weekly.



A) An LED indicates that the oiler is being supplied power and is currently active.

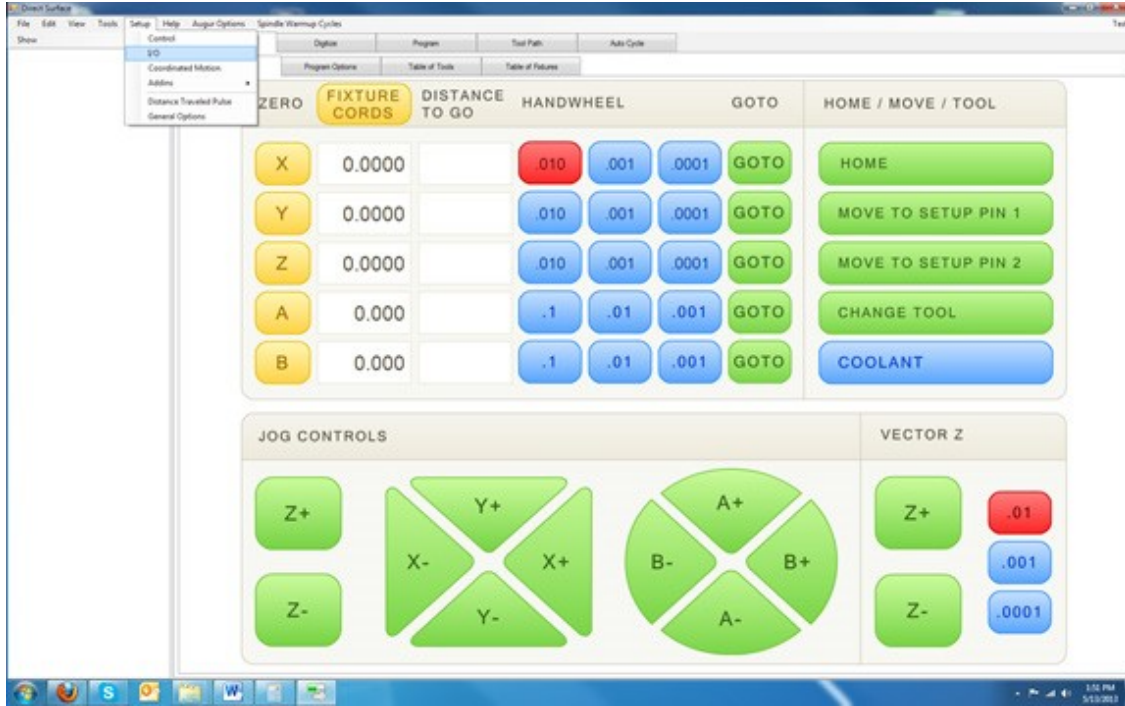
B) An LED indicates that the oiler is being supplied power but is not currently active.

C) This is the fill cap for the oiler. Be sure the filter is in place while filling.

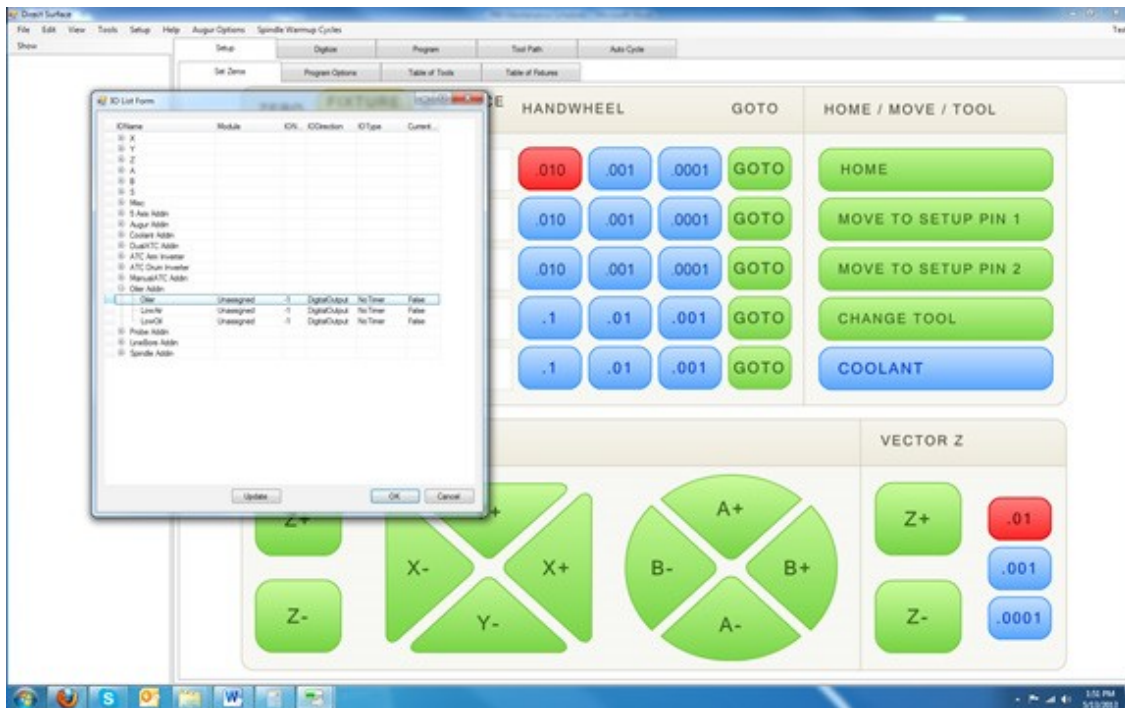
D) This is the maximum amount of oil allowed in the oiler. DO NOT OVERFILL. Overfilling can cause permanent pump damage.

E) This is the minimum amount of oil allowed in the oiler. DO NOT ALLOW TO EMPTY. An empty reservoir can cause permanent pump damage.

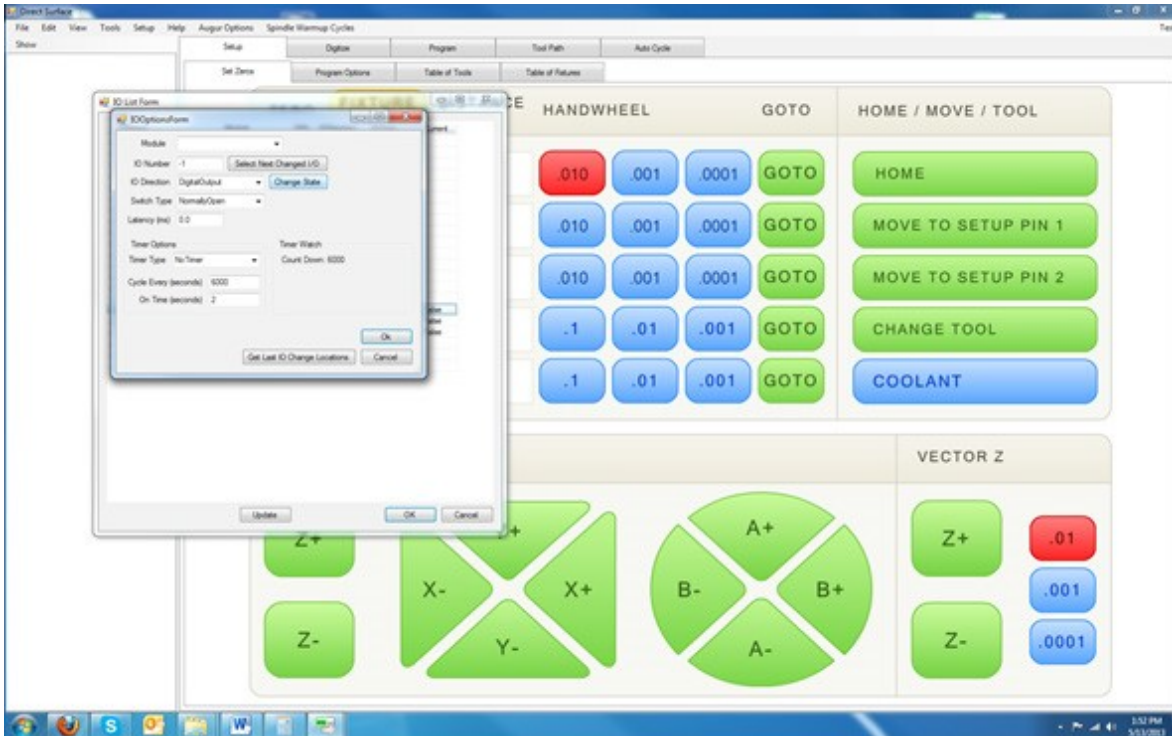
To check the functionality of the pump, go to Setup > I/O.



Expand the “Oiler Addin” section and double-click on “Oiler.”



Click on the “Chane State” button ONE TIME. This will apply power to the oiler at the rear of the machine. Once you have done this, walk to the rear of the machine (within 30 seconds) and check that the pump is operating by visually observing the “ACT” LED is on.



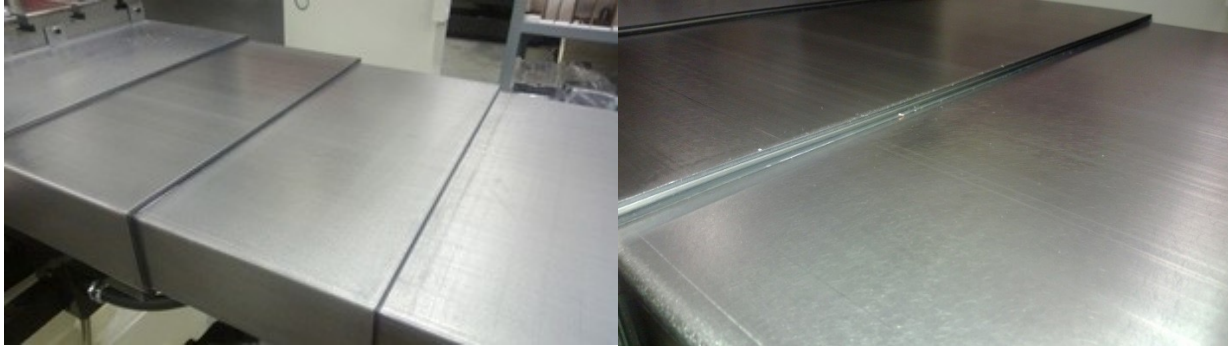
Once you have verified that the oil pump is active, return to the monitor and click the “Change State” button one time to release power from the oiler. Visually check the oiler to verify that power has been released. Close all setup windows.

If the “ACT” LED is not on but the “INT” LED is, remain in the rear of the machine and have someone else press “Change State” button one time to turn off the “INT” LED, then once more to turn the power back on. The “ACT” LED should come on and stay active for approximately 30 seconds. If it does, return to the monitor and click the “Change State” button one time to release power from the oiler. Visually check the oiler to verify that power has been released. Close all setup windows.

If the “ACT” LED does not illuminate at all, or is illuminated for less than 20 seconds, please contact a Rottler Manufacturing technician for further assistance.

Way Cover Maintenance

Way covers should be inspected weekly. Move table to limit of its travel on each side and clean any chips from the covers. It is important to keep all way covers in good working condition. Doing this will allow the way covers to keep coolant and dirt from entering the ways and dramatically reduce wear on the machine. You should visually inspect the X axis way covers to the left and right of the table, Y axis way covers on the front and rear of the table, and the Z axis way cover under the spindle base. The ways should be free of rust and the seals should be in contact with the way cover for the entire width of the seal.

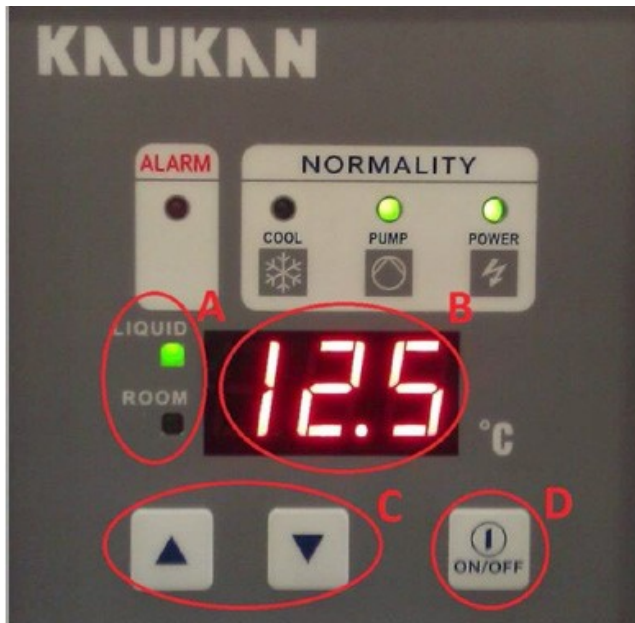


Fully extend the way cover being inspected and wipe clean with WD-40 (or a similar lubricant). If there is rust on the way cover, coat a Scotch-Brite pad with WD-40 and gently clean the surface in a circular motion until the rust is removed. Wipe clean with WD-40 after completed.

If any of the seals are damaged or the way covers are dented in a way that doesn't allow them to seal for the entire width of the way and throughout travel, the way cover must be repaired or replaced. Please contact a Rottler Manufacturing technician to obtain replacement parts.

Check Spindle Chiller Level and Settings

The spindle on this machine is equipped with an oil chiller unit. This oil chiller acts as a reservoir and a temperature regulator for the spindle. Once per month the chiller should be checked for proper settings and oil levels.



- A) Indicates whether the number displayed is room or oil temperature.
- B) Celsius reading of temperature.
- C) Allows you to change temperature settings of the oil chiller.
- D) Toggles the temperature display between oil and room temperature.

To check the temperature settings, first press the ON/ OFF button until the "ROOM" LED is illuminated. This will display the room temperature in Celsius. Next, hold either of the 'up/down' buttons until the numbers on the display flash. They will display a number between 15 and -15. This number indicates the target oil temperature in comparison to the room temperature. For best results this number should display 3.0 in a room that has an average temperature of 19.5 degrees(C) or lower, or -3.0 in a room that has an average temperature of 20 degrees(C) or higher. Press the "ON/OFF" button to save any changes.

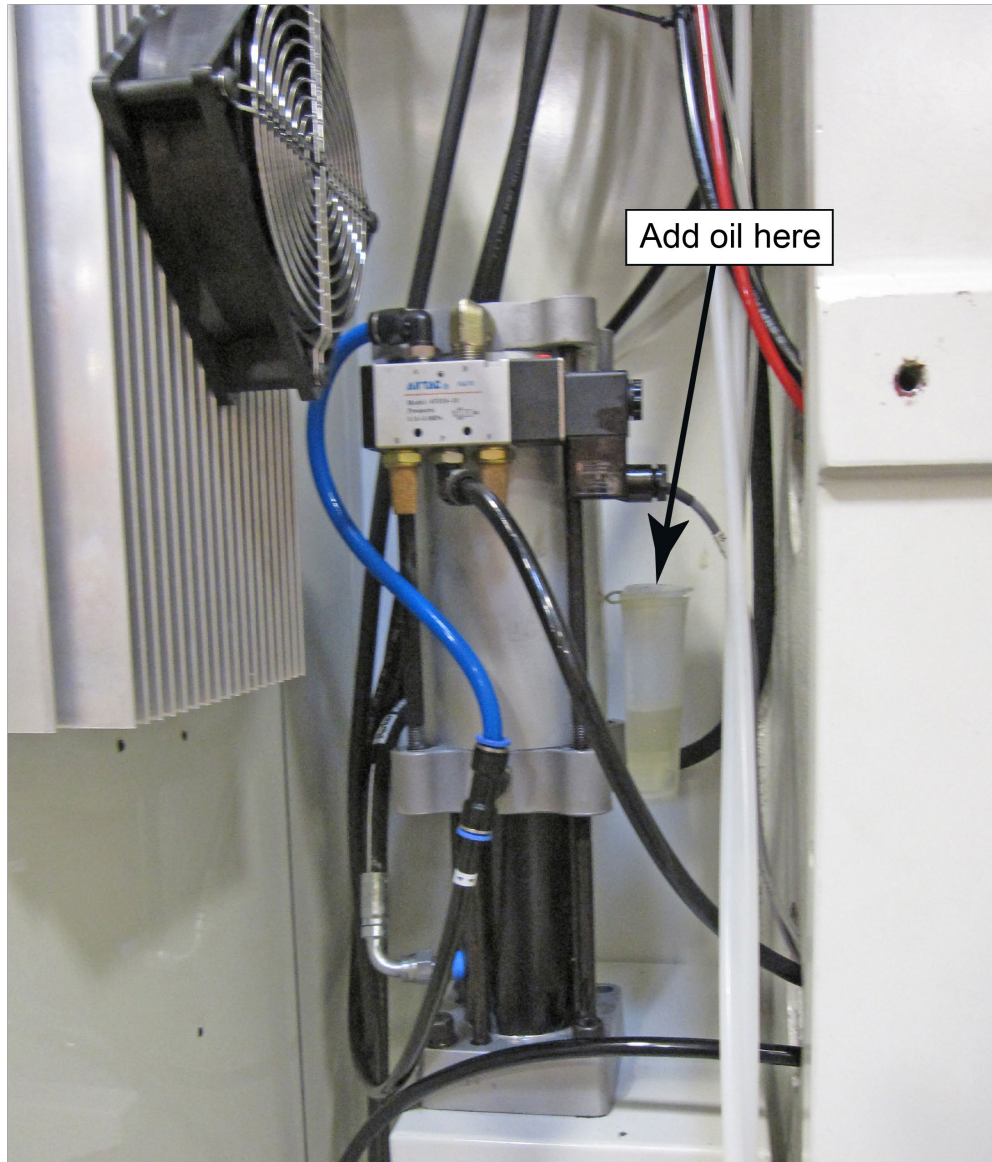
The oil level sight glass is located on the bottom of the oil cooler. This also has a mercury thermometer in it to indicate oil temperature. This sight glass should be filled to the black line at the top. If the oil is not filled to the black line it must be topped off with air tool oil. The oil fill can be reached by removing the air filter and two phillips head screws located above the panel labeled "SUPPLY."

Check Drawbar Oil Level

Once per month the oil level in the drawbar should be checked. If the oil level gets too low it can cause permanent damage to the drawbar. The reservoir is a clear container on the side of the drawbar. It should be filled to the top line with clean tool oil. If it is not, simply remove the cap, refill, and replace the cap.

If the reservoir is ever completely empty during this check please contact a Rottler Manufacturing technician for trouble shooting procedures.





Replace Coolant

It is imperative that the coolant in the machine retains all of its lubricating properties. If it fails to do this it can cause the machine to rust in inaccessible areas, and cause permanent machine damage. The coolant should always be mixed according to the coolant manufacturer's specifications. (Generally near a 10:1 water to coolant solution mixture.)

To replace the coolant in the machine you may either install a petcock in the drainage plug in the rear of the coolant tank, or remove it via a pump/vacuum from the top of the tank where the coolant pump is located. Due to the baffle system within the coolant tank, this may leave sediment in the bottom of the tank. If machining a lot of ferrous metals it may be necessary to clean this sediment out by removing the cover of the coolant tank. (Remember; the coolant from this machine may be considered "hazardous waste." Please check with local laws and dispose of the coolant accordingly.)

Refill the coolant tank with water/coolant mixture until it is near the top of the lowest point on the coolant tank. (Usually the coolant pump housing.)



Lubrication

Automatic Lubrication System

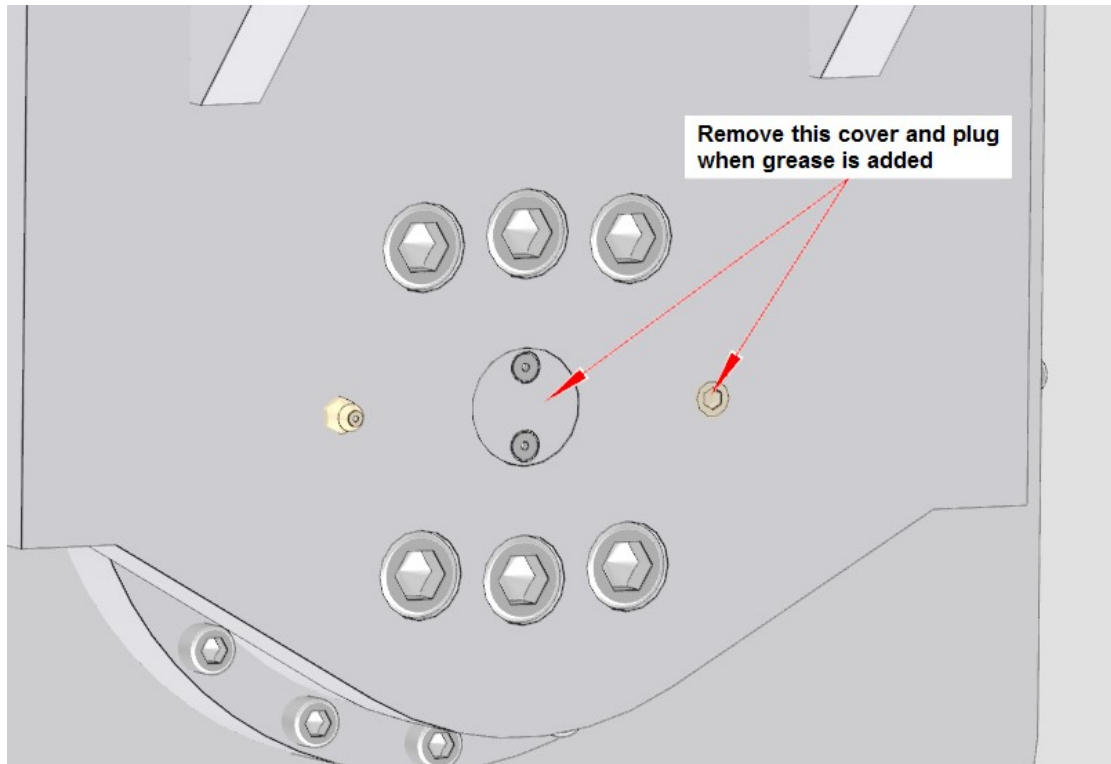
The automatic lubrication system includes metering valves for proportional distribution and includes an alarm for low fluid level warning. Still, please check fluid level before operation. Add **Union 76 Way Oil HD-68**, or equivalent, as needed in reservoir at rear of machine.

Power Draw Bar Lubrication

The Power Draw Bar assembly needs to have oil supplied in the air line to it. Use machine tool oil in this reservoir. The reservoir is located on the back of the main column of the machine. Refer to the following illustration for filling location.

A & B-Axis Gearbox Lubrication

The A & B-Axis gearboxes should be greased on a weekly basis. Fill with grease weekly ensures that any coolant that may have seeped into the gearbox is forced out when grease is pumped into the gearbox. Remove the plug and cover plate located on the spindle base. Add grease at the grease fitting until there is overflow coming out of hole where cover plate was removed. Remove excess grease and replace cover plate. Continue to add grease until there is overflow coming out of the plug hole. Remove excess grease and replace plug.



Vertical Ballscrew Bearings

Every 175 Hours:

These bearings should be greased with ***Unoba EP 2 Multi Purpose Grease or equivalent NLGI 2 grease.***

Probe “On-Center” Adjustment

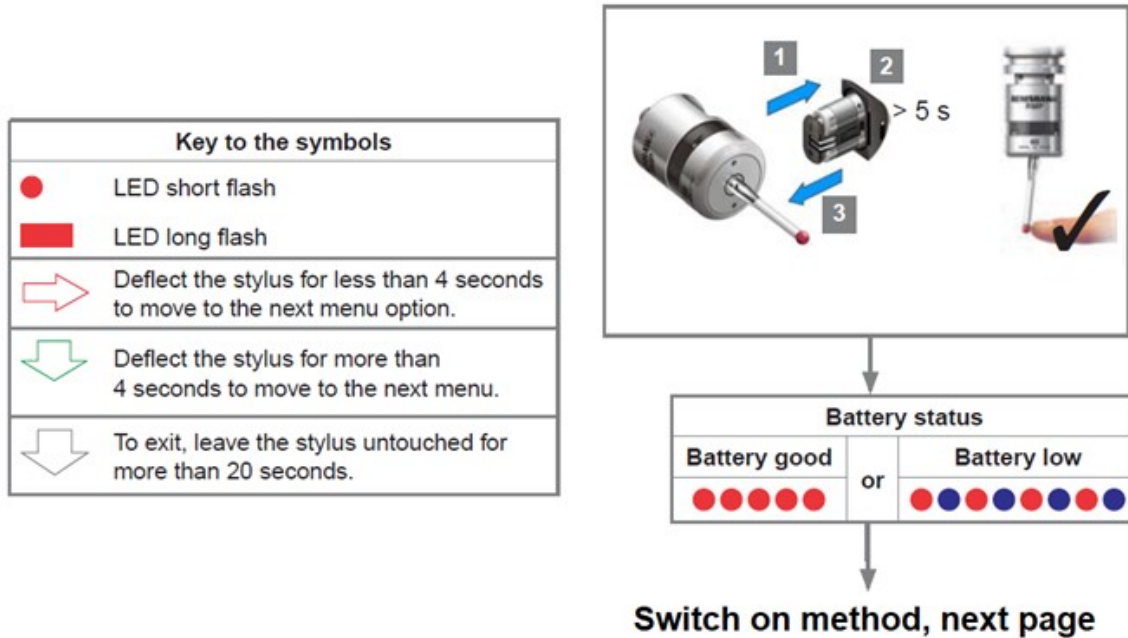
This covers setup and calibration of the probe, so it will accurately position your machine.

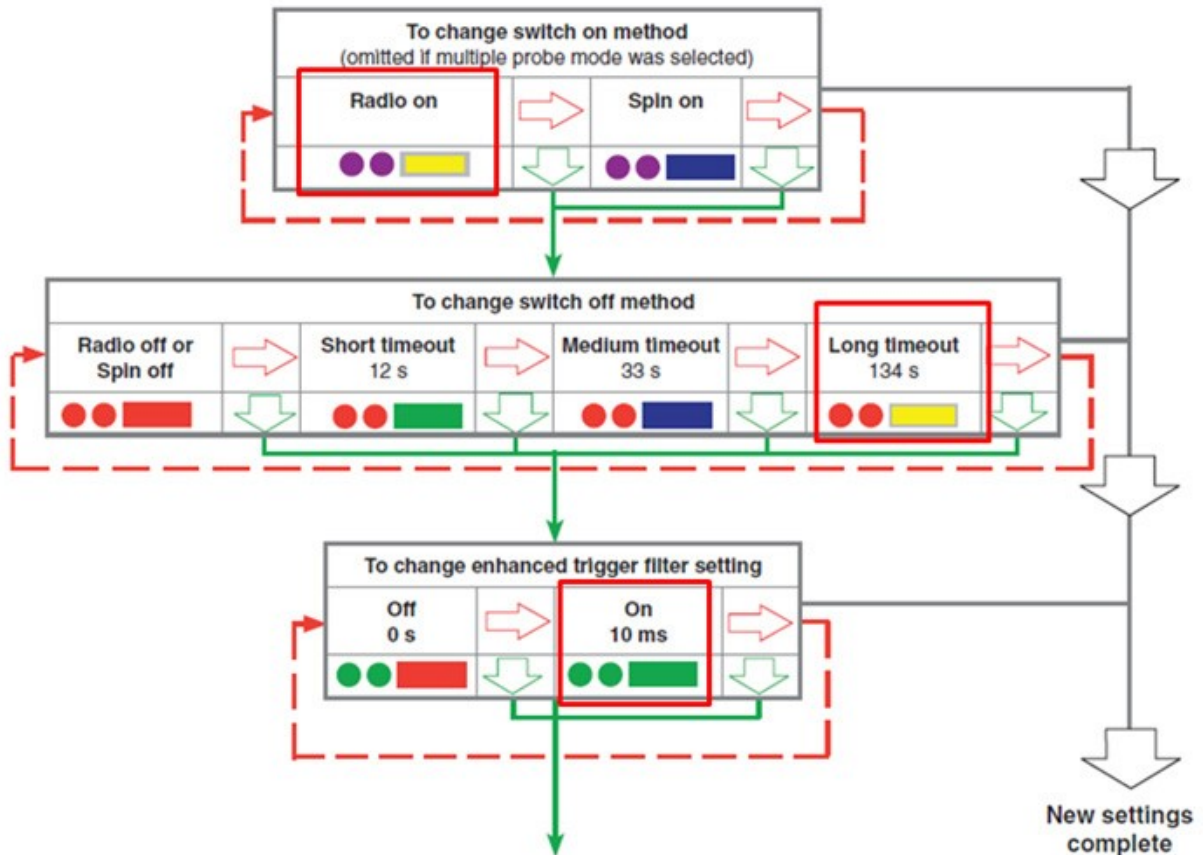
- Verify that the four adjusting screws and two locking screws are installed in the probe tool holder.
- Assemble probe on either CAT 40 Shank or Rottler Taper
- With the machine breaker that supplies power to the probe receiver turned off;
- Install batteries in the probe WITH stylus deflected.

Probe LED check will run.

- Release stylus after battery check this will put you in edit mode.
- First will be Switch off method, you want this at purple, purple, yellow (Radio On). If it is not, deflect and release stylus quickly to change the mode.
- Hold the stylus deflected until the colors change to move to the next setting.
- You should be at Switch Off method; it should be red, red, yellow (134 seconds). If it is not, deflect and release stylus quickly to change the mode.
- Hold the stylus deflected until the colors change to move to the next setting.

- You should be at Enhanced trigger filter; it should be **green, green, green** (on). If it is not, deflect and release stylus quickly to change the mode.
- Hold the stylus deflected until the colors change again to move to the next setting.
- You should be at Acquisition mode, **light blue, light blue, light blue**.
- Turn on machine and quickly deflect and release the stylus. This must be done within 10 seconds of turning on the power breaker to the probe. If you are watching the RMI-Q (located ON the machine) you will see the right light turn **red, yellow, red, yellow, red, yellow** is shows the partnership has been acquired.
- Go into the software and do a probe auto center and hit start probe to verify that it works correctly.

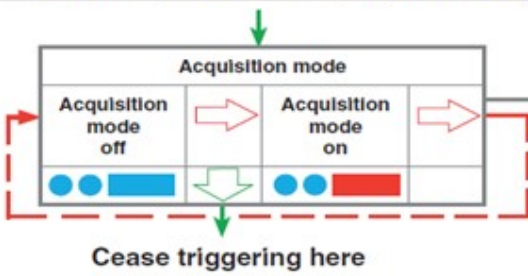




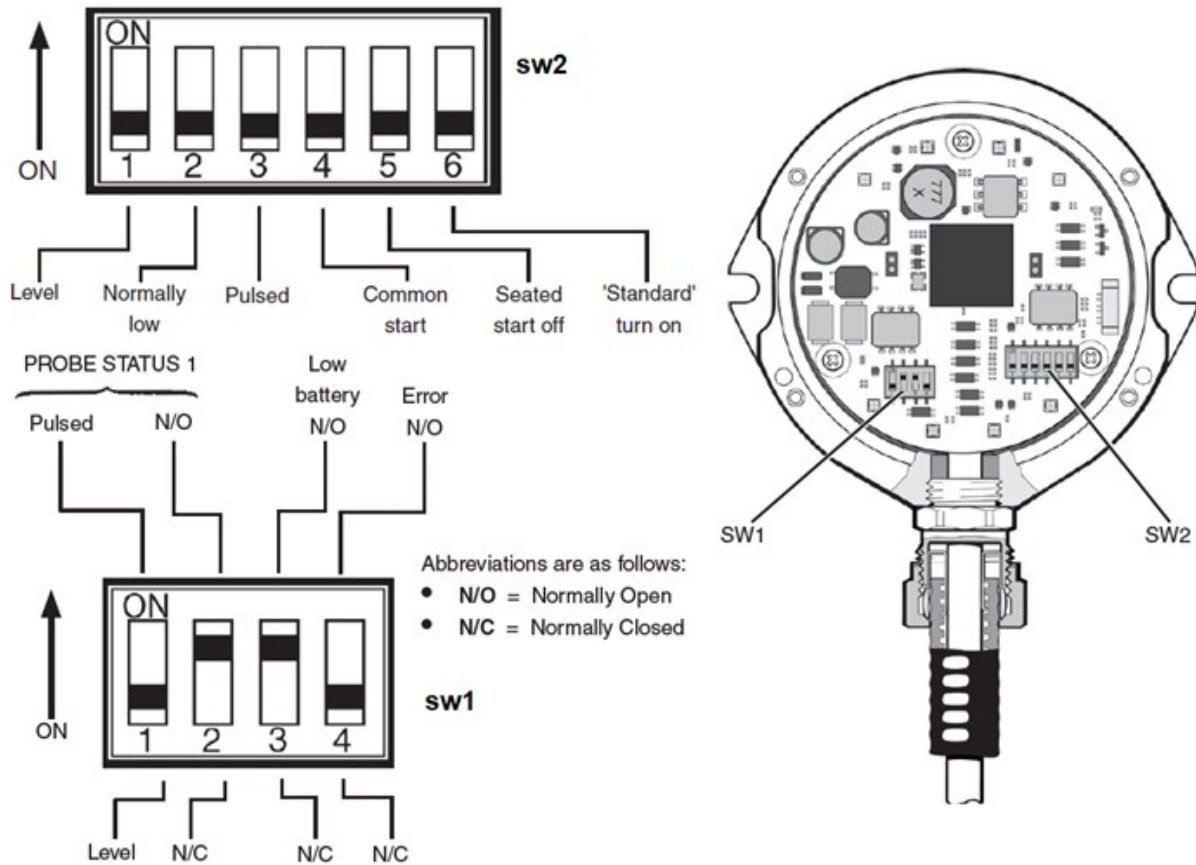
Changing the probe settings (continued)

Note: After the RMI has been acquired, the RMP40 will only show Acquisition mode off.

See RMP40 - RMI partnership.



If the Probe does not turn off after 137 seconds you will need to make sure that the RMI-Q switches are shown in the following positions:



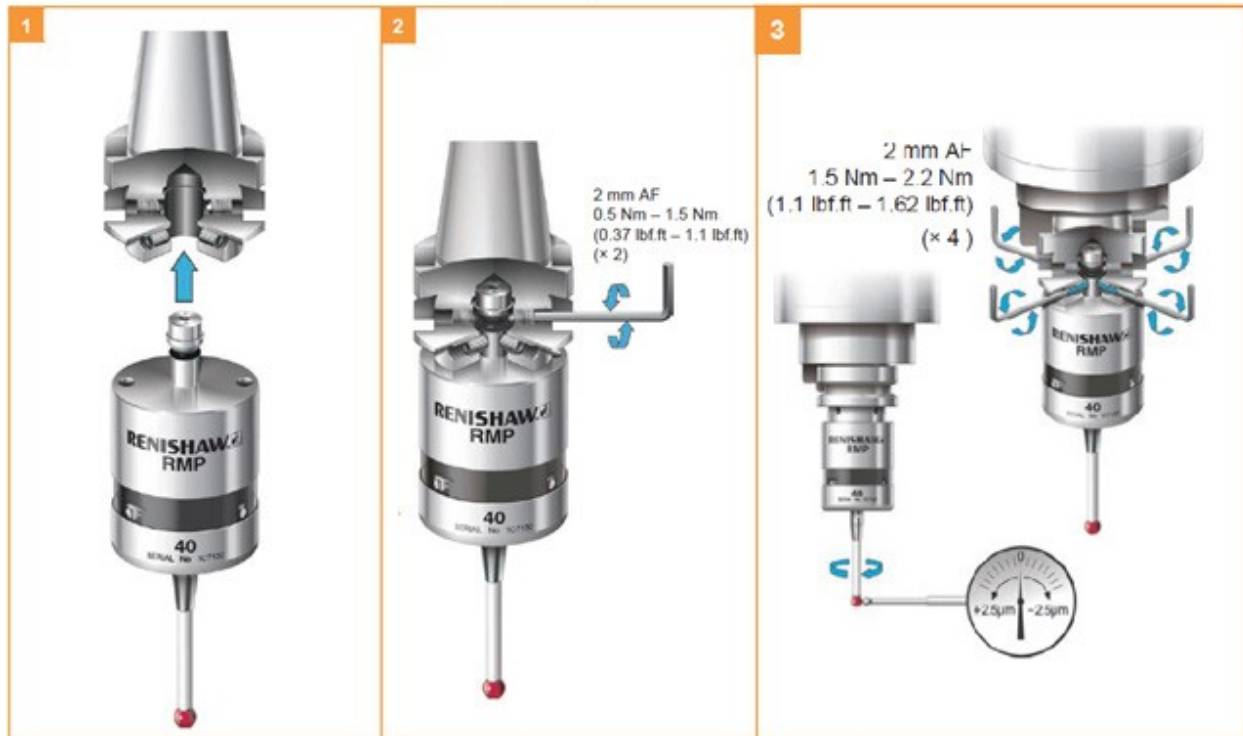
During normal use, the difference between the touch position and the reported position does not change, but it is important that the probe is calibrated in the following circumstances:

- when a probe system is to be used for the first time;
- when a new stylus is fitted to the probe;
- when it is suspected that the stylus has become distorted or that the probe has crashed;
- at regular intervals to compensate for mechanical changes of your machine tool;
- if repeatability of relocation of the probe shank is poor. In this case, the probe may need to be recalibrated each time it is selected.

It is good practice to set the tip of the stylus on center, because this reduces the effect of any variation in spindle and tool orientation. A small amount of run-out is acceptable, and can be compensated for as part of the normal calibration process.

- calibrating either in a bored hole of known size, a ring gauge, or on a datum sphere.

Mounting the probe on a shank



- Dial the probe stylus into center using a .0001" indicator to within .0005" the tighter tolerance you hold the more accurate the machine will be. You must use an indicator that takes very little pressure to get a reading. Excessive pressure on the stylus will deflect the probe and you will not be able to dial it in correctly.
- Go to the Main/Block Model screen and select the Table of Tools. You may only have a Default Tool #0 listed.
- Press Add Tool. This will bring up a dialog box. Change the name from default tool to probe style that you are installing i.e. 50mm stylus, 100mm stylus. Set the diameter to .2360" this is default probe tip on a 50mm, 100mm, and 17.5mm.
- Install a block, or parallels onto the machine and secure it solidly to the machine table.
- Place the Ring Gauge onto the top of the block, use Probe Auto Center to find center zero your X and Y axis here. Make sure you use a ring gauge or a hole of a known diameter. This will set the correct probe timing.
- Adjust the probed diameter by going to the IO under Setup Electronics and changing the Probe MS. You will need to increase or decrease the MS of the probe to achieve correct Probe Diameter.
- Repeat until the correct diameter is displayed.
- Probe Auto Center the ring gauge, without moving X or Y, remove the probe up in Z and Install the cutter head. Put a magnet base with the Last Word indicator on the cutter head and sweep the cylinder/ring gauge.
- The variation in X and Y Should be less than .0005.
- If not add compensation to ProbeOffset under > Setup Eletronics-Addins-ProbeSetup

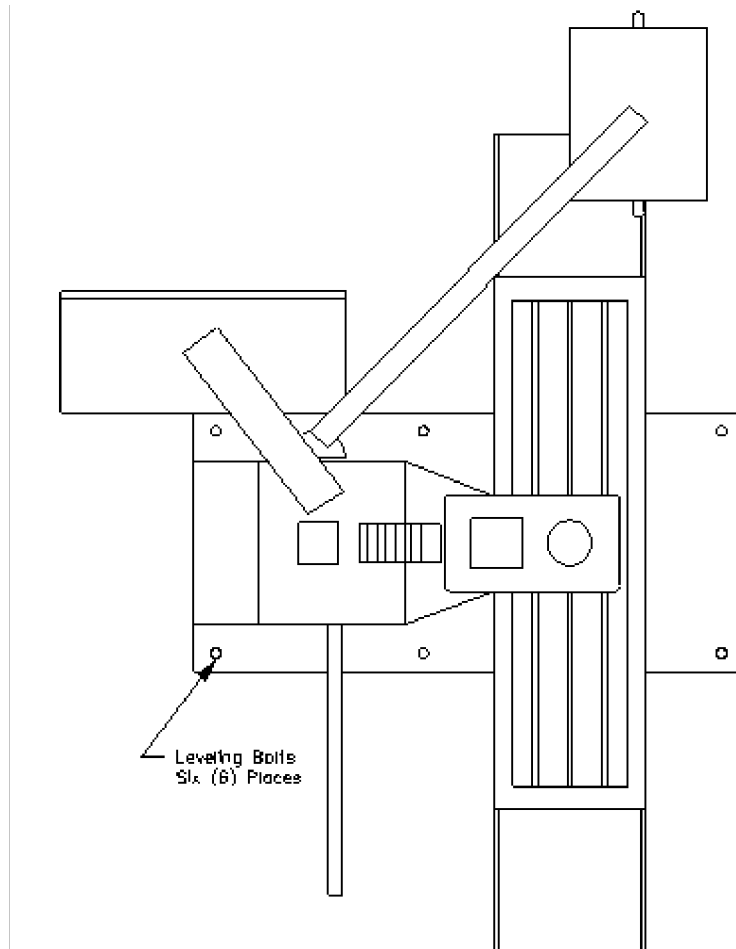
Leveling and Alignment

The following is a description of how to properly level and align the EM69P machine. These procedures should be followed in the order they written to obtain correct machine level and alignment.

Leveling the Machine

After uncrating the EM69P set it down in desired location with leveling bolts and leveling pads installed.

Remove the Y-Axis protective rubber located on the backside of the table. This is where you will position the level to level the machine. A .0005" increment per foot precision level is required.



(Illustration depicts the procedure described, but does not represent actual machine)

Using the four (4) corner leveling bolt to start with, bring the machine up to level in both directions (front to back and left to right) within .0005" per foot.

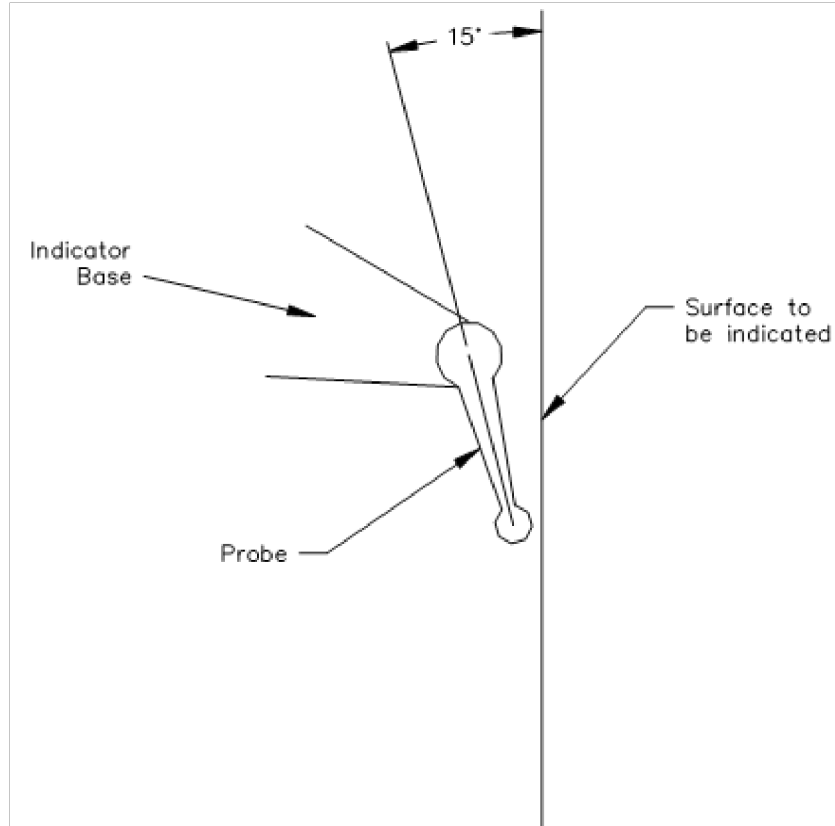
After you have leveled the bed using the four corner bolts, move to the middle leveling bolts. Bring these bolts down until they have approximately the same amount of pressure on them as them as the four corner bolts. Be careful not to throw the level of the machine off while doing this.

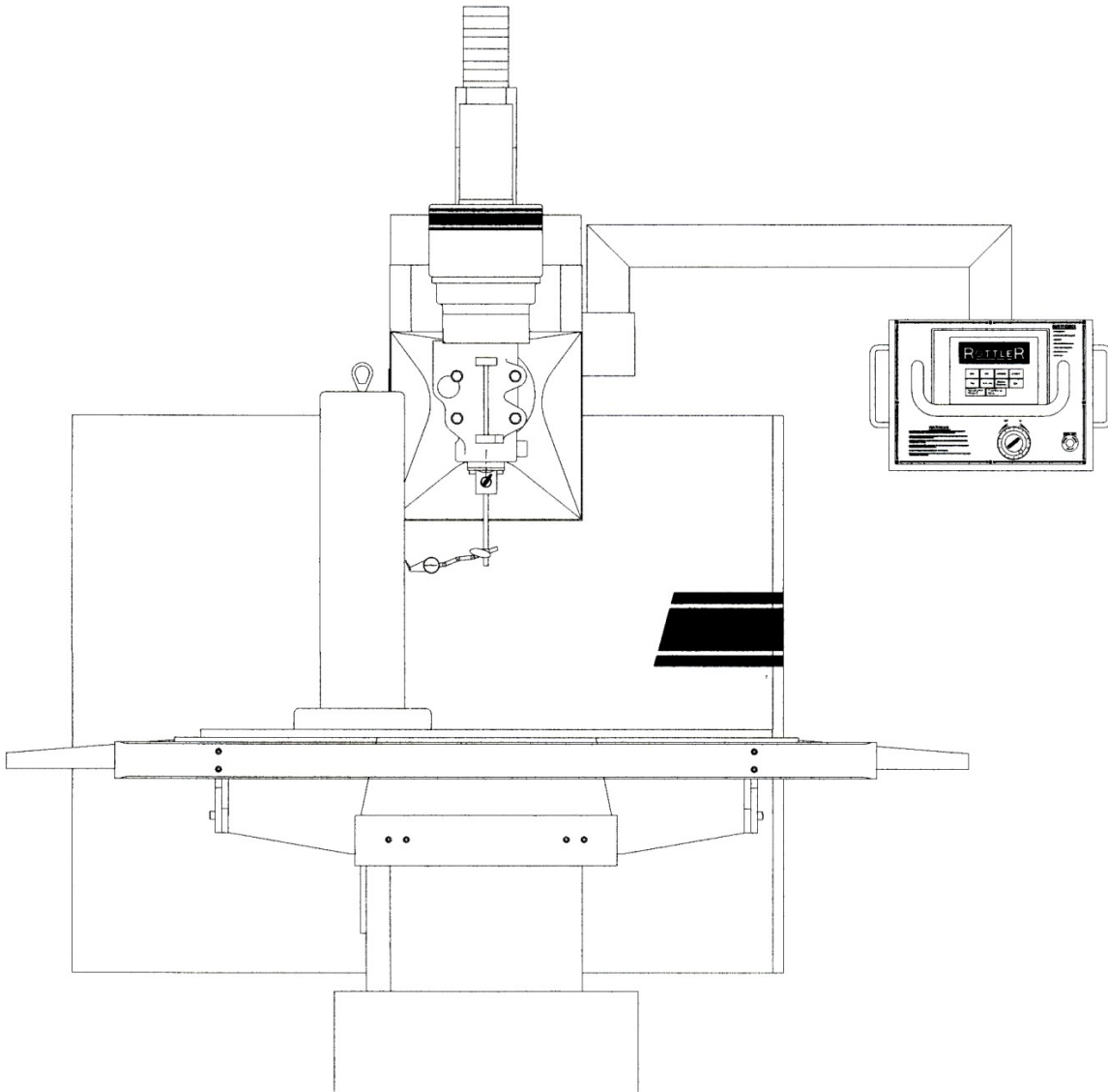
This will put the lower casting level.

Alignment

Place the alignment cylinder on the table in roughly the same position as shown on the following page.

Note: The position (angle) of the probe to the surface you are indicating is critical. Using an incorrect angle on the probe will result in inaccurate readings from the surface being indicated. The angle of the probe should be at about 15 degrees from the surface being indicated (see illustration 2).

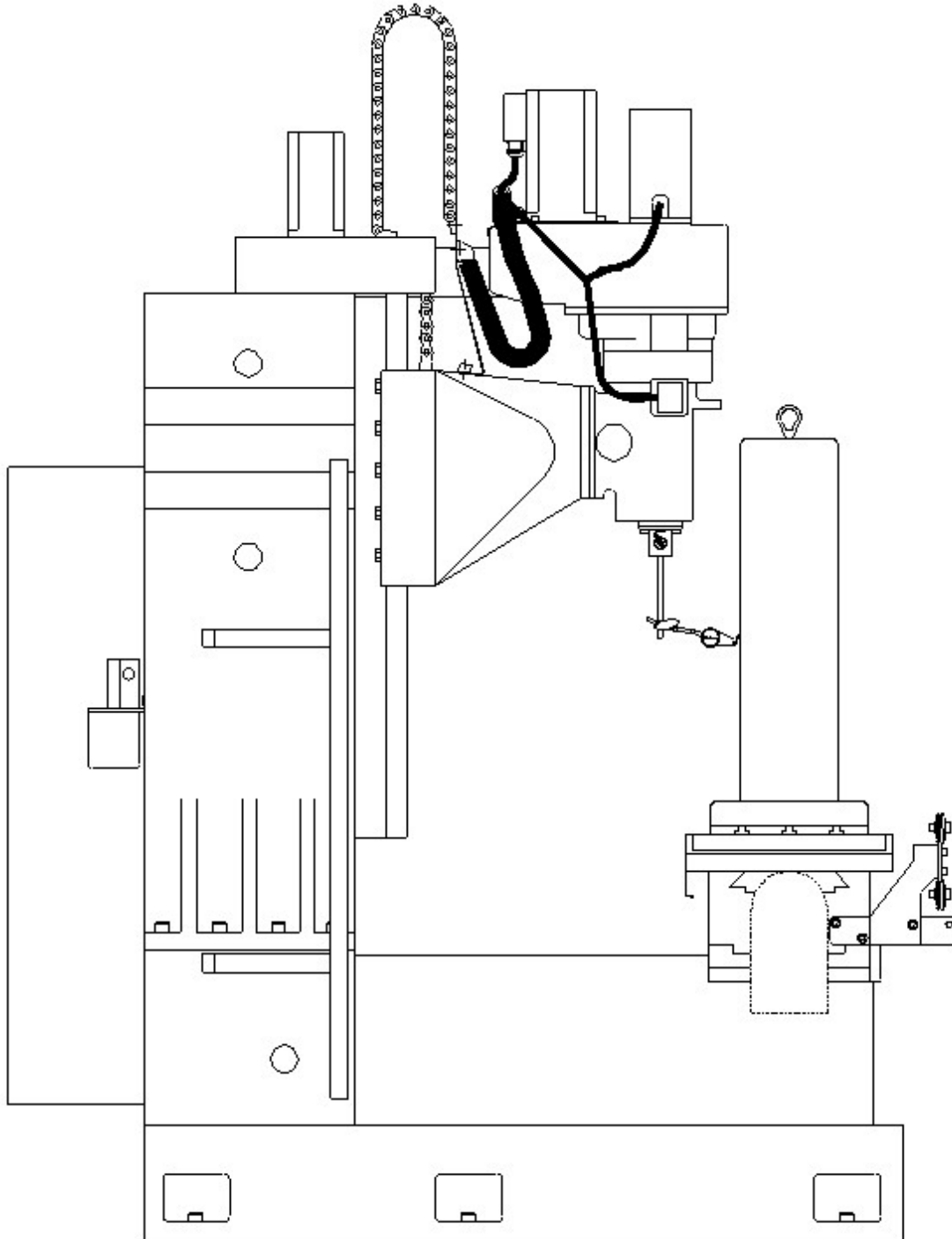




(Illustration depicts the procedure described, but does not represent actual machine)

Put about .010" pressure on the indicator. Run the vertical throughout its full travel. The runout should not be more than .0005. If the runout is more than this, check the table top as well as the bottom of the alignment cylinder for burrs or debris.

Move the table out and check the perpendicularity of the vertical ways. This should be within .0005".



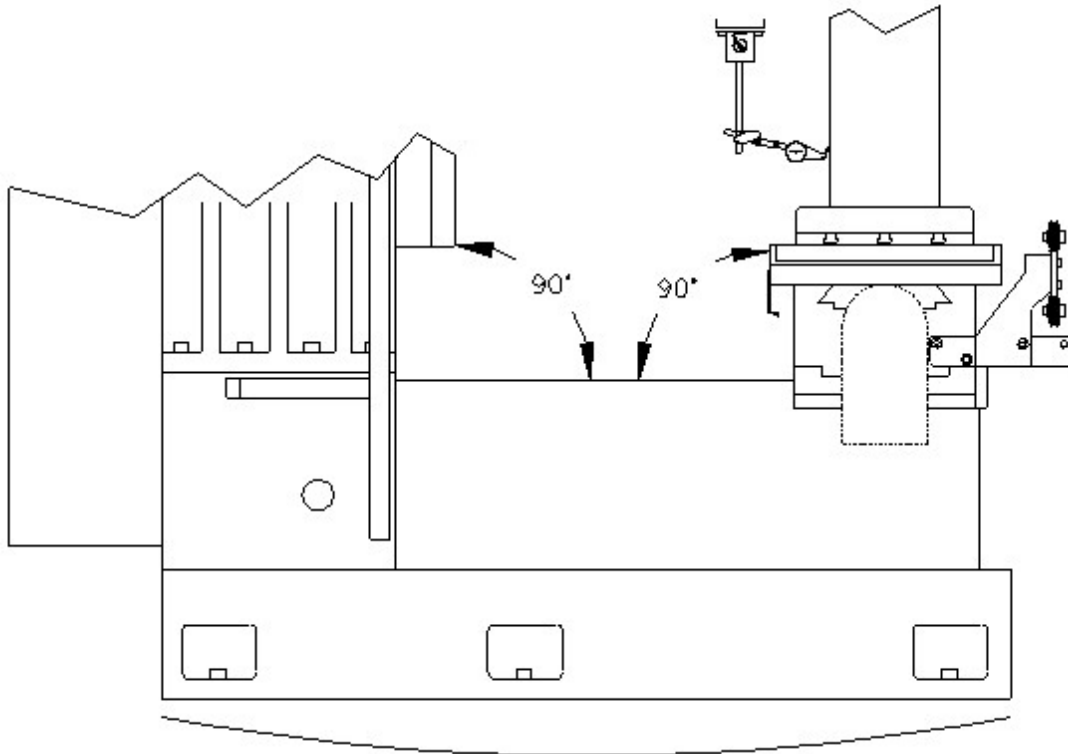
(Illustration depicts the procedure described, but does not represent actual machine)

If the Vertical perpendicularity is not within tolerance the Middle Leveling Bolts may need to be adjusted.

Middle Leveling Bolts

If the procedures for the Leveling was followed correctly, it is unlikely that the deviance from Front to Back is being caused by the Middle Leveling Bolts. The following are examples of what could be caused by incorrect pressure on the middle leveling bolts.

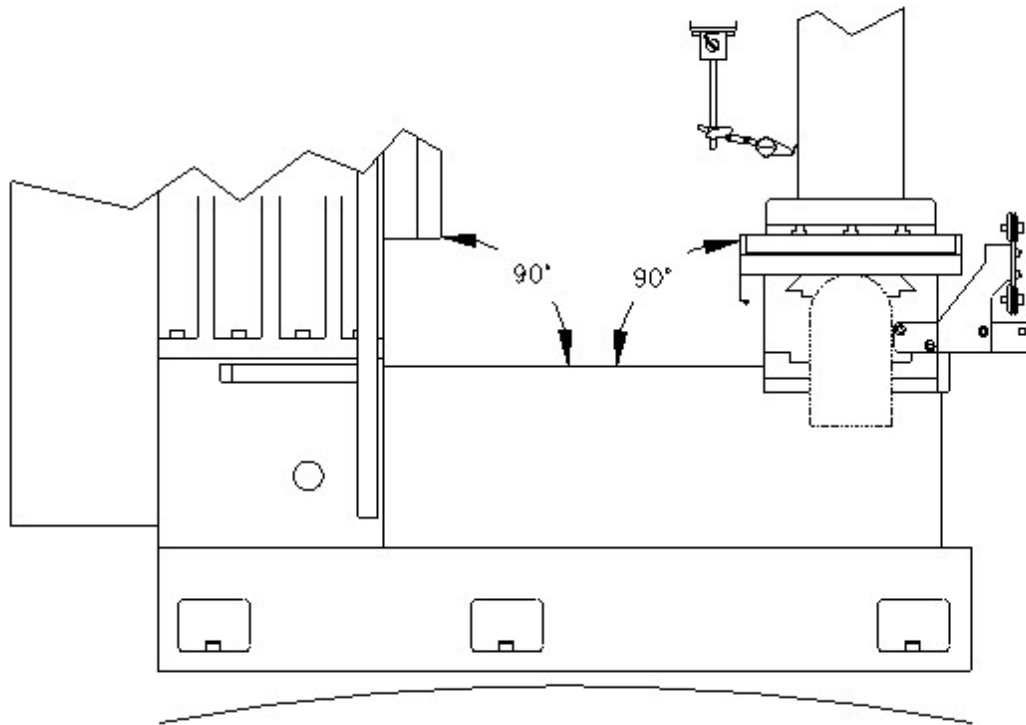
Example 1: Zero the indicator on the top of the cylinder. When traveling to the bottom of the cylinder, if the reading decreases past $-.001$ " to something such as $-.002$ ", then the middle leveling bolts have too little pressure on them and it is bowing the casting slightly in the middle as shown below.



The arched line underneath the picture is illustrating the bow to the casting if the middle leveling bolts have too little pressure on them.

To correct the deviance slowly add pressure to the middle bolts equally. Be sure to watch the level of the machine to be sure not to throw it off. After adding pressure from the middle bolts you can remove pressure from the front and rear corner bolts to bring the deviance within $.001$ ".

Example 2: Zero the indicator on the top of the cylinder. When traveling to the bottom of the cylinder, if the reading decreases past $+.001$ " to something such as $+.002$ ", then the middle leveling bolts have too much pressure on them and it is bowing the casting slightly in the middle as shown below.

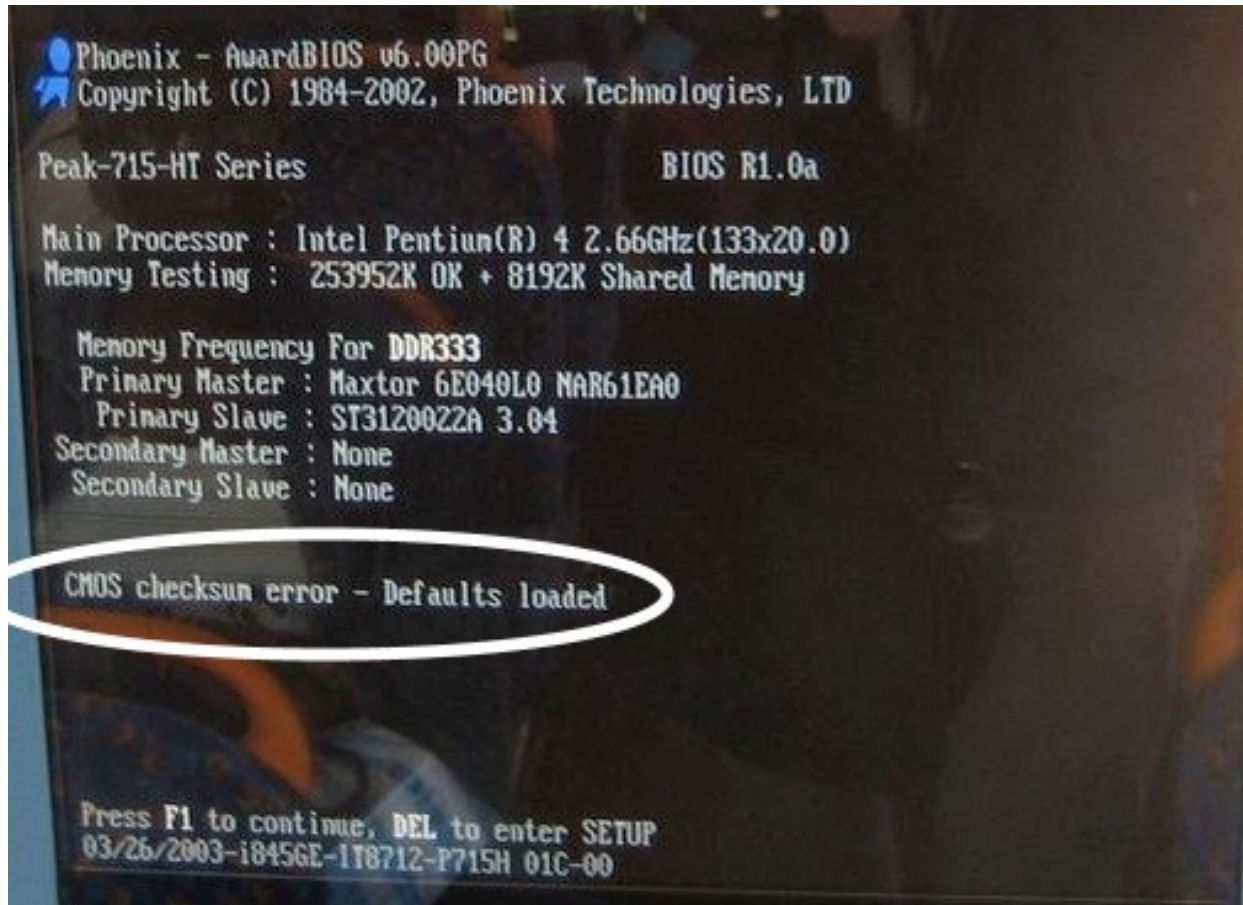


The arched line underneath the picture is illustrating the bow to the casting if the middle leveling bolts have too much pressure on them.

To correct the deviance slowly remove pressure from the middle bolts equally. Be sure to watch the level of the machine to be sure not to throw it off. After relieving pressure from the middle bolts you can apply slightly more pressure to the front corner bolts to bring the deviance within .001”.

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.

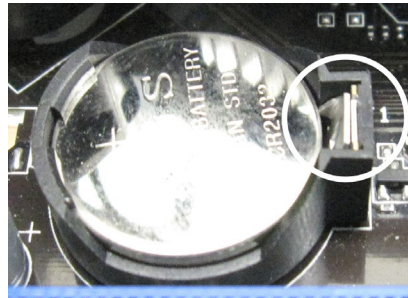
Remove the cover.



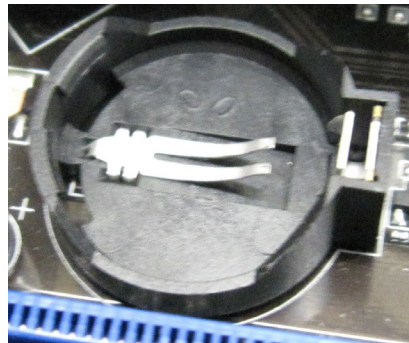
Locate the battery on the motherboard.



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.

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TROUBLESHOOTING

Problem:

Icon on screen does not move to area touched.

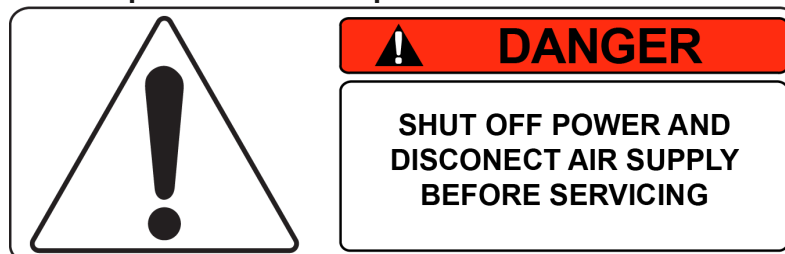
Solution:

Follow the procedure below to recalibrate the touchscreen.

1. Get to the Alignment screen.
 1. If an Elo icon is available in the tool tray at the lower right side of the desktop, click it, then click Align.
 2. Otherwise, go to the Windows Control Panel, double-click Elo Touchscreen and click the Align button on the General tab.
 1. If Windows XP and no Elo icon, click the "Switch to Classic View" button on the left
 2. If Windows 7 and no Elo icon, look for "View by: Category" text toward the upper right; click it and select "Small icons"
2. Touch and release the upper left target; the target should jump to the lower right.
3. Touch and release the lower right target; the target should jump to the upper right.
4. Touch and release the upper right target; a check screen should appear.
5. Touch and release the green check mark; the check screen should disappear.
6. The cursor should now jump to the point of touch.
7. If the Elo Control Panel is open, close it and the Windows Control Panel.

Problem:

Tool change was interrupted and not completed

**Solution:**

If a tool change is interrupted and not completed, the machine must be shut down. Disconnect the power supply and remove the air supply from the machine. Remove the tool by hand.

For further assistance in troubleshooting:

Please visit the service tab of our web page at Send a Service Request www.rottlermfg.com or contact the Rottler Factory Service at 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

MACHINE PARTS

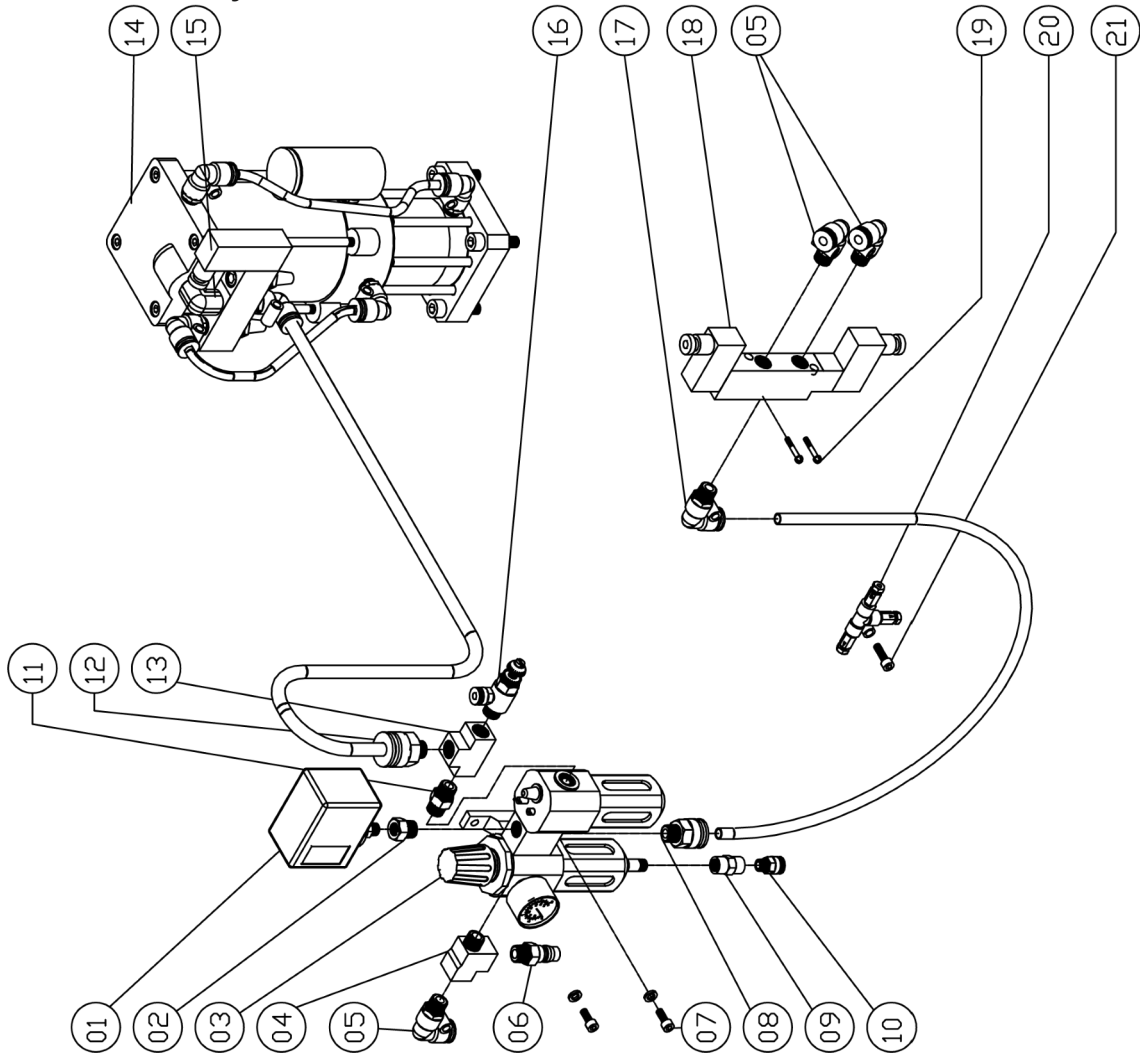
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Machine Parts

Air Control Assembly Parts

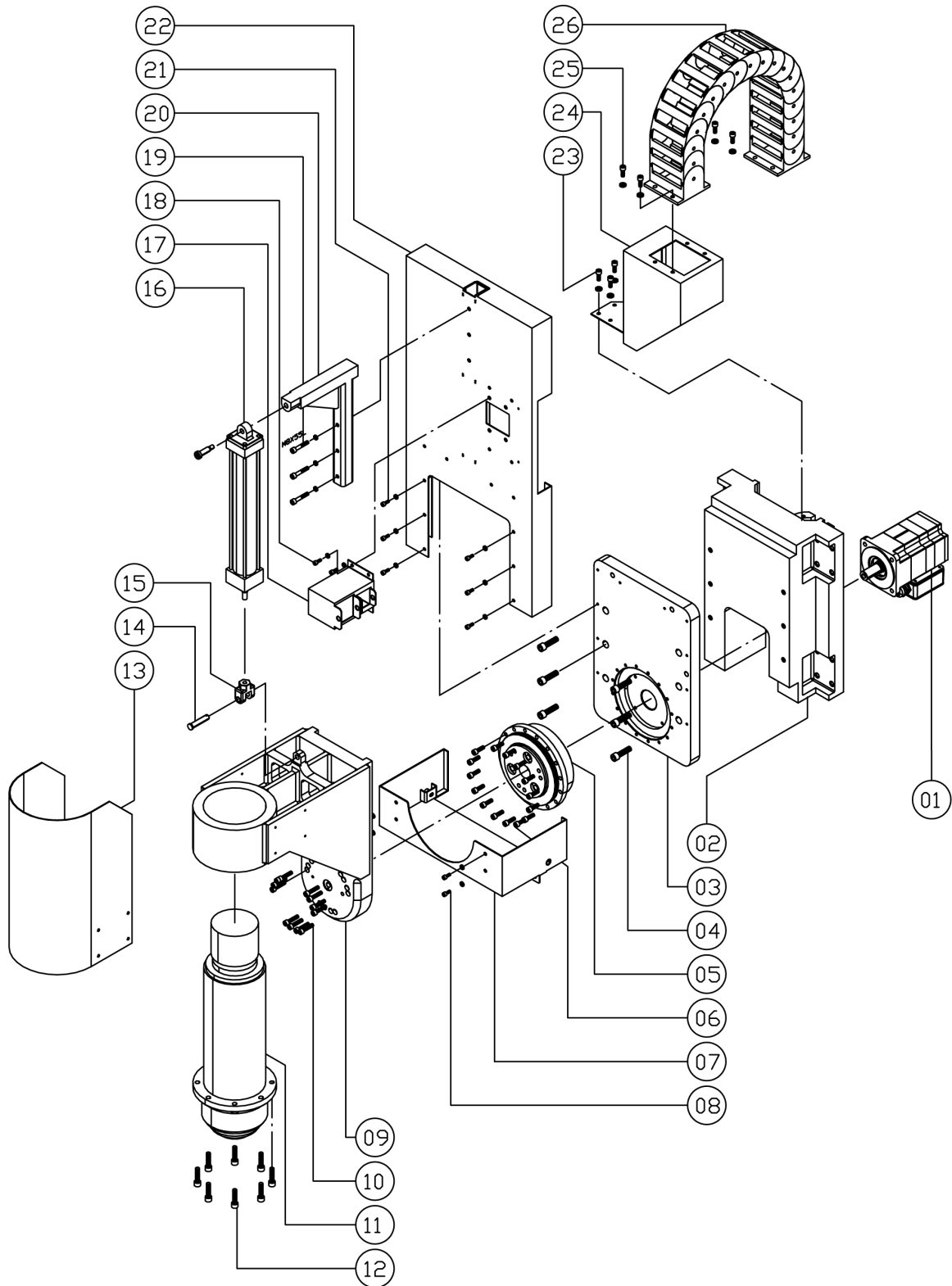
EM69P (Air Control Component Assembly)



EM69P Part List					
Air Control Component Assmebly					
	Part Number	Part Name	Specification	Qty	Remark
01		Gauge pressure switch	SAFE-S971	1	
02		Bushing	PT3/8xPF1/4	1	
03	MV13601020-7	3 Way connector	MACP300-10A	1	
04		Thread connector	PT3/8xPT3/8xPT3/8	1	
05		90° Quick joint	PT3/8x \varnothing 8	3	
06		Double hose end join	PT3/8x \varnothing 1/2"	1	
07		Cap Screw	M6x1Px16L	2	
08		Air quick connector	PT3/8x \varnothing 10	1	
09		Bushing	PT1/4xPT1/4	1	
10		Quick joint	PT1/4x \varnothing 6	1	
11		Joint	PT3/8xPT3/8	1	
12		Quick joint	PT3/8x \varnothing 12	1	
13		Three thread connector	PT3/8xPT3/8	1	
14		Air to oil cylinder	90~100kgf/Cm ² , 80C.C	1	
15		Air solenoid valve	4V310-10(DC21.6~26.4V)	1	
16		Quick joint	PT3/8x \varnothing 6	1	
17		90° Quick joint	PT3/8x \varnothing 10	1	
18		Air solenoid valve	MVSC-220-4E2(DC24V)	1	
19		Cross recessed pan head screw	M4x0.7Px45L	2	
20	EM-154-17	3 Way junction		1	
21		Cap Screw	M6x1Px25L	1	

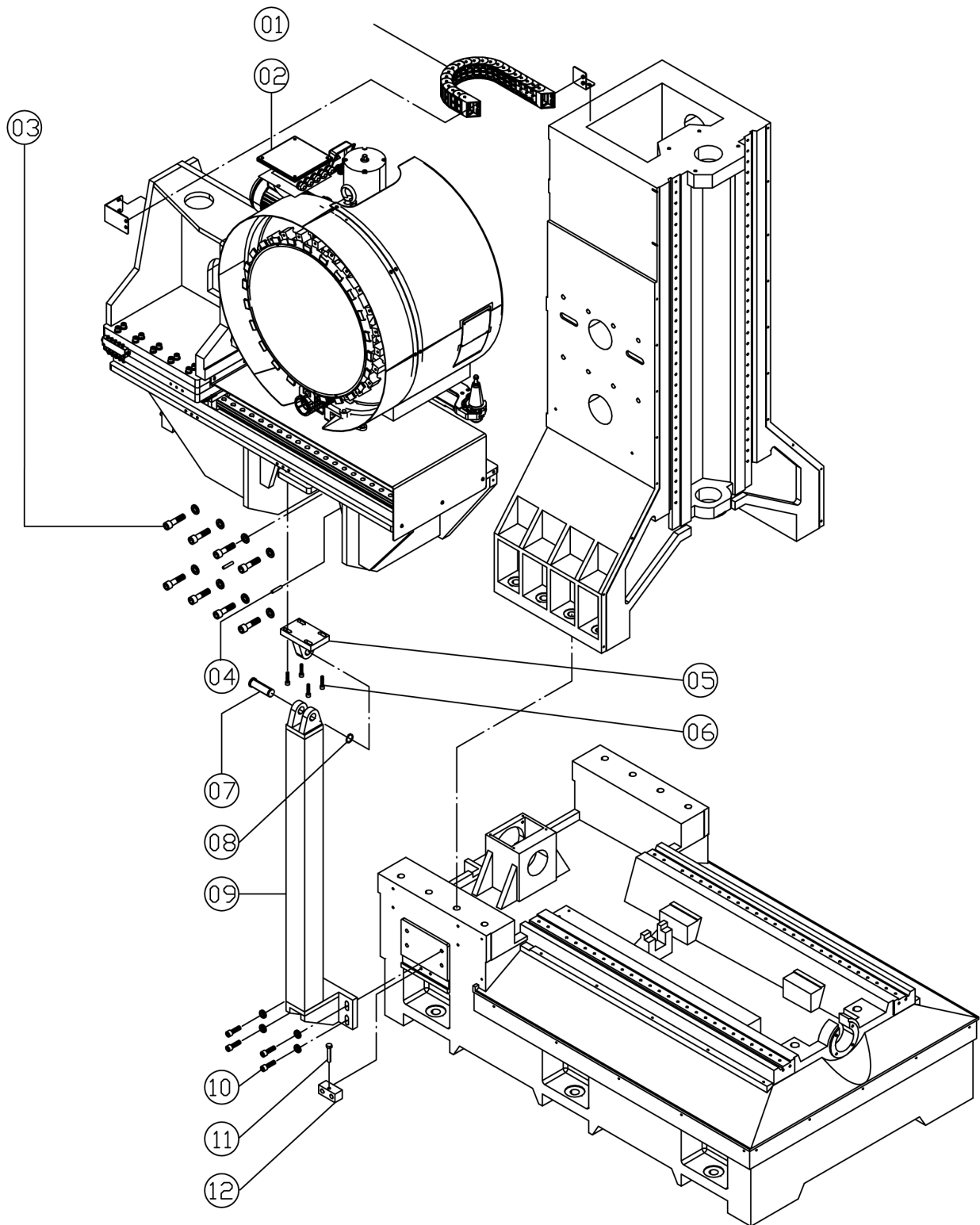
Spindle Head Assembly Parts

EM69P (Spindle Head Assembly)



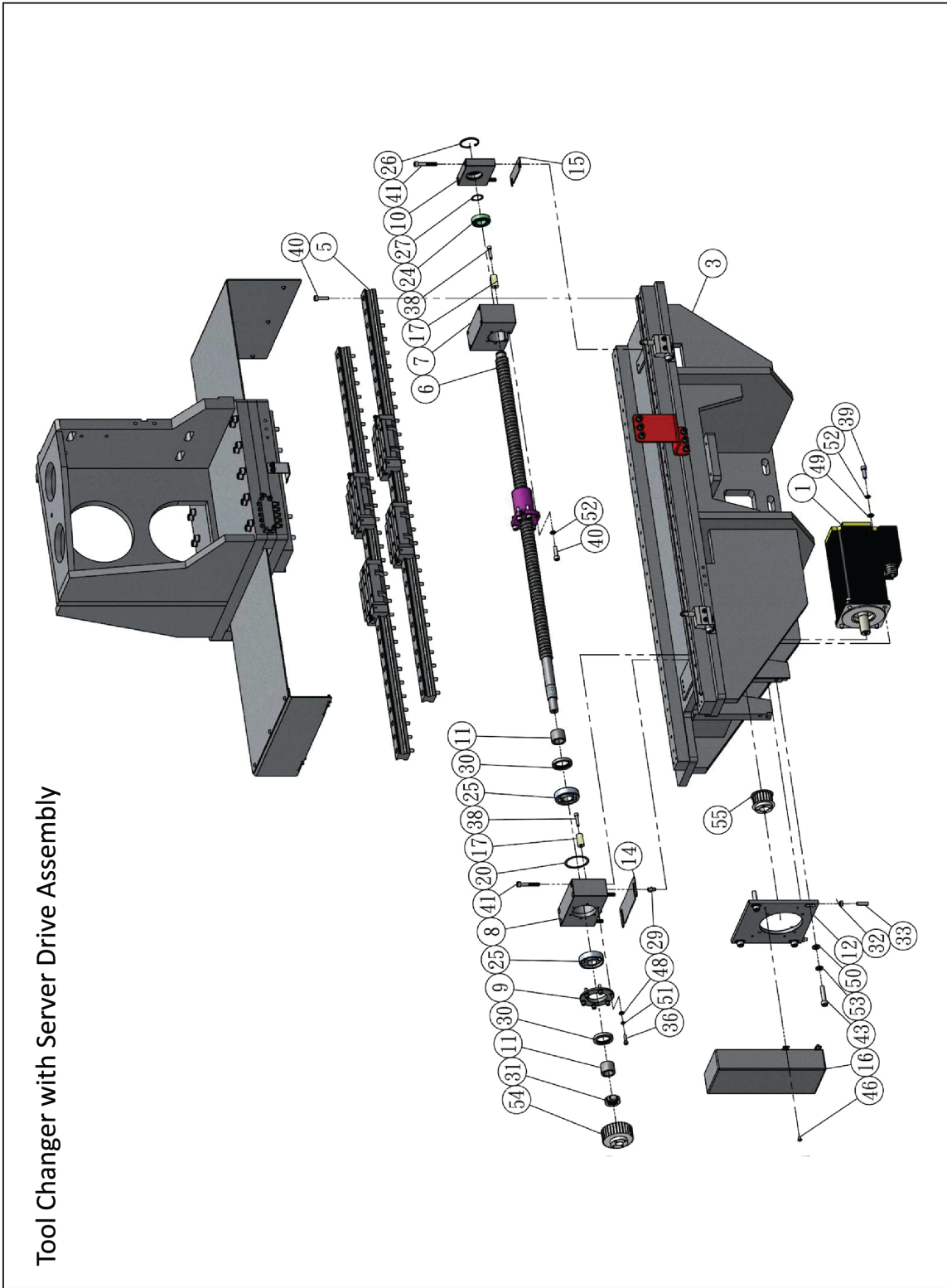
EM69P Part List					
Spindle Head Assembly					
	Part Number	Part Name	Specification	Qty	Remark
01		B-Axis Server Motor	BSM90N-1250	1	
02	8554010	Mount Block		1	
03		Adaptor	5540	4	
04		Cap screw	M12x1.75Px45L	6	
05		Gear Reducer	5538A	1	
06		Cap screw	5/16-18UNC-1.18"	16	
07		Lower Cover		4	
08		Button Head Cap Screws	1/4-20UNC-0.375"	1	
09		Spindle Motor Mount	5541	4	
10		Cap screw	5/16-18UNC-1.38"	1	
11		Built in Spindle		1	
12		Cap screw	M10x1.5Px40L	8	
13		Spindle Cover		1	
14		Shaft		1	
15		Connector		1	
16		Cylinder		1	
17		Cable Chain Bracket	5544A	1	
18		Cap screw	M6x1Px16L	4	
19		Cap screw	5/16-18UNC-2.25"	3	
20		Upper Cylinder Pivot Mount		1	
21		Cap screw	1/4-20UNC-0.375"	6	
22		Cover	5544	3	
23		Cap screw	M6x1Px16L	4	
24		Cable Chain Bracket		1	
25		Cap screw	M6x1Px16L	4	
26	8540260	Cable Chain		4	

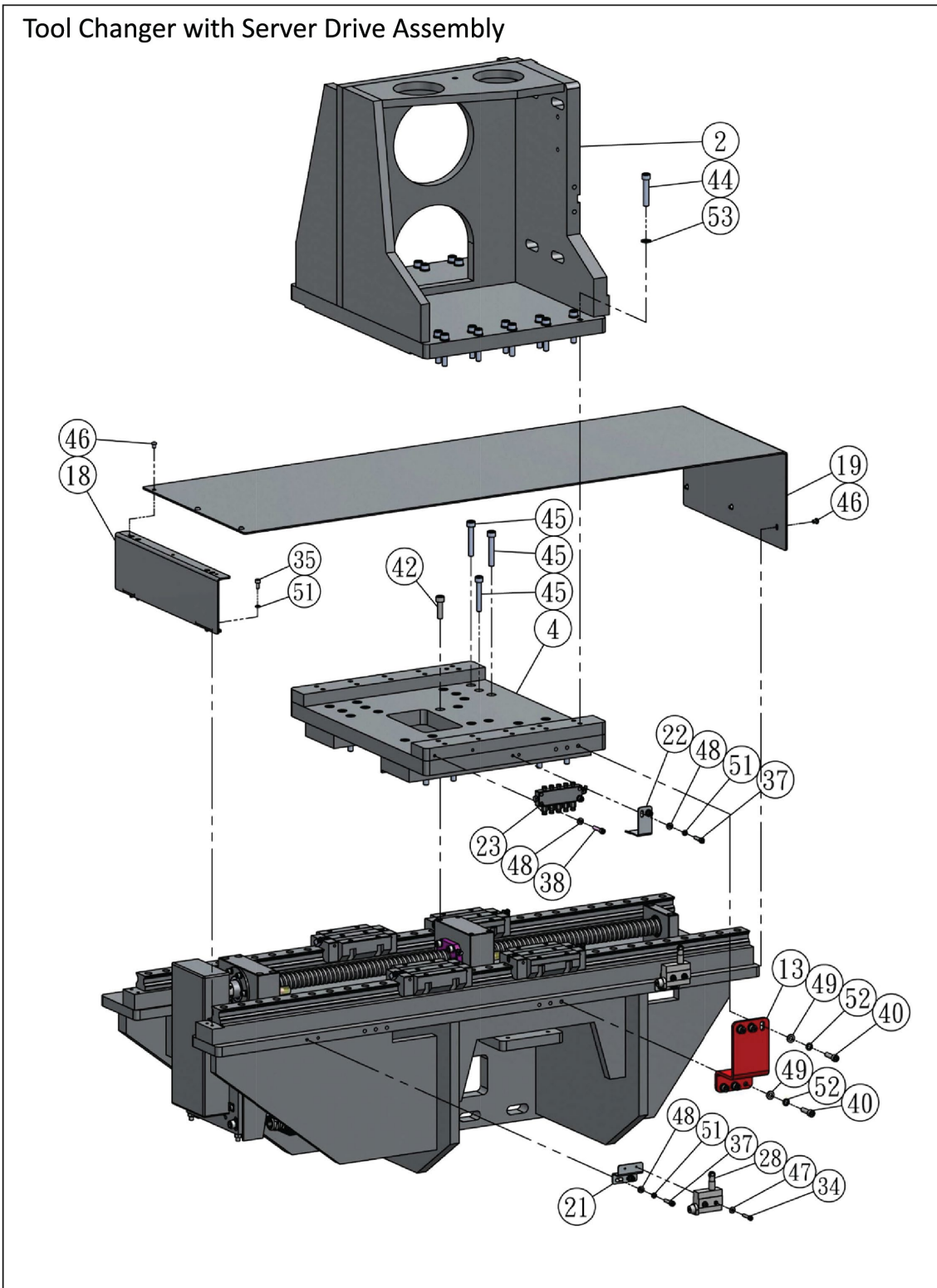
Tool Changer Assembly Parts
EM69P (Tool Changer System Assembly)



EM69P Part List					
Tool Changer System Assembly					
	Part Number	Part name	Specification	Qty	Remark
01	8560160	Cable Chain	SQ303-I-KR100-L1020-NO2	1	
02	GR0003-DK40#CAT24T-C	Tool Changer System	CAT40 - 24Tool	1 Set	
03		Cap Screw	M16x2.0Px55L	8	
04		Location Pin	φ 8X40L	2	
05	8560110	Connector Plate		1	
06		Cap Screw	M8x1.25Px35L	4	
07	8560120	Shaft		1	
08		Retaining Rings-C Type	S25	1	
09	8560100	Tool Changer Support		1	
10		Cap Screw	M12x1.75Px40L	4	
11		Hex Head Bolt	M10X1.5PX60L	1	
12	MV13440160	Adjustment Block		1	

Tool Changer Server Drive Assembly Parts

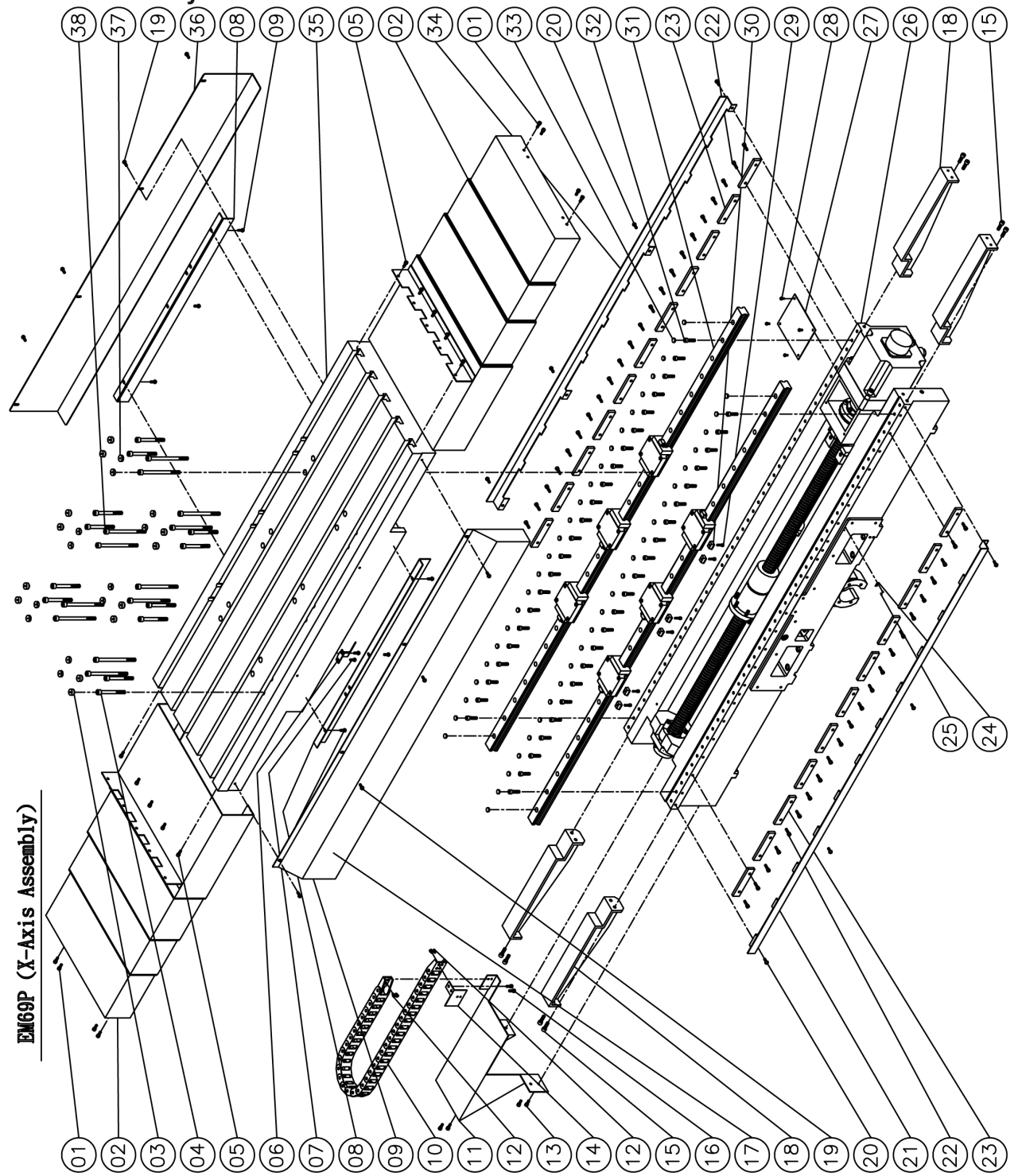




EM69P Part List					
Tool Changer With Server Drive Assembly					
	Part Number	Part Name	Specification	Qty	Remark
01		Server Motor		1	
02	DF0173301	Tool Changer Mount Block		1	
03	DF0173401	Bracket		1	
04	DF0173501	Slide Block		1	
05	DG0101901	Linear Guideway	MAR35LE 1195L	2	
06	DG0102001	Ballscrew	FSIN3210 1053L	1	
07	DG0102101	Ballscrew Nut Housing		1	
08	DG0102201	Bearing Housing		1	
09	DG0102301	Push Plate		1	
10	DG0102401	Bearing Housing		1	
11	DG0102501	Spacer		2	
12	DG0102601	Motor Adaptor		1	
13	DG0102701	Shipping Plate		1	
14	DG0102801	Shim A		1	
15	DG0102901	Shim B		1	
16	DG0103001	Cover		1	
17	DG0103101	Bumper		4	
18	DG0103201	Bracket		1	
19	DG0103301	Ballscrew Cover		1	
20	DG0103501	Shim Ring		1	
21	DG0103601	Limit Switch Bracket		2	
22	DG0103701	Cam		1	
23	DB-6A	Grease Nipple Distributor		1	
24	BA6005-J-020	Bearing	BA6005(NACHI)	1	
25	BA7305B	Bearing	BA7305B	2	
26	CI047	Retaining Ring-C Type	R47	1	

27	CO025	Retaining Ring-C Type	S25	1	
28	LM-CT-7311	Limit Switch		2	
29	PIN0820	Pin	Ø8x20L	2	
30	TC03505008	Oil Seal	35x50x8	2	
31	YSRM2515	Luck Nut	M25x1.5P	1	
32	M08125008	NUT	M8x1.25Px8L	2	
33	MA08125030	Set Crew	M8x1.25Px30L	2	
34	MI05080025	Cap Screw	M5x0.8Px25L	4	
35	MI06100012	Cap Screw	M6x1.0Px12L	4	
36	MI06100020	Cap Screw	M6x1.0Px20L	6	
37	MI06100025	Cap Screw	M6x1.0Px25L	6	
38	MI06100030	Cap Screw	M6x1.0Px30L	6	
39	MI08125025	Cap Screw	M8x1.25Px25L	4	
40	MI08125030	Cap Screw	M8x1.25Px30L	72	
41	MI08125050	Cap Screw	M8x1.25Px50L	6	
42	MI10150035	Cap Screw	M10x1.5Px35L	4	
43	MI10150045	Cap Screw	M10x1.5Px45L	4	
44	MI10150055	Cap Screw	M10x1.5Px55L	20	
45	MI10150060	Cap Screw	M10x1.5Px60L	24	
46	MR06100008	Button Head Cap Screw	M6*1.0P*8L	10	
47	W05	Washer	M5	4	
48	W06	Washer	M6	14	
49	W08	Washer	M8	10	
50	W10	Washer	M10	4	
51	WS06	Speing Washer	M6	16	
52	WS08	Speing Washer	M8	16	
53	WS10	Speing Washer	M10	24	
54	EM-303A	Pulley	8Mx32T	1	
55	DL-1018B	Pulley	8Mx20T	1	

X-Axis Assembly Parts

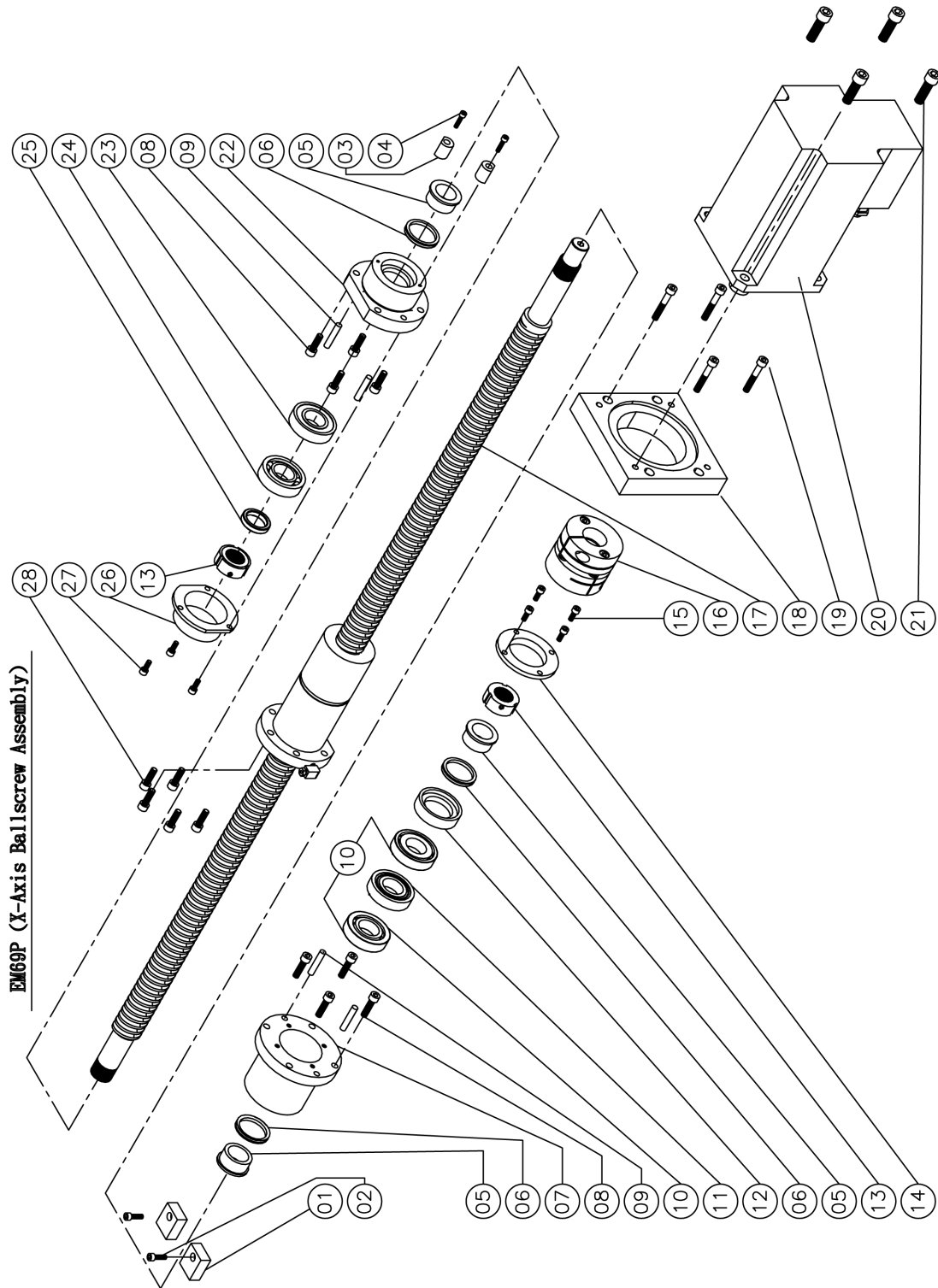


EM69P (X-Axis Assembly)

EM69P Part List					
X-Axis Assembly					
	Part Number	Part name	Specification	Qty	Remark
01		Cap Screw	M6x1Px16L	8	
02	10521220	X Telescopic Covers		2	
03	7520251	Copper Bolt Cap		12	
04		Cap Screw	M10x1.5Px95L	12	
05		Cap Screw	M6x1Px20L	10	
06	10520340	Origin Indicator		1	
07		Cap Screw	M6x1Px14L	2	
08	10520331	Guideway Cover		2	
09		Cap Screw	M6x1Px14L	6	
10		Cable Chain	SQ603xIIIxKR75x1020L	1	
11	10520200	Cable Chain Support		1	
12		Cap Screw	M5x0.8Px8L	4	
13		Cap Screw	M6x1Px14L	4	
14	10520211	Cable Chain Bracket		1	
15		Cap Screw	M8x1.25Px25L	8	
16		Cap Screw	M6x1Px14L	2	
17	10520250	Table Cover		1	
18	10520230	Telescopic Covers Bracket		4	
19		Button Head Cap Screws	M6x1Px14L	8	
20		Button Head Cap Screws	M6x1Px14L	8	
21	10520300	Guideway Cover		1	
22		Cap Screw	M6x1Px20L	44	
23	10531030	Push Plate		22	
24	CE-0050	Origin		1	
25		Rivet	∅2x5L	2	
26	10531013	Saddle		1	

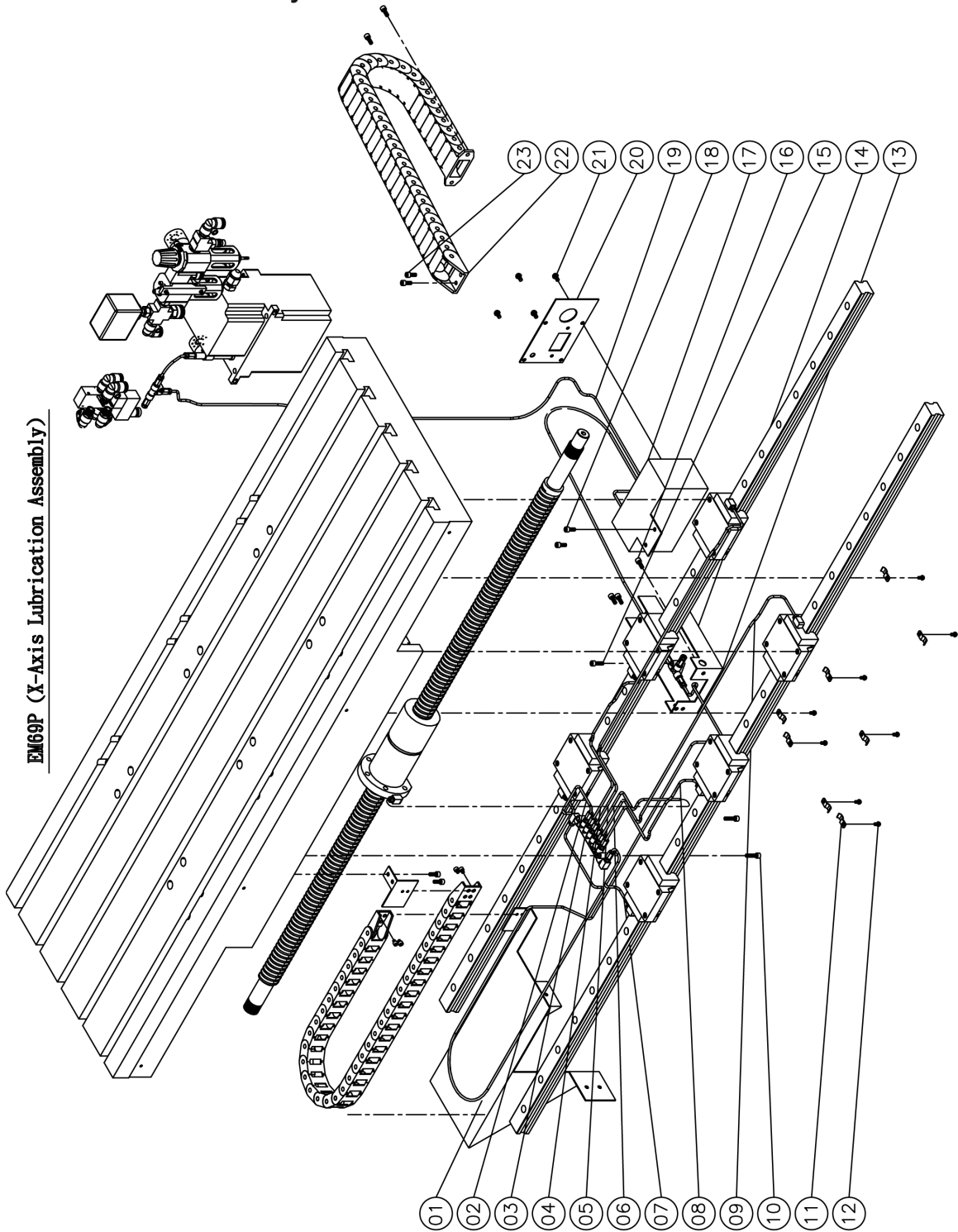
27	10520280	Plate		1	
28		Button Head Cap Screws	M5x0.8Px12L	4	
29		Cap Screw	M5x0.8Px16L	6	
30		Tapper Gib	T1	6	
31	10521021	Linear Guideway		2	
32		Cap Screw	M8x1.25Px35L	90	
33		Bolt Cap	C8	98	
34	10520310	Guideway Cover		1	
35	10521010	Table		1	
36	10521320	Table Cover		1	
37	7520251	Copper Bolt Cap		12	
38		Cap Screw	M10x1.5Px145L	12	

X-Axis Ballscrew Assembly Parts



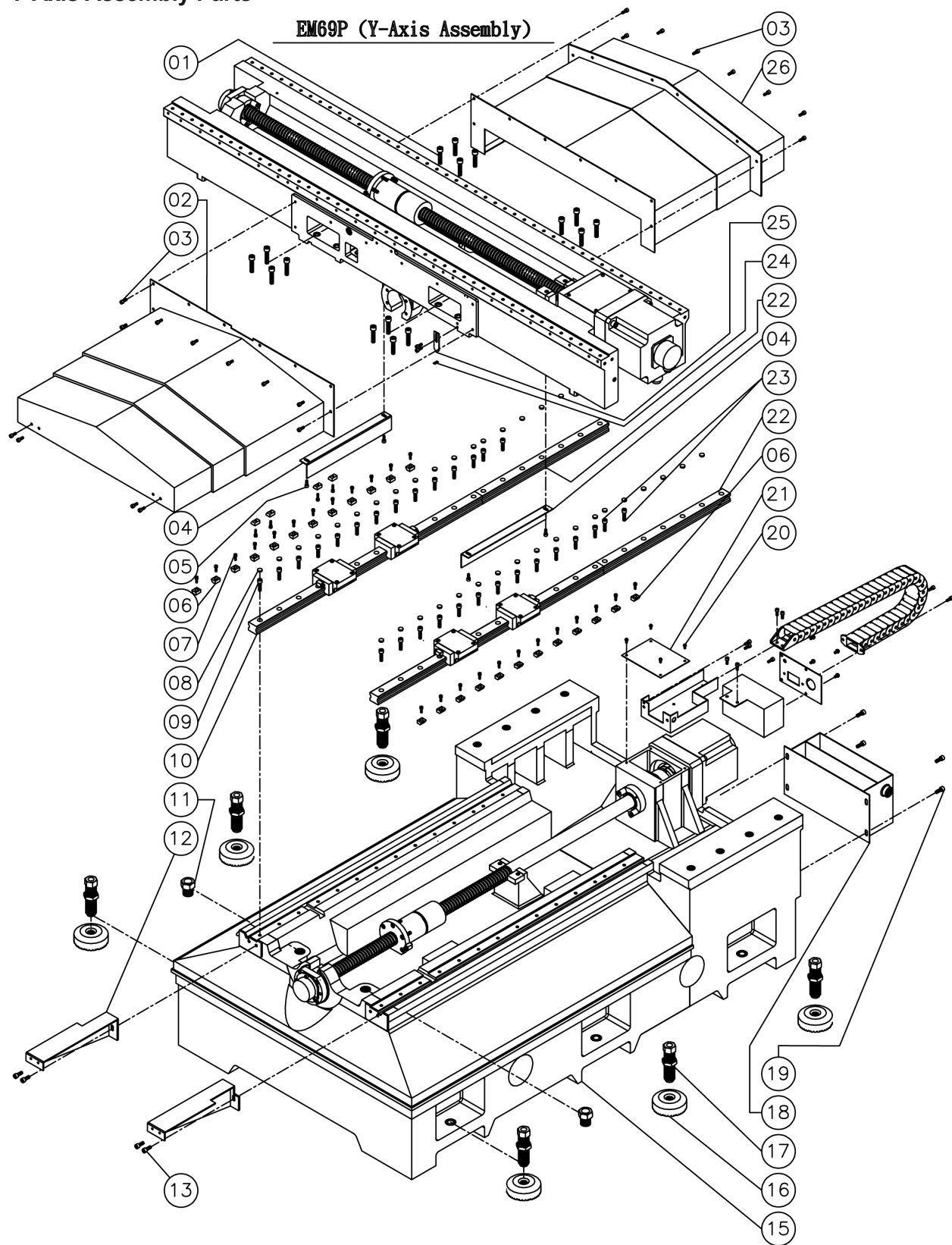
EM69P Part List					
X-Axis Ballscrew Assembly					
	Part Number	Part Name	Specification	Qty	Remark
01	7530070	Bumper		2	
02		Cap Screw	M6x1Px20L	2	
03	7520171	Bumper		2	
04		Cap Screw	M5x0.8Px20L	2	
05	8521090	Spacer		3	
06		Oil Seal	V-40A	3	
07	7520032	Bearing Housing		1	
08		Cap Screw	M8x1.25Px30L	8	
09		Location Pin	∅8x40L	4	
10	Q-30TAC62C	Bearing	30TAC62C(DB)	2	
11	8521190	Spacer		1	
12	7520051	Spacer		1	
13		Lock Nut	YSF30-M30x1.5P	2	
14	7520062	Push Plate		1	
15		Cap Screw	M6x1Px16L	4	
16	8541120	Coupling		1	
17	1052040	X-Axis Ballscrew		1	
18	8520120	Motor Adaptor		1	
19		Cap Screw	M8x1.25Px50L	4	
20		Server Motor	BSM100C-3150	1	
21		Cap Screw	M12x1.75Px40L	4	
22	8521081	Bearing Housing		1	
23	Q-6206Z	Bearing	6206Z	1	
24	Q-7206BW	Bearing	7206BW	1	
25	MV13200080	Spacer		1	
26	MV13200110	Cover		1	
27		Cap Screw	M6x1Px12L	3	
28		Cap Screw	M8x1.25Px25L	5	

X-Axis Lubrication Assembly Parts



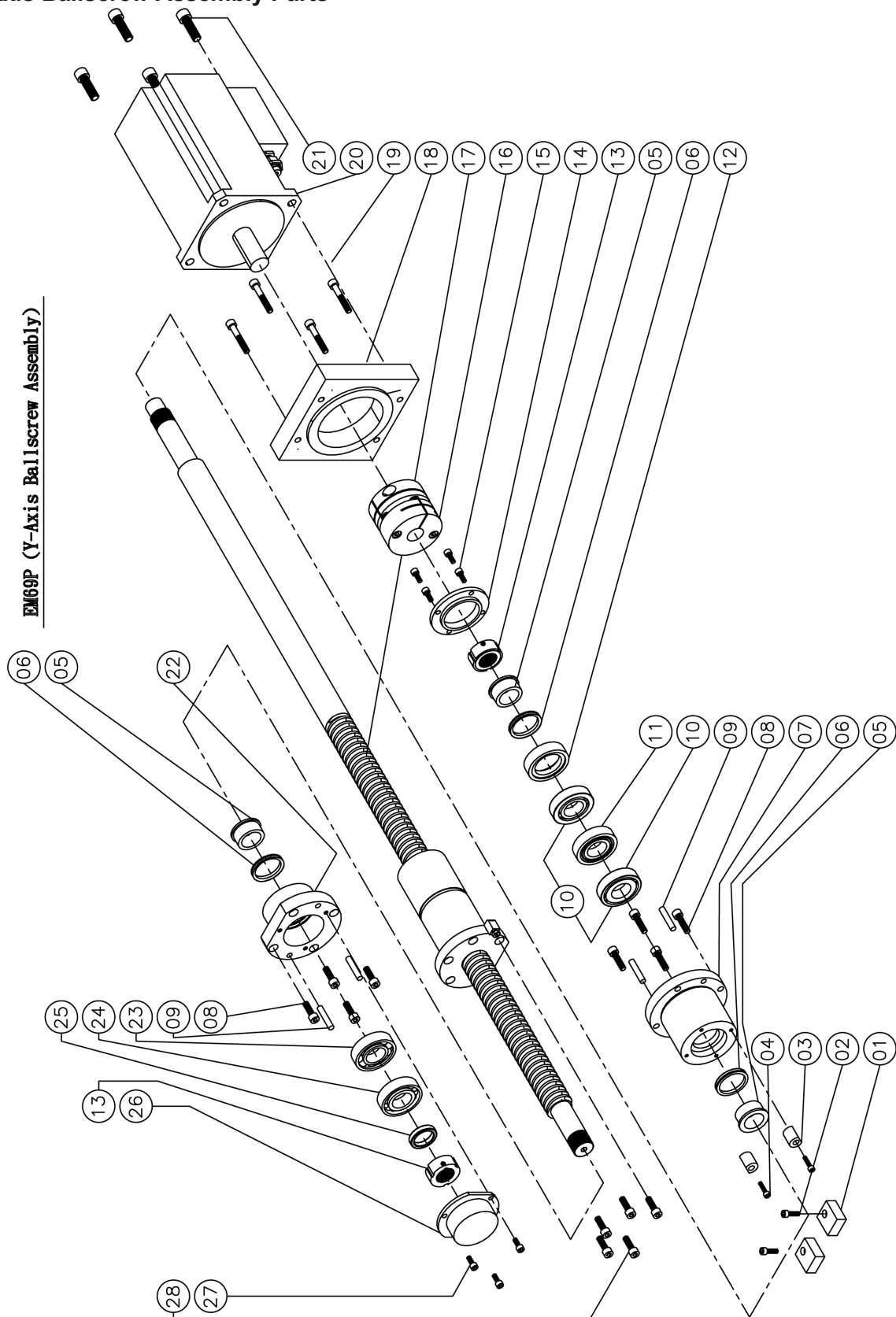
EM69P Part List					
X-Axis Lubrication Assembly					
	Part Number	Part Name	Specification	Qty	Remark
01		Nylon Pipe	∅4x2400L	1	
02		Nylon Pipe	∅4x280L	1	
03	EM-154-29	Volume Distributor		1	
04		Nylon Pipe	∅4x480L	1	
05		Nylon Pipe	∅4x940L	1	
06		Nylon Pipe	∅4x315L	1	
07		Nylon Pipe	∅4x250L	1	
08		Nylon Pipe	∅4x460L	1	
09		Nylon Pipe	∅4x930L	1	
10		Cap Screw	M6x1Px25L	2	
11		Pipe Clamps	∅4	8	
12		Button Head Cap Screws	M5x0.8Px12L	8	
13	7530242	Cable Chain Bracket		1	
14	EM-154-17	3 Way Junction		1	
15		Cap Screw	M6x1Px25L	1	
16		Cap Screw	M6x1Px16L	3	
17	7530172	Cable Chain Bracket		1	
18		Cap Screw	M6x1Px16L	2	
19		Nylon Pipe	∅4x2700L	1	
20	7530172-1	Plate		1	
21		Button Head Cap Screws	M6x1Px12L	4	
22	7530150	Cable Chain	SQ303-I-KR100-850L-No1	1	
23		Cap Screw	M6x1Px14L	4	

Y-Axis Assembly Parts



EM69P Part List					
Y-Axis Assembly					
	Part Number	Part Name	Specification	Qty	Remark
01		Cap Screw	M10x1.5Px45L	16	
02	7530112	Y Telescopic Cover(Front)		1	
03		Cap Screw	M6x1Px16L	16	
04	8520391	Cover		2	
05		Cap Screw	M6x1Px16L	4	
06		Tapper Gib	T1	46	
07		Cap Screw	M5x0.8Px16L	46	
08		Bolt Cap	C8	60	
09		Cap Screw	M8x1.25Px30L	24	
10	7531020	Linear Guideway		2	
11		Hex Head Bolt	M30x3.5Px25L	2	
12	7530123	Telescopic Cover Bracket		1 set	
13		Cap Screw	M8x1.25Px20L	4	
14					
15	7531033	Base		1	
16	ECL-10600	Leveling pads		6	
17	7530280	Leveling bolts		6	
18	7530061	Oil/Water Separating Tank		1	
19		Cap Screw	M8x1.25Px20L	4	
20		Button Head Cap Screws	M5x0.8Px12L	4	
21	7520100	Plate		1	
22	7531180	Linear Guideway		2	
23		Cap Screw	M8x1.25Px30L	4	
24	CE-0050	Origin		1	
25	7530221	Origin Indicator		1	
26	7530132	Y Telescopic Cover(Behind)		1	

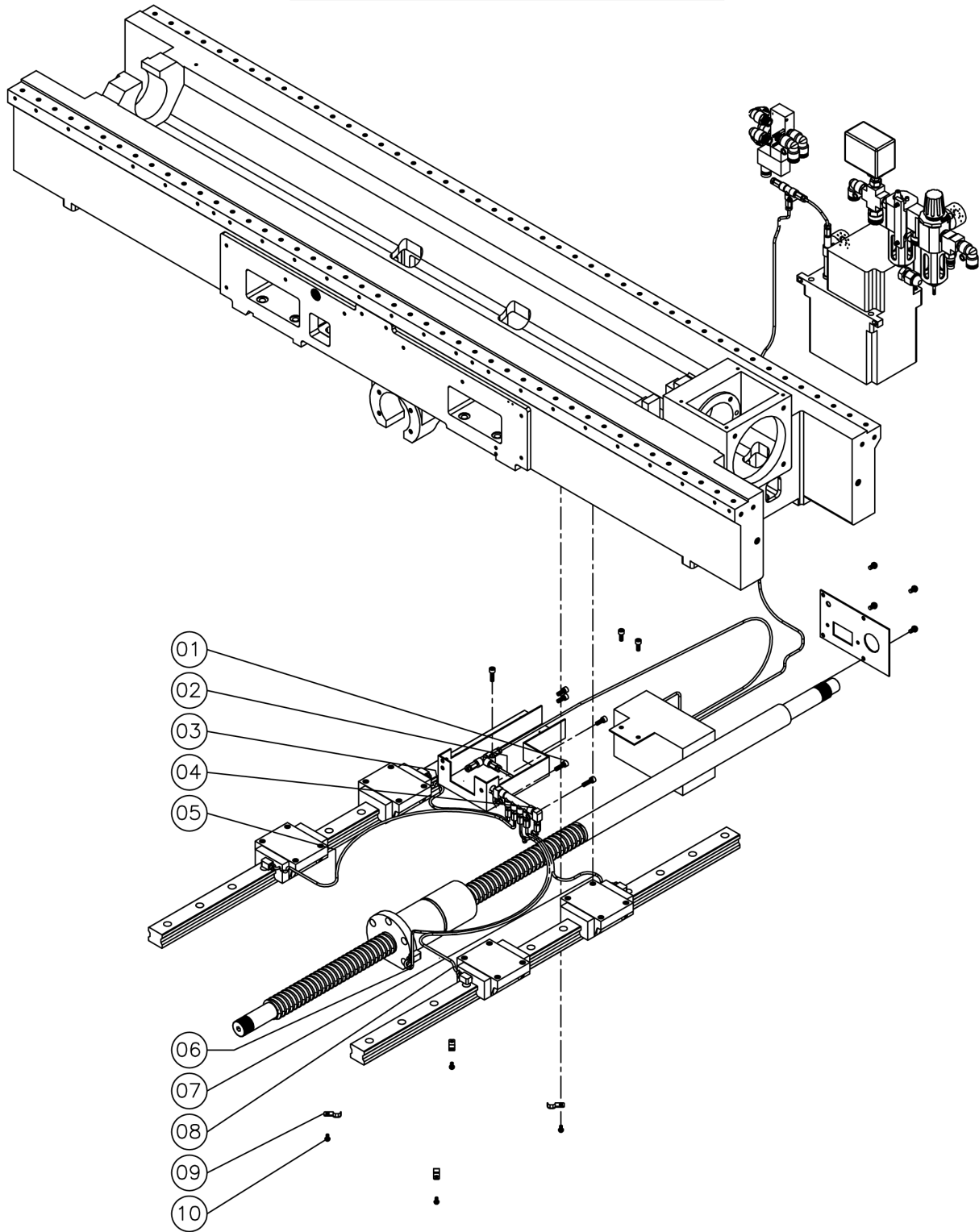
Y-Axis Ballscrew Assembly Parts



EM69P (Y-Axis Ballscrew Assembly)

EM69P Part List					
Y-Axis Ballscrew Assembly					
	Part Number	Part Name	Specification	Qty	Remark
01	7530070	Bumper		2	
02		Cap Screw	M6x1Px20L	2	
03	7520171	Bumper		2	
04		Cap Screw	M5x0.8Px20L	2	
05	8521090	Spacer		3	
06		Oil Seal	V-40A	3	
07	7520032	Bearing Housing		1	
08		Cap Screw	M8x1.25Px30L	8	
09		Location Pin	∅8x40L	4	
10	Q30TAC62C	Bearing	30TAC62C(DB)	2	
11	8521190	Spacer		1	
12	7520051	Spacer		1	
13		Lock Nut	YSF30-M30x1.5P	2	
14	7520062	Push Plate		1	
15		Cap Screw	M6x1Px16L	4	
16	8541120	Coupling		1	
17	7531040	Y-Axis Ballscrew		1	
18	8520120	Adaptor		1	
19		Cap Screw	M8x1.25Px50L	4	
20		Server Motro	BSM100C-3150	1	
21		Cap Screw	M12x1.75Px40L	4	
22	8521081	Bearing Housing		1	
23	Q-6206Z	Bearing	6206Z	1	
24	Q-7206BW	Bearing	7206BW	1	
25	MV13200080	Spacer		1	
26	MV13200110	Cover		1	
27		Cap Screw	M6x1Px12L	3	
28		Cap Screw	M8x1.25Px25L	5	

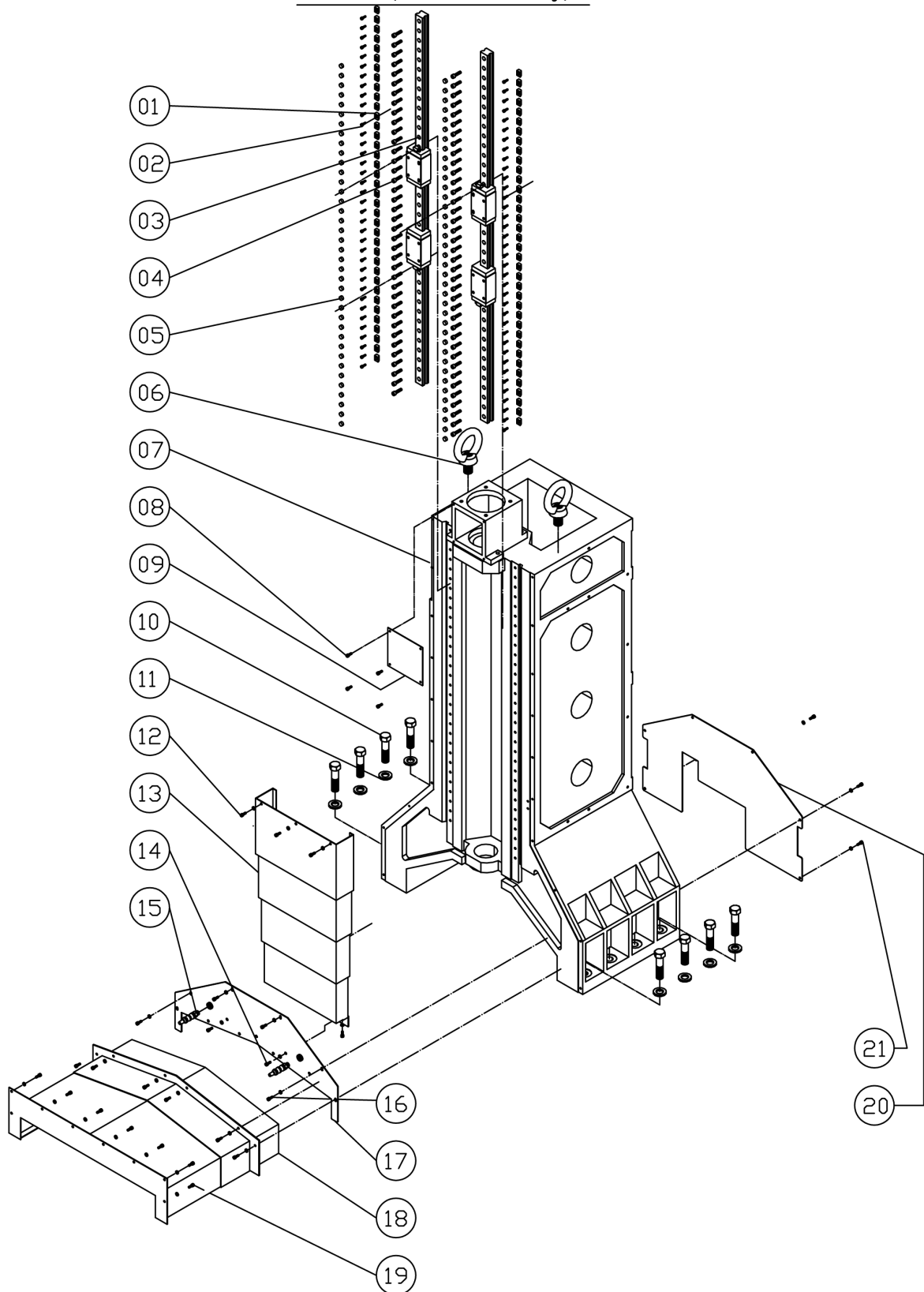
Y-Axis Lubrication Assembly Parts EM69P (Y-Axis Lubrication Assembly)



EM69P Part List					
Y-Axis Lubrication Assembly					
	Part Number	Part Name	Specification	Qty	Remark
01		Cap Screw	M6x1Px25L	2	
02		Nylon Pipe	∅4x130L	1	
03		Nylon Pipe	∅4x300L	1	
04	EM-154-16	Volume Distributor		1	
05		Nylon Pipe	∅4x650L	1	
06		Nylon Pipe	∅4x720L	1	
07		Nylon Pipe	∅4x300L	1	
08		Nylon Pipe	∅4x650L	1	
09		Pipe Clamps		4	
10		Button Head Cap Screws	M5x0.8Px12L	4	

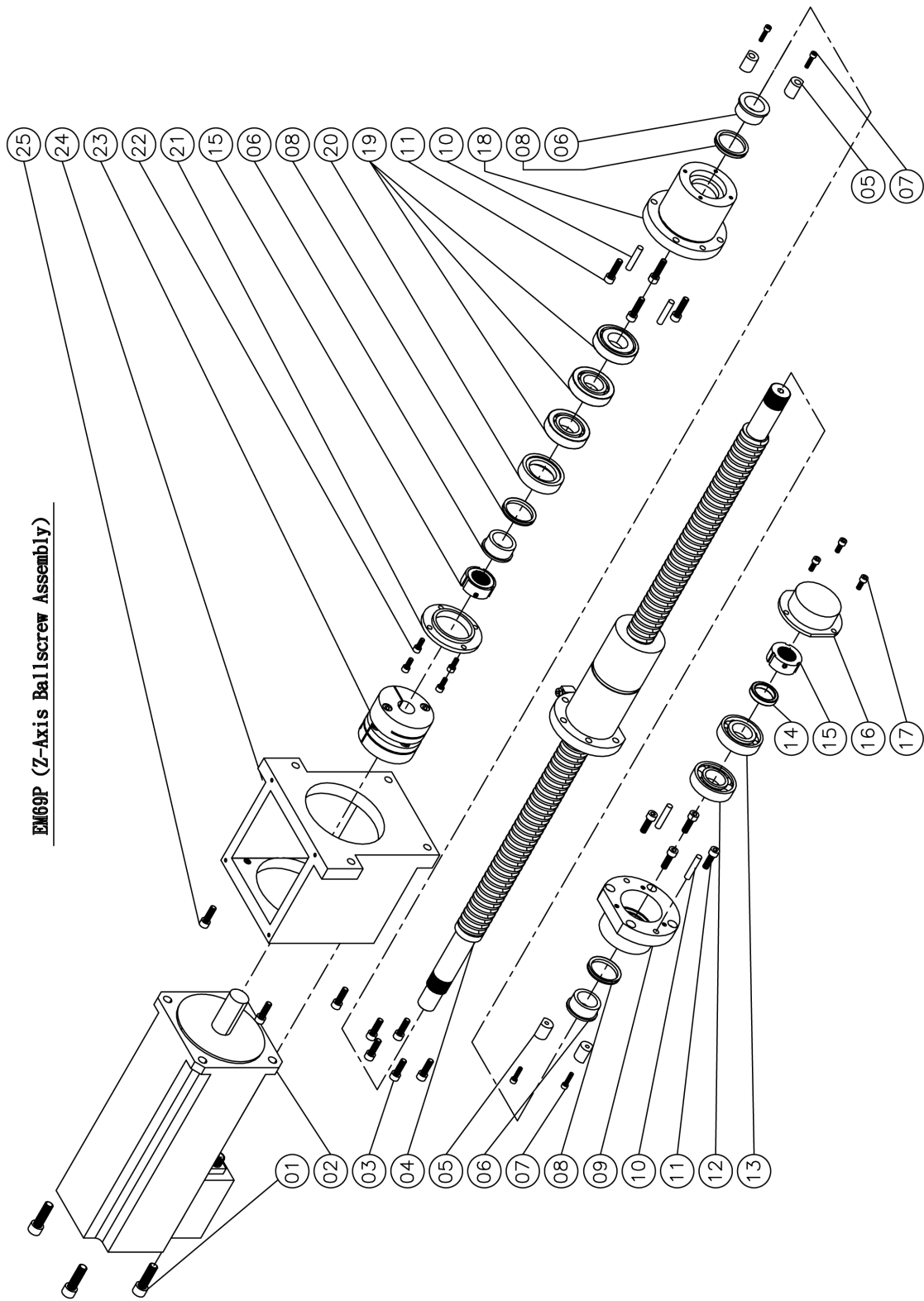
Z-Axis Assembly Parts

EM69P (Z-Axis Assembly)



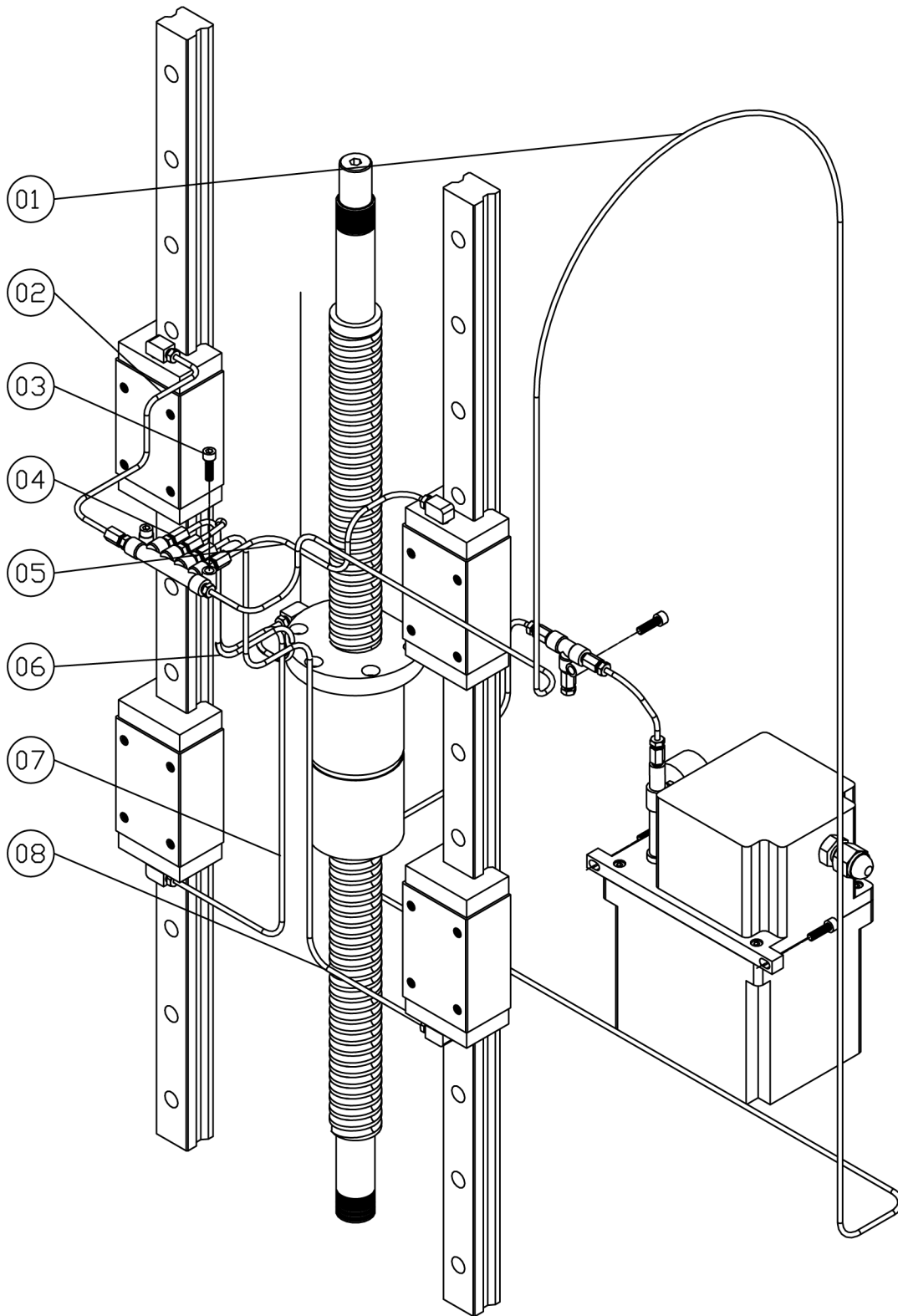
EM69P Part List					
Z-Axis Assembly					
	Part Number	Part Name	Specification	Qty	Remark
01		Tapper Gib	T1	74	
02		Cap Screw	M5x0.8Px16L	26	
03	8541022	Linear Guideway		1 Set	
04		Cap Screw	M8x1.25Px30L	76	
05		Bolt Cap	C8	26	
06		Lifting Eye Bolt	M30x3.5P	2	
07	8542011	Column		1	
08		Cap Screw	M5x0.8Px16L	4	
09		Plate		1	
10		Hex Head Bolt	M24x3Px90L	8	
11	7540150	Washer	M24	8	
12		Cap Screw	M6x1Px16L	5	
13	8542100	Z Telescopic Covers		1	
14		Cap Screw	M6x1.0Px16L	3	
15	7530290	Adjustable Hose		2	
16		Cap Screw	M6x1Px16L	4	
17	7540083	Cover		1	
18	7530132	Y Telescopic Covers(Behind)		1	
19		Cap Screw	M6x1Px16L	14	
20	7540200	Cover		1	
21		Cap Screw	M6x1Px16L	6	

Z-Axis Ballscrew Assembly Parts



EM69P Part List					
Z-Axis Ball Screw Assembly					
	Part Number	Part Name	Specification	Qty	Remark
01		Cap Screw	M12x1.75Px40L	4	
02		Server Motor	BSM100C-4150-BB0	1	
03		Cap Screw	M8x1.25Px25L	5	
04	8542040	Z-Axis Ball Screw		1	
05	7520171	Bumper		4	
06	8521090	Spacer		3	
07		Cap Screw	M5x0.8Px20L	4	
08		Oil Seal	V-40A	3	
09	8521081	Bearing Housing		1	
10		Location Pin	∅8x40L	4	
11		Cap Screw	M8x1.25Px30L	8	
12	Q-6206Z	Bearing	6206Z	1	
13	Q-7206BW	Bearing	7206BW	1	
14	MV13200080	Spacer		1	
15		Lock Nut	YSF30-M30x1.5P	2	
16	MV13200110	Cover		1	
17		Cap Screw	M6x1Px12L	3	
18	7520032	Bearing Housing		1	
19	Q-30TAC62C	Bearing	30TAC62C(DB)	3	
20	7520051	Spacer		1	
21	7520062	Push Plate		1	
22		Cap Screw	M6x1Px16L	4	
23	8541120	Coupling		1	
24	EFL-31040	Motor mount		1	
25		Cap Screw	M10x1.5Px45L	4	

Z-Axis Lubrication Assembly Parts
EM69P (Z-Axis Lubrication Assembly)



EM69P Part List					
Z-Axis Lubrication Assembly					
	Part Number	Part Name	Specification	Qty	Remark
01		Nylon Pipe	∅4x3800L	1	
02		Nylon Pipe	∅4x270L	1	
03		Cap Screw	M6x1Px25L	2	
04	EM-154-15	Volume Distributor		1	
05		Nylon Pipe	∅4x290L	1	
06		Nylon Pipe	∅4x350L	1	
07		Nylon Pipe	∅4x540L	1	
08		Nylon Pipe	∅4x540L	1	

OPTIONS

Optional Equipment

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

SDS

The Safety Data Sheets list shown in this section are the substances and materials that an operator is most likely to come in contact with while using this machine.

Other substances and materials are used in the manufacture, testing, and shipping of this machine. A complete list of the Safety Data Sheets of substances and materials used by Rottler Manufacturing during manufacturing, testing, and shipping is located on the Manual flash drive shipped with the machine. Safety Data Sheets are also located on the company web site: <http://www.rottlermfg.com/documentation.php>

- 1) Phillips 66 CP Oil**
- 2) Dyna Cool K-2002**
- 3) Mobil Vactra Oil #2**
- 4) Valvoline High Performance Gear Oil**
- 5) Valvoline Synpower Synthetic Oil**
- 6) Molywhite #00 Grease**

Safety Data Sheet

According to OSHA HCS 2012 (29 CFR 1910.1200), Health Canada HPR (SOR/2015-17), and Mexico NOM-018-STPS-2015



SECTION 1: Identification

Product Identifier CP Oil
Other means of identification Phillips 66 CP Oil 22
 Phillips 66 CP Oil 32
Code LBPH817726
Relevant identified uses Industrial Oil
Uses advised against All others
24 Hour Emergency Phone Number CHEMTREC: 1-800-424-9300
 CHEMTREC México 01-800-681-9531

Manufacturer/Supplier Phillips 66 Lubricants P.O. Box 4428 Houston, TX 77210	SDS Information URL: www.phillips66.com/SDS Phone: 800-762-0942 Email: SDS@P66.com	Customer Service U.S.: 800-368-7128 or International: 1-832-765-2500 Technical Information 1-877-445-9198
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SECTION 2: Hazard identification

Classified Hazards	Hazards Not Otherwise Classified (HNOC)
No classified hazards	PHNOC: None known HHNOC: None known

Label elements

No classified hazards

SECTION 3: Composition/information on ingredients

Chemical Name	CASRN	Concentration
Distillates, petroleum, hydrotreated heavy paraffinic	64742-54-7	>95

¹ 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: 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.

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

Most important symptoms and effects, both acute and delayed: 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. Prolonged or repeated contact may dry skin and cause irritation.

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.

SECTION 5: Firefighting measures

NFPA 704: National Fire Protection Association

Health: 0 **Flammability:** 1 **Instability:** 00 =



minimal hazard
 1 = slight hazard
 2 = moderate hazard
 3 = severe hazard
 4 = extreme hazard

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.

Specific hazards arising from the chemical

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.

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.

Special protective actions for fire-fighters: 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 the hazard area and deny entry to unnecessary and unprotected personnel. 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.

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

SECTION 6: Accidental release measures

Personal precautions, protective equipment and emergency procedures: 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 and contain 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).

Methods and material for containment and cleaning 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.

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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). Spills will produce very 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

Occupational exposure limits

The following constituents are the only constituents of the product which have a PEL, TLV or other recommended exposure limit. At this time, the other constituents have no known exposure limits.

Chemical Name	ACGIH	OSHA	Mexico	Phillips 66
Distillates, petroleum, hydrotreated heavy paraffinic	TWA: 5mg/m ³ STEL: 10 mg/m ³ 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.

Biological occupational exposure limits

Note: This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies

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 rubber

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

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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
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to be specifications.

Appearance: Amber, Transparent

Flash Point: > 302 °F / > 150 °C

Physical Form: Liquid

Test Method: Pensky-Martens Closed Cup (PMCC), ASTM D93, EPA 1010

Odor: Petroleum

Initial Boiling Point/Range: No data

Odor Threshold: No data

Vapor Pressure: <1 mm Hg

pH: Not applicable

Partition Coefficient (n-octanol/water) (Kow): No data

Vapor Density (air=1): >1

Melting/Freezing Point: < -11 °F / < -24 °C

Upper Explosive Limits (vol % in air): No data

Auto-ignition Temperature: No data

Lower Explosive Limits (vol % in air): No data

Decomposition Temperature: No data

Evaporation Rate (nBuAc=1): No data

Specific Gravity (water=1): 0.86 @ 60°F (15.6°C)

Particle Size: Not applicable

Bulk Density: 7.1-7.2 lbs/gal

Percent Volatile: No data

Viscosity: 4.0 - 6 cSt @ 100°C; 20.5 - 35 cSt @ 40°C

Flammability (solid, gas): Not applicable

Pour Point: < -11 °F / < -24 °C

Solubility in Water: Negligible

SECTION 10: Stability and reactivity

Reactivity: Not chemically reactive.

Chemical stability: Stable under normal ambient and anticipated conditions of use.

Possibility of hazardous reactions: Hazardous reactions not anticipated.

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

Incompatible materials: Avoid contact with strong oxidizing agents and strong reducing agents.

Hazardous decomposition products: Not anticipated under normal conditions of use.

SECTION 11: Toxicological information

Information on Toxicological Effects

Substance / Mixture

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

Likely Routes of Exposure: Inhalation, eye contact, skin contact

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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.

Skin Sensitization: No information available on the mixture, however none of the components have been classified for skin sensitization (or are below the concentration threshold for classification).

Respiratory Sensitization: No information available.

Specific Target Organ Toxicity (Single Exposure): Not expected to cause organ effects from single exposure.

Specific Target Organ Toxicity (Repeated Exposure): Not expected to cause organ effects from repeated exposure.

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).

Germ Cell Mutagenicity: No information available on the mixture, however none of the components have been classified for

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germ cell mutagenicity (or are below the concentration threshold for classification).

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

Distillates, petroleum, hydrotreated heavy paraffinic

Carcinogenicity: This oil has been highly refined by a variety of processes to reduce aromatics and improve performance characteristics. It meets the IP-346 criteria of less than 3 percent PAH's and is not considered a carcinogen by the International Agency for Research on Cancer.

SECTION 12: Ecological information

GHS Classification: No classified hazards

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.

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

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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 SDS 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)

UN Number: Not regulated

UN proper shipping name: None

Transport hazard class(es): None

Packing Group: None

Environmental Hazards: This product does not meet the DOT/UN/IMDG/IMO criteria of a marine pollutant

Special precautions for user: 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)

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code: Not applicable

SECTION 15: Regulatory information

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

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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)

Should this product meet EPCRA 311/312 Tier reporting criteria at 40 CFR 370, refer to Section 2 of this SDS for appropriate classifications.

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.

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 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.

SECTION 16: Other information

Issue Date:	Previous Issue Date:	SDS Number	Status:
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Revised Sections or Basis for Revision:

Exposure limits (Section 8); Regulatory information (Section 15)

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Legend (pursuant to NOM-018-STPS-2015):

The information within is considered correct but is not exhaustive and will be used for guidance only, which is based on the current knowledge of the substance or mixture and is applicable to the appropriate safety precautions for the product.

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; HPR = Hazardous Products Regulations; 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)

Disclaimer of Expressed and implied Warranties:

The information presented in this Safety Data Sheet is based on data believed to be accurate as of the date this Safety Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.



SAFETY DATA SHEET

DYNA COOL K-2002

Issue Date: 13-May-2015

Revision Date: 25-January-2018

Version 1

1. IDENTIFICATION

Product Identifier

Product Name DYNA COOL K-2002

Other means of identification

SDS # DYNA-004
Product Code 5428

Recommended use of the chemical and restrictions on use

Recommended use Metalworking fluid
Restrictions on use Industrial use only

Details of the supplier of the safety data sheet

Manufacturer Address

Company Name: DYNA TECH Chemical Specialties, Inc.
 Address: P. O. Box 34
 Colgate, WI 53017
 Telephone: 262-646-7600
 Fax: 262-820-9176

Emergency Telephone Number (24 hours/day): INFOTRAC 1-352-323-3500 (International) 1-800-535-5053
 (North America)

2. HAZARDS IDENTIFICATION

Hazard Classification Not classified as hazardous under 29CFR 1910.1200 (HazCom 2012)

Label Elements

Hazard Symbol: No symbol.
Signal Word: No signal word.
Hazard Statement: Not applicable.
Precautionary Statement: Not applicable.

Other hazards which do not result in GHS classification: None.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous Component(s):

CHEMICAL NAME	CAS-No.	CONCENTRATION
Mineral oil	Confidential	20 – 50%
Triethanolamine	102-71-6	5 – 10%
Ethoxylated alcohol	Confidential	1 – 5%
Biocide	Confidential	1 - 5%

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Sodium hydroxide	1310-73-2	10 – 20%
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Specific chemical identities and/or exact percentages have been withheld as trade secrets.

DYNA TECH Chemical Specialties, Inc.

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DYNA-004 – DYNA COOL K-2002

4. FIRST-AID MEASURES

- Ingestion:** Rinse mouth thoroughly. Call a POISON CENTER/doctor/.../ if you feel unwell. Do NOT induce vomiting.
- Inhalation:** Move to fresh air. Call a POISON CENTER/doctor/.../ if you feel unwell.
- Skin Contact:** Remove contaminated/saturated clothing and shoes. Wash contact areas with soap and water. If skin irritation occurs: Get medical advice/attention.
- Eye Contact:** Flush thoroughly with water. If irritation occurs, get medical assistance. Continue to rinse for at least 15 minutes.

Most important symptoms/effects, acute and delayed

Symptoms: No data available.

Indication of immediate medical attention and special treatment needed

Treatment: Get medical attention as appropriate or if symptoms persist.

5. FIRE-FIGHTING MEASURES

General Fire Hazards: No unusual fire or explosion hazards noted.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media: Water spray, fog, CO₂, dry chemical or regular foam. Use fire-extinguishing media appropriate for surrounding materials.

Revision Date: 25-January-2018

Unsuitable extinguishing media: Do not use water jet as an extinguisher, as this will spread the fire.

Specific hazards arising from the chemical: Heat may cause the containers to explode. During fire, gases hazardous to health may be formed.

Special protective equipment and precautions for firefighters

Special firefighting procedures: No data available.

Special protective equipment for firefighters: Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures: See Section 8 of the SDS for Personal Protective Equipment. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Keep unauthorized personnel away. Ensure adequate ventilation.

Methods and material for containment and cleaning up: Absorb with sand or other inert absorbent. Stop the flow of material, if this is without risk.

Environmental Precautions: Avoid release to the environment. Do not contaminate water sources or sewer. Prevent further leakage or spillage if safe to do so.

DYNA TECH Chemical Specialties, Inc.

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DYNA-004 – DYNA COOL K-2002

7. HANDLING AND STORAGE

Revision Date: 25-January-2018

Precautions for safe handling:

End-users should follow industry best practices for handling and using this product.

Guidance may be found using the current version of ASTM Standard E1497-05: Standard Practice for Selection and Safe Use of Water-Miscible and Straight Oil Metal Removal Fluids. Contains amines. Do not add sodium nitrite or other nitrosating agents which may form cancer causing nitrosamines. Contains a component that when heated at or above 300F (150C) may generate Formaldehyde vapors. Observe good industrial hygiene practices. Wear appropriate personal protective equipment. Do not expose to intense heat as product may expand and pressurize container.

Conditions for safe storage, including any incompatibilities:

Store in original tightly closed container. Avoid contact with oxidizing agents. Store away from incompatible materials.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits

CHEMICAL NAME	TYPE	EXPOSURE LIMIT VALUES	SOURCE
Mineral oil - Mist.	PEL	5 mg/m ³	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)
Mineral oil – Mist.	STEL	10 mg/m ³	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)
Triethanolamine	TWA	5 mg/m ³	US. ACGIH Threshold Limit Values (03 2012)
Sodium hydroxide	PEL	2 mg/m ³	US. OSHA Table Z-1 Limits for Air Contaminant (29 CFR 1910-1000) (02 2006)
Sodium hydroxide	Ceiling	2 mf/m ³	US. ACGIH Threshold Limit Values (03-2012)

Protective Measures:

Use personal protective equipment as required.

Respiratory Protection:

In case of inadequate ventilation, use suitable respirator. Seek advice from supervisor on the company's respiratory protection standards.

Eye Protection:

Wear safety glasses with side shields (or goggles).

Skin and Body Protection:

Wear chemical-resistant gloves, footwear, and protective clothing appropriate for the risk of exposure. Contact health and safety professional or manufacturer for specific information.

Hygiene measures:

Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Contaminated work clothing should be laundered prior to re-use. Discard contaminated footwear that cannot be cleaned. Avoid contact with skin, eyes, and clothing.

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Revision Date: 25-January-2018

9. PHYSICAL AND CHEMICAL PROPERTIES**Appearance**

Physical state:	Liquid
Form:	No data available.
Color:	Blue
Odor:	Mild
Odor threshold:	No data available.
pH:	No data available.
Melting point/freezing point:	No data available.
Initial boiling point and boiling range:	No data available.
Flash Point:	Not applicable
Evaporation rate:	No data available.
Flammability (solid, gas):	No data available.
Upper/lower limit on flammability or explosive limits	
Flammability limit - upper (%):	No data available.
Flammability limit - lower (%):	No data available.
Explosive limit - upper (%):	No data available.
Explosive limit - lower (%):	No data available.
Vapor pressure:	No data available.
Vapor density:	No data available.
Relative density:	1.07
Solubility(ies)	
Solubility in water:	Soluble.
Solubility (other):	No data available.
Partition coefficient (n-octanol/water):	No data available.
Auto-ignition temperature:	No data available.
Decomposition temperature:	No data available.
Viscosity:	> 20.5 mm ² /s (40 °C)

Other Information

VOC:	10.18 g/l (ASTM E 1868-10)
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10. STABILITY AND REACTIVITY

Reactivity:	Not reactive during normal use.
Chemical Stability:	Material is stable under normal conditions.

DYNA-004 – DYNA COOL K-2002

Possibility of Hazardous Reactions: None under normal conditions.

Conditions to Avoid: Avoid heat or contamination.

Incompatible Materials: No data available.

Hazardous Decomposition Products: Formaldehyde

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Revision Date: 25-January-2018

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Ingestion: May be ingested by accident. Ingestion may cause irritation and malaise.

Inhalation: Inhalation is the primary route of exposure. In high concentrations, vapors, fumes or mists may irritate nose, throat and mucus membranes.

Skin Contact: Prolonged skin contact may cause redness and irritation.

Eye Contact: Eye contact is possible and should be avoided.

Symptoms related to the physical, chemical and toxicological characteristics

Ingestion: No data available.

Inhalation: No data available.

Skin Contact: No data available.

Eye Contact: No data available.

Information on toxicological effects

Acute toxicity (list all possible routes of exposure)

Oral Product: ATEmix (>): > 5000 mg/kg

Dermal Product: ATEmix (>): 2000-5000 mg/kg

Inhalation Product: Not classified for acute toxicity based on available data.

Repeated Dose Toxicity Product: No data available.

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Skin Corrosion/Irritation Product: No data available.

Serious Eye Damage/Eye Irritation Product: No data available.

Respiratory or Skin Sensitization Product: May cause an allergic skin reaction.

Carcinogenicity Product: No data available.

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:
No carcinogenic components identified.

U.S. National Toxicology Program (NTP) Report on Carcinogens:
No carcinogenic components identified.

U.S. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):
No carcinogenic components identified.

Germ Cell Mutagenicity

In Vitro Product: No data available.

In Vivo Product: No data available.

Reproductive Toxicity Product: No data available

**Specific Target Organ Toxicity –
Single Exposure Product:** No data available

**Specific Target Organ Toxicity –
Repeated Exposure Product:** No data available

Aspiration Hazard Product: No data available.

Other effects: No data available.

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Revision Date: 25-January-2018

12. ECOLOGICAL INFORMATION

DYNA-004 – DYNA COOL K-2002

General information: This product has not been evaluated for ecological toxicity or other environmental effects.

13. DISPOSAL CONSIDERATIONS

Disposal instructions:

Discharge, treatment, or disposal may be subject to national, state, or local laws. Dispose of waste at an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal. It is the responsibility of the product user or owner to determine at the time of disposal, which waste regulations, must be applied.

Contaminated Packaging: Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. TRANSPORT INFORMATION

DOT Not regulated

IMDG Not regulated.

IATA Not regulated

15. REGULATORY INFORMATION

US Federal Regulations

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

None present or none present in regulated quantities.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard Categories

Not listed.

SARA 313 (TRI Reporting)

None present or none present in regulated quantities.

US State Regulations

US. California Proposition 65

This product contains chemical(s) known to the State of California to cause cancer and/or to cause birth defects or other reproductive harm.

16. OTHER INFORMATION

Issue Date: 13-May-2015
Revision Date: 25-January-2018
Revision Note: Updated information.
Version #: 1
Further Information: No data available.

DYNA-004 – DYNA COOL K-2002

Disclaimer

The information provided in this 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, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. This information should be used to make an independent determination of the methods to safeguard workers and the environment. 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

DYNA TECH Chemical Specialties, Inc.

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Product Name: MOBIL VACTRA OIL NO. 2
Revision Date: 30 Aug 2018

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SAFETY DATA SHEET

SECTION 1	PRODUCT AND COMPANY IDENTIFICATION
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PRODUCT

Product Name: MOBIL VACTRA OIL NO. 2
Product Description: Base Oil and Additives
Product Code: 201560901015, 600494-85
Intended Use: Lubricant

COMPANY IDENTIFICATION

Supplier: East Coast Lubes Pty Ltd (Queensland and Northern Territory)
A.B.N. 37 117 203 611
Cnr North and Mort Streets
Toowoomba, Queensland 4350 Australia

24 Hour Emergency Telephone 1300 131 001
Supplier General Contact 1800 069 019

Supplier: Southern Cross Lubes (Victoria and Tasmania, New South Wales and Australian Capital Territory)
58-66 Ajax Road
Altona, Victoria 3018, Australia

24 Hour Emergency Telephone 1300 131 001
Product Technical Information
Supplier General Contact 1300 466 245
1300 552 861

Supplier: Perkal Pty Ltd Trading as Statewide Oil (Western Australia)
A.B.N. 43 009 283 363
14 Beete Street
Welshpool, Western Australia 6106 Australia

24 Hour Emergency Telephone (8:00am to 4:30pm Mon to Fri) 1300 919
Product Technical Information 904
Supplier General Contact (08) 9350 6777
(08) 9350 6777

Supplier: Perkal Pty Ltd Trading as Statewide Oil (South Australia)
A.B.N. 43 009 283 363
6-10 Streiff Rd
Wingfield, South Australia 5013 Australia



Product Name: MOBIL VACTRA OIL NO. 2
Revision Date: 30 Aug 2018

24 Hour Emergency Telephone
Product Technical Information
Supplier General Contact

(8:00am to 4:30pm Mon to Fri)

1300 919 904

(08) 8359 8995
(08) 8359 8995

SECTION 2	HAZARDS IDENTIFICATION
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This material is not hazardous according to regulatory guidelines (see (M)SDS Section 15).

Contains: PHOSPHORIC ACID ESTERS, AMINE SALT May produce an allergic reaction.

Other hazard information:

Physical / Chemical Hazards:

No significant hazards.

Health Hazards:

High-pressure injection under skin may cause serious damage. Excessive exposure may result in eye, skin, or respiratory irritation.

Environmental Hazards:

No significant hazards.

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

SECTION 3	COMPOSITION / INFORMATION ON INGREDIENTS
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This material is defined as a mixture.

Reportable Hazardous Substance(s) or Complex Substance(s)

Name	CAS#	Concentration*	GHS Hazard Codes
2,6-DI-TERT-BUTYL-P-CRESOL	128-37-0	0.1 - < 1%	H400(M factor 1), H410(M factor 1)



Product Name: MOBIL VACTRA OIL NO. 2

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PHOSPHORIC ACID ESTERS, AMINE SALT	Confidential	0.1 - < 1%	H227, H302, H317, H318, H401, H411
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* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume. Other ingredients determined not to be hazardous up to 100%.

SECTION 4	FIRST AID MEASURES
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INHALATION

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

SKIN CONTACT

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by

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a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

EYE CONTACT

Flush thoroughly with water. If irritation occurs, get medical assistance.

INGESTION

First aid is normally not required. Seek medical attention if discomfort occurs.

NOTE TO PHYSICIAN

None

SECTION 5	FIRE FIGHTING MEASURES
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EXTINGUISHING MEDIA

Appropriate Extinguishing Media: Use water fog, foam, dry chemical or carbon dioxide (CO₂) to extinguish flames.

Inappropriate Extinguishing Media: Straight streams of water

FIRE FIGHTING

Fire Fighting Instructions: Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.



Product Name: MOBIL VACTRA OIL NO. 2

Revision Date: 30 Aug 2018

Hazardous Combustion Products: Aldehydes, Incomplete combustion products, Oxides of carbon, Smoke, Fume, Sulphur oxides

FLAMMABILITY PROPERTIES

Flash Point [Method]: >205°C (401°F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: N/D

SECTION 6	ACCIDENTAL RELEASE MEASURES
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NOTIFICATION PROCEDURES

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

PROTECTIVE MEASURES

Avoid contact with spilled material. See Section 5 for fire fighting information. See the Hazard Identification Section for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for advice on the minimum requirements for personal protective equipment. Additional protective measures may be necessary, depending on the specific circumstances and/or the expert judgment of the emergency responders.

For emergency responders: Respiratory protection: respiratory protection will be necessary only in special cases, e.g., formation of mists. Half-face or full-face respirator with filter(s) for dust/organic vapor or Self

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Contained Breathing Apparatus (SCBA) can be used depending on the size of spill and potential level of exposure. If the exposure cannot be completely characterized or an oxygen deficient atmosphere is possible or anticipated, SCBA is recommended. Work gloves that are resistant to hydrocarbons are recommended. Gloves made of polyvinyl acetate (PVA) are not water-resistant and are not suitable for emergency use. Chemical goggles are recommended if splashes or contact with eyes is possible. Small spills: normal antistatic work clothes are usually adequate. Large spills: full body suit of chemical resistant, antistatic material is recommended.

SPILL MANAGEMENT

Land Spill: Stop leak if you can do so without risk. Recover by pumping or with suitable absorbent.

Water Spill: Stop leak if you can do so without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

ENVIRONMENTAL PRECAUTIONS



Product Name: MOBIL VACTRA OIL NO. 2

Revision Date: 30 Aug 2018

Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

SECTION 7 HANDLING AND STORAGE

HANDLING

Prevent small spills and leakage to avoid slip hazard. Material can accumulate static charges which may cause an electrical spark (ignition source). When the material is handled in bulk, an electrical spark could ignite any flammable vapors from liquids or residues that may be present (e.g., during switch-loading operations). Use proper bonding and/or earthing procedures. However, bonding and earthing may not eliminate the hazard from static accumulation. Consult local applicable standards for guidance. Additional references include American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practice on Static Electricity) or CENELEC CLC/TR 50404 (Electrostatics - Code of practice for the avoidance of hazards due to static electricity).

Static Accumulator: This material is a static accumulator.

STORAGE

The type of container used to store the material may affect static accumulation and dissipation. Do not store in open or unlabelled containers. Keep away from incompatible materials.

Material is defined under the National Standard [NOHSC:1015] Storage and Handling of Workplace Dangerous Goods.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMIT VALUES

Exposure limits/standards (Note: Exposure limits are not additive)

Substance Name	Form	Limit/Standard	Note	Source
2,6-DI-TERT-BUTYL-P-CRESOL		TWA 10 mg/m ³		Australia OELs

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2,6-DI-TERT-BUTYL-P-CRESOL	Inhalable fraction and vapour	TWA	2 mg/m ³		ACGIH
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Exposure limits/standards for materials that can be formed when handling this product:

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

Biological limits

No biological limits allocated.

ENGINEERING CONTROLS



Product Name: MOBIL VACTRA OIL NO. 2

Revision Date: 30 Aug 2018

The level of protection and types of controls necessary will vary depending upon potential exposure conditions.

Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

Respiratory Protection: If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate. Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

Particulate

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

Hand Protection: Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

Nitrile, Viton

No protection is ordinarily required under normal conditions of use.

Eye Protection: If contact is likely, safety glasses with side shields are recommended.

Skin and Body Protection: Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

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Specific Hygiene Measures: Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

ENVIRONMENTAL CONTROLS



Product Name: MOBIL VACTRA OIL NO. 2

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Comply with applicable environmental regulations limiting discharge to air, water and soil. Protect the environment by applying appropriate control measures to prevent or limit emissions.

SECTION 9	PHYSICAL AND CHEMICAL PROPERTIES
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Note: Physical and chemical properties are provided for safety, health and environmental considerations only and may not fully represent product specifications. Contact the Supplier for additional information.

GENERAL INFORMATION

Physical State: Liquid

Colour: Amber

Odour: Characteristic

Odour Threshold: N/D

IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

Relative Density (at 15 °C): 0.883

Flammability (Solid, Gas): N/A

Flash Point [Method]: >205°C (401°F) [ASTM D-92]

Flammable Limits (Approximate volume % in air): LEL: 0.9 UEL: 7.0

Autoignition Temperature: N/D

Boiling Point / Range: > 316°C (600°F)

Decomposition Temperature: N/D

Vapour Density (Air = 1): > 2 at 101 kPa

Vapour Pressure: < 0.013 kPa (0.1 mm Hg) at 20 °C

Evaporation Rate (n-butyl acetate = 1): N/D

pH: N/A

Log Pow (n-Octanol/Water Partition Coefficient): > 3.5

Solubility in Water: Negligible

Viscosity: 68 cSt (68 mm²/sec) at 40 °C | 8.6 cSt (8.6 mm²/sec) at 100°C **Oxidizing**

Properties: See Hazards Identification Section.

OTHER INFORMATION

Freezing Point: N/D **Melting**

Point: N/A

Pour Point: -6°C (21°F)

DMSO Extract (mineral oil only), IP-346: < 3 %wt

SECTION 10	STABILITY AND REACTIVITY
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STABILITY: Material is stable under normal conditions.

CONDITIONS TO AVOID: Excessive heat. High energy sources of ignition.



Product Name: MOBIL VACTRA OIL NO. 2

Revision Date: 30 Aug 2018 Page

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INCOMPATIBLE MATERIALS: Strong oxidisers

HAZARDOUS DECOMPOSITION PRODUCTS: Material does not decompose at ambient temperatures.

POSSIBILITY OF HAZARDOUS REACTIONS: Hazardous polymerization will not occur.

SECTION 11	TOXICOLOGICAL INFORMATION
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INFORMATION ON TOXICOLOGICAL EFFECTS

Hazard Class	Conclusion / Remarks
Inhalation	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Irritation: No end point data for material.	Negligible hazard at ambient/normal handling temperatures.
Ingestion	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Skin	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Skin Corrosion/Irritation: No end point data for material.	Negligible irritation to skin at ambient temperatures. Based on assessment of the components.
Eye	
Serious Eye Damage/Irritation: No end point data for material.	May cause mild, short-lasting discomfort to eyes. Based on assessment of the components.
Sensitisation	
Respiratory Sensitization: No end point data for material.	Not expected to be a respiratory sensitizer.
Skin Sensitization: No end point data for material.	Not expected to be a skin sensitizer. Based on assessment of the components.
Aspiration: Data available.	Not expected to be an aspiration hazard. Based on physicochemical properties of the material.
Germ Cell Mutagenicity: No end point data for material.	Not expected to be a germ cell mutagen. Based on assessment of the components.
Carcinogenicity: No end point data for material.	Not expected to cause cancer. Based on assessment of the components.
Reproductive Toxicity: No end point data for material.	Not expected to be a reproductive toxicant. Based on assessment of the components.
Lactation: No end point data for material.	Not expected to cause harm to breast-fed children.
Specific Target Organ Toxicity (STOT)	



Product Name: MOBIL VACTRA OIL NO. 2

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Single Exposure: No end point data for material.	Not expected to cause organ damage from a single exposure.
Repeated Exposure: No end point data for material.	Not expected to cause organ damage from prolonged or repeated exposure. Based on assessment of the components.

OTHER INFORMATION

For the product itself:

Component concentrations in this formulation would not be expected to cause skin sensitization, based on tests of the components, this formulation, or similar formulations.

Contains:

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified Ames

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test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitising in test animals.

IARC Classification:

The following ingredients are cited on the lists below: None.

--REGULATORY LISTS SEARCHED--

1 = IARC 1

2 = IARC 2A

3 = IARC 2B

SECTION 12 ECOLOGICAL INFORMATION

The information given is based on data for the material, components of the material, or for similar materials, through the application of bridging principals.

ECOTOXICITY

Material -- Not expected to be harmful to aquatic organisms.

MOBILITY

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

PERSISTENCE AND DEGRADABILITY

Biodegradation:

Base oil component -- Expected to be inherently biodegradable

BIOACCUMULATION POTENTIAL

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.



Product Name: MOBIL VACTRA OIL NO. 2
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SECTION 13	DISPOSAL CONSIDERATIONS
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Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

DISPOSAL RECOMMENDATIONS

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products. Protect the environment. Dispose of used oil at designated sites. Minimize skin contact. Do not mix used oils with solvents, brake fluids or coolants.

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Empty Container Warning Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

SECTION 14	TRANSPORT INFORMATION
-------------------	------------------------------

LAND (ADG) : Not Regulated for Land Transport

SEA (IMDG): Not Regulated for Sea Transport according to IMDG-Code

Marine Pollutant: No

AIR (IATA): Not Regulated for Air Transport

SECTION 15	REGULATORY INFORMATION
-------------------	-------------------------------

This material is not considered hazardous according to Australia Model Work Health and Safety Regulations.



Product Name: MOBIL VACTRA OIL NO. 2
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Product is not regulated according to Australian Dangerous Goods Code.

No Poison Schedule number allocated by the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) established under the Therapeutic Goods Act.

AS1940 COMBUSTIBLE CLASS: C2

REGULATORY STATUS AND APPLICABLE LAWS AND REGULATIONS

Listed or exempt from listing/notification on the following chemical inventories (May contain substance(s) subject to notification to the EPA Active TSCA inventory prior to import to USA): AICS, DSL, ENCS, IECSC, KECl, PICCS, TCSI, TSCA

SECTION 16	OTHER INFORMATION
-------------------	--------------------------

KEY TO ABBREVIATIONS AND ACRONYMS:

N/D = Not determined, N/A = Not applicable, STEL = Short-Term Exposure Limit, TWA = Time-Weighted Average

KEY TO THE H-CODES CONTAINED IN SECTION 3 OF THIS DOCUMENT (for information only):

H227: Combustible liquid; Flammable Liquid, Cat 4

H302: Harmful if swallowed; Acute Tox Oral, Cat 4

H317: May cause allergic skin reaction; Skin Sensitization, Cat 1

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H318: Causes serious eye damage; Serious Eye Damage/Irr, Cat 1

H400: Very toxic to aquatic life; Acute Env Tox, Cat 1

H401: Toxic to aquatic life; Acute Env Tox, Cat 2

H410: Very toxic to aquatic life with long lasting effects; Chronic Env Tox, Cat 1

H411: Toxic to aquatic life with long lasting effects; Chronic Env Tox, Cat 2

THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:

Southern Cross Lubes (Victoria and Tasmania): Section 01: Supplier Mailing Address information was deleted.

Southern Cross Lubes (Victoria and Tasmania, New South Wales and Australian Capital Territory): Section 01: Supplier Mailing Address information was added.

Section 11 Acute Toxicity data - Header information was deleted.

Section 11 Substance Name - Header information was deleted.

Section 11 Substance Toxicity table - Header information was deleted.

Section 11 Substance Toxicology table information was deleted.

Section 12: information was modified.

The information and recommendations contained herein are, to the best of ExxonMobil's knowledge and belief, accurate and reliable as of the date issued. You can contact ExxonMobil to insure that this document is the most



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current available from ExxonMobil. The information and recommendations are offered for the user's consideration and examination. It is the user's responsibility to satisfy itself that the product is suitable for the intended use. If buyer repackages this product, it is the user's responsibility to insure proper health, safety and other necessary information is included with and/or on the container. Appropriate warnings and safe-handling procedures should be provided to handlers and users. Alteration of this document is strictly prohibited. Except to the extent required by law, republication or retransmission of this document, in whole or in part, is not permitted. The term, "ExxonMobil" is used for convenience, and may include any one or more of ExxonMobil Chemical Company, Exxon Mobil Corporation, or any affiliates in which they directly or indirectly hold any interest.

DGN: 7053124DAU (1014681)

Prepared by: Exxon Mobil Corporation
EMBSI, Clinton NJ USA
Contact Point: See Section 1 for Local Contact number

End of (M)SDS

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29 CFR 1910.1200 (OSHA HazCom 2012)

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product identifier

Trade name : Valvoline™ High Performance SAE 80W-90 Gear Oil

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Relevant identified uses of the substance or mixture and uses advised against

<p>Details of the supplier of the safety data sheet Valvoline LLC 3499 Blazer Parkway Lexington, KY 40509 United States of America (USA) 1-800-TEAMVAL</p>	<p>Emergency telephone number 1-800-VALVOLINE</p> <p>Regulatory Information Number 1-800-TEAMVAL</p> <p>Product Information 1-800-TEAMVAL</p>
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SECTION 2. HAZARDS IDENTIFICATION
GHS Classification

Skin sensitization : Category 1

GHS label elements

Hazard pictograms :



: Warning

Signal Word

May cause an allergic skin reaction.

Hazard Statements

Precautionary Statements

Prevention:

 Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray.
 Contaminated work clothing must not be allowed out of the workplace.
 Wear protective gloves.

Response:

 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.

Disposal:

Dispose of contents/ container to an approved waste disposal plant.

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Other hazards

None known.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance / Mixture : Mixture

Chemical nature : Defatter

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Hazardous components

Chemical name	CAS-No.	Classification	Concentration (%)
RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED	64742-62-7	This material is not considered hazardous under the OSHA Hazard Communication Standard (HazCom 2012).	21.105
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT	64742-47-8	Asp. Tox. 1; H304	1.393
AMINES, C12-14-TERT-ALKYL	68955-53-3	Flam. Liq. 4; H227 Acute Tox. 4; H302 Acute Tox. 2; H330 Acute Tox. 3; H311 Skin Corr. 1B; H314 Eye Dam. 1; H318 Skin Sens. 1A; H317	0.343

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SECTION 4. FIRST AID MEASURES

General advice

:


Move out of dangerous area.
Show this safety data sheet to the doctor in attendance.

If inhaled

:

Do not leave the victim unattended.

If breathed in, move person into fresh air.
If unconscious, place in recovery position and seek medical advice.

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If symptoms persist, call a physician.

In case of skin contact	: Remove contaminated clothing. If irritation develops, get medical attention. If on skin, rinse well with water. First aid is not normally required. However, it is recommended that exposed areas be cleaned by washing with soap and water. Wash contaminated clothing before re-use.
In case of eye contact	: Flush eyes with water as a precaution. Remove contact lenses. Protect unharmed eye. If eye irritation persists, consult a specialist.
If swallowed	: Do not give milk or alcoholic beverages. Never give anything by mouth to an unconscious person. If symptoms persist, call a physician.
Most important symptoms and effects, both acute and delayed	: Acute aspiration 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. Repeated aspiration of small quantities of mineral oil can produce chronic inflammation of the lungs (i.e. lipoid pneumonia) that may progress to pulmonary fibrosis. Symptoms are often subtle and radiological changes appear worse than clinical abnormalities. Occasionally, persistent cough, irritation of the upper respiratory tract, shortness of breath with exertion, fever, and bloody sputum occur. Inhalation exposure to oil mists below current workplace exposure limits is unlikely to cause pulmonary abnormalities. Signs and symptoms of exposure to this material through breathing, swallowing, and/or passage of the material through the skin may include: stomach or intestinal upset (nausea, vomiting, diarrhea) irritation (nose, throat, airways) Headache Dizziness May cause an allergic skin reaction.
Notes to physician	: No hazards which require special first aid measures.

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SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
 Water spray
 Foam

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Carbon dioxide (CO₂)
Dry chemical

- Unsuitable extinguishing media : High volume water jet
- Specific hazards during firefighting : Do not allow run-off from fire fighting to enter drains or water courses.
- Hazardous combustion products : carbon dioxide and carbon monoxide
Hydrocarbons
- Specific extinguishing methods :
- Product is compatible with standard fire-fighting agents.
- Further information : Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.
- Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.

SECTION 6. ACCIDENTAL RELEASE MEASURES

- Personal protective equipment and emergency procedures : Use personal protective equipment.
Persons not wearing protective equipment should be excluded from area of spill until clean-up has been completed.
- Environmental precautions : Prevent product from entering drains.
Prevent further leakage or spillage if safe to do so.
If the product contaminates rivers and lakes or drains inform respective authorities.
-

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Methods and materials for containment and cleaning up : Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).
Keep in suitable, closed containers for disposal.

Other information : Comply with all applicable federal, state, and local regulations.

SECTION 7. HANDLING AND STORAGE

Advice on safe handling : Do not breathe vapours/dust.
Do not smoke.
Persons susceptible to skin sensitisation problems or asthma, allergies, chronic or recurrent respiratory disease should not be employed in any process in which this mixture is being used.

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Container hazardous when empty.
Avoid exposure - obtain special instructions before use.
Avoid contact with skin and eyes.
Smoking, eating and drinking should be prohibited in the application area.
For personal protection see section 8.
Dispose of rinse water in accordance with local and national regulations.

Conditions for safe storage place. : Keep container tightly closed in a dry and well-ventilated place.
Containers which are opened must be carefully resealed and kept upright to prevent leakage.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

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Components with workplace control parameters

Components	CAS-No.	Value type (Form of exposure)	Control parameters / Permissible concentration	Basis
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT	64742-47-8	TWA	5 mg/m3 Mist	OSHA Z-1
		TWA	200 mg/m3 (total hydrocarbon vapor)	ACGIH
		TWA	5 mg/m3 Mist	OSHA P0
		TWA	5 mg/m3 Mist	NIOSH REL
		ST	10 mg/m3 Mist	NIOSH REL
		PEL	5 mg/m3 particulate	CAL PEL

Hazardous components without workplace control parameters

Components	CAS-No.
AMINES, C12-14-TERT-ALKYL	68955-53-3

Engineering measures

: Provide sufficient mechanical (general and/or local exhaust) ventilation to maintain exposure below exposure guidelines (if applicable) or below levels that cause known, suspected or apparent adverse effects.

Personal protective equipment

Respiratory protection : Respiratory protection is not required under normal conditions of use.

Hand protection

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Remarks

: The suitability for a specific workplace should be discussed with the producers of the protective gloves.

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Eye protection : Not required under normal conditions of use. Wear splashproof safety goggles if material could be misted or splashed into eyes.

Skin and body protection : Wear as appropriate:
 Impervious clothing
 Safety shoes
 Choose body protection according to the amount and concentration of the dangerous substance at the work place.
 Discard gloves that show tears, pinholes, or signs of wear.
 Wear resistant gloves (consult your safety equipment supplier).

Hygiene measures : Wash hands before breaks and at the end of workday.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state : liquid

Colour : amber

Odour : No data available

Odour Threshold : No data available

pH : No data available

Melting point/freezing point : No data available

Boiling point/boiling range : > 424.9 °F / 218.3 °C
(1013.333 hPa)

Flash point : > 222 °C
Method: Cleveland open cup

Evaporation rate : > 1
Ethyl Ether

Flammability (solid, gas) : No data available

Upper explosion limit : No data available

Lower explosion limit : No data available

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Vapour pressure : < 0.100000 mmHg

Relative vapour density : > 1AIR=1
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Relative density : 0.89 (60.00 °F)

Density : 0.8916 g/cm3 (15.56 °C)

Solubility(ies)

Water solubility : No data available

Solubility in other solvents : No data available

Partition coefficient:
noctanol/water : No data available

Thermal decomposition : No data available

Viscosity

Viscosity, dynamic : No data available

Viscosity, kinematic : 146 mm2/s (40 °C)

Oxidizing properties : No data available

SECTION 10. STABILITY AND REACTIVITY

Reactivity : No decomposition if stored and applied as directed.

Chemical stability : Stable under recommended storage conditions.

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Possibility of hazardous reactions : Product will not undergo hazardous polymerization.

Incompatible materials : Strong oxidizing agents

Hazardous decomposition products : Aldehydes carbon dioxide and carbon monoxide Carbon monoxide

SECTION 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure : Inhalation
Skin contact
Eye Contact
Ingestion

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Acute toxicity

Not classified based on available information.

Components:

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:

Acute oral toxicity : LD50 (Rat): > 5,000 mg/kg

Acute inhalation toxicity : LC50 (Rat): > 5.58 mg/l
Exposure time: 4 h
Test atmosphere: dust/mist
Assessment: Not classified as acutely toxic by inhalation under GHS.
Remarks: No mortality observed at this dose.

Acute dermal toxicity : LD50 (Rabbit): > 5,000 mg/kg
Remarks: No mortality observed at this dose.

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LD50 (Rabbit): > 2,000 mg/kg
 Assessment: Not classified as acutely toxic by dermal absorption under GHS.

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT:

Acute oral toxicity : LD50 (Rat): > 5,000 mg/kg

Acute dermal toxicity : LD50 (Rabbit): > 3,160 mg/kg
 Assessment: No adverse effect has been observed in acute dermal toxicity tests.

AMINES, C12-14-TERT-ALKYL:

Acute oral toxicity : LD50 (Rat): 612 mg/kg
 Method: OECD Test Guideline 401

Acute inhalation toxicity : LC50 (Rat, female): 1.19 mg/l
 Exposure time: 4 h
 Test atmosphere: vapour
 Method: OECD Test Guideline 403

Acute dermal toxicity : LD50 (Rat): 251 mg/kg
 Method: OECD Test Guideline 402

Skin corrosion/irritation

Not classified based on available information.

Product:

Remarks: May cause skin irritation in susceptible persons.

Components:

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:

Species: Rabbit

Result: No skin irritation

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT:

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Result: Slight, transient irritation

AMINES, C12-14-TERT-ALKYL:

Species: Rabbit

Result: Corrosive after 3 minutes to 1 hour of exposure

Serious eye damage/eye irritation Not classified based on available information.

Product:

Remarks: Vapours may cause irritation to the eyes, respiratory system and the skin.

Remarks: Unlikely to cause eye irritation or injury.

Components:

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:

Species: Rabbit

Result: No eye irritation

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT:

Result: Slight, transient irritation

AMINES, C12-14-TERT-ALKYL:

Species: Rabbit

Result: Corrosive

Respiratory or skin sensitisation

Skin sensitisation: May cause an allergic skin reaction.

Respiratory sensitisation: Not classified based on available information.

Components:

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:

Test Type: Buehler Test

Species: Guinea pig

Assessment: Does not cause skin sensitisation.

AMINES, C12-14-TERT-ALKYL:

Test Type: Buehler Test

Species: Guinea pig

Assessment: The product is a skin sensitiser, sub-category 1A.

Germ cell mutagenicity

Not classified based on available information.

Components:

AMINES, C12-14-TERT-ALKYL:



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Genotoxicity in vitro : Test Type: Ames test
 Test species: Salmonella typhimurium
 Metabolic activation: with and without metabolic
 activation Method: OECD Test Guideline 471
 Result: negative

Genotoxicity in vivo : Test Type: Micronucleus test
 Test species: Mouse

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Cell type: Bone marrow
Method: OECD Test Guideline 474
Result: negative

Carcinogenicity

Not classified based on available information.

Reproductive toxicity

Not classified based on available information.

STOT - single exposure

Not classified based on available information.

STOT - repeated exposure

Not classified based on available information.

Aspiration toxicity

Not classified based on available information.

Product:

No aspiration toxicity classification

Components:

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:

No aspiration toxicity classification

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT:

May be fatal if swallowed and enters airways.

Further information**Product:**

Remarks: No data available

SECTION 12. ECOLOGICAL INFORMATION**Ecotoxicity****Product:**

Ecotoxicology Assessment

Acute aquatic toxicity : Acute aquatic toxicity Category 3; Harmful to aquatic life.

Chronic aquatic toxicity : Chronic aquatic toxicity Category 3; Harmful to aquatic life with long lasting effects.

Components:

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:

Toxicity to fish : LL50 (*Pimephales promelas* (fathead minnow)): > 100 mg/l
 Exposure time: 96 h
 Test Type: static test
 Test substance: WAF
 Method: OECD Test Guideline 203
 Remarks: No toxicity at the limit of solubility

Toxicity to daphnia and other aquatic invertebrates : EL50 (*Daphnia magna* (Water flea)): > 10,000 mg/l
 Exposure time: 48 h
 Test Type: static test
 Test substance: WAF

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Method: OECD Test Guideline 202

Toxicity to algae : NOEL (*Pseudokirchneriella subcapitata* (green algae)): >= 100 mg/l
 End point: Growth inhibition
 Exposure time: 72 h
 Test Type: static test
 Test substance: WAF
 Method: OECD Test Guideline 201

Toxicity to fish (Chronic toxicity) : NOELR (*Oncorhynchus mykiss* (rainbow trout)): Calculated >= 1,000 mg/l
 Exposure time: 14 d

Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity) : NOEL (*Daphnia* (water flea)): 10 mg/l
 Exposure time: 21 d
 Test substance: WAF
 Method: OECD Test Guideline 211

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT:
 Toxicity to fish

Toxicity to algae

Toxicity to daphnia and other aquatic invertebrates

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Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity)

Remarks: Information given is based on data obtained from similar substances.

: LC50 (Oncorhynchus mykiss (rainbow trout)): 2 - 5 mg/l

: EL50 (Pseudokirchneriella subcapitata (green algae)): > 1 - 3 mg/l Exposure time: 72 h

Exposure time: 96 h

Test Type: static test

Test substance: WAF


Method: OECD Test Guideline 201

Test Type: semi-static test

Remarks: Information given is based on data obtained from similar substances.

Test substance:

: NOEL (Water flea (Daphnia magna)): 0.48 mg/l

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AMINES, C12-14-TERT-ALKYL:

WAF
Method: OECD
Test Guideline
203

Exposure time: 21 d
Test Type: semi-static test
Test substance: WAF

Remarks: Information given is based on data obtained from similar substances.

Method: OECD Test Guideline 211

Remarks: Information given is based on data obtained from similar substances.

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Toxicity to fish

: EL50 (Water flea (Daphnia magna)): 1.4 mg/l

Exposure time: 48 h

Toxicity to daphnia and other aquatic invertebrates

Test Type: static test

Test substance:

Toxicity to algae

WAF
Method: OECD
Test Guideline
202

	: EC50 (Water flea (Daphnia magna)): 2.5 mg/l Exposure time: 48 h Test Type: static test
M-Factor (Acute aquatic toxicity)	: ErC50 (Pseudokirchneriella subcapitata (microalgae)): 0.44 mg/l End point: Growth inhibition Exposure time: 72 h Test Type: static test Method: OECD Test Guideline 201
Toxicity to fish (Chronic toxicity)	NOEC (Pseudokirchneriella subcapitata (microalgae)): 0.05 mg/l End point: Growth inhibition Exposure time: 72 h Test Type: static test Method: OECD Test Guideline 201
M-Factor (Chronic aquatic toxicity)	: LC50 (Oncorhynchus mykiss (rainbow trout)): 1.3 mg/l
Exposure time: 96 h	: NOEC (Oncorhynchus mykiss (rainbow trout)): 0.078 mg/l
Test Type: static test	Exposure time: 96 d
Method: OECD Test Guideline 203	Test Type: flow-through test Method: OECD Test Guideline 210

Persistence and degradability**Components:**

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:

Biodegradability : Result: Not readily biodegradable.
Biodegradation: 2 - 4 %
Exposure time: 28 d
Method: OECD Test Guideline 301B

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT:

Biodegradability : Result: Inherently biodegradable
Biodegradation: 58.6 %
Exposure time: 28 d
Method: OECD Test Guideline 301F

Remarks: Expected to be biodegradable

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Biodegradability : Result: Not readily biodegradable.
 Biodegradation: 22 %
 Exposure time: 28 d
 Method: OECD Test Guideline 301D

No data available

Bioaccumulative potential**Components:**

AMINES, C12-14-TERT-ALKYL:

Partition coefficient: : log Pow: 2.9
 noctanol/water

No data available

Mobility in soil**Components:**

No data available

Other adverse effects

No data available

Product:

Additional ecological information : An environmental hazard cannot be excluded in the event of unprofessional handling or disposal., Harmful to aquatic life with long lasting effects.


Components:**SECTION 13. DISPOSAL CONSIDERATIONS****Disposal methods**

General advice : The product should not be allowed to enter drains, water courses or the soil.
 Do not contaminate ponds, waterways or ditches with chemical or used container.
 Send to a licensed waste management company.

Dispose of in accordance with all applicable local, state and federal regulations.

Contaminated packaging : Empty remaining contents.
 Dispose of as unused product.
 Empty containers should be taken to an approved waste handling site for recycling or disposal.
 Do not re-use empty containers.

SECTION 14. TRANSPORT INFORMATION**International transport regulations****REGULATION**

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ID NUMBER	PROPER SHIPPING NAME	*HAZARD CLASS	SUBSIDIARY HAZARDS	PACKING GROUP	MARINE POLLUTANT / LTD. QTY.
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U.S. DOT - ROAD

Not dangerous goods

CFR_RAIL_C

Not dangerous goods

U.S. DOT - INLAND WATERWAYS

Not dangerous goods

TDG_ROAD_C

Not dangerous goods

TDG_RAIL_C

Not dangerous goods

TDG_INWT_C

Not dangerous goods

INTERNATIONAL MARITIME DANGEROUS GOODS


Not dangerous goods

INTERNATIONAL AIR TRANSPORT ASSOCIATION - CARGO

Not dangerous goods

INTERNATIONAL AIR TRANSPORT ASSOCIATION - PASSENGER

Not dangerous goods

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MX_DG

Not dangerous goods

*ORM = ORM-D, CBL = COMBUSTIBLE LIQUID

Marine pollutant	no
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Dangerous goods descriptions (if indicated above) may not reflect quantity, end-use or region-specific exceptions that can be applied. Consult shipping documents for descriptions that are specific to the shipment.

SECTION 15. REGULATORY INFORMATION

SARA 311/312 Hazards : Acute Health Hazard

SARA 313 This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

California Prop 65 This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

The components of this product are reported in the following inventories:

TSCA : On TSCA Inventory

DSL : All components of this product are on the Canadian DSL

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- AICS : On the inventory, or in compliance with the inventory
- ENCS : On the inventory, or in compliance with the inventory
- KECI : On the inventory, or in compliance with the inventory
- PICCS : On the inventory, or in compliance with the inventory
- IECSC : On the inventory, or in compliance with the inventory

Inventories

AICS (Australia), DSL (Canada), IECSC (China), REACH (European Union), ENCS (Japan), ISHL (Japan), KECI (Korea), NZIoC (New Zealand), PICCS (Philippines), TCSI (Taiwan), TSCA (USA)

SECTION 16. OTHER INFORMATION

Further information

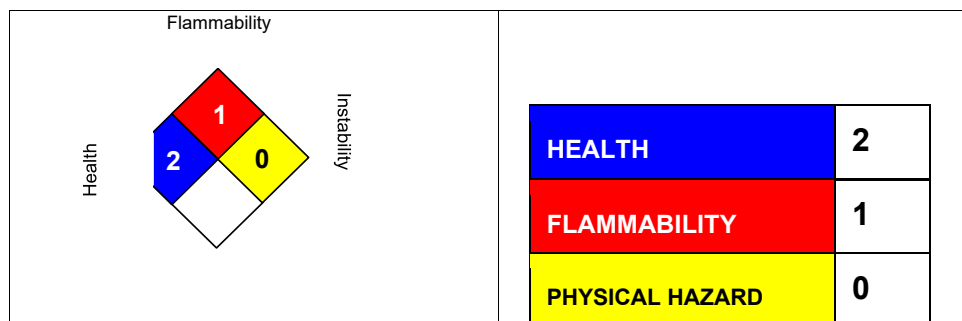
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NFPA:	HMIS III:
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Special hazard.

0 = not significant, 1
 =Slight, 2 = Moderate, 3 = High
 4 = Extreme, * = Chronic

NFPA Flammable and Combustible Liquids Classification

Combustible Liquid Class IIIB

Full text of H-Statements

H227	Combustible liquid.
H302	Harmful if swallowed.
H304	May be fatal if swallowed and enters airways.
H311	Toxic in contact with skin.
H314	Causes severe skin burns and eye damage.
H317	May cause an allergic skin reaction.
H318	Causes serious eye damage.
H330	Fatal if inhaled.

Sources of key data used to compile the Safety Data Sheet

Valvoline internal data including own and sponsored test reports

The UNECE administers regional agreements implementing harmonised classification for labelling (GHS) and transport.

The information accumulated herein is believed to be accurate but is not warranted to be whether originating with the company or not. Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances. This SDS has been prepared by Valvoline's Environmental Health and Safety Department (1-800-VALVOLINE).

List of abbreviations and acronyms that could be, but not necessarily are, used in this safety data sheet :

ACGIH : American Conference of Industrial Hygienists

BEI : Biological Exposure Index

CAS : Chemical Abstracts Service (Division of the American Chemical Society).

CMR : Carcinogenic, Mutagenic or Toxic for Reproduction

FG : Food grade


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GHS : Globally Harmonized System of Classification and Labeling of Chemicals.
H-statement : Hazard Statement
IATA : International Air Transport Association.
IATA-DGR : Dangerous Goods Regulation by the "International Air Transport Association" (IATA).

ICAO : International Civil Aviation Organization
ICAO-TI (ICAO) : Technical Instructions by the "International Civil Aviation Organization"
IMDG : International Maritime Code for Dangerous Goods
ISO : International Organization for Standardization
logPow : octanol-water partition coefficient
LCxx : Lethal Concentration, for xx percent of test population
LDxx : Lethal Dose, for xx percent of test population.
ICxx : Inhibitory Concentration for xx of a substance
Ecxx : Effective Concentration of xx
N.O.S. : Not Otherwise Specified
OECD : Organization for Economic Co-operation and Development
OEL : Occupational Exposure Limit P-Statement : Precautionary Statement
PBT : Persistent , Bioaccumulative and Toxic
PPE : Personal Protective Equipment
STEL : Short-term exposure limit
STOT : Specific Target Organ Toxicity
TLV : Threshold Limit Value TWA : Time-weighted average
vPvB : Very Persistent and Very Bioaccumulative WEL : Workplace Exposure Level

CERCLA : Comprehensive Environmental Response, Compensation, and Liability Act
DOT : Department of Transportation
FIFRA : Federal Insecticide, Fungicide, and Rodenticide Act
HMIRC : Hazardous Materials Information Review Commission
HMIS : Hazardous Materials Identification System
NFPA : National Fire Protection Association
NIOSH : National Institute for Occupational Safety and Health
OSHA : Occupational Safety and Health Administration
PMRA : Health Canada Pest Management Regulatory Agency
RTK : Right to Know
WHMIS : Workplace Hazardous Materials Information System

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29 CFR 1910.1200 (OSHA HazCom 2012)

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION**Product identifier**

Trade name : Synpower™ 75W-90
SYNTHETIC GEAR OIL

Recommended use of the chemical and restrictions on use

Details of the supplier of the safety data sheet Valvoline LLC 3499 Blazer Parkway Lexington, KY 40509 United States of America SDS@valvoline.com	Emergency telephone number 1-800-VALVOLINE Regulatory Information Number 1-800-TEAMVAL Product Information 1-800-TEAMVAL
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SECTION 2. HAZARDS IDENTIFICATION

GHS Classification

Eye irritation : Category 2A

Skin sensitization : Category 1

GHS Label element

Hazard pictograms : 

Warning

Signal Word : May cause an allergic skin reaction.
Causes serious eye irritation.

Hazard Statements

Precautionary Statements **Prevention:**
Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray.
Wash skin thoroughly after handling.
Contaminated work clothing must not be allowed out of the workplace.
Wear eye protection/ face protection.
Wear protective gloves.

Response:


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IF ON SKIN: Wash with plenty of soap and water.
IF IN EYES: Rinse cautiously with water for several minutes.
Remove contact lenses, if present and easy to do. Continue rinsing.
If skin irritation or rash occurs: Get medical advice/ attention.
If eye irritation persists: Get medical advice/ attention.
Wash contaminated clothing before reuse.
Disposal:
Dispose of contents/ container to an approved waste disposal plant.

Other hazards

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None known.


SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance / Mixture : Mixture

Chemical nature : Defatter

Hazardous components

Chemical Name	CAS-No.	Classification	Concentration (%)
HEAVY PARAFFINIC DISTILLATE	64742-54-7	Asp. Tox. 1; H304	61.42
DI-TERT-BUTYL POLYSULFIDE	68937-96-2	Flam. Liq. 4; H227 Skin Sens. 1B; H317	4.99
WHITE MINERAL OIL	8042-47-5	Not a hazardous substance or mixture.	2.90
Phosphoric acid esters, amine salt	91745-46-9	Acute Tox. 4; H302 Eye Dam. 1; H318 Skin Sens. 1; H317 Aquatic Acute 2; H401 Aquatic Chronic 2; H411	1.99

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SECTION 4. FIRST AID MEASURES

General advice

Notes to physician

If inhaled

: Move out of dangerous area.
 Show this safety data sheet to the doctor in attendance.
 Do not leave the victim unattended.

In case of skin contact

: If breathed in, move person into fresh air. If unconscious place in recovery position and seek medical advice.
 If symptoms persist, call a physician.

In case of eye contact

: Remove contaminated clothing. If irritation develops, get medical attention. If on skin, rinse well with water.
 First aid is not normally required. However, it is recommended that exposed areas be cleaned by washing with soap and water.
 Wash contaminated clothing before re-use.


If swallowed

: Immediately flush eye(s) with plenty of water.
 Remove contact lenses.
 Protect unharmed eye.

Most important symptoms and effects, both acute and delayed

: Do not give milk or alcoholic beverages.
 Never give anything by mouth to an unconscious person.
 If symptoms persist, call a physician.

: Acute aspiration 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. Repeated aspiration of small quantities of mineral oil can produce chronic inflammation of the lungs (i.e. lipoid pneumonia) that may progress to pulmonary fibrosis. Symptoms are often subtle and radiological changes appear worse than clinical abnormalities. Occasionally, persistent cough, irritation of the upper respiratory tract, shortness of breath with exertion, fever, and bloody sputum occur. Inhalation exposure

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to oil
mists
below
current
workplac
e
exposure
limits is
unlikely to
cause
pulmonar
y
abnormali
ties.

Signs and symptoms of exposure to this material through breathing, swallowing, and/or passage of the material through the skin may include:
acne stomach or intestinal upset (nausea, vomiting, diarrhea)
irritation (nose, throat, airways) May cause an allergic skin reaction.
Causes serious eye irritation.

: No hazards which require special first aid measures.

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SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Water spray
Foam
Carbon dioxide (CO₂)
Dry chemical

Unsuitable extinguishing media : High volume water jet

Specific hazards during firefighting : Do not allow run-off from fire fighting to enter drains or water courses.

Hazardous combustion products : carbon dioxide and carbon monoxide
Hydrocarbons
Aldehydes
Sulphur oxides
Hydrogen chloride gas
Nitrogen oxides (NO_x)
Oxides of phosphorus

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Specific extinguishing methods :

Product is compatible with standard fire-fighting agents.

Further information : Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.

Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal protective equipment and emergency procedures precautions: Use personal protective equipment. Persons not wearing protective equipment should be excluded from area of spill until clean-up has been completed.

Environmental precautions : Prevent product from entering drains. Prevent further leakage or spillage if safe to do so. If the product contaminates rivers and lakes or drains inform respective authorities.

Methods and materials for containment and cleaning up : Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Keep in suitable, closed containers for disposal.

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Other information : Comply with all applicable federal, state, and local regulations.

SECTION 7. HANDLING AND STORAGE

Advice on safe handling : Do not breathe vapours/dust.

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Do not smoke.
 Persons susceptible to skin sensitisation problems or asthma, allergies, chronic or recurrent respiratory disease should not be employed in any process in which this mixture is being used.
 Container hazardous when empty.
 Avoid exposure - obtain special instructions before use.
 Avoid contact with skin and eyes.
 Smoking, eating and drinking should be prohibited in the application area.
 For personal protection see section 8.
 Dispose of rinse water in accordance with local and national regulations.


Conditions for safe storage : Keep container tightly closed in a dry and well-ventilated place.
 Containers which are opened must be carefully resealed and kept upright to prevent leakage.
 Electrical installations / working materials must comply with the technological safety standards.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Value type (Form of exposure)	Control parameters / Permissible concentration	Basis
WHITE MINERAL OIL	8042-47-5	REL	5 mg/m3 Mist.	NIOSH/GUID E
		STEL	10 mg/m3 Mist.	NIOSH/GUID E
		PEL	5 mg/m3 Mist.	OSHA_TRANS
		TWA	5 mg/m3 Mist.	TN OEL
		TWA	5 mg/m3 Inhalable fraction.	ACGIH

Engineering measures : Provide sufficient mechanical (general and/or local exhaust) ventilation to maintain exposure below exposure guidelines (if applicable) or below levels that cause known, suspected or apparent adverse effects.

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Personal protective equipment

Hand protection

Remarks : The suitability for a specific workplace should be discussed with the producers of the protective gloves.

Eye protection

: Wear chemical splash goggles when there is the potential for exposure of the eyes to liquid, vapor or mist.

Skin and body protection

: Wear as appropriate:
 impervious clothing
 Safety shoes
 Choose body protection according to the amount and concentration of the dangerous substance at the work place.
 Discard gloves that show tears, pinholes, or signs of wear.
 Wear resistant gloves (consult your safety equipment supplier).

Hygiene measures

: Wash hands before breaks and at the end of workday.
 When using do not eat or drink.
 When using do not smoke.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state : liquid

Odour : mild

Odour Threshold : No data available


pH : No data available

Melting point/freezing point : No data available

Boiling point/boiling range : No data available

Flash point : > 390 °F / > 199 °C
 Method: Cleveland open cup

Evaporation rate : No data available

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Flammability (solid, gas) : No data available

Upper explosion limit : 6 %(V)
Calculated Explosive Limit

Lower explosion limit : 1 %(V)
Calculated Explosive Limit

Vapour pressure : 1.3333333 hPa (20 °C)
Calculated Vapor Pressure

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Relative vapour density : No data available

Relative density : No data available

Density : 0.86 g/cm³ (15.56 °C)

Solubility(ies)
Water solubility : No data available

Solubility in other solvents : No data available

Partition coefficient:
noctanol/water : No data available

Thermal decomposition : No data available

Viscosity
Viscosity, dynamic : No data available

Viscosity, kinematic : 100 mm²/s (40 °C)

Oxidizing properties : No data available

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SECTION 10. STABILITY AND REACTIVITY

Reactivity : No decomposition if stored and applied as directed.

Chemical stability : Stable under recommended storage conditions.

Possibility of hazardous reactions : Product will not undergo hazardous polymerization.

Conditions to avoid : excessive heat
Exposure to sunlight.

Incompatible materials : Iron
steel
Strong acids
Strong oxidizing agents

Hazardous decomposition products : carbon dioxide and carbon monoxide
Hydrocarbons
Hydrogen chloride gas
Nitrogen oxides (NO_x)
Oxides of phosphorus
Sulphur oxides

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SECTION 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure : Inhalation
Skin contact
Eye Contact
Ingestion

Acute toxicity

Not classified based on available information.

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Components:**HEAVY PARAFFINIC DISTILLATE:**

Acute oral toxicity : LD 50 (Rat): > 15 g/kg

Acute dermal toxicity : LD 50 (Rabbit): > 5 g/kg

DI-TERT-BUTYL POLYSULFIDE:Acute oral toxicity : LD50 (Rat): > 2,000 mg/kg
Method: OECD Test Guideline 401Acute dermal toxicity : LD50 (Rat): > 2,000 mg/kg
Method: OECD Test Guideline 402**WHITE MINERAL OIL:**

Acute oral toxicity : LD 50 (Rat): 50,000 mg/kg

Acute dermal toxicity : LD 50 (Rabbit): > 2,000 mg/kg
Assessment: Not classified as acutely toxic by
dermal absorption under GHS.**Phosphoric acid esters, amine salt:**

Acute oral toxicity : LD 50 (Rat): 2,000 mg/kg

Skin corrosion/irritation

Not classified based on available information.

Product:

Remarks: May cause skin irritation in susceptible persons.

Components:**HEAVY PARAFFINIC DISTILLATE:**

Result: Mildly irritating to skin

DI-TERT-BUTYL POLYSULFIDE:

Result: Slightly to moderately irritating to skin

WHITE MINERAL OIL:

Result: Not irritating to skin

Phosphoric acid esters, amine salt:

Result: Mildly irritating to skin

Serious eye damage/eye irritation

Causes serious eye irritation.

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Product:

Remarks: Vapours may cause irritation to the eyes, respiratory system and the skin., Causes serious eye irritation.

Components:

HEAVY PARAFFINIC DISTILLATE:

Result: Not irritating to eyes

DI-TERT-BUTYL POLYSULFIDE:

Result: Slightly irritating to eyes

WHITE MINERAL OIL:

Result: Not irritating to eyes

Phosphoric acid esters, amine salt:

Result: Severely irritating to eyes

Respiratory or skin sensitisation

Skin sensitisation: May cause an allergic skin reaction.

Respiratory sensitisation: Not classified based on available information.

Components:

DI-TERT-BUTYL POLYSULFIDE:

Test Type: Maximisation Test (GPMT)

Species: Guinea pig

Assessment: The product is a skin sensitiser, sub-category 1B.

Method: OECD Test Guideline 406

Phosphoric acid esters, amine salt:

Assessment: May cause sensitisation by skin contact.

Germ cell mutagenicity


Not classified based on available information.

Components:

DI-TERT-BUTYL POLYSULFIDE:

Genotoxicity in vitro : Test Type: in vitro assay

Result: Positive results were obtained in some in vitro tests.

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Genotoxicity in vivo : Test Type: Micronucleus test Test
species: Mouse
Cell type: Bone marrow
Method: OECD Test Guideline 474
Result: negative

Carcinogenicity

Not classified based on available information.

Reproductive toxicity

Not classified based on available information.

STOT - single exposure

Not classified based on available information.

STOT - repeated exposure

Not classified based on available information.

Aspiration toxicity

Not classified based on available information.

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Components:

HEAVY PARAFFINIC DISTILLATE:

May be fatal if swallowed and enters airways.

Further information**Product:**

Remarks: No data available

Carcinogenicity:**IARC**


No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

OSHA

No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

NTP

No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

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SECTION 12. ECOLOGICAL INFORMATION
Ecotoxicity**Components:**

HEAVY PARAFFINIC DISTILLATE:

Toxicity to fish : LL50 (Fish): > 100 mg/l

Toxicity to daphnia and other aquatic invertebrates : EL50 (Aquatic invertebrates): > 10,000 mg/l

Toxicity to algae : EL50 (Algae, algal mat (Algae)): > 100 mg/l

Toxicity to fish (Chronic toxicity) : NOEC (Fish): 10 mg/l

Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity) : NOEC (Aquatic invertebrates): 10 mg/l


DI-TERT-BUTYL POLYSULFIDE:

Toxicity to daphnia and other aquatic invertebrates : EC50 (Water flea (Daphnia magna)): 0.24 mg/l
Exposure time: 48 h
Test Type: static test
Method: OECD Test Guideline 202Toxicity to algae : EC50 (Pseudokirchneriella subcapitata (microalgae)): 2.45 mg/l
End point: Growth inhibition
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 Exposure time: 72 h
 Test Type: static test
 Method: OECD Test Guideline 201

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NOEC (Pseudokirchneriella subcapitata (microalgae)): 0.1 mg/l
 End point: Growth inhibition
 Exposure time: 72 h
 Test Type: static test
 Method: OECD Test Guideline 201

Phosphoric acid esters, amine salt:

Ecotoxicology Assessment

Acute aquatic toxicity : Toxic to aquatic life.

Chronic aquatic toxicity : Toxic to aquatic life with long lasting effects.

Persistence and degradability**Components:**

DI-TERT-BUTYL POLYSULFIDE:

Biodegradability : Result: Not readily biodegradable.
 Biodegradation: 13 %
 Exposure time: 28 d
 Method: OECD Test Guideline 301B

Bioaccumulative potential**Components:**

DI-TERT-BUTYL POLYSULFIDE:

Partition coefficient: : log Pow: 5.6 (20 °C) pH:
 noctanol/water 7

Mobility in soil**Components:**

No data available

Other adverse effects


No data available

Product:

Additional ecological information : An environmental hazard cannot be excluded in the event of unprofessional handling or disposal., Toxic to aquatic life with long lasting effects.

Components:**SECTION 13. DISPOSAL CONSIDERATIONS****Disposal methods**

General advice : The product should not be allowed to enter drains, water

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courses or the soil.
 Do not contaminate ponds, waterways or ditches with
 chemical or used container.
 Send to a licensed waste management company.

Dispose of in accordance with all applicable local, state and
 federal regulations.

Contaminated packaging : Empty remaining contents.
 Dispose of as unused product.
 Empty containers should be taken to an approved waste
 handling site for recycling or disposal.
 Do not re-use empty containers.

SECTION 14. TRANSPORT INFORMATION

International transport regulations

REGULATION

ID NUMBER	PROPER SHIPPING NAME	*HAZARD CLASS	SUBSIDIARY HAZARDS	PACKING GROUP	MARINE POLLUTANT / LTD. QTY.

U.S. DOT - ROAD

Not dangerous goods

CFR_RAIL_C

Not dangerous goods

U.S. DOT - INLAND WATERWAYS


Not dangerous goods

TDG_ROAD_C

Not dangerous goods

TDG_RAIL_C

Not dangerous goods

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TDG_INWT_C

Not dangerous goods

INTERNATIONAL MARITIME DANGEROUS GOODS

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Not dangerous goods	MARINE POLLUTANT:(DI-TERT-BUTYL POLYSULFID E)

INTERNATIONAL AIR TRANSPORT ASSOCIATION - CARGO

Not dangerous goods

INTERNATIONAL AIR TRANSPORT ASSOCIATION - PASSENGER

Not dangerous goods

MX_DG

Not dangerous goods

*ORM = ORM-D, CBL = COMBUSTIBLE LIQUID

Marine pollutant	yes
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Dangerous goods descriptions (if indicated above) may not reflect quantity, end-use or region-specific exceptions that can be applied. Consult shipping documents for descriptions that are specific to the shipment.

SECTION 15. REGULATORY INFORMATION

SARA 311/312 Hazards : Acute Health Hazard

SARA 313 : This material does not contain any chemical components with **Component(s)** **SARA 313** known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

Pennsylvania Right To Know

HEAVY PARAFFINIC DISTILLATE	64742-54-7	50.00 - 70.00 %
VISCOSITY MODIFIER	Not Assigned	20.00 - 30.00 %
DI-TERT-BUTYL POLYSULFIDE	68937-96-2	1.00 - 5.00 %
WHITE MINERAL OIL	8042-47-5	1.00 - 5.00 %

New Jersey Right To Know


HEAVY PARAFFINIC DISTILLATE	64742-54-7	50.00 - 70.00 %
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VV975			1.1
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VISCOSITY MODIFIER	Not Assigned	20.00 - 30.00 %
DI-TERT-BUTYL POLYSULFIDE	68937-96-2	1.00 - 5.00 %
WHITE MINERAL OIL	8042-47-5	1.00 - 5.00 %
LUBRICANT ADDITIVE	Not Assigned	1.00 - 5.00 %

California Prop 65

Proposition 65 warnings are not required for this product based on the results of a risk assessment.

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The components of this product are reported in the following inventories:

TSCA	: On TSCA Inventory
DSL	: All components of this product are on the Canadian DSL.
AUSTR	: On the inventory, or in compliance with the inventory
NZIOC	: Not in compliance with the inventory
ENCS	: On the inventory, or in compliance with the inventory
KECL	: On the inventory, or in compliance with the inventory
PICCS	: On the inventory, or in compliance with the inventory
IECSC	: On the inventory, or in compliance with the inventory

Inventories

AICS (Australia), DSL (Canada), IECSC (China), REACH (European Union), ENCS (Japan), ISHL (Japan), KECL (Korea), NZIoC (New Zealand), PICCS (Philippines), TSCA (USA)

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Version:

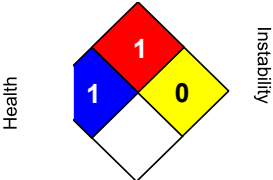
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SECTION 16. OTHER INFORMATION

Further information

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<p>NFPA:</p> <p style="text-align: center;">Flammability</p>  <p style="text-align: center;">Special hazard.</p>	<p>HMIS III:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="background-color: blue; color: white; text-align: center;">HEALTH</td> <td style="text-align: center;">2</td> </tr> <tr> <td style="background-color: red; color: white; text-align: center;">FLAMMABILITY</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="background-color: yellow; text-align: center;">PHYSICAL HAZARD</td> <td></td> </tr> </table> <p style="text-align: center; font-size: small;"> 0 = not significant, 1 = Slight, 2 = Moderate, 3 = High 4 = Extreme, * = Chronic </p>	HEALTH	2	FLAMMABILITY	1	PHYSICAL HAZARD	
HEALTH	2						
FLAMMABILITY	1						
PHYSICAL HAZARD							

NFPA Flammable and Combustible Liquids Classification

Combustible Liquid Class IIIB

Full text of H-Statements referred to under sections 2 and 3.

- H227 Combustible liquid.
- H302 Harmful if swallowed.
- H304 May be fatal if swallowed and enters airways.
- H317 May cause an allergic skin reaction.
- H318 Causes serious eye damage.

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H401 Toxic to aquatic life.
H411 Toxic to aquatic life with long lasting effects.

Sources of key data used to compile the Safety Data Sheet

Valvoline internal data including own and sponsored test reports

The UNECE administers regional agreements implementing harmonised classification for labelling (GHS) and transport.

The information accumulated herein is believed to be accurate but is not warranted to be whether originating with the company or not. Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances. This SDS has been prepared by Valvoline's Environmental Health and Safety Department (1-800-825-8654).

List of abbreviations and acronyms that could be, but not necessarily are, used in this safety data sheet :

ACGIH : American Conference of Industrial Hygienists

BEI : Biological Exposure Index

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CAS : Chemical Abstracts Service (Division of the American Chemical Society).

CMR : Carcinogenic, Mutagenic or Toxic for Reproduction

FG : Food grade

GHS : Globally Harmonized System of Classification and Labeling of Chemicals.

H-statement : Hazard Statement

IATA : International Air Transport Association.

IATA-DGR : Dangerous Goods Regulation by the "International Air Transport Association" (IATA).

ICAO : International Civil Aviation Organization

ICAO-TI (ICAO) : Technical Instructions by the "International Civil Aviation Organization"

IMDG : International Maritime Code for Dangerous Goods

ISO : International Organization for Standardization


logPow : octanol-water partition coefficient

LCxx : Lethal Concentration, for xx percent of test

population LDxx : Lethal Dose, for xx percent of test

population. IC_{xx} : Inhibitory Concentration for xx of
a substance
Ec_{xx} : Effective Concentration of xx
N.O.S.: Not Otherwise Specified
OECD : Organization for Economic Co-operation and Development
OEL : Occupational Exposure Limit P-Statement
: Precautionary Statement
PBT : Persistent , Bioaccumulative and Toxic
PPE : Personal Protective Equipment
STEL : Short-term exposure limit
STOT : Specific Target Organ
Toxicity TLV : Threshold Limit Value
TWA : Time-weighted
average
vPvB : Very Persistent and Very Bioaccumulative
WEL : Workplace Exposure Level

CERCLA : Comprehensive Environmental Response, Compensation, and Liability Act
DOT : Department of Transportation
FIFRA : Federal Insecticide, Fungicide, and Rodenticide Act
HMIRC : Hazardous Materials Information Review Commission
HMIS : Hazardous Materials Identification System
NFPA : National Fire Protection Association
NIOSH : National Institute for Occupational Safety and Health
OSHA : Occupational Safety and Health Administration
PMRA : Health Canada Pest Management Regulatory Agency
RTK : Right to Know
WHMIS : Workplace Hazardous Materials Information System

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[MOLYWHITE RE No.00][KYODO YUSHI CO., LTD.][07-543]

Components:

Component	Contents(%)
Base oil (Synthetic hydrocarbon oil, refined mineral oil)	85-95
Thickener(Lithium soap)	< 10
EP additive(Containing molybdenum compounds,	< 5
Oxidation inhibitor(Butylated hydroxytoluene (BHT))	< 5
Additive(s) (Containing barium compounds)	< 5

Hazardous Ingredients:

Component	CAS No.	Contents(%)
Molybdenum compounds	Confidential	1-3

See Section 8 for exposure limits (if applicable).

See Section 15 for legal controlled substance (if applicable).

4. First-aid measures

Eye Contact:

- Immediately flush with water for at least 15 minutes. Get medical attention.

Skin Contact:

- Thoroughly remove with cloth or paper and wash carefully with soap and water.

Inhalation:

- Remove the victim from the contamination to fresh air. Cover the victim in a blanket to keep warm and quiet. Consult a physician.

Ingestion:

- Do not induce vomiting. Immediate consult a physician.

Notes to Physicians:

- Supportive care. Treatment based on judgment of the physician in response to reactions of the patient.

5. Fire-fighting measures

Flammable Limits: No data available.

Autoignition Temperature: No data available.

Extinguishing Media:

- Foam, dry chemical, CO₂, dry sand.

Unsuitable Extinguishing Media:

- Do not use water. Water can be dangerous possibly leading to fire spread.

Specific Hazards with Regard to Fire-fighting:

- Thermal decomposition and combustion may produce carbon monoxide and/or carbon dioxide.

Specific Methods of Fire-fighting:

- In the early stages of fire, use dry chemical, CO₂, dry sand, etc. fire-extinguisher.
- In case of massive fire, use foam fire-extinguisher to shut off the air supply.
- Get all persons to safety. Authorized personnel only at the fire site.

Protection of Firefighters:

- Fire-fighters should wear protective equipment.
- Start fire fighting from the windward side.

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[MOLYWHITE RE No.00][KYODO YUSHI CO., LTD.][07-543]

6. Accidental release measures

Personal Precautions:

- Wear protective equipment during cleanup work.

Environmental Precautions:

- Prevent spills from entering sewers or waterway.

Methods for Clean-Up:

- For small spills, absorb with inert material (e.g., dry sand, sawdust or waste cloth), then place in a chemical waste container with a cover for disposal.
- For large spills, dike to keep spillage in a safe place for later disposal.

Prevention of Secondary Hazards:

- Immediately shut off all sources of ignition.

7. Handling and storage

Handling

Technical Measures:

- Handle the product in a well-ventilated place. Do not leak, flood or scatter the product to prevent unwanted evaporation.

Precautions:

- Contact with eye may cause irritation. Use protective glasses to avoid contact with eyes.
- Contact with skin may cause irritation. Use protective gloves to avoid skin contact.
- Do not swallow. (Drinking the product may cause diarrhea and vomiting.)
- Close container after each use.

Precautions for Safe Handling:

- Wear gloves to avoid injury on hands at opening the container.

Storage

Appropriate Storage Conditions:

- Keep container closed to protect from dust/water ingress after use.
- Store in a cool, dry place, away from direct sunlight, heat source and fire.
- Keep out of reach of children.

Safe Packaging Materials:

- Do not expose empty container to pressure.
- Do not weld, heat, drill or cut container. Residue ignition and explosion hazards.

8. Exposure controls/personal protection

Exposure Guidelines

ACGIH

- Butylated hydroxytoluene (BHT): TWA 2mg/m³
- Mineral oil: TWA 5mg/m³

Engineering Controls:

- When vapor or mist exhales, install an apparatus to close the vapor/mist source or ventilation equipment.

Protective Equipment

Respiratory Protection:

- Wear a gas mask for organic gas when needed (not necessary under normal conditions).

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[MOLYWHITE RE No.00][KYODO YUSHI CO., LTD.][07-543]

Hand Protection:

- Wear oil-resistant protective gloves in case of prolonged and/or repeated skin contact.

Eye Protection:

- Wear chemical safety goggles whenever the product splashes.

Skin and Body Protection:

- Wear long-sleeved oil-resistant working clothes whenever handling for many hours and/or getting wet. Immediately take off the wet clothes and thoroughly wash them before reusing.

9. Physical and chemical properties

Appearance

Form	: Semi-fluid
Color	: Yellow
Odor	: Slight odor
pH	: No data available.
Melting point	: No data available.
Flash point	: 190°C(Seta)
Vapor pressure	: No data available.
Solubility in water	: Insoluble in water
Vapor density	: No data available.
Density	: 0.87(25°C)g/cm ³
Partition coefficient: n-octanol/water	: No data available.
Viscosity	: No data available.
Dropping point	: 193°C

10. Stability and reactivity

Reactivity, Conditions to avoid:

- Avoid contact with strong oxidant.

Chemical Stability:

- Product is stable under normal conditions.

Possibility of Hazardous Reactions:

- Not available.

Materials to avoid:

- Strong oxidizers.

Hazardous Decomposition Products:

- This material is expected to be stable under normal conditions of use.

11. Toxicological information

Information on the likely routes of exposure: Not applicable.

Delayed and immediate effects and also chronic effects from short- and long-term exposure

Acute toxicity - Oral:

- Not classified based on the category of each ingredient or the product properties.
- Refined mineral oil LD50 Acute oral >5 g/kg (rat)

Acute toxicity - Dermal:

- Not classified based on the category of each ingredient or the product properties.

Acute toxicity - Inhalation (Gases): No data available.

Acute toxicity - Inhalation (Vapors): No data available.

Acute toxicity - Inhalation (Dusts and mists): No data available.

Skin corrosion/irritation: No data available.

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Eye damage/irritation: No data available.
Sensitization - Respiratory: No data available.
Sensitization - Skin: No data available.
Germ cell mutagenicity: No data available.
Carcinogenicity: No data available.
Toxic to reproduction: No data available.
Effects on or via lactation: No data available.
Specific target organ toxicity (Single exposure):
No data available.
Specific target organ toxicity (Repeated exposure):
No data available.
Aspiration hazard: No data available.
Other Toxicity Information
NTP Report on Carcinogens: Not listed.
IARC Monographs: Not listed.

12. Ecological information

Ecotoxicity
Hazardous to the aquatic environment (Acute hazard):
No data available.
Hazardous to the aquatic environment (Long-term hazard):
• Classified under Category Chronic 3 based on the category of each ingredient or the product properties.
Persistence and Degradability: No data available.
Bioaccumulative potential: No data available.
Mobility in soil: No data available.
Hazardous to the ozone layer: No data available.

13. Disposal considerations

Waste Residues:
• Properly dispose of in accordance with any relevant regulations.
• Properly dispose of by a licensed waste disposer.
• For in-house incineration disposal, ensure exhaust gas treatment (washing treatment, etc.) to prevent air pollution from sulfur oxides.
• No dumping.
• When burning, be sure to do so on someone's watch in a safe place and in the way that burning and/or explosion will never pose a potential hazard.
Contaminated Packaging:
• Dispose of container after completely removing the contents.

14. Transport information

DOT Hazardous Materials: Not applicable.
UN Transport of Dangerous Goods
UN Number: Not applicable.
UN Proper Shipping Name: Not applicable.
Transport Hazard Class: Not applicable.
Packing Group: Not applicable.
Land(RID/ADR): Not applicable.
Sea(IMO/IMDG): Not applicable.
Air(ICAO/IATA): Not applicable.
Specific Precautionary Transport Measures and Conditions:
• Contains combustible liquid. Keep fire away.
• Handle with care to prevent container damage.

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- Ensure proper packaging before shipping to avoid load shifting and falling accident.

15. Regulatory information

Regulatory information with regard to this product in your country or your region should be examined by your own responsibility.

US TSCA (Toxic Substances Control Act)

All components of this product are listed on the TSCA inventory of Chemical Substances.

US OSHA (Occupational Safety and Health Act):

This product is hazardous according to the OSHA Hazard Communication Standard, 29 CFR 1910.1200, since this product contains OSHA Hazardous Substances;

Name	CAS No.	Contents(%)
Molybdenum compounds	Confidential	1-3

US CERCLA

(Comprehensive Environmental Release, Compensation & Liability Act):

CERCLA Hazardous Substances:

Name	CAS No.	Contents(%)
Zinc compounds	Confidential	0.1-0.5

US SARA (Superfund Amendment & Reauthorization Act) Title III:

SARA Extremely Hazardous Substances (302): None

SARA Hazard Categories (311/312): None

SARA Toxic Release Inventory (TRI) (313):

Name	CAS No.	Contents(%)
Barium compounds	Confidential	0.3-0.7
Zinc compounds	Confidential	0.1-0.5

16. Other Information

NFPA

Health hazards: 1
 Flammability: 1
 Instability: 0
 Special Hazard: -

Contact Information

Name: KYODO YUSHI CO., LTD.
 International Business Dept.
 Address: 2-2-30, Tsujido Kandai, Fujisawa-Shi, Kanagawa, Japan
 TEL: +81-466-33-3157

Name: KYODO YUSHI USA INC.
 Address: Continental Towers - Tower I, 1701 Golf Road, Suite 1108
 Rolling Meadows 60008 IL, U.S.A.
 TEL: +1-847-364-2020
 E-mail: info@kyodoyushiusa.com

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[MOLYWHITE RE No.00][KYODO YUSHI CO., LTD.][07-543]

Original date: Oct/31/2014

Revision date: / /

References

- 1.OSHA Hazard Communication Standard 29 CFR 1910.1200
- 2.Thresholds limit values for chemical substances and physical agents and biological exposure indices, ACGIH(2012)
- 3.IARC MONOGRAPHS ON THE EVALUATION OF THE CARCINOGENIC RISK OF CHEMICALS TO HUMANS VOLUME 33
- 4.Report on Carcinogens Twelfth Edition 2011, NTP
- 5.EU CLP Regulation (EC No 1272/2008 ANNEX VI Harmonised classification and labelling for certain hazardous substances)
- 6.Globally Harmonized System of Classification and Labelling of Chemicals (GHS) Third revised edition.

Disclaimer

This SDS is an addition and complementary document beside the technical data sheet.The information is based upon our knowledge about the product at the date of edition.

Since we cannot anticipate or control the different conditions under which these information or our product may be used, we make no guarantee that recommendations will be adequate for all individuals and situations.