December 5, 2008 Rev 5

F68A

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 F68A 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 F68A 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 F68A is a precision, single point, high speed boring machine. The F68A 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 F68A 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 F68A 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:

WARNING

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

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

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

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

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

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

WARNING This machine is capable of causing severe bodily injury.

WARNING

Safety Instructions for Machine Use

KEEP GUARDS IN PLACE and in proper working order.

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

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

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

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

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

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

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

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

NEVER ALLOW UNSUPERVISED OR UNTRAINED PERSONNEL TO OPERATE THE MACHINE. Make sure any instructions you give in regards to machine operation are approved, correct, safe, and clearly understood.

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

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

Electrical Power:

All electrical power should be removed from the machine before opening the rear electrical enclosure. It is recommended that the machine have a electrical LOCK-OUT device installed.

Make sure all electrical equipment has the proper electrical overload protection.

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

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

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

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

The F68A operates under computerized control and, as is all computerized equipment, and is susceptible to extraneous electrical impulses internally for externally produced. The

machine may make moves out of the operator control at any time. The operator should work in and around the machine with caution at all times.

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

Make sure all electrical equipment has the proper overload protection. The F68A should have ***a fully isolated*** power supply to prevent damage and uncontrolled movement of the machine. If the F68A 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 F68A 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 F68A.

Machine Operator:
The operator of the F68A should be a skilled machinist craftsman who is well versed in the caution, care, and knowledge required to safely operate metal cutting tools.

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

The F68A 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:

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

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

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.***

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, and these mistakes will become obvious the minute the cut starts

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

Find out what the problem is; return the spindle to its up position without causing more damage. To restart the machine, turn the Emergency Stop Button CW until the button pops out. 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 F68A 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 F68A 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.

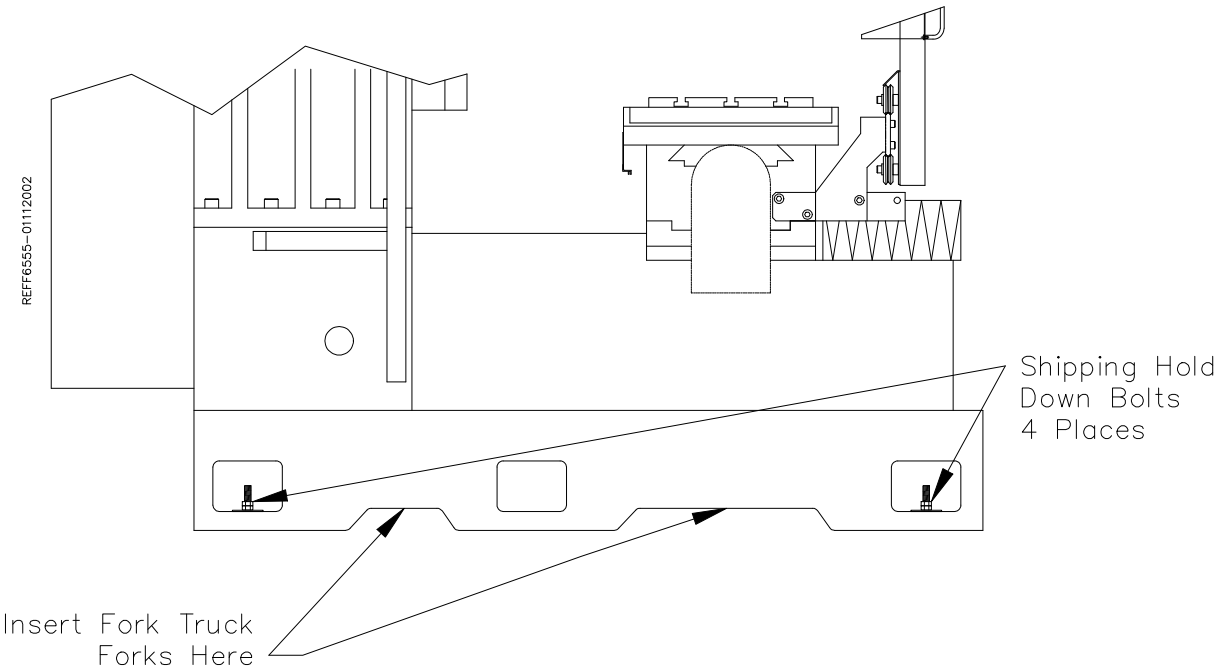
For shops where large production runs are anticipated, the work pieces should be loaded and unloaded directly from a conveyer. If this is not the case, we suggest you pay considerable attention to the crane so that it covers an adequate area to allow the operator to back up and remove work pieces without 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 F68A 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 F68A can be picked up from the pallet in two (2) different ways. See the following page for illustration of these procedures.

Type One:

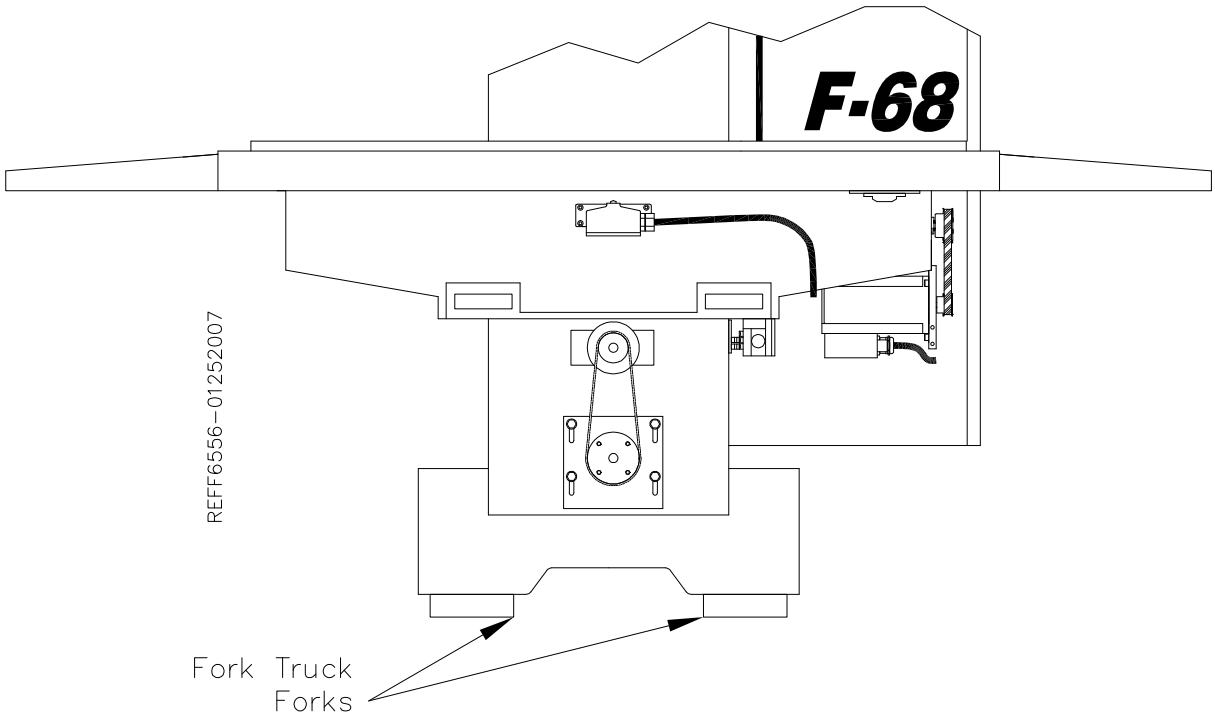


Be sure that the forks are at least Four inches through the opposite side of the casting.

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 F68A properly is very important if you are to use the F68A to its full blue printing capabilities as well as maximizing the use of Rottler fixturing.

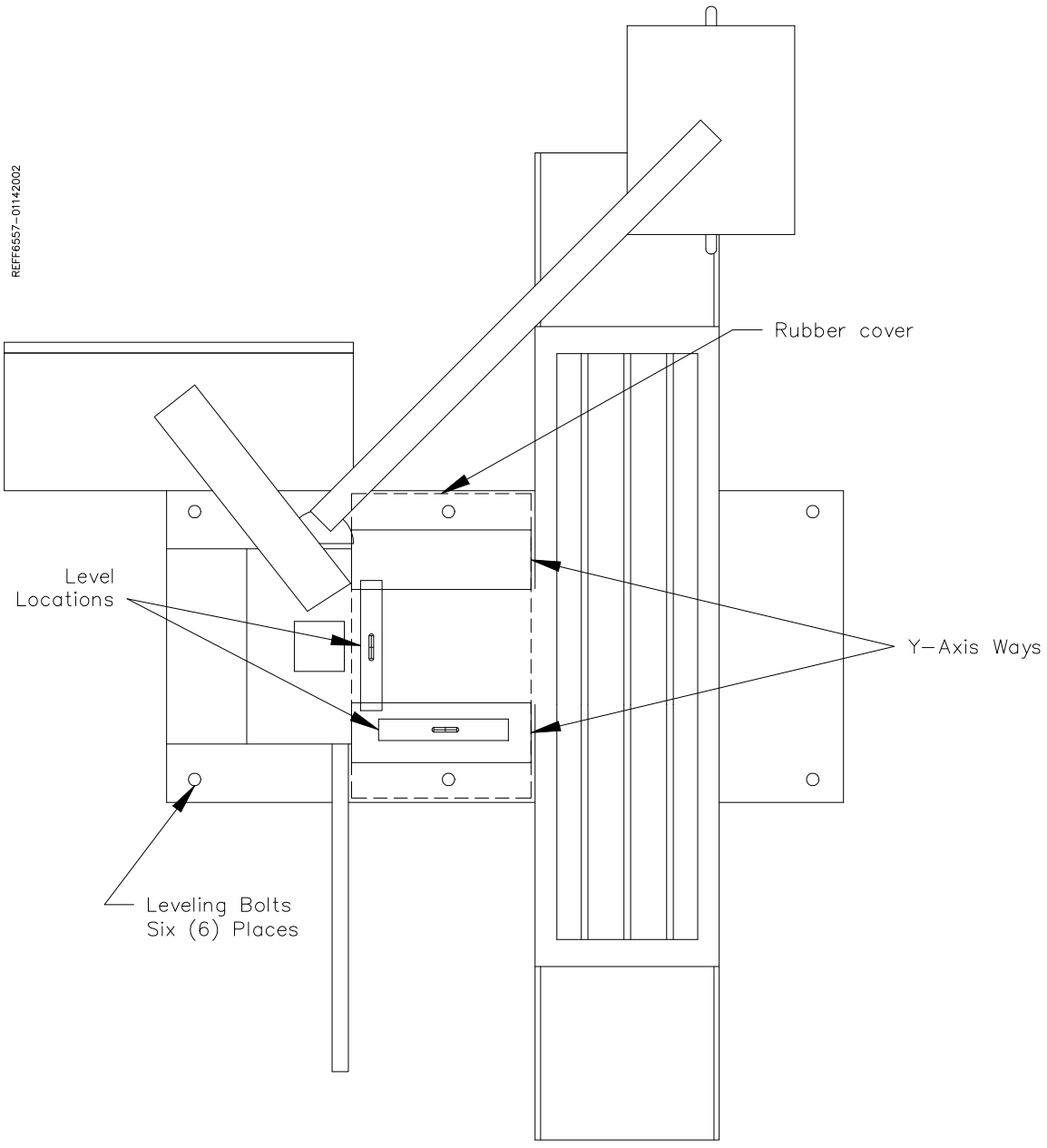
Use the following instructions to properly level the F68A.

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”.

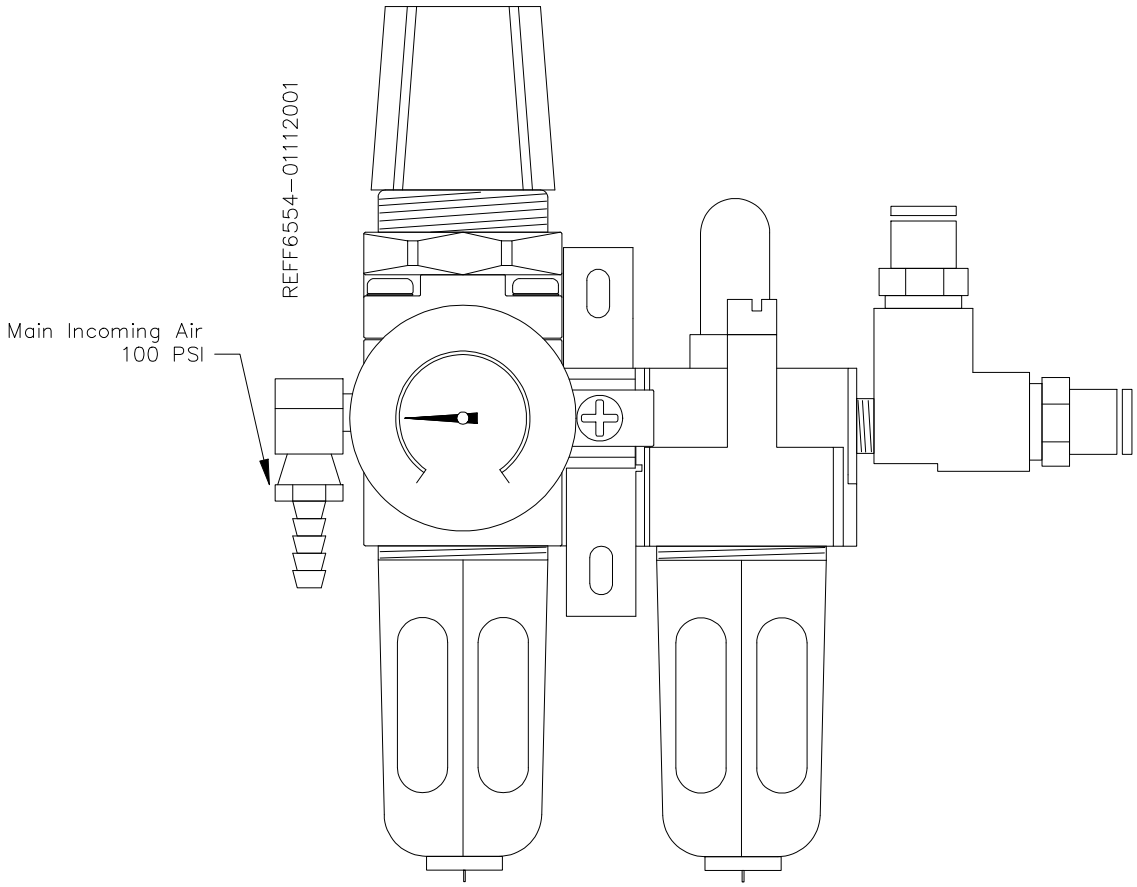
Check the level in both directions on the Table. If it does not match the alignment of the Y-Axis ways refer to the Maintenance Chapter of this manual for full alignment procedures.

Leveling Locations:



Air Supply:
It is very important that the air source for the F68A 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.

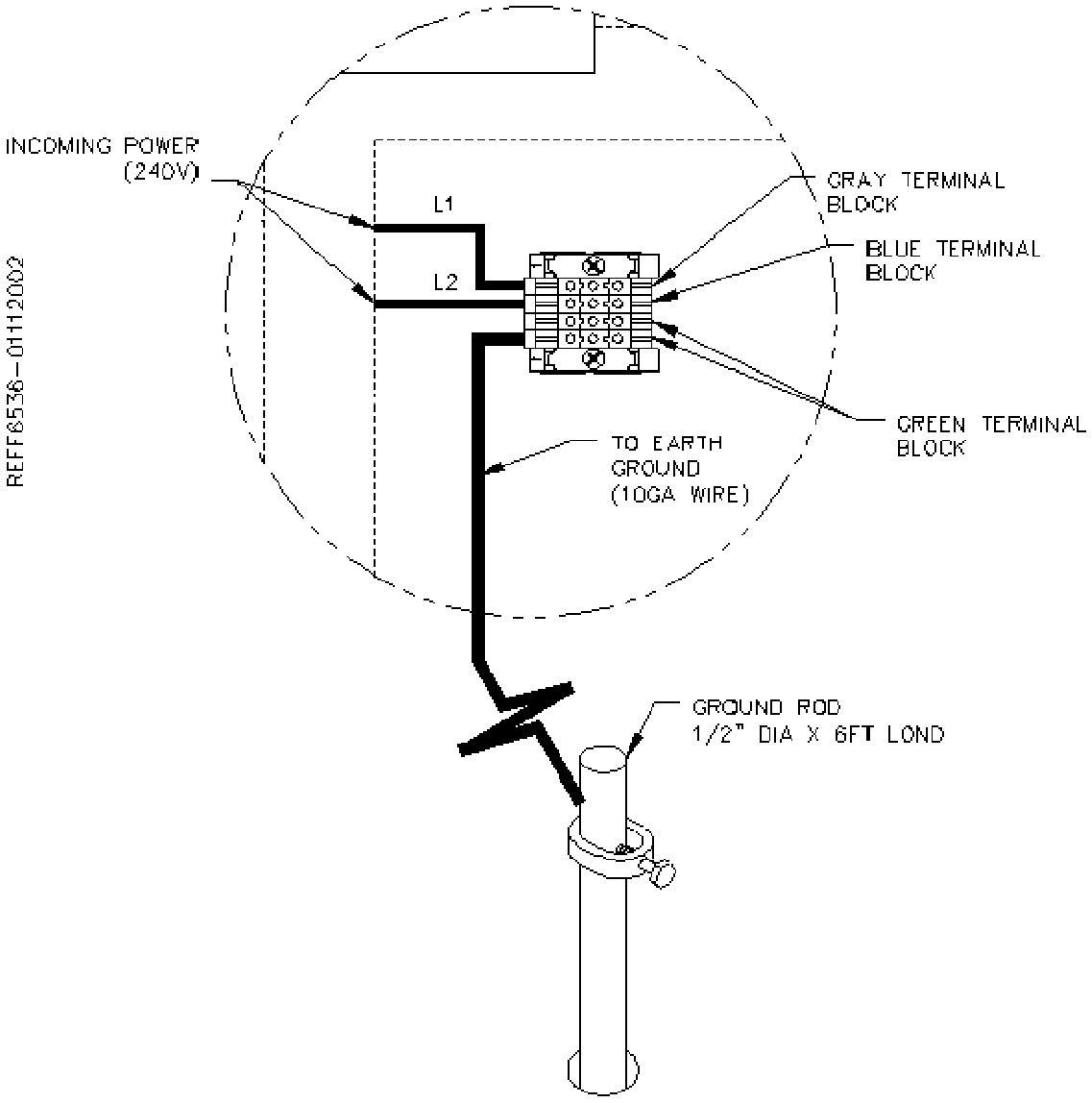


Power Supply:
This machine has the following power requirements:

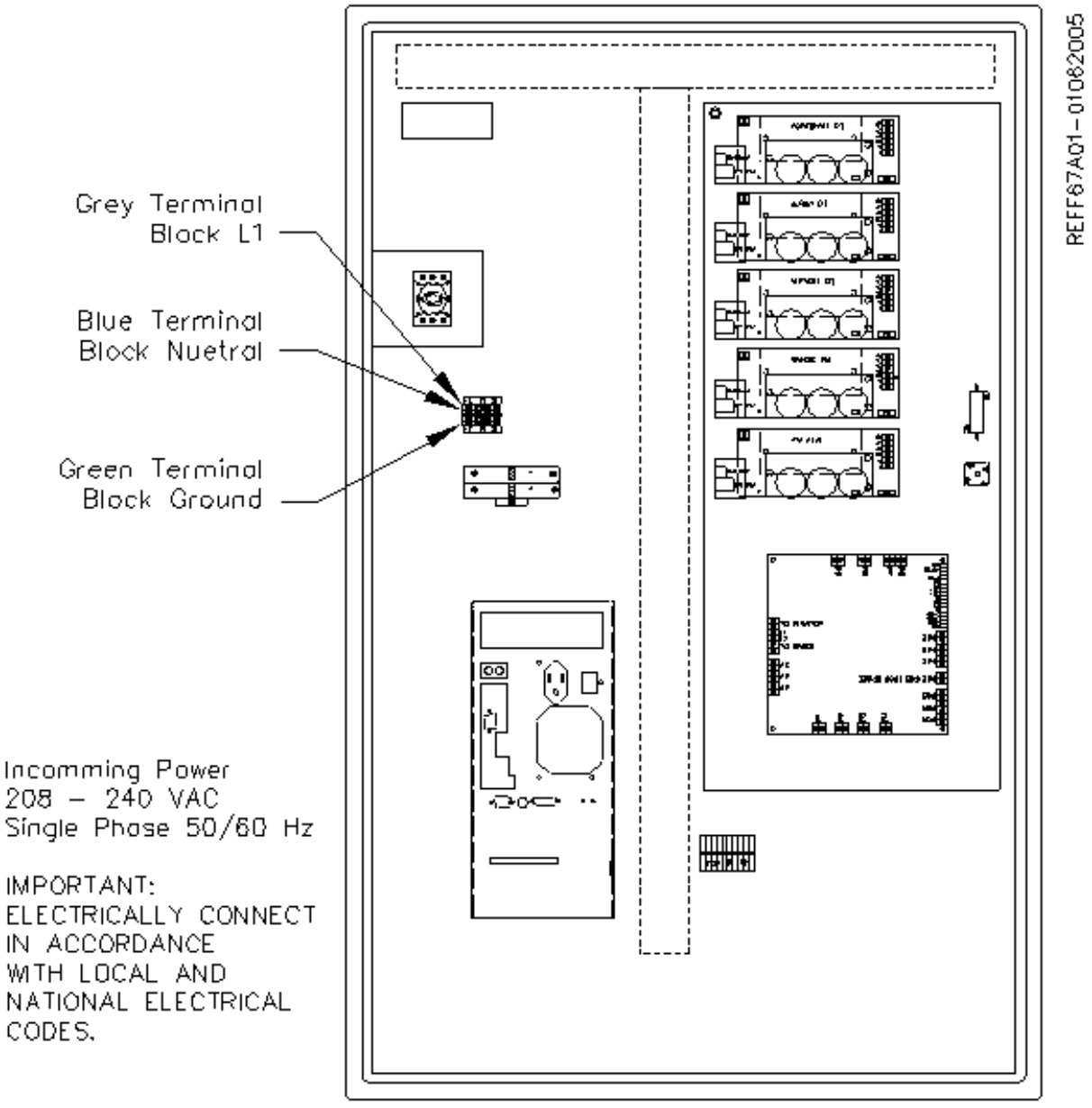
208 to 240 VAC
Single Phase
50 or 60 Hertz
30 amps

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:

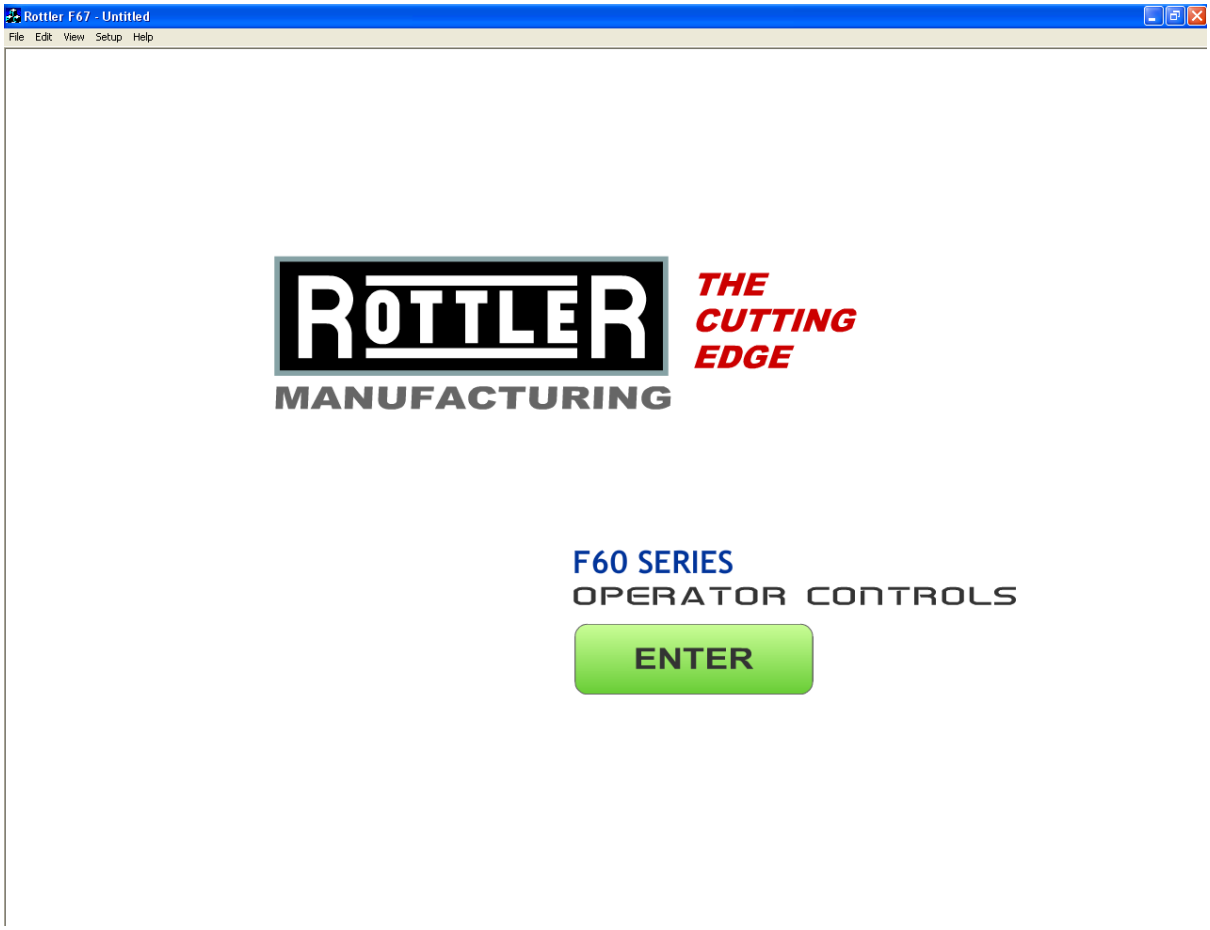
Once power has been supplied to the machine measure the incoming voltage with a meter to verify proper voltages before turning the Main Power switch on. Failure to measure and record proper voltages to the machine could cause damage and will void factory warranty. Measure L1 to L2 and record on the installation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

Power Up:

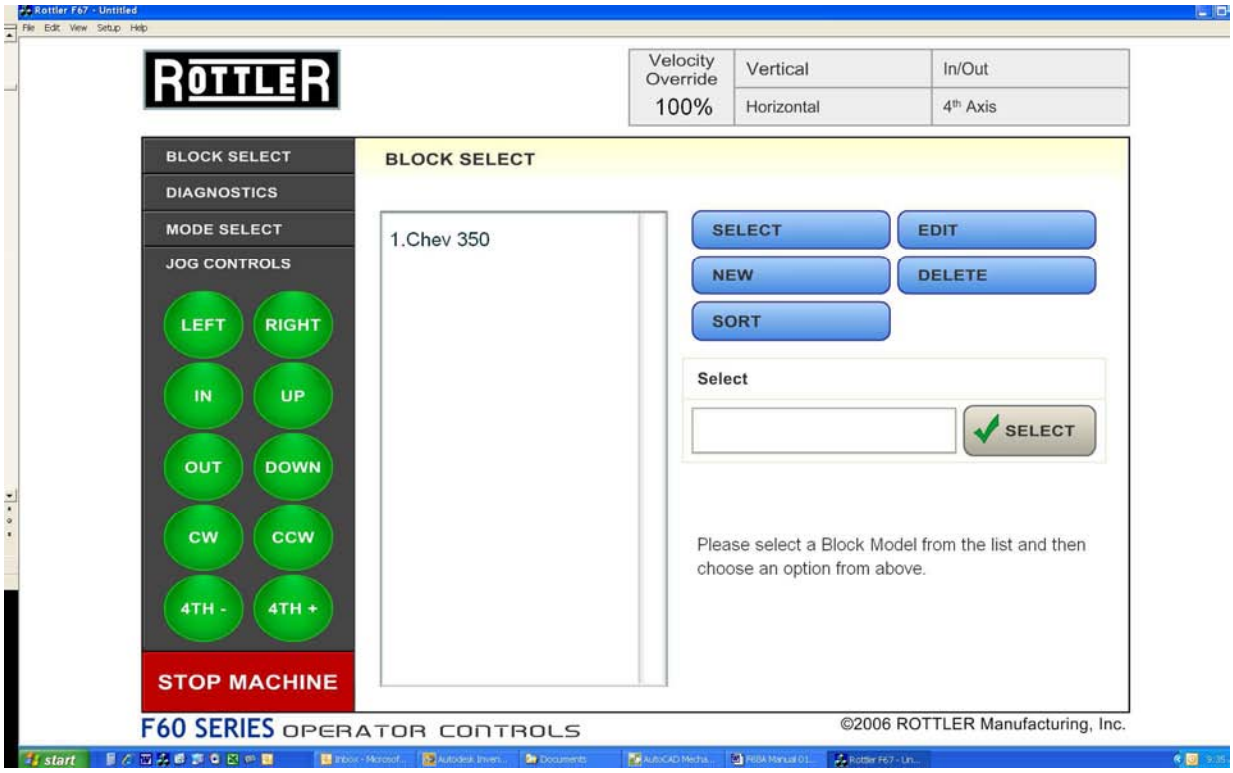
Turn the Main Power switch on. Allow a few minutes for the machine to fully boot up.

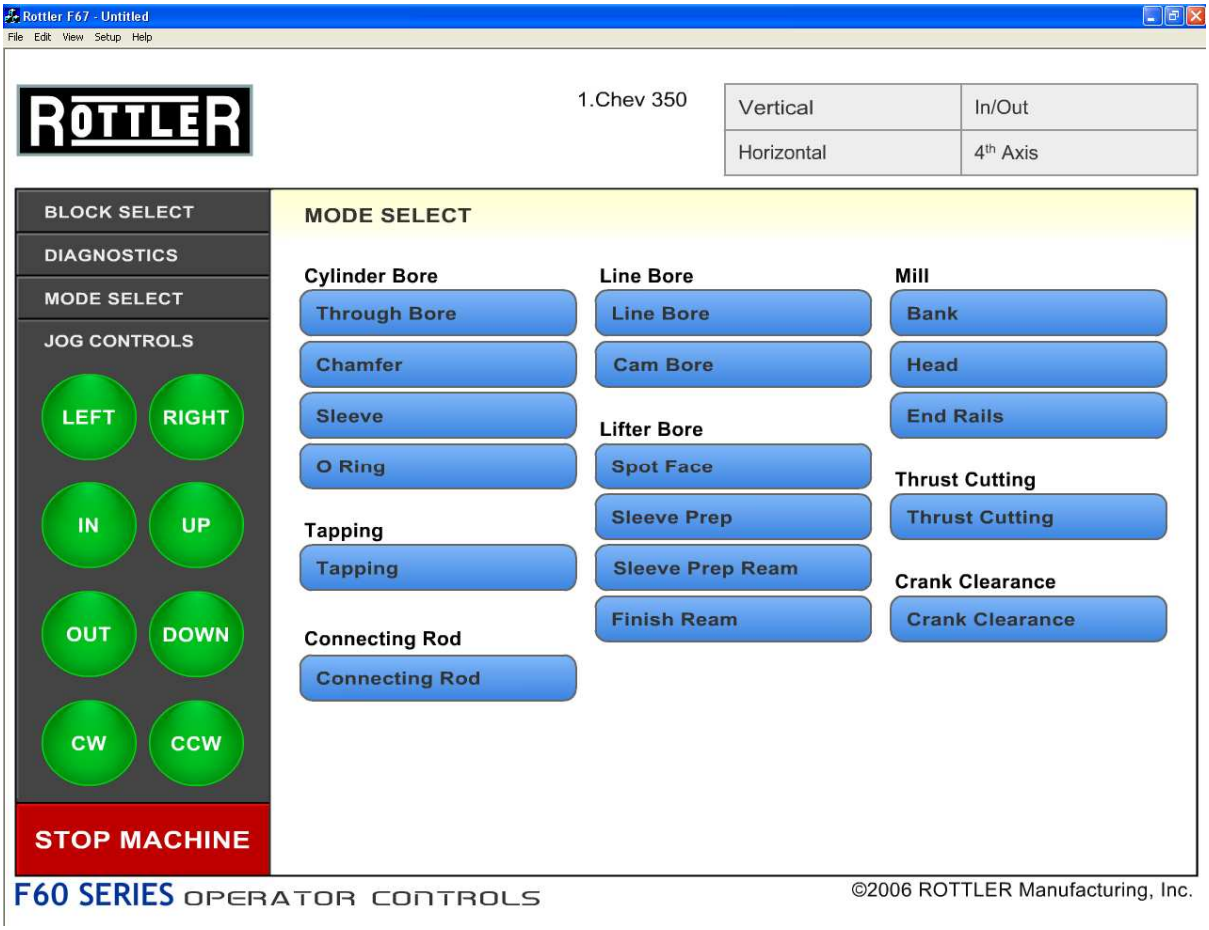
Note: The Rottler F68A uses a touch screen for control and data transfer to the computer. Be careful not to touch the screen until the machine has fully booted up and a Rottler screen is showing. If the screen is touched prior to full boot –up it may activate a function or interfere with proper boot-up.

The first screen to appear is the Rottler Manufacturing Start Up screen. Press the ENTER button to start the Rottler software.



The next screen to appear is the Block Select screen. At this point, select any block and press SELECT. This needs to be done to be able to move the machine so the shipping restraints can be removed.


Rottler F67 - Untitled
File Edit View Setup Help
ROTTLER
Velocity Override
100%
Vertical
In/Out
Horizontal
4th Axis
BLOCK SELECT
DIAGNOSTICS
MODE SELECT
JOG CONTROLS
LEFT
RIGHT
IN
UP
OUT
DOWN
CW
CCW
4TH -
4TH +
STOP MACHINE
BLOCK SELECT
1.Chev 350
SELECT
EDIT
NEW
DELETE
SORT
Select
SELECT
Please select a Block Model from the list and then choose an option from above.
F60 SERIES OPERATOR CONTROLS
©2006 ROTTLER Manufacturing, Inc.
start

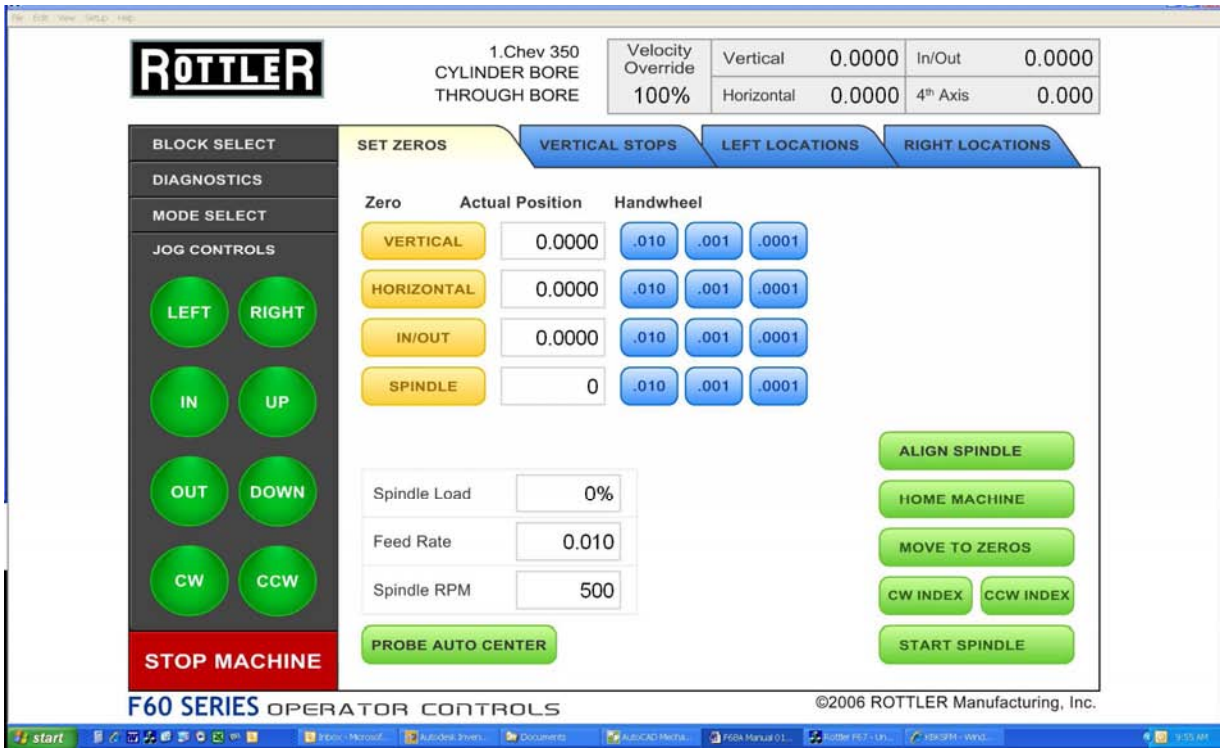


This is the Mode Select screen. To remove shipping restraints select THROUGH BORE. This will take you to the Rottler program where the handwheel can be used.

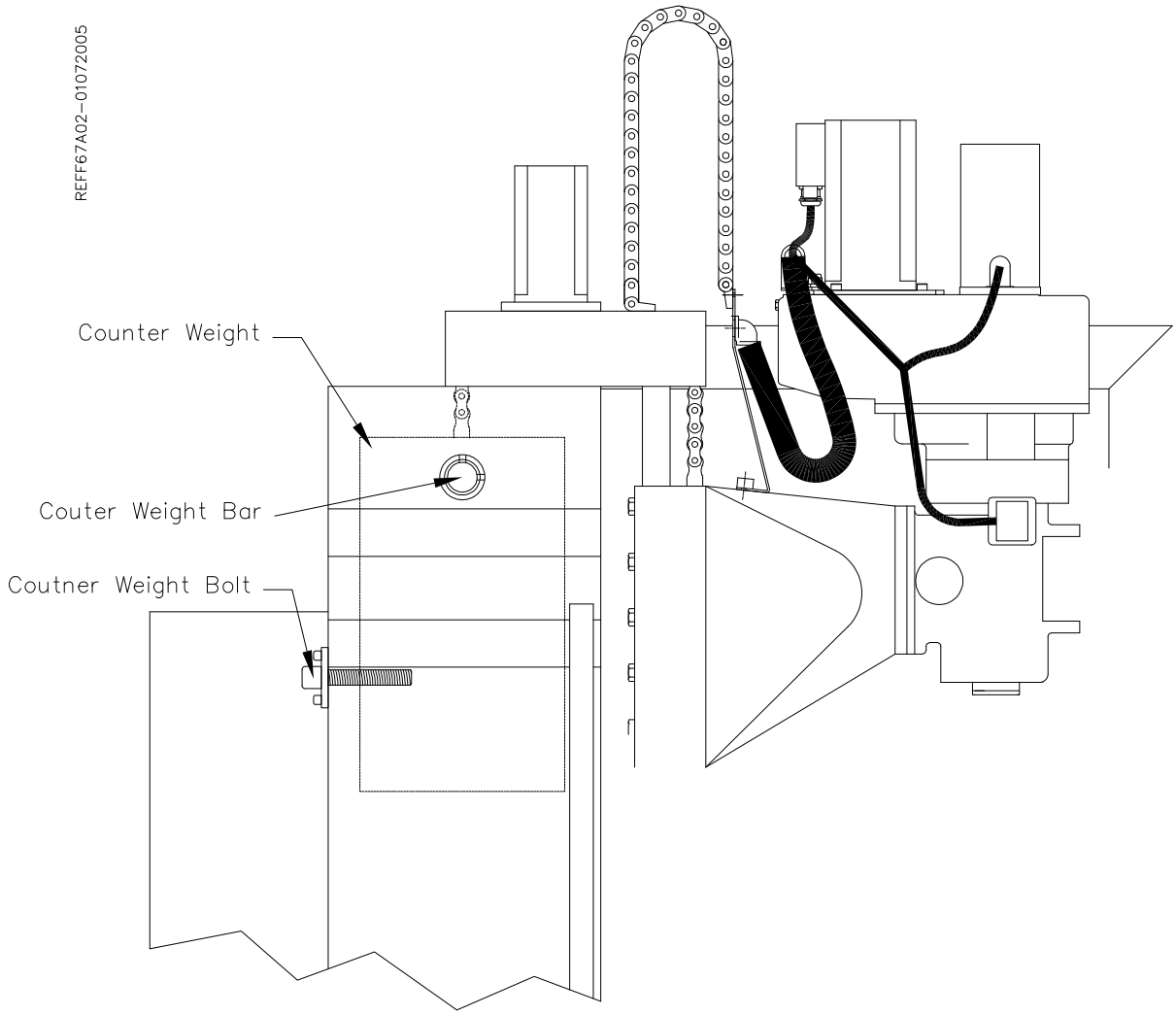
Shipping Restraints:
There are three main shipping restraints on the F68A. A restraint under the spindle, a bar through the counter weight and a Bolt in the top of the counter-weight. The following is the procedure for removing these restraints.

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 VERTICAL .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 F68A 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 XP Home 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.

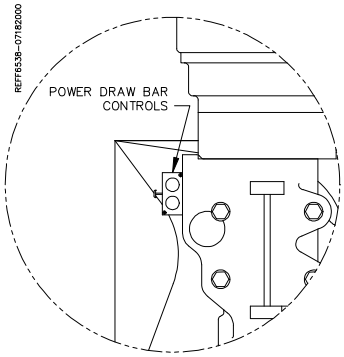
From any screen press FILE and then EXIT button. This will shut down the Rottler program. The terminal will show the computer desktop screen.

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. It is now OK to turn Main Power off to the machine.

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.

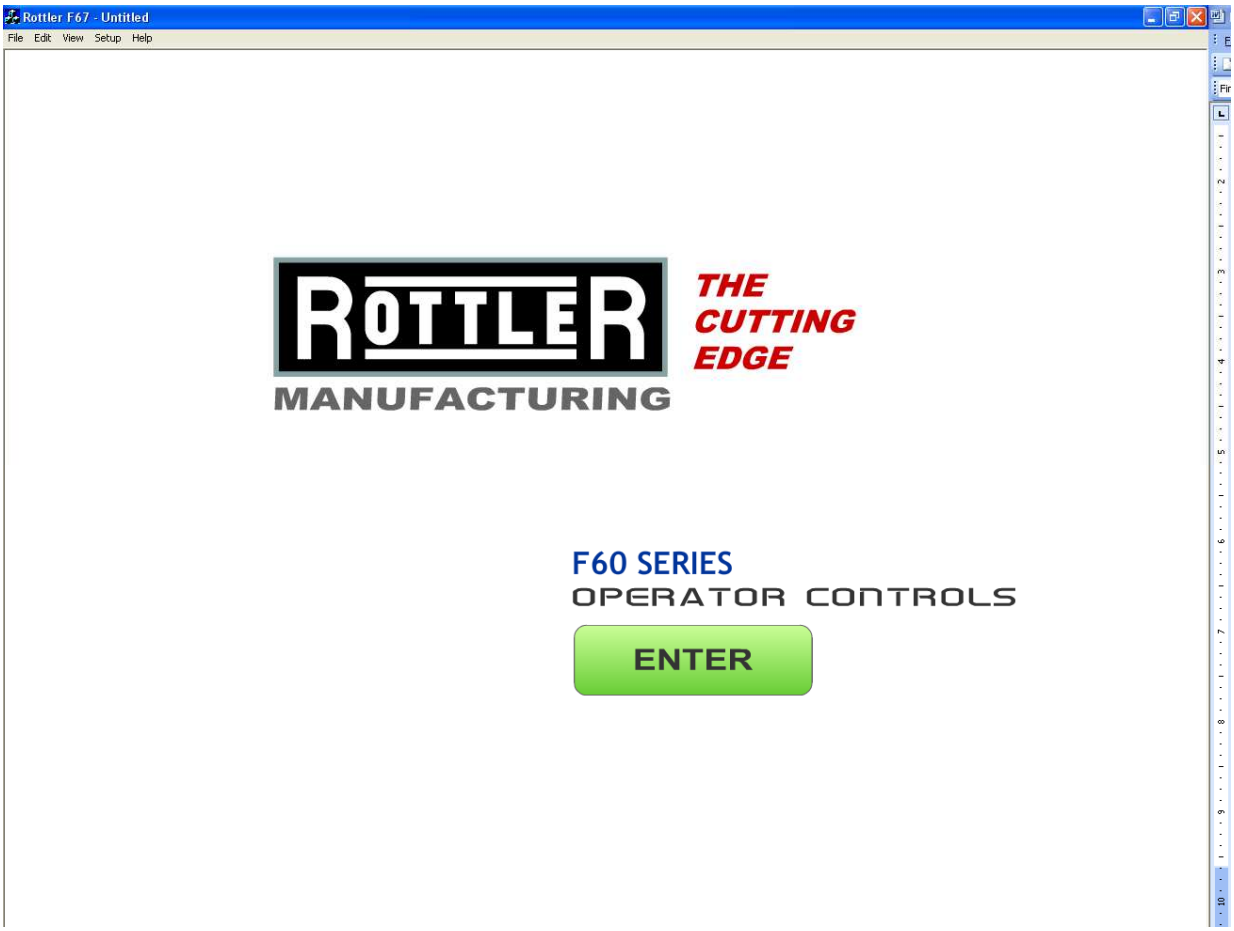
This switch will spin the draw bar Forward or Reverse to install or remove the tool holder
All tool holders on the F68A are standard 40 taper and can be purchase through your local tooling vendor.



Initialization Screen:

When the F68A 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 Rottler Initialization screen will appear.

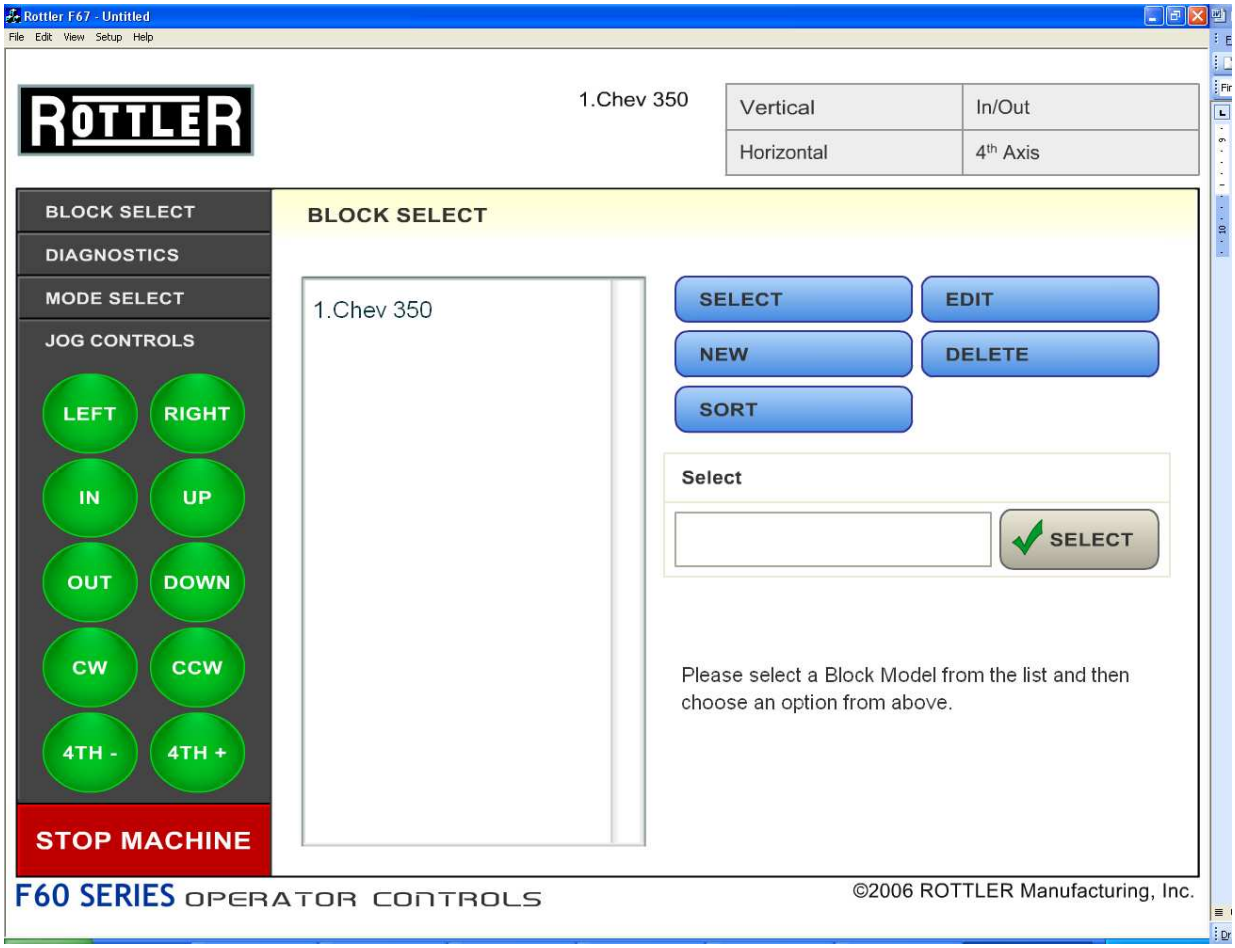
NPTE: Do not push any buttons or icons on the screen before the Rottler program starts or an error may be caused on the computer.



Press the ENTER button to start using the Rottler Program.

General Information:

The Rottler software operates on what we call the Block Model mode. You select or create the block you are working with. Once selected, all operations the F68A can perform are stored in that block model. The following is a more detailed list of the screens.



Block Select:
This screen allows you to select, create, edit or delete a block model.

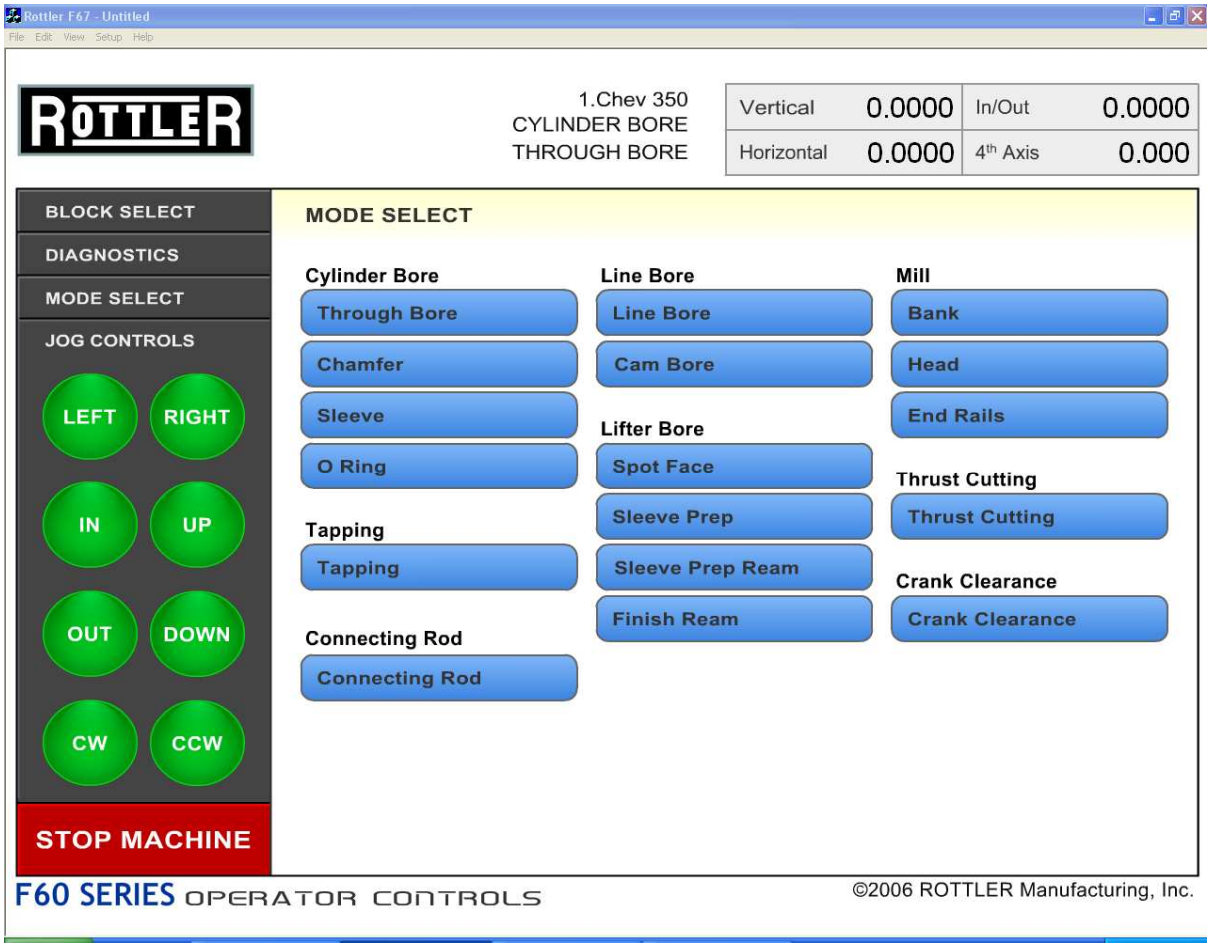
Select and Continue:
You need to select a block (by touch the screen) from the list on the left, then press the SELECT AND CONTINUE button. This will change the screen to the MODE SELECT Screen.

New Block Model:
Pressing this button will bring up an ADD button next to the NEW BLOK MODEL entry screen. Using the keyboard, type the desired name for your block. Press ADD. This will add the block to the list on the left.

Edit Block Model:
To Edit a Block Model name, select a block from the list on the left and then press EDIT BLOCK MODEL. This will put the name of the selected block in the EDIT BLOCK MODEL screen. Use the keyboard to edit the name, press SAVE.

Delete Block:
To delete a block, select the block from the list on the left. Press the DELETE BLOCK BUTTON. The screen will ask you if you want to delete the block. Select DELETE to delete the selected block..

Sort Block Models:



Mode Select:
One you have selected a block the screen will switch to the MODE SELECT screen. This screen contains all the operations the F68A can perform. There are several modes you can select, this manual will describe one operation for each mode, all other operations in that mode are the same.

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

Cylinder Bore 3 Axis:

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

Through Bore:

Set Zero Tab:

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

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

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

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

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

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

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

Home Machine:
Pressing this button will cause the spindle to go up to the Vertical Home position and then creep off the limit switch to an index point. This point will be the same every time the machine is homed. Once the vertical has homed, the in/out and Horizontal will perform the same process simultaneously.

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

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

Important:

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

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

Probe Auto Center:
The Probe is an option on the F68A machine. When this button is pressed a single Probing routine wil be run in the position the machine is currently at.

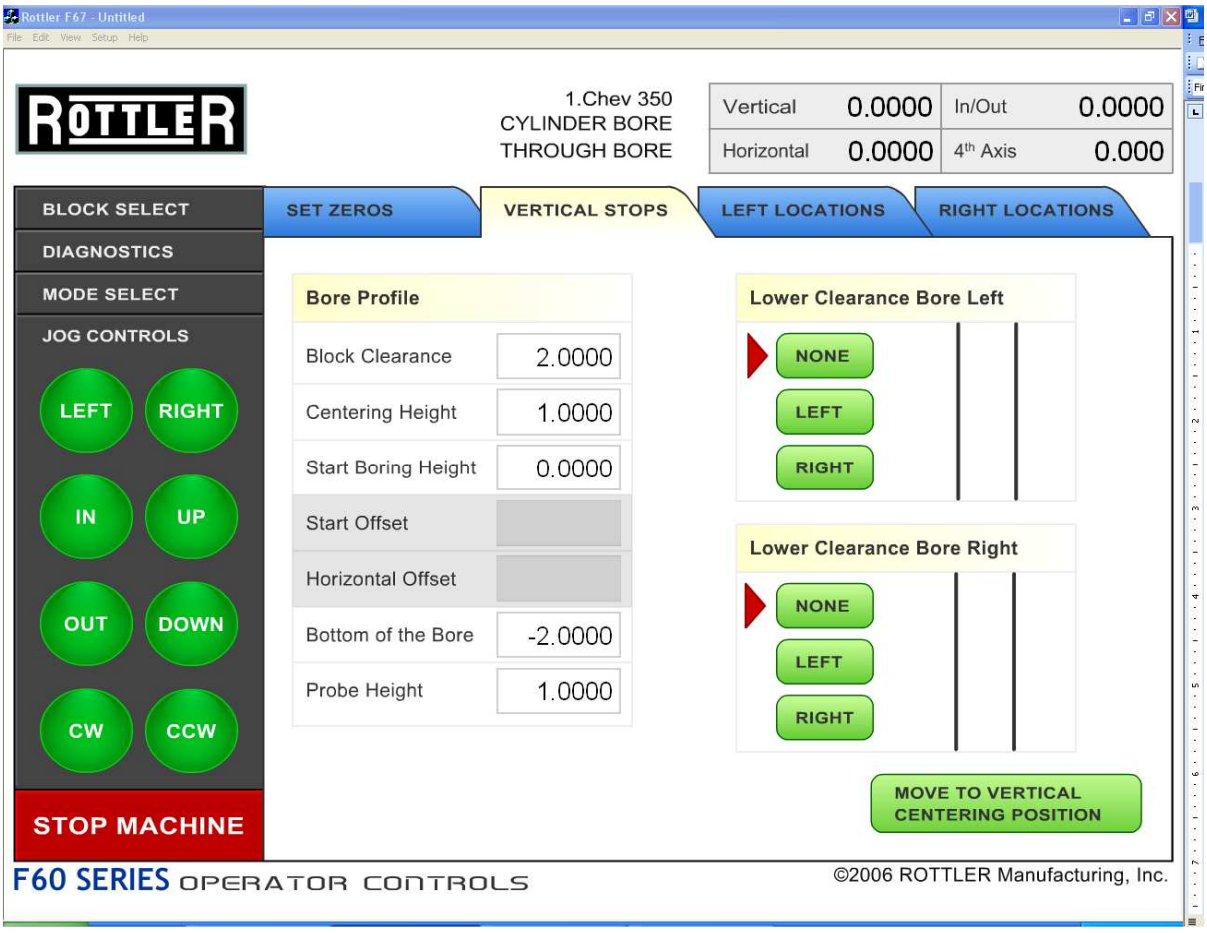
Vertical Stops Tab:

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

If the machine is equipped with a probe there is an additional stop (Probe Height).

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

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



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 of the Left or Right bank of the block. 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”

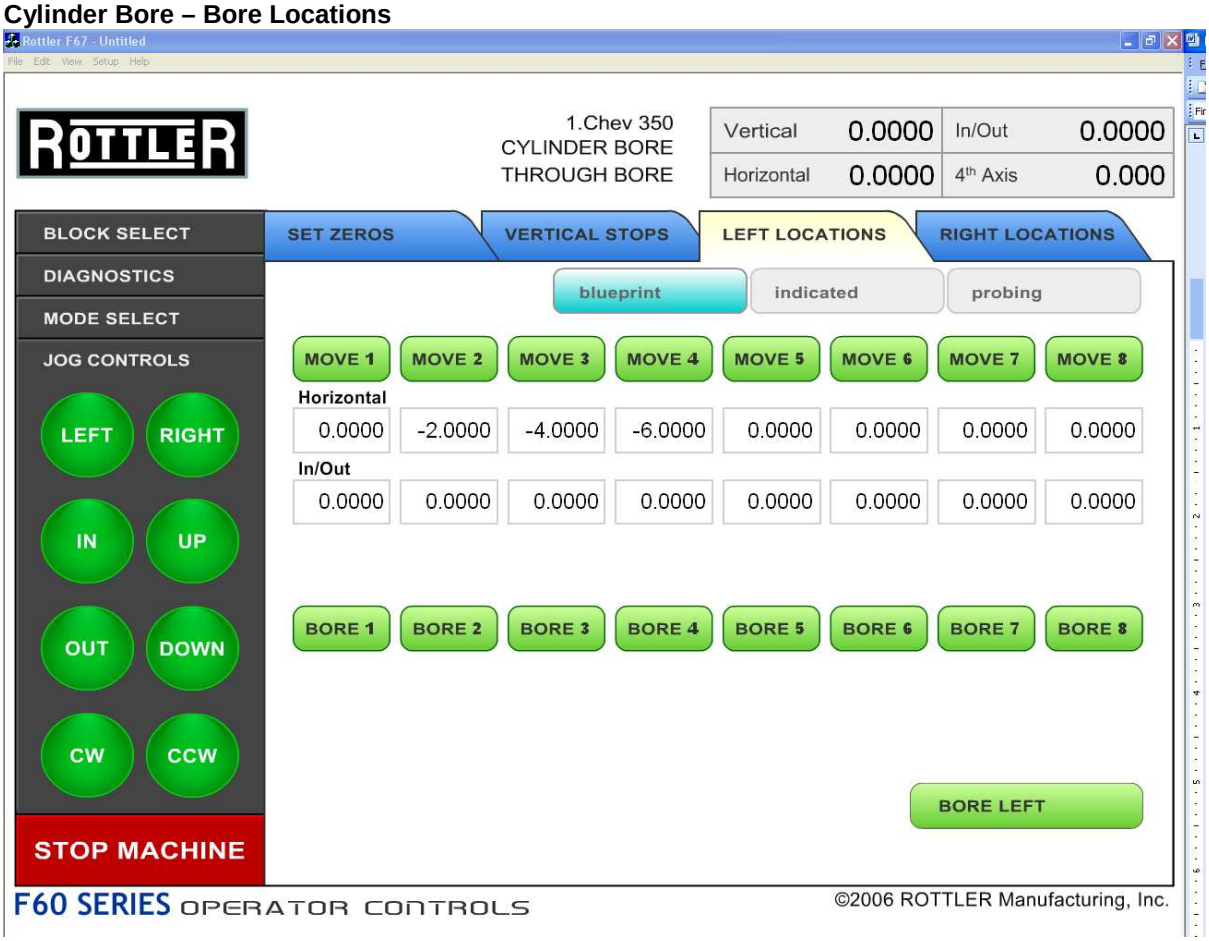
Left and Right Locations Tab:

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

Cylinder Bore – Bore Locations



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

Blueprint:

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

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

Move Buttons:

When pressed, these buttons will move the machine, under power, to the Horizontal and In/Out positions shown in the data boxes below the Move button. The Vertical will move to the Clearance height before it

makes the Horizontal or In/Out moves. After it has moved to the Horizontal and In/Out positions the Vertical will move to the Centering Height. After this, all motion stops.

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

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

Double Clicking this button will automatically run a single bore sequence on the associated bore. The Control will ask you if you are sure you want to bore this cylinder.

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

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

Copy from Blueprint:
Pressing this button will copy the values from the Blueprint screen into the Indicated screen. This a time saving feature. Copying the blueprint values give the operator a rough estimate of the cylinder location to start indicating the cylinder in.

Copy from Probed:
Pressing this button will copy the values from the Probed screen into the Indicated screen.

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

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

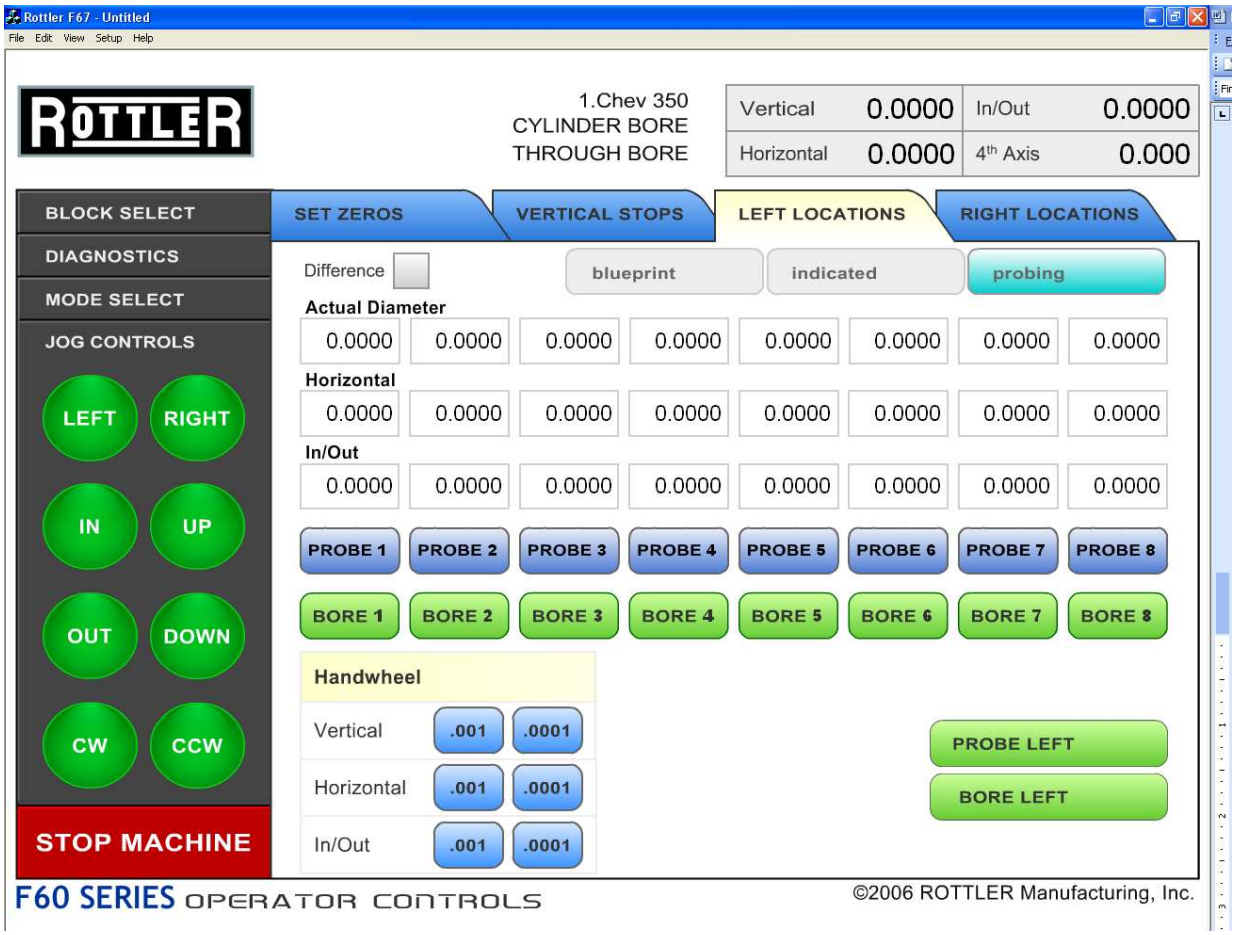
Touching this button again (with a pause in between touches) will turn the button back to green. All green bores will be bored if the "Bore Left" button is pressed. The control will ask you if you sure you want to bore the selected bores.

Double Clicking this button will automatically run a single bore sequence on the associated bore. The Control will ask you if you are sure you want to bore this cylinder.

Bore Left and Right:
Pressing this button will cause the entire Left or Right bank to be bored automatically.

Probing:
The probe is an option on the F68A machine.

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



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

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

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

Lifter Bore:

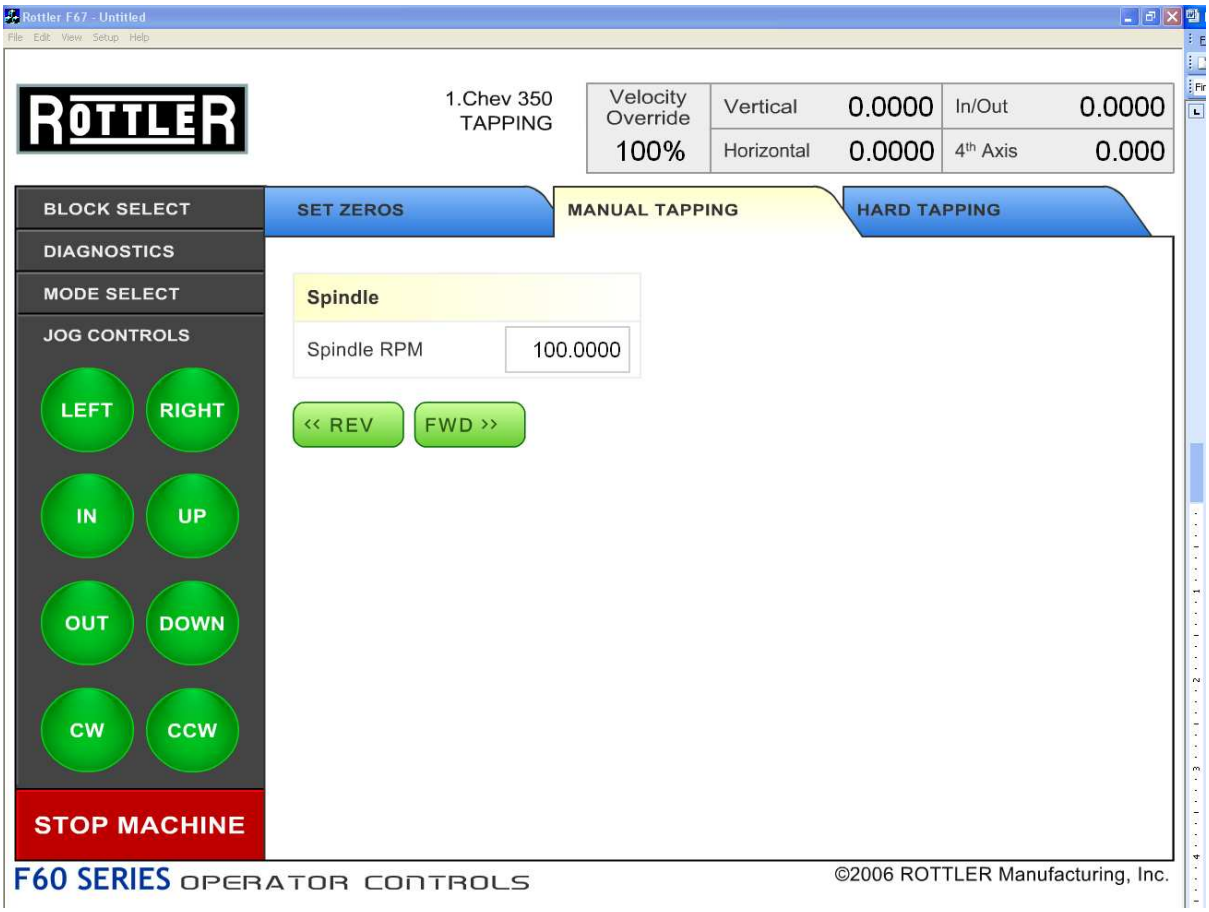
The Lifter Bore Mode and its buttons operate identical to the Bore Mode with a couple of exceptions.

On the Program Vertical Stops screen, lower Clearance Offset is not an option.
After a bore is complete the spindle will not offset .020" for tool clearance unless the "Horizontal Offset after Cycle" box is checked. This is used when a single point boring tool is used for lifter boring.

Tapping:

This mode can be used to manually or Rigid tap a hole.

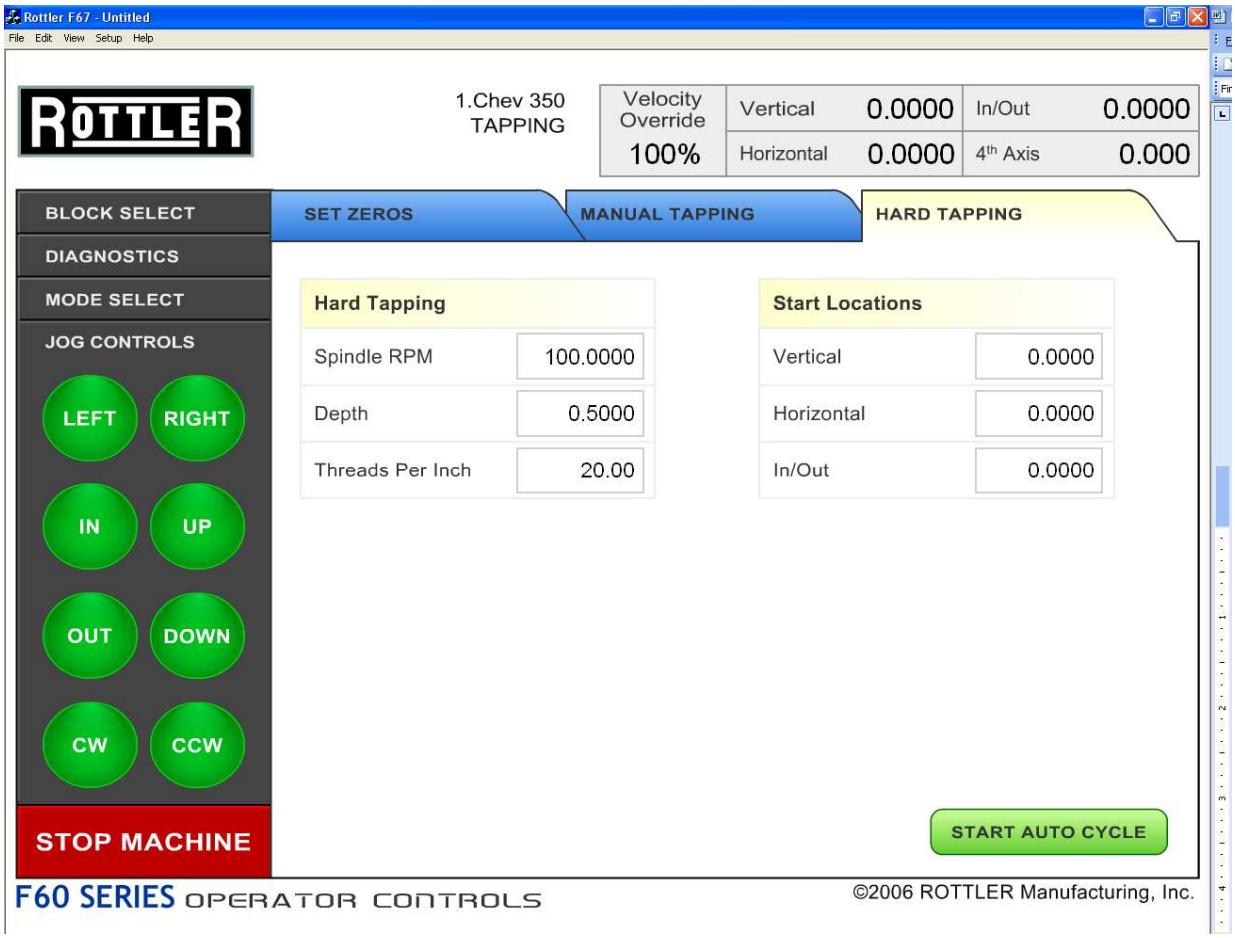
Manual Tapping:



FWD:
Pressing this button causes the spindle to rotate in a forward direction at the programmed RPM.

REV:
Pressing this button causes the spindle to rotate in a Reverse direction at the programmed RPM.

Hard (Rigid) Tapping:



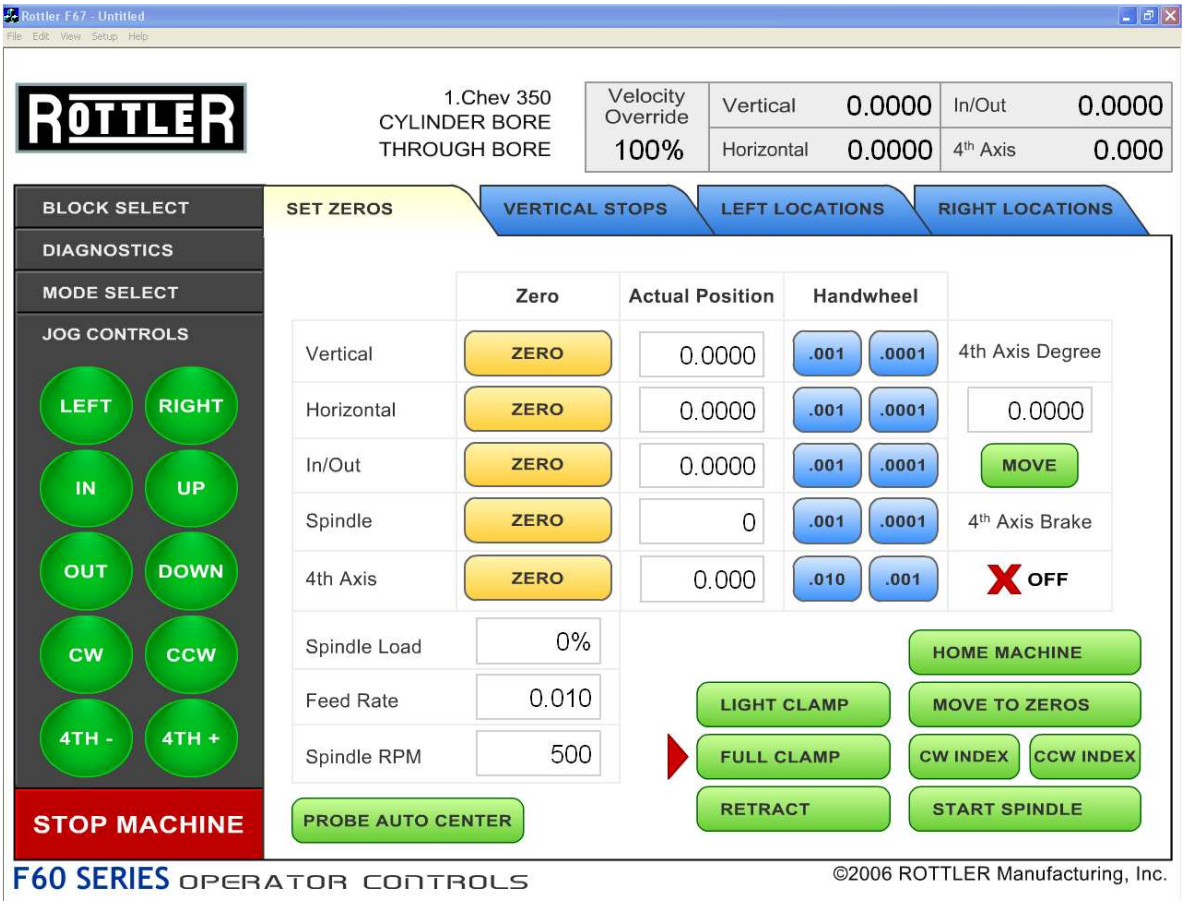
For all the other modes of operation the Control Definition and button function remain the same. The exact operation of each Operating Mode will be discussed in detail in the Operating Instruction chapter in this manual.

Cylinder Bore 4 Axis:

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

Through Bore:

Set Zero Tab:



Jog Controls:

4Th-:

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

4Th+:

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

4th Axis Degree and Move:

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

4th axis Brake:

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

Light Clamp:

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

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

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

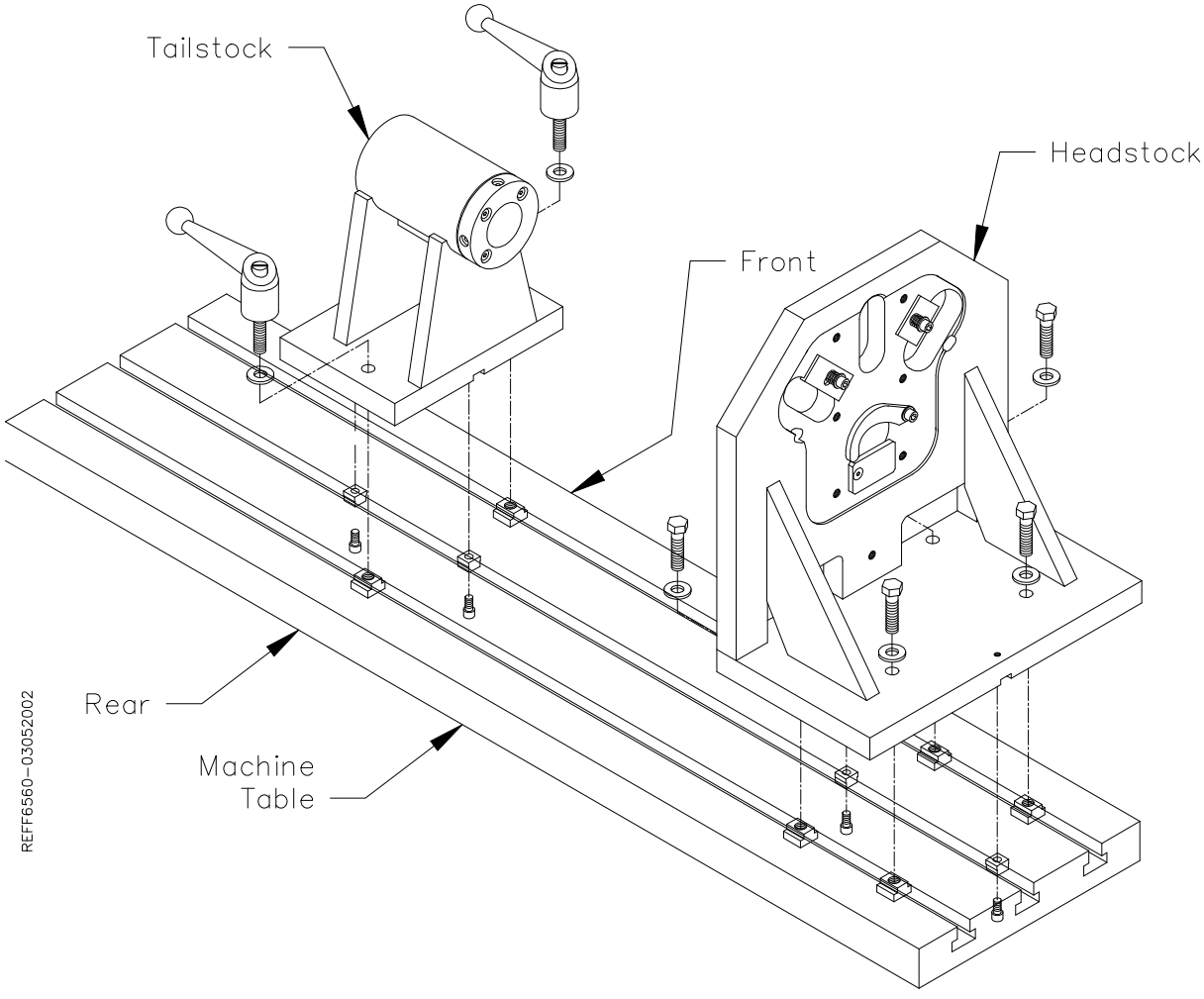
Chapter 3 Operating Instructions:

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

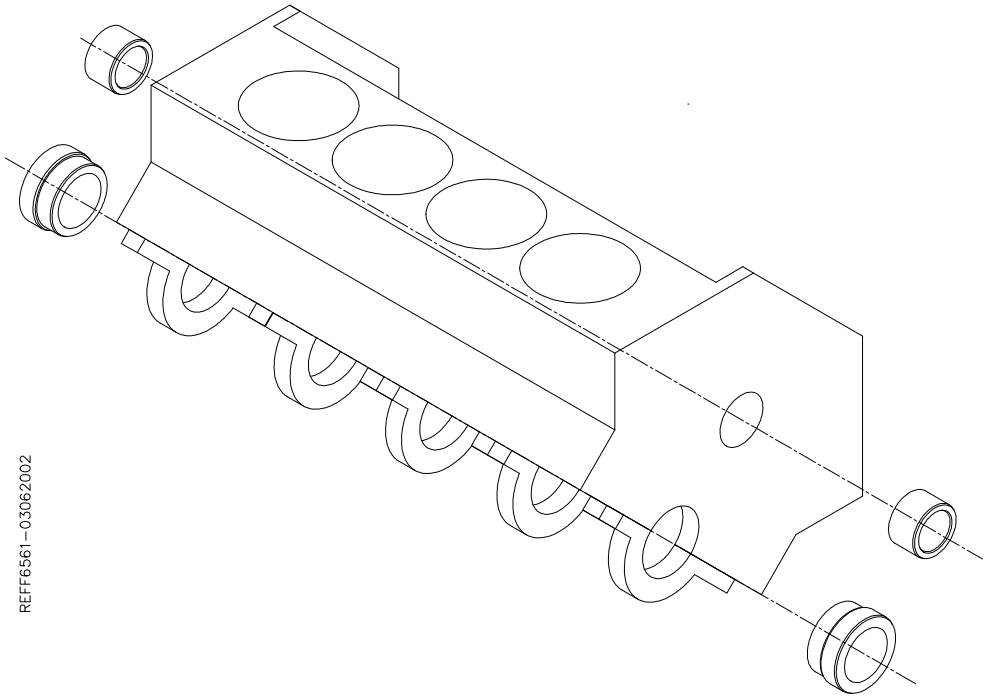
All modes of operation will be discussed in this chapter.

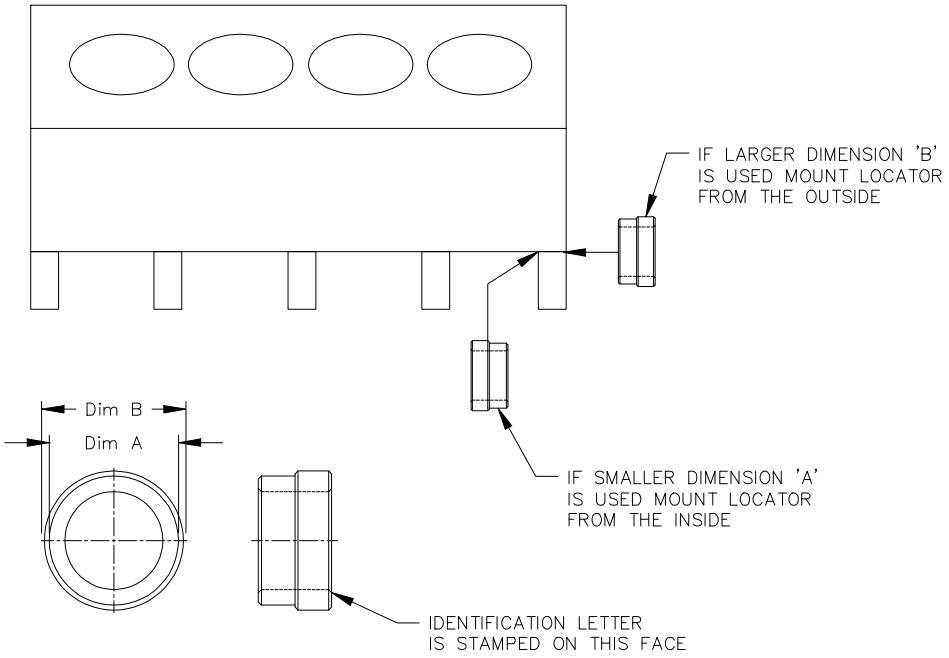
Loading a Block:

Performance Fixture 650-3-1 Boring:
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.
Install the Tail Stock onto the right hand side of the table but do not tighten down.



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.

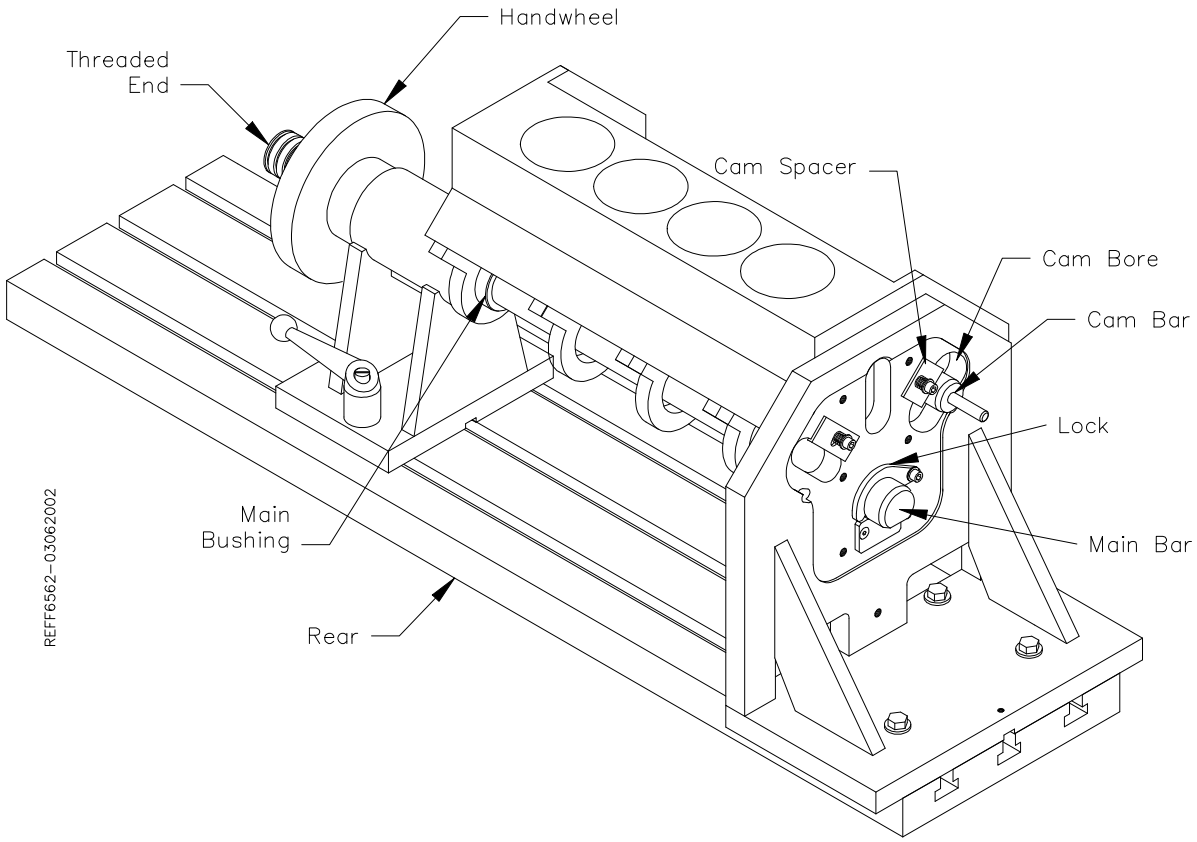




Note: Each locator covers two bearing diameters ('A' and 'B'). The unused diameter MUST be placed INSIDE the block to prevent interference with the Index plates.

1) 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.
2) 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.
3) 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.
4) Snap the Cam spacer into place.
5) Push the Tail stock up to the block. Tighten the Handwheel with a quick snapping motion.
6) Tighten the two handles on the Tail stock.

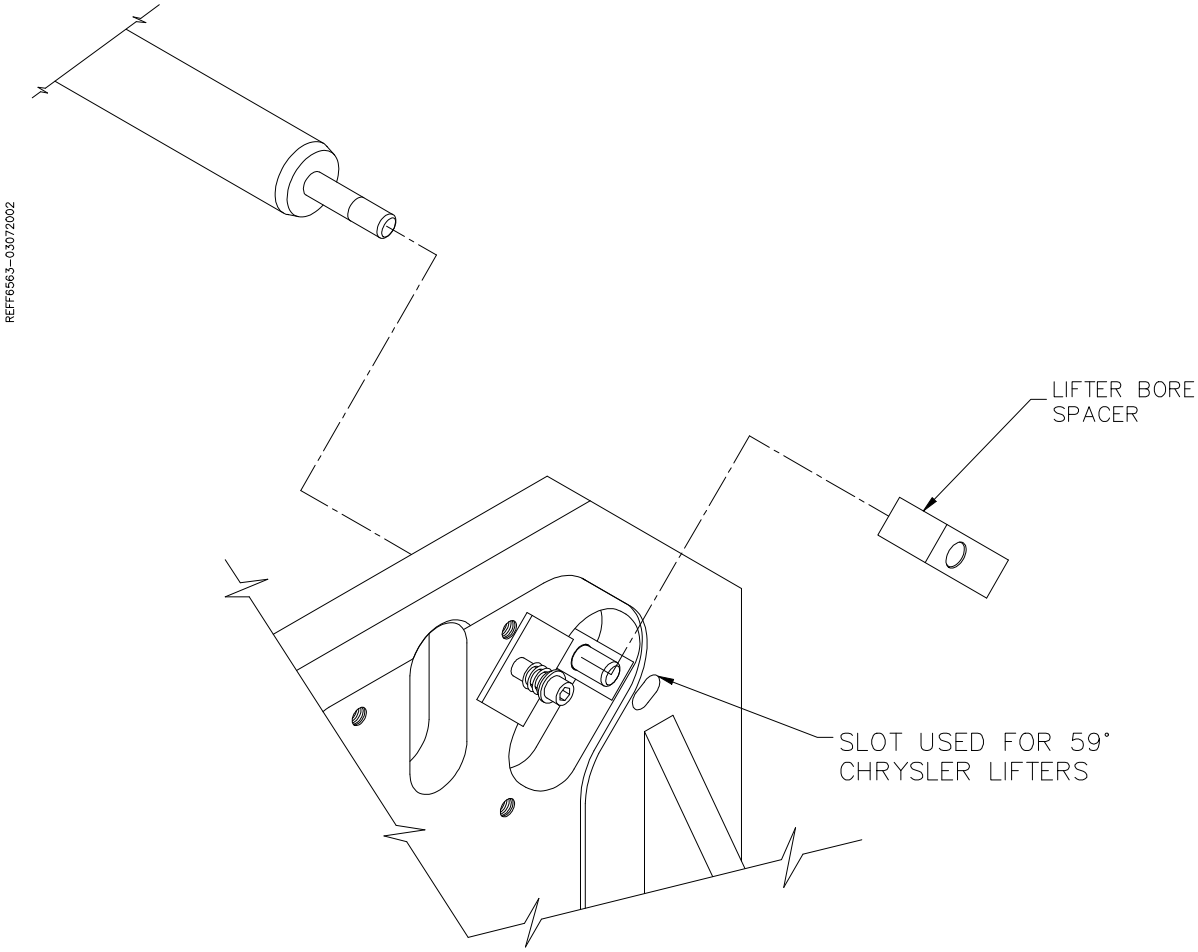
The block and fixture are now locked in place and ready for machining.



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.

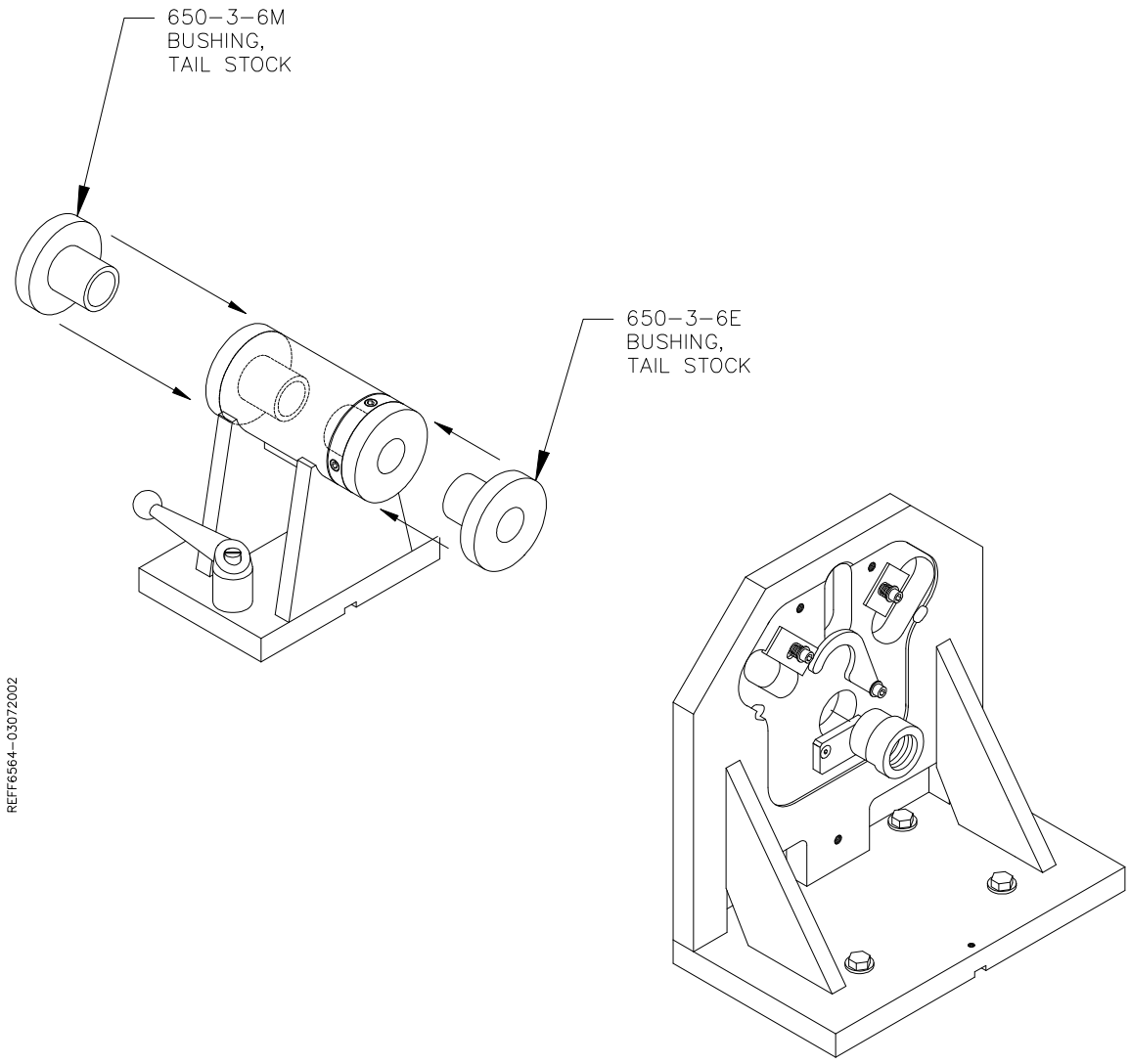


Lower End Machining Package 650-3-1A:

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.

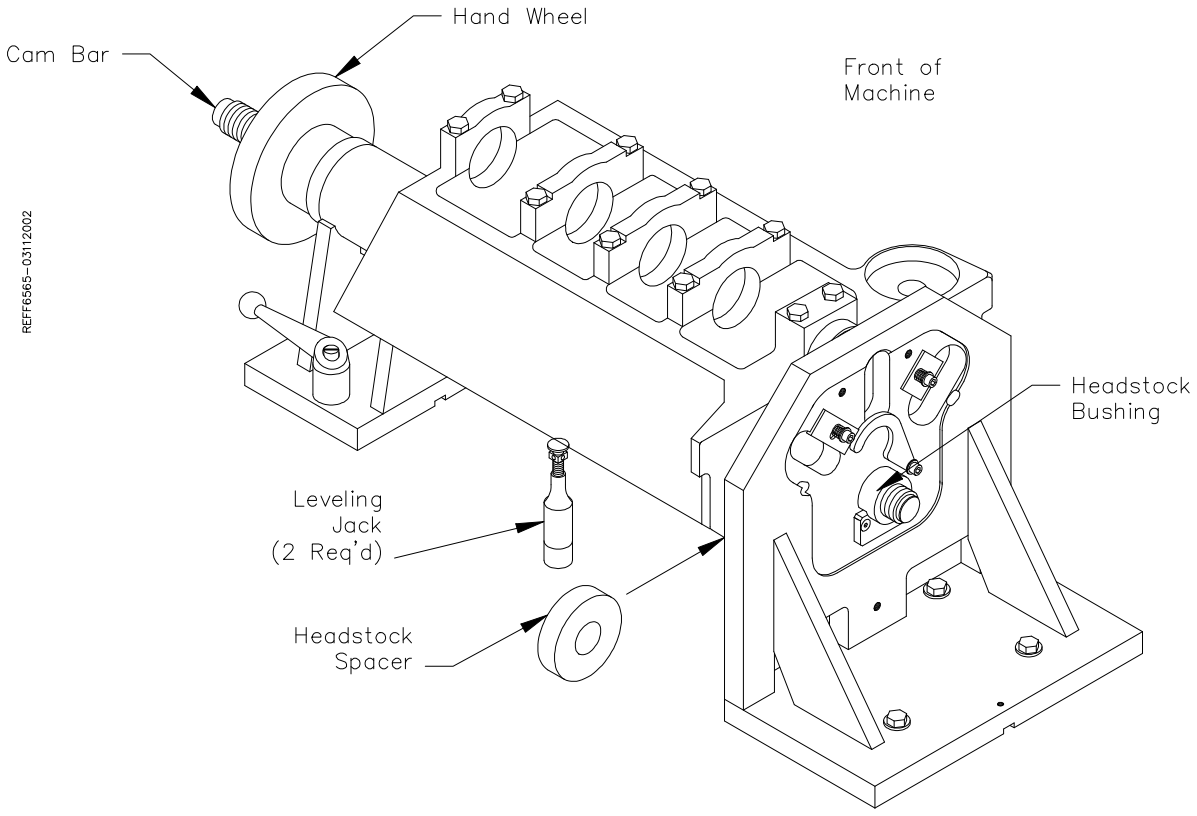
Install the Tail Stock onto the right hand side of the table but do not tighten down.

Install the Tail stock bushings 650-3-6E and 650-3-6M into the Tail stock as shown below.



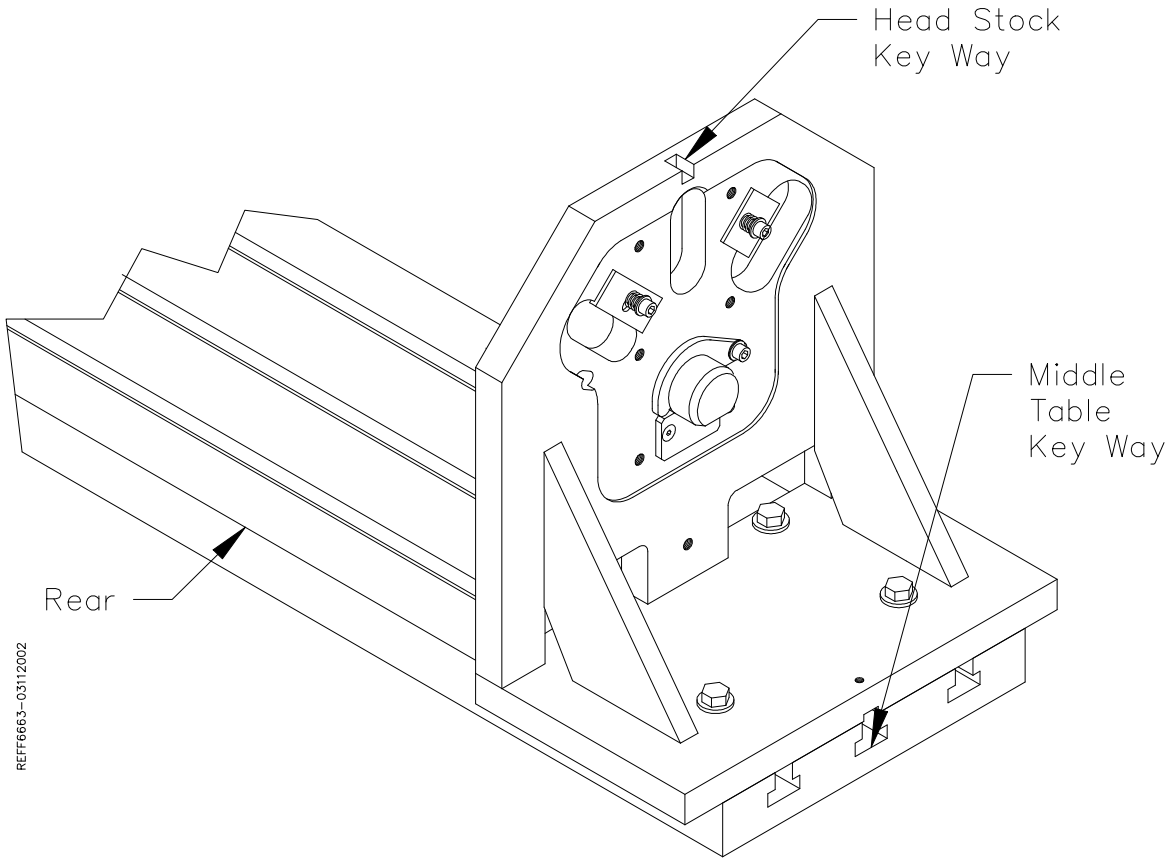
2) Select the correct size Cam Bushings for the block you are using and install them into the block.
3) Using a slow travel hoist, position the block between the Head stock and Tail stock with the Bell housing end of the block towards the Head stock with the Main Caps facing up.
4) Install Head stock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

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

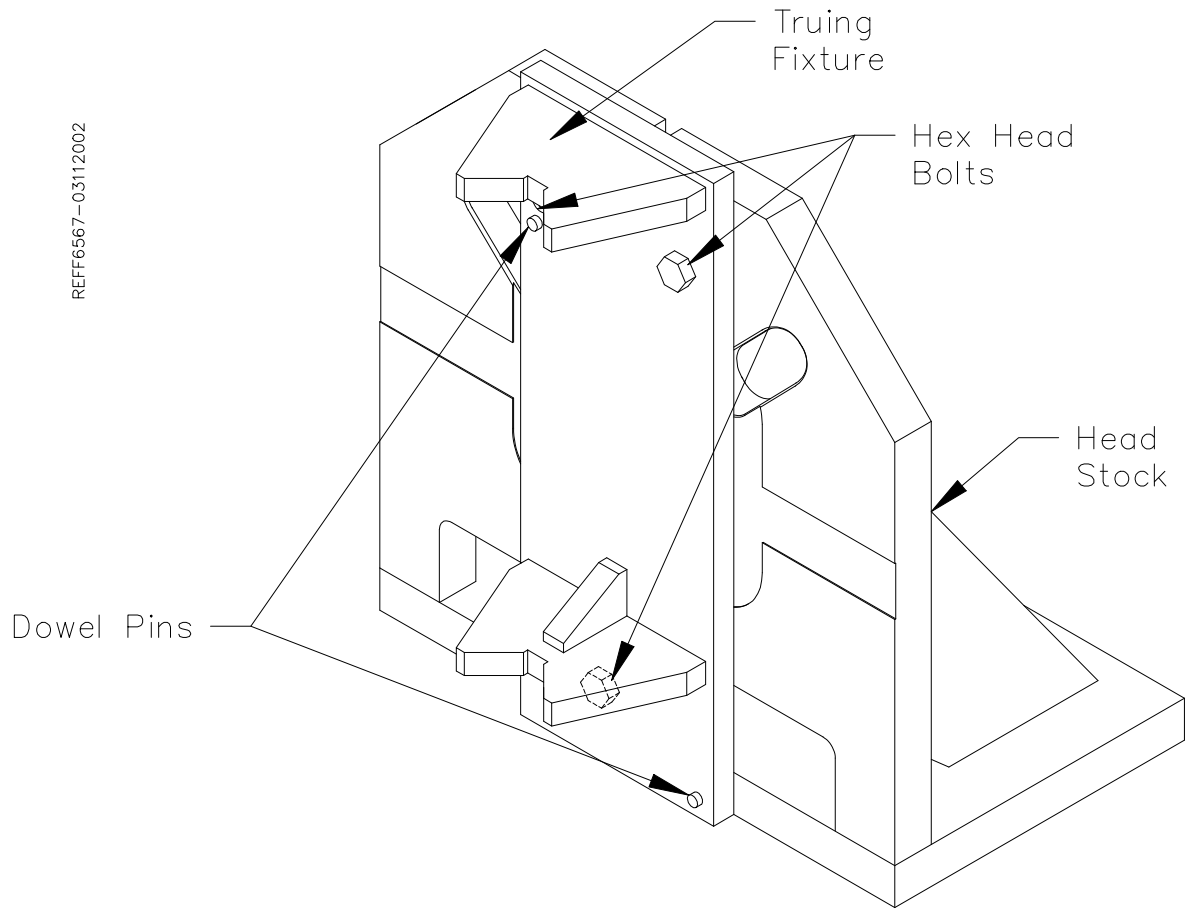


Block End Truing Fixture 650-3-30:
If you are truing the ends of a block use the standard Head stock mentioned in the Maintenance section of this manual.
If you are Boring the Cam Tunnels with this fixture follow the standard Head stock in the Maintenance section of this manual plus the procedure below:

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.



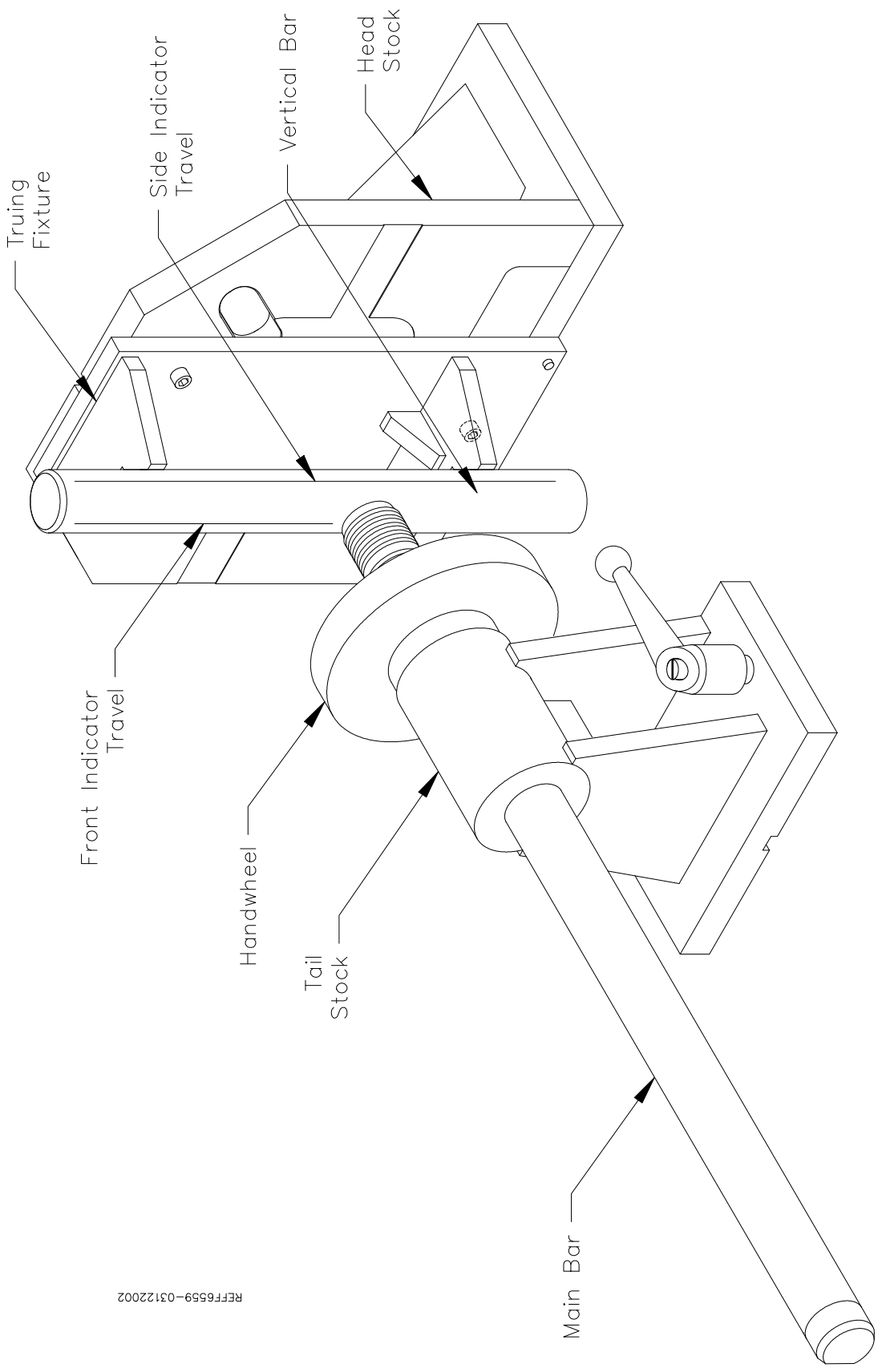
4) Install the Truing Fixture onto the Head stock. Slide the two Dowel pins on the Truing Fixture into the appropriate Dowel holes on the Head stock.
5) Bolt the Truing Fixture to the Head stock using the three supplied Hex Head Bolts.



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.

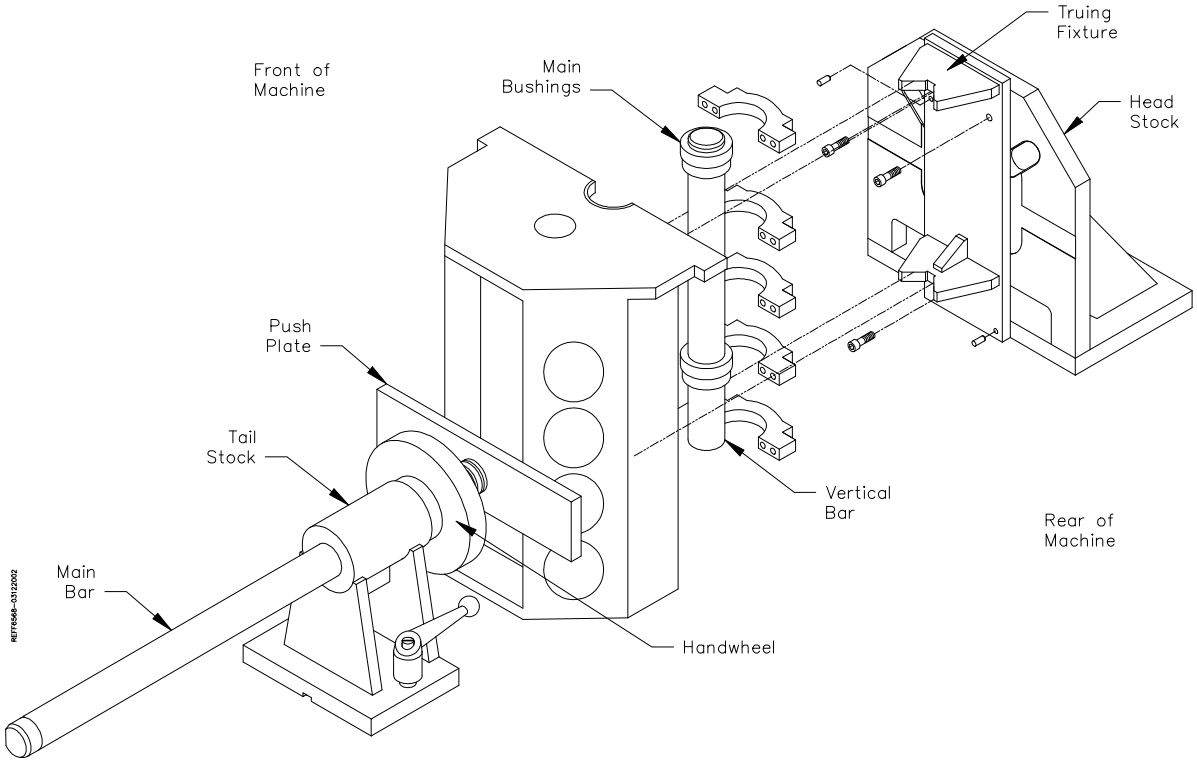
6) Slide the Main Bar though the Tail stock (threaded end first).
7) Thread the Handwheel onto the Main Bar.
8) Place the Vertical Bar into the “V” on the Truing Fixture.
9) Slide the Tail stock towards the Head stock until the Main Bar just touches the vertical Bar.
10) Tighten the Tail stock down.
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.

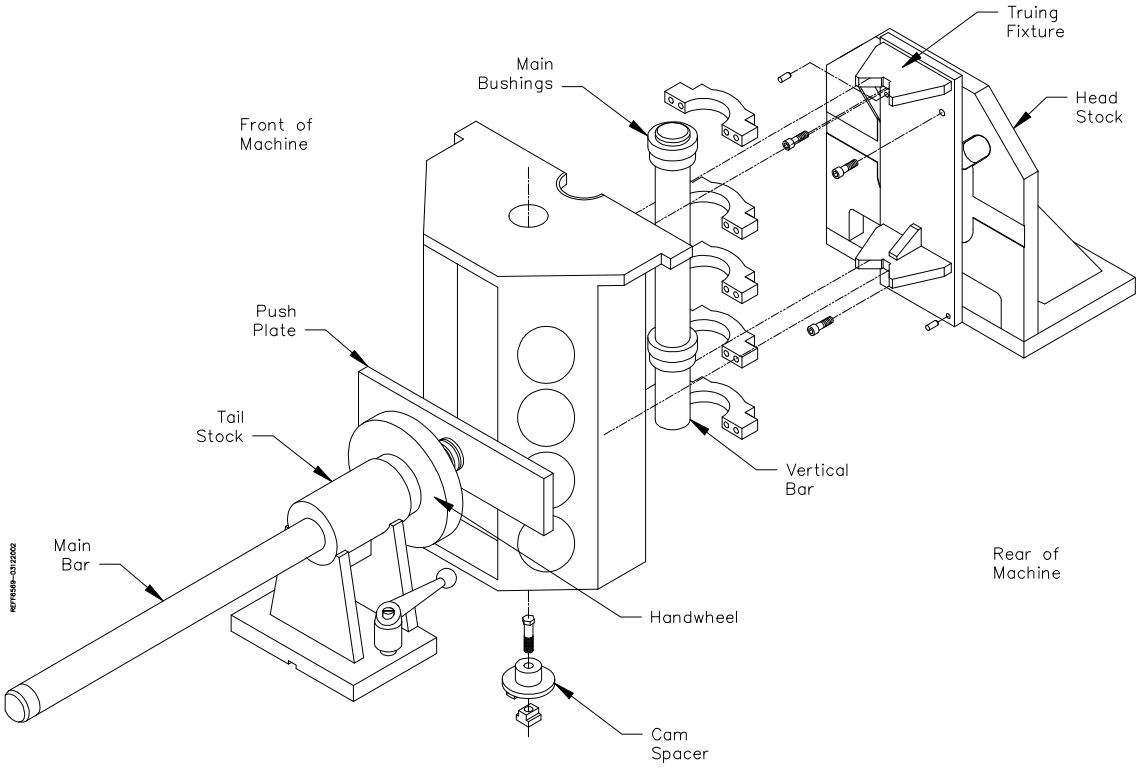
The block and fixture are now locked in place and ready for machining.



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

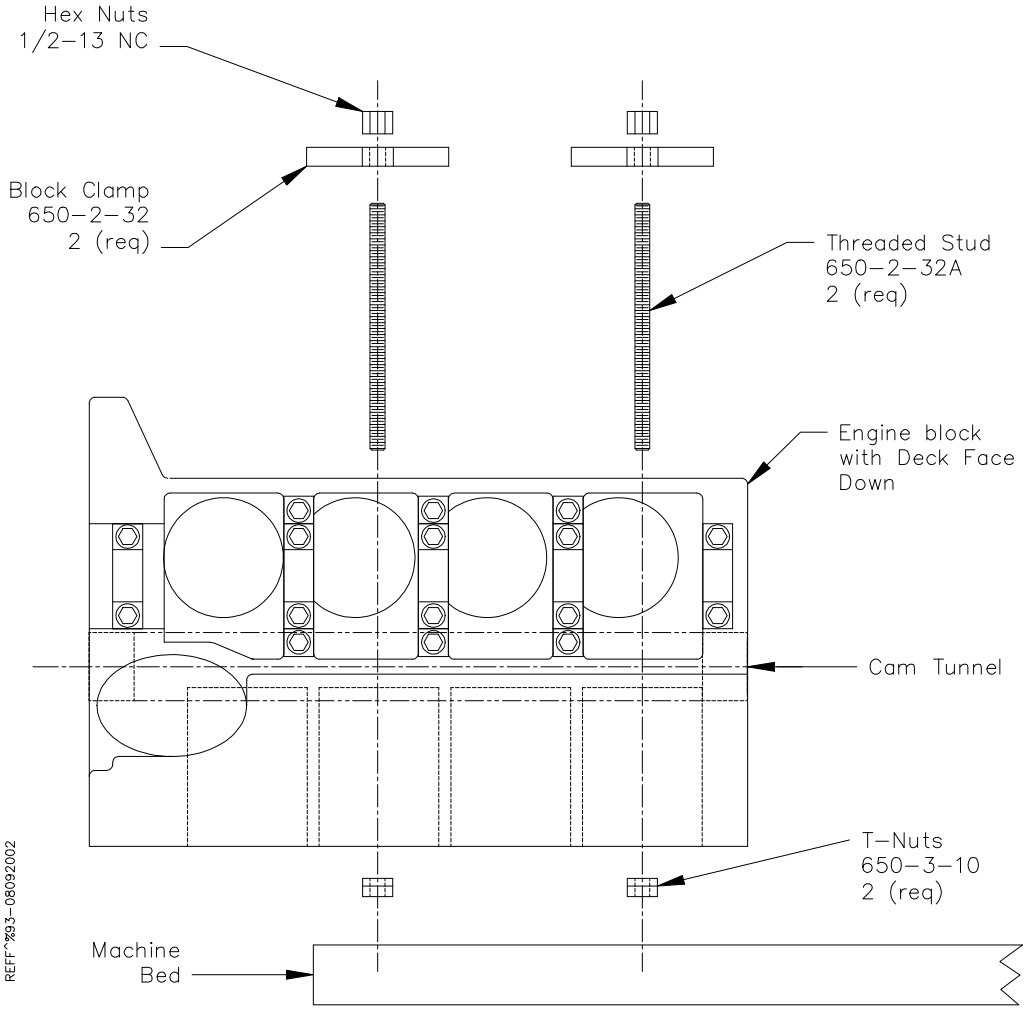
1) Use the same set up and line up procedure as with the standard End Truing Fixture discussed earlier in this section.
2) Place the Cam Spacer in the middle T-slot of the machine bed along with T-Nut and Bolt.
3) Select the correct Cam Bushing for the block you are going to be machining from the table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

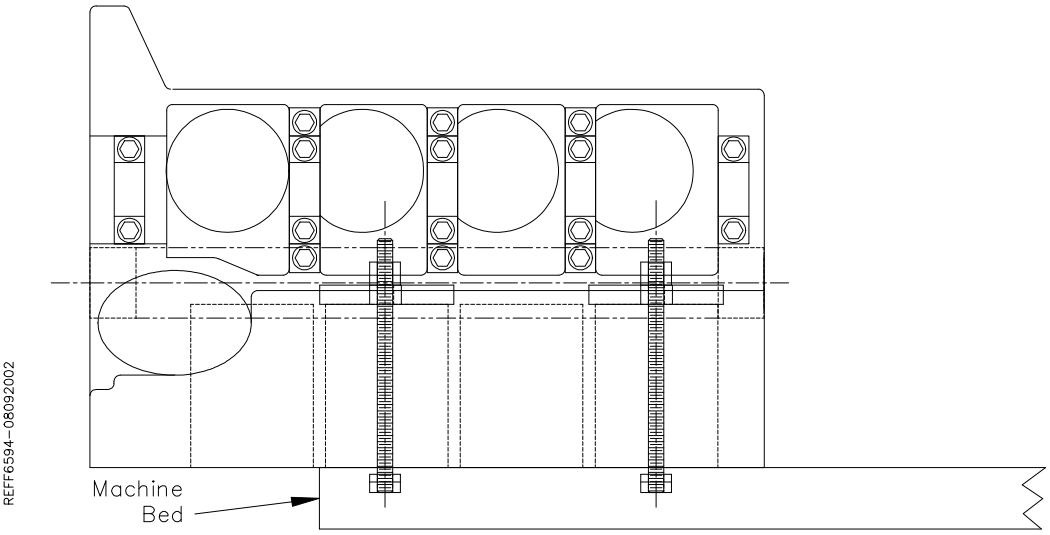
The block and fixture are now locked in place and ready for machining.



Cam Tunnel Boring:

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





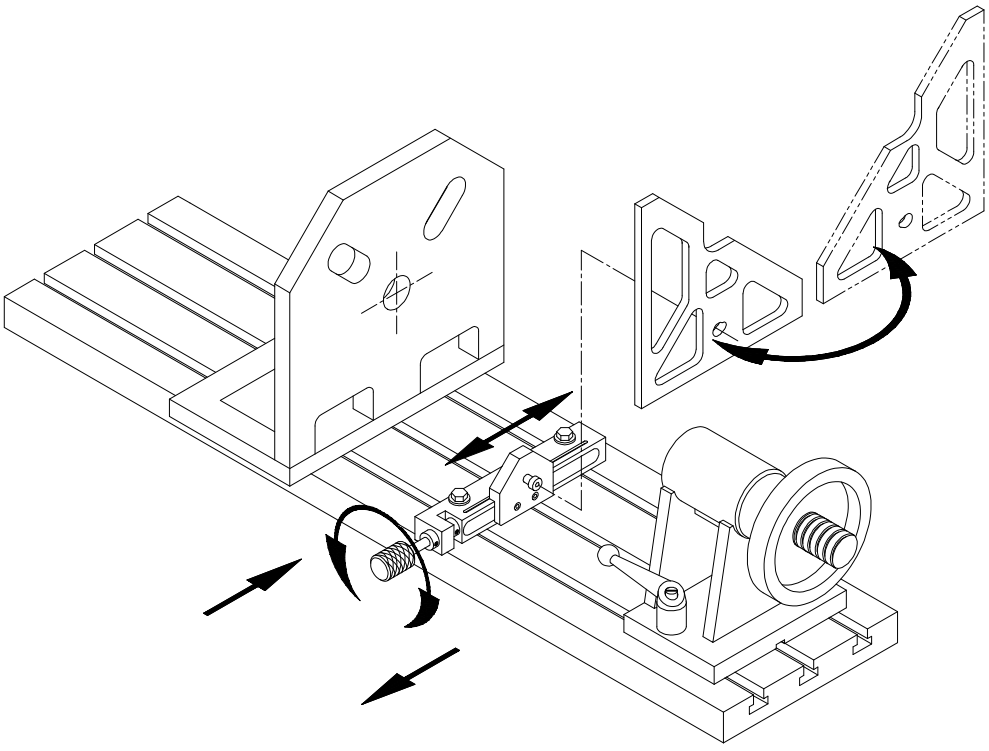
Screw the supplied ½-13 NC nuts on to the threaded rod and snug them up. Do not tighten tehm all the way at this point.
Attach a magnetic base indicator to the spindle and run it along the upper pan rail to get it relatively straight. It does not need to be perfectly strait because a double flex coupling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

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

650-3-20A Pan Rail Wedge Fixture
Installation and Operation

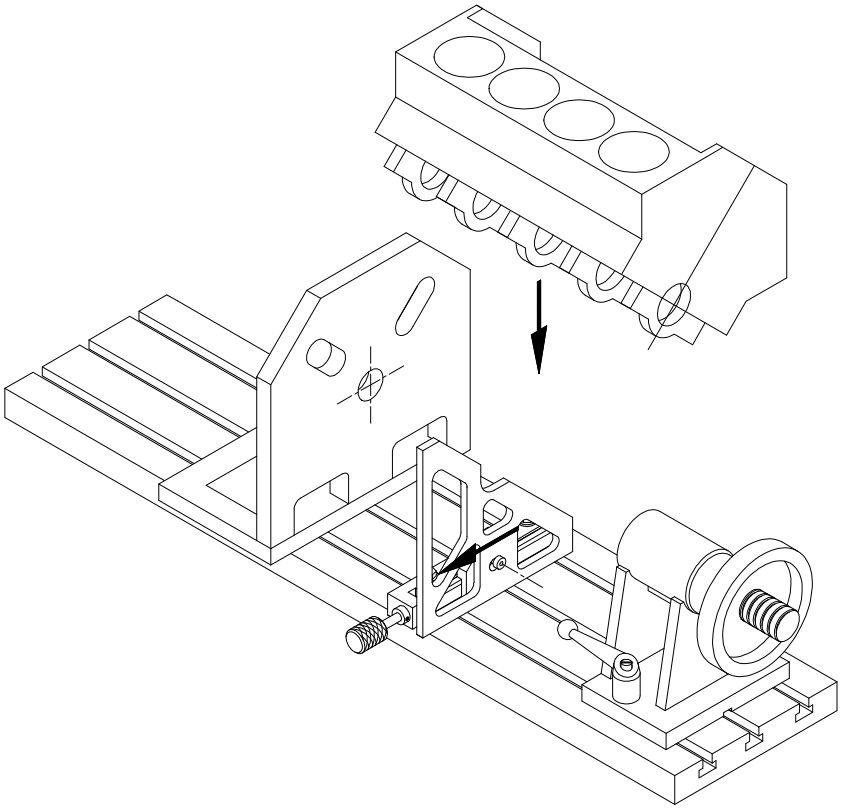
The 650-3-20A Pan Rail Wedge Fixture is used with the Performance fixture to set the correct cylinder bank angle for milling and boring operations. This fixture positions the block using the pan rail to set this angle. Both V-blocks and Y-blocks, as well as overhead cam blocks can all be set using this fixture.

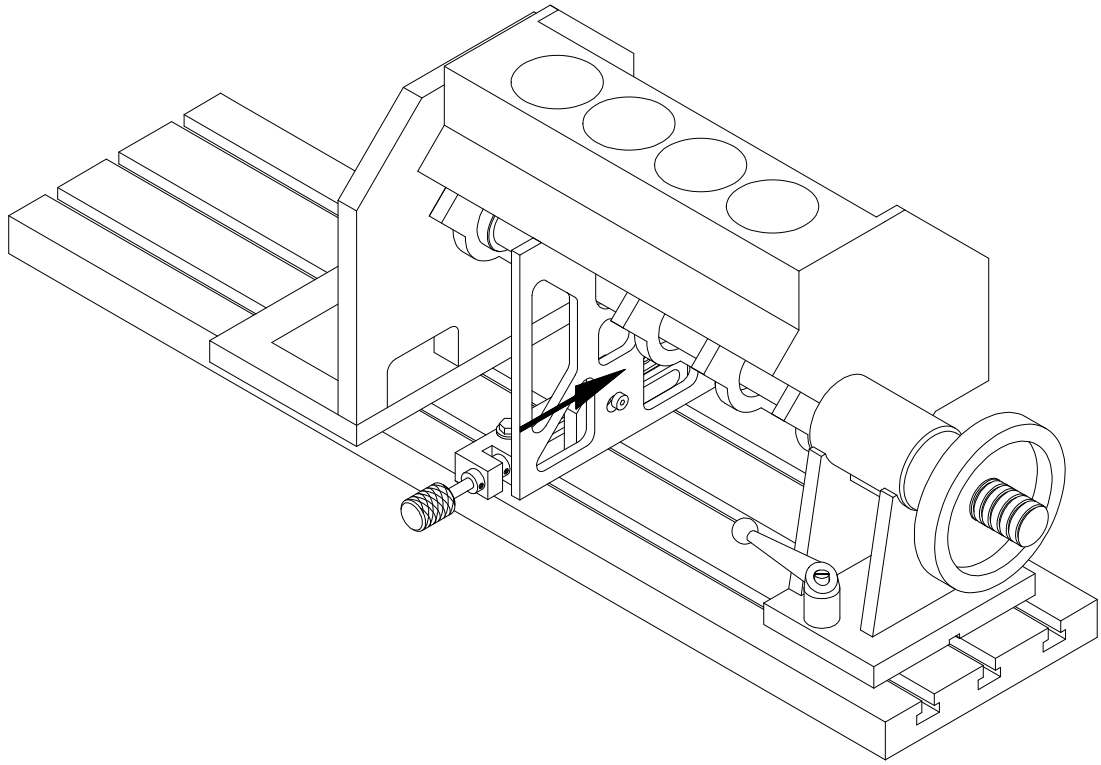
Mounting:
The pan rail fixture is mounted to the machine table between the head stock and tail stock of the performance fixture. Locate the fixture approximately centered between two of the main bearing caps. The key attached to base locates to the center keyway of the table. Once positioned, tighten the (2)(MF-150) hex bolts to secure. Choose the correct wedge for the block being machined from the list below:
650-3-23H Tall 30 deg. Wedge – 60 deg. V-blocks
650-3-23G Tall 45 deg. Wedge – 90 deg. V-blocks
650-3-23B Short 30 deg. Wedge – 60 deg. Y-blocks
650-3-23A Short 45 deg. Wedge – 90 deg. Y-blocks
These wedges can be flipped to face angled surface toward front or rear, depending on which bank of the block will be machined first. Mount the wedge to the fixture by sliding the keyhole over the shoulder screw in the 650-3-24 support plate. Turning the knob clockwise moves the wedge towards the operator, counterclockwise moves the wedge away from the operator. Operate the knob to move the wedge away from the block for loading.



Loading the block:

Note: for this fixture to work properly and with accuracy the block pan rails must be clean, smooth, and free of burrs. Burrs, dirt, and gasket material left of the pan rails will not let this fixture perform correctly. Install the wedge on the support plate with the angled surface facing the pan rails. Turn the knob to move support plate and wedge away from the centerline of the fixture to allow room to install the block in the fixture. Load the block with the bank you wish to machine approximately in position. Turn knob to bring wedge up to contact the pan rail. Once contacted, keep turning the knob until the wedge contacts both pan rails. At this point, the wedge should make firm contact with both the pan rails and the table. This contact can be checked with shim at both pan rails and front and rear at bottom of the wedge. Now the operator can tighten the performance fixture and proceed with machining. Note: this fixture is designed to position the block, not hold the block. Failure to tighten the fixture could result in block movement, causing possible block and/or machine damage and operator injury.

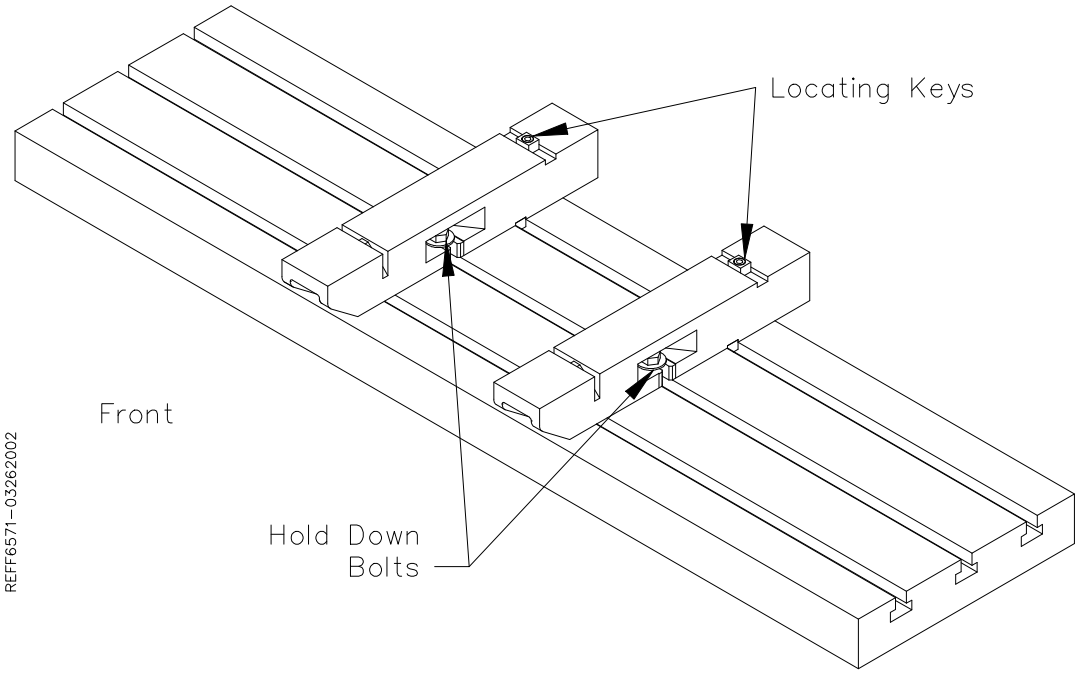




Switching banks:
After machining the first bank, clear chips away from the fixtures moving parts, especially around the contact surfaces of the wedge. Turn the knob to move the wedge away from the pan rails. Move the support plate away far enough to disengage the wedge from the shoulder screw. Remove the wedge from the support plate. Loosen the block and rotate to the other bank, again, approximately in the correct position. Turn the knob to position the support plate to install the wedge, turned around to again face the angled surface to the pan rails. Make sure the contact surfaces of the wedge are clean and free of chips. Turn the knob to move the wedge into contact with the pan rails, and continue until full contact with pan rails is made. Full contact can be checked with shim at both pan rails and front and rear at bottom of the wedge. Tighten the performance fixture and proceed with machining.

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

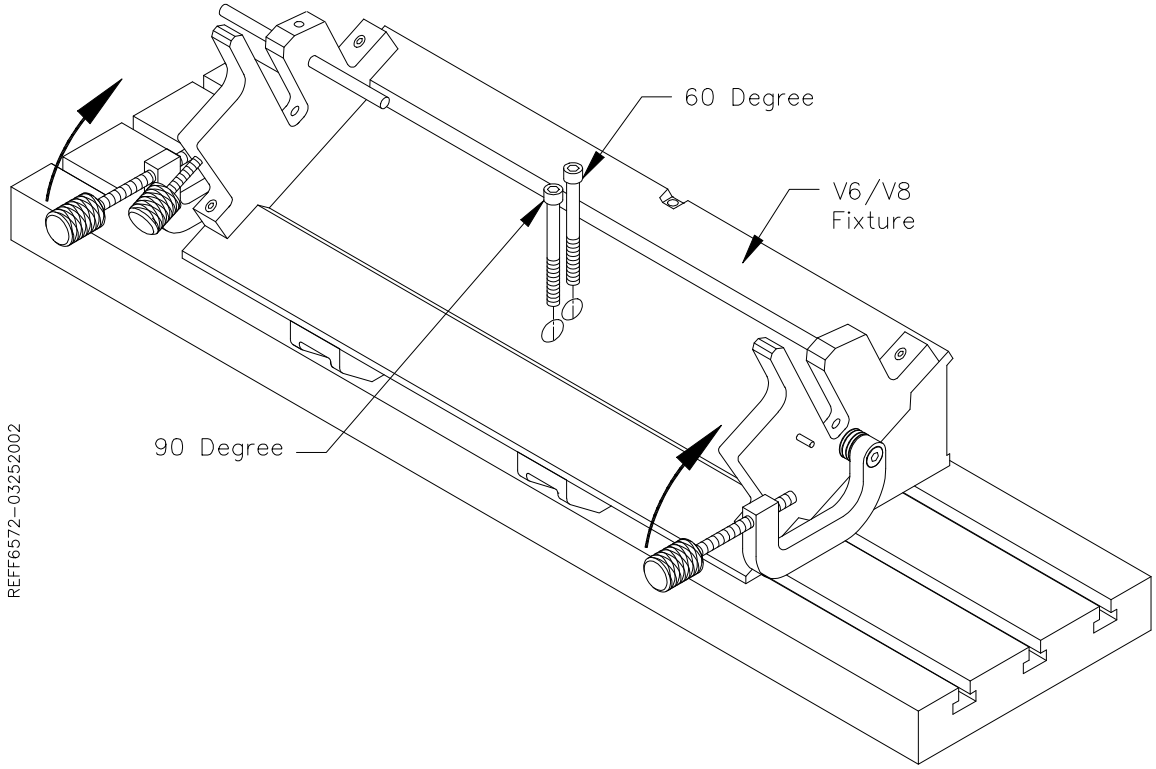
Place parallels 650-3-34 on Machine bed 10 inches apart and secure with T-Nut and Hex bolts that are provided. The keys on the bottom of the parallels go in the back Key Way.



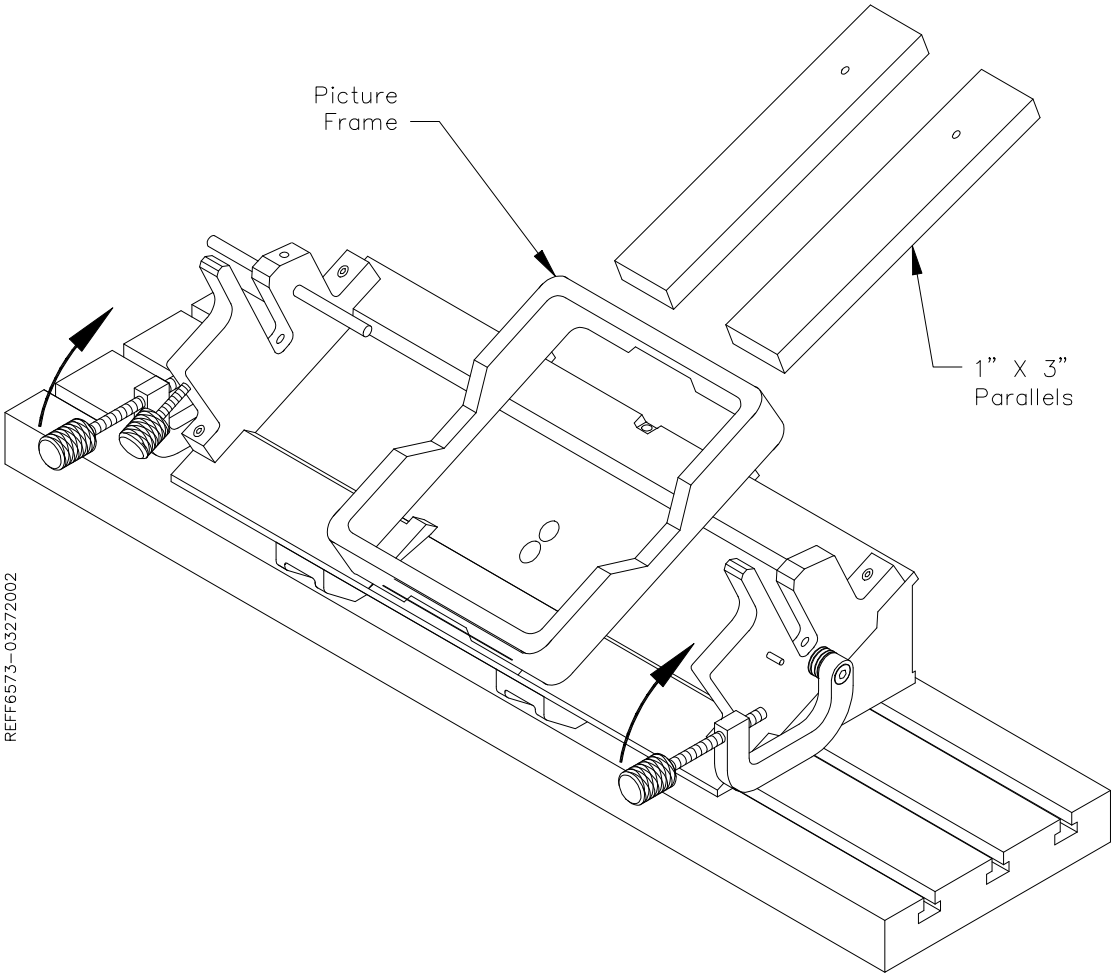
Select the 60 or 90 degree position for the fixture. Using a slow moving hoist, set the V6/V8 fixture onto the parallels.

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.

Use the supplied Socket Head cap Screw and T-Nut to secure the fixture in place.

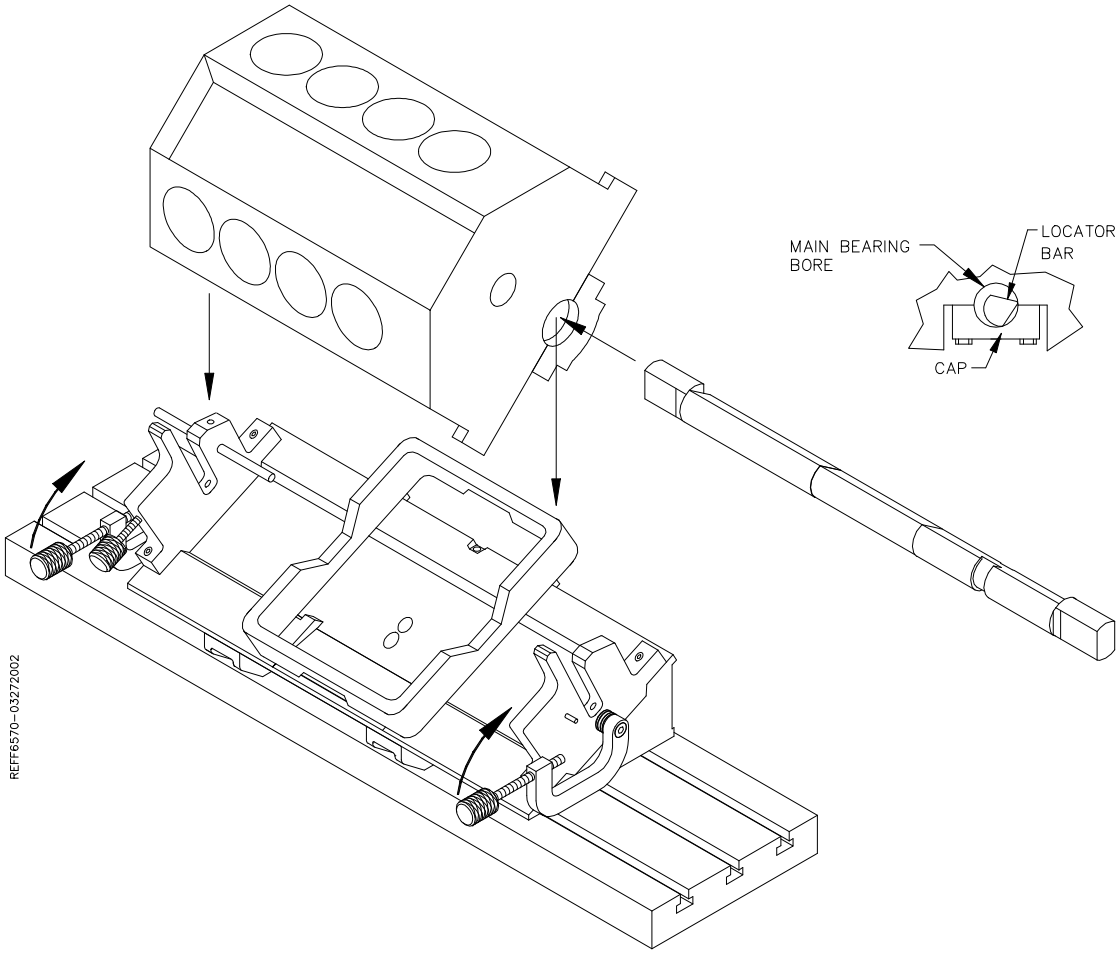


Decide if the Picture Frame or the 1” X 3” will need to be used.



Slide the Locator Bar through the Mains of the block.
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.

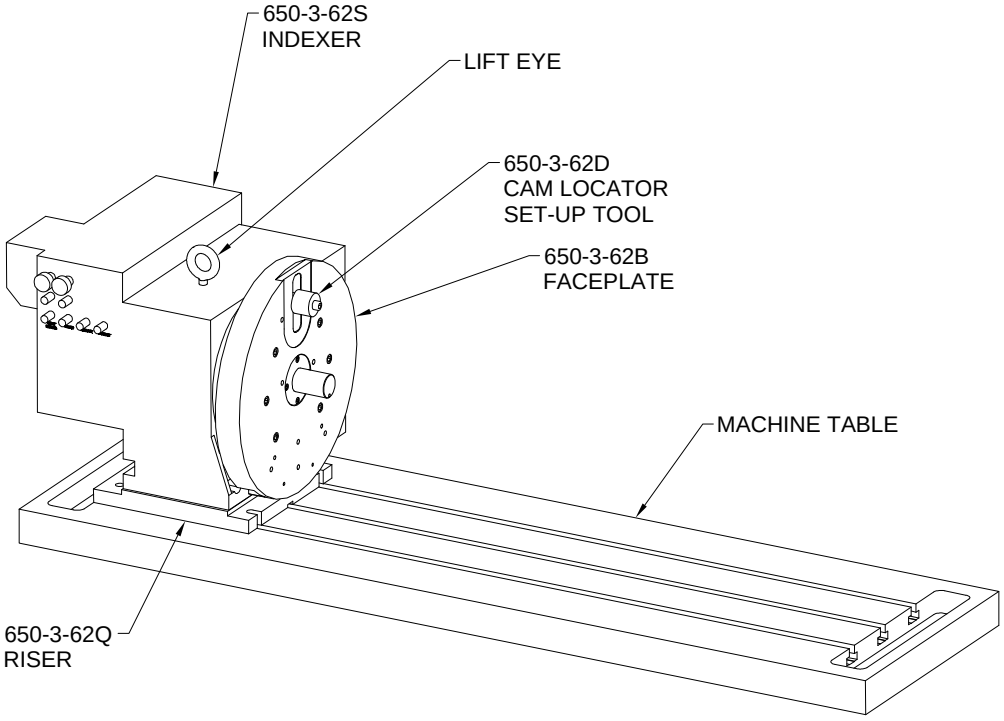

MAIN BEARING BORE
LOCATOR BAR
CAP
REFF6570-03272002

The 650-3-59 Auto performance fixture is designed to quickly and accurately fixture v-style engine blocks for boring, surfacing, and other assorted machining operations. This fixture consists of an indexing headstock and an extending tailstock. This fixture is controlled with onscreen commands on the F67 and F68 series machines. Locator sets are available to fit specific blocks and provide quick change over between different block styles. As with any precision tooling, careful machine set up and block preparation are critical to consistent accuracy and quality work.

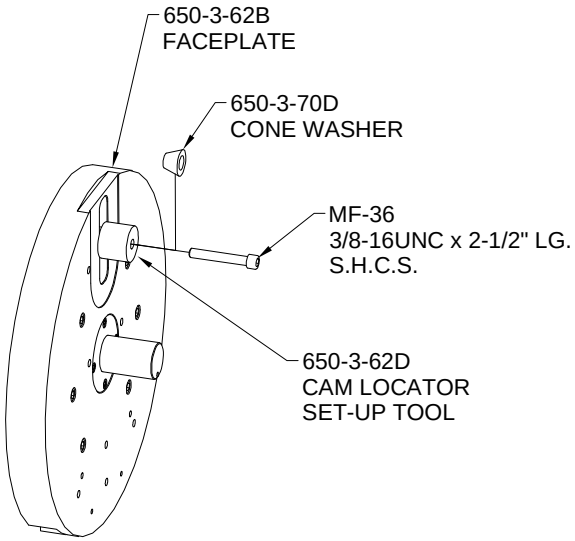
Mount the indexer unit to machine.

The indexer unit for this fixture can be lifted using the supplied lift eye on top of the indexer. This eye can stay on the indexer in use. The indexer should be positioned on the left end of the machine table with the keys on the bottom of the 650-3-62Q riser plate in the center keyway.

Push the indexer back so the keys are against the backside of the center keyway of the machine table and tighten (4) mounting bolts. Use an indicator to check 650-3-62B faceplate for straightness both vertically and horizontally.

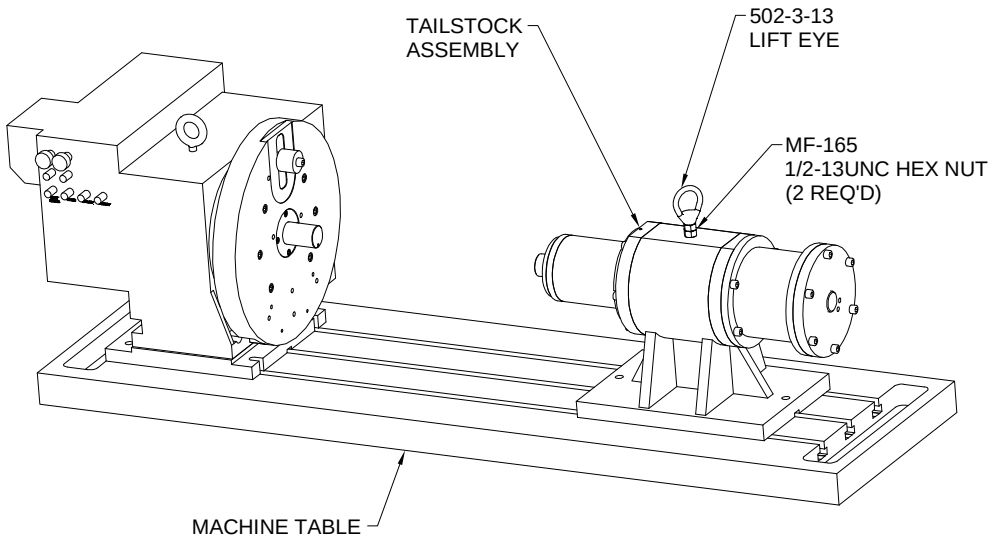


The 650-3-62D cam locator set-up tool should be installed on the indexer from the factory. This tool is used to check the angle ‘0’ of the indexer. The diameter of this tool is the same diameter as the shaft on the 650-3-62H faceplate pinion. With the indexer set to 0 degrees these two shafts should be aligned vertically. An indicator can be used to check this. With the two shafts aligned vertically, the flat machined on the top of the 650-3-62B faceplate should indicate 0. The number stamped on the machined flat is the exact distance from the flat to the headstock centerline. The two flats milled at 45 degrees to each side of this central flat are set to the same distance from centerline.



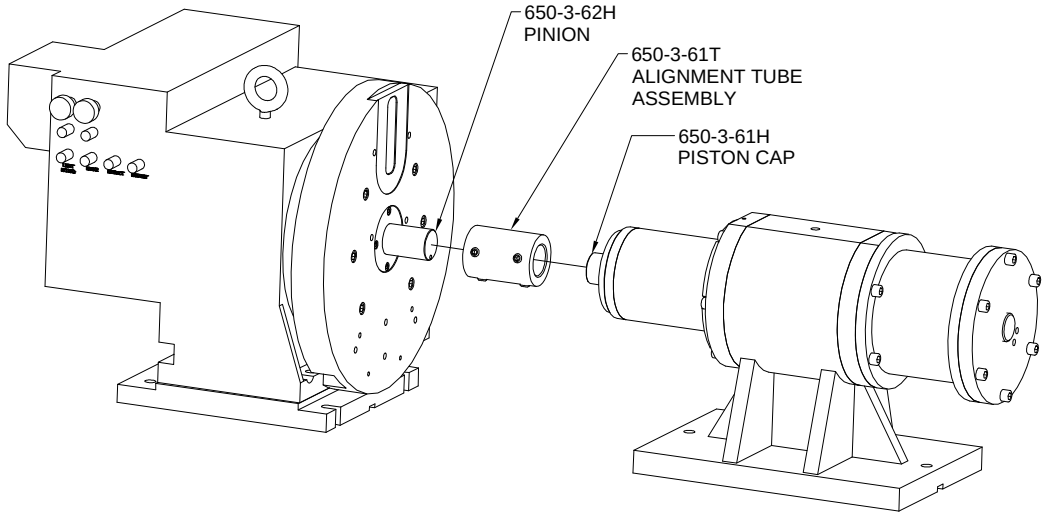
Mount the tailstock unit onto machine.

The tailstock can be lifted using the supplied 502-3-13 lift eye. Note: the lift eye has (2) ½-13unc nuts attached to it to prevent threading the lift eye too deep into the housing and contacting the 650-3-61G piston tube. Do not remove these nuts or substitute a longer thread as this will damage precision parts of this assembly. After moving the tailstock into position remove the lift eye and replace it with 650-3-61S ½-13 x 5/8" long socket button head screw to keep contamination out of the housing.



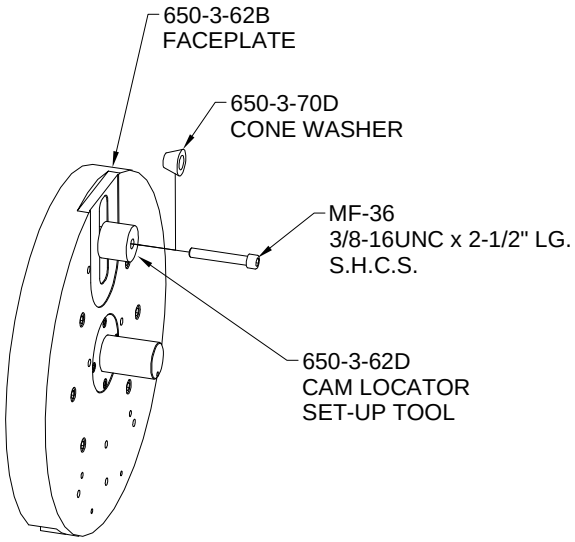
Install 650-3-61T alignment tool assembly to the pinion shaft of the indexer unit. Slide the tailstock up to place the 650-3-61H piston cap nose into the alignment tool. At this point the keys of the tailstock should

be against the back of the machine table center keyway. When moving the tailstock to accommodate different block sizes the keys must be pushed against the keyway each time to ensure alignment before tightening the (2) mounting bolts. Remove the alignment tool assembly and place aside for future checking of alignment.



Using the 4th Axis Fixture:

The 650-3-62D cam locator set-up tool should be installed on the indexer from the factory. This tool is used to check the angle '0' of the indexer. The diameter of this tool is the same diameter as the shaft on the 650-3-62H faceplate pinion. With the indexer set to 0 degrees these two shafts should be aligned vertically. An indicator can be used to check this. With the two shafts aligned vertically, the flat machined on the top of the 650-3-62B faceplate should indicate 0. The number stamped on the machined flat is the exact distance from the flat to the headstock centerline. The two flats milled at 45 degrees to each side of this central flat are set to the same distance from centerline.

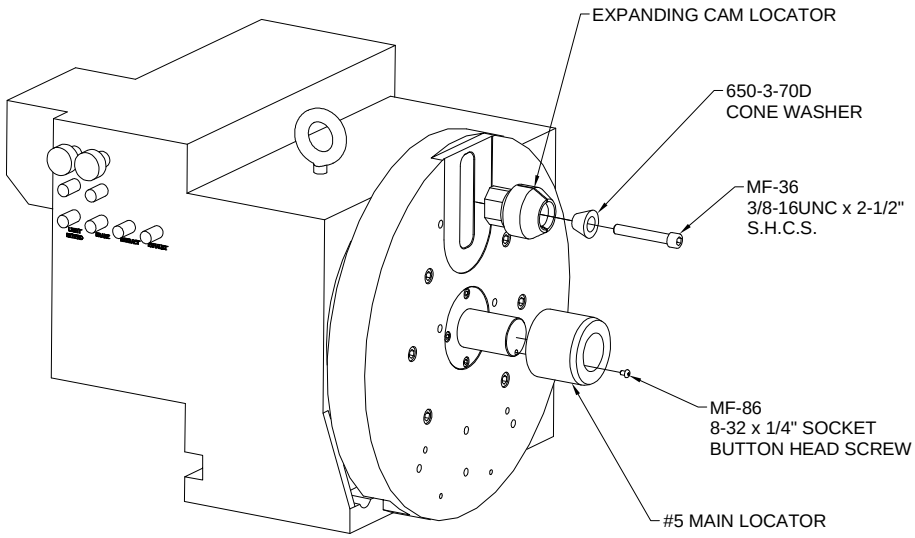


Locators: This fixture requires the use of locator sets, sized to fit individual engine blocks. These sets consist of (1) cam bearing bore locator, (1) #5 main bearing bore locator, and (1) #1 main bearing bore locator.

Main bearing bore locators: The #5 main locator is sized to fit onto the 650-3-62H faceplate pinion with the tapered end facing out. This locator is retained on the pinion by the MF-86 button head screw in the pinion. The #1 main locator is sized to fit onto the 650-3-61H piston cap of the tailstock with the tapered end facing out. This locator is also retained by an MF-86 button head screw.

Expanding cam bore locator: The cam bore locator is sized to fit into the 650-3-62B faceplate. To load the specific locator: remove the MF-36 3/8-16UNC cap screw and the 650-3-62D setup tool from the faceplate. The setup tool should be set aside for checking indexer '0' in the future. Install the cam locator with its socket fitting into the slot in the faceplate. The 650-3-70D cone washer is installed into the mating countersink in the locator, and held in by re-installing the 3/8-16UNC cap screw. This cap screw threads into the 650-3-62V cam locator nut that is trapped in the 650-3-62B faceplate Tighten the cap screw just enough to hold the locator in the desired location in the slot.

CAM AND MAIN LOCATOR INSTALLATION



Loading an engine block:

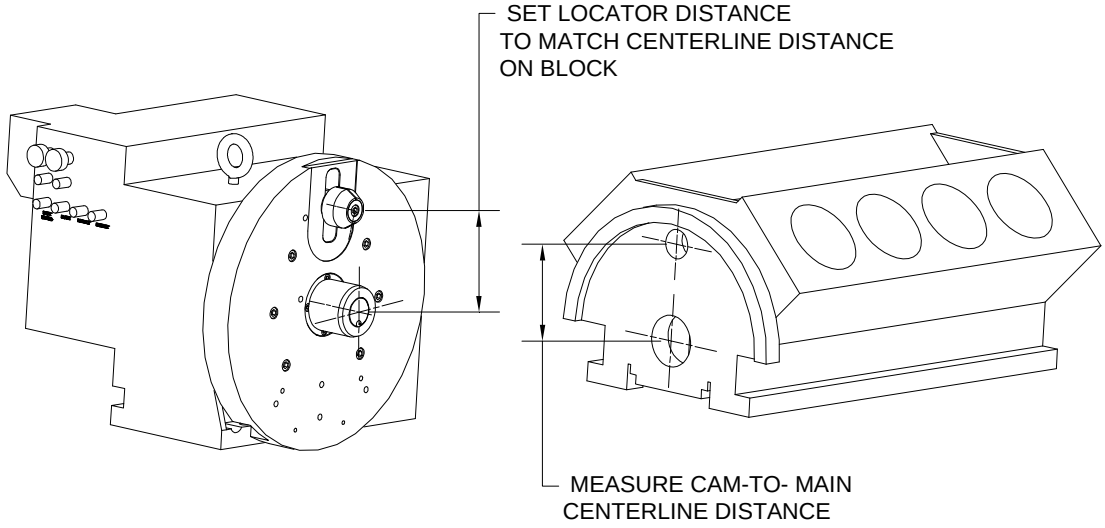
This fixture requires the main bearing bores, the rear cam bearing bore, and the transmission mounting surface of the engine block be clean and free from nicks, dings, and foreign particles. Failing to ensure this will result in poor performance of your fixture.

The tailstock must be positioned to allow space to install the engine block, but still be close enough to clamp the block within the 6" of stroke allowed by the tailstock piston. Approximately 3-1/2" of the stroke will be used to take up the required length of the locators, leaving approximately 2-1/2" of room to position the tailstock.

Generally, measure the overall length of the engine block and add 1". This will be the space to leave between the pinion noses of the headstock and tailstock with the tailstock piston retracted. Example: a 20" long engine block will require the pinion noses to be 21" apart. This will leave ½" of room on each end of the engine block for loading and still be within the stroke length of the tailstock.

After setting the distance between the pinion noses, tighten the tailstock down with its keys pushed back against the center keyway of the table.

Measure the distance between the centerlines of the main and cam bores of the block. Slide the adjustable cam locator to be equal to this distance. Lightly tighten the MF-36 cap screw to keep the cam locator in place.



Using a hoist, load the engine block down between the pinions with the bell housing surface facing the headstock. Slide the blocks main bore over the #5 main locator on the headstock and position the block to slide the cam bore over the cam locator. Tapers on the outside of both locators will aid in positioning. Push the block flush up against the faceplate and activate the 'light extend'. This will extend the tailstock piston with limited pressure to locate the block on the tailstock. CAUTION: keep fingers and all other objects out of the path of the tailstock piston. Even with limited pressure, severe injury could occur if this rule is not followed. If desired, a hex socket and long extension can reach through the cam bores from the front of the block and be used to tighten the cap screw holding the cam locator in place. The 650-3-70D cone washer will expand the cam locator to provide a tighter fit on the cam bore, further centering the block on the indexer '0'. Once the block is located properly, full tailstock pressure can be applied after rotating the indexer to the desired angle.

After machining is complete, unload the block in reverse order. Loosen the cap screw on the cam locator to release pressure on the cam bore of the block. Position the hoist to hold block and retract the tailstock. Slide the block off the faceplate and locators to remove.

Readjusting tailstock piston alignment:

Checking for tailstock alignment may be required after heavy use or after a crash has occurred. The first step is to check all possible variables before making adjustments.

Headstock: make sure the headstock is pushed back with the keys against the back of the center keyway of the machine table. Tighten the (4) bolts to secure the headstock to the table and check faceplate for squareness.

Tailstock: the tailstock also must be pushed back with the keys against the back of the center keyway of the machine table.

With both units tightened down as described above, an indicator can be used to check the alignment between the two pinions both vertically and horizontally. If the alignment is out more than .001 in either direction an adjustment must be made.

The headstock pinion should be checked for runout. With an indicator placed on the 650-3-62H pinion, rotate the indexer. The runout here should be no more than .0005. Runout of this pinion can be adjusted by loosening the (6) MF-33A 3/8-16 cap screws holding the faceplate to the indexer and tapping the faceplate until the pinion runs true. Retighten the (6) cap screws. Check both pinions with an indicator again for alignment. If still not aligned within specs the tailstock will need adjustment.

Begin with the tailstock piston retracted. Remove the 650-3-61K cushion from the tailstock piston cap. Note the timing of the 650-3-61H piston cap relative to the piston tube to reassemble in the same configuration. Remove the (4) MF-5 cap screws from the 650-3-61H piston cap. If the cap does not slide out, the MF-5 cap screws can be threaded into the four tapped holes of the cap and evenly tightened to push the cap out of the 650-3-61G piston tube. Beneath the piston cap is the 650-3-61J nose plate which is attached to the piston of the 650-3-61E stroking cylinder with a MF-172 ½-20 hex nut. Activating the tailstock to light extend should push the nose plate out of the piston tube. Using the flats on the cylinder piston to keep it from turning, removed the ½-20 hex nut. Slide the nose plate off of the cylinder piston.

Remove the (4) MF-34 3/8-16 x 2" long cap screws holding the 650-3-61C tailstock extension on. The tailstock extension with the stroking cylinder should slide out through the back of the housing.

Slide the piston tube to be centered in the tailstock housing. Reinstall the 650-3-61H nose plate in the piston tube. Remove 6247A retainer, 6248 wiper, 6249 felt compressor, and 6251 felt oiler from front of 6225A bearing carrier. Loosen 100-82-2B 8-32 brass tipped set screw in bearing carrier. Tighten 6223 spindle nut until piston tube will not slide by hand. Loosen the (6) MF-32 3/8-16 cap screws holding the 6225A carrier on the housing. Loosen the (6) MF-31 3/8-16 cap screws holding the 650-3-61F rear bushing on the housing.

Install the 650-3-61T alignment tube assembly over the pinion of the headstock. Slide the tailstock up to fit the tailstock pinion into the alignment tube. Tighten (4) setscrews on the alignment tube to lock the two pinions in alignment. Push the tailstock housing to the rear to contact the keys with the middle keyway of the machine table and tighten its two mounting bolts. Check the piston tube with an indicator across the top and the back on both ends for straightness. Tap on either the carrier or the rear bushing to adjust alignment. The piston tube should be straight within .0005 in both directions. Retighten the 3/8-16 cap screws holding both the carrier and the rear bushing. Loosen the tailstock mounting bolts. Loosen the (4) set screws of the alignment tube assembly and slide the tailstock back from the headstock. Push the tailstock back on the middle keyway and tighten the mounting bolts. Recheck alignment of the pinions with an indicator in both directions. Recheck the straightness of the piston tube with an indicator. If alignment is within specs, reassemble the tailstock as follows:

Loosen the 6223 spindle nut until the piston tube can be moved by hand applying about 40-50 lbs. of force. Tighten the 100-82-2B set screw to lock the nut in place. Remove the 650-3-61H piston cap. Reinstall the 650-3-61C tailstock extension with the stroking cylinder attached and lightly tighten its (4) mounting cap screws. The stroking piston cylinder should be sticking out the front of the piston tube. Reinstall the 650-3-61J nose plate and tighten the ½-20 nut to secure. Release the air pressure from the stroking cylinder and slide its piston back by hand into the piston tube until the nose plate contacts the bottom of the counterbore in the piston tube. Tighten the (4) cap screws holding the 650-3-61C tailstock extension on. Reinstall the 650-3-61H piston cap and 650-3-61K cushion.

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 F68A 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.

Homing:

The F68A ***MUST*** be homed anytime it is turned off. If the machine has not been homed the reference positions for all programs 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:

Cylinder Bore Mode 3 Axis:

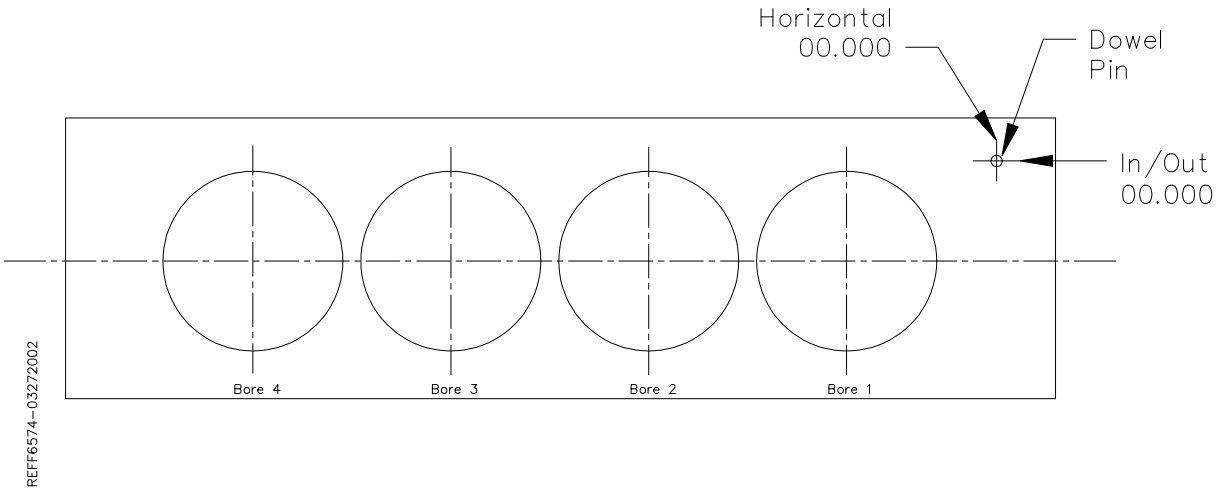
Select Cylinder Bore and then through Bore on the control panel. This will bring up the boring program with the Set Zeros tab shown.

Setting Zeros:

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

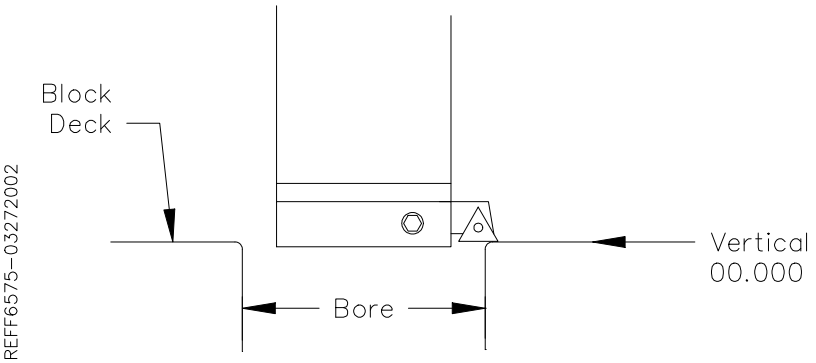
Horizontal and In/Out Zero:

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:
There are three different ways to use the boring software, Blueprinting, Indicating and Probing. It is not unusual for all three modes to be used on the same size block. The vertical stops for these different operating programs will vary. Be sure the vertical stops are set correctly for the mode you are using.

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.



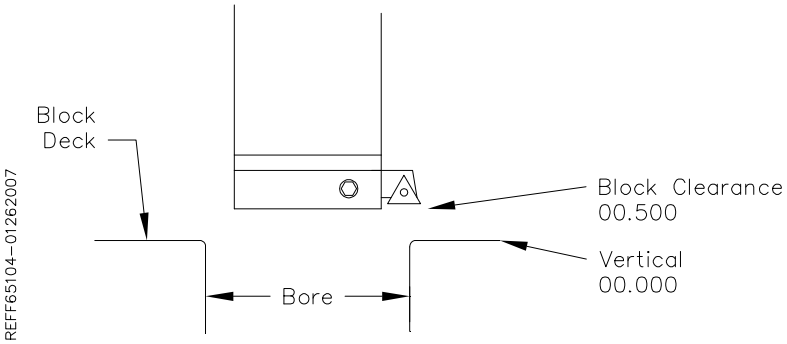
The zeros points for all axis have now been set. All the numbers entered from this point on will reference these zero positions. You are finished with the Set Zeros screen, select the next Tab to the Right.

Blueprinting:

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

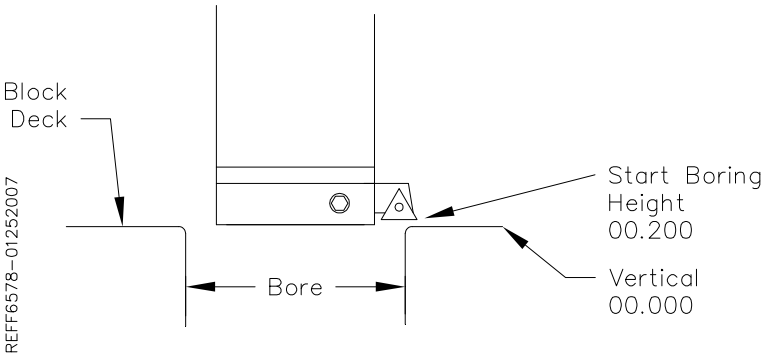
Programming Vertical Stops:
To build a program you must set the Vertical Stops for the program. There are six (6) Vertical stops used in the boring program. Four of them are required to build an operational program. The Lower Clearance Stops are optional and will be described below.

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.

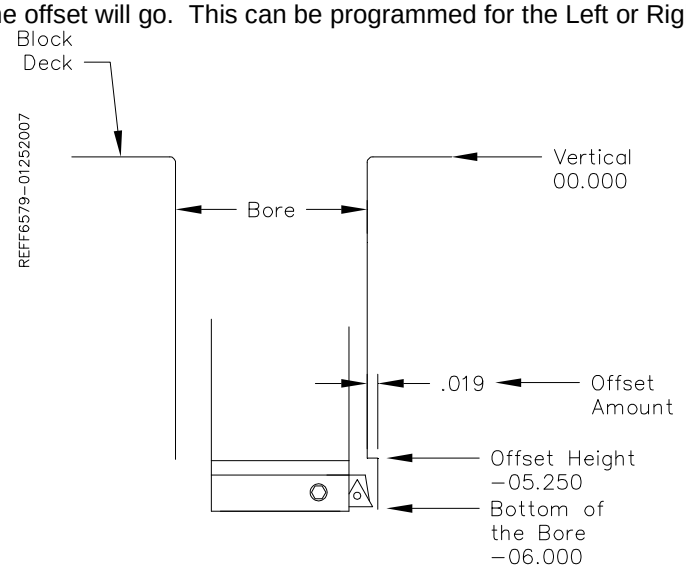


Centering Height:
When Blueprinting this stop is not needed. It should be the same as the block Clearance Height.

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

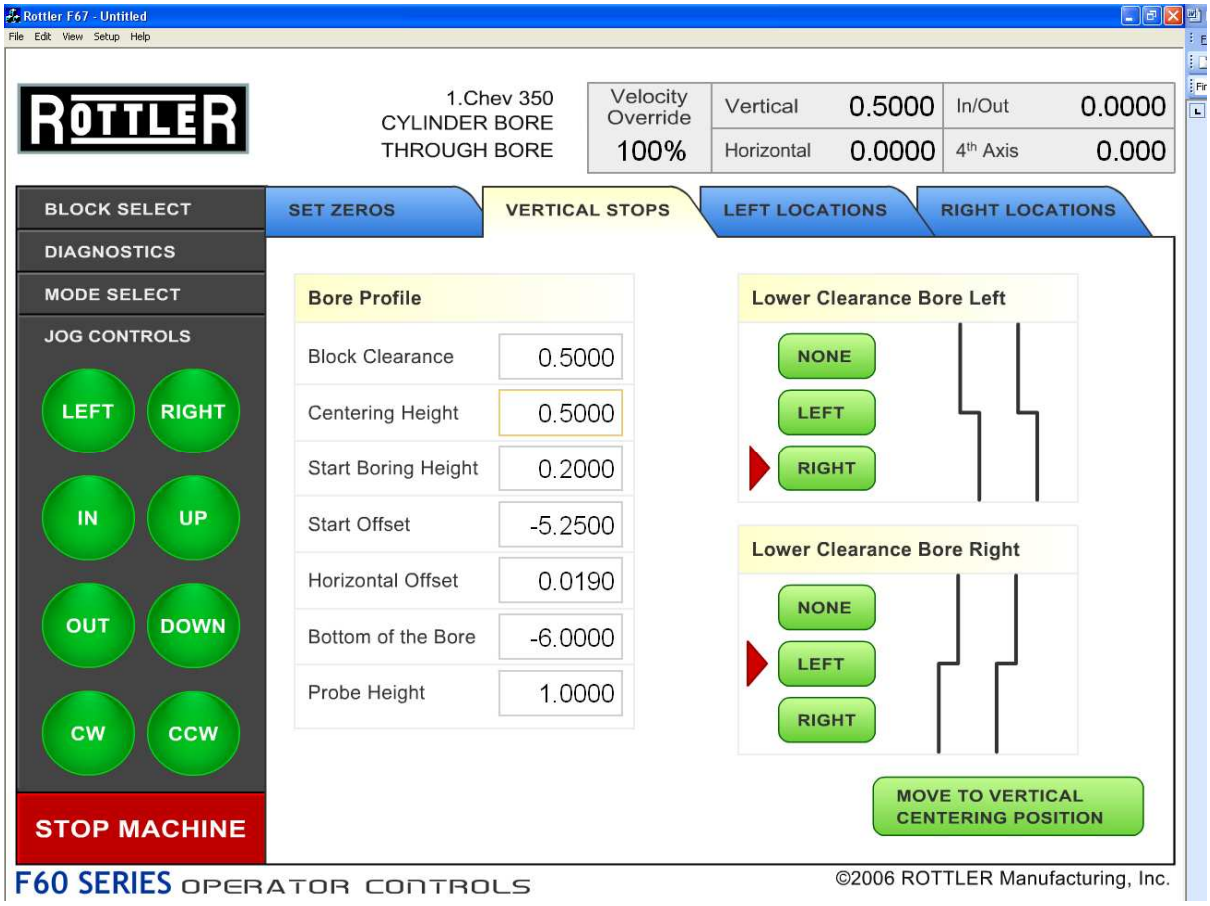


Lower Clearance Bore:
This option is used to offset the cutterhead to the Left or the Right to make clearance for Honing below the cylinder. It can be turned off, offset Left or offset right. If Left or Right is selected the controller will ask you at what position do you want the offset (Offset Height) 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 can be programmed for the Left or Right banks.



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

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



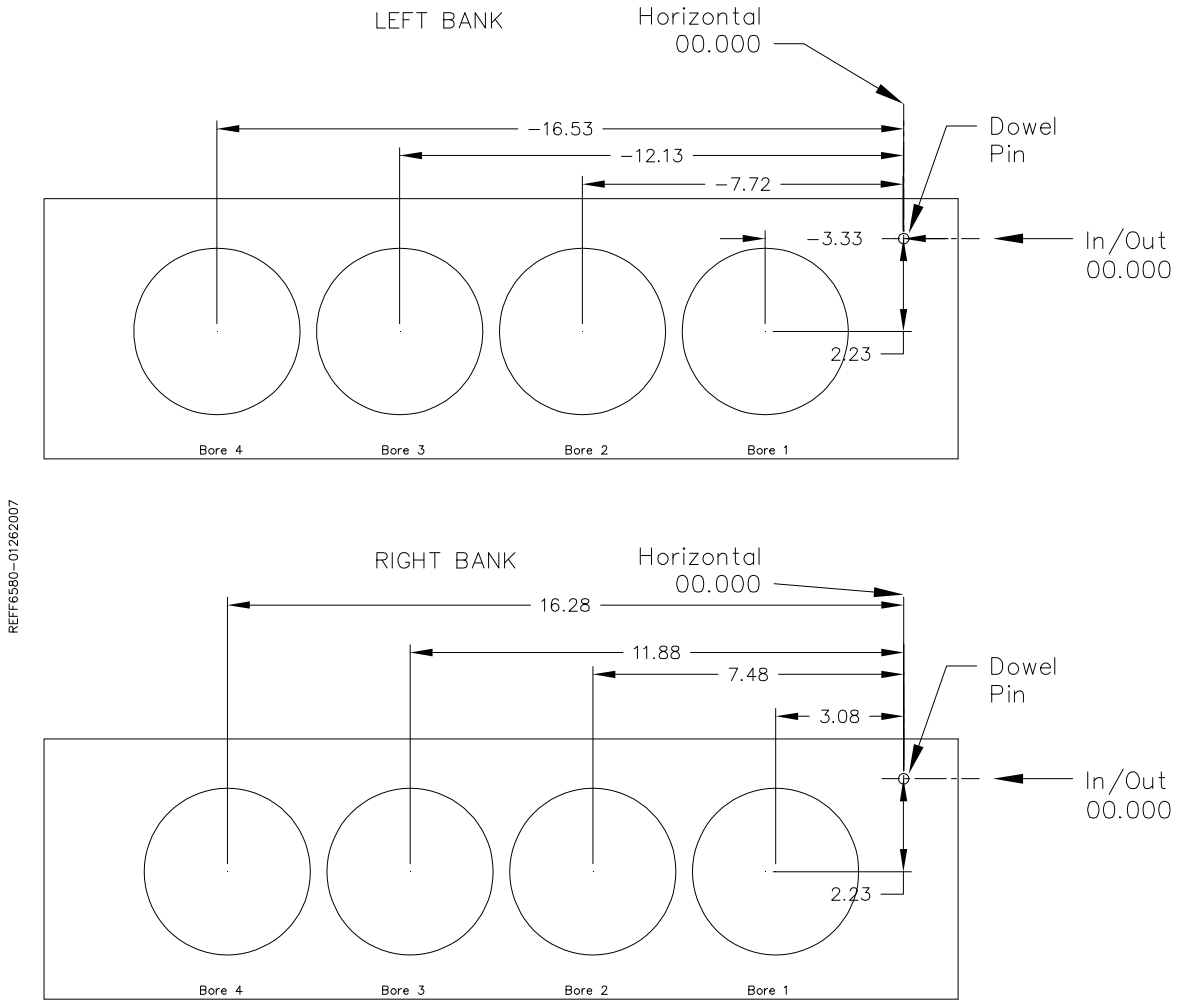
Probe Height:
When using the optional Probe… install the probe into the spindle after your vertical positions have been set using the cutterhead. Bring the tip of the probe down to the location in the bore you want to probe. Look at the actual Position read out for the Vertical. This will be the Probe Height value.

CAUTION **Make sure the Block clearance height is sufficient for the probe to clear the block deck when moving to the next cylinder. If not the probe will crash into the cylinder wall and break.**

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

Bore Locations:

To build a program you must set the 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 screens would look like for the above block.

The Horizontal and In/Out stops have now been set.

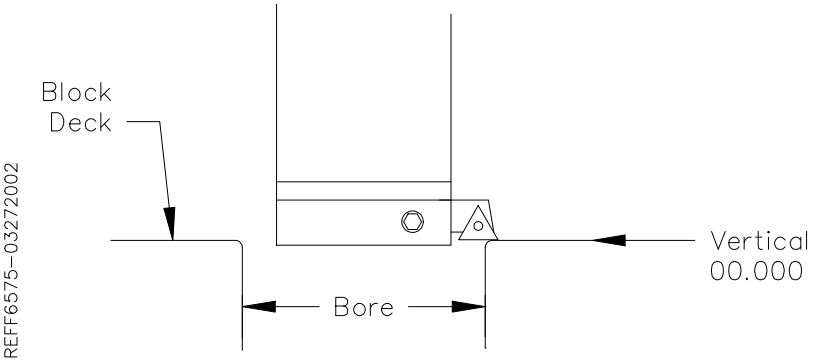
Boring a Block:
Once the Vertical, Horizontal and In/Out stops have all been entered the Spindle RPM and Feed Rate need to be entered. This is done on the Set Zeros screen. Once this is doen you can go to the Left and/or Right Bore location screens and bore the cylinders.

You can bore individual cylinders by pressing the Bore button associated with the cylinder or the entire bank by pressing the Bore Left or Bore right button. When the Bore Left or Bore Right buttons are pressed the button will turn red and display PAUSE. If the automatic cycle is running… pressing this button will pause the cycle. Pressing it again will resume the cycle.

CAUTION **Do not move the machine around when a cycle is paused. This will eliminate the pause feature and the cycle will start all over if the button is pressed again.**

Vertical Zero:
There are three different ways to use the boring software, Blueprinting, Indicating and Probing. It is not unusual for all three modes to be used on the same size block. The vertical stops for these different operating programs will vary. Be sure the vertical stops are set correctly for the mode you are using.

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.

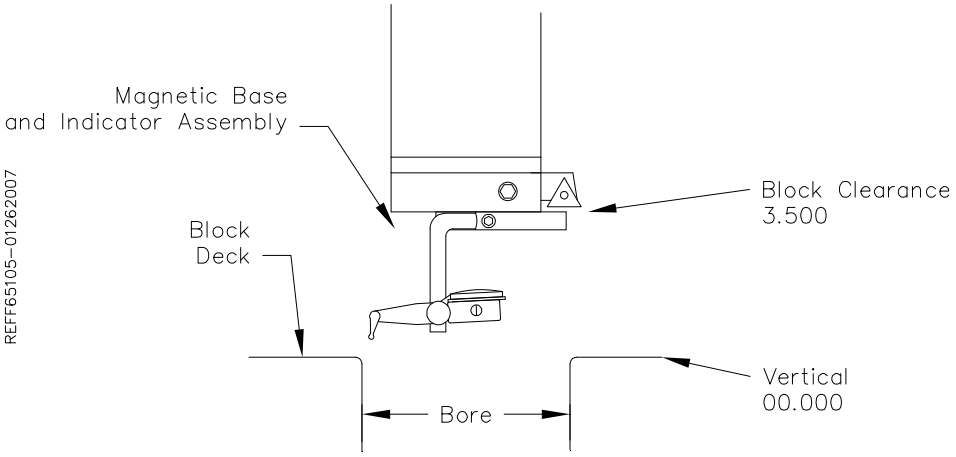


The zeros points for all axis have now been set. All the numbers entered from this point on will reference these zero positions. You are finished with the Set Zeros screen, select the next Tab to the Right.

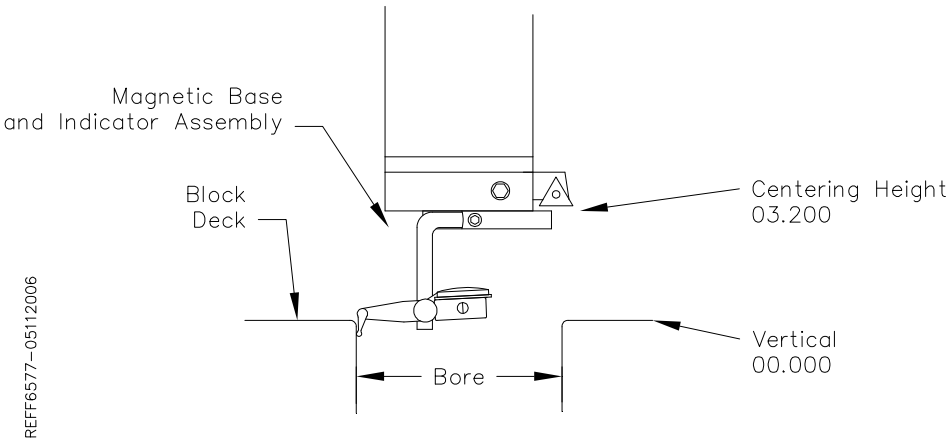
Indicating:
Even if you are not going to be boring a block to the blue print specifications it is recommended to have these values entered. It will speed up the process of indicating and probing a block by giving the operator a close estimate of bore location.

Programming Vertical Stops:
To build a program you must set the Vertical Stops for the program. There are six (6) Vertical stops used in the boring program. Four of them are required to build an operational program. The Lower Clearance Stops are optional and will be described below.

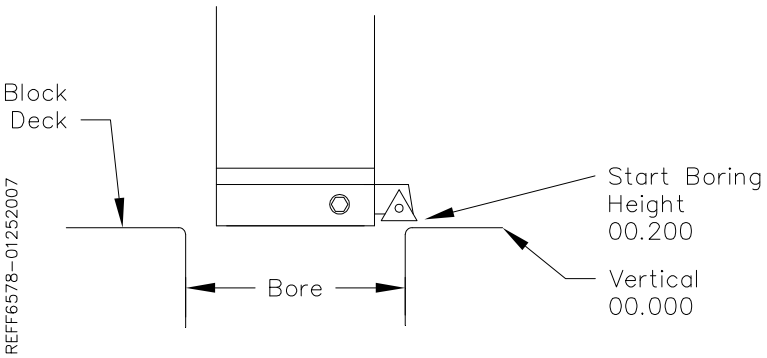
Block Clearance:
This is the distance above the zero position or block deck allowing the cutterhead to move to the next bore unobstructed. When you are indicating the cylinders in you must have this stop set so the indicator will clear the block surface when traveling to the next hole.



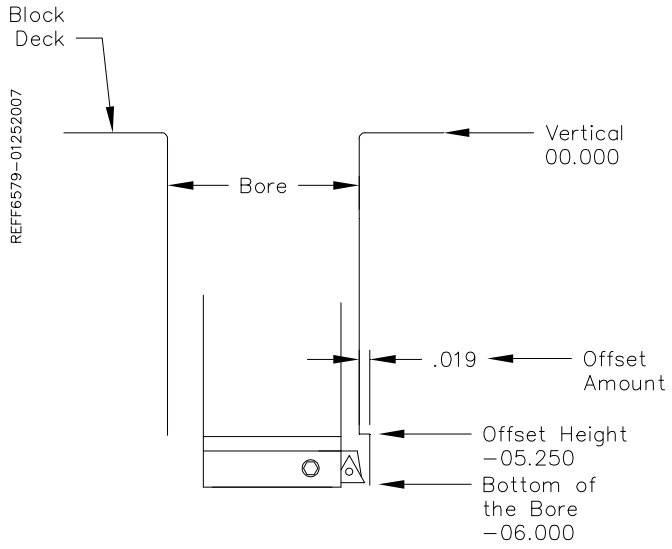
Centering Height:
This is a distance above the vertical zero where you will be manually centering the block. The drawing below is a typical set up for manual centering or indicting a cylinder.



Start Boring Height:
This is the distance above zero or the block deck where you want the cutterhead to start rotating and the downward feed to start. Generally this is just a short distance above the block deck to minimize the amount of time the machine bores through air. 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 can be programmed for the Left or Right banks.


Block
Deck
REFF6579-01252007
Vertical
00.000
Bore
.019
Offset
Amount
Offset Height
-05.250
Bottom of
the Bore
-06.000

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

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

Probe Height:
When using the optional Probe… install the probe into the spindle after your vertical positions have been set using the cutterhead. Bring the tip of the probe down to the location in the bore you want to probe. Look at the actual Position read out for the Vertical. This will be the Probe Height value.

CAUTION **Make sure the Block clearance height is sufficient for the probe to clear the block deck when moving to the next cylinder. If not the probe will crash into the cylinder wall and break.**

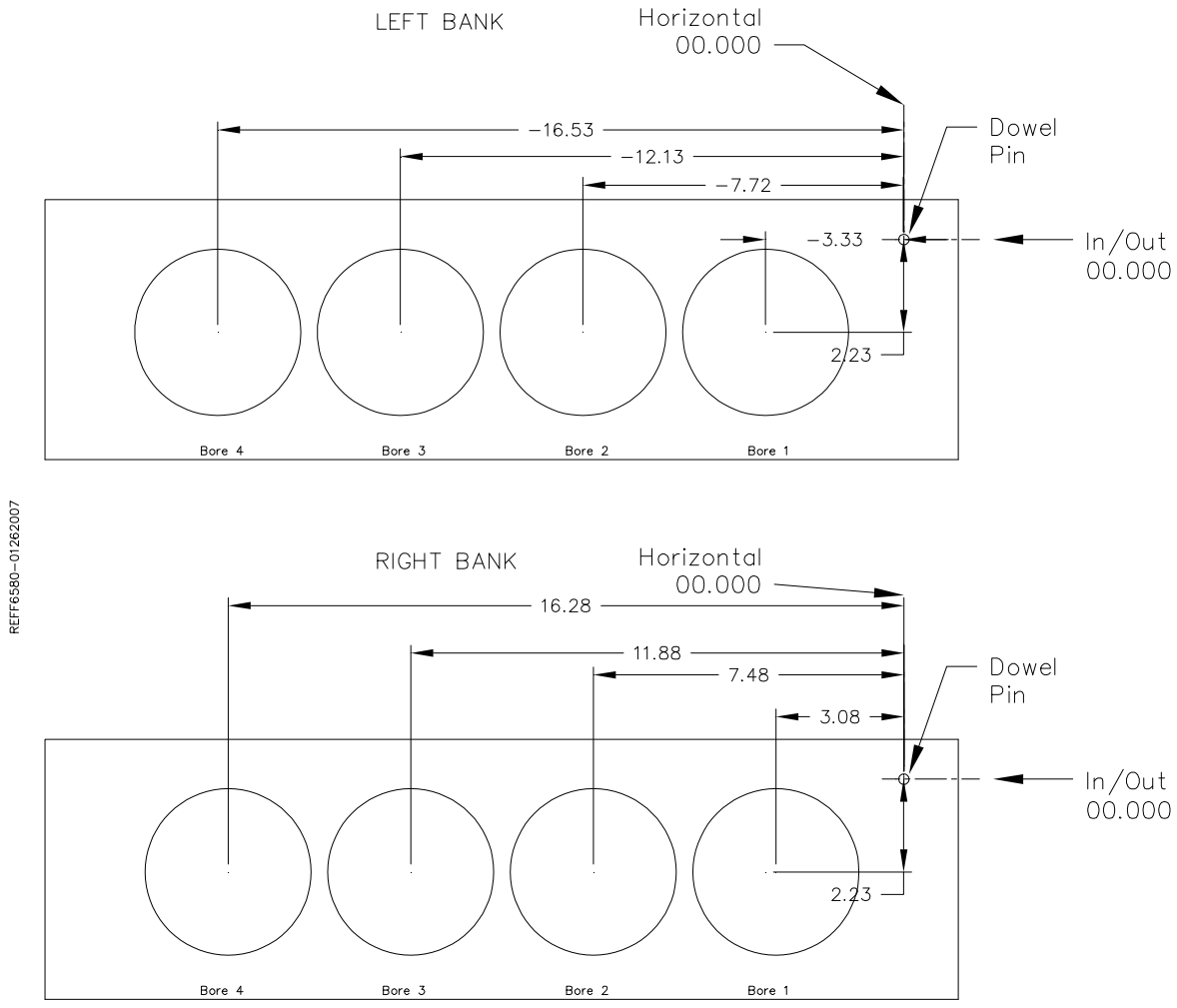
The Vertical stops have now been set. You are finished with the Vertical Stops screen, select Left and/or Right Locations.

Bore Locations:
To build a program you must set the 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.

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

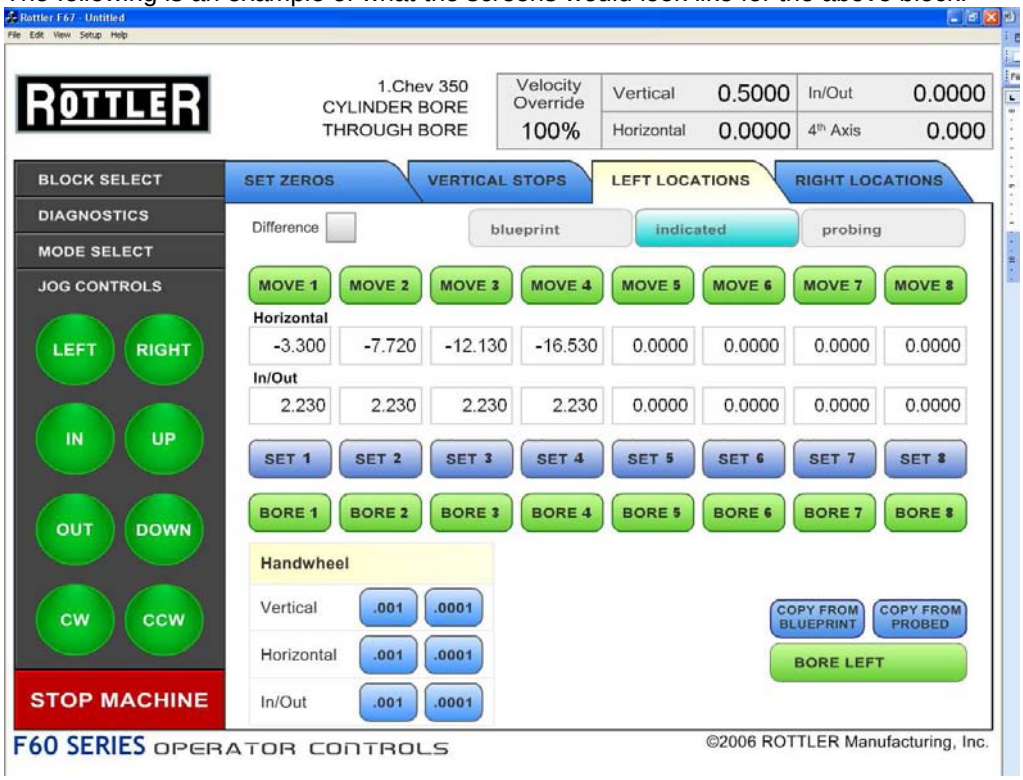
Select Left Locations and then Indicated. Press the Move 1 button. The machine will move the first cylinder and stop at the centering position. Manually indicate the cylinder in using the Horizontal and In/Out handwheel. Once the cylinder is centered press the Set 1 button. This will transfer the current position of the machine into the first set of Data Boxes. Repeat this process for all the cylinders that need to be indicated.

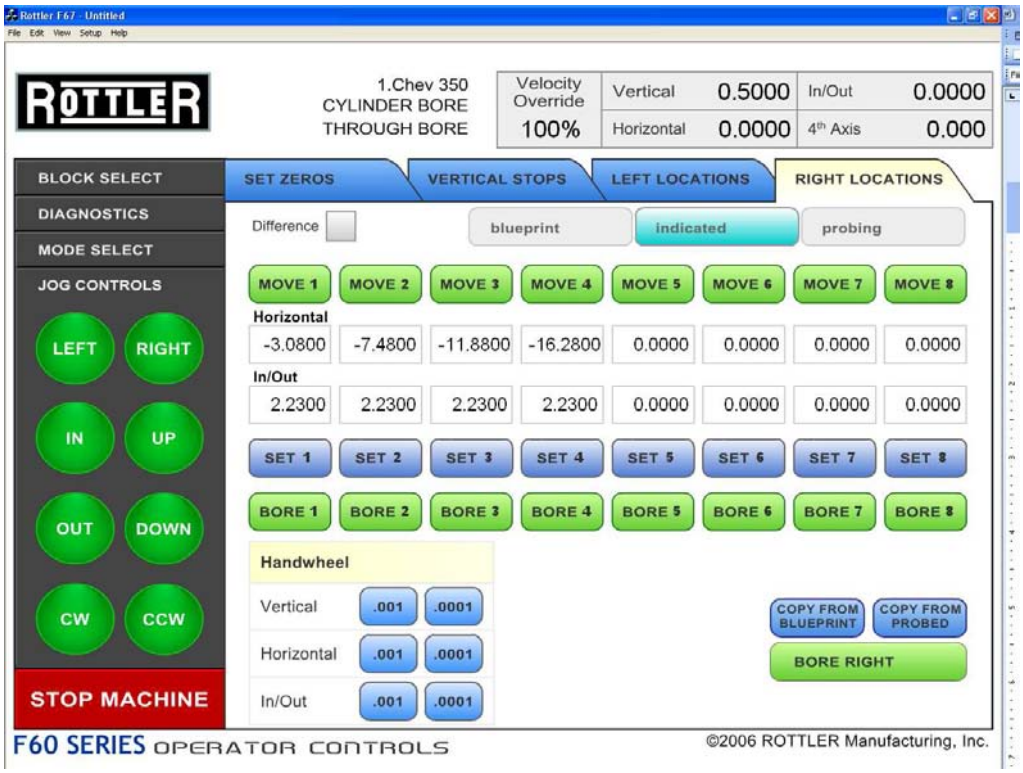
Press the Right Locations tab and repeat the above procedure for the cylinders to be indicated on the right bank.



REFF6580-01262007

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





The Horizontal and In/Out stops have now been set.

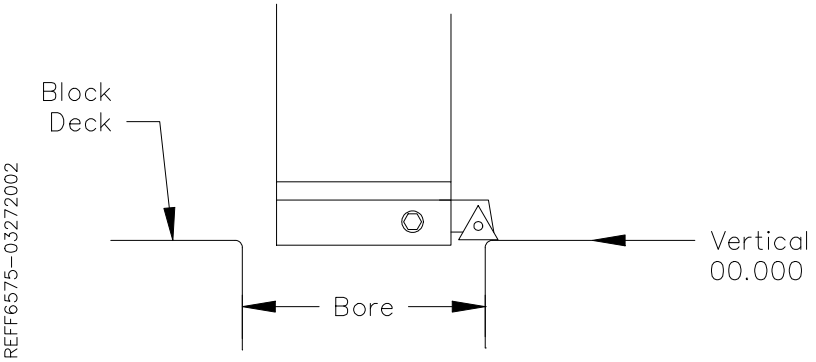
Boring a Block:
Once the Vertical, Horizontal and In/Out stops have all been entered the Spindle RPM and Feed Rate need to be entered. This is done on the Set Zeros screen. Once this is done you can go to the Left and/or Right Bore location screens and bore the cylinders.

You can bore individual cylinders by pressing the Bore button associated with the cylinder or the entire bank by pressing the Bore Left or Bore right button. When the Bore Left or Bore Right buttons are pressed the button will turn red and display PAUSE. If the automatic cycle is running… pressing this button will pause the cycle. Pressing it again will resume the cycle.

CAUTION **Do not move the machine around when a cycle is paused. This will eliminate the pause feature and the cycle will start all over if the button is pressed again.**

Vertical Zero:
There are three different ways to use the boring software, Blueprinting, Indicating and Probing. It is not unusual for all three modes to be used on the same size block. The vertical stops for these different operating programs will vary. Be sure the vertical stops are set correctly for the mode you are using.

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.

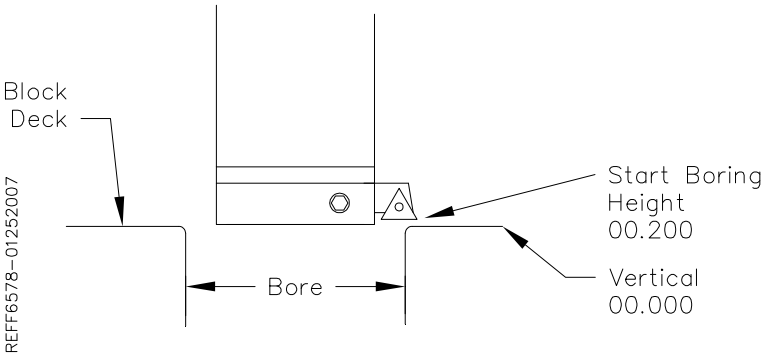
Probing:
Even if you are not going to be boring a block to the blue print specifications it is recommended to have these values entered. It will speed up the process of indicating and probing a block by giving the operator a close estimate of bore location.

Programming Vertical Stops:
To build a program you must set the Vertical Stops for the program. There are six (6) Vertical stops used in the boring program. Four of them are required to build an operational program. The Lower Clearance Stops are optional and will be described below.

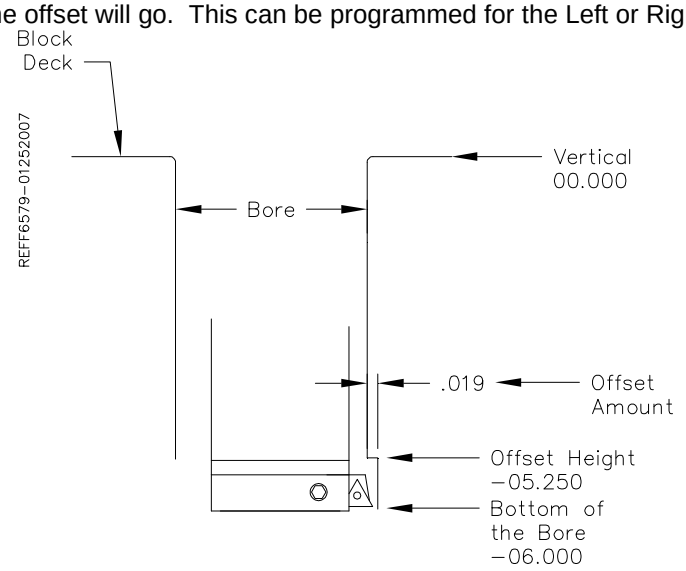
Block Clearance:
This is the distance above the zero position or block deck allowing the probe to move to the next bore unobstructed.

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

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

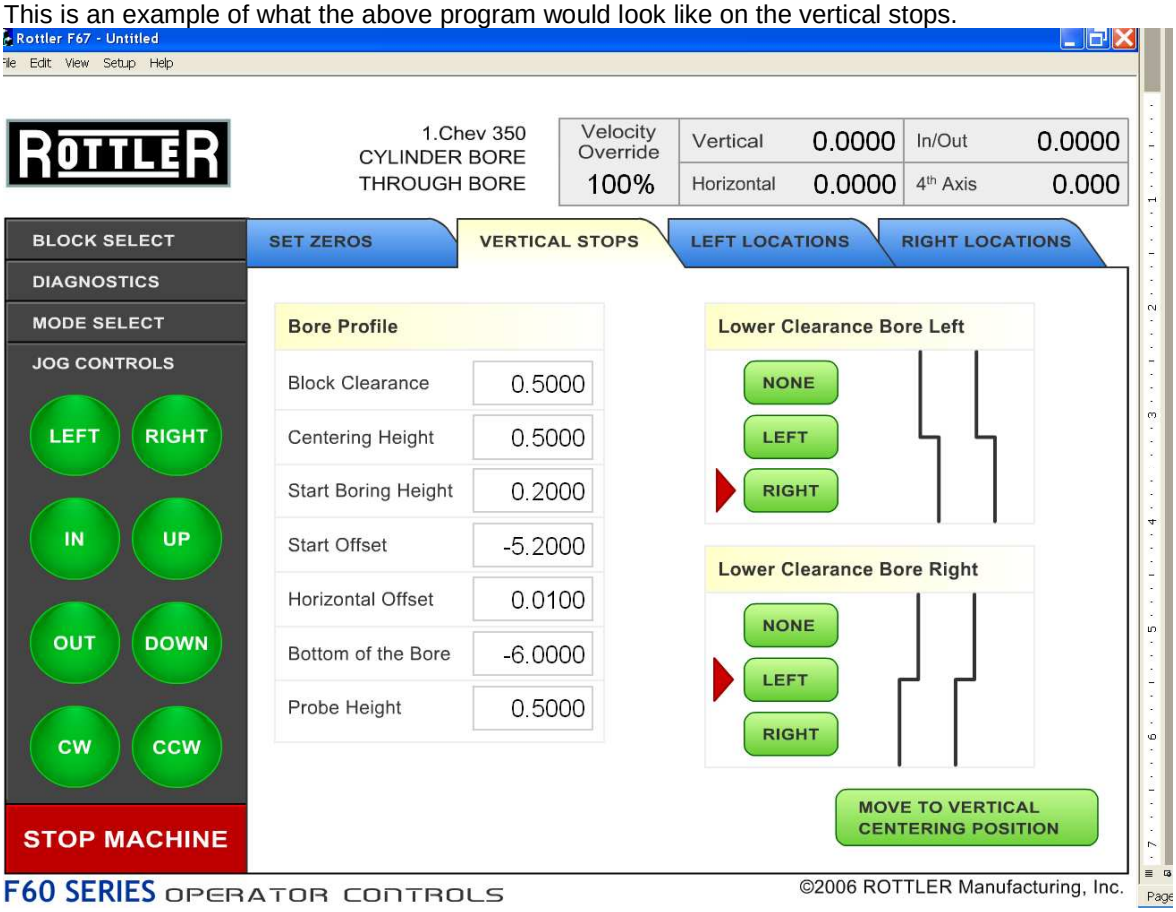


Lower Clearance Bore:
This option is used to offset the cutterhead to the Left or the Right to make clearance for Honing below the cylinder. It can be turned off, offset Left or offset right. If Left or Right is selected the controller will ask you at what position do you want the offset (Offset Height) 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 can be programmed for the Left or Right banks.



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

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



Probe Height:
When using the optional Probe… install the probe into the spindle after your vertical positions have been set using the cutterhead. Bring the tip of the probe down to the location in the bore you want to probe. Look at the actual Position read out for the Vertical. This will be the Probe Height value.

CAUTION **Make sure the Block clearance height is sufficient for the probe to clear the block deck when moving to the next cylinder. If not the probe will crash into the cylinder wall and break.**

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

Bore Locations:
To build a program you must set the 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.

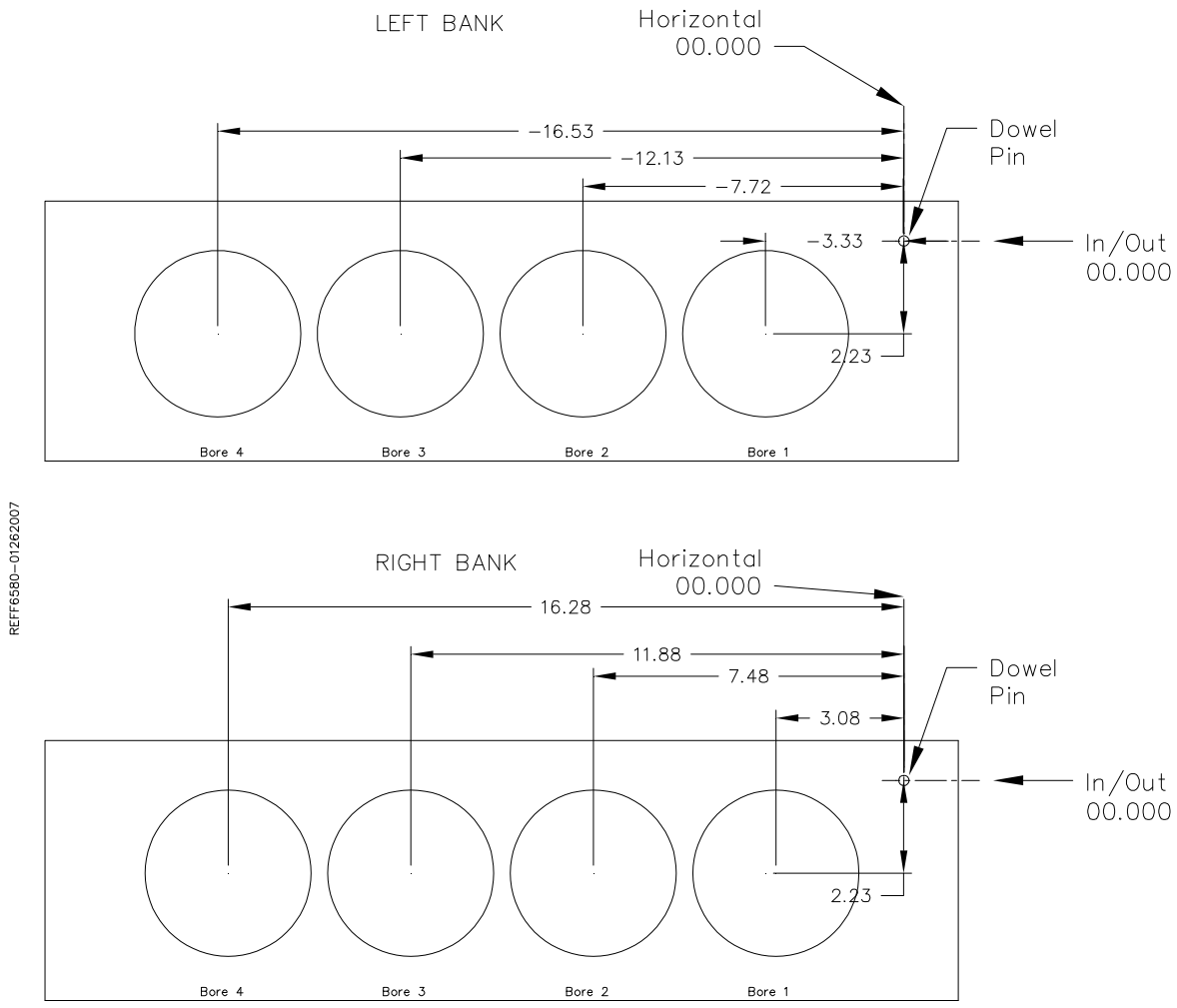
Select Left Locations and the Blueprint. Program the blueprint values (or close approximation) into the Horizontal and In/Out stops. Do the same for the Right Locations.

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

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

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

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



The Horizontal and In/Out stops have now been set.

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

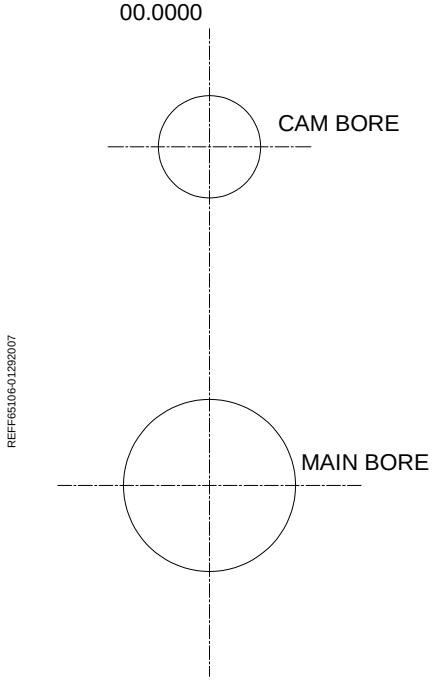
You can bore individual cylinders by pressing the Bore button associated with the cylinder or the entire bank by pressing the Bore Left or Bore right button. When the Bore Left or Bore Right buttons are pressed the button will turn red and display PAUSE. If the automatic cycle is running… pressing this button will pause the cycle. Pressing it again will resume the cycle.

CAUTION **Do not move the machine around when a cycle is paused. This will eliminate the pause feature and the cycle will start all over if the button is pressed again.**

Cylinder Bore Mode 4th Axis:
Select Cylinder Bore and then Through Bore on the control panel. This will bring up the boring program with the Set Zeros tab shown.

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

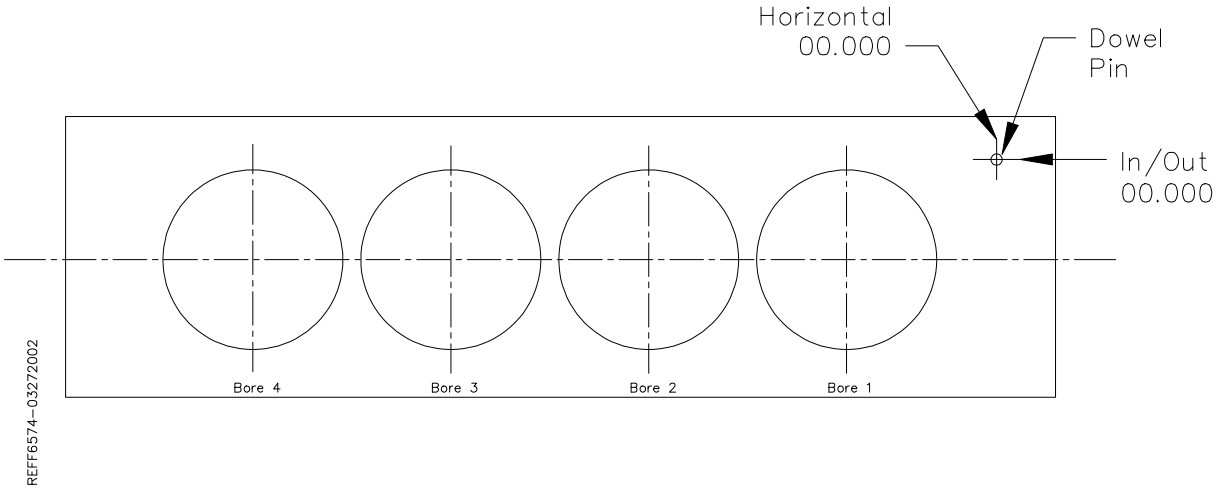
4th Axis Zero:
The correct way to set the 4th Axis is on the centerline of the Main and the Cam bores as shown below.



Finding the Centerline Zero:
To find the centerline of the Main or Cam bore use the electronic probe to touch the high spot on the left or the right of the Main or Cam bar. Press the In/Out zero at this position. Touch the robe on the opposite side of the bar at the same vertical position. Look at the actual position display, divide this number by 2 and then move the In/out Axis until the Actual Position Read out matches the divided number.

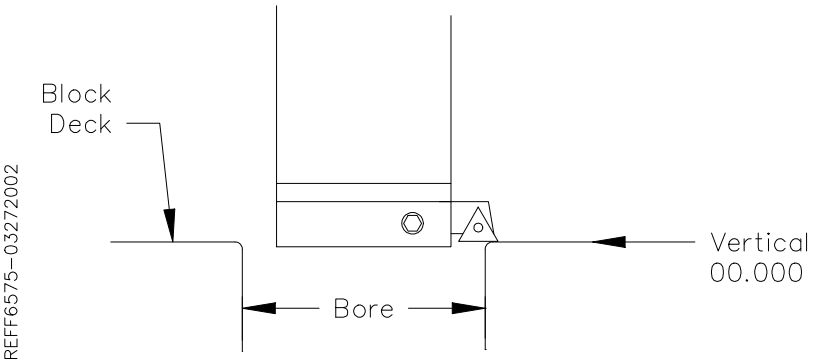
Horizontal and In/Out Zero:

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:
There are three different ways to use the boring software, Blueprinting, Indicating and Probing. It is not unusual for all three modes to be used on the same size block. The vertical stops for these different operating programs will vary. Be sure the vertical stops are set correctly for the mode you are using.

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 next this button will go to zero. The Vertical zero has now been set.



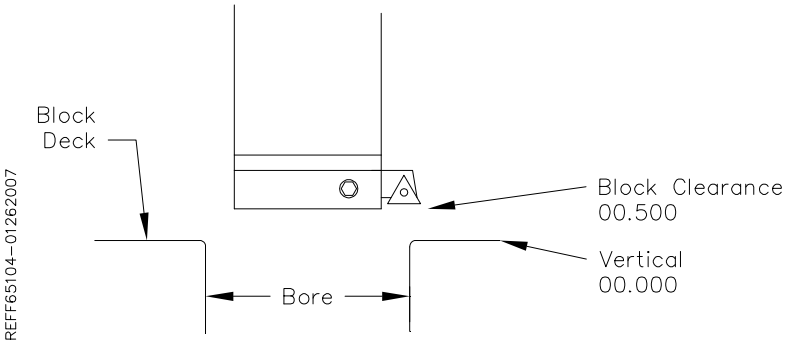
The zeros points for all axis have now been set. All the numbers entered from this point on will reference these zero positions. You are finished with the Set Zeros screen, select the next Tab to the Right.

Blueprinting:

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

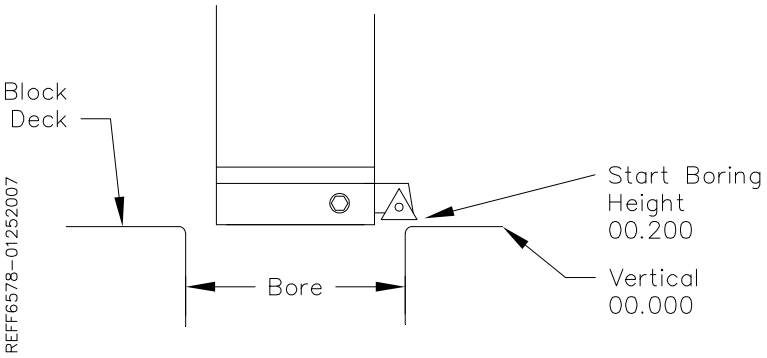
Programming Vertical Stops:
To build a program you must set the Vertical Stops for the program. There are six (6) Vertical stops used in the boring program. Four of them are required to build an operational program. The Lower Clearance Stops are optional and will be described below.

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.

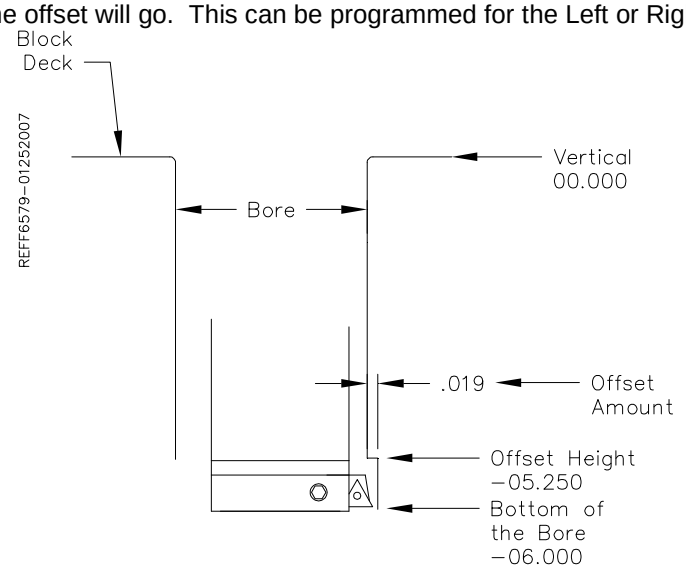


Centering Height:
When Blueprinting this stop is not needed. It should be the same as the block Clearance Height.

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

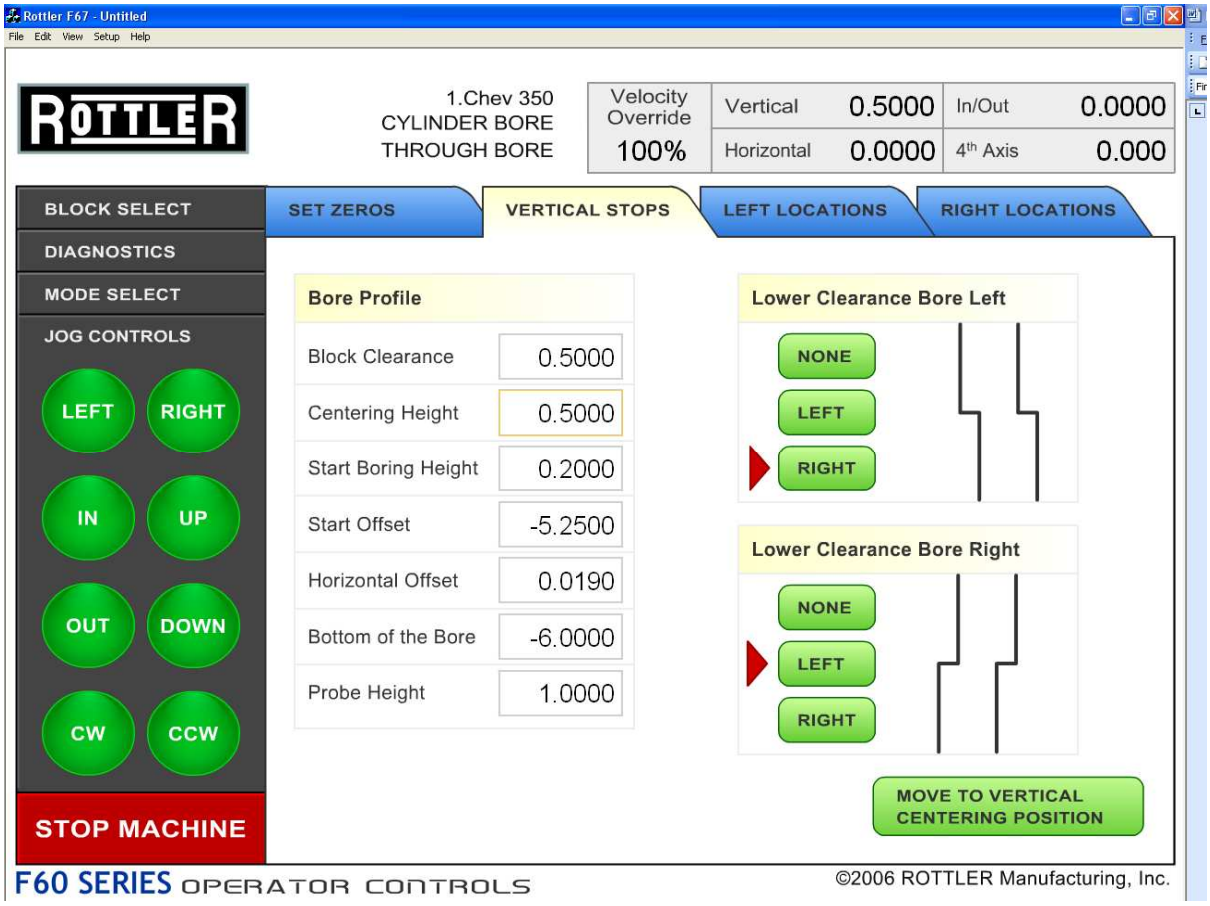


Lower Clearance Bore:
This option is used to offset the cutterhead to the Left or the Right to make clearance for Honing below the cylinder. It can be turned off, offset Left or offset right. If Left or Right is selected the controller will ask you at what position do you want the offset (Offset Height) 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 can be programmed for the Left or Right banks.



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

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

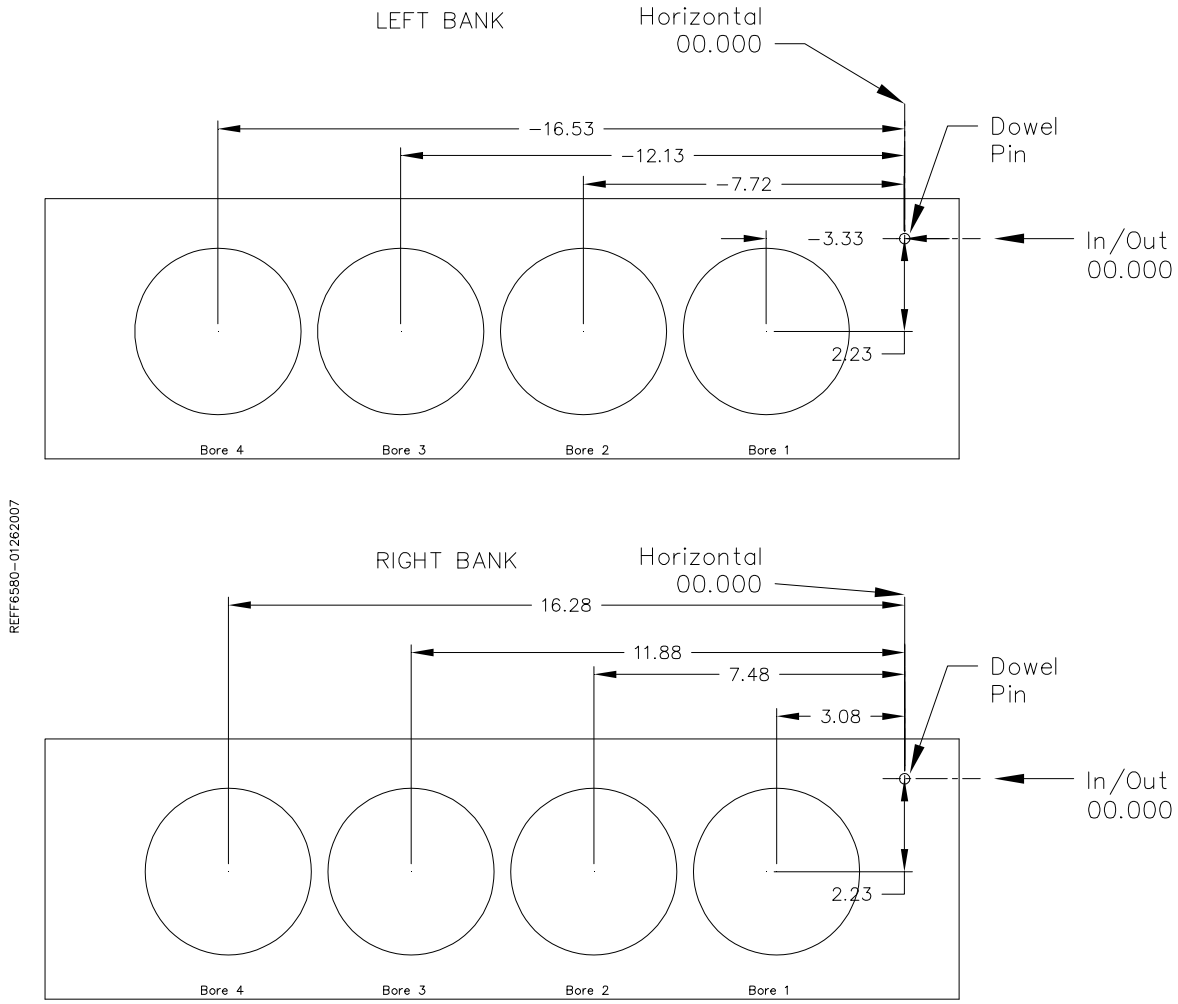


Probe Height:
When using the optional Probe… install the probe into the spindle after your vertical positions have been set using the cutterhead. Bring the tip of the probe down to the location in the bore you want to probe. Look at the actual Position read out for the Vertical. This will be the Probe Height value.

CAUTION **Make sure the Block clearance height is sufficient for the probe to clear the block deck when moving to the next cylinder. If not the probe will crash into the cylinder wall and break.**

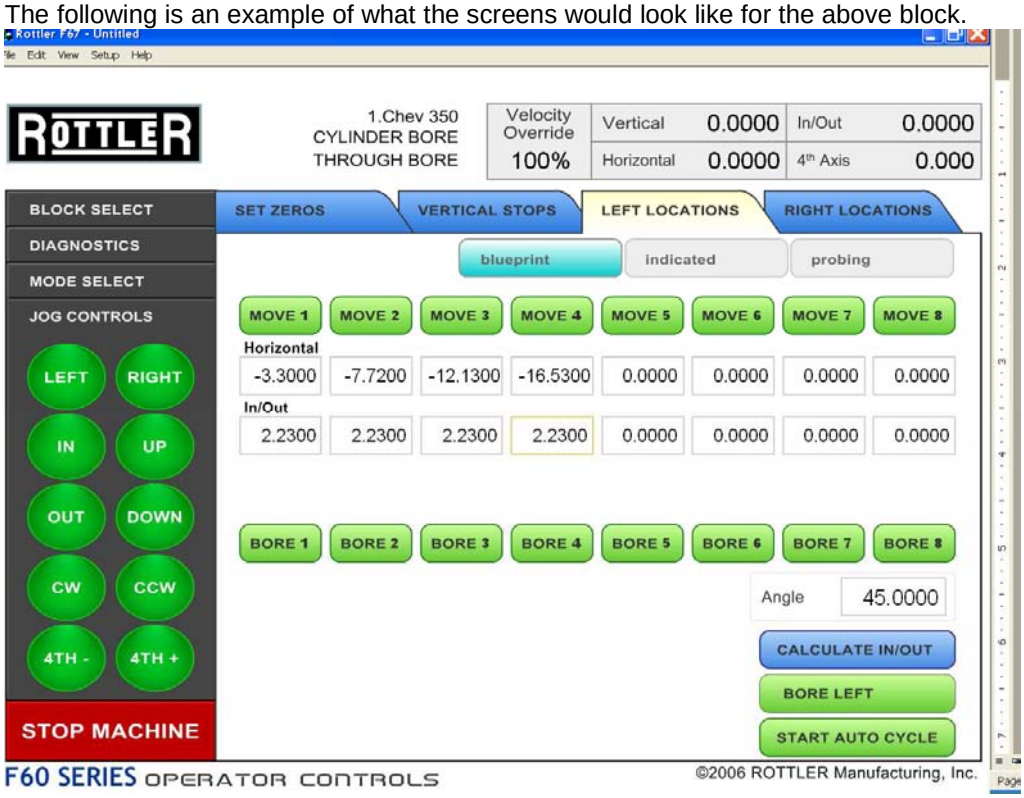
The Vertical stops have now been set. You are finished with the Vertical Stops screen, select Left and/or Right Locations.

Bore Locations:
To build a program you must set the 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.



Block Angle:
When using the 4th axis you must set the angle of the block on the Left and Right Location screens. For this example it is 45 Degrees. This tells the program what position each bank is relative to the 4th Axis Zero position.

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



The Horizontal and In/Out stops have now been set.

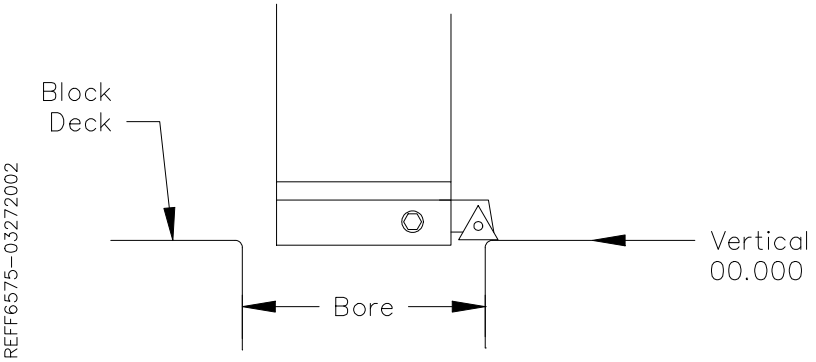
Boring a Block:
Once the Vertical, Horizontal and In/Out stops have all been entered the Spindle RPM and Feed Rate need to be entered. This is done on the Set Zeros screen. Once this is done you can go to the Left and/or Right Bore location screens and bore the cylinders.

You can bore individual cylinders by pressing the Bore button associated with the cylinder or the entire bank by pressing the Bore Left or Bore right button. With the 4th Axis you can bore both banks automatically by pressing Start Auto Cycle. When the Bore Left or Bore Right buttons are pressed the button will turn red and display PAUSE. If the automatic cycle is running… pressing this button will pause the cycle. Pressing it again will resume the cycle.

CAUTION **Do not move the machine around when a cycle is paused. This will eliminate the pause feature and the cycle will start all over if the button is pressed again.**

Vertical Zero:
There are three different ways to use the boring software, Blueprinting, Indicating and Probing. It is not unusual for all three modes to be used on the same size block. The vertical stops for these different operating programs will vary. Be sure the vertical stops are set correctly for the mode you are using.

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.

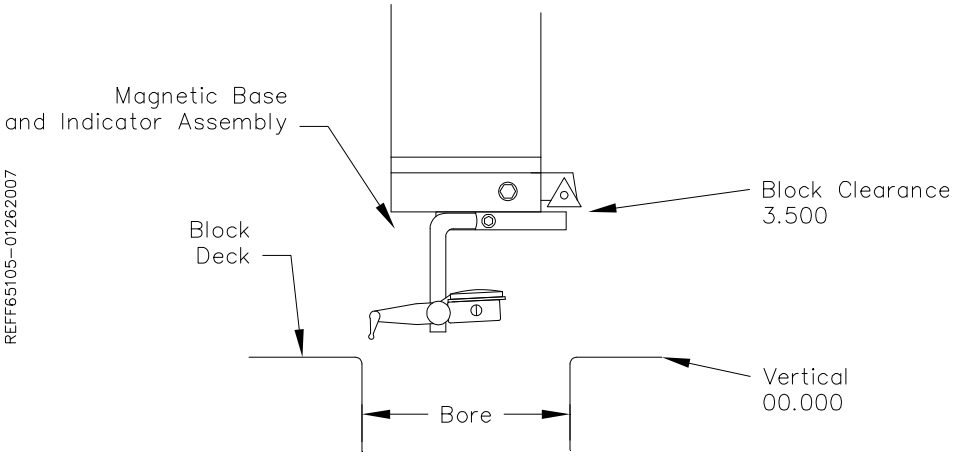


The zeros points for all axis have now been set. All the numbers entered from this point on will reference these zero positions. You are finished with the Set Zeros screen, select the next Tab to the Right.

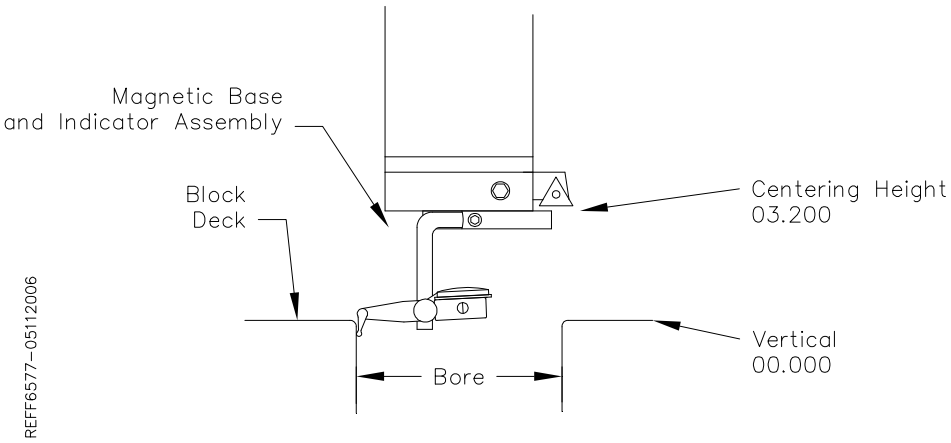
Indicating:
Even if you are not going to be boring a block to the blue print specifications it is recommended to have these values entered. It will speed up the process of indicating and probing a block by giving the operator a close estimate of bore location.

Programming Vertical Stops:
To build a program you must set the Vertical Stops for the program. There are six (6) Vertical stops used in the boring program. Four of them are required to build an operational program. The Lower Clearance Stops are optional and will be described below.

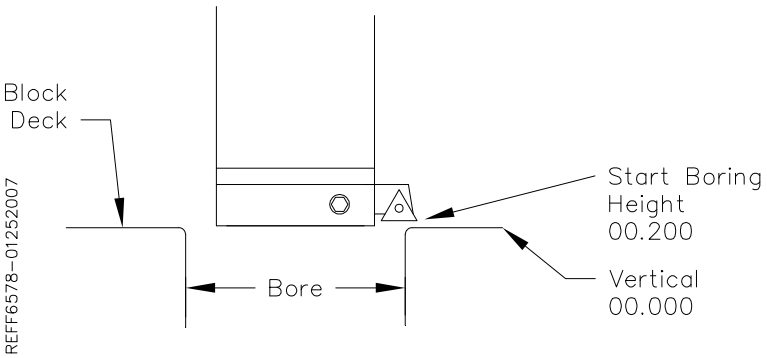
Block Clearance:
This is the distance above the zero position or block deck allowing the cutterhead to move to the next bore unobstructed. When you are indicating the cylinders in you must have this stop set so the indicator will clear the block surface when traveling to the next hole.



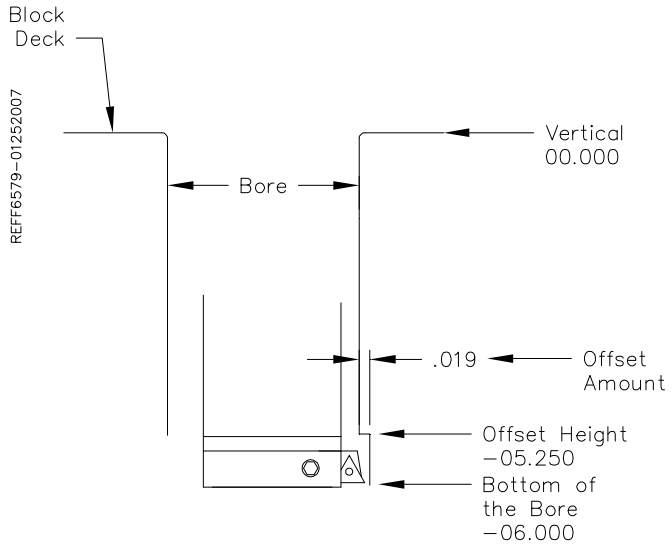
Centering Height:
This is a distance above the vertical zero where you will be manually centering the block. The drawing below is a typical set up for manual centering or indicting a cylinder.



Start Boring Height:
This is the distance above zero or the block deck where you want the cutterhead to start rotating and the downward feed to start. Generally this is just a short distance above the block deck to minimize the amount of time the machine bores through air. 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 can be programmed for the Left or Right banks.


Block
Deck
REFF6579-01252007
Vertical
00.000
Bore
.019
Offset
Amount
Offset Height
-05.250
Bottom of
the Bore
-06.000

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

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

Probe Height:
When using the optional Probe… install the probe into the spindle after your vertical positions have been set using the cutterhead. Bring the tip of the probe down to the location in the bore you want to probe. Look at the actual Position read out for the Vertical. This will be the Probe Height value.

CAUTION **Make sure the Block clearance height is sufficient for the probe to clear the block deck when moving to the next cylinder. If not the probe will crash into the cylinder wall and break.**

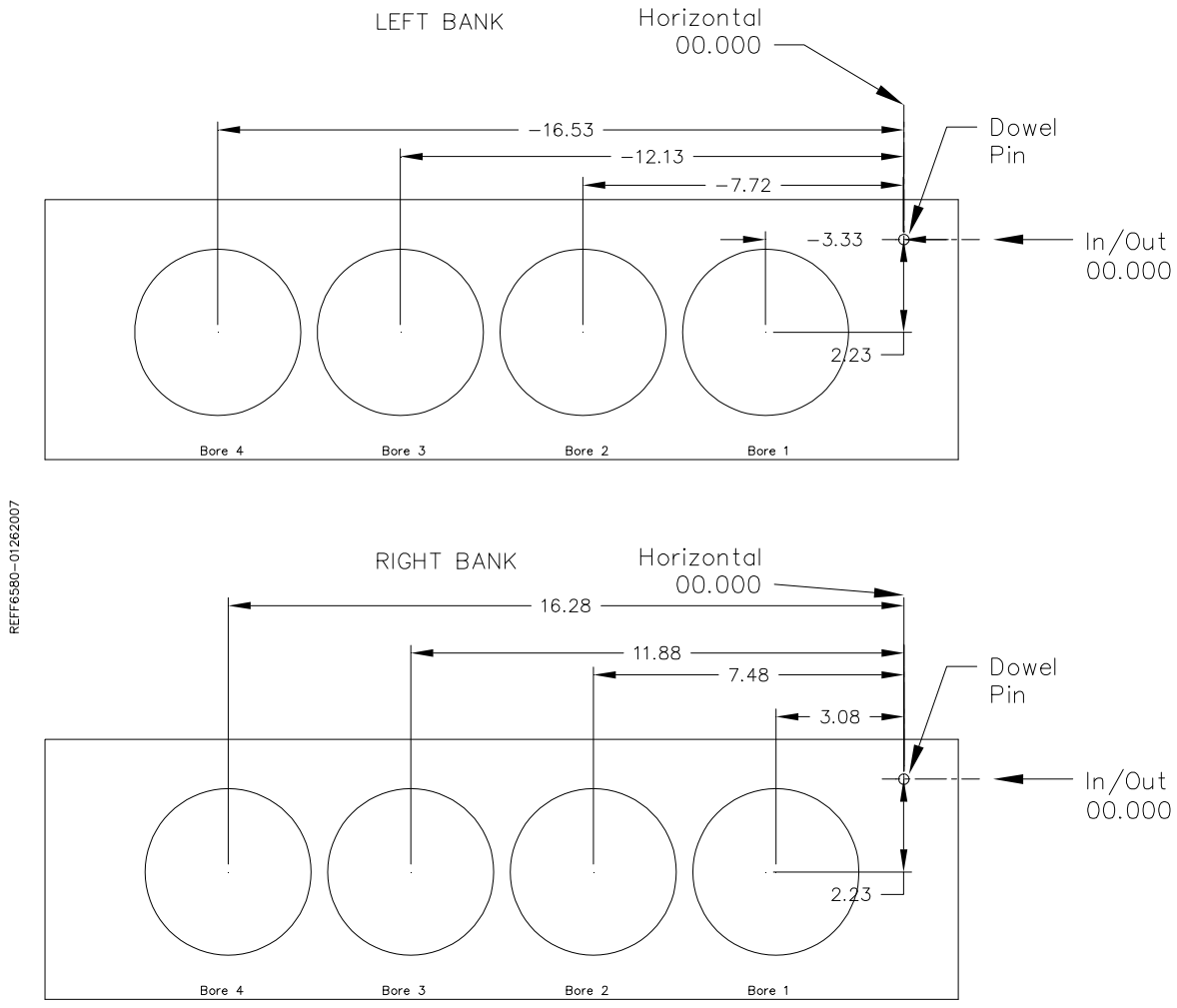
The Vertical stops have now been set. You are finished with the Vertical Stops screen, select Left and/or Right Locations.

Bore Locations:
To build a program you must set the 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.

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

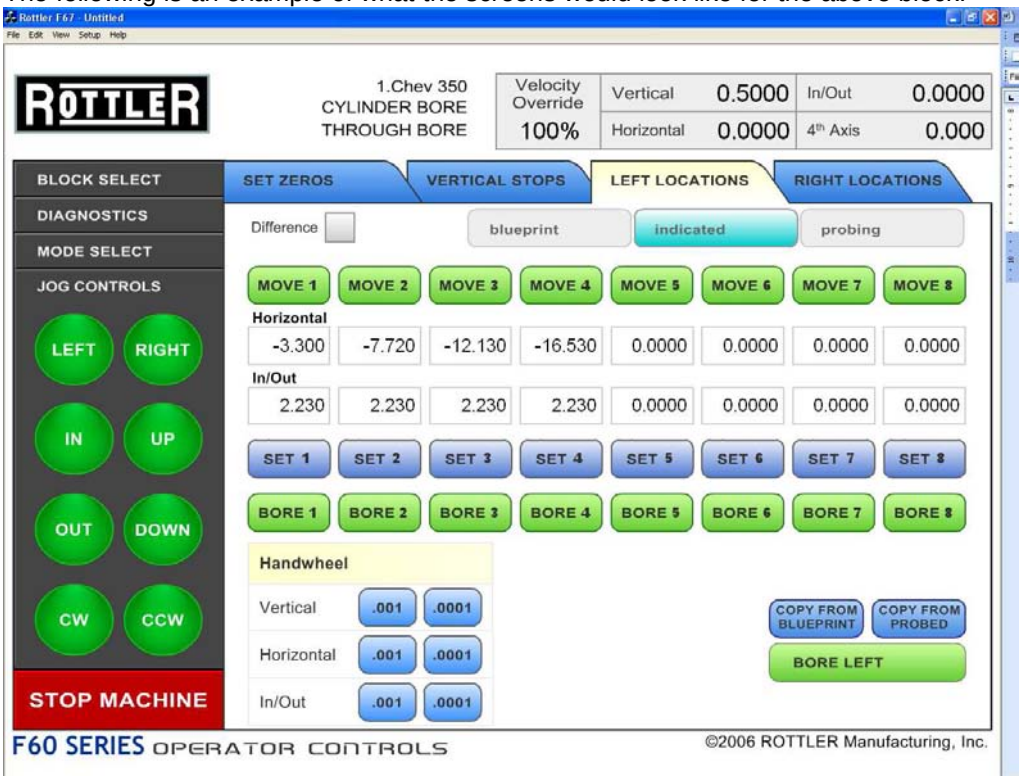
Select Left Locations and then Indicated. Press the Move 1 button. The machine will move the first cylinder and stop at the centering position. Manually indicate the cylinder in using the Horizontal and In/Out handwheel. Once the cylinder is centered press the Set 1 button. This will transfer the current position of the machine into the first set of Data Boxes. Repeat this process for all the cylinders that need to be indicated.

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



REFF6580-01262007

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



The Horizontal and In/Out stops have now been set.

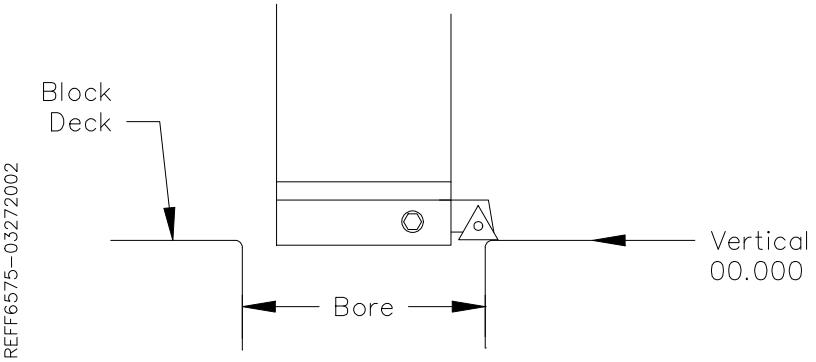
Boring a Block:
Once the Vertical, Horizontal and In/Out stops have all been entered the Spindle RPM and Feed Rate need to be entered. This is done on the Set Zeros screen. Once this is done you can go to the Left and/or Right Bore location screens and bore the cylinders.

You can bore individual cylinders by pressing the Bore button associated with the cylinder or the entire bank by pressing the Bore Left or Bore right button. With the 4th Axis you can bore both banks automatically by pressing Start Auto Cycle. When the Bore Left or Bore Right buttons are pressed the button will turn red and display PAUSE. If the automatic cycle is running… pressing this button will pause the cycle. Pressing it again will resume the cycle.

CAUTION **Do not move the machine around when a cycle is paused. This will eliminate the pause feature and the cycle will start all over if the button is pressed again.**

Vertical Zero:
There are three different ways to use the boring software, Blueprinting, Indicating and Probing. It is not unusual for all three modes to be used on the same size block. The vertical stops for these different operating programs will vary. Be sure the vertical stops are set correctly for the mode you are using.

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.

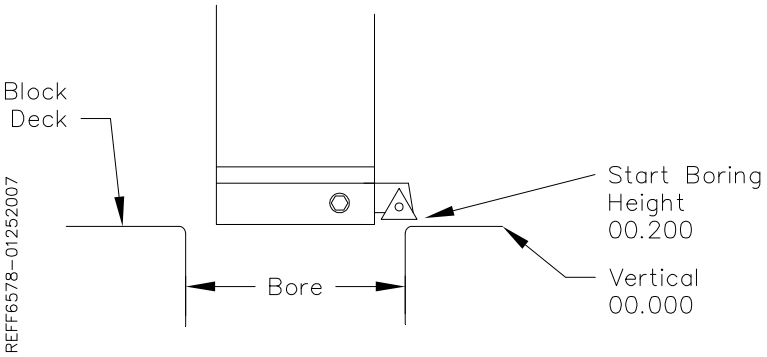
Probing:
Even if you are not going to be boring a block to the blue print specifications it is recommended to have these values entered. It will speed up the process of indicating and probing a block by giving the operator a close estimate of bore location.

Programming Vertical Stops:
To build a program you must set the Vertical Stops for the program. There are six (6) Vertical stops used in the boring program. Four of them are required to build an operational program. The Lower Clearance Stops are optional and will be described below.

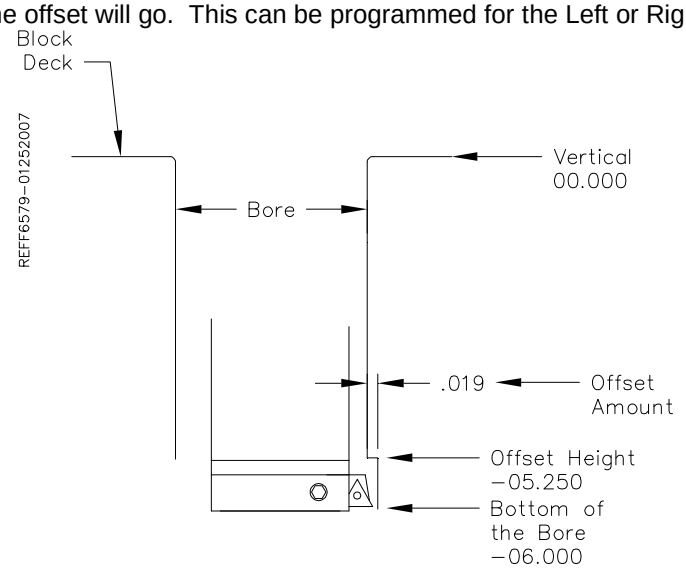
Block Clearance:
This is the distance above the zero position or block deck allowing the probe to move to the next bore unobstructed.

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

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

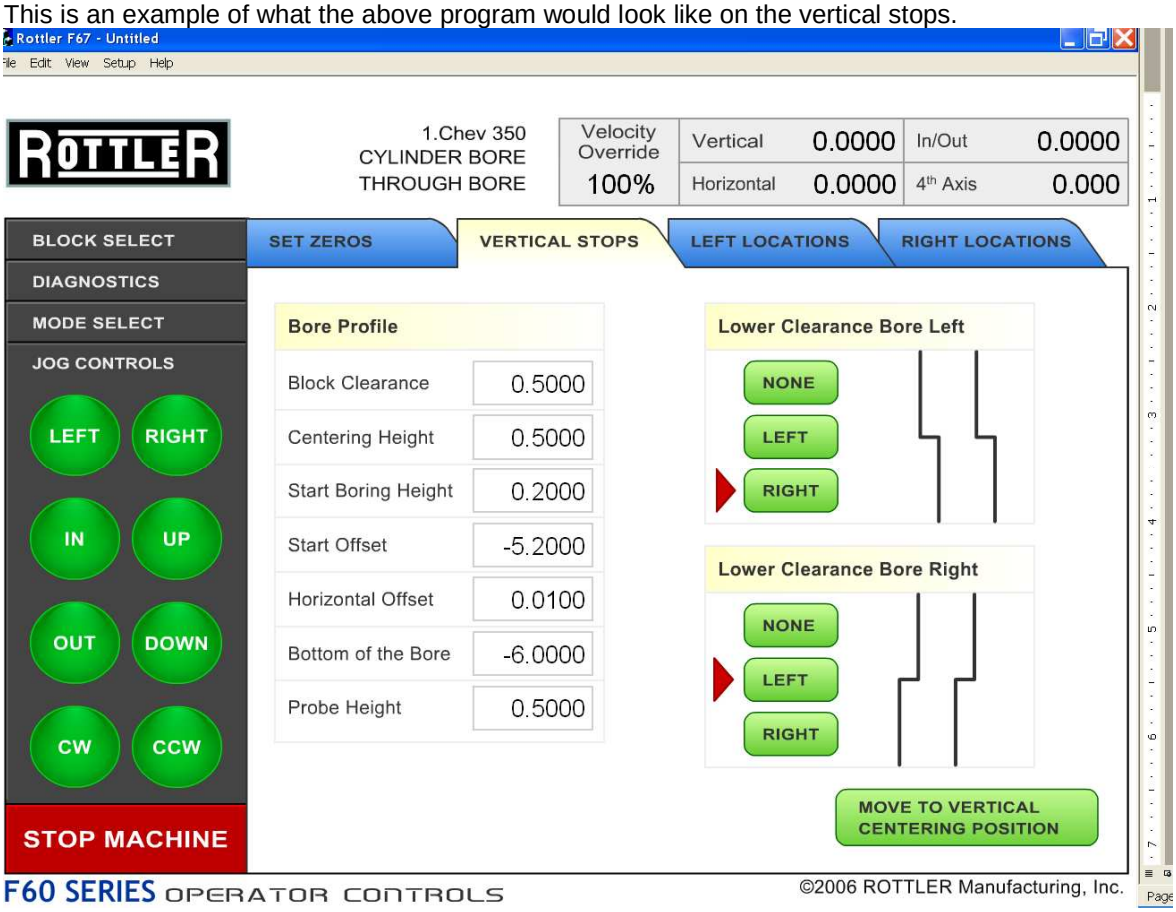


Lower Clearance Bore:
This option is used to offset the cutterhead to the Left or the Right to make clearance for Honing below the cylinder. It can be turned off, offset Left or offset right. If Left or Right is selected the controller will ask you at what position do you want the offset (Offset Height) 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 can be programmed for the Left or Right banks.



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

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



Probe Height:
When using the optional Probe… install the probe into the spindle after your vertical positions have been set using the cutterhead. Bring the tip of the probe down to the location in the bore you want to probe. Look at the actual Position read out for the Vertical. This will be the Probe Height value.

CAUTION **Make sure the Block clearance height is sufficient for the probe to clear the block deck when moving to the next cylinder. If not the probe will crash into the cylinder wall and break.**

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

Bore Locations:
To build a program you must set the 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.

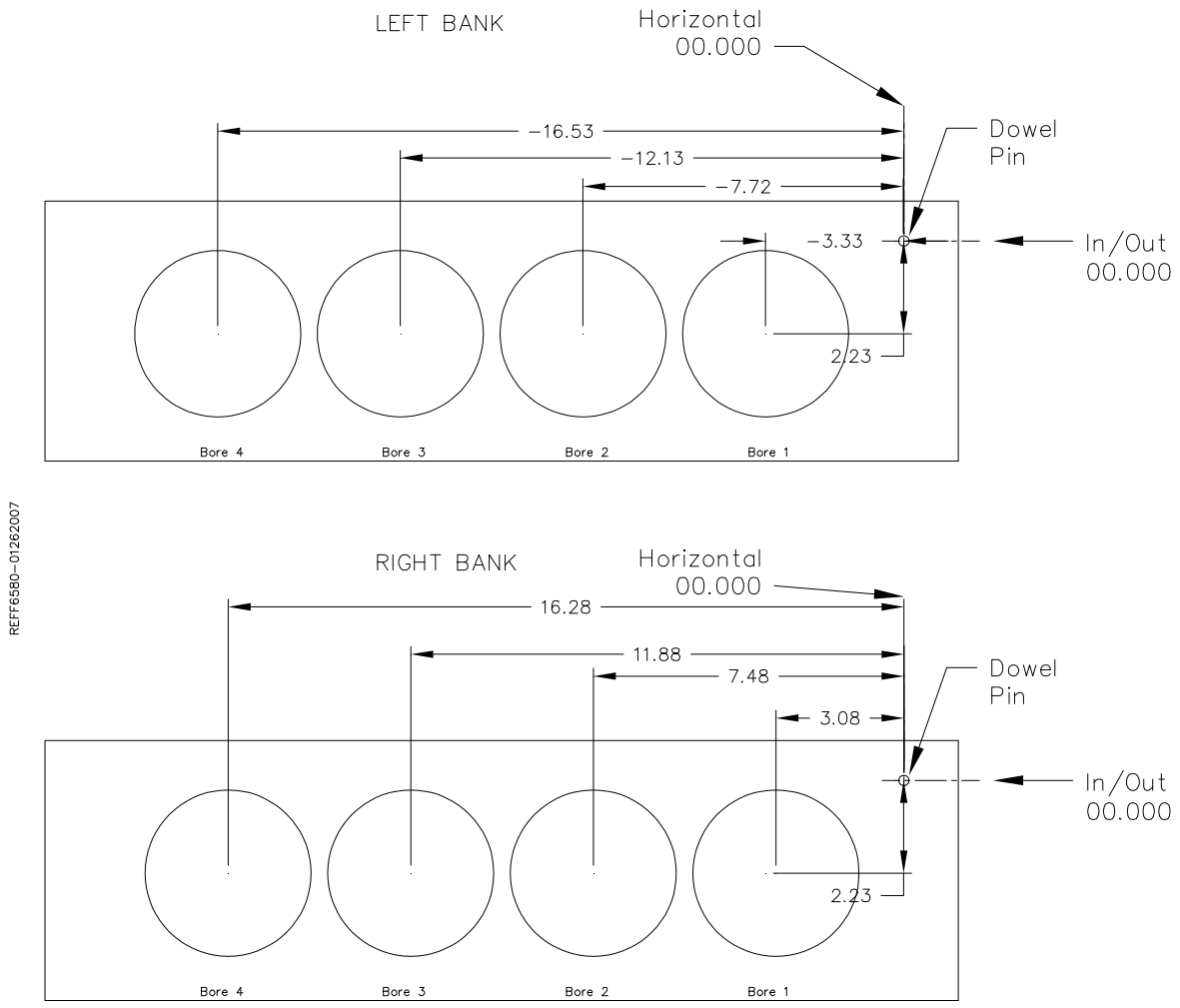
Select Left Locations and the Blueprint. Program the blueprint values (or close approximation) into the Horizontal and In/Out stops. Do the same for the Right Locations.

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

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

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

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



The Horizontal and In/Out stops have now been set.

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

You can bore individual cylinders by pressing the Bore button associated with the cylinder or the entire bank by pressing the Bore Left or Bore right button. With the 4th Axis you can bore both banks automatically by pressing Start Auto Cycle. When the Bore Left or Bore Right buttons are pressed the button will turn red and display PAUSE. If the automatic cycle is running… pressing this button will pause the cycle. Pressing it again will resume the cycle.

CAUTION **Do not move the machine around when a cycle is paused. This will eliminate the pause feature and the cycle will start all over if the button is pressed again.**

NOTE: Boring for Chamfer, Sleeve and O Ring operate the exact same way as through bore. The Vertical Stops will change for these different modes.

Tapping 3 and 4 Axis:

Tapping for 3 and 4 axis is the same with the exception of the Move and Clamp buttons for the 4th Axis fixture.

Set Zeroes:
For Hard Tapping the zero point for all axis must be set.

You can set your zero points off of any location, the Hard Tapping Screen has Start Locations where values would be entered to locate the tapping position.

Or, using a dial indicator or a electronic probe center the spindle over the hole to be tapped. Place the Tap in the holder and vertically locate the tap just above the hole to be tapped. Press the vertical zero button here.

Manual Tapping:
There is no Manual tapping for the F68A machine. For tapping refer to the Hard Tapping section.

Hard Tapping:
You must set the Spindle RPM, Depth to be tapped from the zero position and the Threads per inch. When using the Rottler program for tapping you can only tap one hole automatically.

Press the Start Auto Cycle to run the tapping cycle.

Mill Mode 3 Axis:

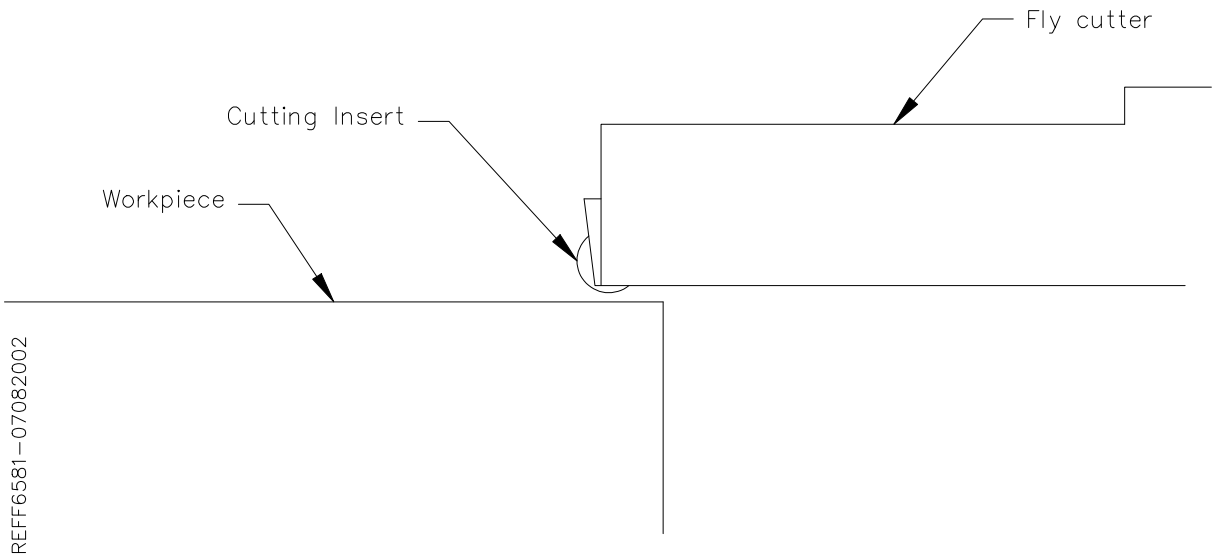
Setting Zeros:
The purpose of setting zero points is to give the operator a specific point to build programs from. The machine also uses these zero points to run the program from. The zero points can be set at any point in the machines' travel. Each axis (except the Spindle rotation) will need to have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

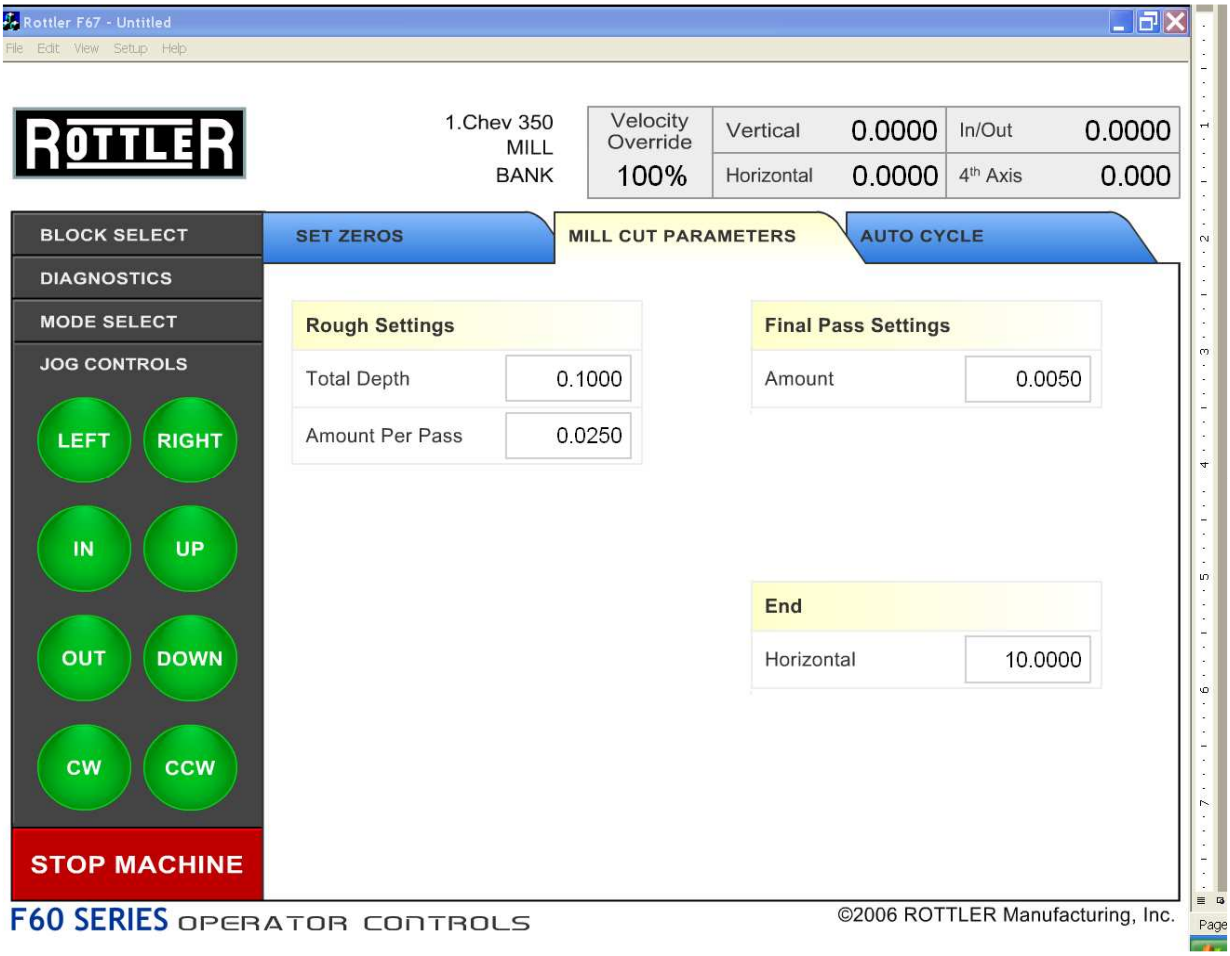


Set the Spindle RPM and Feed rate on this screen.

Start the spindle. Press the Vertical .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 F68A will use to run the automatic cycle.



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 ENTER. 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.

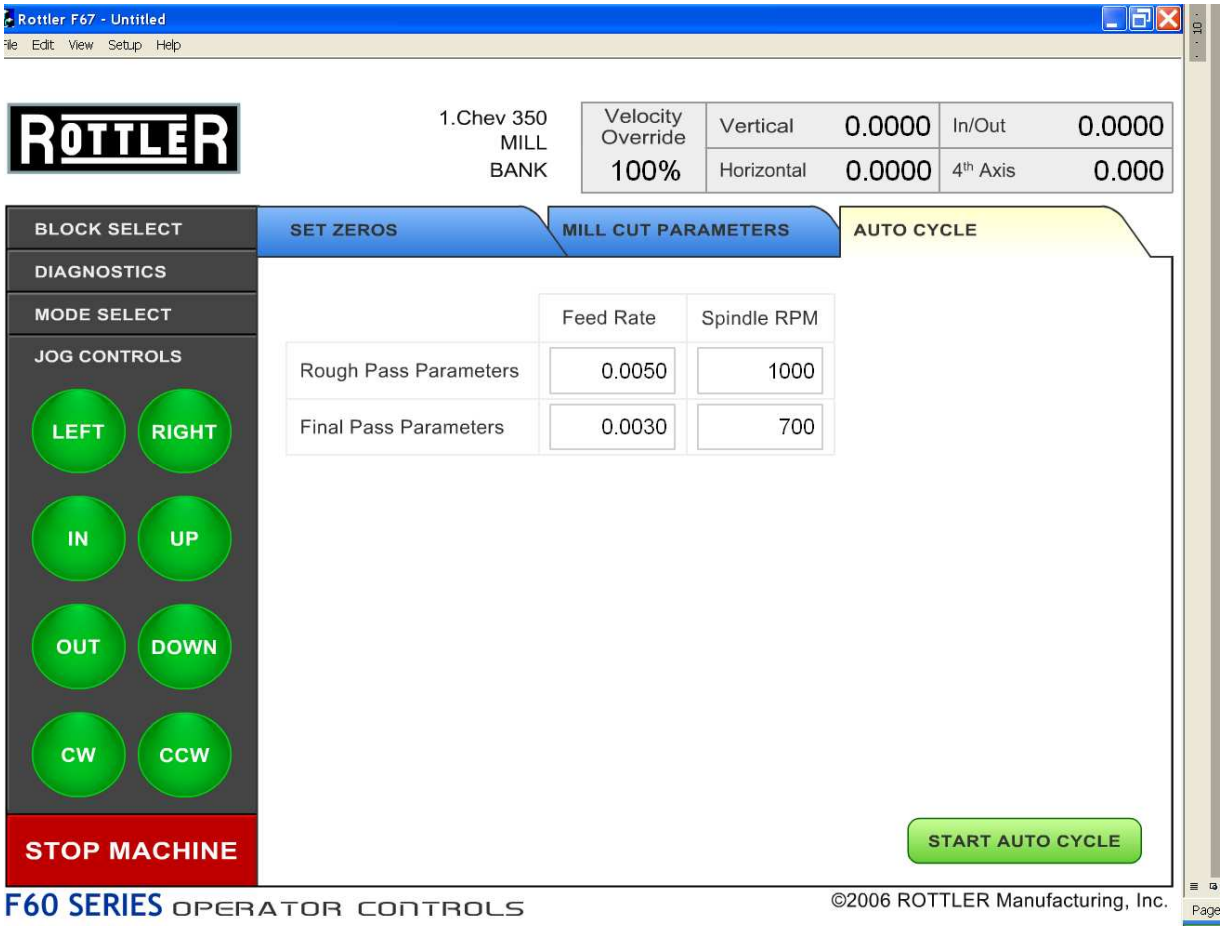
Rough Settings:
These values are entered to take several passes on a work piece.

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 divisible 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.

Auto Cycle:
This screen sets the Spindle RPM and Feed Rate the Auto Cycle will use to run the program.



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.

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.

Mill Mode 4th Axis:

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.

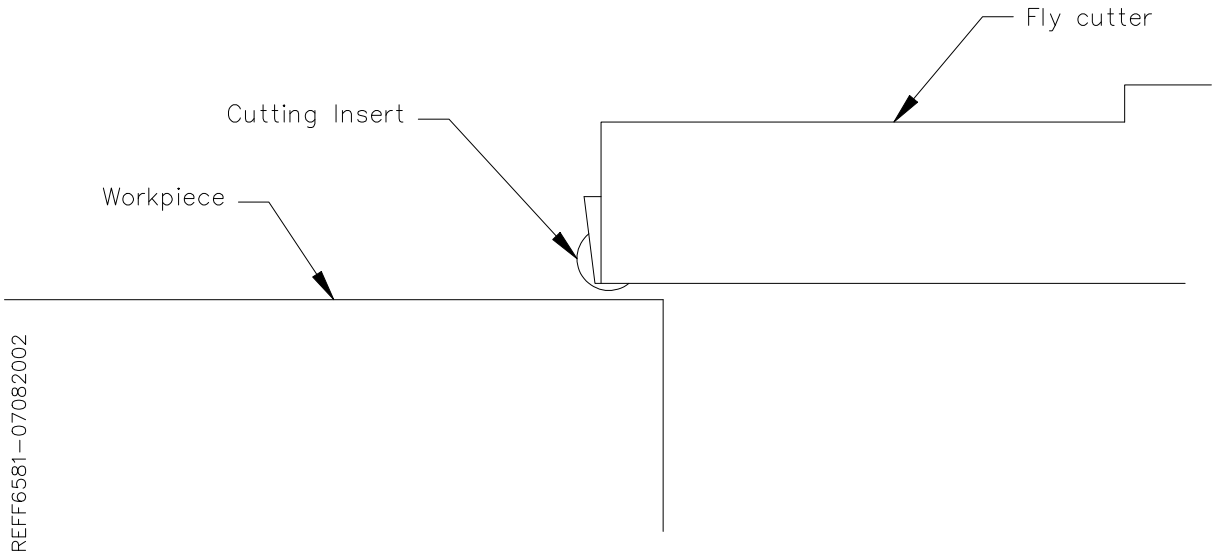
Horizontal Zero:
For this example we are going to set the Horizontal Zero approximately ¼" from the right hand side of the work piece.

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.

CAUTION **When setting the vertical zero it is important to check the deck height on both banks of the block before starting a cycle. It is possible that the right bank may be higher than the left bank where the vertical zero was set. This would cause a crash when the block rotated and the cycle was started on the right side.**

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.

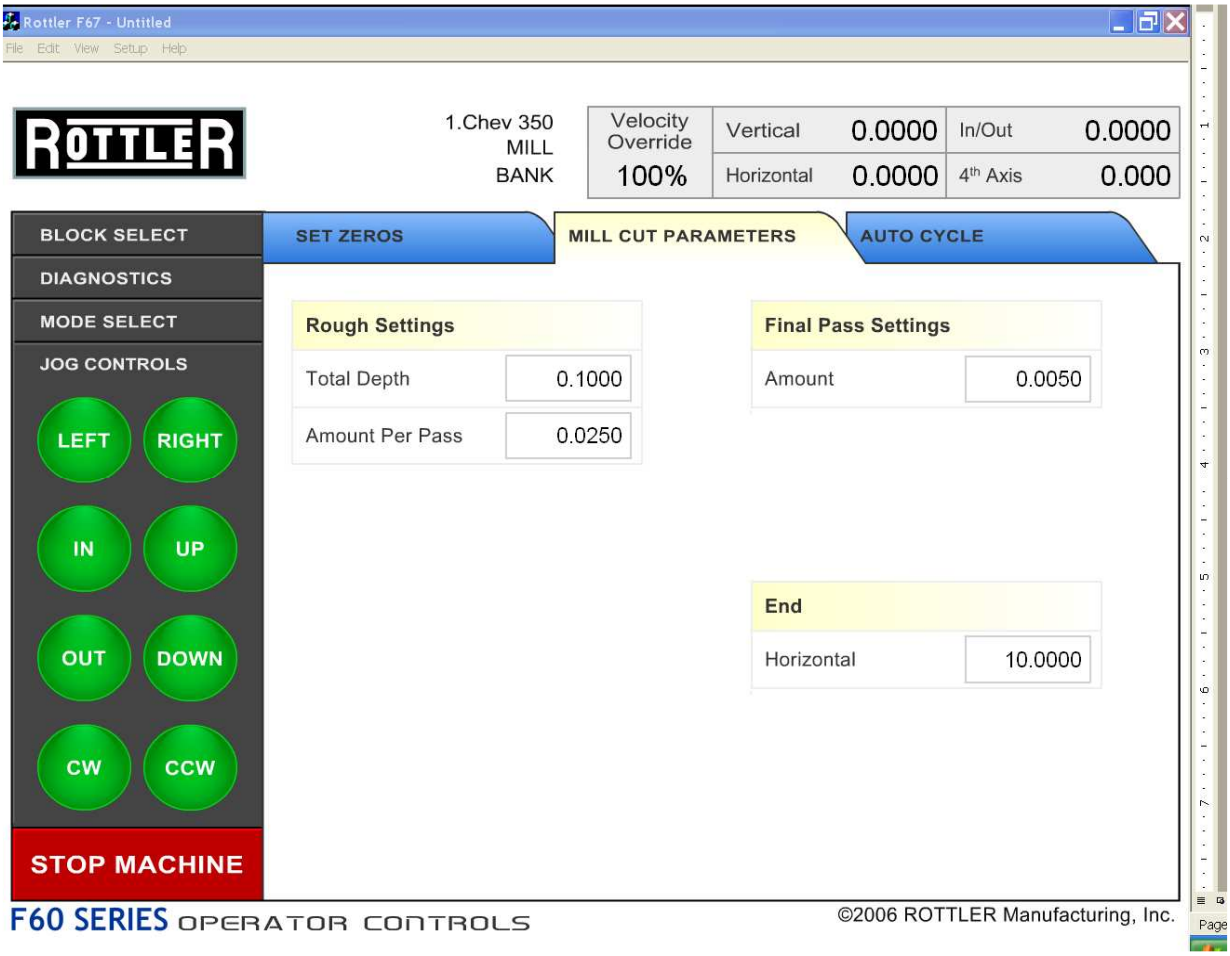


Set the Spindle RPM and Feed rate on this screen.

Start the spindle. Press the Vertical .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 F68A will use to run the automatic cycle.



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 ENTER. 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.

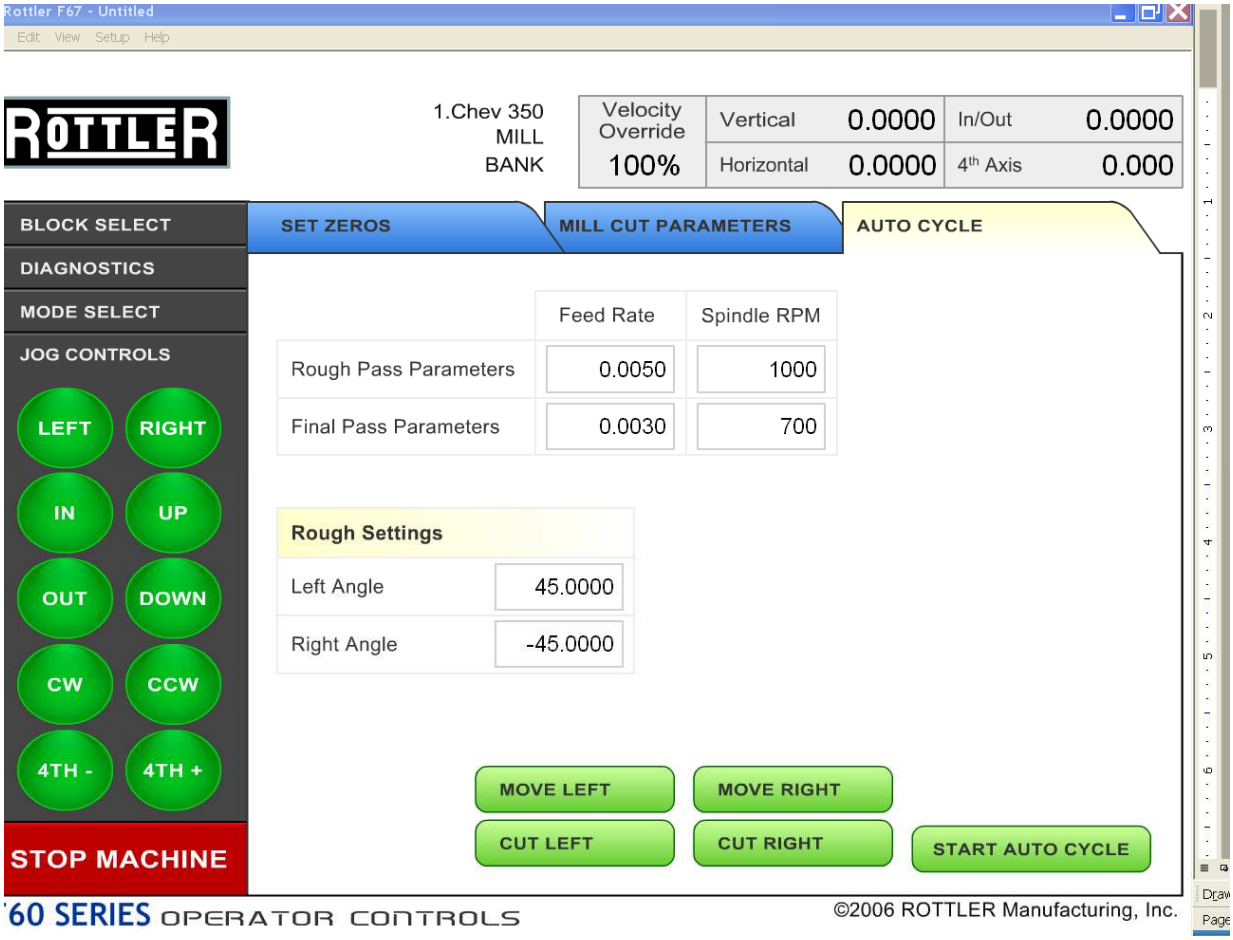
Rough Settings:
These values are entered to take several passes on a work piece.

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 divisible 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.

Auto Cycle:
This screen sets the Spindle RPM and Feed Rate the Auto Cycle will use to run the program.



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.

Move Left and Right:
Pressing this button will rotate the block from the left to the right bank and back.

Cut Left and Right:
Pressing this button causes an auto cycle on the associated bank at the degree entered in the data boxes.

Running the Auto Cycle:
Pressing this button will cause the following: The block will rotate to the specified angle for the left bank. The vertical will come down to the zero position plus the amount for specified per pass. The spindle will start and right travel will start at the Feed Rate specified. Feeding will continue until the End stop is reached. The spindle will return to the starting point and run as many passes as programmed.

The cutterhead will then move out of the way while the fixture rotates to the degree specified for the right bank. The same cycle will then be performed on right bank.

Lifter Bore Mode 3 Axis:

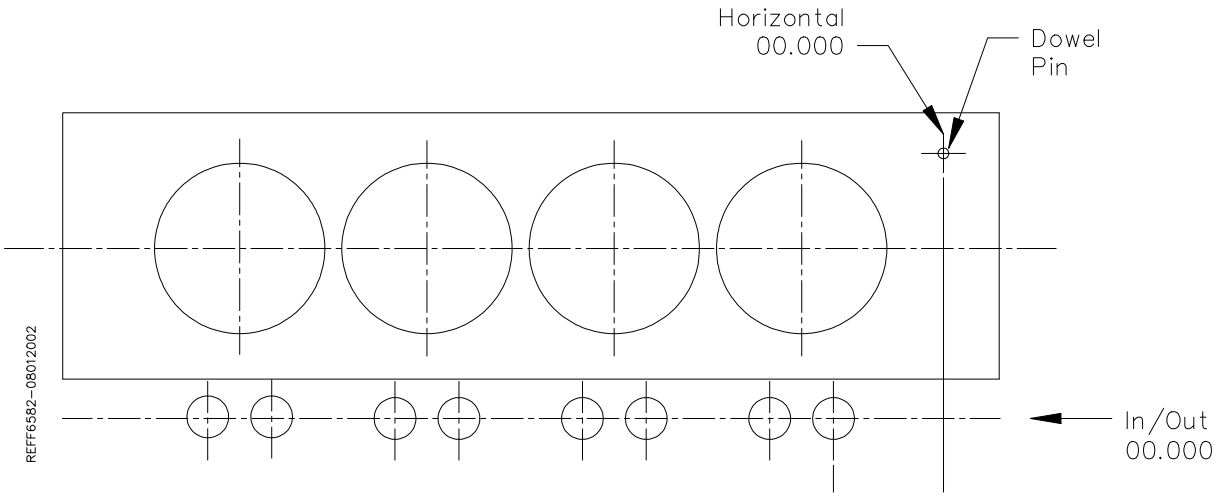
To mount a block for Lifter Boring refer to Performance Fixture Boring and Lifter Boring earlier in this section.

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.

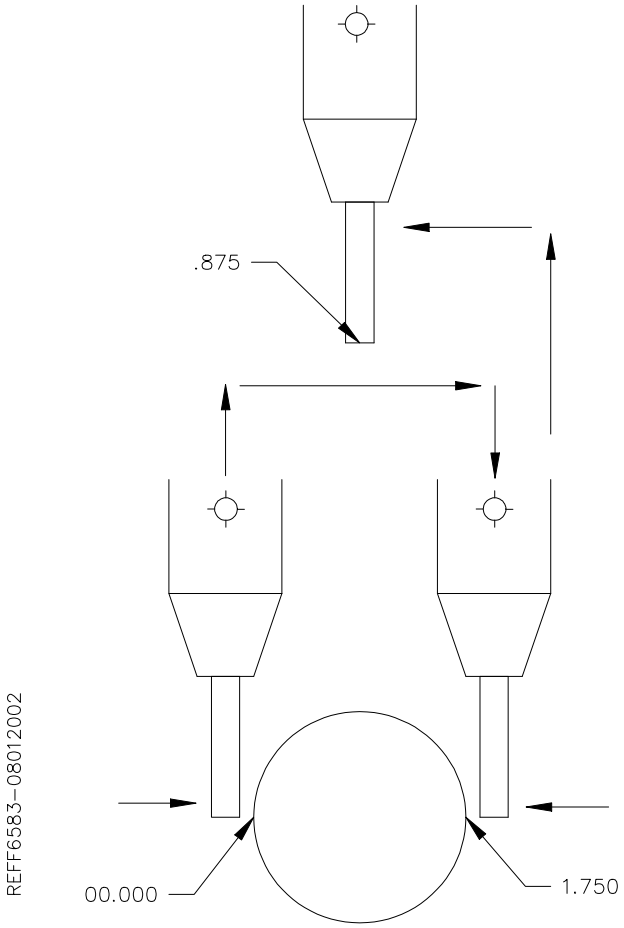
Horizontal Zero:
For this example, the Dowel pin will be used to set the Horizontal Zero. Using an indicator or electronic probe center the spindle on the Dowel Pin then press the Horizontal and In/Out Zero buttons. The display above these buttons will go to zeroes. The Horizontal zero position has now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

For this example the center line of the Cam bore is the In/Out zero point.

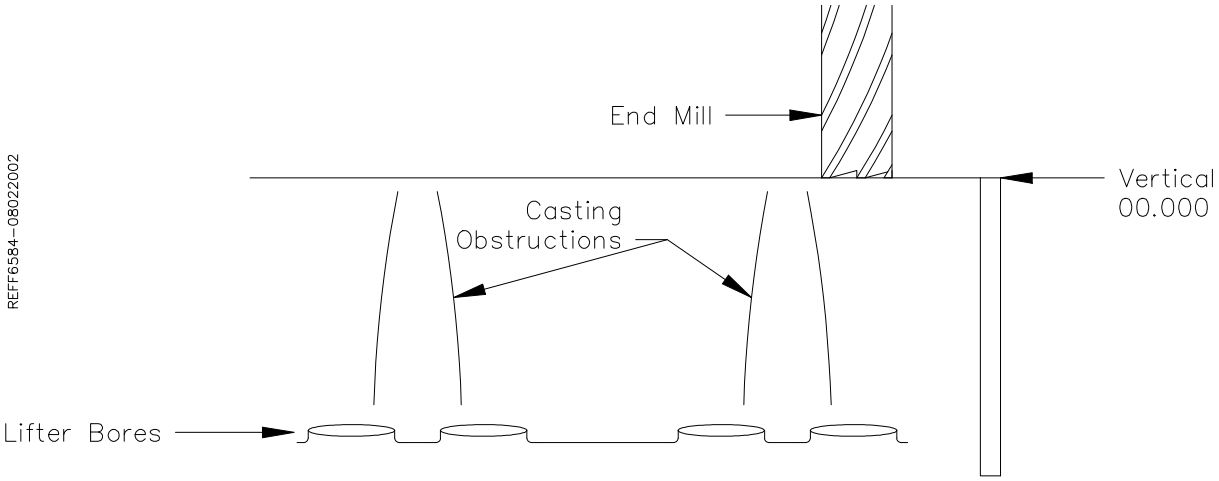


You can also use the dowel pin In/Out as a zero position. If you are using the Dowel pin as the zero location, the In/Out data boxes will need to have a value entered in them.

With the Dowel pin as the zero point, use the indicator as described above to find the center of the Cam bar. When you are doing this however do not reset the In/Out zero position.

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

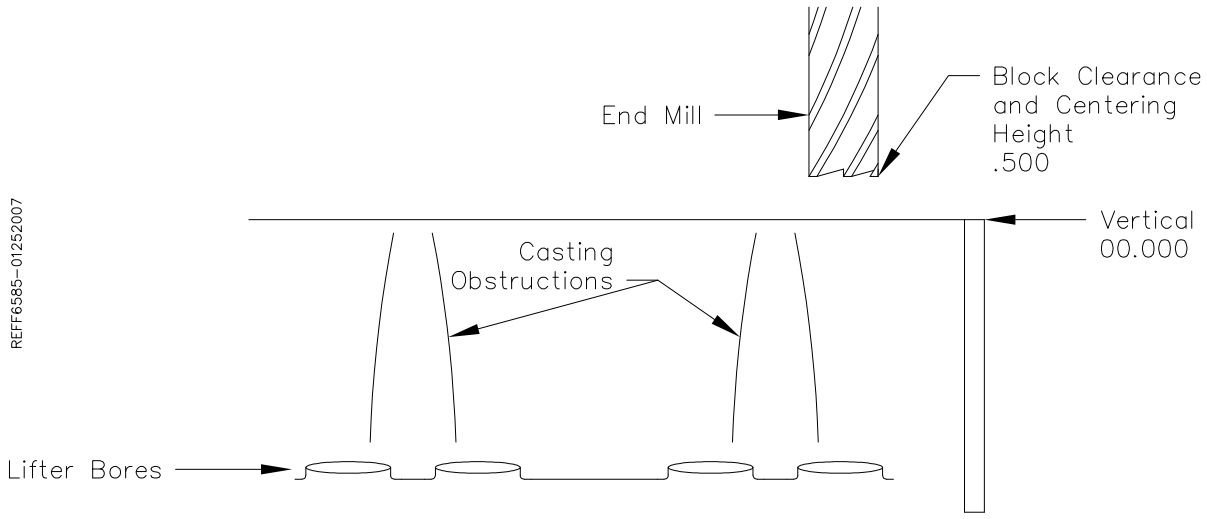


The zeros points for all axis have now been set. All the numbers entered from this point on will reference these zero positions. You are finished with the Set Zeros screen, select the next Tab to the Right.

Blueprinting:

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. Plus one used with the Probing option.

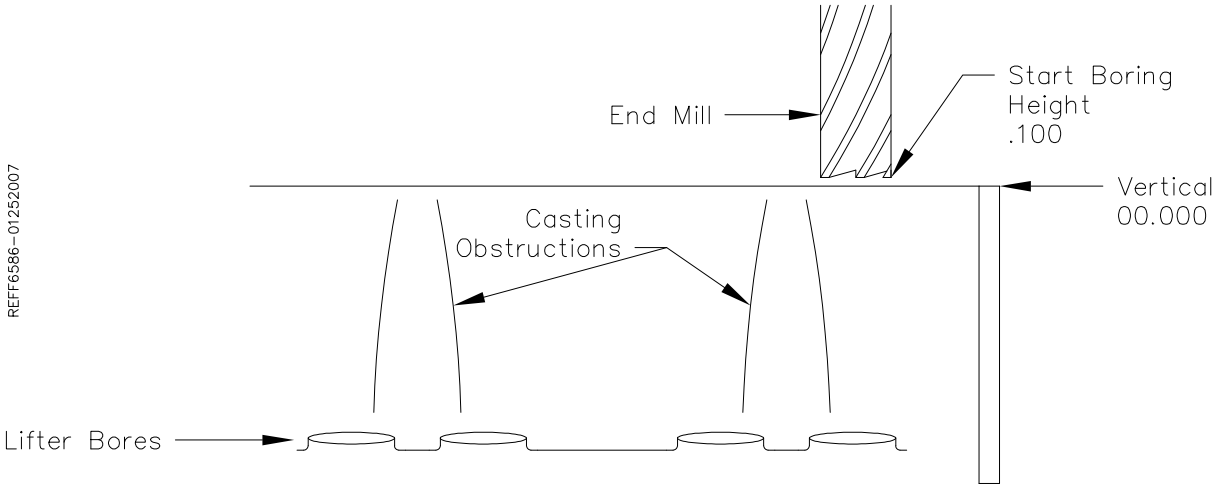
Block Clearance:
This is the distance above the Vertical Zero position (block deck in this case) that will allow the end Mill to travel over to the next Lifter Bore unobstructed. This will be a negative number.



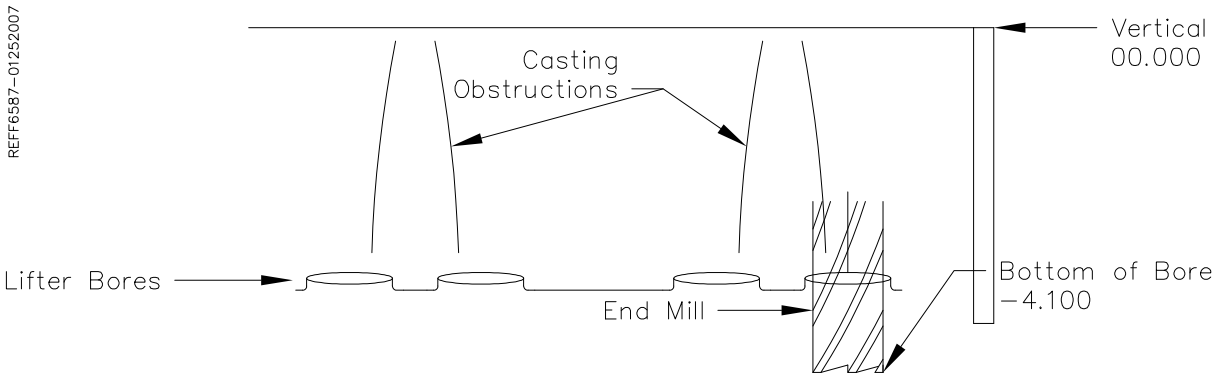
Centering Height:
Centering is not used in Blueprinting Lifter Bore Mode. The positions of the Lifter Bores are derived from a blue print or other documentation. Therefore, the Block Clearance and the Centering Height can be the same.

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

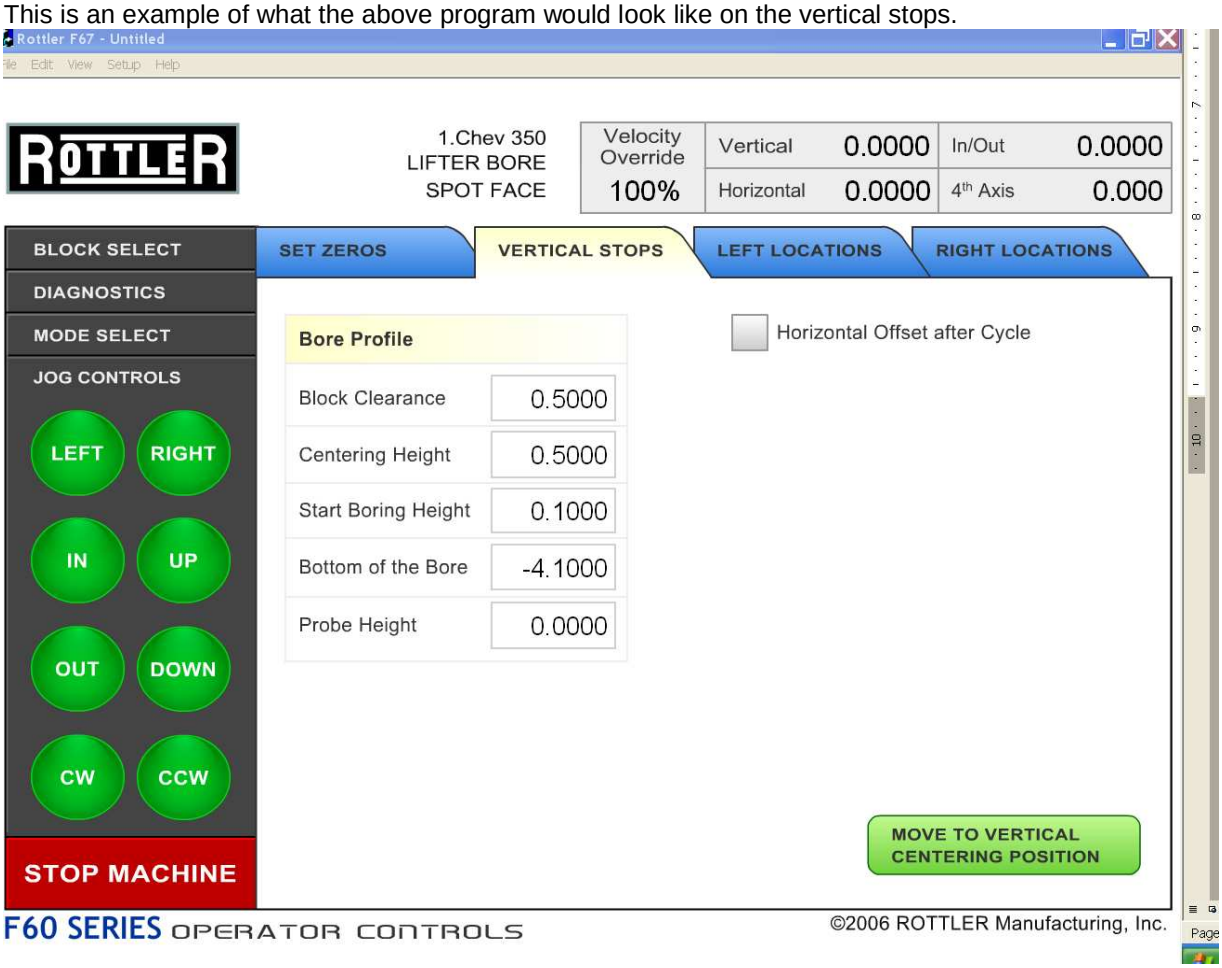
CAUTION **You must be very careful when setting this height. There are very often obstructions in the cast that will not allow you to rapid travel all the way down to the start of the Lifter Bore. If you are not sure that the End Mill can clear all the way to the Lifter Bore on each bore, the Start Boring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



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

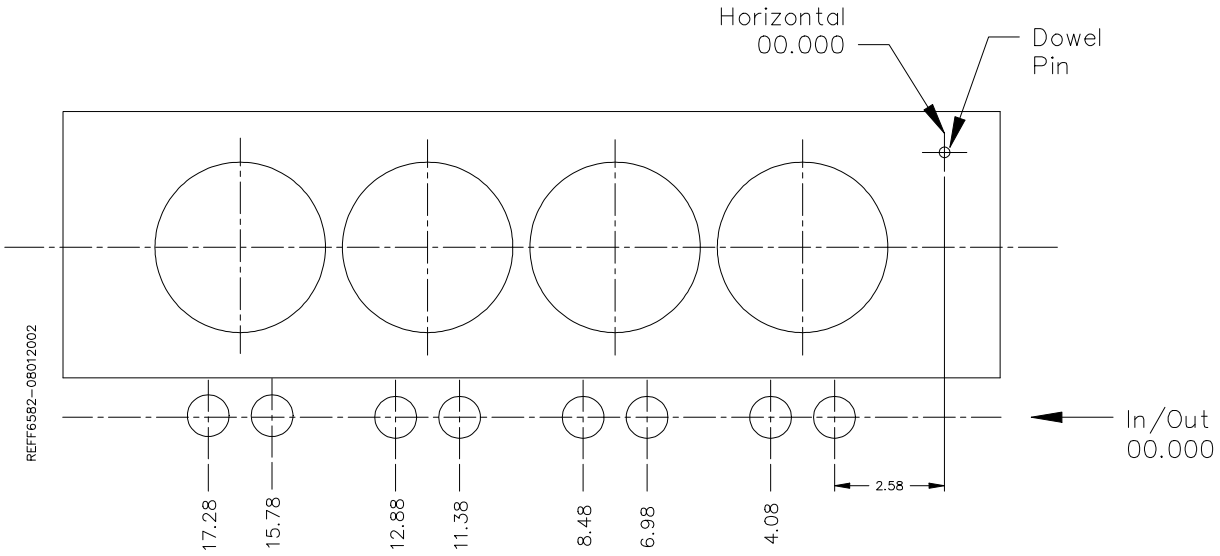


Probe Height:
When using the optional Probe… install the probe into the spindle after your vertical positions have been set using the cutterhead. Bring the tip of the probe down to the location in the bore you want to probe. Look at the actual Position read out for the Vertical. This will be the Probe Height value.

CAUTION **Make sure the Block clearance height is sufficient for the probe to clear the block deck when moving to the next cylinder. If not the probe will crash into the cylinder wall and break.**

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

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.

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 to 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” button will cause the machine to run the full 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:

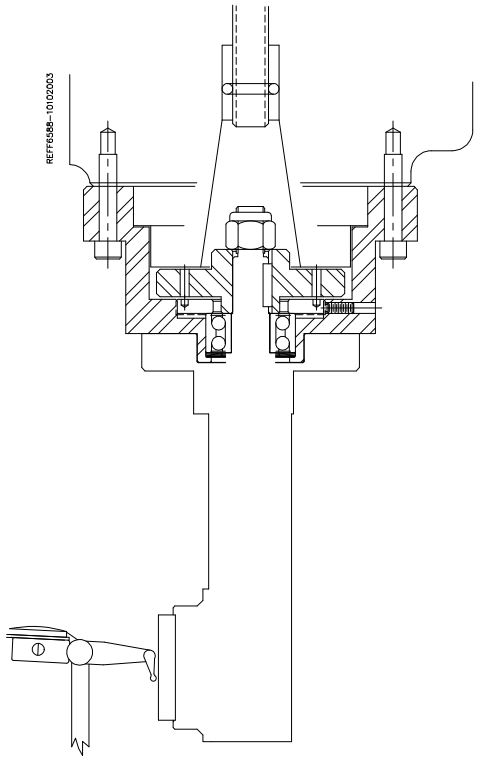
To mount a block for Line Boring refer to Lower end Machining Package earlier in this section.

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.



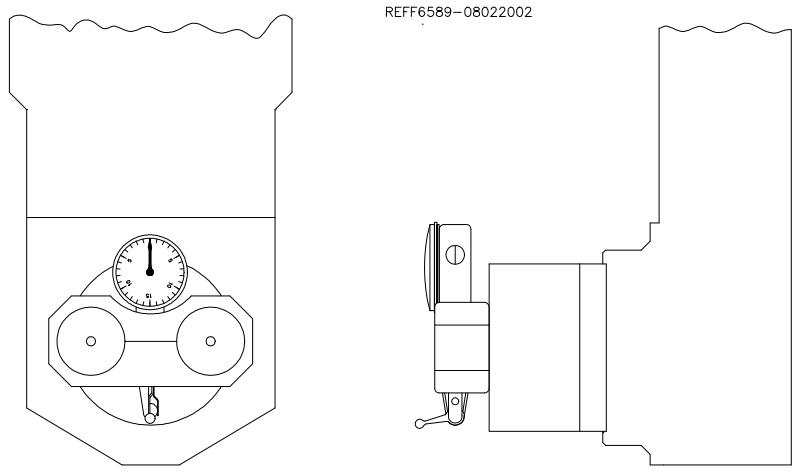
Put some pressure on the indicator. Using the In/Out handwheel move the indicator form one side to the other noting the amount of difference. Keep the indicator on that side of the head and rotate it half of the noted distance. Repeat this procedure until there is less than .0005" variance.

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.

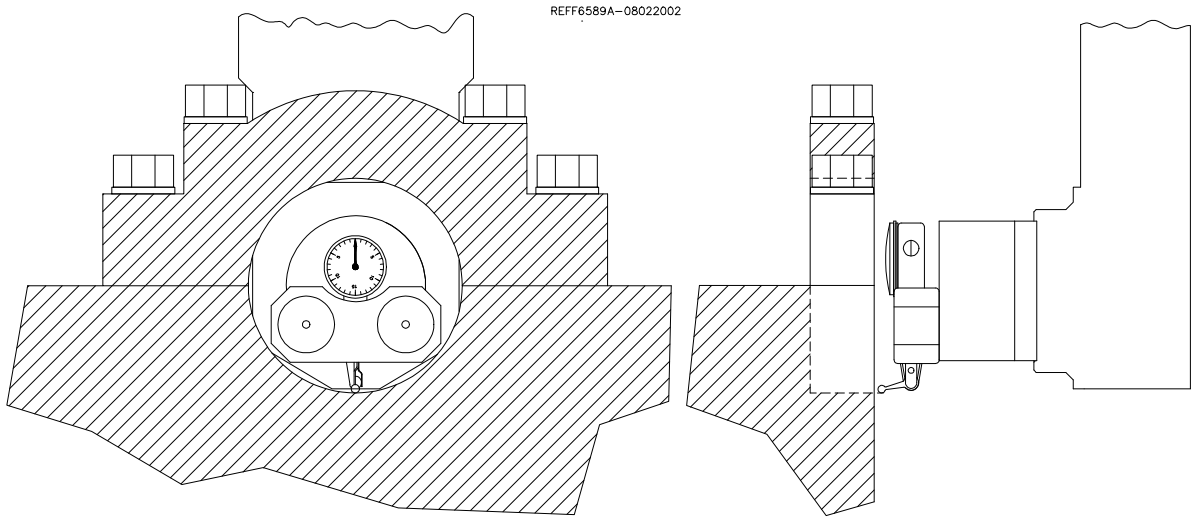
Horizontal Zero:
The Horizontal should be set about .050" from the front of the first main to be bored, making sure that that position will allow the head to travel up without interference. Bring the head down and roughly center it in front of the first main. It does not need to be perfectly centered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

If you press the MOVE buttons or the Cycle Start button the machine will not move the In/Out axis to the zero position. You need to move the In/Out axis to the zero position manually before you press Cycle Start.

The machine will go idle at this time. Pressing the "Start Auto Cycle" button will cause the entire cycle to run.

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

Thrust Cutting:

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

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

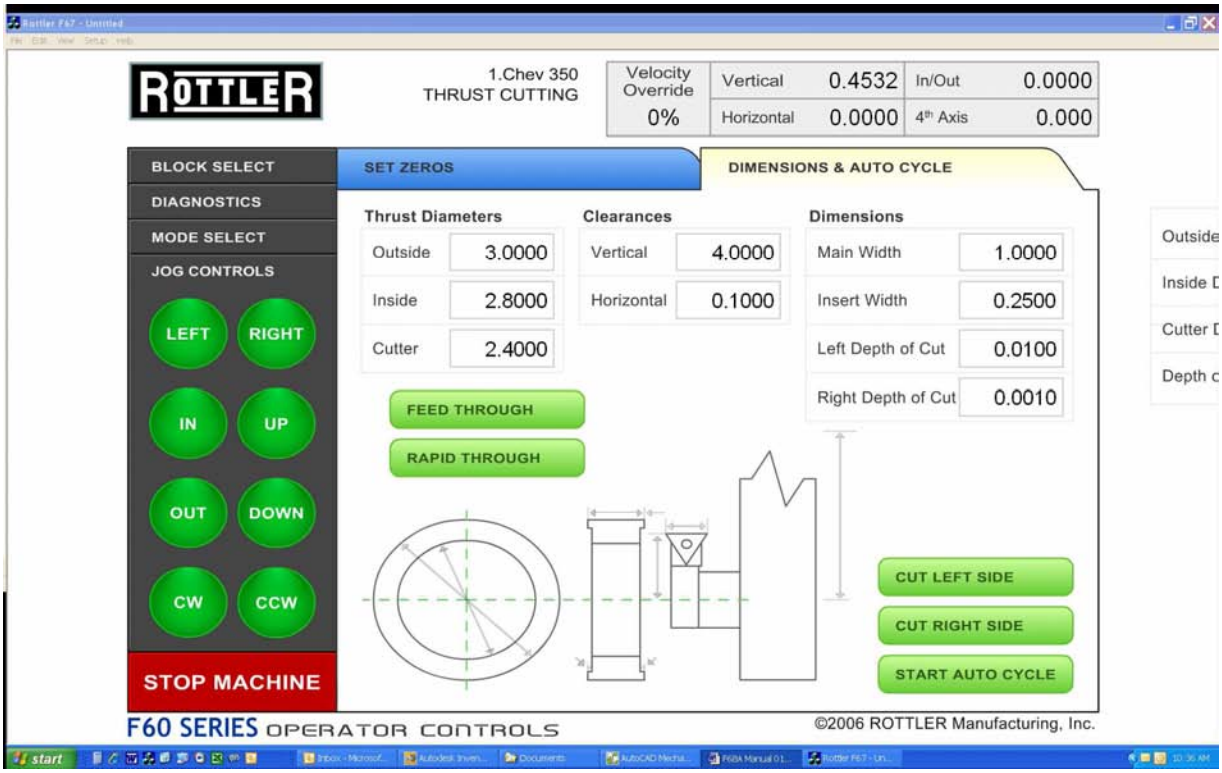
To set the Horizontal Zero, bring the cutter in using the Horizontal Hand Wheel until it just touches off the current thrust face. Press the Horizontal Zero Button here. The computer will use this zero point when cutting the depth of the thrust face.

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.

Dimensions & Auto Cycle:

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.



Thrust Dimensions:

Outside:
This is the Outside dimension of the thrust face to be machined.

Inside:
This is the Inside dimension of the thrust face to be machined.

Cutter:
This is the radius, from the center of the 90 degree head to the tip of the insert.

Clearances:

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

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

Dimensions:

Main Width:
Width of the Main.

Insert Width:
Width of the Insert.

Left Depth of Cut:
Depth of left cut.

Right Depth of Cut:
Depth of right cut.

Feed Through:
Pressing this button will cause a red dot to appear next to the button. This indicates that the machine will Feed through the program.

Rapid Through:
Pressing this button will cause a red dot to appear next to the button. This indicates that the machine will Rapid through the program.

Cut Right Side:
If you select Cut Right Side the automatic cycle will cut the thrust face on the right hand side of the Main.

Cut Left Side:
If you select Cut left Side the automatic cycle will cut the thrust face on the left hand side of the Main.

Description and Running of the Auto Cycle:
You will need to enter the Feed Rate and Spindle RPM the program will run at.

There are no Move to buttons in this program. You ***MUST*** be at the zero positions when the Auto Cycle is started.

Start Auto Cycle:
When you are at the 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.

Center the spindle over the Main bore using the electronic probe or magnetic base with indicator. Zero the Horizontal and In/Out axis.
The Cam spacer placed in the center T-Slot should put the Cam tunnel in line with the Main bore.
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.
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.

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

You can also skip the above procedure and center on the existing Cam bore.
Once centered on the Cam bore or set to correct the Cam bore, zero the Horizontal and In/Out axis.
Install the 650-2-3F cutterhead into the spindle.
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”.

Bore the distributor end Cam bore.

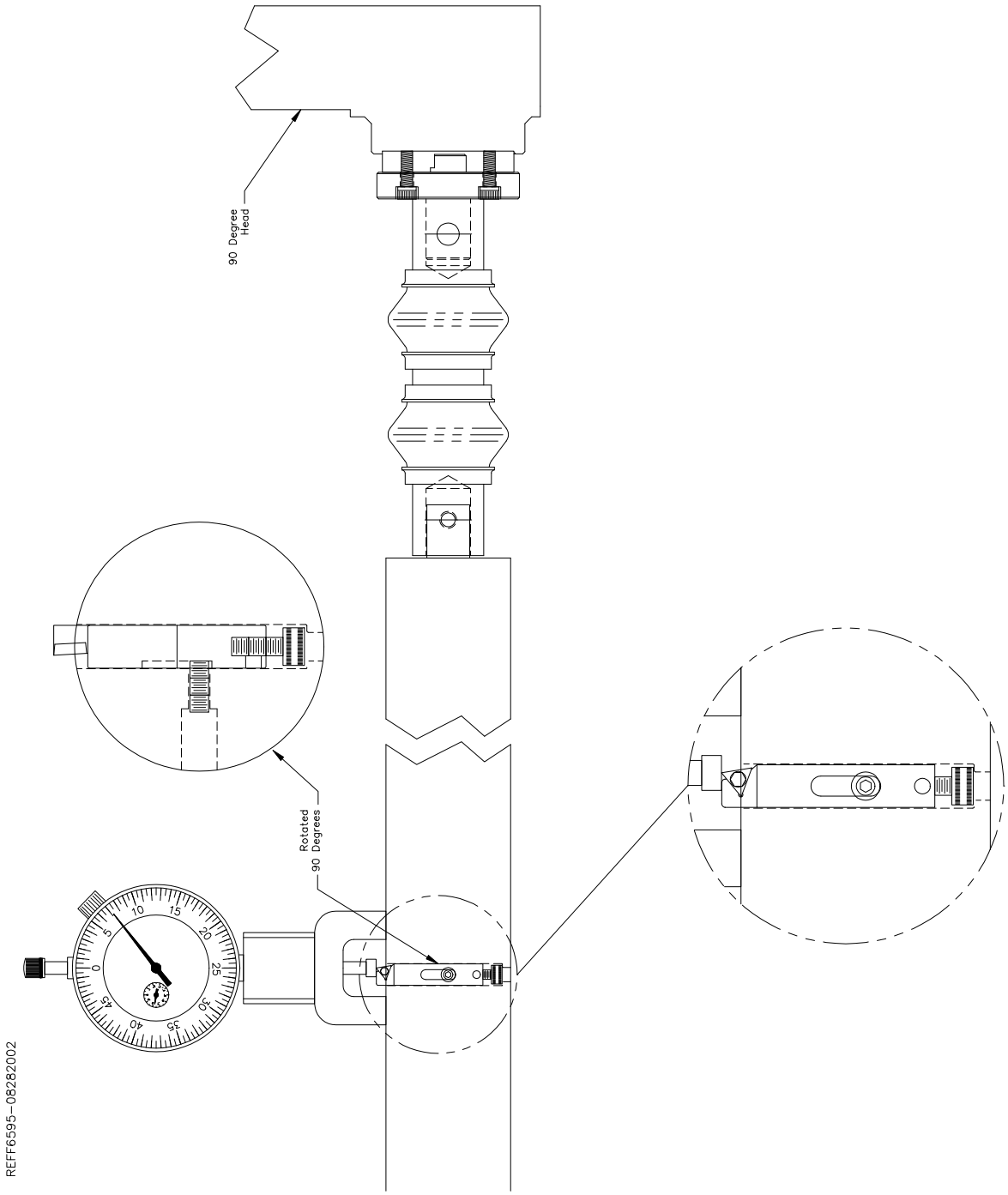
Note: To bore the oil groove in the Cam Bore, refer to the Cam Bore Oil Groove section in this chapter. This is a CNC operation.

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

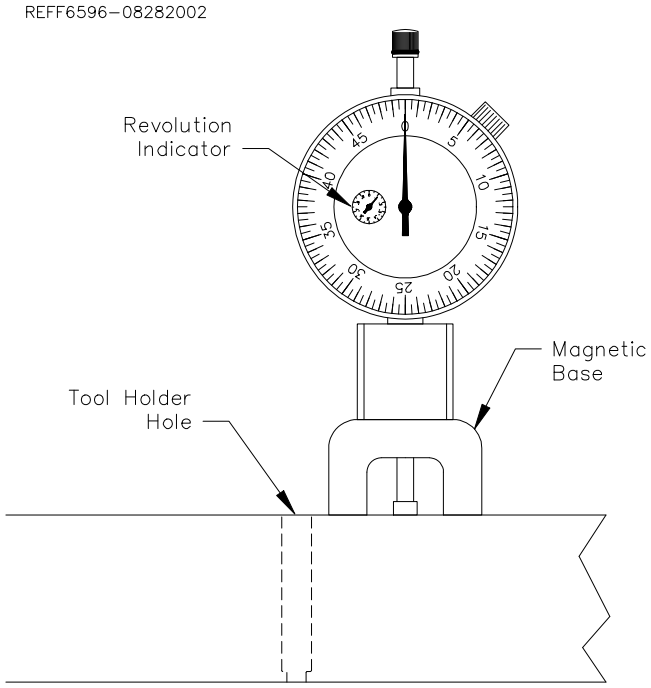
Cam Tunnel Boring:
To bore the center of the Cam tunnel refer to Cam Tunnel Boring in the Block Mounting section of this chapter. Mount the block as shown.

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.

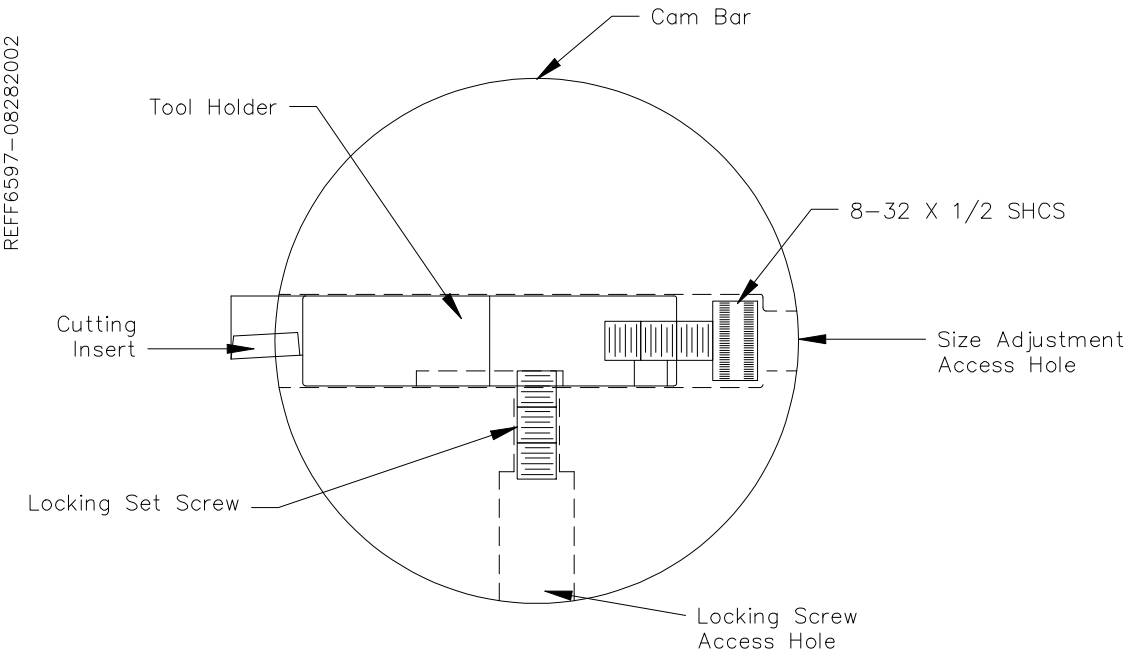


Setting Cutting Size:
The diameter of the Cam Bar 650-2-32D is 1.7500". The 8-32 X ½" socket head cap screw on the back of tool holder is used to adjust size. When the tool holder is inserted into the Cam Bar the cap screw goes against a ledge inside the Cam Bar. When the cap screw is turned in the size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

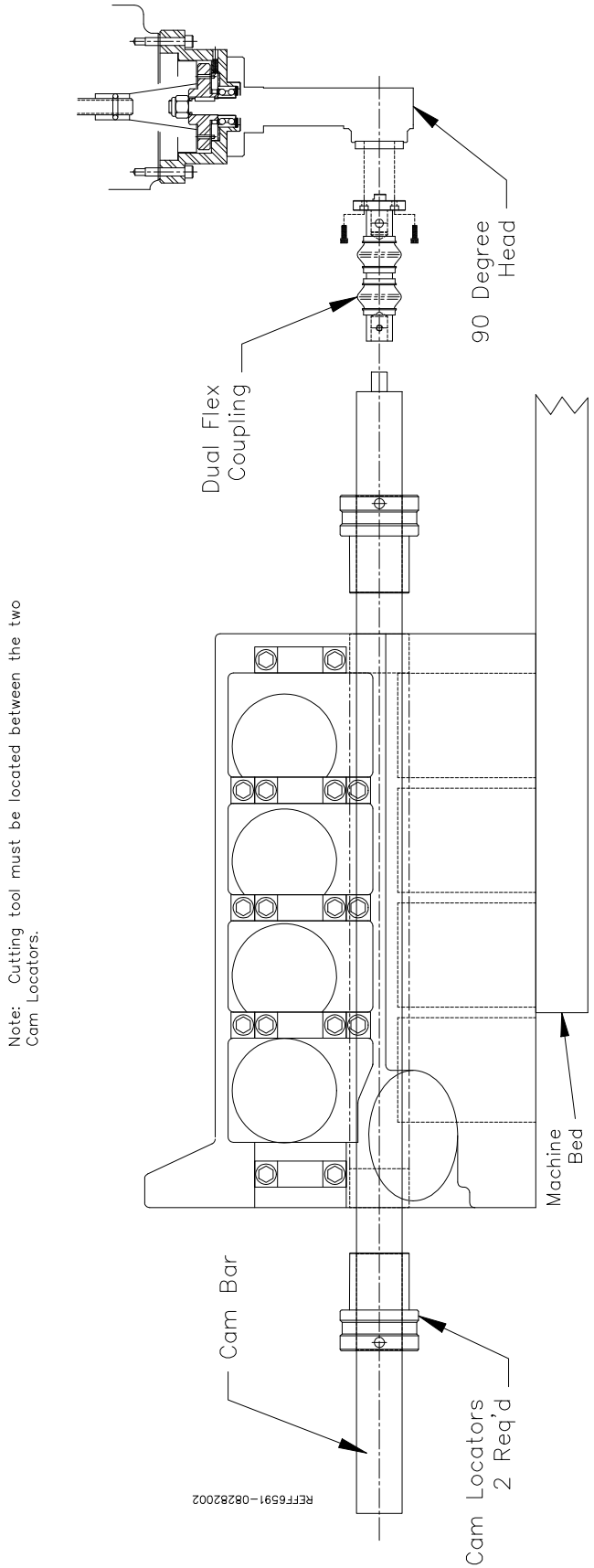
CAUTION **When adjusting the size on the tool holder, you must remember that the amount that will be taken off of the diameter will be twice the reading on the dial indicator.**

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.



Refer to the Line boring section of this chapter for mounting and alignment of the 90 degree head.
Select Line Bore Mode of operation.
Mount the dual flex coupling to the 90 degree head with the two (2) supplied socket head cap screws.
Install one Cam Bearing Locator into the left side of the block.
Slide the Cam Bar into the Cam Tunnel and then into the right side locator. Keep the end of the Cam Bar with the adapter on it to the right.
Slide the second locator onto the Cam Bar, then the locator into the Cam Bore. The cutting tool needs to be between the two (2) locators.
Bring the 90 degree head down and line up the end of the dual flex coupling with the adapter on the Cam Bar. This does not have to be a precise line up, the dual flex coupling will take care of any alignment variance. Tighten the socket head cap screw on the dual flex coupling on to the adapter on the Cam Bar.
Press the Vertical, Horizontal and In/Out zero buttons.
Final set up should look line the drawing on the following page. The mounting components are not shown on this drawing. Refer to the block mounting section of this chapter.



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.

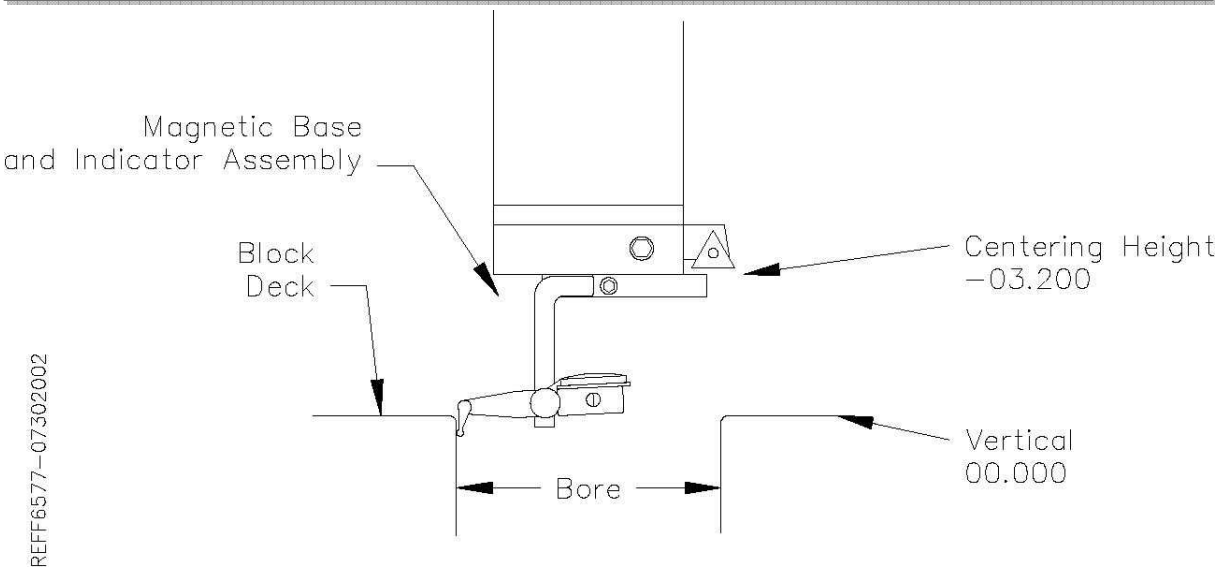
Con Rod:

Manual Screen

This screen is used to set the center of the conrod to be bored and a vertical height reference for the cutterhead and boring tool to be used.

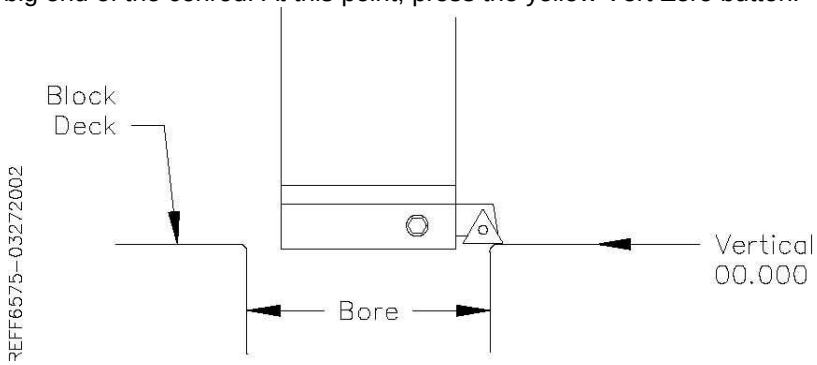
Setting In/Out and Horizontal Zero

Using a suitable Magnetic Base and Indicator assembly as shown below, indicate in the center of the conrod and touch the Yellow Horizontal Zero and In/Out Zero Buttons to set the machine to the center of the conrod. Normally only the conrod half of the big end is used for centering. When setting the In/Out Zero, the last movement of travel when indicating the bore of the conrod, must be in the inwards direction. When setting the Horizontal Zero, the last movement of travel when indicating the bore of the conrod, must be in the leftwards direction. This will eliminate any backlash that may be in the machine.

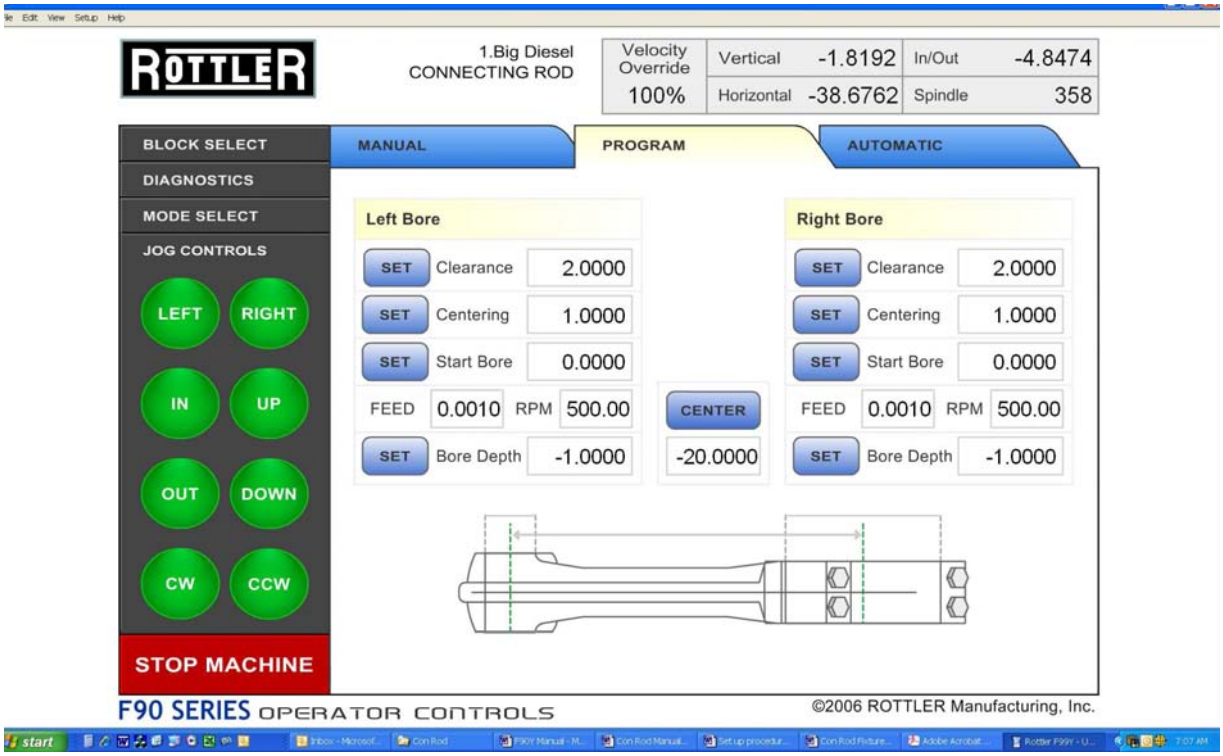


Setting Vertical Zero

Fit the cutterhead and boring tool that is going to be used to bore the big end. Once the Horiz and In/Out center has be established, slowly lower the cutterhead until the boring tool just makes contact with the thrust face of the big end of the conrod. At this point, press the yellow Vert Zero button.



Program Screen



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

Measure: This allows a position to be set where the conrod will move to be able to measure a bore easily without interference of the cutterhead, this is normally set to move the conrod away from the machine towards the operator.

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

Centering: This is the vertical height of the cutterhead with reference to vertical zero to where the cutterhead will move in order to center the bore with a dial gauge.

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

Bore Depth: This is the vertical height of the cutterhead with reference to vertical zero to where the cutterhead will stop boring, index the boring tool to the right, move the conrod to the right for tool clearance then rapid the cutterhead upwards to the clearance position.

Center Set: This is where the center to center distance of the big end and small end of the rod can be programmed.

Automatic Screen

This screen is used to run programs such as bore right big end of the conrod. When the green buttons are touched, the machine will move to the position or start an automatic cycle.

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

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

Fixture Control Panel

Set up procedure for conrod fixture

Select the widest big and small end ball locators that will fit inside the conrod big and small end bores.
Press Locate Right and the right hand ball locator will move up and stop against it's end stop, then remove the air pressure supply to the conrod fixture so that the ball locator pivot arms may be moved manually.
Fit the selected ball locators to the right and left hand mounting positions. Be sure there are no chips and that the locators fix exactly in their mounting positions.
Connect the air pressure to the fixture.
Press Locate Right Button, the right hand ball locator will move up and stop against it's end stop.
Select the correct conrod support and place across the conrod fixture.
Place the conrod to be bored into the fixture so that the big end bore touches both the balls of the right hand ball locators.
Adjust the conrod rest so that the rod lies approximately horizontal.
Adjust the 3 big end support pads so that each support pad locates on the side of the big end and does not protrude into the big end bore. This will require removing and refitting the conrod to be sure the 3 support pads are correctly located and their hold down cap screws are tight.
Readjust the conrod support to allow the conrod to lie horizontal with no rock or tilt of the conrod on the 3 big end support pads.

Remove the conrod from the fixture.
Press locate left and the left hand small end ball locating device will lift up.
When the left hand ball locating device is at it's end of travel, place the conrod back in the fixture and adjust the left hand slide assembly so that both the left hand locating balls contact the bore inside the conrod small end.
Remove the conrod from the fixture.
Slide the left hand locating assembly approx ½" (12.7mm) to the right and lock both hold down handles securely, this will ensure that the small end ball locators contact the small end with some preload.
Place the conrod in the fixture.
Position the clamp arms so that their feet are approx 1/8" (3mm) above the side of the big end, be sure that hey do nor protrude into the big end bore to be machined and adjust their travel limit stops and lock the lock nuts.
Press the Light Clamp button, this will places light clamping pressure on the clamp arms and lightly hold the conrod down against the 3 support pads under the big end of the conrod.
Press the Locate Left button, the small end ball locator will move up and contact the bore of the small end of the conrod and firmly press it against the big end and straighten the conrod along the center of the fixture.
Select a set of wedges that will allow the outside of the small end of the conrod to be supported during boring so that there is no chatter or vibration during boring.
Press Wedge Engage button, the wedges will be pressed against the outside of the small end.
The conrod is now ready to be bored.

Air Pressure Settings

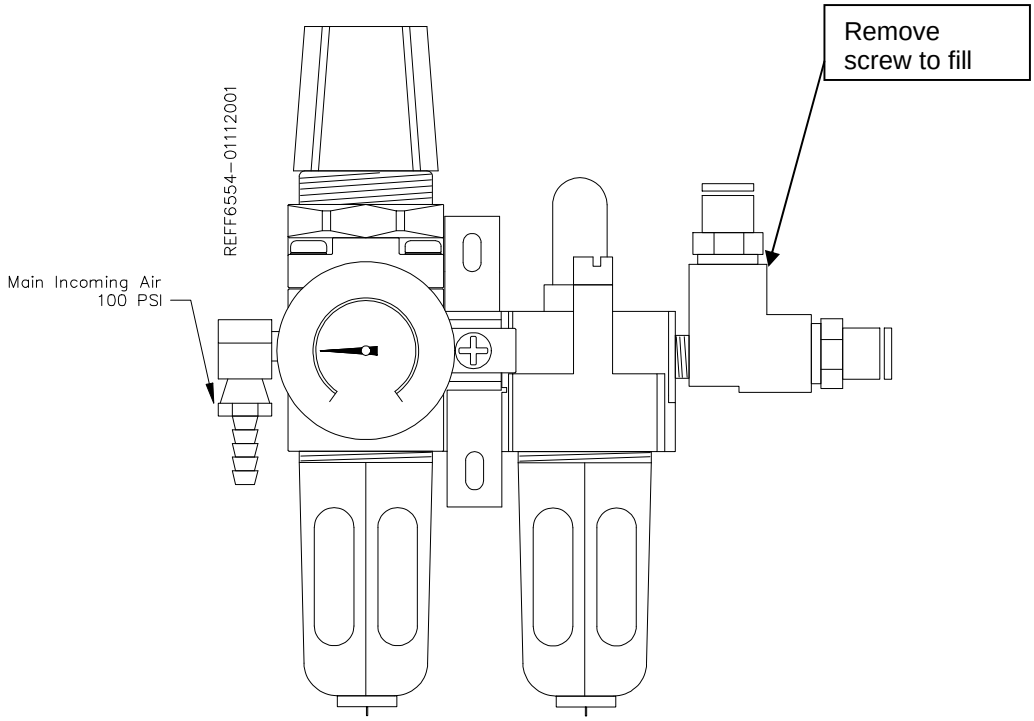
Right Hand Side Air Gage:	Locate Right	100psi	(6.5Bar)
Second from Right Hand Side:	Light Clamp	15psi	(1.0Bar)
Second from Left Hand Side:	Locate Left	30psi	(2.0Bar)
Left Hand Side Air Gage:	Wedge Engage	30psi	(2.0Bar)

Chapter 4 Maintenance:

Lubrication

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

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



Probe "On-Center" Adjustment:

The optional shank adapter assembly allows the OMP40 to be mounted on shanks suitable for the MP10, MP12 and MP700 Probes.

Step 1 - Adapter Assembly:

Assemble the 650-3-59H adapter plate as shown. Fully tighten screw A to 0.68 lbf (3.0 Nm)

Step 2 – Probe / shank Mounting:

Fully loosen all screws and fit shank adapter to shank as shown on the following page. Tighten screw B to 1.35 lb ft (6 Nm)

Fully tighten screw C to 0.49 lb ft (2.2 Nm)

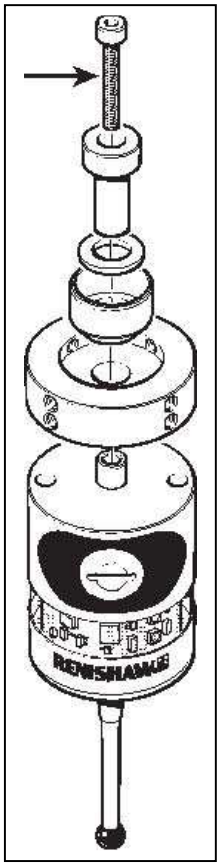
Fit Probe / Shank assembly into machine spindle.

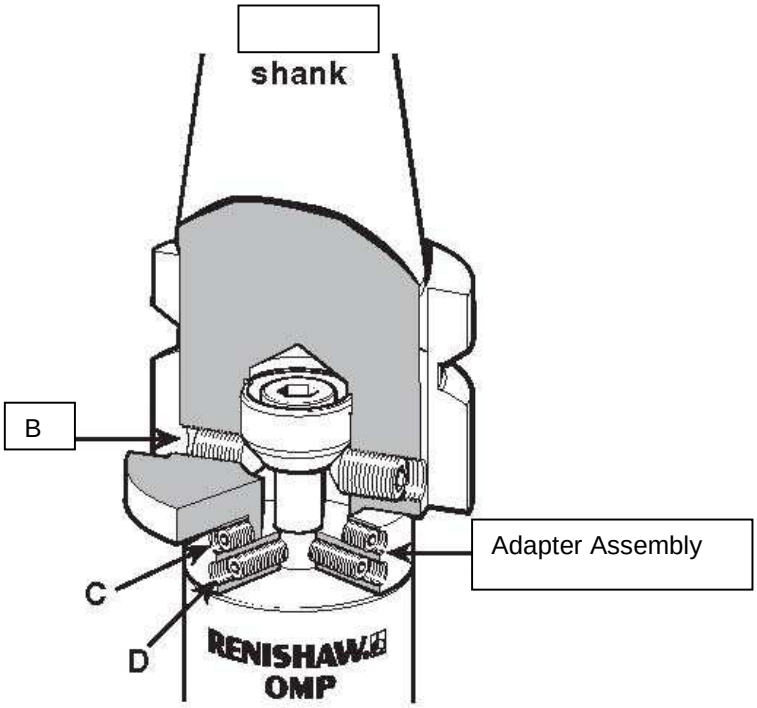
Step 3 – Adjustment:

There are four screws D. Each will move the probe relative to the shank in the X or Y direction as pressure is applied. Tighten screw individually, backing off after each movement.

Use screws D in opposition at the same time to move the probe, progressively tightening then as the final setting is approached. Use two Allen keys if needed. Tip run out should be .002" (5 Microns) should be achievable.

It is important that all four screws (D) are tightened to 0.49 lbft (2.2 Nm) once the final setting has been achieved.




shank
B
Adapter Assembly
C
D
RENISHAW
OMP

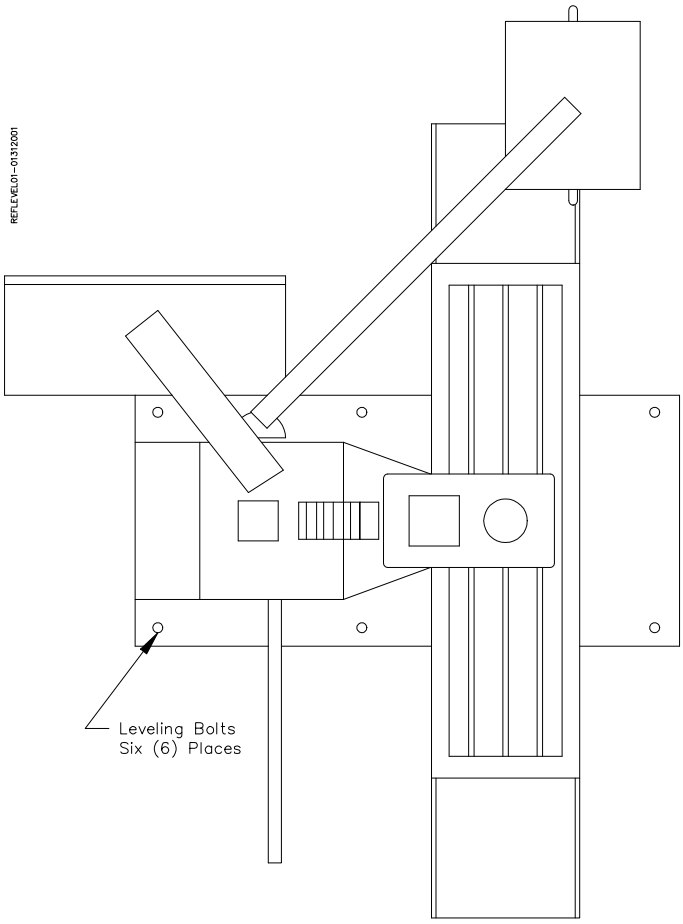
Leveling and Alignment:

The following is a description of how to properly level and align the F68A machine. These procedures should be followed in the order they written to obtain correct machine level and alignment.

Leveling the Machine:

After uncrating the F68A 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.



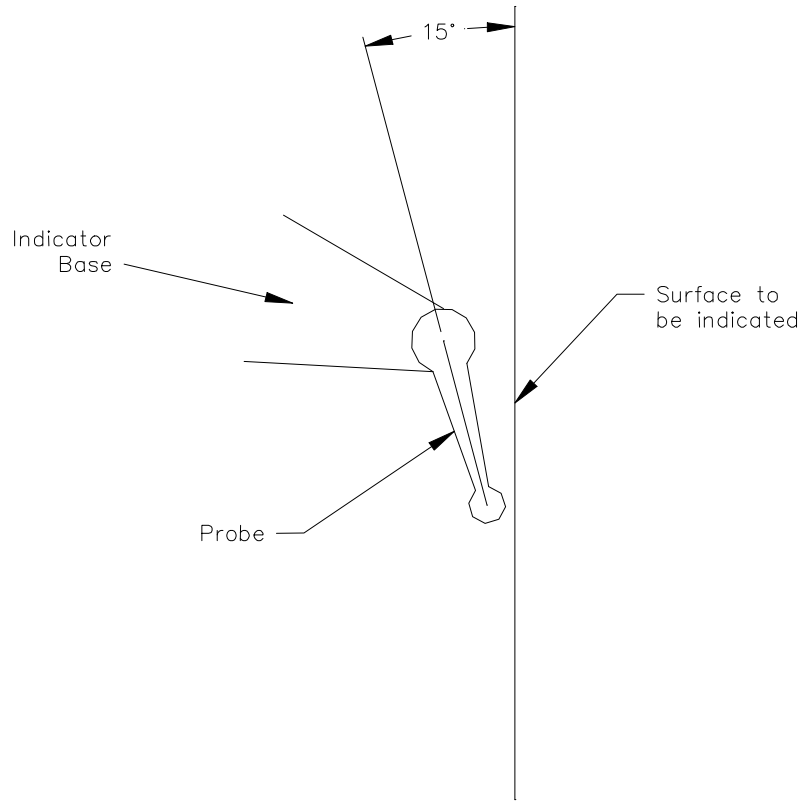
Using the four (4) corner leveling bolt to start with, bring the machine up to level in both directions (front to back and left to right) within .0005" per foot.

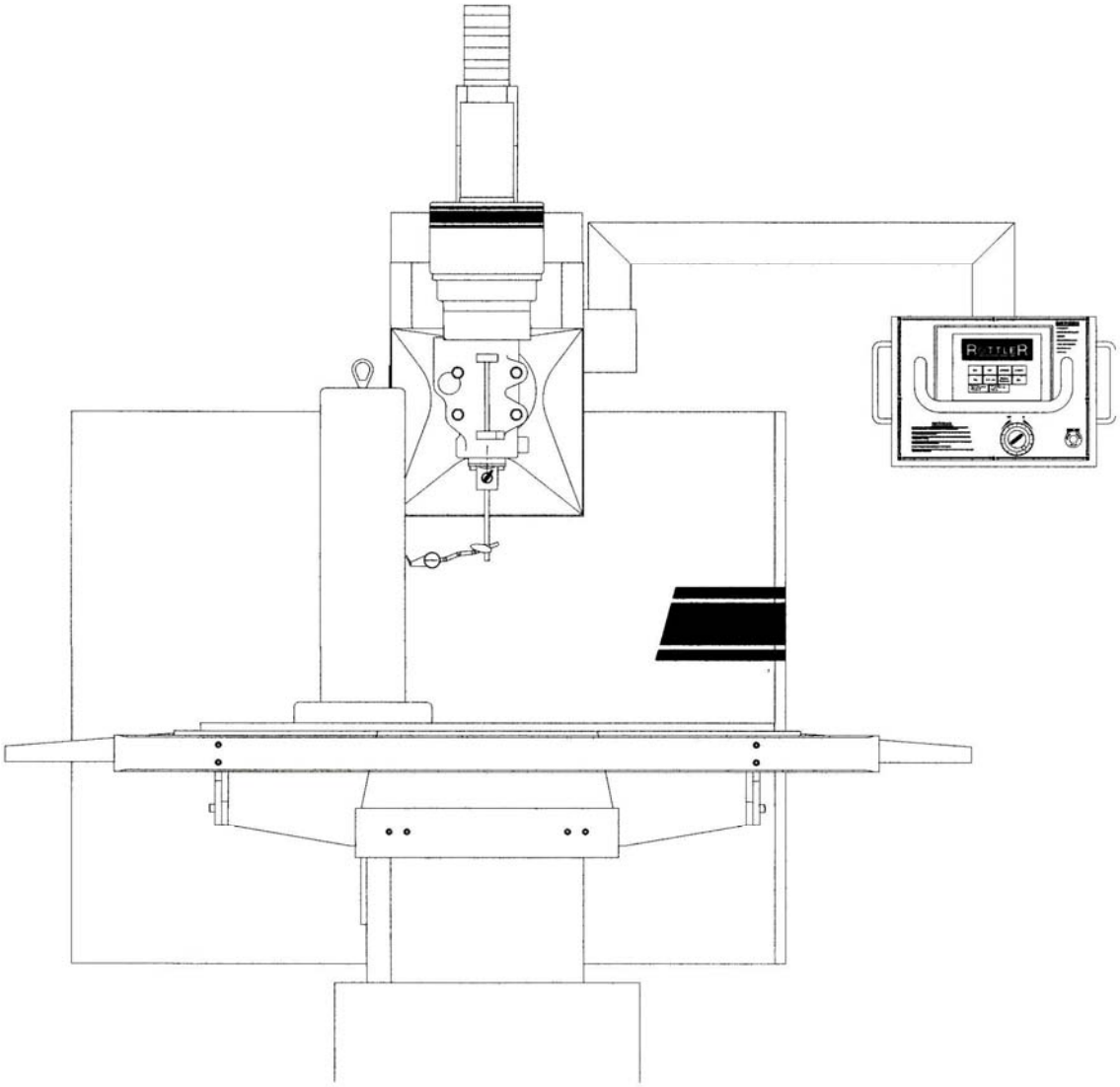
After you have leveled the bed using the four corner bolts, move to the middle leveling bolts. Bring these bolts down until they have approximately the same amount of pressure on them as them as the four corner bolts. Be careful not to throw the level of the machine off while doing this.

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.

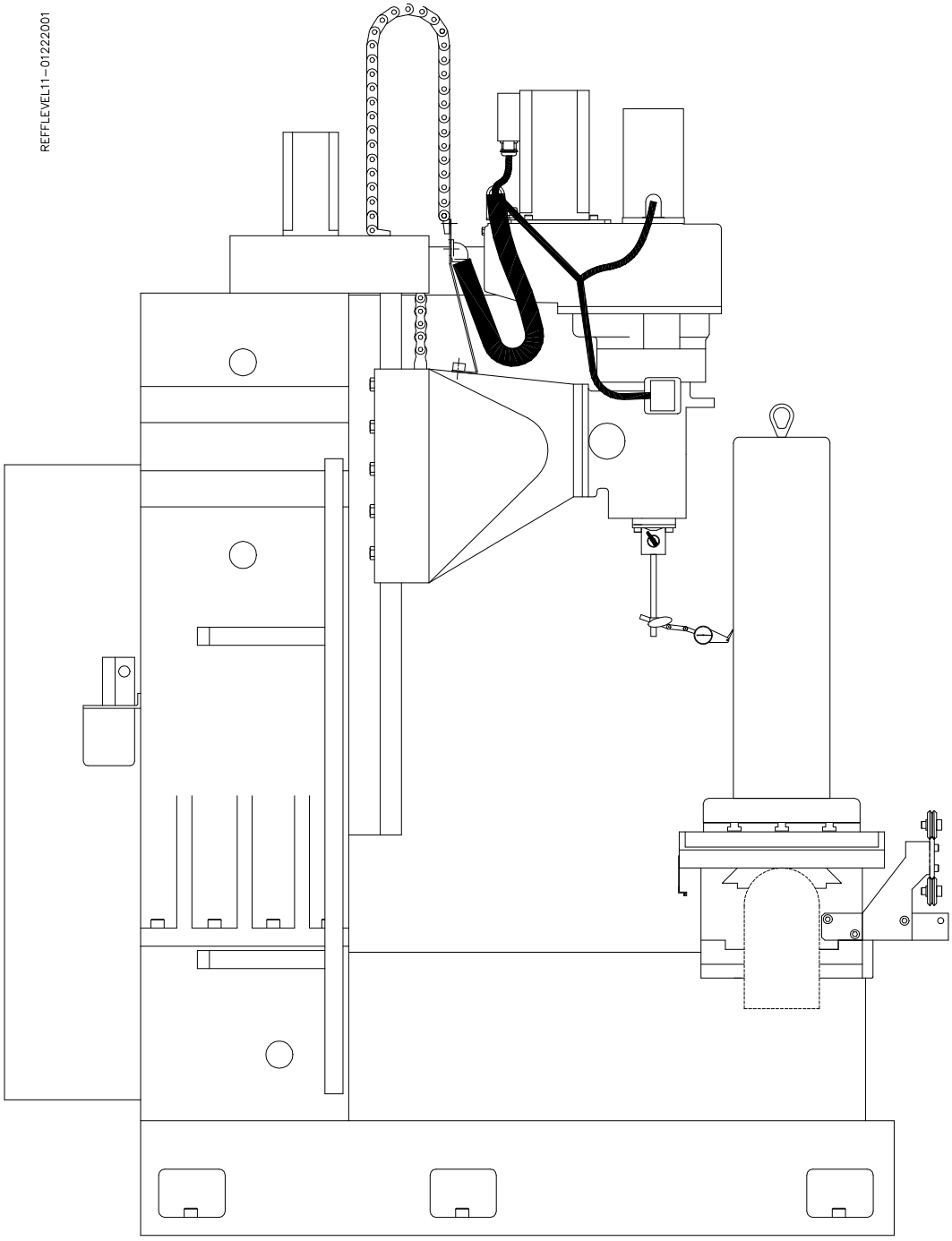
Note: The position (angle) of the probe to the surface you are indicating is critical. Using an incorrect angle on the probe will result in inaccurate readings from the surface being indicated. The angle of the probe should be at about 15 degrees from the surface being indicated (see illustration 2).





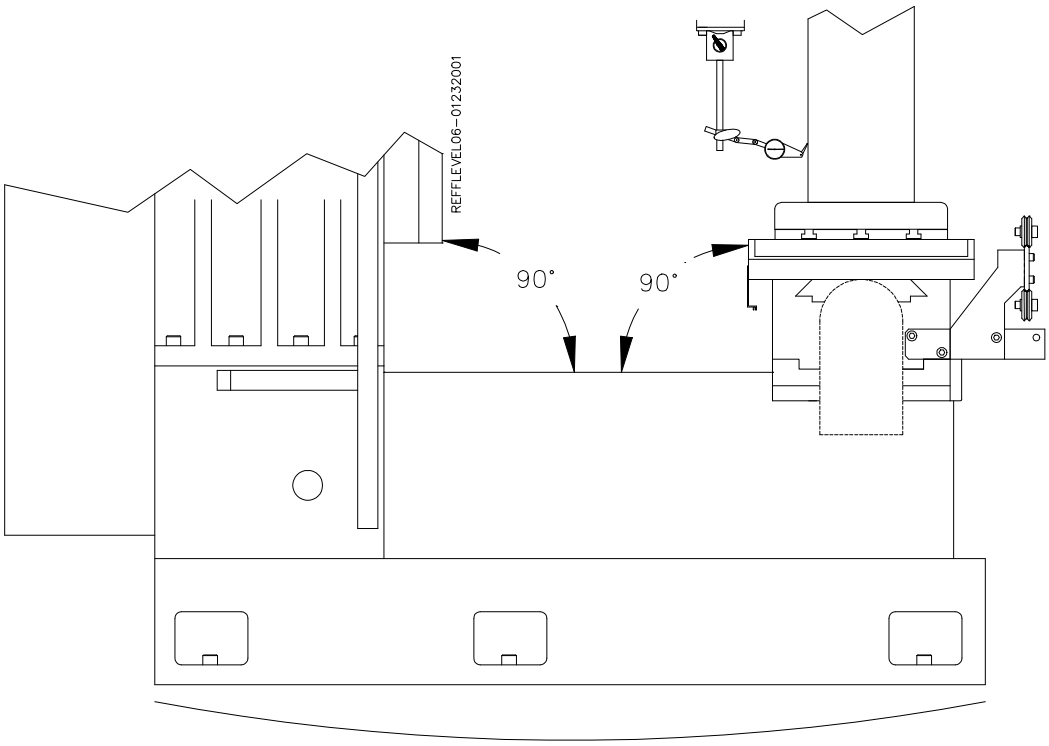
Put about .010” pressure on the indicator. Run the vertical throughout its full travel. The runout should not be more than .0005. If the runout is more than this, check the table top as well as the bottom of the alignment cylinder for burrs or debris.

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.

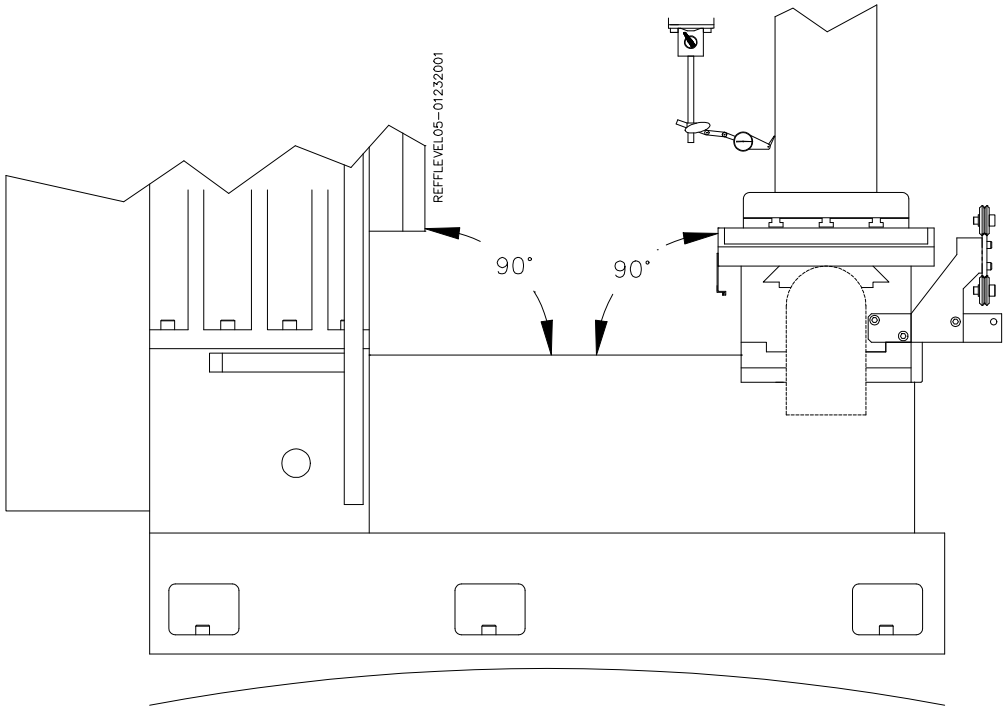
Middle Leveling Bolts:
If the procedures for the Leveling was followed correctly, it is unlikely that the deviance from Front to Back is being caused by the Middle Leveling Bolts. The following are examples of what could be caused by incorrect pressure on the middle leveling bolts.
Example 1: Zero the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

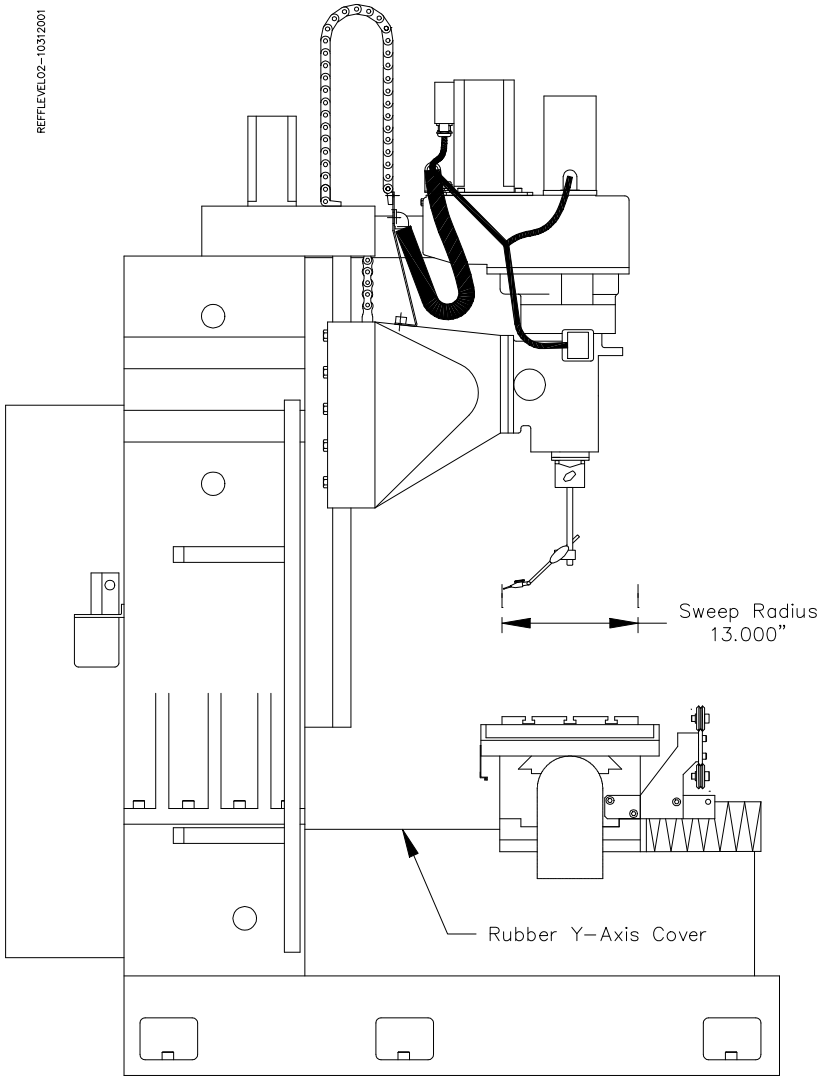
To correct the deviance slowly remove pressure from the middle bolts equally. Be sure to watch the level of the machine to be sure not to throw it off. After relieving pressure from the middle bolts you can apply slightly more pressure to the front corner bolts to bring the deviance within .001".

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

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

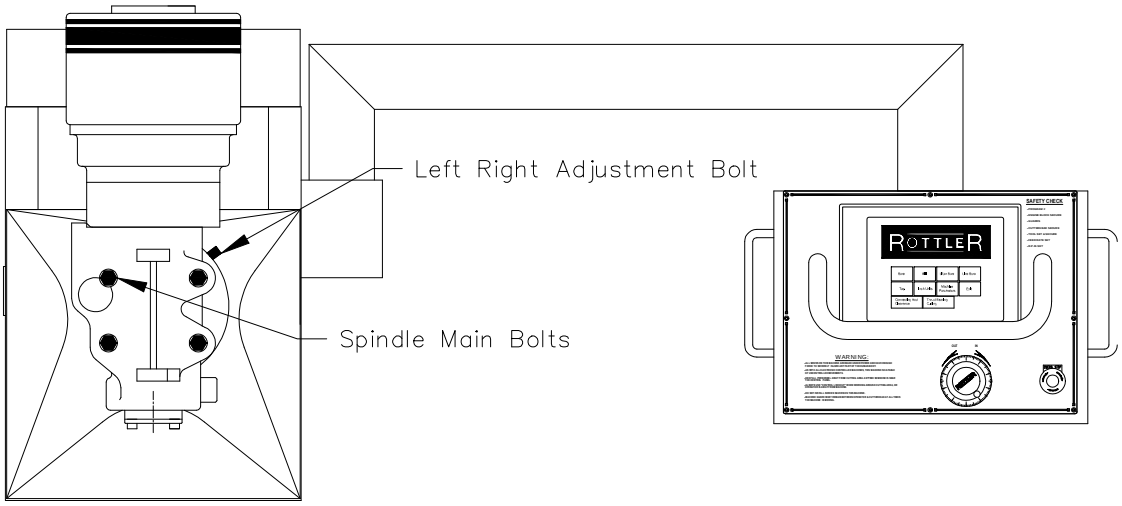
Use the following illustration for a visual reference on installing and using the Magnetic base indicator correctly.

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.



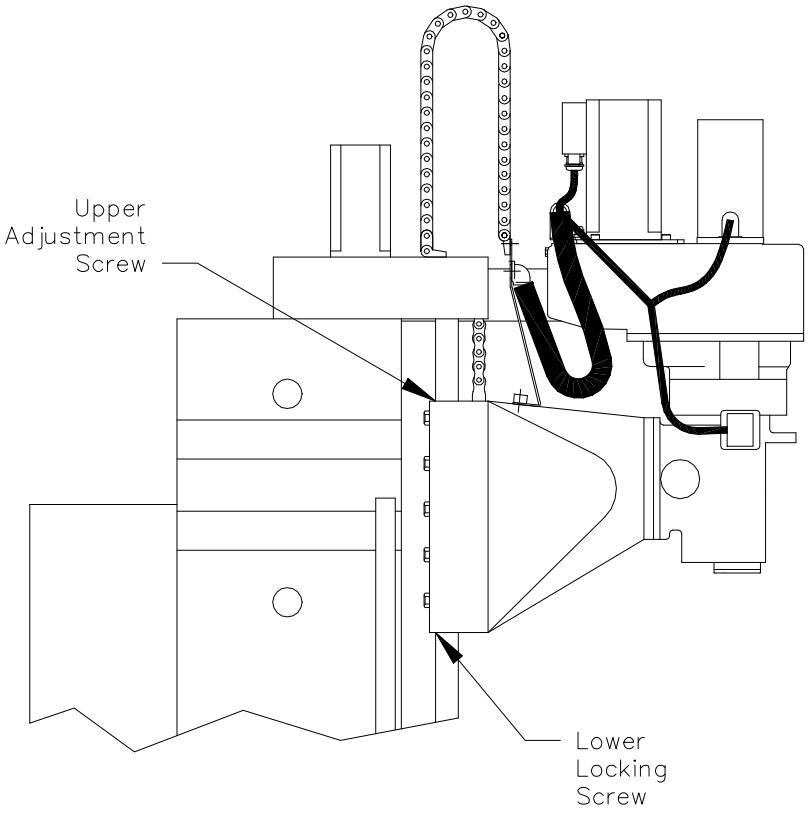
Check the Front to Back sweep it should be within .0005. If it is not, the Vertical gibs may need adjustment.

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.

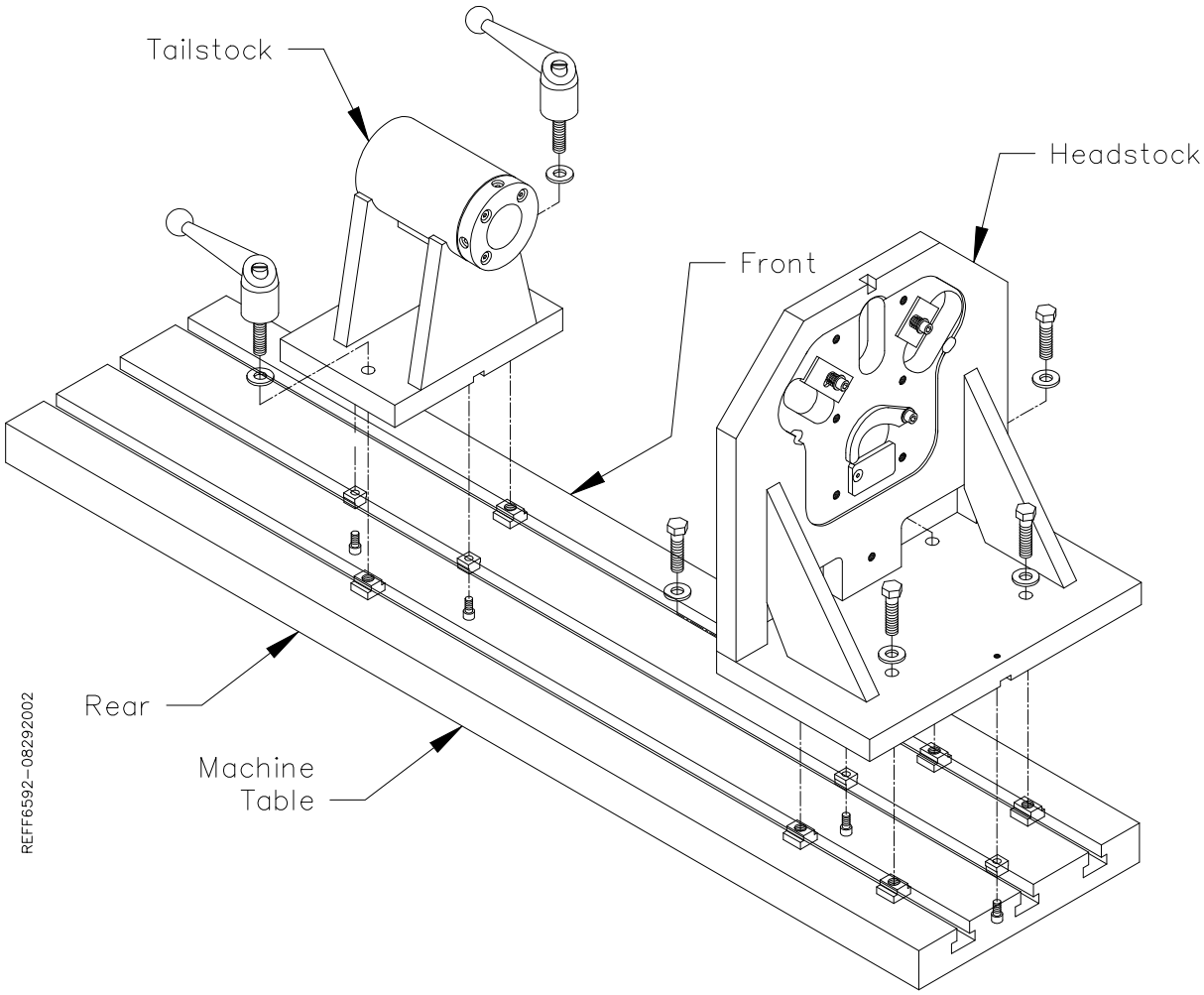
Loosening Gibs:
To loosen the gibs, loosen the top screw. Start tightening the lower screw until the correct alignment is achieved. When the correct alignment is achieved, tighten the upper screw to lock adjustment in place.

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.

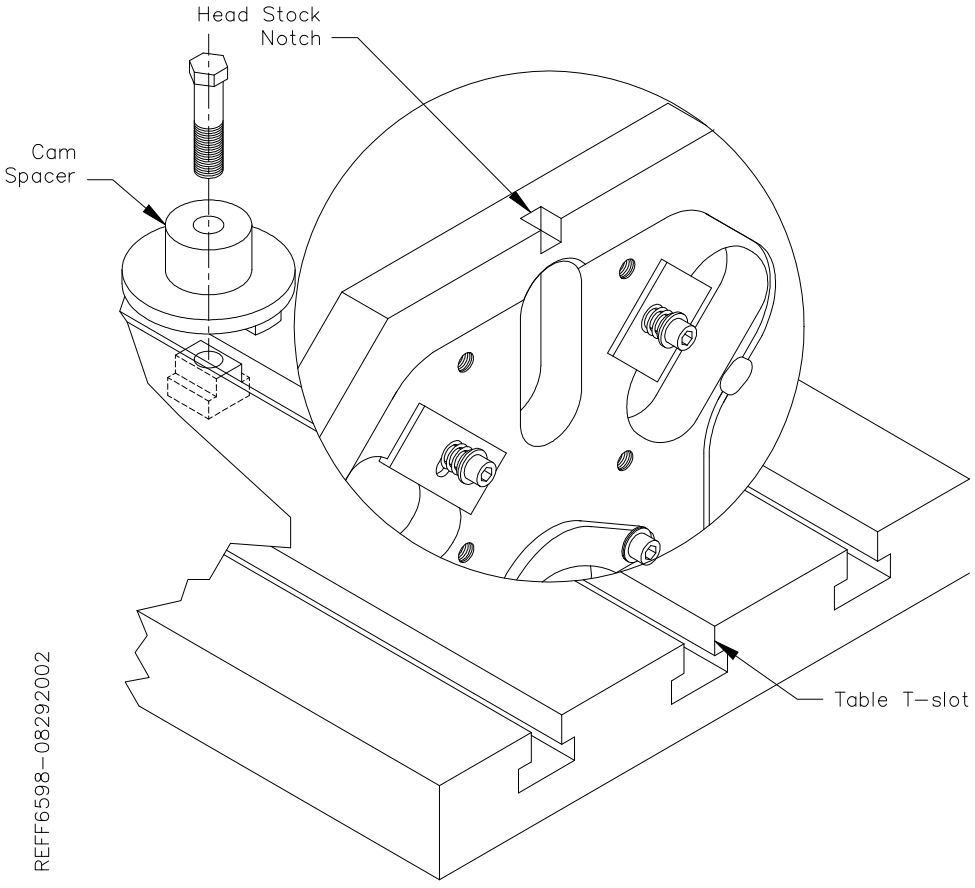
Performance Fixture Line-Up (Cam End Tunnel Boring):
Install the keys for the Head and Tail Stock into the machine bed as shown on previous page. Place the Head and Tail Stock onto the machine table. Install the hold down bolts but do not tighten them down.

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.

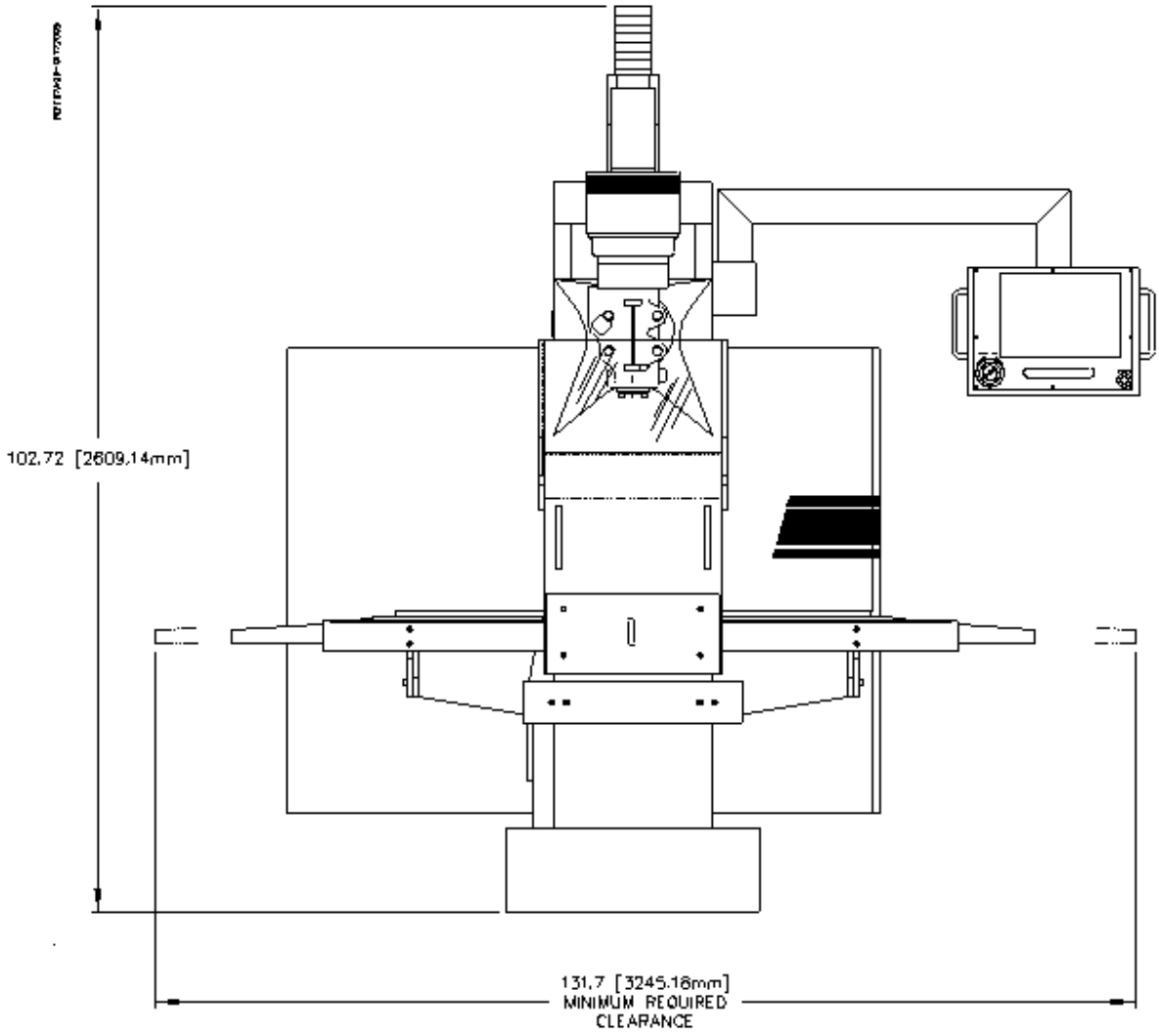
To install block info onto your machine:

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.

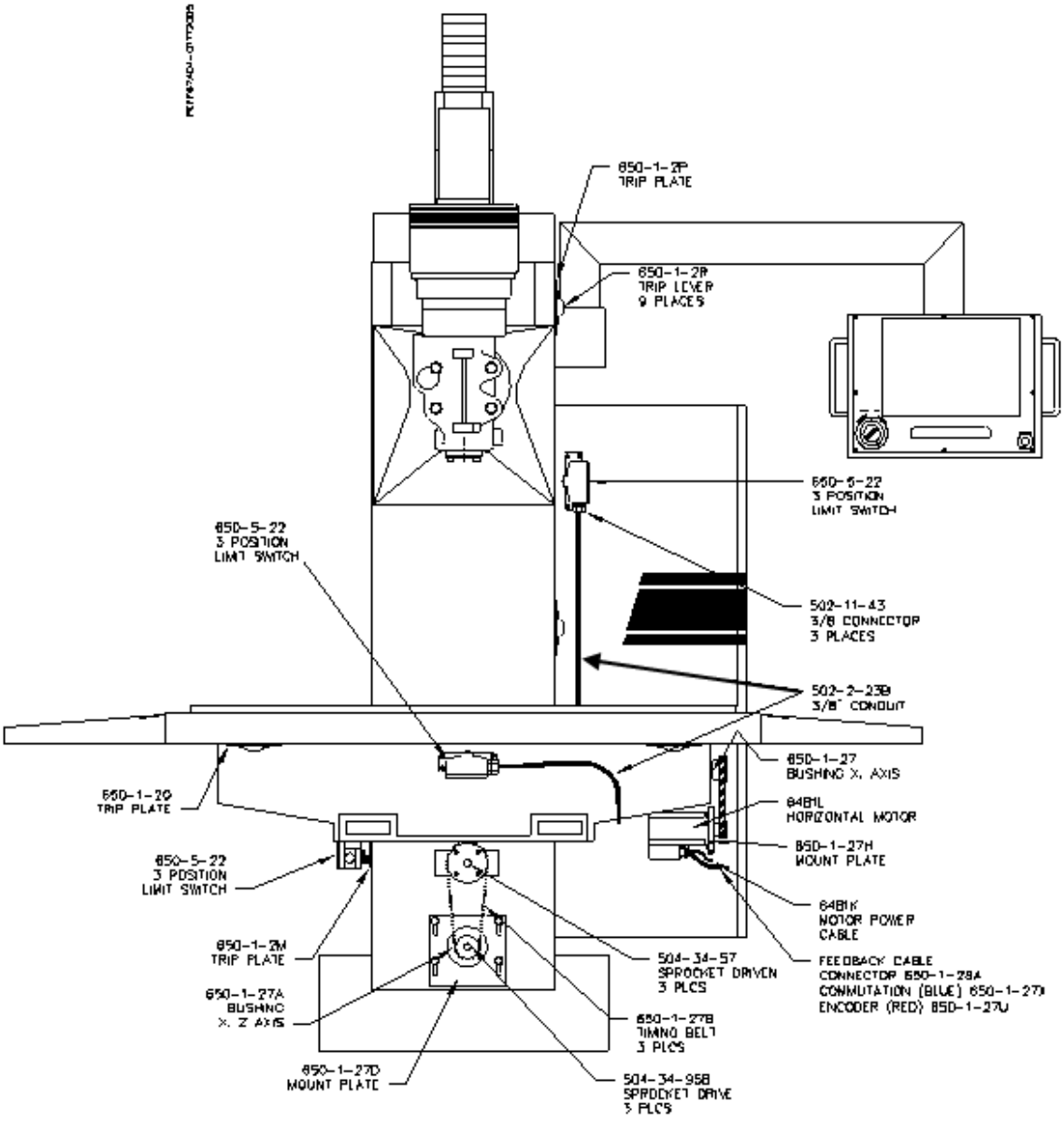
Chapter 5 Troubleshooting:

Chapter 6 Machine Parts:

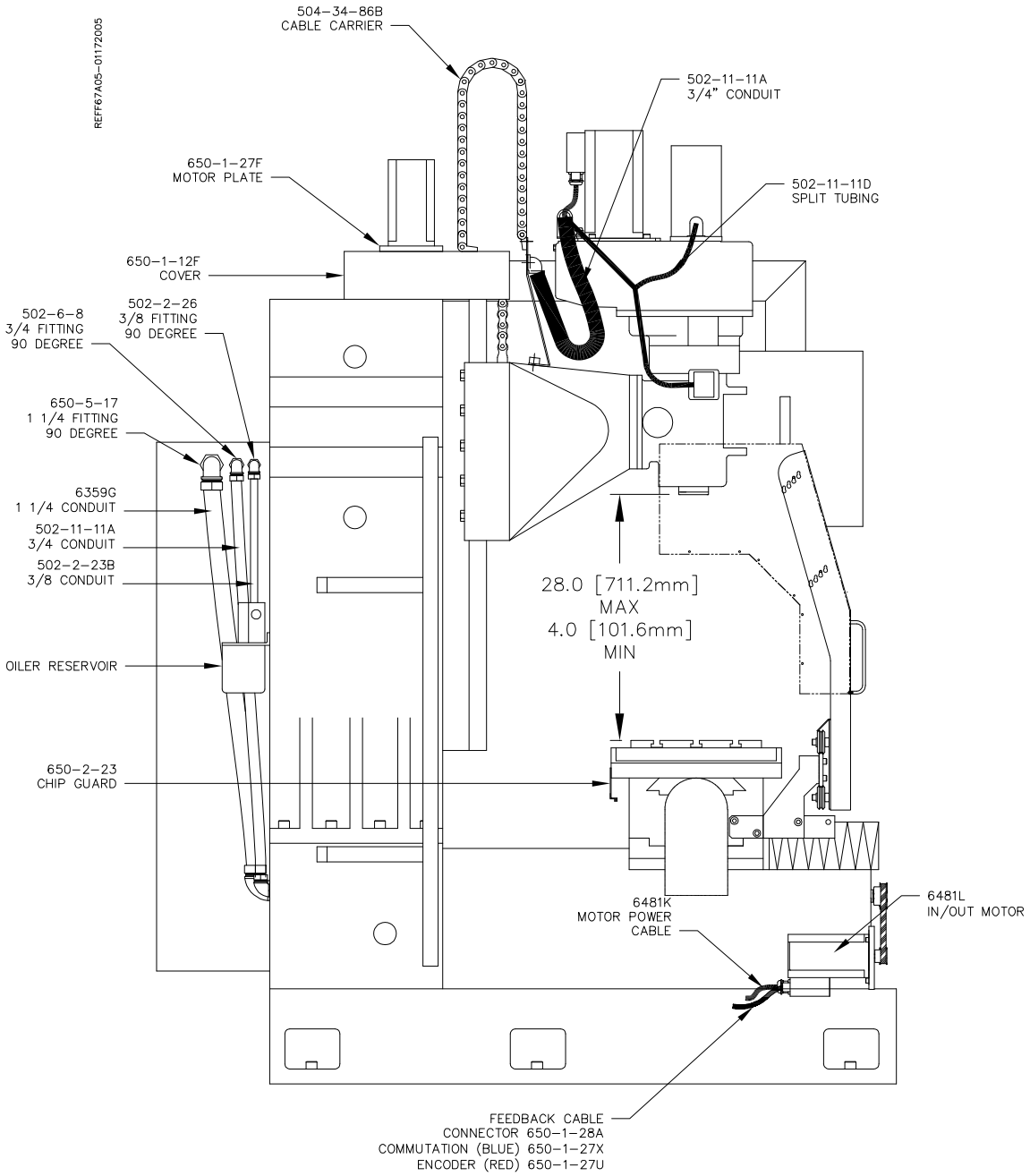
F68A Front View:



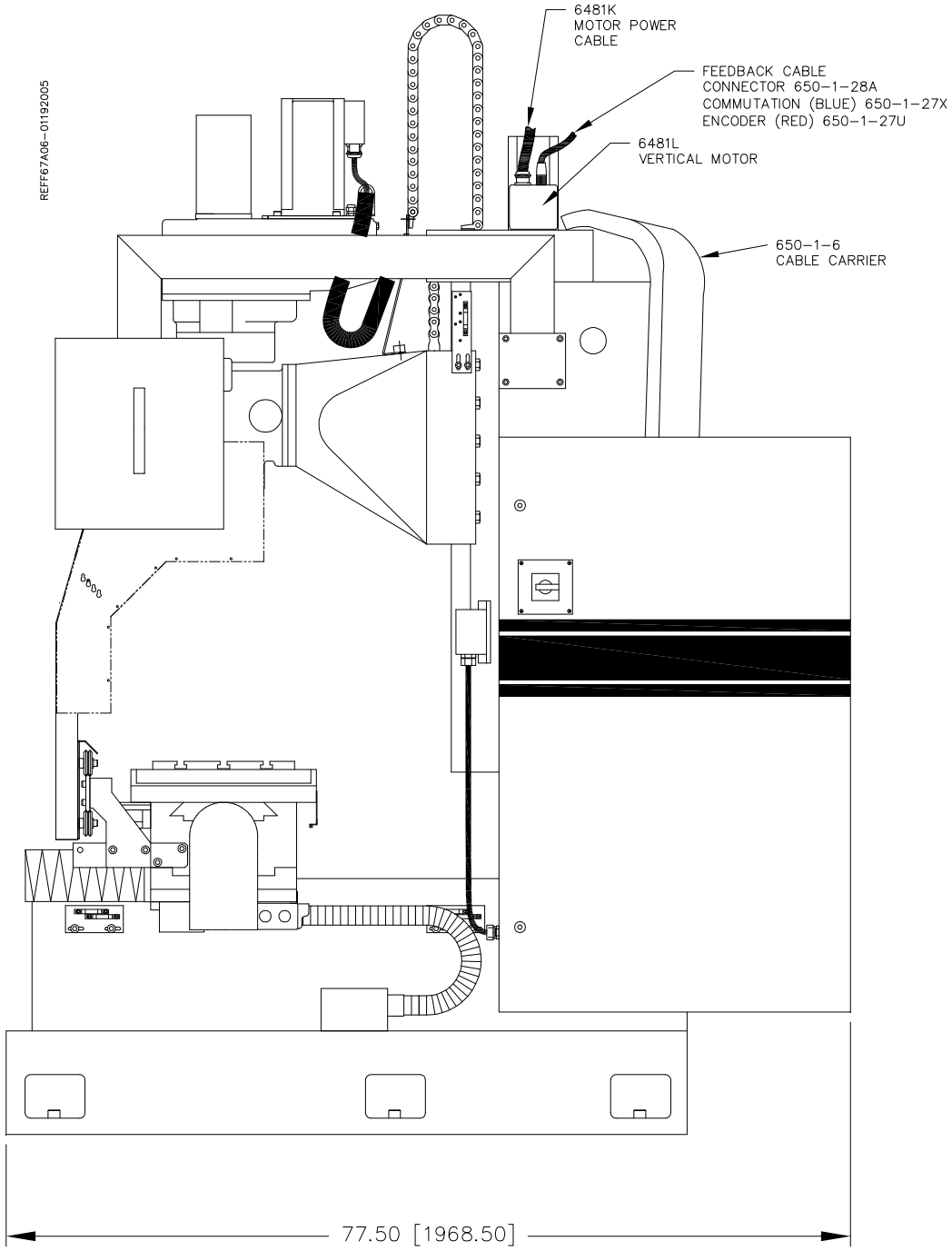
Drive Motors and Switches:



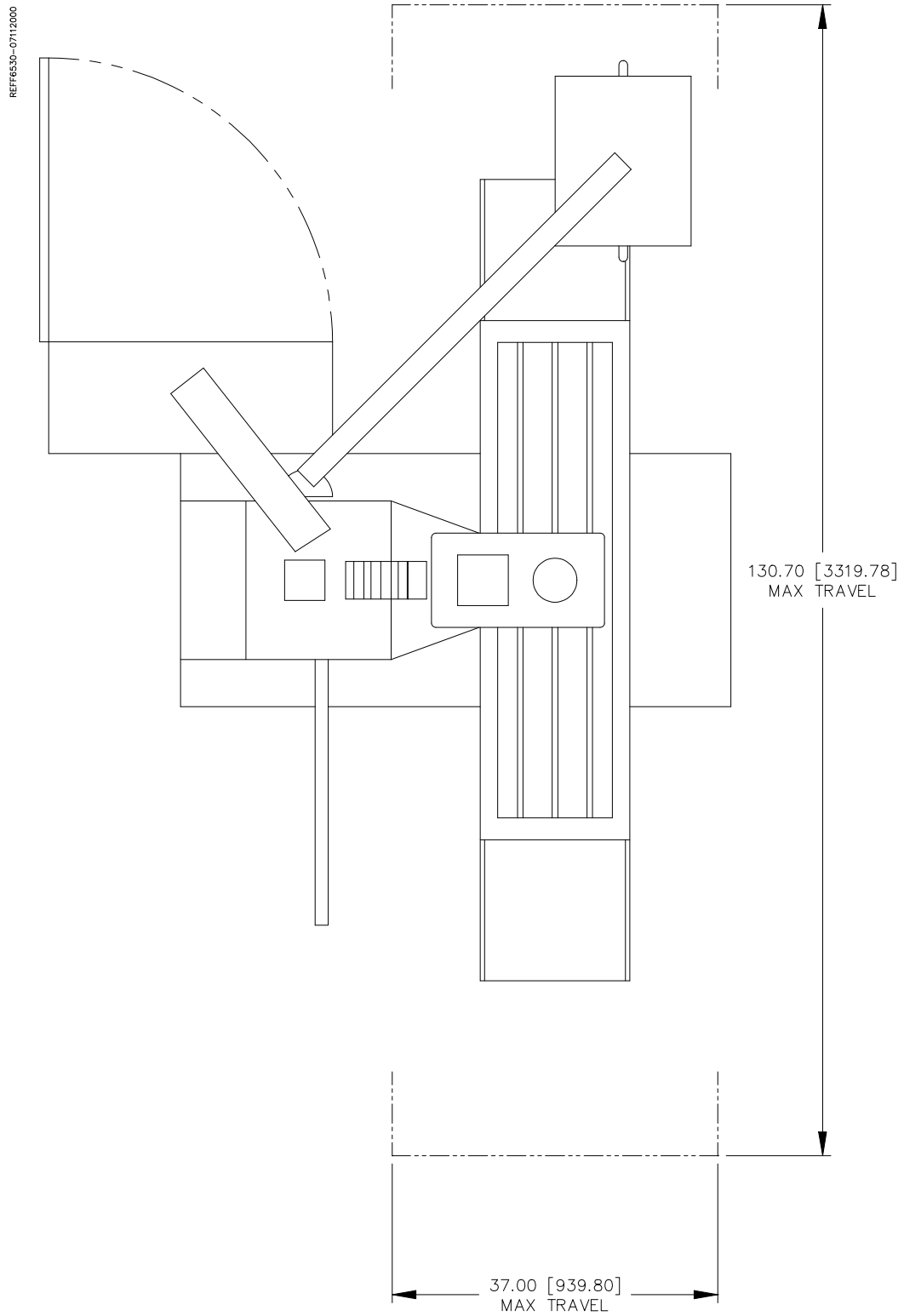
F68A left Side View:



F68A Right Side View:



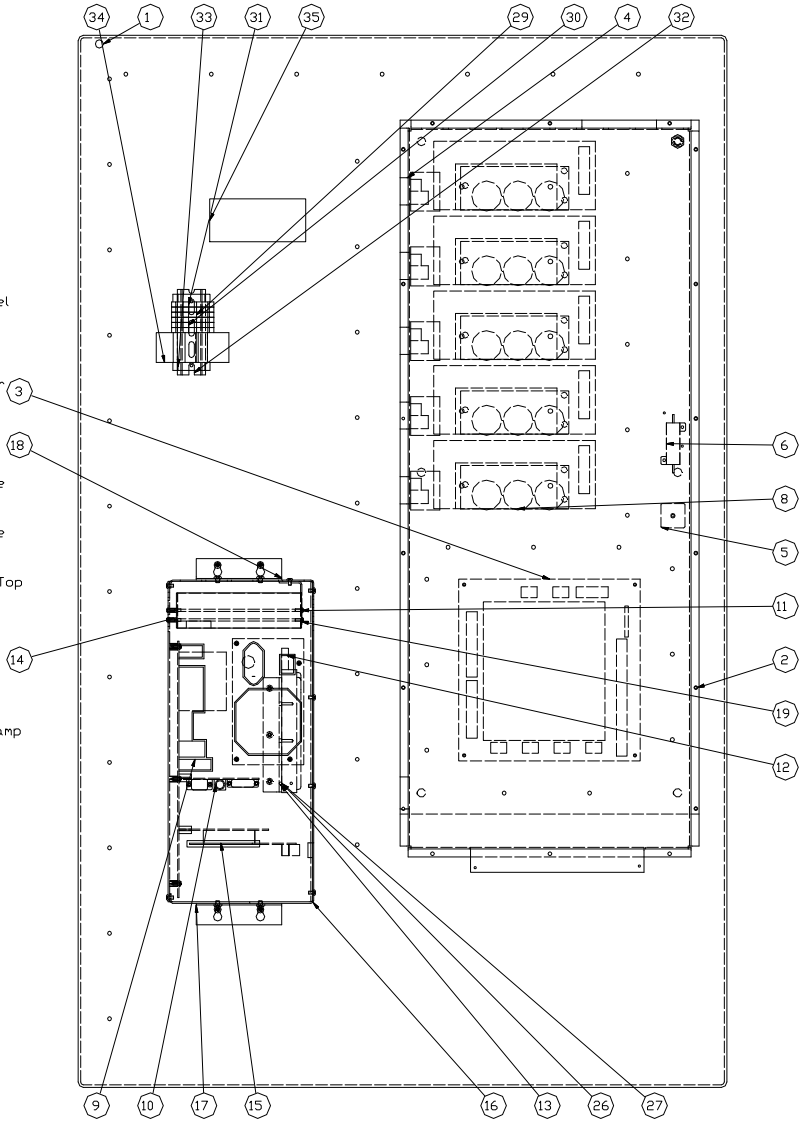
F68A Top View:



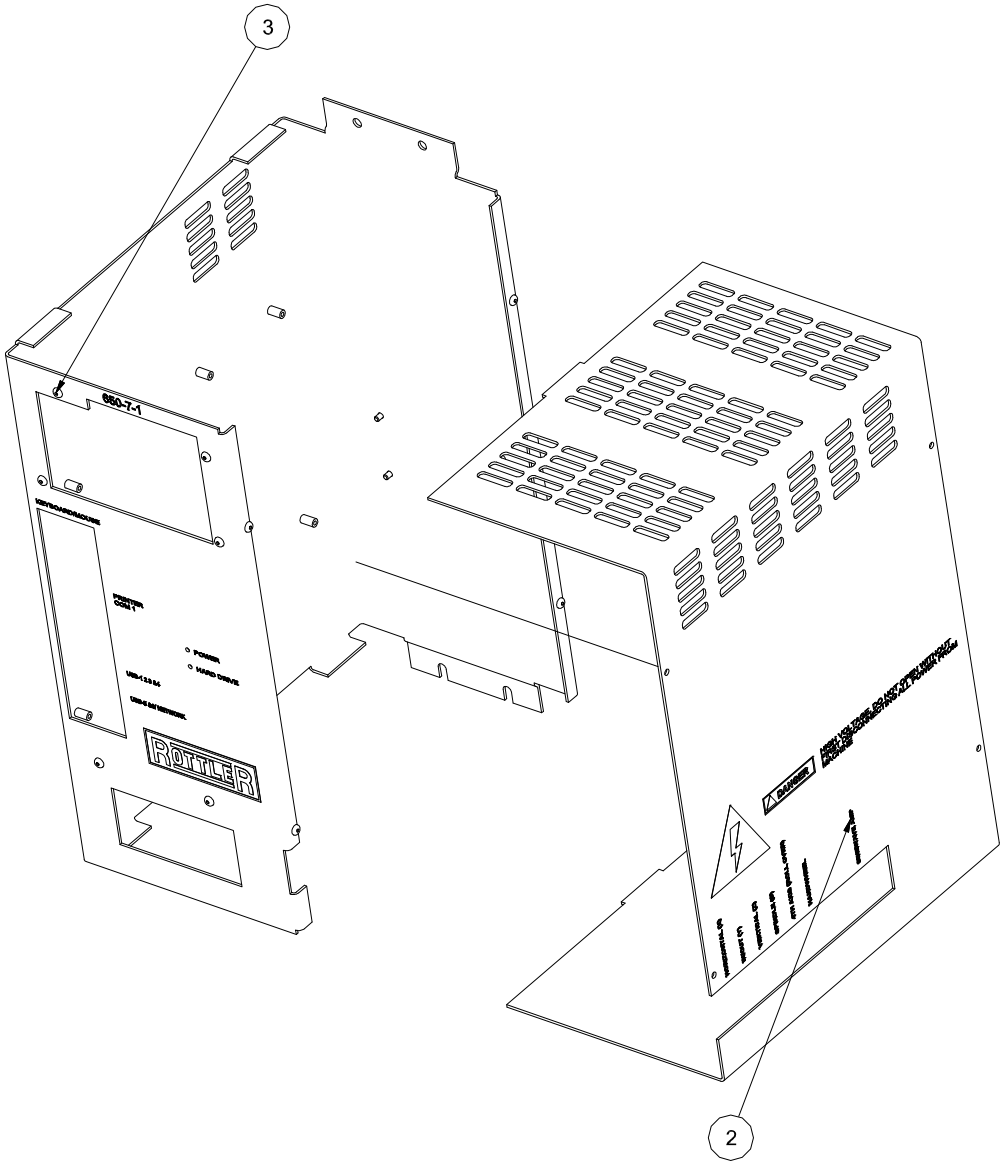
Electrical Panel:

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-1-1D	F67A Electrical Panel
2	1	650-1-27S	F67A Heat Sink
3	1	650-1-27P	Relay Board
4	1	650-1-27R	F67A Drive Cover
5	1	650-1-27Z	Bridge Rectifier
6	1	650-1-27Y	Soft Start Resistor
8	5	650-1-27N	Direct Motion Amp
9	1	650-1-28Z	ASUS Mother Board
10	1	650-1-28Y	Video Card
11	1	650-1-28U	CD ROM
12	1	650-1-28W	ATX Power Supply
13	1	650-1-28F	Case, Computer, Side
14	4	650-1-28E	M3-.5 x 10 Standoff
15	1	650-1-27Q	PCI Interface Card
16	1	650-1-28G	Case, Computer, Side
17	1	650-1-28D	Bracket, Mounting, Bottom
18	1	650-1-28C	Bracket, Mounting, Top
19	1	650-1-27W	Bracket, CD
26	1	650-1-28V	80.00 GB Hard Drive
27	1	650-1-28B	Bracket, Hard Drive
29	2	514-7-74C	Terminal Blue
30	2	514-7-74D	Terminal Grey
31	2	514-7-74E	Ground Block
32	1	504-35-3F	Din Rail
33	2	504-35-3M	End Cap
34	1	504-35-3Q	Circuit Breaker, 3 amp
35	1	Monitor PS	

REFF67A07-01192005



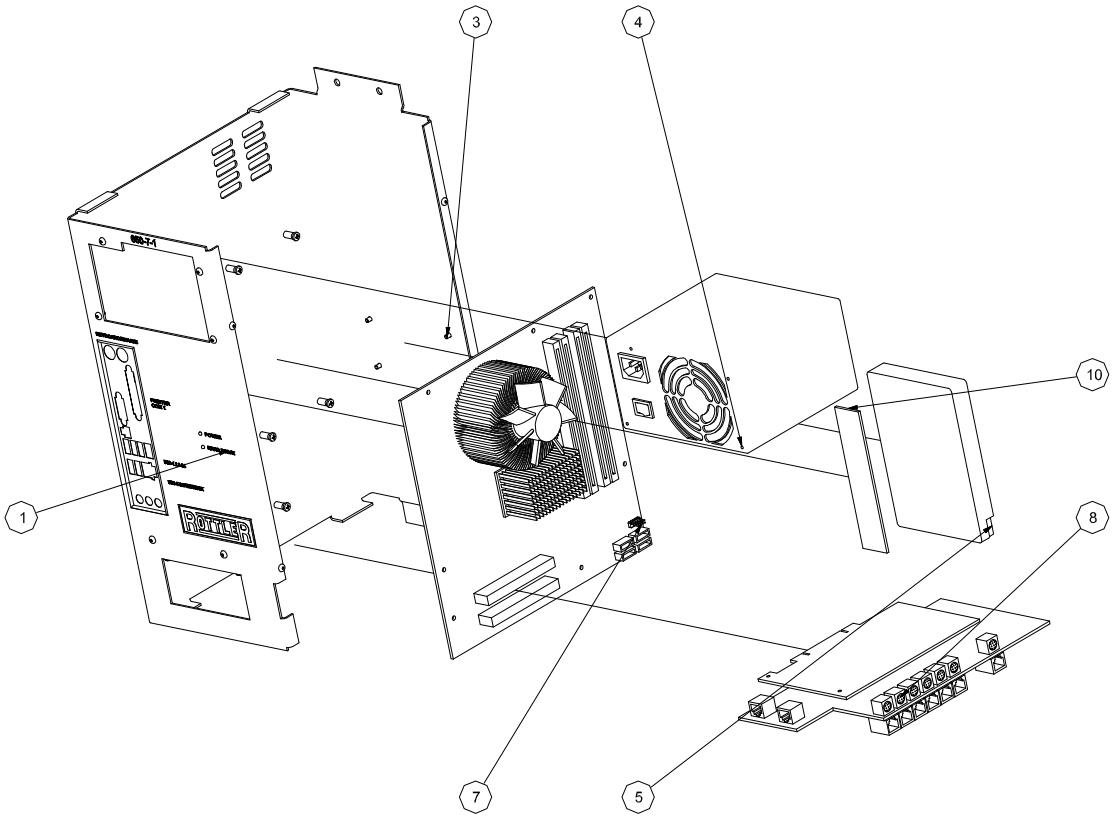
Computer Enclosure 650-1-27X:



REFF90Y19-02092007

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-1-27Y	Computer Case, Front
2	1	650-1-27Z	Case, Computer, Side

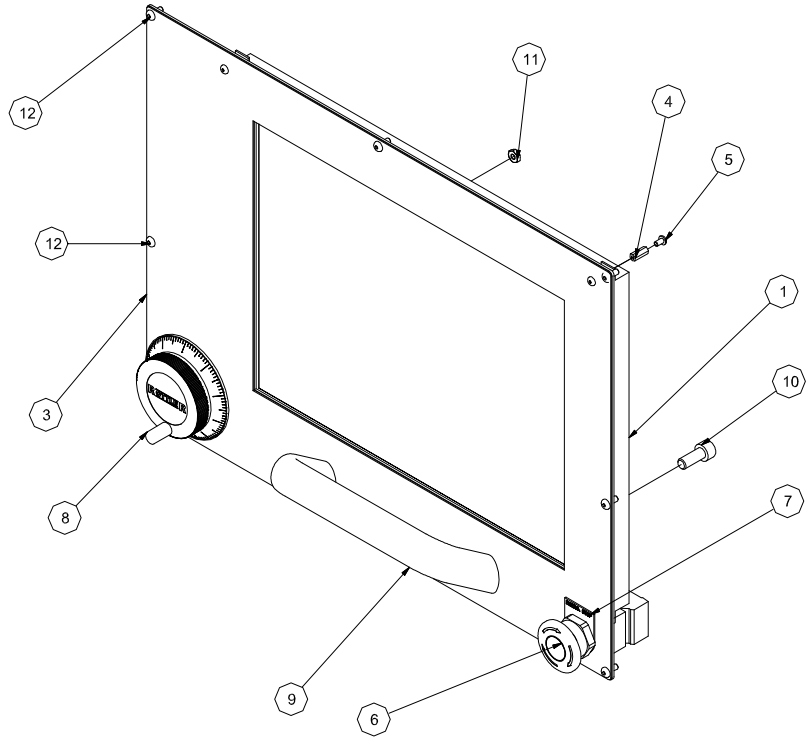
Computer 650-7-1:



REFF90Y-02092007

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-1-27Y	Computer Case, Front
2	1	650-1-27Z	Case, Computer, Side
4	1	650-7-1C	Power Supply
5	1	650-7-1F	Hard Drive
7	1	650-6-1A	Mother Board
8	1	650-1-27Q	PCI Card
9	2	650-1-29F	Bracket, PCI Card
10	1	650-7-1B	512 Mb DDR2 RAM

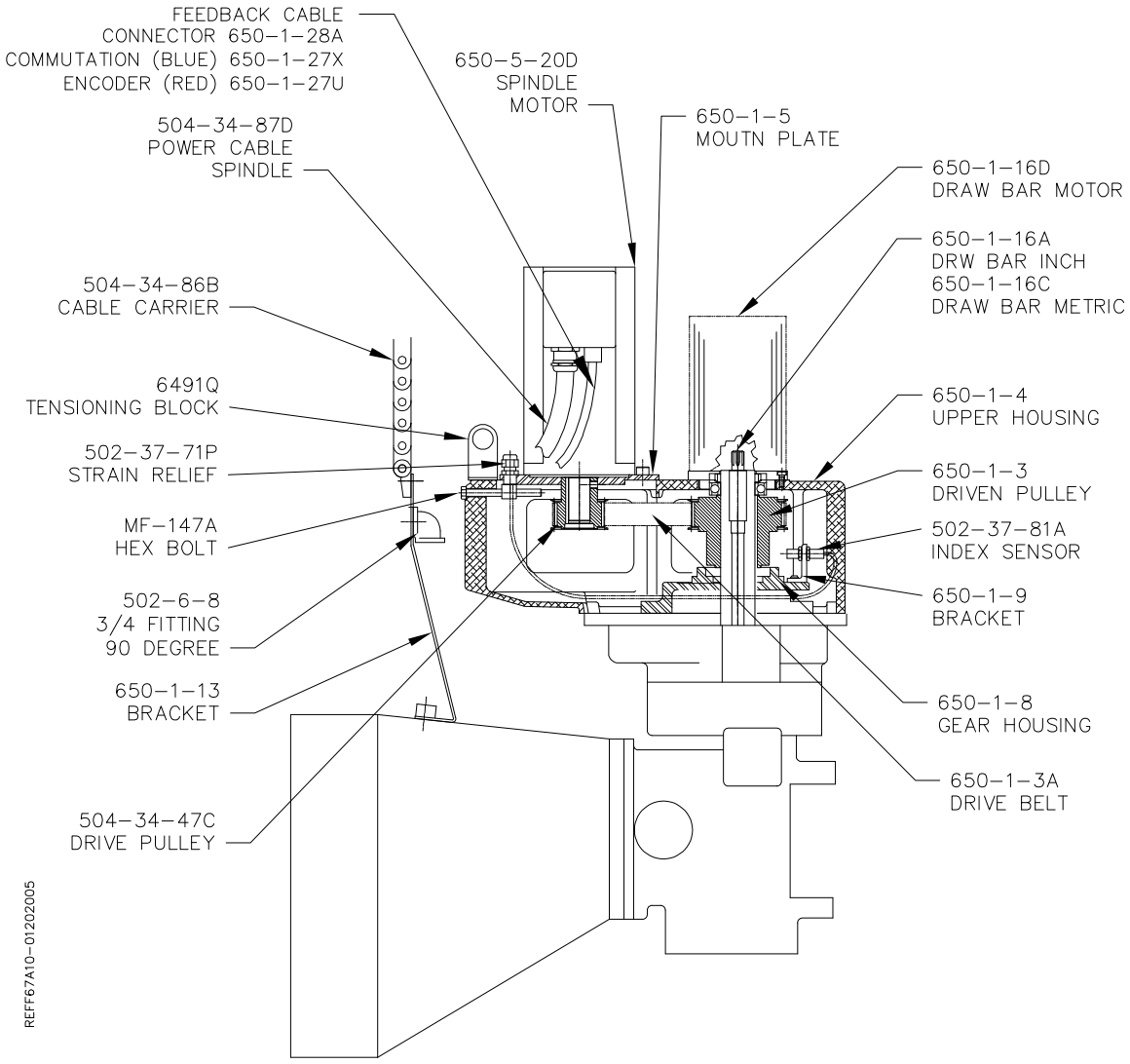
F68A Control Panel:



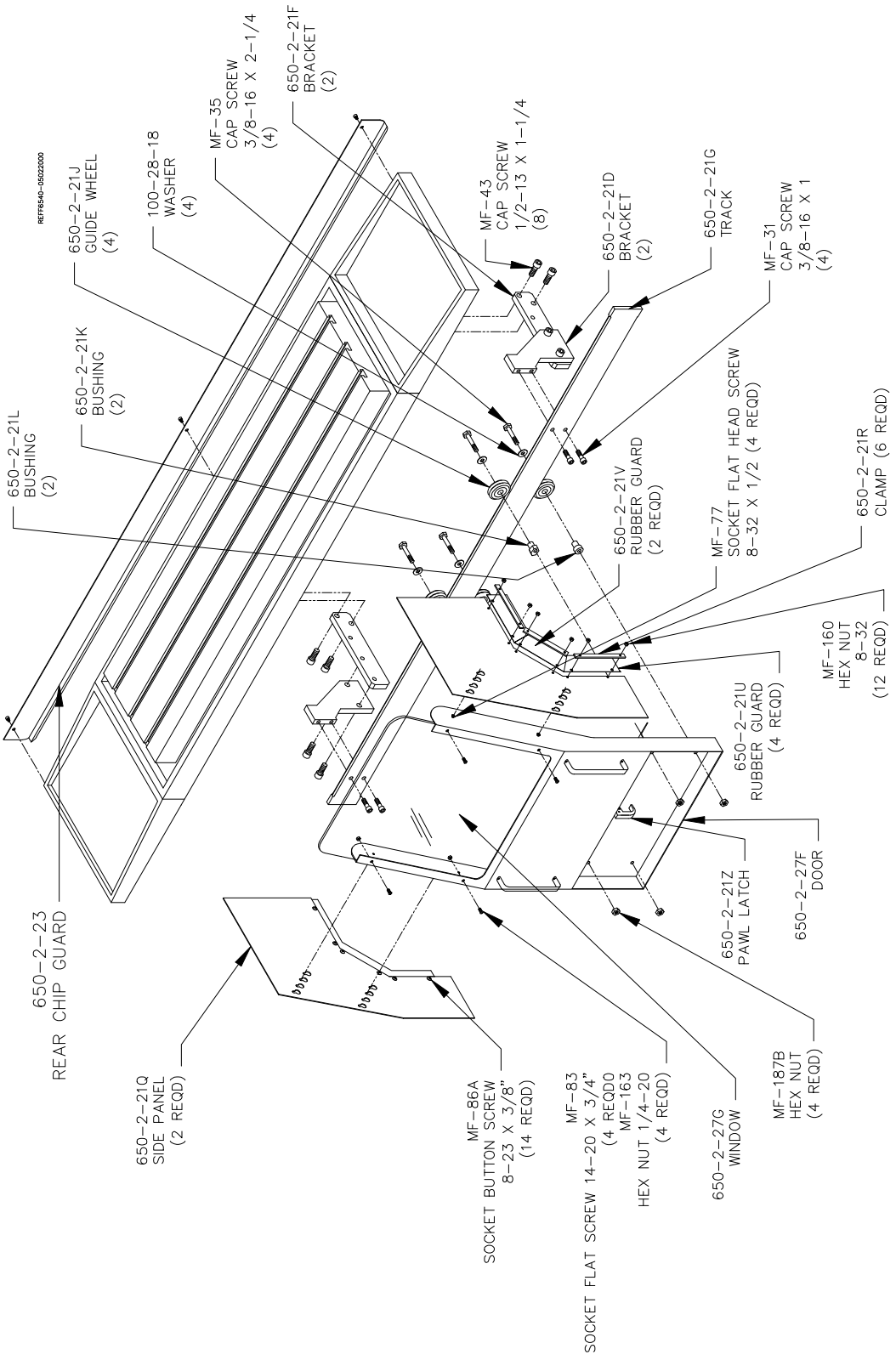
REFF68A10

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-1-28X	Touch Screen
2	1	650-1-27V	Face Plate
3	1	650-1-28T	Face Plate Overlay F67A
4	4	7178D	6-32 x .5" Threaded Standoff
5	8	ANSI B18.3 - No. 6-40 - 1/4	Hexagon Socket Button Head Cap Screw
6	1	6389D	E-Stop Button
7	1	6389B	E-Stop Nameplate
8	1	6428	Electronic Handwheel
9	1	650-1-2G	Handle, Pendant
10	2	ANSI B18.3.1M - M8x1.25 x 20	Forged Socket Head Cap Screw x Metric
11	3	ANSI B18.6.3 - 8 - 36	Hex Machine Screw Nut
12	8	ANSI B18.3.4M - M4 x 0.7 x 10	Forged Hexagon Socket Button Head Cap Screw - Metric

Upper Belt Housing:

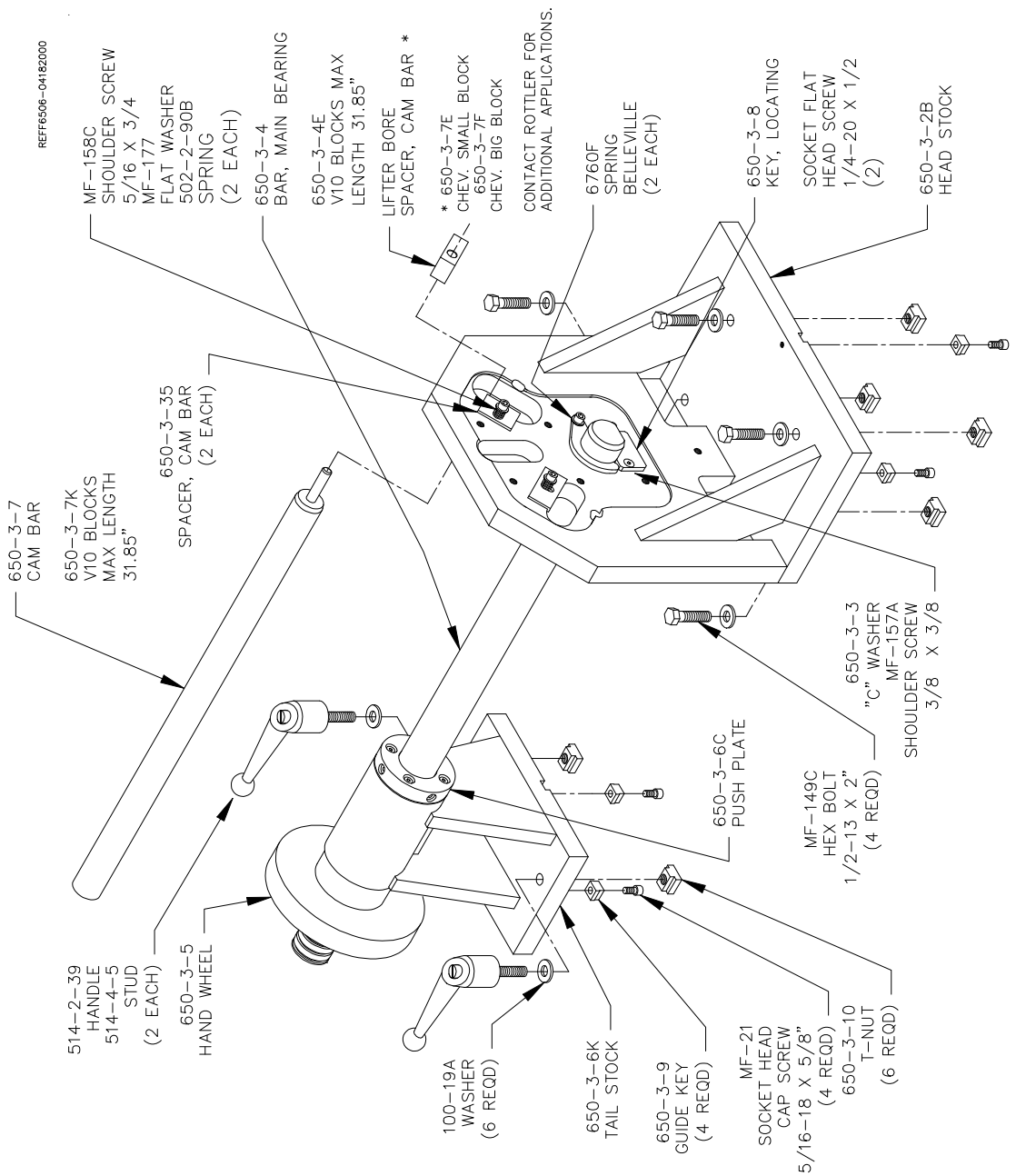


Chip Shield Assembly 650-2-27H:



Chapter 7 Options:

Performance Fixture 650-3-1:

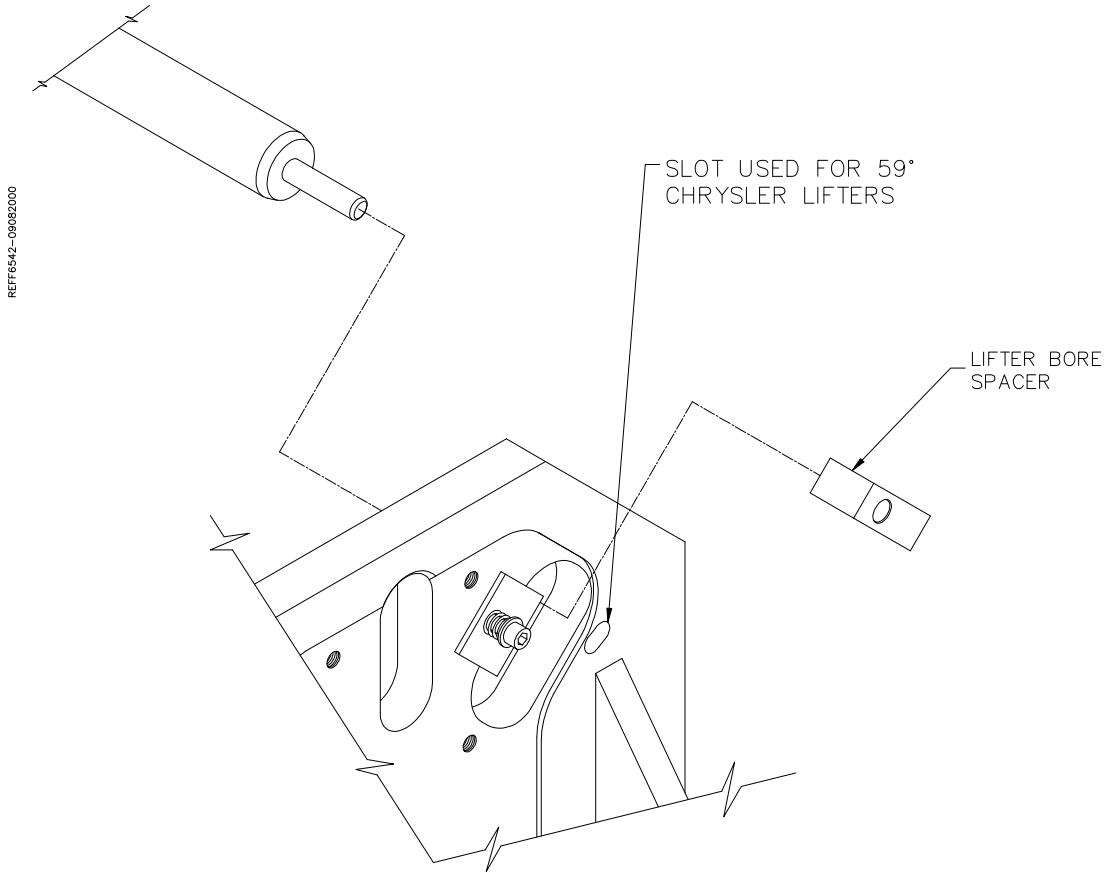


Lifter Bore Spacers:

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
650-3-7S	44-Degree Chevy Small Block
650-3-7T	48 Degree Chrysler Big Block

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
650-3-19V	7.3 IHC DIESEL V8 2.2305 / 2.2320	 650-3-14Z	 2.2295 DIA.	 2
650-3-19W	3.0 GM V6 1.9355 / 1.9375	 650-3-14Z	 1.9345 DIA.	 2
650-3-19X	2.400 / 2.401	 650-3-15F	 2.3990 DIA.	 2
650-3-19Y	CHEVY LSI 2.328 / 2.329	 650-3-15G	 2.3270 DIA.	 2
650-3-19Z	HOLDEN V8 2.0290 / 2.0310 1.7098 / 1.7118	 650-3-15H 650-3-15J	 2.0280 DIA. 1.7088 DIA.	 1 1
650-3-63	ALL CAM BORES 2.148 / 2.150	 650-3-15K	 2.1480 DIA.	 2
650-3-63A	ALL CAM BORES 1.9155 / 1.9170	 650-3-15L	 1.9155 DIA	 2
650-3-63B	ALL CAM BORES 2.3630 / 2.3650	 650-3-15M	 2.3630 DIA	 2
650-3-63C	ALL CAM BORES 2.0400 / 2.0415	 650-3-15N	 2.0390 DIA	 2
650-3-63D	ALL CAM BORES 2.3000 / 2..3020	 650-3-15P	 2.2990 DIA	 2
650-3-63E	ALL CAM BORES 2.3500 / 2.3515	 650-3-15Q	 2.490 DIA	 2
650-3-63F	ALL CAM BORES 2.0600 / 2.0615	 650-3-15R	 2.0590 DIA	 2
650-3-63G	ALL CAM BORES 2.0450	 650-3-15S	 2.0440 DIA	 2
650-3-63H	ALL CAM BORES #1 – 1.9150 #2 – 1.7935	 650-3-15T 650-3-15U	 1.9140 DIA. 2.7935 DIA	 1 1
650-3-63J	ALL CAM BORES 2.1580 / 2.1585	 650-3-15V	 2.1570 DIA	 2
650-3-63K	ALL CAM BORES 2.3161 / 2.3181			 2
650-3-63L	ALL CAM BORES 2.3455 / 2.3460	 650-3-15X	 2.345 DIA	 2

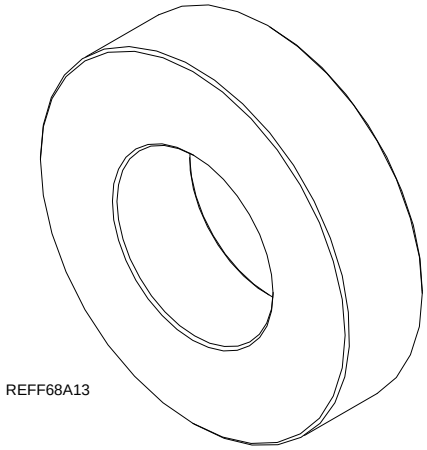
Main Bearing Locators:

Selection List:
Note: Each locator covers two bearing diameters. The unused diameter MUST be placed INSIDE the block to prevent interference with the Index Plates>

502-1-47A	Locator, Main Bearing Chev V8 (350) Chev V6 (4.3L) (2.6391" [67.033mm]) Chev V8 (400Sb) Chev V6 (3.4L) (2.8390" [72.111mm])
502-1-47B	Locator, Main Bearing Chev, V8 (396/400Bb/454) (2.9365" [74.587mm]) Buick V6 (231 Cu. In.) (2.6855" [68.212mm])
502-1-47C	Locator, Main Bearing Buick/Olds/Pontiac V8 (350/389/400) (3.1866" [80.940mm]) Buick/Pontiac V8 (421/428/455) (3.4365" [87.287mm])

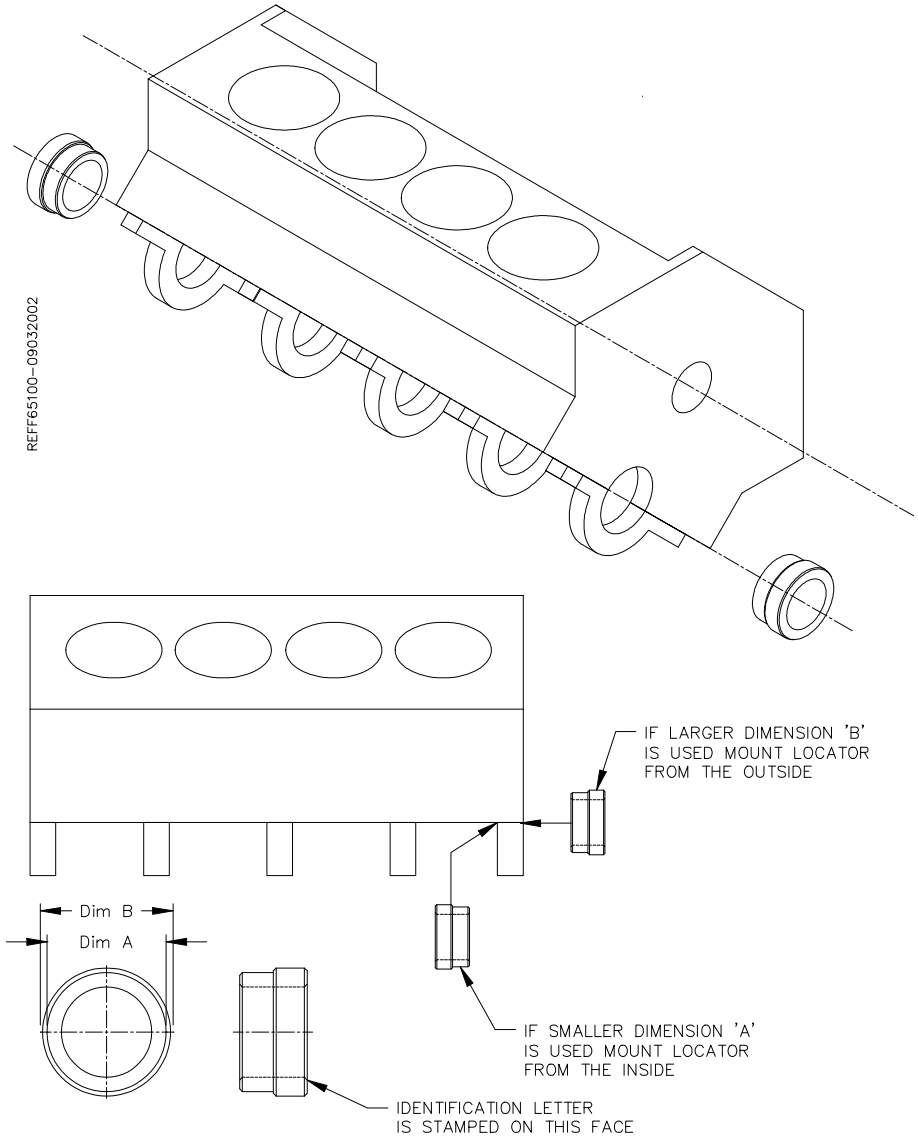
502-1-47D	Locator, main bearing Ford V8 (351C) (2.9402" [74681mm]) Ford V8 (351W/429/460) (3.1907" [81.044mm])
502-1-47E	Locator, main bearing Ford V8 (289/302) (2.4397" [61.968mm]) Mopar V8 (360) (3.0010" [76.225mm])
502-1-47F	Locator, main bearing Mopar V8 (318/340) (2.6910" [68.351mm]) Mopar V8 (426/440) (2.9410" [74.701mm])
502-1-47G	Locator, main bearing Chev V8 (283/327 early) (2.4892" [63.226mm]) Chev V8 (5.3L 1999 & newer) (2.7490" [69.825mm]) Chev LS-1 (2.7495" [69.825mm])
502-1-47H	Locator, main bearing with brass tipped set screws (3.3137 diameter) special application
502-1-47J	Locator, main bearing 928 Porsche V8 5L block (2.953" [75.260mm])
502-1-47K	Locator, main bearing GM 6.5L/395 cu. in. diesel application (3.1420" [79.807mm])
502-1-47L	Locator, main bearing Ford 4.6 (2.8491") Ford ZETGC (2.4528" [62.301mm])
502-1-47M	Locator, main bearing Honda 1.8 (2.3216") Mitsubishi 2.0 (2.4002" [60.965mm])
502-1-47N	Locator, main bearing AMC-Chrysler (2.9396" [74.666mm])
502-1-47P	Locator, main bearing 7.3 IHC Diesel V8 (3.315/3.316" [84.201/84.226mm]) 3.0 Toyota V6 (2.677/2.678" [67.996/68.021mm])
502-1-47Q	Locator, main bearing Holden V8 (2.5906/2.5916" 65.801/65.827mm])
502-1-47R	Locator, main bearing 2.5 liter Subaru (2.5185/2.5195" [63.970/63996mm]) 2.2 liter Honda (2.1250/2.1260" [53.975/54.00mm])
502-1-47S	Locator, main bearing (2.719/2.720" [69.063/69.088mm])
502-1-47T	Locator, main bearing (2.491/2.492" [63.271/63.297mm])
502-1-47U	Locator, main bearing (2.8175/2.8180" [71.565/71.577mm])
502-1-47V	Locator, main bearing (3.3854/3.3862" [85.989/86.009mm])
502-1-47W	Locator, main bearing (2.6601/2.6606" [67.567/67.579mm])
502-1-47X	Locator, main bearing (2.6635" [67.653mm])
502-1-47Y	Locator, main bearing (2.5184") [63.967mm]
502-1-47Z	Locator, main bearing (2.6228") [66.619mm)
502-1-48A	Locator, main bearing (2.3615") [59.982mm]
502-1-48B	Locator, Main Bearing (2.3196/2.5409") [58.918/64.539mm]
502-1-48C	Locator, Main Bearing (2.3191") [58.905mm]
502-1-48D	Locator, Main Bearing (2.5044" [63.612mm]
502-1-48E	Locator, Main Bearing (2.2347" [56.761mm]
502-1-48F	Locator, Main Bearing (2.8330" [71.958mm]
502-1-48G	Locator, Main Bearing (2.9995" / 2.7556") [76.073 / 69.992mm]
502-1-48H	Locator, Main Bearing (2.7520') [69.901mm] Chrysler Hemi 5.7 & 6.1
502-1-48J	Locator, Main Bearing (2.6690") [67.79mm]
502-1-48K	Locator, Main Bearing with 3.13 shoulder (2.9405") [74.689mm]

Spacer Set for Honda, Subaru and Mitsubishi Blocks 650-3-4F:

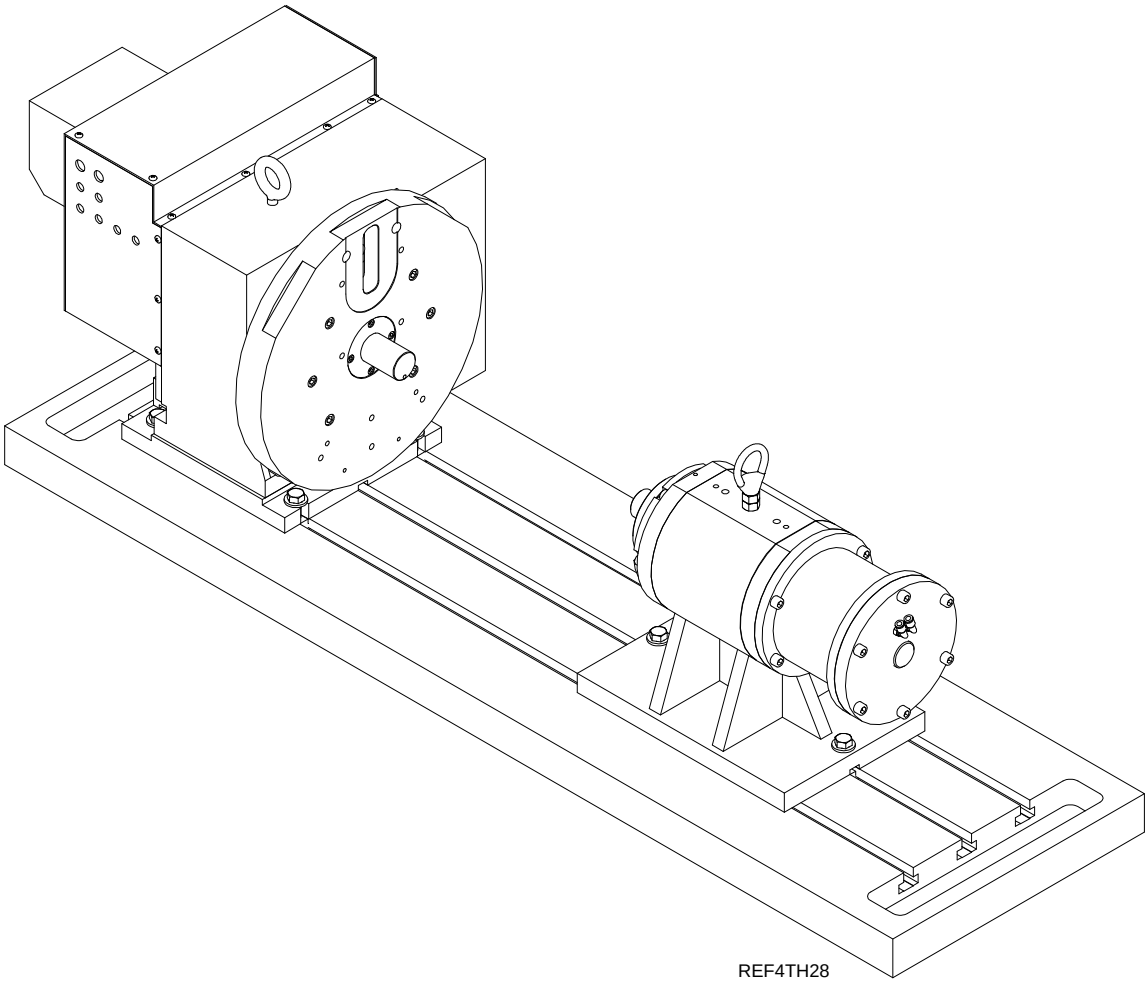


REFF68A13

Main Bearing Locator Installation

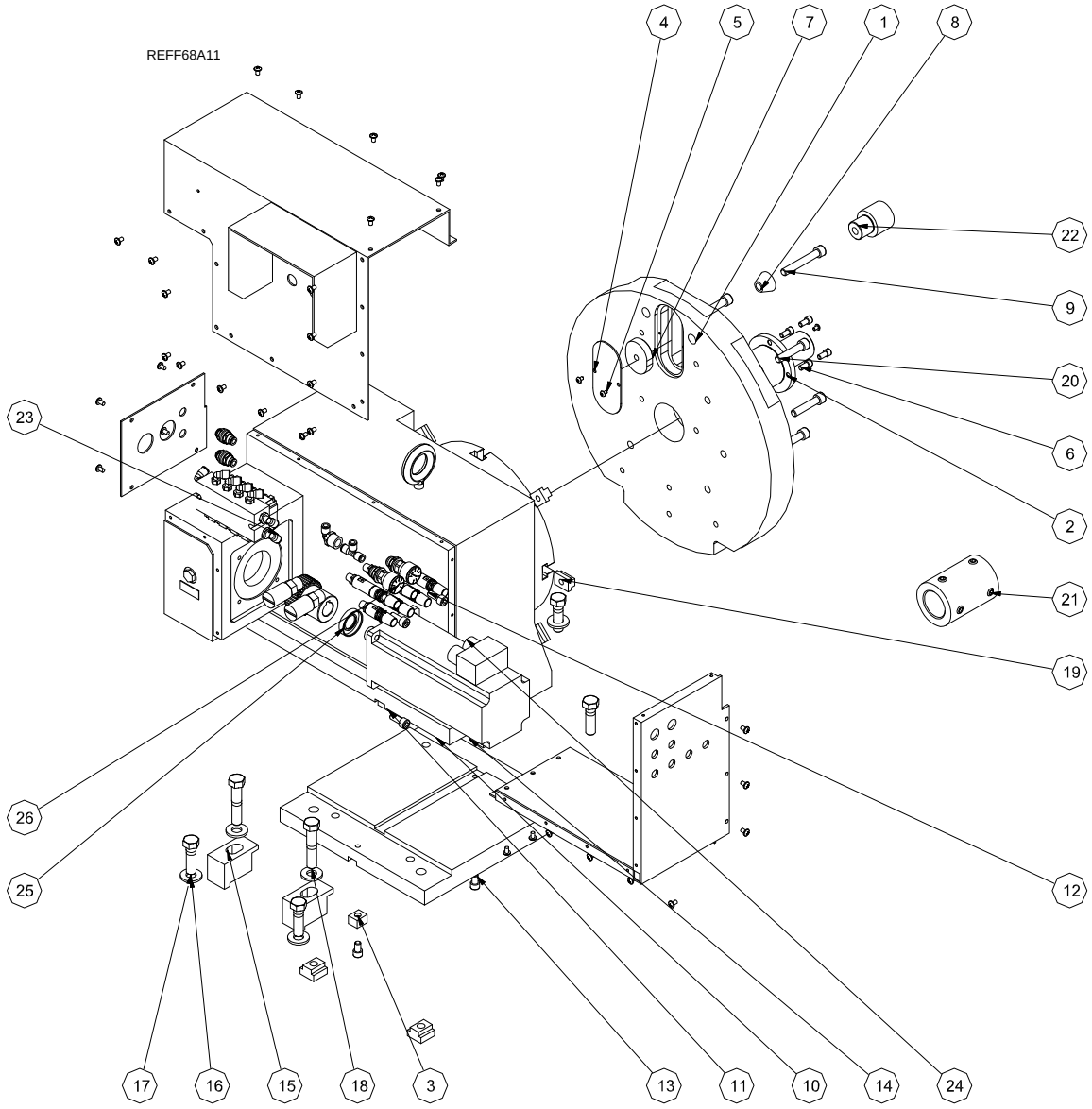


Automatic 4th Axis Block Roll Over Fixture 650-3-59:



REF4TH28

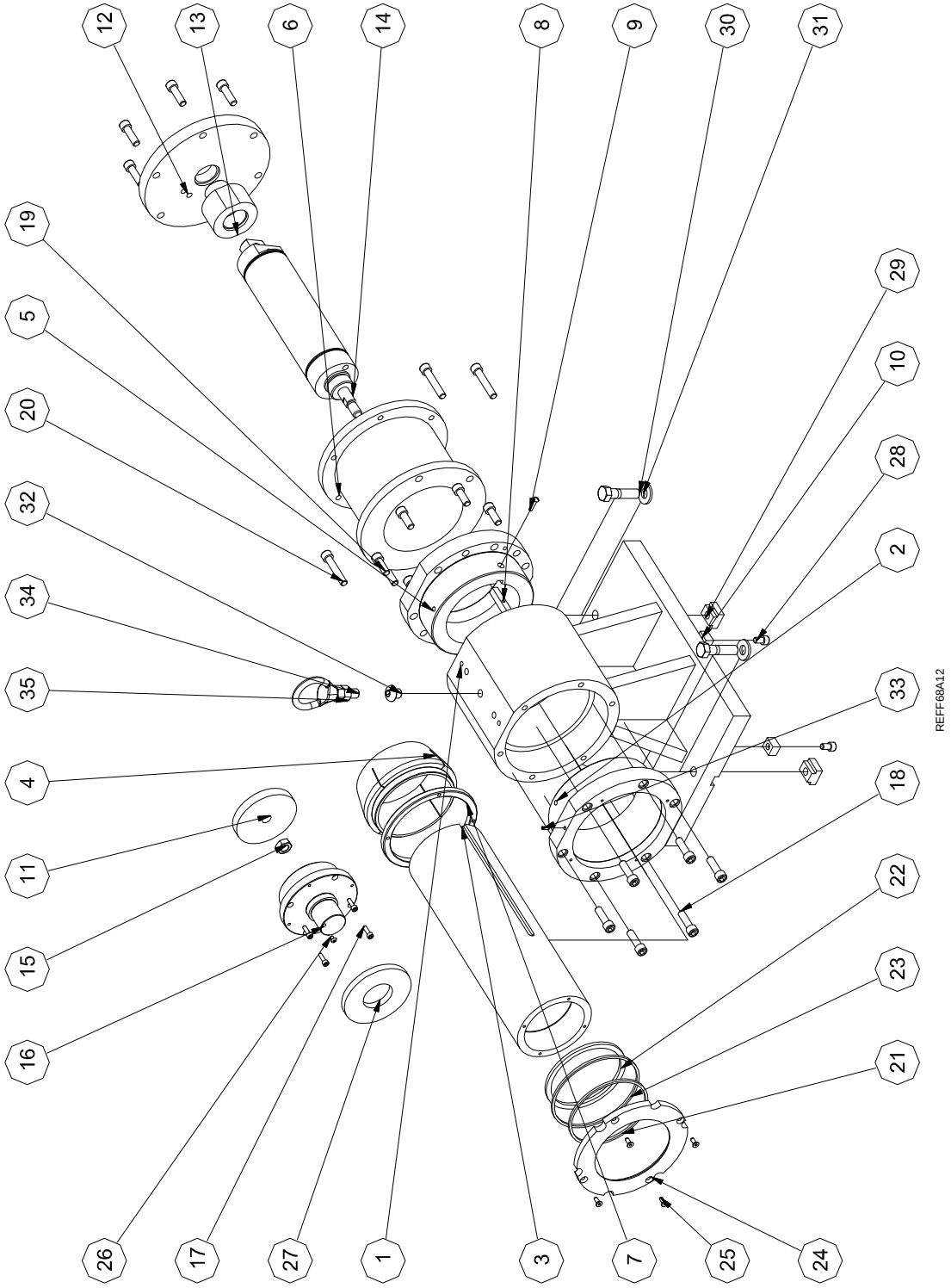
4th Axis Headstock:



4th Axis Headstock (cont):

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-62B	FACEPLATE - AUTO PERFORMANCE FIXTURE
2	1	650-3-62H	PINION, FACEPLATE - AUTO PERFORMANCE FIXTURE
3	2	650-3-9	Key
4	1	650-3-62G	COVER, CAM LOCATOR NUT - AUTO PERFORMANCE FIXTURE
5	3	Mf-86	Socket Button Head Cap Screw8 - 32 x 1/4
6	4	Mf-12	Socket Head Cap screw 1/4 - 20 UNC - 1/2
7	1	650-3-62V	NUT, EXPANDING CAM LOCATOR - AUTO PERFORMANCE FIXTURE
8	1	650-3-70D	CONE WASHER, EXPANDING CAM LOCATOR - AUTO PERFORMANCE FIXTURE
9	1	Mf-36	Socket Head Cap screw 3/8 - 16 UNC - 2 1/2
10	1	650-3-62Q	RISER PLATE, INDEXER - AUTO PERFORMANCE FIXTURE
11	2	INDEXER KEY	
12	6	ANSI B18.3.1M - M8x1.25 x 20	Forged Socket Head Cap Screw x Metric
13	2	Mf-21A	Socket Head Cap screw 5/16 - 18 UNC - 1/2
14	4	650-3-10	TN-5 T-Nut
15	2	650-3-72	CLAMP, INDEXER - AUTO PERFORMANCE FIXTURE
16	8	100-19A	Hardened washer 17/32 I.D.
17	6	ANSI/ASME B18.2.1 - 1/2-13 UNC - 1.75	1/2-13 UNC X 1.75 HHMS
18	2	ANSI/ASME B18.2.1 - 1/2-13 UNC - 2.5	1/2-13 UNC X 2.5 HHMS
19	6	650-3-61P	T-NUT, FACEPLATE - AUTO PERF. FIXTURE
20	6	Mf-33A	Socket Head Cap screw 3/8 - 16 UNC - 1 3/4
21	1	650-3-61T	ALIGNMENT TUBE ASSEMBLY - AUTO PERFORMANCE FIXTURE
22	1	650-3-62D	CAM LOCATION SET-UP TOOL - AUTO PERFORMANCE FIXTURE
23	1	650-3-62S	Indexer
24	1	650-3-62T	Motor
25	1	650-3-61N	Oil Seal

4th Axis Tailstock:

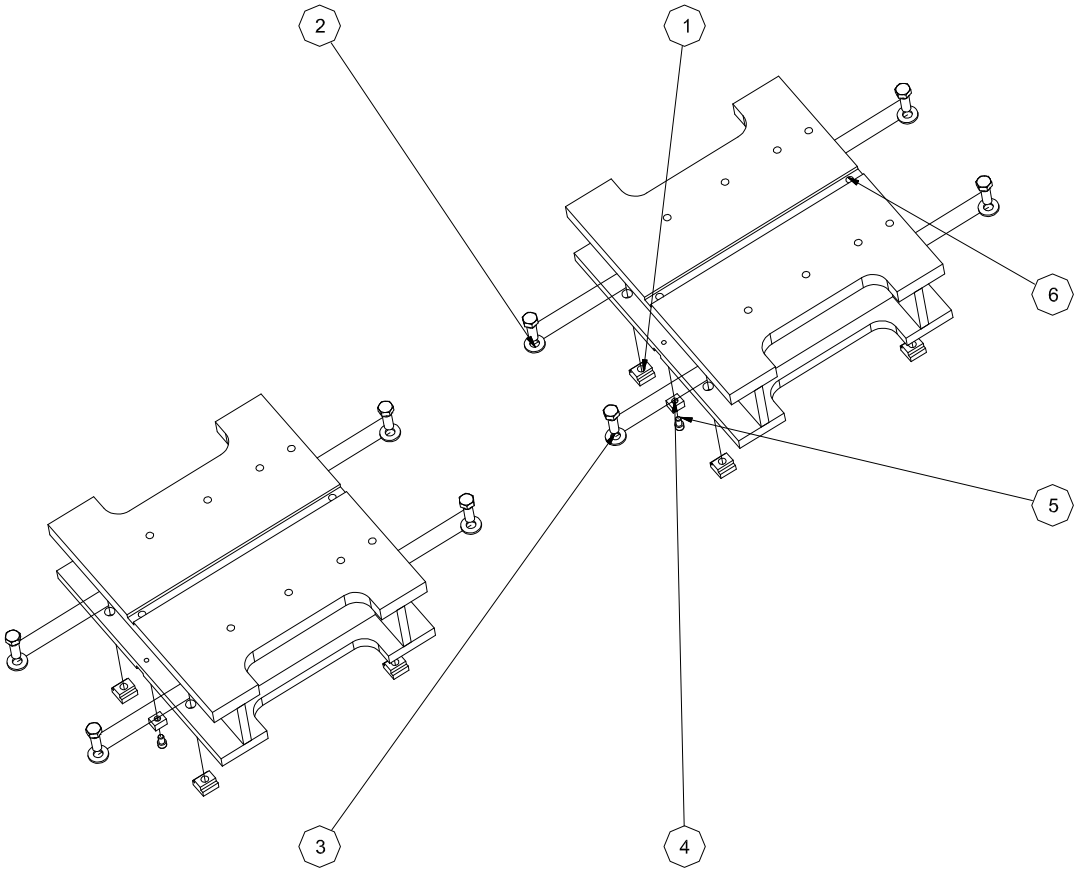


4th Axis Tailstock (cont):

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-61A	TAILSTOCK HOUSING, AUTO PERF. FIXTURE
2	1	6225A	Lower Bearing Carrier
3	1	650-3-61G	PISTON TUBE, TAILSTOCK - AUTO PERFORMANCE FIXTURE
4	1	6222A	Outer Spindle Bushing
5	1	650-3-61F	REAR BUSHING, TAILSTOCK - AUTO PERFORMANCE FIXTURE
6	1	650-3-61C	EXTENSION, TAIL STOCK - AUTO PERFORMANCE FIXTURE
7	1	6223	Outer Spindle Nut
8	1	6226	KEY, OUTER SPINDLE
9	1	ANSI B18.6.3 - 10 - 24 x 3/4	Slotted Round Head Machine Screw
10	2	650-3-9	Key
11	1	650-3-61J	NOSE PLATE, TAILSTOCK - AUTO PERFORMANCE FIXTURE
12	1	650-3-61L	ENDCAP, TAILSTOCK - AUTO PERFORMANCE FIXTURE
13	1	650-3-61M	SPACER, AIR CYLINDER, TAILSTOCK - AUTO PERFORMANCE FIXTURE
14	1	650-3-61E	STROKING CYLINDER, TAILSTOCK - AUTO PERFORMANCE FIXTURE
15	1	ANSI B18.2.2 - 1/2 - 20	Hex Jam Nut
16	1	650-3-61H	PISTON CAP, TAILSTOCK - AUTO PERFORMANCE FIXTURE
17	4	Mf-5	Socket Head Cap screw No. 10 - 24 UNC - 5/8
18	12	Mf-32	Socket Head Cap screw 3/8 - 16 UNC - 1 1/4
19	6	Mf-31	Socket Head Cap screw 3/8 - 16 UNC - 1
20	4	Mf-34	Socket Head Cap screw 3/8 - 16 UNC - 2
21	1	6248	Square Ring
22	1	6249	Felt Oiler
23	1	6251	Square Ring
24	1	6247A	Retainer
25	4	Mf-79	Hexagon Socket Flat Countersunk Head Cap Screw
26	1	Mf-86	Socket Button Head Cap Screw8 - 32 x 1/4
27	1	650-3-61K	CUSHION, TAILSTOCK - AUTO PERFORMANCE FIXTURE
28	2	Mf-21A	Socket Head Cap screw 5/16 - 18 UNC - 1/2
29	2	650-3-10	TN-5 T-Nut
30	2	ANSI/ASME B18.2.1 - 1/2-13 UNC - 2	1/2-13 UNC X 2 HHMS
31	2	100-19A	Hardened washer 17/32 I.D.
32	1	ANSI B18.3 - 1/2 - 13 x 5/8	Socket Button Head Cap Screw1/2 - 13 x 5/8
33	1	100-82-2B	
34	1	502-3-13	Lift Eye
35	2	ANSI B18.2.2 - 1/2 - 13	Hex Nut
36	1	ASME B18.21.1 - No. 10 Regular. Carbon Steel	Helical Spring Lock Washer

F68A12

5” Riser for 4th Axis Head and tail Stock:

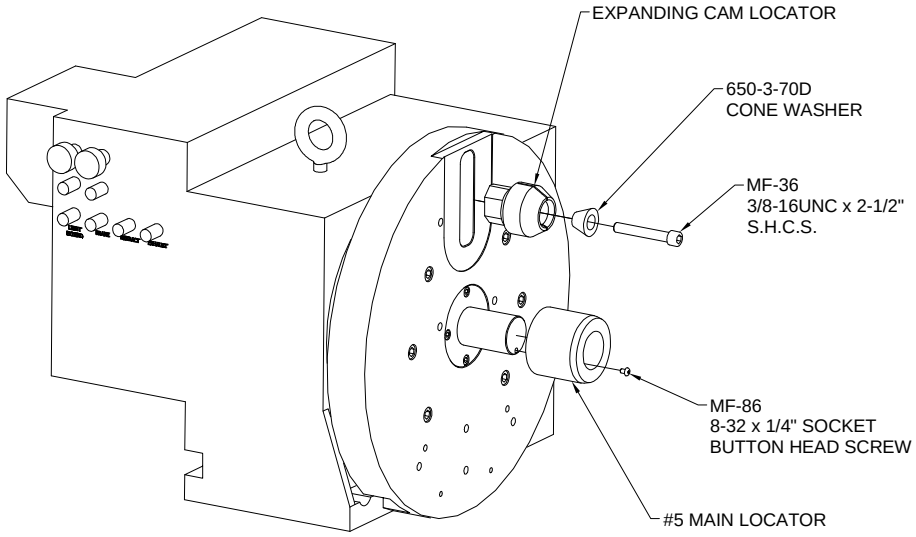


REFF68A14

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	8	650-3-10	TN-5 T-Nut
2	8	100-19A	Hardened washer 17/32 I.D.
3	8	ANSI/ASME B18.2.1 - 1/2-13 UNC - 1.5	1/2-13 UNC X 1.5 HHMS
4	4	650-3-9	Key
5	4	Mf-21A	Socket Head Cap screw 5/16 - 18 UNC - 1/2
6	1	650-3-61R	SUPPORT PARALLEL ASSEMBLY - F7/8 AND 4TH AXIS FIXTURE

Cam and Main Locator Installation:

CAM AND MAIN LOCATOR INSTALLATION



Cam and Main Bearing Locator Sets for 4th Axis Roll Over:

	Main & Cam Bearing Locator sets for Rottler 4th Axis Roll Over Fixture. (If customer requires sizes other than available ex stock, Rottler will manufacture the required size.)
	(Customer must provide the size, including tolerance, of the bore(s) the locator will be used in. Rottler will use this information to design the actual locator.) (Sold in Sets)
650-3-68	LOCATOR, ASSEMBLY, (SMALL BLOCK CHEV) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69, 650-3-69E and 650-3-70C
650-3-68A	LOCATOR, ASSEMBLY, (FORD 289/302) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69A, 650-3-69F and 650-3-62Z
650-3-68B	LOCATOR, ASSEMBLY, (BIG BLOCK CHEV) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69B, 650-3-69G and 650-3-62W
650-3-68C	LOCATOR, ASSEMBLY, (FORD 460) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69C, 650-3-69H and 650-3-62Z
650-3-68D	LOCATOR, ASSEMBLY, (MORPAR 360) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69D, 650-3-69J and 650-3-62Y
650-3-68E	LOCATOR, ASSEMBLY, (CHEV 63mm) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69, 650-3-69E and 650-3-70
650-3-68F	LOCATOR, ASSEMBLY, (CHEV 58mm) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69, 650-3-69E and 650-3-70A
650-3-68G	LOCATOR, ASSEMBLY, (CHEV BOWTIE) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69, 650-3-69E and 650-3-70B
650-3-68H	LOCATOR, ASSEMBLY, (FORD 351W) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69R, 650-3-69S and 650-3-62Z
650-3-68J	LOCATOR, ASSEMBLY, (SMALL BLOCK CHEV 400) 4TH AXIS FIXTURE

	NOTE: Assembly of 650-3-69T, 650-3-69U and 650-3-70C
650-3-68K	LOCATOR, ASSEMBLY, (MOPAR 318) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69P, 650-3-69Q and 650-3-62Y
650-3-68L	LOCATOR, ASSEMBLY, (CHEV 327) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69K, 650-3-69L and 650-3-70C
650-3-68M	LOCATOR, ASSEMBLY, (CHEV 5.3L ("99&UP") 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69M, 650-3-69N and 650-3-70C
650-3-68N	LOCATOR, ASSEMBLY, (BUICK/OLDS/PONTIAC 350/400) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69X, 650-3-69Y and 650-3-70E
650-3-68P	LOCATOR, ASSEMBLY, (FORD 351C) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69V, 650-3-69W and 650-3-62Z
650-3-68Q	LOCATOR, ASSEMBLY, (MOPAR 383/426/440) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69Z, 650-3-71 and 650-3-70G
650-3-68R	LOCATOR, ASSEMBLY, (CHEV GEN3 LS1/LS6) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69M, 650-3-69N and 650-3-70H
650-3-68S	LOCATOR, ASSEMBLY,(GM 6.5 LITRE V8) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-71B, 650-3-71A, 650-3-70U, 650-3-70C, Set of 2 Mains/2 Cams
650-3-68T	LOCATOR ASSEMBLY, (CHEVY LS7) 4TH AXIS FIXTURE
	NOTE: Assembly of 650-3-69M, 650-3-69N, 650-3-83M

Individual Main Locators for 4th Axis:

650-3-69	Locator – Main #5 (2.6406-2.6421 bore) (67.07mm-67.11mm)
650-3-69A	Locator – Main #5 (2.4412-2.4428 bore) (62.01mm-62.05mm)
650-3-69B	Locator – Main #5 (2.9380-2.9395 bore) (74.63mm-74.66mm)
650-3-69C	Locator – Main #5 (3.1922-3.1937 bore) (81.08mm-81.12mm)
650-3-69D	Locator- Main #5 (3.0025-3.0040 bore) (76.26mm-76.30mm)
650-3-69E	Locator – Main #1 (2.6406-2.6421 bore) (67.07mm-67.11mm)
650-3-69F	Locator – Main #1 (2.4412-2.4427 bore) (62.01mm-62.04mm)
650-3-69G	Locator – Main #2 (2.9380-2.9395 bore) (74.63mm-74.66mm)
650-3-69H	Locator – Main #1 (3.1922-3.1937 bore) (81.08mm-81.12mm)
650-3-69J	Locator – Main #1 (3.0025-3.0040 bore) (76.26mm-76.30mm)
650-3-69K	Locator – Main #5 (2.4897-2.4912 bore) (63.24mm-63.28mm)
650-3-69L	Locator – Main #1 (2.4897-2.4912 bore) (63.24mm-63.28mm)
650-3-69M	Locator – Main #5 (2.7495-2.7510 bore) (69.84mm-69.88mm)
650-3-69N	Locator – Main #1 (2.7495-2.7510 bore) (69.84mm-69.88mm)
650-3-69P	Locator – Main #5 (2.6915-2.6930 bore) (68.36mm-68.40mm)
650-3-69Q	Locator – Main #1 (2.6915-2.6930 bore) (68.36mm-68.40mm)
650-3-69R	Locator – Main #5 (3.1912-3.1927 bore) (81.06mm-81.09mm)
650-3-69S	Locator – Main #1 (3.1912-3.1927 bore) (81.06mm-81.09mm)
650-3-69T	Locator – Main #5 (2.8395-2.8410 bore) (72.12mm-72.16mm)
650-3-69U	Locator – Main #1 (2.8395-2.8410 bore) (72.12mm-72.16mm)
650-3-69V	Locator – Main #5 (2.9417-2.9432 bore) (74.72mm-74.76mm)
650-3-69W	Locator – Main #1 (2.9417-2.9432 bore) (74.72mm-74.76mm)
650-3-69X	Locator – Main #5 (3.1880-3.1895 bore) (80.98mm-81.01mm)
650-2-69Y	Locator – Main #1 (3.1880-3.1895 bore) (80.98mm-81.01mm)
650-2-69Z	Locator – Main #5 (2.9425-2.9440 bore) (74.74mm-74.78mm)

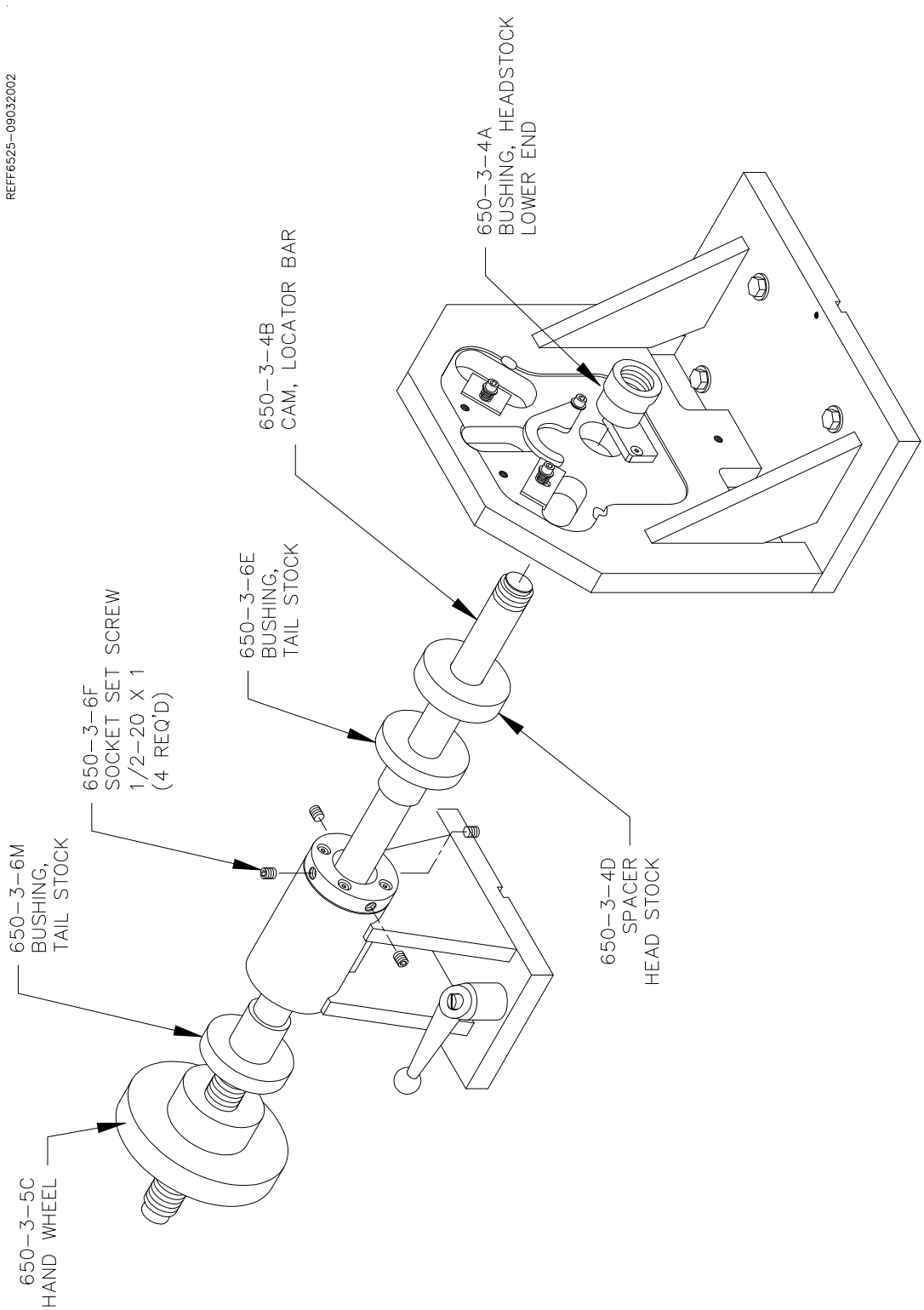
650-3-71	Locator – Main #1 (2.9425-2.9440 bore) (74.74mm-74.78mm)
650-3-71A	Locator – Main #1 (3.1427-3.1437 bore) (79.83mm-79.85mm)
650-3-71B	Locator – Main #5 (3.1427-3.1437 bore) (79.83mm-79.85mm
650-3-71C	Locator – Main #1 (2.8150-2.8160 bore) (71.50mm-71.53mm)
650-3-71D	Locator – Main #5 (2.8150-2.8160 bore) (71.50mm-71.53mm)
650-3-71E	Locator – Main #5 (2.2367-2.2377 bore) (56.81mm-56.84mm)
650-3-71F	Locator – Main #1 (2.2367-2.2377 bore) (56.81mm-56.84mm)
650-3-71G	Locator – Main #1 (2.9425-2.9440 bore) (74.74mm-74.78mm)
650-3-71H	Locator – Main #1 (2.8340-2.8345 bore) (71.99mm-72.01mm)
650-3-71J	Locator – Main #5 (2.8340-2.8345 bore) (71.99mm-72.01mm)
650-3-71K	Locator – Blank Main #1
650-3-71L	Locator – Blank Main #5
650-3-71M	Locator – Main #1 (3.6960-3.0700bore) (77.88mm-77.98mm)
650-3-71N	Locator - Main #5 (3.6960-3.0700 bore) (93.88mm-77.98mm)
650-3-71P	Locator - Main #1 (2.6869-2.6871 bore) (68.25mm-68.25mm)
650-3-71Q	Locator - Main #5 (2.6869-2.6871 bore) (68.25mm-68.25mm)
650-3-71R	Locator - Main #5 (2.6758-2.676 bore) (68.97mm-67.97mm)
650-3-71S	Locator - Main #1 (2.6758-2.676 bore) (68.97mm-67.97mm)
650-3-71T	Locator - Main #5 (3.0696-3.0703 bore) (77.97mm-77.99mm)
650-3-71U	Locator - Main #1 (3.0696-2.0703 bore) (77.97mm-77.99mm)
650-3-71V	Locator - Main #5 (3.3152-3.3162 bore) (84.21mm-84.23mm)
650-3-71W	Locator - Main #1 (3.3152-3.3262 bore) (84.21mm-84.23mm)

Individual Cam Locators for 4th Axis:

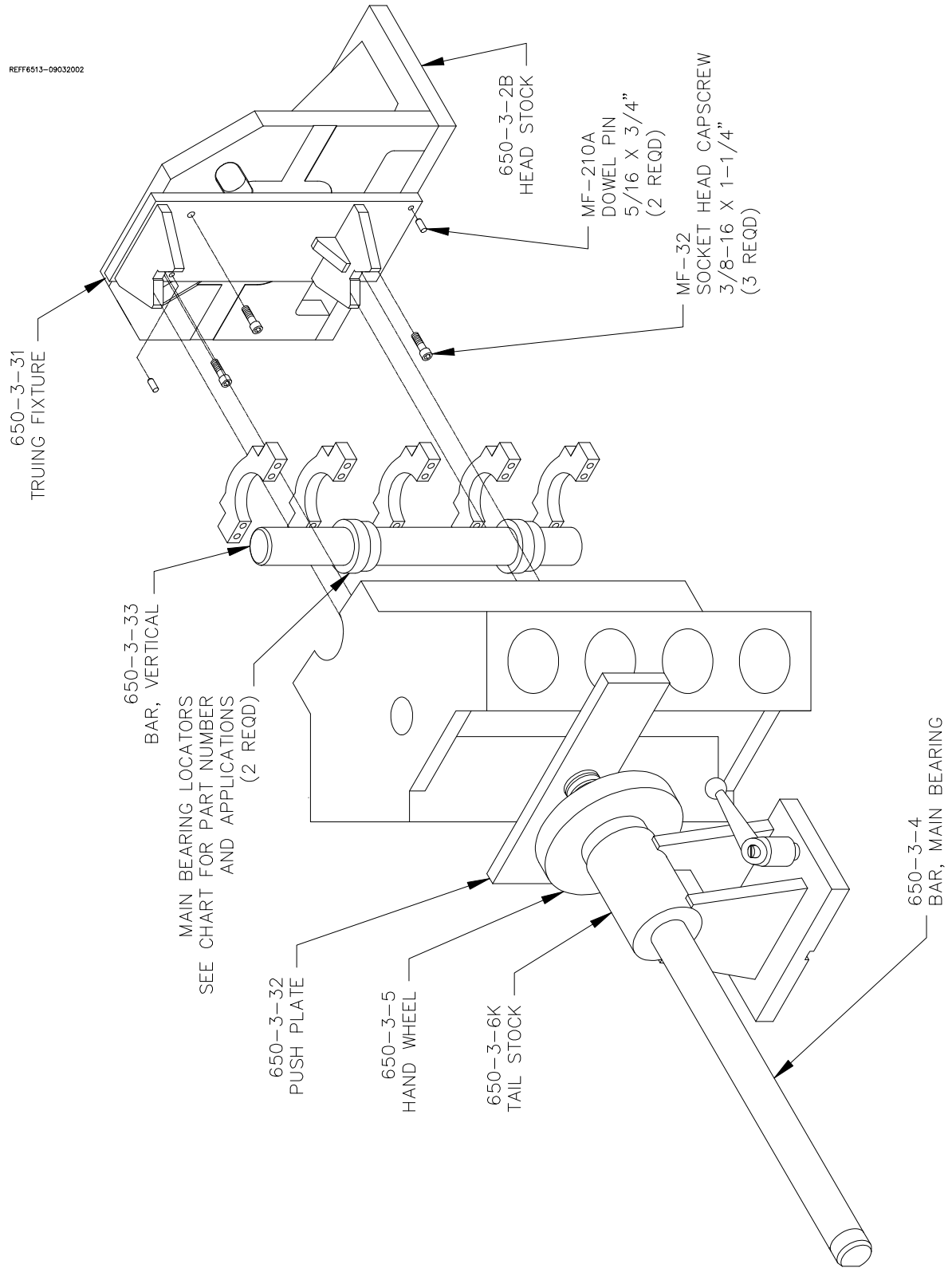
650-3-62W	Locator, Cam, Expanding (2.1295-2.1280 bore) (54.08mm-5405mm)
650-3-62X	Locator, Cam, Expanding (2.2490-2.2505 bore) (57.12mm-57.16mm)
650-3-62Y	Locator, Cam, Expanding (1.6920-1.6935 bore) (42.98mm-43.01mm)
650-3-62Z	Locator, Cam, Expanding (2.1440-2.1455 bore) (54.46mm-5450mm)
650-3-70	Locator, Cam, Expanding (2.4780-2.4795 bore) (62.94mm-62.98mm)
650-3-70A	Locator, Cam, Expanding (2.2820-2.2835 bore) (57.96mm-58.00mm)
650-3-70B	Locator, Cam, Expanding (1.9900-2.0005 bore) (50.77mm-50.81mm)
650-3-70C	Locator, Cam, Expanding (2.0090-2.0105 bore) (51.03mm-51.07mm)
650-3-70E	Locator, Cam, Expanding (2.0875-2.0890 bore) (53.02mm-53.06mm)
650-3-70G	Locator, Cam, Expanding (1.8795-1.8810 bore) (47.74mm-47.78mm)
650-3-70H	Locator, Cam, Expanding (2.3255-2.3270 bore) (59.07mm-59.11mm)
650-3-70J	Locator, Cam, Expanding (2.3475-2.3490 bore) (59.60mm-59.66mm)
650-3-70K	Locator, Cam, Expanding (2.3475-2.3490 bore) (59.60mm-59.66mm)
650-3-70L	Locator, Cam, Expanding (2.2305-2.2320 bore) (56.65mm-56.69mm)
650-3-70M	Locator, Cam, Expanding (2.1255-2.1265 bore) (53.99mm-54.01mm)
650-3-70N	Locator, Cam, Expanding (1.7955-1.7975 bore) (45.61mm-45.66mm)
650-3-70P	Locator, Cam, Expanding (1.9155-1.9175 bore) (48.65mm-48.70mm)
650-3-70Q	Locator, Cam, Expanding (2.1410-2.1430 bore) (54.38mm-5432mm)
650-3-70R	Locator, Cam, Expanding (2.0575-2.0585 bore) (52.56mm-52.29mm)
650-3-70S	Locator, Cam, Expanding (2.0297-2.0317 bore) (51.55mm-51.61mm)
650-3-70T	Locator, Cam, Expanding (2.6780-2.6740 Bore) (67.89mm-67.92mm)
650-3-70U	Locator, Cam, Expanding (2.1675-2.1685 Bore) (55.05mm-55.08mm)
650-3-70V	Locator, Cam, Expanding (1.8480-1.8490 Bore) (46.94mm-46.96mm)
650-3-70W	Locator, Cam, Expanding (2.1190-2.1205 Bore) (53.82mm-53.86mm)

650-3-70X	Locator, Cam, Expanding (2.3745-2.3755 Bore) (60.31mm-60.34mm)
650-3-70Y	Locator, Cam, Expanding (2.4000-2.4010 Bore) (60.96mm-60.98mm)
650-3-70Z	Locator, Cam, Expanding (2.6763-2.6773 Bore) (67.98mm-68.00mm)
650-3-83	Locator, Cam Expanding (2.3070-2.3974 Bore) (58.90mm-60.89mm)
650-3-83A	Locator, Cam Expanding (2.1653-2.1663 Bore) (54.99mm-55.02mm)
650-3-83B	Locator, Cam Expanding (1.927-1.929 Bore) (48.85mm-48.99mm)
650-3-83C	Locator, Cam Expanding (2.6406-2.6416 Bore) (67.07mm-67.10mm)
650-3-83E	Locator, Cam Expanding (2.0380-2.0400 Bore) (51.77mm-51.82mm)
650-3-83F	Locator, Cam, Expanding (2.208-2.209 bore) (56.08mm-56.11mm) 4th axis fixture
650-3-83M	Locator, Cam, Expanding for Chevy LS7

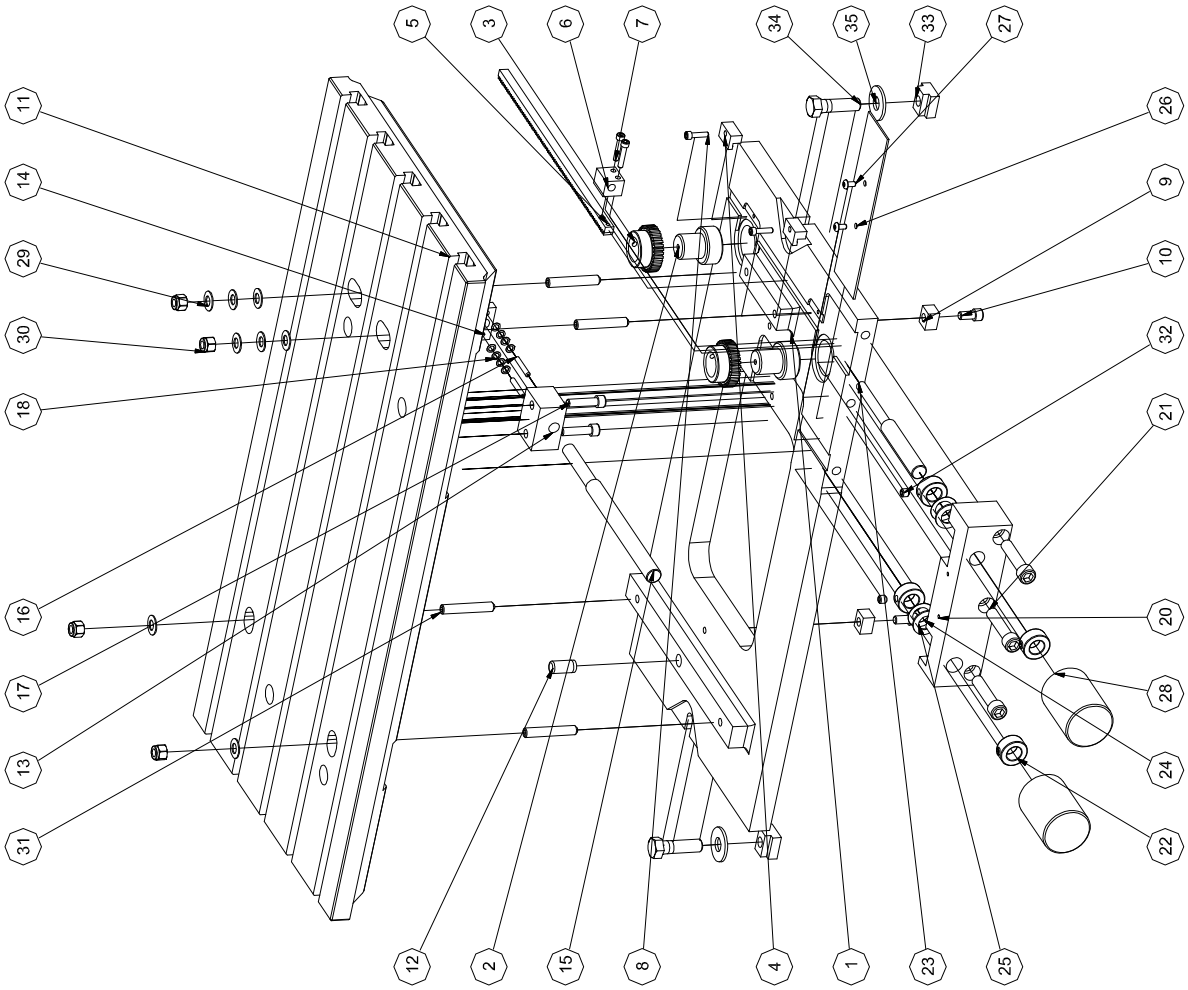
Lower End machining Package 650-3-1A:



Block End truing Fixture 650-3-30:



Line Bore Pivot Table 650-3-56:

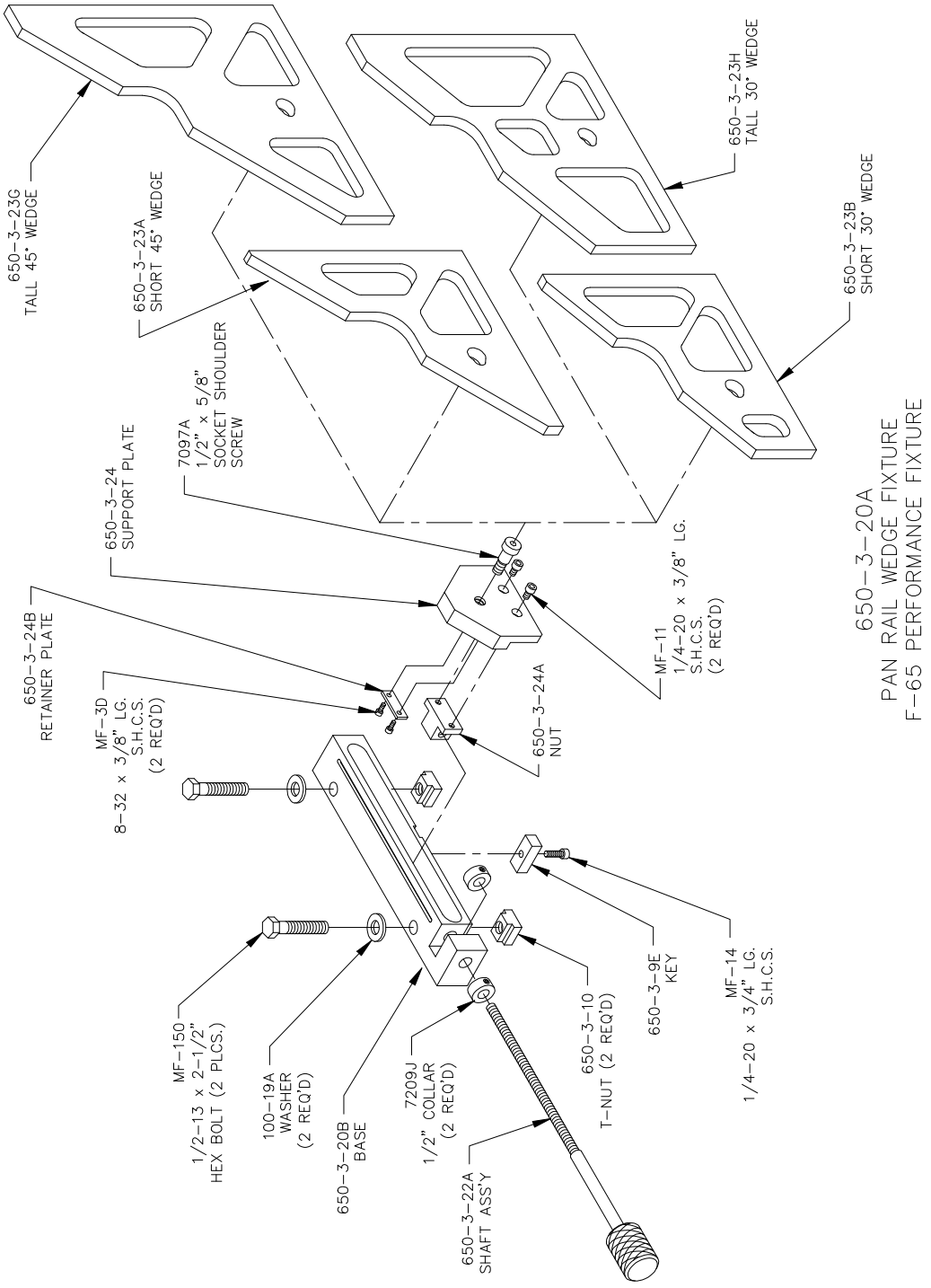


Parts List

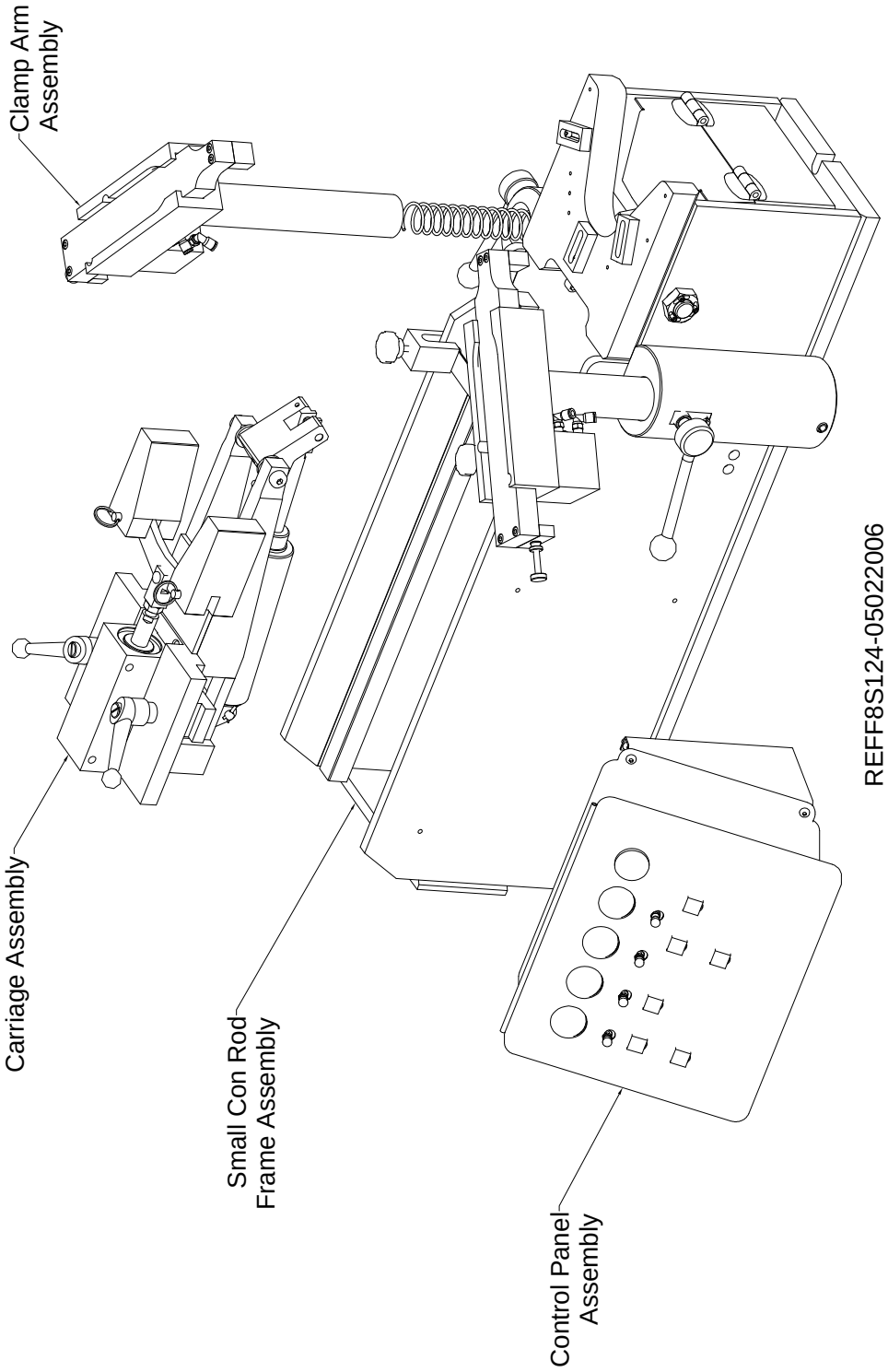
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-56C	Lower Plate
2	2	650-3-56D	Jack Screw
3	2	650-3-56F	Gear
4	2	650-3-56K	Retainer
5	1	650-3-56V	Rack
6	1	650-3-56W	Threaded Block
7	2	ANSI B18.3 - No. 10 - 24 - 1	Hexagon Socket Head Cap Screw
8	2	ANSI B18.3 - No. 10 - 24 - 3/4	Hexagon Socket Head Cap Screw
9	2	650-3-9	Key
10	2	ANSI B18.3 - 5/16 - 18 - 5/8	Hexagon Socket Head Cap Screw
11	1	650-3-56A	Table Top
12	1	ANSI B18.8.2 - 1/2 x 1	Pin - Hardened Ground Machine Dowel
13	1	650-3-56N	Threaded Block
14	1	650-3-56R	Lock Plate
15	1	650-2-29D	Shaft
16	2	ANSI B18.3 - 10-24 UNC x 1.25	Hexagon Socket Set Screw - Cup Point
17	2	ANSI B18.3 - 5/16 - 18 - 1 1/4	Hexagon Socket Head Cap Screw
18	8	650-3-56Q	Spring
19	2	MF-186B	
20	1	650-3-56L	Control Block
21	3	ANSI B18.3 - 7/16 - 14 - 2	Hexagon Socket Head Cap Screw
22	4	7199E	Collar
23	1	650-3-56U	Shaft
24	2	650-3-56S	Belleville spring Reid BDB-65
25	2	514-7-20	Washer
26	1	650-3-56T	chip Shield
27	2	ANSI B18.3 - 10 - 24 x 3/8	Hexagon Socket Button Head Cap Screw
28	2	650-2-29E	Handle
29	8	650-2-28P	Washer
30	4	MF-187B	
31	4	MF-75B	
32	4	ANSI B18.3 - 5/16-18 UNC x 0.31	Hexagon Socket Set Screw - Cup Point
33	2	650-3-10	TN-5 T-Nut
34	2	ANSI/ASME B18.2.1 - 1/2-13 UNC - 1.75	Hex Bolt - UNC (Regular Thread - Inch)
35	2	MF-180	1/2" FLAT WASHER

REFF68A37

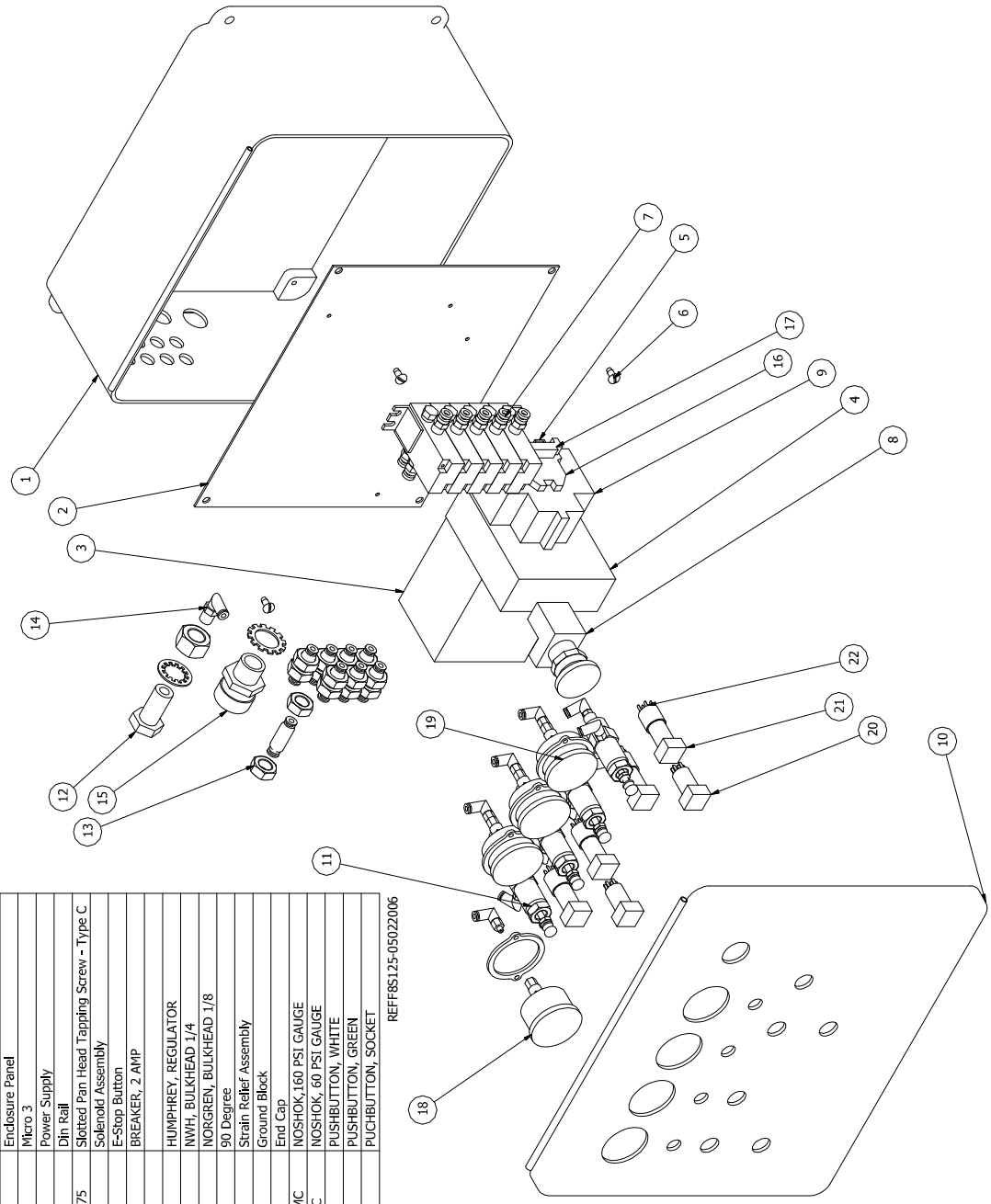
Pan Rail Wedge Fixture 650-3-20A



650-3-44R Small Precision Connecting Rod Fixture



650-3-44R Small Precision Connecting Rod Fixture – Control Panel

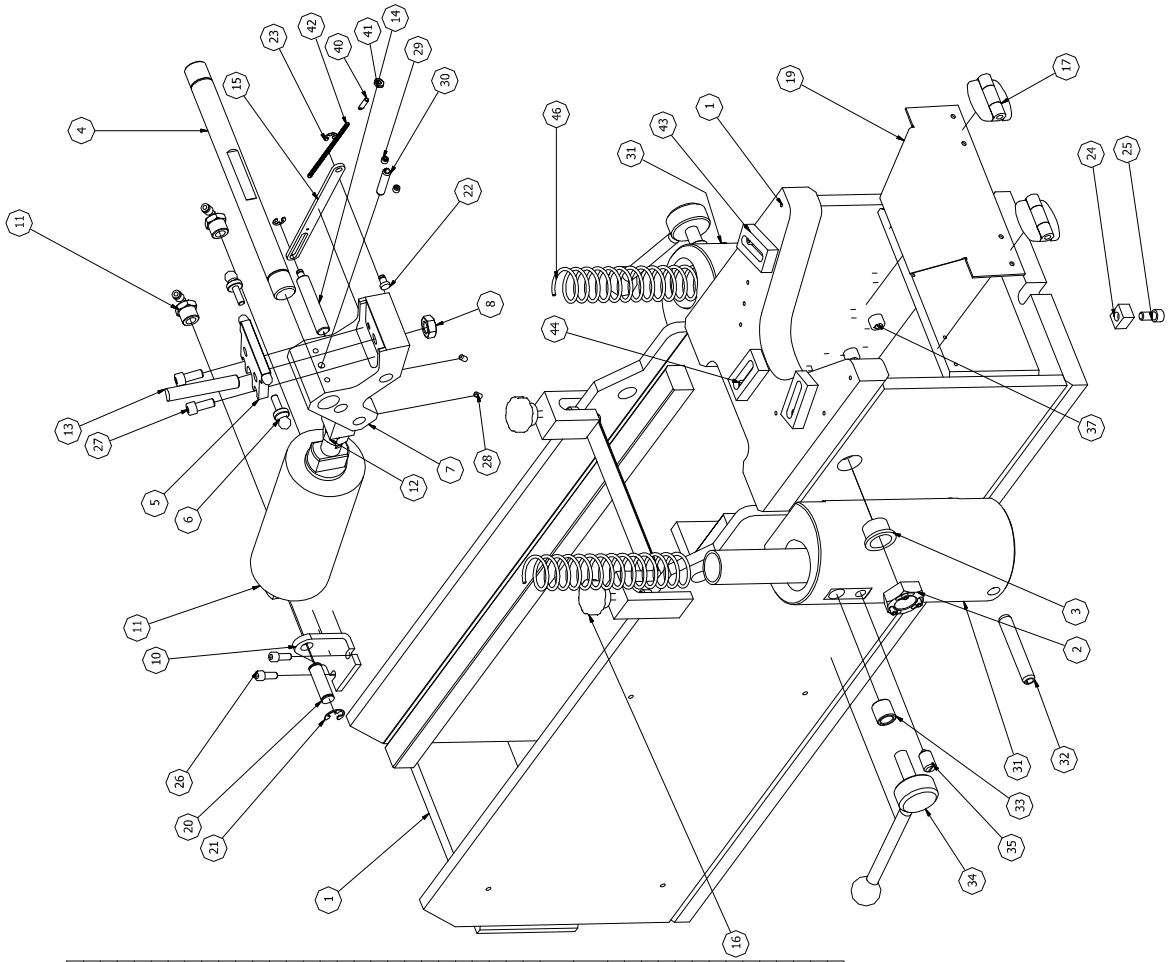


650-3-47T Parts List - Control Panel Complete w/ Air (Buchannan)

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	J1210HPL	Enclosure
2	1	BP1210AL	Enclosure Panel
3	1	PLC	Micro 3
4	1	650-3-47V	Power Supply
5	1	504-35-3F	Din Rail
6	4	ANSI B18.6.4 - 10-32 UNF - 0.375	Slotted Pan Head Tapping Screw - Type C
7	1	410-24vdc	Solenoid Assembly
8	1	6389	E-Stop Button
9	1	504-35-3	BREAKER, 2 AMP
10	1	Con Rod Lid1	
11	4	RSR	HUMPHREY, REGULATOR
12	1	PMF 532-N01U	NWH, BULKHEAD 1/4
13	8	C2029200	NORGREN, BULKHEAD 1/8
14	1	Air Fitting2	90 Degree
15	1	400-7-7	Strain Relief Assembly
16	1	514-7-74E	Ground Block
17	2	504-35-3M	End Cap
18	3	15.110.160PSI 1/8NPT 10/32PMC	NOSHOK,160 PSI GAUGE
19	1	15.110.60PSI 1/8NPT 10/31PMC	NOSHOK, 60 PSI GAUGE
20	2	6491U	PUSHBUTTON, WHITE
21	4	6491S	PUSHBUTTON, GREEN
22	4	502-37-59A	PUCHBUTTON, SOCKET

REFF8S125-05022006

650-3-44R Small Precision Connecting Rod Fixture – Small Frame

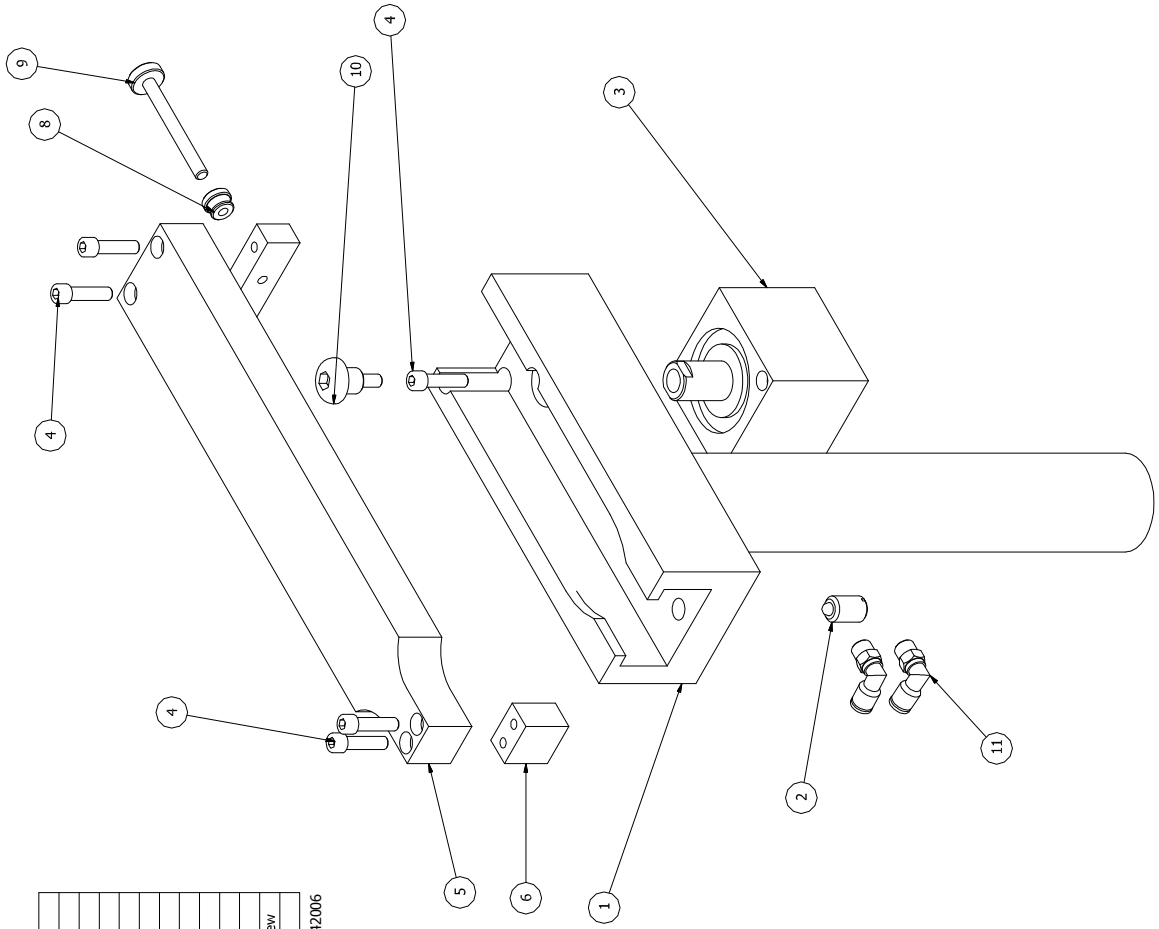


Small Precision Connecting Rod Fixture Parts List

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-67B	Small Frame
2	2	650-3-46T	Lock Nut REID BLN-105
3	2	650-3-46U	Flange Bearing Symmco SF-2832-12
4	1	650-3-46G	Pivot Shaft
5	1	650-3-46N	Locator 1.78
6	2	650-3-46C	Tooling Ball Reid #TCB-26820
7	1	650-3-46J	Locator Holder
8	1	ANSI B18.2.2 - 1/2 - 13	Hex Jam Nut
9	1	650-3-45H	Pivot Bracket Right
10	1	650-3-45K	Pivot Bracket Left
11	1	650-3-45G	Locating Cylinder
12	1	650-3-45J	Rod Clevis
13	1	650-3-47K	Stop Screw - Set 1/2-13 x 3
14	1	650-3-46K	Pivot Pin
15	1	650-3-46L	Linkage Arm
16	1	650-3-47B	Support Strap
17	2	650-3-46S	Hinge, Dust Cover
19	1	650-3-46Q	Locator Cover Con Rod Fixture
20	1	PIN1	Included in 650-3-47J
21	2	E_CLIP	Included in 650-3-47J
22	1	650-3-46H	Linkage Pin
23	2	650-3-46R	E-clip - Truearc E-Ring #RE-25ST
24	2	650-3-9	Key
25	2	MF-21 ANSI B18.3 - 5/16 - 18 - 5/8	Hexagon Socket Head Cap Screw
26	4	MF-13 ANSI B18.3 - 1/4 - 20 - 5/8	Hexagon Socket Head Cap Screw
27	2	MF-22 ANSI B18.3 - 5/16 - 18 - 3/4	Hexagon Socket Head Cap Screw
28	2	MF-53 ANSI B18.3 - 10-24 UNC - 0.375	Type B - Hexagon Socket Set Screw - Cup Point - UNC (Regular Thread - Inch)
29	2	MF-60 ANSI B18.3 - 1/4-20 UNC - 0.25	Type B - Hexagon Socket Set Screw - Cup Point - UNC (Regular Thread - Inch)
30	1	MF-210 ANSI B18.8.2 - 5/16 x 2.1/2	Pin - Slotted Spring
31	2	650-3-49Q	Clamp Base, ConRod Clamp arms
32	2	ANSI B18.8.2 - 1/2 x 3	Pin - Slotted Spring
33	2	6310R	Thread Insert
34	2	6310N	Handle
35	2	502-8-52C	Spring Plunger
37	8	ANSI B18.3 - 3/8 - 16 - 1	Hexagon Socket Head Cap Screw
40	1	650-3-48P	spring anchor Reid CSA-50
41	1	ANSI B18.6.3 - 8 - 32	Hex Machine Screw Nut UNC
42	1	514-7-83N	Extension Spring
43	3	650-3-48L	Support Parallel
44	3	ANSI B18.3 - No. 10 - 24 - 3/8	Hexagon Socket Head Cap Screw
45	2	650-3-49G	Support Tube
46	2	650-3-49M	Spring

REFF8S126-05032006

650-3-44R Small Precision Connecting Rod Fixture – Clamp Arm Assembly

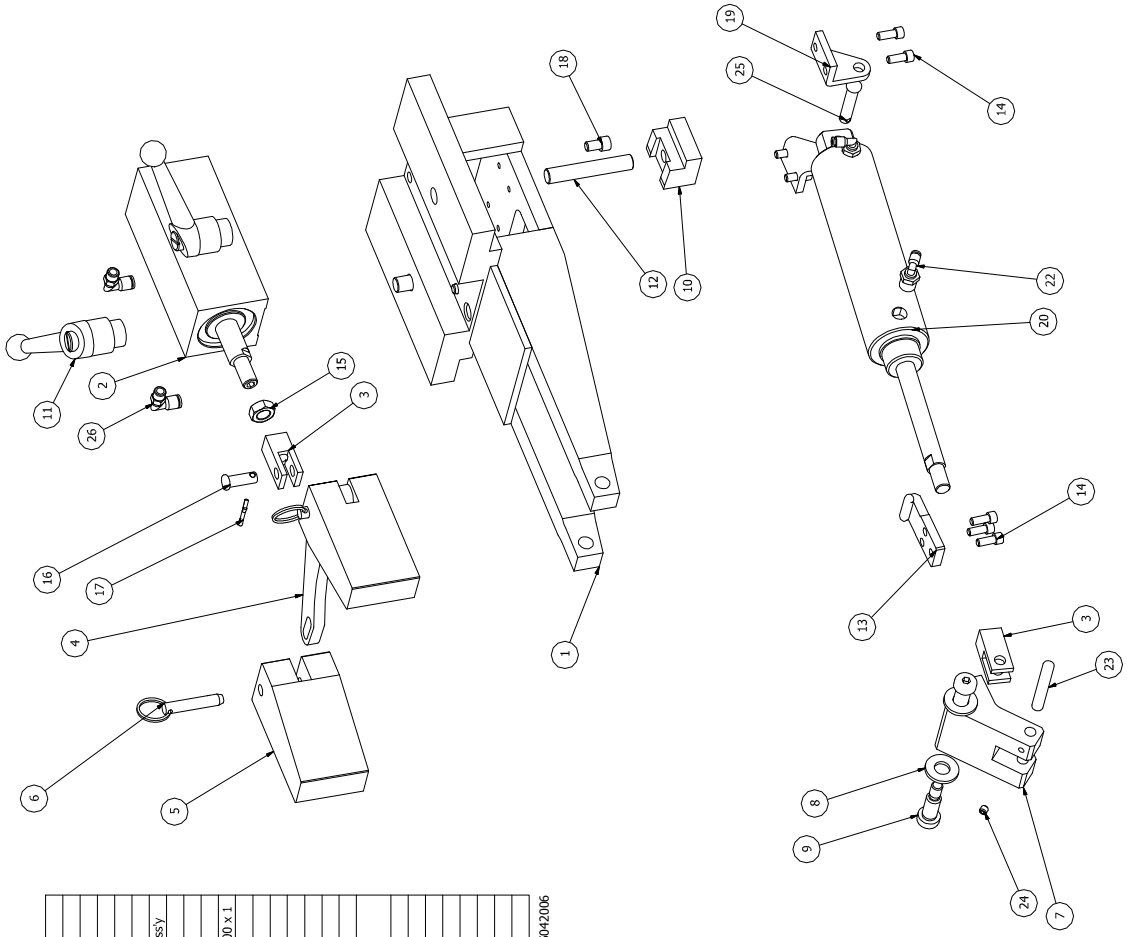


Small Precision Connecting Rod Fixture Clamp Arm Assembly Parts List

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-49H	Clamp Leg
2	1	502-8-52C	Spring Plunger
3	1	650-3-45E	Clamp Arm Cylinder
4	6	ANSI B18.3 - 1/4 - 20 UNC - 1	Hexagon Socket Head Cap Screw
5	1	650-3-49K	Clamp Arm
6	1	650-3-49L	Extension
7	1	650-3-49N	Stop Block
8	1	650-3-34J	Thumbknob Reid aj-721
9	1	650-3-34S	Clamp Screw
10	1	ANSI B18.3 - 1/2-20 - 5/8	Hexagon Socket Button Head Cap Screw
11	2	514-4-17Y	Legris Angle

REFF8S127-05042006

650-3-44R Small Precision Connecting Rod Fixture – Carriage Assembly

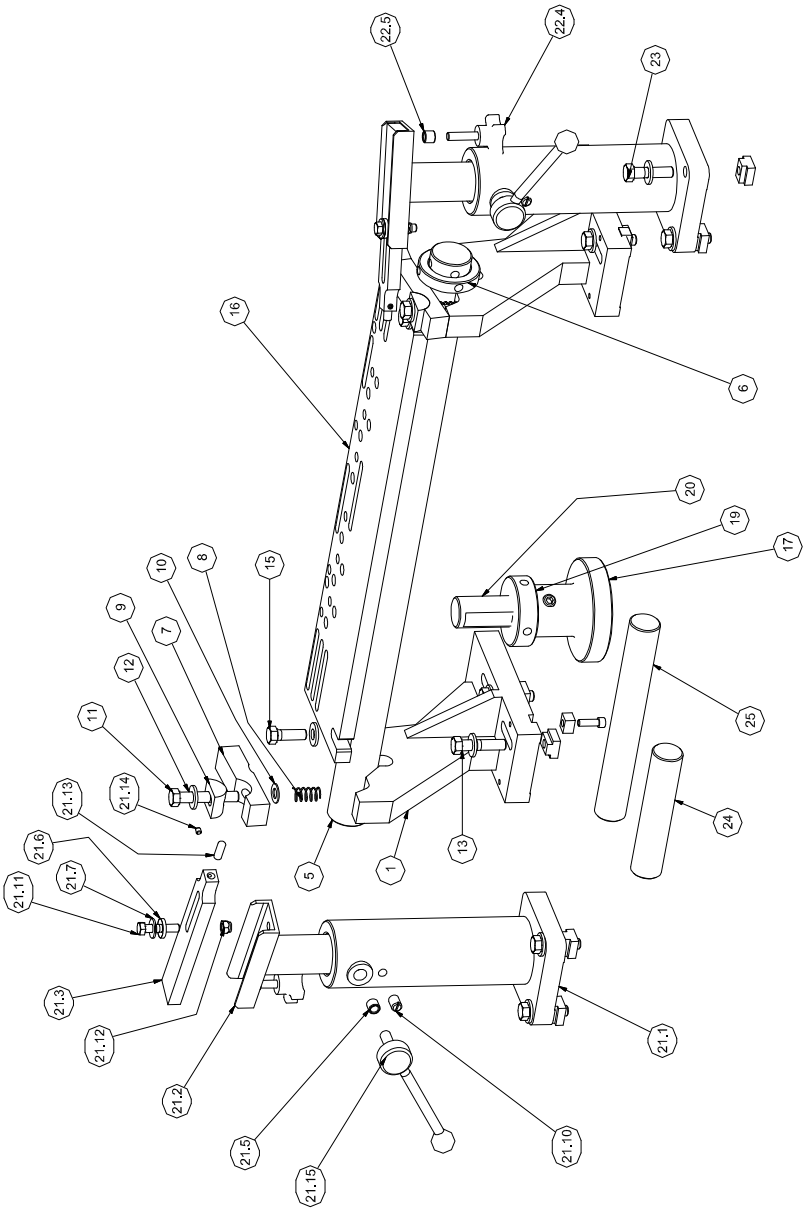


Small Precision Connecting Rod Fixture Carriage Assembly Parts List

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-67	Carriage, Machining
2	1	650-3-45D	Wedge Cylinder
3	2	650-3-45L	Clevis
4	1	650-3-48J	Linkgage, Wedge
5	2	650-3-48G	Wedge Clamp - Medium Con-Rod Fixture ass'y
6	2	650-3-48K	Release Pin, Clamp Wedge
7	1	650-3-47D	Centering Lever
8	2	100-19A	Hardened washer 17/32 I.D.
9	2	650-4-45	Hexagon Socket Head Shoulder Screw 0.500 x 1
10	2	650-3-48	Clamp Shoe
11	2	514-2-39	Handle
12	2	514-4-5B	Stud
13	1	650-3-47S	Centering Block - Medium Long
14	7	MF-13 ANSI B18.3 - 1/4 - 20 - 5/8	Hexagon Socket Head Cap Screw
15	1	ANSI B18.2.2 - 1/2 - 20	Hex Jam Nut
16	1	Rod Clevis Pin RC-5	
17	2	ANSI B18.8.1 - 1/8 x 3/4 Extended Prong Square Cut Type	Pin - Cotter
18	4	ANSI B18.3 - 5/16 - 18 - 1/2	Hexagon Socket Head Cap Screw
19	2	650-3-45K	Pivot Bracket
20	1	650-3-45F	Norgren RLG04
22	2	legris angle 25x532	Legris Angle 25X532
23	1	MF-212A ANSI B18.8.2 - 3/8 x 2 1/4	Pin - Hardened Ground Production Dowel
24	1	MF-6D ANSI B18.3 - 1/4-20 UNC x 0.25	Hexagon Socket Set Screw - Cup Point
25	1	Pivot Pin Norgren cyl	
26	2		Legris Angle

REFF8S128-05042006

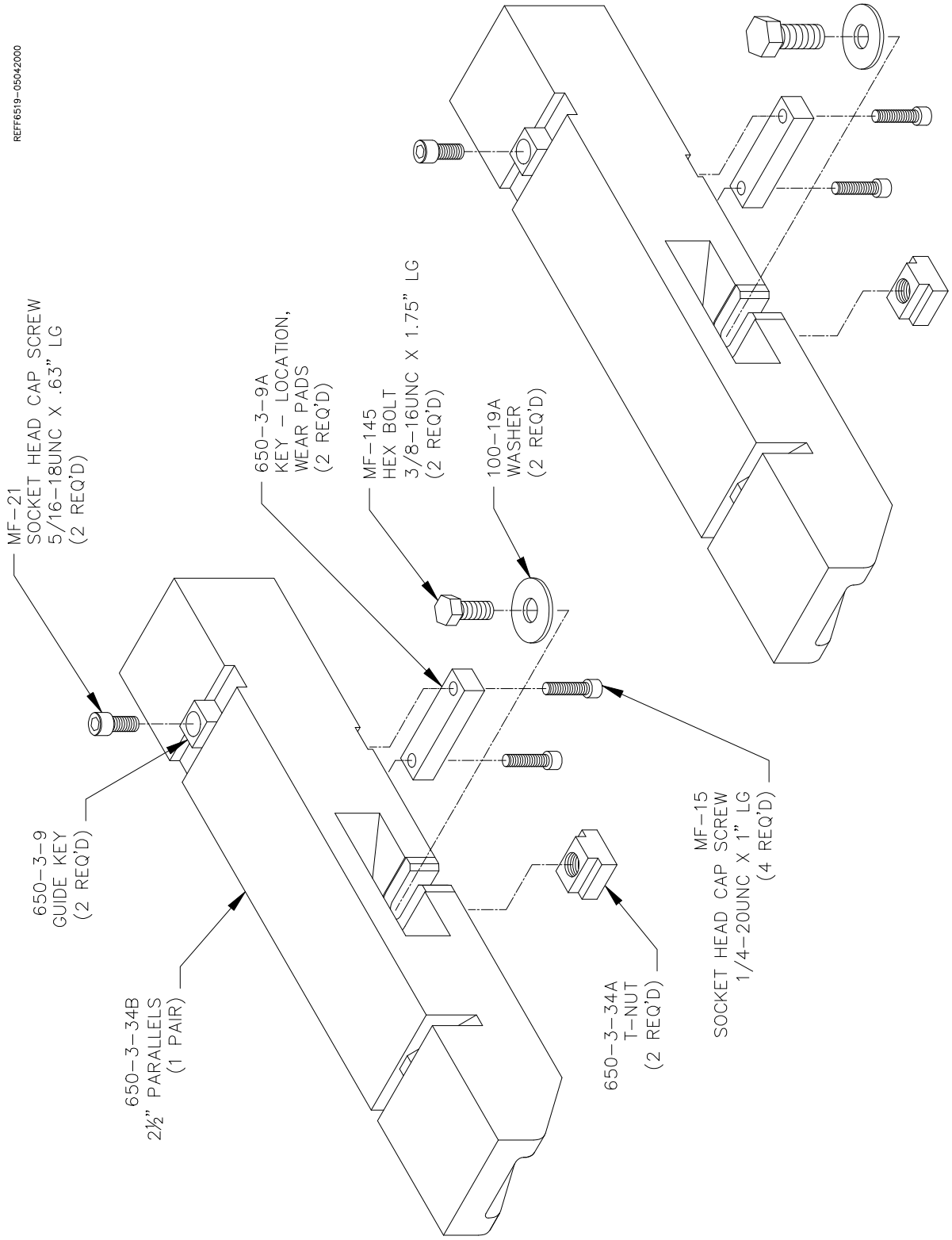
Economy Fixture 7241P:



Parts List

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	7241K	Left Support
2	1	7241L	Right. Support
3	4	650-3-9	Key
4	4	Mf-23	Socket Head Cap screw 5/16 - 18 UNC - 1
5	1	7241E	LOCATOR BAR
6	1	7241D	Cam Bushing
7	2	7241F	CLamp Finger
8	2	502-2-11F	Spring
9	2	7241G	PIVOT
10	2	100-19	Hardened Washer
11	2	ANSI/ASME B18.2.1 - 1/2-13 UNC - 3	Hex Bolt - UNC (Regular Thread - Inch)
12	12	100-19A	Hardened washer 17/32 I.D.
13	4	ANSI/ASME B18.2.1 - 1/2-13 UNC - 2.25	Hex Bolt - UNC (Regular Thread - Inch)
14	8	650-3-10	TN-5 T-Nut
15	2	ANSI/ASME B18.2.1 - 1/2-13 UNC - 1.5	Hex Bolt - UNC (Regular Thread - Inch)
16	1	7241H	Mount Plate
17	1	7241Q	
18	1	6395B	5/8-11 Half Dog 1" long
19	1	6566C	Jackling Nut
20	1	7241N	
21	1	7242B-1 Left	
21.1	1	7242	Clamp Base
21.2	1	7242F	Clamp Tower Leg
21.3	1	7242E	Clamp Shoe
21.4	1	7242H	Knob
21.5	2	7242J	Thread Insert 3/8-16
21.6	1	7242K 1	Spherical Washer Lower
21.7	1	7242K 2	Spherical Washer Upper
21.8	1	7242L	Spacer Tube
21.9	1	650-3-49M	Spring
21.10	1	502-8-52C	Spring Plunger
21.11	1	ANSI/ASME B18.2.1 - 3/8-16 UNC - 1.75	Hex Bolt - UNC (Regular Thread - Inch)
21.12	1	IFI 100/107 - 3/8 - 16 Metal Type	Prevailing Torque Type Hex Nut
21.13	1	ANSI B18.8.2 - 3/8 x 1	Pin - Hardened Ground Production Dowel
21.14	1	ANSI B18.3 - 1/4-20 UNC x 0.25	Hexagon Socket Set Screw - Flat Point
21.15	1	6310J	Clamp Handle
22.4	1	7242H	Knob
22.5	2	7242J	Thread Insert 3/8-16
23	4	ANSI/ASME B18.2.1 - 1/2-13 UNC - 2	Hex Bolt - UNC (Regular Thread - Inch)
24	1	6396	Jackling Screw 7" lg.
25	1	6396A	

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 clamps 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).

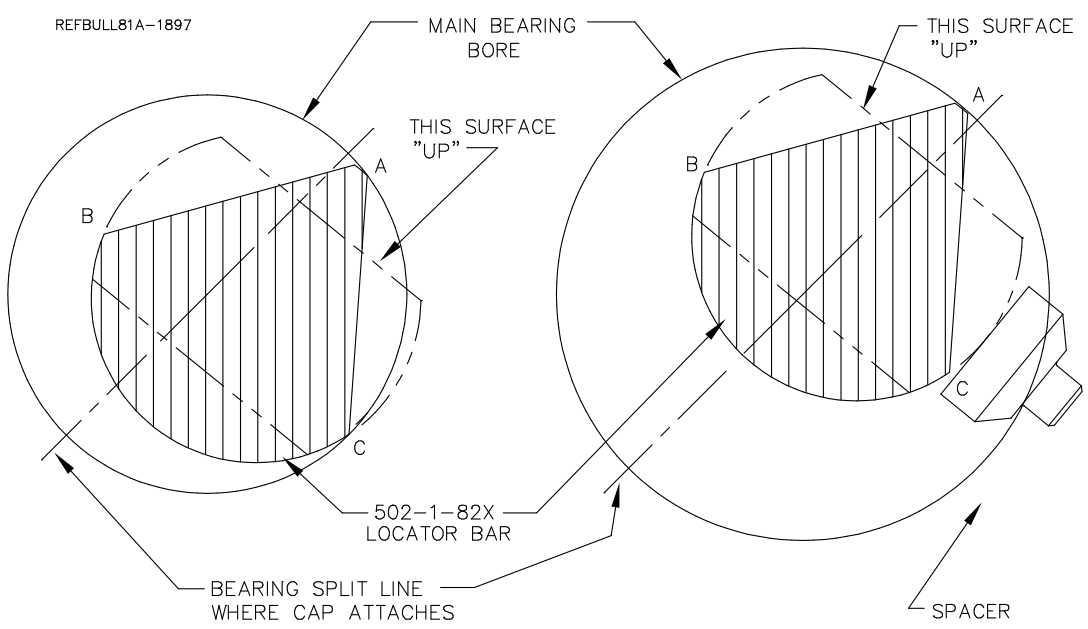
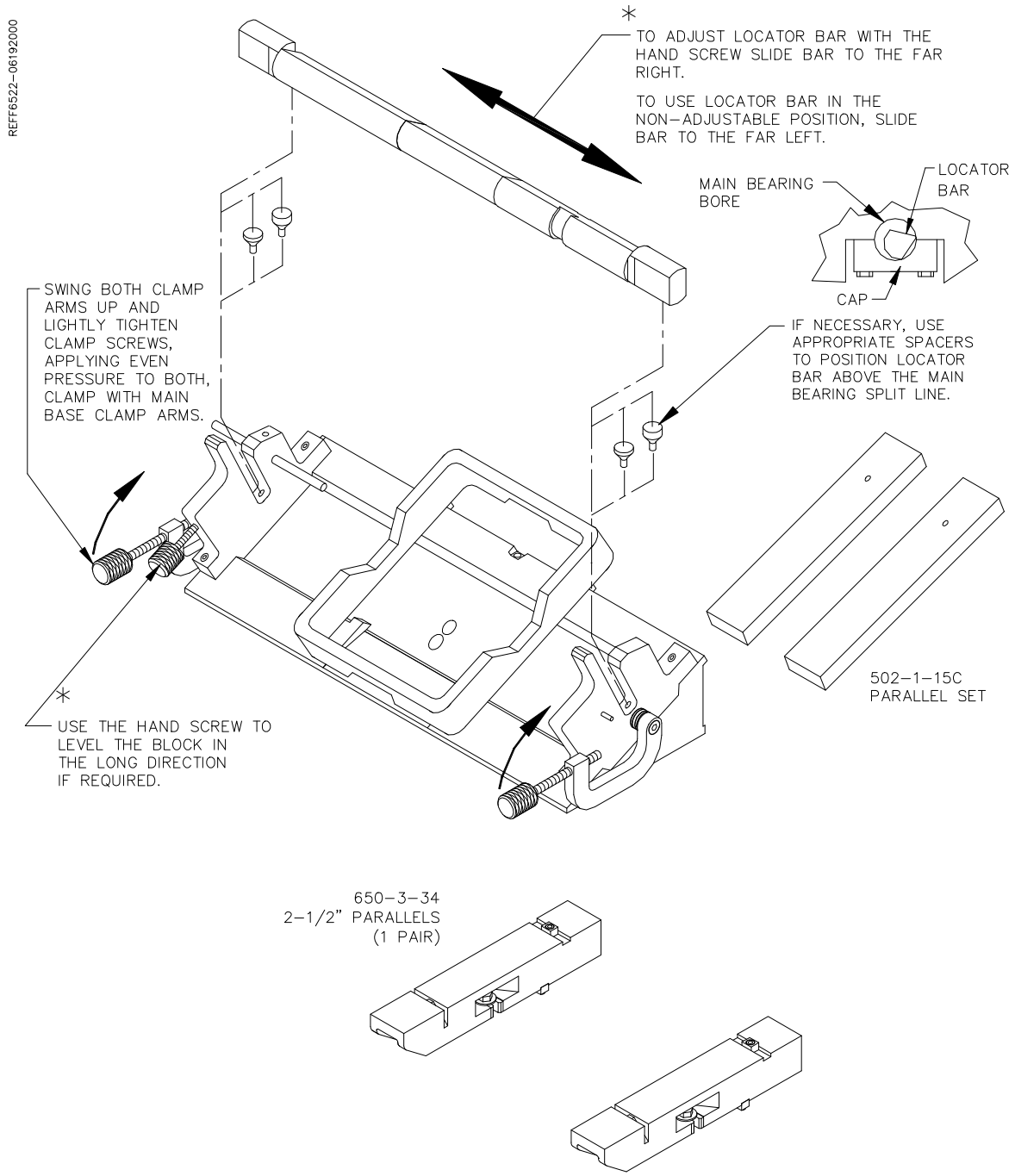


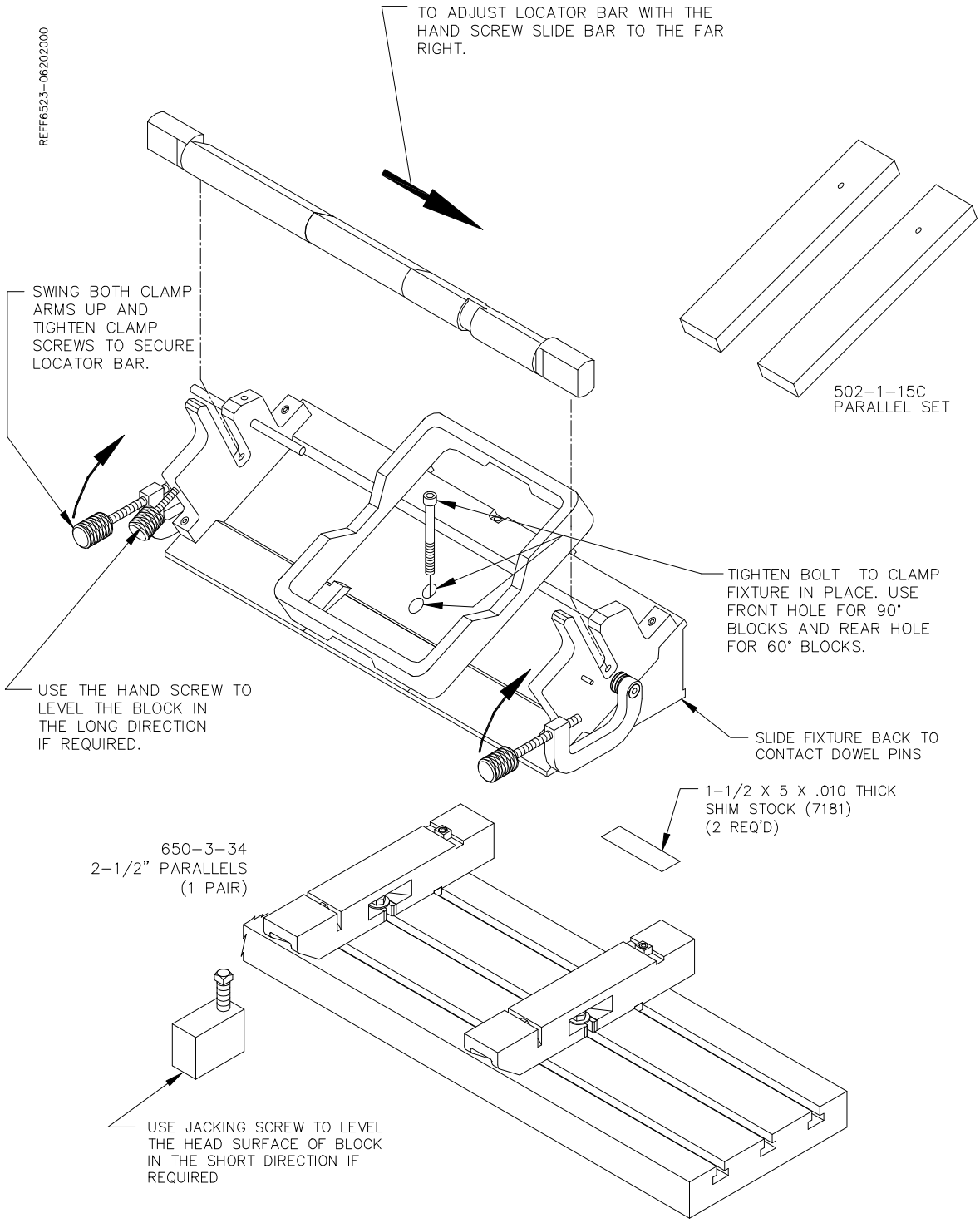
FIGURE 1

FIGURE 2

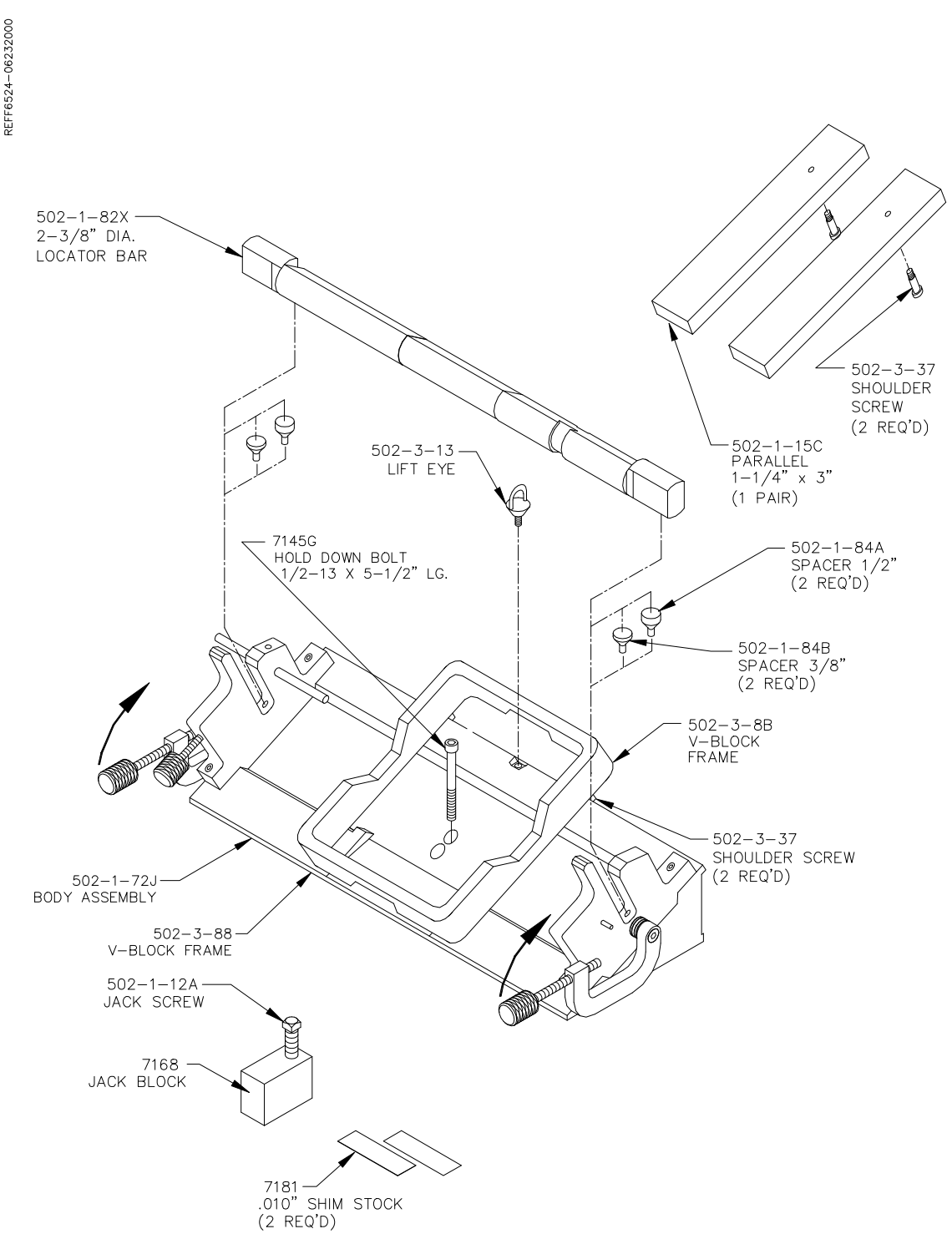
Manual Fixture Assembly 502-1-72H:

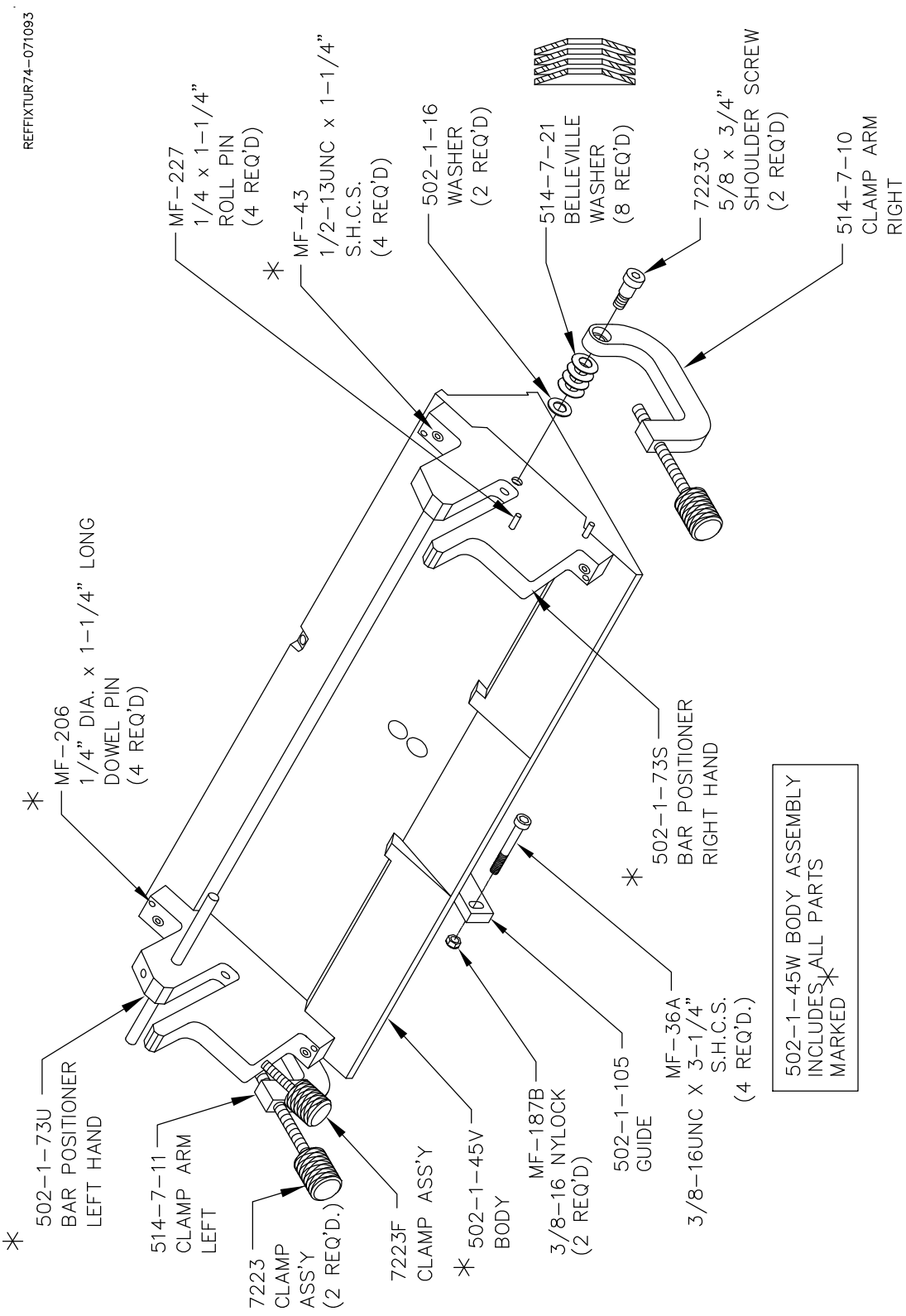


V6/V8 Manual Fixture Body Assembly 502-1-72J:

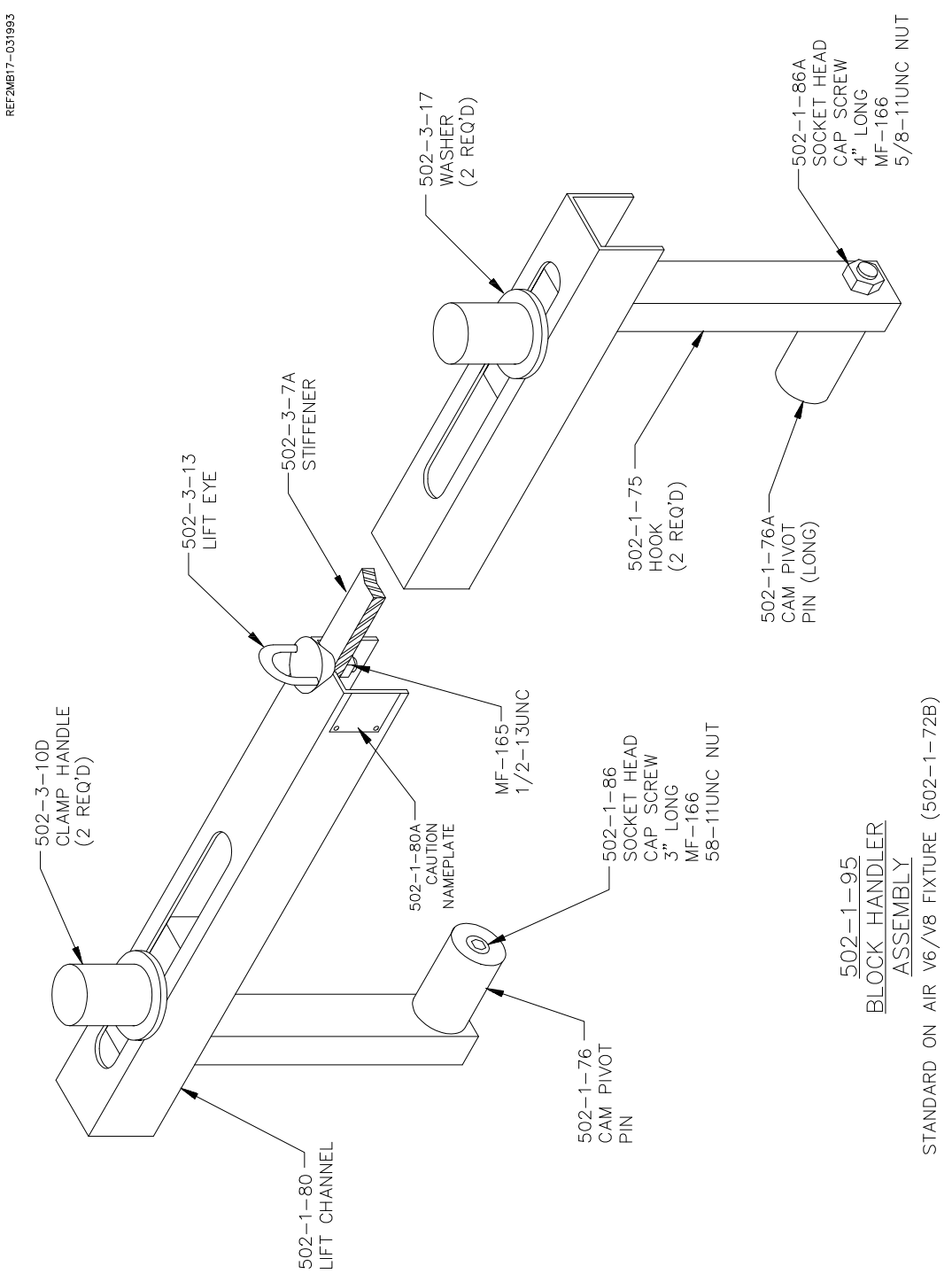


V6/V8 Manual Fixture Body Assembly 502-1-72J: (cont)

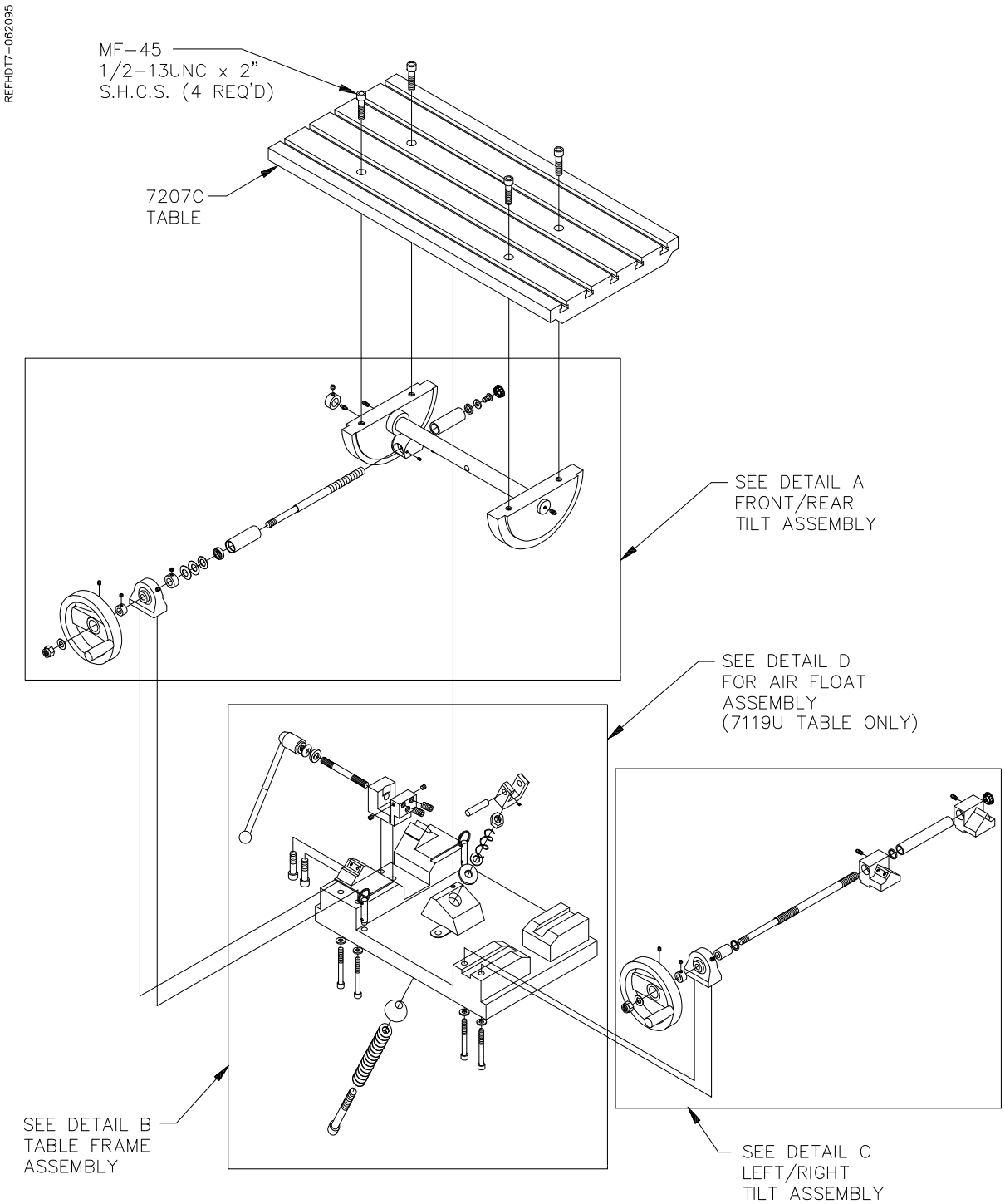



REFFIXTUR74-071093
MF-227
1/4 x 1-1/4"
ROLL PIN
(4 REQ'D)
MF-43
1/2-13UNC x 1-1/4"
S.H.C.S.
(4 REQ'D)
502-1-16
WASHER
(2 REQ'D)
514-7-21
BELLEVILLE
WASHER
(8 REQ'D)
7223C
5/8 x 3/4"
SHOULDER SCREW
(2 REQ'D)
514-7-10
CLAMP ARM
RIGHT
MF-206
1/4" DIA. x 1-1/4" LONG
DOWEL PIN
(4 REQ'D)
502-1-73S
BAR POSITIONER
RIGHT HAND
502-1-73U
BAR POSITIONER
LEFT HAND
514-7-11
CLAMP ARM
LEFT
7223
CLAMP
ASS'Y
(2 REQ'D.)
7223F
CLAMP ASS'Y
502-1-45V
BODY
MF-187B
3/8-16 NYLOCK
(2 REQ'D)
502-1-105
GUIDE
MF-36A
3/8-16UNC X 3-1/4"
S.H.C.S.
(4 REQ'D.)
502-1-45W BODY ASSEMBLY
INCLUDES ALL PARTS
MARKED *

Block Handler 502-1-95:



Dual Axis Leveling Table 7209M:



ROTTLER DUAL AXIS FIXTURE TABLE

7119V – FIXTURE TABLE WITHOUT AIR FLOAT OPTION

7119W – FIXTURE TABLE WITH AIR FLOAT OPTION

APPROXIMATE TABLE WEIGHT: 325 LBS.

Front/Rear Tilt Assembly:

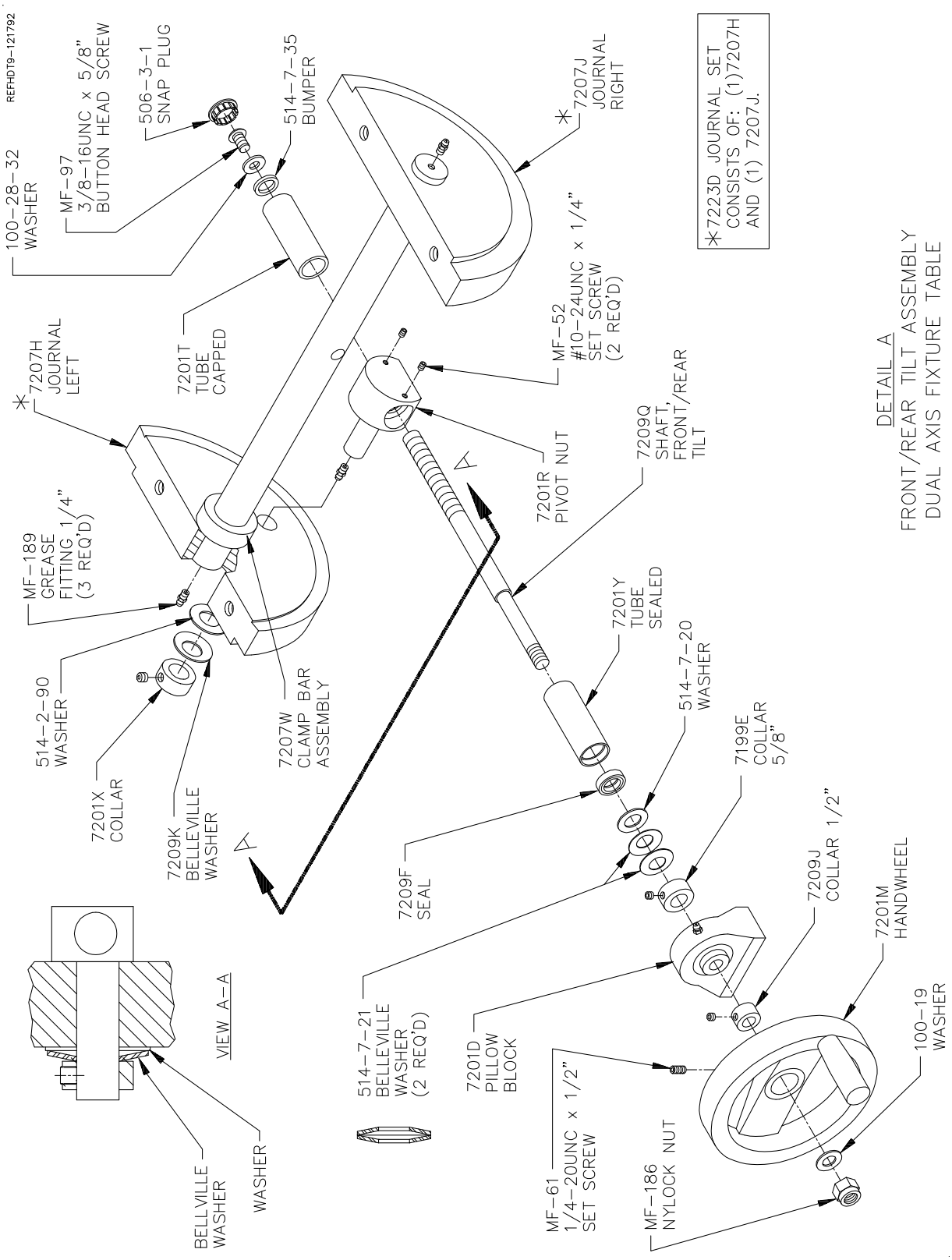
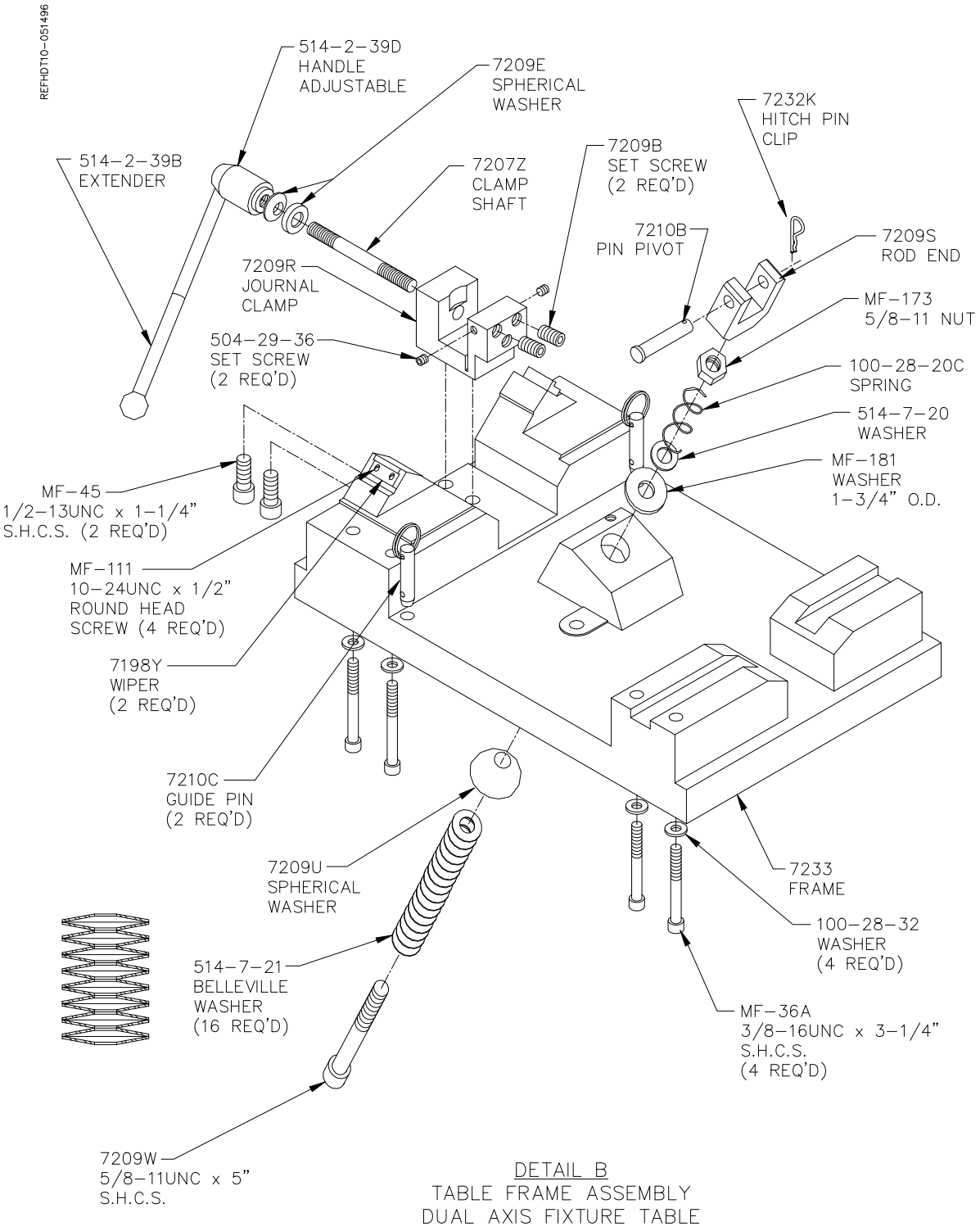
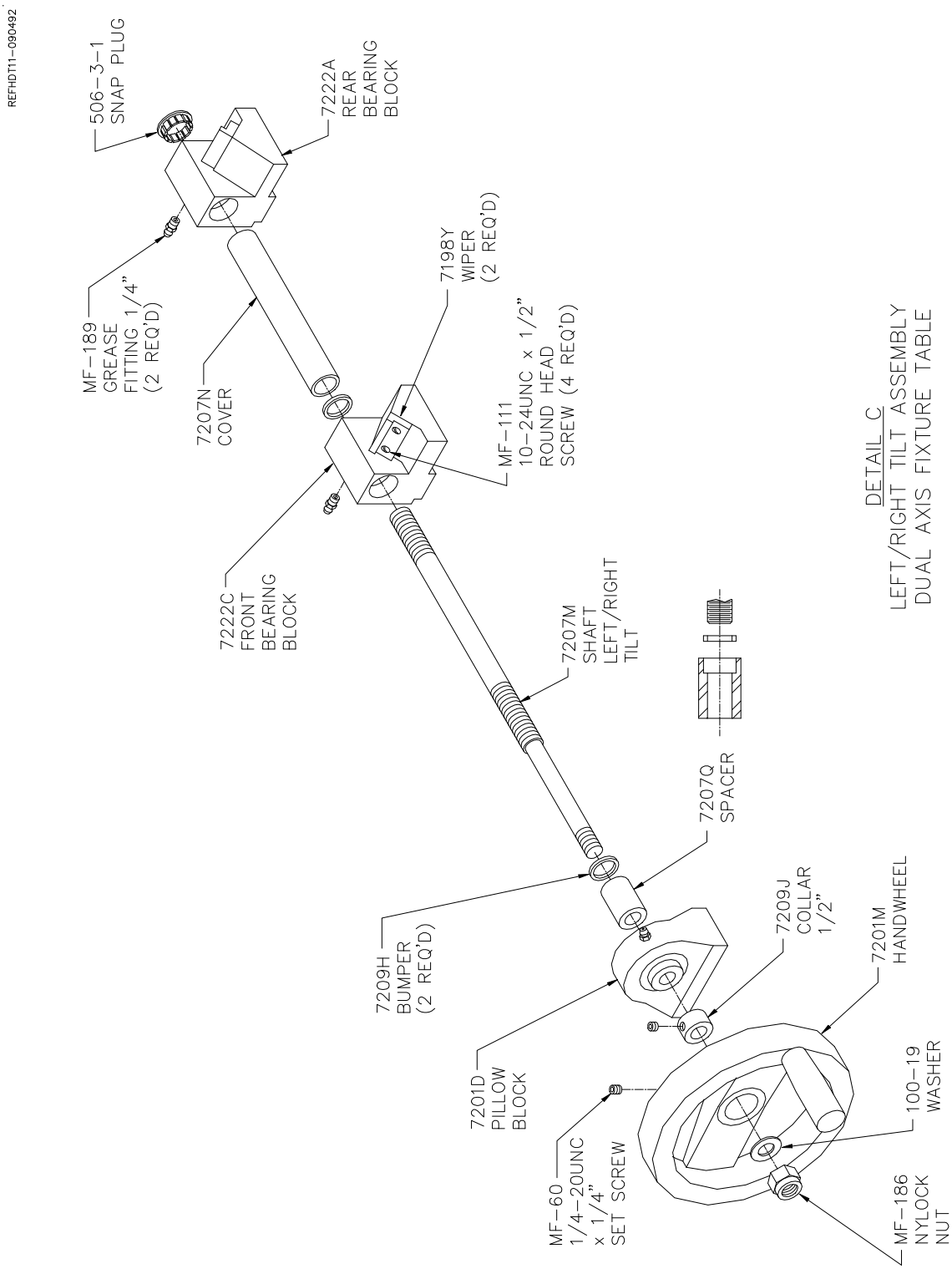


Table Frame Assembly:

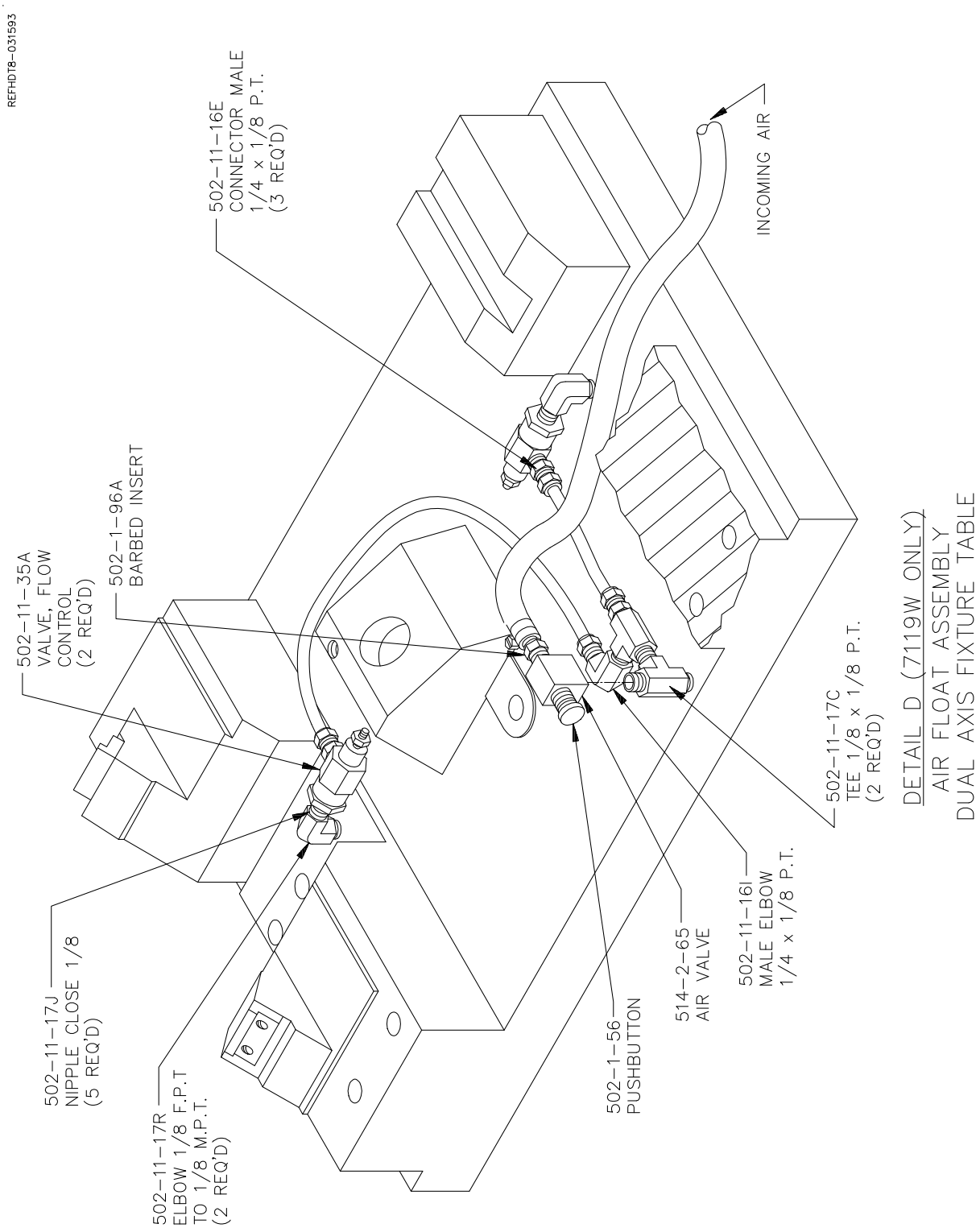


DETAIL B
TABLE FRAME ASSEMBLY
DUAL AXIS FIXTURE TABLE

Left/Right Tilt Assembly:



Air Float Assembly:

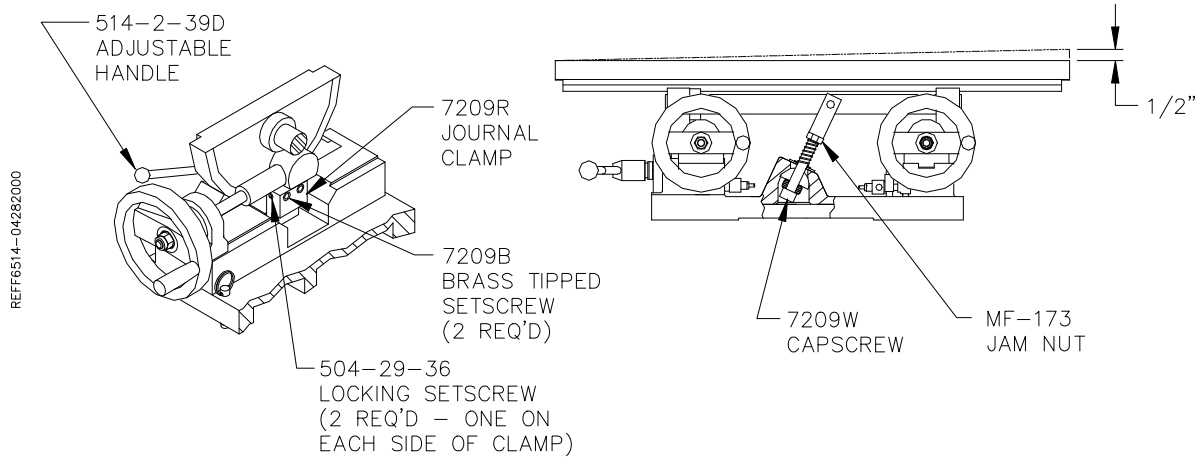


Dual Axis Leveling Table:

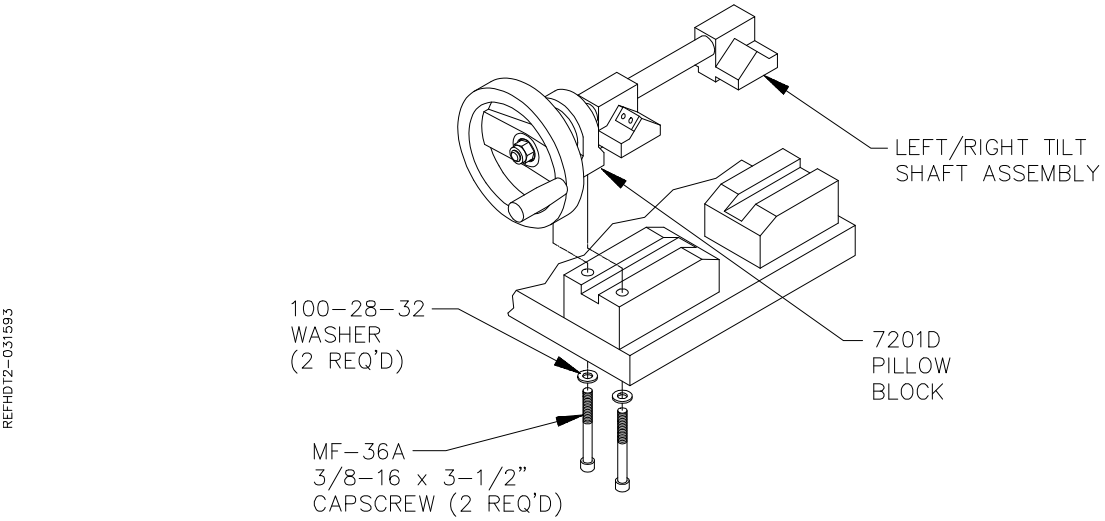
Adjustment Procedure:

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

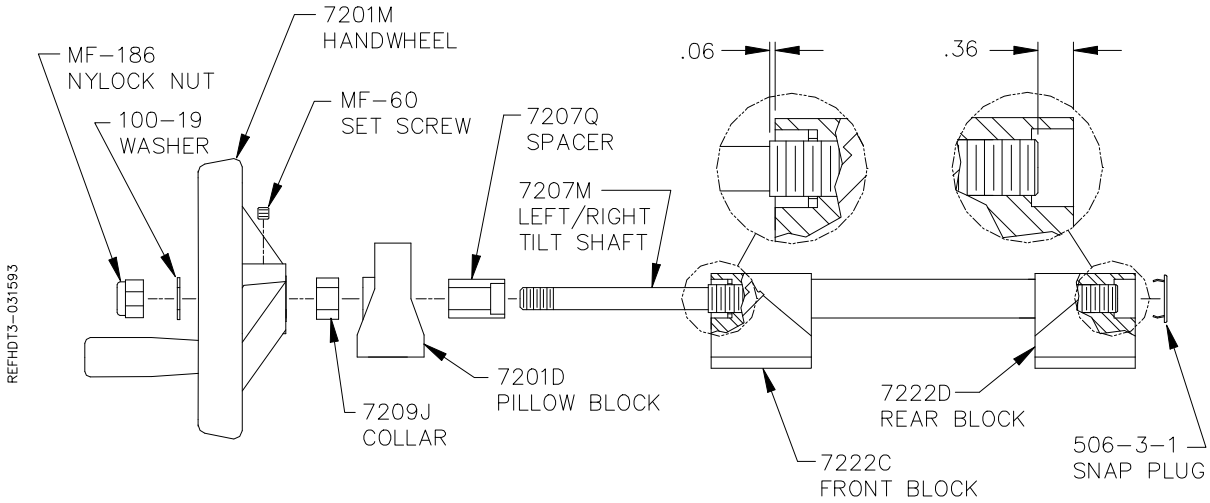
Secure table to Machine surface.
Level table in both directions. Loosen Jam nut (MF-173) and cap screw (7209W) on the table clamp. Loosen adjustable handle (514-2-93D) on the left side of table. Loosen (2) locking set screws (504-29-36) on both sides of journal clamp. Loosen (2) brass tipped set screws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



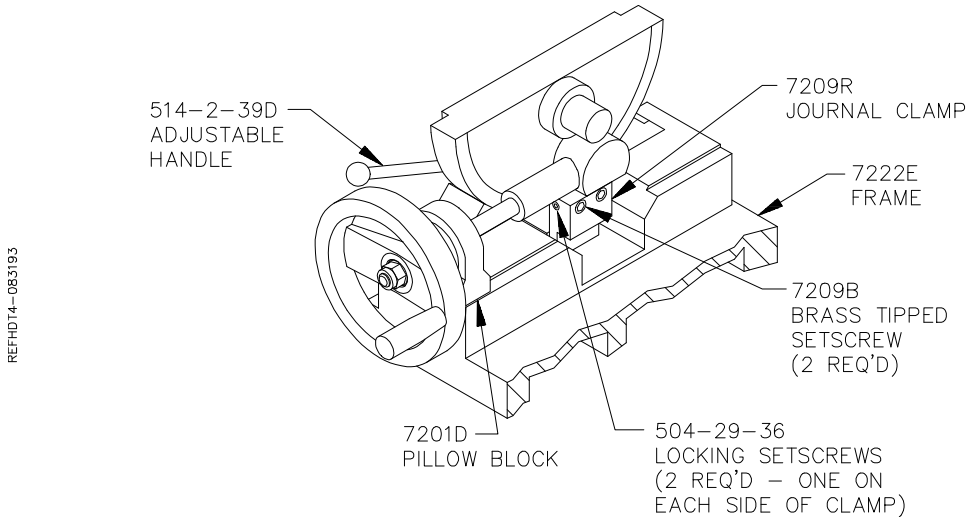
Remove (2) cap screws on right hand pillow block (7210D). Remove tilt shaft assembly from fixture.



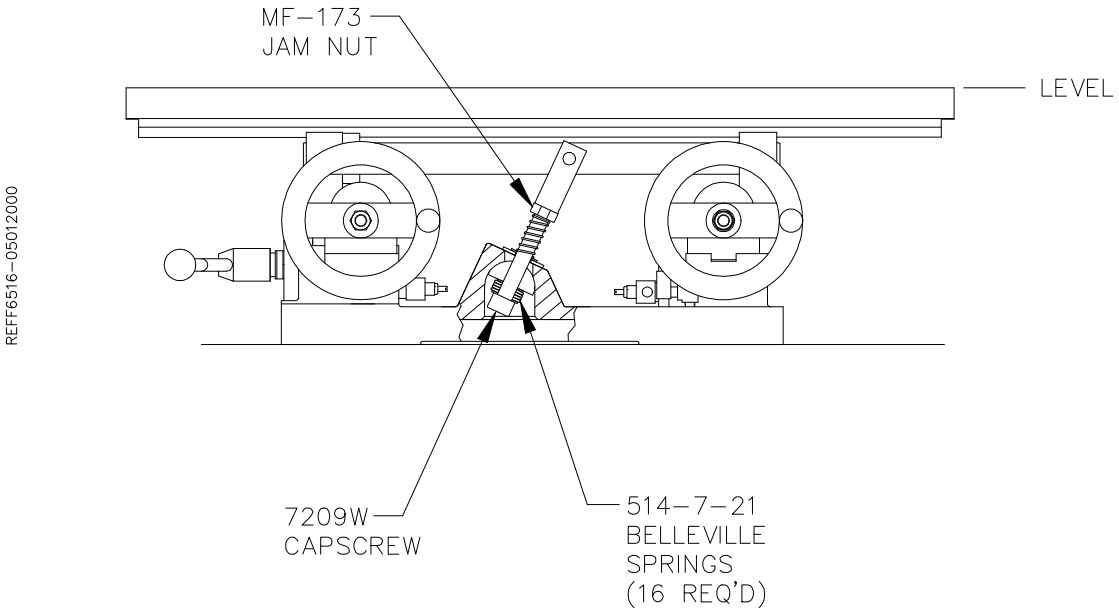
Remove nylock nut (MF-186) and washer (100-19) from shaft (7207M). Loosen set screw (MF-60) and remove hand wheel (7201M). Slide spacer (7207Q) off tilt shaft. Remove snap plug (506-3-1) from rear block (7207L).



Adjust assembly by threading blocks in or out to set them to dimensions shown below.
Reassemble left/right tilt shaft assembly.
Place tilt shaft assembly back into frame.
Lower table top into position. Reinstall (2) cap screws on right hand pillow block. Do not tighten these screws yet.
Loosen bolts on left hand pillow block (7201D). Right hand pillow block should still be loose.
Loosen (2) bolts holding journal clamp (7209R) to frame (7209T).
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.
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.
Tighten locking set screws on journal clamp and both pillow blocks.
Tighten mounting bolts on journal clamp and both pillow blocks.

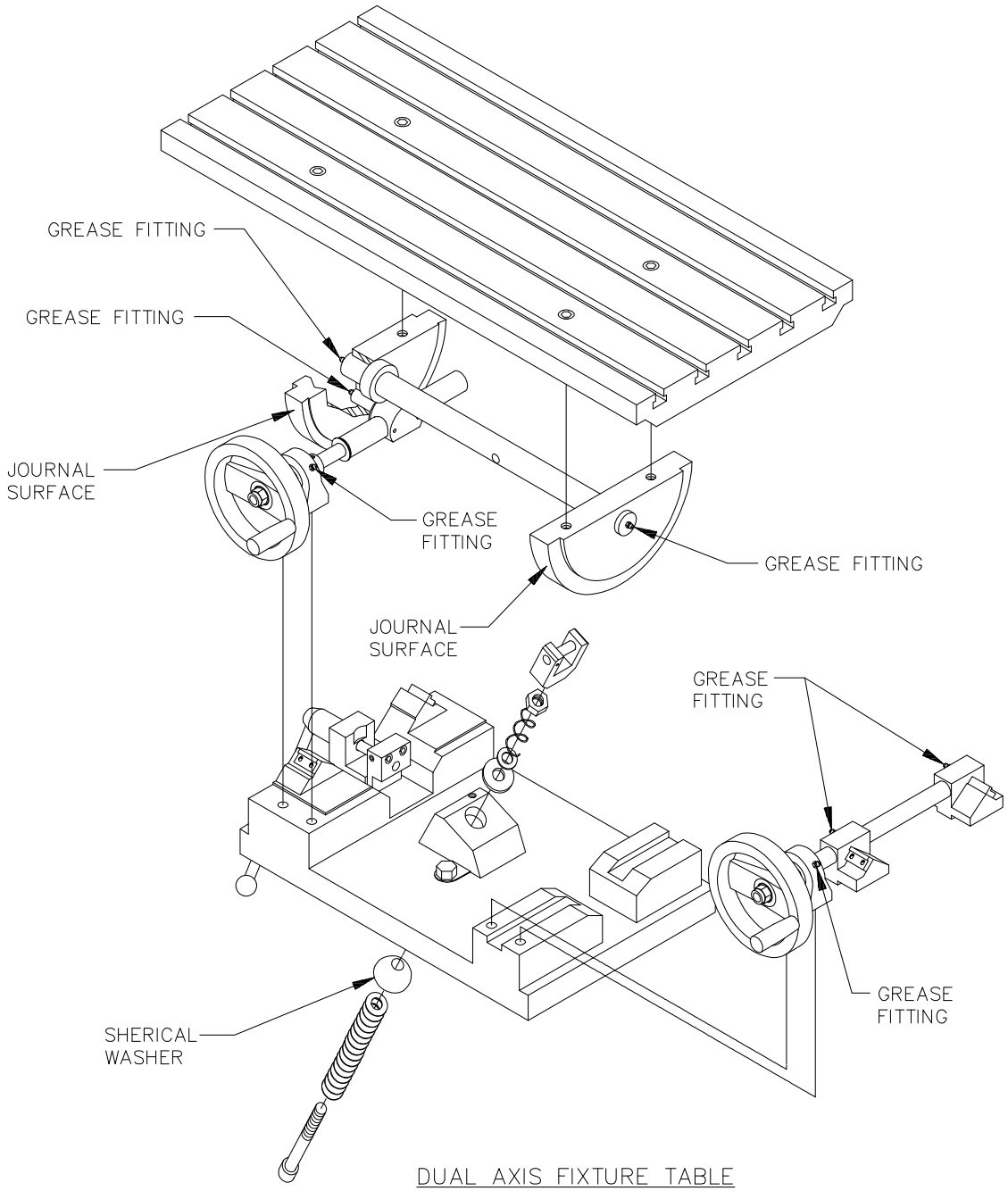


Level table in both directions.
Adjustable handle (514-2-39D) on left side of table should still be loose.
Tighten cap screw (7209W) on table clamp to flatten it's Belleville springs (514-7-21) then back off 3-1/2 turns from tight. Tighten jam nut on table clamp.
Table should now travel both 1/8" min.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



Lubrication:

REFHDT13-062095



DUAL AXIS FIXTURE TABLE LUBRICATION

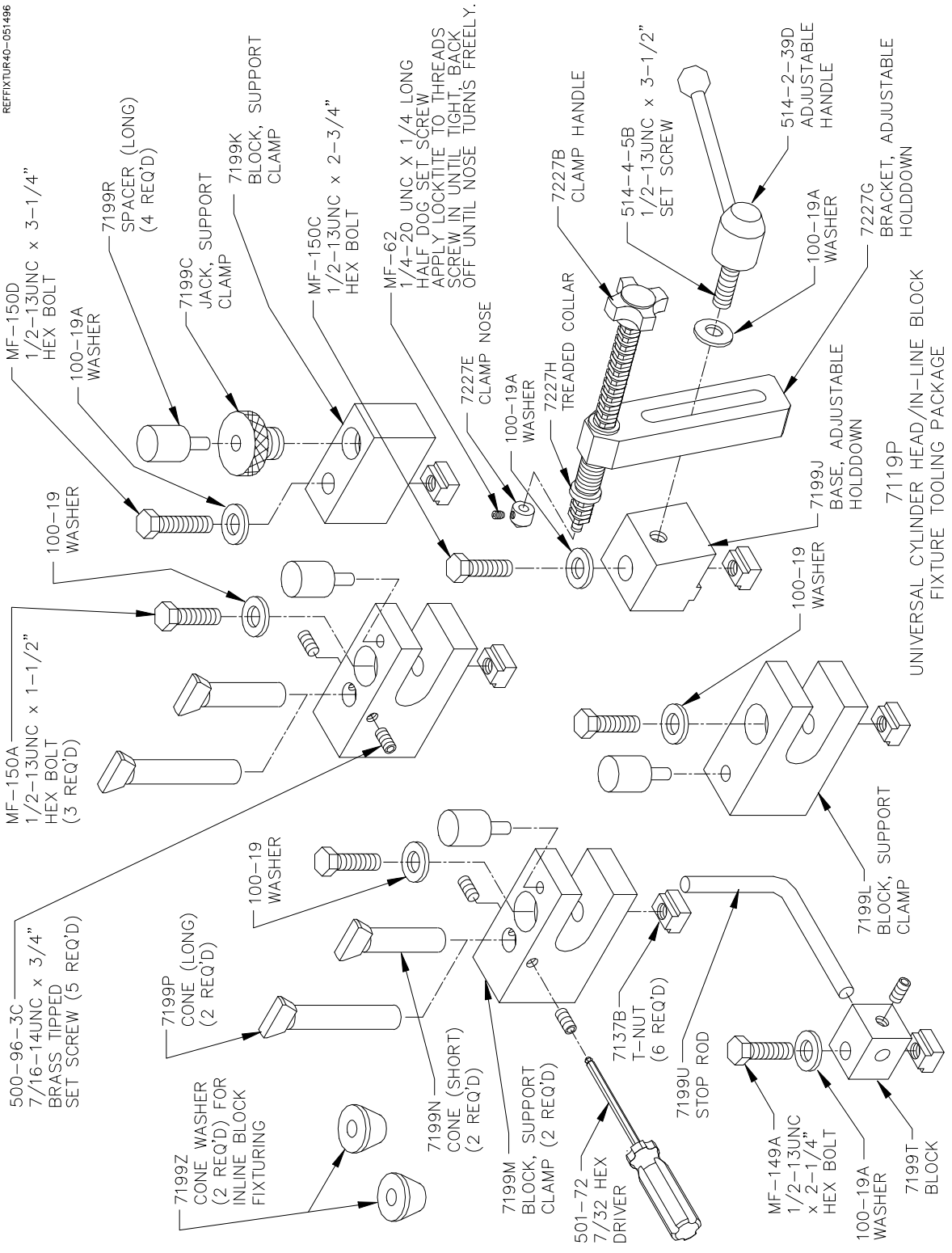
USE F2 MULTIPURPOSE GREASE, CHEVRON DUROLITH, OR ANY EQUIVALENT LITHIUM BARIUM GREASE.

200 HOURS: ADD 2 OR 3 SHOTS OF GREASE TO THE GREASE FITTINGS SHOWN.

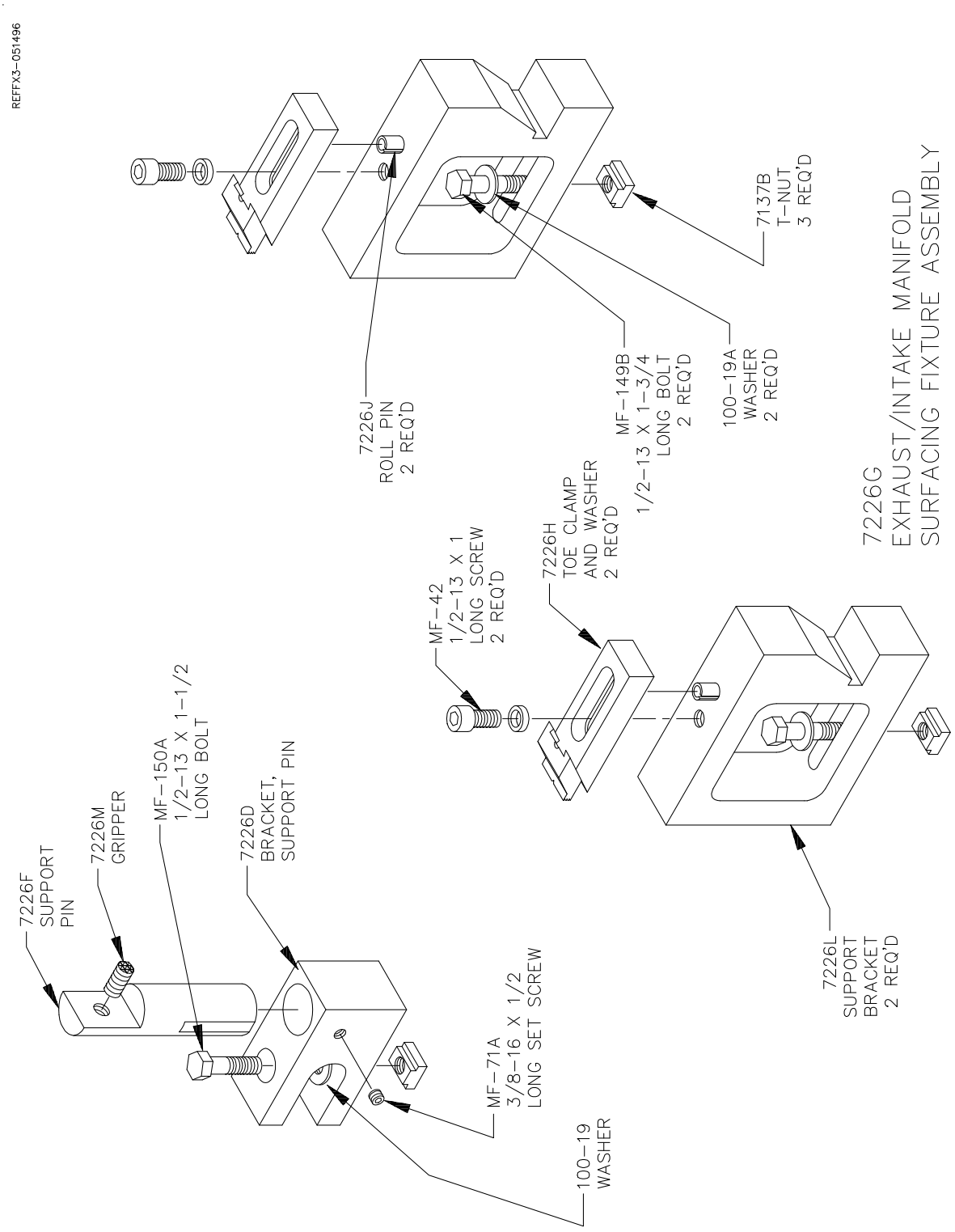
40 HOURS: CLEAN AND ADD GREASE TO THE BEARING SURFACES OF THE JOURNALS.

1000 HOURS: DISASSEMBLE, CLEAN, AND GREASE THE SPHERICAL WASHER.

Universal Tooling Package 7119P:



Exhaust/Intake Manifold Surfacing Fixture Assembly 7226G:



Exhaust/Intake Manifold Fixture:

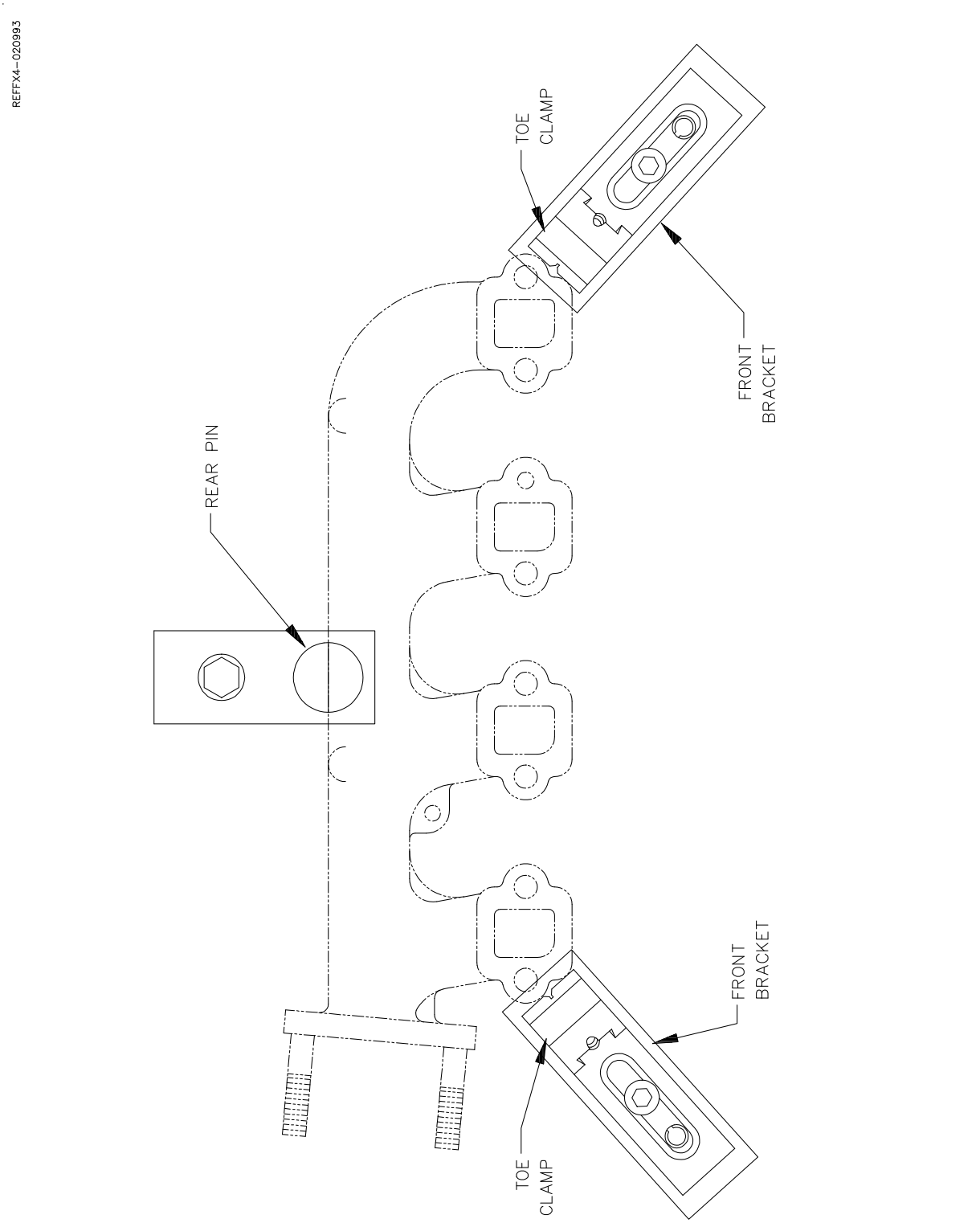
Instructions

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

Exhaust Manifolds

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.
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.
Adjust the rear pin up and down to bring the manifold close to level.
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.
Level the manifold surface using the hand wheels and the dual axis level system of the table.
Make sure there are no obstructions in the way of the cutterhead you are using.
The manifold is ready to surface.

Typical Exhaust Manifold Set-up:



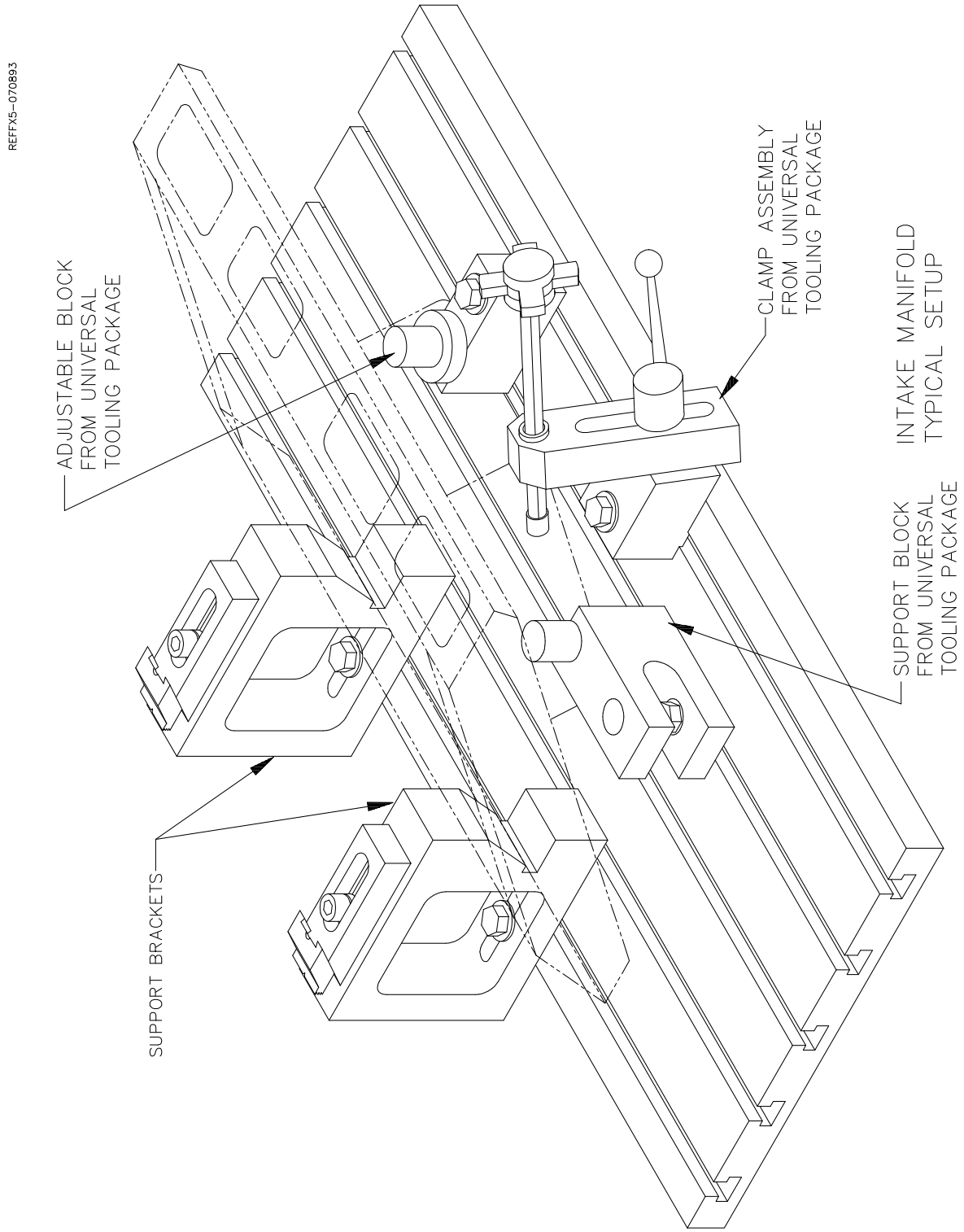
Intake Instructions:

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

This fixture is designed primarily for the intake manifolds from 90 degree V8 engines.
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.
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.
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.
Tighten the clamp handle securely. Check to make sure the manifold did not move.
Using a small precision level, level the exposed intake surface, in both directions, by tilting the dual axis table as necessary.
Using the left hand wheel only, rotate the table to level the lower surface of the manifold.
This surface is ready to cut.
After surfacing , rotate the table using the left hand wheel only, down to the center or lower surface.
Level this surface.
This surface is ready to cut.
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.
Using the left hand wheel, level the second lower surface and cut it.

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

Typical Intake Manifold Set-up:



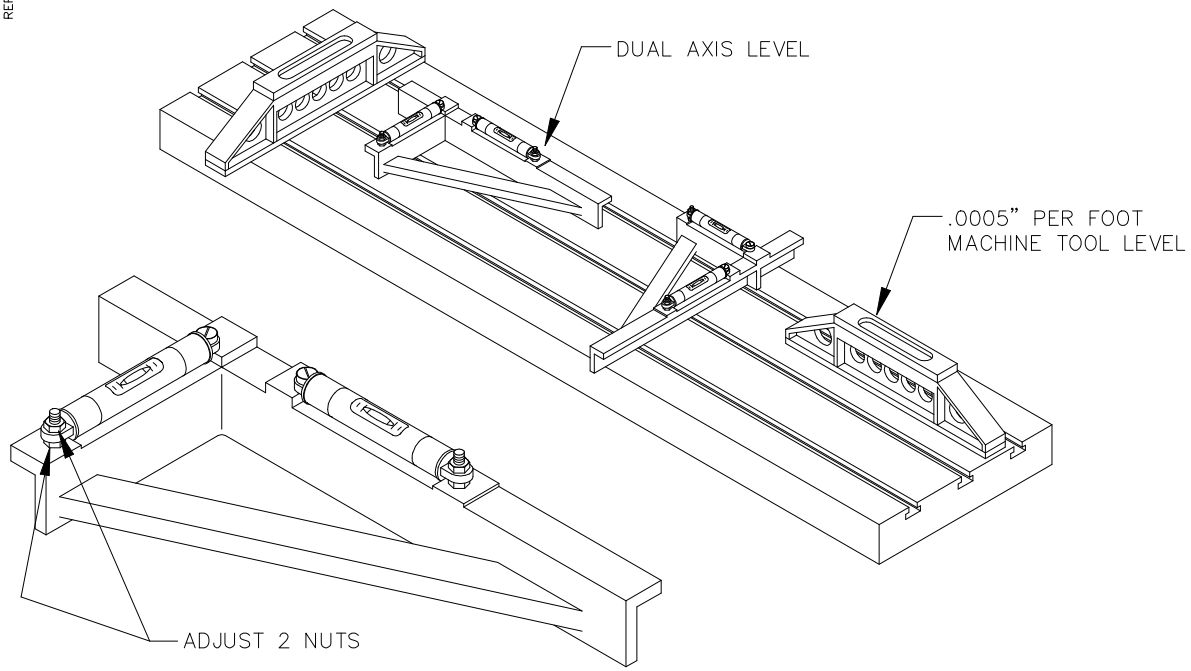
Dual Axis Level Assembly 7125A:

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

Level machine with a .0005/foot machine tool level so that the work surface is level within .0005/foot in both axis.

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. 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 weekly re-check should be adequate, unless you have a reason to doubt accuracy.

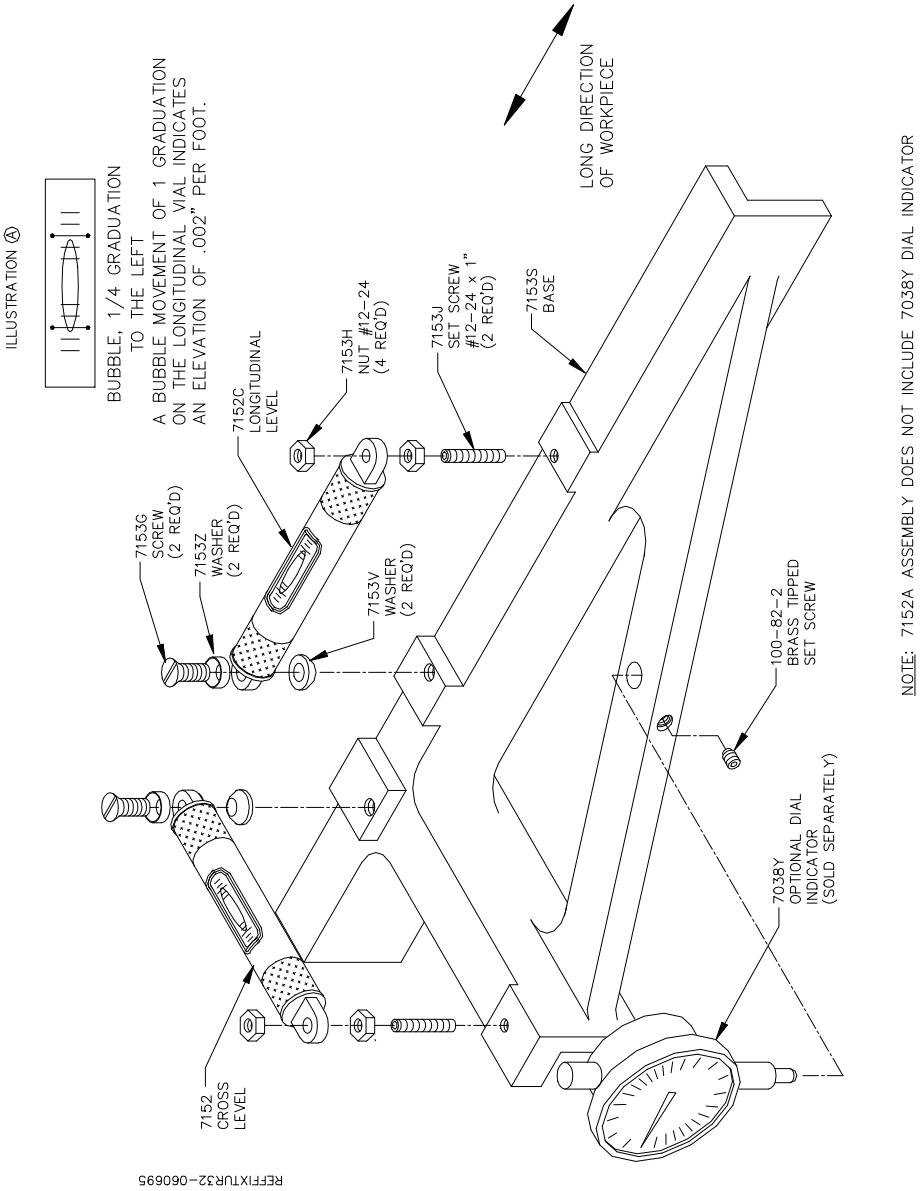
REFF6517--05022000



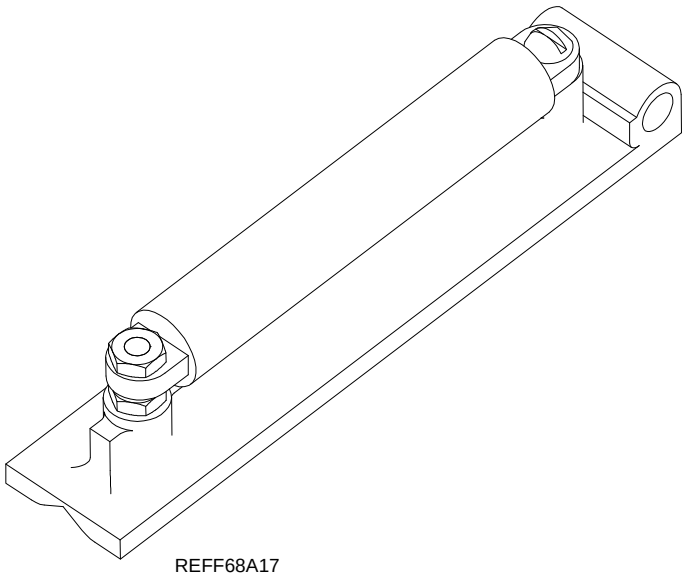
The following procedures are necessary to properly use the leveling table and dual axis level for single cut milling of cylinder head decks.

Place the cylinder head on the table and clamp into place approximately level.
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.
Now, in order to adjust for minimal stock removal, look at the flatness dial indicator (7038Y) reading.

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.
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.

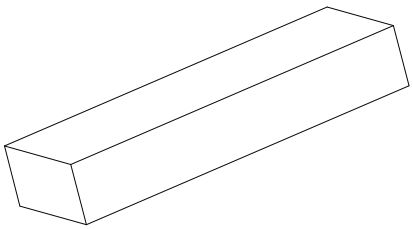


Level Intake and Exhaust Manifold 650-3-38:

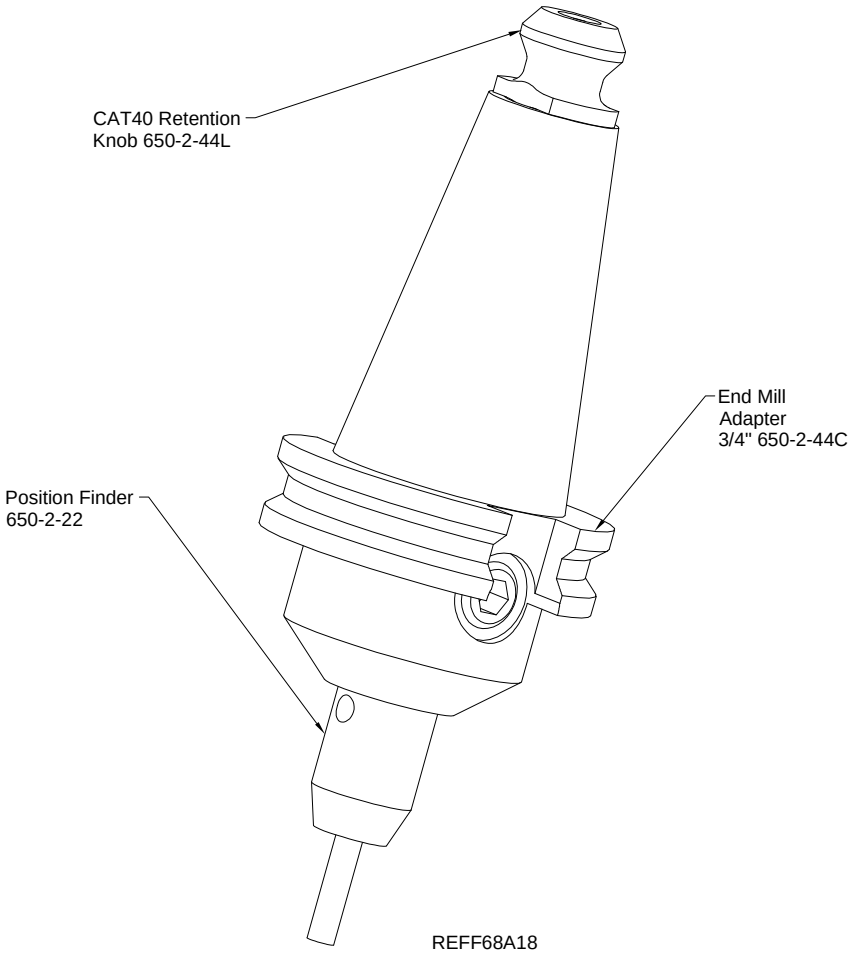


REFF68A17

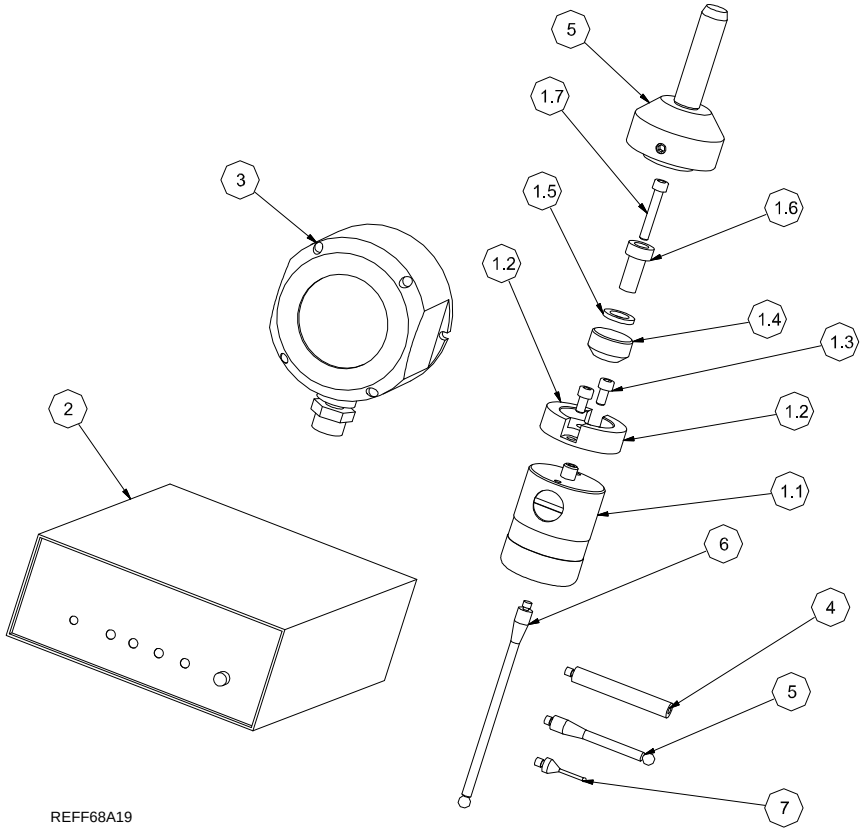
Combination Grit Sharpening Stone 650-2-11H:



3 Dimensional Electronic Position Finder 650-2-44Q:



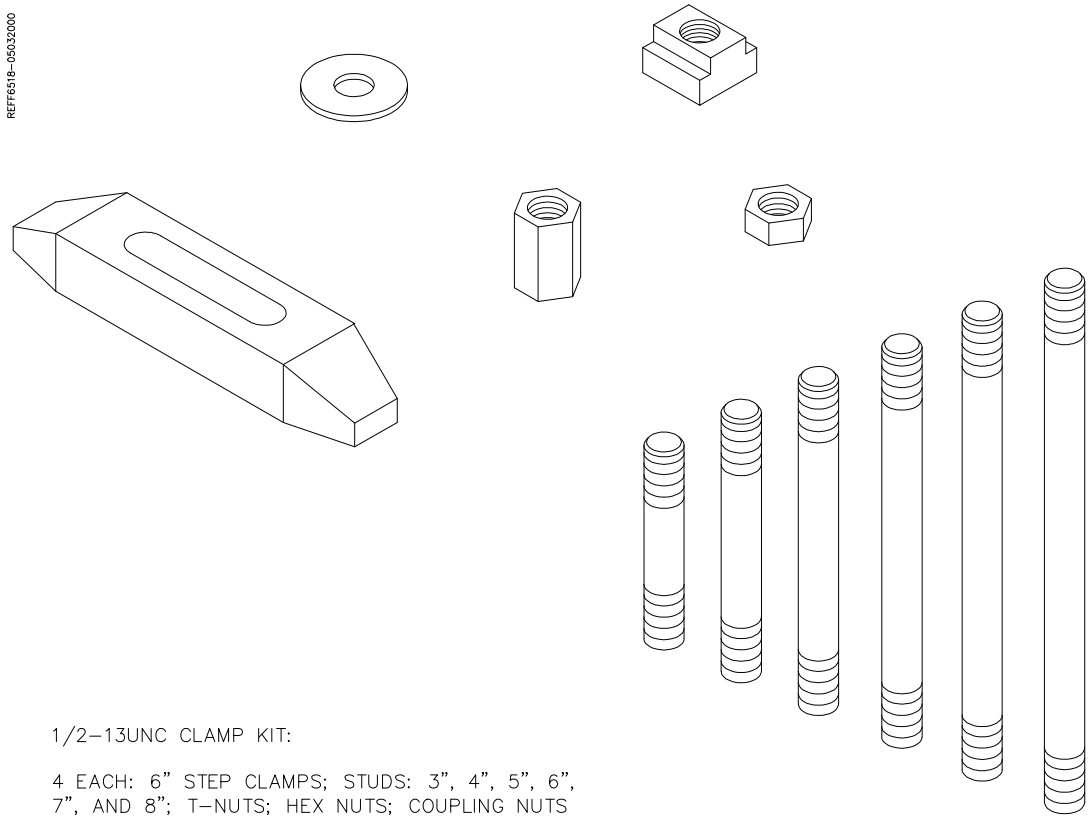
Renishaw Wireless Probing System 650-3-59J:



Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-59A	Harware Kit OMP40
1.1	1	650-3-59A Probe	Probe MP40
1.2	1	650-3-59H Plate	Adapter Plate
1.3	2	ANSI B18.3 - No. 8 - 32 UNC - 5/16	Hexagon Socket Head Cap Screw
1.4	1	650-3-59H Cup	Adjudting Cone
1.5	1	650-3-59H Washer	Washer
1.6	1	650-3-59H Shaft	Shaft
1.7	1	ANSI B18.3 - No. 8 - 32 UNC - 1	Hexagon Socket Head Cap Screw
2	1	650-3-59A Interface	MI12 Interface
3	1	650-3-59A Reciever	OMM Reciever
4	1	650-3-59K	Stylus Exrtension
5	2	650-3-59B	50 mm Stylus
6	2	650-3-59C	100 mm Stylus
7	1	650-3-59E	Small Stylus
8	2	ANSI B18.3 - 1/4-20 UNC x 0.31	Hexagon Socket Set Screw - Cone Point

½” Clamp Kit:

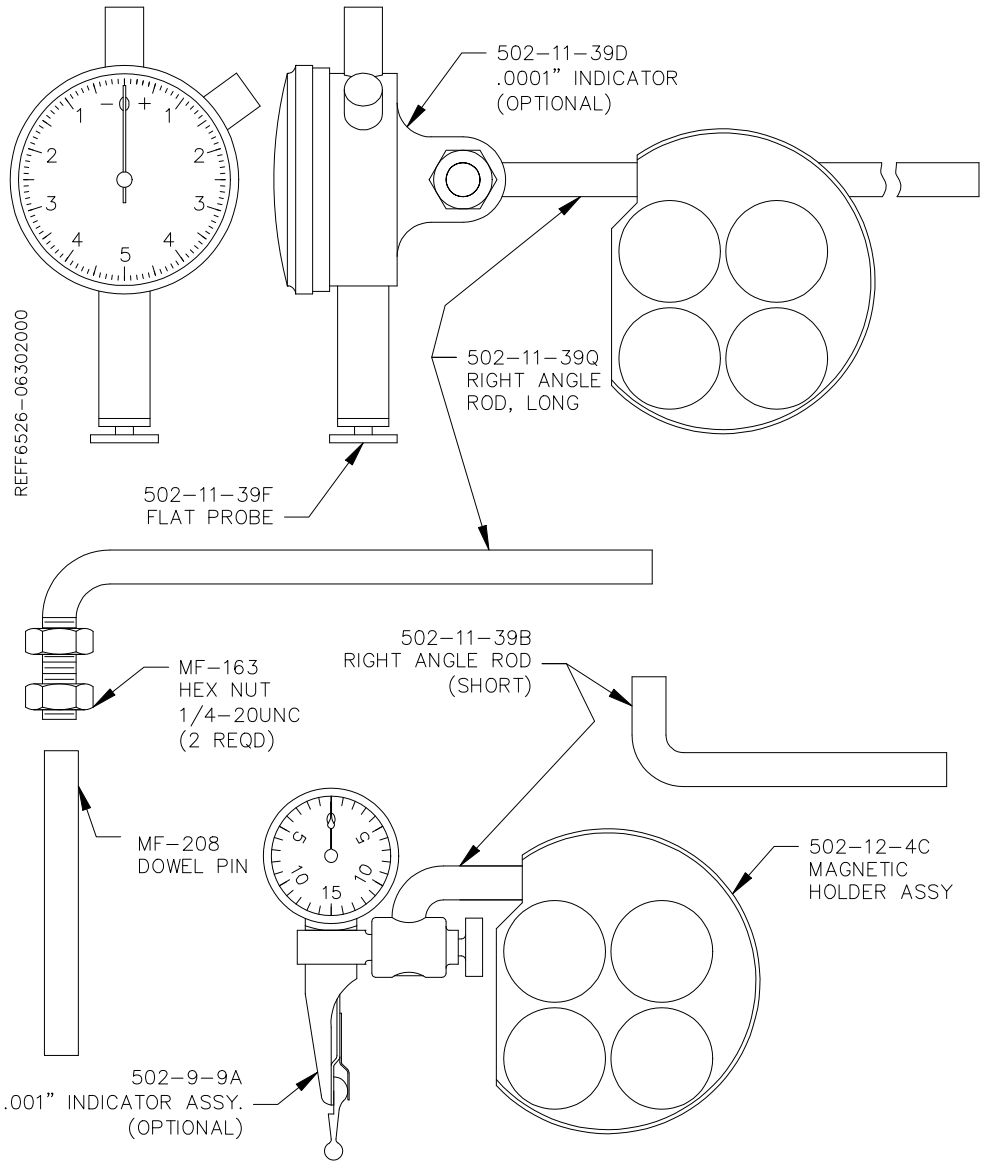
650-3-37



1/2–13UNC CLAMP KIT:

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

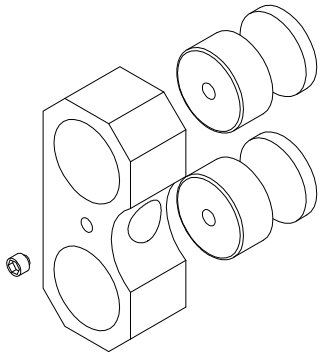
Magnetic Indicator Holder 502-12-4:



Magnetic Indicator Holder 502-12-4A:

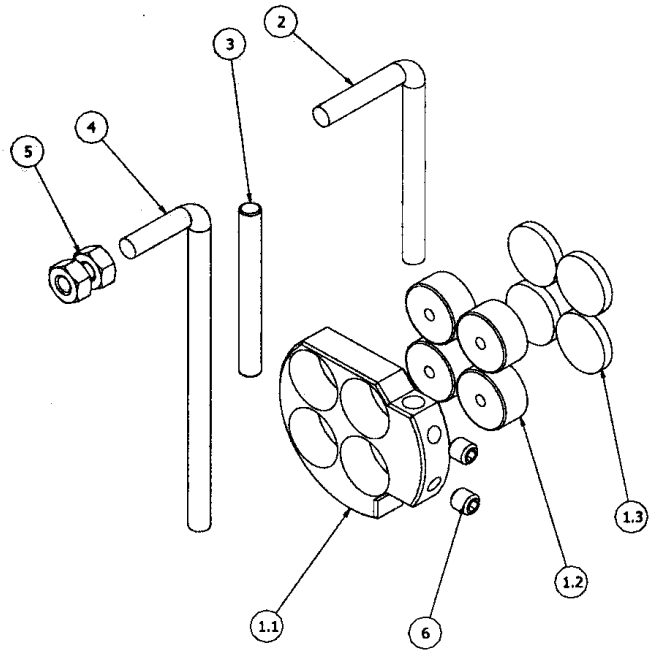
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-12-4B	Magnet Holder, Indicator Assembly
2	1	502-12-4D	SOCKET SET SCREW, BRASS TIPPED 8-32 X 1//8
3	2	502-11-39	Magnet
4	2	Magnet Washer	

REFF68A36

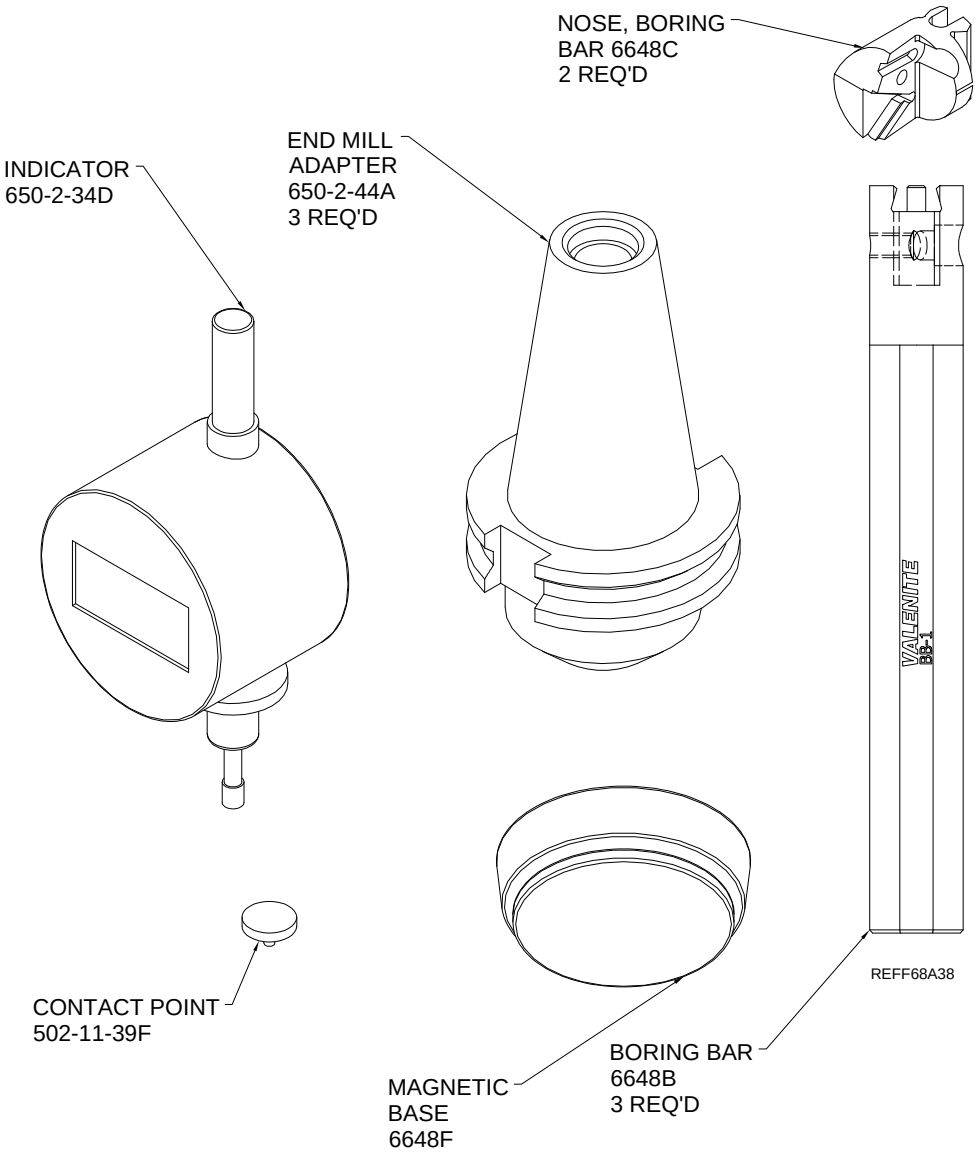


502-12-4 Magnetic Holder Assembly:

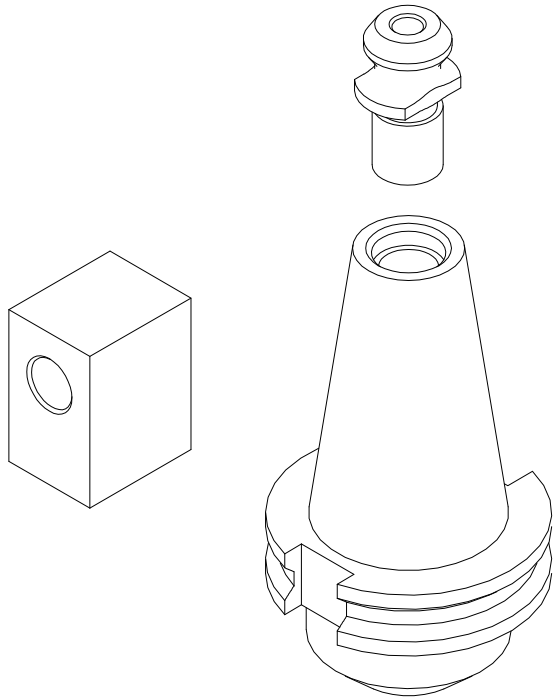
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-12-4C	Magnet Holder Assembly w/ Magnets Installed
1.1	1	502-11-39A	Holder, Magnet
1.2	4	502-11-39	Magnet
1.3	4	Magnet Washer	
2	1	502-11-39B	Rod, Adapter Right Angle
3	1	ANSI B18.8.2 - 1/4 x 2 1/4	Pin - Hardened Ground Production Dowel
4	1	502-11-39Q	Rod, Adapter Right Angle Long
5	2	ANSI B18.2.2 - 1/4 - 20	Hex Nut
6	2	ANSI B18.3 - 1/4-20 UNC x 0.25	Hexagon Socket Set Screw - Flat Point



Lifter Bore Tooling Kit 6648H:



Chevrolet Lifter Bore Tooling Package 650-2-44R:



Additional Tooling Included with 650-2-44R

650-2-20C	End mill, Special .980" [24.892mm] diameter x 8 1/2" [216mm] long-4 flute (1" [25.40mm] Shank) (Chev)
650-2-44A	Adaptor-1" [25.40mm] CAT 40 taper **(2 required)** Cost for each:
650-2-20L	End mill, Center cutting, 1 1/8" [28.575mm] diameter x 6 1/2" [165.10mm] long-6 flute (1" [25.40mm] Shank) (Chev and Ford)
650-2-20F	Expansion reamer, Special .998" [25.349] diameter x 10 1/2" long [267mm] (7/8" [22.225mm] Shank) (Chev)
650-2-44B	Adaptor-7/8" (22.225mm) CAT 40 taper
650-2-20M	Expansion reamer, Special .842/.843" [21.387/21.412mm] diameter X 9 1/2" long [241mm] (5/8" [15.875mm] Shank) (Chev)
650-2-44D	Adaptor-5/8" [15.875mm] CAT 40 taper
650-3-7E	4-degree cam bar spacer-Chev. Small block only
650-3-7F	6.25 degree cam bar spacer-Chev. Big block only
650-2-44L	Retention Knob (4 required)

Tooling Required for Additional Block models not included in the Chevrolet Package:

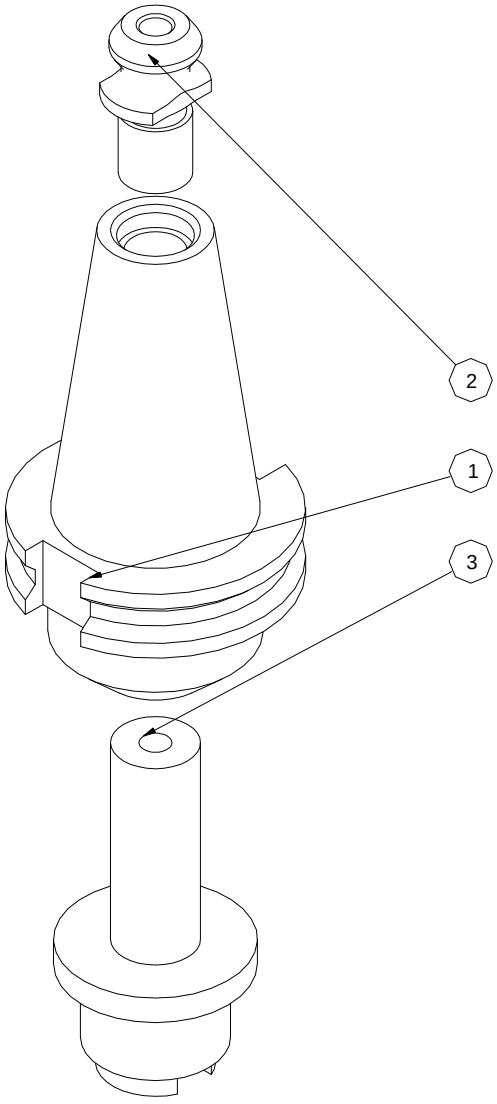
650-2-20Q	End mill, Special .859" [21.819] diameter X 8 1/4" [210mm] long-4 flute (7/8" [22.225mm] shank)-Requires 650-2-20G adaptor (Ford)
650-2-20J	Expansion reamer, .875" [22.225mm] diameter X 10" [254mm] long (3/4" [19.05mm] Shank) (Ford)
650-2-20X	End mill, Special .890" [22.606mm] diameter X 8 1/4" [210mm] long-4 flute (7/8" [22.225mm] shank)-Requires 650-2-20G adaptor (Mopar)
650-2-20V	Expansion reamer, .9035/.904" [22.949/22.962mm] diameter X 10" [254mm] long (3/4" [19.05mm] Shank) (Mopar)
650-2-20Y	Expansion reamer. Special .993 diameter [25.22mm] X 10-1/2" [267mm] long (7/8" [22.225mm] shank) (Mopar)
650-2-44C	Adaptor-3/4" (19.05mm) CAT 40 taper w/Retention Knob 650-2-44L

	Complete Listing of CAT 40 Taper End Mill Holders
650-2-44J	Adaptor-1/2" (12.70mm) CAT 40 taper with 650-2-44L Retention Knob
650-2-44D	Adaptor-5/8" (15.875mm) CAT 40 taper with 650-2-44L Retention Knob
650-2-44C	Adaptor-3/4" (19.05mm) 1 CAT 40 taper with 650-2-44L Retention Knob
650-2-44B	Adaptor-7/8" (22.225mm) CAT 40 taper with 650-2-44L Retention Knob
650-2-44A	Adaptor-1" (25.40mm) CAT 40 taper with 650-2-44L Retention Knob
650-2-44K	Adaptor-1 1/4" (31.75mm) CAT 40 taper with 650-2-44L Retention Knob

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

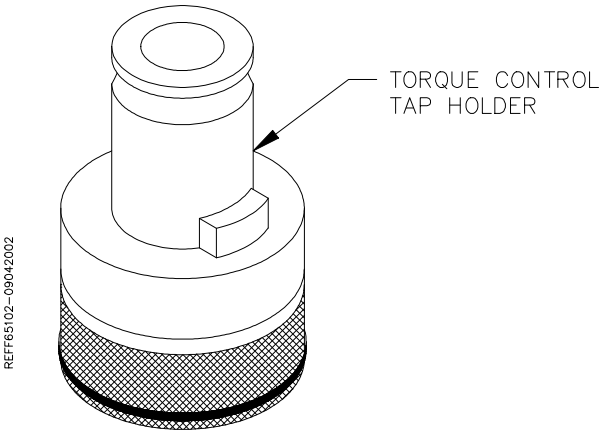
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-44C	Adapter 3/4"
2	1	650-2-44L	CAT 40 Retention Knob
3	1	650-2-11B	Quick Change Straight Shank

REF658A40



Torque Control Tap Holders:

Use with 650-2-11B Assembly



650-2-11C	Torque Control Tap Holder for 1/4" (6.35mm) taps
650-2-11D	Torque Control Tap Holder for 5/16" (7.95mm) taps
650-2-11E	Torque Control Tap Holder for 3/8" (9.525mm) taps
650-2-11F	Torque Control Tap Holder for 7/16" 11.13mm) taps
650-2-11G	Torque Control Tap Holder for 1/2" (12.70mm) taps

Precision Drill Chuck Assembly 650-2-44M:

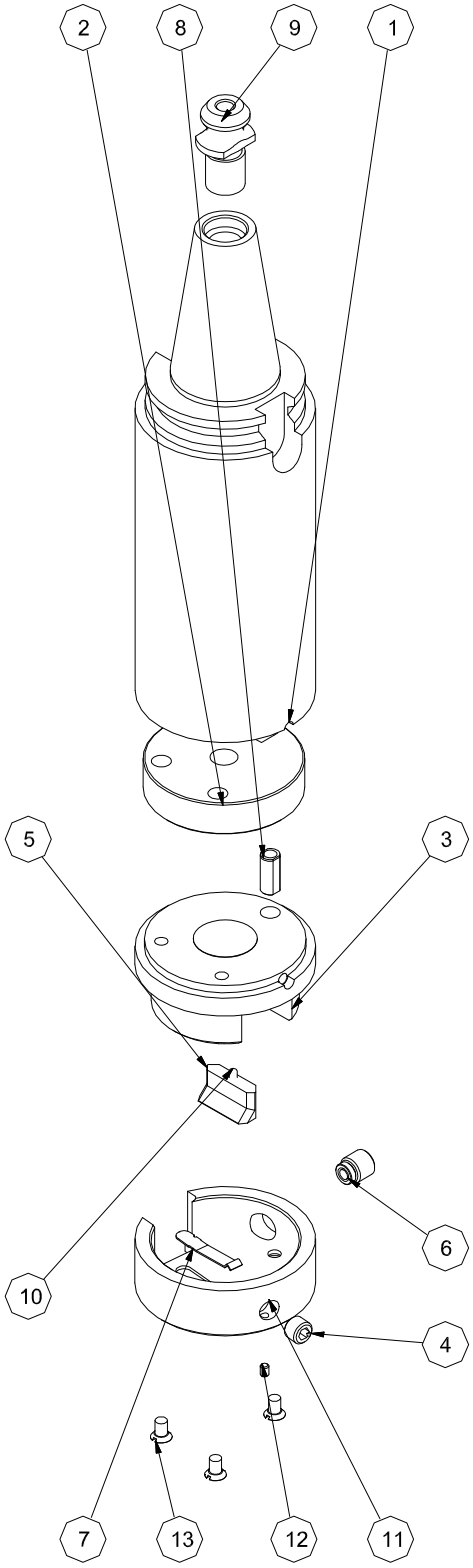
650-2-44	Drill Chuck Adaptor
650-2-9B	Drill Chuck - 1/8-5/8" (3.175-15.875mm) with key
650-2-44L	Retention Knob

2.9” Cutterhead:

650-2-14B with Tooling
650-2-14C without Tooling

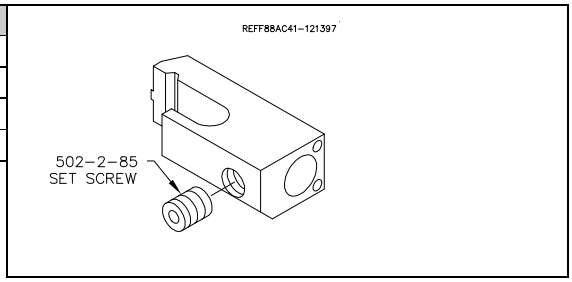
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-15E	
2	1	6521	Counter Weight
3	1	650-2-16	BODY, 2.9" STUB BAR F60
4	1	502-2-85B	Index Screw
5	1	6263A	Tool Holder Clamp Screw
6	1	501-70A	Tool Holder Lock Screw ass'y
7	1	100-1A	Tool Lock Spring
8	1	502-2-45B	Bushing - Counterweight
9	1	650-2-44L	CAT40 Retention Knob
10	1	ANSI B18.8.2 - 1/8 x 5/16	Pin - Hardened Ground Production Dowel
11	1	650-2-17	Cap, 2.9" Stub Bar
12	1	ANSI B18.3 - 6-32 UNC x 0.19	Hexagon Socket Set Screw - Flat Point
13	3	ANSI B18.6.3 - 10-24 UNC x 2.25	Slotted Undercut Flat Countersunk Head Machine Screw

REFF68A20



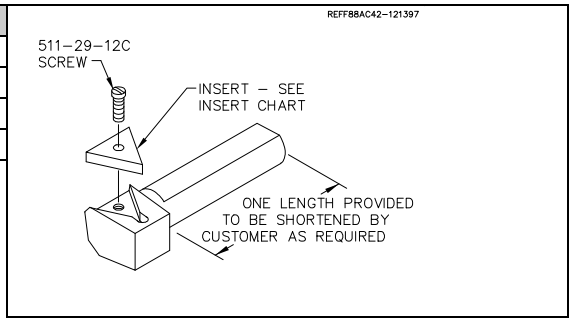
2.9" Cutterhead Standard Tooling:

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



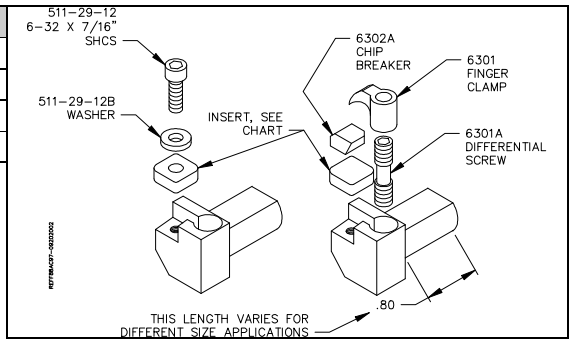
6598K Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6598M	6520H	3.75" – 4.00"
6598M	6520A	4.00" – 4.50"
6598M	6520B	4.50" – 5.00"

Triangle insert positive rake



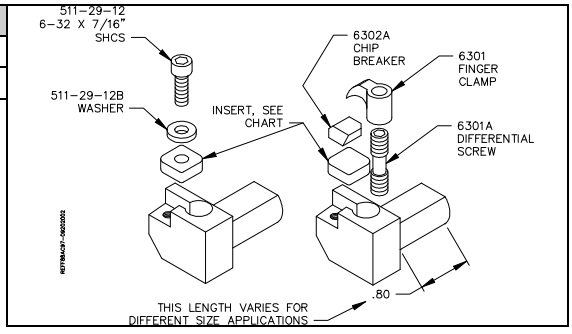
6598K Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6260L	6520H	3.75" – 4.00"
6260L	6520A	4.00" – 4.50"
6260L	6520B	4.50" – 5.00"

Square insert negative rake



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

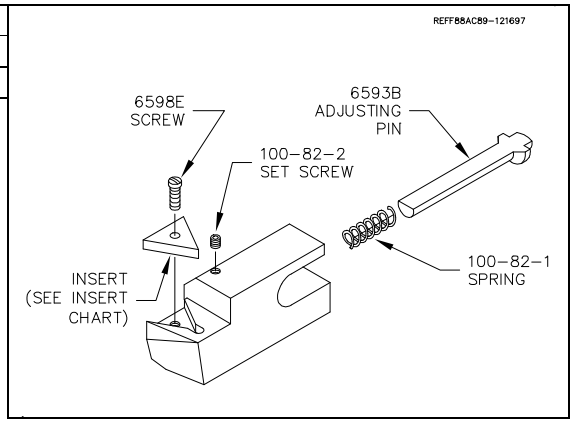
Square insert negative rake



Cartridge Tool Holders:

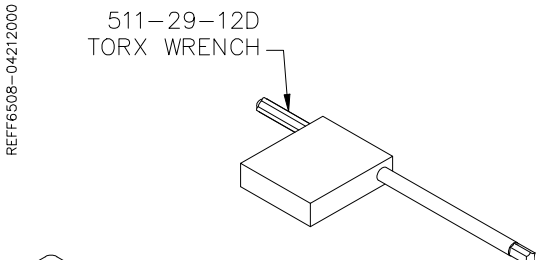
Tool Holder	Length	Bore Range
6593C	2.03”	2.90” – 3.40”
6593D	2.25”	3.40” – 3.90”

Triangle insert positive rake



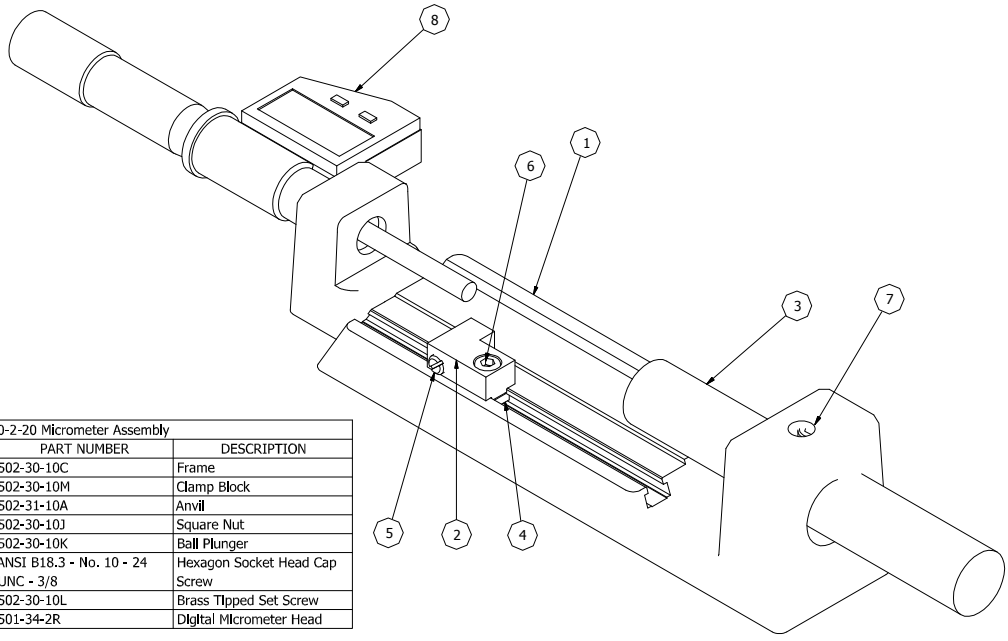
511-29-12D Torx Wrench

For use with Torx style screw in Triangle cartridges.



900-2-20 Universal Digital Micrometer Assembly

2.9” – 5.0”

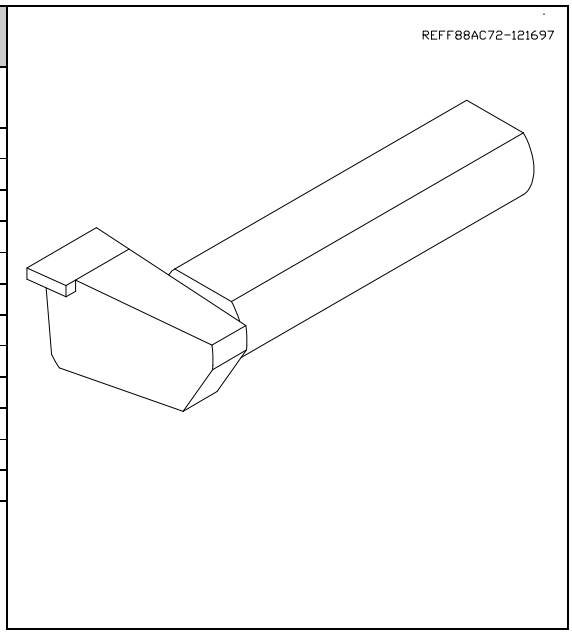


900-2-20 Micrometer Assembly			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-30-10C	Frame
2	1	502-30-10M	Clamp Block
3	1	502-31-10A	Anvil
4	1	502-30-10J	Square Nut
5	1	502-30-10K	Ball Plunger
6	1	ANSI B18.3 - No. 10 - 24 UNC - 3/8	Hexagon Socket Head Cap Screw
7	1	502-30-10L	Brass Tipped Set Screw
8	1	501-34-2R	Digital Micrometer Head

REFF68A21

2.9" Cutterhead Optional Tooling:

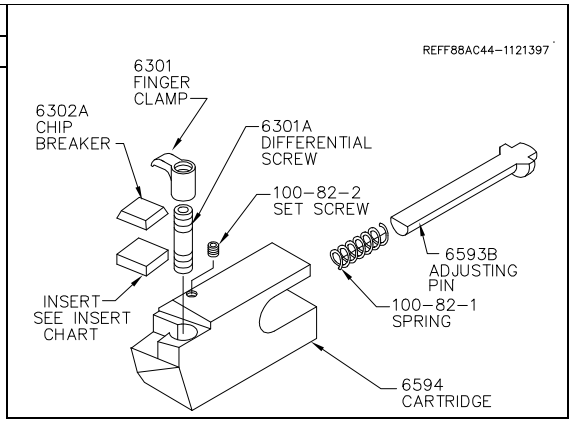
6513 Series Grooving Tool Bits when used with 6520 Holders			
Tool Bit	Groove DIA.	Tool Holder	Bore Range
6513J	.037"	6520H	3.55" – 3.95"
6513J	.037"	6520A	3.95" – 4.45"
6513J	.037"	6520B	4.45" – 4.85"
6513L	.039"	6520H	3.55" – 3.95"
6513L	.039"	6520A	3.95" – 4.45"
6513L	.039"	6520B	4.45" – 4.85"
6513N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



6594 Cartridge Tool Holder:

Bore Range
2.90" – 3.90"

Square insert negative rake



Miscellaneous Tooling for 650-2-14B Cutterhead:

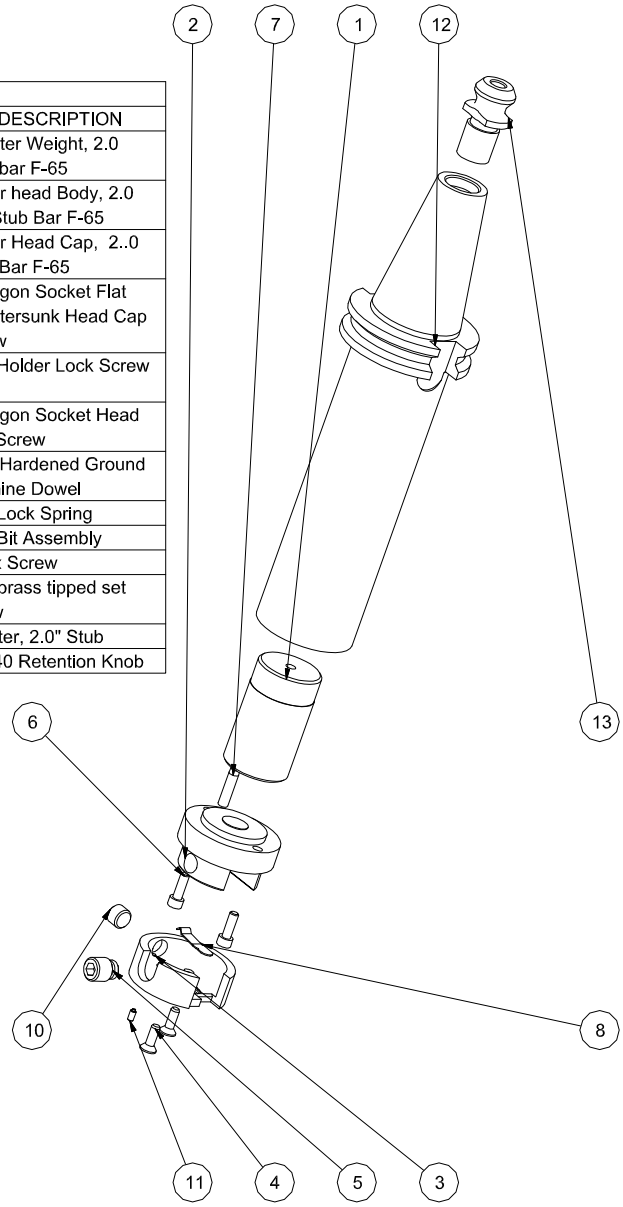
501-29-6K	PCD Tipped Insert for Boring Aluminum Only - ideal for finishing boring of aluminum blocks in preparation for a sleeve.
6598M	Cartridge, Triangular, Pos. Rake, 13/16 Shank Length, For Counter Boring
6513J	Toolbit, brazed carbide-.037 wide O ring grooving
6513L	Toolbit, brazed carbide-.039 wide O ring grooving
6513N	Toolbit, brazed carbide-.060 wide O ring grooving
6513P	Toolbit, brazed carbide - .085 wide O ring grooving
6747H	Cartridge assembly-30 degree chamfer for Triangular positive rake inserts
6747F	Cartridge assembly-20 degree chamfer for Triangular positive rake inserts
6747G	Cartridge assembly - 15 degree chamfer for Triangular positive rake inserts
6593L	Cartridge assembly, offset indexable insert, triangular positive rake (3.14 - 3.40 diameter)
6593M	Cartridge assembly, offset indexable insert, triangular positive rake (3.40 - 3.90 diameter)
6593N	Cartridge assembly, offset indexable insert, triangular positive rake (3.90 - 4.40 diameter)
6593P	Cartridge assembly, offset indexable insert, triangular positive rake (4.40 - 4.90 diameter)

2.0” Cutterhead:

650-2-1D with Tooling
650-2-1E without Tooling

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-5	Counter Weight, 2.0 Stub bar F-65
2	1	650-2-4	Cutter head Body, 2.0 dia. Stub Bar F-65
3	1	650-2-6	Cutter Head Cap, 2..0 Stub Bar F-65
4	2	ANSI B18.3 - 8-32 UNC x 0.5	Hexagon Socket Flat Countersunk Head Cap Screw
5	1	501-70A	Tool Holder Lock Screw ass'y
6	2	ANSI B18.3 - No. 8 - 32 - 1/2	Hexagon Socket Head Cap Screw
7	1	ANSI B18.8.2 - 3/16 x 3/4	Pin - Hardened Ground Machine Dowel
8	1	100-1B	Tool Lock Spring
9	1	6801E	Tool Bit Assembly
10	1	502-2-85B	Index Screw
11	1	650-2-6A	4-40 brass tipped set screw
12	1	650-2-3N	Adapter, 2.0" Stub
13	1	650-2-44L	CAT40 Retention Knob

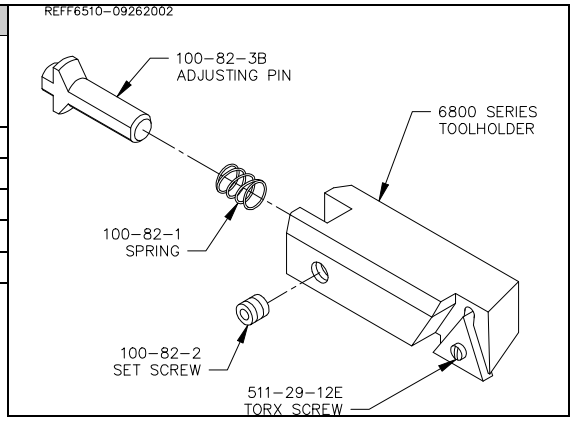
REFF68A21



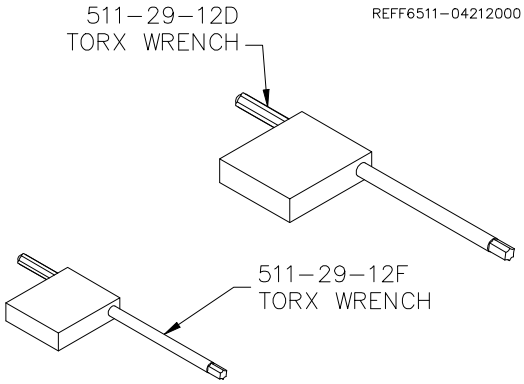
2.0” Cutterhead Standard Tooling:

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”

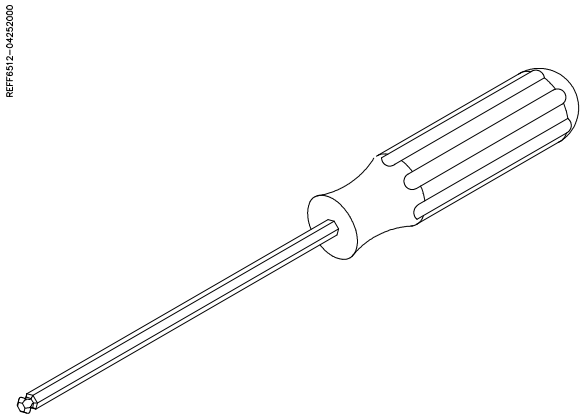
Triangle insert positive rake



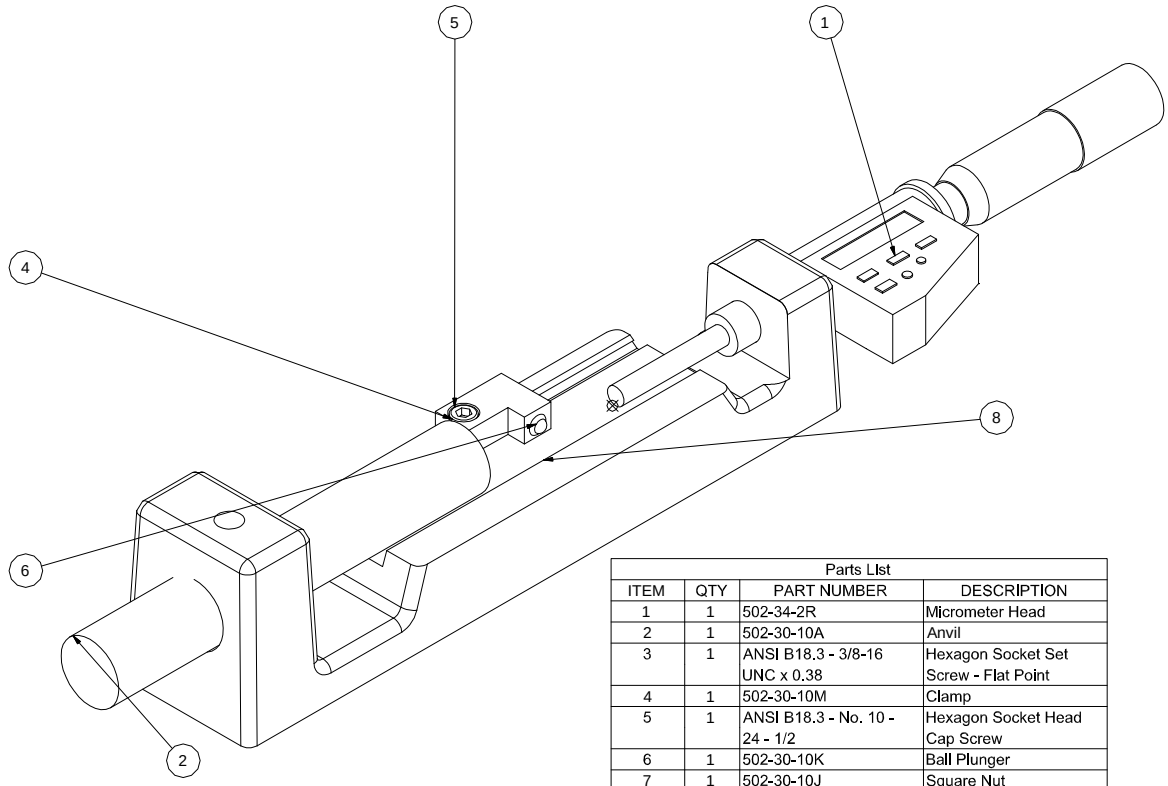
511-29-12F Torx Wrench
For use with Torx style screw in Triangle cartridges.



501-72J Hex Driver

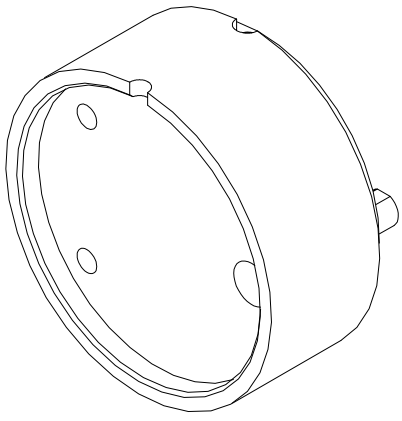


900-2-19 Micrometer Assembly
2.0” – 4.0”



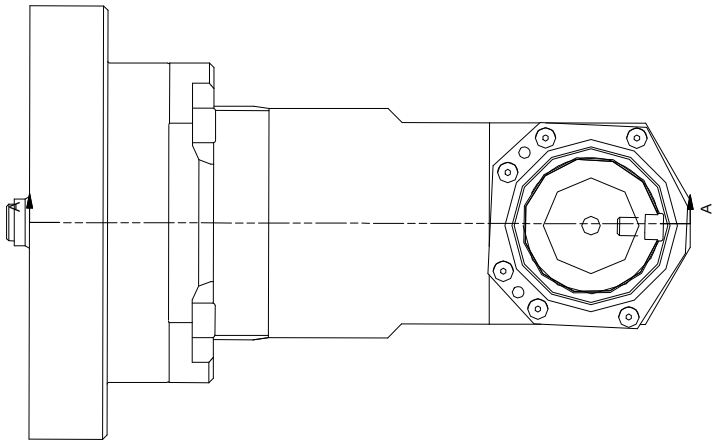
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10A	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square Nut
8	1	502-30-10B	Micrometer Frame

650-2-16D Extender for 650-2-14C Cutterhead:



REFF68A22

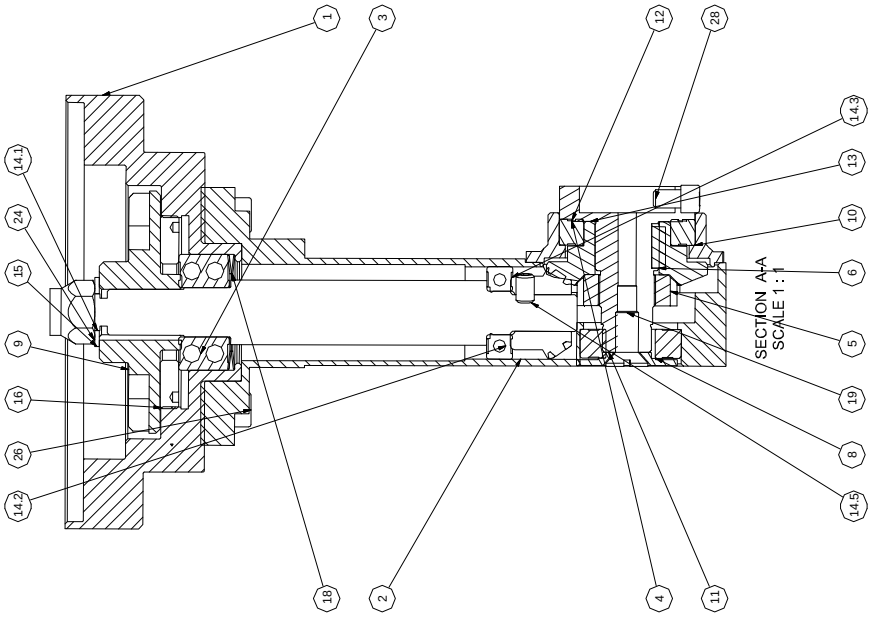
Right Angle Drive 6753M:



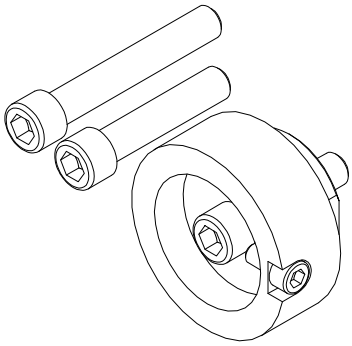
Parts List

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6770D	Hub, Mounting
2	1	6773C	Housing
3	1	502-9-32	Bearing, Ball MRC 5203SBKFF
4	1	502-9-72C	Bearing
5	1	6705B	Nut, Lock Bearing
6	1	650-2-18M	Key, Micarta
7	1	6752Q	Key
8	1	6753E	Bearing, 90 Degree Head
9	1	6771B	Driver
10	1	6774D	Cover, Bearing Retainer
11	1	6766F	Spacer, Bearing Vertical
12	1	650-2-42	Shaft, Horizontal Precision
13	1	6766W	Gear, Ring
14	1	6775A	Pinion and Shaft assembly
14.1	1	6775	Shaft, Vertical
14.2	1	700-11	Ball Bearing
14.3	1	6752M	Pinion, right angle drive
14.4	1	6752Q	Key
14.5	1	ANSI B18.3 - 1/4-20 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
15	1	100-19	Hardened Washer
16	1	6772A	NUT, BEARING LINE BORE HEAD
17	1	ANSI B18.3 - 10-24 UNC x 0.38	Hexagon Socket Set Screw - Half Dog Point
18	2	6007A	Washer, Belleville
19	1	6774K	Slotted Flat Countersunk 5/16-24 x 3/4
20	6	6774E	Hexagon Socket Head Cap Screw
21	1	650-2-43A	SPACER - 1.50" LONG
22	1	650-2-43	1.05 SPACER
23	1	650-2-43B	SPACER - .70" LONG
24	1	IFI 100/107 - 1/2 - 13 Top Insert Type	Prevailing Torque Type Hex Nut
25	1	ANSI B18.3 - 1/4-20 UNC x 0.25	Hexagon Socket Set Screw - Flat Point
26	4	5/16-0.75-UNC	S.H.C.S. 5/16 - 18 UNC - 3/4
27	2	ANSI B18.8.2 - 5/32 x 1/2	Pin - Hardened Ground Production Dowel
28	1	MI-11	Socket Head Cap screw 1/4 - 20 UNC - 3/8

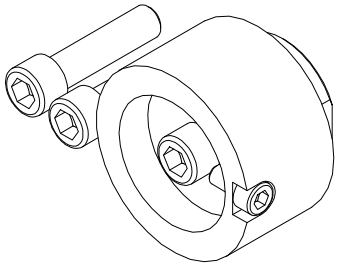
REFF68A24



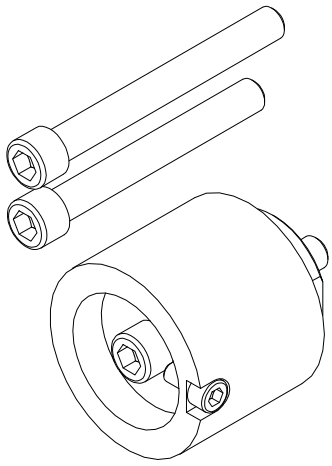
Extension Spacer for Right Angle Drive Assemblies:



Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-43B	SPACER - .70" LONG
2	1	ANSI B18.3 - No. 10 - 24 - 3/8	Hexagon Socket Head Cap Screw
3	1	ANSI B18.3 - 5/16 - 18 - 1 1/4	Hexagon Socket Head Cap Screw
4	1	ANSI B18.3 - 5/16 - 18 - 1 1/2	Hexagon Socket Head Cap Screw
5	1	ANSI B18.3 - 5/16 - 18 - 2	Hexagon Socket Head Cap Screw



Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-43	1.05 SPACER
2	1	ANSI B18.3 - No. 10 - 24 - 3/8	Hexagon Socket Head Cap Screw
3	1	ANSI B18.3 - 5/16 - 18 - 5/8	Hexagon Socket Head Cap Screw
4	1	ANSI B18.3 - 5/16 - 18 - 1	Hexagon Socket Head Cap Screw
5	1	ANSI B18.3 - 5/16 - 18 - 1 1/4	Hexagon Socket Head Cap Screw

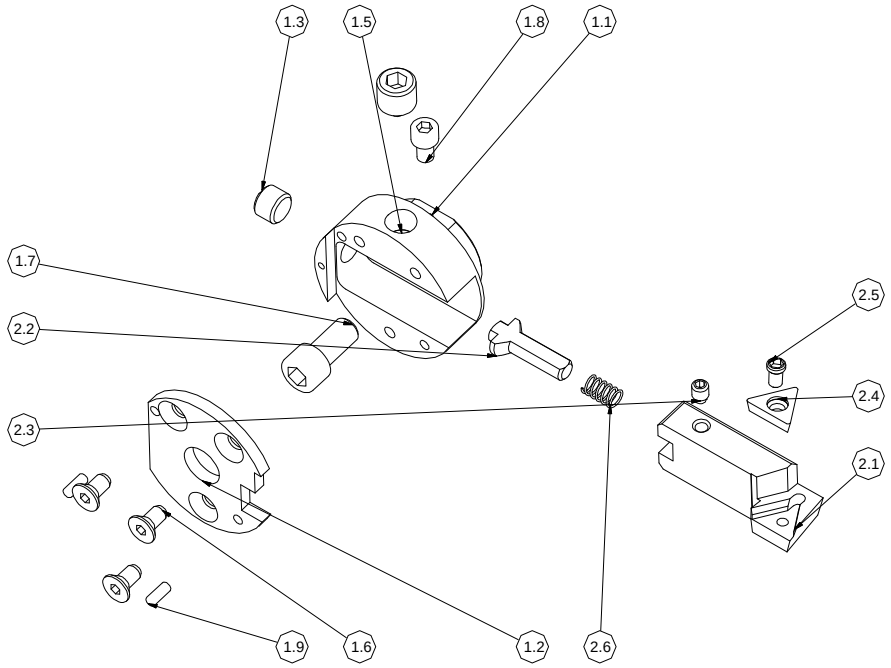


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-43A	SPACER - 1.50" LONG
2	1	ANSI B18.3 - No. 10 - 24 - 3/8	Hexagon Socket Head Cap Screw
3	1	ANSI B18.3 - 5/16 - 18 - 2	Hexagon Socket Head Cap Screw
4	1	ANSI B18.3 - 5/16 - 18 - 2 1/2	Hexagon Socket Head Cap Screw
5	1	ANSI B18.3 - 5/16 - 18 UNC - 2 3/4	Hexagon Socket Head Cap Screw

REFF68A25

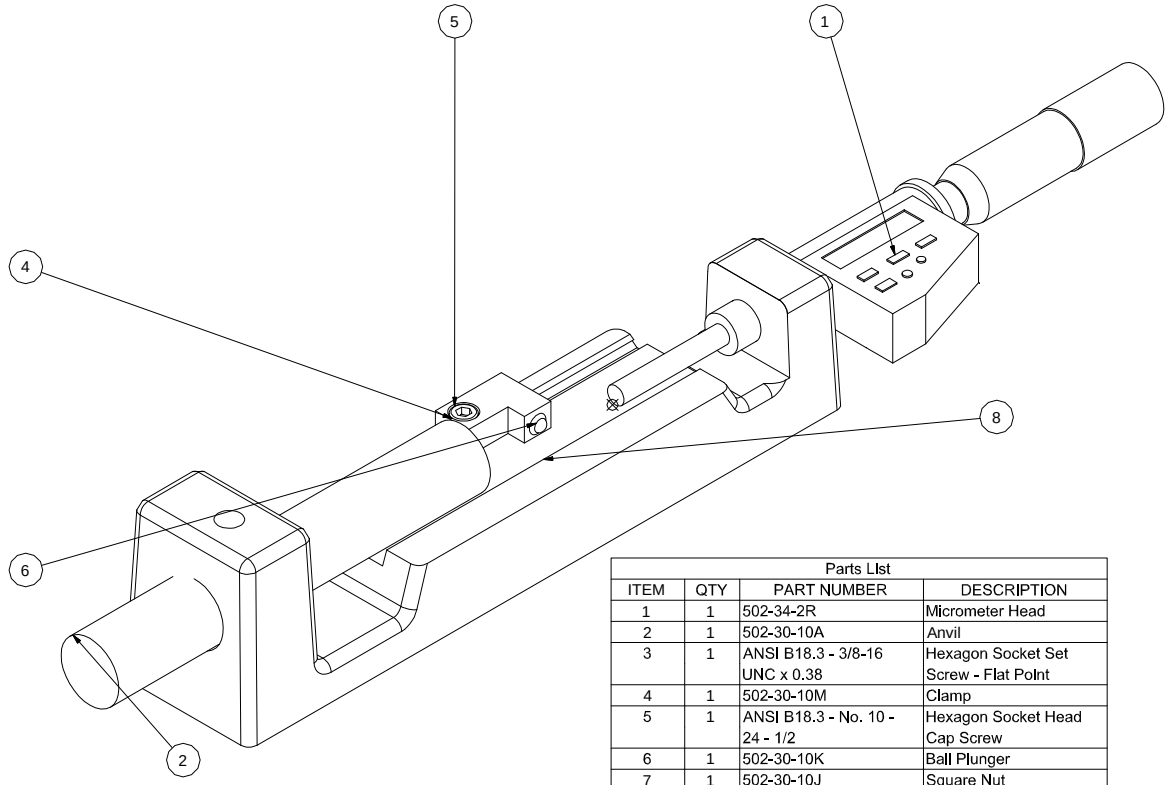
Right Angle Drive Tooling:

650-2-39B Line Bore Cutterhead 1.9” to 4.0”:



Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-39F	
1.1	1	650-2-40A	SmallCutterhead Body
1.2	1	650-2-41	Cutter Head Cover
1.3	1	502-2-85B	Index Screw
1.4	1	650-2-6A	4-40 brass tipped set screw
1.5	1	501-70A	Tool Holder Lock Screw ass'y
1.6	3	ANSI B18.3 - 10-24 UNC x 0.375	Hexagon Socket Flat Countersunk Head Cap Screw
1.7	1	Mf-21	Socket Head Cap screw 5/16 - 18 UNC - 5/8
1.8	1	ANSI B18.3 - No. 10 - 24 UNC - 5/16	Hexagon Socket Head Cap Screw
1.9	2	ANSI B18.8.2 - 1/8 x 5/16	Pin - Hardened Ground Production Dowel
2	1	6801E	Tool Bit Assembly
2.1	1	6800E	Tool Cartridge
2.2	1	100-82-3B	Adjusting Pin
2.3	1	100-82-2	Set Screw, brass tipped
2.4	1	RT322	
2.5	1	511-29-12C	Insert Screw m5
2.6	1	100-82-1	Spring

Micrometer Assembly 900-2-19:

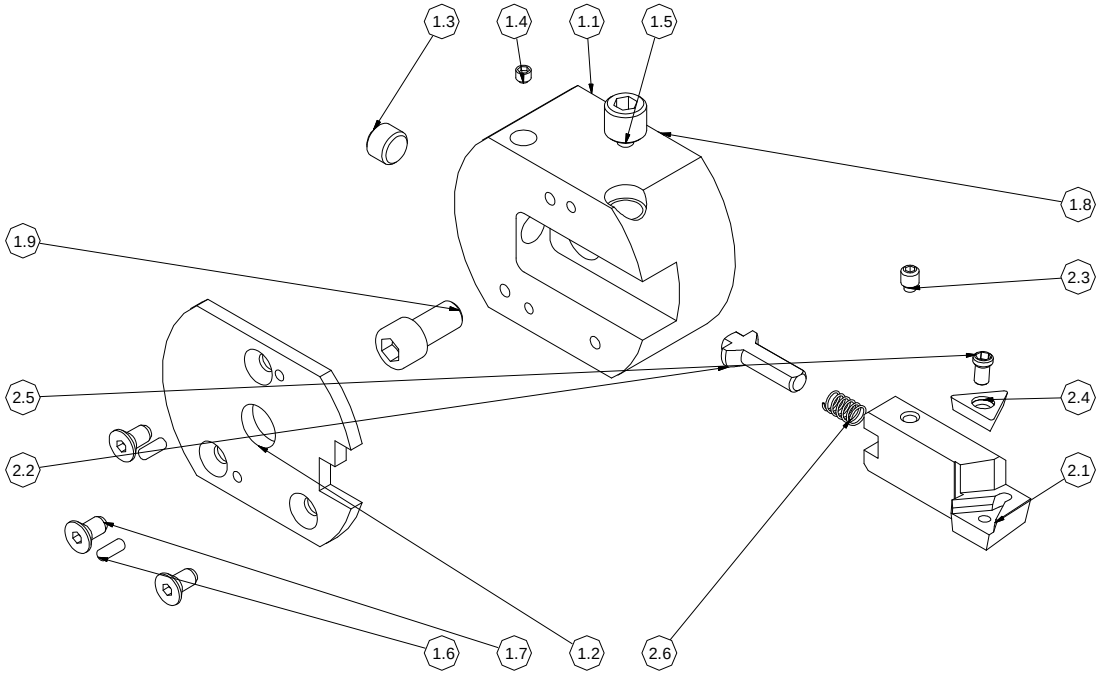


Parts LIst			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10A	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square Nut
8	1	502-30-10B	Micrometer Frame

6801B	Toolholder Assembly, Indexable Insert 1/4" triangle, positive rake (1.44" overall length) 2.0” – 2.4”
6801C	Toolholder Assembly, Indexable Insert 3/8" triangle, positive rake (1.65" overall length) 2.4” – 2.8”
6801D	Toolholder Assembly Indexable Insert 3/8" triangle, positive rake (1.85" overall length) 2.8” – 3.2”
6801E	Toolholder Assembly Indexable Insert 3/8" triangle, positive rake (2.05" overall length) 3.2” – 3.6”
6801F	Toolholder Assembly Indexable Insert 3/8" triangle, positive rake (2.25" overall length) 3.6” – 4.0”

Right Angle Drive Tooling:

650-2-39C Line Bore Cutterhead 2.9” to 5.6”:

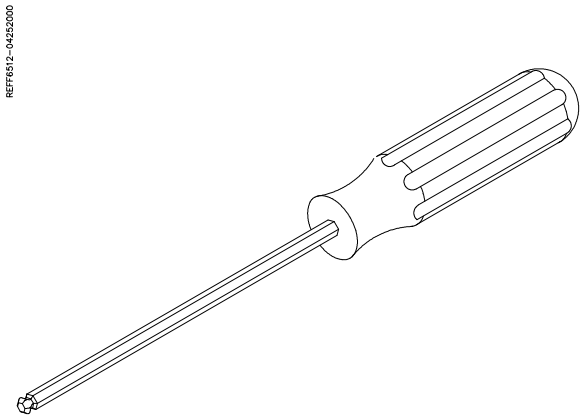


REFF68A27

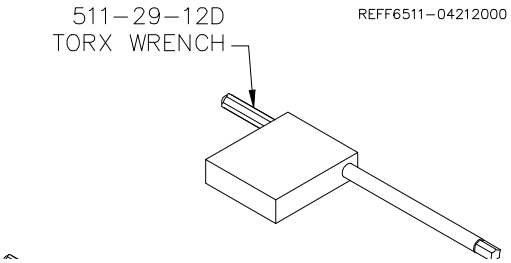
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-39G	
1.1	1	650-2-16B.IPT	
1.2	1	650-2-17A	CAP 2.9" PRECISION LINE BORE CUTTREHEAD
1.3	1	502-2-85B	Index Screw
1.4	1	502-12-4D	SOCKET SET SCREW, BRASS TIPPED 8-32 X 1//8
1.5	1	501-70A	Tool Holder Lock Screw ass'y
1.6	2	ANSI B18.8.2 - 1/8 x 5/16	Pin - Hardened Ground Production Dowel
1.7	3	ANSI B18.3 - 10-24 UNC x 0.375	Hexagon Socket Flat Countersunk Head Cap Screw
1.8	1	ANSI B18.3 - No. 10 - 24 UNC - 5/16	Hexagon Socket Head Cap Screw
1.9	1	Mf-21	Socket Head Cap screw 5/16 - 18 UNC - 5/8
2	1	6801E	Tool Bit Assembly
2.1	1	6800E	Tool Cartridge
2.2	1	100-82-3B	Adjusting Pin
2.3	1	100-82-2	Set Screw, brass tipped
2.4	1	RT322	
2.5	1	511-29-12C	Insert Screw m5
2.6	1	100-82-1	Spring

6801C	Toolholder Assembly, Indexable Insert 3/8" triangle, positive rake (1.65" overall length)
6801D	Toolholder Assembly Indexable Insert 3/8" triangle, positive rake (1.85" overall length)
6801E	Toolholder Assembly Indexable Insert 3/8" triangle, positive rake (2.05" overall length)
6801F	Toolholder Assembly Indexable Insert 3/8" triangle, positive rake (2.25" overall length)
6801G	Toolholder Assembly Indexable Insert 3/8" triangle, positive rake (2.45" overall length)
6801H	Toolholder Assembly Indexable Insert 3/8" triangle, positive rake (2.65" overall length)
6801J	Toolholder Assembly Indexable Insert 3/8" triangle, positive rake (2.85" overall length)

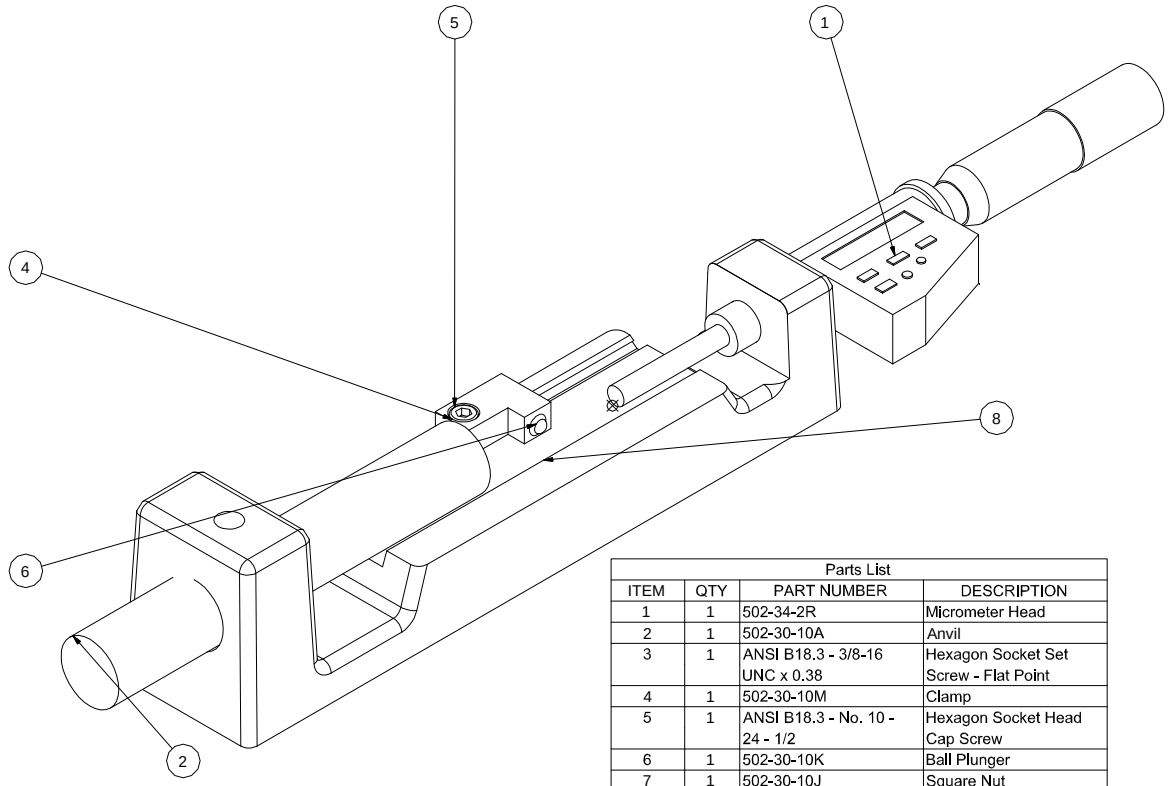
Hex Driver 3/16” 501-72J



Torx Wrench 511-29-12D

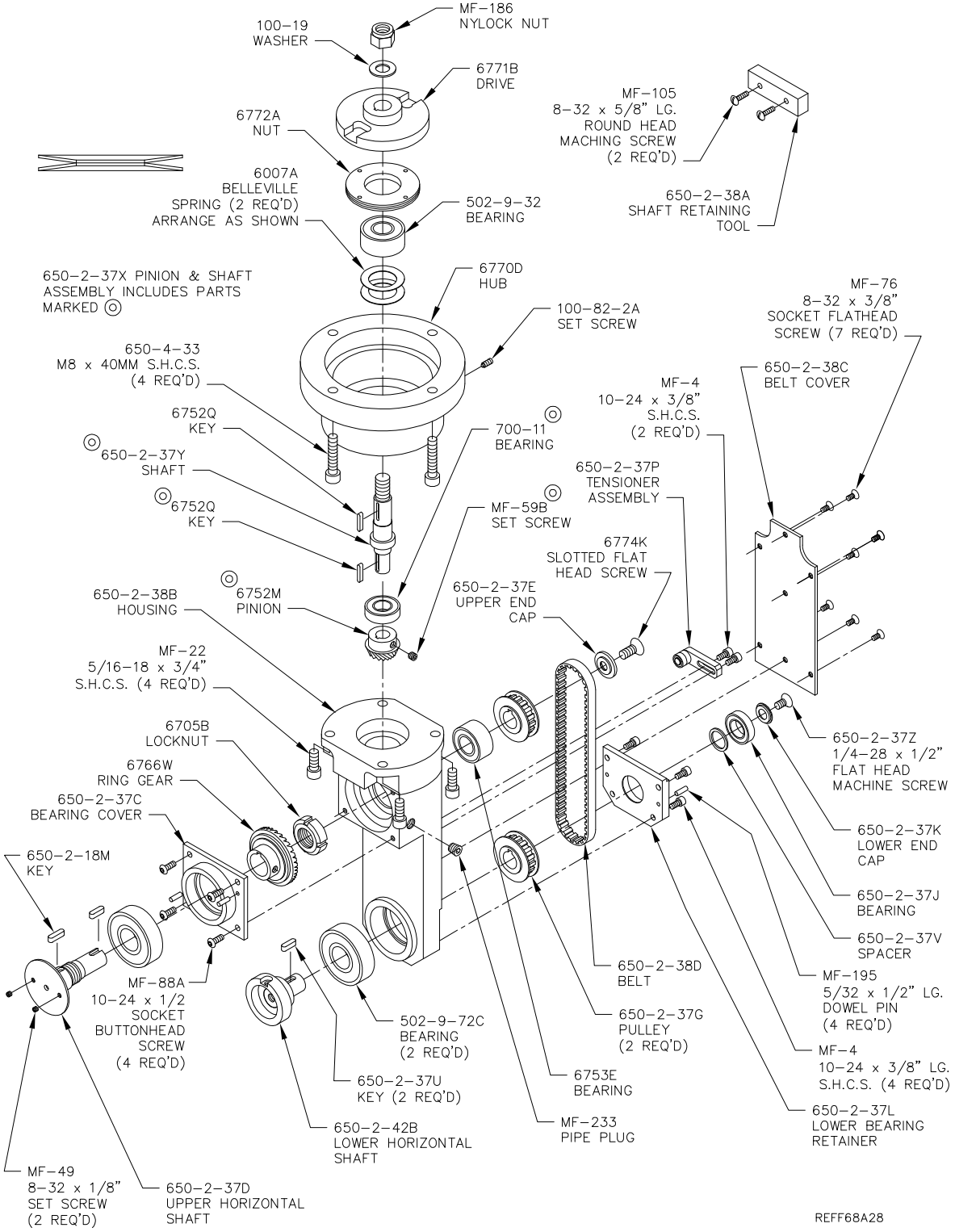


Micrometer Assembly 900-2-19:



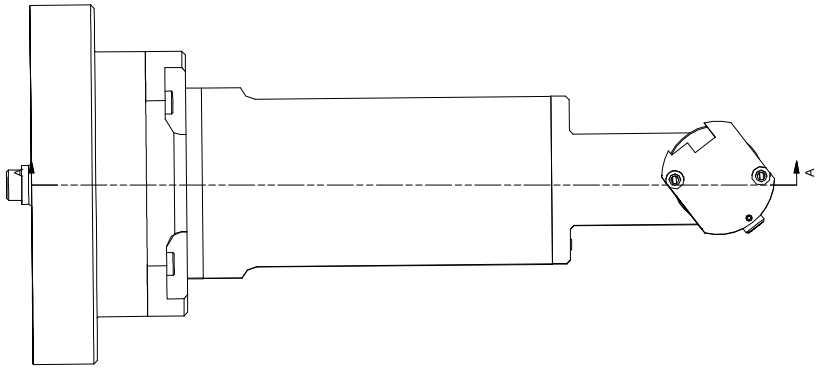
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10A	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square Nut
8	1	502-30-10B	Micrometer Frame

Right Angle Drive 650-2-37A:



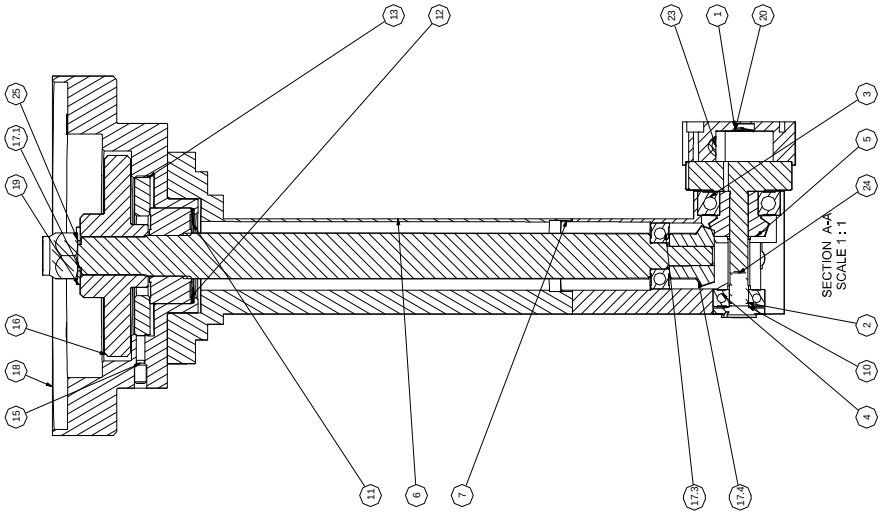
The same cutterheads and tooling applies to the 650-2-37A as the 6753M.

Special Extended Narrow 90 Degree Line Bore Head 6753N:



Parts List

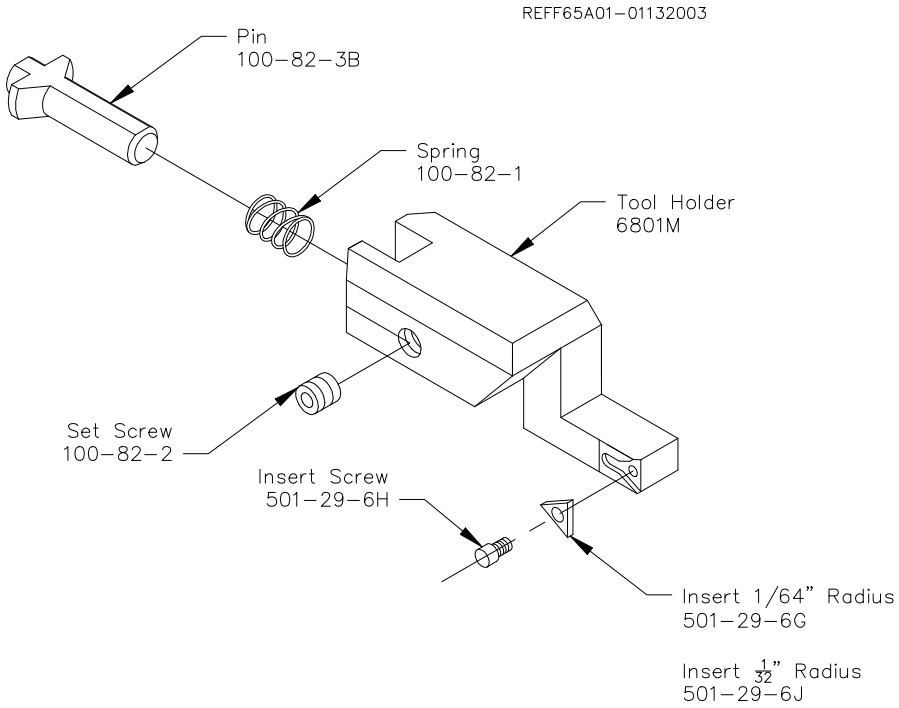
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-19H	Cutter Head Cap
2	1	650-2-19J	Shaft, Horizontal
3	1	650-2-19K	Bearing, MRC 103KSZZ
4	1	650-2-19L	Bearing, MRC- R6-ZZ
5	1	650-2-19R	Spiral bevel gear, Boston Gear-HLSK110Y-L
6	1	650-2-19X	Upper Housing, Right Angle Drive Narrow
7	1	650-2-19Y	Lower Housing, Right angle Drive, Narrow
8	8	650-4-18	Low Head Cap Screw, 1/4-20 x 5/8
9	1	ANSI B18.8.2 - 3/16 x 1	Pin - Hardened Ground Production Dowel
10	1	650-2-19S	Cover Rear, End Cap
11	2	6007A	Belleville Spring, B5203
12	1	502-3-32	Bearing, Ball MRC 5203DDBSFF
13	1	6772A	Nut, Bearing Line Bore Head
14	1	6752O	Key
15	1	100-82-2A	Brass tipped 10-24
16	1	6771B	Driver, F-65
17	1	650-2-19Z	Assembly, Vertical shaft
17.1	1	650-2-19N	Vertical Shaft
17.2	1	650-2-19W	Key
17.3	1	650-2-19T	Bearing MRC 101kszz
17.4	1	650-2-19Q	Spiral Bevel gear Boston HLSK110Y-R
17.5	1	#10-0.25-UNF	Cone Point 10-32 UNF x 0.25
18	1	6770D	Hub, Mounting
19	1	100-19	Hardened Washer
20	1	100-1B	Tool Lock Spring
21	2	502-2-85B	Index Screw
22	1	650-2-8A	4-40 brass tipped set screw
23	1	501-70G	Tool lock set screw
24	1	6774K	Slotted Flat Countersunk 5/16-24 x 3/4
25	1	IFI 100/107 - 1/2 - 13 Metal Type	Prevailing Torque Type Hex Nut



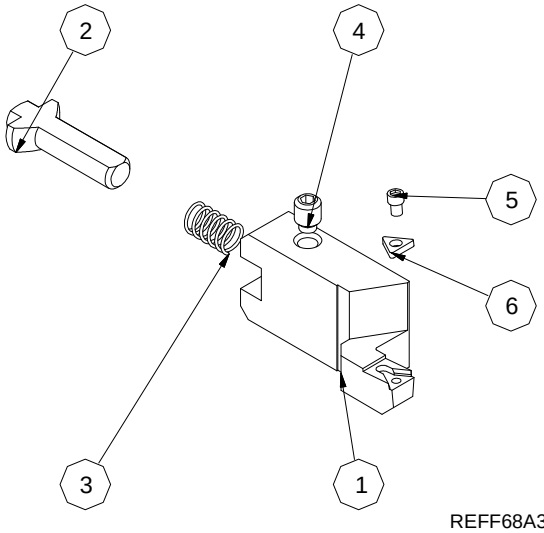
6801N	(1) Toolholder Assembly Indexable Insert 1/4" (6.35mm) IC triangle, Positive Rake. (Extreme offset toolholder, also add to order at no charge: (1) 502-30-10G, (1) 502-30-10J and (1) MF-5 required to set this tool in 900-2-19 micrometer.)
6801B	(1) Toolholder Assembly Indexable Insert 1/4" (6.35mm) IC triangle, Positive Rake
RT211	Insert, triangular 1/4" (6.35mm) 1/64 radius (1/4 tri. Insert holders only) general purpose and sleeving
RT212	Insert, triangular 1/4" (6.35mm) 1/32 radius (1/4 tri. Insert holders only) general purpose and sleeving
900-2-19	Universal Micrometer Assembly Digital Reading (inch and metric) for 1/2"

	tooling
501-72J	Hex driver-3/16" (4.775mm)
511-29-12F	Wrench-Torx-1/4" (6.35mm) Triangular insert holder
6753P	Special Extended Main Line Bore 90-degree right angle drive assembly without tooling

Thrust Facing Tool Holder:
6801M



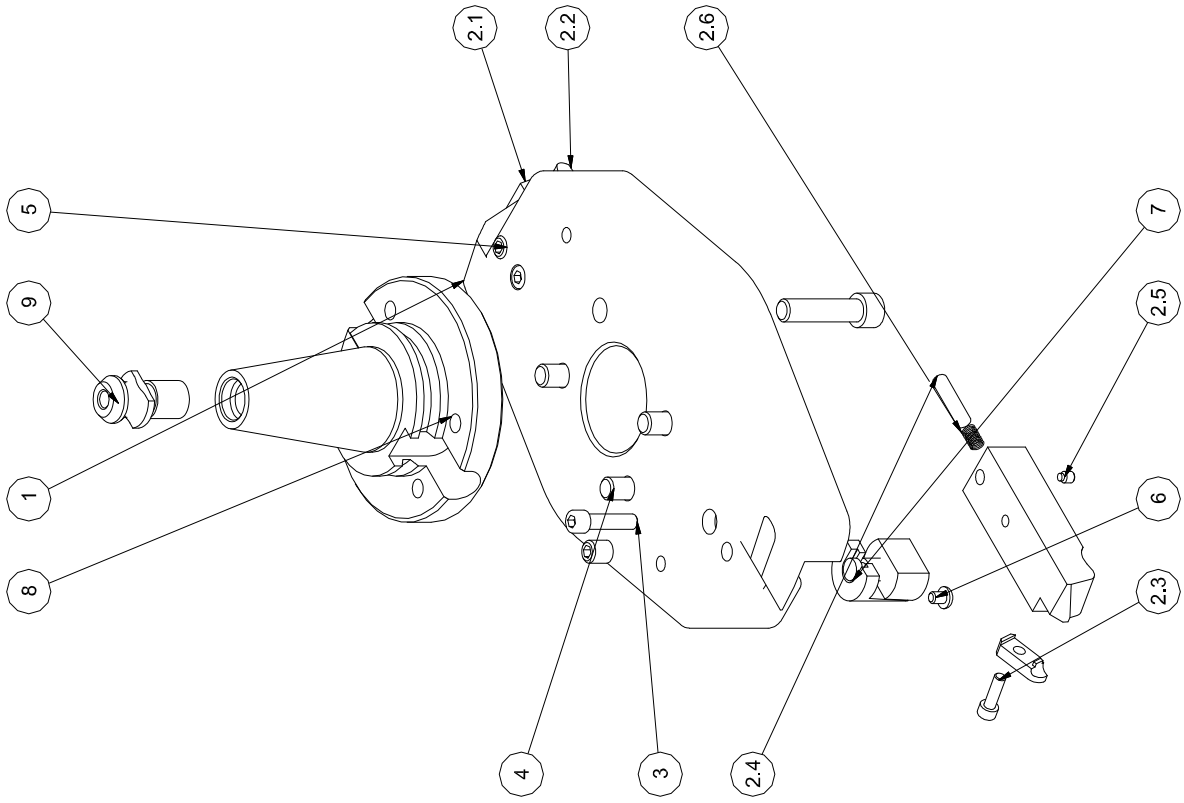
Thrust Facing Tool Holder:
6801P



REFF68A30

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6800P	Thrust tool Small
2	1	100-82-3B	Adjusting Pin
3	1	100-82-1	Spring
4	1	100-82-2	Set Screw, brass tipped
5	1	501-29-6H	Insert Screw
6	1	501-29-6J	Insert, triangle 1/32" Rad.

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

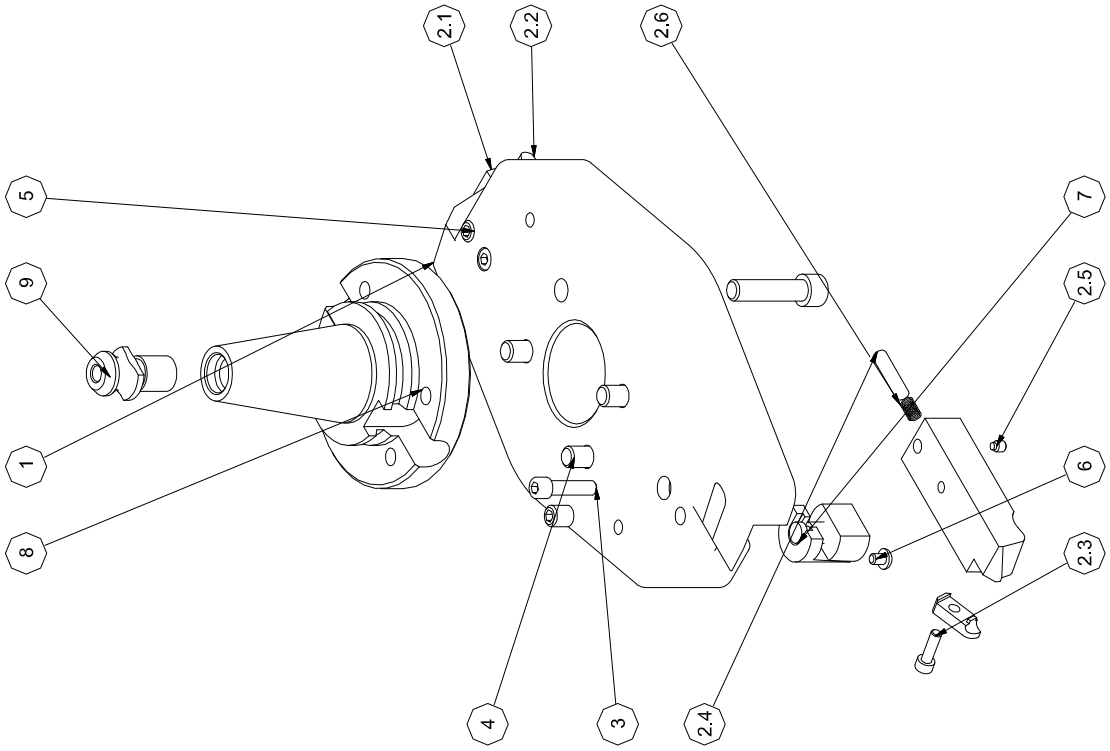


Parts List

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	7206L	
2	2	7202W	TOOL HOLDER ASSEMBLY, FLY CUTTER
2.1	1	7202P	Holder, Fly Cutter Tool
2.2	1	7202Q	Clamp, Tool Holder
2.3	1	ANSI B18.3 - 10-32 UNF - 0.625	Hexagon Socket Head Cap Screw
2.4	1	ANSI B18.8.2 - 1/4 x 1	Pin - Hardened Ground Production Dowel
2.5	1	100-82-2	Set Screw, brass tipped
2.6	1	100-82-4	Spring, Adjusting
3	2	Mf-15	Socket Head Cap screw 1/4 - 20 UNC - 1
4	4	Mf-33	Socket Head Cap screw 3/8 - 16 UNC - 1 1/2
5	2	ANSI B18.3 - 3/8-16 UNC x 0.44	Hexagon Socket Set Screw - Oval Point
6	2	Mf-87	Socket Button Head Cap Screw10 - 24 x 1/4
7	2	7206K	'L' LOCK
8	1	650-2-7E	Adapter, CAT 40
9	1	650-2-44L	CAT 40 Retention Knob

REFF68A31

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

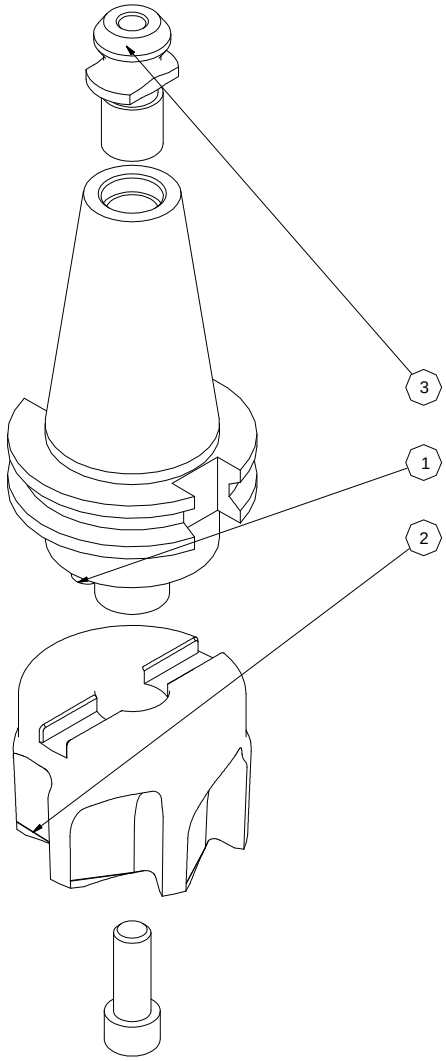


Parts List

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	7206G	Flycutter 14"
2	2	7202W	TOOL HOLDER ASSEMBLY, FLY CUTTER
2.1	1	7202P	Holder, Fly Cutter Tool
2.2	1	7202Q	Clamp, Tool Holder
2.3	1	ANSI B18.3 - 10-32 UNF - 0.625	Hexagon Socket Head Cap Screw
2.4	1	ANSI B18.8.2 - 1/4 x 1	Pin - Hardened Ground Production Dowel
2.5	1	100-82-2	Set Screw, brass tipped
2.6	1	100-82-4	Spring, Adjusting
3	2	Mf-15	Socket Head Cap screw 1/4 - 20 UNC - 1
4	4	Mf-33	Socket Head Cap screw 3/8 - 16 UNC - 1 1/2
5	2	ANSI B18.3 - 3/8-16 UNC x 0.44	Hexagon Socket Set Screw - Oval Point
6	2	Mf-87	Socket Button Head Cap Screw10 - 24 x 1/4
7	2	7206K	'L' LOCK
8	1	650-2-7E	Adapter, CAT 40
9	1	650-2-44L	CAT 40 Retention Knob

REFF68A32

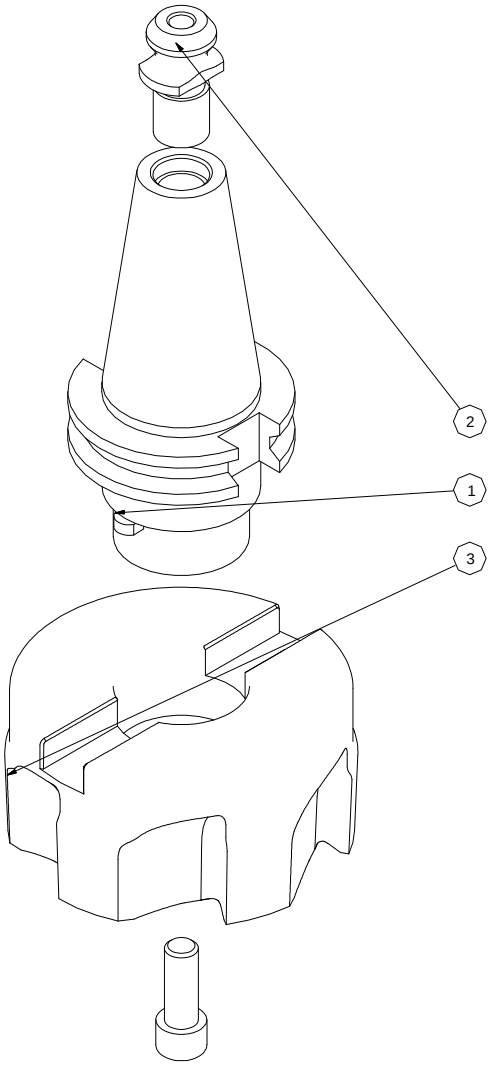
2 ½" Shell Mill Assembly w/ Tooling:
650-2-44N



REFF68A33

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-44G	Adapter 3/4" Bore
2	1	7224E	2.5" Shell Mill
3	1	650-2-44L	CAT 40 Retention Knob

4” Shell Mill Assembly w/ Tooling:
650-2-44P



Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-44F	Adapter for Shell Mill w/ 1.5" Bore
2	1	650-2-44L	CAT40 Retention Knob
3	1	7224F	4" Shell Mill

Complete Listing of NMTB 40 Taper Shell Mill Arbors:

Part #	Width of Shell Mill Bore
6502-44G	¾”
650-2-44E	1”
650-2-44H	1 ¼”
650-2-44F	1 ½”

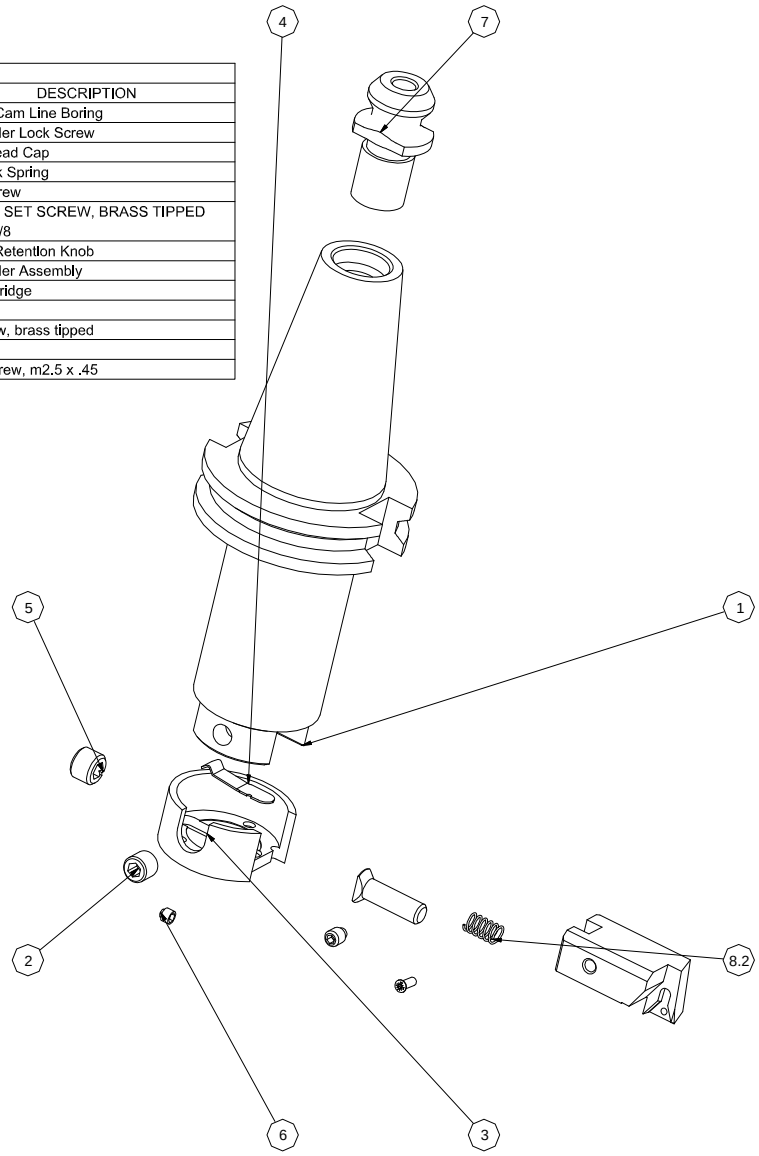
Cam Line Boring Tooling Package:

650-3-43T:
Requires 650-3-30 Block End Truing Fixture, 650-3-1 Performance Fixture, 67753M Right Angle Drive Assembly.

1.9" Cutterhead:
650-2-3Q w/ Tooling:
650-2-3R w/o Tooling:

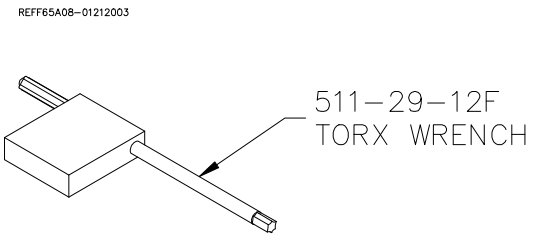
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-3M	Adapter Cam Line Boring
2	1	502-25-1	Tool Holder Lock Screw
3	1	600-5	Cutter Head Cap
4	1	100-1B	Tool Lock Spring
5	1	502-2-85B	Index Screw
6	1	502-12-4D	SOCKET SET SCREW, BRASS TIPPED 8-32 X 1//8
7	1	650-2-44L	CAT 40 Retention Knob
8	1	6802B	Tool Holder Assembly
8.1	1	6800B	Tool Cartridge
8.2	1	100-82-1	Spring
8.3	1	100-82-2	Set Screw, brass tipped
8.4	1	100-82-3D	
8.5	1	511-29-12E	Insert Screw, m2.5 x .45

REFF68A35

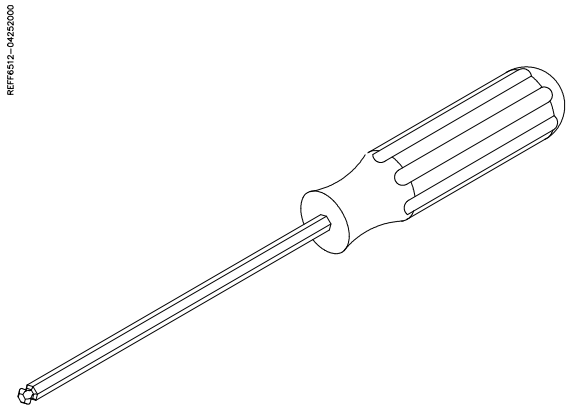


6802B	Tool holder assembly, indexable insert 1/4" [6.35mm] triangle, positive rake 1.9 to 2.3" [48.26 to 58.42mm] diameter. Cam line bore cutterhead only
6802C	Tool holder assembly, 3/8" [9.525mm] triangular positive rake 2.3 to 2.7" [58.42 to 68.58mm] diameter. (Optional) NOTE: requires 3/8" [9.525mm] insert, RT321 or RT322
RT211	Insert, triangular 1/4" (6.35mm] 1/64 radius (1/4 tri. Insert holders only) general purpose and sleeving
RT212	Insert, triangular 1/4" (6.35mm) 1/32 radius (1/4 tri. Insert holders only) general purpose and sleeving

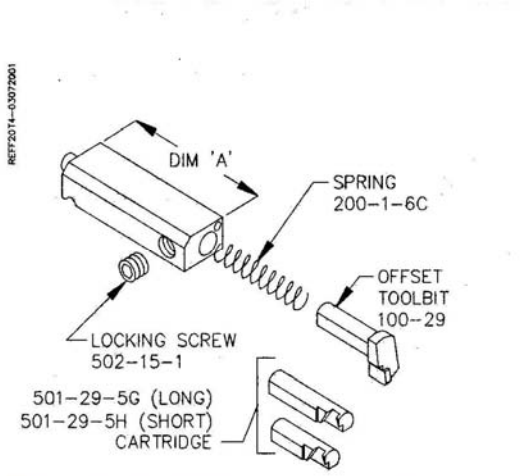
511-29-12F Torx Wrench:



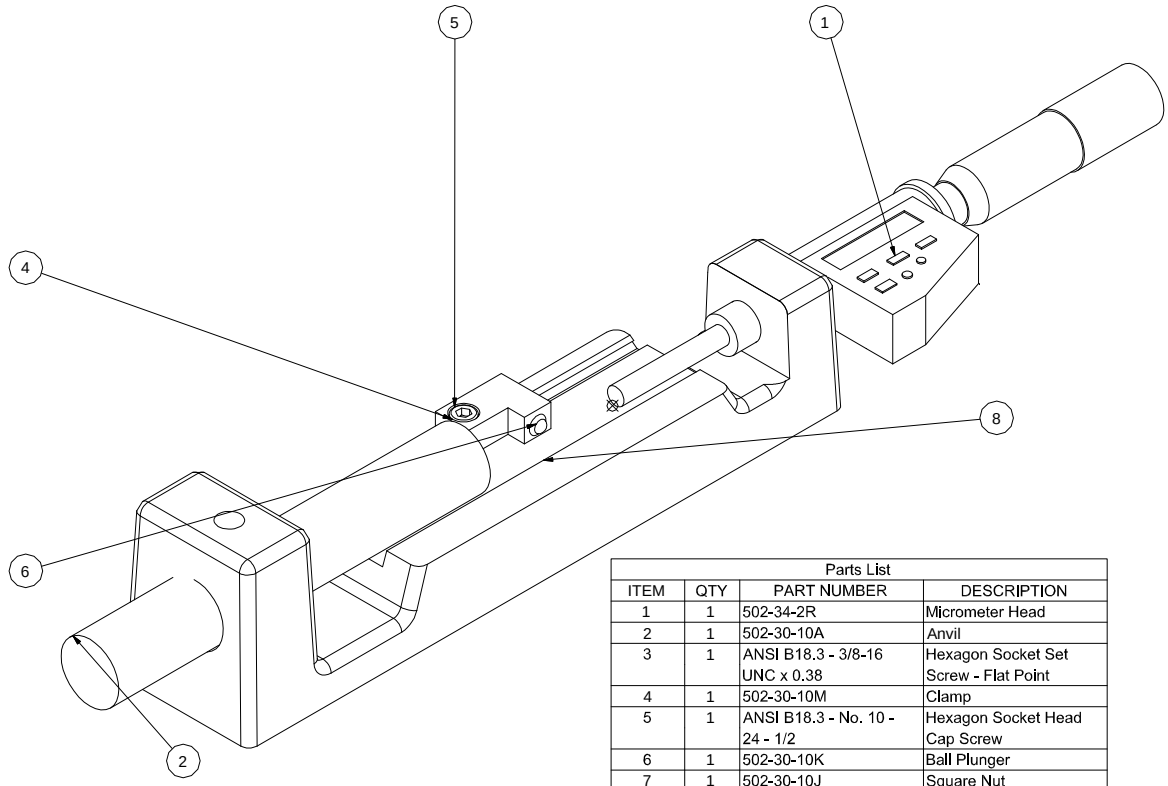
501-72A Hex Driver:



Tool Holder Dim 'A'	Toolbit	Bore Range
199-96 / 1.25"	100-29	2.32 - 2.69
	501-29-5H	1.56 - 2.19
	501-29-5G	2.37 - 2.69
199-89 / 1.50"	100-29	2.32 - 3.19
	501-29-5H	1.94 - 2.69
	501-29-5G	2.38 - 3.19
199-90 / 1.75"	100-29	2.81 - 3.69
	501-29-5H	2.44 - 3.88
	501-29-5G	2.64 - 3.69
199-94 / 2.25"	100-29	3.82 - 4.69
	501-29-5H	3.44 - 3.69
	501-29-5G	3.50 - 4.69

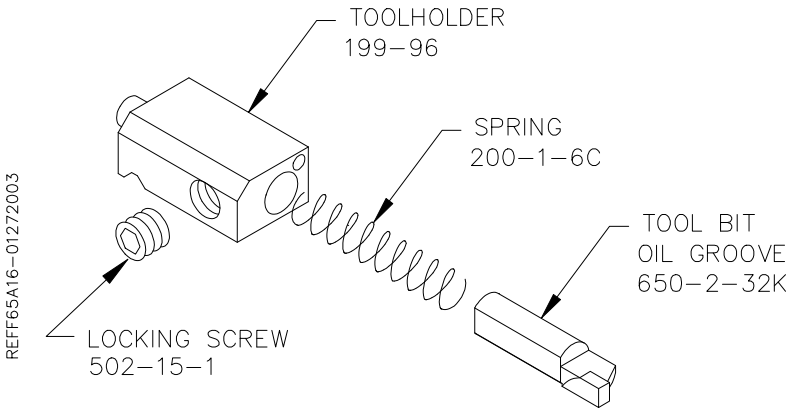


900-2-19 Micrometer Assembly:
1.5” – 4.1”

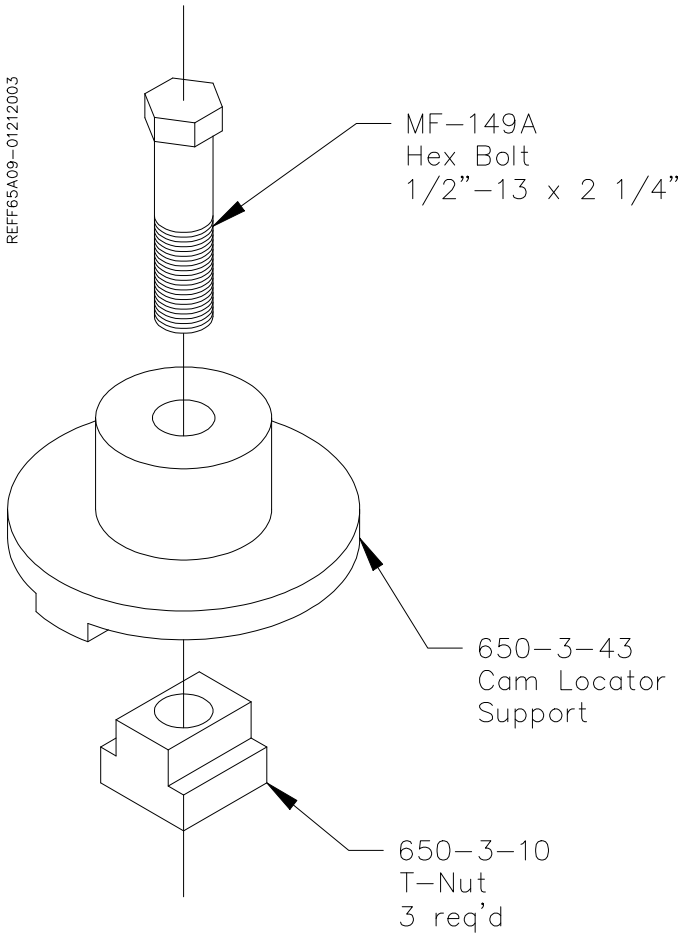


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10A	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square Nut
8	1	502-30-10B	Micrometer Frame

Oil Groove Tooling 650-2-32K:

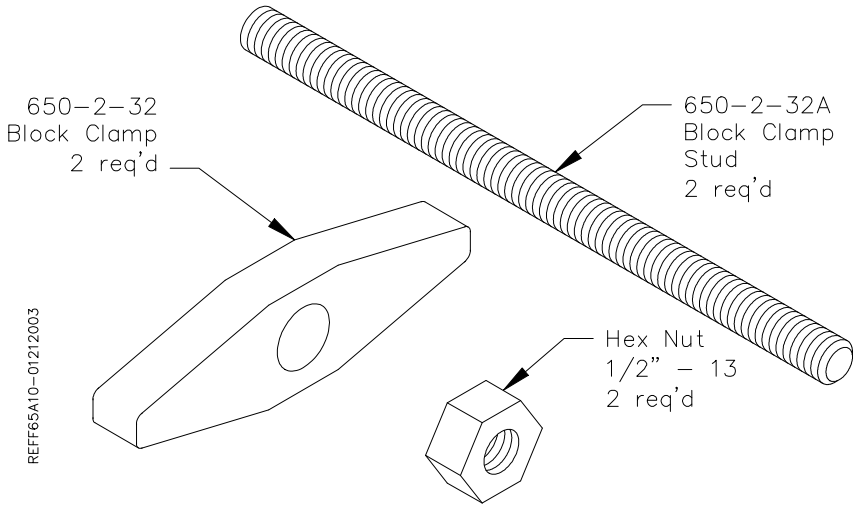


Cam Locator Support:
650-3-43

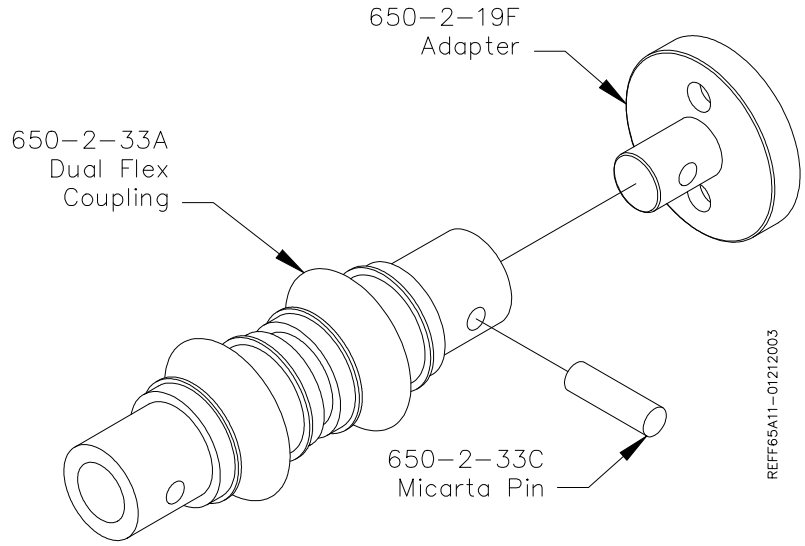


Block Clamp:
650-2-32 (2 Required).

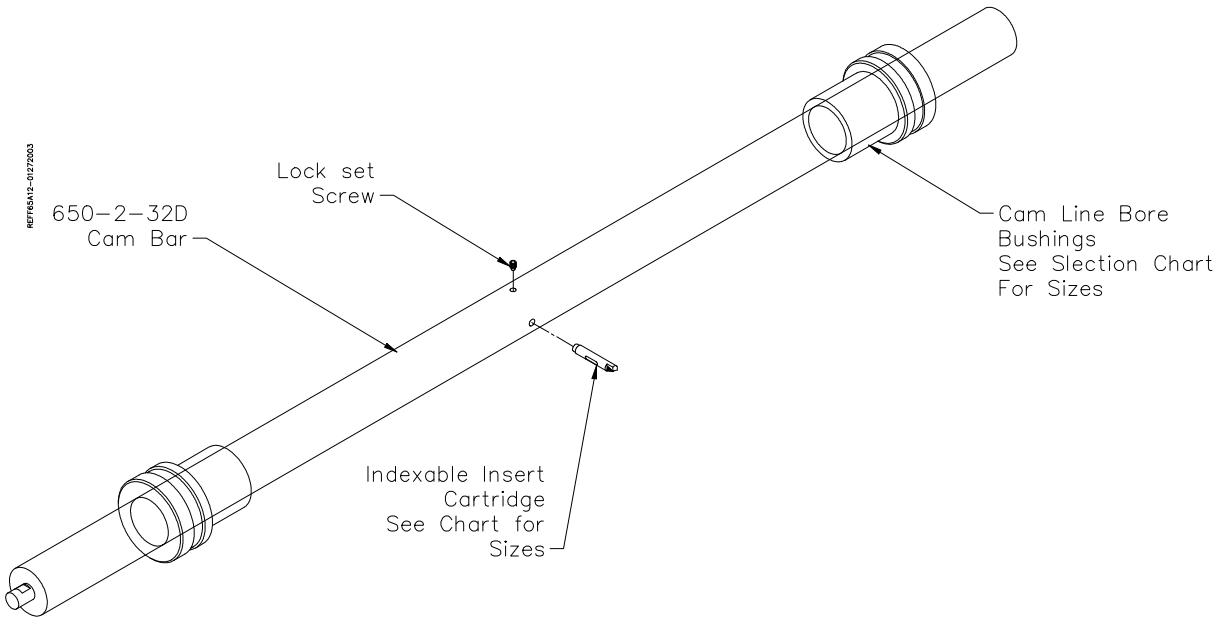
Block Clamp Stud:
650-2-32A



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



Cam Line Boring Bar:
650-2-32D

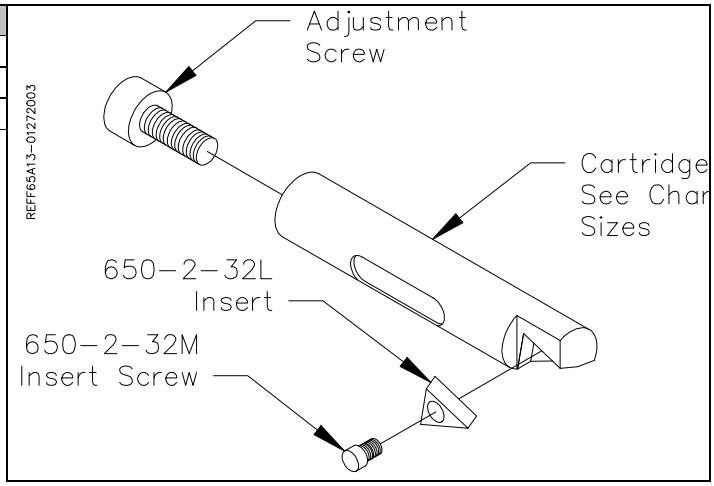


Cam Line Bore Bushings:

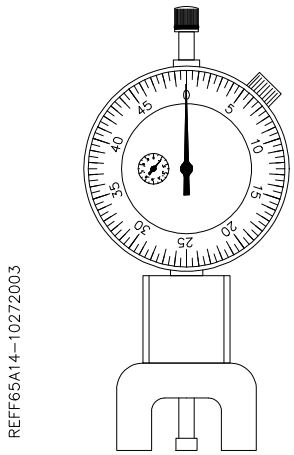
	Cam Line Bar Bushings. (If customer requires sizes other than listed below, Rottler will manufacture the required size.) (Customer must provide the size, including tolerance,
	of the housing bore(s) the bushing will be used in. Rottler will use this information to design the actual bushing.) (Sold in Pairs) Bushings are machined smaller than housing bore.
650-3-43B	Bushing - 63Mm (2.480" +/- .0007) (Sold in pairs)
650-3-43C	Bushing - 58Mm (2.282" +/- .0007) (Sold in pairs)
650-3-43D	Bushing - (2.250" +/- .0007) (Sold in pairs)
650-3-43E	Bushing - (2.790" +/- .0007) (Sold in pairs)
650-3-43F	Bushing - (2.309" +/- .0007) (Sold in pairs)
650-3-43G	Bushing - (2.500" +/- .0007) (Sold in pairs)
650-3-43H	Bushing - (2.120" +/- .0007) (Sold in pairs)
650-3-43J	Bushing - (2.030" +/- .0007) (Sold in pairs)
650-3-43K	Bushing - (2.040" +/- .0015) (Sold in pairs)
650-3-43L	Bushing - (2.400" +/-.0007) (Sold in pairs)
650-3-43M	Bushing - (2.125" +/-.0007) (Sold in pairs)
650-3-43N	Bushing - (2.150" +/- .0007) (Sold in pairs)
650-3-43P	Bushing - (2.300" +/- .0007) (Sold in pairs)
650-3-43Q	Bushing - (2.060" +/- .0007) (Sold in pairs)
650-3-43R	Bushing - (2.6733"+/-.0007) (Sold in pairs)
650-3-43S	Bushing - (2.0450 +/- .0007) (Sold in pairs)

Cam Line Boring Cartridges:

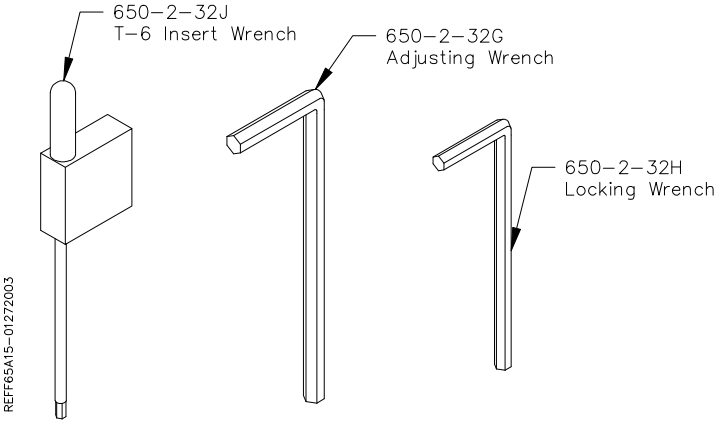
Cam Line Bore Cartridges:		
Part Number	Length	Range
650-2-32E	1.530”	1.985” – 2.650”
650-2-32F	1.650”	2.250” – 2.850”



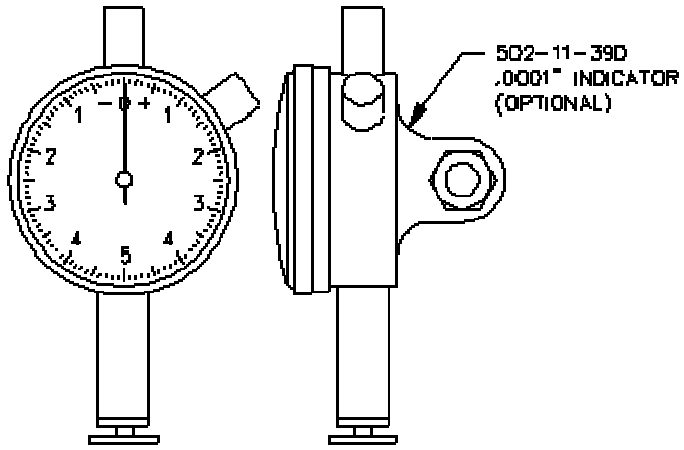
Tool Setting Indicator:
650-2-33



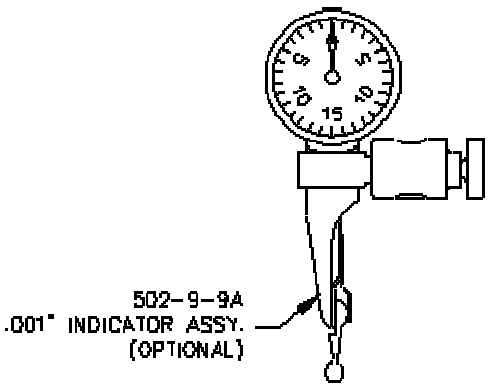
Wrenches:



502-11-39D: Mechanical Run Out Indicator for Precision Bore Adjustment (.0001 Resolution)



502-9-9A: Mechanical Run Out Indicator General Purpose (.001 Resolution)



650-2-60A: Lifter Bore Tooling Kit

650-2-44L CAT 40 RETENTION KNOB

650-2-63 DIAL CARTRIDGE .723

650-2-65 INSERT FOR DIAL CARTRIDGE

650-2-44A END MILL ADAPTOR

650-2-64 DIAL CARTRIDGE .976

650-2-20C END MILL .980 X 8 1/2

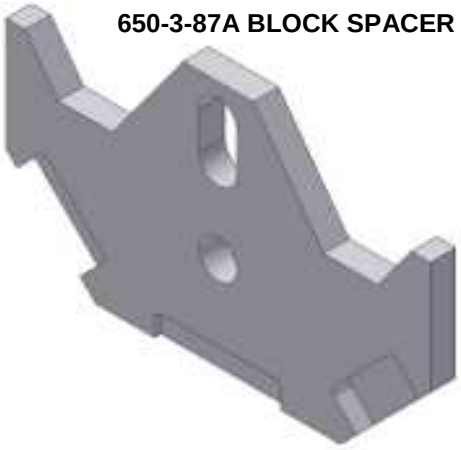
650-2-20L END MILL 1 1/8 X 6 1/2

650-2-62 BORING BAR .866 TO .1.218

650-2-61 BORING BAR .750 TO .906

650-2-44W: BLOCK LIGHTENING TOOLING PACKAGE FOR DART BLOCKS

650-3-87A BLOCK SPACER



650-3-69 LOCATOR MAIN #5 2.6406/2.6421

650-3-14R LOCATOR CAM 1.9990/2.0010

650-2-45B INSERT FOR 1 1/2" INDEXABLE TOOLHOLDER MILL

650-2-45D INSERT FOR 1" INDEXABLE TOOLHOLDER MILL

650-2-44S END MILL ADAPTER 5/8"

650-2-44A END MILL ADATPER 1"

650-2-45C 1" INDEXABLE MILL

650-2-45A 1 1/2" INDEXABLE MILL

650-2-44K END MILL ADAPTER 11/4"

650-2-44L KNOB CAT 40 TAPER

650-2-44V 1" X 4" 4 FLUTE END MILL

650-2-44U 5/8" X 3.5" 4 FLUTE END MILL

650-2-44T 5/8" X 6.0" 4 FLUTE END MILL

650-2-44X BLOCK LIGHTENING TOOLING KIT FOR WORLD PRODUCTS BLOCKS

650-3-87A BLOCK SPACER

650-3-69 LOCATOR MAIN #5 2.6406/2.6421

650-3-14G LOCATOR CAM 2.0190/2.0210

650-3-14 LOCATOR CAM 2.0090/2.0110

650-2-45B INSERT FOR 1 1/2" INDEXABLE TOOLHOLDER MILL

650-2-45D INSERT FOR 1" INDEXABLE TOOLHOLDER MILL

650-2-44S END MILL ADAPTER 5/8"

650-2-44A END MILL ADATPER 1"

650-2-45C 1" INDEXABLE MILL

650-2-45A 1 1/2" INDEXABLE MILL

650-2-44K END MILL ADAPTER 11/4"

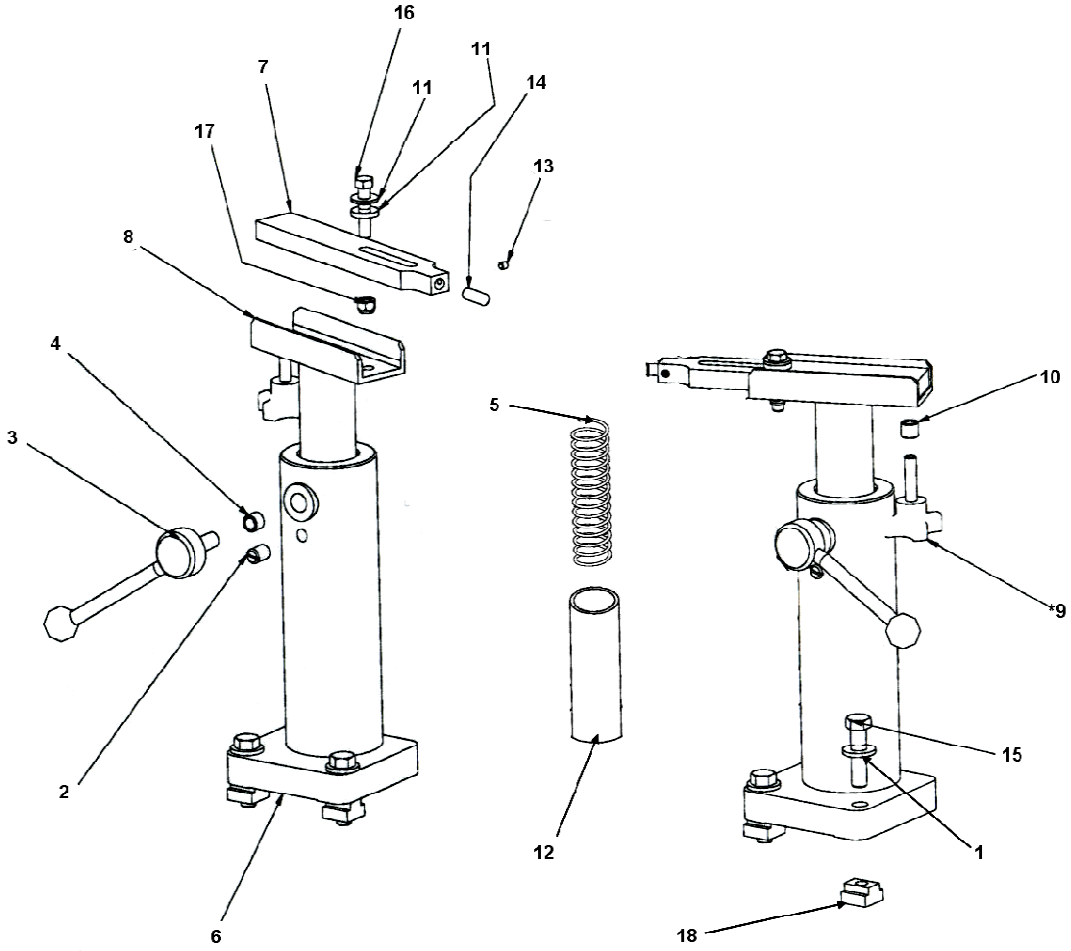
650-2-44L KNOB CAT 40 TAPER

650-2-44V 1" X 4" 4 FLUTE END MILL

650-2-44U 5/8" X 3.5" 4 FLUTE END MILL

650-2-44T 5/8" X 6.0" 4 FLUTE END MILL

Clamp Tower Assembly 7242M:



7242M PARTS LIST

ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	100-19A	WASHER, HARDENED
2	2	502-8-52C	PLUNGER, SPRING
3	2	6310N	HANDLE ASSEMBLY
4	2	6310R	INSERT, THREADED
5	2	650-3-49M	SPRING
6	2	7242	CLAMP TOWER BASE
7	2	7242E	CLAMP SHOE
8	2	7242F	CLAMP LEG
9	2	7242H	HAND KNOB
10	2	7242J	INSERT, THREADED
11	2	7242K	SPHERICAL WASHER
12	2	7242L	SPACER
13	2	MF-60	SSSCP 1/4-20 X 1/4
14	2	MF-212	DOWEL PIN 3/8 X 1
15	4	MF-149C	HEX BOLT 1/2-13 X 2
16	2	MF-145	HEX BOLT 3/8-16 X 1 3/4
17	2	MF-187B	NYLOK NUT 3/8-16
18	4	650-3-10	T-NUT