January 20, 2003 Rev 0

F65A

MULTI PURPOSE MACHINING CENTER

MACHINE SERIAL NUMBER

_____

OPERATIONS AND MAINTENANCE
MANUAL

MANUFACTURED BY:

ROTTLER MANUFACTURING COMPANY
8029 South 200th Street
Kent Washington 98032
USA

Phone: (253) 872-7050
Fax: (253) 395-0230
Website: http://www.rottlermfg.com

NOTE: WHEN ORDERING REPLACEMENT PARTS,
PLEASE GIVE THE MODEL AND SERIAL NUMBER.

ORDER BY PART NUMBER.
THERE IS A MINIMUM ORDER OF $25.00

Chapter 1 Introduction / Safety / Installation:

Introduction:

This manual is arranged in sections as listed in the table of contents.

It is required that the new user of the F65 Boring Machine read this manual before operation. Pay close attention to the sections concerning safety.

The Controls Definition and Operating Instructions chapters should be read very carefully 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 F65 series machine gains experience with using 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 needs to read and become familiar with these areas as well

Description:

The model F65 is a precision, single point, high speed boring machine. The F65 can be equipped with tooling and accessories for re-boring most American passenger car and truck engines, In-lines as well as 60 and 90 degree V-types.

The F65 machines can be easily tooled to machines a wide range of engines, including European and Asian.

The machine is designed to maintain the alignment of cylinder bores to the Pan Rails and Main Bearing bore locations, as was done in the original factory machining. This overcomes the many inaccuracies and out-of-alignment problems associated with the clamping of portable boring bars to the cylinder head surface of the blocks.

Convenient controls, fast block clamping, air floated Spindle Base positioning and clamping, means considerable savings in floor to floor time and operator involvement.

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

Limited Warranty:

Rottler Manufacturing Company Model F65 parts and equipment is warranted as to materials and workmanship. This limited warranty remains in effect for one year from the date of delivery, provided the machine is owned and operated by the original purchaser and is operated and maintained as per the instructions in the manual.

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

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.

Freight charges on warranty items (non-air shipment only) will be paid by Rottler Manufacturing for a period of 60 days only from the date of installation or set-up by a qualified service technician or sales representative.

Freight charges after the 60 day period are the customer's responsibility.

Safety Information:

CAUTION: *This machine is capable of causing sever bodily injury!*

The operator of the F65 should be a skilled machinist craftsman who is well versed in the caution, care, and knowledge required to safely operate metal cutting tools. ***Eye protection must be worn at all times by the operator and all other personnel in the area of the machine.***

The operator should be extremely cautious when working around the cutting tool area.

When boring the machine is capable of throwing metal chips over 10- feet from the cutting area. ***Always use the guards.***

The F65 operates under computerized control and, as is all computerized equipment, 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.

Electrical Power:

Make sure all electrical equipment has the proper overload protection. The F65 should have ***a fully isolated*** power supply to prevent damage and uncontrolled movement of the machine. If the F65 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 the F65 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 later in this chapter for voltage and amperage requirements of the F65.

Machine Operator:

The operator of the F65 should be a skilled machinist craftsman who is well versed in the caution, care, and knowledge required to safely operate metal cutting tools. ***Eye protection must be worn at all times by the operator and all other personnel in the area of the machine.***

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.

The F65 machines have the following areas of exposed moving parts that you must train yourself to respect and stay away from when they are in motion:

1. **Tool Sharpening** – Must be done with care and dexterity to get good bore results, be alert to the light pressure required for tool sharpening.

CAUTION: *Exposed diamond wheel is a potential hazard to your hands, fingers, and face. Eye protection must be worn when working in this area.*

2. **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.

3. **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.

4. **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 of Block Handler Assembly. Lifting Eye can eventually fail if the eye is reset in line with the 502-1-80 lift channel. ***Eye must be at a right angle.***

5. Machine Maintenance – Any machine adjustment, maintenance or parts replacement absolutely requires a complete power disconnection from the machine, ***this is an absolute rule.***

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, 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. Make sure the button has been depress for at least 1 ½ minutes or the drive will not have time to reset and they will not function.

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.

Machine Installation:

Location:

The productivity of the F65 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 F65 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 conveyer. 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.

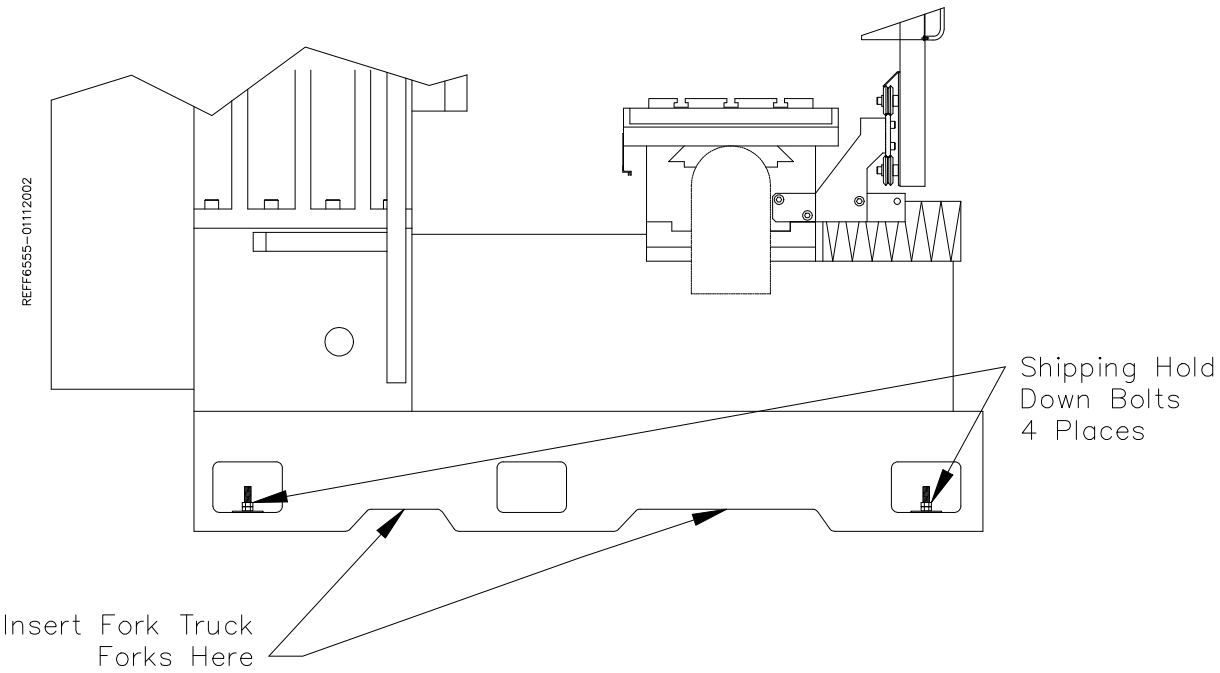
Unpacking and Lifting:

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

Remove the Nuts and Jam Nuts from the Four (4) bolts holding the F65 to the crate. These bolts are located at the four bottom corners of the Main Base.

You will need a Fork Truck with a minimum of 8,000 lb. Capacity. The F65 can be picked up from the pallet in two (2) different ways. See the following page for illustration of these procedures.

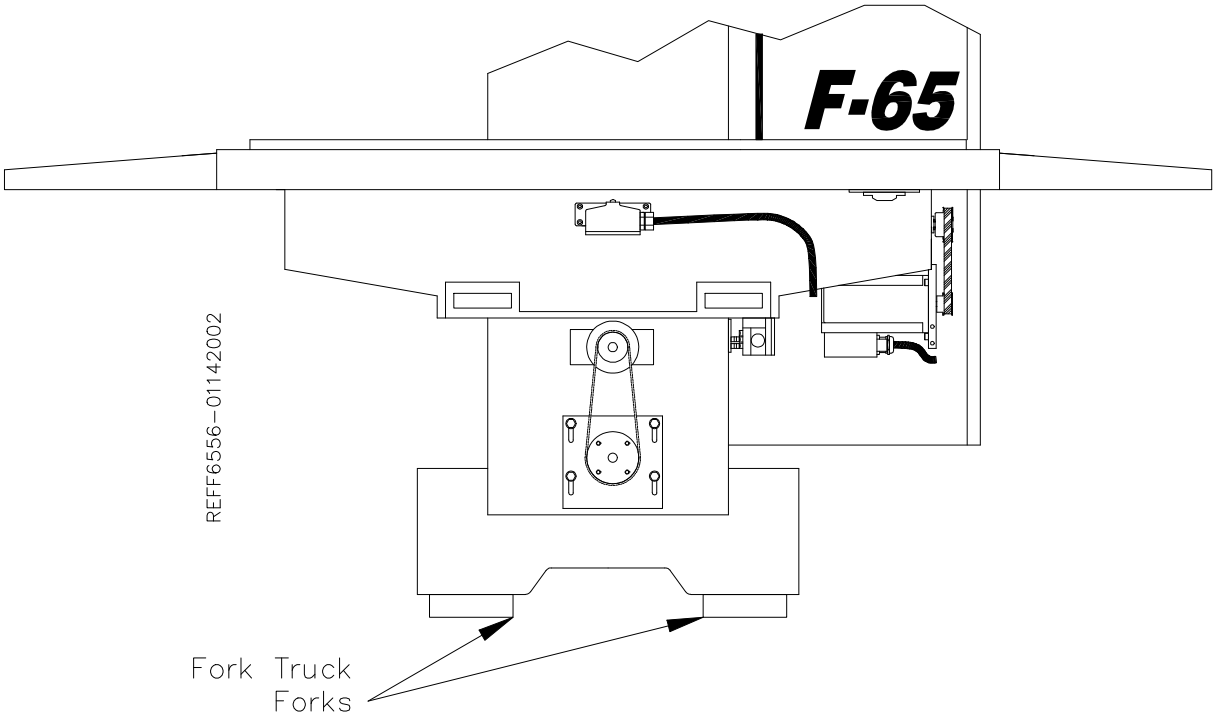
Type One:



Be sure that the forks are at least Four inches through the opposite side of the casting.

CAUTION: *This machine is extremely top heavy. Use extreme care whenever this machine is being used. Do not use quick or sharp movement.*

Type Two:



Remove the Toolbox, Parallels and optional equipment form the machine. Completely clean these articles along with the rest of the machine with solvent, rust inhibitor was applied at the time of shipment. Any of the rust inhibitor left on the machine will allow Cast Iron dust to build up and cause premature wear to the machine.

> ***IMPORTANT:***
> The ways under the table as well as the ways behind the Vertical gibs were sprayed with rust inhibitor as well. It is extremely important that these surfaces be cleaned thoroughly. Use a cleaner, such as WD-40 to clean the ways where the table and the spindle unit are not sitting. Move the table and spindle unit onto the area that has been cleaned and clean where they were sitting. Spray the ways with WD-40 and move the table and spindle unit over the sprayed area. You must do this several time to get all of the rust inhibitor off of the gib surfaces. If you do not the rust inhibitor will plug up the oiler holes and also cause sticktion when moving in small increments, such as handwheel.

Leveling and Alignment:
Leveling the F65 properly is very important if you are to use the F65 to its full blue printing capabilities as well as maximizing the use of Rottler fixturing.

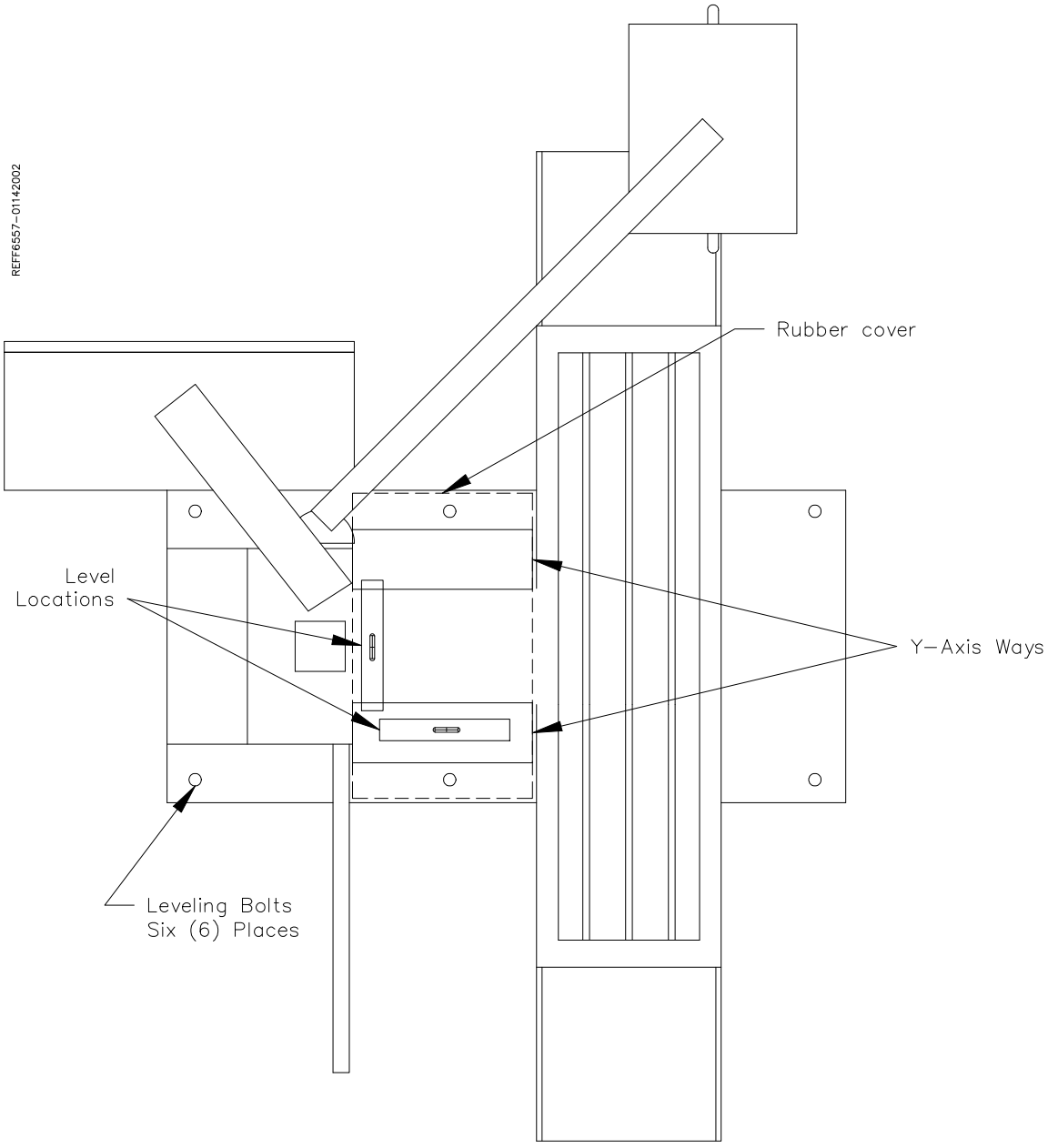
Use the following instructions to properly level the F65.

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 he 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”.

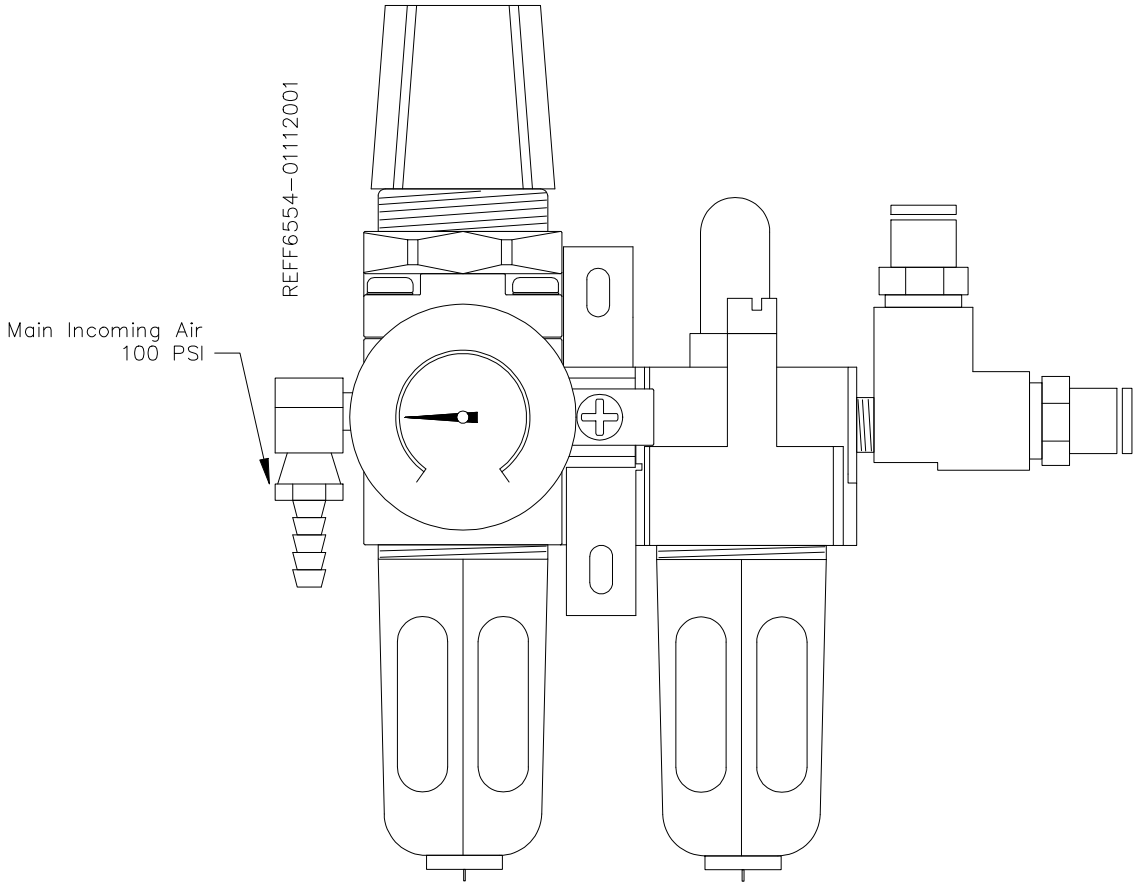
Check the level in both directions on the Table. If it does not match the alignment of the Y-Axis ways refer to the Maintenance Chapter of this manual for full alignment procedures.

Leveling Locations:



Air Supply:
It is very important that the air source for the F65 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 right hand side of the main rear enclosure.

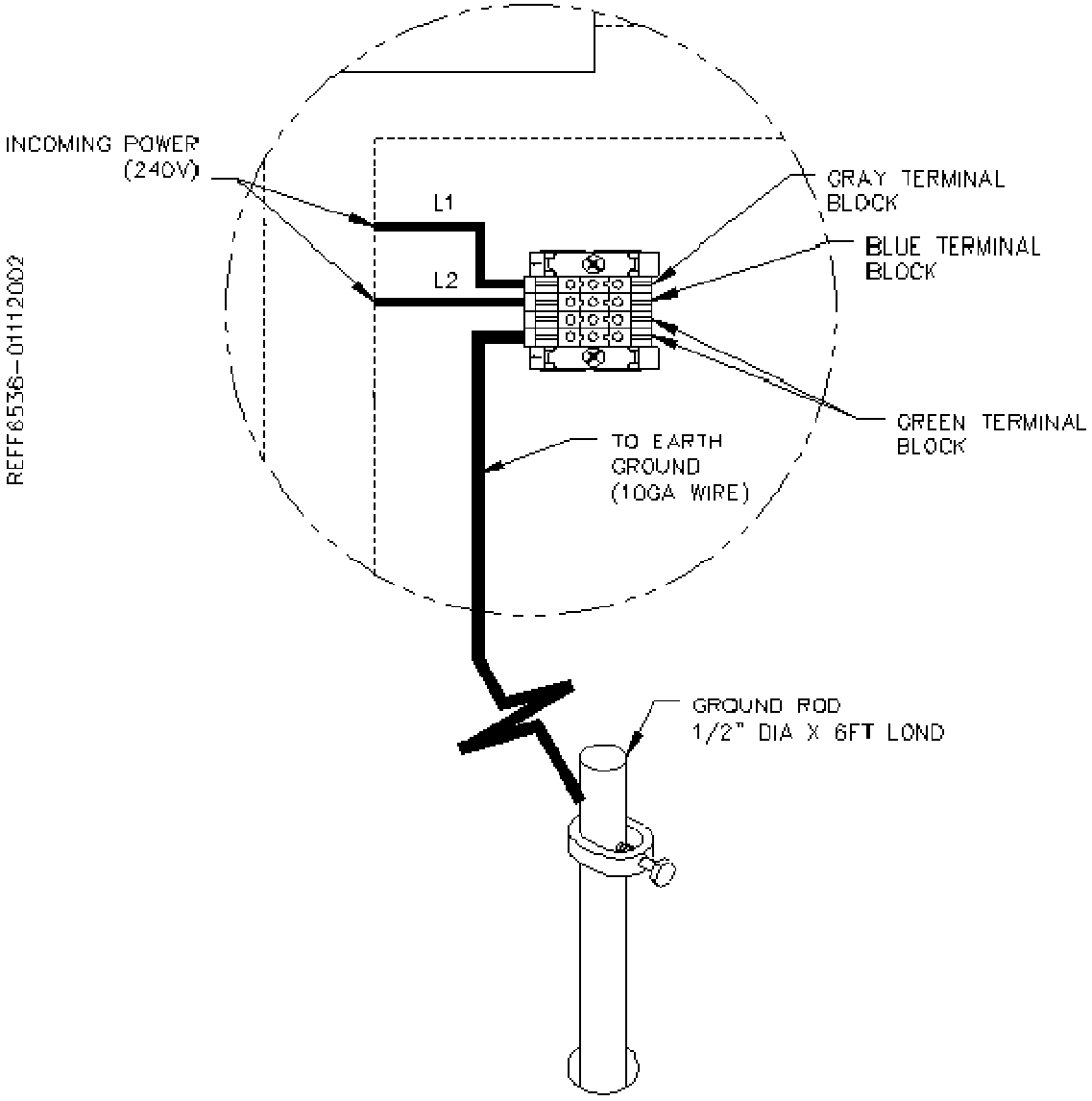


Power Supply:
This machine has the following power requirements:

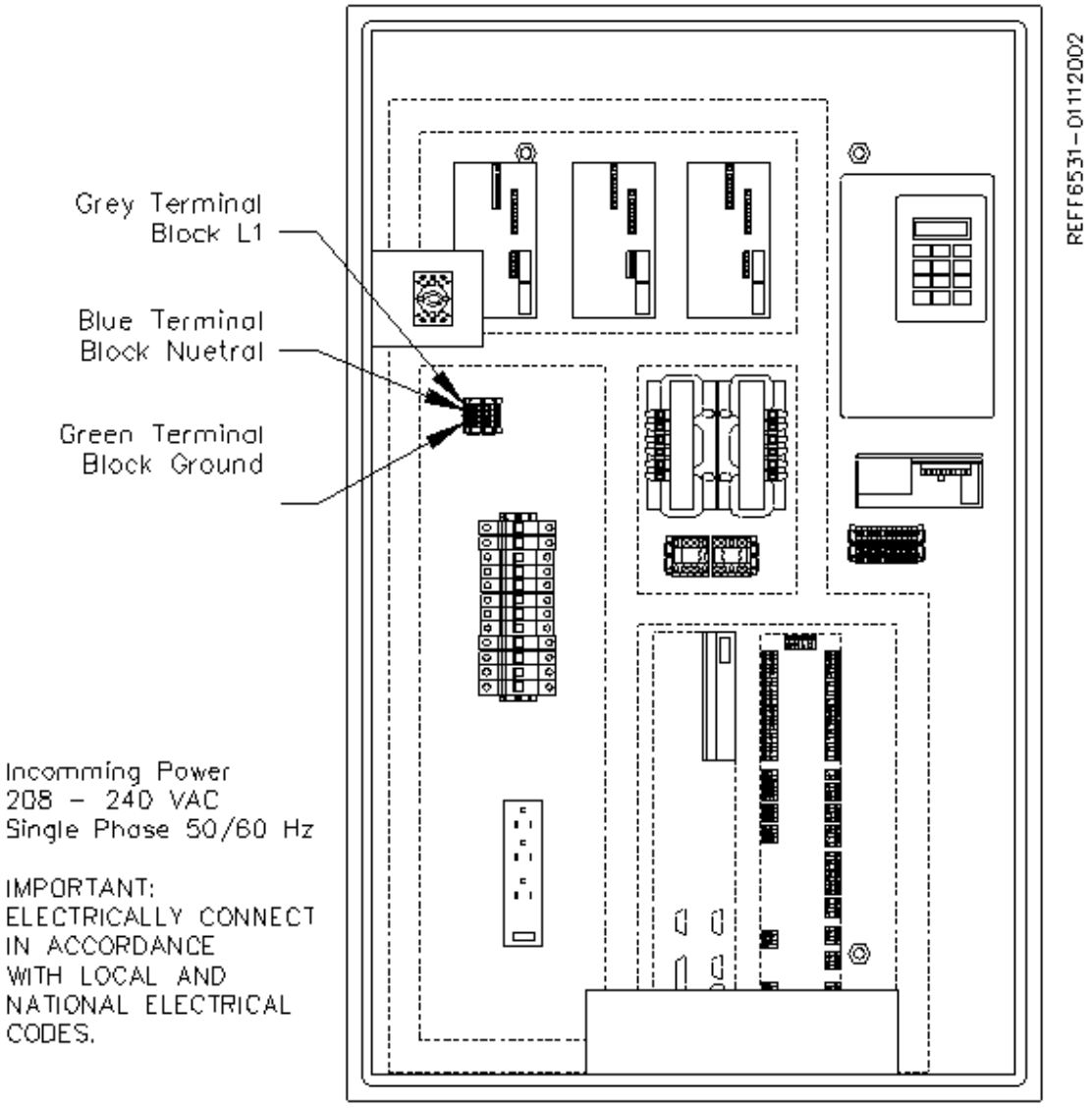
208 to 240 VAC
Single Phase
50 or 60 Hertz
30 amps

See illustration below for correct connection of "measured" incoming power. Connect single phase wiring to the main rear enclosure, located on the right rear of machine base. The connection point for power is located inside the enclosure. The connection termination point is located on the left hand side of the electrical panel about half way up. Connect L1 to the Grey terminal block, L2 (neutral) to the blue terminal block. Attach wire from the grounding rod to the second green and yellow terminal. ***Important: Electrically connect in accordance with national and local electrical codes.***

Grounding:
This machine must be connected to a good earth ground rod. A 6 foot, ½" 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.



Electrical Enclosure:



Getting Started:

Once power has been supplied to the machine measure the incoming voltage with a meter to verify proper voltages before turning the Main Power switch on. Failure to measure and record proper voltages to the machine could cause damage and will void factory warranty. Measure L1 to L2 and record on the installation report. Record L1 to ground and L2 to ground and record on the installation report.

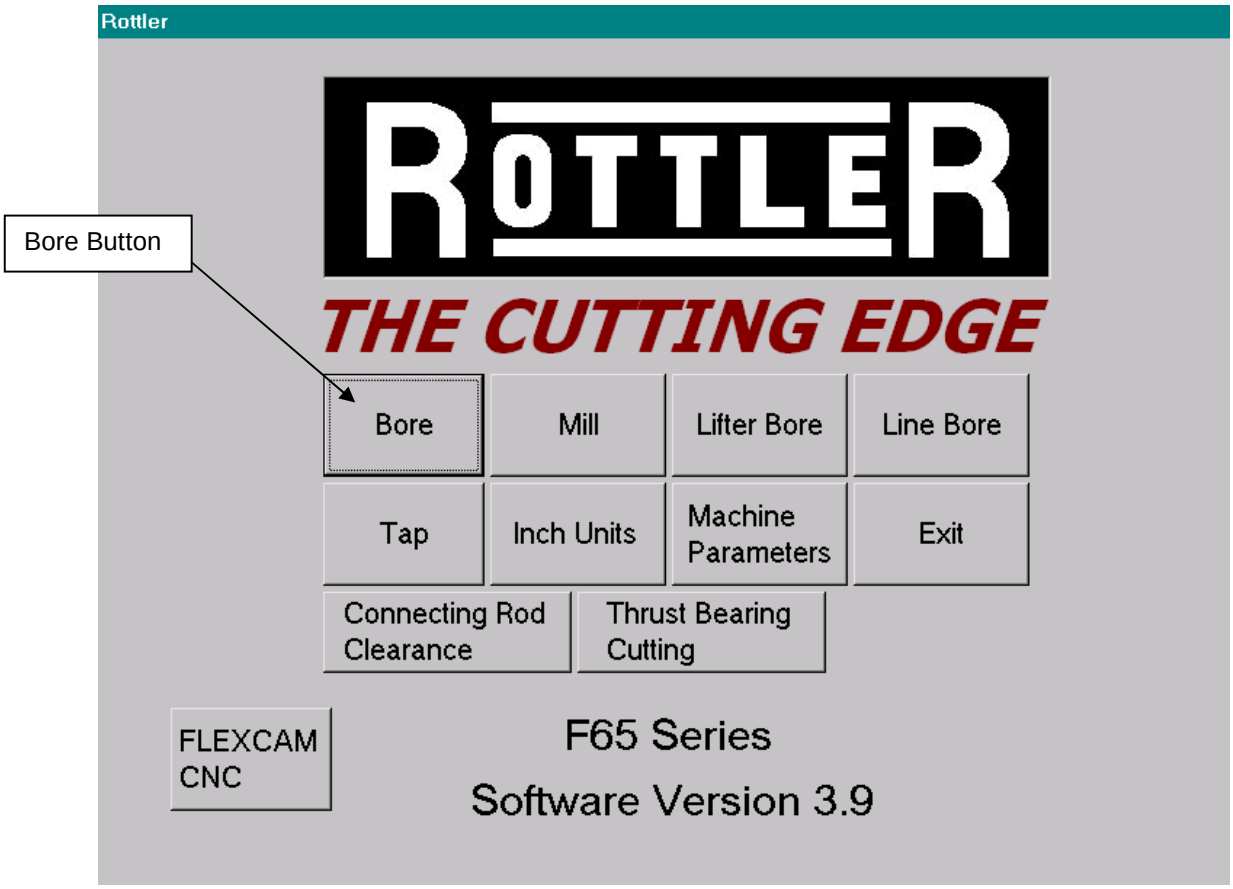
Power Up:

Turn the Main Power switch on. Allow a few minutes for the machine to fully boot up.

Note: The Rottler F65 uses a touch screen for control and data transfer to the computer. Be careful not to touch the screen until the machine has fully booted up and a Rottler screen is showing. If the screen is touched prior to full boot –up it may activate a function or interfere with proper boot-up.

The first screen to appear after boot up it the Initialization Screen. After the system is initialized another screen will appear with a button toward the bottom of the screen that says “Click to Enable Axis”. Press this button once and the drives will enable and the Main Menu will appear.

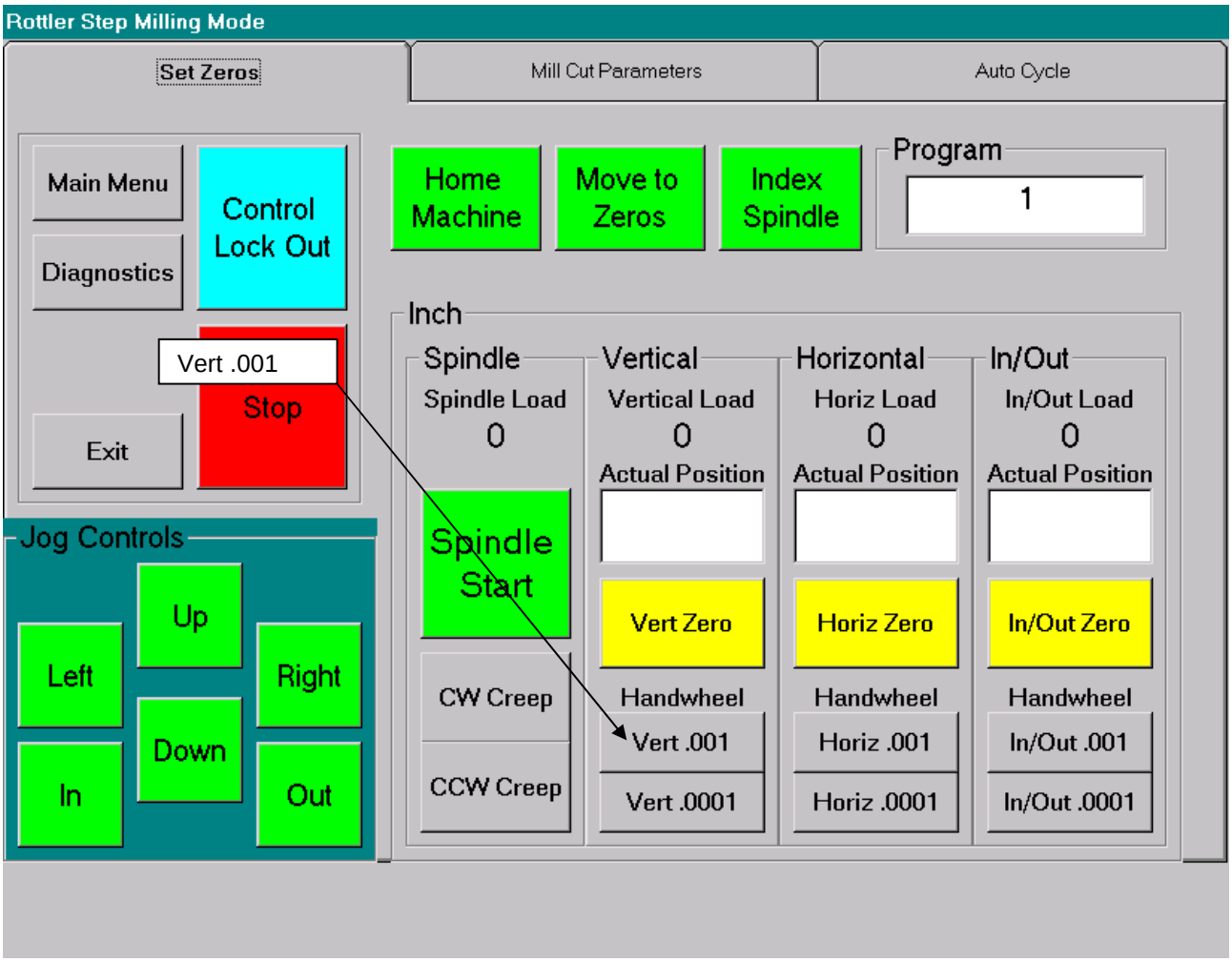
Press the Bore button on the Main Menu. This will put the F65 in Bore mode; this is the mode you want to be in to undo the holding devises that were install before shipping.



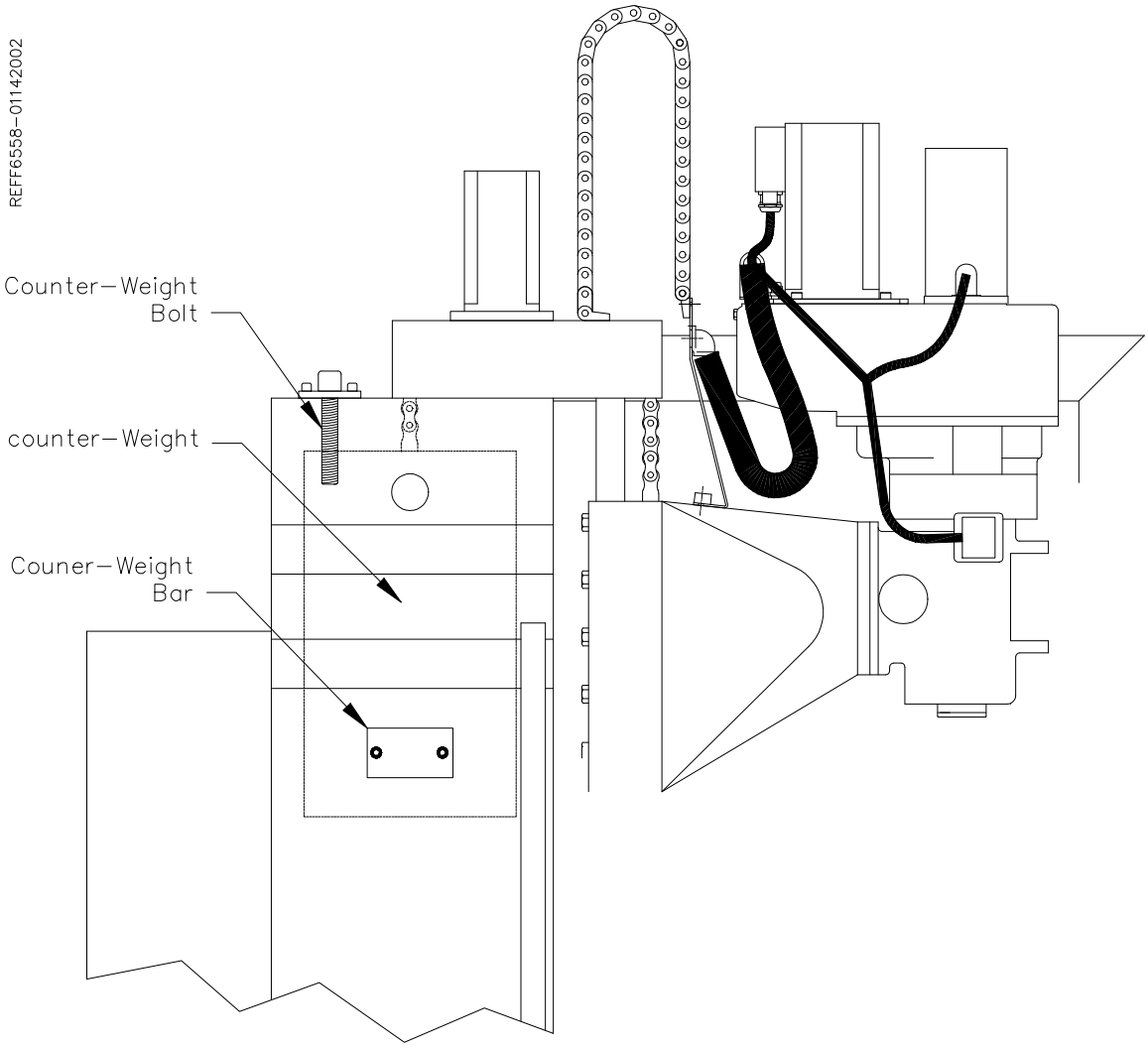
Shipping Restraints:
There are three main shipping restraints on the F65. A restraint under the spindle, a bar through the counter weight and a Bolt in the top of the counter-weight. The following is the procedure for removing these restraints.

IMPORTANT: Do not ouch any of the rapid travel movements on the machine at this time.

Spindle Support:
Once in the Bore Mode (Set Zero Tab) press the Vert .001 Handwheel button. Use the handwheel to move the spindle up until it clears the spindle support. Unbolt and remove the spindle support from the table.



Counter-Weight Bar and Bolt:
Remove the two bolts securing the Counter-Weight Bar. Using the Vertical handwheel move the Spindle head up slowly until the Counter-Weight bar is free. Remove the bar and save for possible later use in shipping. Loosen the Counter-Weight bolt until it is free from the Counter-Weight. Once it is free, it can remain in the bracket. The Rapid travel buttons can now be used on the machine.



It is important that the operator of the F65 read the Control Definitions chapter in this manual before proceeding any further.

Chapter 2 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 Definition:

The computer and controller are located in the main rear electrical enclosure. This unit is a full computer, running Windows 98 operating system. Contact the factory if more information on the computer system is required.

Changing or tampering with computer settings without factory authorization will void the factory warranty and may cause the machine to become inoperable.

Master Power On/Off Switch:
This switch is located on the main electrical control enclosure on the right hand side 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 and start the Rottler program.

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.

From the Main Menu, press the “EXIT” button on touch screen. This will shut down the Rottler program. The terminal will show the computer desktop screen. The “Start” bar is in the “Auto Hide” mode when the Rottler program is shut down. Touch the screen as low as possible, this should bring the “Start” bar up onto the screen.

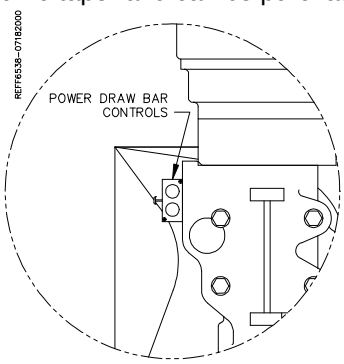
Press the “Start” button in the left-hand side of the Start Bar. This will bring up the “Start Menu”. Press the “Shutdown” line at the bottom of the Start Menu. This will bring up a Pop Up menu, make sure that “shut down computer” is selected and press “OK”.

This will shut down the computer and tell you when it is OK to shut off the power. The shutdown process could take a couple of minutes.

Power Air Draw Bar Switch:
This switch is located just to the left of the spindle mounted on the spindle housing. It has a In and Out button along with a safety button. The safety button on the left-hand side of the switch must be held in to operate the In or Out buttons.

This switch will spin the draw bar Forward or Reverse to install or remove the tool holder.

All tool holders on the F65 are standard 40 taper and can be purchase through your local tooling vendor.

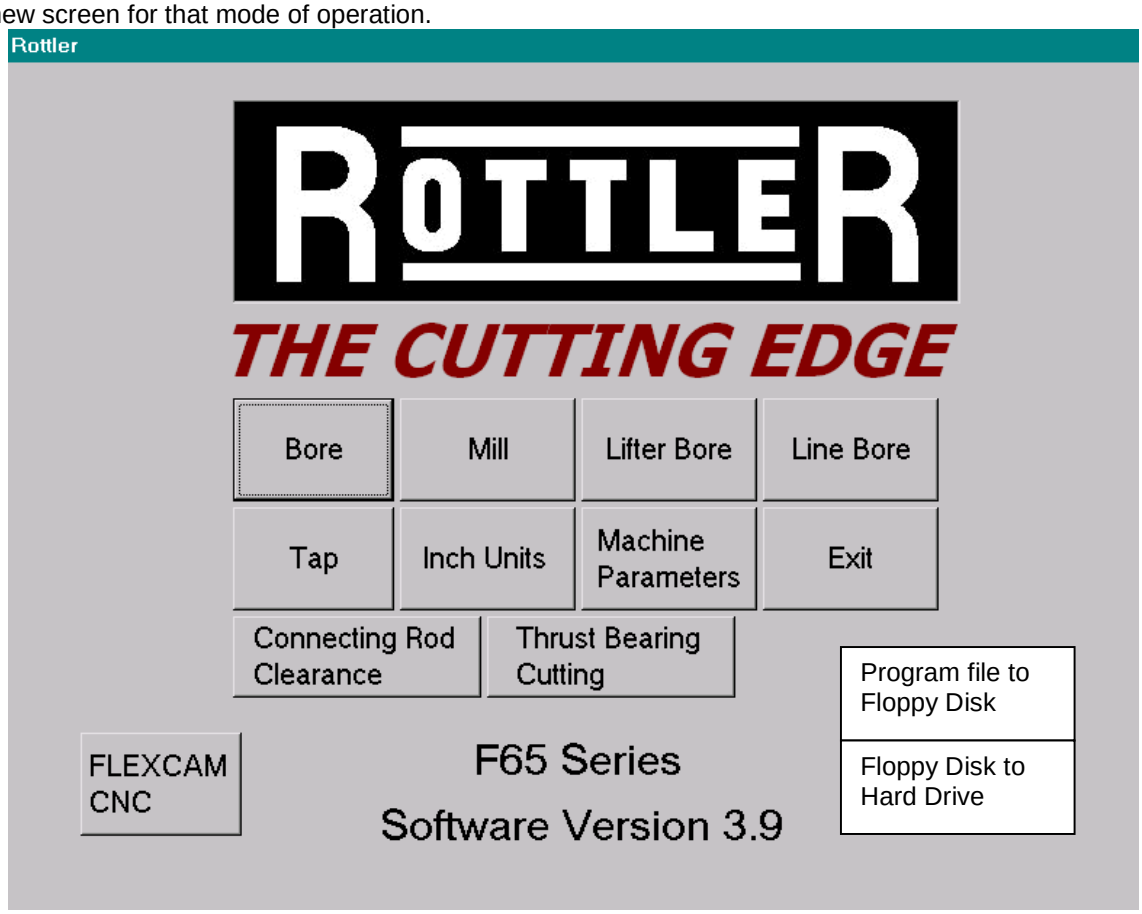


Main Menu:

When the F65 is powered up the Rottler program is automatically started. It may take several minutes for the computer to power up and start the Rottler program. Once the program is started, the Main Menu will appear on the screen.

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

The F65 has several modes of operation. These modes are all displayed on the Main Menu. If you did not purchase any optional modes of operation they may not appear on the Main Menu or will be blanked out. To start a particular mode of operation press that button on the Main Menu screen. This will bring up a new screen for that mode of operation.



Machine Parameters:

This button will take you to the Machine Parameter screen. This screen stores the parameters that control the operation of the machine. The Machine Parameter screen has a double password protection on it. If you feel the parameters have been corrupted in some way, contact the factory for assistance in entering the passwords and loading the default values into the machine.

CAUTION: *Changing the Machine Parameters without factory assistance will cause the machine not to operator properly and will void the factory warranty.*

Exit:

Pressing this button will cause the Rottler program to shut down. The computer itself will remain in operation. If this button is pressed accidentally and the Rottler program closes there is a secondary icon in the middle of the touch screen. Double press the icon rapidly and the Rottler program will re-start and the Main Menu will appear.

FlexCam CNC:
This button will take you to the FlexPad. This is used to run CNC programs. Refer to the Operating Instructions section of this manual.

Saving and Restoring Operator Programs:

Program File to Floppy Disk:
To save your operation programs to a floppy disk, open the electrical cabinet door and turn the machine on. Wait until the machine has fully powered up. Press the enable Axis button. This will take you to the Main Menu. Insert a blank Floppy into the computer (black box on the lower left of the electrical panel. From the Main Menu press the Program file to Floppy Button, this will copy all operator programs to the floppy. Remove the floppy from machine and store in a safe place.

Floppy Disk to Hard Drive:
Use the same procedure as above but insert the floppy with your saved programs on it. Press the Floppy Disk to Hard Drive button, the programs will be copied from the Floppy to the correct place on the Hard Disk. Remove the floppy from machine and store in a safe place.

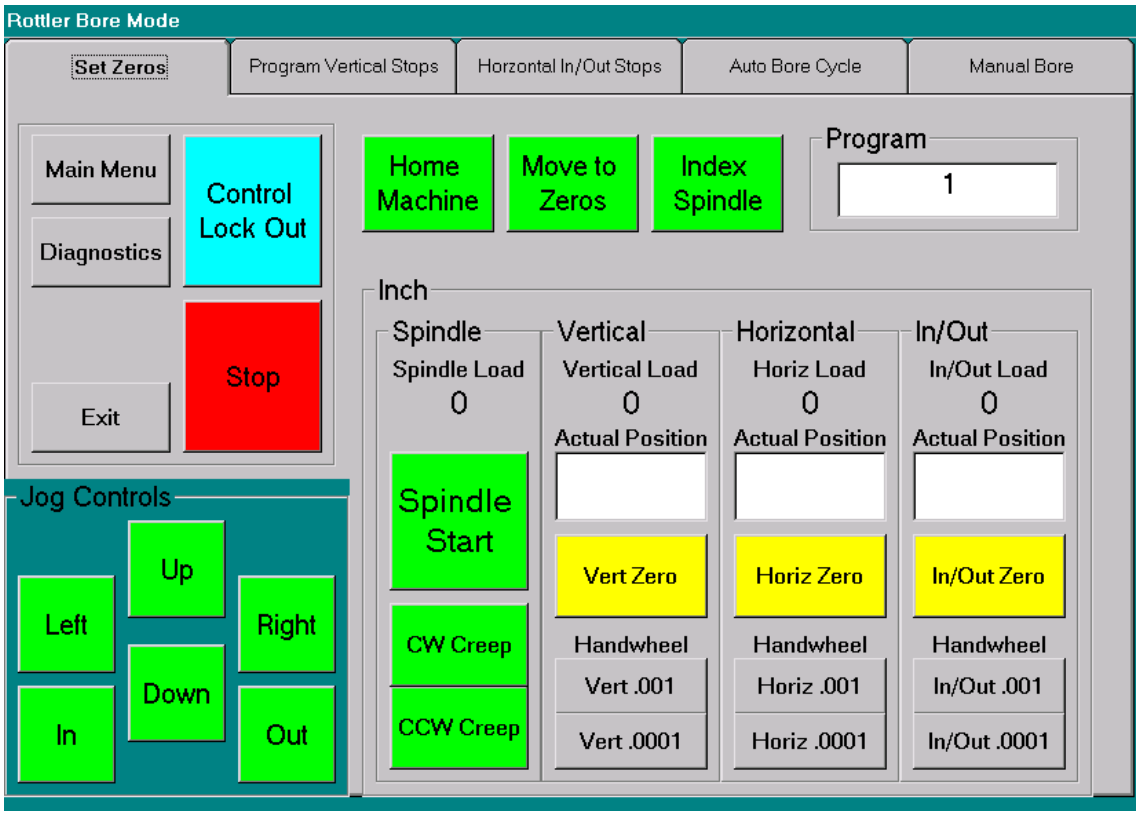
Mode Buttons:

These buttons, such as Bore, Mill, Lifter Bore, and Tap will take you to their individual operation screens. For operation of these modes refer to their designated sections later in this chapter.

Several buttons and their functions will be described in the first part of this section. As the same buttons appear on different screens later in this chapter, their operation and function will remain the same as stated here and will not be repeated.

Bore Mode:

The following picture shows the first screen that will appear after the Bore button has been pressed from the Main Menu. This screen has several "Tabs" on it that will help to walk you through the correct order to build a program.



Bore Mode - Set Zeros

Set Zeros Tab:

This screen is used to set zero points from which the program will operate. All values entered by the operator will reference the "zero" positions. This screen has several function buttons as well as operational buttons that are defined below.

Main Menu:
Pressing this button will take you back to the Main Menu of the Rottler program.

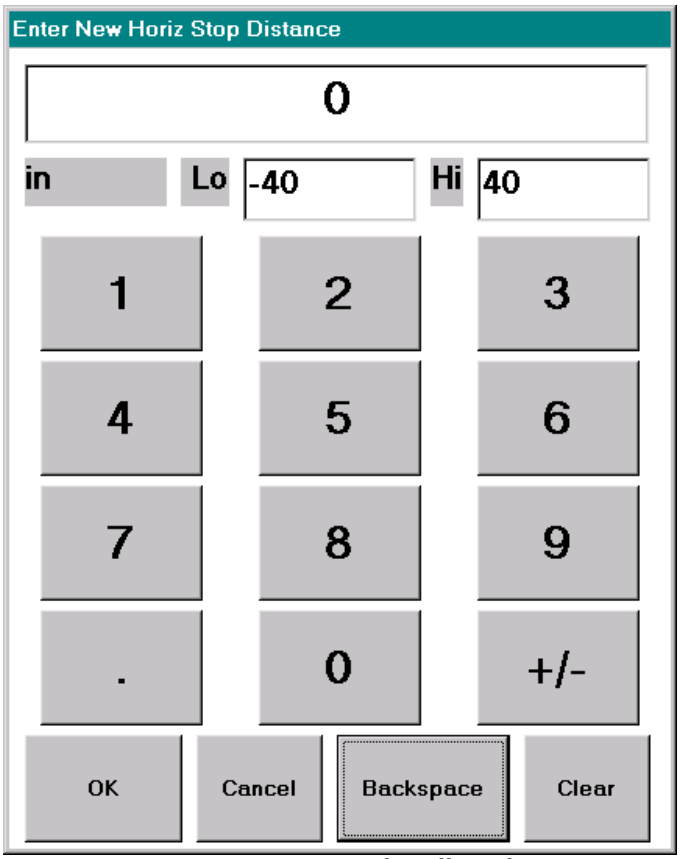
Diagnostics:
Pressing this button will take you to the machine Diagnostic screen. This screen shows the status of various drives and switches on the machine. Refer to Diagnostics later in this chapter for a full explanation of the diagnostic functions.

Exit:
This has the same function as the exit button on the Main Menu.

Home Machine:
This button, when pressed will ask you if you really intend to home the machine. This is a safety feature designed to keep the machine from making it's home moves if accidentally pressed. Pressing "Yes" on this screen will cause the machine to home all axis starting with the Vertical, In/Out, Horizontal and then Spindle. This operation must be done every time the machine is turned on, the e-stop has been pressed, or the modes of operation are changed (Mill to Bore). Homing the machine allows the computer to determine the full working area of the machine as well as give it a reference point to where the part origin is located. The machine will home to the same place every time it is pressed.

Note: Failure to home the machine will result in positioning errors and improper running of the program.

Program:
The button is used to change the program number the machine will run. When this button is pressed, a Pop-Up menu will appear. Press the desired program number on the keypad and then OK. That program is now the operating program.



Pop-Up Key pad – All Modes

Load Meters:
These digitally display the actual load on all of the motors. The value is represented in percentage of full motor load. The Vertical, Horizontal and In/Out axis will always have a load on them as they are holding position. The spindle will only show a load when it is running.

Move to Zeros:
This button will automatically move the axis to their zero position. Before the move is made, the display will ask you "Have you homed the machine?" If you have homed the machine press "Yes". It will then ask you "Is the tool clear to move to the zero positions?" If all is clear press "Yes". If the answer to any of these questions is no, the display will tell you what to do before making the move to zeros.

CAUTION: *Be sure of the answers to all of these questions. When the machine makes its move to zero positions it is under full power and speed.*

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

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

Handwheel Buttons:
These buttons will activate their associated axis for use with the handwheel. The upper button of each axis will move the machine in .001" per detent and the lower .0001" per detent of the handwheel. Pressing any of the axis buttons will disengage the handwheel.

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

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

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

Control Lockout:
Pressing this button will pop-up a window telling you "The control has been locked out. When this is displayed all buttons on the control are locked out and will not activate any machine function. Pressing OK on the window will close the window and unlock all of the controls.

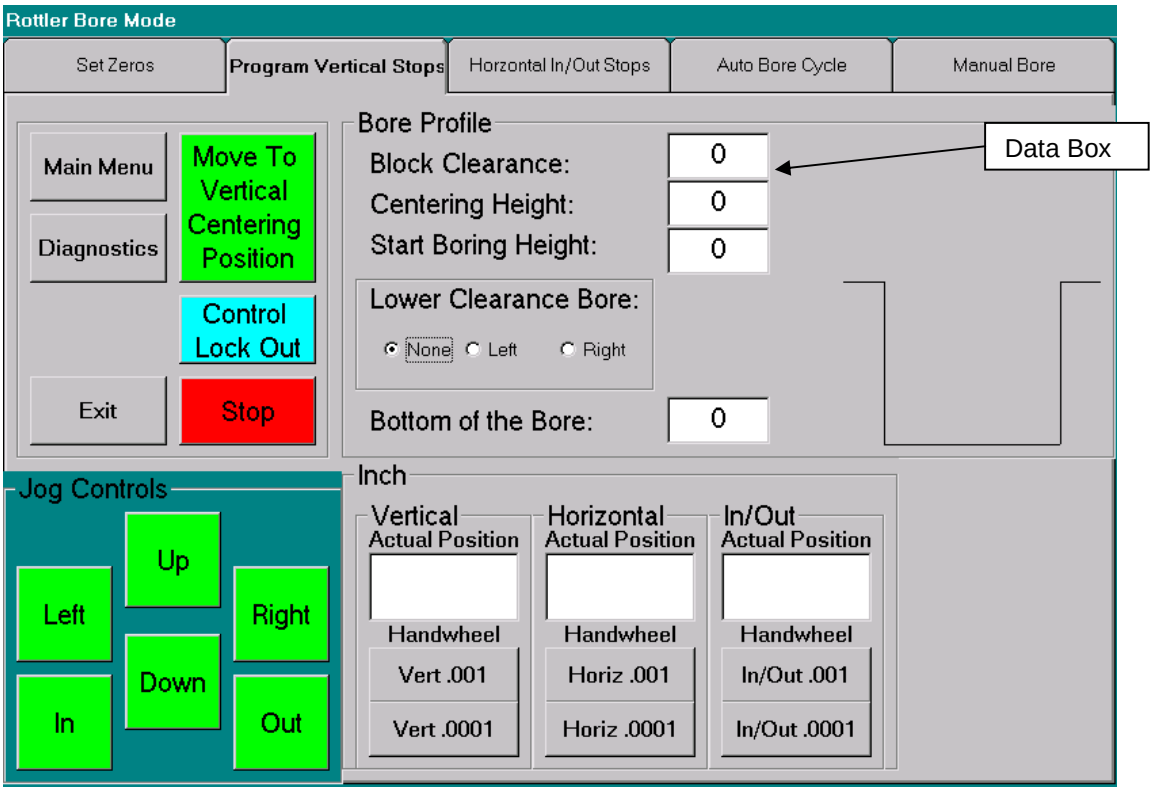
Note: Use the Control Lockout button anytime you are working near any of the moving parts of the machine. This will stop any accidental button pressing from harming operators.

Program Vertical Stops Tab:

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

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

To enter any of the Vertical Stops press the Data box next to the Vertical stop you want to enter. A pop-up menu will appear. Press the desired numerical value and then press OK. The numerical data will then appear in the data box



Bore Mode – Program Vertical Stops

Move to Vertical Centering Position:
This button will move the machine under power to the Vertical Centering Height specified by the operator.

Lower Clearance Bore:
This is an option you can use when boring a cylinder. You can select an offset to the Right or Left. When an offset to the Right or Left is selected two (2) data boxes will appear. The first data box is to enter the Vertical position you want the offset to be made. The second is to enter the amount of offset you want. You can enter an offset up to .020”

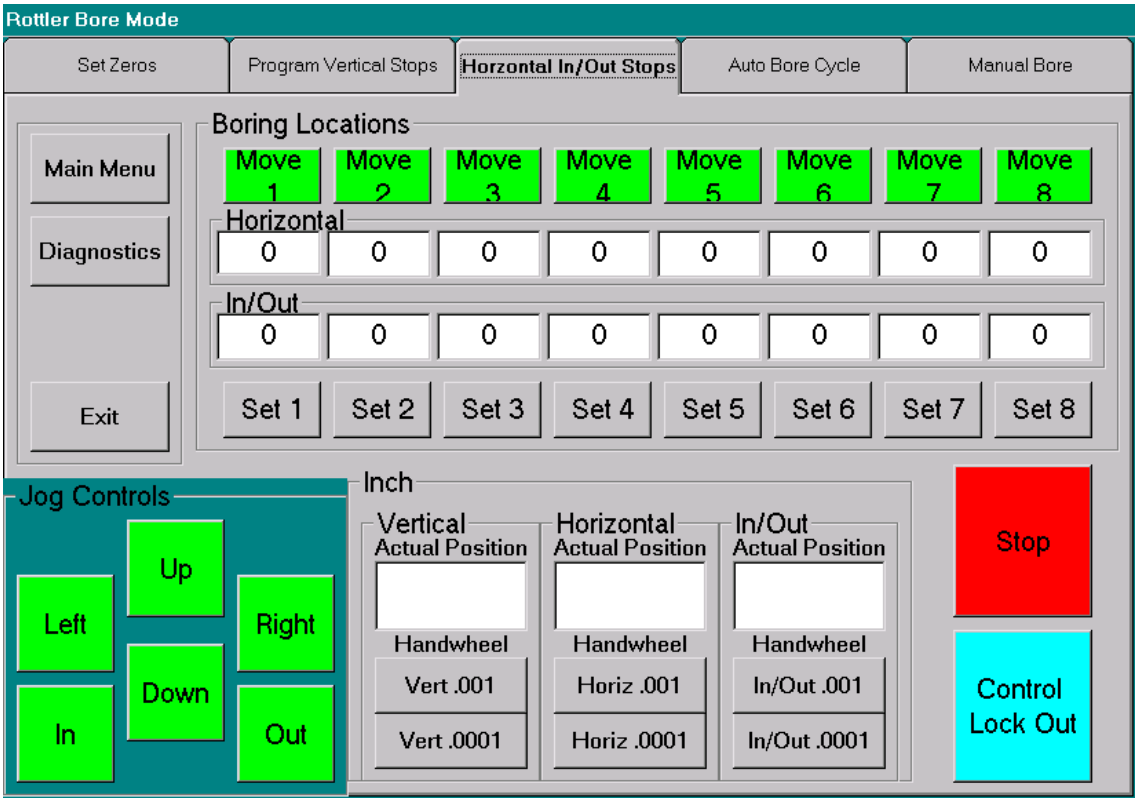
All other buttons and displays on this screen function as described earlier in this chapter. Select the tab to the right, labeled “Horizontal In/Out Stops”.

Horizontal In/Out Stops Tab:

This screen is used to set the Horizontal and In/Out stops the machine will use to bore a block. There are eight Horizontal and In/Out stops used on this screen.

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

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



Bore Mode – Horizontal In/Out Stops

Move Buttons:

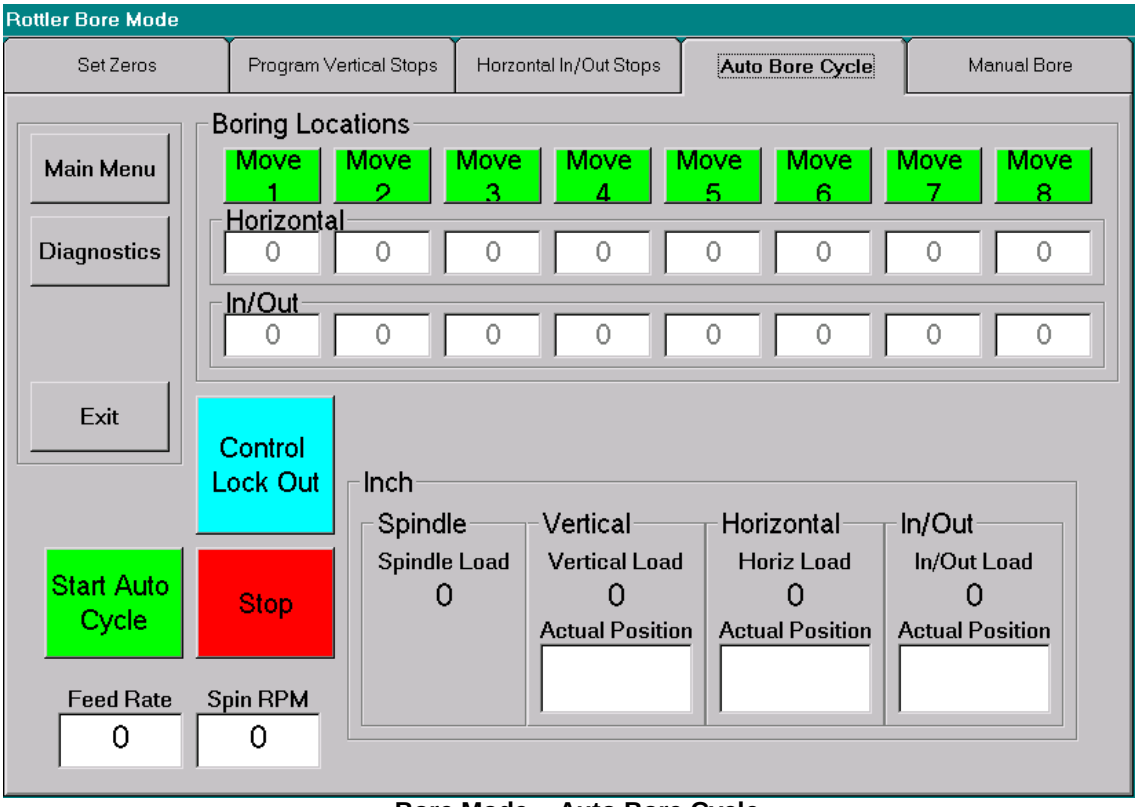
When pressed, these buttons will move the machine, under power, to the Horizontal and In/Out positions shown in the data boxes below the Move button. The Vertical will move to the Clearance height before it makes the Horizontal or In/Out moves. After it has moved to the Horizontal and In/Out positions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

Set Buttons:

Pressing these buttons will set the Horizontal and In/Out data boxes to the current machine position. The functionality of these buttons will be defined in the Operating Instructions chapter of this manual.

Auto Bore Cycle Tab:

The function of this screen is to take the data you have previously entered and allow the operator to run an automatic cycle.



Bore Mode – Auto Bore Cycle

Spin RPM:

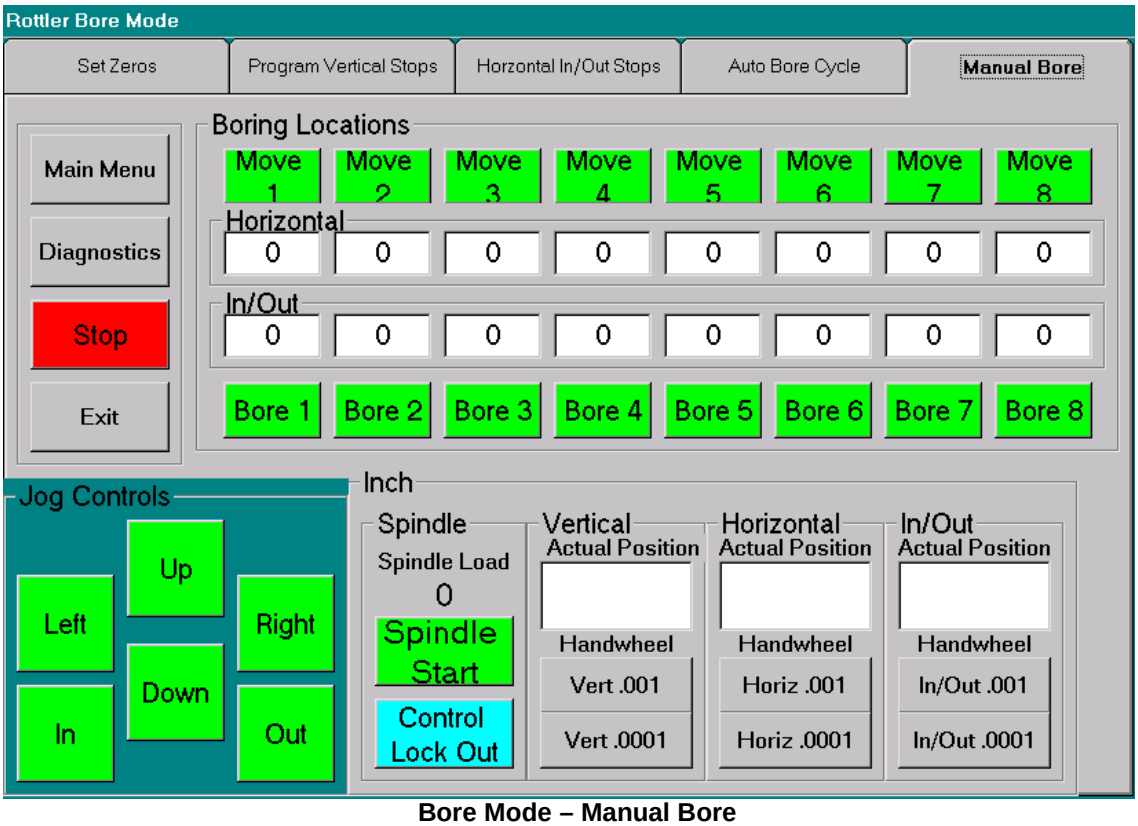
Pressing this data box will pop-up a numeric keypad. Press the desired Spindle RPM and then press OK. The RPM you entered will now be displayed in the data box.

Feed Rate:

Pressing this data box will pop-up a numeric keypad. Press the desired Feed Rate and then press OK. The Feed Rate you entered will now be displayed in the data box. Feed Rate on the F65 is expressed in thousands of an inch per spindle revolution.

Manual Bore Tab:

The purpose of this screen is to allow the operator to bore individual cylinder without having to use the Auto Cycle.



Bore Mode – Manual Bore

Bore Buttons:

Pressing these buttons will cause the machine to bore the cylinder associated with the Bore button pressed. After the bore has been completed the spindle will return to the Clearance Height and stop.

Lifter Bore:

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

1) On the Program Vertical Stops screen, lower Clearance Offset is not an option.
2) After a bore is complete the spindle will not offset .020” for tool clearance.

Additional Screens and Operations:

Only the Main Menu, Bore Mode and Lifter Bore were discussed in this chapter. The buttons and their functions remain very similar through out the other modes of operation.

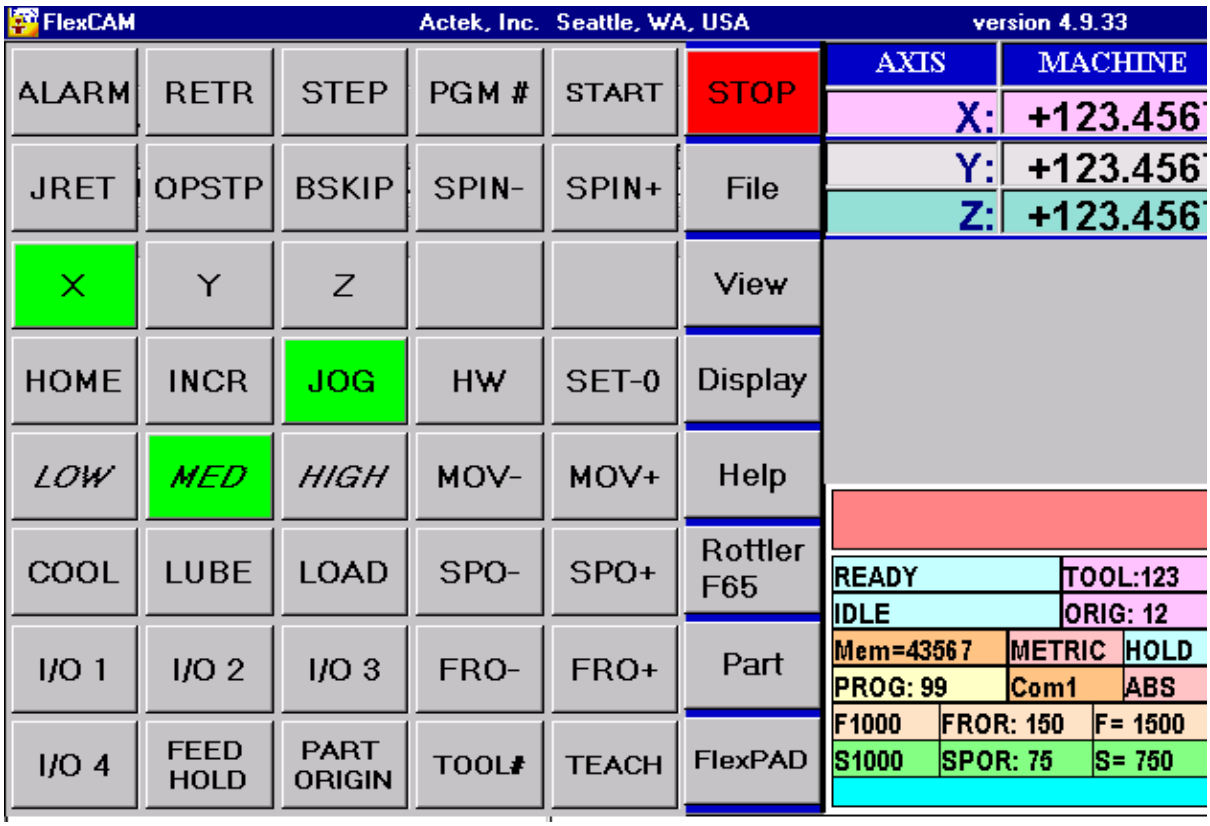
The individual screens and their functions will be discussed in the Operating Instructions section of this manual.

FlexCam and FlexPad:

FlexCam is the Operator Interface used to execute “G-Code” programs.

To get to the FlexCam Operator Interface you will need to press the “FLEXCAM CNC” button on the Rottler Main Menu.

The screen that will appear when this button is pressed is considered the FlexPad. All FlexCam operations start from this screen.



Flex Pad

Button Definition:

Axis X, Y, Z:
X = Horizontal Axis
Y = In/Out Axis
Z = Vertical Axis

Pressing any of these buttons will select that axis for movement or an operation. Only one of these buttons can be selected at a time. When an Axis is selected it will turn green. These buttons, by themselves do not initiate any movement, they are used in conjunction with other button on the FlexPad.

LOW, MED, HIGH:
Pressing these button will select the speed the selected axis will Jog or at what scale the Handwheel will operate. Only one of these buttons can be selected at a time. When a speed is selected it will turn green. These buttons are used in conjunction with the X, Y, and Z buttons.

JOG, HW:
When pressed, these buttons will select a Jog or a Handwheel function. You can select either Jog or HW, not both at the same time. These buttons will turn green when selected. These buttons are used in conjunction with the X, Y, Z and LOW, MED, HIGH buttons.

MOV+, MOV-:
Pressing one of these buttons will initiate a move from the selected axis at the selected speed. MOV+ is always a move away from Home, MOV – is always a move towards Home. The following is a description of those moves:

MOV +	**MOV –**
X = Right	X = Left
Y = In	Y = Out
Z = Down	Z = Up

Example 1:
Select “Z” for the Vertical axis – It will turn green.
Select “MED” for a medium speed – It will turn green.
Select “JOG” for a Jog movement – It will turn green.

To initiate the move press the “MOV +” or “MOV –“. The machine will move Up or Down as long as you keep the button depressed.

Example 2:
Select “X” for the Horizontal axis – It will turn green.
Select “HIGH” for a .001 per increment move – It will turn green.
Select “HW” for a Handwheel movement – It will turn green.

To initiate movement turn the Handwheel CW or CCW. The machine will move .001 per increment in the Left or Right direction.

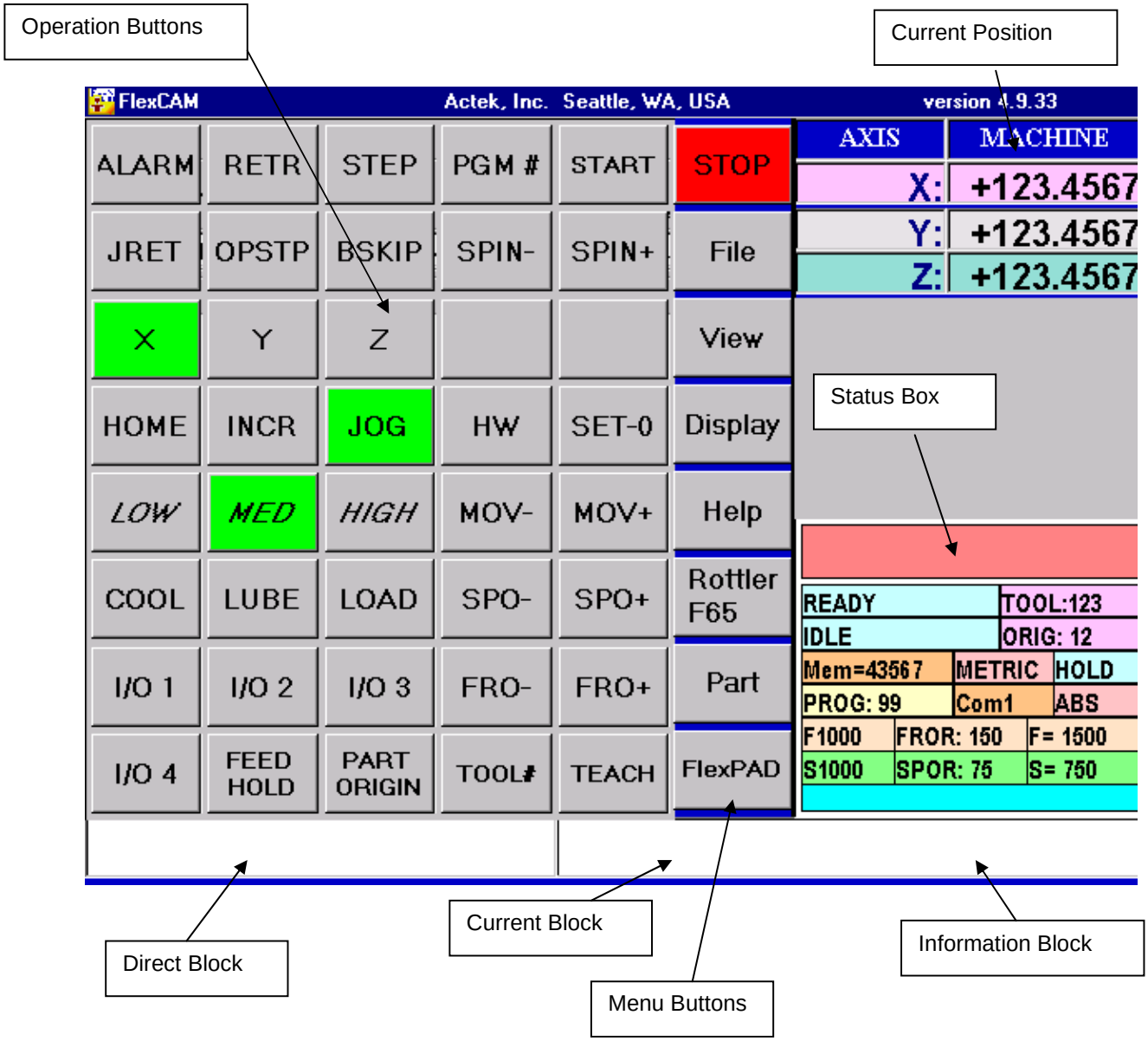
FRO +, FRO -:
These are Feed Rate Override buttons. They will override the current Feed Rate the machine is set at. These can be changed while the machine is idle or running. The Feed Rate Override is expressed in percentage of the current set value.

Example:
If the current Feed Rate is set at 20 inches per minute, pressing the FRO+ button twice will set the Feed Rate Override to 102. This equals 102 % of 20 inches, which would be 20.4 inches per minute.

Note: The Feed Rate Override and the Spindle Override settings can be seen in the Information block on the lower right hand side of the screen. See following illustration.

SPO +, SPO -:
These are Spindle Override buttons. They will override the current Spindle Speed the machine is set at. These can be changed while the machine is idle or running. The Spindle Override is expressed in percentage of the current set value.

Example:
If the current Spindle Speed is set at 200 RPM, pressing the SPO+ button twice will set the Spindle Override to 102. This equals 102 % of 200 RPM, which would be 204 RPM.



SPIN -, SPIN+:
These buttons will start and stop the spindle at the current programmed RPM. The SPIN – will start the spindle in a CCW direction and SPIN + in a CW direction. The buttons will turn green when pressed and the spindle will stay on until the button is pressed again or the STOP button is pressed.

HOME:
This button downloads the Home routine into the controller. When pressed the Start button will turn Yellow. If you are ready to Home the machine press the Start button. The machine will then execute the Home routine. This is the same Home routine the Rottler screens use. Anytime the machine has been shut off, Emergency stop pressed or the Rottler and FlexCam programs closed the machine needs to be Homed again.

SET-0:
When this button is pressed the X, Y and Z axis buttons will turn yellow. Press the Axis you want to zero. You can only zero one axis at a time, you must press the Set 0 button before each axis to be zeroed.

ALARM:
This button is Grey and says ALARM when the machine is operating normally. When an ALARM is generated or an operation is finished the alarm button will then turn red and read RESET. The Alarm can be read in the Status Box, correct the alarm and then hit the RESET button. Once RESET has been pressed the button will go back to reading ALARM. The ALARM button is also triggered when an action by the controller is completed. For Example: If you are downloading a program, the button will turn red and read RESET when the program is finished downloading. The Status Box will read “Download Finished”. You can press the RESET and continue.

STEP:
If a program has been loaded into the controller you can run the program line by line by pressing this button. Each press of the button will execute one line of code.

PRG#:
This button will put up a Pop-Up menu for you to enter the program number you want to use.

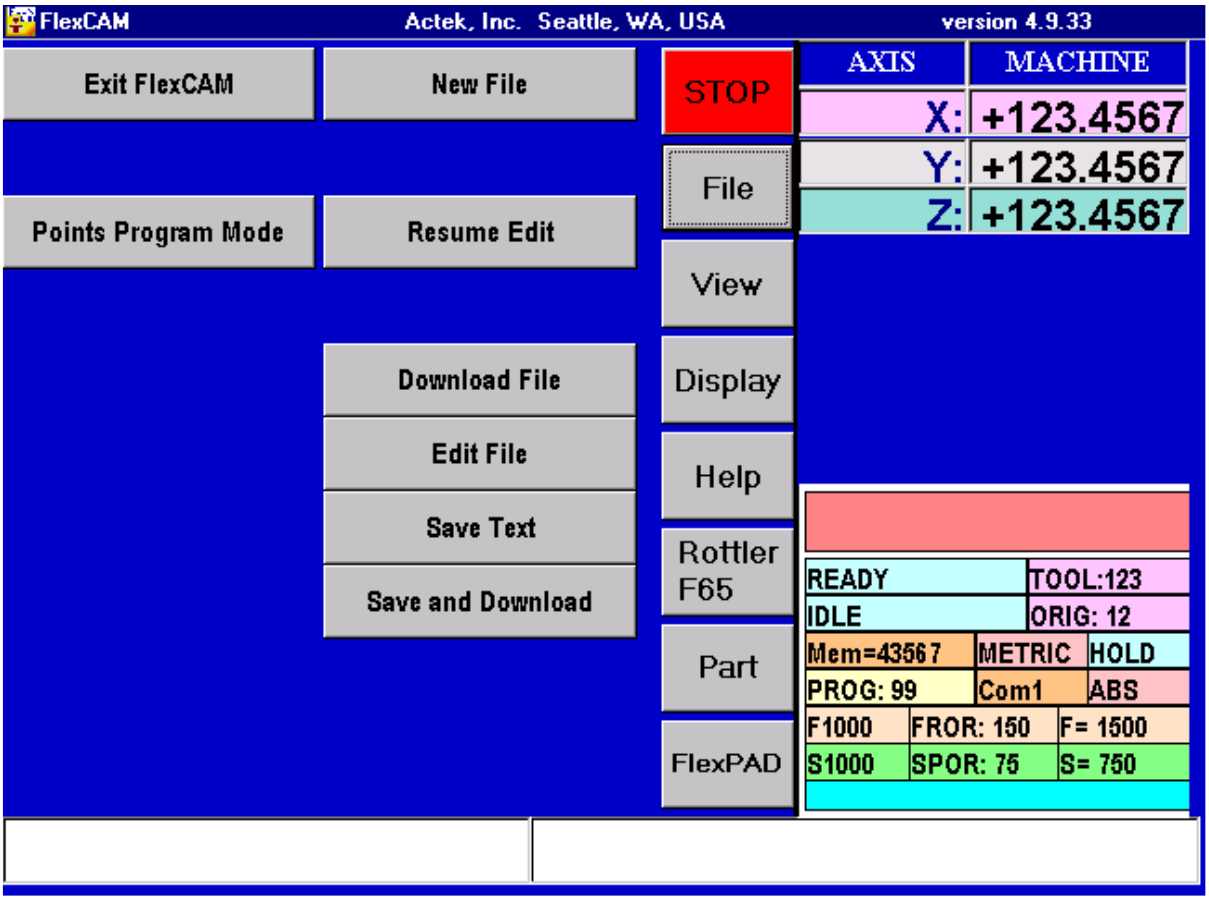
STOP:
This button will stop any motion as well as stop any program that is running.

FlexPad Menu Buttons:

These buttons are located just to the right of the middle of the touch screen and are in a column vertically.

File:

This button will bring up another menu with other options. The following illustration shows the menu that will appear when the File button is pressed.



Exit FlexCAM:

Do not use this button. To exit go back to the Rottler Main Menu and Exit from there.

New File:

This button will open up an blank file on the left hand side of the screen.

Points Program Mode:

This button will bring up a pop-up menu that you will need to select a points mode program from.

Resume Edit:

This button will open the last file you were editing.

Download File:

This button will up a pop-up menu that you will need to select a program to download to the controller.

Edit File:

This button will up a pop-up menu that you will need to select a program to Edit.

Save Text:

This button will save text into a file. If the text you are trying to save is has not previously been saved and given a name, a pop-up menu will prompt you to give it a name and location to save to.

Save and Download:

This button will save any changes made and then download that file to the controller. If the text you are trying to save is has not previously been saved and given a name, a pop-up menu will prompt you to give it a name and location to save to.

View:

This button will bring up another menu with other options, when these options are pressed it will change the view you are looking at. Not all of the option buttons on the View menu are operational at this time.

Display:

This button will bring up another menu with other options, when these options are pressed it will change the view you are looking at. Not all of the option buttons on the Display menu are operational at this time.

Help:

This button will bring up a pop up menu with other options. The options for the Help menu are listed below. The Help function of FlexCAM is a work in progress, some topics you will find are defined with allot of detail, other you may find a little spare.

Contents:

This button will bring up a general list of the Help topics. If you click on an item in the general list it will expand so you can pick a more specific item.

Index:

This button will bring up a pop-up menu that lists the Help topics in alphanumerical order. There is also a data entry box you can type a subject into.

Rottler F65:

Pressing this button will take you back to the Rottler Main Menu.

Part:

This button will take you to the parts screen. This function is not fully defined and can be implemented in future upgrades to the software.

FlexPAD:

This button will take you back to the FlexPAD screen if you are in another file command.

Chapter 3 Operating Instructions:

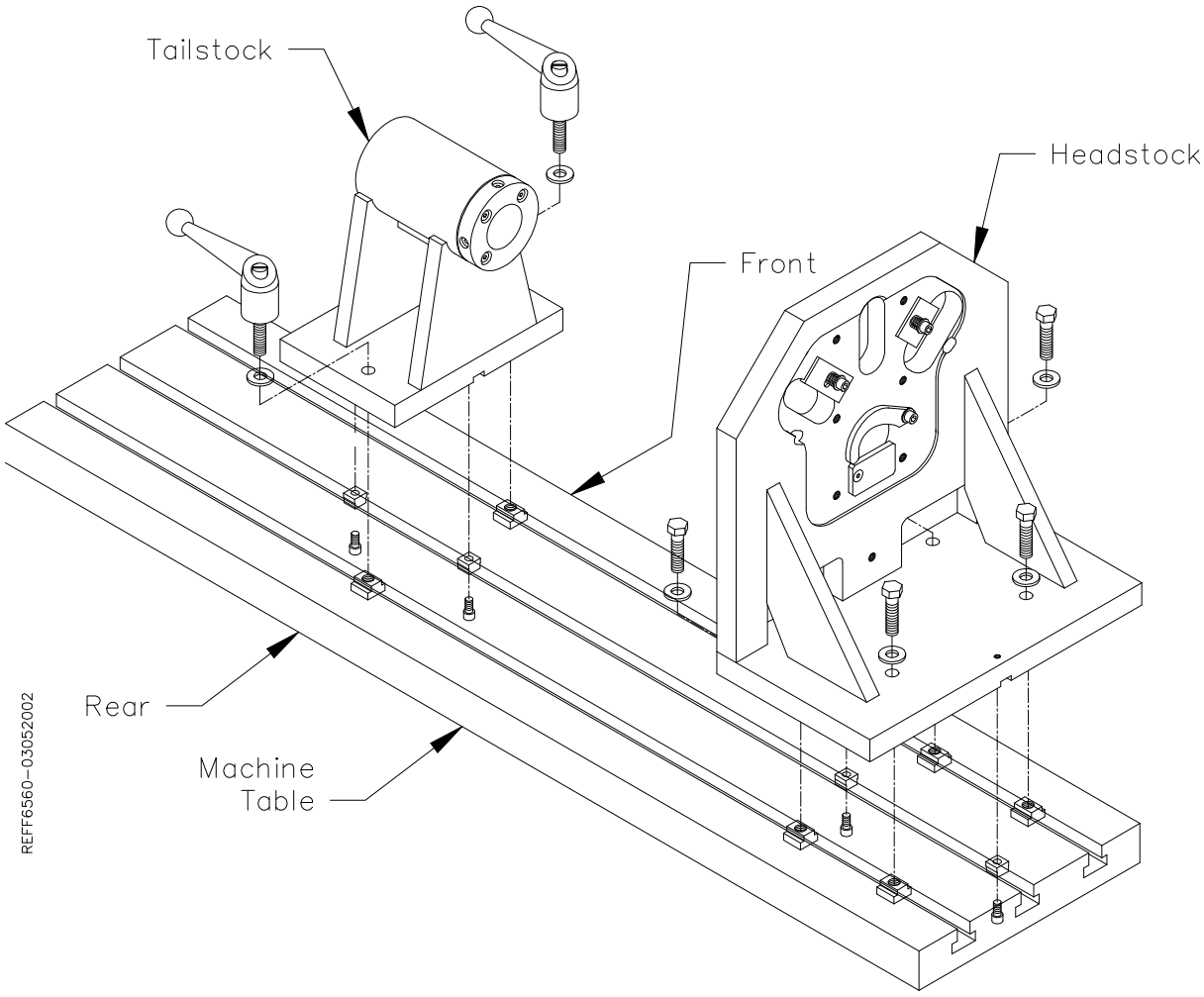
The purpose of this chapter is to explain and then guide the operator from loading blocks to running an automatic cycle.

All modes of operation will be discussed in this chapter.

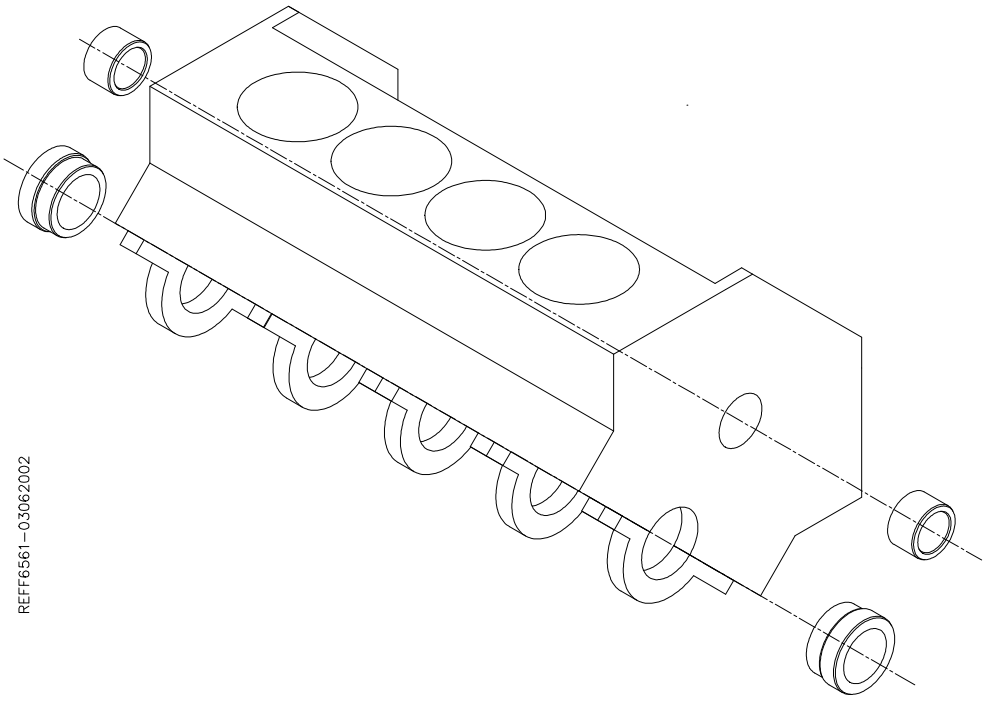
Loading a Block:

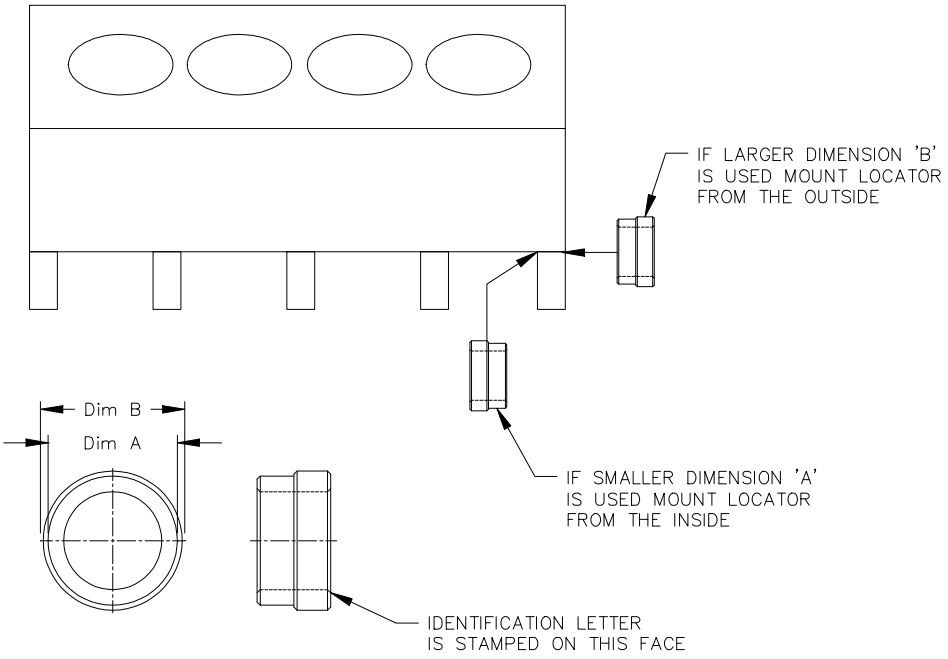
Performance Fixture 650-3-1 Boring:

1) Install and align the performance fixture head stock on the left hand side of the table as shown below. Follow the alignment procedures for the Performance fixture in the Maintenance section of this manual. Tighten the Head Stock to the table securely using the four Hex bolts and T-Nuts.
2) Install the Tail Stock onto the right hand side of the table but do not tighten down.



3) Select the correct Main and Cam bushing for the block you are going to be using from the tables in the Options section of this manual. Place bushings in block as shown below.

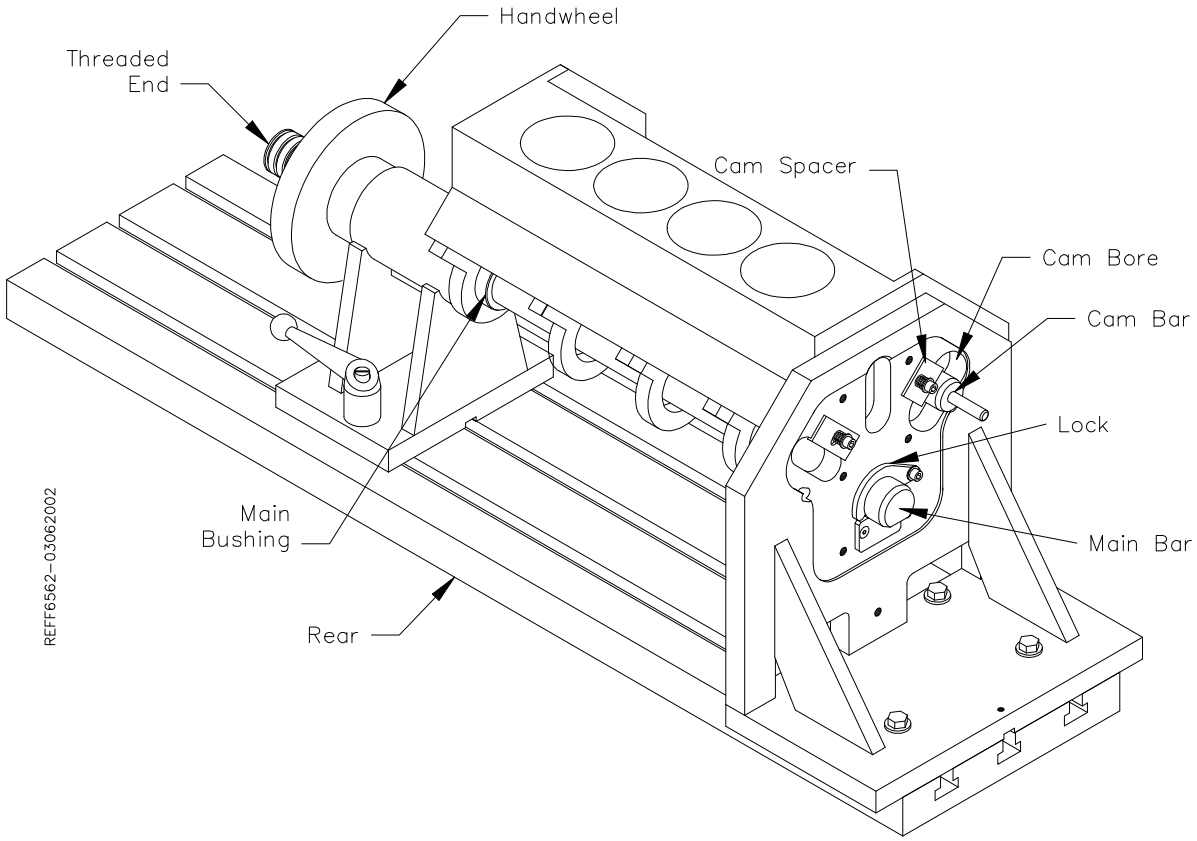




Note: Each locator covers two bearing diameters ('A' and 'B'). The unused diameter <u>MUST</u> be placed <u>INSIDE</u> the block to prevent interference with the Index plates.

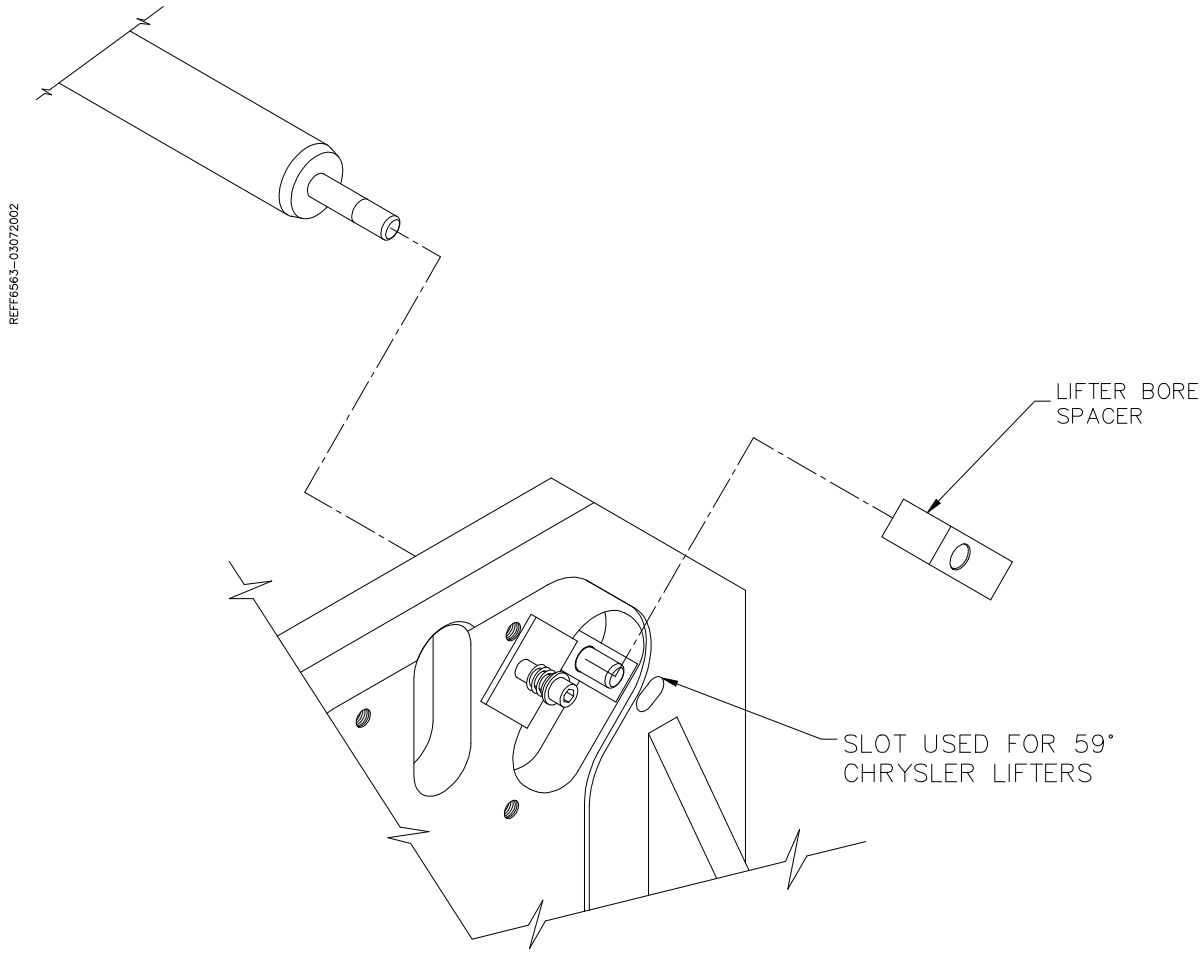
4) Using a slow travel hoist, position the block between the Head stock and Tail stock with the Bell housing end of the block towards the Head stock.
5) Slide the unthreaded end of the Main Bar through the Tail stock, both Main bushings and into the Head stock with the flat facing down. The threaded end of the Main Bar should be on the Tail stock side of the table. Slide the Lock into the groove on the Main Bar.
6) Rotate the block until the bank you want to bore is facing up. Make sure the cam spacer is not in the cam Bore area at this time. Slide the Cam Bar through the two Cam bushings and into the Head stock with the reduced diameter at the Head stock.
7) Snap the Cam spacer into place.
8) Push the Tail stock up to the block. Tighten the Handwheel with a quick snapping motion.
9) Tighten the two handles on the Tail stock.

The block and fixture are now locked in place and ready for machining.



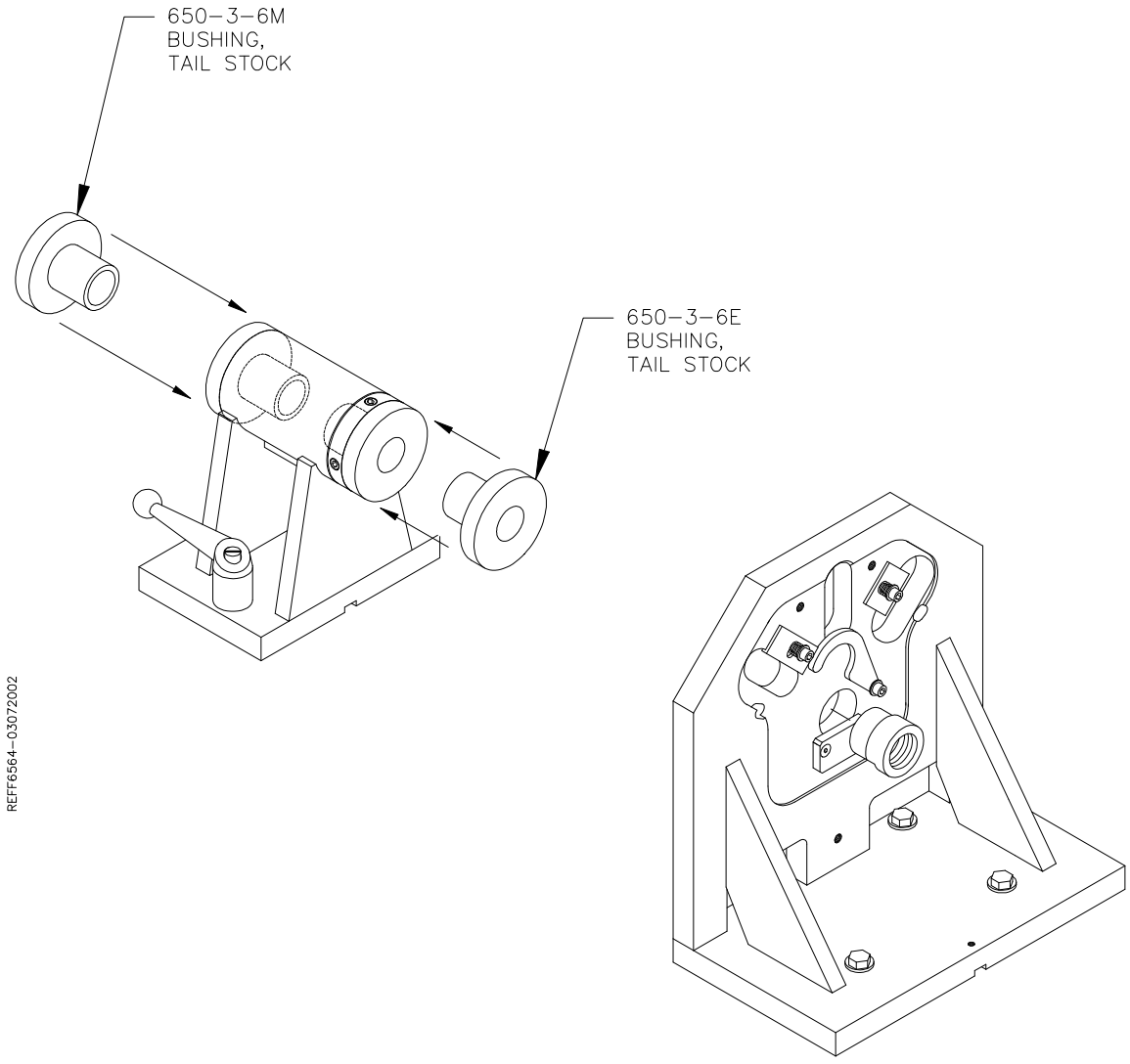
Performance Fixture 650-3-1 Lifter Boring:
The same procedure for loading a block in Lifter boring as was used in Boring with an exception in the Cam Bar area.

1) Instead of the Cam Bar being slid through the Cam Bore to its full Diameter, the small shaft on the end of the Cam Bar is used in conjunction with spacer Blocks.
2) Select the correct Spacer from the Chart in the Options section of this manual for the angle of the Lifter Bores.
3) The Cam Spacer must be out of the Cam Bore.
4) See illustration below for spacer installation.



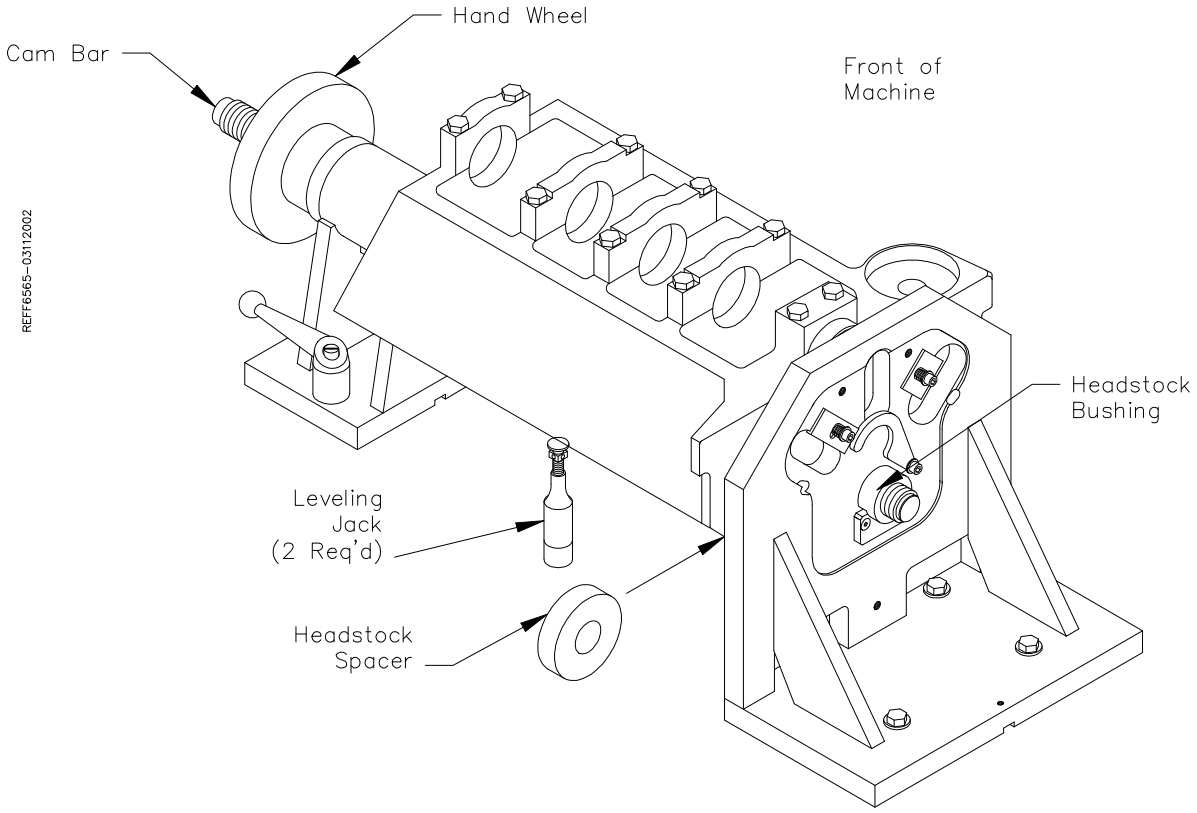
Lower End Machining Package 650-3-1A:

1) Install and align the performance fixture head stock on the left hand side of the table as shown in the Performance Fixture section. Follow the alignment procedures for the Performance fixture in the Maintenance section of this manual. Tighten the Head Stock to the table securely using the four Hex bolts and T-Nuts.
2) Install the Tail Stock onto the right hand side of the table but do not tighten down.
3) Install the Tail stock bushings 650-3-6E and 650-3-6M into the Tail stock as shown below.



4) Select the correct size Cam Bushings for the block you are using and install them into the block.
5) Using a slow travel hoist, position the block between the Head stock and Tail stock with the Bell housing end of the block towards the Head stock with the Main Caps facing up.
6) Install Head stock bushing into Head stock with the flat facing down and the smaller diameter into the Main bore of the Head stock.
7) Slide the Cam Bar (short threaded end first) through the Tail stock bushings, Cam bushings (installed in block) and Head stock Spacer.
8) Thread the Cam Bar into the Head stock Bushing until tight.
9) Slide the Tail stock up to the block.
10) Snug the handwheel up to the Tail stock but do not lock in place.
11) Install the Leveling Jacks between the underside of the block and the bed of the machine. One each side.
12) Rotate the block until the Pan Rails are even to each other.
13) Make sure there is even pressure on each of the Leveling Jacks.
14) Tighten the Handwheel into place.
15) Tighten the Tail stock into place using the handles.

The block and fixture are now locked in place and ready for machining.

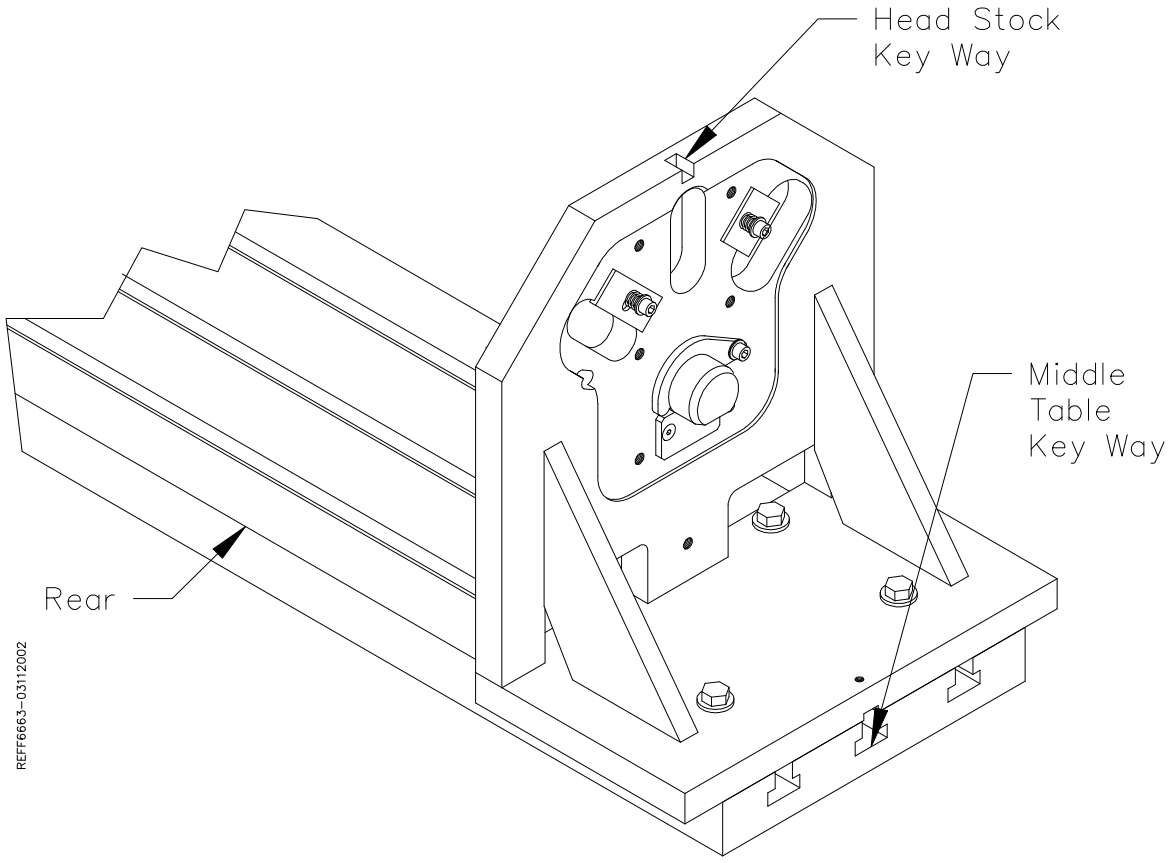


Block End Truing Fixture 650-3-30:

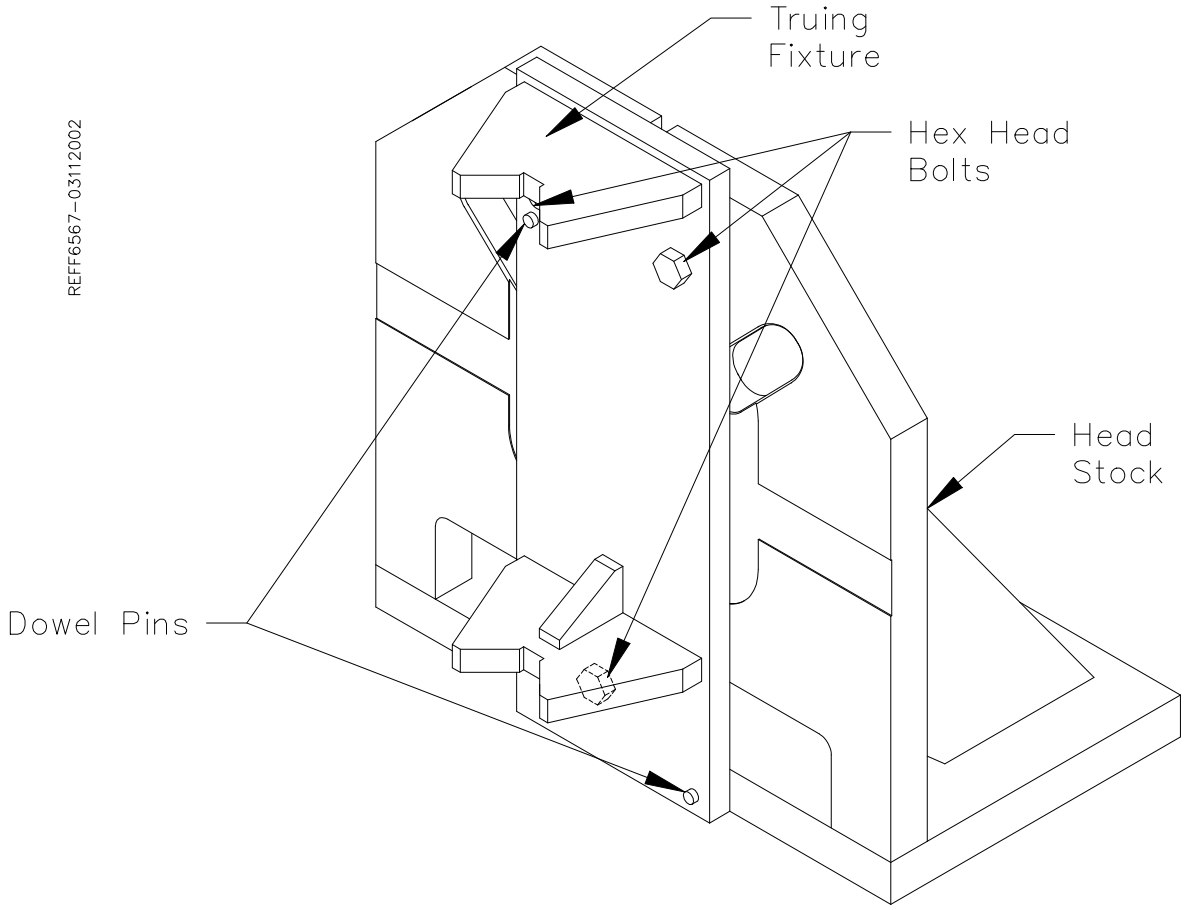
If you are truing the ends of a block use the standard Head stock mentioned in the Maintenance section of this manual.

If you are Boring the Cam Tunnels with this fixture follow the standard Head stock in the Maintenance section of this manual plus the procedure below:

1) Do not have the Head stock hold down bolts all the way tight, the fixture may need to be moved slightly.
2) The center of the Key Way on the Head stock need to be lined up with the center of the middle Key Way on the machine bed. This will place the center of the Main bore directly inline with the center of the Cam bore.
3) Lock the Head stock in place.



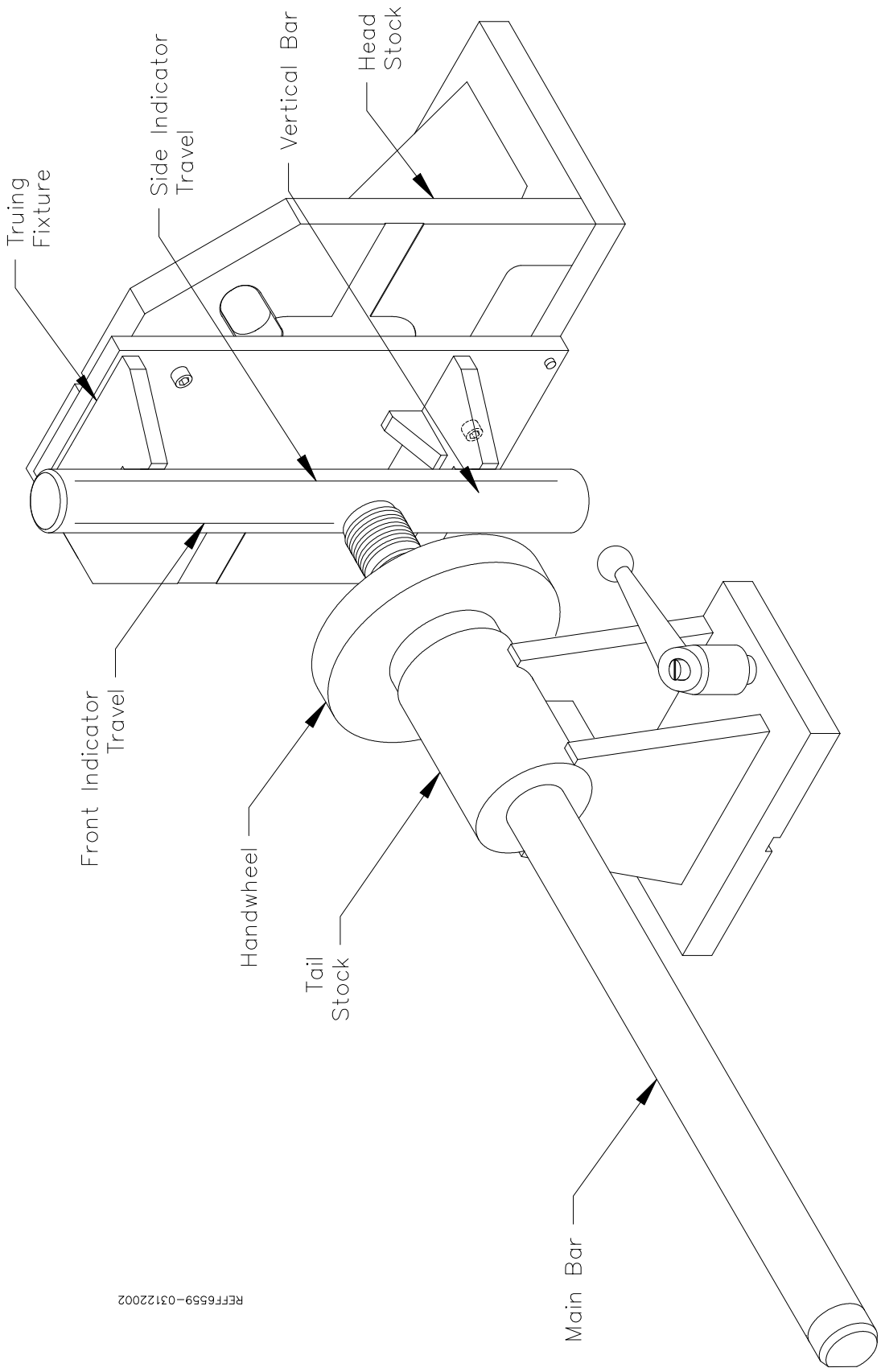
4) Install the Truing Fixture onto the Head stock. Slide the two Dowel pins on the Truing Fixture into the appropriate Dowel holes on the Head stock.
5) Bolt the Truing Fixture to the Head stock using the three supplied Hex Head Bolts.



The following steps are designed to check the Vertical Bar for straightness. This Bar was checked and tested at Rottler Manufacturing. The following steps are to make sure there is not a burr or debris between any of the parts.

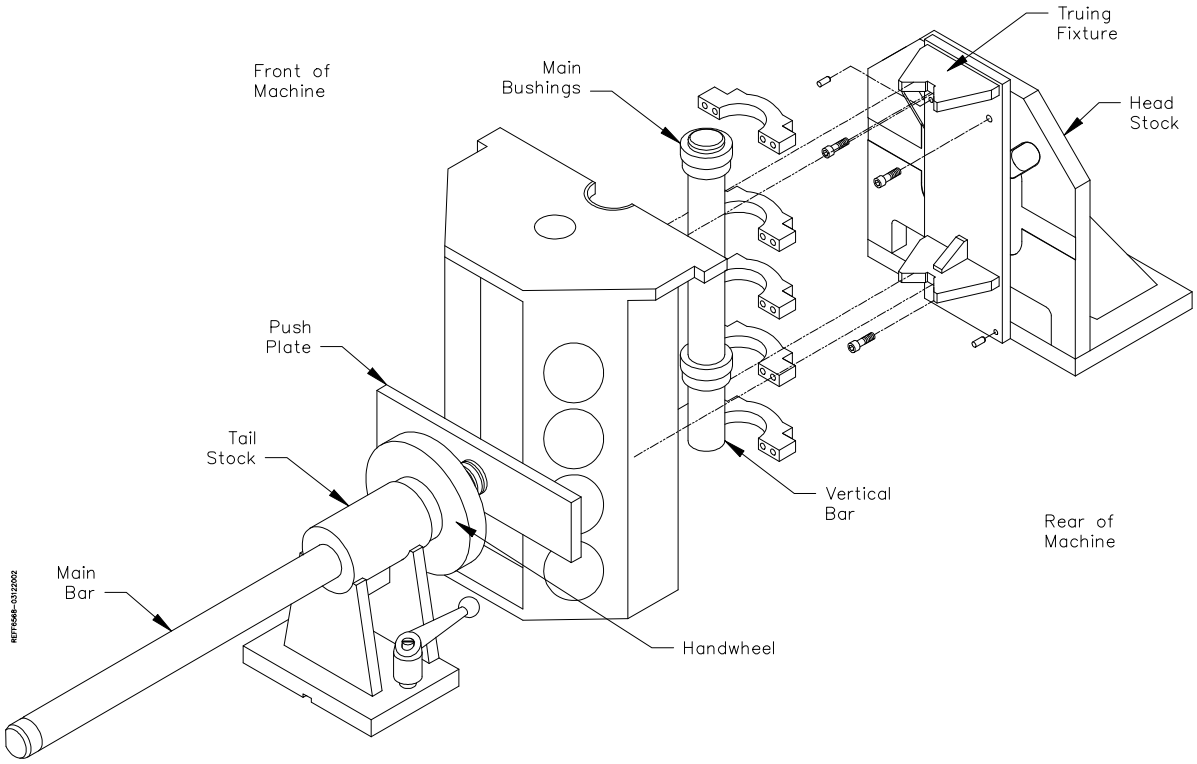
6) Slide the Main Bar though the Tail stock (threaded end first).
7) Thread the Handwheel onto the Main Bar.
8) Place the Vertical Bar into the “V” on the Truing Fixture.
9) Slide the Tail stock towards the Head stock until the Main Bar just touches the vertical Bar.
10) Tighten the Tail stock down.
11) Turn the Handwheel until the Main Bar holds the Vertical Bar securely in place.
12) Attach a indicator to the machine spindle or cutterhead and run it up and down the front and side face of the Vertical Bar. It should be within .0015 variance.

Note: Front face will only have half travel as the Main Bar obstruct full travel..


Truing Fixture
Side Indicator Travel
Vertical Bar
Head Stock
Front Indicator Travel
Handwheel
Tail Stock
Main Bar
REFF6559-03122002

13) Loosen the Handwheel and remove the Vertical Bar.
14) Loosen the Tail stock and slide it to the right hand side of the machine table.
15) Select the correct Main Bushing for the block you are machining from the table in the Options section of this manual. Install the Main bushings as shown in the Performance Fixture earlier in this section.
16) Using a slow travel hoist position the block between the Head stock and tail stock with the Main Caps facing the Head stock as shown.
17) Slide the Vertical Bar into the Main bushings from the top. You will want to put a spacer on the table below the Vertical Bar so the bar does not go below the top V on the Truing fixture
18) Slide the towards the Head stock so that the Main Vertical Bar come to rest in the Vs on the truing fixture.
19) Slide the Tail stock up to the block and insert push plate as shown.
20) Tighten down the Tail stock.
21) Turn the Handwheel until the push plate has enough tension on it to keep the block from moving.

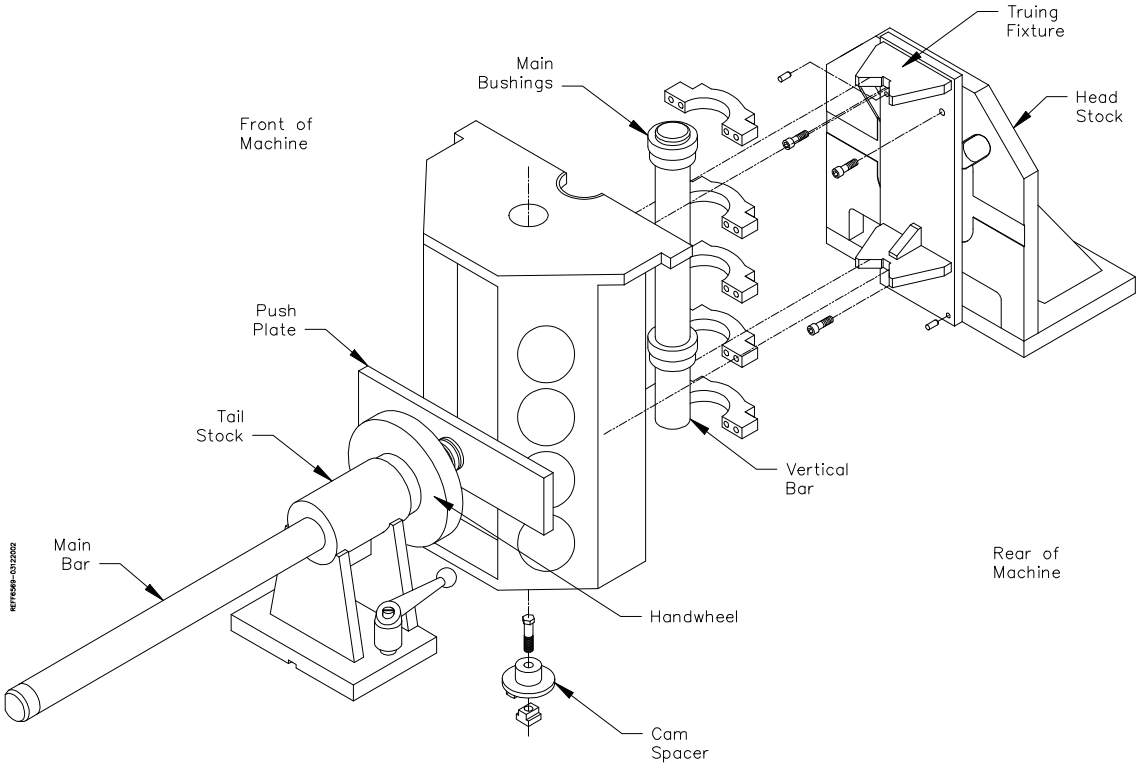
The block and fixture are now locked in place and ready for machining.



Block End Truing Fixture 650-3-30 when used with Cam Boring:
When using the End truing Fixture for Cam Boring you will also need tooling package 650-3-43A

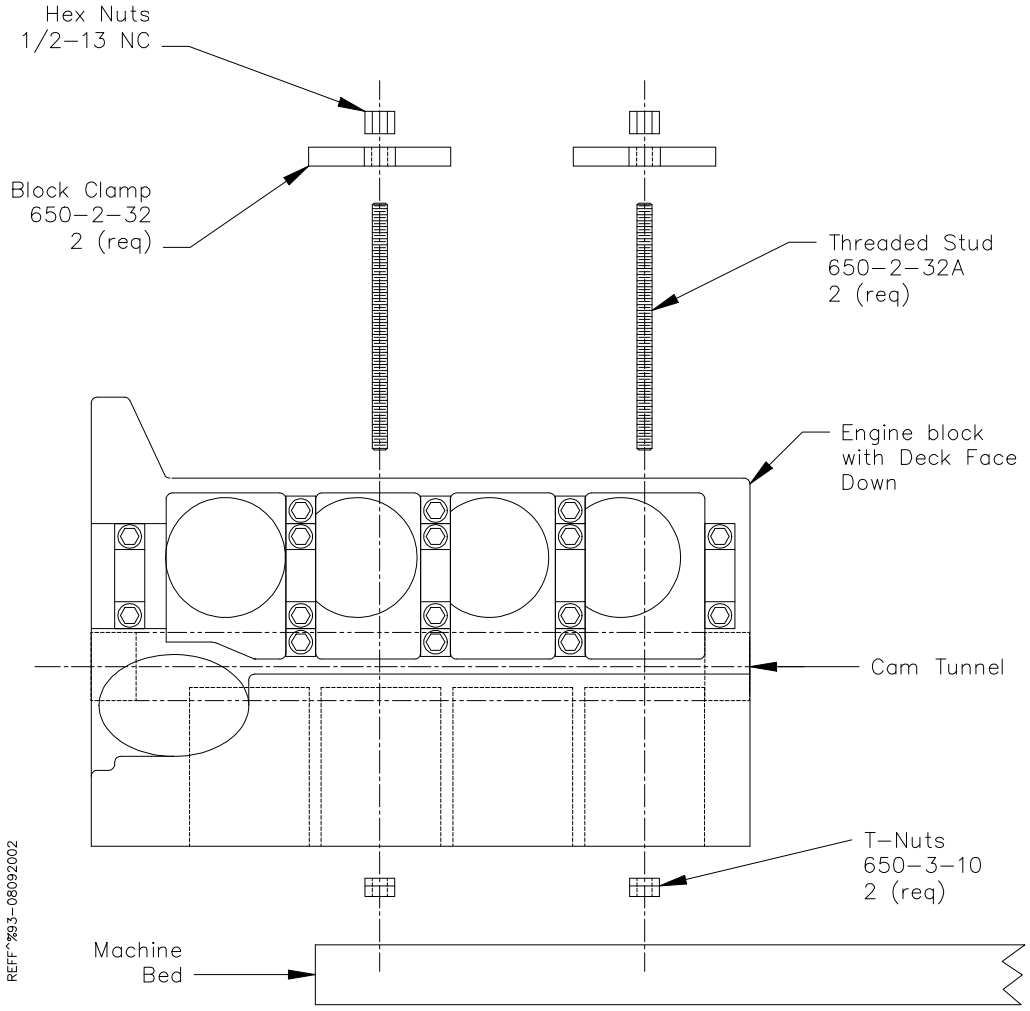
1) Use the same set up and line up procedure as with the standard End Truing Fixture discussed earlier in this section.
2) Place the Cam Spacer in the middle T-slot of the machine bed along with T-Nut and Bolt.
3) Select the correct Cam Bushing for the block you are going to be machining from the table in the Option section of this manual.
4) Place the Cam Bushing over the Cam Spacer. This will put the Cam and Main in-line and on center with the Fixturing.

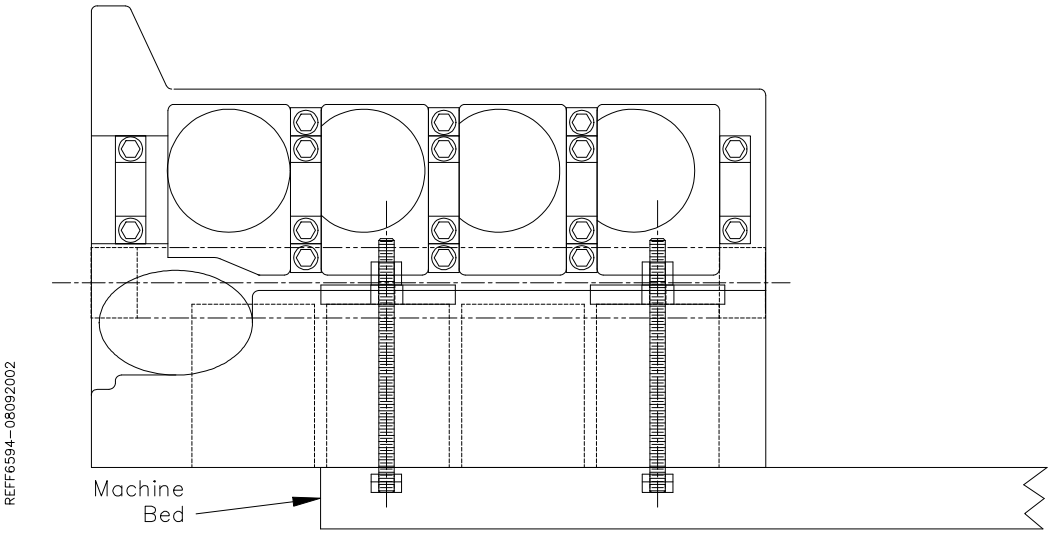
The block and fixture are now locked in place and ready for machining.



Cam Tunnel Boring:

1) Place two T-Nuts in the outside keyway (closest to operator).
2) Mount block onto machine bed, as shown below with the right most cylinder hanging off the machine bed.
3) Place threaded rod through the first and third bores and thread into T-Nuts.



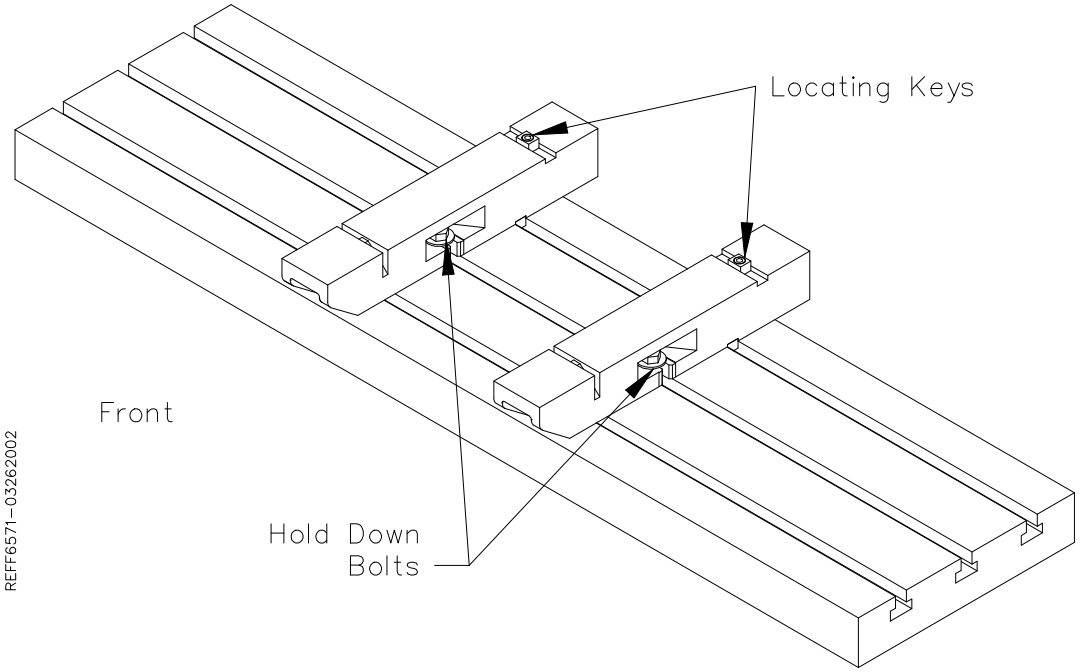


4) Screw the supplied ½-13 NC nuts on to the threaded rod and snug them up. Do not tighten tehm all the way at this point.
5) Attach a magnetic base indicator to the spindle and run it along the upper pan rail to get it relatively straight. It does not need to be perfectly strait because a double flex coupling is used.
6) Tighten the ½-13 nuts down.

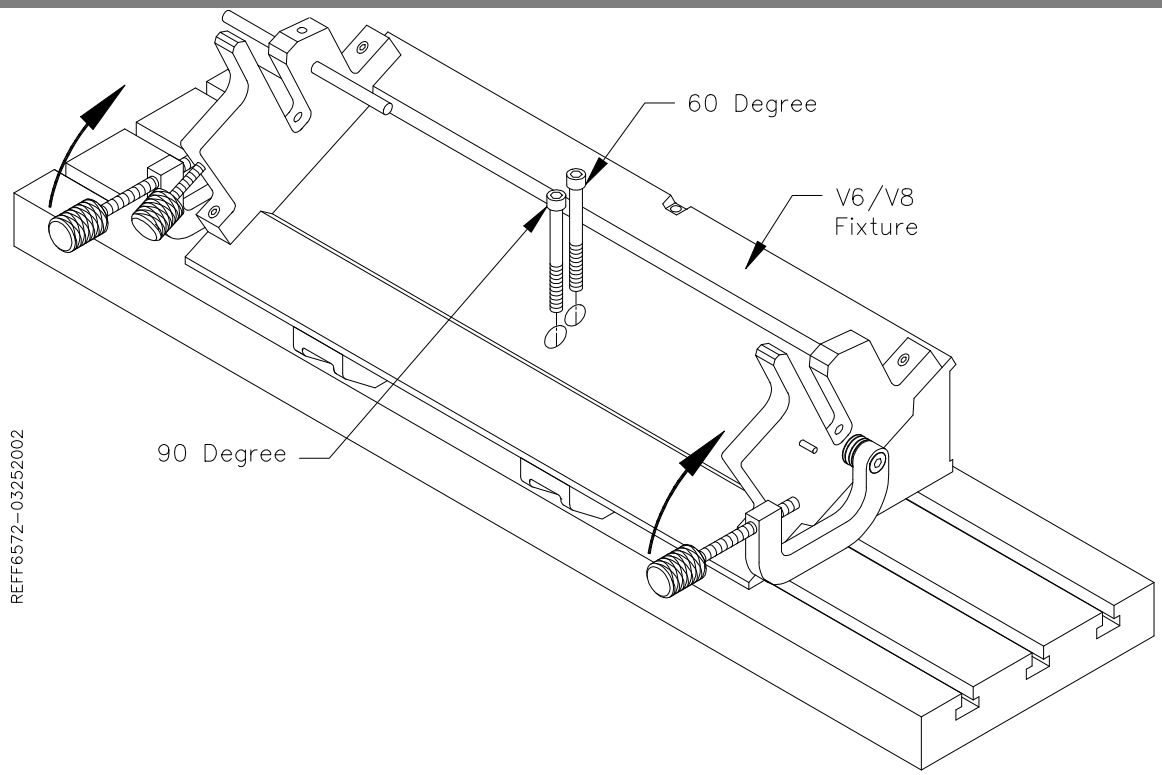
The block and fixture are now locked in place and ready for machining.

V6/V8 Manual Fixture Assembly 502-1-72H:

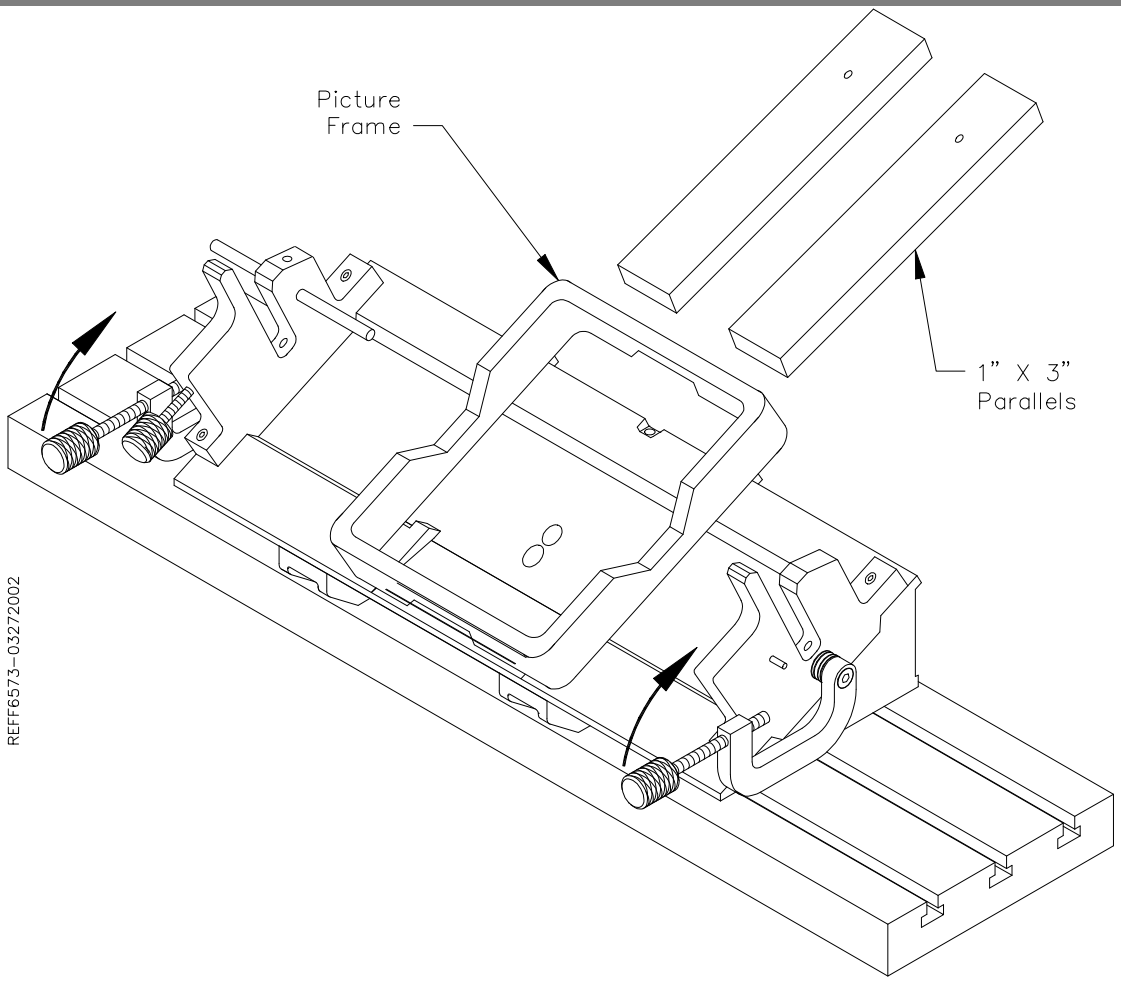
1) Place parallels 650-3-34 on Machine bed 10 inches apart and secure with T-Nut and Hex bolts that are provided. The keys on the bottom of the parallels go in the back Key Way.



2) Select the 60 or 90 degree position for the fixture. Using a slow moving hoist, set the V6/V8 fixture onto the parallels.
3) Push the V6/V8 fixture back on the parallels until the keys in the top of the parallels line up to the machined sections on the rear of the V6/V8 fixture.
4) Use the supplied Socket Head cap Screw and T-Nut to secure the fixture in place.

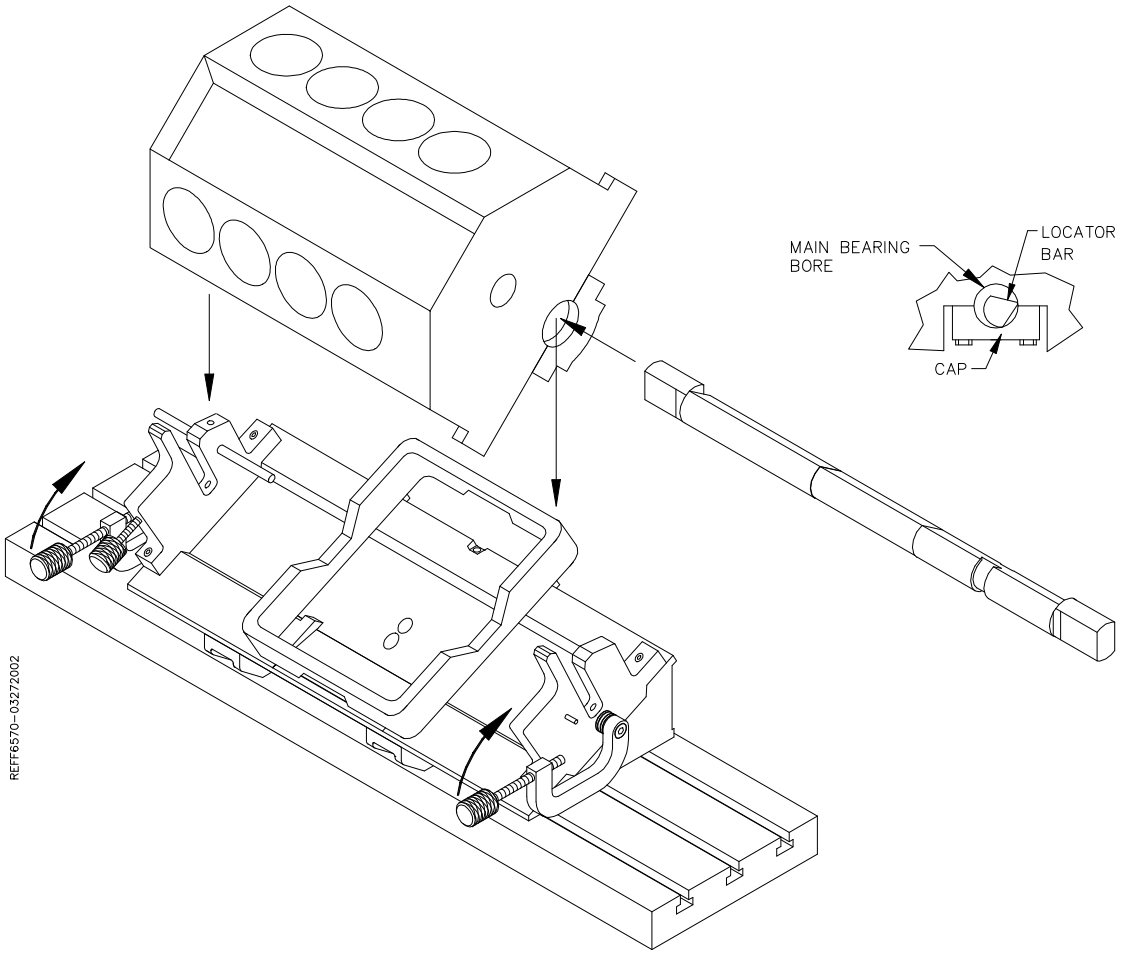


5) Decide if the Picture Frame or the 1” X 3” will need to be used.



6) Slide the Locator Bar through the Mains of the block.
7) Lower the block with the Locator Bar installed into the V6/V8 fixture. Clamp the Locator Bar with the screw in clamps. Shown on next page.

For a more detailed description on properly using and adjusting the V6/V8 fixture refer to the Manual V6/V8 Combination Fixture 502-1-72H in the Options section of this manual.


MAIN BEARING BORE
LOCATOR BAR
CAP
REFF6570-03272002

General Machine Information:

Before starting to build or use any of the Rottler operating programs it is important to understand how the machine operates internally.

The Rottler F65 model uses Computerized Numeric Control (CNC). The CNC is always operating when the machine is turned on. However, you will not see the CNC controls unless you switch over to the CNC operating screen. This is know as Flexcam or the Flexpad. Using and operating the Flexpad will be discussed later in this chapter.

Any move away from home in any axis is a positive move. Any move towards home is a negative move.

Homing:

The F65 ***MUST*** be homed anytime it is turned on or an Emergency stop has been pressed. If the machine has not been homed the reference positions for all program will be off.

The purpose of Homing the machine is to set reference points in each axis for the machine to operate from. If the machine is not homed the reference points may be off position. The reference point is set in exactly the same position each time the machine is homed. The machine keeps track of these reference positions internally and the operator will not see them.

Building Programs:

Bore Mode:

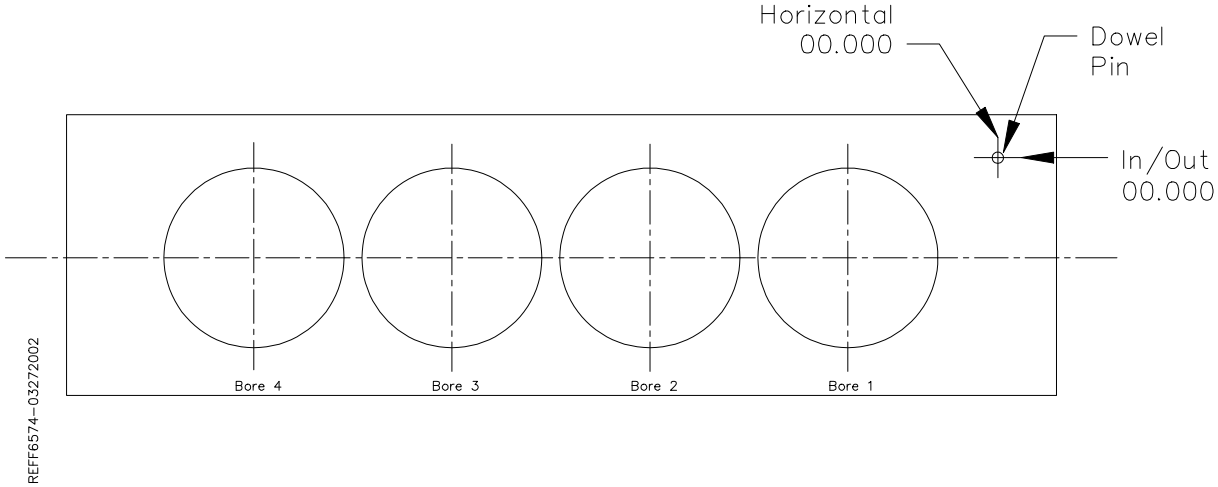
Select the Bore button from the Main Menu. This will bring up the Bore Mode with the Set Zeros tab shown.

Setting Zeros:

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

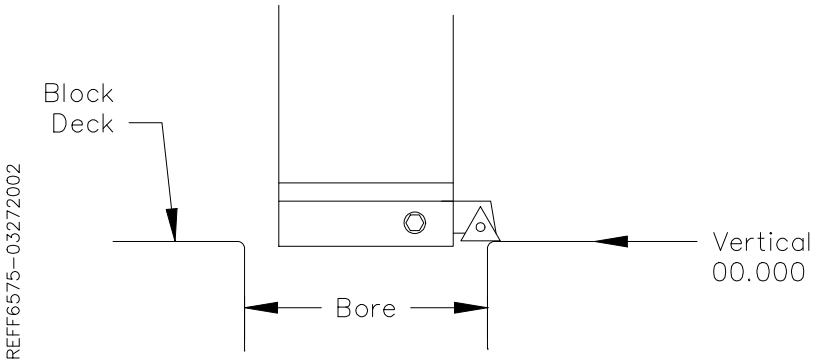
Horizontal and In/Out Zero:

For this example, the Dowel Pin will be our zero point for the Horizontal and In/Out axis. Using an indicator or electronic probe center the spindle on the Dowel Pin then press the Horizontal and In/Out Zero buttons. The display above these buttons will go to zeroes. The Horizontal and In/Out zero positions have now been set.



Vertical Zero:

For this example the deck will be our zero for the 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 above this button will go to zero. The Vertical zero has now been set.



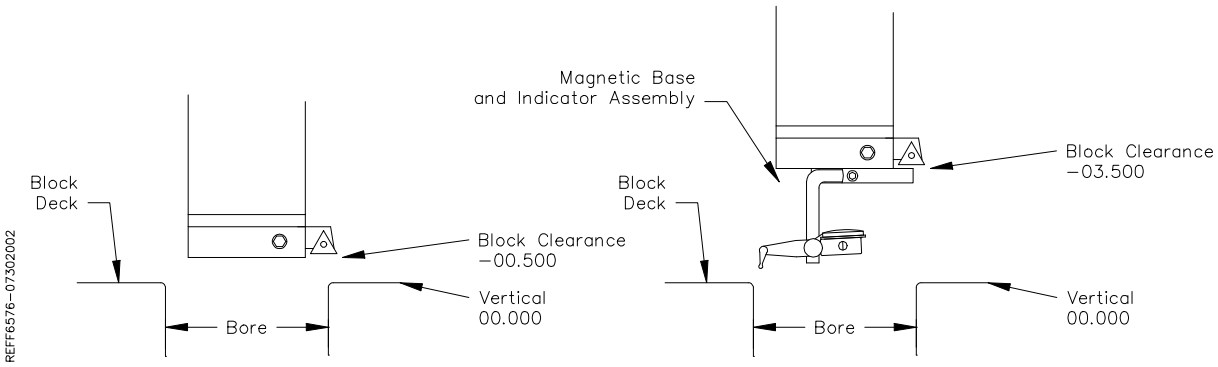
The zeros points for all axis have now been set. All the numbers entered from this point on will reference these zero positions. You are finished with the Set Zeros screen, select the next Tab to the Right.

Programming Vertical Stops:

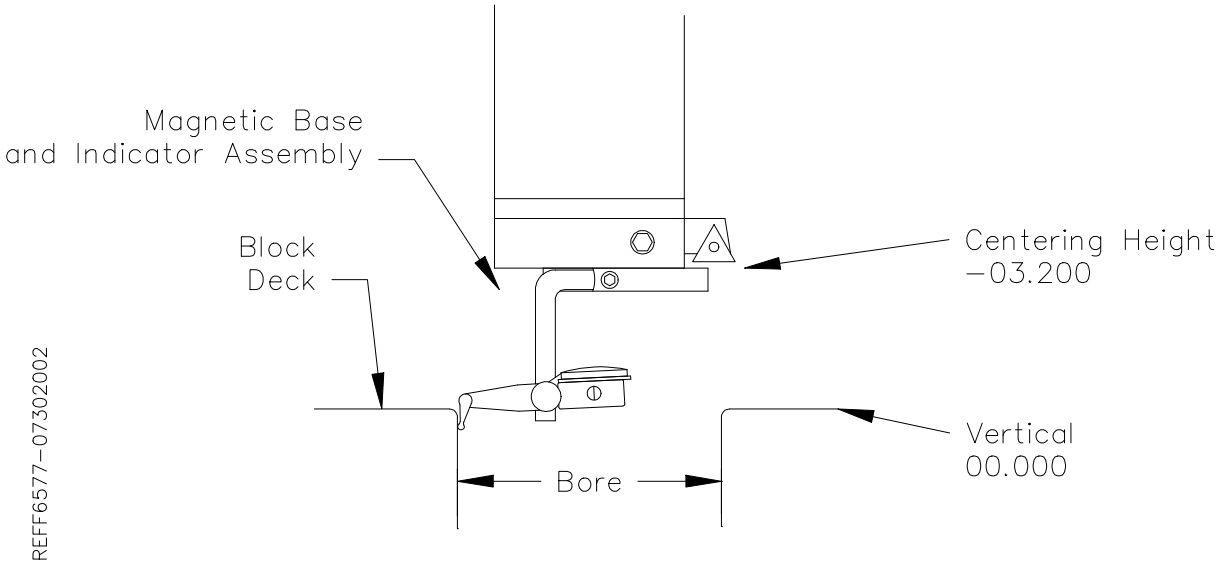
To build a program you must set the Vertical Stops for the program. There are four (4) Vertical stops used in the boring program.

Block Clearance:

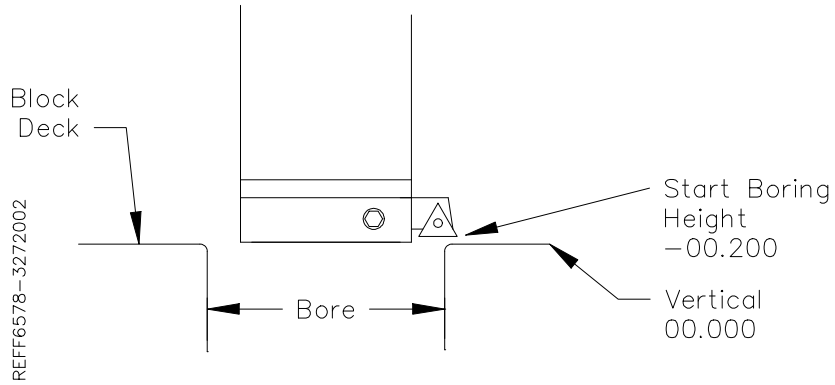
This is the distance above the zero position or block deck allowing the cutterhead to move to the next bore unobstructed. If you are Blueprinting a block the number will be just enough to allow the cutterhead to clear the block deck. If you are not blue printing you will need a larger number to allow the centering assembly to clear the block deck. This will be a Negative number. Both systems are shown below.



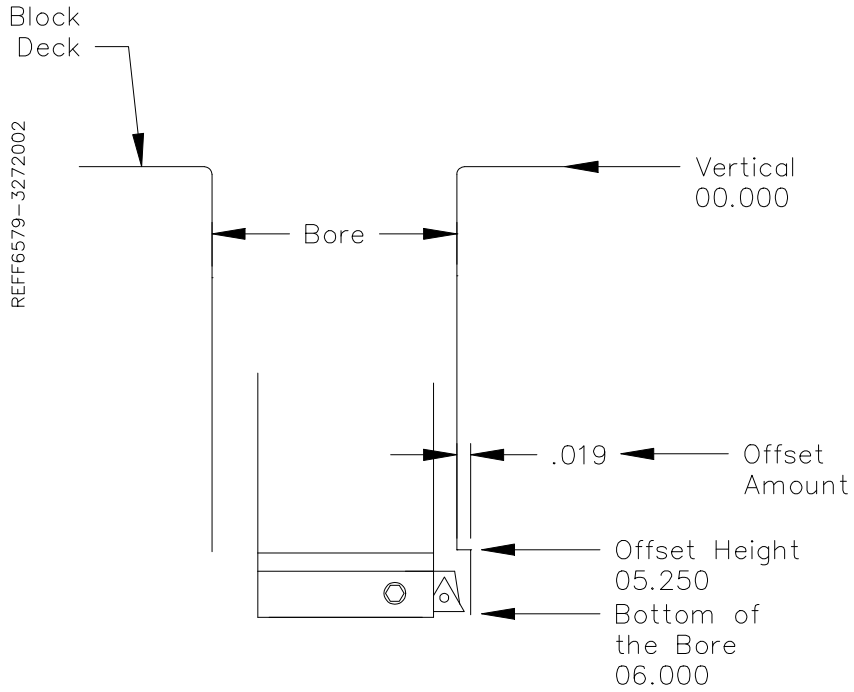
Centering Height:
This is the distance above the zero position or block deck where you would be manually centering at. If you are Blueprinting a block this position can be the same as the Block Clearance setting. This will be a negative number.



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. This will be a negative number.



Lower Clearance Bore:
This option is used to offset the cutterhead to the Left or the Right to make clearance for Honing below the cylinder. It can be turned off, offset Left or offset right. If Left or Right is selected the controller will ask you at what position do you want the offset (Offset Height) to start and then how far do you want to offset (Horizontal Offset). There is a picture of the bore on the screen that will visually show the direction the offset will go. This will be a positive number.



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. This will be a positive number. When the spindle retracts it will then go to the block Clearance position.

This is an example of what the two types of programs discussed would look like.

Blueprinting:

Block Clearance	-00.500
Centering Height	-00.500
Start Boring Height	-00.200
Lower Clearance Bore	
Offset Height	05.250
Horizontal Offset	00.019
Bottom of the Bore	06.000

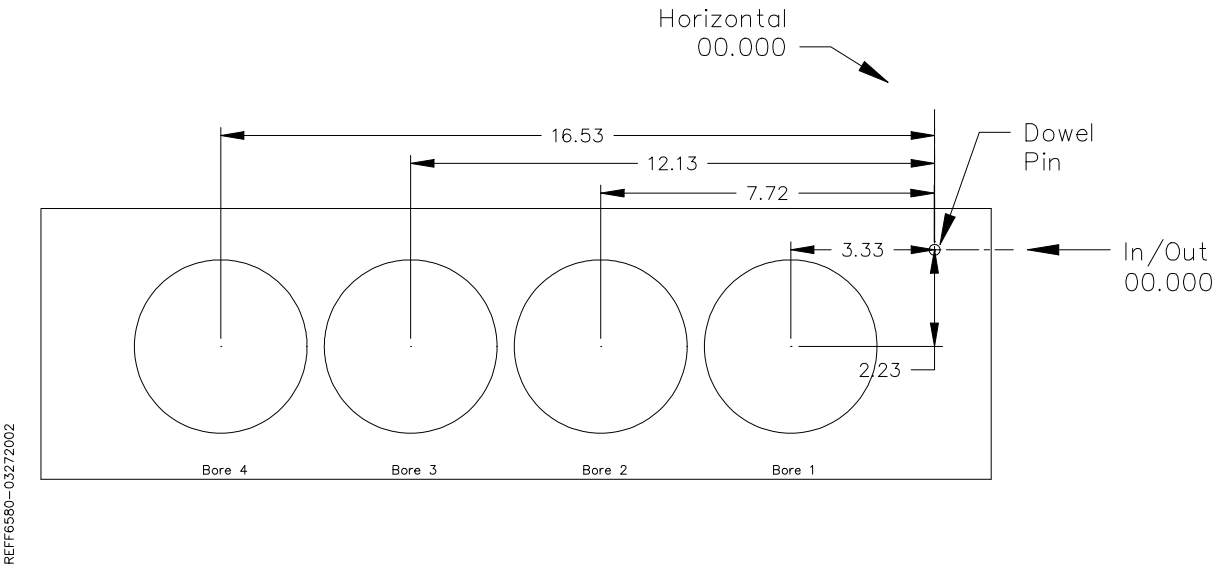
Manual Centering:

Block Clearance	-03.500
Centering Height	-03.200
Start Boring Height	-00.200
Lower Clearance Bore	
Offset Height	05.250
Horizontal Offset	00.019
Bottom of the Bore	06.000

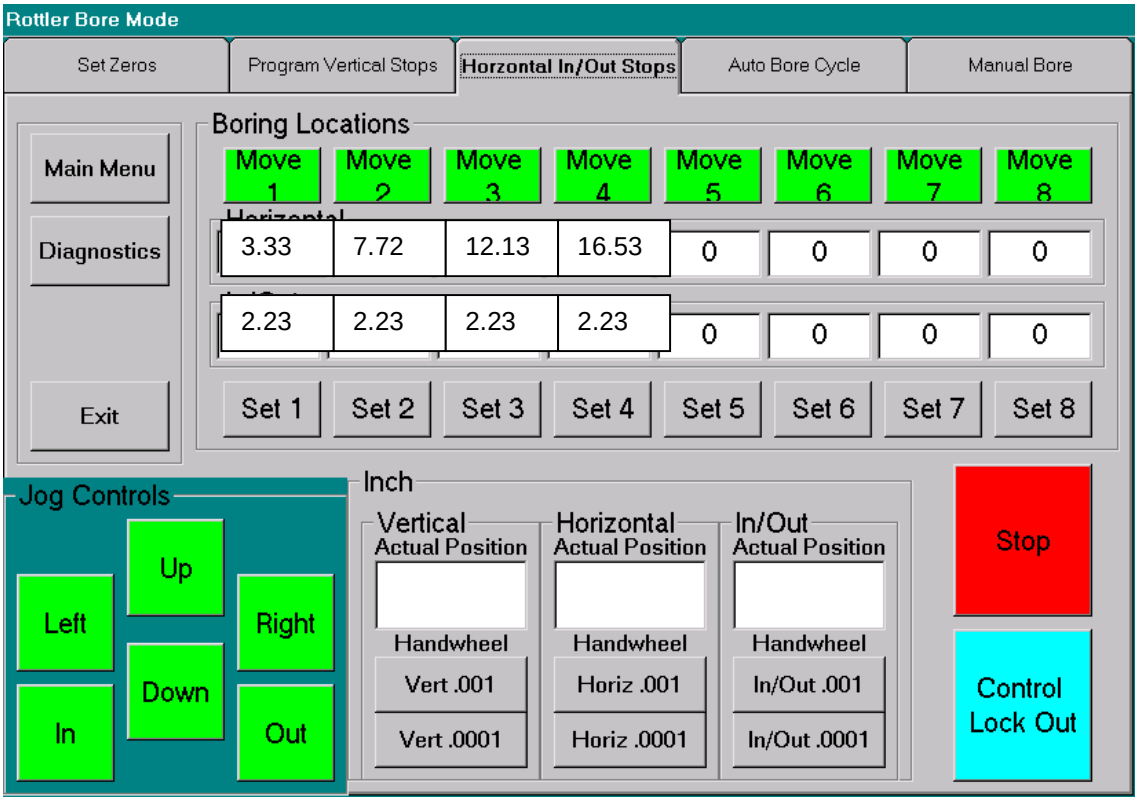
The Vertical stops have now been set. You are finished with the Program Vertical Stops screen, select the next Tab to the Right.

Programming Horizontal and In/Out Stops: Blueprinting a Block

To build a program you must set the Horizontal and In/Out Stops for the program. There are eight (8) Horizontal and In/Out stops used in the boring program. All Horizontal and In/Out stop are based from where their zero positions were set. The following illustration will show how the stop positions were derived. These stops would be used when blueprinting a block.



The following is an example of what the screen would look like for the above block.



The Horizontal and In/Out stops have now been set. You are finished with the Horizontal In/Out Stops screen, select the next Tab to the Right.

Programming Horizontal and In/Out Stops: Manually Centering a Block

Many blocks do not have the cylinders in the exact location the blueprint says they should be. This could be from the original block or from previous boring. You may not be taking enough material out of the block to clean up the cylinders if you are using the Blueprinting dimensions. In this case you would need to manually center in each bore.

The same process applies when Manually Centering a block as does with Blueprinting. Instead of using the given dimensions off of a blueprint for a block, you will go cylinder to cylinder and manually center the cutterhead in the cylinder using a mechanical indicator or electronic probe. When you are centered in the first cylinder press the “Set 1” button, the controller will grab the current Horizontal and In/Out positions and insert them into the cylinder one data boxes. Continue the same procedure for all cylinders to be bored.

The Horizontal and In/Out stops have now been set. You are finished with the Horizontal In/Out Stops screen, select the next Tab to the Right.

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 1” button. The spindle will move up the Vertical Block Clearance distance if it is not already there. It will then move the Horizontal and In/Out axis to there set position. The vertical will then move down to the centering position and stop. The machine will go idle at this time. Pressing the “Start Auto Cycle” will cause a pop-up menu to appear stating what is about to do and then asking if it is OK to proceed. If you press “Yes” the auto cycle will start running. If you press “No” the pop-up menu will disappear and you are able to change any information in the program.

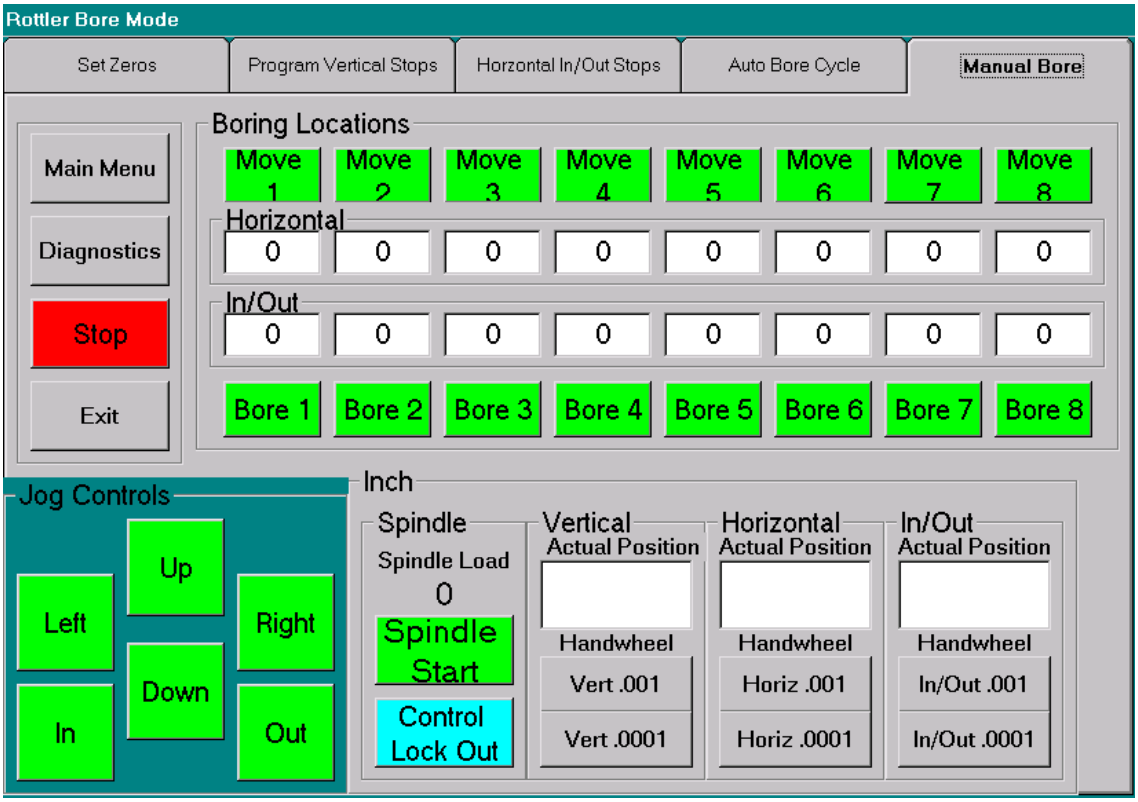
When the program is running the “Start Auto Cycle” button will change to “Press to Pause”. If this button is pressed the machine will pause the program right where it is. At this point the screens are locked out from changing anything. The button will the change to “Press to Resume”. If you want to resume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

The Auto Cycle can be started from any position. For example you can press any of the Move buttons (the machine will move to that position) and then press the “Start auto cycle”. The machine will run the program from that position on.

After a program has been completed the machine will move the spindle over to the first cylinder and down to the Centering Height.

Manual Boring:

Select the Manual Bore tab on the touch screen. This screen has Move buttons as well as Bore buttons. The following picture shows the location of the Move and Bore buttons.



The Move buttons operate the same as they do in all other screens. The Bore buttons will move to the cylinder that Bore button is associated with and then bore that cylinder. If the spindle is already above the cylinder that is to be bored, it will bore that cylinder and retract to the Clearance Height.

The Bore buttons will operate as long as there is a horizontal stop programmed.

Mill Mode:

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.

Horizontal Zero:

For this example we are going to set the Horizontal Zero approximately ¼" from the right hand side of the work piece.

In/Out Zero:

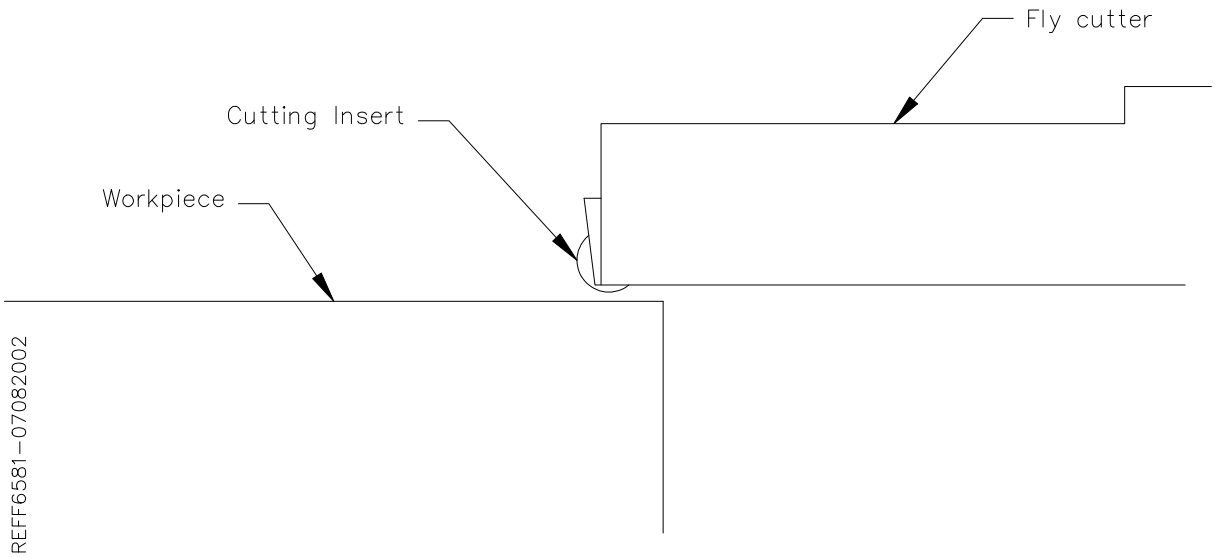
For this example we are going to set the In/Out Zero at the center line of the work piece.

Vertical Zero:

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

Example:

Install the Milling cutterhead you will be using into the machine. Move the In/Out axis and center the work piece under the spindle. Press the In/Out Zero button here. Move the Horizontal Axis to that the cutter is overhanging the work piece about ¼". Bring the Vertical Axis down until the cutter is just above the work piece. At this time it should look similar to the drawing below.



Start the spindle at the RPM you will be using on the work piece. If a RPM has not yet been programmed, go to the Auto Cycle screen and enter a RPM.

Press the Vert .001 button to put the handwheel in .001 per detent. Slowly move the spindle downward until you can hear or see the cutter just touch the block. Press your Vertical Zero button here. Press the Right travel button to feed the spindle off of the work piece. When the cutter has cleared the work piece press the Right travel button again to stop the feeding. Press the Horizontal Zero here.

Your zero position for all axis have now been set.

Mill cut Parameters:
This screen is used to set certain parameters the F65 will use to the automatic cycle.

Start:

These values tell the computer where you would like to start the automatic program in relationship to the set zero point. These values can be entered by touching the displayed area and then through a numeric pop-up keypad. You can also enter the number by moving the machine to the desired positions and then pressing the "Set" button associated with each axis. Pressing the "Set" button will take the current displayed information from the Actual position display and load it into the start positions. For normal Milling operations these buttons are generally not used.

End:

This displays the current end stop value. To enter a new value press the display and a pop-up numerical key pad will appear. Press the desired end stop value and then OK. The end stop position is a absolute value. If your reference point has been set and you have a value such as four in the horizontal start position and an end position of seven, the machine will only actually mill for three inches. The end position will always reference the zero position set on the previous screen.

Rough Settings:
These values are entered to take several passes on a work piece.

Total Depth:
This value will be the total amount of material you want to take off the work piece, including the amount of the final pass.

Amount Per Pass:
This is the amount of material removed from the work piece on each pass of the cutterhead.

Note: ***You do not need to have evenly dividable numbers in these sections, the computer will do the math to remove the correct amount each time and for the final pass to be at the amount you set.***

Final Pass Settings:
This value is sets the information for the final pass.

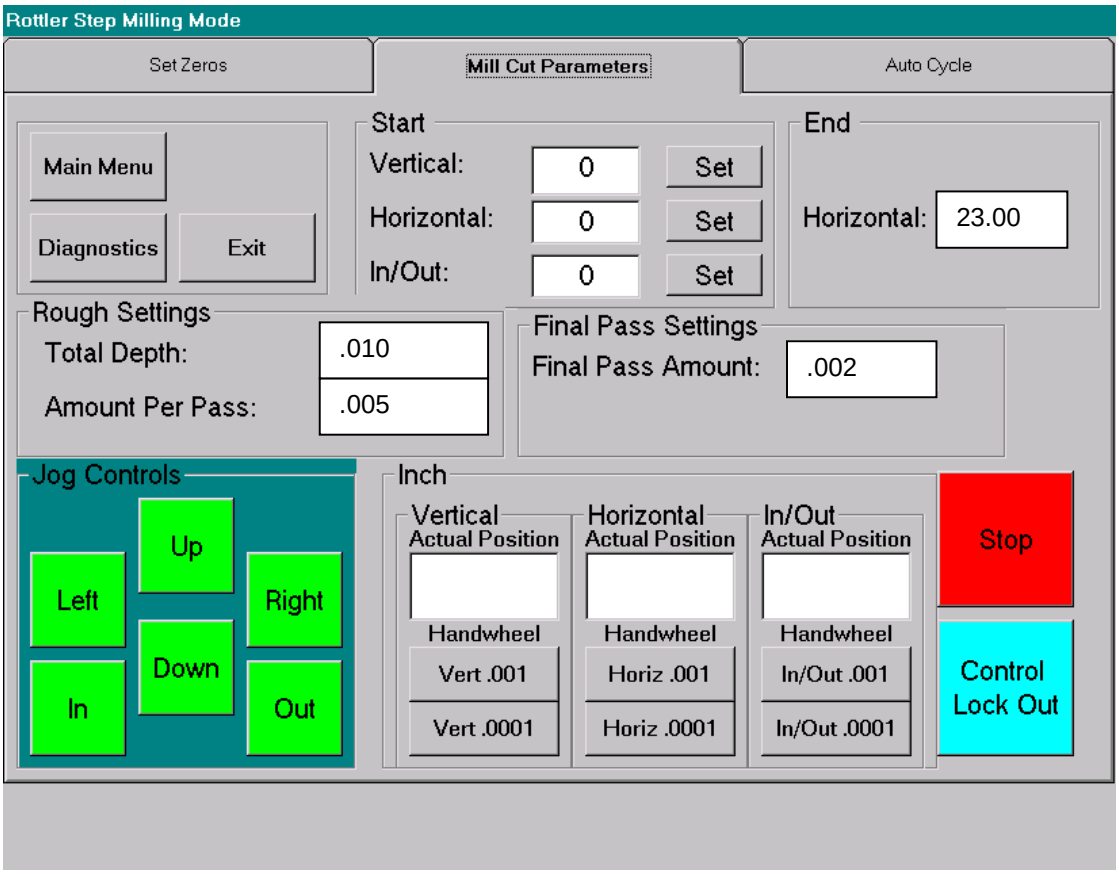
Final Pass Amount:
This is a numeric value that will set the amount the machine will take on its final pass. No matter what values you have in the rough setting area the final pass will always be what is specified here.

All of the buttons on this screen function the same as they are described earlier in this chapter.

Select the Auto Cycle tab next to this screen to continue.

Single Pass:
To take a single pass, enter the same value in the Rough Setting as you do in the Final Pass Amount. The machine will drop down the set amount, make a single pass, lift vertically one inch, and return to the zero points on the Horizontal.

The following is an example of what the screen would look like for a standard Multiple Pass Milling operation.



Running the Auto Cycle:
A Feed Rate and spindle RPM must be entered to run an auto cycle. You must enter a Feed Rate and RPM for both the Roughing and Finish Passes. If you are making a single pass, you only need to enter a speed and feed in the Final Pass section.

Lifter Bore Mode:

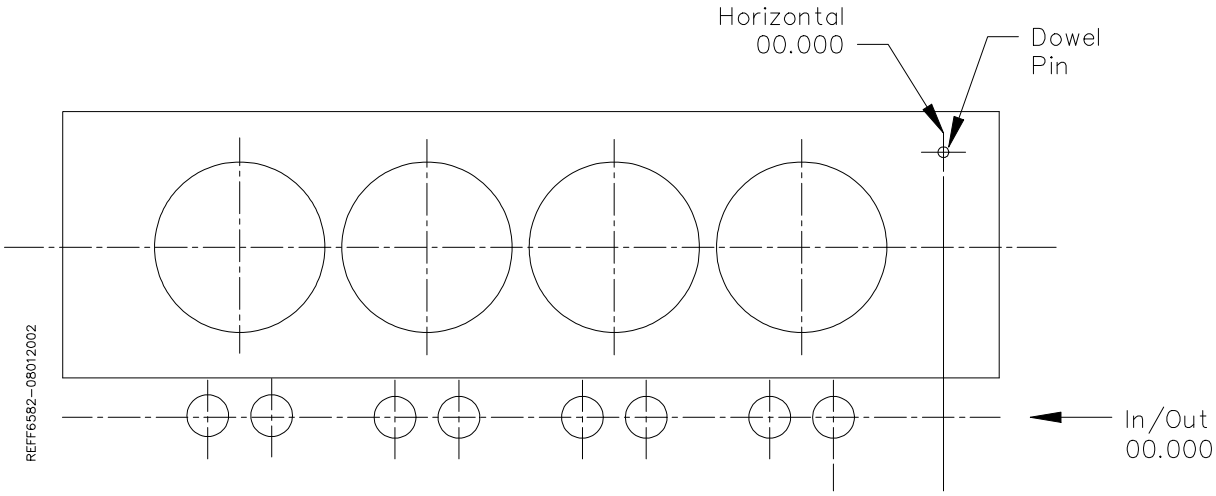
To mount a block for Lifter Boring refer to Performance Fixture Boring and Lifter Boring earlier in this section.

Use the chart in the Options section of this manual to select the correct spacer for the angle of the lifter bores.

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

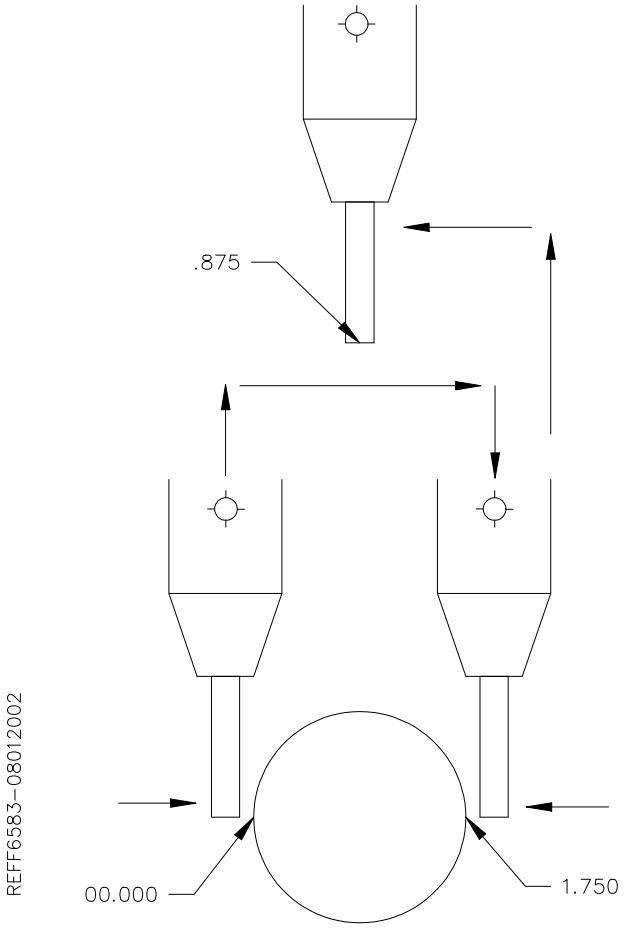
Setting Zeros:
The purpose of setting zero points is to give the operator a specific point to build programs from. The machine also uses these zero points to run the program from. The zero points can be set at any point in the machines' travel. Each axis (except the Spindle rotation) will need to have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

Horizontal Zero:
For this example, the Dowel pin will be used to set the Horizontal Zero. Using an indicator or electronic probe center the spindle on the Dowel Pin then press the Horizontal and In/Out Zero buttons. The display above these buttons will go to zeroes. The Horizontal zero position has now been set.



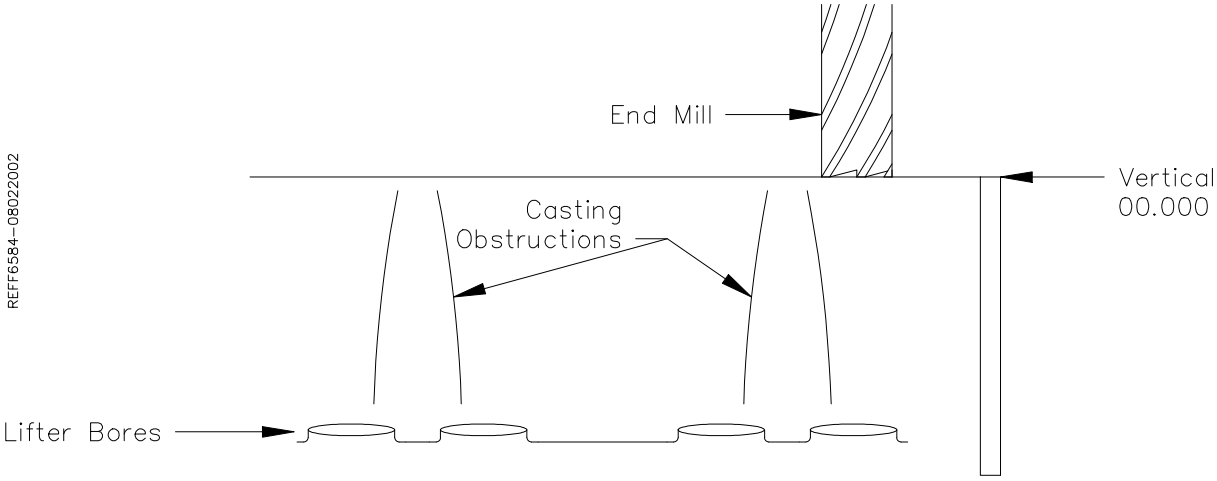
In / Out Zero:

The In/Out zero position 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). Using the In/Out handwheel bring the probe up to the Cam Bar until it lights. Press the In/Out 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 In/Out position reading. Divide this reading by two. Bring the spindle up until it can clear the Cam Bar. Use the In/Out handwheel and move the In/Out position until it matches the divided number. This is the center line of the Cam Bar. Press the IN/Out Zero button now. The In/Out zero position has been set. The following illustration visual shows the above description.



Vertical Zero:

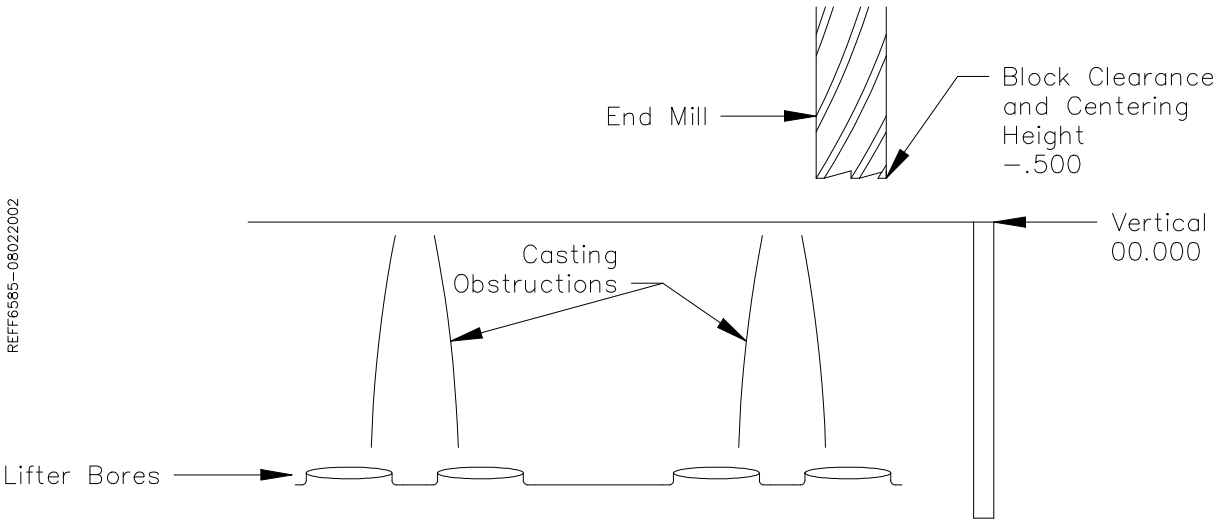
For this example the highest part of the deck (block is inclined) as the Vertical Zero point. Using the Vertical handwheel bring a point of the End Mill down to just touch the block. It is a good idea to use a piece of paper between the End Mill and the block surface, direct contact between the End Mill point and the block surface can chip the End Mill. Press the Vertical Zero button here. 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.

Programming Vertical Stops:
To build a program you must set the Vertical Stops. There are four (4) vertical stops used in the Lifter bore Mode.

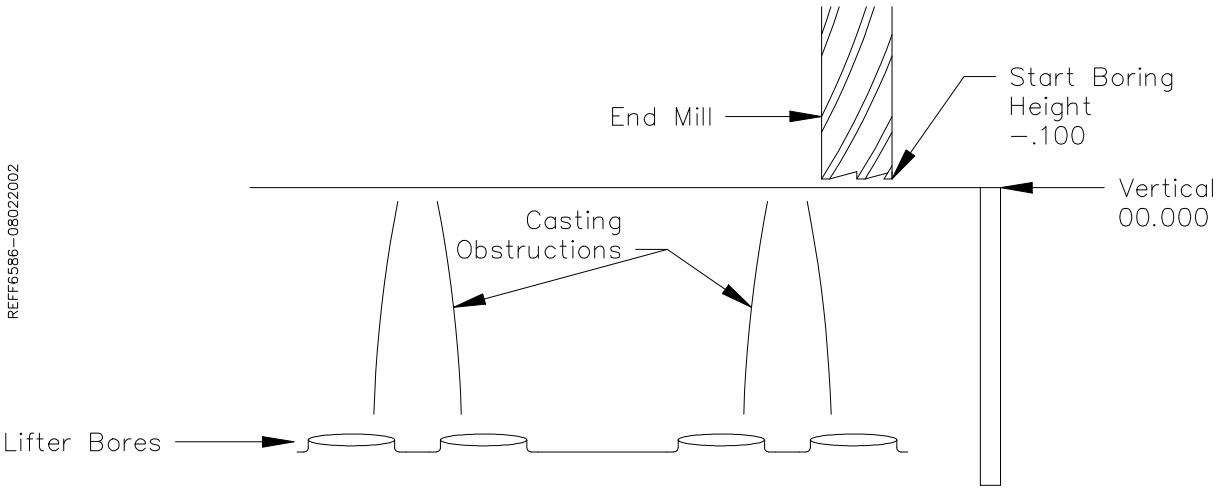
Block Clearance:
This is the distance above the Vertical Zero position (block deck in this case) that will allow the end Mill to travel over to the next Lifter Bore unobstructed. This will be a negative number.



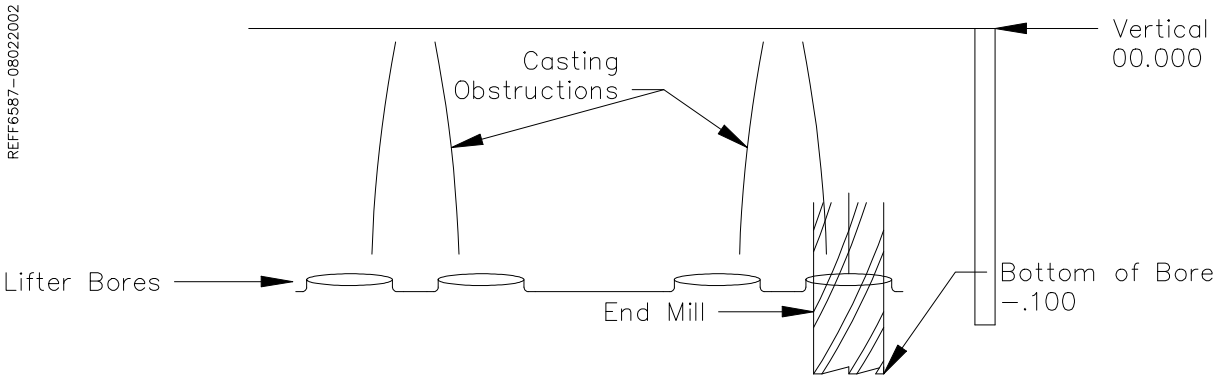
Centering Height:
Centering is not used in Lifter Bore Mode. The positions of the Lifter Bores are derived from a blue print or other documentation. Therefore, the Block Clearance and the Centering Height can be the same.

Start Boring Height:
This is the position you want the cutterhead to start rotating the downward feed to start.

CAUTION: *You must be very careful when setting this height. There is very often obstructions in the cast that will not allow you to rapid travel all the way down to the start of the Lifter Bore. If you are not sure that the End Mill can clear all the way to the Lifter Bore on each bore, the Start Boring position must be set above the zero position.*



Bottom of 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. This will be a positive number. When the spindle retracts it will then go to the block Clearance position.



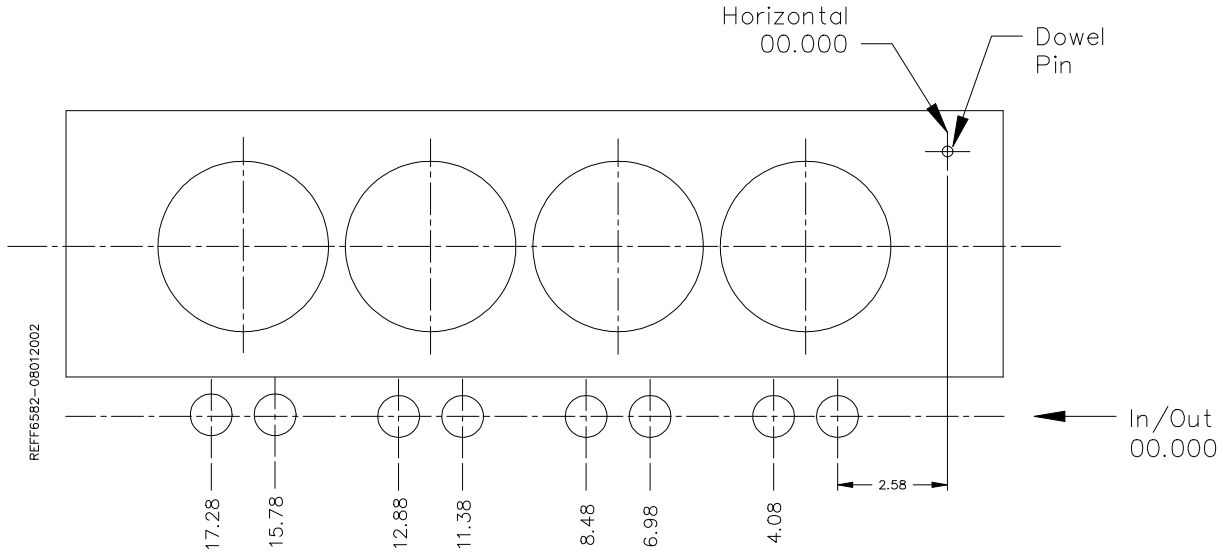
An example of what this program would look is below.

Block Clearance	-00.500
Centering Height	-00.500
Start Boring Height	-00.100
Bottom of the Bore	01.500

The Vertical stops have now been set. You are finished with the Program Vertical Stops screen, select the next Tab to the Right.

Programming Horizontal Stops:

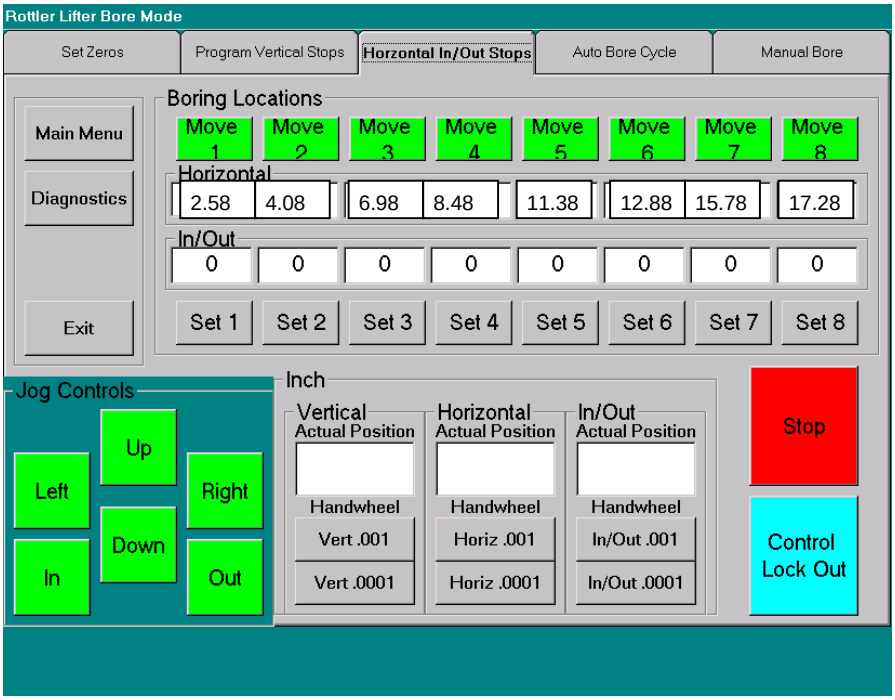
To build a program you must set the Horizontal Stops for the program. There are eight (8) Horizontal Stops used in the Lifter Bore program. All Horizontal Stop are based from where the zero position was set. The following illustration will show how the stop positions were derived. The Horizontal Stops start with Stop 1 and go from right to left.



Programming In/Out Stops:

The Lifter bores are all on the same centerline as the Cam Bore where the In/Out axis was zeroed. Therefore, the In/Out Stops will all be set at zero.

The following is an example of what the screen would look like for the above illustration.



The Horizontal and In/Out stops have now been set. You are finished with the Horizontal In/Out Stops screen, select the next Tab to the Right.

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 1” button. The spindle will move up the Vertical Block Clearance distance if it is not already there. It will then move the Horizontal and In/Out axis to there set position. The vertical will then move down to the centering position and stop. The machine will go idle at this time. Pressing the “Start Auto Cycle” will cause a pop-up menu to appear stating what is about to do and then asking if it is OK to proceed. If you press “Yes” the auto cycle will start running. If you press “No” the pop-up menu will disappear and you are able to change any information in the program.

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

The Auto Cycle can be started from any position. For example you can press any of the Move buttons (the machine will move to that position) and then press the “Start auto cycle”. The machine will run the program from that position on.

After a program has been completed the machine will move the spindle over to the first cylinder and down to the Centering Height.

Line Bore Mode:

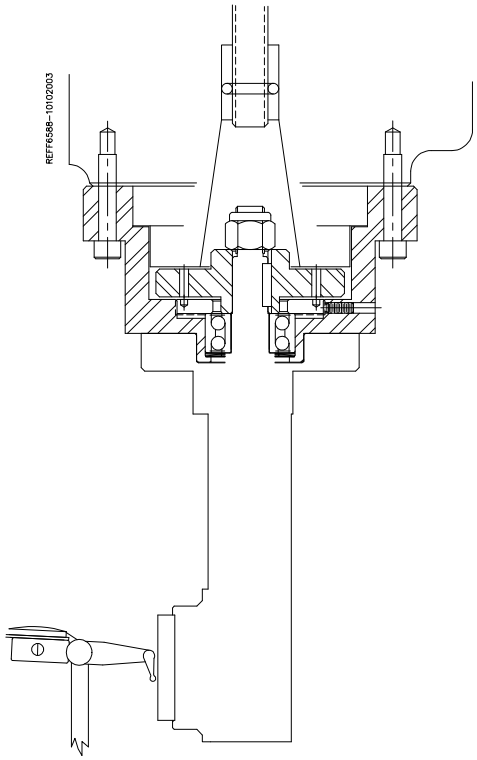
To mount a block for Line Boring refer to Lower end Machining Package earlier in this section.

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

At this point a block should be mounted into the fixture with pan rails level to each other and the support jacks in place. The handwheel should tight as well as the bolts for the fixture.

Mounting and Aligning the 90 Degree Head:
Mount the 90 degree head onto the spindle and just snug the four mounting bolts. Use the following instructions to align the head.

Mount a .001" or .0001" dial indicator to the machine table or block. The 90 degree head has two machined surfaces that can easily be used to align the head. The two surfaces and indicator positions are shown below.



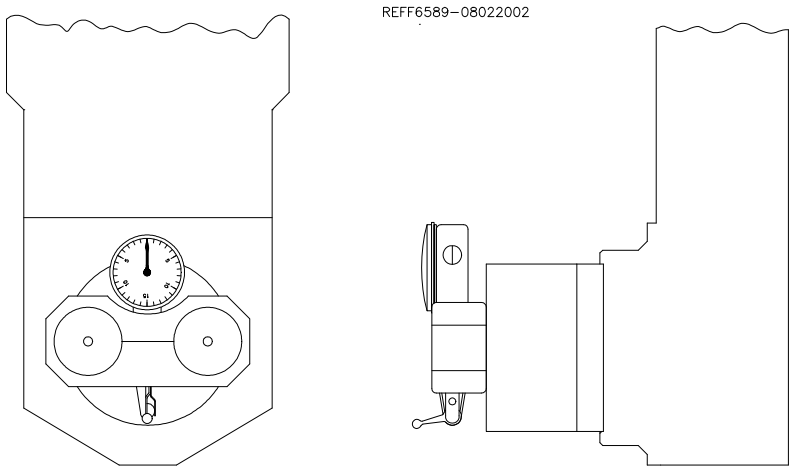
Put some pressure on the indicator. Using the In/Out handwheel move the indicator form one side to the other noting the amount of difference. Keep the indicator on that side of the head and rotate it half of the noted distance. Repeat this procedure until there is less than .0005" variance.

Tighten the four 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.

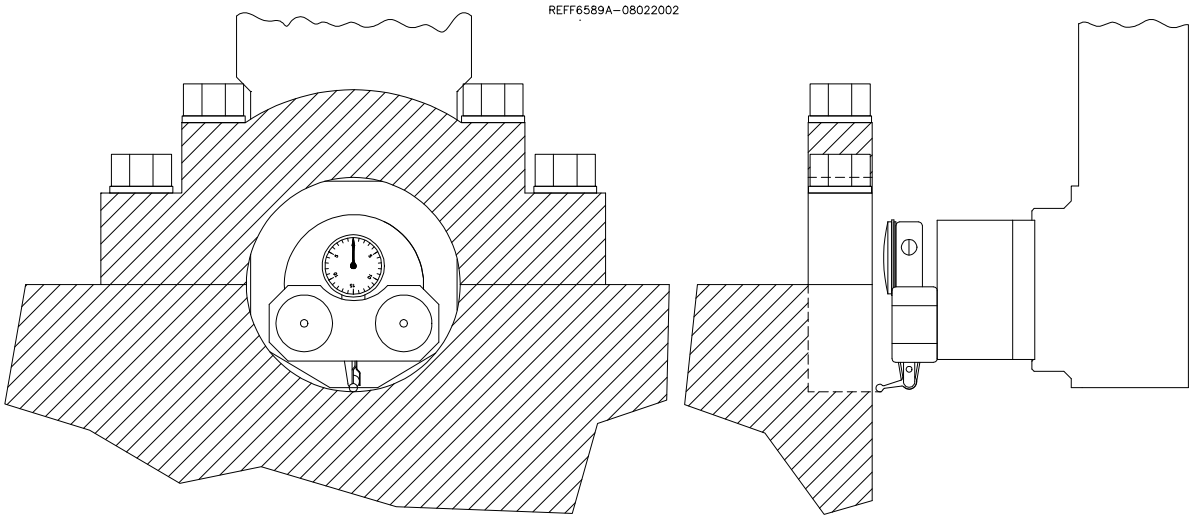
Horizontal Zero:
The Horizontal should be set about .050” from the front of the first main to be bored, making sure that that position will allow the head to travel up without interference. Bring the head down and roughly center it in front of the first main. It does not need to be perfectly centered to set the horizontal zero. Press the Horizontal Zero button at this location.

In/Out and Vertical Zero:
Locate the supplied Last Word indicator and small magnetic base. Mount on cutterhead as shown below.



Using the Horizontal handwheel 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 to indicate from.

Physically move the indicator and mag base on the cutterhead until there is about .010” pressure on it. Start rotating the spindle CW and CCW watching he indicator. As there is too much or too little pressure on the indicator, use the In/Out and Vertical handwheel to adjust the spindle in the bore until all three point are equal. Press the In/Out and Vertical zero buttons at this point.



The Vertical stops have now been set. You are finished with the Program Vertical Stops screen, select the next Tab to the Right.

Programming Vertical Stops:
To build a program you must set the Vertical Stops. There are two (2) vertical stops used in the Line bore mode.

Bore Centerline:
The first vertical stop is on the main bore centerline. The vertical zero was set on the bore centerline, Therefore this stop will always be zero.

Block Clearance:
This stop is set at a negative value that will allow the 90 degree head to travel over the cap and bolts to the next main bore unobstructed.

Programming Horizontal Stops:
The Horizontal Zero was set .050" before the first Main Bore, so 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

Programming In/Out Stops:
There are no In/Out stops to program in the Line bore Mode. The is lined up in the performance fixture and the bores will stay on the same In/Out centerline.

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 Zeroes" 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" will cause a pop-up menu to appear stating what is about to do and then asking if it is OK to proceed. If you press "Yes" the auto cycle will start running. If you press "No" the pop-up menu will disappear and you are able to change any information in the program.

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

The Auto Cycle can be started from any position. For example you can press any of the Move buttons (the machine will move to that position) and then press the "Start auto cycle". The machine will run the program from that position on.

After a program has been completed the machine will move the spindle over to the first Main Bore at the Clearance Distance.

Thrust Bearing 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 affect the operation of the Auto Cycle.

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

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

Setting Zeros:

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

Horizontal Zero:

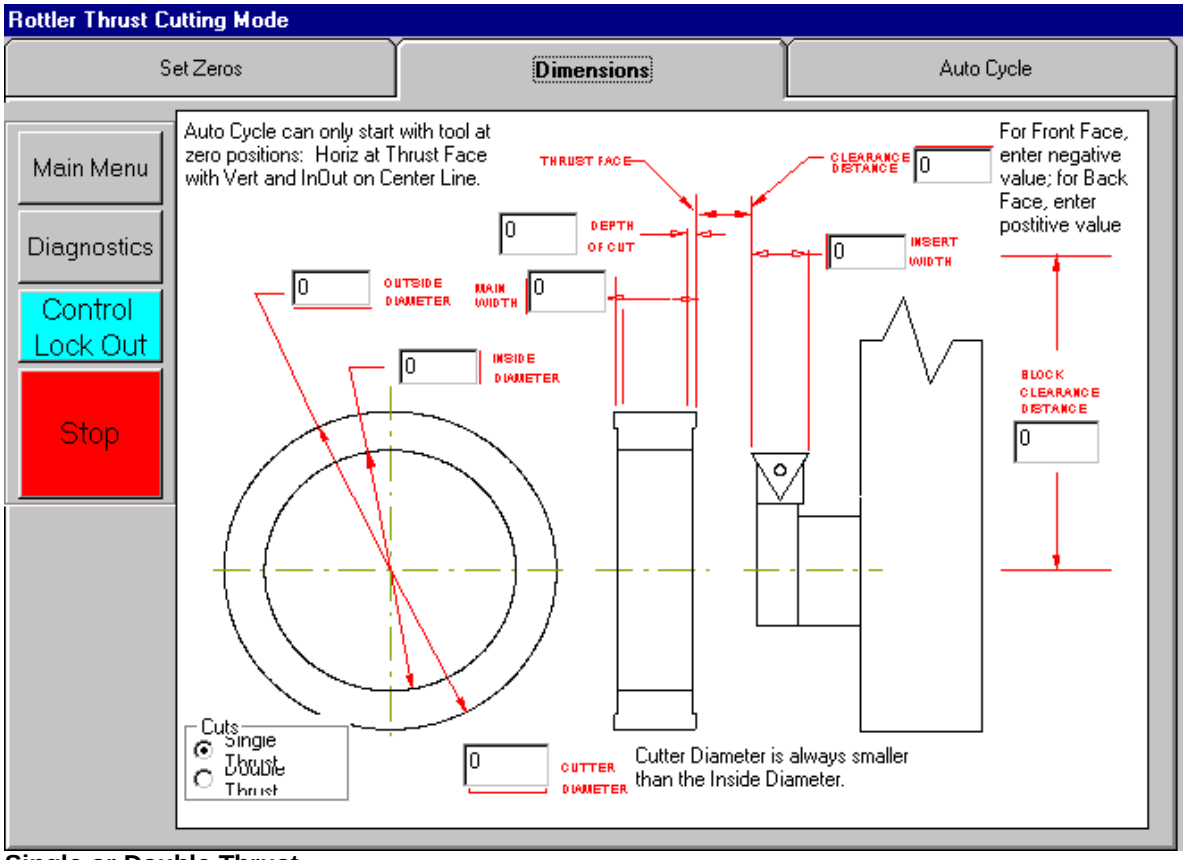
To set the Horizontal Zero, bring the cutter in using the Horizontal Hand Wheel until it just touches off the current thrust face. Press the Horizontal Zero Button here. The computer will use this zero point when cutting the depth of the thrust face.

Follow the procedure for setting zeros in the Line Bore Mode section of this chapter. Set the Horizontal zero on the Main Bearing that is to have the Thrust cut.

After the zeroes have been set select the nest tab to the right, Dimensions.

Setting Dimensions:

There are several values that need to be set on this screen for the program to operate properly. Below is illustration and a description of each of these values.



Single or Double Thrust:
You can select if you would like to cut a single or double thrust on a Main bore in a single automatic cycle.

Single Thrust:
If you select single thrust the automatic cycle will cut the thrust face on the right hand side of the Main.

Double thrust:
If you select double thrust the automatic cycle will cut the thrust face on the right hand side of the Main and then move through the Main and cut the left side of the Main.

Note: A special tool holder 6801M is needed to do the double thrust cutting. It is recommended that this tool is also used in single thrust cutting but not absolutely necessary.

Inside Diameter:
Enter the inside diameter of the main you are cutting the thrust on.

Outside Diameter:
Enter the outside diameter of the thrust you are going to be cutting.

Cutter Diameter:
Enter the diameter of the cutting tool you will be using.

Note: The Cutter Diameter must be smaller than the Inside Diameter.

Main Width: (Double Thrust only)
Enter the width of the main you are going to be cutting a double thrust on. This tells the computer how far to move to cut the second thrust face.

Depth of Cut:
Enter the depth you want the thrust face to be after cutting.

Clearance Distance:
This is the distance the 90 degree head will need to move to the right to clear all obstructions and retract vertically to the block clearance height.

Insert Width: (Double Thrust only)
Enter the width of the Insert being used.

Block Clearance:
Enter the distance the 90 degree head will need to clear the Main Caps vertically. This will be a negative number.

All values have now been set. Select the next tab to the right, Auto Cycle.

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.

Single Thrust:
When you are at the zero positions press the Auto Cycle, the spindle will start at the programmed RPM. 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 cutter head is back at the center point (zero positions) of the Main all motion will stop. The cutterhead will then retract horizontally to the clearance distance then vertically to the block clearance distance.

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

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

Cam End Tunnel Boring:

To bore the end tunnels on a block refer to Block End Truing Fixture 650-3-30 when used with Cam Boring for set 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.

1) Center the spindle over the Main bore using the electronic probe or magnetic base with indicator. Zero the Horizontal and In/Out axis.
2) The Cam spacer placed in the center T-Slot should put the Cam tunnel in line with the Main bore.
3) Move the table the specified distance toward the Cam Tunnel. This distance should in the blue printing specifications for the block you are working with.
4) Check that you are on center of the cam bore with the electronic probe or indicator. If it is not on center the block may have been previously bored or honed incorrectly.

CAUTION: *Be very careful when correcting the existing Cam bore on the In/Out axis. This could cause the distributor gears to be damaged.*

5) You can also skip the above procedure and center on the existing Cam bore.
6) Once centered on the Cam bore or set to correct the Cam bore, zero the Horizontal and In/Out axis.
7) Install the 650-2-3F cutterhead into the spindle.
8) Refer the Bore Mode, Programming Vertical Stops earlier in this chapter to set the vertical stops.

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.

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".

9) Bore the distributor end Cam bore.

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.

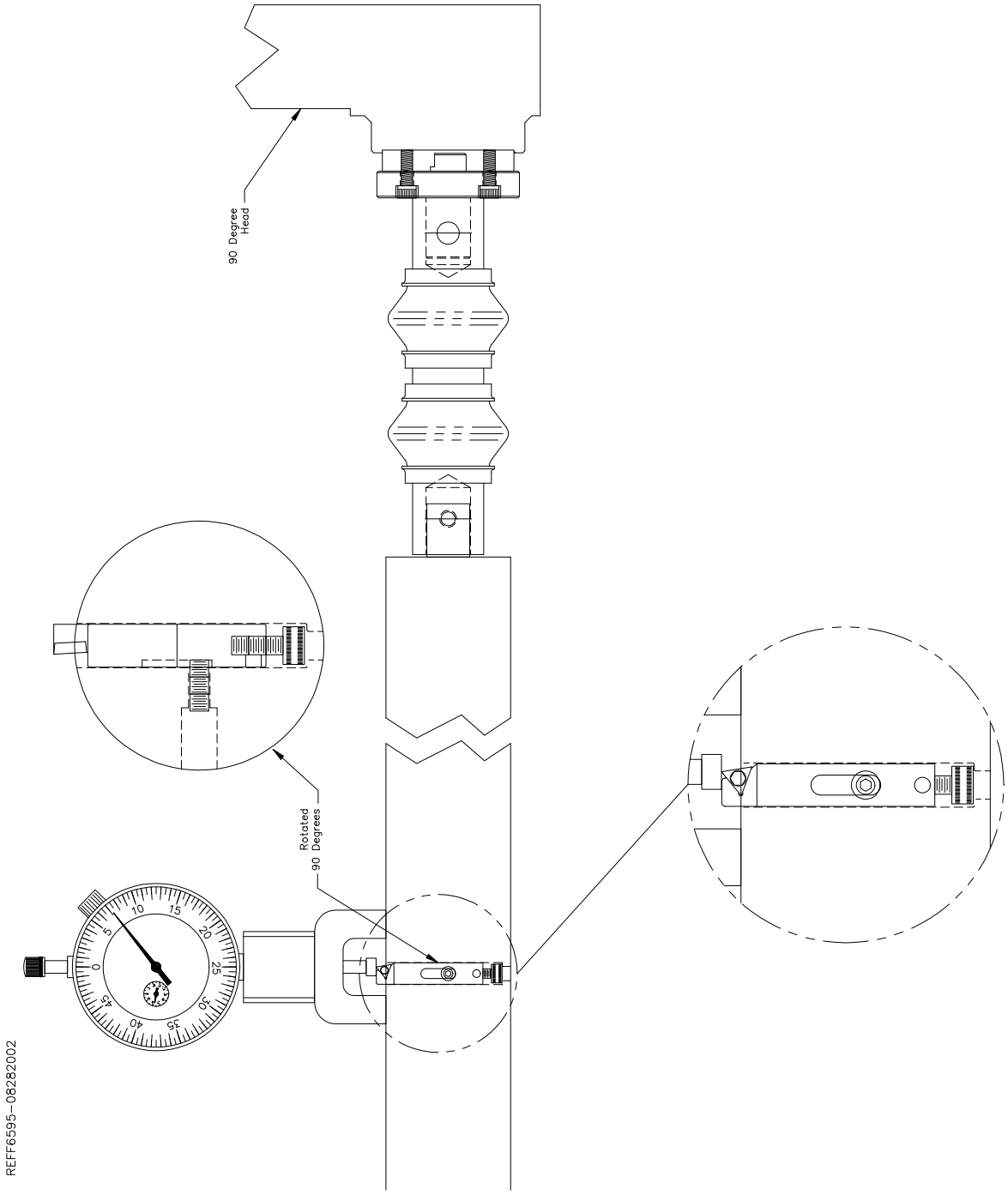
10) Remove the block from the fixture, select a Cam bushing that will fit the bore that was made on the distributor end of the block.
11) Rotate the block so that the distributor end is now facing down. Tighten the block into the fixture. The Cam spacer will put the end bores in line.
12) Press the move to zeros button.
13) Bore this end off the block.
14) Remove the block and the fixturing from the machine.

Refer to Cam Tunnel Boring in this chapter to bore the center tunnel of the Cam.

Cam Tunnel Boring:

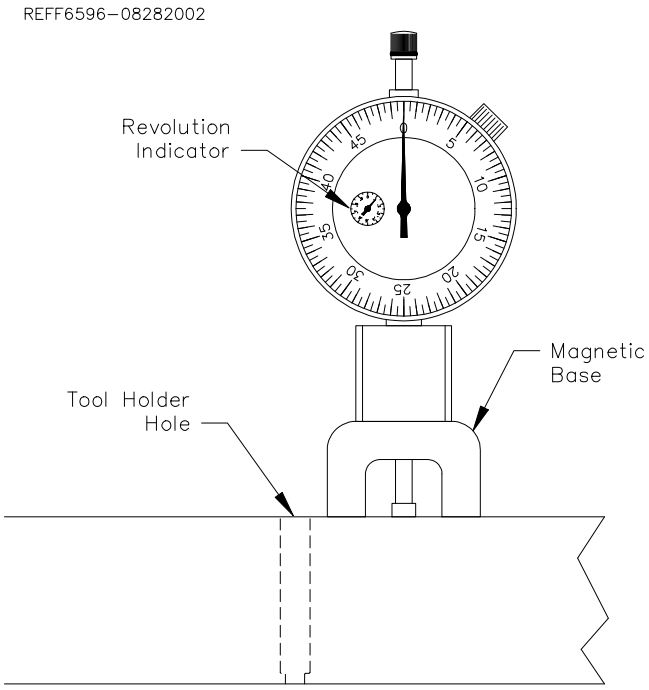
To bore the center of the Cam tunnel refer to Cam Tunnel Boring in the Block Mounting section of this chapter. Mount the block as shown.

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



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

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

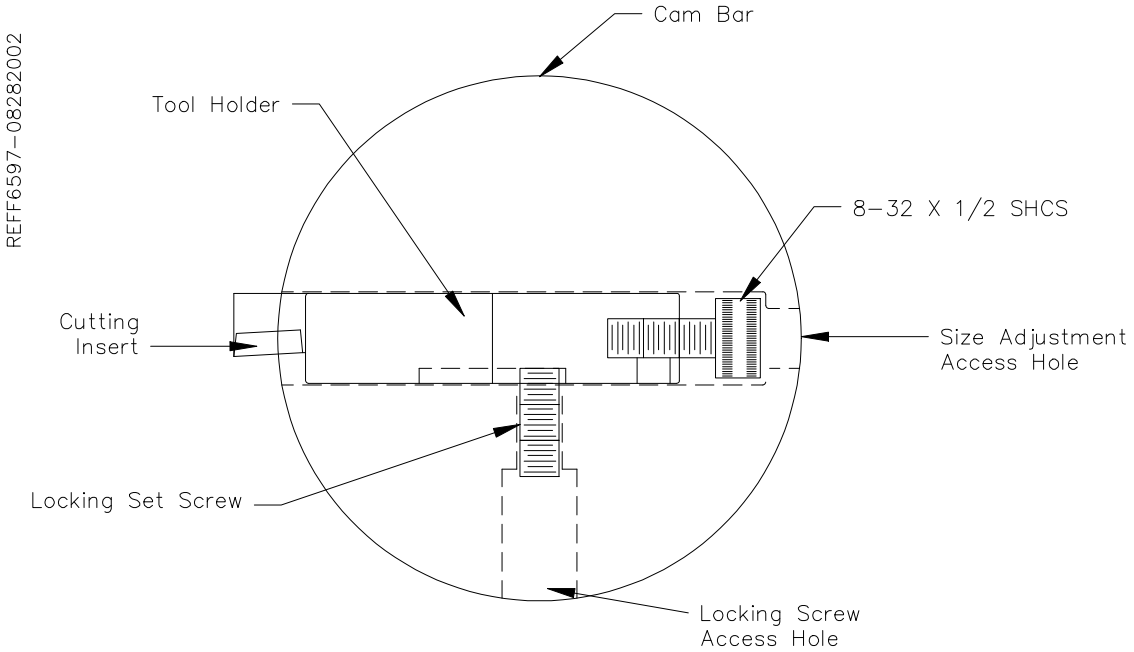


Setting Cutting Size:
The diameter of the Cam Bar 650-2-32D is 1.7500". The 8-32 X ½" socket head cap screw on the back of tool holder is used to adjust size. When the tool holder is inserted into the Cam Bar the cap screw goes against a ledge inside the Cam Bar. When the cap screw is turned in the size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

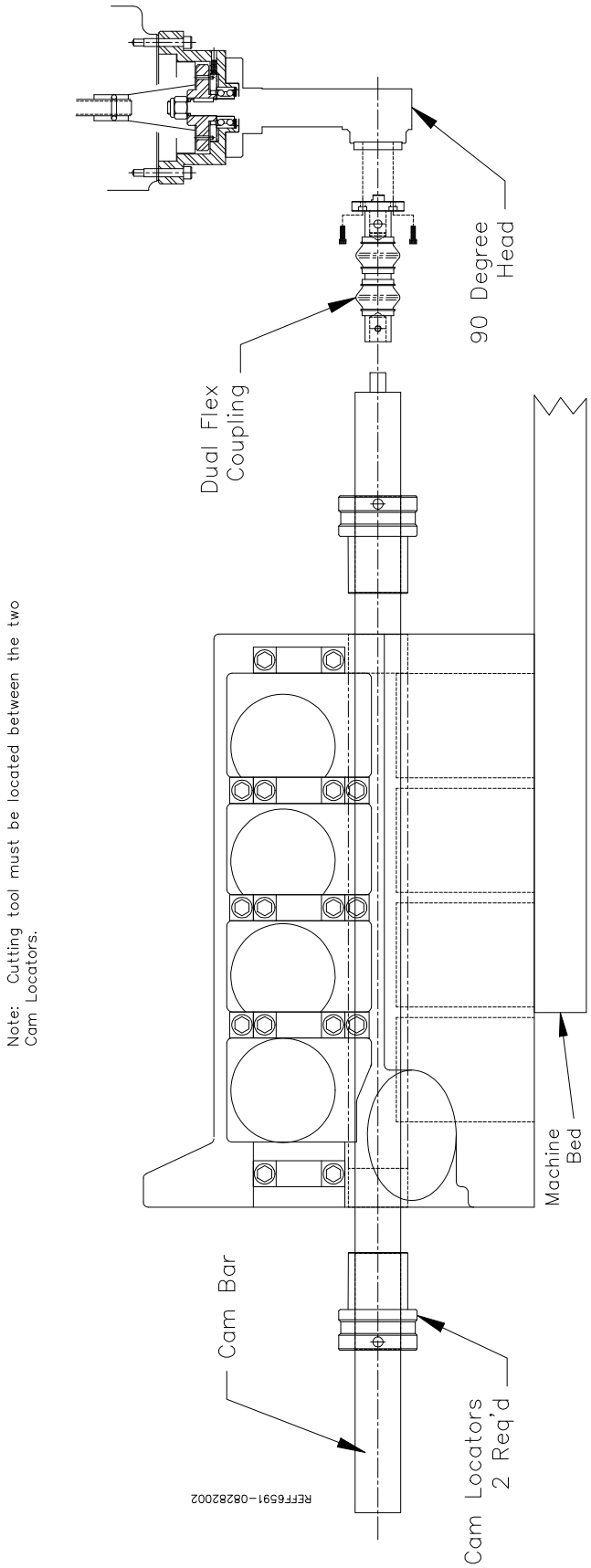
CAUTION: *When adjusting the size on the tool holder, you must remember that the amount that will be taken off of the diameter will be twice the reading on the dial indicator.*

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.



1) Refer to the Line boring section of this chapter for mounting and alignment of the 90 degree head.
2) Select Line Bore Mode of operation.
3) Mount the dual flex coupling to the 90 degree head with the two (2) supplied socket head cap screws.
4) Install one Cam Bearing Locator into the left side of the block.
5) 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.
6) 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.
7) 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.
8) Press the Vertical, Horizontal and In/Out zero buttons.
9) Final set up should look line the drawing on the following page. The mounting components are not shown on this drawing. Refer to the block mounting section of this chapter.



Note: Cutting tool must be located between the two Cam Locators.

Setting Vertical Stops:
Make sure the machine is at the zero positions as described previously.

When using the Line Bore Mode to do the Cam Tunnel boring the vertical stops described here will never change. They must be used to run an a 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.

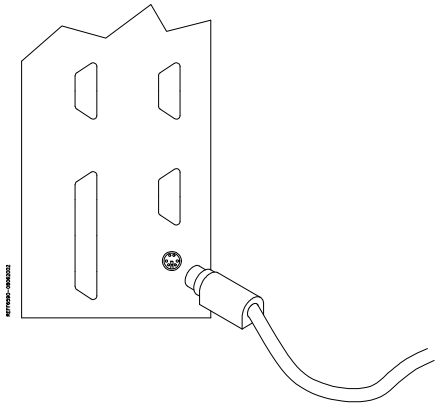
Size is not critical on the first two passes, these tools can be set and not adjusted for each use. The third tool should be checked with the dial indicator for final size each time you use it.

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.*

FlexCAM:

Keyboard Installation:
When working in and with the FlexCAM program it is a good idea to have the keyboard plugged into the computer. The F65 comes with an adapter from PS2 to AT or XT keyboards. If you are using a keyboard other than the one supplied, this may be needed. Use the following illustration to connect the keyboard to the computer in the rear enclosure. There is a keyboard extension cable run from the computer in the rear enclosure up to the pendant box. Remove the back of the pendant box and string the cable through the hole in the bottom of the pendant box.



Running a G-Code Program:
Running a G-Code program is a relatively easy thing to do, understanding what the G-Codes are doing on the other hand, takes schooling and experience. The following example will show how to run a existing G-Code program, not how to write or edit these programs

G-Codes and their operations will not be discussed in this manual. If there are questions on specific G-Code uses, a CNC programmer or the FlexCAM Help section should be utilized.

Rottler Manufacturing has written several G-Code programs to be used on the F65. These programs will be discussed in some detail on how to use and edit them. There are some basic rules that must be followed when working in G-Code files in FlexCAM

1) All numeric positions must have four characters after the decimal point. Such as 5.0000.
2) Spindle RPM is expressed as its straight value. Such as 500.
3) Inches Per Minute is expressed with an implied decimal point before the last digit.
   Example 5 inches per minute is expressed as 50

File Type and Location:
The type of files that FlexCAM run are ACT files. They will have an act extension on them after the file name. Example: F65groove.Act

All the ACT files are stored in the following location. C:/Flexcam/Act/

Downloading a File:
To run a program you must download the file from the computer to the controller. Use the following procedure to do this.

1) Bring up FexCam.
2) Press the “File” button.
3) Press “Download File” button. A pop-up screen will open showing the ACT directory. Select the file you wish to download. Then press the “Open” button. The FlexPAD screen will come back. The Status Box will display that it is downloading. When the download is complete the Status Box will say “Download Finished”. You can press the RESET button to clear this message.

Assigning a Program Number to a G-Code File:
The program number for a G-Code file is kept inside the file. If you do not know the program number of a file, you can open the file. The first line of the program should contain the % sign and then the program number. The first line of a program should look like this: %25

Selecting a Program to Run:
Press the PRG # on the FlexPAD. This will bring up a numeric keypad, type in the number of the program you are going to use. The number of the program in the Information Block will change.

General Information:
The program is now in the controller and ready to run. You will need to move the machine to the starting position and zero all axis. The Feed Rate and Spindle RPM are set in the program itself.

Safety Checks:

Zeros:
As with all CNC machines the zero positions are not saved with each program. If you leave the FlexCAM program and come back to it, you will need to reset your zeros. Always verify your zero position before starting the program.

Program Number:
The machine is under CNC control even when you are using the Rottler screens. If the machine is homes or performs some other automatic operation the program number will change. Always verify the program number in the Information Block before starting the program.

Rottler CNC Programs:

Cam Bore Oil Groove:
Install a block on the machine using the Block End Truing system described earlier in this chapter.

1) Using the electronic probe or indicator, center the spindle on the cam bore. Zero the X and Y axis.
2) Install the 650-2-3F Stub Bar into the spindle.
3) Set the 650-2-32K tool bit for a diameter smaller that the diameter of the Cam Bore. Record this diameter for use in the program. Install the tool bit into the cutterhead.
4) Bring the tool down until you can just touch it off of the top of the Cam Bore. Set the Z axis zero.
5) Download the Oil Groove.act file.
6) Select File and then Edit File on the FlexPAD.
7) Select the Oil Groove program and then press the Open button.
8) The Oil groove file will open on the left hand side of screen. The following is a list and description of the values you need to set to run this program.

```
N8010 #80=2.3825       ( GROOVE DIA. )
N8015 #81=2.2750       ( CUTTER DIA. )
N8020 #82=0.7500       ( DEPTH OF CUT )
N8025 #85=400       ( SPINDLE SPEED )
N8030 #86=10       ( FEED )
```

N8010 #80=2.3825 (GROOVE DIA.)
This is the outside diameter of the oil groove you want to cut into the Cam Bore. The description of the line is in the parenthesis.

N8015 #81=2.2750 (CUTTER DIA.)
This is the diameter of the tool bit you just set.

N8020 #82=0.7500 (DEPTH OF CUT)
This is the distance down from the Vertical zero you want the oil groove located.

N8025 #85=400 (SPINDLE SPEED)
This is the Spindle RPM.

N8030 #86=10 (FEED)
This is the Feed Rate expressed in inches per minute the oil groove will be cut at.

Do not change any other numbers in this program or it will not operate properly.

9) Change the program number to 88.

Program Description:
Move machine to zero locations. Press the START button on the FlexPAD. The spindle will start as the rapids vertically down to the DEPTH OF CUT location. The machine then starts a circular interpolation using the GROOVE DIA and CUTTER DIA information and cuts the oil groove. When finished the machine returns to the X and Y zero and retract the Z to a –0.5000. The program is finished and FlexCAM is idle.

Connecting Rod Clearance:
Install a block on the machine using the Lower End Machining package described earlier in this chapter.

This program is designed to run with the Bell Housing end of the block up against the performance fixture.

1) Using the electronic probe or indictor center the X and Y over the dowel pin hole in the right rear corner of the block. Zero the X and Y axis.
2) Install the End Mill you will be using into the spindle.
3) Touch the End Mill off of the pan rail and zero the Z axis.
4) Download the Rod Clearance program.
5) Select File and then Edit File on the FlexPAD.
6) Select the Rod Clearance program and then press the Open button.
7) The Rod Clearance file will open on the left hand side of screen. The following is a list and description of the values you need to set to run this program.

#70=6.5000 (FIRST X LOCATION)
#71=11.0000 (SECOND X LOCATION)
#72=15.5000 (THIRD X LOCATION)
#73=15.5000 (FORTH X LOCATION)
#74=4.6000 (Y C/L LOCATION)
#75=1.5000 (WIDTH)
#76=7.4000 (DIA. OF THE CLEARANCE)
#77=1.0000 (DIA. OF CUTTER)
#79=5.0 (FEED)

#70=6.5000 (FIRST X LOCATION)
This is the Horizontal location of the first clearance cut. It is the distance from the Horizontal zero location.

#71=11.0000 (SECOND X LOCATION)
This is the Horizontal location of the second clearance cut. It is the distance from the Horizontal zero location.

#72=15.5000 (THIRD X LOCATION)
This is the Horizontal location of the third clearance cut. It is the distance from the Horizontal zero location.

#73=15.5000 (FORTH X LOCATION)
This is the Horizontal location of the fourth clearance cut. It is the distance from the Horizontal zero location.

#74=4.6000 (Y C/L LOCATION)
This is the distance from the In/Out zero position to the center line of the main.

#75=1.5000 (WIDTH)
This is how wide the clearance cut is going to be.

#76=7.4000 (DIA. OF THE CLEARANCE)
This is the diameter of the Arc that the End Mill is going to cut. The center of this diameter is going to be the Vertical zero position.

#77=1.0000 (DIA. OF CUTTER)
This is the diameter of the end Mill you are using.

#78=500 (SPEED)
Spindle RPM the cut will be made at.

#79=5.0 (FEED)
Feed Rate (in inches per minute) the cut will be made at.

Do not change any other numbers in this program or it will not operate properly.

8) Change the program number to 77.

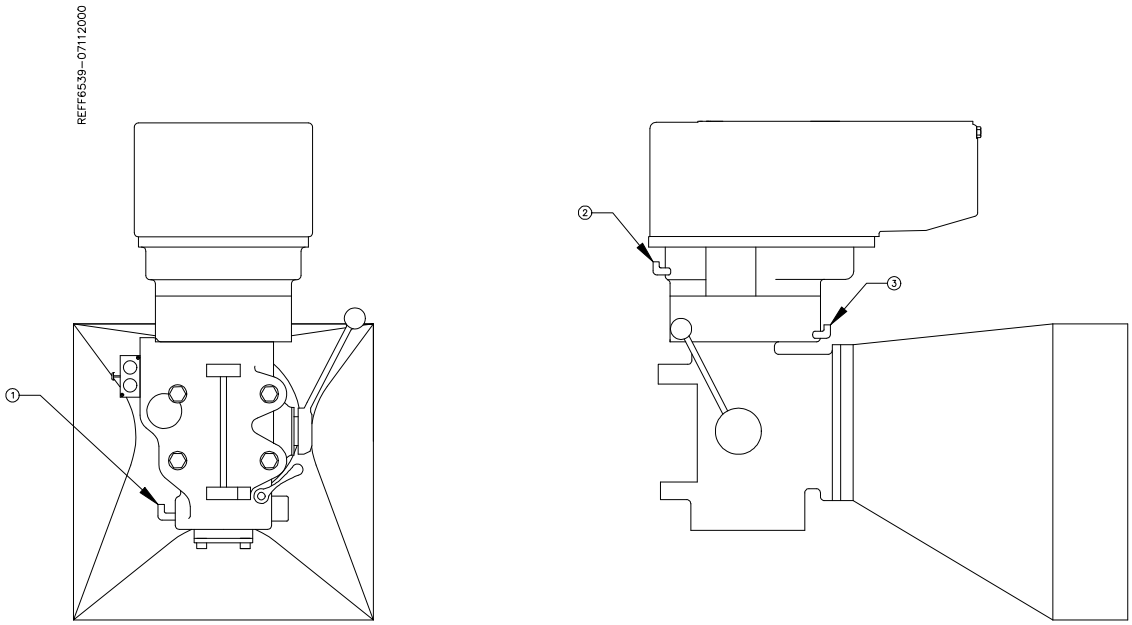
Program Description:
Move machine to zero locations. Press the START button on the FlexPAD. The Spindle will retract Vertically –2.000 Inches. The spindle will start at the programmed speed. The X axis will move to the FIRST X LOCATION while the Y will move to the outside edge of the arc that it will be cutting. The spindle will then start feeding in that Arc. When the Arc is completed the X will rapid over the specified WIDTH distance and repeat the Arc in the opposite direction. This action will be repeated until all X LOCATIONS have been machined.

Chapter 4 Maintenance:

Lubrication

Manual Lubrication

Lubricate, in the places indicated, weekly with 5-6 drops of ***Union 76 Way Oil HD-68*** or equivalent lubricant.

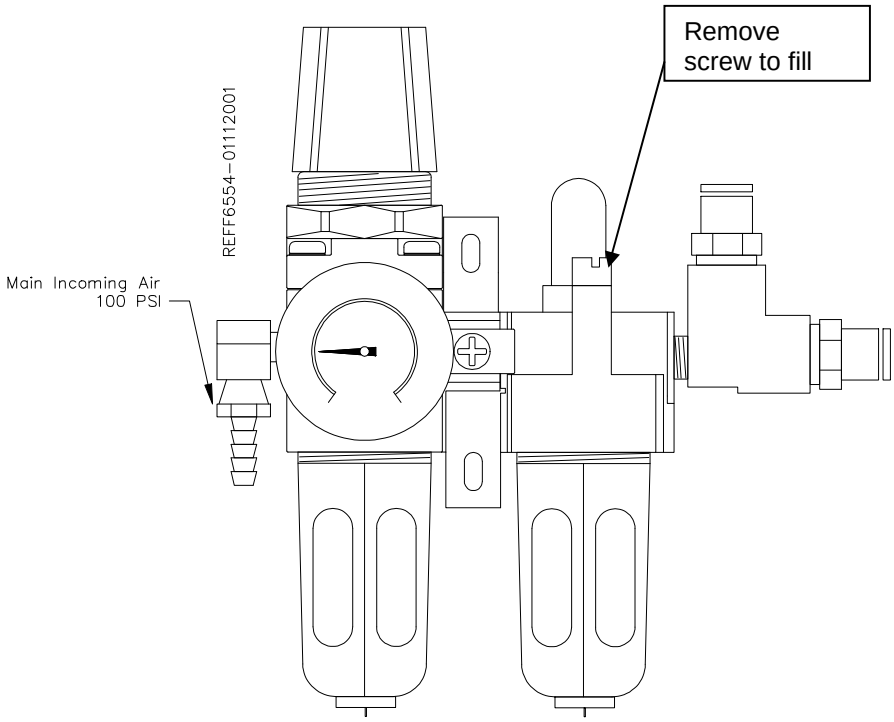


Automatic Lubrication System

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.



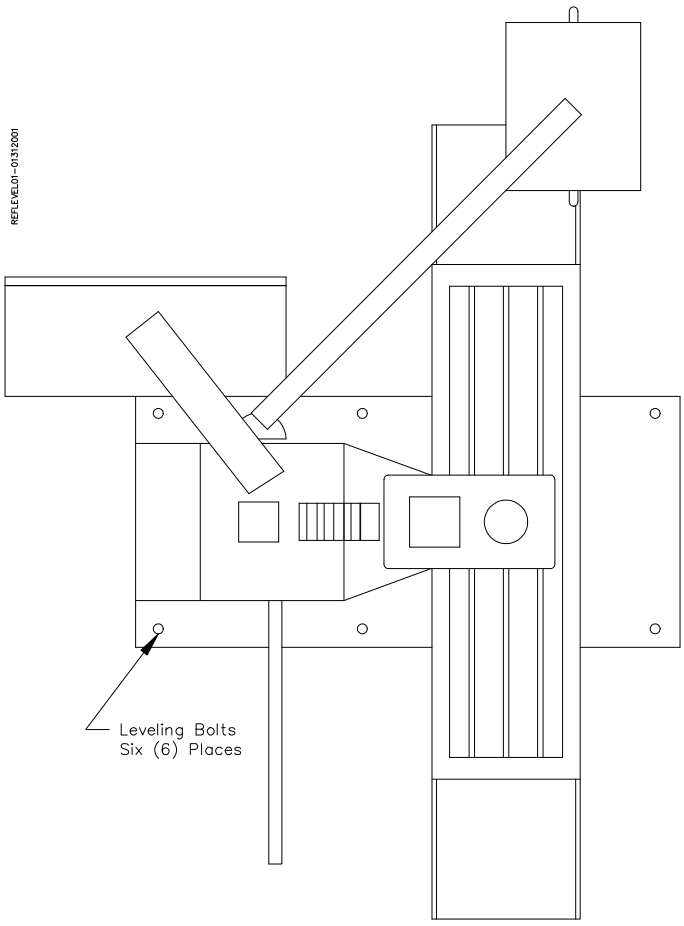
Leveling and Alignment:

The following is a description of how to properly level and align the F65 machine. These procedures should be followed in the order they written to obtain correct machine level and alignment.

Leveling the Machine:

After uncrating the F65 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.



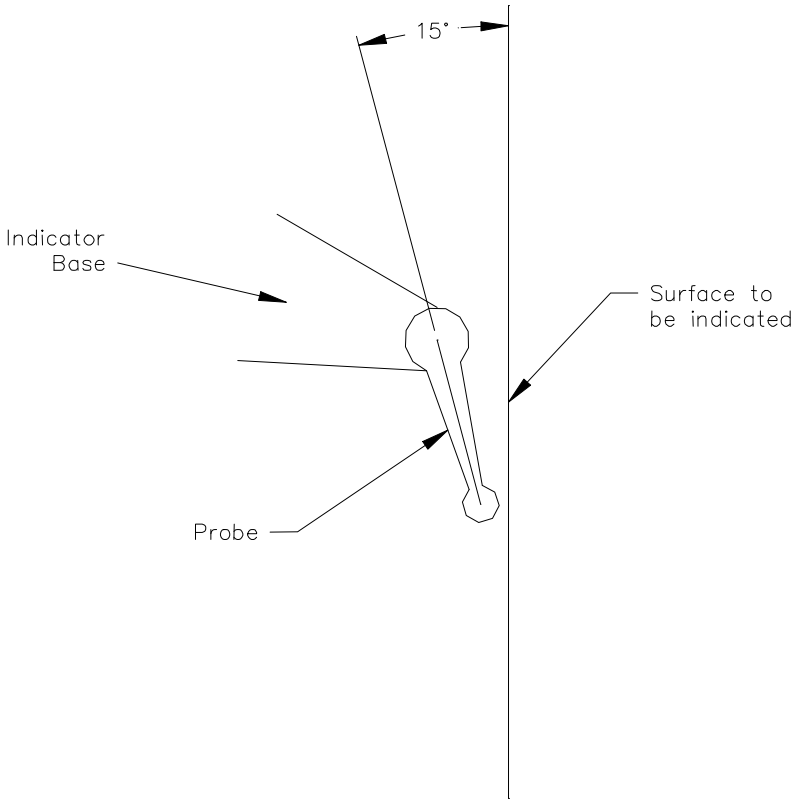
Using the four (4) corner leveling bolt to start with, bring the machine up to level in both directions (front to back and left to right) within .0005" per foot.

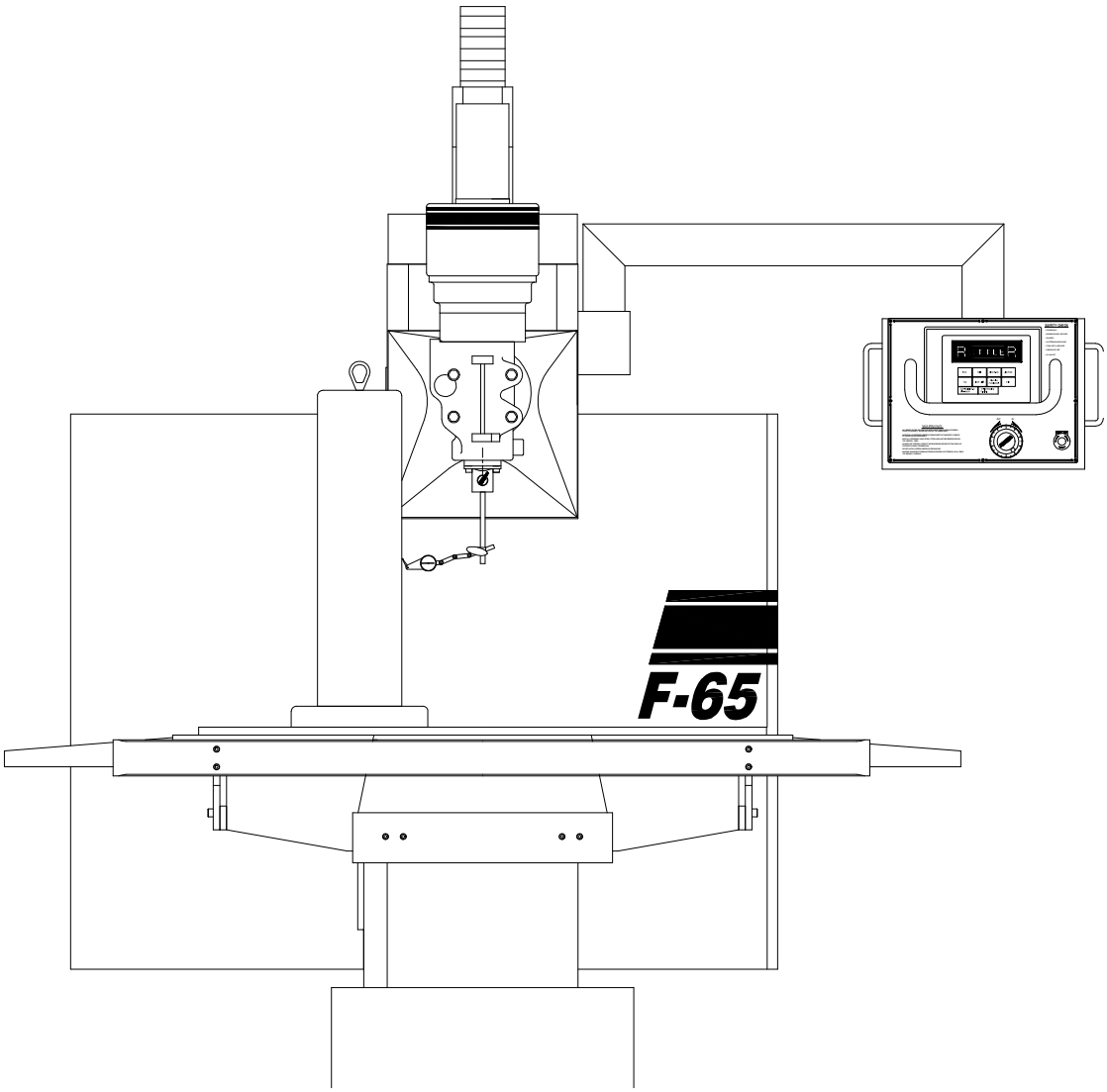
After you have leveled the bed using the four corner bolts, move to the middle leveling bolts. Bring these bolts down until they have approximately the same amount of pressure on them as them as the four corner bolts. Be careful not to throw the level of the machine off while doing this.

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.

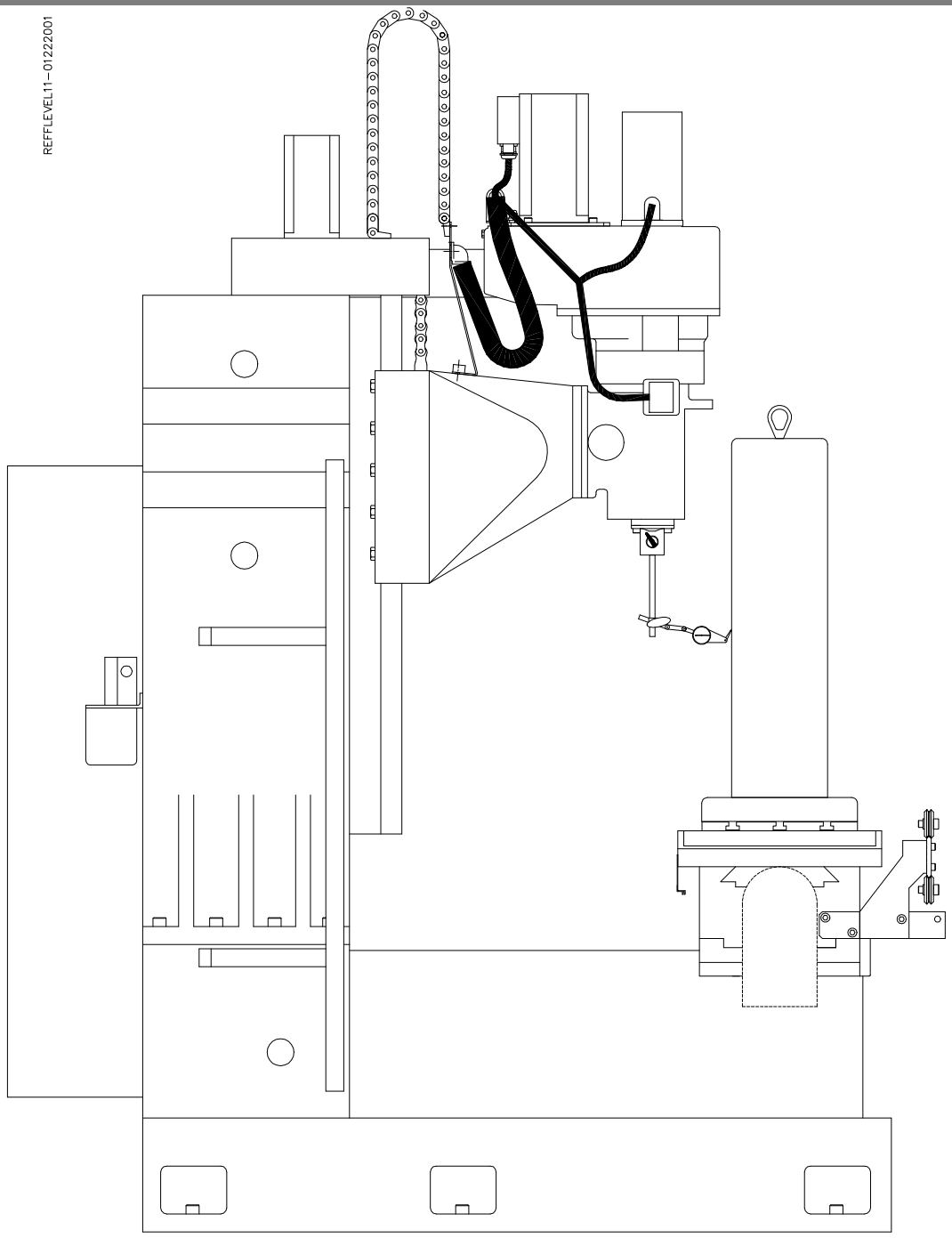
Note: The position (angle) of the probe to the surface you are indicating is critical. Using an incorrect angle on the probe will result in inaccurate readings from the surface being indicated. The angle of the probe should be at about 15 degrees from the surface being indicated (see illustration 2).





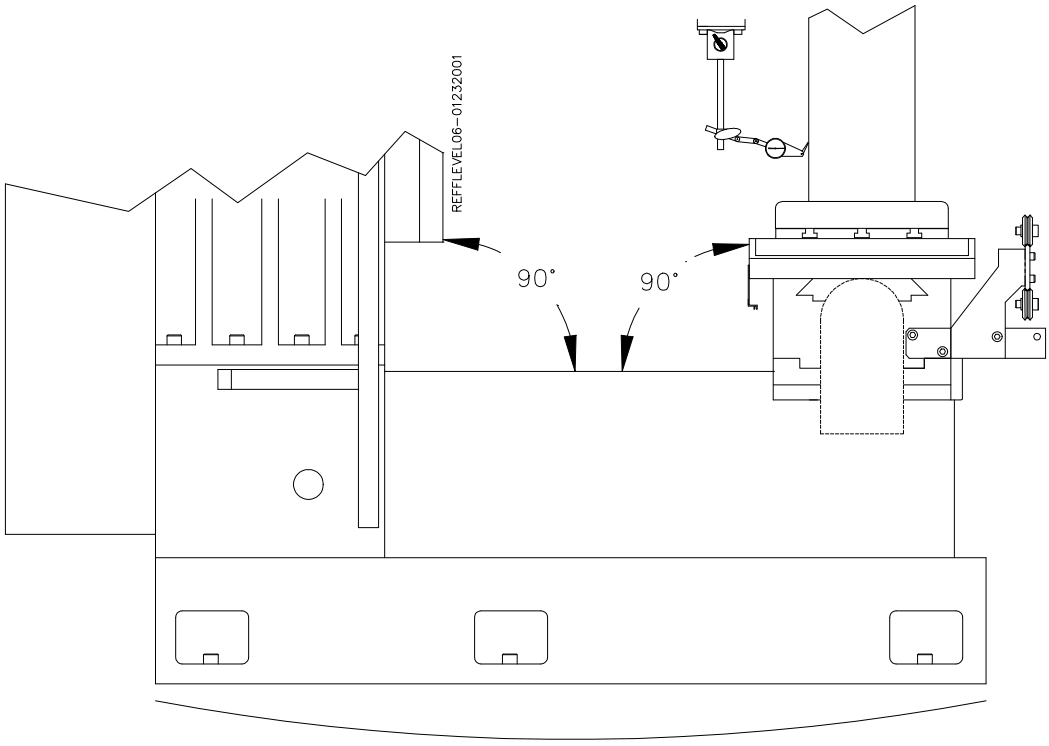
Put about .010” pressure on the indicator. Run the vertical throughout its full travel. The runout should not be more than .0005. If the runout is more than this, check the table top as well as the bottom of the alignment cylinder for burrs or debris.

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



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

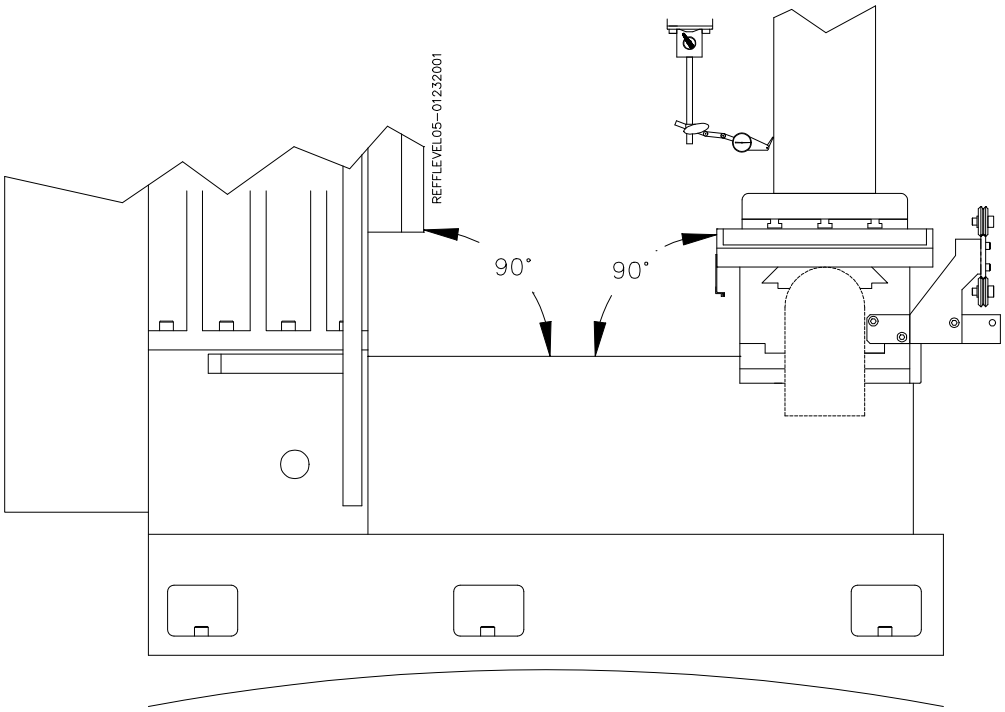
Middle Leveling Bolts:
If the procedures for the Leveling was followed correctly, it is unlikely that the deviance from Front to Back is being caused by the Middle Leveling Bolts. The following are examples of what could be caused by incorrect pressure on the middle leveling bolts.
Example 1: Zero the 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.

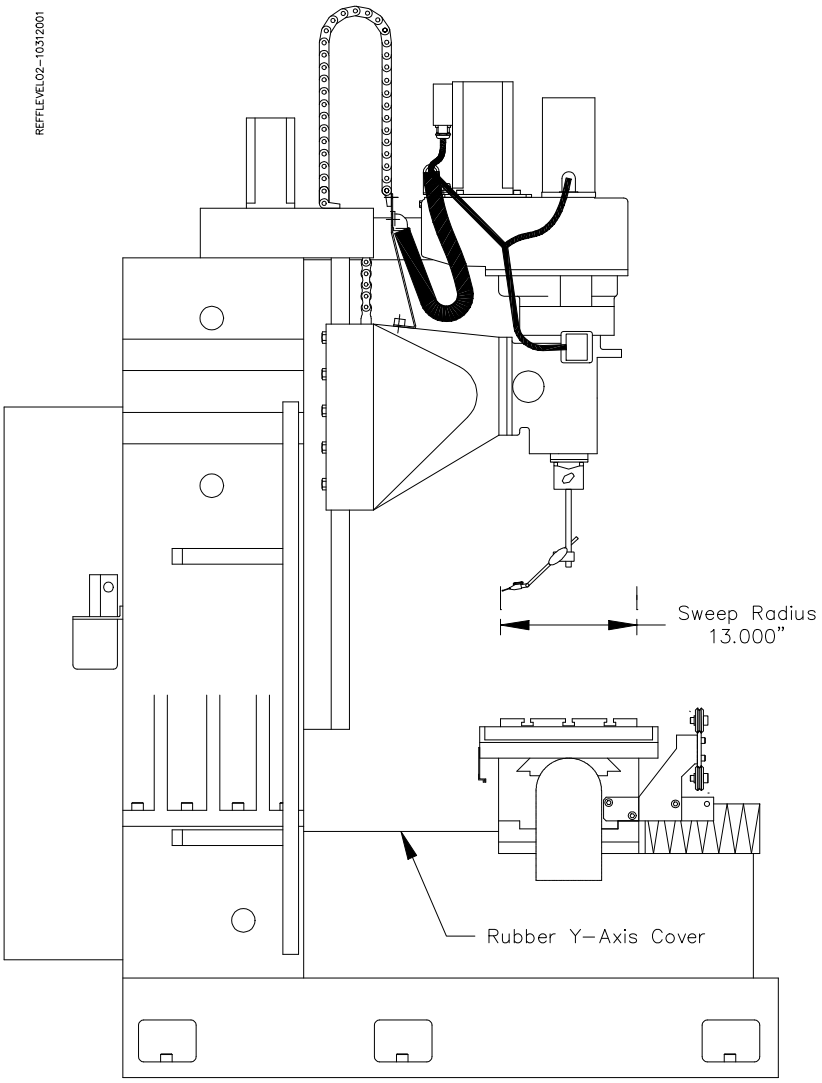
To correct the deviance slowly remove pressure from the middle bolts equally. Be sure to watch the level of the machine to be sure not to throw it off. After relieving pressure from the middle bolts you can apply slightly more pressure to the front corner bolts to bring the deviance within .001".

Sweeping the Spindle:
Remove any fixturing or tooling from the machine table and clean thoroughly.

Attach a mag base indicator to the bottom of the spindle. Make sure that the mag base is attached in such a way that the spindle is able to be rotated 360 degrees without interference.

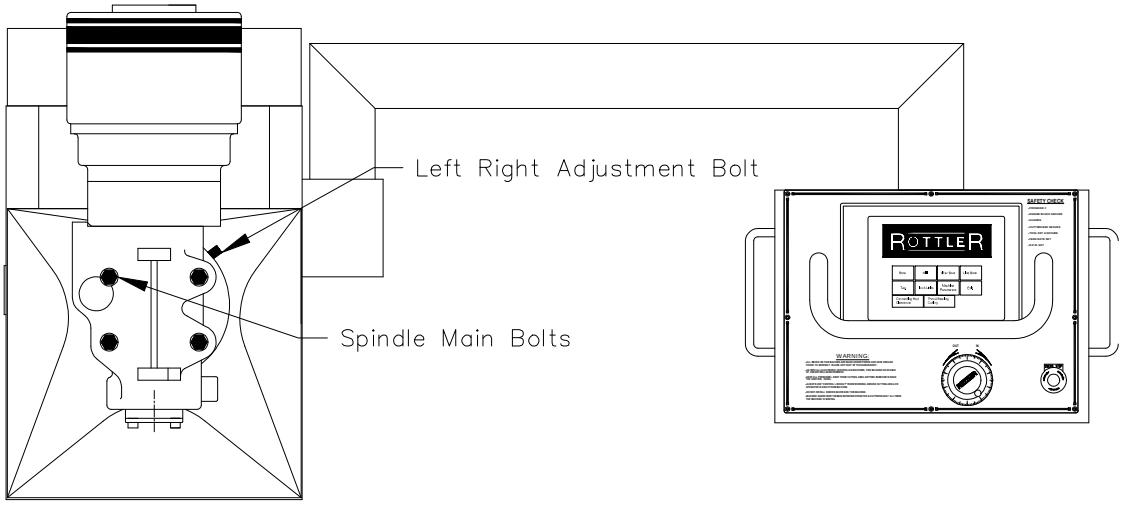
Use the following illustration for a visual reference on installing and using the Mag base indicator correctly.

Left Side



Loosen the four Spindle Main Bolts slightly. Using the Adjustment bolt on the right hand side of the spindle head, sweep the spindle to within +/- .0002 Left to Right. Do not worry about the Front to Back reading at this time as the Spindle Main bolts are not tight

Once the Left to Right has been aligned, tighten the Spindle Main Bolts to 80-ft. lbs. Verify the Left to Right sweep again to make sure it did not change while tightening the Spindle Main bolts.



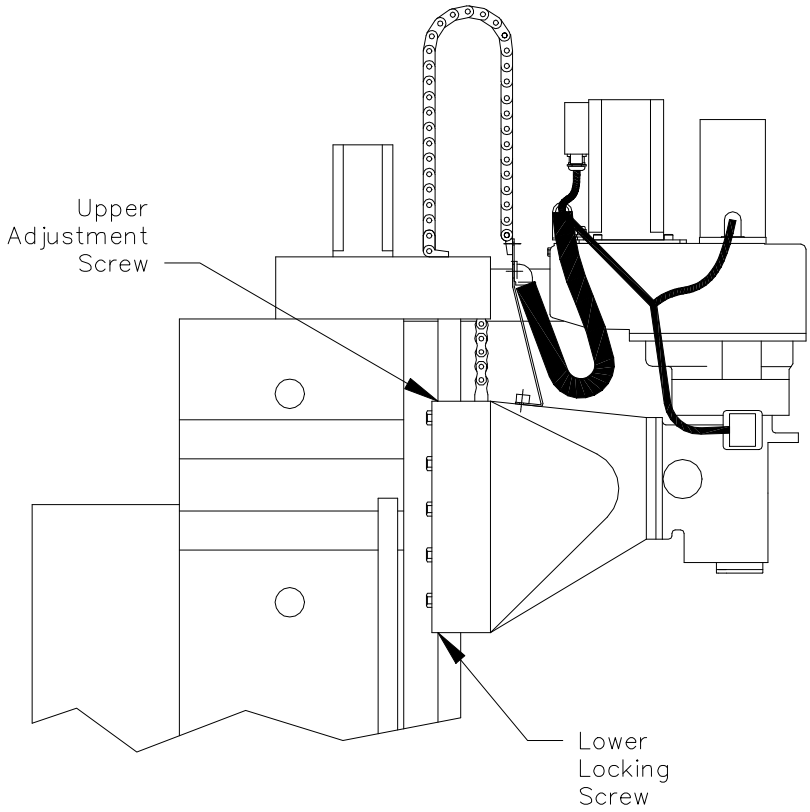
Check the Front to Back sweep it should be within .0005. If it is not, the Vertical gibs may need adjustment.

Vertical Gib Adjustment:

Gib adjustments can affect the sweep of the spindle front to back. With the indicator in the 6 O'clock position (as you face the front of the machine) tightening the vertical gibs will lessen the pressure on the indicator probe. Loosening the gib will increase the amount of pressure on the indicator probe.

Example: If you have a reading of 0.0 on the indicator at the 6 O'clock position and -.002" in the 12 O'clock position, tightening the gibs will bring the front of the spindle up. Adjust the gibs until you are within the factory specified .001" deviance.

To adjust the vertical gibs locate the screw at the top and bottom of the gibs.



Tightening Gibs:
To tighten the gibs, loosen the lower screw. Start tightening the top screw until the correct alignment is achieved. When the correct alignment is achieved, tighten the lower screw to lock the adjustment in place.

Note: Adjusting the gibs too tight will cause sticktion and erratic movement in the vertical travel.

Loosening Gibs:
To loosen the gibs, loosen the top screw. Start tightening the lower screw until the correct alignment is achieved. When the correct alignment is achieved, tighten the upper screw to lock adjustment in place.

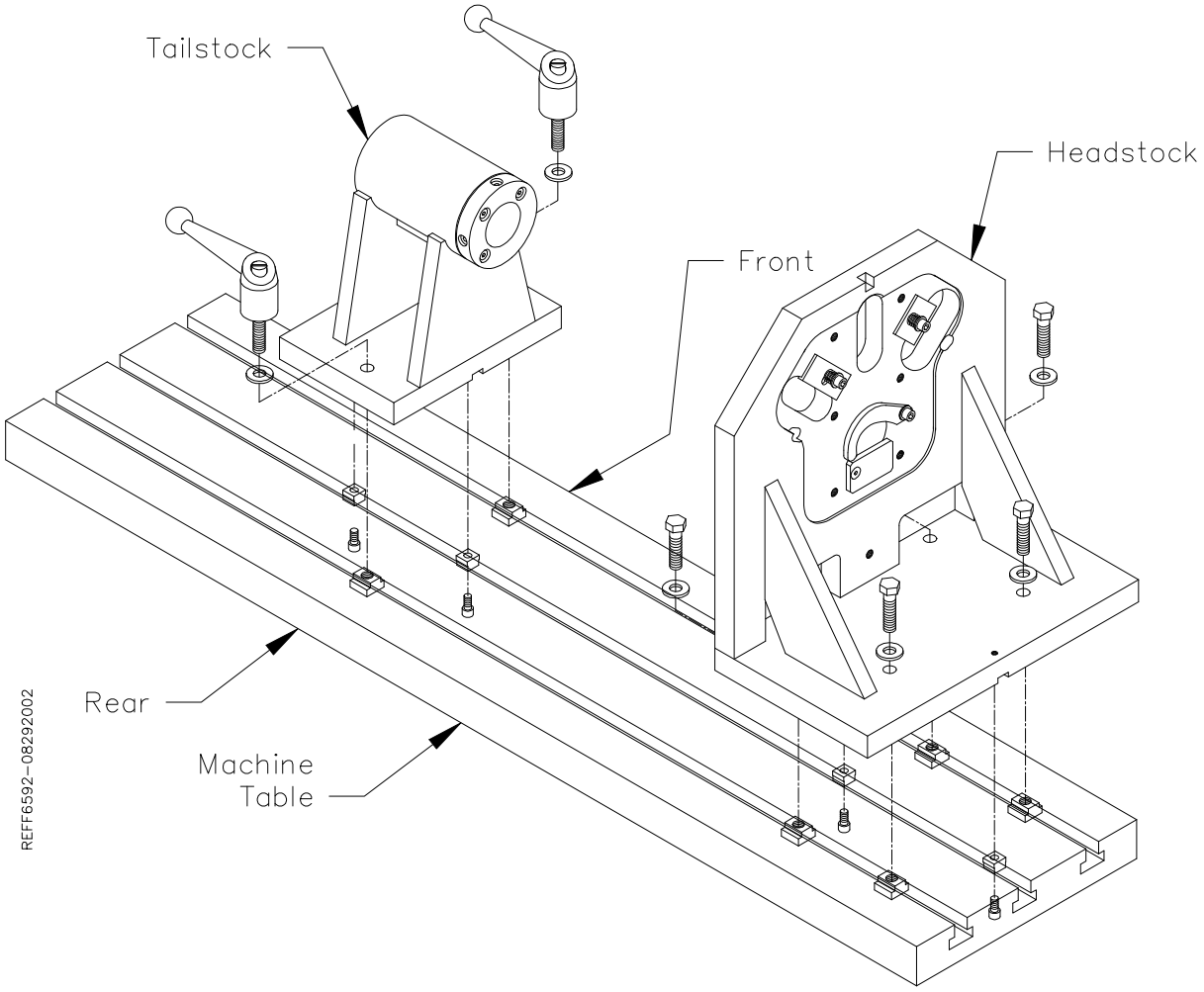
Note: Having the gibs too loose will cause erratic bore size and finish.

If you do not know how tight or loose the gibs are adjusted, you can remove the way wipers from the top of the gib. When you look in at the gib you will see a horizontal scribe line on most of the gibs. This can be aligned with the internal casting for a starting point. The gibs may need further adjustment at this point. This is only recommended as a starting point.

If there are any questions on this procedure contact Rottler Manufacturing Service Department.

Performance Fixture Line-Up:

Install the keys for the Head and Tail Stock into the machine bed as shown below. Place the Head and Tail Stock onto the machine table. Install the hold down bolts but do not tighten them down.



Push the head and tail stock toward the rear of the machine until the their keys but up against the table key ways. Snug the hold down bolts and handles. Attach a magnetic base and indicator to the spindle. Run the indicator across the face of the head stock front to back. Adjust the fixture until the indicator runs within .001". Lock the hold down bolts in place. Run the indicator from top to bottom on the head stock. It should be within .001". If it is not, pull the fixture from the table and check for burrs or dings in the head stock and table surface. Be sure there is not debris on the head stock or machine table. Re-install the head stock and follow the previous procedure. Check the face of the head stock again to be sure it did not move while tightening down the bolts.

Install the Main Bar though the tail stock and into the head stock. Run the indicator along the back side of the bar. It should be within .002" through out the travel. Adjust the tail stock in or out as needed to align the bar. Tighten down the locking handles. Run the indicator along the top of the bar. It should be within .002". If it is not, pull the fixture from the table and check for burrs or dings in the tail stock and table surface. Be sure there is not debris on the tail stock or machine table. Re-install the tail stock and follow the previous procedure. Check the bar again to be sure it did not move while tightening down the bolts.

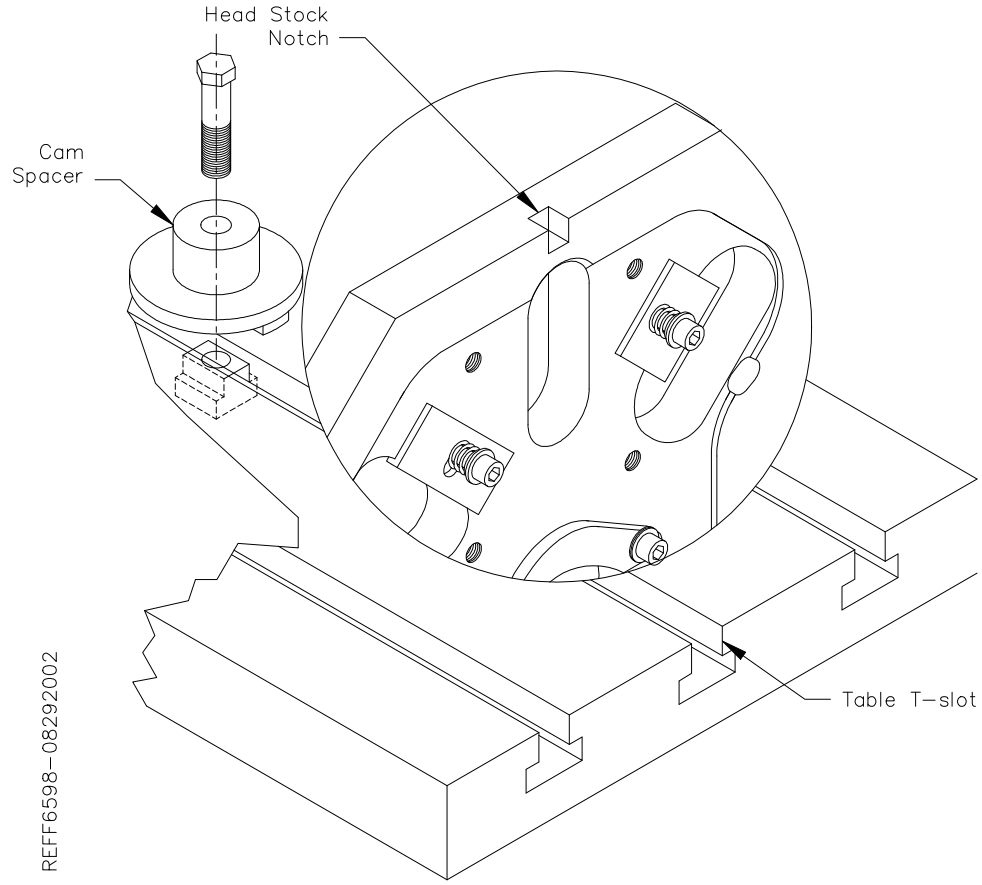
Performance Fixture Line-Up (Cam End Tunnel Boring):
Install the keys for the Head and Tail Stock into the machine bed as shown on previous page. Place the Head and Tail Stock onto the machine table. Install the hold down bolts but do not tighten them down.

The center of the middle table key way needs to be lined up with the center of the Head Stock notch. Using the electronic probe, touch the front side of the middle keyway. Zero the In/Out position. Using the handwheel, move the table out until the probe touches the back side of the key way. Record the numerical reading in the In/Out position box. Divide this number in half, handwheel the In/Out axis until the numerical reading is the same as the halved number. Zero the In/Out axis again. The spindle is now centered over the middle key way. Adjust the head stock In/Out until the center of the Head Stock notch is at the In/Out zero position.

Attach a magnetic base and indicator to the spindle. Run the indicator across the face of the head stock front to back. Adjust the fixture until the indicator runs within .001". Lock the hold down bolts in place. Run the indicator from top to bottom on the head stock. It should be within .001". If it is not, pull the fixture from the table and check for burrs or dings in the head stock and table surface. Be sure there is not debris on the head stock or machine table. Re-install the head stock and follow the previous procedure. Check the face of the head stock again to be sure it did not move while tightening down the bolts.

Mount the End Truing V-End Truing Fixture (650-3-31) to the Head stock. Mount the block to the Truing Fixture. The above procedure has aligned the fixture so the main bore in on the same center line as the middle keyway.

Install the Cam spacer into the middle keyway. Place the bottom Cam Bore on the block over the cam Spacer with the correct bushing installed. This will put the Cam Bore in line with the Main bore.



To copy block info from your machine:

On the machine that has the info to be copied from, with the Rottler program up, go to **file,** click **open,** with the new window open scroll to **local disk C:,** open **rottler,** open **backup 3 axis** (if you have an F90 or a F60 with only 3 axis software) or **backup 4 axis** (if it is newer F60 software or has 4th axis**),** open **2008** (or the latest year), open **08** (or the latest month), then pick a date in the following list that comes up (these are constantly added to, they are current dates: **2008** = year, **08** = month), copy it to thumb drive.

To install block info onto your machine:

On the machine to copy this to, with the Rottler program up, go to **file,** click **open,** when the new window opens up scroll to USB memory stick and find the copied file, and then open. You will need to select a block and mode, re-input the spindle speed, choose a different mode, so it will ask you if you want to save changes, that is the key.

Chapter 5 Troubleshooting:

No Axis Movement: All Axis

In the description below the horizontal drive is referred to but the description applies to all drives and motors on the F65.

Possible Cause:

Drive has "tripped"

- Open the rear enclosure and then re-apply power to the machine leaving the door open.

CAUTION: *The machine has power to all wires at this point.*

- The Horizontal drive is a Baldor SD26M2A05-TR brushless AC servo drive. When the drive "trips" the light at the top center of the drive will turn red. When power is cycled off and on again the drive is automatically reset. If the light on the Horizontal drive is green then operate the machine until a fault occurs again. At this point you will still have access to the rear panel without cycling power.
- Remove the keypad from the spindle drive unit and plug the black cable that came with the machine into the keypad and then into the drive. The keypad will then display the fault that caused the drive to trip. Refer to the users manual included in the machine and/or call service at Rottler Manufacturing.
- The drive can be reset from the keypad you have plugged into it.

CAUTION*: You must first use the machine control to go into the diagnostic mode and then to the error screen and disable the drive. If the drive is reset from the keypad with the enable on the machine will make an uncontrolled move that can cause injury or damage to work piece. Refer to the Diagnostic section of this manual for enabling and disabling drives.*

No power to drive:

- Emergency stop button may be in. From the bore or mill screen press the diagnostics button on the screen. Select the input tab. The e-stop listing should be blue, if it is yellow the e-stop is in or there is a loose or broken wire in the e-stop circuit. Using the supplied wiring diagram follow the connections from the pendant down to the rear enclosure. Is the e-stop opto module lit? Refer to the wiring diagram for the location of the opto module.
- Breaker has tripped. Check all breakers in be sure they are showing red. Red means that power is flowing through the breaker.
- There could be power to the drive but the light is still not coming on. There could be a loose connection at the drive. If all connections are good replace drive.
- Contacts inside the main power relays may have arched. This can cause a disruption in the flow of power to the drive. Using a AC volt meter check power in and out of the relay. Use the wiring diagram supplied with the machine to locate the correct wires. If there is power in to the relay but not out shut the power off to the machine and slide the activator switch on the drive from the 0 position to the 1 position several times. This will often clean the contacts inside the relay. If the relay still will not conduct power replace the relay.

Loose connection:

- Check all connections at drive and at computer. Sometimes during shipping the stranded cable vibrates and spreads making a bad connection. When the machine was originally installed all connection in the rear enclosure should have been checked for security. Loose connection often will not show up for a period of time.
- It is possible that the encoder or power cables to the motor have come loose. Check these connections on the motor for security.

Drive not Enabled:

- Select the diagnostic button from the screen you are using. This will pop-up a menu on the screen, select ready/enable from the tabs at the top. If the box next to the drive name is blue that means the drive is enabled and should be ready for operation. If the box is yellow then the drive has been disabled and is not ready for operation. The box next to the spindle is always yellow unless the spindle is rotating. Under normal conditions all boxes will be blue except for the spindle. If the drives are not enabled when they should be refer to the "Error Screen" operation section in this manual.

Belt or Pulley connections:

- Check the Horizontal position read out on the control unit. Is the numbers counting up or down when you press the Horizontal move buttons? If they are then the motor is moving but the ballscrew is not. This can be caused if the pulley to the ballscrew is loose or the belt has come off of the pulleys. Use the mechanical parts breakdown of this manual to determine the location of the correct motor.

Resolver Alignment:

- It is possible for the drive to loose the electronic alignment of the resolver. If this happens, the motor will draw a high amperage when moving or will not move at all. Contact the factory for assistance in the procedure.

Erratic or "Jittery" Movement: All Axis

Possible Cause:

Gib Adjustment:

- The Gibs on the machine may be too tight or not oiled. Refer to the maintenance section of this manual for the proper Gib adjustment.

Resolver Alignment:

- The resolver may be out of phase slightly. Contact the factory for help with this procedure.

DriveTuning:

- The drive may be out of tune with the motor. As drives and motor get older the inductance in each changes slightly. As the inductance changes it may be necessary to change the tuning in the drive to smooth the operation of the motor. Contact the factory for help with this procedure.

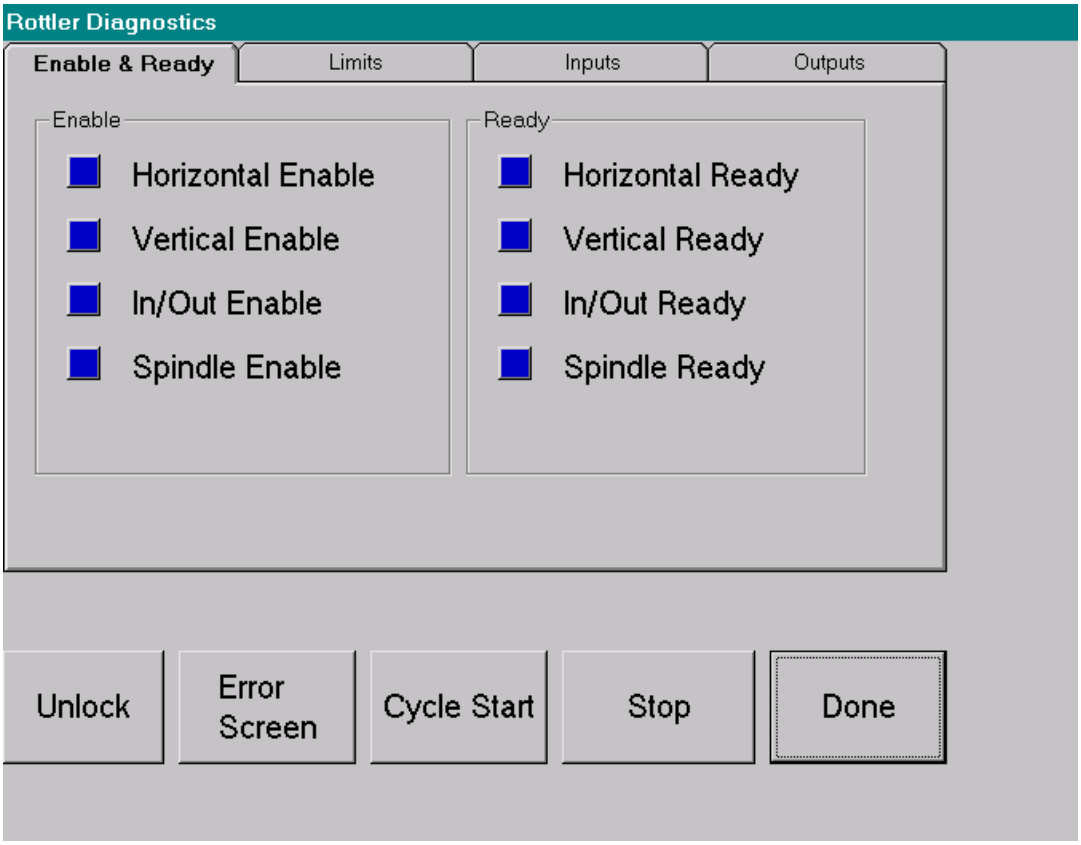
For additional troubleshooting information refer to the Diagnostic and Error Screen definition sections in this Chapter. Machine error codes and drive references are located there.

Diagnostics:

All screens on the F65 have a diagnostics button. Pressing this button will bring up a pop-up menu with several tabs on it. These tabs and the information located on them will help assist the operator in determining the trouble with the machine.

All tabs have blue and yellow indicators on them. These indicators change color as the status of different parts of the machine change.

Enable/Ready:
This tab indicates if the drives are ready to be used and if they have been enabled by the computer.

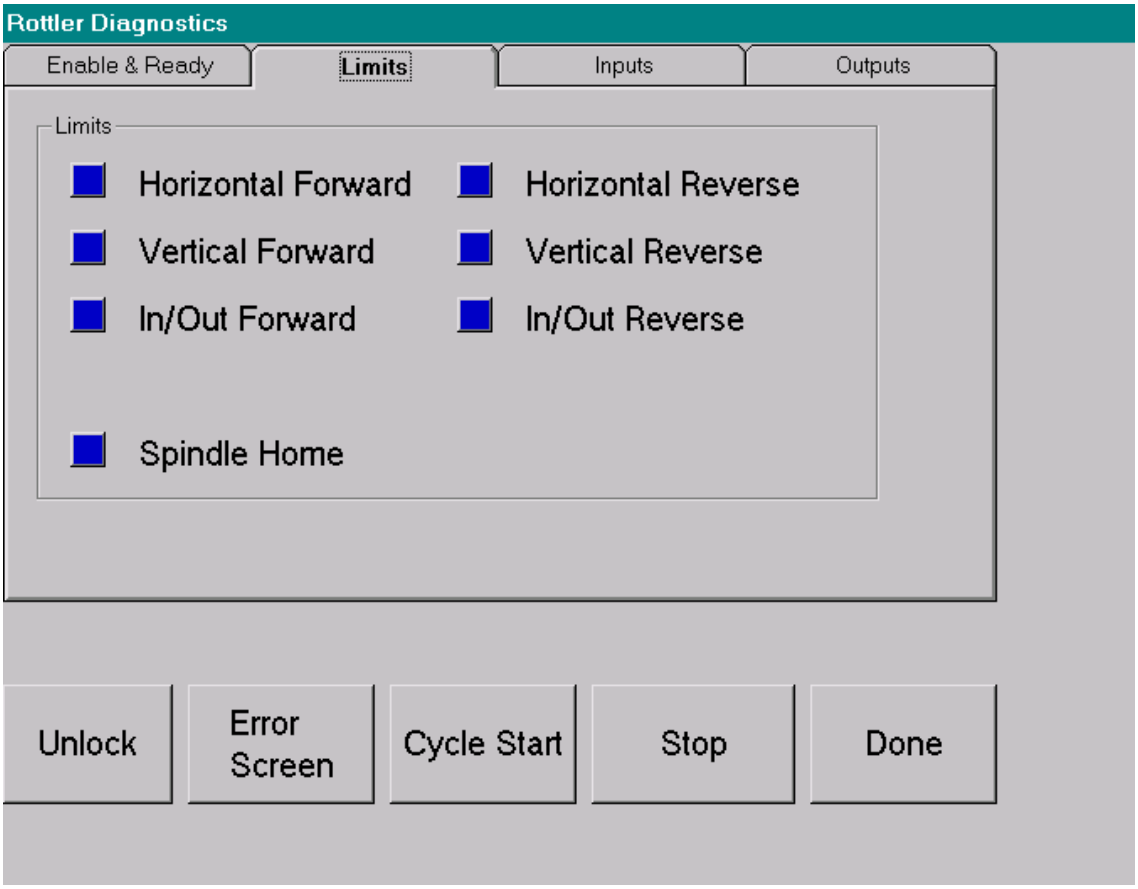


Enable and Ready

The squares next to the Drive Enables indicate the status of the drive. If the square is blue, the drive is enabled by the computer. If the square is yellow, the computer has not enabled the drive. The normal operational status is all squares blue except for the spindle. The spindle is only enabled when it is told to run. This allows you to rotate the cutterhead by hand. All other drives are enabled all the time because they hold the position they are at. The compute will disable drive if faults have occurred. Drives can be manually enabled and disabled in the Error Screen.

The squares next to the Drive Ready indicate the status of each drive. In normal operation they should all be blue meaning they are ready to operate. If they are yellow the drive has told the computer that a fault has occurred. If a fault has occurred on the drive it's indicator LED will turn from green to red. Drives must be reset by turning main power off to the machine for at least two minute.

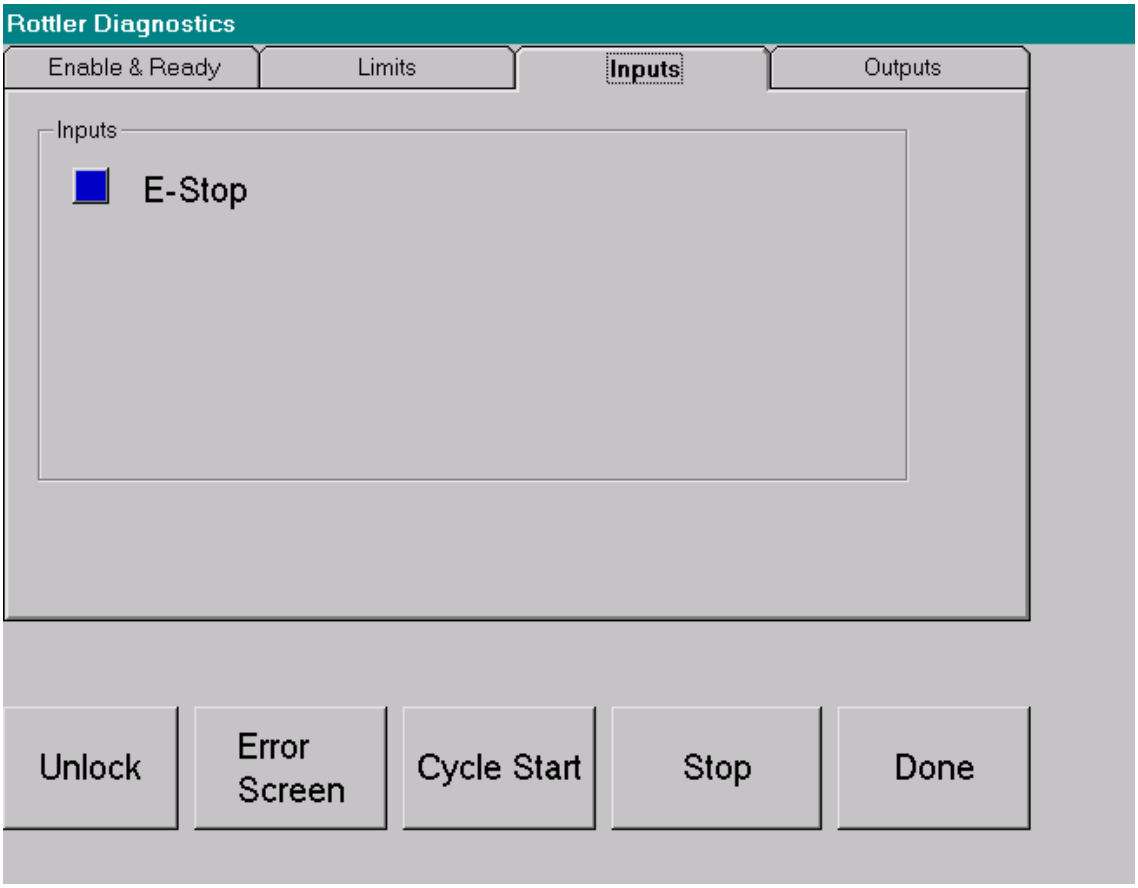
Limits:
This tab indicates the status of all travel Limit Switches.



Limits

The squares next to the switch designation show the status of the limit switches. If the squares are blue the limit switches are not activated. If they are yellow the switches are activated.

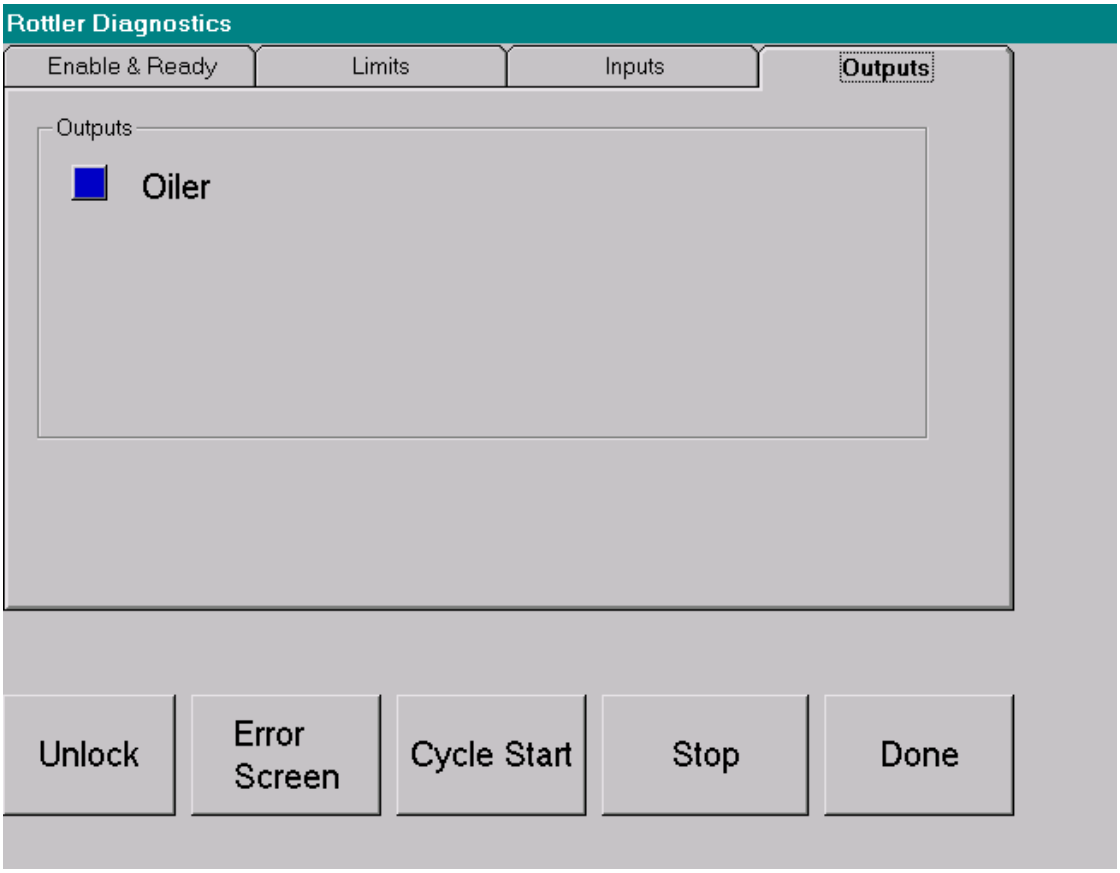
Inputs:
This tab tells the operator the status of the machine inputs.



Inputs

This screen shows the status of the e-stop switch, blue is not activated and yellow means the e-stop is not activated. This can be used when the e-stop is physically disengaged but the machine is still not operating. This shows you the status of what the computer is seeing. If the computer is seeing a e-stop activation when it should not it could mean a broken wire.

Outputs:
This tab tells the operator the status of the machine outputs.

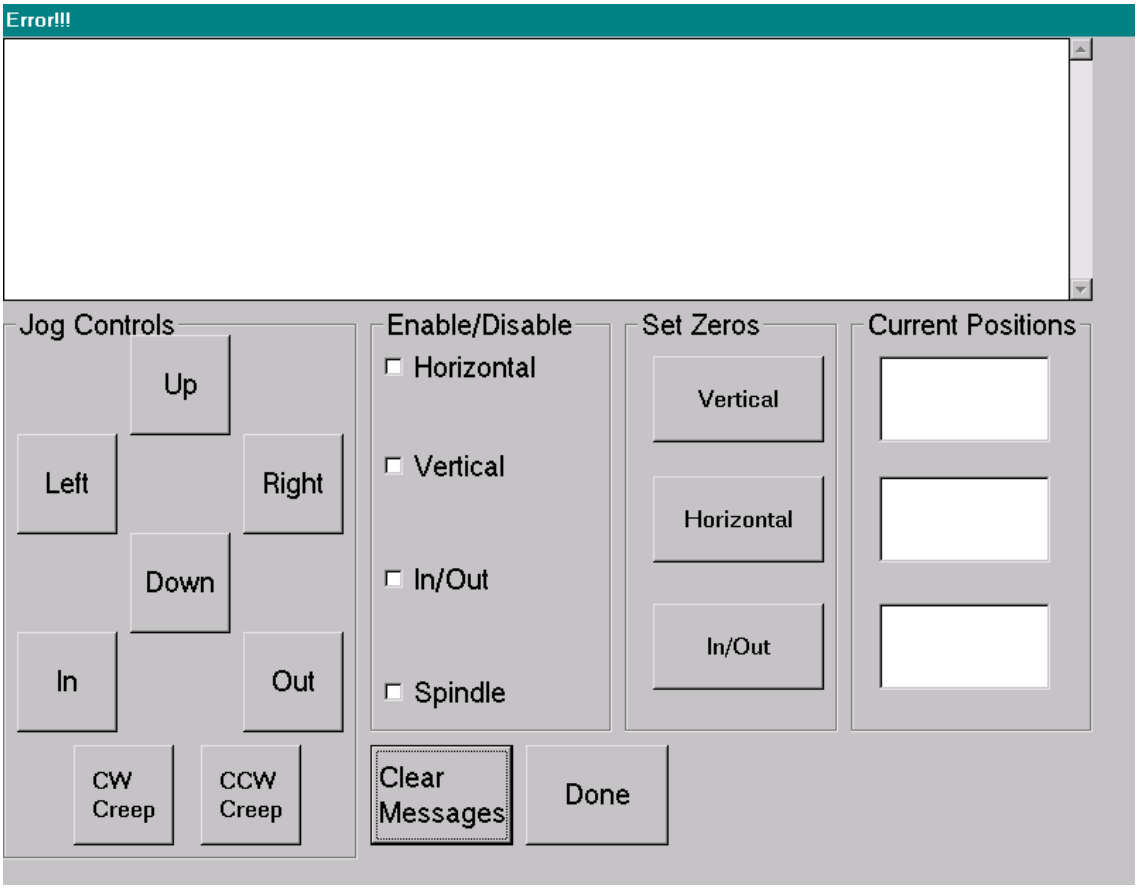


Outputs

This screen tells you when the oiler is oiling and when it is not. Blue means the oiler is not active and yellow means the oiler is active. If the oiler is physically not operating this screen will tell you if the computer is trying to activate it or not.

Error Screen:

This screen is designed to pop-up when the computer has detected an error of some kind.



Error Screen

Error Messages:
When errors occur in the machine the computer will pop-up this screen and display in the upper portion what type of error has occurred. You cannot move off of this screen until you have cleared the error condition.

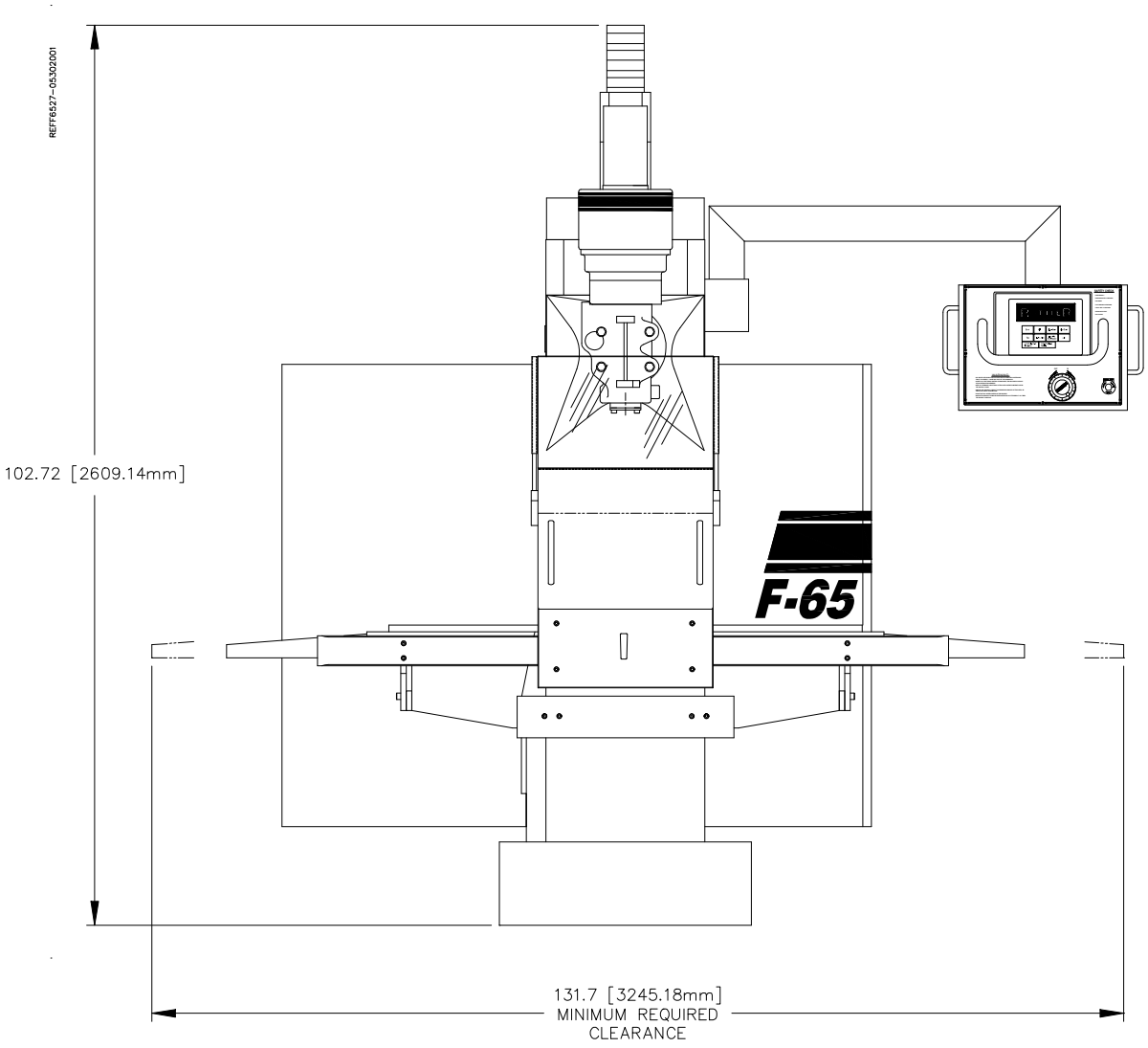
Once an error message is displayed the computer does not check the status of that error automatically. Once you think you have cleared the error you must press the Check Status button once. At that time the computer will check all error conditions and display the results. Once all of the errors have been cleared pressing the Done button will clear the error screen from view.

You can manually enable and disable drives from this screen. Next to the drive designation there are small boxes. If the drives are enabled a check will appear in these boxes. To manually enable or disable, touch the screen above the box for the associated drive.

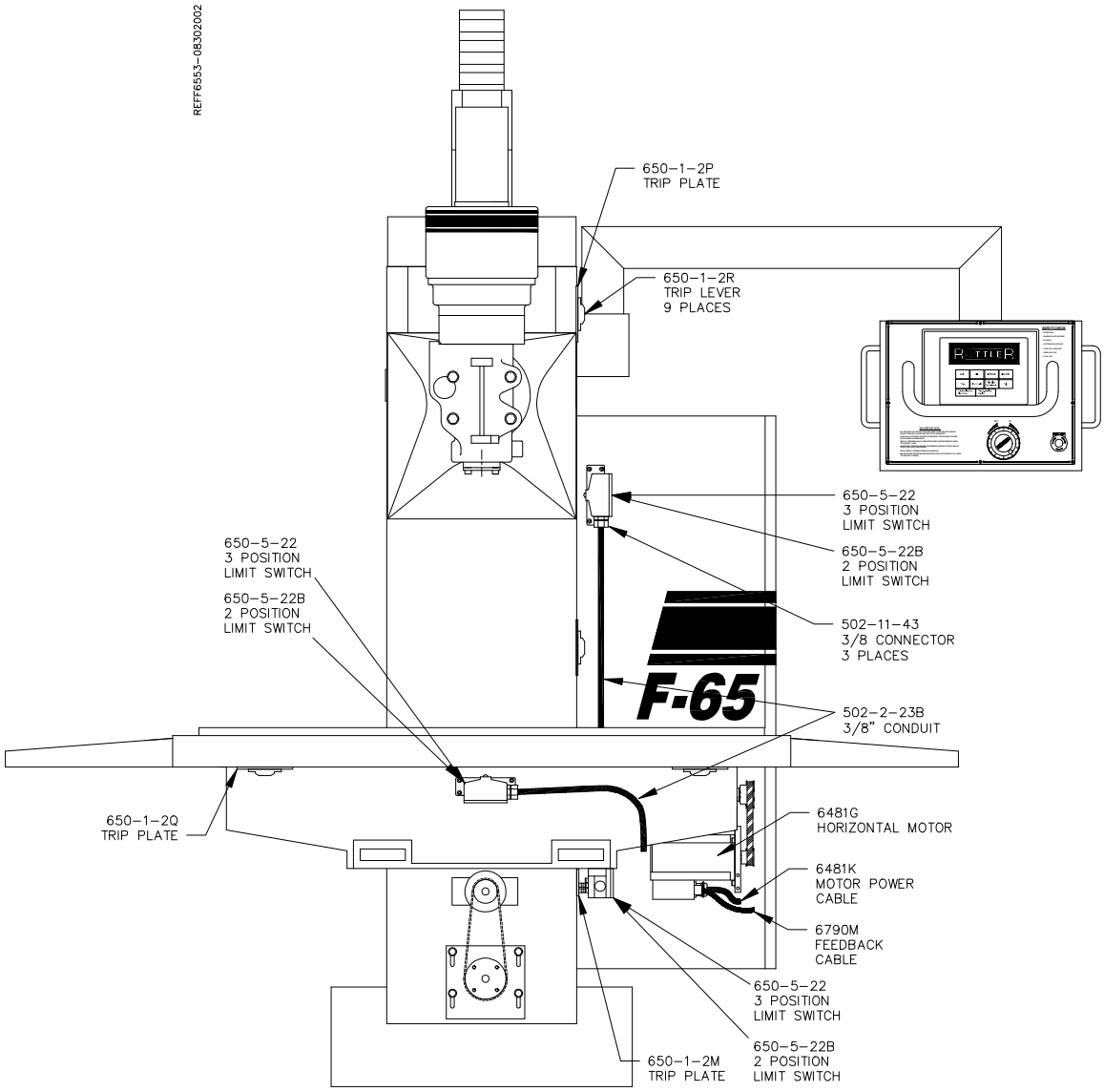
All other buttons have the same function as described earlier in the operation section of the manual.

Chapter 6 Machine Parts:

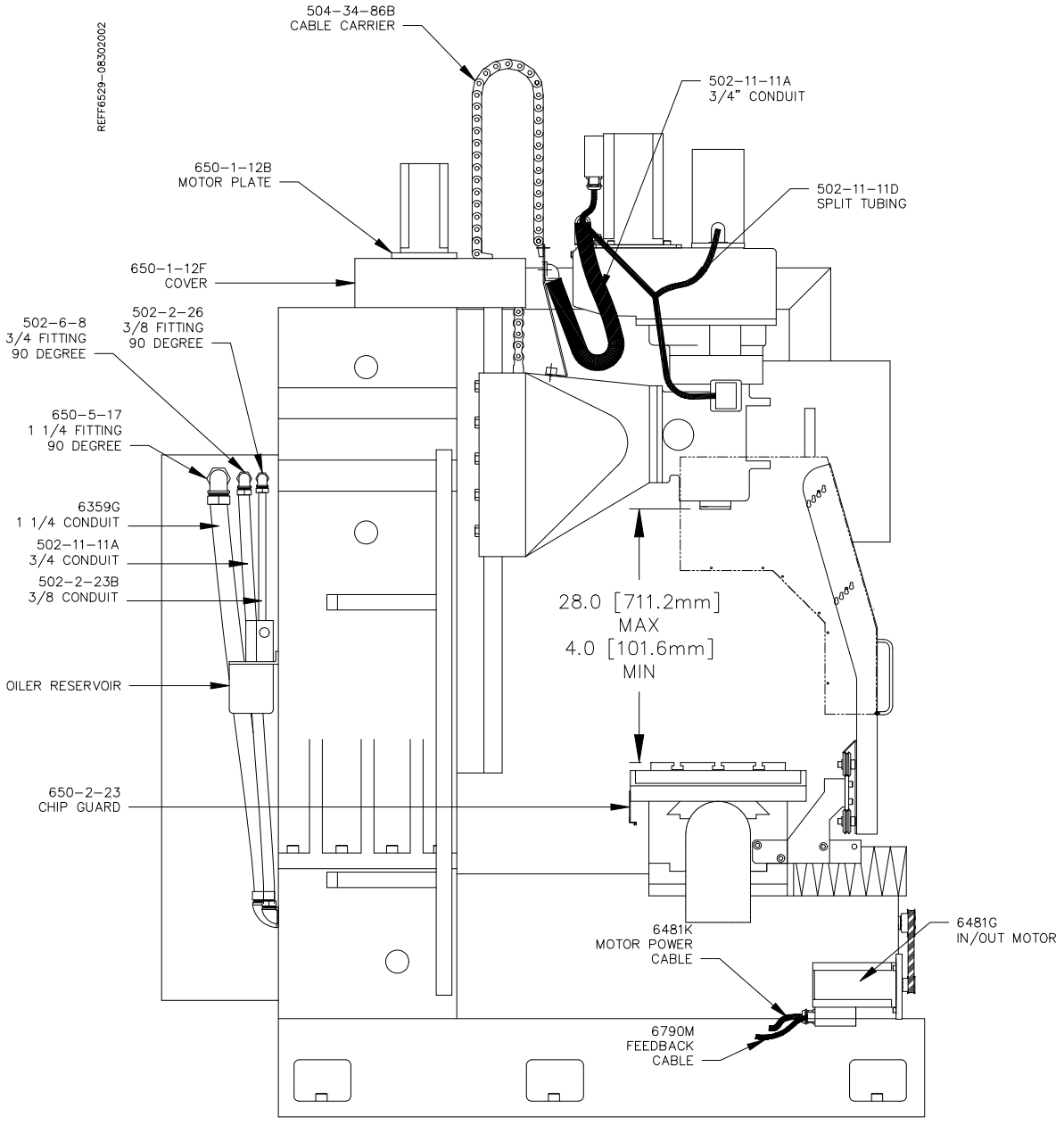
F65 Front View:



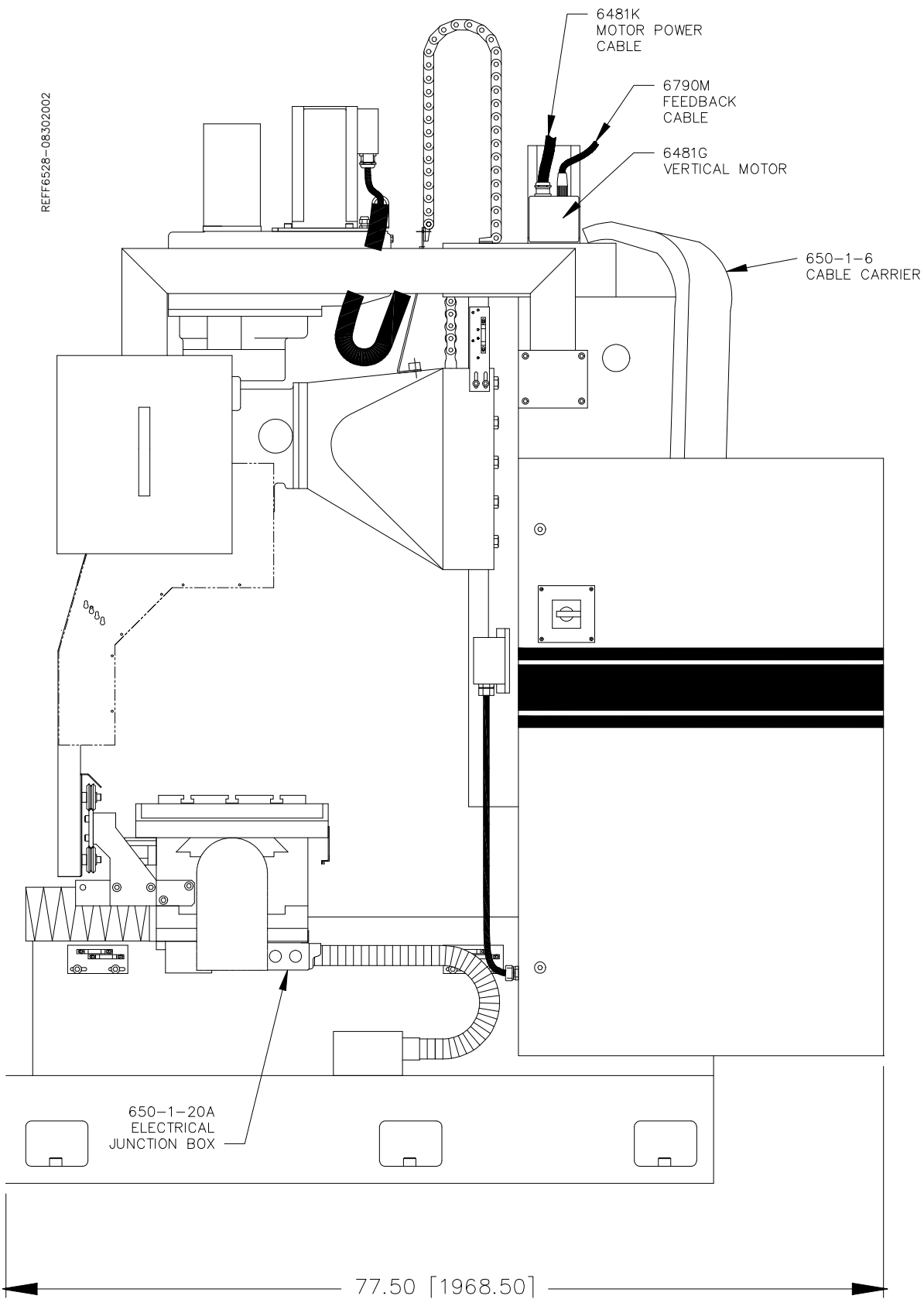
Drive Motors and Switches:



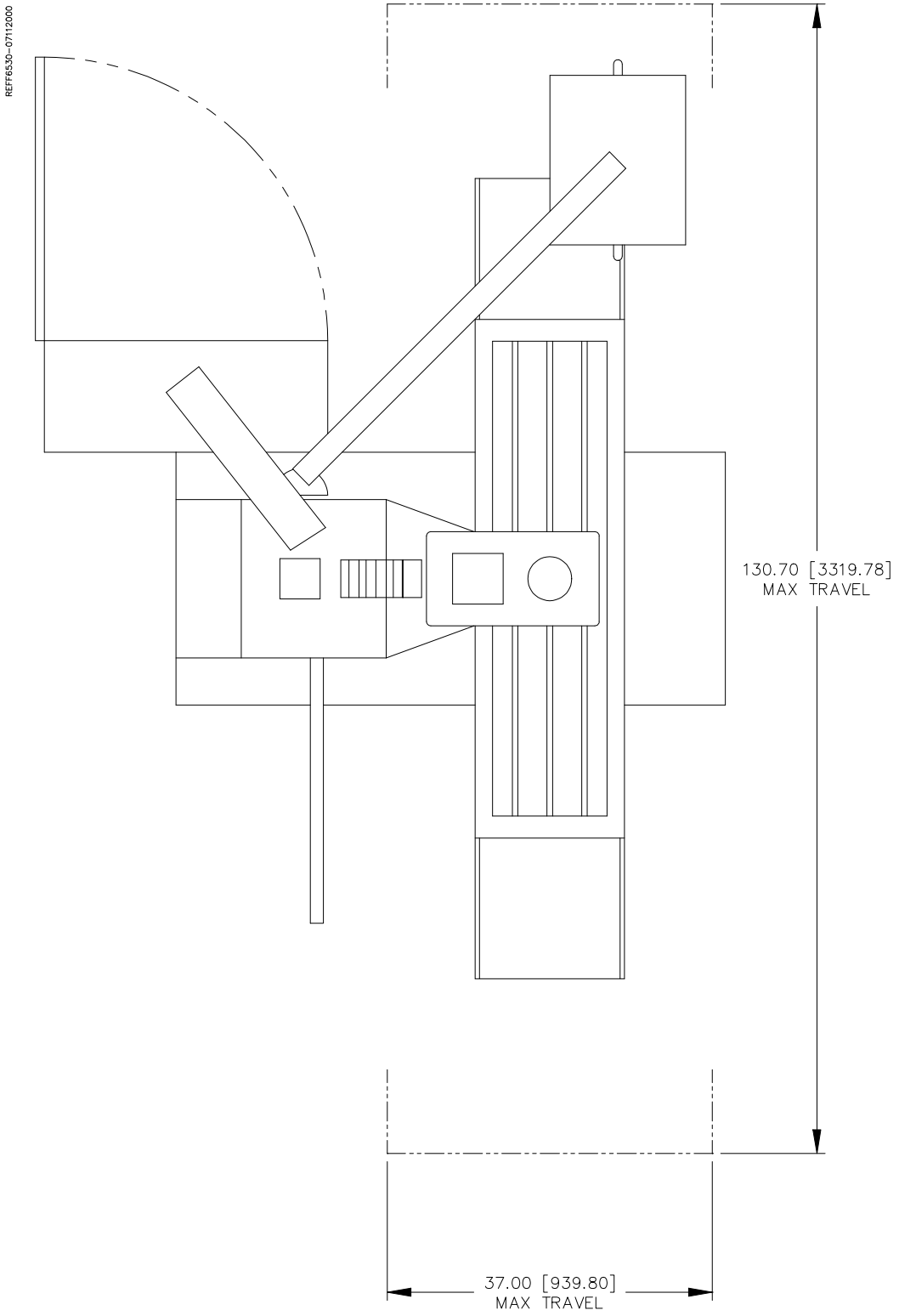
F65 left Side View:



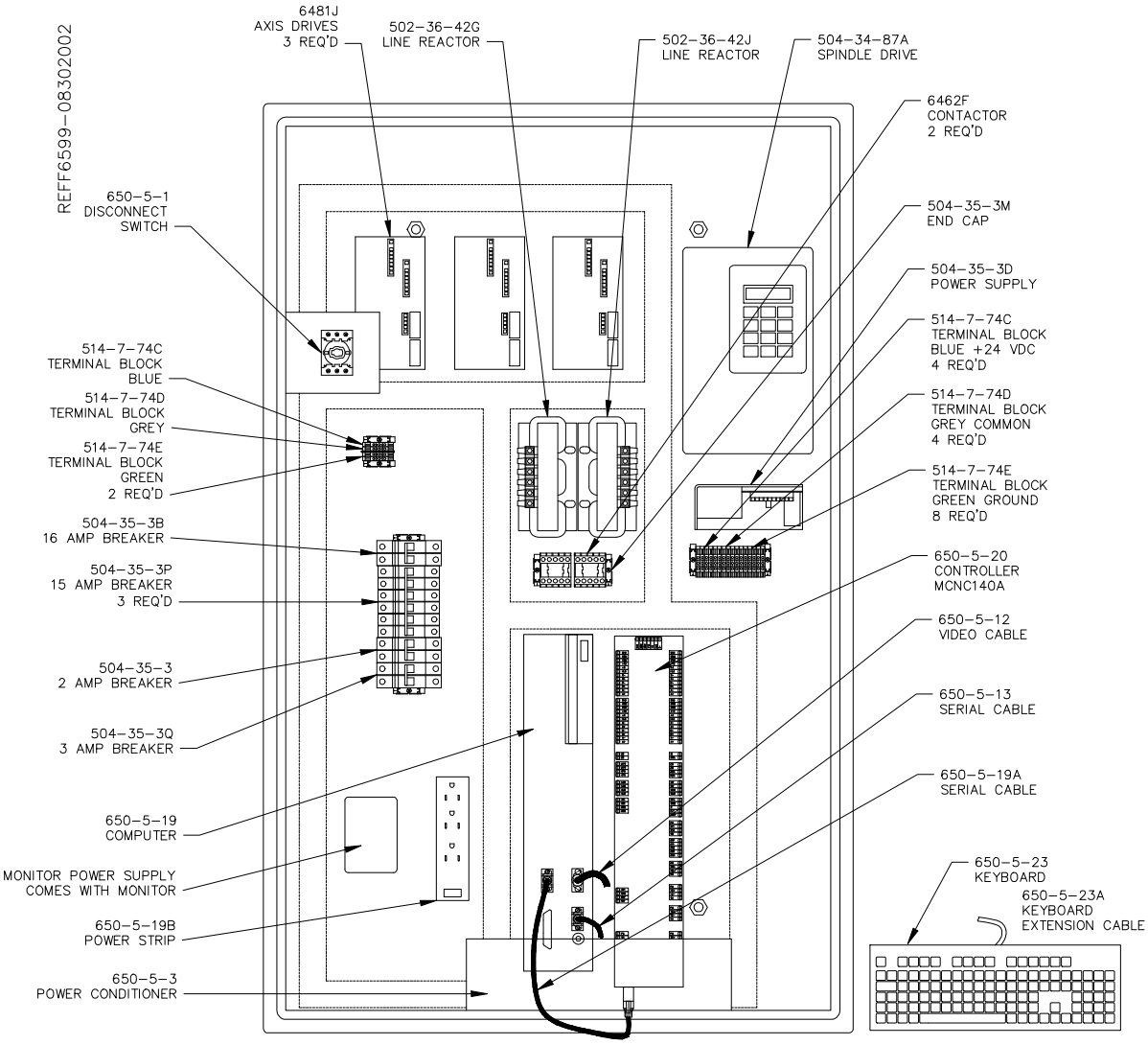
F65 Right Side View:



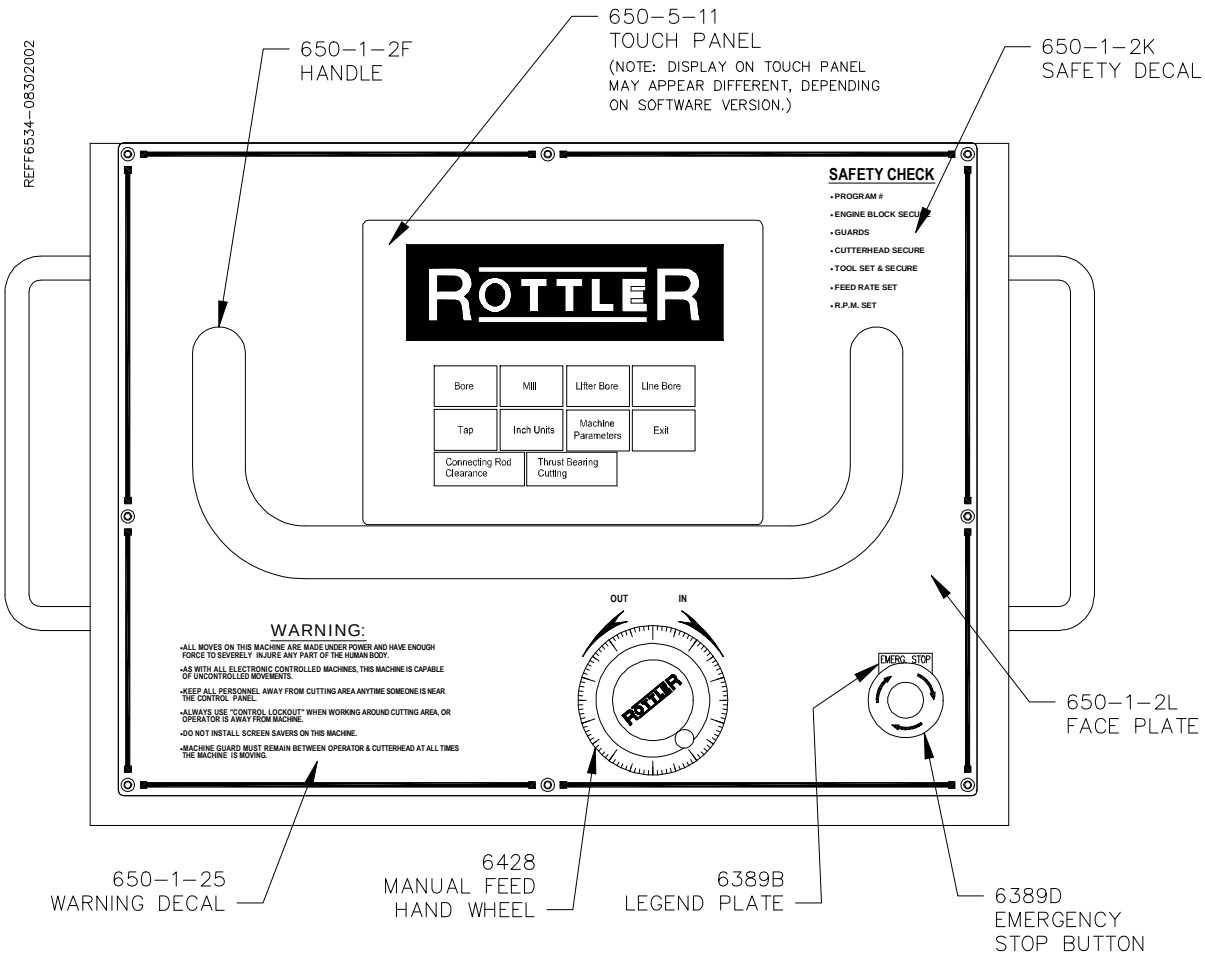
F65 Top View:


REFF6530-07112000
130.70 [3319.78]
MAX TRAVEL
37.00 [939.80]
MAX TRAVEL

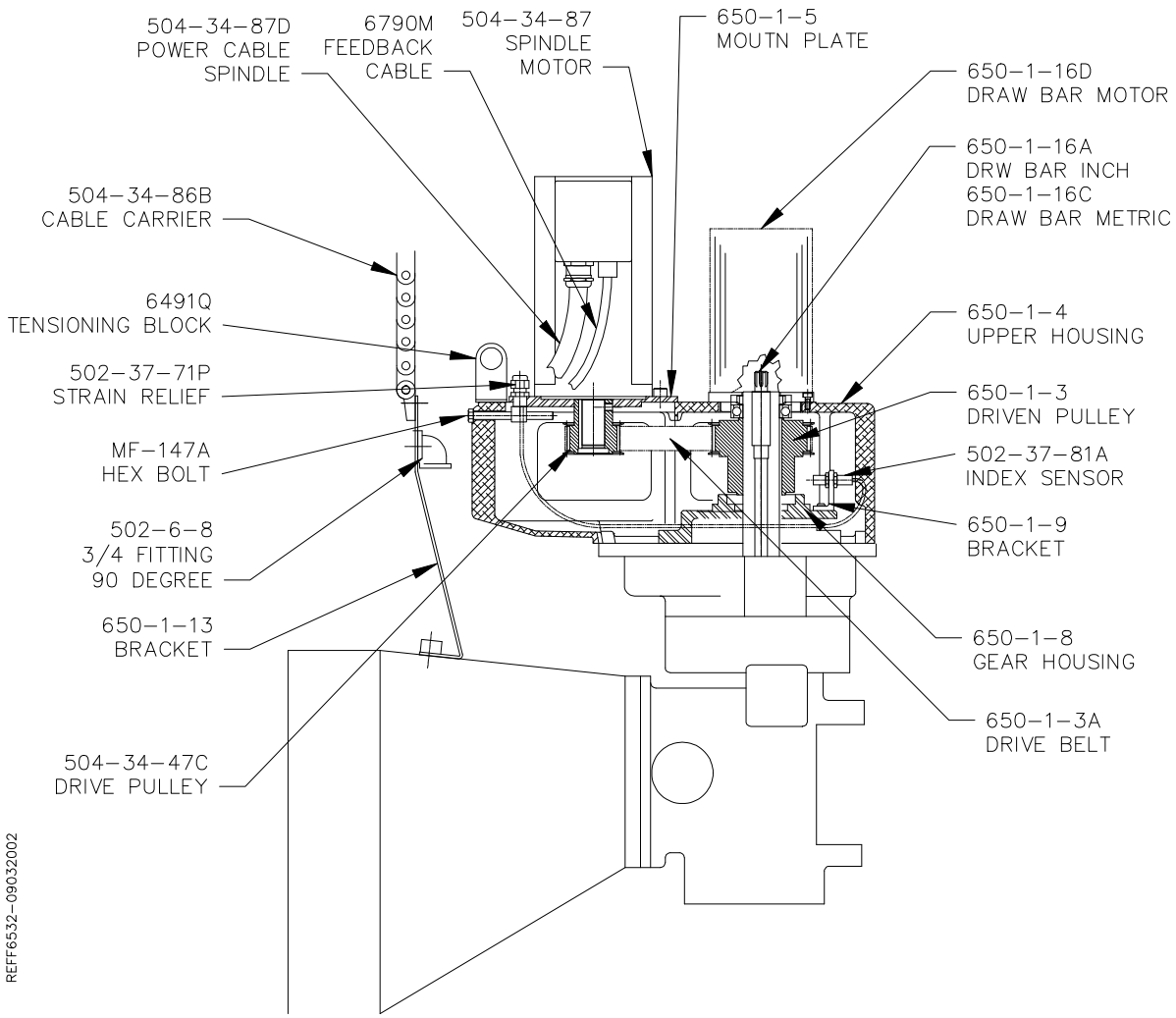
Electrical Panel:



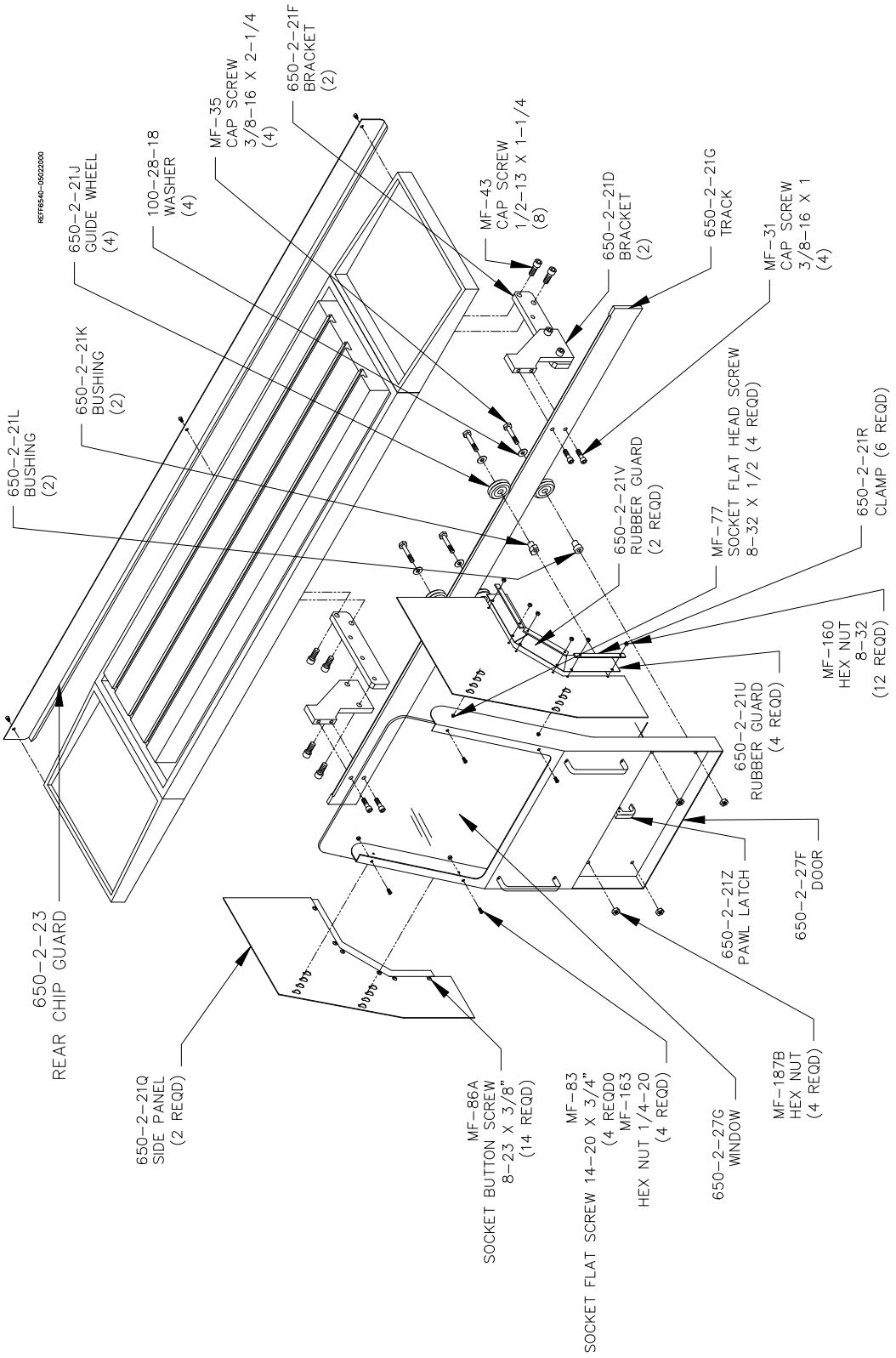
F65 Control Panel:



Upper Belt Housing:

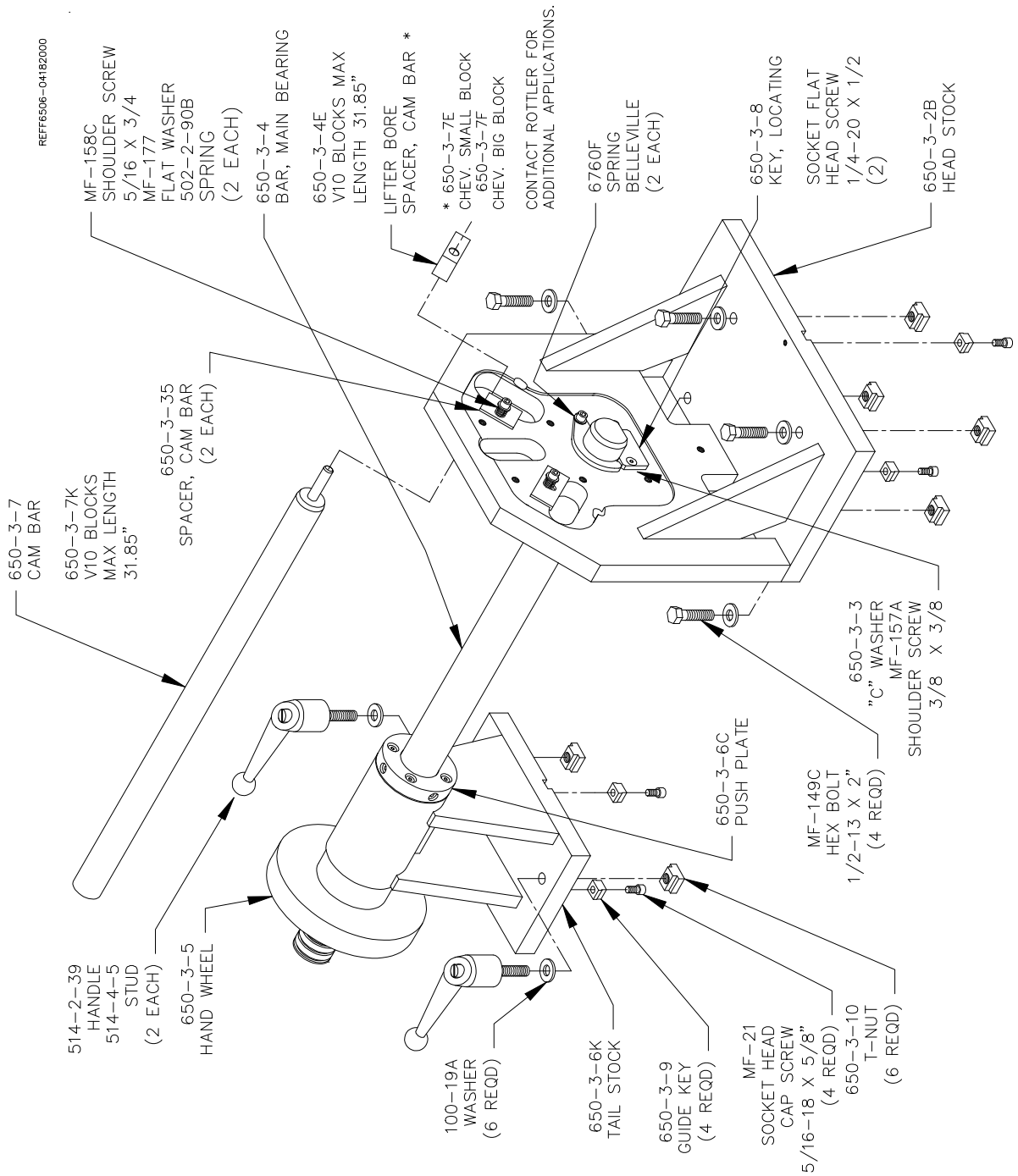


Chip Shield Assembly 650-2-27H:



Chapter 7 Options:

Performance Fixture 650-3-1:

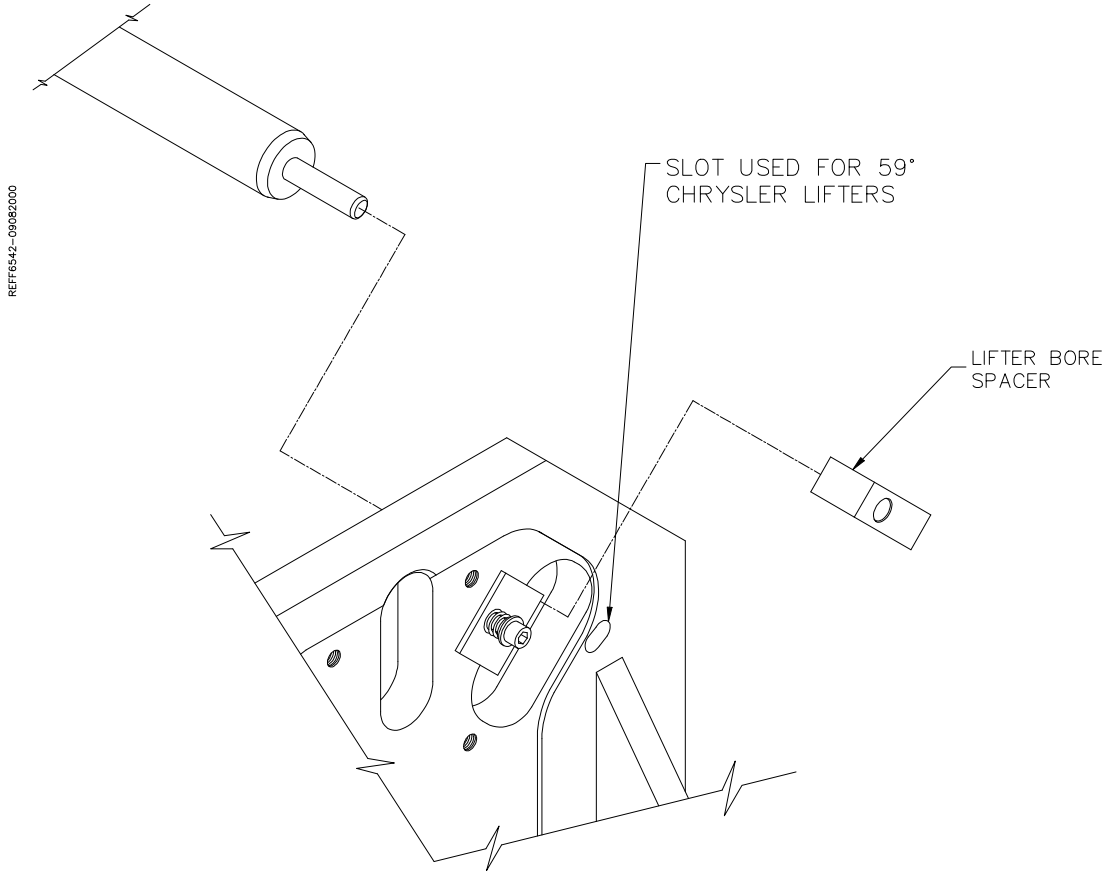


Lifter Bore Spacers:

Application Chart:

650-3-7E	**Chevy Small Block**
650-3-7F	**Chevy Big Block Intake (No spacer needed for exhaust)**
650-3-7G	**Ford 289-302-351W**
650-3-7H	**Ford 429-460**
650-3-7J	**Chrysler Small Block (Factory Race Block – 48 degrees) Production small blocks use the smaller slot.**
650-3-7N	**42-Degree Chevy Aurora**
650-3-7P	**43-Degree Chevy Aurora**
650-3-7Q	**44-Degree Chevy Aurora**

The following block lifters are at 45 degrees and do not require a lifter bore spacer: *Ford 390/427, 351C/400C, Chrysler 383/400, 413/426W/440, 426 HEMI, Chev Big Block (exhaust).*



Cam Bearing Locators:

Application / Selection Chart:

ASSY. NUMBER	APPLICATION	LOCATOR NUMBERS	LOCATOR DIAMETER	QTY
650-3-19	SMALL BLOCK CHEV 283327/350/400 2.0090/2.0110 BORE #5 2.0190/2.0210 BORE #1	 650-3-14 BORE #5 650-3-14G BORE #1	 2.0085 DIA. 2.0185 DIA.	 1 1
650-3-19A	BIG BLOCK CHEV 396/427/454 2.1295/2.1305 BORE #5 2.1395/2.1405 BORE #1	 650-3-14A BORE #5 650-3-14H BORE #1	 2.1290 DIA. 2.2390 DIA.	 1 1
650-3-19B	BIG BLOCK FORD (CHEV SB ROLLER BEARING) 2.2485/2.2505 BORE	650-3-14B	2.2480 DIA.	2
650-3-19C	SMALL BLOCK FORD 260/289/302/351W 2.1440/2.1450 BORE #5 2.2041/2.2051 BORE #1	 650-3-14D BORE #5 650-3-14C BORE #1	 2.1435 DIA. 2.2036 DIA.	 1 1
650-3-19D	351M FORD 2.1440/2.1450 BORE #5 2.2995/2.2505 BORE #1	 650-3-14D BORE #5 650-3-14B BORE #1	 2.1435 DIA. 2.2490 DIA.	 1 1
650-3-19E	SMALL BLOCK CHRYSLER 318/340/360 1.6920/1.6930 BORE #5 2.1295/2.1305 BORE #1	 650-3-14F BORE #5 650-3-14E BORE #1	 DIA. 2.1290 DIA.	 1 1
650-3-19F	BIG BLOCK CHRYSLER 383/426/440 1.8795/1.8805 BORE #5 2.1295/2.1305 BORE #1	 650-3-14J BORE #5 650-3-14E BORE #1	 DIA. 2.1290 DIA.	 1 1
650-3-19G	PROSTOCK BB CHEV 2.4780/2.4790 BORE	650-3-14K	2.4775 DIA.	2
650-3-19H	PROSTOCK BB CHEV 2.6733/2.6743 BORE	650-3-14L	2.6728 DIA.	2
650-3-19J	CHEV SB ROLLER BEARING 1.8745/1.8750 BORE	650-3-14M	1.8740 DIA.	2
650-3-19K	PONTIAC 455 2.2297/2.0317 BORE	650-3-14N	2.0292 DIA.	2
650-3-19L	CHEV CNC BOW-TIE BLOCK 2.1200/2.1210 BORE	650-3-14P	2.1195 DIA.	2
650-3-19M	CHEV SB ROLLER BEARING 2.2827/2.2831 BORE	650-3-14Q	2.2822 DIA.	2
650-3-19N	CHEV CNC BOW-TIE BLOCK 1.9990/2.0010 BORE	650-3-14R	1.9985 DIA.	2
650-3-19P	ALUMINUM LS1 BLOCK 2.3223 / 2.3224	650-3-14S	2.2332 DIA.	2
650-3-19Q	FORD 390 BLOCK 2.3095 / 2.3105 BORE #1 2.2495 / 2.2505 BORE #5	650-3-14T 650-3-14B	2.3085 DIA. 2.2490 DIA.	1 1
650-3-19R	ROLLER BEARING 2.4985 / 2.5005	650-3-14U	2.4980	2
650-3-19T	BUICK/CAD/OLDS/PONTIAC 1978-84 2.1670 / 2.1680 #1 2.0870 / 2.0880 #5	 650-3-14W 650-3-14X	 2.1670 DIA. 2.0870 DIA.	 1 1

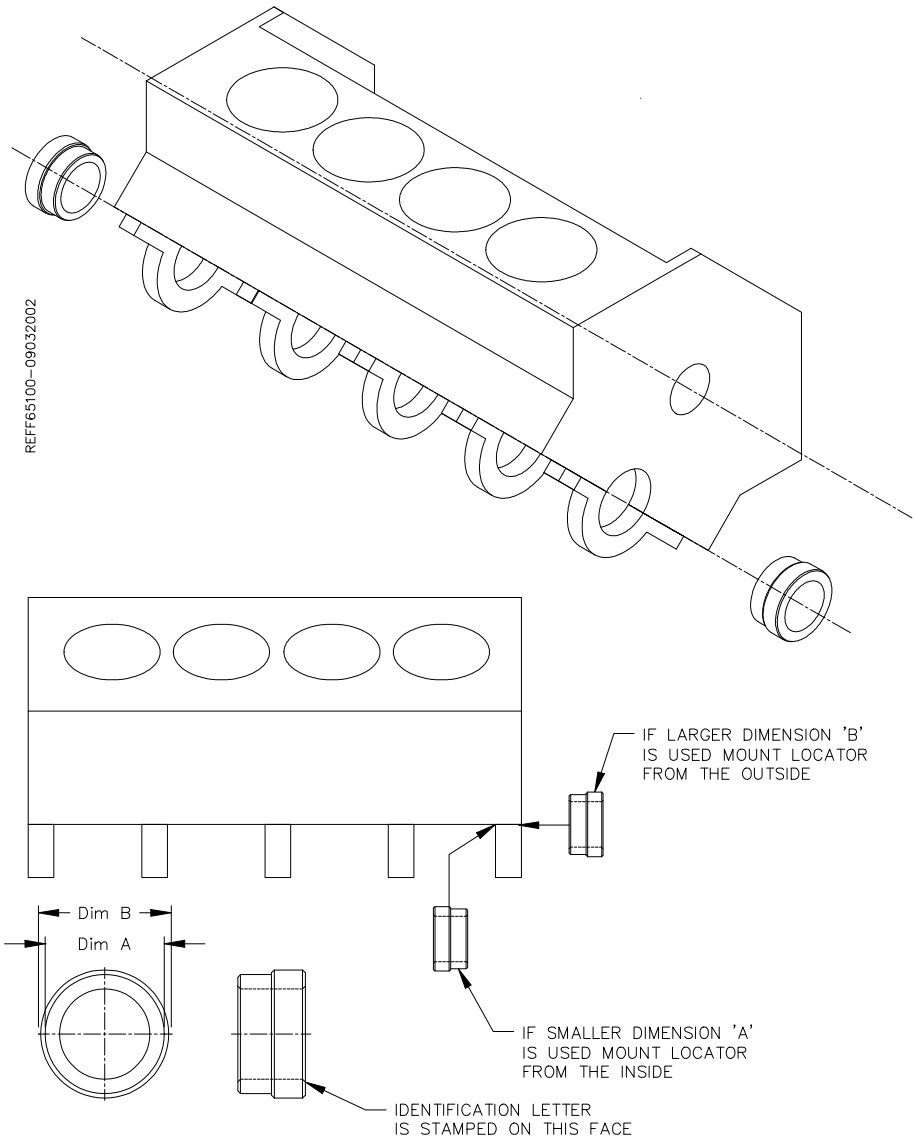
650-3-19U	CAM BORES 1.9675 / 1.9685	650-3-14V	1.9685 DIA	2

Main Bearing Locators:

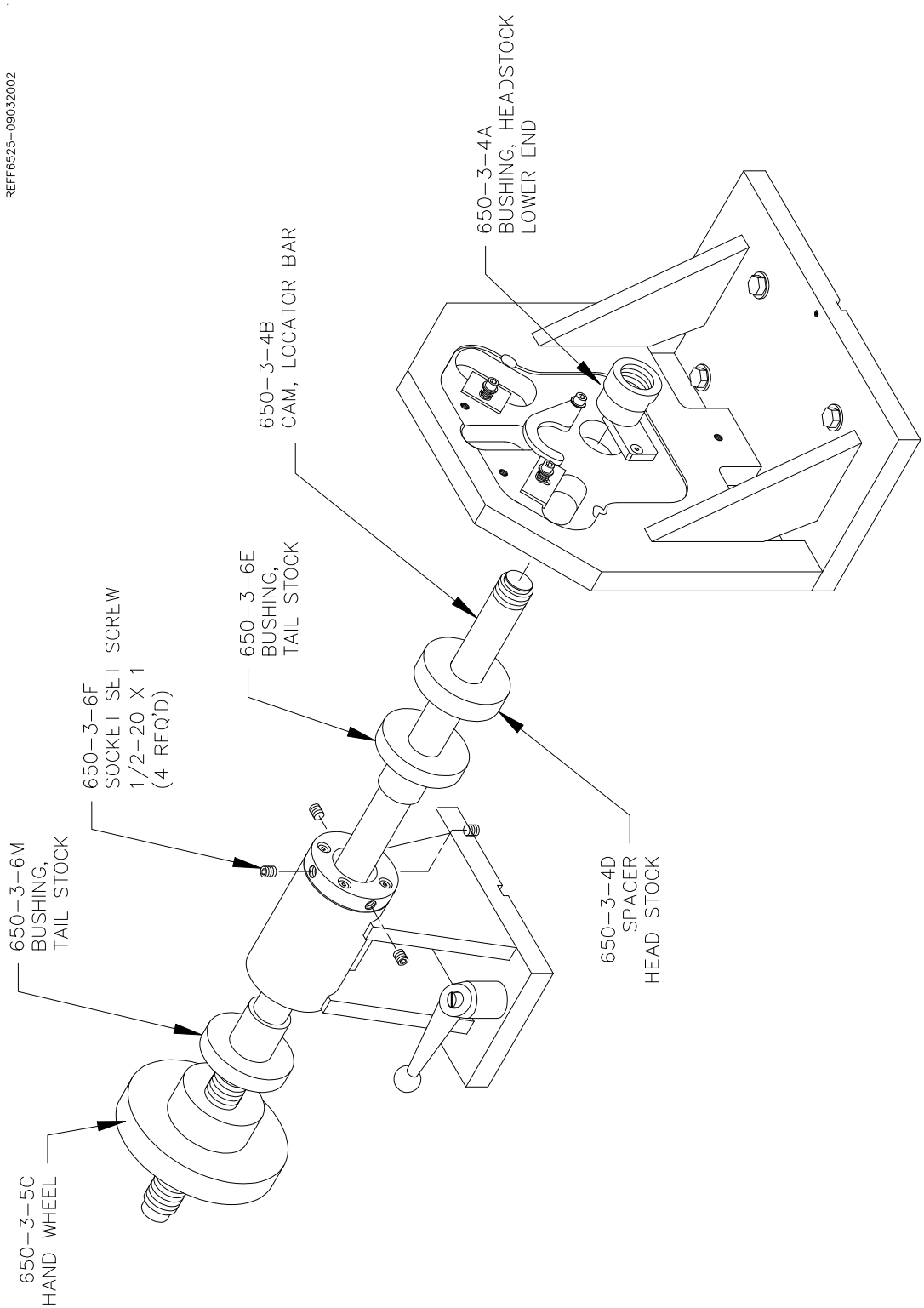
Selection List:

Note: Each locator covers two bearing diameters ('A' and 'B'). The unused diameter <u>MUST</u> be placed <u>INSIDE</u> the block to prevent interference with the Index Plates>

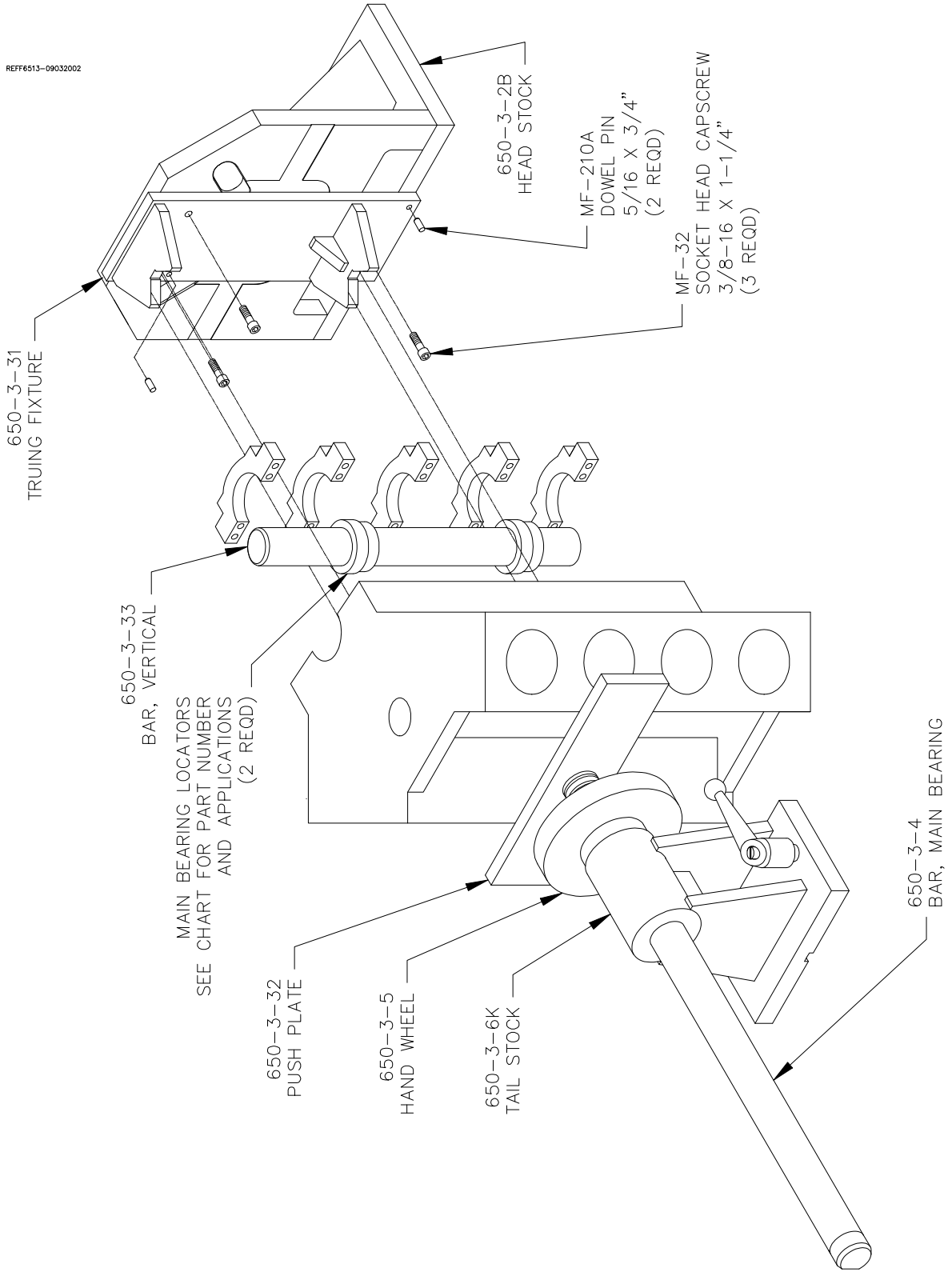
Part Number	Make	Displacement CU. IN.	Main Locator Diameter "A" Dia.	"B" Dia.
502-1-47A	Chev V/8	302/327/350(1968 and newer)/4.3L V/6	2.6391 $^{+.0010}/_{-.0000}$	
	Chev V/8	400 SB/3.4L V/6		2.8390 $^{+.0010}/_{-.0000}$
502-1-47B	Chev V/8	396/ 427/ 454		2.9365 $^{+.0010}/_{-.0000}$
	Buick V/6	231	2.6855 $^{+.0010}/_{-.0000}$	
502-1-47C	Buick/Olds/Pontiac V/8	350/ 389/ 400	3.1865 $^{+.0010}/_{-.0000}$	
	Buick/Pontiac V/8	421/ 428/ 455		3.4365 $^{+.0010}/_{-.0000}$
502-1-47D	Ford V/8	351C	2.9402 $^{+.0010}/_{-.0000}$	
	Ford V/8	351M/351W/429/460		3.1907 $^{+.0010}/_{-.0000}$
502-1-47E	Ford V/8	289/ 302	2.4397 $^{+.0010}/_{-.0000}$	
	Mopar V/8	360		3.0010 $^{+.0010}/_{-.0000}$
502-1-47F	Mopar V/8	318/ 340	2.6910 $^{+.0010}/_{-.0000}$	
	Mopar V/8	426/ 440		2.9410 $^{+.0010}/_{-.0000}$
502-1-47G	Chev V/8 Chev V/8	283/302/327(thru 1967) 5.3L('99 and newer)	2.4892 $^{+.0010}/_{-.0000}$	2.7490 $^{+.0010}/_{-.0000}$
502-1-47H		SPECIAL APPLICATION	3.3137 $^{+.0010}/_{-.0000}$	
502-1-47J	Porche V8	928	2.9510 $^{+.0010}/_{-.0000}$	
502-1-47K	GM	6.5 L/395 DIESEL	3.1420 $^{+.0010}/_{-.0000}$	
502-1-47L	Ford	4.6 ZETGC	2.4528 $^{+.0010}/_{-.0000}$	2.8491 $^{+.0010}/_{-.0000}$
502-1-47M	Honda Mitsubishi	1.8 L 2.0 L	2.3216 $^{+.0010}/_{-.0000}$	2.4002 $^{+.0010}/_{-.0000}$
502-1-47N	AMC Chrysler		2.9396 $^{+.0010}/_{-.0000}$	


REFF65100-09032002
IF LARGER DIMENSION 'B'
IS USED MOUNT LOCATOR
FROM THE OUTSIDE
Dim B
Dim A
IF SMALLER DIMENSION 'A'
IS USED MOUNT LOCATOR
FROM THE INSIDE
IDENTIFICATION LETTER
IS STAMPED ON THIS FACE

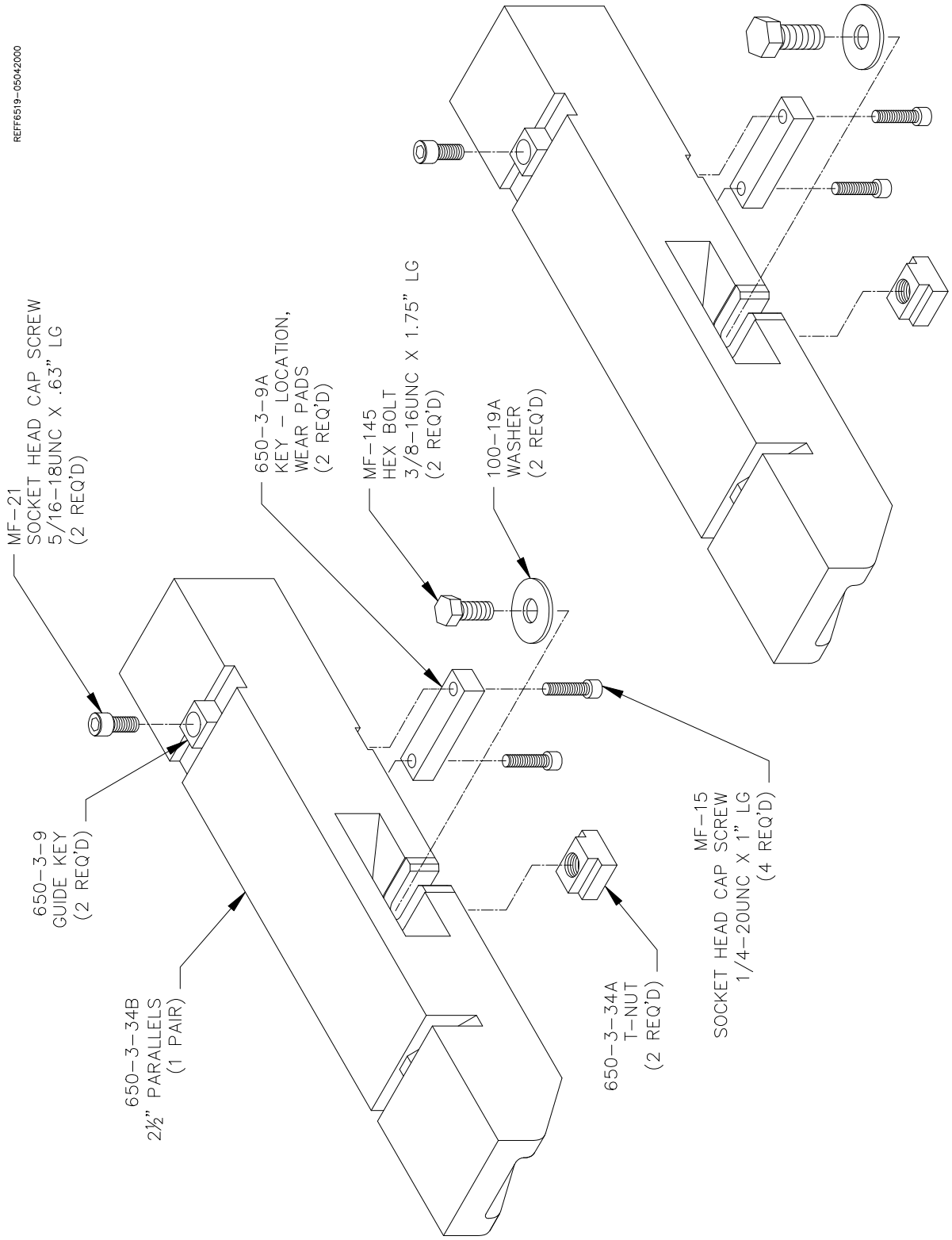
Lower End machining Package 650-3-1A:



Block End truing Fixture 650-3-30:



2 ½" Wear pad Assembly 650-3-34:



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

Caution: *Handle block and fixture with **Extreme** care and guidance. **A block hoist is required.** Mishandling of a heavy engine block and fixture could result in the dropping of parts and possible personal injury**. Be Careful!***

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

Boring Machine Application

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

Care must be taken to assure the contact edges of the locator bar are near the cap split line. A pair of 3/8" and ½" spacers are provided for blocks with large main bearing bores, to enable the bar to locate near the main bearing split line. (See figure 2)

V-blocks:
(blocks with main bearing center lines no more than ½" higher than the pan rail plane) are mounted with the 502-3-8B V-block frame in place. Select the 90-degree option placement of the frame to suit block length, or main bearing caps will interfere with frame. Rotate frame 90 degrees by moving its shoulder screws to alternate set of holes.

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

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

CAUTION: *Extreme care must be taken by operator whenever handling large blocks. Large blocks may cause fixture to tip when floated too far outward. We recommend leaving hoist attached when moving these blocks. Large blocks should be lifted from the block bank surface. **DO NOT** use the 502-1-95 block handler assembly on these blocks.*

Normal Operating Procedure:
The normal operation procedure on smaller V-blocks is to first pick up the block. If using the optional 502-1-95 block handler (see page 3.22), attach it to the block making sure the cam lifters are **COMPLETELY** engaged, and that the lift hook is approximately centered in the block lengthwise. Place the 502-1-82X locator bar through the main bearings and hoist the block into the fixture. Pulling the block towards you, with the locator against the positioners, will prevent jamming in the slot of the guides during the loading and unloading operations. The locator bar is positioned with the word ***'UP'*** that is on the end of the bar facing ***up*** and away from the operator. (see figure 1) After the locator bar is engaged in the positioners, pivot block outwards as you lower it. Slide block to the far left (this is the non adjustable position).

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

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

hand-screw as required. For the non-adjustable position slide locator bar to the far left. (See illustration page 3.15.)

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

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

Loosen locator bar handscrews and rotate clcamps out of the way. Lift the block, either from the deck surface or with the optional 502-1-95 block handler (see page 3.22). Turn the block 180 degrees & reload to duplicate the operation on the other bank.

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

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

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

Figure 2 502-1-82X main bearing locator bar indexes near bearing split line. Point C does not contact the bearing cap but rests on matched spacers, that are provided to fit in the bar positioners slot. If there is a means of holding the block down such as block clamp towers, this method may be used in large bores in order to properly index near the bearing split line. *If extreme care is used* this method may be used to index blocks without bearing caps attached. (Optional clamp down must be provided).

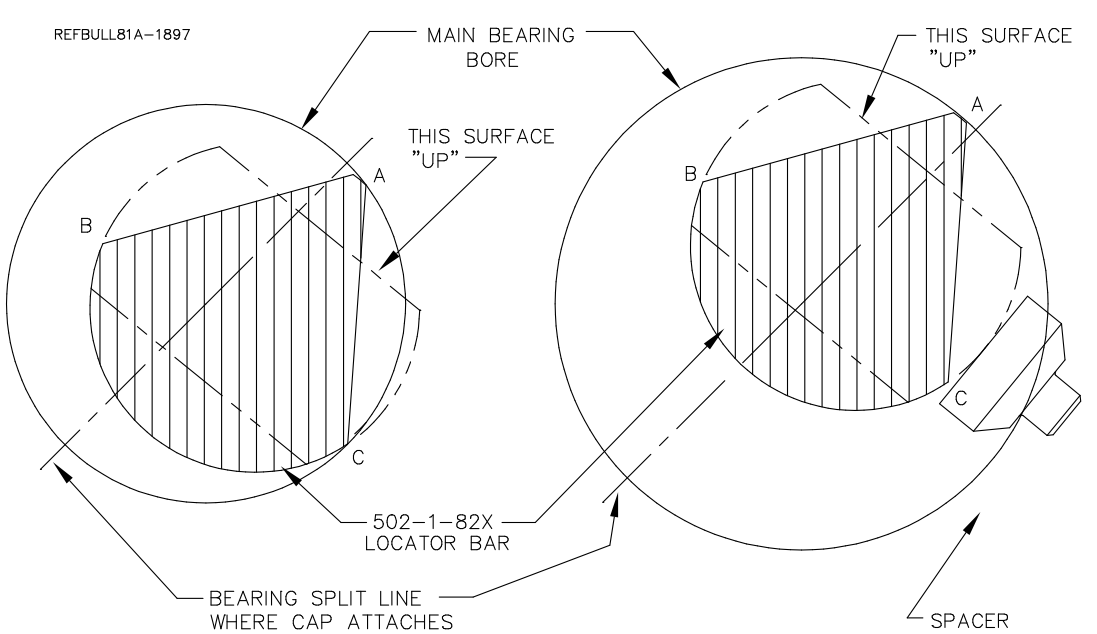
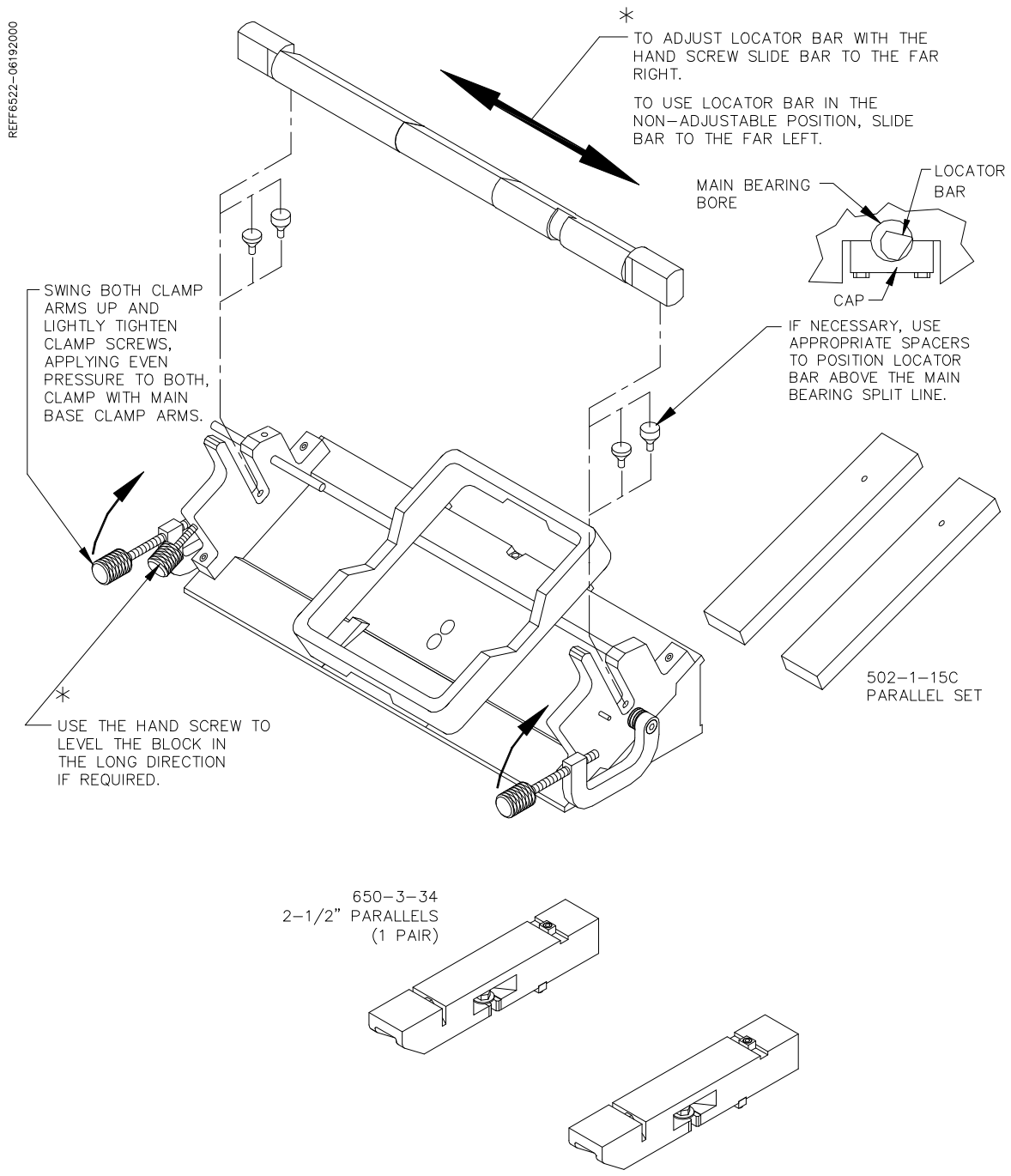
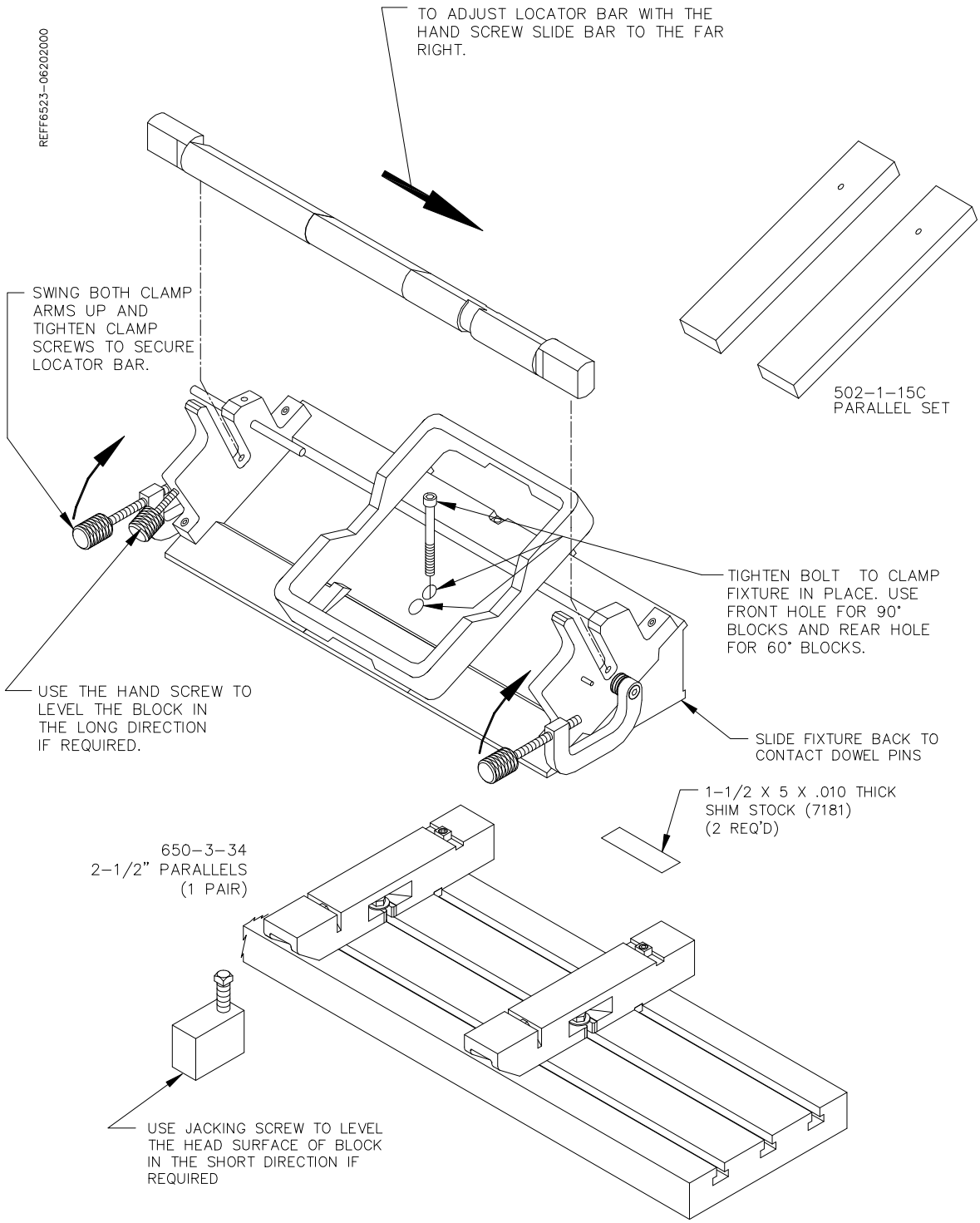


FIGURE 1 FIGURE 2

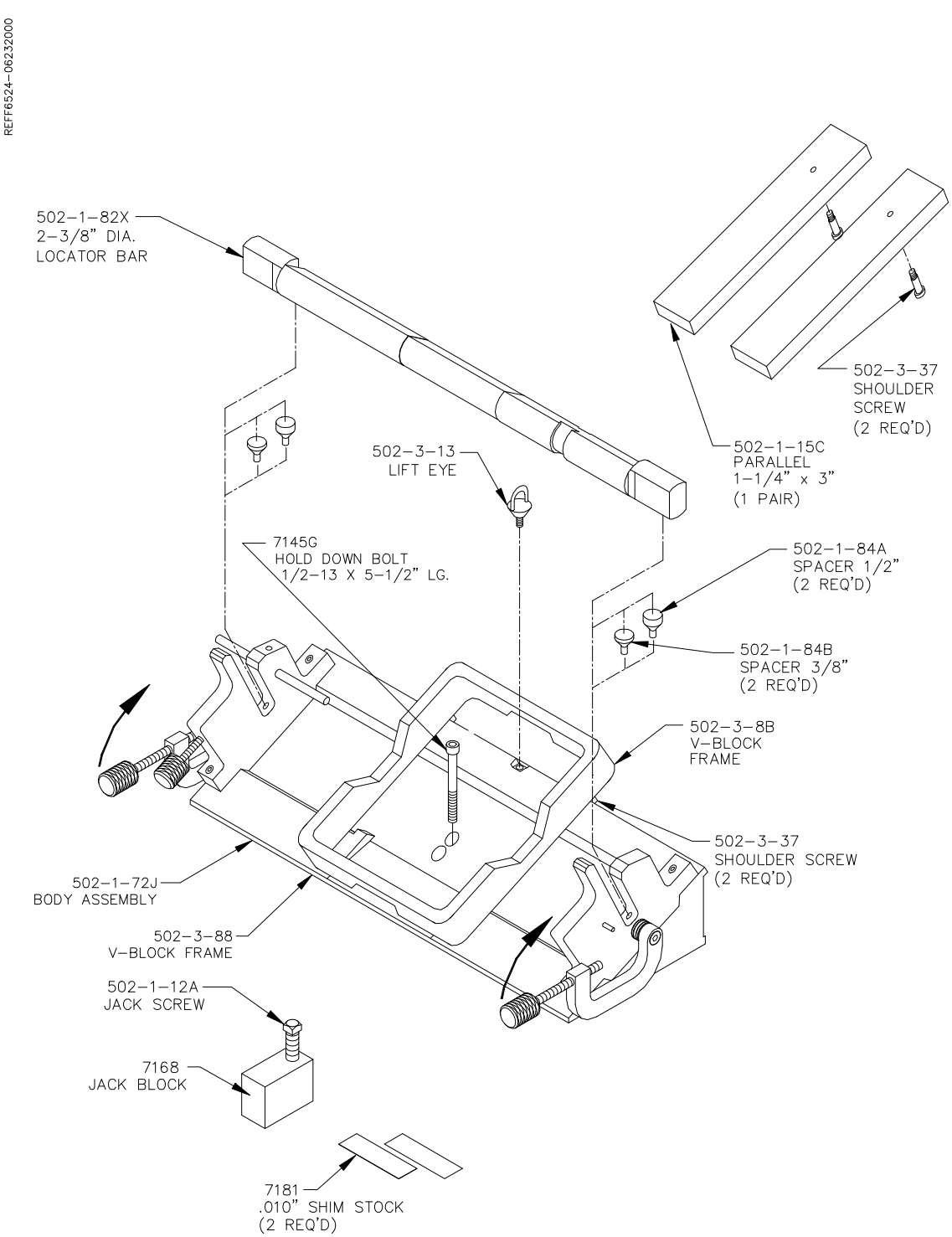
Manual Fixture Assembly 502-1-72H:

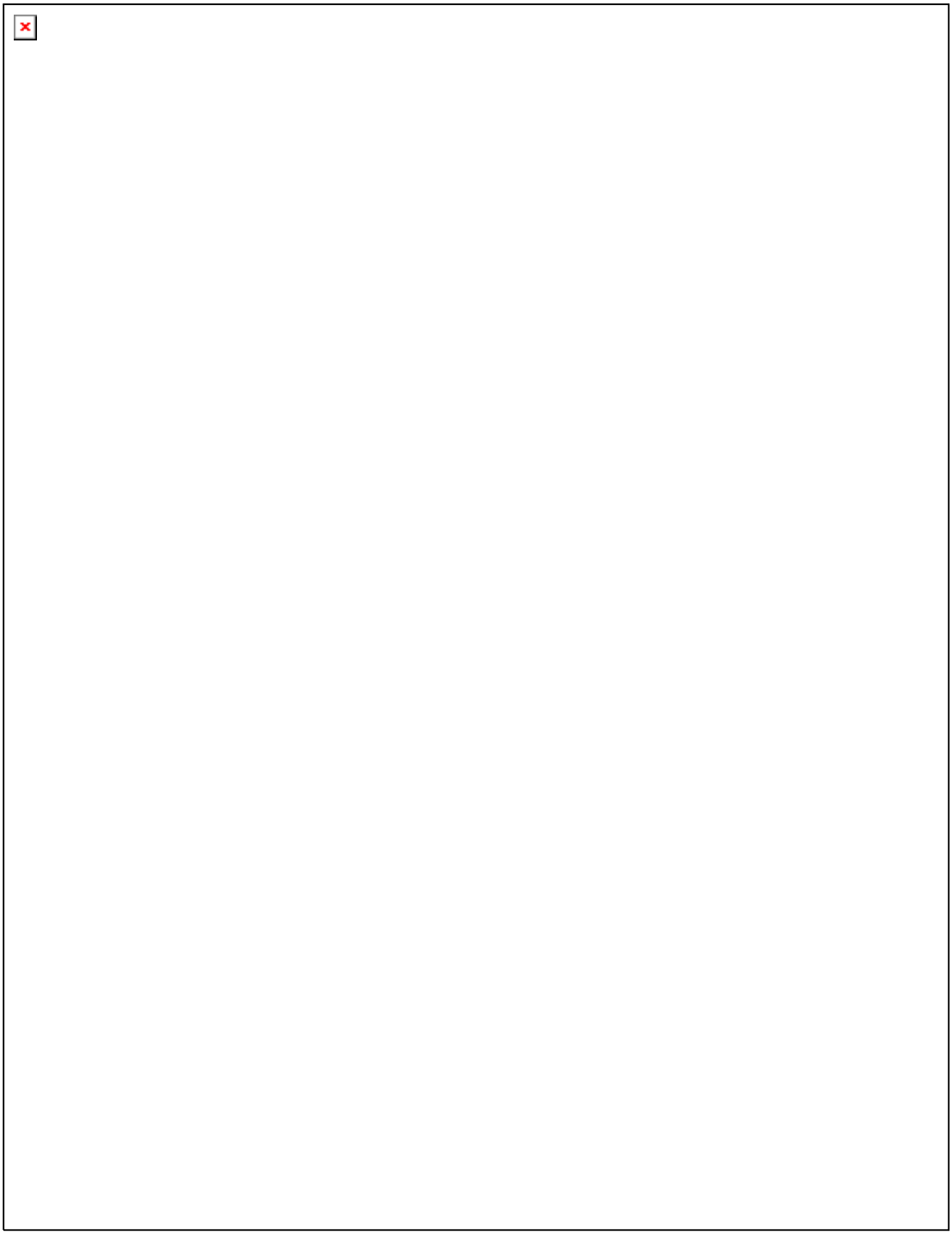


V6/V8 Manual Fixture Body Assembly 502-1-72J:

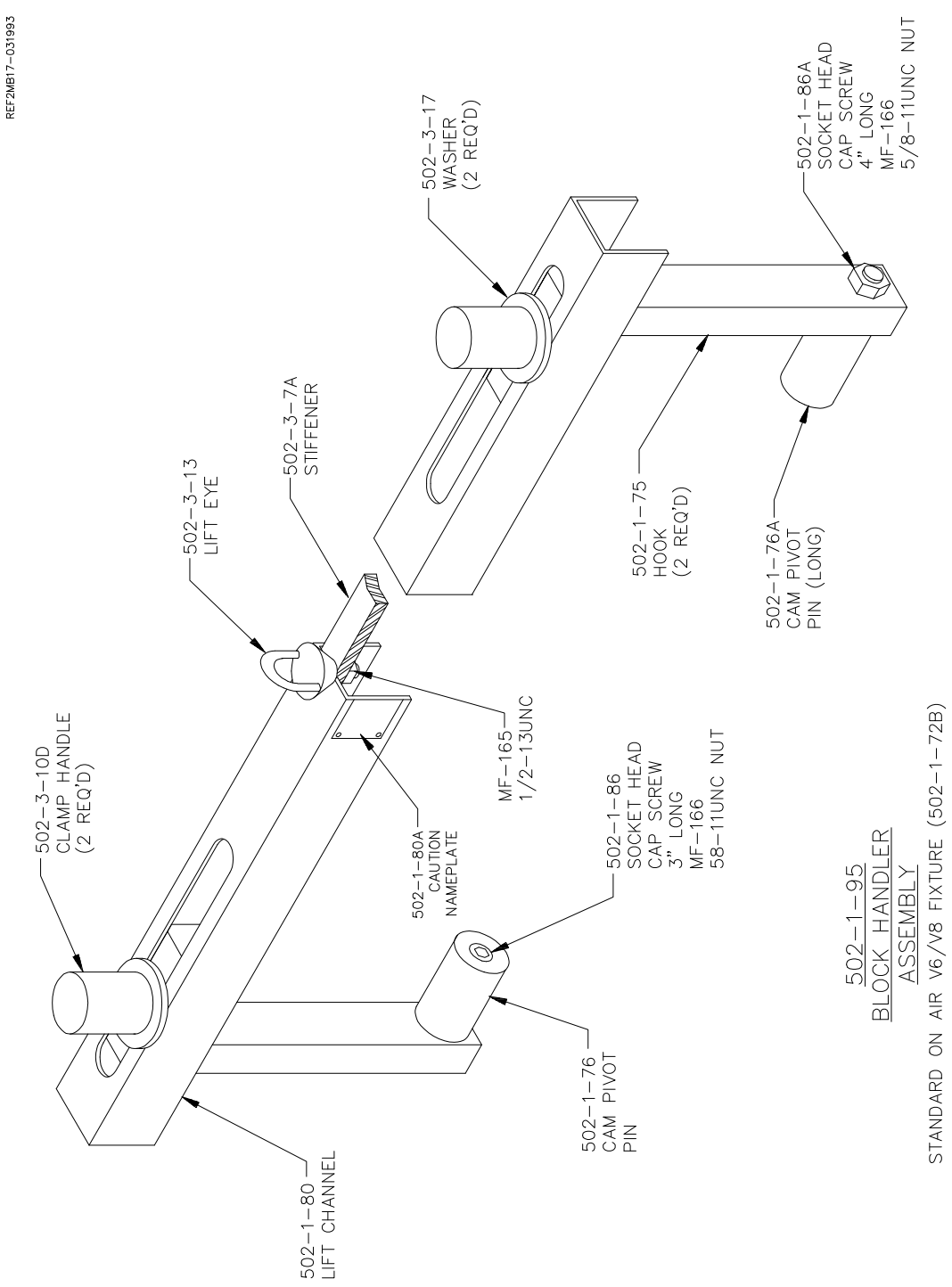


V6/V8 Manual Fixture Body Assembly 502-1-72J: (cont)





Block Handler 502-1-95:



Dual Axis Leveling Table 7209M:

Front/Rear Tilt Assembly:

Table Frame Assembly:

Left/Right Tilt Assembly:

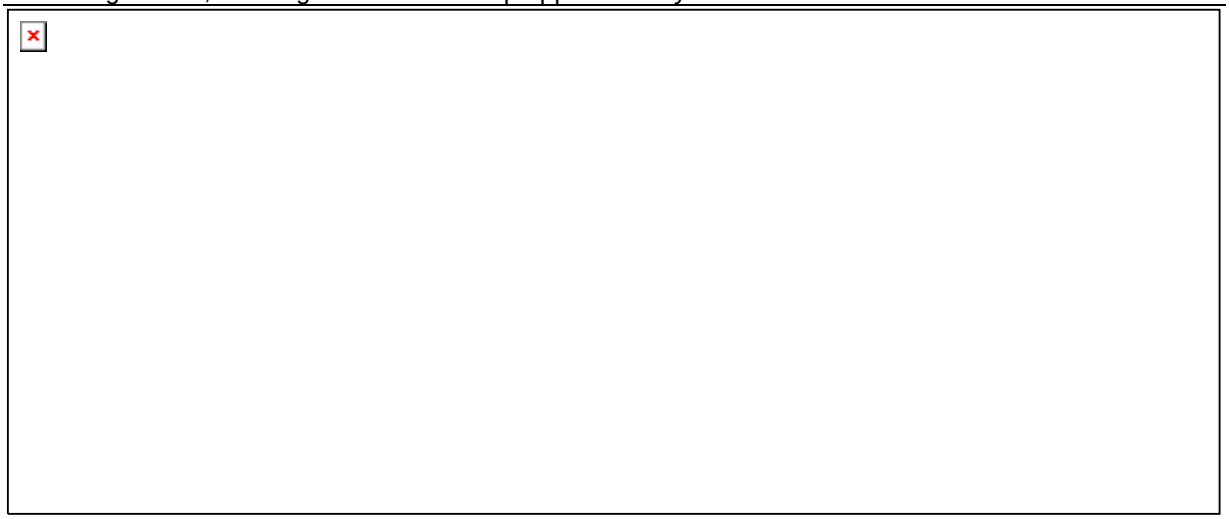
Air Float Assembly:

Dual Axis Leveling Table:

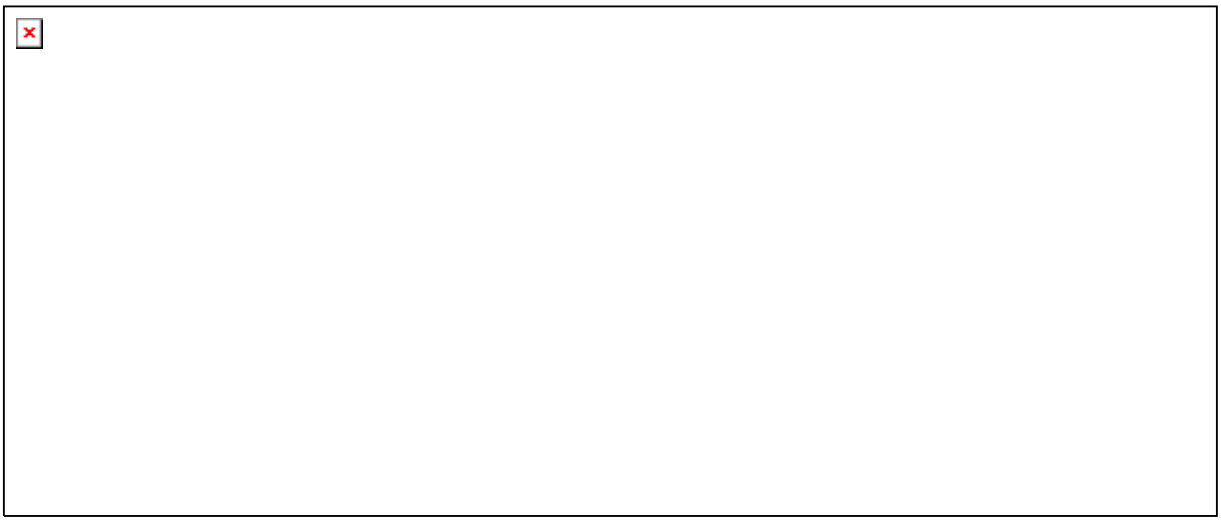
Adjustment Procedure:

Note: This fixture is set at the factory and should not require further adjustments. Adjustment is required after any disassembly.

1. Secure table to Machine surface.
2. Level table in both directions. Loosen Jam nut (MF-173) and capscrew (7209W) on the table clamp. Loosen adjustable handle (514-2-93D) on the left side of table. Loosen (2) locking set screws (504-29-36) on both sides of journal clamp. Loosen (2) brass tipped set screws (7209B).
3. Using a hoist, raise right end of table top approximately ½".

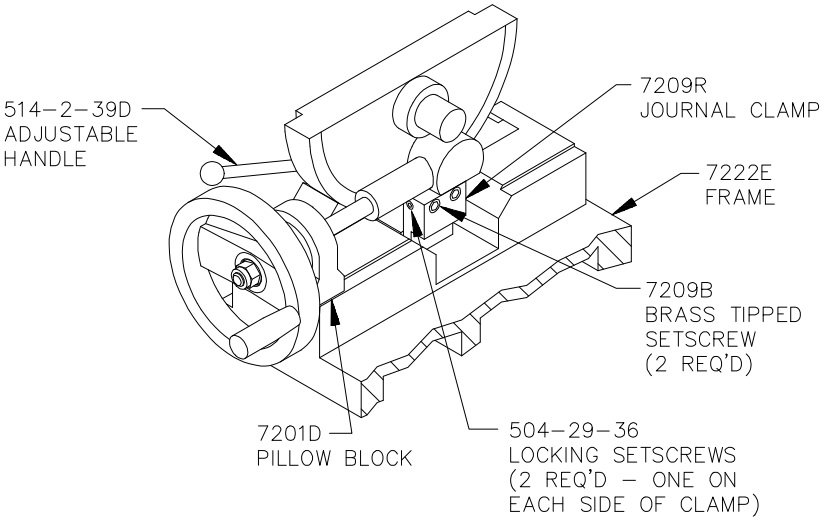


4. Remove (2) capscrews on right hand pillow block (7210D). Remove tilt shaft assembly from fixture.



Remove nylock nut (MF-186) and washer (100-19) from shaft (7207M). Loosen set screw (MF-60) and remove hand wheel (7201M). Slide spacer (7207Q) off tilt shaft. Remove snap plug (506-3-1) from rear block (7207L).

5. Adjust assembly by threading blocks in or out to set them to dimensions shown below.
6. Reassemble left/right tilt shaft assembly.
7. Place tilt shaft assembly back into frame.
8. Lower table top into position. Reinstall (2) cap screws on right hand pillow block. Do not tighten these screws yet.
9. Loosen bolts on left hand pillow block (7201D). Right hand pillow block should still be loose.
10. Loosen (2) bolts holding journal clamp (7209R) to frame (7209T).
11. Adjustable handle (514-2-39D) on left side of table and (2) locking set screws (504-29-36) on sides of journal clamp should still be loose.
12. Turn (2) brass tipped set screws (7209B) in until the left hand journal is pushed all the way to the left. Back off set screws until they just contact journal.
13. Tighten locking set screws on journal clamp and both pillow blocks.
14. Tighten mounting bolts on journal clamp and both pillow blocks.



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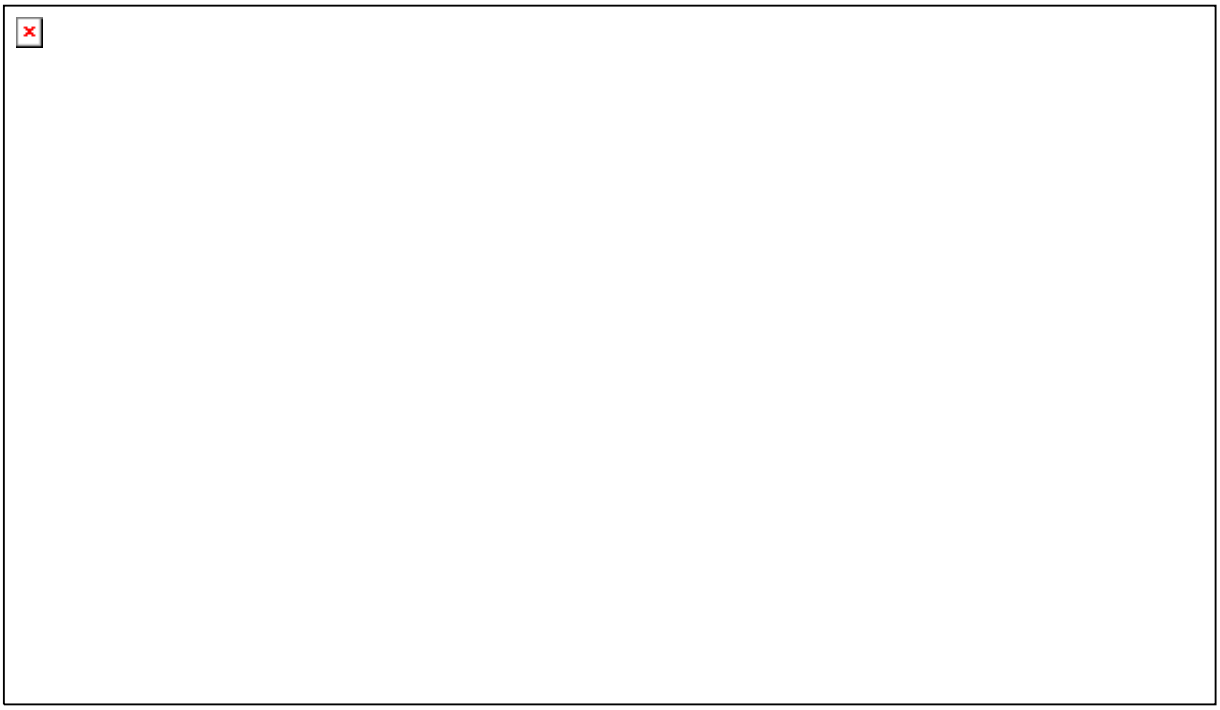
15. Level table in both directions.
16. Adjustable handle (514-2-39D) on left side of table should still be loose.
17. Tighten cap screw (7209W) on table clamp to flatten it's Belleville springs (514-7-21) then back off 3-1/2 turns from tight. Tighten jam nut on table clamp.
18. Table should now travel both 1/8" min. up and 1/8" min. down from level in left/right tilt.
19. Check with shim stock to make sure that journals sit properly on frame at all four contact points.



Lubrication:

Universal Tooling Package 7119P:

Exhaust/Intake Manifold Surfacing Fixture Assembly 7226G:

Exhaust/Intake Manifold Fixture:

Instructions

This fixture is designed to hold most exhaust manifolds and most intake manifolds from 90 degree V8 Engines.

Exhaust Manifolds

1) Most exhaust manifolds will be surfaced with the supports positioned approximately as shown on next page. Occasionally it may be necessary to rearrange the support blocks to accommodate an unusual manifold.
2) Place a manifold on the two front brackets. Adjust the rear pin to provide the best support. The best place for the front brackets is under the machined area, for the manifold mounting bolts, at the outside corners of the manifold. The rear pin should be approximately midway between the front brackets on the rear of the part. The pin should support under the main body of the manifold.
3) Adjust the rear pin up and down to bring the manifold close to level.
4) Tighten the toe clamps evenly against the cast surface of the manifold (be sure the toe clamps are not pushing on a machined surface). Tighten firmly, test for clamp tightness with a soft face mallet.
5) Level the manifold surface using the hand wheels and the dual axis level system of the table.
6) Make sure there are no obstructions in the way of the cutterhead you are using.
7) The manifold is ready to surface.

Typical Exhaust Manifold Set-up:

Intake Instructions:

This fixture will require parts from the Rottler universal head tooling package.

1. This fixture is designed primarily for the intake manifolds from 90 degree V8 engines.
2. Start with the support blocks arranged as shown on the next page. Leave the hold down bolts finger tight so that the block will slide easily.
3. Place the manifold in the two rear support brackets so they fit flush and parallel on the intake surface. Tighten the hold down bolts securely.
4. Adjust the remaining two support blocks to give support to the manifold at the front. Slide the clamp assembly over and position the clamp foot so it will push on a solid area of the manifold, approximately centered.
5. Tighten the clamp handle securely. Check to make sure the manifold did not move.
6. Using a small precision level, level the exposed intake surface, in both directions, by tilting the dual axis table as necessary.
7. Using the left hand wheel only, rotate the table to level the lower surface of the manifold.
8. This surface is ready to cut.
9. After surfacing , rotate the table using the left hand wheel only, down to the center or lower surface. Level this surface.
10. This surface is ready to cut.
11. Loosen the clamp screw and remove the manifold. Turn it around and reload with the fresh cut surface in the rear support blocks. Level the intake manifold surface and cut.
12. Using the left hand wheel, level the second lower surface and cut it.

Caution: At all stages of this process be sure there are no obstructions that might interfere with the cutterhead.

Typical Intake Manifold Set-up:

Dual Axis Level Assembly 7125A:

Method of leveling set up, and periodic verification of Rottler F-65 Machining Center.

1. Level machine with a .0005/foot machine tool level so that the work surface is level within .0005/foot in both axis.
2. Now place dual axis level (7152A) on the work surface. It should read level in both vials, the vials will need to be adjusted if they do not read level. Turn the level 90 degrees and check in this direction also.
3. The leveling check should be made frequently on a new machine since typical floor support conditions take a while to permanently seat in. Then a wwekly re-check should be adequate, unless you have a reason to doubt accuracy.

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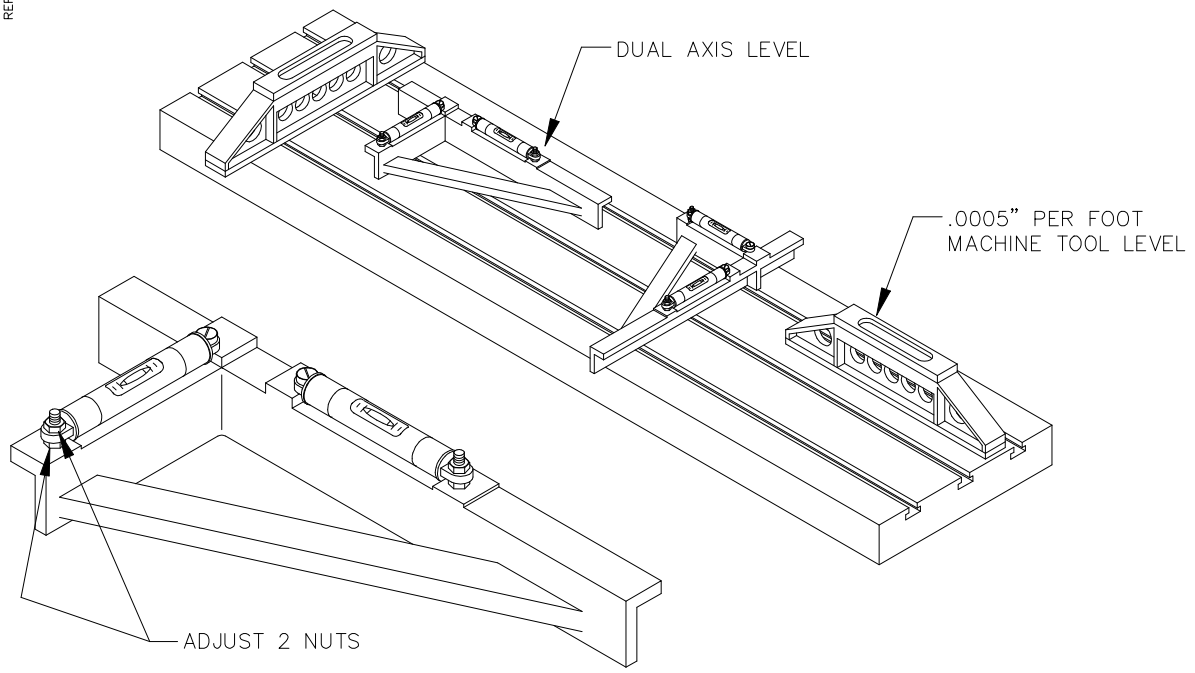


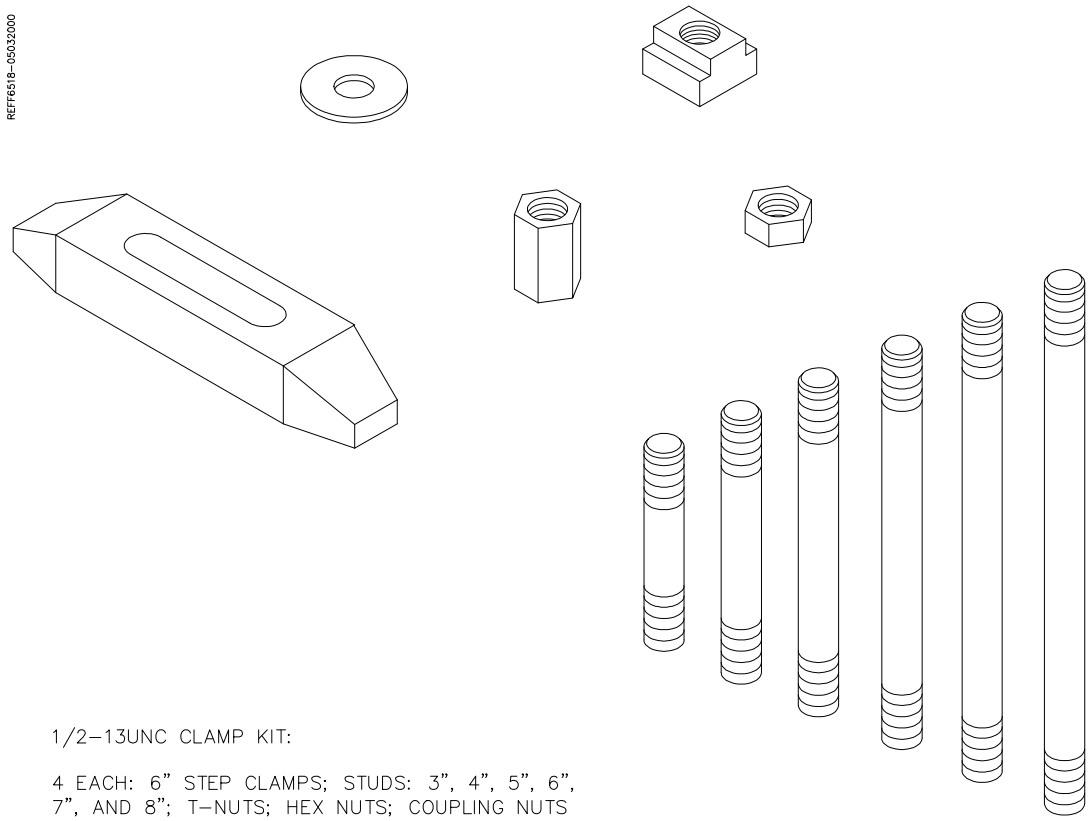
The following procedures are necessary to properly use the leveling table and dual axis level for single cut milling of cylinder head decks.

1. Place the cylinder head on the table and clamp into place approximately level.
2. Place level on head surface and adjust the hand wheels so that cross level is centered and longitudinal level bubble moves slightly left of center, approximately ¼ graduation (see illustration A). The purpose of this is to assure clean up of the extreme left of the head.
3. Now, in order to adjust for minimal stock removal, look at the flatness dial indicator (7038Y) reading.

    a) If the reading is at “0” or past “0” the surface is flat or convex. Accordingly, set the cutter height dial at .002 to .003 past “0” and begin cut.
    b) If the level dial is short of “0” that means the deck surface is concave and you will have to remove more material at the beginning of the cut. In general, add about .003” on cutter depth for every .002” the level dial is short of “0” on short heads. On long heads add .005” of cutter depth for every .002” of indicator reading. It is important to finish with a single as much as possible. Multiple cuts will result in more tool wear as well as considerably more time cost.

½” Clamp Kit:

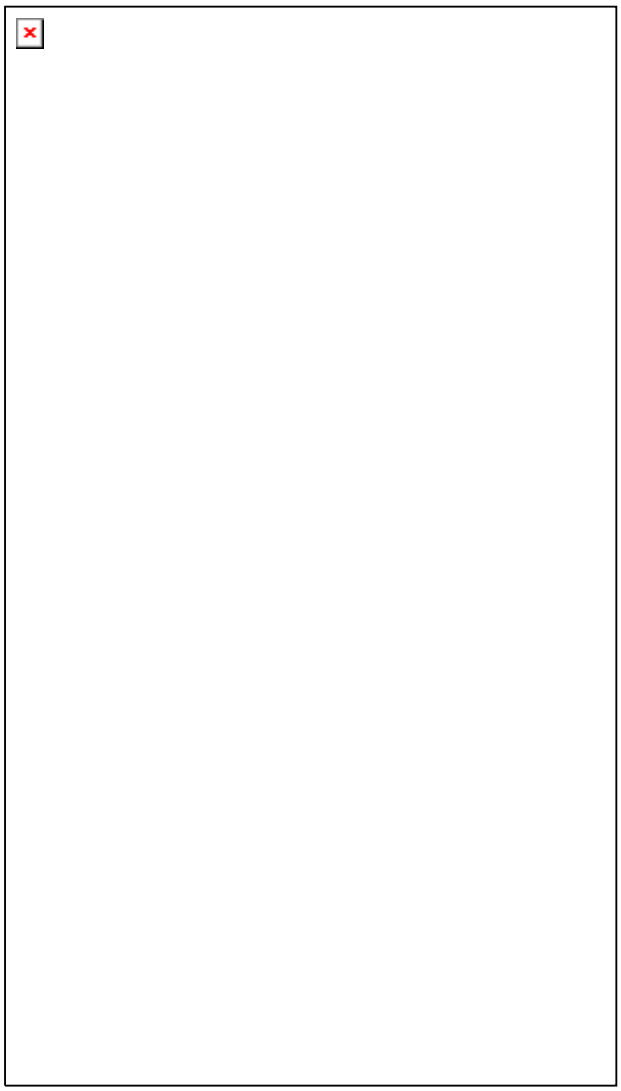
650-3-37



1/2–13UNC CLAMP KIT:

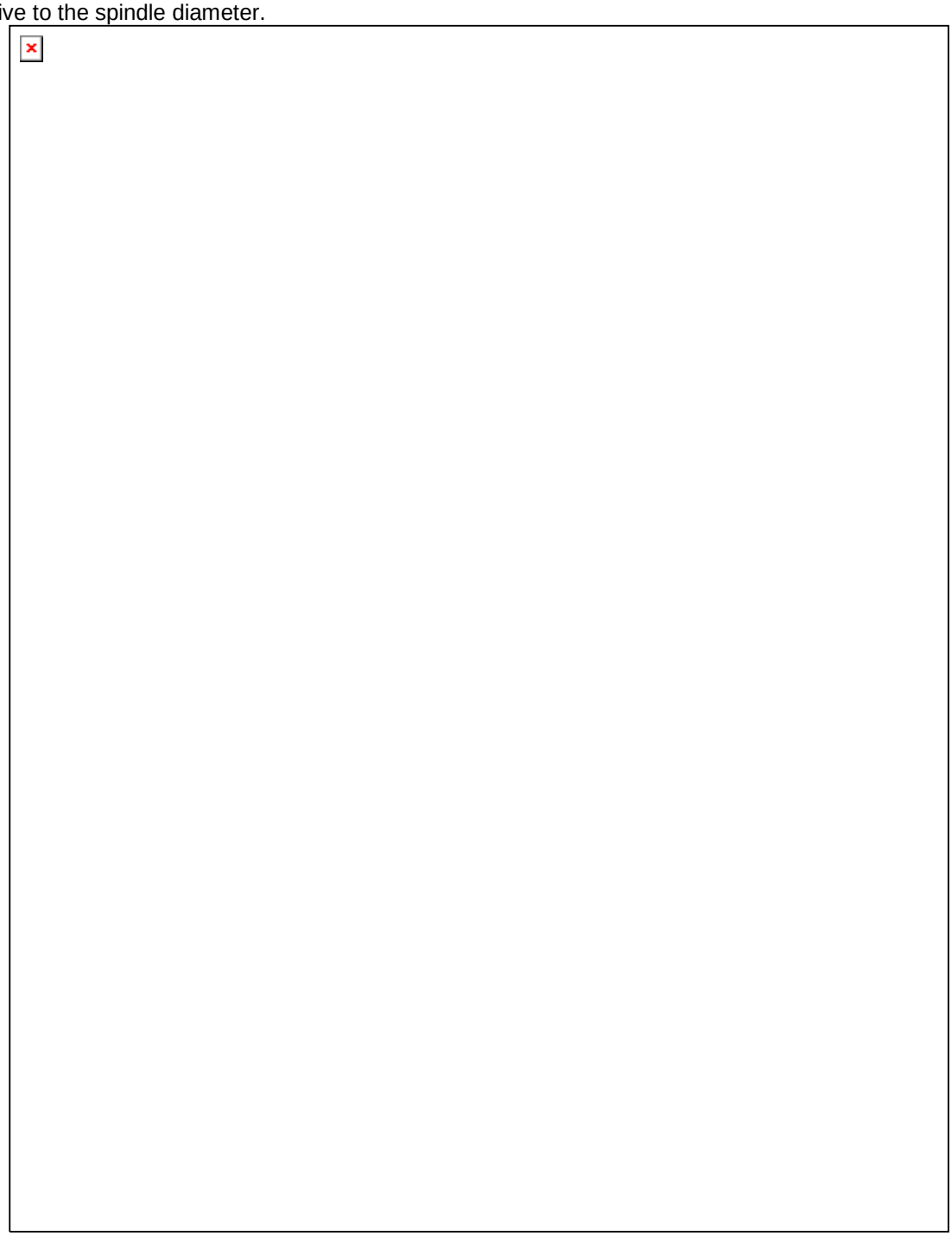
4 EACH: 6” STEP CLAMPS; STUDS: 3”, 4”, 5”, 6”, 7”, AND 8”; T–NUTS; HEX NUTS; COUPLING NUTS

3 Dimensional Electronic Position Finder 502-9-9G:

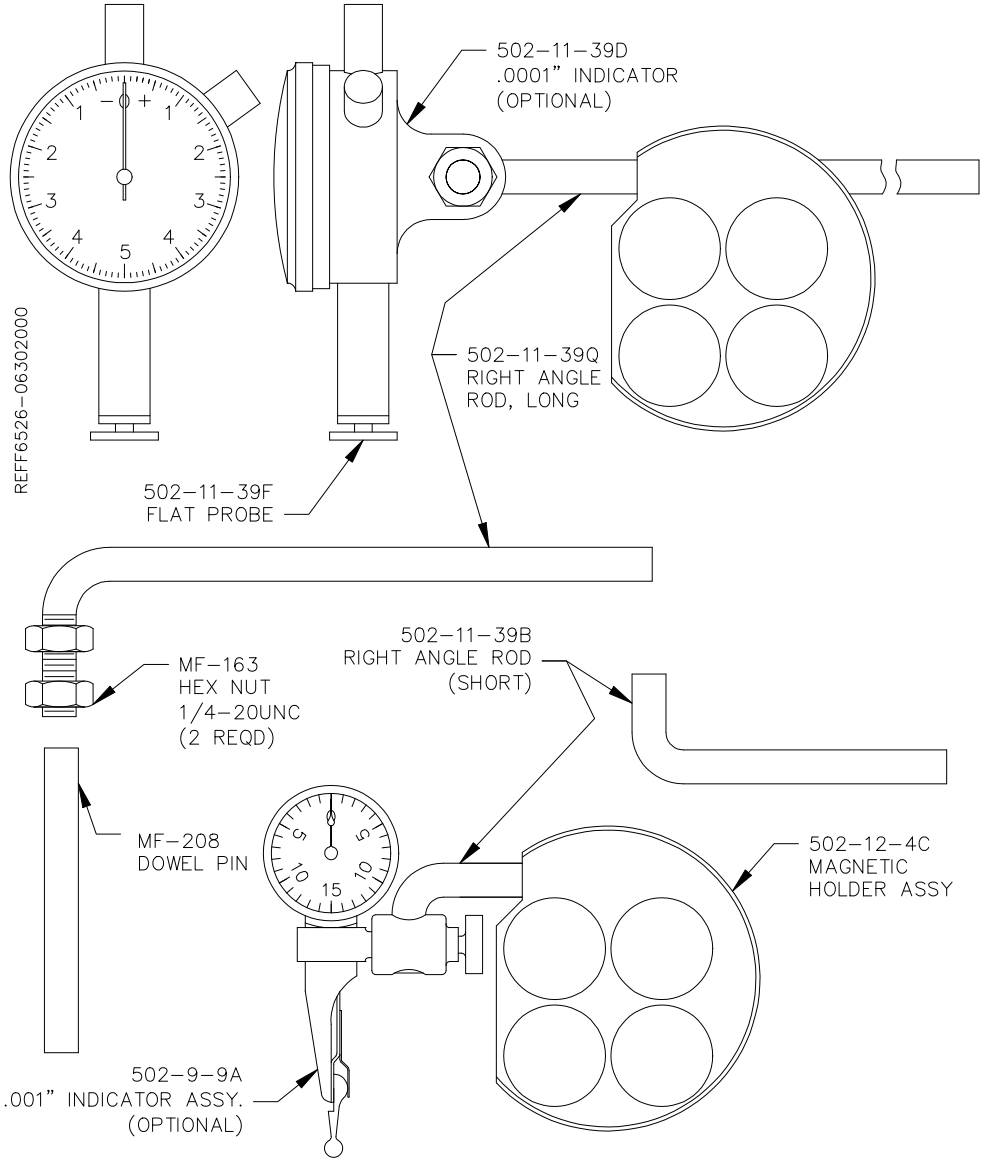


Remote run-Out indicating System 502-12-7A:

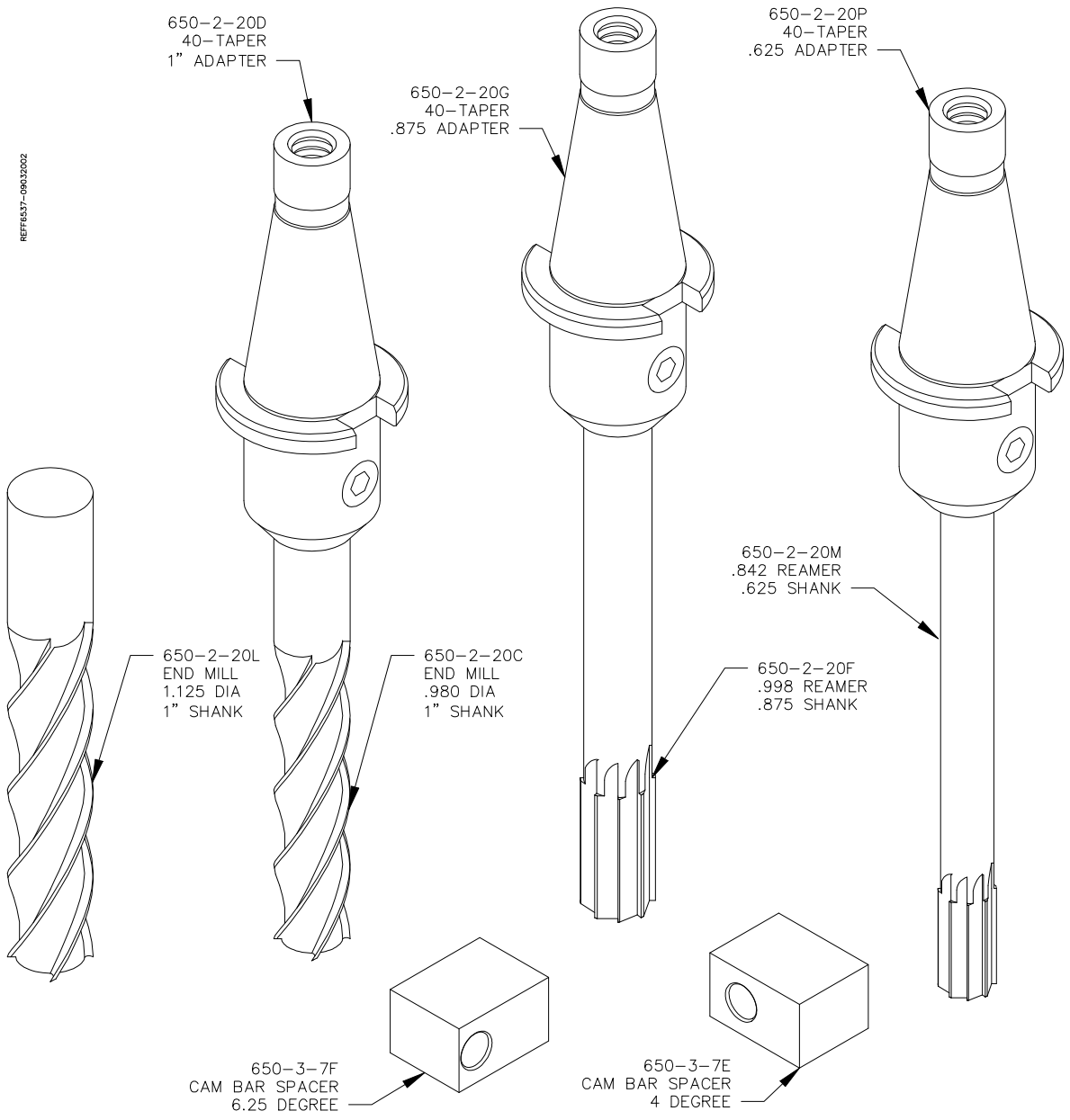
An optional remote indication air probe and gauge system is also available to check bore and face run-out. The stationary indicator allows easier reading and can be used in lower bore extremities where the mechanical dial indicator cannot be seen. The air probe can be used in a considerably smaller bore size relative to the spindle diameter.



Magnetic Indicator Holder 502-12-4:



Lifter Bore Tooling Package 650-2-20:



Additional Lifter Bore Tooling:

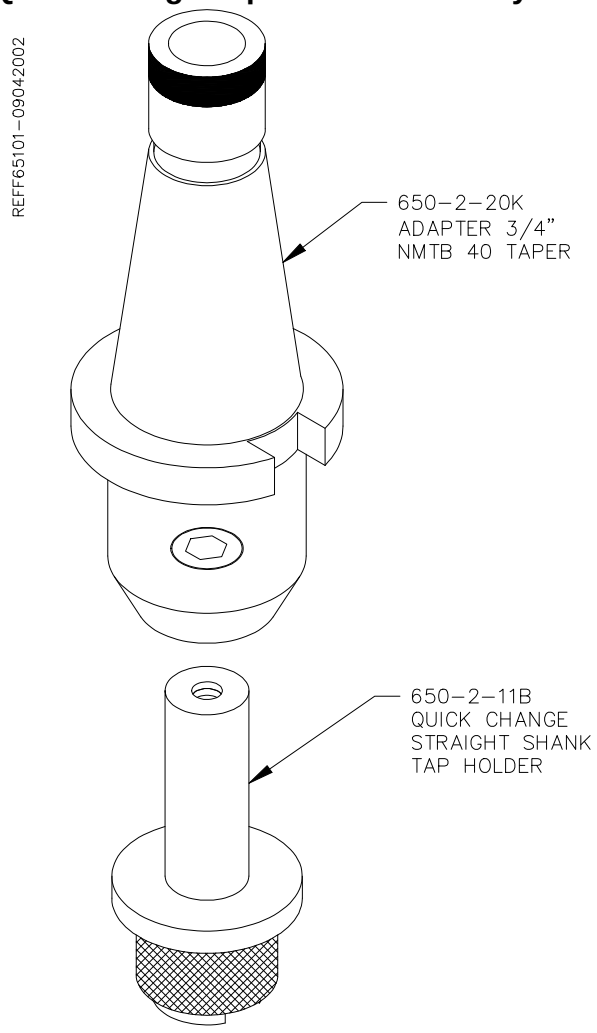
650-2-20Q	End mill, Special .859" Dia. X 8 1/4" long-4 flute (7/8" shank)-(Ford)
650-2-20X	End mill, Special .890" Dia. X 8 1/4" long-4 flute (7/8" shank)-(Mopar)

650-2-20J	Expansion reamer, .875" Dia. X 10" long (3/4" Shank) (Ford)
650-2-20V	Expansion reamer, .9035/.904" Dia. X 10" long (3/4" Shank) (Mopar)
650-2-20Y	Expansion reamer. Special .993 dia. X 10-1/2" long (7/8" shank) (Mopar)

650-3-7G	Spacer, cam bar 3.5 degree Ford 289/302/351W
650-3-7H	Spacer, cam bar 4-degree Ford 429/400
650-3-7J	Spacer cam bar 48-degree Mopar small block (Race)

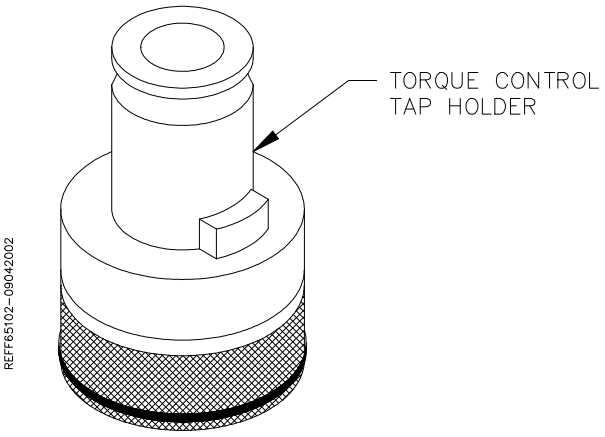
650-2-20R	Adaptor-1/2" NMTB 40 taper
650-2-20P	Adaptor-5/8" NMTB 40 taper
650-2-20K	Adaptor-3/4" NMTB 40 taper
650-2-20G	Adaptor-7/8" NMTB 40 taper
650-2-20D	Adaptor-1" NMTB 40 taper
650-2-20S	Adaptor-1 1/4" NMTB 40 taper

Quick Change Tap Holder Assembly 650-2-11J:



Torque Control Tap Holders:

Use with 650-2-11J Assembly

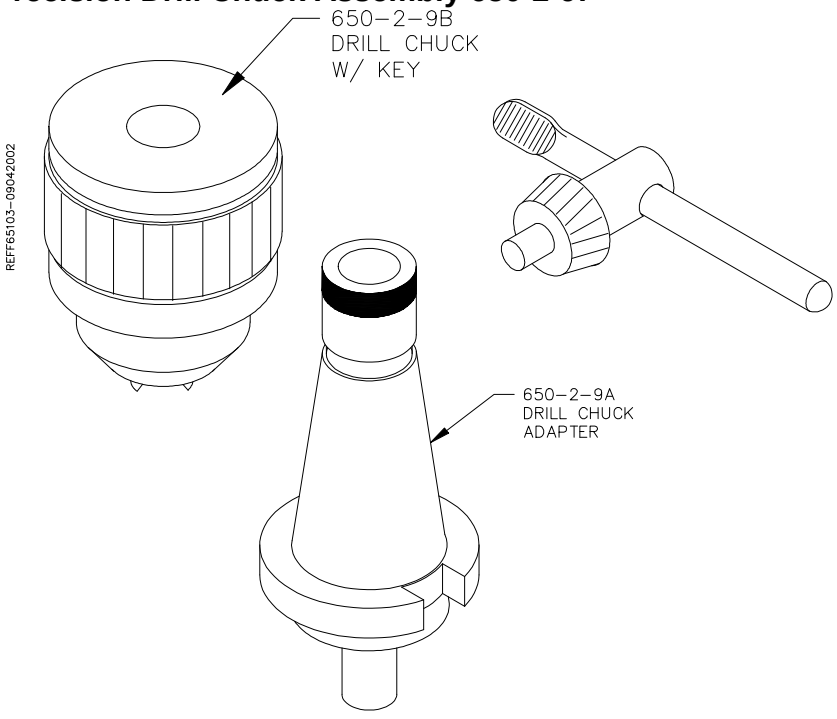


650-2-11C	Torque Control Tap Holder for 1/4" taps
650-2-11D	Torque Control Tap Holder for 5/16" taps
650-2-11E	Torque Control Tap Holder for 3/8" taps
650-2-11F	Torque Control Tap Holder for 7/16" taps
650-2-11G	Torque Control Tap Holder for 1/2" taps

Adapters NMTB 40 Taper:

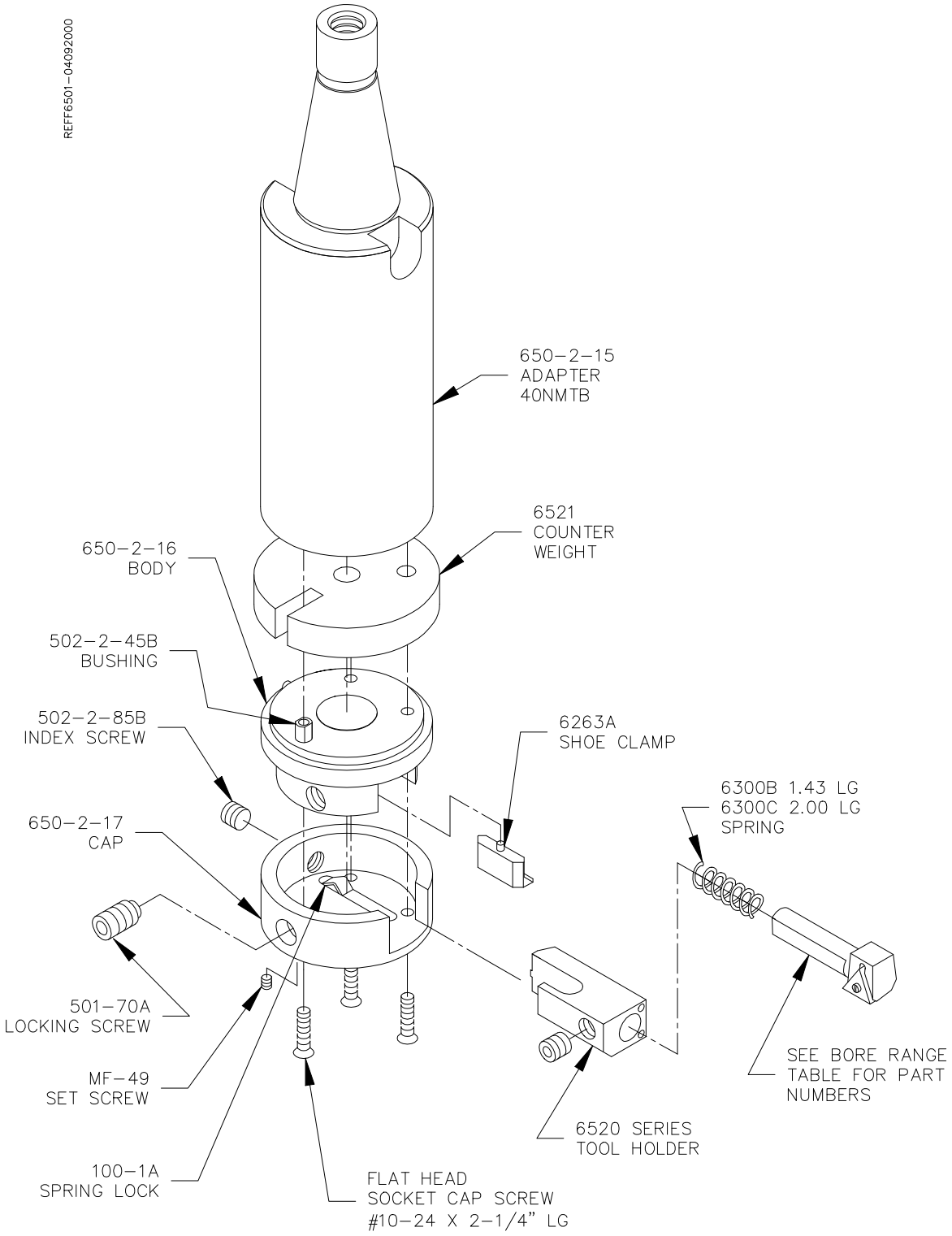
650-2-20R	Adaptor-1/2" NMTB 40 taper
650-2-20P	Adaptor-5/8" NMTB 40 taper
650-2-20K	Adaptor-3/4" NMTB 40 taper
650-2-20G	Adaptor-7/8" NMTB 40 taper
650-2-20D	Adaptor-1" NMTB 40 taper
650-2-20S	Adaptor-1 1/4" NMTB 40 taper

Precision Drill Chuck Assembly 650-2-9:



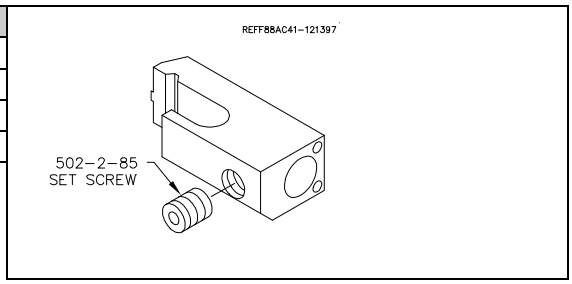
2.9” Cutterhead:

650-2-14 with Tooling
650-2-14A without Tooling



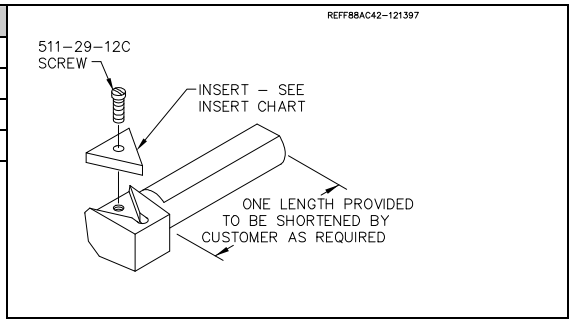
2.9" Cutterhead Standard Tooling:

6520 Series Tool Holders	
Tool Holder	Length
6520H	2.25"
6520A	2.37"
6520B	2.62"



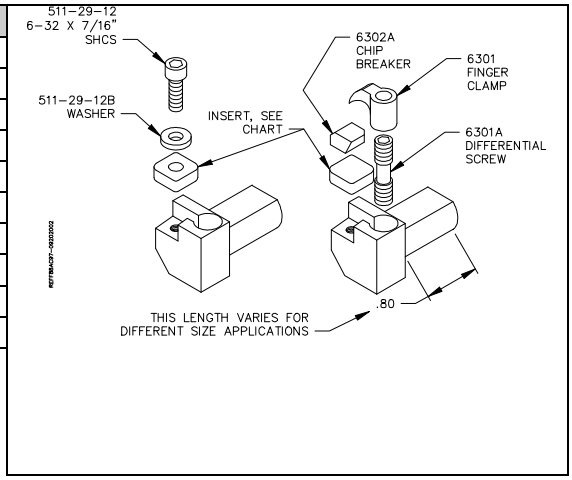
6598K Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6598K	6520H	3.75" – 4.00"
6598K	6520A	4.00" – 4.50"
6598K	6520B	4.50" – 5.00"

Triangle insert positive rake



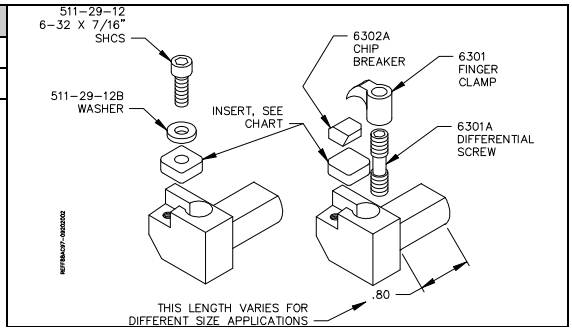
6260 Series Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6260K	6520H	3.75" – 4.00"
6260K	6520A	
6260K	6520B	
6260L	6520H	4.00" – 4.50"
6260L	6520A	
6260L	6520B	
6260M	6520H	
6260M	6520A	
6260M	6520B	4.50" – 5.00"

Square insert negative rake



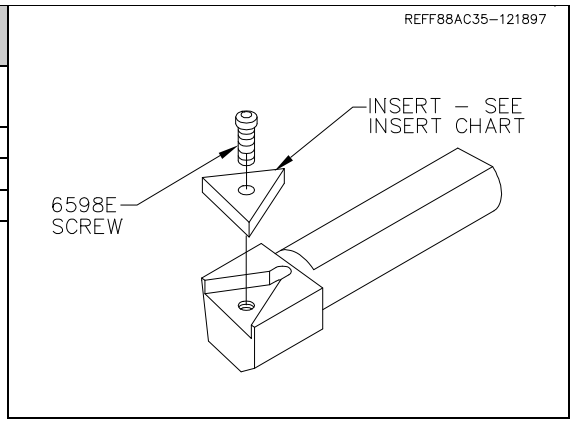
6260 SeriesTool Bit when used with 6520 Holders	
Tool Bit	Bore Range
6260W	3.78" – 5.24"

Square insert negative rake

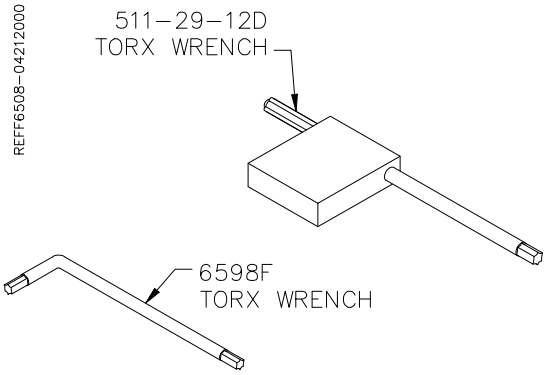


6547 Series Chamfering Tool Bits when used with 6520 Holders		
Tool Bit	Chamfer Angle	Bore Range
6547F	30	3.10” – 5.00”
6547G	20	3.30” – 5.00”
6547M	15	3.45” – 5.00”

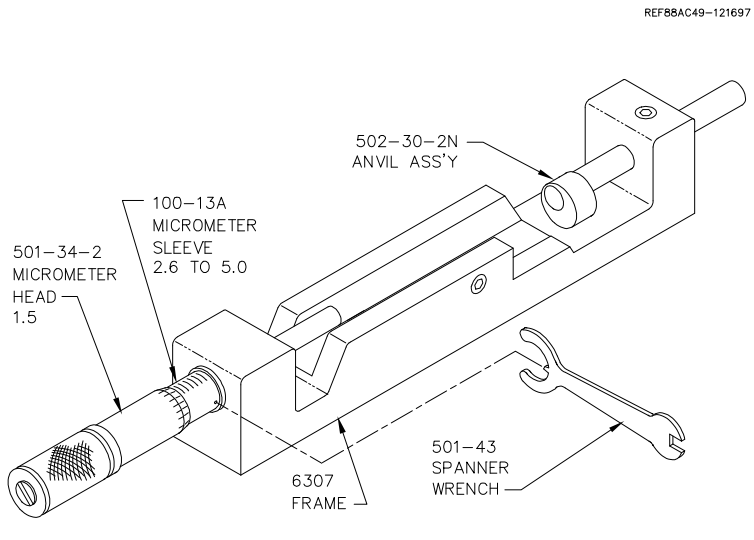
Triangle insert positive rake



511-29-12D Torx Wrench
6598F Torx Wrench
For use with Torx style screw in Triangle cartridges.

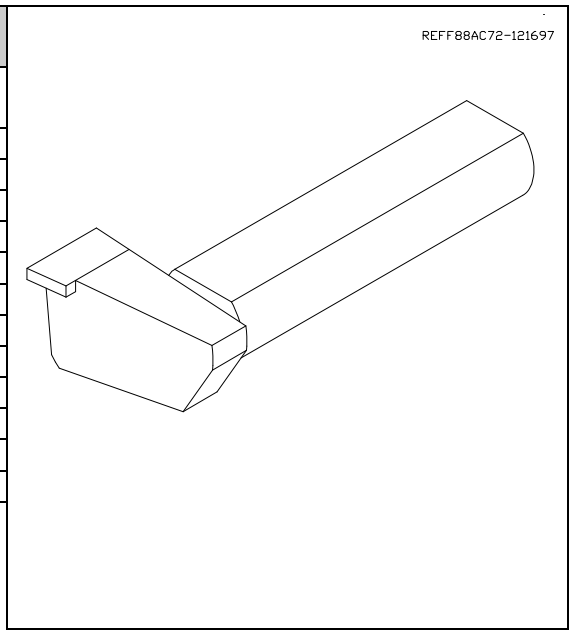


6307F Micrometer Assembly
2.9” – 5.0”



2.9” Cutterhead Optional Tooling:

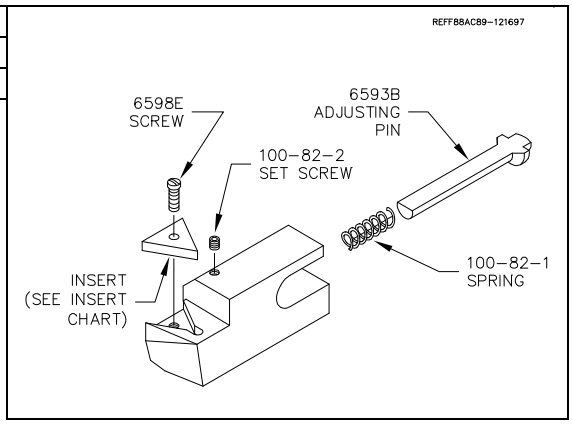
6513 Series Grooving Tool Bits when used with 6520 Holders			
Tool Bit	Groove DIA.	Tool Holder	Bore Range
6513J	.037”	6520H	3.55” – 3.95”
6513J	.037”	6520A	3.95” – 4.45”
6513J	.037”	6520B	4.45” – 4.85”
6513L	.039”	6520H	3.55” – 3.95”
6513L	.039”	6520A	3.95” – 4.45”
6513L	.039”	6520B	4.45” – 4.85”
6513N	.060”	6520H	3.55” – 3.95”
6513N	.060”	6520A	3.95” – 4.45”
6513N	.060”	6520B	4.45” – 4.85”
6513P	.085”	6520H	3.55” – 3.95”
6513P	.085”	6520A	3.95” – 4.45”
6513P	.085”	6520B	4.45” – 4.85”



Cartridge Tool Holders:

Tool Holder	Length	Bore Range
6593C	2.03”	2.90” – 3.40”
6593D	2.25”	3.40” – 3.90”

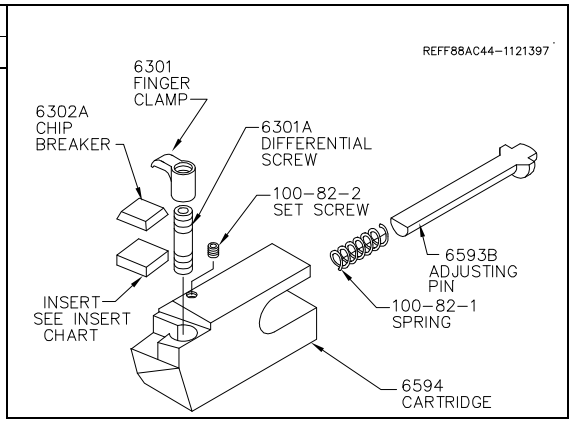
Triangle insert positive rake



6594 Cartridge Tool Holder:

Bore Range
2.90” – 3.90”

Square insert negative rake



Boring Inserts:

Speeds and Feed Rates will vary from Cutter Head to Cutter Head when using the same insert due to the different properties of each Cutter Head.

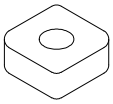
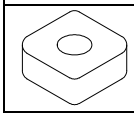
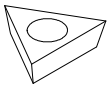
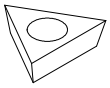
Boring Speeds and Feeds:
The Following insert feeds and speeds are designed to be used with the 650-2-14 Cutter Head Assembly.

Below is a description of the cutting inserts available from Rottler. The inserts have gone through extensive performance testing. To take full advantage of the capabilities of your Rottler Machine, we highly recommend Rottler tooling be used. This chart uses SFM or Surface Feet Per Minute as a speed reference. To calculate SFM to RPM use the following formula.

RPM = SFM X 3.83
DIAMETER

Example:
SFM = 800
4.00" Bore

800 X 3.83 = 3064 Divide by the diameter 4.00 = 766 RPM

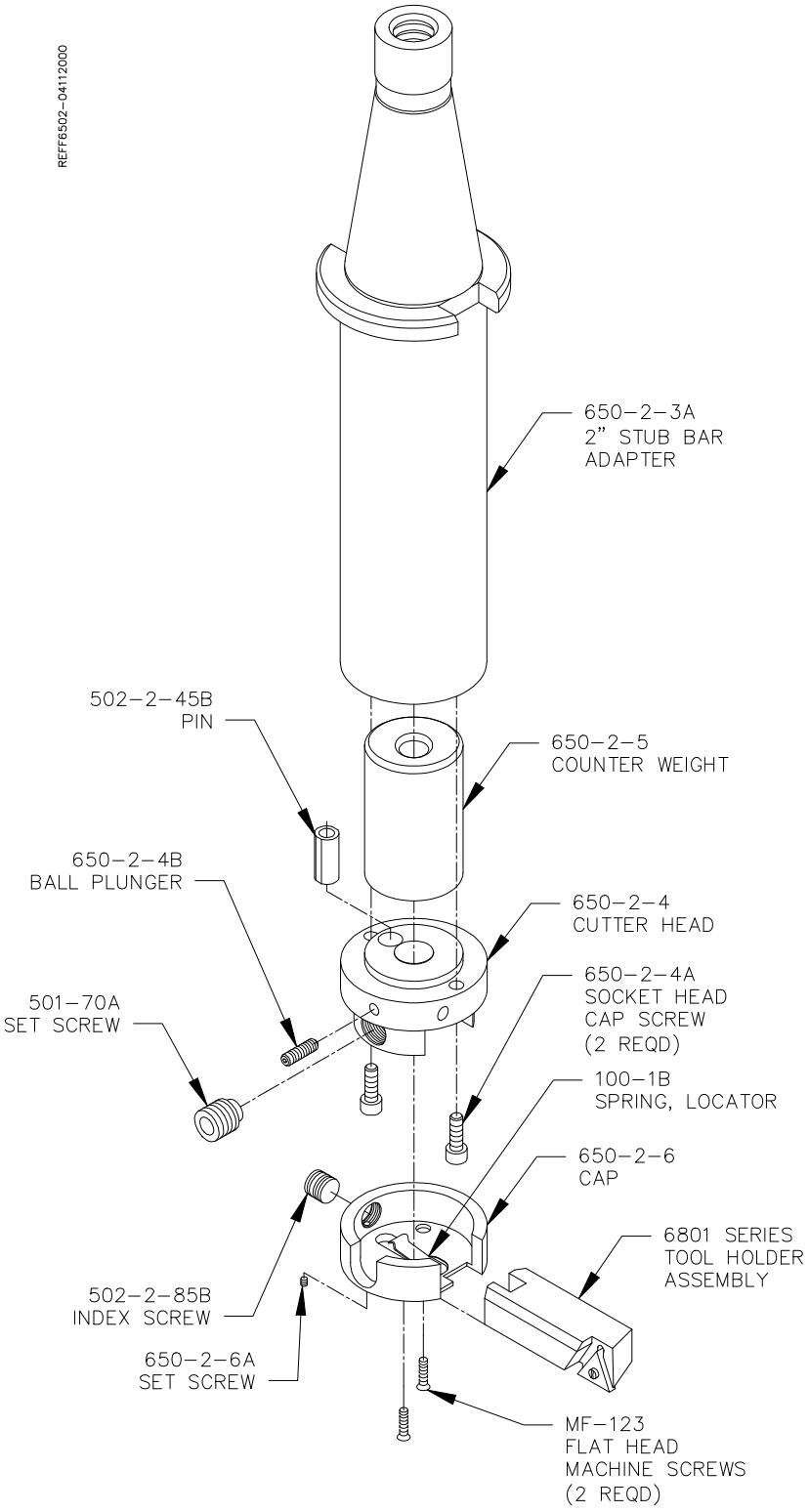
Insert	Part #	Description	Application
	501-29-6B	This is a 3/8" I.C. (inscribed circle) square insert with a gold titanium coating.	It is used for through boring when removing .010-.060 inches on the diameter. For best tool life use 500 - 800 SFM. Use a feed rate of .004 - .010 to obtain the typical surface finish.
	501-29-6E	This is a 3/8" I.C. (inscribed circle) square insert with a purple ceramic coating.	For best tool life use 800 - 1200 SFM. Use a feed rate of .006 - .012 to obtain the typical surface finish.
	RT321	A 3/8" IC triangular insert with a dark purple ceramic coating and 1/64" cutting radius.	The ceramic coating gives excellent results for both heavy sleeve cutting and finishing of cast iron and nodular cast iron when a square step is required. The 1/64" radius should be used when machining to a step where the mating part requires a smaller radius to eliminate an interference problem. If you are machining a long bore where the spindle must be extended towards the limits of its travel or if a long stub bar is being used, the 1/64" radius will minimize the possibility of chatter. A feed rate of .002 - .005 should be used to obtain a typical surface finish. When machining large counter bores typically found in Cummins or Cat Blocks, a feed rate of .002 - .004/rev. should be used. When cutting gray cast iron use a speed in the 800 – 1200 SFM area for best productivity and tool life. When cutting nodular cast iron the speed should be in the 200 – 400 SFM area. Nodular cast iron is found most often in high performance engine blocks or sleeves.
	RT322	This is the same insert as RT321, except it has a 1/32" radius.	This larger radius insert will give a smoother finish when sleeve cutting to allow easier sleeve fitting and closer metal to metal contact for heat transfer. The 1/32" radius is stronger

			than the 1/64 radius of the RT321. The RT322 should always be used for sleeve cuts unless the finish part requires the smaller radius for clearance or you are cutting a long bore. The larger radius creates more tool pressure than the small tool radius. The increased tool pressure will create chatter in the finish. A feed rate of .002 - .010 should be used to obtain a typical surface finish. When machining large counter bores typically found in Cummins or Cat Blocks, a feed rate of .002 - .004/rev. should be used. When cutting gray cast iron use a speed in the 800 – 1200 SFM area for best productivity and tool life. When cutting nodular cast iron the speed should be in the 200 – 400 SFM area. Nodular cast iron is found most often in high performance engine blocks or sleeves.
	RT211	A 3/8” IC triangular insert with a dark purple ceramic coating and 1/64” cutting radius.	The ceramic coating gives excellent results for both heavy sleeve cutting and finishing of cast iron and nodular cast iron when a square step is required. The 1/64” radius should be used when machining to a step where the mating part requires a smaller radius to eliminate an interference problem. If you are machining a long bore where the spindle must be extended towards the limits of its travel or if a long stub bar is being used, the 1/64” radius will minimize the possibility of chatter. A feed rate of .002 - .005 should be used to obtain a typical surface finish. When machining large counter bores typically found in Cummins or Cat Blocks, a feed rate of .002 - .004/rev. should be used. When cutting gray cast iron use a speed in the 800 – 1200 SFM area for best productivity and tool life. When cutting nodular cast iron the speed should be in the 200 – 400 SFM area. Nodular cast iron is found most often in high performance engine blocks or sleeves.
	RT221	This is the same insert as RT321, except it has a 1/32” radius.	This larger radius insert will give a smoother finish when sleeve cutting to allow easier sleeve fitting and closer metal to metal contact for heat transfer. The 1/32” radius is stronger than the 1/64 radius of the RT321. The RT322 should always be used for sleeve cuts unless the finish part requires the smaller radius for clearance or you are cutting a long bore. The larger radius creates more tool pressure than the small tool radius. The increased tool pressure will create chatter in the finish. A feed rate of .002 - .010 should be used to obtain a typical surface finish. When machining large counter bores typically found in Cummins or Cat Blocks, a feed rate of .002 - .004/rev. should be used. When cutting gray cast iron use a speed in the 800 – 1200 SFM area for best productivity and tool life. When cutting nodular cast iron the speed should be

			in the 200 – 400 SFM area. Nodular cast iron is found most often in high performance engine blocks or sleeves.
	6301E	This is a square 3/8" I.C., 1/32" Radius, Solid, CBN-Cubic Boron Nitride – Insert	These inserts are intended for use on high speed F-84/85 boring machines up to 2000 RPM. A feed rate of .010" - .014" per revolution. They have exceptional life when boring .040" or less at a high rate of speed.
	6301J	This is a square 3/8" I.C., 1/16" Radius, Solid, CBN-Cubic Boron Nitride – Insert	These inserts are intended for use on high speed F-84/85 boring machines up to 2000 RPM. A feed rate of .010" - .014" per revolution. They have exceptional life when boring .040" or less at a high rate of speed. The large radius will increase the tool pressure and could cause chatter in the bore when used near the limits of the cutterhead.

2.0” Cutterhead:

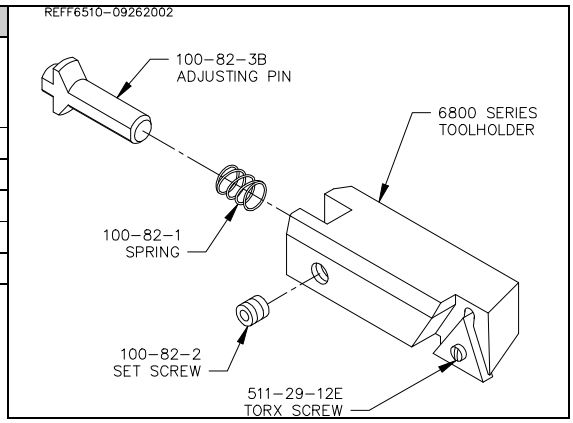
650-2-1 w/o Tooling
650-2-1A w/ Tooling



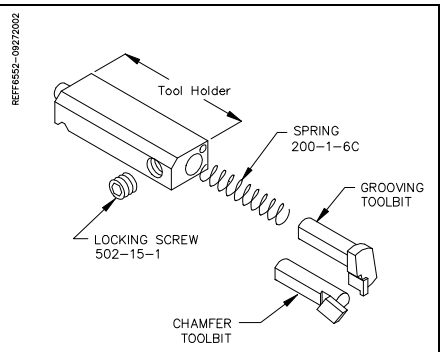
2.0" Cutterhead Standard Tooling:

6801 Series Tool Holders			
Assembly Part #	Tool Holder Part #	Length	Bore Range
6801B	6800B	1.54"	2.0" – 2.4"
6801C	6800C	1.75"	2.4" – 2.8"
6801D	6800D	1.95"	2.8" – 3.2"
6801E	6800E	2.15"	3.2" – 3.6"
6801F	6800F	2.35"	3.6" – 4.0"

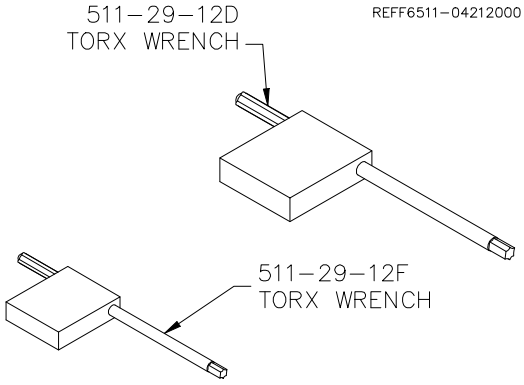
Triangle insert positive rake



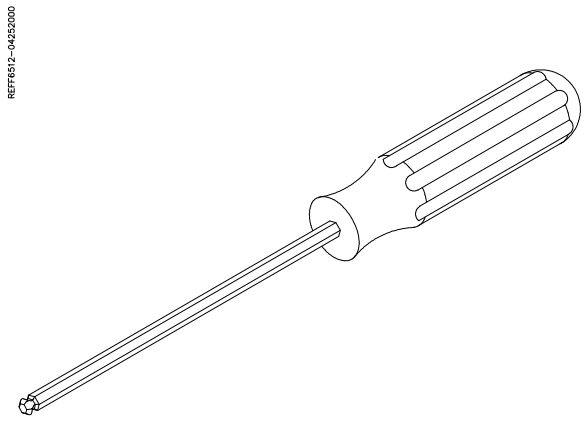
199 Series Tool Holders					
Tool Holder	**Holder Length**	**Tool Bit Grooving**	**Tool bit Chamfer**	**Degree or Width**	**Bore Range**
199-96	1.25"		501-33B	15 Deg	2.15" – 2.80"
"	"		501-33C	20 Deg	"
"	"		501-33D	30 Deg	"
"	"	501-31-3		.037"	"
"	"	501-31-1		.048"	"
199-89	1.50"		501-33B	15 Deg	2.80" – 3.45"
"	"		501-33C	20 Deg	"
"	"		501-33D	30 Deg	"
"	"	501-31-3		.037"	"
"	"	501-31-1		.048"	"
199-90	1.75"		501-33B	15 Deg	3.45" – 4.10"
"	"		501-33C	20 Deg	"
"	"		501-33D	30 Deg	"
"	"	501-31-3		.037"	"
"	"	501-31-1		.048"	"
199-94	2.25"		501-33B	15 Deg	4.10" – 4.75"
"	"		501-33C	20 Deg	"
"	"		501-33D	30 Deg	"
"	"	501-31-3		.037"	"
"	"	501-31-1		.048"	"



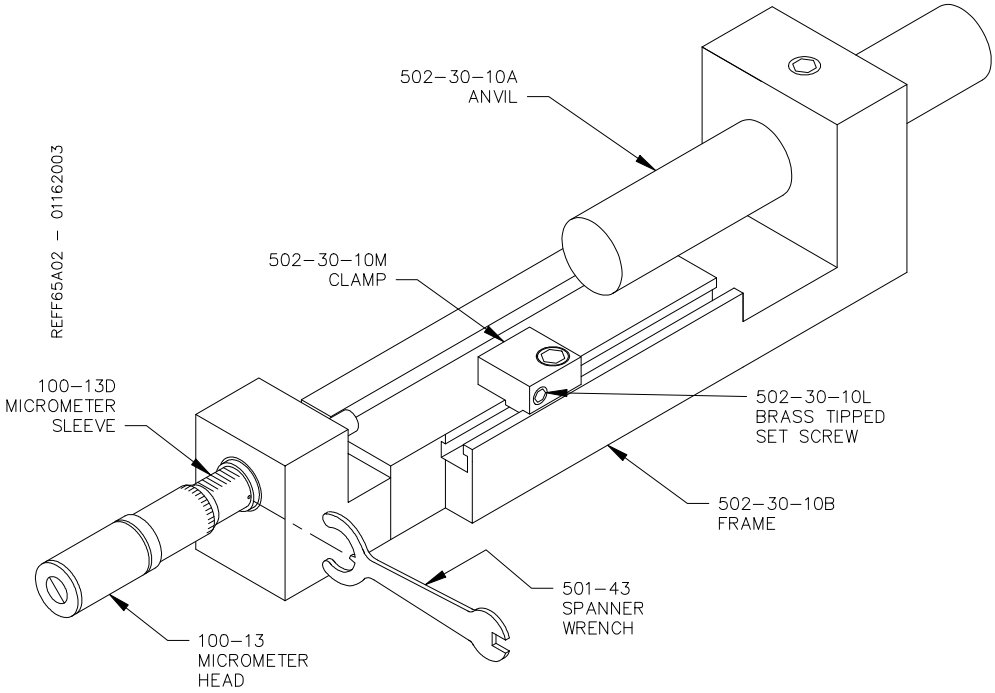
511-29-12D Torx Wrench
511-29-12F Torx Wrench
For use with Torx style screw in Triangle cartridges.



501-72J Hex Driver



900-2-11 Micrometer Assembly
2.0" – 4.0"



Boring Inserts:

Speeds and Feed Rates will vary from Cutter Head to Cutter Head when using the same insert due to the different properties of each Cutter Head.

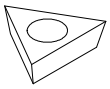
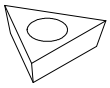
Boring Speeds and Feeds:
The Following insert feeds and speeds are designed to be used with the 650-2-1 Cutter Head Assembly.

Below is a description of the cutting inserts available from Rottler. The inserts have gone through extensive performance testing. To take full advantage of the capabilities of your Rottler Machine, we highly recommend Rottler tooling be used. This chart uses SFM or Surface Feet Per Minute as a speed reference. To calculate SFM to RPM use the following formula.

RPM = SFM X 3.83
DIAMETER

Example:
SFM = 800
4.00” Bore

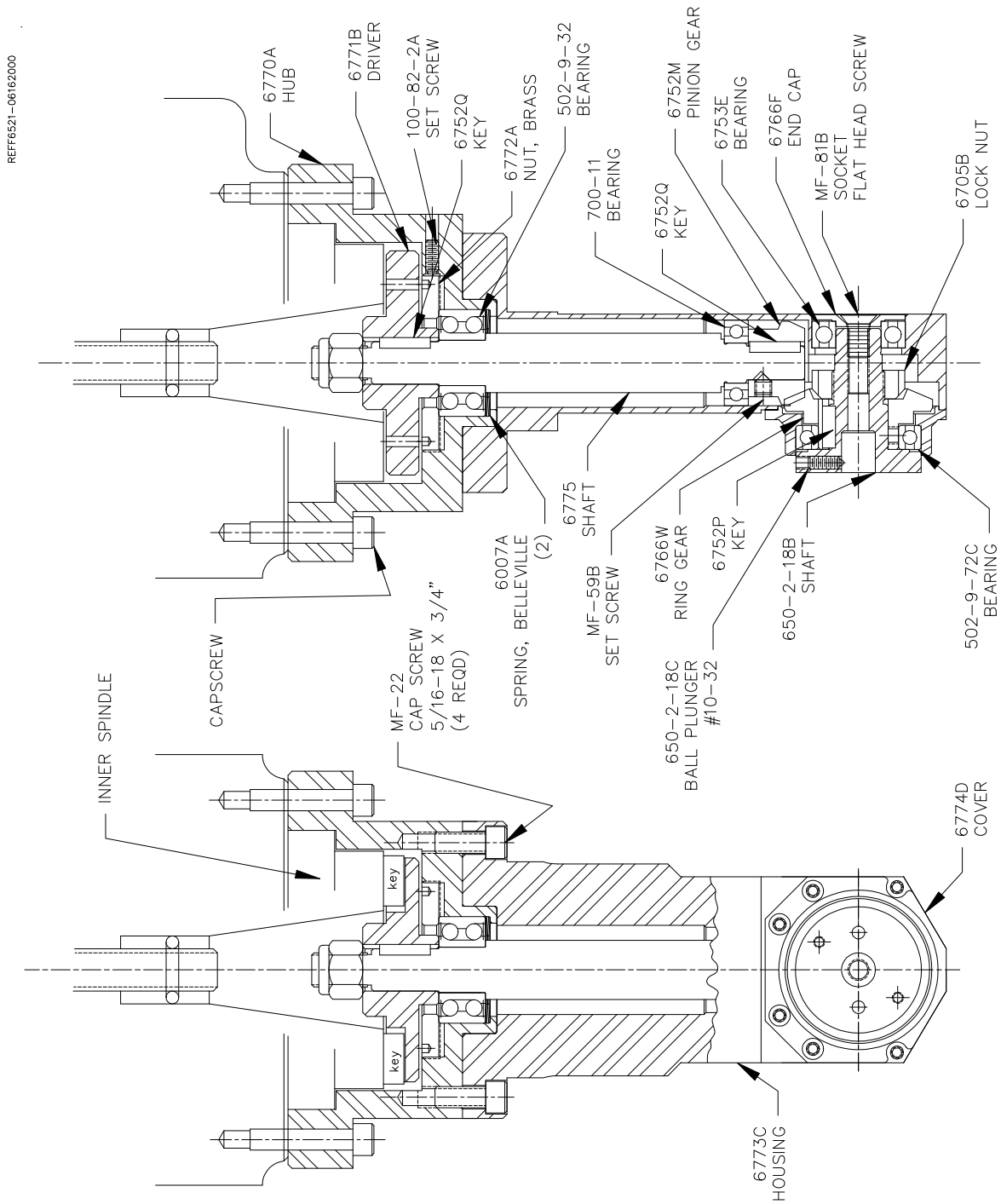
800 X 3.83 = 3064 Divide by the diameter 4.00 = 766 RPM

Insert	Part #	Description	Application
	RT321	A 3/8” IC triangular insert with a dark purple ceramic coating and 1/64” cutting radius.	The ceramic coating gives excellent results for both heavy sleeve cutting and finishing of cast iron and nodular cast iron when a square step is required. The 1/64” radius should be used when machining to a step where the mating part requires a smaller radius to eliminate an interference problem. If you are machining a long bore where the spindle must be extended towards the limits of its travel or if a long stub bar is being used, the 1/64” radius will minimize the possibility of chatter. A feed rate of .002 - .005 should be used to obtain a typical surface finish. When machining large counter bores typically found in Cummins or Cat Blocks, a feed rate of .002 - .004/rev. should be used. When cutting gray cast iron use a speed in the 400 – 600 SFM area for best productivity and tool life. When cutting nodular cast iron the speed should be in the 200 – 400 SFM area. Nodular cast iron is found most often in high performance engine blocks or sleeves.
	RT322	This is the same insert as RT321, except it has a 1/32” radius.	This larger radius insert will give a smoother finish when sleeve cutting to allow easier sleeve fitting and closer metal to metal contact for heat transfer. The 1/32” radius is stronger than the 1/64 radius of the RT321. The RT322 should always be used for sleeve cuts unless the finish part requires the smaller radius for clearance or you are cutting a long bore. The larger radius creates more tool pressure than the small tool radius. The increased tool pressure will create chatter in the finish. A feed rate of .002 - .010 should be used to obtain a typical surface finish. When machining large counter bores typically found in Cummins or Cat Blocks, a feed rate of .002 - .004/rev. should be used. When cutting gray cast iron use a speed in the 400 – 600 SFM area for best productivity and tool life. When cutting nodular cast iron the speed should be in the 200 – 400 SFM area. Nodular cast iron is found most often in high performance engine blocks or sleeves.
	RT211	A 3/8” IC triangular insert with a dark purple ceramic coating and 1/64” cutting radius.	The ceramic coating gives excellent results for both heavy sleeve cutting and finishing of cast iron and nodular cast iron when a square step is required. The 1/64” radius should be used when machining to a step where the mating part requires a smaller radius to eliminate an interference problem. If you are machining a

			long bore where the spindle must be extended towards the limits of its travel or if a long stub bar is being used, the 1/64" radius will minimize the possibility of chatter. A feed rate of .002 - .005 should be used to obtain a typical surface finish. When machining large counter bores typically found in Cummins or Cat Blocks, a feed rate of .002 - .004/rev. should be used. When cutting gray cast iron use a speed in the 400 – 600 SFM area for best productivity and tool life. When cutting nodular cast iron the speed should be in the 200 – 400 SFM area. Nodular cast iron is found most often in high performance engine blocks or sleeves.
	RT221	This is the same insert as RT321, except it has a 1/32" radius.	This larger radius insert will give a smoother finish when sleeve cutting to allow easier sleeve fitting and closer metal to metal contact for heat transfer. The 1/32" radius is stronger than the 1/64 radius of the RT321. The RT322 should always be used for sleeve cuts unless the finish part requires the smaller radius for clearance or you are cutting a long bore. The larger radius creates more tool pressure than the small tool radius. The increased tool pressure will create chatter in the finish. A feed rate of .002 - .010 should be used to obtain a typical surface finish. When machining large counter bores typically found in Cummins or Cat Blocks, a feed rate of .002 - .004/rev. should be used. When cutting gray cast iron use a speed in the 400 – 600 SFM area for best productivity and tool life. When cutting nodular cast iron the speed should be in the 200 – 400 SFM area. Nodular cast iron is found most often in high performance engine blocks or sleeves.

Right Angle Drive:

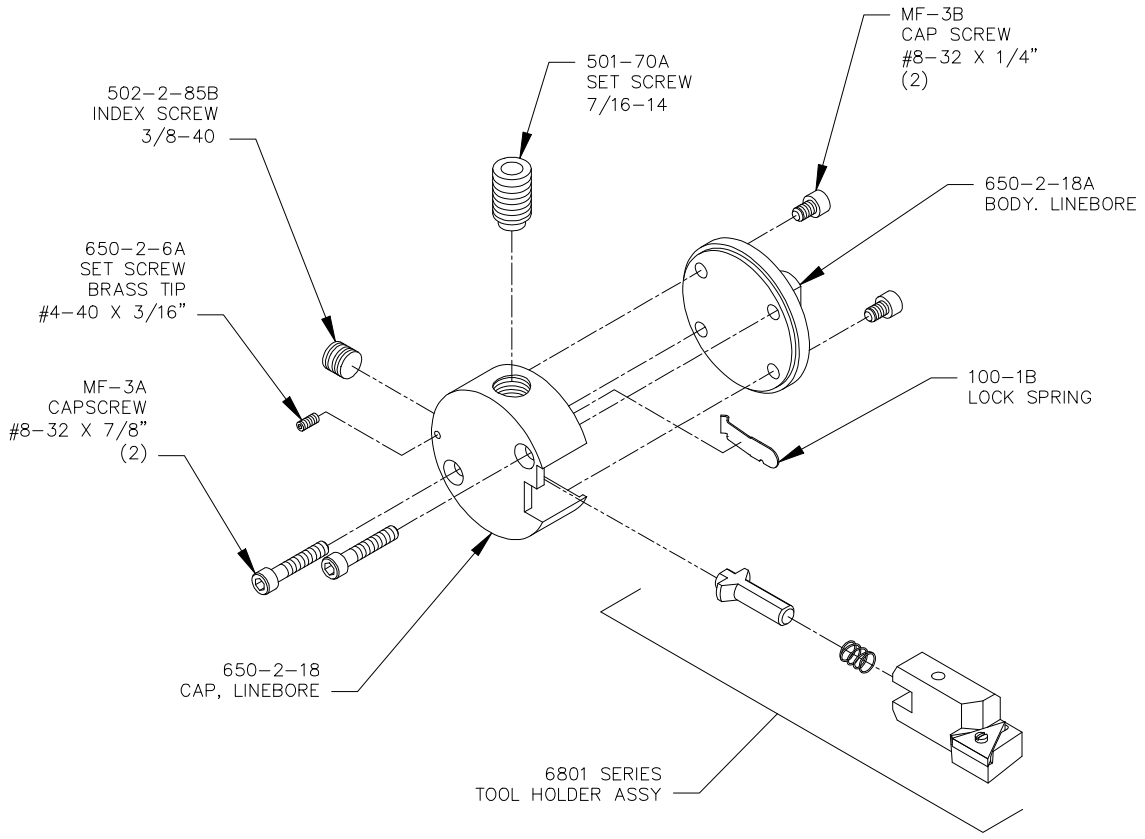
6733A w/o Tooling
650-2-19A w/ Tooling



Right Angle Drive Tooling:

650-2-19 Line Bore Cutterhead:

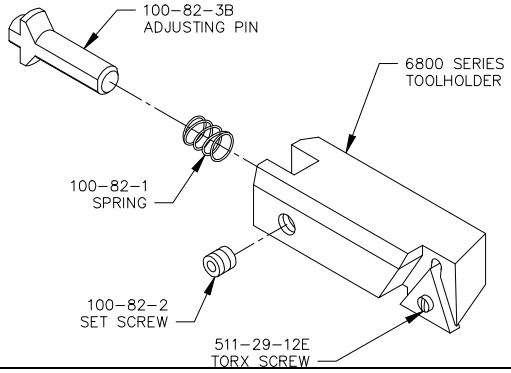
REFF6507–04192000



6801 Series Tool Holders			
Assembly Part #	Tool Holder Part #	Length	Bore Range
6801B	6800B	1.54”	2.0” – 2.4”
6801C	6800C	1.75”	2.4” – 2.8”
6801D	6800D	1.95”	2.8” – 3.2”
6801E	6800E	2.15”	3.2” – 3.6”
6801F	6800F	2.35”	3.6” – 4.0”

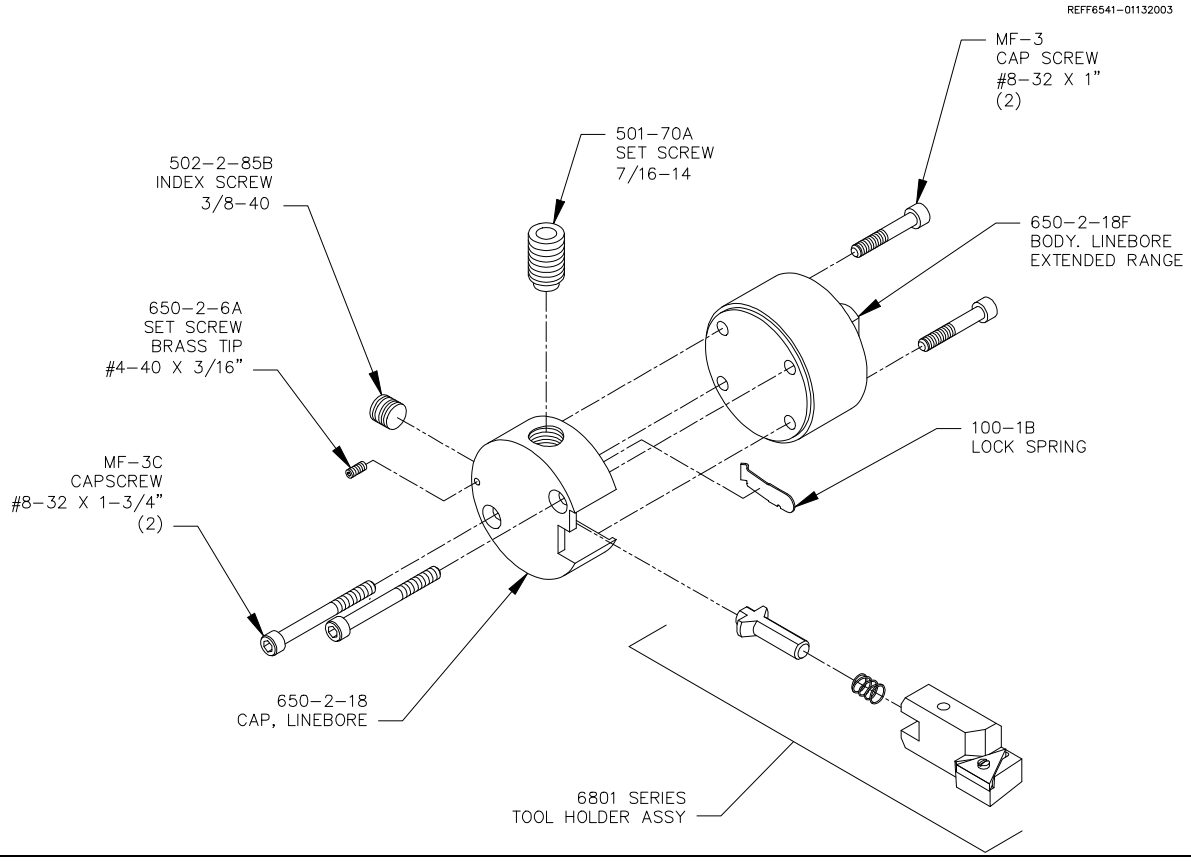
Triangle insert positive rake

REFF6510–09262002



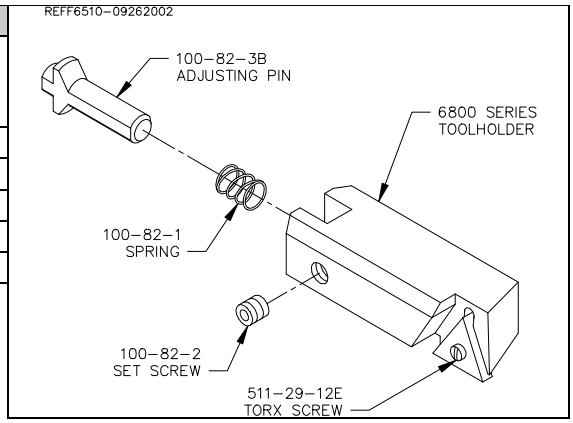
Right Angle Drive Tooling:

650-2-19B Extended Range Line Bore Cutterhead w/ Tooling:
650-2-19C Extended Range Line Bore Cutterhead w/o Tooling:

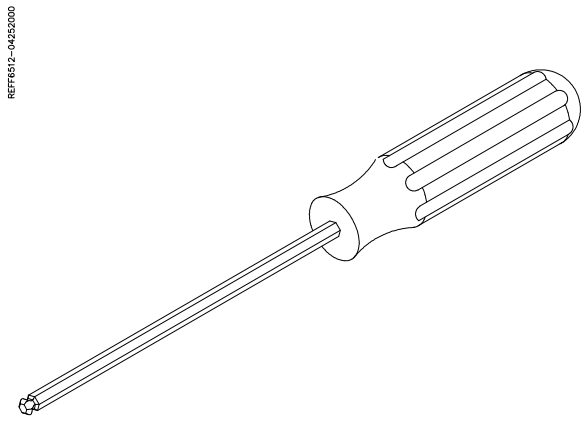


6801 Series Tool Holders			
Assembly Part #	Tool Holder Part #	Length	Bore Range
6801B	6800B	1.54”	2.0” – 2.4”
6801C	6800C	1.75”	2.4” – 2.8”
6801D	6800D	1.95”	2.8” – 3.2”
6801E	6800E	2.15”	3.2” – 3.6”
6801F	6800F	2.35”	3.6” – 4.0”

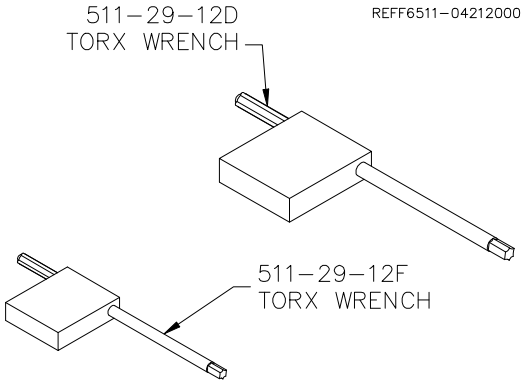
Triangle insert positive rake



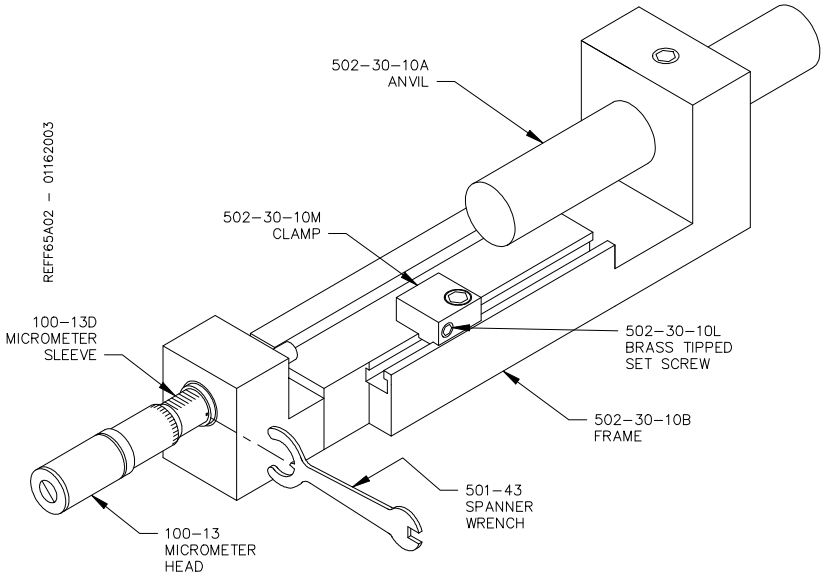
Hex Driver 3/16” 501-72J



Torx Wrench 511-29-12D
Torx Wrench 511-29-12F



Micrometer Assembly 900-2-11
2.0” – 4.0”



Boring Inserts:

Speeds and Feed Rates will vary from Cutter Head to Cutter Head when using the same insert due to the different properties of each Cutter Head.

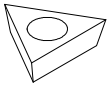
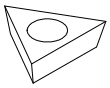
Boring Speeds and Feeds:
The Following insert feeds and speeds are designed to be used with the 650-2-19 and 19B Cutter Head Assemblies.

Below is a description of the cutting inserts available from Rottler. The inserts have gone through extensive performance testing. To take full advantage of the capabilities of your Rottler Machine, we highly recommend Rottler tooling be used. This chart uses SFM or Surface Feet Per Minute as a speed reference. To calculate SFM to RPM use the following formula.

RPM = SFM X 3.83
DIAMETER

Example:
SFM = 800
4.00" Bore

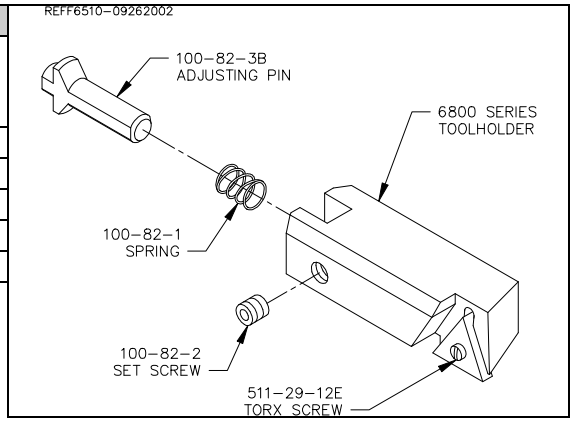
800 X 3.83 = 3064 Divide by the diameter 4.00 = 766 RPM

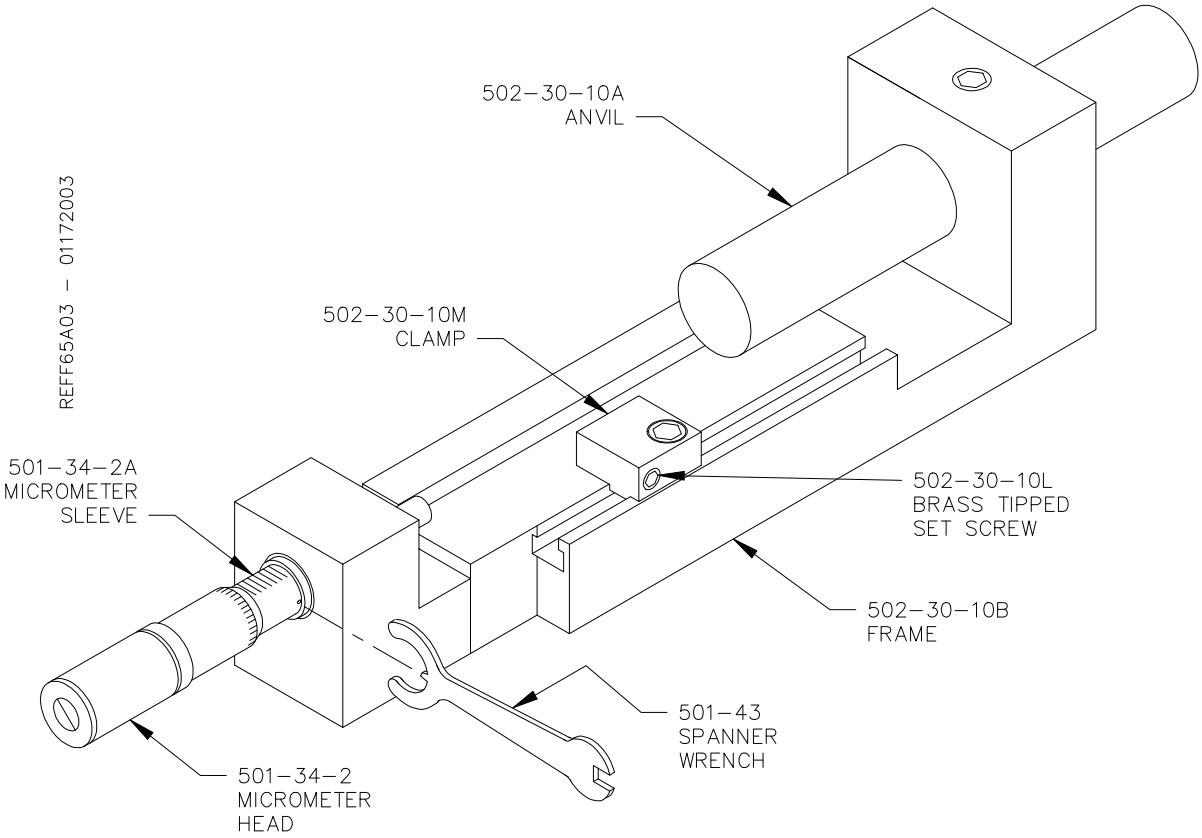
Insert	Part #	Description	Application
	RT321	A 3/8" IC triangular insert with a dark purple ceramic coating and 1/64" cutting radius.	The ceramic coating gives excellent results for both heavy sleeve cutting and finishing of cast iron and nodular cast iron. The 1/64" will minimize the possibility of chatter on a line bore. A feed rate of .002 - .003 should be used to obtain a typical surface finish. A speed of 200 to 400 SFM should be used for best results.
	RT322	This is the same insert as RT321, except it has a 1/32" radius.	This larger radius insert will give a smoother finish but increase the possibility of chatter. A feed rate of .002 - .003 should be used to obtain a typical surface finish. A speed of 200 to 400 SFM should be used for best results.
	RT211	A 3/8" IC triangular insert with a dark purple ceramic coating and 1/64" cutting radius.	The ceramic coating gives excellent results for both heavy sleeve cutting and finishing of cast iron and nodular cast iron. The 1/64" will minimize the possibility of chatter on a line bore. A feed rate of .002 - .003 should be used to obtain a typical surface finish. A speed of 200 to 400 SFM should be used for best results.
	RT221	This is the same insert as RT321, except it has a 1/32" radius.	This larger radius insert will give a smoother finish but increase the possibility of chatter. A feed rate of .002 - .003 should be used to obtain a typical surface finish. A speed of 200 to 400 SFM should be used for best results.

Optional Main Line Bore Tooling:
4” to 6”
(must use micrometer 900-2-5)

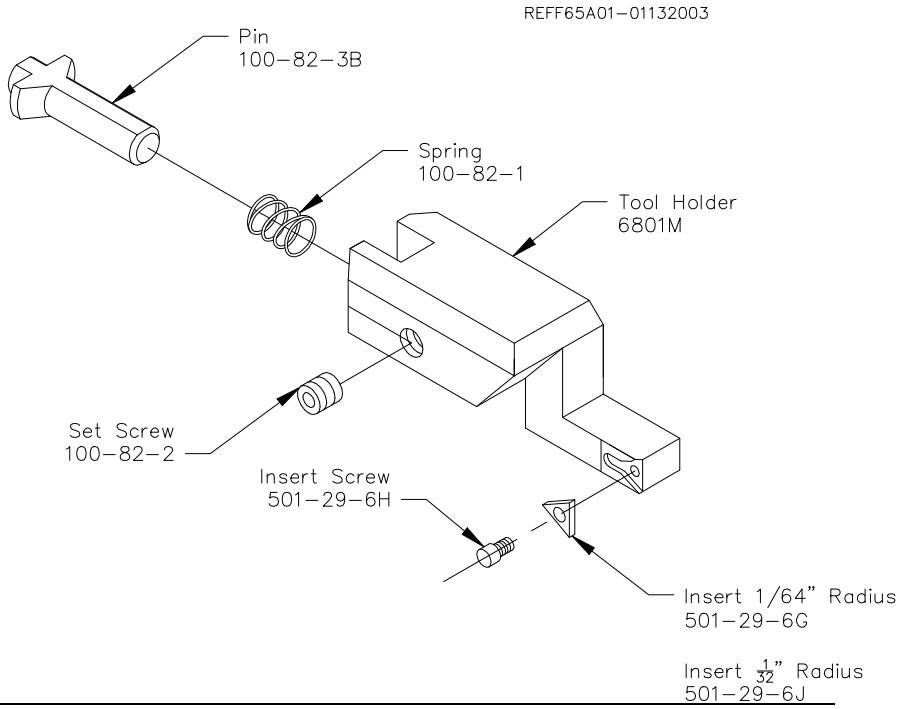
6801 Series Tool Holders			
Assembly Part #	Tool Holder Part #	Length	Bore Range
6801G	6800G	2.55”	4.0” – 4.4”
6801H	6800H	2.75”	4.4” – 4.8”
6801J	6800J	2.95”	4.8” – 5.2”
6801K	6800K	3.15”	5.2” – 5.6”
6801L	6800L	3.35”	5.6” – 6.0”

Triangle insert positive rake

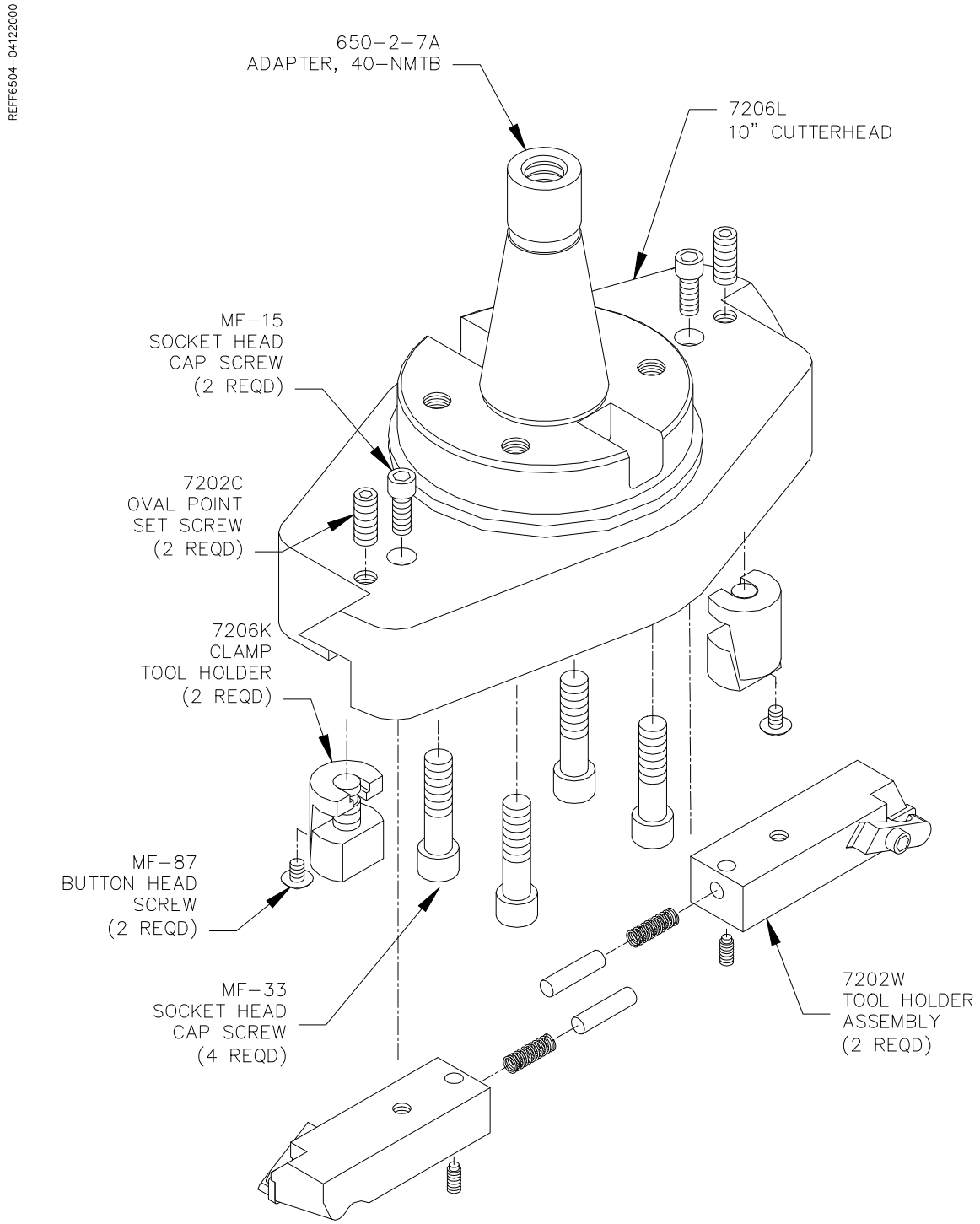




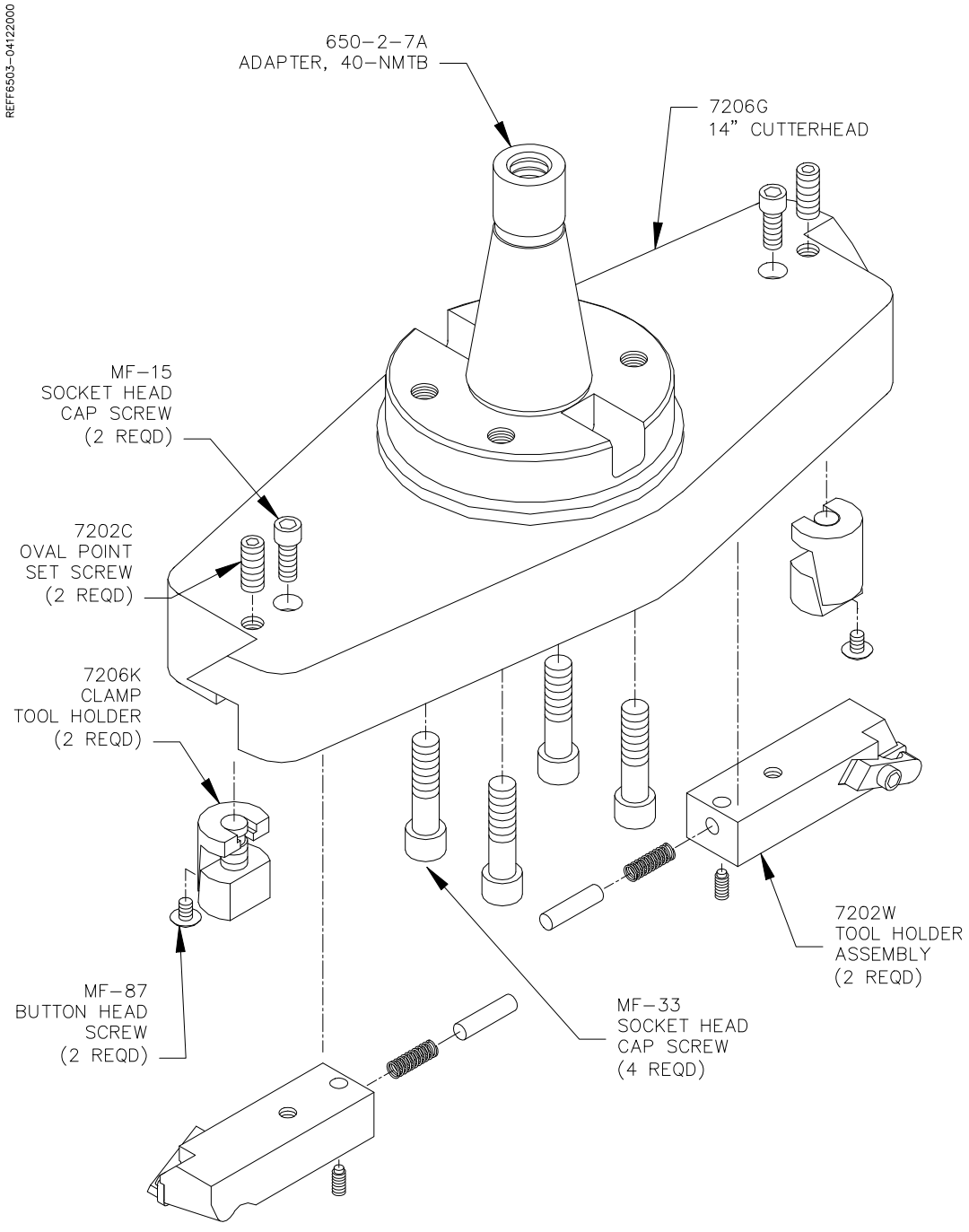
Thrust Facing Tool Holder;
6801M



10” Surfacing Head w/ Tooling:
650-2-8B



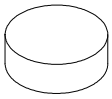
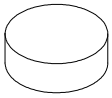
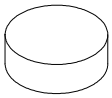
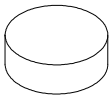
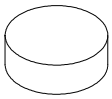
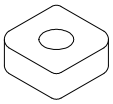
14” Surfacing Head w/ Tooling:
650-2-8C

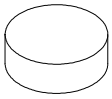
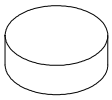


Surfacing Inserts:

Surfacing Speeds and Feeds:

Below is a description of the cutting inserts available from Rottler. The inserts have gone through extensive performance testing. To take full advantage of the capabilities of your Rottler Machine, we highly recommend Rottler tooling be used.

Insert	Part #	Description	Application
	6303B	A round 3/8" IC, double sided, CBN Insert.	An excellent, long life insert for surfacing cast iron heads and blocks -round shape gives many cutting edges on each side of insert. When using a 14" cutterhead (SF, F65, F80) speeds range from 900-1200 RPM.
	6303M	A round 3/8" IC, single sided, PCD Insert.	For use on aluminum only - heads and blocks without liners. This insert has a thin layer of PCD applied to a carbide disk. The diamond appears to be a shiny black wafer. The hardness of the diamond resists the abrasive nature of the silica in aluminum heads and blocks. RPM speeds with a 14" cutter range from 900-2000 RPM.
	6303K	A round, 3/8" IC, single sided, coated carbide Insert.	This is a very economical, general purpose insert for surfacing aluminum. It is advisable to use this insert for rough cutting to remove welding or contaminants before. A PCD insert should be used for the final cut to give the super fine finish required for MLS (multi layer steel) head gaskets. RPM speeds with a 14" cutterhead range from 600-1000RPM.
	6303S	A round 3/8" IC, single sided, CBN Insert.	For use on aluminum blocks with iron liners and aluminum heads with steel pre-combustion chambers. When cutting aluminum heads with pre-combustion chambers it is best to use Rottler Manufacturing's spray mist coolant system. RPM speeds with a 14" cutter range from 650-750 RPM.
	6303R	A round 3/8" IC, single sided, CBN Insert.	For use on cast iron heads with steel pre-combustion chambers. RPM speed with a 14" cutter range from 600-700 RPM.
	501-29-6E	This is a 3/8" IC square carbide insert with a purple ceramic coating.	This carbide insert is normally used for high speed boring. It works well as an economical insert for rough surfacing or heavy stock removal of cast iron. A CBN insert should be used for the final finish cut.
	6301J	A square 3/8" IC, 1/16" Radius, double sided, CBN Insert.	The 1/16" radius of this insert will produce a more accurate (flatter) finish than a round insert typically used for surfacing. This insert is often used on F80-Series machines when surfacing large diesel blocks which are high in nickel. The square surfacing insert is intended for F80 applications where it may

			encounter heavier cuts and greater interrupted cuts. When using an 18” cutter speeds range from 600-800 RPM, and with a 14” cutter speeds range from 900-1200 RPM.
	6303P	A round 1/2” IC, single sided, PCD Insert.	For use on aluminum only - heads and blocks without liners. This insert has a thin layer of PCD applied to the top of a carbide disk. The diamond appears to be a shiny black wafer. The hardness of the diamond resists the abrasive nature of the silica in aluminum heads and blocks. RPM speeds with a 14” cutter range from 1000-2000 RPM. This insert gives the maximum productivity when cutting aluminum. Requires the purchase of 1/2” negative rake tool holders. The standard Rottler 3/8” IC tool holders will not hold this insert.
	6303Q	A round 1/2” IC double sided, CBN Insert.	An excellent insert for machining cast iron heads and blocks. Round shape gives many cutting edges on each side of insert. Requires the purchase of 1/2” negative rake tool holders. The standard Rottler 3/8” IC tool holders will not hold this insert.

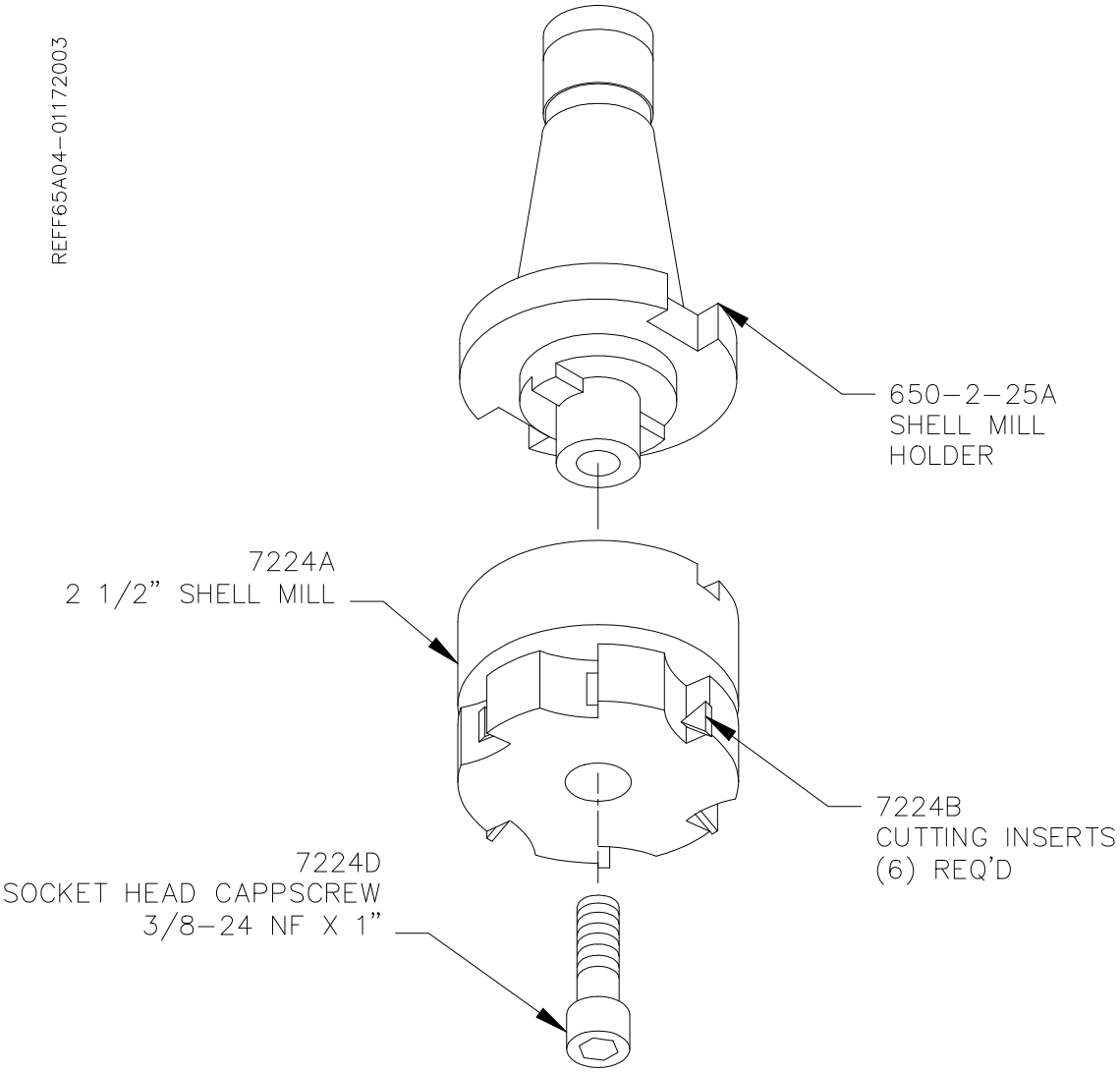
General Information:

Rottler CBN and PCD Inserts are laser marked with our part number on one side. On single sided inserts, the part number is on the back side of the insert.

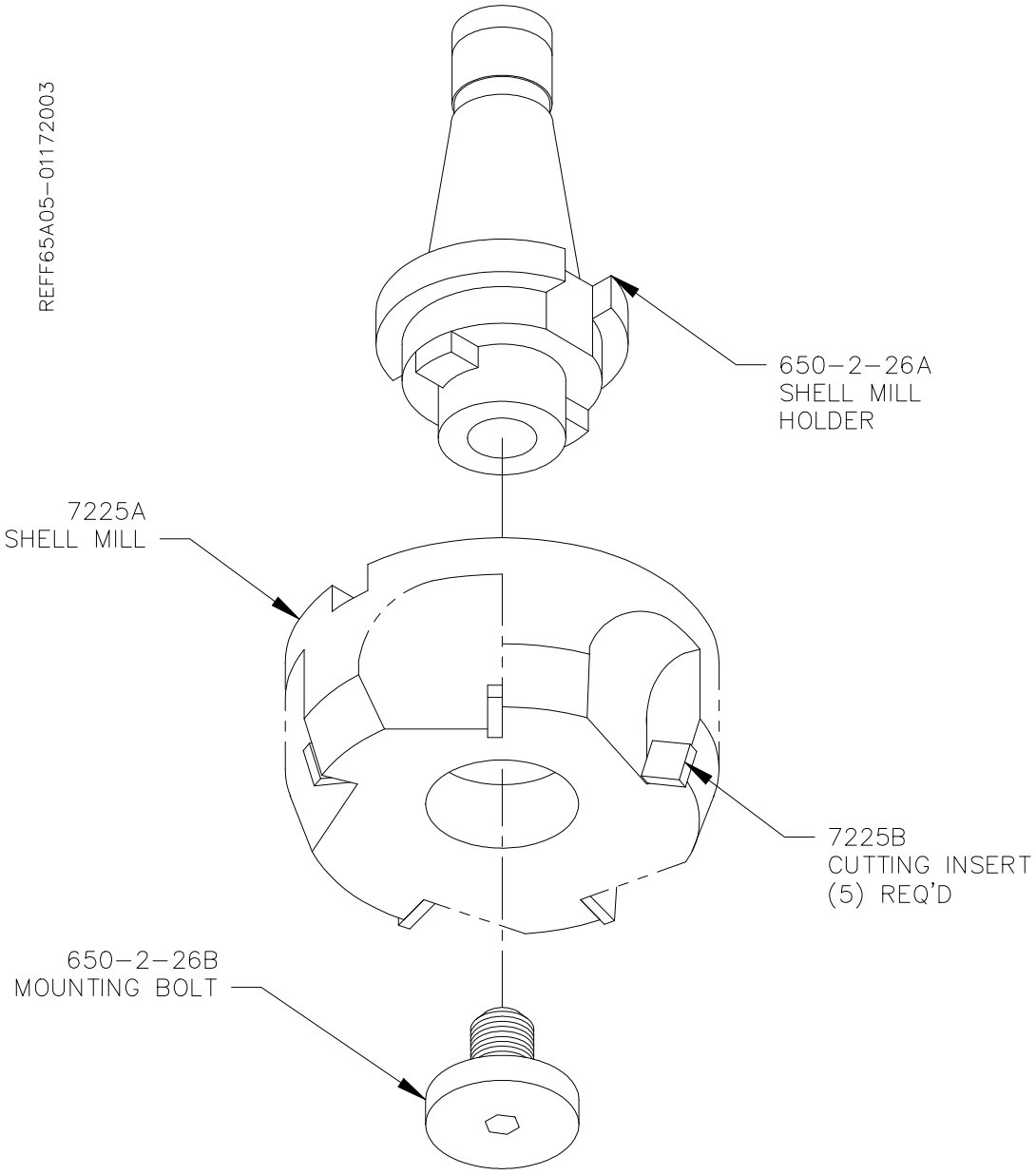
Rottler surfacing insert toolholders are designated IC (inscribed circle) which means they can hold square and round inserts with the same IC, for example, a 3/8” IC round and 3/8” IC square insert will fit into the standard 3/8” IC Rottler toolholders.

Rottler SF, F65 and F80 Series machines are supplied standard with Rottler 3/8” IC toolholders fitted to our surfacing heads. Optional 1/2” tool holders are interchangeable with 3/8” toolholders.

2 ½" Shell Mill Assembly w/ Tooling:
650-2-25



4" Shell Mill Assembly w/ Tooling:
650-2-26



Complete Listing of NMTB 40 Taper Shell Mill Arbors:

Part #	Width of Shell Mill Bore
6502-25A	¾"
650-2-20T	1"
650-2-26A	1 ¼"
650-2-20U	1 ½"

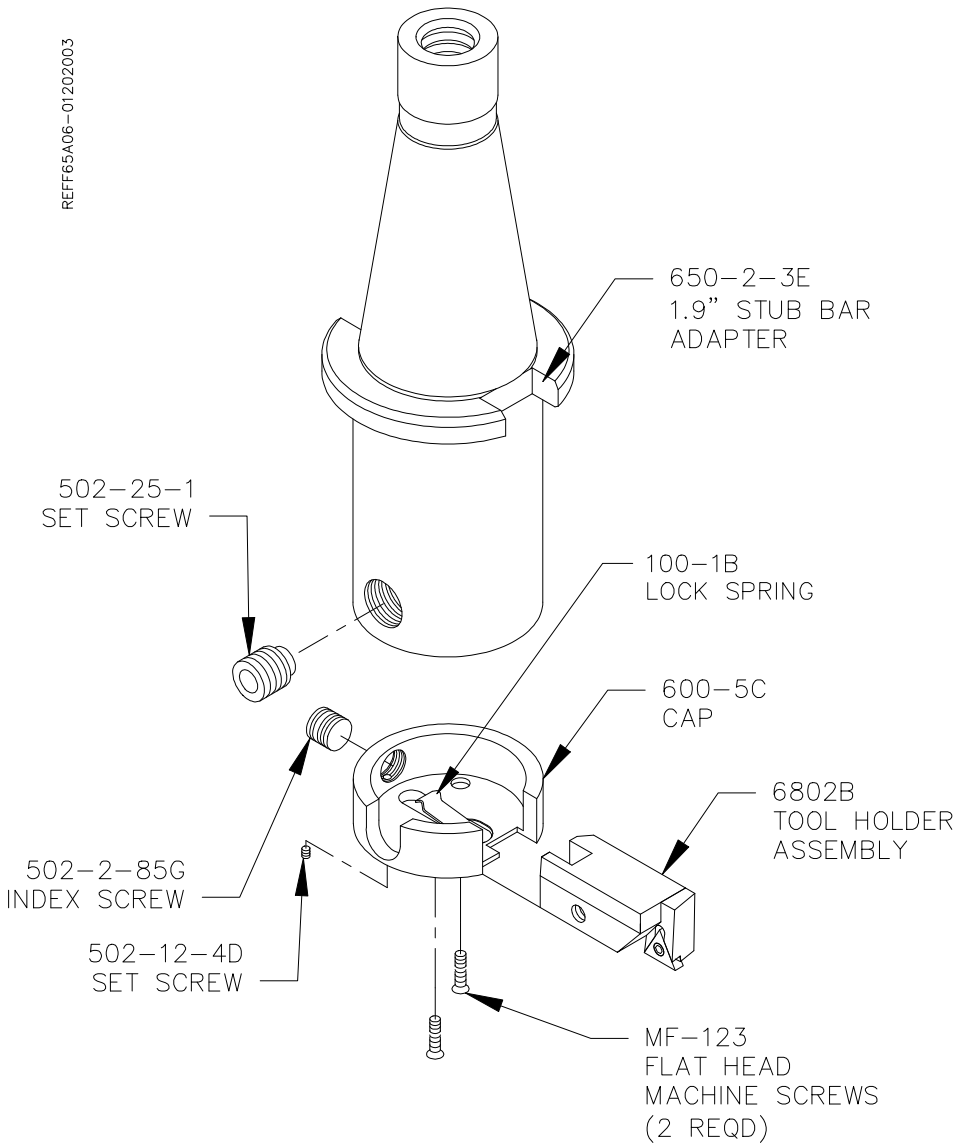
Cam Line Boring Tooling Package:

650-3-43A:

Requires 650-3-30 Block End Truing Fixture, 650-3-1 Performance Fixture, 6773A Right Angle Drive Assembly.

1.9" Cutterhead:

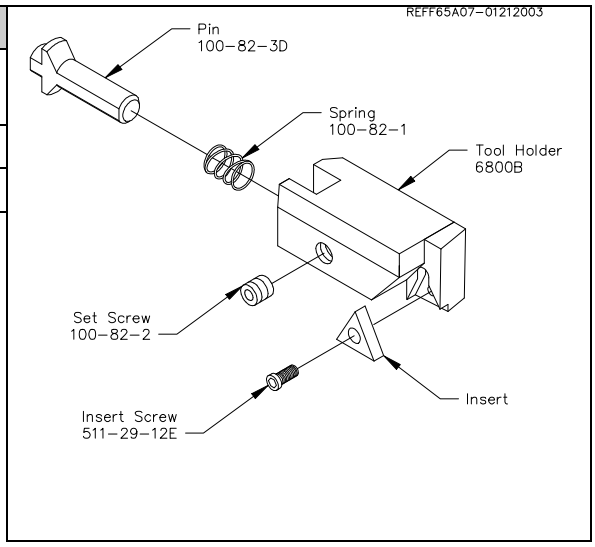
650-2-3F w/ Tooling:
650-2-3G w/o Tooling:



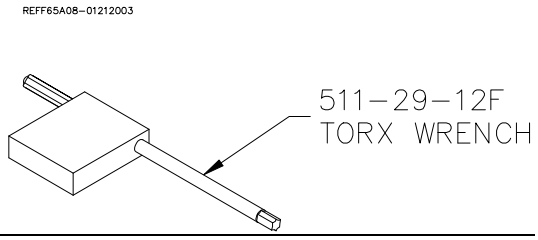
1.9" Cutterhead Standard Tooling:

6802B Tool Holder			
Assembly Part #	Tool Holder Part #	Length	
6802B	6800B	2.082"	
6802C	6800C	2.3" – 2.7"	**optional**

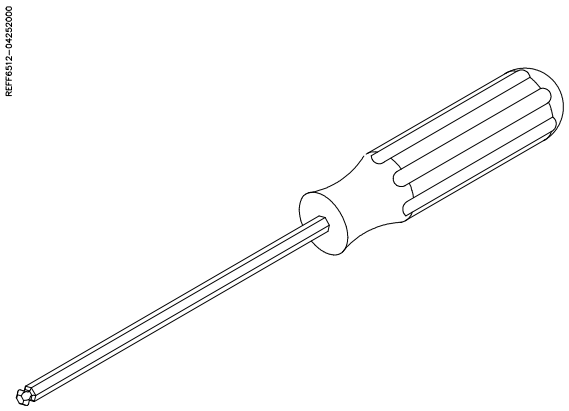
Triangle insert positive rake. 6802C requires a 3/8" IC insert.



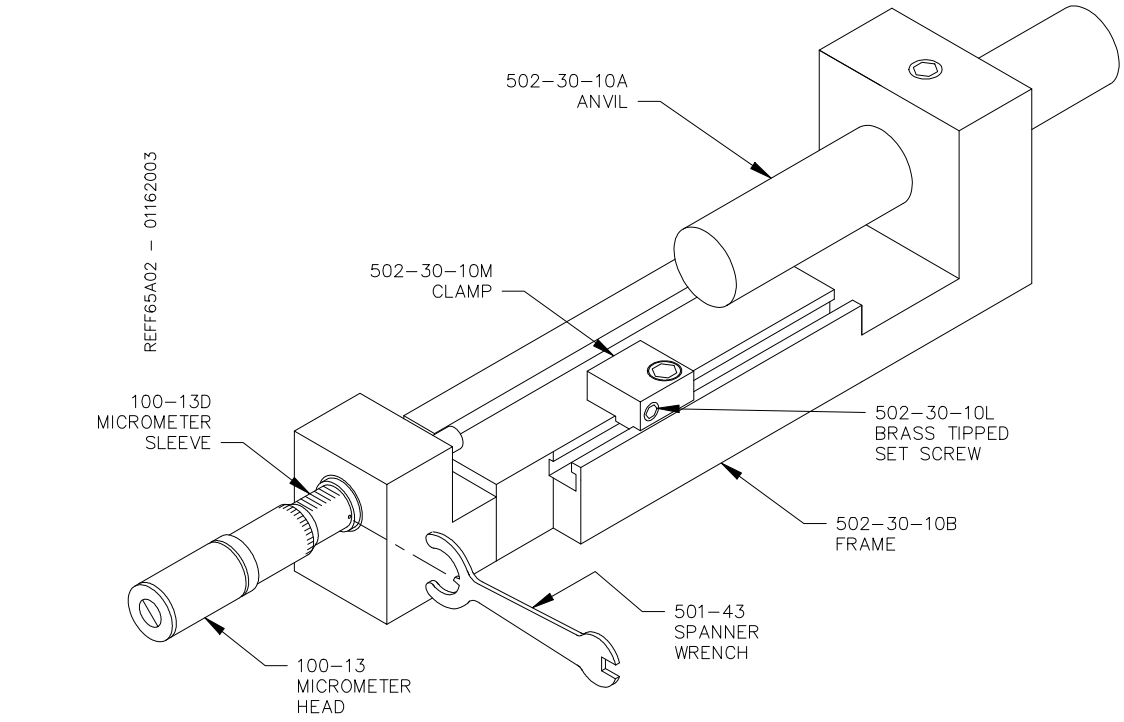
511-29-12F Torx Wrench:



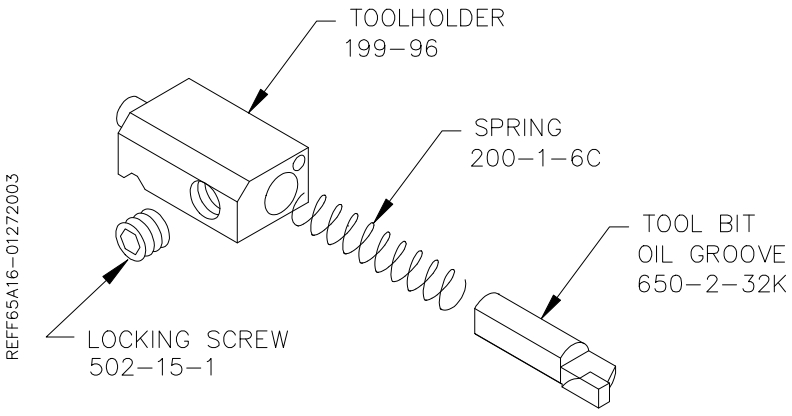
501-72A Hex Driver:



900-2-11 Micrometer Assembly:
1.5" – 4.1"



Oil Groove Tooling:



Boring Inserts:

Speeds and Feed Rates will vary from Cutter Head to Cutter Head when using the same insert due to the different properties of each Cutter Head.

Boring Speeds and Feeds:
The Following insert feeds and speeds are designed to be used with the 650-2-3F Cutter Head Assembly.

Below is a description of the cutting inserts available from Rottler. The inserts have gone through extensive performance testing. To take full advantage of the capabilities of your Rottler Machine, we highly recommend Rottler tooling be used. This chart uses SFM or Surface Feet Per Minute as a speed reference. To calculate SFM to RPM use the following formula.

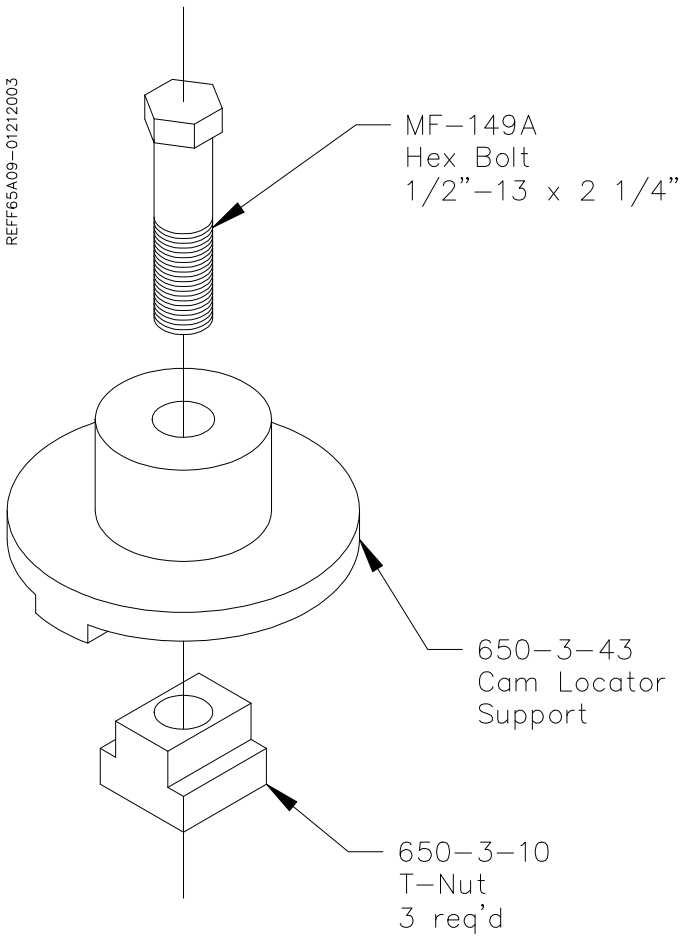
RPM = SFM X 3.83
DIAMETER

Example:
SFM = 800
4.00" Bore

800 X 3.83 = 3064 Divide by the diameter 4.00 = 766 RPM

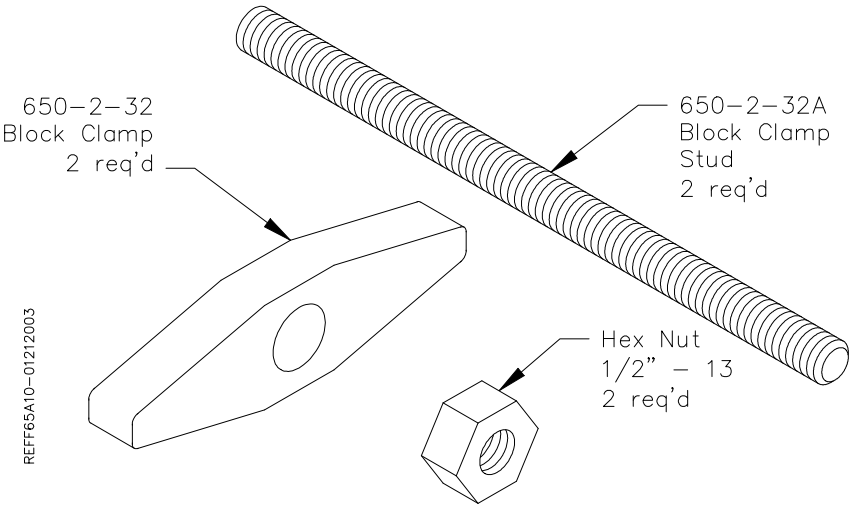
Insert	Part #	Description	Application
	RT211	A 3/8" IC triangular insert with a dark purple ceramic coating and 1/64" cutting radius.	The ceramic coating gives excellent results for both heavy sleeve cutting and finishing of cast iron and nodular cast iron. The 1/64" will minimize the possibility of chatter on a line bore. A feed rate of .002 - .003 should be used to obtain a typical surface finish. A speed of 200 to 400 SFM should be used for best results.
	RT221	This is the same insert as RT321, except it has a 1/32" radius.	This larger radius insert will give a smoother finish but increase the possibility of chatter. A feed rate of .002 - .003 should be used to obtain a typical surface finish. A speed of 200 to 400 SFM should be used for best results.

Cam Locator Support:
650-3-43

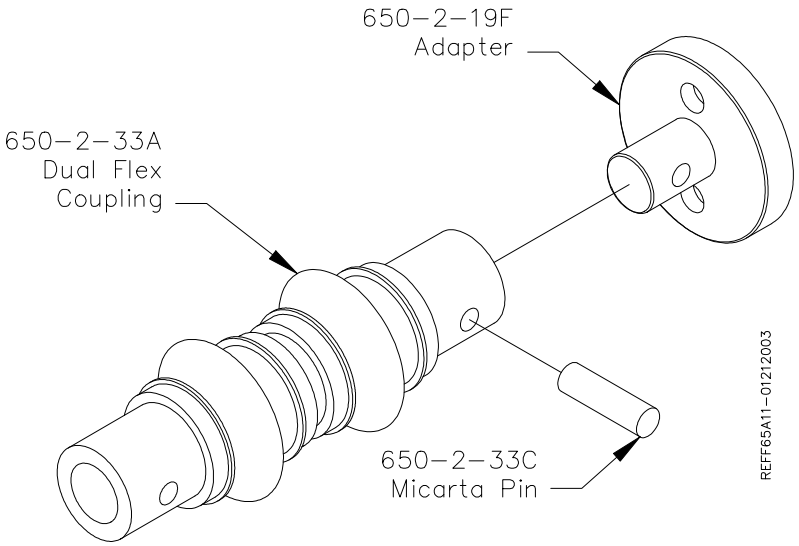


Block Clamp:
650-2-32

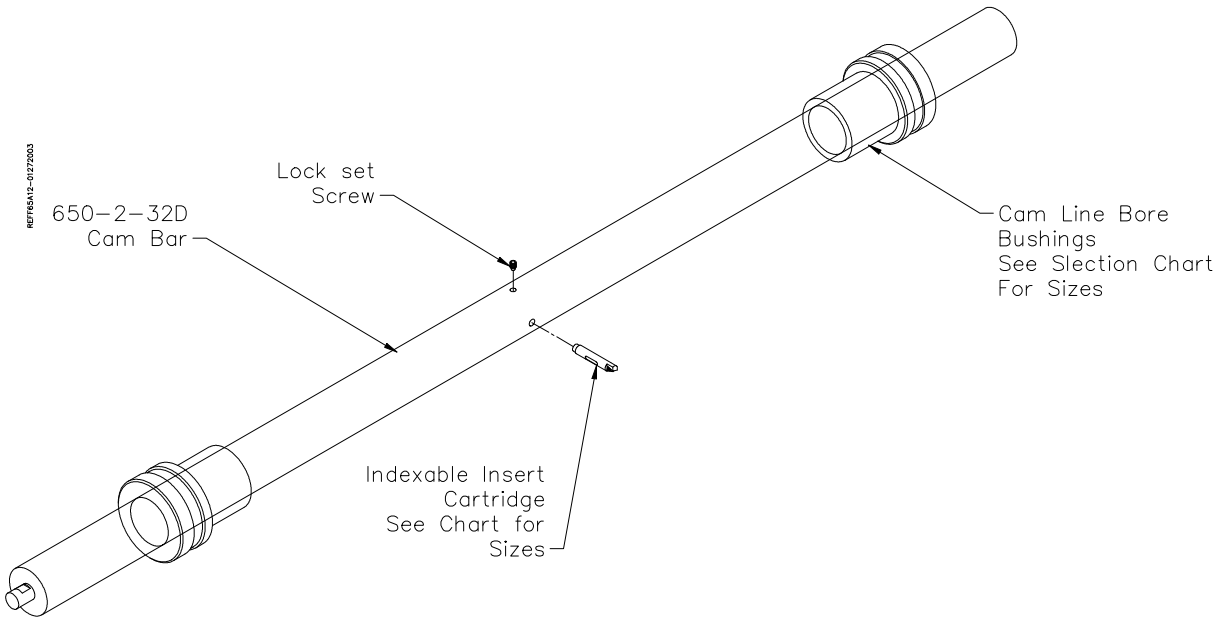
Block Clamp Stud:
650-2-32A



Adapter and Dual Flex Coupling Assembly:
650-2-19G



Cam Line Boring Bar:
650-2-32D

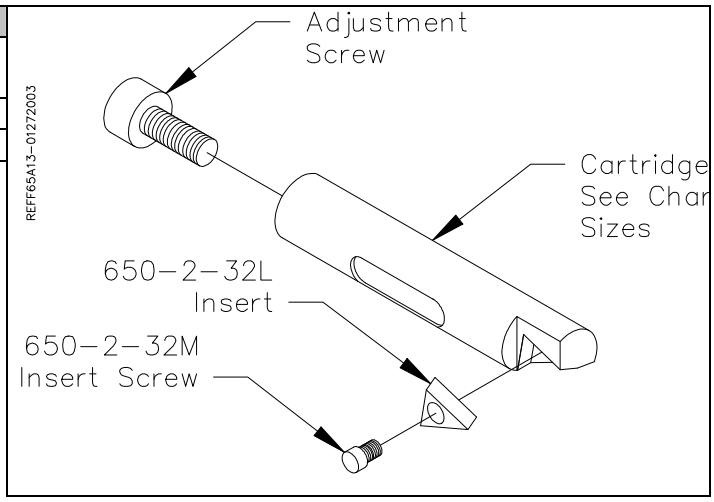


Cam Line Bore Bushings:

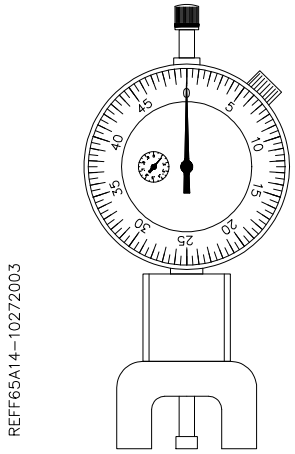
Part Number	Bushing Sizes
650-3-43B	63mm (2.480” +/- .0007”)
650-3-43C	58mm (2.282” +/- .0007”)
650-3-43D	(2.250” +/- .0007”)
650-3-43E	(2.790” +/- .0007”)
650-3-43F	(2.309” +/- .0007”)
650-3-43G	(2.500” +/- .0007”)
650-3-43H	(2.120” +/- .0007”)
650-3-43J	(2.030” +/- .0007”)
650-3-43K	(2.040” +/- .0015”)

Cam Line Boring Cartridges:

Cam Line Bore Cartridges:		
Part Number	**Length**	**Range**
650-2-32E	1.530”	1.985” – 2.650”
650-2-32F	1.650”	2.250” – 2.850”



Tool Setting Indicator:
650-2-33



Wrenches: