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ROTTLER
MANUFACTURING

**THE
CUTTING
EDGE**

F65M

MULTI PURPOSE MACHINING CENTER

MACHINE SERIAL NUMBER

OPERATIONS AND MAINTENANCE
MANUAL



MANUFACTURED BY:

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PLEASE GIVE THE MODEL AND SERIAL NUMBER.

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

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Chapter 1 Introduction / Safety / Installation:

Introduction:

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

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

The Controls Definition and Operating Instructions chapters should be read very carefully in order to familiarize the user with the actual button pushing sequences required to carry out a job. These chapters in the manual should be considered an introduction. As the operators of the F65 series machine gains experience with using different functions of the machine, complicated setups and programs will make more sense.

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

Description:

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

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

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

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

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

Limited Warranty:

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

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

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

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

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

Safety Information:

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

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

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

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

The F65 operates under computerized control and, as is all computerized equipment, is susceptible to extraneous electrical impulses internally for externally produced. The machine may make moves out of the operator control at any time. The operator should work in and around the machine with caution at all times.

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

Electrical Power:

Make sure all electrical equipment has the proper overload protection. The F65 should have ***a fully isolated*** power supply to prevent damage and uncontrolled movement of the machine. If the F65 is on the same power lines that are running to other electrical equipment (grinders, welders, and other AC motors) electrical noise can be induced into the F65 electrical system. Electrical noise can cause the controller to see false signals to move. Not supplying a fully isolated supply to the machine may void factory warranty. Refer to the Power supply section later in this chapter for voltage and amperage requirements of the F65.

Machine Operator:

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

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

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

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

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

2. **Cutting Tool Area** – Any operation involving hands in the cutter head area, such as inspection or alignment of the cutter head or tools, changing Centering Fingers, tool insertion, and removal, cutter head changes, and size checking etc. requires the machine to be in Neutral.
3. **Machining** – Eye protection must be worn during all operations of the machine. Hands must be kept completely away from the cutter head. All chip guards must be in position during machine operations.

4. **Work Loading and Unloading** – Carefully develop handling methods of loading and unloading work pieces so that no injury can result if hoist equipment or lift connection should fail. Periodically check lift components for damage that may cause failure of Block Handler Assembly. Lifting Eye can eventually fail if the eye is reset in line with the 502-1-80 lift channel. ***Eye must be at a right angle.***
5. Machine Maintenance – Any machine adjustment, maintenance or parts replacement absolutely requires a complete power disconnection from the machine, ***this is an absolute rule.***

Emergency Procedure:

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

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

Find out what the problem is; return the spindle to its up position without causing more damage. To restart the machine, turn the Emergency Stop Button CW until the button pops out. Make sure the button has been depress for at least 1 ½ minutes or the drive will not have time to reset and they will not function.

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

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

Machine Installation:

Location:

The productivity of the F65 will depend a great deal on the proper initial installation. Pay particular attention to the means by which work pieces are lifted into and out of the machine as well as the material handling to and from other operations in your shop. The proper loading arrangements and work location for your F65 is extremely important.

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

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

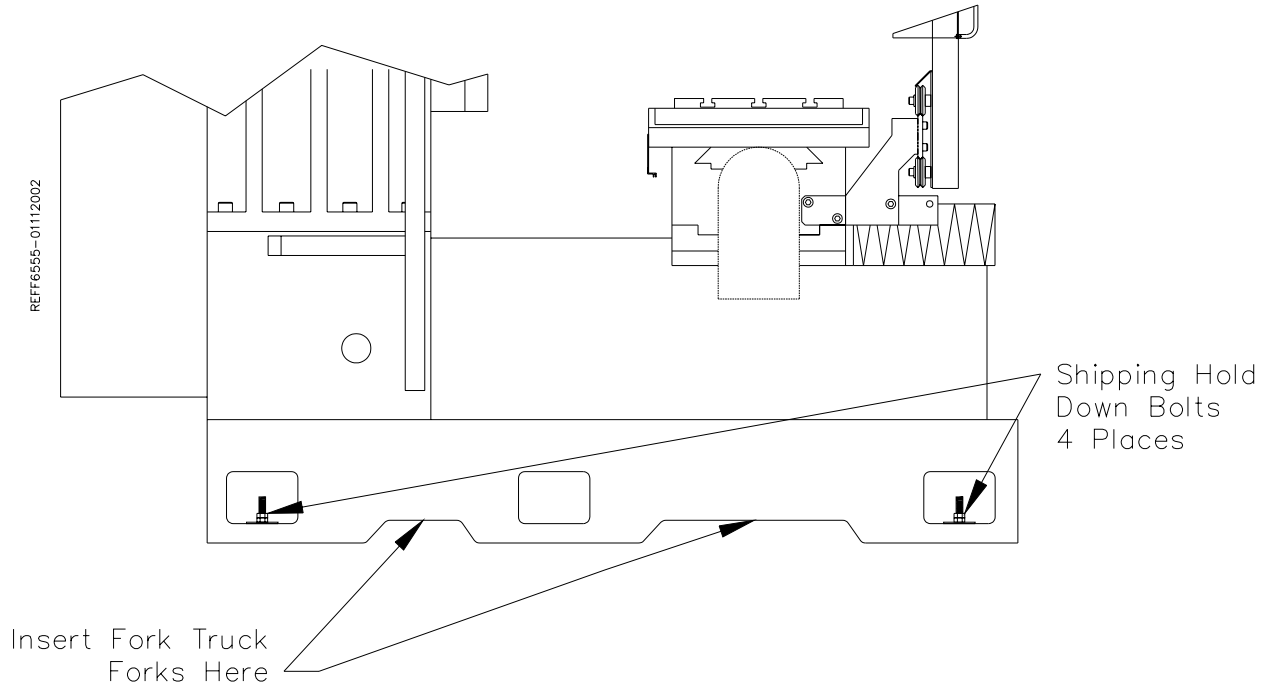
Unpacking and Lifting:

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

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

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

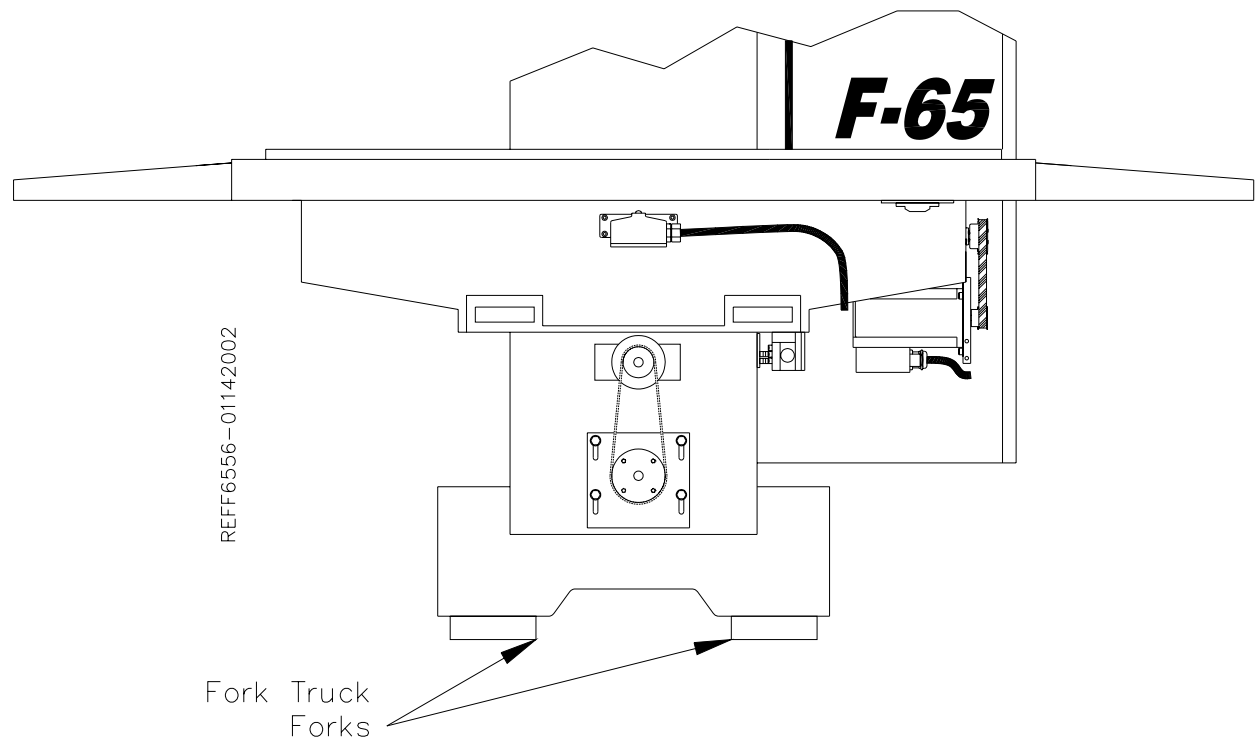
Type One:



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

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

Type Two:



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

IMPORTANT:

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

Leveling and Alignment:

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

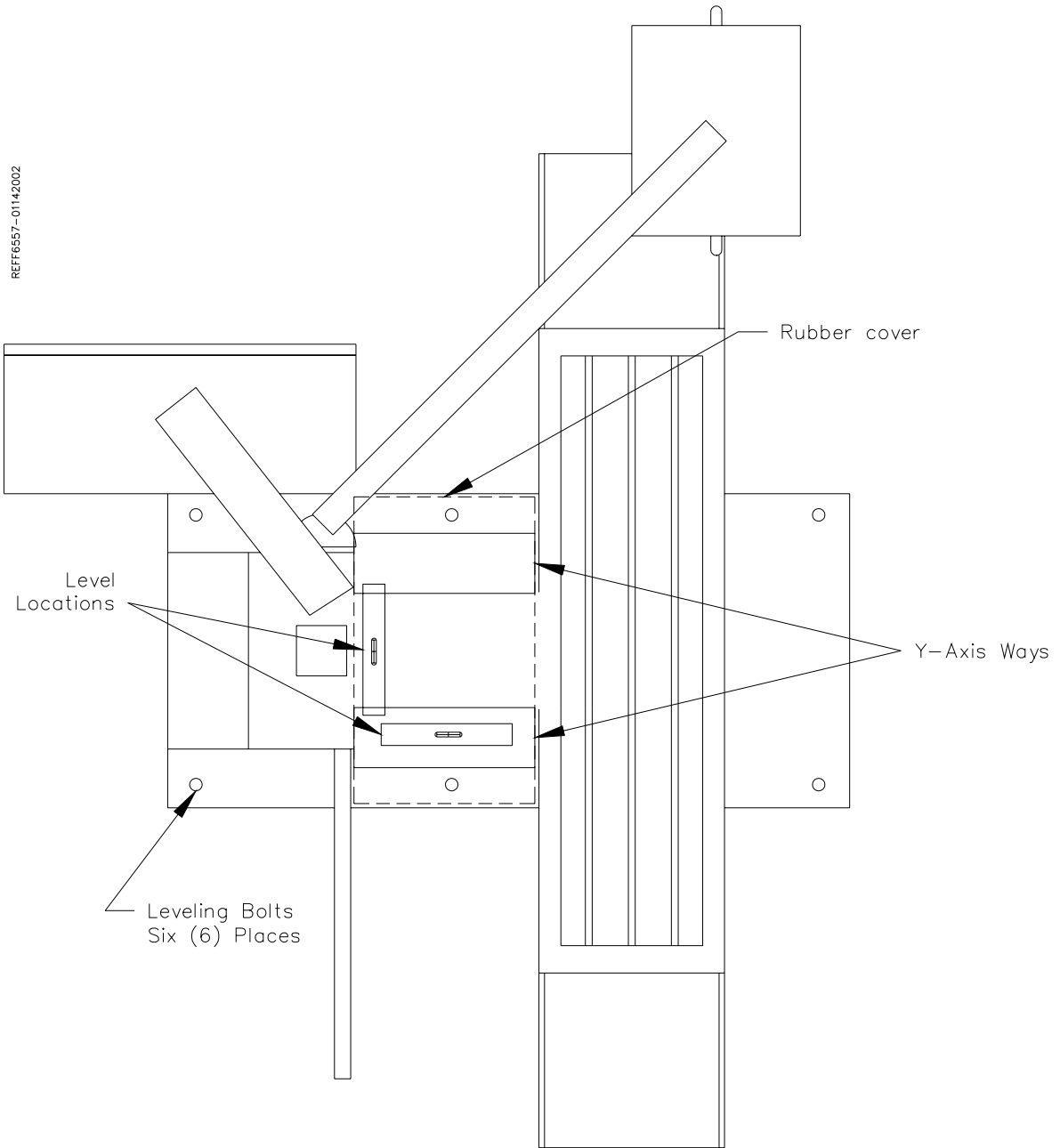
Use the following instructions to properly level the F65.

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

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

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

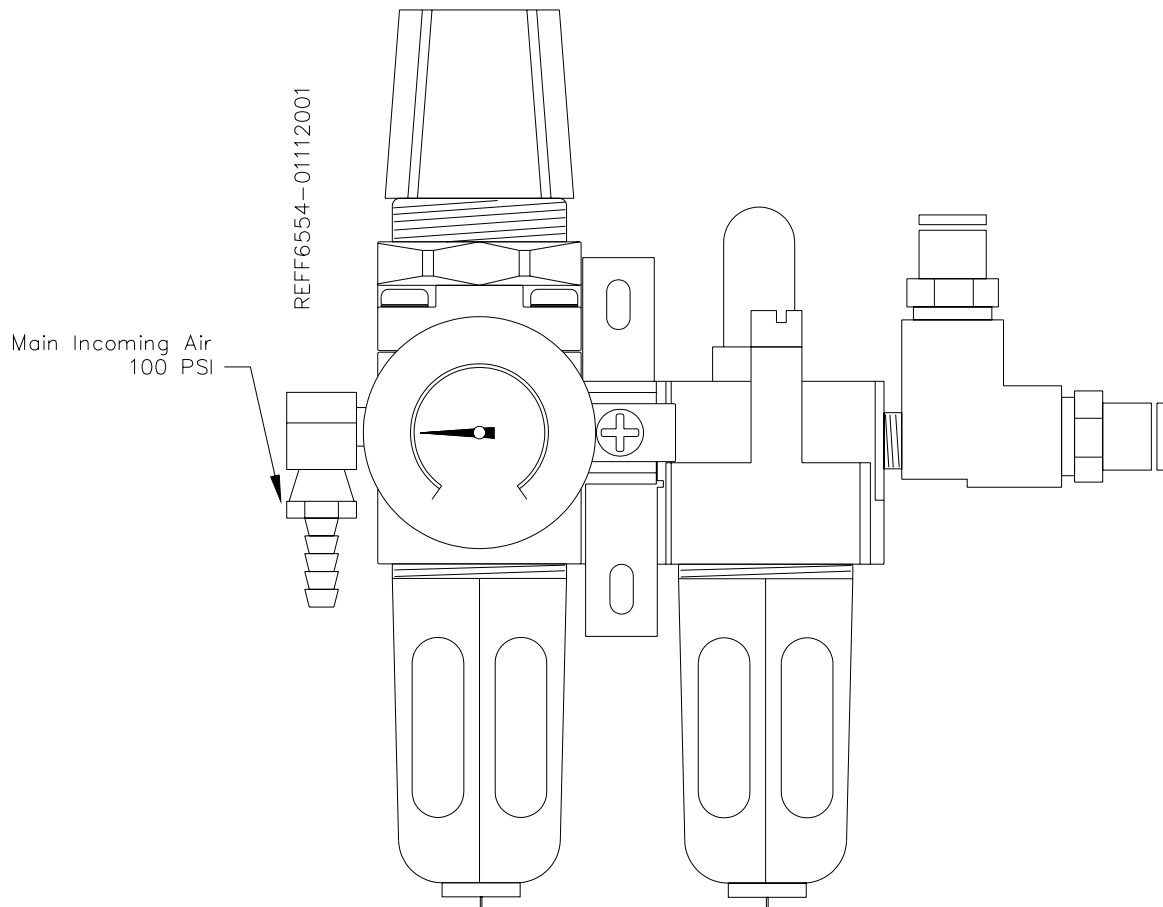
Leveling Locations:



Air Supply:

It is very important that the air source for the F65 be moisture free. Water and oil in the air lines will result in early cylinder and valve failure as well as introducing moisture into the Inner spindle bearings. ***The factory recommends installing a water trap at the machine.***

Attach a 100 P.S.I. air source to the main air intake located on the right hand side of the main rear enclosure.



Power Supply:

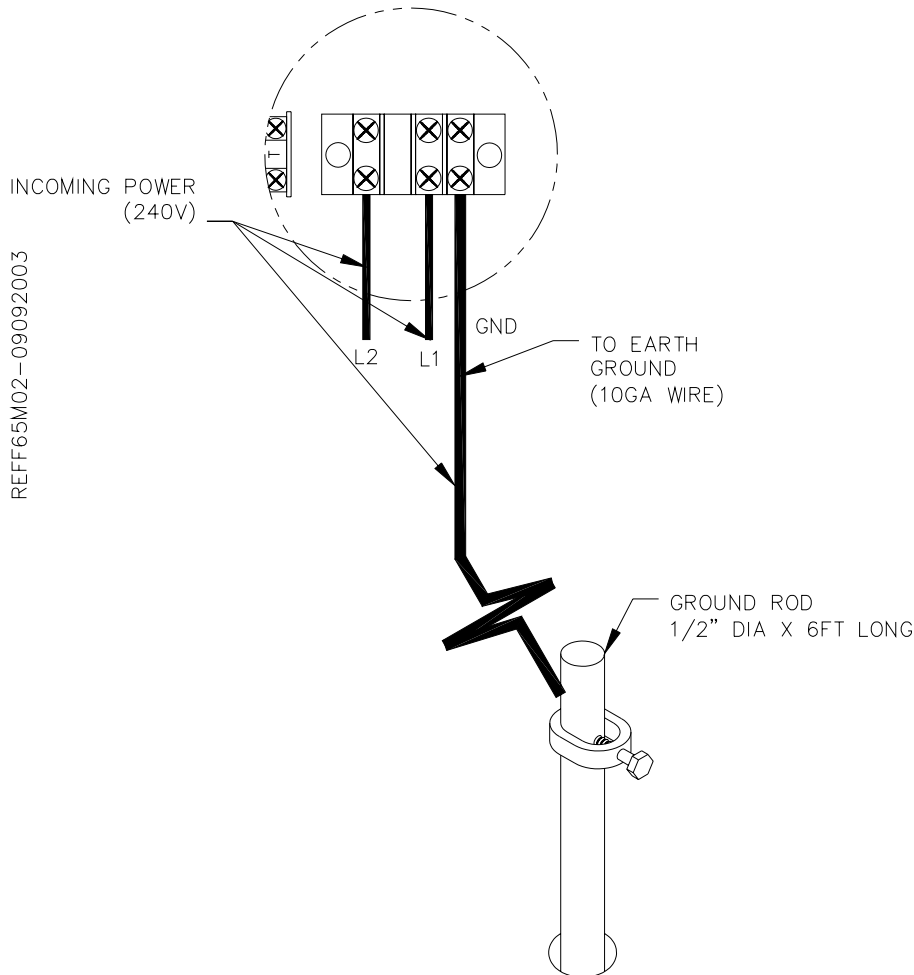
This machine has the following power requirements:

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

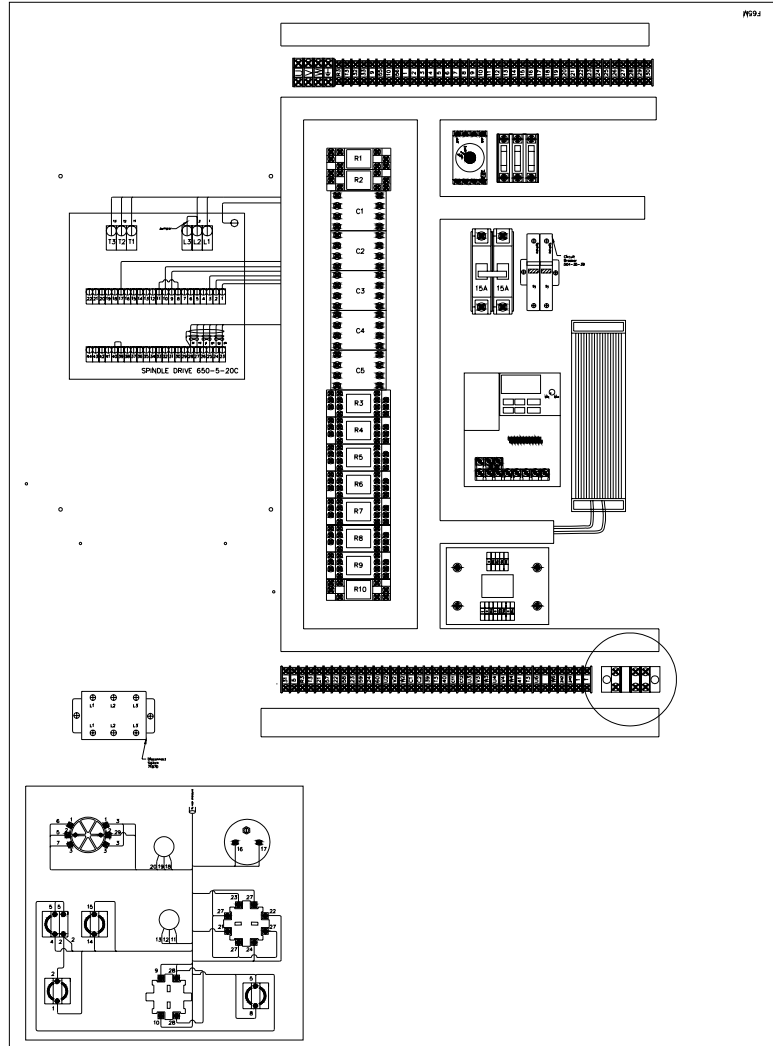
See illustration below for correct connection of “measured” incoming power. Connect single phase wiring to the main rear enclosure, located on the right rear of machine base. The connection point for power is located inside the enclosure. The connection termination point is located on the left hand side of the electrical panel about half way up. Connect L1 to the Grey terminal block, L2 (neutral) to the blue terminal block and shop ground to the green and yellow 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, 1/2” diameter, 15 OHM, Copper grounding rod driven into the earth next to the machines is preferred. Not providing a grounding rod could void factory warranty.



Electrical Enclosure:



REF65M01-09092003

Incomming Power
208 – 240 VAC
Single Phase 50/60 Hz

IMPORTANT:
ELECTRICALLY CONNECT
IN ACCORDANCE
WITH LOCAL AND
NATIONAL ELECTRICAL
CODES.

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.

Shipping Restraints:

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

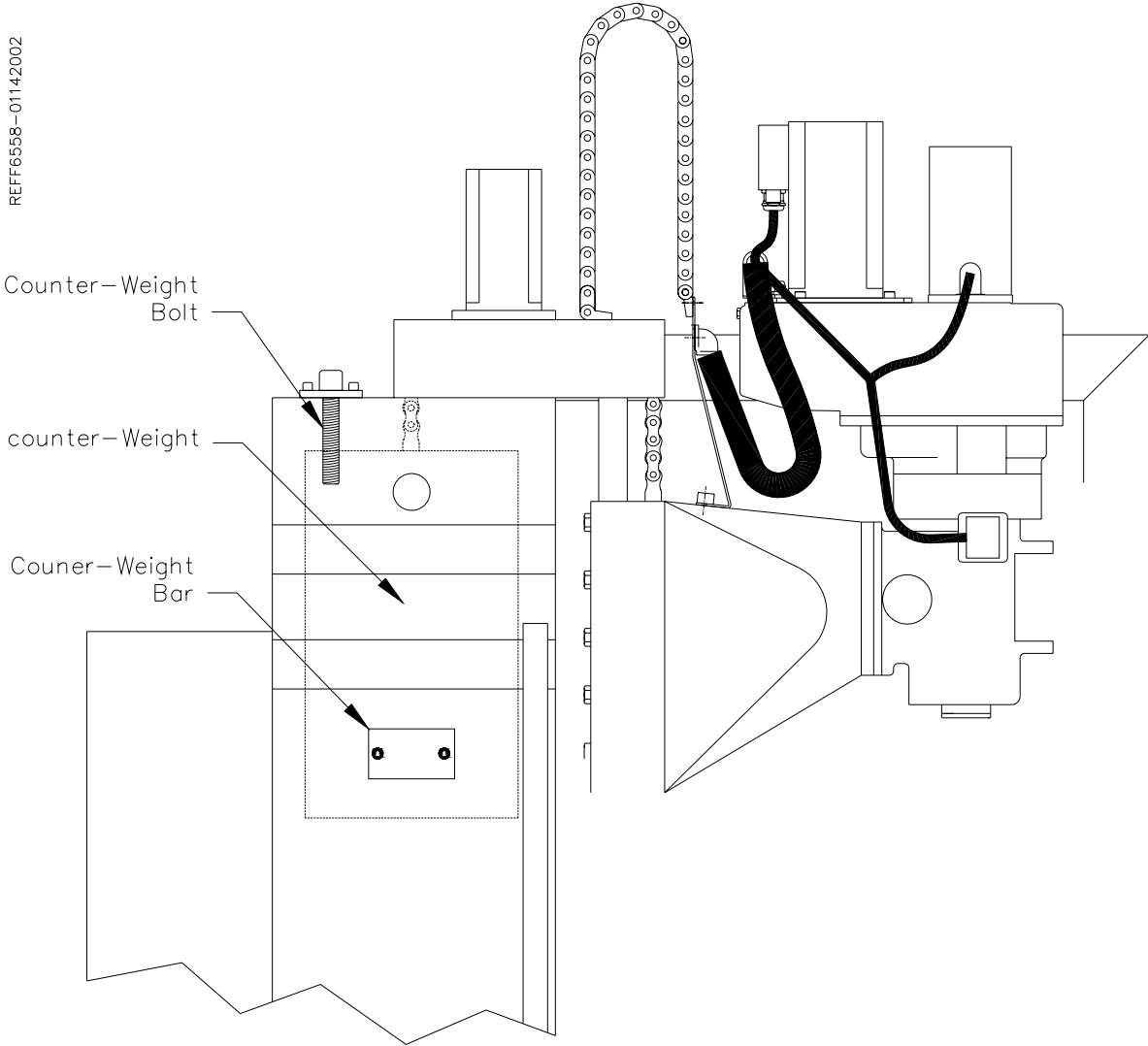
IMPORTANT: Do not touch any of the rapid travel movements on the machine at this time.

Spindle Support:

Use the vertical manual handwheel to lift the up off of the support.

Counter-Weight Bar and Bolt:

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



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

Chapter 2 Control Definitions:

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

Master Power On/Off Switch:

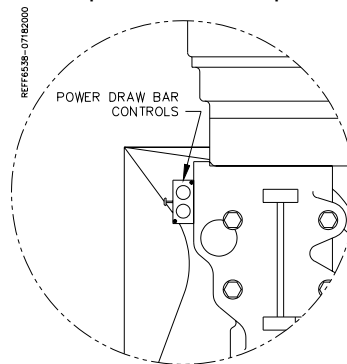
This switch is located on the main electrical control enclosure on the right hand side of the machine. The switch must be in the off position before opening the rear enclosure door.

Power Air Draw Bar Switch:

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

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

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



Chapter 3 Operating Instructions:

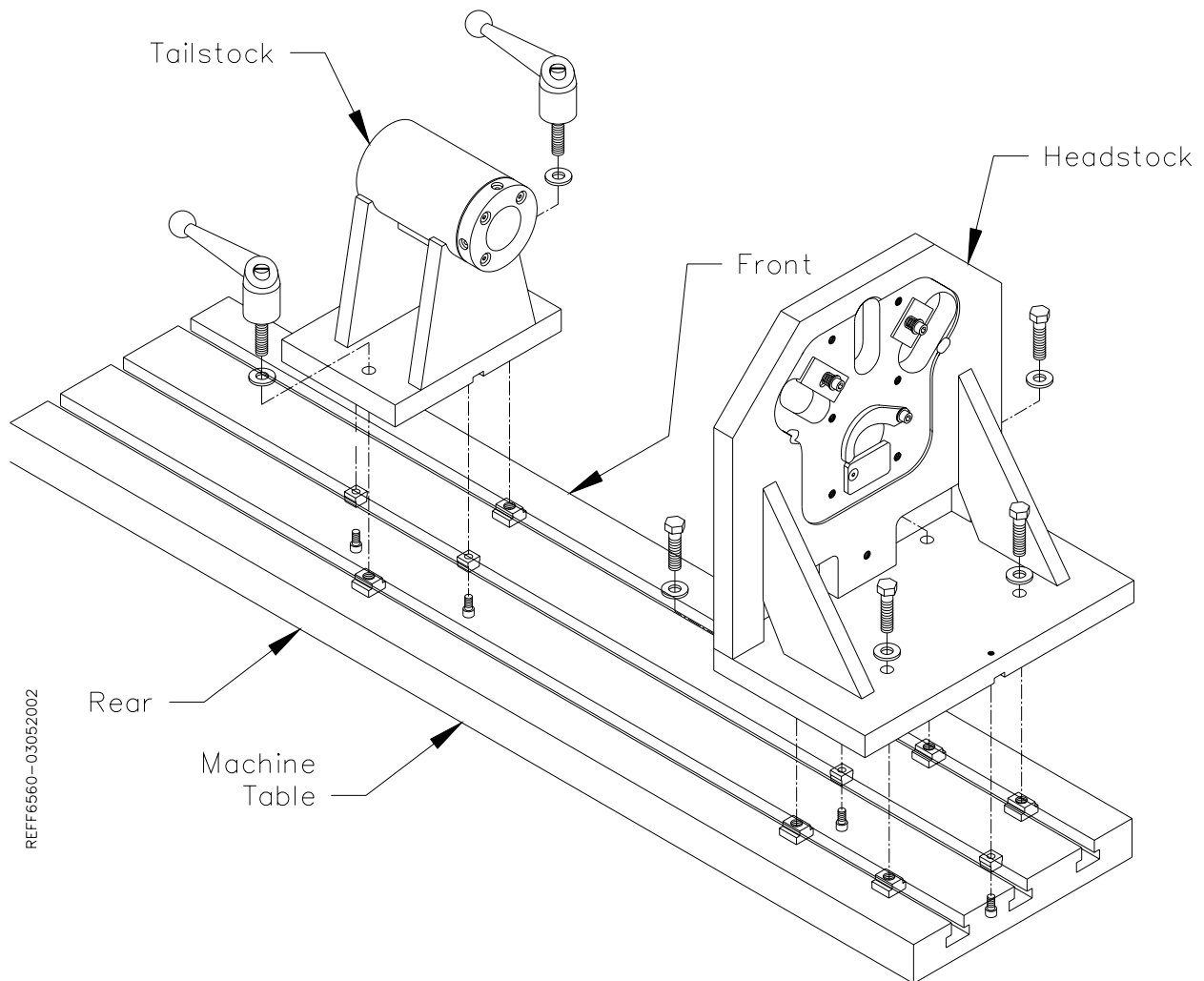
The purpose of this chapter is to explain and then guide the operator from loading blocks to running an automatic cycle.

All modes of operation will be discussed in this chapter.

Loading a Block:

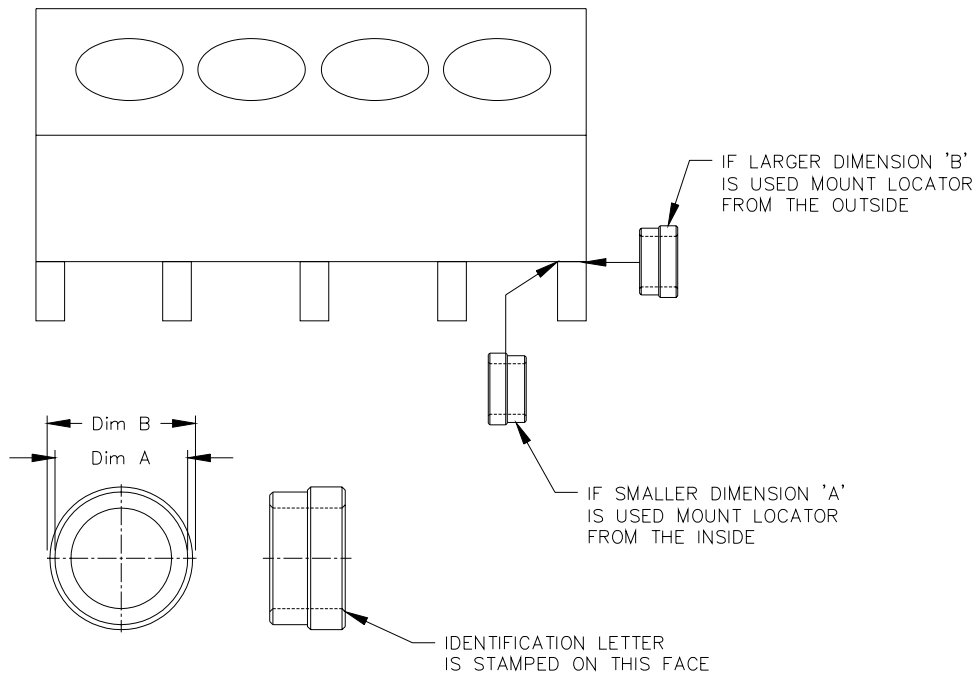
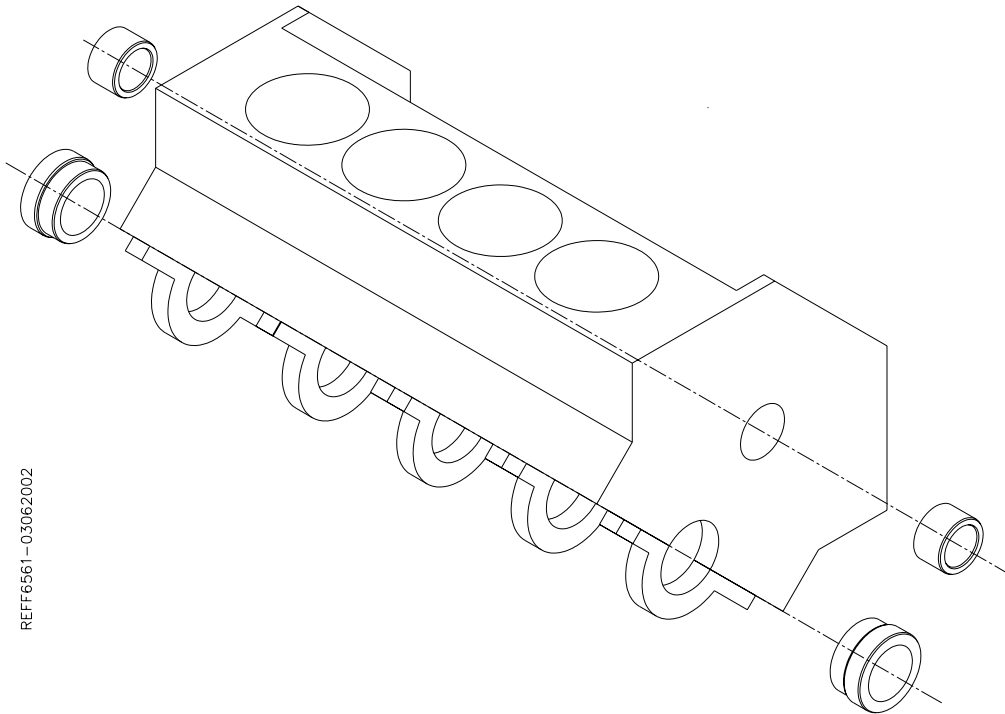
Performance Fixture 650-3-1 Boring:

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



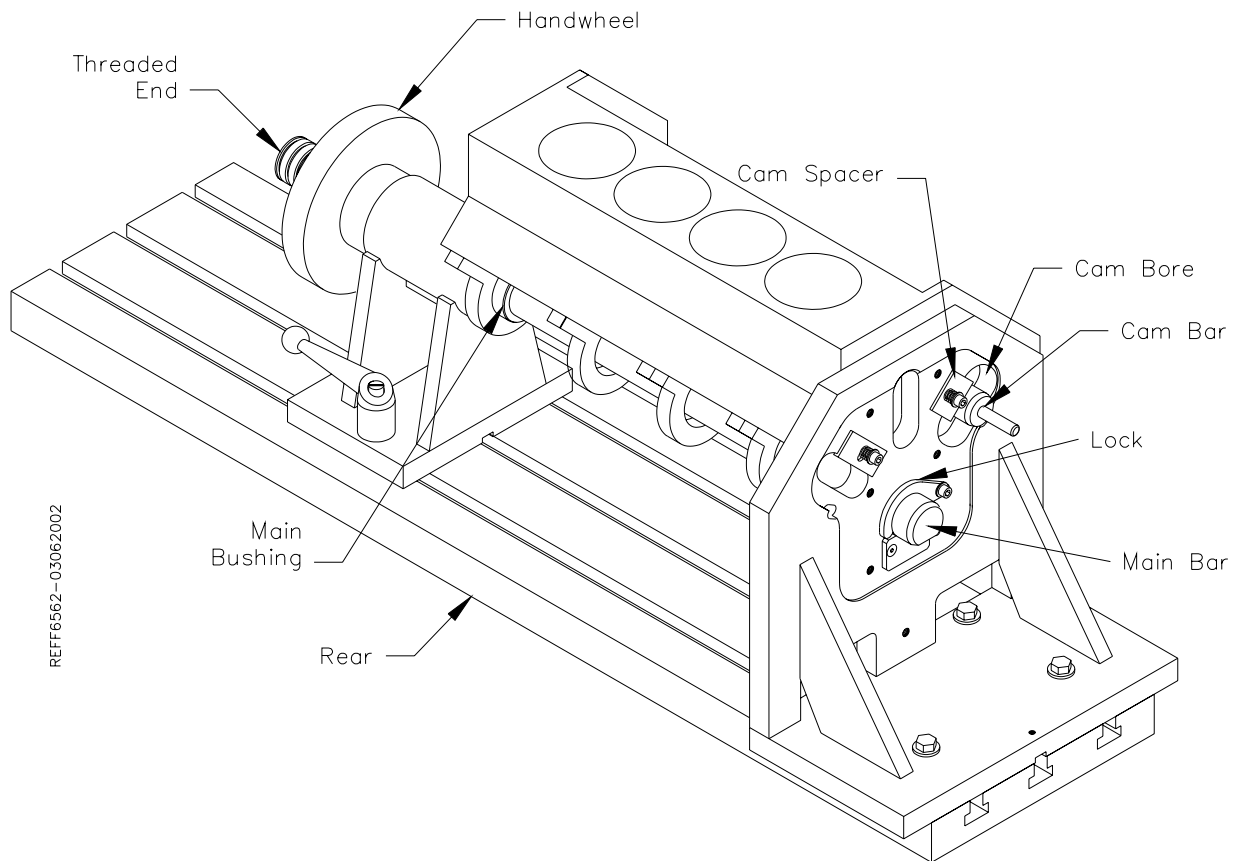
REF6560-03052002

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



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

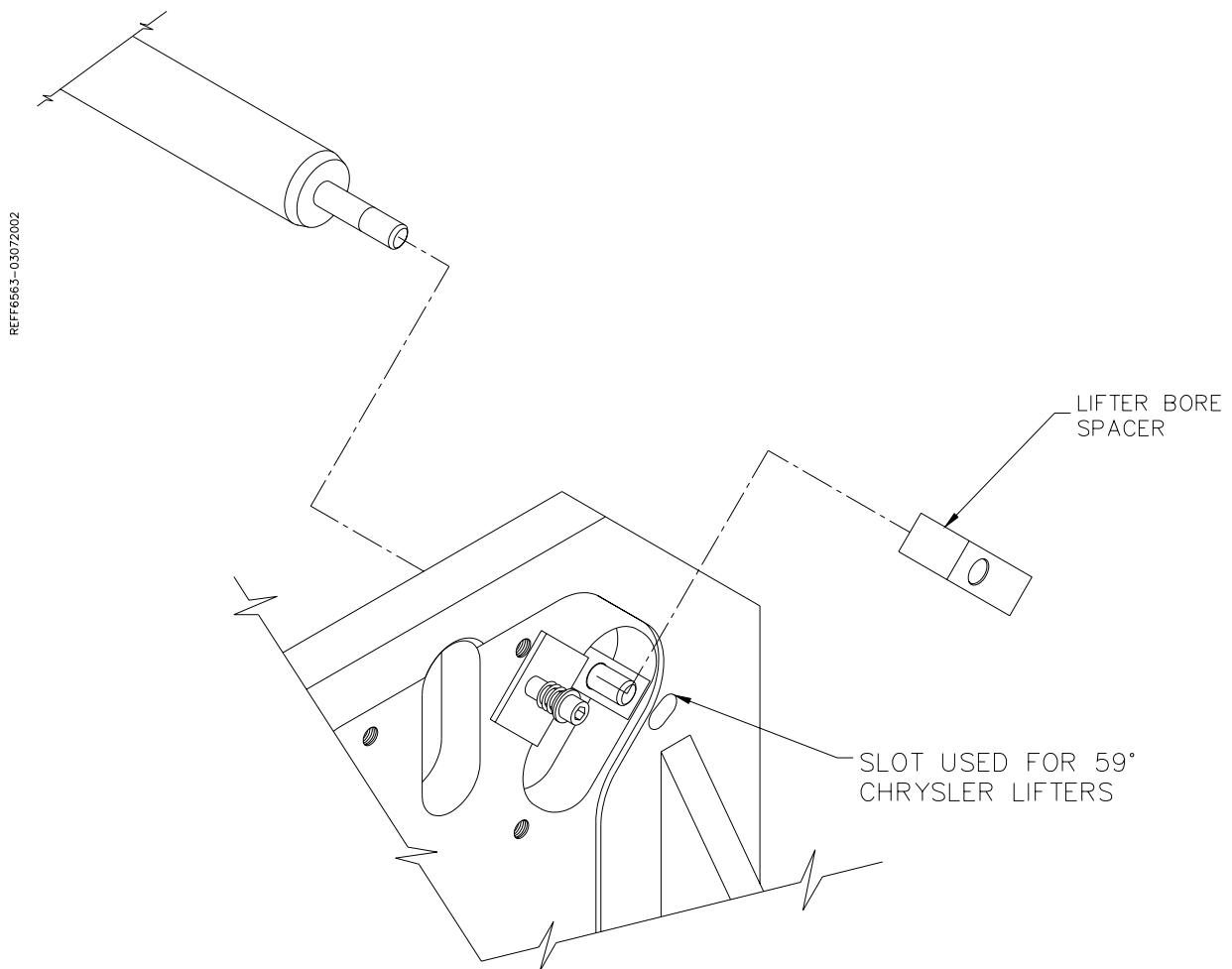
- 4) Using a slow travel hoist, position the block between the Head stock and Tail stock with the Bell housing end of the block towards the Head stock.
 - 5) Slide the unthreaded end of the Main Bar through the Tail stock, both Main bushings and into the Head stock with the flat facing down. The threaded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



Performance Fixture 650-3-1 Lifter Boring:

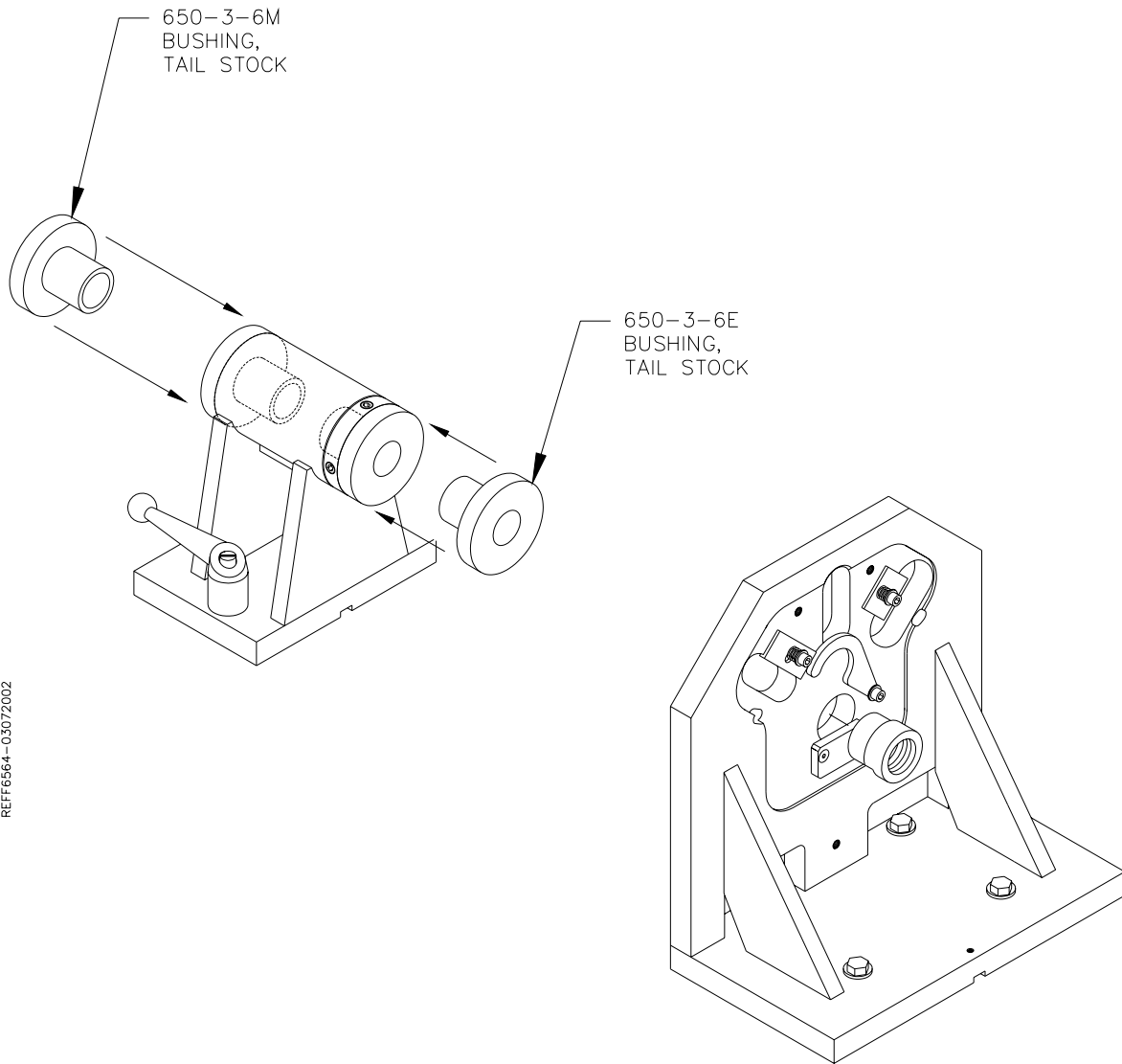
The same procedure for loading a block in Lifter boring as was used in Boring with an exception in the Cam Bar area.

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

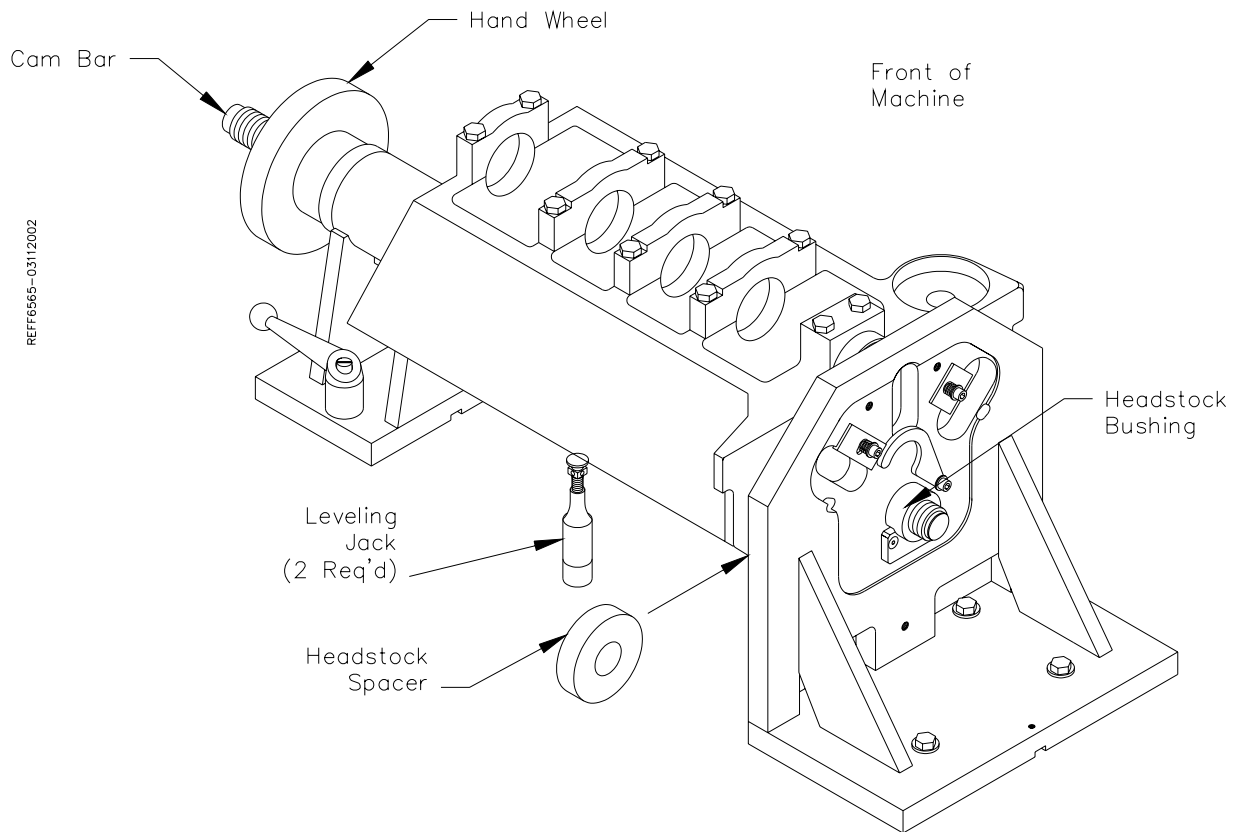


Lower End Machining Package 650-3-1A:

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



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

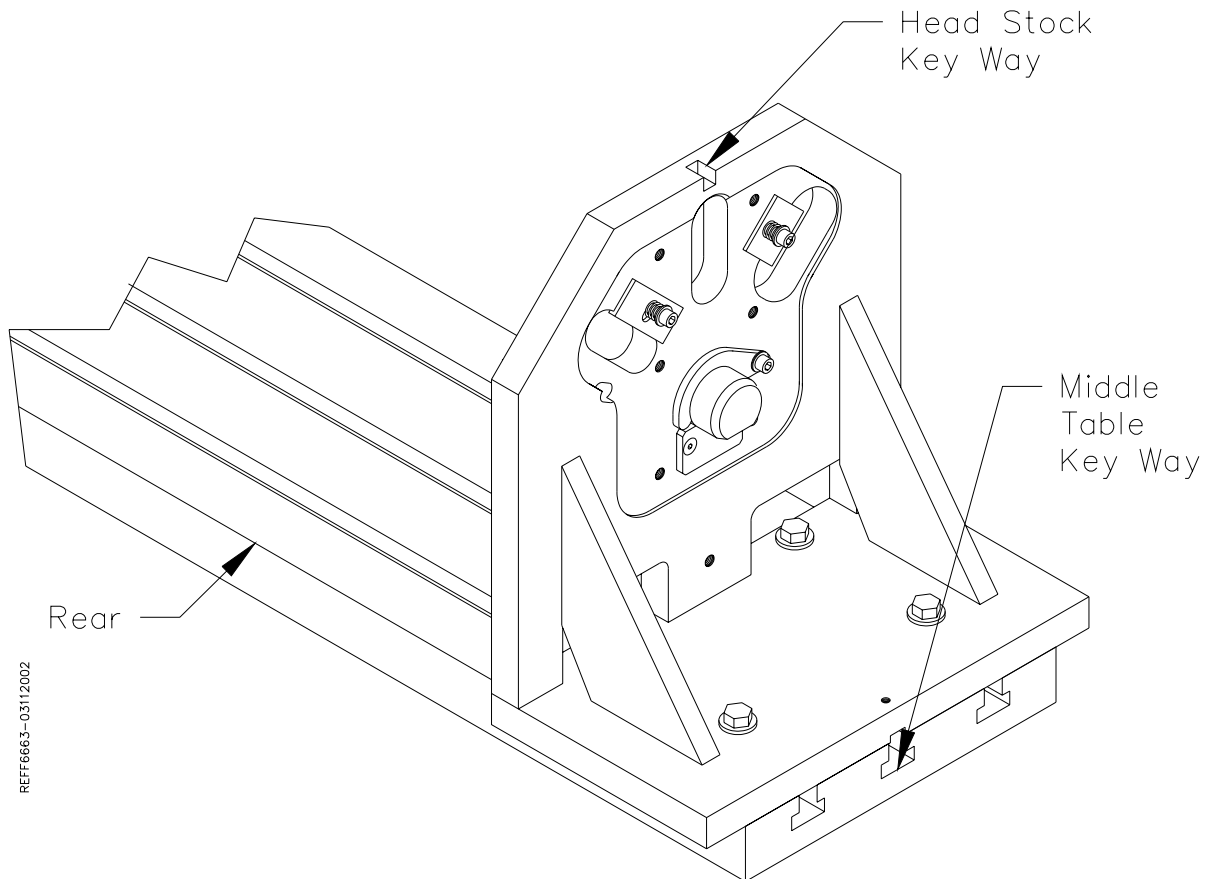


Block End Truing Fixture 650-3-30:

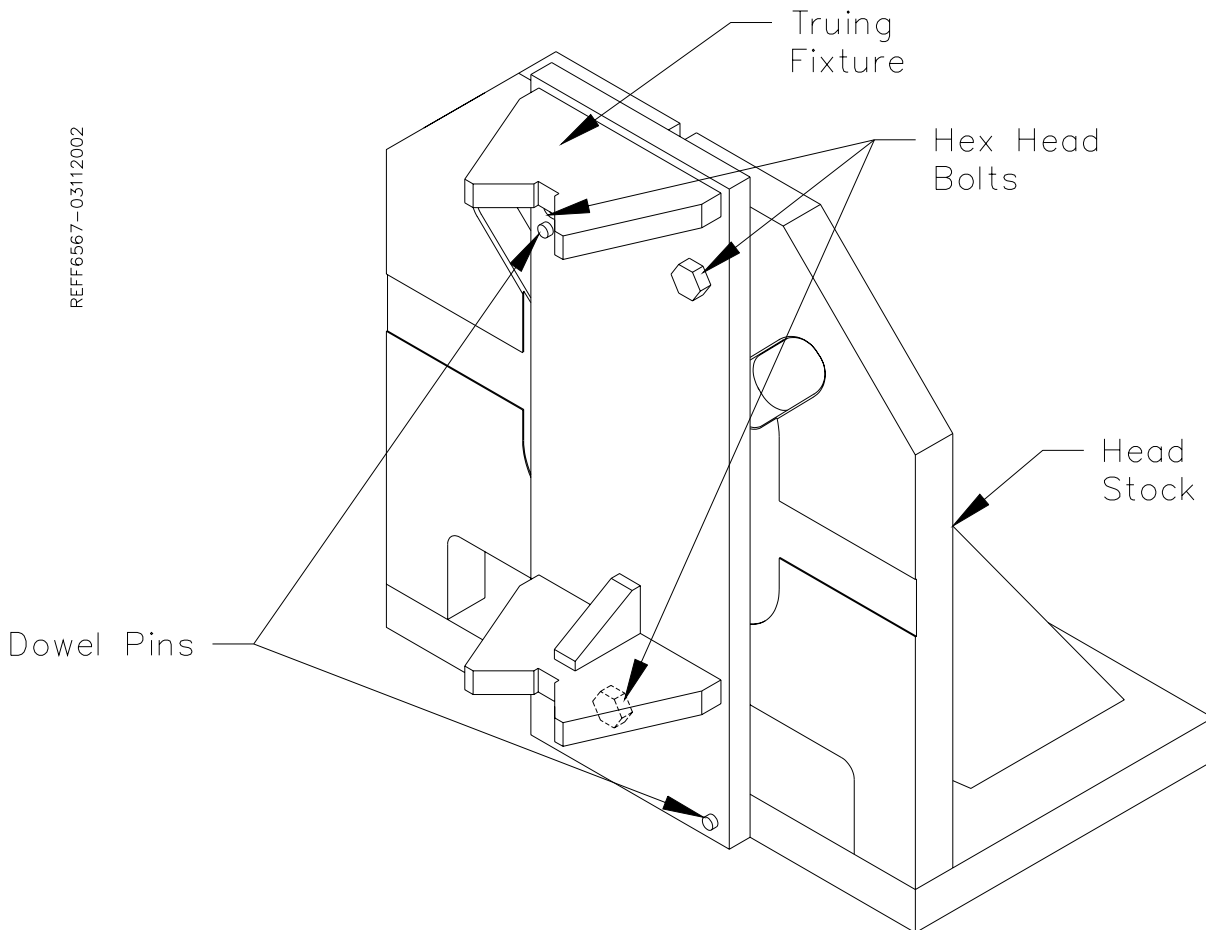
If you are truing the ends of a block use the standard Head stock mentioned in the Maintenance section of this manual.

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

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



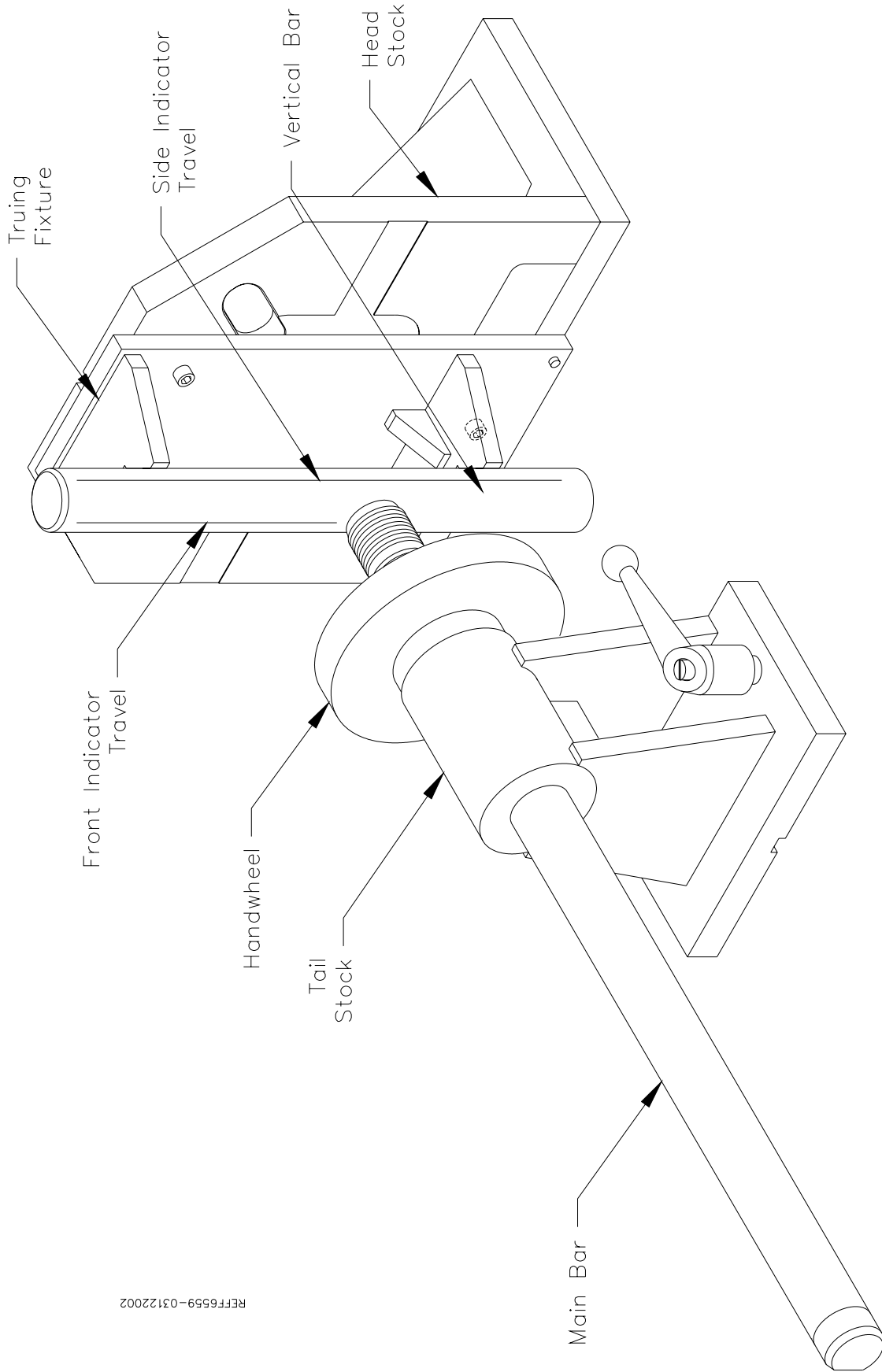
- 4) Install the Truing Fixture onto the Head stock. Slide the two Dowel pins on the Truing Fixture into the appropriate Dowel holes on the Head stock.
- 5) Bolt the Truing Fixture to the Head stock using the three supplied Hex Head Bolts.



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

- 6) Slide the Main Bar through 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 an 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.

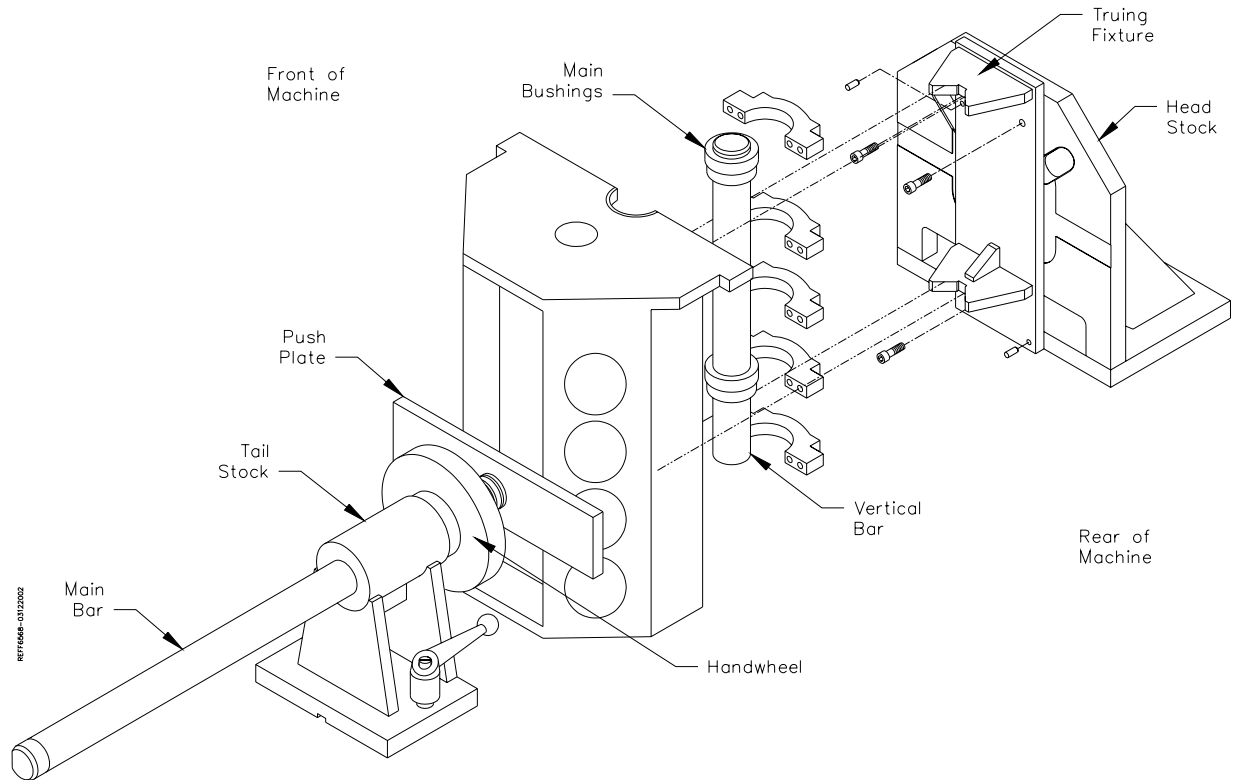
Note: Front face will only have half travel as the Main Bar obstruct full travel..



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

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

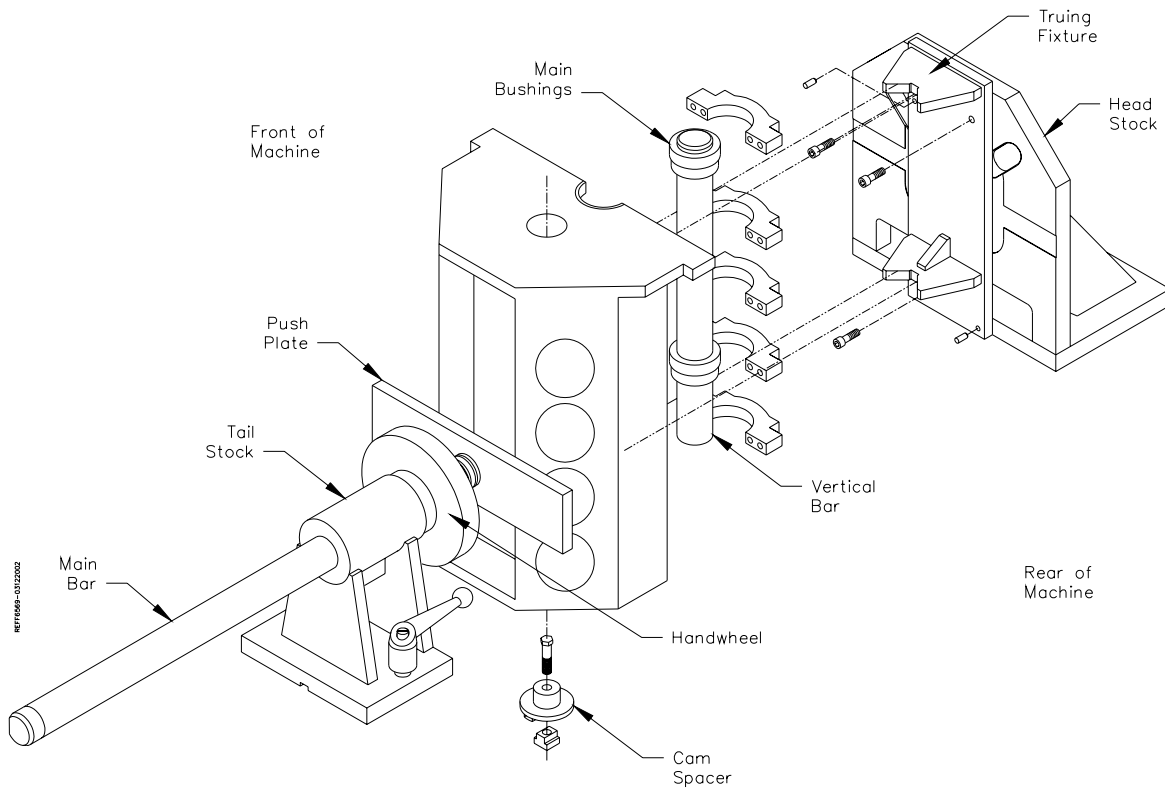


Block End Truing Fixture 650-3-30 when used with Cam Boring:

When using the End truing Fixture for Cam Boring you will also need tooling package 650-3-43A

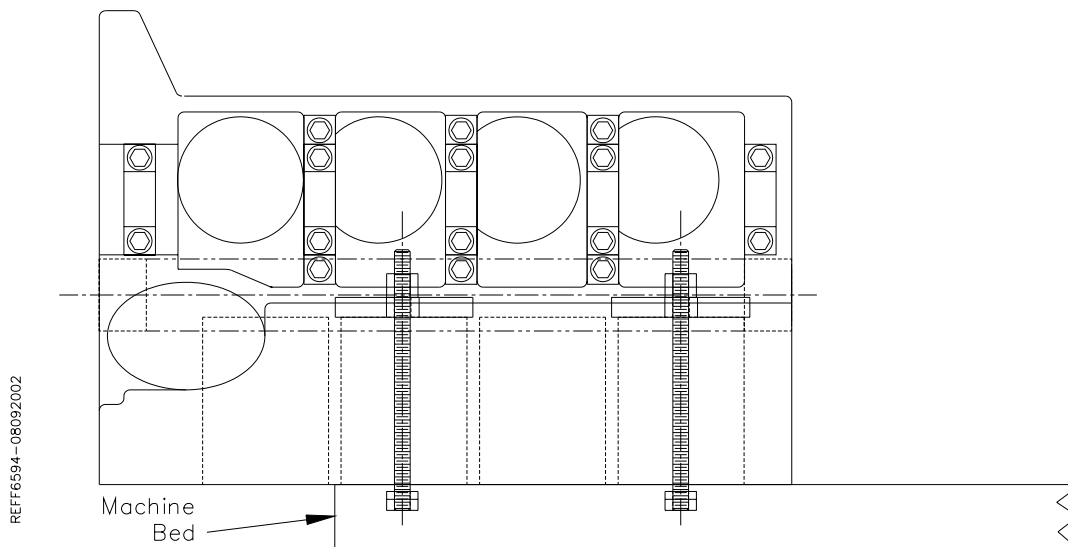
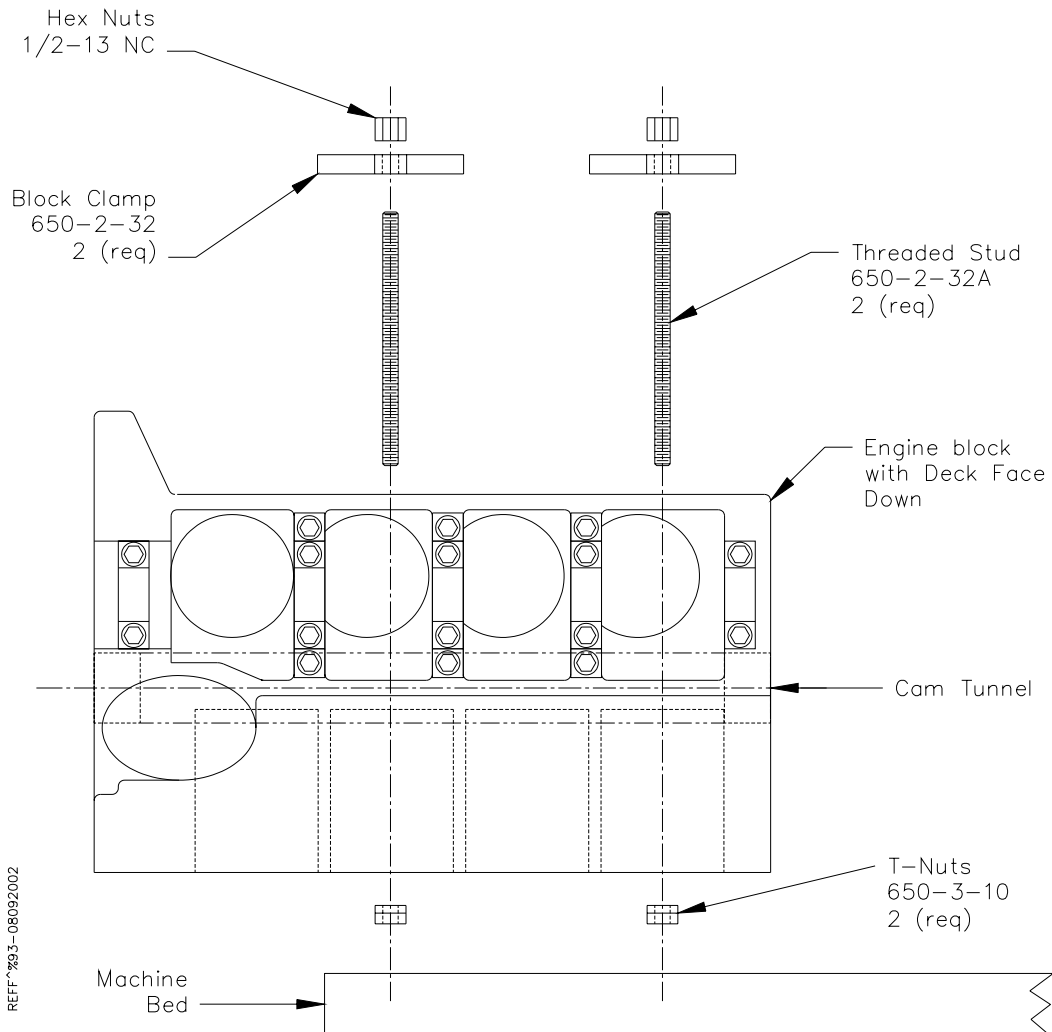
- 1) Use the same set up and line up procedure as with the standard End Truing Fixture discussed earlier in this section.
- 2) Place the Cam Spacer in the middle T-slot of the machine bed along with T-Nut and Bolt.
- 3) Select the correct Cam Bushing for the block you are going to be machining from the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

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



Cam Tunnel Boring:

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

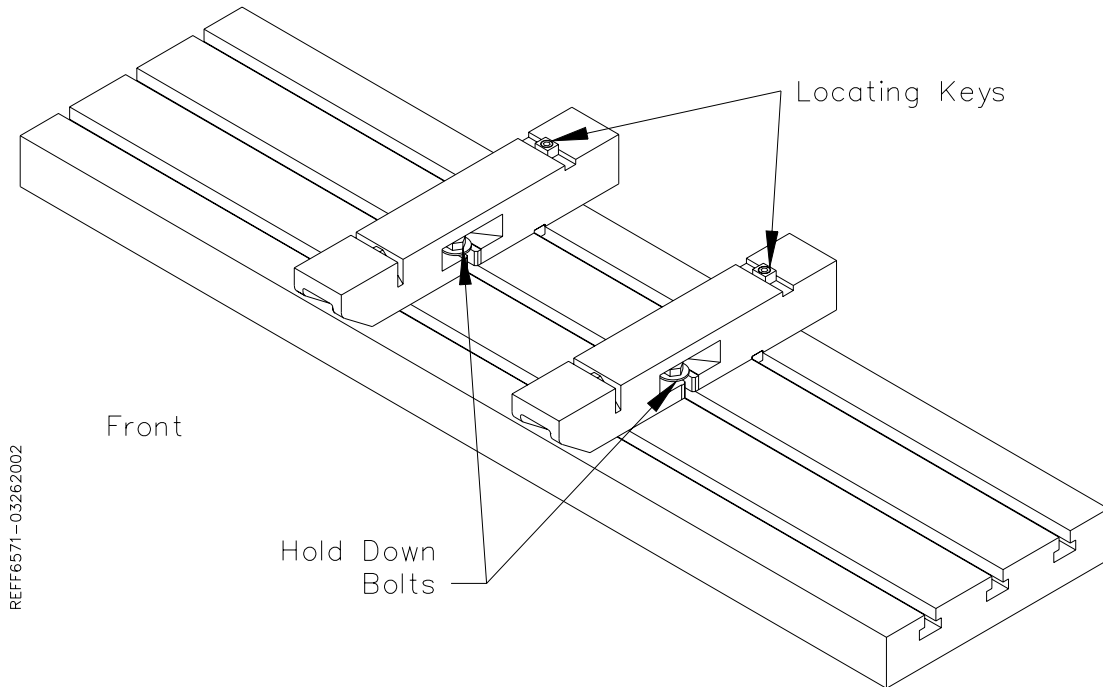


- 4) Screw the supplied ½-13 NC nuts on to the threaded rod and snug them up. Do not tighten them all the way at this point.
- 5) Attach a magnetic base indicator to the spindle and run it along the upper pan rail to get it relatively straight. It does not need to be perfectly straight because a double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

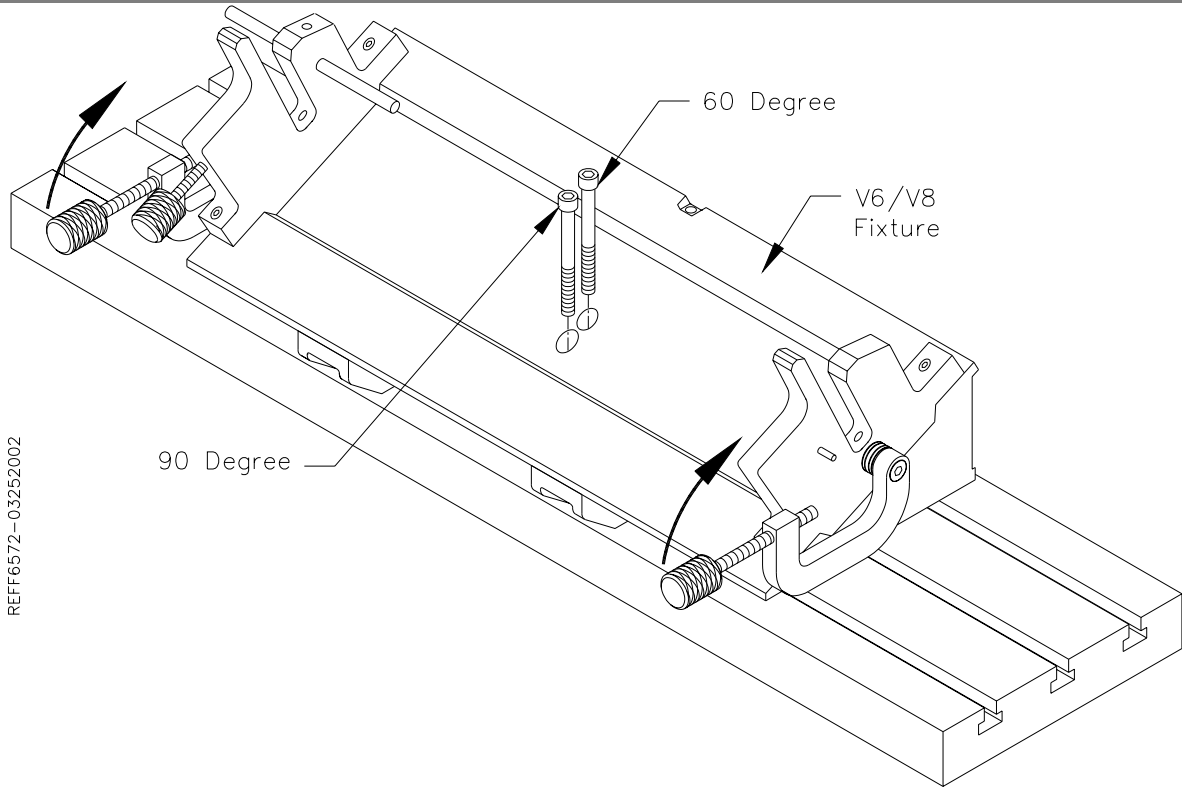
The block and fixture are now locked in place and ready for machining.

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

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

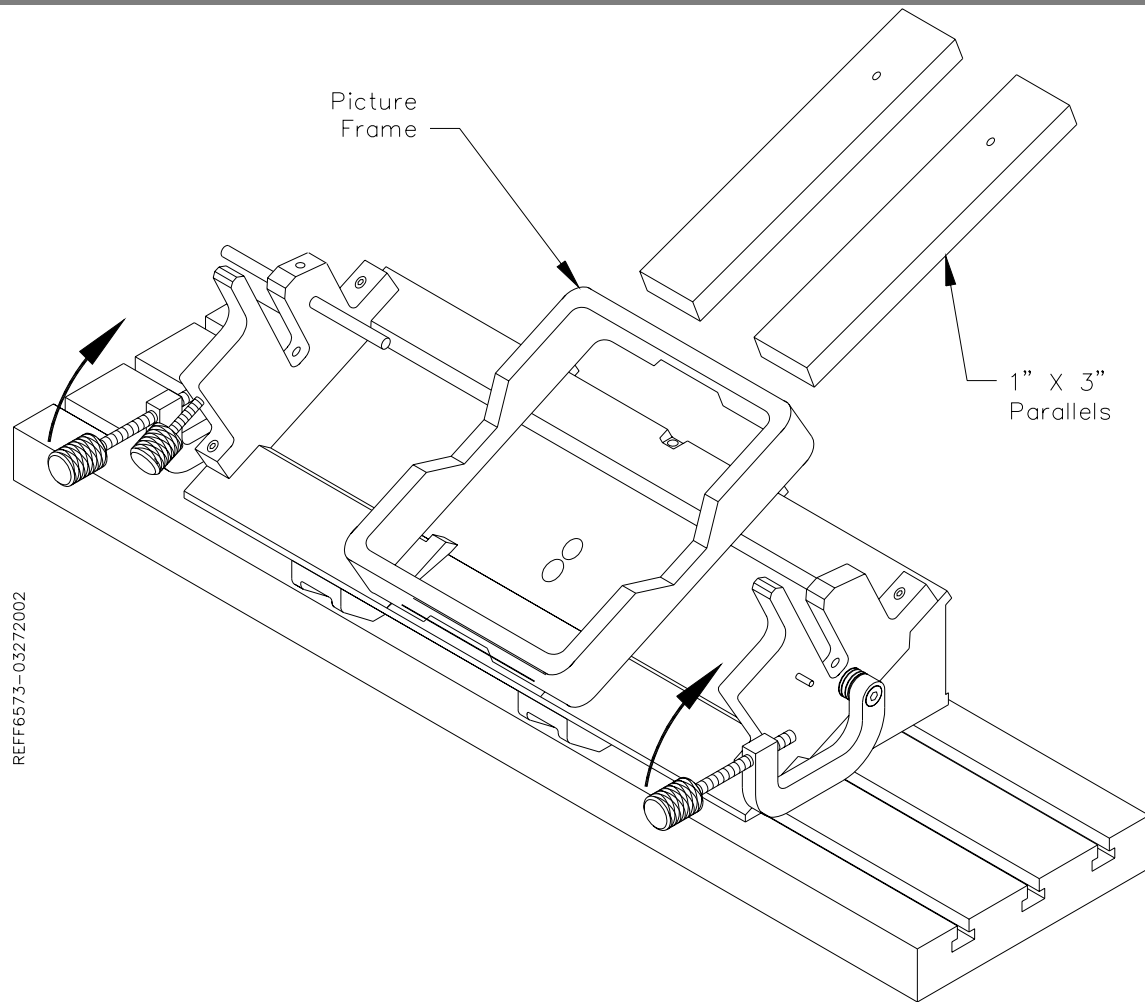


- 2) Select the 60 or 90 degree position for the fixture. Using a slow moving hoist, set the V6/V8 fixture onto the parallels.
- 3) Push the V6/V8 fixture back on the parallels until the keys in the top of the parallels line up to the machined sections on the rear of the V6/V8 fixture.
- 4) Use the supplied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



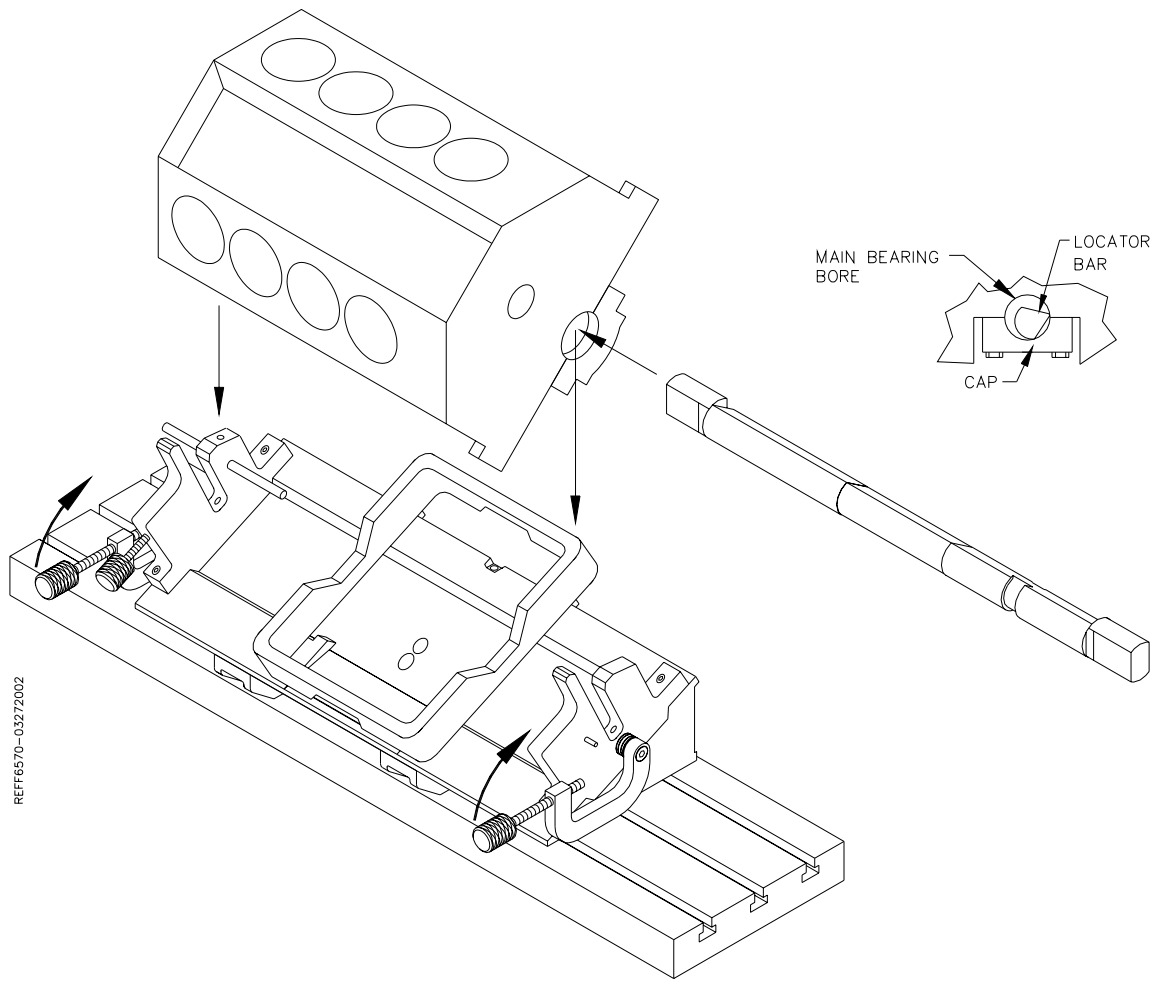
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- 5) Decide if the Picture Frame or the 1" X 3" will need to be used.



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

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

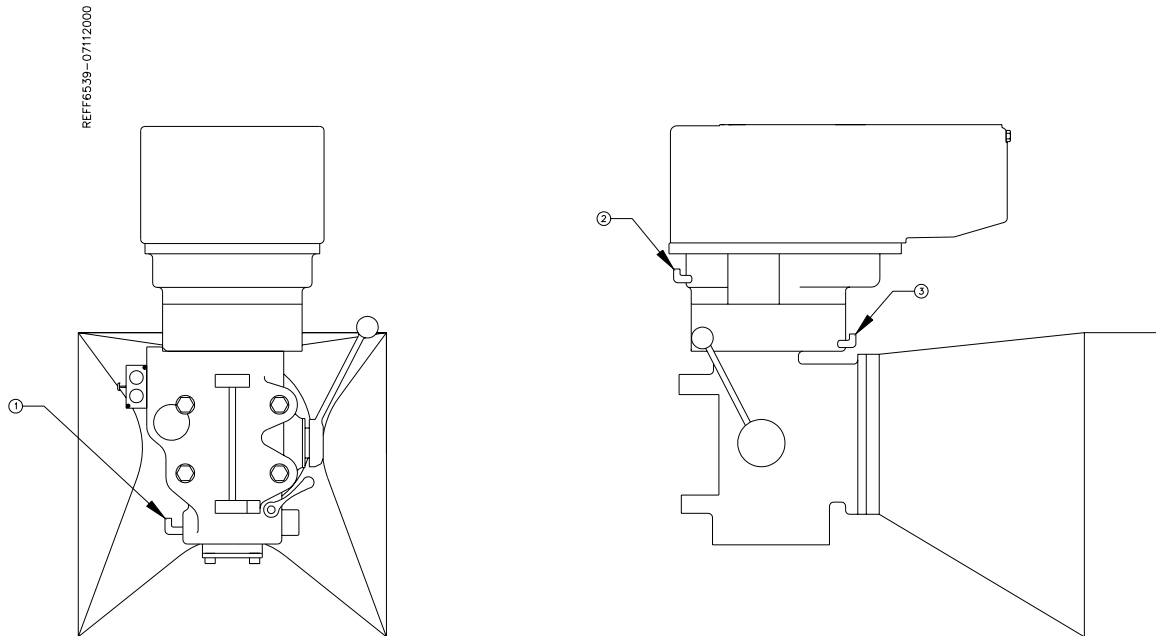


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Chapter 4 Maintenance: Lubrication

Manual Lubrication

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

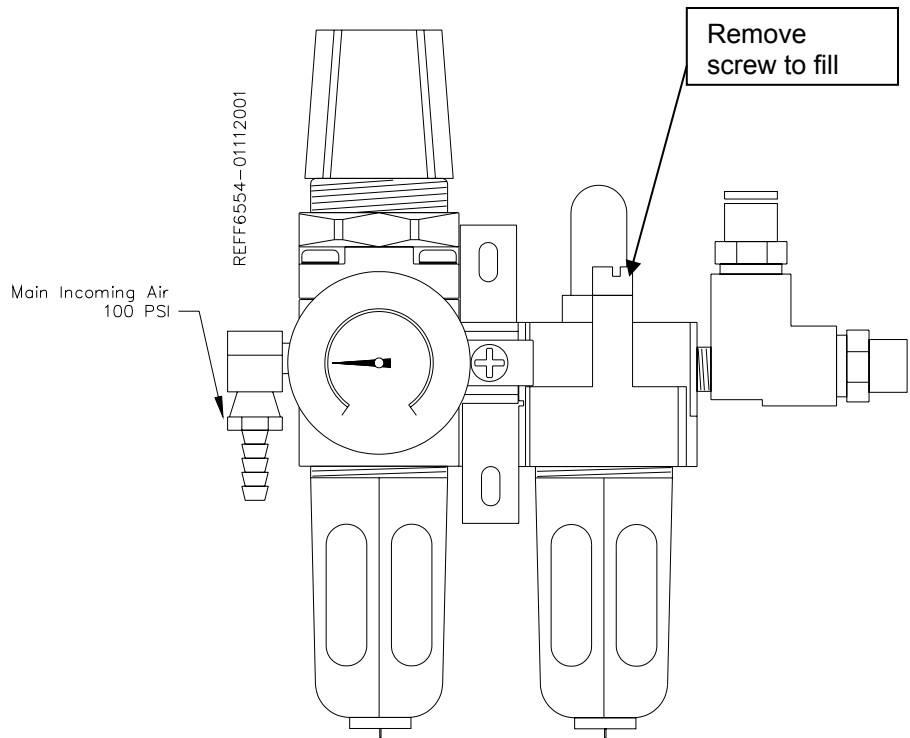


Automatic Lubrication System

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

Power Draw Bar Lubrication:

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



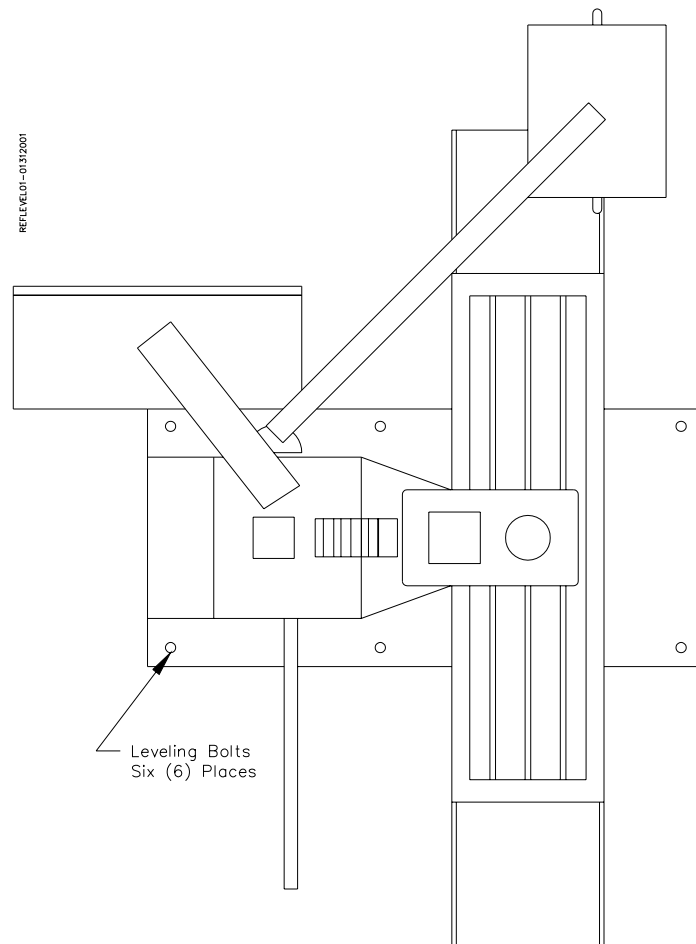
Leveling and Alignment:

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

Leveling the Machine:

After uncrating the F65 set it down in desired location with leveling bolts and leveling pads installed.

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



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

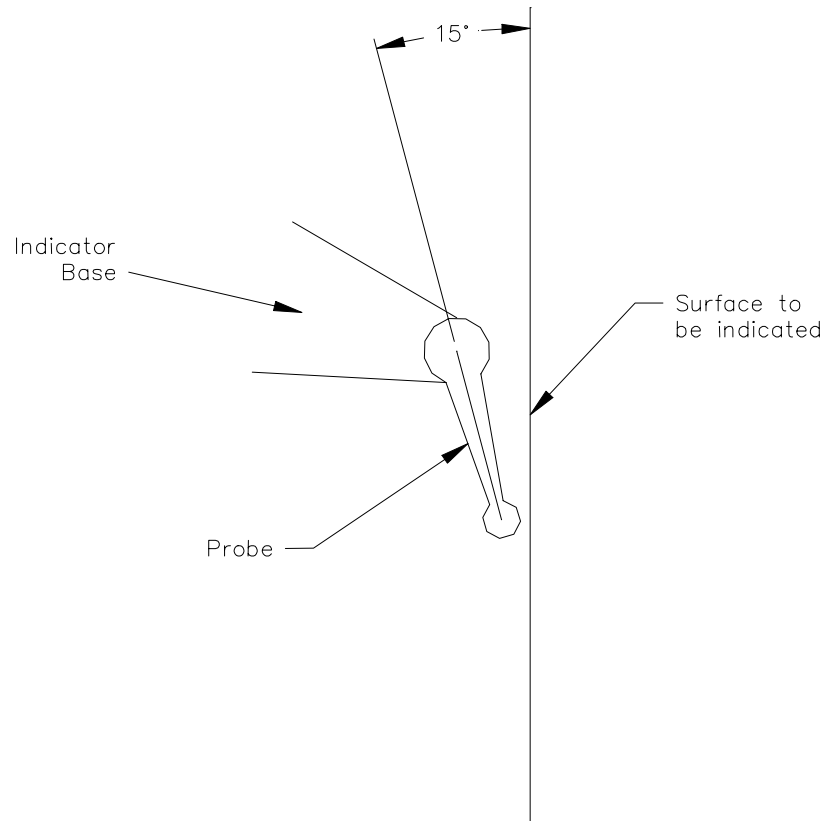
After you have leveled the bed using the four corner bolts, move to the middle leveling bolts. Bring these bolts down until they have approximately the same amount of pressure on them as them as the four corner bolts. Be careful not to throw the level of the machine off while doing this.

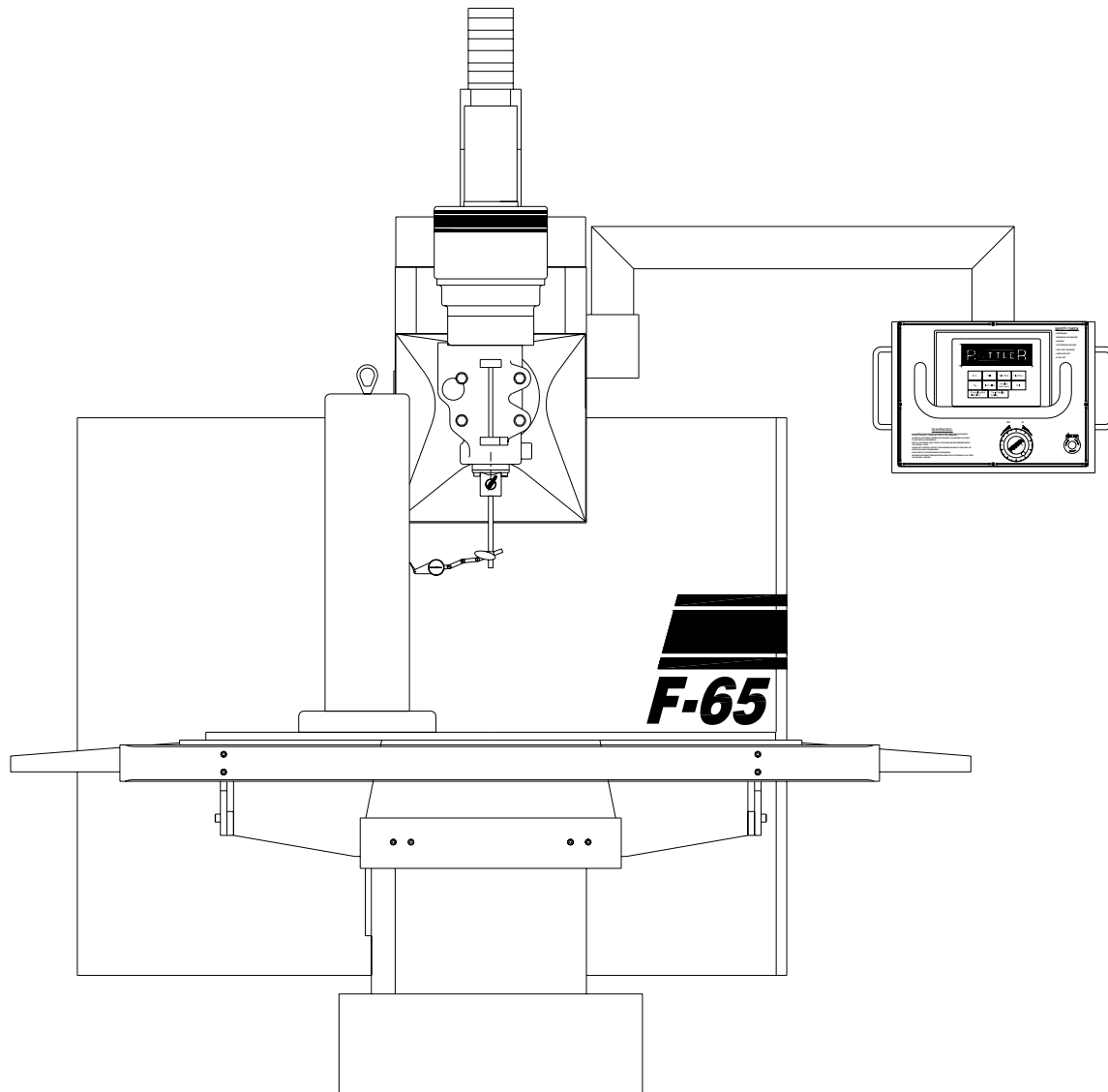
This will put the lower casting level.

Alignment:

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

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

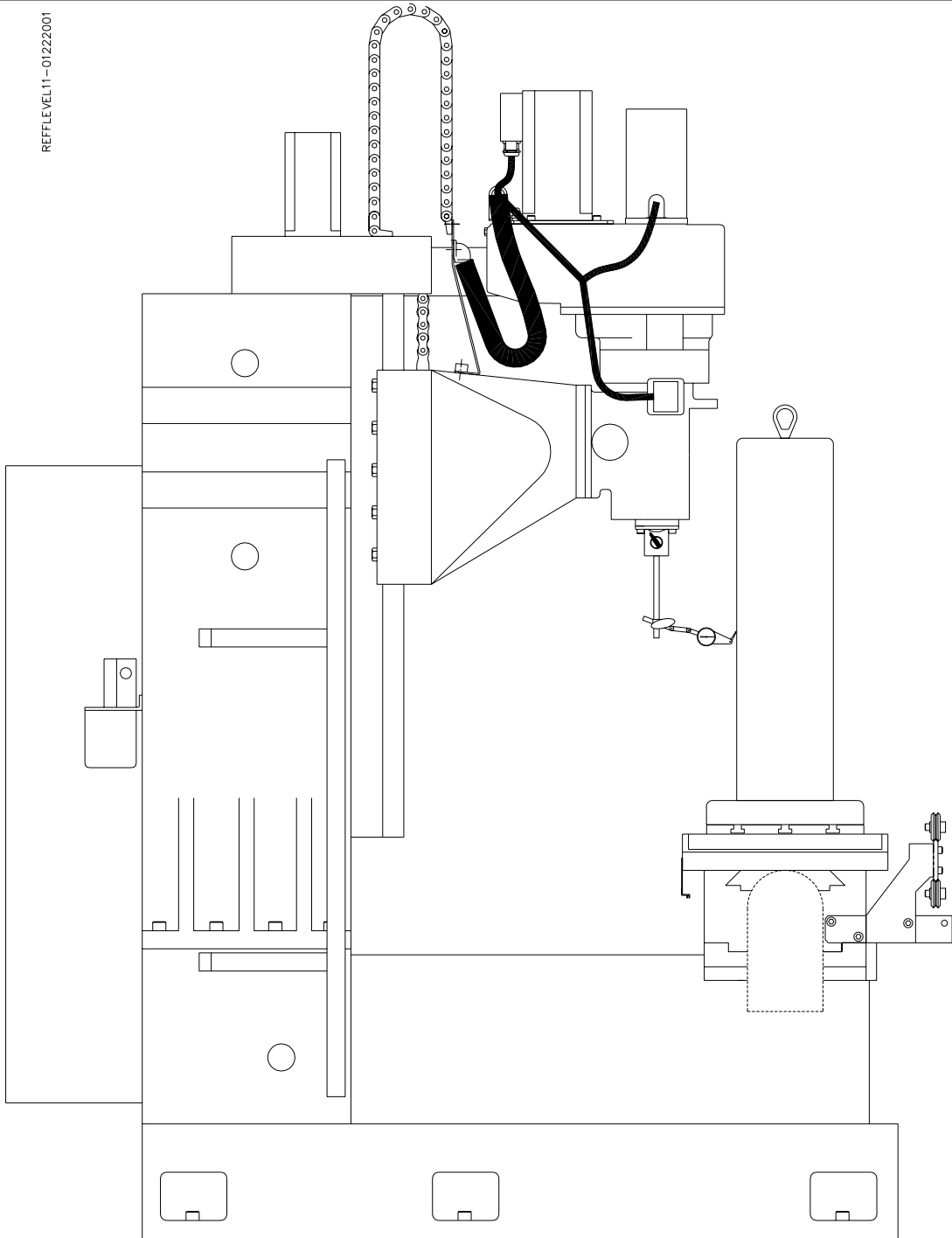




Put about .010" pressure on the indicator. Run the vertical throughout its full travel. The runout should not be more than .0005. If the runout is more than this, check the table top as well as the bottom of the alignment cylinder for burrs or debris.

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

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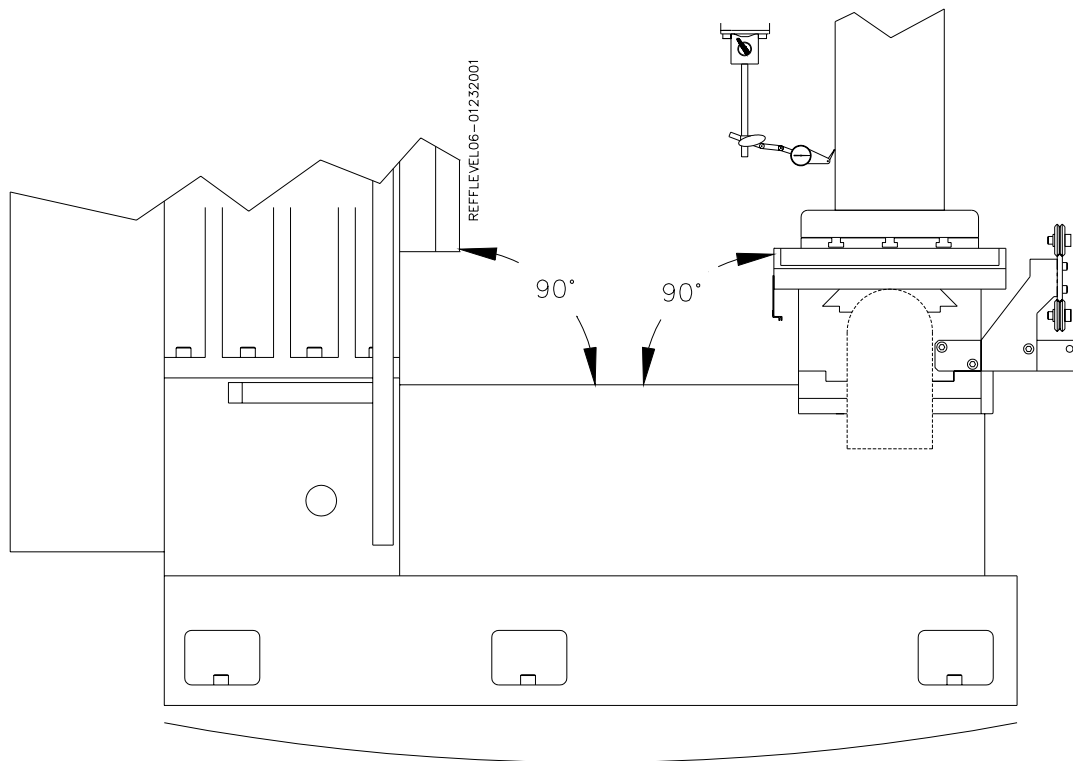


If the Vertical perpendicularity is not within tolerance the Middle Leveling Bolts may need to be adjusted.

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.

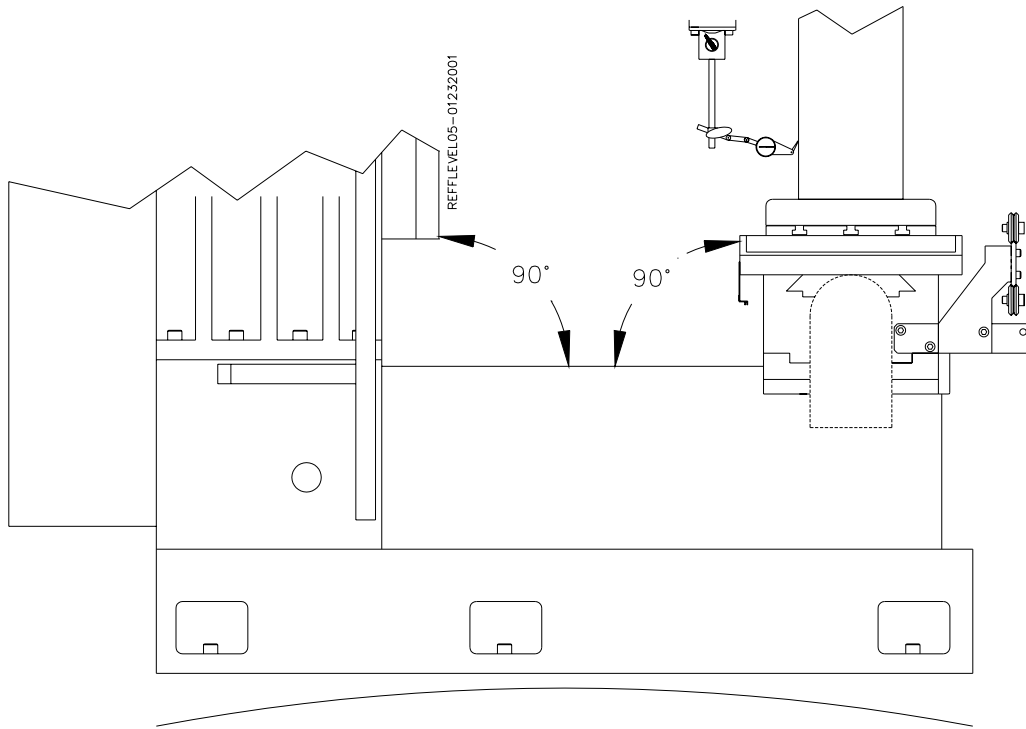
Example 1: Zero the indicator on the top of the cylinder. When traveling to the bottom of the cylinder, if the reading decreases past $-.001$ " to something such as $-.002$ ", then the middle leveling bolts have too little pressure on them and it is bowing the casting slightly in the middle as shown 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 $+0.001$ " to something such as $+0.002$ ", then the middle leveling bolts have too much pressure on them and it is bowing the casting slightly in the middle as shown below.



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

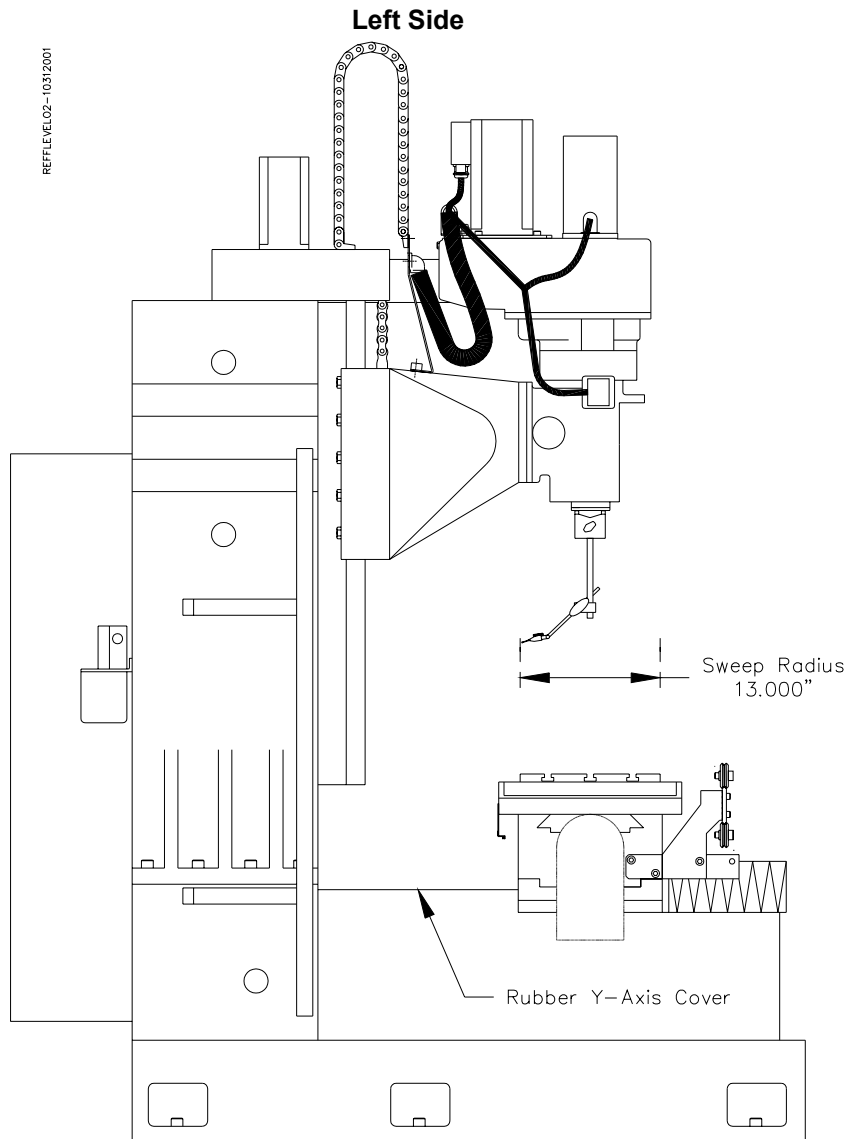
To correct the deviance slowly remove pressure from the middle bolts equally. Be sure to watch the level of the machine to be sure not to throw it off. After relieving pressure from the middle bolts you can apply slightly more pressure to the front corner bolts to bring the deviance within $.001$ ".

Sweeping the Spindle:

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

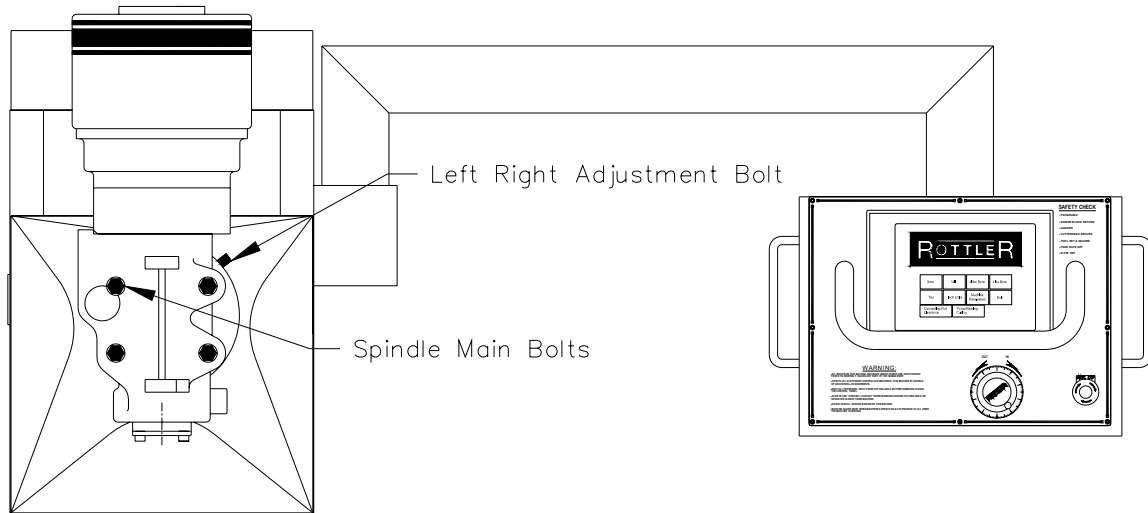
Attach a mag base indicator to the bottom of the spindle. Make sure that the mag base is attached in such a way that the spindle is able to be rotated 360 degrees without interference.

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



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 $\pm .0002$ 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.



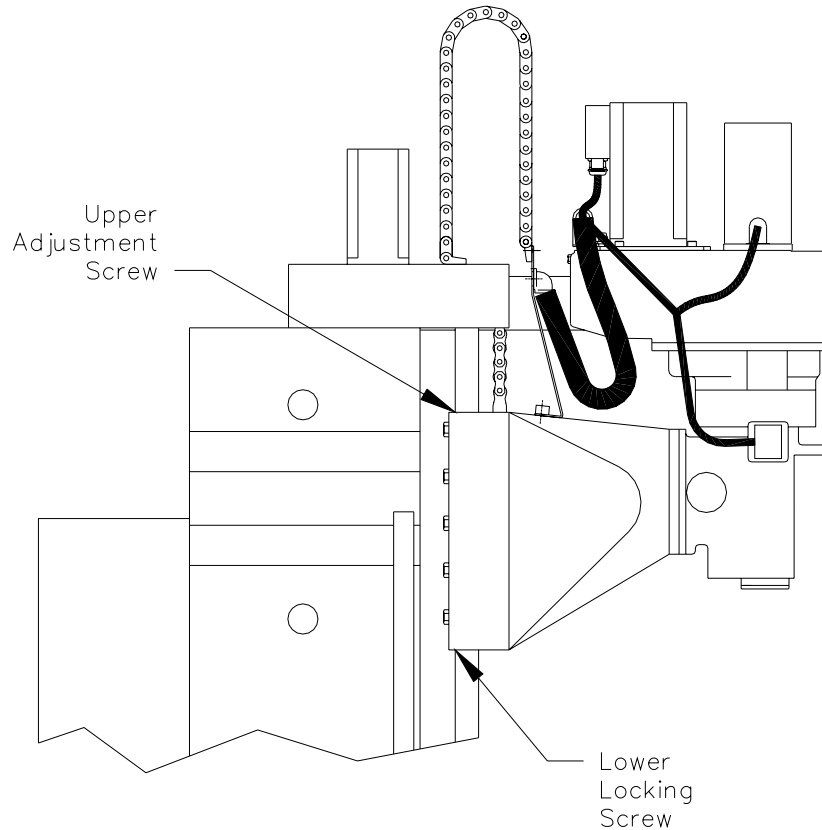
Check the Front to Back sweep it should be within $.0005$. If it is not, the Vertical gibs may need adjustment.

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.

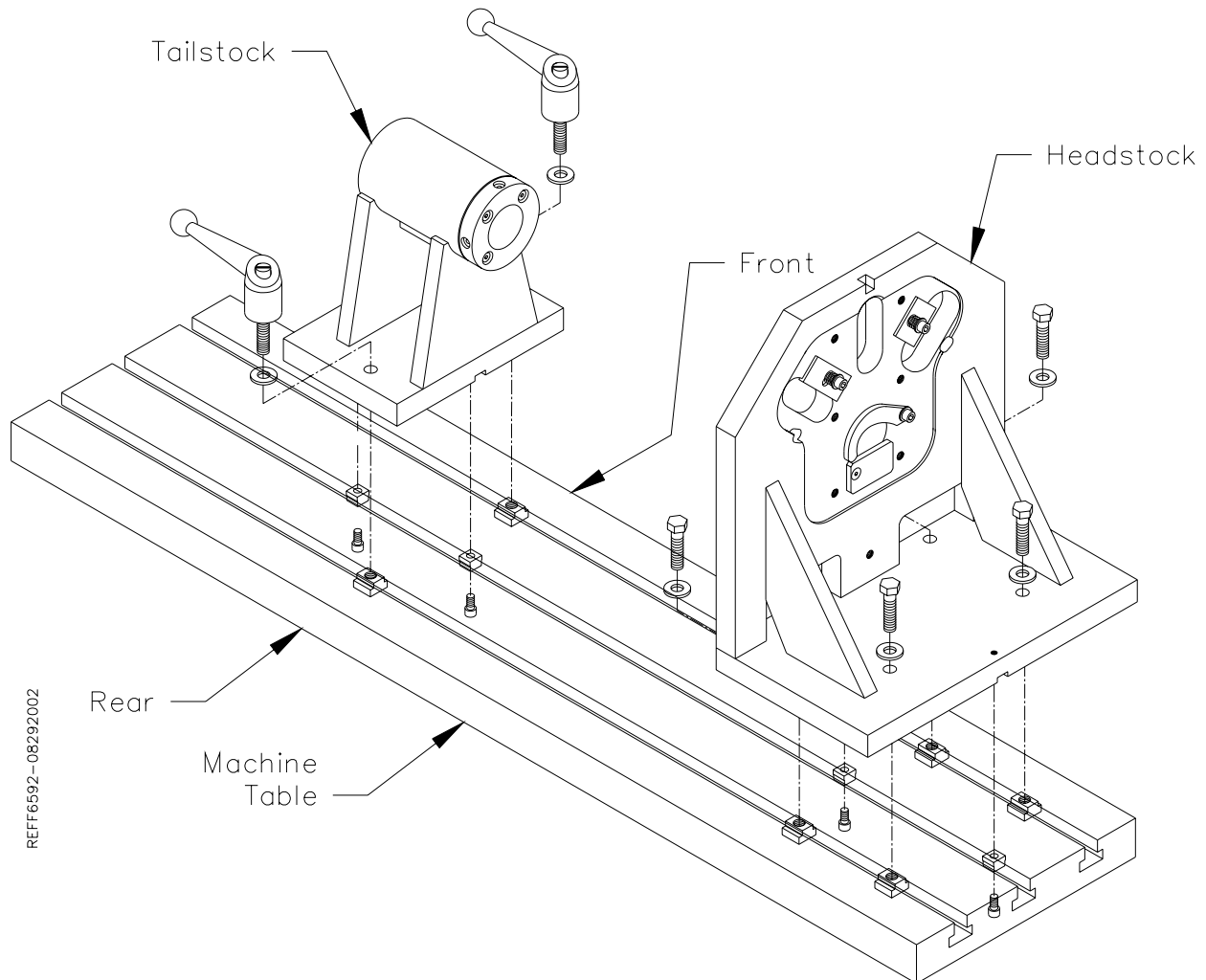
Note: *Having the gibs too loose will cause erratic bore size and finish.*

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 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 through 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):

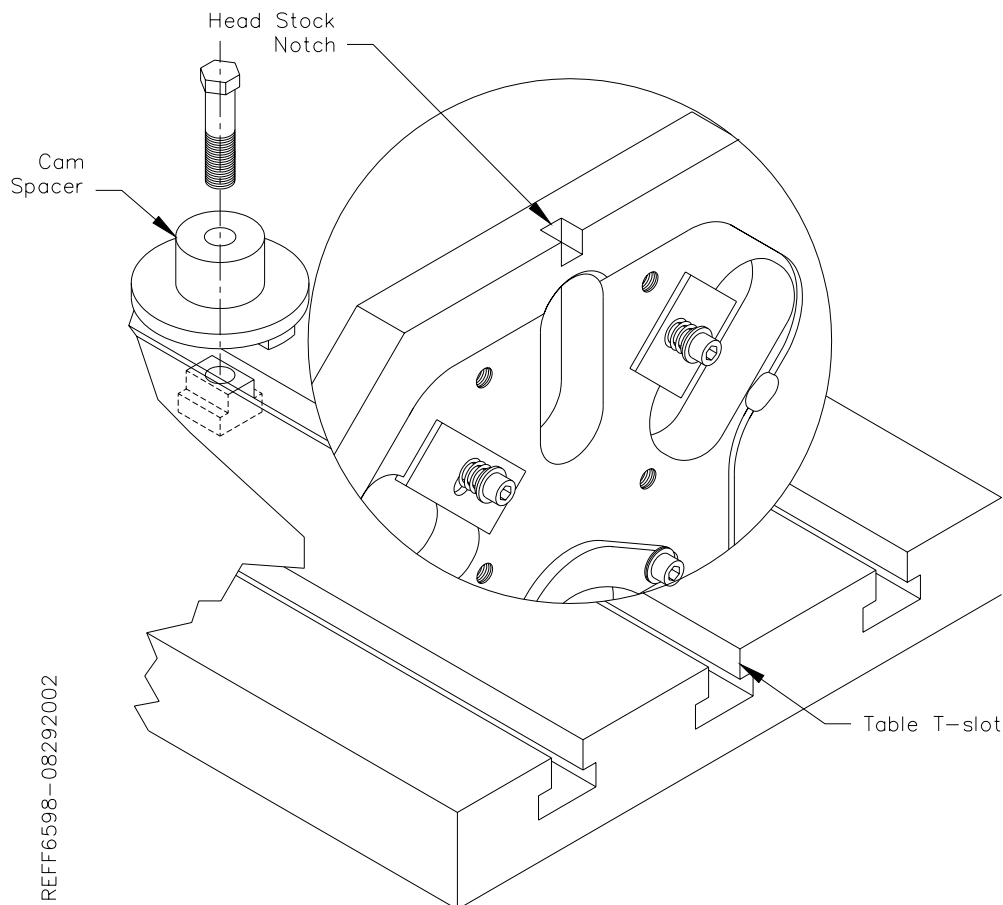
Install the keys for the Head and Tail Stock into the machine bed as shown on previous page. Place the Head and Tail Stock onto the machine table. Install the hold down bolts but do not tighten them down.

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.

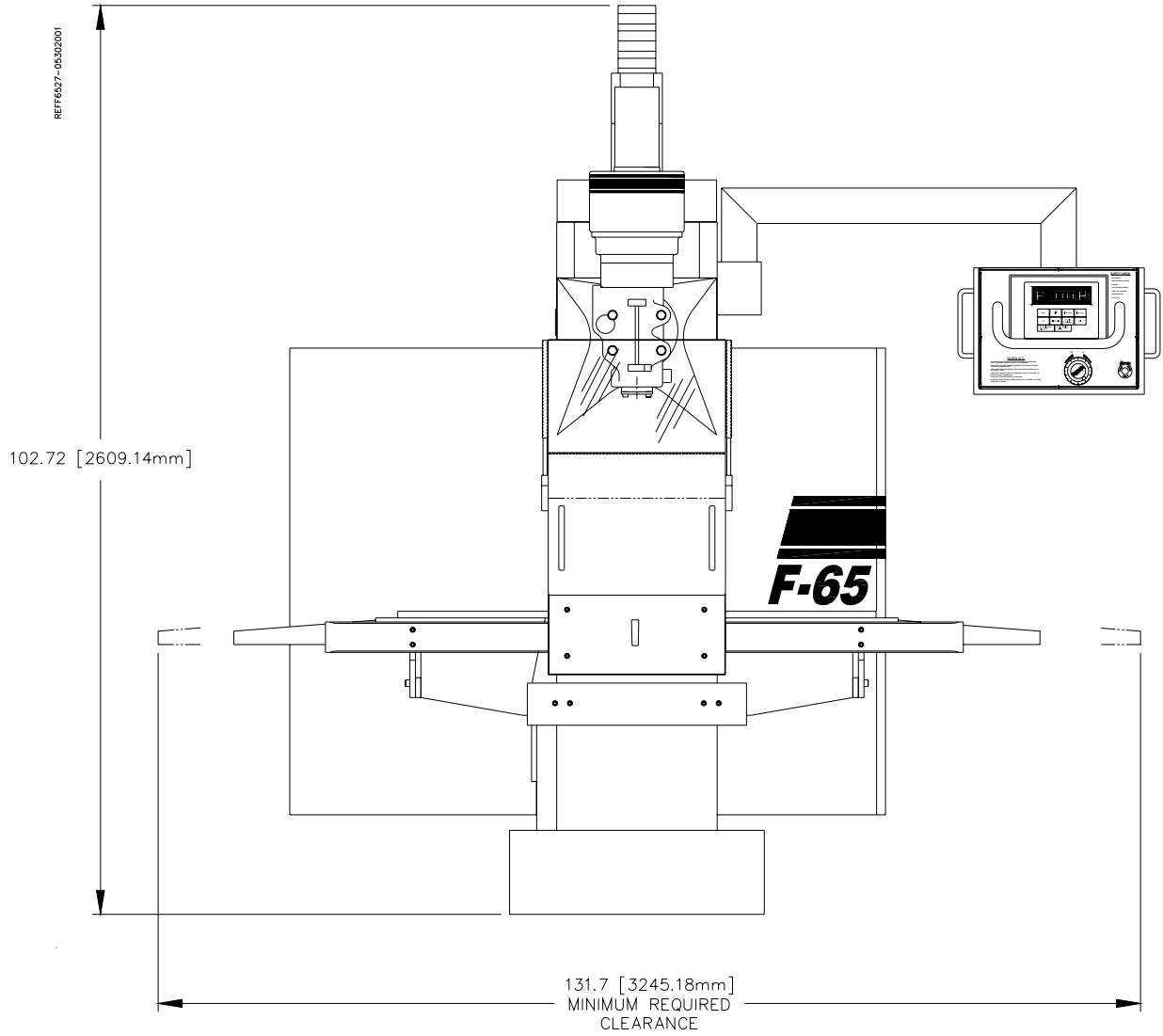
Install the Cam spacer into the middle keyway. Place the bottom Cam Bore on the block over the cam Spacer with the correct bushing installed. This will put the Cam Bore in line with the Main bore.



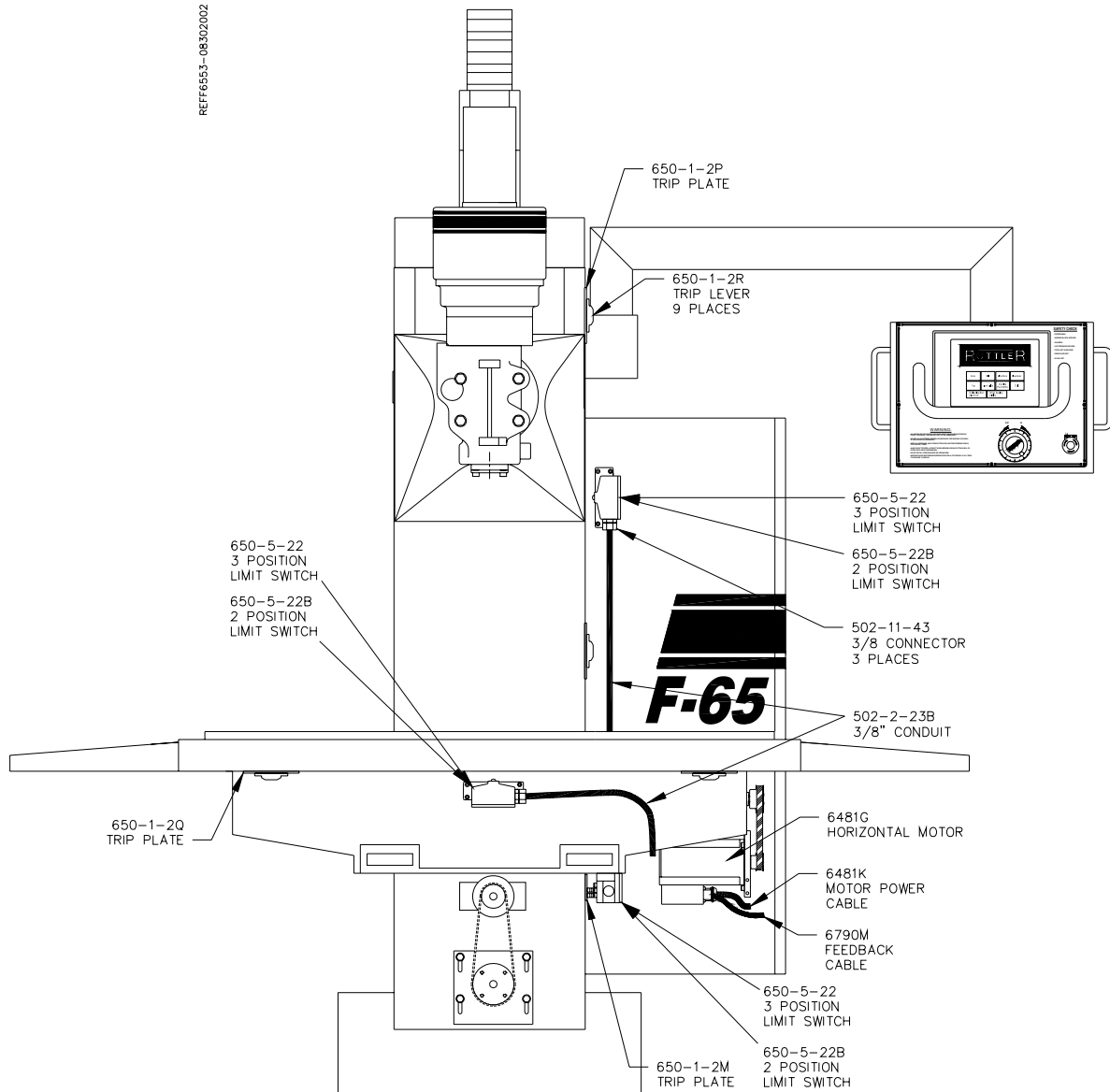
Chapter 5 Troubleshooting:

Chapter 6 Machine Parts:

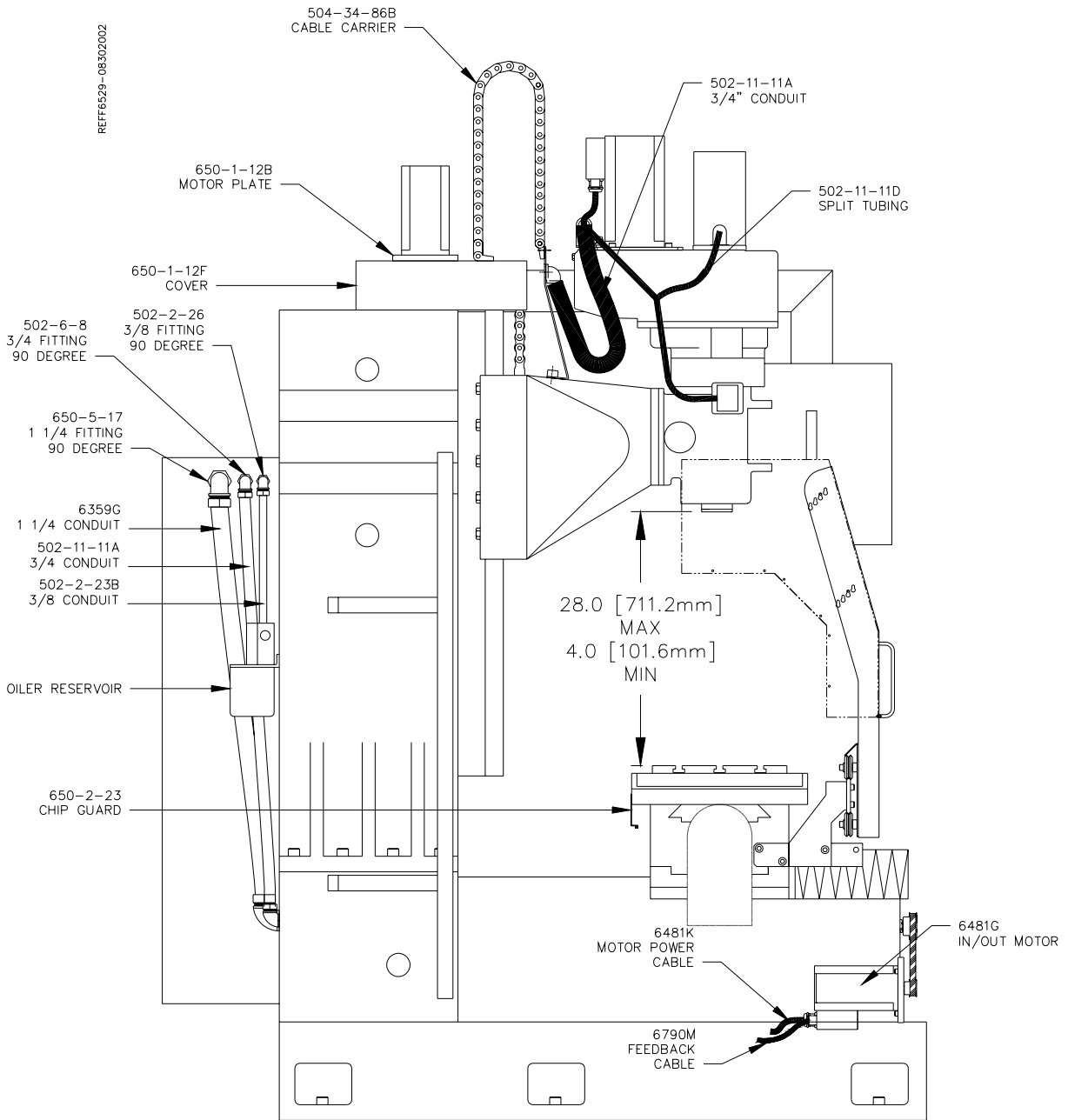
F65 Front View:



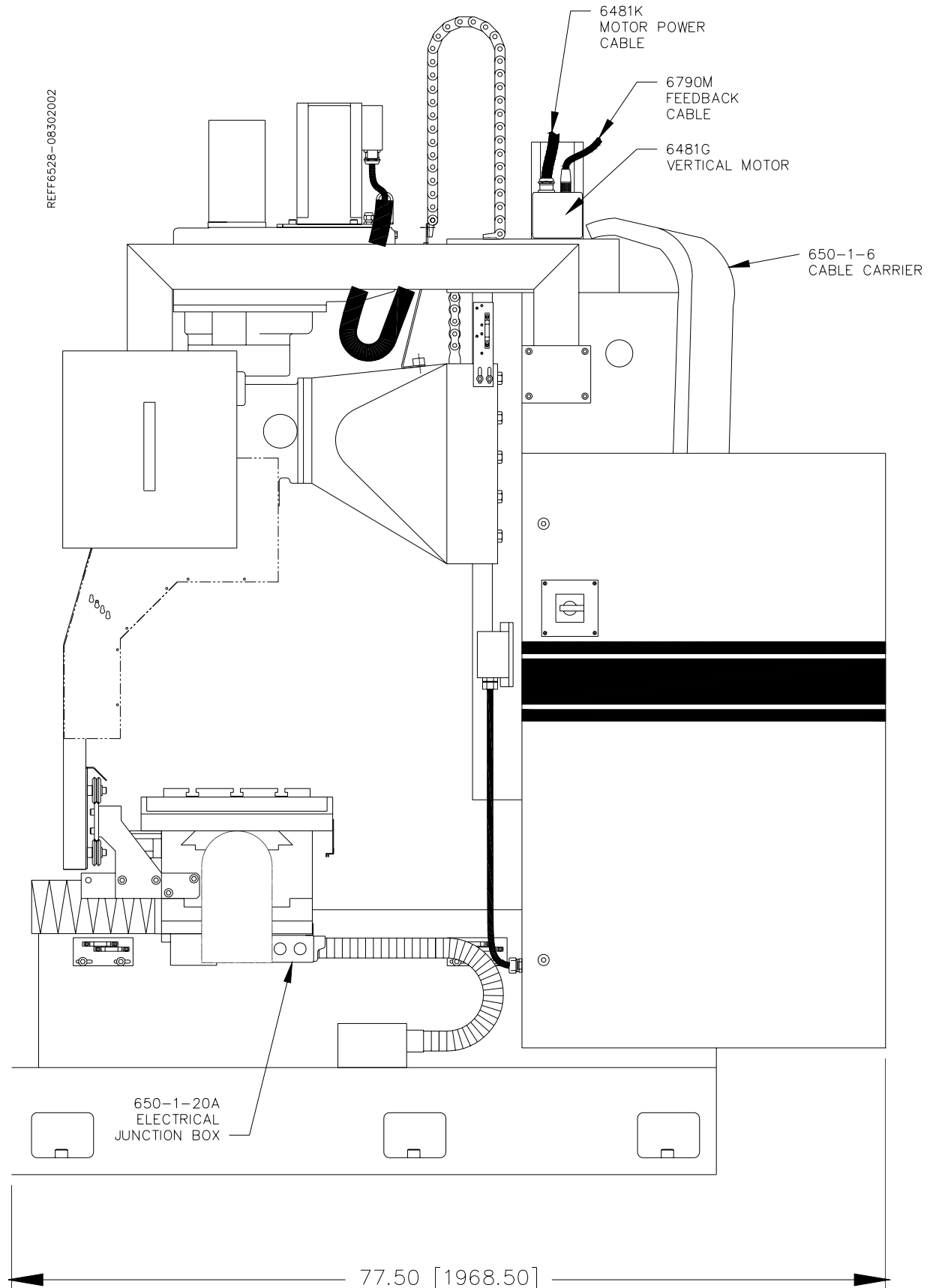
Drive Motors and Switches:



F65 left Side View:

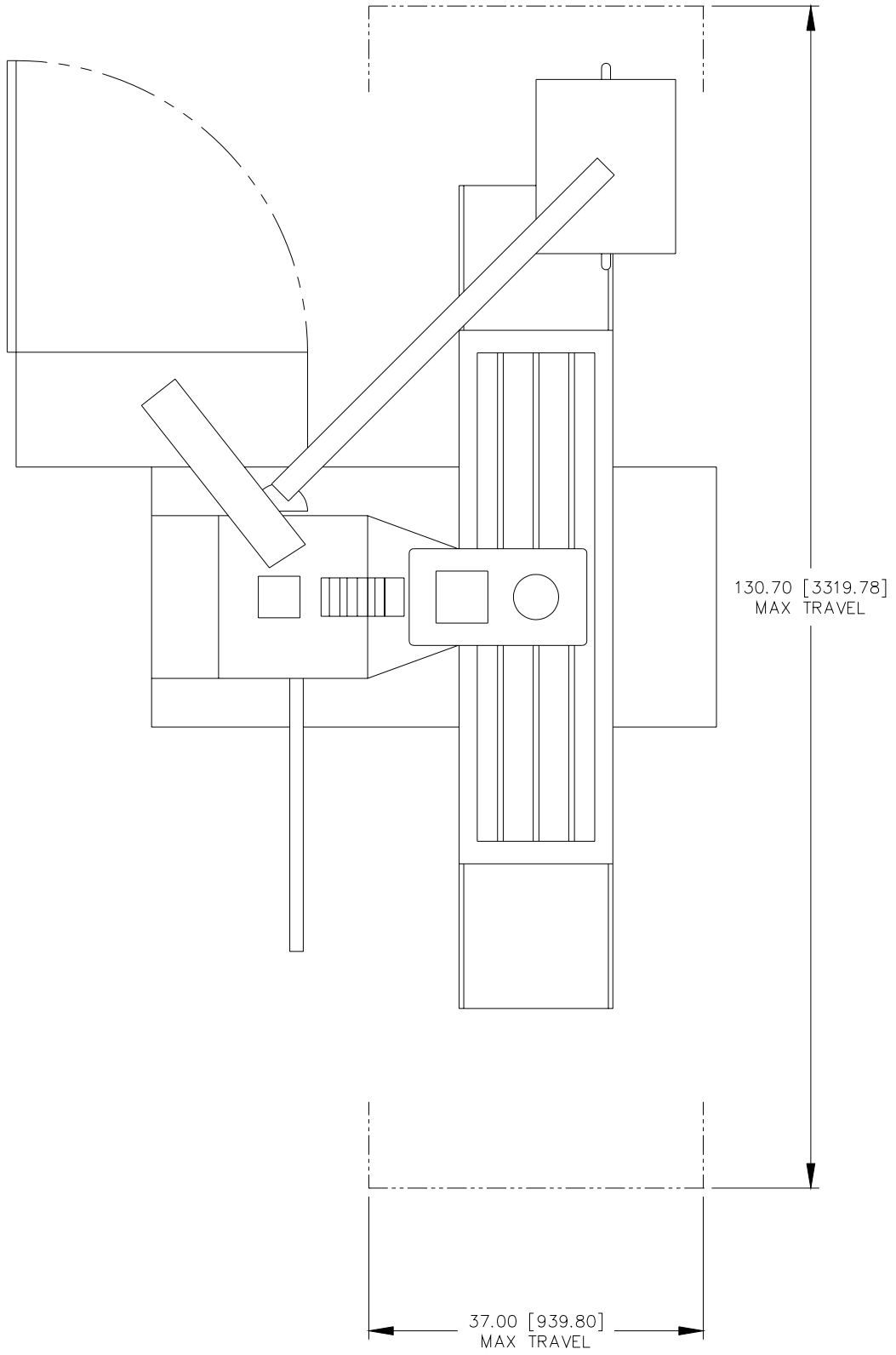


F65 Right Side View:



F65 Top View:

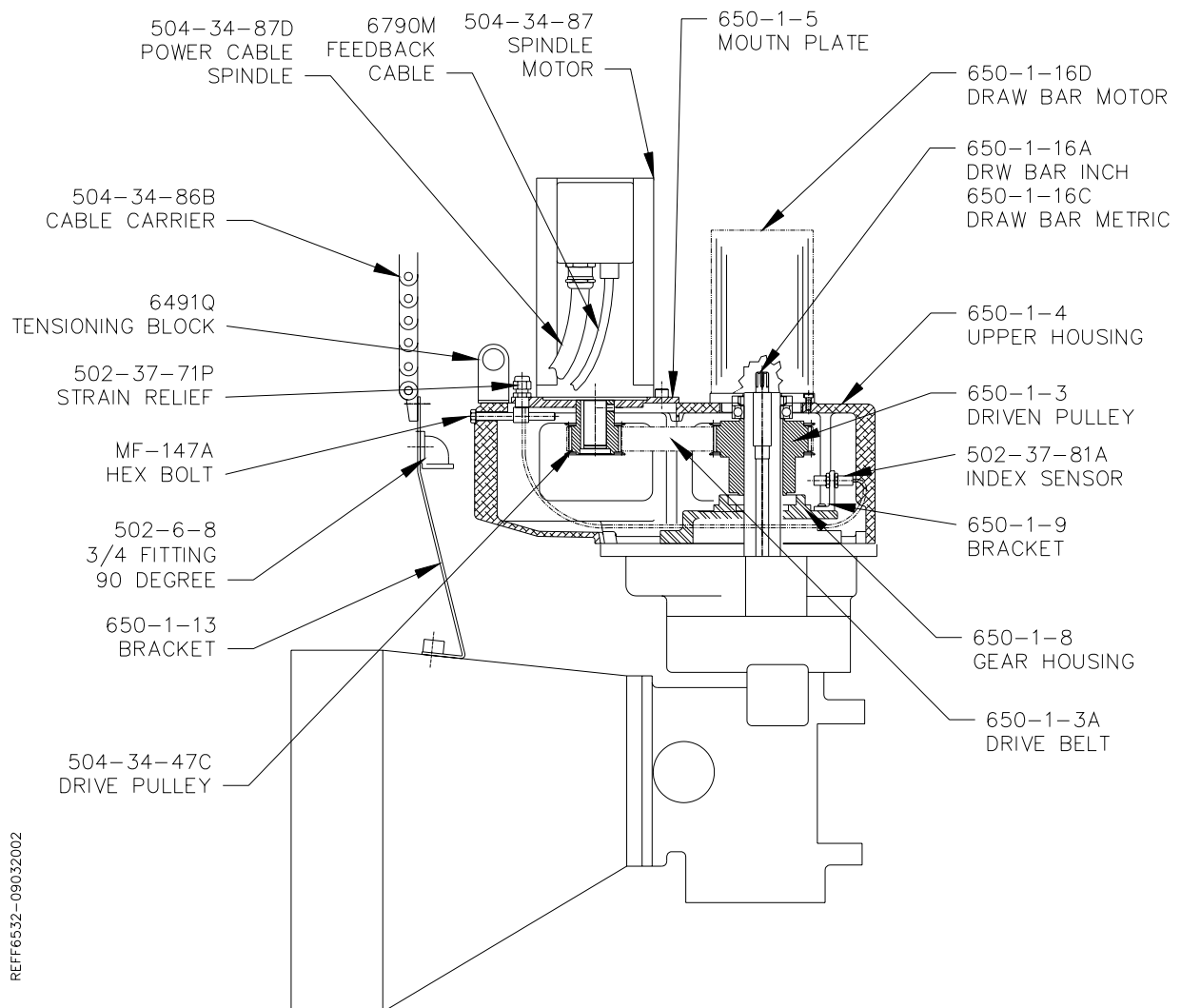
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Electrical Panel:

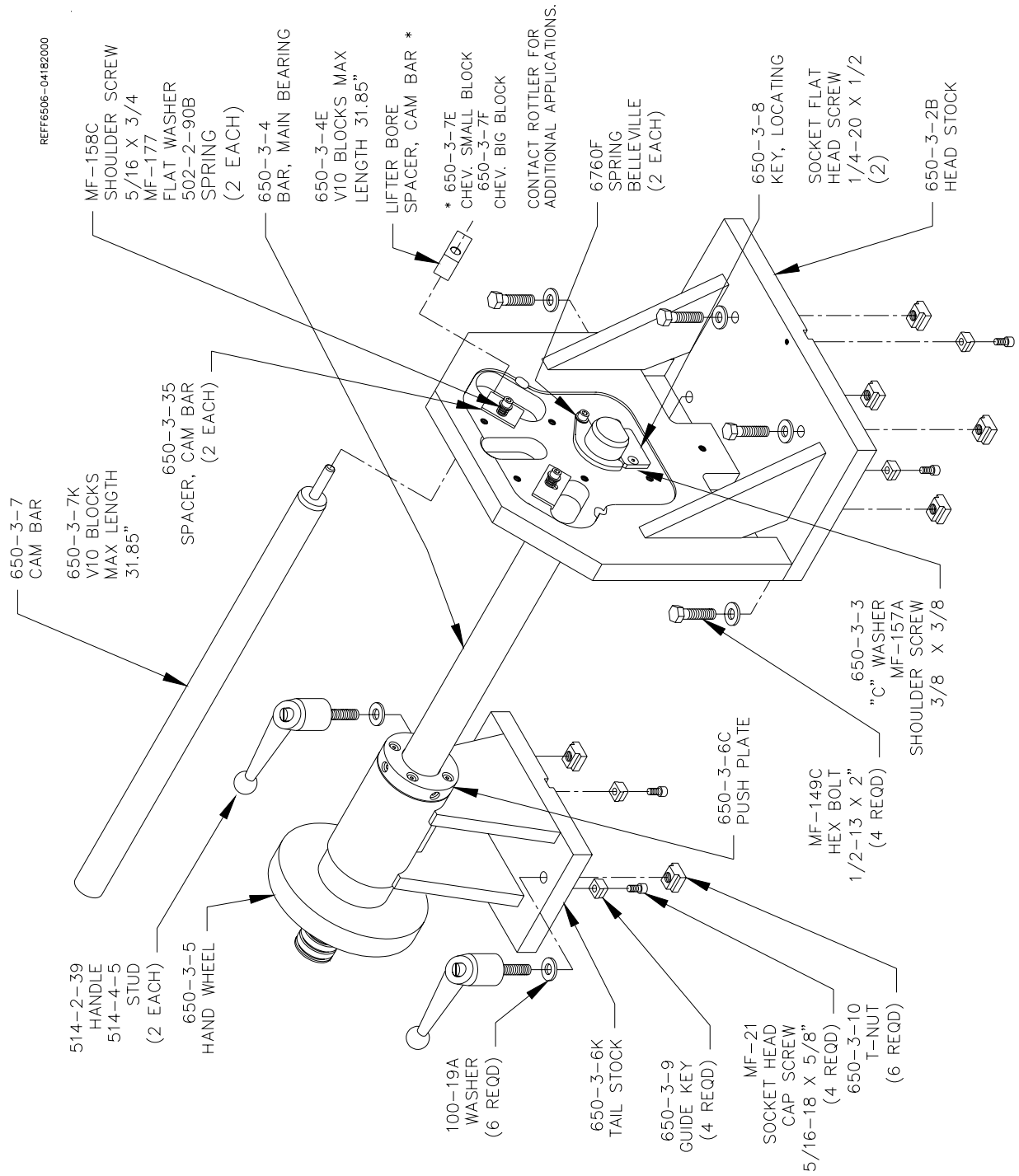
F65 Control Panel:

Upper Belt Housing:



Options:

Performance Fixture 650-3-1:

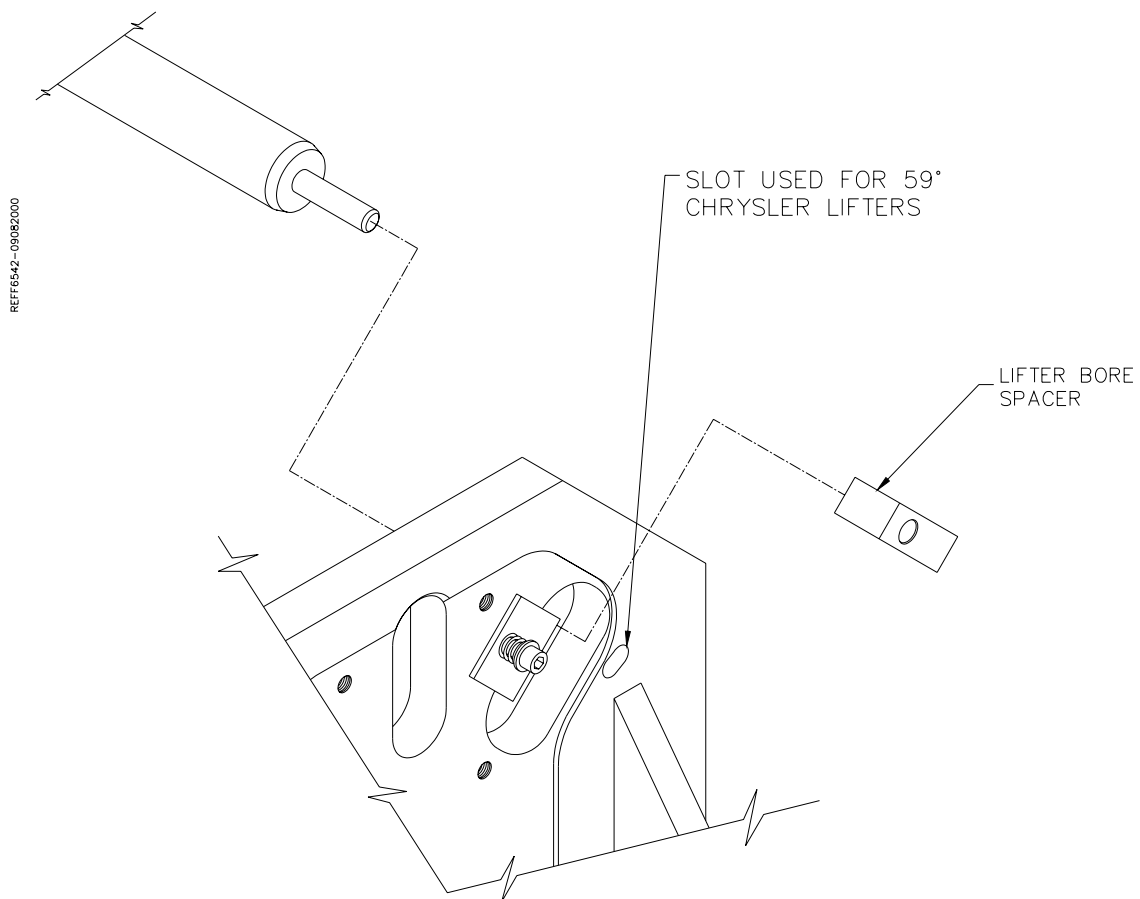


Lifter Bore Spacers:

Application Chart:

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

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



Cam Bearing Locators:**Application / Selection Chart:**

ASSY. NUMBER	APPLICATION	LOCATOR NUMBERS	LOCATOR DIAMETER	QTY
650-3-19	SMALL BLOCK CHEV 283327/350/400 2.0090/2.0110 BORE #5 2.0190/2.0210 BORE #1	650-3-14 BORE #5	2.0085 DIA.	1
		650-3-14G BORE #1	2.0185 DIA.	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	2.1290 DIA.	1
		650-3-14H BORE #1	2.2390 DIA.	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	2.1435 DIA.	1
		650-3-14C BORE #1	2.2036 DIA.	1
650-3-19D	351M FORD 2.1440/2.1450 BORE #5 2.2995/2.2505 BORE #1	650-3-14D BORE #5	2.1435 DIA.	1
		650-3-14B BORE #1	2.2490 DIA.	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	DIA.	1
		650-3-14E BORE #1	2.1290 DIA.	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	DIA.	1
		650-3-14E BORE #1	2.1290 DIA.	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	2.3085 DIA.	1
		650-3-14B	2.2490 DIA.	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	2.1670 DIA.	1
		650-3-14X	2.0870 DIA.	1

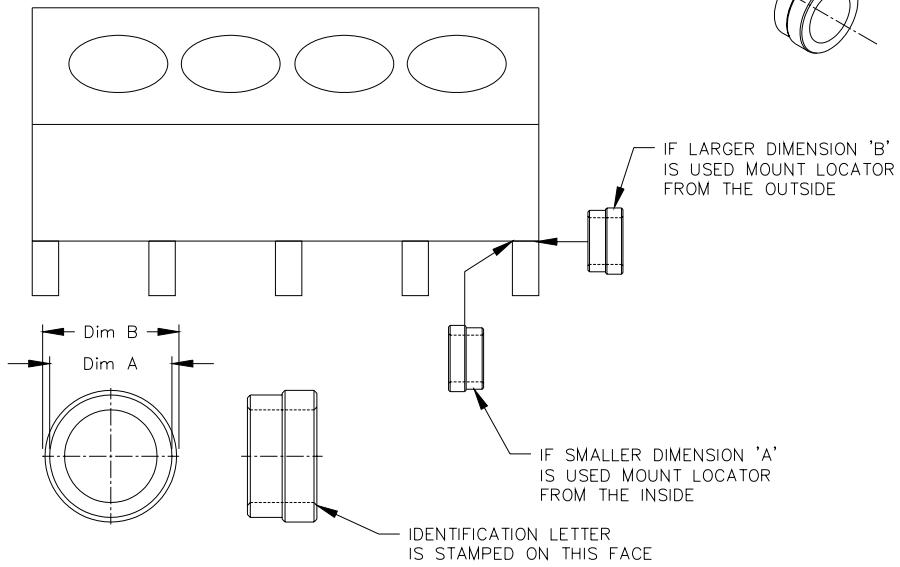
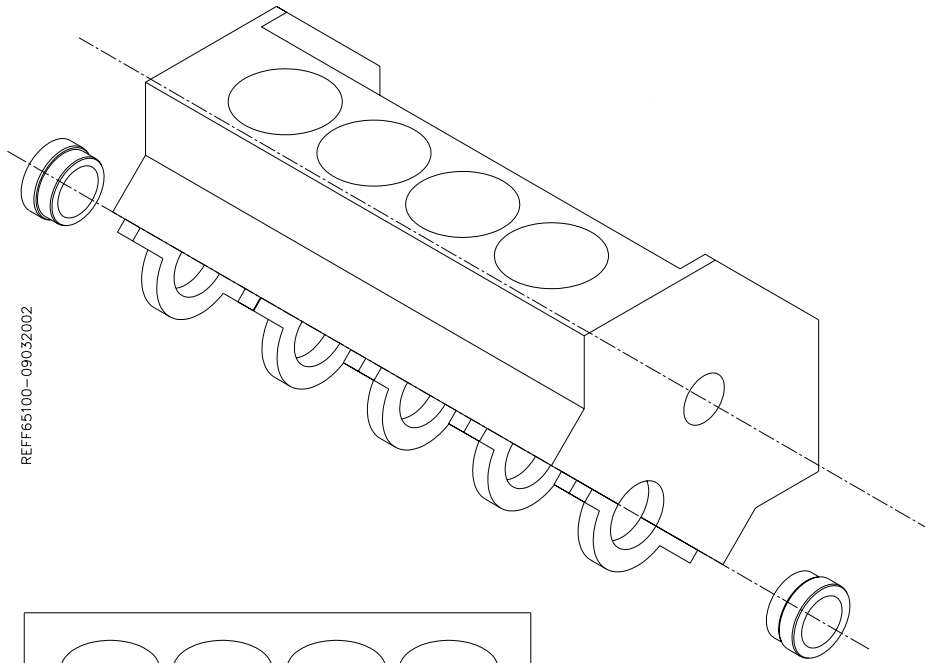
650-3-19U	CAM BORES 1.9675 / 1.9685	650-3-14V	1.9685 DIA	2
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Main Bearing Locators:

Selection List:

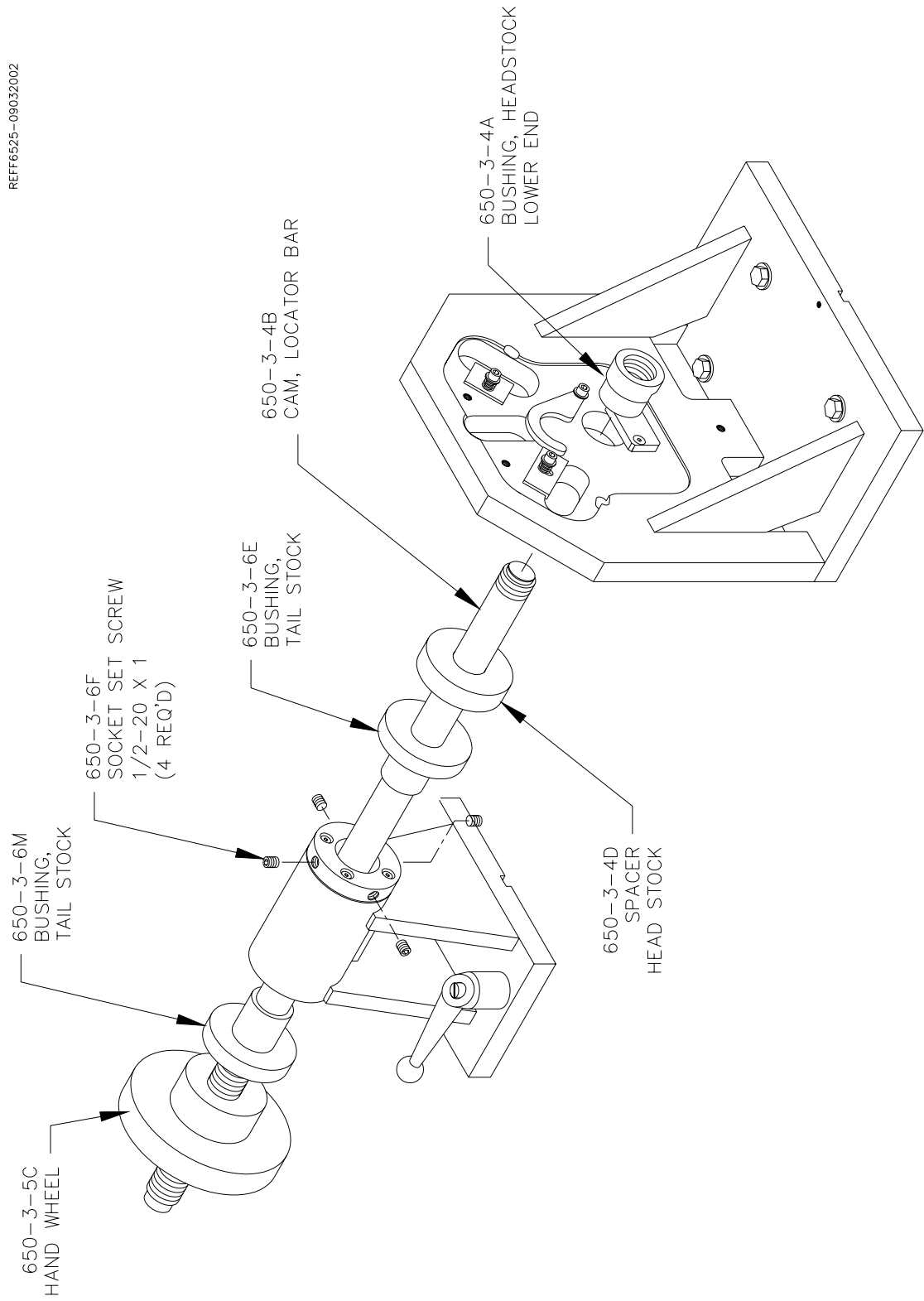
Note: Each locator covers two bearing diameters ('A' and 'B'). The unused diameter MUST be placed INSIDE the block to prevent interference with the Index Plates>

Part Number	Make	Displacement CU. IN.	Main Locator Diameter	
			"A" Dia.	"B" Dia.
502-1-47A	Chev V/8	302/327/350(1968 and newer)/4.3L V/6	2.6391 ^{+0.0010} / _{-.0000}	
	Chev V/8	400 SB/3.4L V/6		2.8390 ^{+0.0010} / _{-.0000}
502-1-47B	Chev V/8	396/ 427/ 454		2.9365 ^{+0.0010} / _{-.0000}
	Buick V/6	231	2.6855 ^{+0.0010} / _{-.0000}	
502-1-47C	Buick/Olds/Pontiac V/8	350/ 389/ 400	3.1865 ^{+0.0010} / _{-.0000}	
	Buick/Pontiac V/8	421/ 428/ 455		3.4365 ^{+0.0010} / _{-.0000}
502-1-47D	Ford V/8	351C	2.9402 ^{+0.0010} / _{-.0000}	
	Ford V/8	351M/351W/429/460		3.1907 ^{+0.0010} / _{-.0000}
502-1-47E	Ford V/8	289/ 302	2.4397 ^{+0.0010} / _{-.0000}	
	Mopar V/8	360		3.0010 ^{+0.0010} / _{-.0000}
502-1-47F	Mopar V/8	318/ 340	2.6910 ^{+0.0010} / _{-.0000}	
	Mopar V/8	426/ 440		2.9410 ^{+0.0010} / _{-.0000}
502-1-47G	Chev V/8	283/302/327(thru 1967)	2.4892 ^{+0.0010} / _{-.0000}	
	Chev V/8	5.3L('99 and newer)		2.7490 ^{+0.0010} / _{-.0000}
502-1-47H		SPECIAL APPLICATION	3.3137 ^{+0.0010} / _{-.0000}	
502-1-47J	Porche V/8	928	2.9510 ^{+0.0010} / _{-.0000}	
502-1-47K	GM	6.5 L/395 DIESEL	3.1420 ^{+0.0010} / _{-.0000}	
502-1-47L	Ford	4.6		2.8491 ^{+0.0010} / _{-.0000}
		ZETGC	2.4528 ^{+0.0010} / _{-.0000}	
502-1-47M	Honda	1.8 L	2.3216 ^{+0.0010} / _{-.0000}	
	Mitsubishi	2.0 L		2.4002 ^{+0.0010} / _{-.0000}
502-1-47N	AMC Chrysler		2.9396 ^{+0.0010} / _{-.0000}	

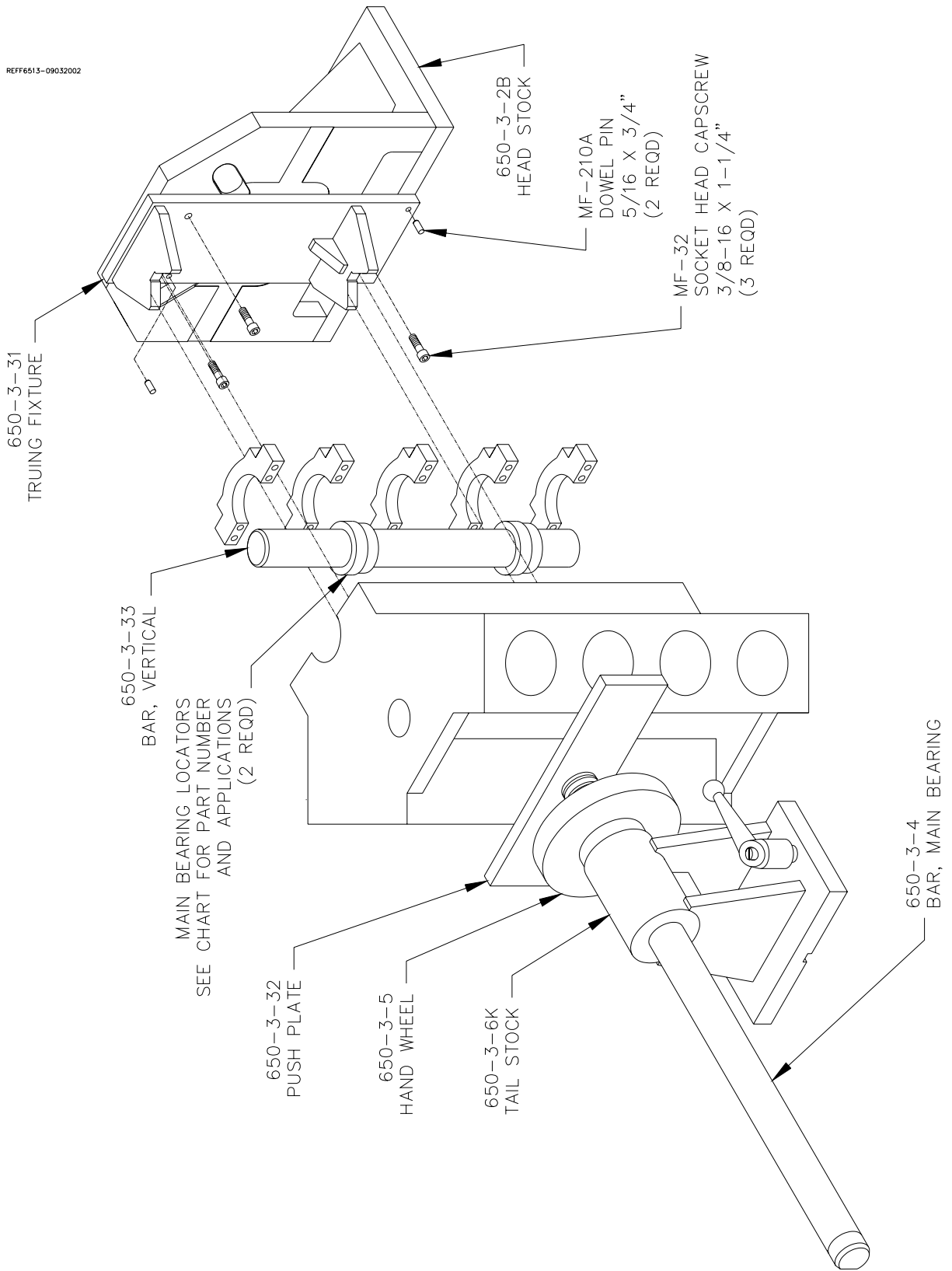


Lower End machining Package 650-3-1A:

REF6525-09032002

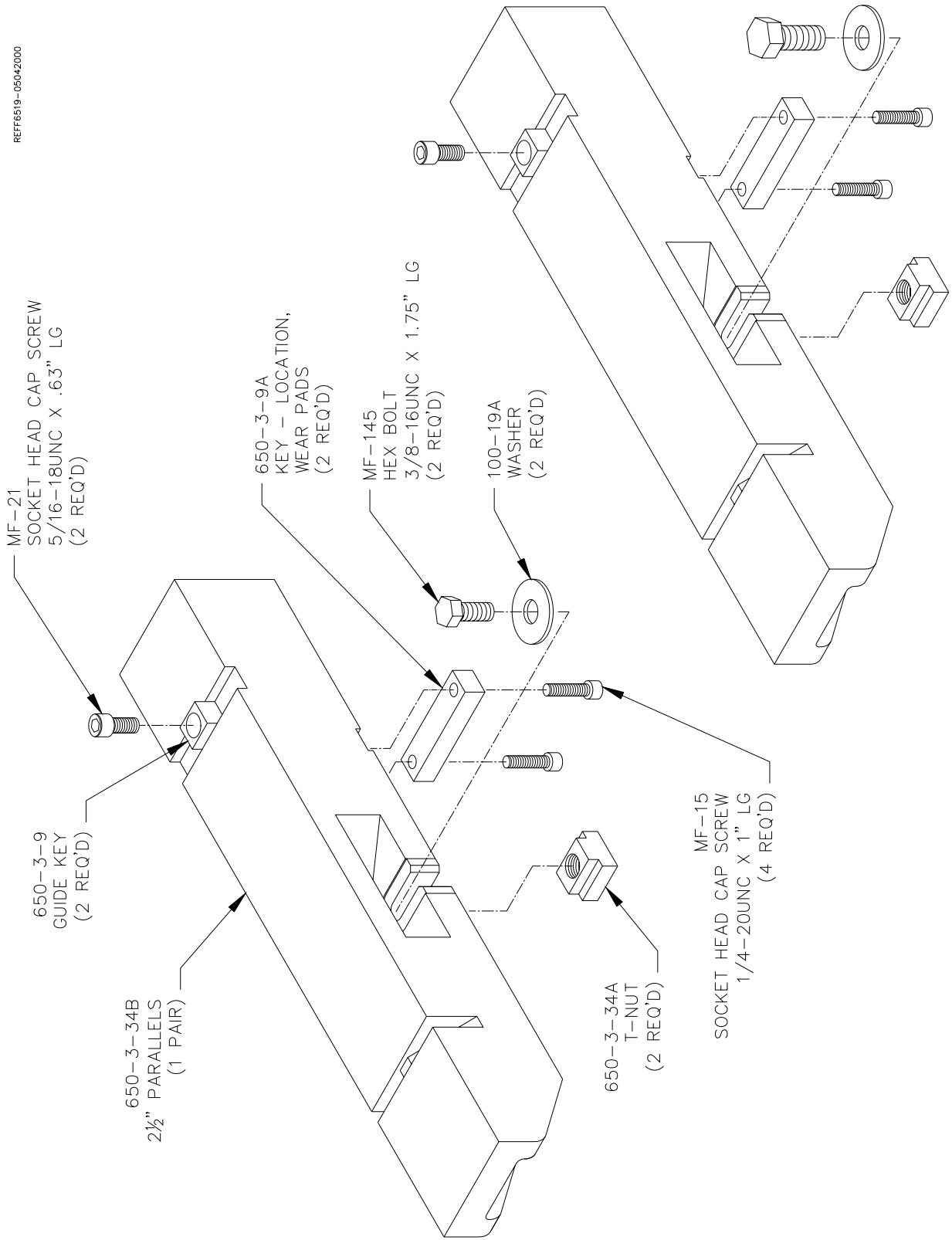


Block End truing Fixture 650-3-30:



2 1/2" Wear pad Assembly 650-3-34:

REF6519-05042000



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 1/2" spacers are provided for blocks with large main bearing bores, to enable the bar to locate near the main bearing split line. (See figure 2)

V-blocks:

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

Y-Blocks:

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

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

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).

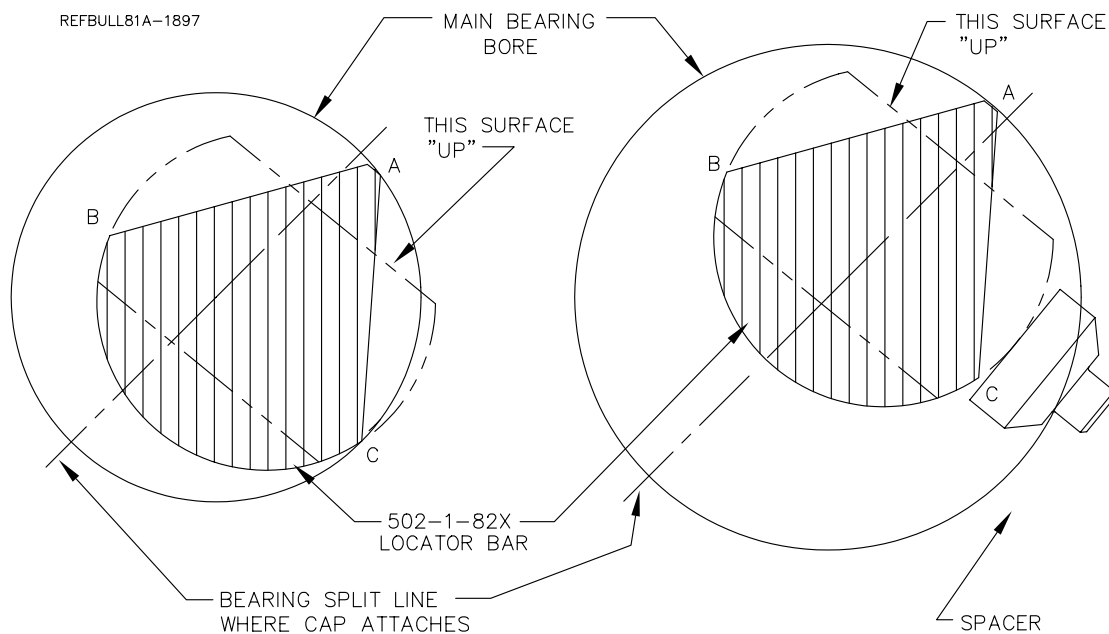
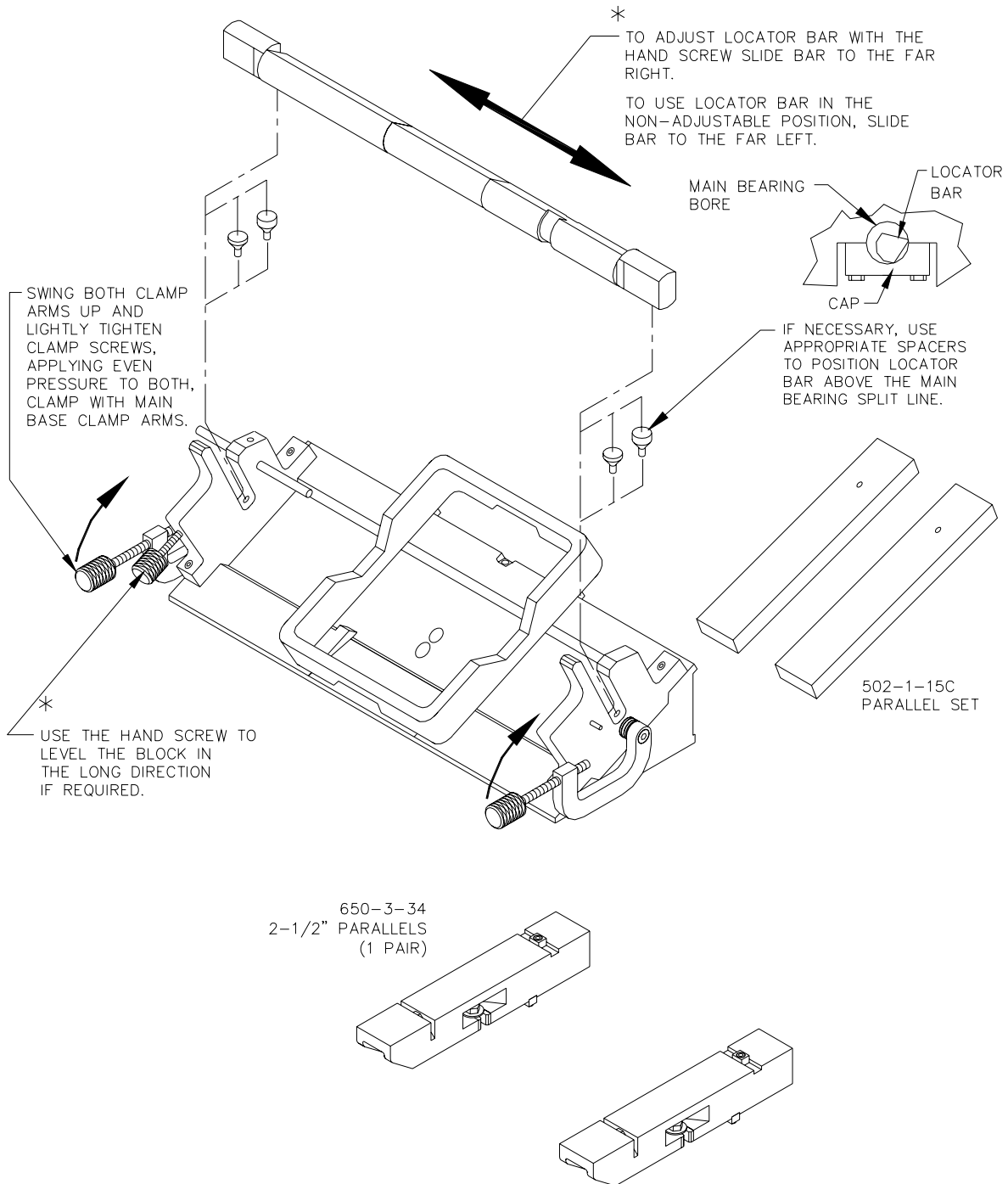


FIGURE 1

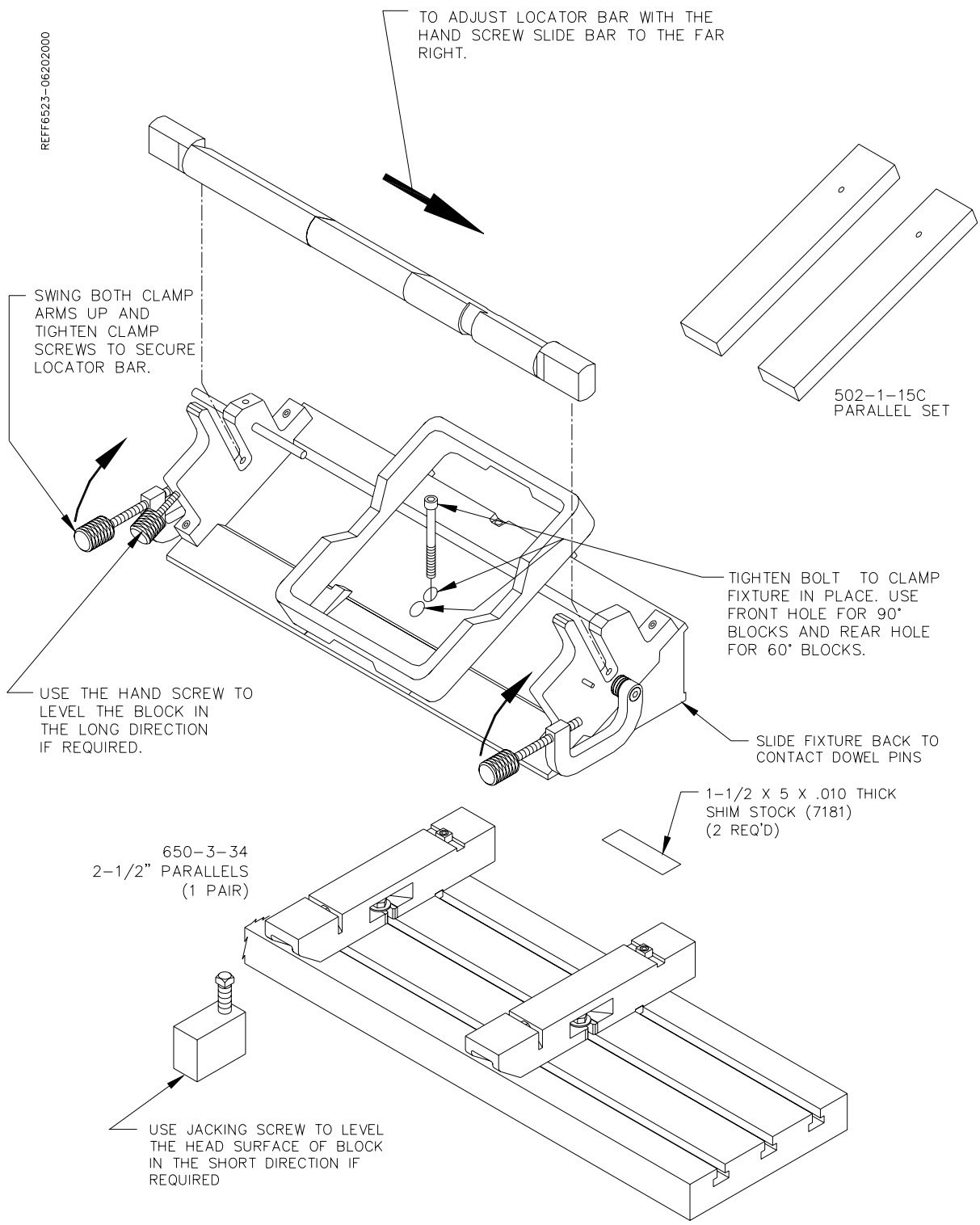
FIGURE 2

Manual Fixture Assembly 502-1-72H:

REF F6522-06192000

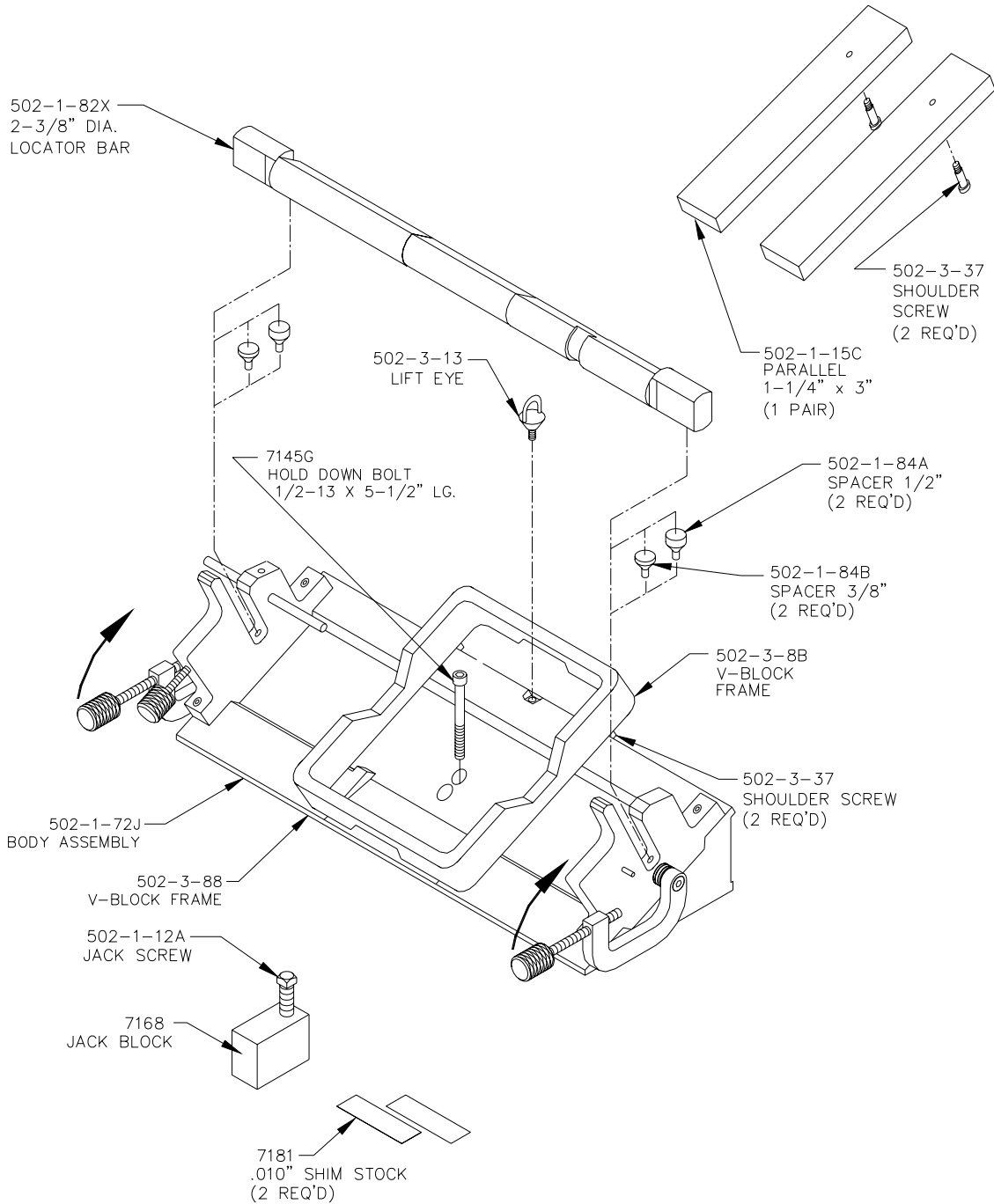


V6/V8 Manual Fixture Body Assembly 502-1-72J:



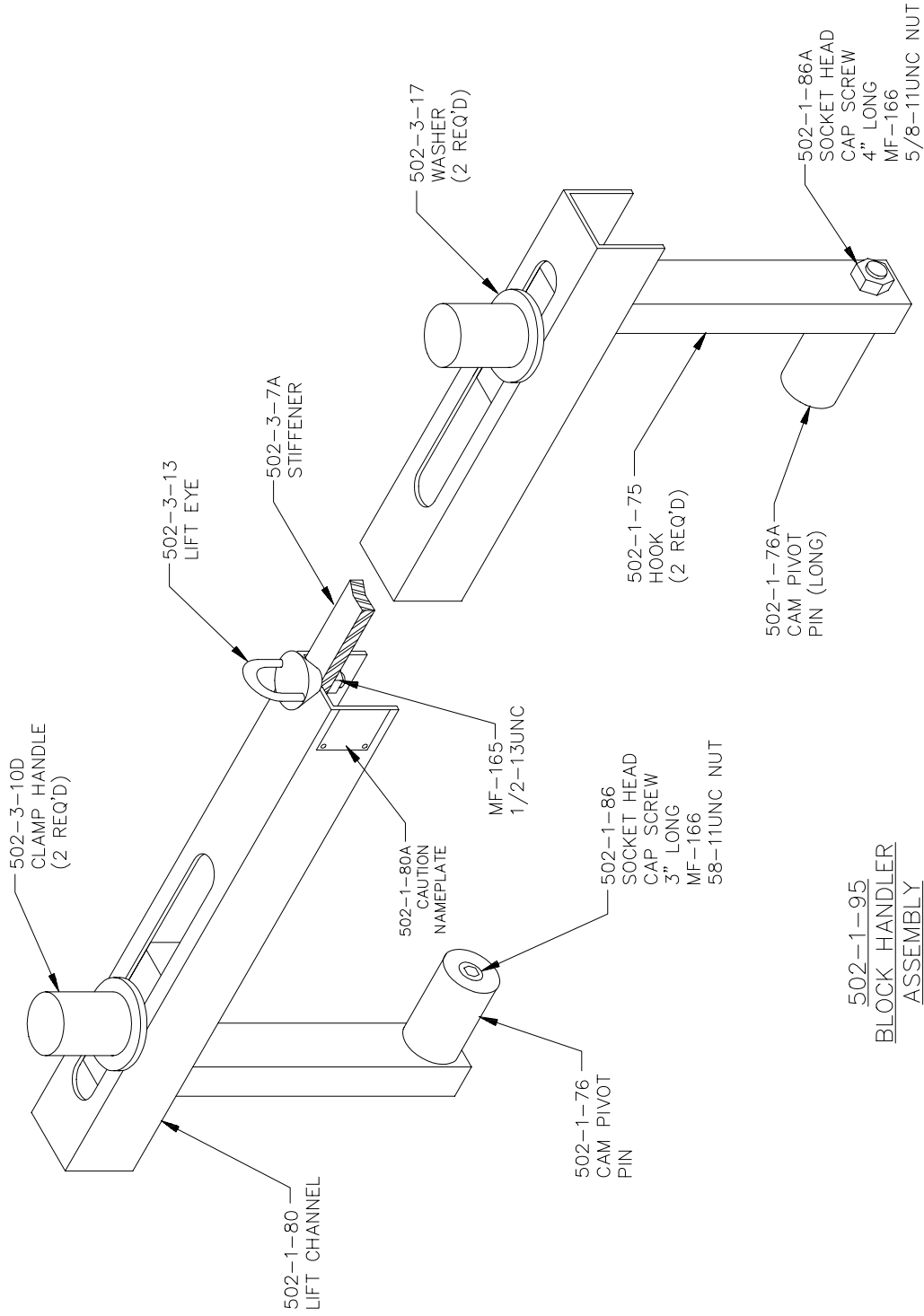
V6/V8 Manual Fixture Body Assembly 502-1-72J: (cont)

REF6524-06232000



Block Handler 502-1-95:

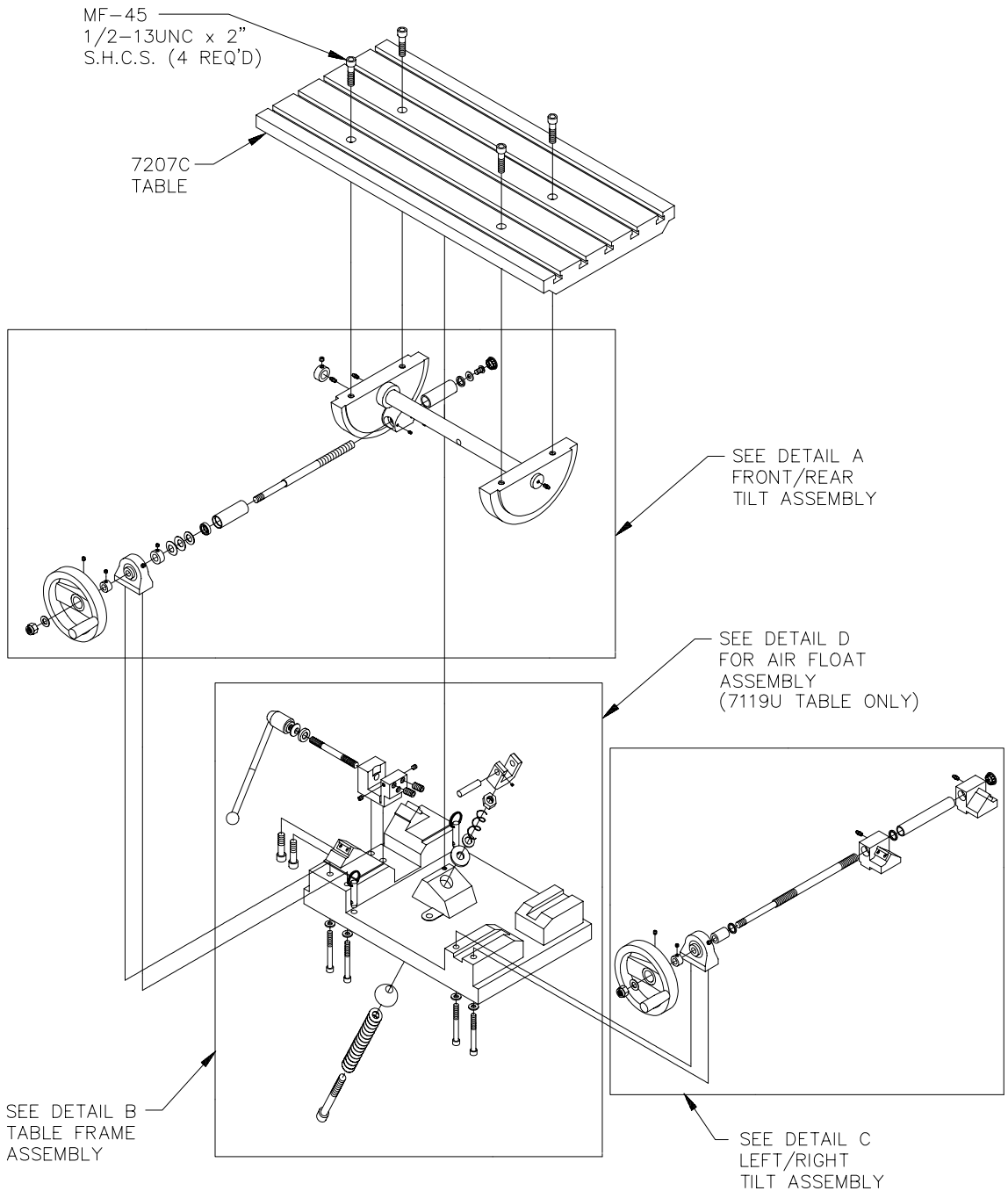
REF2MB17-031993



502-1-95
BLOCK HANDLER
ASSEMBLY
 STANDARD ON AIR V6/V8 FIXTURE (502-1-72B)

Dual Axis Leveling Table 7209M:

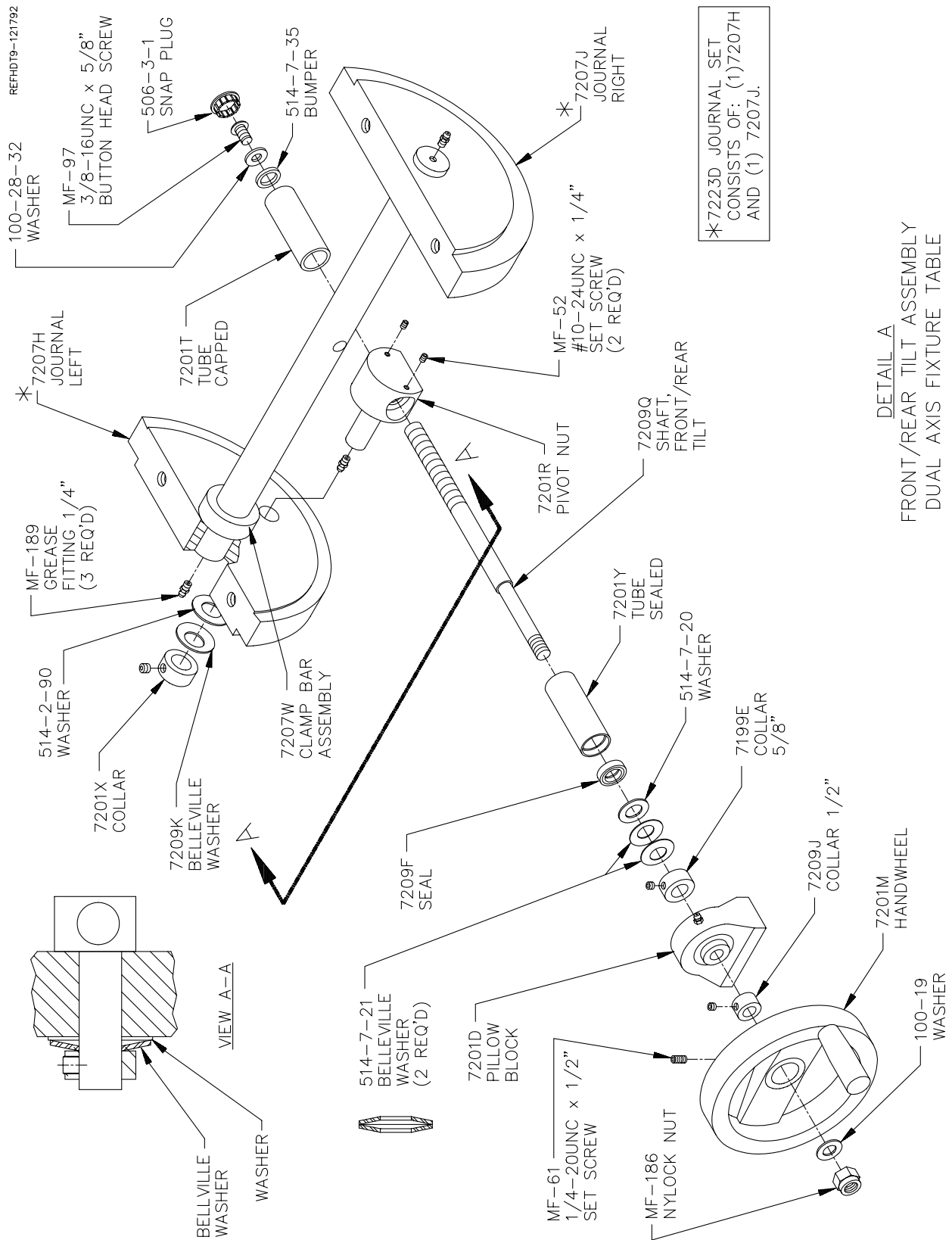
REFHD7-062095



ROTTLER DUAL AXIS FIXTURE TABLE
7119V - FIXTURE TABLE WITHOUT AIR FLOAT OPTION
7119W - FIXTURE TABLE WITH AIR FLOAT OPTION

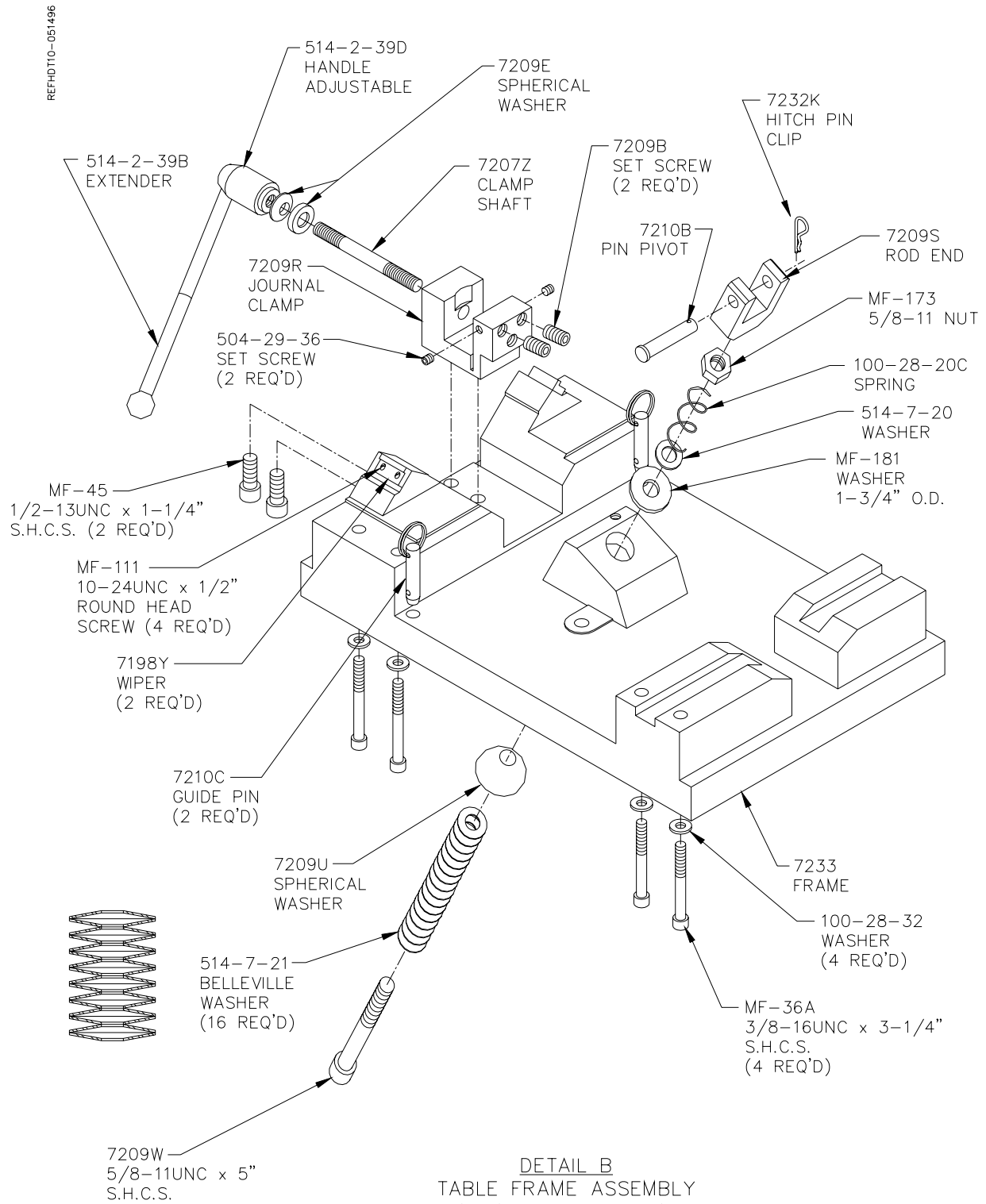
APPROXIMATE TABLE
WEIGHT: 325 LBS.

Front/Rear Tilt Assembly:



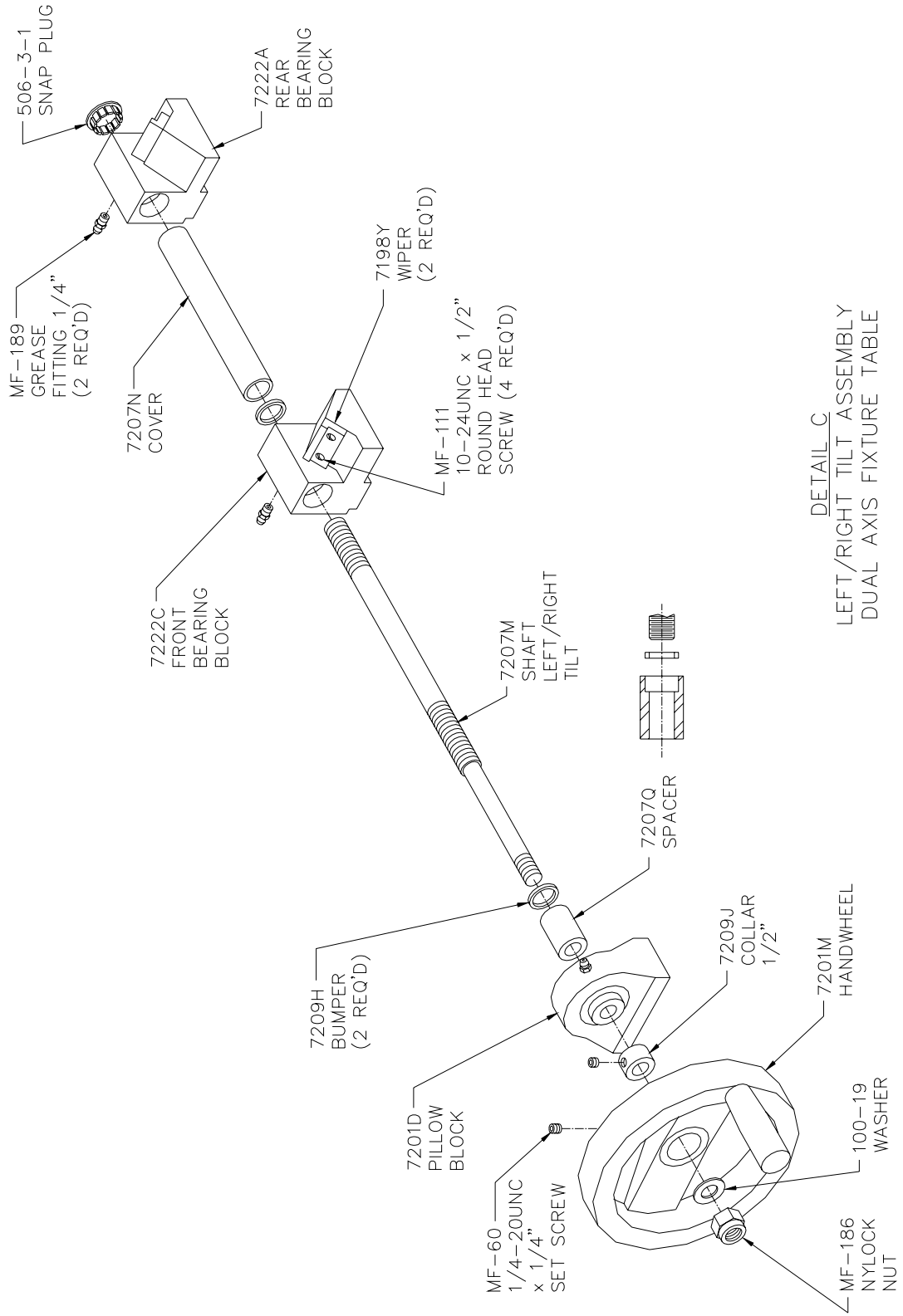
DETAIL A
 FRONT/REAR TILT ASSEMBLY
 DUAL AXIS FIXTURE TABLE

Table Frame Assembly:



Left/Right Tilt Assembly:

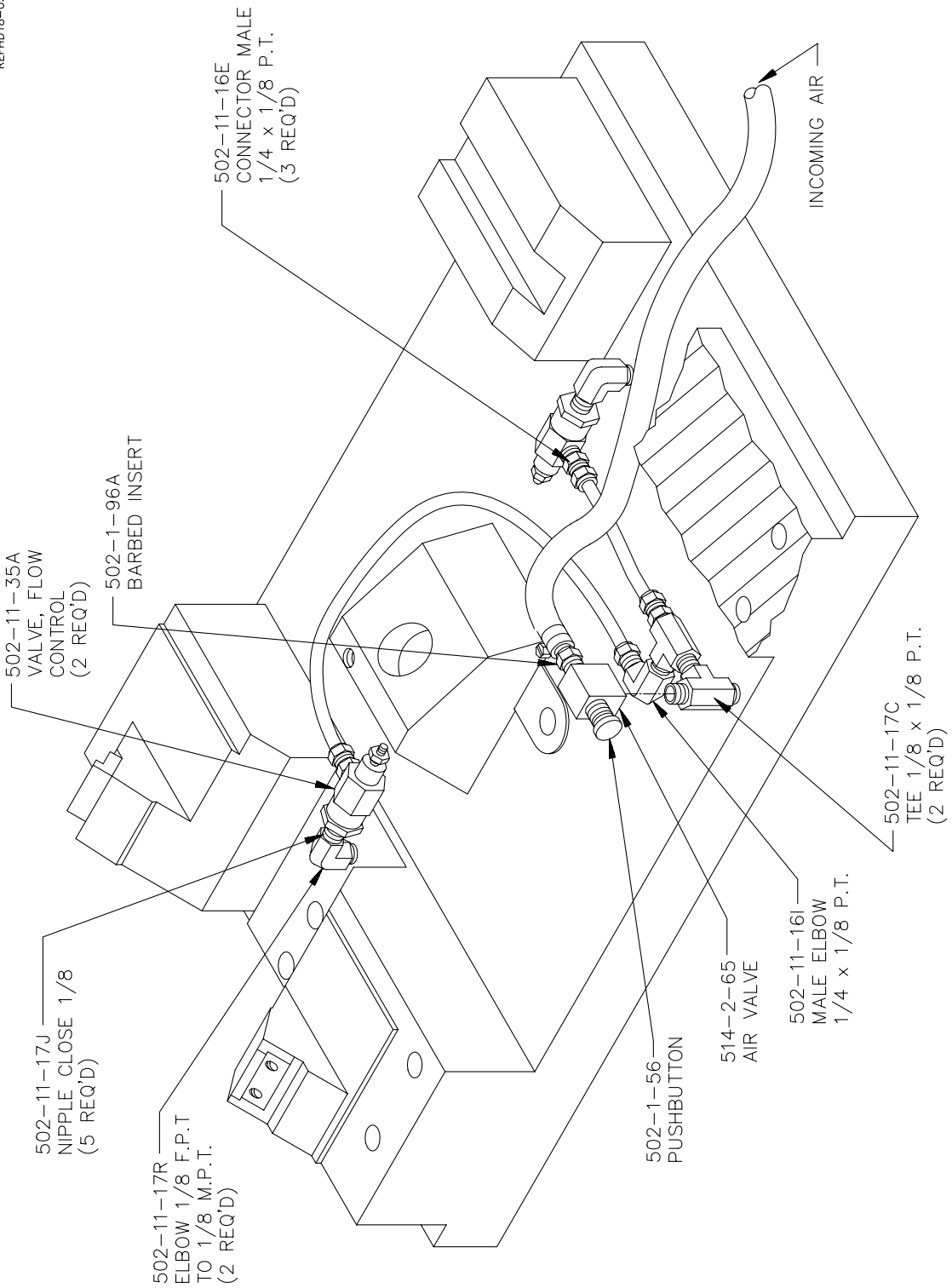
REFHDT11-090492



DETAIL C
LEFT/RIGHT TILT ASSEMBLY
DUAL AXIS FIXTURE TABLE

Air Float Assembly:

REFHDT8-031593



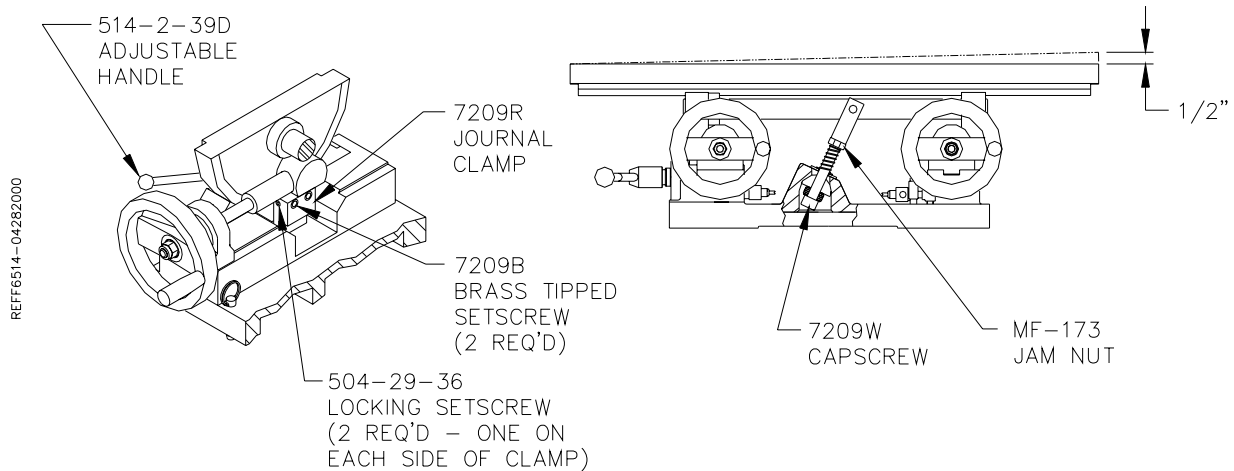
DETAIL D (7119W ONLY)
AIR FLOAT ASSEMBLY
DUAL AXIS FIXTURE TABLE

Dual Axis Leveling Table:

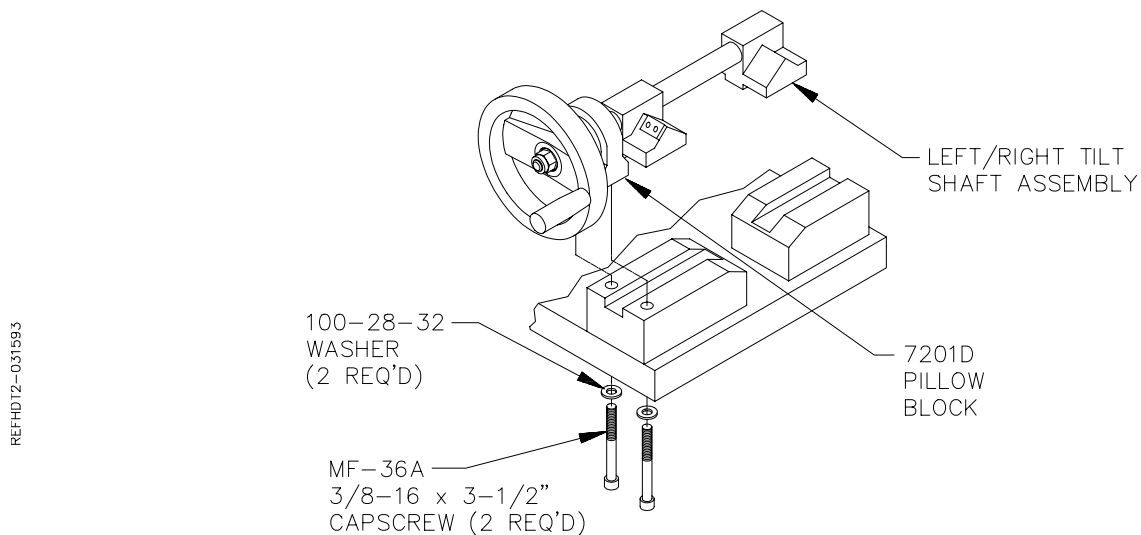
Adjustment Procedure:

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

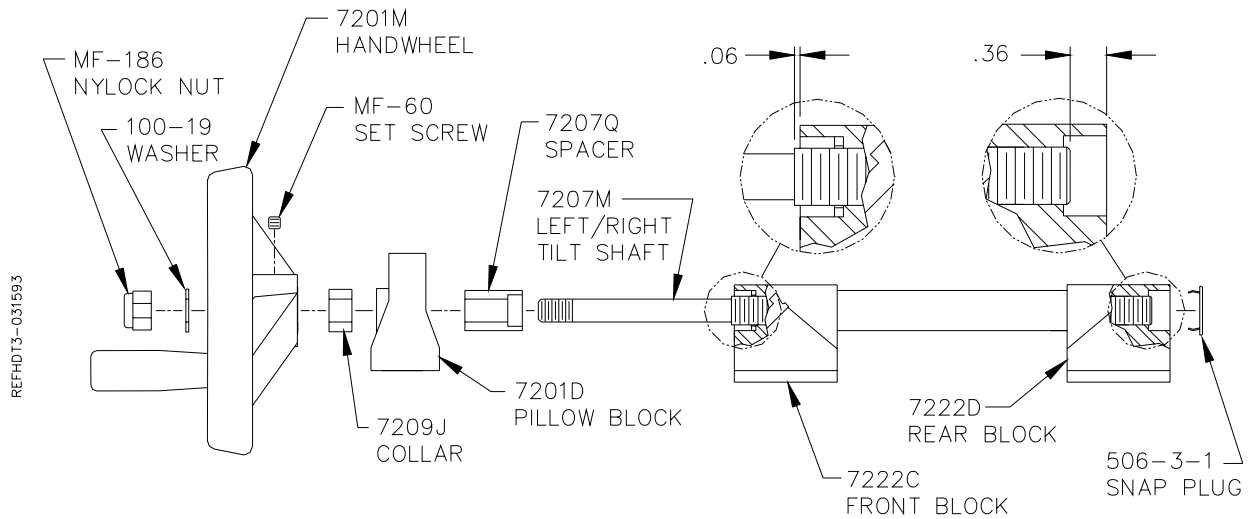
1. Secure table to Machine surface.
2. Level table in both directions. Loosen Jam nut (MF-173) and capscrew (7209W) on the table clamp. Loosen adjustable handle (514-2-93D) on the left side of table. Loosen (2) locking set screws (504-29-36) on both sides of journal clamp. Loosen (2) brass tipped set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



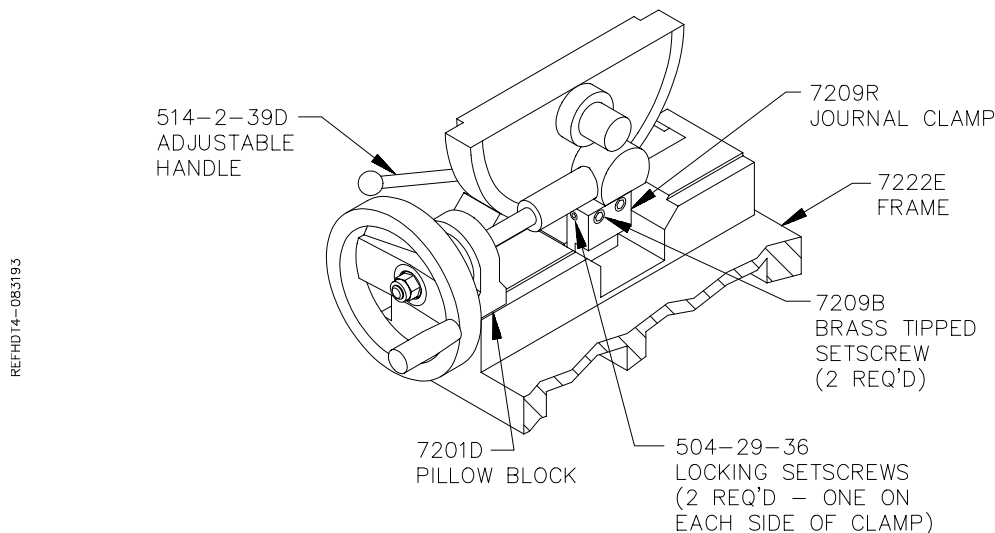
4. Remove (2) capscrews on right hand pillow block (7210D). Remove tilt shaft assembly from fixture.



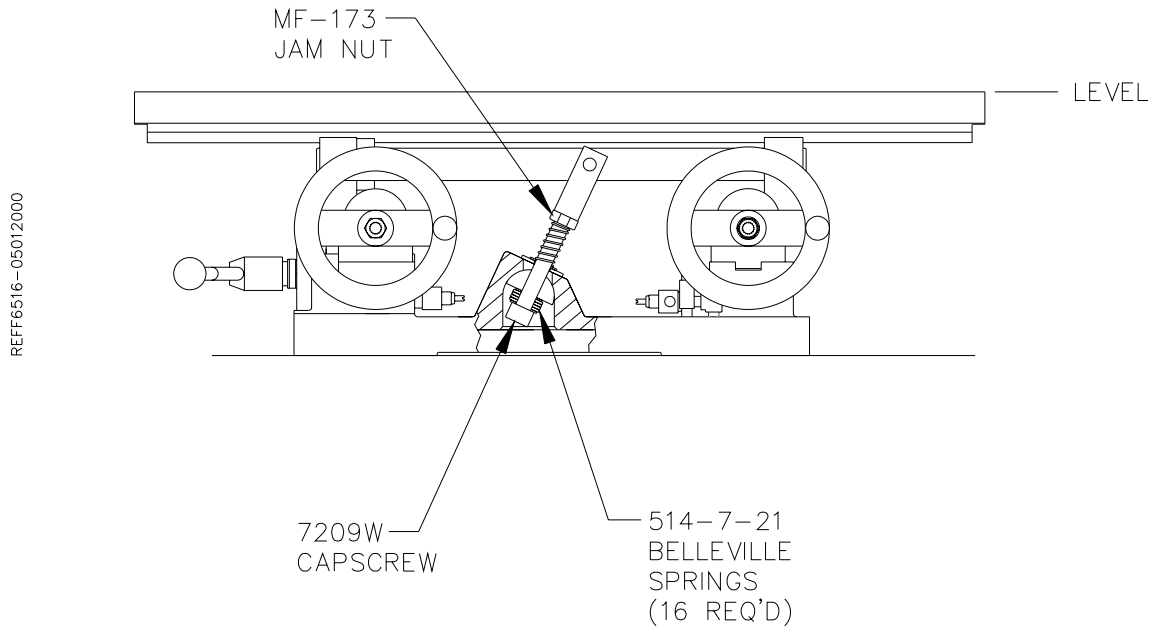
Remove nylock nut (MF-186) and washer (100-19) from shaft (7207M). Loosen set screw (MF-60) and remove hand wheel (7201M). Slide spacer (7207Q) off tilt shaft. Remove snap plug (506-3-1) from rear block (7207L).



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

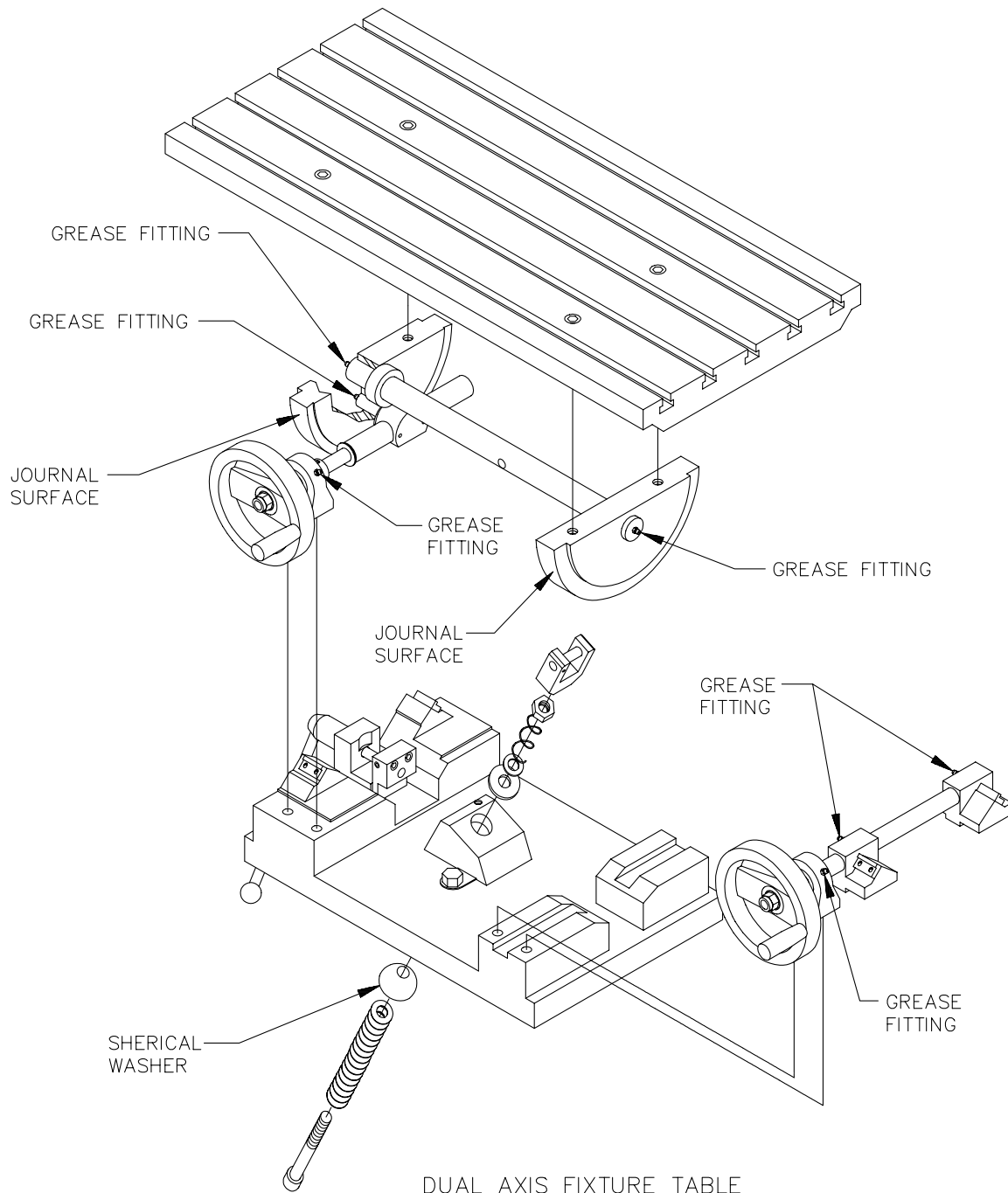


15. Level table in both directions.
16. Adjustable handle (514-2-39D) on left side of table should still be loose.
17. Tighten cap screw (7209W) on table clamp to flatten it's Belleville springs (514-7-21) then back off 3-1/2 turns from tight. Tighten jam nut on table clamp.
18. Table should now travel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



Lubrication:

REFHDT13-062095



DUAL AXIS FIXTURE TABLE
LUBRICATION

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

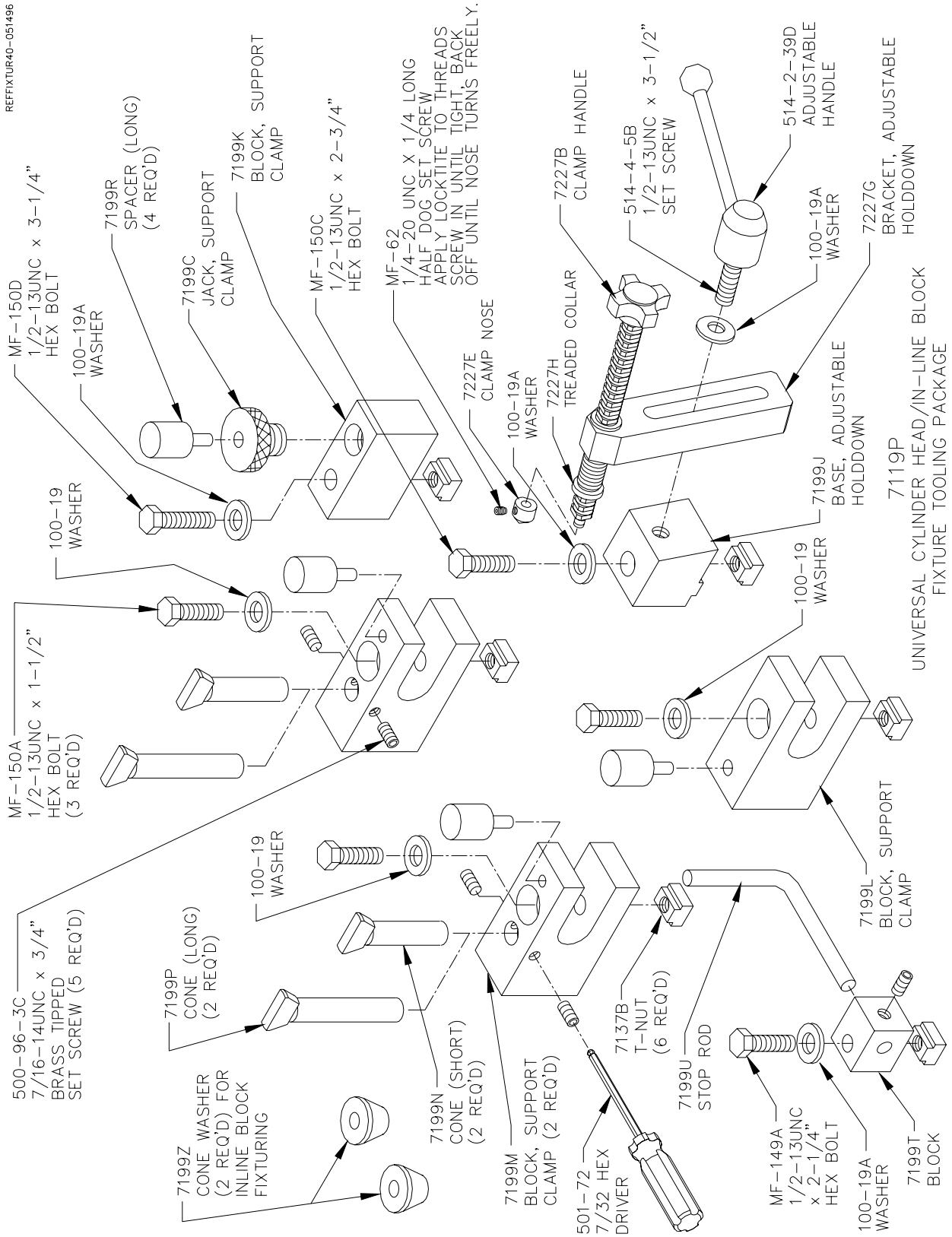
200 HOURS: ADD 2 OR 3 SHOTS OF GREASE TO THE GREASE FITTINGS SHOWN.

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:

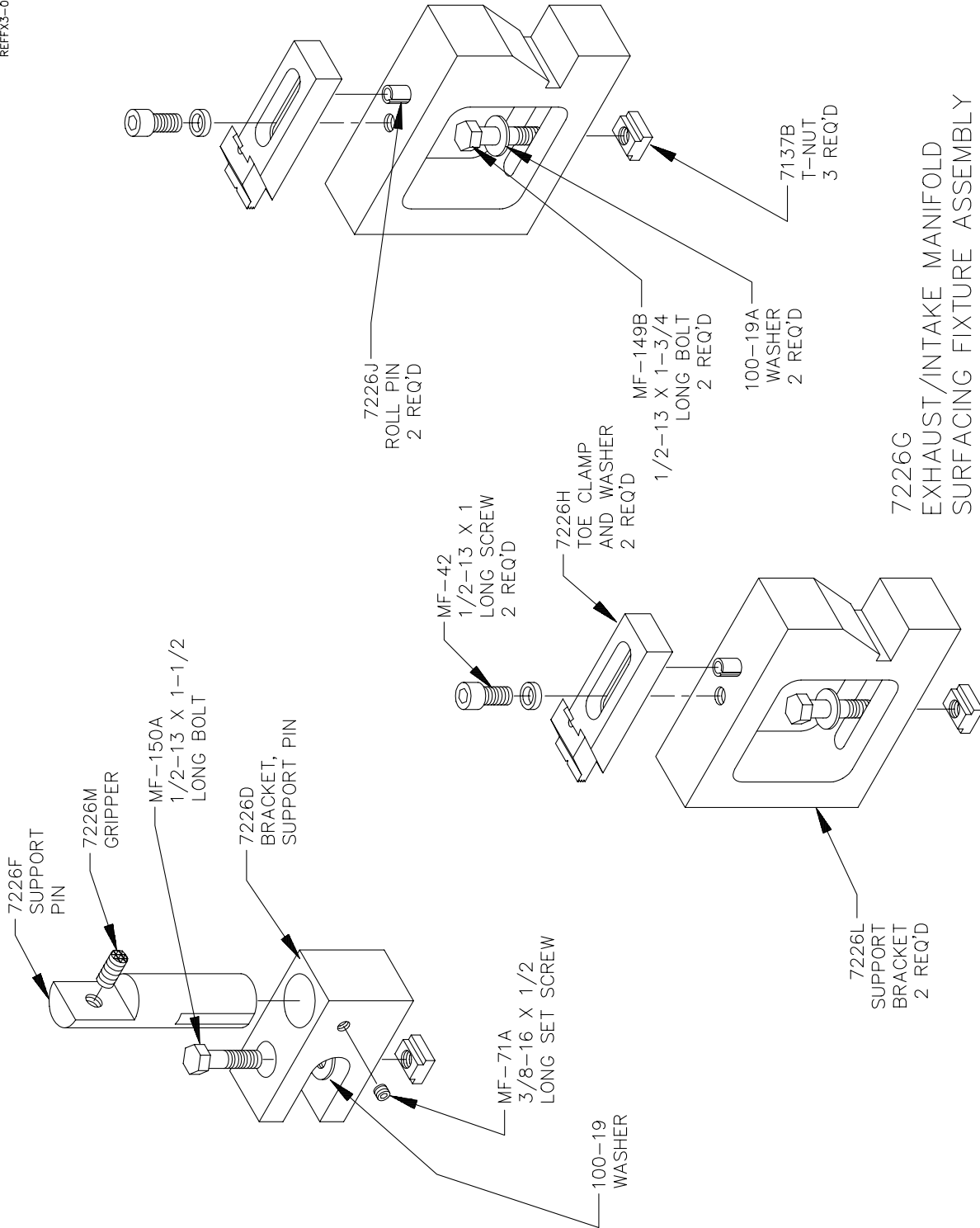
REFIXTUR40-051496



UNIVERSAL CYLINDER HEAD/IN-LINE BLOCK FIXTURE TOOLING PACKAGE

Exhaust/Intake Manifold Surfacing Fixture Assembly 7226G:

REFFX3-051496



7226G EXHAUST/INTAKE MANIFOLD SURFACING FIXTURE ASSEMBLY

Exhaust/Intake Manifold Fixture: Instructions

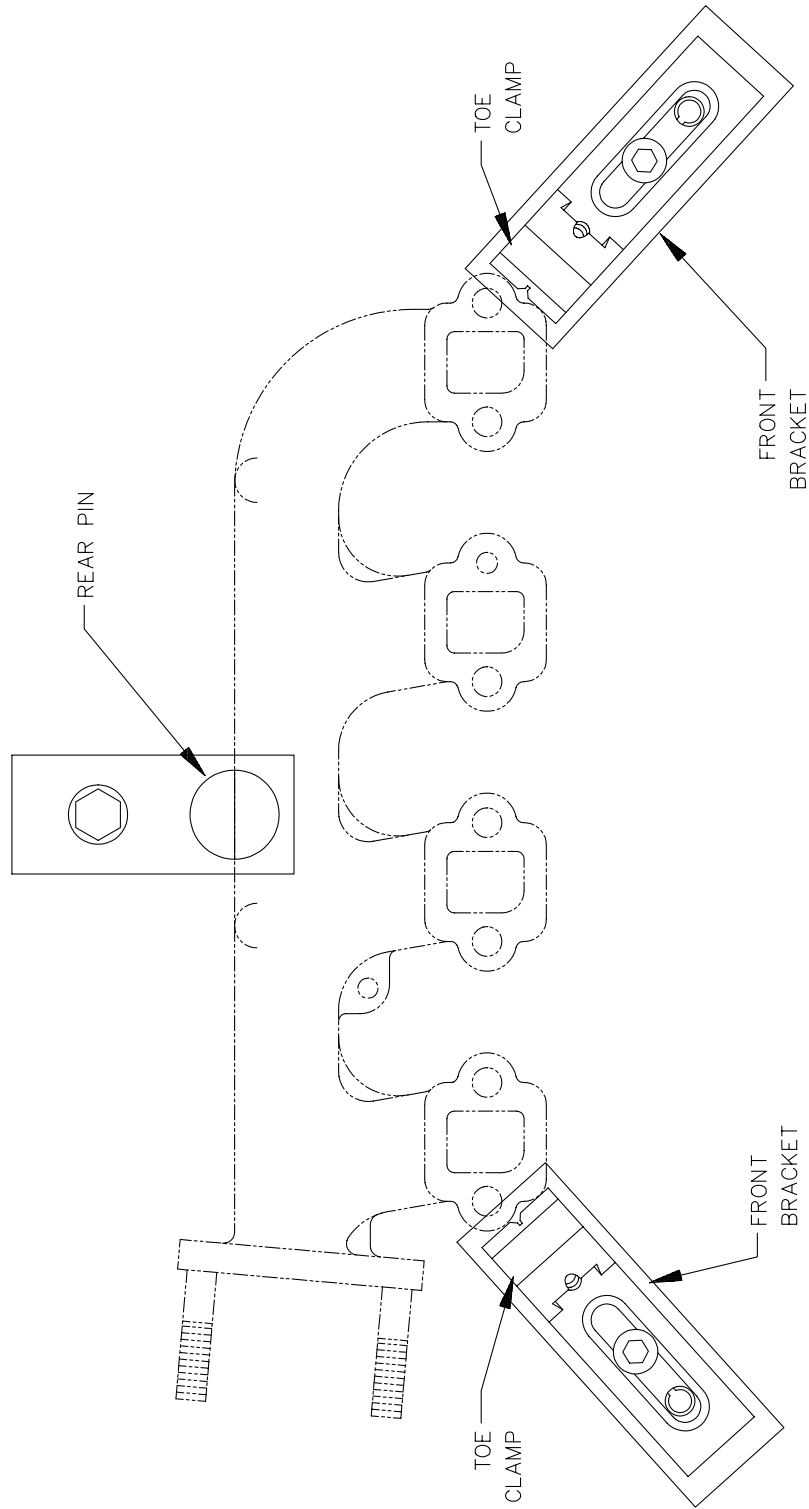
This fixture is designed to hold most exhaust manifolds and most intake manifolds from 90 degree V8 Engines.

Exhaust Manifolds

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

Typical Exhaust Manifold Set-up:

REFFX4-020993



Intake Instructions:

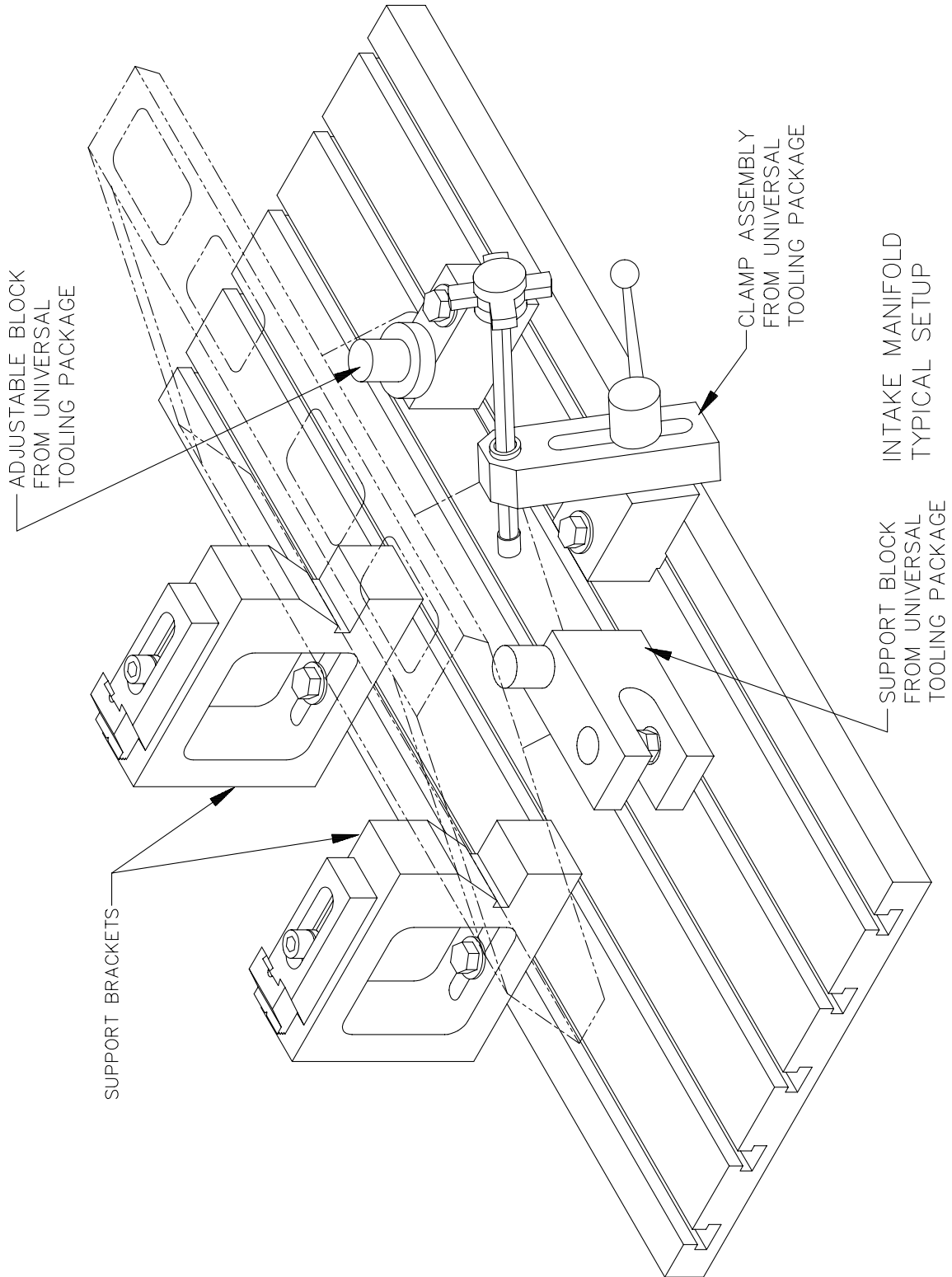
This fixture will require parts from the Rottler universal head tooling package.

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

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

Typical Intake Manifold Set-up:

REFFX5-070893

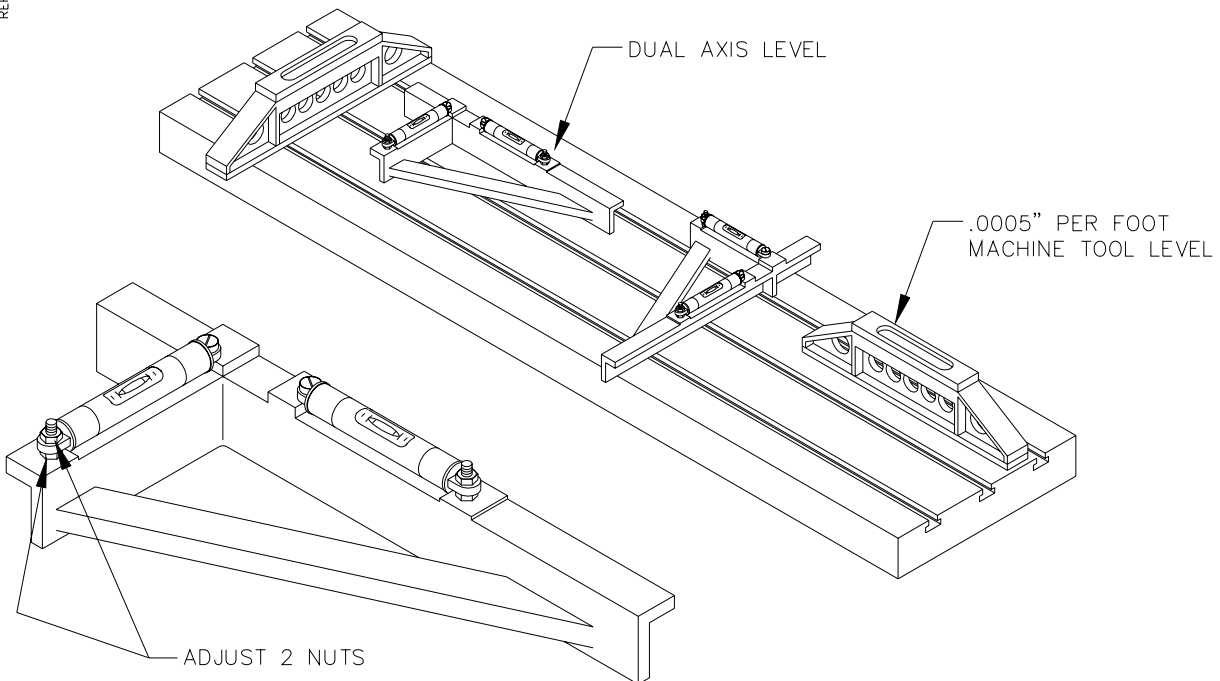


Dual Axis Level Assembly 7125A:

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

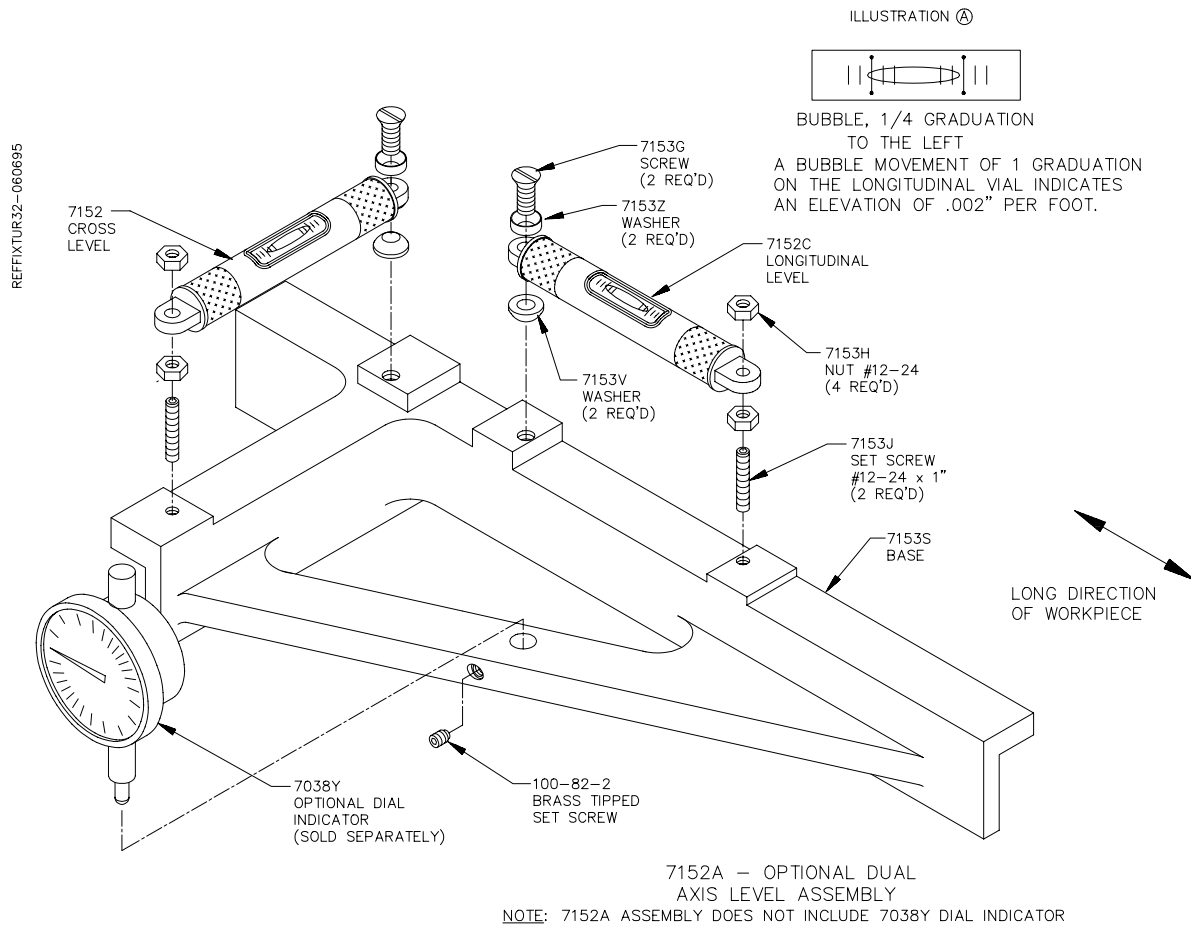
1. Level machine with a .0005/foot machine tool level so that the work surface is level within .0005/foot in both axis.
2. Now place dual axis level (7125A) on the work surface. It should read level in both vials, the vials will need to be adjusted if they do not read level. Turn the level 90 degrees and check in this direction also.
3. The leveling check should be made frequently on a new machine since typical floor support conditions take a while to permanently seat in. Then a weekly re-check should be adequate, unless you have a reason to doubt accuracy.

REF F6517-05022000



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

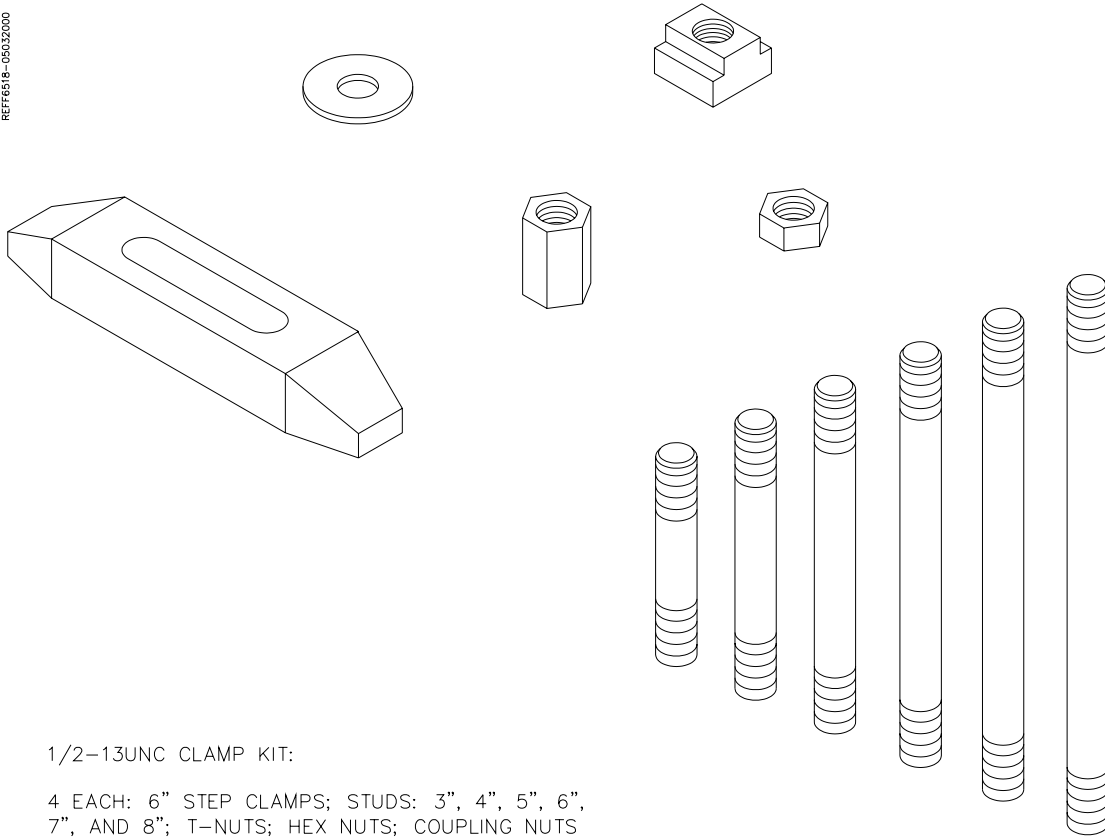
1. Place the cylinder head on the table and clamp into place approximately level.
2. Place level on head surface and adjust the hand wheels so that cross level is centered and longitudinal level bubble moves slightly left of center, approximately $\frac{1}{4}$ graduation (see illustration A). The purpose of this is to assure clean up of the extreme left of the head.
3. Now, in order to adjust for minimal stock removal, look at the flatness dial indicator (7038Y) reading.
 - a) If the reading is at "0" or past "0" the surface is flat or convex. Accordingly, set the cutter height dial at .002 to .003 past "0" and begin cut.
 - b) If the level dial is short of "0" that means the deck surface is concave and you will have to remove more material at the beginning of the cut. In general, add about .003" on cutter depth for every .002" the level dial is short of "0" on short heads. On long heads add .005" of cutter depth for every .002" of indicator reading. It is important to finish with a single as much as possible. Multiple cuts will result in more tool wear as well as considerably more time cost.



1/2" Clamp Kit:

650-3-37

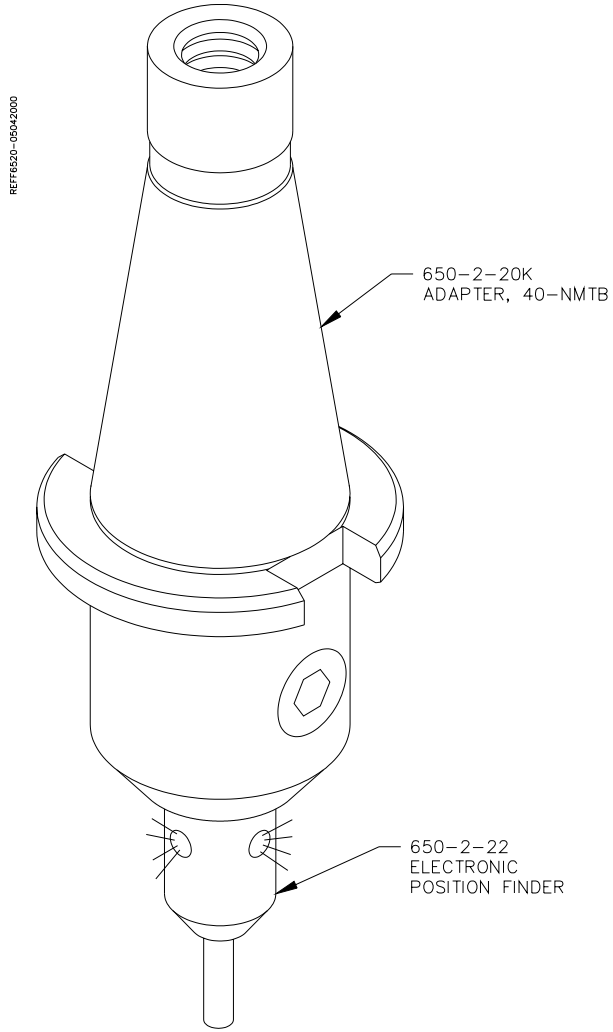
REF F6518-05032000



1/2-13UNC CLAMP KIT:

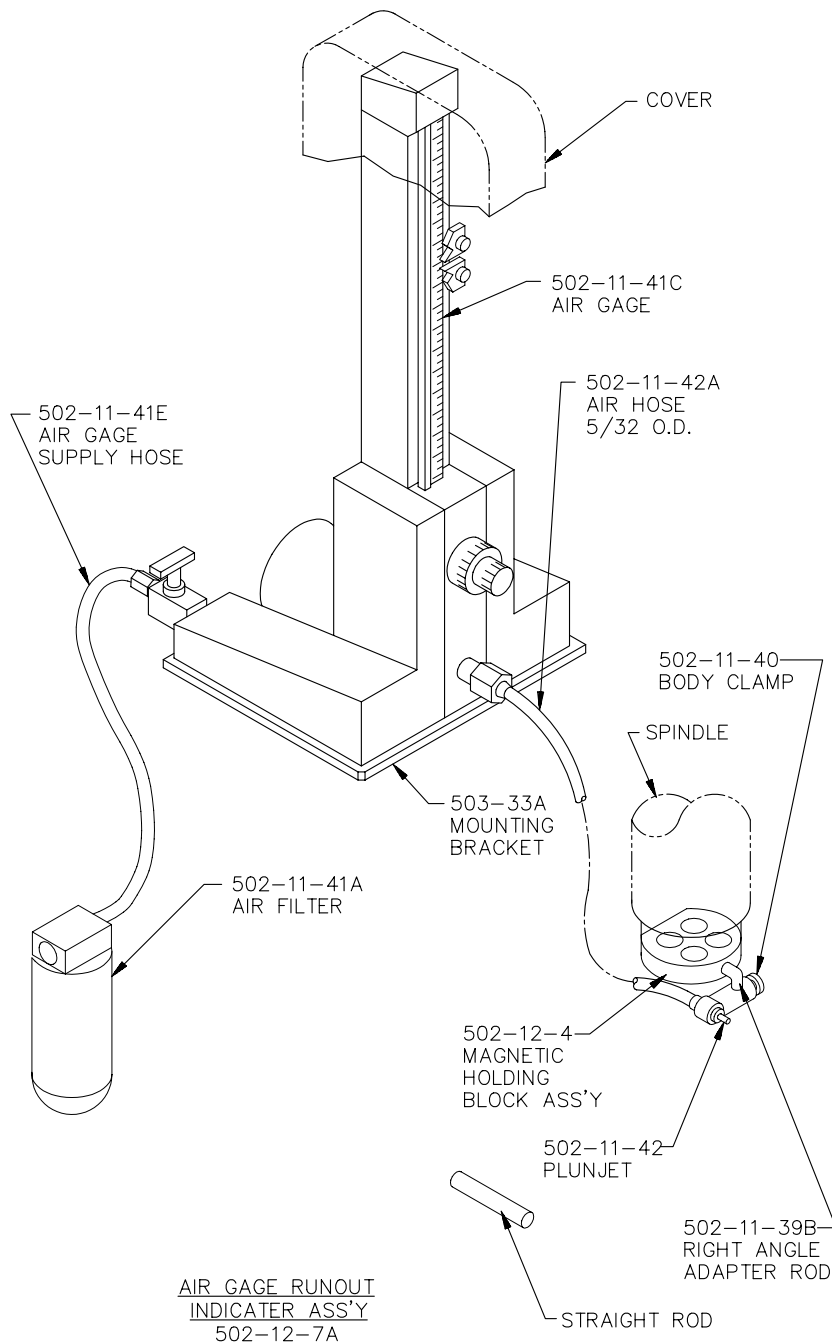
4 EACH: 6" STEP CLAMPS; STUDS: 3", 4", 5", 6", 7", AND 8"; T-NUTS; HEX NUTS; COUPLING NUTS

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

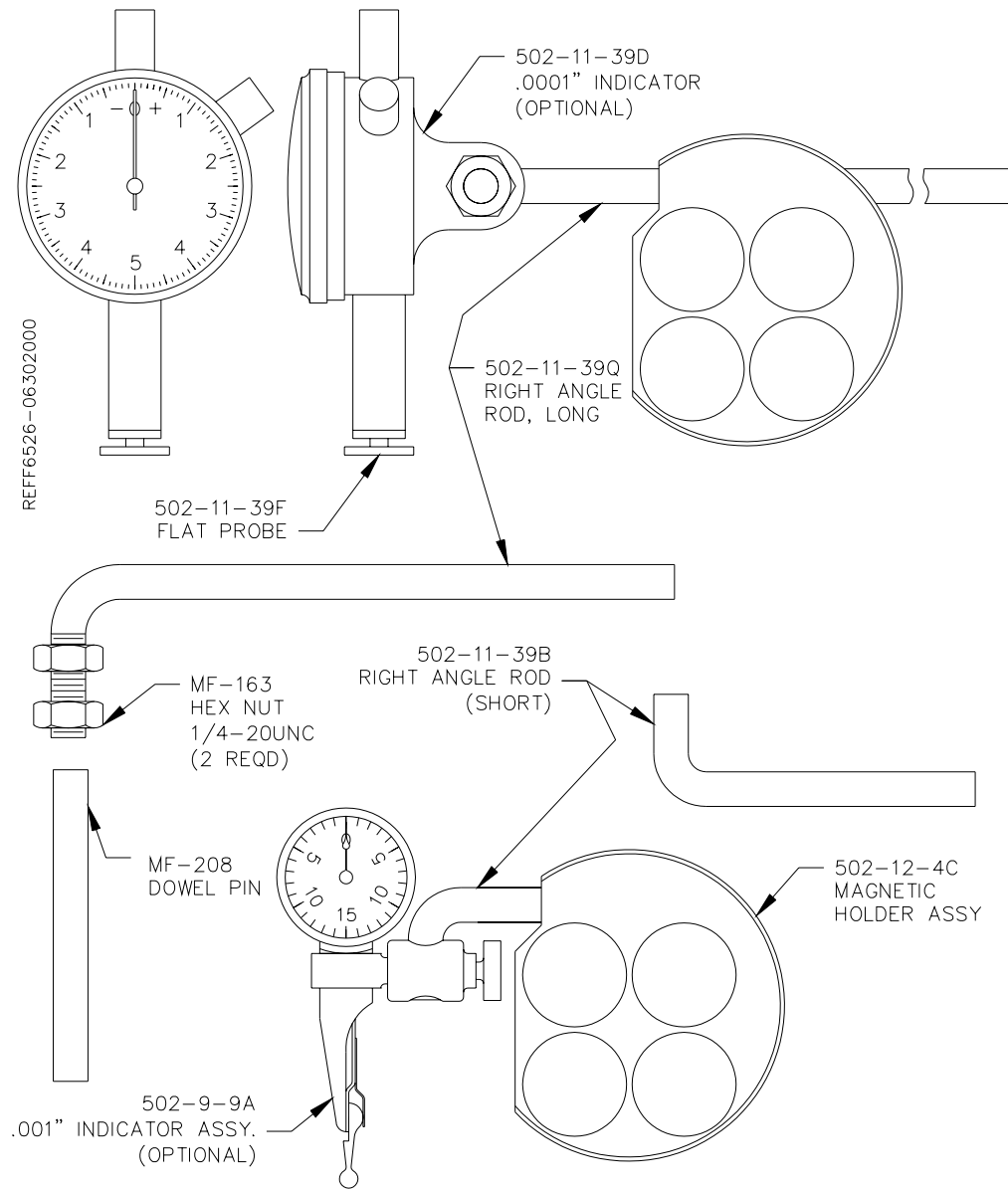


Remote run-Out indicating System 502-12-7A:

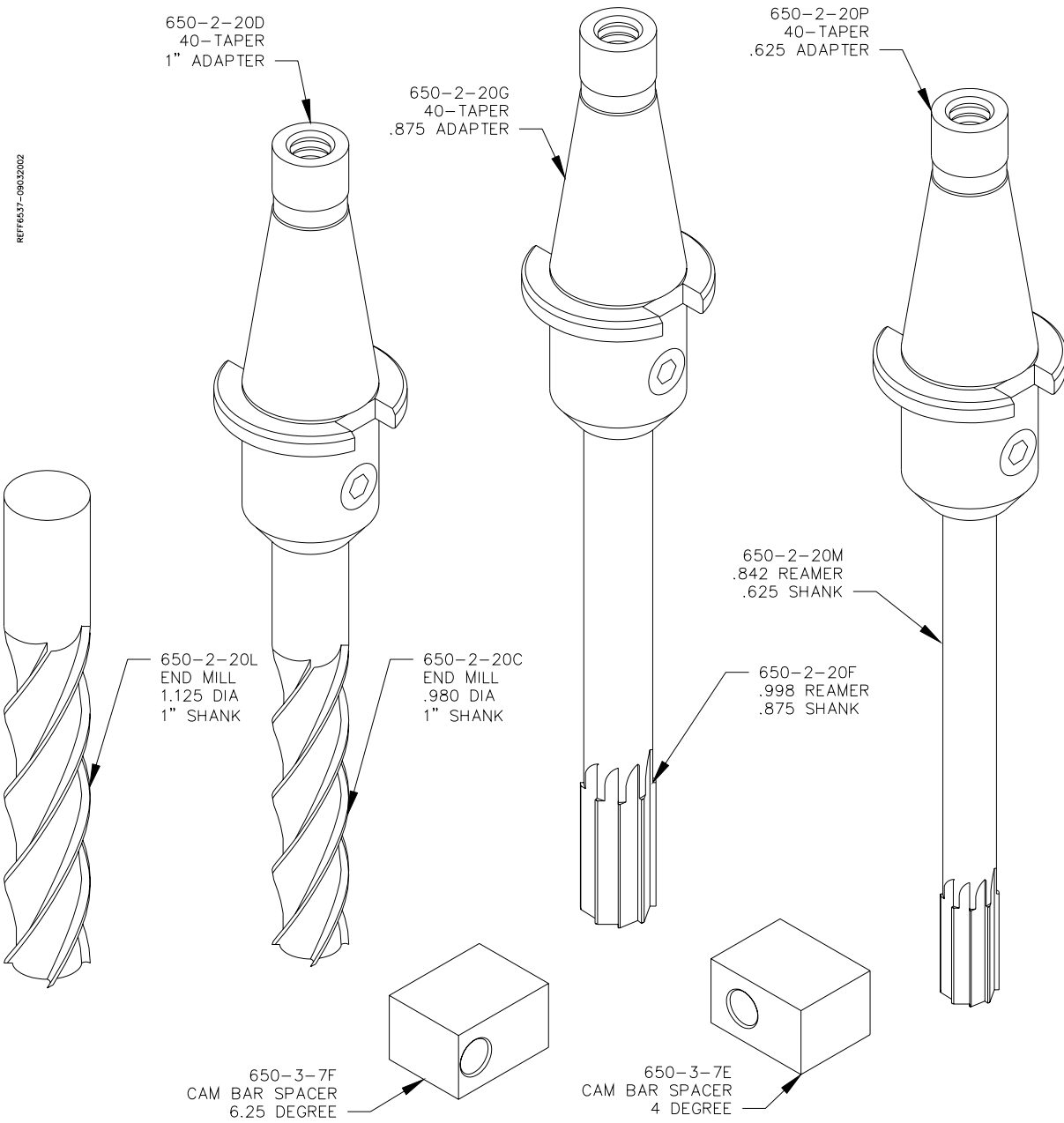
An optional remote indication air probe and gauge system is also available to check bore and face run-out. The stationary indicator allows easier reading and can be used in lower bore extremities where the mechanical dial indicator cannot be seen. The air probe can be used in a considerably smaller bore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



Magnetic Indicator Holder 502-12-4:



Lifter Bore Tooling Package 650-2-20:



Additional Lifter Bore Tooling:

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

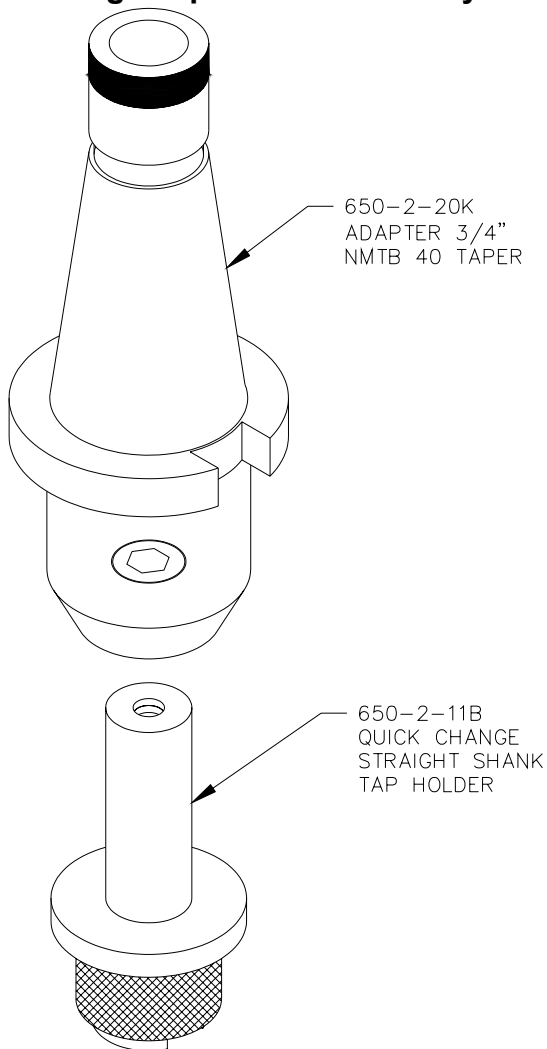
650-2-20J	Expansion reamer, .875" Dia. X 10" long (3/4" Shank) (Ford)
650-2-20V	Expansion reamer, .9035/.904" Dia. X 10" long (3/4" Shank) (Mopar)
650-2-20Y	Expansion reamer. Special .993 dia. X 10-1/2" long (7/8" shank) (Mopar)

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

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

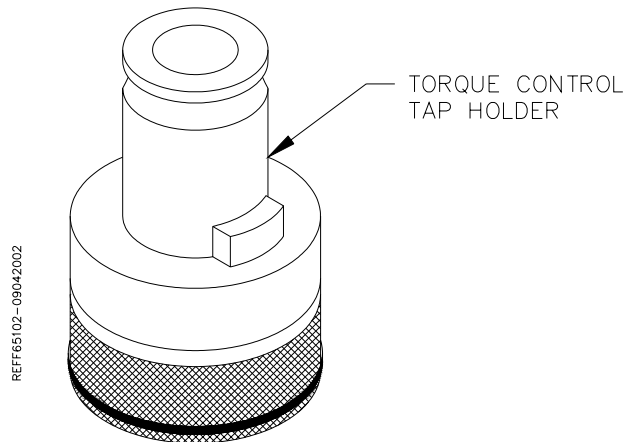
Quick Change Tap Holder Assembly 650-2-11J:

REF65101-09042002



Torque Control Tap Holders:

Use with 650-2-11J Assembly

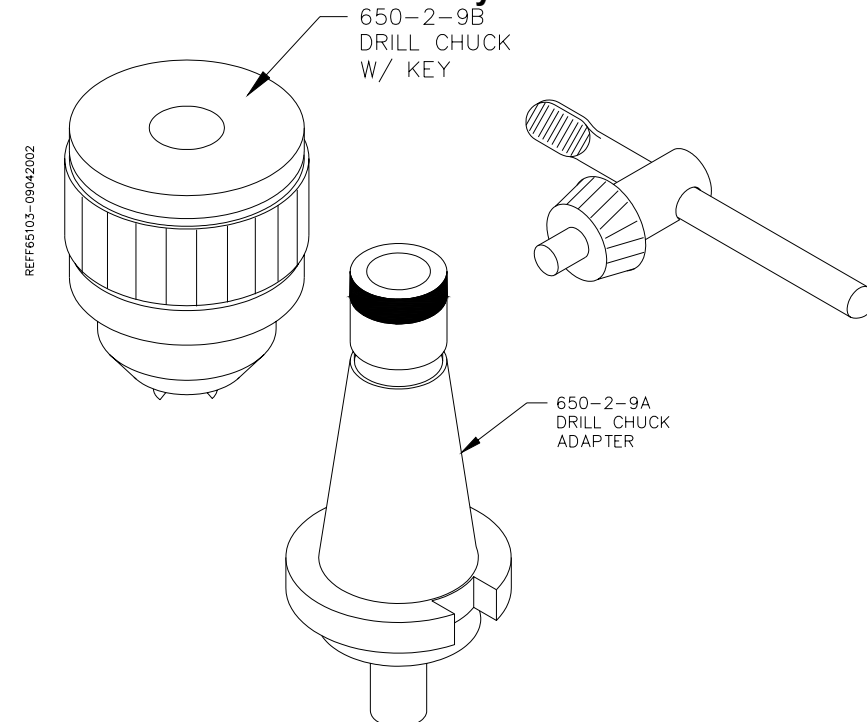


650-2-11C	Torque Control Tap Holder for 1/4" taps
650-2-11D	Torque Control Tap Holder for 5/16" taps
650-2-11E	Torque Control Tap Holder for 3/8" taps
650-2-11F	Torque Control Tap Holder for 7/16" taps
650-2-11G	Torque Control Tap Holder for 1/2" taps

Adapters NMTB 40 Taper:

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

Precision Drill Chuck Assembly 650-2-9:

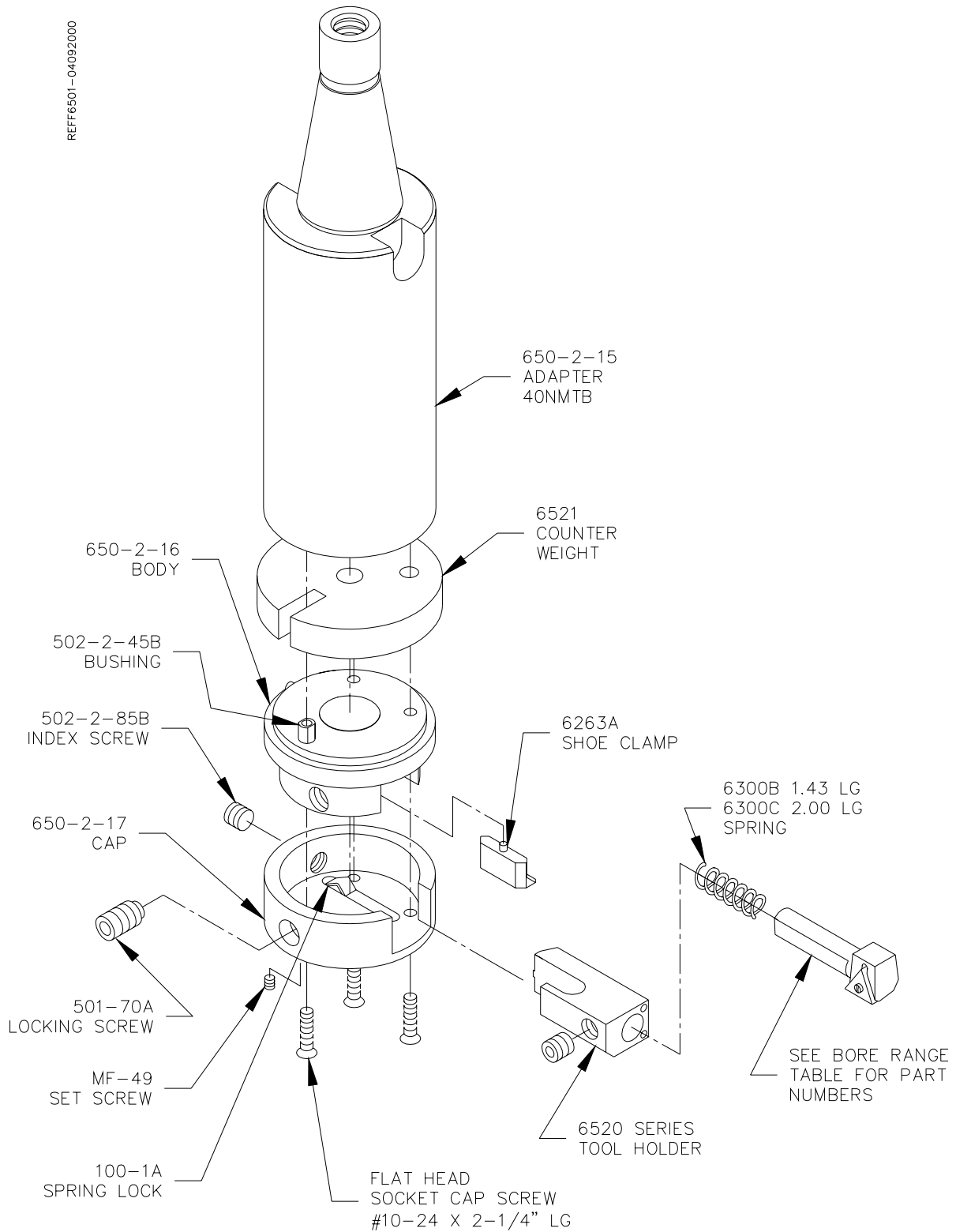


2.9" Cutterhead:

650-2-14 with Tooling

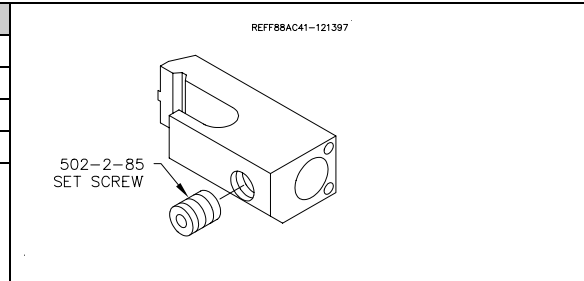
650-2-14A without Tooling

REF6501-04092000



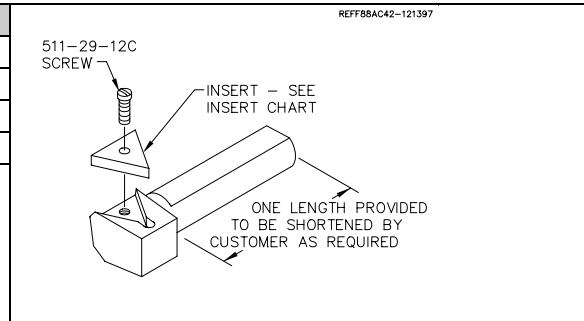
2.9" Cutterhead Standard Tooling:

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



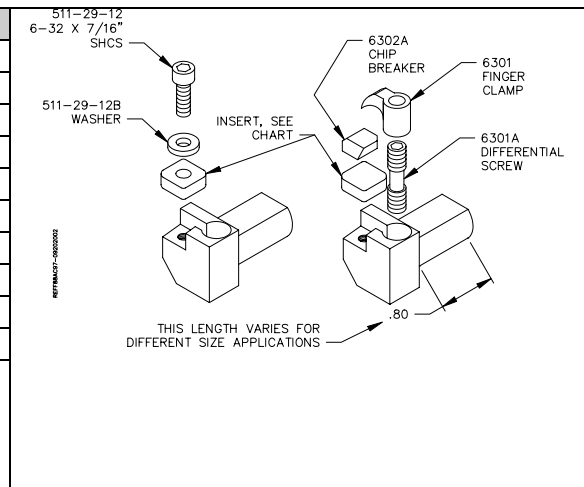
6598K Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6598K	6520H	3.75" – 4.00"
6598K	6520A	4.00" – 4.50"
6598K	6520B	4.50" – 5.00"

Triangle insert positive rake



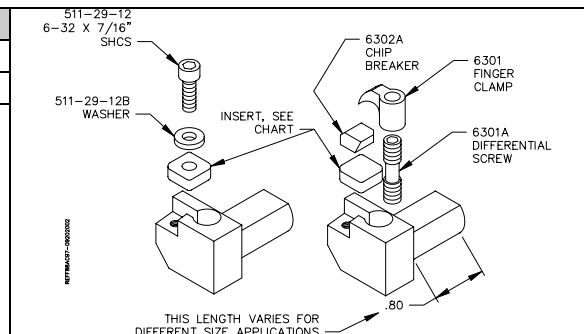
6260 Series Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6260K	6520H	3.75" – 4.00"
6260K	6520A	
6260K	6520B	
6260L	6520H	4.00" – 4.50"
6260L	6520A	
6260L	6520B	
6260M	6520H	
6260M	6520A	
6260M	6520B	4.50" – 5.00"

Square insert negative rake



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

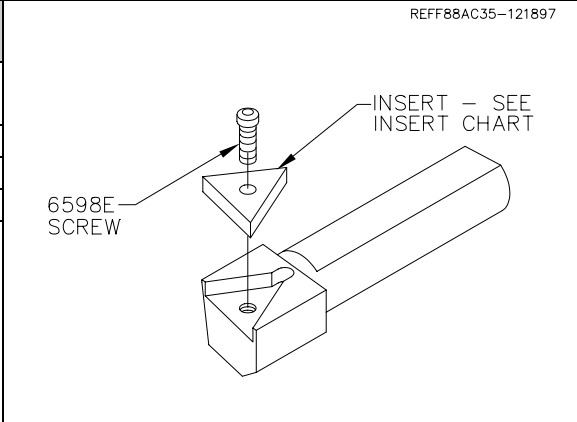
Square insert negative rake



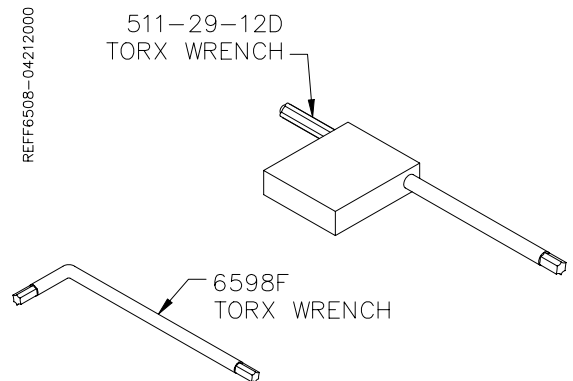
6547 Series Chamfering Tool Bits when used with 6520 Holders		
Tool Bit	Chamfer Angle	Bore Range
6547F	30	3.10" – 5.00"
6547G	20	3.30" – 5.00"
6547M	15	3.45" – 5.00"

Triangle insert positive rake

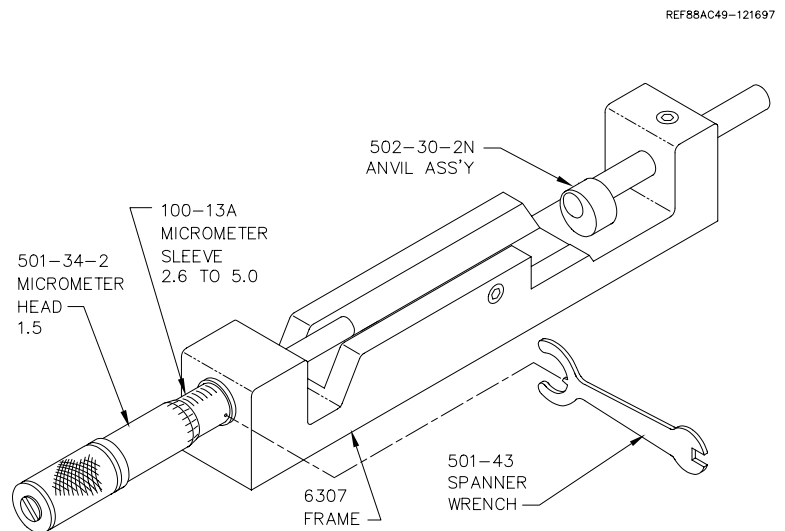
REF88AC35-121897


511-29-12D Torx Wrench**6598F Torx Wrench**

For use with Torx style screw in Triangle cartridges.

**6307F Micrometer Assembly**

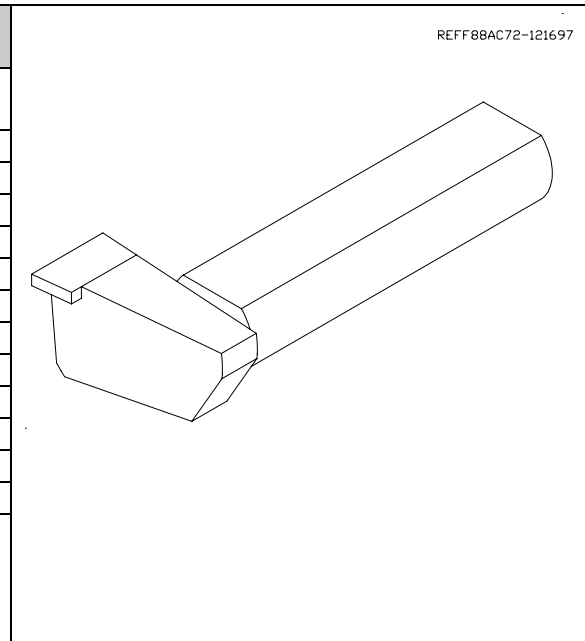
2.9" – 5.0"



2.9" Cutterhead Optional Tooling:

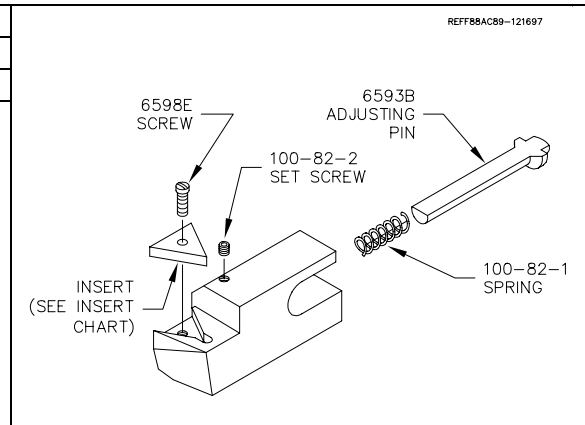
6513 Series Grooving Tool Bits when used with 6520 Holders			
Tool Bit	Groove DIA.	Tool Holder	Bore Range
6513J	.037"	6520H	3.55" – 3.95"
6513J	.037"	6520A	3.95" – 4.45"
6513J	.037"	6520B	4.45" – 4.85"
6513L	.039"	6520H	3.55" – 3.95"
6513L	.039"	6520A	3.95" – 4.45"
6513L	.039"	6520B	4.45" – 4.85"
6513N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

Square insert negative rake

**Cartridge Tool Holders:**

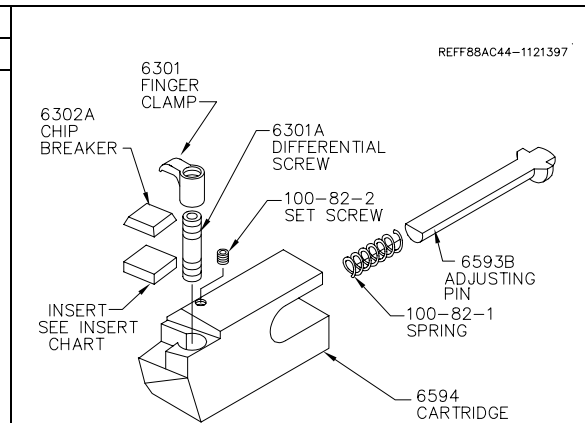
Tool Holder	Length	Bore Range
6593C	2.03"	2.90" – 3.40"
6593D	2.25"	3.40" – 3.90"

Triangle insert positive rake

**6594 Cartridge Tool Holder:**

Bore Range
2.90" – 3.90"

Square insert negative rake



Boring Inserts:

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

Boring Speeds and Feeds:

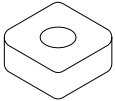
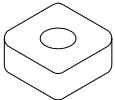
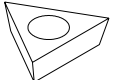
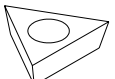
The Following insert feeds and speeds are designed to be used with the 650-2-14 Cutter Head Assembly.



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



$$\text{RPM} = \frac{\text{SFM} \times 3.83}{\text{DIAMETER}}$$

Example:
SFM = 800
4.00" Bore

$$800 \times 3.83 = 3064 \text{ Divide by the diameter } 4.00 = 766 \text{ RPM}$$

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

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

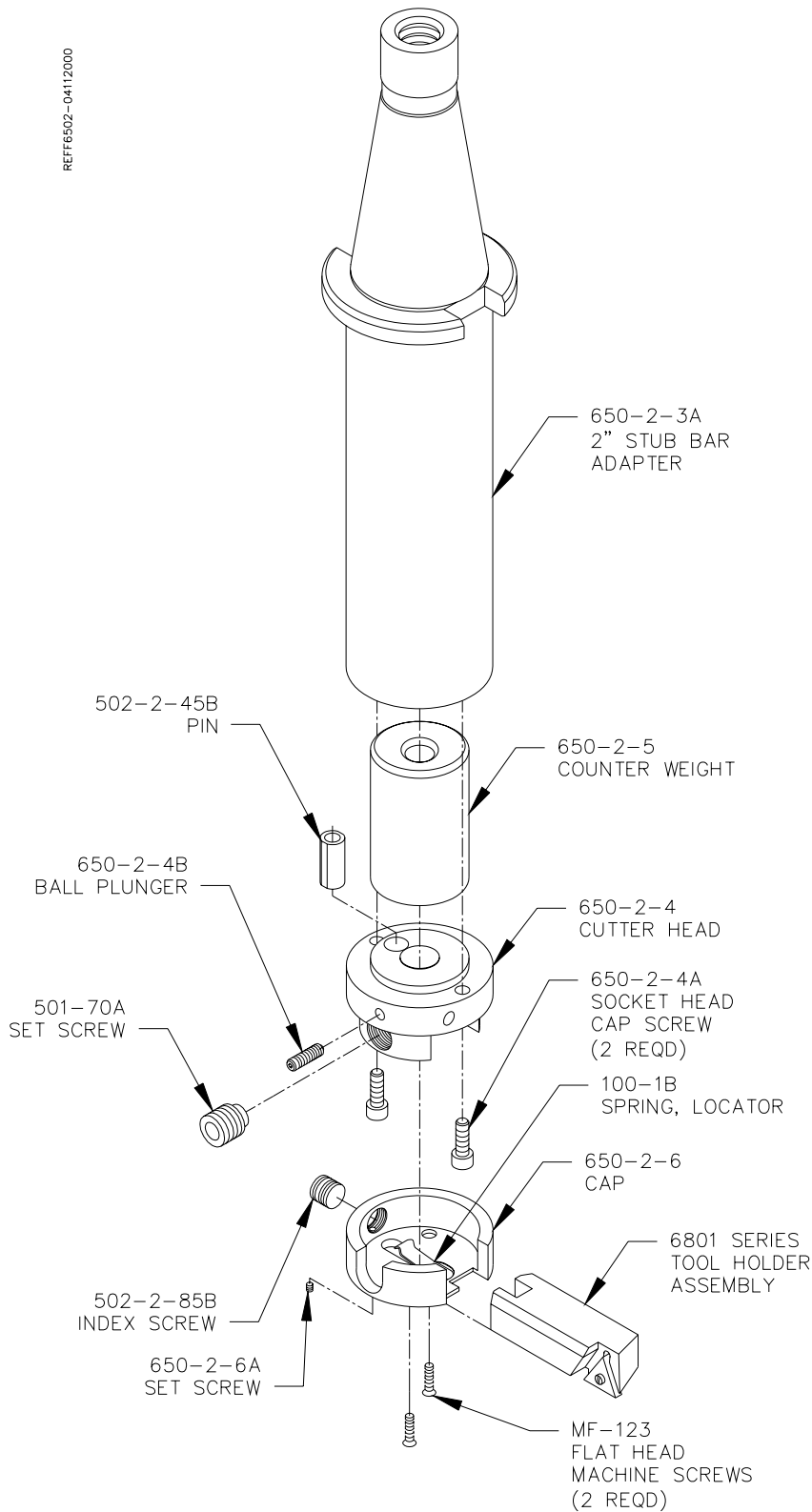
			in the 200 – 400 SFM area. Nodular cast iron is found most often in high performance engine blocks or sleeves.
	6301E	This is a square 3/8" I.C., 1/32" Radius, Solid, CBN-Cubic Boron Nitride – Insert	These inserts are intended for use on high speed F-84/85 boring machines up to 2000 RPM. A feed rate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

2.0" Cutterhead:

650-2-1 w/o Tooling

650-2-1A w/ Tooling

REF6502-04112000



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

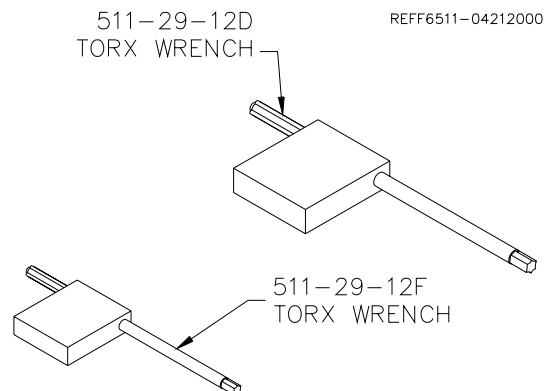
REF6510-09262002

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

REF6502-09272002

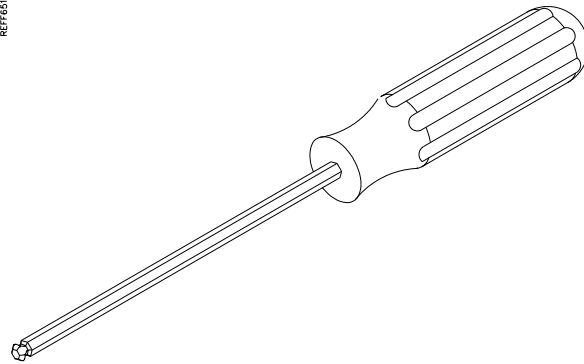
511-29-12D Torx Wrench**511-29-12F Torx Wrench**

For use with Torx style screw in Triangle cartridges.

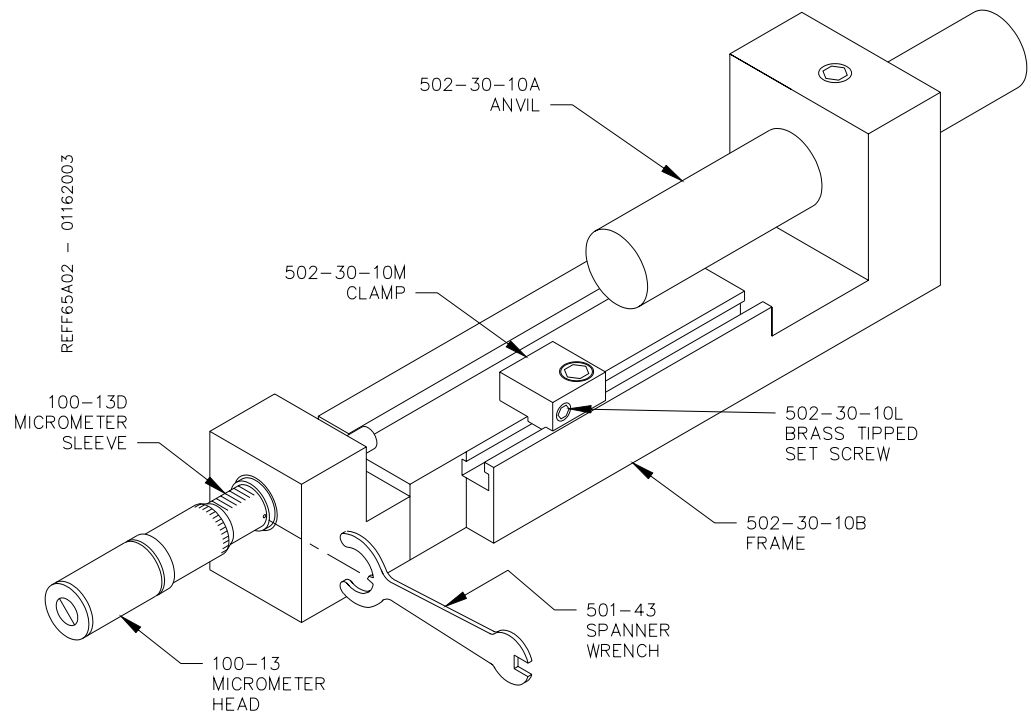


501-72J Hex Driver

REF6512-0422000

**900-2-11 Micrometer Assembly**

2.0" – 4.0"

**Boring Inserts:**

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

Boring Speeds and Feeds:

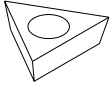
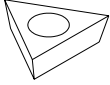

The Following insert feeds and speeds are designed to be used with the 650-2-1 Cutter Head Assembly.


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

$$\text{RPM} = \frac{\text{SFM} \times 3.83}{\text{DIAMETER}}$$

Example:
SFM = 800
4.00" Bore

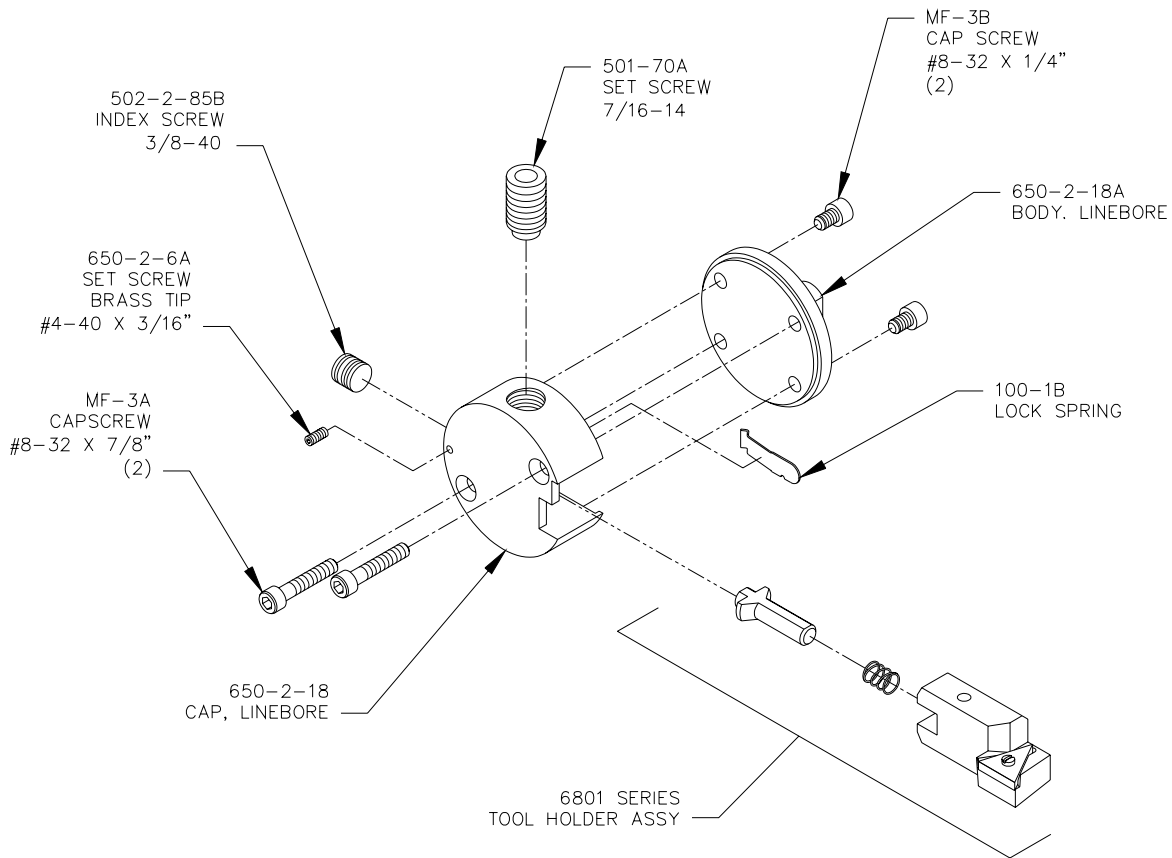
$800 \times 3.83 = 3064$ Divide by the diameter 4.00 = 766 RPM

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

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

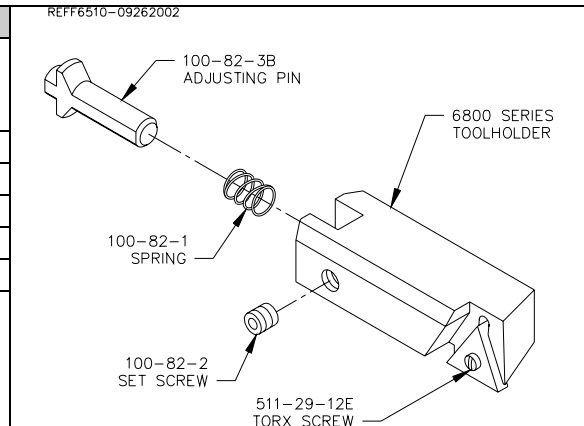
Right Angle Drive Tooling: 650-2-19 Line Bore Cutterhead:

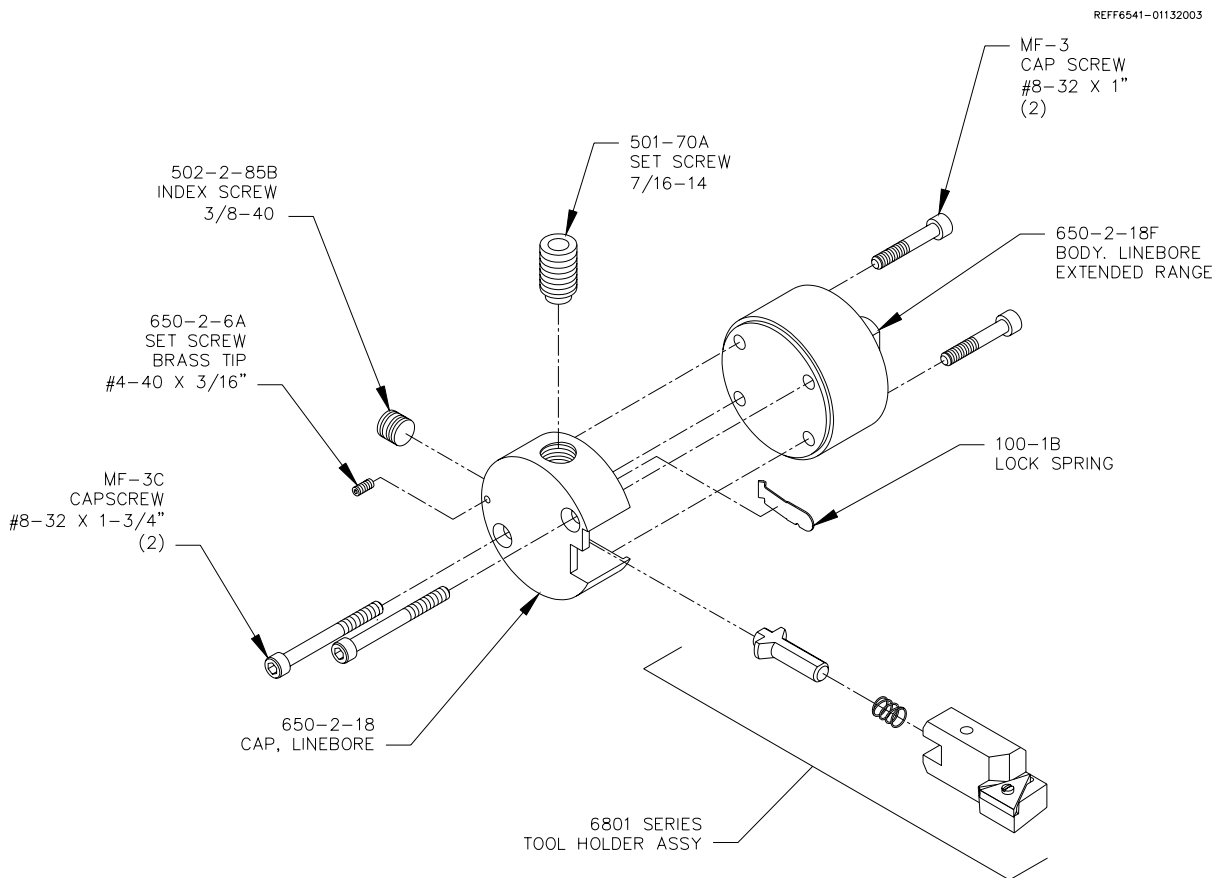
REF6507-04192000



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

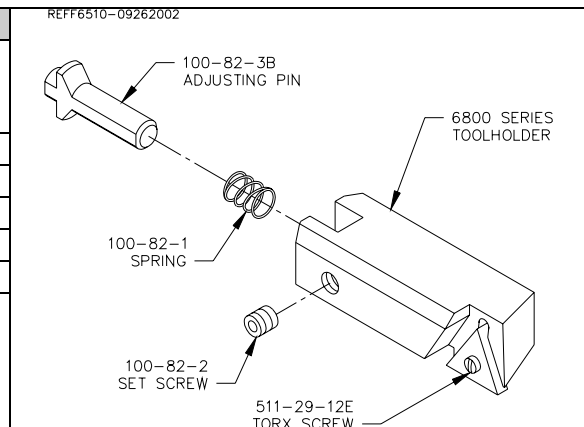
Triangle insert positive rake



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

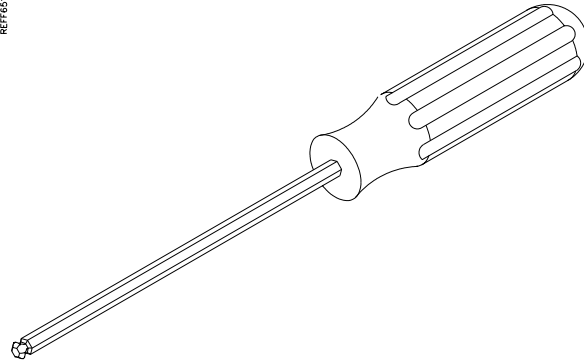
6801 Series Tool Holders			
Assembly Part #	Tool Holder Part #	Length	Bore Range
6801B	6800B	1.54"	2.0" – 2.4"
6801C	6800C	1.75"	2.4" – 2.8"
6801D	6800D	1.95"	2.8" – 3.2"
6801E	6800E	2.15"	3.2" – 3.6"
6801F	6800F	2.35"	3.6" – 4.0"

Triangle insert positive rake



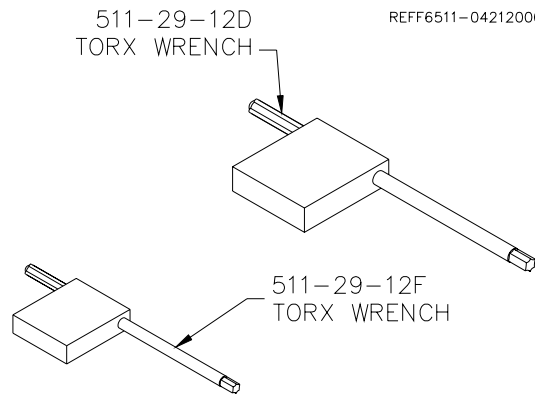
Hex Driver 3/16" 501-72J

REF6512-0422000

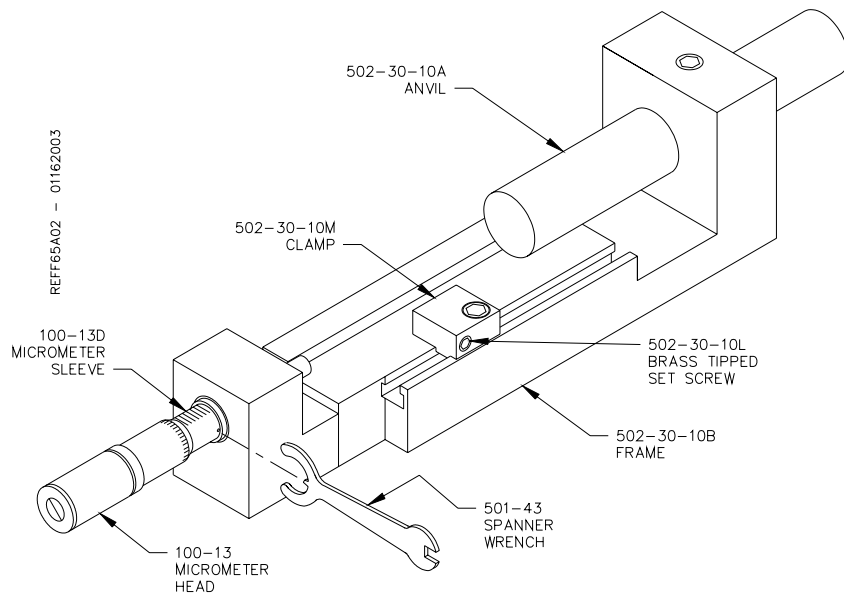


Torx Wrench 511-29-12D
Torx Wrench 511-29-12F

REF6511-04212000



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



Boring Inserts:

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

Boring Speeds and Feeds:

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

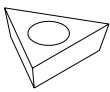
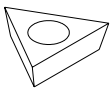


Below is a description of the cutting inserts available from Rottler. The inserts have gone through extensive performance testing. To take full advantage of the capabilities of your Rottler Machine, we highly recommend Rottler tooling be used. This chart uses SFM or Surface Feet Per Minute as a speed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

$$\text{RPM} = \text{SFM} \times 3.83 \\ \text{DIAMETER}$$

Example:

SFM = 800
4.00" Bore

$$800 \times 3.83 = 3064 \text{ Divide by the diameter } 4.00 = 766 \text{ RPM}$$

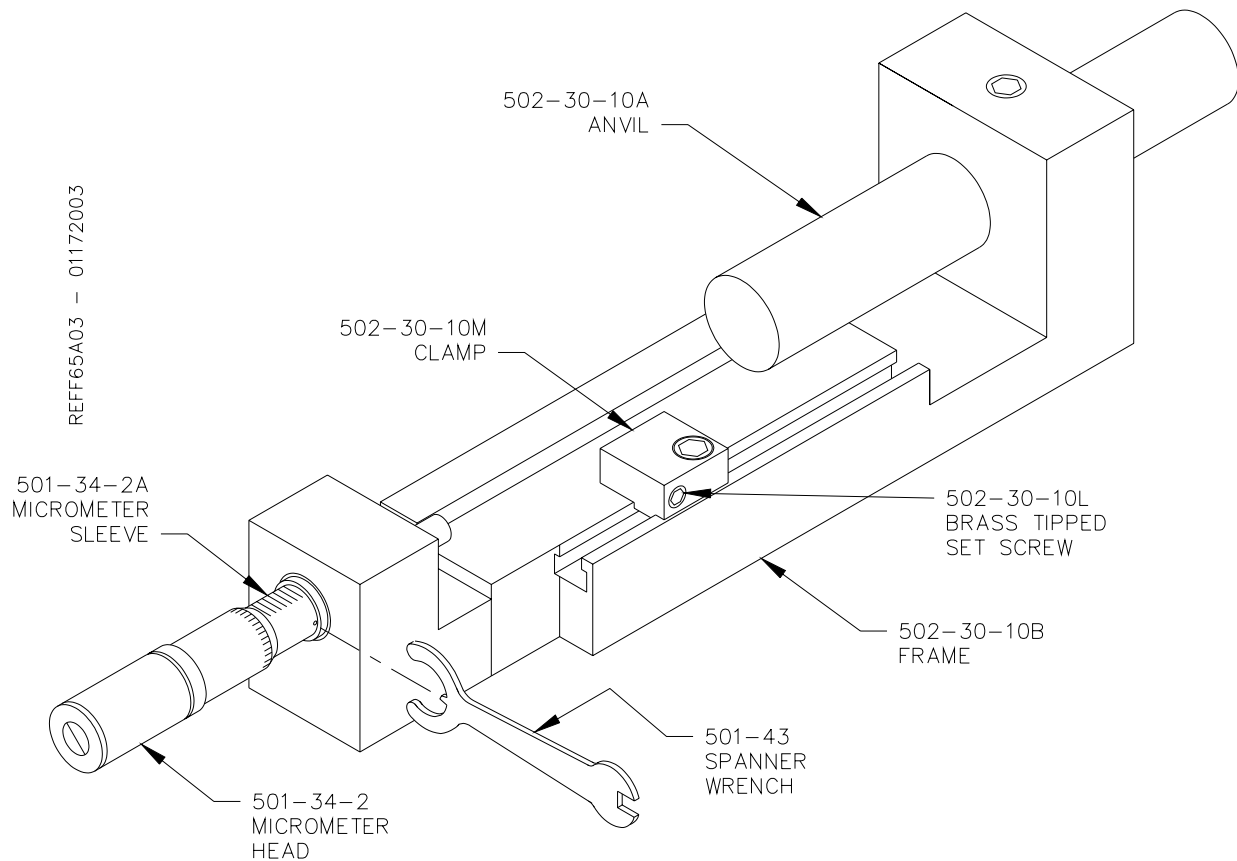
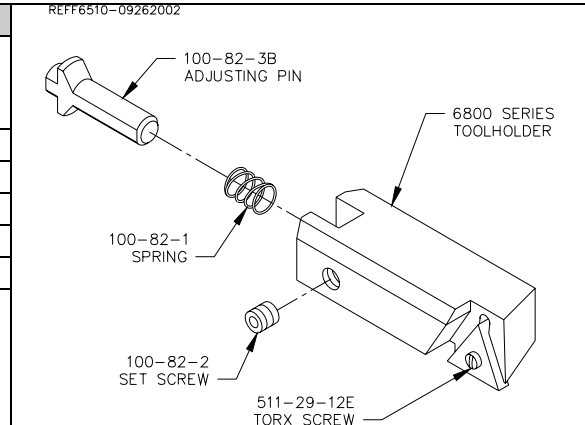
Insert	Part #	Description	Application
	RT321	A 3/8" IC triangular insert with a dark purple ceramic coating and 1/64" cutting radius.	The ceramic coating gives excellent results for both heavy sleeve cutting and finishing of cast iron and nodular cast iron. The 1/64" will minimize the possibility of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

Optional Main Line Bore Tooling: 4" to 6"

(must use micrometer 900-2-5)

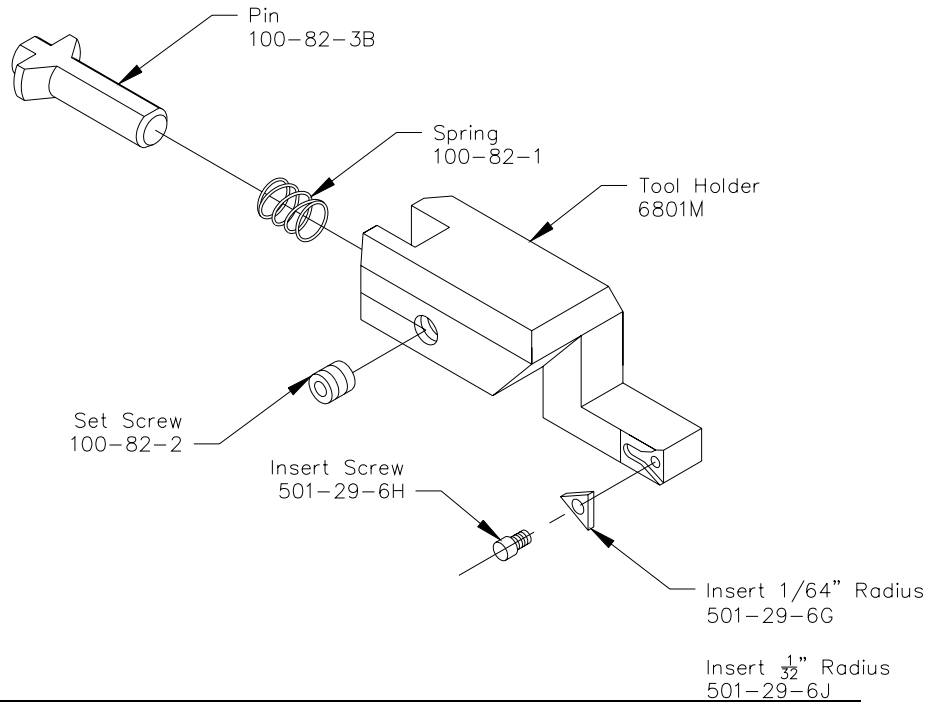
6801 Series Tool Holders			
Assembly Part #	Tool Holder Part #	Length	Bore Range
6801G	6800G	2.55"	4.0" – 4.4"
6801H	6800H	2.75"	4.4" – 4.8"
6801J	6800J	2.95"	4.8" – 5.2"
6801K	6800K	3.15"	5.2" – 5.6"
6801L	6800L	3.35"	5.6" – 6.0"

Triangle insert positive rake



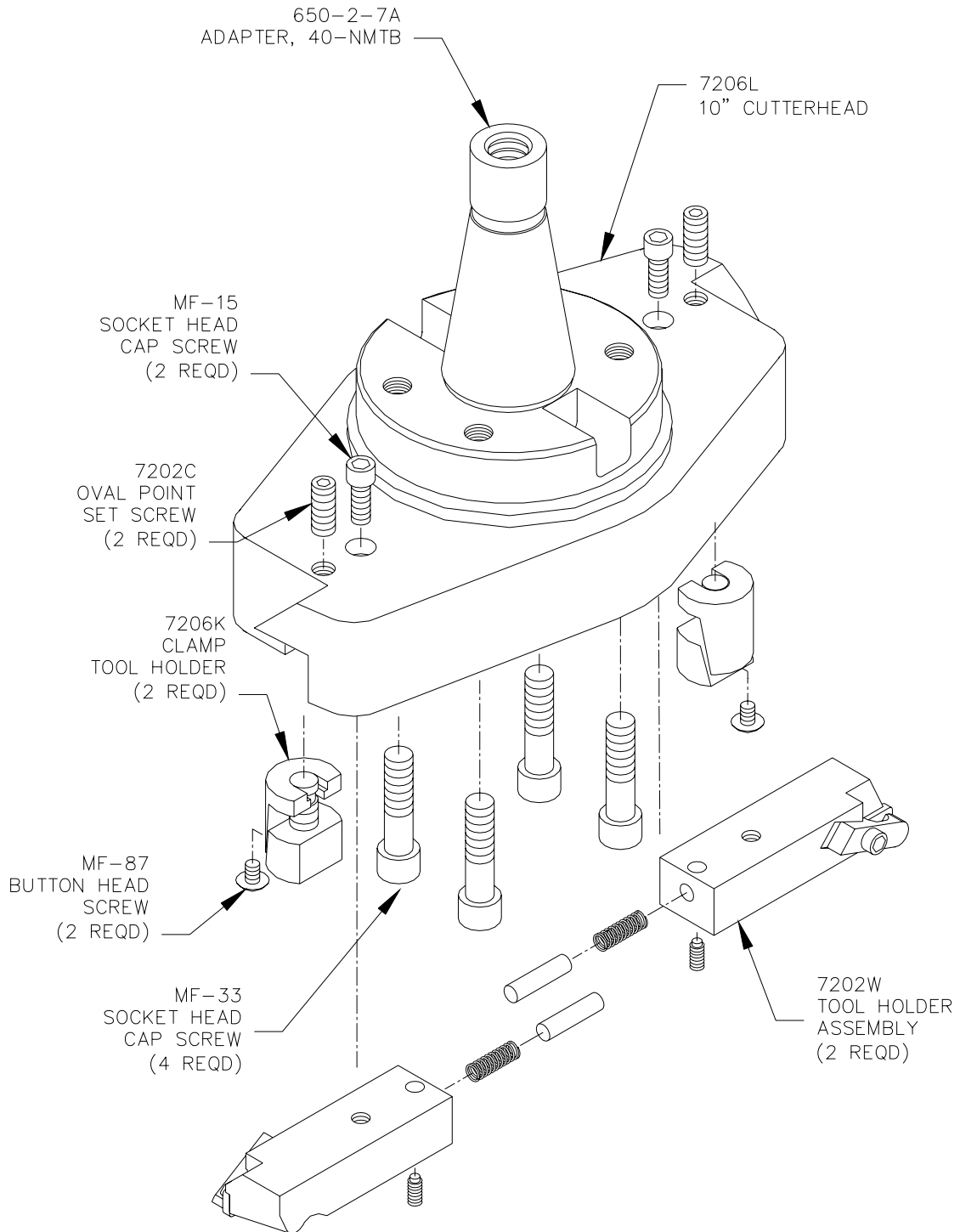
**Thrust Facing Tool Holder;
6801M**

REF65A01-01132003



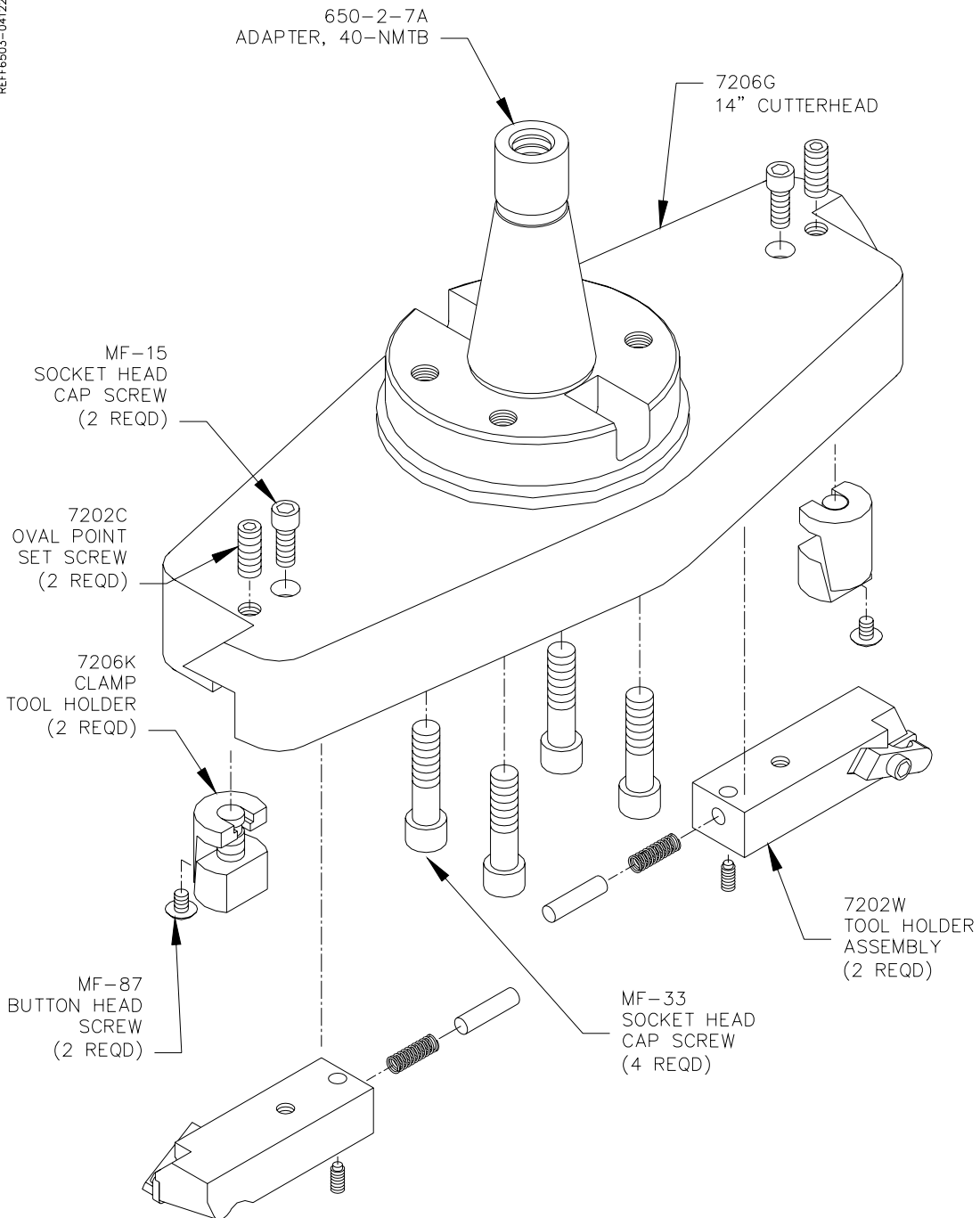
**10" Surfacing Head w/ Tooling:
650-2-8B**

REF6504-04122000



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

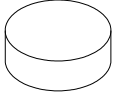
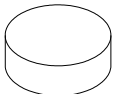
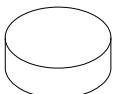
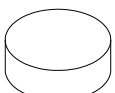
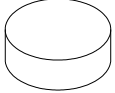
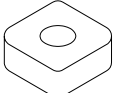
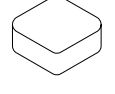
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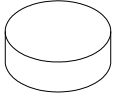
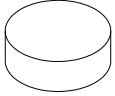


Surfacing Inserts:

Surfacing Speeds and Feeds:

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

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

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

General Information:

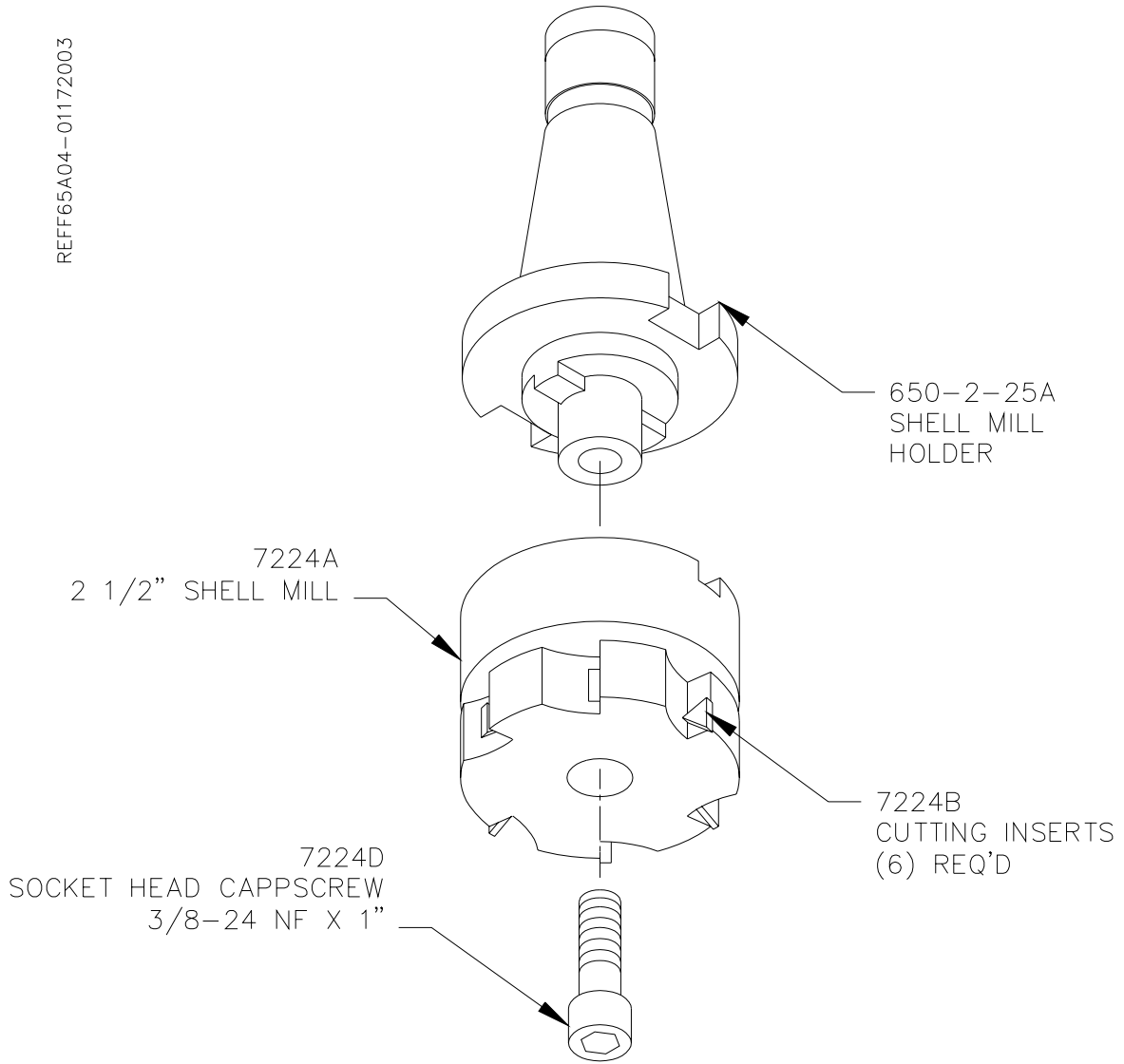
Rottler CBN and PCD Inserts are laser marked with our part number on one side. On single sided inserts, the part number is on the back side of the insert.

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

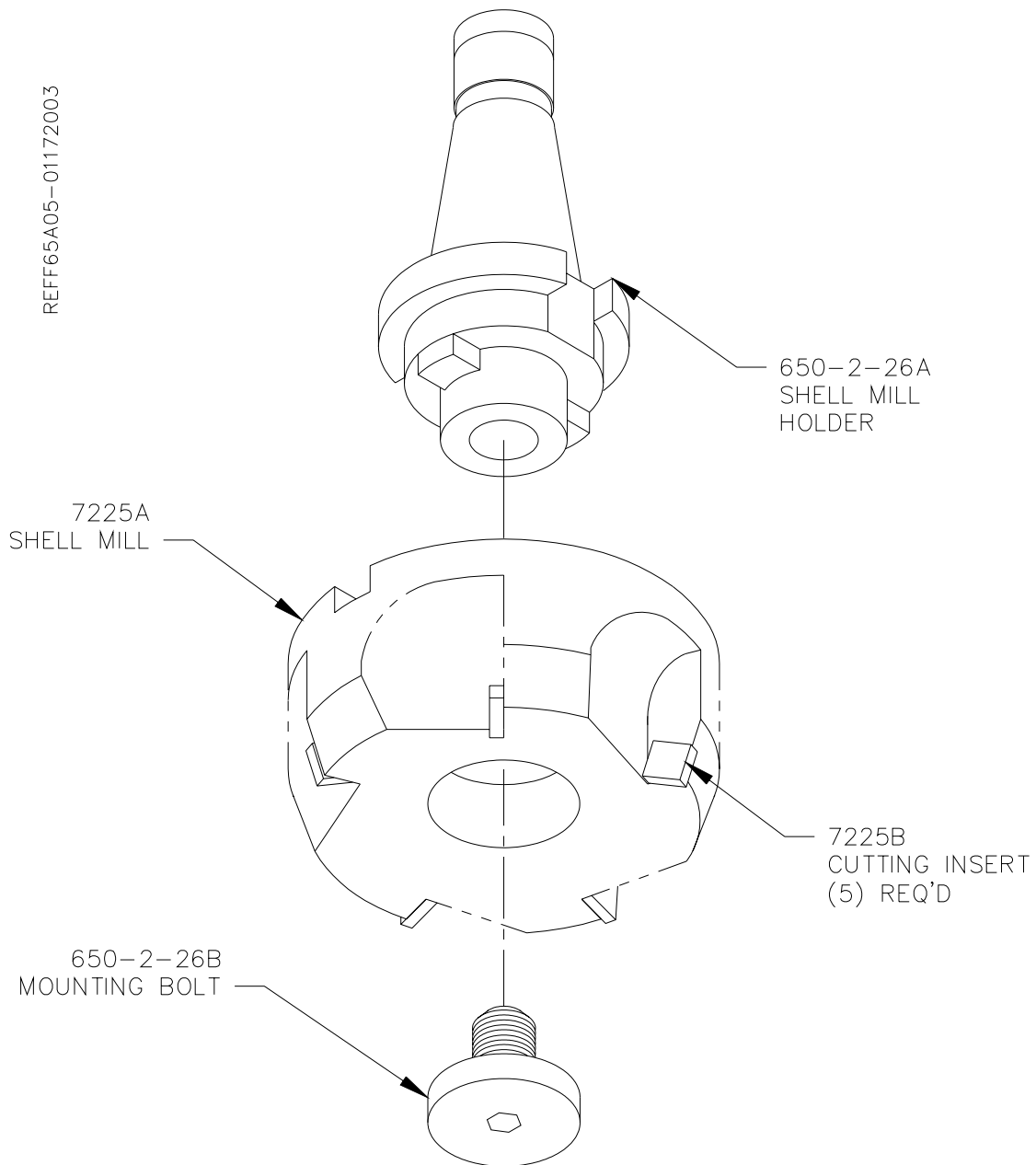
Rottler SF, F65 and F80 Series machines are supplied standard with Rottler 3/8" IC toolholders fitted to our surfacing heads. Optional 1/2" tool holders are interchangeable with 3/8" toolholders.

**2 1/2" Shell Mill Assembly w/ Tooling:
650-2-25**

REF65A04-01172003



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



Complete Listing of NMTB 40 Taper Shell Mill Arbors:

Part #	Width of Shell Mill Bore
6502-25A	$\frac{3}{4}$ "
650-2-20T	1"
650-2-26A	$1 \frac{1}{4}$ "
650-2-20U	$1 \frac{1}{2}$ "

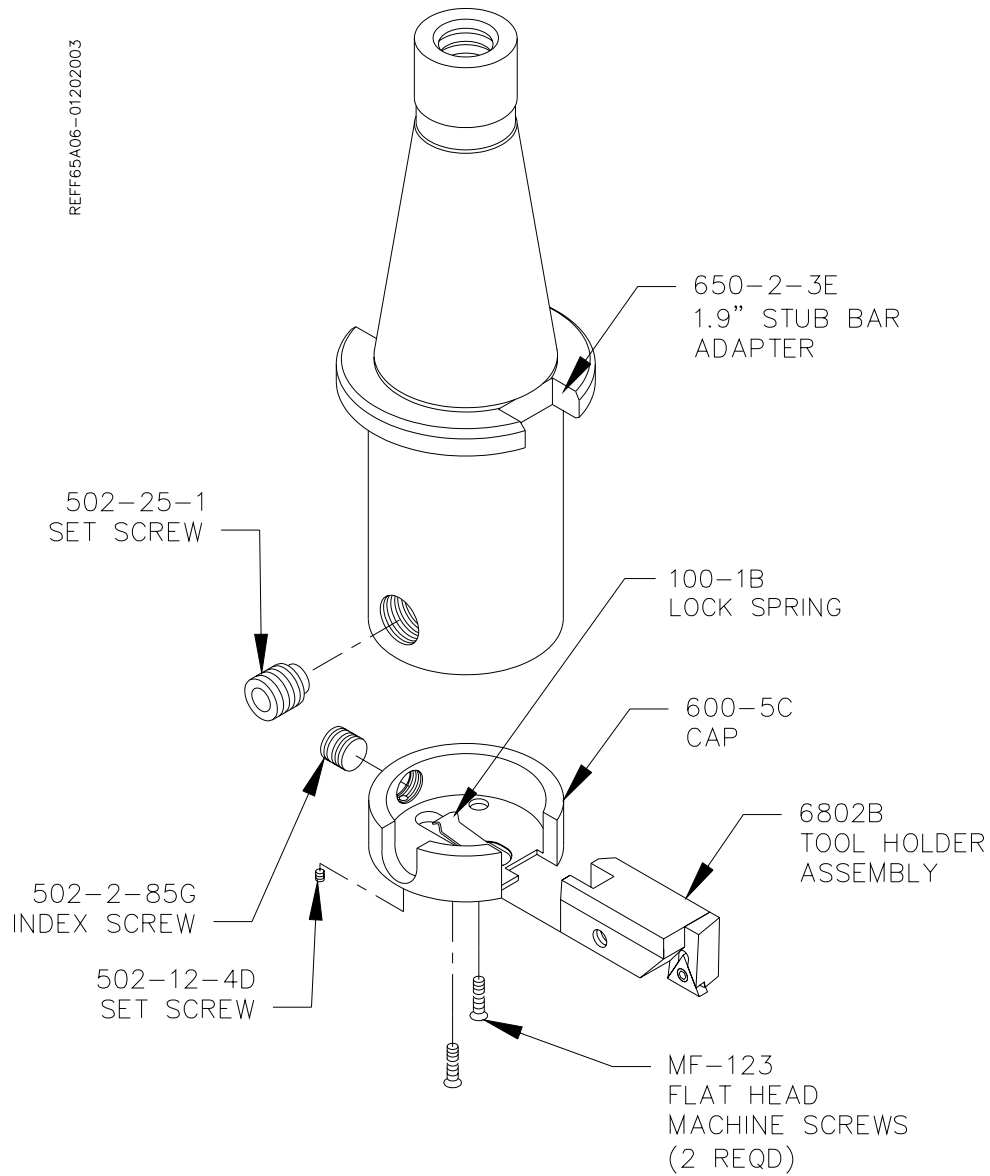
Cam Line Boring Tooling Package:**650-3-43A:**

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

1.9" Cutterhead:

650-2-3F w/ Tooling:

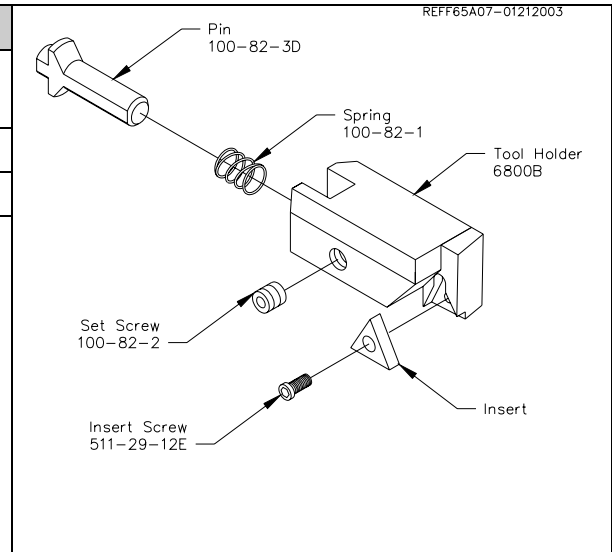
650-2-3G w/o Tooling:



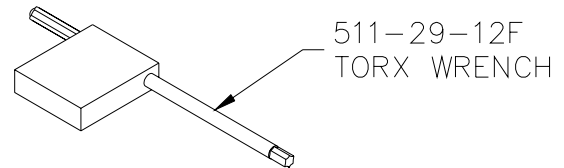
1.9" Cutterhead Standard Tooling:

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

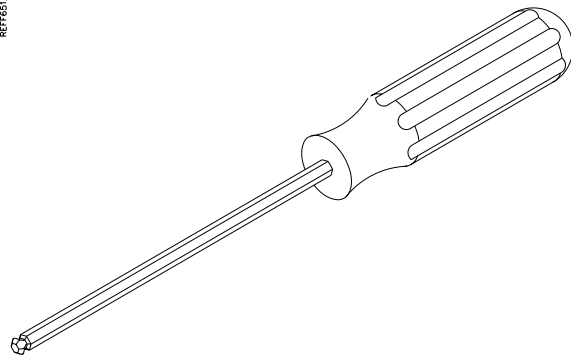
Triangle insert positive rake. 6802C requires a 3/8" IC insert.

**511-29-12F Torx Wrench:**

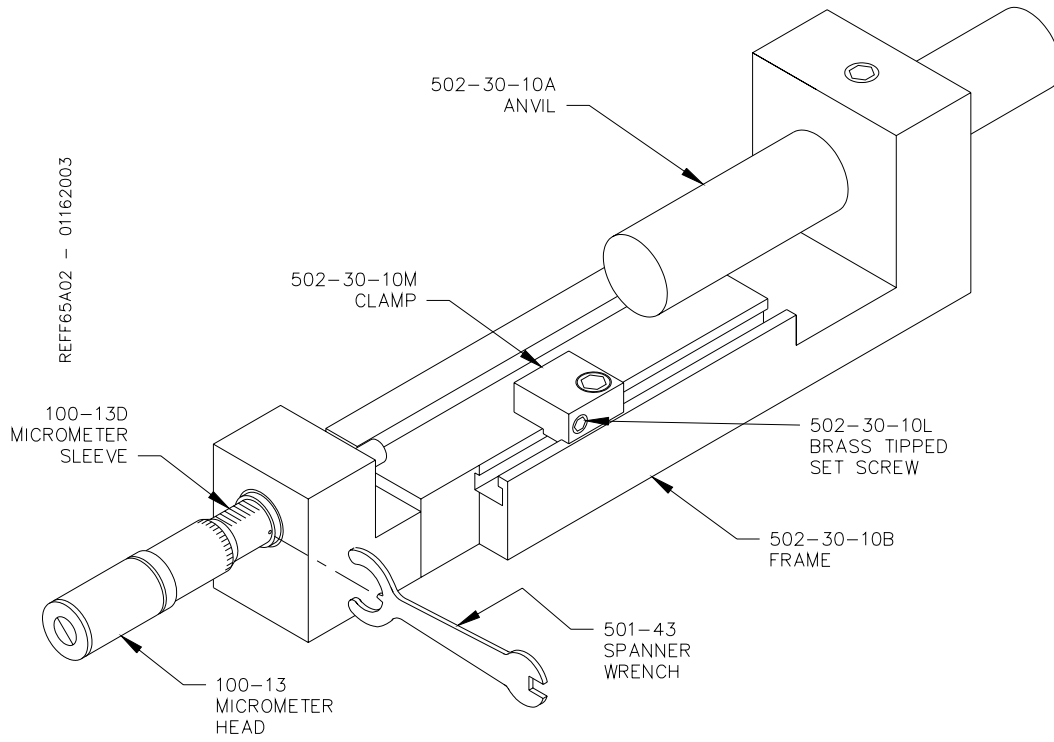
REF65A08-01212003

**501-72A Hex Driver:**

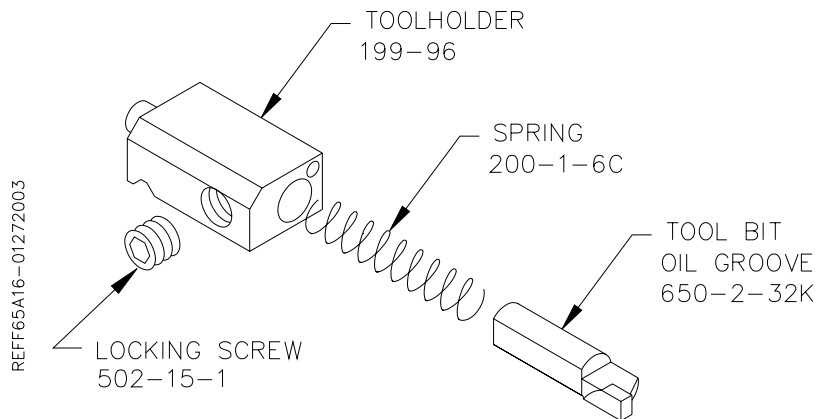
REF65I2-0425000



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



Oil Groove Tooling:



Boring Inserts:

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

Boring Speeds and Feeds:

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

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



$$\text{RPM} = \frac{\text{SFM} \times 3.83}{\text{DIAMETER}}$$

Example:

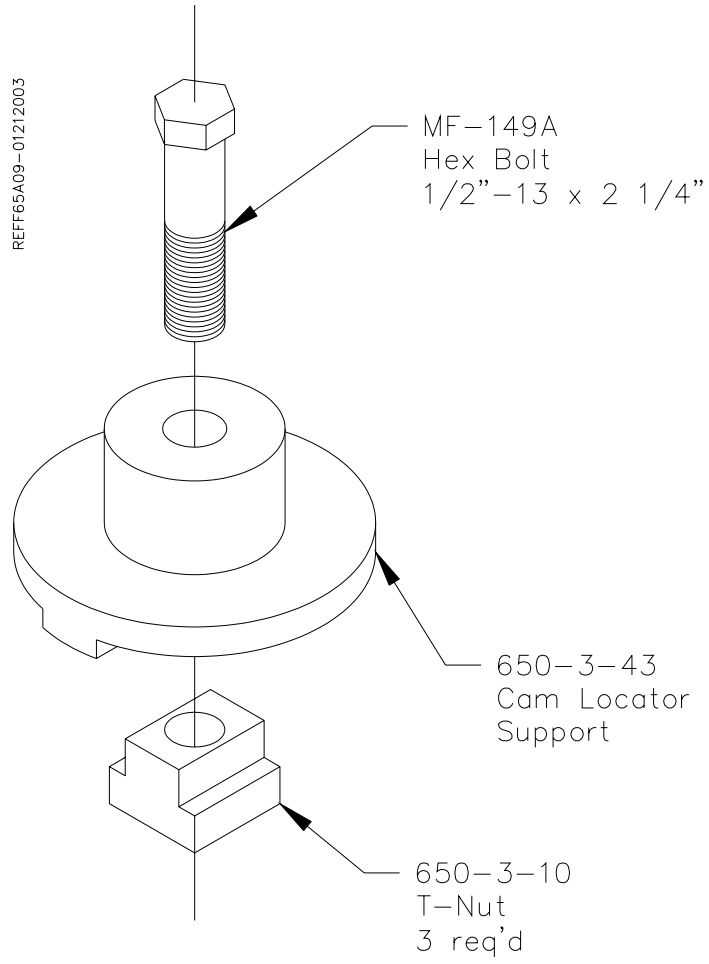
SFM = 800

4.00" Bore

$$800 \times 3.83 = 3064 \text{ Divide by the diameter } 4.00 = 766 \text{ RPM}$$

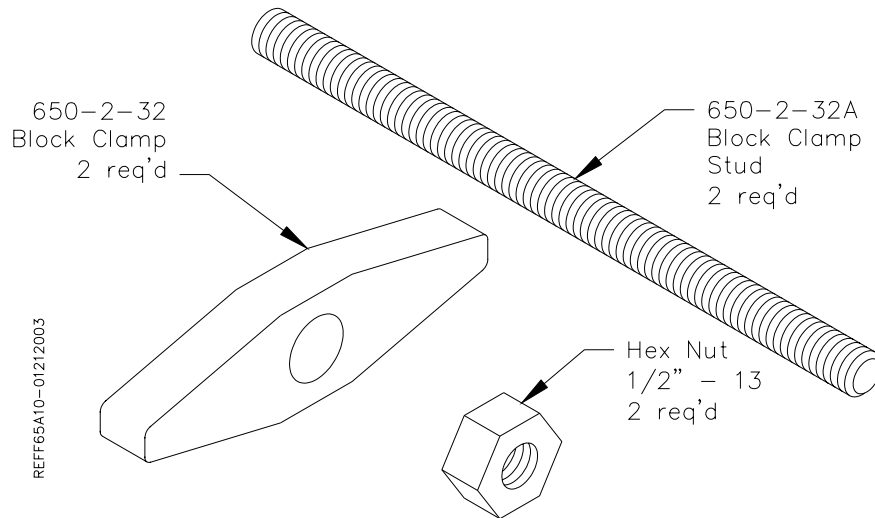
Insert	Part #	Description	Application
	RT211	A 3/8" IC triangular insert with a dark purple ceramic coating and 1/64" cutting radius.	The ceramic coating gives excellent results for both heavy sleeve cutting and finishing of cast iron and nodular cast iron. The 1/64" will minimize the possibility of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

**Cam Locator Support:
650-3-43**

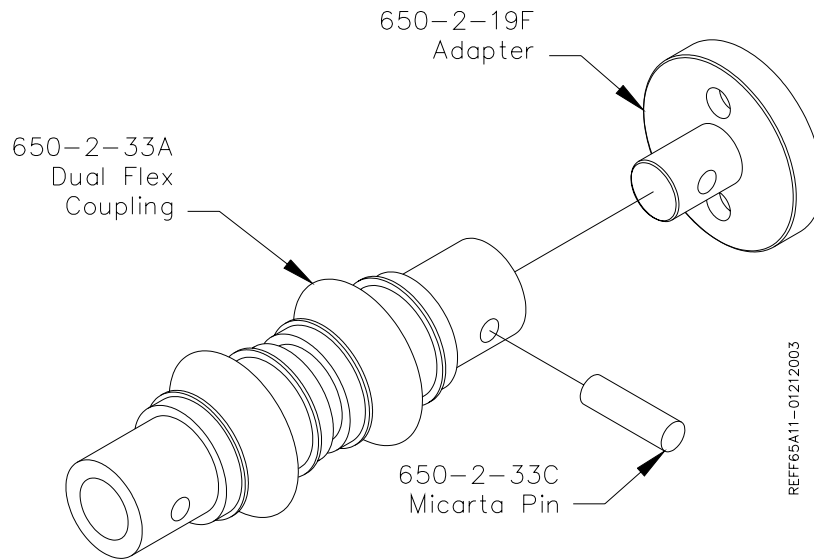


**Block Clamp:
650-2-32**

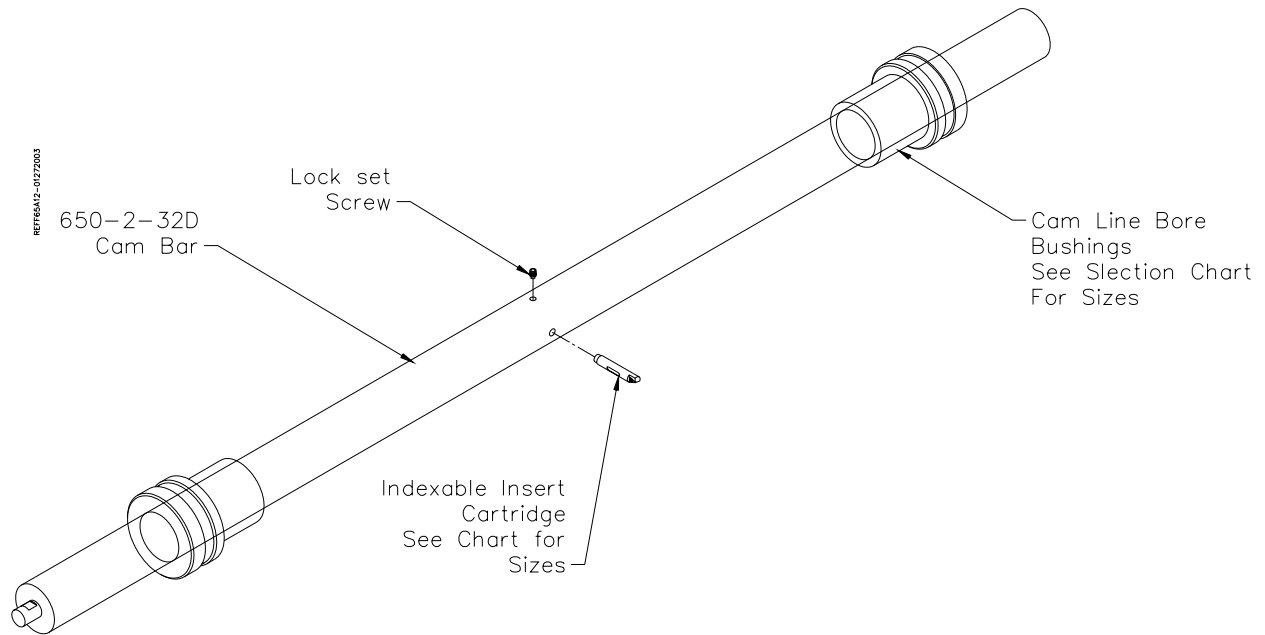
**Block Clamp Stud:
650-2-32A**



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



Cam Line Boring Bar: 650-2-32D

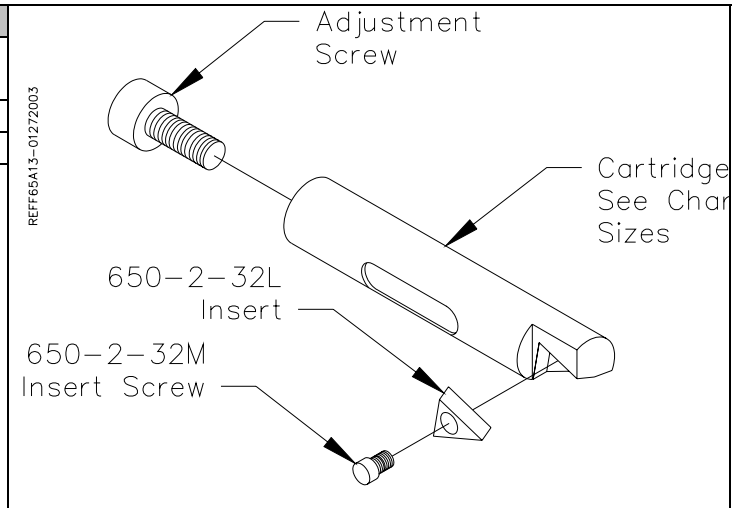
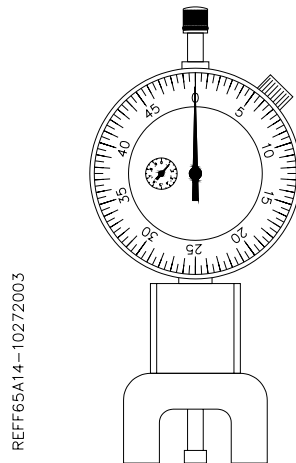


Cam Line Bore Bushings:

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

Cam Line Boring Cartridges:

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

**Tool Setting Indicator:
650-2-33****Wrenches:**