



F80S Series

BORING MACHINE

MACHINE SERIAL NUMBER

OPERATIONS AND MAINTENANCE
MANUAL



MANUFACTURED BY:

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NOTE: WHEN ORDERING REPLACEMENT PARTS,
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:

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

We suggest that the new user of the F80S first read the CONTROL DEFINITIONS to get an idea how the machine operates.

The Operating Instructions chapter should be read in order to familiarize the user with the actual button pushing sequences required to carry out a job. These chapters in the manual should be considered an introduction. As the operators of the F-80S series machines gain experience with using the different functions of the machine, complicated setups and programs will make more sense.

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

Description:

The model F80S machine is a precision, single point boring, and high-speed surfacing unit. The machine can be equipped with tooling and accessories for surfacing and re-boring most American passenger car and truck engines, In-lines, as well as 90 and 60 degree V-types.

F80 machines can be easily tooled, to machine a wide range of engines, including European and Asian engines, also, the machine can be easily adapted to perform other boring and surfacing operations.

The machine is designed, to maintain alignment of cylinder bores, and cylinder head, deck surfaces 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 clamping portable boring bars to the cylinder head surface of 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 resetting 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.

All feeds and rapid travels are power operated and controlled from the control panel.

Limited Warranty:

Rottler Manufacturing Company, Model F80S 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 instructions in this manual.

The factory will repair or replace, at their option, tools proven to be defective.

We accept no responsibility for defects caused by external damage, wear, abuse, or misuse, nor do we accept any obligation to provide compensation for other direct or indirect costs connected to 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 date of installation or set-up by a qualified service technician or sales rep.

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

Safety Information:



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



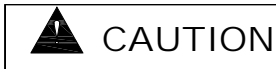
This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



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



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



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



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



This machine is capable of causing severe bodily injury.



Safety Instructions for Machine Use

1. **KEEP GUARDS IN PLACE** and in proper working order.
2. **KEEP WORK AREA CLEAN.** Cluttered areas and benches invite accidents.
3. **KEEP CHILDREN AND VISITORS AWAY.** All children and visitors should be kept a safe distance from work area.
4. **WEAR THE PROPER APPAREL. DO NOT** wear loose clothing, gloves, rings, bracelets, or other jewelry which may get caught in moving parts. Non-Slip foot wear is recommended. Wear protective hair covering to contain long hair.
5. **ALWAYS USE SAFETY GLASSES.** Also use face or dust mask if cutting operation is dusty. Everyday eye glasses only have impact resistant lenses, they are NOT safety glasses.
6. **DO NOT OVER-REACH.** Keep proper footing and balance at all times.

7. **USE THE RECOMMENDED ACCESSORIES.** Consult the manual for recommended accessories. The use of improper accessories may cause risk of injury.
8. **CHECK DAMAGED PARTS.** Before further use of the machine, a guard or other part that is damaged should be checked to determine that it will operate properly and perform its intended function. Check for alignment of moving parts, breakage of parts, mounting, and other conditions that may affect its operation. A guard or other part that is damaged should be properly repaired or replaced.
9. **NEVER OPERATE A MACHINE WHEN TIRED, OR UNDER THE INFLUENCE OF DRUGS OR ALCOHOL.** Full mental alertness is required at all times when running a machine.
10. **NEVER ALLOW UNSUPERVISED OR UNTRAINED PERSONNEL TO OPERATE THE MACHINE.** Make sure any instructions you give in regards to machine operation are approved, correct, safe, and clearly understood.
11. **IF AT ANY TIME YOU ARE EXPERIENCING DIFFICULTIES** performing the intended operation, stop using the machine! Then contact our service department or ask a qualified expert how the operation should be performed.

**CAUTION**

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

Electrical Power:

**DANGER**

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

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

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

**WARNING**

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

**CAUTION**

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

**CAUTION**

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



The F80S operates under computerized control and, as is all computerized equipment, and is susceptible to extraneous electrical impulses internally for externally produced. The machine may make moves out of the operator control at any time. The operator should work in and around the machine with caution at all times.

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

Make sure all electrical equipment has the proper overload protection. The F80S should have **a fully isolated** power supply to prevent damage and uncontrolled movement of the machine. If the F80S 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 F80S 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 F80S.

Machine Operator:

The operator of the F80S should be a skilled machinist craftsman who is well versed in the caution, care, and knowledge required to safely operate metal cutting tools.

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

The F80S machines have the following areas of exposed moving parts that you must train yourself to respect and stay away from when they are in motion:



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



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



Work Loading and Unloading – Carefully develop handling methods of loading and unloading work pieces so that no injury can result if hoist equipment or lift connection should fail. Periodically check lift components for damage that may cause failure of Block Handler Assembly. Lifting Eye can eventually fail if the eye is reset in line with the 502-1-80 lift channel. **Eye must be at a right angle.**



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

Emergency Procedure:

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

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

Find out what the problem is; return the spindle to its up position without causing more damage. To restart the machine, turn the Emergency Stop Button CW until the button pops out. Make sure the button has been depressed 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 this machine will depend a great deal on its proper initial installation. Pay particular attention to the means by which work pieces are lifted into the machine as well as the material handling to and from other operations in your shop.

The proper loading arrangement and area location for your F80S machine is extremely important.

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

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

Unpacking:

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

Remove the toolbox, parallels and optional equipment from the machine. Completely clean these articles as well as the rest of the machine with solvent. Rust inhibitor was applied, at the time of shipment. Any of this left on the machine, will allow cast iron dust to collect in that area, which could cause premature wear.

Column Hold Down:

The machine was shipped with the column held in place with chains and turnbuckles to the Main bed. Do not attempt to move the machine under power until these restraints have been removed.

Leveling:

Located in the bottom of the main base are the leveling and tie down screws. If care is taken, the main base can be leveled extremely accurately. Start by placing the jacking pads under the jacking screws. Adjust the jacking screws so the lowest point of the main base is at least 1/4" off the jacking pad. Make sure all the jacking screws are touching their jacking pads. Use a precision machinist's level, and check the base at several points to get an idea where the high and low spots are, adjust evenly where necessary. Start with the back way surface. With your precision level, level the back way in the lengthwise direction to .0005" per foot. Take the readings approximately mid way between the jacking points.

Use a precision metal support to span the distance between the front and rear parallels. (Support must be parallel within .0005" in its length). Take readings over every jacking bolt and level within .0005" over the length of the base. Be sure to use the jacking points down the middle of the main base.

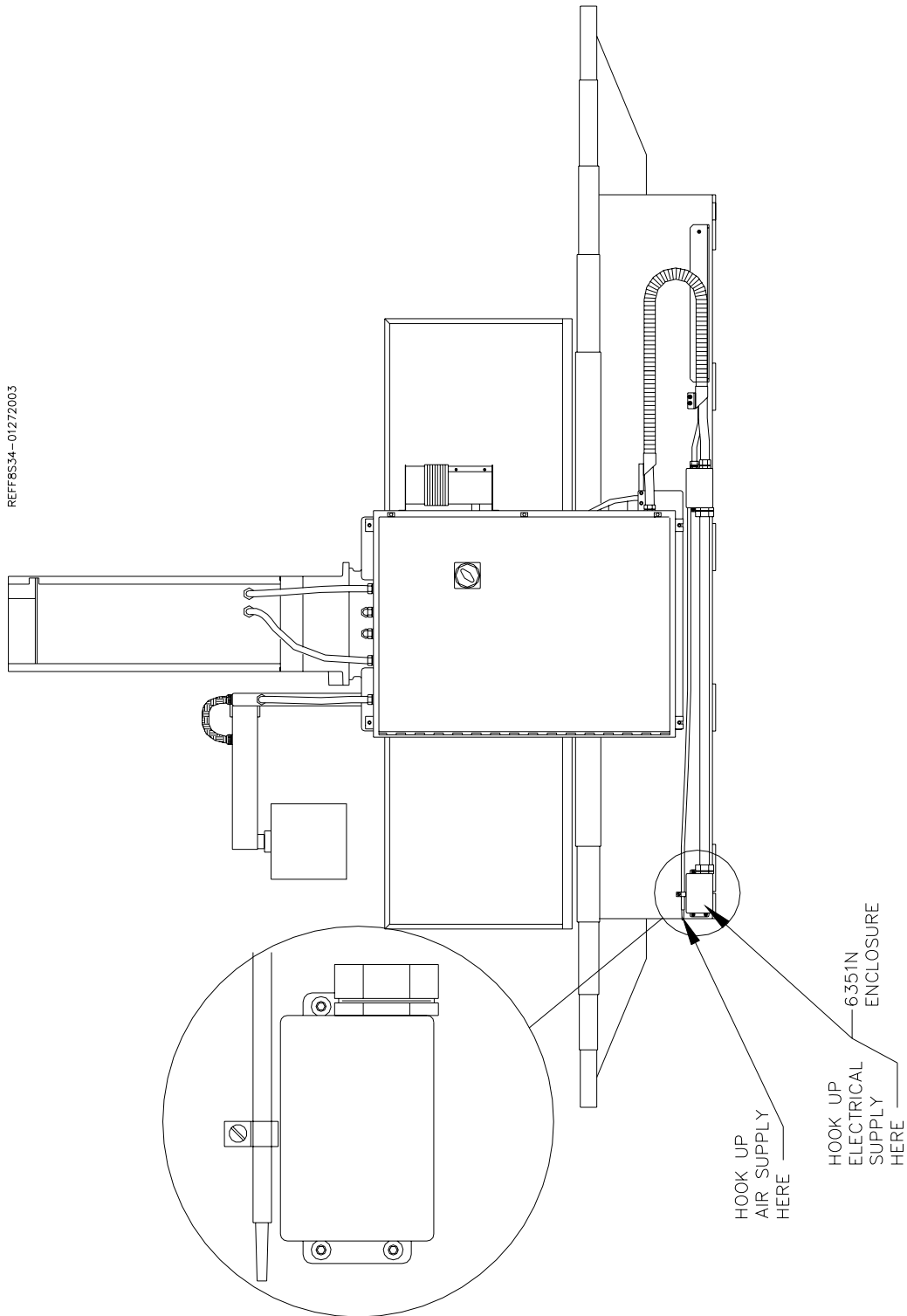
Recheck the way surfaces for level. Now check the machine table. Using the front jacking screws level the table within .0005" in both directions.

Be sure that all jacking bolts have approximately equal weight on them. As you go leveling the base snug the tie down bolts to help hold the main base in place. Recheck all areas of the main base for level.

Air Supply:

It is very important the air source for the F80S machine be moisture free. Water and oil in the line will result in early cylinder and valve failure. The factory recommends installing a water trap at the machine.

Attach a 100 P.S.I. air source to the appropriate intake in the small enclosure located on the left rear of the machine near the bottom.



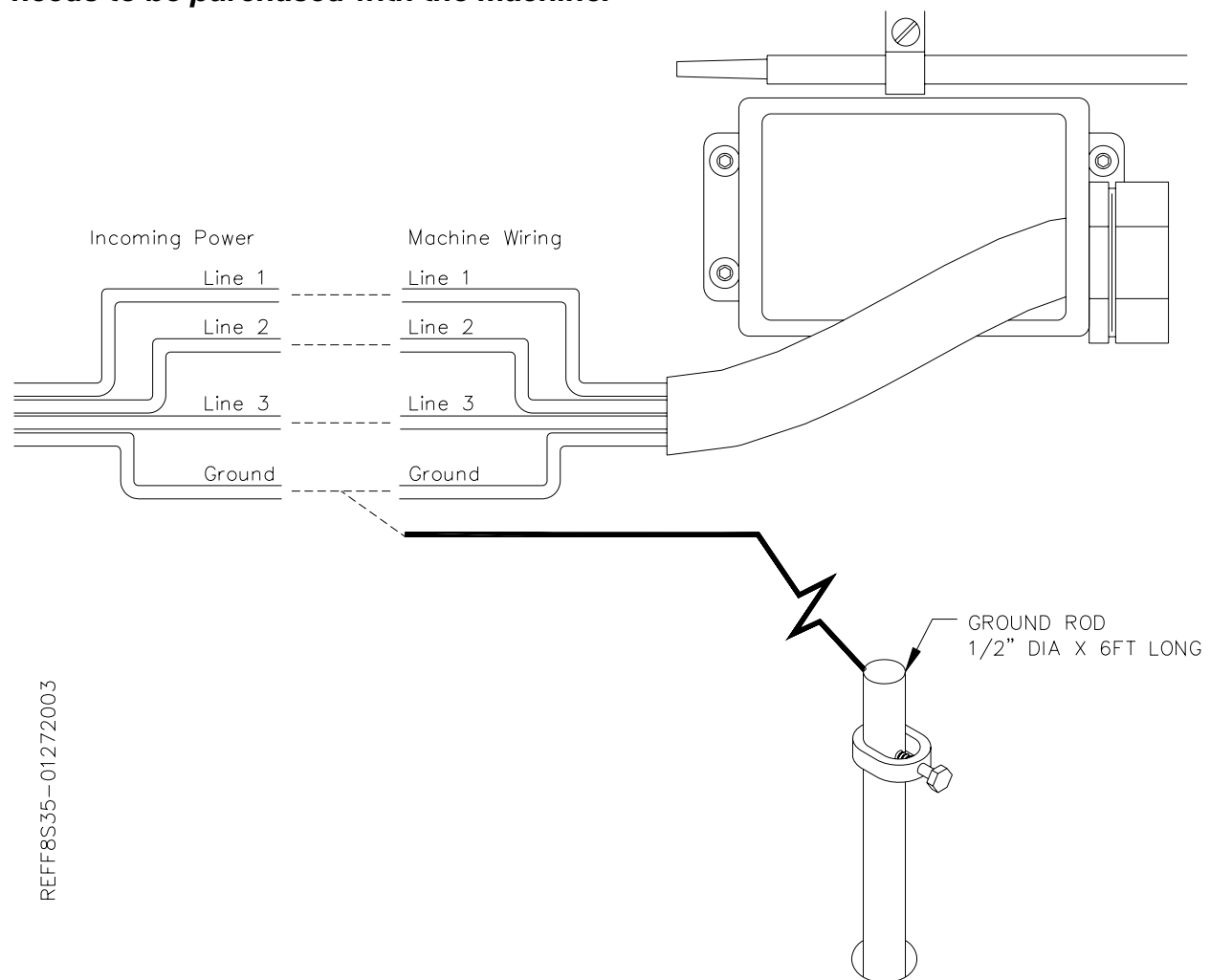
Power Supply:

This machine has the following power requirements:

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

See illustration below for correct connection of “measured” incoming power. Connect three phase wiring to the electrical box located on the back of the machine in the lower right hand corner. See previous illustration. **Important: Electrically connect in accordance with national and local electrical codes.**

Note: For voltages over 240 VAC (380 – 440 VAC) a factory supplied transformer needs to be purchased with the machine.

**Grounding:**

This machine must be connected to a good earth ground rod. A 6 foot, ½" diameter, 15 OHM, Copper grounding rod driven into the earth next to the machines is preferred. Not providing a grounding rod could void factory warranty.

F84S Customer Responsibility prior to arrival of Rottler Technician:

Remove machine from truck. Weight: F84 is 12,000 lbs.

Provide foundation and hold down bolt system. A selection of recommended fasteners is included in this packet along with the plans for the approved foundation.

Open the door on the spindle base. There are two threaded rods going through the spindle base to the deck. Remove the rods and the nuts from the machine.

Remove fixturing and misc. from machine and clean.

Install machine on foundation with jack pads under jacking bolts.

Install hold down nuts and bolts.

Rough level machine.

Connect electricity, (3 phase, 208 to 240 VAC with a 60 amp breaker and an isolated ground) to machine.

Connect air supply of proper pressure and capacity (95/100 PSI, 3 C.F.M) to machine. (Note: air supply must be free from water and oil as this will damage electrical and air components.)

Customer should attempt to have junk work piece for operator training.

Operator should read the manual before training begins.

Fill out customer portion of the checklist in this packet to properly qualify warranty on the equipment.

The following are approved methods to install the spindle base when required:

1. Check column top and spindle base bottom for rust and nicks if spindle must be installed; Clean and stone as required.
2. When lifting spindle unit, keep in mind the front to back center of gravity is located Approximately 12 inches from the front end and has a tendency to fall forward.
3. Install spindle unit on column, if required, using one of the methods below (Spindle unit Weighs 1,800 lbs.)

Using overhead bridle with chains.

Connect three chains, one at rear of spindle base and one each on front right and left side. Use a chain or rope to connect the right and left chains at the top of the spindle unit to prevent the spindle unit from falling forward.

Be careful to watch clearance of all items.

Lift spindle unit into place.

Install spindle clamp nuts before lifting is removed.

Remove lifting device.

Using fork lift angle iron brackets.

Bolt brackets to each side of spindle base and use a forklift to lift spindle unit on to column.

Be careful to watch clearance of all items.

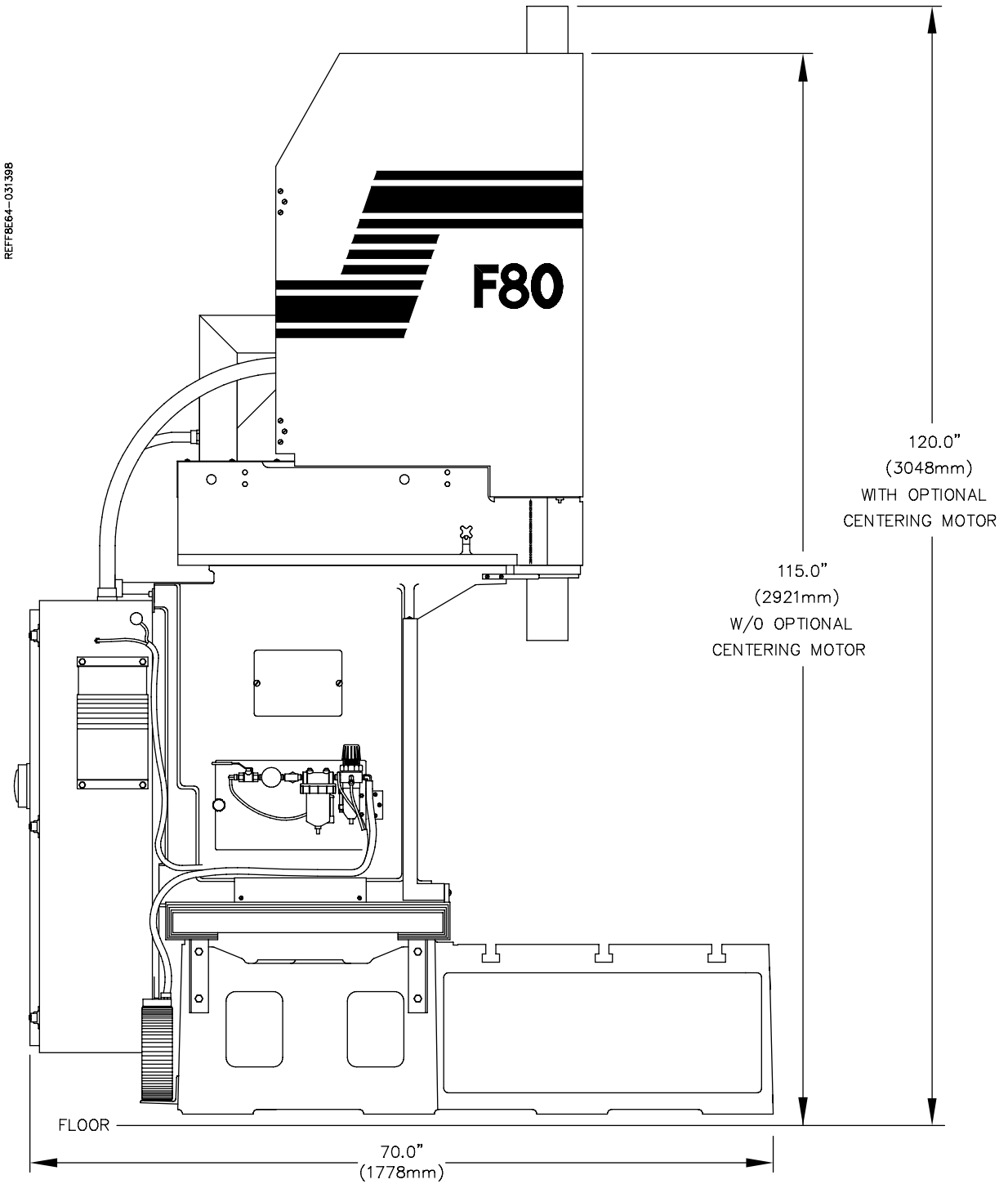
Lift spindle unit into place.

Install spindle clamp nuts before lifting is removed.

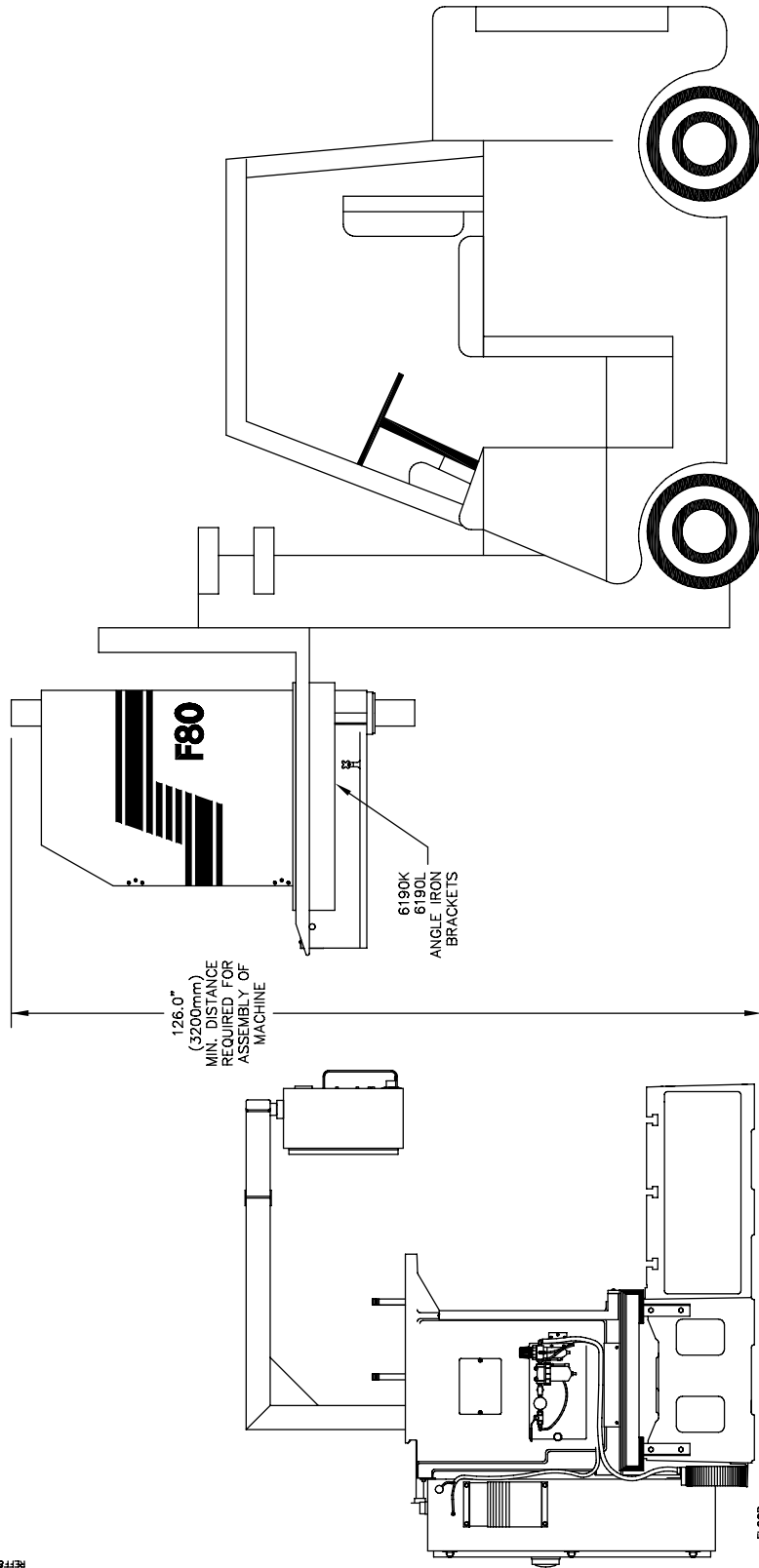
Remove lifting device.

Note: Under extreme height restrictions, the cover, centering motor, and mounting plate can be removed to gain an extra 8 inches of clearance. However, they must be reinstalled prior to machine startup.

F84S Clearance Heights:

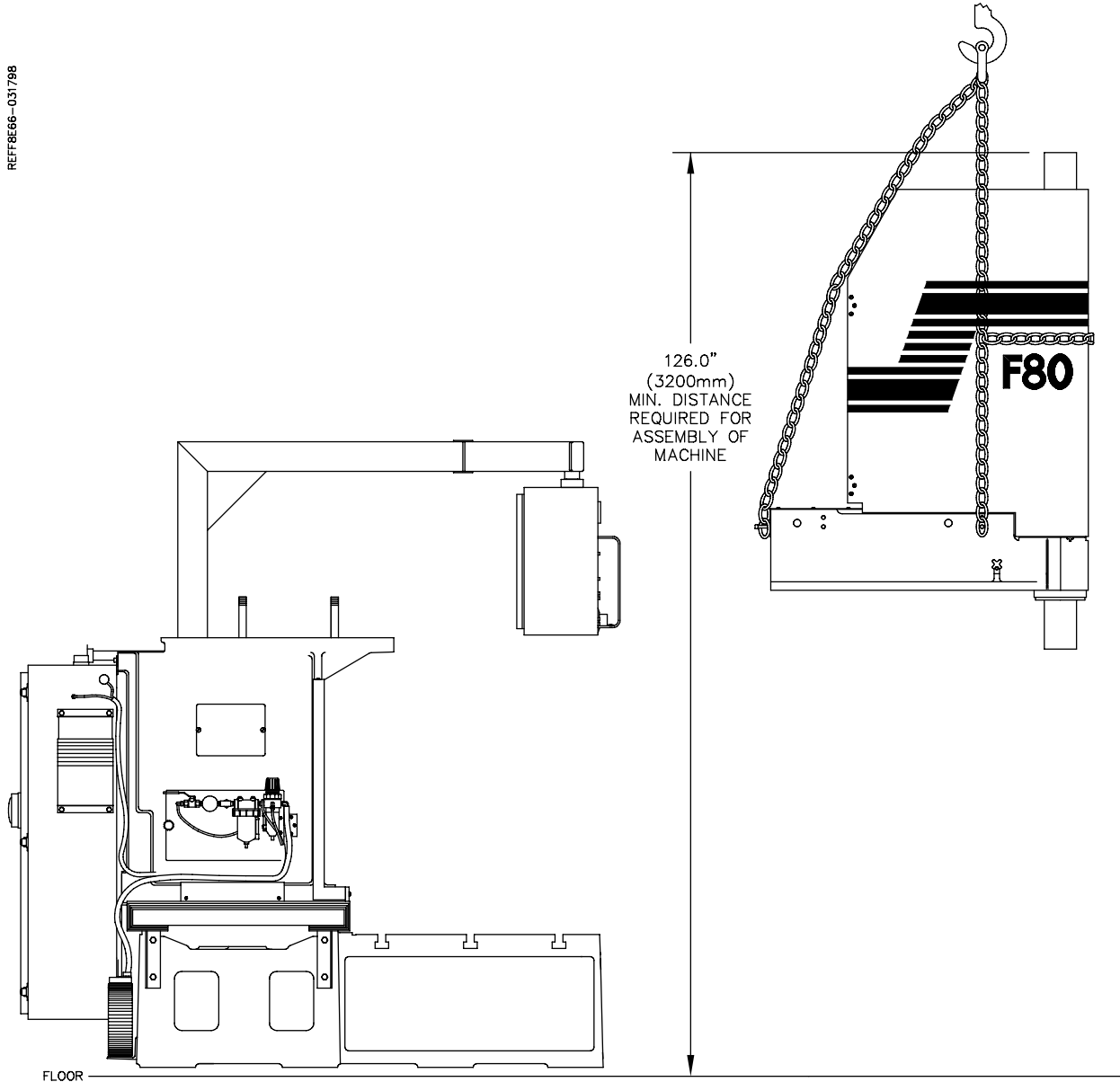


F84S Using Fork Lift Angle Iron Brackets:

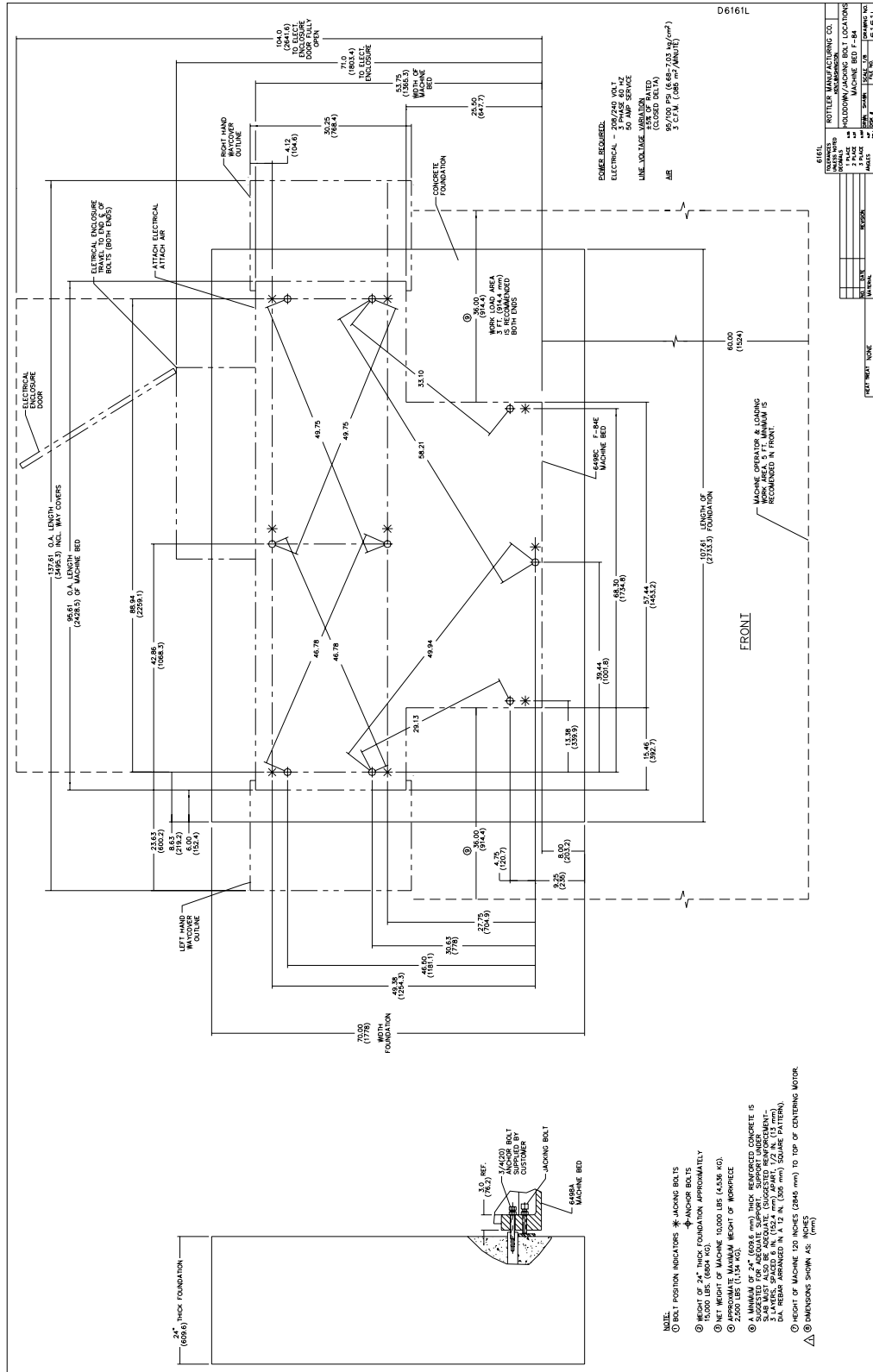


F84S Using Overhead Bridal with Chains:

REF F8E66-031788



F84S Hold-down / Jacking Bolt Locations:



F85S Customer Responsibility prior to arrival of Rottler Technician:

Remove machine from truck. Weight: F84 is 13,000 lbs.

Provide foundation and hold down bolt system. A selection of recommended fasteners is included in this packet along with the plans for the approved foundation.

Open the door on the spindle base. There are two threaded rods going through the spindle base to the deck. Remove the rods and the nuts from the machine.

Remove fixturing and misc. from machine and clean.

Install machine on foundation with jack pads under jacking bolts.

Install hold down nuts and bolts.

Rough level machine.

Connect electricity, (3 phase, 208 to 240 VAC with a 60 amp breaker and an isolated ground) to machine.

Connect air supply of proper pressure and capacity (95/100 PSI, 3 C.F.M) to machine. (Note: air supply must be free from water and oil as this will damage electrical and air components.)

Customer should attempt to have junk work piece for operator training.

Operator should read the manual before training begins.

Fill out customer portion of the checklist in this packet to properly qualify warranty on the equipment.

The following are approved methods to install the spindle base when required:

1. Check column top and spindle base bottom for rust and nicks if spindle must be installed; Clean and stone as required.
2. When lifting spindle unit, keep in mind the front to back center of gravity is located Approximately 12 inches from the front end and has a tendency to fall forward.
3. Install spindle unit on column, if required, using one of the methods below (Spindle unit Weighs 1,800 lbs.)

Using overhead bridle with chains.

Connect three chains, one at rear of spindle base and one each on front right and left side. Use a chain or rope to connect the right and left chains at the top of the spindle unit to prevent the spindle unit from falling forward.

Be careful to watch clearance of all items.

Lift spindle unit into place.

Install spindle clamp nuts before lifting is removed.

Remove lifting device.

Using fork lift angle iron brackets.

Bolt brackets to each side of spindle base and use a forklift to lift spindle unit on to column.

Be careful to watch clearance of all items.

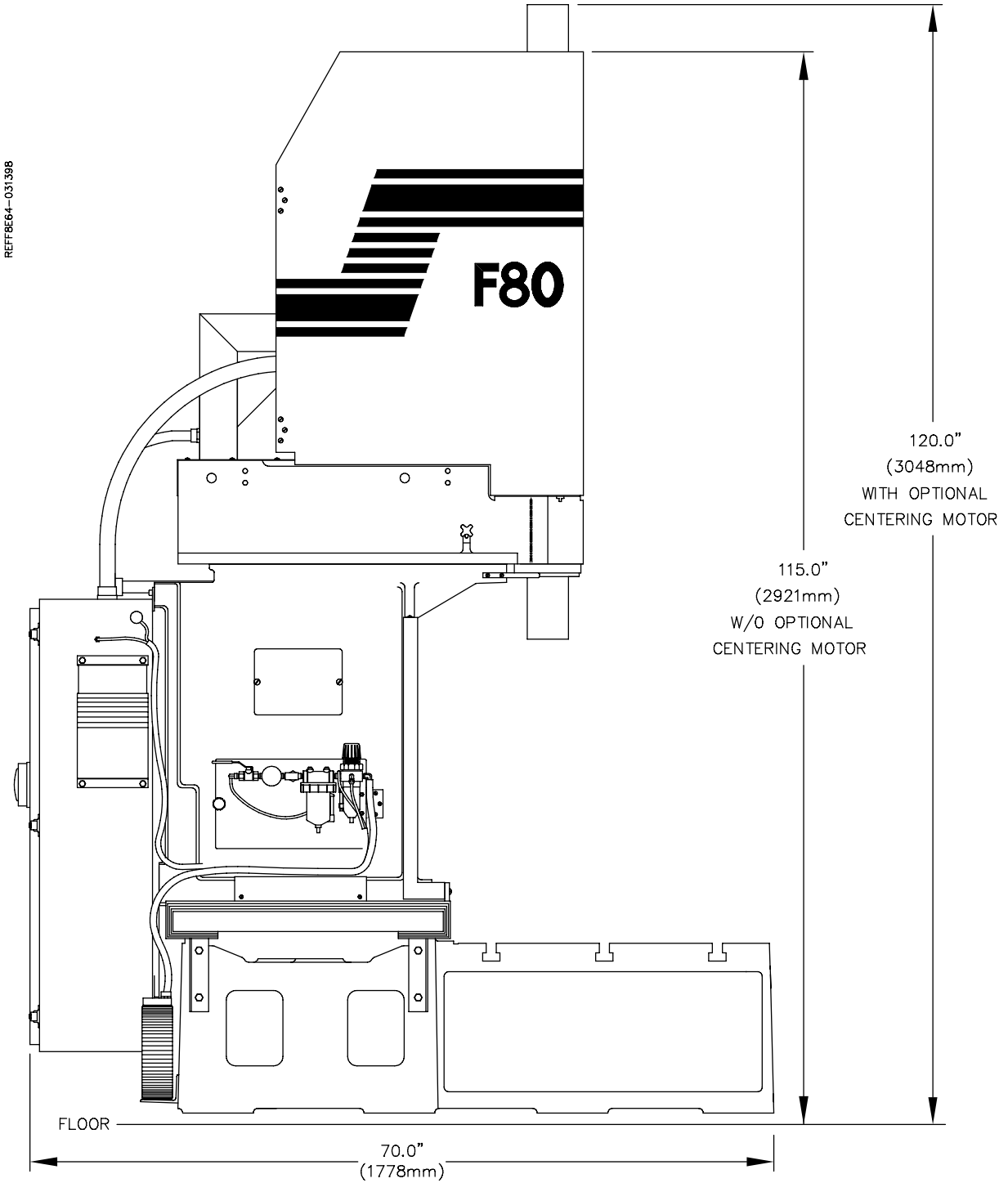
Lift spindle unit into place.

Install spindle clamp nuts before lifting is removed.

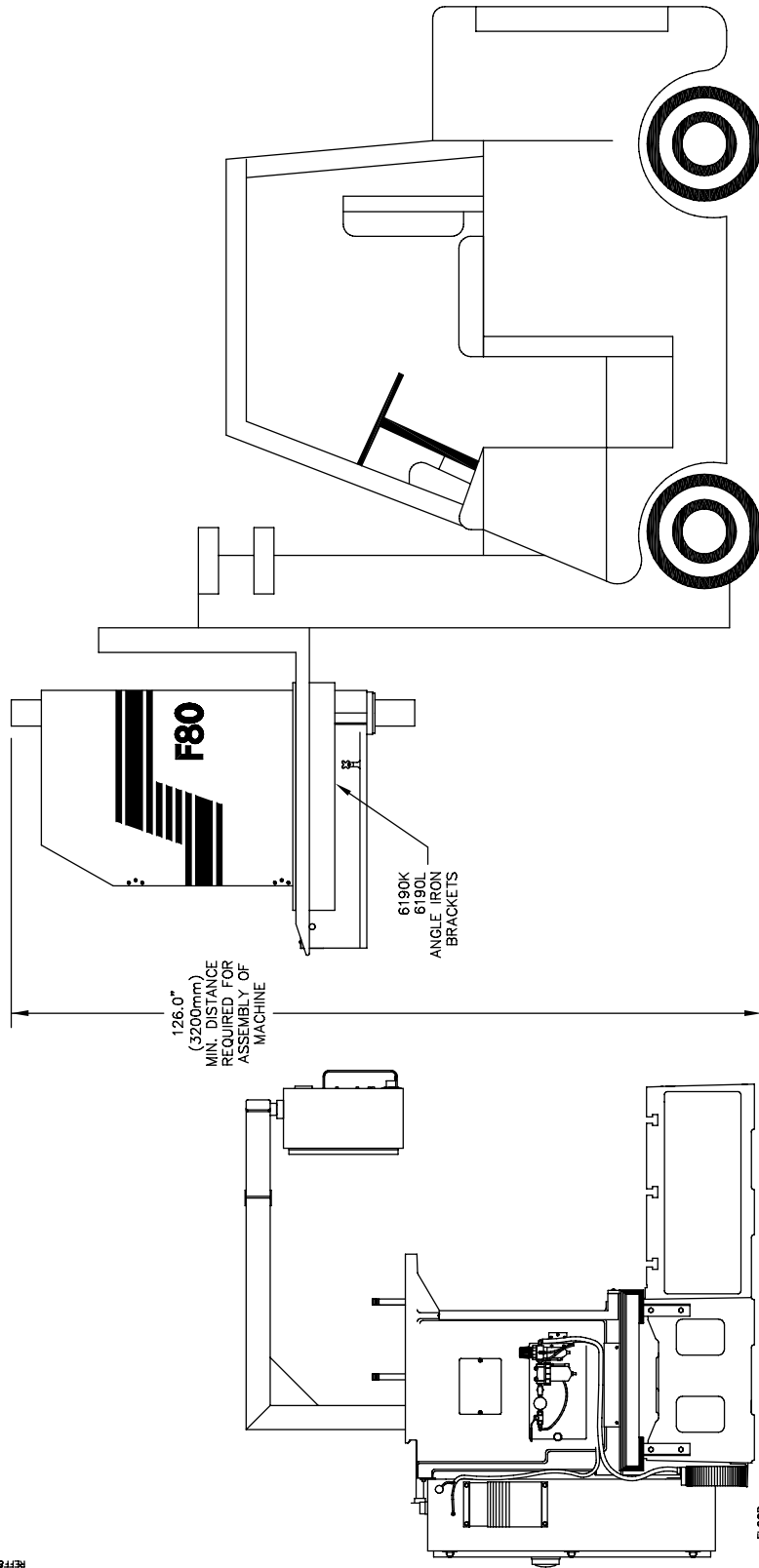
Remove lifting device.

Note: Under extreme height restrictions, the cover, centering motor, and mounting plate can be removed to gain an extra 8 inches of clearance. However, they must be reinstalled prior to machine startup.

F85S Clearance Heights:

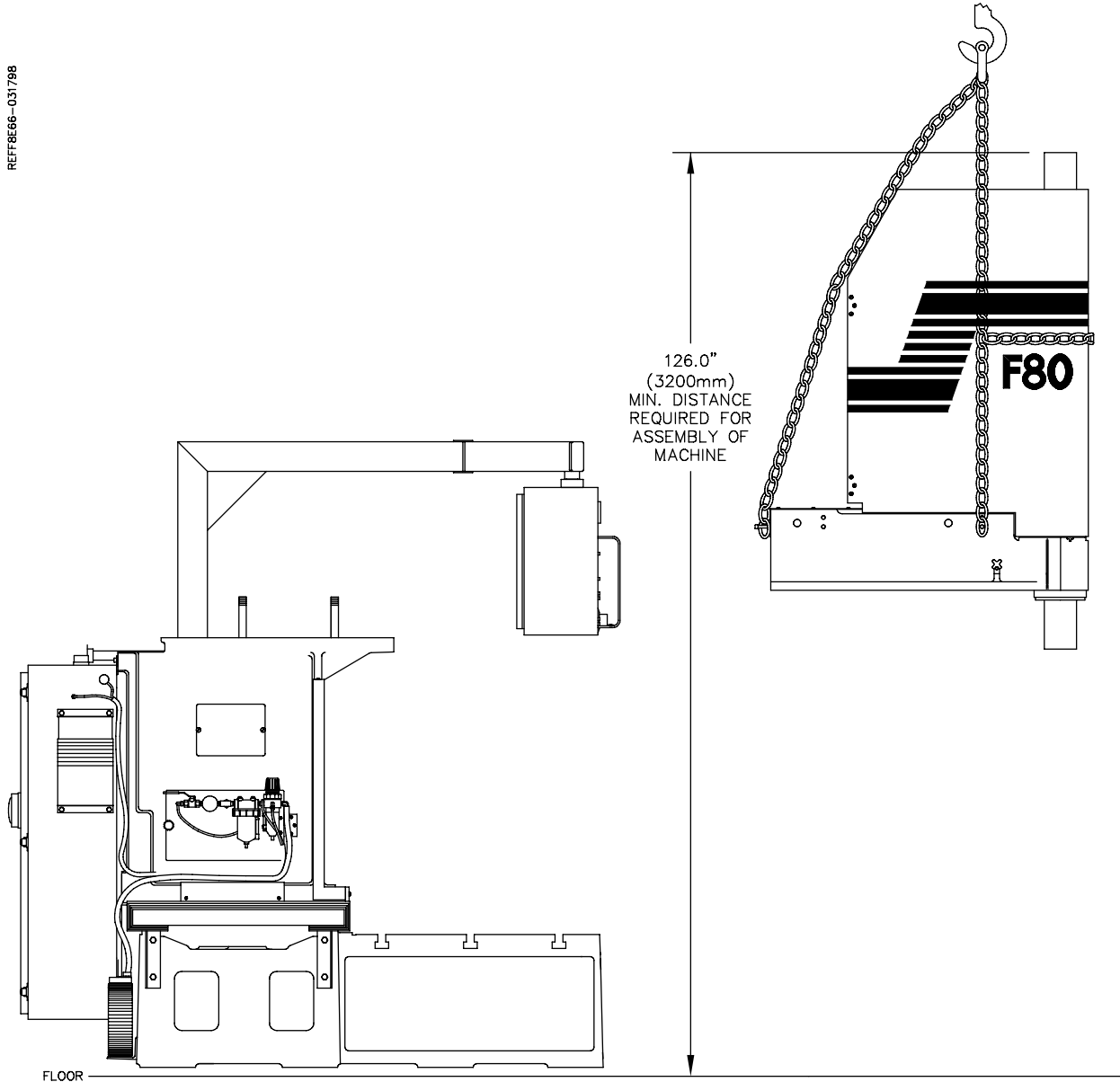


F85S Using Fork Lift Angle Iron Brackets:

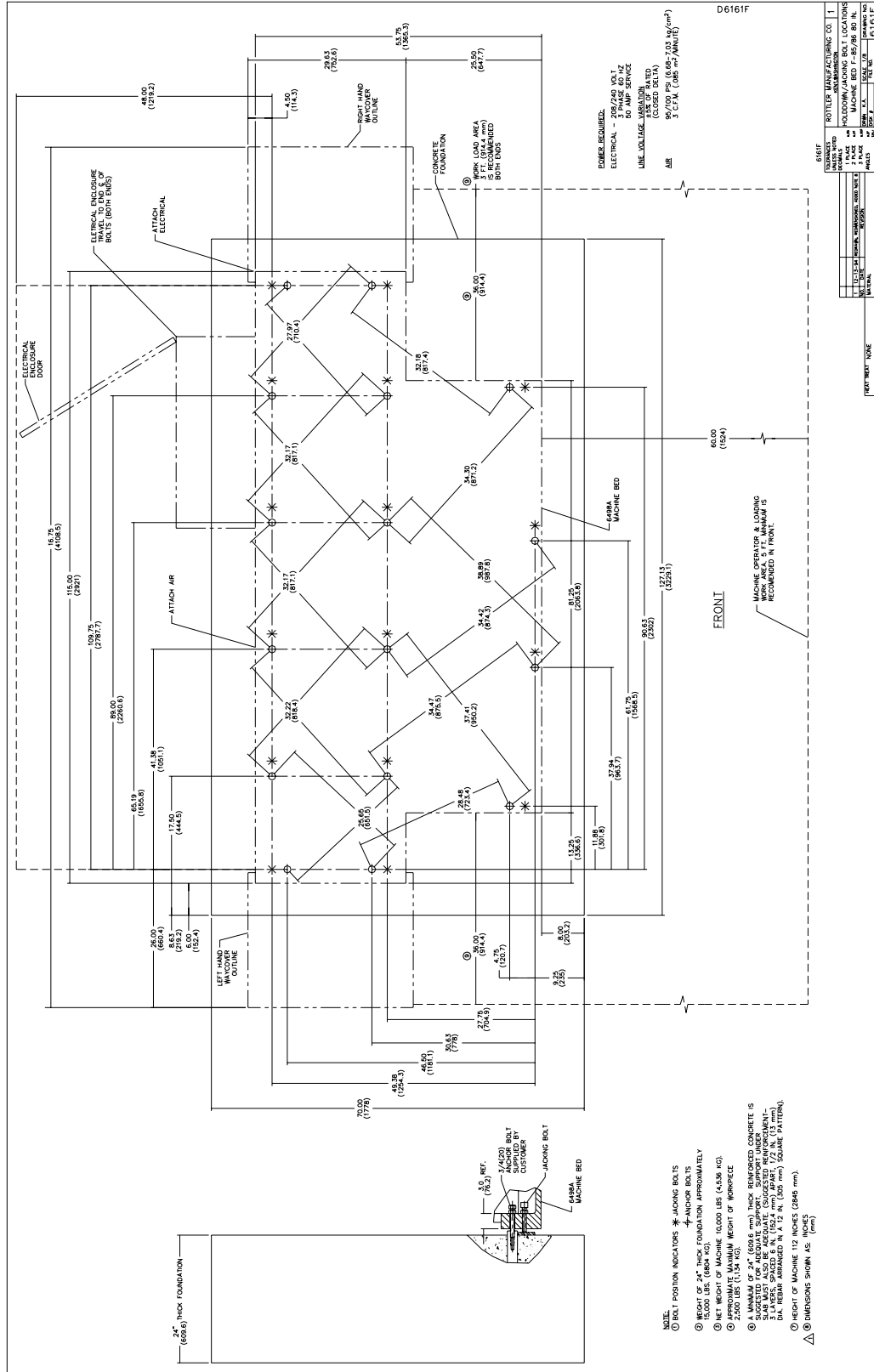


F85S Using Overhead Bridal with Chains:

REF F8566-031788



F85S Hold-down / Jacking Bolt Locations:



F88S Customer Responsibility prior to arrival of Rottler Technician:

Remove machine from truck. Weight: F84 is 15,000 lbs.

Provide foundation and hold down bolt system. A selection of recommended fasteners is included in this packet along with the plans for the approved foundation.

Open the door on the spindle base. There are two threaded rods going through the spindle base to the deck. Remove the rods and the nuts from the machine.

Remove fixturing and misc. from machine and clean.

Install machine on foundation with jack pads under jacking bolts.

Install hold down nuts and bolts.

Rough level machine.

Connect electricity, (3 phase, 208 to 240 VAC with a 60 amp breaker and an isolated ground) to machine.

Connect air supply of proper pressure and capacity (95/100 PSI, 3 C.F.M) to machine. (Note: air supply must be free from water and oil as this will damage electrical and air components.)

Customer should attempt to have junk work piece for operator training.

Operator should read the manual before training begins.

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Using overhead bridle with chains.

Connect three chains, one at rear of spindle base and one each on front right and left side. Use a chain or rope to connect the right and left chains at the top of the spindle unit to prevent the spindle unit from falling forward.

Be careful to watch clearance of all items.

Lift spindle unit into place.

Install spindle clamp nuts before lifting is removed.

Remove lifting device.

Using fork lift angle iron brackets.

Bolt brackets to each side of spindle base and use a forklift to lift spindle unit on to column.

Be careful to watch clearance of all items.

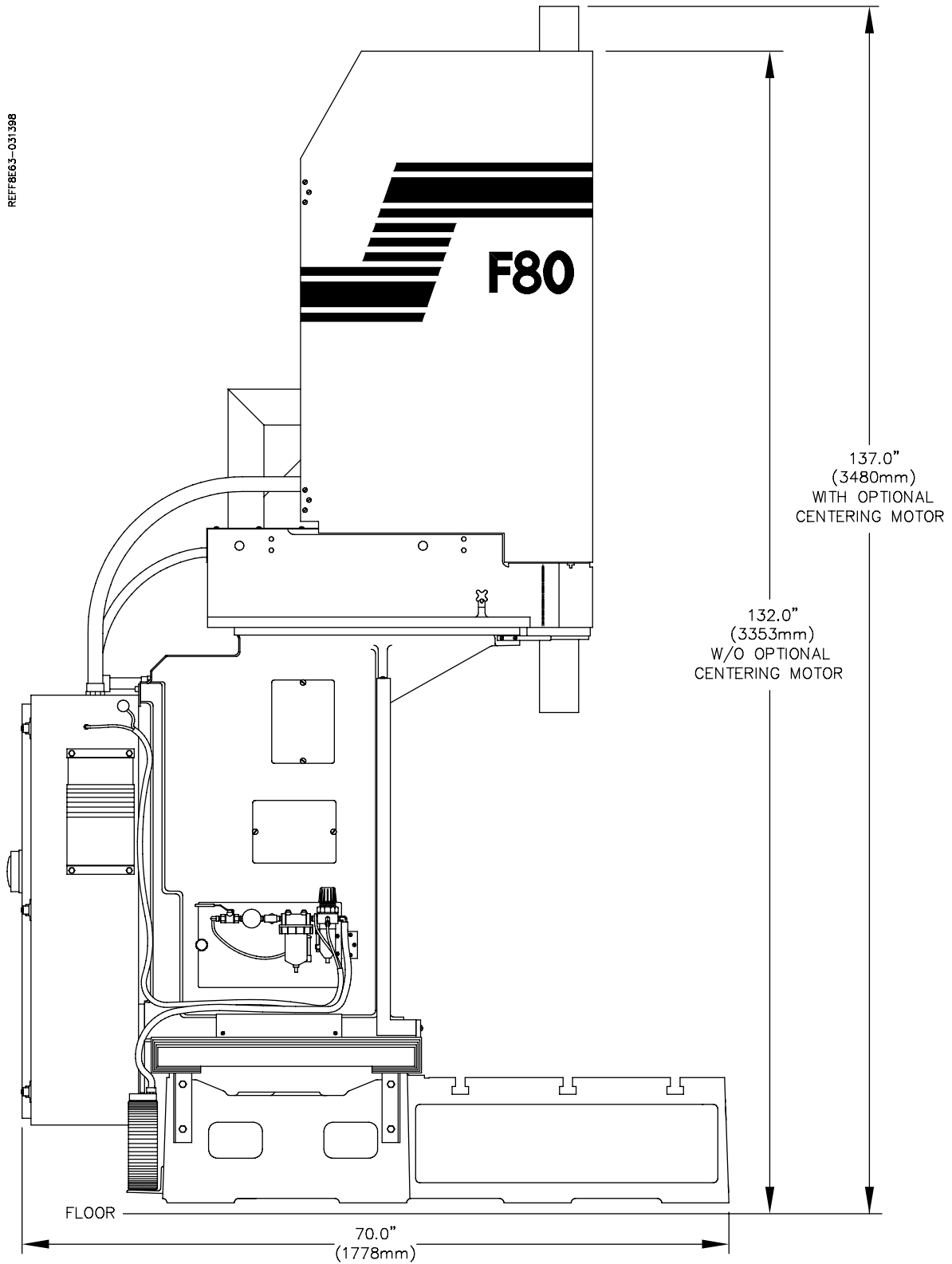
Lift spindle unit into place.

Install spindle clamp nuts before lifting is removed.

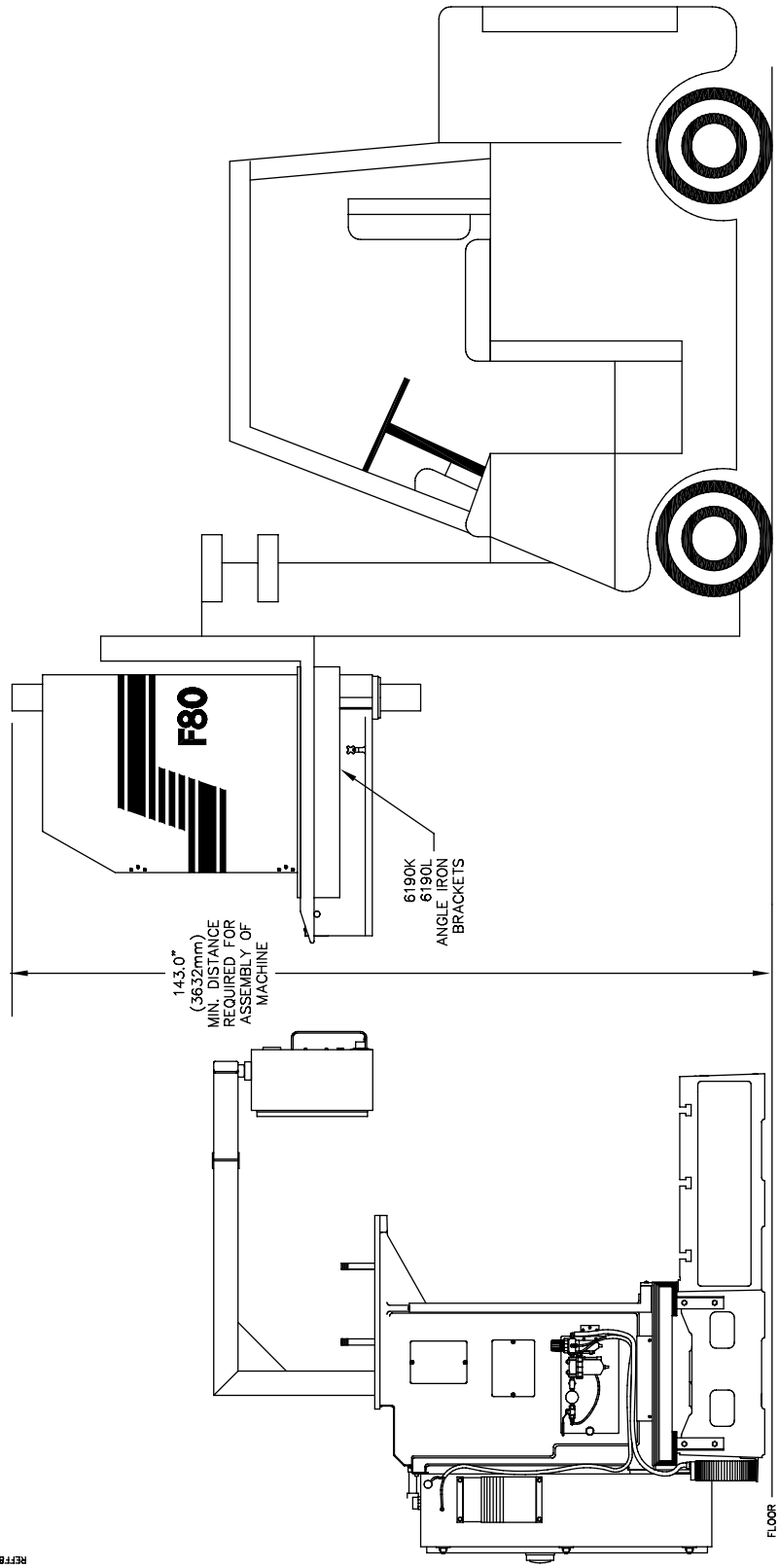
Remove lifting device.

Note: Under extreme height restrictions, the cover, centering motor, and mounting plate can be removed to gain an extra 8 inches of clearance. However, they must be reinstalled prior to machine startup.

F88S Clearance Heights:



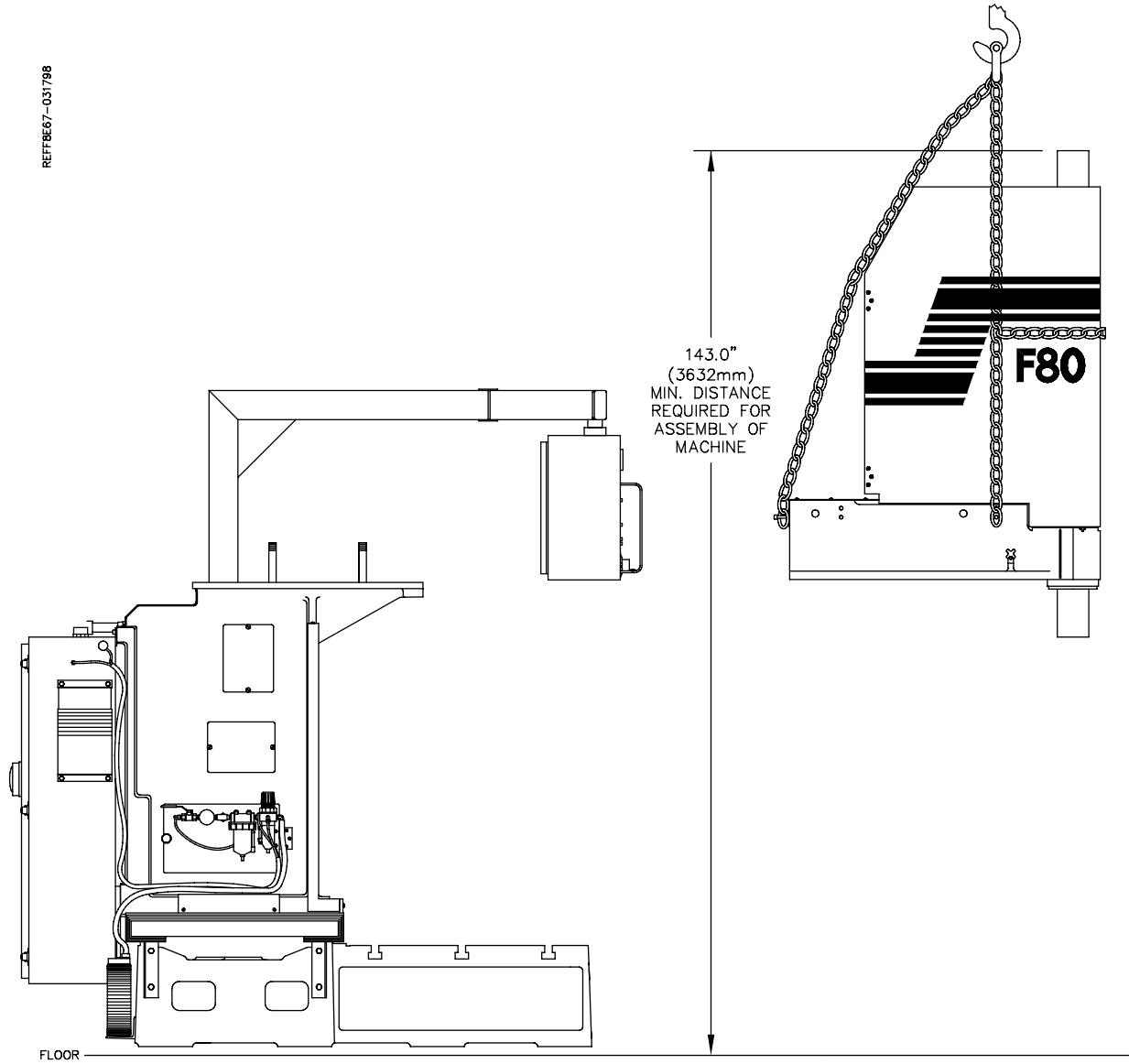
F88S Using Fork Lift Angle Iron Brackets:



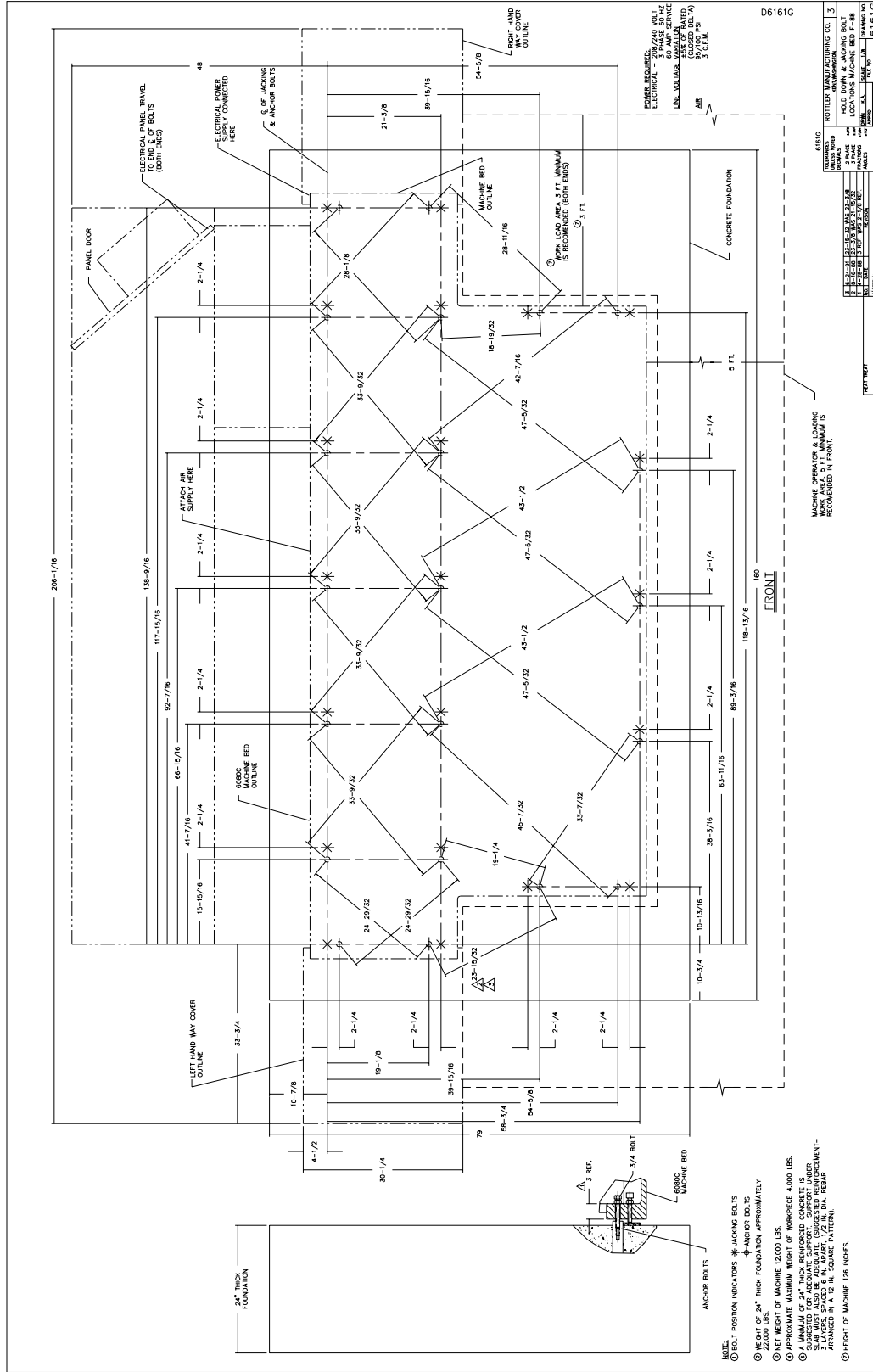
REF: BE66-031798

F88S Using Overhead Bridal with Chains:

REFFB67-031798



F88S Hold-down / Jacking Bolt Locations:



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.

Building and using programs is covered in the Operating Instructions chapter of this manual.

Controller Definition:

The F80S Series machine is under full Computerized Numeric Control. The control is located in the main rear electrical enclosure. Contact the factory before tampering with the control in this machine. Tampering with the controller will void the factory warranty on the machine.

Master Power On/Off Switch:

This switch is located on the Main rear electrical enclosure on the right hand side. When the machine is first turned on it will take several moments for the controller to boot up and run through the start up sequence. Once the machine is turned off you **MUST** wait at least a minute for all the drives to power down. If you do not, the machine will not run. **NEVER** turn power to the machine off in the Mill mode. The machine will restart automatically in the Bore mode but the spindle base will be tilted .0003 for Milling still.

This switch must be turned off to open the electrical enclosure door.

Power Draw Bar Switch:

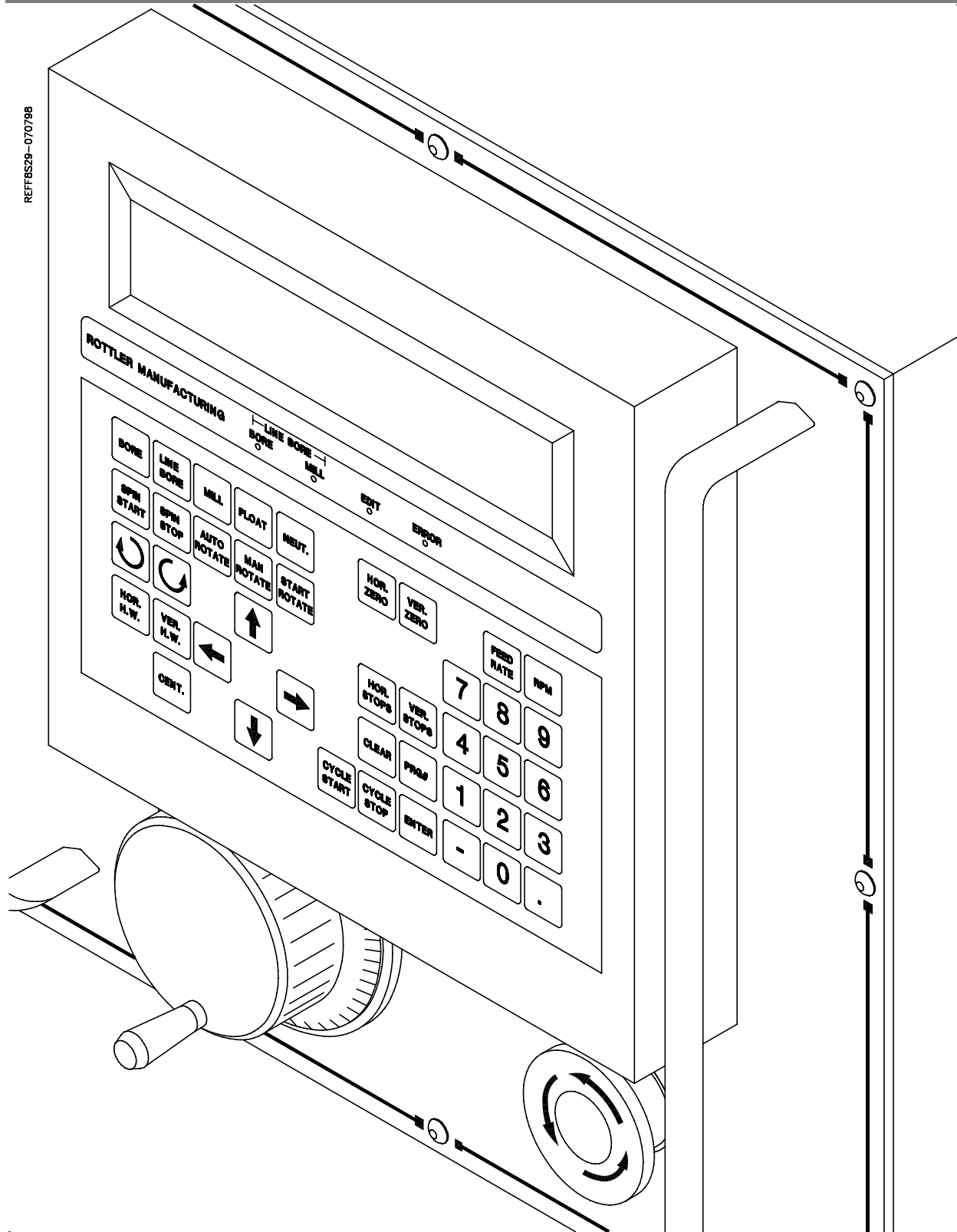
This switch is located on the left front face of the spindle unit. Actuate the switch to release the cutter head from the inner spindle. The cutter head will drop about 1/4"; this will clear its drive key. Turning cutter head 90 degrees, in either direction, will release it from the draw bar.



The cutter heads are heavy and free to fall once released from the draw bar.

Note: *If the spindle start button is pressed, while the draw bar switch is in its release position, the spindle will not turn. 'COS OPEN' will be displayed on the position readout. This is a safety to prevent the spindle from turning in the event the cutter head is not secured in the spindle.*

REFFB29-070798



Mode Buttons:

Bore:

When the Bore button is pressed, the machine will enable all of the boring functions and movements. While in Bore Mode none of the Mill Mode or Line Bore functions will operate. The machine can be switched back and forth from Bore Mode, Mill Mode to Line Bore at any time. If the spindle base is not already clamped, it will be clamped when the Bore button is pressed.

NOTE: Always select Bore Mode before turning the machine off.

Mill:

When Mill button is pressed, the machine will enable all of the milling functions and movements. While in Mill Mode none of the Bore Mode or Line Bore functions will operate. The machine can be switched back and forth from Bore Mode, Mill Mode to Line Bore at any time.

When you enter Mill Mode the machine will go through a sequence to tilt the spindle base approximately .003" to the left. This will then only allow the left side of the fly cutter to touch the block surface. The following is the sequence the machine uses to tilt the spindle base:

Clamps unlock, Lift cylinder engaged (lifts the spindle base on the right hand side .010"), Wedge engaged (slides the wedge onto a .0035" ledge), Lift cylinder released (drops spindle base onto wedge) and then the clamps are engaged again.

NOTE: Do not put machine in Mill Mode when 'Y'-axis pin is in place. See 'Y'-axis pin. Do not turn master power switch off when machine is in Mill Mode.

Line Bore:

When Line Bore button is pressed, the machine will enable all of the Line Bore functions and movements. While in Line Bore Mode none of the Bore Mode or Mill functions will operate. The machine can be switched back and forth from Bore Mode, Mill Mode to Line Bore at any time. The line boring right angle drive assembly has a 2:1 gear ratio. When the machine is in line bore mode and a RPM and feed rate is selected the control will adjust for the gear ratio. If 300 RPM and .002 feed is selected the horizontal shaft of the right angle drive will turn at 300 RPM and feed at .002/revolution.

NOTE: The right angle drive should be run at the operating RPM for at least ten (10) minutes prior to use. The heat created by the head will cause it to grow in length (Vertical direction).

Mode Programs:

The following programs are optional and must be purchased with the machine to operate. Program numbers and codes will not be provided in this manual.

Optional Programs:

Lower Sleeve Repair Software.

Channel – Boring Software.

Water-jacket Repair Software.

Plunge Cutting Software.

Movement Buttons:

Up:

The Up button activates the rapid travel or feed up function of the spindle, depending on whether or not the spindle is turning.

When the spindle rotation is off, the Up button will activate the rapid up. Rapid up is locked in when the Up button is pressed and will continue to rapid up even though the button is not being held. The travel will stop when the Up button is pressed again, a down travel is pressed, the spindle reaches the home position, or a programmed stop is reached.

When the spindle rotation is on the Up button will activate the feed up, and can be stopped in the same manner as the rapid up travel and by stopping the spindle rotation.

Down:

The Down button activates the rapid travel or feed down function of the spindle, depending on whether or not the spindle is turning.

Feed down travel will engage when the spindle rotation is on. Rapid down travel will engage when the spindle rotation is off. When feeding down the travel will continue until the spindle rotation is stopped, up travel is pressed, or one of the programmed stops is reached.

In rapid mode the button must be held down for continuous travel. Travel will stop if any of the programmed stops are reached (Stops 1, 2 or 3). If the spindle is allowed to over travel its lower limit switch the spindle will stop and a "VERT POS'N JAM" error message will be displayed on the position readout. The message must be cleared before travel will be allowed.

Left:

This button activates the left travel of the column either in the feed mode or in the rapid mode.

Feed left travel will engage when the spindle rotation is on. Travel will continue until the spindle is stopped, right travel is pressed, or a programmed stop is reached.

Rapid left travel will engage when the spindle rotation is off. Travel will continue only while the Left button is held. Travel will stop if any of the horizontal stops are reached. If the column is allowed to over travel its left limit switch the column will stop and a "HORIZ POS'N JAM" error message will be displayed on the position display. The message must be cleared before travel will be allowed.

Right:

This button activates the Right travel of the column either in the feed mode or the rapid mode.

Feed Right travel will engage when the spindle rotation is on. Travel will continue until the spindle rotation is stopped, left travel button is pressed, or home limit switch is reached.

Rapid Right travel will engage when the spindle rotation is off. Travel will continue after the button is pressed and released. The rapid travel will continue until the home position is reached, or the left or right button is pressed.

Handwheel:

The Handwheel allows the column and spindle to be positioned precisely by hand. Turning it clockwise will move the column left or the spindle down, depending on which axis is selected. Turning it counter clockwise will move the column to the right or the spindle up.

Horizontal Handwheel:

When the Horizontal Handwheel Button is pressed the display will show Hor. Handwheel Course. When the button is first pressed the handwheel will move the machine .001" per division on the handwheel. If you push the button a second time the display will show Hor Handwheel Fine and the handwheel will move the machine .0001" per division of the handwheel.

Vertical Handwheel:

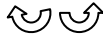
When the Vertical Handwheel Button is pressed the display will show Vert. Handwheel Course. When the button is first pressed the handwheel will move the machine .001" per division on the handwheel. If you push the button a second time the display will show Vert Handwheel Fine and the handwheel will move the machine .0001" per division of the handwheel.

Spin Start:

This button is used to turn the spindle rotation on and off. Press the Spin Start Button and the spindle will rotate clockwise. The Spin Start Button will not operate, when the machine is: in neutral, in float, or when the cutter head draw bar is unlocked.

Spin Stop:

The Spin Stop button is used to stop the spindle from rotating after it has been started with the spin Start button.

Spindle Creep Buttons:

These buttons allow the operator to rotate or jog the spindle slowly in either direction. The clockwise button jogs the spindle clockwise. The counter-clockwise button jogs the spindle, counter clockwise. Spindle creep will work when the machine is in any mode. It will only turn the spindle one revolution. To continue, rotate the spindle the opposite direction. The spindle will only rotate as long as the button is held down. When the button is released the spindle will stop.

Operation Buttons:**Float:**

This button operates in bore mode only. It unclamps the spindle base and floats it on a cushion of air. When the Float function is on, none of the powered machine movements operate except the handwheel. Press the bore button to clamp the spindle base again.

Neutral:

This button operates in bore mode only. It unclamps the spindle base and partially floats it on a cushion of air. Use this function for precision positioning of the spindle on the In/Out axis. When the Neutral function is on, none of the powered machine movements operate except the handwheel. Press the bore button to clamp the spindle base again.

Prg#:

The Prg# button is pressed to view the active program number and to change the program. Press Prg# and the display will show will the current program number. To change the program number use the numeric key pad to select the desired program. Press enter to use the selected program.

RPM:

This button allows spindle R.P.M. to be changed. The spindle R.P.M. can be changed while the spindle is running. Press the button to display the current setting, enter in the new desired rate on the numeric key pad, and press 'Enter' to activate the new setting. If you make a mistake entering the number that you want, press the clear button, re-enter the correct number then press enter. Set the R.P.M. the same way in either bore mode or in mill mode. The settings are independent, so changing the boring R.P.M. does not effect the milling R.P.M. The R.P.M. will be stored in program memory. When the program is used at later time the R.P.M. settings will be recalled.

Feed Rate:

Press this button to display the currently active feed rate. The feed rate can be changed any time, including when the machine is running. Press the button to display the current setting, enter in the new desired rate on the numeric key pad, and press 'Enter' to activate the new setting. If you make a mistake entering the number that you want, press the clear button, reenter the correct number then press enter.

Hor Zero:

Use this button to zero the horizontal position for convenience in positioning, and for establishing the parts origin when using the boring program. When the machine is first, powered up, the display will show random values. The Hor. Zero button will zero the display at the current machine position. This can be done at any position that suits a particular need, usually the machine is zeroed at the centering position of the first hole to be bored.

Vert Zero:

Use this button to zero the vertical position for convenience in positioning and for establishing the parts origin when using the boring program. When the machine is first powered up, the display will show random values. The Vert. Zero button will zero the display at the current machine position. This can be done at any position that suits a particular need, usually the machine is zeroed at the centering position of the first hole to be bored.

Cent:

After locating the cutter head in the centering position, press this button to extend the centering fingers. The control will execute the automatic centering sequence as follows: Spindle Clamp "off", Spindle float "on", centering fingers "extend" for 1.5 seconds (or the value in the centering finger parameter), Spindle float "off", Spindle Clamp "on", Centering fingers "retract".

Enter:

This button is used to enter previously selected data into the machine's memory. Some examples are: feed rate, spindle R.P.M., and position stops.

Cycle Start:

When the Cycle Start button is pressed an automatic sequence will start. Make sure the proper program is selected, the machine has been oriented to the part, and the part is secured in the fixture before starting an automatic cycle.

The Cycle Start button starts an automatic cycle. Automatic operation will stop when the spindle up, down, left, right, or cycle stop buttons, are pressed.

Automatic sequencing may be started at any place on its cycle, depending on the horizontal and vertical positions:

If the horizontal axis is not at a stop (within +/- .0005" or .005 cm):

If the vertical axis is at or above Vertical stop #4 (top of hole), there is a horizontal, rapid move left to the next stop.

If the vertical axis is not at or above vertical stop #4, there is a vertical rapid move up to vertical stop #4, then the machine will move left to the next stop.

If the horizontal axis is at a stop (within +/- .0005" or .005cm):

If the vertical axis is above vertical stop #1, (centering position), the machine will rapid down to vertical stop #1. The spindle is turned off first, if necessary.

If the vertical axis is at vertical stop #1, the automatic operation starts with the auto centering sequence.

If the vertical axis is below the vertical stop #1, and above vertical stop #2, the spindle will do a rapid jog down to stop #2, the feed sequence will be executed, and the machine will continue on with the automatic cycle.

If the vertical axis is at vertical stop #2, the automatic operation starts with the feed sequence to stop #3, followed with the rapid up move and continuation of the automatic cycle.

If the vertical axis is below the vertical stop #2, the feed sequence is executed and continues automatic operation.

If the vertical axis is below the vertical stop #2, and above vertical stop #3, the spindle is turned on (or remains on), and a feed move is made down to vertical stop #3. The retract sequence will be executed and the machine will continue on with the automatic cycle.

If the vertical axis is at vertical stop #3, the automatic operation starts with the automatic retract sequence followed with the rapid up move and continuation of the automatic cycle.

If the vertical axis is below the vertical stop #3, automatic operation is inhibited.

Cycle Stop:

Pressing this button stops a cycle that has been started by pressing the Cycle Start Button. If the machine is not running an automatic cycle no action will be seen by the operator.

Emergency Stop:

This button is located on the lower right hand side of the pendant.



The operator and all personnel in the working area should be familiar with the location and operation of the Emergency Stop Button. Before re-setting the Emergency Stop button, make sure whatever situation led to pressing the Emergency Stop button has been cleared.

Press this button in an emergency situation. This deactivates two relays located between main power breaks and the servo amplifiers, cutting off power to all axis.

Note: *If the Emergency Stop has been pressed it must remain in for at least a minute to allow the drives to power down. The machine will not operate if this time is not observed.*

To re-set the Emergency Stop button turn it, it will pop out. Press the clear button to restart the machine functions. The machine will lose its position reference during an emergency stop. The machine must be homed and the “zero” position reset for proper operation.

Low Oil Indicator:

The low oil switch signals the computer, if the oil reservoir is low or empty, it will show “LOW OIL” on the display. The machine will not operate until the oil reservoir has been re-filled.

‘Y’ Axis Lever:

This lever is located on the right side of the spindle base and is used to move it in and out. It may be used when the spindle base is in float, or neutral, but not when it is clamped. To operate the lever pull straight out completely, then it is in operating position.

‘Y’ Axis Alignment Pin:

Only use this pin when the machine is in Line Bore mode.

NOTE: *Do Not change machine from bore mode to mill mode with the ‘Y’-Axis Alignment Pin in its down or operating position-----The pin will be bent and require replacement.*

The ‘Y’-Axis Alignment Pin prevents the spindle base from floating from side to side but allows the it to move in and out. It is used with the Line Boring head. It can also be useful in combination with the ‘Y’-Axis lever when indicating certain types of work pieces.

The operating knob for this pin is located on the front left side of the spindle base. Put the machine in float, loosen the operating knob, push the knob down then move the spindle base slowly left and right until the pin slips into its slot. Tighten the operating knob. The machine can now be put in float, neutral, or clamp.

Pay extra attention when line boring with the Y-axis pin in place. A horizontal crash could bend the pin.

Note: To replace the pin the spindle unit must be lifted off the machine.

Machine Parameters:

Machine Parameter	Description	F84S & F85S High Speed	F88S Low Speed
0 – 110	Not Defined	-----	-----
111	Horizontal Acceleration	1000	1000
112	Vertical Acceleration	1000	1000
113	Spindle Acceleration	1000	1000
114	Horizontal Rapid Speed	15000	15000
115	Vertical Rapid Speed	15000	15000
116	Lock Machine Parameters: 0000 to Lock, 9999 to Unlock	9999	9999
117	Maximum Feed Rate = (0 - .040 in/rev, 0 - .099 cm/rev)	.040	.040
118	Maximum Spindle RPM's	2000	1000
119	Horizontal Creep Velocity	800	800
120	Vertical Creep Velocity	800	800
121	Spindle Creep Velocity	25	25
122	Spindle Delay turn off	02	02
123	Oiler (# of seconds between oiling while spindle is running)	600	450
124	English or Metric Mode = 1-English, 2-Metric	1	1
125	Spindle Washout Speed	125	125
126	Ballscrew Compensation 0 to 1 Ft.		
127	Ballscrew Compensation 1 to 2 Ft.		
128	Ballscrew Compensation 2 to 3 Ft.		
129	Ballscrew Compensation 3 to 4 Ft.		
130	Ballscrew Compensation 4 to 5 Ft.		
131	Ballscrew Compensation 5 to 6 Ft.		
132	Ballscrew Compensation 6 to 7 Ft.		
133	Ballscrew Compensation 7 to 8 Ft.		
134	Ballscrew Compensation 8 to 9 Ft.		
135	Ballscrew Compensation 9 to 10 Ft.		
136	Ballscrew Compensation 10 to 11 Ft.		
137	Ballscrew Compensation 11 to 12 Ft.		
138	Ballscrew Compensation 12 to 13 Ft.		
139	Distance from 0.000 to Horizontal Home	0.000	0.000
140	Auto Center Finger Extension Time, 0 = Not Installed	2.5	2.5
141	Auto Rotate Fixture Clearance Distance, 0 = Not Installed	0.000	0.000
142	Spindle Drive Type, 1=Servo Closed Loop, 2 = Unipolar, 3 = Servo Open Loop	1	1
143	Hand wheel switch Type, 1 = pushbutton, 2 = Manual Switch	1	1
144	Spindle Drive Gain	.5	.5
145	Home Clearance Distance	0	0
146	Encoder Counts per Spindle Revolution	1935	2734
147	Spindle Hold During Centering – 1=No, 2=Yes	2	2
148	Maximum Time Between Spindle Revolutions for Sensor Input	1.0	1.0
149	Spindle Delay on Index pulse when Indexing Manually	0.4	0.4
150	Spindle Encoder Prescale: Divide incoming pulses by 1,2,4, or 8	04	04
151	Spindle Index Type, 1 = encoder, 2 = NPN, 3 = PNP, 4 = Change	3	3
151	Spindle Index Type, 1 = encoder, 2 = NPN, 3 = PNP, 4 = Change	1 after 4-28-04	1 after 4-28-04
152	Auto Centering Speed, 0 = Old Style, or 2047 for Speed	2047	2047
153	Spindle Load Offset = 1000 to 3000	1600	1600
154	Spindle Load Span = 25 to 4000	4000	4000

155	Horizontal Load Offset = 1000 to 3000	1000	1000
156	Horizontal Load Span = 25 to 4000	2500	2500
157	Vertical Load Offset = 1000 to 3000	1000	1000
158	Vertical Load Span = 25 to 4000	2850	2850
159	Horizontal Jog Acceleration	1000	1000
160	Vertical Jog Acceleration	1000	1000
161	Second Lock Code: 000 = Lock, 999 = Unlock	999	999
162	Horizontal Encoder counts per revolution	1024	1024
163	Vertical Encoder counts per revolution	1024	1024
164	Piloting RPM	25	25
165	Piloting Feed Rate	.250	.250
166	Final Plunge Bore RPMs	02	02
167	Autocycle 1 = On, 0 = Off	0	0

Chapter 3 Operating Instructions:

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

All modes of operation will be discussed in this chapter.

Note: *We recommend, particularly for operators unfamiliar with the boring machine, to practice on a junk block in order to become familiar with the controls and procedures of the boring machine.*

Loading Blocks: Small Gas and Diesel:

Manual V6/V8 Combination Fixture:

502-1-72H



WARNING Handle the block and fixture with **EXTREME** care and guidance. A block hoist is **REQUIRED**. Mishandling of a heavy engine block and fixture may result in the dropping of parts and personal injury.

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.

See illustration on the following page.

Boring 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:

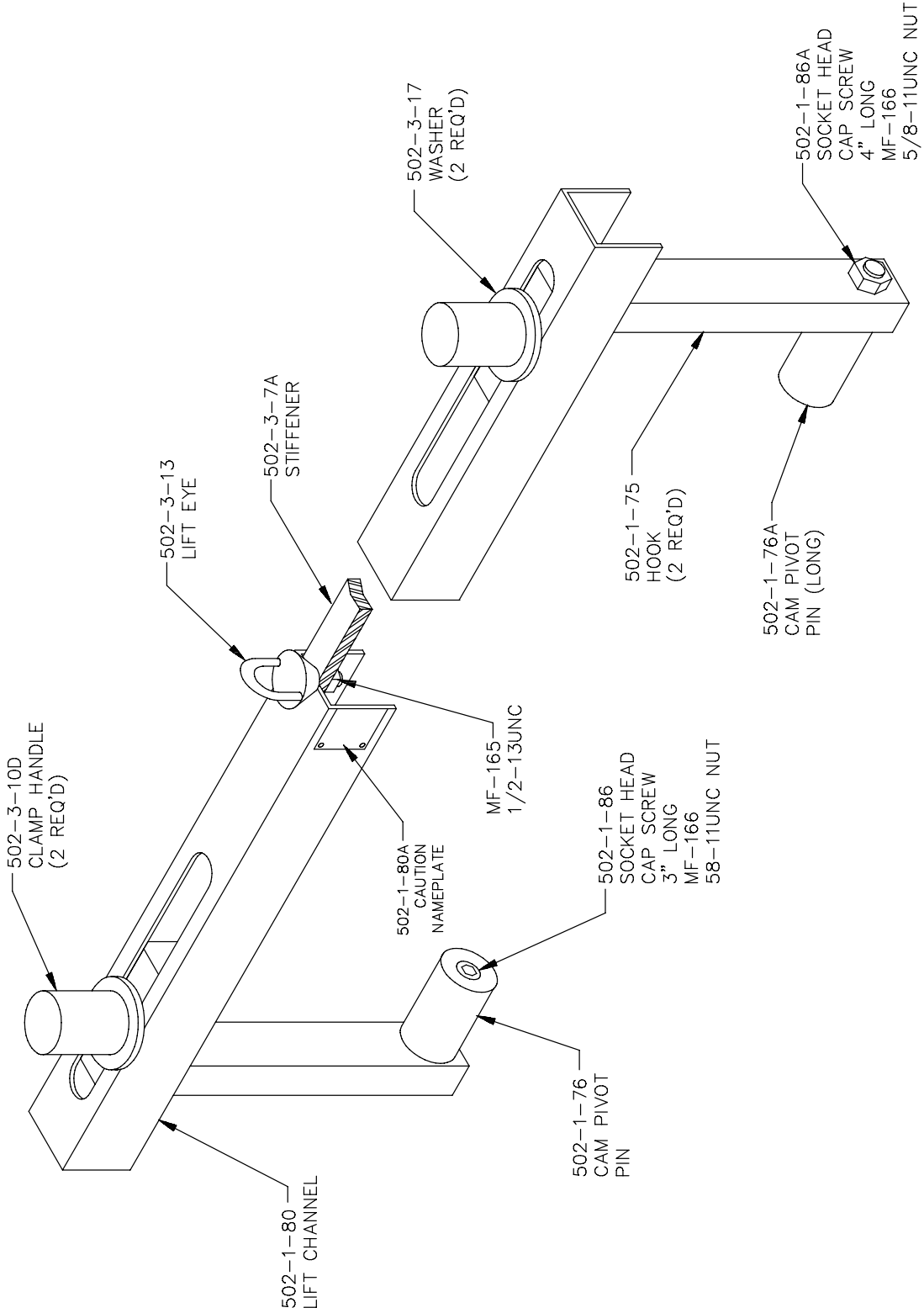
(blocks with main bearing center lines no more than 1/2" higher than the pan rail plane) are mounted with the 502-3-8B V-block frame in place. Select the 90-degree option placement of the frame to suit block length, or main bearing caps will interfere with frame. Rotate frame 90 degrees by moving its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

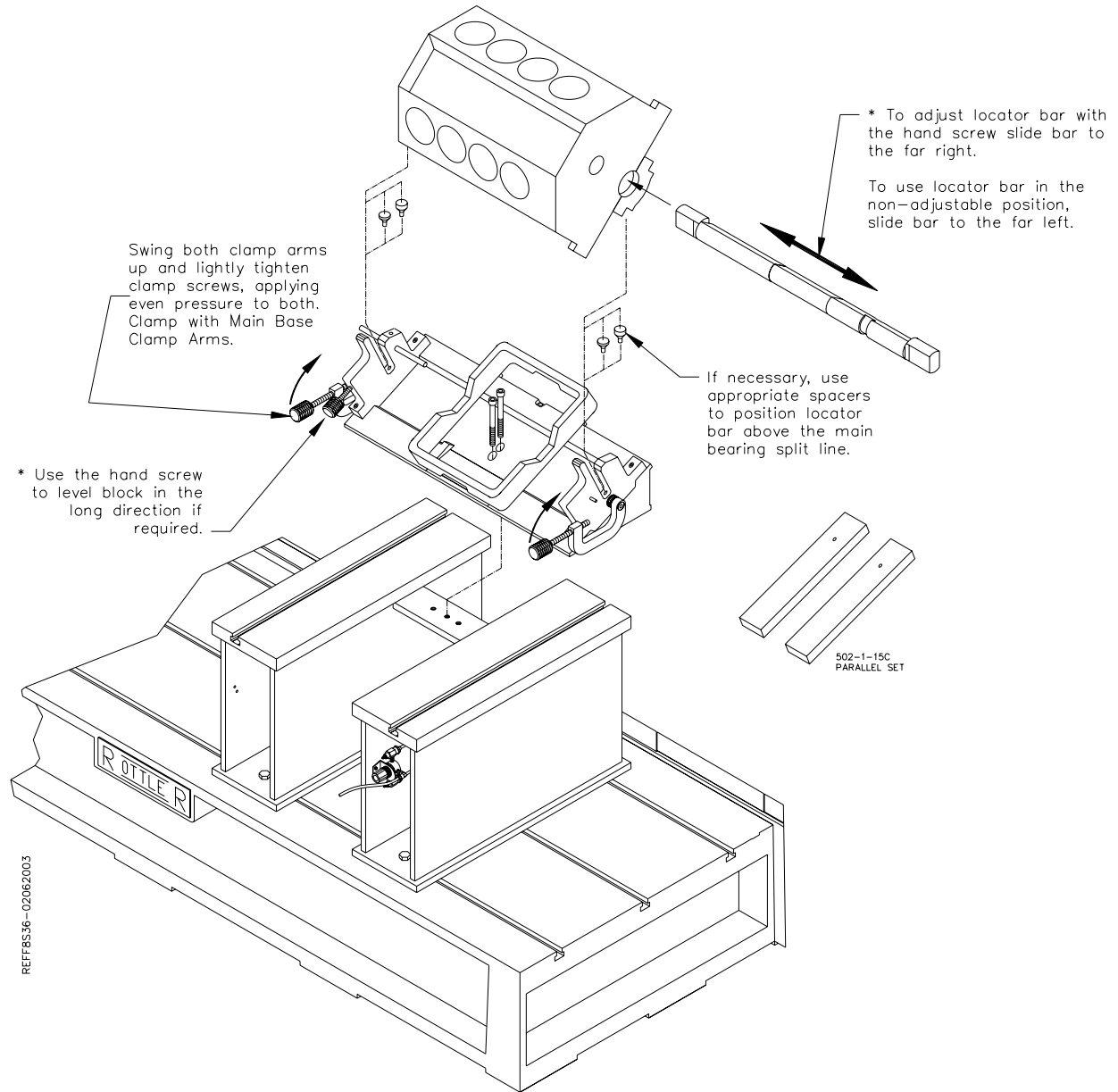
This fixture may be easily repositioned on the support parallels (without a block in place) to shift from the 60 degree support surface to the 90 degree support surface or vice versa.

REF2MB17-031993



▲ WARNING

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.



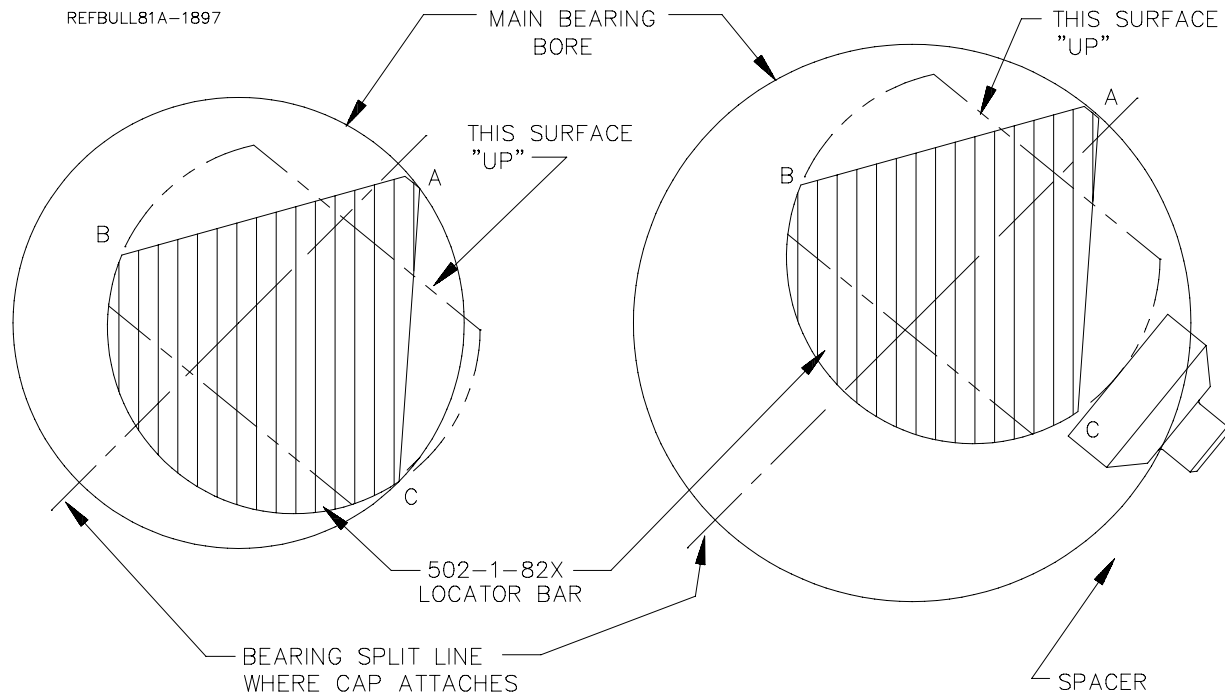


FIGURE 1

FIGURE 2

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 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.

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 hand screws and rotate clamps out of the way. Lift the block, either from the deck surface or with the optional 502-1-95 block handler. 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).

Ford 2800 cc V6:**GM-V6 Citation:**

Cutter-heads that clear main bearing bosses of these blocks are:

#600-2

Stub bar 6-1/2" long.

#600-8-8A

Stub bar 3" long

#600-8-6

Blind Hole cutter-head

#502-13D

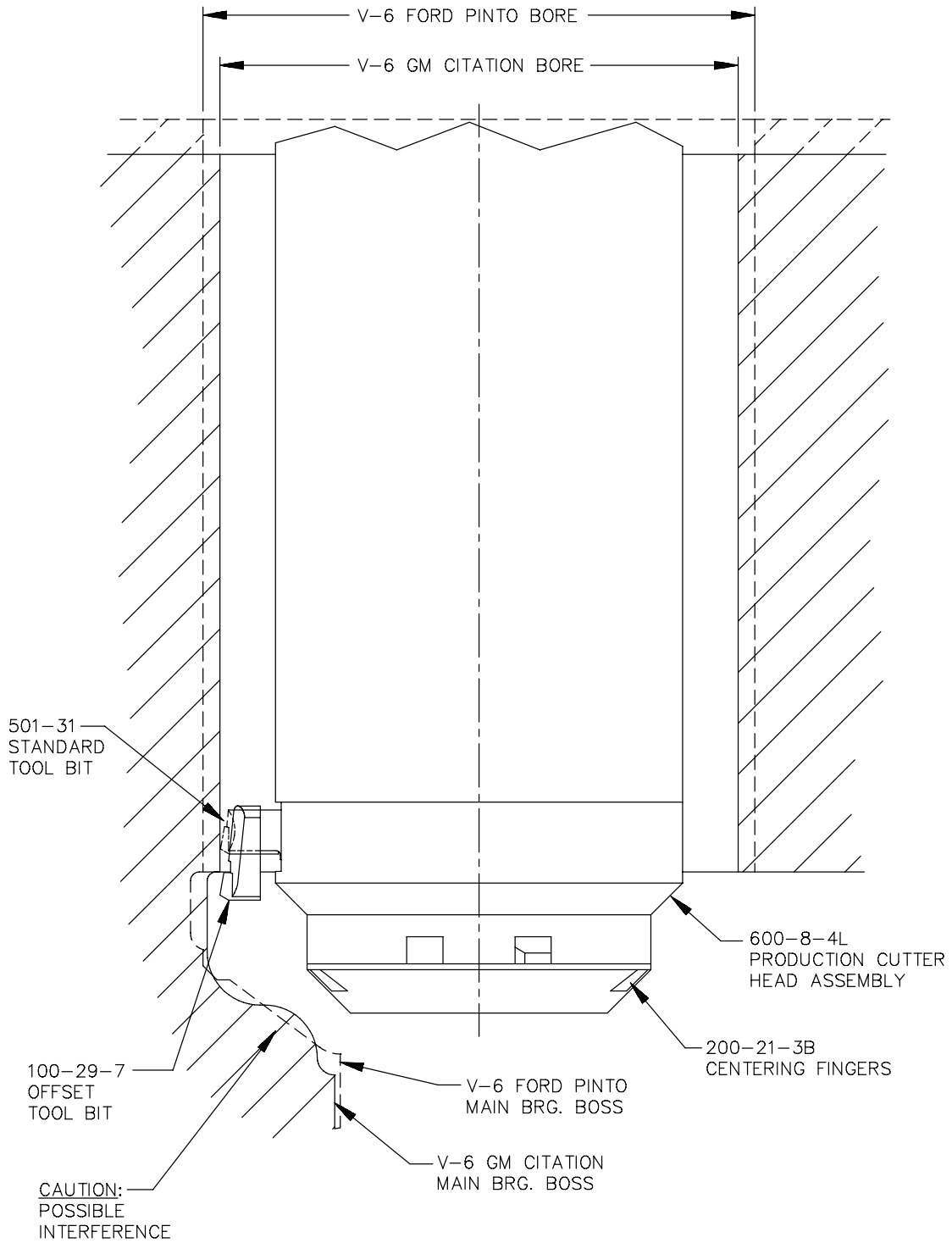
Short production stub bar

See illustration on the following page.

NOTE: Production cutter-head, Part #600-8-4, will not clear main bosses of these blocks. New production cutter-head, part #600-8-4L, will clear main bosses with offset tool #100-29-7

Ford and GM V6 Boss Interference Illustration:

REFBUL19-100192



Surfacing 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.

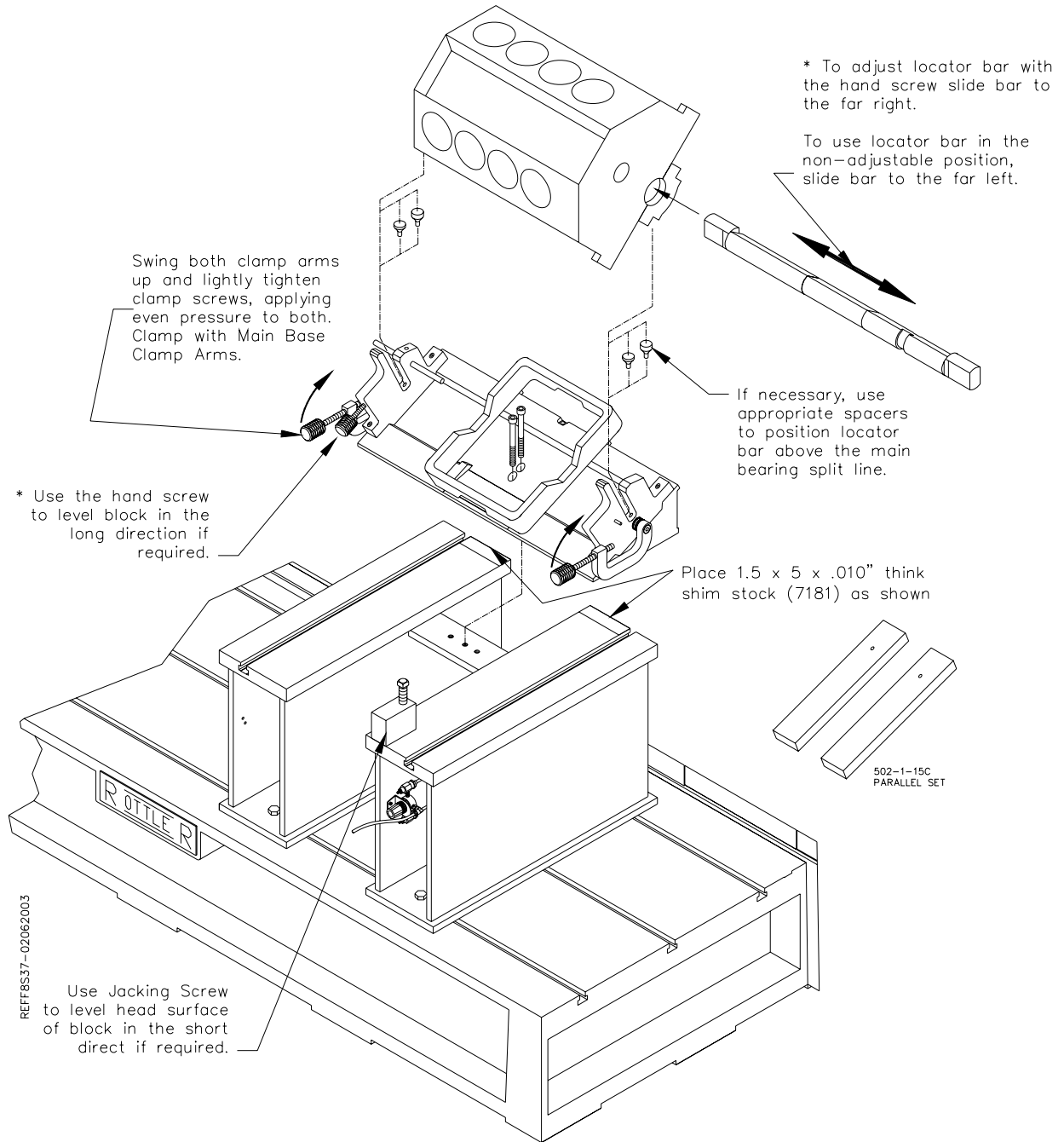
Y-Blocks:

(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.

▲ WARNING

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 9.20), 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.

Push fixture back into surfacing position with the back of the fixture on the Shim Stock. The shim stock is put in place to raise the back side of the block, you can then use the Jacking Screw to raise and lower the front of the block. 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, surface, and pull fixture back to the load position.

Loosen locator bar hand screws and rotate clamps out of the way. Lift the block, either from the deck surface or with the optional 502-1-95 block. 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

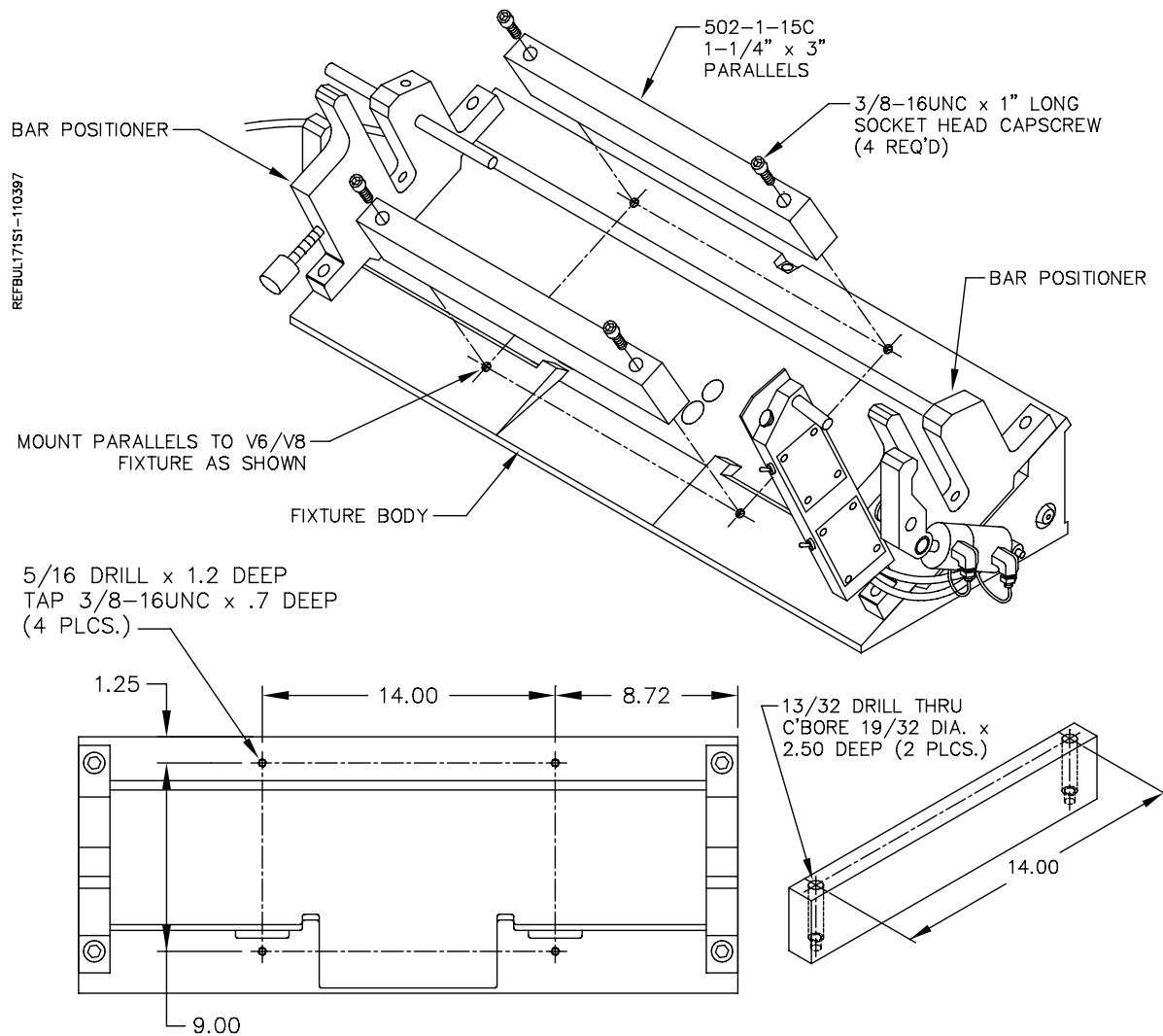
502-1-82X main bearing locator bar indexes near bearing split line. Point C does not contact the bearing cap but rests on matched spacers that are provided to fit in the bar positioners slot. If there is a means of holding the block down such as block clamp towers, this method may be used in large bores 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).

Retrofitting 502-1-15C Parallels to V6/V8 Combination Fixture

(Special Applications)

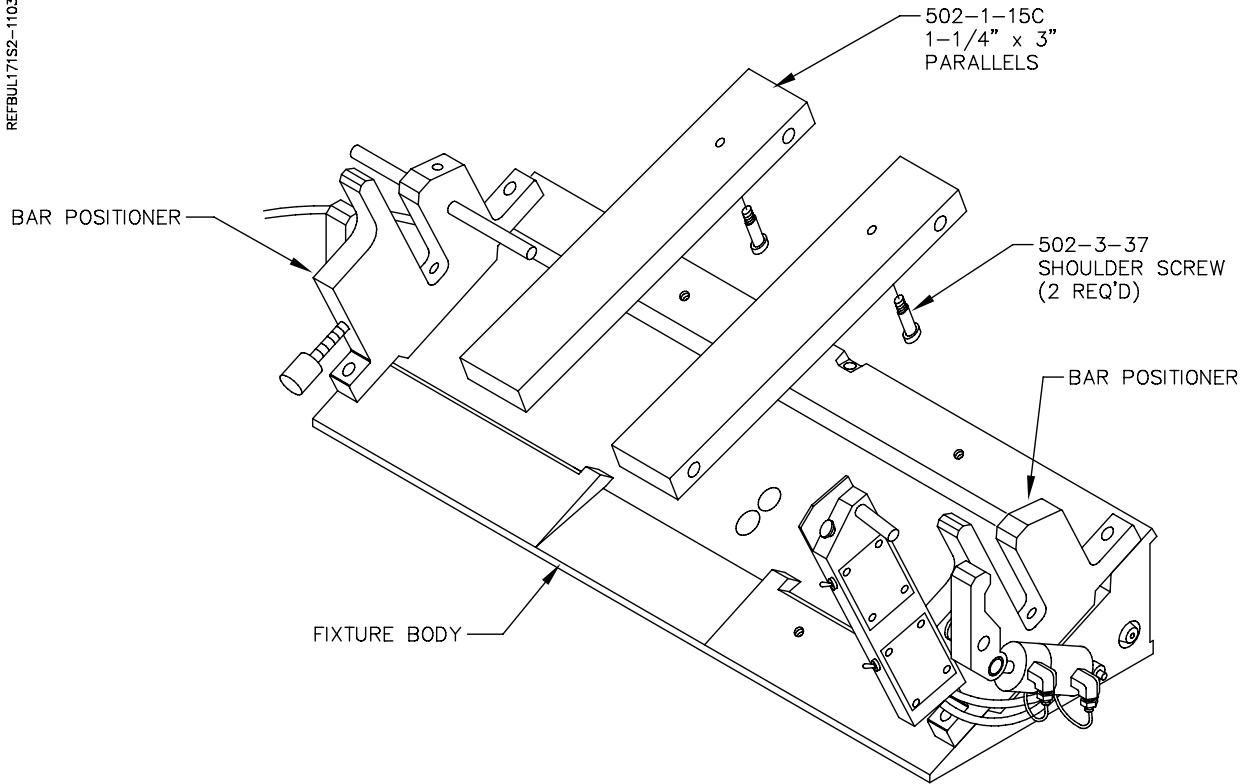
Some engine blocks with large main bores (3-1/8" and larger) cause a problem of the locator bar bottoming out in the bar positioners and/or the V-shaped relief's of the 502-3-8B V-block frame before clamping the block properly. Mounting the 502-1-15C parallel set as shown below in place of the V-block frame will provide proper clearance for clamping. Older style fixtures and parallels can be modified to this configuration using illustrations below.

V-6 blocks with one-piece 'caged' main bearing caps (all caps are connected) can interfere with 502-3-8B V-block frame. The parallel arrangement shown below will allow proper support and clamping of these blocks.



Some V-6 engine blocks (for example Buick V-6) have main bearing bores that are too low in respect to the pan rails. This presents a problem of the locator bar bottoming out in the bar positioners before the block is properly clamped. Positioning the 502-1-15C parallel set as shown below will raise the block enough to provide proper clamping.

REFBUL17152-110397



Diesel Blocks: 6725 Diesel Fixture:

Small Diesel V Blocks:

On these blocks it will be necessary to install the 6370Z, 10" parallels or 6794E, 8" parallels onto the bed of the machine. These parallels are keyed, place them onto the deck surface and then push them toward the rear of the machine. This will locate them evenly on the middle keyway of the machine bed. Place the two 6553F main bearing supports onto the parallels, these are also keyed and fit into the machined slots on the parallels. This will put the two main bearing supports in line with each other. Tighten all bolts to lock the parallels and main bearing support into place. Select the correct size main bearing locators and install them into the mains of the block..

Note: *Make sure there are no burrs or debris in the main bearing bores where they will contact the main bearing locators. This can cause the block not to clamp properly and may cause tipping or rocking of the block.*

WARNING

Handle these large blocks with Extreme care and guidance. A block hoist is required when handling these blocks. These blocks should be lifted from the block bank surface. DO NOT use 502-1-95 Block Handler assembly on these blocks.

Install the main bearing locators into the mains of the engine block. Lower the block so that the locators go into the main bearing support.

DANGER

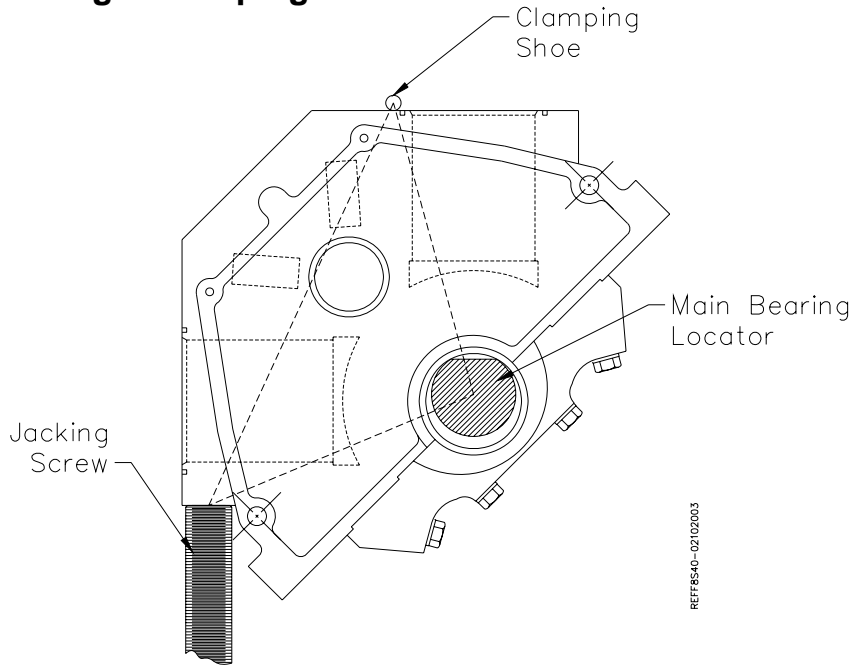
The hoist must remain attached to the block until it is firmly clamped into position. The blocks will have a tendency to tip forward until they are properly supported and clamp. When not properly supported and attached to a hoist these blocks will roll forward and out of the fixture. This will cause severe injury or death to operator.

Select the correct jacking screw to reach the block. Place the jacking screws into the jack bodies and place on the parallels in a location they will support the block from rolling forward.

Position the block clamps so the front of the shoe will clamp the block in the middle on both ends. The following illustration shows the correct triangle clamping system that should be used.

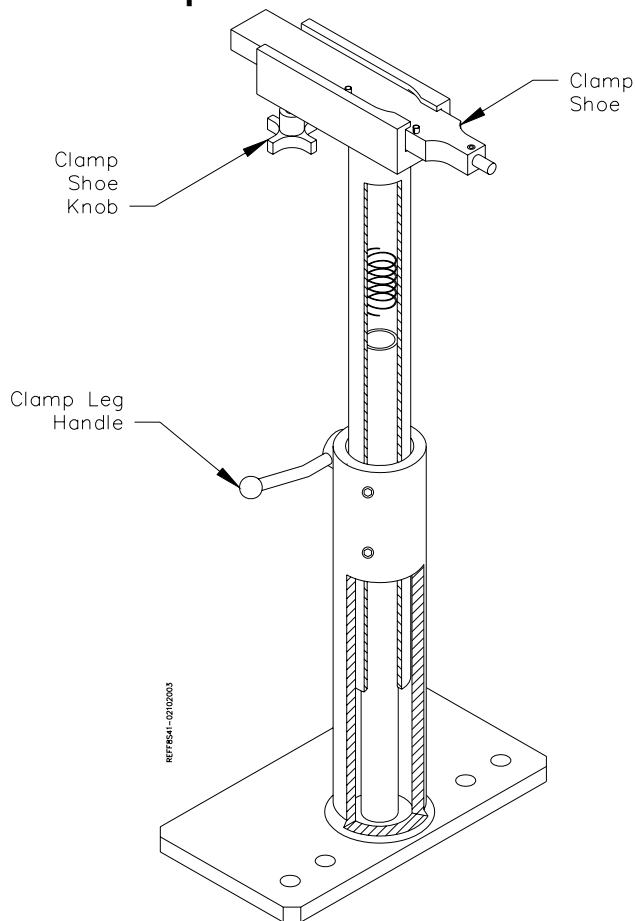
You can raise and lower the ends of the block by rotating the Hex nut located on the ends of the main bearing locators.

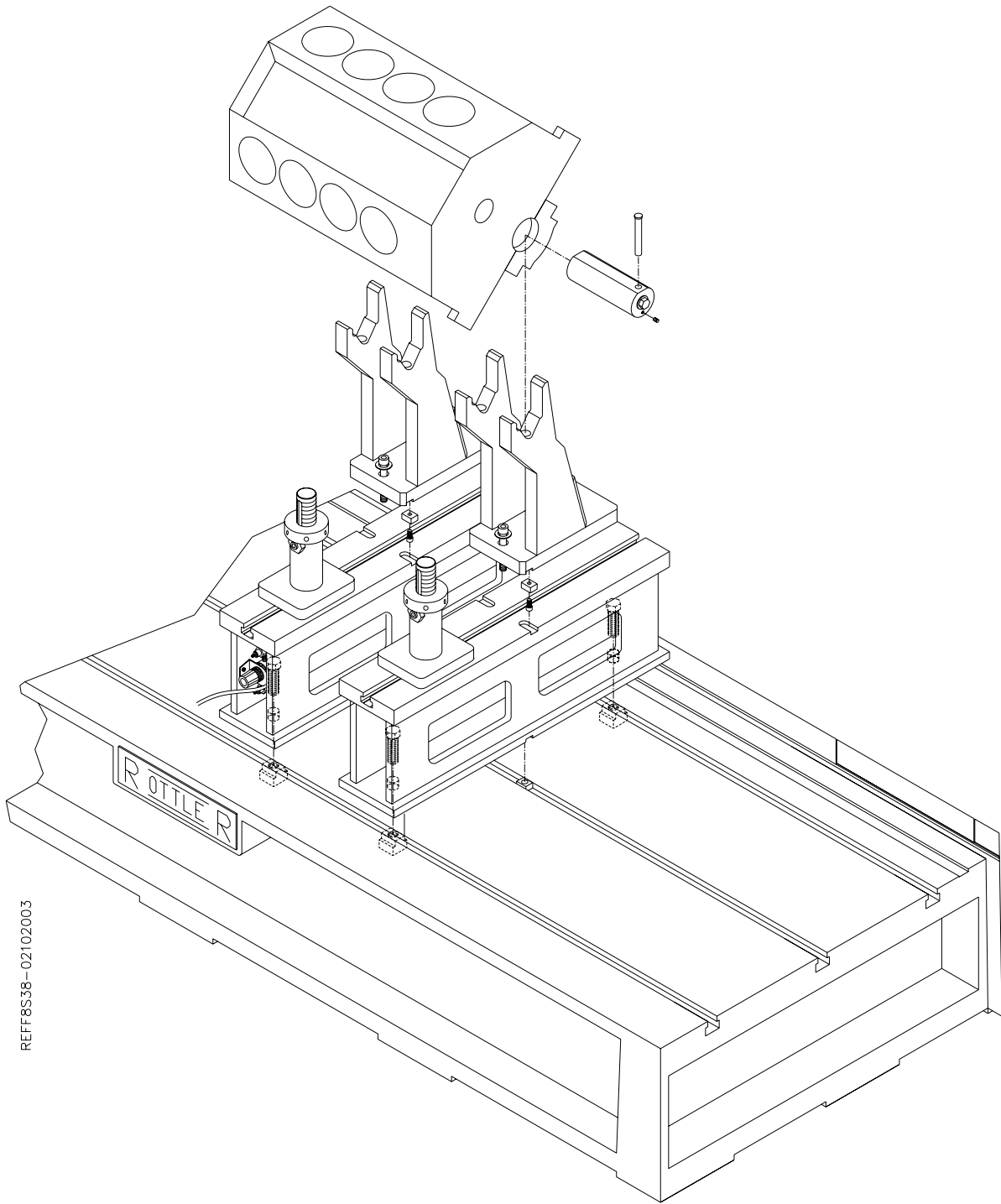
Triangle Clamping:



Adjust the height so the shoes rest on the clamp points. Tighten the clamp leg handles. Actuate the clamp shoes by turning their knobs. Apply pressure to the two clamps as evenly as possible to avoid tipping the block up on one side.

Block Clamp Arm:





REF8538-02102003

Small Diesel In Line Blocks:

On these blocks it will be necessary to install the 6370Z, 10" parallels or 6794E, 8" parallels onto the bed of the machine. These parallels are keyed, place them onto the deck surface and then push them toward the rear of the machine. This will locate them evenly on the middle keyway of the machine bed. Place the two 6553F main bearing supports onto the parallels, these are also keyed and fit into the machined slots on the parallels. This will put the two main bearing supports in line with each other. Tighten all bolts to lock the parallels and main bearing support into place. Select the correct size main bearing locators and install them into the mains of the block..

Note: *Make sure there are no burrs or debris in the main bearing bores where they will contact the main bearing locators. This can cause the block not to clamp properly and may cause tipping or rocking of the block.*

WARNING

Handle these large blocks with Extreme care and guidance. A block hoist is required when handling these blocks. These blocks should be lifted from the block bank surface. DO NOT use 502-1-95 Block Handler assembly on these blocks.

Install the main bearing locators into the mains of the engine block. Lower the block so that the locators go into the main bearing support.

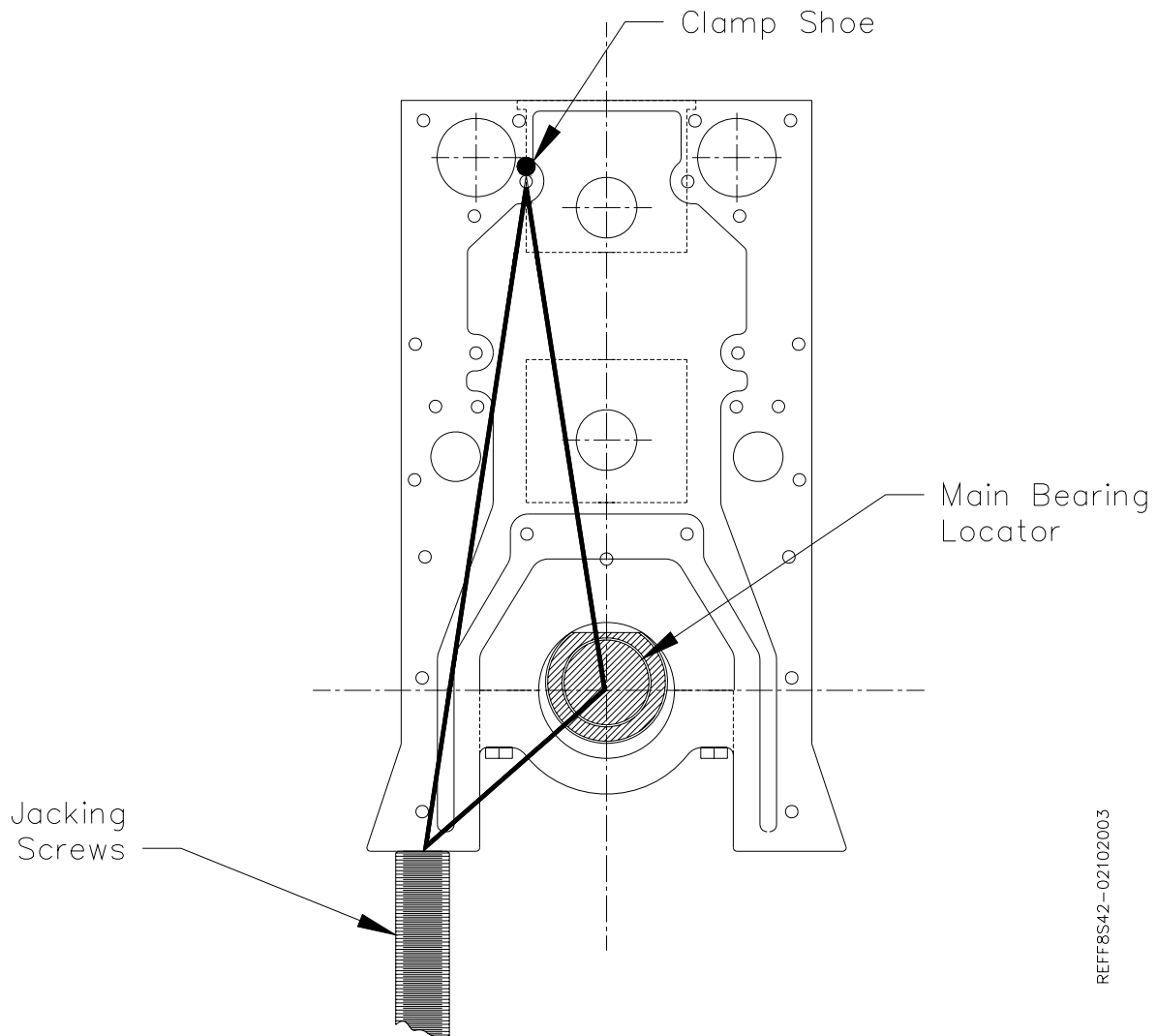
DANGER

The hoist must remain attached to the block until it is firmly clamped into position. The blocks will have a tendency to tip until they are properly supported and clamp. When not properly supported and attached to a hoist these blocks will roll forward or backwards and out of the fixture. This will cause severe injury or death to operator.

Select the correct jacking screws to reach the block. Place the jacking screws into the jack bodies and place on the machine bed in a location they will support the block from rolling forwards or backwards. Use these Jacking screws to level the block front to back.

Position the block clamps so the front of the shoe will clamp the block in the middle on both ends. The following illustration shows the correct triangle clamping system that should be used.

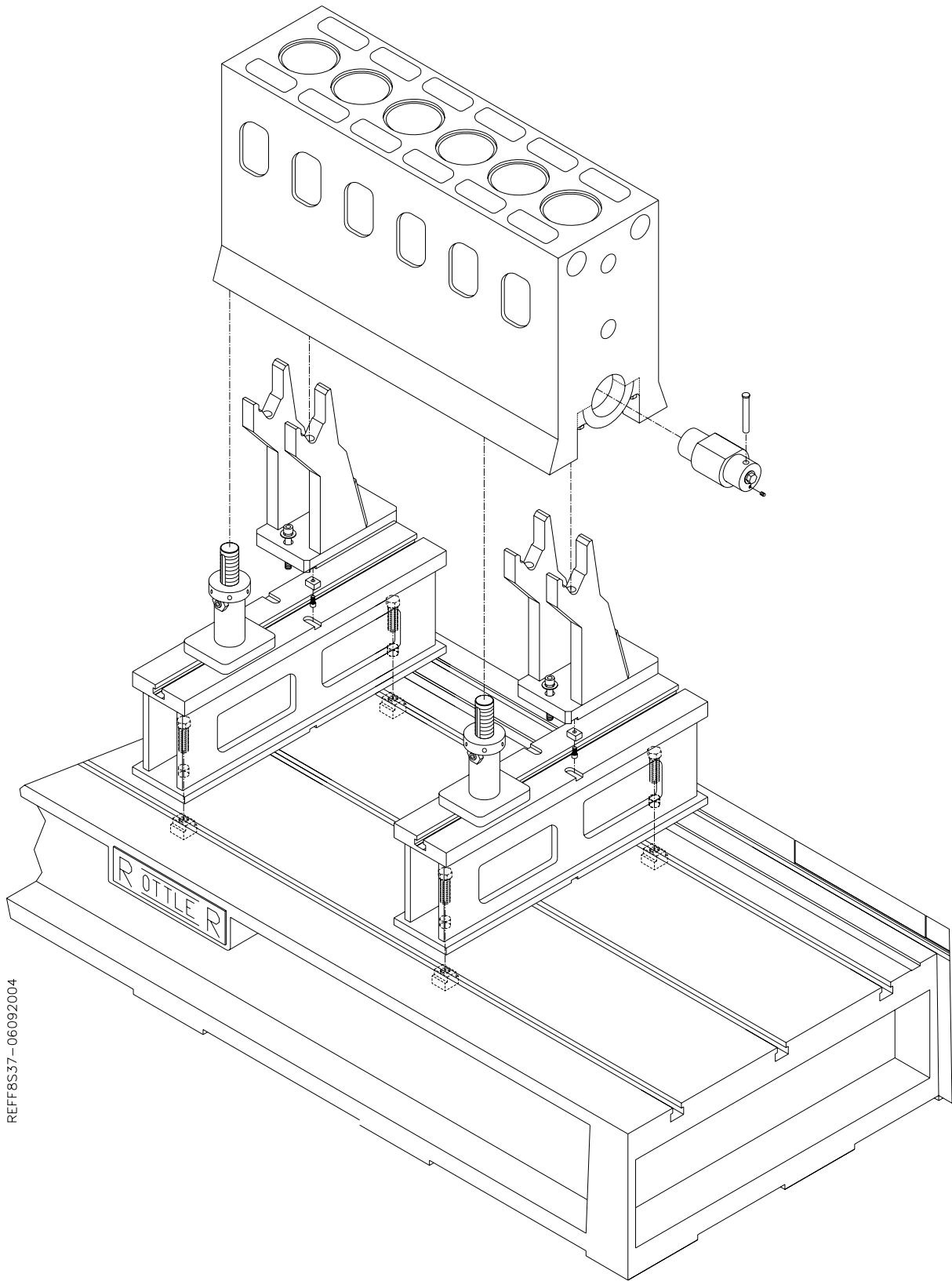
You can raise and lower the ends of the block by rotating the Hex nut located on the ends of the main bearing locators.

Triangle Clamping:

Adjust the height so the shoes rest on the clamp points. Tighten the clamp leg handles. Actuate the clamp shoes by turning their knobs. Apply pressure to the two clamps as evenly as possible to avoid tipping the block up on one side.

Be sure the clamp is below the deck surface if you are boring and between the jacking screw and main locator.

▲ WARNING Do not release the hoist or lifting device from the block until the clamping is secure.



REF8S37-06092004

6405A 399 Cat Block Fixture:

Place the 6405 supports on the machine bed. Make sure there is no debris or burrs on the mating surfaced. The supports should be placed with the two (2) bolt hole towards the rear of the machine. The two dowels on the bottom of the supports go into the middle key way on the main bed. Place the supports the same distance apart as the mains you will be using. Push the support back toward the rear of the machine, they will butt up against the dowel pins. This will line the supports up with each other. Tighten the three (3) mounting bolts on each support. Place the 6406 Alignment tube on the right hand support. Place the adjustable alignment tube on the left hand support.

▲ WARNING

Handle these large blocks with Extreme care and guidance. A block hoist is required when handling these blocks. These blocks should be lifted from the block bank surface.

▲ DANGER

The hoist must remain attached to the block until it is firmly clamped into position. The blocks will have a tendency to tip until they are properly supported and clamp. When not properly supported and attached to a hoist these blocks will roll forward or backwards and out of the fixture. This will cause severe injury or death to operator.

A main bearing bore will be on each side of the support, locating on the alignment tubes. Bolt the jacking blocks to the engine block. Measure the distance they are apart. Set the Jacking Bodies with the Jack Bolt installed onto the machine base the same distance apart as the jacking blocks. Secure to the deck with at least one bolt.

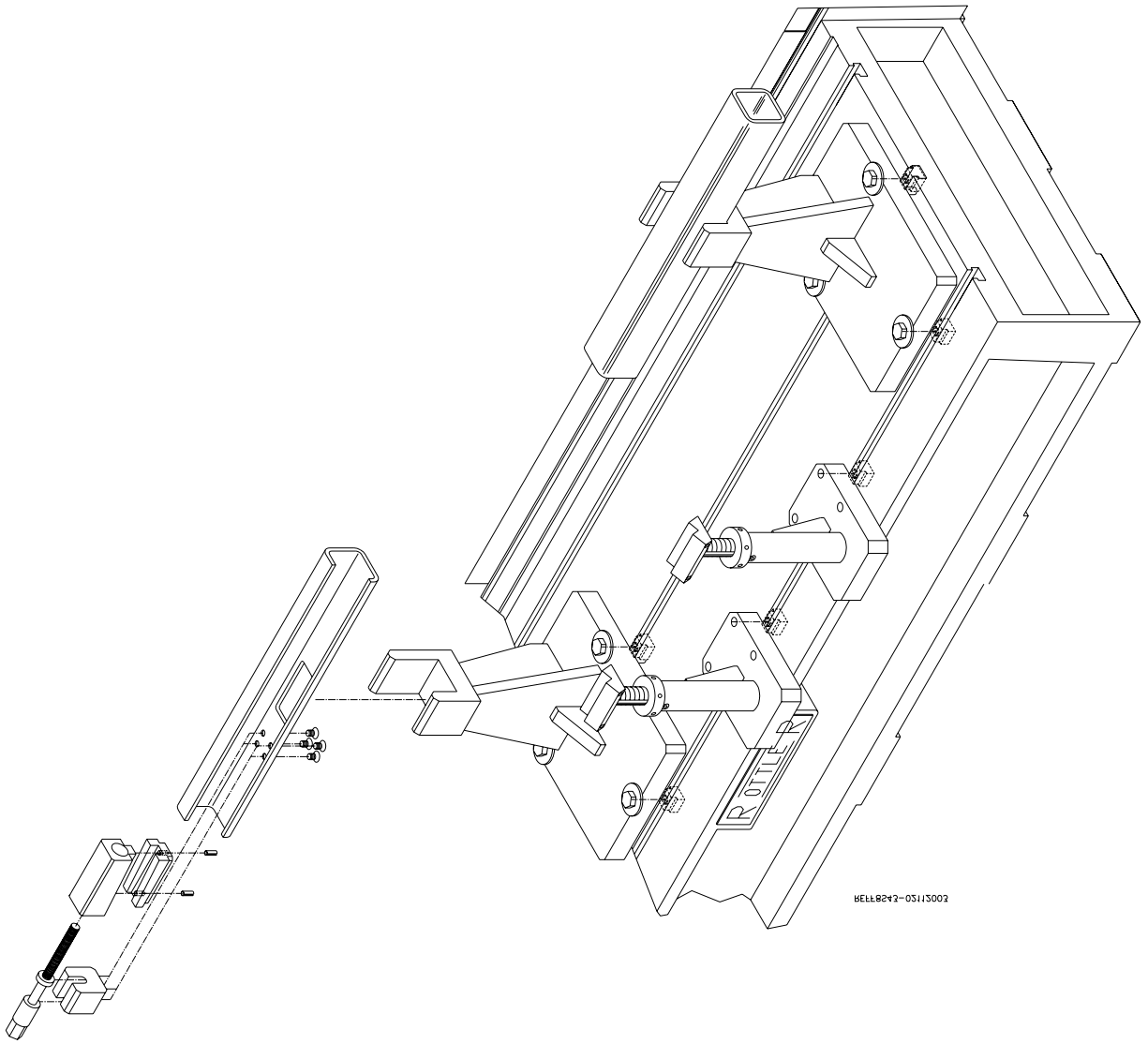
Lower the block down onto the alignment tubes. Place a level on the deck of the engine block and check the level front to back. Use the jacking screws to raise or lower the front of the engine block. When the block is level front to back, tighten the set screw in the Jacking Body.

Check the level of the engine block left to right. Use the Adjustable Alignment tube on the left hand support to raise or lower the left hand side until level.

Position the block clamps so the front of the shoe will clamp the block in the middle on both ends. The following illustration shows the correct triangle clamping system that should be used.

Use the same triangle clamping technique to clamp this size block also.

Adjust the height so the shoes rest on the clamp points. Tighten the clamp leg handles. Actuate the clamp shoes by turning their knobs. Apply pressure to the two clamps as evenly as possible to avoid tipping the block up on one side.



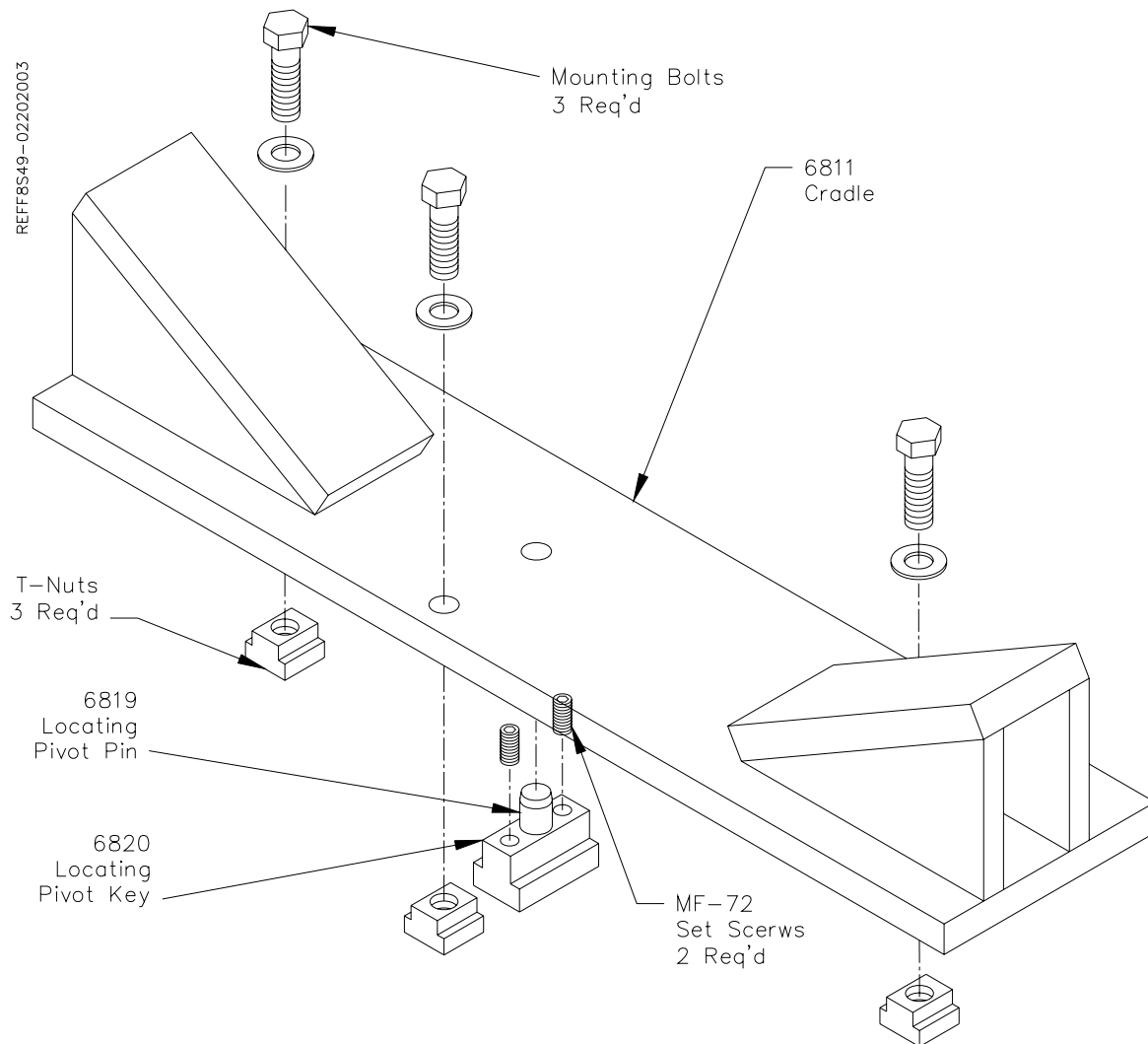
6810 Waukesha 7042 Block Line Bore Fixture:

This fixture is designed to be mounted directly on the bed of an F88 machine. Due to the large size of the Waukesha 7042 block, care must be taken when loading and unloading to avoid bumping the block into the column or spindle unit.

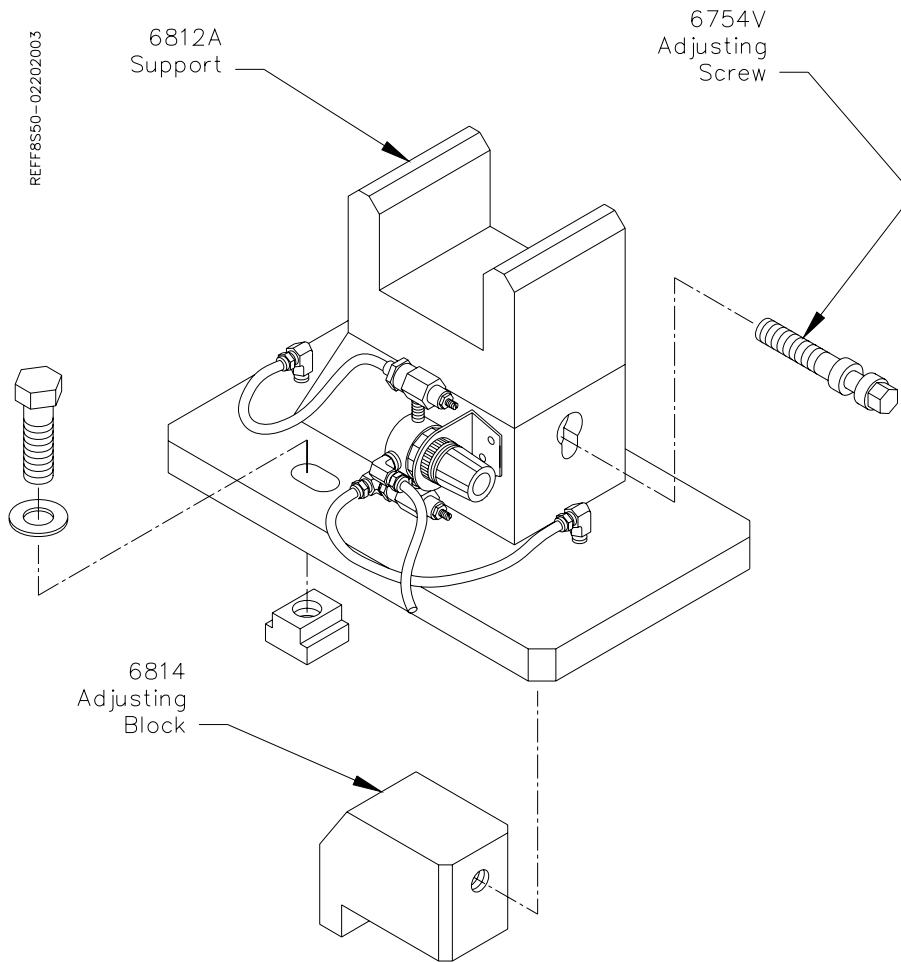
▲ WARNING

Handle these large blocks with Extreme care and guidance. A block hoist is required when handling these blocks.

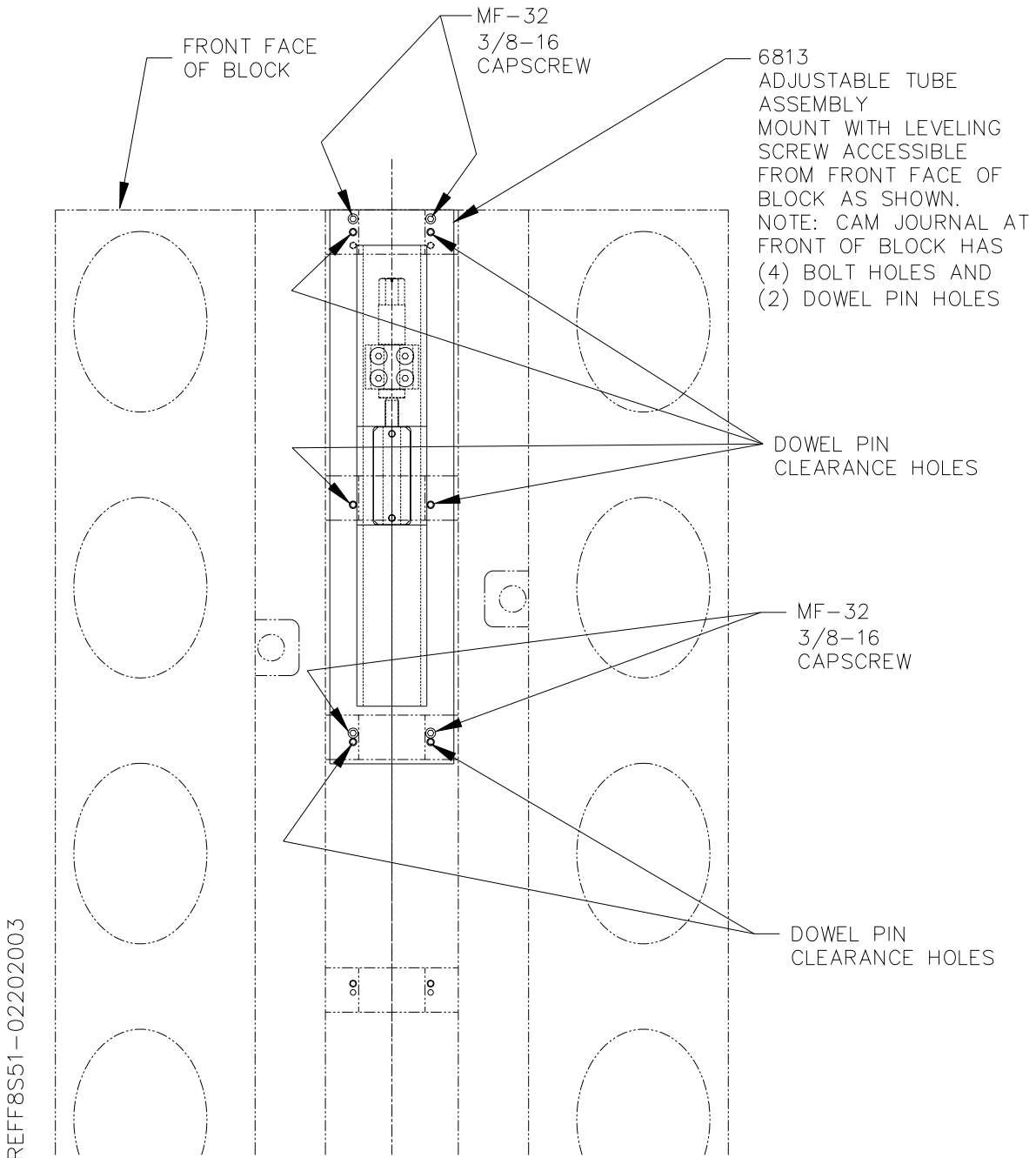
Use the diagram on the following pages when referring to part numbers listed below. This Line Bore fixture consists of a stationary cradle and an adjustable support. The Cradle (6811A) is mounted to the machine bed over the locating pivot key and pin assembly. The locating pivot pin (6819) is pressed into the locating pivot key (6820). This assembly is positioned in the center keyway of the machine bed and the (2) set screws (MF-72) are tightened to lock the key in place. The Cradle is positioned over the pin and mounted to the machine bed. With the mounting bolts installed but not tight this provides a standard pivot point for the Cradle.



The support (6812A) is assembled with the adjusting screw (6754V) and the adjusting block (6814). This assembly is mounted to the machine bed with the lower tab of the adjusting block in the center keyway.

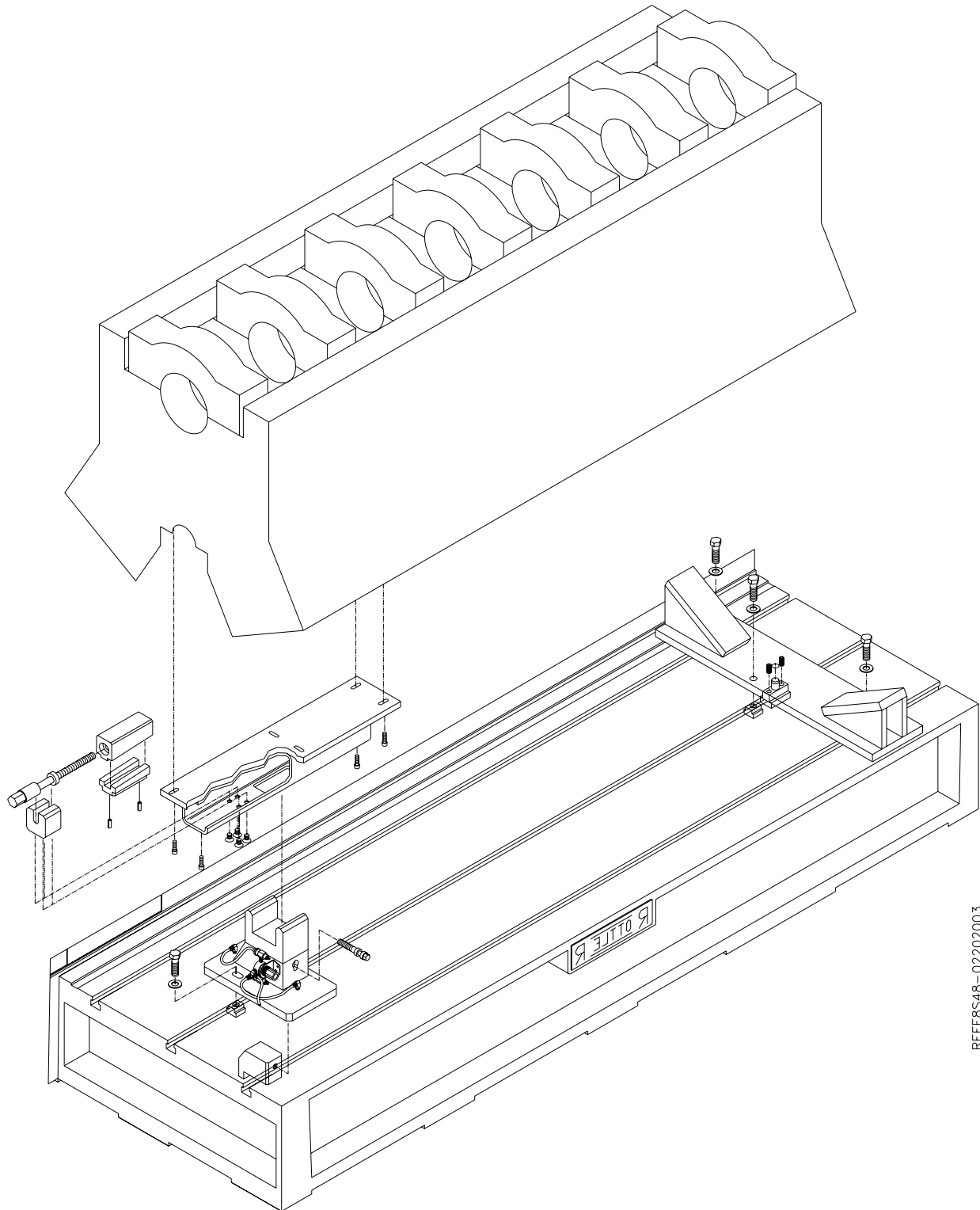


The adjustable tube (6813) is bolted to the Waukesha Block using the Cam Bearing Cap mounting holes. The adjustable tube has ten (10) holes drilled in it. Four (4) of the holes are used to bolt the adjustable tube to the engine block, the remaining six (6) holes are clearance for the cap alignment dowel pins in the engine block. Since the Cam Bearing Caps are not evenly spaced along the block, the adjustable tube must be mounted on the front end of the block as shown in the following illustration.



The upper and lower leveling pads, bracket and screw are already installed in the adjustable tube.

With the adjustable tube installed, the block is ready to be lowered into the Cradle and Support. Use caution to locate the adjustable tube correctly on the support. The two roll pins (MF-229B) installed in the lower leveling pad (6411) are designed to locate the leveling pads properly.



REFFS48-02202003

All mounting bolts should be loose to start with. Due to the design of this fixture the Cradle end of the block is stationary both in relation ship to the machine bed key way and in height. This end is not adjustable. The adjustable end of the fixture is located on the same keyway as the cradle. Once the block is loaded into the fixture it is ready to be leveled. Level the block using the using the leveling screw (6408) inside the adjustable tube. The front of the block is adjusted in and out by activating the air float on the support. Once the block is located in and out deactivate the air float and tighten the support end

mounting bolt to lock into place. Tighten the three (3) mounting bolts on the Cradle end of the fixture now. The level of the block should be checked again at this time.

6821 F88 Line Bore Fixture:

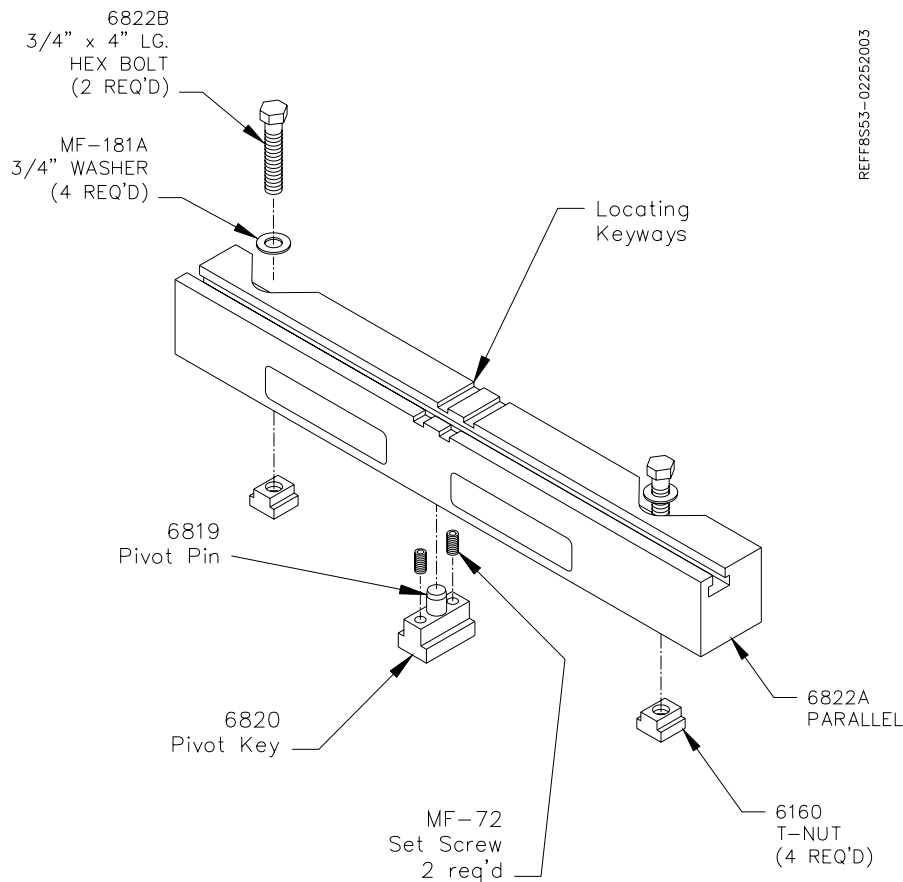
This fixture can only be used on a F88.

This fixture is designed to be mounted directly on the bed of an F88 machine. Due to the large size of these blocks, care must be taken when loading and unloading to avoid bumping the block into the column or spindle unit.

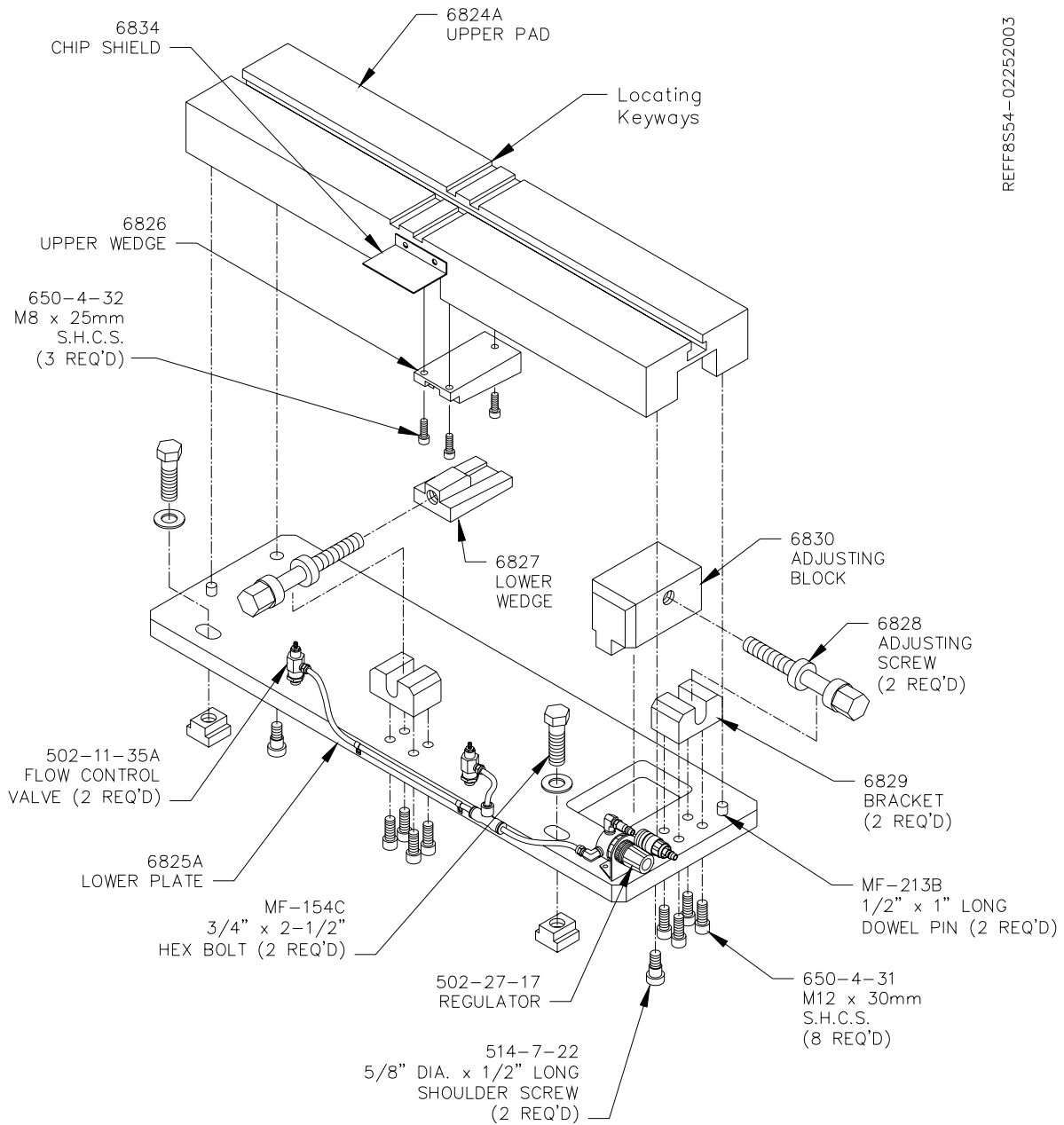
▲ WARNING Handle these large blocks with Extreme care and guidance. A block hoist is required when handling these blocks.

Use diagrams on the following pages when referring to part numbers listed below. This Line Bore fixture consists of a stationary parallel and an adjustable parallel used in conjunction with a cradle that fits the block to be machined.

Install the 6820 Pivot Key (with Pivot Pin already pressed in) into the center keyway on the right hand side of the F88 bed. Tighten the two MF-72 set screws down. This will hold the Pivot key in place while the parallel pivots on the Pivot Pin (6819). Place the parallel onto the pivot pin, install the mounting bolts and washers but do not tighten down.

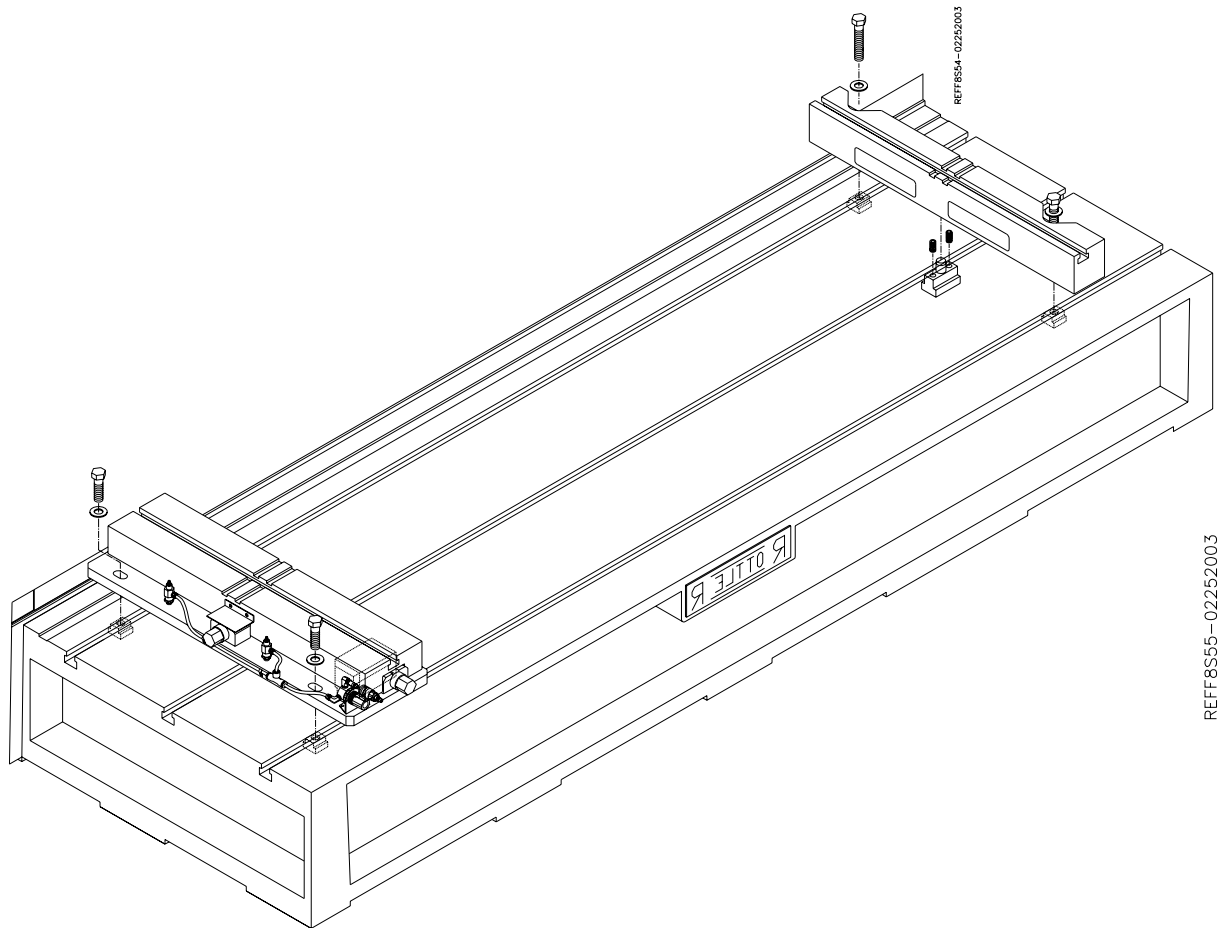


Install the adjustable parallel onto the left hand side of the F88 machine bed with the In/Out adjusting block (6830) located in the front keyway. Install the mounting bolts and washers but do not tighten down.



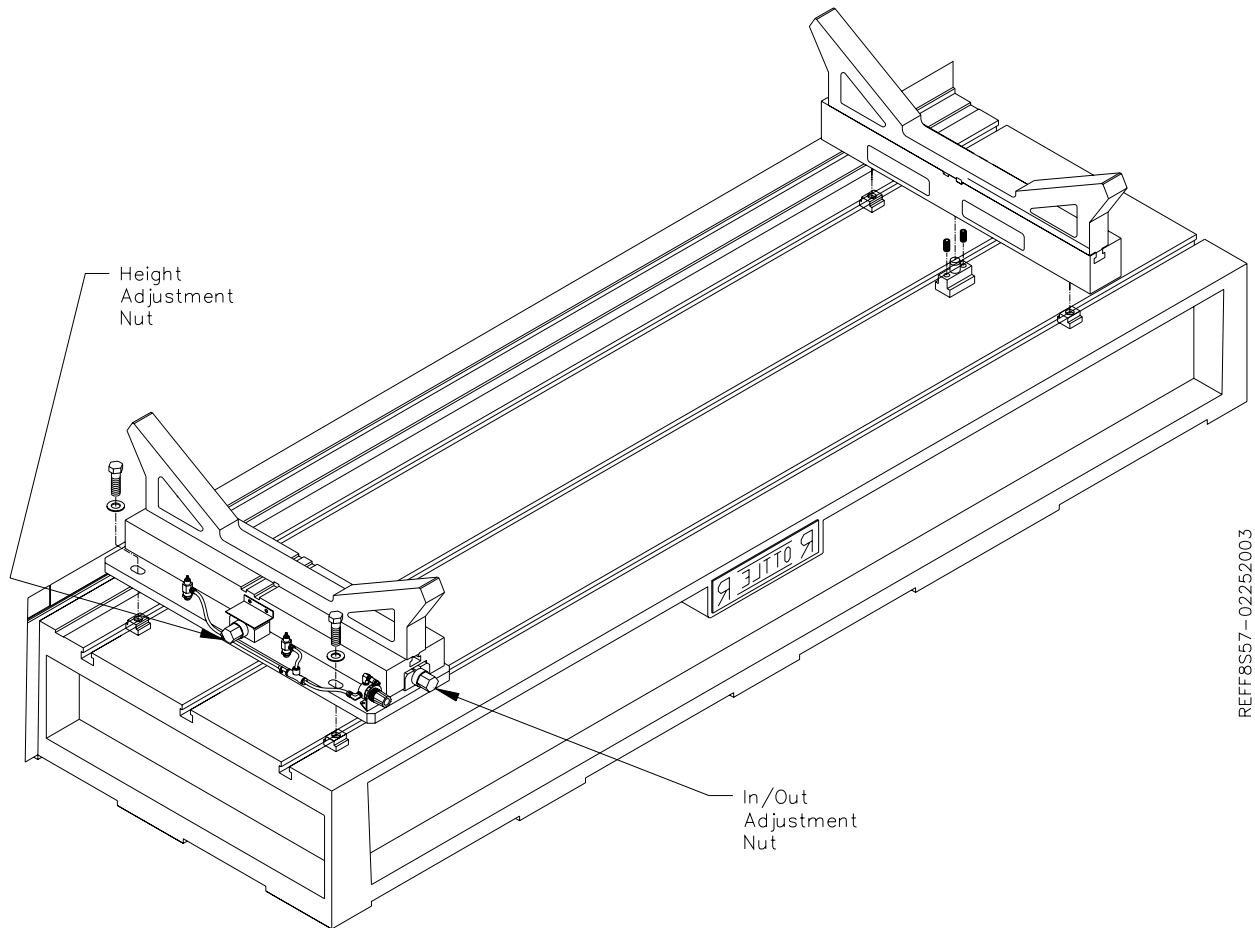
REF8554-02252003

Once both parallels are installed on the machine bed, place a magnetic indicator on the spindle towards the main bed. Indicate the adjustable parallel into the stationary parallel to within .002" on the In/Out and height. This lines the fixture up close so the block can be loaded and then use minor adjustments on the fixture to line the block up.

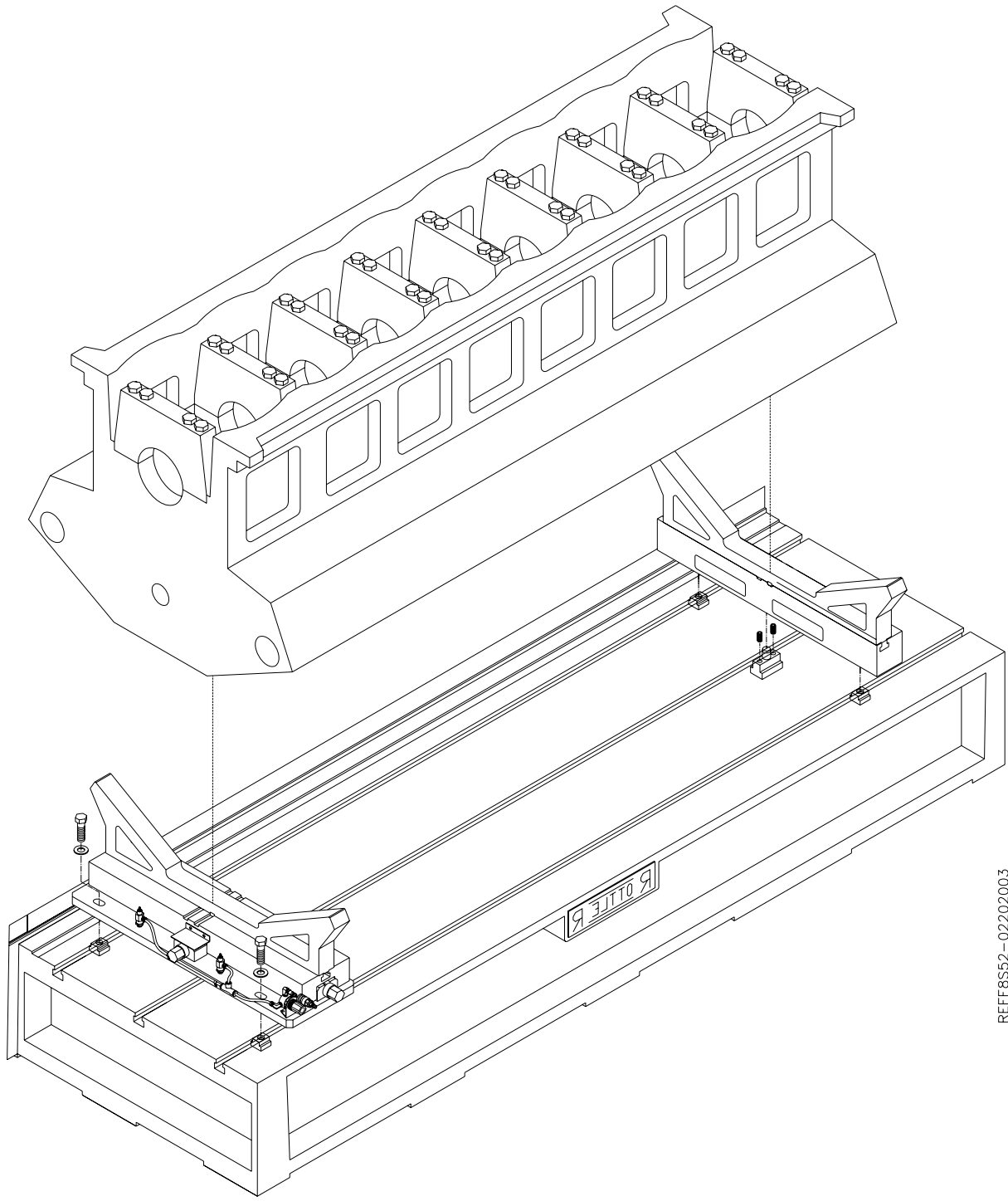


Select the set of V cradles for the block you are going to be machining. There are three (3) types of cradles that can be used on this fixture 90 degree, 115 degree and CAT 3500. There are risers available that can be mounted to the cradles to accommodate certain blocks. For cradle and riser selection refer to the Options section of this manual. The CAT 3500 series cradle is shown in this example.

Place the cradles on the parallels, line up the horizontal key on the cradles with the key slot on the parallels. Install mounting bolts and lock the cradles down.



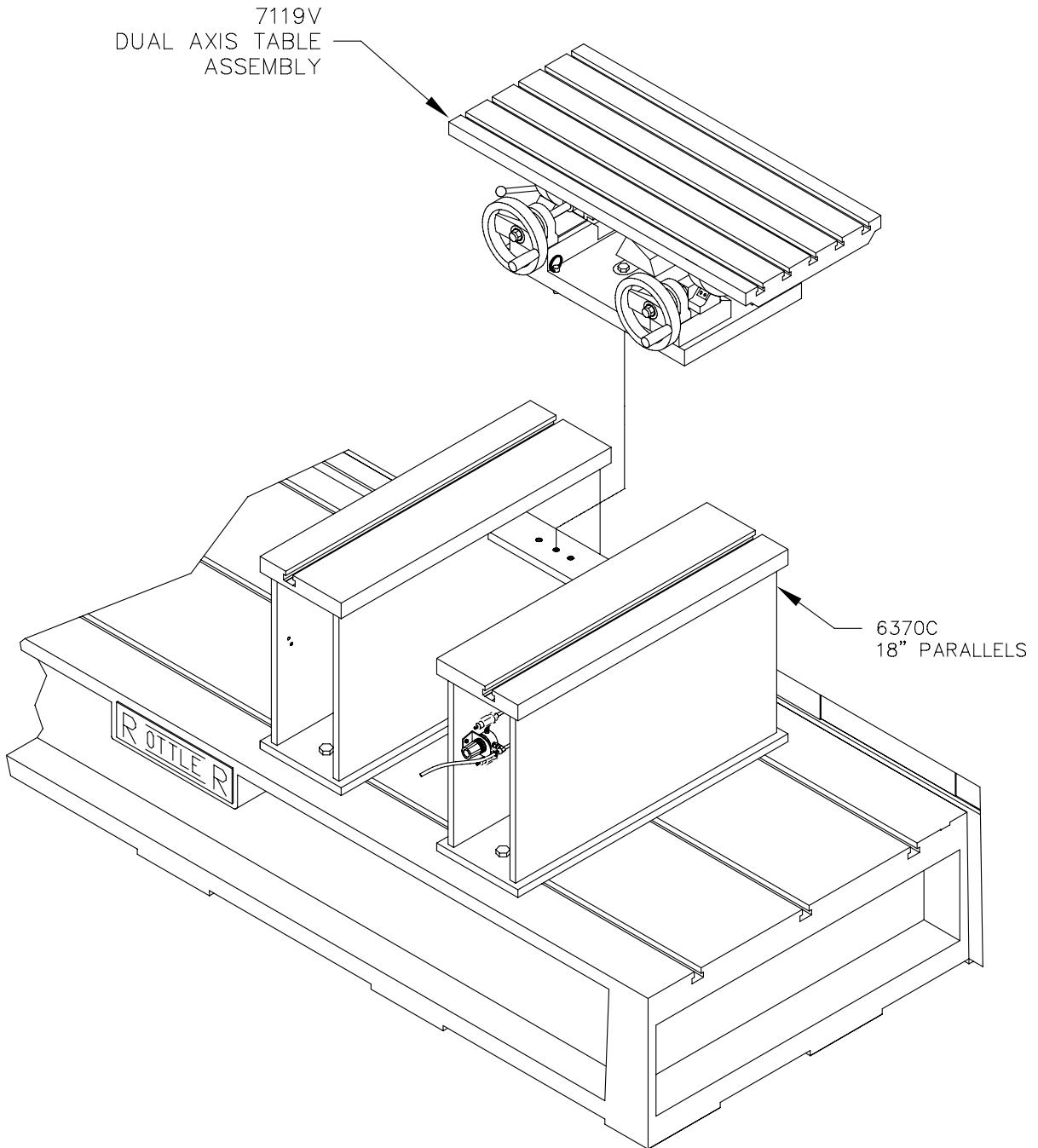
Lower the block slowly down into the cradles. The block is now ready for alignment.



REF:852-02202003

7119V Dual Axis Table Assembly:

REFBUL90-120197



Instructions for Small In-Line Blocks:

The Dual Axis Table has the capability of holding small (less than 13 1/2" from pan rail to head surface) in-line cylinder blocks for resurfacing. This will require the use of parts from the 7119P Universal Head Fixturing package.

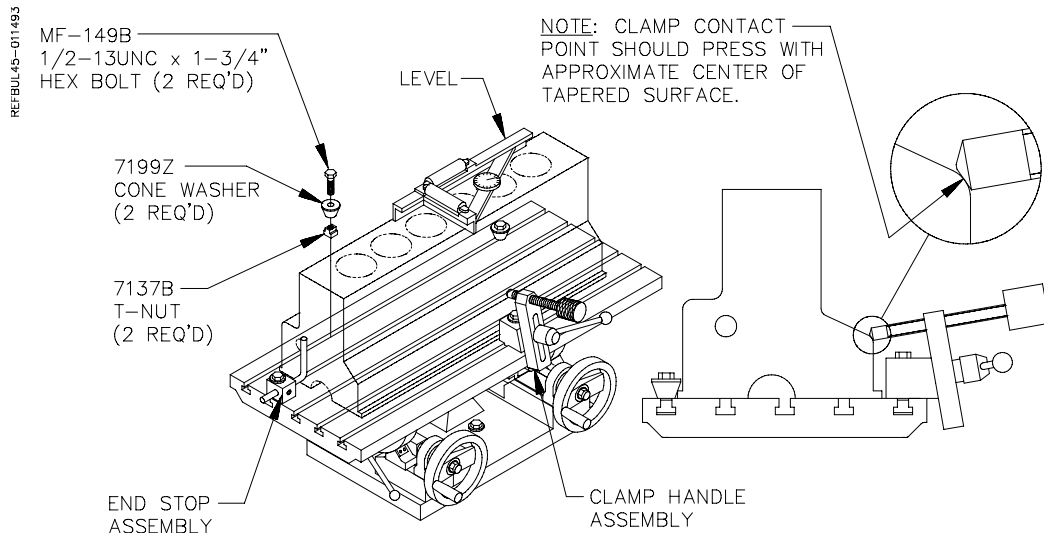
Mounting Block to Table:

There are two (2) methods for mounting blocks to the Table. Blocks with the main caps removed or with the raised main bearings can be mounted directly to the table surface. Block with the main bearing caps installed which are lower than the pan rail surface must be mounted using support blocks from the Universal Fixturing package.

Blocks with Main Caps Removed or Raised Main Bearings:

Remove any burrs from pan rails of block.

Locate cone washers on table to approximately center block in path of cutter-head and 'hook' the edge of the pan rail in the rear. Clamp the block using clamp handle assembly. We suggest you install the stop rod assembly on the left hand end of the block. This is an added safety precaution.



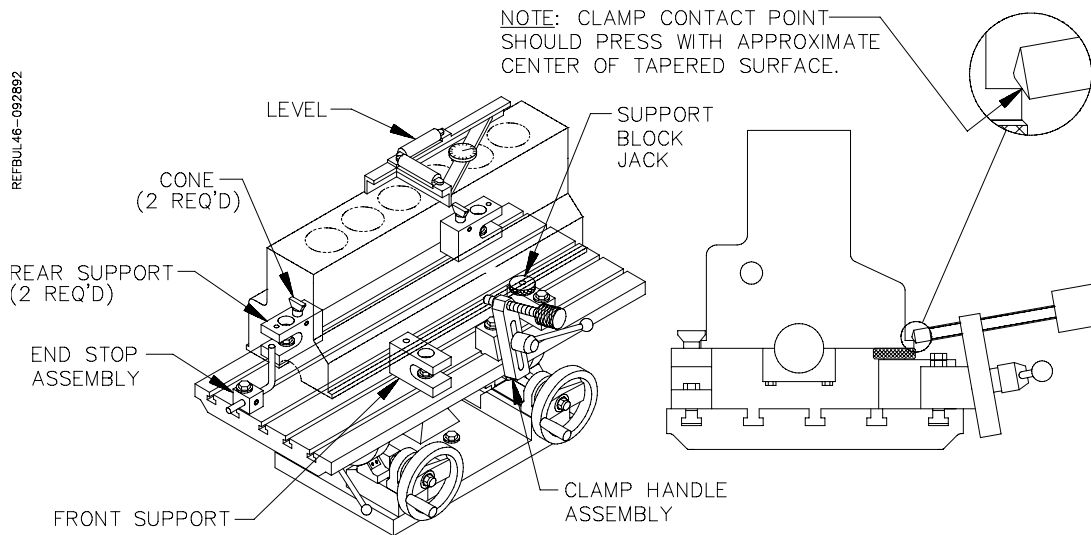
Check that all bolts and holdowns are tight. Loosen table clamp and level head surface of block in both directions. Lock table clamp and recheck block for level.

Blocks with Main Caps Installed:

Remove any burrs from pan rails of block.

Position rear supports and front supports to hold block approximately centered in path of cutter-head. Generally, place the front supports closer together than the rear supports.

Place the block on the supports. Reposition the supports if necessary to clear main caps. Etc. Elevate the cones to hook the pan rail in the rear. Tighten set screws to lock cones in place. Tighten the hex bolts on the supports. Adjust the support block jack to eliminate any rocking. Lightly apply the clamp handle assembly.

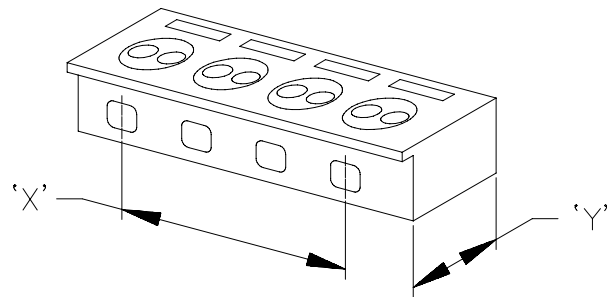


Loosen table clamp and level head surface of block in both directions. Lock table clamp. With the level still on the block tighten clamp handle assembly with appropriate clamp nose on the lower portion of a port or indent near the middle of the block. Tighten the clamp 1/8 to 1/4 turn after contacting the block. Do not over-tighten. Watch the level as you tighten to check for movement or warping. If the block moves or warps, repositioning the front supports inward will generally solve the problem. Check to see that the block cannot be moved in the fixture. We suggest that you install the stop rod assembly on the left hand end of the block. This is an added safety precaution.

Typical Head Set Up Procedure:

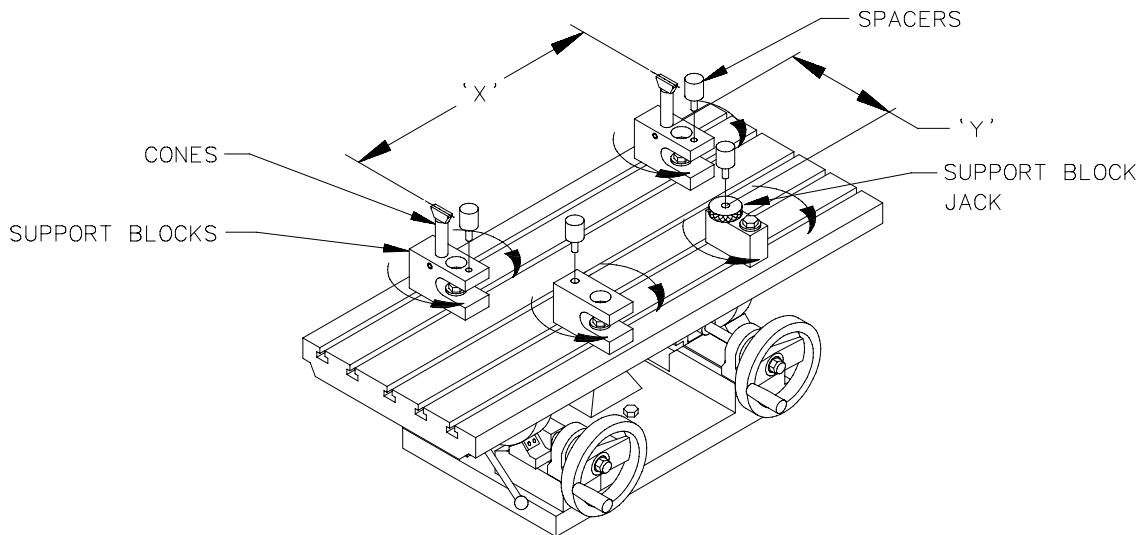
Find the desired ports or bosses, in the head, to position cones (long or short) on rear support blocks. Measure the distance between the centerlines of these ports (bosses) within 1/16" (1mm – 5mm). Measure the distance from rear support points to front support points on the head.

REFSETUP1 – 022594



Position rear support blocks and front support blocks to hold the head approximately centered on the table top and spaced apart per dimensions measured in step '1' above. Generally, place the front blocks closer together than the rear blocks. If necessary, use either 2 or 4 spacers to raise the head for clearing studs or to angle the head so the cutterhead clears the head clamp handle assembly.

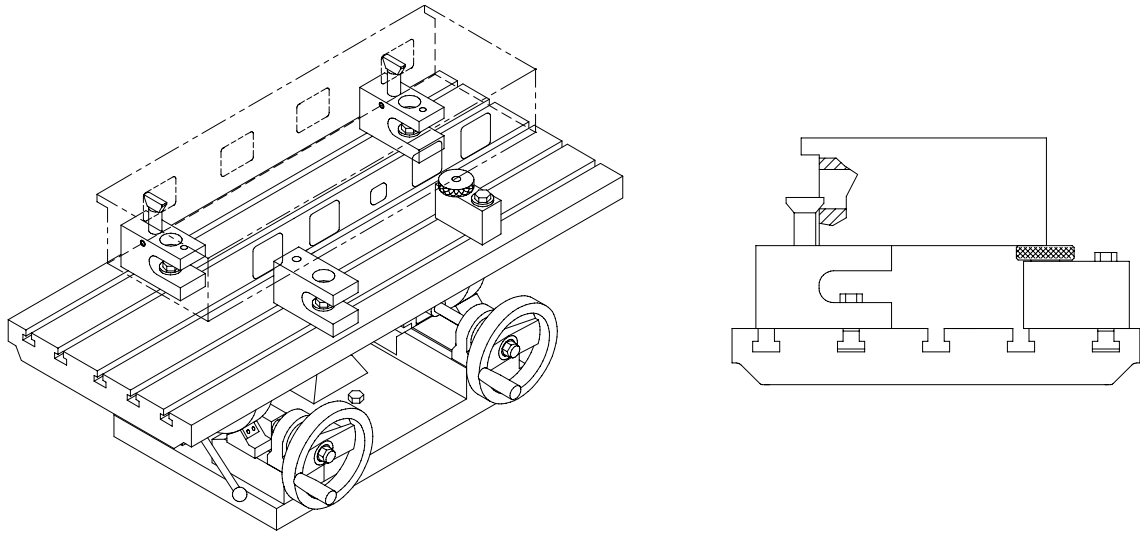
REFSETUP2 – 092292



Place the head on the support blocks. Elevate the cones to 'hook' the two ports (bosses) on the head and tighten their set-screws. Adjust the position of the front support blocks if necessary. Tighten the hex bolts on the support blocks. Push the head back firmly into the cones. Adjust the support block jack to eliminate any rocking of the head. Do not tighten the head clamp handle assembly yet.

Unlock the table. Using the two hand-wheels, level the head surface to be cut. Lock the table in this position.

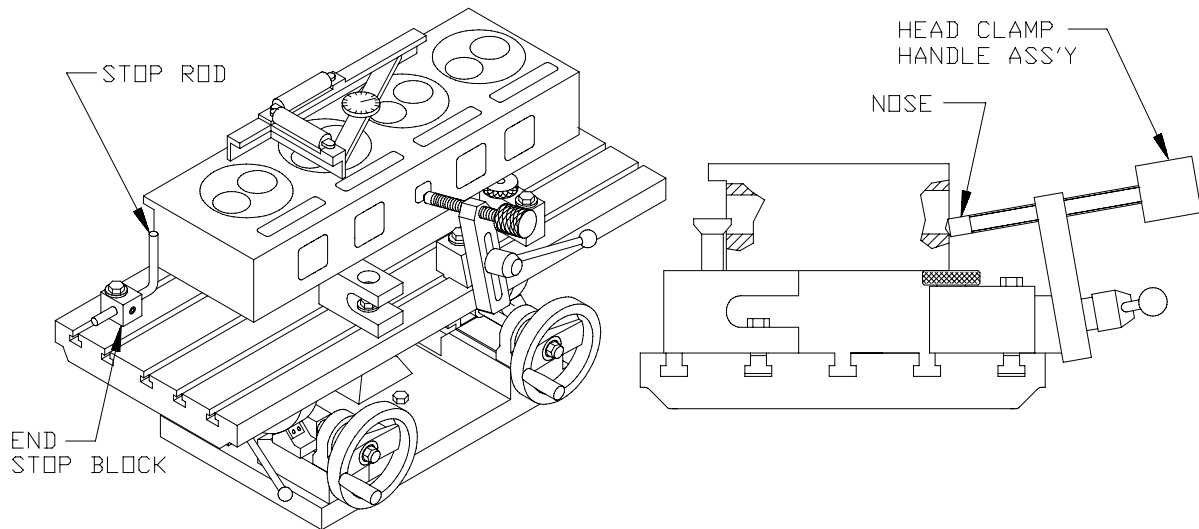
REFSETUP3-092292



The head clamp handle assembly has a replaceable nose that pushes on the head. With the level still on the head surface, tighten the head clamp handle assembly on the lower edge of a port or indent near the middle of the head. Tighten the clamp 1/8 to 1/4 turn after contacting the head. Do not over tighten. Watch the level as you tighten to check for movement or warping. Some heads are very sensitive to support block placement, and the front support blocks may have to be moved slightly inward to prevent this warping. Check to see that the head cannot be moved in the fixture.

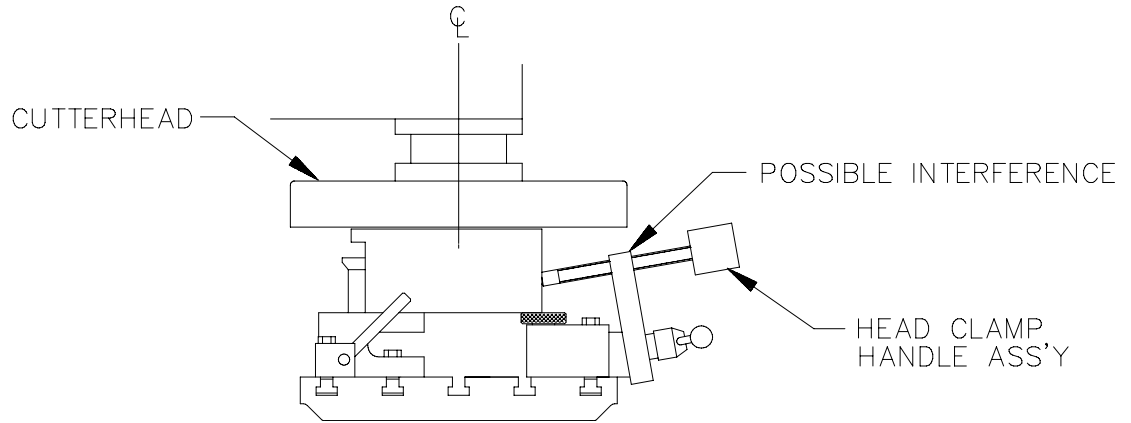
Slide the end stop block up against the left end of the head towards the rear. If possible, rotate the stop rod to contact a machined area on the end of the head. This will aid in loading a run of similar heads.

REFSETUP4-123192



Visually check for clearance between the cutterhead and head fixture tooling pieces, especially the head clamp handle, assembly. The head should be approximately centered in the path of the cutterhead.

REFSETUP5-022594



General Information:

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

The F88S Series machine operates under computerized control. The machine does not know what block is on the machine nor what the operator intends to do. It will follow the program put in by the operator, it is important to double check all programs before running them.

Homing:

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

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

Building Programs:

Bore Mode:

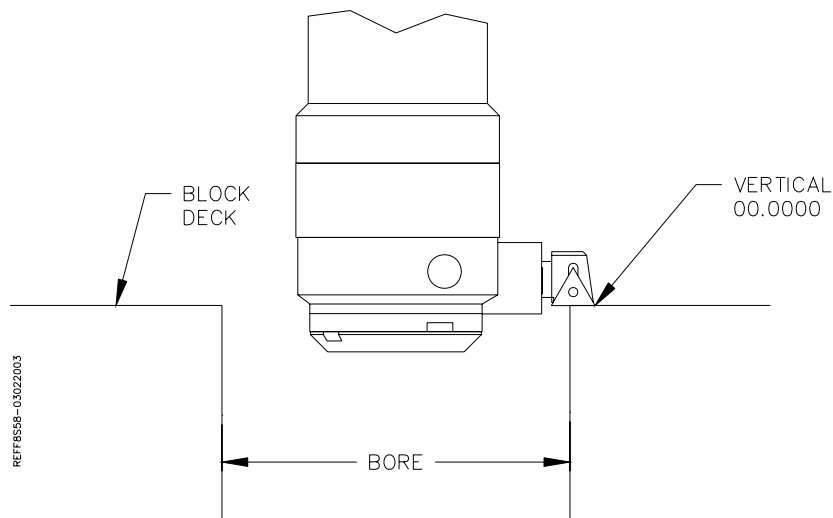
Press the Bore button from the operator control panel. This will put the machine in Bore Mode and clamp the spindle base if it is not already clamped.

Bore Mode uses programs 1 thru 99. Each program has four (4) Vertical stops and twelve (12) Horizontal stops.

Note: *The Y-Axis pin should not be engaged at this time.*

Setting Zero Positions:

Bring the cutterhead over to the first cylinder and center in the bore. Insert a tool holder with a cutter into the cutterhead. Using the Vertical Handwheel bring the cutter down until it just touches off the top of the block. At this point press you Vertical and Horizontal Zero buttons. This will make the top of the block the Vertical Zero position. You will build the program referencing this position.



Vertical Stop Definitions:

Vertical stops are stored in each programs memory. Each time you change programs the vertical stops will change to those stored with the program.

There are four (4) Vertical Stops used in the Bore Mode:

- Stop #1 = Centering Height
- Stop #2 = Start Bore Height
- Stop #3 = Bottom Bore Height
- Stop #4 = Clearance Height

If you are running the machine manually, the spindle will stop at all the vertical stop positions. 1, 2 and 3 during rapid down and 4 in rapid up.

Stop #1 – Centering:

This is the height (in relationship to the Vertical Zero) the machine will center.

Note: This stop needs to be a negative value or it will go down past the vertical zero to a positive value. This will result in a crash.

There are several options that the F80S machine can do when centering.

Manual:

This is used if the Auto Centering is not installed on the machine or the operator wants to center the machine manually. Machine Parameter 140 needs to be set to a zero (0) value.

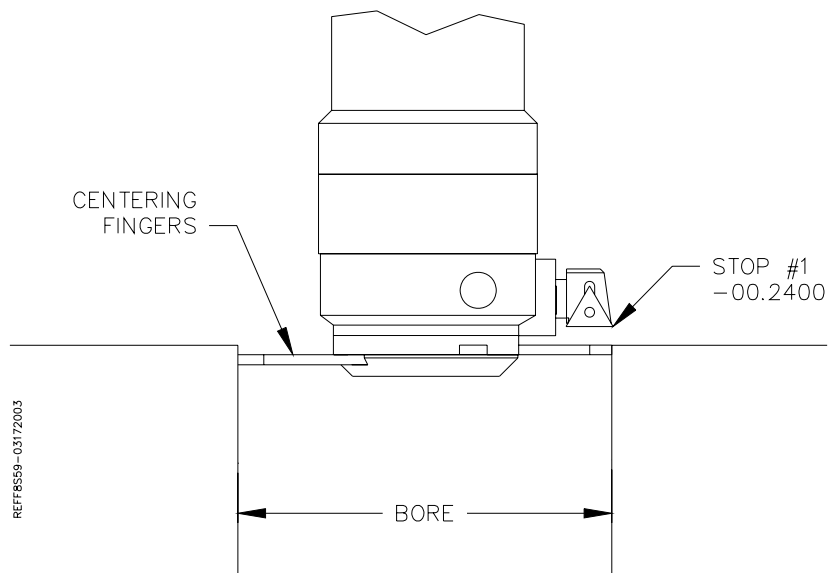
The machine will stop and each cylinder at the Centering Height and wait for the operator to center the machine. After the centering is done the operator needs to press Cycle Start again to bore the cylinder.

Automatic Centering:

This is the most common use of the centering system. The machine will automatically center in each cylinder and then bore that cylinder. Machine parameter 140 needs to be set 2.5.

Automatic (Centering disabled):

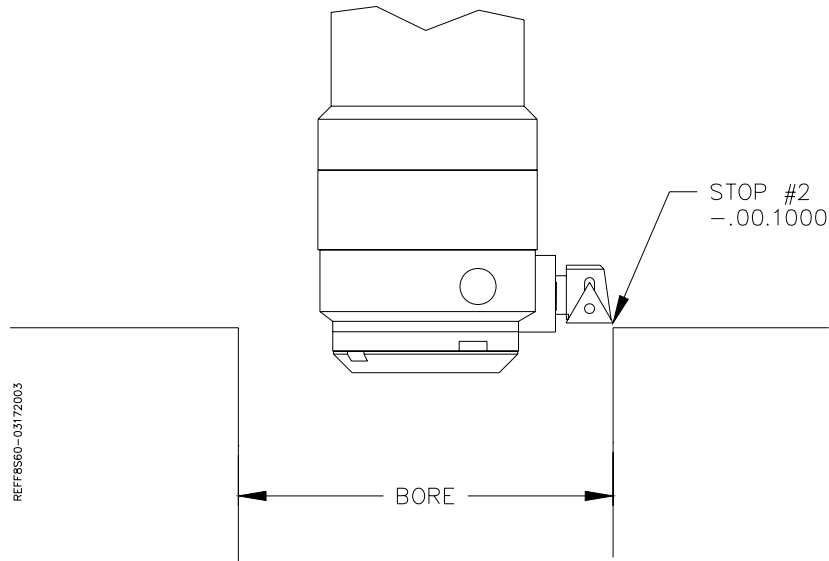
The machine will bore each cylinder without stopping or centering. Machine parameter 140 needs to be set at -0.1.



Stop #2 Start Bore:

This is the height at which the spindle will start rotating and the vertical down feed will start. There is a rapid down move from Stop #1 to Stop #2. This stop is set to minimize the amount of time the spindle is boring air. In the example shown this is a small distance, but, with some of the cutterheads used on the F80S there is a lot more distance here and a slow RPM and feed rate are used.

Note: This stop needs to be a negative value or it will go down past the vertical zero to a positive value. This will result in a crash.



Stop #3 Bottom Bore:

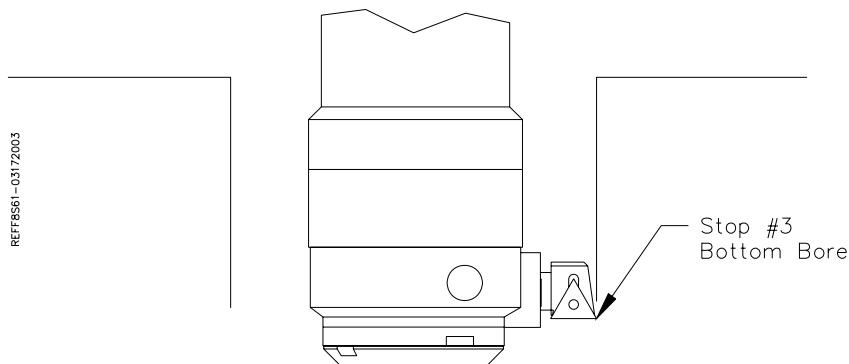
This Stop is the depth of the bore. The following is the sequence of operation the machine performs when it gets to this stop.

As the machine comes to within .002" of the programmed stop, spindle rotation slows to the value set in Machine Parameter 125. The Feed Rate slows to .001" per revolution of the spindle.

When the programmed stop is reached the vertical feed stops. The spindle takes 2 more revolutions (or the value in Machine Parameter 122)

As the spindle completes the revolution, it moves up .010", Indexes the tool at the Spindle Creep speed (Machine Parameter 121), move to the left .020".

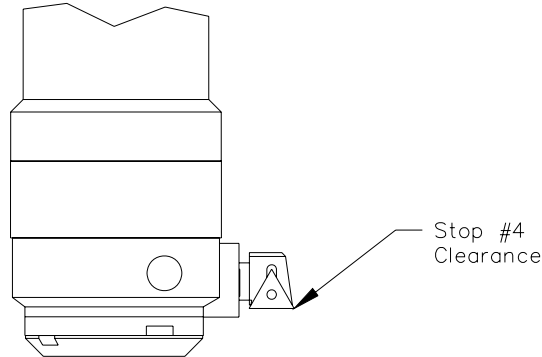
The spindle then does a rapid up move to Stop #4.



Stop #4 Clearance Height:

This stop is above the block deck. It needs to be a large enough value so the cutterhead can travel to the next cylinder without hitting any obstructions.

Note: *This stop needs to be a negative value or it will go down past the vertical zero to a positive value. This will result in a crash.*



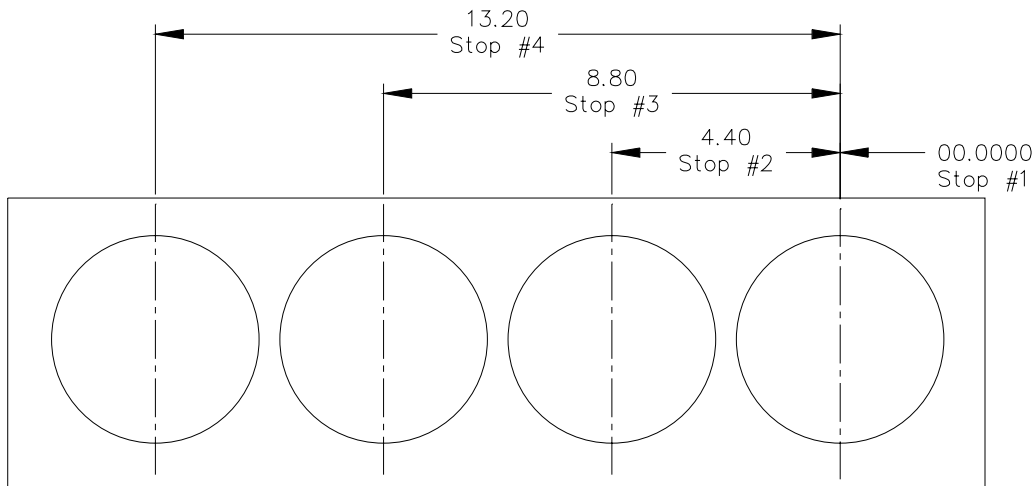
REF F8562-03172003

Horizontal Stop Definitions:

Horizontal stops are stored in each programs memory. Each time you change programs the Horizontal stops will change to those stored with the program.

There are twelve (12) Horizontal Stops used in the Bore Mode:

Center the spindle cutterhead in the first cylinder. Press the Horizontal Zero button. This will set the zero position the Horizontal stops will reference. The Horizontal stops are the distance each cylinders center line is from the horizontal zero point. These stops are accumulative, refer to the drawing below.

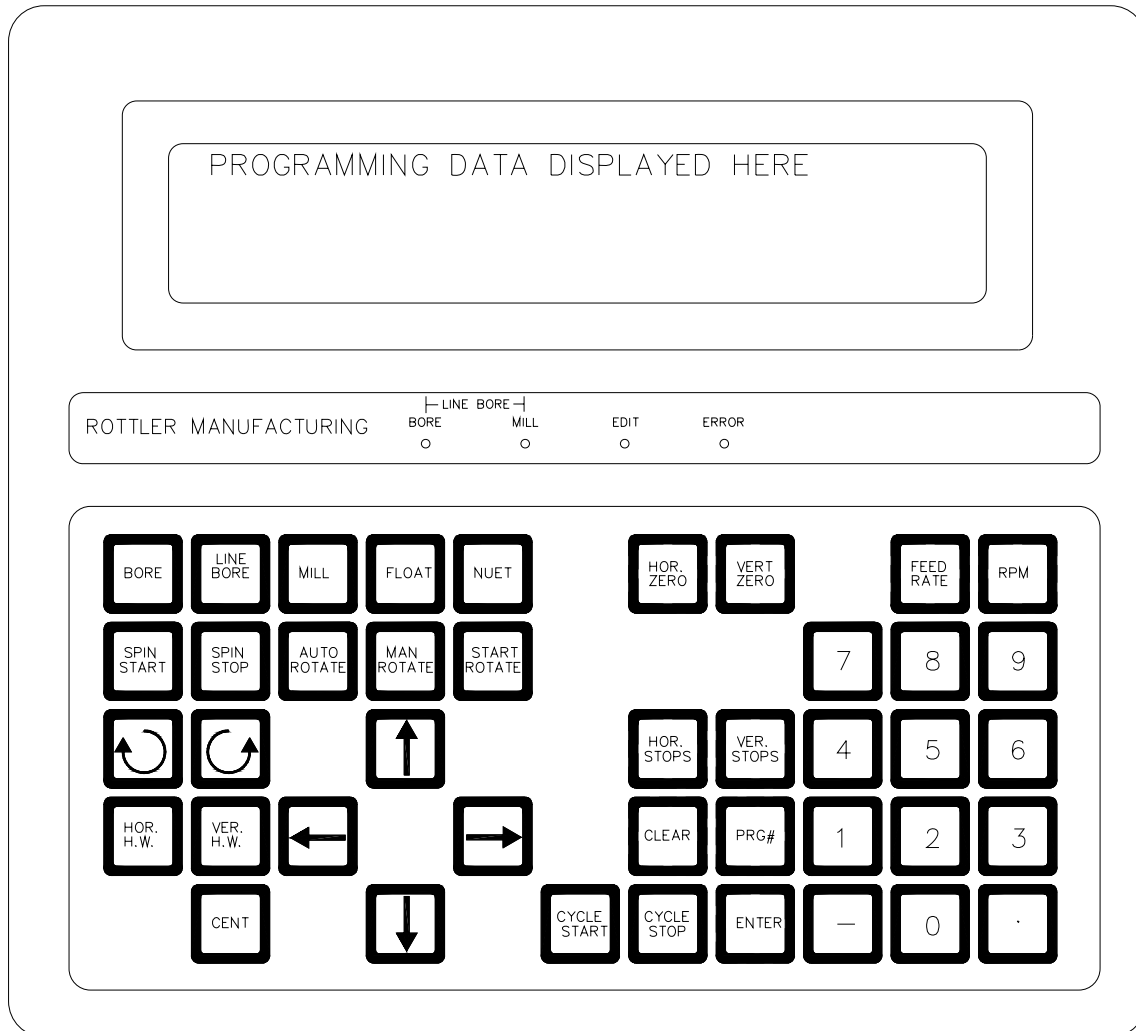


REF F8563-03172003

Selecting a Program Number:

The program numbers for boring are 2 to 99. Rottler manufacturing suggests you leave program 1 open for free travel. This is helpful when performing maintenance or diagnostic.

Below is an illustration of the F80S control panel.



Press **PRG#** on the Control Panel

Control Panel will show the current program on the top line. If you want to keep using that program just press **ENTER**. If you want change the program number press the program number you want to use and then press **ENTER**. Display will return to the operating screen.

Entering Vertical Stops:

Press **VER STOPS** and then **ENTER**. The program number and 1st stop will be shown on the top line of the display.

If you do not want to change that stop value press **ENTER**. The control will then display Stop 2.

If you want to change that stop value, type in the new value and then press **ENTER**. The control will then display Stop 2.

Follow this process until you have programmed all Vertical Stops. When the last stop is programmed and the **ENTER** button is pressed the display will return to the operating screen.

Entering Horizontal Stops:

Press **HOR STOPS** and then **ENTER**. The program number and 1st stop will be shown on the top line of the display.

If you do not want to change that stop value press **ENTER**. The control will then display Stop 2.

If you want to change that stop value, type in the new value and then press **ENTER**. The control will then display Stop 2.

Follow this process until you have programmed all Horizontal Stops. When the last stop is programmed and the **ENTER** button is pressed the display will return to the operating screen.

If you have entered all the stops you need, you can exit the Horizontal Stops by pressing the **HOR STOPS** button at any time. Any changes you made will be saved.

Viewing Vertical and Horizontal Stops:

To view the Vertical and Horizontal Stops without changing them press the **VER STOPS** or **HOR STOPS**, do not press enter after this. The control will display the first stop. Pressing the **VER STOPS** or **HOR STOPS** again will scroll through the stops.

RPM:

Each program needs to have its own RPM entered. If a RPM was not entered the program will not run properly. To enter the RPM press the **RPM** button, type in desired RPM and then press **ENTER**. The new RPM will be displayed on the screen.

Feed Rate:

Each program needs to have its own Feed Rate entered. If a Feed Rate was not entered the program will not run properly. To enter the Feed Rate press the **FEED RATE** button, type in desired Feed Rate and then press **ENTER**. The new Feed Rate will be displayed on the screen.

Safety Check:

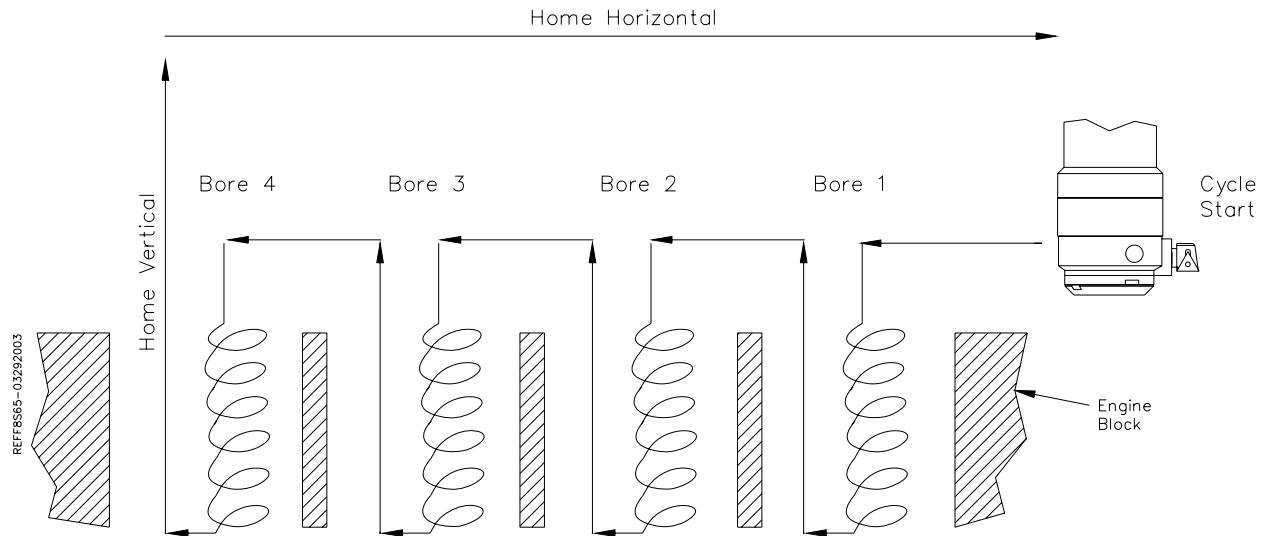
Before starting a cycle the operator needs to perform a safety check every time. Make sure you check the following:

- Correct Program Number.
- Engine Block is Secure.
- All Guards are in place.
- Boring Tool Set and Secure in Cutterhead.
- RPM set.
- Feed Rate set.

Automatic Cycle:

The program is now ready to run. Bring the machine to the right past the Horizontal zero position. Bring the machine up to Vertical Stop 4 (Clearance). Press the **CYCLE START** button. You can stop the cycle by pressing the **CYCLE STOP** button at any time. It is recommended that the **CYCLE STOP** button only be used during the automatic horizontal travel. The cycle can be started again by pressing the **CYCLE START** button again. The machine will continue the cycle from the position it is at. It will not start the cycle over. To run an entire cycle you have to be at or to the right of the Horizontal Zero position.

The following illustration shows the path the automatic cycle will run.



Manual Cycle:

You can also run a single bore cycle with the F80S. Center the cutterhead on the cylinder you want to bore, move the cutterhead to the Start Bore or Stop #2 position. Then press SPINDLE START and then the DOWN button. The spindle will start and down feed will begin. The machine will finish that bore, retract and move over the next horizontal stop. It will then stop the cycle.

Bore Mode w/ Auto Rotate Fixture:

Machine Parameter 141 must be at a value other than zero (0). If this parameter is at zero it is telling the machine there is no rotate fixture installed. All inputs and outputs associated with the Auto Rotate are ignored. The value entered into Machine Parameter 141 is the distance the machine will move after the last bore, on the first bank, to the left. This distance is to move the spindle out of the way to the block can be rotated.

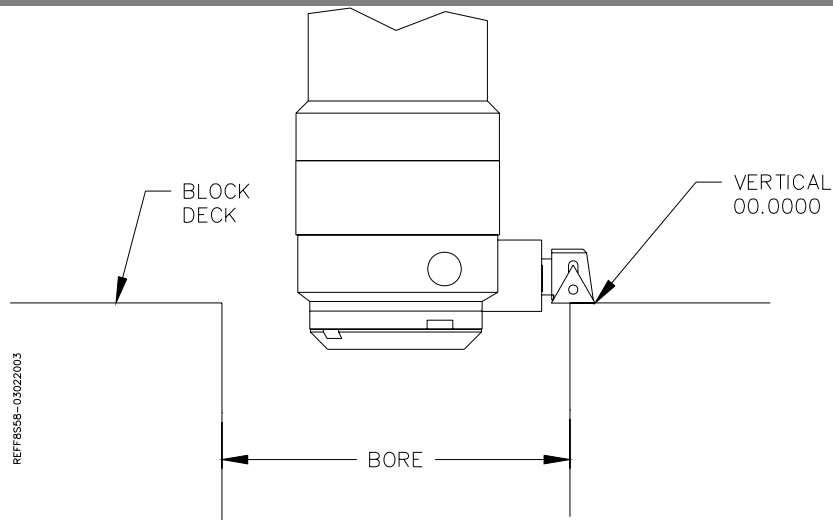
Press the Bore button from the operator control panel. This will put the machine in Bore Mode and clamp the spindle base if it is not already clamped.

Bore Mode uses programs 1 thru 99. Each program has four (4) Vertical stops and twelve (12) Horizontal stops.

Note: *The Y-Axis pin should not be engaged at this time.*

Setting Zero Positions:

Bring the cutterhead over to the first cylinder and center in the bore. Insert a tool holder with a cutter into the cutterhead. Using the Vertical Handwheel bring the cutter down until it just touches off the top of the block. At this point press you Vertical and Horizontal Zero buttons. This will make the top of the block the Vertical Zero position. You will build the program referencing this position.



Vertical Stop Definitions:

Vertical stops are stored in each programs memory. Each time you change programs the vertical stops will change to those stored with the program.

There are four (4) Vertical Stops used in the Bore Mode:

- Stop #1 = Centering Height
- Stop #2 = Start Bore Height
- Stop #3 = Bottom Bore Height
- Stop #4 = Clearance Height

If you are running the machine manually, the spindle will stop at all the vertical stop positions. 1, 2 and 3 during rapid down and 4 in rapid up.

Stop #1 – Centering:

This is the height (in relationship to the Vertical Zero) the machine will center.

Note: *This stop needs to be a negative value or it will go down past the vertical zero to a positive value. This will result in a crash.*

There are several options that the F80S machine can do when centering.

Manual:

This is used if the Auto Centering is not installed on the machine or the operator wants to center the machine manually. Machine Parameter 140 needs to be set to a zero (0) value.

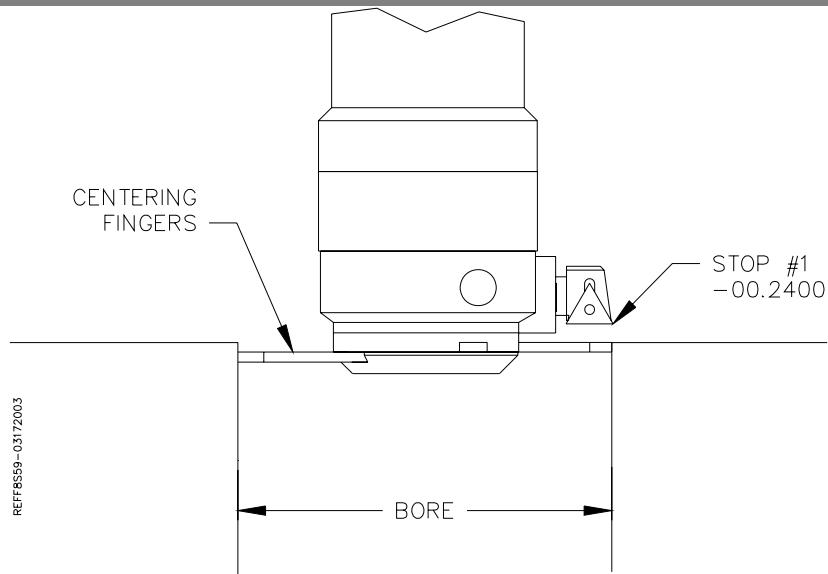
The machine will stop and each cylinder at the Centering Height and wait for the operator to center the machine. After the centering is done the operator needs to press Cycle Start again to bore the cylinder.

Automatic Centering:

This is the most common use of the centering system. The machine will automatically center in each cylinder and then bore that cylinder. Machine parameter 140 needs to be set 2.5.

Automatic (Centering disabled):

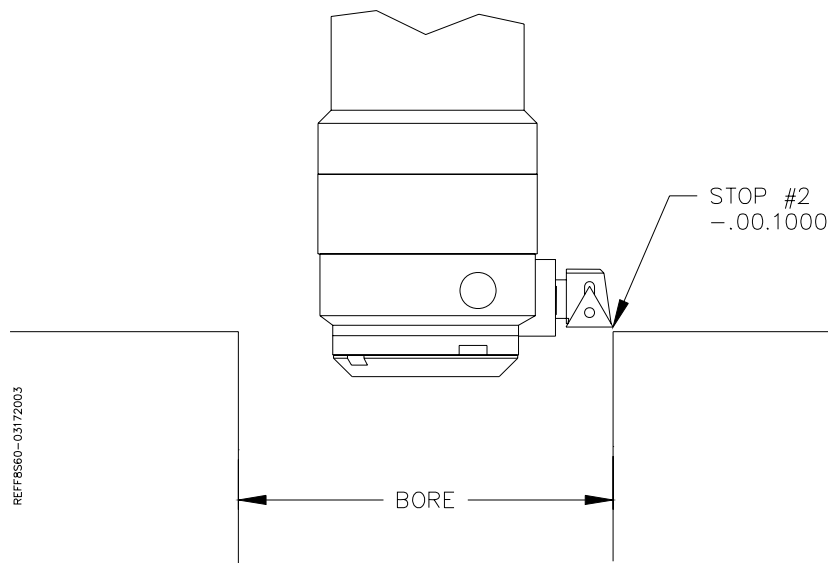
The machine will bore each cylinder without stopping or centering. Machine parameter 140 needs to be set at -0.1.



Stop #2 Start Bore:

This is the height at which the spindle will start rotating and the vertical down feed will start. There is a rapid down move from Stop #1 to Stop #2. This stop is set to minimize the amount of time the spindle is boring air. In the example shown this is a small distance, but, with some of the cutterheads used on the F80S there is a lot more distance here and a slow RPM and feed rate are used.

Note: This stop needs to be a negative value or it will go down past the vertical zero to a positive value. This will result in a crash.



Stop #3 Bottom Bore:

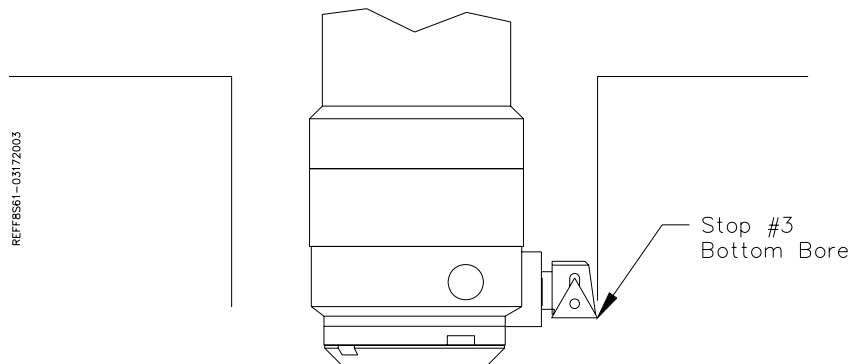
This Stop is the depth of the bore. The following is the sequence of operation the machine performs when it gets to this stop.

As the machine comes to within .002" of the programmed stop, spindle rotation slows to the value set in Machine Parameter 125. The Feed Rate slows to .001" per revolution of the spindle.

When the programmed stop is reached the vertical feed stops. The spindle takes 2 more revolutions (or the value in Machine Parameter 122)

As the spindle completes the revolution, it moves up .010", Indexes the tool at the Spindle Creep speed (Machine Parameter 121), move to the left .020".

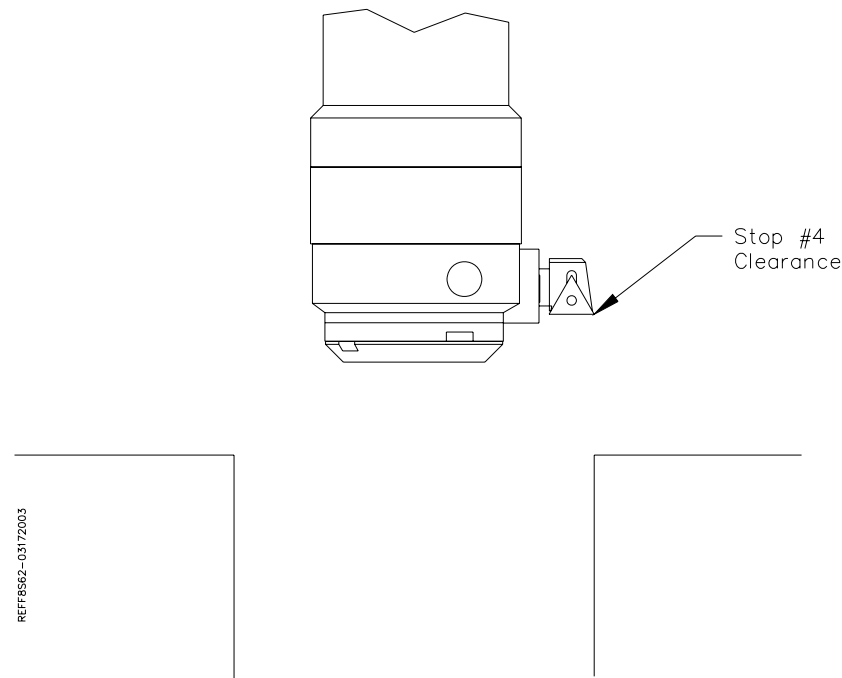
The spindle then does a rapid up move to Stop #4.



Stop #4 Clearance Height:

This stop is above the block deck. It needs to be a large enough value so the cutterhead can travel to the next cylinder without hitting any obstructions.

Note: *This stop needs to be a negative value or it will go down past the vertical zero to a positive value. This will result in a crash.*



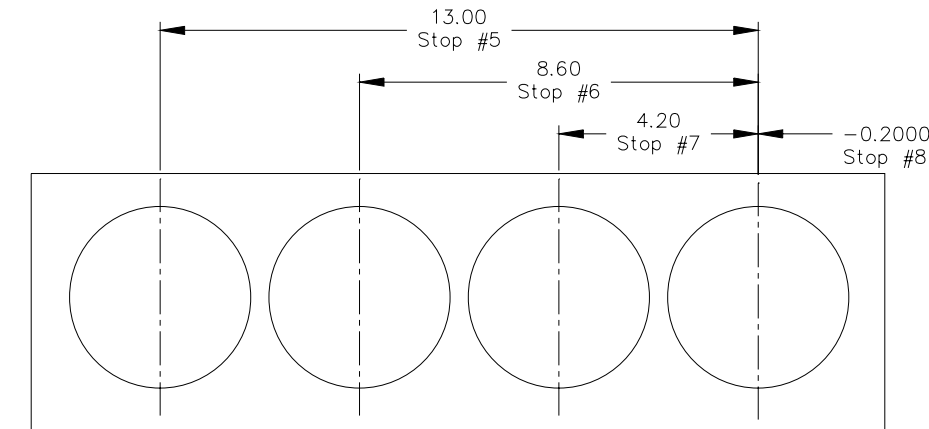
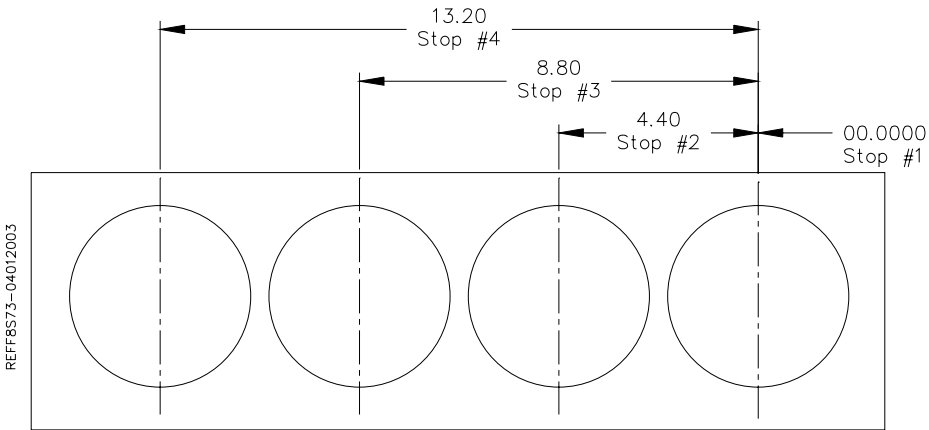
Horizontal Stop Definitions:

Horizontal stops are stored in each programs memory. Each time you change programs the Horizontal stops will change to those stored with the program.

There are twelve (12) Horizontal Stops used in the Bore Mode. After entering each stop you will be prompted for a rotate value. The following are the rotate values.

- 0 = No Rotate
- 1 = Forward Rotate, this is a Counter Clockwise rotation.
- 2 = Reverse Rotate, this is a Clockwise rotation.

Center the spindle cutterhead in the first cylinder. Press the Horizontal Zero button. This will set the zero position the Horizontal stops will reference. The Horizontal stops are the distance each cylinders center line is from the horizontal zero point. These stops are accumulative, refer to the drawing below.

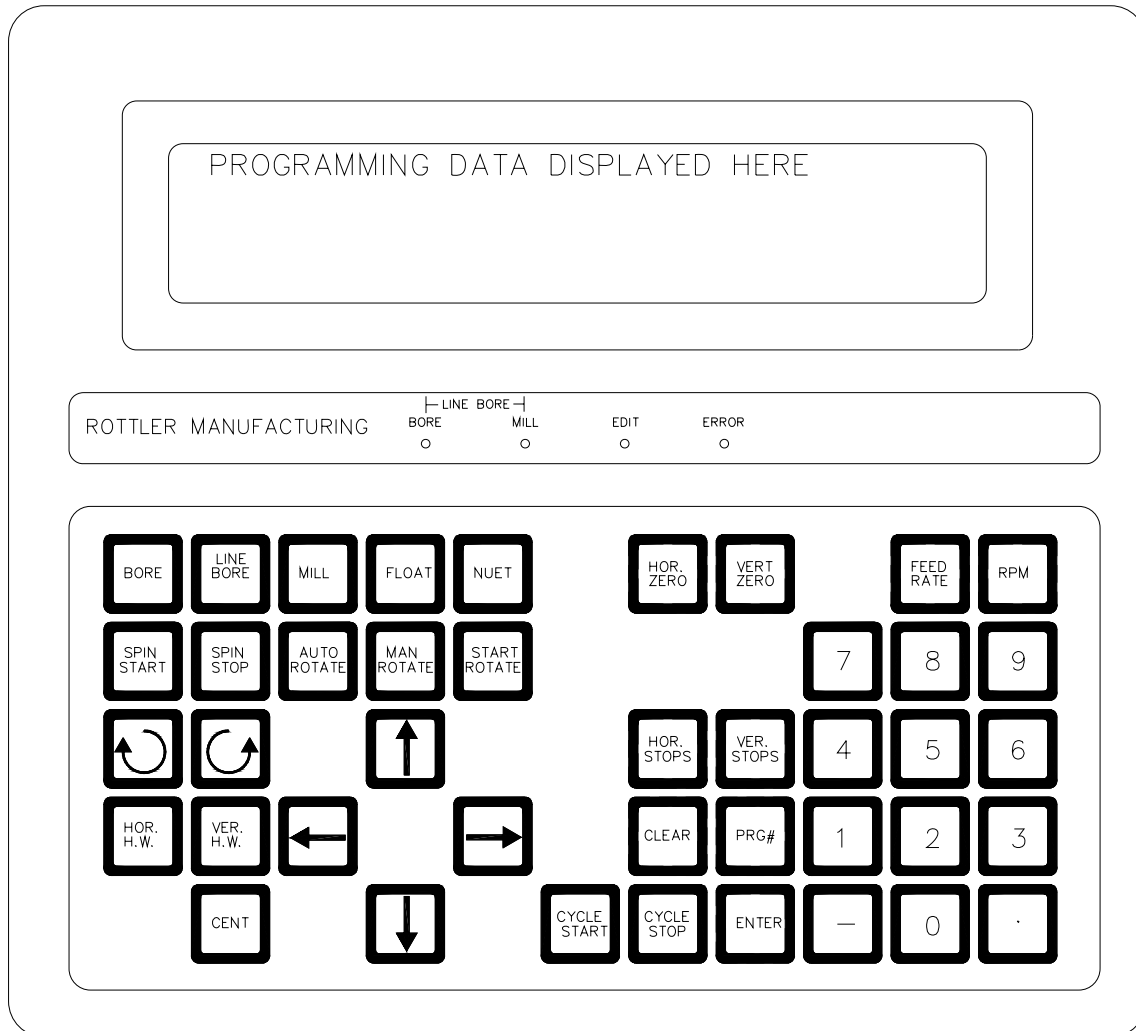


Note: There is a rotate of the fixture between stop 4 and 5. On the first bank the machine bores the cylinders from right to left. After the rotate, the machine will bore the second bank from left to right. Stops 5 thru 8 will be a decreasing value.

Selecting a Program Number:

The program numbers for boring are 2 to 99. Rottler manufacturing suggests you leave program 1 open for free travel. This is helpful when performing maintenance or diagnostic.

Below is an illustration of the F80S control panel.



Press **PRG#** on the Control Panel

Control Panel will show the current program on the top line. If you want to keep using that program just press **ENTER**. If you want change the program number press the program number you want to use and then press **ENTER**. Display will return to the operating screen.

Entering Vertical Stops:

Press **ENTER**, **VER STOPS** and then **ENTER**. The program number and 1st stop will be shown on the top line of the display.

If you do not want to change that stop value press **ENTER**. The control will then display Stop 2.

If you want to change that stop value, type in the new value and then press **ENTER**. The control will then display Stop 2.

Follow this process until you have programmed all Vertical Stops. When the last stop is programmed and the **ENTER** button is pressed the display will return to the operating screen.

Entering Horizontal Stops:

Press **ENTER**, **HOR STOPS** and then **ENTER**. The program number and 1st stop will be shown on the top line of the display.

If you do not want to change that stop value press **ENTER**. The display will then prompt you for a rotate action. If you do not want the fixture to rotate press "0" and then **ENTER**, press "1" if you want a forward rotate and "2" if you want a reverse rotate then press **ENTER**. The control will then display Stop 2.

If you want to change that stop value, type in the new value and then press **ENTER**. The display will then prompt you for a rotate action. If you do not want the fixture to rotate press "0" and then **ENTER**, press "1" if you want a forward rotate and "2" if you want a reverse rotate then press **ENTER**. The control will then display Stop 2.

Follow this process until you have programmed all Horizontal Stops. When the last stop is programmed and the **ENTER** button is pressed the display will return to the operating screen.

Note: You must put in a reverse rotate after the last Horizontal stop. This will return the Rotate Fixture to the Home position ready for another block to be loaded.

If you have entered all the stops you need, you can exit the Horizontal Stops by pressing the **HOR STOPS** button at any time. Any changes you made will be saved.

Viewing Vertical and Horizontal Stops:

To view the Vertical and Horizontal Stops without changing them press the **VER STOPS** or **HOR STOPS**, do not press enter after this. The control will display the first stop. Pressing the **VER STOPS** or **HOR STOPS** again will scroll through the stops.

RPM:

Each program needs to have its own RPM entered. If a RPM was not entered the program will not run properly. To enter the RPM press the **RPM** button, type in desired RPM and then press **ENTER**. The new RPM will be displayed on the screen.

Feed Rate:

Each program needs to have its own Feed Rate entered. If a Feed Rate was not entered the program will not run properly. To enter the Feed Rate press the **FEED RATE** button, type in desired Feed Rate and then press **ENTER**. The new Feed Rate will be displayed on the screen.

Safety Check:

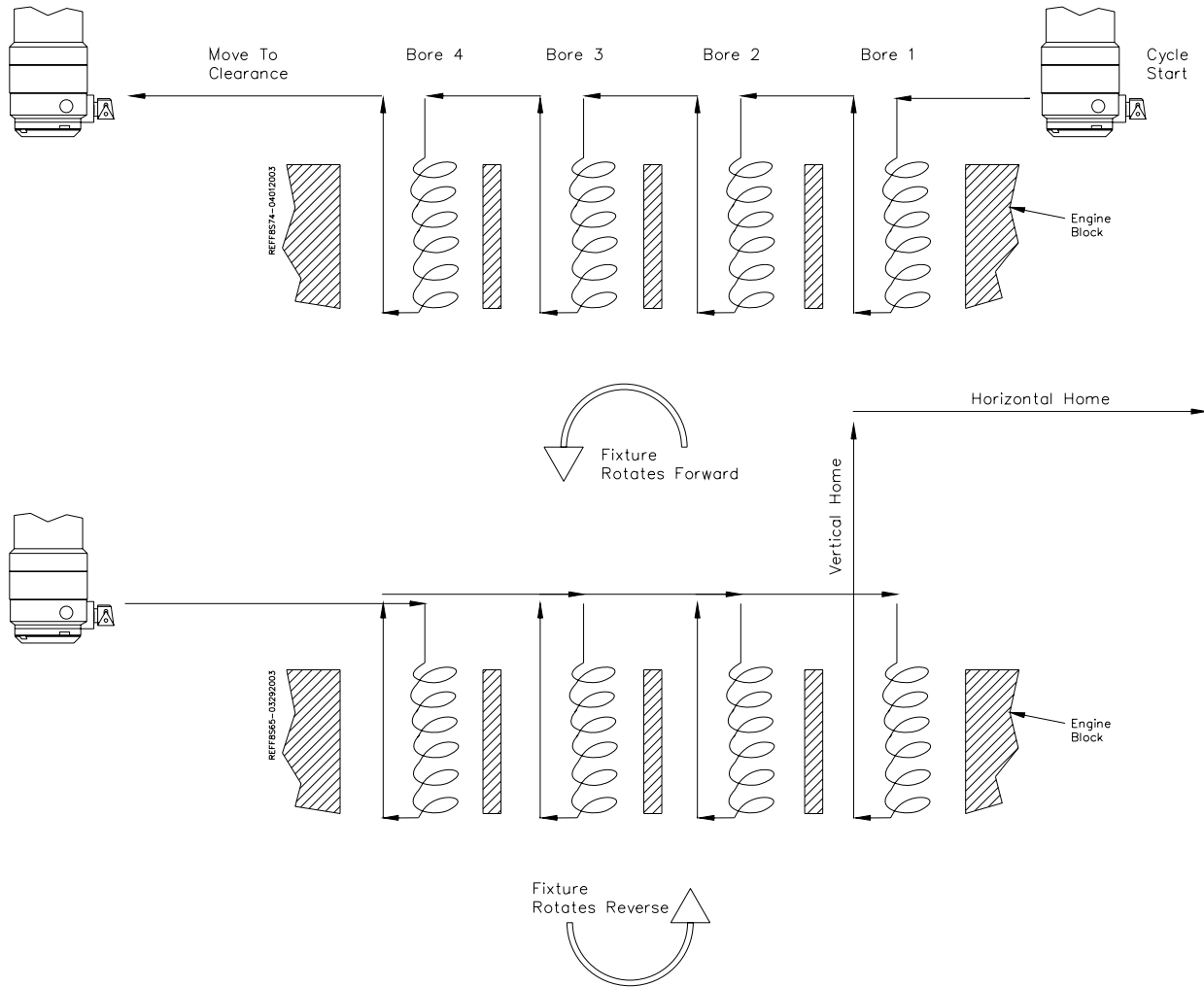
Before starting a cycle the operator needs to perform a safety check every time. Make sure you check the following:

- Correct Program Number.
- Engine Block is Secure.
- All Guards are in place.
- Boring Tool Set and Secure in Cutterhead.
- RPM set.
- Feed Rate set.

Automatic Cycle:

The program is now ready to run. Bring the machine to the right past the Horizontal zero position. Bring the machine up to Vertical Stop 4 (Clearance). Press the **CYCLE START** button. You can stop the cycle by pressing the **CYCLE STOP** button at any time. It is recommended that the **CYCLE STOP** button only be used during the automatic horizontal travel. The cycle can be started again by pressing the **CYCLE START** button again. The machine will continue the cycle from the position it is at. It will not start the cycle over. To run an entire cycle you have to be at or to the right of the Horizontal Zero position.

The following illustration shows the path the automatic cycle will run.



Manual Cycle:

You can also run a single bore cycle with the F80S. Center the cutterhead on the cylinder you want to bore, move the cutterhead to the Start Bore or Stop #2 position. Then press SPINDLE START and then the DOWN button. The spindle will start and down feed will begin. The machine will finish that bore, retract and move over the next horizontal stop. It will then stop the cycle.

Lower Sleeve Repair:

Press the Bore button from the operator control panel. This will put the machine in Bore Mode and clamp the spindle base if it is not already clamped.

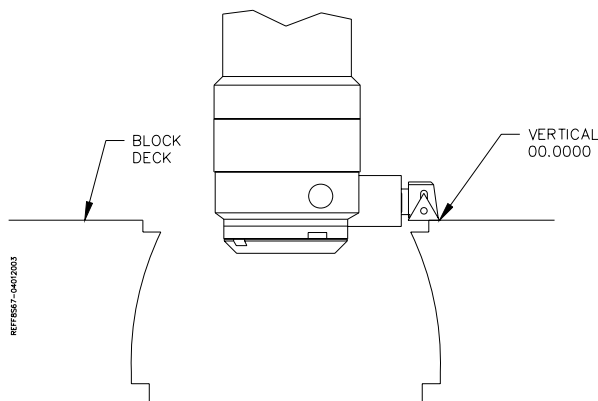
If Lower Sleeve repair software was not purchased with the machine, this program will not operate.

Lower Sleeve Repair uses programs 121 thru 150. Each program has four (4) Vertical stops, twelve (12) Horizontal stops and one Offset setting.

Note: *The Y-Axis pin should not be engaged at this time.*

Setting Zero Positions:

Bring the cutterhead over to the first cylinder and center in the bore. Insert a tool holder with a cutter into the cutterhead. Using the Vertical Handwheel bring the cutter down until it just touches off the top of the block. At this point press you Vertical and Horizontal Zero buttons. This will make the top of the block the Vertical Zero position. You will build the program referencing this position.



Vertical Stop Definitions:

Vertical stops are stored in each programs memory. Each time you change programs the vertical stops will change to those stored with the program.

There are four (4) Vertical Stops used in the Bore Mode:

Stop #1 = Centering Height

After entering Stop #1 you will be prompted for the Offset amount. Type in the offset amount and press **ENTER**.

Stop #2 = Start Bore Height

Stop #3 = Bottom Bore Height

Stop #4 = Clearance Height

If you are running the machine manually, the spindle will stop at all the vertical stop positions. 1, 2 and 3 during rapid down and 4 in rapid up.

Stop #1 – Centering:

This is the height (in relationship to the Vertical Zero) the machine will center.

Note: *This stop needs to be a negative value or it will go down past the vertical zero to a positive value. This will result in a crash.*

There are several options that the F80S machine can do when centering.

Manual:

This is used if the Auto Centering is not installed on the machine or the operator wants to center the machine manually. Machine Parameter 140 needs to be set to a zero (0) value.

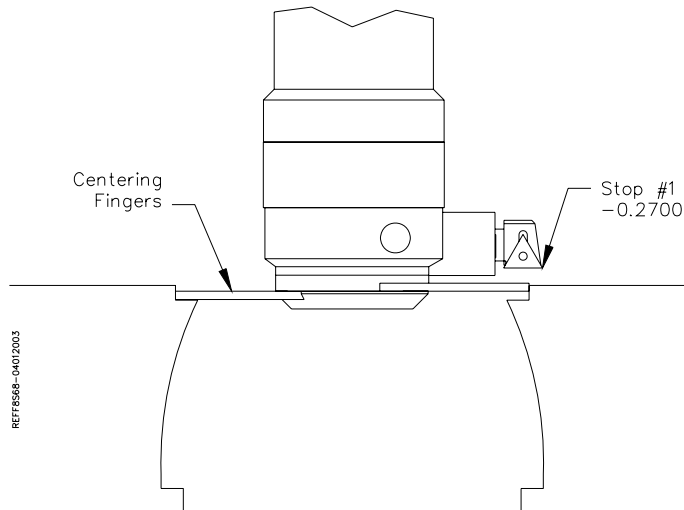
The machine will stop and each cylinder at the Centering Height and wait for the operator to center the machine. After the centering is done the operator needs to press Cycle Start again to bore the cylinder.

Automatic Centering:

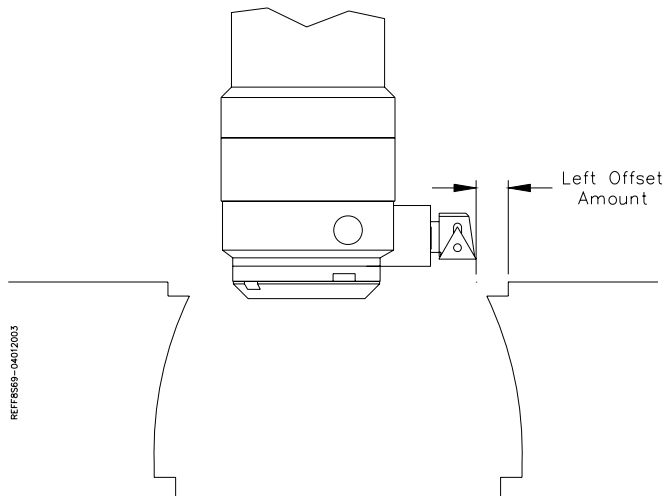
This is the most common use of the centering system. The machine will automatically center in each cylinder and then bore that cylinder. Machine parameter 140 needs to be set 2.5.

Automatic (Centering disabled):

The machine will bore each cylinder without stopping or centering. Machine parameter 140 needs to be set at -0.1.

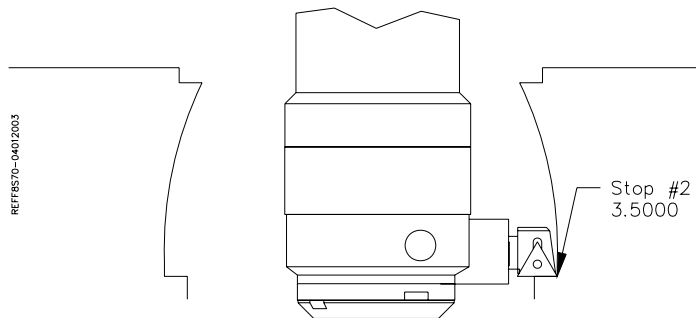
**Offset Distance:**

This is the distance the cutterhead will offset to the left after it centers on the bore. After the bore is complete it will offset the same amount before it retracts out of the cylinder.

**Stop #2 Start Bore:**

This is the height at which the spindle will start rotating and the vertical down feed will start. There is a rapid down move from Stop #1 to Stop #2. This stop is set to minimize the amount of time the spindle is boring air. In the example shown this is a small distance, but, with some of the cutterheads used on the F80S there is a lot more distance here and a slow RPM and feed rate are used.

Note: This stop needs to be a negative value or it will go down past the vertical zero to a positive value. This will result in a crash.



Stop #3 Bottom Bore:

This Stop is the depth of the bore. The following is the sequence of operation the machine performs when it gets to this stop.

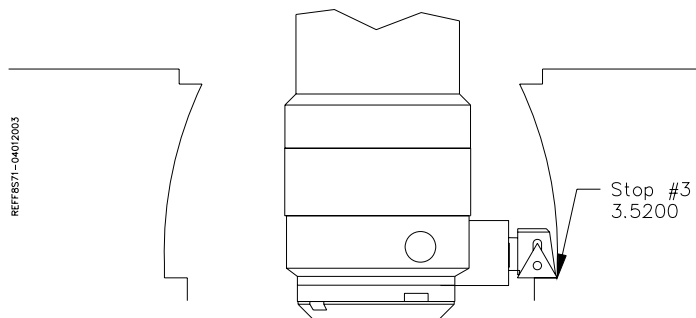
As the machine comes to within .002" of the programmed stop, spindle rotation slows to the value set in Machine Parameter 125. The Feed Rate slows to .001" per revolution of the spindle.

When the programmed stop is reached the vertical feed stops. The spindle takes 2 more revolutions (or the value in Machine Parameter 122)

As the spindle completes the revolution, it moves up .010", Indexes the tool at the Spindle Creep speed (Machine Parameter 121), move to the left .020".

Offset left programmed amount.

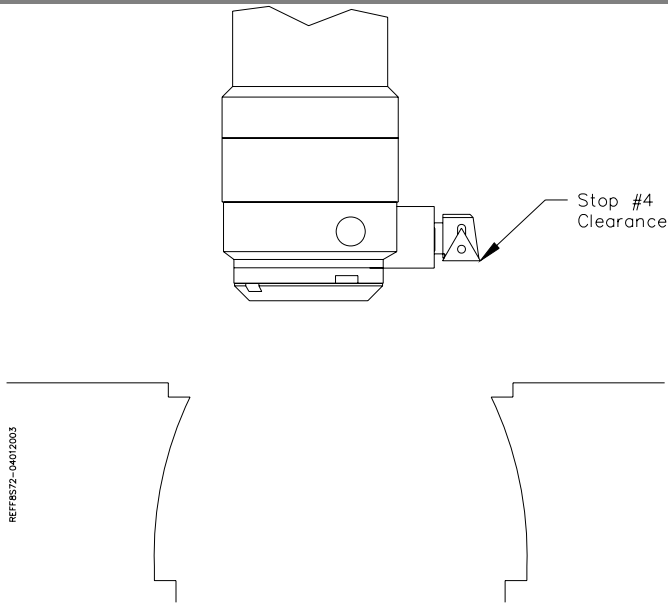
The spindle then does a rapid up move to Stop #4.



Stop #4 Clearance Height:

This stop is above the block deck. It needs to be a large enough value so the cutterhead can travel to the next cylinder without hitting any obstructions.

Note: This stop needs to be a negative value or it will go down past the vertical zero to a positive value. This will result in a crash.

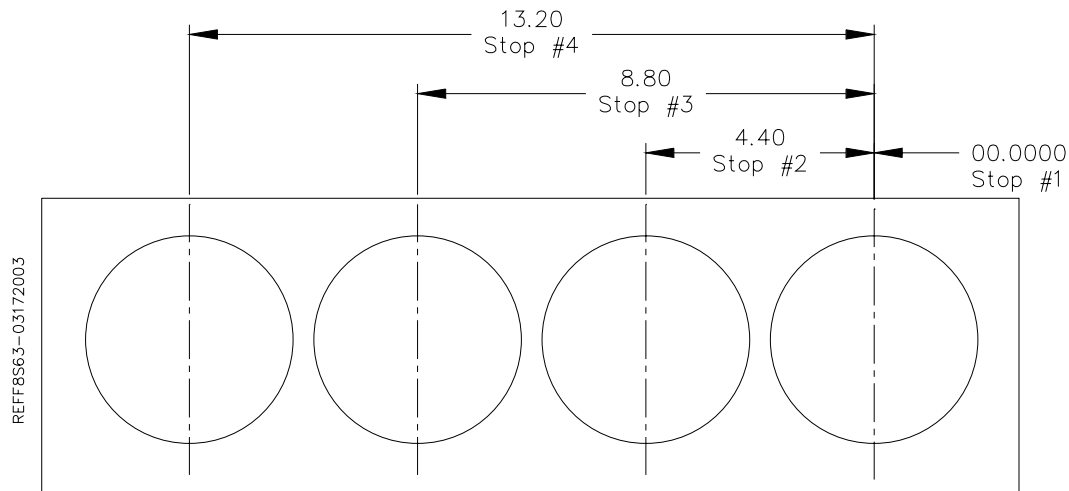


Horizontal Stop Definitions:

Horizontal stops are stored in each programs memory. Each time you change programs the Horizontal stops will change to those stored with the program.

There are twelve (12) Horizontal Stops used in the Lower Sleeve Software:

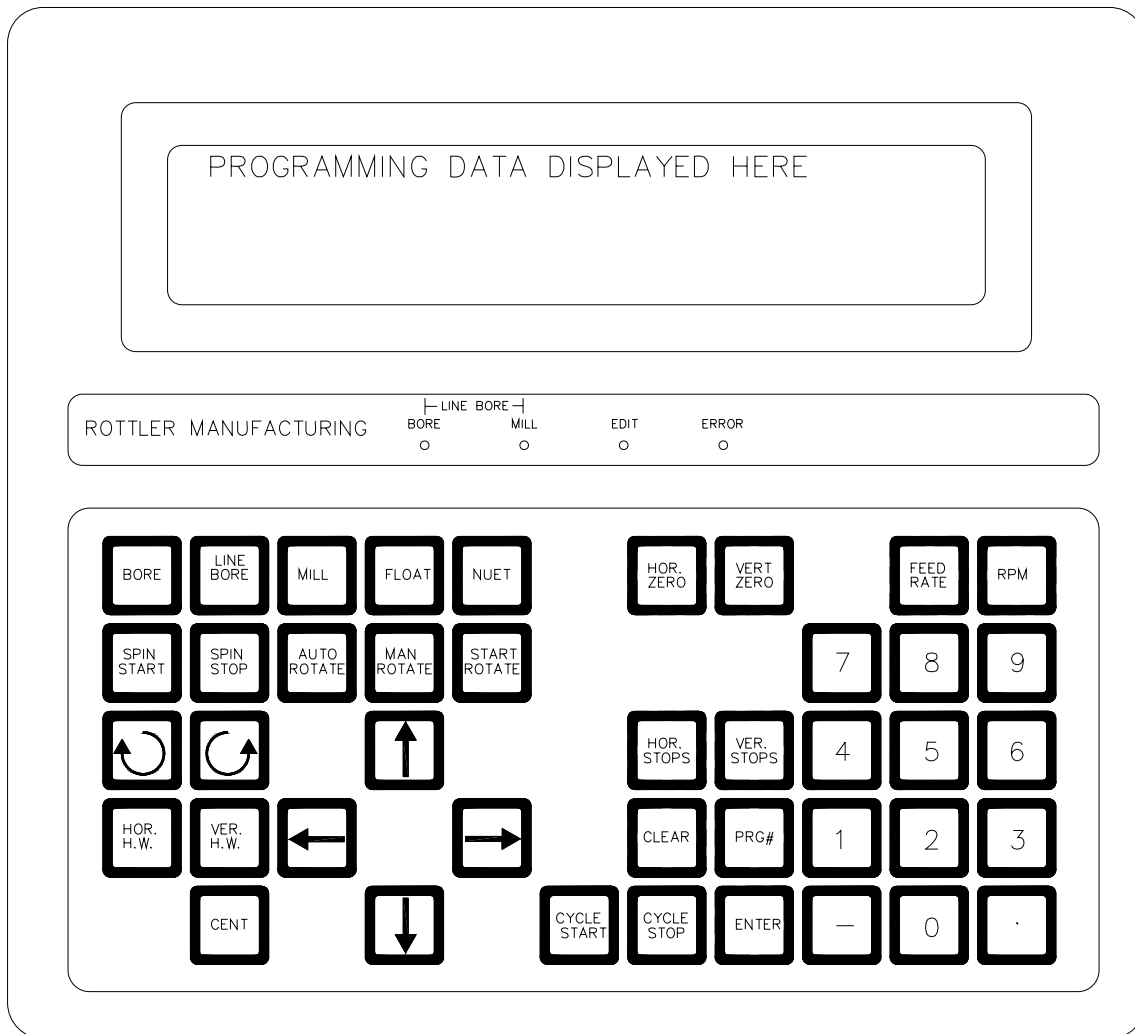
Center the spindle cutterhead in the first cylinder. Press the Horizontal Zero button. This will set the zero position the Horizontal stops will reference. The Horizontal stops are the distance each cylinders center line is from the horizontal zero point. These stops are accumulative, refer to the drawing below.



Selecting a Program Number:

The program numbers for Lower Sleeve Repair boring are 121 to 150. Rottler manufacturing suggests you leave program 121 open for free travel. This is helpful when performing maintenance or diagnostic.

Below is an illustration of the F80S control panel.



Press **PRG#** on the Control Panel

Control Panel will show the current program on the top line. If you want to keep using that program just press **ENTER**. If you want change the program number press the program number you want to use and then press **ENTER**. Display will return to the operating screen.

Entering Vertical Stops:

Press **ENTER**, **VER STOPS** and then **ENTER**. The program number and 1st stop will be shown on the top line of the display.

If you do not want to change that stop value press **ENTER**. The control will then display Stop 2.

If you want to change that stop value, type in the new value and then press **ENTER**. The control will then display Stop 2.

Follow this process until you have programmed all Vertical Stops. When the last stop is programmed and the **ENTER** button is pressed the display will return to the operating screen.

Entering Horizontal Stops:

Press **ENTER**, **HOR STOPS** and then **ENTER**. The program number and 1st stop will be shown on the top line of the display.

If you do not want to change that stop value press **ENTER**. The control will then display Stop 2.

If you want to change that stop value, type in the new value and then press **ENTER**. The control will then display Stop 2.

Follow this process until you have programmed all Horizontal Stops. When the last stop is programmed and the **ENTER** button is pressed the display will return to the operating screen.

If you have entered all the stops you need, you can exit the Horizontal Stops by pressing the **HOR STOPS** button at any time. Any changes you made will be saved.

Viewing Vertical and Horizontal Stops:

To view the Vertical and Horizontal Stops without changing them press the **VER STOPS** or **HOR STOPS**, do not press enter after this. The control will display the first stop. Pressing the **VER STOPS** or **HOR STOPS** again will scroll through the stops.

RPM:

Each program needs to have its own RPM entered. If a RPM was not entered the program will not run properly. To enter the RPM press the **RPM** button, type in desired RPM and then press **ENTER**. The new RPM will be displayed on the screen.

Feed Rate:

Each program needs to have its own Feed Rate entered. If a Feed Rate was not entered the program will not run properly. To enter the Feed Rate press the **FEED RATE** button, type in desired Feed Rate and then press **ENTER**. The new Feed Rate will be displayed on the screen.

Safety Check:

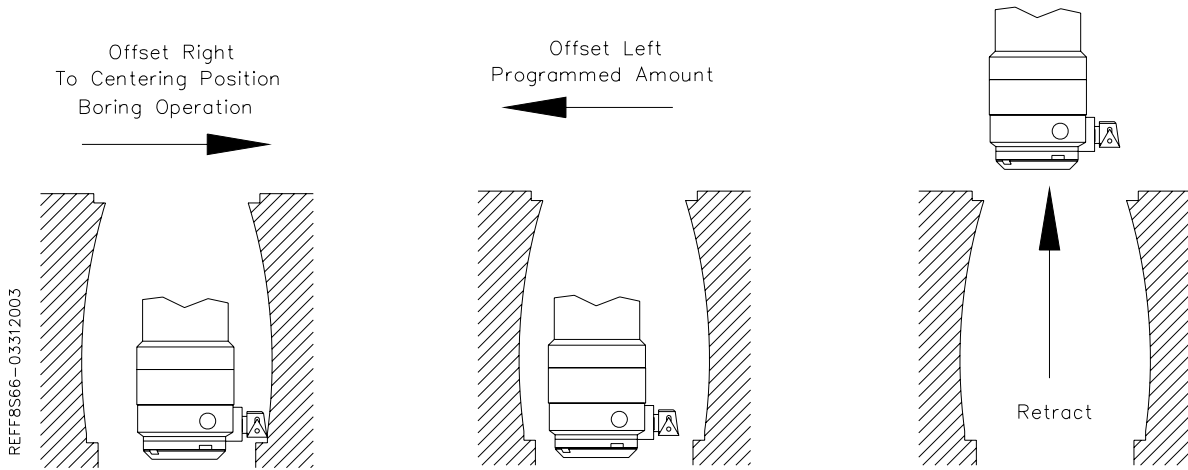
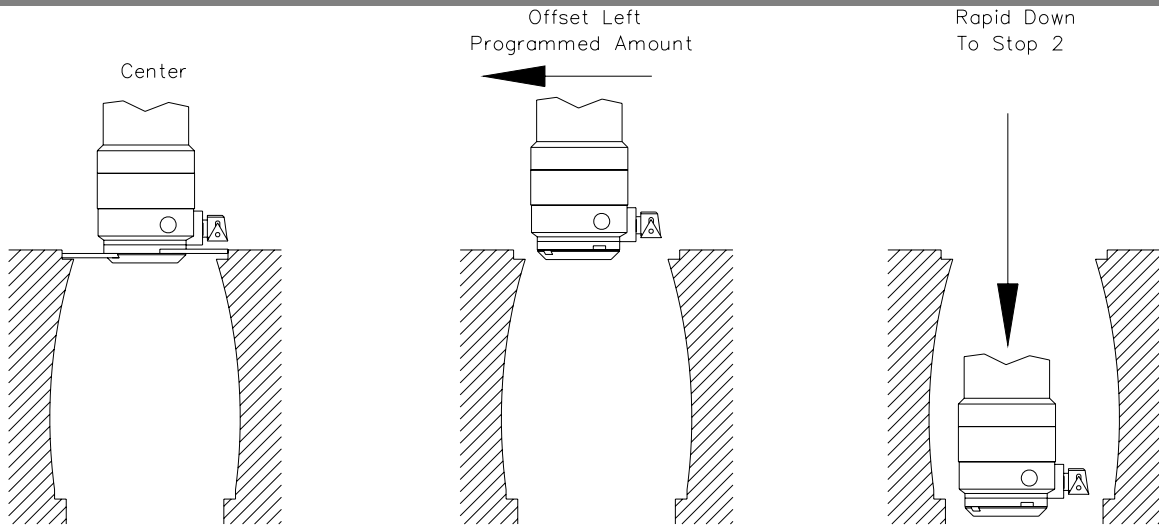
Before starting a cycle the operator needs to perform a safety check every time. Make sure you check the following:

- Correct Program Number.
- Engine Block is Secure.
- All Guards are in place.
- Boring Tool Set and Secure in Cutterhead.
- RPM set.
- Feed Rate set.

Automatic Cycle:

The program is now ready to run. Bring the machine to the right past the Horizontal zero position. Bring the machine up to Vertical Stop 4 (Clearance). Press the **CYCLE START** button. You can stop the cycle by pressing the **CYCLE STOP** button at any time. It is recommended that the **CYCLE STOP** button only be used during the automatic horizontal travel. The cycle can be started again by pressing the **CYCLE START** button again. The machine will continue the cycle from the position it is at. It will not start the cycle over. To run an entire cycle you have to be at or to the right of the Horizontal Zero position.

The following illustration shows the process of the Lower Sleeve Repair software.



Plunge Cutting:

This software operates exactly the same as the Bore Mode except there is not a .020" offset when Vertical Stop #3 is reached. The Plunge Cutting software uses programs 371 thru 390.

This software was developed to be able to perform some of the following operations without damaging the cutting tool.

Drilling
Chamfering
O-ring grooving
Lifter Boring

Refer to the Bore Mode section of this chapter for programming and running cycles for this software.

Mill Mode:

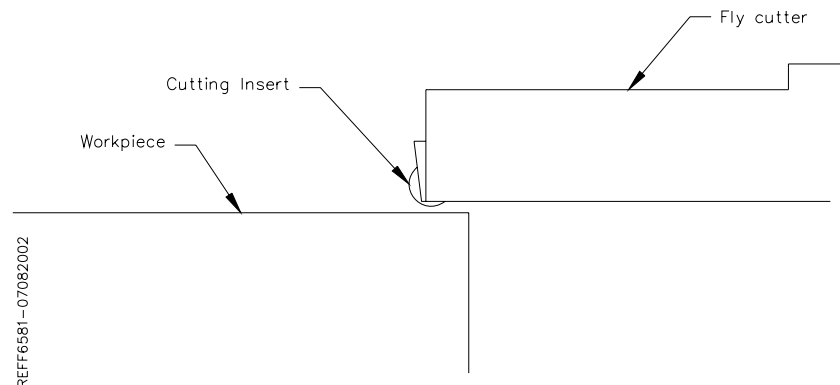
Press the MILL button on the control panel. This will unclamp the base, lift the right hand side of the base approx .015", slide a .003" wedge into place and re-clamp the spindle base. This will put a .0025" to .003" tilt on the fly cutter. This is to prevent the cutter from cutting on the backside.

The Mill Mode can use programs 1 thru 99. Mill Mode has no vertical stops and one (1) Horizontal stop.

Note: Never have the Y-Axis pin installed when you go into the Mill Mode. Severe damage to the pin will result and the spindle base will have to be removed from the machine to replace.

Setting Zero Positions:

Bring the flycutter slightly over the work piece on the right hand side. Start the spindle and slowly hand wheel the flycutter down until it just touches the top of the block. Handwheel the flycutter to the right until the cutting insert clears the block. Stop the spindle. Press the **HORIZ** and **VER. ZERO** buttons at this time. The flycutter should be centered on the work piece for the In/Out travel.



Horizontal Stop Definition:

There is only one horizontal stop in the Mill Mode. It is a distance from the Horizontal Zero position where the cutter has finished cutting the work piece.

Entering Horizontal Stops:

Press **HOR STOPS** and then **ENTER**.

If you do not want to change that stop value press **ENTER**.

If you want to change that stop value, type in the new value and then press **ENTER**.

Viewing Horizontal Stops:

To view the Vertical and Horizontal Stops without changing them press the **HOR STOPS** button, press **ENTER** after this. The control will display the Horizontal stop. Pressing the **HOR STOPS** again will exit out of viewing mode.

RPM:

Each program needs to have it's own RPM entered. If a RPM was not entered the program will not run properly. To enter the RPM press the **RPM** button, type in desired RPM and then press **ENTER**. The new RPM will be displayed on the screen.

Feed Rate:

Each program needs to have it's own Feed Rate entered. If a Feed Rate was not entered the program will not run properly. To enter the Feed Rate press the **FEED RATE** button, type in desired Feed Rate and then press **ENTER**. The new Feed Rate will be displayed on the screen.

Safety Check:

Before starting a cycle the operator needs to perform a safety check every time. Make sure you check the following:

- Correct Program Number.
- Engine Block is Secure.
- All Guards are in place.
- Surfacing tool bits set correctly and tightened securely.
- RPM set.
- Feed Rate set.

Automatic Cycle:

The program is now ready to run. Bring the machine to the right past the Horizontal zero position. Bring the machine up above the work piece. Press the **CYCLE START** button. You can stop the cycle by pressing the **CYCLE STOP** button at any time. It is recommended that the **CYCLE STOP** button only be used during the automatic horizontal travel. The cycle can be started again by pressing the **CYCLE START** button again. The machine will continue the cycle from the position it is at. It will not start the cycle over. To run an entire cycle you have to be at or to the right of the Horizontal Zero position.

Manual Cycle:

You can run a manual cycle by pressing **SPINDLE START** and then the **LEFT** button. The spindle will start and feed left will start at the programmed speed. Left feed will continue until the horizontal stop position is reached. The spindle and feed will stop and this point and the machine becomes idle.

Setting the Inserts

Move the traveling column to approximately the middle of the main base.

CAUTION Turn off all power to machine before proceeding.

Attach a dial runout indicator to a, solidly mounted, cylinder head or engine block, etc..

Setting the Insert Distance from Center:

Rotate cutter head and check to see that both inserts are the same distance from the center of the spindle, within .002.

If adjustment is necessary loosen the two tool holder clamp screws, and the up adjustment screw. Move tool holder in or out required distance.

Retighten all screws and recheck both inserts.

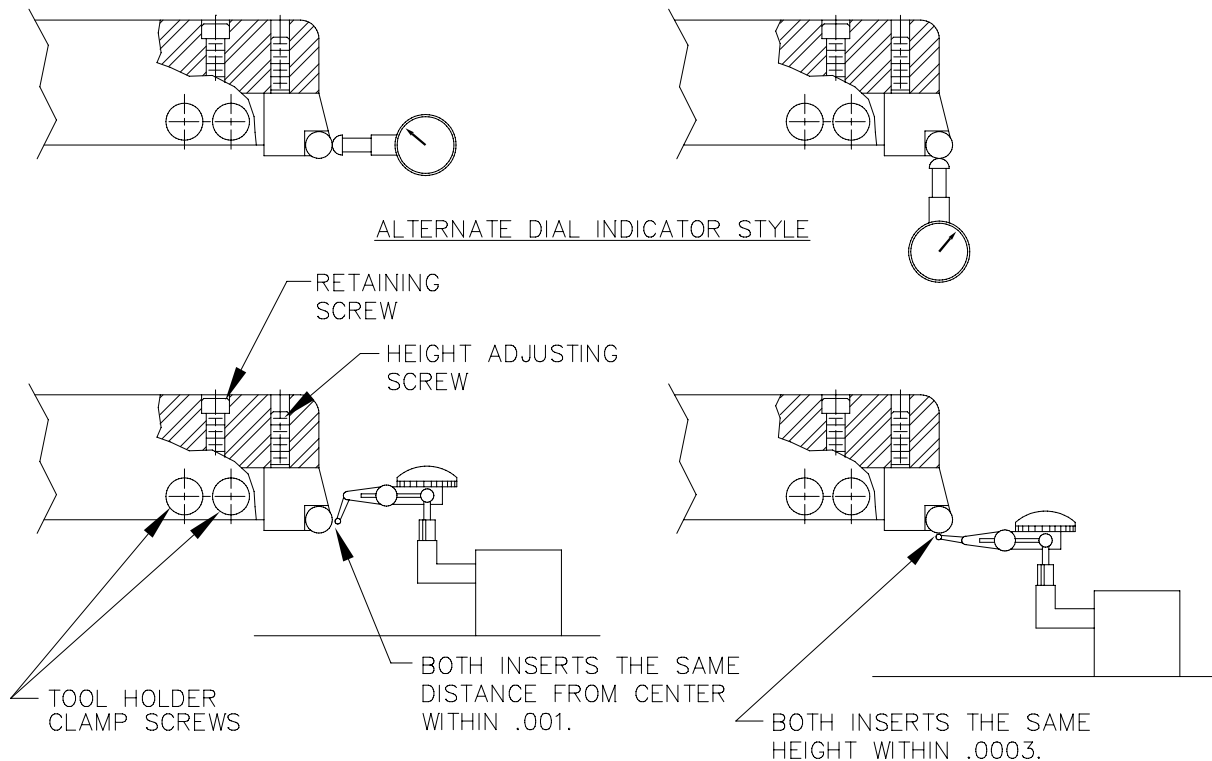
Setting the Insert Height:

Rotate cutter head and check to see that both inserts are the same height within .0003.

If adjustment is necessary loosen the two tool holder clamp screws then alternately loosen and tighten the up and down adjusting screws.

Retighten all screws and recheck both inserts.

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Water Jacket Repair:

The Water Jacket Repair software is designed to work with the 6787N self feeding head. At certain places in the program the operator of the F80S machine will need to engage and disengage the feed on the head.

Below is a description of how the program operates.

When Cycle Start is pressed there will be a vertical rapid move to the programmed centering position (Vertical Stop 1).

Spindle is Indexed opposite of the normal index position. Centering procedure is performed.

There will then be a vertical rapid move to the next vertical stop (Vertical Stop 2). This is the position you want the cutting to begin.

At this point the spindle will start rotation at the RPM programmed for that program. When the vertical stops were programmed the control asked for a time delay value. This time delay value is how long you want the spindle to rotate while the self feeding head is expanding. When the spindle rotation starts the operator is going to need to manually engage the self feeding head.

When the next vertical stop (Vertical Stop 3) is reached the machine will perform the washout procedure.

The tool is then indexed. The machine will offset (to clear the tool from the wall) a distance that was programmed into the computer when the vertical stops were entered.

The spindle will then retract the next vertical stop (Vertical Stop 4) out of the bore so the head can clear the block. There is then a horizontal rapid move to the 2nd horizontal stop.

The machine will stop at this point to allow the operator re-set the self feeding head.

Pressing Cycle Start again will repeat the above process on the second hole.

As you read these direction while at the machine they will become much clearer.

Line Bore Mode:

Press the Line Bore button from the operator control panel. This will put the machine in Line Bore Mode and clamp the spindle base if it is not already clamped.

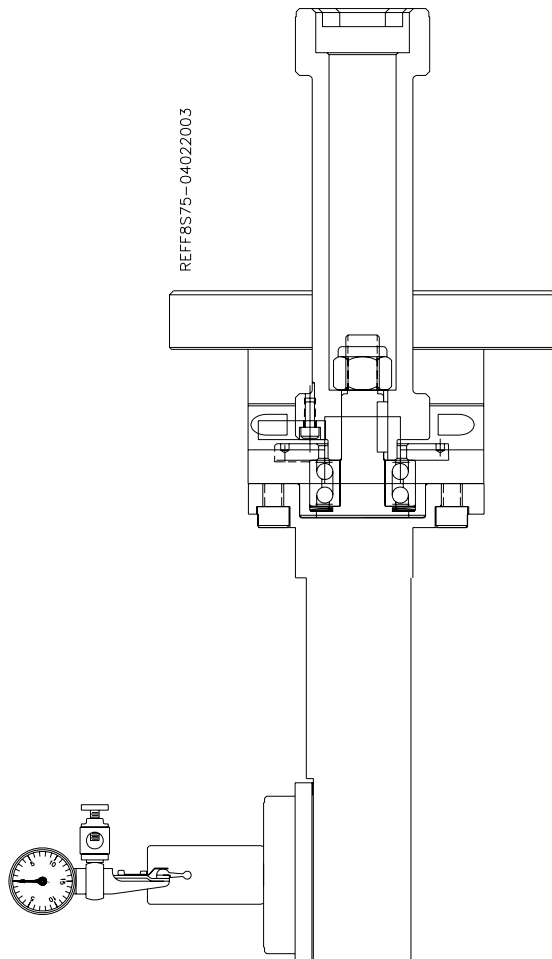
Select the block to be line bored, use the block mounting instructions earlier in this chapter to do so.

Line Bore Mode uses programs 1 thru 99. Each program has one (1) Vertical stop and twelve (12) Horizontal stops.

Install the Y-Axis pin.

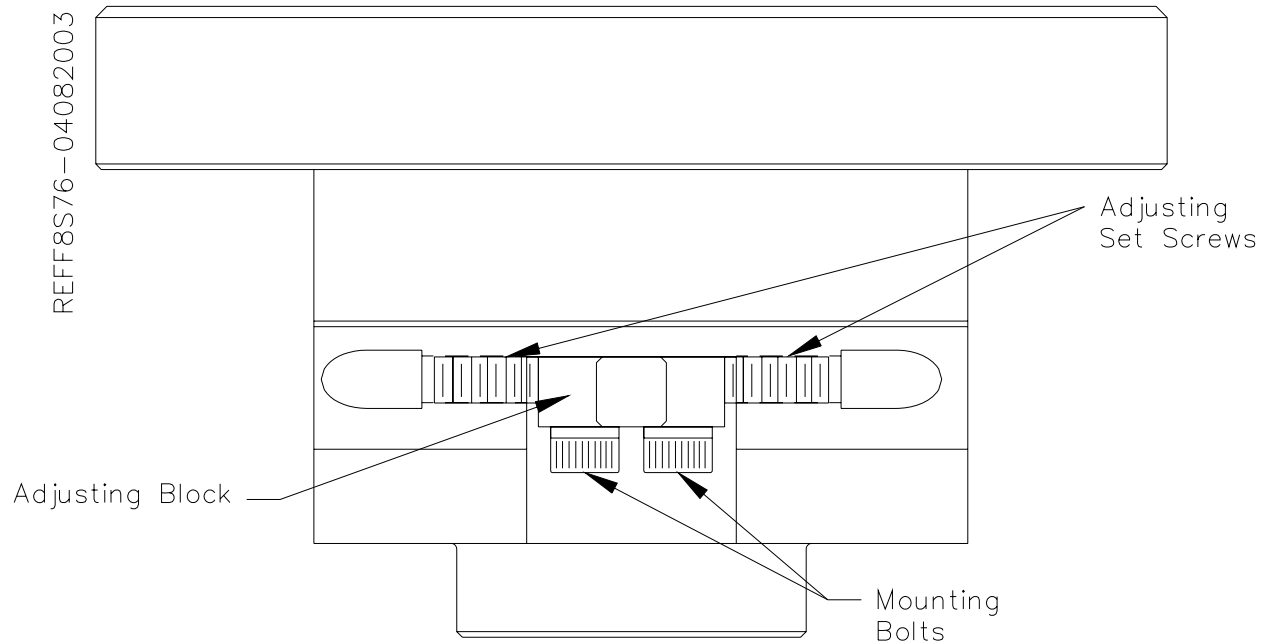
Aligning the 90 Degree Drive 6753J:

Mount the 90 degree head to the spindle. Do not tighten the screw on the back side of the collar at this time. Index the spindle so the flat on the 90 degree shaft is facing away from the operator. Place a magnetic base indicator on the block or fixturing. Place the probe of the indicator on the rounded part of the shaft (do not indicate off of the flat) with about .010" pressure. Use the horizontal handwheel to move the indicator the full length of the shaft, note the amount of movement on the indicator.



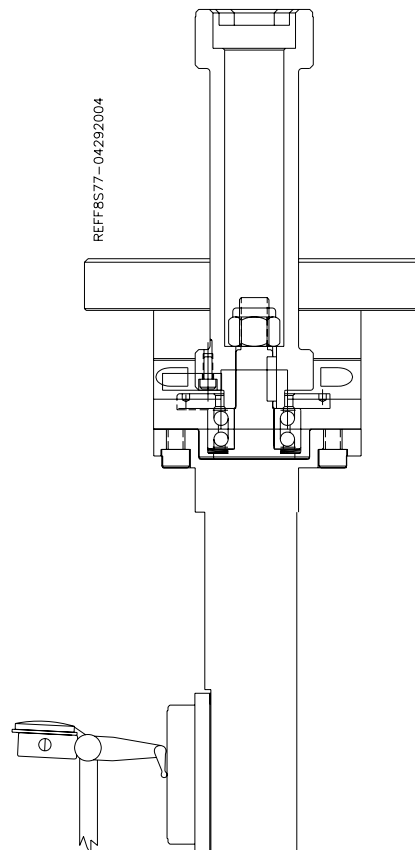
There are two (2) adjusting set screws and an adjustment block on the front of the collar. The two set screws push up against the adjustment block to turn the head left or right. The adjusting block is keyed to the outer spindle. The two bolts mounting the adjusting block to the collar need to be slightly loose. Start turning the set screw that will rotate the head the direction you need to go. The right set screw will rotate the head counter clockwise and the left clockwise. The set screw will move the key on the adjusting block until it hits the keyway in the outer spindle. Once the key is touching the outer spindle, turning the set screw will start rotating the head. As you are turning one set screw you will need to keep the opposite set

screw backed off or it will stop the travel. Once the shaft is lined up tighten the mounting bolts for the adjustment block, then tighten both set screws. Tighten the bolt on the back side of the collar.



Aligning the 90 Degree Drive 6753J:

Mount the 90 degree head to the spindle. Do not tighten the screw on the back side of the collar at this time. Index the spindle so the flat on the 90 degree shaft is facing away from the operator. Place a magnetic base indicator on the block or fixturing. Place the probe of the indicator on the front flat of the head with about .010" pressure on it. Use the Horizontal handwheel to run the indicator the full length of the front face, not the amount of movement on the indicator.



There are two (2) adjusting set screws and an adjustment block on the front of the collar (refer to the illustration on the previous page). The two set screws push up against the adjustment block to turn the head left or right. The adjusting block is keyed to the outer spindle. The two bolts mounting the adjusting block to the collar need to be slightly loose. Start turning the set screw that will rotate the head the direction you need to go. The right set screw will rotate the head counter clockwise and the left clockwise. The set screw will move the key on the adjusting block until it hits the keyway in the outer spindle. Once the key is touching the outer spindle, turning the set screw will start rotating the head. As you are turning one set screw you will need to keep the opposite set screw backed off or it will stop the travel. Once the shaft is lined up tighten the mounting bolts for the adjustment block, then tighten both set screws. Tighten the bolt on the backside of the collar.

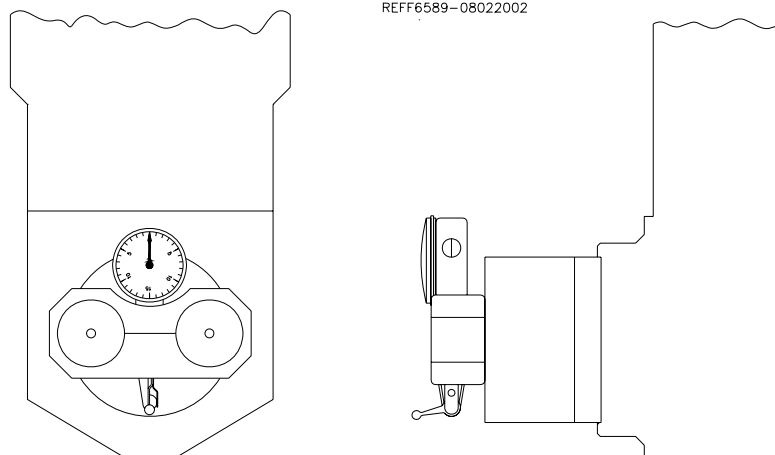
Setting Zero Positions:

Horizontal Zero:

The Horizontal zero should be set about .050" from the front of the first main to be bored, making sure that the position will allow the head to travel up without interference from the main caps. Bring the head down and roughly center it in front of the first main. It does not need to be perfectly centered to set the Horizontal zero. Press the **HOR ZERO** button here.

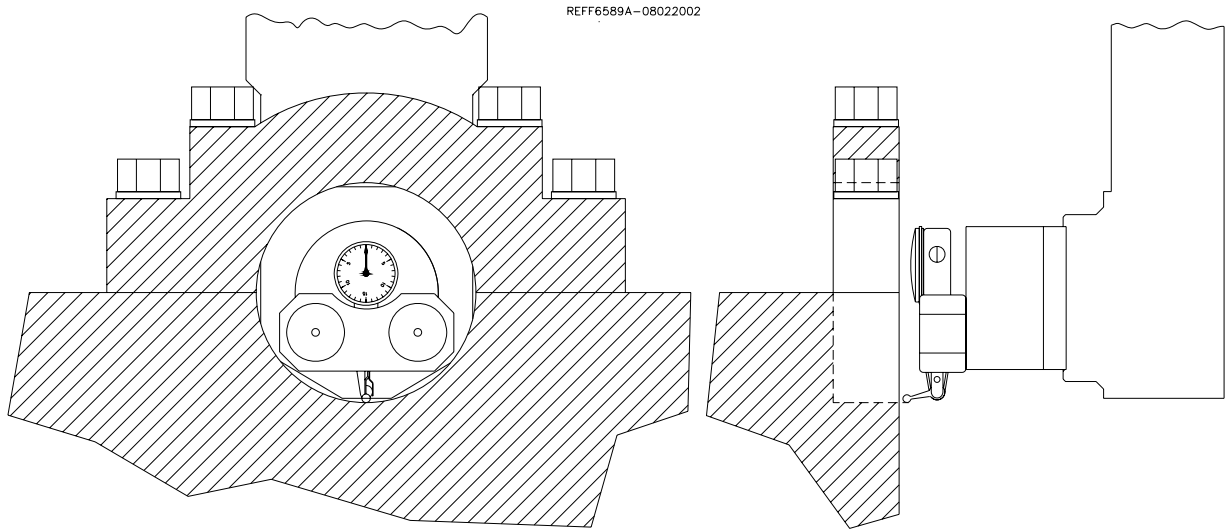
Vertical Zero:

Located the small magnetic base and Last Word indicator or Air Gauge. Mount on the cutterhead as show below. If you are using the Air Gauge Runout system, mount it the same way with the air plunger in place of the indicator probe.



Using the Horizontal handwheel, move the indicator so it is inside the main bore. You should not be touching the main bore with the indicator at this time. You will be indicating the front, back and bottom of the saddle, generally the cap is not used to indicate from.

Physically move the indicator and mag base on the cutterhead until there is about .010" pressure on it. Start rotating the spindle using the CW and CCW buttons on the control panel watching the indicator. As there is more or less pressure on the indicator, use the Vertical handwheel and the Y-Axis lever (located on the right hand side of the spindle base) to move the spindle base around until all three points are equal on the indicator. Press the VERT ZERO at this point.



You have now set the Horizontal and Vertical Zero positions.

Vertical Stop Definition:

There is only one Vertical stop in the line bore mode. This is the distance up the cutterhead will have to travel to clear the main caps when it moves horizontal. This will always be a negative number. This stop references the Vertical zero position which is always the center of the Main Bore.

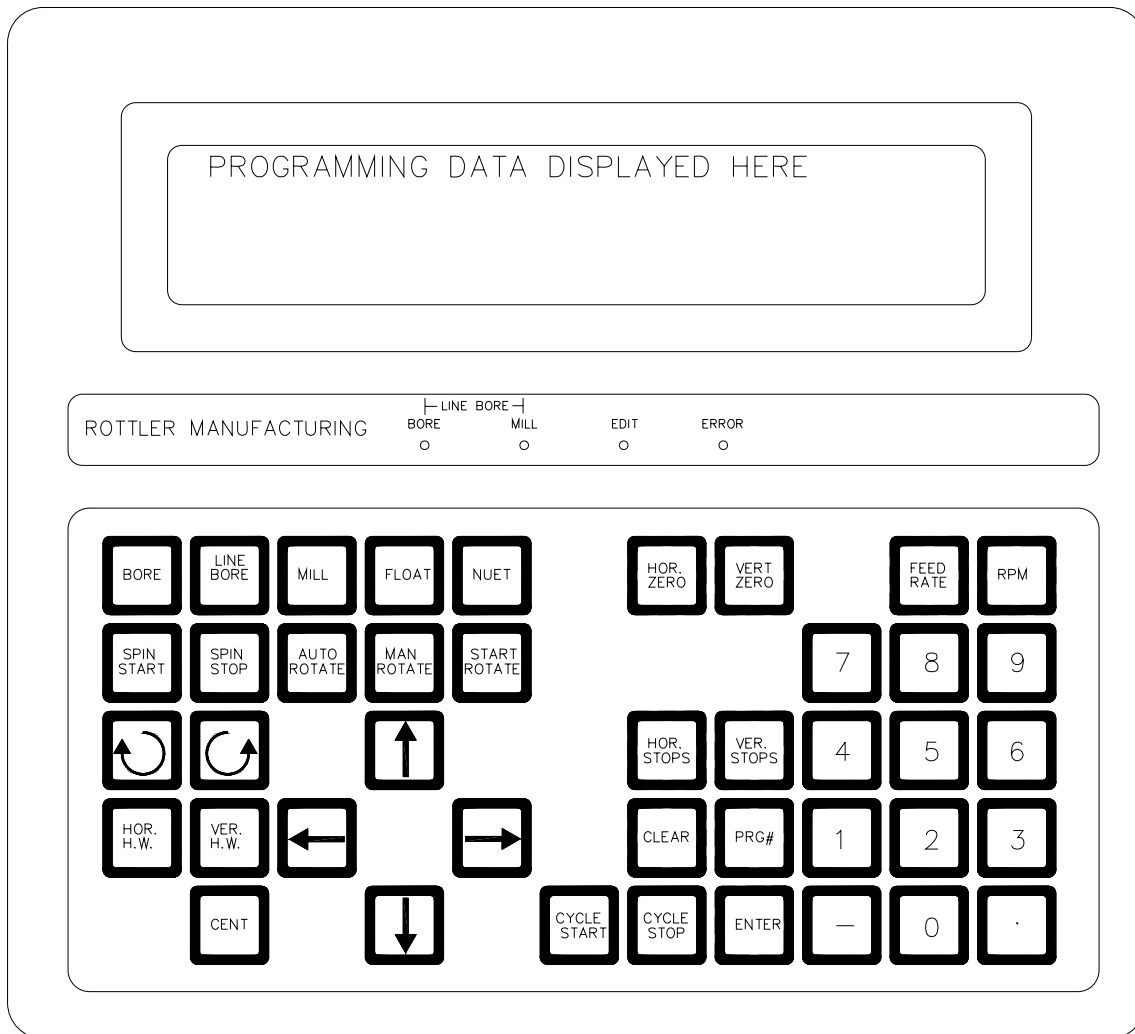
Horizontal Stop Definition:

The horizontal stops are the distance between each main bore. These stops are accumulative from the Horizontal Zero position.

Selecting a Program Number:

The program numbers for Line Boring are 1 to 99. Rottler manufacturing suggests you leave program 1 open for free travel. This is helpful when performing maintenance or diagnostic.

Below is an illustration of the F80S control panel.



Press **PRG#** on the Control Panel

Control Panel will show the current program on the top line. If you want to keep using that program just press **ENTER**. If you want change the program number, press the program number you want to use and then press **ENTER**. Display will return to the operating screen.

Entering Vertical Stops:

Press **ENTER**, **VER STOPS** and then **ENTER**. The program number and 1st stop will be shown on the top line of the display.

If you do not want to change that stop value press **ENTER**.

Entering Horizontal Stops and Bore Length:

Press **ENTER**, **HOR STOPS** and then **ENTER**. The program number and 1st stop will be shown on the top line of the display.

If you do not want to change that stop value press **ENTER**. The display will then display the current Bore length for that stop. If you want to change that value, press the desired value on the keypad and then press **ENTER**. If you do not want to change that value just press **ENTER** and the display will go to the second stop. This process will continue until all the horizontal stops and bore length are entered.

If you have entered all of the stop you want, you can press **HOR STOPS**, that will exit the programming process while saving changes.

Viewing Vertical and Horizontal Stops:

To view the Vertical and Horizontal Stops with out changing them press the **VER STOPS** or **HOR STOPS**, do not press enter after this. The control will display the first stop. Pressing the **VER STOPS** or **HOR STOPS** again will scroll through the stops.

Note: The line boring head has a two to one (2:1) gear ration in it. For every two turns of the main spindle the cutterhead will only rotate one. This is taken into consideration in the software for the RPM and the Feed Rate. Only enter the values you want at the line boring head.

RPM:

Each program needs to have it's own RPM entered. If a RPM was not entered the program will not run properly. To enter the RPM press the **RPM** button, type in desired RPM and then press **ENTER**. The new RPM will be displayed on the screen.

Feed Rate:

Each program needs to have it's own Feed Rate entered. If a Feed Rate was not entered the program will not run properly. To enter the Feed Rate press the **FEED RATE** button, type in desired Feed Rate and then press **ENTER**. The new Feed Rate will be displayed on the screen.

Safety Check:

Before starting a cycle the operator needs to perform a safety check every time. Make sure you check the following:

- Correct Program Number.
- Engine Block is Secure.
- All Guards are in place.
- Boring Tool Set and Secure in Cutterhead.
- RPM set.
- Feed Rate set.

Automatic Cycle:

The program is now ready to run. Bring the machine to the right past the Horizontal zero position. Bring the machine up to the Vertical Stop (Clearance). Press the **CYCLE START** button. You can stop the cycle by pressing the **CYCLE STOP** button at any time. It is recommended that the **CYCLE STOP** button only be used during the automatic horizontal travel. The cycle can be started again by pressing the **CYCLE START** button again. The machine will continue the cycle from the position it is at. It will not start the cycle over. To run an entire cycle you have to be you have to be at or to the right of the Horizontal Zero position.

Chapter 4 Maintenance:

Lubrication:

Refer to illustration following these written instructions:

Below are the directions that explain how and where to add oil to the different systems:

▲ CAUTION Do not overfill any of the lubrication points, serious electrical damage may result.

Outer Spindle:

The Outer Spindle is hard chromed and is supported in tapered, cast iron spindle bushings. The Outer Spindle supports the Inner Spindle, bearings, seals etc... and maintains the boring rigidity.

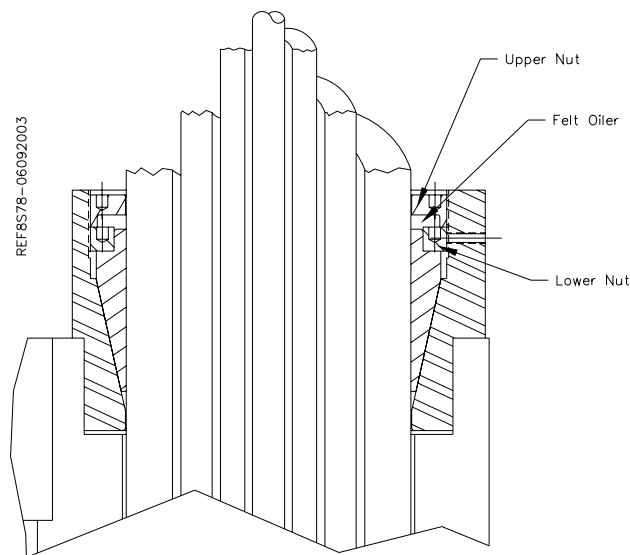
Every 8 hours:

The Outer Spindle needs to be moved down to the lower limit, wiped clean, and then lightly coated with a light weight #10 oil. This is very important, if the spindle is allowed to operate dirty the cast iron dust will act as an abrasive on the spindle chrome. This will cause the spindle to wear prematurely. The outer spindle is a very expensive item to replace.

Every 1000 Hours:

Open the sheet metal cover from the front of the spindle unit. There is a large nut where the outer spindle passes through the top of the spindle base. Using a spanner wrench or punch carefully remove the top spindle nut.

Note: Do not adjust the nut below the felt wiper (see the mechanical section for correct adjustment of this nut).



Slide the felt wiper back into place and tighten the Upper Nut back down.

Upper Belt Housing:

No lubrication is necessary in the Upper Belt Housing.

Oil Reservoir System:

IMPORTANT!! – Every 8 hours check the oil supply lines to the upper spindle to be sure they are full of oil.

The oil reservoir system is located inside the lower portion of the column. This system lubricates the following:

- Ways
- Inner Spindle Bearings (Upper and Lower)
- Horizontal Ballscrew
- Outer Spindle

Every 175 Hours:

The oil level of the reservoir should be checked, and filled with a light weight #10 spindle oil.

When the oil reservoir is low or empty on the F80S machine, the control will “LOW OIL” and will not run until the reservoir has been filled.

The oil system may require priming if the reservoir has been run empty. You can do this manually or automatically. To prime automatically, change the oiler machine parameter #123 to a value of 10. This will turn the oiler solenoid on every ten seconds as long as the spindle is running. Take note when the oil lines are full, reset the oiler parameter and operate the machine normally. To prime manually, open the air door on the lower left hand side of the column, locate the blue solenoid, press the manual override button on the solenoid repeatedly until the oil lines are full. You need to pause for a second between button presses to allow the valve to reset. Pressing the button too fast will not pump oil through the system.

Centering Shaft:

The inner spindle supports the top of the centering shaft. There is no grease fitting here.

Every 1000 Hrs:

Remove the small set screw located near the top of the draw bar. Place several drops of light weight #10 oil in here and replace the set screw.

Pillow Block Bearings (Centering Shaft):

The manual centering control shaft pillow blocks are located on the right side of the spindle base. The upper bearing is on top of the Top Plate and the lower is directly above the centering handle inside the main cover.

Every 175 Hours:

The Pillow blocks should be greased using **Unoba EP 2 Multi Purpose Grease or equivalent NLGI 2 grease**. Grease through grease fitting provided.

Centering Control Shaft:

The Centering Control Shaft is located inside the spindle unit on the right hand side vertically.

Every 175 Hours:

The shaft should be greased with **Unoba EP 2 Multi Purpose Grease or equivalent NLGI 2 grease**. Wipe a small amount of grease directly onto the shaft.

Inner Spindle Bearings:

The Inner Spindle Bearings are lubricated from the oil reservoir system. It is normal for a small amount of this oil to seep through the spindle bearings and onto the cutterhead.

Vertical Ballscrew Bearings:

The Upper Pillow Block bearing is located on the top plate just below the driven sprocket. The lower bearing set is located at the bottom of the ballscrew in the spindle base.

Every 175 Hours:

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

Y-Axis Lever:

The Y-Axis lever is located on the right hand side of the spindle base towards the rear.

Every 1000 Hours:

Pull the y-Axis lever out at wipe a small amount of **Unoba EP 2 Multi Purpose Grease or equivalent NLGI 2 grease** on the shaft. Then remove the sheet metal cover on the rear of the spindle base and grease the rack and pinion assembly the Y-Axis shaft fits onto.

Column Feed Gear Housing:

The Column Feed Gear Housing is located inside the main column. Remove the two lower inspection plates from the right hand side of the column. Located the gear housing towards the bottom (the ballscrew goes through it).

Every 1000 Hours:

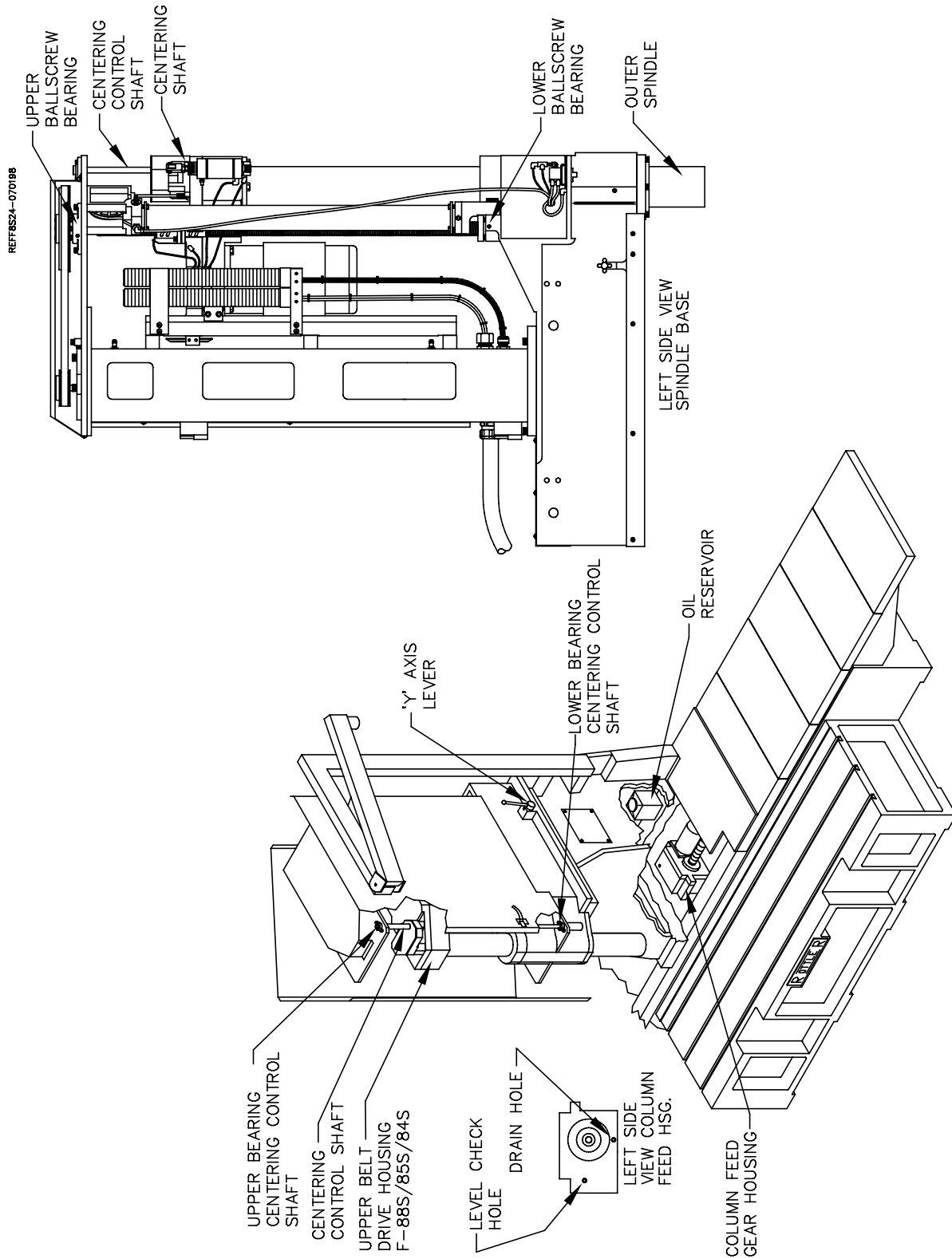
Check and fill the gear housing with **76 MP Gear Lube 80w-90 (ISO VG-100-150)**. Locate the fill hole on top of the gear housing. Locate the level check hole on the side of the gear. Fill only to the level of the Check hole.

Note: *If gear housing is over filled serious electrical damage may occur to the Horizontal Servo Motor.*

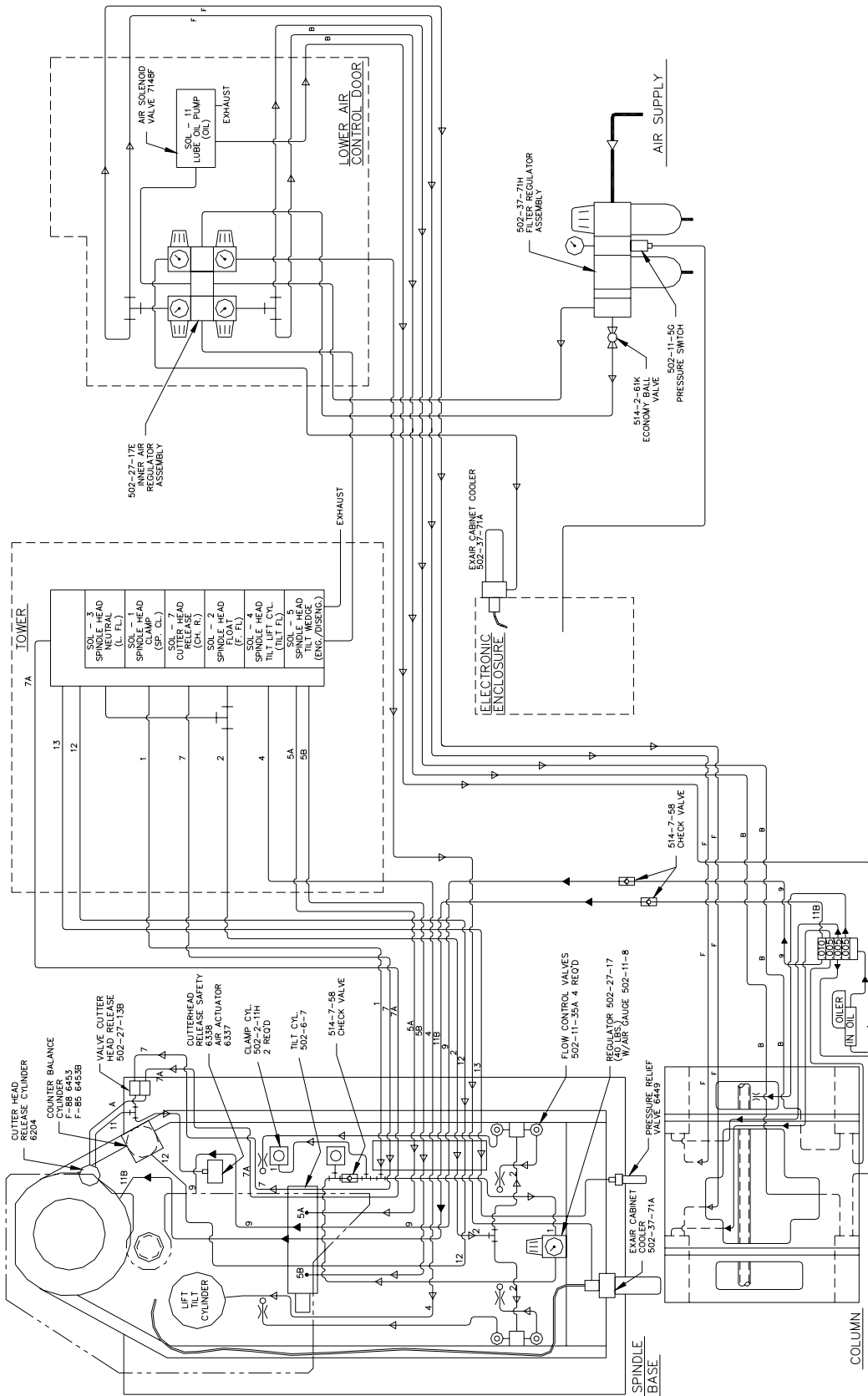
Quick Reference Lubrication Chart:

Assembly	Frequency	Lube Operation
Outer Spindle	8 Hours	Wipe with oil
	1000 Hours	Soak felt wiper with oil
Oil Reservoir System	8 Hours	Check upper oil lines are full
	175 Hours	Fill reservoir with oil if needed
Centering Shaft	1000 Hours	Add several drops of oil
Pillow Block Bearings	175 Hours	Grease
Centering Control Shaft	175 Hours	Grease
Vertical Ballscrew Bearings	175 Hours	Grease
Swing Arm Hinge	1000 Hours	Grease
Y-Axis Lever	1000 Hours	Grease
Column Feed Gear Housing	1000 Hours	Fill with oil

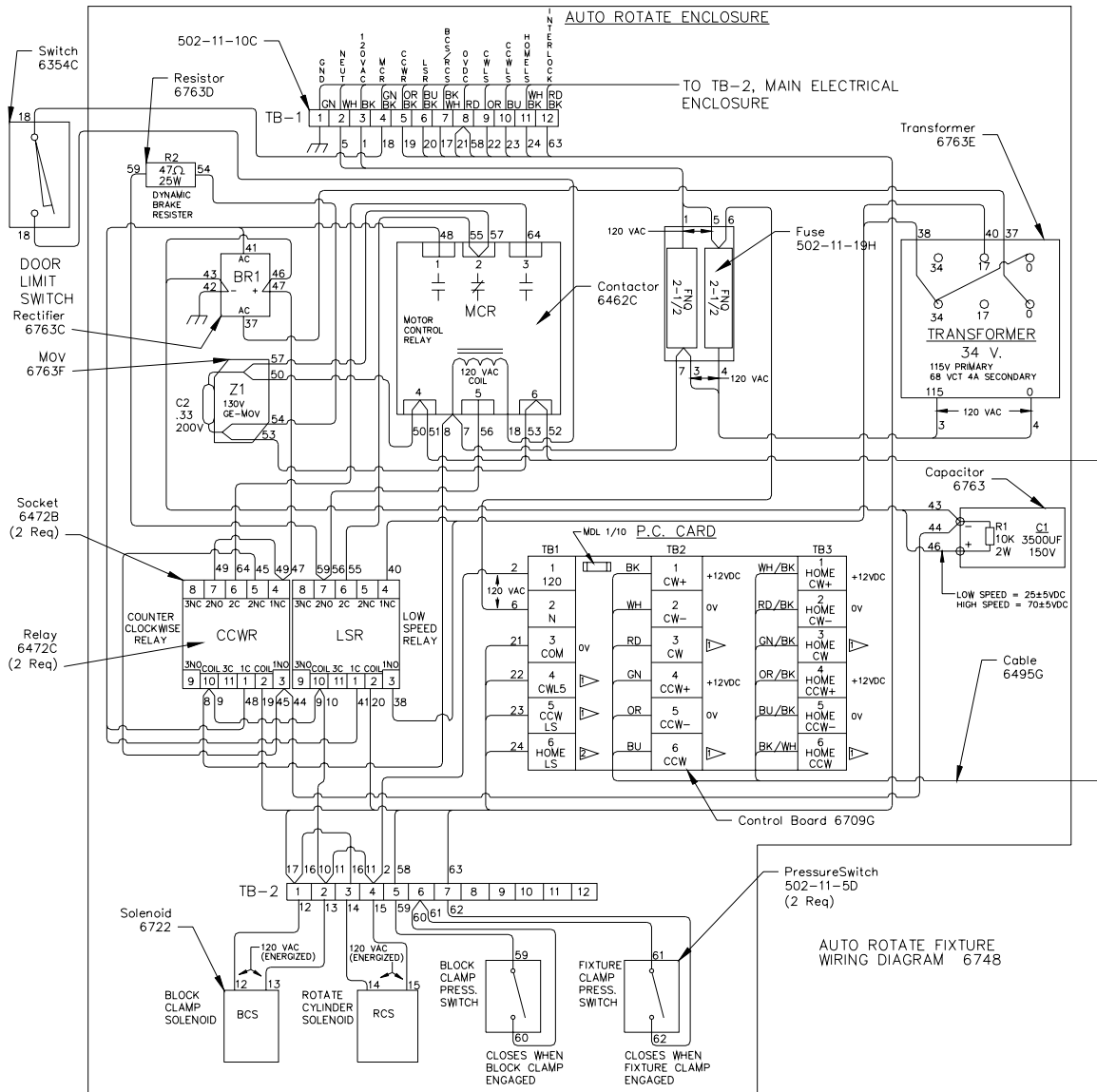
Lubrication:



Air Logic:

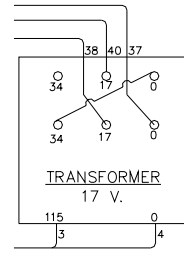


Auto Rotate Wiring Diagram:

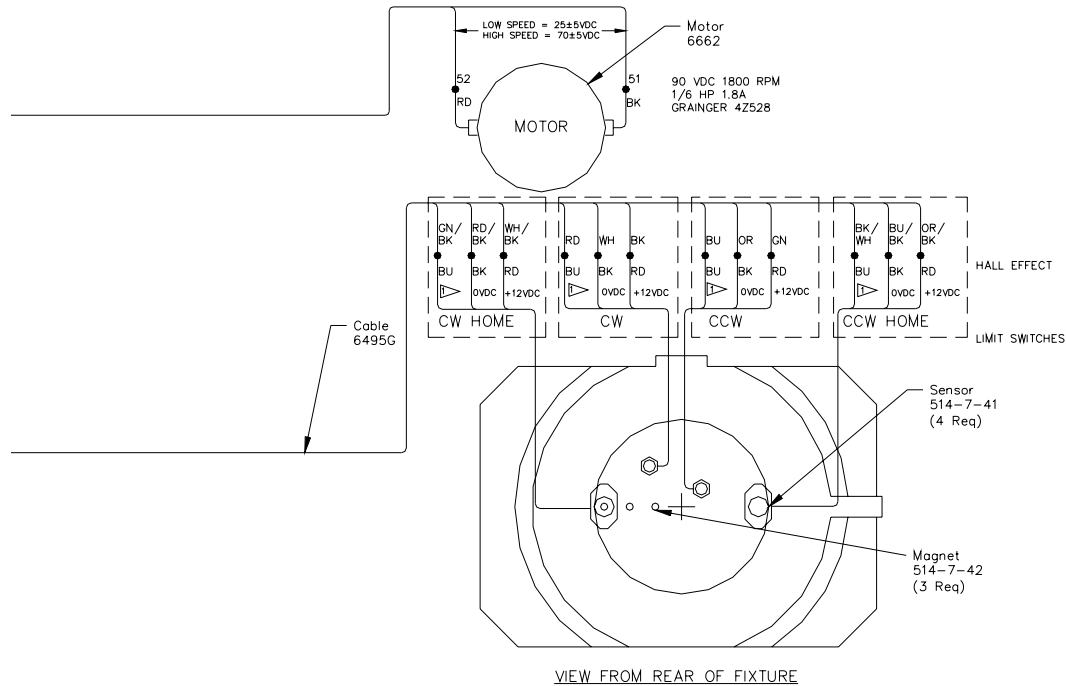


Auto Rotate Wiring Diagram Continued:

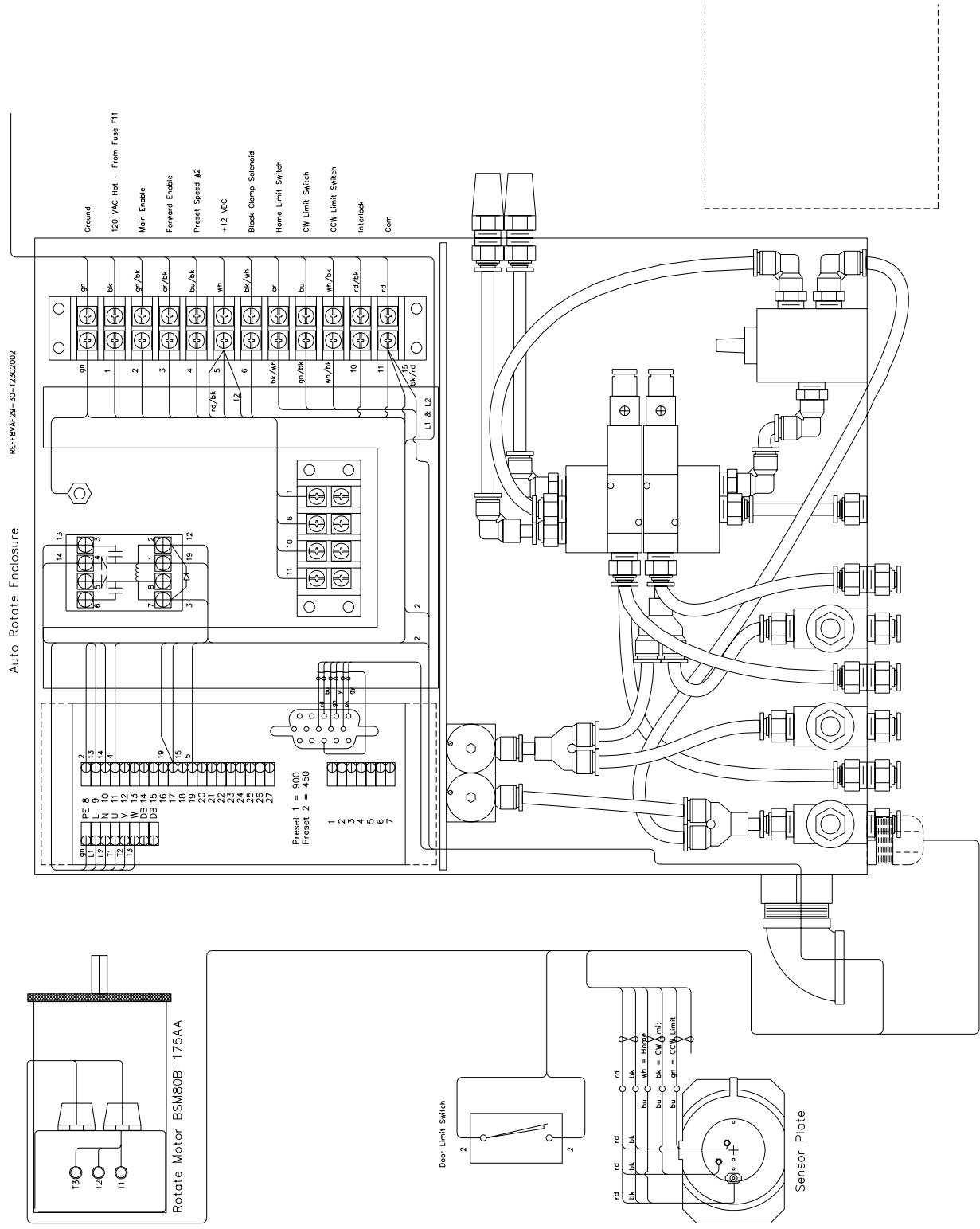
- NOTE
- ▷ 0 VDC W/MAGNET NEAR HALL EFFECT SWITCH
 - ▷ +12 VDC W/MAGNET AWAY FROM HALL EFFECT SWITCH
 - ▷ COMBINED CWHOME & CCWHOME SIGNAL
 - ▷ 0 VDC W/MAGNET NEAR EITHER CWHOME OR CCWHOME HALL EFFECT SWITCH
 - ▷ +12 VDC W/MAGNETS AWAY FROM BOTH CWHOME AND CCWHOME HALL EFFECT SWITCHES
 - ▷ MCR MOTOR CONTROL RELAY
 - ▷ CCWR COUNTER CLOCKWISE RELAY
 - ▷ LSR LOW SPEED RELAY
 - ▷ BCS BLOCK CLAMP SOLENOID
 - ▷ RCS ROTATIONAL CLAMP SOLENOID
 - ▷ CWLS CLOCKWISE LIMIT SWITCH
 - ▷ CCWLS COUNTER CLOCKWISE LIMIT SWITCH
 - ▷ HOME/LS HOME LIMIT SWITCH



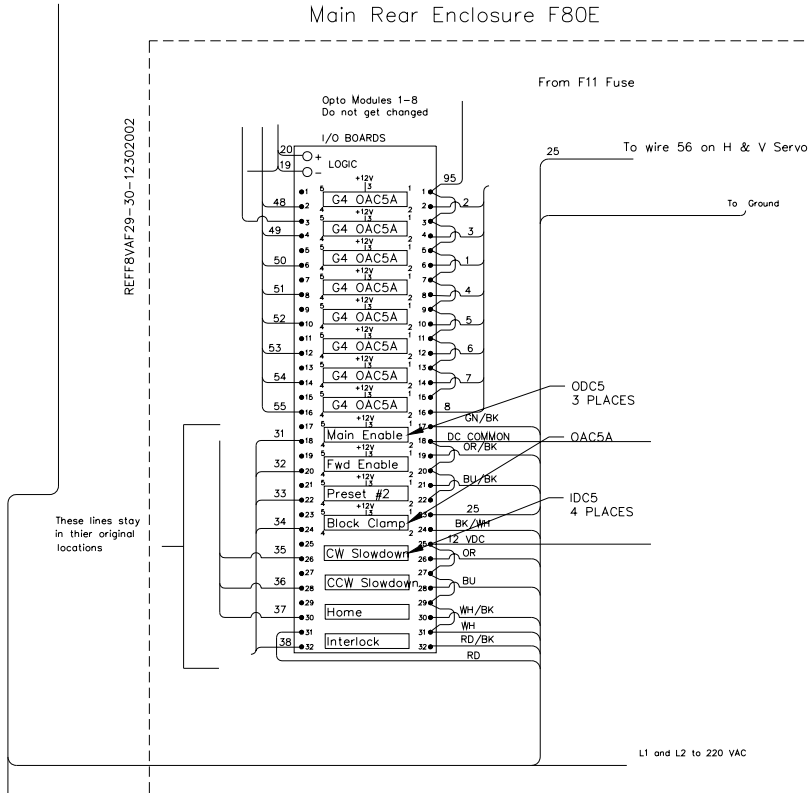
ALTERNATE TRANSFORMER HOOKUP



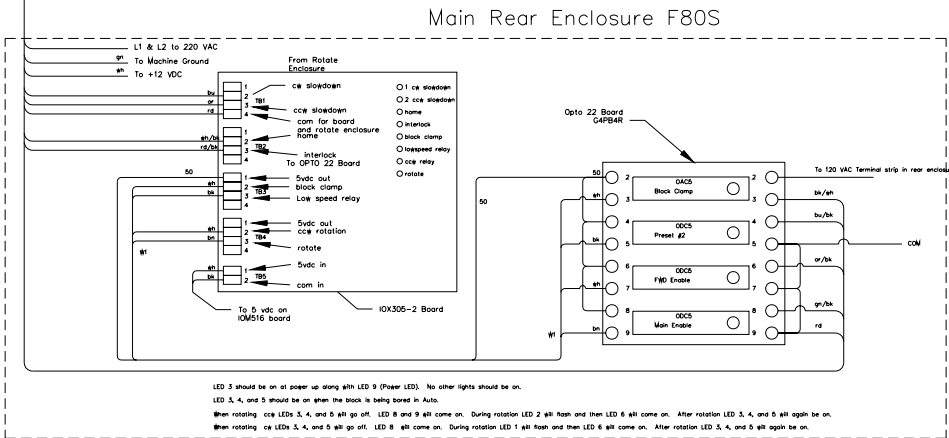
Auto Rotate Wiring Diagram Upgrade Model: Effective After 12/20/2002



Auto Rotate Wiring Diagram Upgrade Model: Effective After 12/20/2002 Continued:

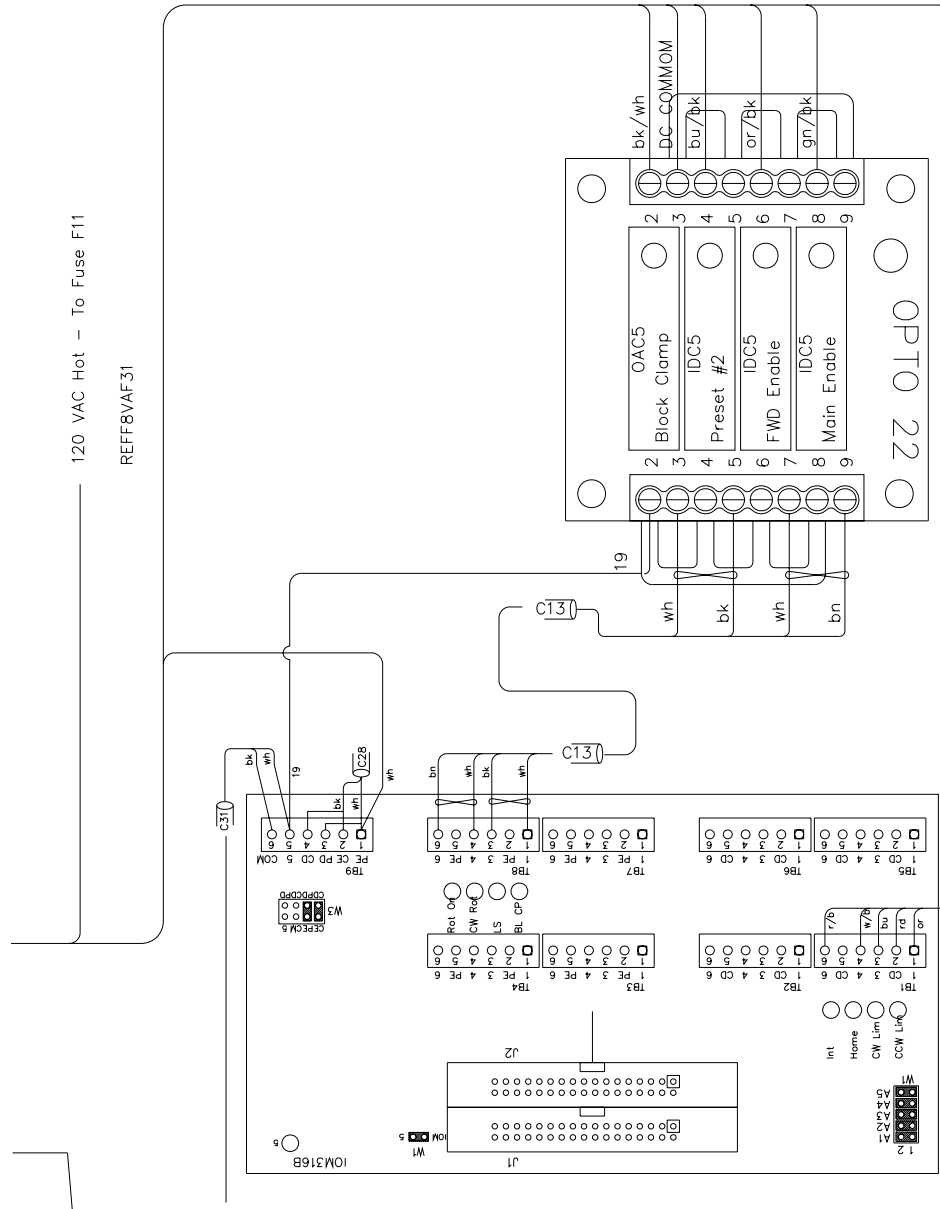


FOR AUTO ROTATE ON F80S
WITH THE MCNC130 CONTROLLER
SEE DRAWING 6455V

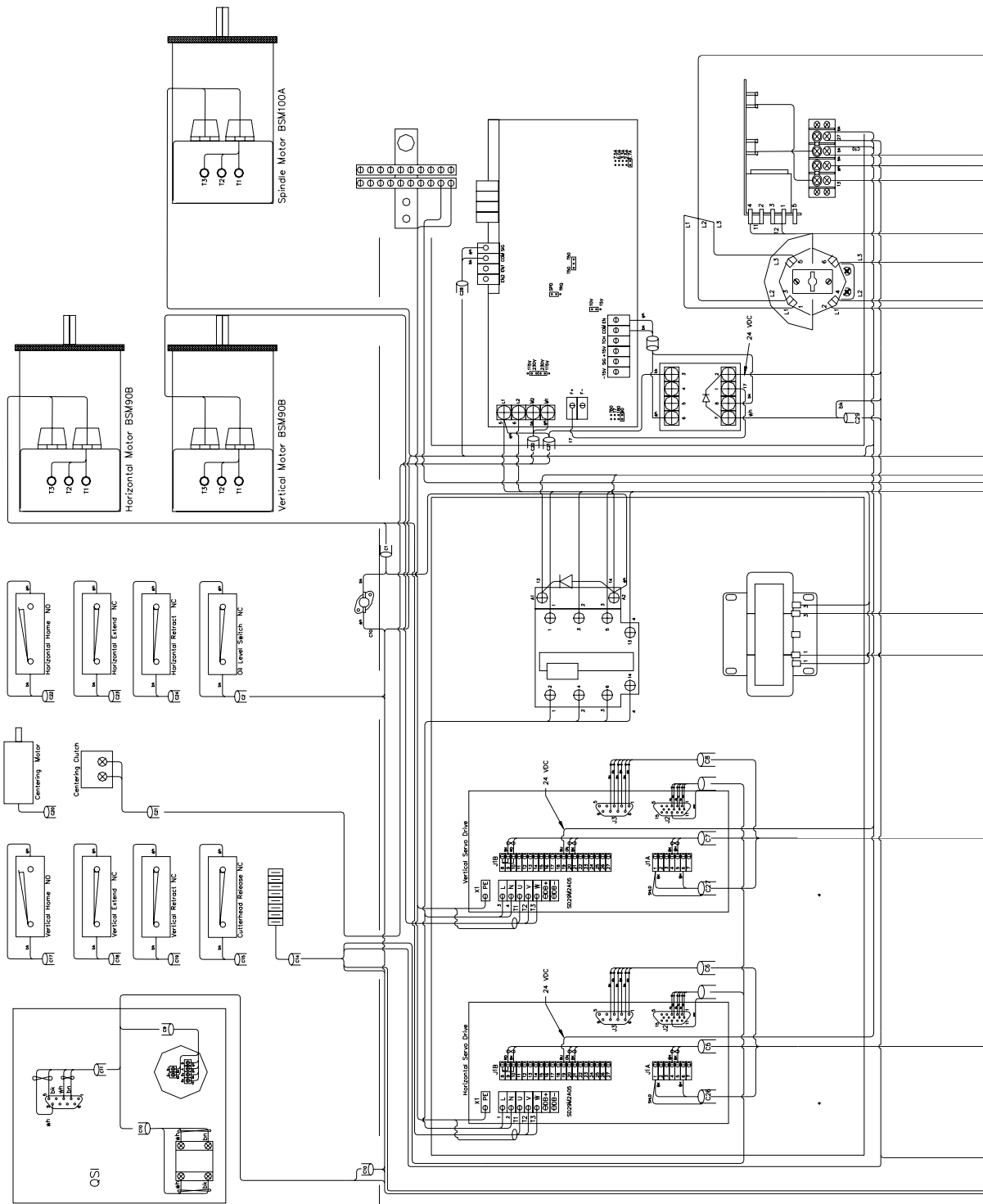


Auto Rotate Wiring Diagram Upgrade Model:

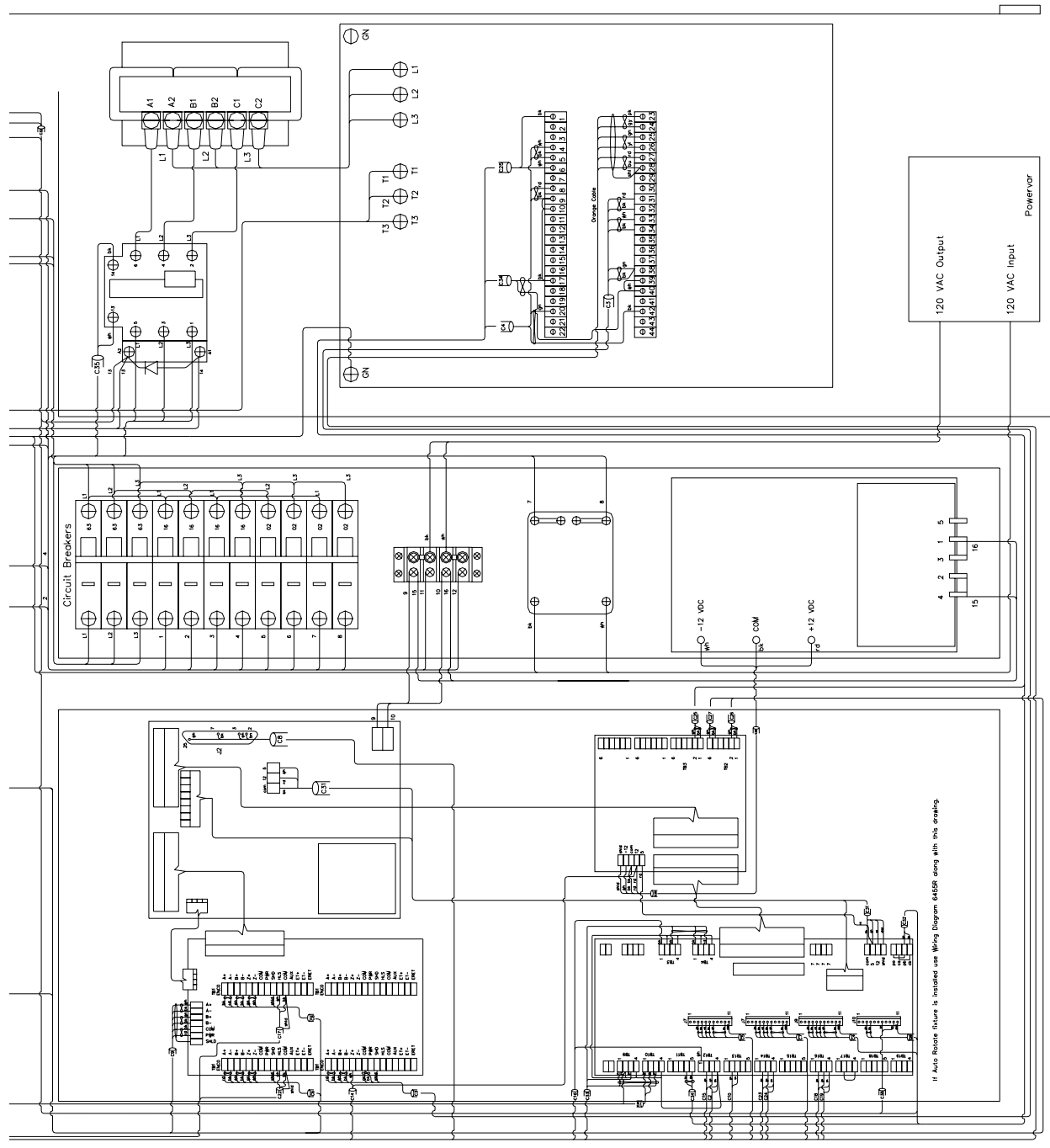
Effective After 12/20/2002 Continued:



F80S Wiring Diagram:

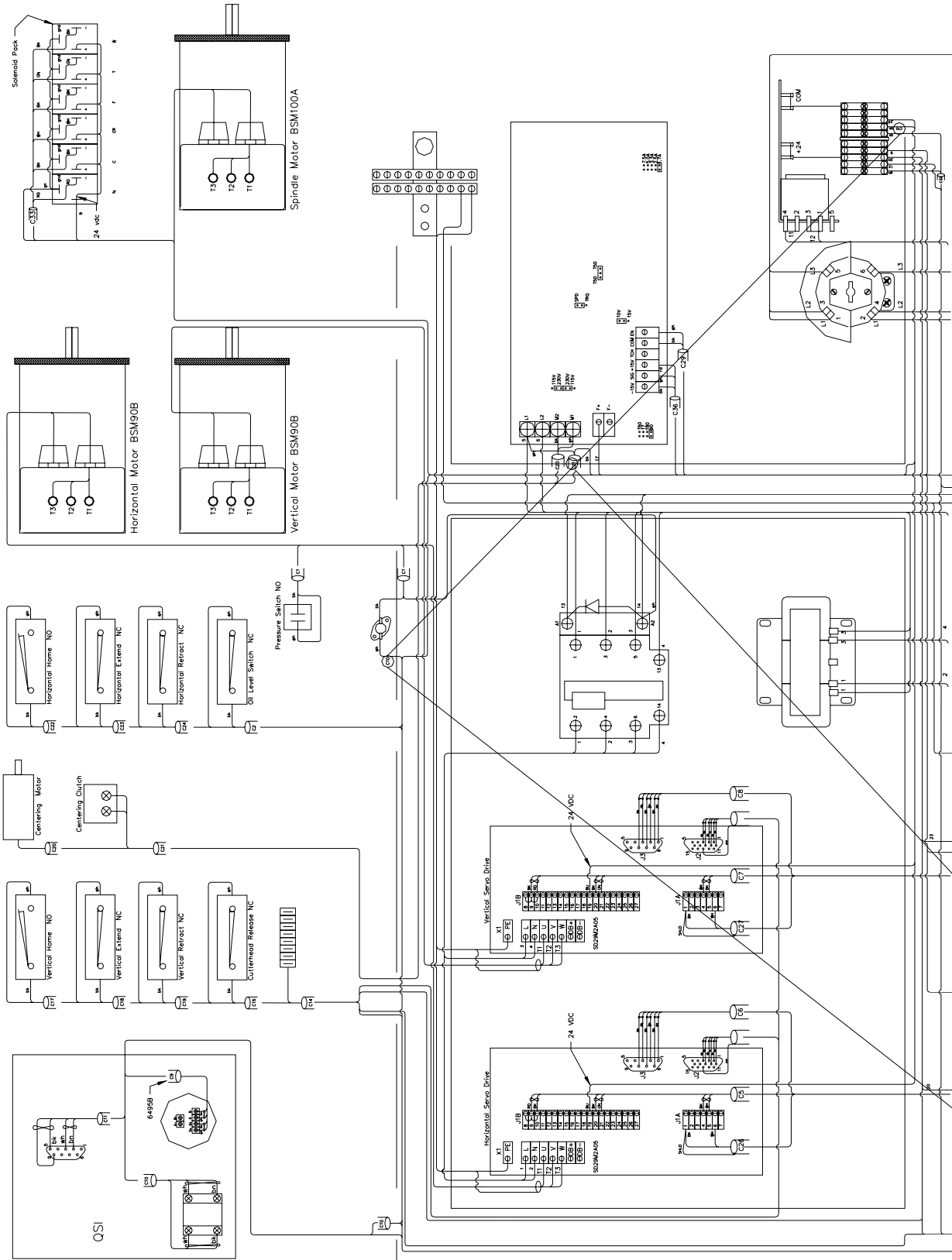


F80S Wiring Diagram Continued:



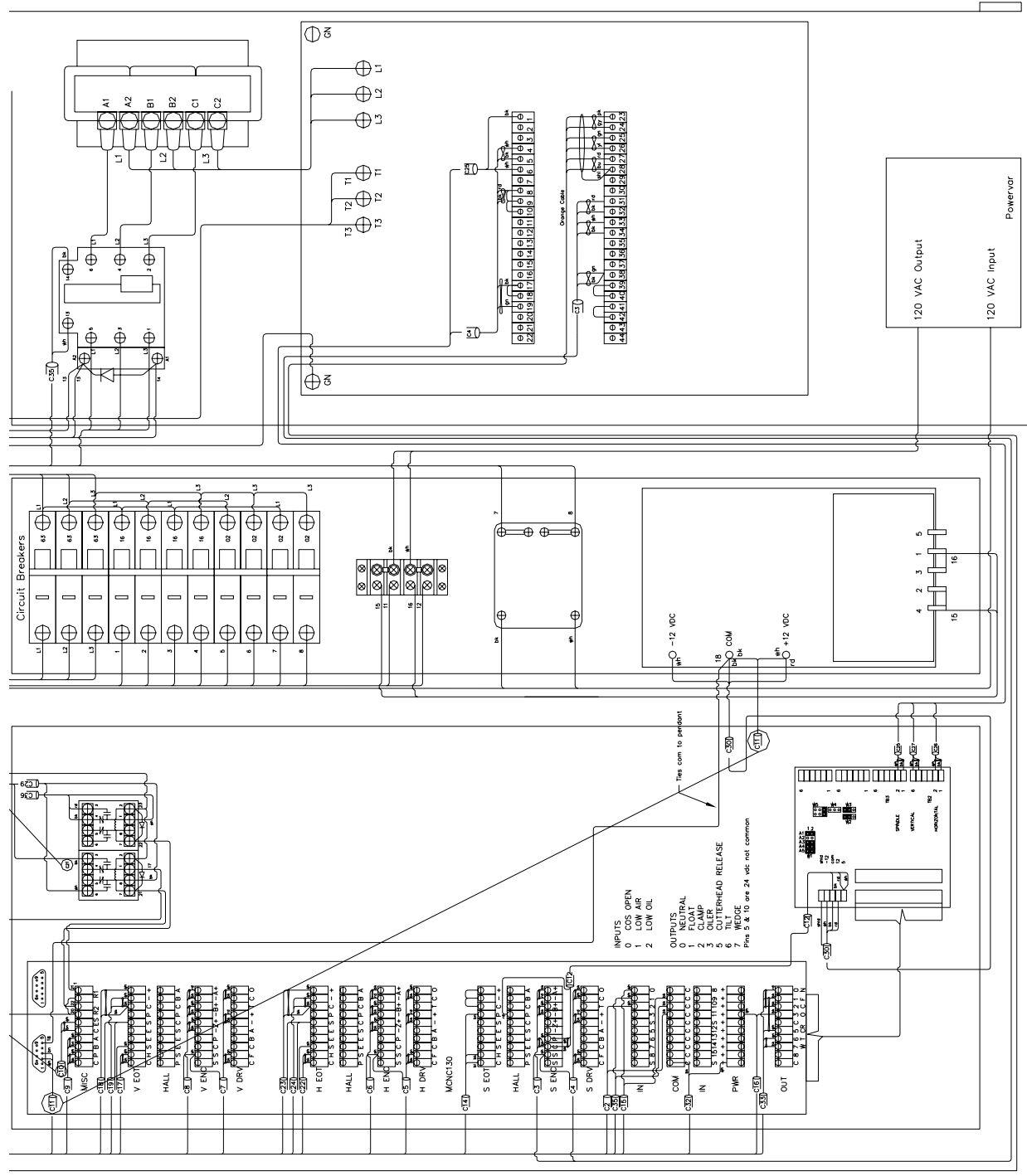
F80S Wiring Diagram:

Effective After 10/10/2002



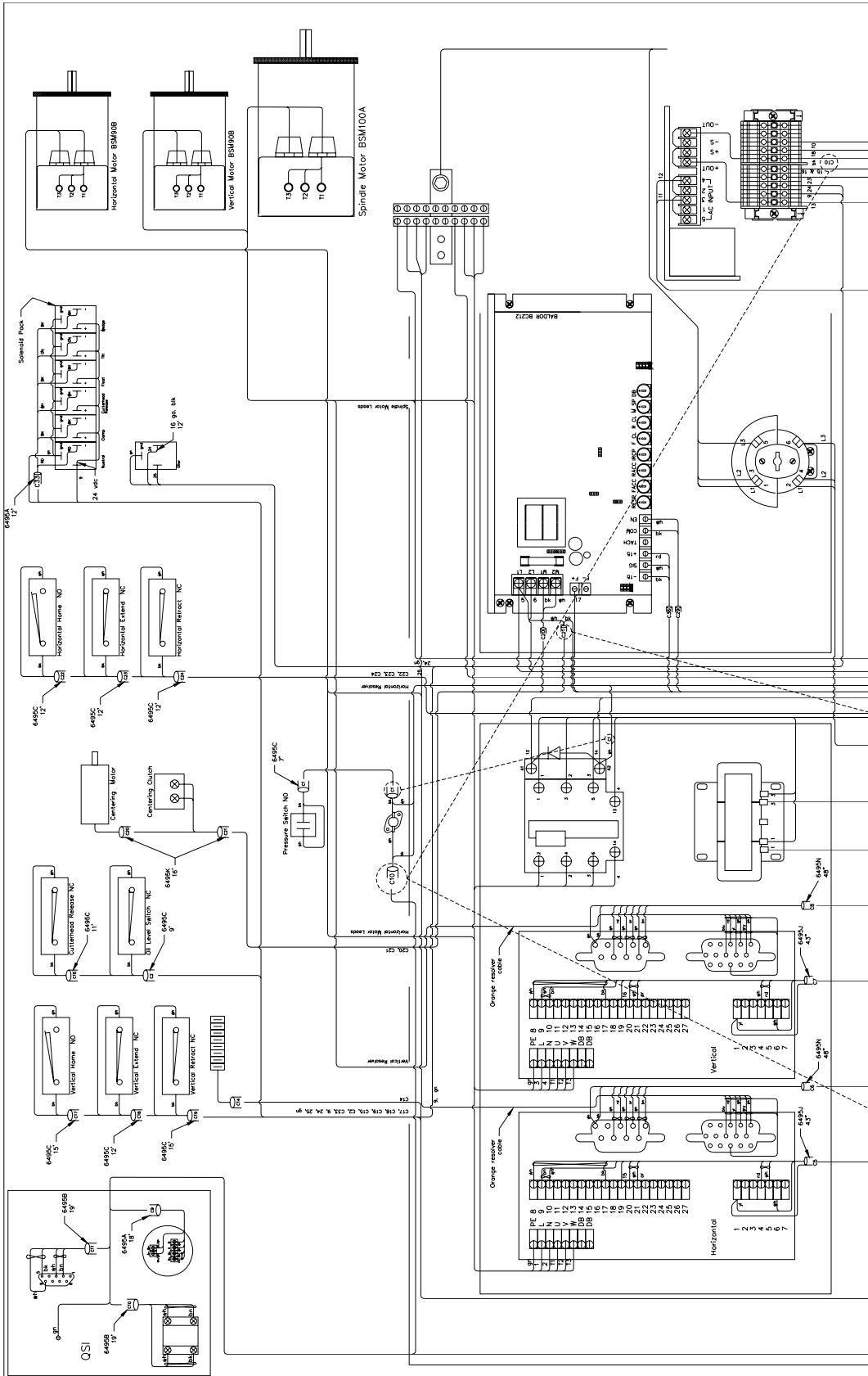
F80S Wiring Diagram Continued:

Effective After 10/10/2002



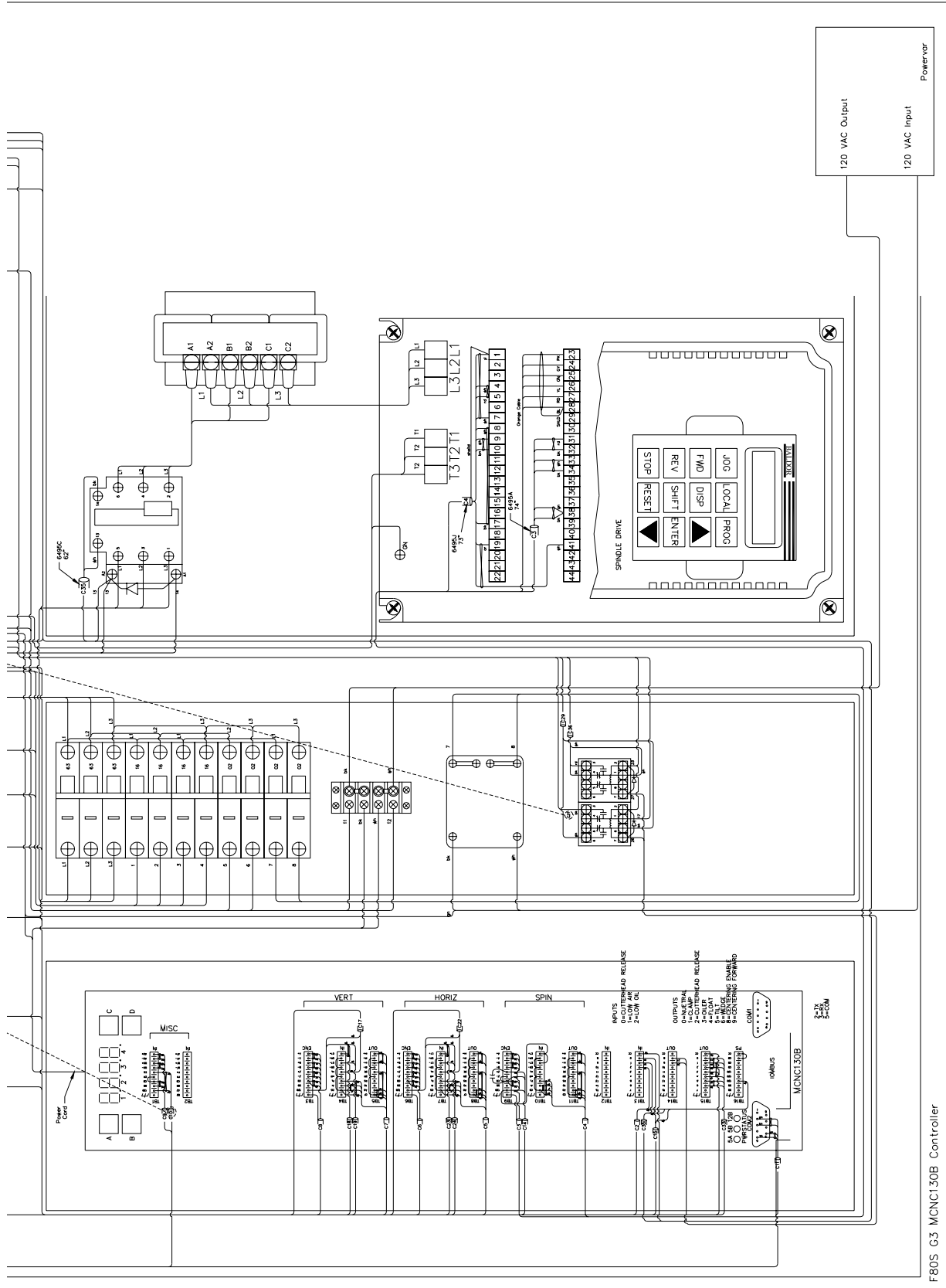
F80S Wiring Diagram:

Effective after 4/20/2004



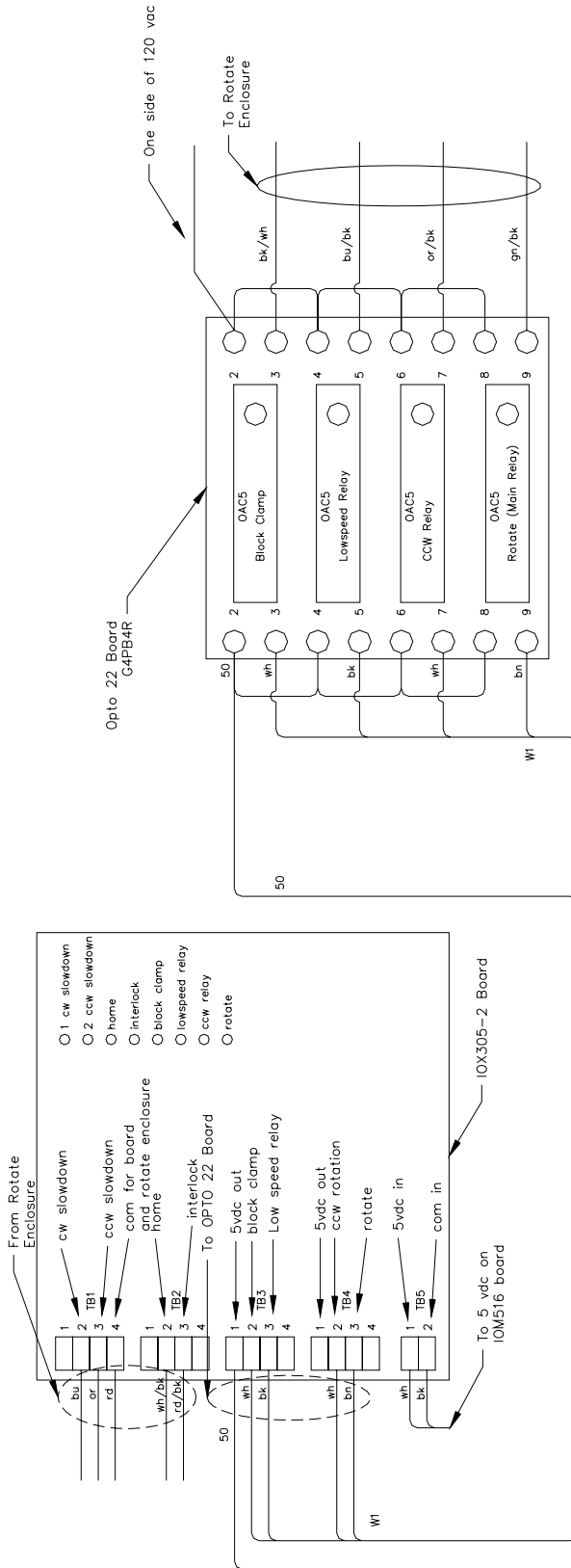
F80S Wiring Diagram Continued:

Effective After 4/30/2004



F80S G3 MCNC130B Controller

F80S W/ Auto Rotate Wiring Diagram:



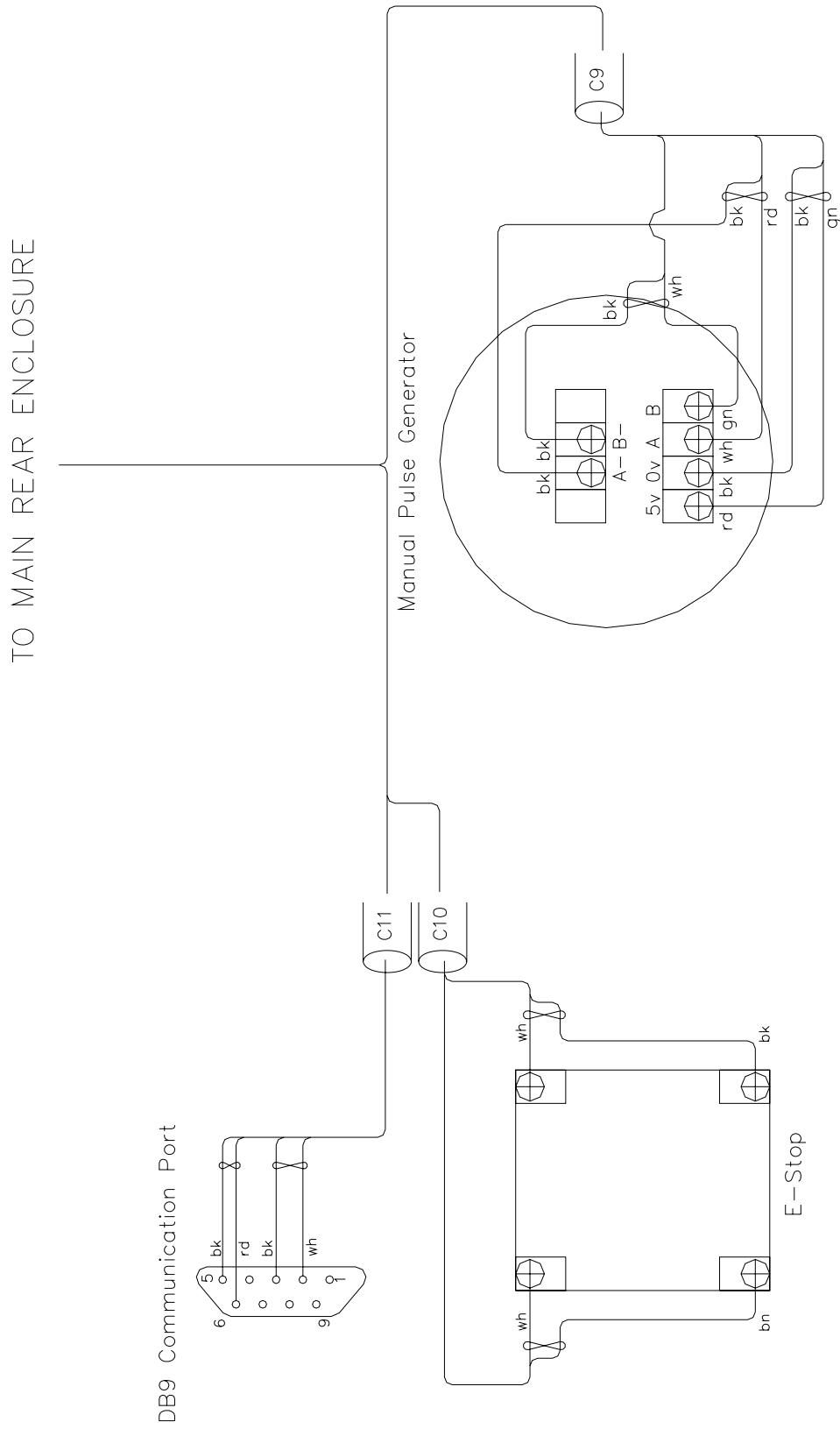
LED 3 should be on at power up along with LED 9 (Power LED). No other lights should be on.

LED 3, 4, and 5 should be on when the block is being bored in Auto.

When rotating ccw LEDs 3, 4, and 5 will go off. LED 8 and 9 will come on. During rotation LED 2 will flash and then LED 6 will come on. After rotation LED 3, 4, and 5 will again be on.

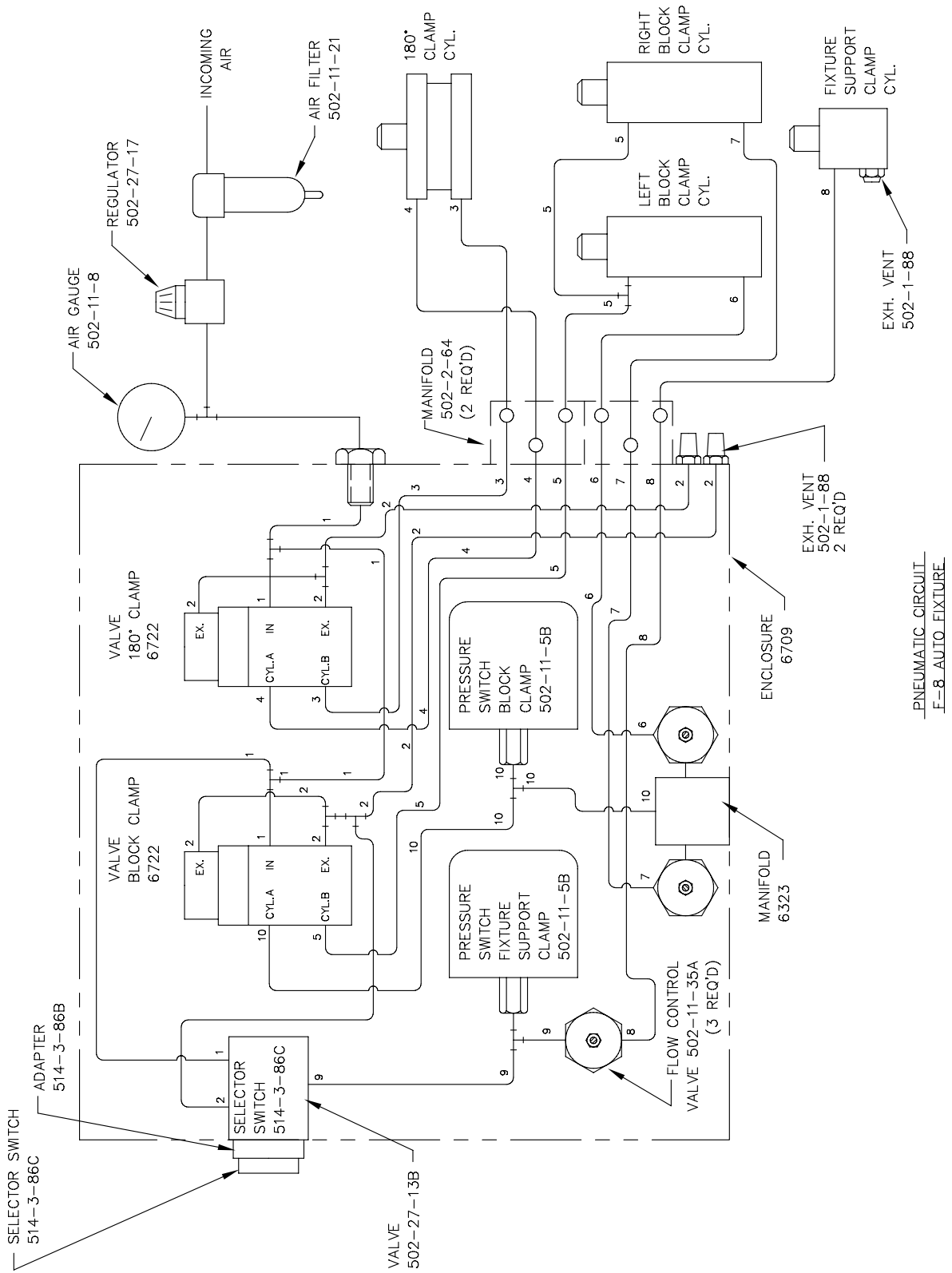
When rotating cw LEDs 3, 4, and 5 will go off. LED 8 will come on. During rotation LED 1 will flash and then LED 6 will come on. After rotation LED 3, 4, and 5 will again be on.

F80S Pendant Wiring Diagram:

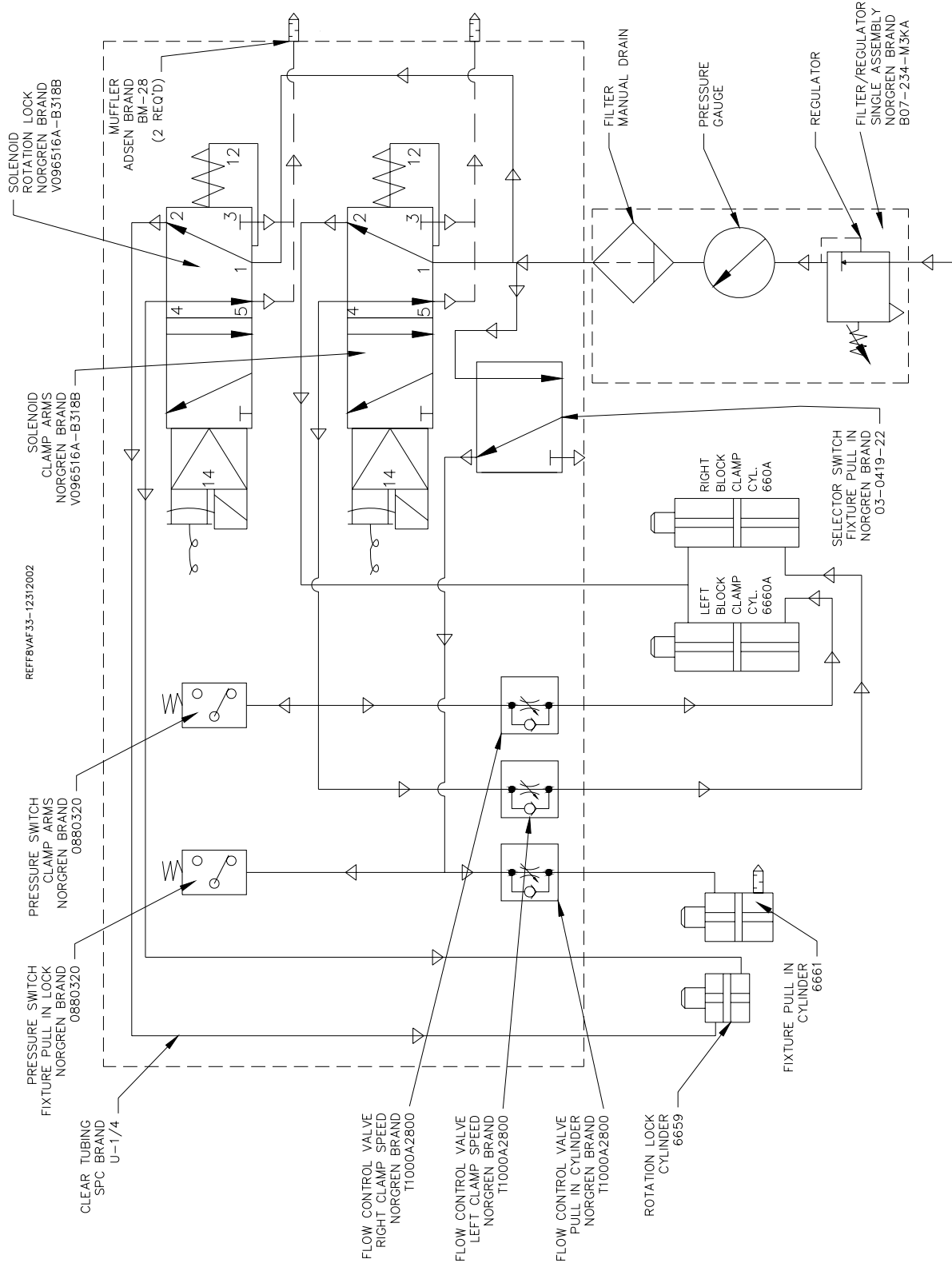


Auto Rotate Air Logic Diagram:

REFFBVAF9-121397



F80S Auto Rotate Air Logic Diagram Update Model: Effective After 12/20/2003



Vertical Servo Drive Belt Replacement / Adjustment:

⚠ CAUTION

Turn off all power to machine before attempting to adjust or replace belt. Serious injury may result.

The Vertical servo drive belt is located on top of the Spindle Unit.

Remove the four screws holding the top cover down. Remove top cover.

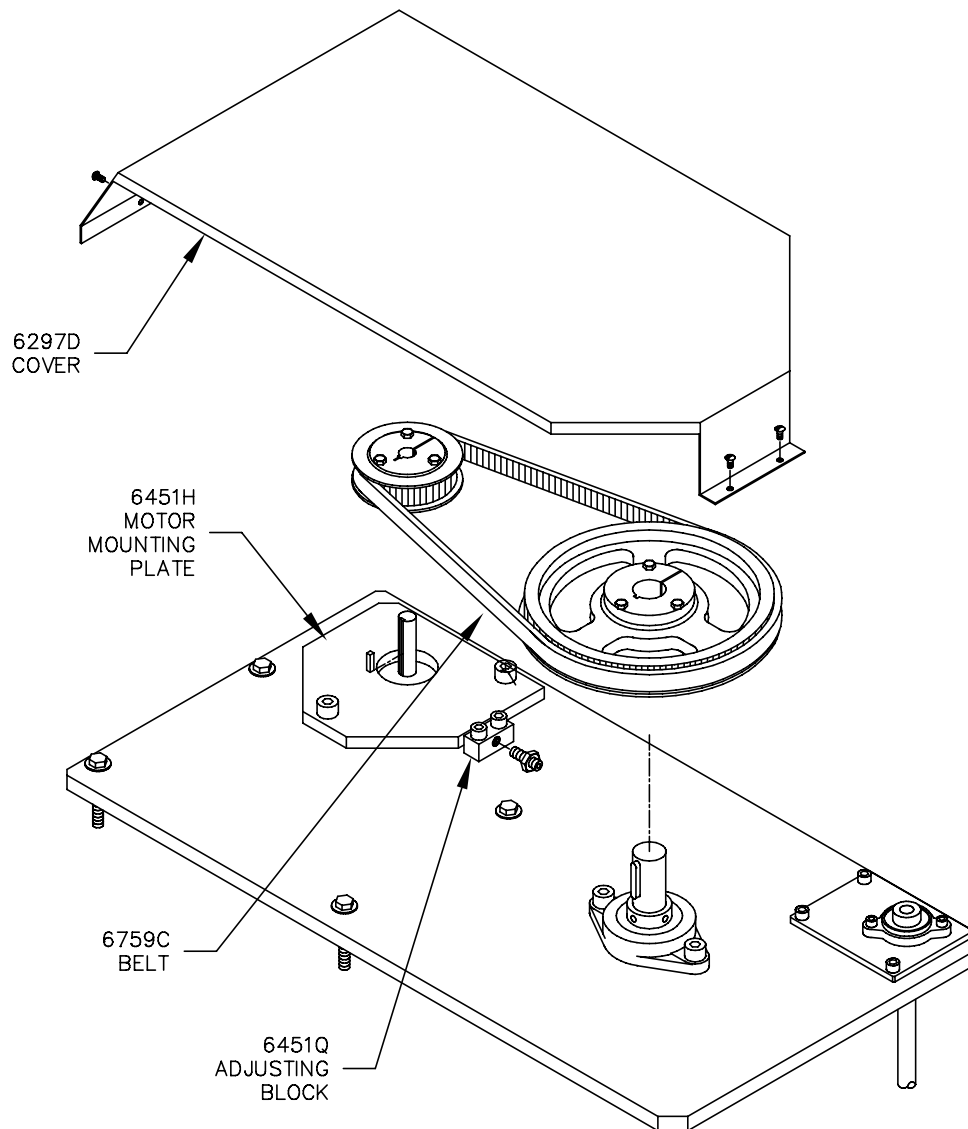
Loosen the two bolts securing the motor mounting plate and the tensioning set screw. Slide the motor mounting plate to loosen. Replace belt is needed.

Adjust servo motor mounting plate, using the tensioning set screw so the belt will deflect 5/16" when a force of 2 to 4 pounds is applied midway between the pulleys.

Fully tighten the two bolts mounting the plate.

Replace the cover on the top plate.

REF8E59-121397



Outer Spindle Adjustment:

This adjustment should be made if you start to get taper in the lower portion of the bore or if the Spindle “Drops” when the power and air are turned off.

Open the main spindle base door.

Located where the outer spindle comes out of the spindle base, is the upper retainer ring (6224). Use a spanner wrench or modified punch to loosen the retainer. Lift the retainer out of the way and use a small screw driver to carefully lift the felt oiler (6250). Use a piece of tape or rag to secure the two pieces at the top of the outer spindle. Damage to the upper retainer threads will result if the outer spindle is moved and the retainer comes into contact with the spindle base.

Where the outer spindle comes out of the spindle base is the lower retainer(6247A). Remove the four (4) Allen head screws and slide the retainer off the spindle (the retainer will require cleaning before re-installing). Slide the two square wipers and the felt oiler off the spindle also.

Note: This is a good time to replace the Upper and Lower felt oilers if they are dirty. This will expose the lower adjustment nut, do not remove this.

Loosen the small Allen head set screw that lock the outer spindle adjustment nuts (6223). The set screws are located on the front of the lower bearing carrier (6225A), and on the front of the flanged sleeve (6221C),

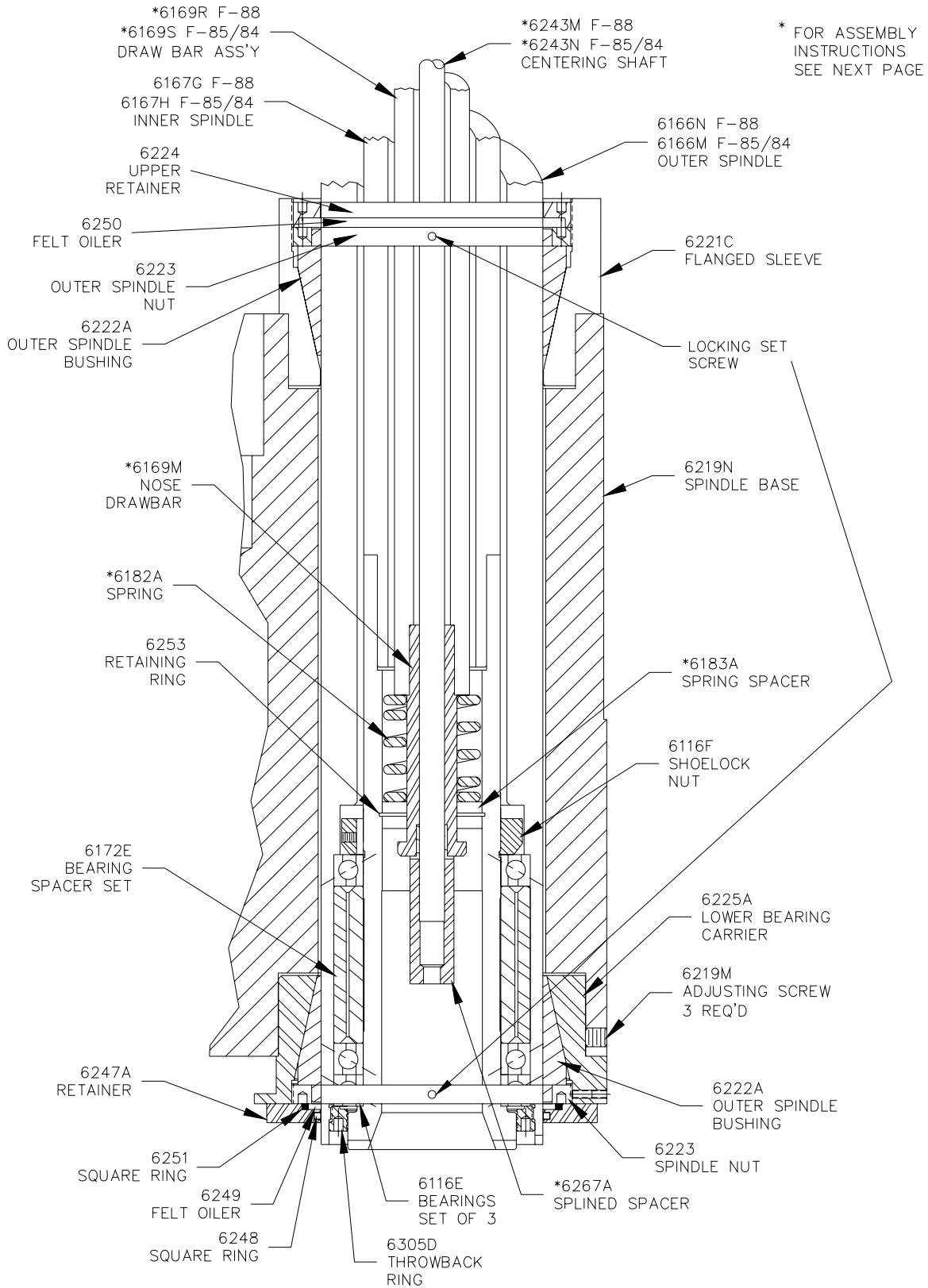
Important: Loosen the set screw before you attempt to adjust the outer spindle nuts or damage to the threads may result.

Using a spanner wrench or modified punch tighten the upper and lower nuts equally until the outer spindle will no longer fall when the air and power are off. If the bores still have taper you may need to tighten the upper and lower nuts a little more.

To make sure the outer spindle adjustment is not too tight, place a .001” indicator on the bottom of the cutterhead to a flat surface. Place the machine in Vertical Handwheel mode at .001” per increment. Put about .005” pressure on the indicator. With every detent of the handwheel you should see a .001” movement on the indicator. If you have to move the handwheel several detents before the outer spindle move the desired distance the outer spindle adjustment may be too tight or there is not an adequate amount of oil on the spindle.

Re-assemble in the reverse order.

REF F8579-06172003



Inner Spindle Adjustment:

This adjustment should be made if you getting chatter or out of round bores.

Open the main spindle base door.

Install the surfacing cutterhead or a boring cutterhead with a long tool holder installed into the machine.

Locate the opening on the belt housing. This is located at the top of the outer spindle. Inside is the inner spindle adjustment nut (6091A). The adjustment nut has hole drilled in it along it's perimeter to allow for an adjustment rod.

Insert the adjustment rod into one of the holes in the adjustment nut.

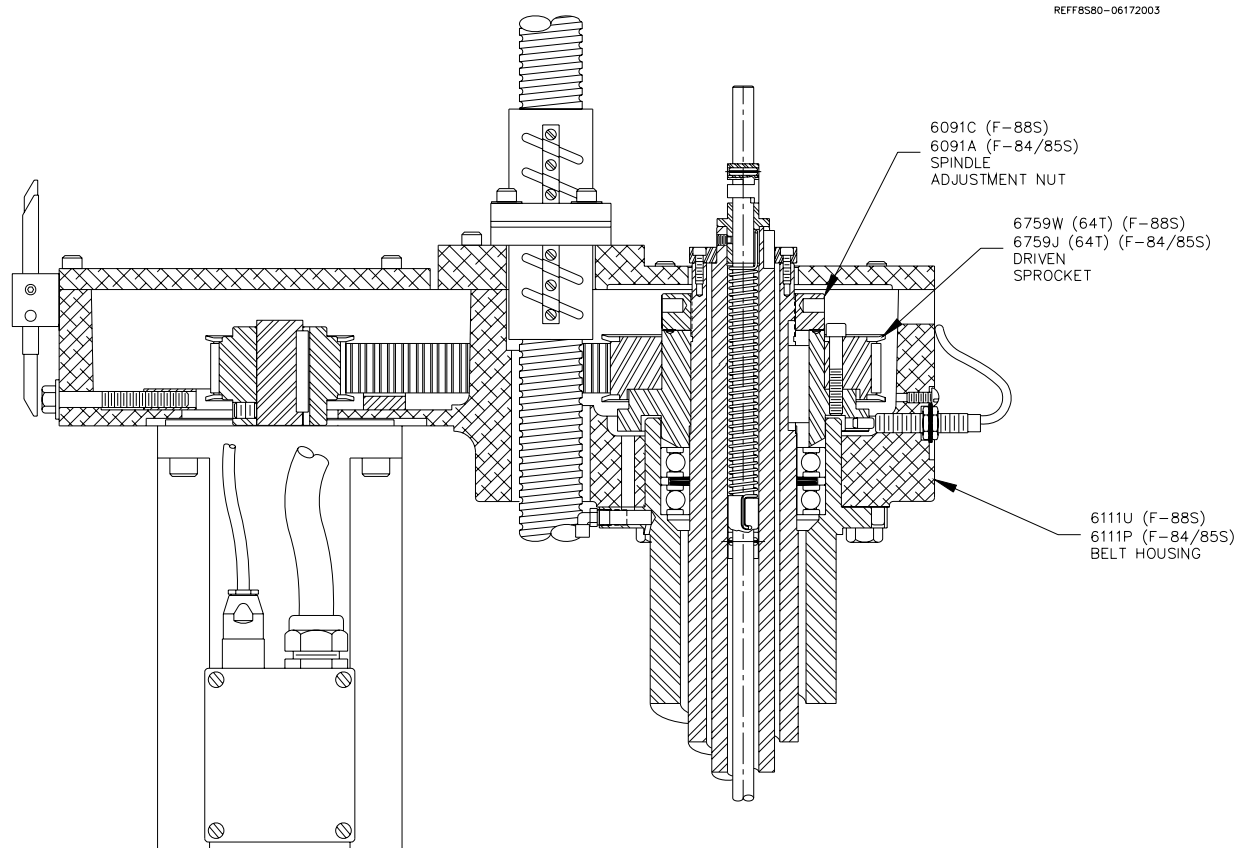
Rotate the head 1 turn Clockwise looking from the top, letting the adjustment rod move up against the end of the slot in the belt housing. This will loosen the inner spindle adjustment.

Now carefully turn the cutterhead Counter Clockwise looking from the top. The cutterhead will turn easily and you should be able to feel the spring loaded ball detent in the nut. At some point the torque required to turn the cutterhead will sharply increase, immediately stop turning the cutterhead. This indicates that the Belleville washers have collapsed and the bearing is bottomed out.

IMPORTANT: DO NOT OVER TIGHTEN, SEVERE BEARING DAMAGE WILL OCCUR AND REPLACEMENT WILL BE NECESSARY.

Now turn the cutterhead Clockwise of detent.

Remove the adjustment rod, the inner spindle is now properly adjusted.



F80S Upper Housing Disassembly:

Travel the machine to the right Home position.

Remove the spindle base door and right side cover.

Place a board across the spindle base directly below the spindle motor (6790K or 6790U). Lower the spindle until the motor just touches the board.



CAUTION Disconnect all power and air to the machine before continuing, severe bodily injury may occur.

Remove the four (4) bolts securing the motor the belt housing. Remove the two (2) bolts that secure the cable carrier (6314K) to the upper housing. Remove the oil and air lines from the upper housing.

Note: *It is not necessary to disconnect the spindle motor wiring.*

Rotate the vertical ballscrew by hand until it is about eight (8) inches from the top plate.

Place a board, of proper length, between the bottom of the upper housing and the top of the spindle base to prevent it from falling.

Remove the two bolts that secure the centering gear housing (6168H) to the belt housing. Work the centering housing up off the centering shaft. Tie it up to the top plate.

IMPORTANT!!: *Do not attempt to move the vertical under power when the centering housing is not bolted to the belt housing or the upper plate. Severe damage will result to the centering shaft!!*

Remove the Clevis Pin (7210B) from the draw bar actuator bracket (6174B). Lift the actuator arm (6173B), move the arm and cylinder off to the side. Remove the air cylinder (6204A), clevis pin (6189A) and mount bracket (6188C) from the side of the belt housing. Remove the two (2) bolts that attach the draw bar actuator bracket (6174B) to the to belt housing cover.

Remove the counter weight cable (6453 F or 6453G) from the upper housing by loosening the lock nut and unscrewing the cable nut.

Note: *When reassembling, be sure not to thread the cable nut in too far as it may come in contact with the driven pulley.*

Remove the eight (8) screws holding the inner spindle end cap (6180A). Unscrew these bolts slowly around the diameter of the end cap as they are under spring pressure from the draw bar. Remove the cap by pulling straight up.

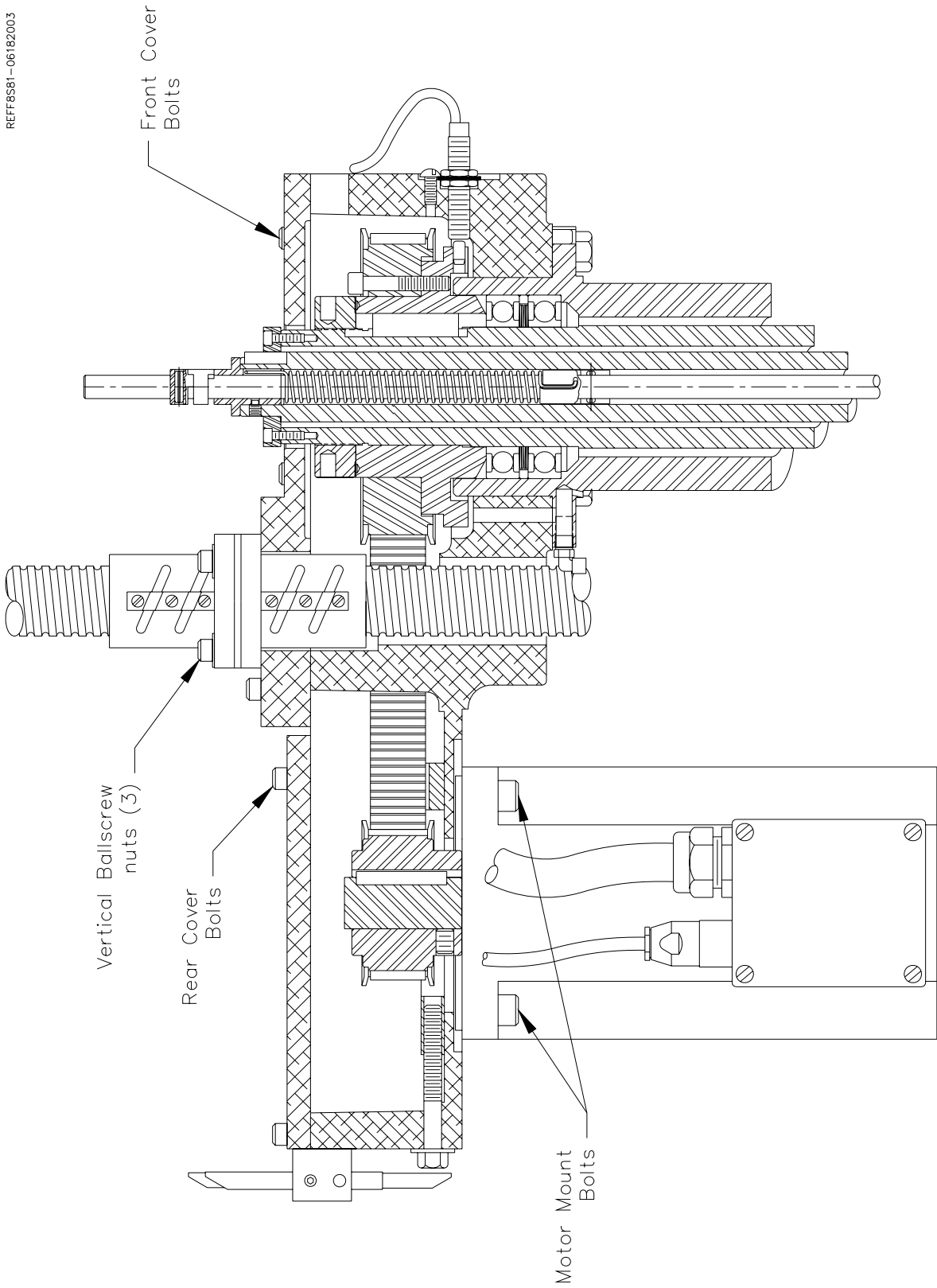
Note: *When reinstalling, the end cap must be aligned concentric to the draw bar.*

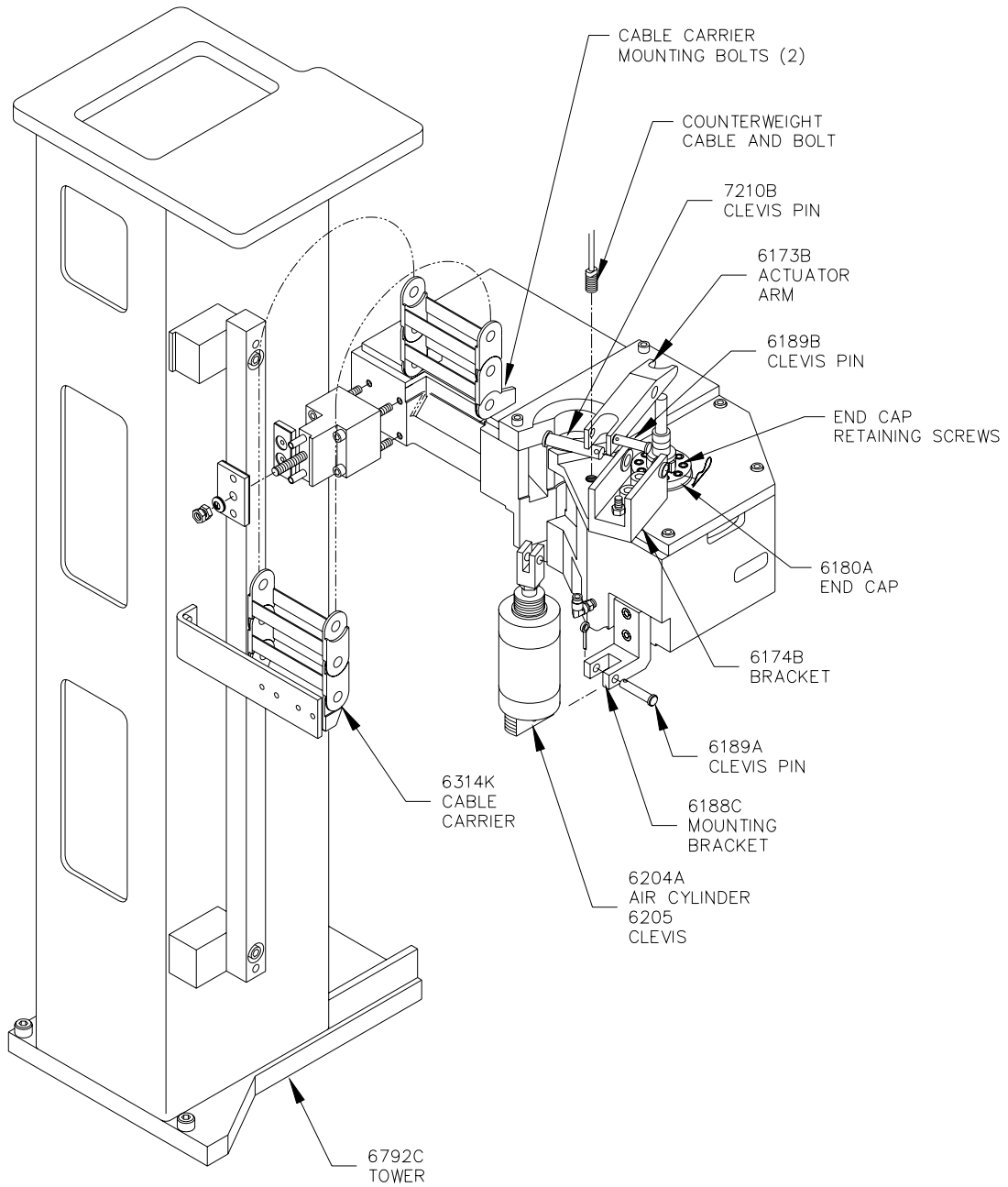
Remove the three (3) screws that secure the vertical ballscrew nut to the belt housing. Holding the nut with one hand, turn the ballscrew with the other to move it up and out of the way so the belt housing lid can be removed.

Remove the bolts securing the belt housing covers. The covers are pinned to the belt housing. Use a soft face mallet to carefully remove the covers.

From this position you can remove and/or replace pulleys and belts.

REFFS81-06182003





F80S Inner Spindle Removal:

Prior to following these instruction, perform the steps in Upper Housing Disassembly.

IMPORTANT: *When removing bearings, bellevilles and spacers, not the direction they come off for correct reassembly.*

The driven pulley and inner spindle adjustment nut must be in place before continuing. Remove the LEFT HAND THREAD throwback ring (6305D) from the bottom of the outer spindle.

Note: *If the driven pulley and inner spindle adjustment nut are not in place the inner spindle will be able to fall out of the outer spindle.*

While supporting the inner spindle from the bottom, remove the inner spindle adjustment nut and driven pulley from the top.

The inner spindle is now free to be removed from the bottom. This spindle is precision fit into the outer spindle, it may be necessary to tap the top of the inner spindle with a soft face mallet to get the spindle to drop out.

Note: *Be sure of the thrust direction of the bearings on reassembly.*

Reassemble in the reverse order.

Inner Spindle Angular Contact Bearing Replacement:

Prior to following these instruction, perform the steps in Upper Housing Disassembly and Inner Spindle Removal.

Loosen the three (3) Allen head set screws on the shoelock nut (6116F).

Loosen the shoelock nut and slide off of the top of the spindle.

Note: *Be very careful not to damage the threads when sliding nuts, bearings and sleeves off the top of the inner spindle. These are very fine threads used for the inner spindle adjustment nut.*

Remove the top bearing by tapping lightly and evenly on both sides of the bearing. After the bearing is moved slightly off of the spacer set (6172E) tap the inner race.

Note: *Tapping on the outer race can cause it to roll off of the bearings. Generally after removing the bearings from the inner spindle they are not suitable for re-use.*

Remove the spacer set.

Remove the two lower bearings (6116E) set of three (3) the same way as the top bearing.

Stand the spindle on end so that the bearing pack is nearest the floor.

Make sure inner spindle is free of all dirt and debris.

Lightly coat the lower bearing pack area with a light weight #10 oil.

If you have a bearing heater available to you, it is the preferred method of bearing installation. If not, follow the instructions below.

Slide the two (2) lower bearings onto the inner spindle with the correct bearing thrust direction until they stop. Use a small brass punch to lightly tap each side of the bearing on the inner race until both bearings are seated at the bottom of the spindle.

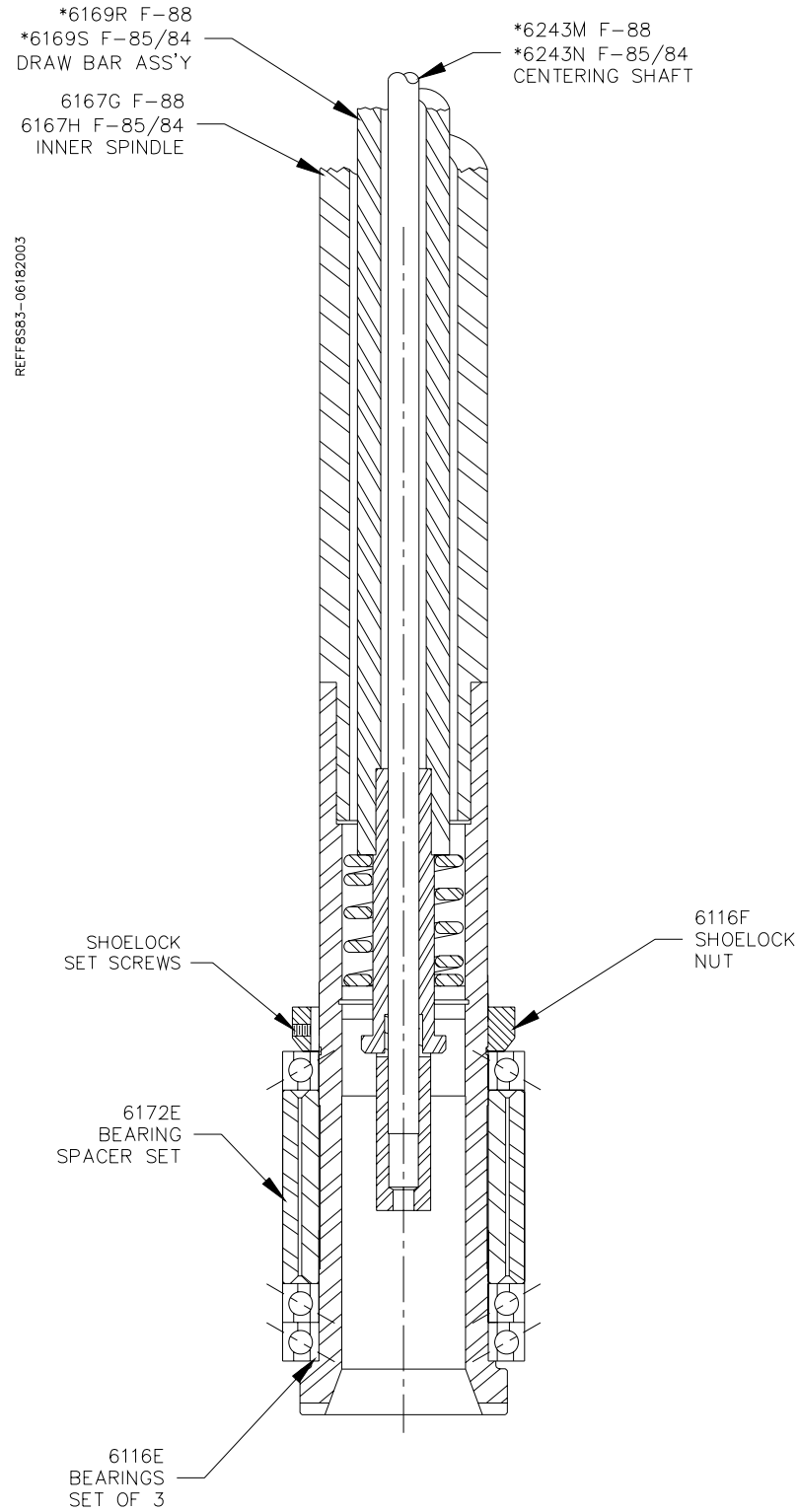
Install the spacer set.

Install the top bearing using the same procedure as the lower bearings until it is seated against the spacer set.

Install the shoelock nut and tighten with a spanner wrench until the inner races of the bearings and spacer set are fully seated together.

Tighten the three (3) set screws on the shoelock nut.

Place the inner spindle in a vise near the bearing pack and lock the vise. Indicate the bearing set to within .0005" all the way around. Adjust the spacer set by tapping the high side lightly with a brass drift.



Spindle Sweep:

The outer spindle must be swept into the main bed of the machine to achieve accurate bores.

Remove all fixturing from the machine bed, clean and stone if needed.

Install a boring cutterhead into the machine.

Install the sweep are into the cutterhead.

Bring the machine down until you have about .005" pressure on the indicator.

CAUTION

Disconnect all power and air to the machine before continuing, severe bodily injury may occur.

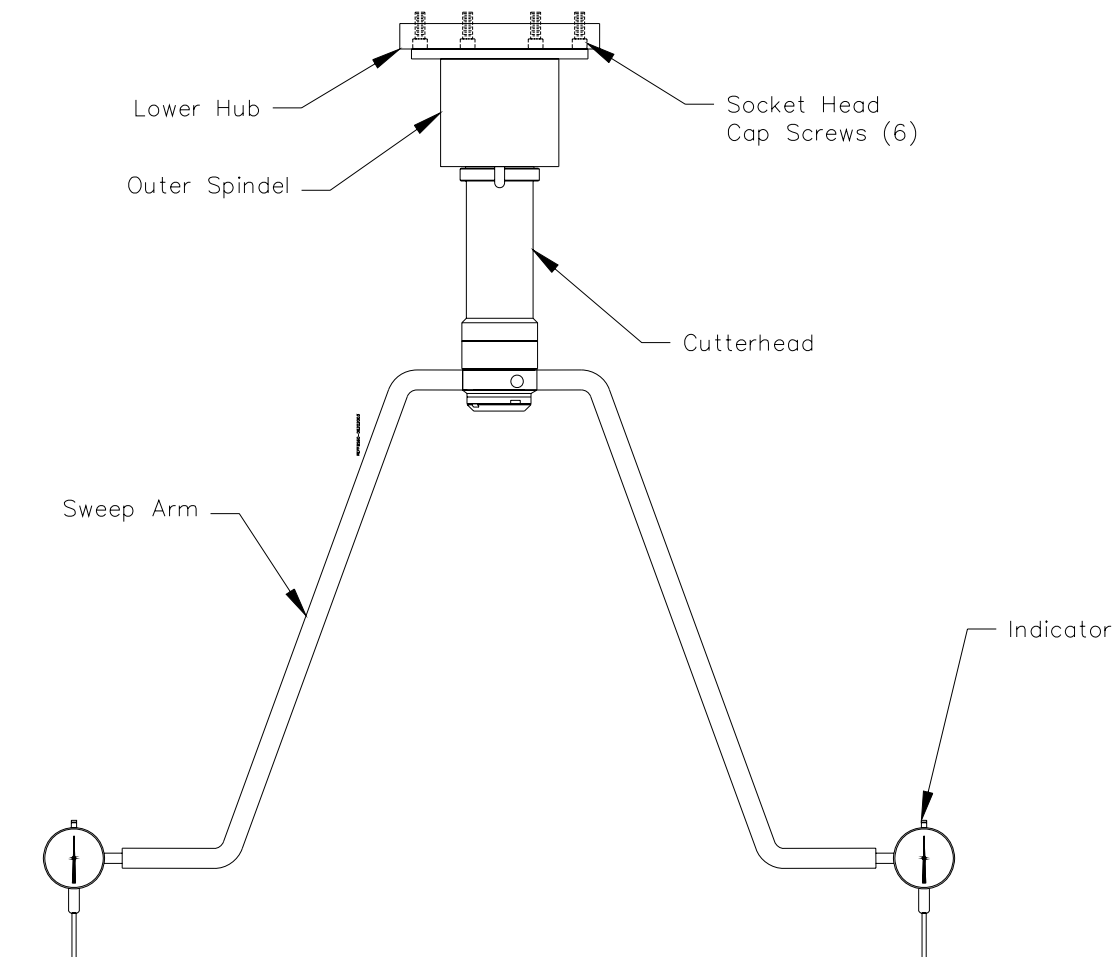
Turn the sweep arm to the 9 O'clock position. Zero the indicator here.

Loosen the 6 socket head cap screws on the lower spindle hub. You do not want them all the way loose, just snug.

Use the three (3) set screws in the spindle base to move the spindle until the indicator reads within .0005" with a full 360 degree sweep of the indicator.

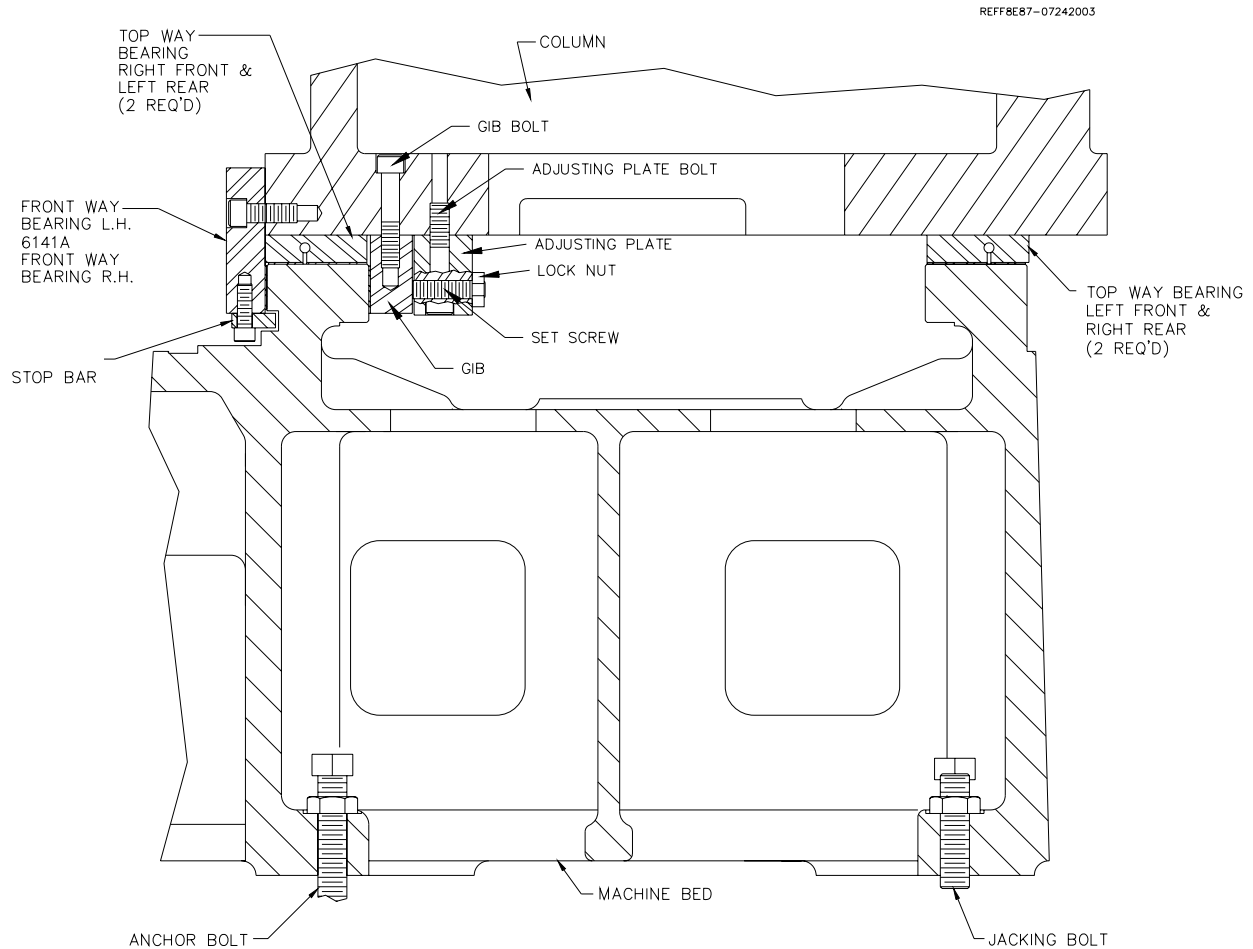
Note: You do not want the right hand side of the spindle to be more positive than the left, it will interfere with the automatic tilt of the machine when in Mill mode.

Once the spindle is swept in tighten the six (6) socket head cap screws and double check that the sweep did not move.



Horizontal Gibs:

The Horizontal gibs are located under the main column, on the back side of the front way. These gibs keep the column from “cocking” when the direction of travel is changed. This adjustment becomes more critical when line boring. If the gibs are too loose the column will turn slightly side ways when traveling. This will cause the alignment of the right angle drive to be off. The cutterhead will then cut heavier on one side of the bore.



To adjust:

Loosen the Gib bolts (two on each side)

Loosen the Lock Nut on the set screw.

Tighten the set screw as much as possible using only the correct size Allen Wrench. This will pull the Front Way bearing up against the front way while pressing the Gib up against the back of the Front Way.

Loosen the Set Screw.

Tighten the set screw up until you can feel it contact the Gib.

Lock the Lock nut.

Run the machine back and forth to let the gibs adjust to adjust in.

Tighten the Gib bolts.

If the machine will not travel full speed or the handwheel movement is erratic the gibs may be too tight. Re-adjust leaving the Set Screw a little bit looser than the previous adjustment.

Spindle Belt Adjustment:

The spindle belt should not require adjustment very often, but if required use the following instructions.

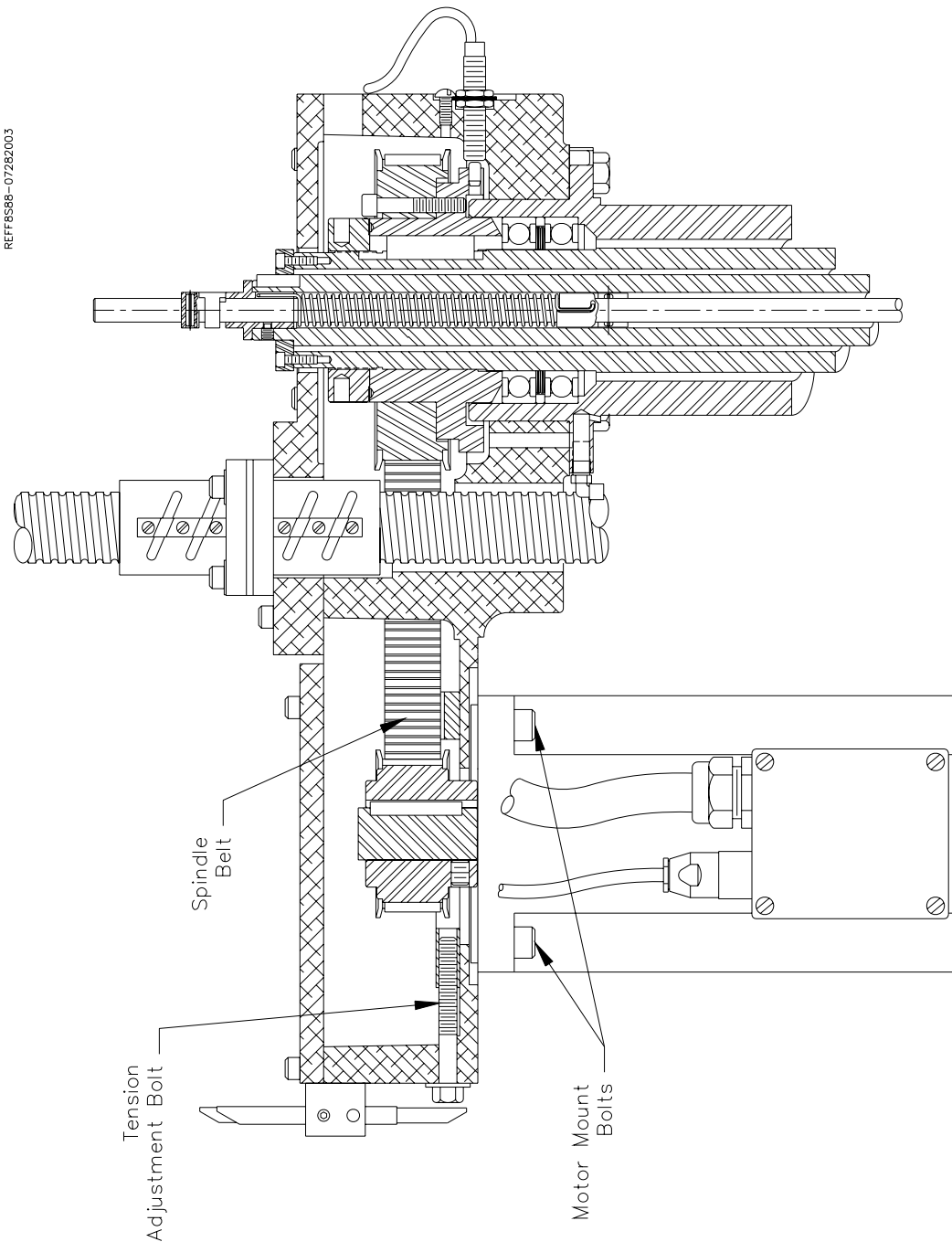
Open the Spindle Base shroud.

Loosen the four Motor mounting bolts on the spindle motor.

Tighten or loosen the Tension adjustment bolt on the rear of the belt housing until 5 pounds of pressure causes the spindle belt to deflect $\frac{1}{4}$ ".

If the spindle motor is run at high speed and a high pitched whining is heard from the belt housing area the belt adjustment is probably too tight.

If you can visually see the belt jumping around while running the belt is too loose.



Preventative Maintenance Quick Reference Chart:

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

Procedure	Frequency
Inner Spindle	1000 Hours
Outer Spindle	500 Hours
Horizontal Gibs	2000 Hours
Vertical Belt	1000 Hours
Spindle Belt	1000 Hours
Spindle Sweep	150 Hours
Horizontal Ballscrew	2000 Hours
Horizontal Backlash	1000 Hours
Vertical Backlash	1000 Hours
Spindle Tilt	500 Hours
Machine Level	1000 Hours
Spindle Wear	2000 Hours
Horizontal Way Wear	2000 Hours

Digital Micrometer setting instructions:

Turn the digital micrometer thimble in until the end of the micrometer is flush with the edge of the micrometer frame. Then turn the thimble out until the '0' mark on the thimble lines up exactly with the line on the barrel.



Select mode: Press the mm/in button until the desired mode is shown in the digital display.

Note: use a small instrument such as a pen to gently push the buttons, They are quite small and a bit delicate.



Determine which cutter head bore range the micrometer is going to be used on. (example; 2.9 – 6.0)

Press and hold the set button, then press the + or – button. “Set” will flash in the display. This places the micrometer in edit mode.

Press and hold the + or – buttons to change the display number to the minimum bore diameter determined earlier (example; 2.9).

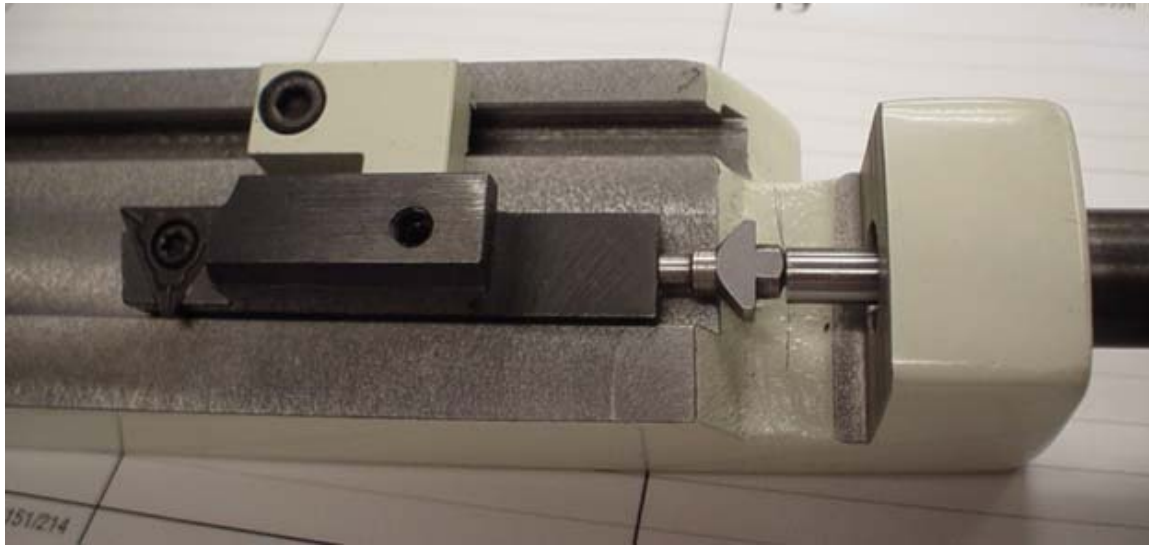
Press the set button to exit the edit mode. “Set” should no longer be shown in the display. The micrometer head is now set to the bore range. (After initial setting, there is no need to press the set button again unless display is lost at which time the micrometer must be reset)

Set up the cutter head and bore a set up hole. Measure the bore accurately. Set the digital micrometer to this exact dimension.

Loosen the set screw holding the large diameter anvil. Slide the anvil back out of the way.



Place the tool holder used to bore the hole into the micrometer frame. Slide the location nub on the back of the tool holder gently up to the end of the micrometer shaft.



Move the micrometer anvil up until it touches the end of the cutting tip of the tool holder. Tighten the set screw.



Back off the micrometer then bring it back up to the tool holder and check that the number on the display reads accurately the dimension of the set up bore.

The micrometer is now set up for this cutter head.

Note: this procedure must be repeated to set the micrometer to a different cutter head. The micrometer can only be set to one cutter head at a time.

Note: The REL function is not used on these mics.

Chapter 5 Troubleshooting:

Electrical:

Interlocks, Exceptions and Errors:

All motion is inhibited if:

The Emergency stop is pressed.

Any error condition is active and has not been taken care of.

Controller has lost the machine parameters. This can be caused by electrical noise or a bad battery back up chip. All of the machine parameters will need to be re-entered.

Spindle Rotation Inhibited:

Spindle ready input to controller is false. Read out will display "SPINDLE NOT READY". Turn main machine power off, wait at least one minute then turn power back on.

Cutterhead Override is active – turn the cutterhead drawbar switch to it's locked position.

Horizontal or Vertical axis is making a rapid move.

Error Conditions:

The F80S machine has a fault detection system. When a fault is detected, the type of fault will be displayed on the control panel. Below is a list of faults for the F80S machine.

Emergency Stop:

The Emergency Stop button has been pressed. The emergency stop button has two sets of contacts. One set sends a signal to the controller, the controller then sends out 0 volts signals to the drives and disables them. The second set of contacts is hard wired to the power relays for the drives. When the emergency stop button is pressed, the contactors open and power is removed from all drives.

To release the Emergency stop button turn it clockwise and it will pop out. Press the clear button on the control panel to clear the text error from the screen.

Note: *The Emergency Stop button has to be in for at least one minute before releasing it or the drive will not have time to shut down properly.*

Horiz Pos'n Jam:

Horizontal Position Jam. All motion stops. Controller disables drive and sends a 0 volts signal. Error message will remain on screen until acknowledged by pressing the Clear button. If you cannot run the horizontal after pressing clear the machine will need to be shut down. Wait one minute before re-applying power.

Vert Pos'n Jam:

Vertical Position Jam. All motion stops. Controller disables drive and sends a 0 volts signal. Error message will remain on screen until acknowledged by pressing the Clear button. If you cannot run the vertical after pressing clear the machine will need to be shut down. Wait one minute before re-applying power.

Spindle Jam:

Spindle Position Jam. All motion stops. Controller disables drive and sends a 0 volts signal. Error message will remain on screen until acknowledged by pressing the Clear button. If you cannot run the spindle after pressing clear the machine will need to be shut down. Wait one minute before re-applying power.

Spindle Not Ready:

The spindle drive ready command is not present at the controller. Controller disables drive and sends a 0 volts signal. Error message will remain on screen until acknowledged by pressing the Clear button. If you cannot run the spindle after pressing clear the machine will need to be shut down. Wait one minute before re-applying power.

COS Open:

Cutterhead Override Switch. The cutterhead override switch is open. Spindle motion is inhibited. To resolve, close the cutterhead release switch on the left hand side of the spindle base. Press the Clear button on the control panel.

Parameter Fault:

Parameter Fault. The controller has lost the machines operating parameters. The parameter may appear to be correct when viewing them but the controller is not seeing them. This message is displayed at start up and when any movement is attempted. Acknowledge the message by pressing the clear button. ALL machine parameters must be re-entered. Even if the parameters look correct, they must be re-entered or the error will not clear.

Low Oil:

Oil level detection switch is open. All motion is stopped. Machine will not operate until the oil reservoir has been filled and the Clear button has been pressed.

Machine Parameters:

The F80S series machine uses a set of Machine Parameters to define it's operation. A list of these parameters is located in the Control Definition section of this manual.

Important: Do not change machine parameters without permission from the factory. Changing Machine Parameters will cause the machine not to run properly or at all in some cases.

Rear Electrical Enclosure:

Disconnect the main power from the machine before doing any work in the rear electrical enclosure. Electrocution may occur.

This section describes some of the electrical components and values of the F80S series machine. The F80S machine has had two (2) different electrical control systems, the COP 1140 system on the early F80S machines and the MCNC130 on the current machines. This section will discuss both types of controls. Machines built after October 10, 2002 will have the MCNC130 controller.

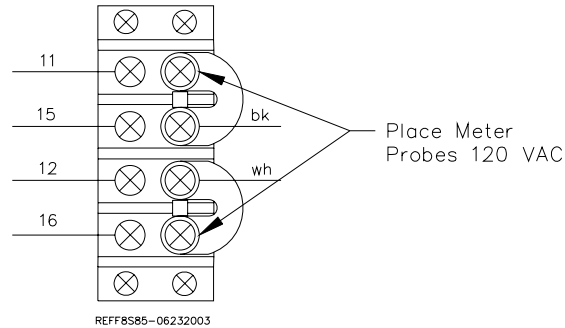
Use the Electrical Enclosure diagram located in the Machine Parts chapter of this manual.

When trouble shooting the rear enclosure it is important to first check the breakers located in the middle of the panel and then fuses on individual components. The breakers are not tripped if the switch is to the right. They are also color coded or have symbols, green or "0" is off or tripped and red or "I" on or not tripped.

Check all connections for security.

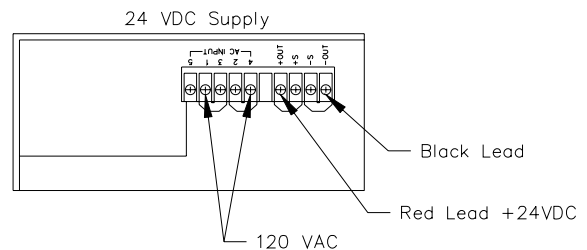
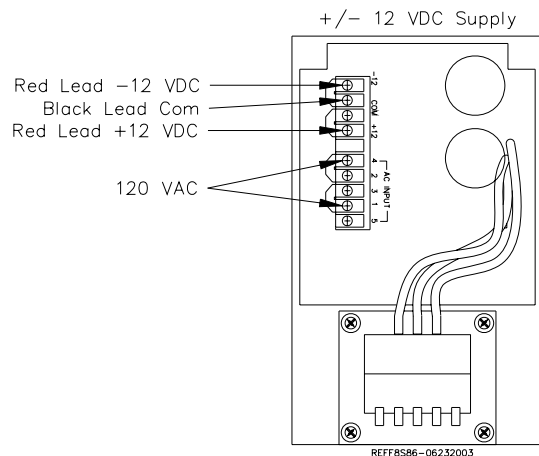
Transformer:

There is one (1) transformer / power condition in the rear enclosure. It is located on the lower portion of the panel. The transformer is 208/240 VAC input and 110/120 VAC output. The 120 VAC output from the transformer can be measured on the terminal strip located in the middle of the panel. If you do not measure 120 VAC across these terminals, measure the incoming voltage to the machine. It needs to be between 208 and 240 VAC.



DC Power Supplies:

There are two DC supplies in the rear enclosure, one in the upper right hand side of the cabinet and one in the lower center of the cabinet. The upper right supply is the 24 VDC supply and the other is a +/- 12 VDC supply. Later models of this machine will not have the +/- 12 VDC Supply.



The 24 VDC supplies voltage to the following:
 Controller
 Inputs and Outputs
 Solenoid Pack
 Reference Voltage for Servo Drives

The +/- 12 VDC supplies voltage to the following:
 IOM516 Board (for load meters)
 Power to the Pendant
 Com to the Pendant

Servo Drives:

There are three (3) AC brushless Servo drives in the F80S machine, Vertical, Horizontal and Spindle. The Vertical and Horizontal drives are in the upper left hand corner and the Spindle is in the lower right.

Adjusting Servo Drives:

The servo drives are tuned and programmed at the factory. If the drives need to be tuned contact the factory for assistance.

Note: *Changes made to the servo drives may cause them to become inoperable.*

A programming cable was provided with the machine. It is to be used in conjunction with the display pad on the spindle drive. This cable and pad will plug into both the vertical and horizontal drives. The display will show the current state of the drive as well as keep a record of errors.

Lubrication:

The lubrication system is controlled by a timer in the controller. The timer is only active when the spindle is on. The length of time between oiling is set in the Machine Parameters (See Control Definition Chapter). If there is a suspected problem with the lubrication system, use the pneumatic diagram to find the oiler solenoid located on the back of the main incoming air door. Manually activate the solenoid and look for oil flow. If there is no oil flow, check for air coming out of the solenoid valve to the oil pump. If there is no air when manually activated, replace solenoid. If there is air to the pump, replace the pump.

Automatic Centering:

The automatic centering system consists of DC drive, DC gear motor, magnetic clutch and relay system. If the automatic centering is not working, use the following table to trouble shoot.

Symptom	Possible Cause	Corrective Action
Centering does not operate	Blown Fuse on DC Control	Replace the fuse.
	Fuse Continues to blow	Remove motor and clutch leads (one at a time) from centering drive. Does fuse quit blowing?
		Check for short in motor or wiring to machine ground. If the short is in the motor, replace.
	Motor not turning.	Check voltage out of the drive. Is voltage present at the motor? If voltage is present at the motor and centering handle is free, replace motor.
	Clutch not engaging	Is voltage present at Clutch?
		Check gap setting for clutch.
	Bind or Jammed centering system	Follow center shaft from handle to locate bind. Gear may be broken or worn in centering gear box.

Vertical and Horizontal Axis Control:

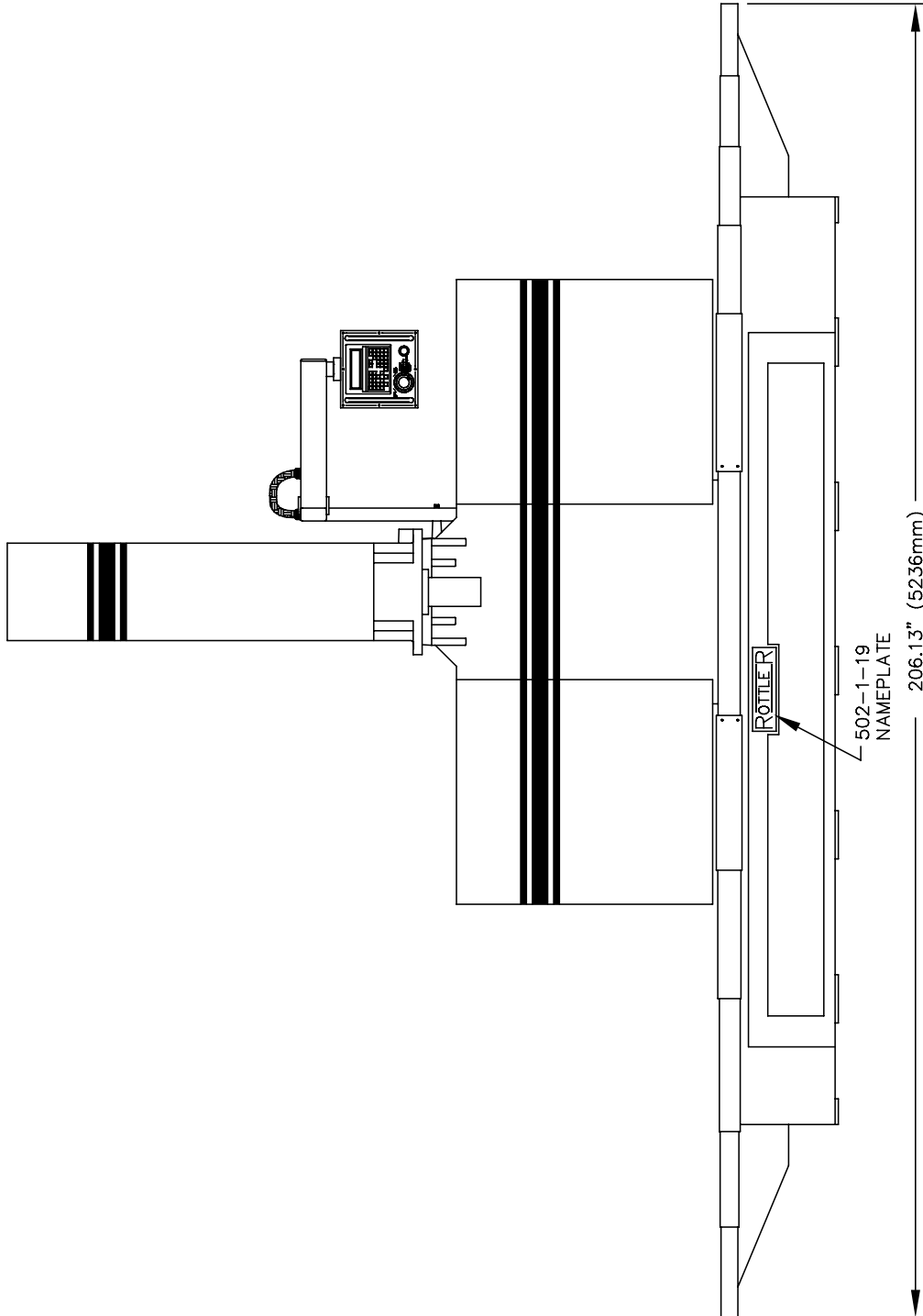
The Vertical and Horizontal axis are controlled by a precision digital feedback loop. The following table list some of the symptoms and possible causes for troubleshooting these axis.

Symptom	Possible Cause	Corrective Action
Axis runs smoothly in one direction but not the other.	Misaligned resolver	Run the Feedback Align procedure in the Auto Tuning section of the Baldor Manual.
	Load Difference	There may be a bind on one of the ballscrews when moving one direction. The loads when moving each direction should be within 10% of each other.
		Make sure both ends of the ballscrews are properly secured.

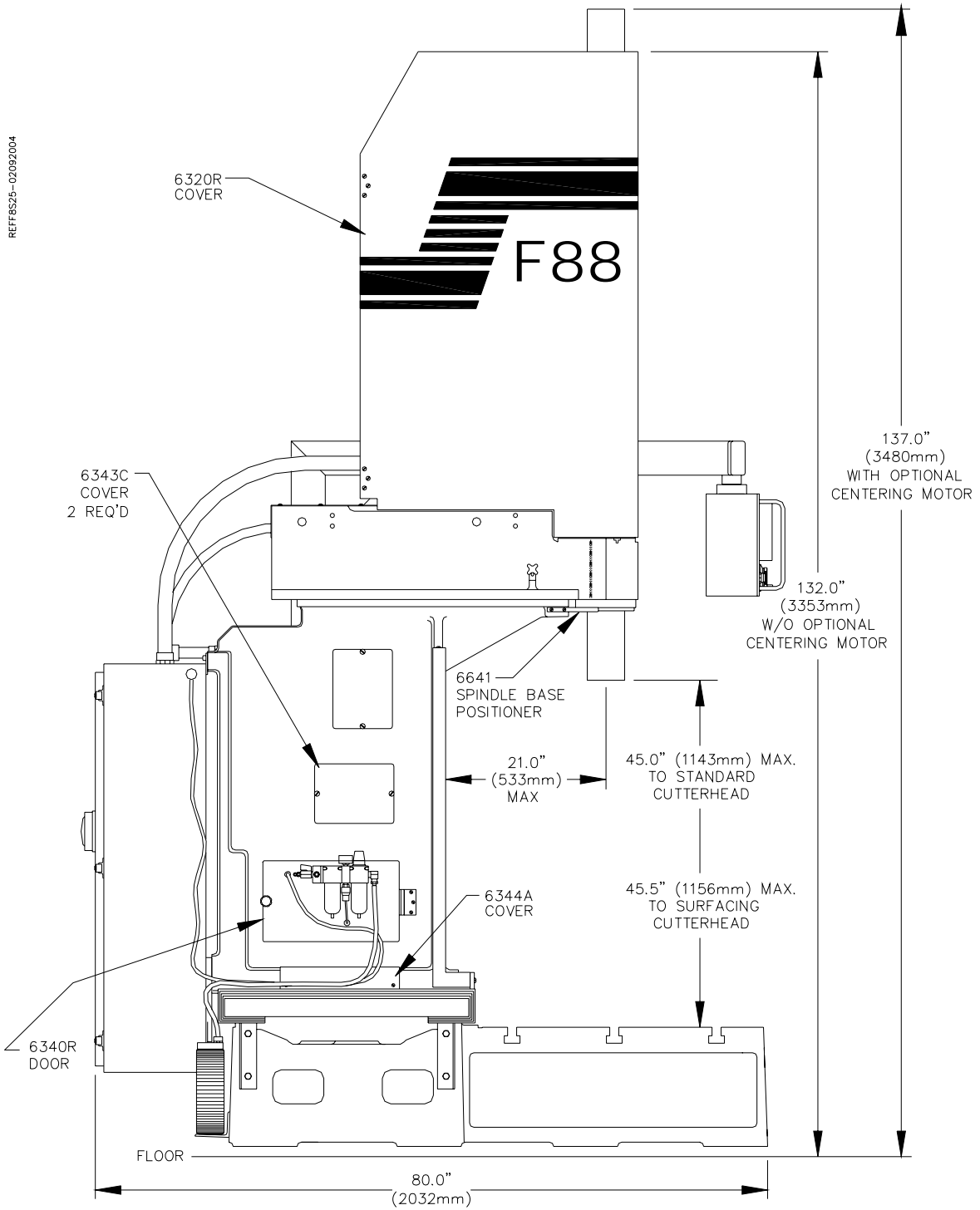
		Make sure the gearbox is secured properly and is not moving with a direction change.
		Ballscrew not properly aligned. Contact factory for assistance in checking the alignment of the ballscrew.
	Oil in Horizontal motor	Motor may have gotten oil through the seals. Check the resolver cable to be sure there is not oil contaminating the mating parts to the motor. Replace motor if needed.
	Vertical Belt Tension	Check the vertical motor belt tension. Apply a four pound force to the to the belt between the pulleys. You should observe a 3/8" deflection.
Axis runs roughly in both directions.	Misaligned resolver	Run the Feedback Align procedure in the Auto Tuning section of the Baldor Manual.
	Load Difference	There may be a bind on one of the ballscrews when moving one direction. The loads when moving each direction should be within 10% of each other.
		Make sure both ends of the ballscrews are properly secured.
		Make sure the gearbox is secured properly and is not moving with a direction change.
		Ballscrew not properly aligned. Contact factory for assistance in checking the alignment of the ballscrew.
	Oil in Horizontal motor	Motor may have gotten oil through the seals. Check the resolver cable to be sure there is not oil contaminating the mating parts to the motor. Replace motor if needed.
	Vertical Belt Tension	Check the vertical motor belt tension. Apply a four pound force to the to the belt between the pulleys. You should observe a 3/8" deflection.

Chapter 6 Machine Parts: F88S Front View:

REF F88S-042998

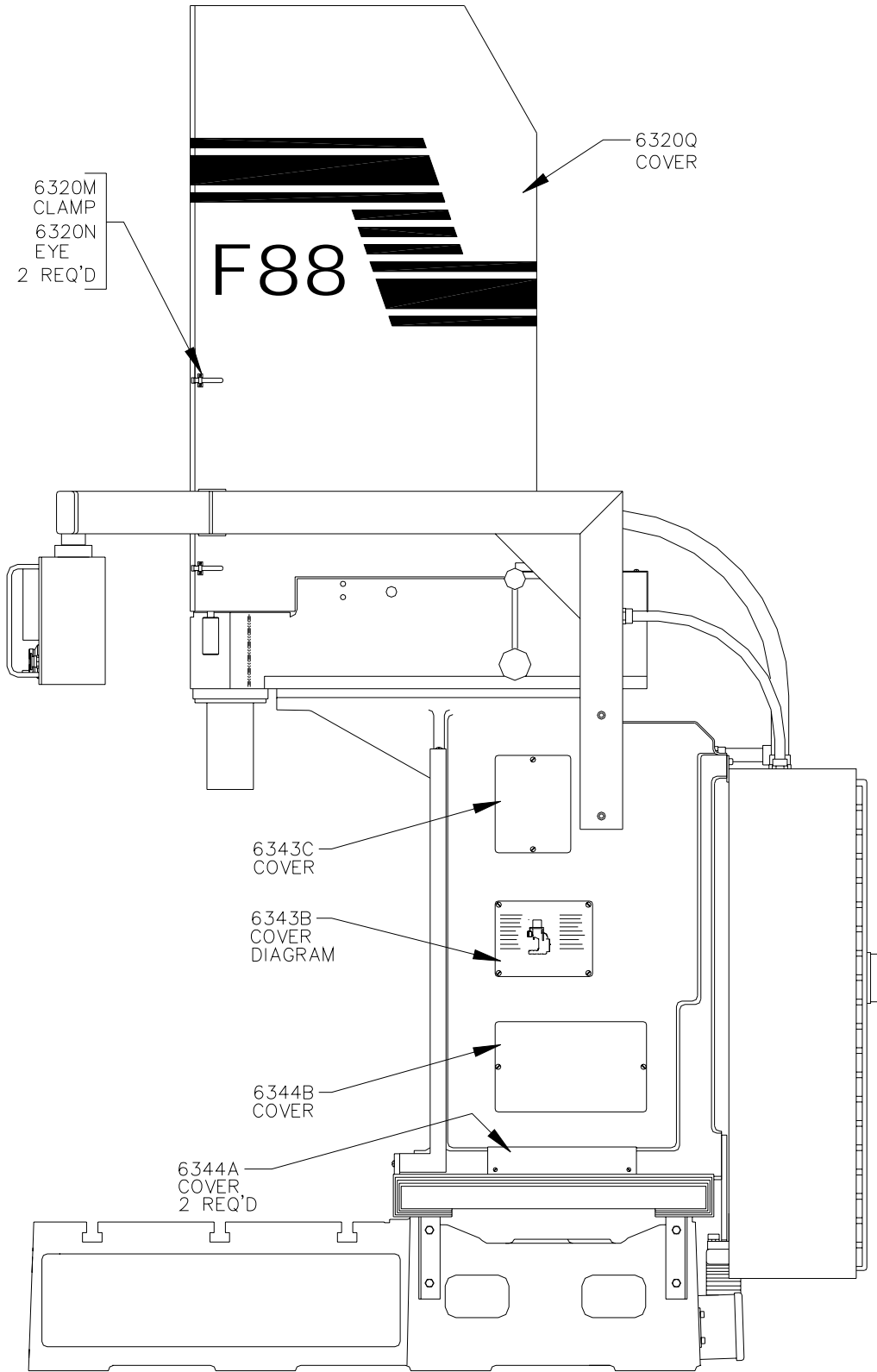


F88S Left Side View:



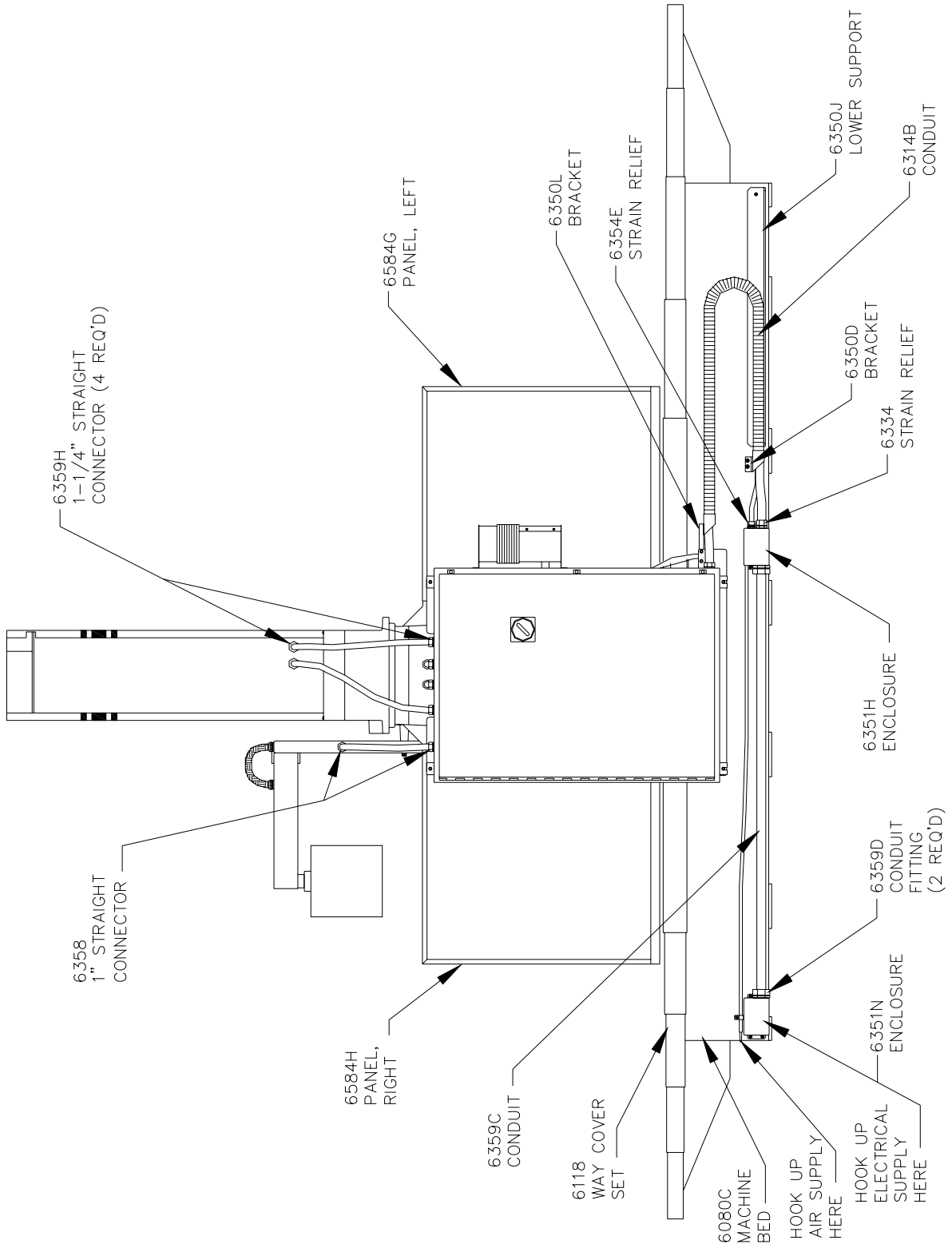
F88S Right Side View:

REF F88S-02092004



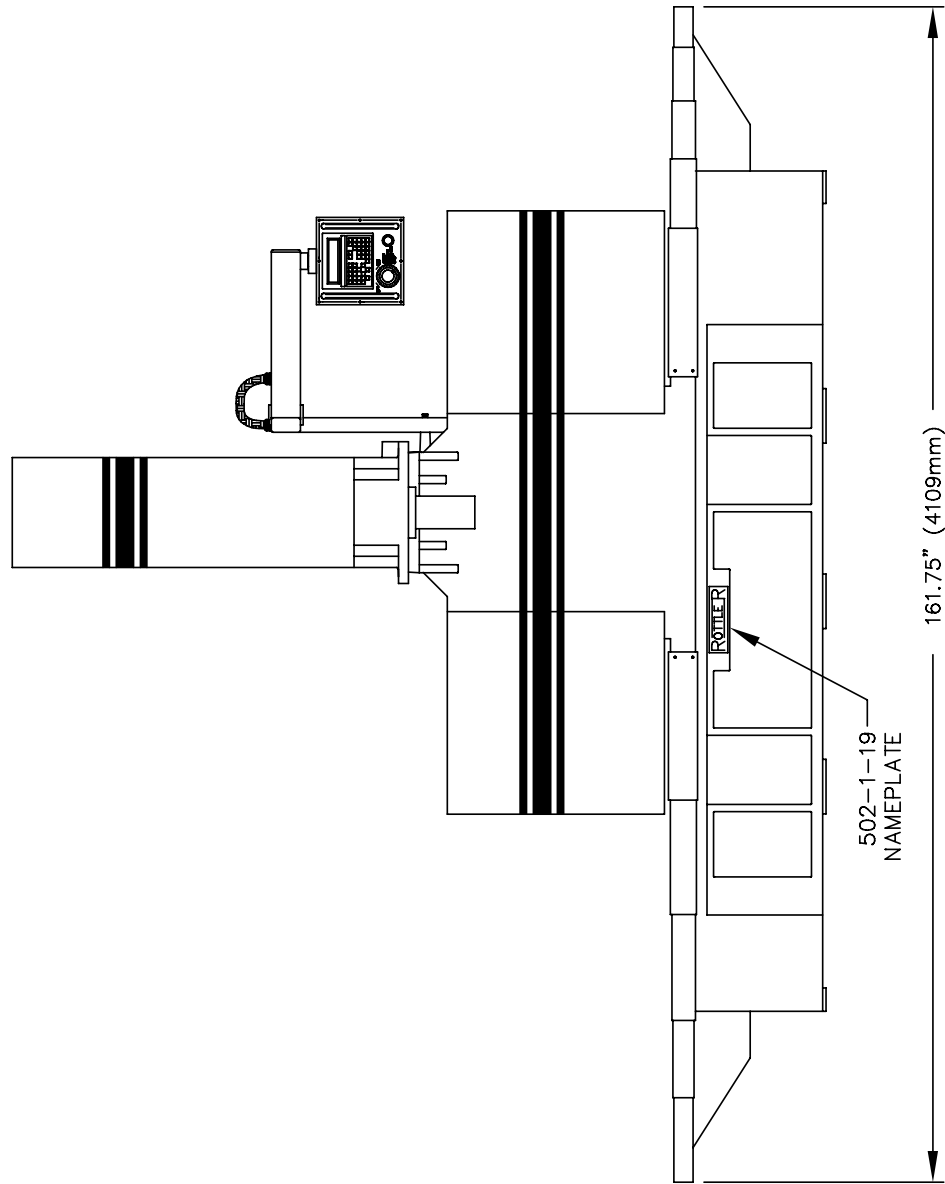
F88S Rear View:

REF F856-01222001



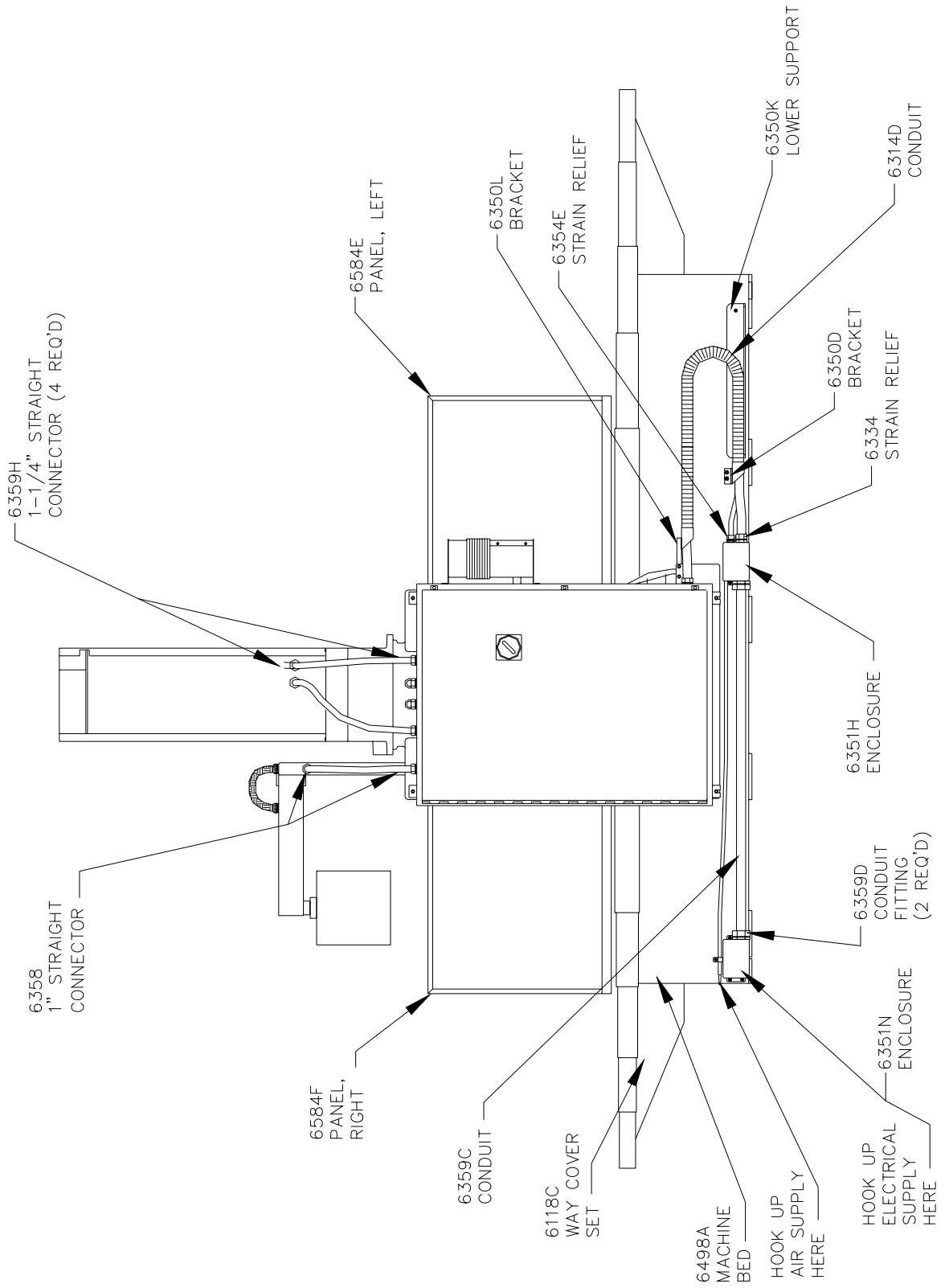
F85 Front View:

REF F857-043098



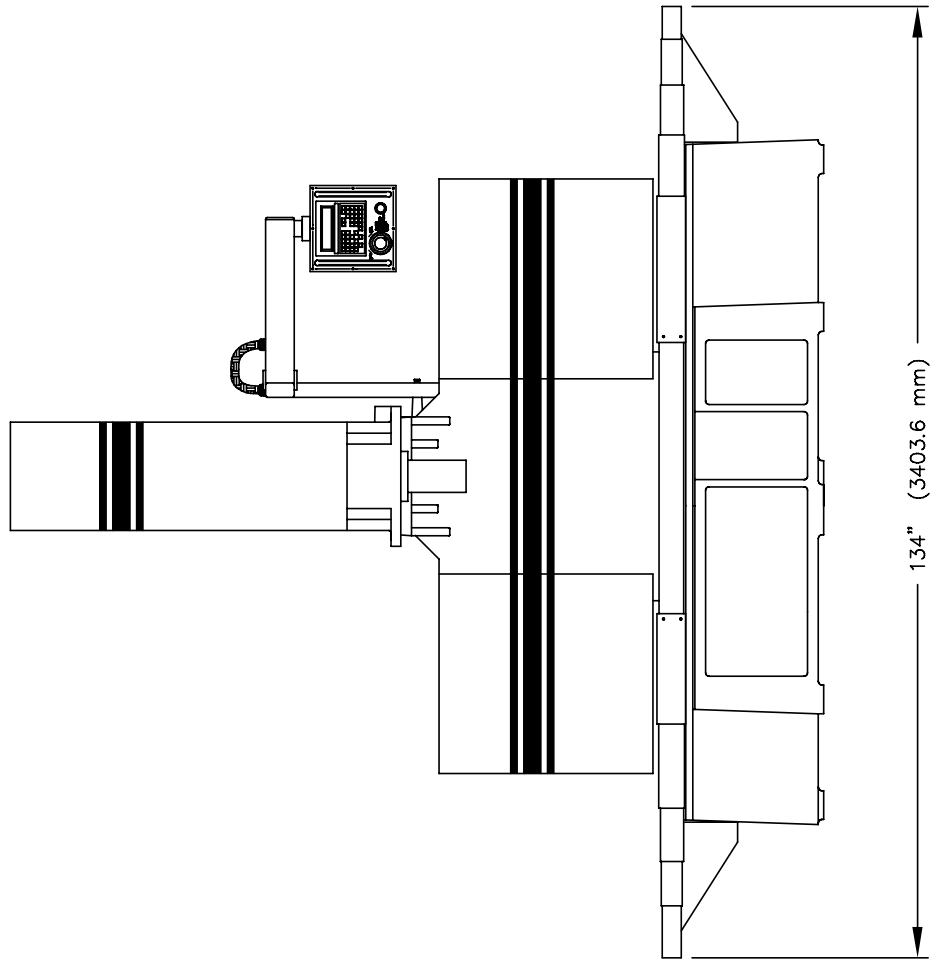
F85S Rear View:

REF F858-01222001



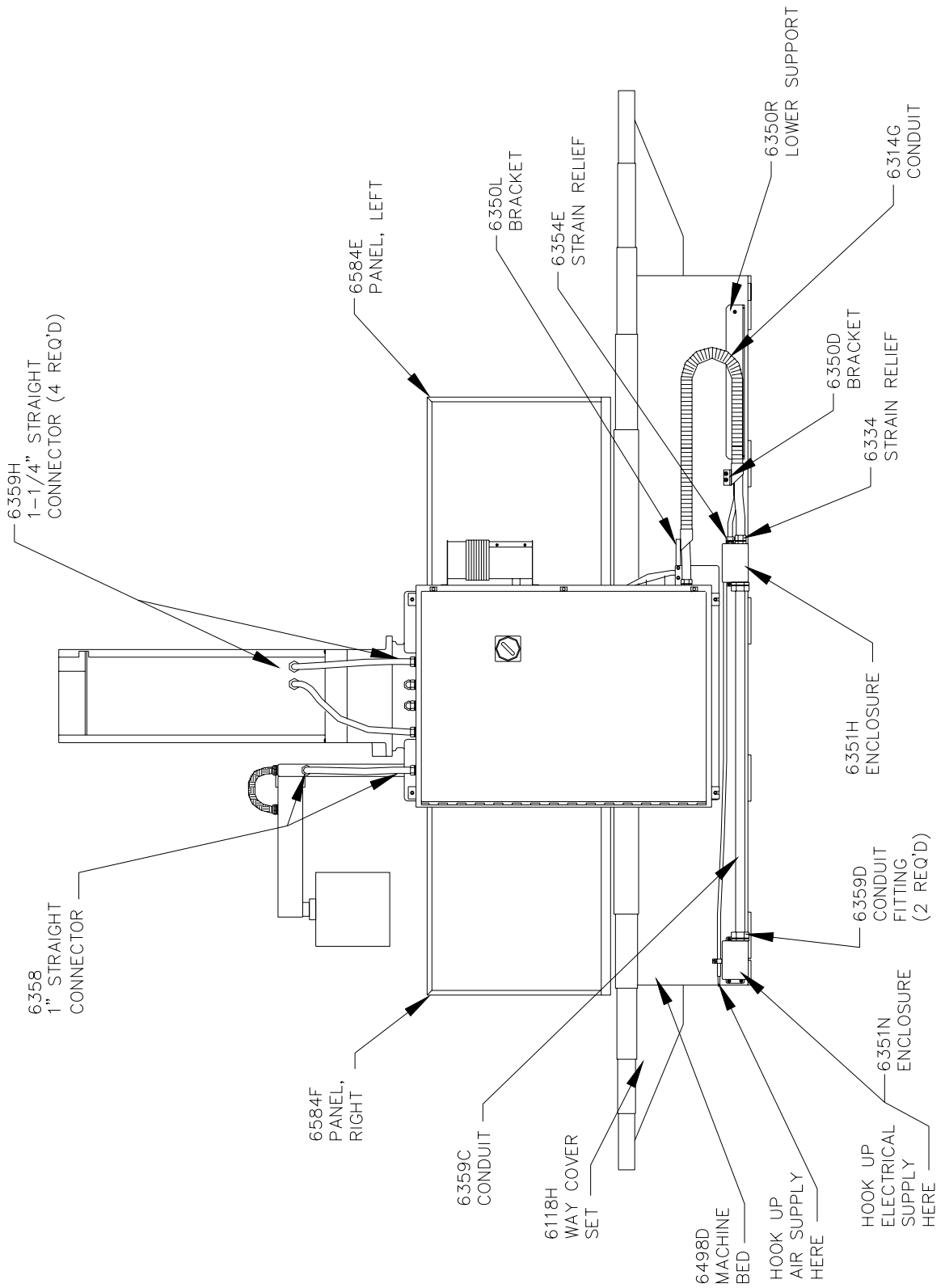
F84S Front View:

REF F80S-043098



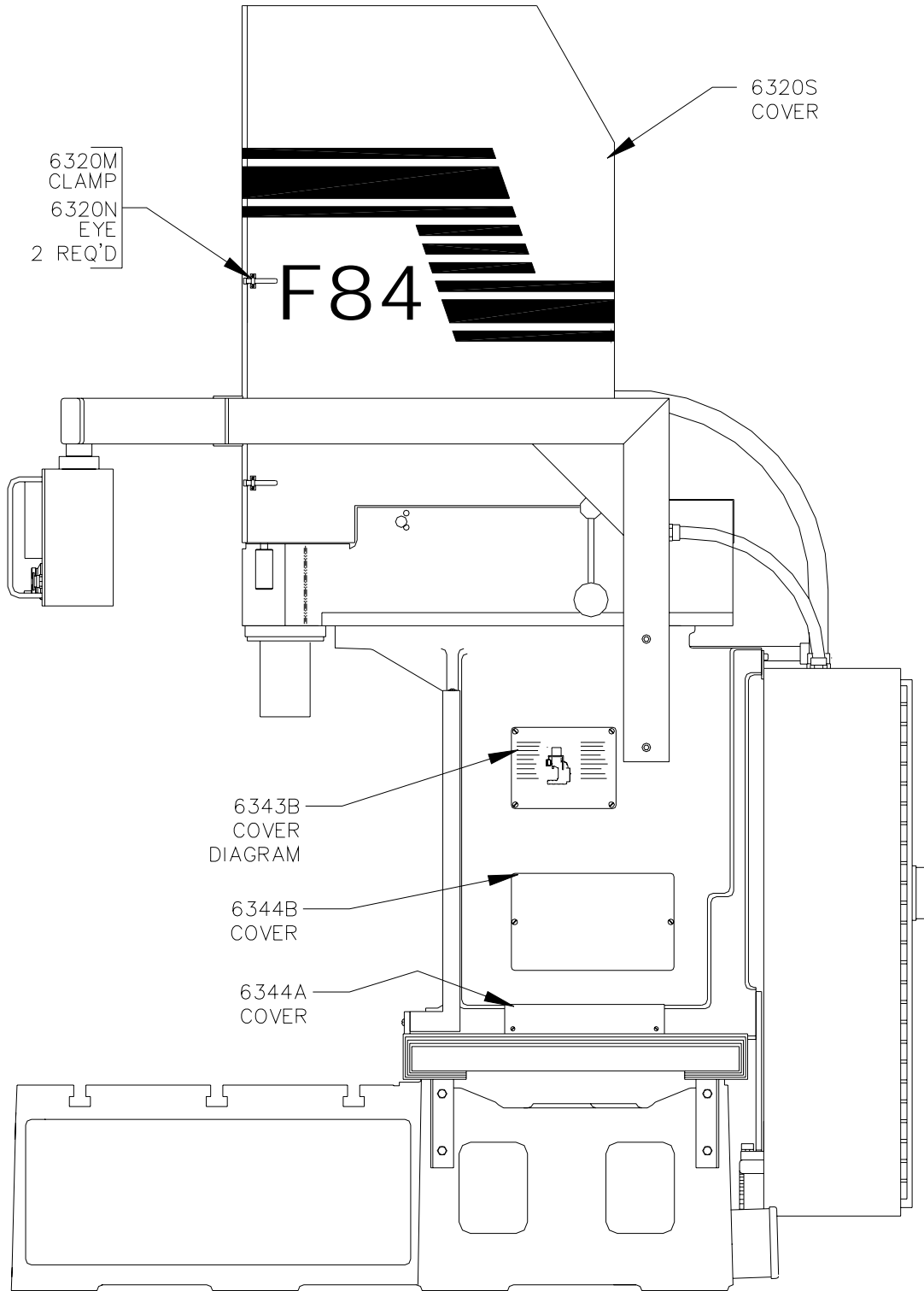
F84S Rear View:

REF F8510-01222001

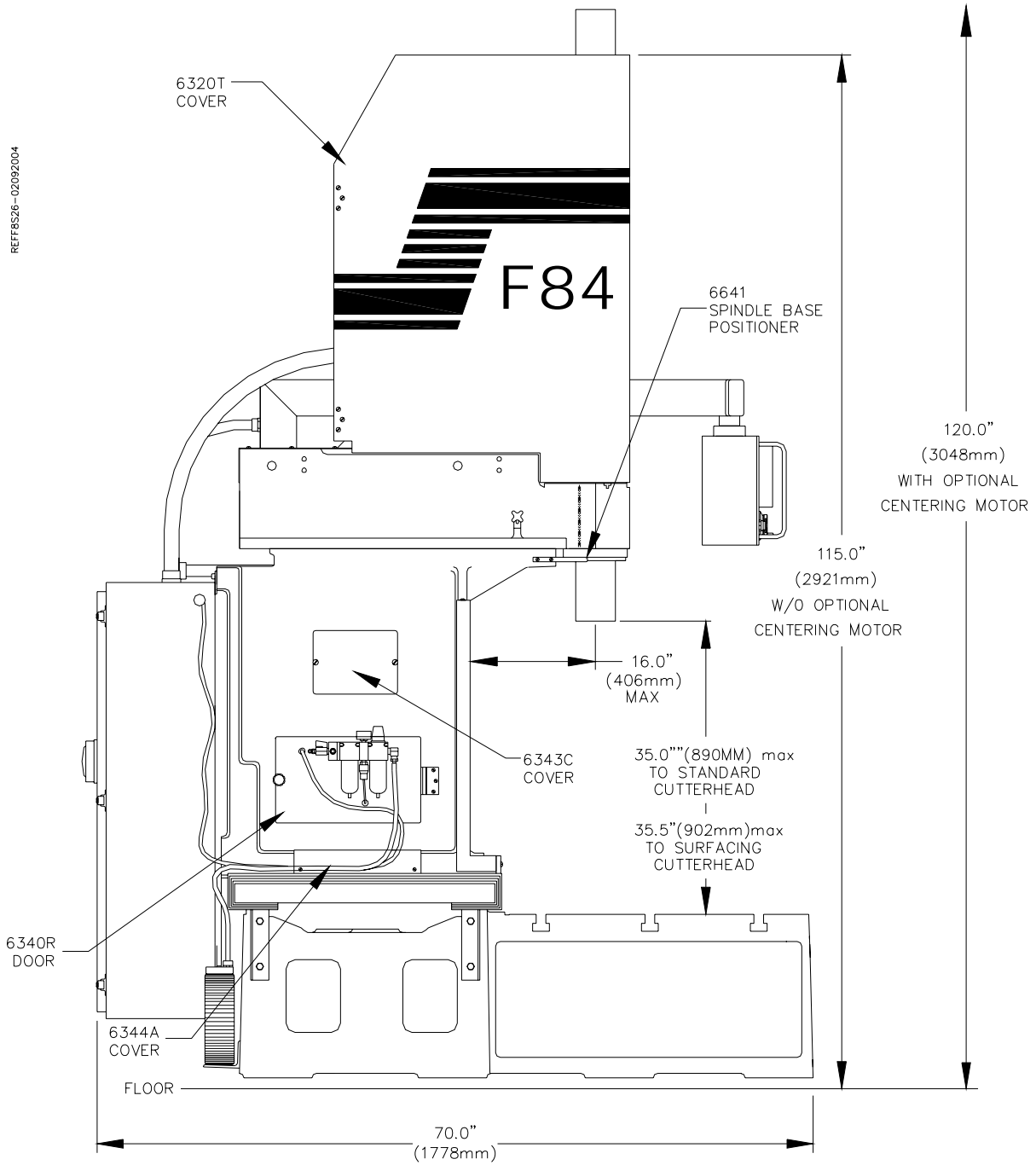


F85S – F84S Right Side View:

REF F8511 – 02/09/2004

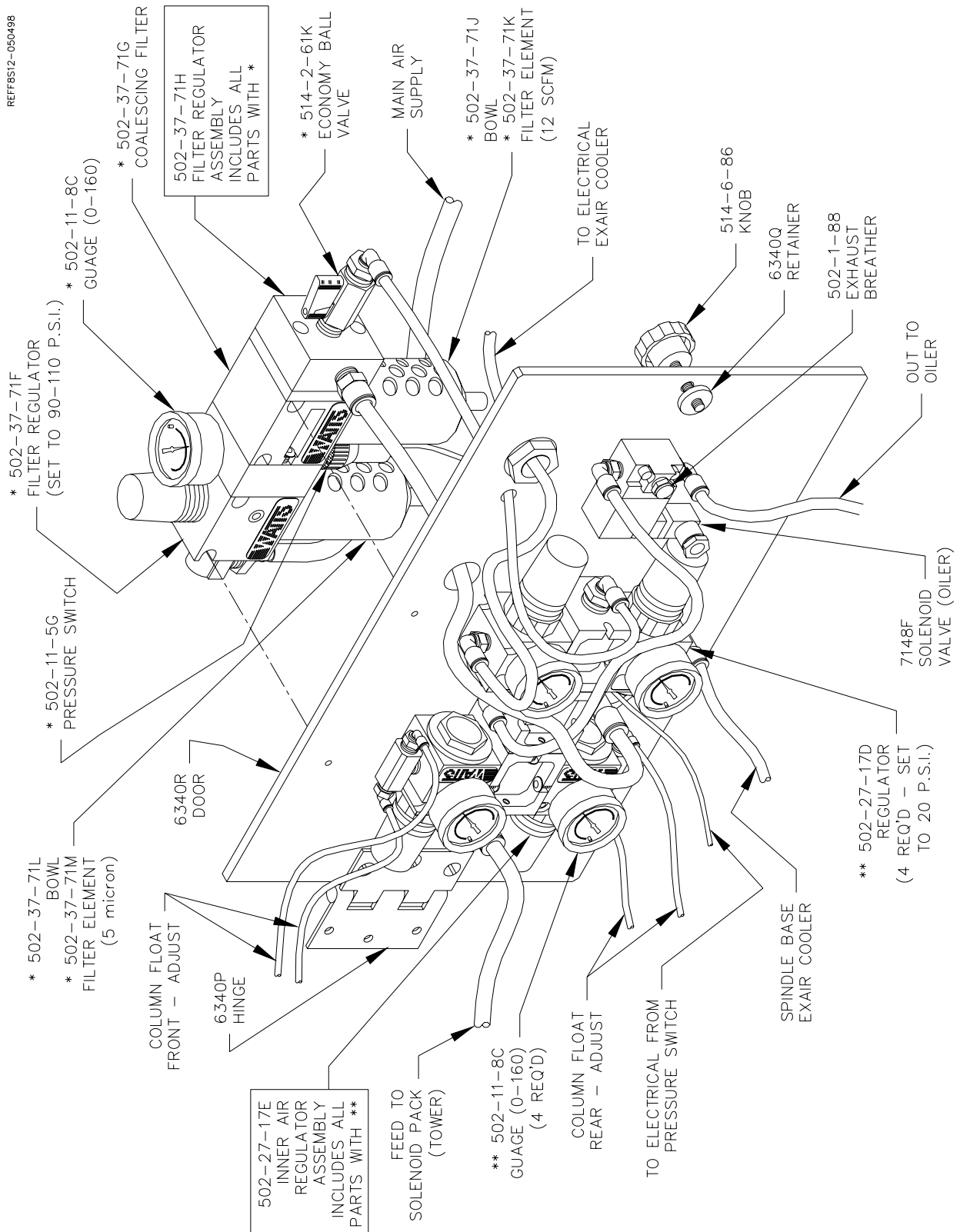


F85S – F84S Left Side View:



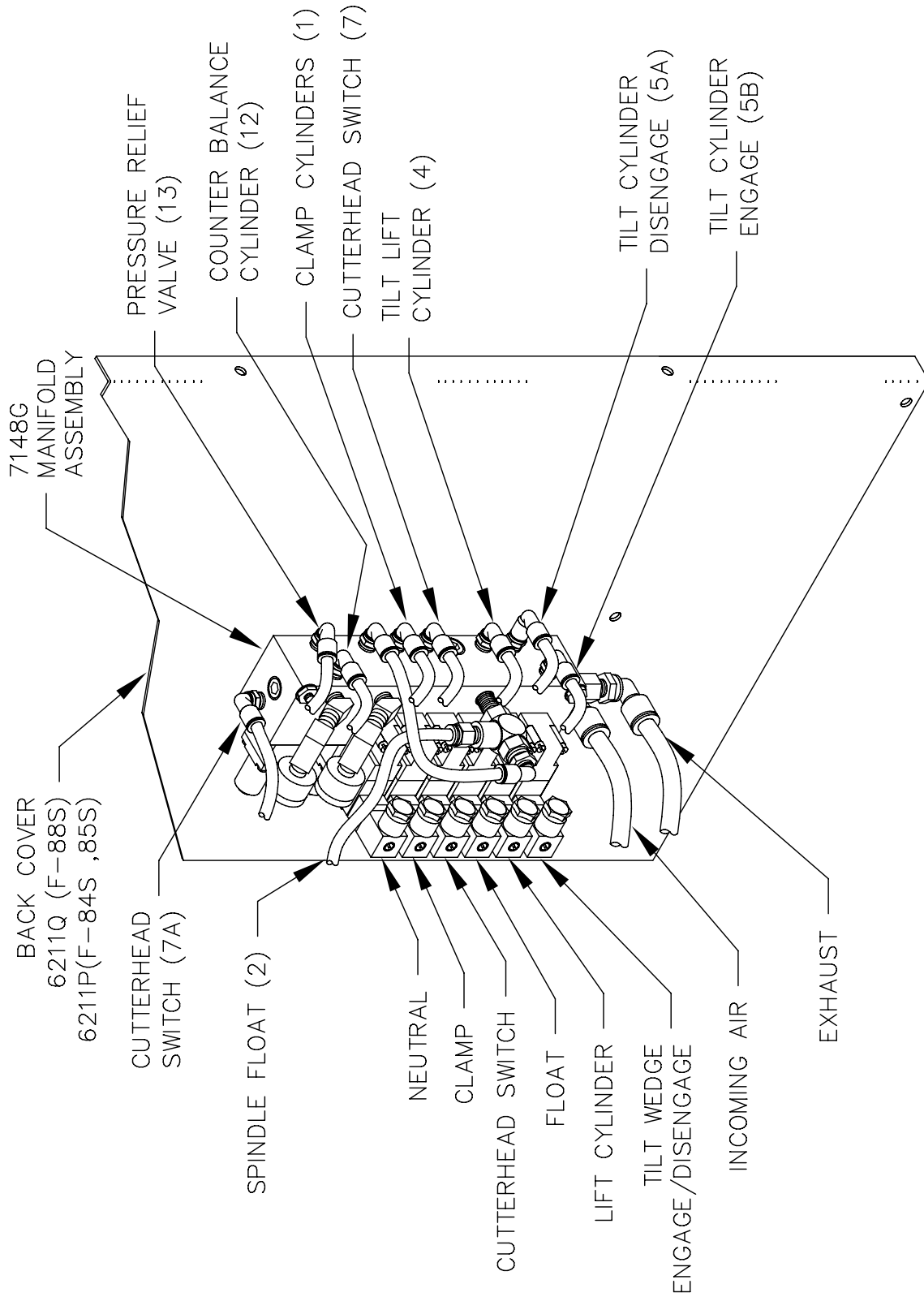
Air Control Door:

REF F8S12-050498

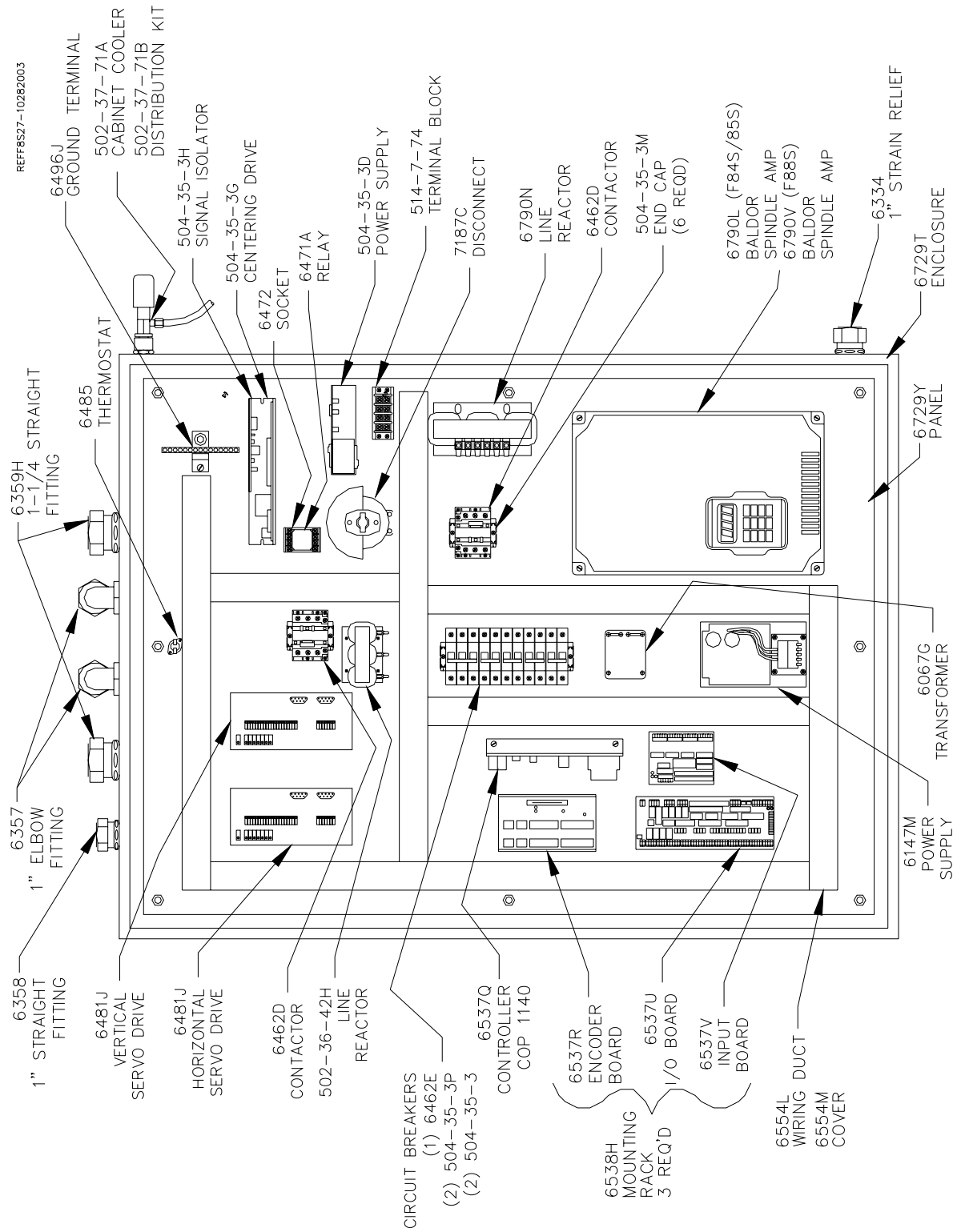


Air Control Tower:

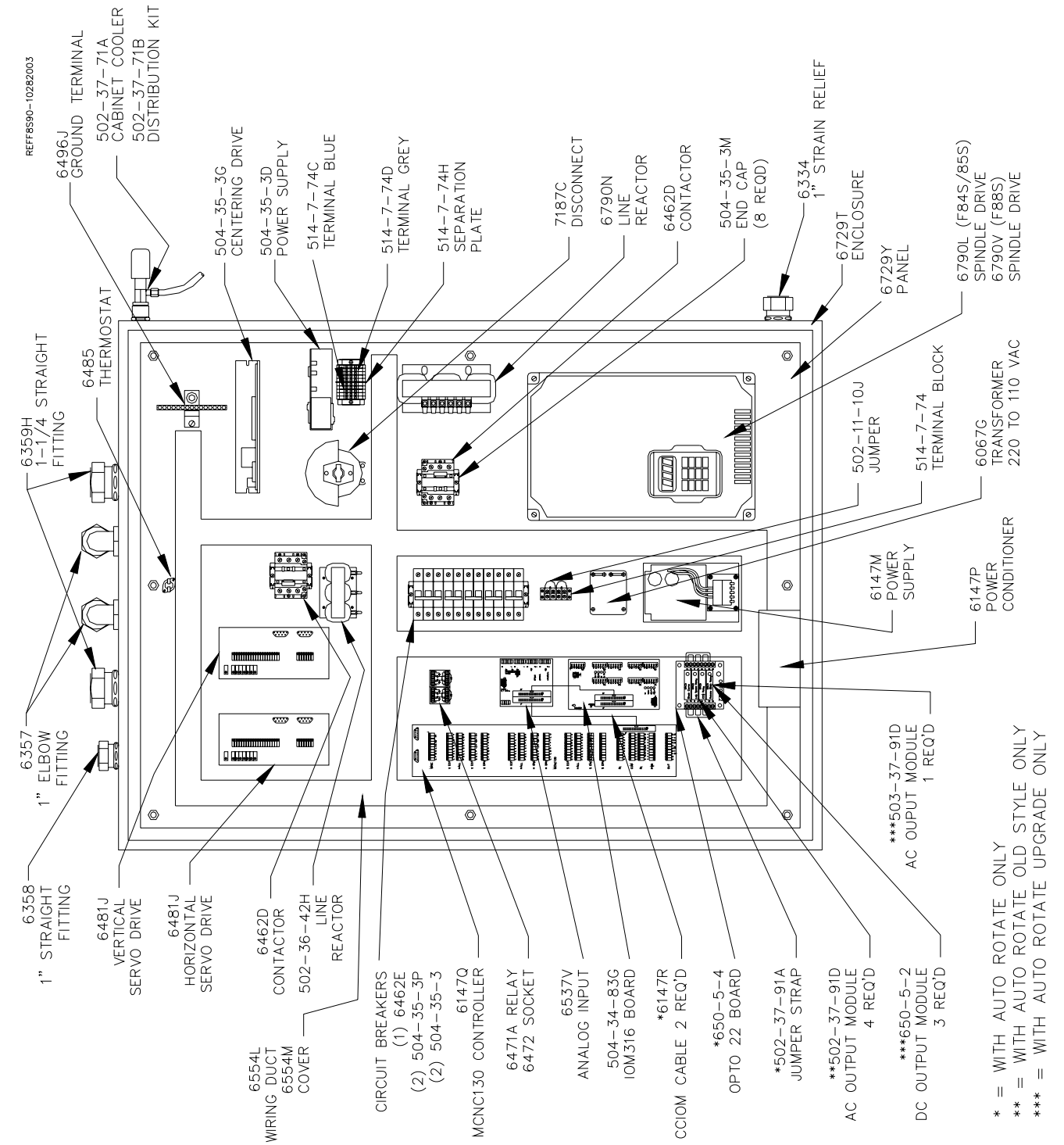
REF8S13-070298



Electrical Enclosure Early F80S Series:

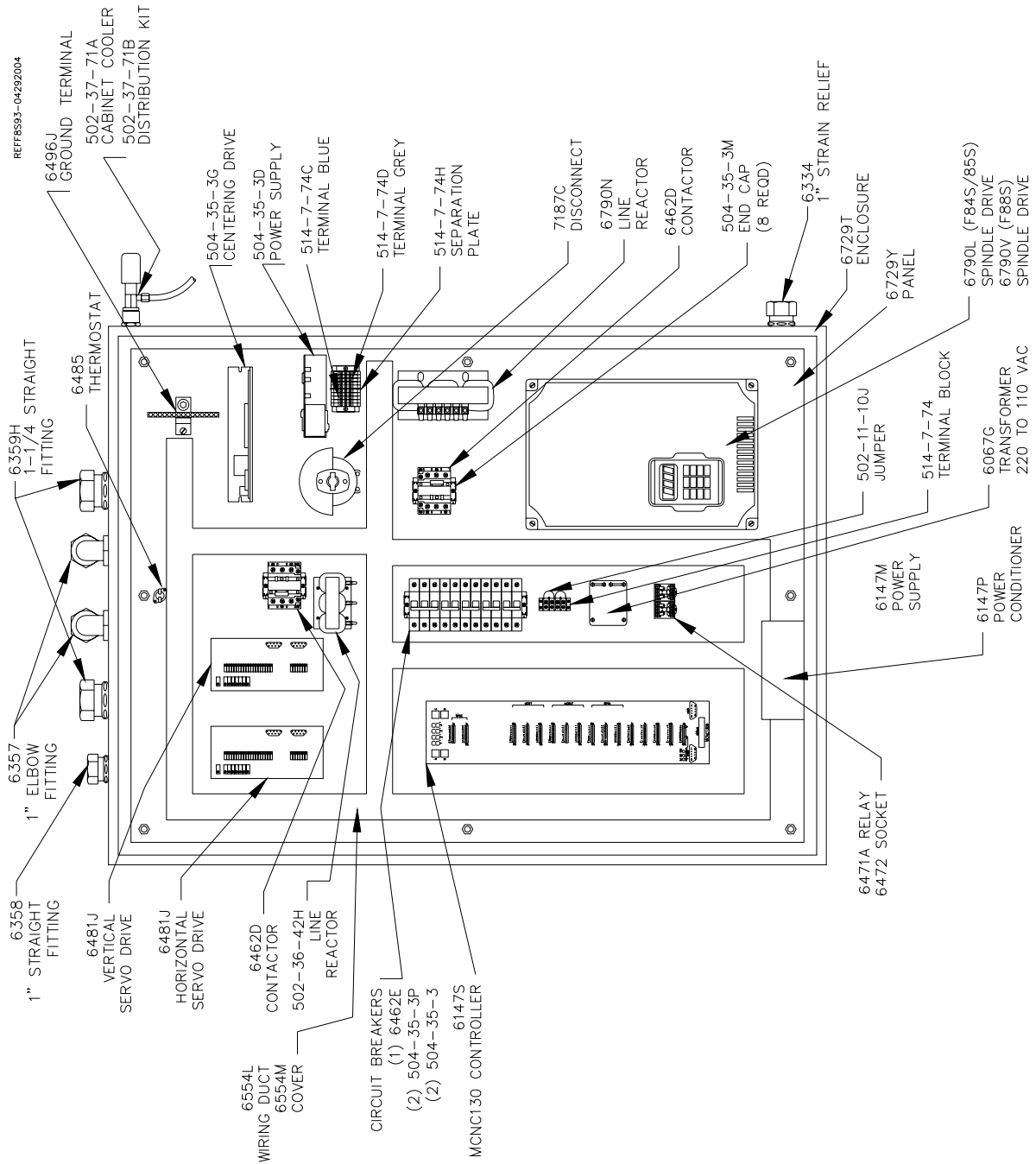


Electrical Enclosure Late F80S Series:



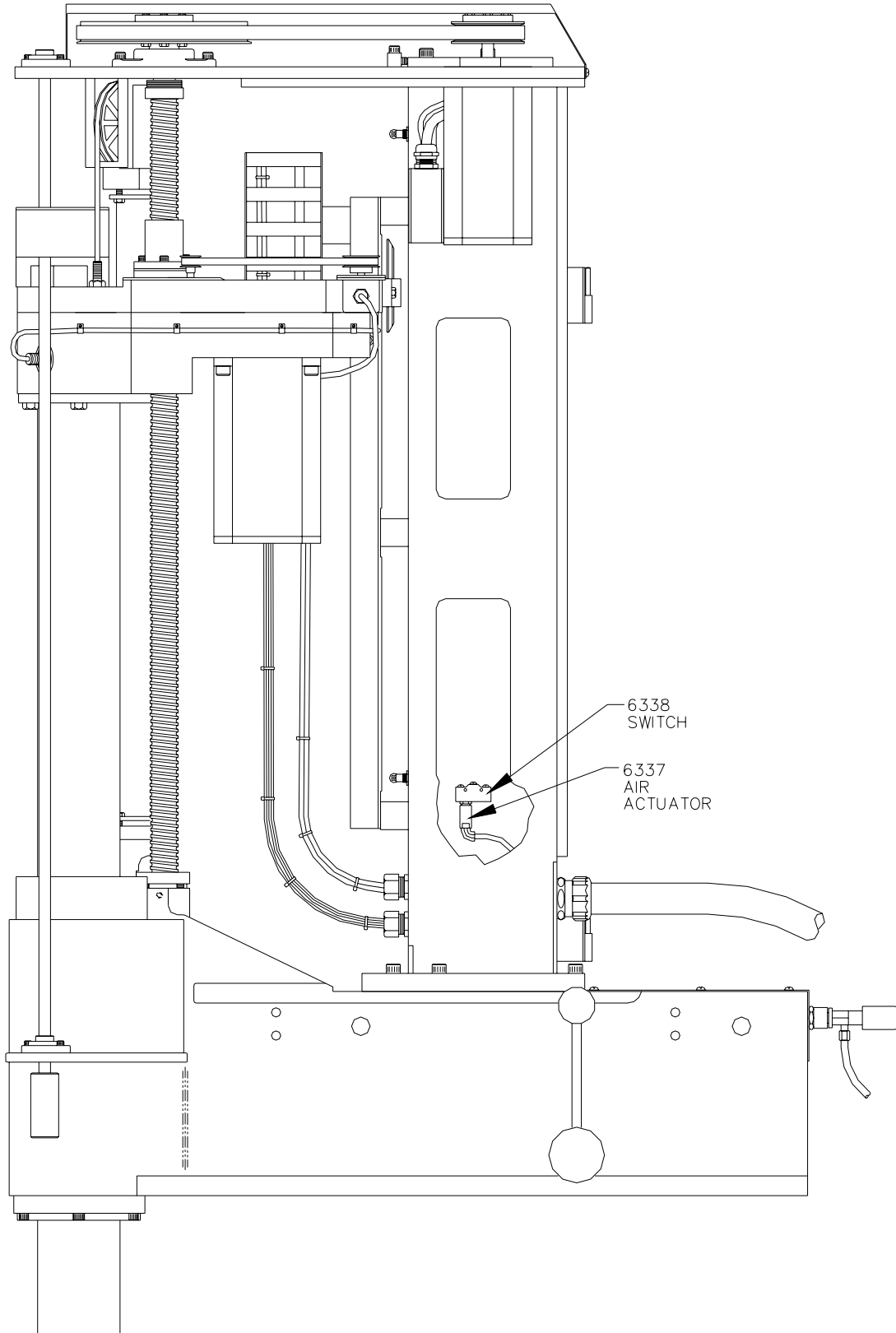
Electrical Enclosure F80S Series:

Effective after 04-30-2004



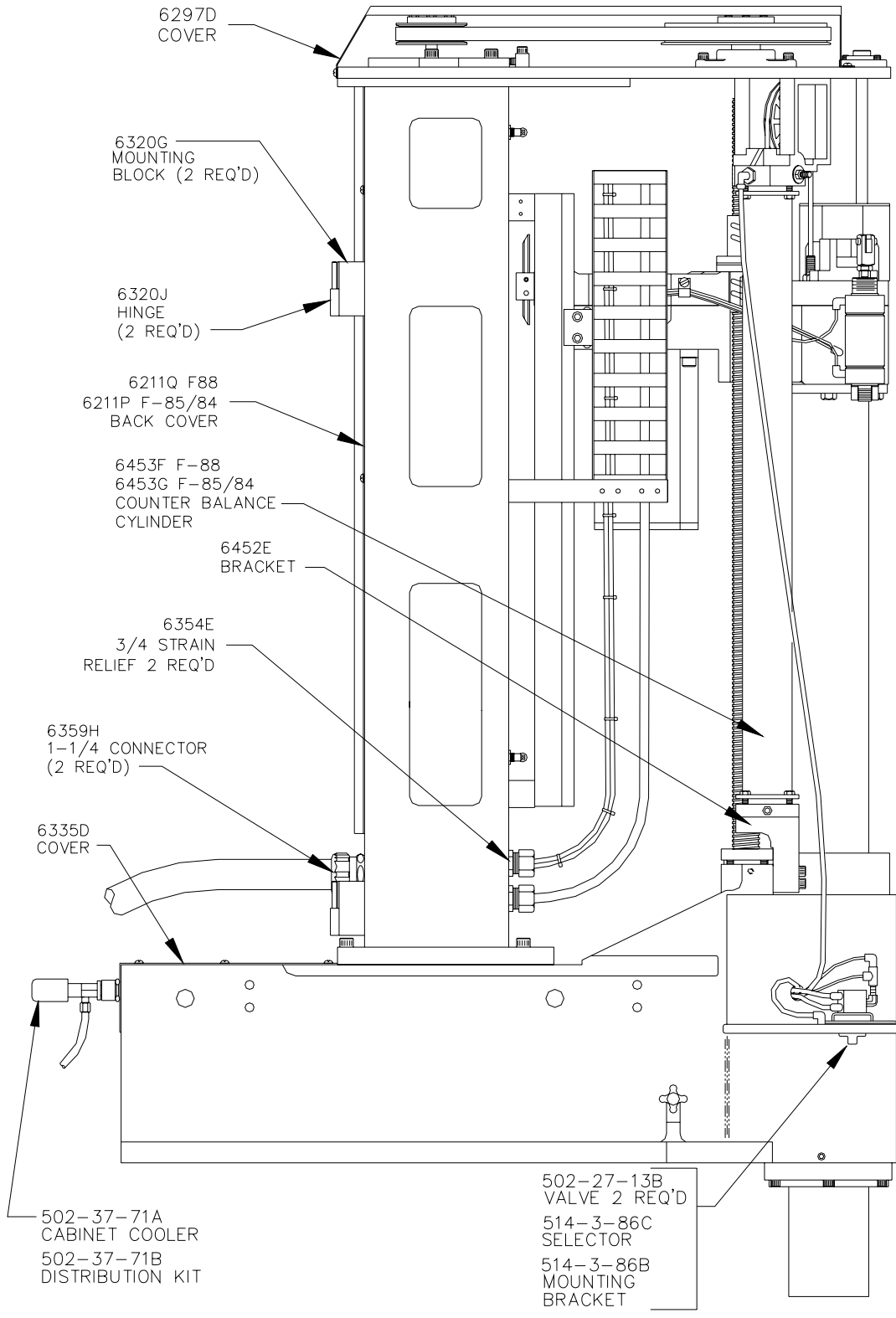
Right side Spindle Base:

REFFB515-062598



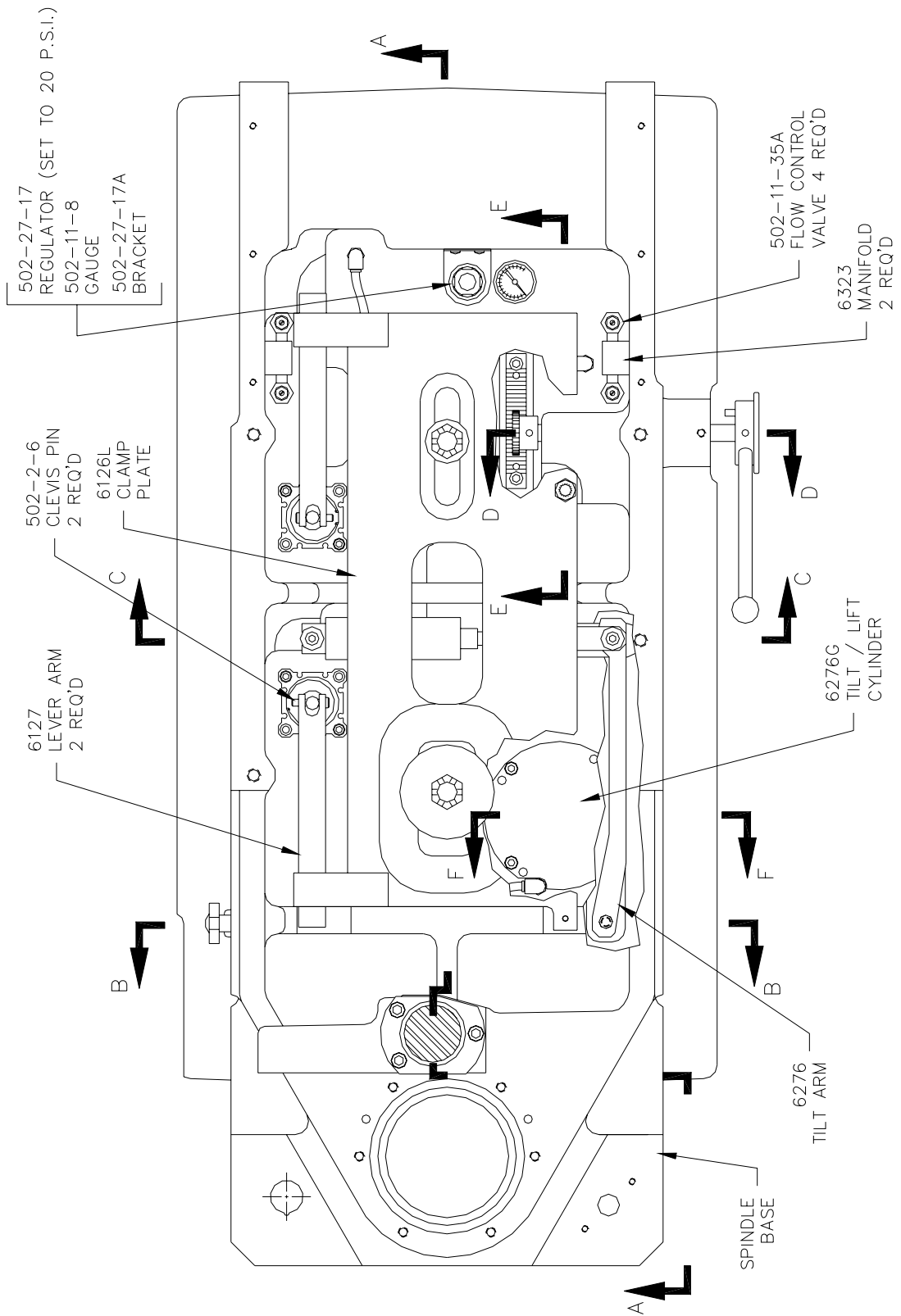
Left Side Spindle Base:

REF F8516-01222001



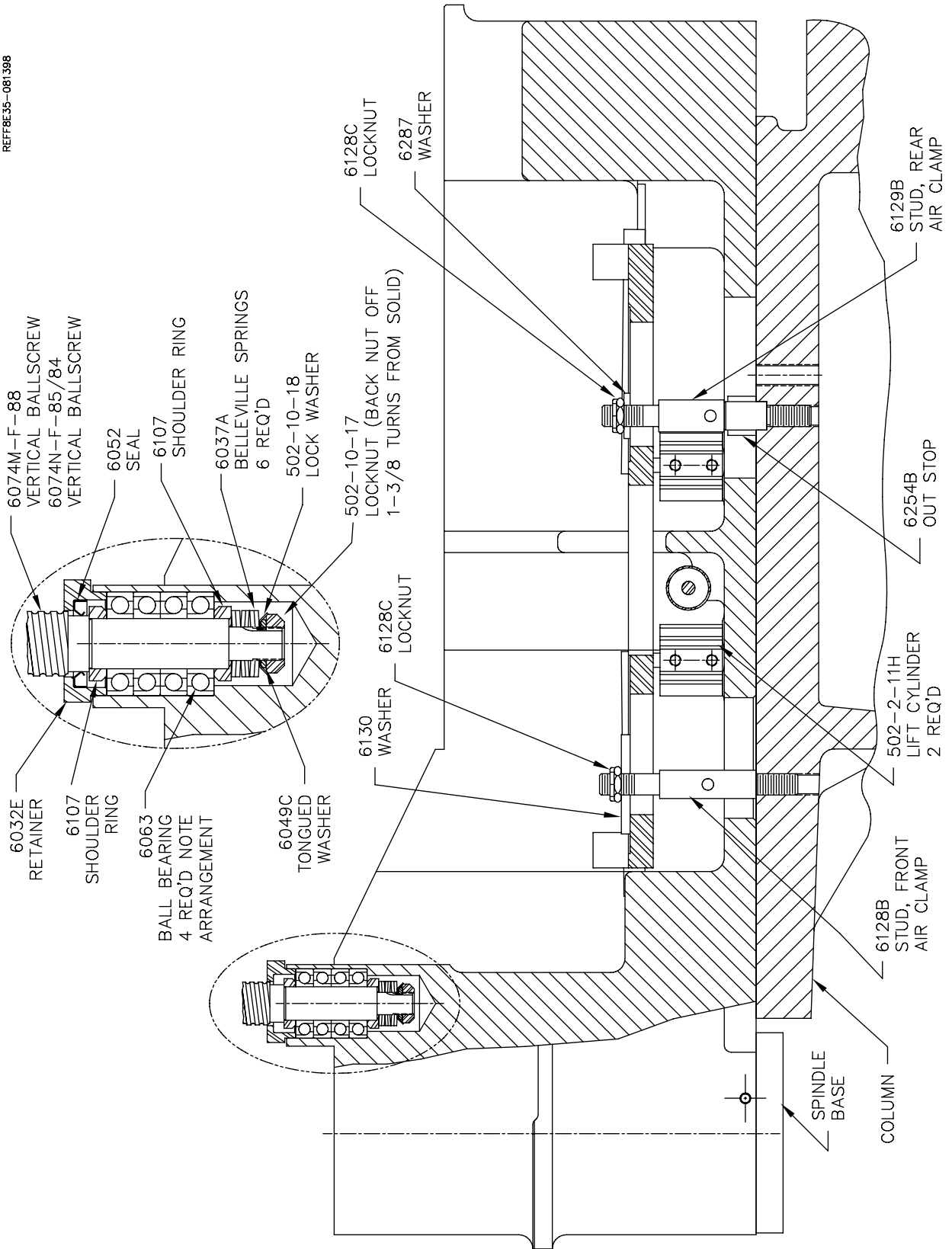
Spindle Base Top View:

REF F8E34-110597



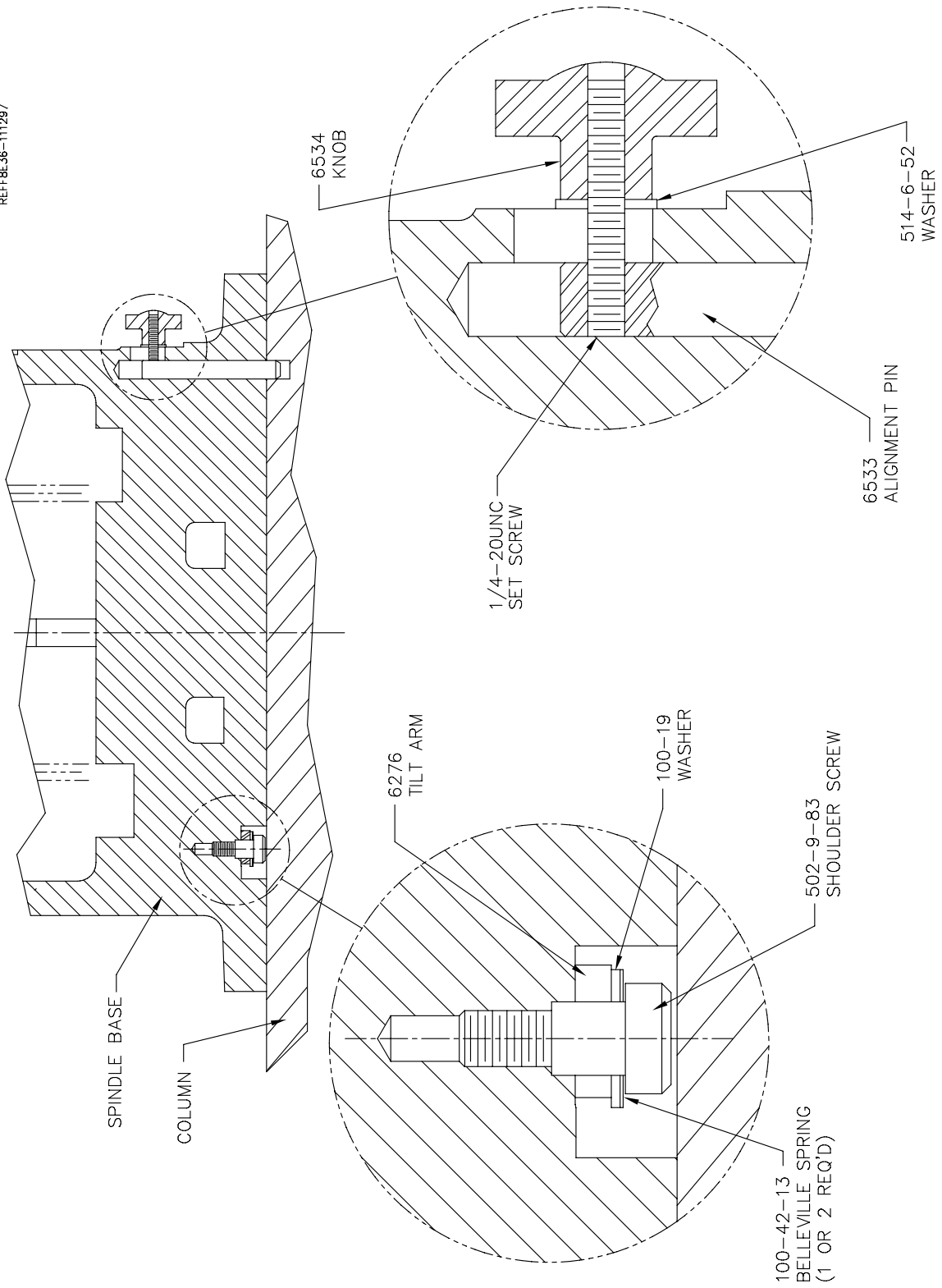
Spindle Base Section A-A:

REFFB35-081398



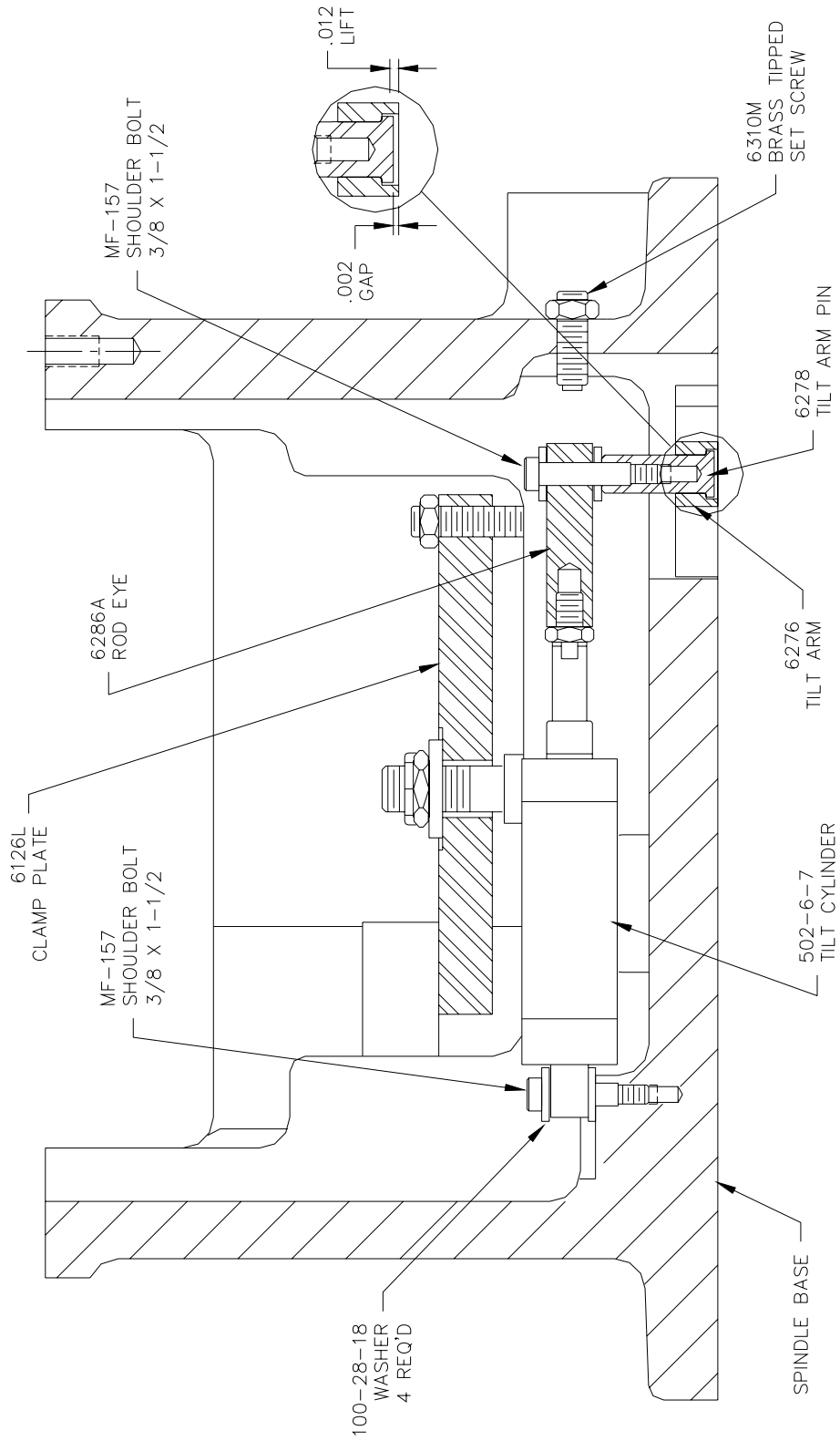
Spindle Base Section B-B:

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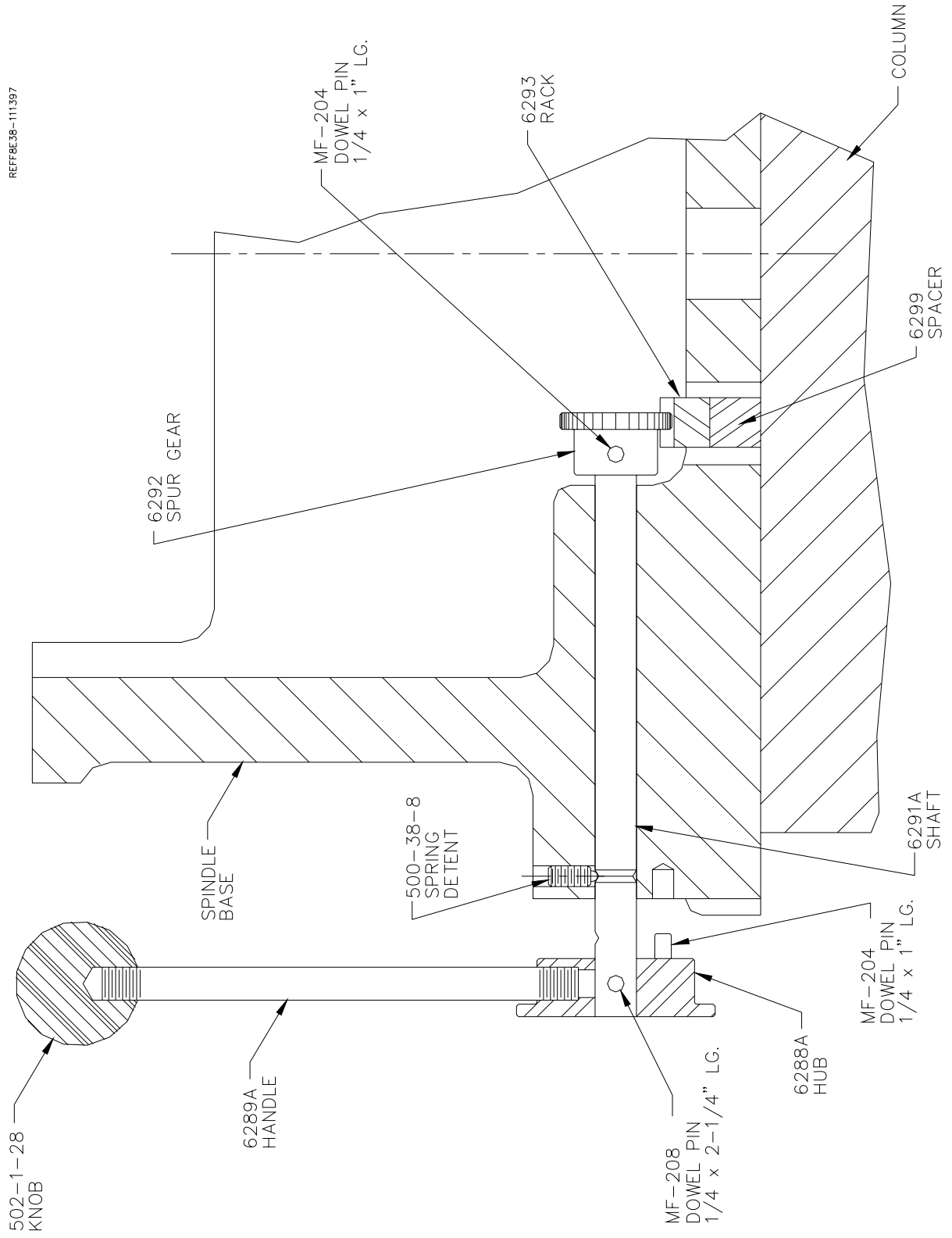


Spindle Base Section C-C:

REF F8S20-063098



Spindle Base Section D-D:



Spindle Base Section E-E:

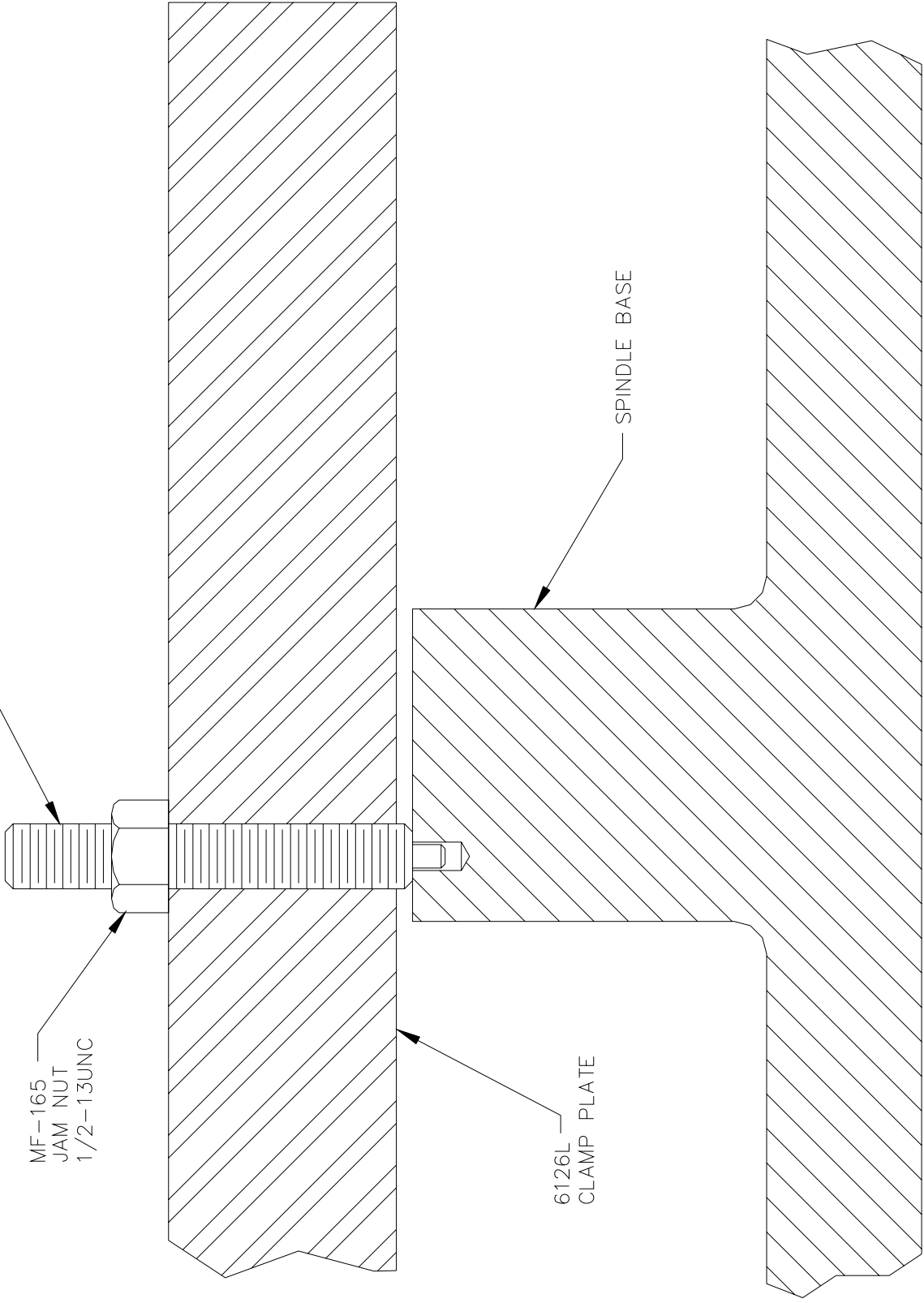
REF8E38-111397

6126J
ADJUSTING SCREW

MF-165
JAM NUT
1/2-13UNC

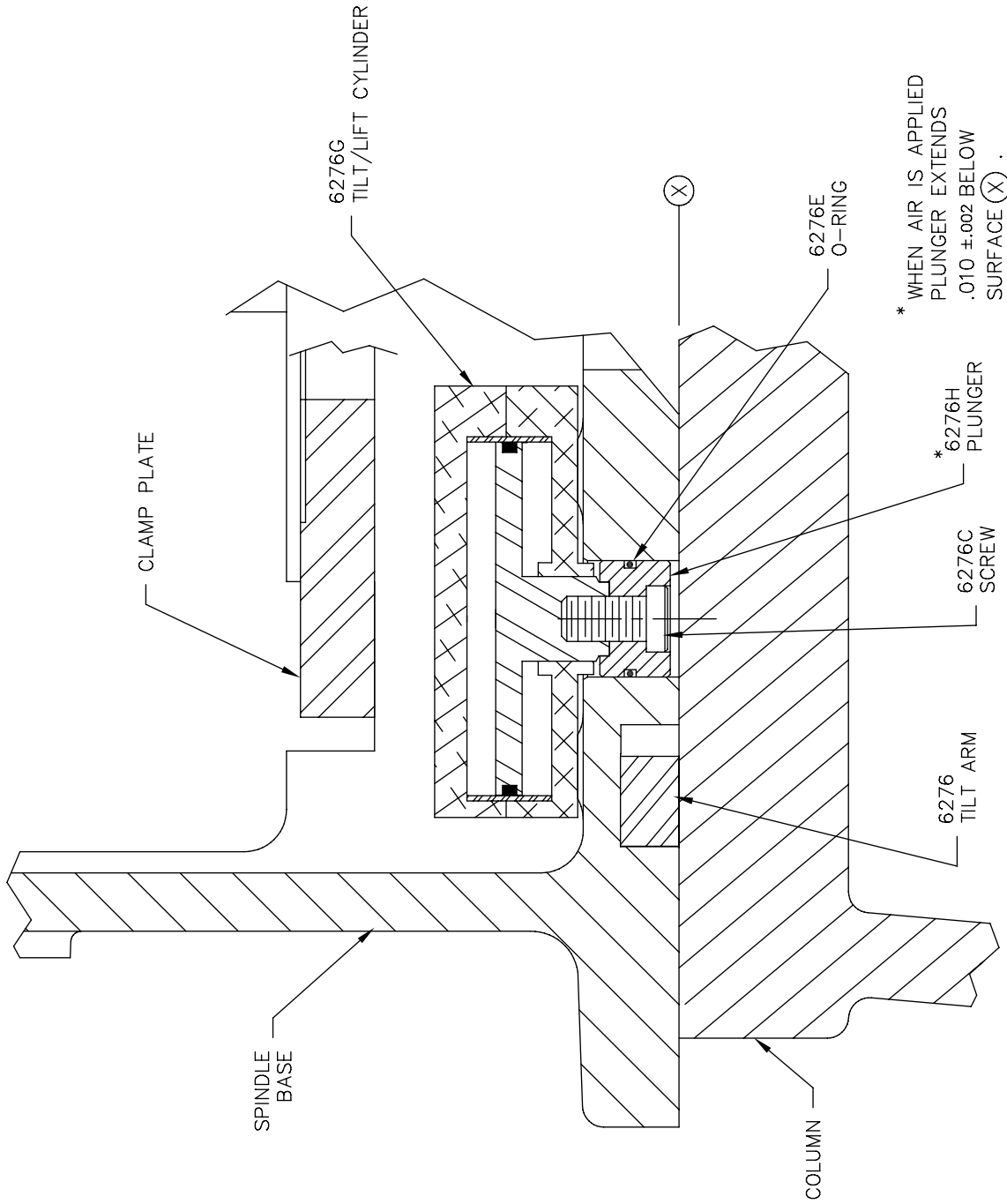
6126L
CLAMP PLATE

SPINDLE BASE



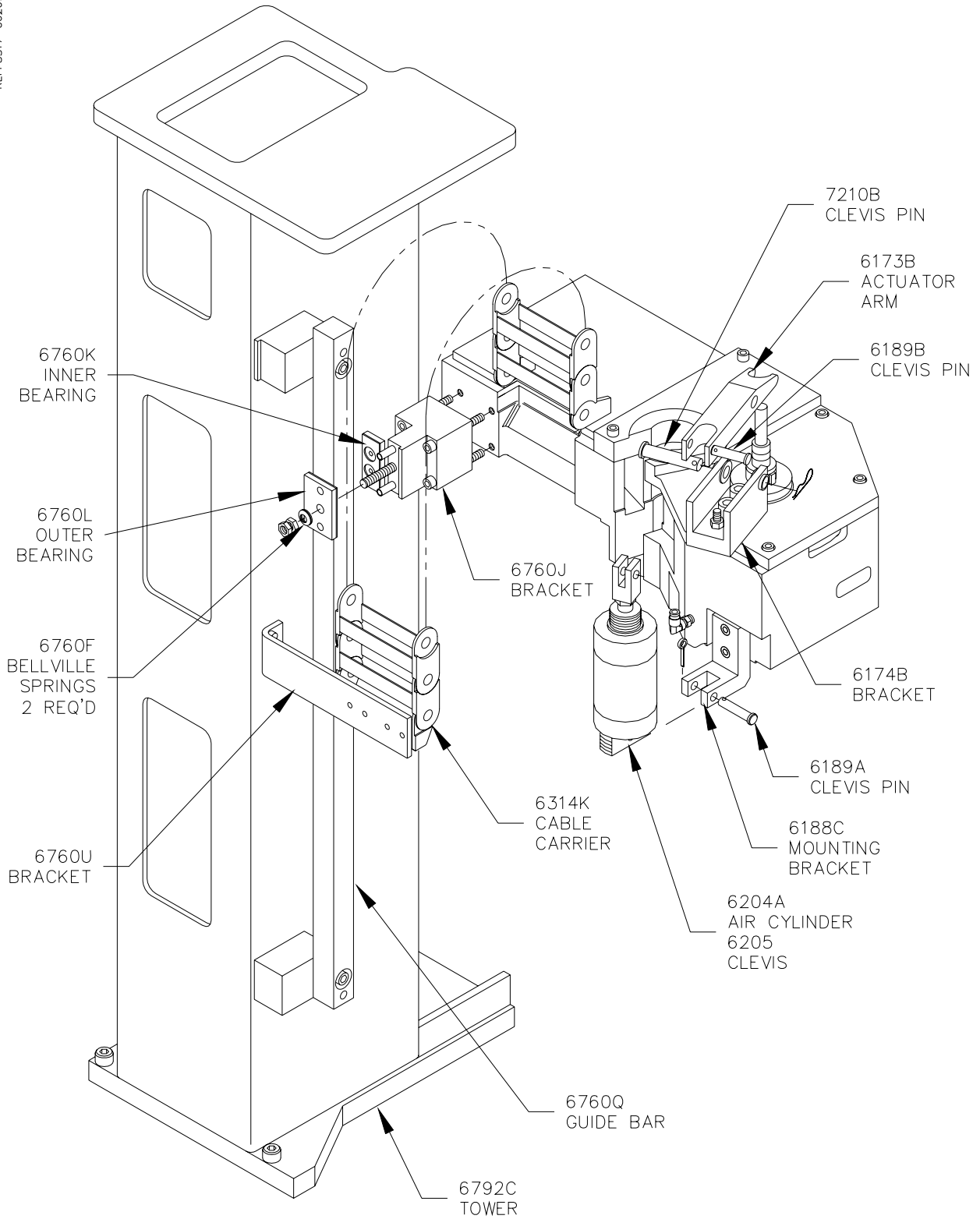
Spindle Base Section F-F:

REF F8S21-063098



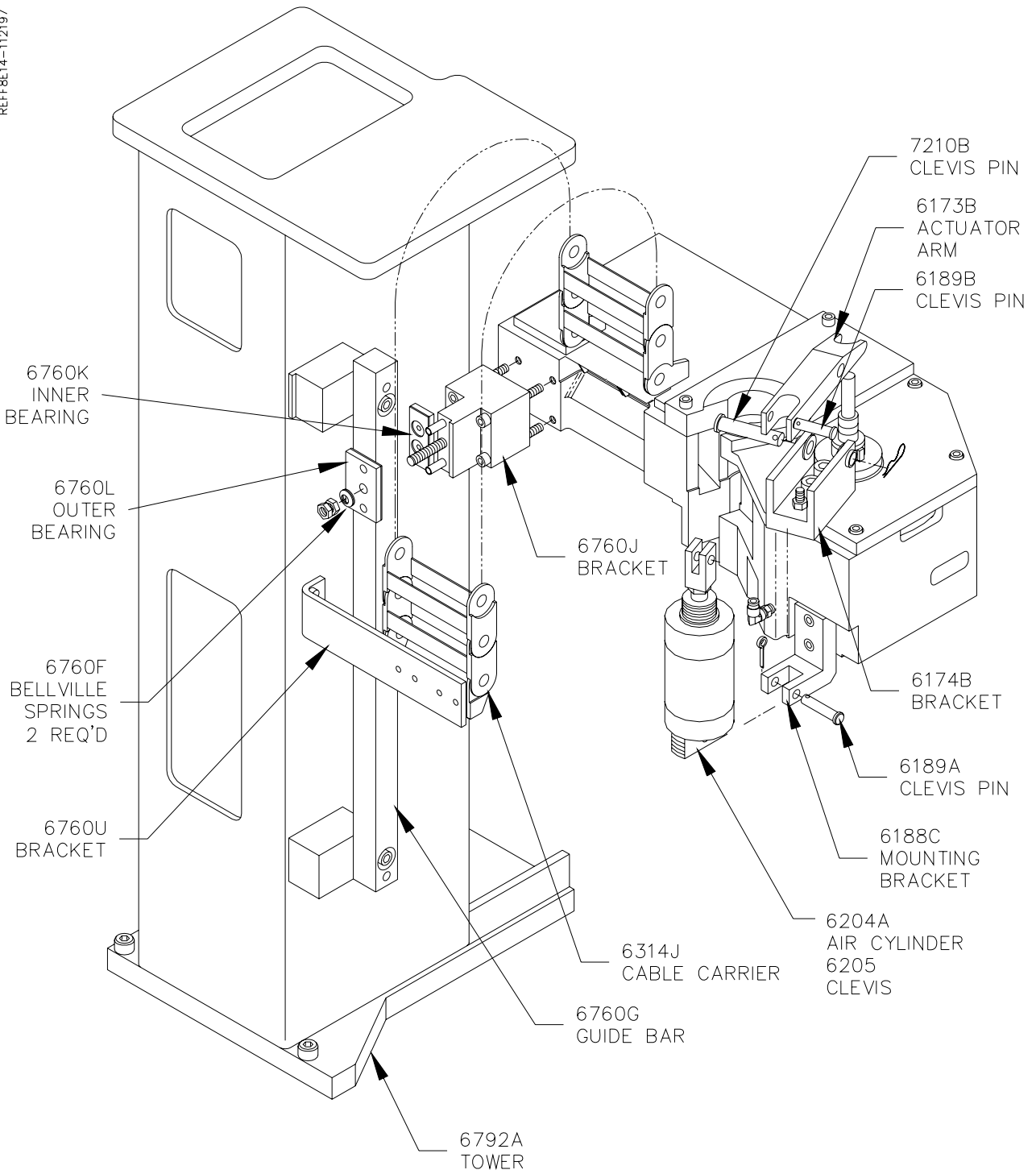
F88S Tower Assembly:

REF F8S17-062698



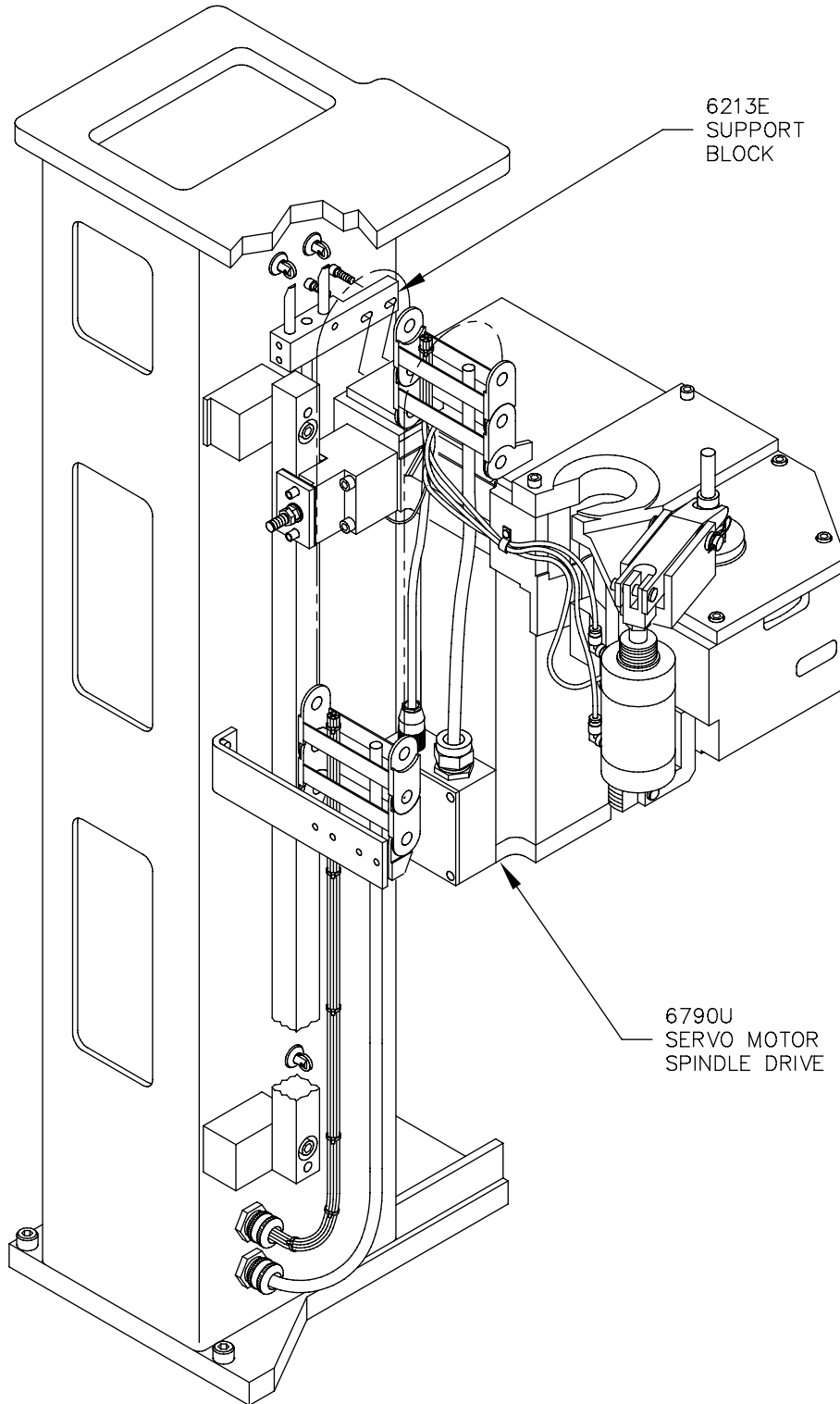
F85S / F84S Tower Assembly:

REFFB14-112197



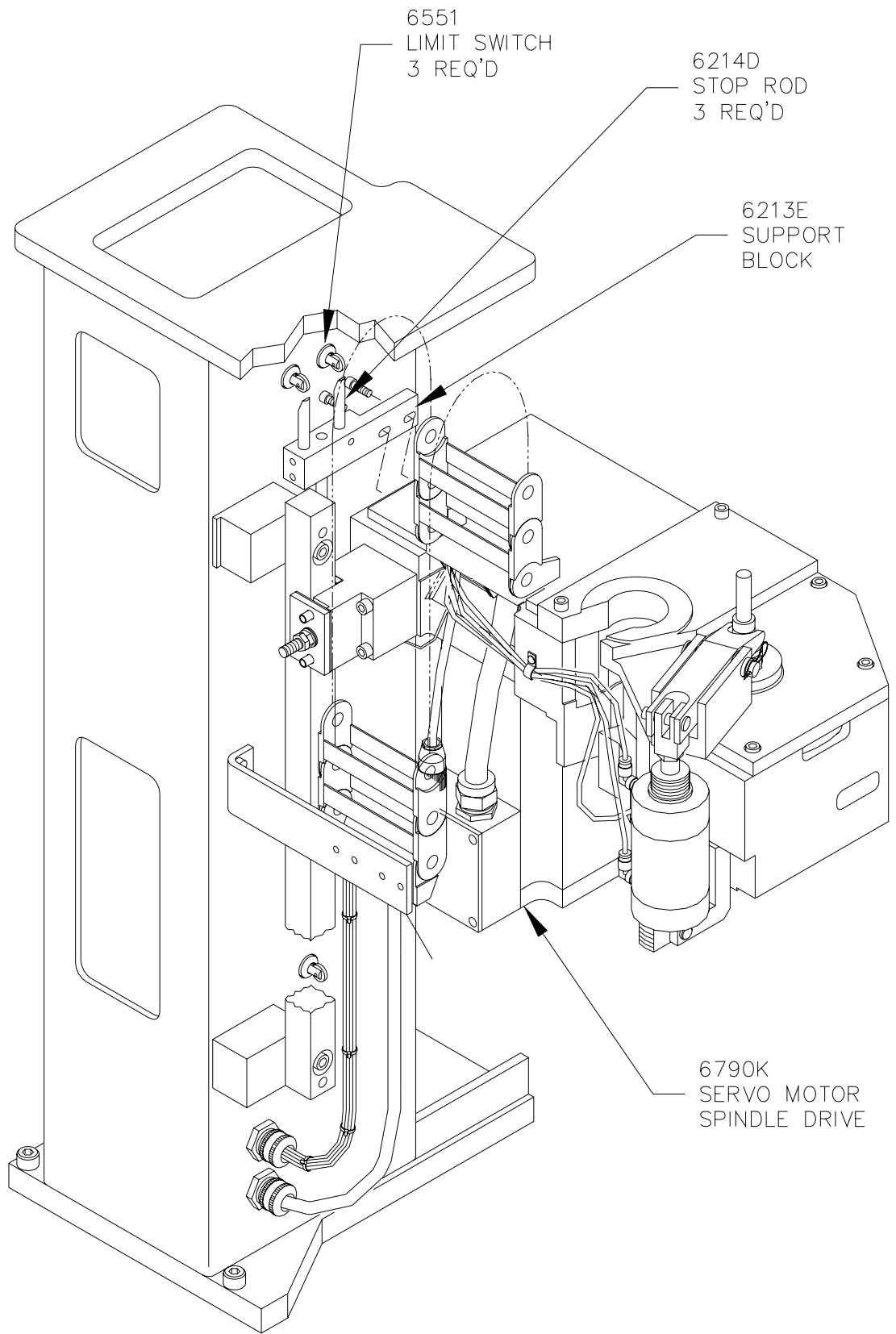
F88S Motor Assembly:

REF F8S19-062698

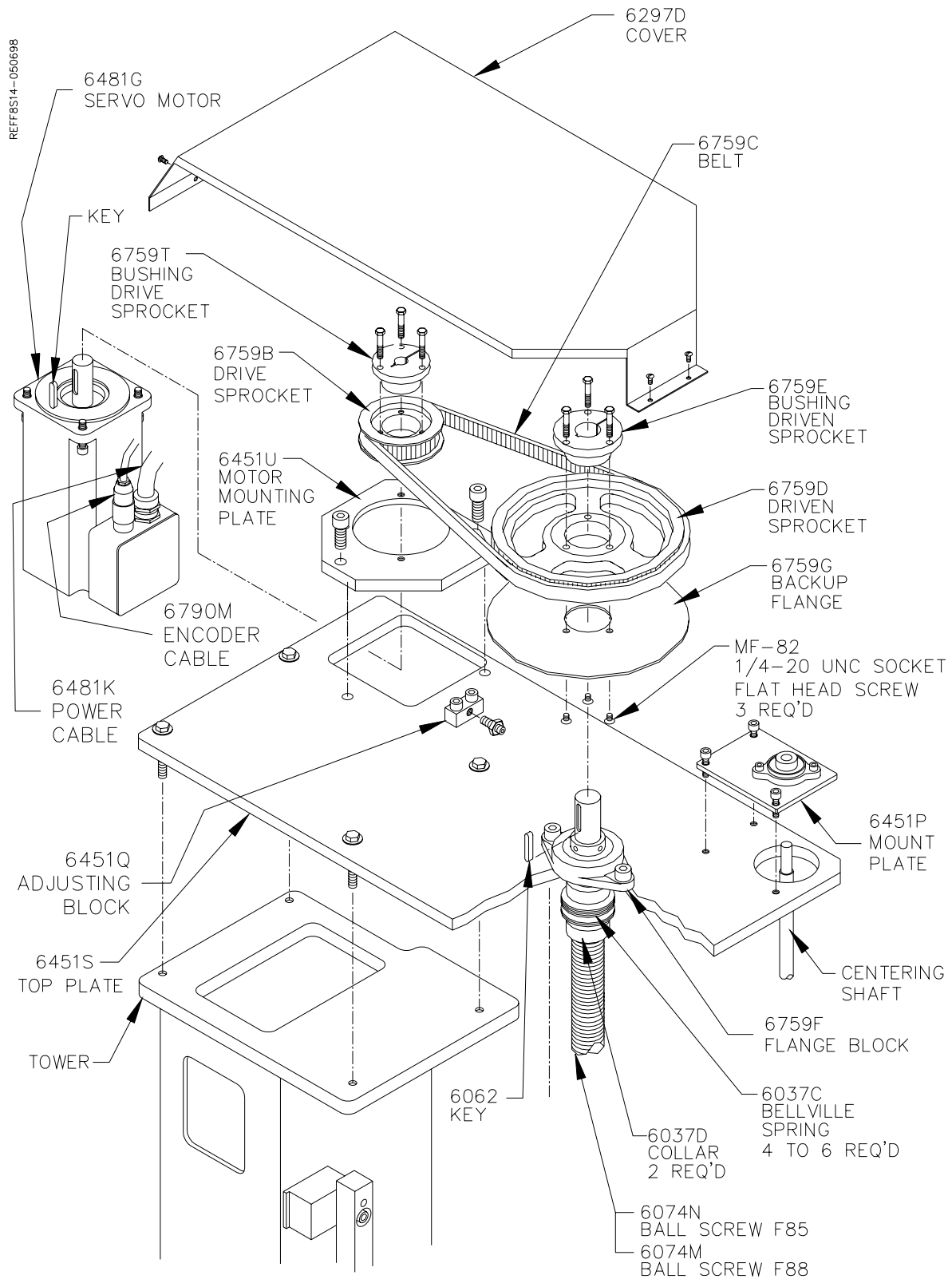


F85S / F84S Motor Assembly:

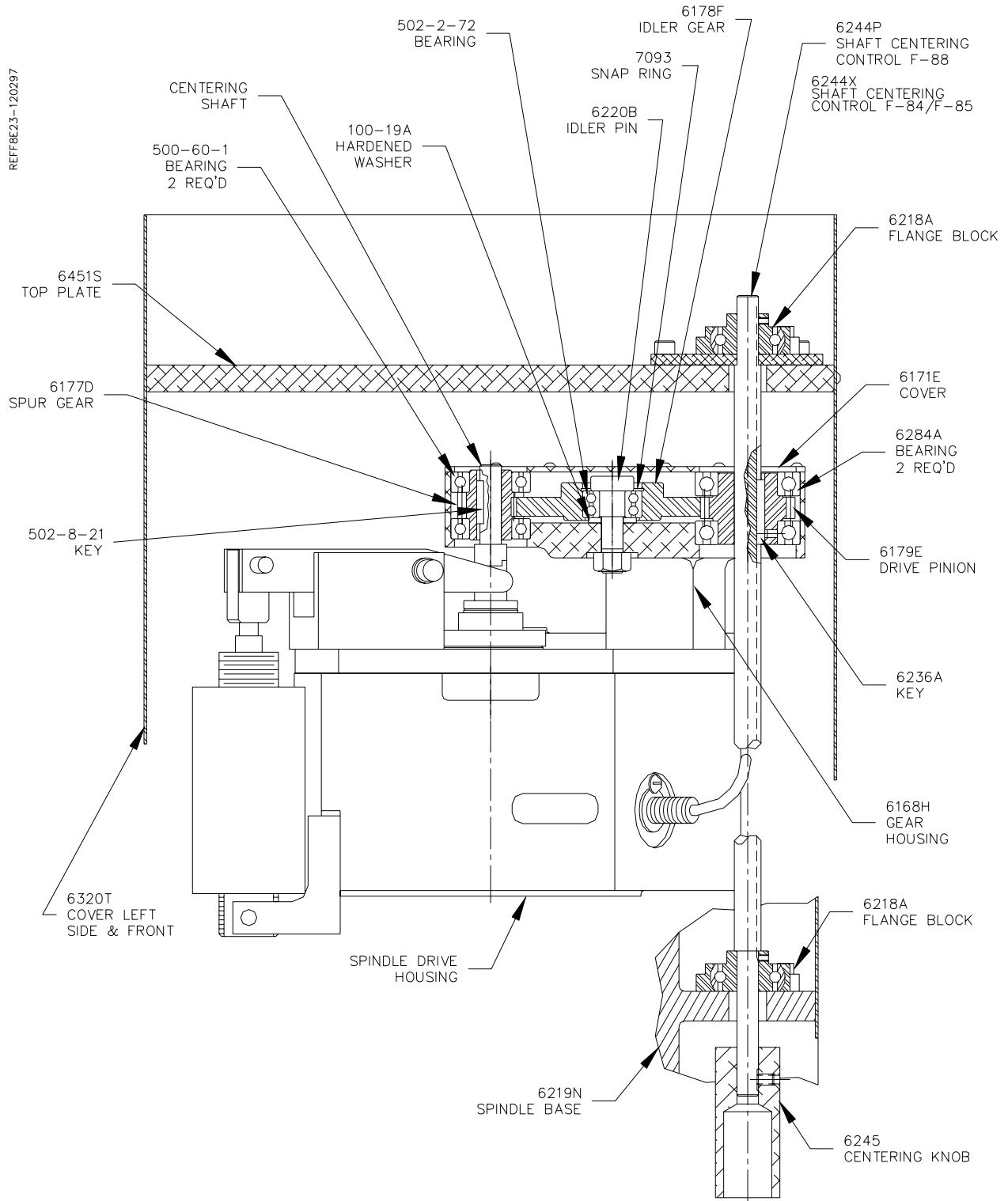
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Top Plate Assembly:

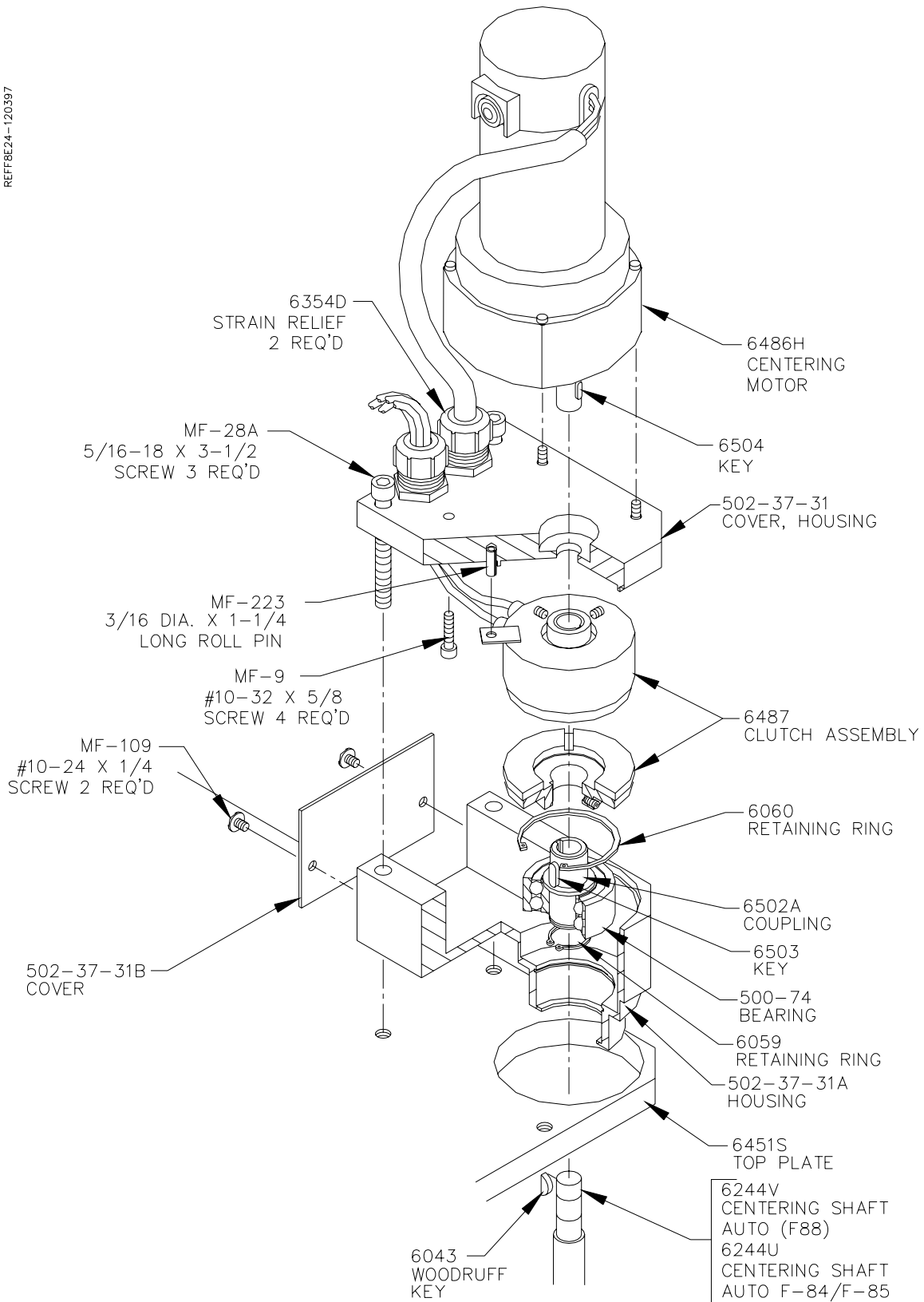


Centering Gear Housing:



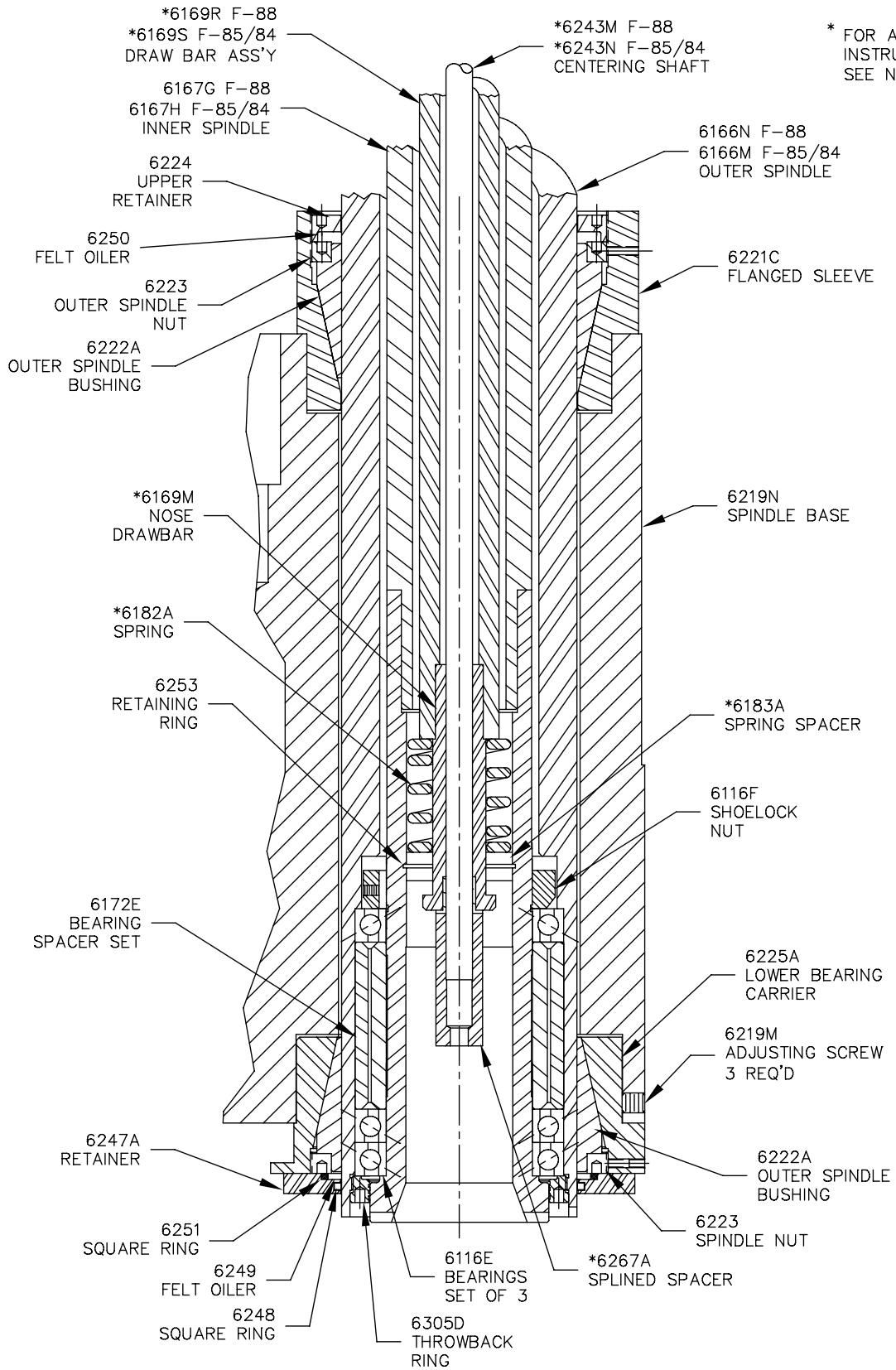
Auto Centering Motor and Clutch:

REF F8E24-120397



Lower Spindle:

REFFBET16-030998



* FOR ASSEMBLY INSTRUCTIONS SEE NEXT PAGE

*6169R F-88

*6169S F-85/84

DRAW BAR ASS'Y

6167G F-88

6167H F-85/84

INNER SPINDLE

6224

UPPER

RETAINER

6250

FELT OILER

6223

OUTER SPINDLE

NUT

6222A

OUTER SPINDLE

BUSHING

*6169M

NOSE

DRAWBAR

*6182A

SPRING

6253

RETAINING

RING

6172E

BEARING

SPACER SET

6247A

RETAINER

SQUARE

RING

6249

FELT OILER

6248

SQUARE RING

6116E

BEARINGS

SET OF 3

6305D

THROWBACK RING

*6243M F-88

*6243N F-85/84

CENTERING SHAFT

6166N F-88

6166M F-85/84

OUTER SPINDLE

6221C

FLANGED SLEEVE

6219N

SPINDLE BASE

*6183A

SPRING SPACER

6116F

SHOELock

NUT

6225A

LOWER BEARING

CARRIER

6219M

ADJUSTING SCREW

3 REQ'D

6222A

OUTER SPINDLE

BUSHING

6223

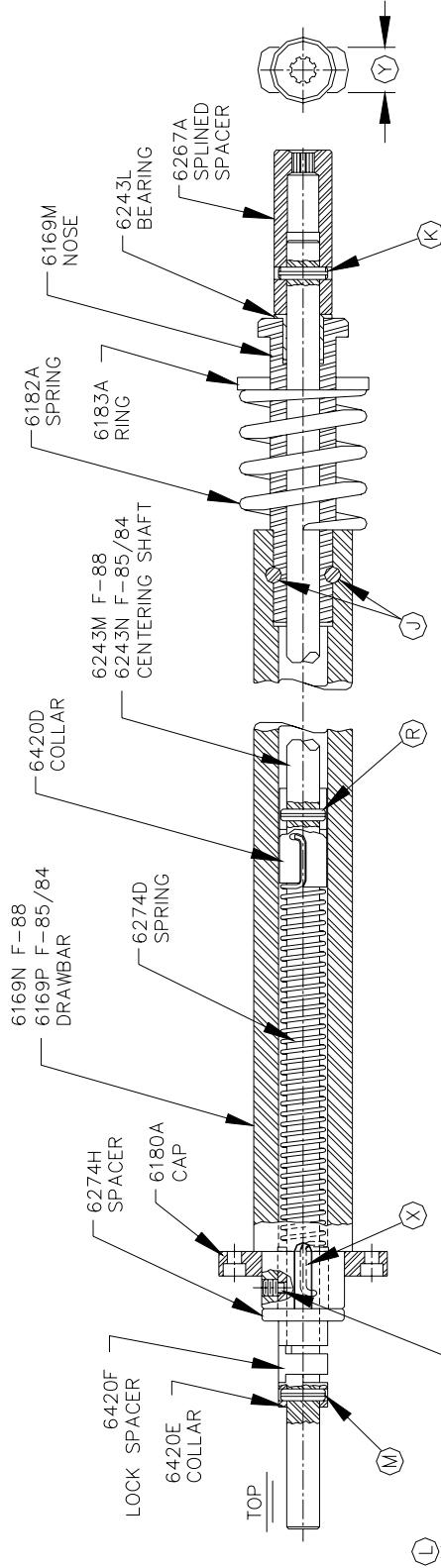
SPINDLE NUT

*6267A

SPLINED SPACER

Draw Bar / Centering Assembly:

REF F8E18-120497



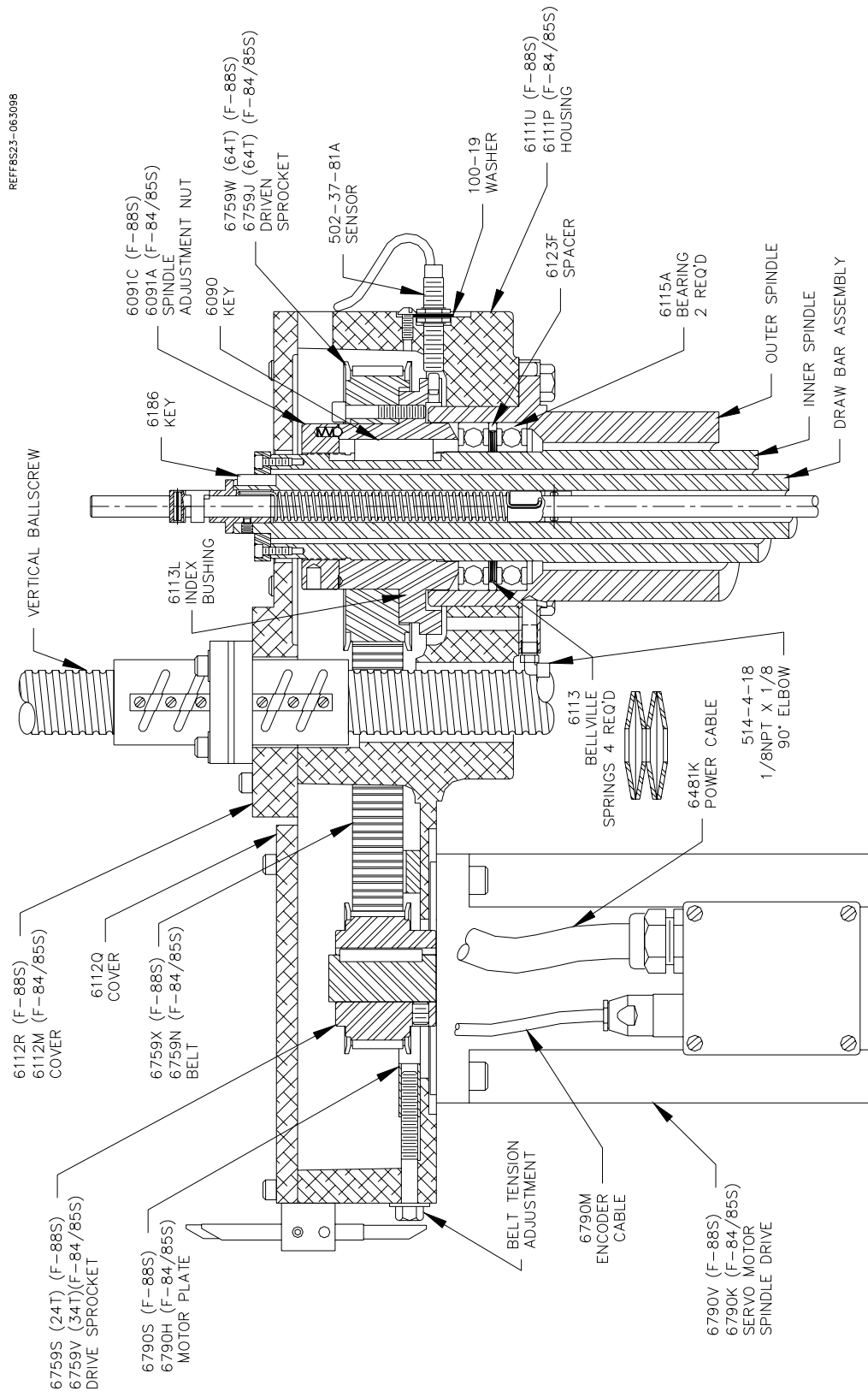
ASSEMBLY PROCEDURE

- ① ASSEMBLE RING (6183A) AND SPRING (6182A) ONTO NOSE (6169M). PRESS NOSE INTO DRAWBAR (6169N). CAUTION KEYWAY (X) AND LOCKING EARS (Y) TO BE TIMED 90° AS SHOWN. INSTALL (2) 1/4 X 3/4 LONG DOWEL PINS (J)
- ② INSERT CENTERING SHAFT (6243M) FROM TOP. SLIDE ON SPLINED SPACER (6267A). PIN WITH 3/16 X 3/4 LONG ROLL PIN. (K)
- ③ ASSEMBLE COLLAR (6420D), SPRING (6274D), AND SPACER (6274H). SLIDE OVER CENTERING SHAFT UNTIL COLLAR (6420D) LOCKS WITH ROLL PIN (R). LOCK IN PLACE WITH HALF DOG SET SCREW (L). SLIDE ON LOCK SPACER (6420F) AND COLLAR (6420E). (LOOKING FROM TOP) ROTATE COUNTER CLOCKWISE UNTIL STOPPED. ROTATE CENTERING SHAFT CLOCKWISE 2 TURNS. PIN WITH 3/16 X 5/8 LONG ROLL PIN. (M)

(L) MF-62
1/4 LONG HEX
SOCKET SET SCREW
HALF DOG

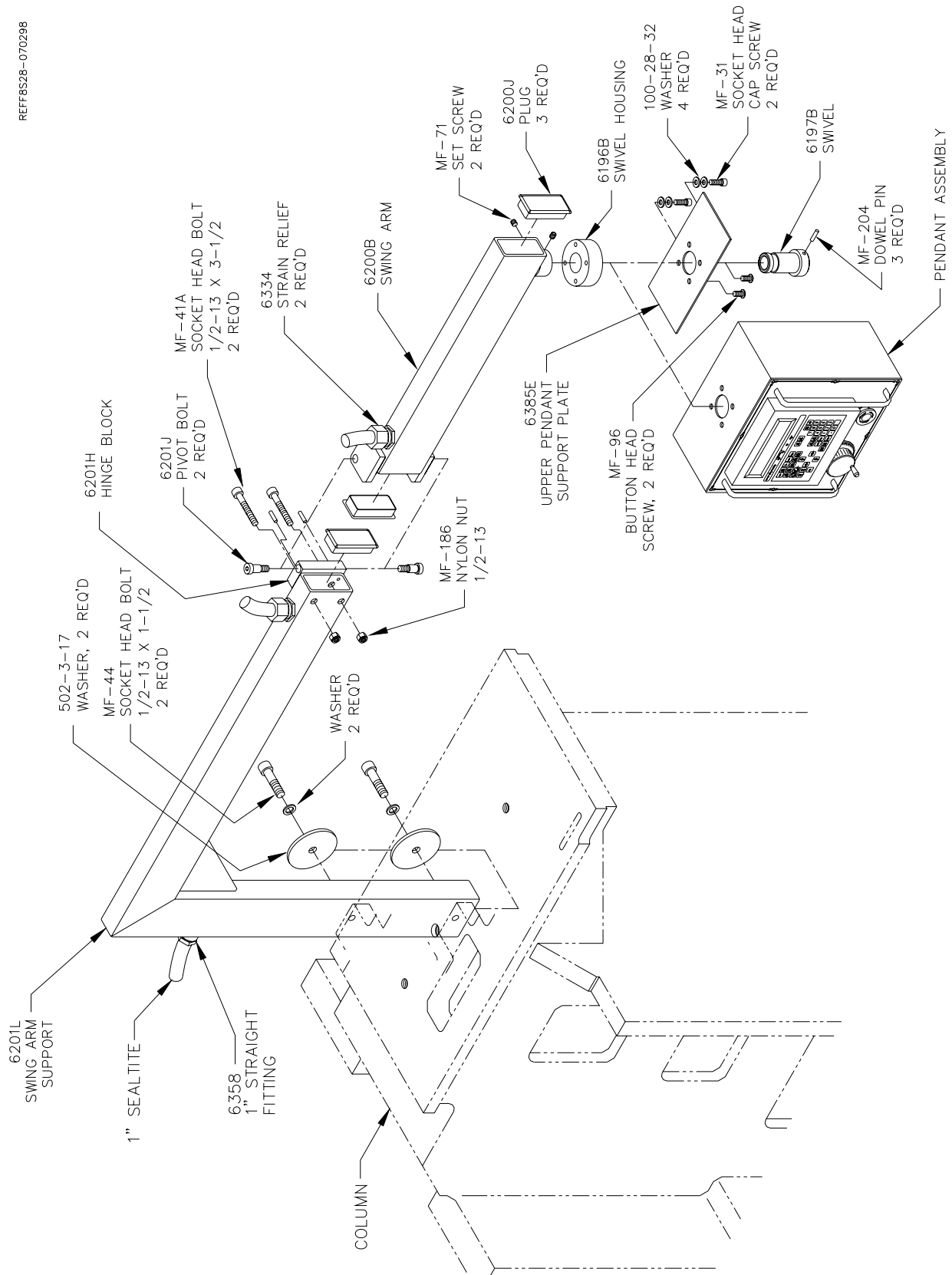
6169S F-85/84
6169R F-88 DRAWBAR/CENTERING SHAFT ASSEMBLY

Upper Housing F80S (Belt Drive):



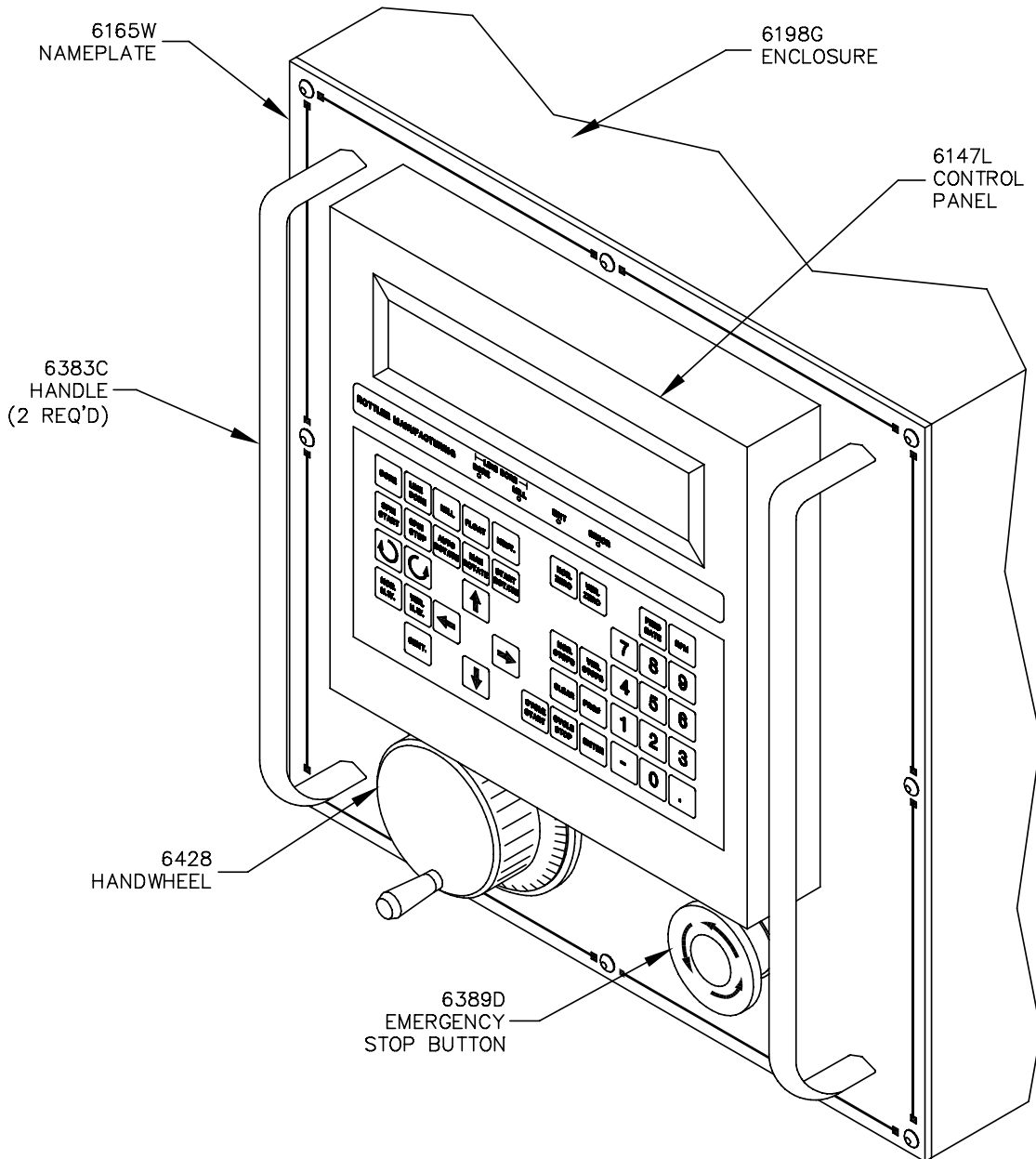
Pendant Swing Arm:

REF6528-070298



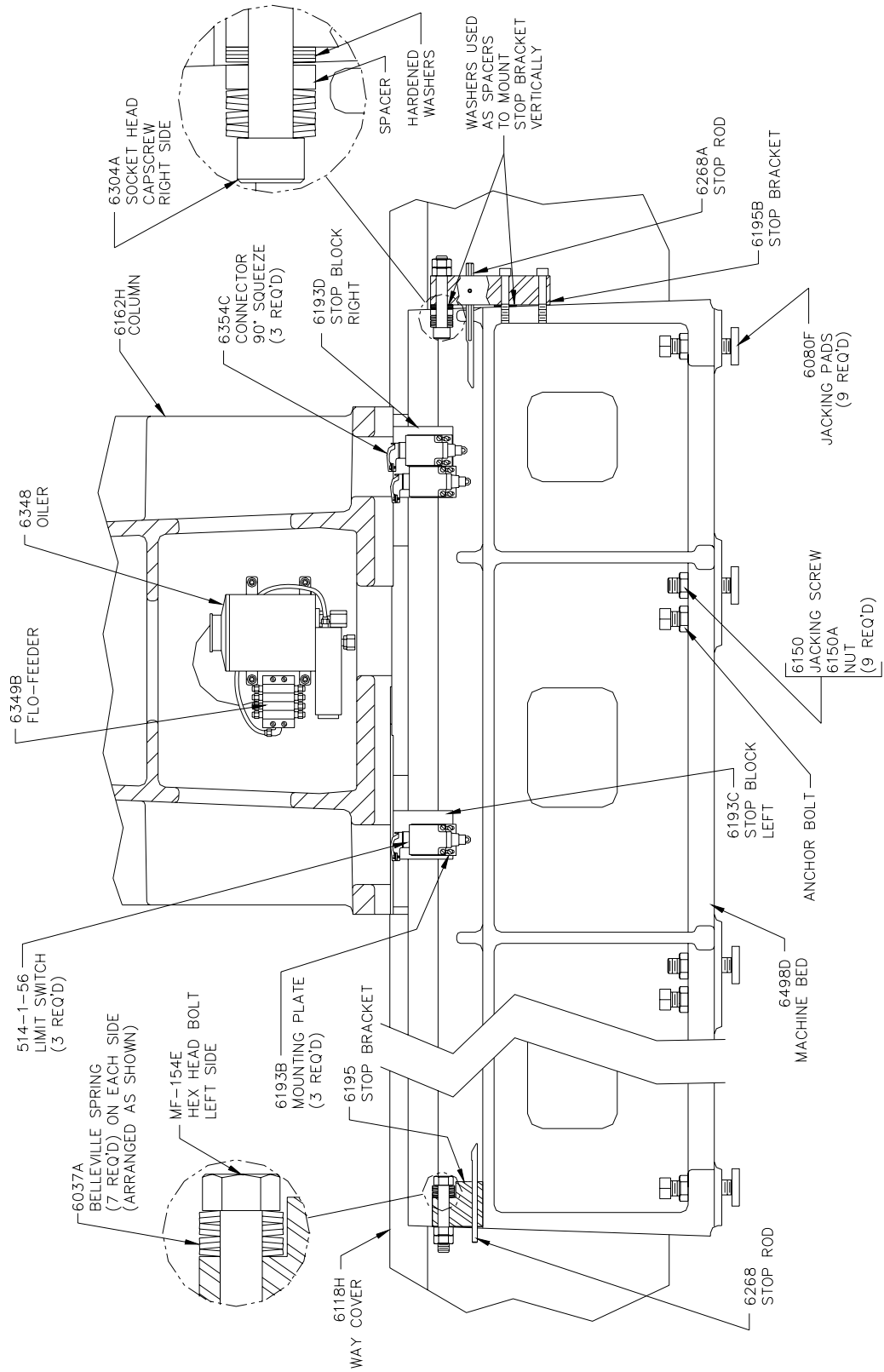
Pendant Assembly:

REF F80S1-070698



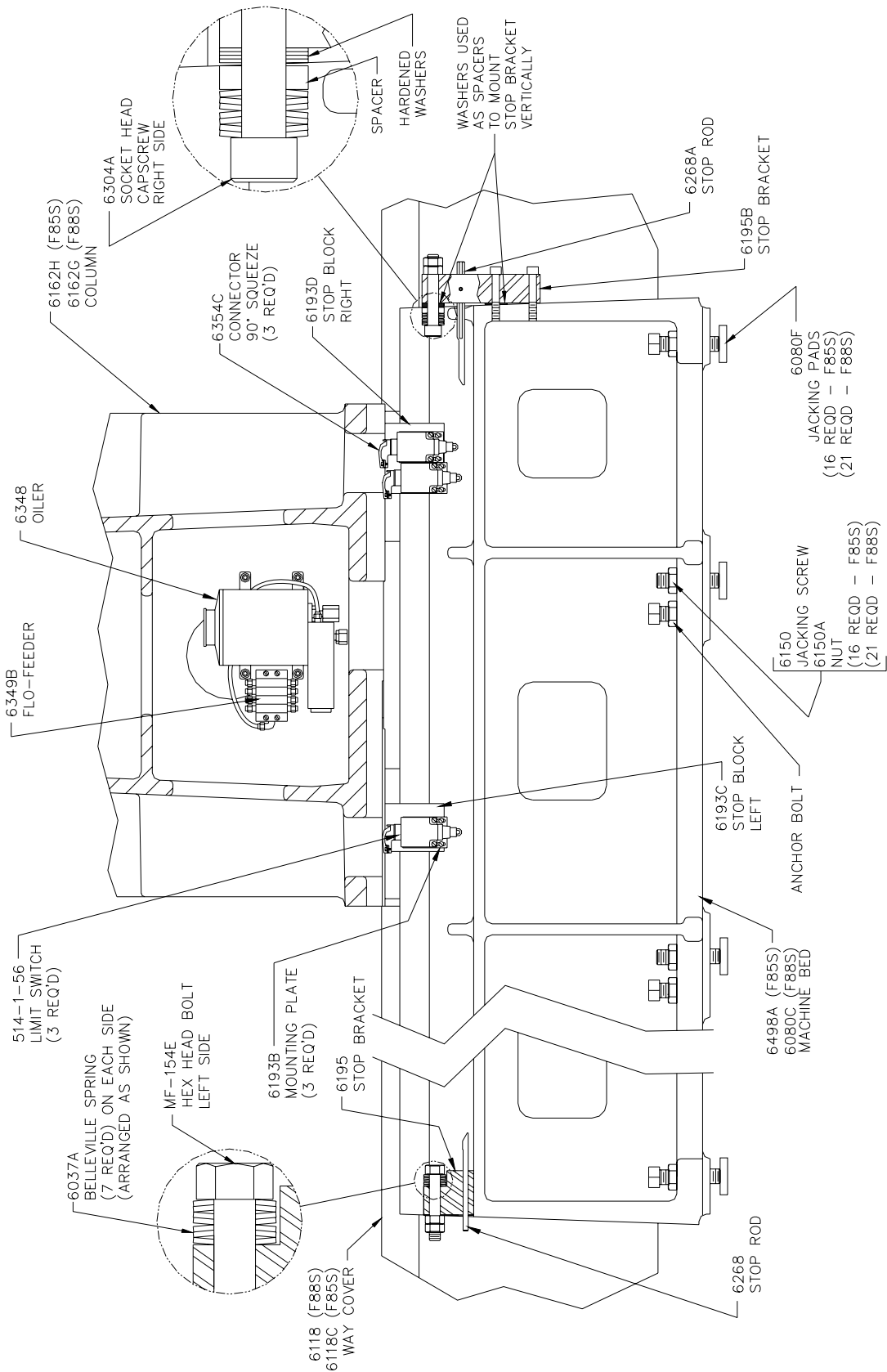
F84S Machine Bed:

REF F8E56-120297

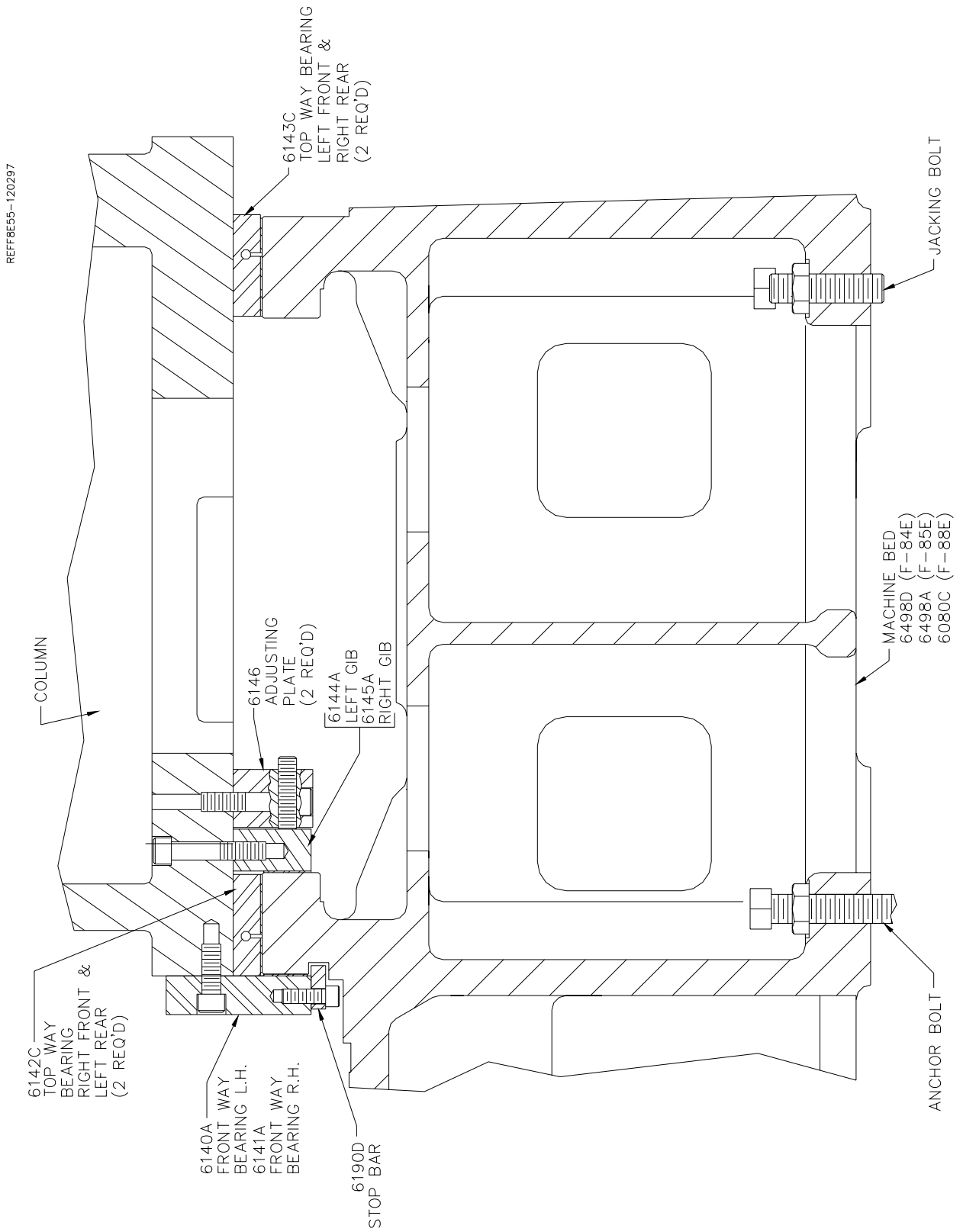


F85S / F88S Machine Bed:

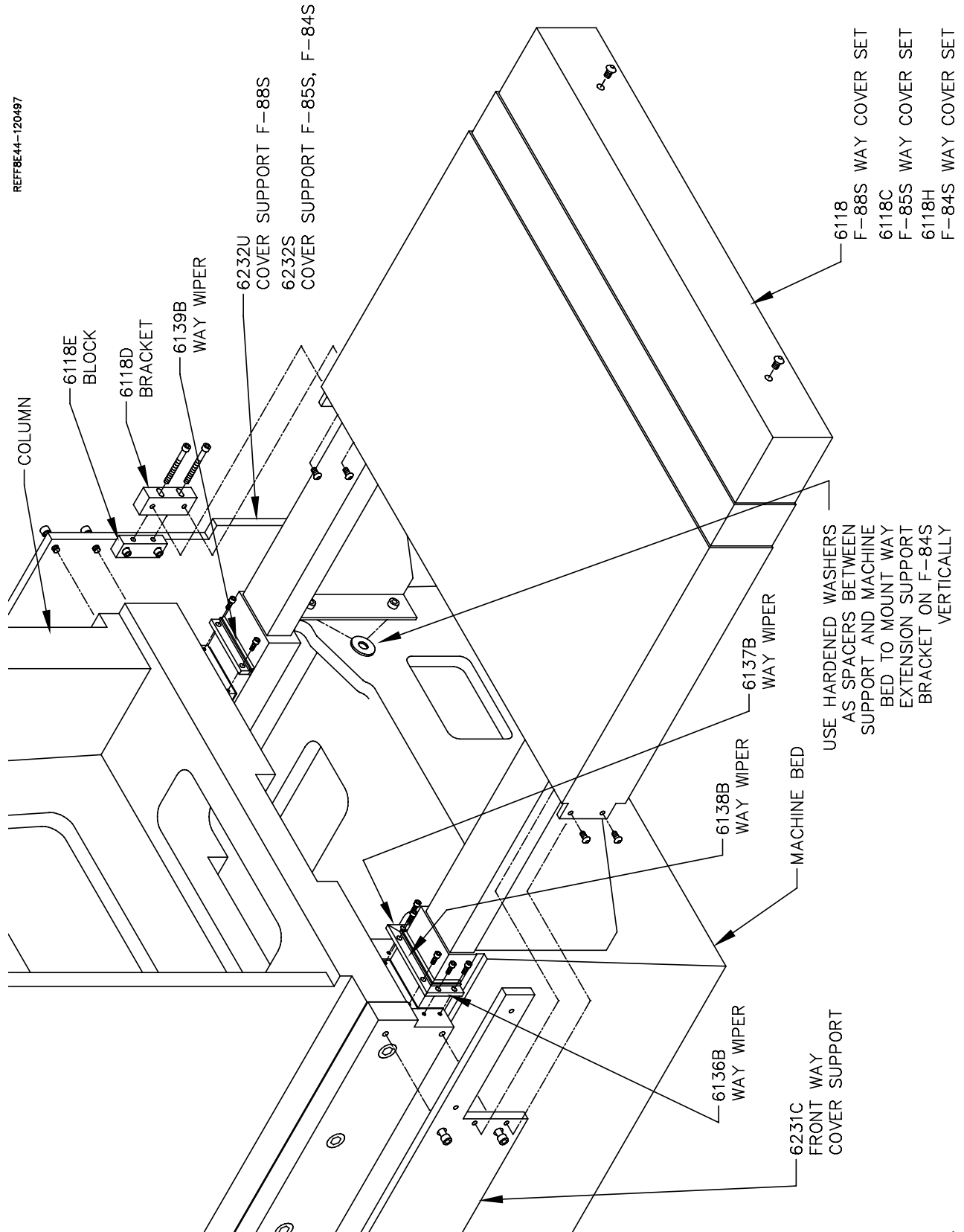
REFFBE54-12152003



F88S / F85S / F84S Runway:



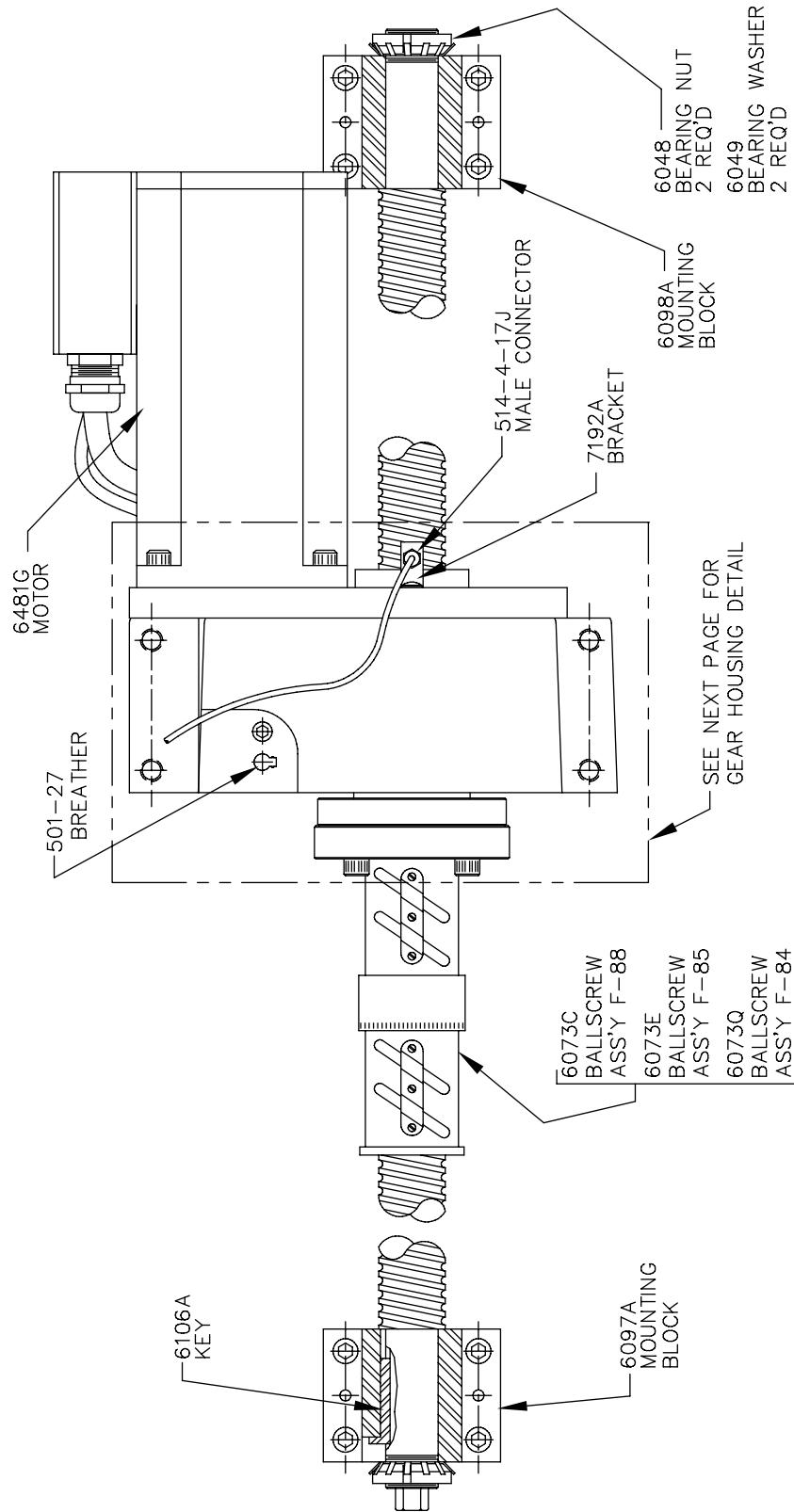
Way Cover Assembly:



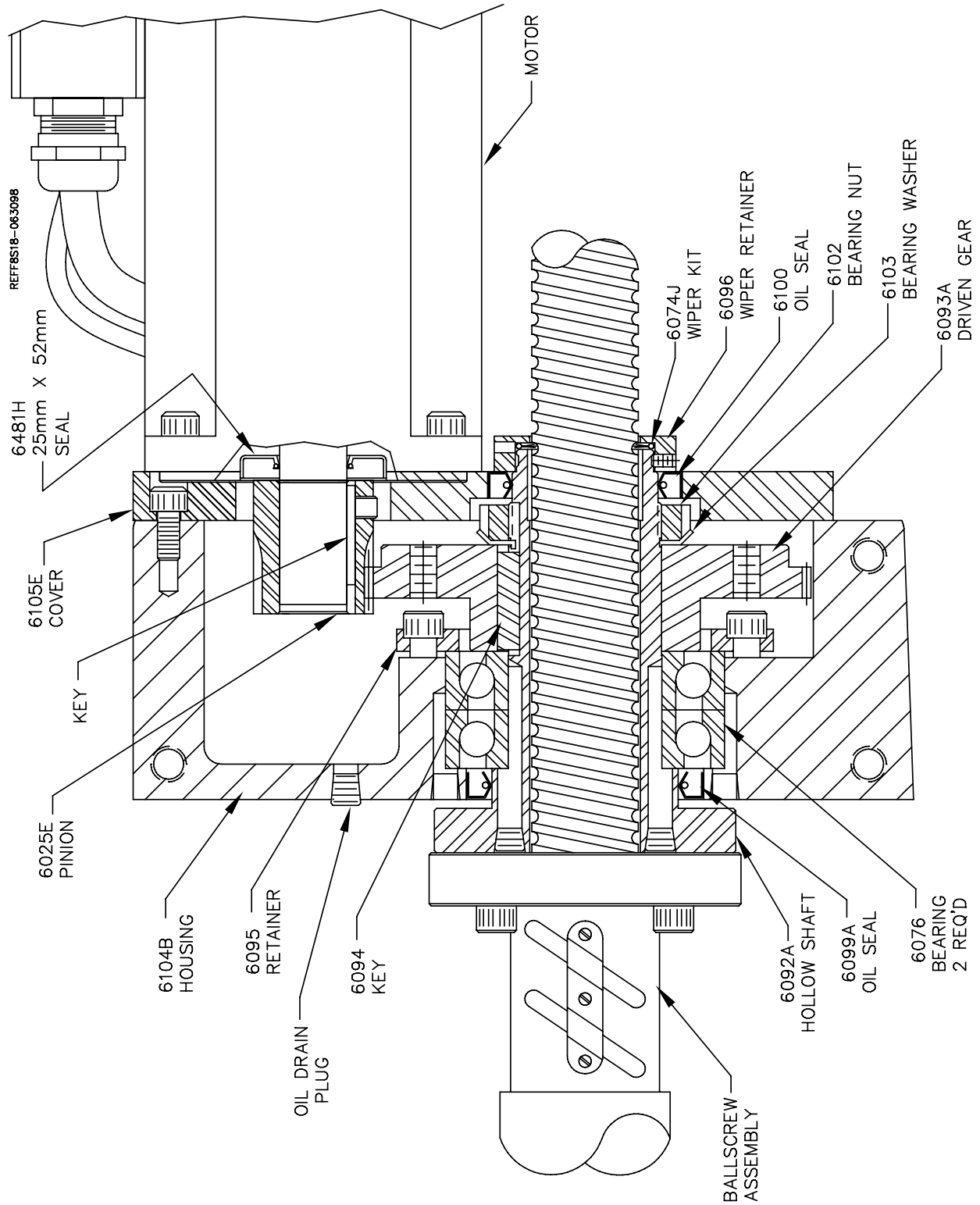
REFFB44-120497

Column Drive Assembly:

REFFS22-065098

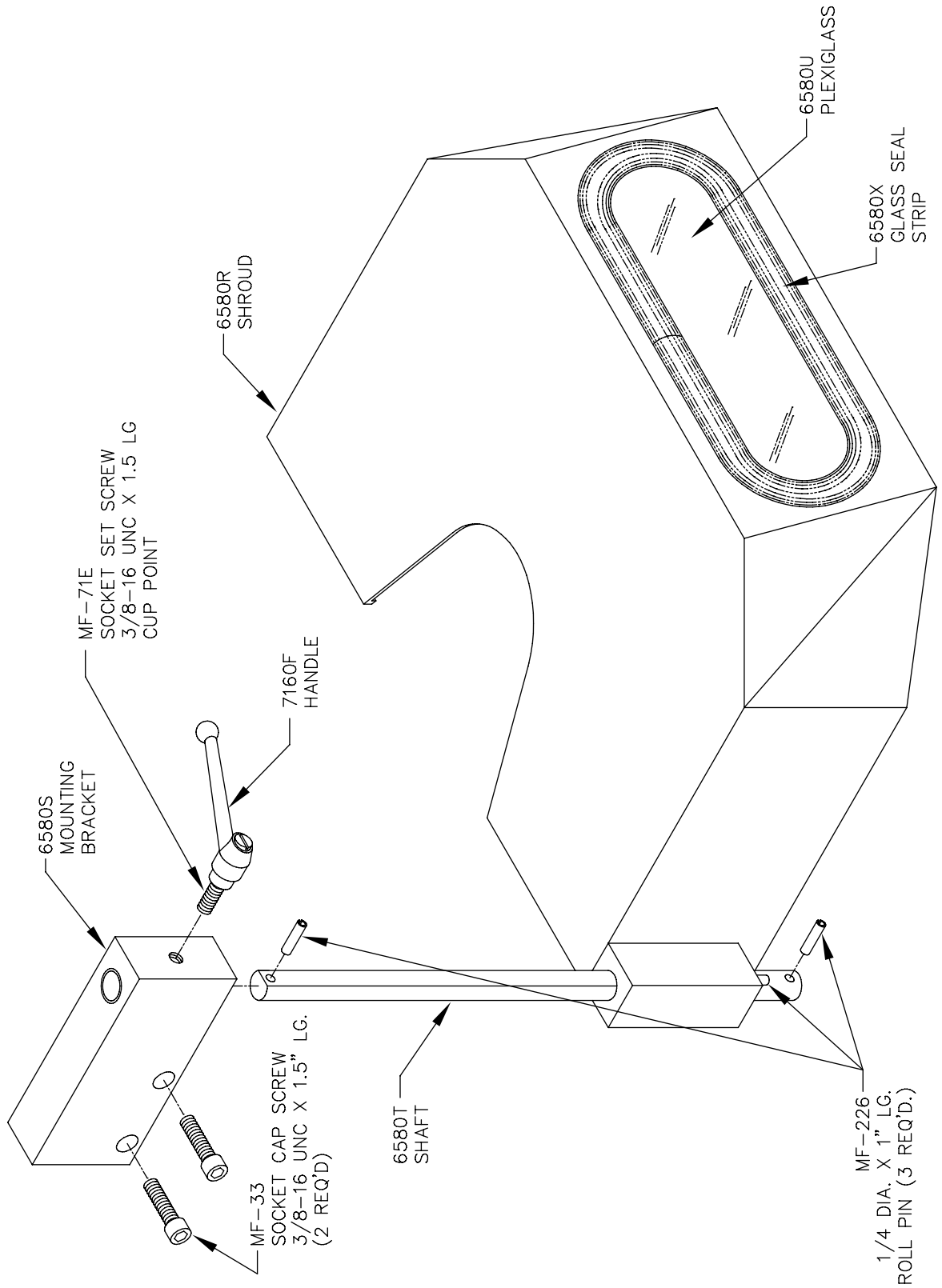


Column Drive Gear Housing:

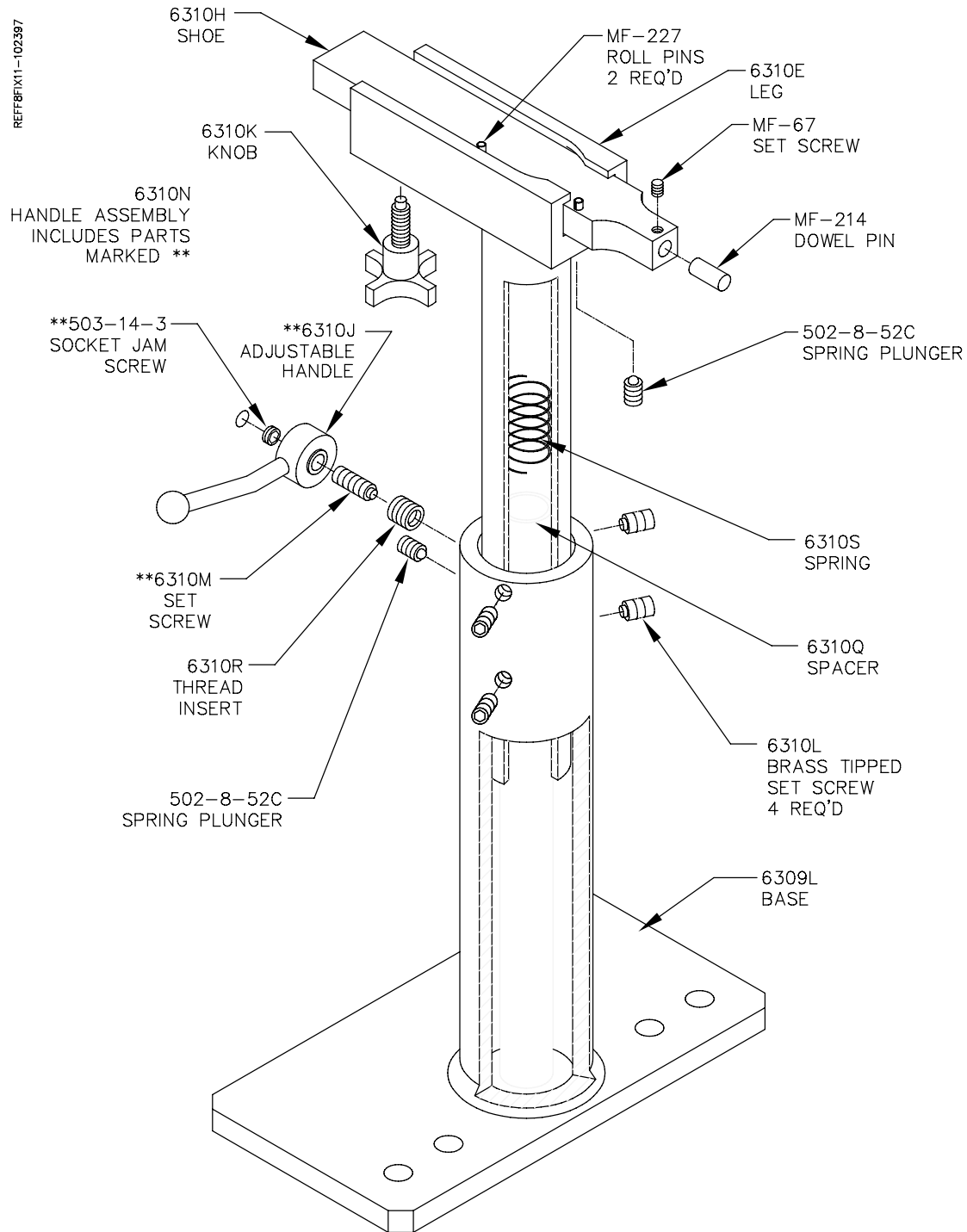


6580W Chip Shield Assembly:

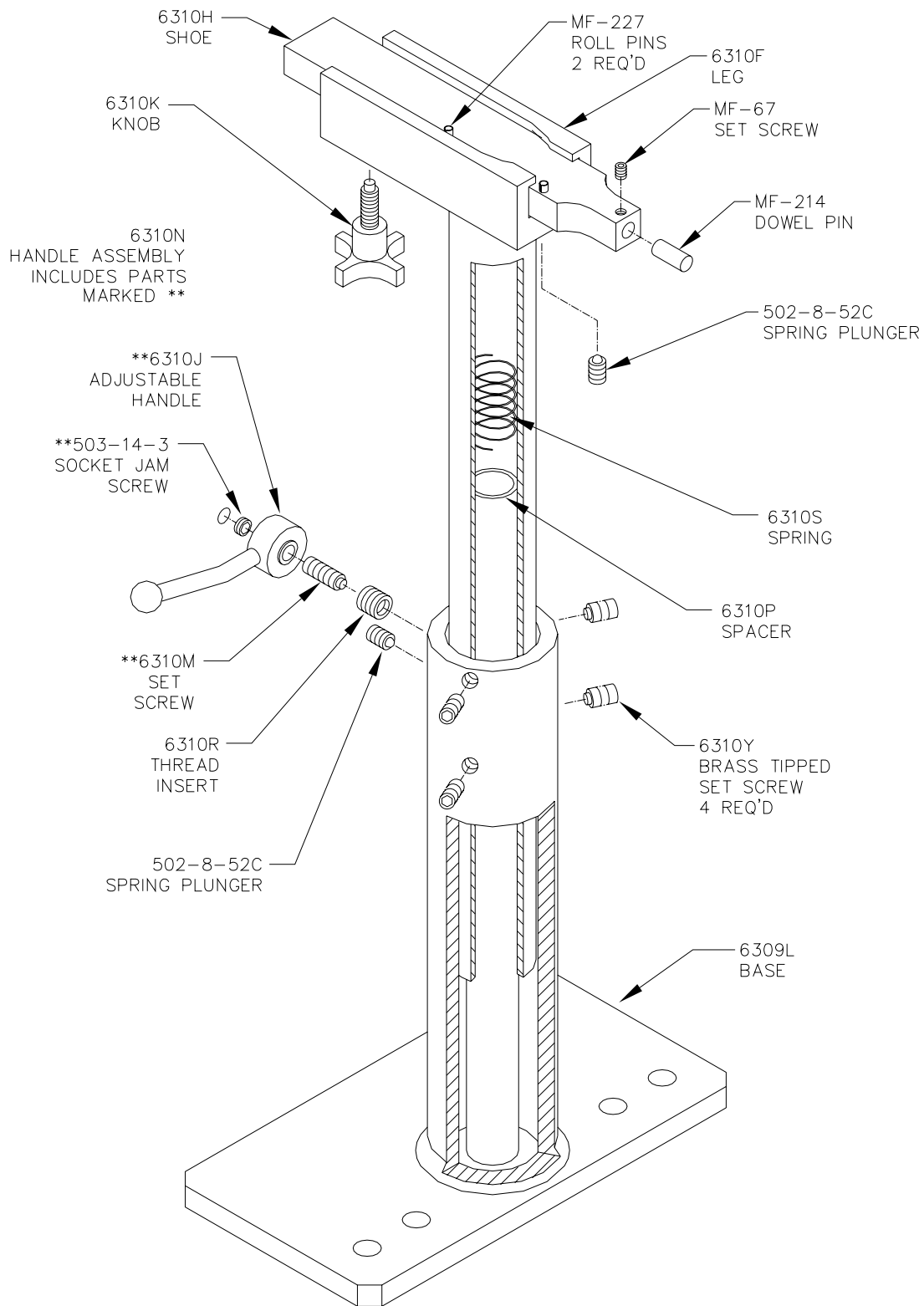
REF F8E48-102397



Chapter 7 Options: 6309M Short Clamp Arm Assembly:



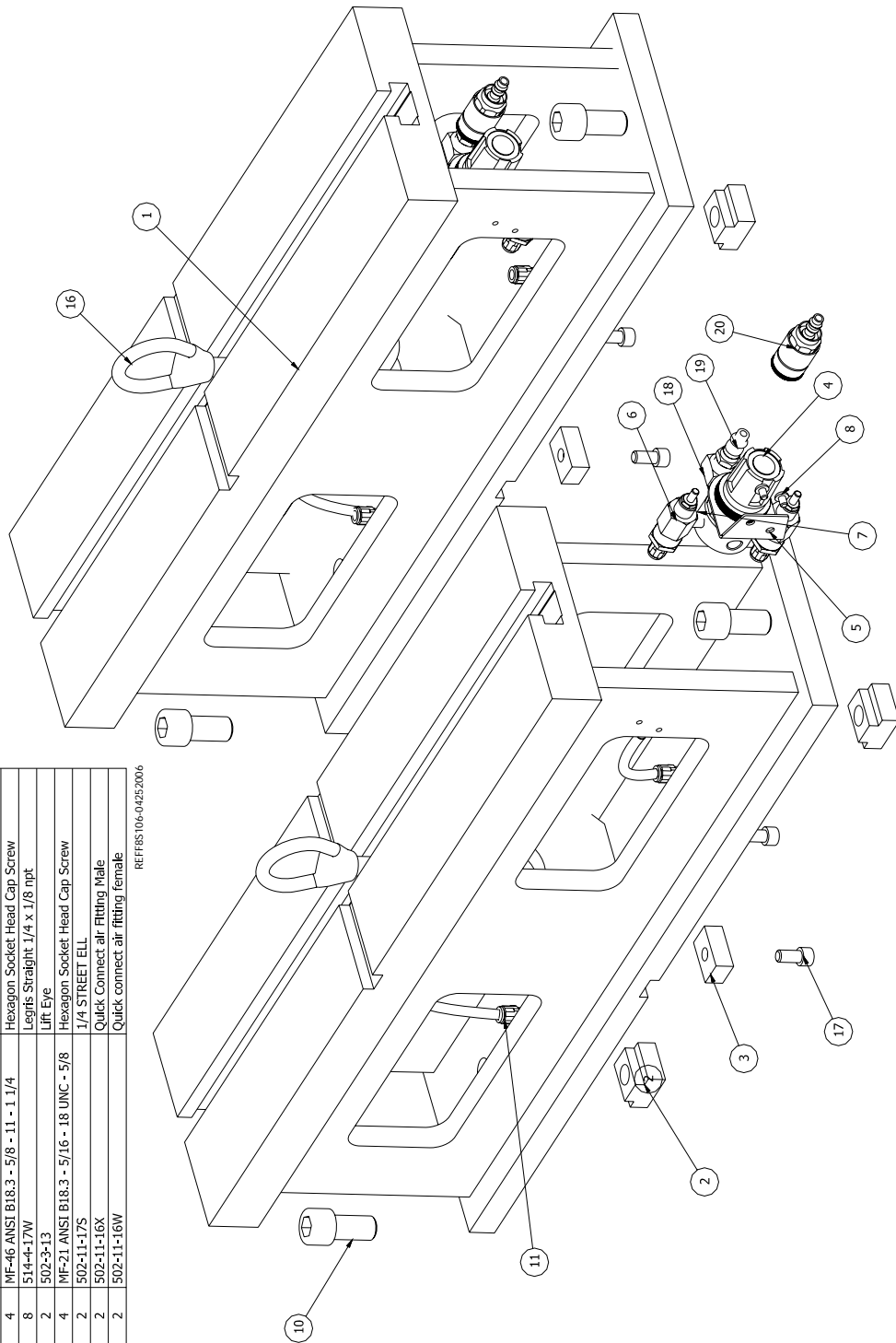
6309N Tall Clamp Arm Assembly 6309N:



6794E 8" Parallel Assembly F84 / F85:

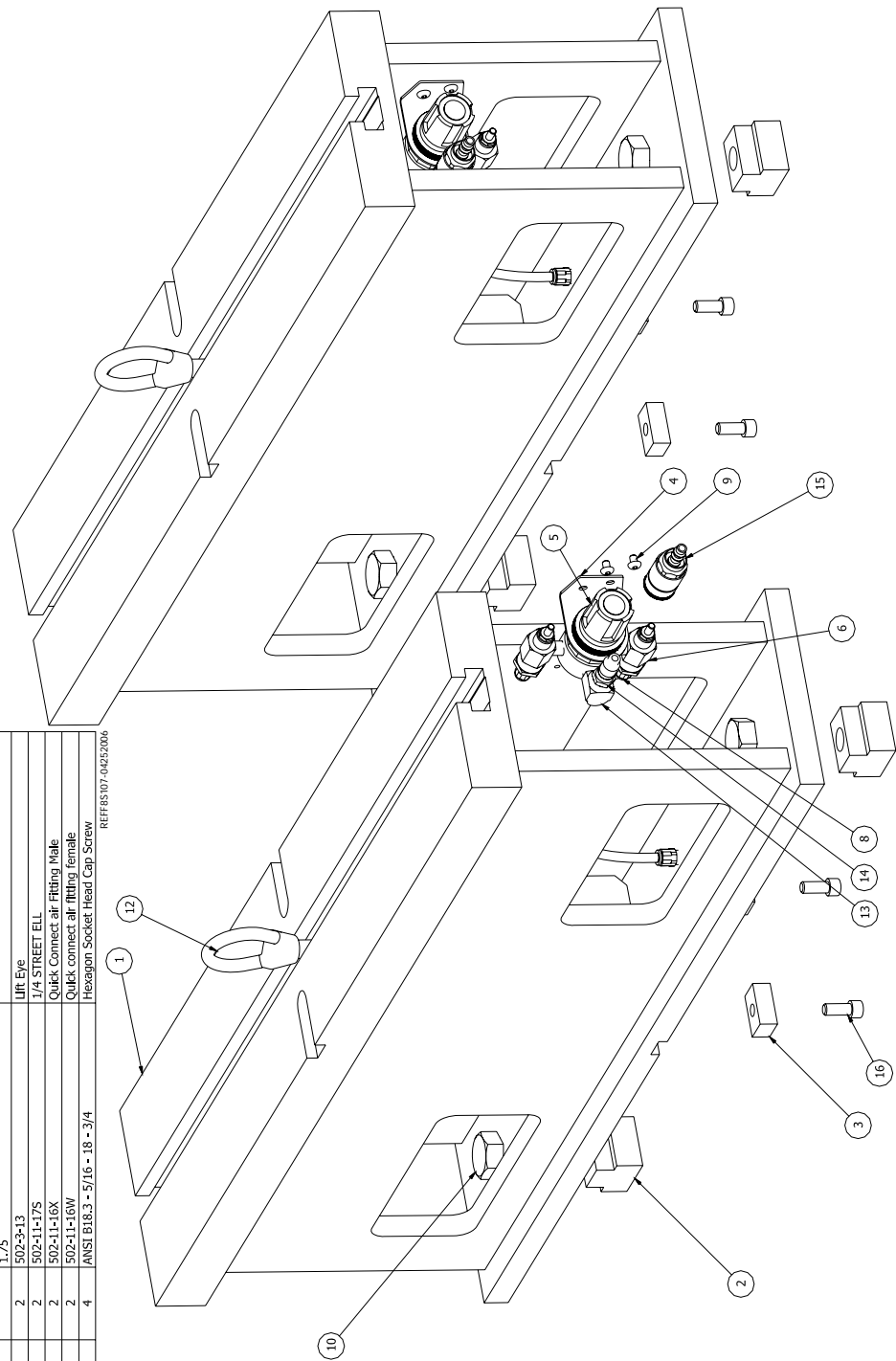
6794E Part List - 8" Parallel - F84/F85		
ITEM	QTY	DESCRIPTION
1	2	8 Inch Parallel Machining
2	4	3/4" T-Nut
3	4	Guide Key
4	2	Regulator 0 - 60 PSI
5	2	Regulator Bracket
6	4	Flo Control
7	4	Close Nipple
8	4	Hexagon Socket Button Head Cap Screw
10	4	Hexagon Socket Head Cap Screw
11	8	Legrits Straight 1/4 x 1/8 npt
16	2	Lift Eye
17	4	Hexagon Socket Head Cap Screw
18	2	1/4 STREET ELL
19	2	Quick Connect air Fitting Male
20	2	Quick connect air fitting female

REF F85106-04252006



6370Z 10" Parallel Assembly F88:

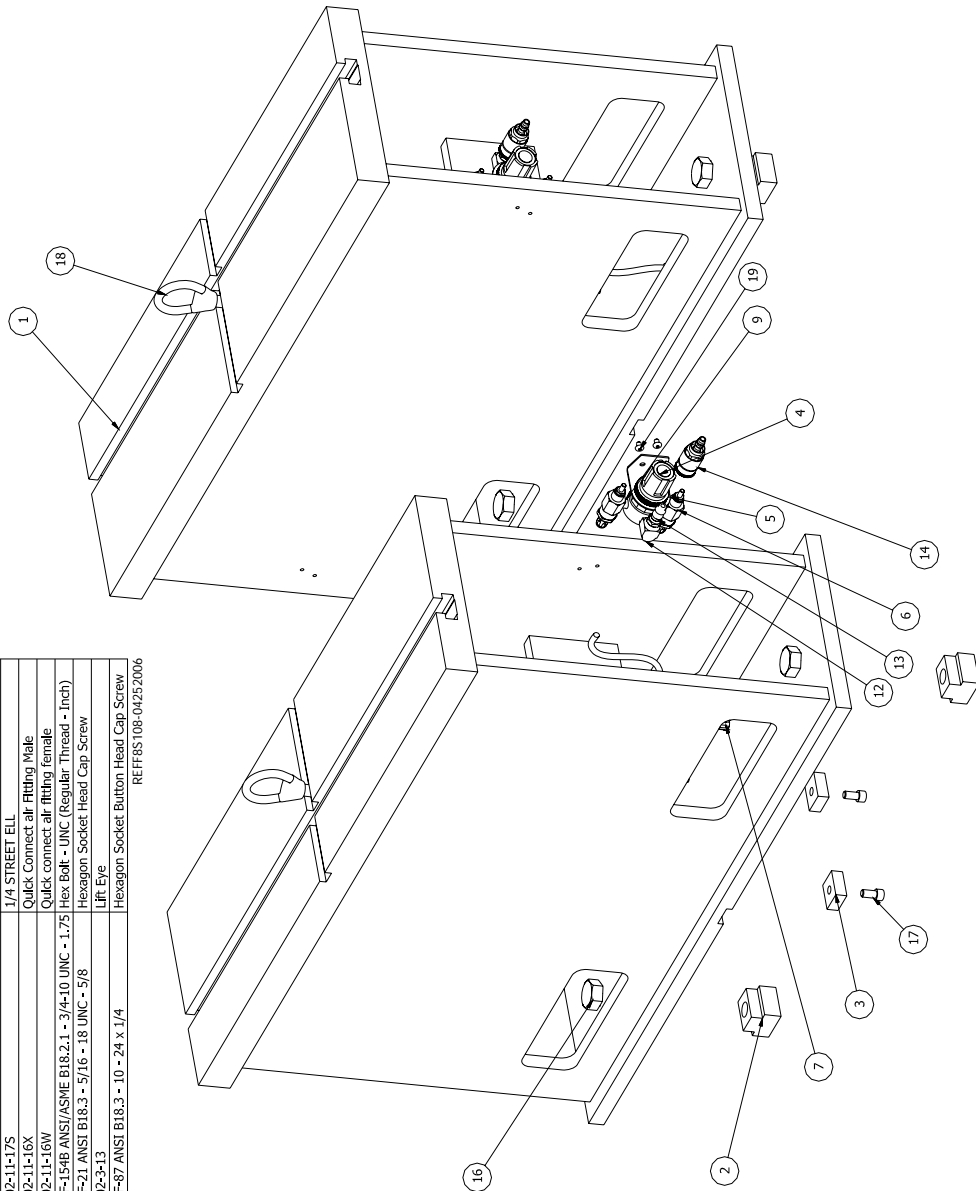
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	6370Y	10" Parallel Machining
2	4	6160	T-Nut
3	4	65531	Guide Key
4	2	502-27-17A	Regulator Bracket
5	2	502-27-17	Regulator 0 - 60 PSI
6	4	502-11-35A	Plo Control
7	4	502-11-17J	Close Nipple
8	8	514-4-17W	Legris Straight 1/4 x 1/8 npt
9	4	MF-67 ANSI B18.3 - 10 - 24 x 1/4	Hexagon Socket Button Head Cap Screw
10	4	MF-154B ANSI/ASME B18.2.1 - 3/4-10 UNC - 1.75	Hex Bolt - UNC (Regular Thread - Inch)
12	2	502-3-13	Lift Eye
13	2	502-11-17S	1/4 STREET ELL
14	2	502-11-16X	Quick Connect air Fitting Male
15	2	502-11-16W	Quick connect air fitting female
16	4	ANSI B18.3 - 5/16 - 18 - 3/4	Hexagon Socket Head Cap Screw



6370C 18" Parallel Assembly F88:

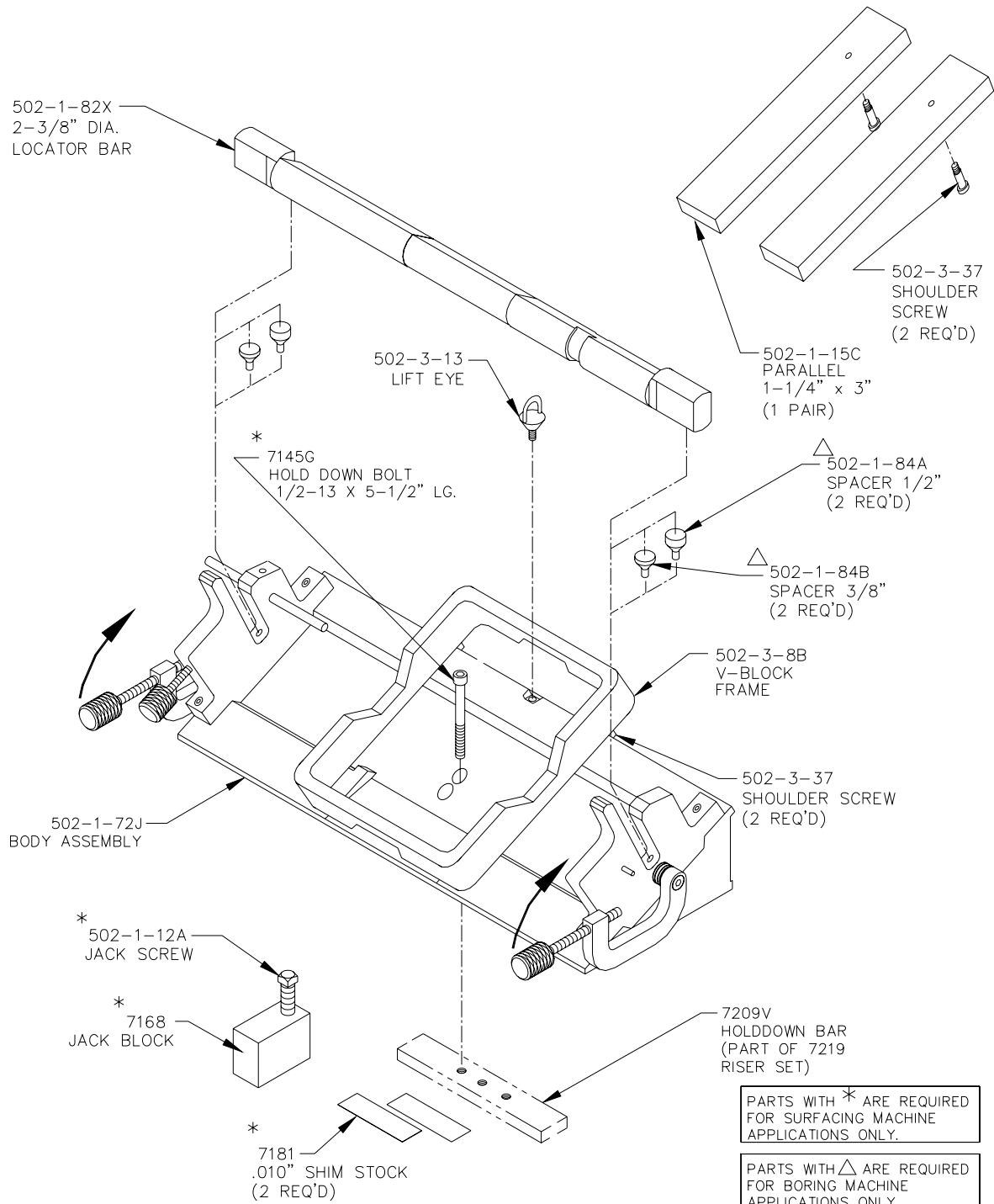
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	6370M	
2	4	6160	T-Nut
3	4	6553K	Guide Key
4	2	502-27-17	Regulator 0 - 60 PSI
5	2	502-27-17A	Regulator Bracket
6	4	502-11-35A	Flc Control
7	8	514-4-17W	Legits Straight, 1/4 x 1/8 npt
9	4	502-11-17J	Close Nipple
12	2	502-11-17S	1/4 STREET ELL
13	2	502-11-16X	Quick Connect air Fitting Male
14	2	502-11-16W	Quick connect air fitting female
16	4	MF-154B ANSI/ASME B18.2.1 - 3/4-10 UNC - 1.75	Hex Bolt - UNC (Regular Thread - Inch)
17	4	MF-21 ANSI B18.3 - 5/16 - 18 UNC - 5/8	Hexagon Socket Head Cap Screw
18	2	502-3-13	Lift Eye
19	4	MF-87 ANSI B18.3 - 10 - 24 x 1/4	Hexagon Socket Button Head Cap Screw

REF F85 108-04252006

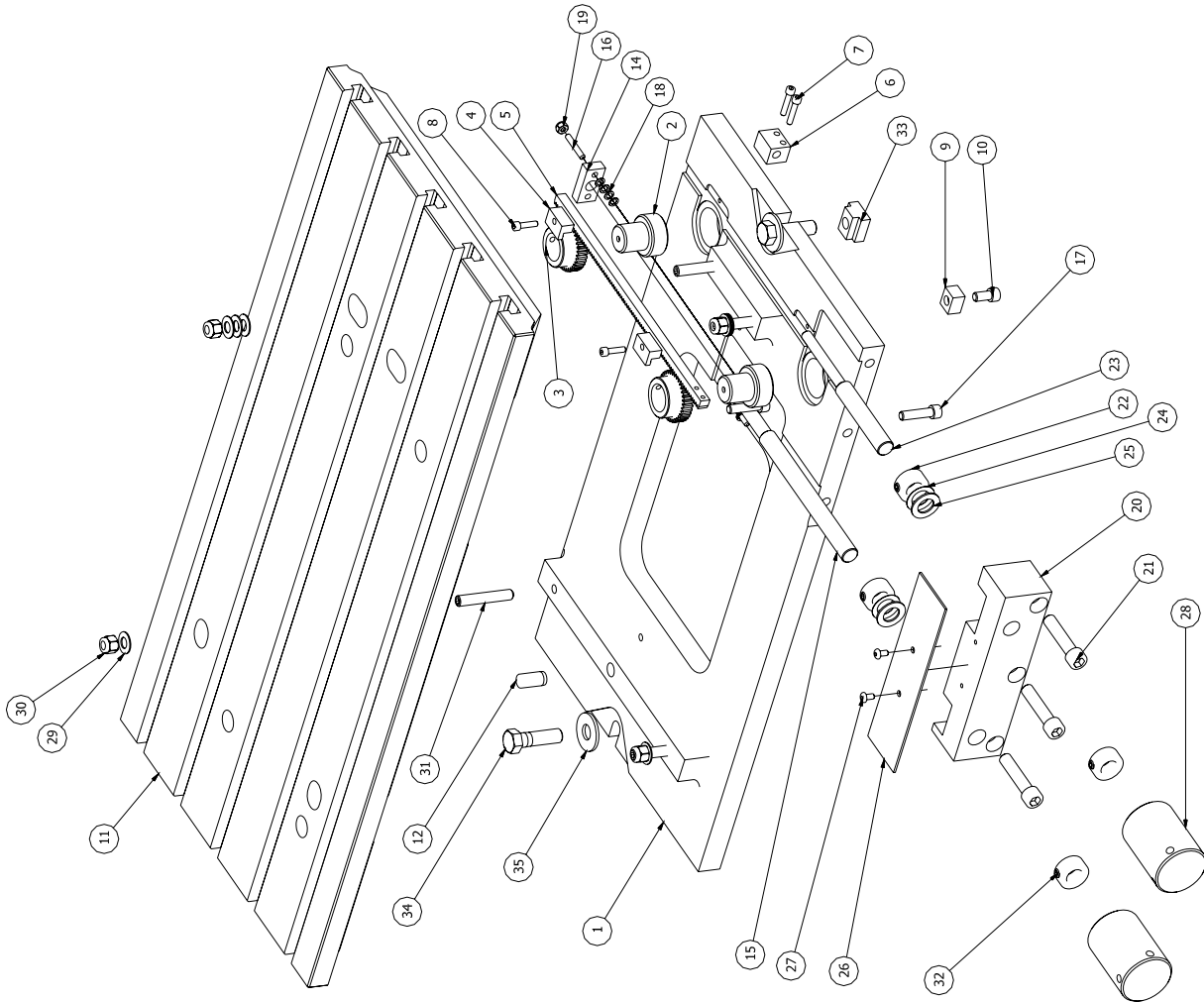


502-37-72H V6 / V8 Manual Fixture Assembly:

REFIXTUR75-110397



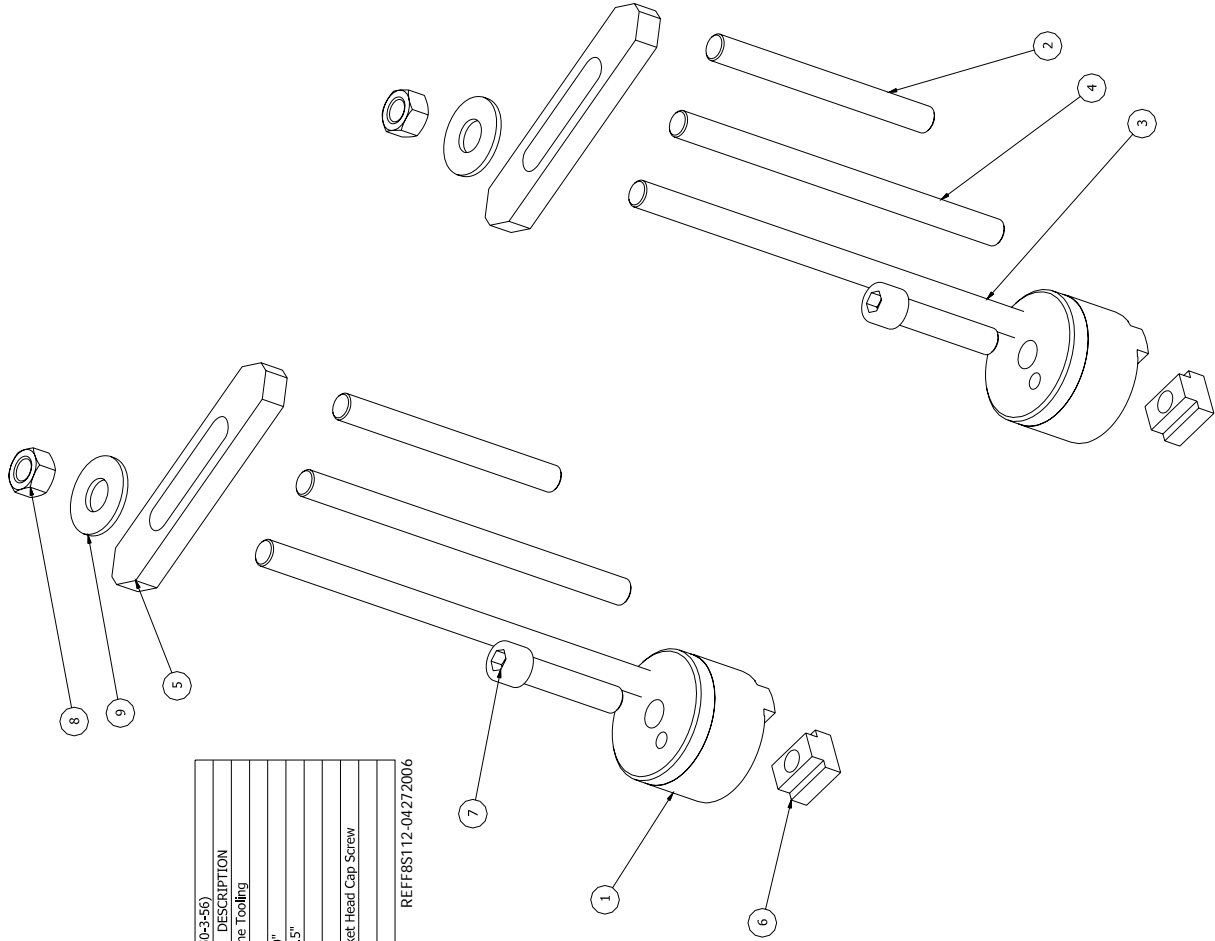
650-3-56 Line Bore Pivot Table



ITEM	QTY	650-3-56 Parts List - Line Bore Pivot Table PART NUMBER	DESCRIPTION
1	1	650-3-56C	Lower Plate, Pivot Table
2	2	650-3-56D	Jack Screw, Pivot Table
3	2	650-3-56F	Gear, Pivot Table
4	2	650-3-56K	Retainer, Rack Pivot Table
5	1	650-3-56V	Rack, Pivot Table
6	1	MF-6A ANSI B18.3 - No. 10 - 24 - 1	Threaded Block, Gear Rack
7	2	ANSI B18.3 - No. 10 - 24 - 3/4	Hexagon Socket Head Cap Screw
8	2	650-3-9	Hexagon Socket Head Cap Screw
9	2	MF-21 ANSI B18.3 - 5/16 - 18 - 5/8	Key
10	2	650-3-56A	Hexagon Socket Head Cap Screw
11	1	MF-213B ANSI B18.8.2 - 1/2 x 1	Table Top, Pivot Table
12	1	650-3-56N	Pin - Hardened Ground Machine Dowel
13	1	650-3-56N	Threaded Block, Rotate Adjust
14	1	650-3-56R	Lock Plate, Rotate Adjust
15	1	650-2-29D	Shaft, Rotate Adjust
16	2	MF-57A ANSI B18.3 - 10-24 UNC x 1.25	Hexagon Socket Set Screw - Cup Point
17	2	MF-24 ANSI B18.3 - 5/16 - 18 - 1 1/4	Hexagon Socket Head Cap Screw
18	8	650-3-56Q	Spring, Belleville Rotate Adjust
19	2	MF-1868	NYlock Nut - 10-24
20	1	650-3-56L	Control Block, Handwheel, Pivot Table
21	3	MF-40A ANSI B18.3 - 7/16 - 14 - 2	Hexagon Socket Head Cap Screw
22	4	7199E	Collar, Support Block
23	1	650-3-56U	Shaft, Lift Adjust
24	2	650-3-56S	Belleville spring Rold BDB-65
25	2	514-7-20	Washer, Thrust
26	1	650-3-56T	Chip Shield, Control Block
27	2	MF-88 ANSI B18.3 - 10 - 24 x 3/8	Hexagon Socket Button Head Cap Screw
28	2	650-2-29E	Handle, Pivot Table
29	8	650-2-28P	Washer, Belleville
30	4	MF-187B	NYlock Nut 3/16-18
31	4	MF-75B	Socket Set Screw Flat Point 3/8-16 x 2 1/4
32	4	ANSI B18.3 - 5/16-18 UNC x 0.31	Hexagon Socket Set Screw - Cup Point
33	2	650-3-10	TH-5 T-NUT
34	2	MF-149BANSI/ASME B18.2.1 - 1/2-13 UNC - 1.75	Hex Bolt - UNC (Regular Thread - Inch)
35	2	MF-180	1/2" FLAT WASHER

REF8S111-04272006

650-3-57 In Line Tooling Package (included w/ 650-3-56)



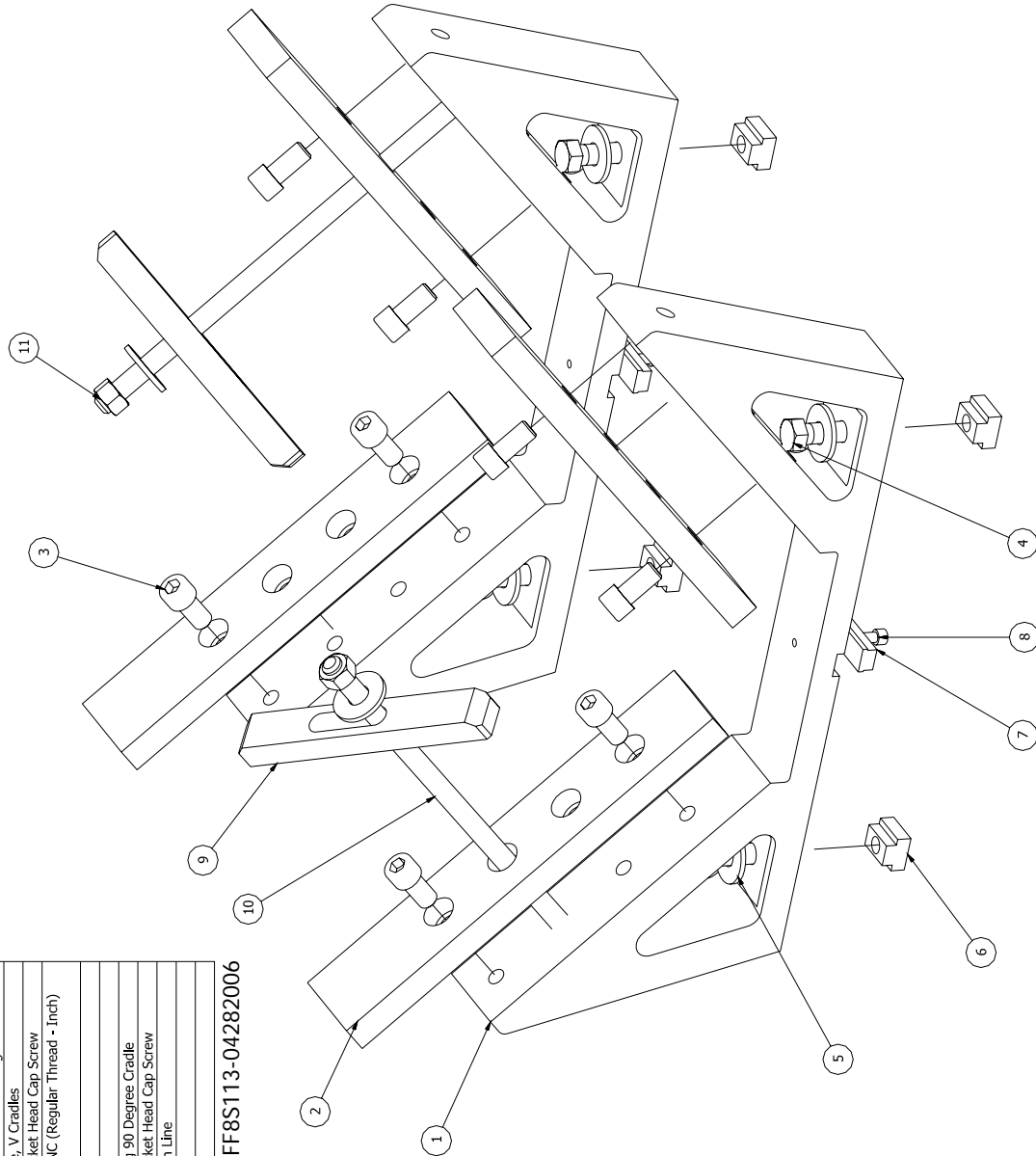
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	650-3-57A	Locator, In Line Tooling
2	2	650-3-57C	Clamp Rod 5"
3	2	650-3-57G	Clamp Rod 10"
4	2	650-3-57H	Clamp Rod, 7.5"
5	2	650-3-57B	Clamp Bar
6	2	7137B	T-Nut
7	2	MF-41C ANSI B18.3 - 1/2 - 13 - 2 1/4	Hexagon Socket Head Cap Screw
8	2	MF-165 ANSI B18.2.2 - 1/2 - 13	Hex Nut
9	2	MF-180 ANSI B18.22.1 - 9/16 - wide - Type A	Washer A

REFFS112-04272006

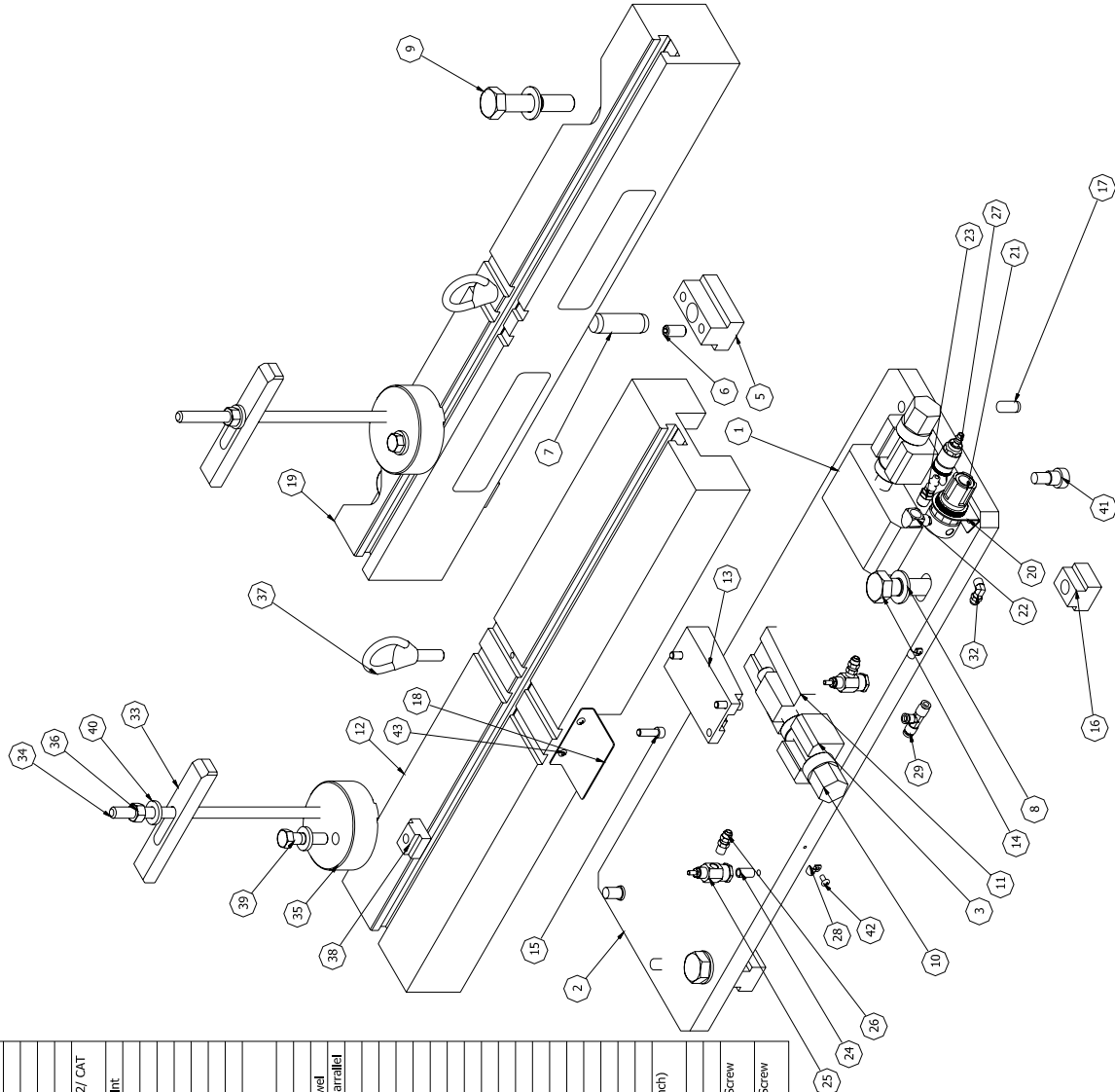
650-3-57J Supports – 90 Degree (included w/ 650-3-56)

ITEM	QTY	650-3-57J PART NUMBER	DESCRIPTION
1	2	6843A	Cradle, Right and Left 90 Degree
2	4	6789D	Adapter Plate, V Cradles
3	8	MF-42 ANSI B18.3 - 1/2 - 13 - 1	Hexagon Socket Head Cap Screw
4	4	MF-150A ANSI/ASME B18.2.1 - 1/2-13 UNC - 1.5	Hex Bolt - UNC (Regular Thread - Inch)
5	6	MF-180	Washer 1/2"
6	4	7137B	T-Nut
7	2	650-3-9F	Key, Locating 90 Degree Cradle
8	2	MF-12 ANSI B18.3 - 1/4 - 20 - 1/2	Hexagon Socket Head Cap Screw
9	2	6833A	Clamp Bar, In Line
10	2	6833B	Clamp Rod
11	2	MF-165 ANSI B18.2.2 - 1/2 - 13	Hex Nut

REF8S113-04282006



6821 Adjustable Universal Line Boring Parallel Assembly



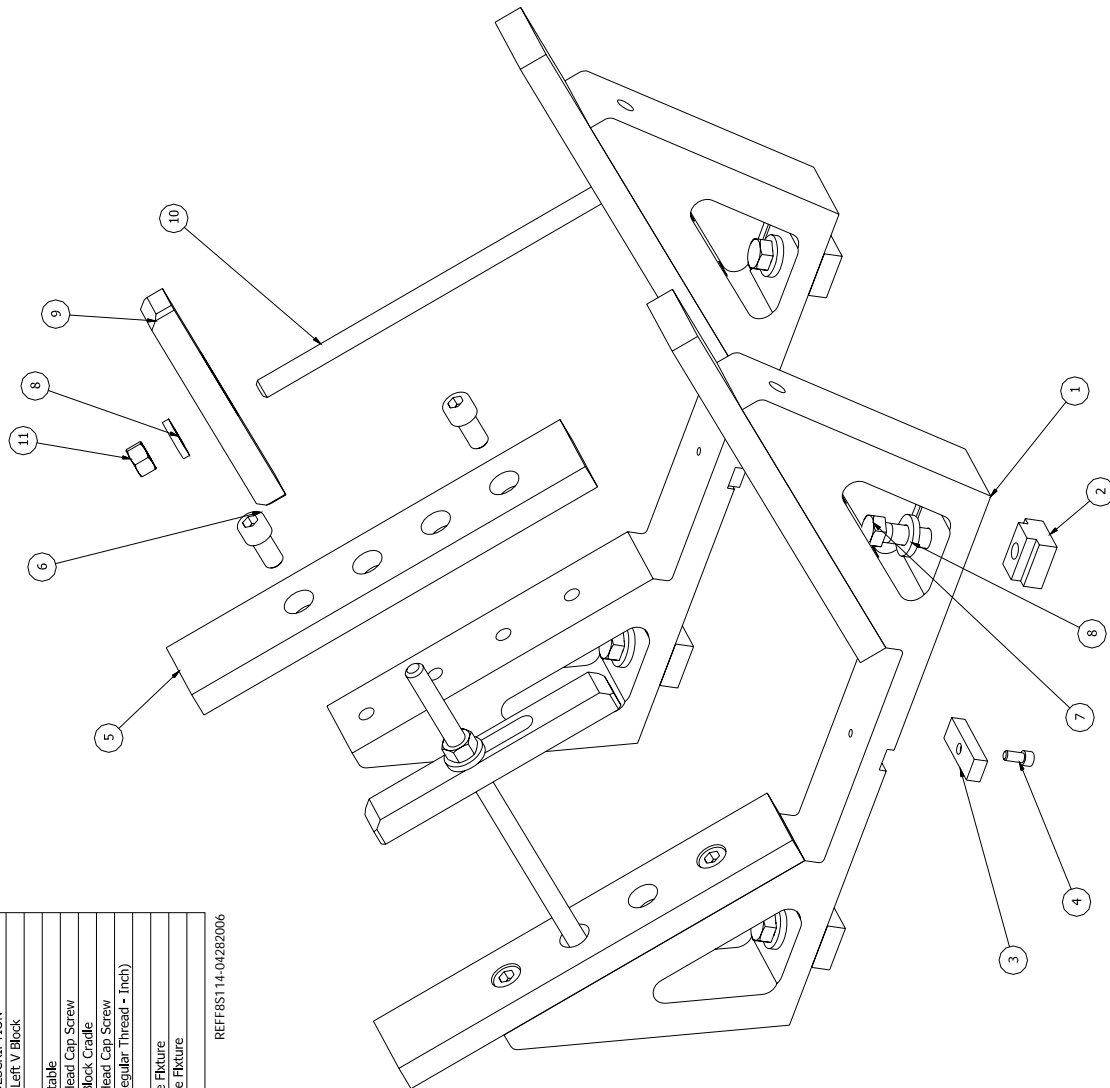
ITEM	QTY	6821 Parts List - Adjustable Parallel Assembly Line Bore Fixture	DESCRIPTION
1	1	6830	Block, Adjusting Adjustable Parallel
2	1	6825A	Plate, Lower Adjustable
3	2	6829	Bracket, Screw Adjustable
4	8	MF-43 ANSI B18.3 - 1/2 - 13 - 1 1/4	Hexagon Socket Head Cap Screw
5	1	6820	Locating Pinpoint Key, Waukesha 7042/ CAT 399
6	2	MF-72 ANSI B18.3 - 1/2-13 UNC x 1	Hexagon Socket Set Screw - Flat Point
7	1	6819	Locating, Pinot Pin
8	4	6287	Washer - 3/4"
9	2	6822B	Hex Bolt - 3/4-10 x 4 UNC
10	2	6828	Screw Adjustable Parallel
11	1	6827	Wedge, Lower Adjustable Parallel
12	1	6824A	Pad, Upper Adjustable Parallel
13	1	6826	Wedge, Upper Adjustable Parallel
14	2	MF-154C ANSI B18.2.1 - 3/4-10 UNC - 2,5	Hex Bolt
15	3	MF-23 ANSI B18.3 - 5/16 - 18 - 1	Hexagon Socket Head Cap Screw
16	4	6160	Nut, T - Hardened
17	2	MF-213B ANSI B18.8.2 - 1/2 x 1	Pin - Hardened Ground Machine Dowel
18	1	6834	Chip Shield, Upper Pad Adjustable Parallel
19	1	6822A	Parallel, Stationary Adjustable
20	1	502-27-17A	Regulator Bracket
21	1	502-27-17	Regulator 0 - 60 PSI
22	1	502-11-17S	1/4 STREET ELL
23	1	502-11-16X	Quick Connect air Fitting Male
24	2	502-11-17J	Nipple, Close 1/8" NPT
25	2	502-11-35A	Flx Control
26	2	502-11-16E	Connector, Male 1/4 x 1/8 PT
27	1	502-11-16W	Quick connect air fitting female
28	2	502-12-16	Clip, Hose
29	1	514-4-17N	Tee, Union 1/4 Tube
30	1	502-11-16I	Elbow, Male 1/4 FPT x 1/8 PT
31	2	6833A	Clamp Bar, In Line
32	2	6833B	Clamp rod, In Line
33	2	6833	Locator, In-Line Block
34	2	MF-165 ANSI B18.2.2 - 1/2 - 13	Hex Nut
35	2	502-3-13	LR Eye
36	2	MF-149C ANSI/ASME B18.2.1 - 1/2-13 UNC - 2	Hex Bolt - UNC (Regular Thread - Inch)
37	2	502-1-11B	Washer A
38	2	514-7-22	Screw, Shoulder
39	2	MF-180 ASTM F436 - 1/2	Cross Recessed Pan Head Machine Screw
40	4	MF-111 ANSI B18.6.3 - No. 10 - 24 - 3/8	Cross Recessed Pan Head Machine Screw
41	2	MF-110 ANSI B18.6.3 - No. 10 - 24 - 1/2	Cross Recessed Pan Head Machine Screw

REFERS110-6127-2006

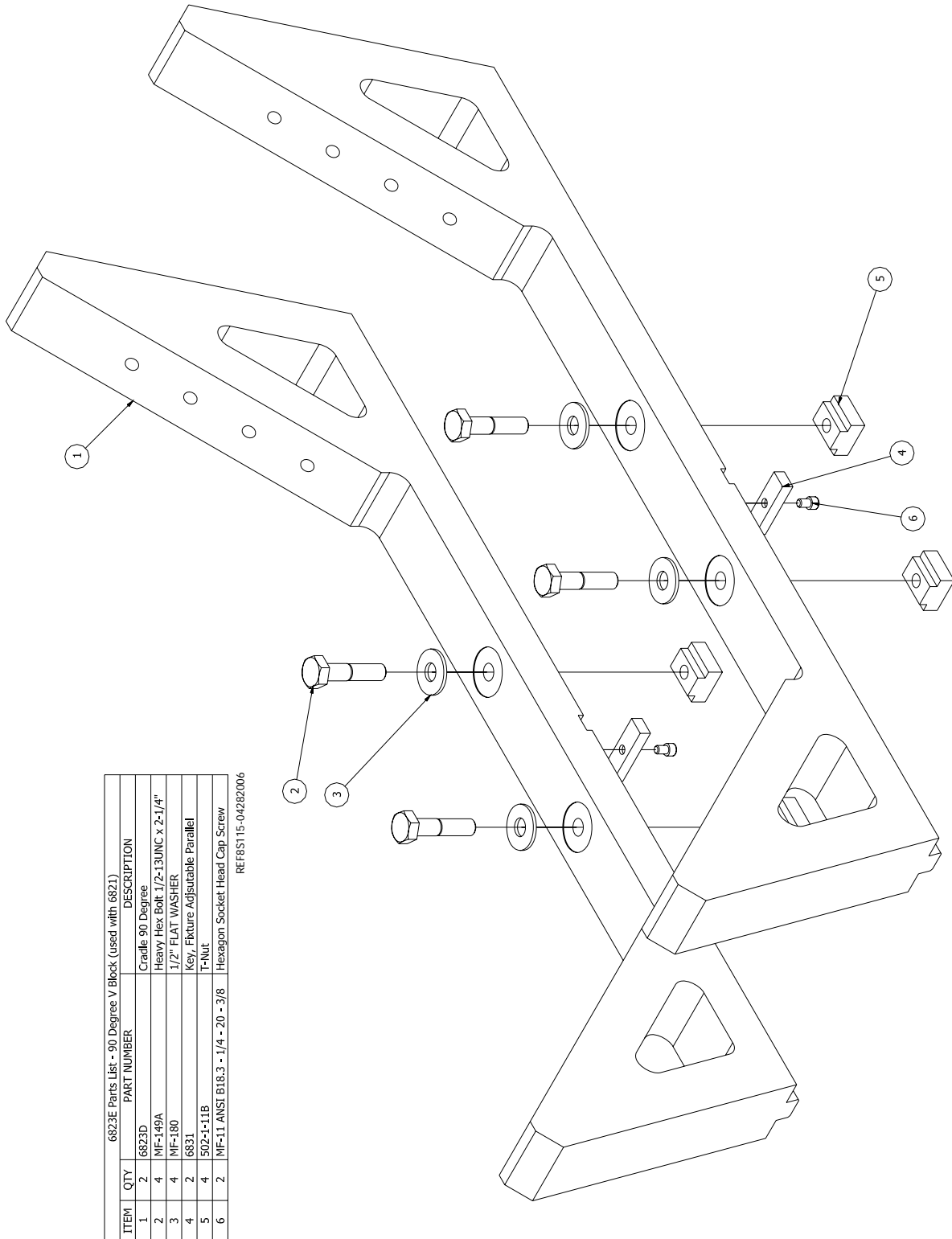
6843 Support V Block 90 Degree – Use with 6821 (F88) and 6843 (F84/85)

ITEM	QTY	6843 Parts List - Supports V Block 90 Degree PART NUMBER	DESCRIPTION
1	2	6843A	Cradle, Right and Left V Block
2	4	502-1-11B	T Nut
3	2	6831	Key, fixture Adjustable
4	2	MF-12 ANSI B18.3 - 1/4 - 20 UNC - 1/2	Hexagon Socket Head Cap Screw
5	4	6789D	Adapter Plate V Block Cradle
6	8	MF-42 ANSI B18.3 - 1/2 - 13 UNC - 1	Hexagon Socket Head Cap Screw
7	4	MF-140A ANSI/ASME B18.2.1 - 1/2-13 UNC - 1.5	Hex Bolt - UNC (Regular Thread - Inch)
8	6	MF-180 ASTM F436 - 1/2	Washer 1/2"
9	2	6833A	Clamp Bar, In Line Fixture
10	2	6833B	Clamp Rod, In Line Fixture
11	2	MF-165 ANSI B18.2.2 - 1/2 - 13	Hex Nut

REFFBST14-04282006



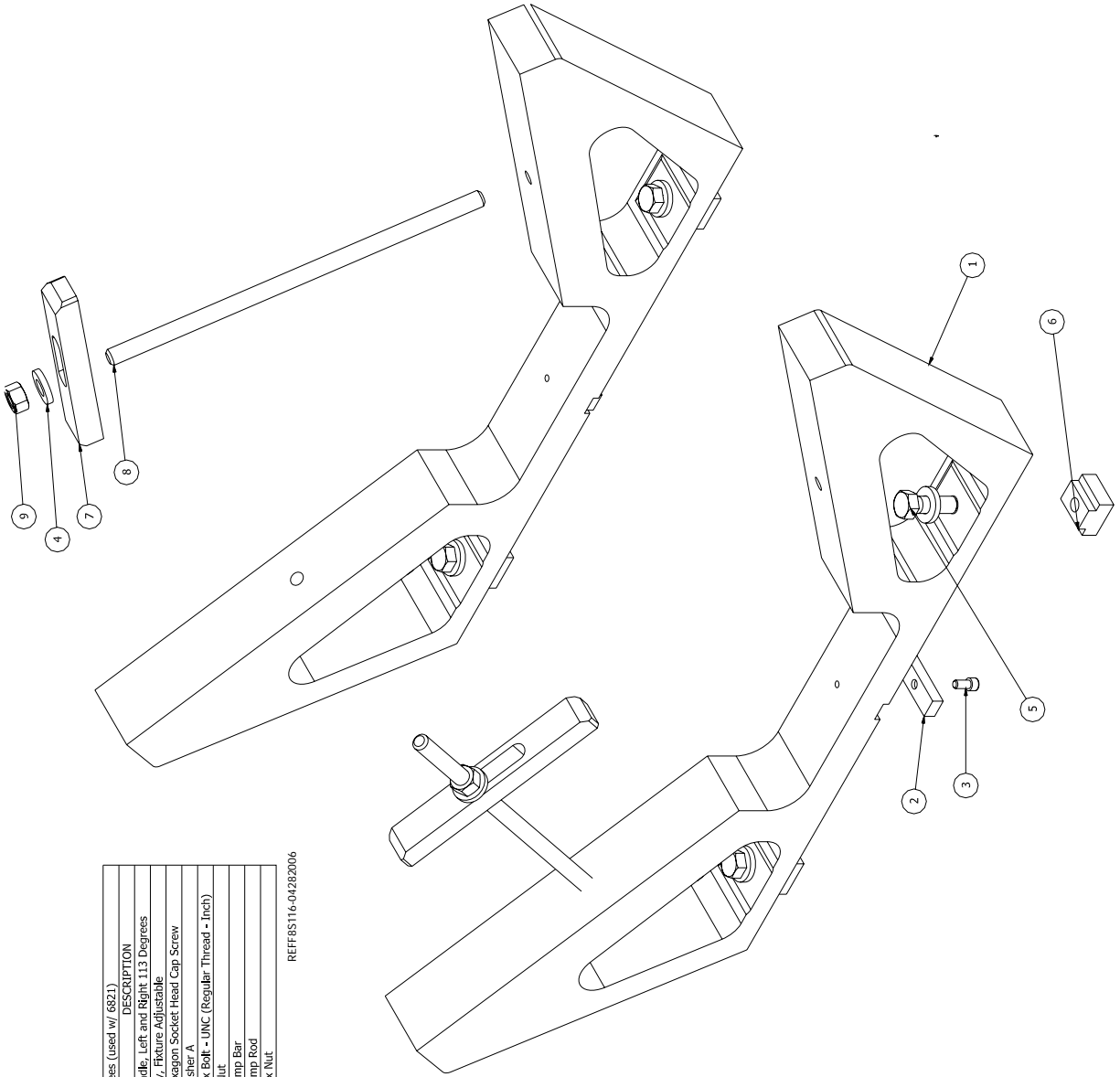
6823E 90 Degree V Block (used w/ 6821)



ITEM	QTY	6823E Parts List - 90 Degree V Block (used with 6821)	DESCRIPTION
1	2	6823D	Cradle 90 Degree
2	4	MF-149A	Heavy Hex Bolt 1/2-13UNC X 2-1/4"
3	4	MF-180	1/2" FLAT WASHER
4	2	6831	Key, Fixture Adjustable Parallel
5	4	502-1-11B	T-Nut
6	2	MF-11 ANST B18.3 - 1/4 - 20 - 3/8	Hexagon Socket Head Cap Screw

REF85115-04282006

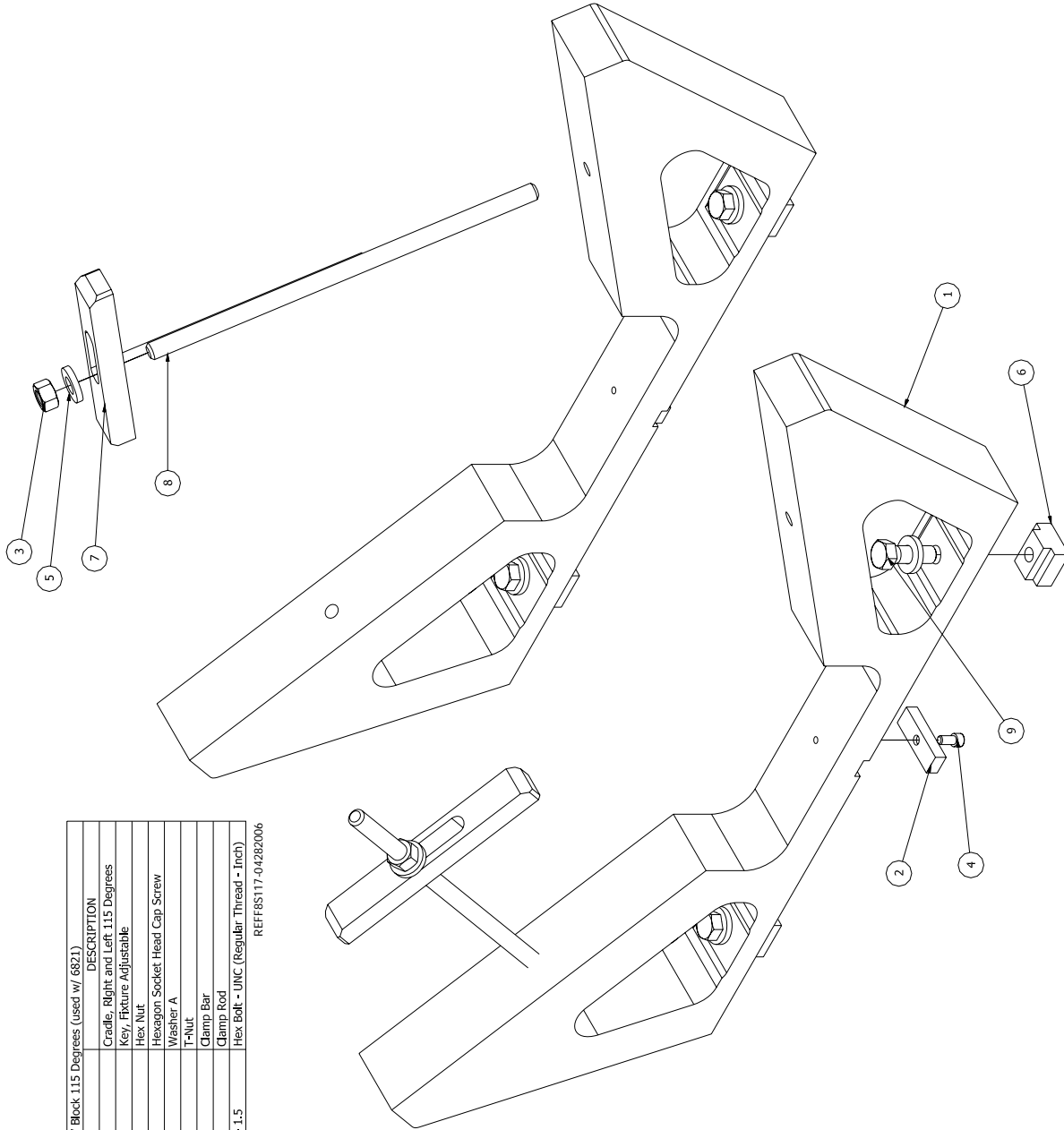
6789L Support, V Block 113 Degrees (used w/ 6821)



ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	6789M	Cradle, Left and Right 113 Degrees
2	2	6831	Key, Fixture Adjustable
3	2	MF-12 ANSI B18.3 - 1/4 - 20 UNC - 1/2	Hexadon Socket Head Cap Screw
4	6	MF-180 ASTM F436 - 1/2	Washer A
5	4	MF-150A ANSI/ASME B18.2.1 - 1/2-13 UNC - 1.5	Hex Bolt - UNC (Regular Thread - Inch)
6	4	502-1-11B	T-Nut
7	2	6833A	Clamp Bar
8	2	6833B	Clamp Rod
9	2	MF-165 ANSI B18.2.2 - 1/2 - 13	Hex Nut

REF85116-04282006

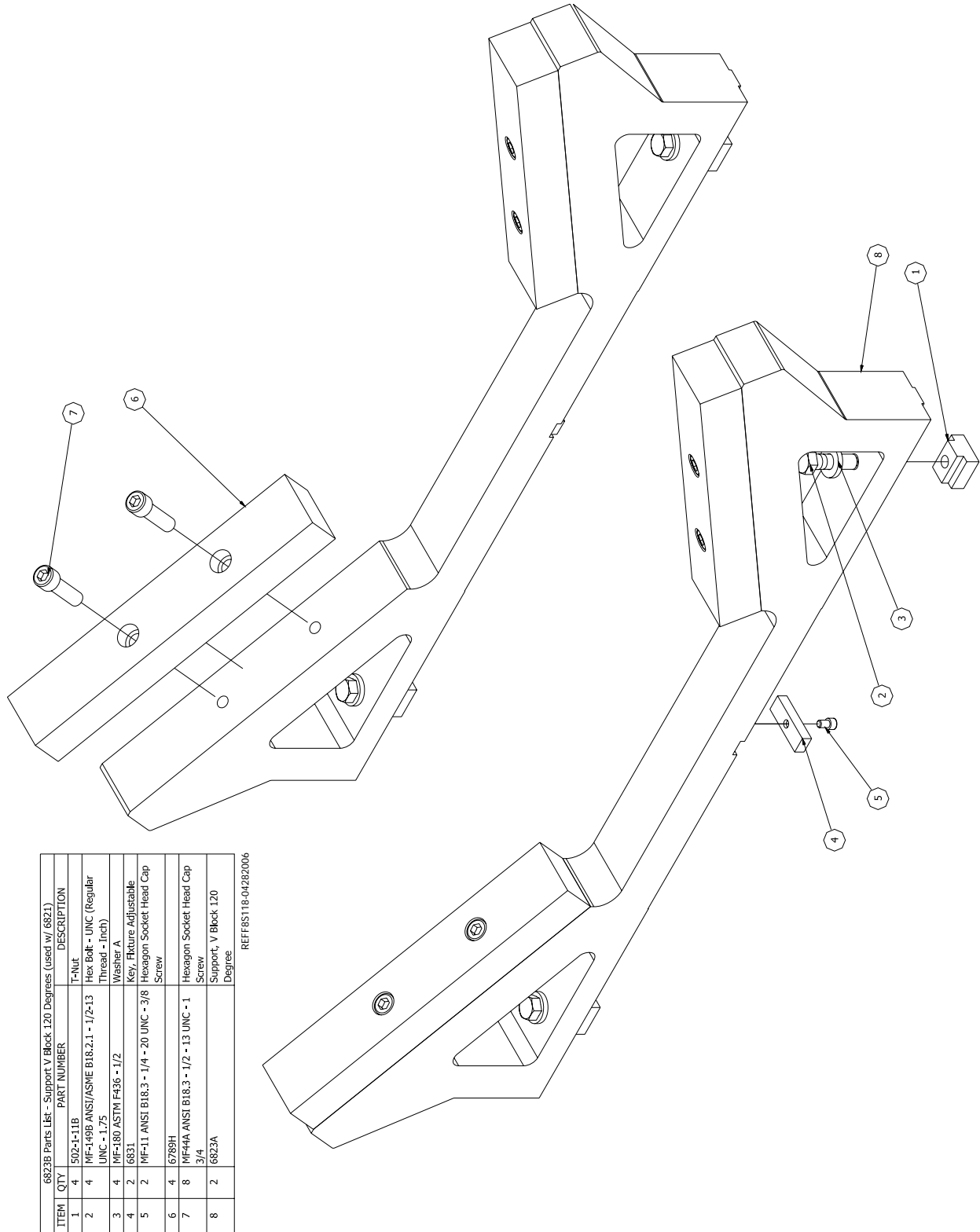
6789E Support V Block 115 Degrees (used w/ 6821)



6789E Parts List - Support V Block 115 Degrees (used w/ 6821)		DESCRIPTION
ITEM	QTY	PART NUMBER
1	2	6789F Cradle, Right and Left 115 Degrees
2	2	6831 Key, Fixture Adjustable
3	2	ANSI B18.2.2 - 1/2 - 13 Hex Nut
4	2	ANSI B18.3 - 1/4 - 20 UNC - 1/2 Hexagon Socket Head Cap Screw
5	6	ASTM F436 - 1/2 Washer A
6	4	502-1-11B T-Nut
7	2	6833A Clamp Bar
8	2	6833B Clamp Rod
9	4	ANSI/ASME B18.2.1 - 1/2-13 UNC - 1.5 Hex Bolt - UNC (Regular Thread - Inch)

REF85117-04282006

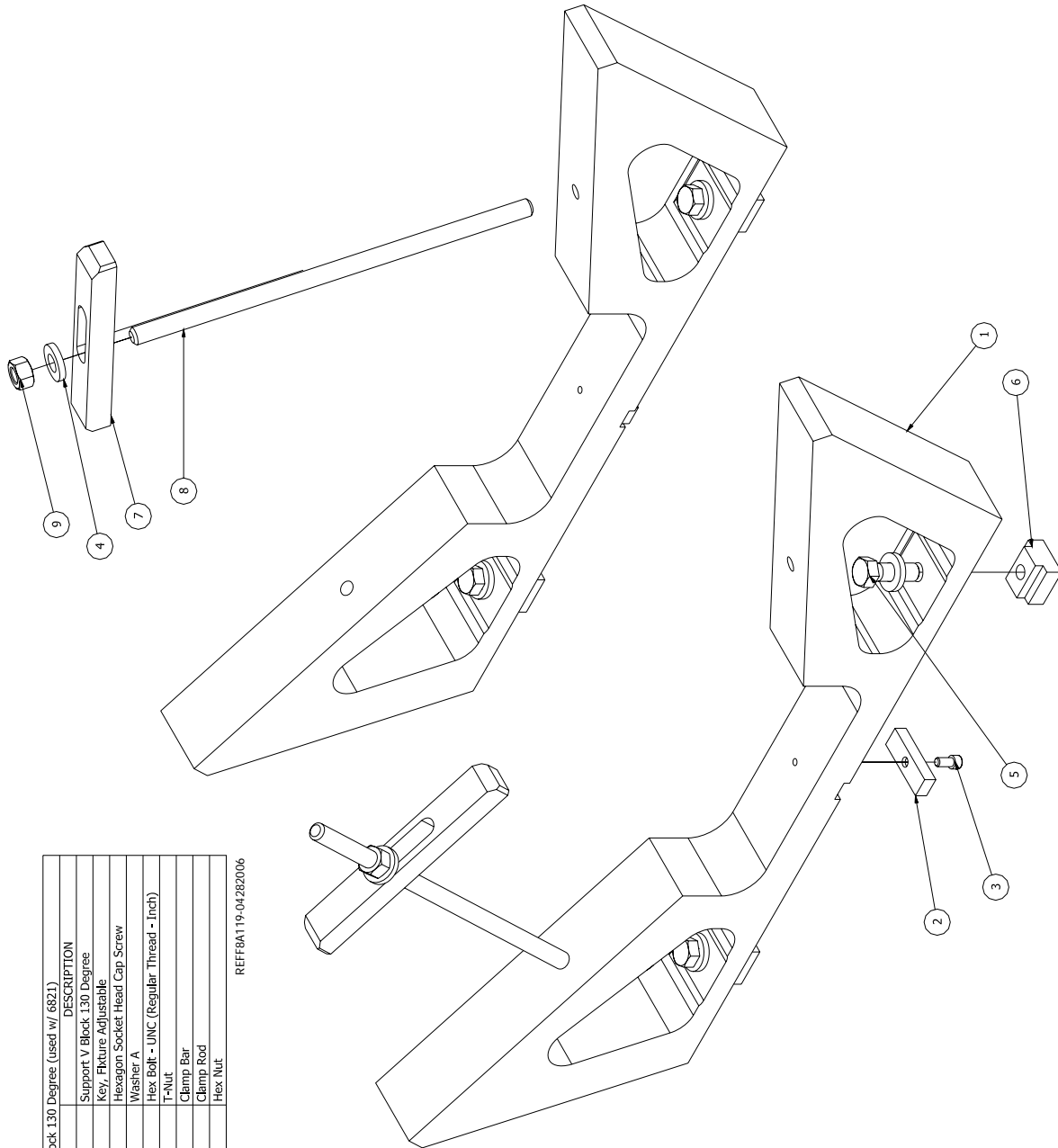
6823B Support, V Block 120 Degrees (used w/ 6821)



ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	502-1-11B	T-Nut
2	4	MF-149B ANSI/ASME B18.2.1 - 1/2-13 UNC - 1.25	Hex Bolt - UNC (Regular Thread - Inch)
3	4	MF-180 ASTM F436 - 1/2	Washer A
4	2	6831	Key, Fixture Adjustable
5	2	MF-11 ANSI B18.3 - 1/4 - 20 UNC - 3/8	Hexagon Socket Head Cap Screw
6	4	6789H	Hexagon Socket Head Cap Screw
7	8	MF44A ANSI B18.3 - 1/2 - 13 UNC - 1 3/4	Support, V Block, 120 Degree
8	2	6823A	

REF F818-04282006

6789K Support V Block 130 Degrees (used w/ 6821)



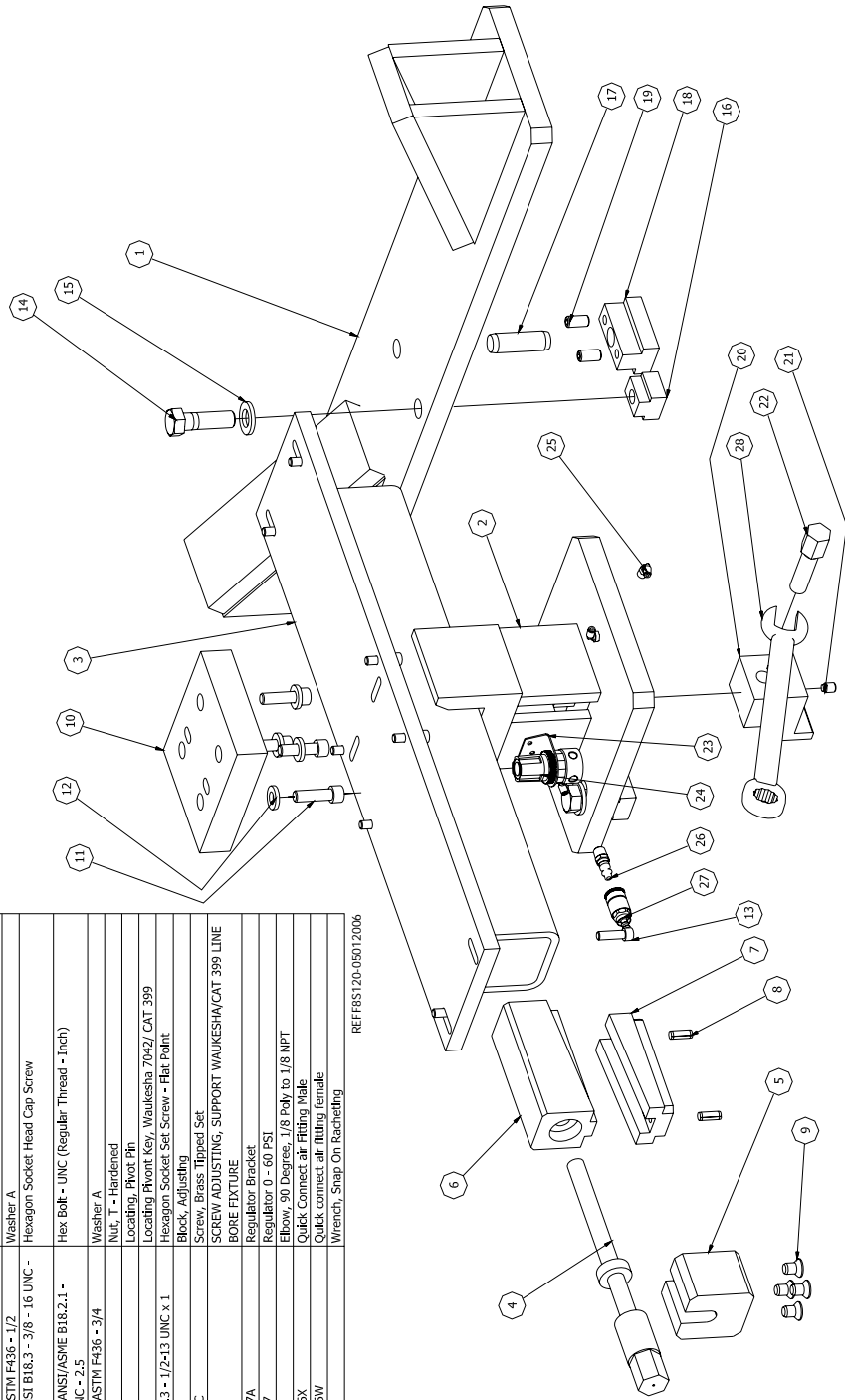
ITEM	QTY	6789K Parts List - Support, V Block 130 Degree (used w/ 6821)	DESCRIPTION
1	2	6789J	Support V Block 130 Degree
2	2	6831	Key Fixture Adjustable
3	2	ANSI B18.3 - 1/4 - 20 UNC - 1/2	Hexagon Socket Head Cap Screw
4	6	ASTM F436 - 1/2	Washer A
5	4	ANSI/ASME B18.2.1 - 1/2-13 UNC - 1.5	Hex Bolt - UNC (Regular Thread - Inch)
6	4	502-1-11B	T-Nut
7	2	6833A	Clamp Bar
8	2	6833B	Clamp Rod
9	2	ANSI B18.2.2 - 1/2 - 13	Hex Nut

REFFBAT19-04282006

6810 – Waukesha 7042, 9360 and CAT 379, 398, 399 Line Bore Fixture

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6811B	Cradle, Waukesha, CAT 399
2	1	6812D	Support, Waukesha, CAT 399
3	1	6813	TUBE ASSEMBLY, ADJUSTABLE WAUKESHA/CAT 399 LINE BORE FIXTURE
4	1	6508	SCREW LEVELING, SUPPORT WAUKESHA/CAT 399 LINE BORE FIXTURE
5	1	6409	BRACKET LEVELING, SUPPORT WAUKESHA/CAT 399 LINE BORE FIXTURE
6	1	6410	PAD, UPPER LEVELING, SUPPORT WAUKESHA/CAT 399 LINE BORE FIXTURE
7	1	6411	PAD, LOWER LEVELING, SUPPORT WAUKESHA/CAT 399 LINE BORE FIXTURE
8	2	MF-229B ANSI B18.8.2 - 3/8 x 1 Standard Duty	Pin - Coiled Spring
9	4	6409A ANSI B18.3 - 1/2-13 UNC x 0.75	Hexagon Socket Flat Countersunk Head Cap Screw
10	1	6813C	Adapter, Waukesha 7042, CAT 399 Line Bore Fixture
11	4	MF-44A ANSI B18.3 - 1/2 - 13 UNC - 1 3/4	Hexagon Socket Head Cap Screw
12	4	MF-180 ASTM F436 - 1/2	Washer A
13	8	MF-32 ANSI B18.3 - 3/8 - 16 UNC - 1 1/4	Hexagon Socket Head Cap Screw
14	5	MF-154C ANSI/ASME B18.2.1 - 3/4-10 UNC - 2.5	Hex Bolt - UNC (Regular Thread - Inch)
15	5	MF-181A ASTM F436 - 3/4	Washer A
16	5	6160	Nut, T - Hardened
17	1	6819	Locating, Photo Pin
18	1	6820	Locating, Photo Key, Waukesha 7042/ CAT 399
19	2	ANSI B18.3 - 1/2-13 UNC x 1	Hexagon Socket Set Screw - Flat Point
20	1	6814A	Block, Adjusting
21	1	50056-3C	Screw, Brass Tipped Set
22	1	6812E	SCREW ADJUSTING, SUPPORT WAUKESHA/CAT 399 LINE BORE FIXTURE
23	1	502-27-17A	Regulator Bracket
24	1	502-27-17	Regulator 0 - 60 PSI
25	4	514-4-18	Elbow, 90 Degree, 1/8 Poly to 1/8 NPT
26	1	502-11-16X	Quick Connect air Fitting Male
27	1	502-11-16W	Quick connect air Fitting Female
28	1	6812F	Wrench, Snap On Ratcheting

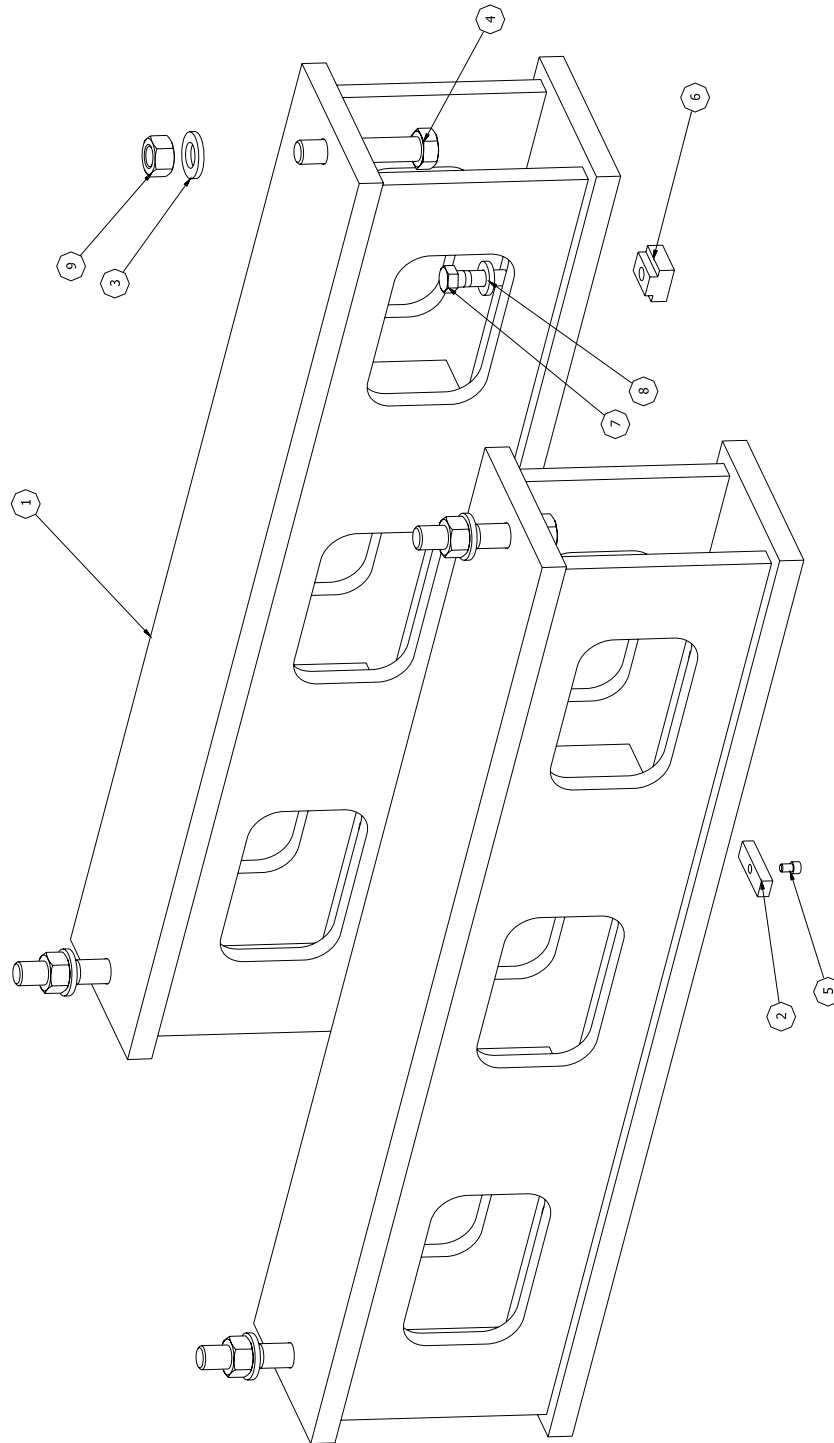
REFERS120-05012006



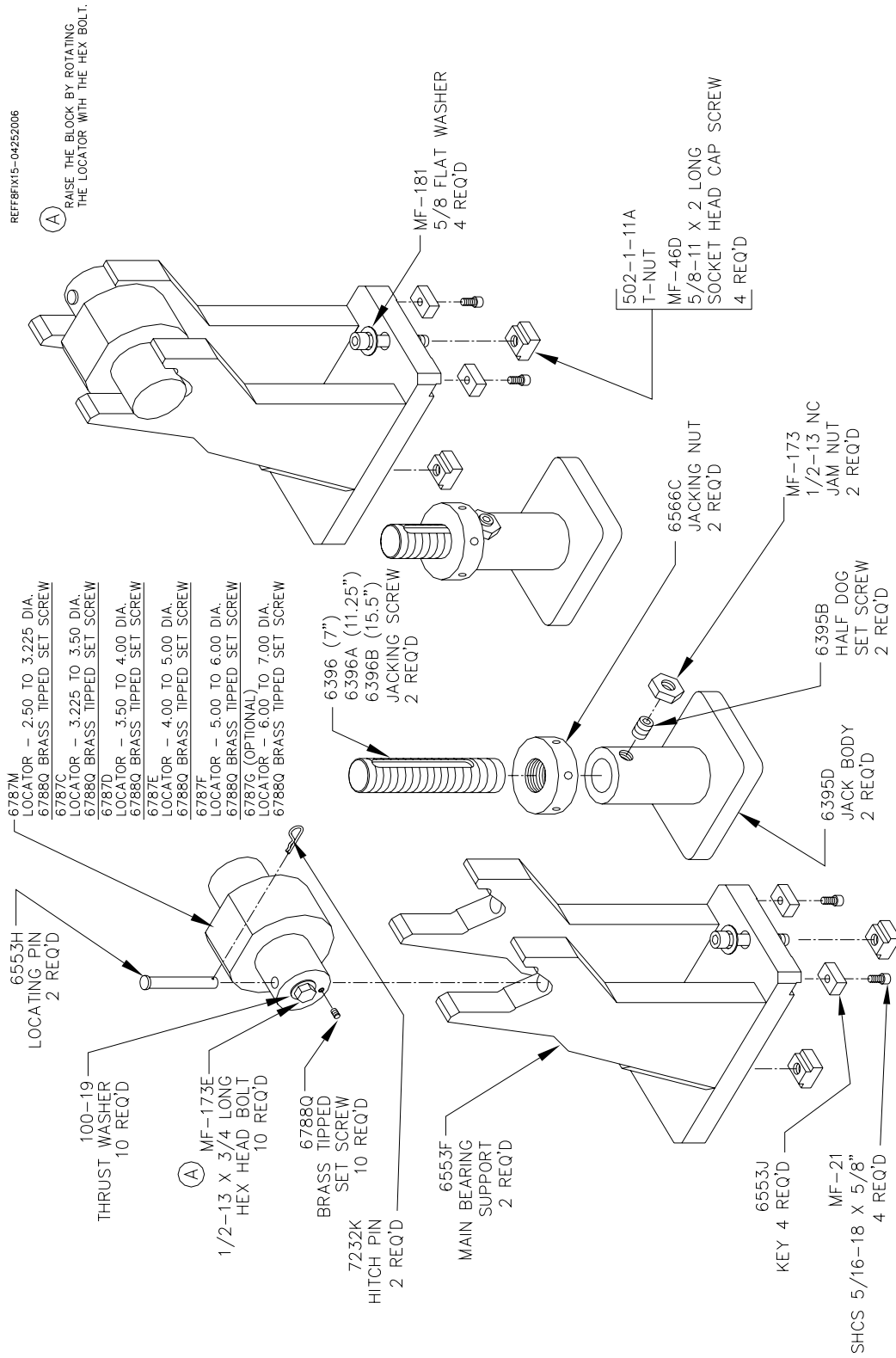
6815 White Superior 8G825 Line Bore Fixturing (used w/ 6821)

ITEM	QTY	6815 Parts List - White Superior 8G825 Line Bore Fixture	DESCRIPTION
1	2	6816A	Parallel, White Superior 8G825 Line Bore Fixture
2	2	6831	Key, Fixture Adjustable
3	8	MF-181A ASTM F436 - 3/4	Washer A
4	4	6822B ANSI/ASME B18.2.1 - 3/4-10 UNC - 4	Hex Bolt - UNC (Regular Thread - Inch)
5	2	MF-11 ANSI B18.3 - 1/4 - 20 UNC - 3/8	Hexagon Socket Head Cap Screw
6	4	502-1-11B	T-Nut
7	4	MF-149B ANSI/ASME B18.2.1 - 1/2-13 UNC - 1.75	Hex Bolt - UNC (Regular Thread - Inch)
8	4	MF-180 ASTM F436 - 1/2	Washer A
9	4	MF-166A ANSI B18.2.2 - 3/4 - 10	Hex Nut

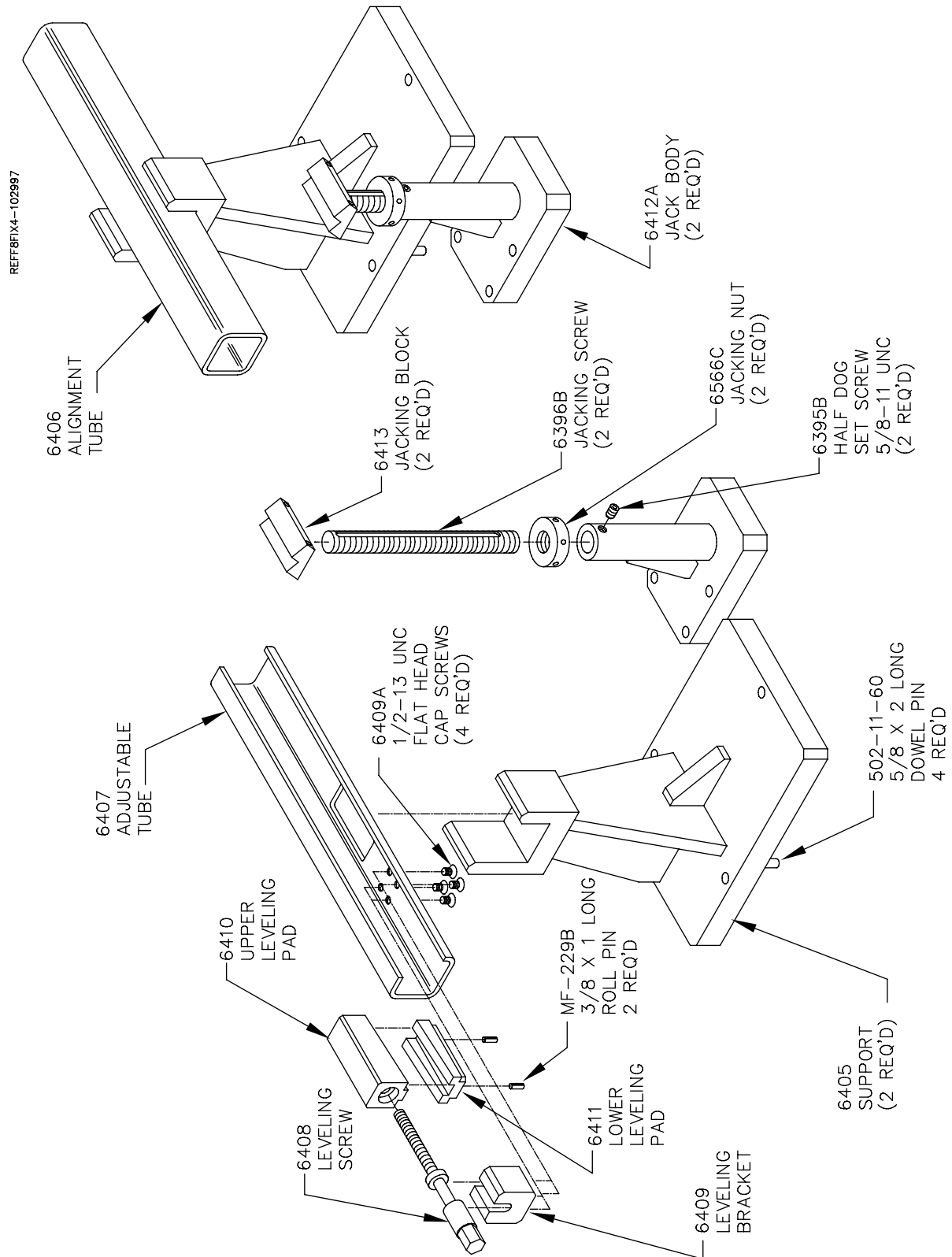
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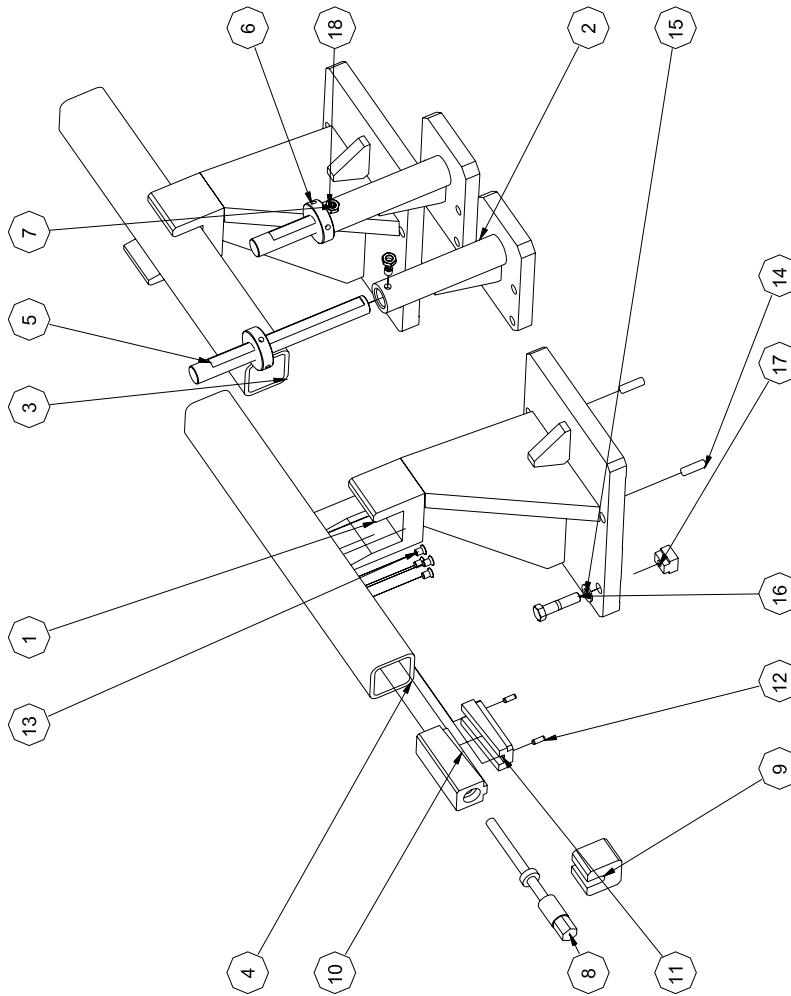
6725 Mid Range in-Line and V Block Fixture:



6405A Large V-Block Fixture:



6405E Large V Block Fixture MTU 4000 V16, V18 & V20

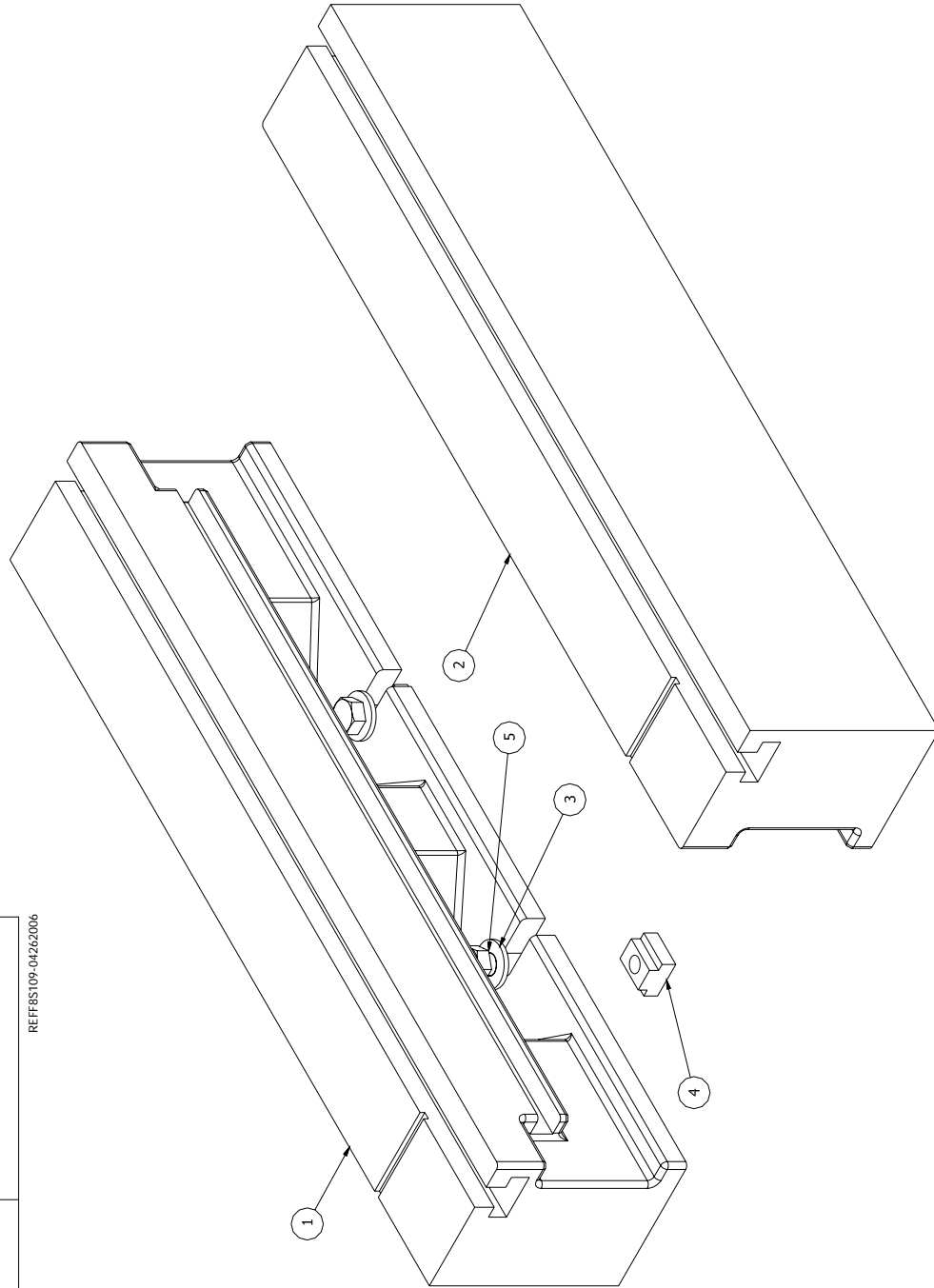


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	6405D	Main Support
2	2	6412A	Jack Body
3	1	6406	Tube-Alignment 4"
4	1	6407	Tube-Main Bearing Adjustable
5	2	6396B	Jacking Screw
6	2	6566C	Nut, Jacking
7	2	ANSI B18.3 - 5/8-11	Hexagon Socket Set Screw - Flat Point
8	1	6408	Screw, Leveling
9	1	6409	Bracket, Leveling
10	1	6410	Pad, Upper
11	1	6411	Pad Lower
12	2	ANSI B18.8.2 - 3/8 x 1	Pin - Collid Spring
13	4	ANSI B18.6.2 - 1/2-13	Slotted Flat Countersunk Head Cap Screw
14	4	502-11-60	5/8 - 2" Dowel Pin
15	1	ANSI B18.22.1 - 3/4 - narrow - Type A	Washer A
16	1	ANSI/ASME B18.2.1 - 3/4-10 UNC - 3.25	Hex Bolt - UNC (Regular Thread - Inch)
17	1	6160	T-Nut
18	2	ANSI B18.2.2 - 5/8 - 11	Hex Jam Nut

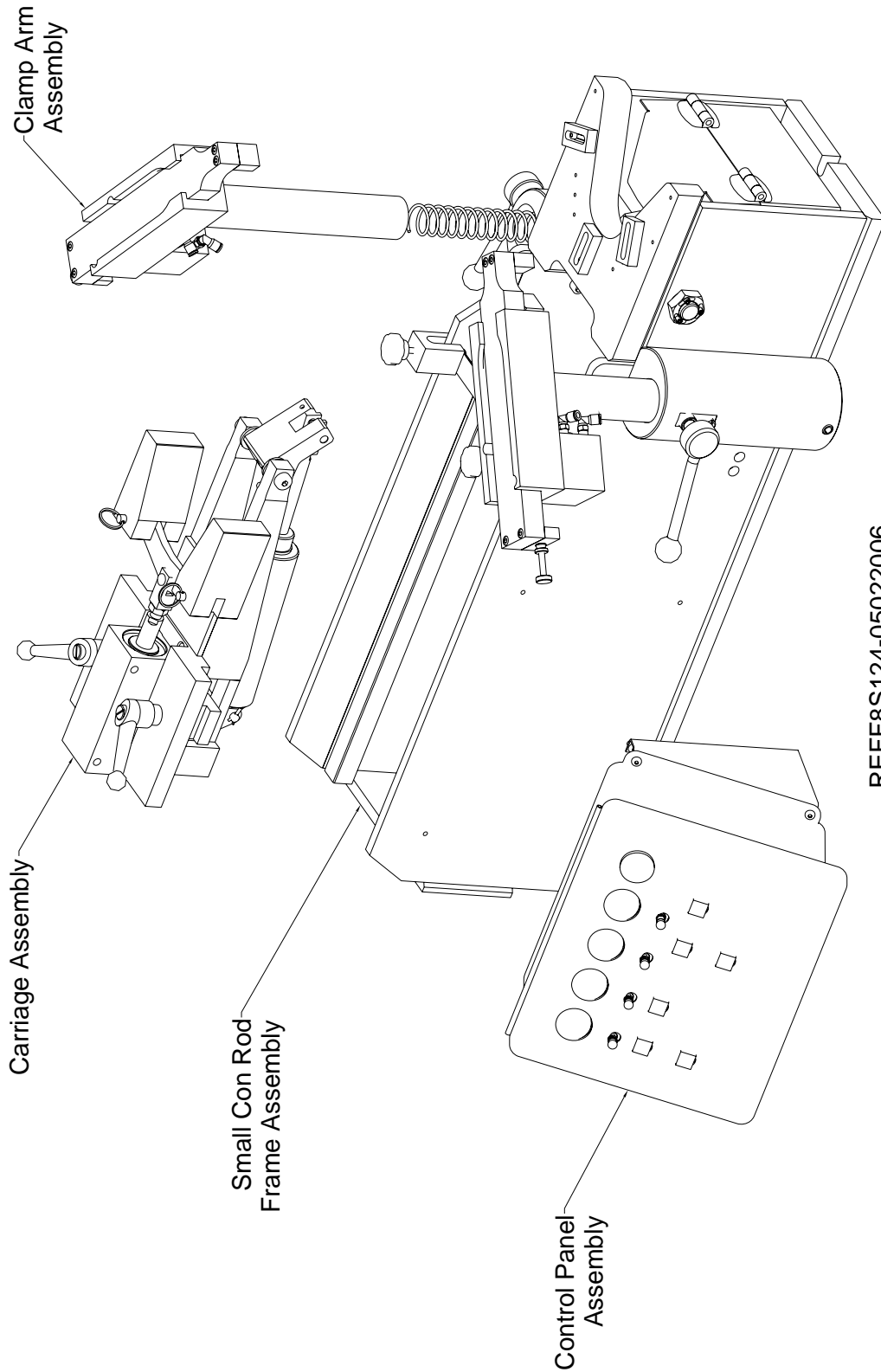
7219W 5.19" Parallel Assembly

7219W Parts List - 5.19" Parallels		
ITEM	QTY	DESCRIPTION
1	1	7219V Riser, 5.19" Left Hand
2	1	7219T Riser, 5.19" Right Hand
3	4	100-19A Hardened washer 17/32 I.D.
4	4	650-3-10 TN-5 T-Nut
5	4	MF-137A ANSI/ASME B18.2.1 - 1/2-13 Hex Bolt - UNC (Regular Thread - Inch)

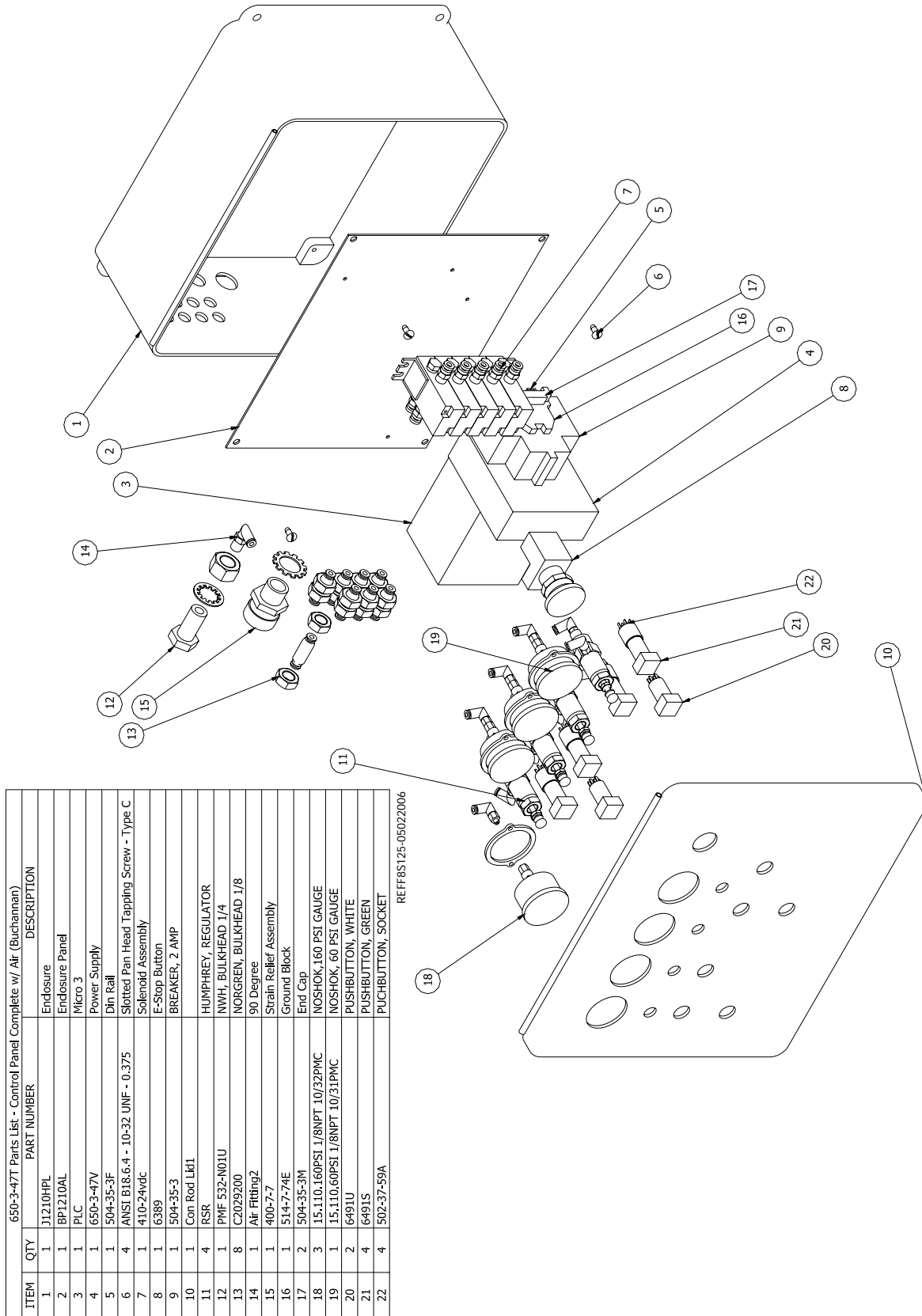
REFFBST109-04262006



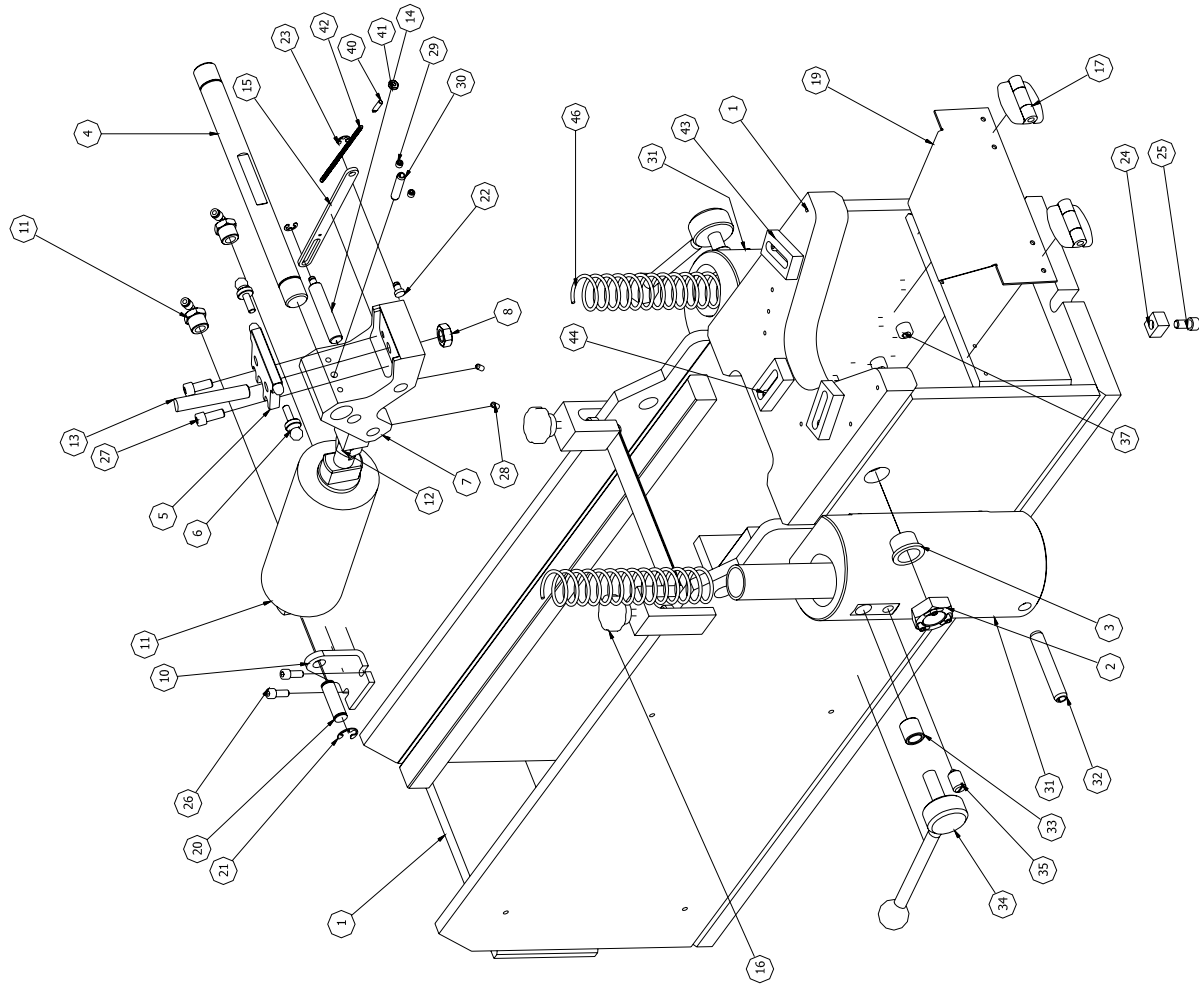
650-3-44R Small Precision Connecting Rod Fixture



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



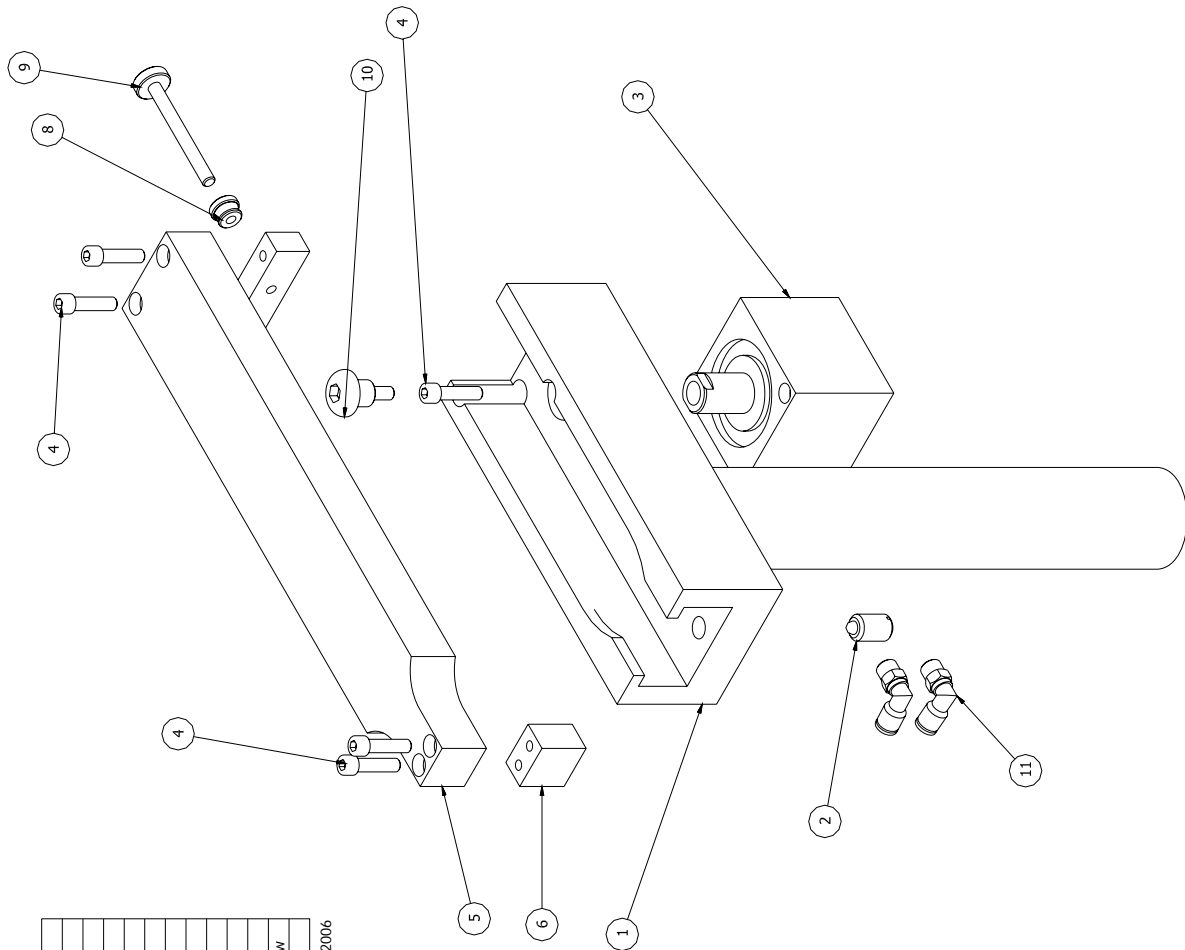
650-3-44R Small Precision Connecting Rod Fixture – Small Frame



Small Precision Connecting Rod Fixture Parts List		
ITEM	QTY	DESCRIPTION
1	1	Small Frame
2	2	Lock Nut REID BLN-105
3	2	Flange Bearing Symmco SF-2832-12
4	1	Pivot Shaft
5	1	Locator 1.78
6	2	Tooling Ball Reald #ITCB-26820
7	1	Locator Holder
8	1	Hex Jam Nut
9	1	Pivot Bracket Right
10	1	Pivot Bracket Left
11	1	Locating Cylinder
12	1	Rod Clevis
13	1	Stop Screw - Set 1/2-13 x 3
14	1	Pivot Pin
15	1	Linkage Arm
16	2	Support Strap
17	2	Hinge, Dust Cover
18	1	Locator Cover Con Rod Fixture
19	1	Included In 650-3-47J
20	1	Pin1
21	2	E. CLIP
22	1	Linkage Pin
23	1	E-clip - Truearc E-Ring #RE-25ST
24	2	Key
25	2	Hexagon Socket Head Cap Screw
26	4	Hexagon Socket Head Cap Screw
27	2	Hexagon Socket Head Cap Screw
28	2	Type B - Hexagon Socket Set Screw - Cup Point - UNC (Regular Thread - Inch)
29	2	Type B - Hexagon Socket Set Screw - Cup Point - UNC (Regular Thread - Inch)
30	1	Pin - Slotted Spring
31	2	Clamp Base, ConRod Clamp arms
32	2	Pin - Slotted Spring
33	2	Thread Insert
34	2	Handle
35	2	502-8-52C
37	8	Hexagon Socket Head Cap Screw
40	1	spring anchor Reald CSA-50
41	1	Hex Machine Screw Nut UNC
42	1	Extension Spring
43	3	Support Parallel
44	3	Hexagon Socket Head Cap Screw
45	2	Support Tube
46	2	Spring

REF8126-0502006

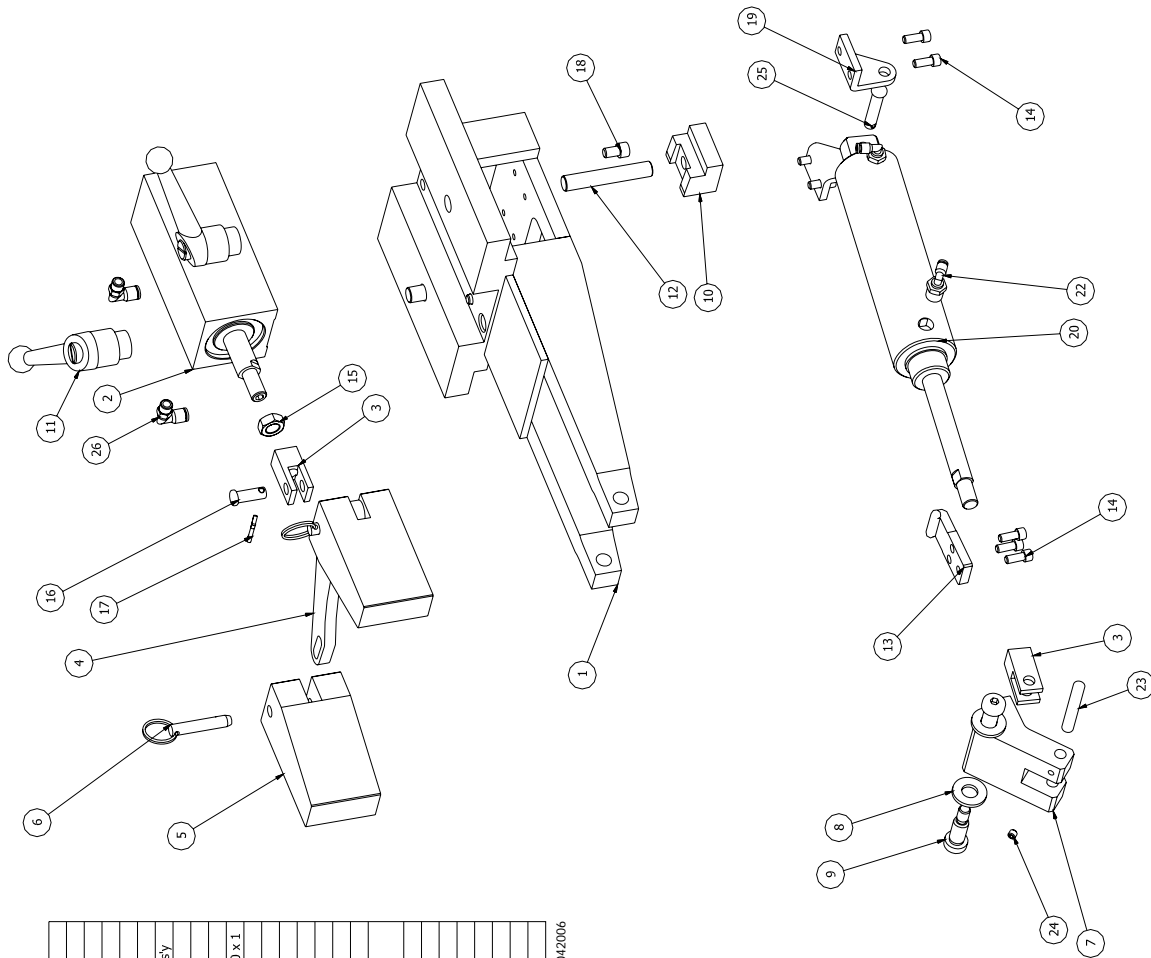
650-3-44R Small Precision Connecting Rod Fixture – Clamp Arm Assembly



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

REF8S127-05042006

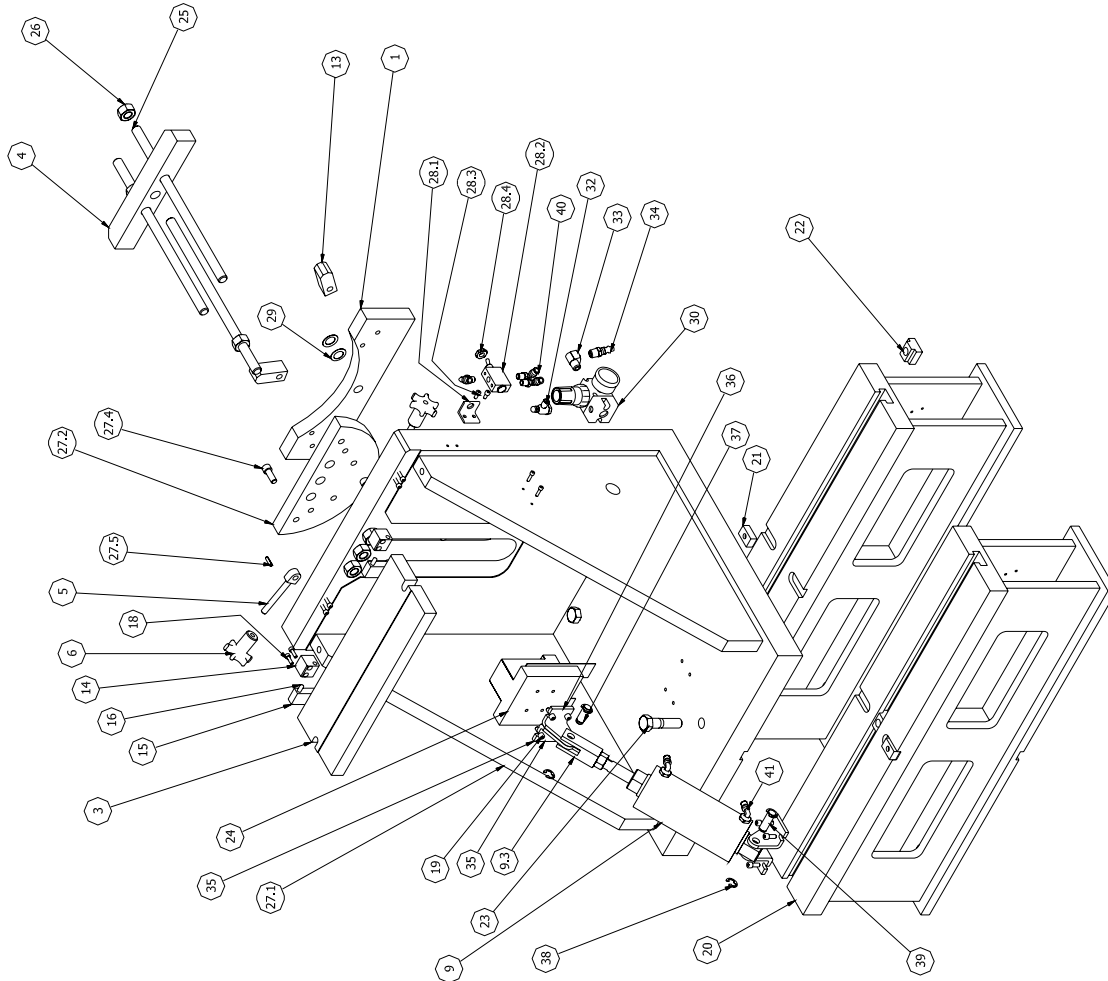
650-3-44R Small Precision Connecting Rod Fixture – Carriage Assembly



ITEM		QTY	PART NUMBER	DESCRIPTION
1	1	650-3-67	Carriage, Machining	
2	1	650-3-45D	Wedge Cylinder	
3	2	650-3-45L	Clevis	
4	1	650-3-48J	Linkage, Wedge	
5	2	650-3-48G	Wedge Clamp - Medium, Con-Rod Fixture ass'y	
6	2	650-3-48K	Release Pin, Clamp Wedge	
7	1	650-3-47D	Centering Lever	
8	2	100-19A	Hardened washer 17/32 I.D.	
9	2	650-4-45	Hexagon Socket Head Shoulder Screw 0.500 x 1	
10	2	650-3-48	Clamp Shoe	
11	2	514-2-39	Handle	
12	2	514-4-58	Stud	
13	1	650-3-47S	Centering Block - Medium Long	
14	7	MF-13 ANSI B18.3 - 1/4 - 20 - 5/8	Hexagon Socket Head Cap Screw	
15	1	ANSI B18.2.2 - 1/2 - 20	Hex Jam Nut	
16	1	Rod Clevis Pin RC-5		
17	2	ANSI B18.8.1 - 1/8 x 3/4 Extended Prong	Pin - Cutter	
18	4	Square Cut Type		
19	2	ANSI B18.3 - 5/16 - 18 - 1/2	Hexagon Socket Head Cap Screw	
20	1	650-3-45K	Pivot Bracket	
21	1	650-3-45F	Norgren RLG04	
22	2	Legris angle 25x532		
23	1	MF-21A ANSI B18.8.2 - 3/8 x 2 1/4	Legris Angle 25x532	
24	1	MF-60 ANSI B18.3 - 1/4-20 UNC x 0.25	Pin - Hardened Ground Production Dowel	
25	1	Pivot Pin, Norgren cyl	Hexagon Socket Set Screw - Cup Point	
26	2	Legris Angle		

REF F8128-05042006

650-3-66 Precision Connecting Rod Cap Milling Fixture

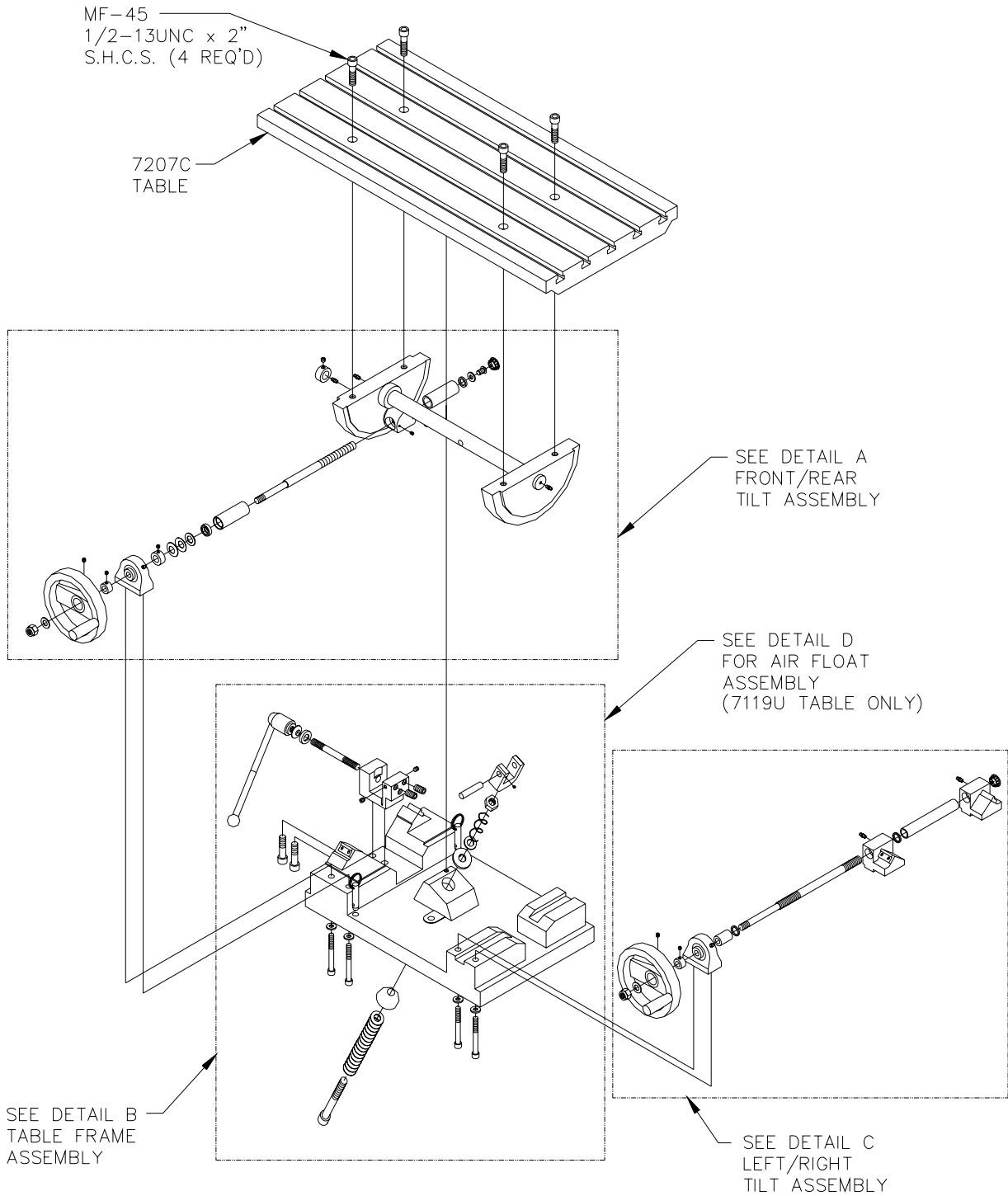


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-3-66C	Carriage, Cap Cutting Fixture
3	1	650-3-66D	Locate Plate
4	1	650-3-66B	Clamp Bar
5	2	650-3-66P	Eye bolt - raid swb-1
6	2	650-3-66N	Knob - raid tc2a
9	2	650-3-45G	Pivot Shaft
9.3	1	650-3-45I	Claws, 1" Bimba D-8314-A
13	2	650-3-66E	UR Assy
14	2	650-3-66H	Lower Hinge
15	2	650-3-66J	Upper Hinge
16	2	MF-207 ANST B18.8.2 - 1/4 x 1 1/2	Pin - Hardened Ground Production Dowel
18	4	MF-5 ANST B18.3 - No. 10 - 24 x 5/8	Hexagon Socket Head Cap Screw
19	8	ANST B18.3 - 1/4 - 20 - 5/8	Hexagon Socket Head Cap Screw
20	2	6370Y	10" Support Parallel
21	2	65533	Locating Key
22	3	502-1-11A	T-Nut, 3/4 Table, 5/8-11 thread
23	3	MF-152A ANST/ASME B18.2.1 - 5/8-11 UNC - 2.5	Hex Bolt - UNC (Regular Thread - Incht)
24	1	650-3-66G	Slide assy (Turdle)
25	3	650-3-66M	Clamp Stud
26	6	MF-166 ANST B18.2.2 - 5/8 - 11	Hex Thick Nut
27	1	650-3-66K	Main Frame Assembly
27.1	1	650-3-66A	Cap Fixture, Main Base
27.2	1	650-3-66L	Thrust Parallel
27.4	4	MF-31 ANST B18.3 - 3/8 - 16	Hexagon Socket Head Cap Screw
27.5	2	MF-30 ANST B18.8.2 - 3/16 x 3/4	Pin - Slotted Spring
27.6	2	MF-213 ANST B18.8.2 - 3/8 x 1 1/2	Pin - Hardened Ground Production Dowel
28	1	Air Switch Assembly	
28.1	1	502-1-55A	Air switch mount bracket
28.2	1	502-1-55	Air Switch, Clippard #MTU-4
28.3	2	mf-4 ANST B18.3 - No. 10 - 24 x 3/8	Hexagon Socket Head Cap Screw
28.4	1	Nut	Mount nut for 502-1-55 air switch.
29	2	650-3-66S	Ballville spring ReId BDP-65
30	1	514-2-70K	Regulator Assy
32	1	502-11-35A	Flow Control
33	1	502-11-17S	1/4 STREET ELL
34	1	502-11-16X	Quick Connect air Fitting Male
39	1	650-3-45H	Pivot Bracket
40	3	514-4-17V	1/4 poly x 1/4 npt 90, Legris metal
41	2	514-4-18B	1/4 poly x 1/4 npt 90, Legris metal
42	4	MF-6 ANST B18.3 - No. 10 - 24 UNC - 3/4	Hexagon Socket Head Cap Screw
43	1	650-3-66Q	Shoulder Screw 5/8 X 1.25
44	2	650-3-66R	Shoulder Screw 1/2 X 1/2
45	2	MF-223 ANST B18.3 - 3/8 - 16 UNC - 1 1/4	Hexagon Socket Head Cap Screw
46	2	MF-3A ANST B18.3 - No. 8 - 32 UNC - 7/8	Hexagon Socket Head Cap Screw

REF65134-05082006

7209M Dual Axis Table Assembly:

REFHD17-062095



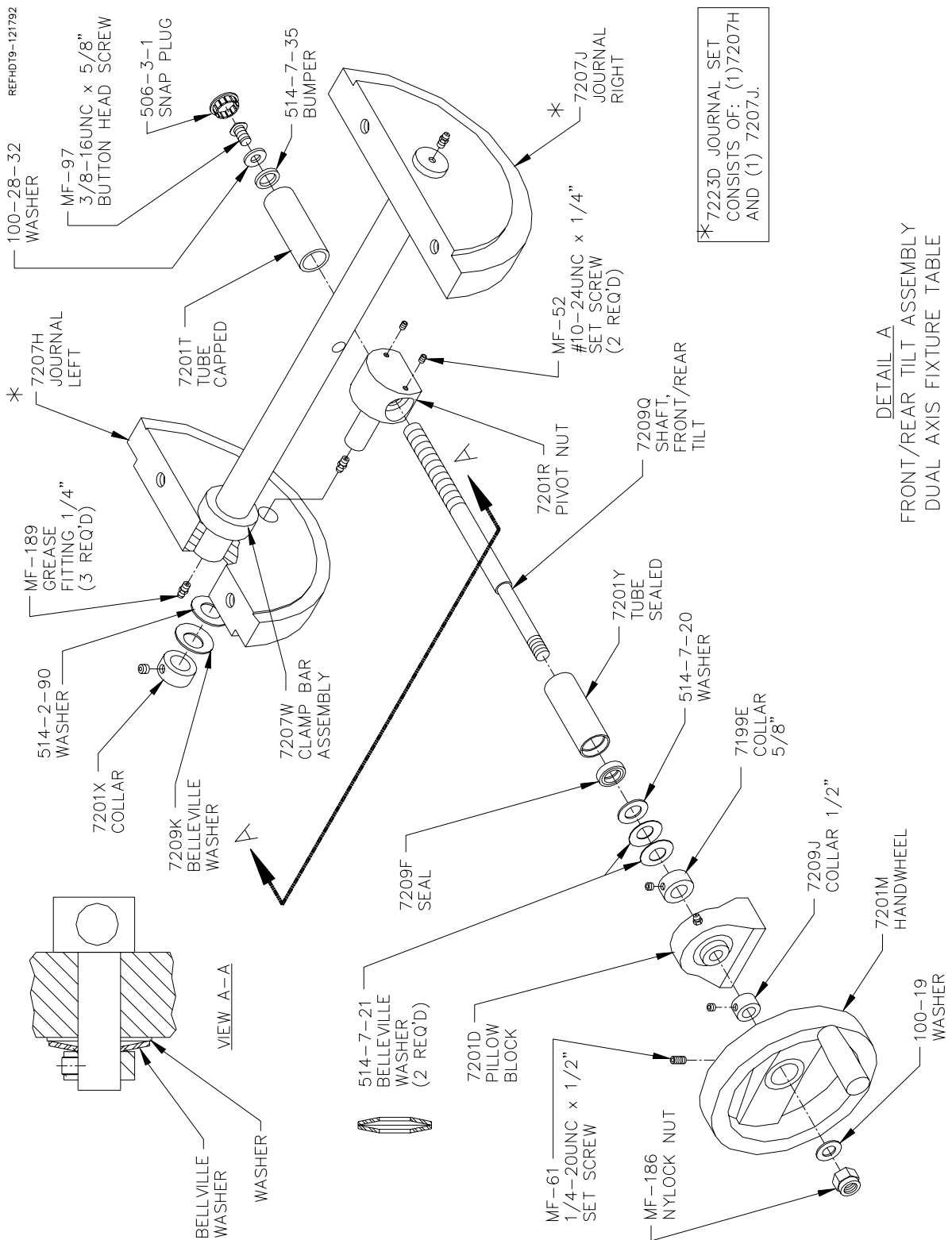
ROTTLER DUAL AXIS FIXTURE TABLE

7119V - FIXTURE TABLE WITHOUT AIR FLOAT OPTION

7119W - FIXTURE TABLE WITH AIR FLOAT OPTION

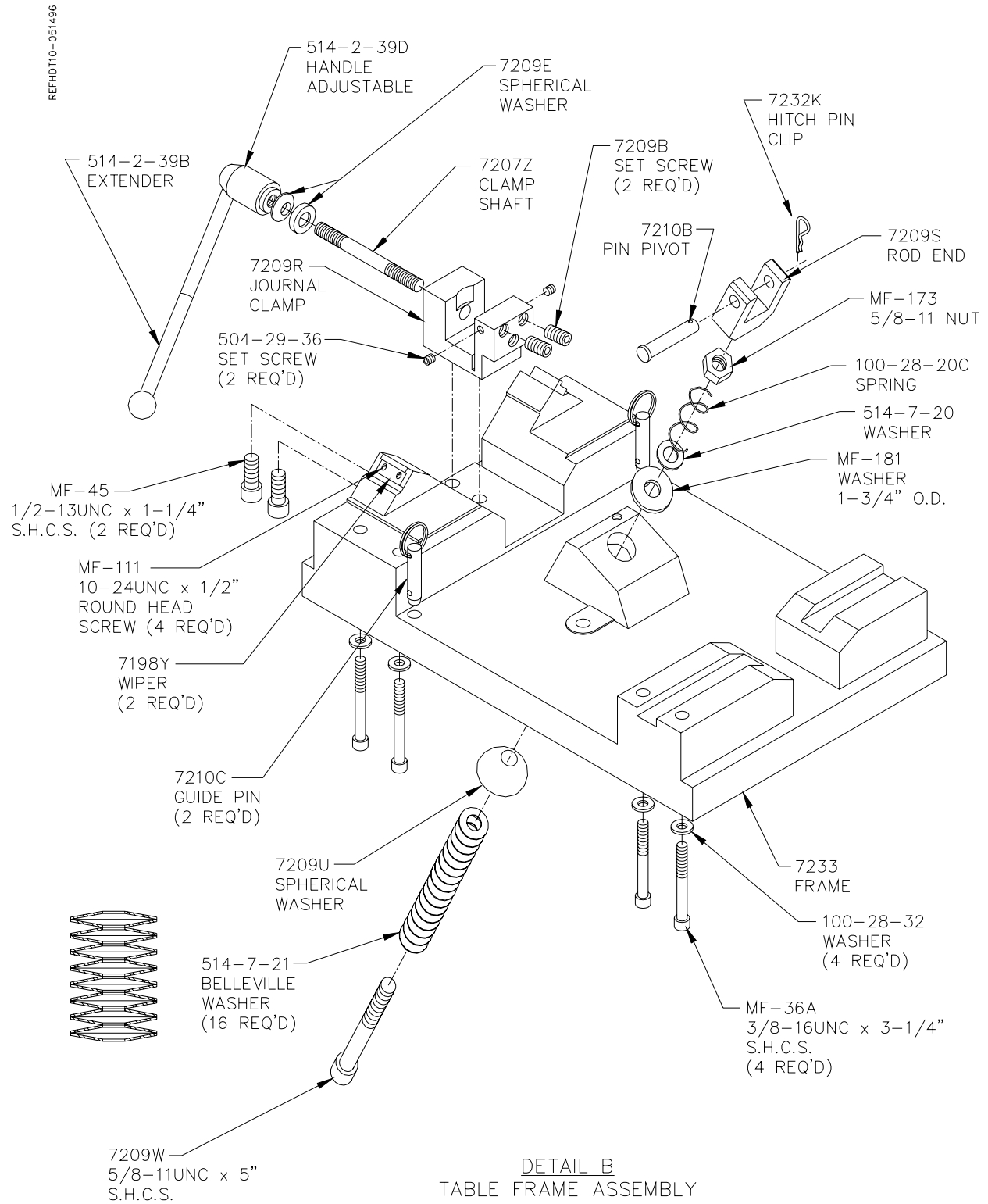
APPROXIMATE TABLE
WEIGHT: 325 LBS.

Front / Rear Tilt Assembly:



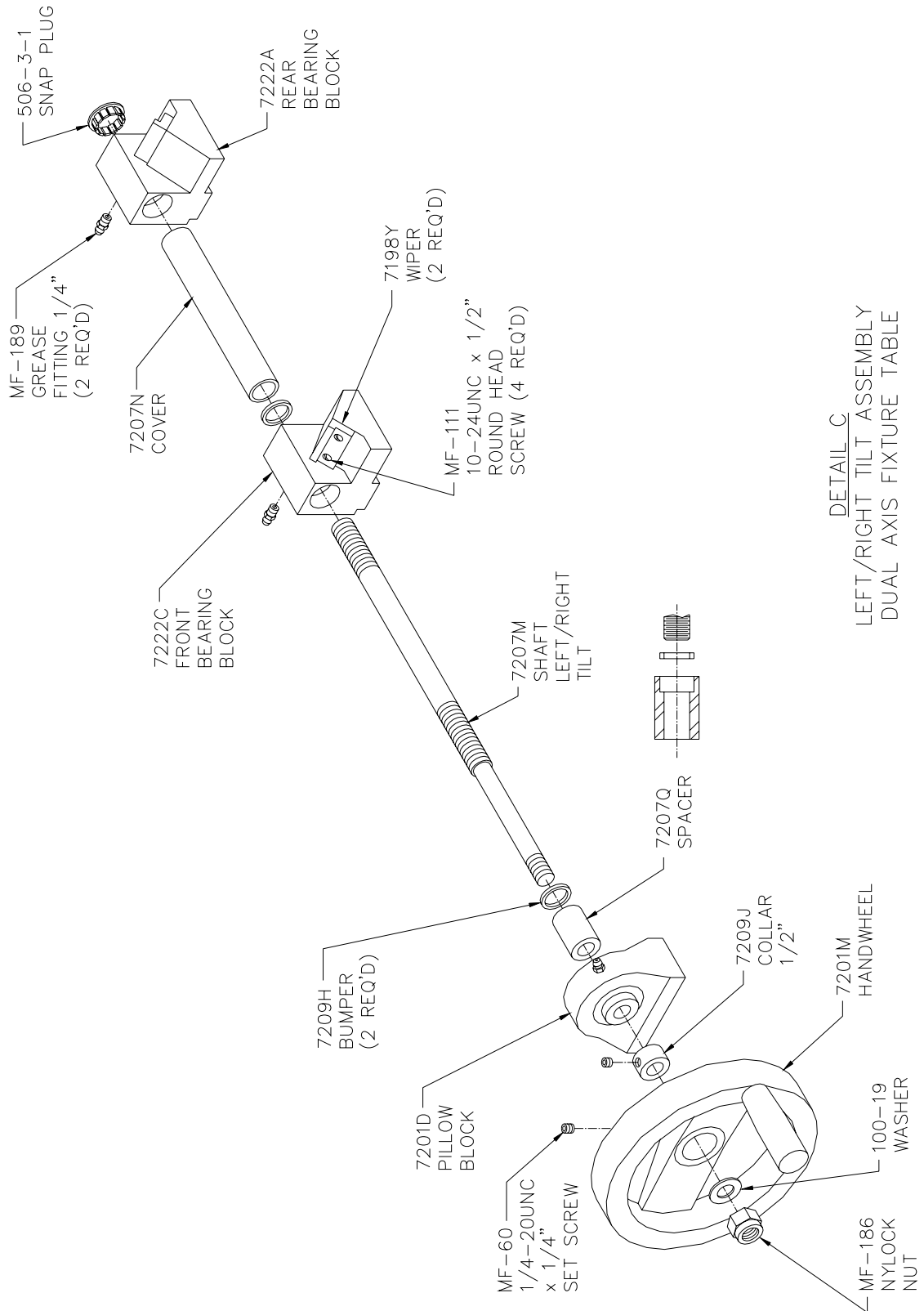
DETAIL A
FRONT/REAR TILT ASSEMBLY
DUAL AXIS FIXTURE TABLE

Table Frame Assembly:



Left / Right Tilt Assembly:

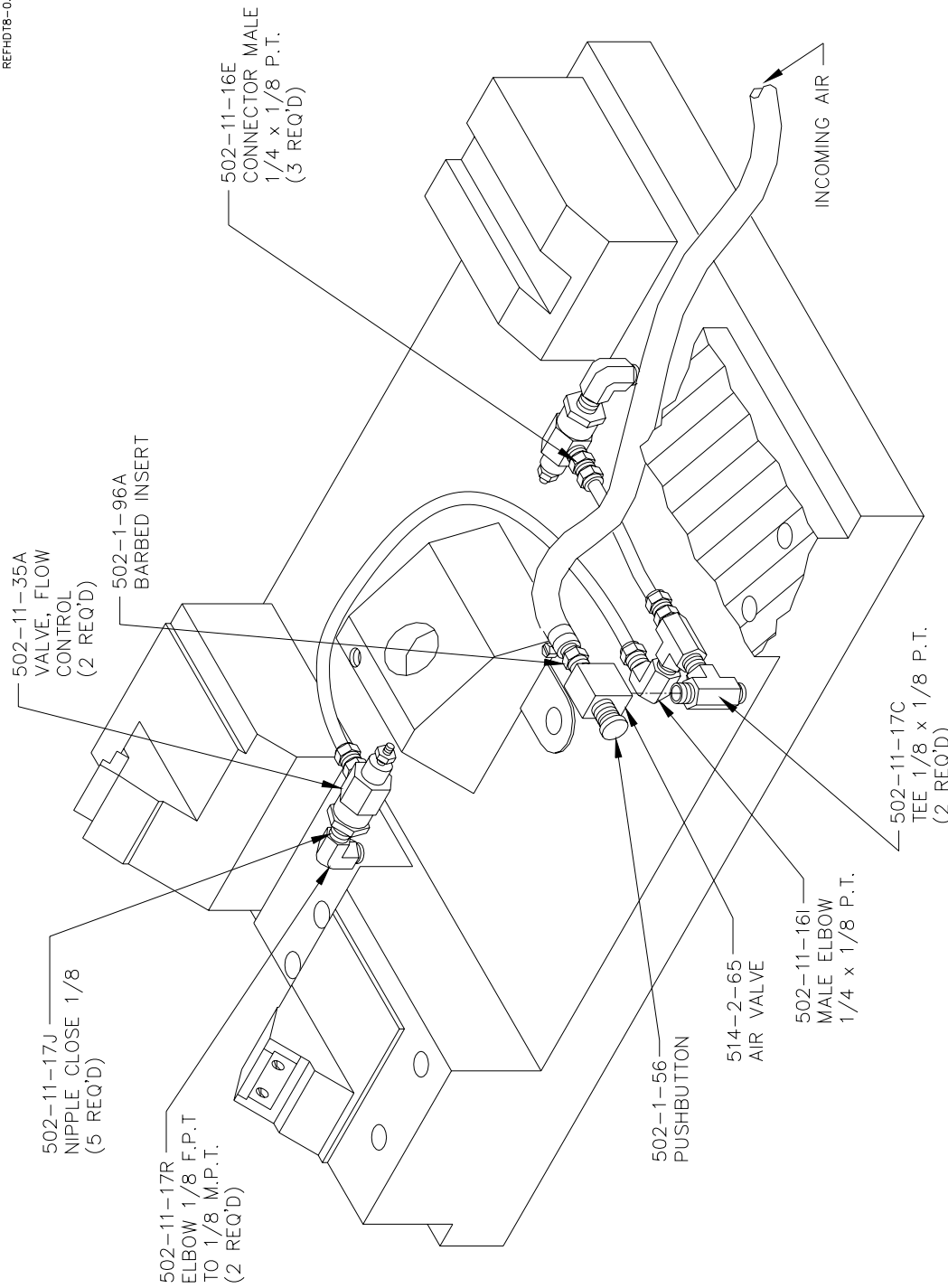
REFHDT11-090492



DETAIL C
LEFT/RIGHT TILT ASSEMBLY
DUAL AXIS FIXTURE TABLE

Air Float Assembly:

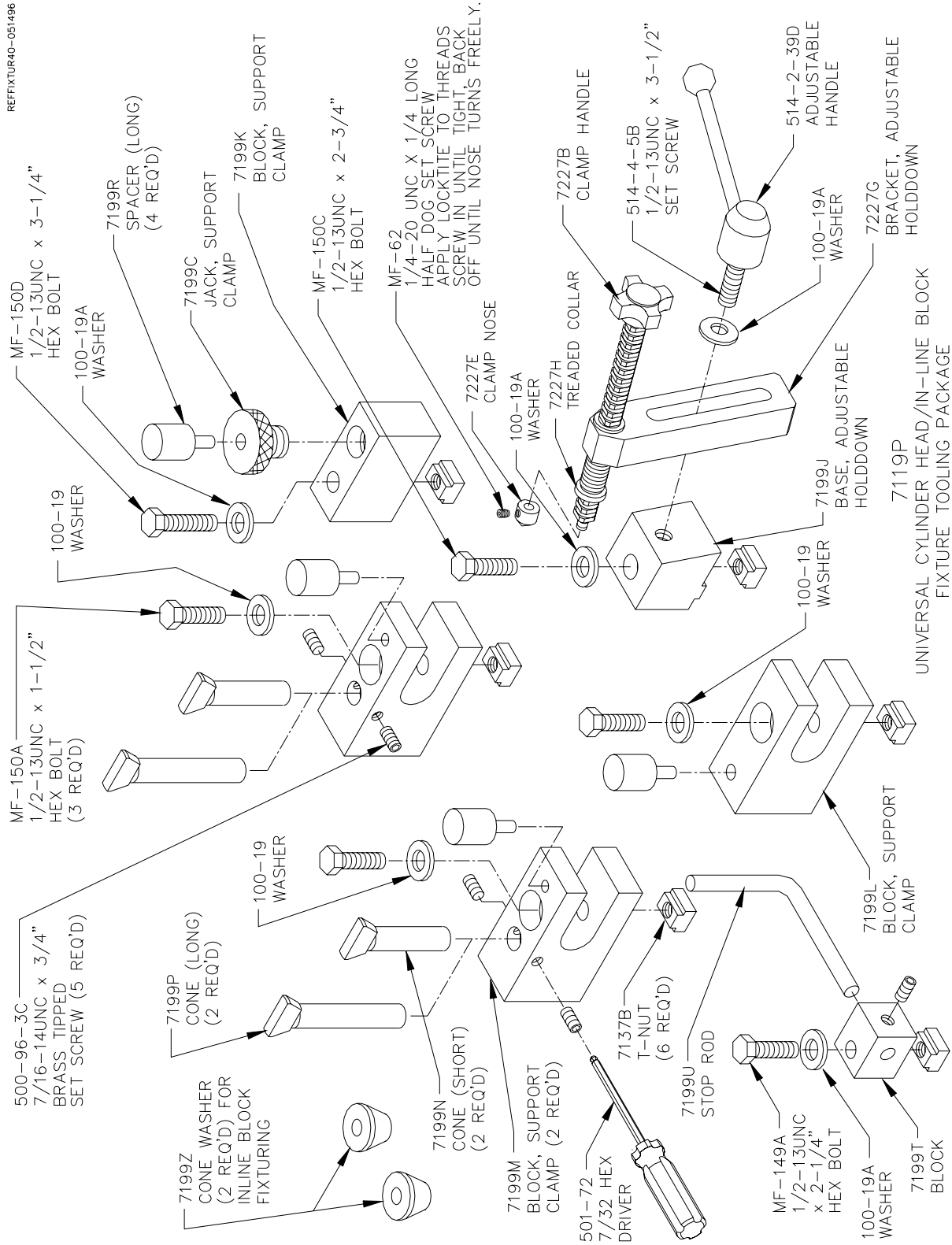
REFHD78-031993



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

7119P Universal Tooling Package:

REF:FXTUR40-051496

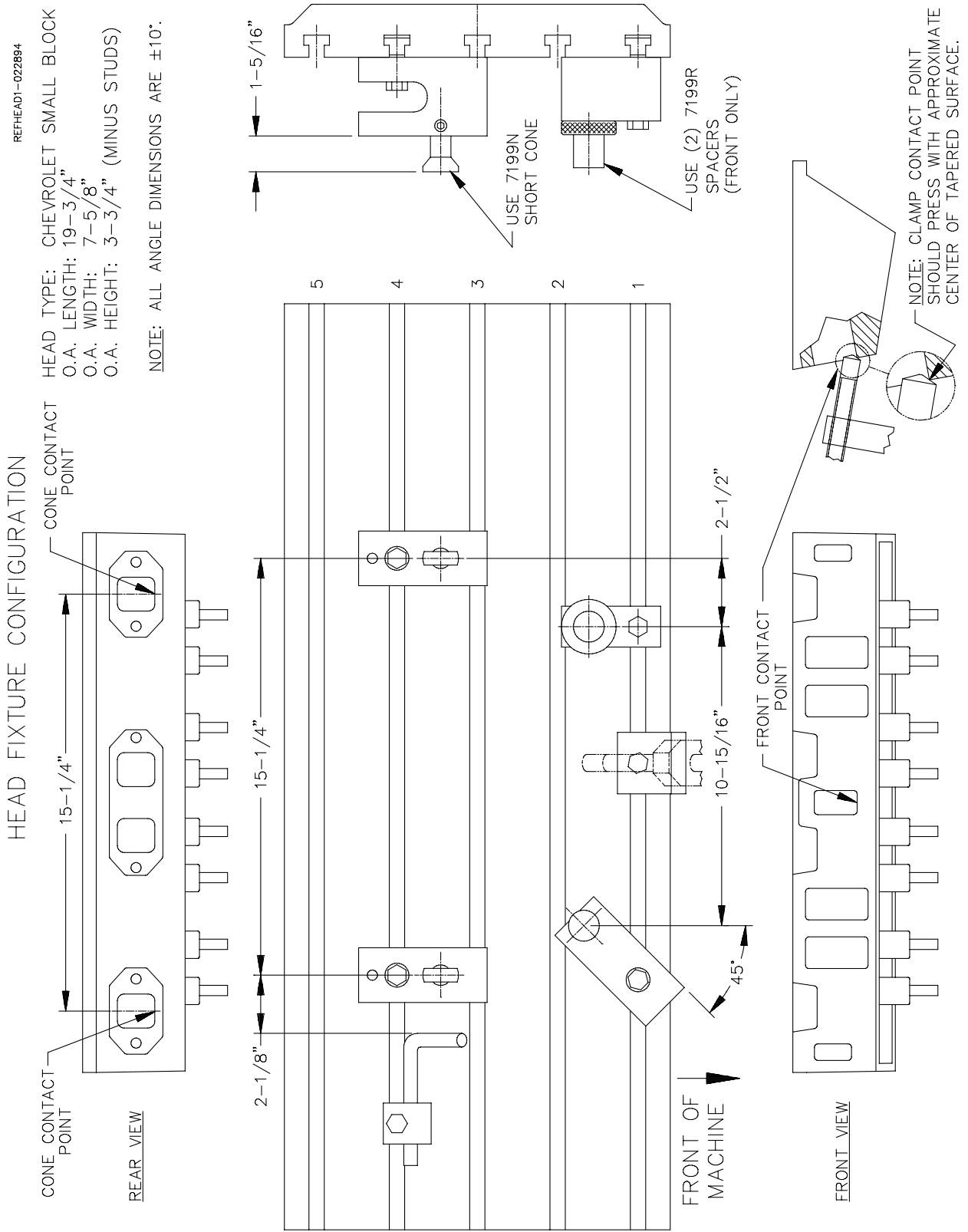


Suggested Set-Up:

The following illustrations show suggested head fixture set-ups for various cylinder heads. Since castings can vary, small adjustments may be necessary to account for differences.

When using this fixture, be sure to have all support blocks tight before beginning a cut. The head clamp handle assembly should be tight enough to not allow the head to move, but not so tight that it will warp the head. Also check to see that the set screws are tight and the adjustable handle on the head clamp handle assembly is tight. The dual axis fixture table must also be locked. Failure to have all pieces secured can lead to a crash condition which could be dangerous to the operator and possibly damage the machine.

Chevrolet Small Block Head:

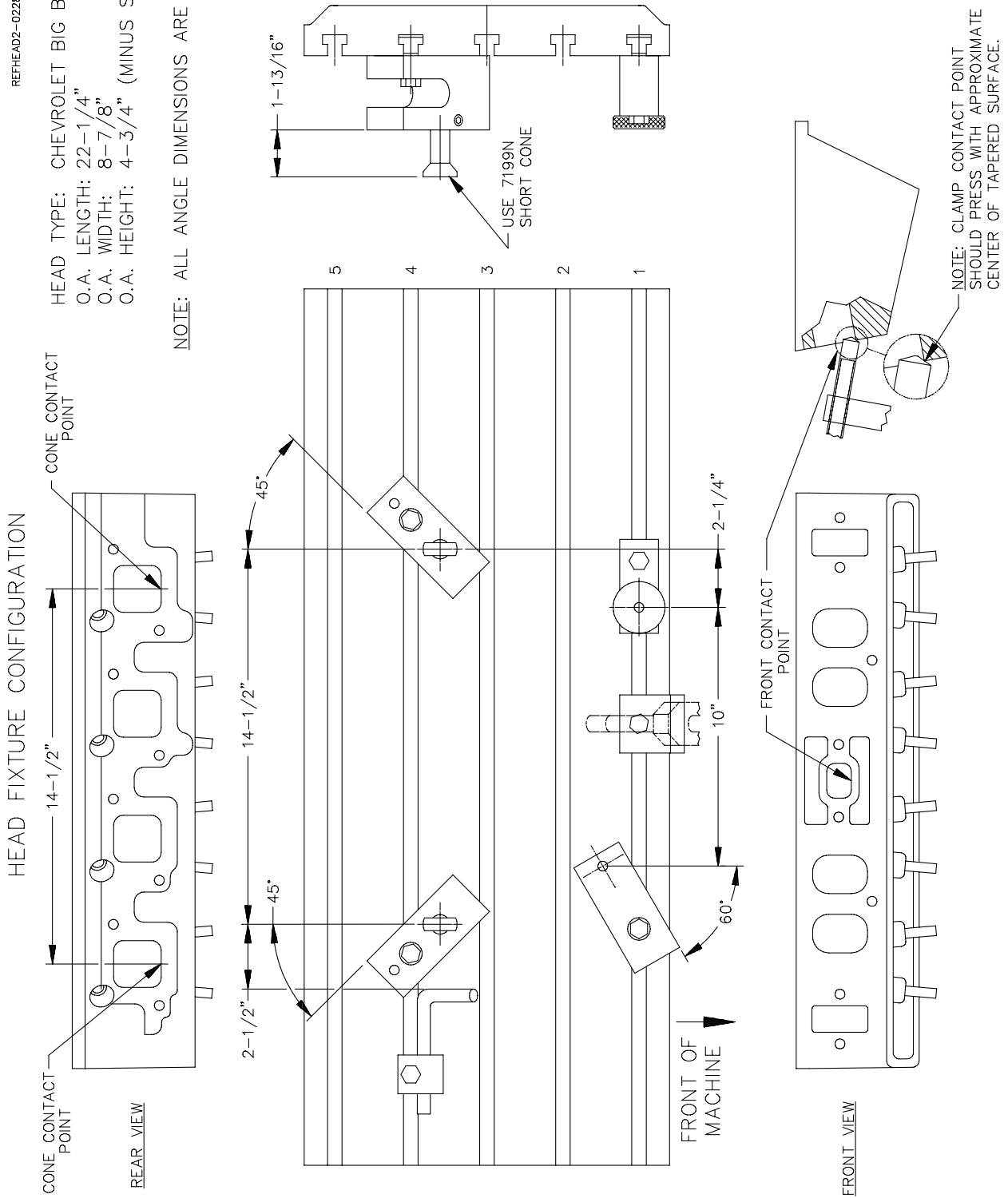


Chevrolet Big Block Head:

REFHEAD2-022894

HEAD TYPE: CHEVROLET BIG BLOCK
O.A. LENGTH: 22-1/4"
O.A. WIDTH: 8-7/8"
O.A. HEIGHT: 4-3/4" (MINUS STUDS)

NOTE: ALL ANGLE DIMENSIONS ARE ±10°.



GM 6.2 Liter Diesel:

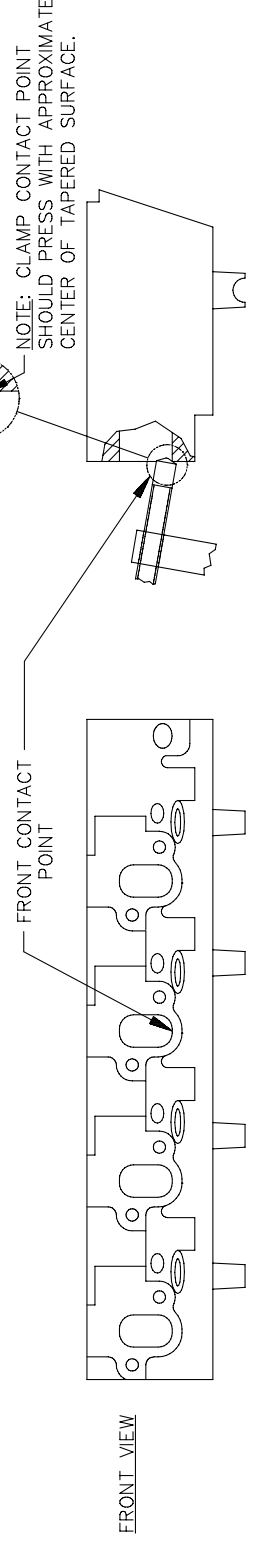
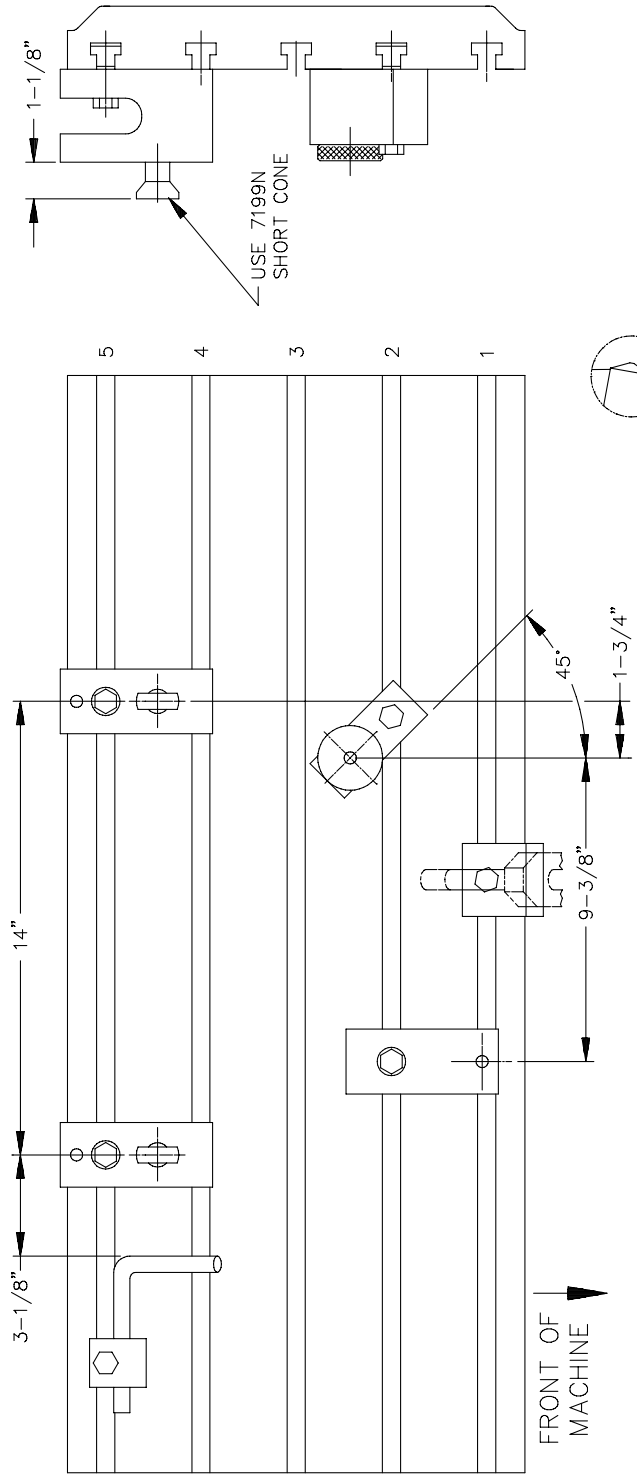
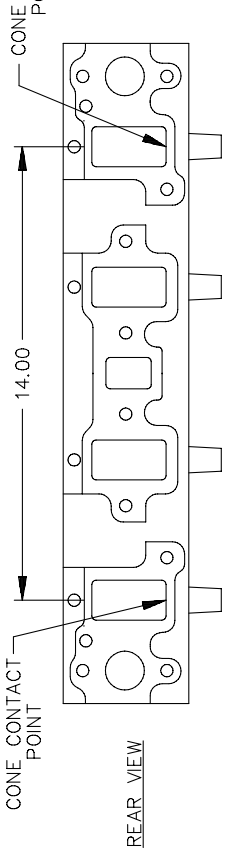
REFHEAD7-022894

HEAD TYPE: GM 6.2L DIESEL
 O.A. LENGTH: 20-3/8"
 O.A. WIDTH: 8-3/8"
 O.A. HEIGHT: 3-7/8" (WITHOUT BOSSES)

NOTE: THIS HEAD HAS PRECOMBUSTION CHAMBERS. THESE CAN BE REMOVED BEFORE CUTTING OR LEFT IN AND CUT WITH SPECIAL INSERTS - SEE CUSTOMER BULLETIN #C49.

NOTE: ALL ANGLE DIMENSIONS ARE ±10°.

HEAD FIXTURE CONFIGURATION

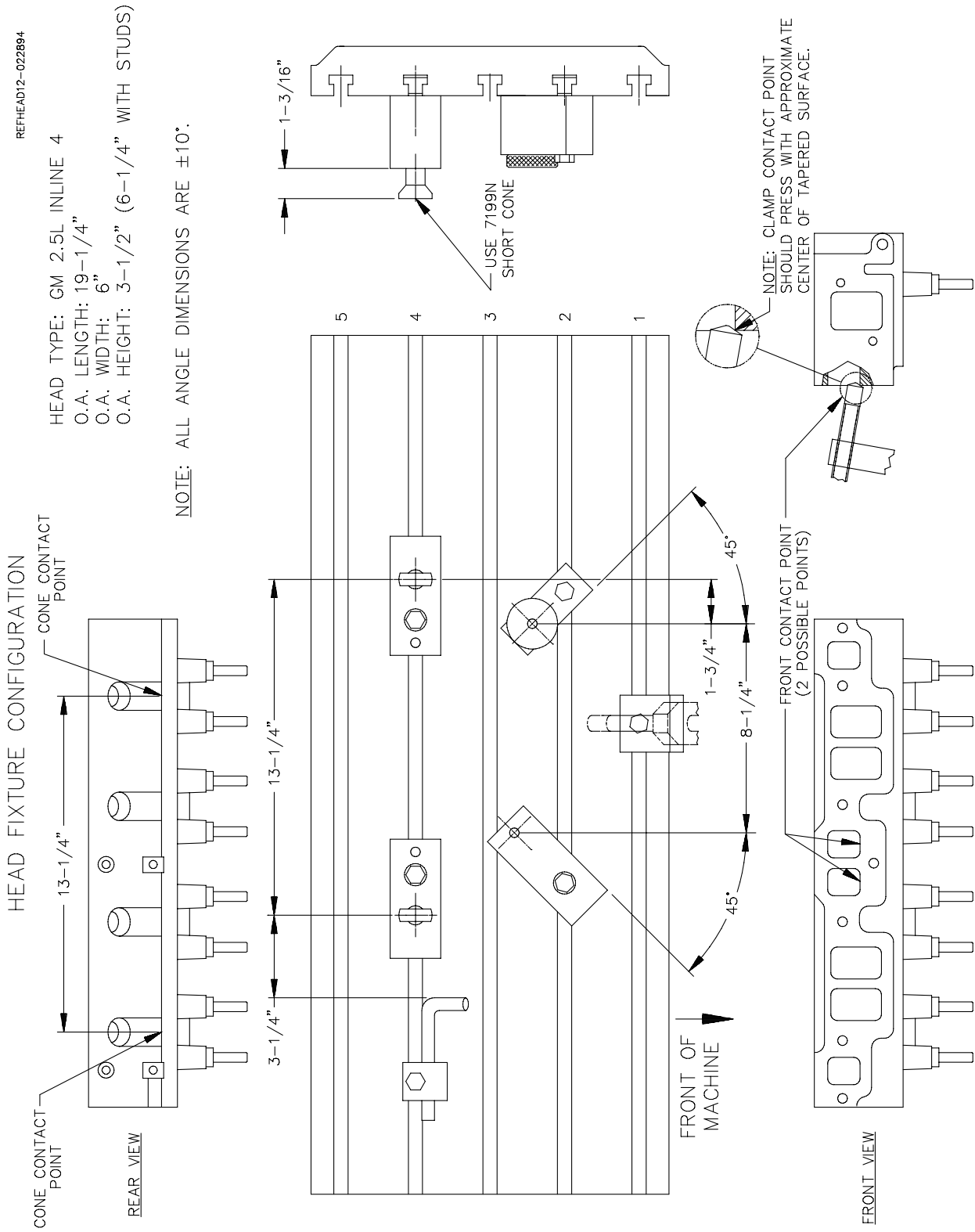


USE 7199N SHORT CONE

FRONT OF MACHINE

FRONT VIEW

GM 2.5 Liter In-Line 4:



GM 2.8 Liter V6:

REFHEAD14-022894

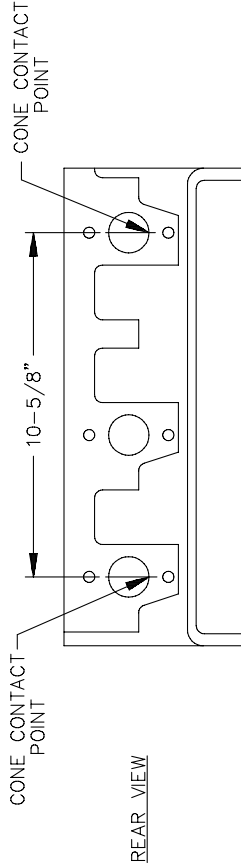
HEAD TYPE: GM 2.8L V-6

O.A. LENGTH: 14-3/4"

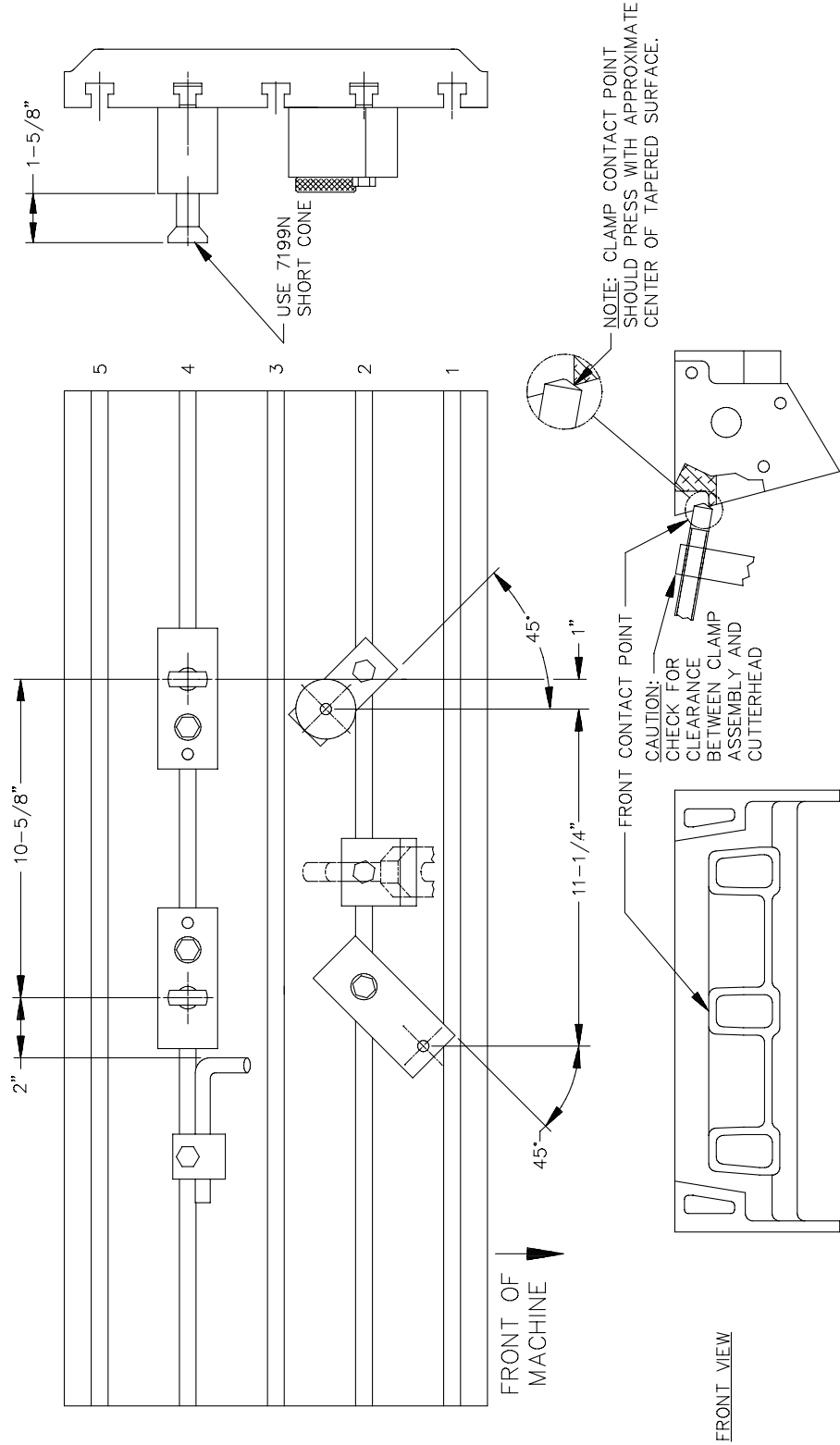
O.A. WIDTH: 5-1/2"

O.A. HEIGHT: 5-1/2"

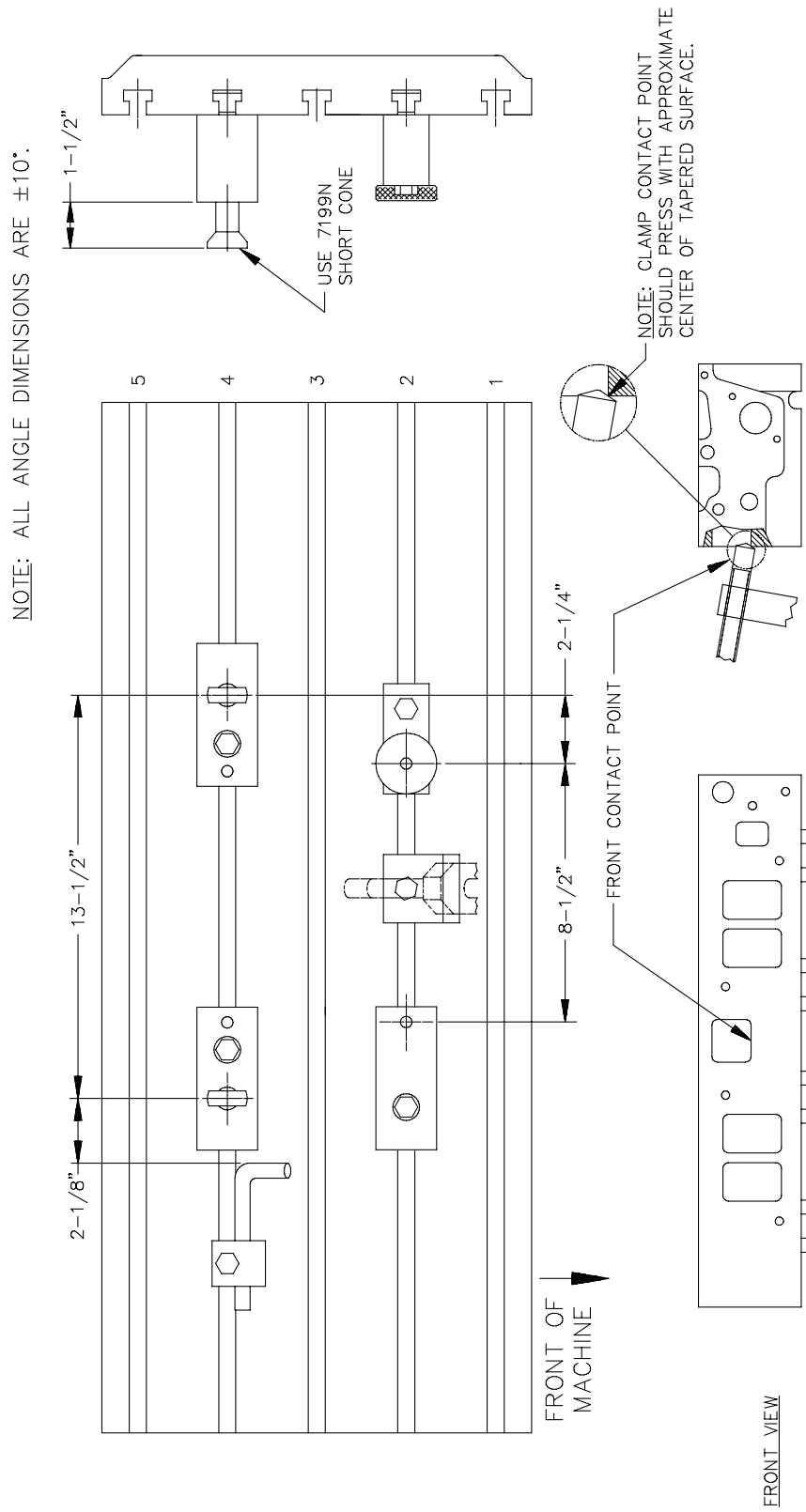
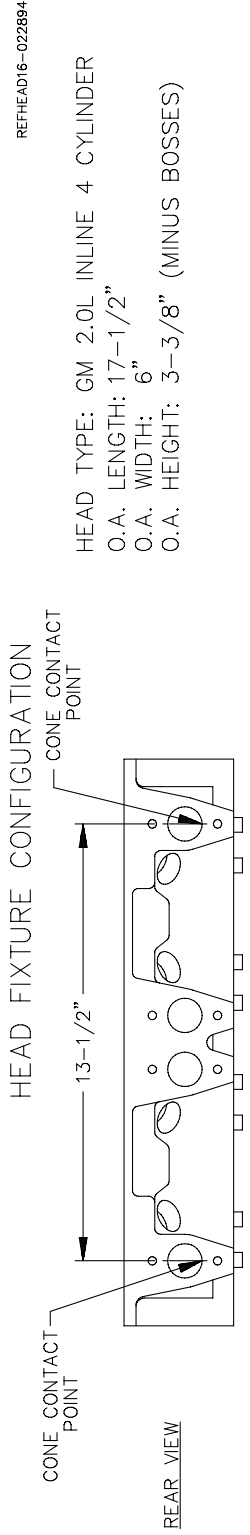
HEAD FIXTURE CONFIGURATION



NOTE: ALL ANGLE DIMENSIONS ARE ±10°



GM 2.0 Liter In-Line 4:

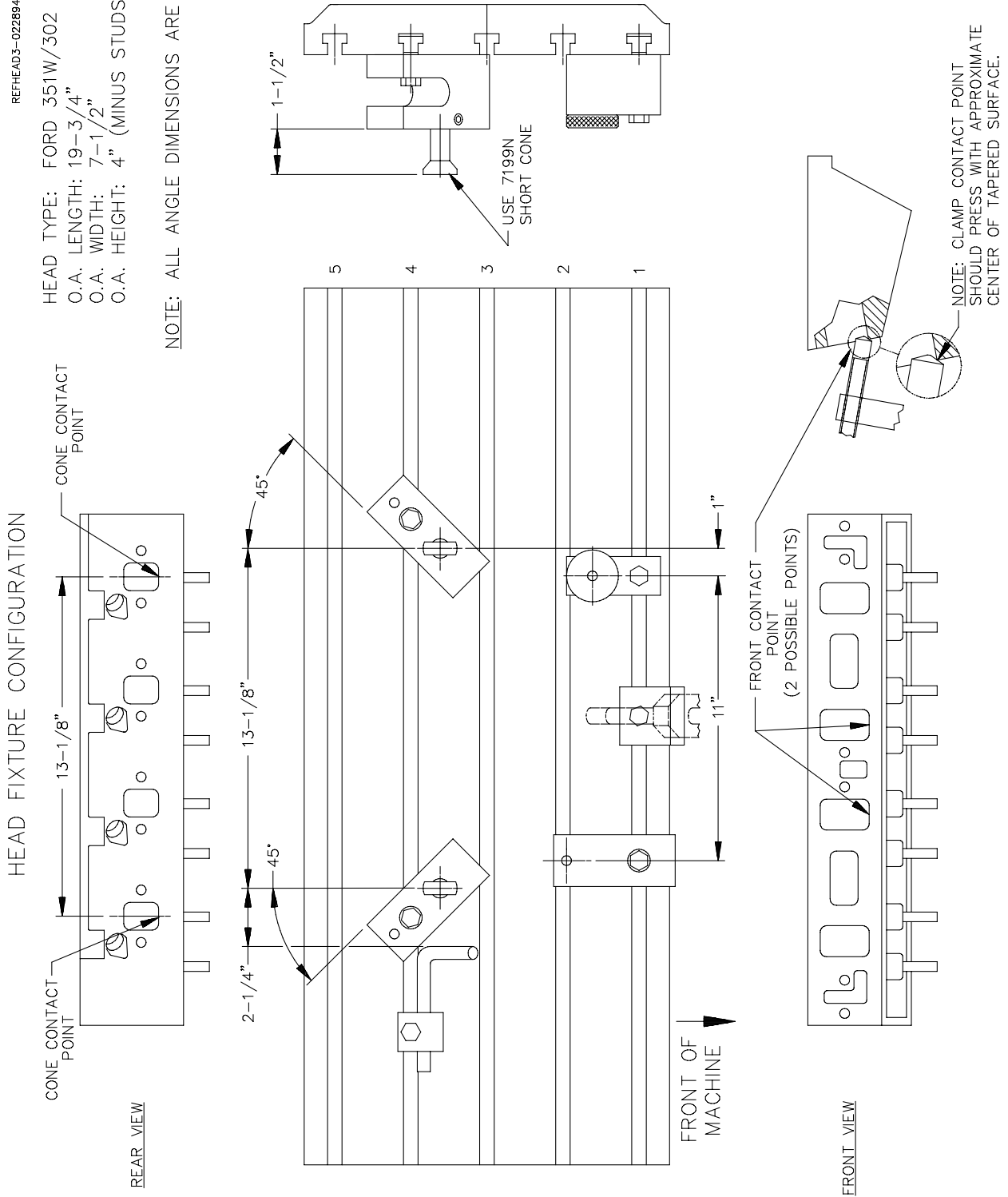


Ford 351 W / 302:

REFHEAD3-022894

HEAD TYPE: FORD 351W/302
 O.A. LENGTH: 19-3/4"
 O.A. WIDTH: 7-1/2"
 O.A. HEIGHT: 4" (MINUS STUDS)

NOTE: ALL ANGLE DIMENSIONS ARE ±10°.

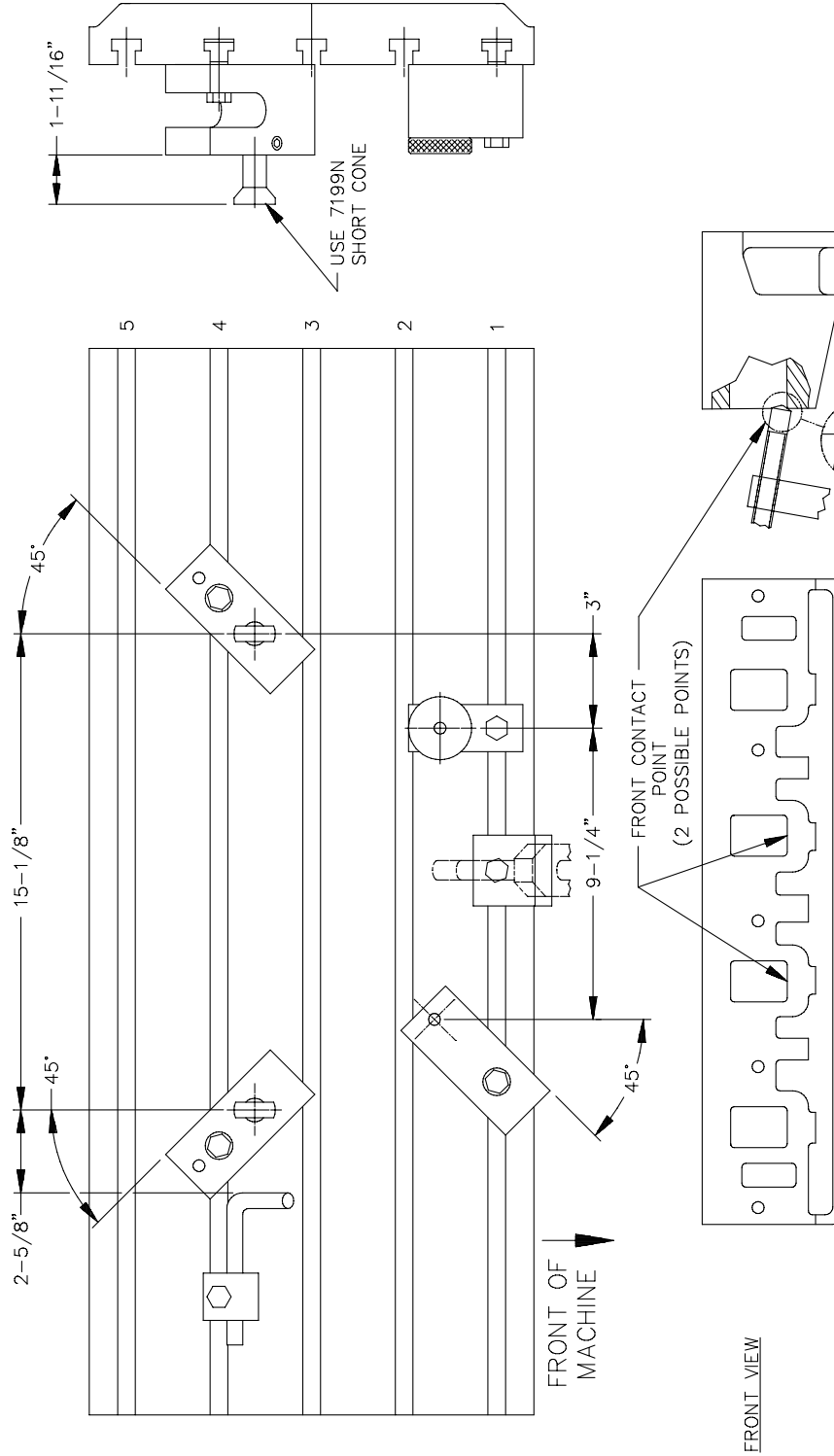
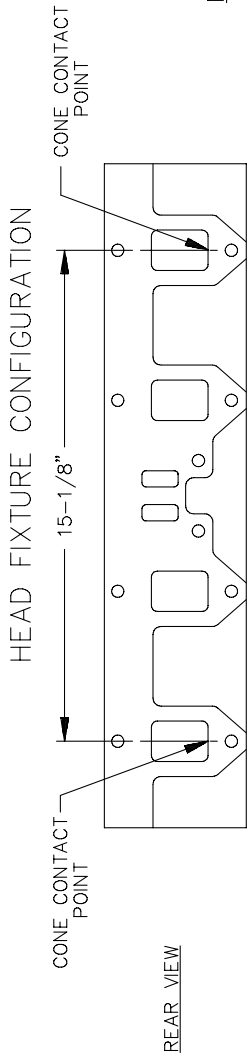


Ford 360 / 390:

REF:HEAD4-022894

HEAD TYPE: FORD 360/390
 O.A. LENGTH: 20-1/2"
 O.A. WIDTH: 5-5/8"
 O.A. HEIGHT: 4-3/8" (NO STUDS)

NOTE: ALL ANGLE DIMENSIONS ARE ±10°.



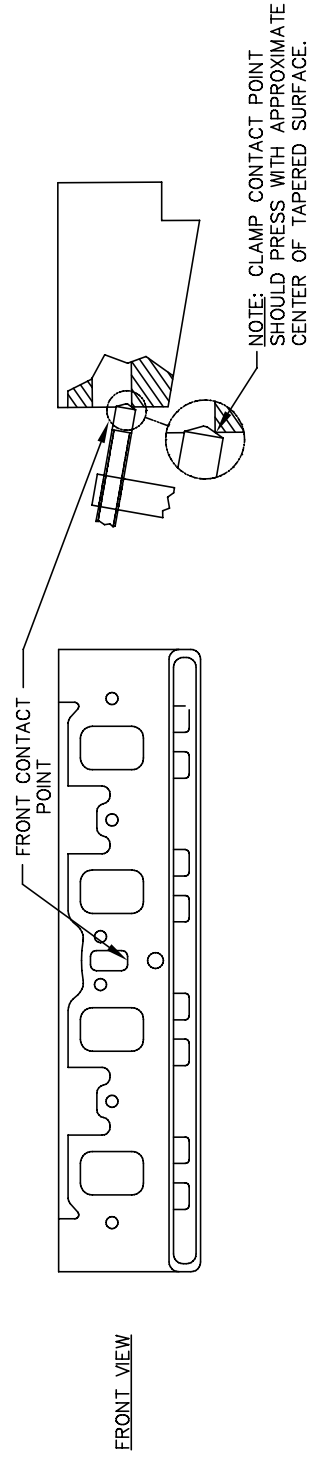
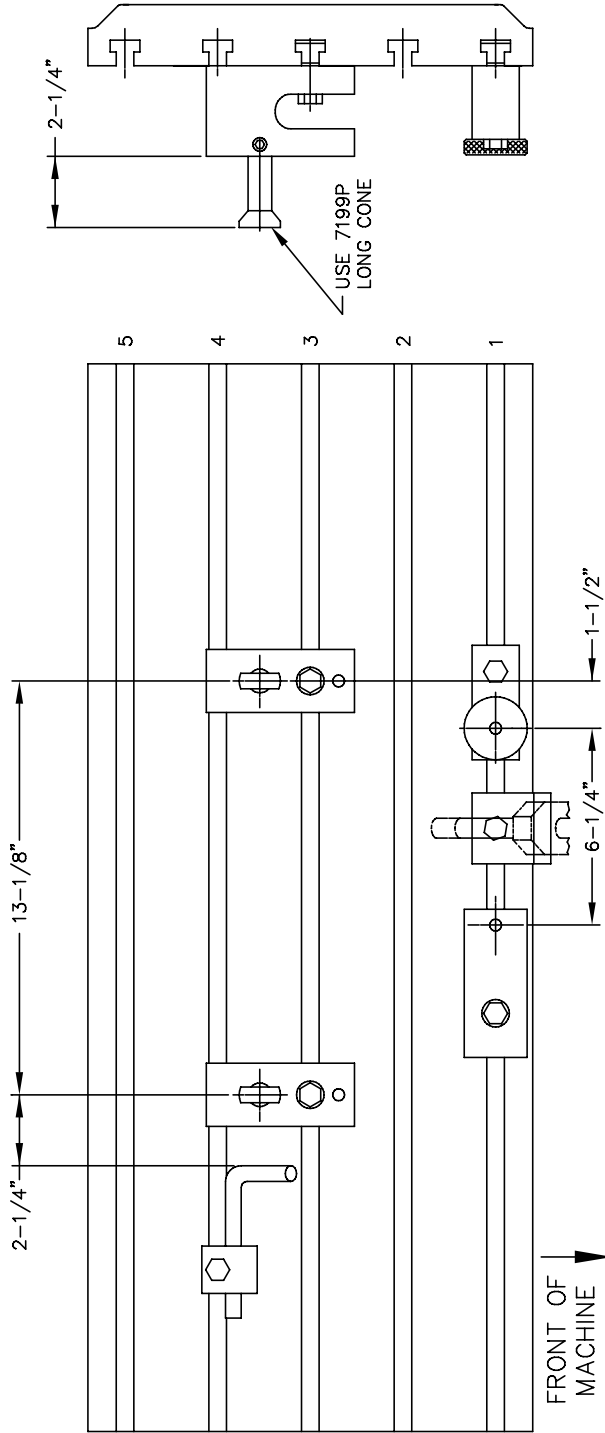
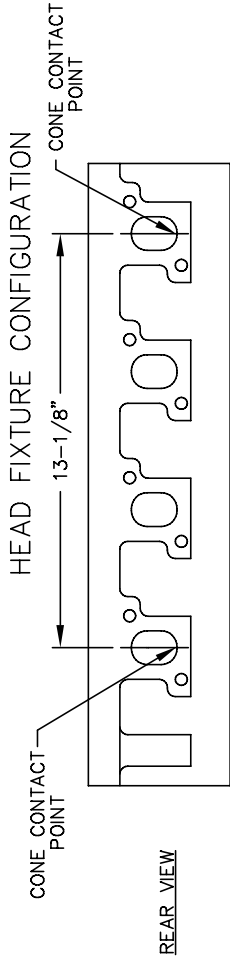
NOTE: CLAMP CONTACT POINT SHOULD PRESS WITH APPROXIMATE CENTER OF TAPERED SURFACE.

Ford 400 / 351M:

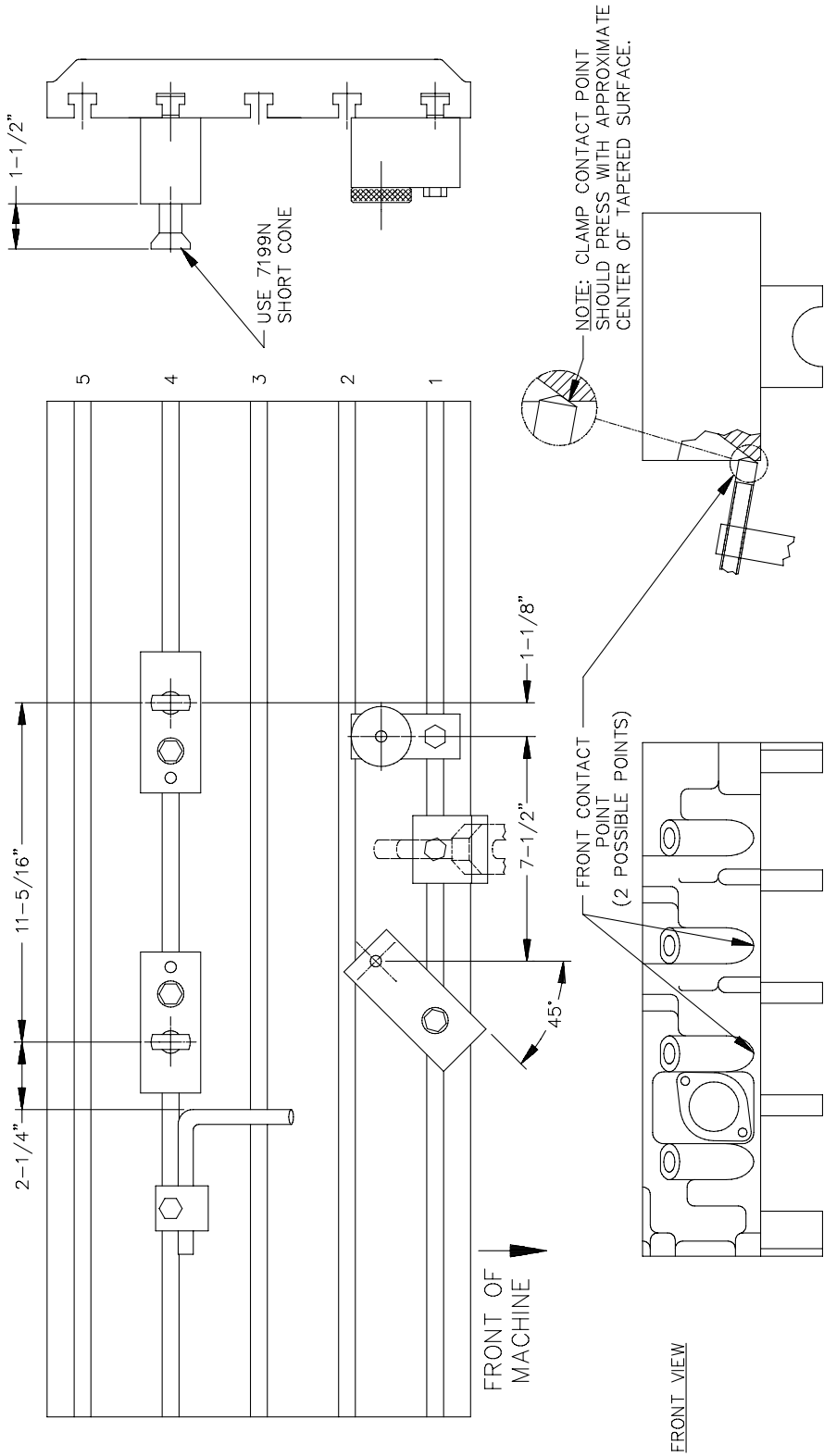
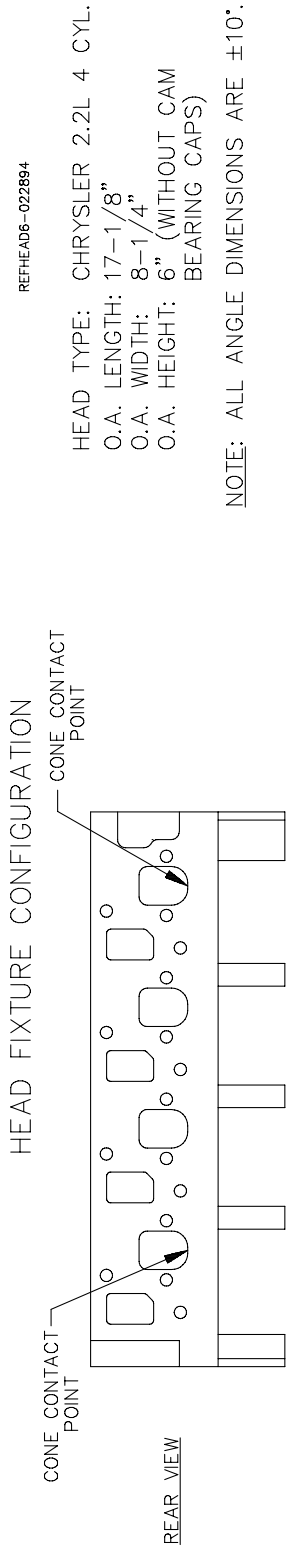
REFHEADS-022884

HEAD TYPE: FORD 400/351 M
 O.A. LENGTH: 19-3/4"
 O.A. WIDTH: 7-1/8"
 O.A. HEIGHT: 4-1/2" (NO STUDS)

NOTE: ALL ANGLE DIMENSIONS ARE ±10°.



Ford Navistar 7.3 Liter Diesel:

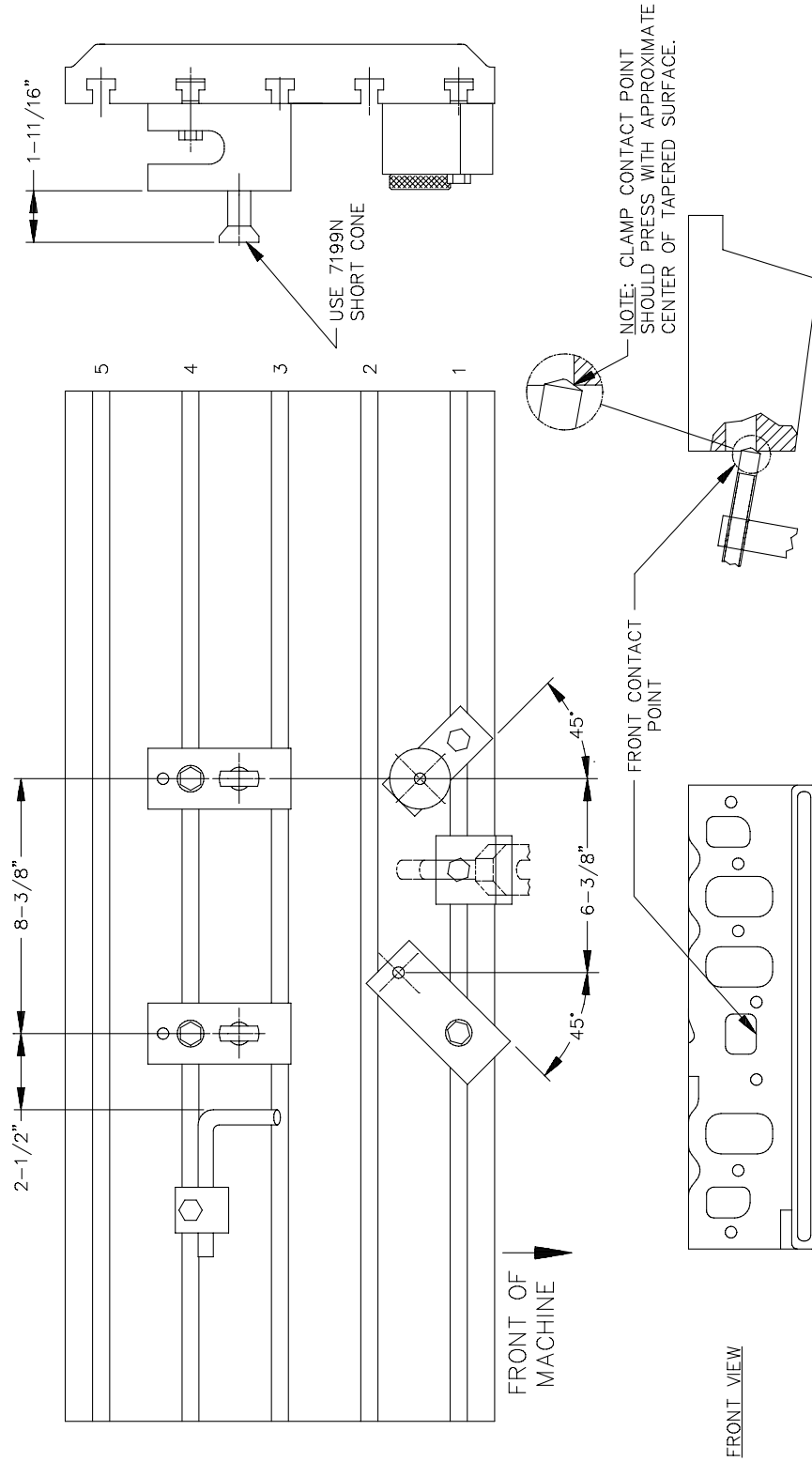
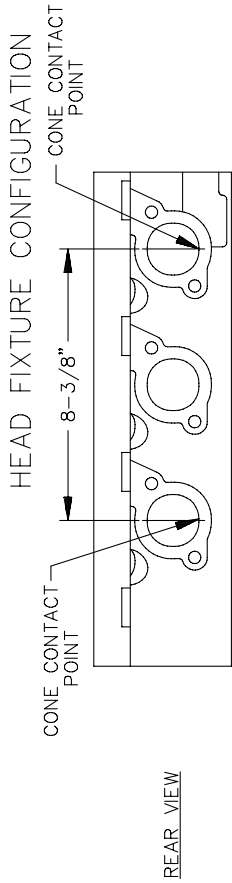


Ford 3.8 Liter (232) V-6:

REFHEAD09-022894

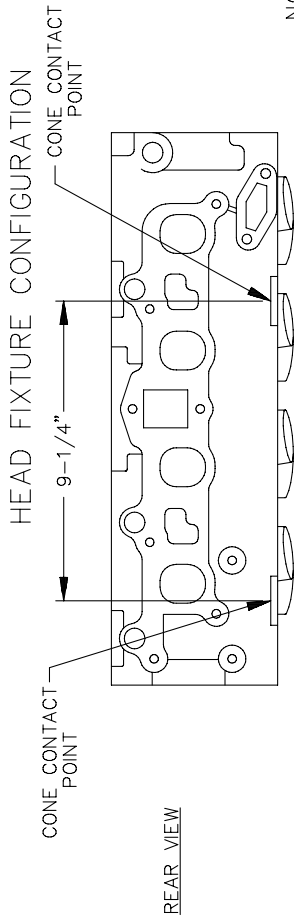
HEAD TYPE: FORD 3.8L (232) V-6
 O.A. LENGTH: 15-1/4"
 O.A. WIDTH: 7-3/4"
 O.A. HEIGHT: 4-1/4"

NOTE: ALL ANGLE DIMENSIONS ARE ±10°.

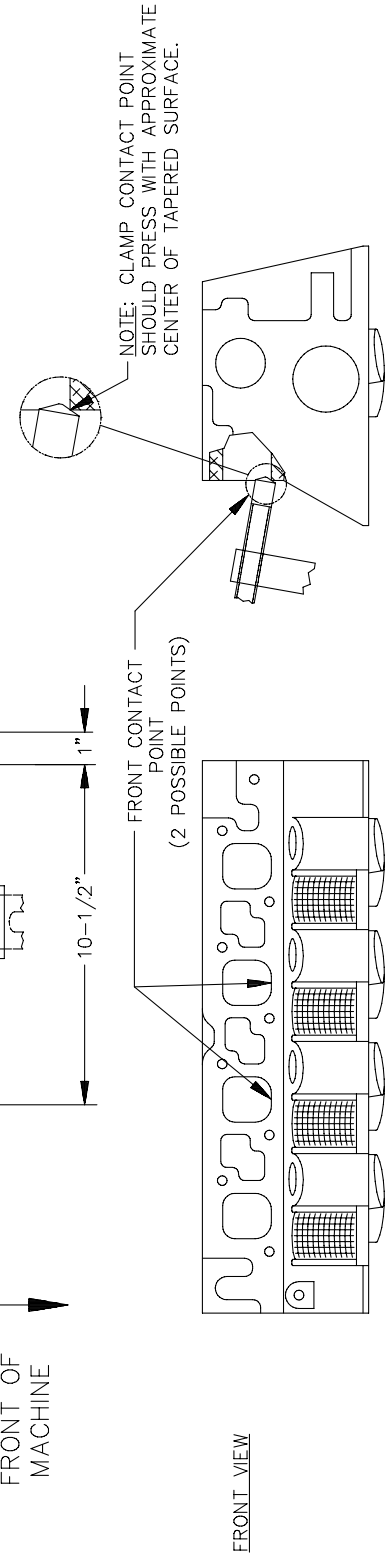
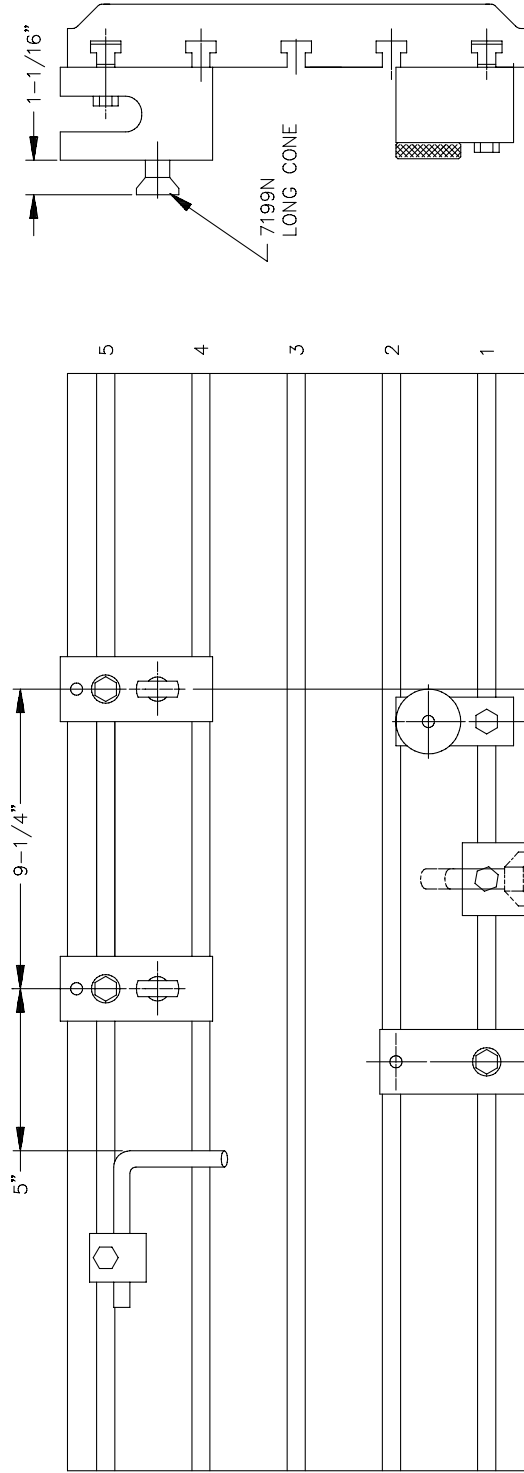


Ford 1.6 Liter In-Line 4 (Escort):

REFHEAD10-022894
 HEAD TYPE: FORD 1.6L INLINE 4 (ESCORT)
 O.A. LENGTH: 17-1/16"
 O.A. WIDTH: 8-5/8"
 O.A. HEIGHT: 5-1/8" (MINUS BOSSES)



NOTE: ALL ANGLE DIMENSIONS ARE ±10°.



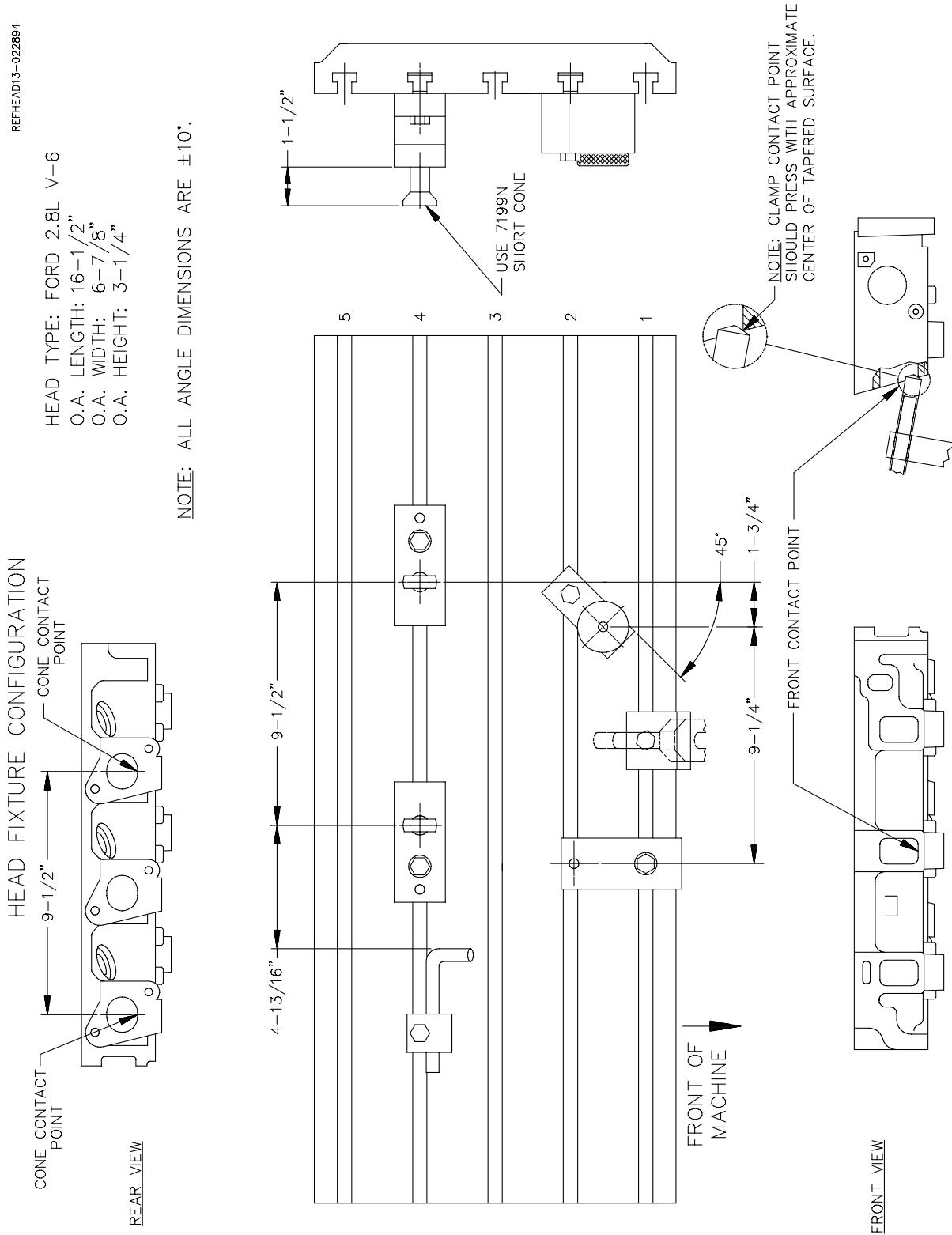
Ford 2.8 Liter V6:

REFHEAD13-022894

HEAD FIXTURE CONFIGURATION

HEAD TYPE: FORD 2.8L V-6
 O.A. LENGTH: 16-1/2"
 O.A. WIDTH: 6-7/8"
 O.A. HEIGHT: 3-1/4"

NOTE: ALL ANGLE DIMENSIONS ARE ±10°.



Ford OHC In-Line 4:

REFHEAD15-022894

HEAD TYPE: FORD OHC INLINE 4 CYLINDER

O.A. LENGTH: 19-1/8"

O.A. WIDTH: 5-7/8"

O.A. HEIGHT: 3-3/4" (7-1/2" WITH CAM TOWERS)

HEAD FIXTURE CONFIGURATION

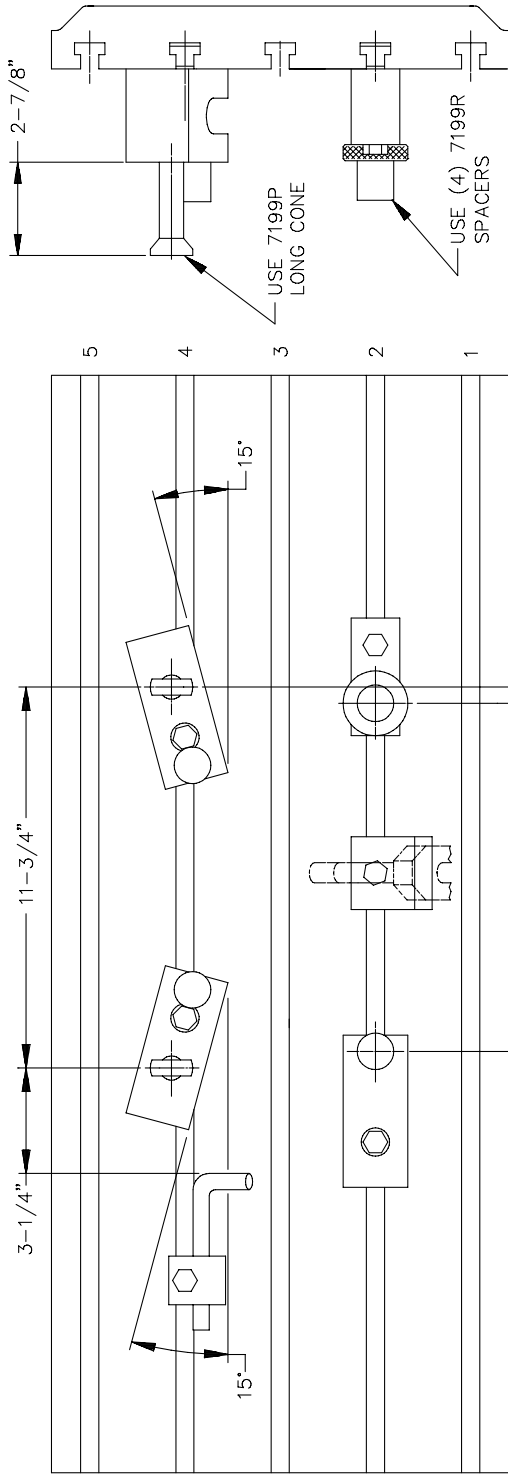
CONE CONTACT POINT

11-3/4"

CONE CONTACT POINT

REAR VIEW

NOTE: ALL ANGLE DIMENSIONS ARE ±10°



FRONT OF MACHINE

FRONT CONTACT POINT

NOTE: CLAMP CONTACT POINT SHOULD PRESS WITH APPROXIMATE CENTER OF TAPERED SURFACE.

FRONT VIEW

Chrysler 360:

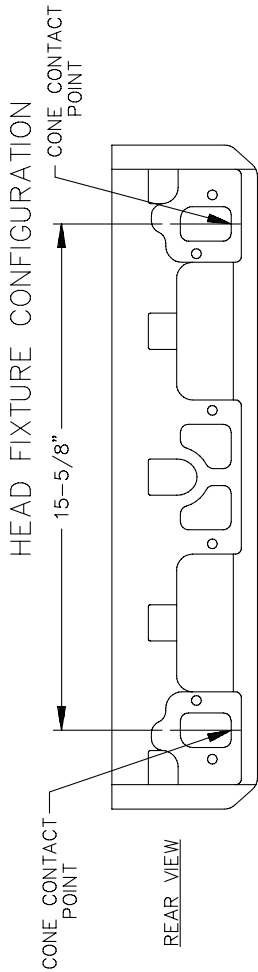
REFHEAD11-022894

HEAD TYPE: CHRYSLER 360

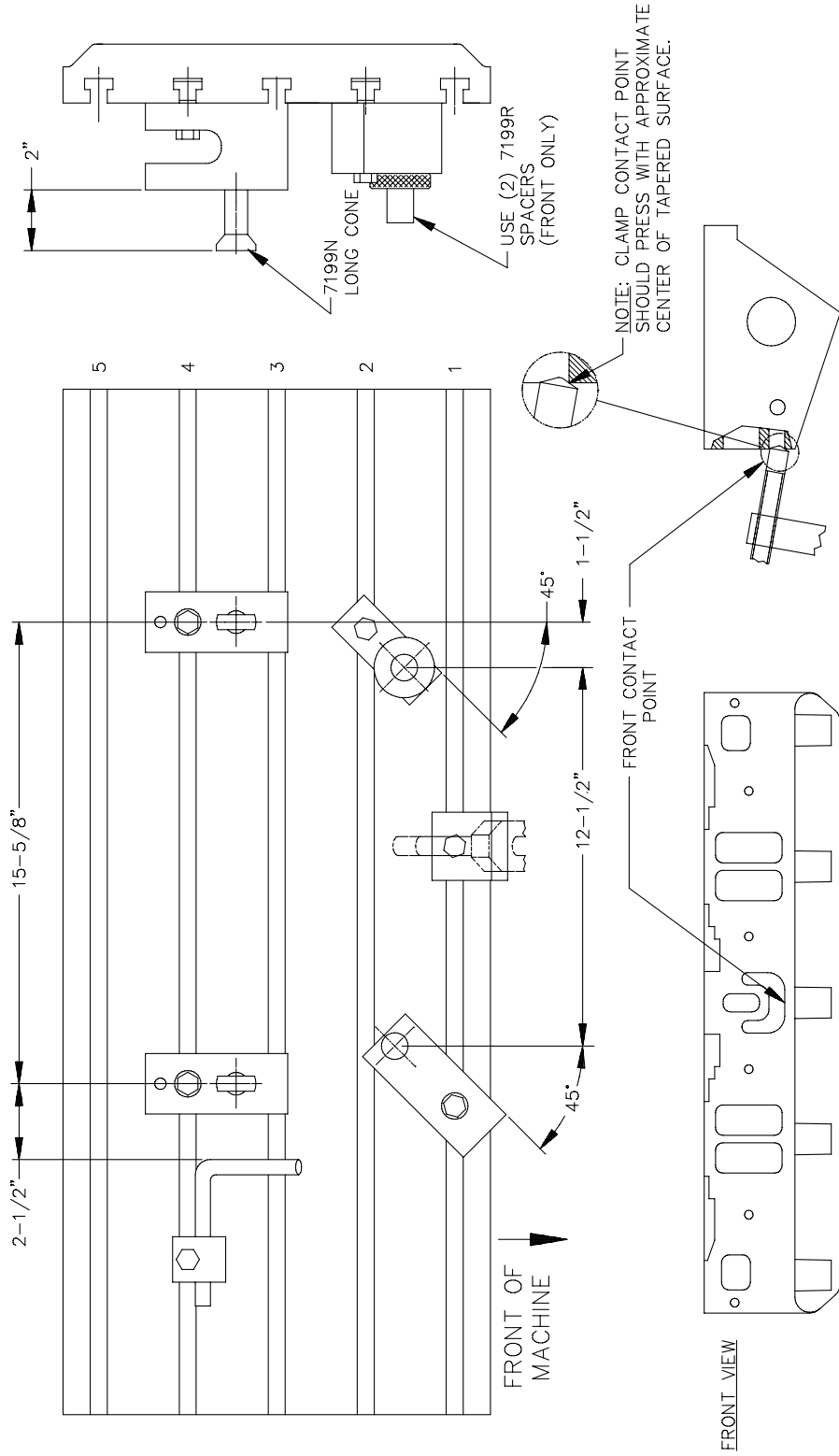
O.A. LENGTH: 20-1/2"

O.A. WIDTH: 7-3/8"

O.A. HEIGHT: 4-1/2"



NOTE: ALL ANGLE DIMENSIONS ARE ±10°.

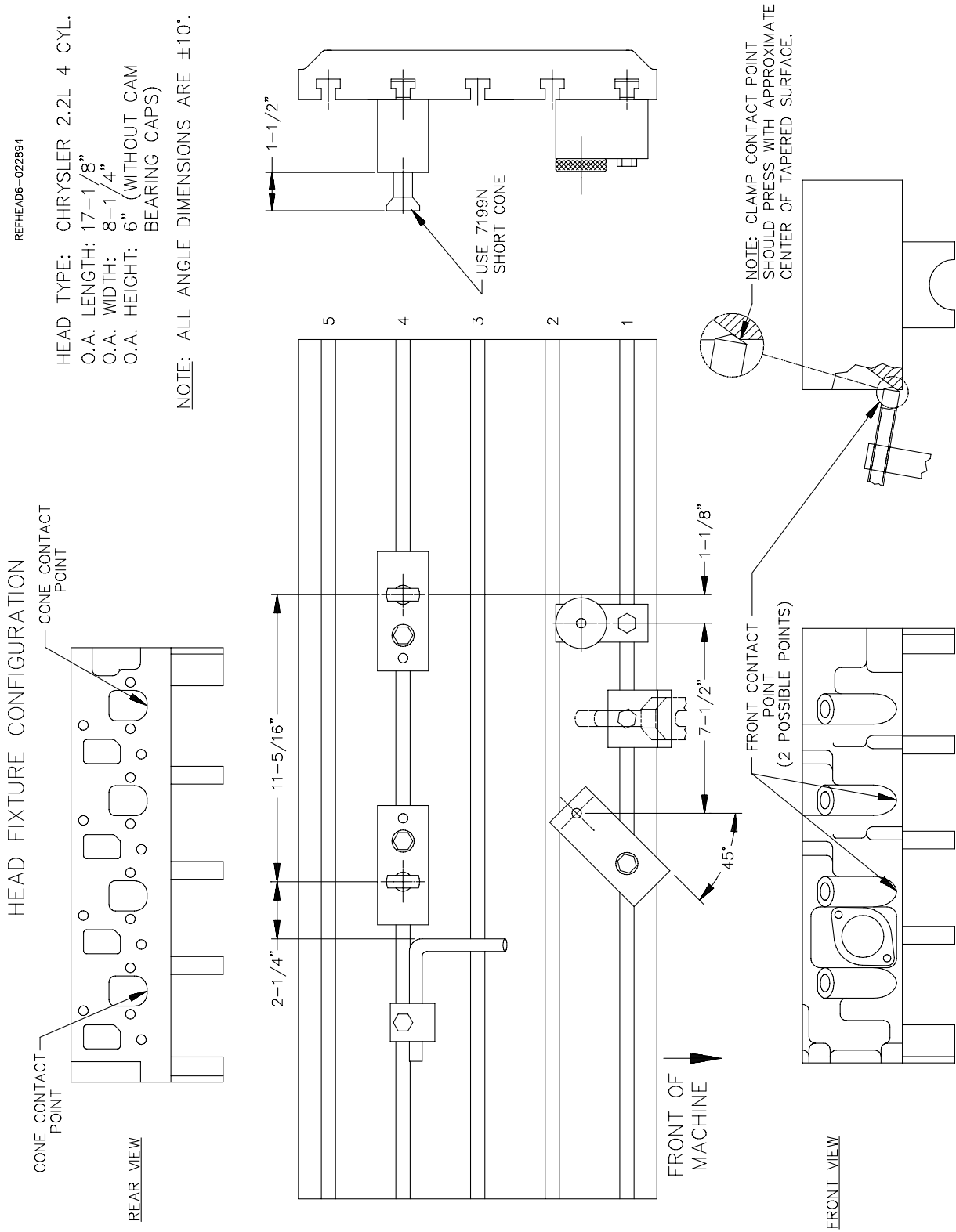


Chrysler 2.2 Liter 4:

REF:HEAD6-022894

HEAD TYPE: CHRYSLER 2.2L 4 CYL.
 O.A. LENGTH: 17-1/8"
 O.A. WIDTH: 8-1/4"
 O.A. HEIGHT: 6" (WITHOUT CAM BEARING CAPS)

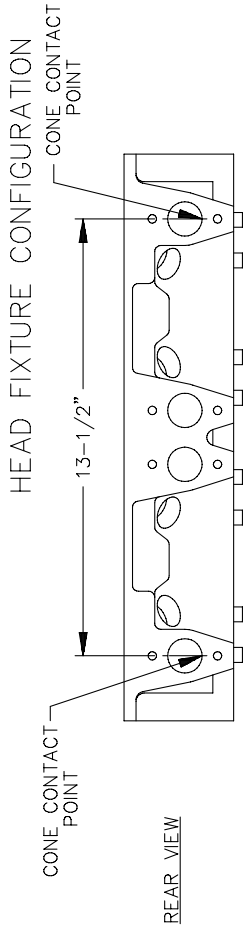
NOTE: ALL ANGLE DIMENSIONS ARE ±10°.



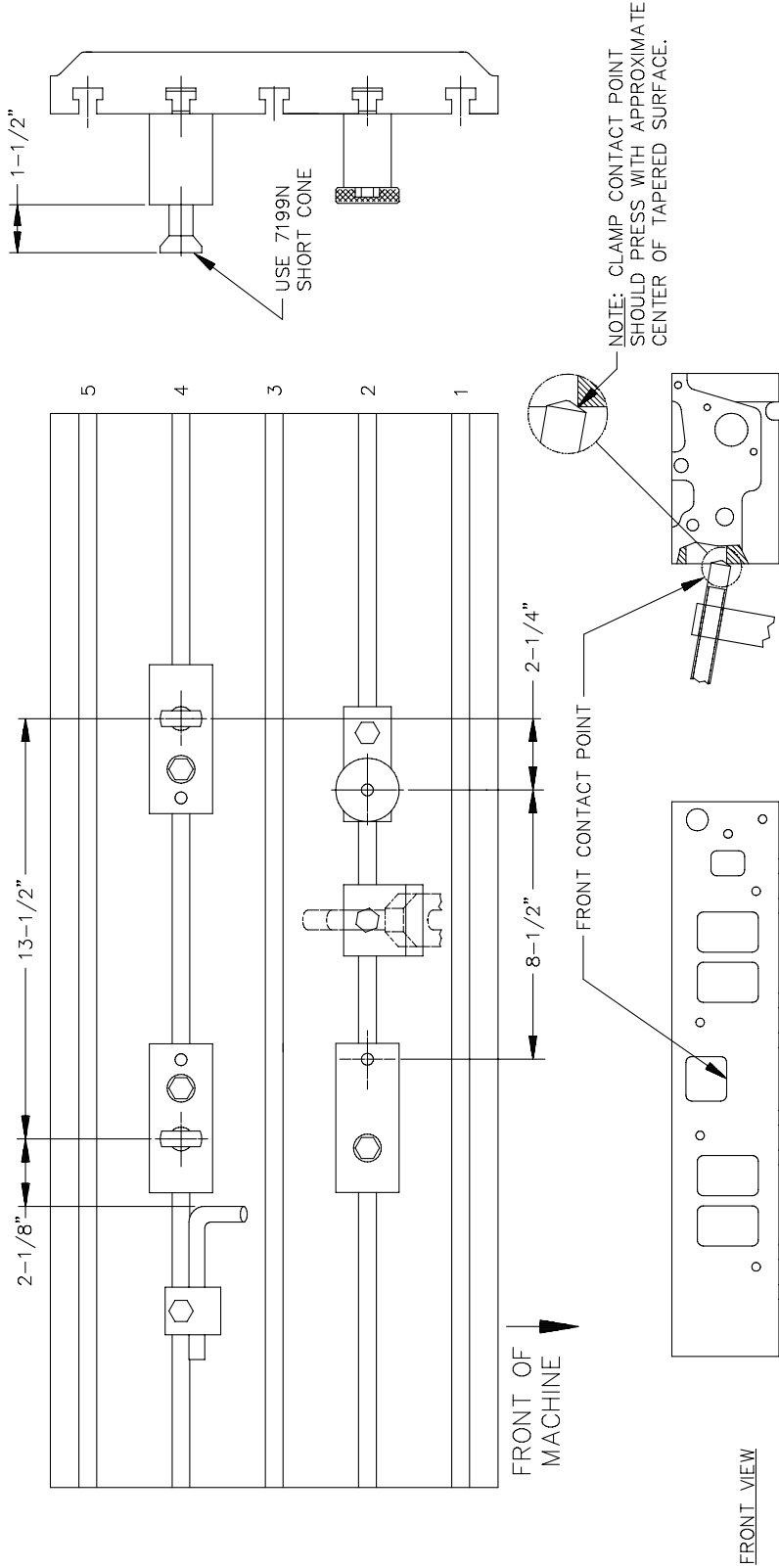
Detroit Diesel 6V92:

REF:HEAD16-022894

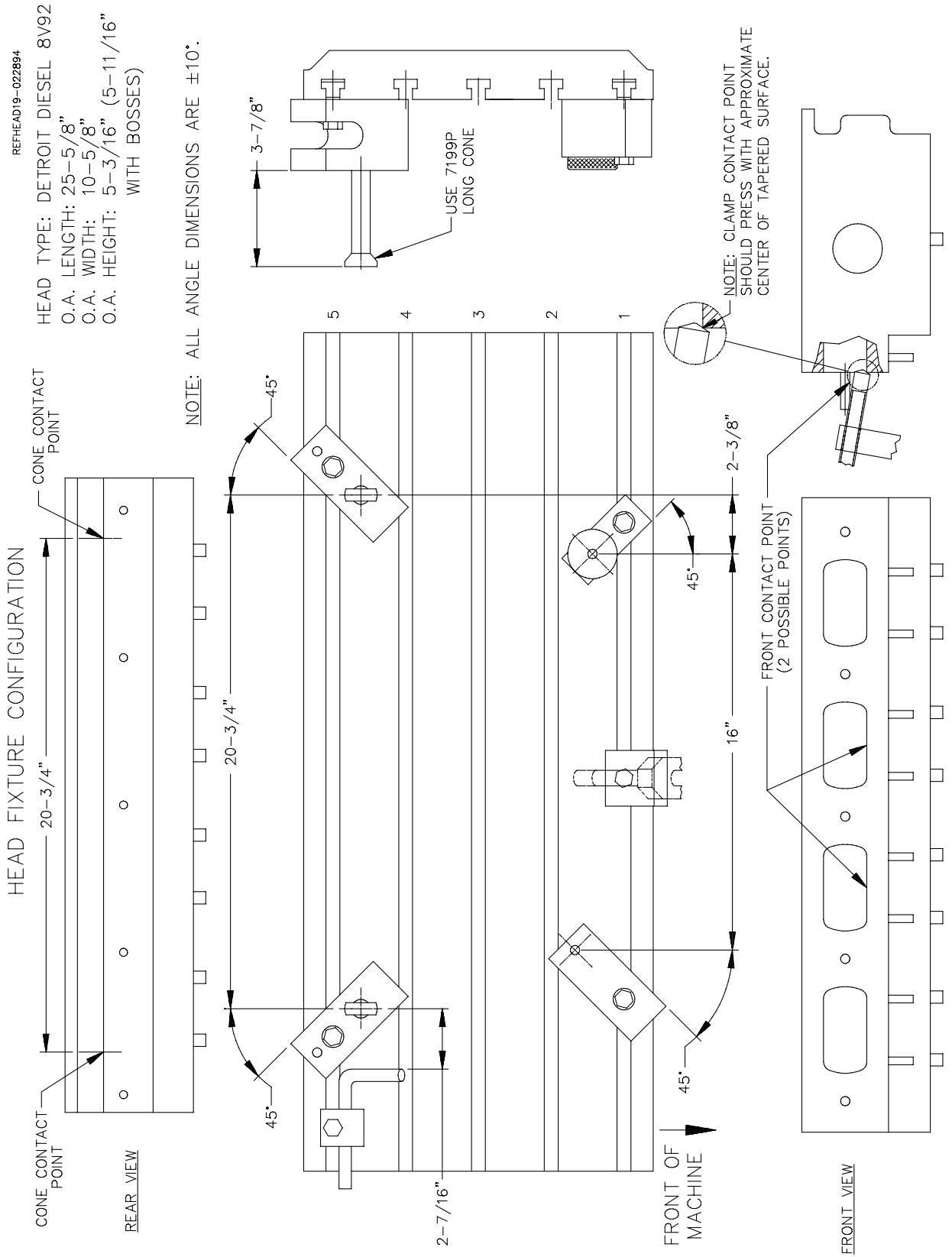
HEAD TYPE: GM 2.0L INLINE 4 CYLINDER
 O.A. LENGTH: 17-1/2"
 O.A. WIDTH: 6"
 O.A. HEIGHT: 3-3/8" (MINUS BOSSES)



NOTE: ALL ANGLE DIMENSIONS ARE ±10°



Detroit Diesel 8V92:

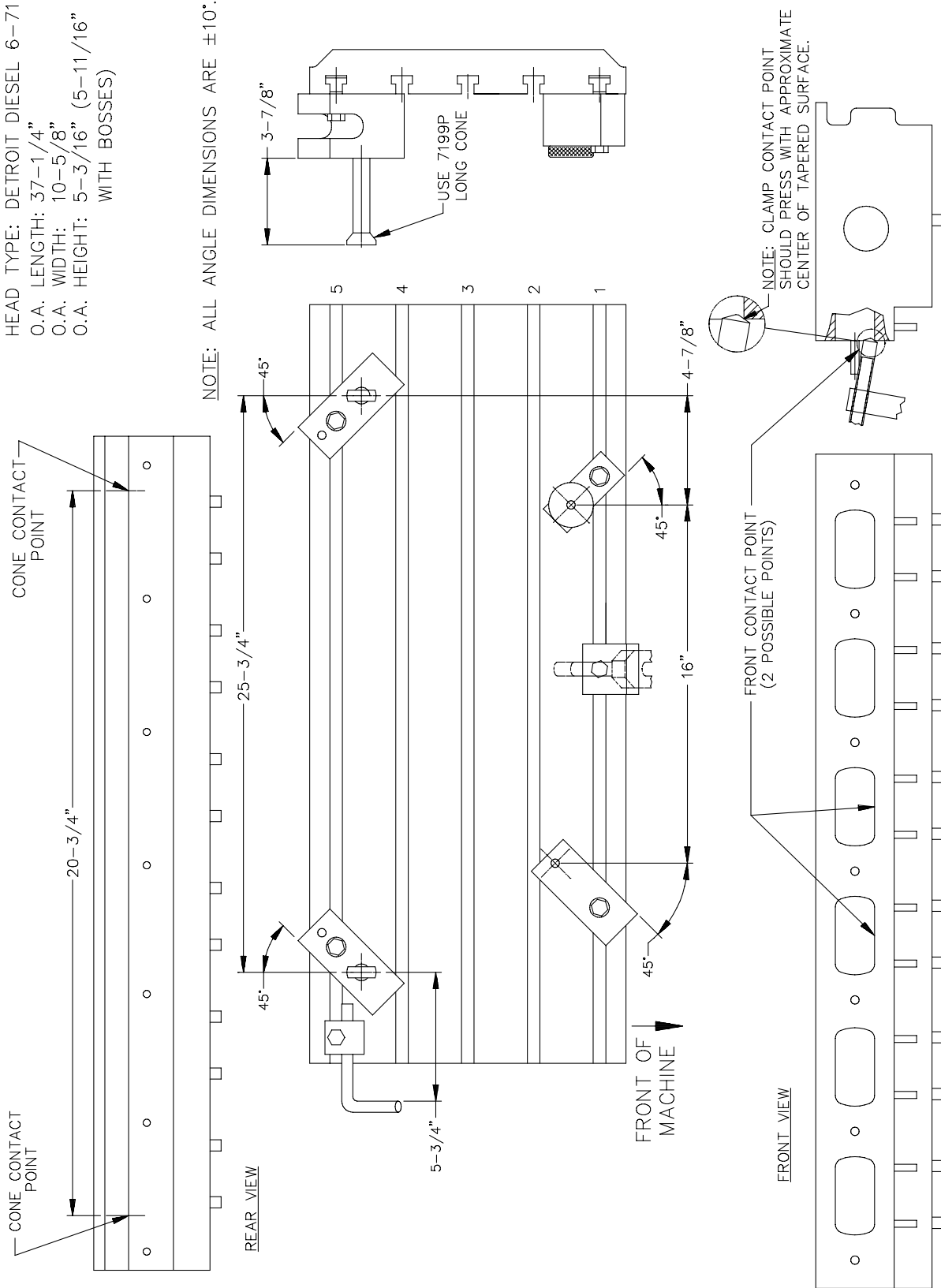


Detroit Diesel 6-71:

REFHEAD20-022894

HEAD TYPE: DETROIT DIESEL 6-71
 O.A. LENGTH: 37-1/4"
 O.A. WIDTH: 10-5/8"
 O.A. HEIGHT: 5-3/16" (5-11/16"
 WITH BOSSES)

HEAD FIXTURE CONFIGURATION



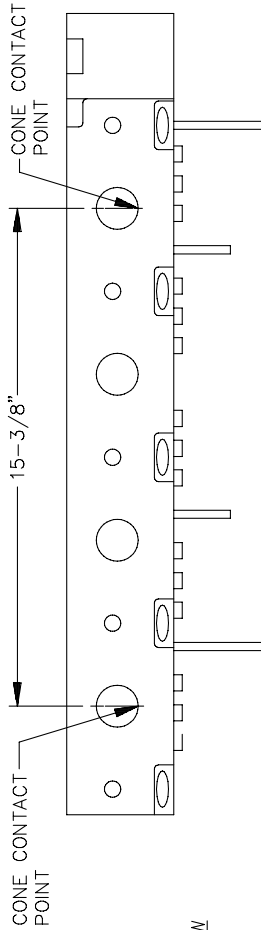
Mercedes 5 Cylinder Diesel:

REFHEAD17-022884

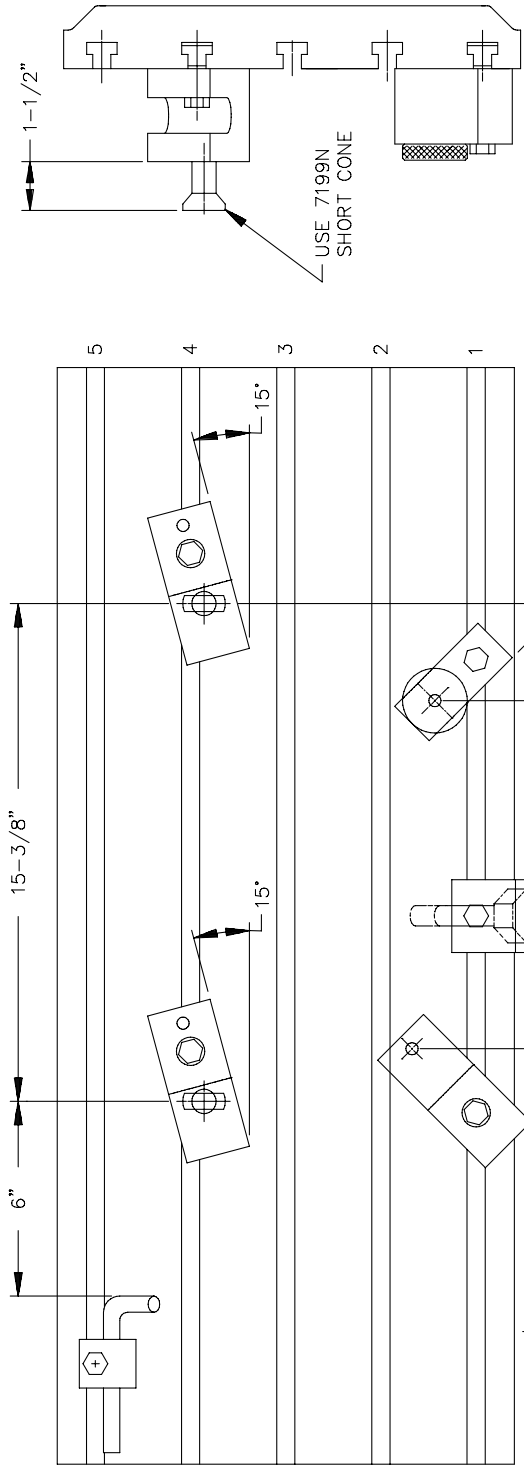
HEAD TYPE: MERCEDES 5 CYLINDER DIESEL
 O.A. LENGTH: 24-3/4"
 O.A. WIDTH: 10-7/8" (14" WITH STUDS)
 O.A. HEIGHT: 3-5/16" (6-1/16" WITH STUDS)

NOTE: THIS HEAD HAS PROTRUDING PRECOMBUSTION CHAMBERS WHICH MUST BE REMOVED BEFORE SURFACING.

NOTE: ALL ANGLE DIMENSIONS ARE ±10°

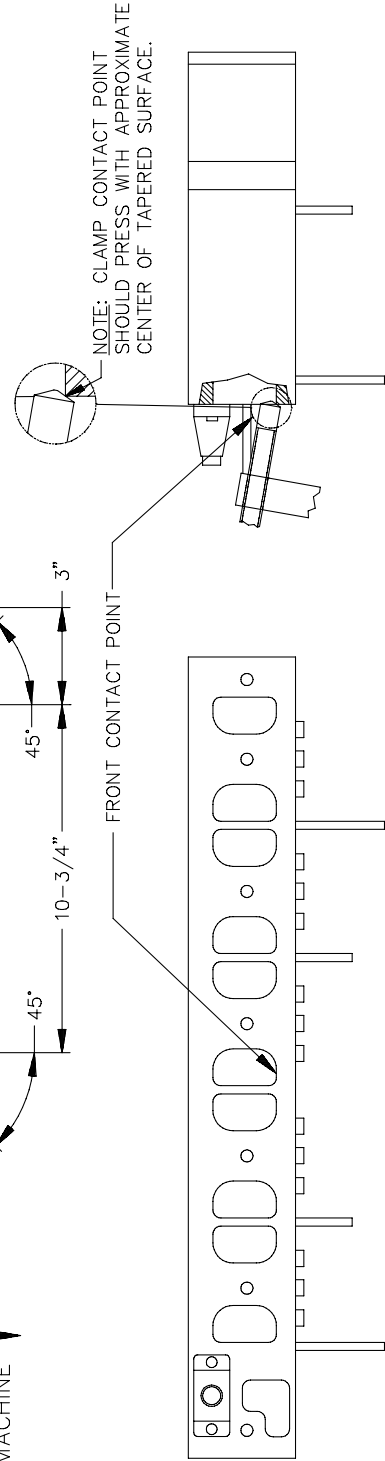


REAR VIEW



FRONT OF MACHINE

FRONT VIEW



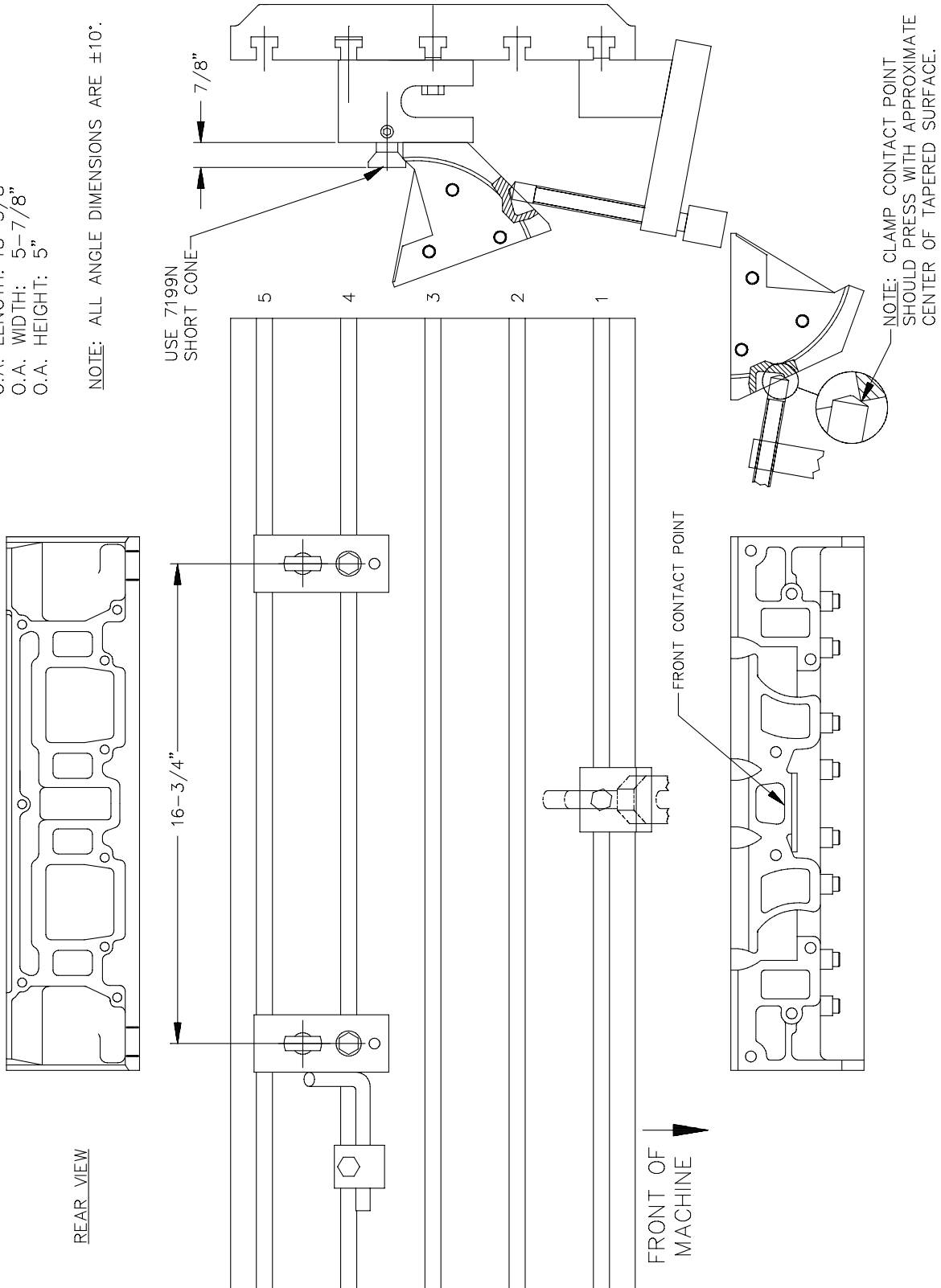
Cadillac 4.1 Liter:

HEAD FIXTURE CONFIGURATION

REFHEAD22-022894

HEAD TYPE: CADILLAC 4.1 L.
 O.A. LENGTH: 18-5/8"
 O.A. WIDTH: 5-7/8"
 O.A. HEIGHT: 5"

NOTE: ALL ANGLE DIMENSIONS ARE ±10°.

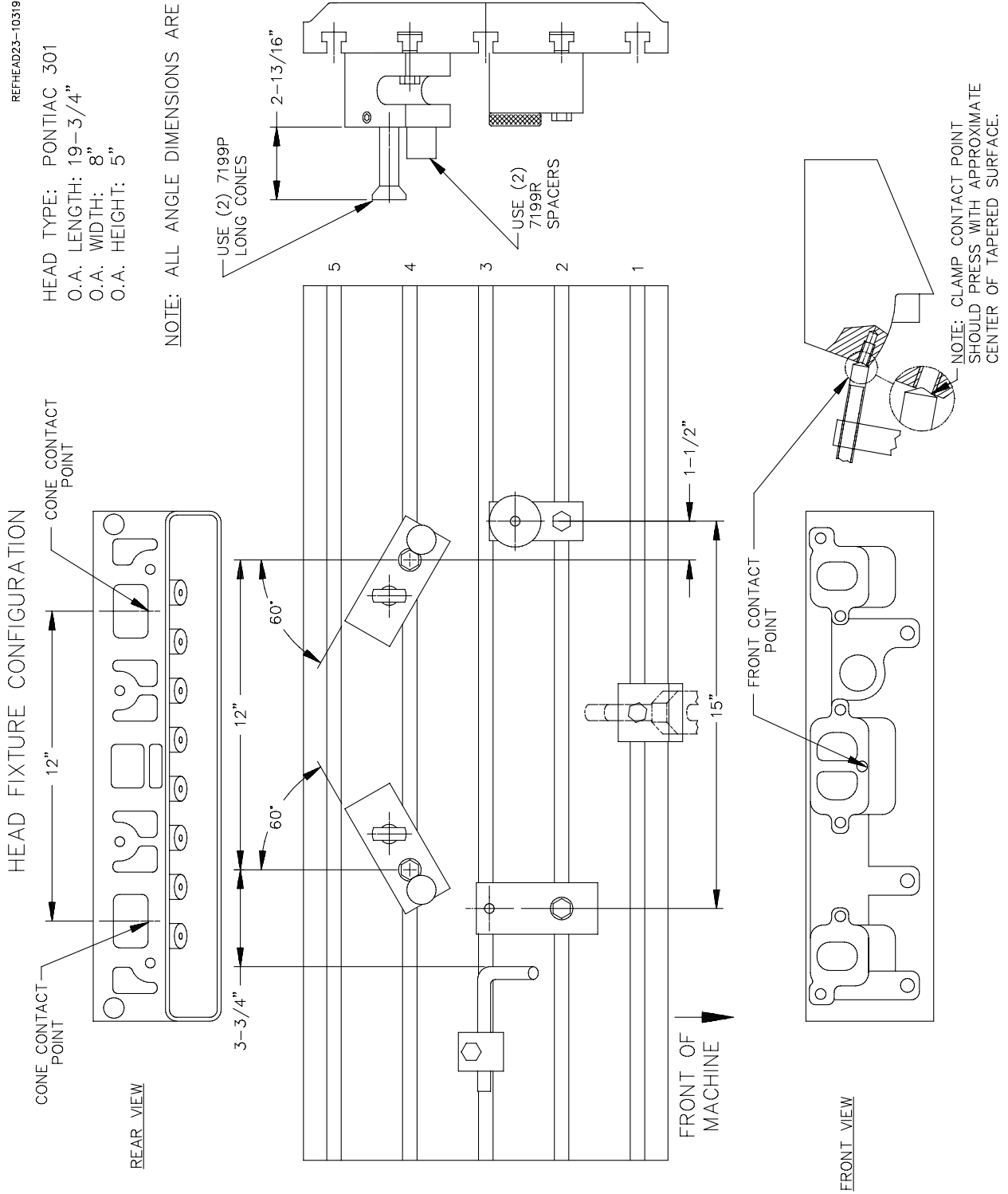


Pontiac 301:

REFHEAD23-103194

HEAD TYPE: PONTIAC 301
O.A. LENGTH: 19-3/4"
O.A. WIDTH: 8"
O.A. HEIGHT: 5"

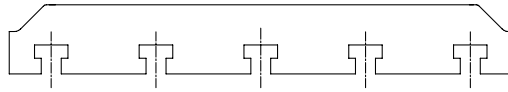
NOTE: ALL ANGLE DIMENSIONS ARE ±10°.



Blank Set-Up Sheet:

REFIDBLANK-022894

HEAD TYPE:
O.A. LENGTH:
O.A. WIDTH:
O.A. HEIGHT:



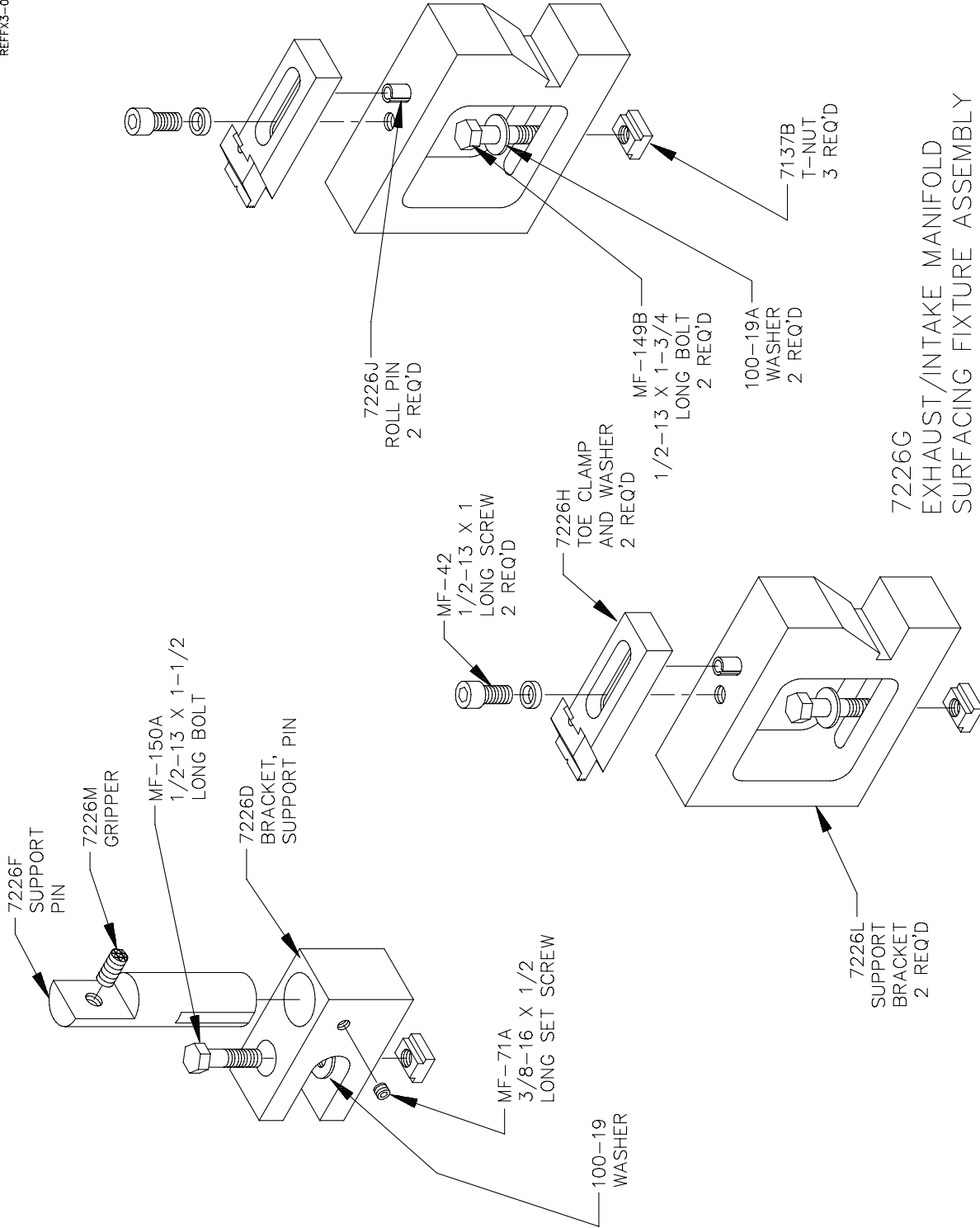
5	4	3	2	1

FRONT OF
MACHINE



7226G Exhaust / Intake Manifold Surfacing Fixture Assembly:

REFFX3-051496



7226G
EXHAUST/INTAKE MANIFOLD
SURFACING FIXTURE ASSEMBLY

Exhaust / Intake Manifold Fixture:

Exhaust instructions:

Note: *This fixturing is designed to hold most exhaust manifolds and most intake manifolds from 90 degree V/8 Engines.*

Most exhaust manifolds will be surfaced with the supports positioned approximately as shown on next page. Occasionally, however it may be necessary to rearrange the support blocks to fit unusual manifolds.

Place a manifold on the two front brackets. Adjust the rear pin to provide the best support. The best place for the front brackets is under the machined area, for the manifold mounting bolts, at the outside corners of the manifold. The rear pin should be approximately midway between the front brackets on the rear of the part. The pin should support under the main body of the manifold.

Adjust the rear pin up and down to bring the manifold close to level.

Tighten the tow 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 faced mallet.

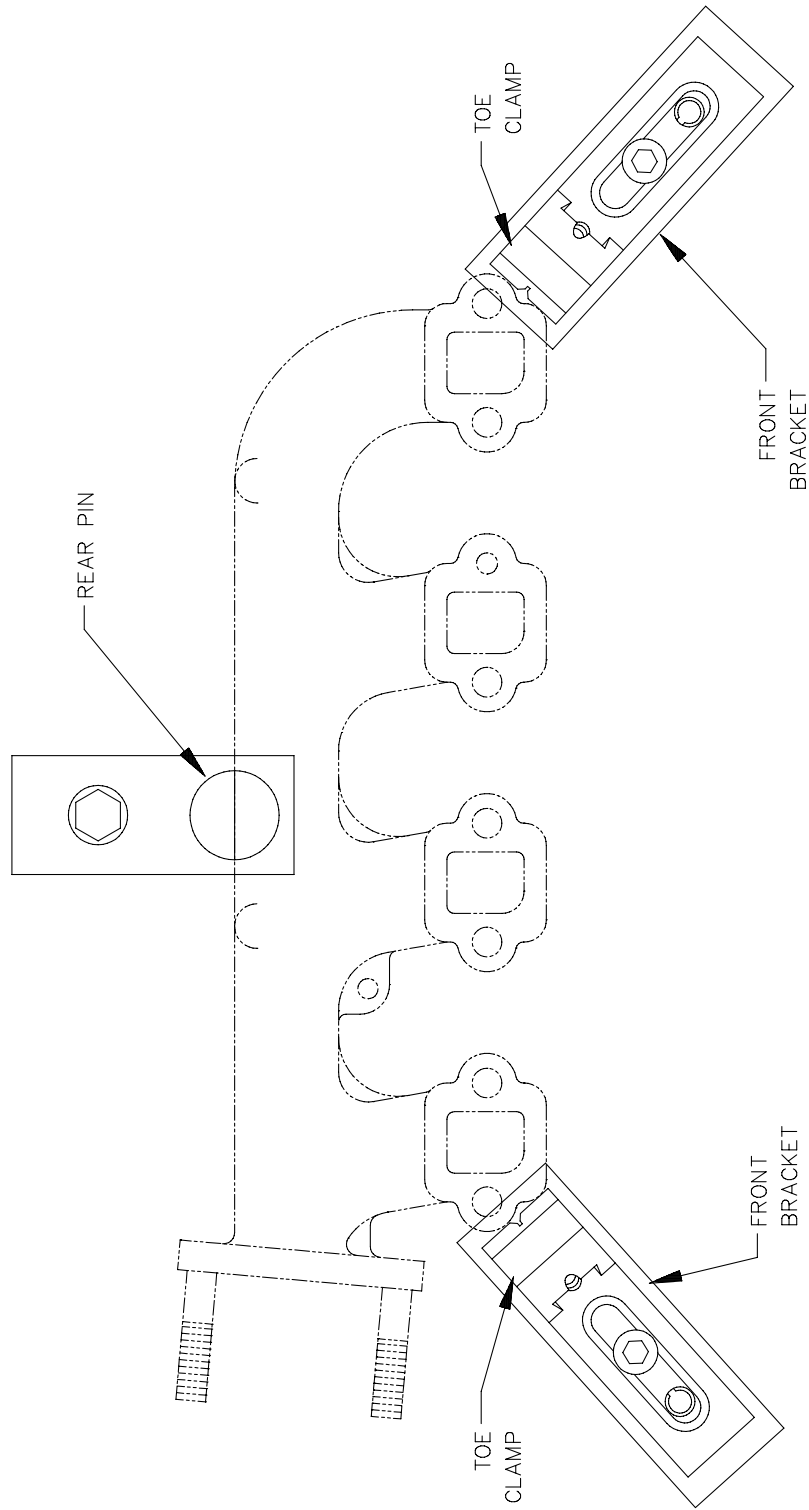
Level the manifold surface using the hand –wheels and the dual axis level system of the table.

Make sure there are no obstructions in the way of the cutterhead you are using. Also be aware of the 14” fly cutter guard, it might interfere with some obstructions. Some manifolds require the use of our 4” diameter shell mill and adapter.

The manifold is ready to surface.

Typical Exhaust Manifold Set-Up:

REFFX4-020993



Intake Instructions:



CAUTION At all stages of this process be sure there are no obstructions that might interfere with the cutterhead or it's guard.

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

This fixture is designed primarily for intake manifolds from 90 degree V-8 engines.

Start with the support blocks arranged as shown on the next page. Leave, the hold down bolts, finger tight, so that the blocks will slide easily.

Place the manifold in the two rear support brackets as shown. Adjust the brackets so they fit flush and parallel on one intake surface. Tighten the hold down bolts securely.

Adjust the remaining two support blocks to give to the manifold at the front. Slide the clamp assembly over and position the clamp foot so it will push on a solid area of the manifold, approximately centered

Tighten the clamp handle securely. Check to make sure the manifold did not move.

Using a small precision level, level the exposed intake surface, in both directions, by tilting the dual axis table as necessary.

Using the left hand-wheel only, rotate the table to level the lower surface of the manifold. This is done to make sure the dual axis table has enough travel. Rotate the table back up to the intake surface. Level this surface again.

This surface is ready to cut.

After surfacing rotate the table, using the left hand-wheel only, down to the center or lower surface, level this surface.

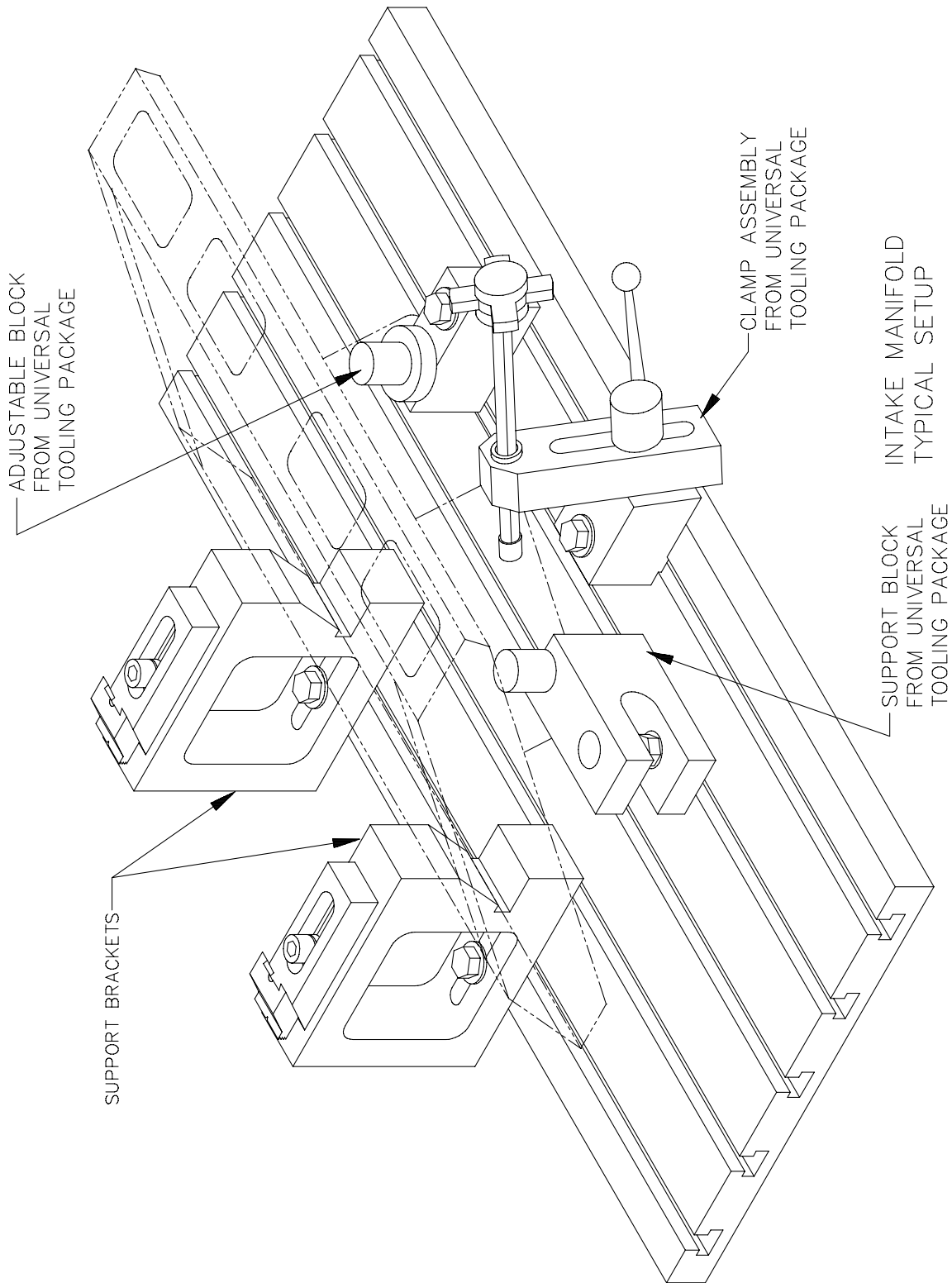
This surface is ready to cut.

Loosen the clamp screw and remove the manifold. Turn it around and reload with the fresh cur surface in the rear support blocks. Level the intake manifold surface and cut.

Using the left hand-wheel level the second lower surface and cut it.

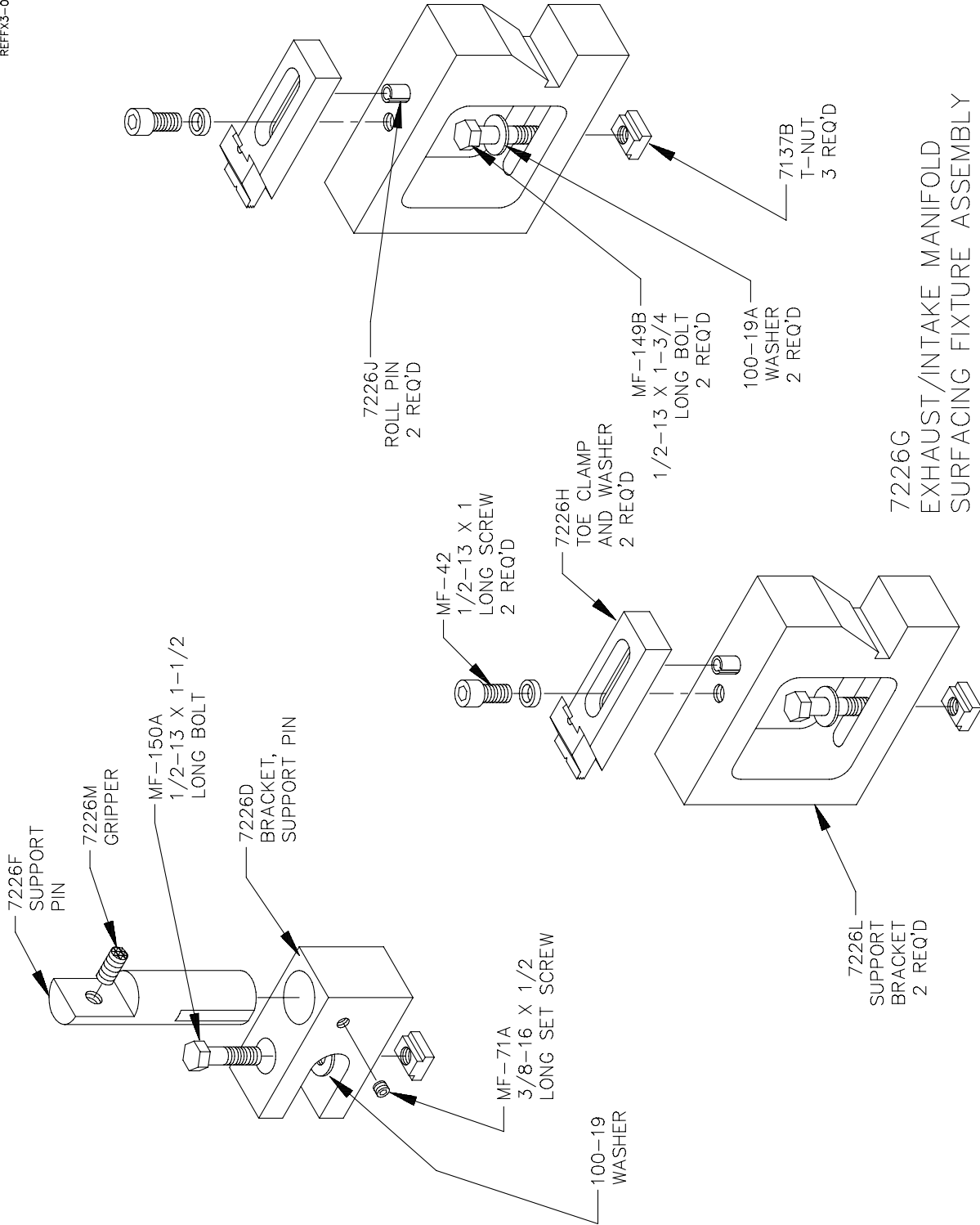
Typical Intake Manifold Set-Up:

REFX5-070893



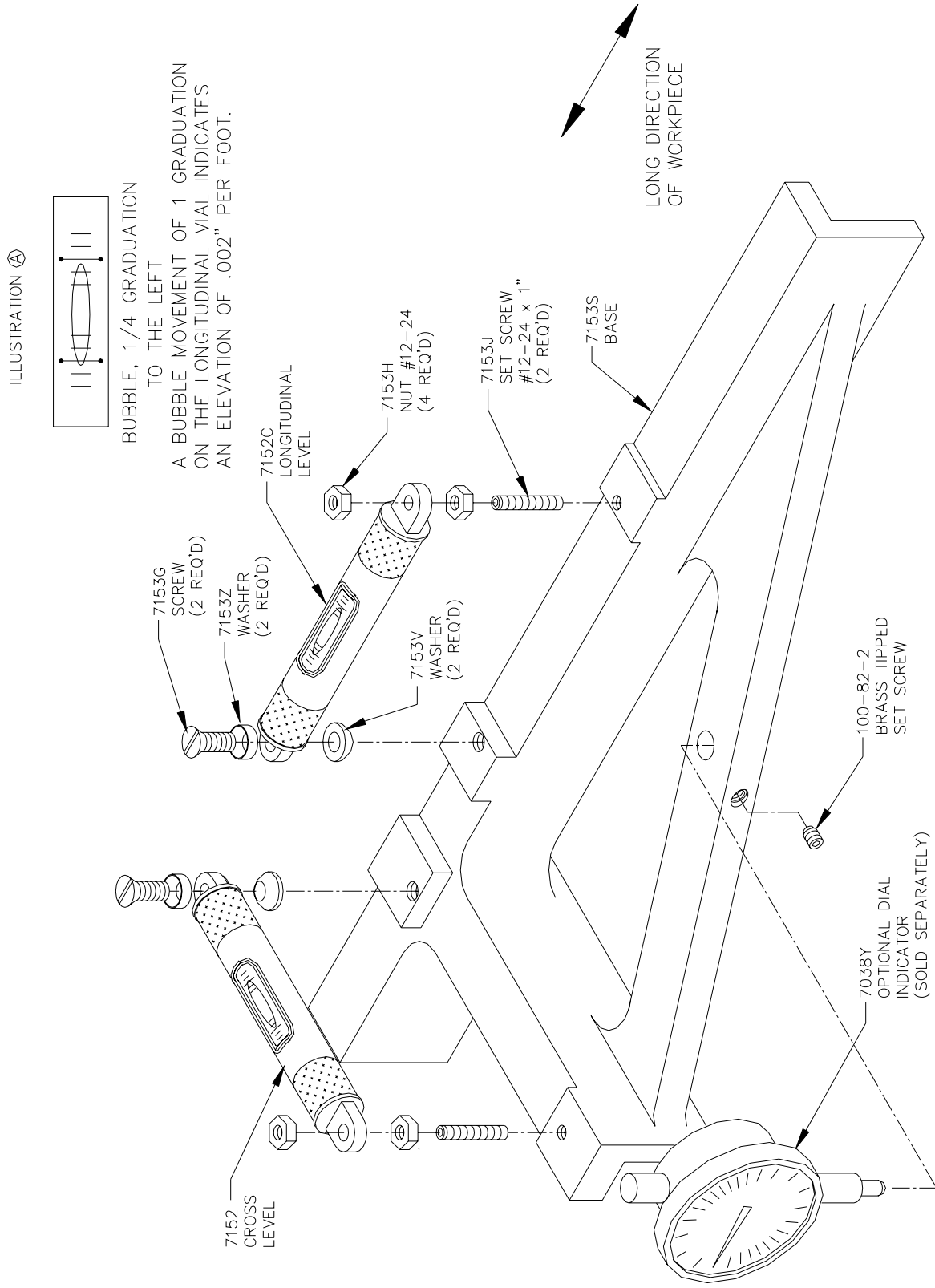
7226G Exhaust / Intake Manifold Assembly:

REFX3-051496



7226G EXHAUST/INTAKE MANIFOLD SURFACING FIXTURE ASSEMBLY

7152A Dual Axis Level Assembly:



REFFIXTUR32-060695

NOTE: 7152A ASSEMBLY DOES NOT INCLUDE 7038Y DIAL INDICATOR

Cutterheads:

Changing Cutterheads:



Press the Emergency Stop button when ever you are changing cutterheads.

Remove the centering fingers before changing the cutterhead. Not doing so could result in the finger not extending or retracting all the way on an automatic cycle.

Turn the cutterhead release knob, the draw bar will drop down about ½". Turn the cutterhead 90 degrees, lower the cutterhead out of the inner spindle slowly so not to damage the taper on either part.

Thoroughly clean the end, including inside the hole, of the cutterhead that is going to be put in. Be sure the cutterhead release switch is on. Line up the slot in the cutterhead, with the draw bar nose. Lift the cutterhead up as high as it will go.

Turn the centering knob handle to engage the centering rod spline inside the cutterhead. Line up the key, on the cutterhead, with the keyway in the inner spindle. Turn the cutterhead release knob to secure the cutterhead. Be sure the key lines up properly so the cutterhead pulls up into the inner spindle.

A dampener weight is in most Rottler boring cutterheads, to improve the performance of the boring machine. The dampener weight requires little or no maintenance. Occasionally, the dampener weight will get contaminated with dirt or liquids. If this happens, the operator will experience chatter problems. The cutterhead will have to be removed, disassembled, and cleaned. Disassembly is done by removing the screws located in the bottom of the cutterhead. (see illustrations following).

Cutting Inserts:

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 cutting tools be used. Rottler machine performance can be significantly reduced if qualified tooling is not used. Using an incorrect insert can result in bore geometry inconsistency, short tool life, and poor surface finish.

Below are general guidelines. When using these inserts it is best to refer to the operator manual of the particular machine you are using. Rottler Manufacturing's latest operator manuals have more detailed information on feeds and speeds for the particular machine and cutterhead that you are using.

Cylinder Boring Inserts

Rottler has just completed the development of group of new triangular inserts for cylinder boring. Extensive trials were made to come up with new inserts that would outperform the older inserts. The result is a group of inserts that are the same unit cost but have 5 – 50% increased tool life. The increased tool life decreases overall operation cost to the end user.

RT321 (General purpose and sleeving)

A 3/8" IC triangular insert with a black ceramic coating and 1/64" cutting radius. This insert is the best to use for counterboring when the small corner radius is required for clearance or when the machine is at its extended travel limits. 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 in the radius. 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 per revolution 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 S.F.P.M. area for best productivity and tool life. When cutting nodular cast iron the speed should be in the 200 – 400 S.F.P.M. area. Nodular cast iron is found most often in high performance engine blocks or sleeves.

RT322 (General purpose and sleeving)

This is the same insert as RT321, except it has a 1/32" radius. This insert is the best to use for heavy sleeve cutting and can also be used for general machining and counterboring. This larger radius insert will give a smoother finish for a given feed rate when sleeve cutting to allow easier sleeve fitting and closer metal to metal contact for heat transfer. It is possible to use a feed rate that is 30% faster with the RT322 compared with the RT321 and still obtain the same finish. The 1/32" radius is stronger than the 1/64 radius of the RT321. The RT322 should always be used for heavy 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 radius. The increased tool pressure may cause chatter in the finish if machining very long bores. A feed rate of .006 - .012 per revolution 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 S.F.P.M. area for best productivity and tool life.

When cutting nodular cast iron the speed should be in the 200 – 400 S.F.P.M. area. Nodular cast iron is found most often in high performance engine blocks or sleeves. When cutting this material it is important to use as high a feed rate as possible - .006 - .010 per revolution should work.

RT211 (General purpose and sleeving)

A 1/4" IC triangular insert with a black ceramic coating and 1/64" cutting radius. 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 S.F.P.M. area for best productivity and tool life. When cutting nodular cast iron the speed should be in the 200 – 400 S.F.P.M. area. Nodular cast iron is found most often in high performance engine blocks or sleeves.

RT212 (General purpose and sleeving)

This is the same insert as RT212, 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 .006 - .012 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 S.F.P.M. area for best productivity and tool life. When cutting nodular cast iron the speed should be in the 200 – 400 S.F.P.M. area. Nodular cast iron is found most often in high performance engine blocks or sleeves.

RT321F (Precision Counterboring and Finishing)

A 3/8" IC triangular insert with a gold coating and 1/64" cutting radius. The coating gives the best finish results when machining precision counter bores often machined in diesel engine blocks. 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 300 - 800 S.F.P.M. area for best productivity and tool life. Tool life of this insert is significantly less than the RT321.

RT322F (Precision Counterboring and Finishing)

A 3/8" IC triangular insert with a gold coating and 1/32" cutting radius. The coating gives the best finish results when machining precision counter bores often machined in diesel engine blocks. A feed rate of .004 - .008 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 300 - 800 S.F.P.M. area for best productivity and tool life. Tool life of this insert is significantly less than the RT322.

RT211F (Precision Counterboring and Finishing)

A 1/4" IC triangular insert with a gold coating and 1/64" cutting radius. The coating gives the best finish results when machining precision counter bores often machined in diesel engine blocks. 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 300 - 800 S.F.P.M. area for best productivity and tool life. Tool life of this insert is significantly less than the RT211

RT212F (Precision Counterboring and Finishing)

A 1/4" IC triangular insert with a gold coating and 1/32" cutting radius. The coating gives the best finish results when machining precision counter bores often machined in diesel engine blocks. 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 300 - 800 S.F.P.M. area for best productivity and tool life. Tool life of this insert is significantly less than the RT211.

RS322 (for high speed oversize through boring)

A 3/8" IC, square insert with a black ceramic coating. It is used on Rottler boring machines for through boring when removing .010" (.25mm) - .060" (1.5mm) inches on the diameter. A very economical insert as it has 8 cutting edges. On a 4" (100mm) bore use 1000 - 1200 RPM and a feed rate of .008" (.2mm) - .012" (.3mm) per rev feed rate to obtain the typical surface finish. The insert can also be used for sleeve cuts when a square step is not required. For example, when used on an F80 or F5 machine it can be run

at 1000 – 1200 RPM and .005/rev (.12mm) feed rate to remove up to .200" (5mm) on the diameter from a 4.200" (106mm) inch bore.

501-29-6B R4 (for oversize through boring)

A 3/8" IC square insert with a gold titanium coating. It is used for through boring when removing .010" (.25mm)-.060" (1.5mm) inches on the diameter. A very economical insert as it has 8 cutting edges. For best tool life use 500 - 800 S.F.P.M. Use a feed rate of .004 - .010 to obtain the typical surface finish. This insert is most commonly used on older boring machines which are not capable of turning faster than 700 RPM.

6301E (for high speed oversize through boring)

This is a square 3/8" IC, 1/32" Radius, double sided, CBN Insert. These inserts are intended for use on high speed boring on Rottler F80 and F60 series machines. On common cast iron blocks the RPM should be set to achieve 1000 – 2200 S.F.P.M. On harder cast irons the RPM should be reduced to obtain acceptable tool life. A feed rate of .010" - .014" per revolution. They have exceptional long life when removing up to .040" on the diameter. They do not give good tool life on some cast irons with high sulfur content.

501-29-6K (for high speed aluminum boring)

This is a 3/8" IC, triangle insert with a black diamond tip. It has a 1/32" radius. This insert is used to bore aluminum cylinders. It can not be used to bore any other material. It is the best insert for finishing aluminum. For best tool life and finish the insert can be run from 400 – 4000 SFM. Feed rates between .004 and .010 should be used.

Surfacing Inserts

Below are the inserts commonly used on Rottler machines in surfacing/milling applications. Please read carefully.

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. When using an 18" cutterhead (F80) speeds range from 600-800 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 600-1000 RPM.

501-29-6E R2

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. **REPLACED BY RS322**

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.

Bi-metal Surfacing**Cylinder Heads with Pre-combustion Chambers**

Cylinder heads with pre-combustion chambers or aluminum engine blocks with cast-iron or steel cylinder sleeves are a challenge to cut and most often require a special cutting insert and special cutting technique. There are many different material combinations so there is not one insert that works the best on all applications. Below is information to use as a guide to the best insert to use and some of the required cutting parameters. Generally the tool life when using any of these inserts in the cutting of bi-metal surfaces will be short when compared to cutting a single material. The cost of the insert per surfacing job will be higher compared with cutting single materials. The customer must incorporate the higher insert cost into the price charged for the surfacing job.

Another excellent alternative to cutting cylinder heads with pre-combustion chambers is to remove the combustion chamber from the head, surface the cylinder head, then use the Rottler Pre-combustion Chamber Re-seating Tool to machine the combustion chamber counterbore back to OEM specification depth. It is fast and economical to use. See Bulletin C49.

Cylinder Heads with Protruding Valve Seats

Some cylinder heads have valve seats that protrude into the head gasket surface. Valve seats are made out of a wide variety of material. Some are very hard or difficult to cut when compared with the aluminum or cast iron head surface. In many cases it is best to cut the valve seat down below the head surface in a seat and guide machine. This takes a few more minutes when cutting the valve seats but it can save a lot of time and minimize tooling cost when surfacing the head.

The following inserts use Rottler 3/8" 9.52mm 'standard' Toolholders supplied with Rottler Surfacing Cutterheads:

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.

6303U

A round 3/8" IC, single sided, CBN Insert. This insert does an excellent job when cutting hard cast iron blocks and heads of a single material or bi-metal. This insert is the best to use when machining compacted graphite cast iron heads and blocks often found in the performance industry. RPM speeds with a 14" cutter range from 650-750 RPM.

6301I

A square 3/8" IC, double sided, ceramic insert. For use on cast iron heads with pre-combustion chambers. You can make one finish cut and two rough cuts with each new cutting edge. Always use a new edge when making a finish cut. Use 350-500 RPM on a 14" diameter cutterhead. See Bulletin C49

6301V

A round 3/8" IC, double sided, ceramic insert. For use on cast iron heads with pre-combustion chambers. You can make one finish cut and two rough cuts with each new cutting edge. Always use a new edge when making a finish cut. Use 350-500 RPM on a 14" diameter cutterhead. See Bulletin C49

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 and with an 18" cutter range from 500-600 RPM.

Special Toolholder and Insert:**7202X**

Holder Assembly, Fly Cutter Tool 3/8" (9.525mm) IC (for use with special insert for aluminum cylinder heads with pre-combustion chamber and cast iron heads with soft precups like Land Rover) **for use with 7202Z insert only**

7202Z

Round Insert, 3/8" gold coated for aluminum cylinder heads with pre-combustion chamber and cast iron heads with soft pre-combustion chambers like Land Rover). Use in 7202X tool holder only. RPM speeds with 14" cutter range from 450-550 RPM and with a 16" cutter, 400-500 RPM.

Main Line Boring Inserts

Use the same RT series inserts as defined under cylinder boring. Depending on type of toolholder, either 1/4" IC or 3/8" IC inserts will be required. Commonly 1/64" radius inserts are used for rough or heavy cutting, and 1/32" radius inserts are used for finish boring for a smooth surface finish. In extreme conditions where the material is hard or the tool is extended and prone to chatter use the 1/64" inserts. The RT"F" series will usually give a better finish but will not cut as fast and generally tool life will be less.

Connecting Rod Inserts

The following inserts are commonly used for boring connecting rods.

RTCR321

A triangular, 3/8 IC, 1/64" radius, silver colored insert. This insert is designed to cut 4140 and other steels that connecting rods are often made of. Cutting speed is critical when using this insert. If the insert is operated at a speed that is too slow the surface finish will not be adequate, the tool life will be shortened, and bore geometry will be compromised. The cutting speed should be 800 – 1300 SFM. Feed rate should be between .001" and .004" per revolution depending on the finish requirements.

When connecting rods made of cast iron or the pin end of connecting rod has a bronze bearing, the RT series of inserts should be used.

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.

Insert breaking or chipping can be caused by several things. It can be caused by not operating the insert at the correct RPM. It is very typical for an insert to break or chip when cutting too slow. Interrupted cuts can cause an insert to break as well. When making a heavy sleeve cut in a cylinder that has been

cracked it is often required to slow the RPM down to ½ the normal operating speed to prevent chipping of the insert.

Cutting Speed Calculation

Inserts are designed to cut within a speed range (S.F.P.M.). In order to convert from cutting speed to RPM, use the following formula:

$$\text{RPM} = \frac{\text{S.F.P.M.} \times 3.82}{\text{DIAMETER}}$$

S.F.P.M. = Surface Feet per Minute

RPM = Revolutions per Minute

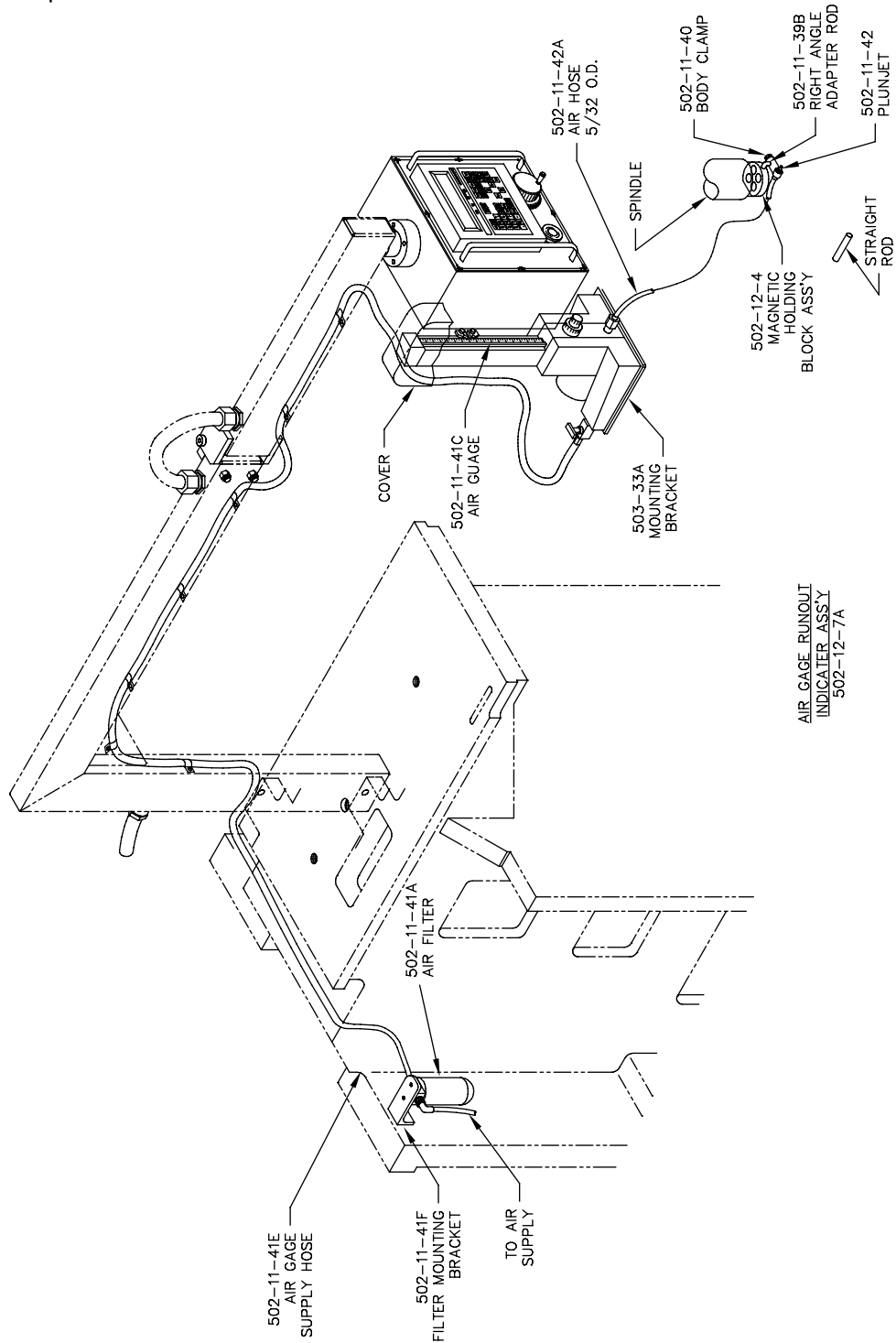
DIAMETER in Inches

Measuring and Indicating Devices:

502-12-7A Remote Runout Indicating System:

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

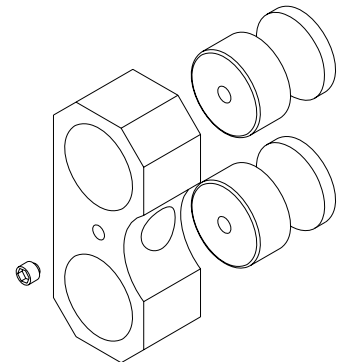
REF853-043098



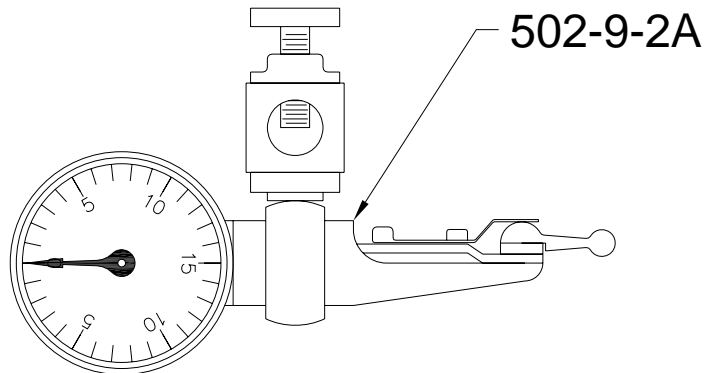
502-12-4A Magnetic Indicator Holder Assembly (requires 502-9-9A Indicator):

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

REF8S135-05082006



502-9-9A Mechanical Runout Indicator, General Purpose (.001" resolution):

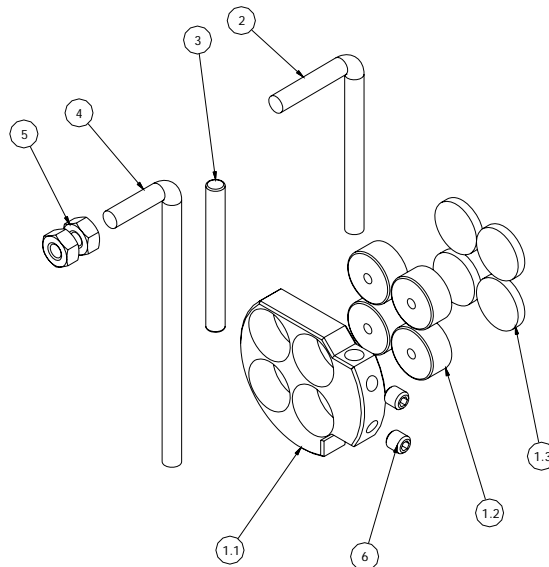


REF8S136-05092006

502-12-4 Magnetic Holder Assembly:

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

REF8S137-05092006

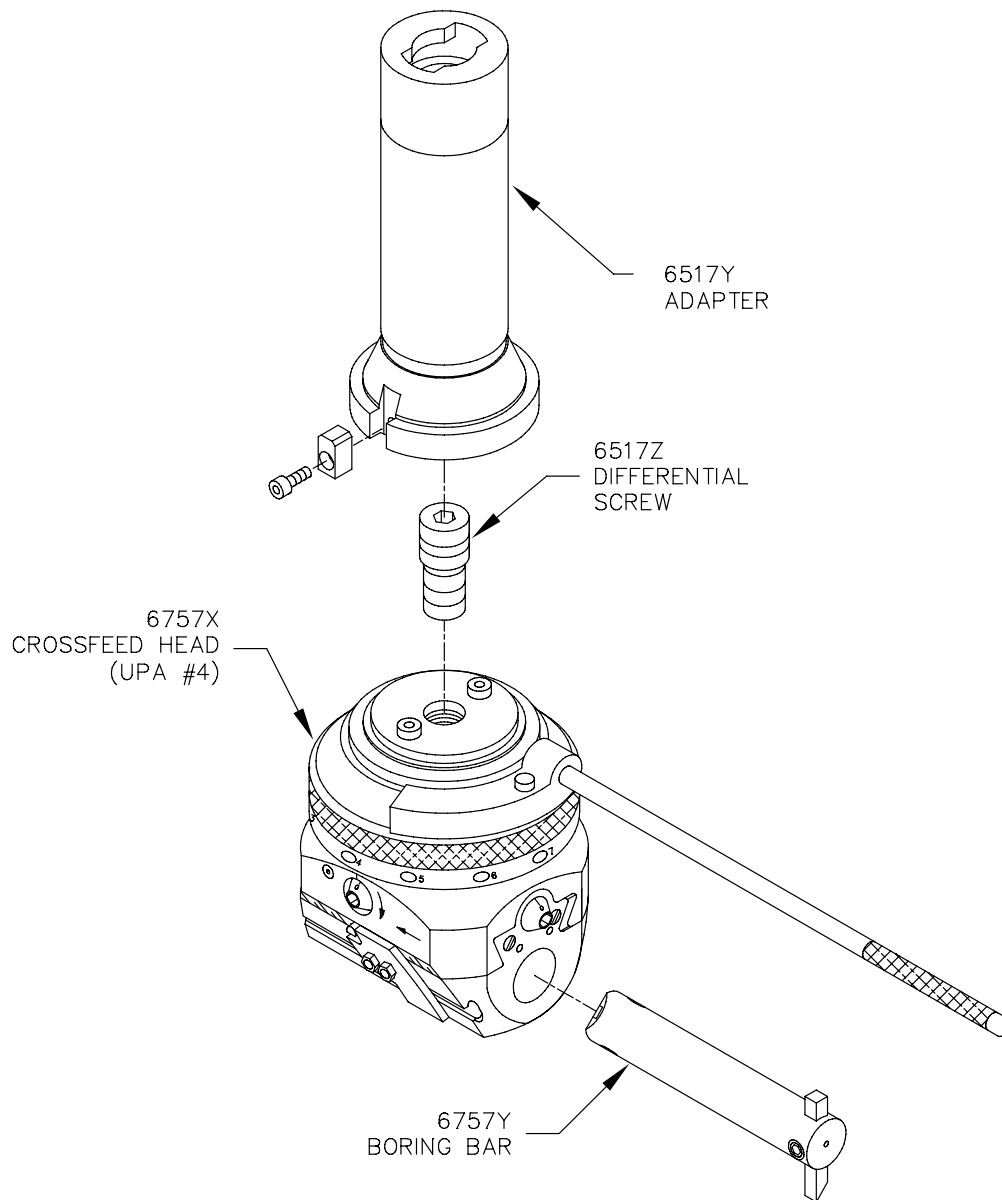


6757Z Cross Feed Head Assembly

The Cross Feed Head is used to machine faces and tapers (chamfers) that are either too wide or inaccessible to our standard counter boring and chamfering tooling packages.

This Cross Feed system is extremely versatile. However, Rottler's standard boring tools are far superior for quick set up and maximum machining performance on standard boring and counter boring operations.

REF88AC90-121397



1.5" Blind Hole Stub Bar:

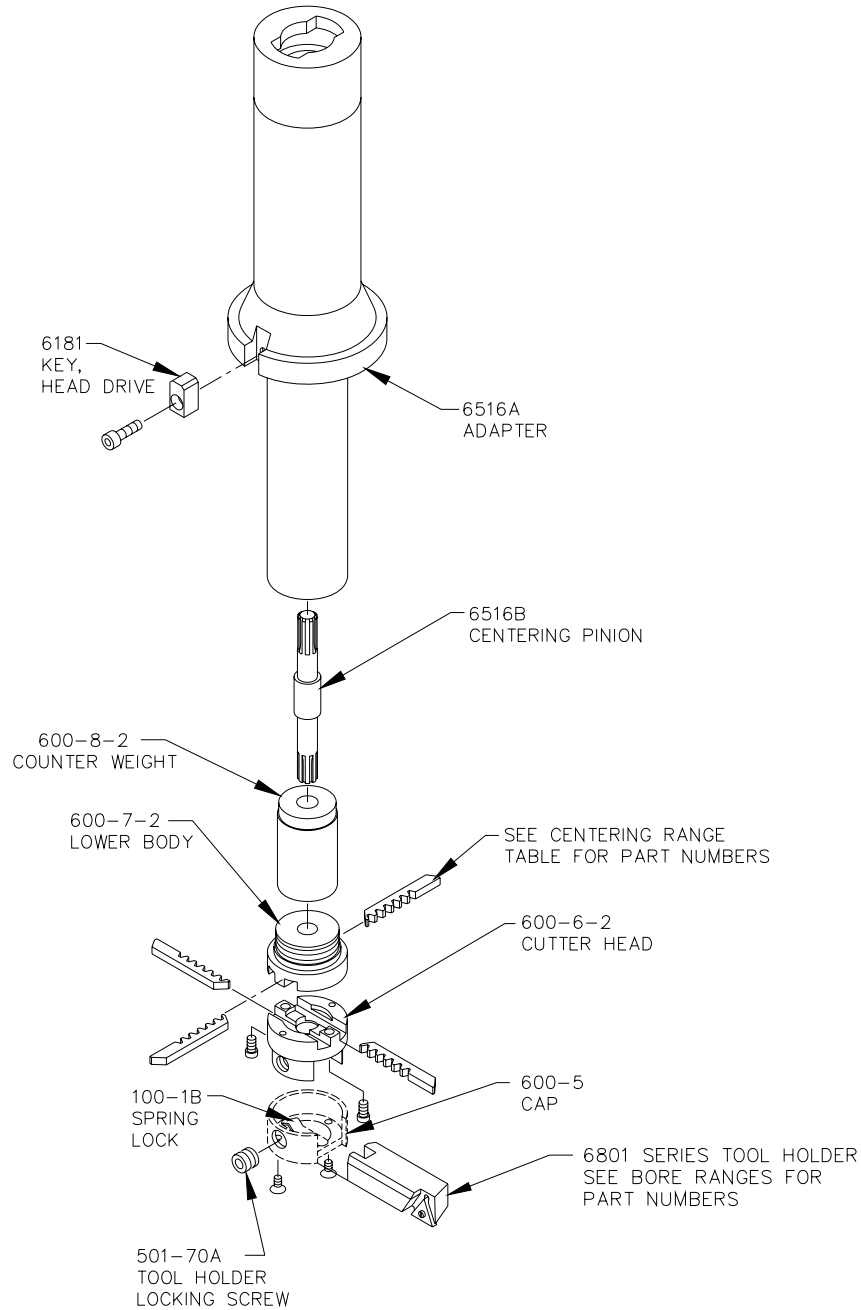
6516 With Tooling

6516C Without Tooling

The 1.5" diameter (38mm) stub boring head has a capacity of 1.5" to 4.1" (38mm to 104mm) diameter by 6.5" (165mm) depth. The 1.5" stub boring head is attached and operates basically the same as the other Rottler cutterheads. This cutterhead is a blind hole cutterhead. The tool bit must be removed to center each bore.

Locate the work piece so the end of the stub boring head is no further than 1" from the beginning of the cut when the spindle is in the upper limit of travel.

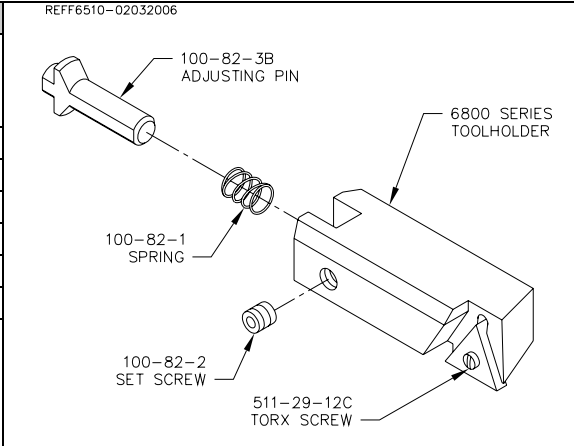
REF F8594-06072004



1.5" Standard Tooling:

6801 Series Tool Holders			
Assembly Part #	Tool Holder Part #	Length	Bore Range
6801A*	6800A	1.23"	1.50" – 2.02"
6801B*	6800B	1.44"	1.96" – 2.56"
6801C	6800C	1.65"	2.38" – 2.98"
6801D	6800D	1.85"	2.78" – 3.38"
6801E	6800E	2.05"	3.18" – 3.78"
6801F	6800F	2.25"	3.58" – 4.18"

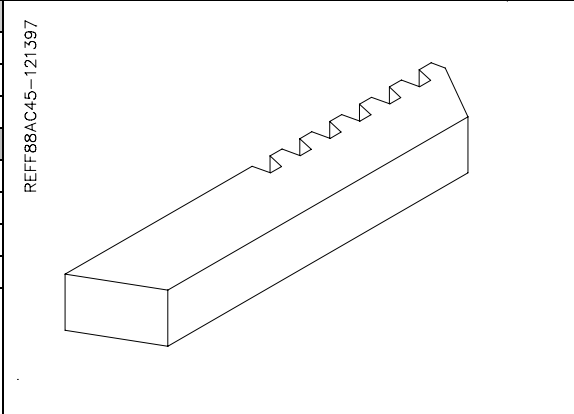
* = 1/4" inserts Triangle insert positive rake



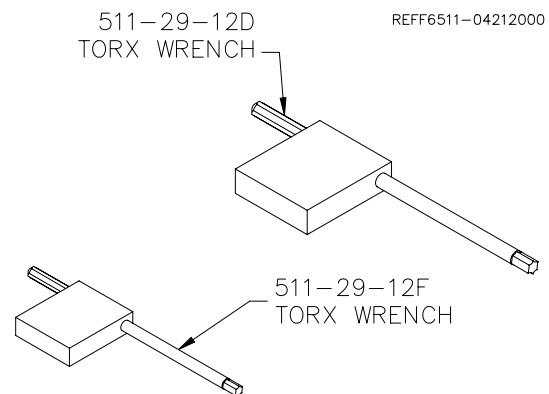
Centering Fingers:

Centering Fingers		
Part Number	Length	Centering Range
200-26-1	1.38"	1.50" – 2.62"
200-26-2	2.13"	2.62" – 4.13"

Standard Inserts	
RT322	3/8 IC TRIANGLE 1/32 RADIUS
RT321	3/8 IC TRIANGLE 1/64 RADIUS
RT211	1/4 IC TRIANGLE 1/32 RADIUS
RT212	1/4 IC TRIANGLE 1/64 RADIUS



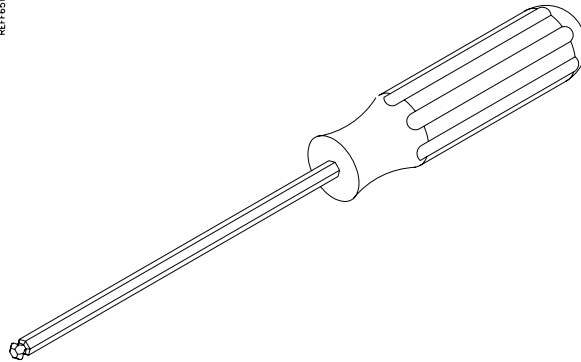
511-29-12D Torx Wrench 511-29-12F Torx Wrench



For use with Torx style screws in Triangle cartridges.

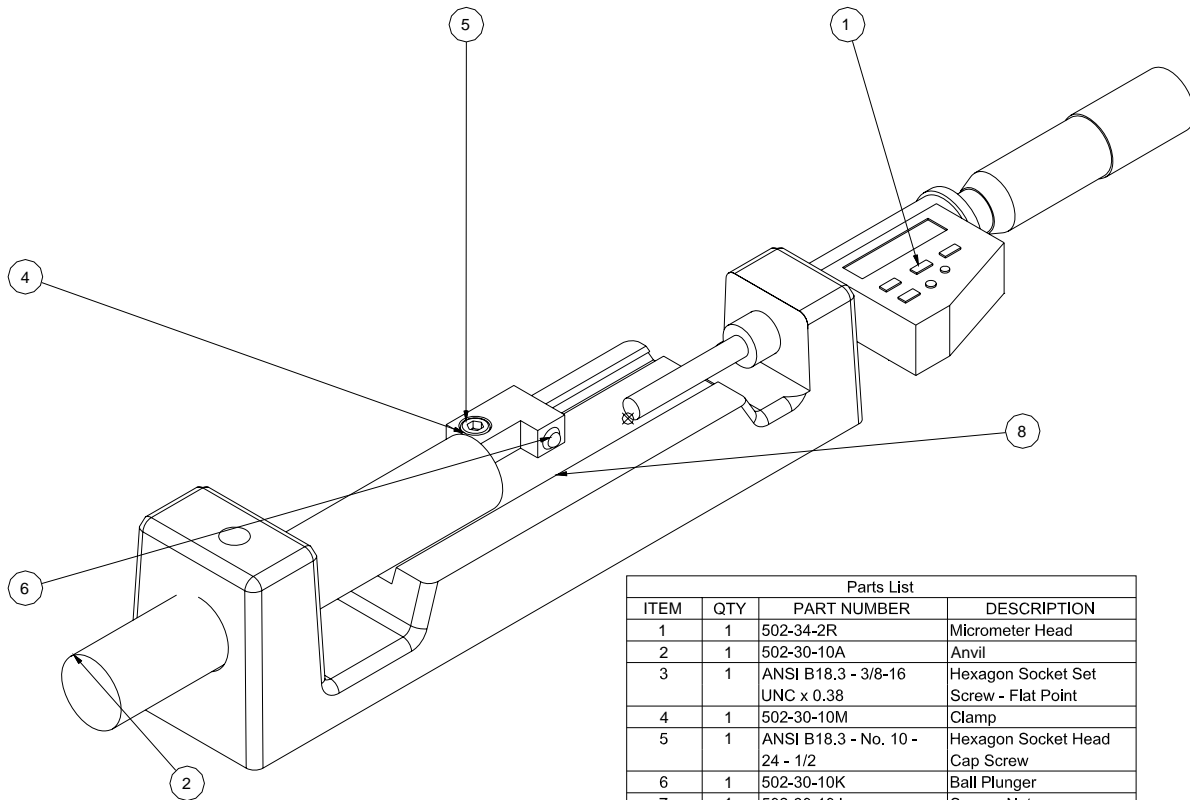
501-72A Hex Driver

REF76512-04252000



900-2-19 Micrometer Assembly:

1.5: - 4.1"

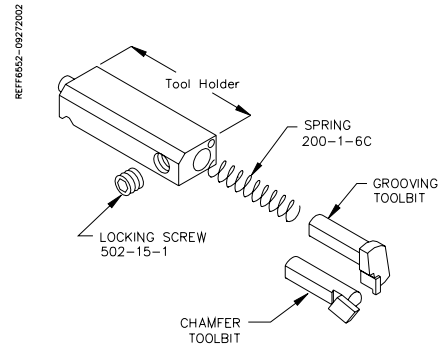


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10A	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square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

6516 Optional Tooling:

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"	"



Important Information for the Best Use of the 1.5" Stub Bar Tooling.

Note: *Inner spindle adjustment (see mechanical maintenance section), must be correct for precision use of stub boring heads.*

The extended Stub Boring Head has considerable over hang, with a small shaft diameter. The cutting tool 'B' land must be kept very narrow, .005" to .015" (.127 mm to .381 mm), if you are using sharpenable carbide tool bits. This will produce the best results with no chatter at the bottom of the bore.

The 1.5" cutterhead will tend to deflect slightly with heavy cuts. If a hole is bored .040 oversize, and is bored again, without changing the tool holder size, it will bore close to .001 more. If the first cut was lighter, the second cut will be proportionately lighter.

You can use the second pass performance (second pass must be made without re-centering) to provide a very precise bore.

2 7/8" Production Stub Bar:

6517T With Tooling

6517S Without Tooling

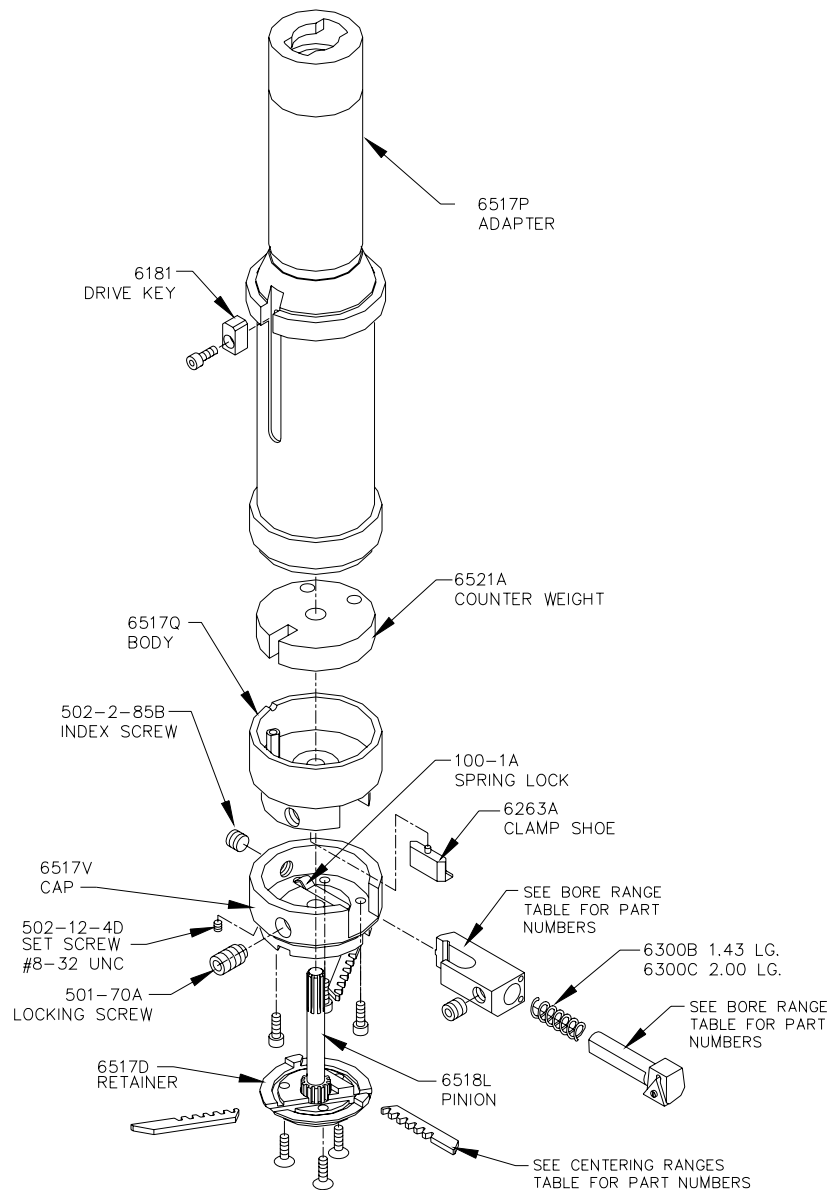
The Production Stub Boring Head has a capacity of 2.90" to 5.00" (74mm to 127mm) to 8.25" deep (210mm). This cutterhead eliminates the need to remove the tool every time you center the spindle in a new bore.

CAUTION

Be sure that this head does not interfere with lower extremities of the block, such as bosses and hubs.

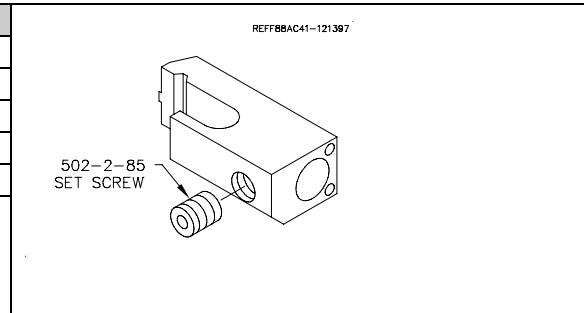
The cutterhead is designed to clear most all obstructions in U.S. passenger car and truck engines.

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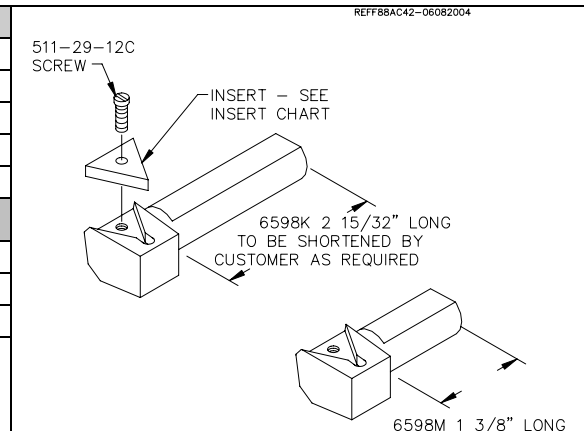


2 7/8" Cutterhead Standard Tooling:

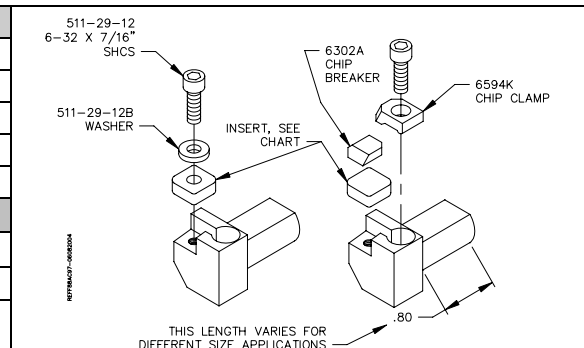
6520 Series Tool Holders	
Tool Holder	Length
6520H	2.25"
6520A	2.37"
6520B	2.62"
6520C	2.87"



6598 Series Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6598M	6520H	3.38" – 3.63"
6598M	6520A	3.63" – 4.00"
6598K	6520B	4.00" – 4.50"
6598K	6520C	4.50" – 5.00"
Standard Inserts		
RT322	3/8 IC TRIANGLE 1/32 RADIUS	
RT321	3/8 IC TRIANGLE 1/64 RADIUS	

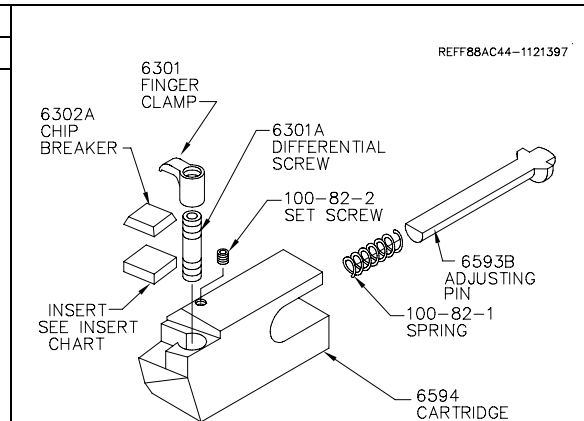


6260 Series Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6260M	6520H	3.38" – 3.63"
6260M	6520A	3.63" – 4.00"
6260L	6520B	4.00" – 4.50"
6260L	6520C	4.50" – 5.00"
Standard Inserts		
RS322	Sq. insert neg rake 1/32 Radius	



6594 Cartridge Tool Holder:

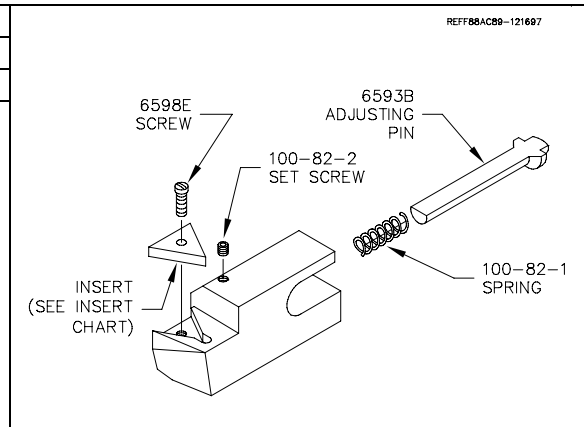
Bore Range
2.90" – 3.40"
Square insert negative rake



Cartridge Tool Holders:

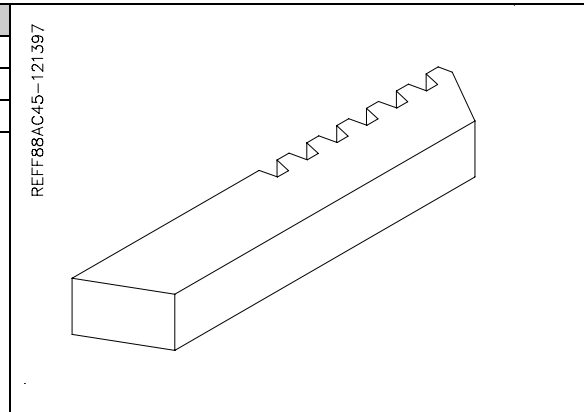
Tool Holder	Length	Bore Range
6593C	2.03"	2.90" – 3.40"
6593D	2.25"	3.40" – 3.90"

Triangle insert positive rake



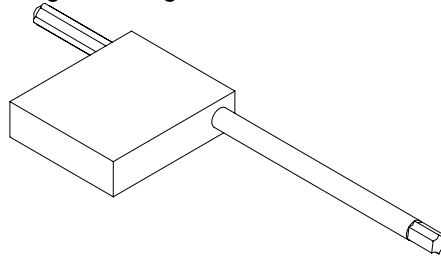
Centering Fingers:

Centering Fingers		
Part Number	Length	Centering Range
6517E	2.26"	2.90" – 4.20"
6517F	3.06"	4.20" – 5.00"



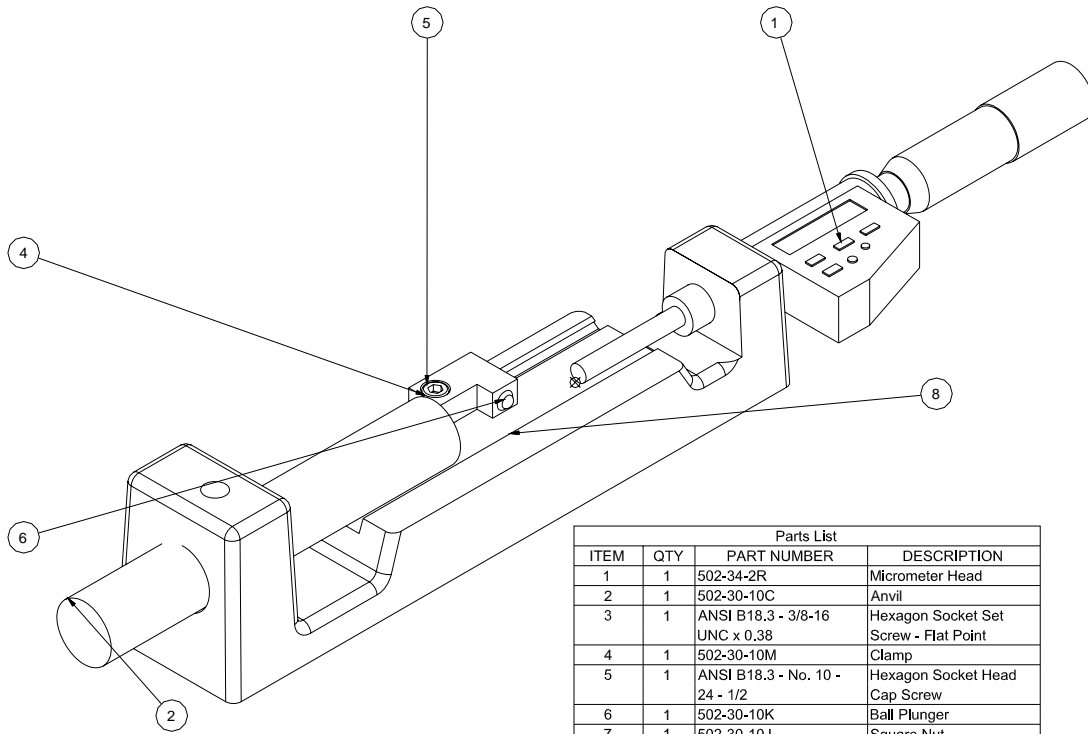
511-29-12D Torx Wrench

For use with Torx style screw in Triangle cartridges.



REFF8S95-06082004

900-2-20 Micrometer Assembly: 2.6" to 5.0" Diameter

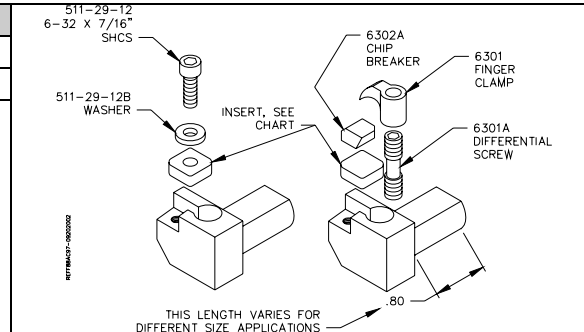


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10C	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square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

6517T Optional Tooling:

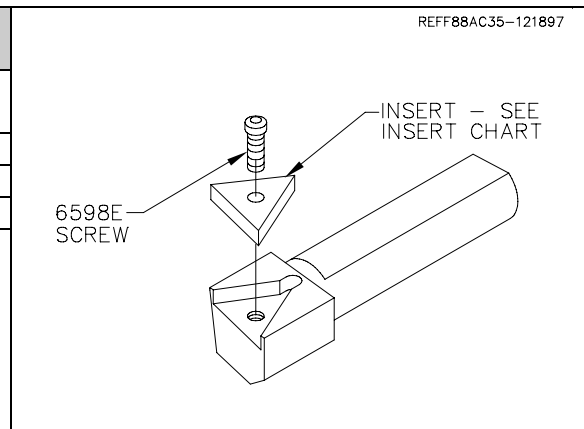
Offset Tool Holders:

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



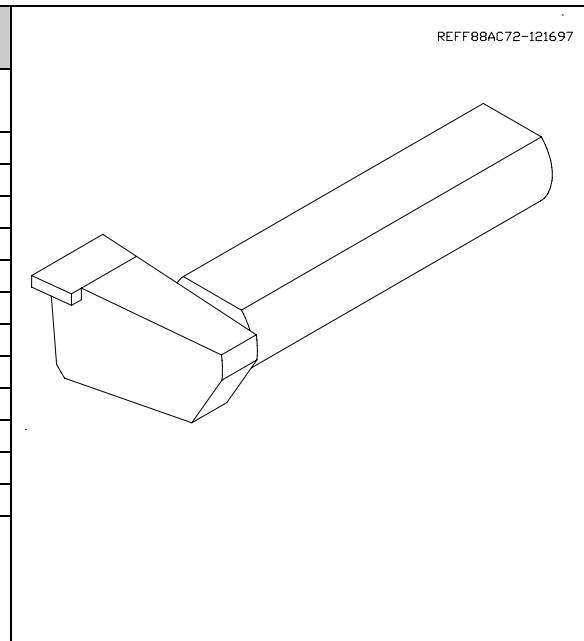
Chamfering Tool Holders:

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		



Grooving Tool Bits:

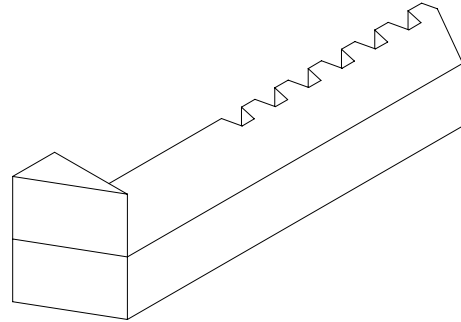
6513 Series Grooving Tool Bits when used with 6520 Holders			
Tool Bit	Groove DIA.	Tool Holder	Bore Range
6513J	.037"	6520H	3.55" – 3.95"
6513J	.037"	6520A	3.95" – 4.45"
6513J	.037"	6520B	4.45" – 4.85"
6513L	.039"	6520H	3.55" – 3.95"
6513L	.039"	6520A	3.95" – 4.45"
6513L	.039"	6520B	4.45" – 4.85"
6513N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



Offset Centering Fingers:

Centering Fingers		
Part Number	Length	Centering Range
6797	2.26"	2.90" – 4.20"
6798	3.06"	4.20" – 5.00"

REF88AC92-070798



2 7/8" Long Production Stub Bar:

6517N With Tooling

6517M Without Tooling

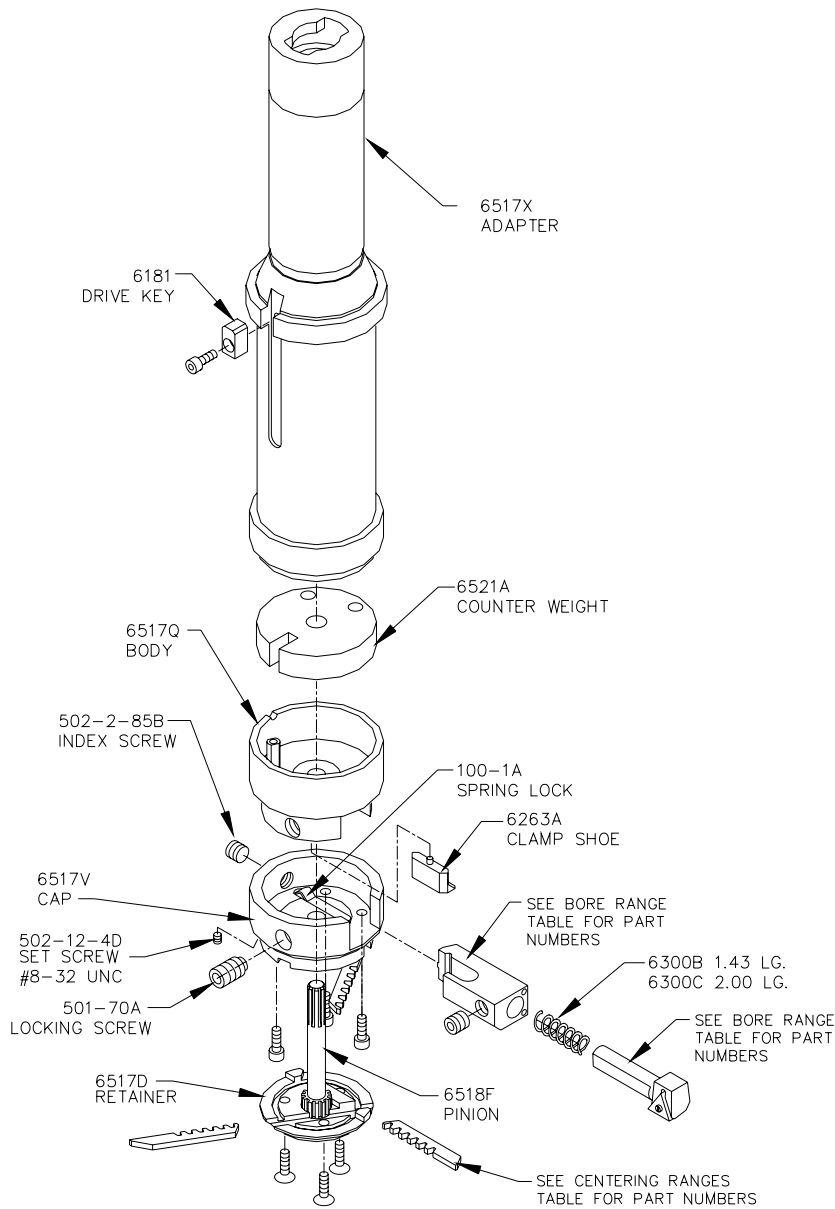
The Long Production Stub Bar is for reaching into deeper bores than can be done with the regular Production stub bar. This cutterhead has a capacity of 2.90" to 5.00" (74mm to 127mm) to 9.50" deep (241mm). This cutterhead eliminates the need to remove the tool every time you center the spindle in a new bore.

CAUTION

Be sure that this head does not interfere with lower extremities of the block, such as bosses and hubs.

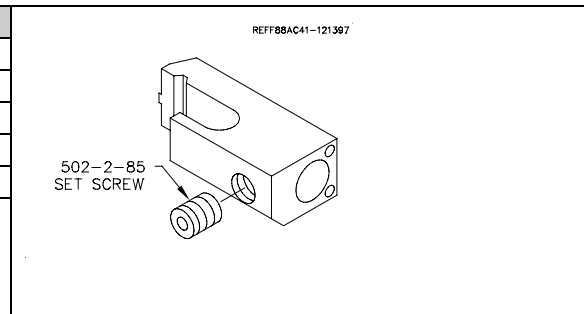
The cutterhead is designed to clear most all obstructions in U.S. passenger car and truck engines.

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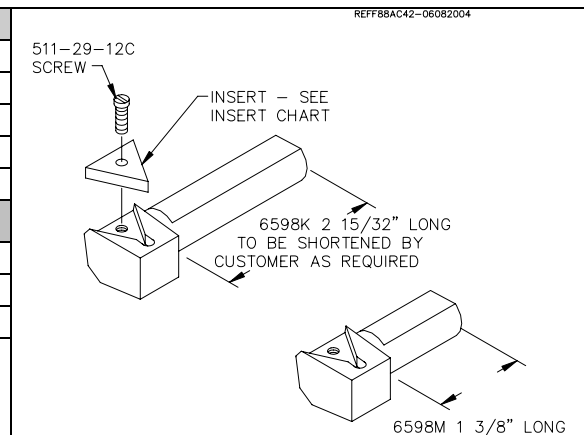


2 7/8" Long Cutterhead Standard Tooling:

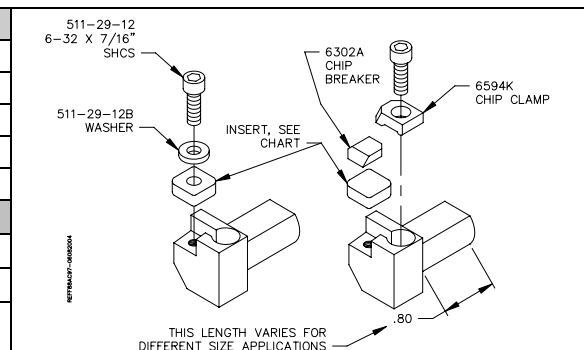
6520 Series Tool Holders	
Tool Holder	Length
6520H	2.25"
6520A	2.37"
6520B	2.62"
6520C	2.87"



6598 Series Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6598M	6520H	3.38" – 3.63"
6598M	6520A	3.63" – 4.00"
6598K	6520B	4.00" – 4.50"
6598K	6520C	4.50" – 5.00"
Standard Inserts		
RT322	3/8 IC TRIANGLE 1/32 RADIUS	
RT321	3/8 IC TRIANGLE 1/64 RADIUS	

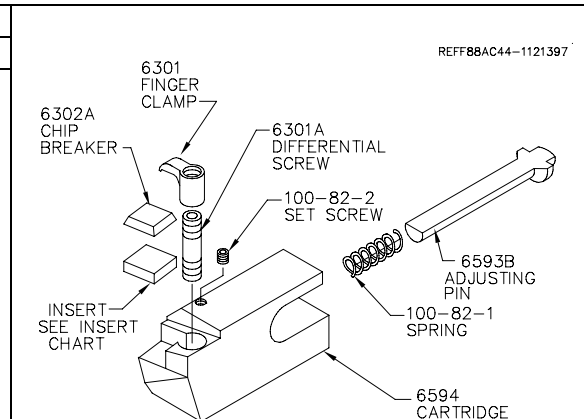


6260 Series Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6260M	6520H	3.38" – 3.63"
6260M	6520A	3.63" – 4.00"
6260L	6520B	4.00" – 4.50"
6260L	6520C	4.50" – 5.00"
Standard Inserts		
RS322	Sq. insert neg rake 1/32 Radius	



6594 Cartridge Tool Holder:

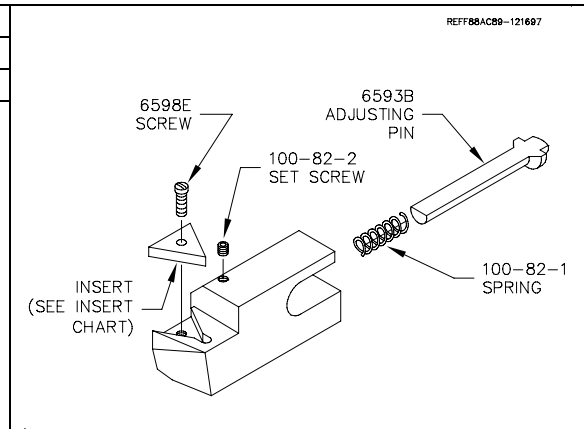
Bore Range
2.90" – 3.40"
Square insert negative rake



Cartridge Tool Holders:

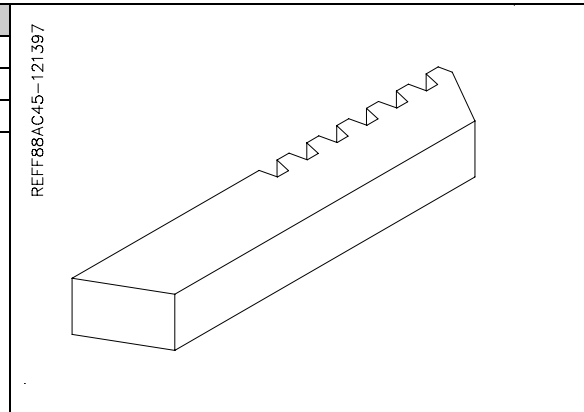
Tool Holder	Length	Bore Range
6593C	2.03"	2.90" – 3.40"
6593D	2.25"	3.40" – 3.90"

Triangle insert positive rake



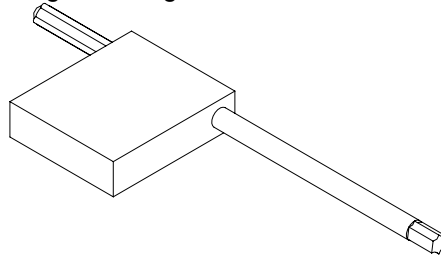
Centering Fingers:

Centering Fingers		
Part Number	Length	Centering Range
6517E	2.26"	2.90" – 4.20"
6517F	3.06"	4.20" – 5.00"



511-29-12D Torx Wrench

For use with Torx style screw in Triangle cartridges.



REFFB8S95-06082004

1.5" Blind Hole Stub Bar:

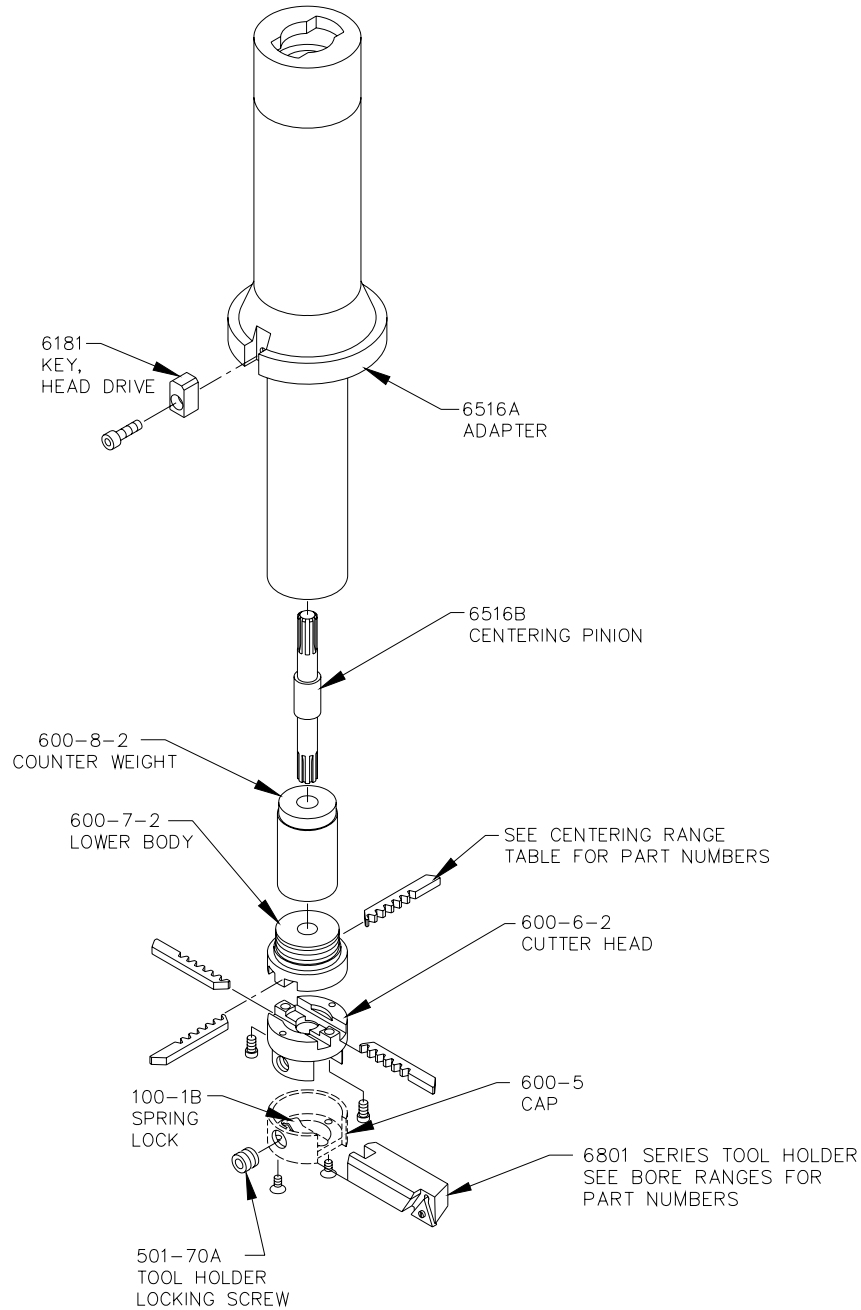
6516 With Tooling

6516C Without Tooling

The 1.5" diameter (38mm) stub boring head has a capacity of 1.5" to 4.1" (38mm to 104mm) diameter by 6.5" (165mm) depth. The 1.5" stub boring head is attached and operates basically the same as the other Rottler cutterheads. This cutterhead is a blind hole cutterhead. The tool bit must be removed to center each bore.

Locate the work piece so the end of the stub boring head is no further than 1" from the beginning of the cut when the spindle is in the upper limit of travel.

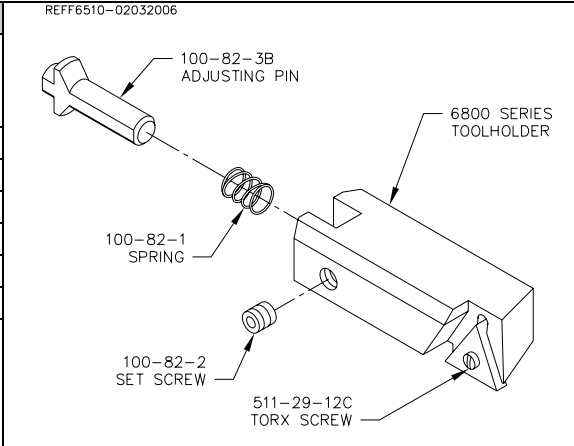
REF: 8594-06072004



1.5" Standard Tooling:

6801 Series Tool Holders			
Assembly Part #	Tool Holder Part #	Length	Bore Range
6801A*	6800A	1.23"	1.50" – 2.02"
6801B*	6800B	1.44"	1.96" – 2.56"
6801C	6800C	1.65"	2.38" – 2.98"
6801D	6800D	1.85"	2.78" – 3.38"
6801E	6800E	2.05"	3.18" – 3.78"
6801F	6800F	2.25"	3.58" – 4.18"

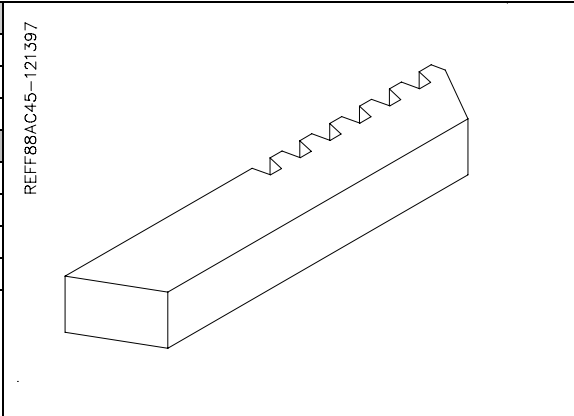
* = 1/4" inserts Triangle insert positive rake



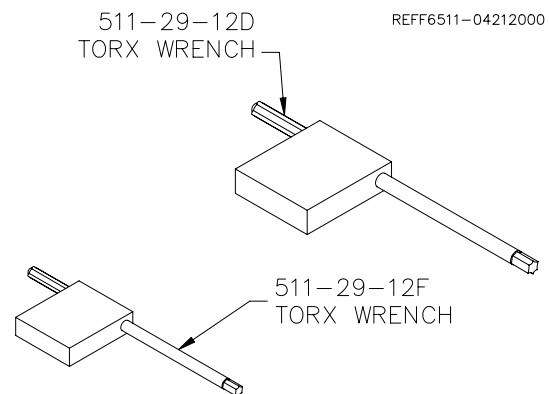
Centering Fingers:

Centering Fingers		
Part Number	Length	Centering Range
200-26-1	1.38"	1.50" – 2.62"
200-26-2	2.13"	2.62" – 4.13"

Standard Inserts	
RT322	3/8 IC TRIANGLE 1/32 RADIUS
RT321	3/8 IC TRIANGLE 1/64 RADIUS
RT211	1/4 IC TRIANGLE 1/32 RADIUS
RT212	1/4 IC TRIANGLE 1/64 RADIUS



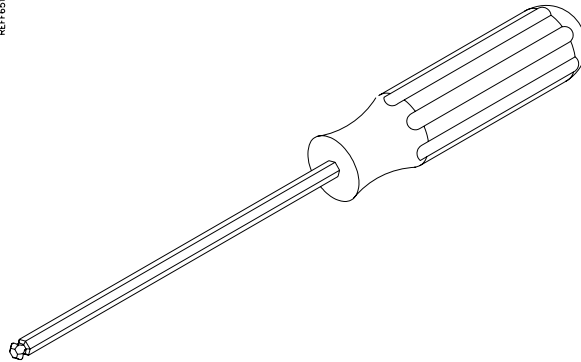
511-29-12D Torx Wrench 511-29-12F Torx Wrench



For use with Torx style screws in Triangle cartridges.

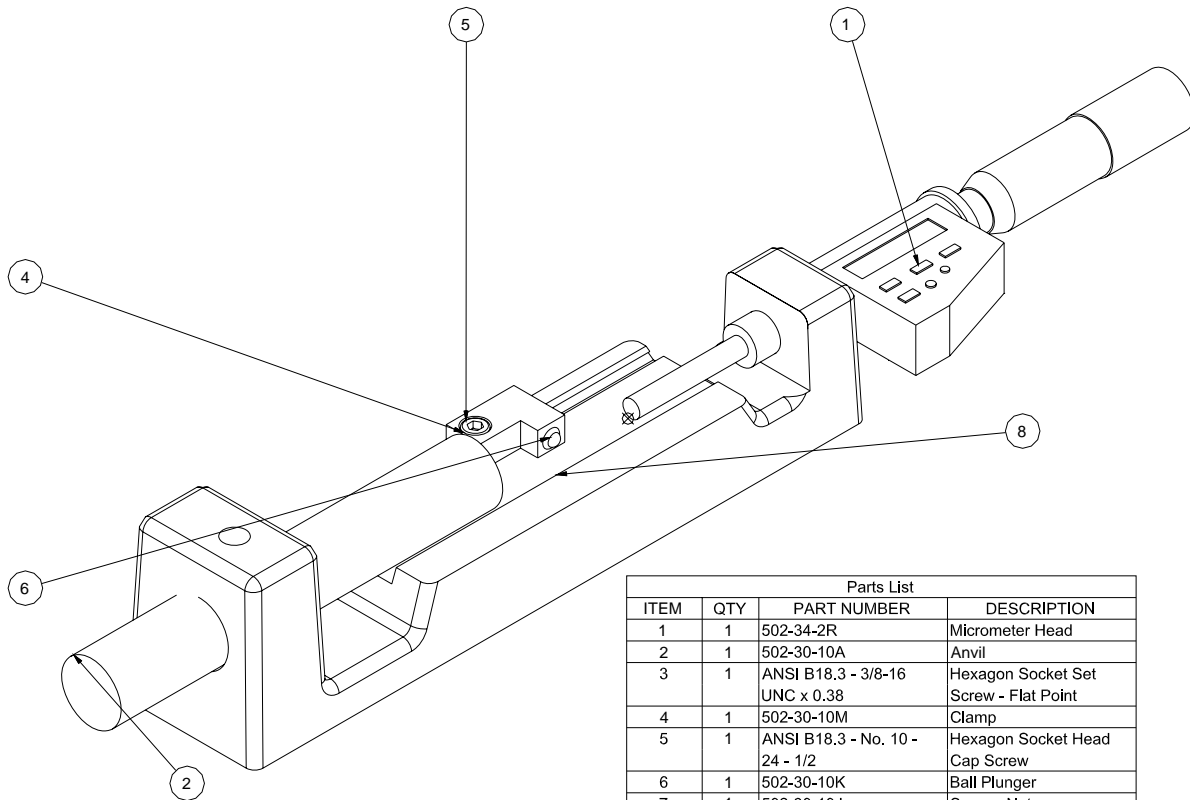
501-72A Hex Driver

REF76512-04252000



900-2-19 Micrometer Assembly:

1.5: - 4.1"

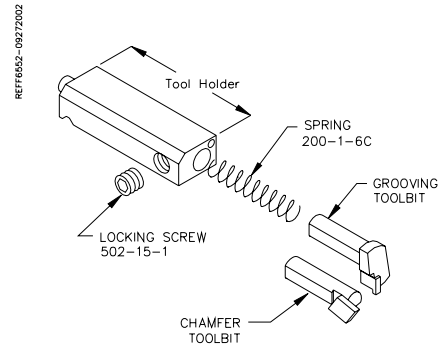


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10A	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square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

6516 Optional Tooling:

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"	"



Important Information for the Best Use of the 1.5" Stub Bar Tooling.

Note: *Inner spindle adjustment (see mechanical maintenance section), must be correct for precision use of stub boring heads.*

The extended Stub Boring Head has considerable over hang, with a small shaft diameter. The cutting tool 'B' land must be kept very narrow, .005" to .015" (.127 mm to .381 mm), if you are using sharpenable carbide tool bits. This will produce the best results with no chatter at the bottom of the bore.

The 1.5" cutterhead will tend to deflect slightly with heavy cuts. If a hole is bored .040 oversize, and is bored again, without changing the tool holder size, it will bore close to .001 more. If the first cut was lighter, the second cut will be proportionately lighter.

You can use the second pass performance (second pass must be made without re-centering) to provide a very precise bore.

2 7/8" Production Stub Bar:

6517T With Tooling

6517S Without Tooling

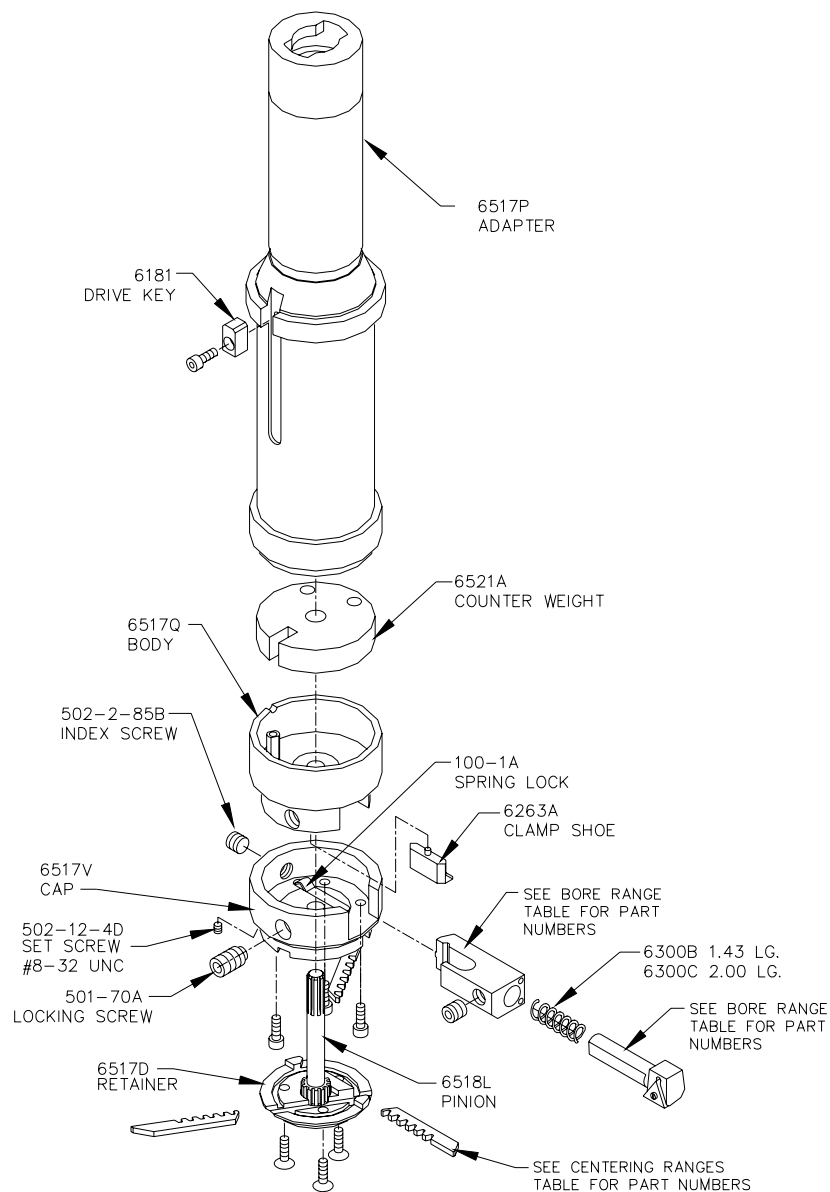
The Production Stub Boring Head has a capacity of 2.90" to 5.00" (74mm to 127mm) to 8.25" deep (210mm). This cutterhead eliminates the need to remove the tool every time you center the spindle in a new bore.

CAUTION

Be sure that this head does not interfere with lower extremities of the block, such as bosses and hubs.

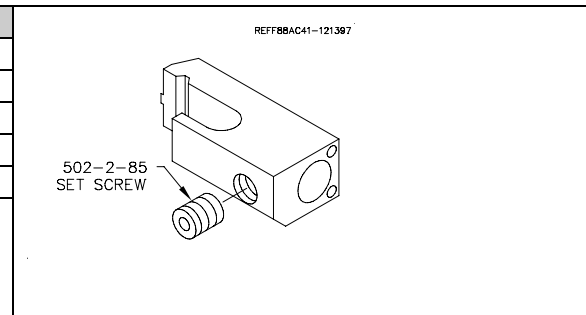
The cutterhead is designed to clear most all obstructions in U.S. passenger car and truck engines.

REFFBAC48-121387

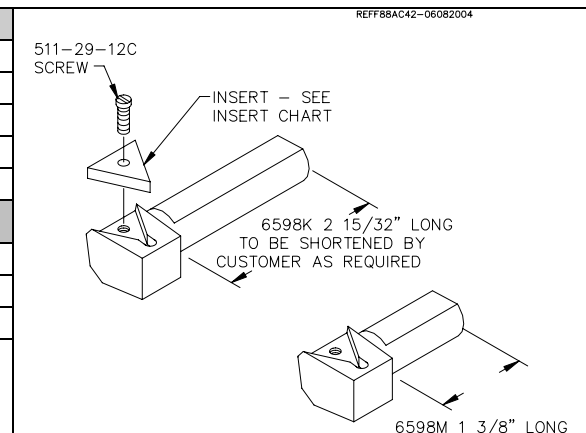


2 7/8" Cutterhead Standard Tooling:

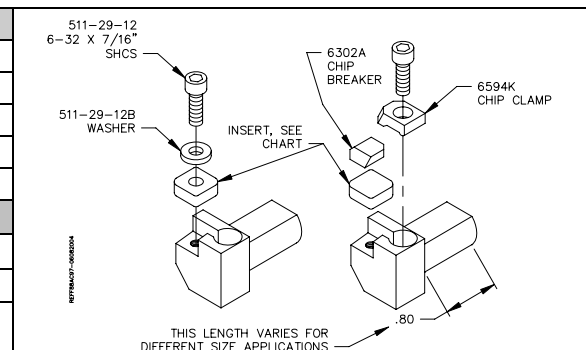
6520 Series Tool Holders	
Tool Holder	Length
6520H	2.25"
6520A	2.37"
6520B	2.62"
6520C	2.87"



6598 Series Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6598M	6520H	3.38" – 3.63"
6598M	6520A	3.63" – 4.00"
6598K	6520B	4.00" – 4.50"
6598K	6520C	4.50" – 5.00"
Standard Inserts		
RT322	3/8 IC TRIANGLE 1/32 RADIUS	
RT321	3/8 IC TRIANGLE 1/64 RADIUS	

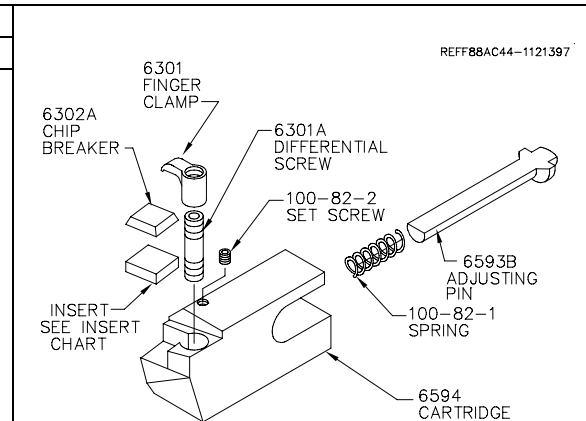


6260 Series Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6260M	6520H	3.38" – 3.63"
6260M	6520A	3.63" – 4.00"
6260L	6520B	4.00" – 4.50"
6260L	6520C	4.50" – 5.00"
Standard Inserts		
RS322	Sq. insert neg rake 1/32 Radius	



6594 Cartridge Tool Holder:

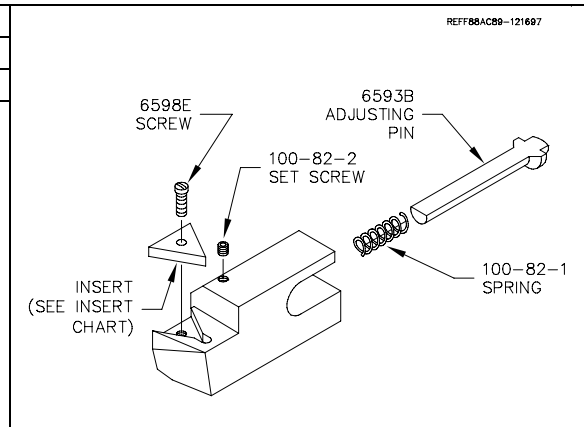
Bore Range
2.90" – 3.40"
Square insert negative rake



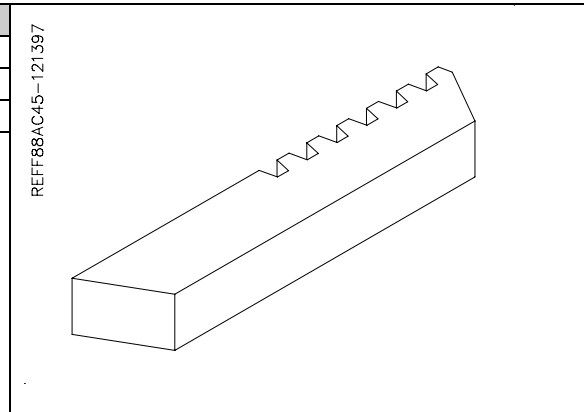
Cartridge Tool Holders:

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

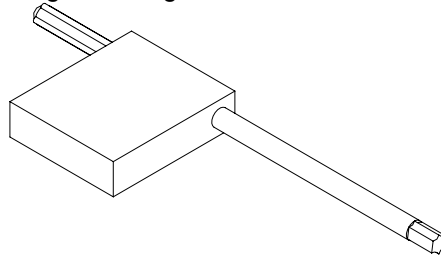
Triangle insert positive rake

**Centering Fingers:**

Centering Fingers		
Part Number	Length	Centering Range
6517E	2.26"	2.90" – 4.20"
6517F	3.06"	4.20" – 5.00"

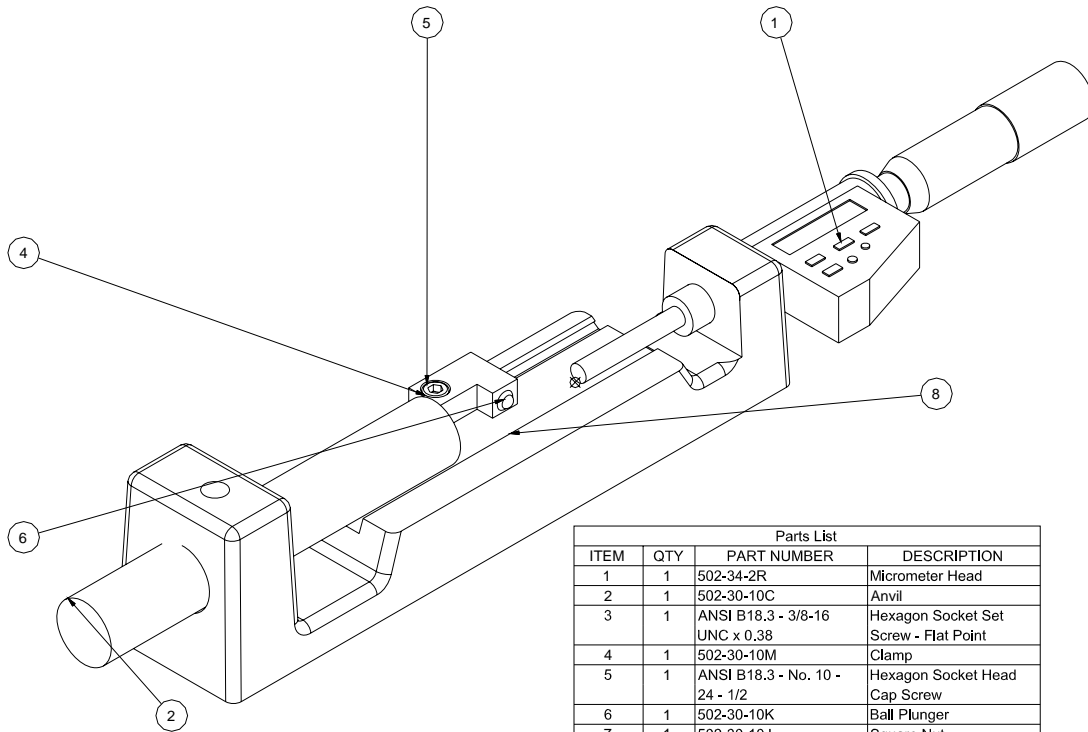
**511-29-12D Torx Wrench**

For use with Torx style screw in Triangle cartridges.



REFFB8S95-06082004

900-2-20 Micrometer Assembly: 2.6" to 5.0" Diameter

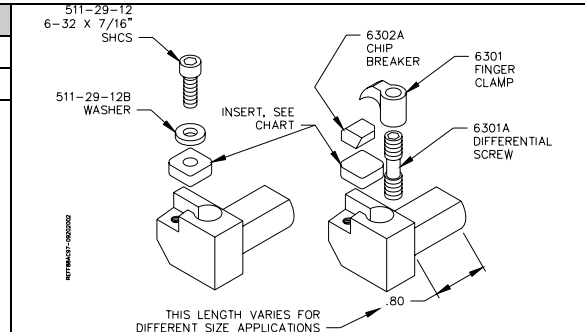


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10C	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square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

6517T Optional Tooling:

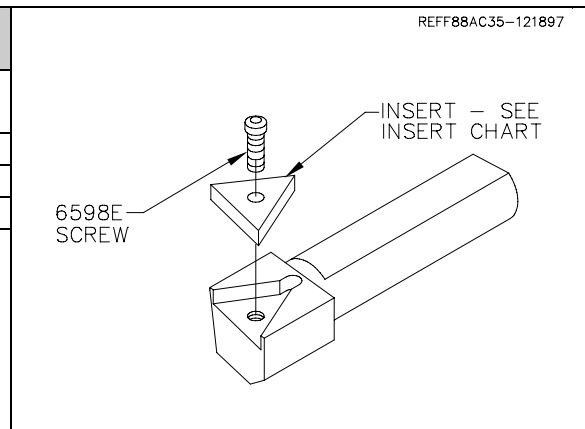
Offset Tool Holders:

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



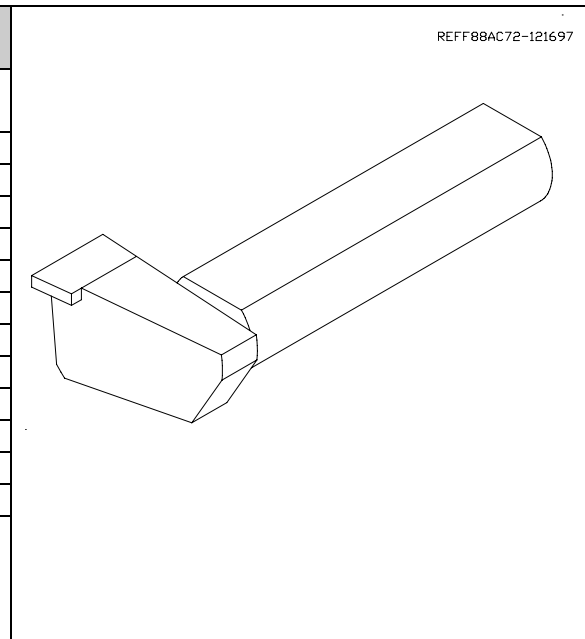
Chamfering Tool Holders:

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		



Grooving Tool Bits:

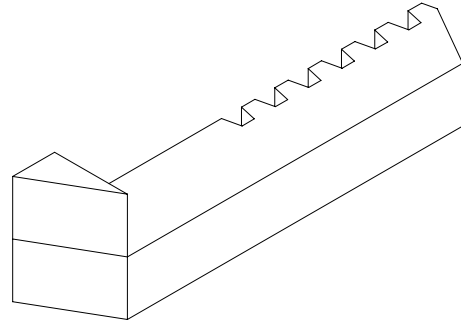
6513 Series Grooving Tool Bits when used with 6520 Holders			
Tool Bit	Groove DIA.	Tool Holder	Bore Range
6513J	.037"	6520H	3.55" – 3.95"
6513J	.037"	6520A	3.95" – 4.45"
6513J	.037"	6520B	4.45" – 4.85"
6513L	.039"	6520H	3.55" – 3.95"
6513L	.039"	6520A	3.95" – 4.45"
6513L	.039"	6520B	4.45" – 4.85"
6513N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



Offset Centering Fingers:

Centering Fingers		
Part Number	Length	Centering Range
6797	2.26"	2.90" – 4.20"
6798	3.06"	4.20" – 5.00"

REF88AC92-070798



2 7/8" Long Production Stub Bar:

6517N With Tooling

6517M Without Tooling

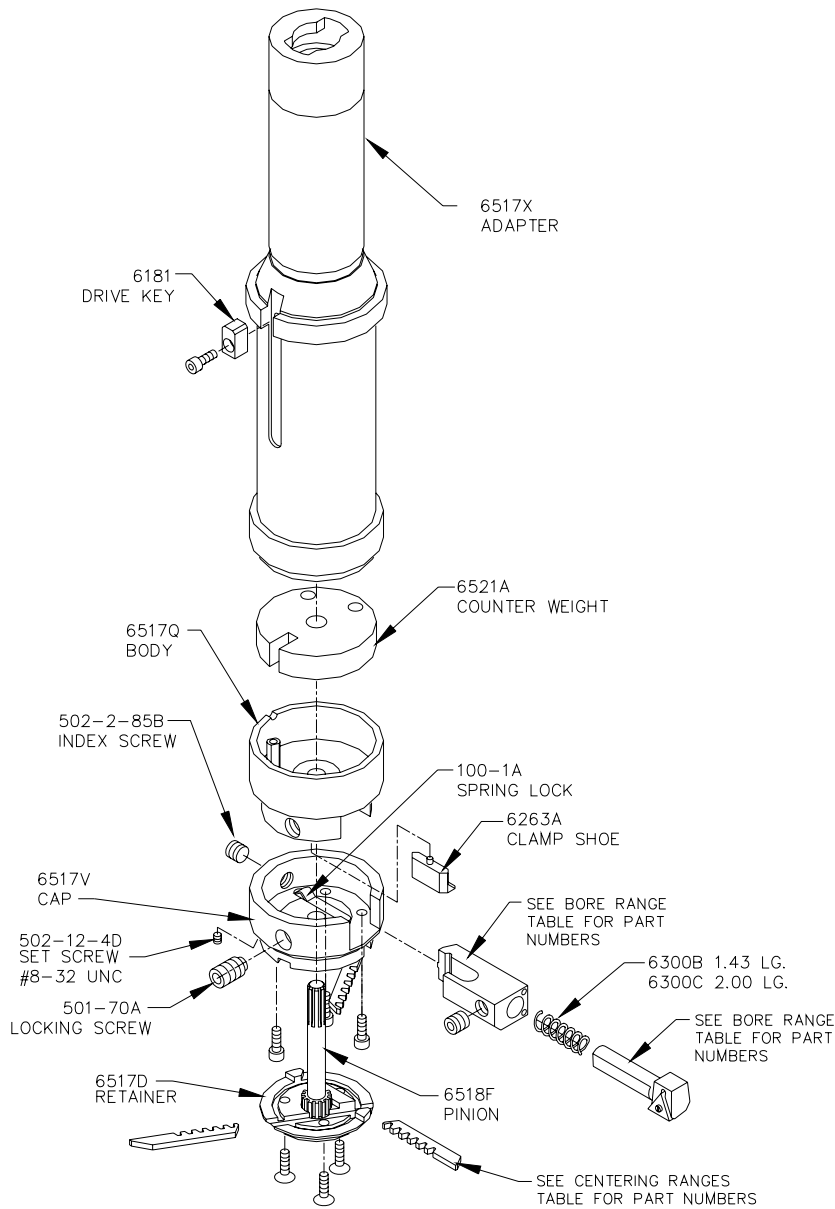
The Long Production Stub Bar is for reaching into deeper bores than can be done with the regular Production stub bar. This cutterhead has a capacity of 2.90" to 5.00" (74mm to 127mm) to 9.50" deep (241mm). This cutterhead eliminates the need to remove the tool every time you center the spindle in a new bore.

CAUTION

Be sure that this head does not interfere with lower extremities of the block, such as bosses and hubs.

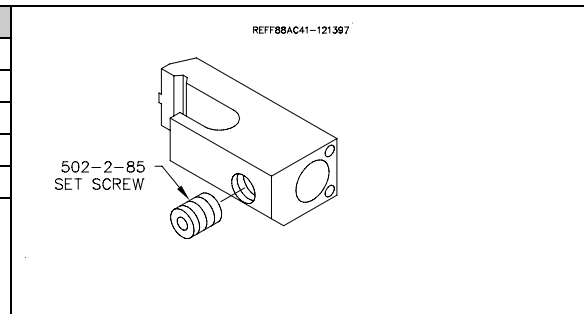
The cutterhead is designed to clear most all obstructions in U.S. passenger car and truck engines.

REFFBACB3-121397

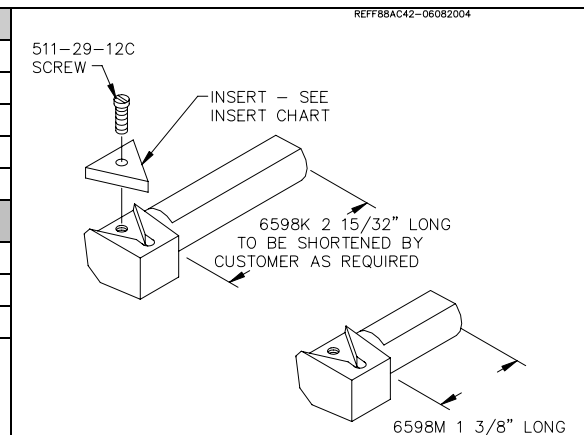


2 7/8" Long Cutterhead Standard Tooling:

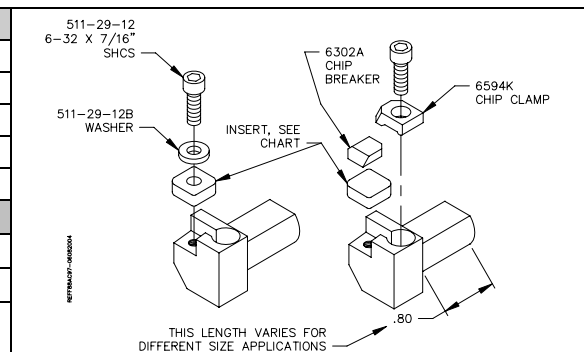
6520 Series Tool Holders	
Tool Holder	Length
6520H	2.25"
6520A	2.37"
6520B	2.62"
6520C	2.87"



6598 Series Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6598M	6520H	3.38" – 3.63"
6598M	6520A	3.63" – 4.00"
6598K	6520B	4.00" – 4.50"
6598K	6520C	4.50" – 5.00"
Standard Inserts		
RT322	3/8 IC TRIANGLE 1/32 RADIUS	
RT321	3/8 IC TRIANGLE 1/64 RADIUS	

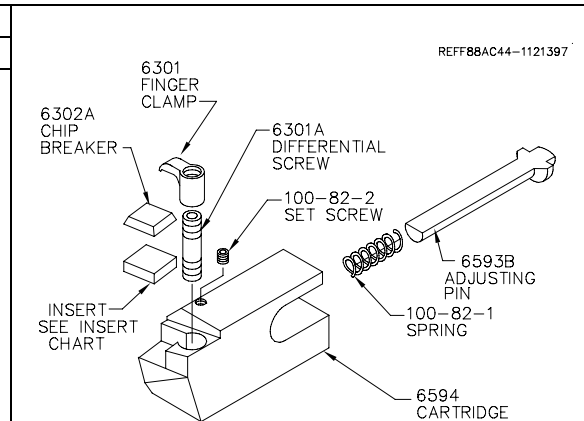


6260 Series Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6260M	6520H	3.38" – 3.63"
6260M	6520A	3.63" – 4.00"
6260L	6520B	4.00" – 4.50"
6260L	6520C	4.50" – 5.00"
Standard Inserts		
RS322	Sq. insert neg rake 1/32 Radius	



6594 Cartridge Tool Holder:

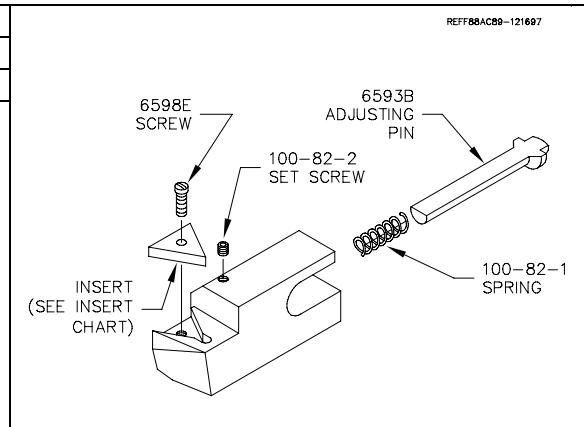
Bore Range
2.90" – 3.40"
Square insert negative rake



Cartridge Tool Holders:

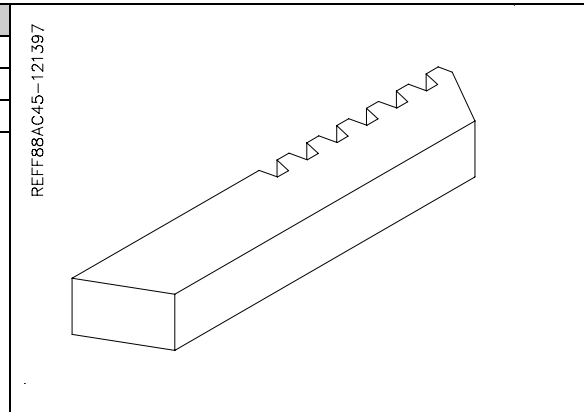
Tool Holder	Length	Bore Range
6593C	2.03"	2.90" – 3.40"
6593D	2.25"	3.40" – 3.90"

Triangle insert positive rake



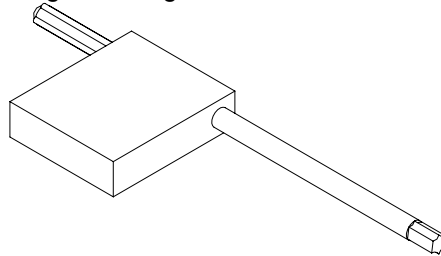
Centering Fingers:

Centering Fingers		
Part Number	Length	Centering Range
6517E	2.26"	2.90" – 4.20"
6517F	3.06"	4.20" – 5.00"



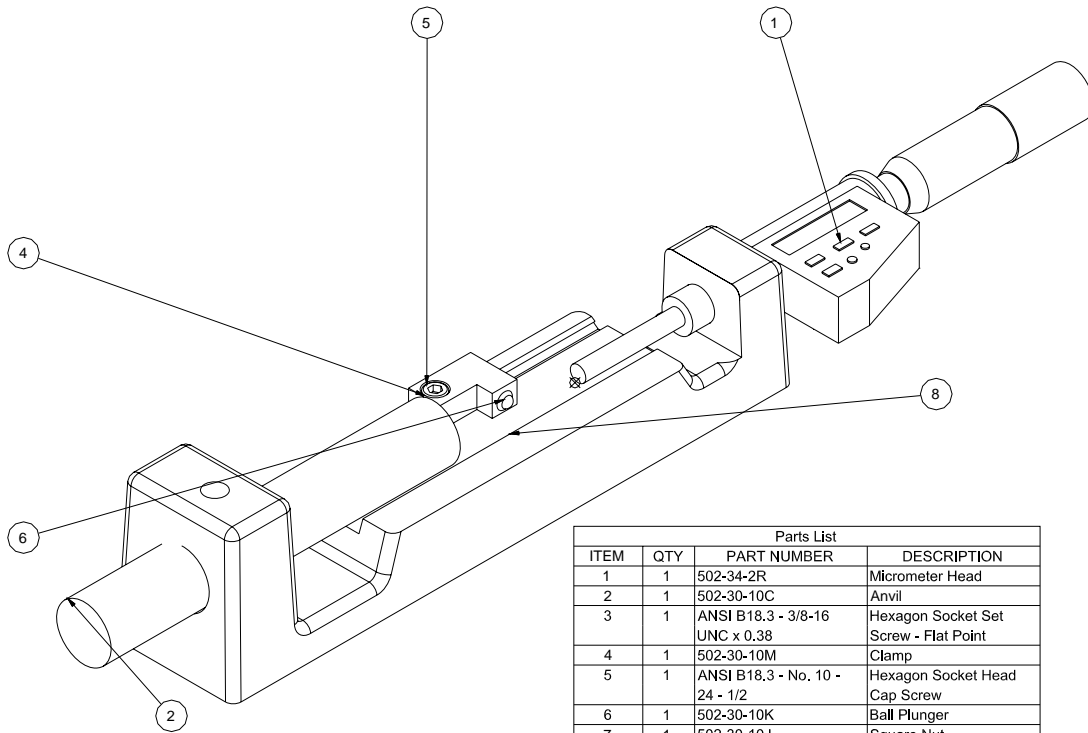
511-29-12D Torx Wrench

For use with Torx style screw in Triangle cartridges.



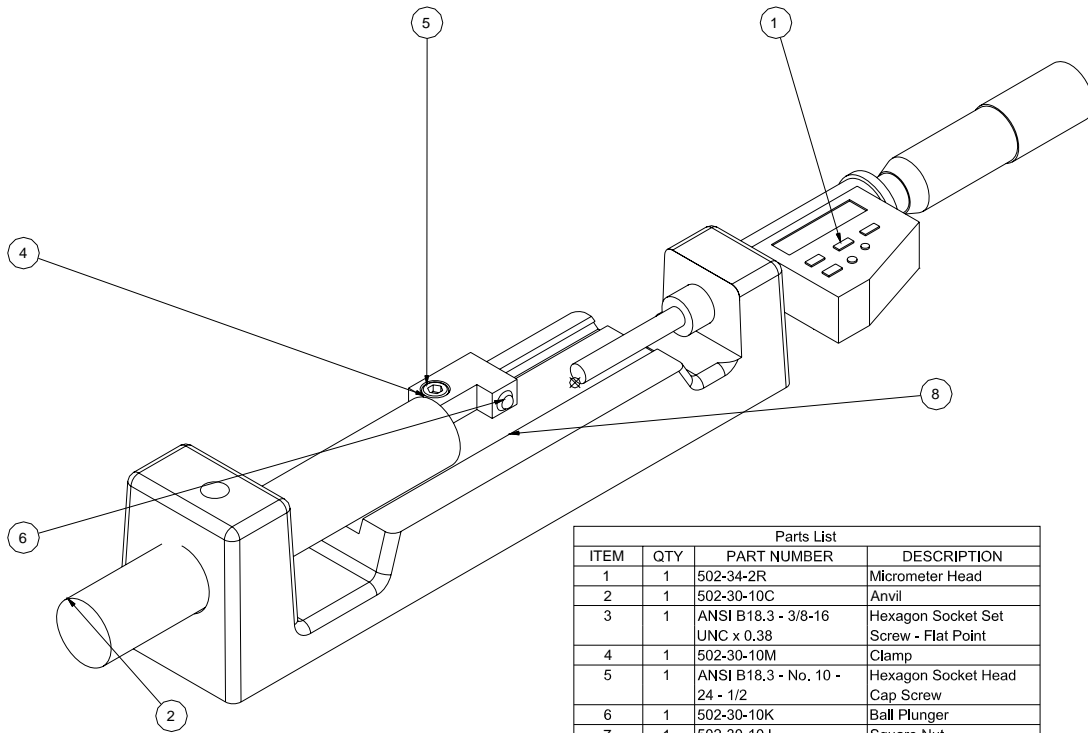
REFF8S95-06082004

900-2-20 Micrometer Assembly: 2.6" to 5.0" Diameter



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

900-2-20 Micrometer Assembly: 2.6" to 5.0" Diameter

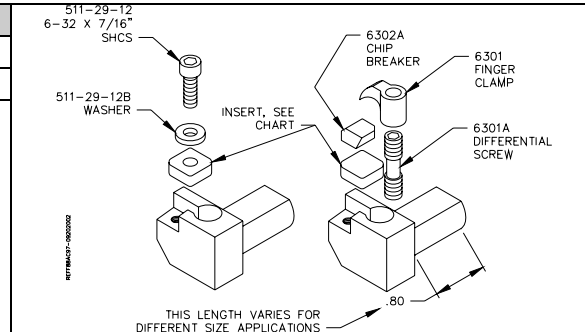


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10C	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square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

6517N Optional Tooling:

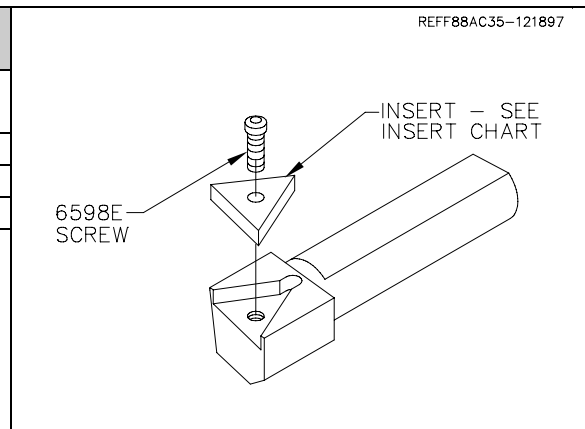
Offset Tool Holders:

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



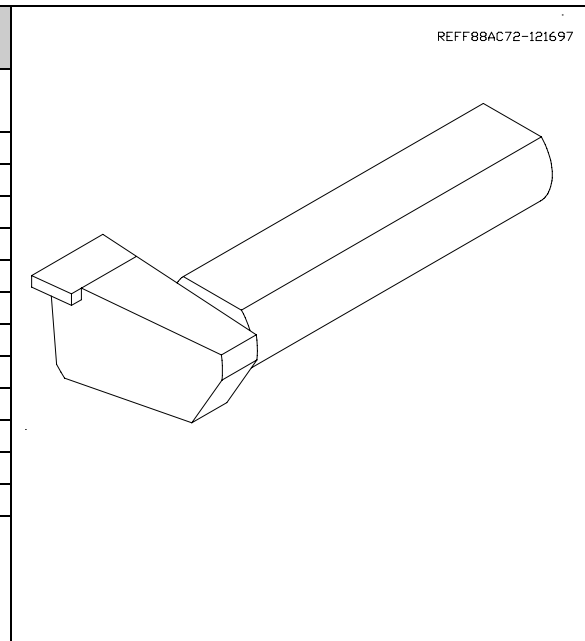
Chamfering Tool Holders:

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		



Grooving Tool Bits:

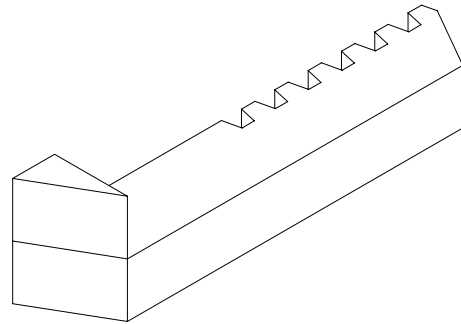
6513 Series Grooving Tool Bits when used with 6520 Holders			
Tool Bit	Groove DIA.	Tool Holder	Bore Range
6513J	.037"	6520H	3.55" – 3.95"
6513J	.037"	6520A	3.95" – 4.45"
6513J	.037"	6520B	4.45" – 4.85"
6513L	.039"	6520H	3.55" – 3.95"
6513L	.039"	6520A	3.95" – 4.45"
6513L	.039"	6520B	4.45" – 4.85"
6513N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



Offset Centering Fingers:

Centering Fingers		
Part Number	Length	Centering Range
6797	2.26"	2.90" – 4.20"
6798	3.06"	4.20" – 5.00"

REF88AC92-070798



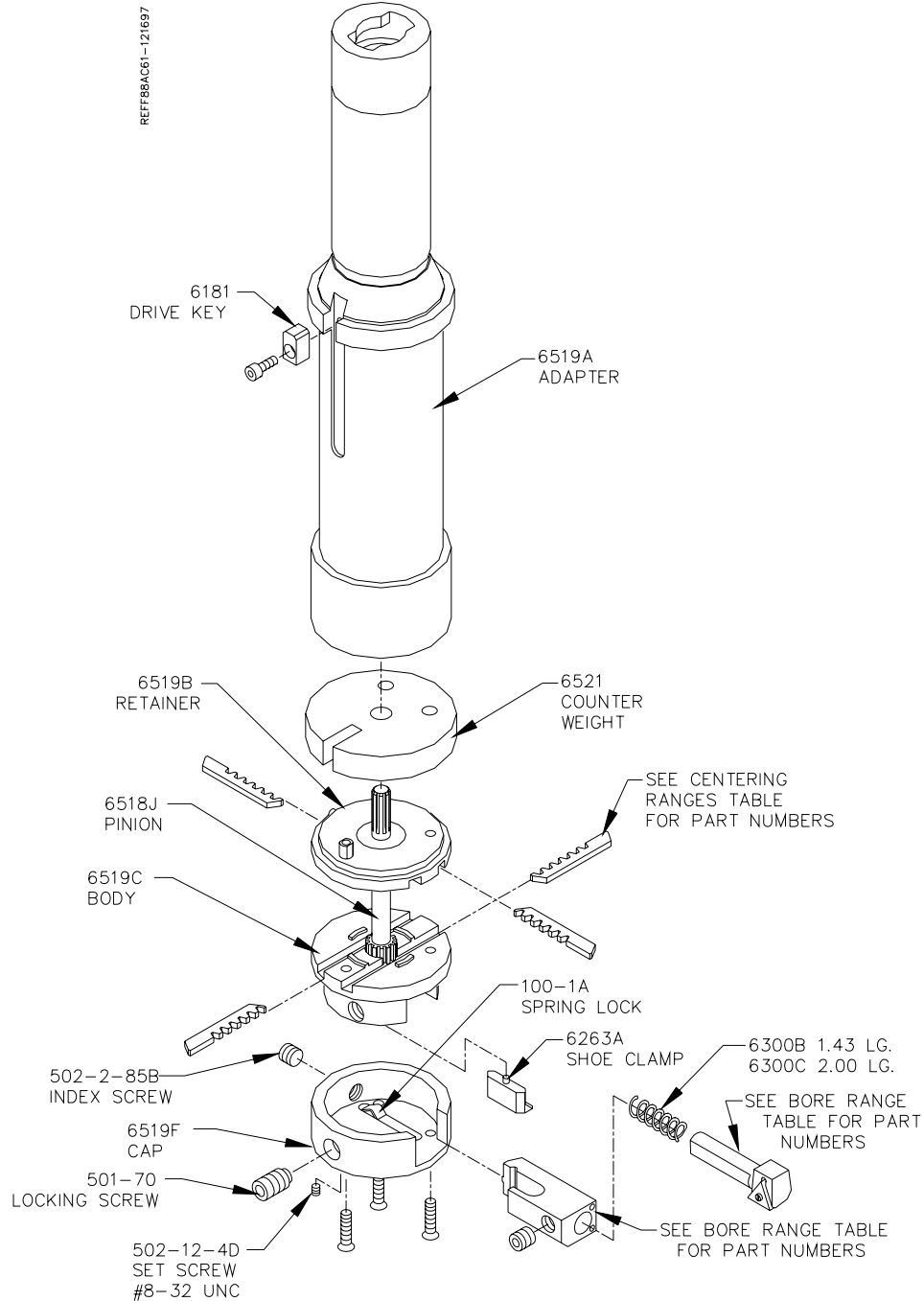
2-7/8" Blind Hole Stub Bar

6519 With Tooling

6519E Without Tooling

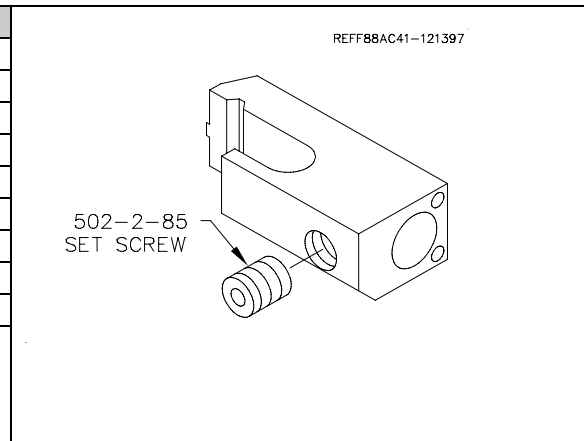
The Blind Hole Stub Boring Head has a capacity of 2.90" to 8.00" (74mm to 203mm) to 8.25" deep (201mm). The Blind Hole style cutterheads are designed for boring close to obstructions at the bottom of a bore. The tool bit is below the centering fingers, which allows the tool bit to be very near the bottom of the cutterhead, in fact, if used with an offset tool bit, it can be completely below the cutterhead.

The tool bit being below the centering fingers requires that the cutterhead be centered in each bore with the tool bit removed, or else the tool bit will crash into the side of the bore during centering.



2 7/8" Blind Hole Cutterhead Standard Tooling:

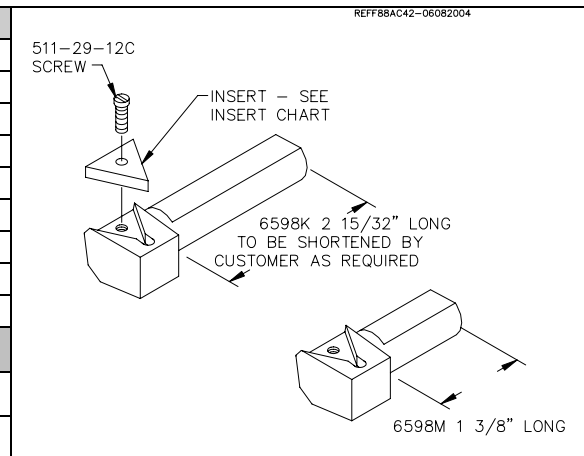
6520 Series Tool Holders	
Tool Holder	Length
6520H	2.25"
6520A	2.37"
6520B	2.62"
6520C	2.87"
6520D	3.12"
6520E	3.37"
6520F	3.62"
6520G	4.12"



6598 Series Tool Bit when used with 6520 Holders		
Tool Bit	Tool Holder	Bore Range
6598M	6520H	3.75" – 4.00"
6598M	6520A	4.00" – 4.50"
6598K	6520B	4.50" – 5.00"
6598K	6520C	5.00" – 5.50"
6598K	6520D	5.50" – 6.00"
6598K	6520E	6.00" – 6.50"
6598K	6520F	6.50" – 7.00"
6598K	6520G	7.00" – 8.00"

Standard Inserts

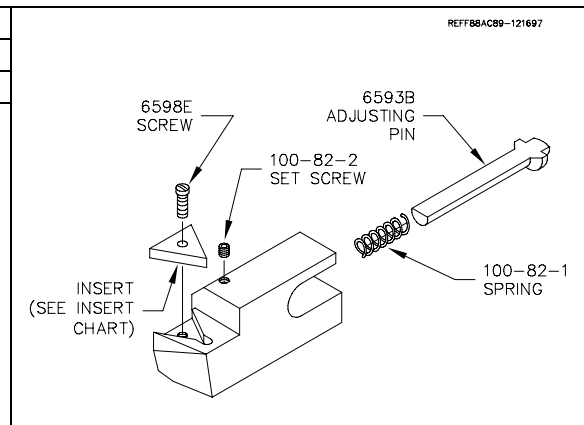
RT322	3/8 IC TRIANGLE 1/32 RADIUS
RT321	3/8 IC TRIANGLE 1/64 RADIUS



Cartridge Tool Holders:

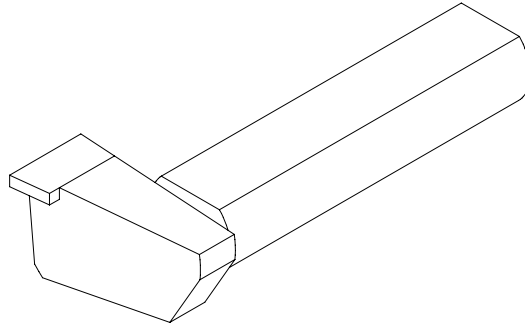
Tool Holder	Length	Bore Range
6593C	2.03"	2.90" – 3.40"
6593D	2.25"	3.40" – 3.90"

Triangle insert positive rake



6513D Offset Tool Bit:

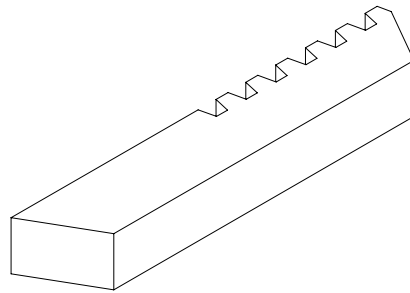
REF88AC72-121697



Centering Fingers:

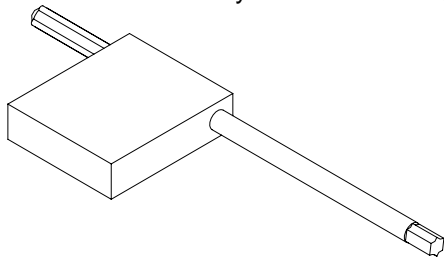
Centering Fingers		
Part Number	Length	Centering Range
200-21-3	2.31"	2.90" – 4.20"
200-21-1	3.06"	3.12" – 6.00"
200-21-2	4.13"	6.00" – 8.00"

REF88AC45-121397



511-29-12D Torx Wrench

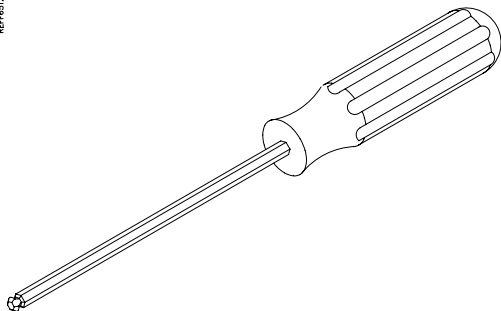
For use with Torx style screw in Triangle cartridges.



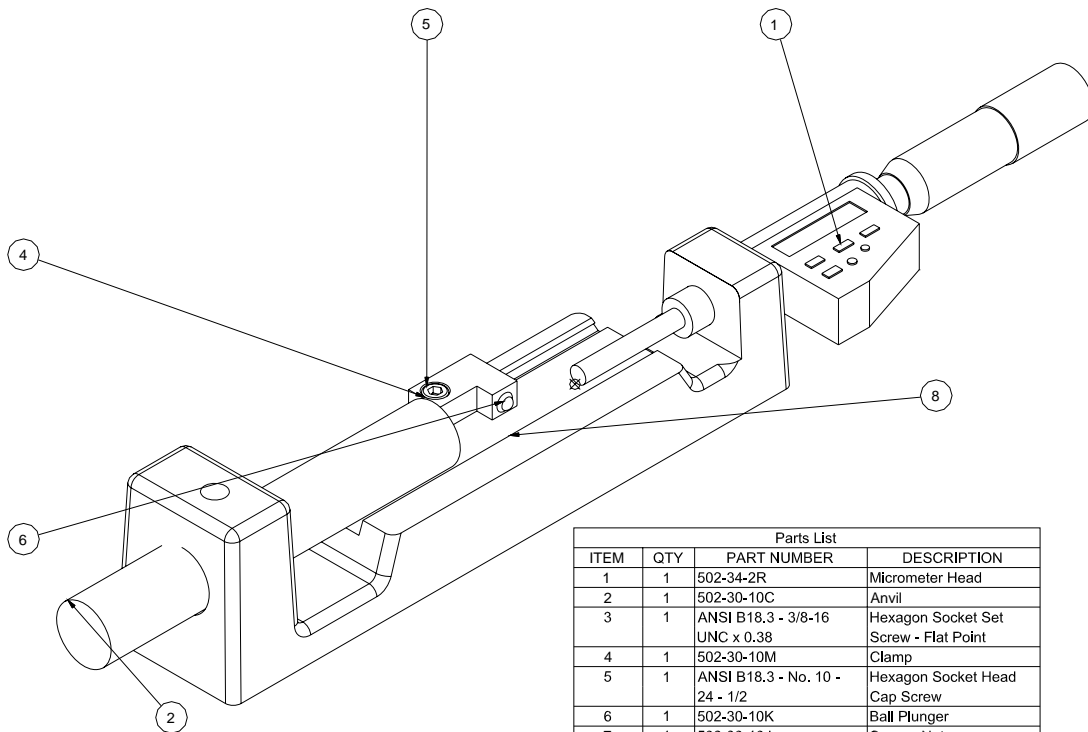
REF8S95-06082004

501-72 Hex Driver

REF817-0432500



900-2-20 Micrometer Assembly: 2.9" – 6.0" and 6.0" – 9.0" Diameter



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

4-1/2" Production Cutterhead

6256A With Tooling

6256B Without Tooling

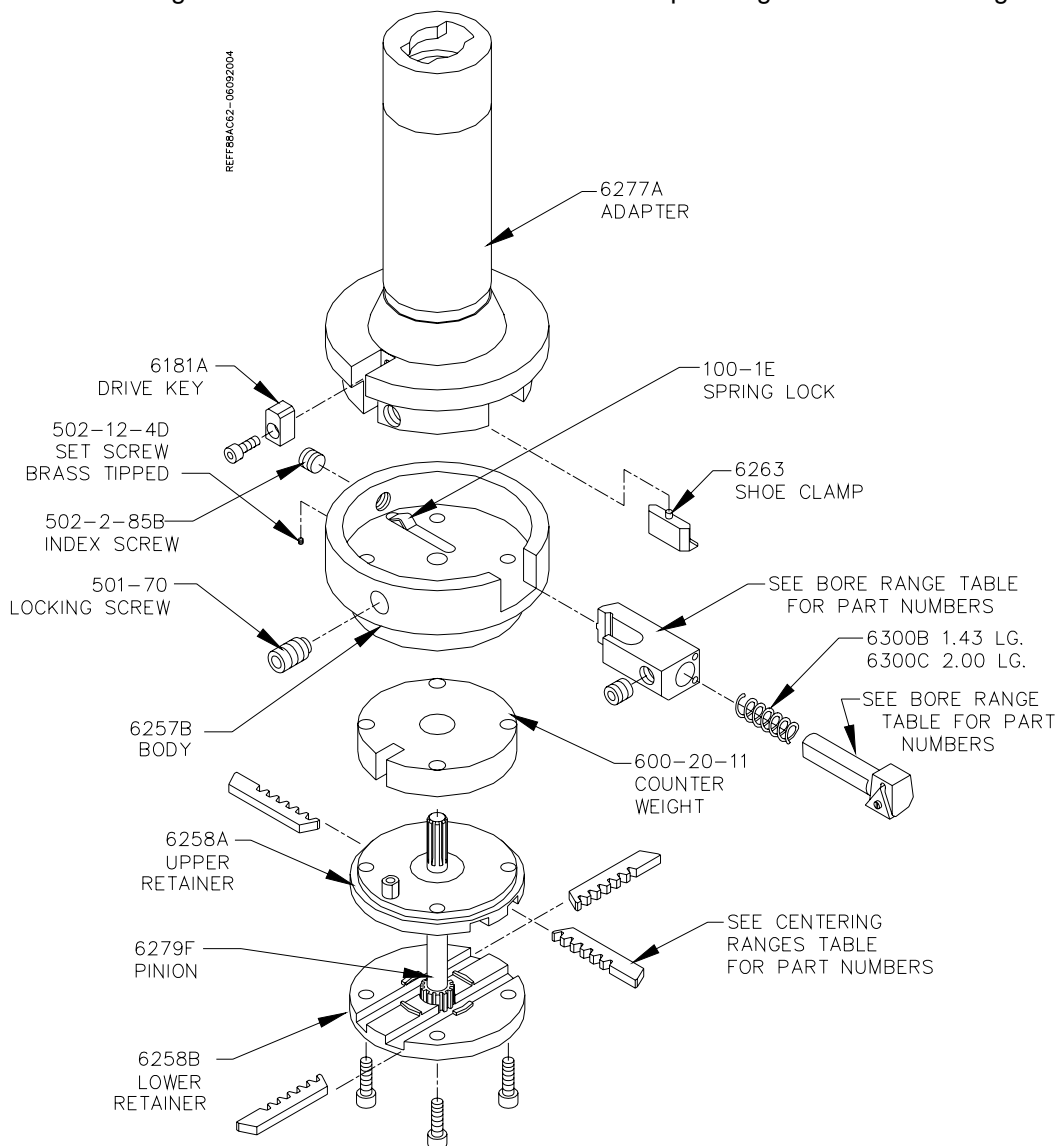
The Production Cutterhead has a standard bore capacity of 4.50" to 9.0".

The production Cutterhead simplifies and speeds up the boring operation. It eliminates the need to remove the tool every time you center the spindle in a new bore.

CAUTION

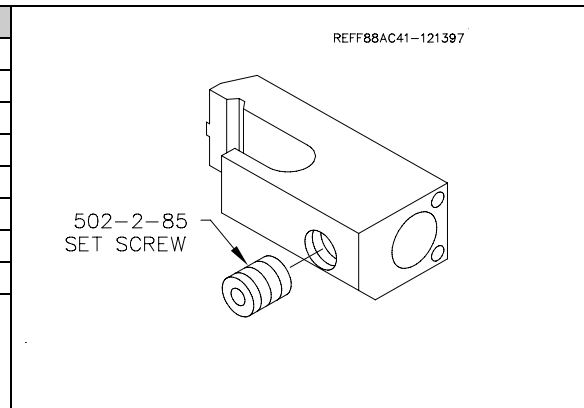
Be sure that this head does not interfere with lower extremities of the block, such as bosses and hubs.

The cutterhead is designed to clear most all obstructions in U.S. passenger car and truck engines.

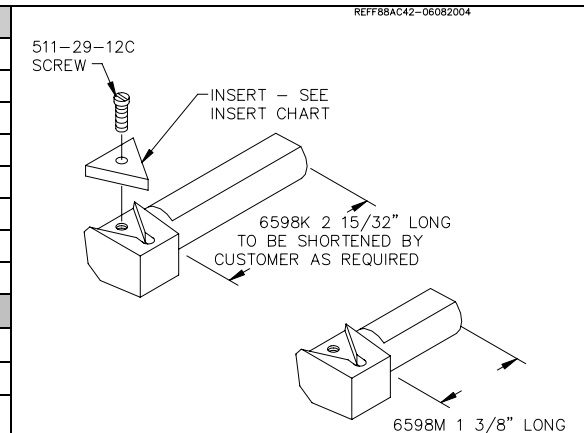


4 1/2" Production Cutterhead Standard Tooling:

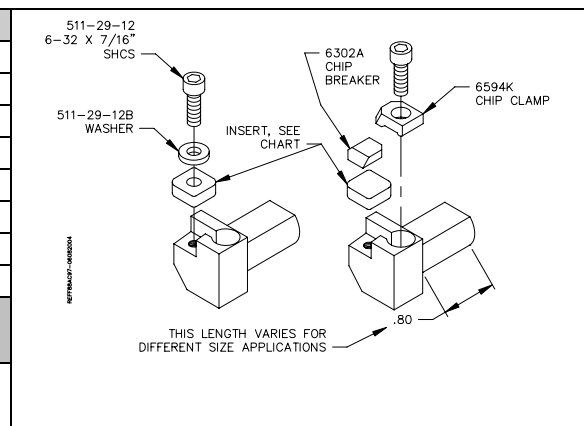
6259 Series Tool Holders	
Tool Holder	Length
6259P	3.13"
6259C	3.37"
6259D	3.62"
6259I	3.87"
6259E	4.13"
6259F	4.62"
6259G	5.13"



6598 Series Tool Bit when used with 6259 Holders		
Tool Bit	Tool Holder	Bore Range
6598M	6259P	4.50" – 5.00"
6598M	6259C	5.00" – 5.50"
6598K	6259D	5.50" – 6.00"
6598K	6259I	6.00" – 6.50"
6598K	6259E	6.50" – 7.00"
6598K	6259F	7.00" – 8.00"
6598K	6259G	8.00" – 9.00"
Standard Inserts		
RT322	3/8 IC TRIANGLE 1/32 RADIUS	
RT321	3/8 IC TRIANGLE 1/64 RADIUS	



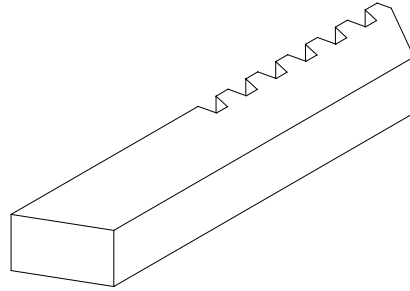
6260 Series Tool Bit when used with 6259 Holders		
Tool Bit	Tool Holder	Bore Range
6260M	6259P	4.50" – 5.00"
6260M	6259C	5.00" – 5.50"
6260L	6259D	5.50" – 6.00"
6260L	6259I	6.00" – 6.50"
6260L	6259E	6.50" – 7.00"
6260L	6259F	7.00" – 8.00"
6260L	6259G	8.00" – 9.00"
Standard Inserts		
RS322	Sq. insert neg rake 1/32 Radius	



Centering Fingers:

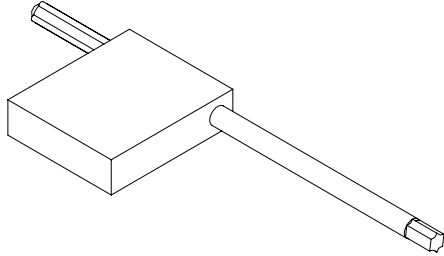
Centering Fingers		
Part Number	Length	Centering Range
600-20-6A	3.06"	3.25" – 6.00"
600-20-6B	4.62"	4.75" – 9.00"

REF88AC45-121397



511-29-12D Torx Wrench

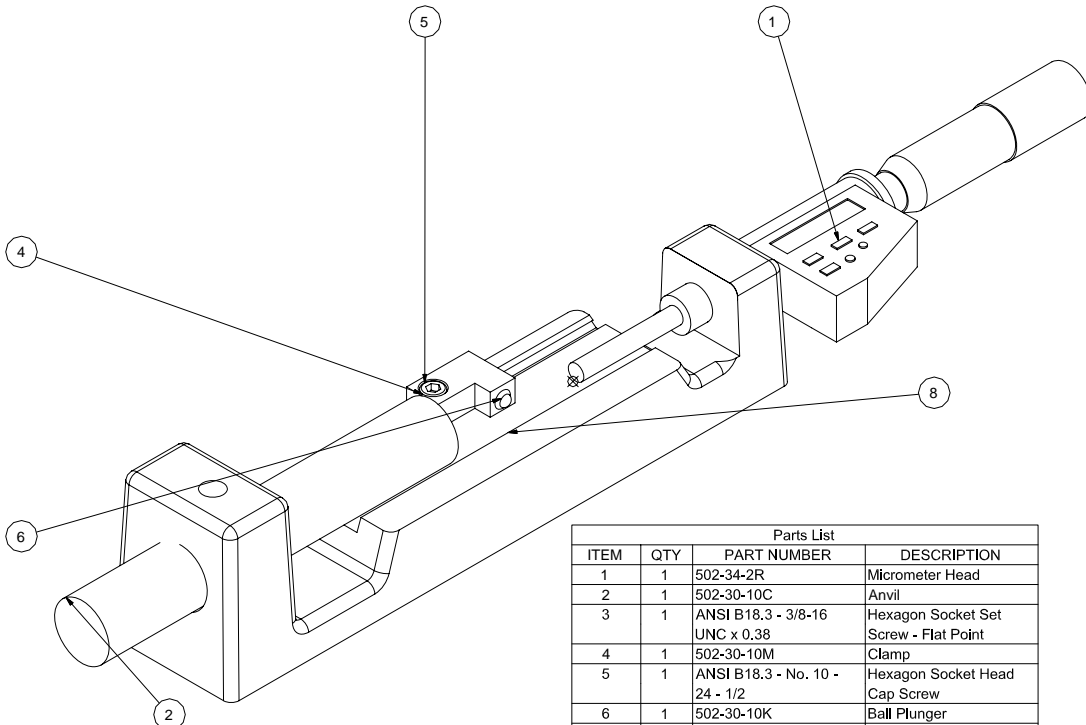
For use with Torx style screw in Triangle cartridges.



REF8S95-06082004

900-2-20 Micrometer Assembly:

2.9" – 6.0" and 6.0" – 9.0" Diameter



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

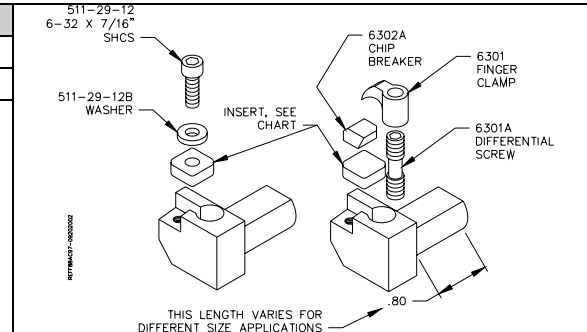
6256A Optional Tooling:

Offset Tool Holders:

6260 Series Tool Bit when used with 6520 Holders

Tool Bit	Bore Range
6260W	3.78" – 5.24"

Square insert negative rake

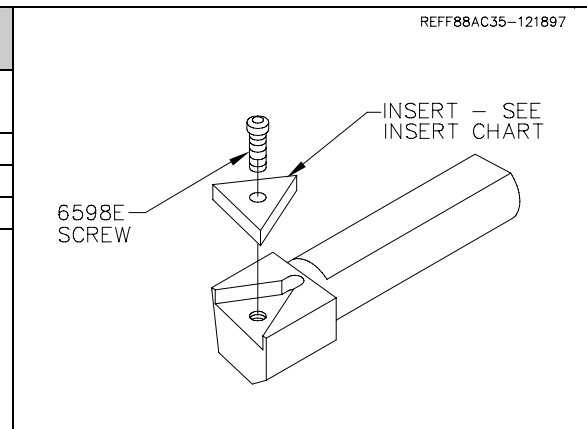


Chamfering Tool Holders:

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"

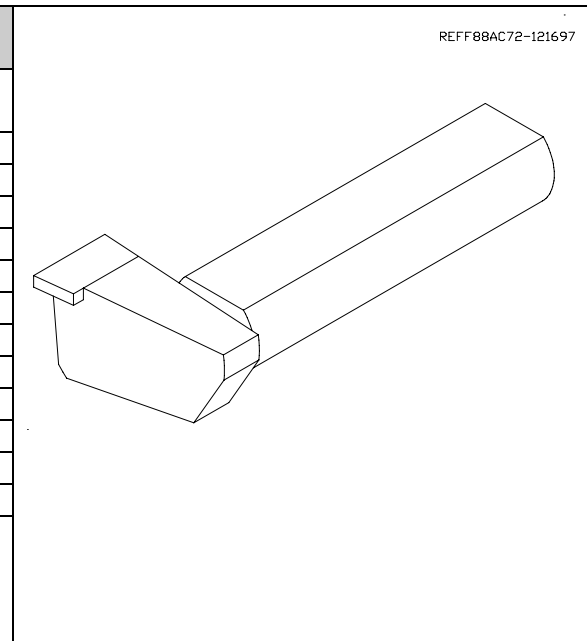
Triangle insert positive rake



Grooving Tool Bits:

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"



7-3/4 Heavy Duty Production Cutterhead

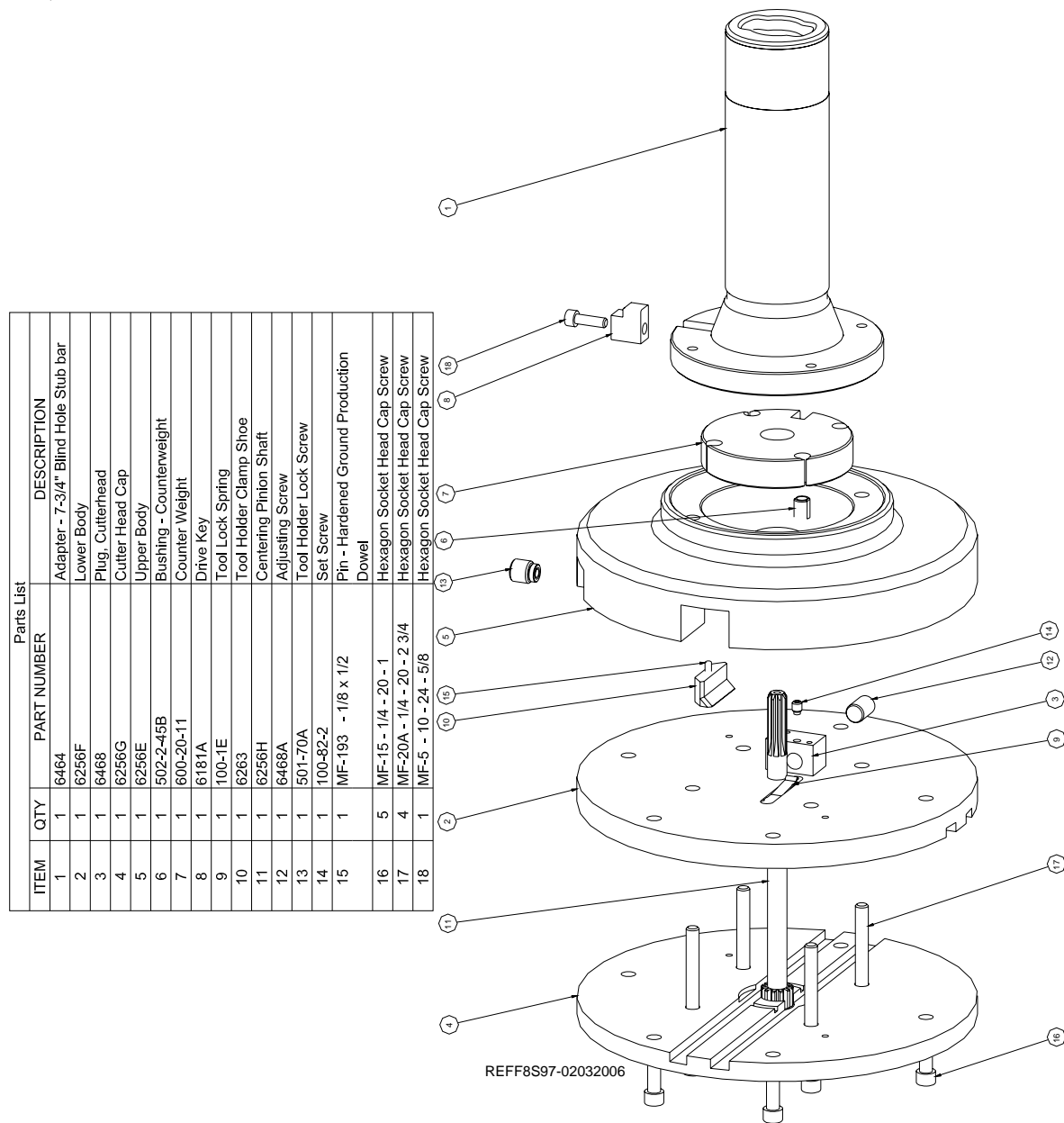
6256C With Tooling
6256D Without Tooling

The Production Cutterhead has a standard bore capacity of 7-3/4" to 14.0".

The production Cutterhead simplifies and speeds up the boring operation. It eliminates the need to remove the tool every time you center the spindle in a new bore.

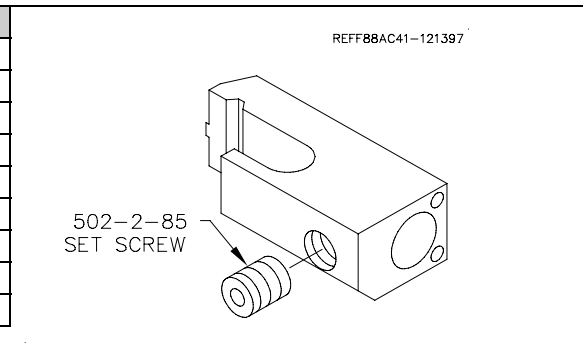
CAUTION

Be sure that this head does not interfere with lower extremities of the block, such as bosses and hubs.

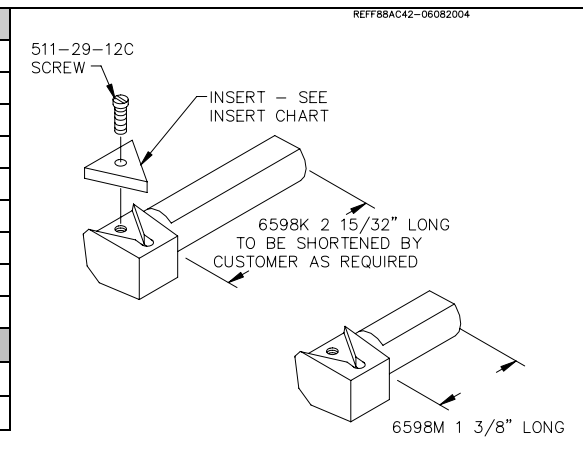


7-3/4 Heavy Duty Production Cutterhead Standard Tooling:

6259 Series Tool Holders	
Tool Holder	Length
6259C	3.37"
6259D	3.62"
6259I	3.87"
6259E	4.13"
6259F	4.62"
6259G	5.13"
6259H	5.62"
6259J	6.13"

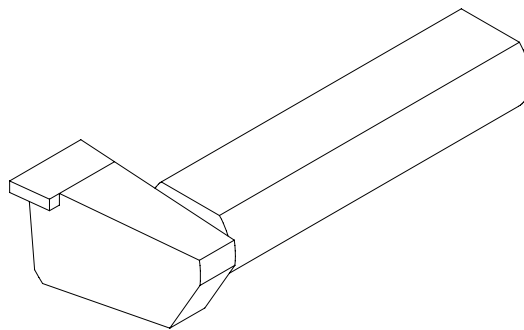


6598 Series Tool Bit when used with 6259 Holders		
Tool Bit	Tool Holder	Bore Range
6598K	6259C	8.00" – 8.25"
6598K	6259D	8.25" – 8.75"
6598K	6259I	8.75" – 9.25"
6598K	6259E	9.25" – 10.25"
6598K	6259F	10.25" – 11.25"
6598K	6259G	11.25" – 12.25"
6598K	6259H	12.25" – 13.25"
6598K	6259J	13.25" – 14.25"
Standard Inserts		
RT322	3/8 IC TRIANGLE 1/32 RADIUS	
RT321	3/8 IC TRIANGLE 1/64 RADIUS	



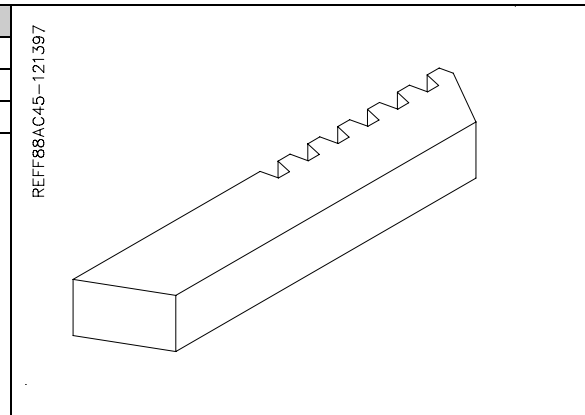
6513D Offset Tool Bit:

REF88AC72-121697



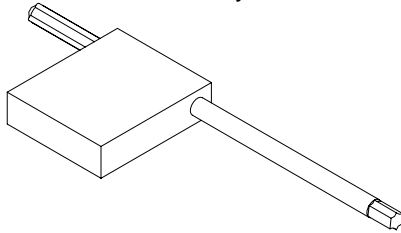
Centering Fingers:

Centering Fingers		
Part Number	Length	Centering Range
600-20-6D	7.562"	7.75" – 14.75"
600-20-6E	11.609"	11.63" – 16.00"



511-29-12D Torx Wrench

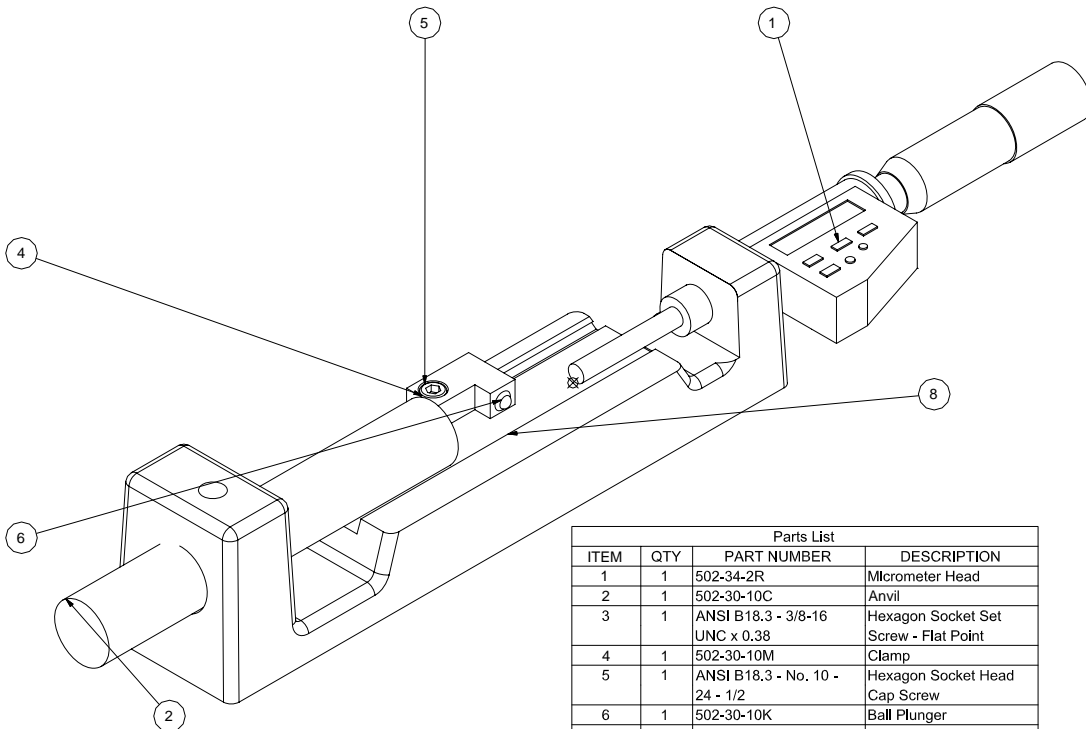
For use with Torx style screw in Triangle cartridges.



REFF8S95-06082004

900-2-20 Micrometer Assembly:

8.0" – 11.0" and 11.0" – 14.0" Diameter



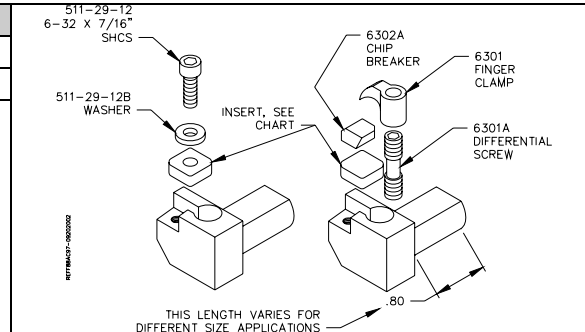
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10C	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square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

7 3/4" Cutterhead Optional Tooling:

Offset Tool Holders:

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

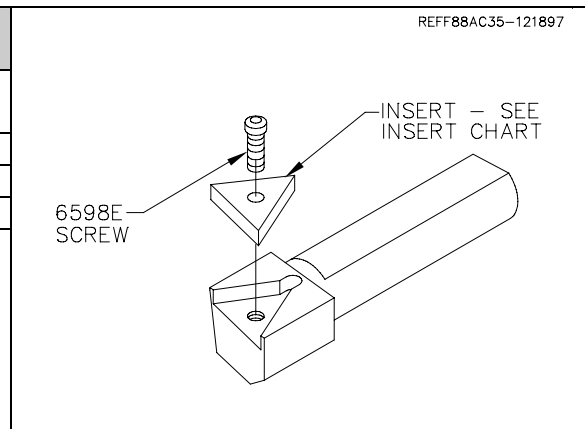
Square insert negative rake



Chamfering Tool Holders:

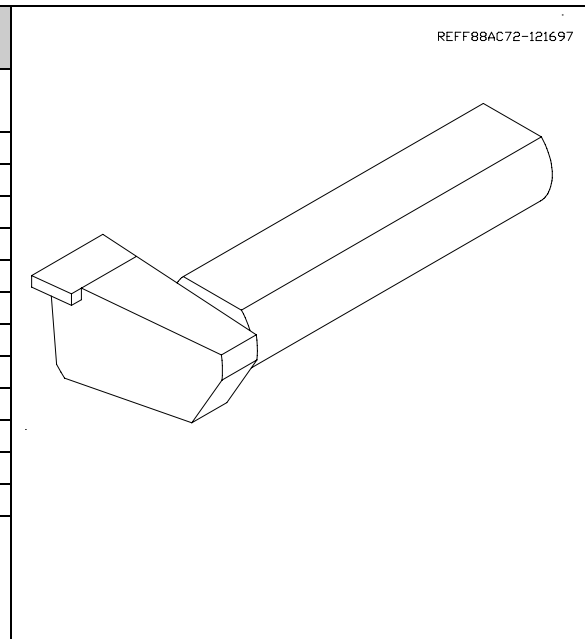
6547 Series Chamfering Tool Bits when used with 6520 Holders		
Tool Bit	Chamfer Angle	Bore Range
6547F	30	3.10" – 5.00"
6547G	20	3.30" – 5.00"
6547M	15	3.45" – 5.00"

Triangle insert positive rake



Grooving Tool Bits:

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"



7-3/4" Blind Hole Cutterhead

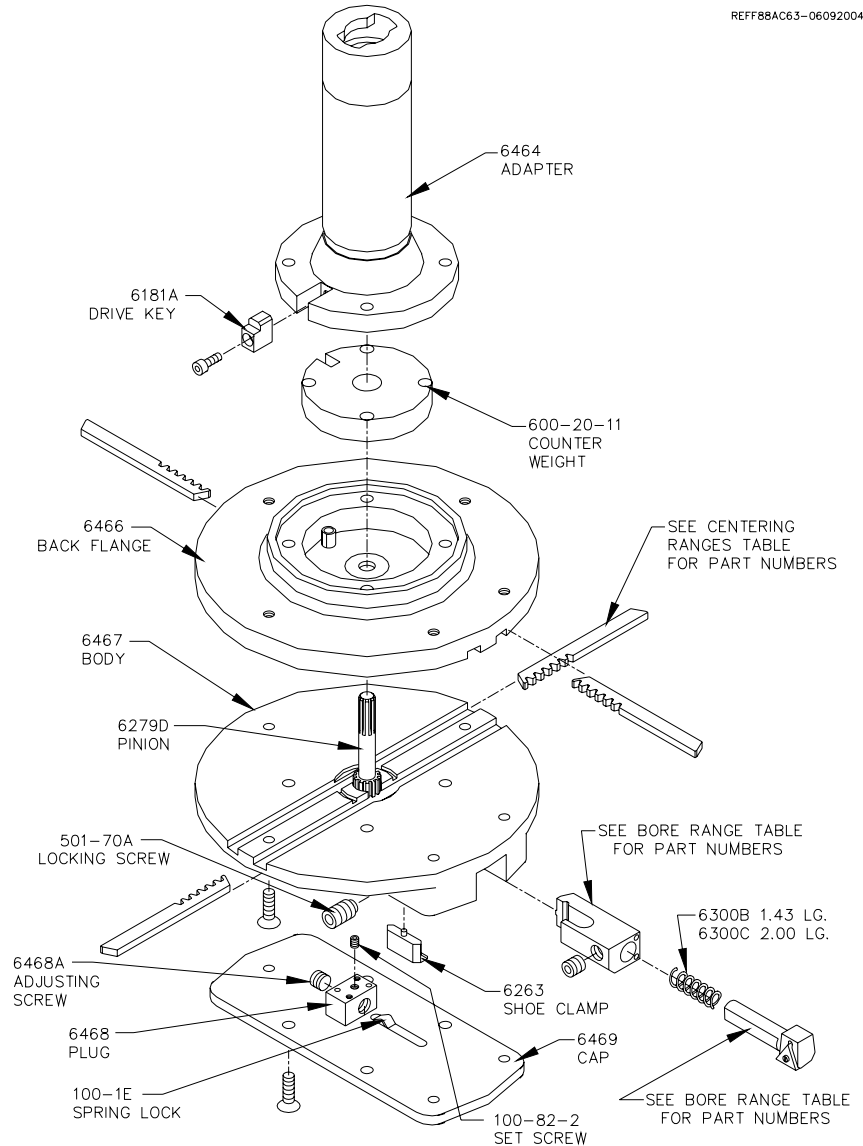
6464A With Tooling

6464B Without Tooling

The 7-3/4" Blind hole cutterhead has a bore capacity of 8.0" x 14.0" x 10.50 depth.

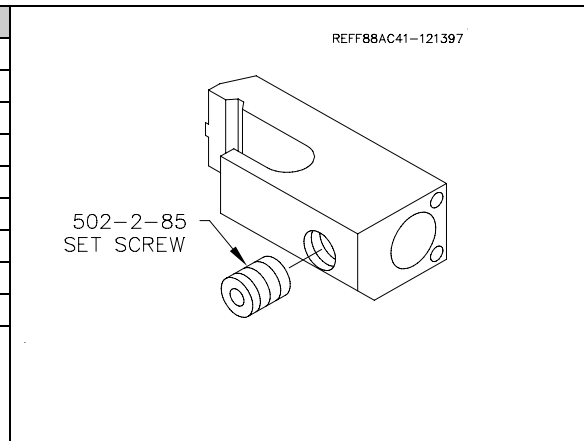
The large blind hole cutterhead is attached and operates in basically the same manner as the smaller cutterheads. The centering fingers are located above the tool holder. This allows the cutterhead to cut very near the bottom of a blind hole or one that has an obstruction near the bottom. The tool holder must be removed to center each bore.

An offset tool bit is provided so that extreme blind holes may be bored.

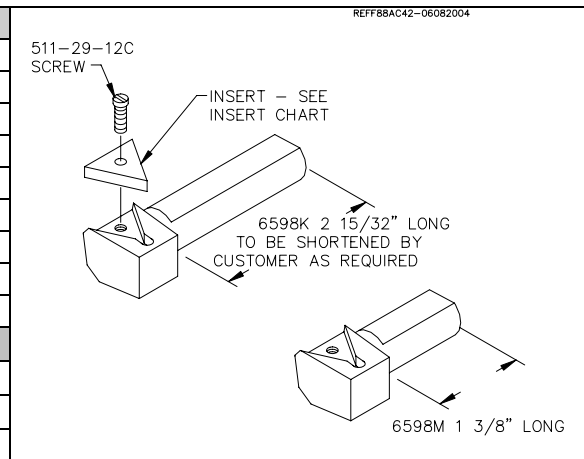


7 3/4" Blind Hole Cutterhead Standard Tooling:

6259 Series Tool Holders	
Tool Holder	Length
6259C	3.37"
6259D	3.62"
6259I	3.87"
6259E	4.13"
6259F	4.62"
6259G	5.13"
6259H	5.62"
6259J	6.13"

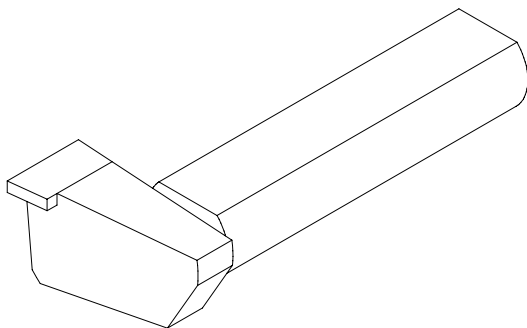


6598 Series Tool Bit when used with 6259 Holders		
Tool Bit	Tool Holder	Bore Range
6598M	6259C	8.00" – 8.25"
6598M	6259D	8.25" – 8.75"
6598K	6259I	8.75" – 9.25"
6598K	6259E	9.25" – 10.25"
6598K	6259F	10.25" – 11.25"
6598K	6259G	11.25" – 12.25"
6598K	6259H	12.25" – 13.25"
6598K	6259J	13.25" – 14.25"
Standard Inserts		
RT322	3/8 IC TRIANGLE 1/32 RADIUS	
RT321	3/8 IC TRIANGLE 1/64 RADIUS	



6513D Offset Tool Bit:

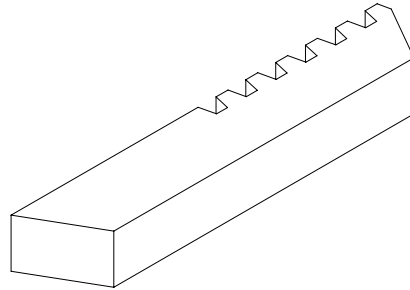
REF88AC72-121697



Centering Fingers:

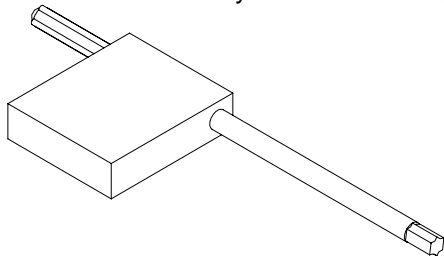
Centering Fingers		
Part Number	Length	Centering Range
600-20-6D	7.50"	7.75" – 14.75"
600-20-6E	11.50"	11.63" – 16.00"

REFFB8AC45-121397



511-29-12D Torx Wrench

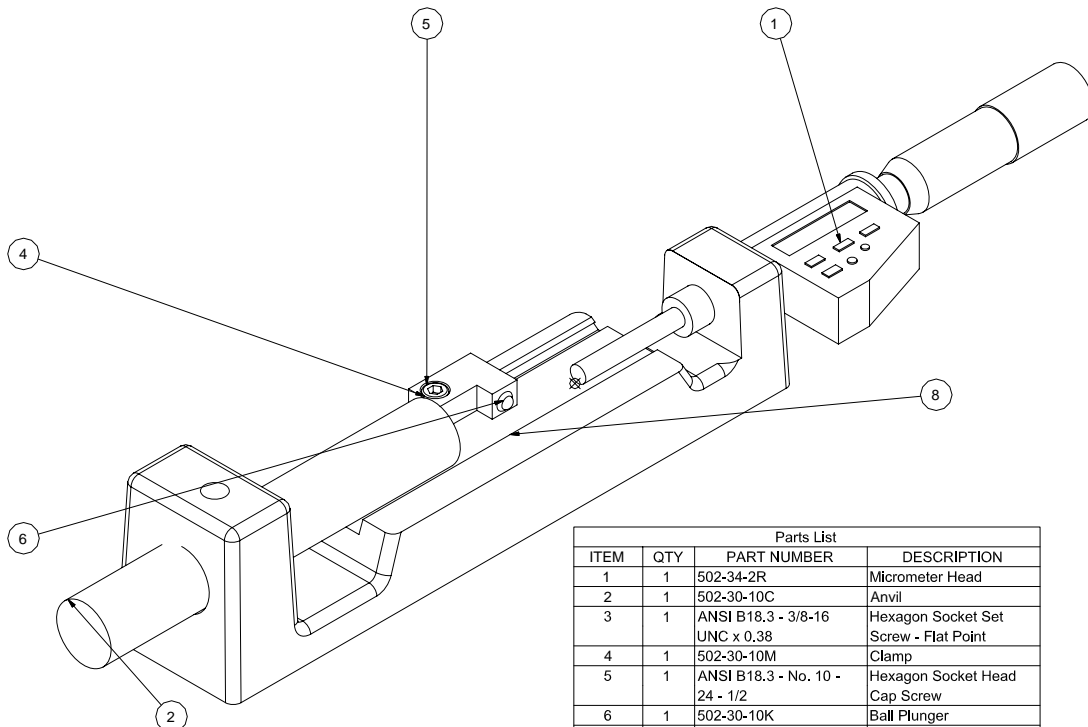
For use with Torx style screw in Triangle cartridges.



REFF8S95-06082004

900-2-20 Micrometer Assembly

8.0" – 11.0" and 11.0 – 14.0" Diameter

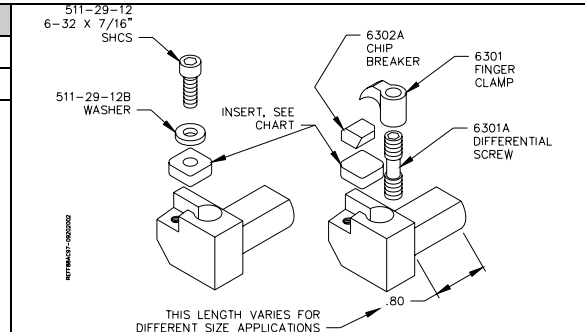


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10C	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square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

7 3/4" Cutterhead Optional Tooling:

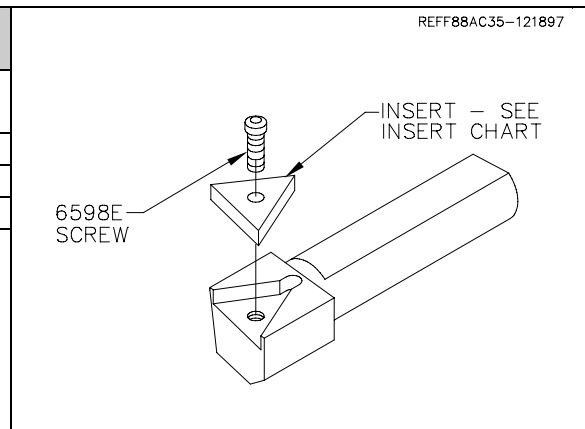
Offset Tool Holders:

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



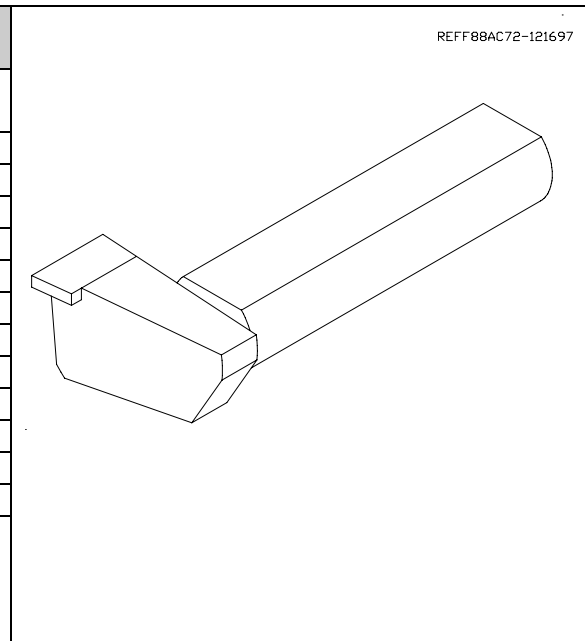
Chamfering Tool Holders:

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		



Grooving Tool Bits:

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"



14" Diameter Cutterhead

6587 With Tooling

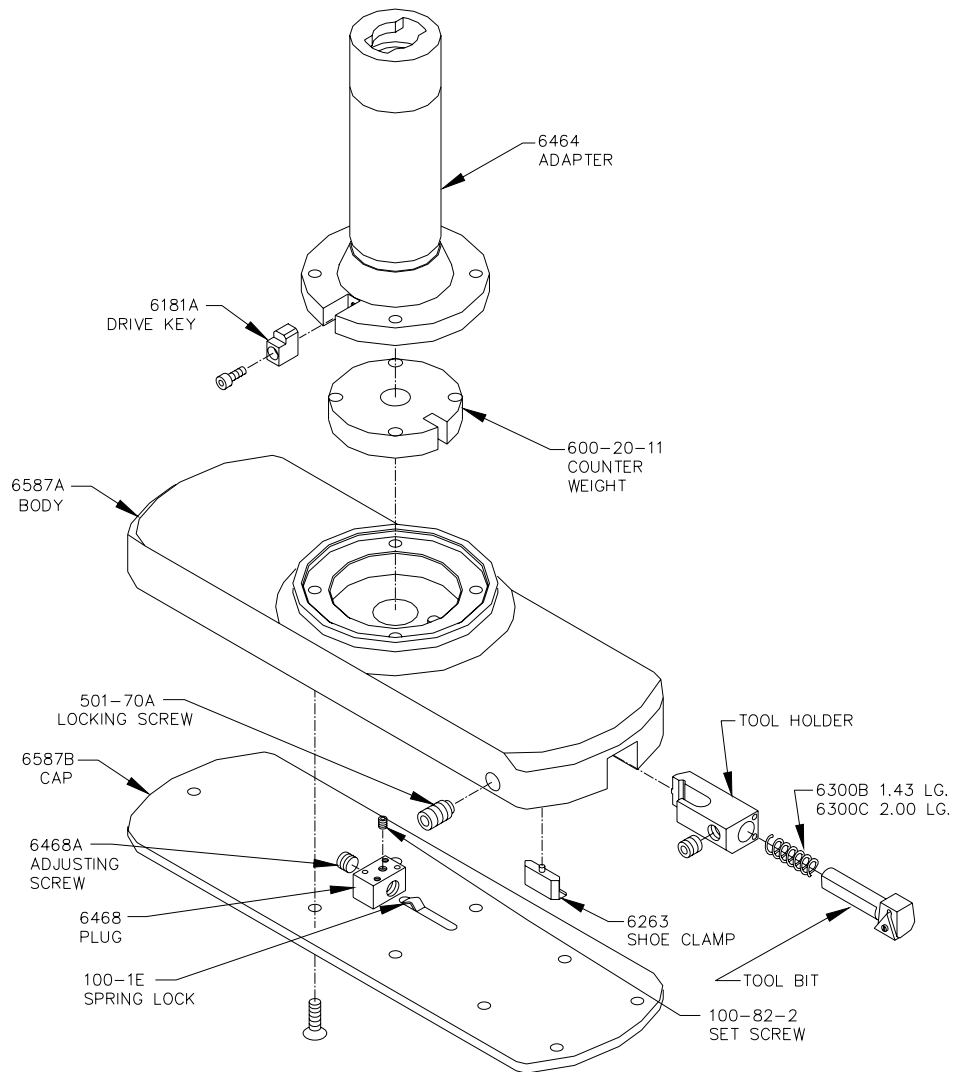
6587D Without Tooling

The 14" cutterhead has a bore capacity of 14.0" to 20.0" diameter.

The large cutterhead is attached in basically the same manner as the smaller cutterheads except that it has no centering fingers.

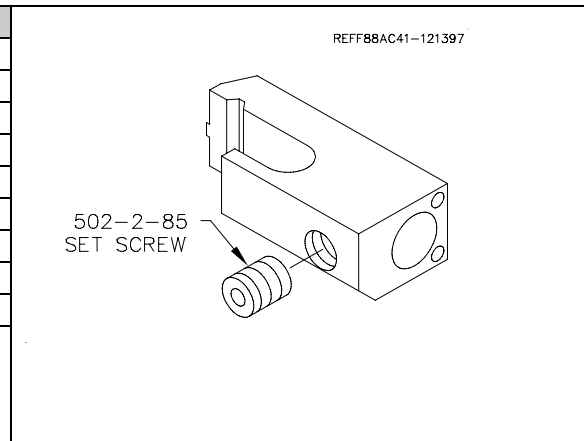
The optional F80 air gauge or a magnetic based dial indicator must be used to center the cutterhead. The toolholder must be removed to center each bore.

REF88AC85-121697



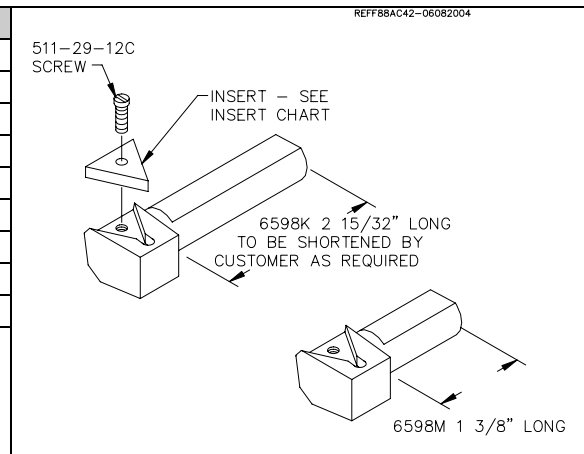
14" Blind Hole Cutterhead Standard Tooling:

6259 Series Tool Holders	
Tool Holder	Length
6259C	3.37"
6259D	3.62"
6259I	3.87"
6259E	4.13"
6259F	4.62"
6259G	5.13"
6259H	5.62"
6259J	6.13"



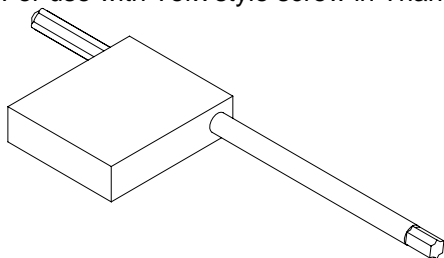
6598 Series Tool Bit when used with 6259 Holders		
Tool Bit	Tool Holder	Bore Range
6598M	6259C	14.00" – 14.50"
6598M	6259D	14.50" – 15.00"
6598K	6259I	15.00" – 15.50"
6598K	6259E	15.50" – 16.50"
6598K	6259F	16.50" – 17.50"
6598K	6259G	17.50" – 18.50"
6598K	6259H	18.50" – 19.50"
6598K	6259J	19.50" – 20.50"

Triangle insert, positive rake



511-29-12D Torx Wrench

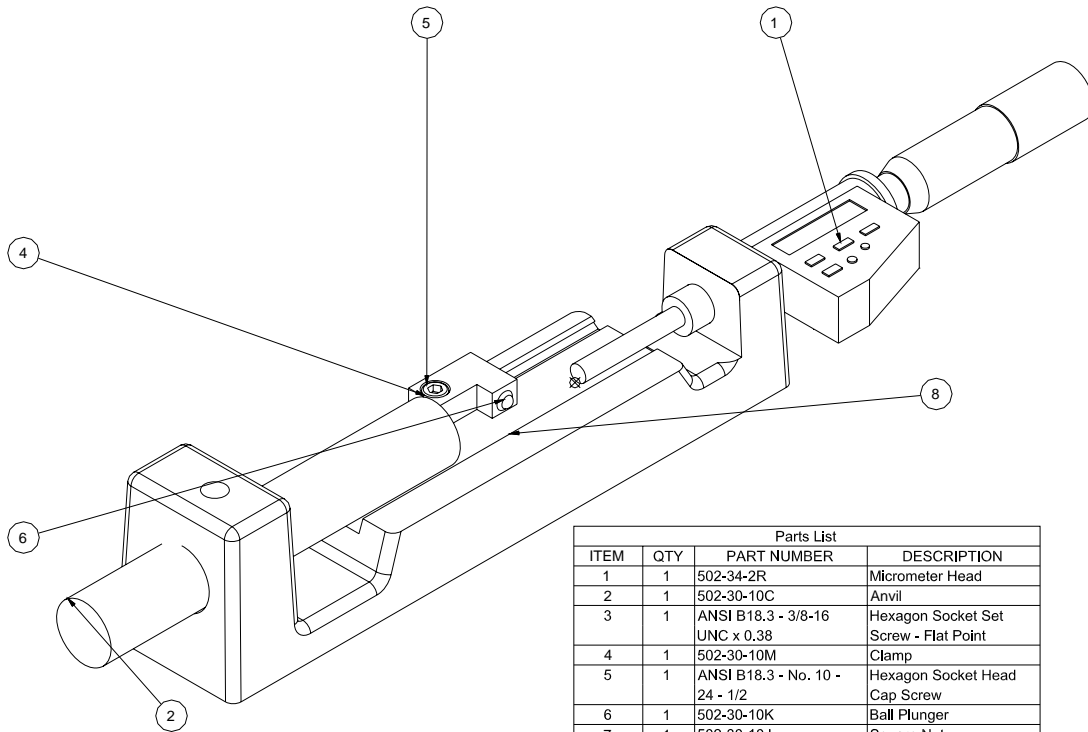
For use with Torx style screw in Triangle cartridges.



REFFB8S95-06082004

900-2-20 Micrometer Assembly:

13.9" – 17.0" and 17.0" – 20.0"
Diameter

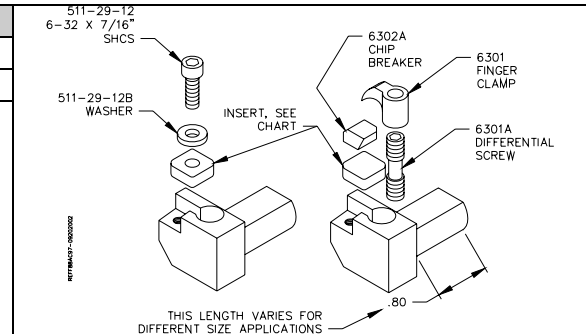


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10C	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square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

14" Cutterhead Optional Tooling:

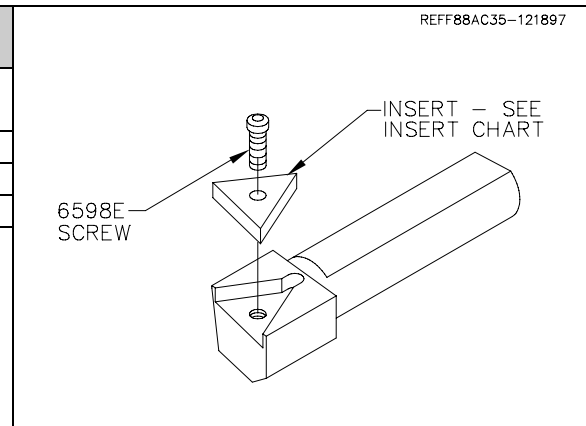
Offset Tool Holders:

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



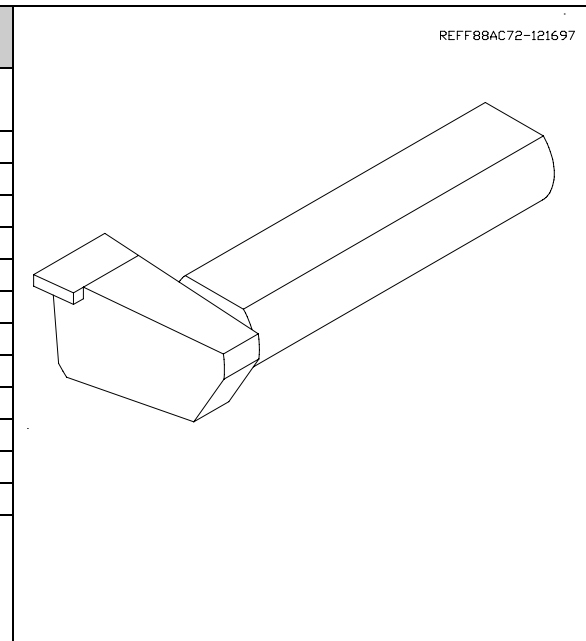
Chamfering Tool Holders:

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		

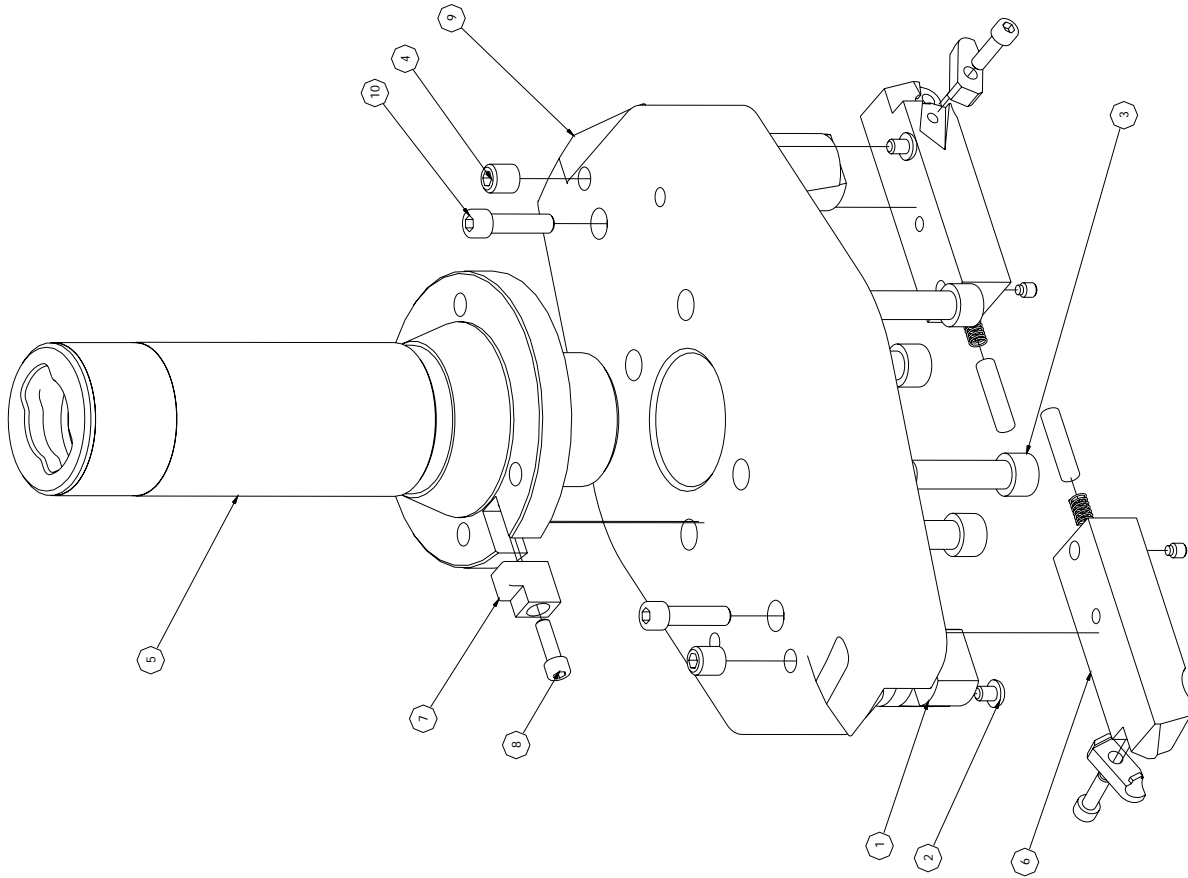


Grooving Tool Bits:

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"



6294V 10" (250 mm) Surfacing Cutterhead



ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	7206K	L LOCK
2	2	MF-87 ANSI B18.3 - 10 - 24 x 1/4	Hexagon Socket Button Head Cap Screw
3	4	7202C ANSI B18.3 - 3/8 - 16 UNC - 1 1/2	Hexagon Socket Head Cap Screw
4	2	MF-33 ANSI B18.3 - 3/8-16 UNC x 0.44	Hexagon Socket Set Screw - Oval Point
5	1	6170B	ADAPTER, SURFACING HEAD
6	2	7202W	TOOL HOLDER ASSEMBLY, FLY CUTTER
7	1	6181A	Drive Key
8	1	MF-5 ANSI B18.3 - No. 10 - 24 UNC - .5/8	Hexagon Socket Head Cap Screw
9	1	7206L	Hexagon Socket Head Cap Screw
10	2	MF-15 ANSI B18.3 - 1/4 - 20 UNC - .1	Hexagon Socket Head Cap Screw

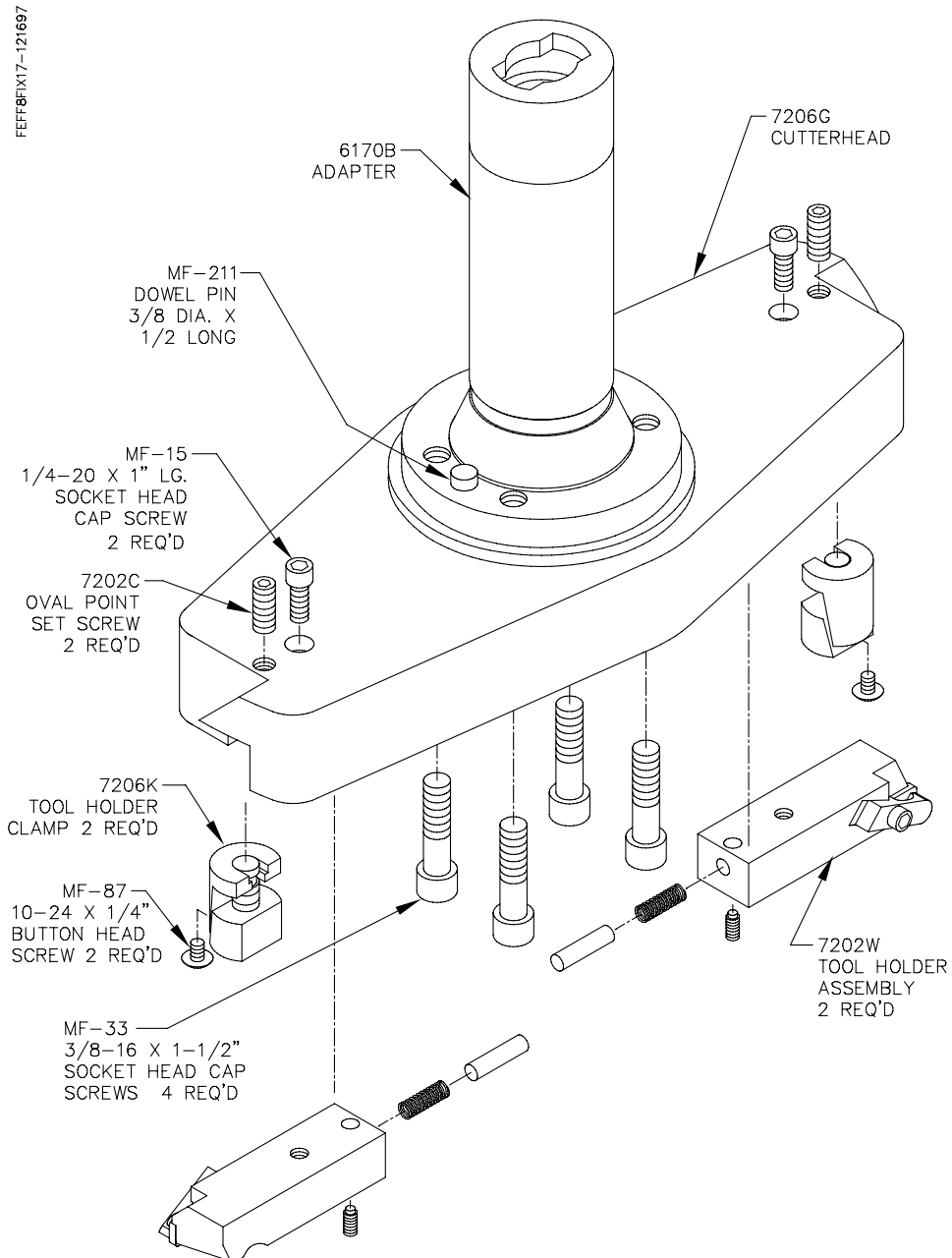
REF: 85122-05012006

14" Surfacing Cutterhead

6294U With Tooling

The 14" Surfacing Cutterhead is used to machine off the mating surfaces of most cylinder blocks and cylinder heads.

The surfacing cutterheads install the same way as the boring cutterheads do.

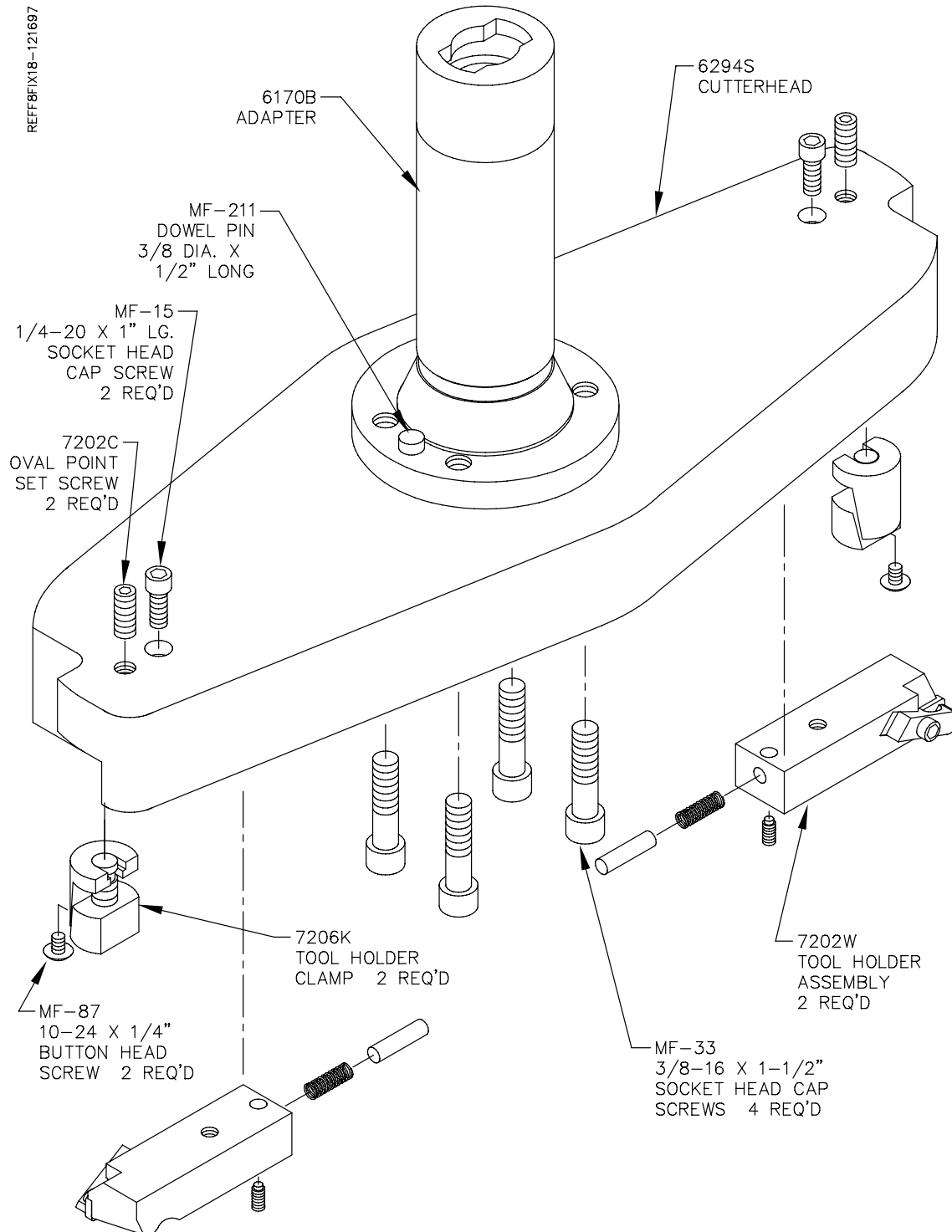


18" Surfacing Cutterhead

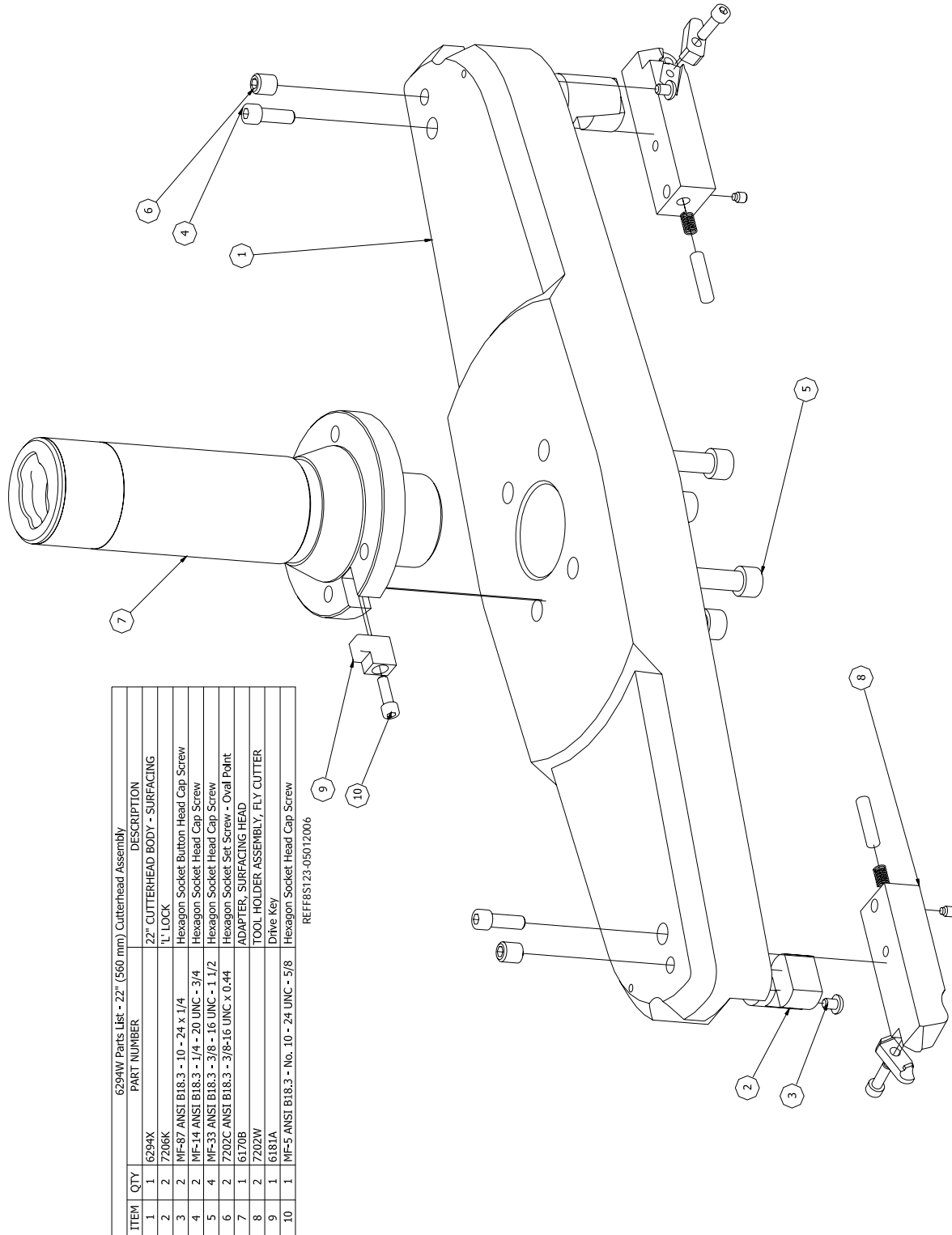
6294T With Tooling

The 18" Surfacing Cutterhead is used to machine the mating surfaces off most cylinder blocks and cylinder heads.

The surfacing cutterheads install the same way as the boring cutterheads do.



6294W 22" (560 mm) Surfacing Cutterhead



Optional Surfacing Tooling:

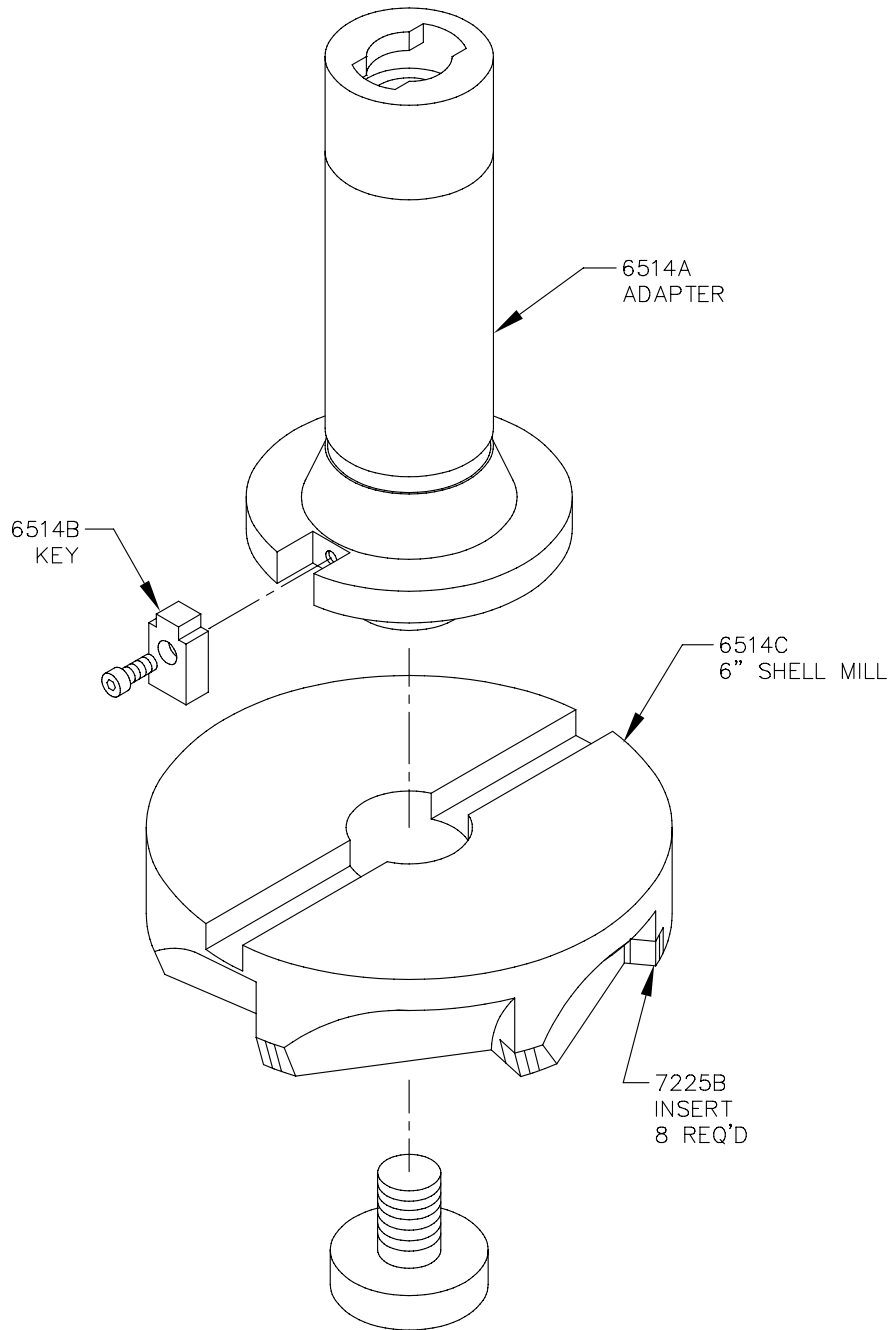
Tool Holder	Description
7202W	Square or Round, 3/8", Negative Rake
7202V	Square or Round, 1/2", Negative Rake
7202U	Square or Round, 1/2", Positive Rake

6" Diameter Shell Mill:

6514 With Tooling

The 6" Diameter Shell Mill was designed for cutting blocks and heads that have been repaired by welding. Using the shell mill instead of the surfacing cutterheads reduces chatter. There are many other jobs that this versatile cutterhead could be used for. Use this cutterhead for any cut that is too narrow for the regular surfacing cutterheads.

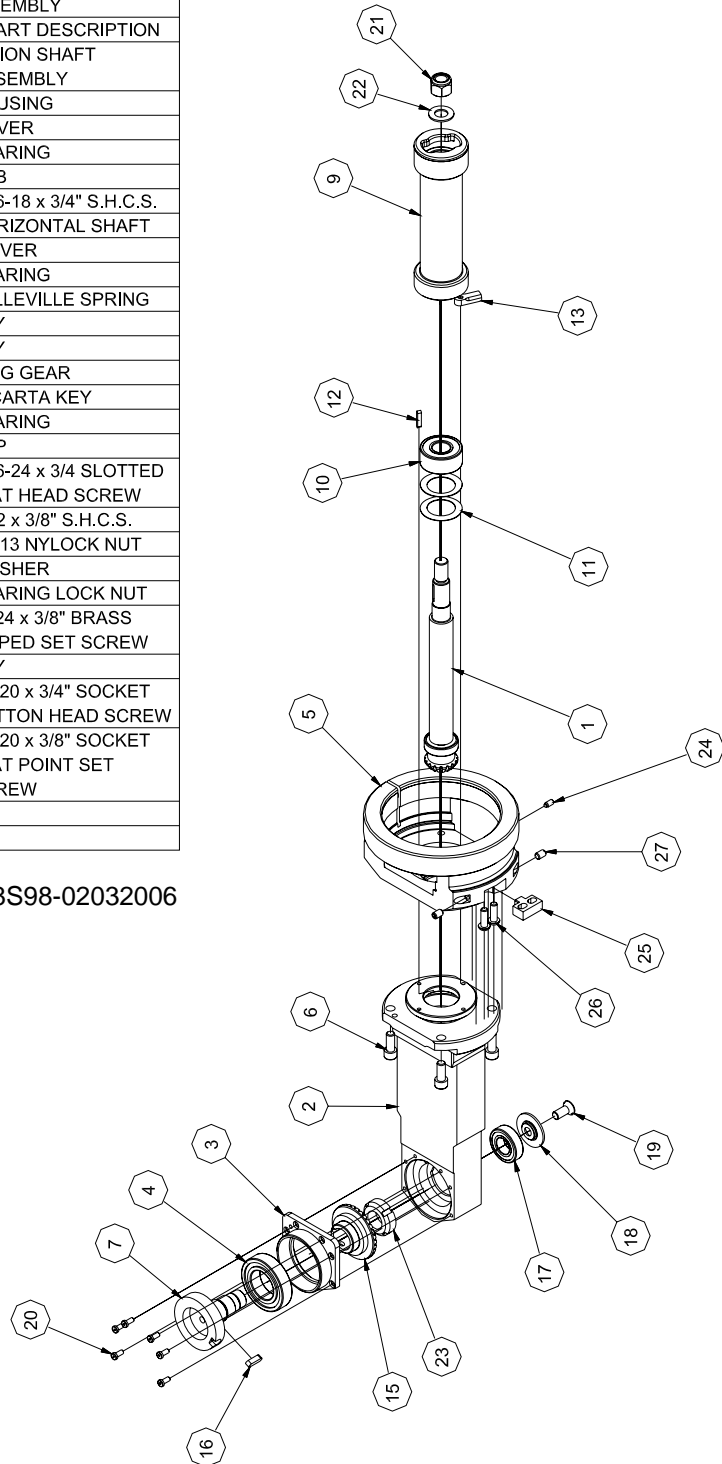
REFFB8AC84-121697



6753J Right Angle Drive:

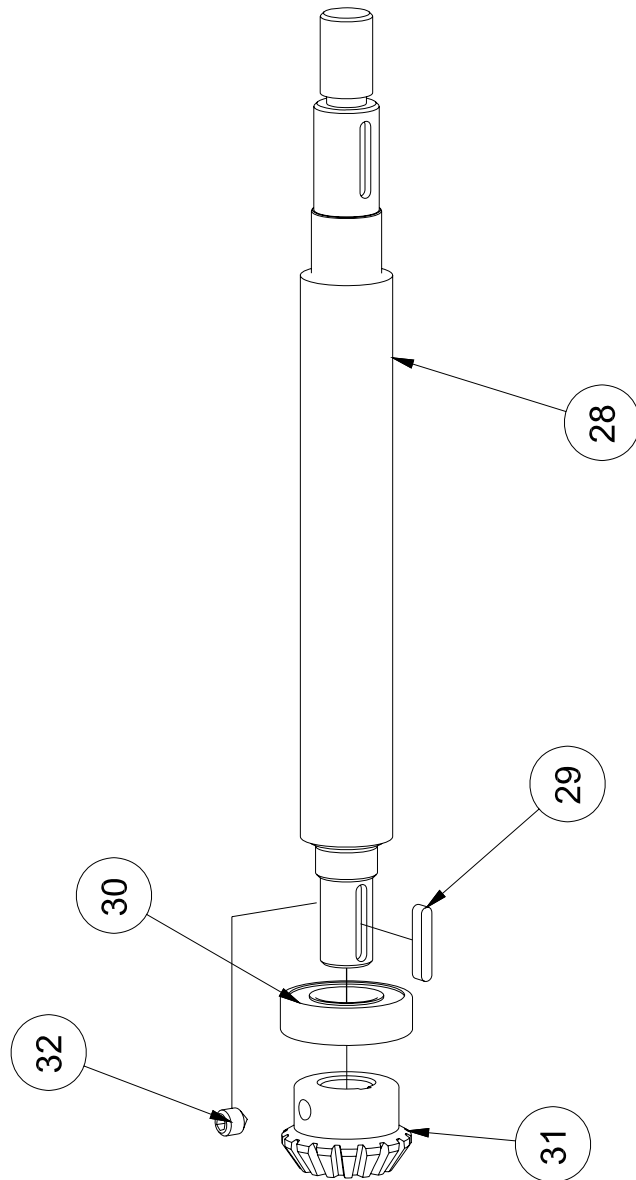
6753J RIGHT ANGLE DRIVE ASSEMBLY			
ITEM	QTY	PART NUMBER	PART DESCRIPTION
1	1	6775C	PINION SHAFT ASSEMBLY
2	1	6773D	HOUSING
3	1	6774	COVER
4	1	502-9-72B	BEARING
5	1	6770B	HUB
6	4	MF-22	5/16-18 x 3/4" S.H.C.S.
7	1	650-2-42A	HORIZONTAL SHAFT
9	1	6771A	DRIVER
10	1	502-9-32	BEARING
11	2	6007A	BELLEVILLE SPRING
12	1	6752Q	KEY
13	1	6776	KEY
15	1	6766W	RING GEAR
16	1	6752P	MICARTA KEY
17	1	6753E	BEARING
18	1	6766F	CAP
19	1	6774K	5/16-24 x 3/4 SLOTTED FLAT HEAD SCREW
20	6	6774E	8-32 x 3/8" S.H.C.S.
21	1	MF-186	1/2-13 NYLOCK NUT
22	1	100-19	WASHER
23	1	6705B	BEARING LOCK NUT
24	1	100-82-2A	10-24 x 3/8" BRASS TIPPED SET SCREW
25	1	6750K	KEY
26	2	MF-92	1/4-20 x 3/4" SOCKET BUTTON HEAD SCREW
27	2	MF-59	1/4-20 x 3/8" SOCKET FLAT POINT SET SCREW
28	1		
29	1		

REFF8S98-02032006



6753J Right Angle Drive Cont.

6775C SHAFT ASSEMBLY			
ITEM	QTY	PART NUMBER	PART DESCRIPTION
28	1	6775B	PINION SHAFT ^①
29	1	6752Q	KEY
30	1	700-11	BEARING
31	1	6752M	PINION
32	1	MF-59B	CONE POINT SET SCREW

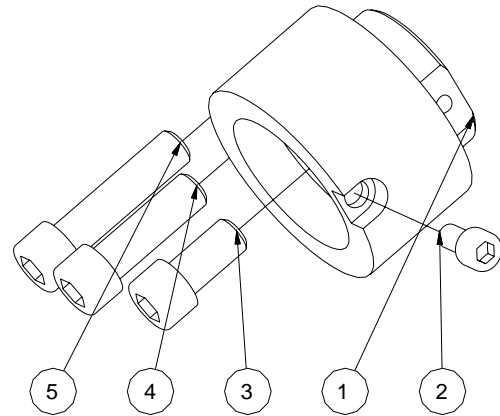


REF F8S99-02032006

6753J Right Angle Drive Standard Tooling:

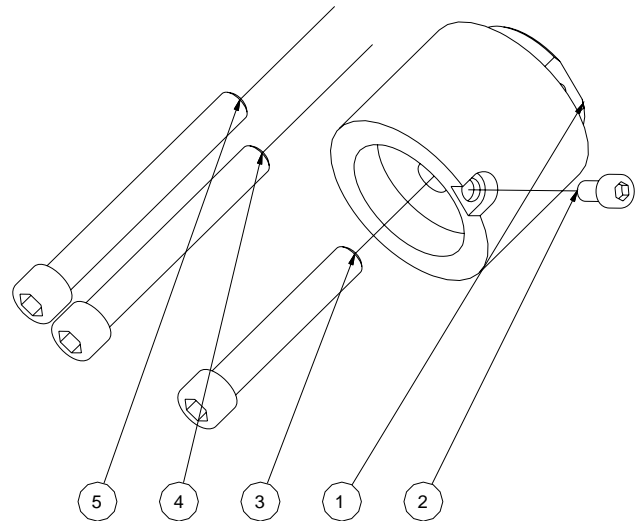
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-43	1.05 SPACER
2	1	ANSI B18.3 - No. 10 - 24 - 3/8	Hexagon Socket Head Cap Screw
3	1	ANSI B18.3 - 5/16 - 18 - 5/8	Hexagon Socket Head Cap Screw
4	1	ANSI B18.3 - 5/16 - 18 - 1	Hexagon Socket Head Cap Screw
5	1	ANSI B18.3 - 5/16 - 18 - 1 1/4	Hexagon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

REF8S100-02152006



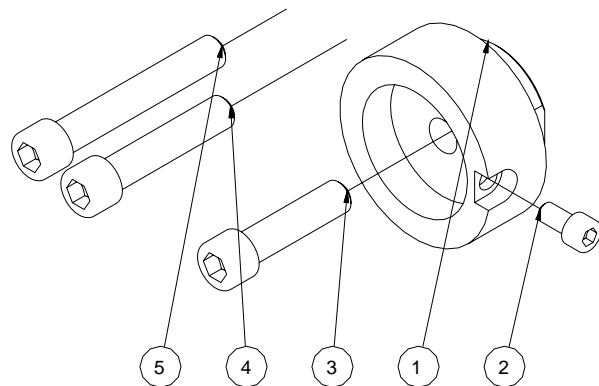
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-43A	SPACER - 1.50" LONG
2	1	ANSI B18.3 - No. 10 - 24 - 3/8	Hexagon Socket Head Cap Screw
3	1	ANSI B18.3 - 5/16 - 18 - 2	Hexagon Socket Head Cap Screw
4	1	ANSI B18.3 - 5/16 - 18 - 2 1/2	Hexagon Socket Head Cap Screw
5	1	ANSI B18.3 - 5/16 - 18 -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

REF8S101-02152006



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

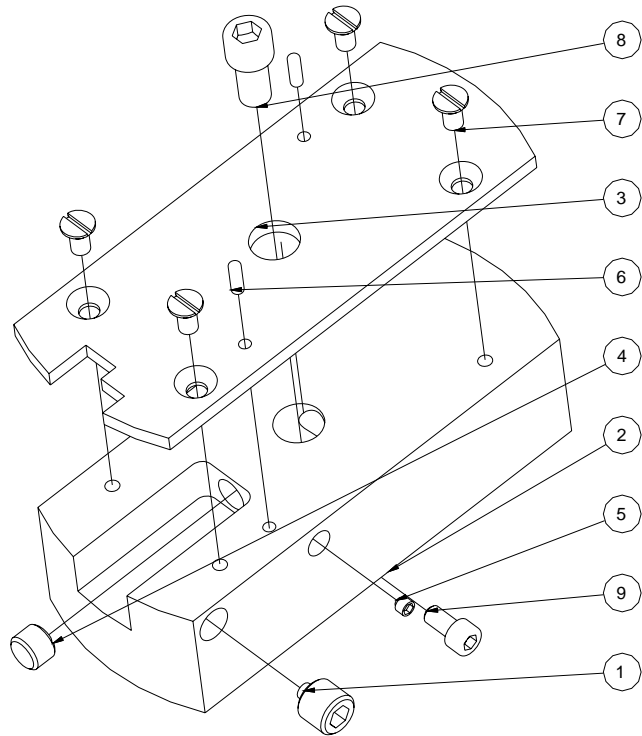
REF8S102-02152006



6753J Right Angle Drive Standard Tooling Cont:

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	501-70A	Tool Holder Lock Screw ass'y
2	1	650-2-16C	BODY, 5.4" PRECISION LINE BORE CUTTERHEAD
3	1	650-2-17B	CAP, 5.4" PRECISION LINE BORE CUTTERHEAD
4	1	502-2-85B	Index Screw
5	1	502-12-4D	SOCKET SET SCREW, BRASS TIPPED 8-32 X 1/8
6	2	ANSI B18.8.2 - 1/8 x 3/8	Pin - Hardened Ground Production Dowel
7	4	ANSI B18.6.2 - 10-24 UNC x 0.375	Slotted Flat Countersunk Head Cap Screw
8	1	ANSI B18.3 - 5/16 - 18 - 5/8	Hexagon Socket Head Cap Screw
9	1	ANSI B18.3 - No. 10 - 24 - 3/8	Hexagon Socket Head Cap Screw

REF8S103-02152006

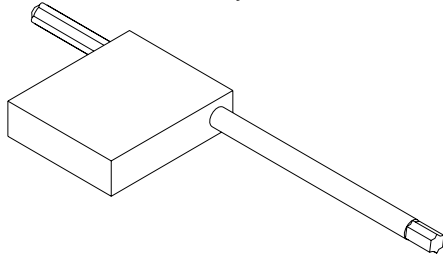


650-2-39A Large Line Bore Head 5.4" – 8.1" (137mm – 206mm)

Toolholder	Toolholder Length	Bore Diameter Range
6801B	1.54" (39mm)	5.4" – 5.7" (137mm – 145mm)
6801C	1.75" (44mm)	5.7" – 6.1" (145mm – 155mm)
6801D	1.95" (50mm)	6.1" – 6.5" (155mm – 165mm)
6801E	2.15" (55mm)	6.5" – 6.9" (165mm – 175mm)
6801F	2.35" (60mm)	6.9" – 7.3" (175mm – 185mm)
6801G	2.55" (65mm)	7.3" – 7.7" (185mm – 195mm)
6801H	2.75" (70mm)	7.7" – 8.1" (196mm – 206mm)

511-29-12D and 511-29-12F Torx Wrenches

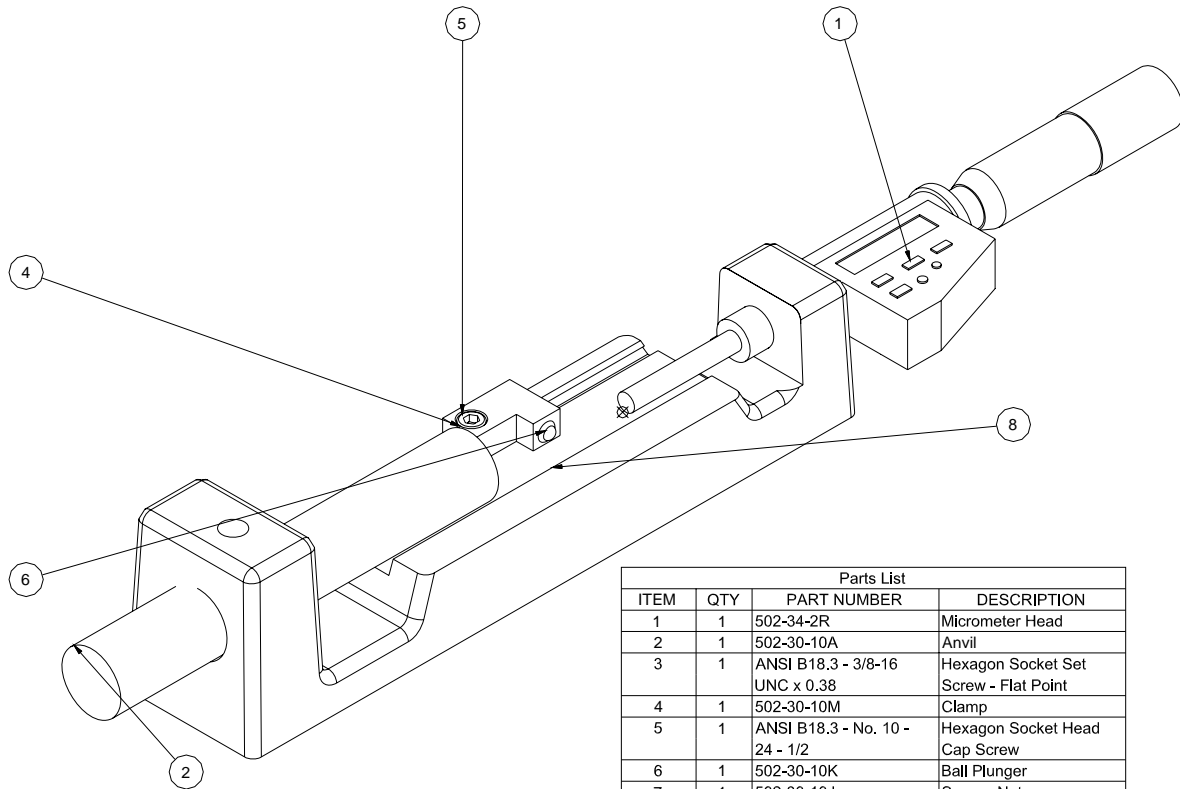
For use with Torx style screw in Triangle cartridges.



REF8S95-06082004

900-2-19 Micrometer Assembly:

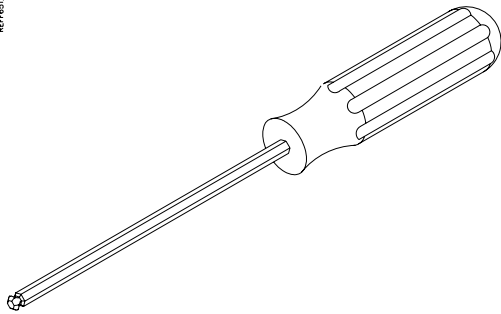
5.4" – 8.1" (137mm – 206mm)



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

501-72 and 501-72J Hex Drivers

REF96912-04290000

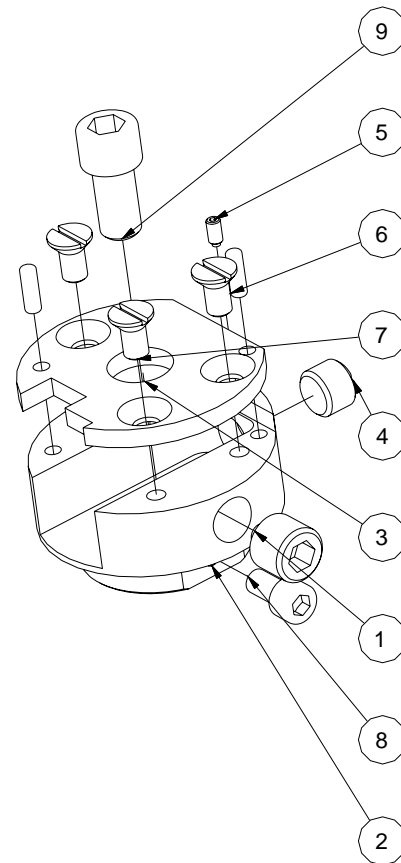


Standard Inserts	
RT322	3/8 IC TRIANGLE 1/32 RADIUS
RT321	3/8 IC TRIANGLE 1/64 RADIUS
RT212	1/4 IC TRIANGLE 1/32 RADIUS
RT211	1/4 IC TRIANGLE 1/64 RADIUS

6753J Right Angle Drive Standard Tooling Cont:

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	501-70A	Tool Holder Lock Screw ass'y
2	1	small cutterhead body	
3	1	small cutterhead cover	
4	1	502-2-85B	Index Screw
5	1	650-2-6A	4-40 brass tipped set screw
6	2	ANSI B18.8.2 - 1/8 x 3/8	Pin - Hardened Ground Production Dowel
7	3	ANSI B18.6.2 - 10-24 UNC x 0.375	Slotted Flat Countersunk Head Cap Screw
8	1	ANSI B18.3 - No. 10 - 24 - 3/8	Hexagon Socket Head Cap Screw
9	1	ANSI B18.3 - 5/16 - 18 - 5/8	Hexagon Socket Head Cap Screw

REF8S104-02162006

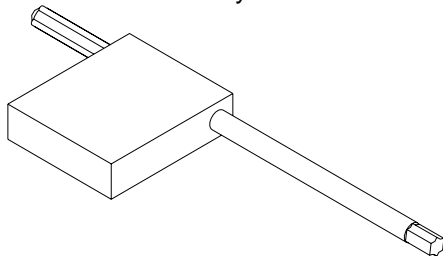


650-2-39B Small Line Bore Head 2.0" – 4.0" (50mm – 100mm)

Toolholder	Toolholder Length	Bore Diameter Range
6801B	1.54" (39mm)	2.0" – 2.4" (51mm – 61mm)
6801C	1.75" (44mm)	2.4" – 2.8" (61mm – 71mm)
6801D	1.95" (50mm)	2.8" – 3.2" (71mm – 81mm)
6801E	2.15" (55mm)	3.2" – 3.6" (81mm – 91mm)
6801F	2.35" (60mm)	3.6" – 4.0" (91mm – 101mm)

511-29-12D and 511-29-12F Torx Wrenches

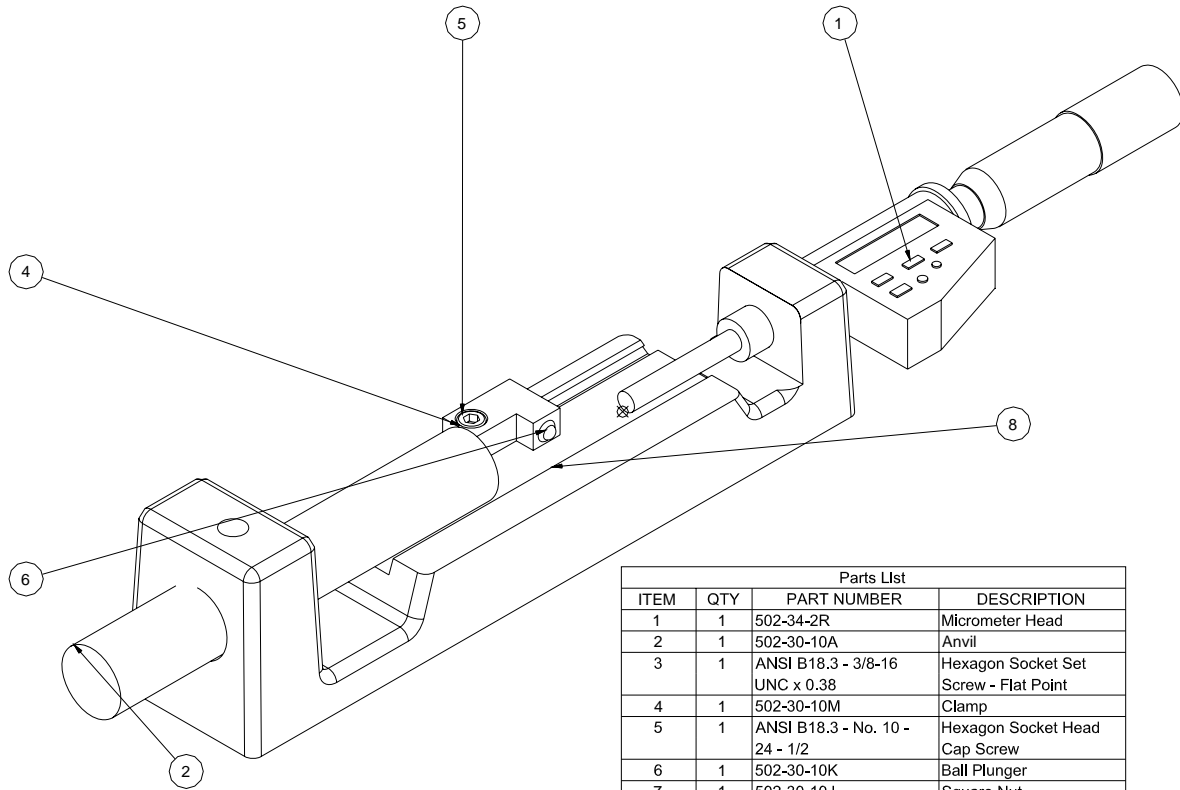
For use with Torx screw in Triangle cartridges.



REF8S95-06082004

900-2-19 Micrometer Assembly:

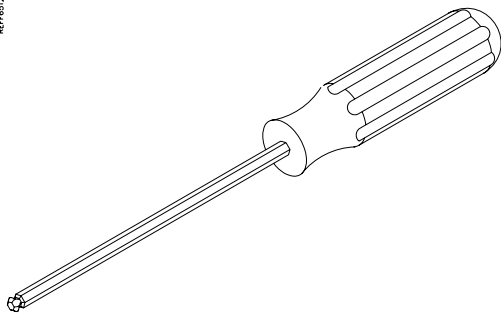
2.0" – 4.0" (50mm – 100mm)



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

501-72 Hex Drivers

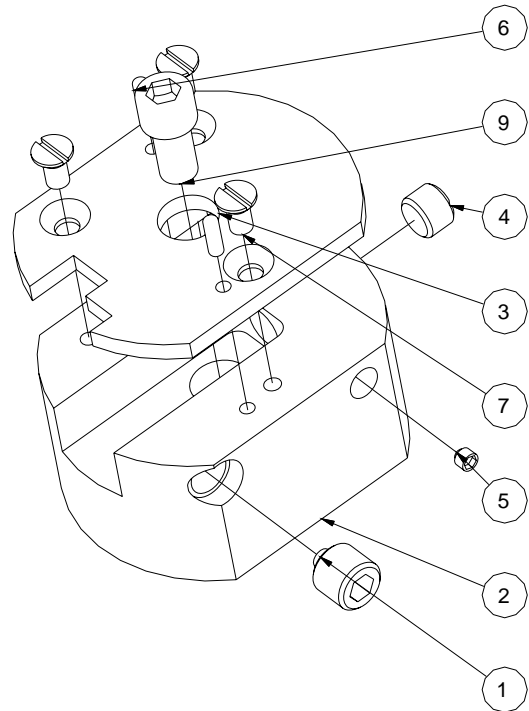
REF602-04250000



Standard Inserts	
RT322	3/8 IC TRIANGLE 1/32 RADIUS
RT321	3/8 IC TRIANGLE 1/64 RADIUS
RT212	1/4 IC TRIANGLE 1/32 RADIUS
RT211	1/4 IC TRIANGLE 1/64 RADIUS

6753J Right Angle Drive Standard Tooling Cont:

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	501-70A	Tool Holder Lock Screw ass'y
2	1	650-2-16B	BODY, 2.9" PRECISION LINE BORE CUTTERHEAD
3	1	650-2-17A	CAP 2.9" PRECISION LINE BORE CUTTREHEAD
4	1	502-2-85B	Index Screw
5	1	502-12-4D	SOCKET SET SCREW, BRASS TIPPED 8-32 X 1/8
6	2	ANSI B18.8.2 - 1/8 x 3/8	Pin - Hardened Ground Production Dowel
7	3	ANSI B18.6.2 - 10-24 UNC x 0.375	Slotted Flat Countersunk Head Cap Screw
8	1	ANSI B18.3 - No. 10 - 24 - 3/8	Hexagon Socket Head Cap Screw
9	1	ANSI B18.3 - 5/16 - 18 - 5/8	Hexagon Socket Head Cap Screw

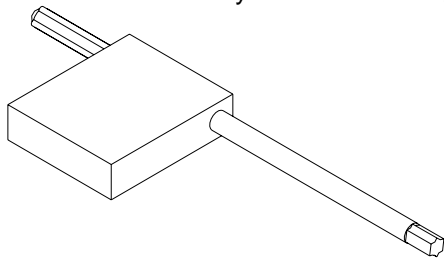


650-2-39C Medium Line Bore Head 2.9" – 5.0" (72mm – 127mm)

Toolholder	Toolholder Length	Bore Diameter Range
6801C	1.75" (44mm)	2.9" – 3.2" (74mm – 81mm)
6801D	1.95" (50mm)	2.4" – 2.8" (81mm – 91mm)
6801E	2.15" (55mm)	2.8" – 3.2" (91mm – 101mm)
6801F	2.35" (60mm)	3.2" – 3.6" (101mm – 112mm)
6801G	2.55" (65mm)	3.6" – 4.0" (112mm – 122mm)
6801H	2.75" (70mm)	3.6" – 4.0" (122mm – 132mm)
6801J	2.95" (75mm)	3.6" – 4.0" (132mm – 142mm)

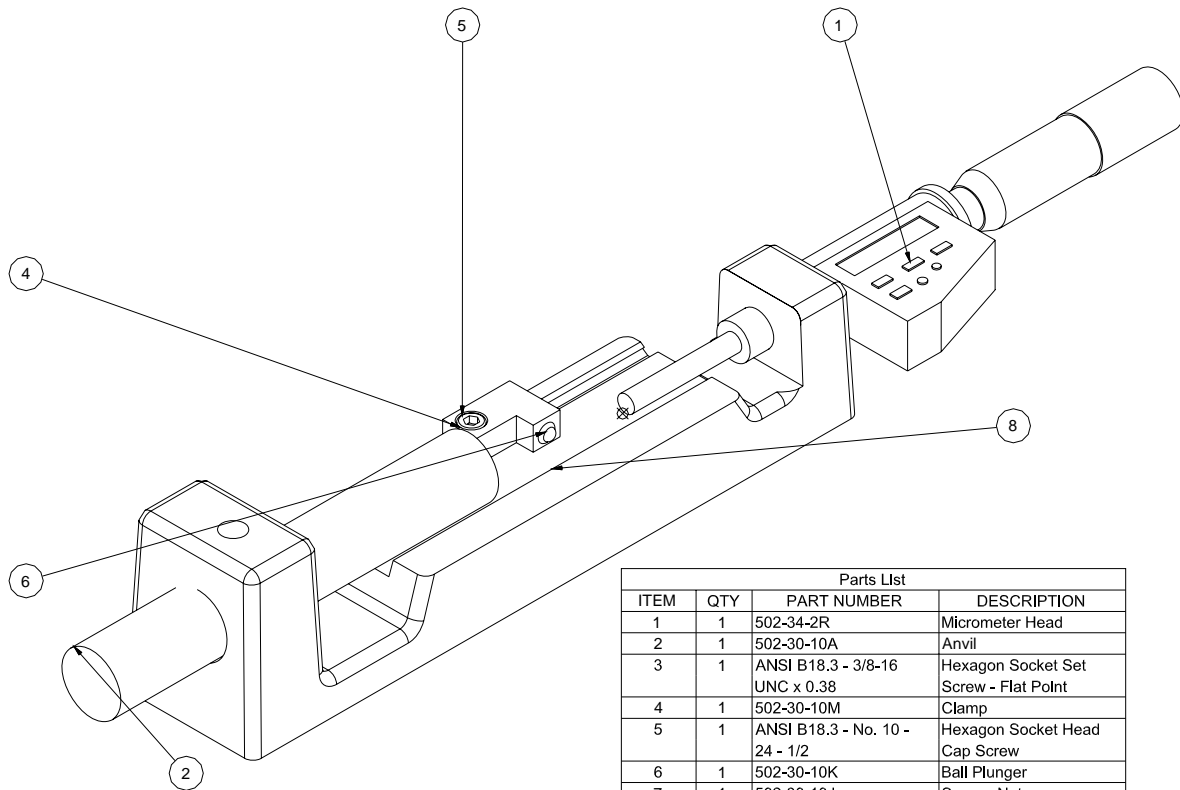
511-29-12D and 511-29-12F Torx Wrenches

For use with Torx screw in Triangle cartridges.



REFF8S95-06082004

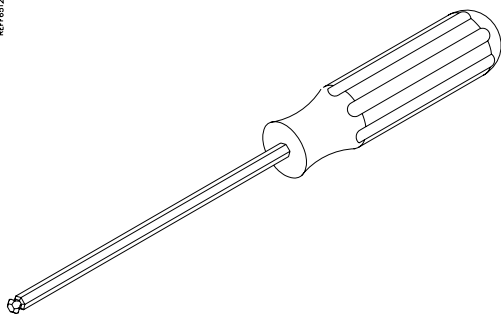
6753J Right Angle Drive Standard Tooling Cont:
900-2-19 Micrometer Assembly:
 2.9" – 5.0" (72mm – 127mm)



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

501-72 Hex Drivers

REF1612-0426200



Standard Inserts	
RT322	3/8 IC TRIANGLE 1/32 RADIUS
RT321	3/8 IC TRIANGLE 1/64 RADIUS

Minimum Distance Between Bearing Housings:

	Cutterheads		
	650-2-39B 1.9" (48.26mm) Dia.	650-2-39C 2.9" (73.66mm) Dia.	650-2-39A 5.4" (137.16mm) Dia.
Right Angle Drive			

F65:

6753K	3.29" (83.57mm)	4.07" (103.38mm)	4.09" (103.63mm)
6753K w/ .70" (17.78mm) Spacer	3.99" (101.35mm)	4.77" (121.16mm)	4.78" (121.41mm)
6753K w/ 1.05" (26.67mm) Spacer	4.34" (110.24mm)	5.12" (130.05mm)	5.13" (130.30mm)
6753K w/ 1.50" (38.10mm) Spacer	4.79" (121.67mm)	5.57" (141.48mm)	5.58" (141.73mm)

Calculating Maximum Bore Depth:

Bores 1.9" – 2.14" (48.26mm – 54.36mm) Dia. = Subtract 2.085 (52.959mm) from total Width.
 Bores 2.14" – 3.12" (54.36mm – 79.25mm) Dia. = Subtract 1.655 (42.037mm) from total Width.
 Bores 3.12" (79.25mm) Dia. and Larger = Subtract 1.457 (37.008mm) from total Width.

F80:

6753J	3.40" (86.36mm)	4.18" (106.17mm)	4.19" (106.43mm)
6753J w/ .70" (17.78mm) Spacer	4.10" (104.14mm)	4.88" (123.95mm)	4.99" (126.75mm)
6753J w/ 1.05" (26.67mm) Spacer	4.45" (113.03mm)	5.23" (132.84mm)	5.24" (133.10mm)
6753J w/ 1.50" (38.10mm) Spacer	4.90" (124.46mm)	5.68" (144.27mm)	5.69" (144.53mm)

Calculating Maximum Bore Depth:

Bores 1.9" – 2.34" (48.26mm – 59.69mm) Dia. = Subtract 2.572 (65.329mm) from total Width.
 Bores 2.35" – 3.69" (59.69mm – 93.73mm) Dia. = Subtract 2.165 (54.991mm) from total Width.
 Bores 3.69" (93.73mm) Dia. and Larger = Subtract 1.457 (37.008mm) from total Width.

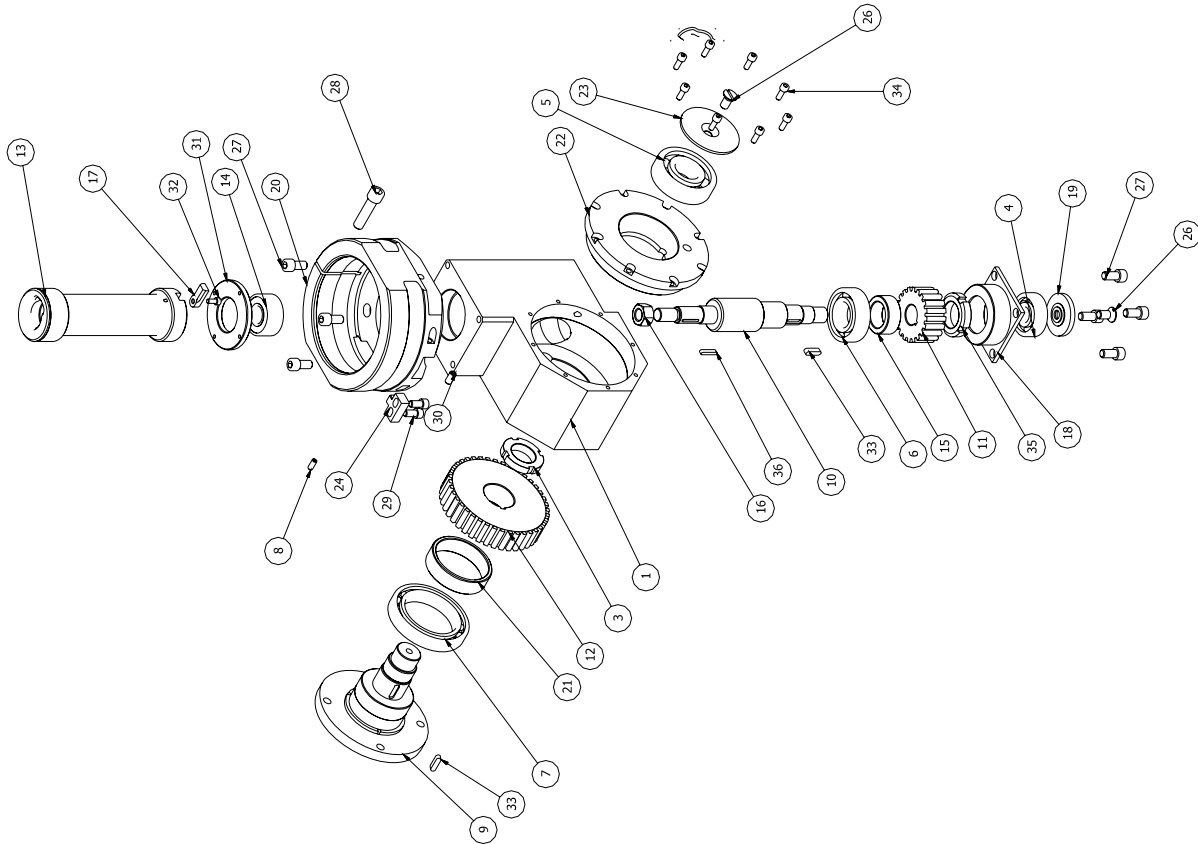
Belt Drive:

6753L & 650-2-37	2.69" (68.33mm)	NOT RECOMMENDED	NOT RECOMMENDED
6753L & 650-2-37 w/ .70" (17.78mm) Spacer	3.40" (86.36mm)	NOT RECOMMENDED	NOT RECOMMENDED
6753L & 650-2-37 w/ 1.05" (26.67mm) Spacer	3.74" (95.00mm)	NOT RECOMMENDED	NOT RECOMMENDED
6753L & 650-2-37 w/ 1.50" (38.10mm) Spacer	4.19" (106.43mm)	NOT RECOMMENDED	NOT RECOMMENDED

Calculating Maximum Bore Depth:

For Bores less than 2.40" (60.96mm) Dia. = Subtract 1.381" (35.077mm) from total Width.
 For bores 2.40" (60.96mm) Dia. and Larger = Subtract .975" (24.765mm) from total Width.

6773F Heavy Duty Offset 90 Degree Drive



6773F Heavy Duty Offset 90 Degree Head Parts List			DESCRIPTION
ITEM	QTY	PART NUMBER	
1	1	6773G	HOUSING, GEAR HEAVY DUTY LINE BORE HEAD
3	1	6777B	Nut, Lock Horizontal Shaft-BH-06
4	1	6778C	Bearing, Lower Vertical Shaft - SKF 6302 ZRS
5	1	6778F	Bearing, End Horizontal Shaft
6	1	6778D	Bearing, Middle Vertical Shaft
7	1	6778E	Bearing, Lead Horizontal Shaft
8	1	100-82-2A	Hexagon Socket Set Screw - Flat Point
9	1	6766X	Shaft, Horizontal
10	1	6777	SHAFT, VERTICAL HEAVY DUTY LINE BORE HEAD
11	1	6778	DRIVE GEAR, HEAVY DUTY LINE BORE HEAD
12	1	6778B	DRIVE GEAR, H EAVY DUTY LINE BORE HEAD
13	1	6773A	DRIVER, F80, F90 LINE BORE HEAD
14	1	502-9-32	Bearing, Ball
15	1	6773F	SPACER, BEARING VERTICAL
16	1	MF-105 ANSI B18.2.2 - 1/2 - 13	Hex Nut
17	1	6776	KEY, DRIVER ADAPTER, F80, F90 SERIES LINE BORE HEAD
18	1	6774F	BEARING RETAINER, VERTICAL HEAVY DUTY LINE BORE HEAD
19	1	6777A	CAP, END VERTICAL SHAFT
20	1	6770C	HUB, MOUNTING 90 HEAD
21	1	6775D	SPACER, BEARING, HORIZONTAL
22	1	6774G	BEARING RETAINER, VERTICAL
23	1	6775E	CAP, END HORIZONTAL SHAFT
24	1	6759K	Key, Location 90 Degree Head
26	2	ANSI B18.6.2 - 5/16-18 UNC x 0.625	Slotted Flat Countersunk Head Cap Screw
27	8	MF-21 ANSI B18.3 - 5/16 - 18 - 5/8	Hexagon Socket Head Cap Screw
28	1	MF-33 ANSI B18.3 - 3/8 - 16 - 1 1/2	Hexagon Socket Head Cap Screw
29	2	MF-12 ANSI B18.3 - 1/4 - 20 - 1/2	Hexagon Socket Head Cap Screw
30	2	MF-56A ANSI B18.3 - 1/4-20 UNC x 0.51	Hexagon Socket Set Screw - Flat Point
31	1	6772A	NUT, BEARING LINE BORE HEAD
32	1	MF-1B ANSI B18.3 - No. 8 - 32 - 3/8	Hexagon Socket Head Cap Screw
33	2	6752P	KEY, MICARTA, 90 DEGREE HEAD
34	8	MF-21	Hexagon Socket Head Cap Screw
35	1	6777C	Nut, Lock Bearing
36	1	6752Q	Key, Steel

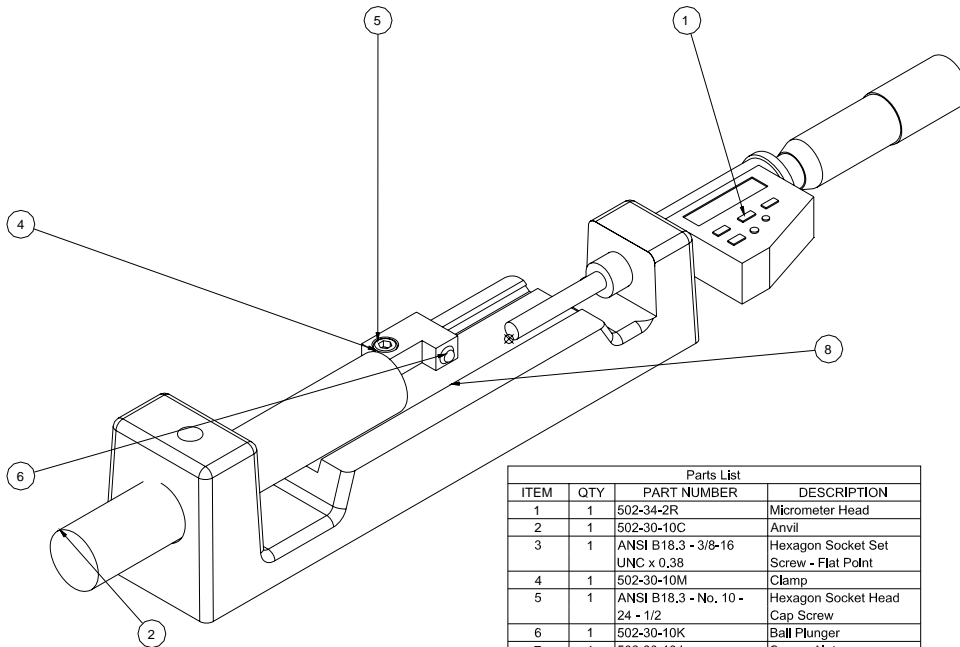
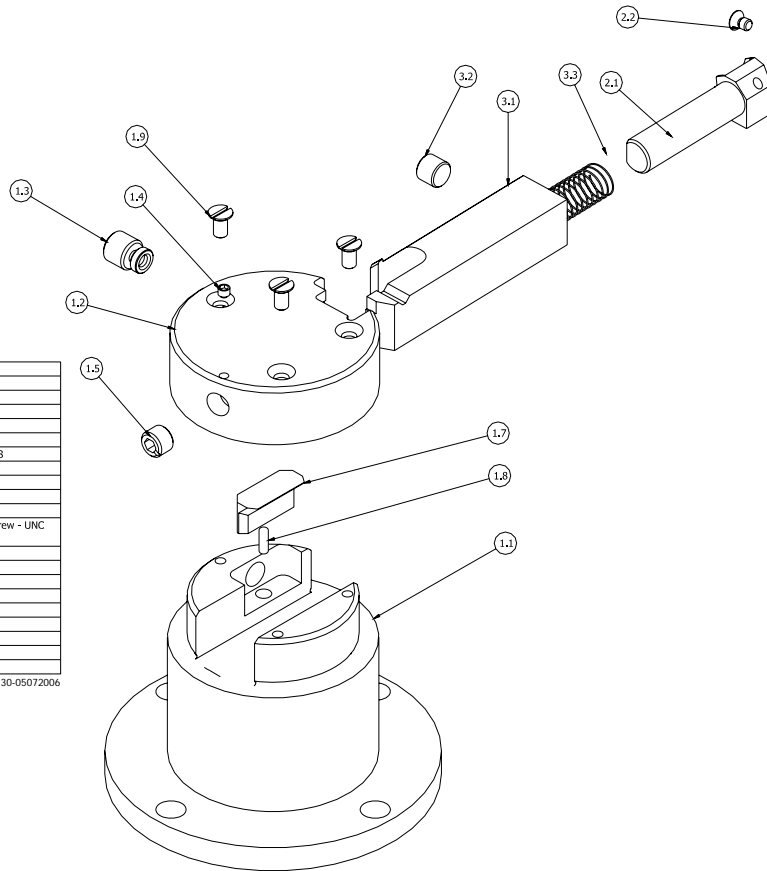
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6519V Heavy Duty Offset 90 Degree Drive w/ 3.00" (76mm) Tooling

Minimum distance between bearing housings 7.94" (102 mm). 900-2-20 Digital Micrometer included.

6519V Cutterhead Body Assembly - Heavy Duty Offset 90 Degree Head Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6519UJ	Cutterhead Body Assembly
1.1	1	6519T	Cutterhead Body
1.2	1	650-2-17	Cap, 2.9" Stub Bar
1.3	1	501-70A	Tool Holder Lock Screw ass'y
1.4	1	502-12-4D	SOCKET SET SCREW, BRASS TIPPED 8-32 X 1/8
1.5	1	502-2-85B	Index Screw
1.6	1	100-1A	Tool Lock Spring
1.7	1	6263A	Tool Holder Clamp Screw
1.8	1	ANSI B18.8.2 - 1/8 x 3/8	Pin - Hardened Ground Production Dowel
1.9	3	ANSI B18.6.3 - 10-24 UNC x 0.375	Slotted 100° Flat Countersunk Head Machine Screw - UNC
2	1	6598K	Cartridge, Indexable Insert Assembly
2.1	1	6598J	Cartridge, Indexable Insert
2.2	1	11-29-12C	Torx Screw M4 x .7 x .315
3	1	6520E	Tool Holder Assembly, 3 3/8" Long
3.1	1	6520E	Tool Holder 3 3/8" Long
	1	6520F	Tool Holder 3 5/8" Long
	1	6520G	Tool Holder 4 1/8" Long
3.2	1	502-2-85	Index Screw 3.8-24 nf x .31 lg.
3.3	1	6520E Spring	

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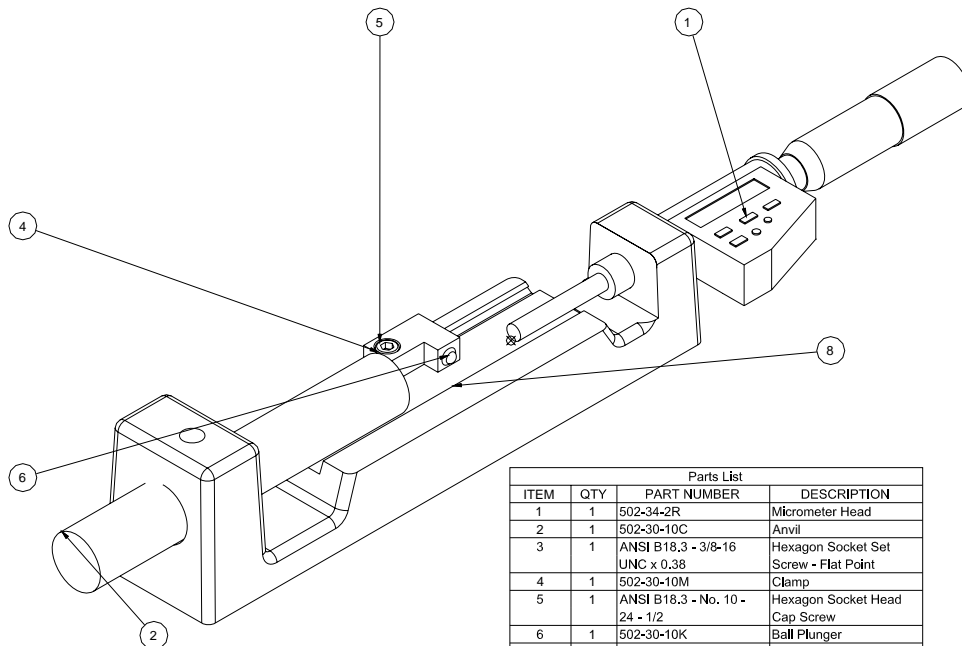
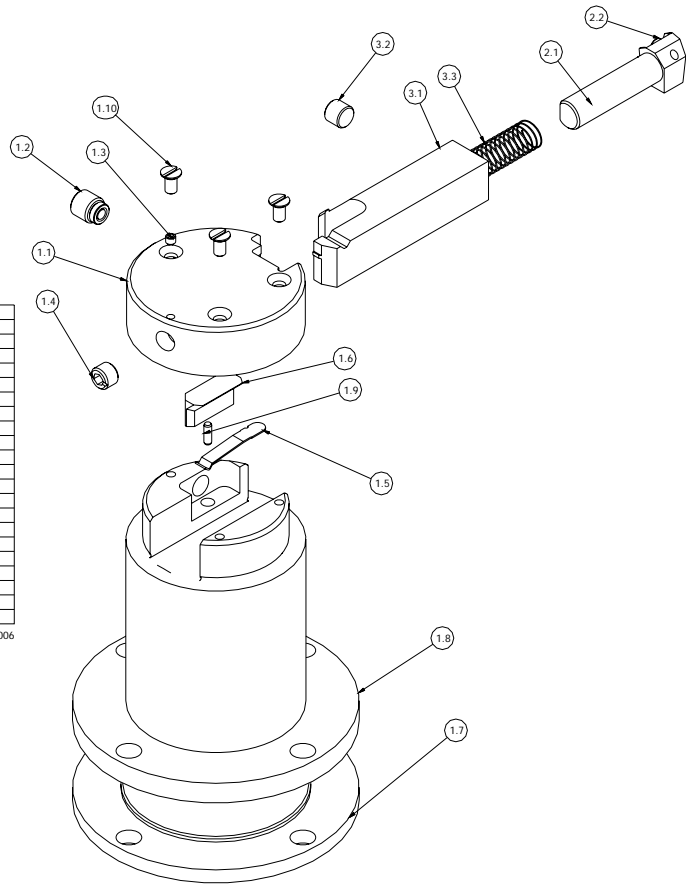
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10C	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square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

6519P Heavy Duty Offset 90 Degree Drive w/ 4.25" (108 mm) Tooling

Minimum distance between bearing housings 8.94" (227 mm). 900-2-20 Digital Micrometer included.

6519P Cutterhead Body Assembly - Heavy Duty 90 Offset Head Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6519S	Cutterhead Body Assembly - w/ Tooling 4.25"
1.1	1	650-2-17	Cap, 2.9" Stub Bar
1.2	1	501-70A	Tool Holder Lock Screw ass'y
1.3	1	502-12-4D	SOCKET SET SCREW, BRASS TIPPED 8-32 X 1/8
1.4	1	502-2-85B	Index Screw
1.5	1	100-1A	Tool Lock Spring
1.6	1	6263A	Tool Holder Clamp Screw
1.7	1	6519W	1/4" Spacer Heavy duty line bore head
1.8	1	6519T	Cutterhead Body
1.9	1	ANSI B18.8.2 - 1/8 x 3/8	Pin - Unhardened Ground Dowel
1.10	3	ANSI B18.6.3 - 10-24 UNC x 0.375	Slotted 100° Flat Countersunk Head Machine Screw - UNC
2	1	6598K	Cartridge, Indexable Insert Assembly
2.1	1	6598J	Cartridge, Indexable Insert
2.2	1	511-29-12C	Torix Screw PH x .7 x .315
3	1	6520E	Tool Holder Assembly, 3 3/8" long
3.1	1	6520E	Tool Holder 3 3/8" Long
	1	6520F	Tool Holder 3 5/8" Long
	1	6520G	Tool Holder 4 1/8" Long
3.2	1	502-2-85	Index Screw 3.8-24 nf x .31 lg.
3.3	1	6520E Spring	

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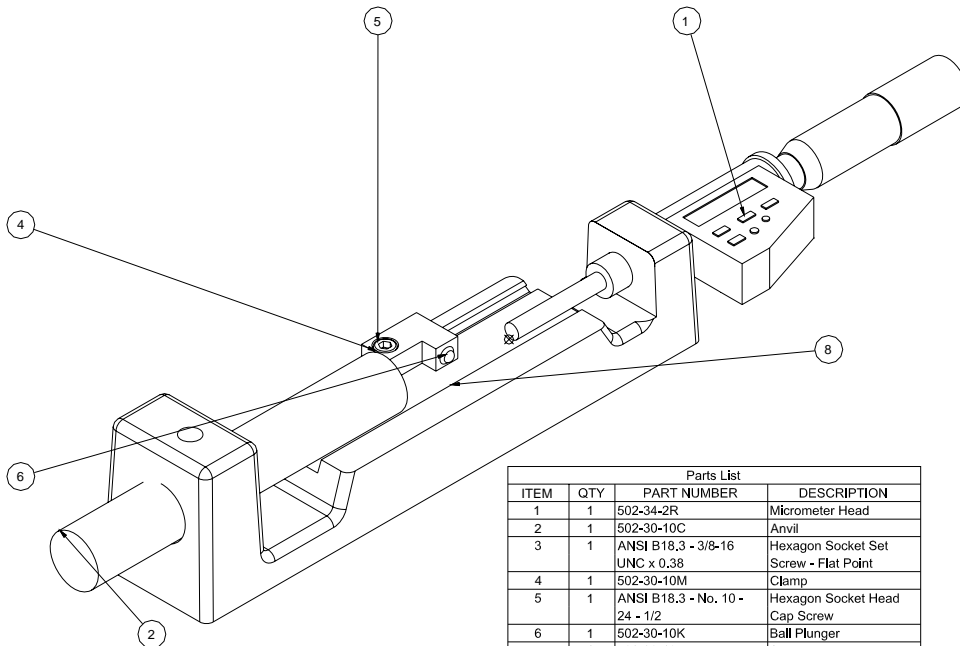
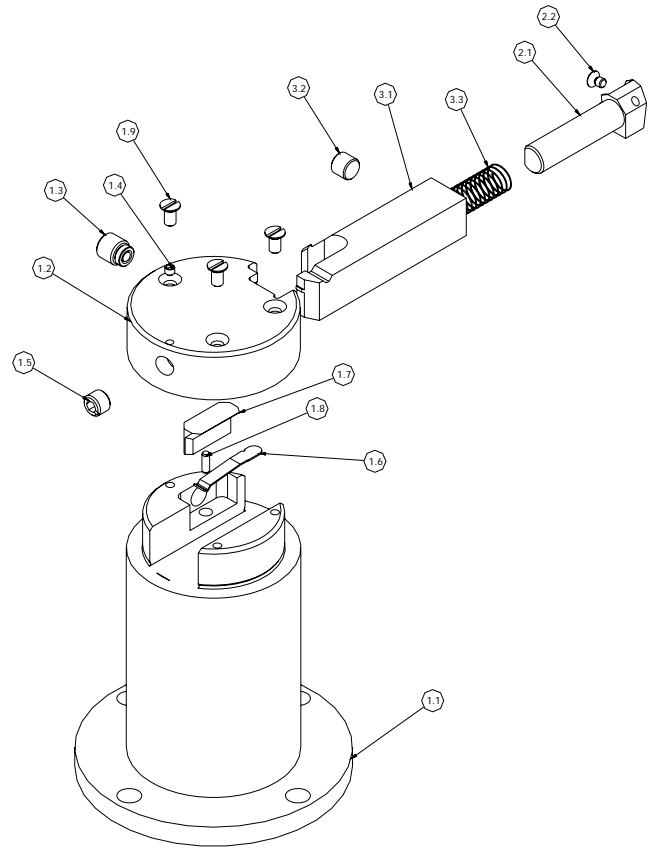


Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10C	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square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

6519M Heavy Duty Offset 90 Degree Drive w/ 5.10" (130 mm) Tooling

Minimum distance between bearing housings 10.04" (255 mm). 900-2-20 Digital Micrometer included.

6519M Cutterhead Body Assembly - Heavy Duty 90 Degree Offset Head Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6519Q	
1.1	1	6519T	Cutterhead Body
1.2	1	650-2-17	Cap, 2.9" Stub Bar
1.3	1	501-70A	Tool Holder Lock Screw ass'y
1.4	1	502-12-4D	SOCKET SET SCREW, BRASS TIPPED 8-32 X 1/8
1.5	1	502-2-85B	Index Screw
1.6	1	100-1A	Tool Lock Spring
1.7	1	6263A	Tool Holder Clamp Screw
1.8	1	ANSI B18.8.2 - 1/8 x 3/8	Pin - Unhardened Ground Dowel
1.9	3	ANSI B18.6.3 - 10-24 UNC x 0.375	Slotted 100° Flat Countersunk Head Machine Screw - UNC
2	1	6598K	Cartridge, Indexable Insert Assembly
2.1	1	6598J	Cartridge, Indexable Insert
2.2	1	511-29-12C	Torx Screw M4 x .7 x .315
3	1	6520E	Tool Holder Assembly, 3 3/8" long
3.1	1	6520E	Tool Holder 3 3/8" Long
	1	6520F	Tool Holder 3 5/8" Long
	1	6520G	Tool Holder 4 1/8" Long
3.2	1	502-2-85	Index Screw 3.8-24 nf x .31 lg. REF FBS132-05072006
3.3	1	6520E Spring	



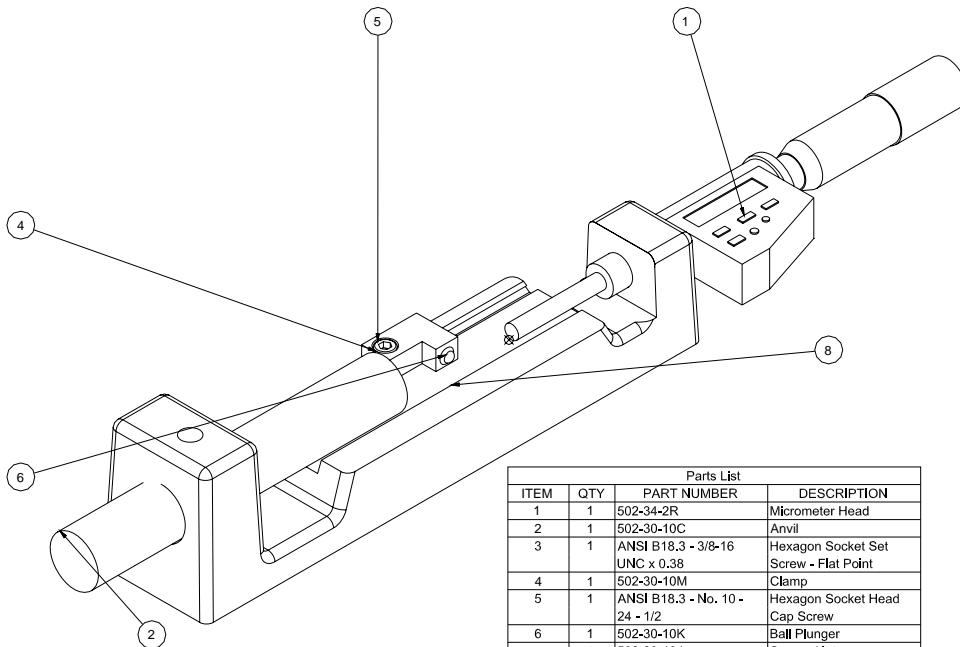
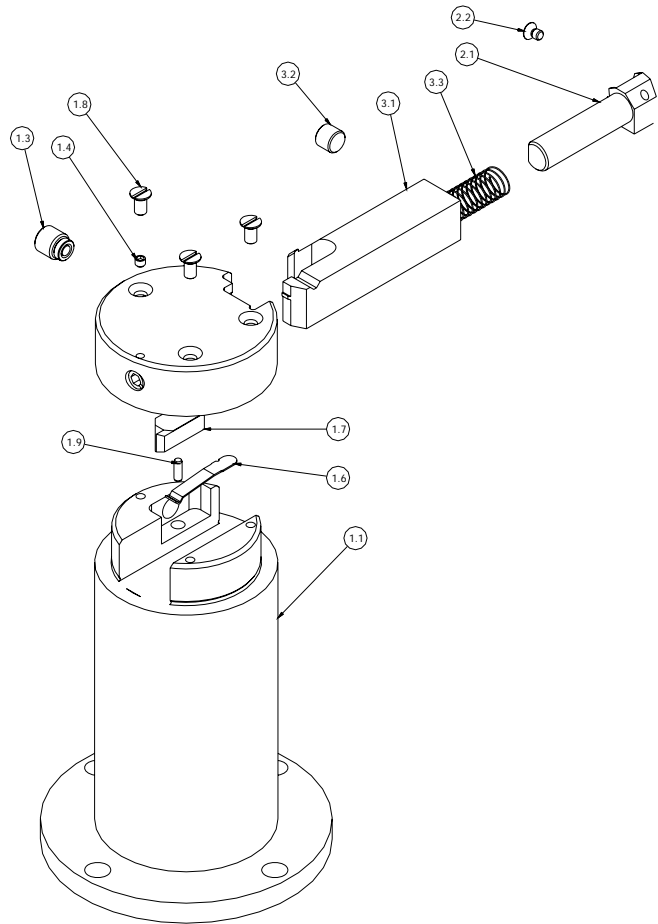
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	502-34-2R	Micrometer Head
2	1	502-30-10C	Anvil
3	1	ANSI B18.3 - 3/8-16 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
4	1	502-30-10M	Clamp
5	1	ANSI B18.3 - No. 10 - 24 - 1/2	Hexagon Socket Head Cap Screw
6	1	502-30-10K	Ball Plunger
7	1	502-30-10J	Square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

6519N Heavy Duty Offset 90 Degree Drive w/ 6.00" (152 mm) Tooling

Minimum distance between bearing housings 10.94" (278 mm). 900-2-20 Digital Micrometer included.

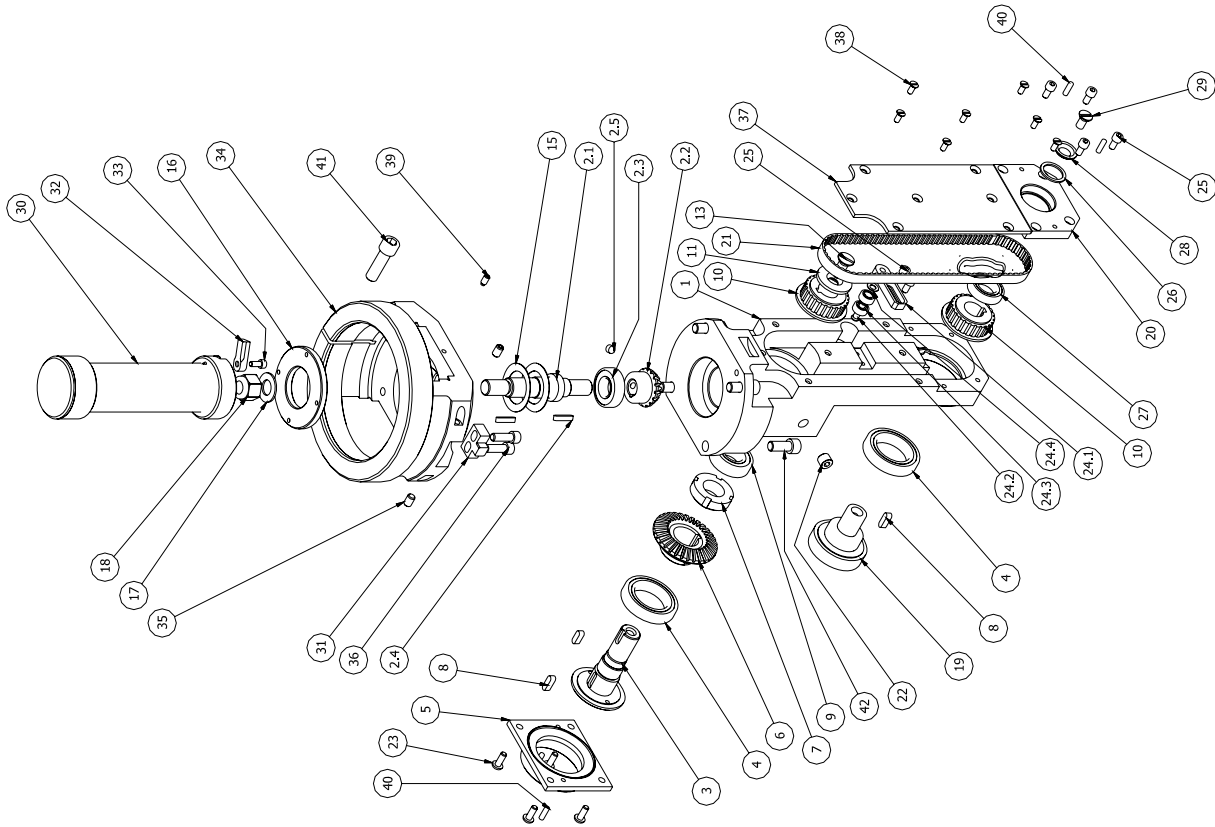
6519N Cutterhead Body Assembly - Heavy Duty 90 Degree Offset Head Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6519K	Cutterhead Body Assembly
1.1	1	6519K	Cutterhead Body
1.2	1	650-2-17	Cap, 2 9/16" Stub Bar
1.3	1	501-70A	Tool Holder Lock Screw Assy
1.4	1	502-12-4D	SOCKET SET SCREW, BRASS TIPPED 8-32 x 1/8
1.5	1	502-2-95B	Index Screw
1.6	1	100-1A	Tool Lock Spring
1.7	1	6263A	Tool Holder Clamp Screw
1.8	3	ANSI B18.6.3 - 10-24 UNC x 0.375	Slotted 100° Flat Countersunk Head Machine Screw - UNC
1.9	1	ANSI B18.8.2 - 1/8 x 3/8	Pin - Unhardened Ground Dowel
2	1	6598K	Cartridge, Indexable Insert Assembly
2.1	1	6598J	Cartridge, Indexable Insert
2.2	1	511-29-12C	Torx Screw M4 x .7 x .315
3	1	6520E	Tool Holder Assembly, 3 3/8" long
3.1	1	6520E	Tool Holder 3 3/8" Long
	1	6520F	Tool Holder 3 5/8" Long
	1	6520G	Tool Holder 4 1/8" Long
3.2	1	502-2-95	Index Screw 3.8-24 nf x .31 lg.
3.3	1	6520E	Spring

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

6753L Right Angle Belt Drive:



ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-38B	Housing, Belt Drive 90 Degree Head
2	1	650-2-37X	Pinion Shaft Assembly, Belt Drive
2.1	1	650-2-37Y	Shaft, Belt Drive
2.2	1	6752M	Pinion, 90 Degree Head
2.3	1	700-11	Bearing, Ball
2.4	1	6752Q	Key, Pinion 90 Degree Head
2.5	1	ANSI B18.3 - 1/4-20 UNC x 0.31	Hexagon Socket Set Screw - Cone Point
3	1	650-2-37D	Shaft, Horizontal
4	2	502-9-72C	Bearing, Ball, Outer
5	1	650-2-37C	Bearing Cover
6	1	6766W	Gear, Ring 90 Degree Head
7	1	6705B	Nut, Lock Bearing
8	2	650-2-18M	Key, Micarta
9	1	6753E	Bearing, 90 Degree Head
10	2	650-2-37G	Pulley, Belt Drive
11	1	650-2-37E	End Cap, Upper Pulley Retainer
12	1	650-2-37U	Key, Micarta
13	1	ANSI B18.6.2 - 5/16-24 UNF - 0.75	Slotted Flat Countersunk Head Cap Screw
14	1	6752Q	Key, Pinion 90 Degree Head
15	2	6007A	Washer, Belleville
16	1	6772A	NUT, BEARING LINE BORE HEAD
17	1	100-19	HARDENED WASHER
18	1	MF-186	Ny-Lock Nut
19	1	650-2-42B	Shaft, Horizontal Lower
20	1	650-2-37L	Lower Bearing Retainer
21	1	650-2-38D	Belt, 90 Degree Head
22	1	Parker Countersunk Hex-Head Plug 219P 219P-2	Countersunk Hex-Head Plug
23	4	ANSI B18.3 - 10 - 24 x 1/2	Hexagon Socket Button Head Cap Screw
24	1	650-2-37P	Belt Tensioner Assembly
24.1	1	650-2-37Q	Bar, Belt Drive
24.2	1	650-2-37R	Pin, Belt Drive
24.3	2	650-2-37S	Bearing, Line Bore Belt Drive
24.4	1	650-2-37W	Washer, Belleville
25	6	MF-4 ANSI B18.3 - No. 10 - 24 UNC - 3/8	Hexagon Socket Head Cap Screw
26	1	650-2-37V	Spacer, Lower
27	1	650-2-37I	Bearing
28	1	650-2-37K	End Cap Lower Belt Drive
29	1	ANSI B18.6.3 - 1/4-20 x 1/2	Slotted Flat Countersunk Head Machine Screw
30	1	6771A	DRIVER, F80, F90 LINE BORE HEAD
31	1	6750K	Key, Location 90 Degree Head
32	1	6776	KEY, DRIVER ADAPTER, F80, F90 SERIES LINE BORE HEAD
33	1	MF-3D ANSI B18.3 - 8-36 UNF - 0.375	Hexagon Socket Head Cap Screw
34	1	6770B	Hub, Mounting 90 Degree Head
35	2	MF-59 ANSI B18.3 - 1/4-20 UNC x 0.38	Hexagon Socket Set Screw - Flat Point
36	2	MF-92 ANSI B18.3 - 1/4 - 20 UNC - 3/4	Hexagon Socket Head Cap Screw
37	1	650-2-38C	Cover, Belt 90 Degree Head
38	7	MF-76 ANSI B18.6.3 - 8-32 UNC x 0.375	Slotted 100° Flat Countersunk Head Machine Screw - UNC
39	1	100-82-2A	Hexagon Socket Set Screw - Brass Tipped
40	4	MF-195 ANSI B18.8.2 - 5/32 x 1/2	Pin - Hardened Ground Production Dowel
41	1	ANSI B18.3 - 3/8-24 UNF - L.25	Hexagon Socket Head Cap Screw
42	4	MF-4 ANSI B18.3 - 5/16-24 UNF - 0.75	Hexagon Socket Head Cap Screw

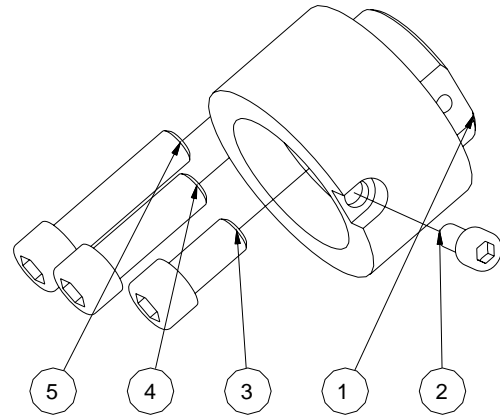
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6753L Right Angle Drive Standard Tooling:

Note: The Belt Driven Right Angle Drive is designed for a limited clearance between bearing caps and it's performance will deteriorate as larger diameters are bored and extension spacers used.

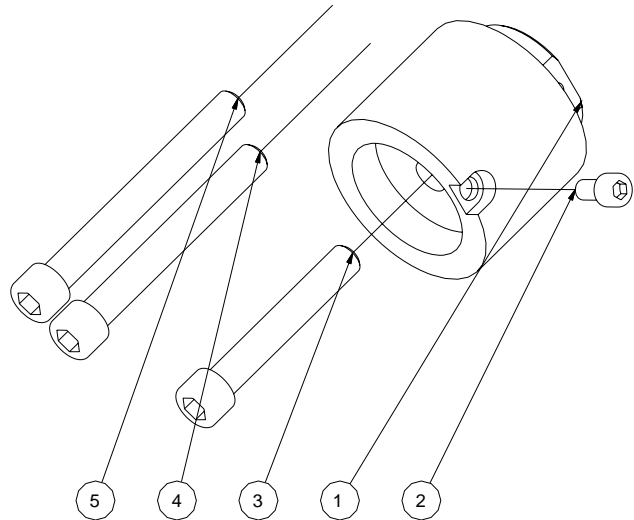
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-43	1.05 SPACER
2	1	ANSI B18.3 - No. 10 - 24 - 3/8	Hexagon Socket Head Cap Screw
3	1	ANSI B18.3 - 5/16 - 18 - 5/8	Hexagon Socket Head Cap Screw
4	1	ANSI B18.3 - 5/16 - 18 - 1	Hexagon Socket Head Cap Screw
5	1	ANSI B18.3 - 5/16 - 18 - 1 1/4	Hexagon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

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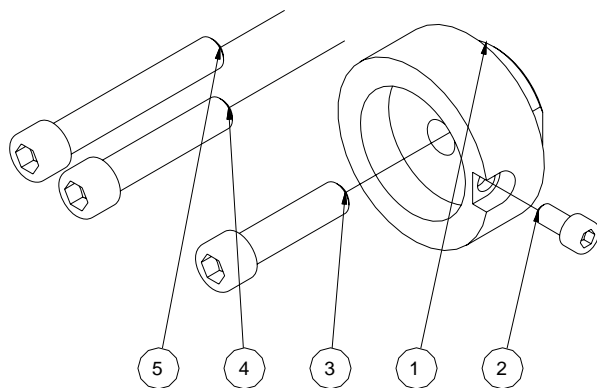
Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	650-2-43A	SPACER - 1.50" LONG
2	1	ANSI B18.3 - No. 10 - 24 - 3/8	Hexagon Socket Head Cap Screw
3	1	ANSI B18.3 - 5/16 - 18 - 2	Hexagon Socket Head Cap Screw
4	1	ANSI B18.3 - 5/16 - 18 - 2 1/2	Hexagon Socket Head Cap Screw
5	1	ANSI B18.3 - 5/16 - 18 -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

REF8S101-02152006



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

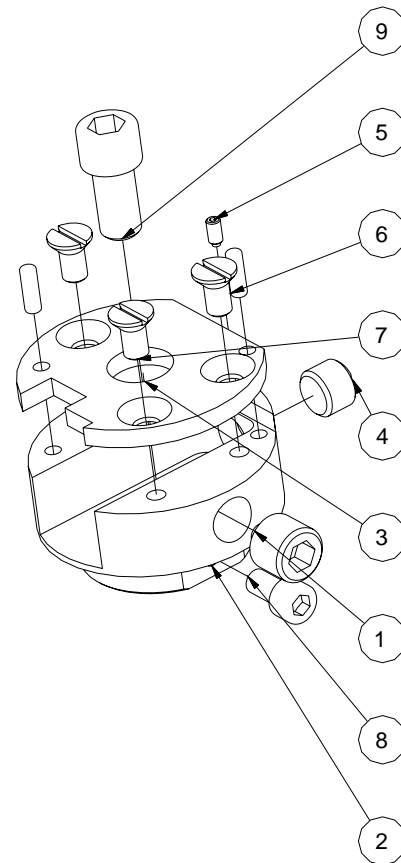
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6753L Right Angle Drive Standard Tooling Cont:

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	501-70A	Tool Holder Lock Screw ass'y
2	1	small cutterhead body	
3	1	small cutterhead cover	
4	1	502-2-85B	Index Screw
5	1	650-2-6A	4-40 brass tipped set screw
6	2	ANSI B18.8.2 - 1/8 x 3/8	Pin - Hardened Ground Production Dowel
7	3	ANSI B18.6.2 - 10-24 UNC x 0.375	Slotted Flat Countersunk Head Cap Screw
8	1	ANSI B18.3 - No. 10 - 24 - 3/8	Hexagon Socket Head Cap Screw
9	1	ANSI B18.3 - 5/16 - 18 - 5/8	Hexagon Socket Head Cap Screw

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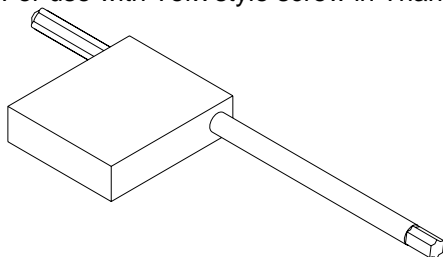
650-2-39B Small Line Bore Head 2.0" – 4.0" (50mm – 100mm)

Toolholder	Toolholder Length	Bore Diameter Range
6801B	1.54" (39mm)	2.0" – 2.4" (51mm – 61mm)
6801C	1.75" (44mm)	2.4" – 2.8" (61mm – 71mm)
6801D	1.95" (50mm)	2.8" – 3.2" (71mm – 81mm)
6801E	2.15" (55mm)	3.2" – 3.6" (81mm – 91mm)
6801F	2.35" (60mm)	3.6" – 4.0" (91mm – 101mm)

When used with 6753L Right angle Drive, minimum distance between bearing housings 2.69" (68.3 mm)

511-29-12D and 511-29-12F Torx Wrenches

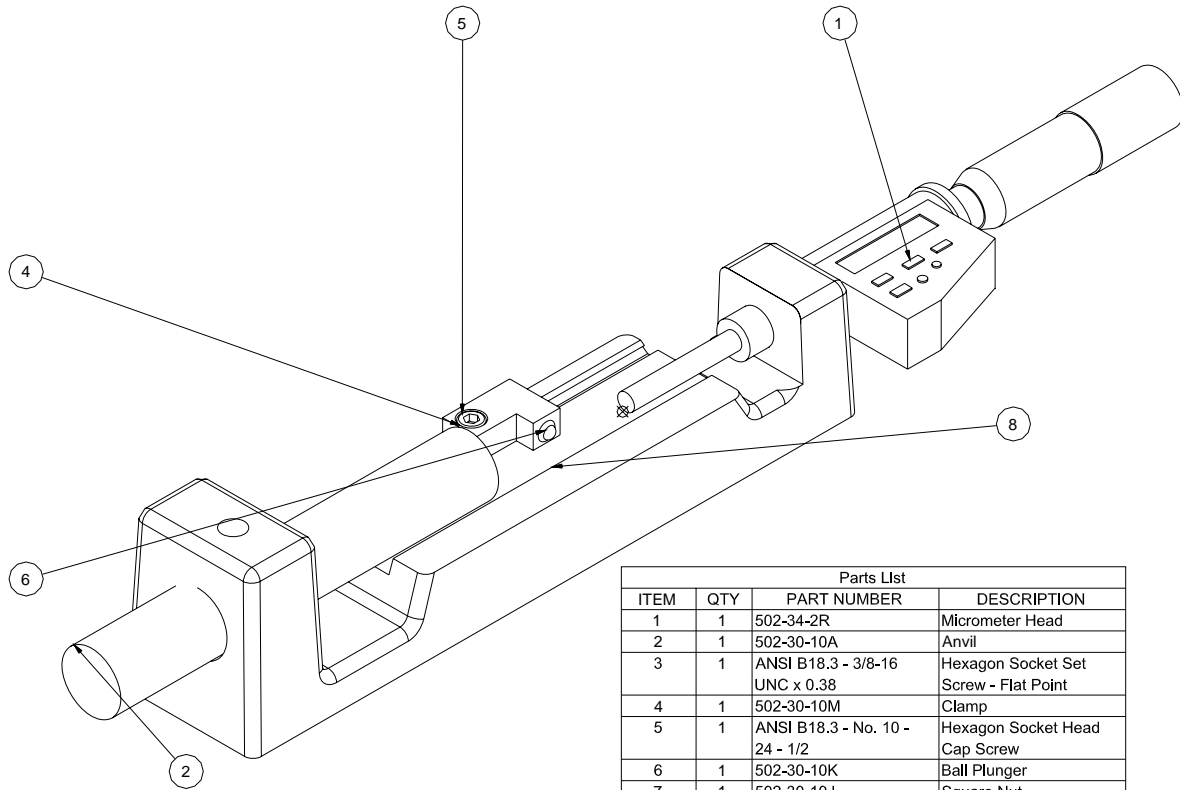
For use with Torx style screw in Triangle cartridges.



REF8S95-06082004

900-2-19 Micrometer Assembly:

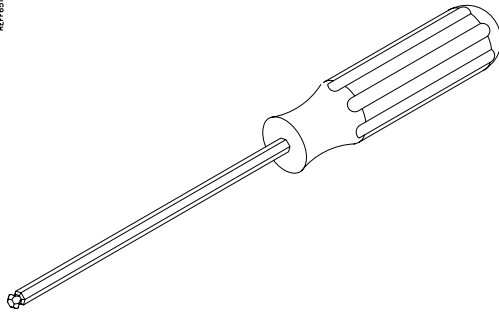
2.0" – 4.0" (50mm – 100mm)



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

501-72 Hex Drivers

REF602-0425000



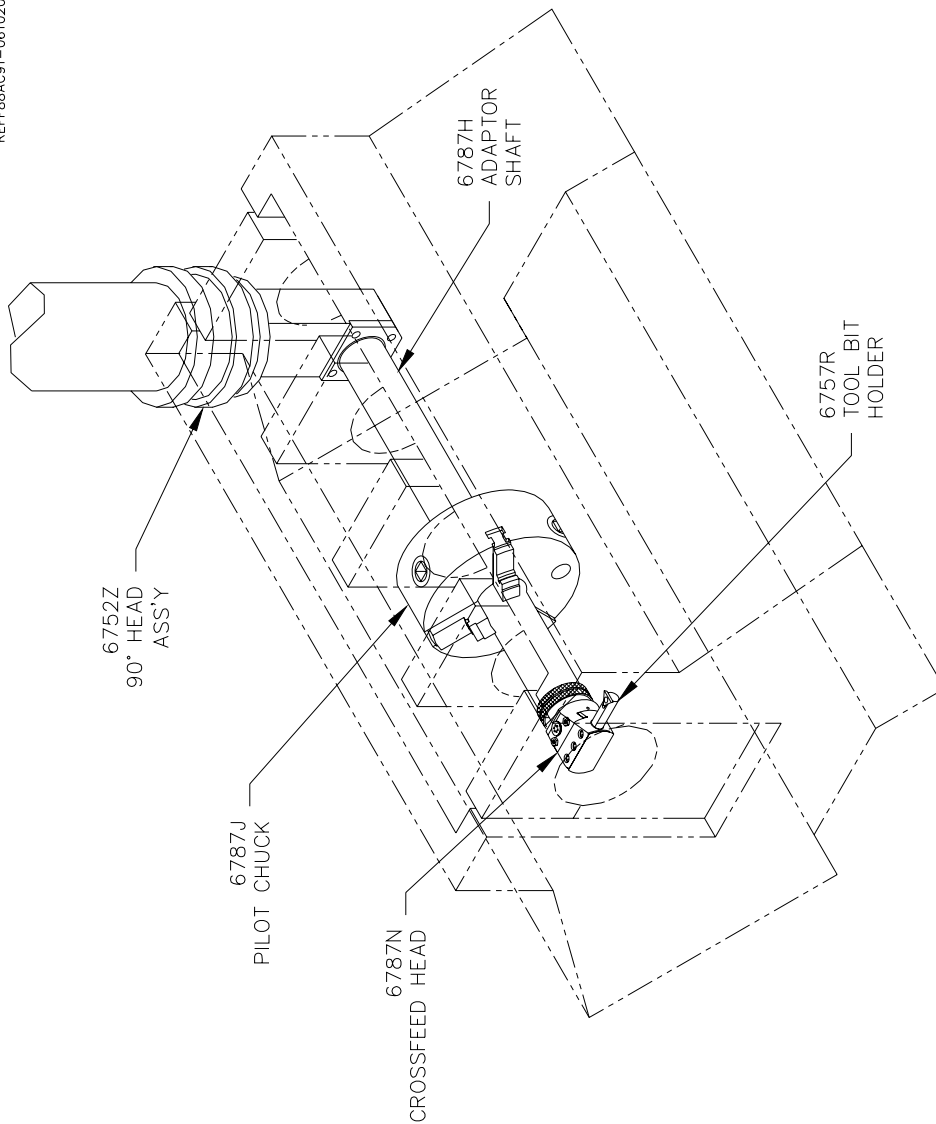
Standard Inserts	
RT322	3/8 IC TRIANGLE 1/32 RADIUS
RT321	3/8 IC TRIANGLE 1/64 RADIUS
RT212	1/4 IC TRIANGLE 1/32 RADIUS
RT211	1/4 IC TRIANGLE 1/64 RADIUS

Thrust Facing Equipment:

The Cross Feed Head used with Rottler's Line Bore Assembly is used to machine faces and bores that are inaccessible to our standard counterboring packages. Here the Line Bore Head is shown cutting a thrust face surface. The Cross Feed Head uses the spindle rotation to drive the cutter out (at .002" per rev.) as it rotates.

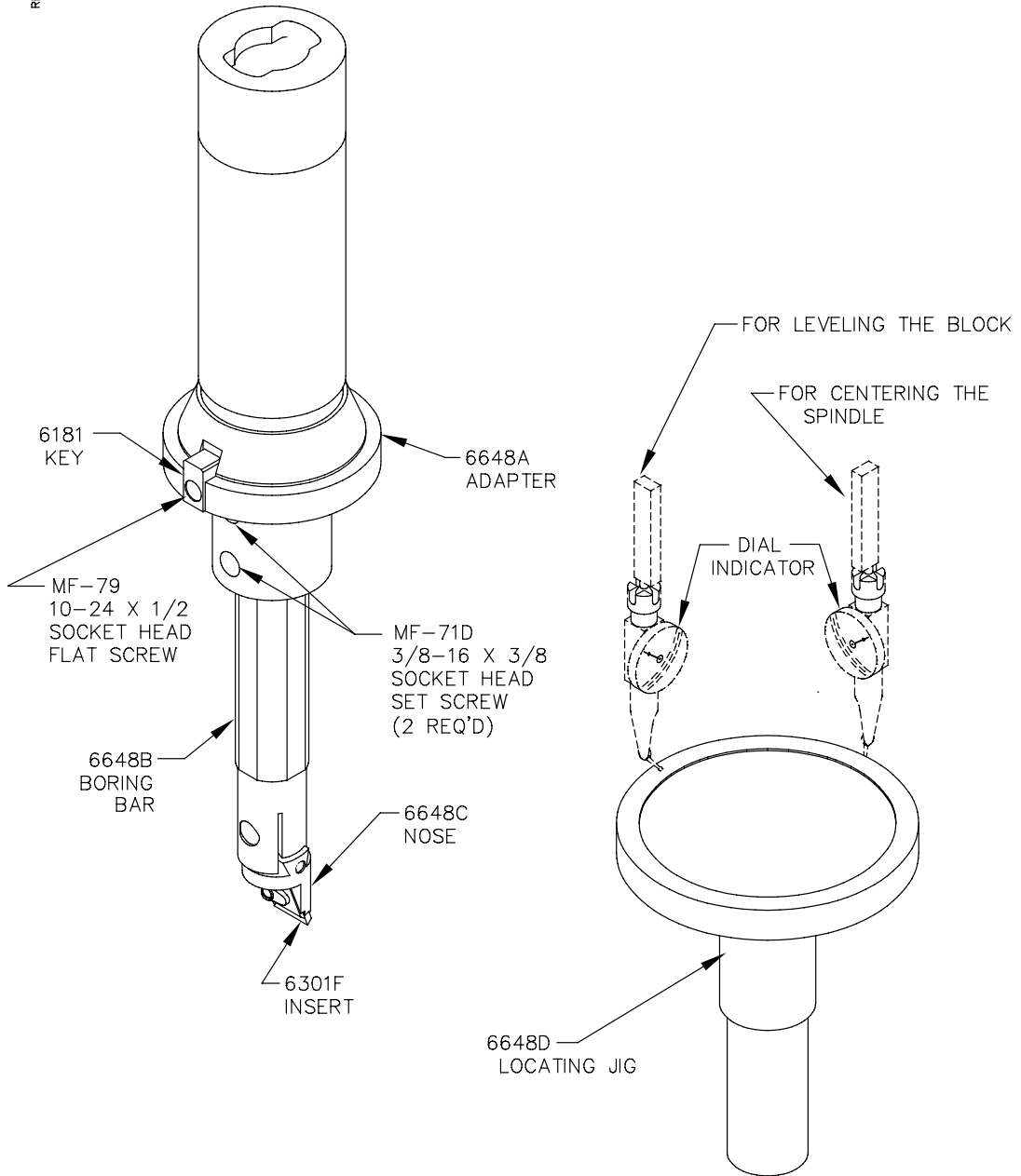
The operator will manually engage the cross feed by holding the feed ring, located on the cross feed head body. When the cutter reaches the maximum diameter of it's cut, the operator will (1) release the ring, (2) jog the cutter off the surface, (3) stop the spindle rotation, (4) engage the retract feed, (5) restart the spindle, (6) hold the feed ring, resulting in the cross feed retracting at the rate of .04" per rev.

REF88AC91-06102004



6648 Caterpillar 3400 Series Tappet Bore Repair Kit:

REFBUL-91-121797



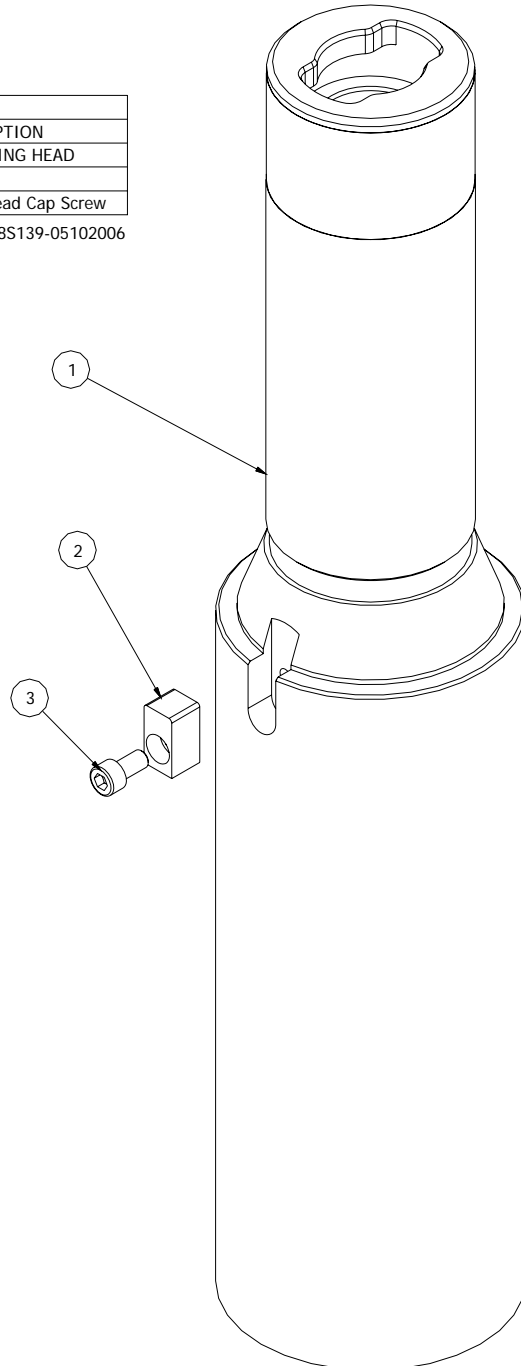
Spindle Adapters for Mounting Universal Tooling

6170C Blank Adapter

This adapter can be machined by the customer to suit special tooling needs.

6170C Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6170L	ADAPTER, SURFACING HEAD
2	1	6181	Drive Key
3	1	ANSI B18.3 - 10-32 UNF - 0.375	Hexagon Socket Head Cap Screw

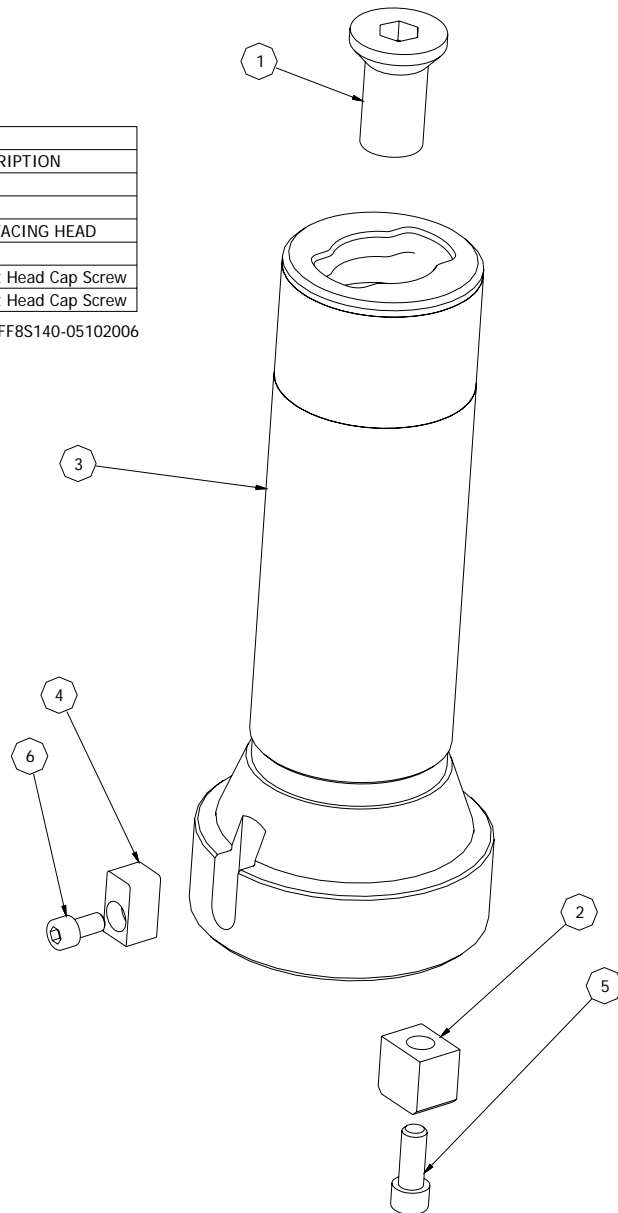
REF F8S139-05102006



6170J #40 Taper Adapter Assembly

Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6170F	Locking Screw
2	1	6170H	Key, Drive
3	1	6170E	ADAPTER, SURFACING HEAD
4	1	6181	Drive Key
5	1	ANSI B18.3 - 1/4 - 20 UNC - 5/8	Hexagon Socket Head Cap Screw
6	1	ANSI B18.3 - No. 10 - 24 UNC - 3/8	Hexagon Socket Head Cap Screw

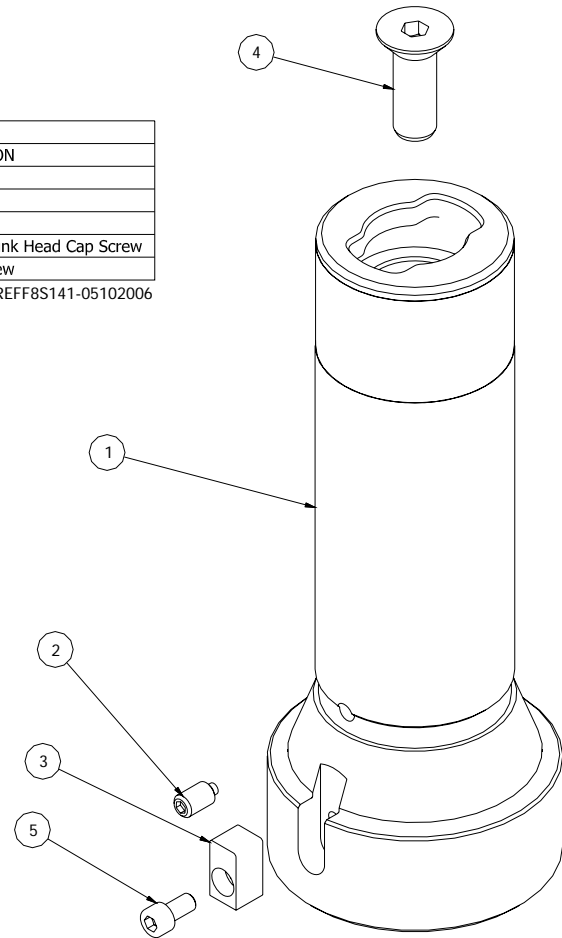
REF8S140-05102006



6170K R8 Adapter Assembly

6170K Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6170D	ADAPTER, FOR R8 TOOLING
2	1	514-3-12K	Screw, key Lower Limit
3	1	6181	Drive Key
4	1	ANSI B18.3 - 7/16-20 UNF x 1.25	Hexagon Socket Flat Countersunk Head Cap Screw
5	1	ANSI B18.3 - 10-32 UNF - 0.375	Hexagon Socket Head Cap Screw

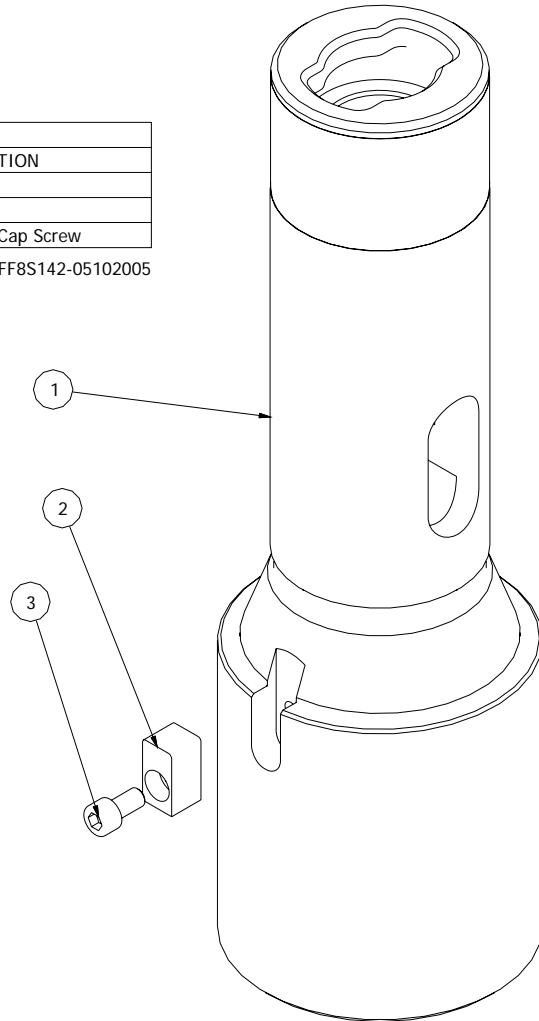
REF8S141-05102006



6514Q Adapter, MT #5

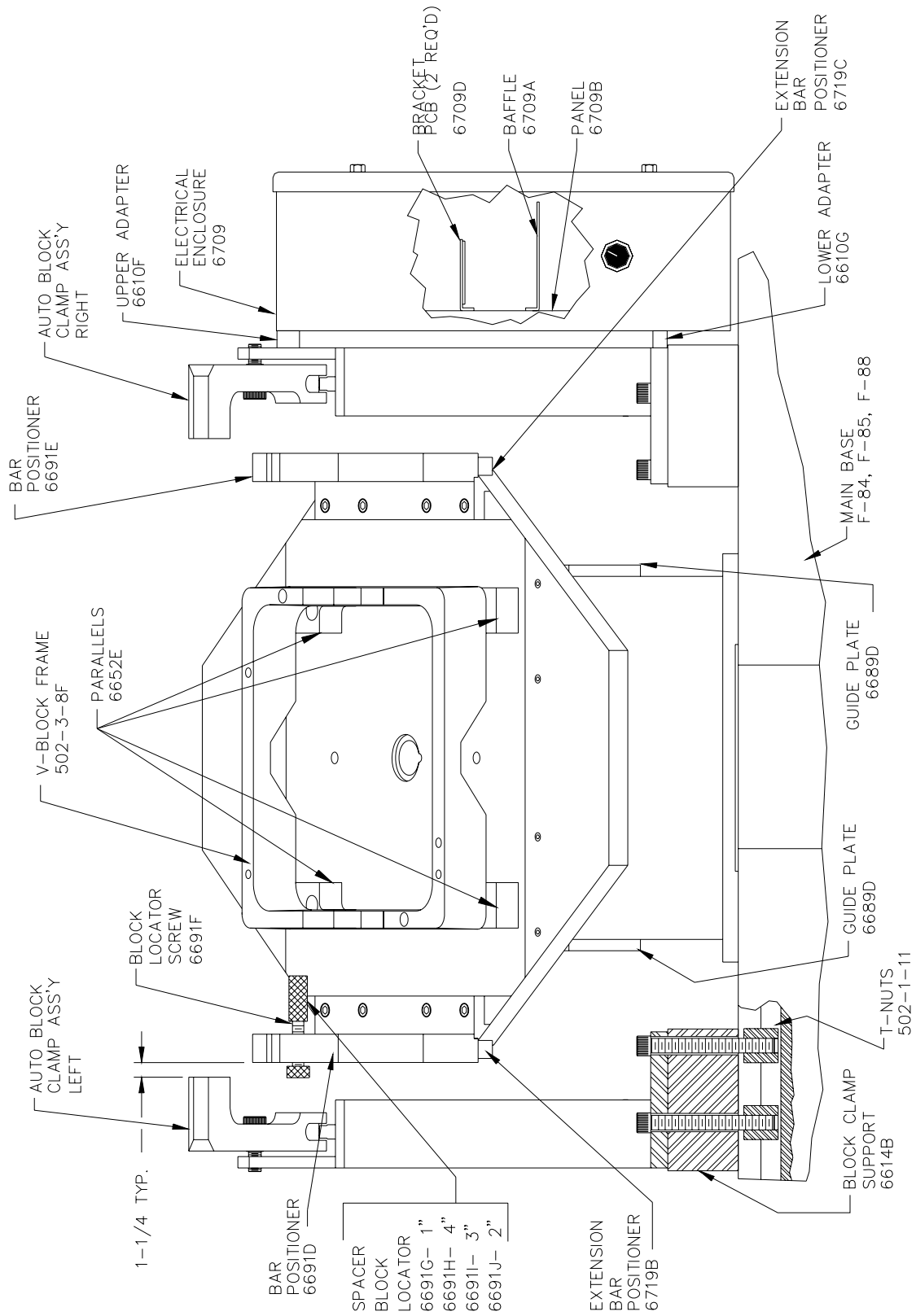
6514QParts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	6514Q	Adapter, MT #5
2	1	6181	Drive Key
3	1	ANSI B18.3 - 10-32 UNF - 0.375	Hexagon Socket Head Cap Screw

REF F8S142-05102005



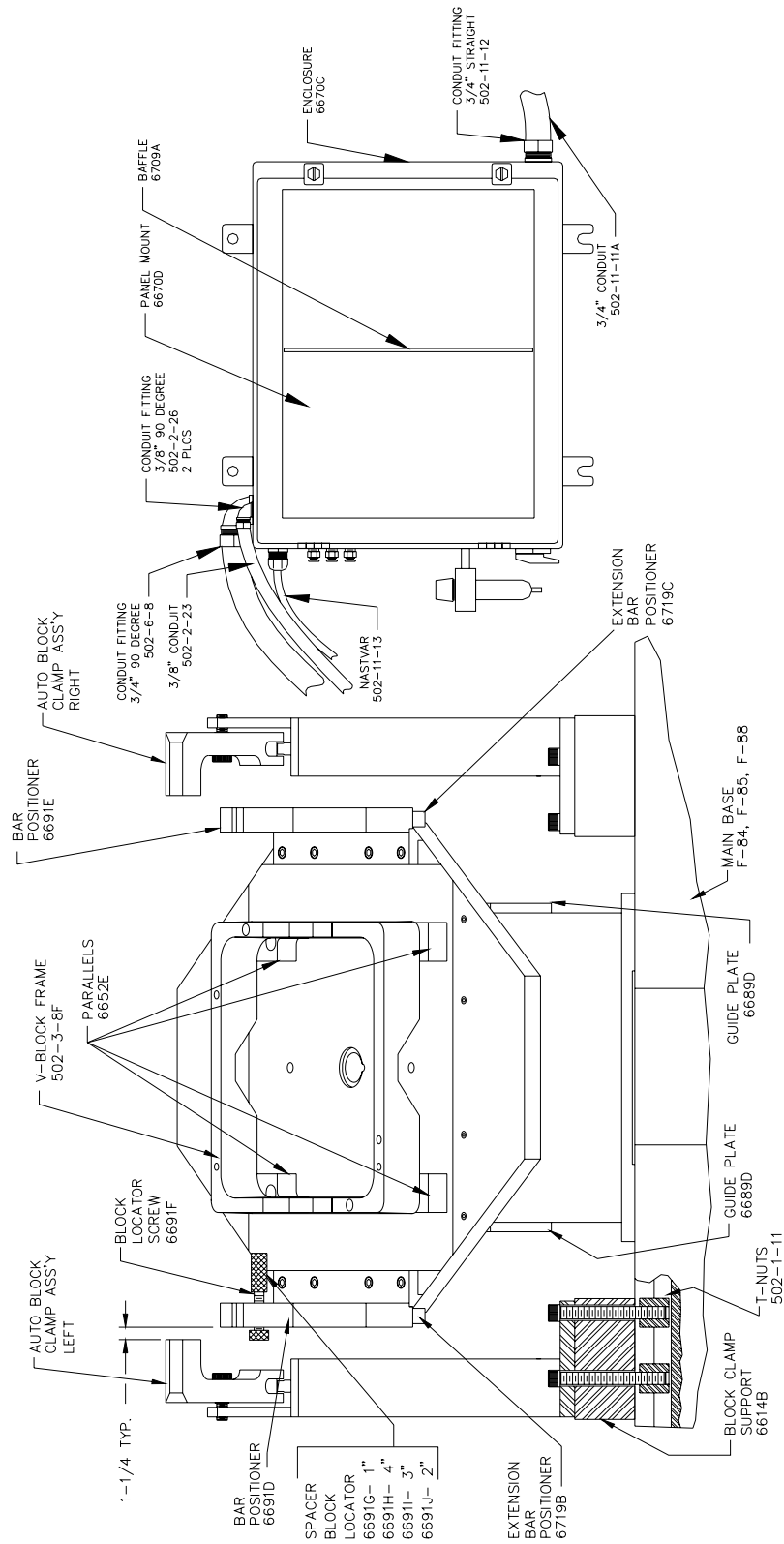
Front View V6/V8 Auto Rotate Fixture:

REFFBVAF23-111497



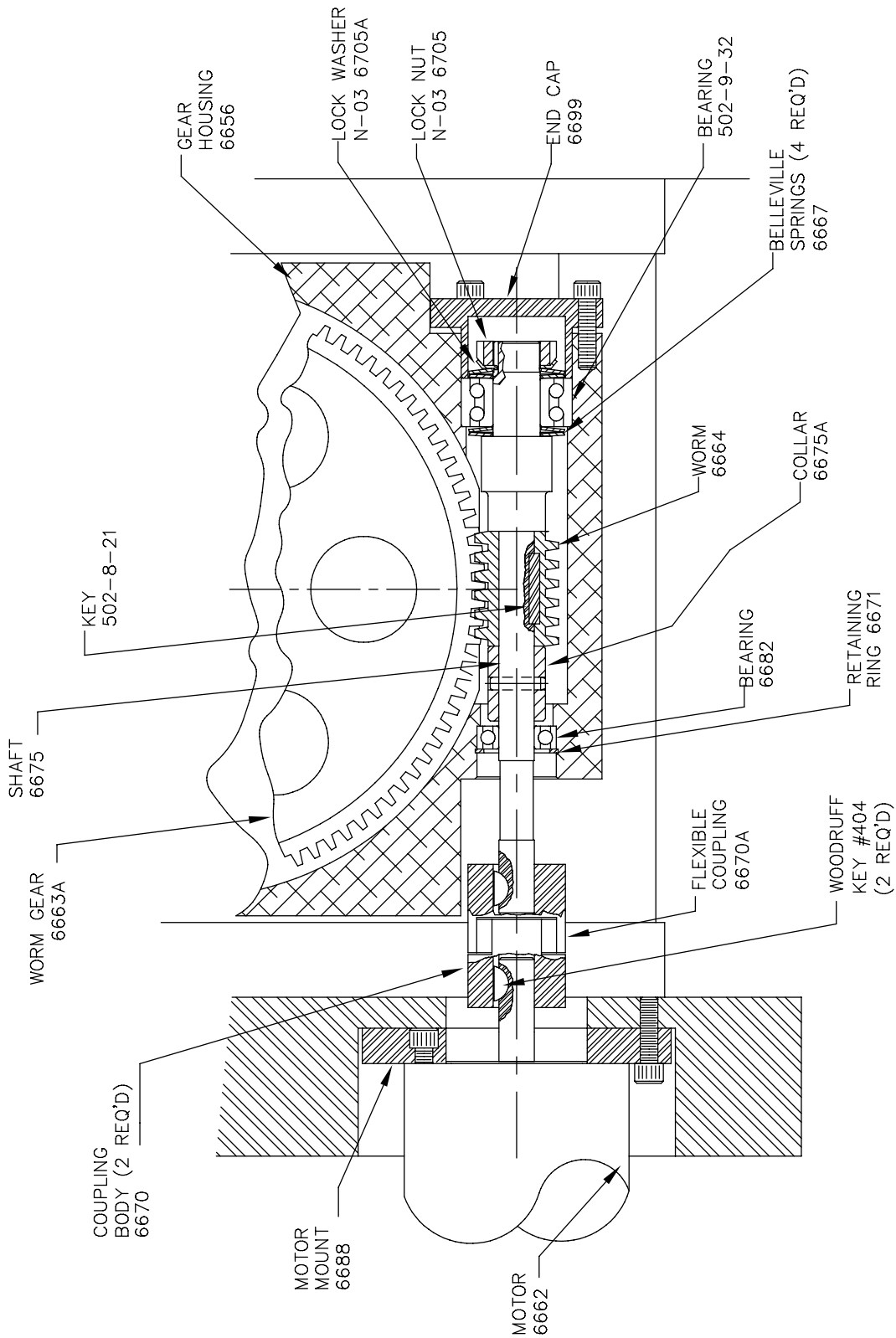
Front View V6/V8 Auto Rotate Fixture Upgrade Model:

Effective after 12/20/202

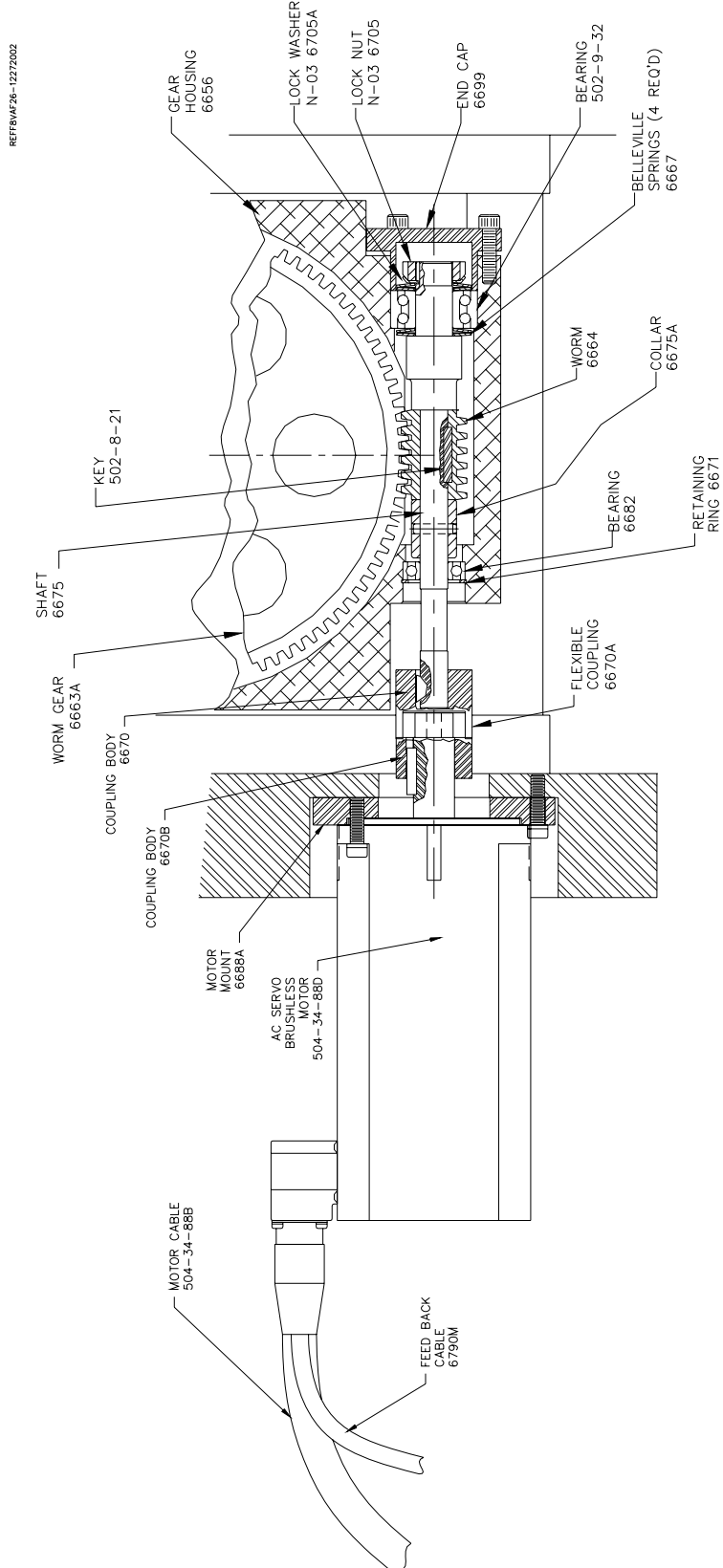


Rotations Drive Assembly:

REFFBVAF6-110897

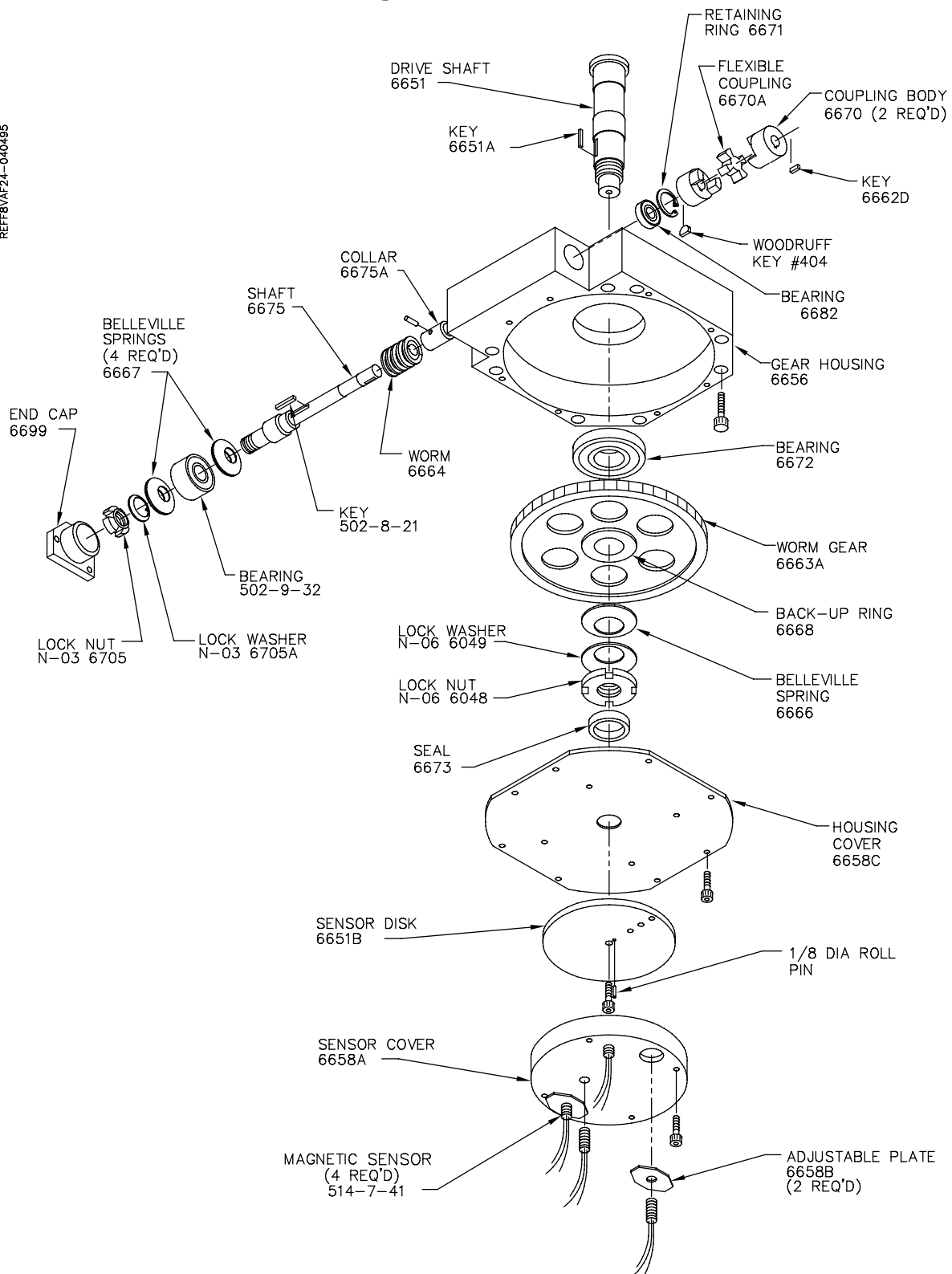


Rotational Drive Assembly Fixture Upgrade Model: Effective after 12/20/2002



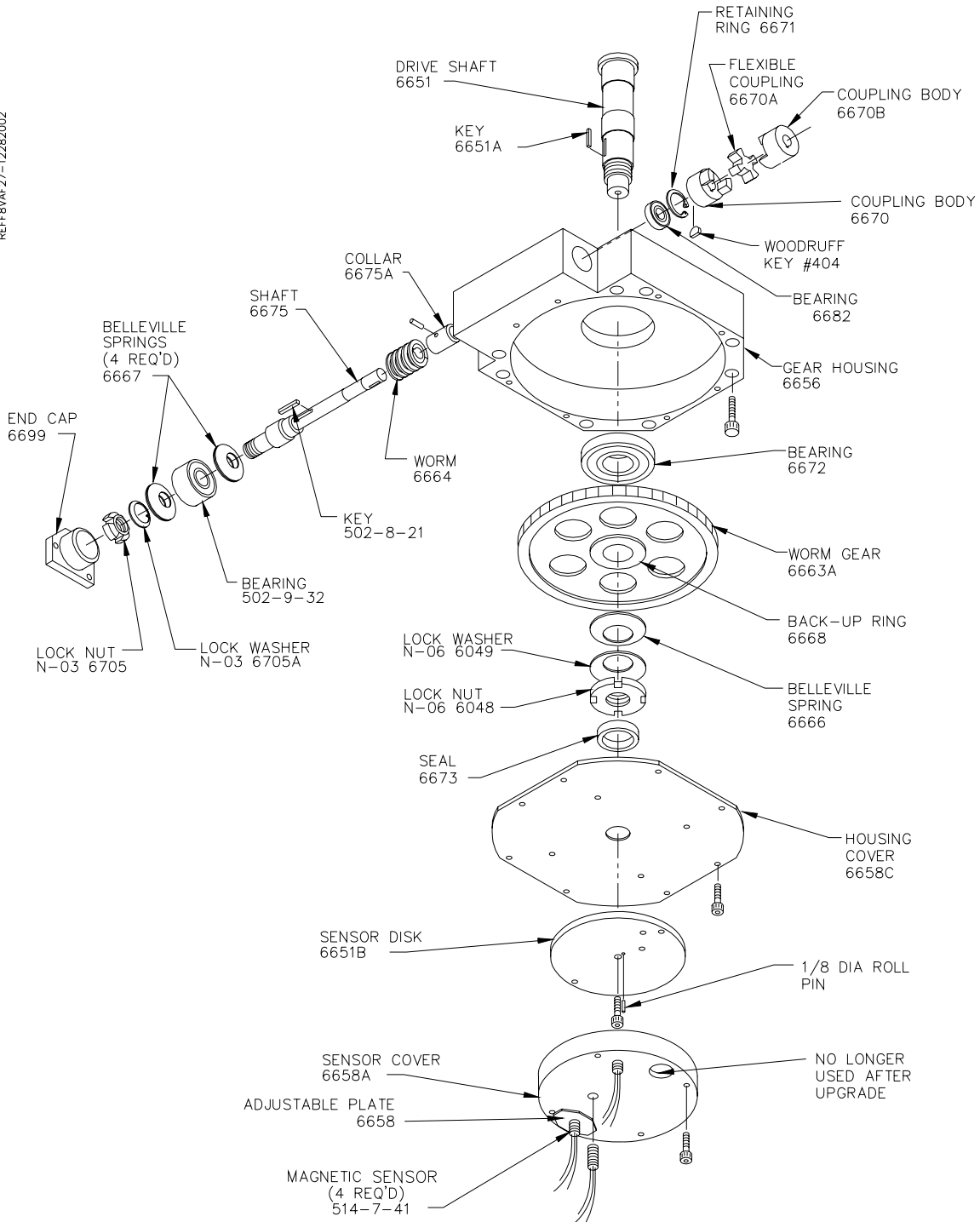
Rotational Drive Gear Housing:

REF F80AF24-040495



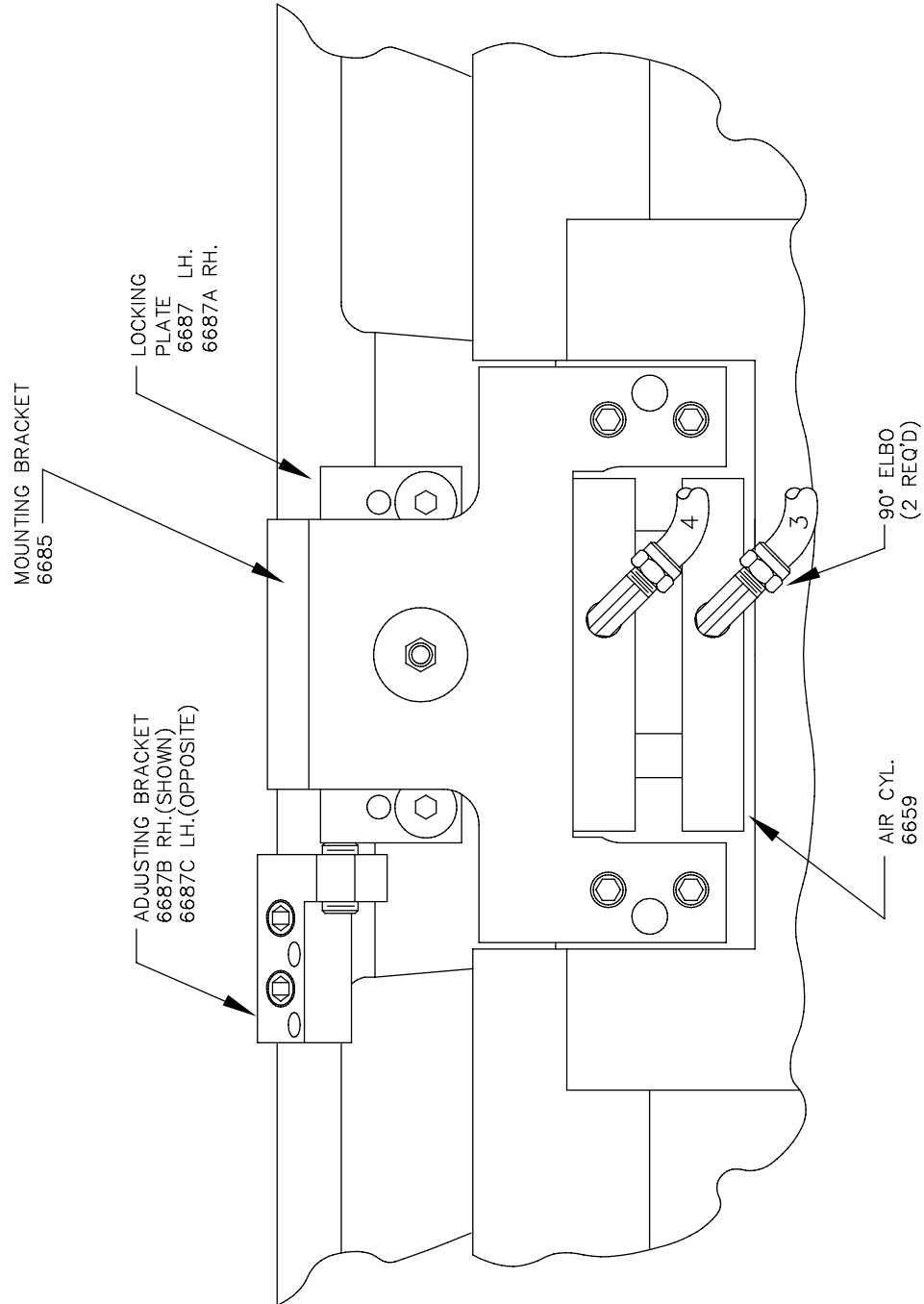
Rotational Drive Gear Housing Upgrade Model: Effective after 12/20/2002

REF88VAF27-12282002



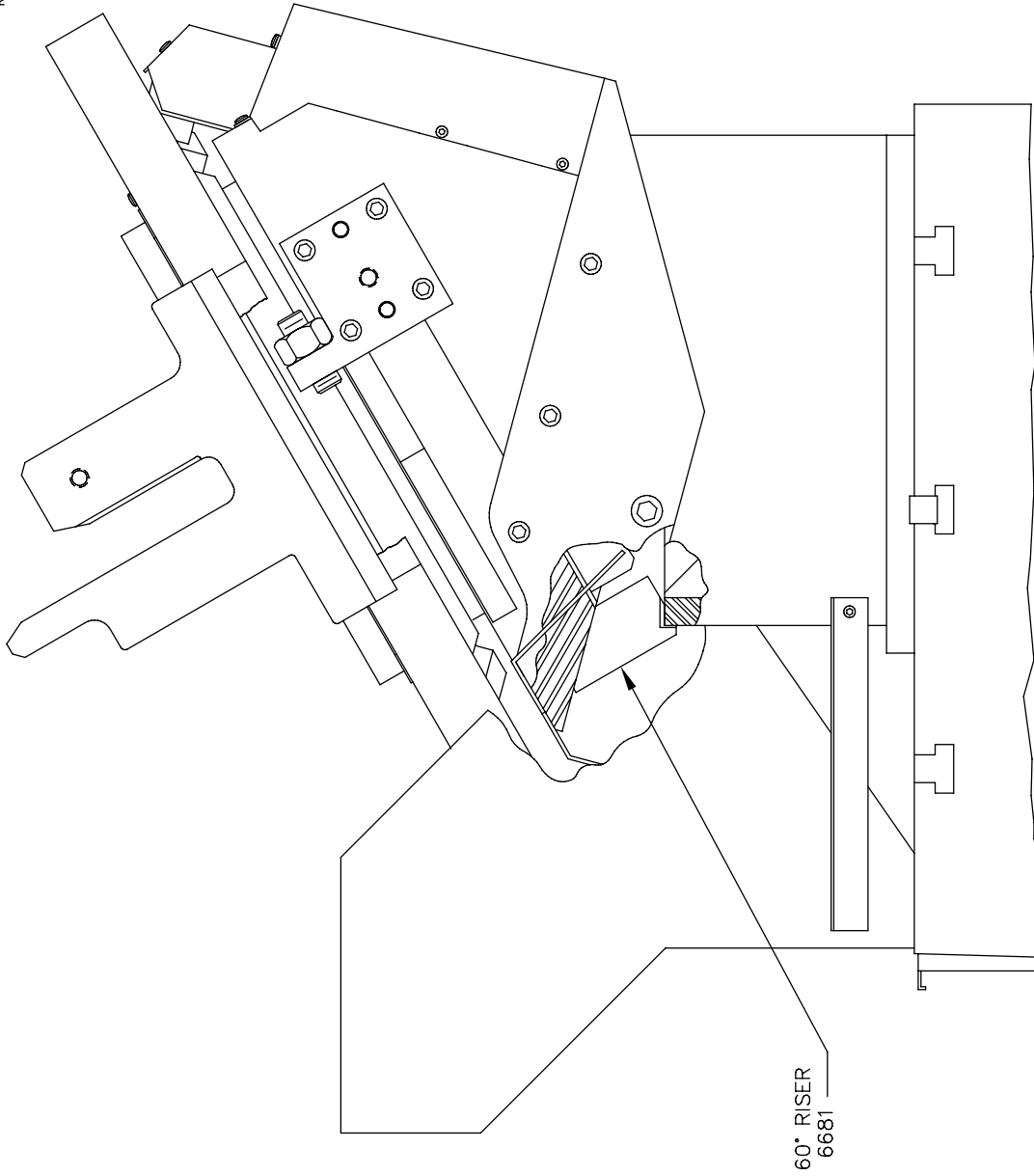
180 Degree Rotational Lock:

REF8VAF5-040495



Right Side View V6/V8 Auto Rotate Fixture:

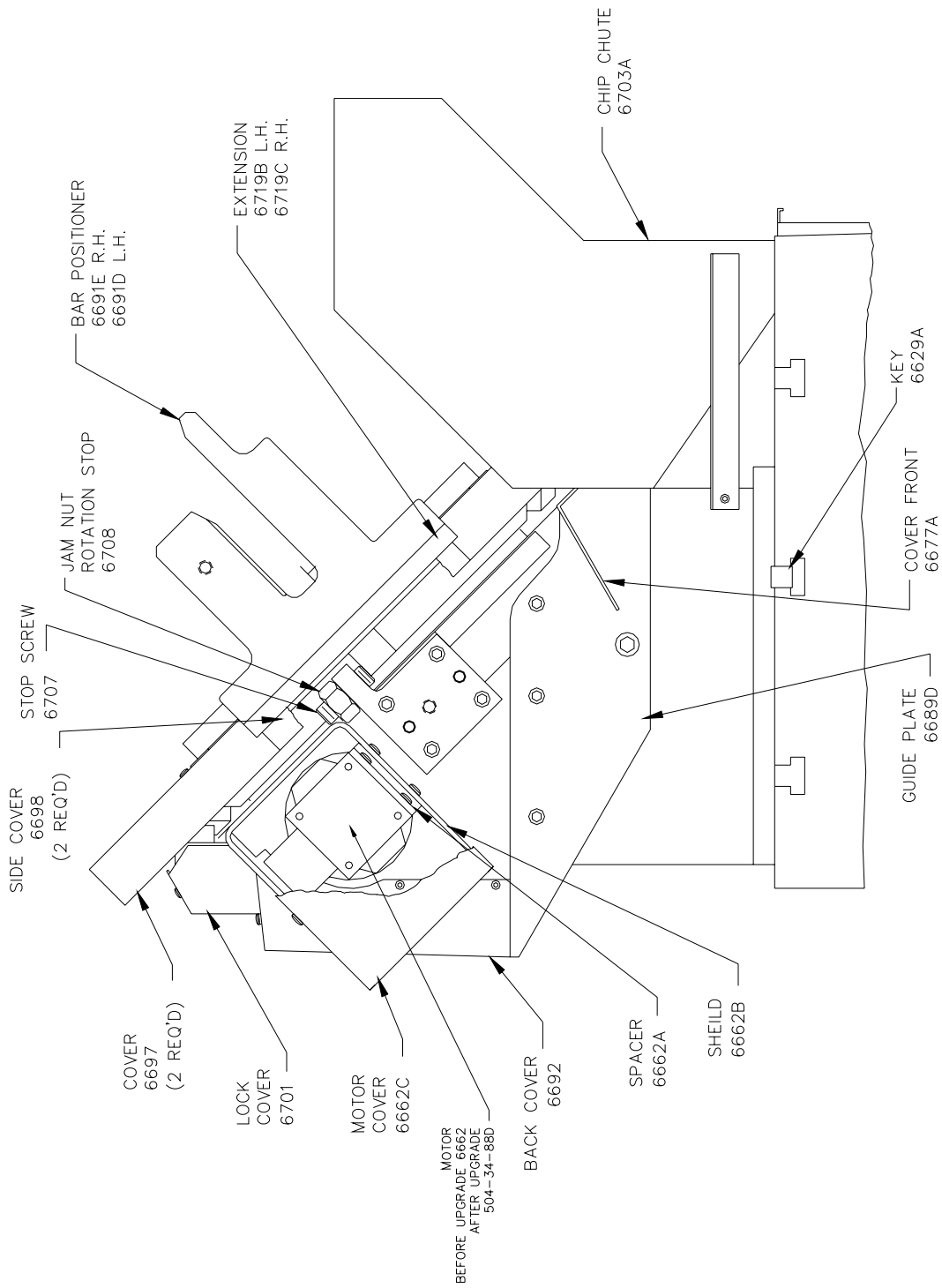
REFFBYAF21-120997



60° RISER
6681

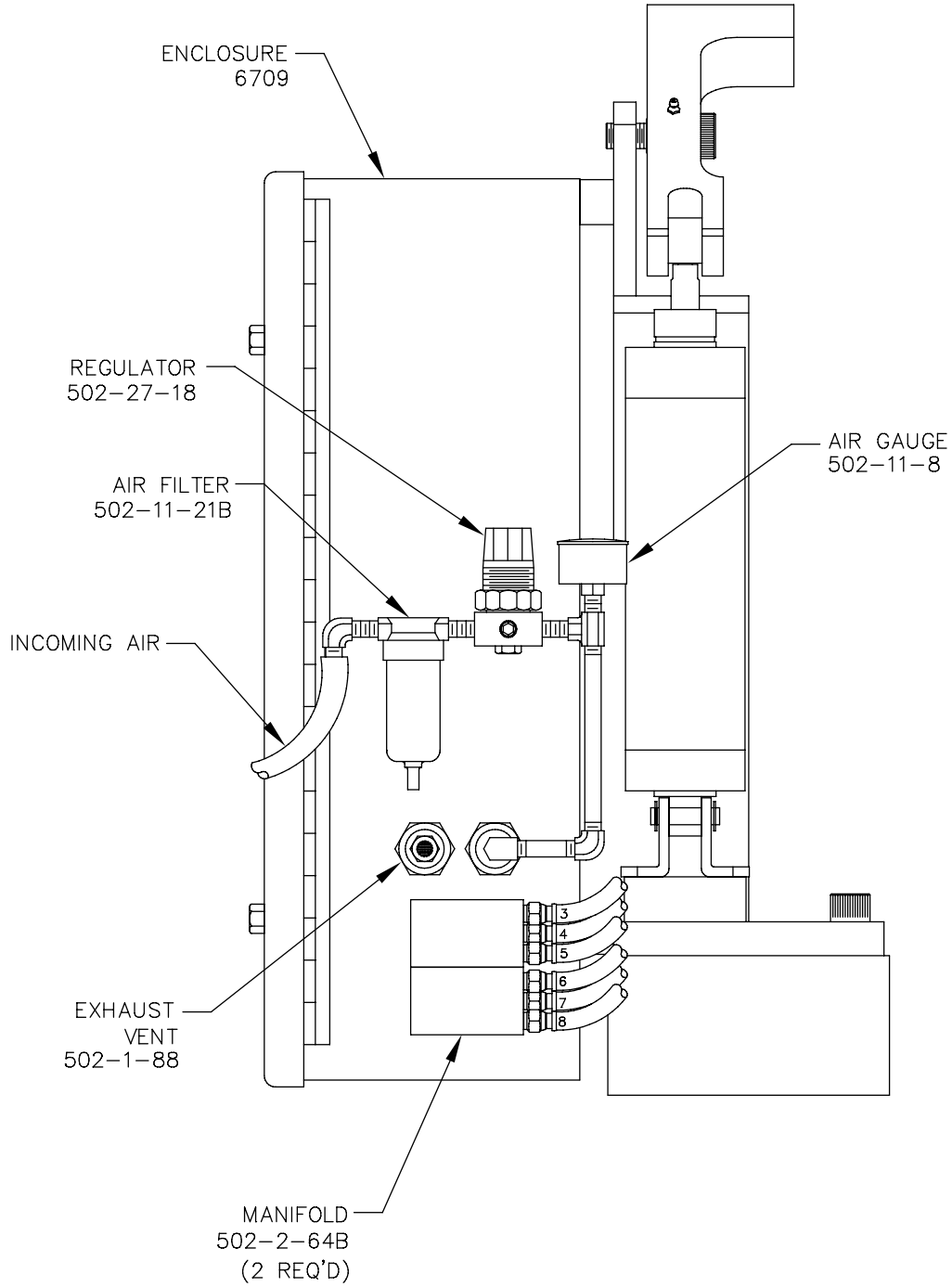
Left Side View V6/V8 Auto Rotate Fixture:

REF8/AF20-12282002

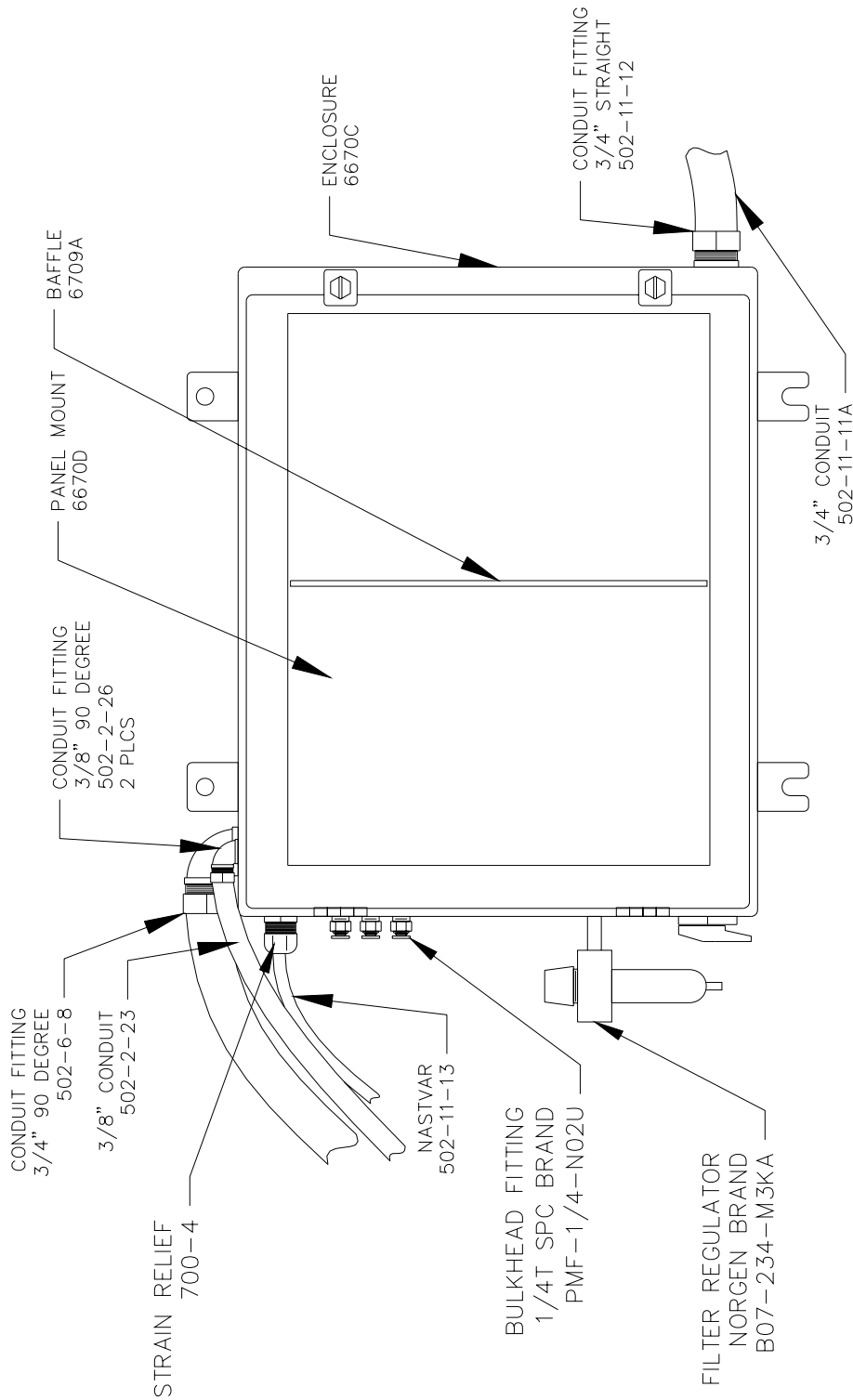


Rear View V6/V8 Auto Rotate, Air Enclosure:

REFFBVAF11-111397



REFFBVAF26 - 12282002

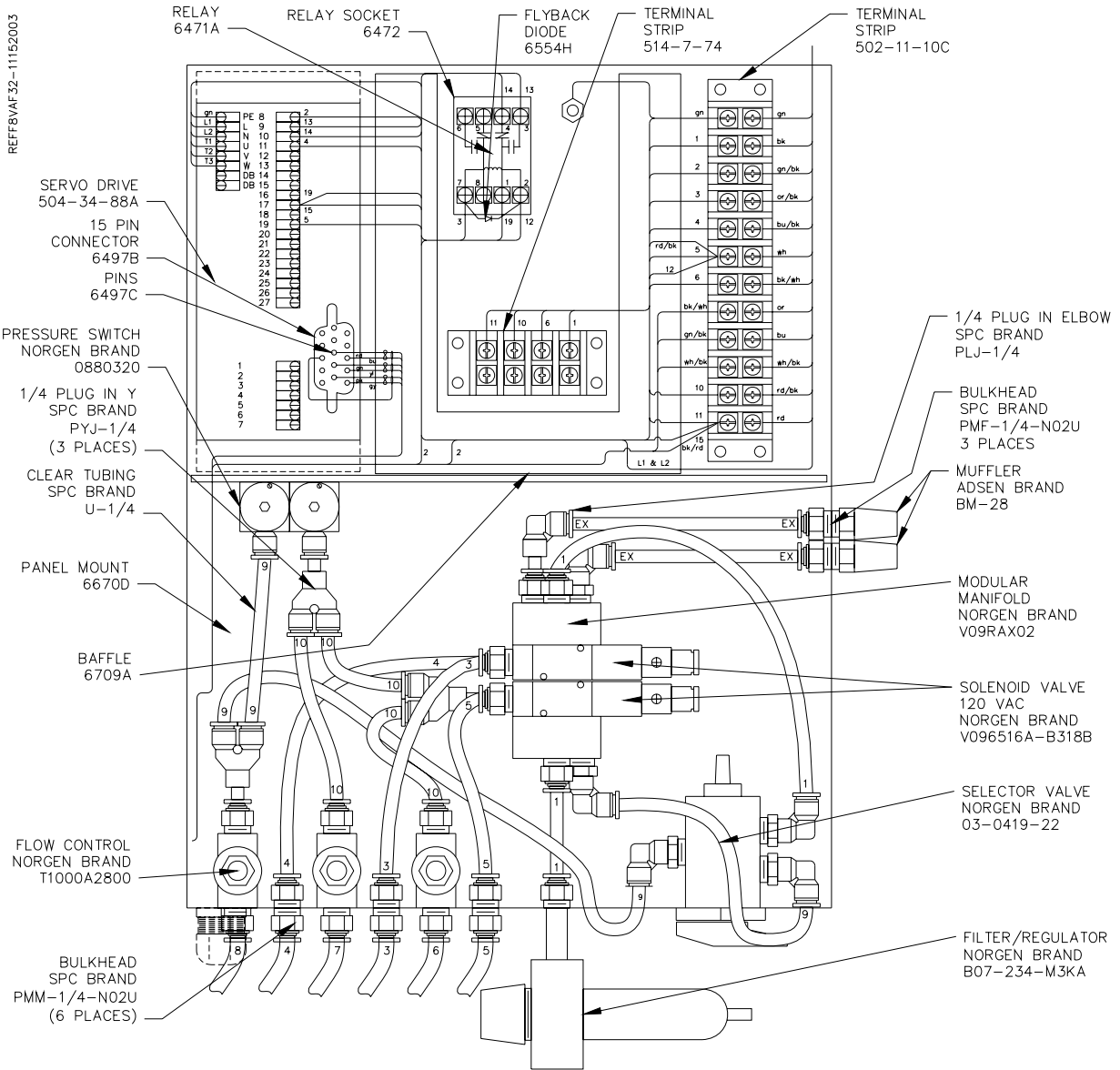


**Front View
V6/V8 Auto
Rotate
Fixture, Air
Enclosure,
Upgrade
Model:**

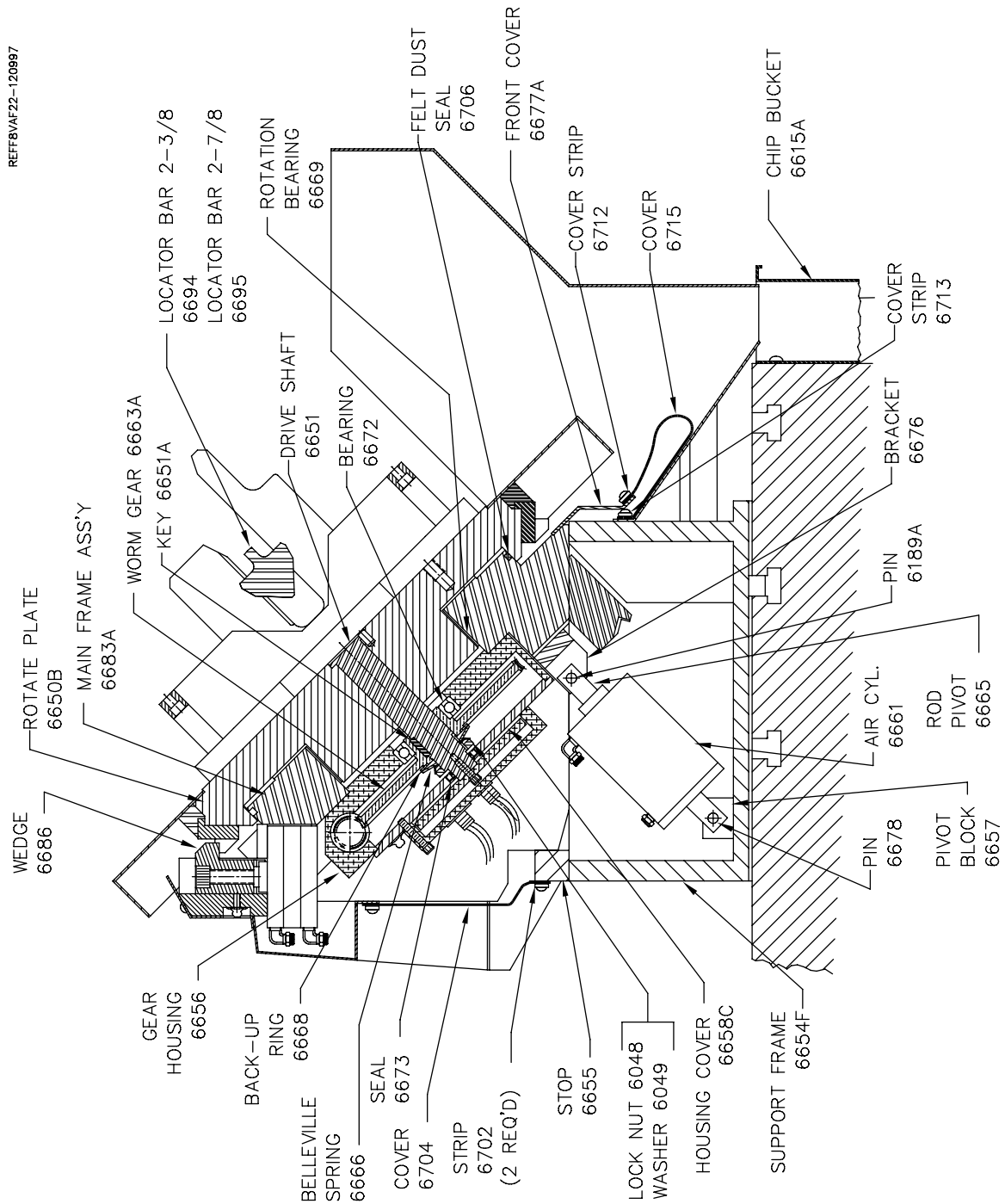
Effective
12/20/2002

After

Auto Rotate Enclosure Upgrade Model: Effective After 12/20/2002

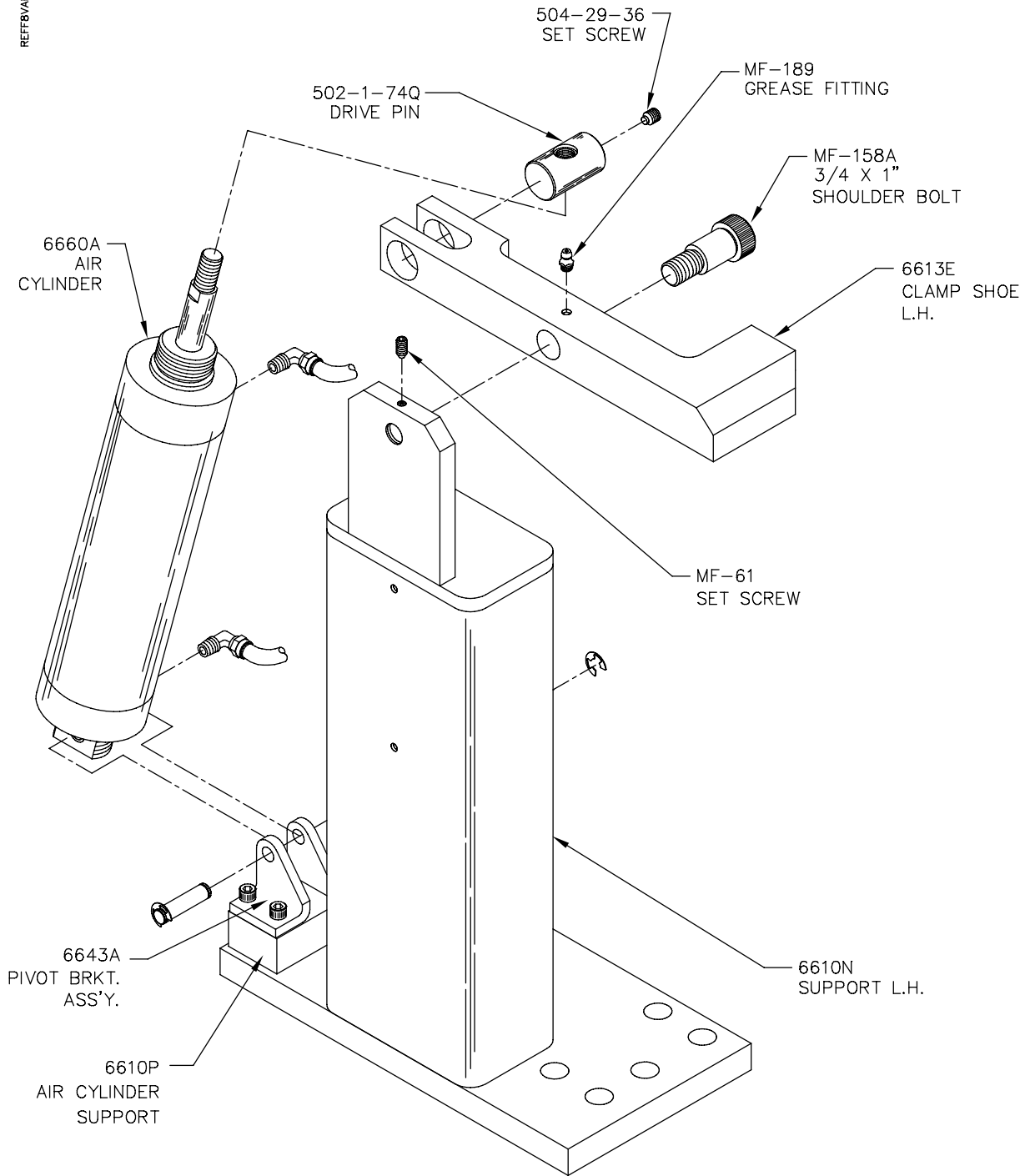


Center Section V6/V8 Auto Rotate Fixture:



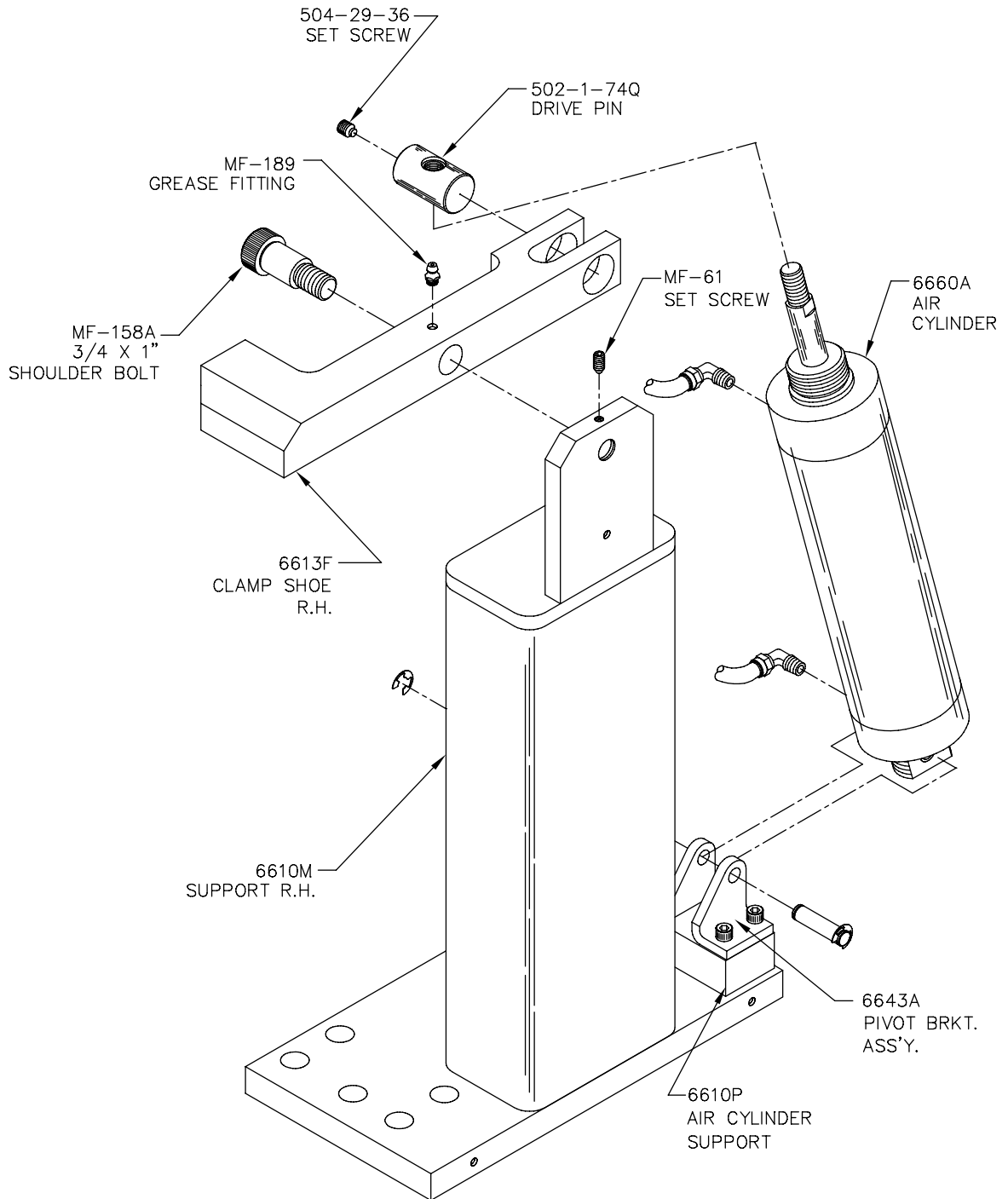
Auto Rotate Block Clamp Left Hand:

REFBVA/7-111397



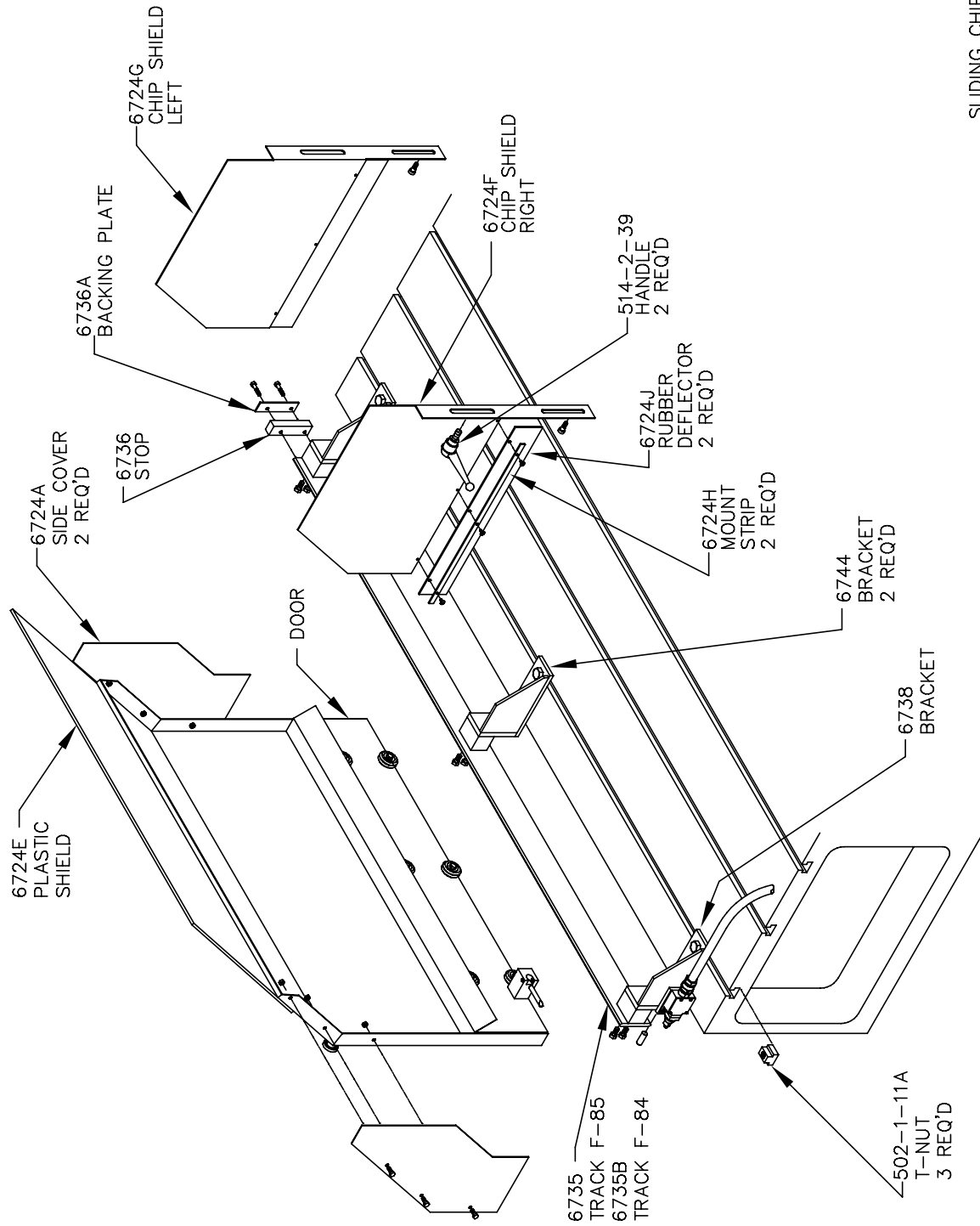
Auto Rotate Block Clamp Right Hand:

REF B/A/F B-111397



Sliding Chip Guard F85 – F84, Single Door:

REFFIXES-121297



SLIDING CHIP GUARD
F-85 SINGLE DOOR

Door Assembly, Single Door:

