

ROTTLER
MANUFACTURING

F80E 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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Introduction:

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

It is suggested that the new user of the F-80 first read the CONTROL DEFINITIONS to get an idea of the way the machine operates.

The BORING INSTRUCTIONS and the MILLING INSTRUCTIONS should then be read to familiarize the user with the actual button pushing sequences required to carry out a job.

The boring and milling instructions should be considered an introduction. With experience the operator will be able to make a wide variety of programs that will best suit the particular requirements of the job.

The rest of the manual contains information on fixturing, cutting tools and maintenance, that the user should read and become familiar with.

Description:

The model F80E machine is a precision, single point tool, boring unit, and a precision high speed surfacer. The machine can be equipped with tooling and accessories for surfacing and reboring most American passenger car and truck engines, Inlines, 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, as well as perform various other boring and surfacing operations.

This machine is designed to maintain alignment of cylinder bores, and deck surfaces to the pan rails and main bearing 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 top 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 F80E parts and equipment are 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.

Standard air and electric components are warranted by their respective manufacturers.

(NOTE: individual warranty periods may vary considerably from Rottler Manufacturing policy).

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

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

Freight charges on warranty items (non-air shipment only) will be paid by Rottler Manufacturing for a period of 60 days only from 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:

CAUTION:

This machine is capable of causing severe bodily injury!

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

In particular, the operator should be very cautious of the cutting tool area.

When surfacing or boring, the machine is capable of projecting chips over 10 feet from the cutting area. Always use guards.

Operator should be very careful to provide adequate clearances around the set-up area when using the machine in an automatic mode.

This F80E machine operates under computer control and is susceptible to extraneous electrical impulses internally or externally produced. The machine may make moves out of the control of the operator at any time, the operator should work in and around the machine with caution.

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

Electrical Power: Make sure all electrical equipment has the proper electrical overload protection.

Machine Operator: Operator of this machine should be a skilled machinist craftsman, that is well versed in the caution, care, and knowledge required to safely operate a metal cutting tool.

If the operator is not a skilled machinist, the operator must pay strict attention to the operating procedure outlined in this manual, and must get instruction from a qualified machinist in both the productive and safe operation of this machine.

Rottler F80E machines have the following areas of exposed moving parts that you must train yourself to respect and stay away from when they are in motion:

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

CAUTION:

Exposed diamond wheel is a potential hazard to your hands, fingers, and face. *Eye protection is a necessity when working in this area.*

2. **Cutting Tool Area** - Any operation involving hands in the cutter head area, such as inspection or alignment of the cutter head or cutting tools, changing centering fingers, tool insertion and removal, cutter head changes, size checking etc... requires that the machine be in Neutral.
3. **Machining** - Including: boring, surfacing, line boring etc... *Eye protection must be worn* during the operation of the machine. Hands

must be kept completely away from cutter head. All chip guards must be in position during machine operations.

4. **Work Loading and Unloading** - Carefully develop handling methods of loading and unloading work pieces, so that no injury can result if hoist equipment or lift connection should fail.

Periodically check lift components for damage that may cause failure of Block Handler Assembly. Lifting eye can eventually fail if the eye is reset in line with the 502-1-80 lift channel. **Eye must be at right angle to this channel.**

5. **Machine Maintenance** - Any machine adjustment, maintenance or parts replacement absolutely requires a complete power disconnect to the machine *This is an absolute rule.*

Emergency Procedure:

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

PRESS THE EMERGENCY STOP BUTTON, LOCATED ON THE CONTROL PANEL, IMMEDIATELY.

Find out what the problem is, return the spindle to its up position, without causing more problems. To start the machine again turn the emergency stop button until it pops out.

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

“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, particularly the means by which cylinder blocks/heads 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 F80E 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 the engine block. An air hoist with speed control makes an ideal method for fast, convenient loading.

If large production runs are anticipated, and the work pieces are not directly loaded and unloaded from a conveyer, 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 workpieces without cluttering up his own 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 tool box, parallels and optional equipment from the machine. Completely clean these articles as well as the machine with solvent. Rust inhibitor is applied at the time of shipment. Any of this inhibitor left on the machine will result in collecting of large amounts of cast iron dirt.

Shipping Clamp:

(see illustration, next page)

Before the column can be moved on the base, it must be unclamped. Remove the screws securing the cover on the lift side of the column below the air enclosure. Pull the way covers out of the way. Underneath the column, at the front, there is a block with a plate bolted to it. This plate is squeezing a small aluminum spacer. Loosen the 2 bolts, remove the aluminum spacer and discard it, retighten the bolts, replace cover, and tighten screws.

Leveling:

Located in the bottom of the main base, are the leveling and tie down screws. With care 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 machinists 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 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 up 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 F80E machine be moisture free. Water and oil in the line will result in early cylinder and valve failure. *Our recommendation is the installation of a water trap at the machine.*

Attach a 100 P.S.I. air source to the appropriate intake at the small enclosure located on the left rear of the machine near the bottom. see illustration on page 8.4 and 8.8.

Power Supply:

This machine requires 208 to 240 VAC three phase, 60 Hz, Current requirement is 50 amps. See wiring diagram for proper hook up of 'measured' incoming AC voltage.

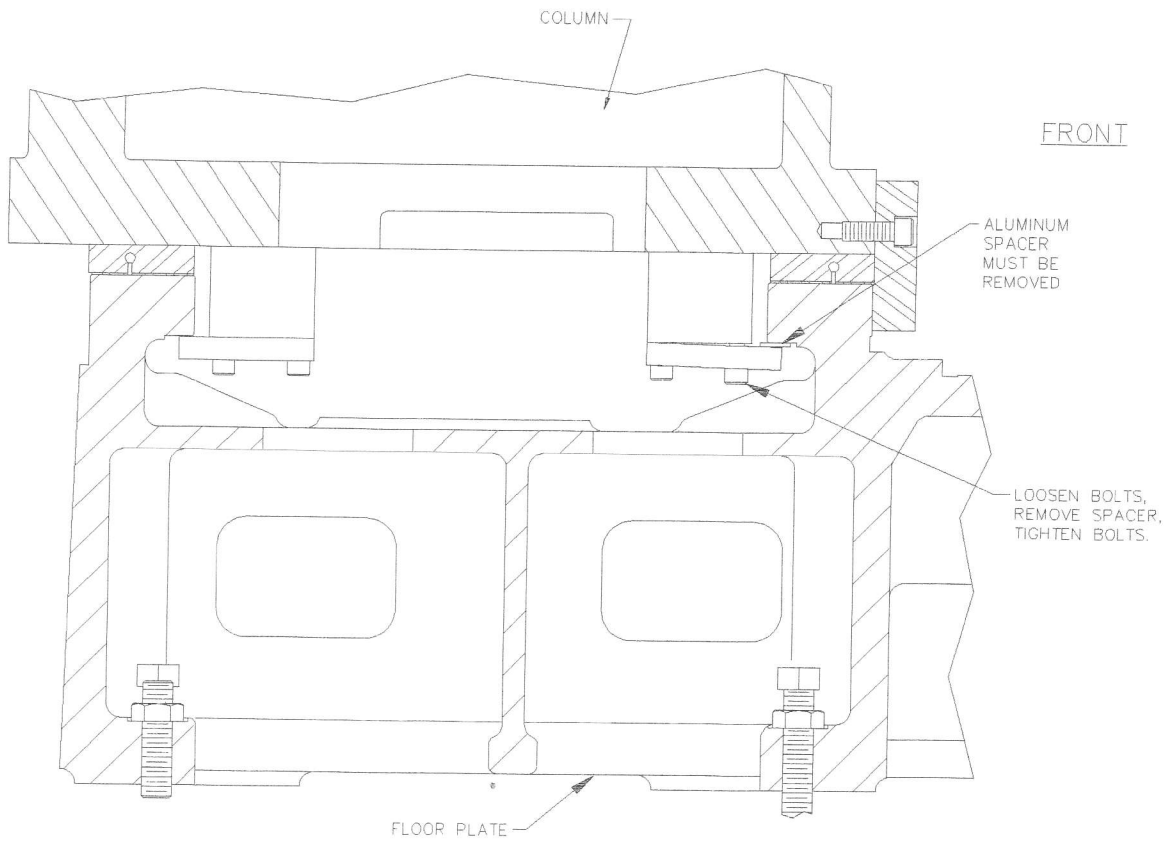
Upon request the machine can be equipped to run on 50 Hz.

Connect three phase wiring to the small enclosure located on the left rear of the machine near the bottom.

Note:

This machine must be connected to a good earth ground.

Shipping Lock:



Master Power On/Off Switch:

This switch is located on the large electrical enclosure on the back of the machine. If the machine is turned off, you must wait 30 seconds to turn it back on, because the spindle amplifier requires that time to reset itself. This switch must be turned off in order 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", which will release its drive key. Turn cutter head 90 degrees to remove.

When the draw bar is in its release position, and the spindle start button is pressed the spindle will not turn. 'COS OPEN' will be displayed on the position readout.

Bore Mode:

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

NOTE:

Always select Bore Mode before turning the machine off.

Mill Mode:

When *Mill Mode* is selected the machine will enable all of the milling functions and movements. While in *Mill Mode* none of the bore mode functions will operate. The machine can be switched back and forth from bore mode to *Mill Mode* at any time. All motion is stopped and any program is aborted before the change is made.

CAUTION:

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*.

Cycle Start/Stop Button:**CAUTION:**

An automatic sequence will start. Make sure the proper program has been selected, the machine has been oriented to the part, and the part is secured in the fixture.

The *Cycle Start/Stop* button stops and starts an automatic cycle in bore mode only. Automatic operation will also stop when the spindle, up, down, left or right 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 #3 (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 #3, there is a vertical rapid move up to vertical stop #3, 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 is turned on (or remains on), and a feed move is made down to vertical stop #2. The retract 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 automatic retract sequence followed with the rapid up move and continuation of the automatic cycle.
- If the vertical axis is below the vertical stop #2, automatic operation is inhibited.

Float Button:

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 will operate. To clamp the spindle base again press the bore button.

Neutral Button:

This button operates in bore mode only. It unclamps the spindle base and partially floats it on a cushion of air. This function is used for precision positioning of the spindle. When the *Neutral* function is on, none of the powered machine movements will operate. To clamp the spindle base again press the bore button.

Up Button:

The *Up Button* activates the rapid or feed up travel of the spindle.

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, or the spindle reaches the home position.

When the spindle is turned 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 Button:

This button activates the down travel of the spindle either in the feed mode or the rapid mode.

Feed down travel will engage when the spindle rotation is on. Rapid down travel will engage when the spindle rotation is off. In the feed mode the travel will continue until the spindle rotation is stopped, up travel is pressed, or one of the stop modes is entered.

In rapid mode the button must be held down for continuous travel. 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.

Left Button:

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.

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.

Right Button:

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

Feed return travel will engage when the spindle rotation is on. Travel will continue until the spindle rotation is stopped, or left travel button is pressed.

Rapid return 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 Button:**

When the *Horizontal Button* is pressed, it lights up, this means that by turning the handwheel, the column will move left or right at the rate set by the .001/.0001 button. The *Horizontal Button* must not be activated (light off) in order for the machine to start in feed mode.

- **Vertical Button:**

When the *Vertical Button* is pressed, it lights up, this means that by turning the handwheel, the spindle will move up or down at the rate set by the .001/.0001 button. The *Vertical Button* must not be activated (light off) in order for the machine to start in feed mode.

- **.001/.0001 Button:**

When the horizontal or the vertical button is pressed this button lights up. With the light lit it is set to .001". That means that for every increment on the handwheel the column or spindle is moved .001". Press the button and the light will go out, then every increment of the handwheel will move the machine .0001".

Spindle Creep Buttons:

These buttons allow the operator to rotate or jog the spindle slowly in either direction. The direction is

controlled by the CW (clockwise) and the CCW (counter clockwise) buttons. Spindle creep will work when the machine is in any mode. Spindle creep will turn the spindle one revolution in one direction. To continue rotation the spindle must be rotated in the opposite direction. The spindle will only rotate as long as the button is pressed and held, when the button is released the spindle will stop.

Spindle Start Button:

This button is used to turn the spindle rotation on and off. When the spindle start button is pressed the spindle will rotate clockwise. Press the Spindle Start Button again and the spindle will rotate two more turns, and stop. The Spindle Start Button will not operate, when the machine is: in neutral, in float, or when the cutter head draw bar is unlocked.

Enter Button:

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

RPM Button:

This button allows spindle R.P.M. to be changed. The spindle R.P.M. can be changed while the machine is cutting. Press the button to display the current setting, enter in the new desired rate on the numeric key pad, 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. R.P.M. is set the same way in either bore mode or mill mode. The settings are independent, so changing the boring R.P.M. does not effect the milling R.P.M.

Feed Rate Button:

Press this button to display the currently active feed rate. The feed rate can be changed any time, including during a cut. Press the button to display the current setting, enter in the new desired rate on the numeric key pad, 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.

NOTE:

Feed rate is entered in thousandths of and inch, for example to enter in a .005" feed rate, type a 5 on the key pad and press enter.

Feed rate is set the same way in either bore mode or mill mode. The settings are independent, so

changing the boring feed rate does not affect the milling.

Horizontal Zero Button:

This button is used 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 *Horizontal 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.

Vertical Zero Button:

This button is used 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 *Vertical 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.

Centering Button:

After locating the cutter head in the centering position press this button to extend the centering fingers. Float must be turned on before the auto centering function is activated. Press and hold the *Centering Button* until the fingers press on the cylinder walls and the spindle base centers. Continue to hold the *Centering Button*, and press the bore button to clamp the spindle base. After the spindle base has clamped release the *Centering Button* and the centering fingers will retract automatically.

Emergency Stop Button:

Press this button in an emergency situation. This deactivates a relay located between the two axis servo drive and the corresponding two axis motors. Also deactivated is a relay between the spindle amplifier and the spindle motor. A signal is sent to the computer which displays "EMERGENCY STOP!".

To recover from an Emergency Stop situation turn the *Emergency Stop Button* and it will pop out. Press the clear button to restart the machine functions. Check the horizontal and vertical zero positions to be sure they are still in memory.

CAUTION:

Before clearing the *Emergency Stop button*, make sure whatever problem caused the E-Stop, has been corrected.

Low Oil Indicator:

The oil reservoir is connected to the computer via the low oil switch. If the computer receives a signal, that the oil reservoir is low or out of oil it will display "LOW OIL" on the display. The machine will not run until the oil reservoir has been refilled.

'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.

'Y'-Axis Alignment Pin:

This pin should only be used when the machine is in bore mode.

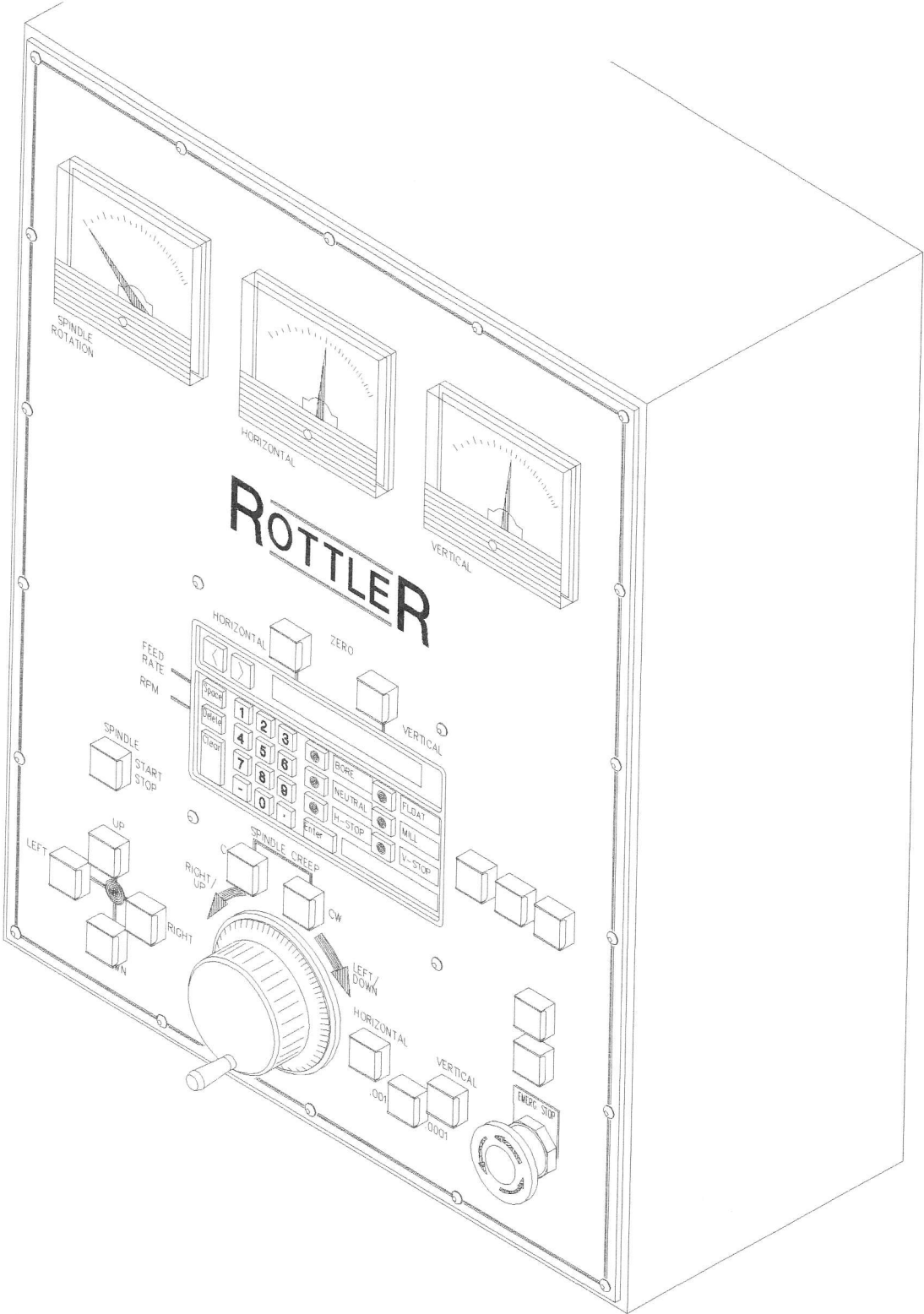
CAUTION:

Do not change machine from bore mode to mill mode with the *Y-Axis Alignment Pin* in its down or operating position-----damage will occur requiring replacement of the pin.

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. Do Not Put in Mill Mode.

Control Illustration:



Boring Instructions:

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:

Place the cylinder block in the proper fixture, auto-rotate fixture, diesel fixture, etc., or directly on the parallel risers, depending on the style and size of block. Apply weight to the top of the block at each end to be sure the block is supported evenly and does not rock, or tip. Dirt or burrs under the mounting surfaces will result in the block not being clamped properly. (Please note it is necessary to properly clean the lower contact points on the block as opposed to cleaning the top of the cylinder block for a portable bar). You will find that some blocks will rock, and tip in the fixture, and should be shimmed as necessary to eliminate the problem.

Locate the block and its fixture so that the cylinders are within the 3" (in-out travel) centering range of the spindle.

CAUTION:

Blocks can be positioned, forcing the spindle base to its travel limits, causing the spindle not to center. This will cause a mechanical crash.

Block Clamps:

(See block clamps illustrations pages 9.2, and 9.3.)
Position clamp arms so the front of the shoe will contact the block on the ends approximately in the middle.

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.

Micrometer:

Determine the cylinder bore size you wish to cut. Place a tool bit into the tool holder.

Place the tool bit and tool holder into the micrometer. Loosen the tool bit lock screw (do not allow the tool bit to snap against the anvil). Set the micrometer head to the desired bore size. Lightly tighten the tool bit lock screw. Back off micrometer head, firmly tighten tool bit lock screw. Recheck micrometer reading.

Choose a tool bit and tool holder combination that will require minimum tool bit overhang. (We recommend a maximum tool bit overhang of 3/4" outside of tool holder).

Before setting make sure the tool bit is properly sharpened, if soldered carbide style, or the insert is in good shape if insert style. (See tool sharpening instructions).

Insert the tool holder into the cutter head and push back to the index point. Tighten the tool lock screw with the plastic handled hex driver provided in your tool box.

Your boring bar micrometer, as with any other measuring tool, should be used delicately and with care, to be assured of great and continued accuracy.

Vertical Stop Definitions:

Vertical stops are not stored in memory. Even though a program is changed the vertical stops will stay the same.

Stop #1.

Manually, operate the controls to place the boring cutter head in the centering position, in the first hole. The proper centering position is with the centering fingers approximately 1/4" in the hole. Press Vertical zero. Press horizontal zero. This will be the vertical centering position.

Manual cycle

After stop #1 is set, if the cutter head is above it and the down button is pressed, it will rapid down to this position and stop. The cutter head is ready to be centered.

Center manually by pressing float, then rotating the manual centering handle to extend the fingers. While maintaining pressure on the fingers press the bore button to clamp the spindle base. Retract the fingers. If the auto center function is installed press float, then press and hold the center button on the pendant. Hold the center button until the cutter head is centered and the bore button is pressed. Release to retract the fingers.

Auto Cycle

When using the auto cycle feature, the machine will travel to the #1 stop position, then automatically center, and move on to stop #2.

The #1 stop is usually set to 00.000 but can be set to any positive value.

Stop #2.

Measure from the cutting point of the tool bit, at stop #1, to the top of the block. Enter a distance for stop #2, approximately .100 less than measured. The purpose of this stop is to minimize the time spent "cutting air" between centering position, and the beginning of the cut.

Manual Cycle

Press the down button and the machine will rapid travel down to stop #2 from stop #1. Press spindle start, then down to start boring. The machine will bore until stop #3 is reached.

If no rapid distance is required, this value can be set to zero, then press spindle start and down directly from the #1 stop position.

Auto Cycle

After the machine has auto centered at stop #1, it will automatically rapid to stop #2 then start the spindle rotation and feed down to stop #3.

If no rapid distance is required, this value can be set to zero, and the machine will start boring from the stop #1 position.

Stop #3.

Stop #3 stops the boring at the bottom of the cut, and retracts the spindle to the top of the bore, to stop #4. Be sure to check for obstructions in the lower areas of the cylinder bore, and set stop #3 so that the cutter head does not crash. Stop #3 is especially designed to control counter bore accuracy and finish. the stop works as follows:

- With the machine boring, as it comes to within .002" of the #3 stop, spindle rotation slows (to the R.P.M. set in parameter #125), and the feed rate slows to .001 per revolution.
- When stop #3 position is reached, the feed stops. The spindle rotates 2 more revolutions (or the value set in machine parameter #122).

- After dwell is completed the machine moves up .010"..... indexes the tool to the right..... offsets horizontally to the left..... then begins the rapid up move to the #4 stop.

Stop #4.

Stop #4 is above the top of the cylinder. After stop #3 is reached and the machine comes up to stop #4 it is ready to travel to the next hole.

CAUTION:

Be sure stop #4 is set high enough for the cutter head to clear the top of the block. Usually this is a negative number for example, -1.5.

Manual Cycle

After reaching stop #4 (if horizontal stops have been set) it will automatically travel left to the next horizontal stop position. Manually press the left button to travel to the next hole, if no horizontal stops have been set.

Auto Cycle

Immediately after reaching stop #4 the machine will rapid travel to the next horizontal stop, rapid down to vertical stop #1, and continue with the automatic boring process. If there is no more horizontal stops programmed, the spindle will travel up to stop #4, stop for just a second and continue to travel up to the home position. The machine will then travel to the horizontal home (far right).

Verify a Program:

Press 'Enter' 100 'Enter' to show on the display the active program number. Press the H-Stop or the V-Stop button to see the horizontal or vertical stop settings in the current program.

It is suggested program 1 be left blank and used for random machine movements. Use programs 2-99 for actual automatic programs.

Selecting a program:

Button Sequence	Display	Comments
'Enter' 100 'Enter'	Pgm# XX	This shows the active program number. 1 through 99. If no change is necessary press 'Enter'.
XX 'Enter'	Current machine position X, and Y.	Press the program number you want to use followed by 'Enter'. If you want to verify the program number press 'Enter' 100 'Enter' again.

Making a Program:

The programming example below uses Program #15. For this example we are making a program for an engine with 6.5000 inch cylinder to cylinder bore spacing. The vertical tool touch off block is .5000 thick. The depth of the bores are 5.750. The program will stop the machine .250 below the bottom of the bore.

Button Sequence	Display	Comments
Main Power	Random Position Values.	Turns power on to machine. Machine will be in Bore Mode. Display will show zero or random position values.
'Up' Button	Random Position Values.	Press and hold the Up button and let the machine return to its vertical home position.
'Right' Button	Random Position Values.	Press the Right button and let the machine return to its horizontal home position.
'Enter' 100 'Enter'	Pgm# 15	Display will show the program number that is currently active, 15. (1 through 99 possible)
15 'Enter'	Current machine position X, and Y.	Press the program number you want to use. 1 through 99. The display will show the position values when 'Enter' is pressed. You can check to make sure you entered the proper program by pressing 'Enter' 100 'Enter'.
'Enter' H-Stop 'Enter'	p15h02 000.0000	Display shows the program number and the 2nd stop dimension. The first stop position is not shown because its dimension is always zero.
6.5 'Enter'	p15h03 000.0000	This enters the dimension of 6.5 for stop 2 then displays the next stop position for entry.
13.0 'Enter'	p15h04 000.0000	This enters the dimension of 13.0 for stop 3 then displays the next stop position for entry.
19.5 'Enter'	p15h05 000.0000	This enters the dimension of 19.5 for stop 4 then displays the next stop position for entry.
26.0 'Enter'	p15h06 000.0000	This enters the dimension of 26.0 for stop 5 then displays the next stop position for entry.
32.5 'Enter'	p15h07 000.000	This enters the dimension of 32.5 for stop 6 then displays the next stop position for entry.
'Enter' 'Enter'	Current machine position X, and Y.	Press 'Enter' repeatedly until the display shows the current position values.
H Stop	p15h02 000.0000	Press the H Stop button to scroll through the horizontal stops for verification.
'Enter' V Stop 'Enter'	p15v1 00.0000	Display shows the active program number and the first vertical stop dimension.
0.000 'Enter'	p15v2 00.0000	Enters first stop and displays the next stop for entry. This is the centering stop. The value for this stop is usually 00.0000
.4000 'Enter'	p15v3 00.0000	Enters the second stop and displays the next stop. An entry of .4000 will cause the machine to rapid down .4000 then begin cutting. In this example the .4000 dimension will rapid the tool bit within .1000 of the block.
6.2500 'Enter'	p15v4 00.0000	Enters the third stop. When the machine reaches this stop it will retract, out of the bore to the fourth stop.
-1.5 'Enter'	Current machine position X, and Y.	Enters the fourth stop. Caution: This stop must be set high enough to allow the bottom of the cutter head to clear the top of the block when it travels to the next hole.
V Stop	p15v1 00.0000	Use the V Stop button to verify the proper numbers are entered.
Safety Check		Check the following: ___ Program# ___ Security of Engine Block ___ Guards ___ Boring Tool set and secure ___ Feed Rate Set ___ R.P.M. Set
H Stop	p15h02 6.50	Use the H Stop button to verify the proper numbers are entered.

Using a Program:

Following are directions for powering up the machine and using a program form memory. For this example we will use program #18.

Button Sequence	Display	Comments
Main Power	Random Position Values	Turns power on to machine. Machine will be in Bore Mode. Display will show zero or random position values.
'Up' button	Random Position Values	Press the Up button and hold until the machine reaches its vertical home position.
'Right' button	Random Position Values	Press the Right button and allow the machine to travel all the way to its home position.
'Left' 'Down' 'Handwheel'	Current Machine Position X, and Y.	Use the buttons and the handwheel to move the machine to the centering position of the first cylinder.
'Enter' 100 'Enter'	pgm# XX	Display will show the program number that is currently active 1 through 99.
18 'Enter'	Current Machine Position X, and Y.	Press the program number you want to use, 1 through 99. The display will show the position values after pressing 'Enter'. You can verify the proper program number by pressing 'Enter' 100 'Enter'.
Horizontal Zero	00.0000, Current Y.	This zeros the Horizontal machine position.
Vertical Zero	00.0000, 00.0000	This zeros the Vertical machine position.
Safety Check		Check the following: <input type="checkbox"/> Program# <input type="checkbox"/> Security of Engine Block <input type="checkbox"/> Guards <input type="checkbox"/> Boring Tool set and secure <input type="checkbox"/> Feed Rate Set <input type="checkbox"/> R.P.M. Set
Cycle Start	Current Machine Position X, and Y.	Machine will start automatic cycle by automatically centering in the first hole.

Making a Program with Optional V6/V8 Auto-Rotate Fixture:

The example below is for boring a V8 engine we will use Program # 23.

Button Sequence	Display	Comments
Main Power	Random Position Values.	Turns power on to machine. Machine will be in Bore Mode. Display will show zero or random position values.
'Up' button	Random Position Values	Press the Up button and hold until the machine reaches its vertical home position.
'Right' button	Random Position Values	Press the Right button and allow the machine to travel all the way to its home position.
'Man' 'Start' button		Press the Man button to release the automatic clamp arms. Press the Start button to 'home the fixture'. The fixture must be in its home position (rotated fully clockwise).
Measure the horizontal stops		The surest way to set the horizontal stops is to use the machines position display to measure the block. Line up the left edge of the cutter head with the left edge of the first bore. Press horizontal zero. move left to the next hole and line up in the same spot as before, write down the dimension. Continue the same across the block. Move clear of the end of the fixture, press 'man' then 'start' to rotate fixture and block. Measure the same way back along the block until all the dimensions are written down. Be sure all holes were measured from the same point. Move the machine clear of the fixture, and home the fixture.
'Left' 'Down' 'Handwheel'	Current Machine Position X, and Y.	Use the buttons and the handwheel to move the machine to the centering position of the first cylinder.
Horizontal Zero	00.0000, Current Y.	This zeros the Horizontal machine position.
Vertical Zero	00.0000, 00.0000	This zeros the Vertical machine position.
'Enter' 116 'Enter'	Lock: 00000	Display shows the current setting of the Lock Code.

9999 'Enter'	Current Machine Position X, Y.	Unlocks the parameter #110 and up, so that they can be changed.
'Enter' 141 'Enter'	Ind clr: 000.000	Display shows the current setting of this parameter. If set to zero Auto-rotate fixture is disabled.
15 'Enter'	Current Machine Position X, Y.	This entry sets the machine to clear the Auto rotate fixture by 15 inches so it can rotate without running into the machine. Use no distance less than 15.
'Enter' 116 'Enter'	Lock: 09999	Display shows the current setting of the Lock Code.
0 'Enter'	Current Machine Position X, Y.	Locks parameters. Display shows Current positions.
'Enter' 100 'Enter'	Pgm# XX	Display will show the program number that is currently active 1 through 99.
23 'Enter'	Current Machine Position X, and Y.	Enter the program number you want to use, 1 through 99. The display will show the position values when 'Enter' is pressed. You can check to make sure you entered the proper program by pressing 'Enter' 100 'Enter'.
'Enter' H Stop 'Enter'	p23h02 000.0000	Display shows the program number and the Second stop dimension. The first stop position is not shown because it is always zero.
Use previously measured distance for stop #2, 'Enter'	Rot F/R=1-2:0	The display is asking for a value to tell it what to do with the rotate fixture. Rotate Forward =F, Rotate Back to home=R, Stay where it is=0.
0 'Enter'	p23h03 000.0000	Display shows the program number and the Third stop dimension.
Use previously measured distance for stop #3, 'Enter'	Rot F/R=1-2:0	Display shows the rotate fixture current setting of 0.
0 'Enter'	p23h04 000.0000	Display shows the program number and the Fourth stop dimension.
Use previously measured distance for stop #4, 'Enter'	Rot F/R=1-2:0	Display shows the rotate fixture current setting of 0.
1 'Enter'	p23h05 000.0000	Entering a 1 causes the machine to travel past the rotate fixture by 15 inches, and the rotate fixture to rotate counter clockwise. Display shows the program number and the Fifth stop dimension.
Use previously measured distance for stop #5, 'Enter'	Rot F/R=1-2:0	Display shows the rotate fixture current setting of 0.
0 'Enter'	p23h06 000.0000	Display shows the program number and the Sixth stop dimension.
Use previously measured distance for stop #6, 'Enter'	Rot F/R=1-2:0	Display shows the rotate fixture current setting of 0.
0 'Enter'	p23h07 000.0000	Display shows the program number and the Seventh stop dimension.
Use previously measured distance for stop #7, 'Enter'	Rot F/R=1-2:0	Display shows the rotate fixture current setting of 0.
0 'Enter'	p23h08 000.0000	Display shows the program number and the Eighth stop dimension.
Use previously measured distance for stop #8, 'Enter'	Rot F/R=1-2:0	Display shows the rotate fixture current setting of 0.
2 'Enter'	p23h09 000.0000	Entering a 2 causes the machine to travel past the rotate fixture by 15 inches, and the rotate fixture to rotate clockwise. Display shows the program number and the next stop dimension.
'Enter' 'Enter'	Current Machine Position X, and Y.	Press 'Enter' and scroll through the rest of the H Stops up to #12, they should all be set to 00.00

H Stop	p23h02 XX.XXXX	Press the H Stop button to scroll through the horizontal stops for verification
'Enter' V Stop 'Enter'	p23v1 00.0000	Display shows the active program number and the first vertical stop dimension.
0.000 'Enter'	p23v2 00.0000	Enters first stop and displays the next stop for entry. This is the centering stop. The value for this stop is usually 00.0000
.4000 'Enter'	p23v3 00.0000	Enters the second stop and displays the next stop. An entry of .4000 will cause the machine to rapid down .4000 then begin cutting. In this example the .4000 dimension will rapid the tool bit within .1000 of the block.
6.2500 'Enter'	p23v4 00.0000	Enters the third stop. When the machine reaches this stop it will retract, out of the bore to the fourth stop.
-1.5 'Enter'	Current machine position X, and Y.	Enters the fourth stop. Caution: This stop must be set high enough to allow the bottom of the cutter head to clear the top of the block when it travels to the next hole.
V Stop	p23v1 00.0000	Use the V Stop button to verify the proper numbers are entered.
Safety Check		Check the following: <input type="checkbox"/> Program# <input type="checkbox"/> Security of Engine Block <input type="checkbox"/> Guards <input type="checkbox"/> Boring Tool set and secure <input type="checkbox"/> Feed Rate Set <input type="checkbox"/> R.P.M. Set

Erasing a Program:

Occasionally you may find that you no longer need a particular program. Programs can be erased by pressing 'Enter' 100 'Enter', selecting the program number to be erased. Press 'Clear' H Stop 'Enter'. All of the horizontal stops of that program are now reset to zero. Press H Stop repeatedly to scroll through the list for verification.

Surfacing Instructions:

We recommend, particularly for operators unfamiliar with the surfacing operation, to practice on a junk block or head, in order to become familiar with the controls and procedures of surfacing.

Loading:

Place the cylinder block, head or other workpiece in the proper fixture, or directly on the parallel risers, depending on the style and size of the block. Apply weight to the top of the block at each end to be sure the block is supported evenly and does not rock, or tip. Dirt or burrs under the mounting surfaces will result in the block not being clamped properly. You will find that some blocks will rock, and tip in the fixtures, and should be shimmed as necessary to eliminate the problem.

Locate the workpiece and its fixturing directly over the center T-slot in the main base. This is the center of the in-out travel of the spindle base.

Block Clamps:

(See block clamps illustrations pages 9.2, and 9.3.) Position clamp arms so the front of the shoe will contact the work piece on the ends, approximately in the middle, (for diesel block fixturing the clamps should contact between, the main bearing supports, and the front jack support points). The top of the block clamps must be low enough that the surfacing cutter does not hit them. Find a hole or a recess in the end of the block to use as a clamping area as opposed to the top of the block for boring.

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 workpiece up on one side.

Leveling:

The top surface of the workpiece to be cut must be leveled to the machine. Use a machinists level, and the fixtures adjustments or shims, to level the work. On a piece that is warped or twisted it may be necessary to take readings at several different locations and average them to get the best clean up.

Surfacing:

The 'Y' Axis lever must be in the up position before the Mill Button is pressed. If it is left down it will be damaged when the spindle base tilts.

Press the Mill button, on the control panel. This disables the bore mode functions and enables the

surfacing mode functions, also the spindle base is tilted approximately .003 to .004 inch. The spindle base is tilted only for surfacing operations, so the heel of the cutterhead doesn't drag.

CAUTION:

Always select bore mode again before turning the machine off. If power is turned off while in mill mode, the spindle base tilt mechanism may be damaged.

In mill mode the Up, Down, Left, Right buttons, all function in rapid travel, as long as the spindle is not turning. If the spindle is turning then left and right operate at the set feed rate speed. The spindle may be adjusted up and down with the spindle running as long as the horizontal feed has not been activated.

Set the spindle speed by pressing the R.P.M. button. The display will show SP rpm: xxxx (current setting). Enter the desired spindle R.P.M. and press enter. The typical setting is 500 to 700 R.P.M.

Set the Feed Rate by pressing the Feed Rate button. The display will show FR in/rev x.xxx (current setting). Enter the desired feed rate and press enter. The typical setting is 0.012 to 0.018 inches per revolution.

The surface operation is designed to be done from right to left. Move the machine so it is in position just over the right edge of the workpiece. Press the spindle start / stop button. With spindle rotating press the vertical button to the right of the hand wheel. Use the hand wheel and slowly lower the spindle until the cutterhead just starts to cut on the block. Press the right button to move the machine off the workpiece. Press the right button again, to stop the cutterhead, when it is clear of the workpiece. Press the vertical zero button. Use the hand wheel to lower the cutterhead to the desired cutting depth. Press the spindle start / stop button then press the left travel button.

The machine will continue cutting at the set feed rate until the spindle start / stop button is pressed again. The cutterhead will slow down and stop. Press the up button, to raise the cutterhead so it will clear the workpiece. Press the right travel button to go back to the start point. Press and hold the down button and the spindle will travel down to the zero position and stop.

Lubrication

Refer to illustrations on page 6.3

Below are directions explaining where and how to add oil to the systems.

Do not overfill any of the lubrication points--serious electrical damage may result.

Outer Spindle:

The *Outer Spindle* is the chromed cylinder that travels up and down from the spindle base. It is supported in cast iron spindle bushings.

Every 8 hours, the *Outer Spindle* should be moved down towards its lower limit, wiped clean, then wiped with, *Union Turbine oil (ISO VG 68)* or equivalent.

Every 1000 Hours, a more complete lubrication should be performed.

Open the sheet metal cover from the front of the spindle unit. There is a large spindle nut where the outer spindle passes through the top of the spindle base. Using a spanner wrench or punch remove the top spindle nut. This exposes a felt oiler. Slide the felt oiler up the *Outer Spindle* and saturate it with *Union Turbine oil (ISO VG 68)* or equivalent.

Do Not adjust the spindle nut that is located below the felt Wiper (see mechanical adjustments).

Slide the felt oiler back into place and screw the spindle nut back into place.

Upper Gear Housing:

The *Upper Gear Housing* is located inside the spindle unit on top of the outer spindle. The *Upper Gear Housing* is lubricated automatically from the lubrication reservoir, located in the column. The oil enters the left side of the housing through a clear oil line. Make sure there are no air bubbles in this line. The oil drains from the *Upper Gear Housing* through a small hole, located in the flange of the outer spindle, and runs down the outer spindle.

Oil Reservoir System:

Warning!

Check, ***Every 8 Hours***, to be sure the automatic oiling system supply lines, in the upper spindle area, are full of oil.

The *Oil Reservoir System* is located inside the lower portion of the column. This oil system lubricates the following:

- Ways
- Upper Gear Housing
- Inner Spindle Bearings
- Horizontal Ball Screw
- Outer Spindle

Every 175 Hours, the oil reservoir level should be checked, and filled if necessary with *Union Turbine oil (ISO VG 68)*, or equivalent.

When the *Oil Reservoir* is low or empty on F80E machines the display will show "LOW OIL", and it will not run, until the reservoir has been refilled.

The oil system may require repriming if the reservoir is run dry. To prime the oil system, change the oil frequency so the oiler solenoid activates approximately every 5 seconds and turn the spindle on at low speed. Let the machine run for about 1/2 hour. Observe the clear oil lines. When the lines are full, change the oiling parameter to its normal running frequency and run the machine normally.

To prime the oil system manually, open the air enclosure, locate solenoid number eight. Press the manual override button, repeatedly until the oil lines are filled.

The frequency of the oiling system can be changed using machine parameter 123 in F80E machines.

Centering Shaft:

The top of the centering shaft is supported by the inner spindle. See page 8.34 for Illustration. There is no grease fitting.

Every 1000 Hours, Remove the small set screw, located near the top of the draw bar, just above the upper housing. Add several drops of *Union Turbine oil (ISO VG 68)*, or equivalent through this hole. Replace set screw.

Centering Control Shaft:

The *Manual Centering Control Shaft* is located vertically inside the spindle unit.

Every 175 Hours, the shaft should be greased with, *F2 Multi-purpose Grease, or Unoba F1 Grease*, or equivalent. Wipe a small amount of grease directly on the shaft.

Inner Spindle Bearings:

The *Inner Spindle Bearings* are lubricated from the oil reservoir system. It is normal for a small amount of oil to seep out of these bearings onto the cutterhead.

Vertical Ball Screw Bearings:

The upper bearing is located above the top plate, directly below the sprocket. The lower bearing is at the bottom of the ball screw in the spindle base.

Every 175 Hours, these bearings should be greased with, *F2 Multi-purpose Grease, Unoba F1 Grease*, or equivalent.

Swing Arm Hinge:

Every 1000 Hours, the *Swing Arm Hinge* should be lubricated with *F2 Multi-purpose Grease, Unoba F1 Grease*, or equivalent, through the grease fitting.

Y-Axis Lever

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

Every 1000 Hours, pull the *Y-Axis Lever* Straight out and wipe a small amount of *F2 Multi-purpose Grease, Unoba F1 Grease*, or equivalent, on the shaft. Then remove the sheet metal cover, on the rear of the spindle base, and grease the rack and pinion assembly inside.

Column Feed Gear Housing:

The *Column Feed Gear Housing* is located inside the column. Remove the two lower inspection plates from the sides of the column. Locate the gear housing (the ball screw passes through it).

Every 1000 hours, check and fill the gear housing with *80/90 weight gear lube*. Locate the fill hole on top of the gear housing. Locate the level check hole on the side of the housing. (Note: the drain hole is located directly under the ballscrew). Fill only to the level check hole.

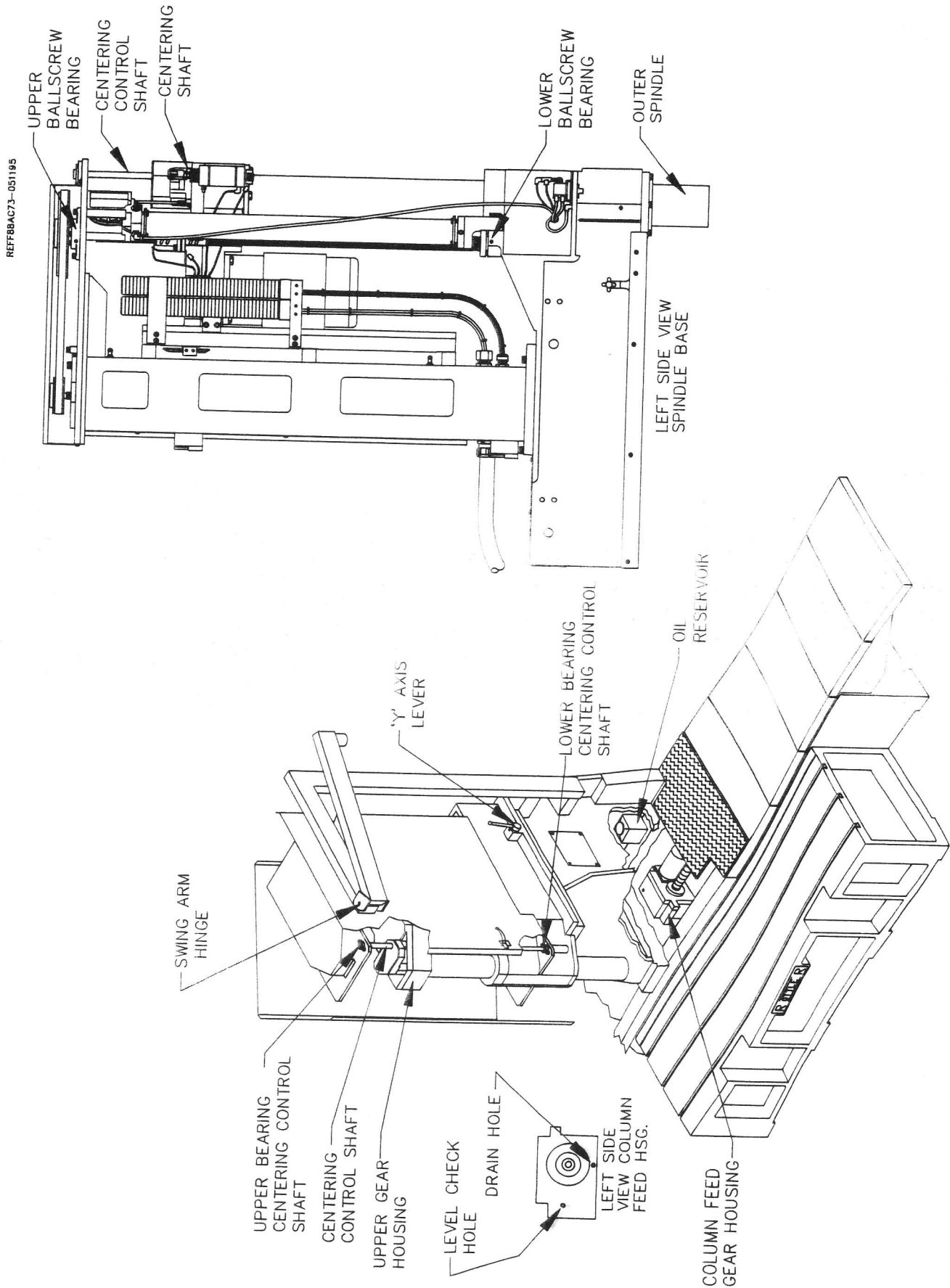
Caution:

IF THIS HOUSING IS OVER FILLED THE SERVO MOTOR WILL BE SERIOUSLY DAMAGED.

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 for quantity
	175 Hours	Fill reservoir with oil
Centering Shaft	1000 Hours	Add several drops of oil
Pillow Block Bearings, Centering Control Shaft	175 Hours	Grease
Centering Control Shaft	175 Hours	Wipe grease on the shaft
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:



Interlocks, Exceptions and Errors:**All motion is inhibited if:**

1. The E-Stop condition is present.
2. Any other error condition is active and has not been taken care of.
3. Machine parameters are bad (battery backed memory failure), re-enter parameters.

Full speed spindle rotation is inhibited if:

1. Spindle ready is false-- Read out will display "SPINDLE DRIVE OFF". Turn main machine power switch off, wait 30 seconds then turn power back on.
2. Cutter override is active-- Turn cutterhead drawbar switch to its locked position.
3. Horizontal or vertical axis is making a rapid move.

Error Conditions:

The F80E machine has a fault detection system. When a fault is detected the type of fault will be displayed in the normal position display area. Below are the different faults that could be displayed.

Display --- EMERGENCY STOP

Emergency stop button shuts down amplifiers. Computer outputs a 0 volt signal while the emergency stop button is engaged. Turn the button clockwise and it will pop out. Press clear and the positions will be displayed.

Display --- HORIZ. POS'N JAM

Horizontal Position Jam. All motion stops. Horizontal axis is shut down with 0 volt signal. Error message remains on display until acknowledged by pressing clear. If pressing clear does not restart the machine, shut off main power at the wall, wait 2 minutes to clear servo driver trip, then restart.

Display --- VERT. POS'N JAM

Vertical Position Jam. All motion stops. Vertical axis is shut down with 0 volt signal. Error message remains on display until acknowledged by pressing clear. If pressing clear does not restart the machine, shut off main power at the wall, wait 2 minutes to clear servo driver trip, then restart.

Display --- SPINDLE JAM

Spindle Position Jam. All motion stops. Spindle amp is shut down with a 0 volt signal, and the Spindle Enable output is turned off.

Display --- COS OPEN

Spindle Drive Inhibit. Inhibits motion when cutterhead is not locked in machine. To resolve, lock cutterhead, and press the clear button.

Display --- PARAMETER FAULT

Battery - Backed Memory Fault. All motion is inhibited. Message is displayed at power-up and when any motion is attempted. Message acknowledged by pressing the clear button. Re-enter machine parameters before starting motion.

Display --- LOW OIL

Low Oil Condition. Stops motion. Shuts down machine until operator adds oil and presses the clear button.

The F80E machine uses the parameters listed below to control its various motions. Most of the parameters are set at the factory, some of the parameters such as R.P.M., Feed Rate, and Stops are readily accessible by the operator and will change as the machine is used. Other parameters are locked and should not be changed without consulting the factory.

Following are notes on the parameters:

1. Entering any value except 9999 for MP116 locks the parameters. Entering 9999 unlocks the parameters.
2. From the position display, pressing Enter once displays "ENTER", if no key is pressed in the next three seconds, or if the Enter key is pressed again, the display reverts back to the position display.
3. If a mistake is made inserting a parameter, press Clear to get the original value back. To display value of parameter without changing it, press Enter after original value is shown.
4. Machine parameters should be changed while the machine is at rest.
5. Pressing "-" changes the sign of the entry, from positive to negative and vice-versa.
6. Decimal points may not be needed, If not needed, it is ignored.

Following are the Machine Parameters:

M. P. Description	Value	Standard Setting	Actual Setting
0-99	Not Defined		
100	Selected set of horizontal stops (1-99)		
101-110	Not Defined		
111	Horizontal Acceleration Rate (unscaled).	4000	
112	Vertical Acceleration Rate (unscaled)	4000	
113	Spindle Acceleration Rate (R.P.M./ sec.)	1000	
114	Horizontal Rapid Velocity (unscaled)	23039	
115	Vertical Rapid Velocity (unscaled)	14506	
116	Lock Code- Use 9999 to unlock parameters above 110		
117	Max Feedrate (.001 in. or .01 cm.)	40	
118	S-Axis max. R.P.M. (rpms) F88	1000	
	F85	2000	
119	Horizontal Creep Velocity	1000	
120	Vertical Creep Velocity	1000	
121	Spindle Creep Velocity	15	
122	No. Rev's before spindle turn off	2	
123	Length for Oil Pump Cycle (seconds)	1000	
124	English/Metric Mode	1 if English 2 if Metric	
125	Final R.P.M.	125	

This is the final R.P.M. the spindle slows down to when executing the boring stop routine (stop number 2). If set at zero the spindle does not slow down. The range is from 1 to 2000, F85
1 to 1000, F88.

126	Leadscrew Compensation,	0-1 ft.	
127	Leadscrew Compensation,	1-2 ft.	
128	Leadscrew Compensation,	2-3 ft.	
129	Leadscrew Compensation,	3-4 ft.	
130	Leadscrew Compensation,	4-5 ft.	
131	Leadscrew Compensation,	5-6 ft.	
132	Leadscrew Compensation,	6-7 ft.	
133	Leadscrew Compensation,	7-8 ft.	
134	Leadscrew Compensation,	8-9 ft.	
135	Leadscrew Compensation,	9-10 ft.	
136	Leadscrew Compensation,	10-11 ft.	
137	Leadscrew Compensation,	11-12 ft.	
138	Leadscrew Compensation,	12-13 ft.	
139	Distance from zero to home position	0.0	
140	Autocenter finger extension time in seconds	2.5 0 = Not Installed	
141	Rotate Fixture Clearance Distance	0=Not Installed 15 = installed	
142	Spindle Drive Type	1=Normal 2=Unipolar	
143	Handwheel Switch Type	1=Pushbutton 2=Toggle Switches	
144	Spindle Gain .1 to 1.0	F85E .25 F88E .501.0	
	Any machine without Lenze Drive		

This chapter gives basic electrical values to assist in trouble shooting the electrical components of the machine. They will be discussed on a component by component basis.

When trouble shooting a problem the first thing that should be done is check for blown fuses on the master fuse block as well as fuses located in the individual components. To properly check a fuse using the continuity method, the fuse must first be removed. A fuse can be checked while installed by checking for voltage between the ends of the fuse. In this case if the voltage is zero the fuse is good. Also, check all connections for tightness. Use the electrical wiring diagram as a reference in finding the various components in the system.

Transformers:

Incoming power at the main breaker should be 208 VAC to 240 VAC, 3 phase. If this voltage is low the spindle amplifier will not deliver full torque at high R.P.M..

The transformer mounted on the outside of the main electrical enclosure transforms the input VAC to two 120 VAC and one 105 VAC secondary taps. If the transformer secondary is suspected, turn off all power, remove the wires from each tap and measure for continuity between X1 and X2, X3 and X4, and X5 and X6. If there is no continuity on any of the taps the transformer must be replaced.

Power Supply:

There is a 12 VDC power supply located in the upper right hand corner of the main cabinet.

This power supply provides 12VDC to the following:

- Pendant lights
- Pendant display terminal
- Pendant switches
- Opto 22 Rack Logic Supply

Servo Motors:

Remove the servo motor armature wires from the appropriate connection points in the main electrical cabinet (see wiring diagram). Check the resistance between the two wires. Check for resistance in five places by rotating the motor and taking a reading. It should be approximately .5 ohms. Check to be sure there is no continuity between either motor lead and ground.

Remove the servo motor tachometer wires from the appropriate connector on the servo amplifier (see

wiring diagram). Check the resistance between the two wires. It should be approximately 165 ohms. Check to be sure there is no continuity between either tach. wire and ground.

This procedure works with either the horizontal or the vertical servo motor.

Servo Amplifier

The Servo Amplifier controls the motors that operate the vertical and horizontal axis. The servo amplifier is located in the upper left corner of the main electrical enclosure. See the Electrical wiring diagram for location of the following items.

The Servo Amplifier consists of the following:

1. Vertical Control Card.
2. Horizontal Control Card.
3. Bus Supply Card.
4. Power Input Card.
5. Capacitor.

Use the electrical wiring diagram to locate the controller and the individual cards.

Adjusting Servo Amplifier.

After a period of time the vertical and horizontal servo motors may start to run with a slight vibration caused by the servo amplifier settings drifting off the original factory specifications. Below are directions for fine tuning the amplifier.

Along the edge of the card you will find the adjustment potentiometers (small blue rectangular boxes with small brass screws in the end). See electrical wiring diagram. The potentiometers are labeled as follows;

- A=Accessory----- No adjustment.
- S=Signal
- C=Current Limit
- R=Response
- T=Tachometer
- B=Balance ---- **DO NOT ADJUST THIS!**

The three adjustments that can be made are; Current Limit, Response, and Tachometer, they should be done in the following order.

Current Limit:

Turn the current limit adjustment screw clockwise 2 turns. If this improves the operation of the machine leave it in that position and go to the next step. If it does not improve the operation of the machine turn it back to its original position.

Tachometer:

If adjusting the horizontal motor remove the motor and secure it for operation outside of the machine. If adjusting the vertical motor remove the timing belt from the servo motor pulley.

Set-up a voltmeter to measure 0-12 VDC.

Using the electrical wiring diagram, locate the appropriate (vertical or horizontal) speed command outputs on the main controller. Attach the +/- voltmeter leads to the +/- speed command outputs from the controller.

Locate the amplifier in the upper left corner of the electrical cabinet. If adjusting the vertical tachometer press the rapid up button on the pendant and monitor the voltmeter. If required, adjust the 'T' potentiometer so the voltmeter reads between 4.5 and 5.5 volts. If adjusting the horizontal tachometer press the rapid right button, monitor the voltmeter and adjust the 'T' potentiometer as required.

Response:

After the above adjustments are made the response should be adjusted. Select the 'R' potentiometer located on the appropriate board (horizontal or vertical). While the machine is moved with rapid motion turn the response slowly in the clockwise direction until you notice a vibration, then stop. Now turn the response in the counter clockwise direction until the vibration stops and then turn one more additional turn counter clockwise.

Lubrication:

The lubrication system is controlled by a timer in the computer. The timer runs only when the spindle rotation is on. If there is a suspected problem with the system use the pneumatic diagram to find the lubrication solenoid located in the air enclosure. Manually actuate the solenoid and observe the oil lines for oil flow. If the oil does not flow there is a problem with the oil pump or possibly a leak in the oil lines. Check and make sure the oiling parameter is set to the correct value in the computer (see parameters in Electrical section.).

Automatic Centering Control, Clutch, and Motor:

The Automatic centering system consists of the Automatic Control, an electric DC magnetic clutch, and a DC Gear Motor. If there is a problem with this system check the fuse on the Automatic Control, also check the small relay located on the board and make sure it is secure. If there is still a problem refer to the electrical wiring diagram for proper voltage and resistance readings of the Automatic Control, the DC

magnetic clutch, and the DC Gear Motor. Refer to the mechanical section for specifications on the clutch gap.

Vertical and Horizontal Axis Control:

The vertical and horizontal axis are controlled by a precision closed loop TAC and Digital Feed Back System.

Below are possible symptoms and methods for determining the exact problem.

Symptom-- Axis runs smoothly in one direction but not in the other. When comparing one direction with the opposite direction, the loads should be within 10 percent.

Problem-- Encoder coupling broken. Check and replace if necessary.

Problem-- If in horizontal axis motor, the motor may be contaminated by over filling of the horizontal gear box. Check armature and tachometer brushes for oil. Replace motor if required.

Problem-- If in vertical axis check timing belt tension. When the belt is pushed in between the pulleys with a four pound force the belt should deflect 3/8 of an inch.

Check the counter-weight cylinder cable and make sure the cable hasn't broken and it runs freely with the machine.

Symptom-- Axis runs roughly in both directions.

Problem-- Lubrication, if the symptom is in the horizontal axis check the ways for proper lubrication, if required adjust the oiling parameter in the computer (see parameters). If the symptom is in the vertical axis check the outer spindle for proper lubrication. See lubrication section of this manual.

Problem-- If it involves the vertical axis the problem may be the timing belt adjustment. (See mechanical chapter - vertical timing belt adjustment).

Problem-- Servo motor amplifier may require adjustment. See Servo Amplifier.

Problem-- Servo motor may be defective. See Servo motor.

Problem-- Outer spindle bushings may be too tight. See outer spindle adjustment in mechanical chapter.

Problem-- Contamination, this occurs in the horizontal motor. Remove the horizontal motor then remove the armature brushes. Check the brushes for oil contamination. If the motor is contaminated replace the motor and make sure the horizontal gear box is not over filled.

Spindle Rotation System:

Symptom-- Spindle does not develop horsepower - Spindle Jams at cutting loads normally encountered. (See Jasper loads less than 100 percent).

Problem-- Re-enter machine parameters concerned with the spindle or S-Axis.

Problem-- If power is normal at all speeds but the top 10 percent, check the main machine 3 phase AC voltage, it must be 230 volts.

Problem-- Check security of spindle encoder timing belt and pulleys. (See mechanical chapter).

Problem-- Spindle Amplifier out of adjustment. (See spindle amplifier adjustment).

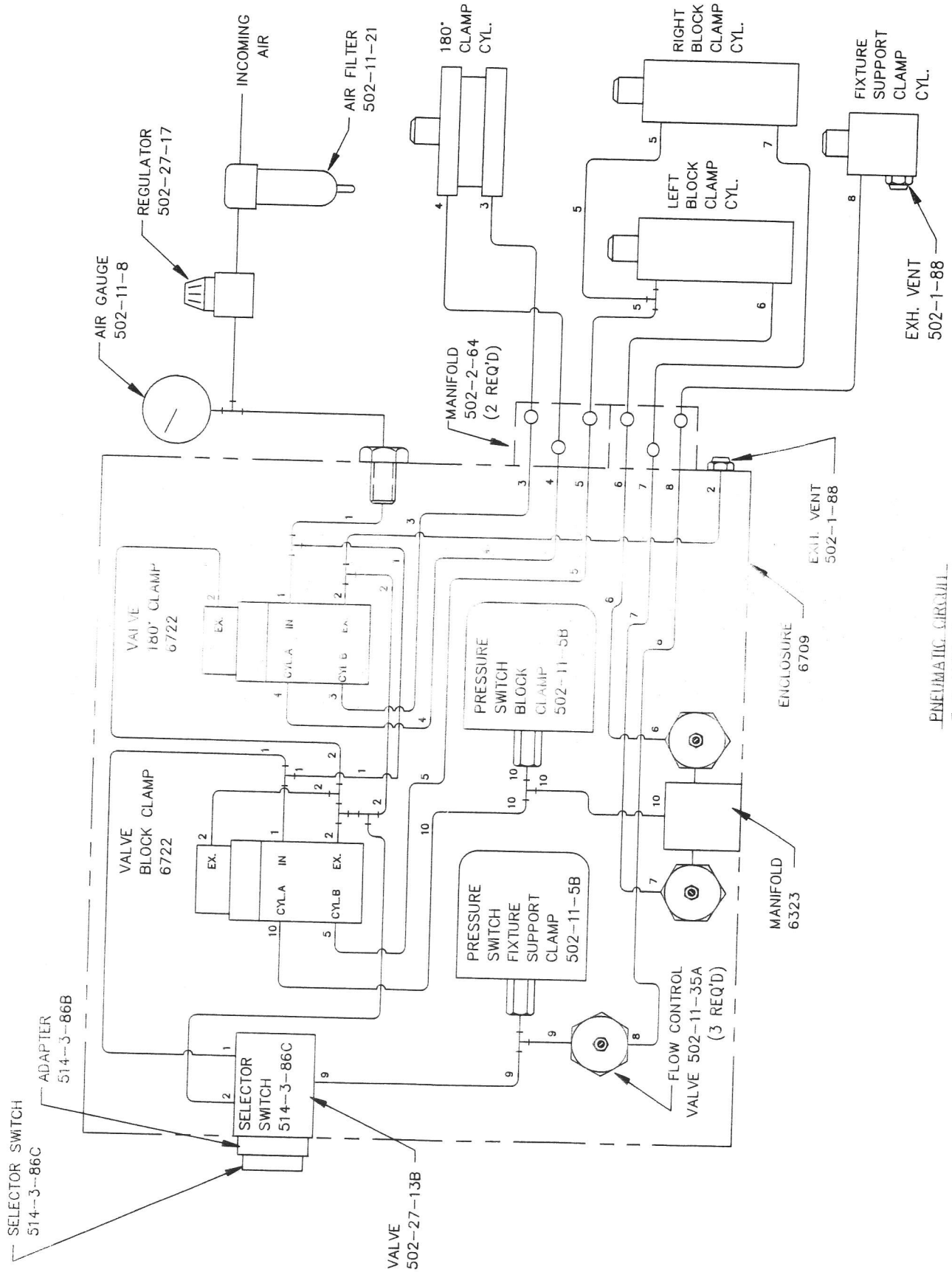
Problem-- Spindle encoder defective-- replace.

Problem-- Spindle motor defective-- replace.

Electrical:

DC motor armature and tachometer brush replacement. Cleaning air conditioner and the inside of the spindle unit. Power supply voltages. Terminal cleaning.

Auto Rotate Air Logic Diagram:



PNEUMATIC CIRCUIT
F-8 AUTO-FIXTURE

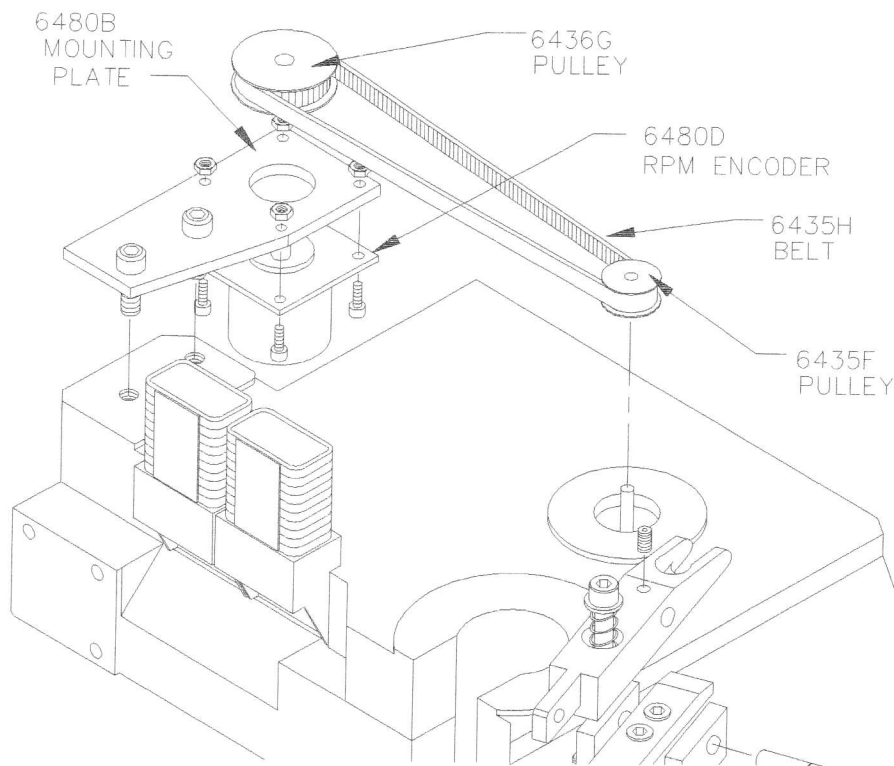
Spindle R.P.M. Belt Replacement / Adjustment:

CAUTION:

Turn off all power to machine before replacing the belt.

See illustrations on pages 8.22 and 8.23.

1. Open the large door on the spindle unit.
2. On the top of the Upper Housing assembly is the spindle R.P.M. encoder and drive belt.
3. Loosen the two bolts securing the encoder mounting plate on to the Upper Housing. Move the encoder in, to loosen and remove the belt.
4. Replace with new belt if necessary.
5. Adjust encoder mounting plate so that the belt will deflect $5/32$ " when a force of 3-1/2 oz. is applied to a point midway between pulley centers.
6. Tighten fully the encoder mounting plate screws.



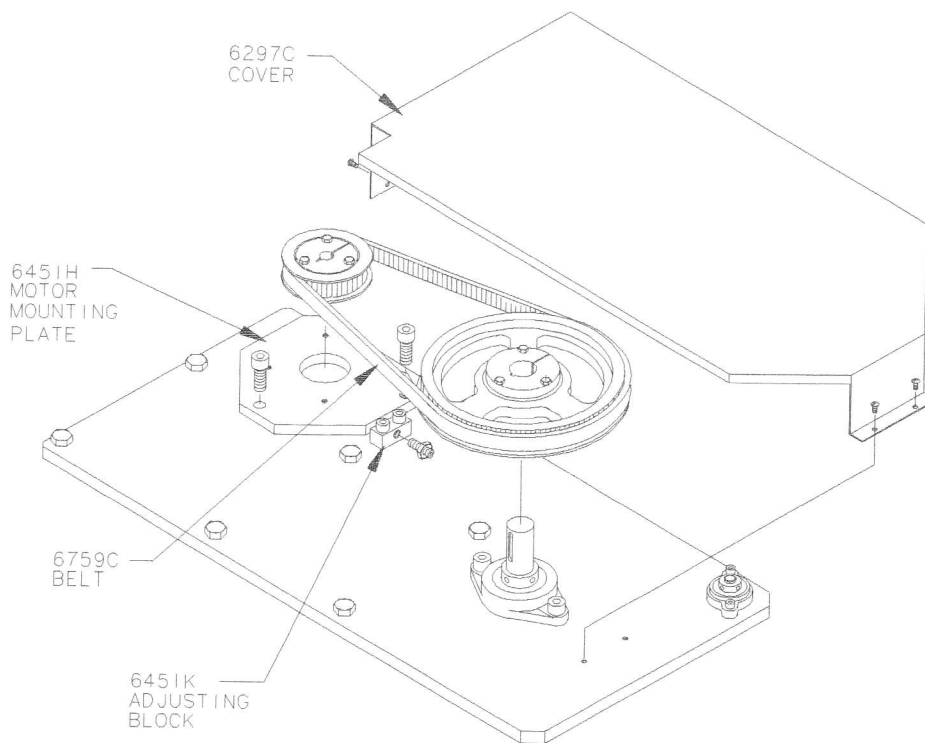
Vertical Servo Drive Belt Replacement / Adjustment:

CAUTION:

Turn off all power to machine before replacing the belt.

See illustrations on page 8.25.

1. The vertical servo drive belt is located at the top of the spindle unit.
2. Remove four screws and remove the cover on top of the top plate.
3. Loosen the two bolts securing the servo motor mounting plate. Slide mounting plate to loosen and remove the belt.
4. Replace with new belt if necessary.
5. Adjust servo motor mounting plate so the belt will deflect 5-16". When a force of 2 to 4 lbs. is applied to a point midway between pulley centers.
6. Fully tighten the servo mounting plate.
7. Replace the cover on the top plate.



F80E Spindle Adjustments:

Outer Spindle Adjustment:

This adjustment should be made every 1000 hours of operation. (Refer to pages 8.28, 8.29 or 8.31, 8.32 for illustrations.)

1. Open the large door on the spindle unit.
2. Located where the outer spindle comes out of the top of the spindle base, is the upper retainer (6224). Use a spanner wrench or a punch to loosen the upper retainer. Lift the retainer up out of the way, and use a small screw driver to carefully lift out the felt oiler (6250). Use a piece of tape to hold the two parts out of the way.
3. Where the outer spindle comes out of the bottom of the spindle base is the lower retainer (6247A). Remove the four allen head screws, and slide the retainer off the end of the spindle.

CAUTION:

This exposes the lower spindle nut. Do Not Remove this nut.

4. Loosen the small allen head set screw that locks the lower spindle nut (6223). The set screw is located in the front of the lower bearing carrier (6225A).
5. To tighten the spindle adjustment, use a spanner wrench or punch and work between the upper and lower spindle adjustment nuts (6223). They should be tightened evenly with approximately the same torque on each nut.

They should be tightened so the vertical spindle load meter reads 40 percent in rapid motion, the acceleration load will be higher.
6. Run the spindle up and down a couple of times to make sure the bushings are seated, and recheck the load readings. Adjust again if required.
7. Reassembly is the reverse. Use a large piece of shim stock to assist the installation of the lower retainer (6247A), and seals.

Inner Spindle Adjustment:

This adjustment should be made every 1000 hours of operation. Refer to pages 8.26, 8.34 and 8.35, for illustrations.

1. Open the large door on the spindle unit.
2. A surfacing cutter head or a boring cutter head with a long tool holder should be installed in the machine.
3. Remove the two screws holding on the small cover (6308) to the front of the upper housing. Inside the exposed opening is the spindle adjustment nut (6091A). The spindle adjustment nut has holes drilled around its perimeter to accept an adjustment rod.
4. Insert an adjustment rod into the spindle adjustment nut.
5. Rotate the cutter head 1/2 turn clockwise (looking from the top), letting the adjustment rod move against the end of the slot. This loosens the inner spindle adjustment.
6. Now carefully rotate the cutter head counter clockwise (looking from the top). The cutter head will be easy to turn and you should be able to feel the spring loaded detent in the adjustment nut.

At some point the torque required to turn the cutter head will sharply increase, immediately stop turning the cutter head.

CAUTION:

Do Not over tighten or severe bearing damage will occur.

7. Now turn the cutter head counter clockwise one or two detents.
8. Remove the adjustment rod and replace the cover.

F80E Upper Housing / Inner Spindle Disassembly:

1. Travel the machine to the right home position.
2. Place a board across the top of the spindle base directly below the drive motor (6033K). Lower the spindle until the motor just touches the board.
9. Remove the 8 screws holding the inner spindle end cap (6180A). Remove the cap by lifting straight up. Refer to page 8.33.

Note: when reassembling the cap must be dialed in concentric to the draw bar.

CAUTION:

Disconnect all power and air to the machine before continuing.

3. Remove the four bolts securing the motor to the upper housing. Remove the screws that attach the conduit (6314E) to the upper housing. Disconnect the oil lines and air lines from the upper housing. (Note: it is not necessary to disconnect the motor leads). Refer to pages 8.12, and 8.13 for illustrations.
 4. Rotate the vertical ball screw (6074M), by hand, to raise the upper housing so its top is about 8 inches below the top plate of the spindle tower. Refer to page 8.13 for illustration.
 5. Place a board, of proper length, between the bottom of the upper housing and the top of the spindle base to prevent the spindle and housing from dropping.
 6. Remove the two bolts that secure the centering gear housing (6168H) to the upper gear housing. Work the centering gear housing up off of the centering shaft. Rotate the housing clear. Refer to page 8.26.
 7. Remove the four bolts that attach the draw bar actuator bracket (6174) to the upper housing. Loosen the set screw securing the pin at the bottom of the actuator cylinder (6204A). Remove the pin, the cylinder, and the pivot assembly. Refer to pages 8.22 or 8.23.
 8. Remove the counterweight cable (6453D or 6453E) from the upper housing by loosening the lock nut and unscrewing the cable end. Refer to page 8.13.
 10. Remove the three screws holding the ball screw nut to the upper housing. Holding the ball screw with one hand turn the nut with the other to raise the nut clear of the upper housing. Refer to page 8.12.
 11. Loosen the two screws holding the encoder bracket (6480B) to the upper housing. Remove the belt (6435H), and the bracket. Loosen the set screw holding the small encoder pulley (6453F) and remove the pulley. Refer to page 8.22 or 8.23.
 12. Remove the 10 bolts securing the cover (6112J) to the top of the upper housing. The cover is pinned to the upper housing. Use a soft face mallet to carefully remove the cover. Refer to pages 8.34 and 8.35.
 13. Remove and replace gears / bearings as required, being careful to install bearings and bevel washers in the proper thrust direction. Refer to page 8.34 and 8.35.
-
- For continued disassembly and removal of the inner spindle continue below.
-
14. The driven gear (6089) and inner spindle adjusting nut (6091A) must be in place before continuing. Remove the left hand thread ring nut (6305D). (**Note:** if the upper adjusting nut and driven gear are not in place the inner spindle will be free to fall).
 15. While supporting the inner spindle from the bottom end remove the inner spindle adjustment nut from the top. Remove the driven gear.
 16. The inner spindle should be free to remove. (**Note:** when replacing bearing (6116E) make sure they are properly installed for thrust support. Refer to pages 8.28, 8.29 & 8.31, 8.32.
 17. Assembly is the reverse.

Inner Spindle Roller Bearing Replacement:

See illustrations on pages 8.28 and 8.31.

1. Disassemble and remove inner spindle as described in F80E upper housing / inner spindle disassembly.
2. Loosen bearing nut (6116B) on the lower part of the inner spindle. Remove the nut and the two bellville spring washers (6513A) located directly below.
3. Remove upper bearing (6116A), bearing spacer (6172A), and lower bearing (6117).
4. Install new lower bearing (6117) (note proper thrust direction on illustrations, pages 8.28 and 8.31). Install bearing spacer (6172A). Install new upper bearing (6116A). (note proper thrust direction on illustrations, pages 8.28 and 8.31).
5. Install the two belleville spring washers (6113A). Make sure they are installed as shown.
6. Thread on bearing nut (6116B). Tighten nut until belleville springs are flattened then loosen the nut 1/4 turn.
7. Use a dial indicator and a soft faced hammer to make the bearing spacer run concentric to the inner spindle within .0005.
8. Assembly is the reverse.



Cutterheads:

CAUTION:

Turn off machine before changing cutterhead.

Remove the centering fingers before changing cutterheads.

Turn the cutterhead release knob and the draw bar will drop the cutterhead down about 1/2". Turn the cutterhead 90 degrees. Let it down carefully.

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 key way 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).

1-1/2" Blind Hole Stub Bar

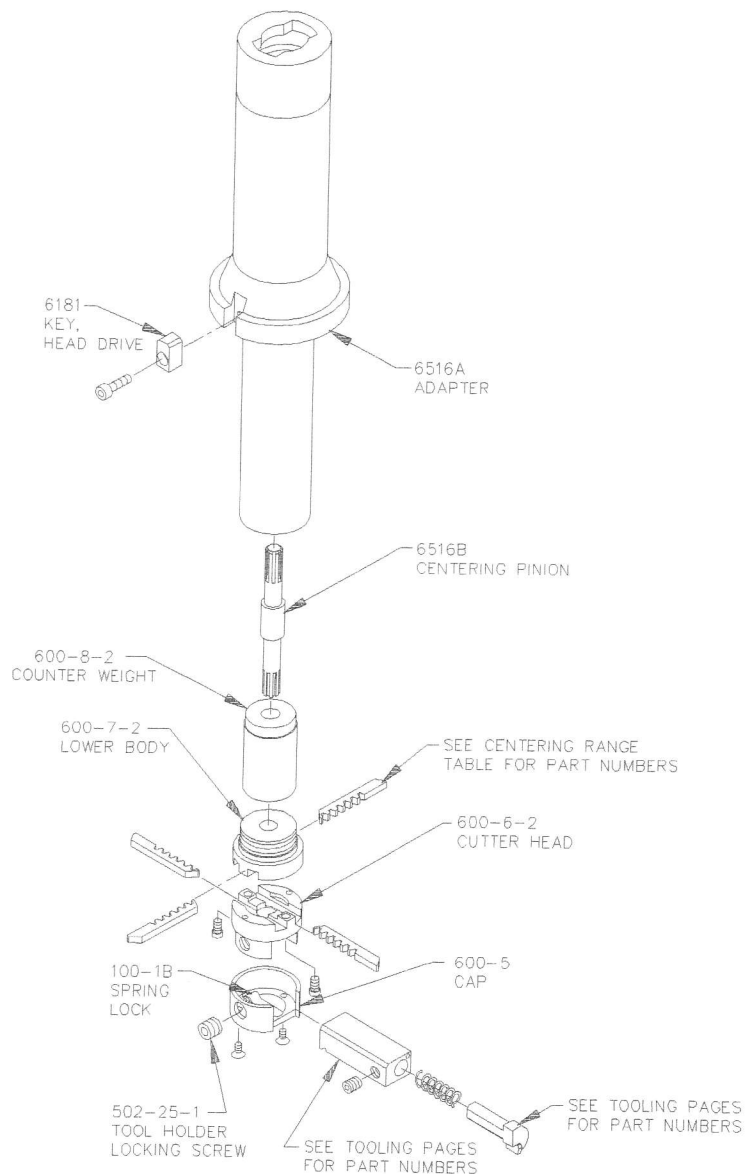
6516 With Tooling
6516C Without Tooling

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.

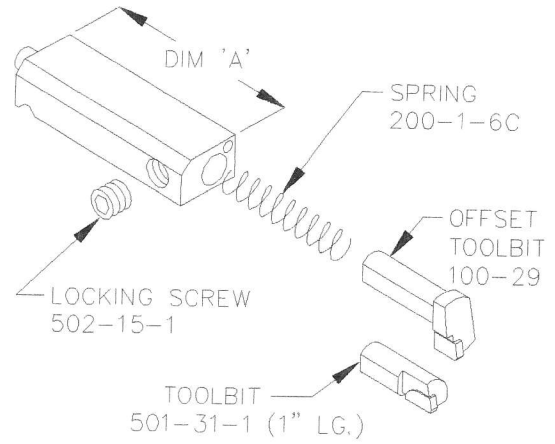
An offset tool bit is also provided in order to bore to the extreme bottom of blind holes.

See page 7.1 for dampener weight cleaning procedure.

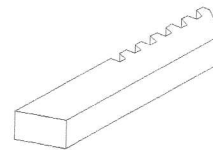


Blind Hole Stub Bar Tooling

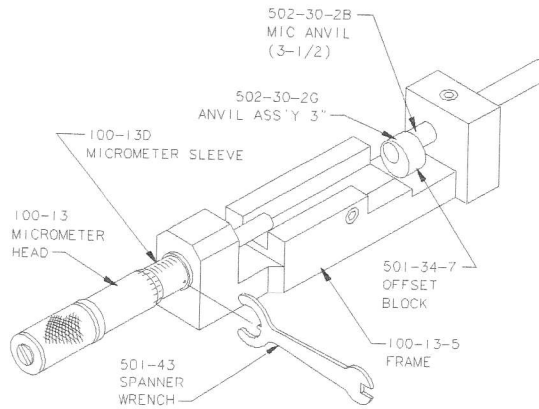
Tool Holder Dim 'A'	Toolbit	Bore Range
199-96 / 1.25"	100-29	2.32 - 2.69
	501-31-1	1.56 - 2.19
199-89 / 1.50"	100-29	2.32 - 3.19
	501-31-1	1.94 - 2.69
199-90 / 1.75"	100-29	2.81 - 3.69
	501-31-1	2.44 - 3.88
199-94 / 2.25"	100-29	3.82 - 4.69
	501-31-1	3.44 - 3.69



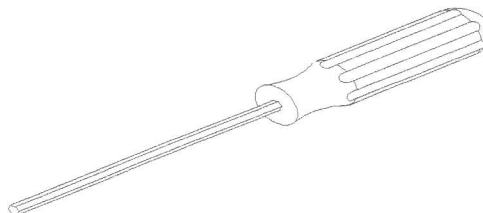
Centering Fingers	Length	Centering Diameter
200-26-1	1.38"	1.50 - 2.62
200-26-2	2.13	2.62 - 4.13



Micrometer Assembly
900-2-11
1.5 - 4.1



5/32 Hex Driver
501-72A



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

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 recentering) to provide a very precise bore.

2-7/8" Production Stub Bar

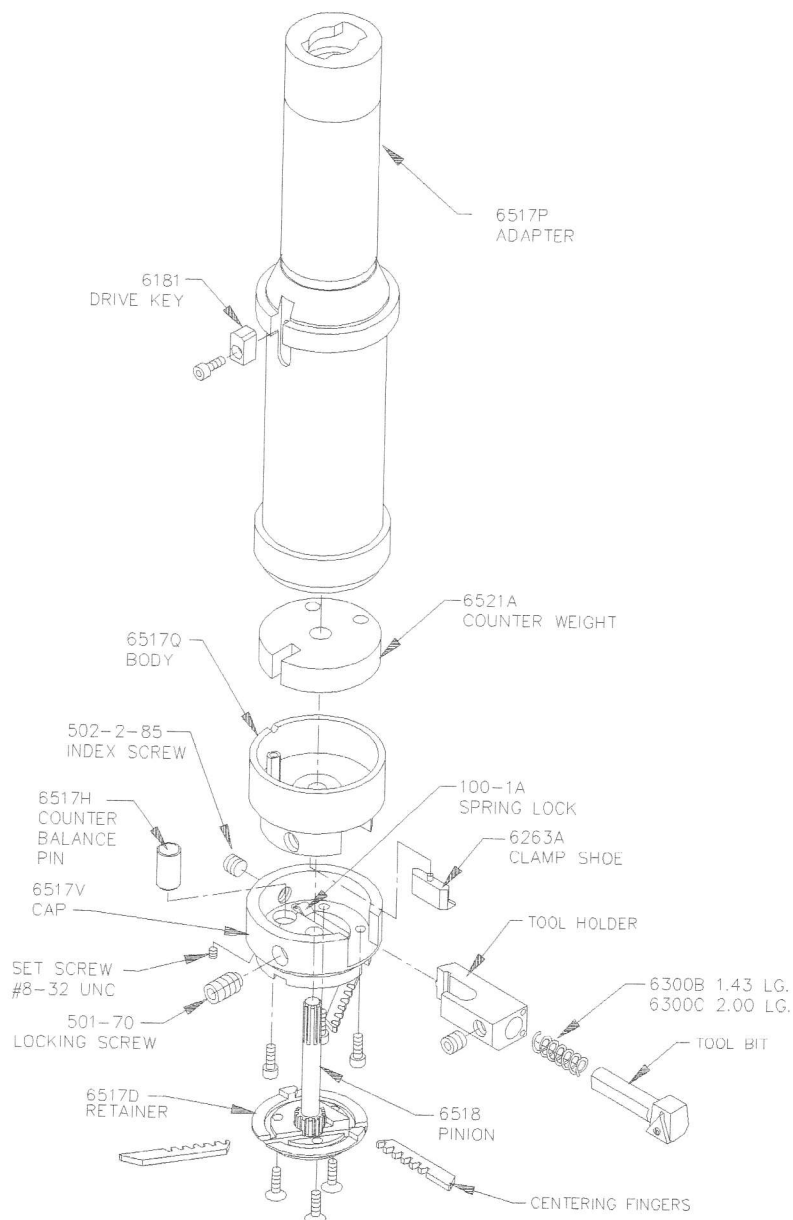
6517T With Tooling
6517S Without Tooling

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.



2-7/8" Long Production Stub Bar

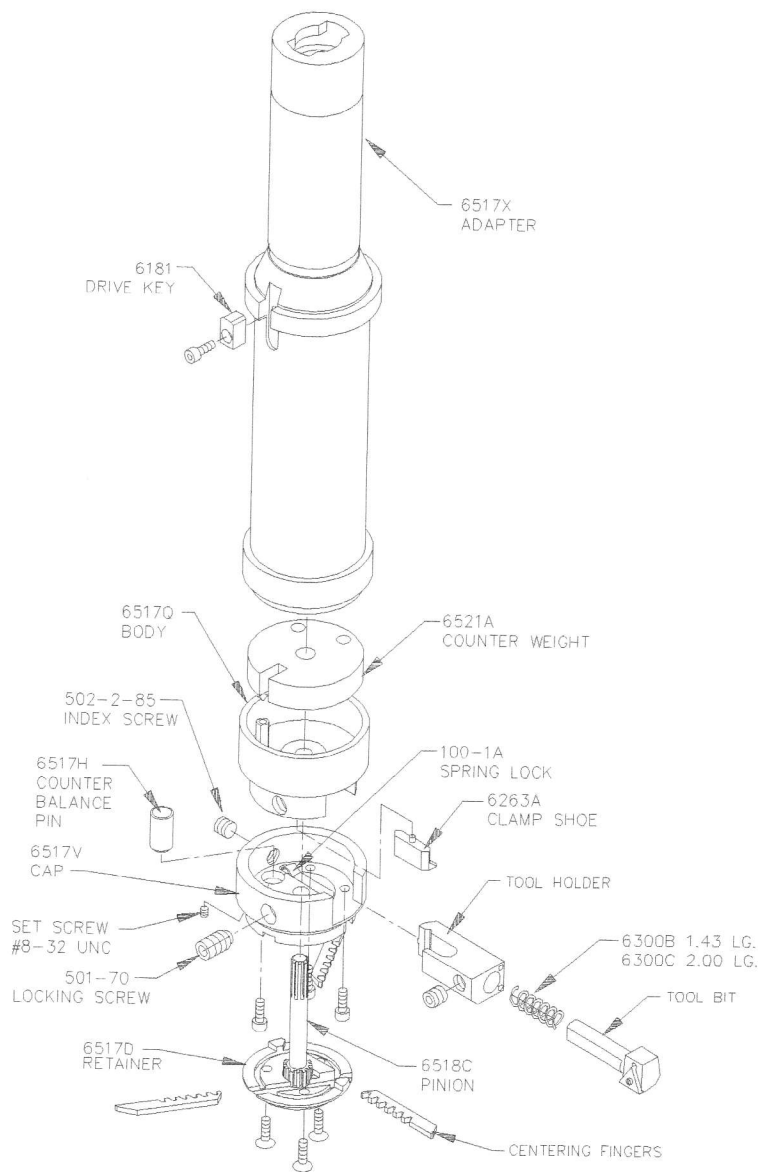
6517N With Tooling
6517M Without Tooling

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:

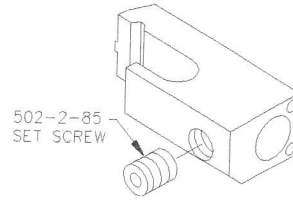
Be sure that this head does not interfere with lower extremities of the block, such as bosses and hubs.

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



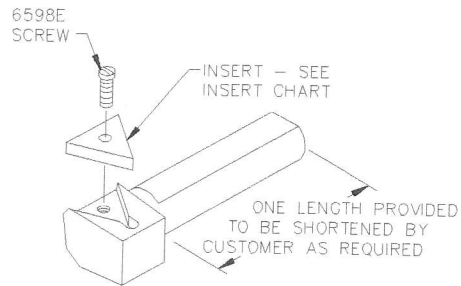
Production Stub Bar Tooling

**6520 Series
Tool Holder**



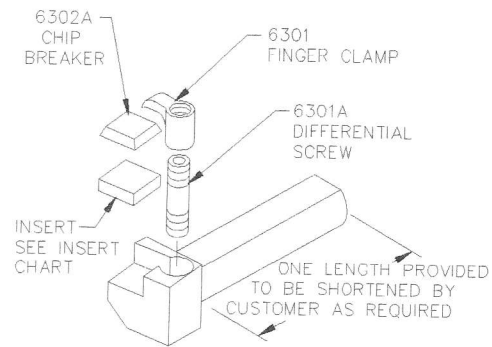
6598C Cartridge - Counter boring
Triangle Insert - Positive Rake.

Tool Holder Part #	Length	Bore Range
6520H	2.25	3.75 - 4.00
6520A	2.37	4.00 - 4.50
6520B	2.62	4.50 - 5.00
6520C	2.87	5.00 - 5.50



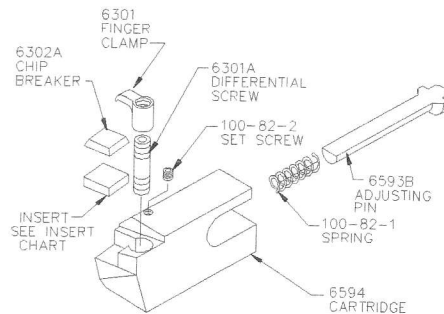
6260L Cartridge - Thru boring
Square Insert - Negative Rake.

Tool Holder Part #	Length	Bore Range
6520H	2.25	3.37 - 3.62
6520A	2.37	3.62 - 4.00
6520B	2.62	4.00 - 4.50
6520C	2.87	4.50 - 5.00



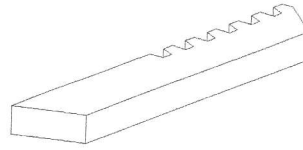
Cartridge / Tool Holder

Cartridge / Toolholder	Length	Bore Range
6594	2.00	2.90 - 3.40

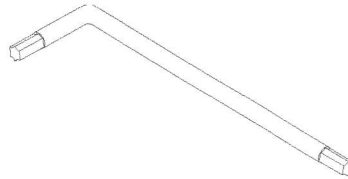


Centering Fingers

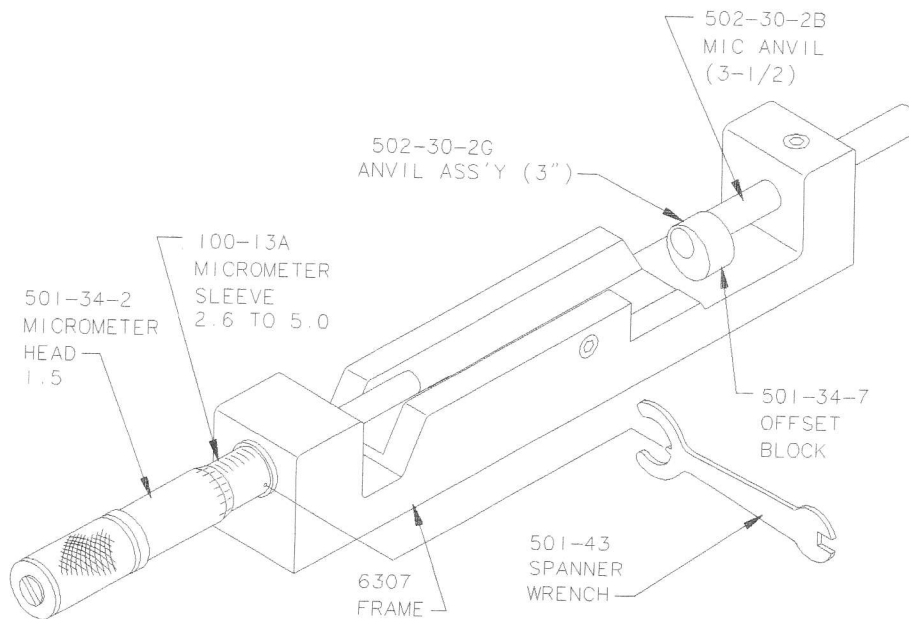
Centering Fingers	Length	Centering Diameter
6517E	2.26	2.90 - 3.40
6517F	3.06	4.20 - 5.00



6598F Torx Wrench
for use with Torx style
screw in Triangle cartridges.



6307G Micrometer Assembly
2.6 to 5.0 Diameter



2-7/8" Blind Hole Stub Bar

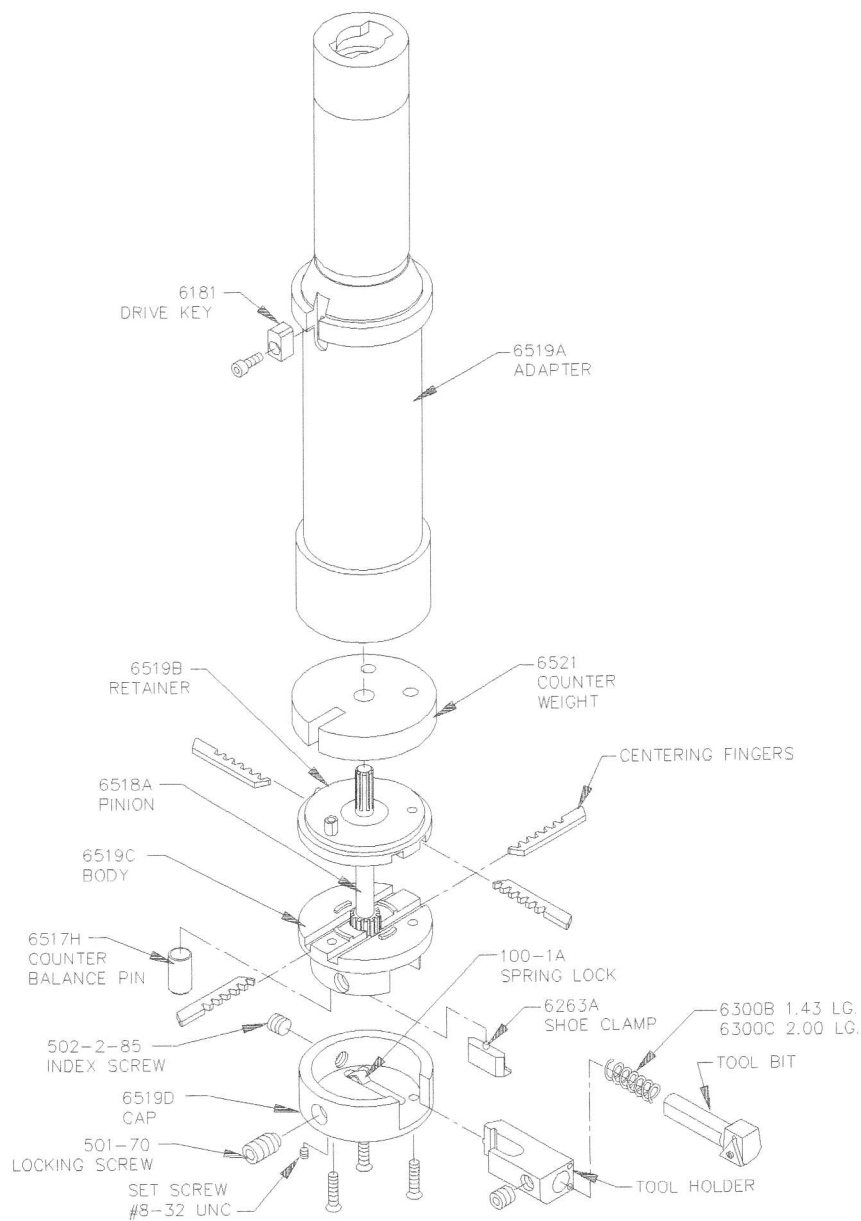
6519 With Tooling

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 (210mm). 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

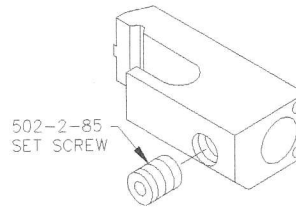
offset tool bit, it can be completely below the cutterhead.

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.



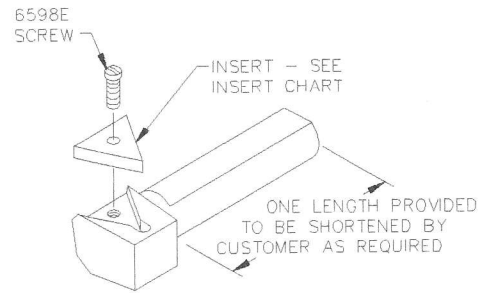
Blind Hole Stub Bar Tooling

6520 Series
Tool Holder



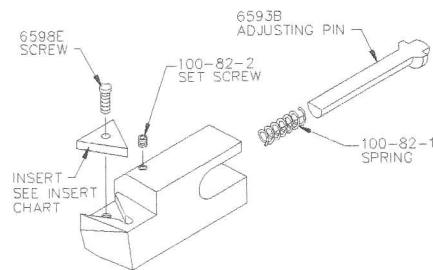
6598C Cartridge - Counter boring
Triangle Insert - Positive Rake.

Tool Holder Part #	Length	Bore Range
6520H	2.25	3.75 - 4.00
6520A	2.37	4.00 - 4.50
6520B	2.62	4.50 - 5.00
6520C	2.87	5.00 - 5.50
6520D	3.13	5.50 - 6.00
6520E	3.37	6.00 - 6.50
6520F	3.62	6.50 - 7.50
6520G	4.13	7.50 - 8.50

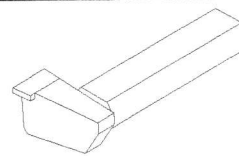


Cartridge / Tool Holder

Cartridge Toolholder	Length	Bore Range
6593C	2.03	2.90 - 3.40
6593D	2.25	3.40 - 3.90

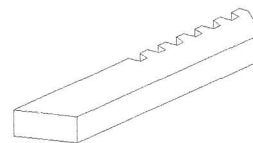


6513D Offset
Tool Bit

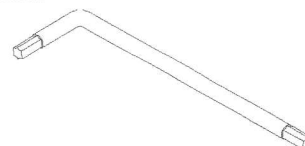


Centering Fingers

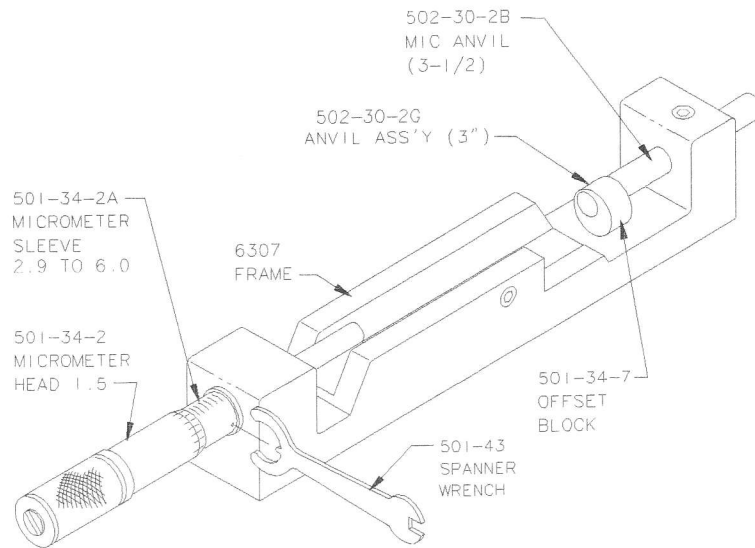
Centering Fingers	Length	Centering Diameter
200-21-3	2.31	2.90 - 4.50
200-21-1	3.06	3.12 - 6.00
200-21-2	4.13	6.00 - 8.00



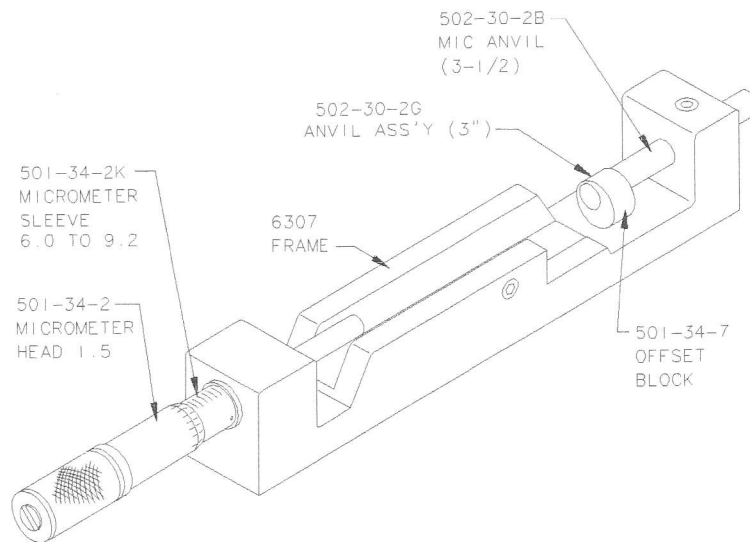
6598F Torx Wrench
for use with Torx style
screw in triangle cartridges.



6307F Micrometer Assembly
2.9 - 6.0 Diameter



6307B Micrometer Assembly
6.0 - 9.0 Diameter



4-1/2" Production Cutterhead

6256A With Tooling
6256B Without Tooling

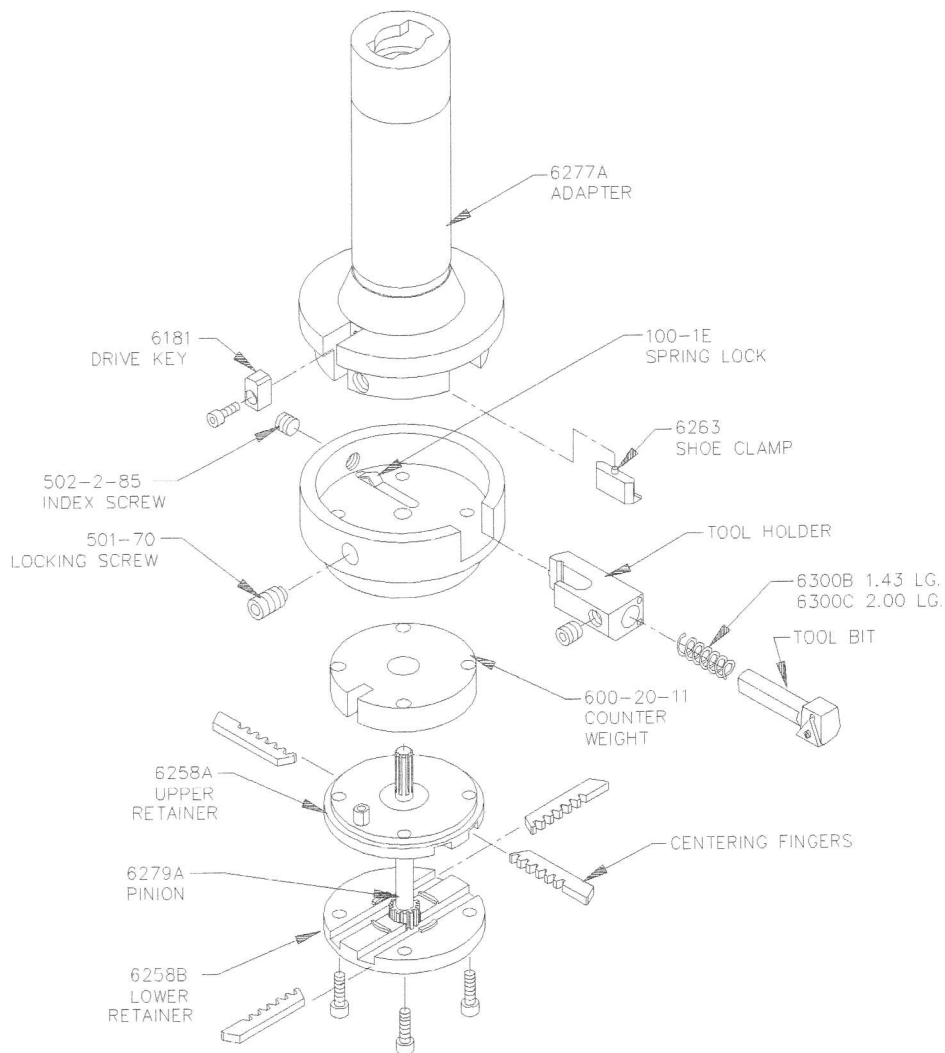
The Production Cutterhead has a standard bore capacity of 4.50" to 9.0".

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:

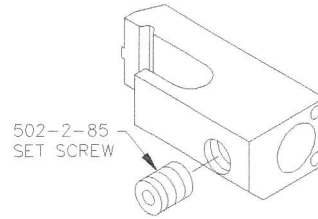
Be sure that this head does not interfere with lower extremities of the block, such as bosses and hubs.

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



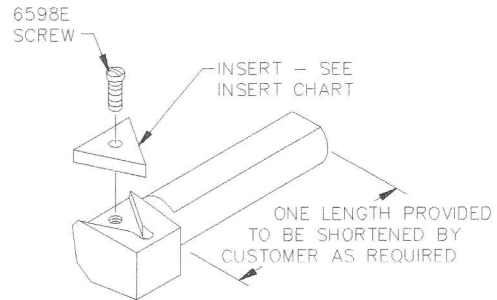
4-1/2" Production Cutterhead Tooling

6259 Series
Tool Holder



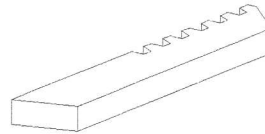
6598C Cartridge - Counter boring
Triangle Insert - Positive Rake

Tool Holder Part #	Length	Bore Range
6259P	3.13	3.90 - 4.40
6259C	3.37	4.40 - 4.90
6259D	3.62	4.90 - 5.40
6259I	3.87	5.40 - 5.90
6259E	4.13	5.90 - 6.90
6259F	4.62	6.90 - 7.90
6259G	5.13	7.90 - 8.90



Centering Fingers

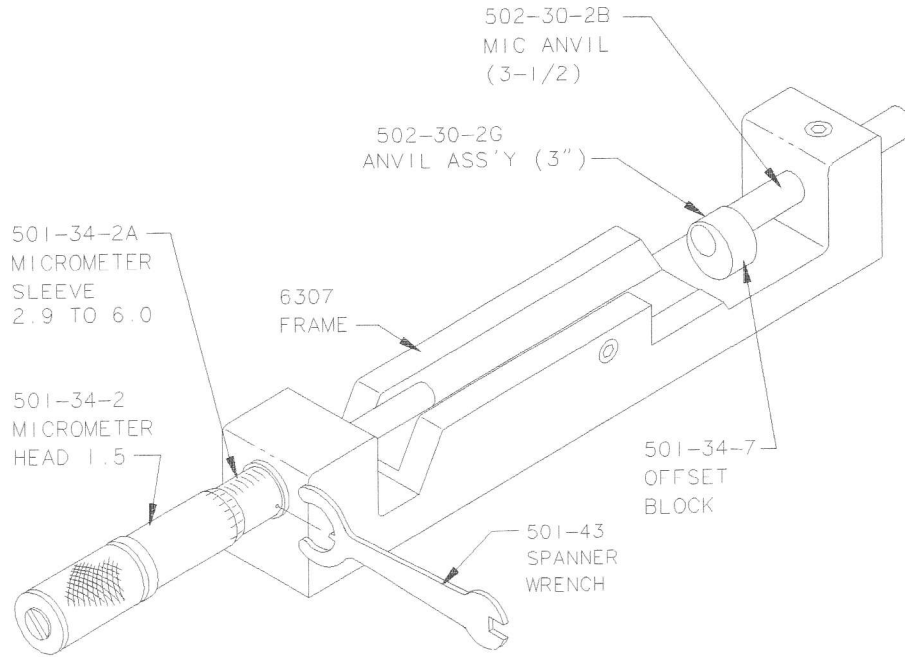
Centering Fingers	Length	Centering Diameter
600-20-6A	3.06	3.25 - 6.00
600-20-6B	4.62	4.75 - 9.00



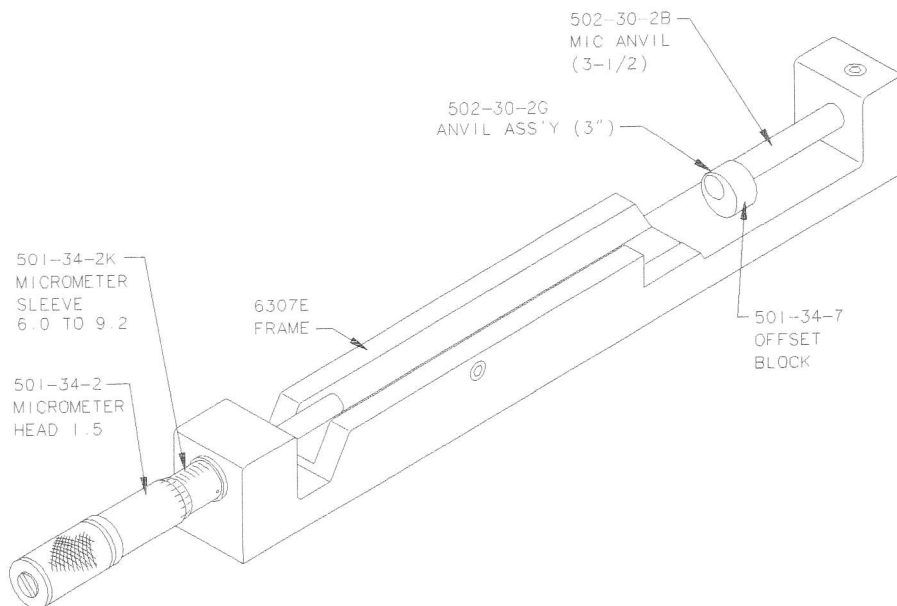
6598F Torx Wrench
for use with Trox style
screw in triangle cartridges



6307F Micrometer Assembly
2.9 - 6.0 Diameter



6307K Micrometer Assembly
6.0 - 9.0 Diameter



7-3/4" Blind Hole Cutterhead

6454A With Tooling

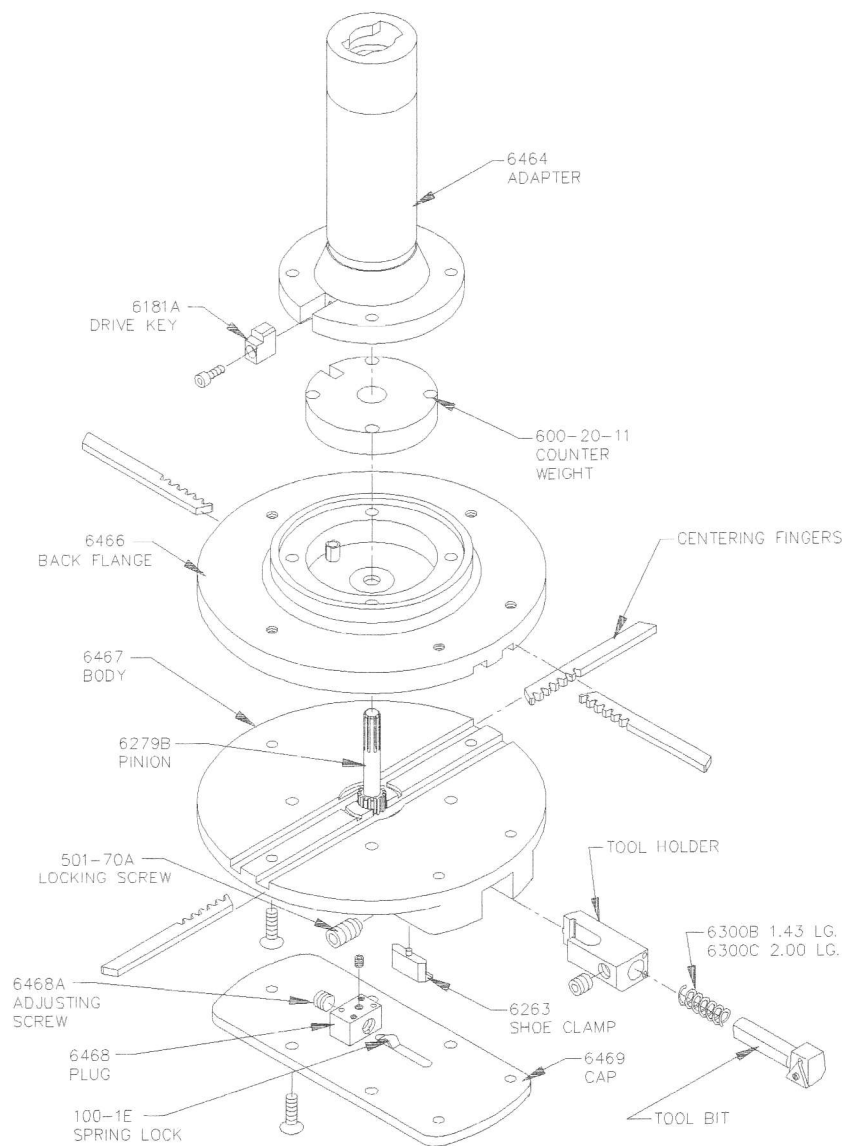
6454B Without Tooling

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

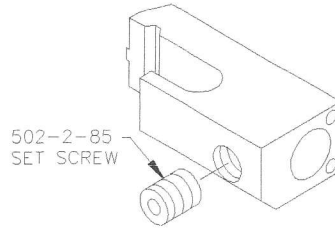
very near the bottom of a blind hole or one that has an obstruction near the bottom. The tool holder must be removed to center each bore.

An offset tool bit is provided so that extreme blind holes may be bored.



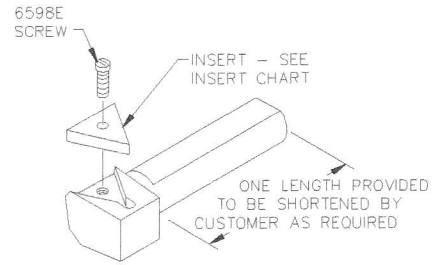
**7-3/4" Blind Hole Cutterhead
Tooling**

**6259 Series
Tool Holder**



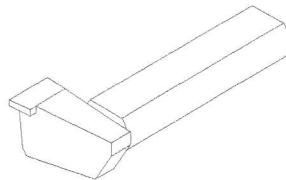
**6598C Cartridge - Counter boring
Triangle Insert - Positive Rake**

Tool Holder Part#	Length	Bore Range
6259C	3.37	7.87 - 8.37
6259D	3.62	8.37 - 8.87
6259I	3.87	8.87 - 9.37
6259E	4.13	9.37 - 10.37
6259F	4.62	10.37 - 11.37
6259G	5.13	11.37 - 12.37
6259H	5.62	12.37 - 13.37
6259J	6.13	13.37 - 14.37



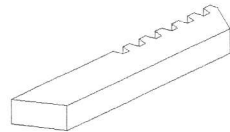
6513D Offset Tool bit

Tool Holder Part#	Length	Bore Range
6259C	3.37	7.50 - 7.87
6259D	3.62	7.87 - 8.43
6259I	3.87	8.43 - 8.62
6259E	4.13	8.62 - 9.62
6259F	4.62	9.62 - 10.62
6259G	5.13	10.62 - 11.62
6259H	5.62	11.62 - 12.62
6259J	6.13	12.62 - 13.62

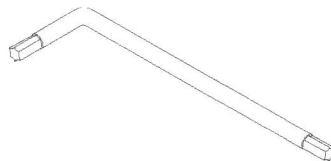


Centering Fingers

Centering Fingers	Length	Centering Diameter
600-20-6D	7.50	7.75 - 14.75
600-20-6E	11.50	11.63 - 16.00

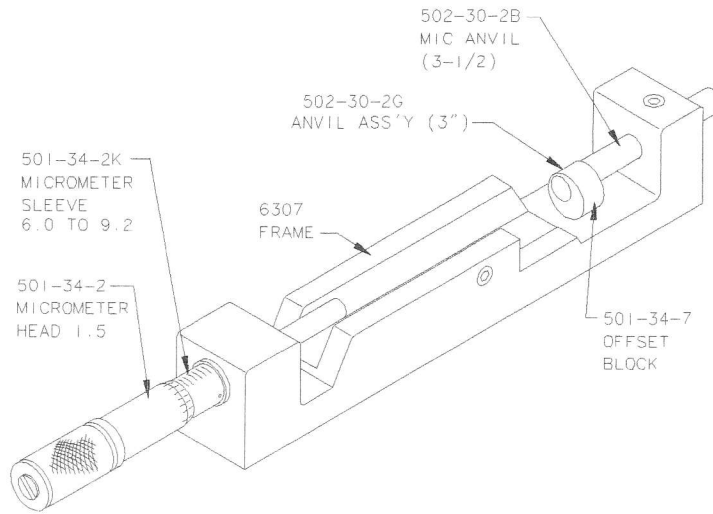


6598F Torx Wrench
for use with Torx style
screw in triangle cartridges



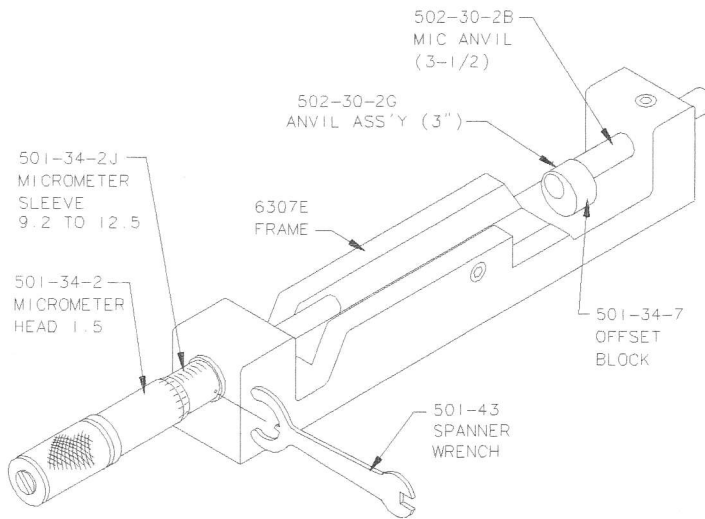
6307B Micrometer Assembly

6.0 - 9.0 Diameter

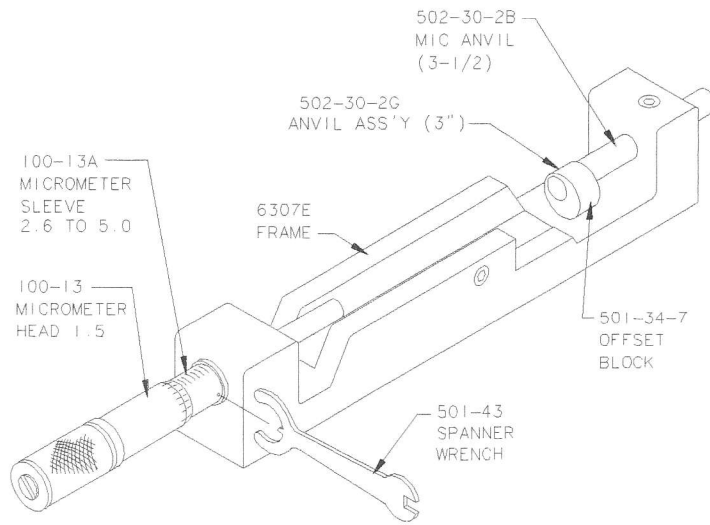


6307C Micrometer Assembly

9.0 - 12.50



6307D Micrometer Assembly
12.50 - 15.0 Diameter

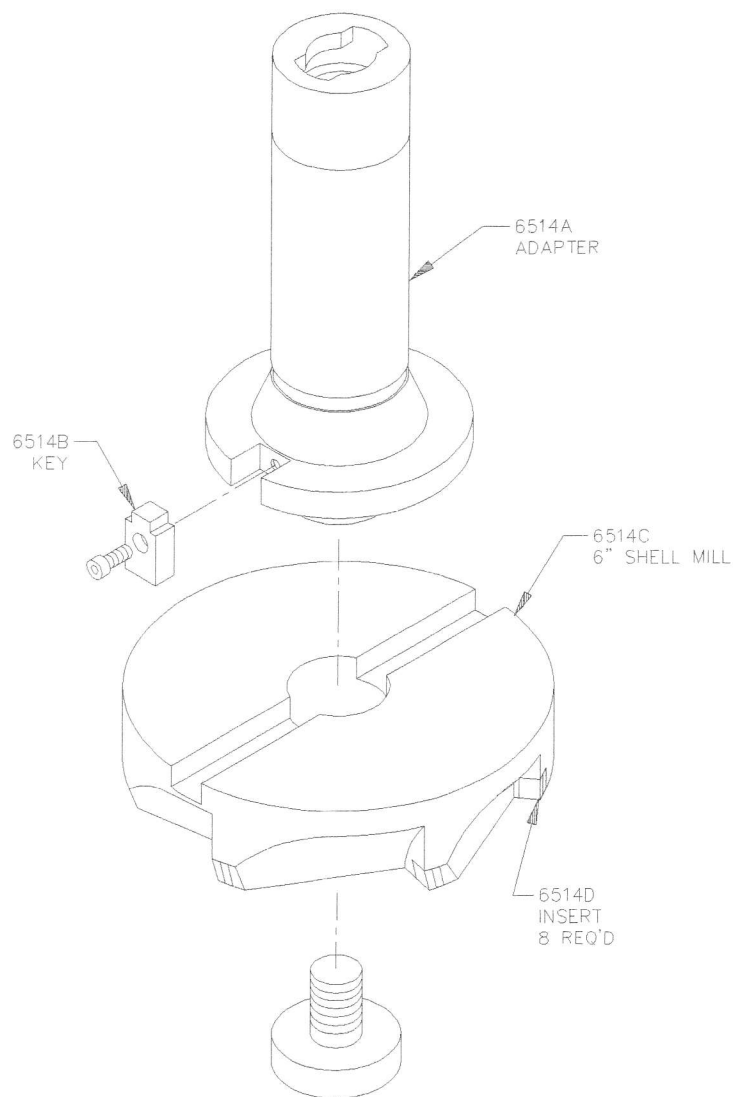


6" Diameter Shell Mill

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.

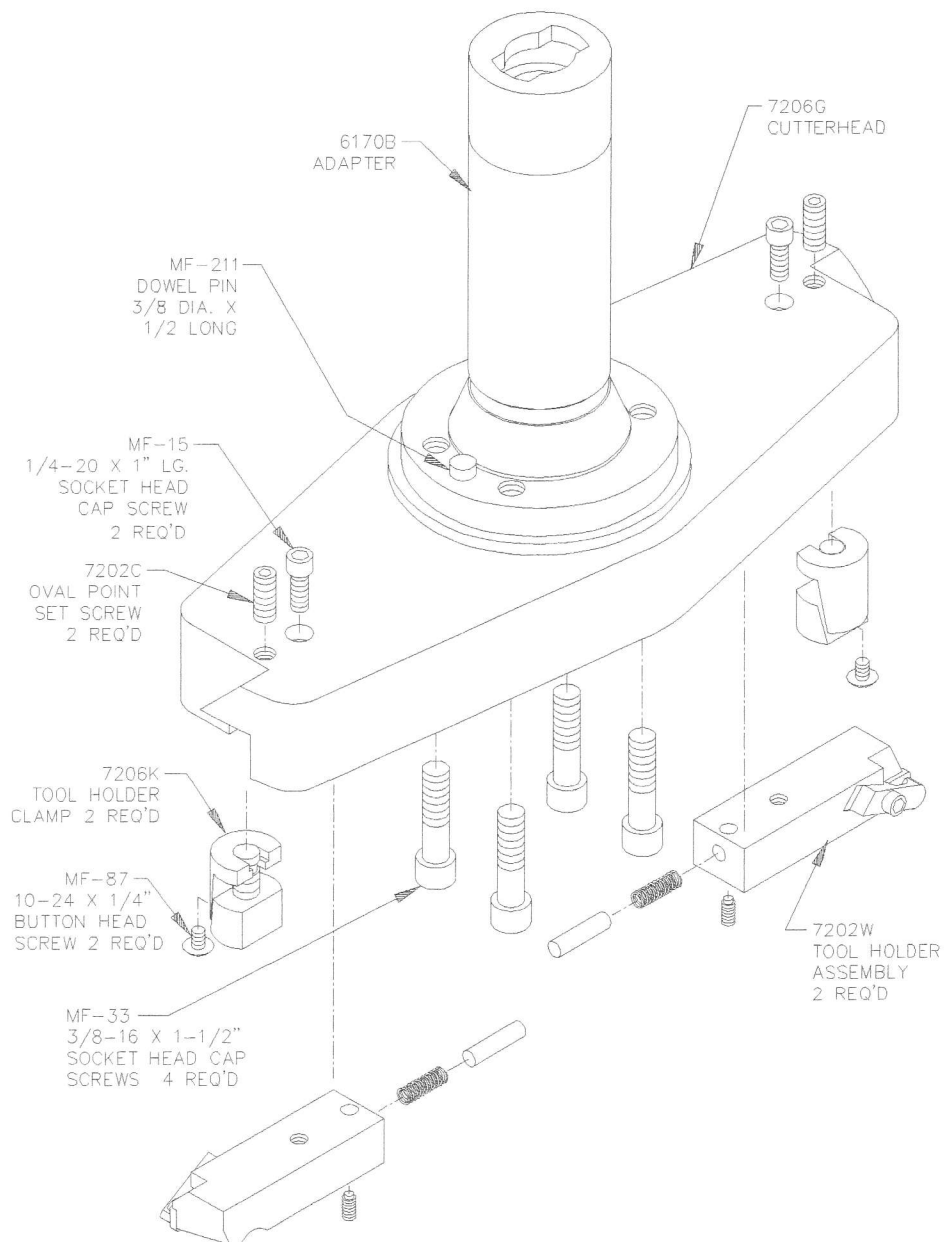
There are many other jobs that this versatile cutterhead could be used for. Use this cutterhead for any cut that is too narrow for the regular surfacing cutterheads.



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.

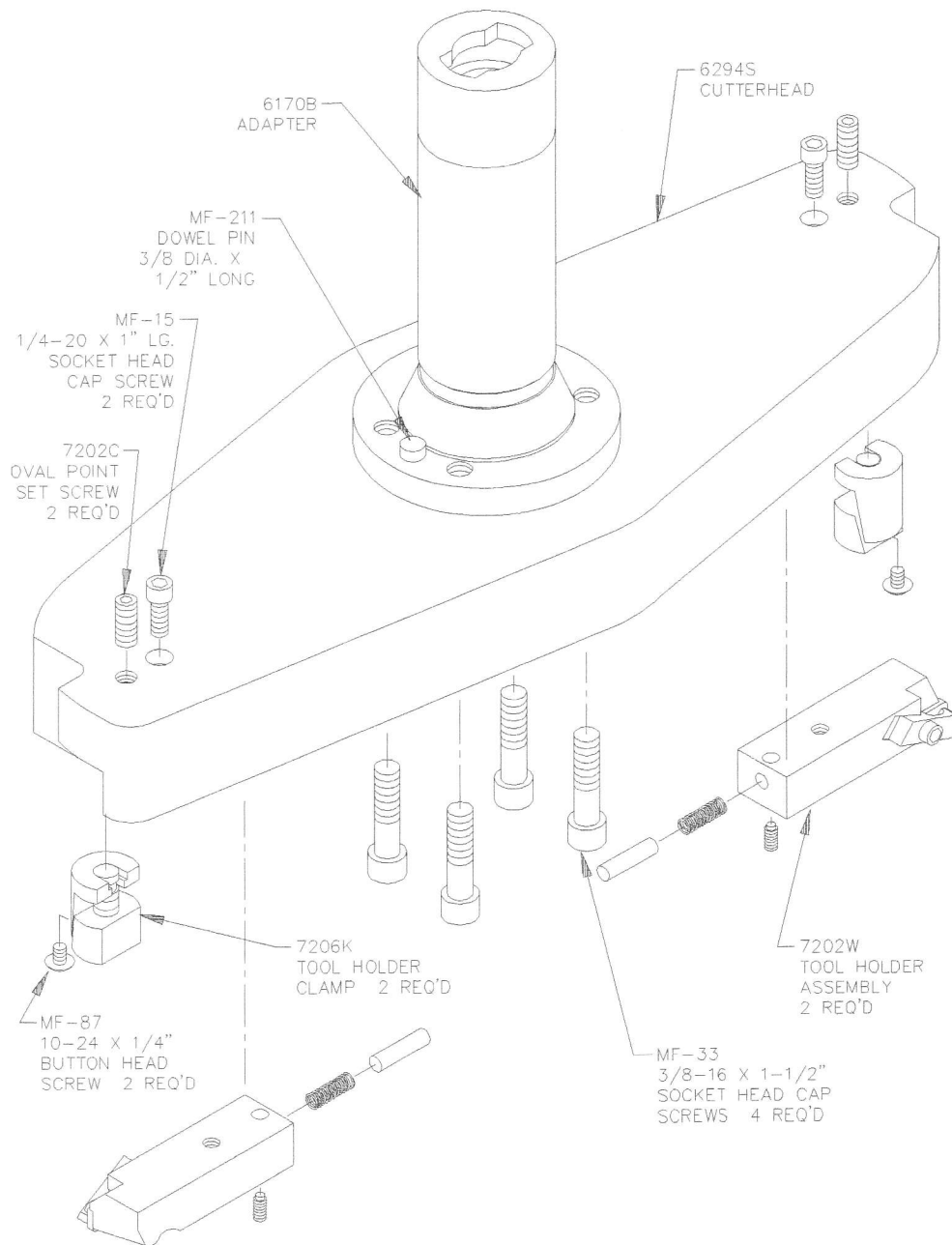
The surfacing cutterheads install the same way as the boring cutterheads do.



18" Surfacing Cutterhead 6294T With Tooling

The 18" Surfacing Cutterhead is used to machine the mating surfaces of most cylinder blocks and cylinder heads.

The surfacing cutterheads install the same way as the boring cutterheads do.



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.

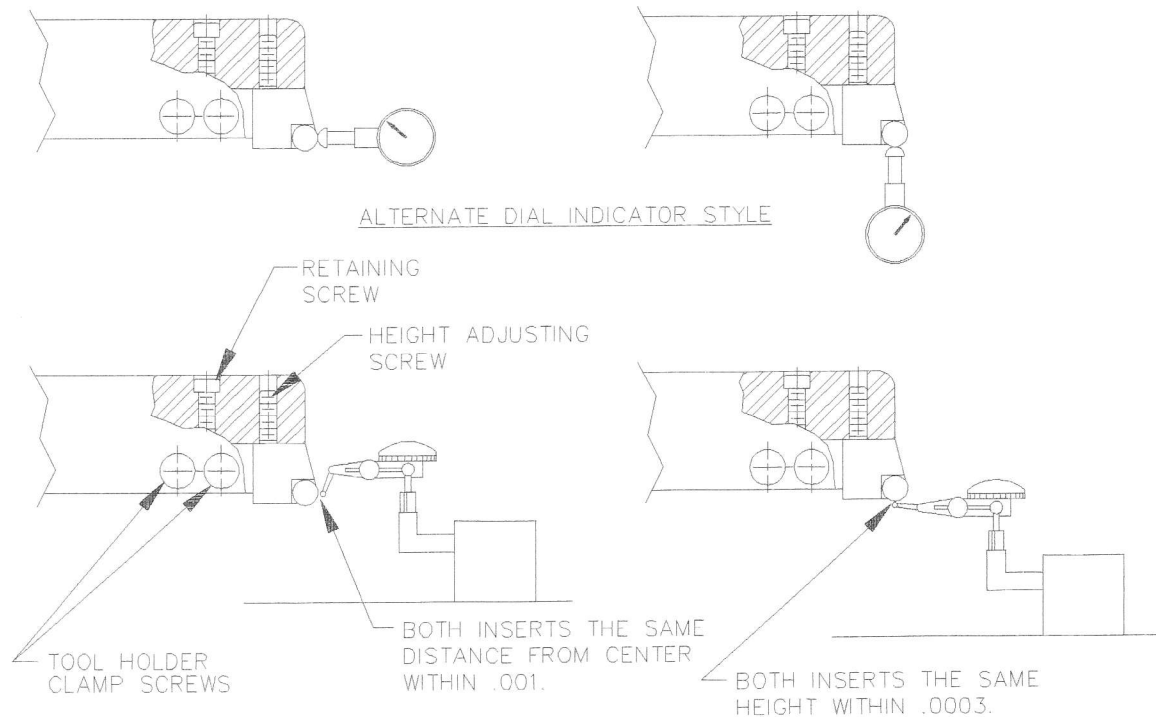
Retighten all screws and recheck both inserts.

Setting the Insert Height:

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

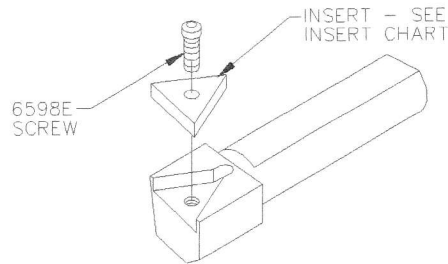
If adjustment is necessary loosen the two tool holder clamp screws then alternately loosen and tighten the up and down adjusting screws.

Retighten all screws and recheck both inserts.



Chamfering Cartridges

- 6747 Cartridge, Chamfer 20 degrees
Triangular Insert, Positive Rake
- 6747A Cartridge, Chamfer 15 degrees
Triangular Insert, Positive Rake
- 6747B Cartridge, Chamfer 30 degrees
Triangular Insert, Positive Rake

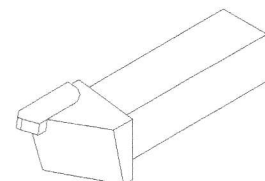


Optional Tools

Insert Chart

The inserts below must be used with the correct cartridge. For example: A square negative rake insert must be used in a square negative rake cartridge.

Part #	Description
<u>Surfacing Cutterheads 6294A or 6294C</u>	
6301L	Insert, square, negative rake, 200-400 sfm 1/16 radius, coated carbide.
6301J	Insert, square, negative rake, 1,600 - 4,000 sfm 1/16 radius, Cubic Boron Nitride C.B.N.
<u>6" Diameter Shell Mill</u>	
6301M	Carboly coated carbide SNMP 432E 16
<u>Thru Boring</u>	
6301E	Insert, square, negative rake, 1,600 - 2,000 sfm 1/32 radius, Cubic Boron Nitride
6301S	Insert, square, negative rake, 1,600 - 2,000 sfm 1/32 radius, Cubic Boron Nitride with a 'B' land.
6302A	Chip breaker - required for thru boring inserts.
<u>Counterbore / Chamfer</u>	
6301F	Insert, triangular, positive rake 1/64 radius, carbide
6301Q	Insert, triangular, positive rake 1/32 radius, carbide
6260C	R8, 1-3/16 long x 1/2 dia. shank, cast iron boring
6260D	R8, 1-7/16 long x 1/2 dia. shank, cast iron boring
6260U	R1, 1-3/16 long x 1/2 dia. shank steel and hard cast iron boring.
6260V	R1, 1-7/16 long x 1/2 dia. shank steel and hard cast iron boring.

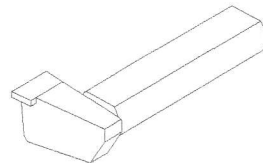
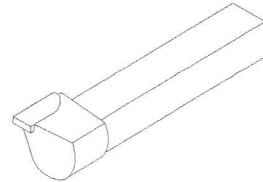
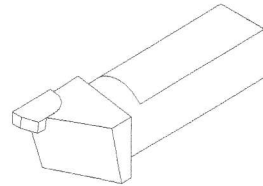


6260P RF, 1-3/16 long x 1/2 dia. shank,
5/16 wide facing

6260R RF, 1-7/8 long x 1/2 dia. shank,
5/16 wide facing

6513E* RFO, 1-7/8 long x 1/2 dia. shank,
5/16 wide facing, 5/16 offset.

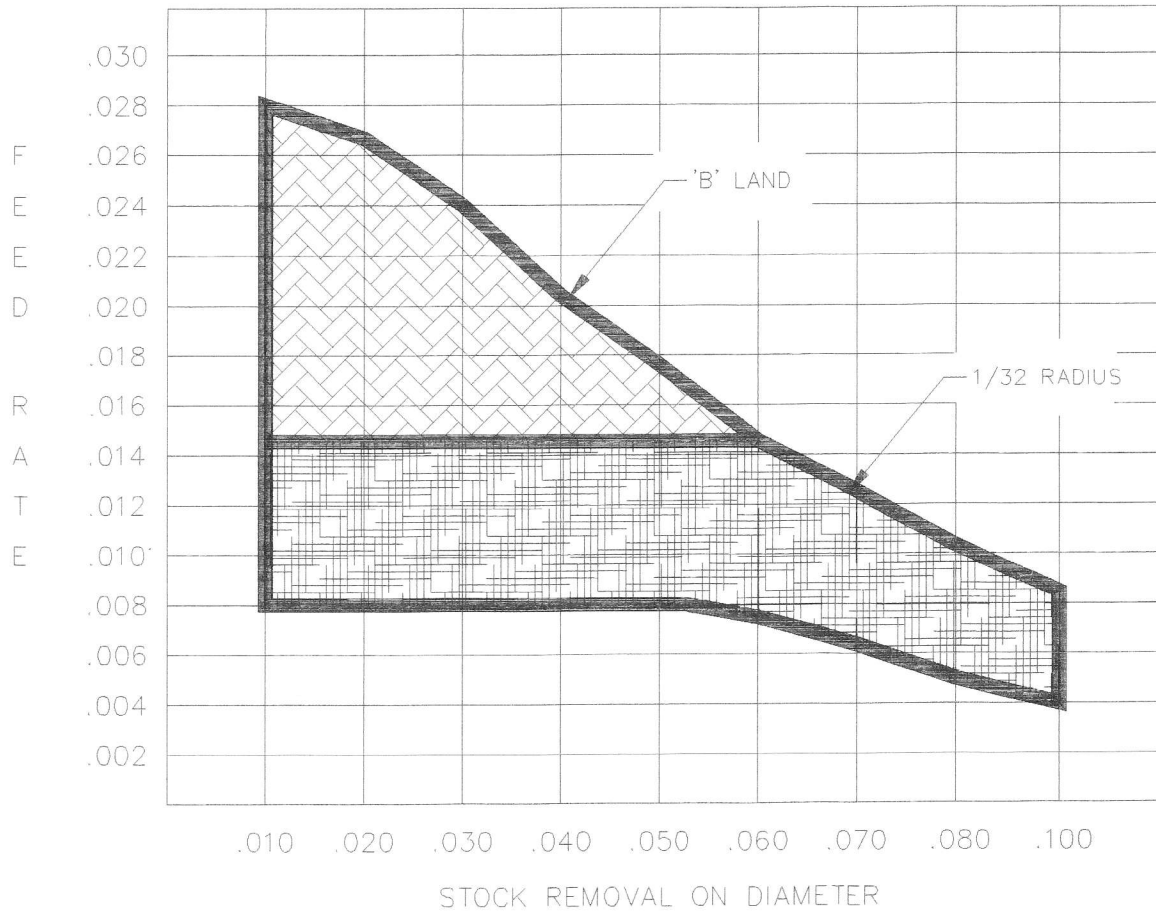
6513D RFO, 1-7/8 long x 1/2 dia. shank,
3/8 wide facing, 5/8 offset.



* Offset dimension is measured from center of tool bit shank to cutting edge of toolbit.

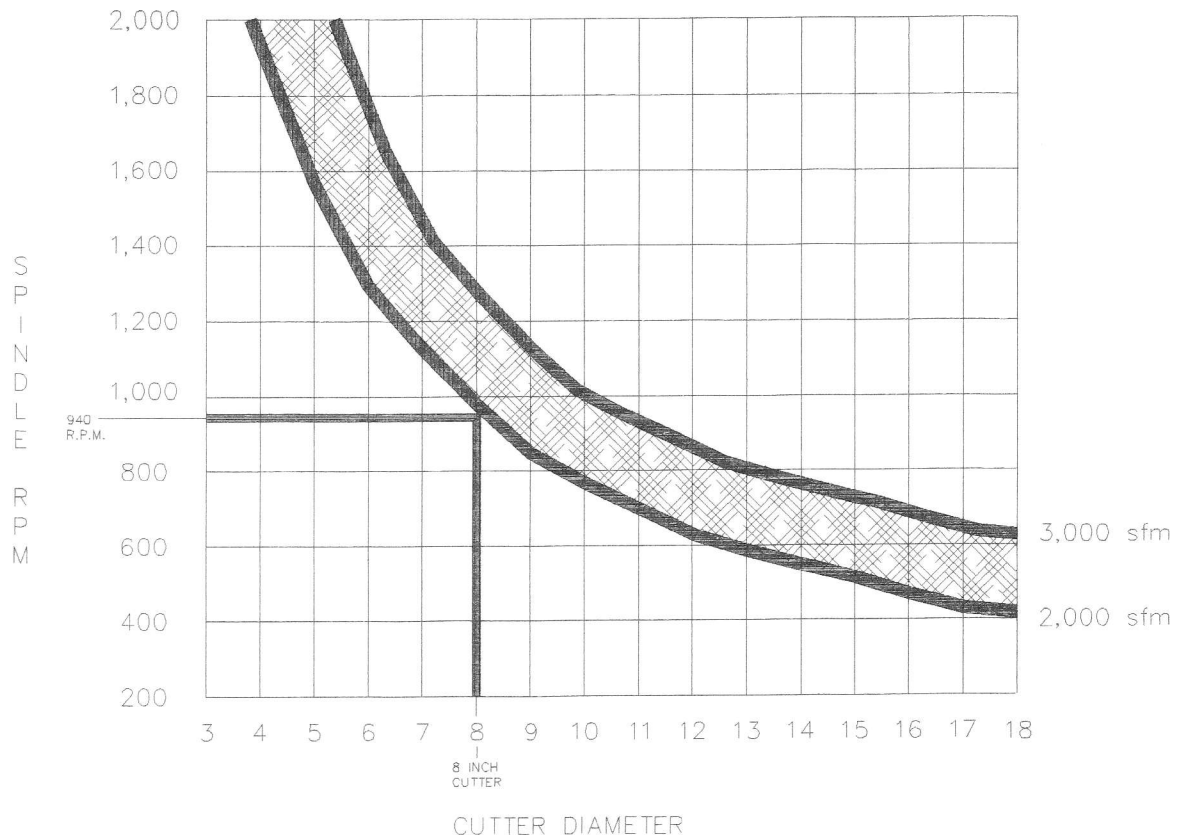
Feed Rate Graph

Feed Rate Graph for C.B.N Inserts
with 1/32 radius or 'B' land



Spindle R.P.M. Graph

Table for determining Spindle R.P.M. for C.B.N. cutting tools. Measure your cutter diameter and find the diameter in the chart. Look from the cutter diameter up to where it intersects the curve. Look from the intersection across to the spindle R.P.M. (see example for 8" cutter). The graph has two curves one for 2,000 sfm and the other for 3,000 sfm. The 2,000 sfm curve will give the best tool life.



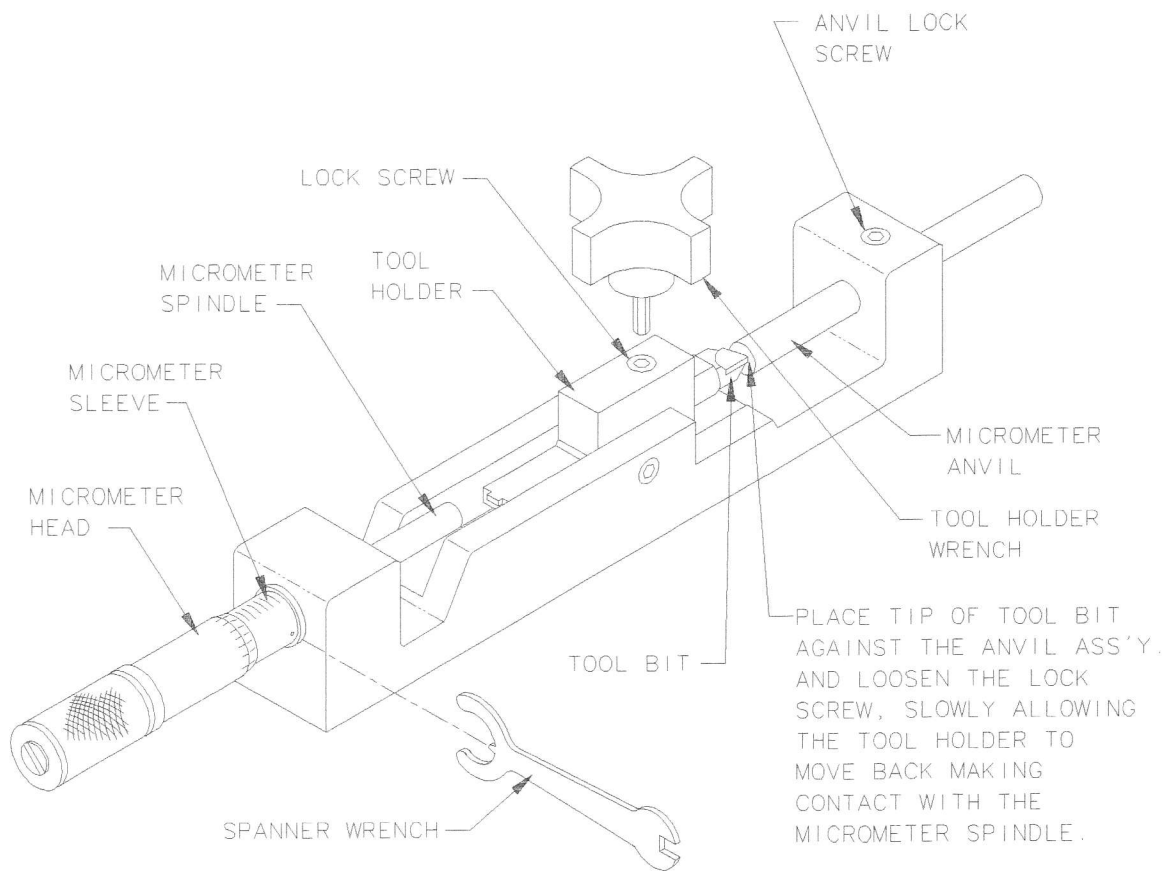
Using the Boring Micrometer:

Your boring micrometer, as with any other measuring tool, should be handled delicately and with care to be assured of the greatest accuracy. Particular attention should be paid to inserting the tool in the micrometer without allowing the tool bit to snap into micrometer anvil.

Care should be used in the method of lightly locking the tool bit before tightening.

After a period of use you will note that the tool bit will force a depression in the micrometer anvil. This, of course, will result in inconsistent sizes, particularly after sharpening the bit.

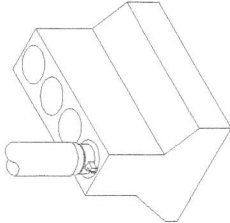
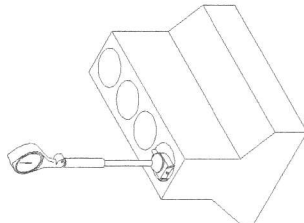
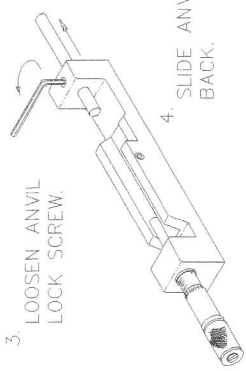
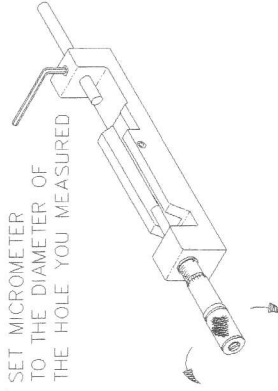
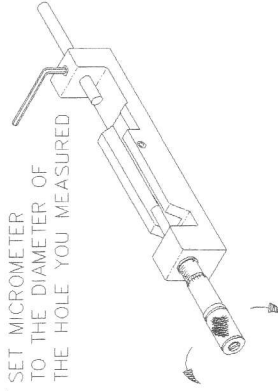
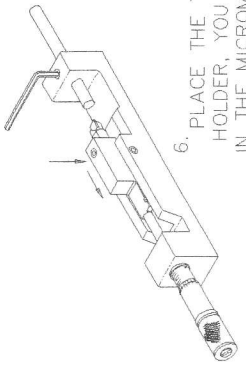
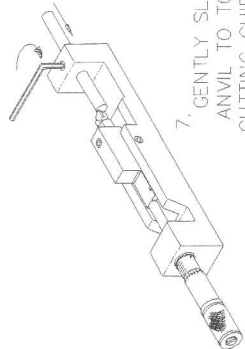
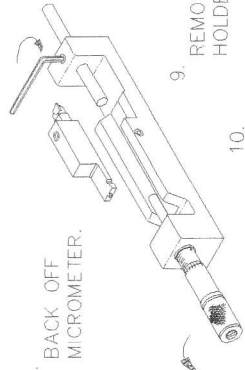
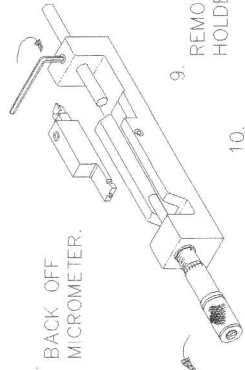
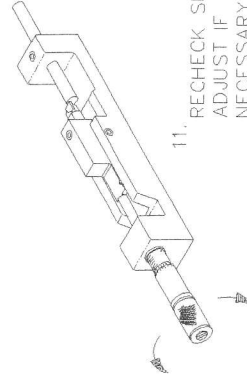
Periodically we would recommend turning the anvil slightly, so that a flat surface is exposed to the tool bit tip.



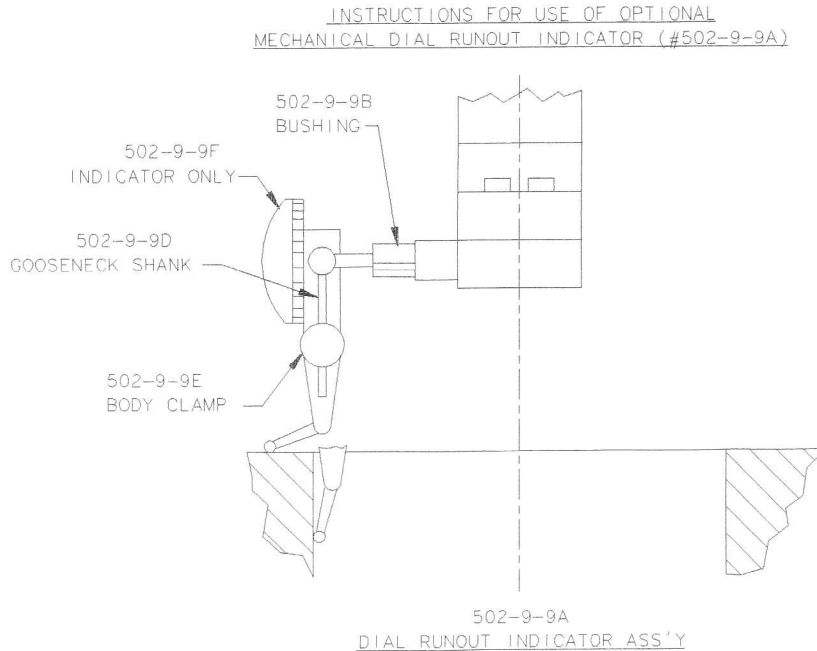
Calibrating Micrometer

PROCEDURE FOR CALIBRATING MICROMETER

AVB-69

<p>1. USE THE BORING MACHINE TO BORE A HOLE IN A SCRAP BLOCK. WITHOUT CHANGING ANY SIZE SETTING REMOVE TOOL HOLDER.</p> 	<p>2. MEASURE THE HOLE THAT YOU BORED.</p> 
<p>3. LOOSEN ANVIL LOCK SCREW.</p> 	<p>4. SLIDE ANVIL BACK.</p> 
<p>5. SET MICROMETER TO THE DIAMETER OF THE HOLE YOU MEASURED.</p> 	<p>6. PLACE THE TOOL HOLDER, YOU USED, IN THE MICROMETER FRAME.</p> 
<p>7. GENTLY SLIDE ANVIL TO TOUCH CUTTING CHIP, AND LIGHTLY TIGHTEN LOCK SCREW.</p> 	<p>8. BACK OFF MICROMETER.</p> 
<p>9. REMOVE TOOL HOLDER.</p> <p>10. TIGHTEN LOCK SCREW.</p> 	<p>11. RECHECK SIZE. ADJUST IF NECESSARY.</p> 

Instructions for Use of the Optional Mechanical Dial Run-out Indicator 502-9-9A



The mechanical dial run-out indicator may be used for checking and if necessary for correcting the centering or the bore concentricity. It may also be used for checking face squareness of the work piece to the boring spindle.

The principle use in checking centering will be for engines requiring an absolute minimum oversize, particularly when irregular wear and screw areas can be found.

To use the indicator, simply place the gooseneck shank in the split bushing provided and insert the appropriate size tool holder. The indicator may be used on any style of cutter head.

Center the spindle by normal use of the centering fingers.

Turn Press the Neutral button.

Now raise the spindle out of the bore and insert the indicator. Make sure the indicator lever is set properly so the dial will travel in the right direction.

Lower the spindle and adjust the indicator mount with either gooseneck, or tool holder lock screw so the probe makes contact.

Turn the spindle, and the indicator will read the total run-out. The spindle is off center, to the bore a distance equal to 1/2 the total run-out.

To clean up a bore, it will be necessary to set the tool about the amount of this run-out, in addition to the basic bore size measurement. If you bump the spindle unit lightly with your hand you will find you can easily reduce the reading to near 'zero' for minimum stock removal.

Similarly if the bore is substantially out of round or has scored wear grooves, you may move the spindle so that you get two maximum equal dial readings at the opposed large portions of the out of round.

Achieving this you will find the bore will clean up on a slightly larger diameter than you measure at the maximum out of round area.

Press the bore button when you have the proper dial reading, remove the indicator, proceed with the boring as usual.

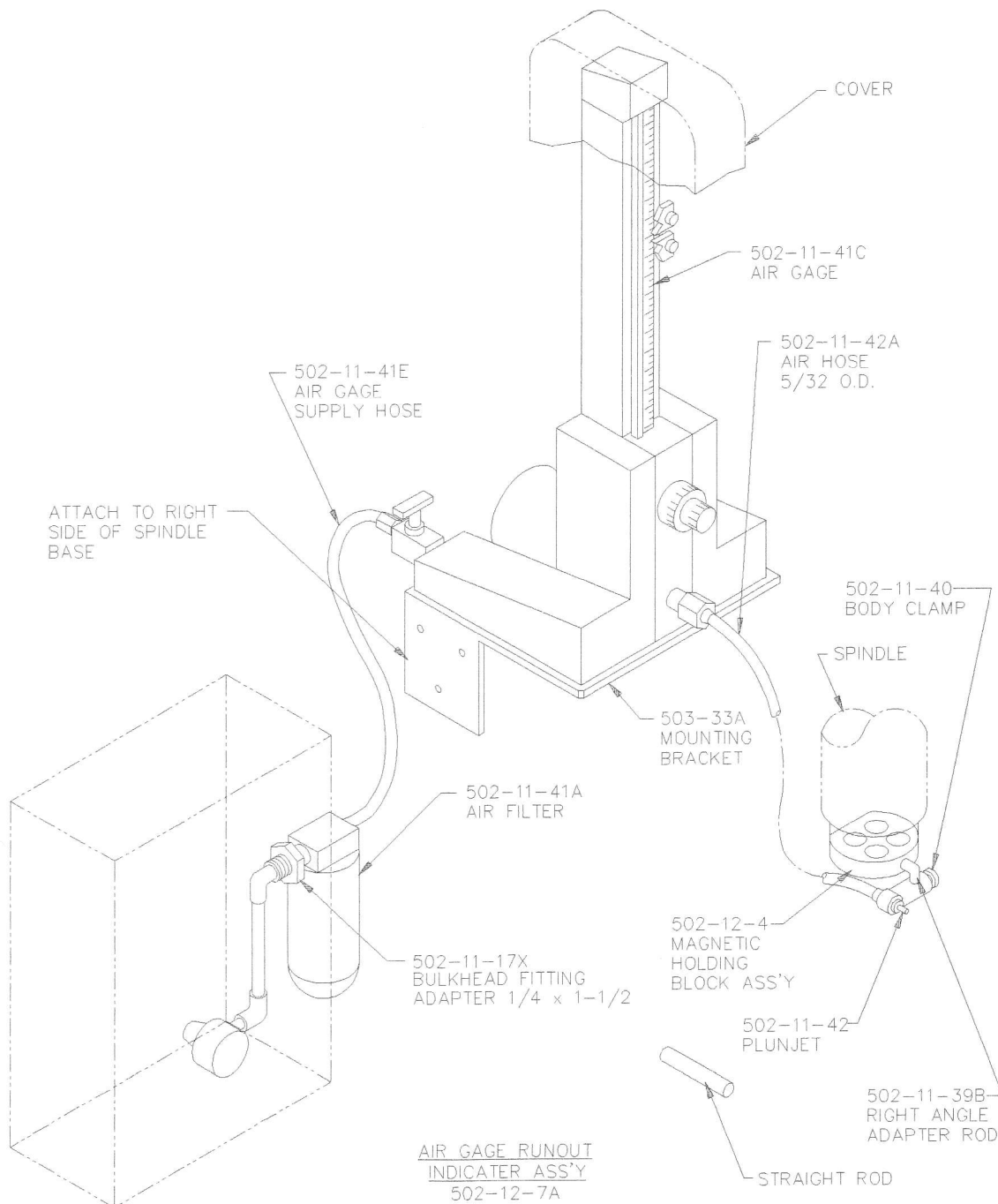
If you wish to check the squareness of the bore face, reset the dial indicator lever for the proper travel direction and adjust the spindle and indicator to contact the surface above the bore. Rotate the spindle to check out of square reading.

Remember, if you wish to correct out of square with shims under the work piece, you will have to use a shim, proportionally larger (as the support points are to the indicator travel extreme) than the out of square reading.

Remote Runout Indicating System:

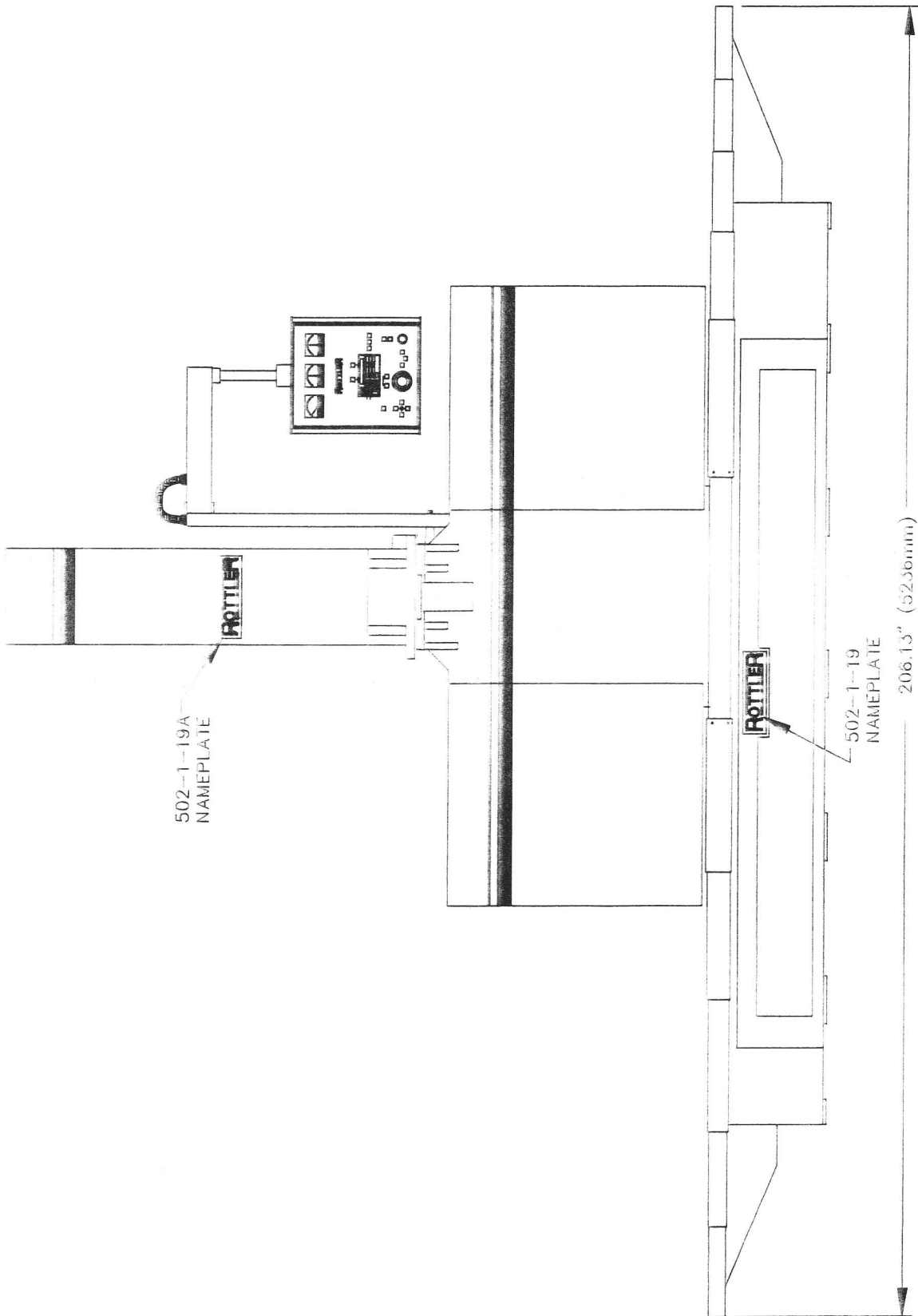
An optional remote indication air probe and gauge system is available, to check bore and face runout. The stationary indicator allows easier reading and

can be used in lower bore extremities where the mechanical dial indicator cannot be seen. The air probe can be used in a considerably smaller bore size relative to the spindle diameter.



Front View F88E:

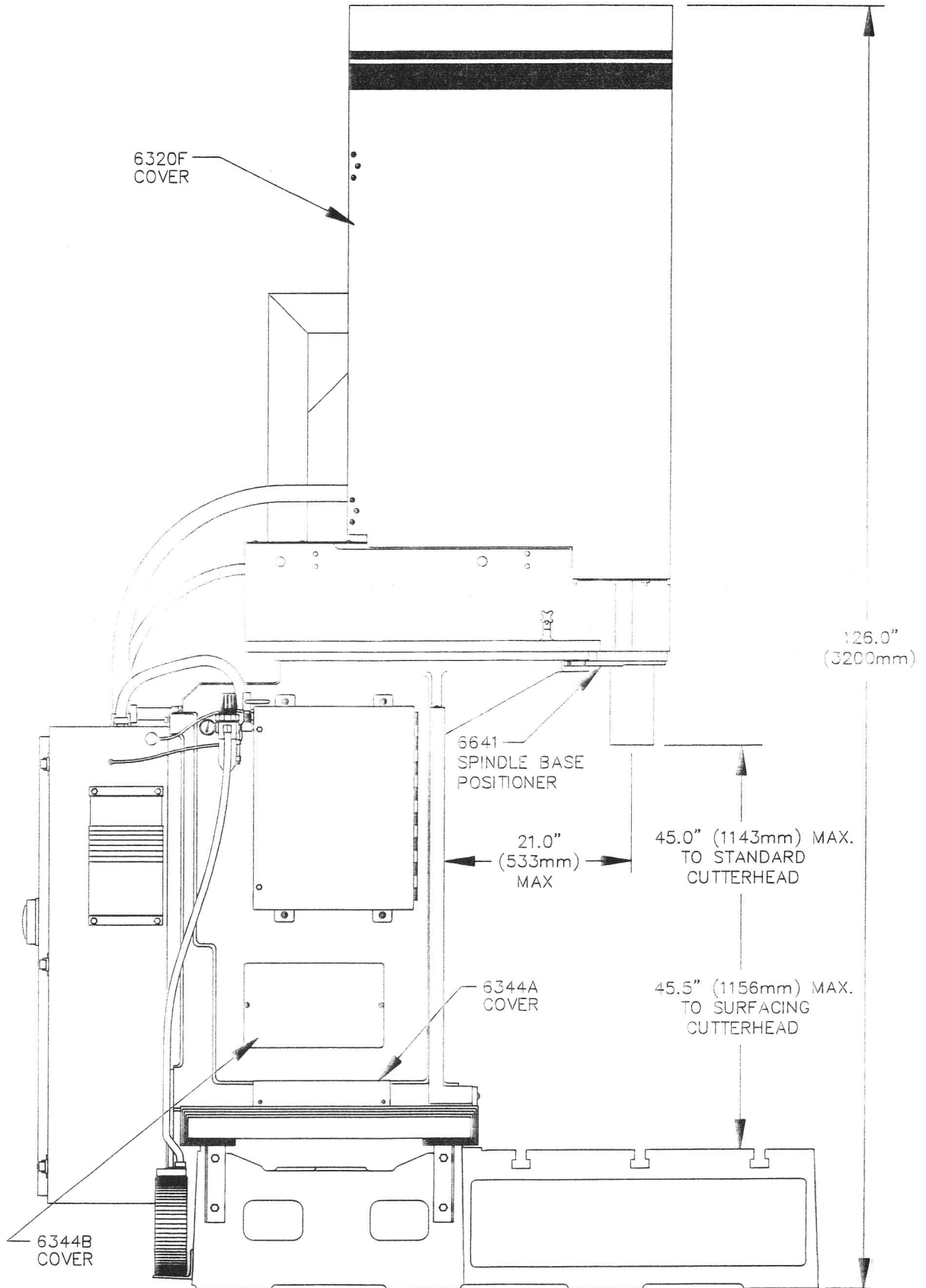
REF8E5-020695



FRONT VIEW F-88E

Left Side View F88E

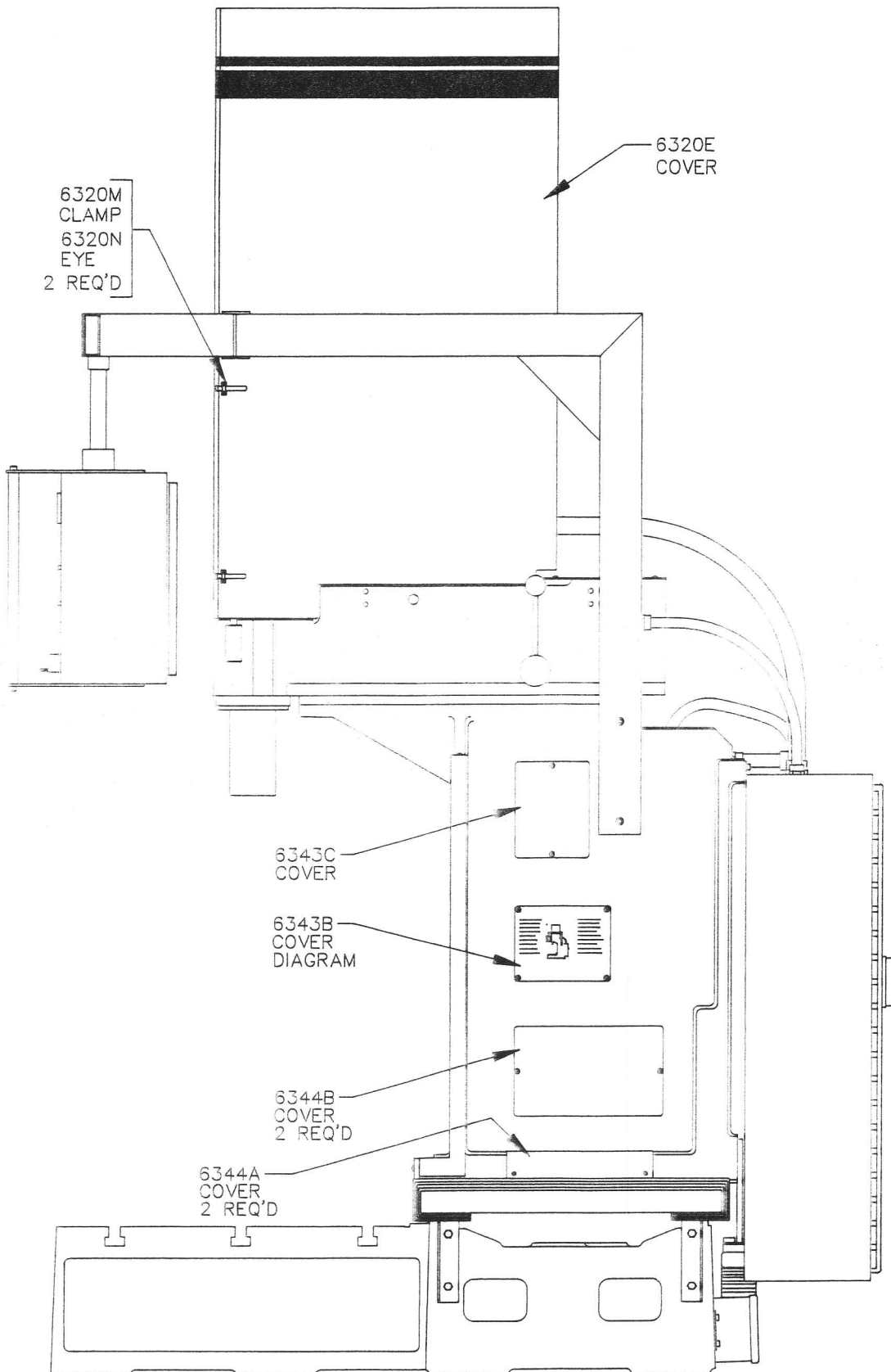
REF F8E7-011095



LEFT SIDE VIEW F-88E

Right Side View F88E

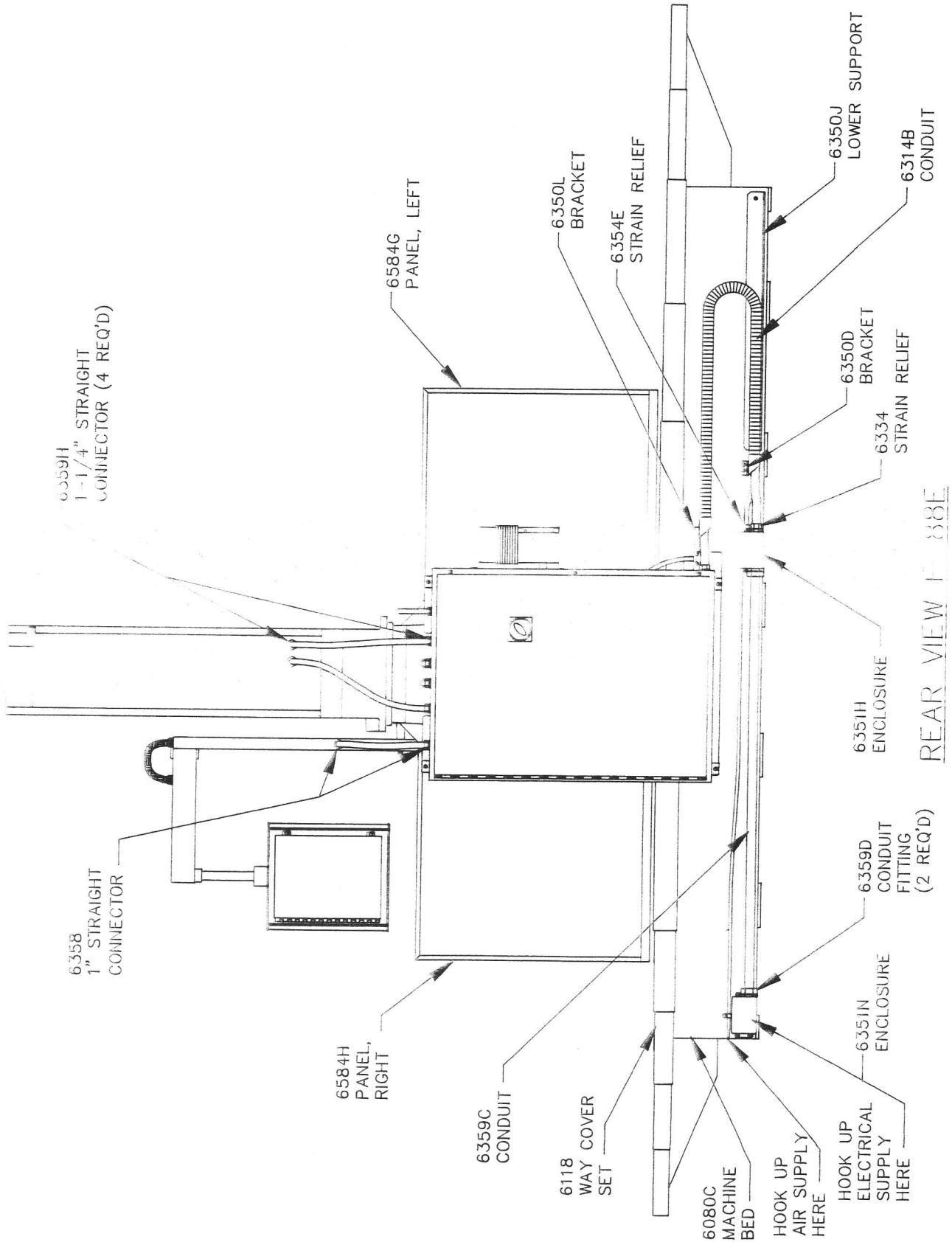
REF F8E42-020795



RIGHT SIDE VIEW F-88E

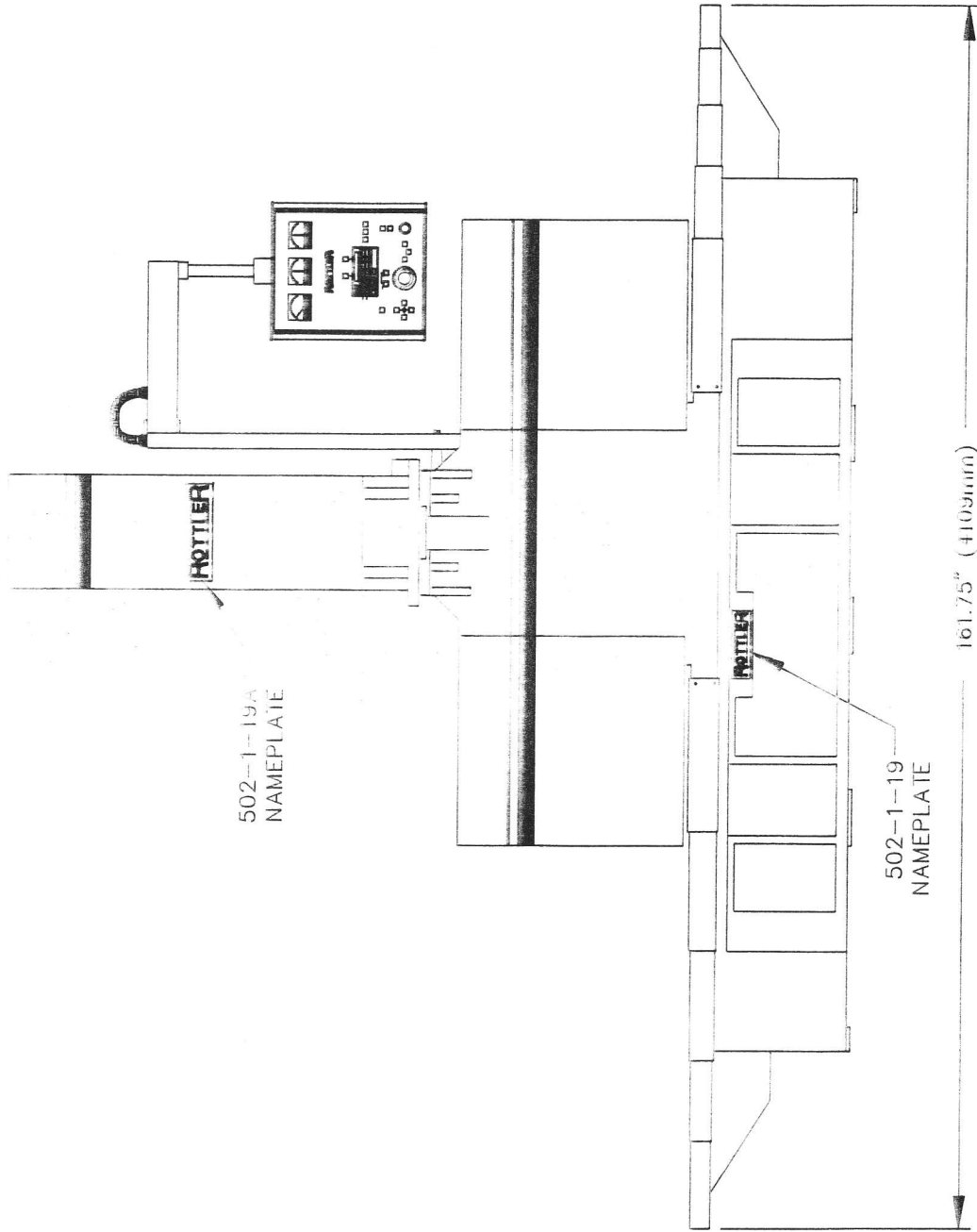
Rear View F88E

REFF8E9-011195



Front View F85E

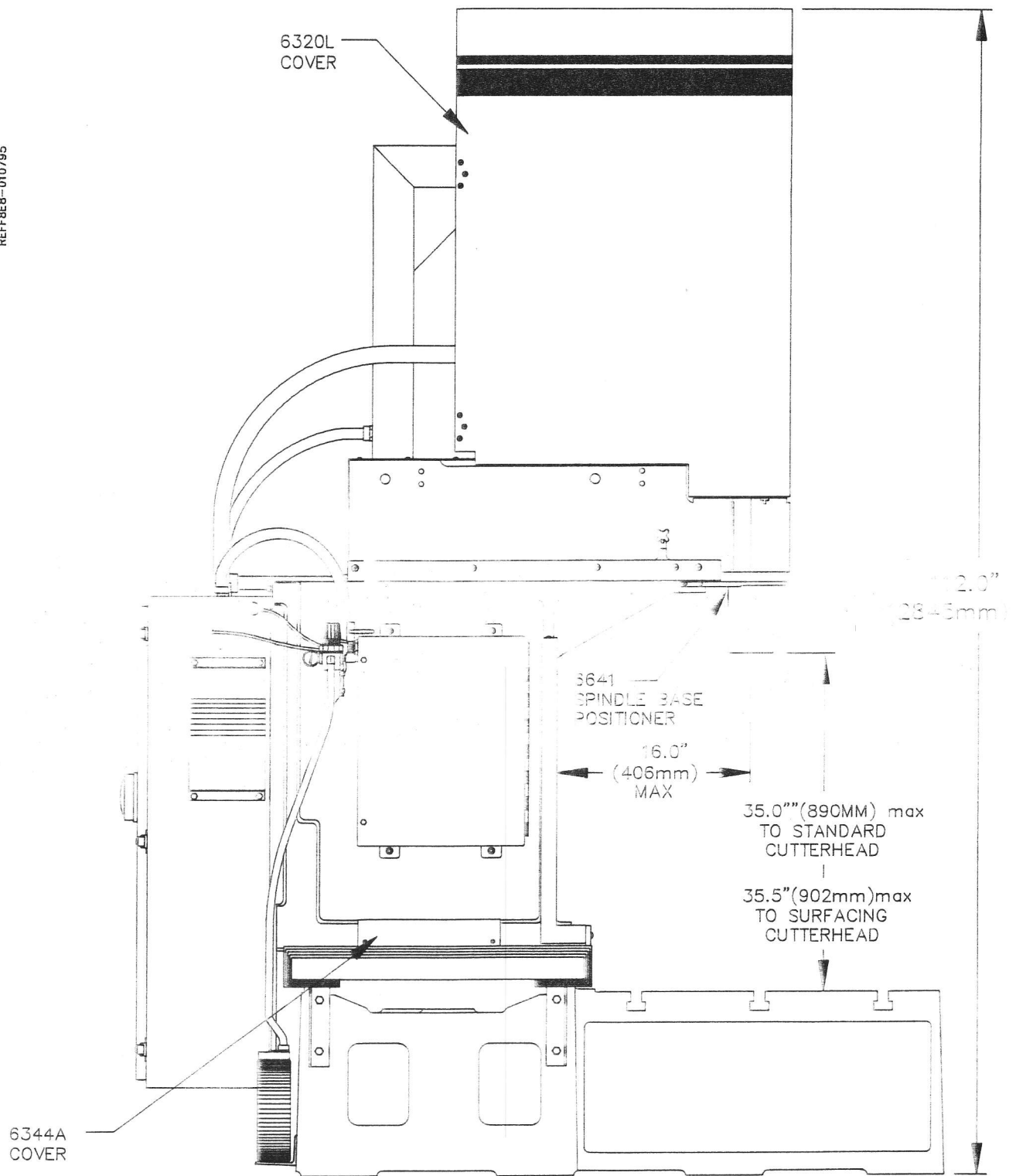
REF866-020795



FRONT VIEW F-85E

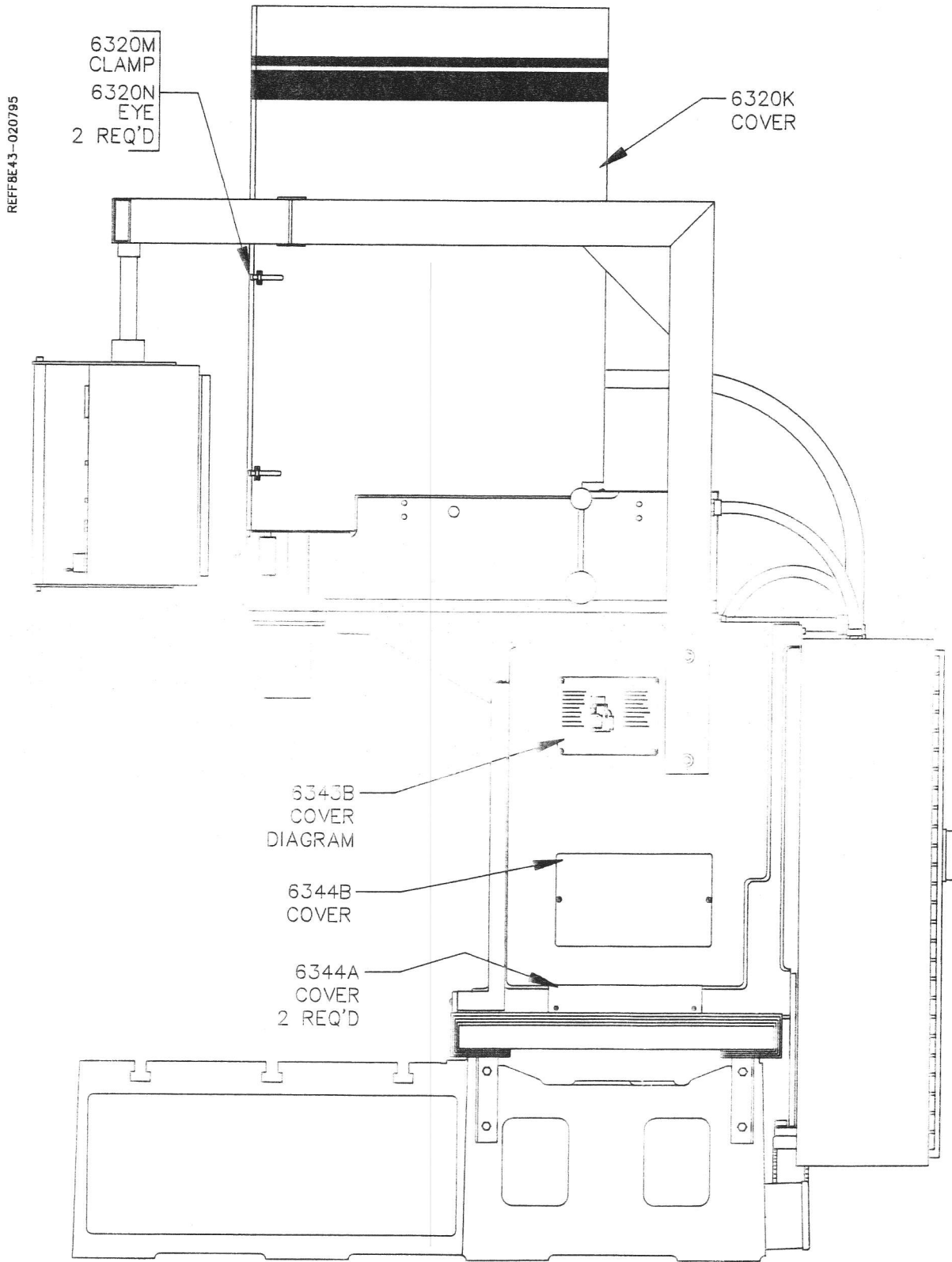
Left Side View F85E

REFFBEB-010795



LEFT SIDE VIEW F-85E

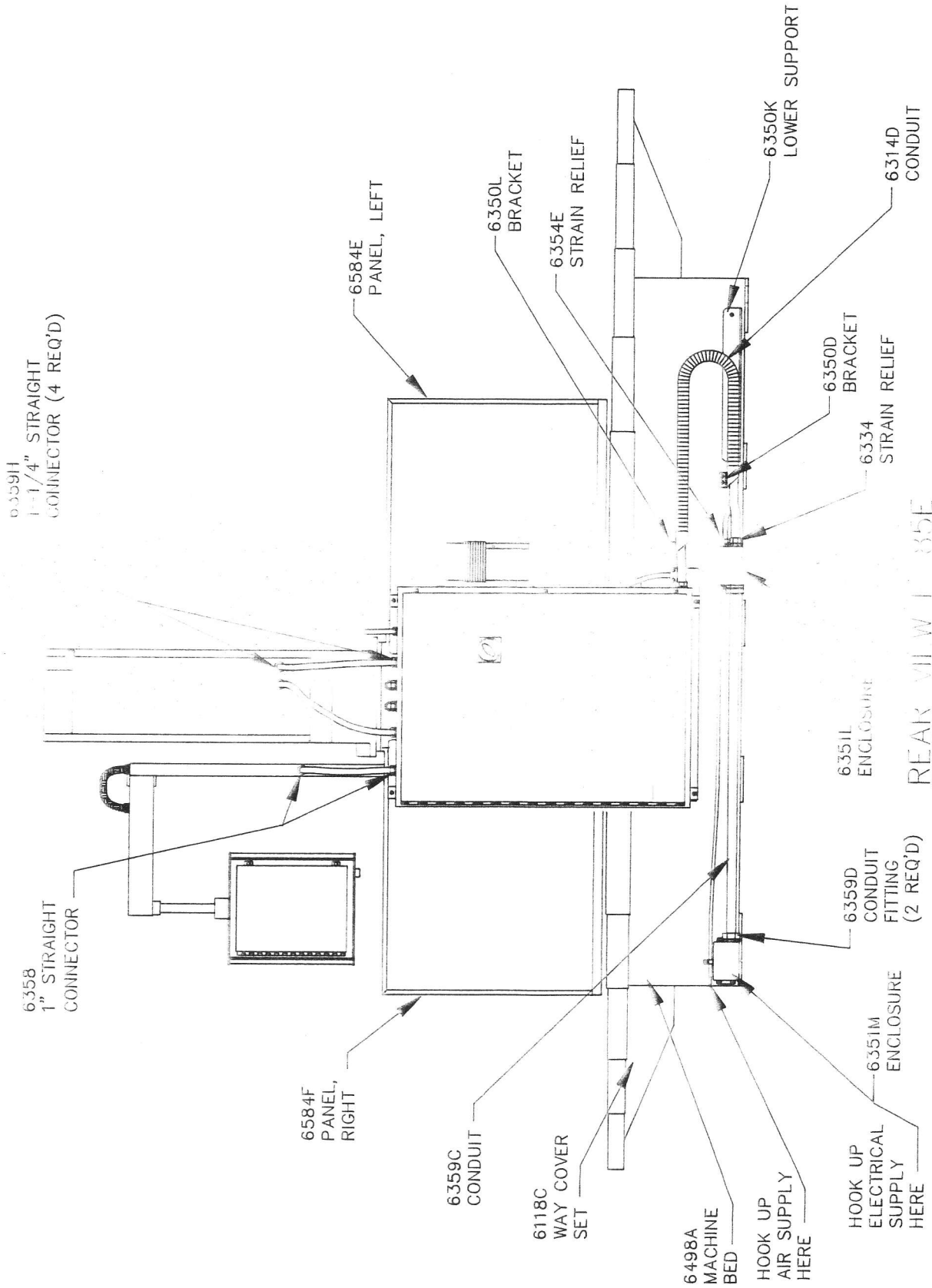
Right Side View F85E



RIGHT SIDE VIEW F-85E

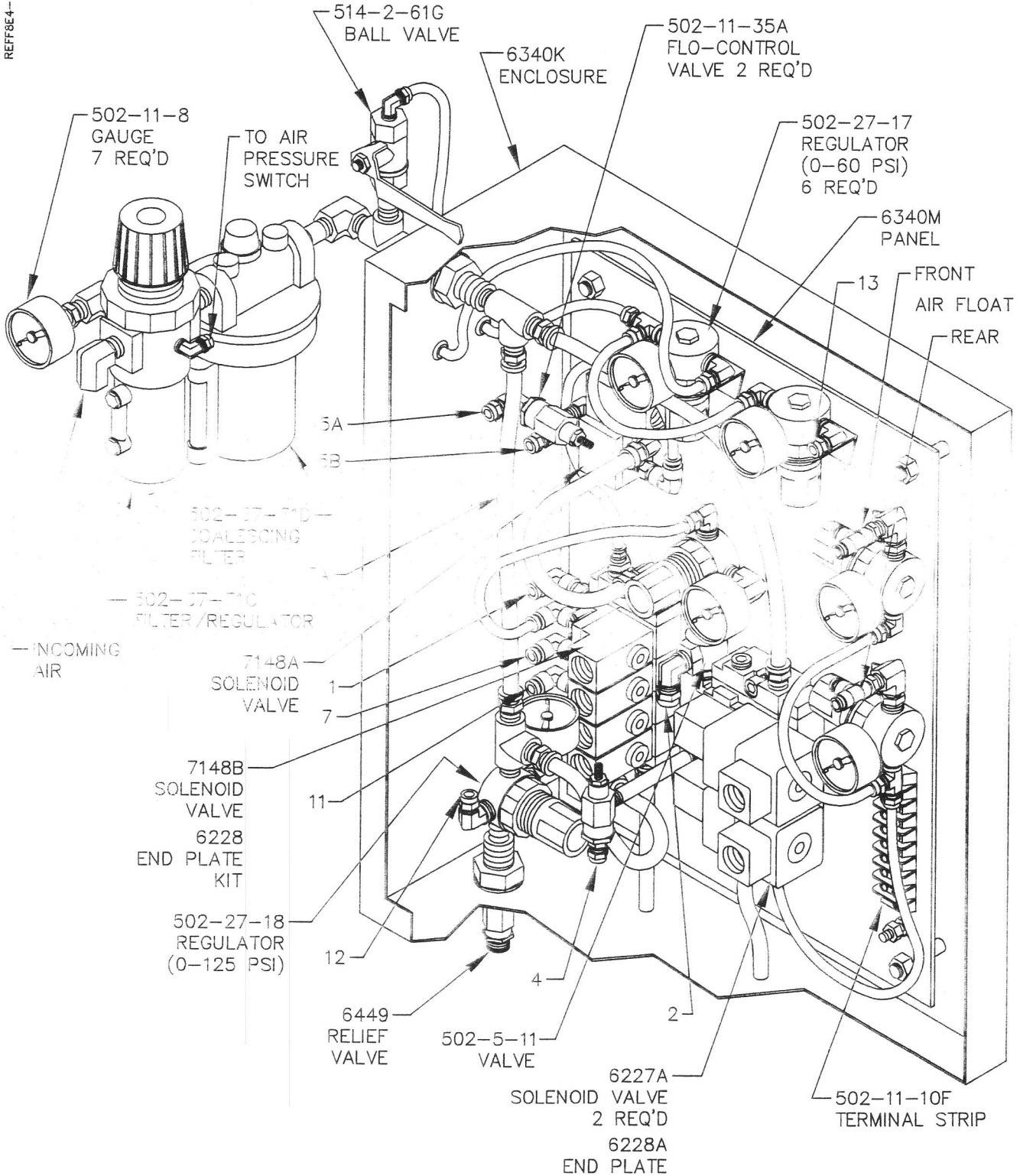
Rear View F85E

REF F8E10-011195



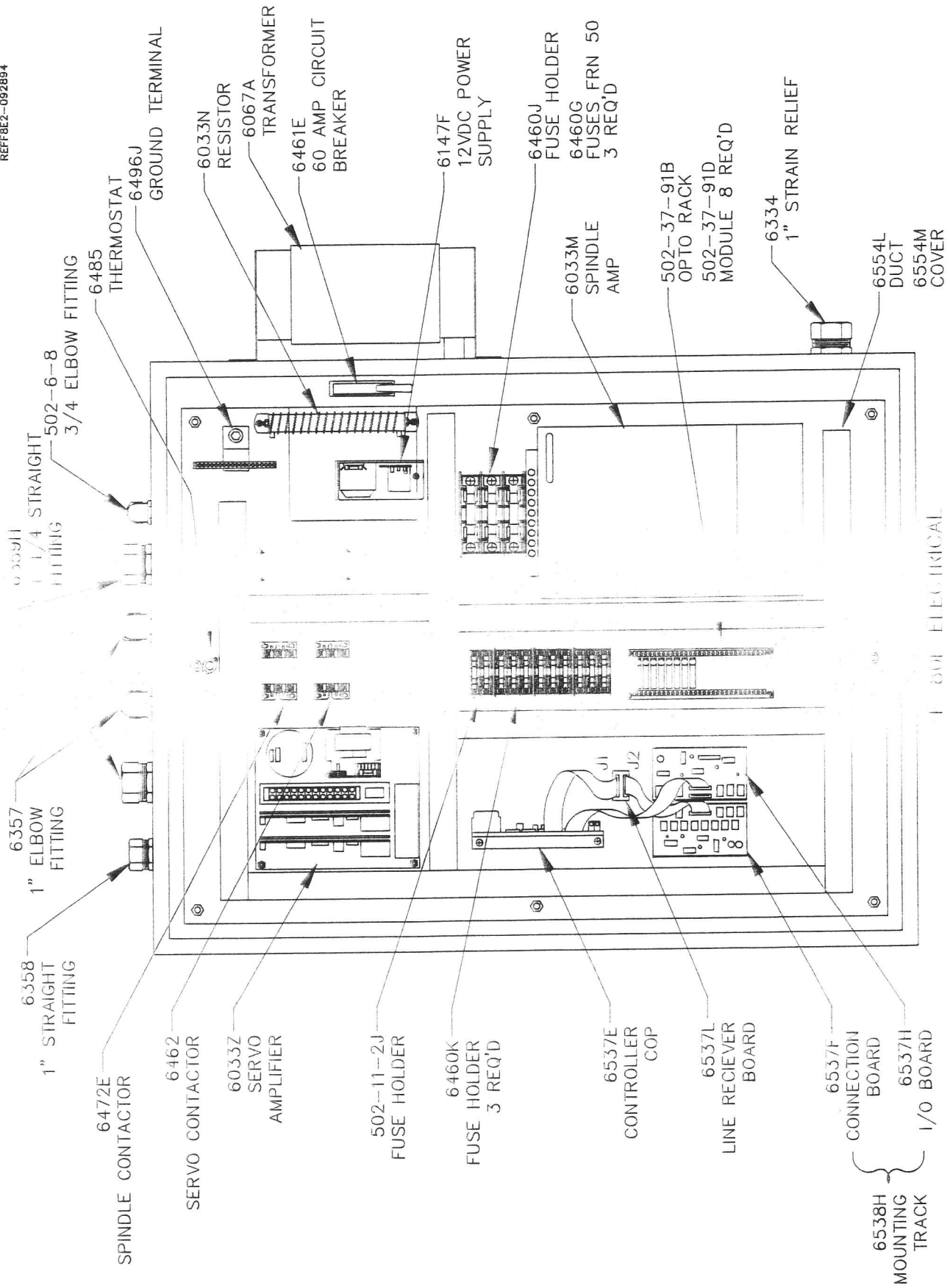
Air Enclosure

REF9E4-22897



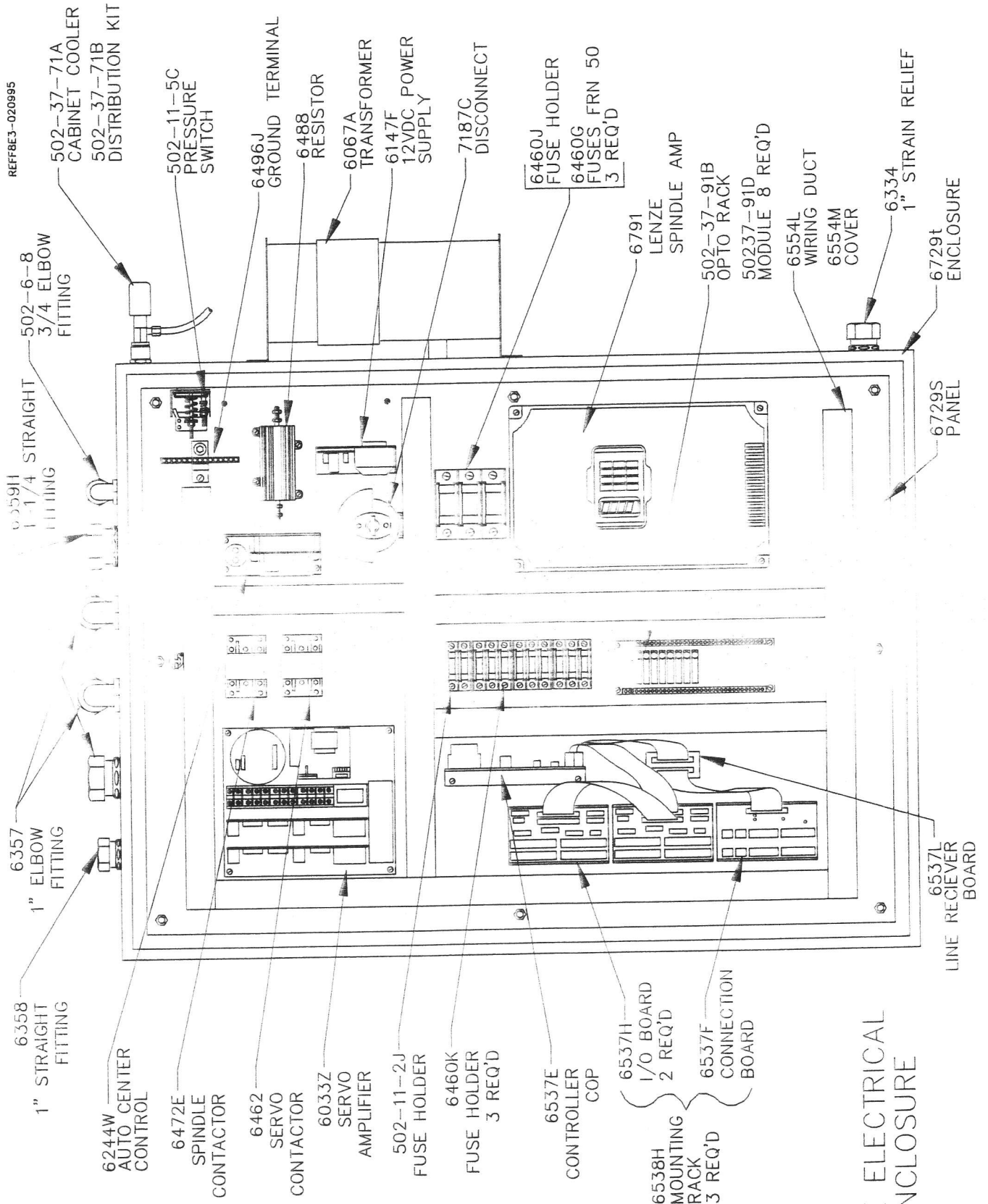
Electrical Enclosure (Baldor Drive)

REFFB2-092894



F 80E ELECTRICAL ENCLOSURE

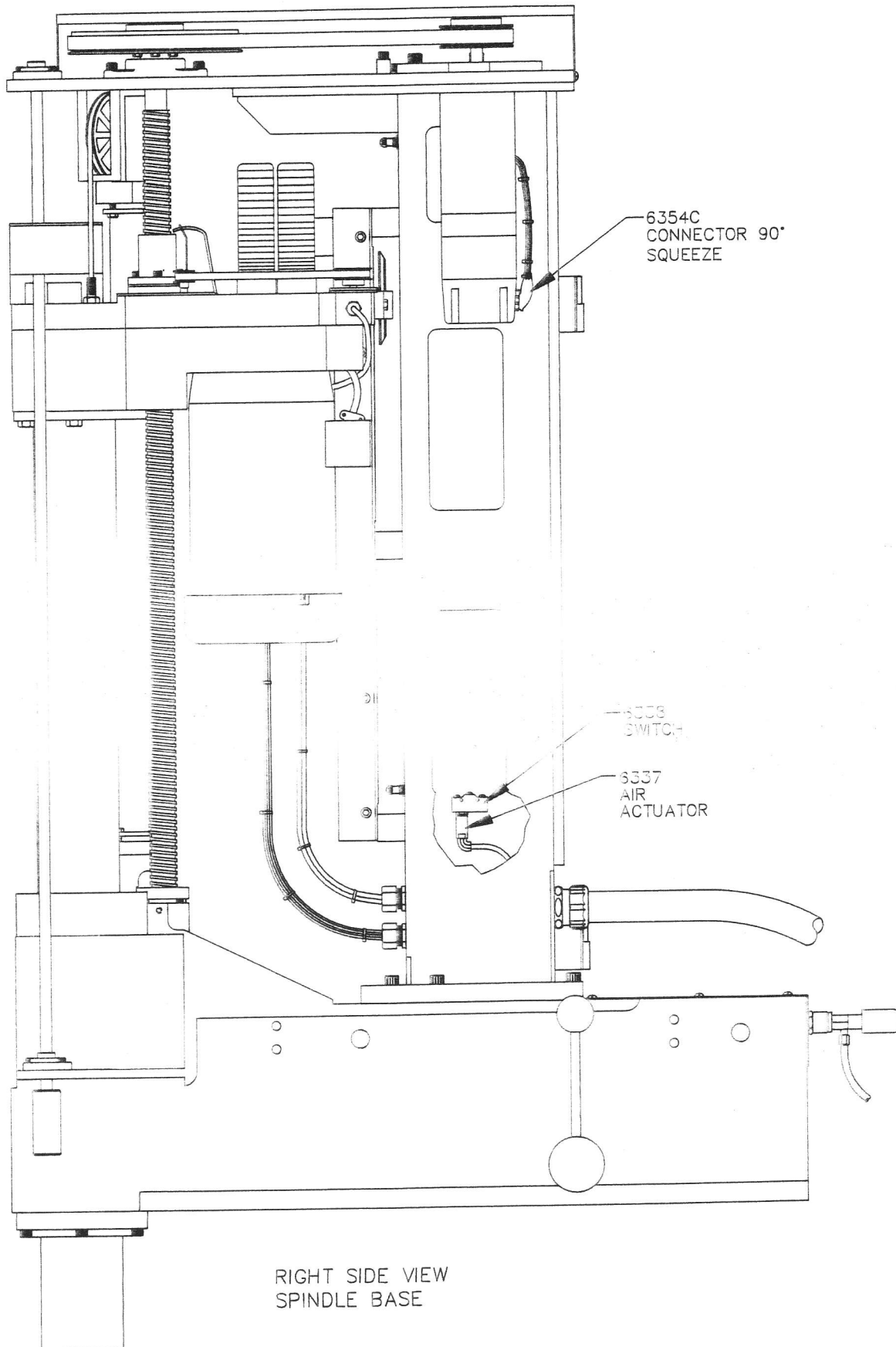
Electrical Enclosure (Lenze Drive)



F8E ELECTRICAL ENCLOSURE

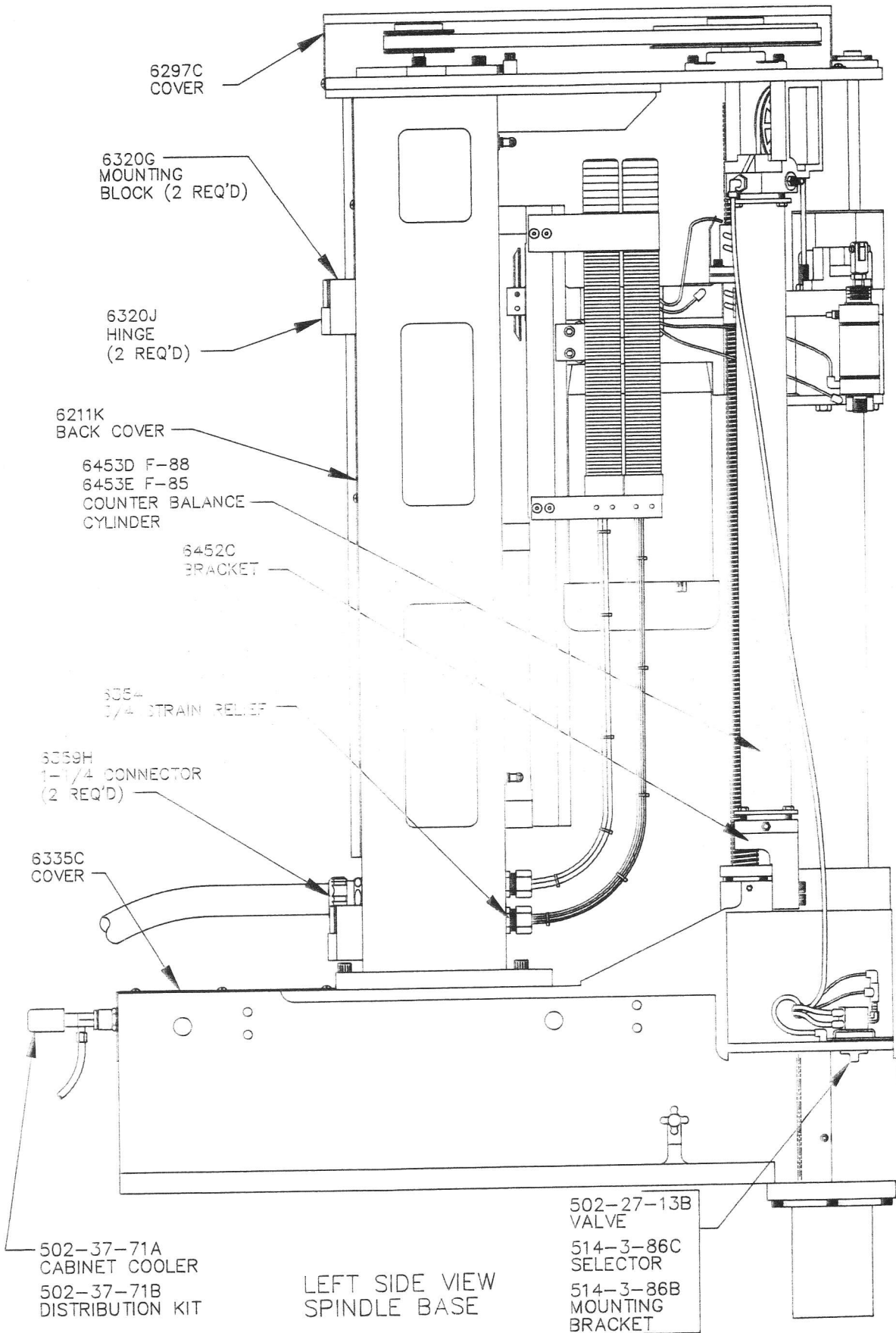
Right Side Spindle Base

REFFB11-020995



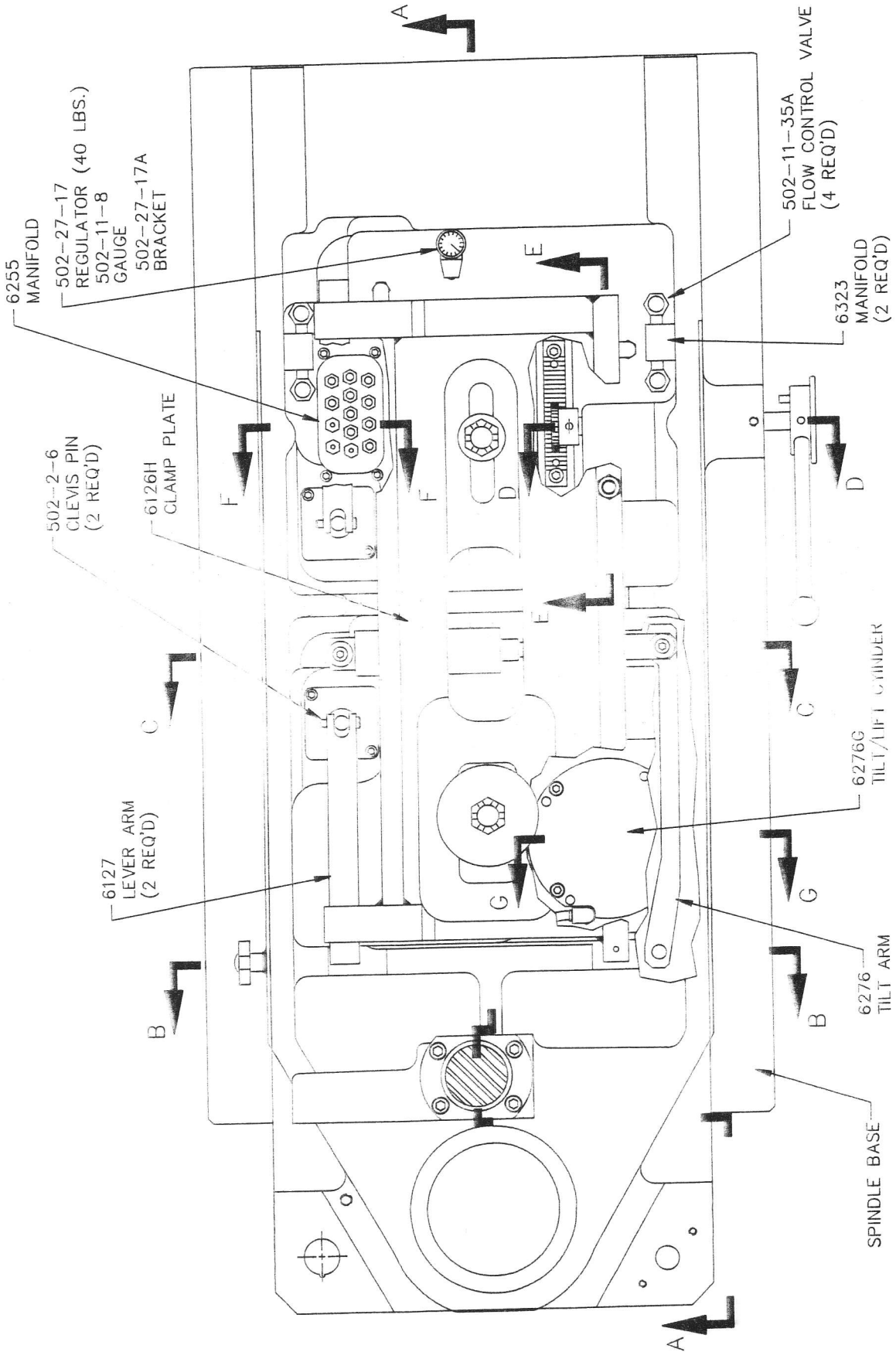
Left Side Spindle Base

REFFB12-020995



Spindle Base Top View

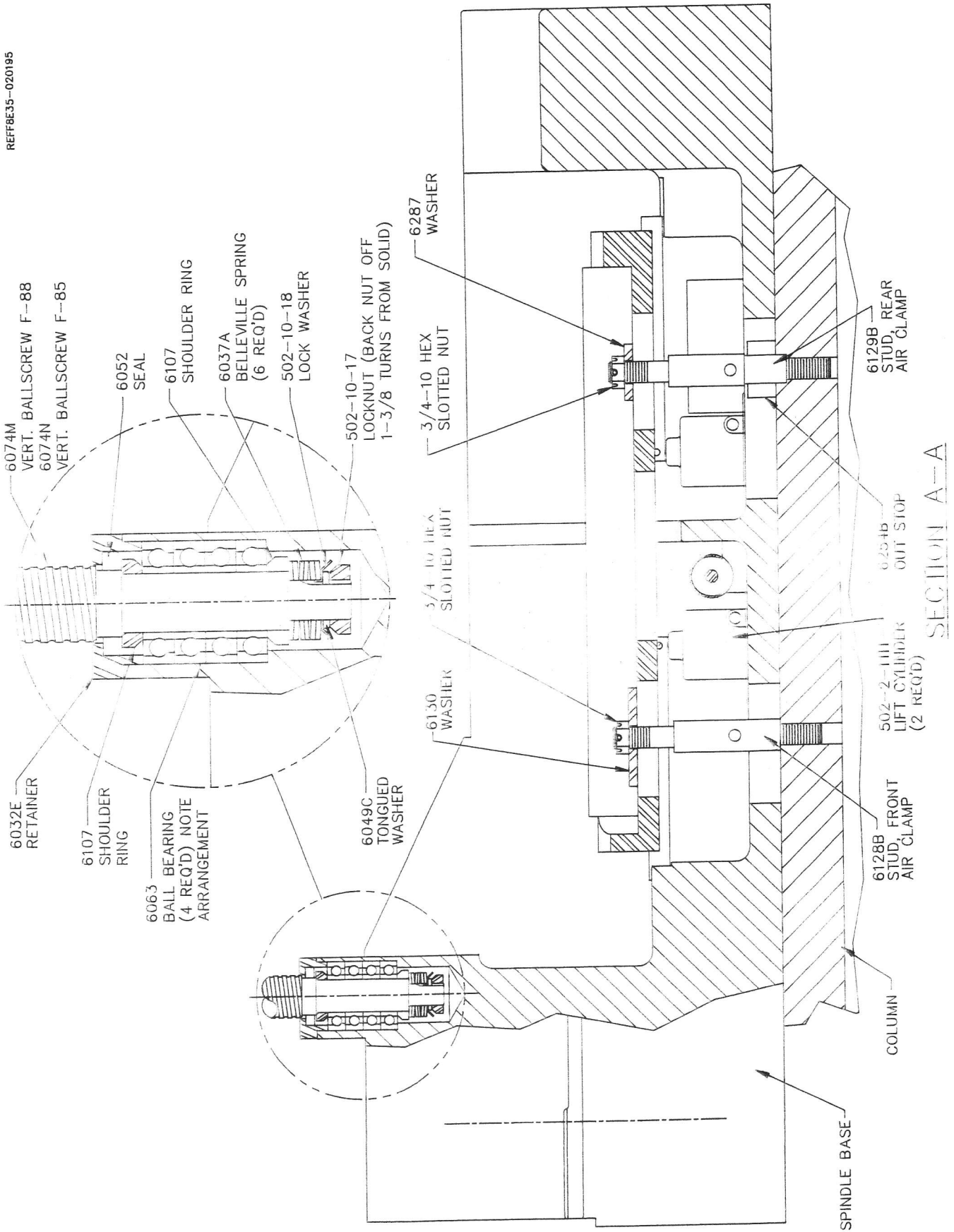
REFFB34-021095



SPINDLE BASE TOP VIEW

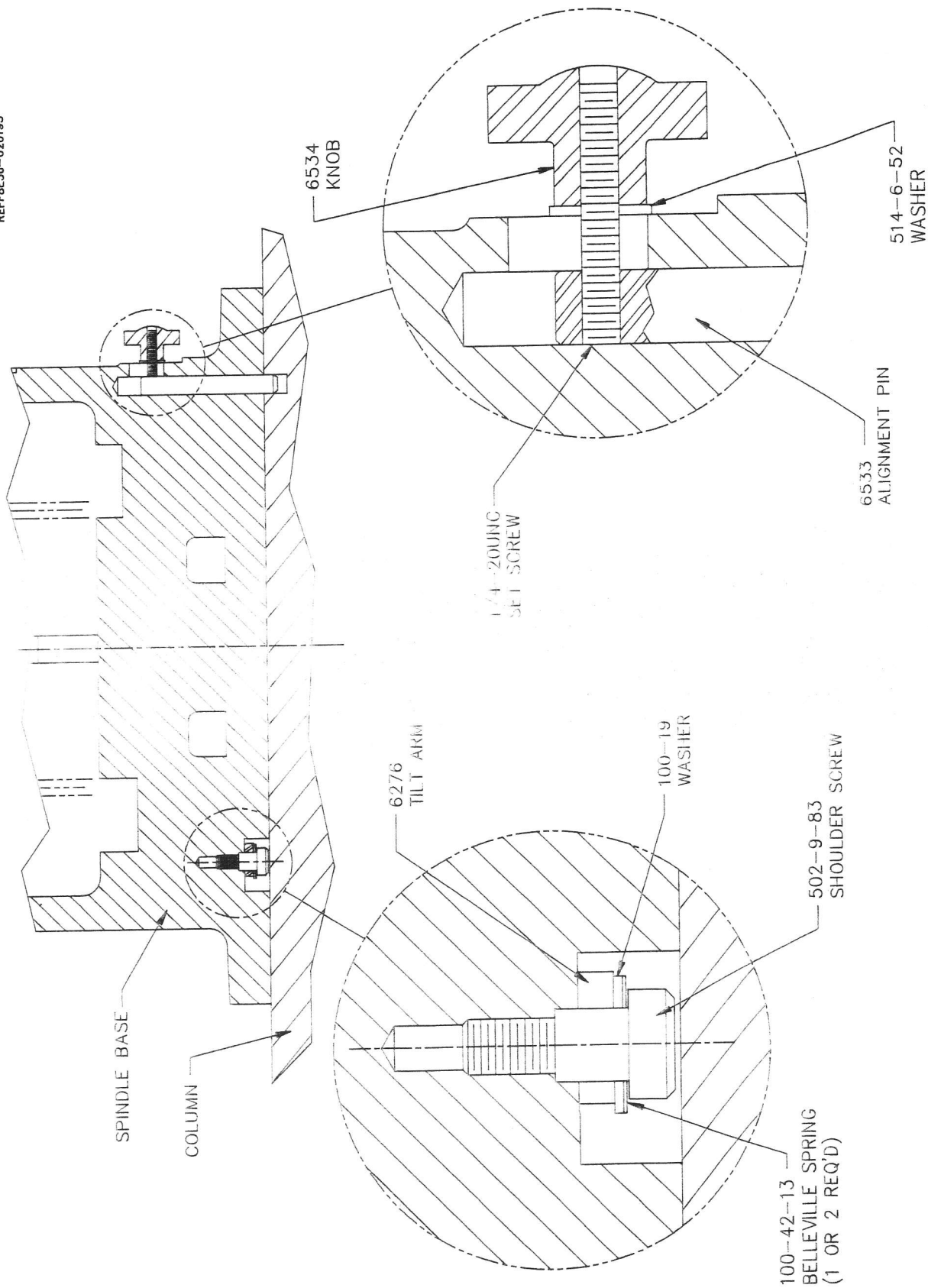
Spindle Base Section A-A

REFFB35-020195



Spindle Base Section B-B

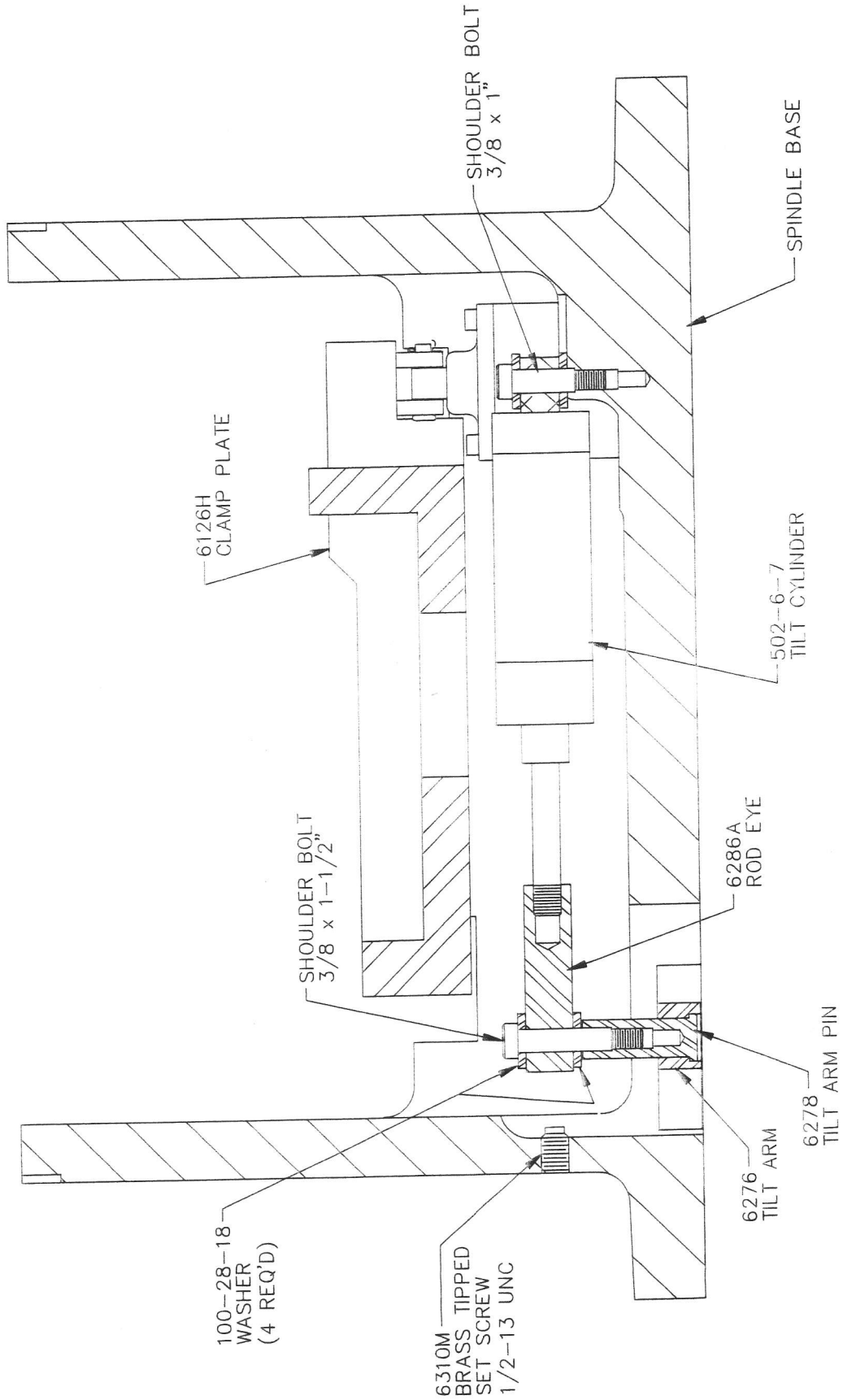
REF B36-020195



SECTION B-B

Spindle Base Section C-C

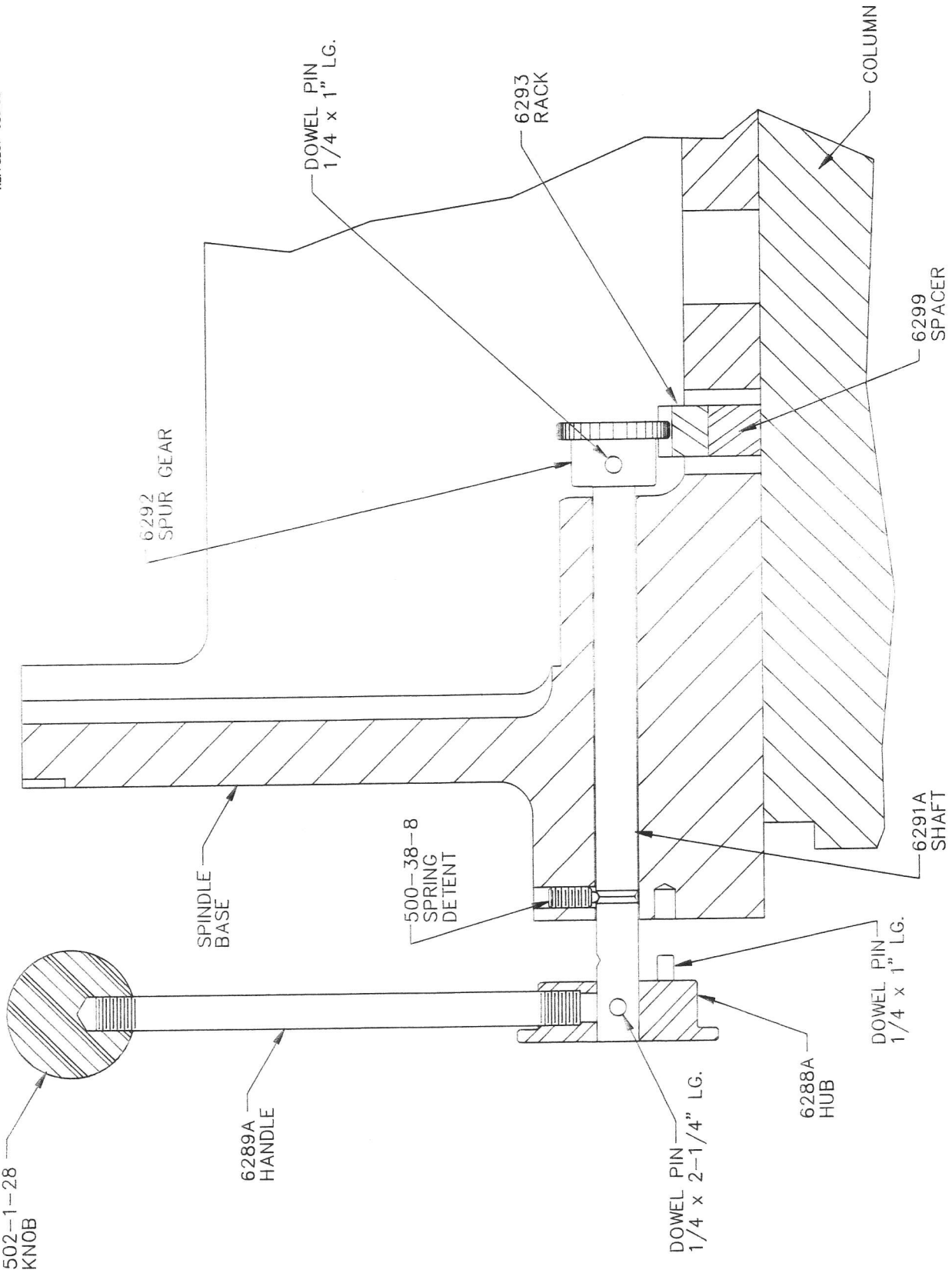
REFFB37-061395



SECTION C-C

Spindle Base Section D-D

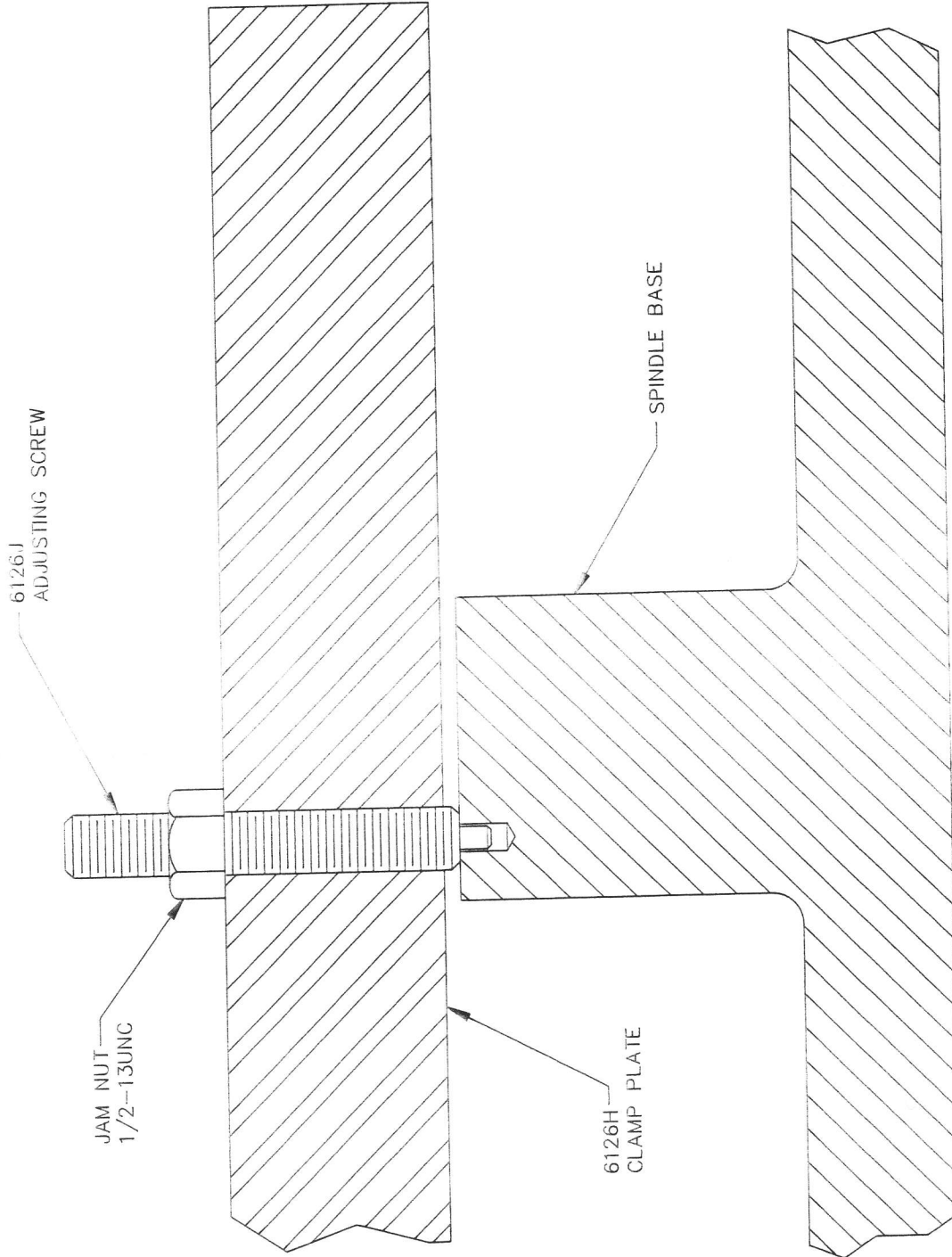
REFFB37-020195



SECTION D-D

Spindle Base Section E-E

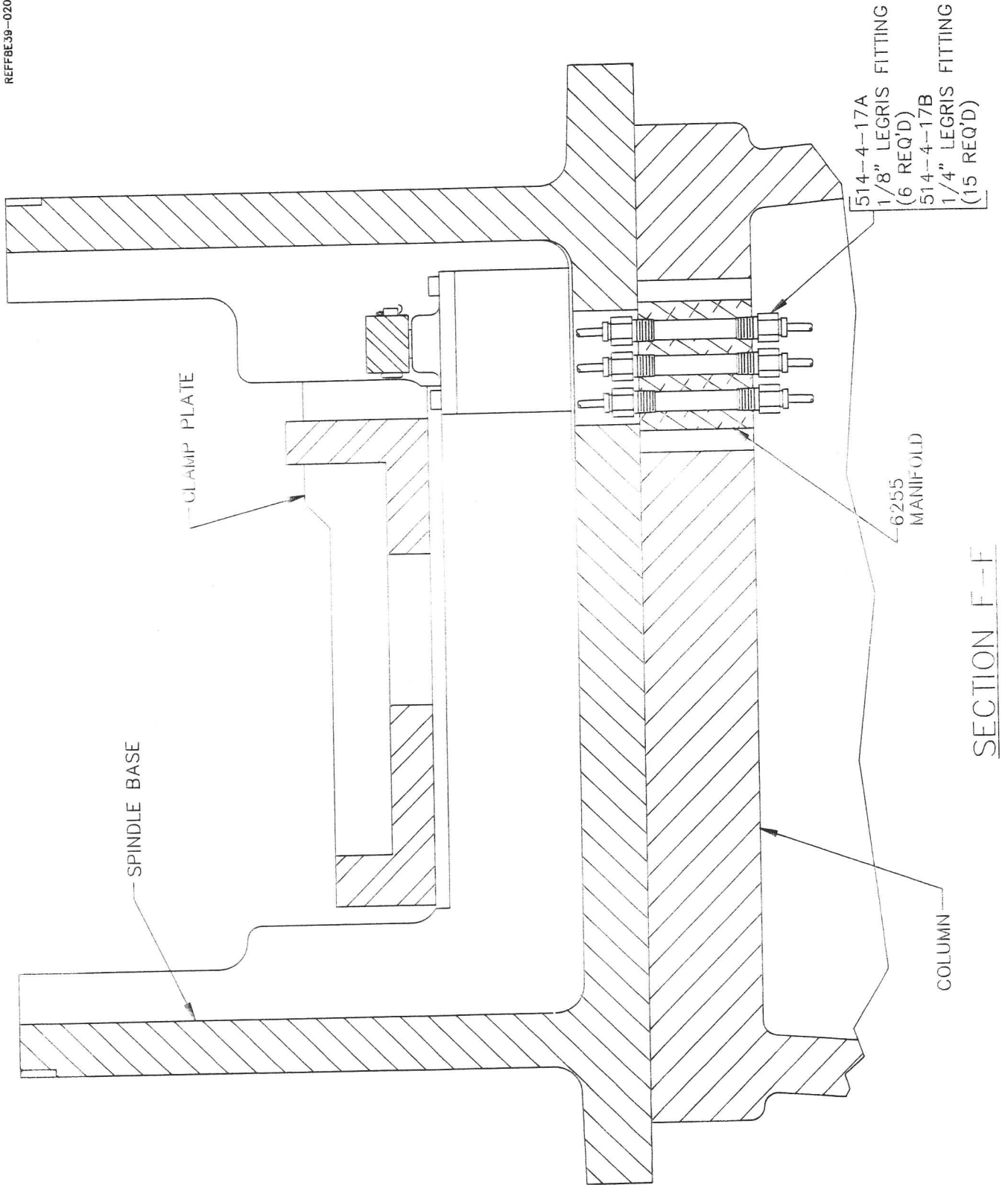
REFFBEC38-020195



SECTION E-E

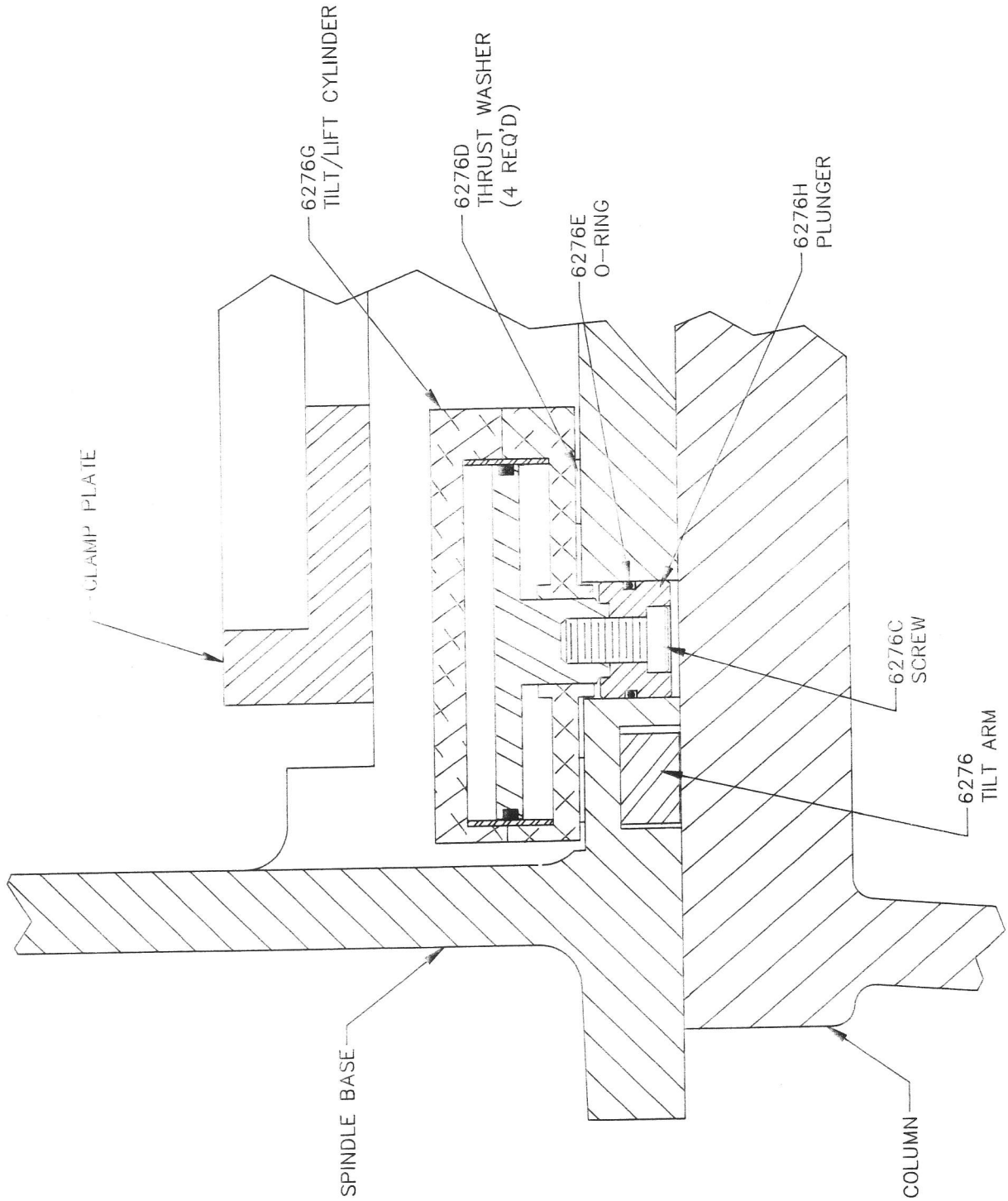
Spindle Base Section F-F

REFFB39-020195



Spindle Base Section G-G

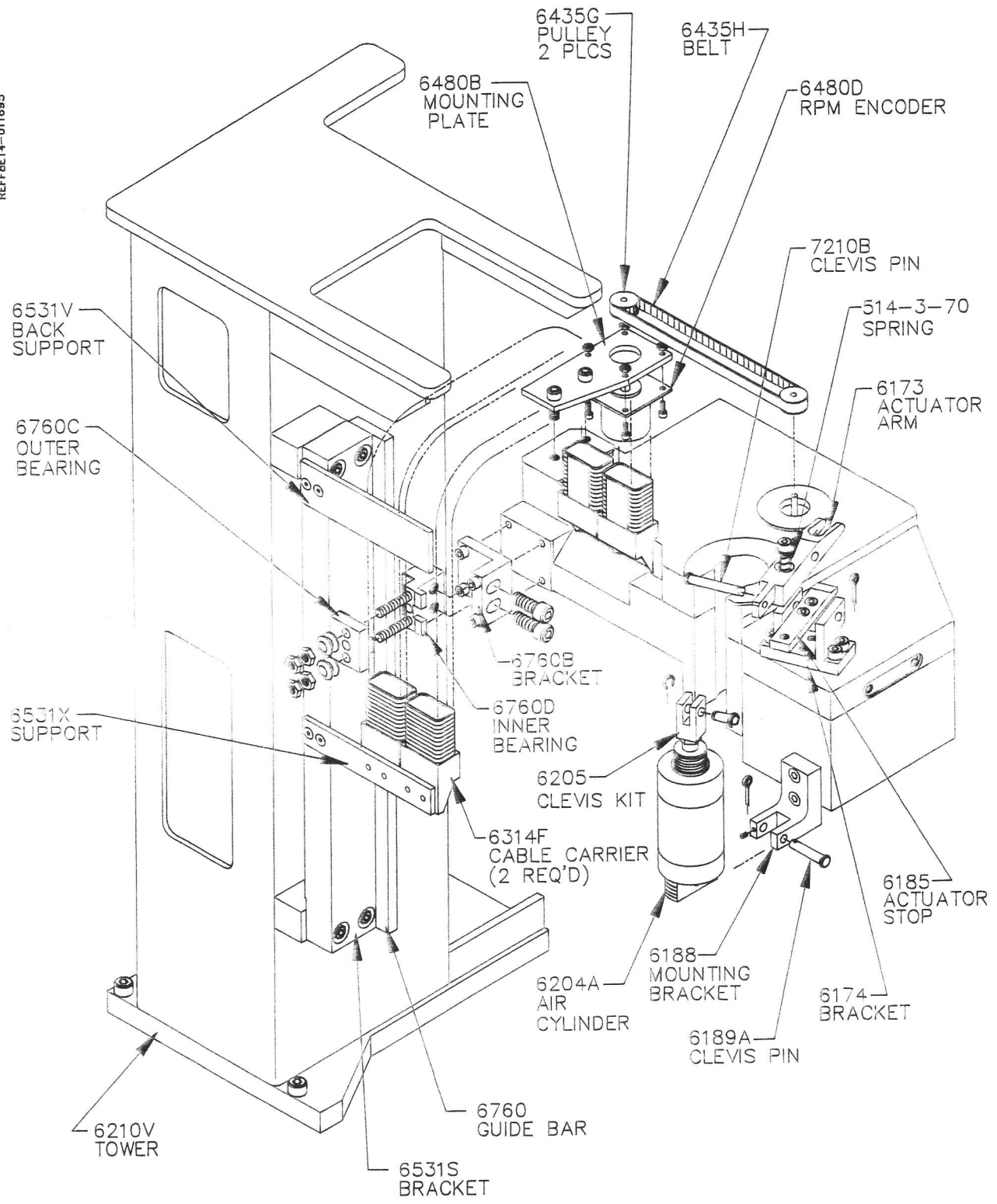
REFFBE40-020195



SECTION G-G

Tower Assembly F85E

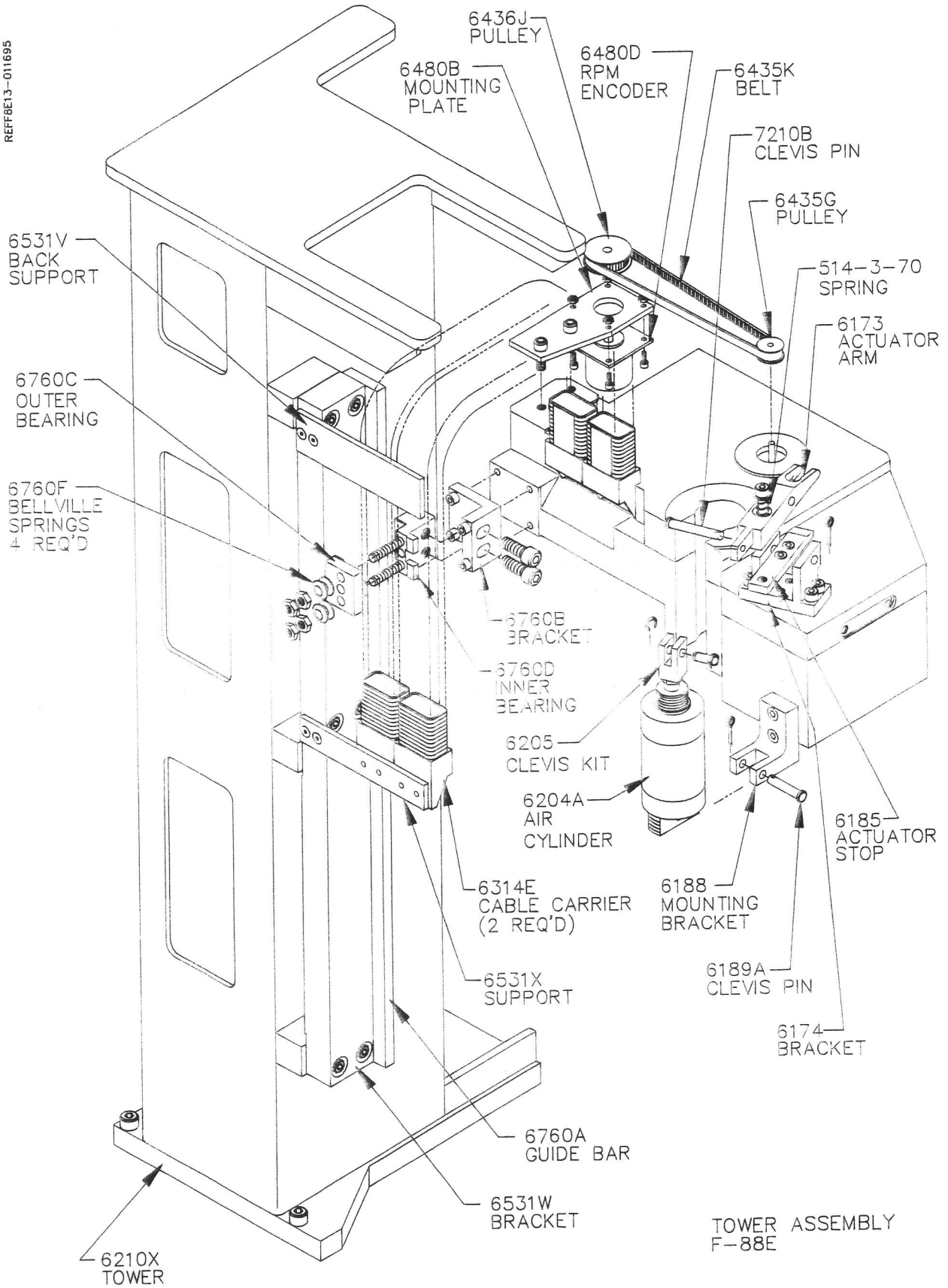
REF F8E14-011695



TOWER ASSEMBLY F-85E

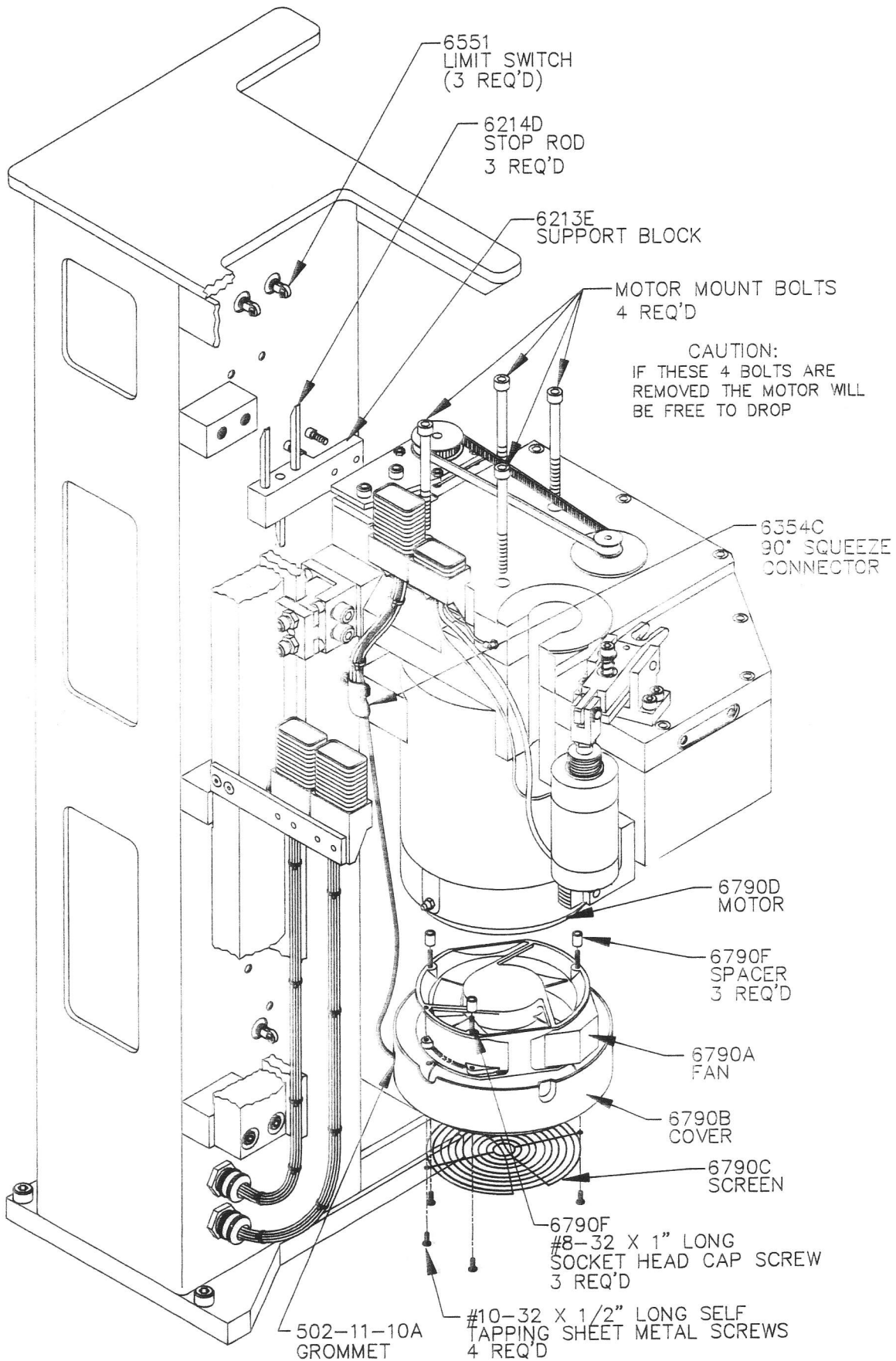
Tower Assembly F88E

REFFBEL3-011695



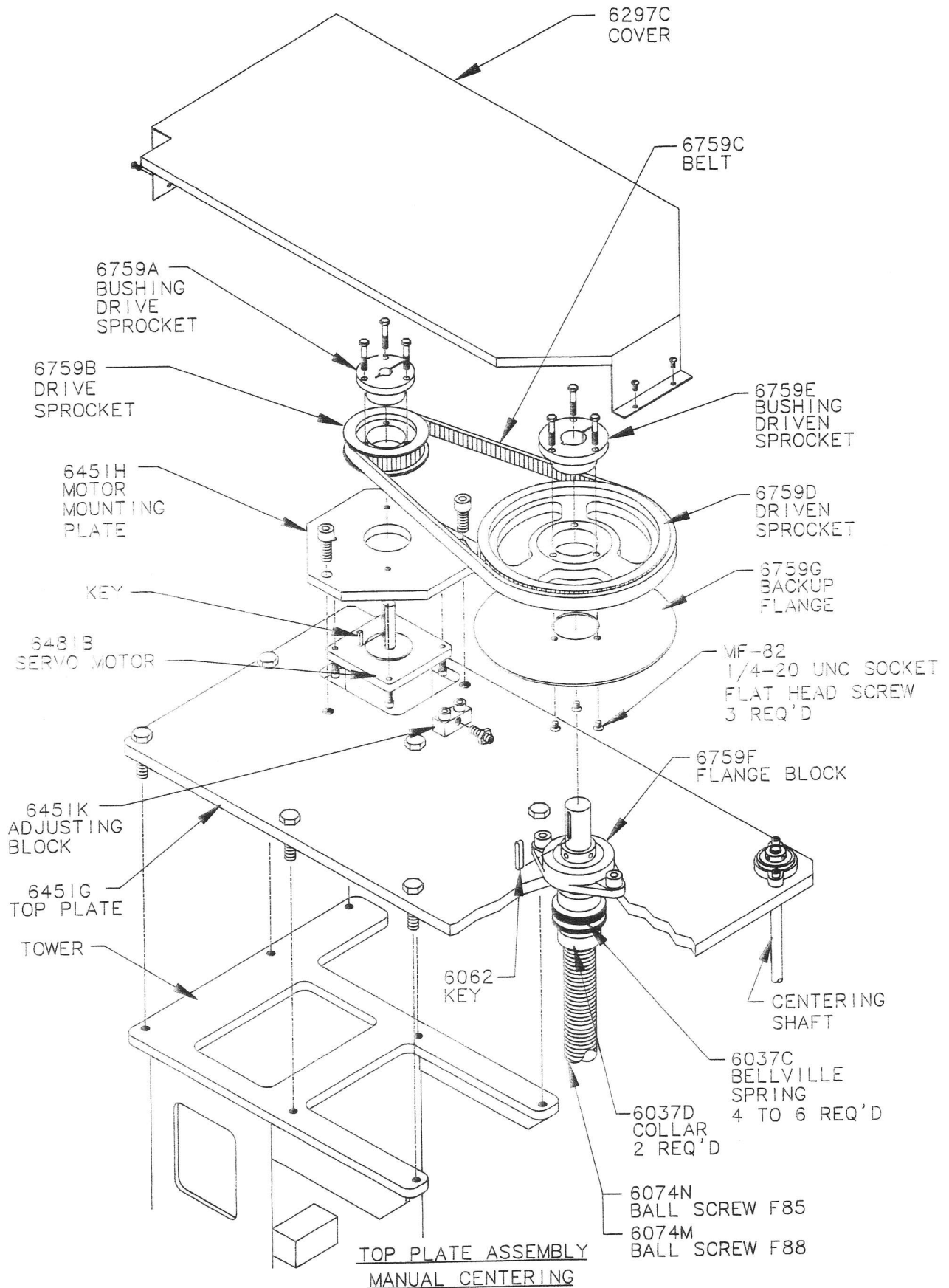
Motor Assembly

REFFBET5-011895

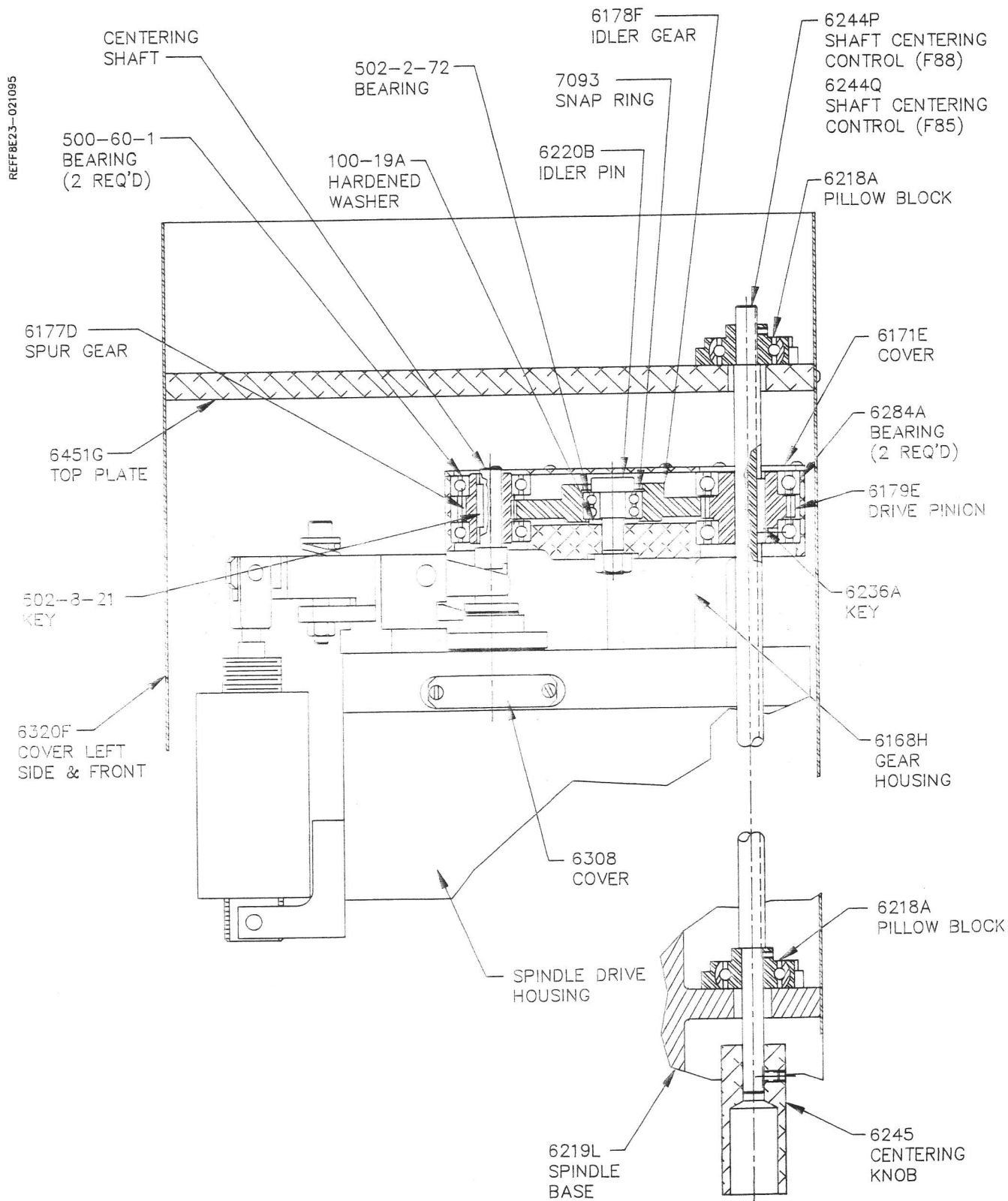


Top Plate Assembly Manual Centering

REF B25-021095

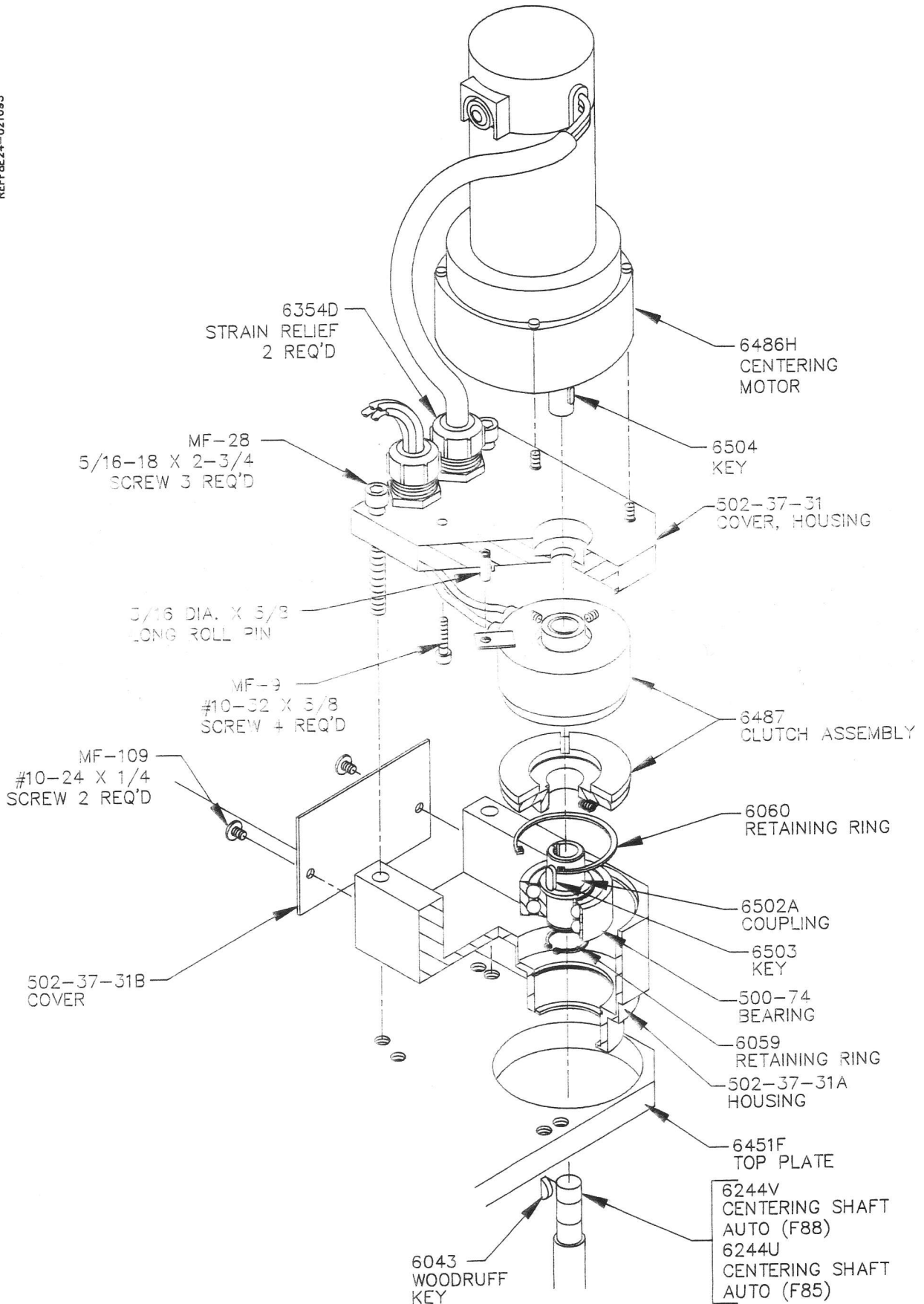


Centering Gear Housing



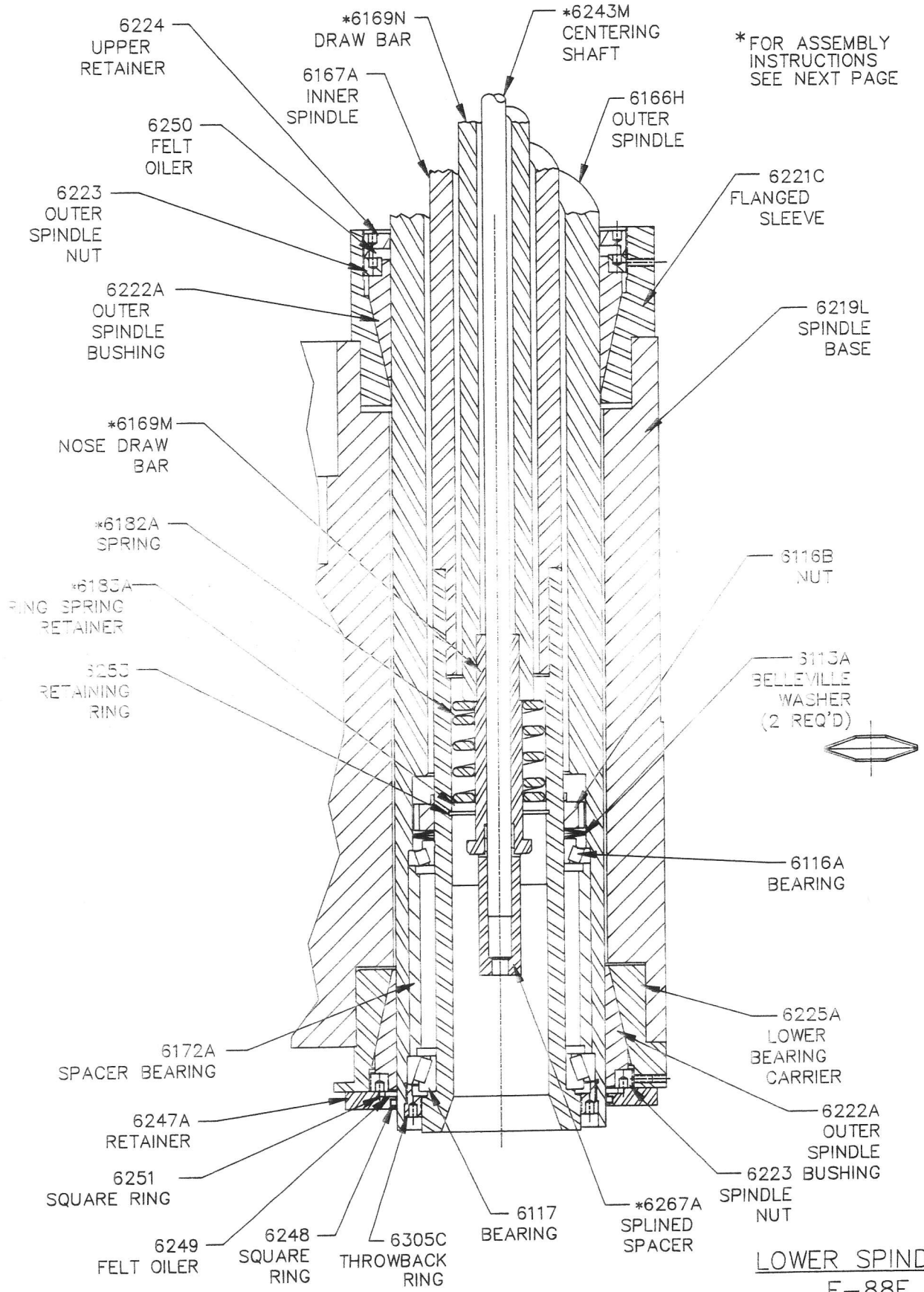
Top Plate Assembly Auto Centering

REFFB24-021095



Lower Spindle F88E (Roller Bearings)

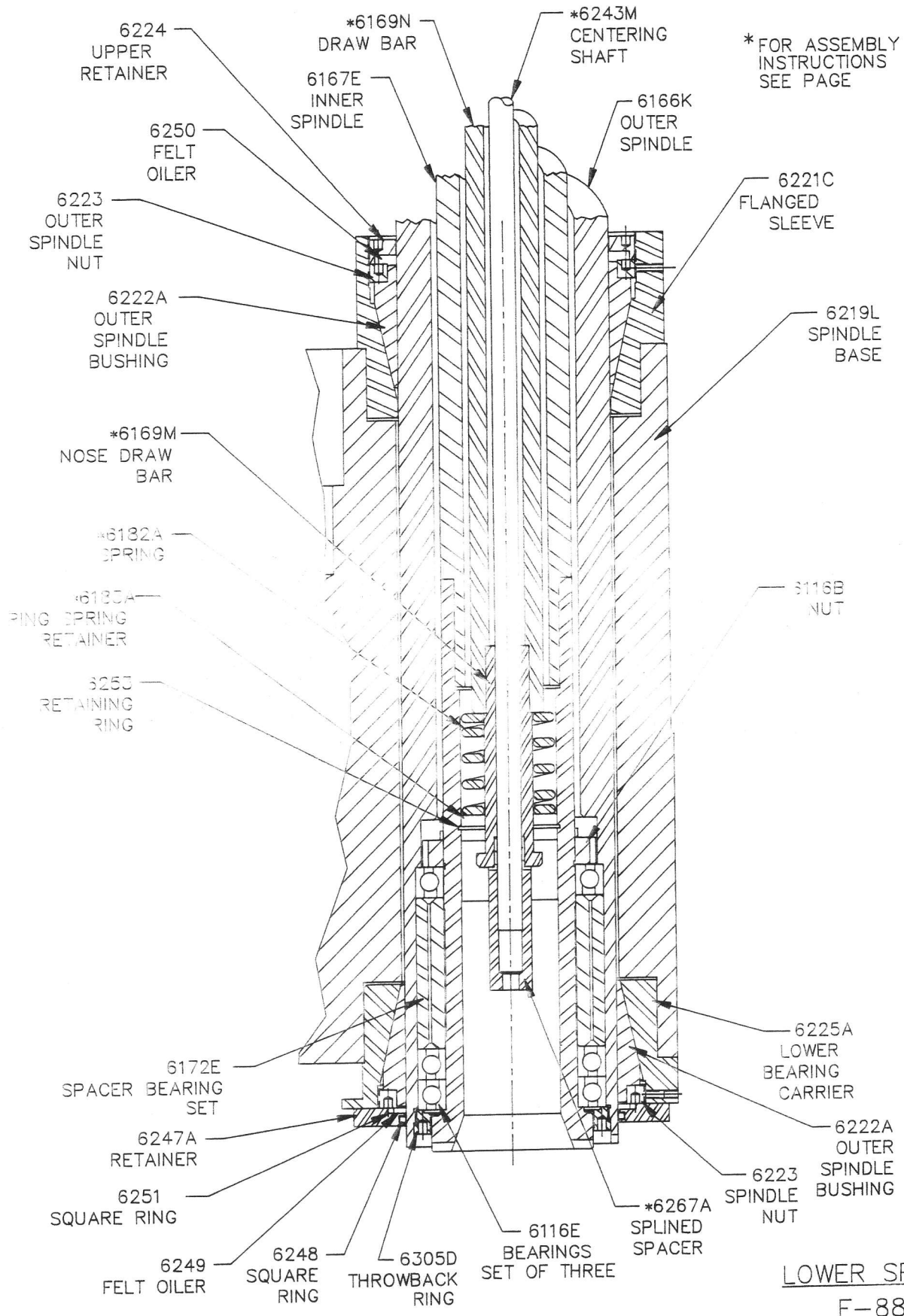
REF F8E17-011995



LOWER SPINDLE F-88E

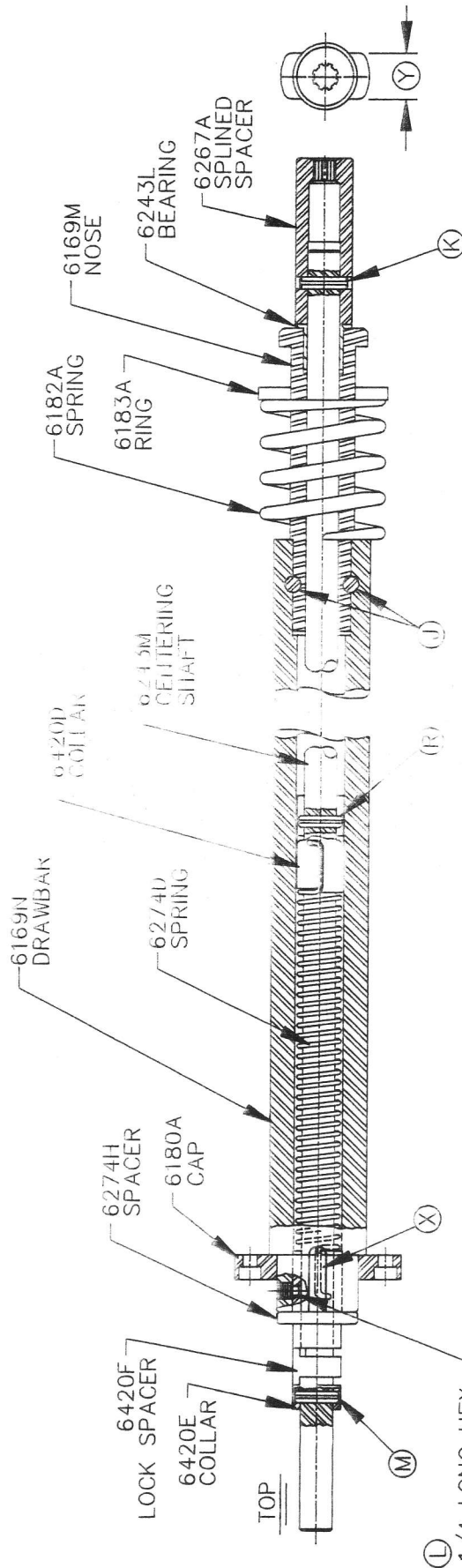
Lower Spindle F88E (Ball Bearings)

REFFBET6-011995



Draw Bar / Centering Shaft Assembly F88E

REFFB818-011895



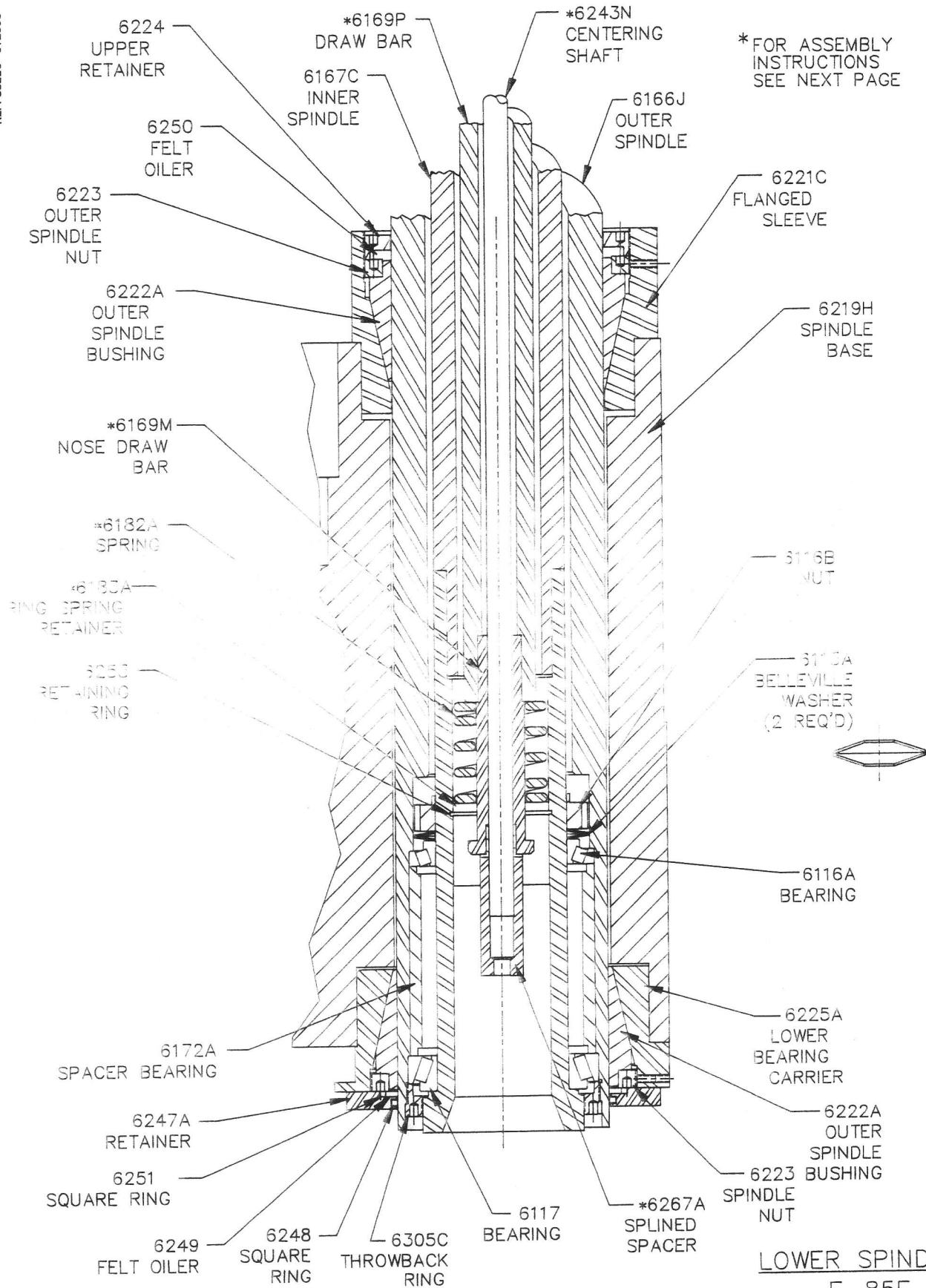
ASSEMBLY PROCEDURE

- ① ASSEMBLE RING (6183A) AND SPRING (6182A) ONTO NOSE (6169M). PRESS NOSE INTO DRAWBAR (6169N). CAUTION KEYWAY (X) AND LOCKING EARS (Y) TO BE TIED 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 ROLLPIN (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)

F-88E DRAWBAR/CENTERING SHAFT ASSEMBLY

Lower Spindle F85E (Roller Bearings)

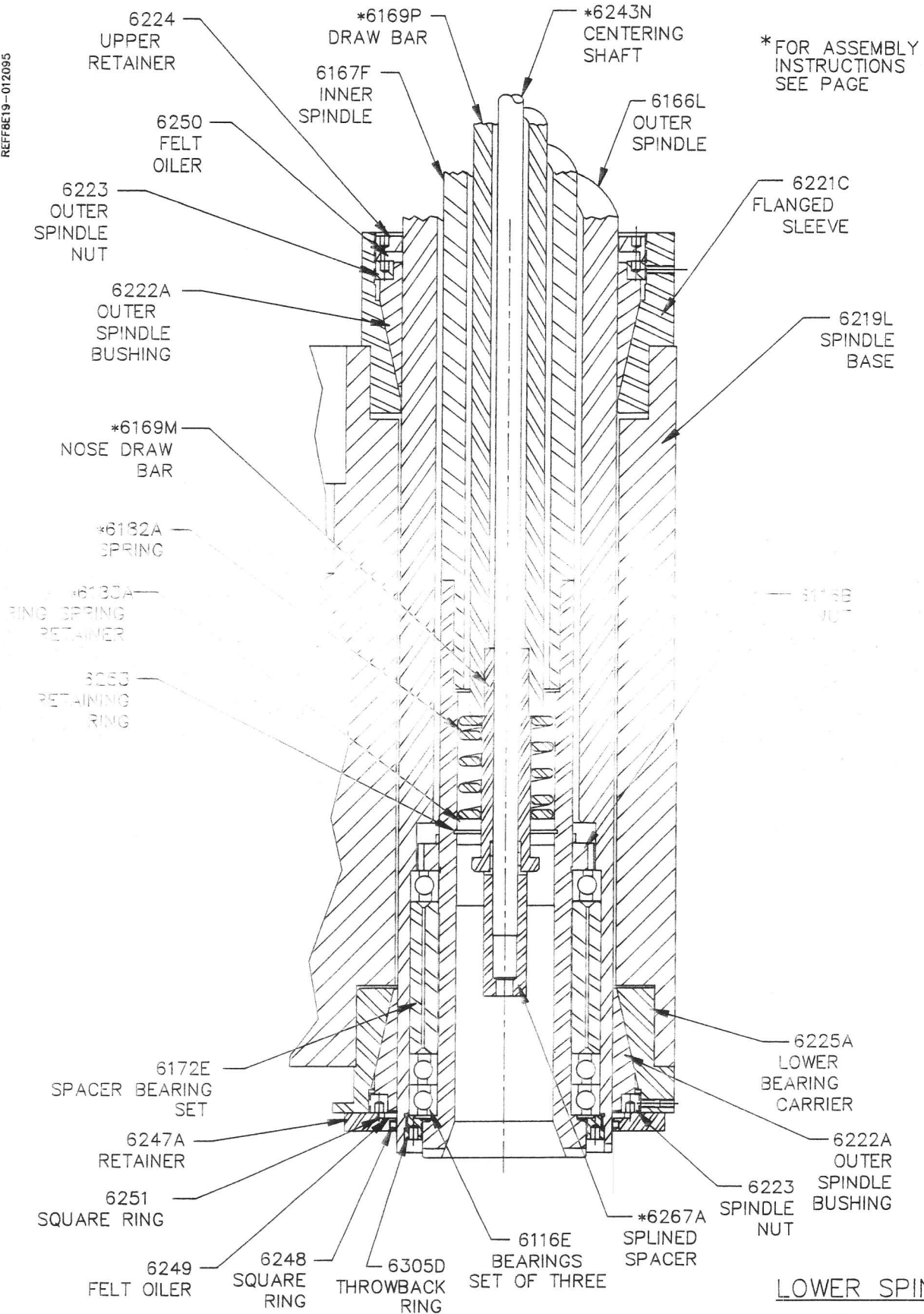
REF F85E20-012095



LOWER SPINDLE F-85E

Lower Spindle F85E (Ball Bearings)

REFFB19-012095



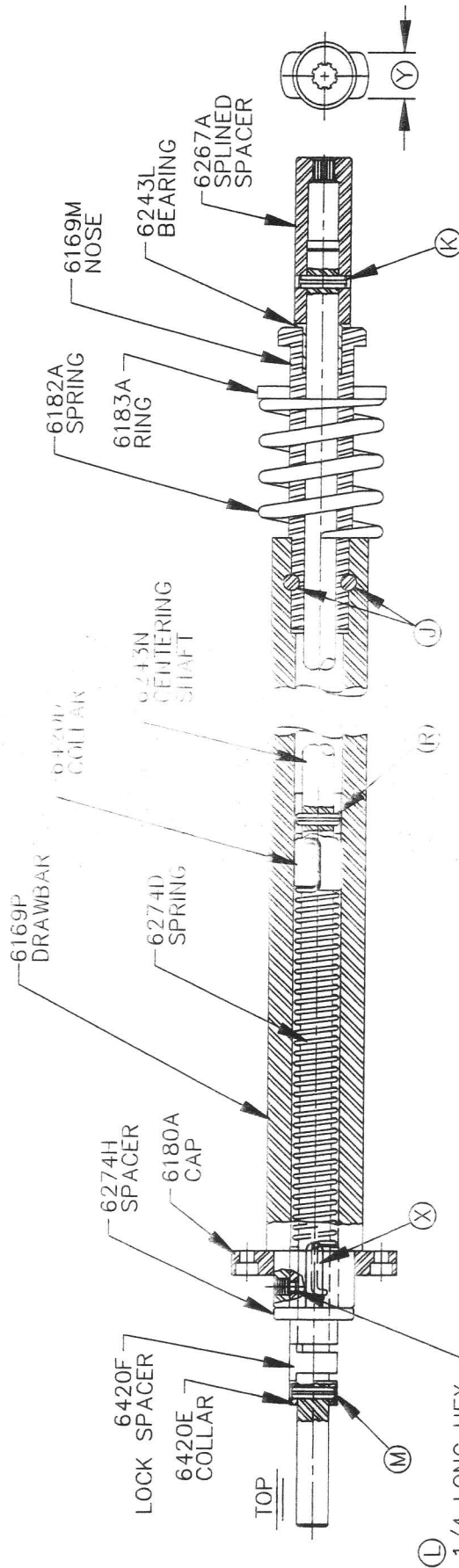
- 6224 UPPER RETAINER
- 6250 FELT OILER
- 6223 OUTER SPINDLE NUT
- 6222A OUTER SPINDLE BUSHING
- *6169M NOSE DRAW BAR
- *6182A SPRING
- *6183A RING SPRING RETAINER
- 6253 RETAINING RING
- 6172E SPACER BEARING SET
- 6247A RETAINER
- 6251 SQUARE RING
- 6249 FELT OILER
- 6248 SQUARE RING
- 6305D THROWBACK RING
- 6116E BEARINGS SET OF THREE
- *6267A SPLINED SPACER
- *6169P DRAW BAR
- 6167F INNER SPINDLE
- *6243N CENTERING SHAFT
- 6166L OUTER SPINDLE
- 6221C FLANGED SLEEVE
- 6219L SPINDLE BASE
- 6116E NUT
- 6225A LOWER BEARING CARRIER
- 6222A OUTER SPINDLE BUSHING
- 6223 SPINDLE BUSHING NUT

* FOR ASSEMBLY INSTRUCTIONS SEE PAGE

LOWER SPINDLE
F-85E

Draw Bar / Centering Shaft Assembly F85E

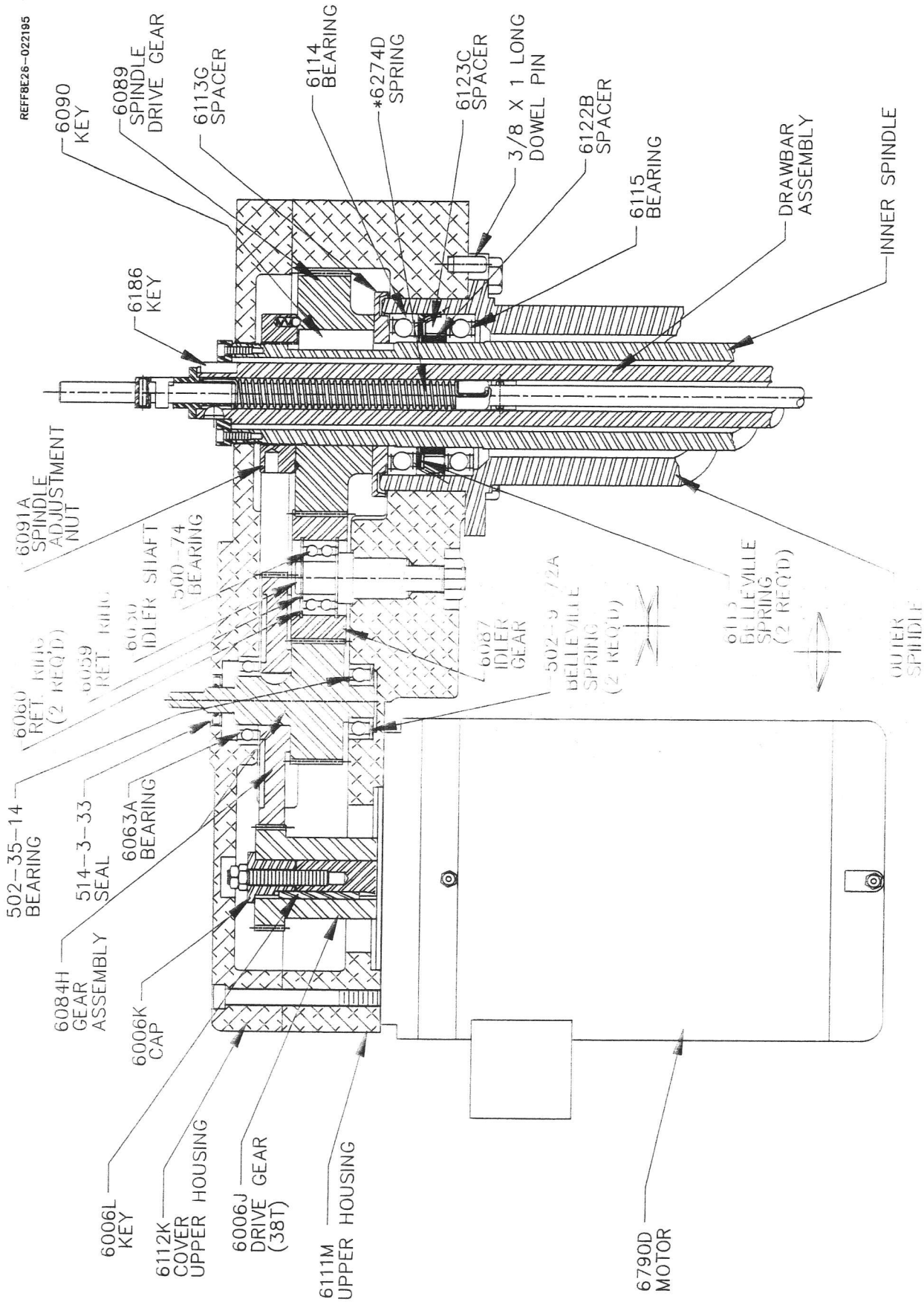
REFR21-012095



ASSEMBLY PROCEDURE

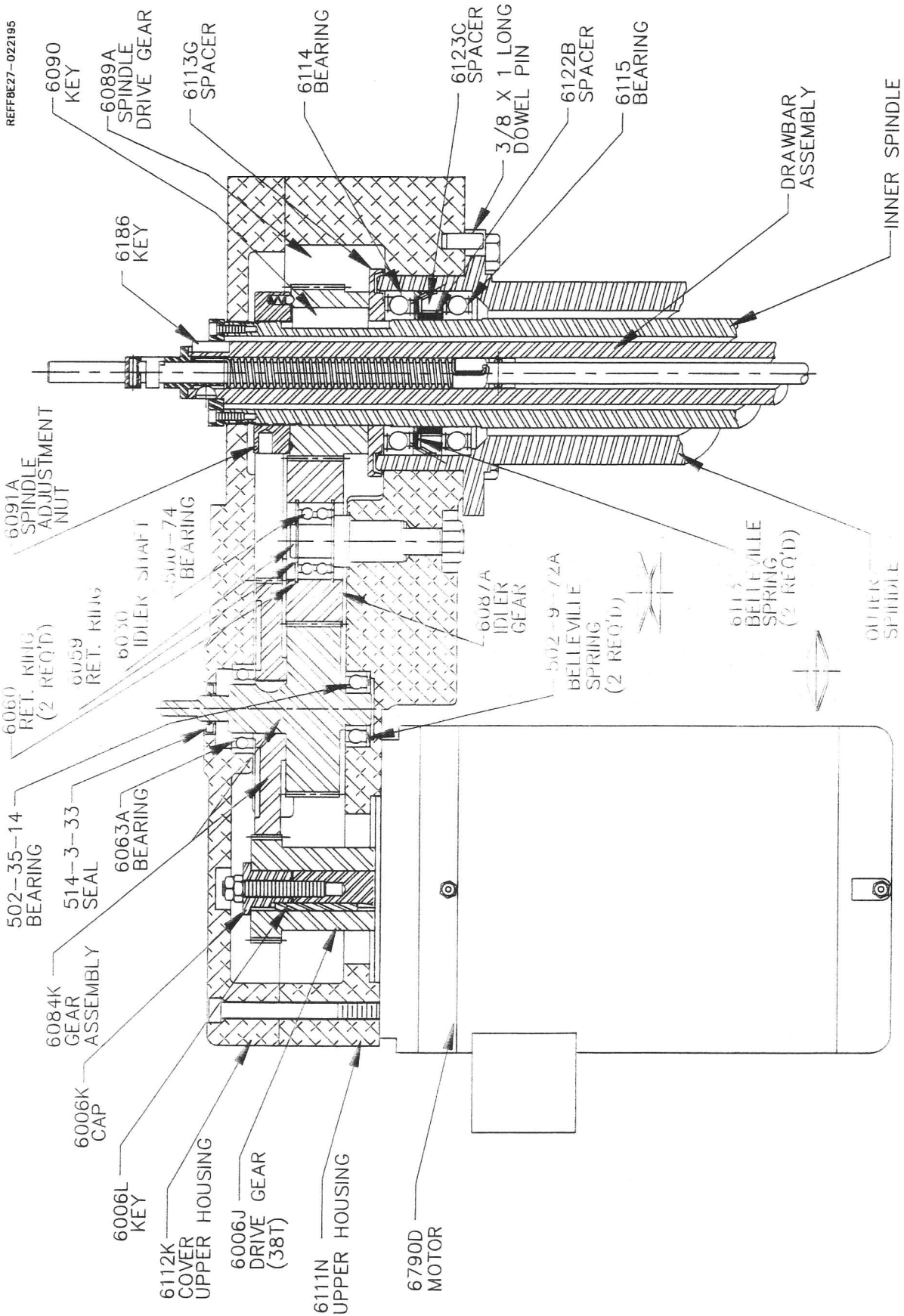
- ① ASSEMBLE RING (6183A) AND SPRING (6182A) ONTO NOSE (6169M). PRESS NOSE INTO DRAWBAR (6169P). CAUTION KEYWAY (X) AND LOCKING EARS (Y) TO BE THREADED 90° AS SHOWN. INSTALL (2) 1/4 X 3/4 LONG DOWEL PINS (J).
- ② INSERT CENTERING SHAFT (6243N) FROM TOP. SLIDE ON SPLINED SPACER (6267A). PIN WITH 3/16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

Upper Housing F88E



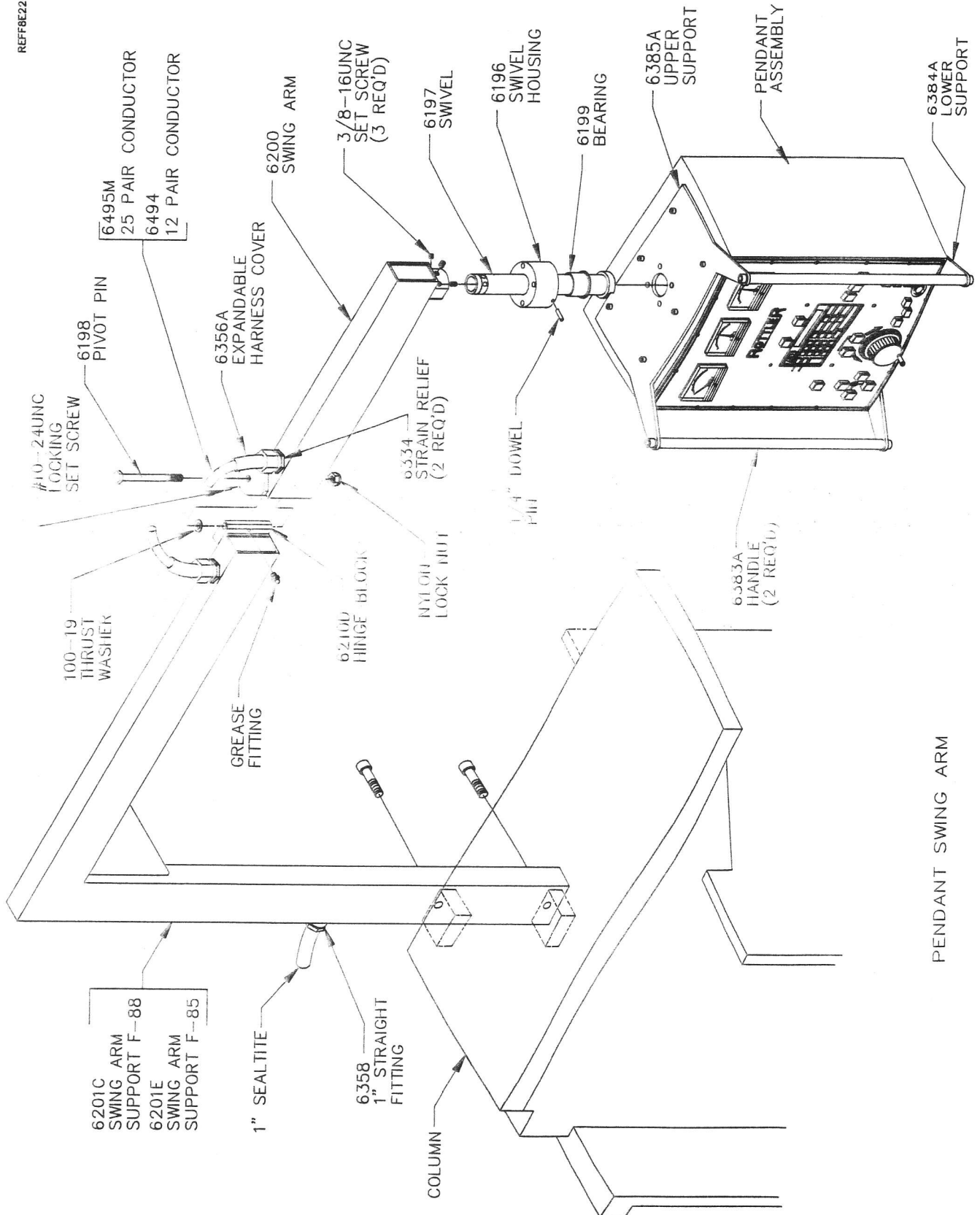
UPPER HOUSING F 88

Upper Housing F85E



Pendant Swing Arm

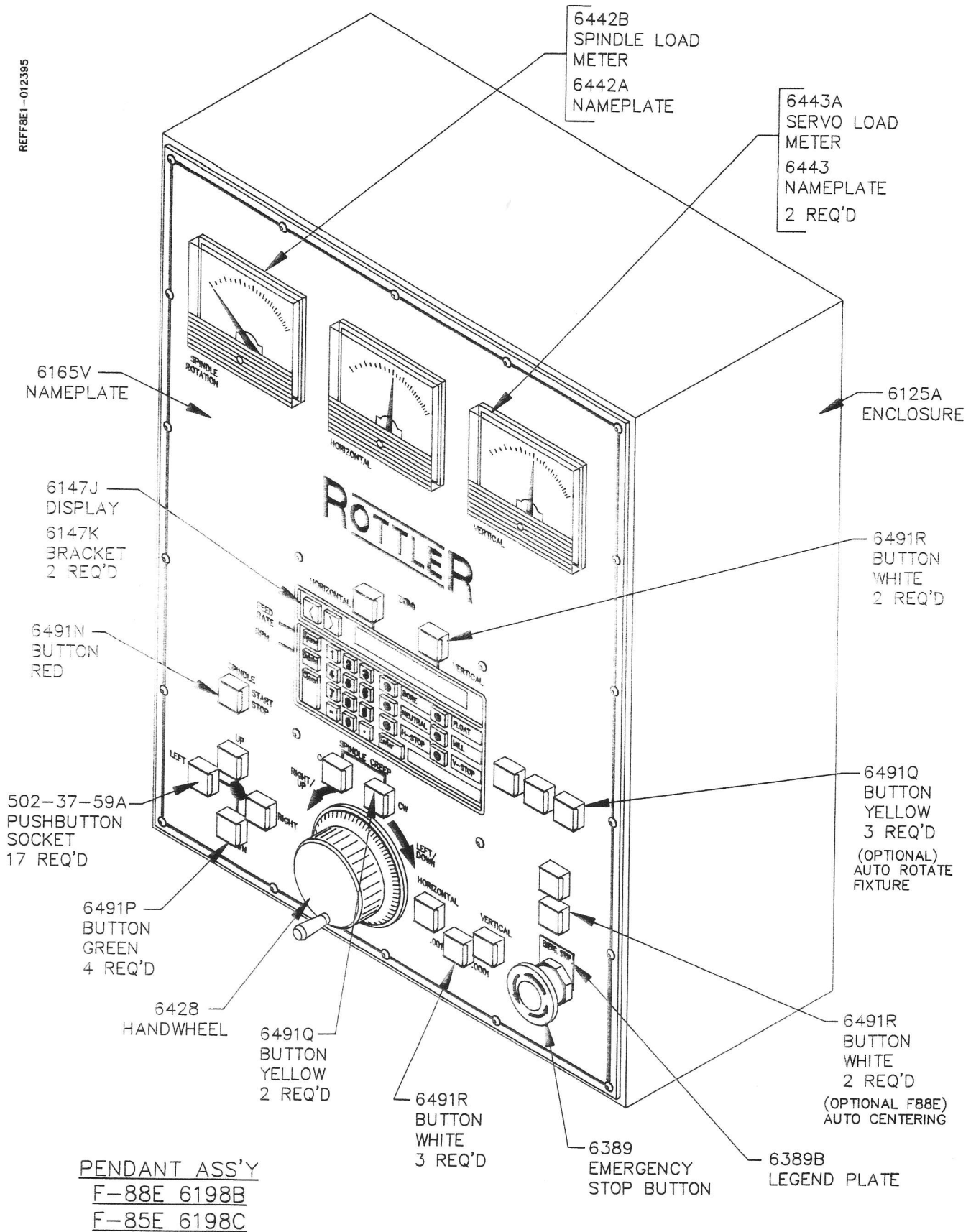
REFFB22-012395



PENDANT SWING ARM

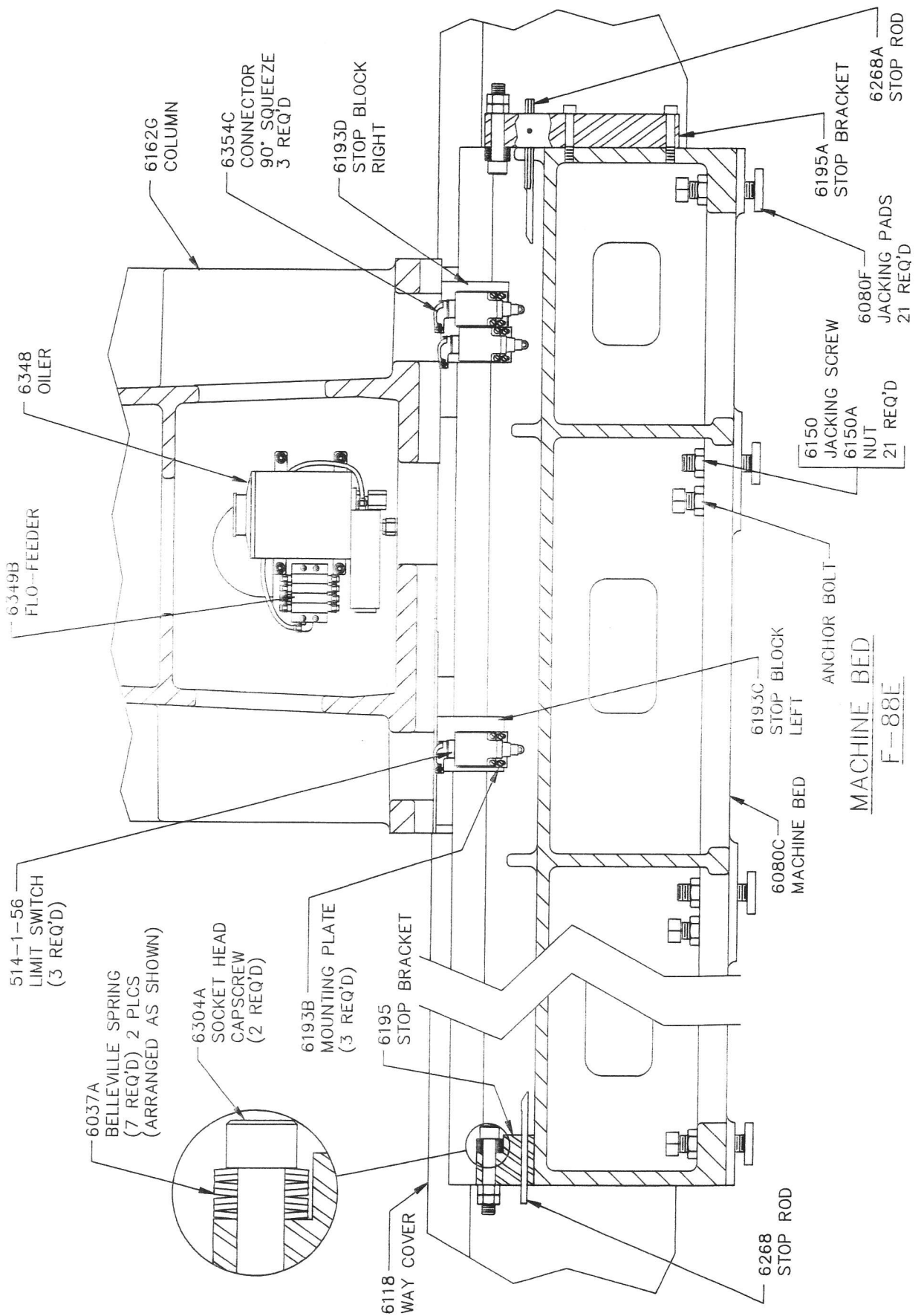
Pendant Assembly

REF B E I - 012395



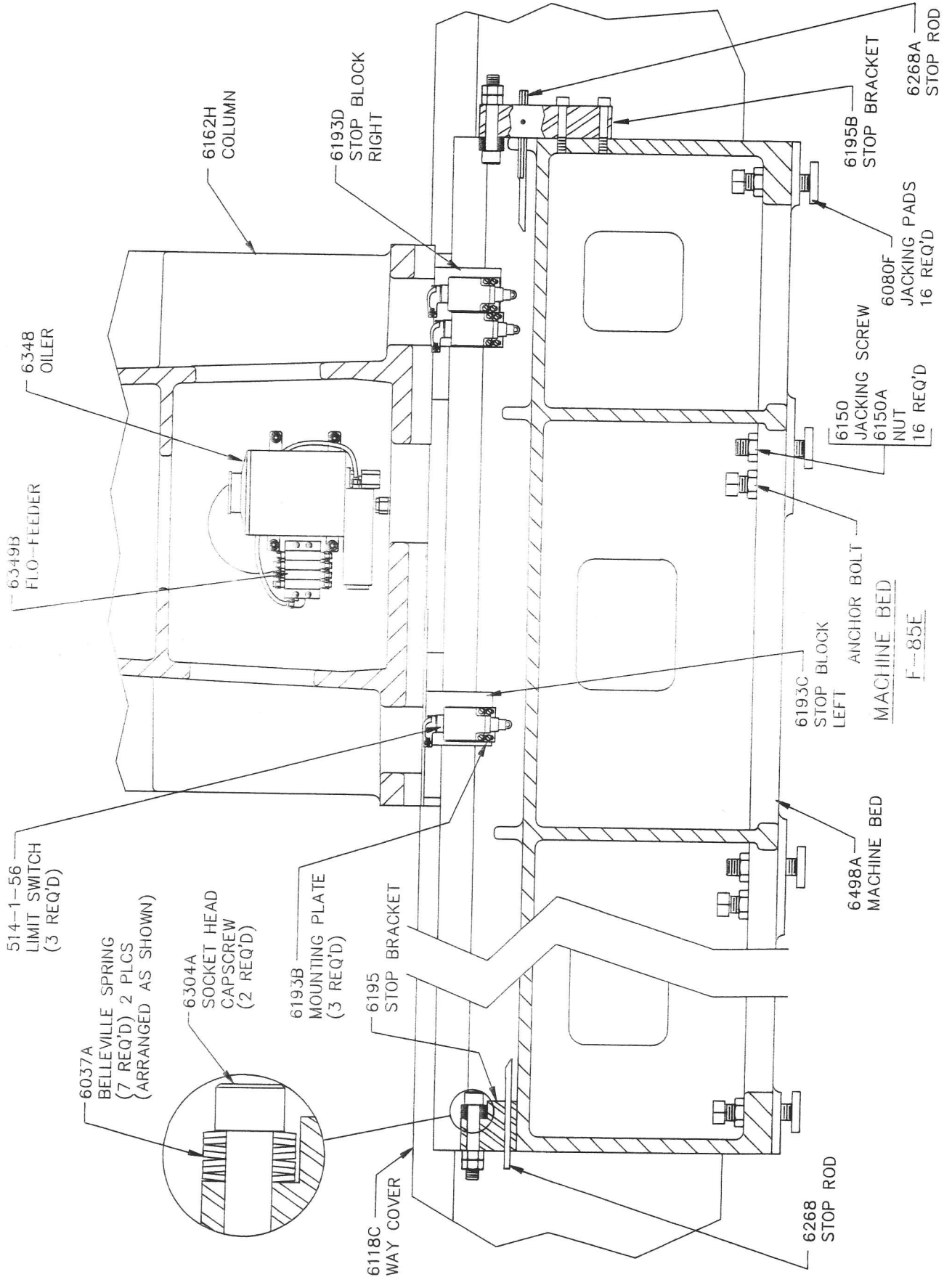
Machine Bed F88E

REF F8E30-022195



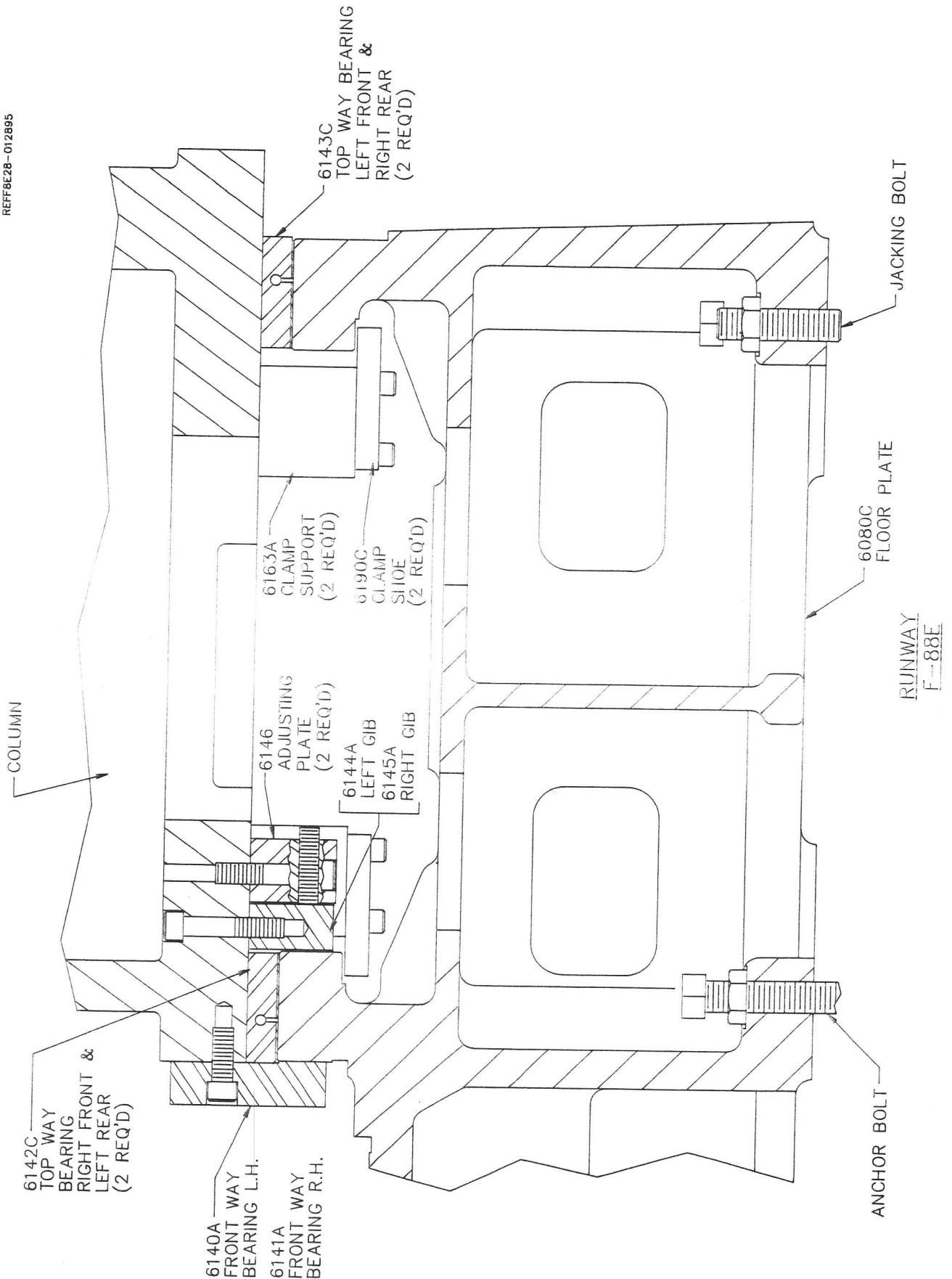
Machine Bed F85E

REFFB31-022195

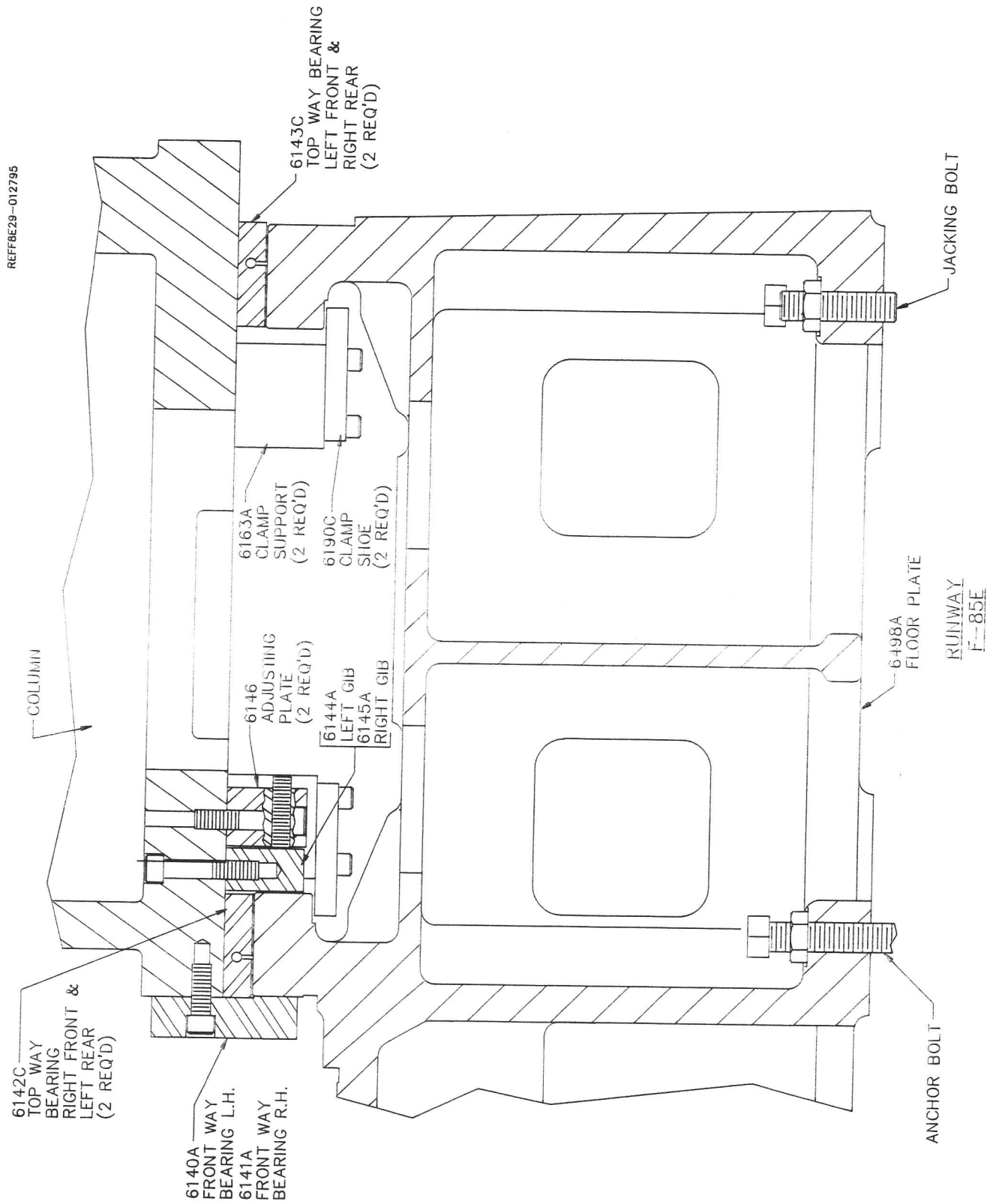


Runway F88E

REF F8E2B-012895

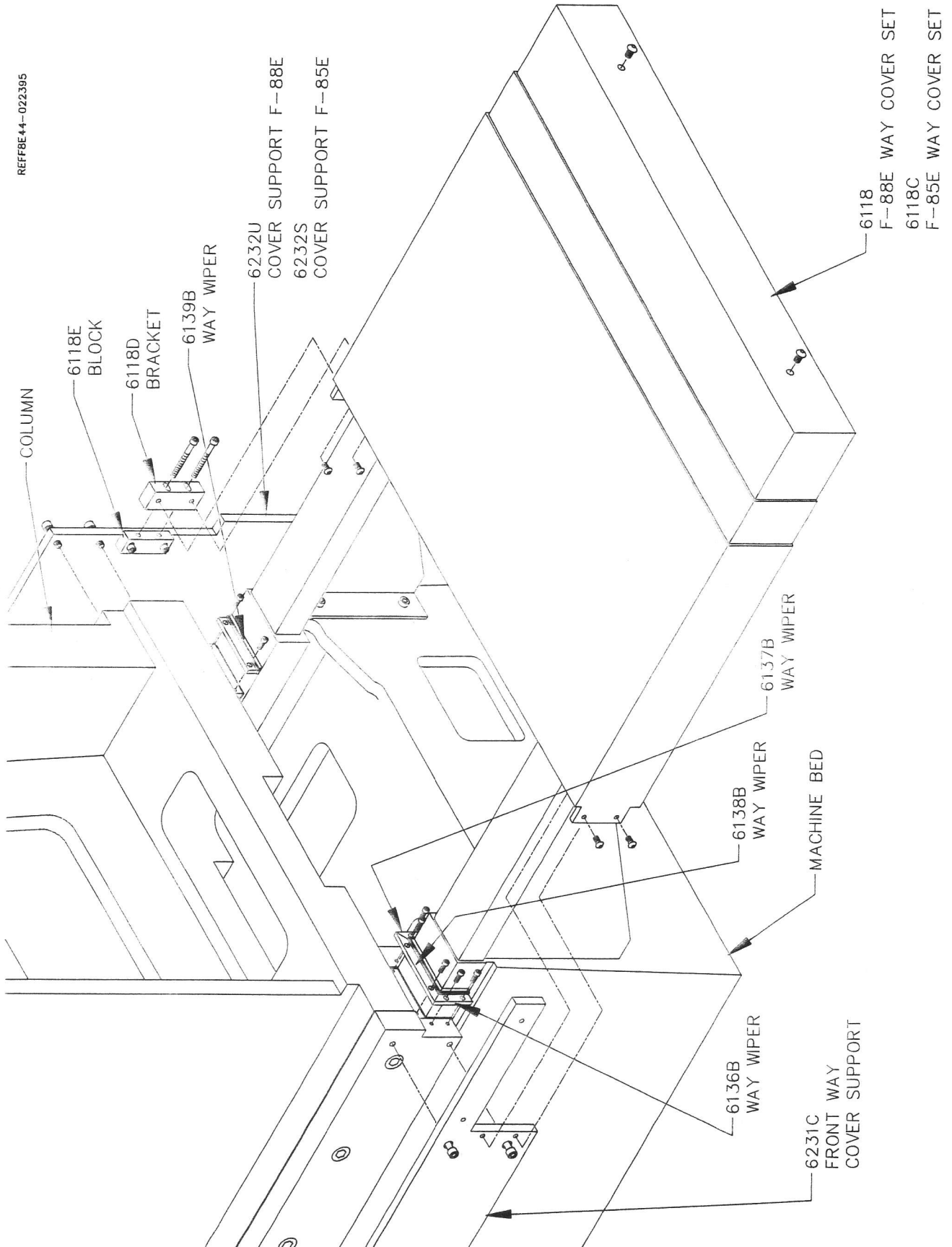


Runway F85E



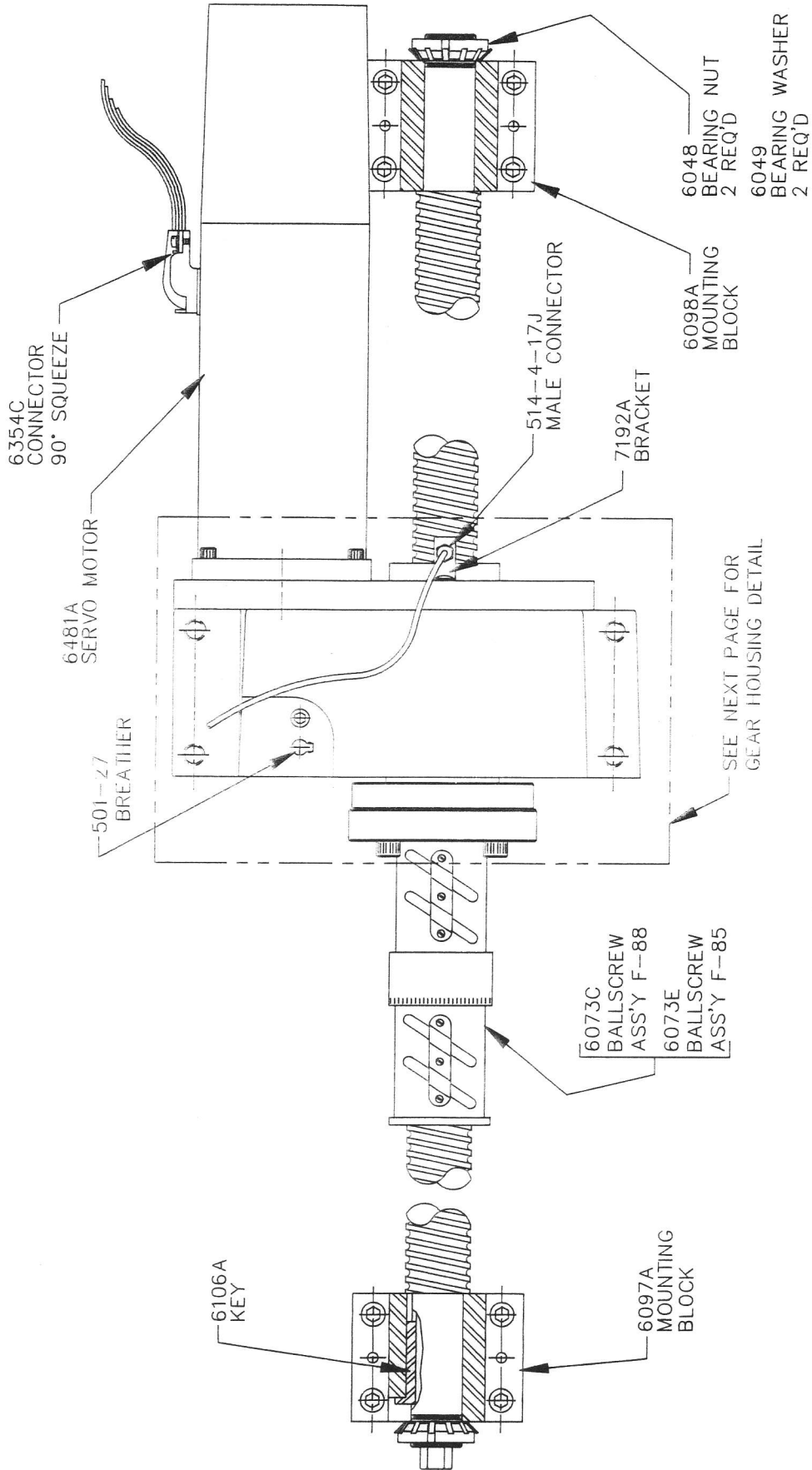
Way Cover Assembly

REFFB44-022395



Column Drive Assembly

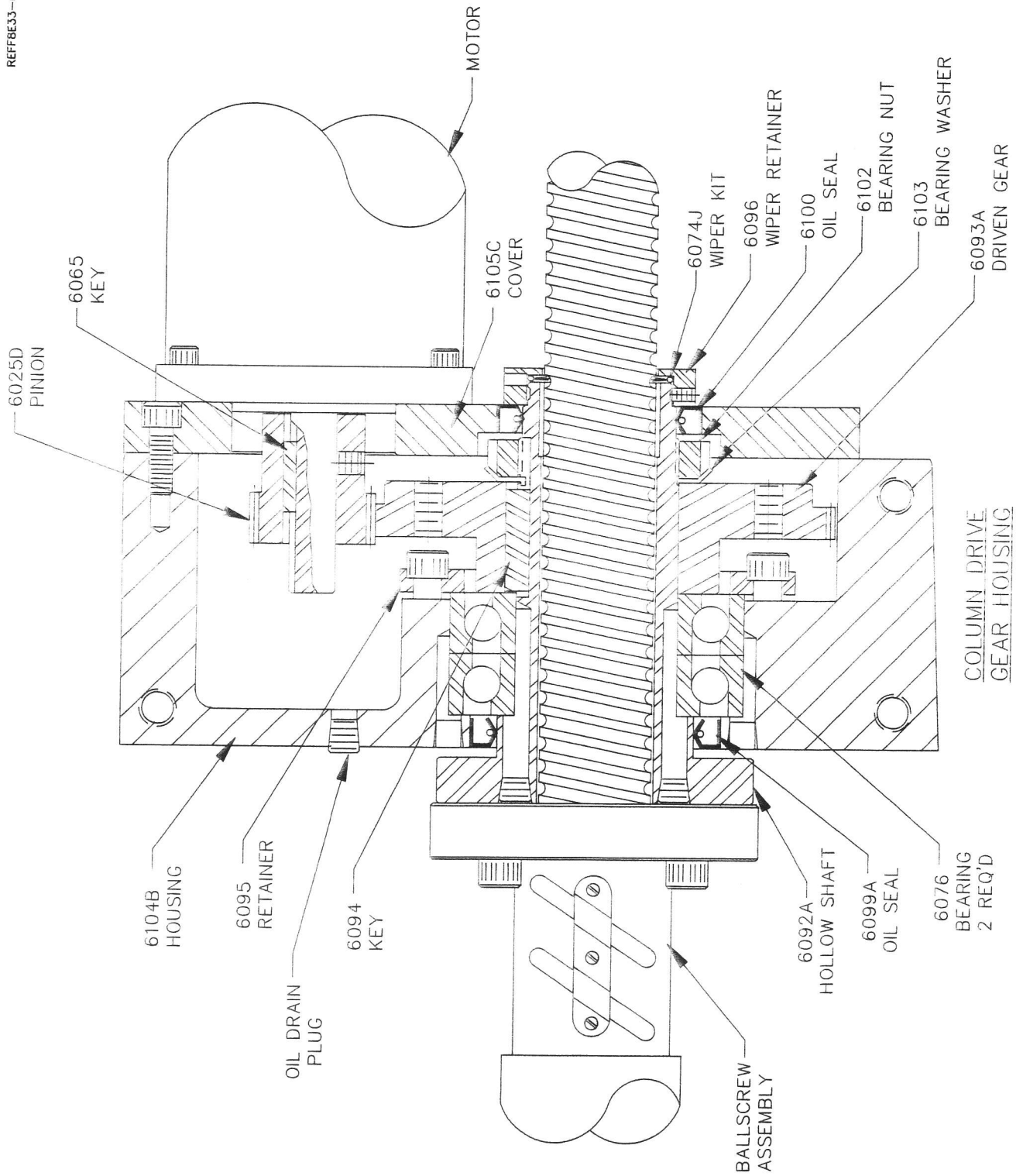
REF8E32-031695



COLUMN DRIVE ASSEMBLY

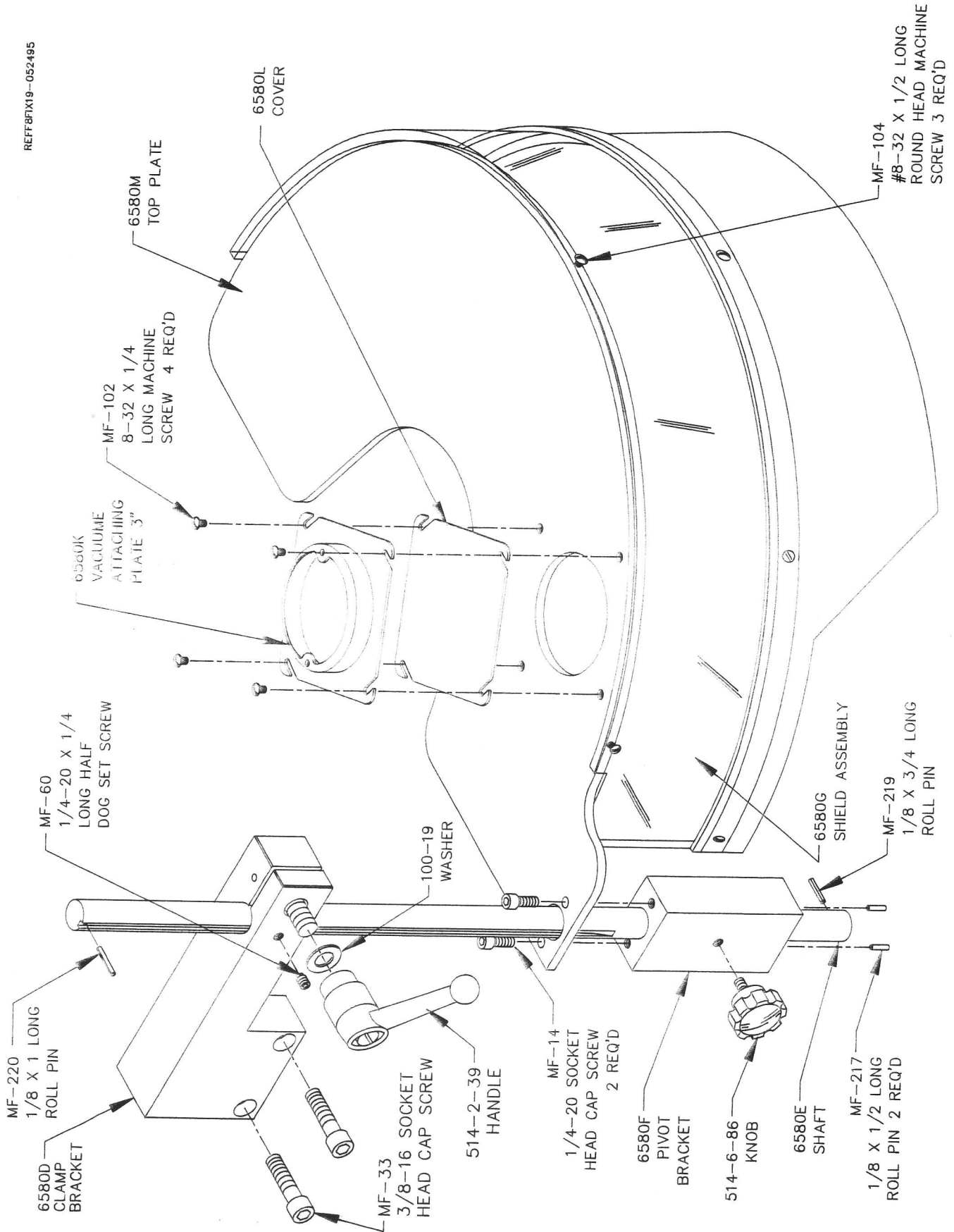
Column Drive Gear Housing

REFFB33-031695



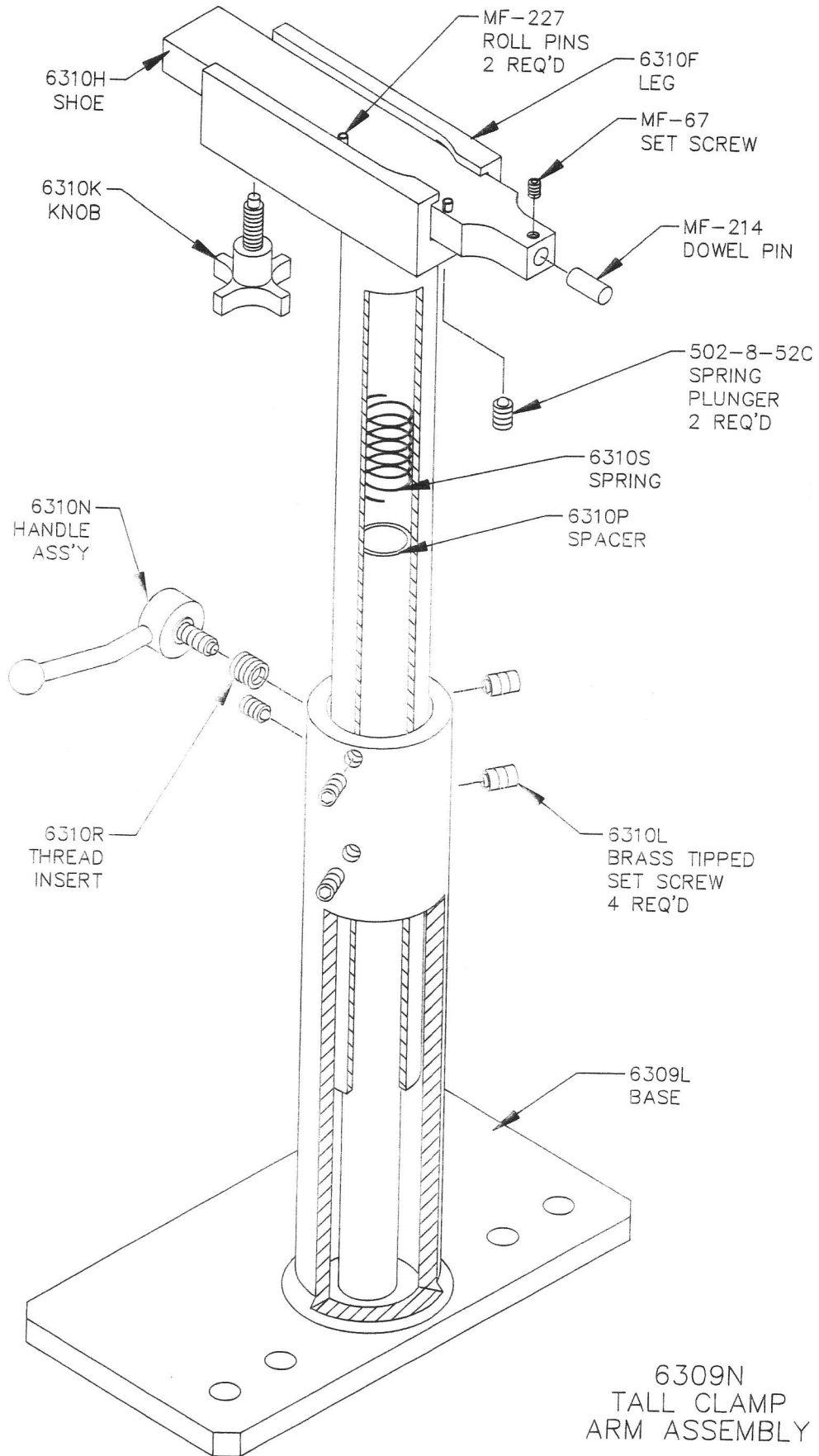
Chip Shield Assembly #6580C

REF: 87X19-052495



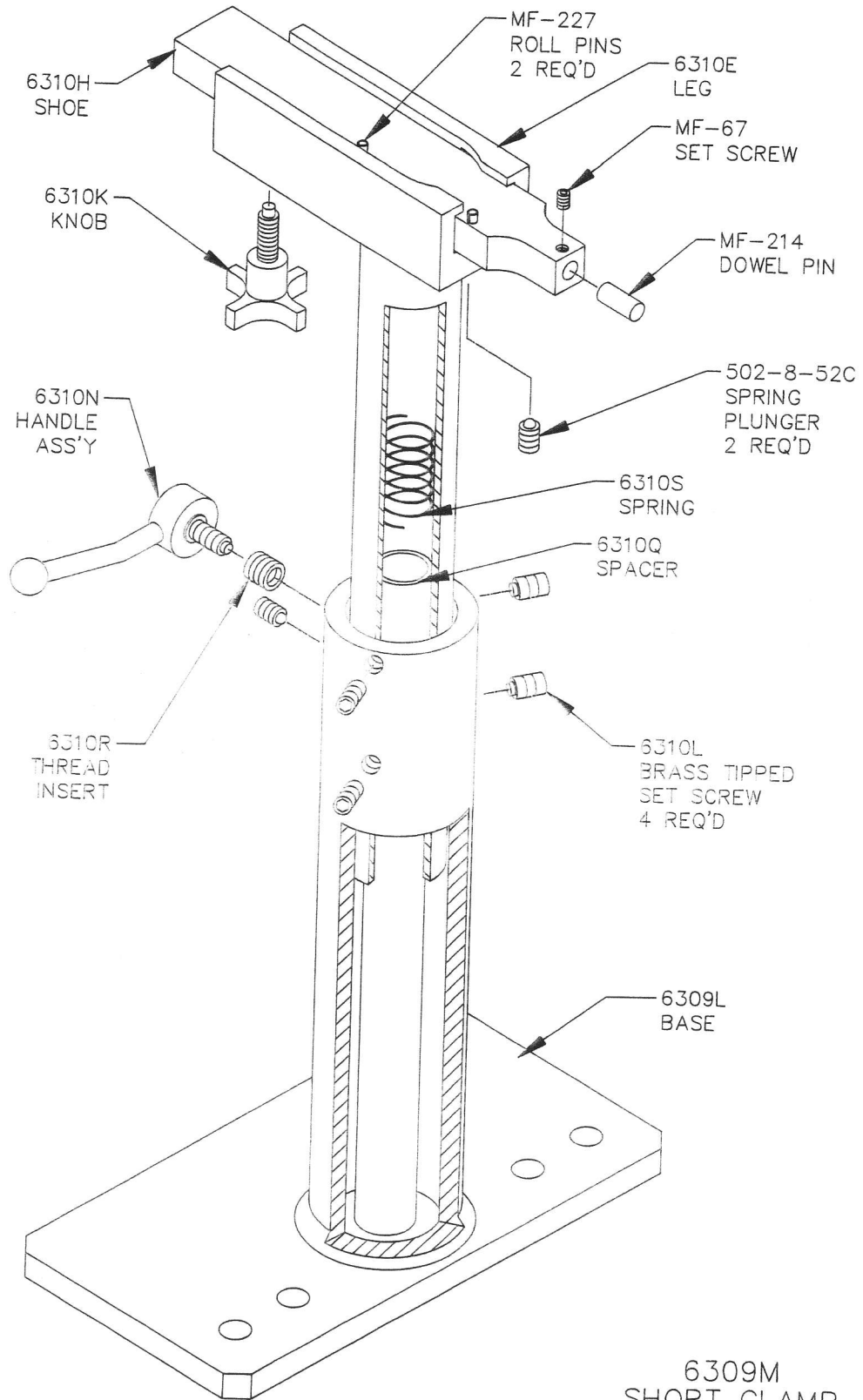
Tall Clamp Arm Assembly

REFFBX10-031795



Short Clamp Arm Assembly

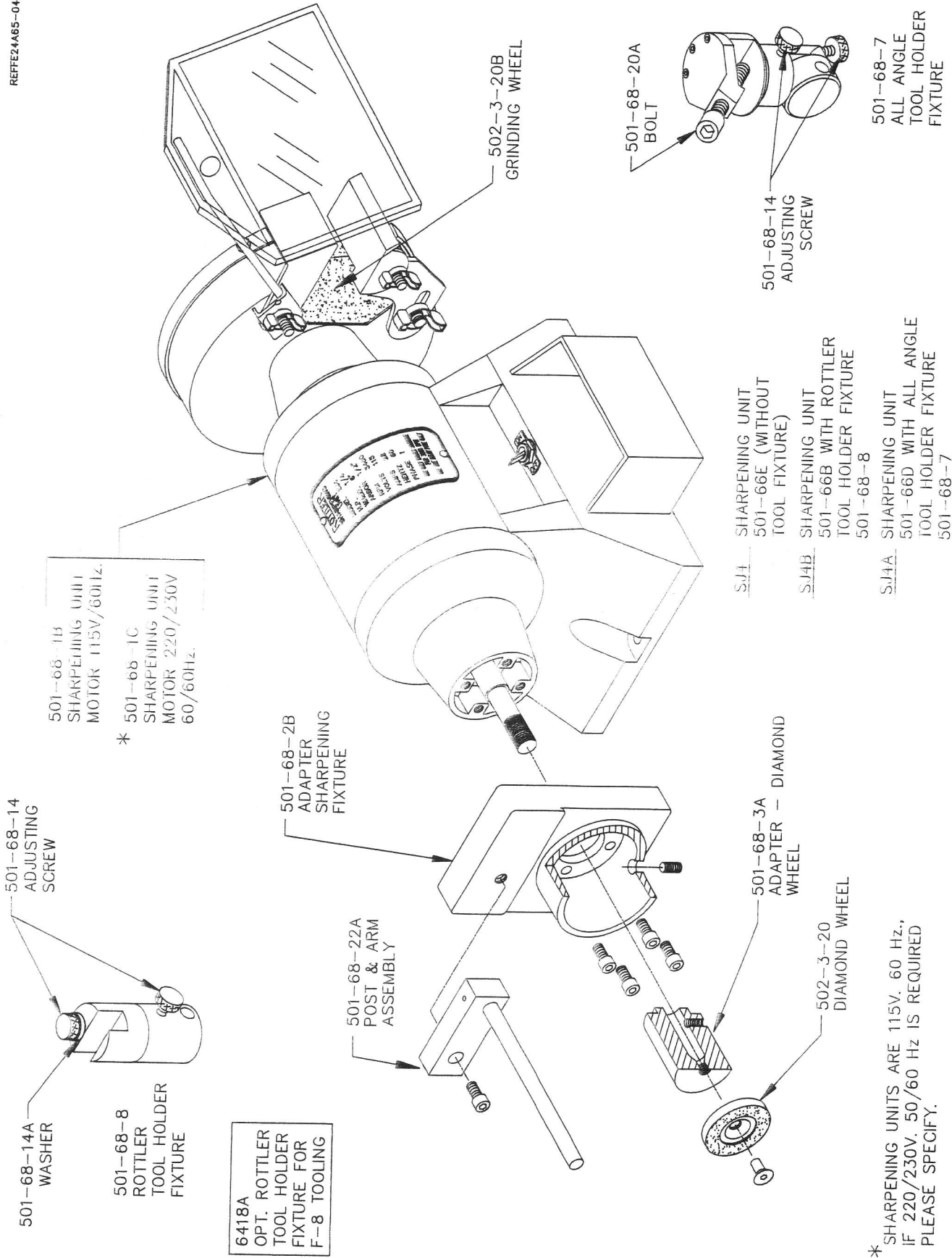
REFFBFIX11-031795



6309M
SHORT CLAMP
ARM ASSEMBLY

SJ4 Sharpener Assembly

REFFE24465-040794

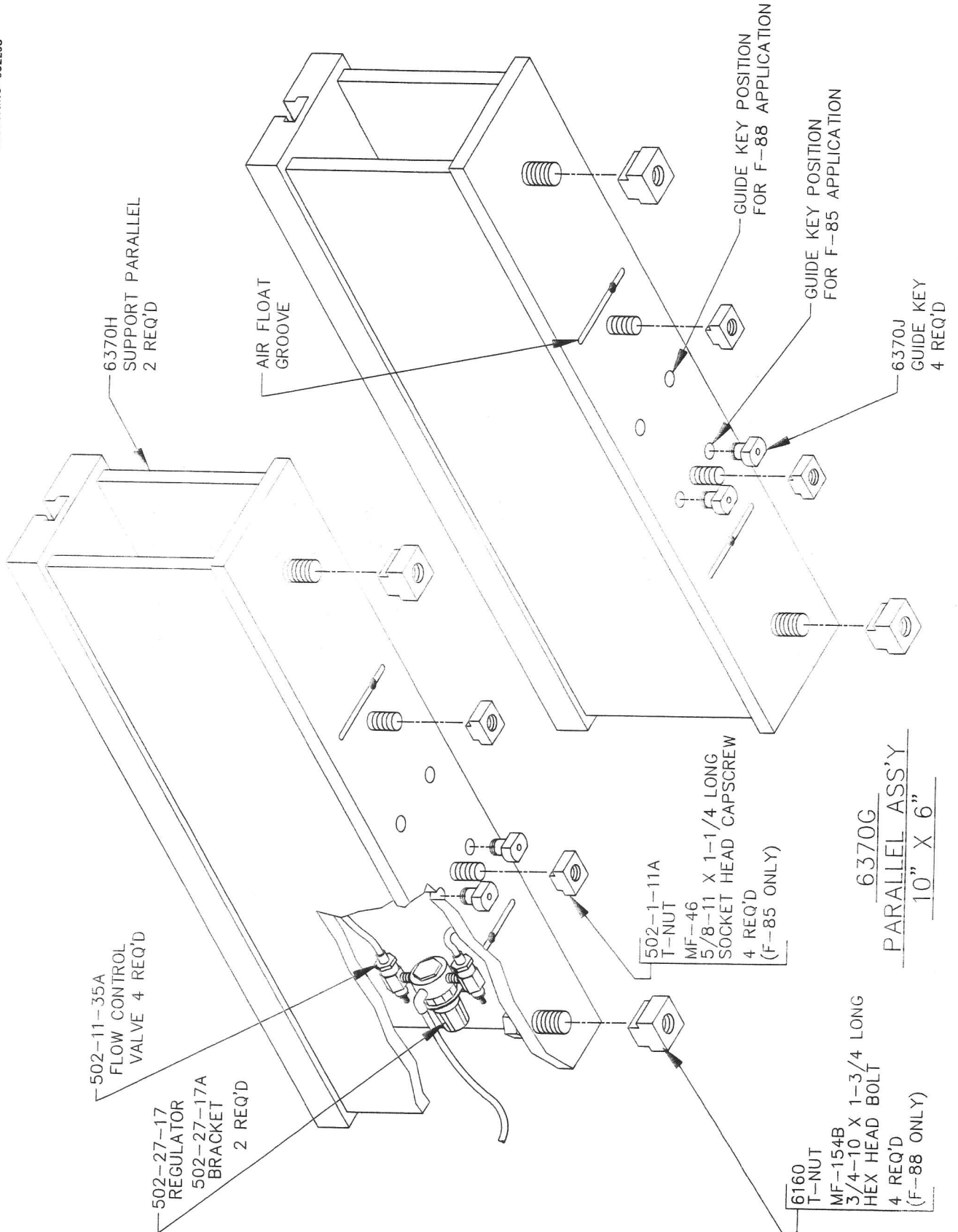


* SHARPENING UNITS ARE 115V. 60 Hz., IF 220/230V. 50/60 Hz IS REQUIRED PLEASE SPECIFY.

- SJ4 SHARPENING UNIT
- 501-66E (WITHOUT TOOL FIXTURE)
- SJ4B SHARPENING UNIT
- 501-66B WITH ROTTLER TOOL HOLDER FIXTURE
- 501-68-8
- SJ4A SHARPENING UNIT
- 501-66D WITH ALL ANGLE TOOL HOLDER FIXTURE
- 501-68-7

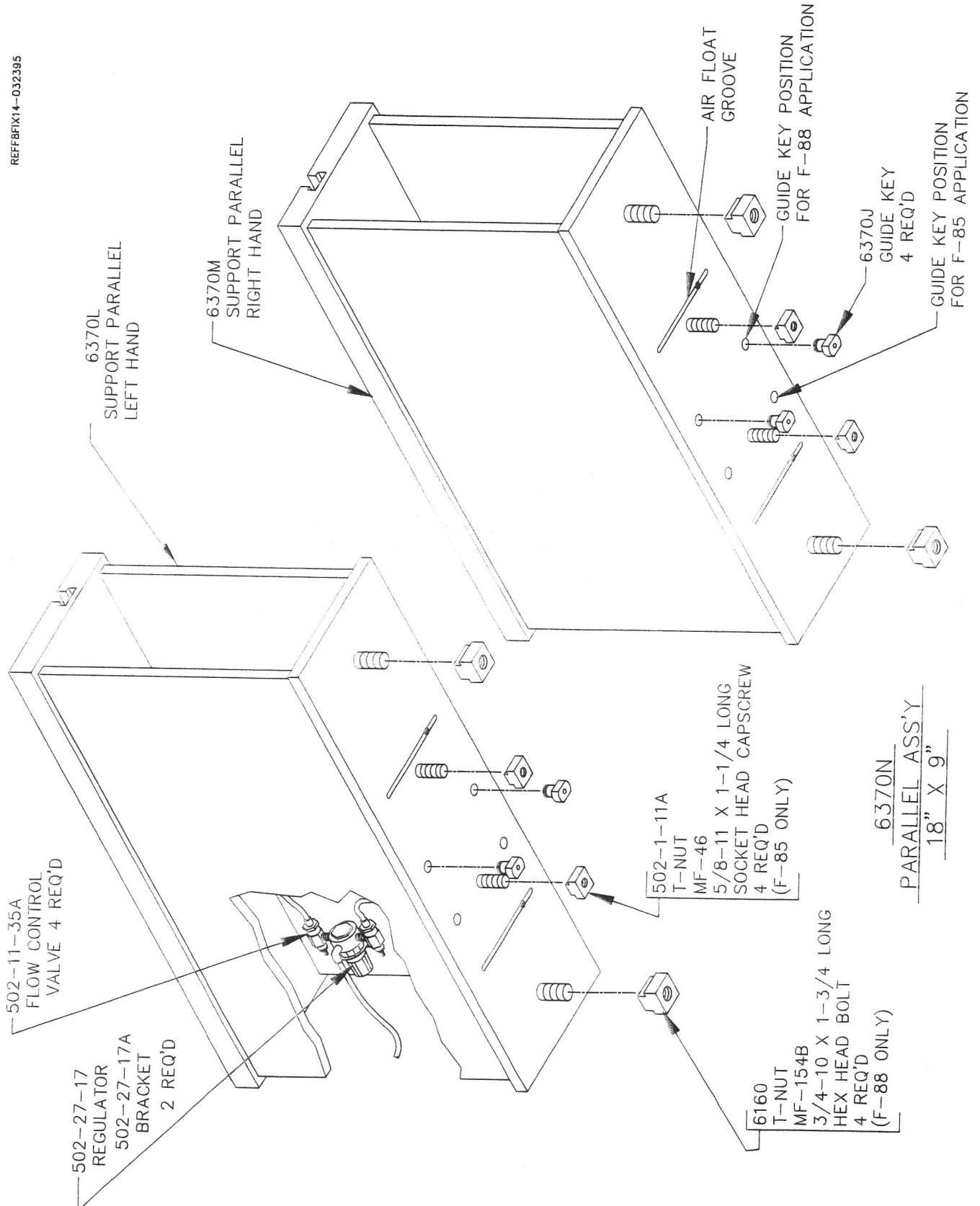
10" x 6" Parallel Assembly

REFFBFK13-032295



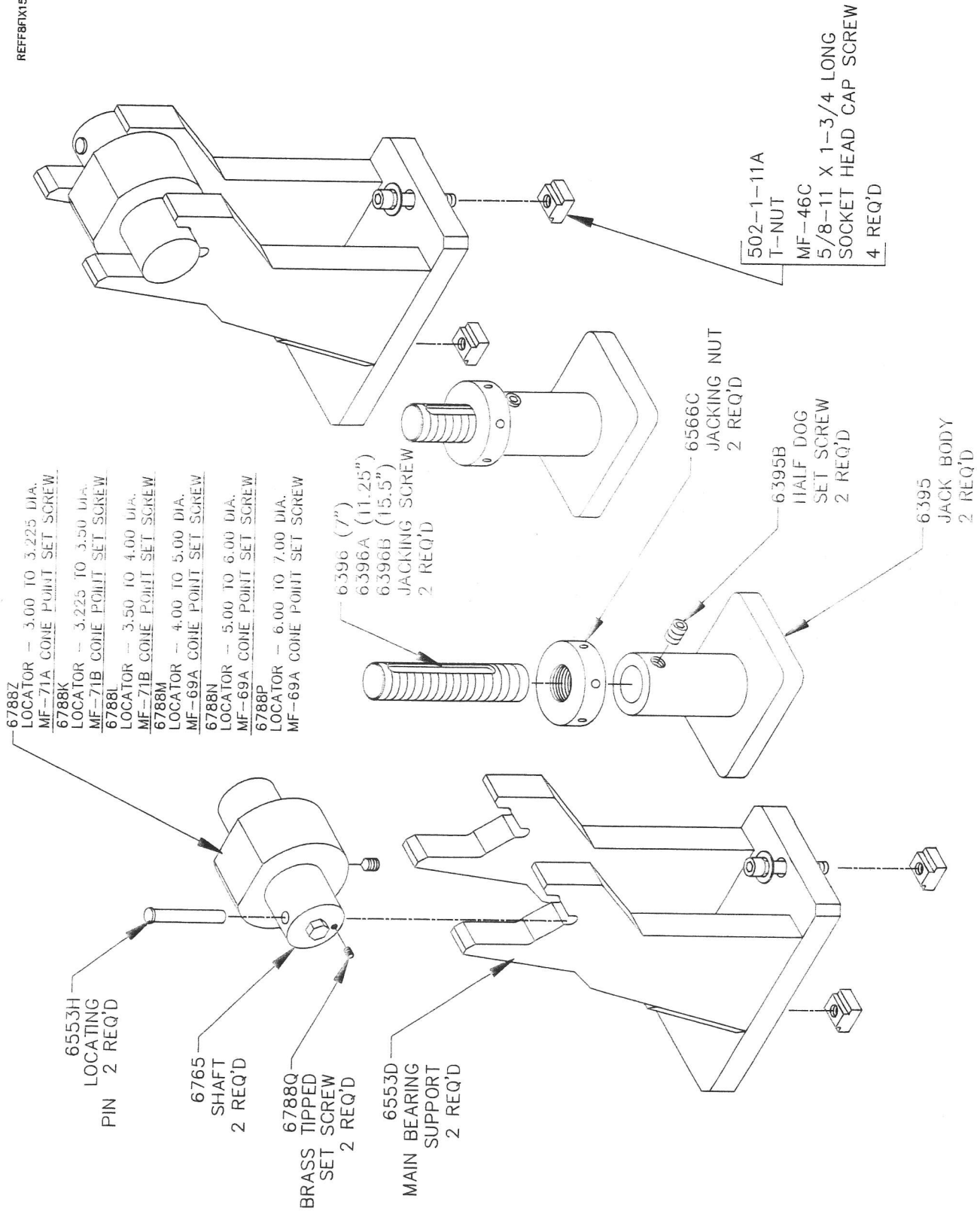
18" x 9" Parallel Assembly

REFFBX14-032395

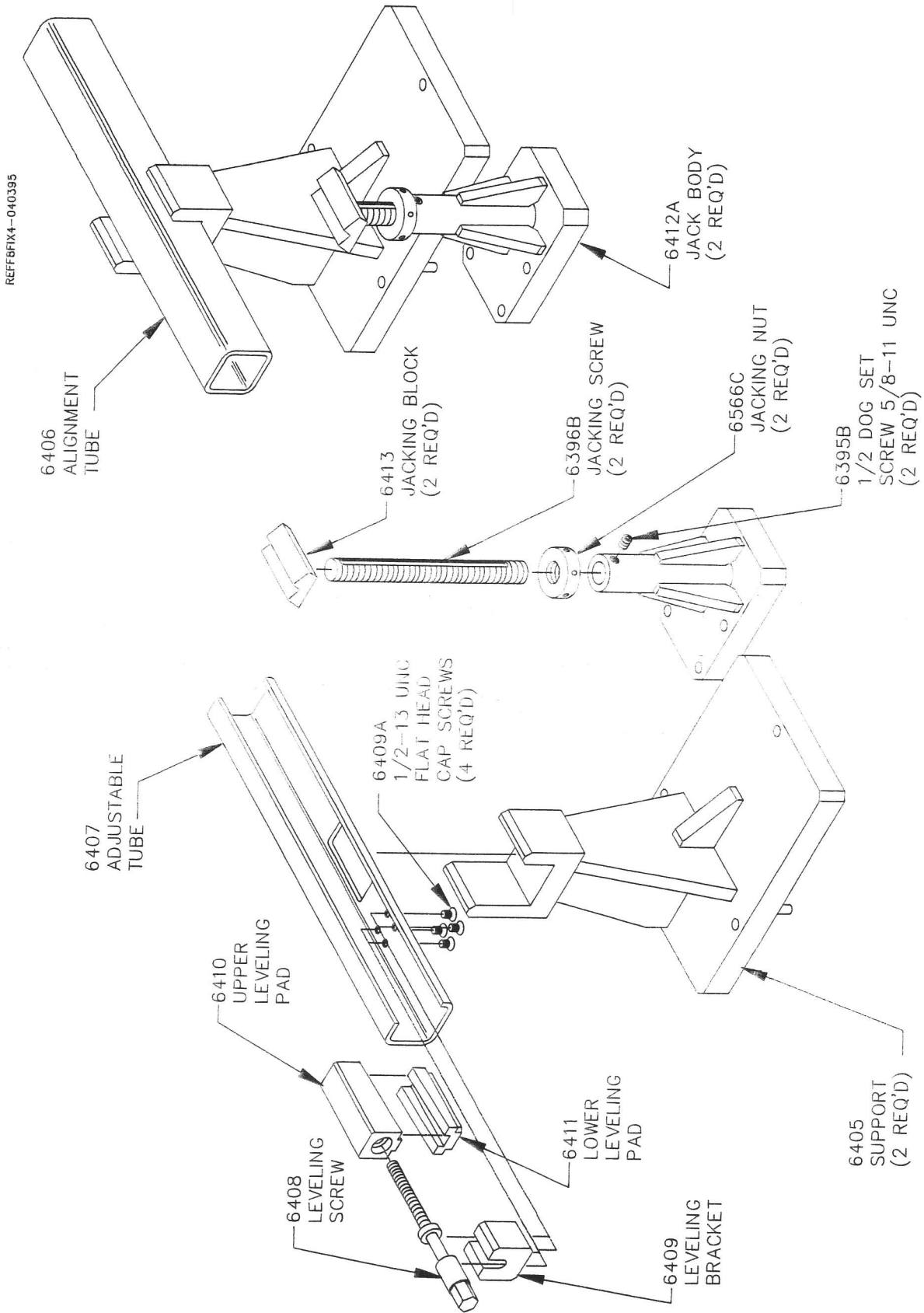


Diesel Fixture

REFFBX15-060595



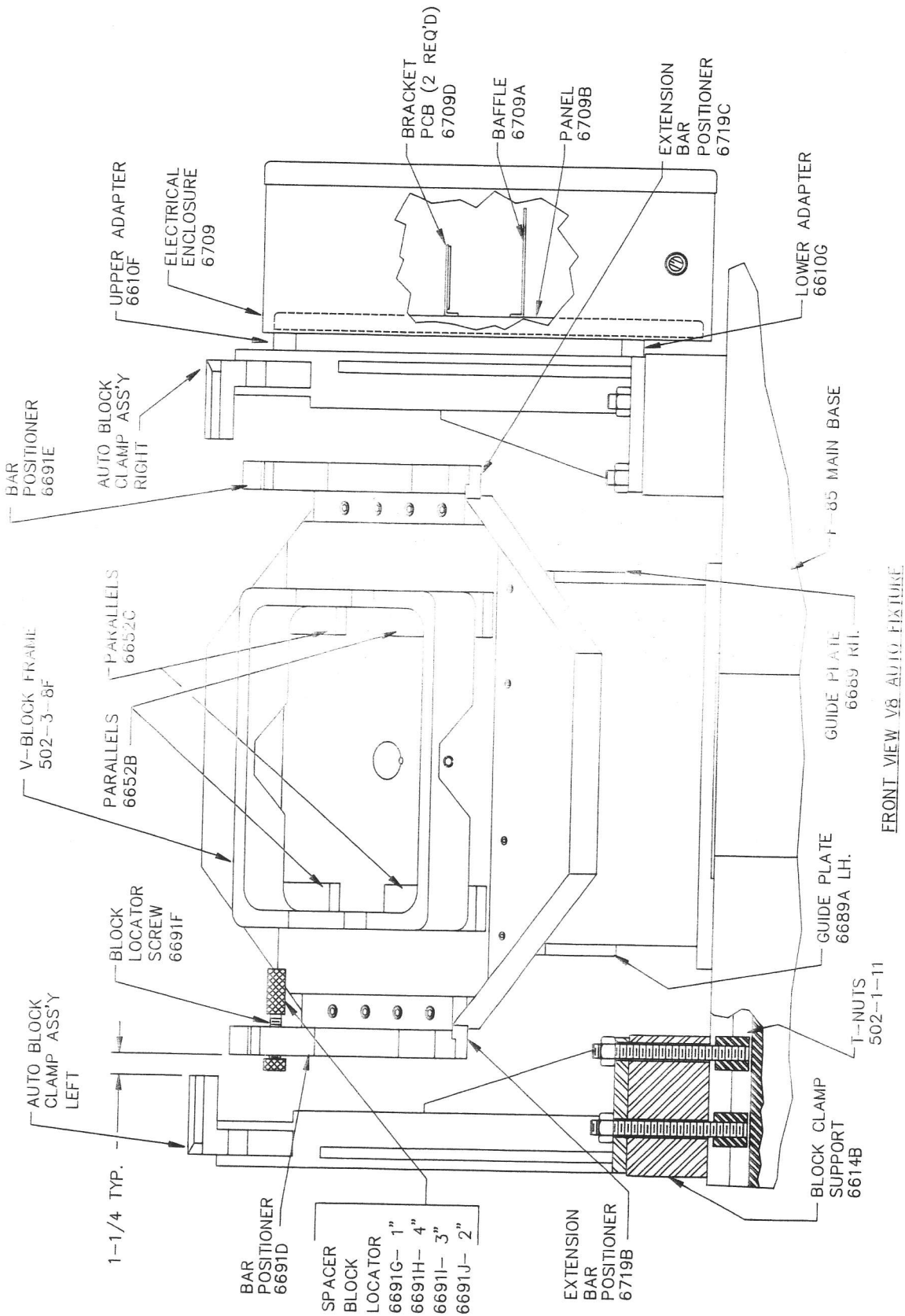
399 Cat Block Fixture



399 CAT BLOCK
FIXTURE 6405A

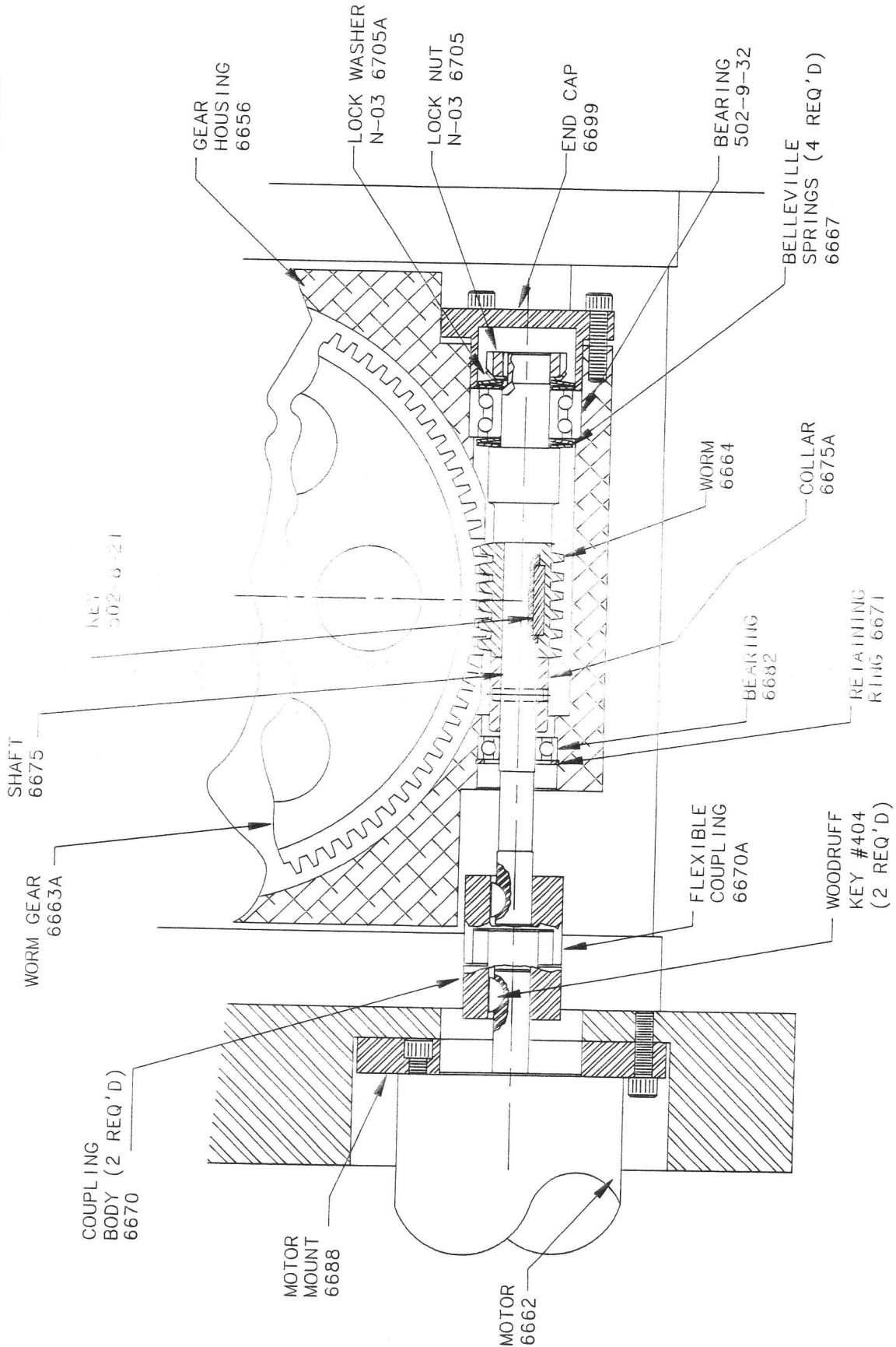
Front View V8 Auto Rotate Fixture

REF8VAF23-040495



Rotational Drive Ass'y

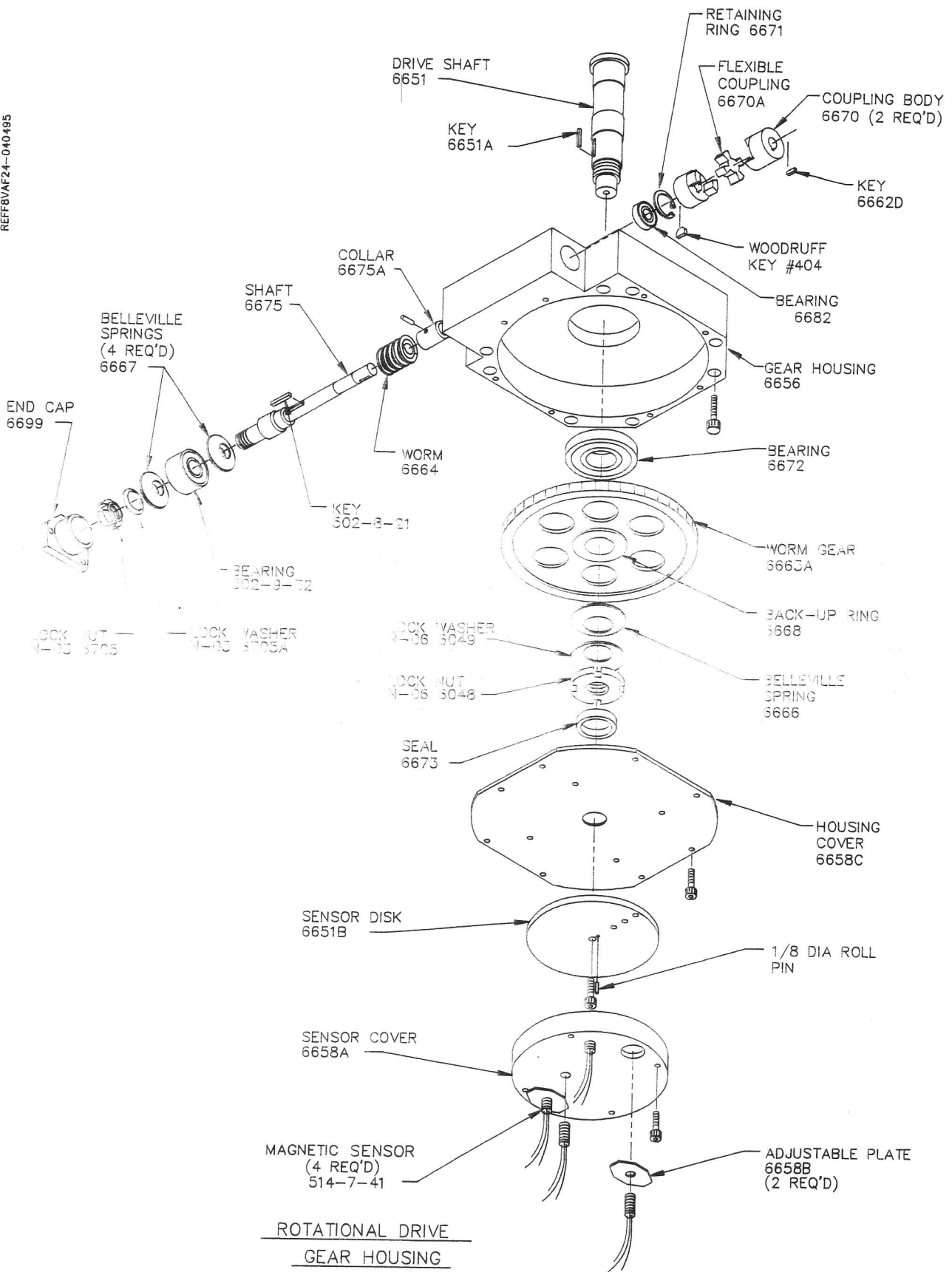
REFFBVAF6-040495



ROTATIONAL DRIVE ASS'Y.

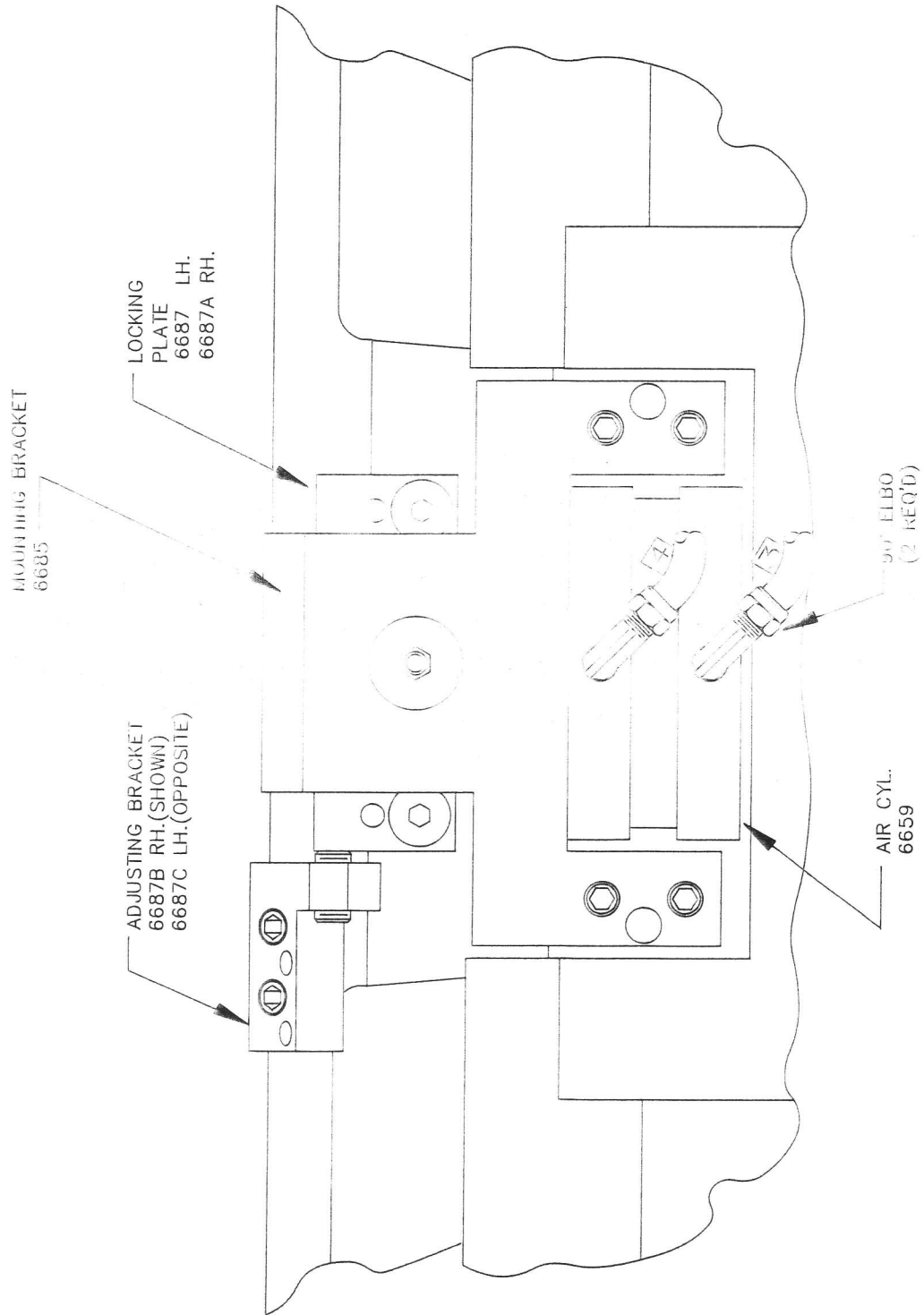
Rotational Drive Gear Housing

REFFBVAF24-040495



180 degree Rotational Lock

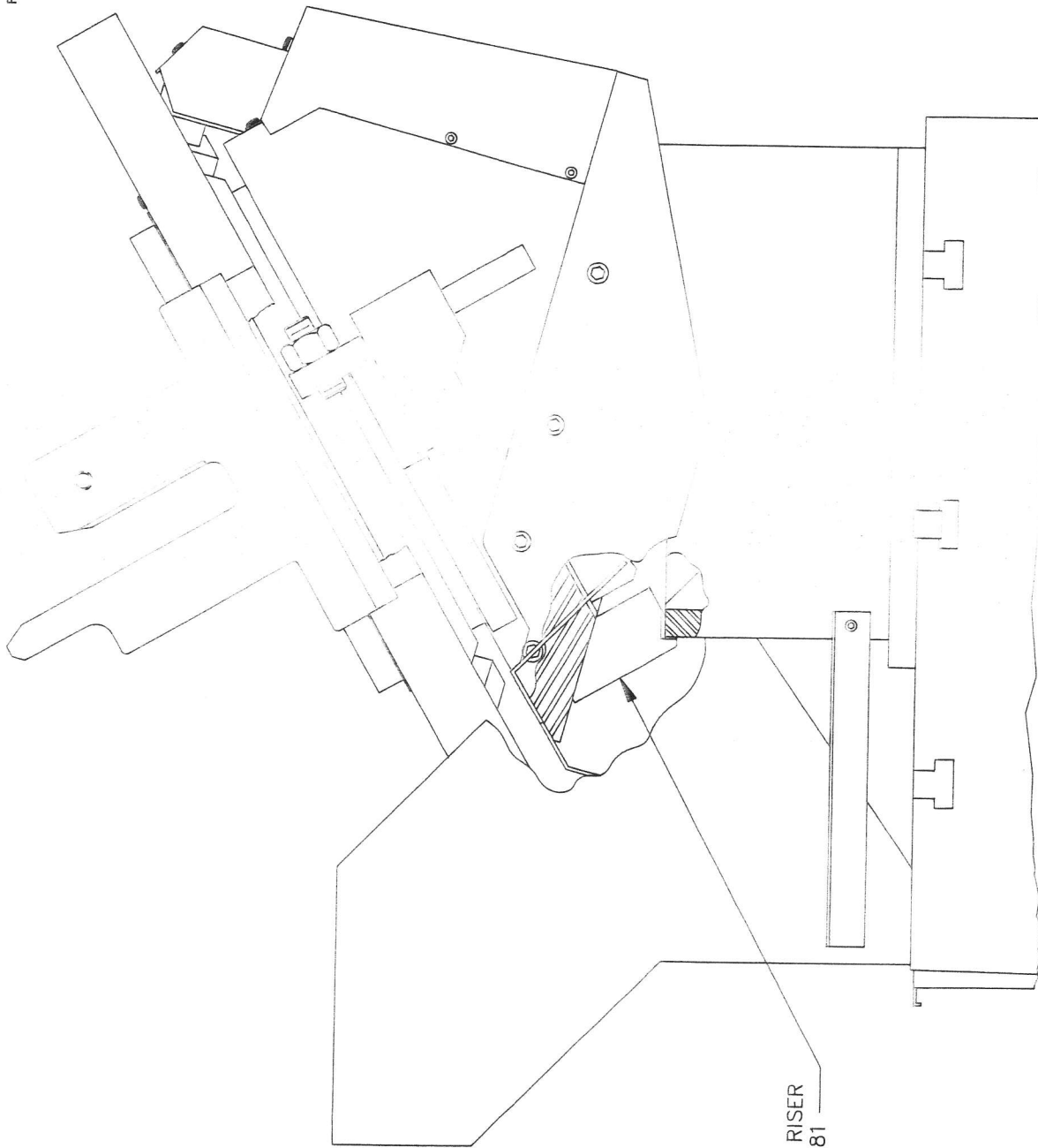
REF8VAF5-040495



180° ROTATIONAL LOCK

Right Side View V8 Auto Rotate Fixture

REFFBVAF21-040495

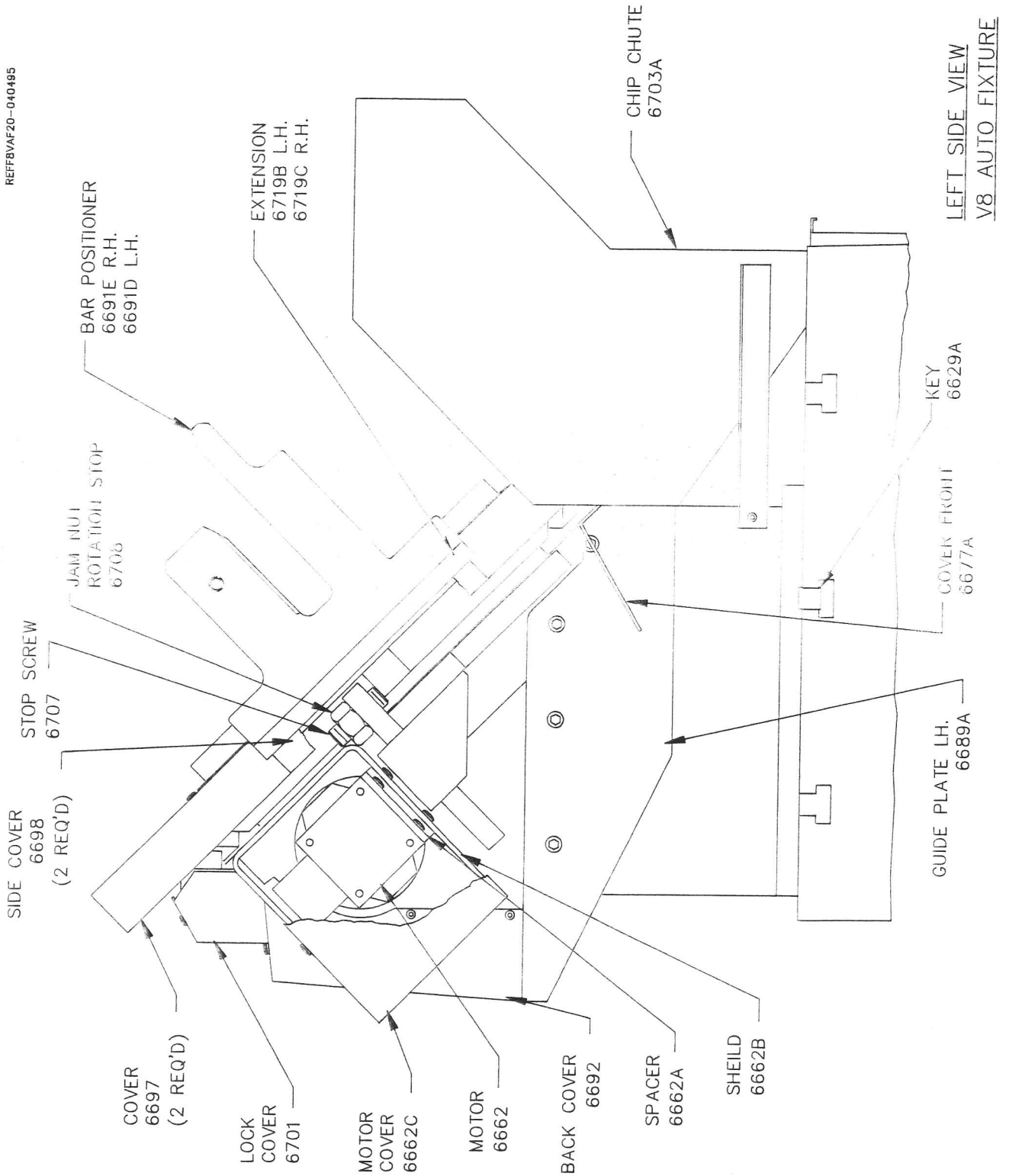


RIGHT SIDE VIEW
V8 AUTO FIXTURE

60° RISER
6681

Left Side View V8 Auto Rotate Fixture

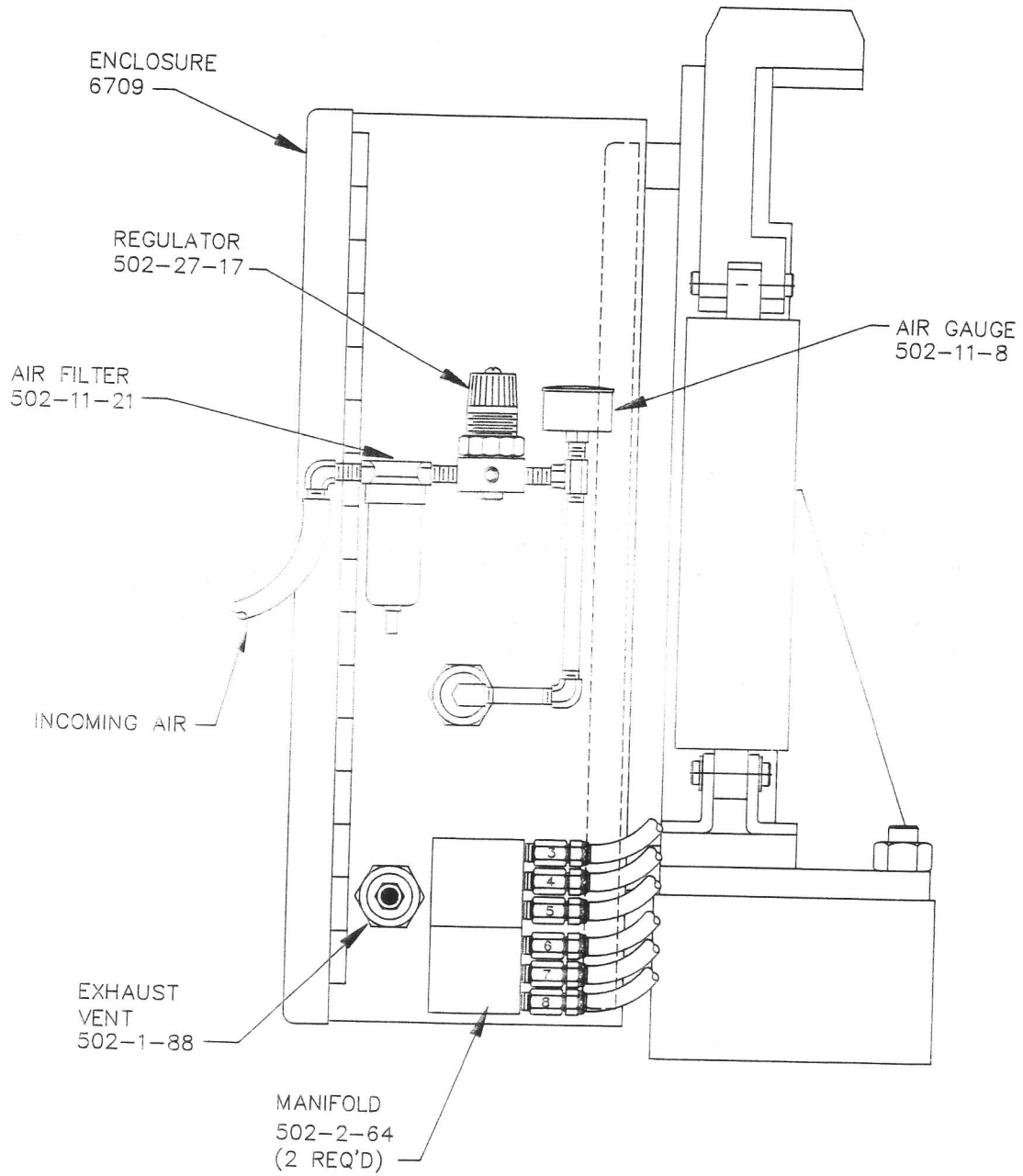
REFFBVAF20-040485



LEFT SIDE VIEW
V8 AUTO FIXTURE

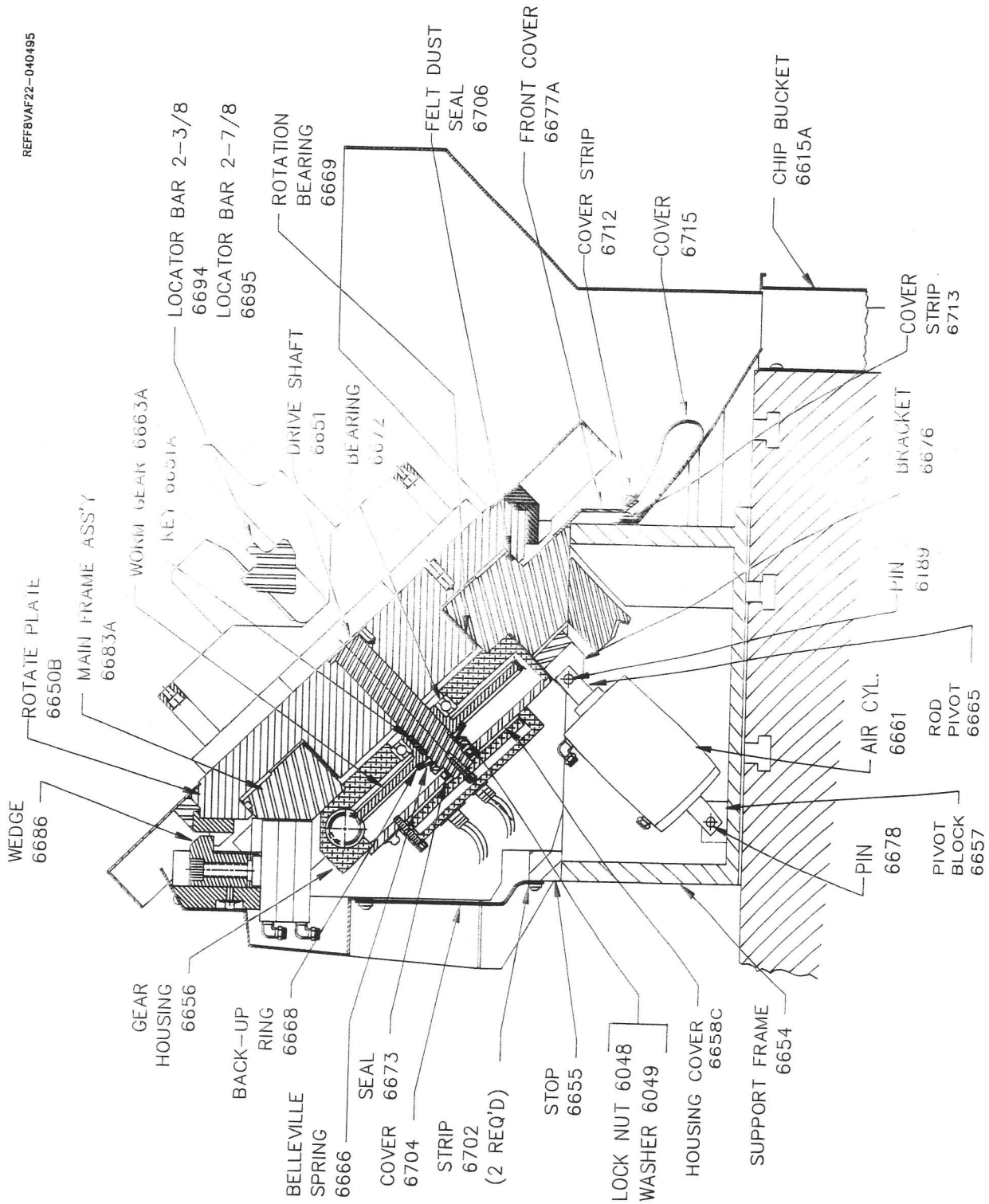
Rear View V8 Auto Fixture Air Enclosure

REF8VAF11-040495



REAR VIEW V8 AUTO FIXTURE AIR ENCLOSURE

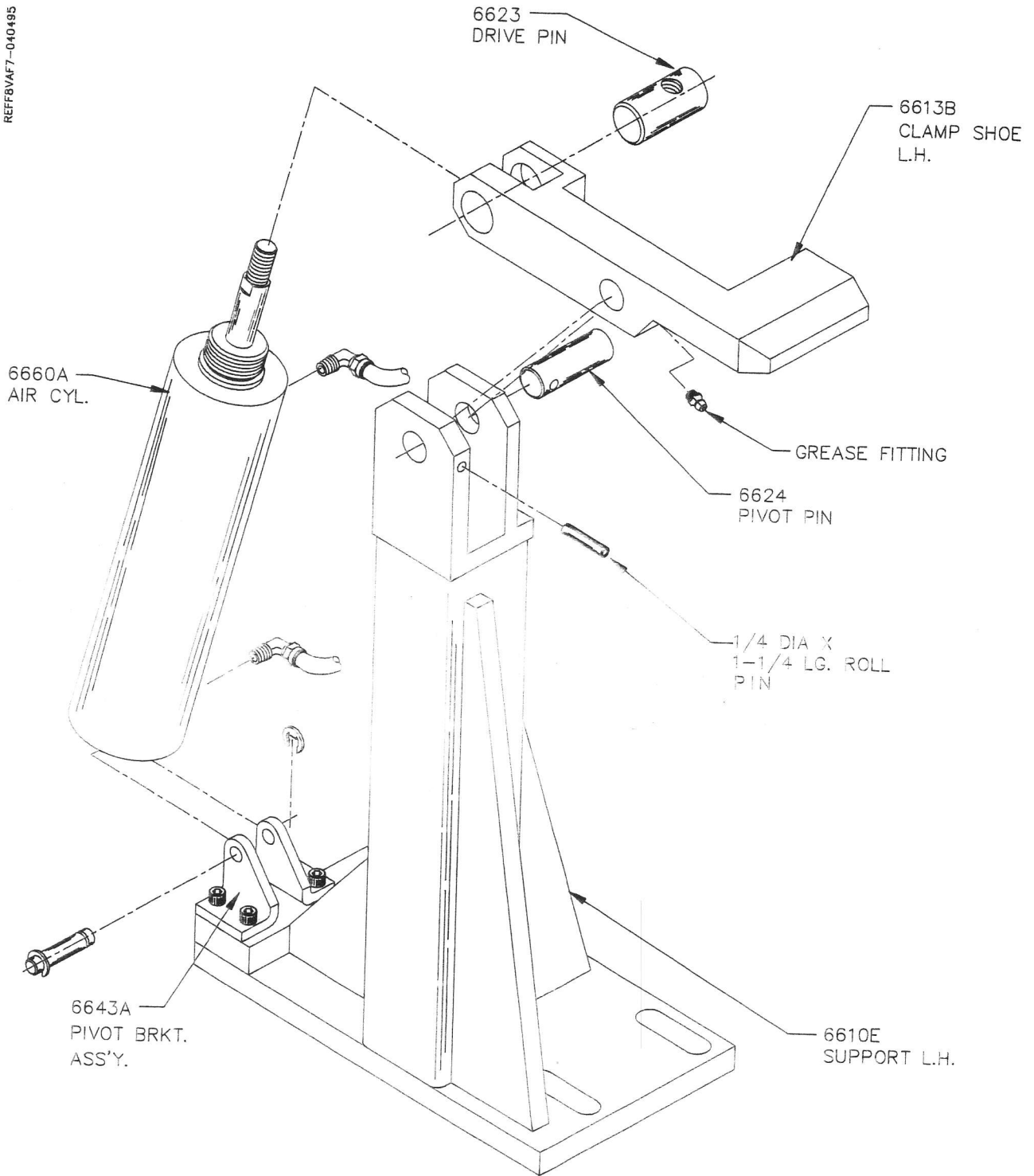
Center Section V8 Auto Rotate Fixture



CENTER SECTION
V8 AUTO ROTATE FIXTURE

Auto Block Clamp L.H.

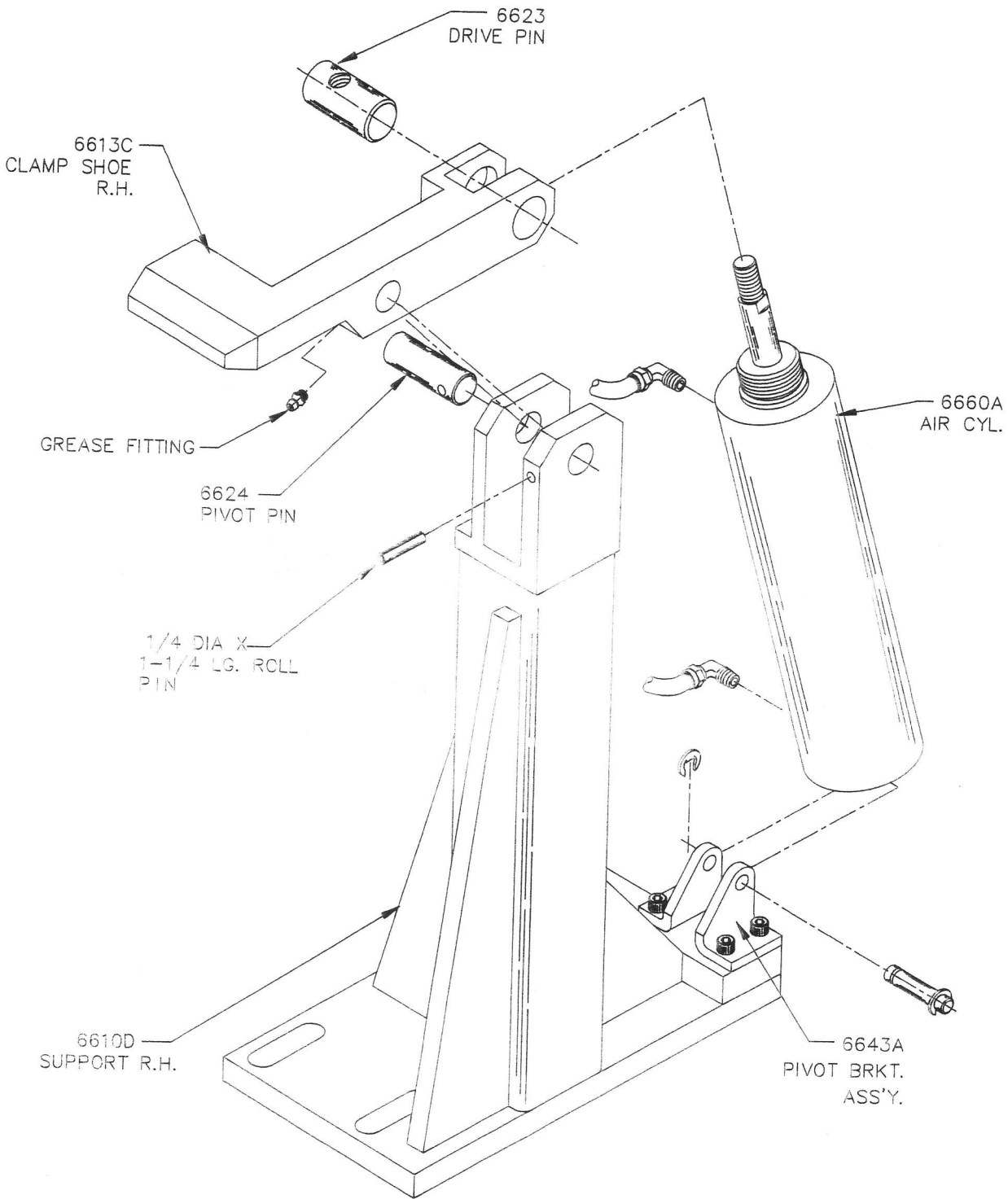
REFFBVAF7-040495



AUTO. BLOCK CLAMP
L.H.

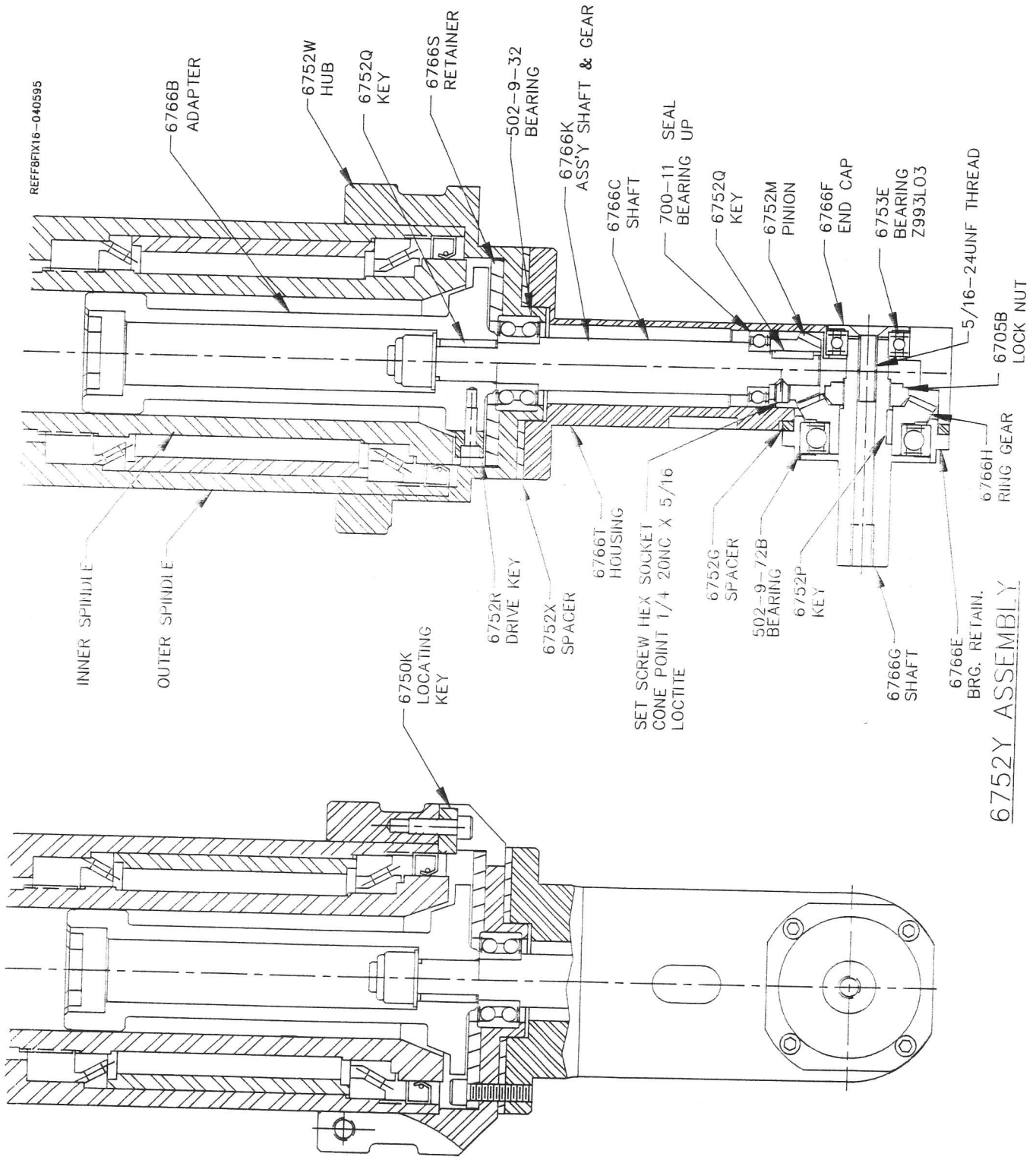
Auto Block Clamp R.H.

REFFBVAFB-040495



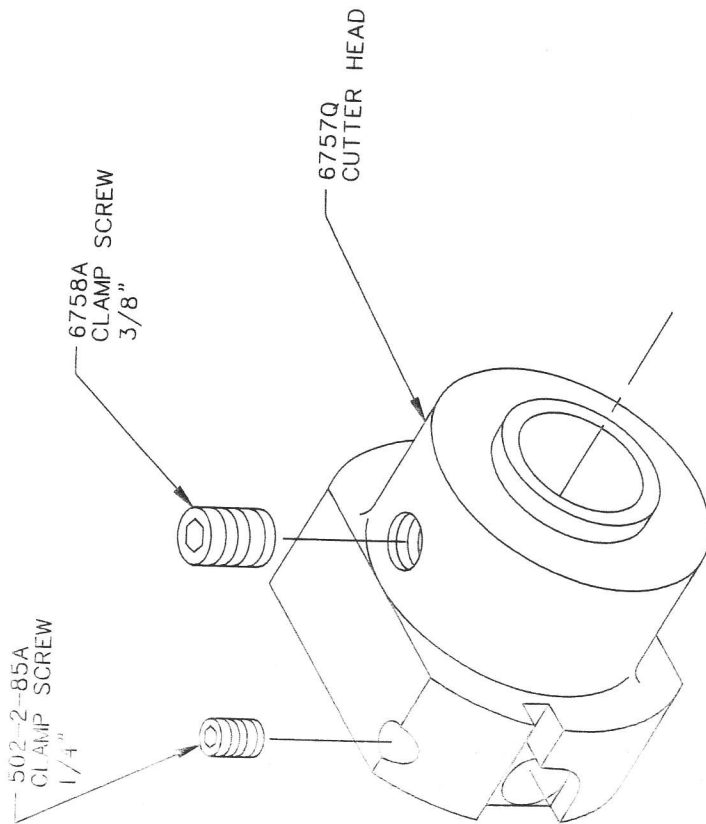
AUTO. BLOCK CLAMP
R.H.

Right Angle Drive Assembly

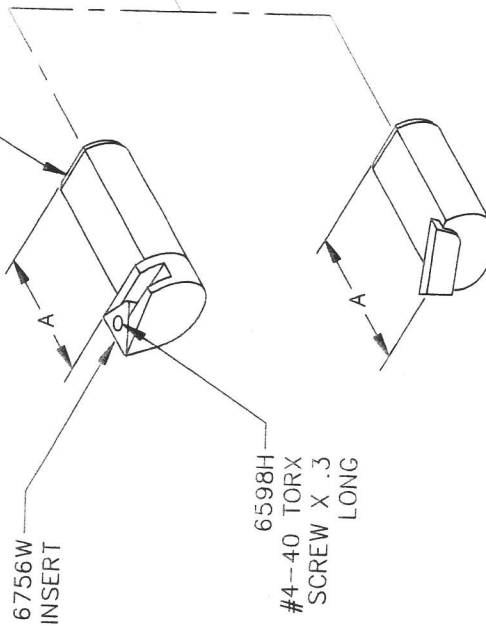


Line Bore Cutterhead Assembly 2.75" to 3.75"

REFLNBOREB-010996



OPTIONAL TOOLING (REWORK STANDARD TOOL BIT SHANK LENGTH)		DIM 'A'
DIA. RANGE	BIT SHANK LENGTH	
2.75" TO 3.2"	.50"	
69mm TO 81mm	12.7mm	
3.1" TO 3.5"	.67"	
79mm TO 89mm	17mm	
3.4" TO 3.76"	.81"	
86mm TO 95mm	20.5mm	

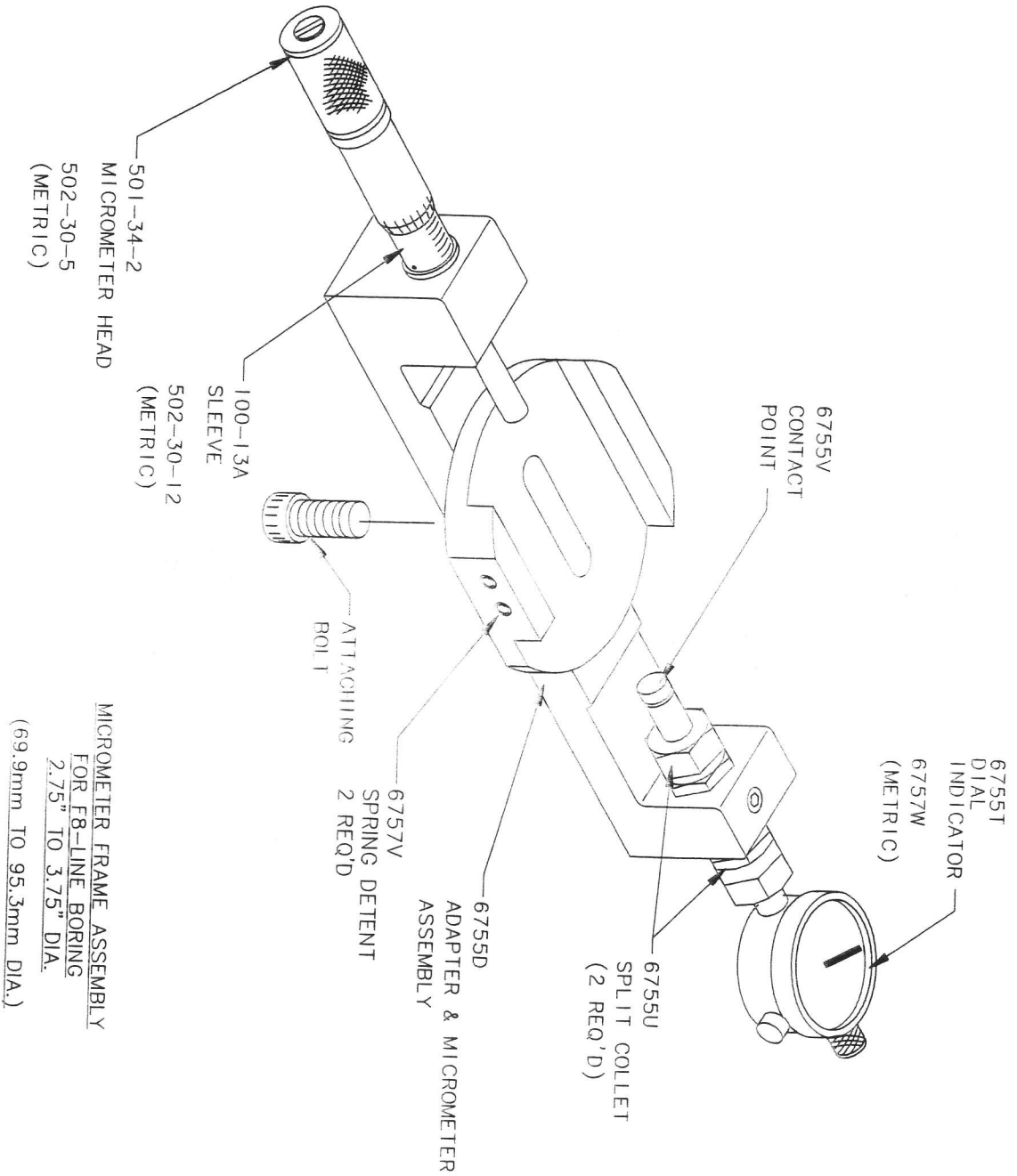


OPTIONAL TOOLING		DIM 'A'
PART #	DESC.	
6755J	CHAMFERING TOOL BIT	1-1/16
6755K	CHAMFERING TOOL BIT	1-3/8

- 6758
- CUTTER HEAD ASSEMBLY
- F8 90° HEAD
- 2.75" TO 3.75" DIA.

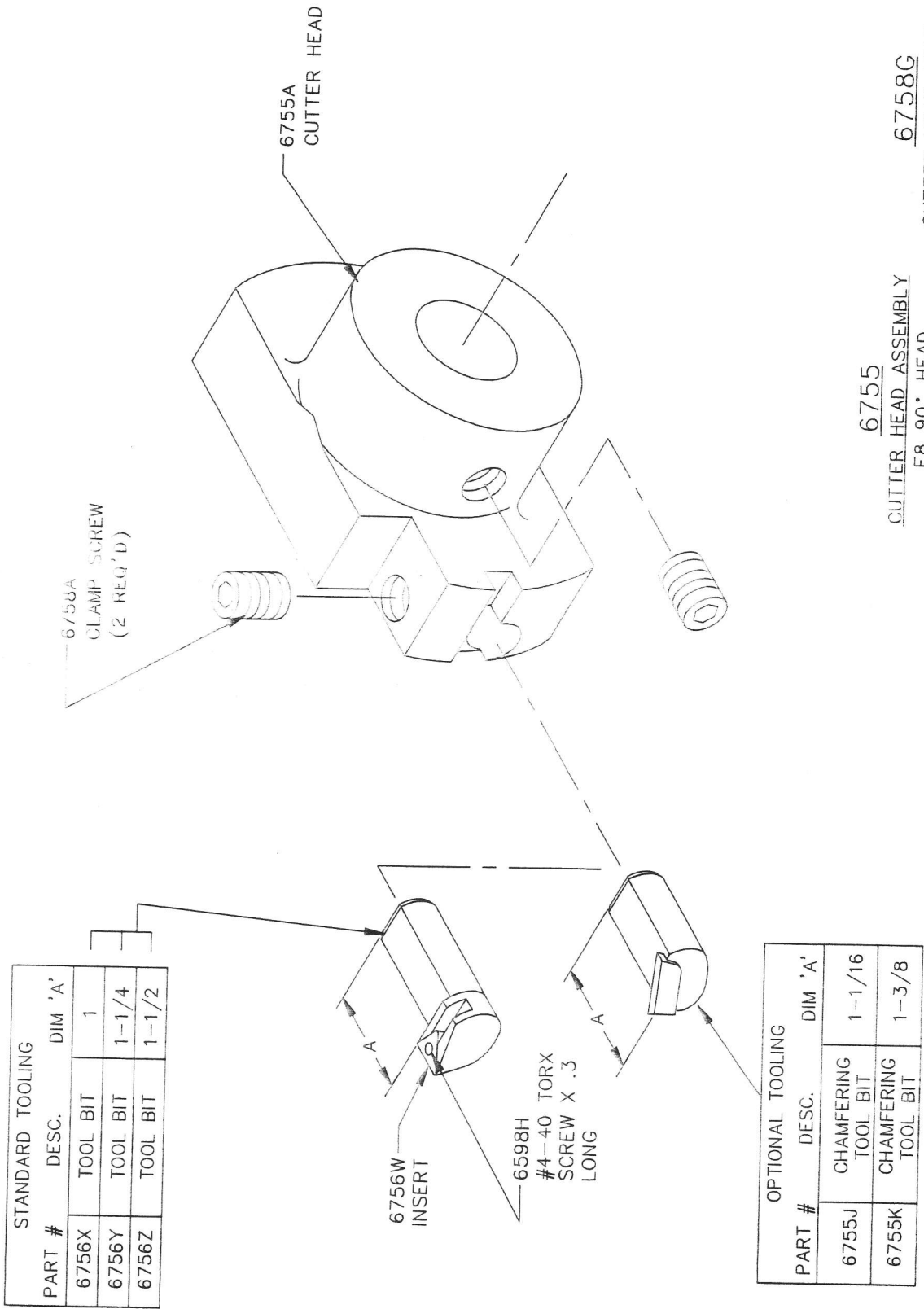
- 6758H
- CUTTER HEAD ASSEMBLY
- F8 90° HEAD (METRIC)
- 69.9mm TO 95.3mm" DIA.

Micrometer Frame Assembly 2.75" to 3.75"



Line Bore Cutterhead Assembly 3.75" to 5.0"

REFLINE066-010996



STANDARD TOOLING		
PART #	DESC.	DIM 'A'
6756X	TOOL BIT	1
6756Y	TOOL BIT	1-1/4
6756Z	TOOL BIT	1-1/2

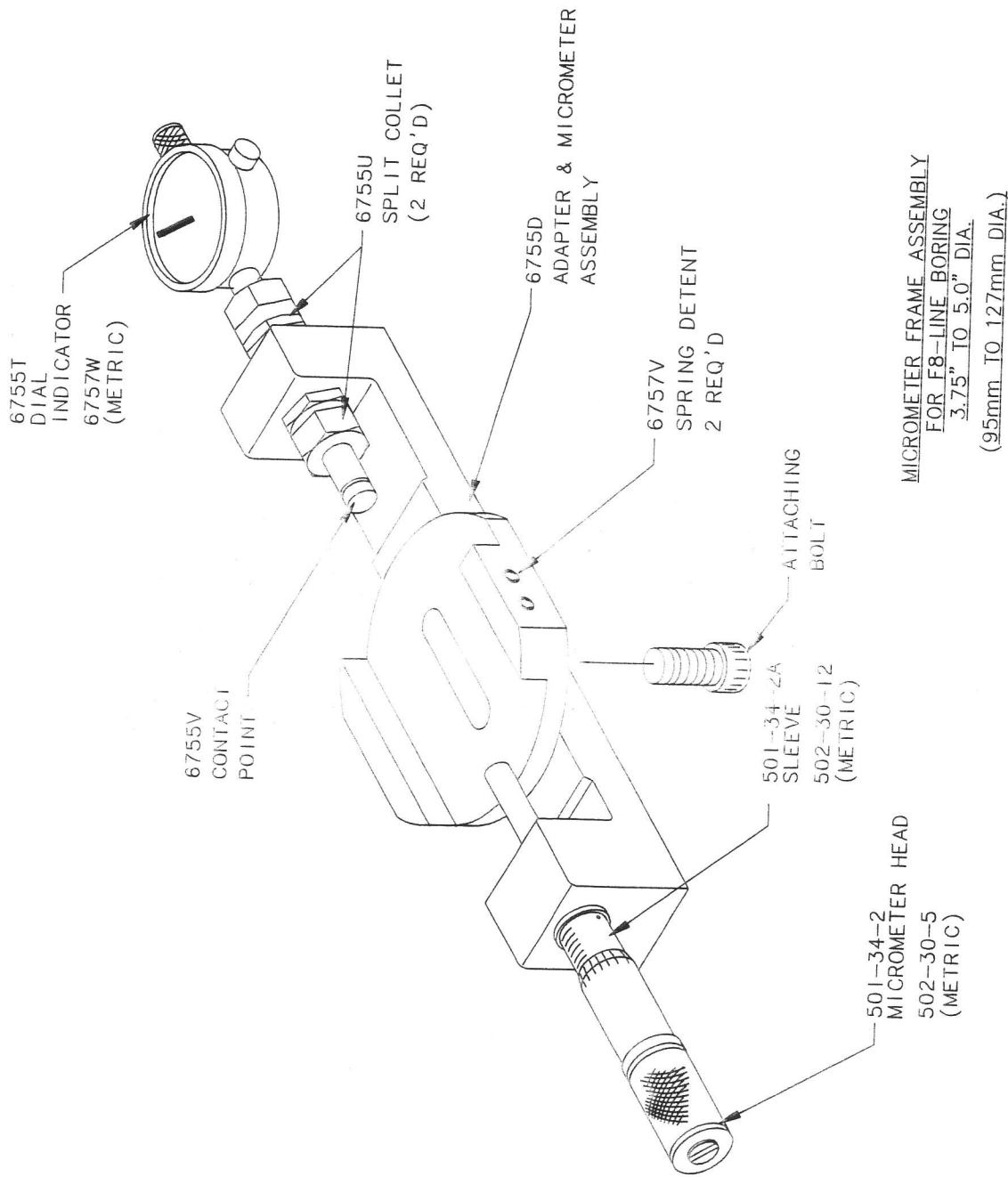
OPTIONAL TOOLING		
PART #	DESC.	DIM 'A'
6755J	CHAMFERING TOOL BIT	1-1/16
6755K	CHAMFERING TOOL BIT	1-3/8

6755
CUTTER HEAD ASSEMBLY
F8 90° HEAD
3.75" TO 5.0" DIA.

6758C
CUTTER HEAD ASSEMBLY
F8 90° HEAD (METRIC)
95mm TO 127mm DIA.

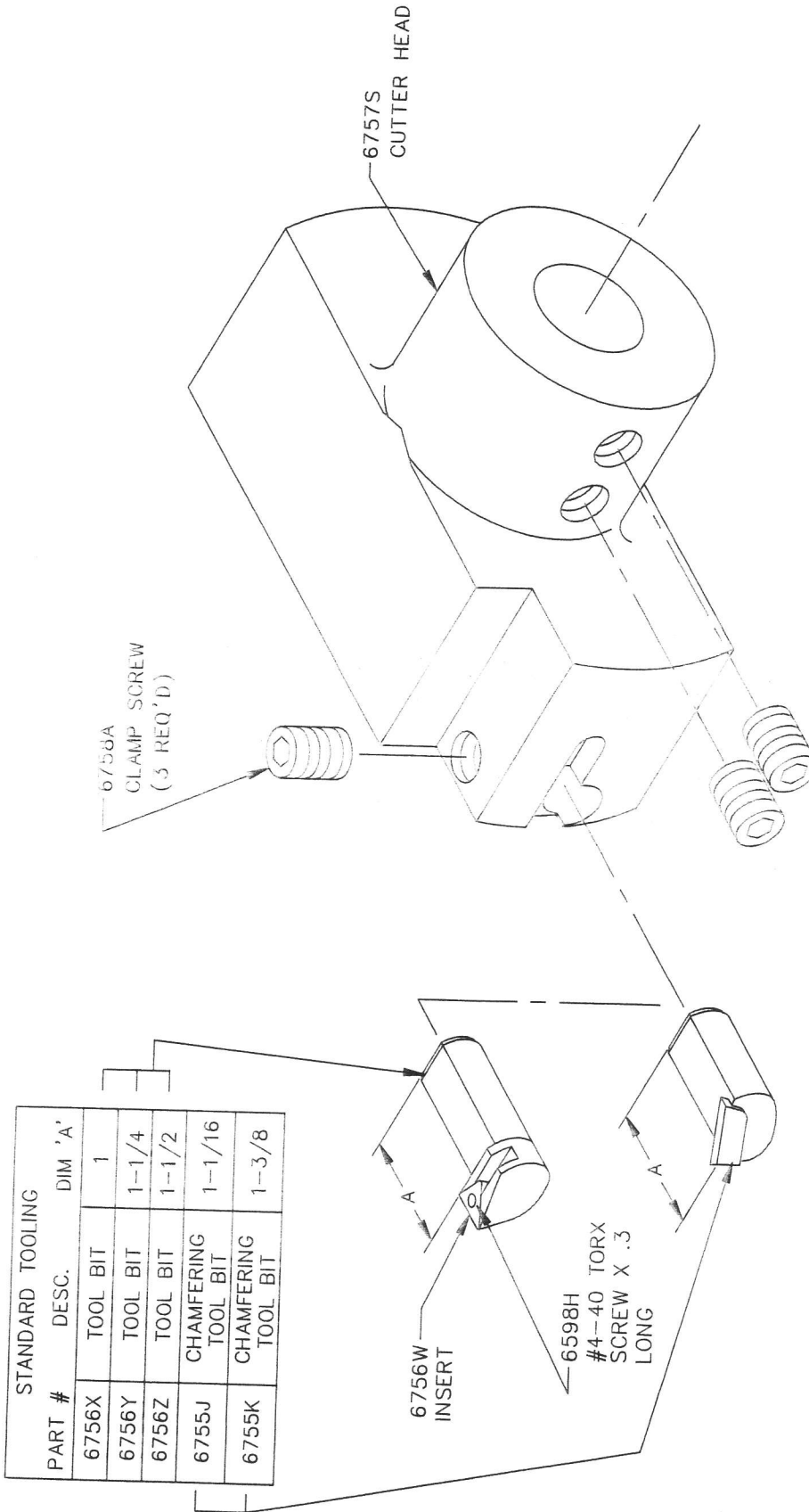
Micrometer Frame Assembly 3.75" to 5.0"

REFLNB0RE5-010996



Line Bore Cutterhead Assembly 4.9" to 6.9"

REFLINEB0RE10-010996

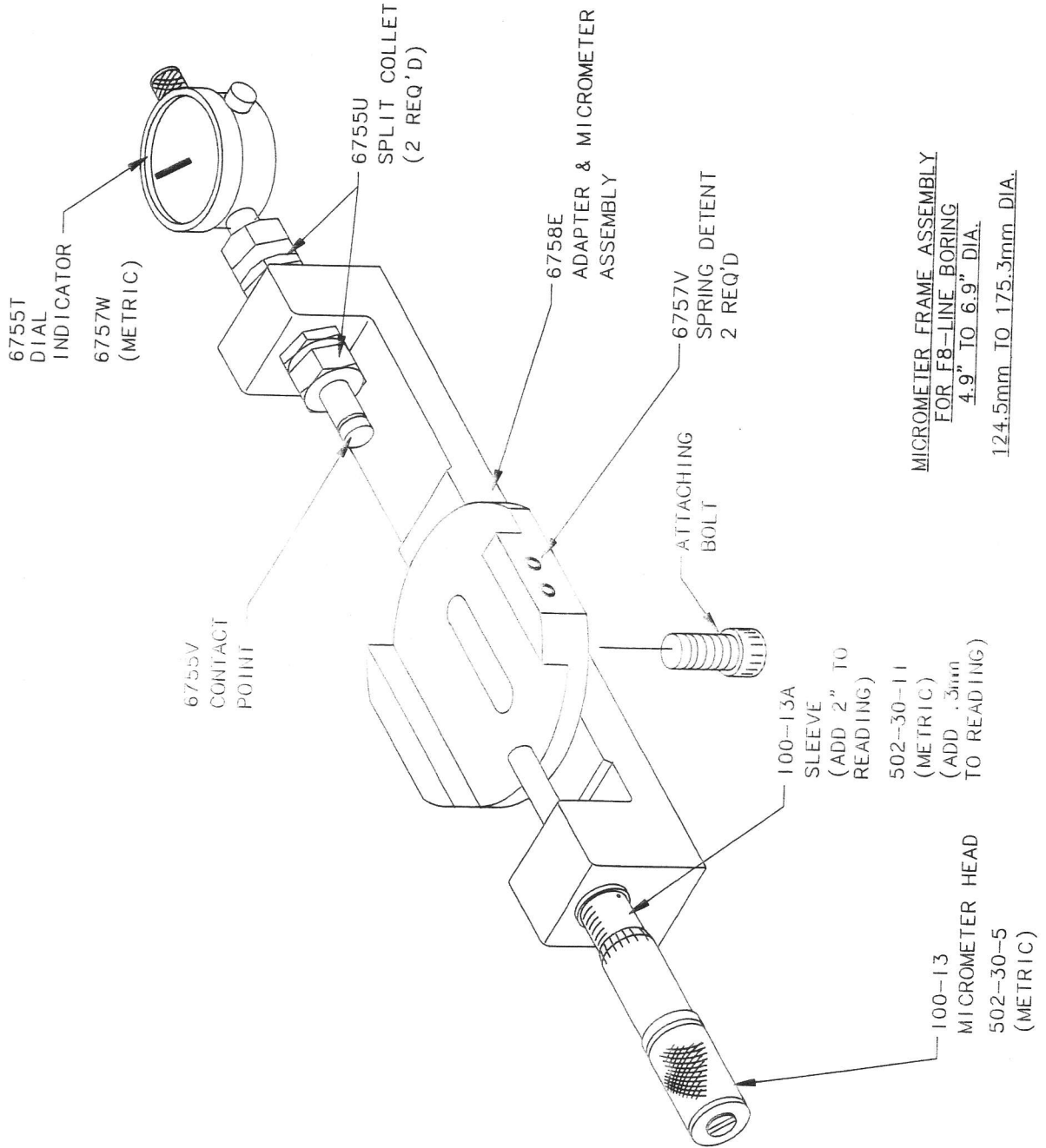


6758F
CUTTER HEAD ASSEMBLY
F8 90° HEAD
4.9" TO 6.9" DIA.

6758J
CUTTER HEAD ASSEMBLY
F8 90° HEAD (METRIC)
124.5mm TO 175.3mm DIA.

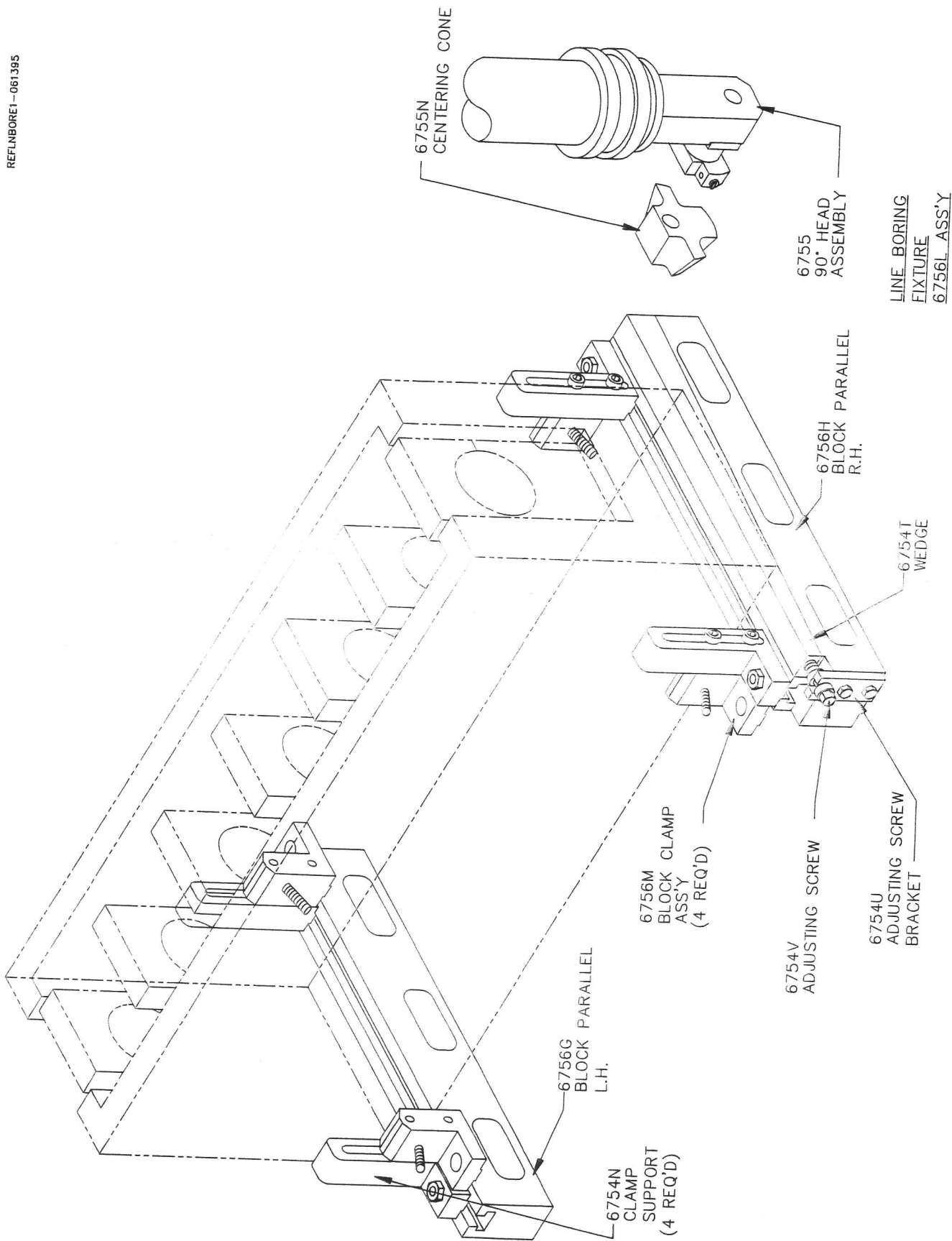
Micrometer Frame Assembly 4.9" to 6.9"

REFLNB0RE11-011096



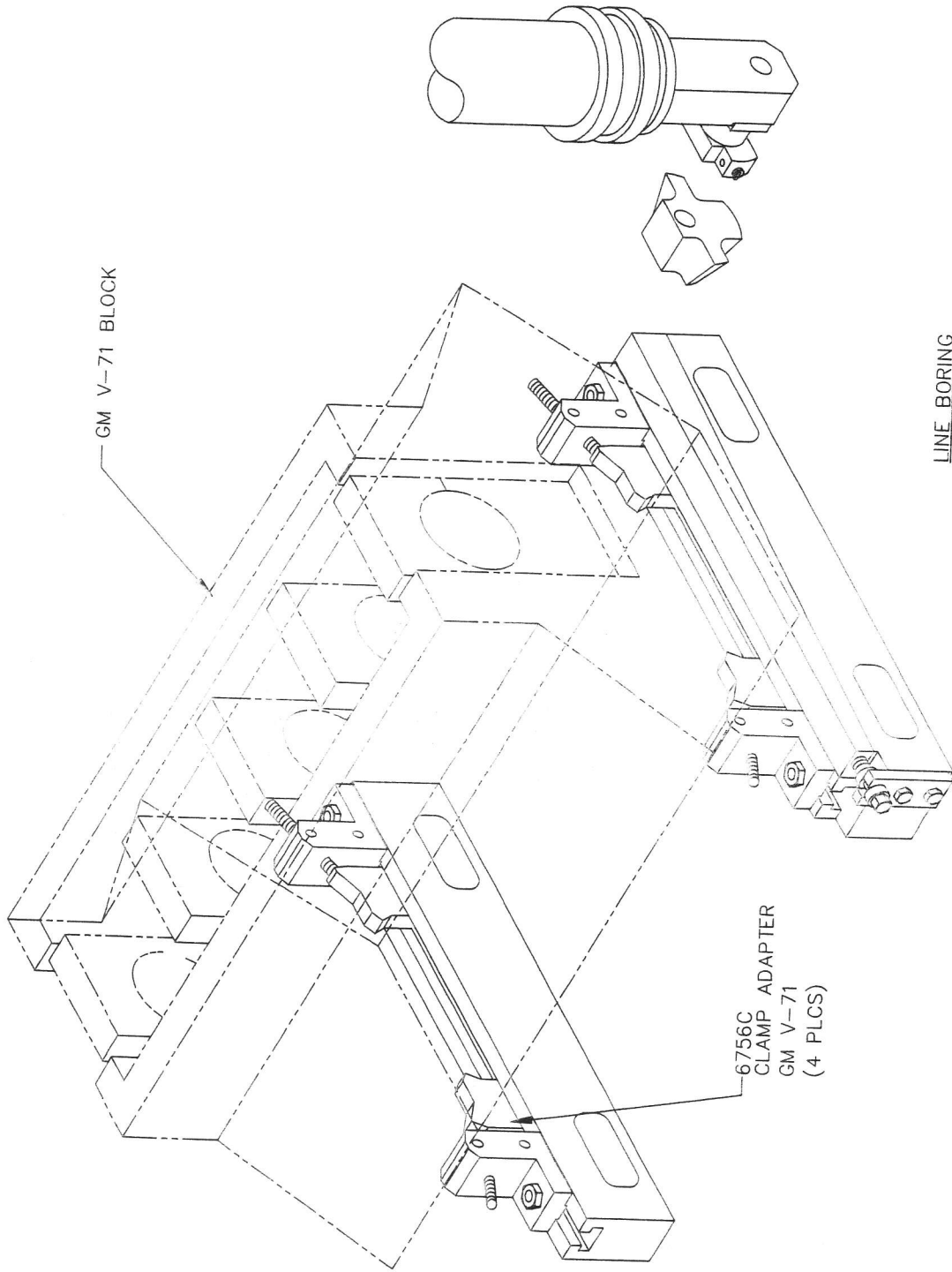
Line Boring Fixture

REFLNBOR1-061395



Line Boring GM V-71 Fixture Assembly

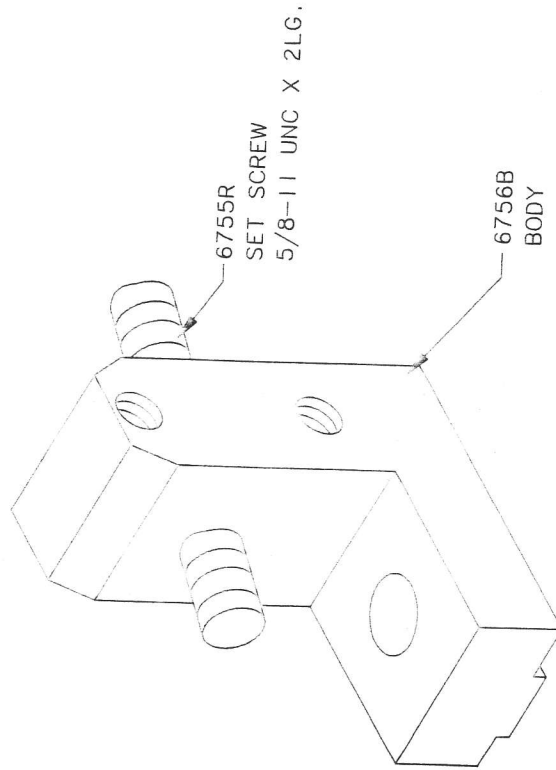
REFLNB0RE4-061395



LINE BORING
GM V-71 FIXTURE
ASSEMBLY

Adjustable Block Clamp Assembly

REFLNB0RE2-061395



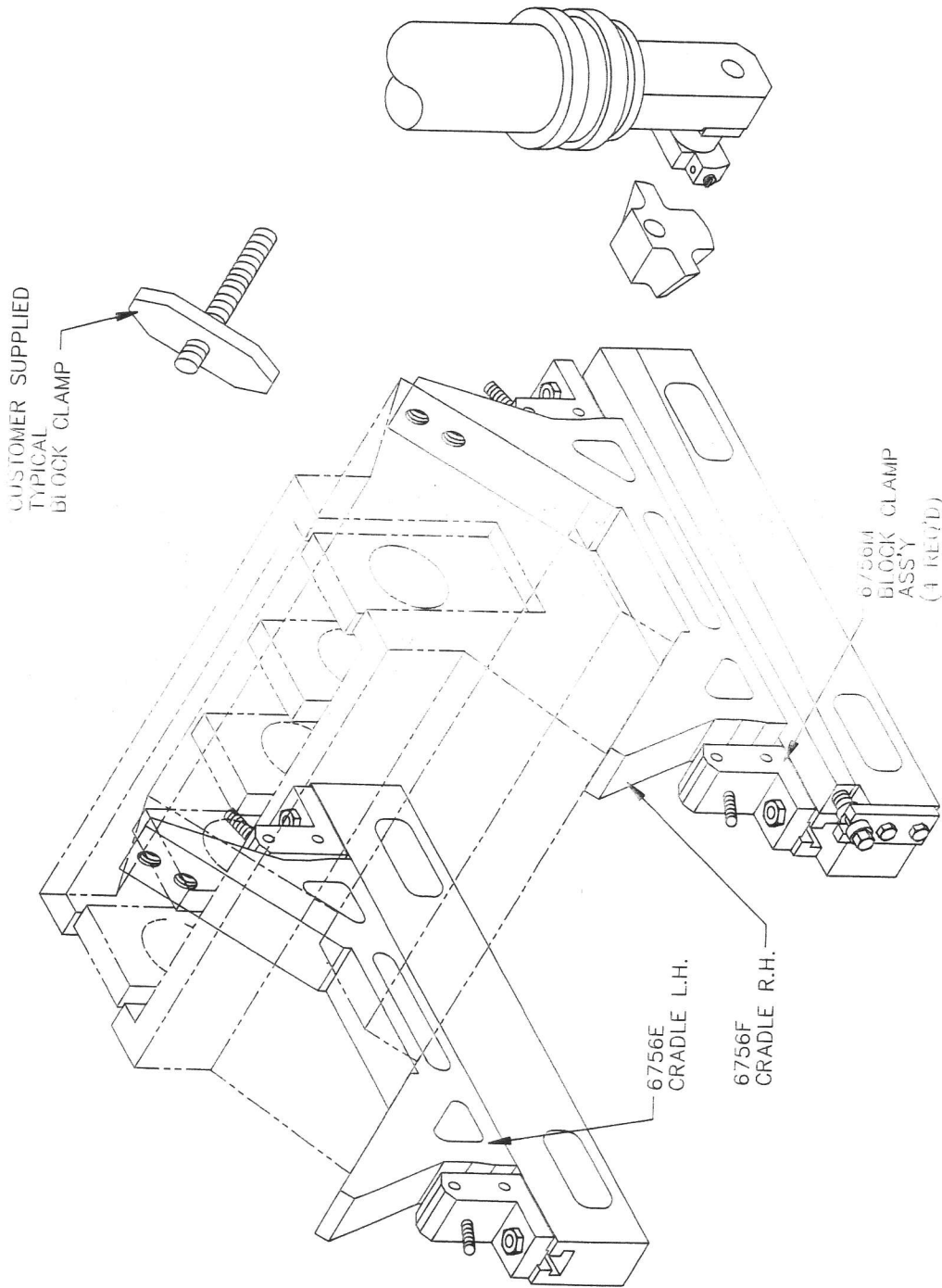
6755R
SET SCREW
5/8-11 UNC X 2LG.

6756B
BODY

6756M
BLOCK CLAMP ASS'Y
ADJUSTABLE

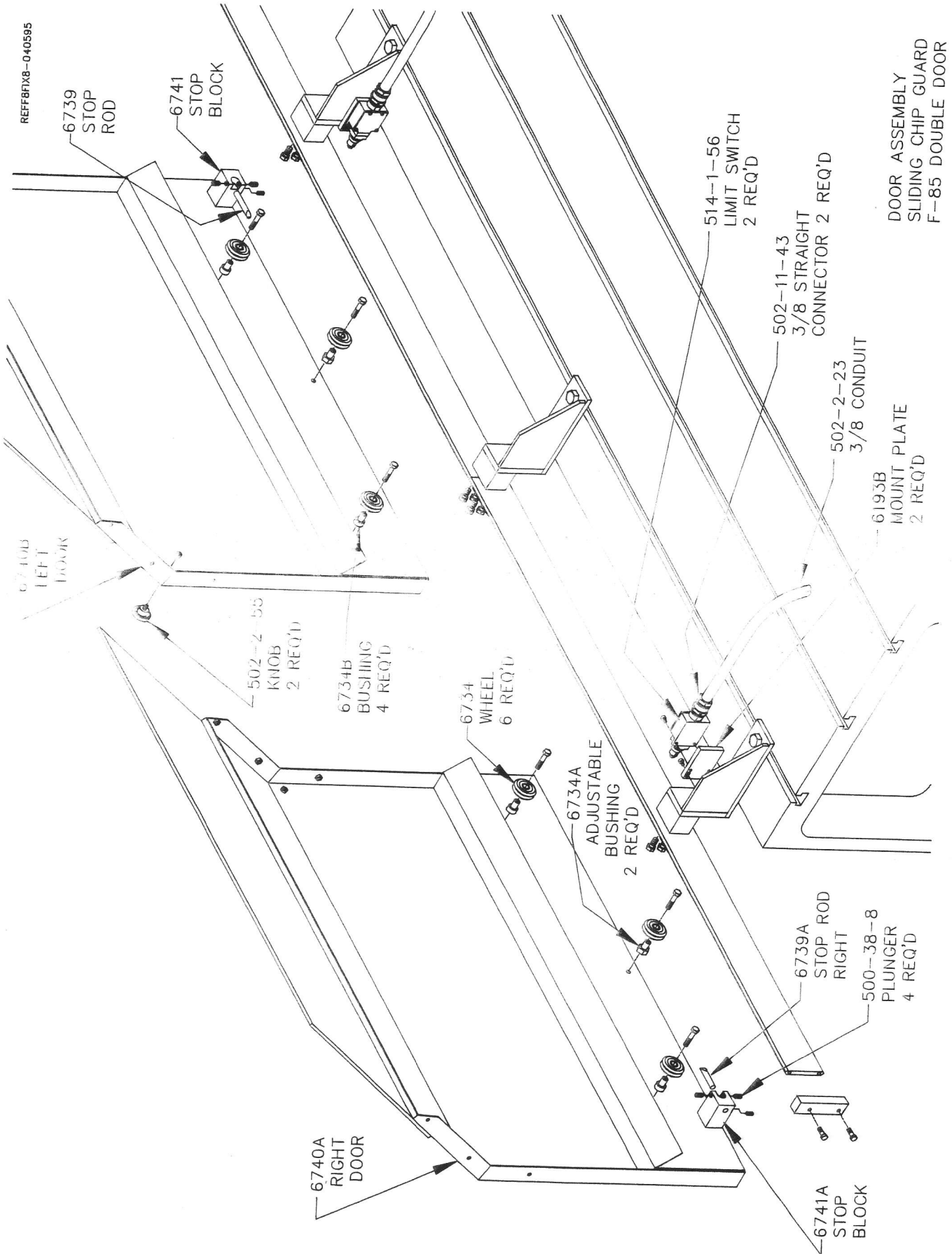
Line Boring V-Fixture

REFLNB0RE3-061395

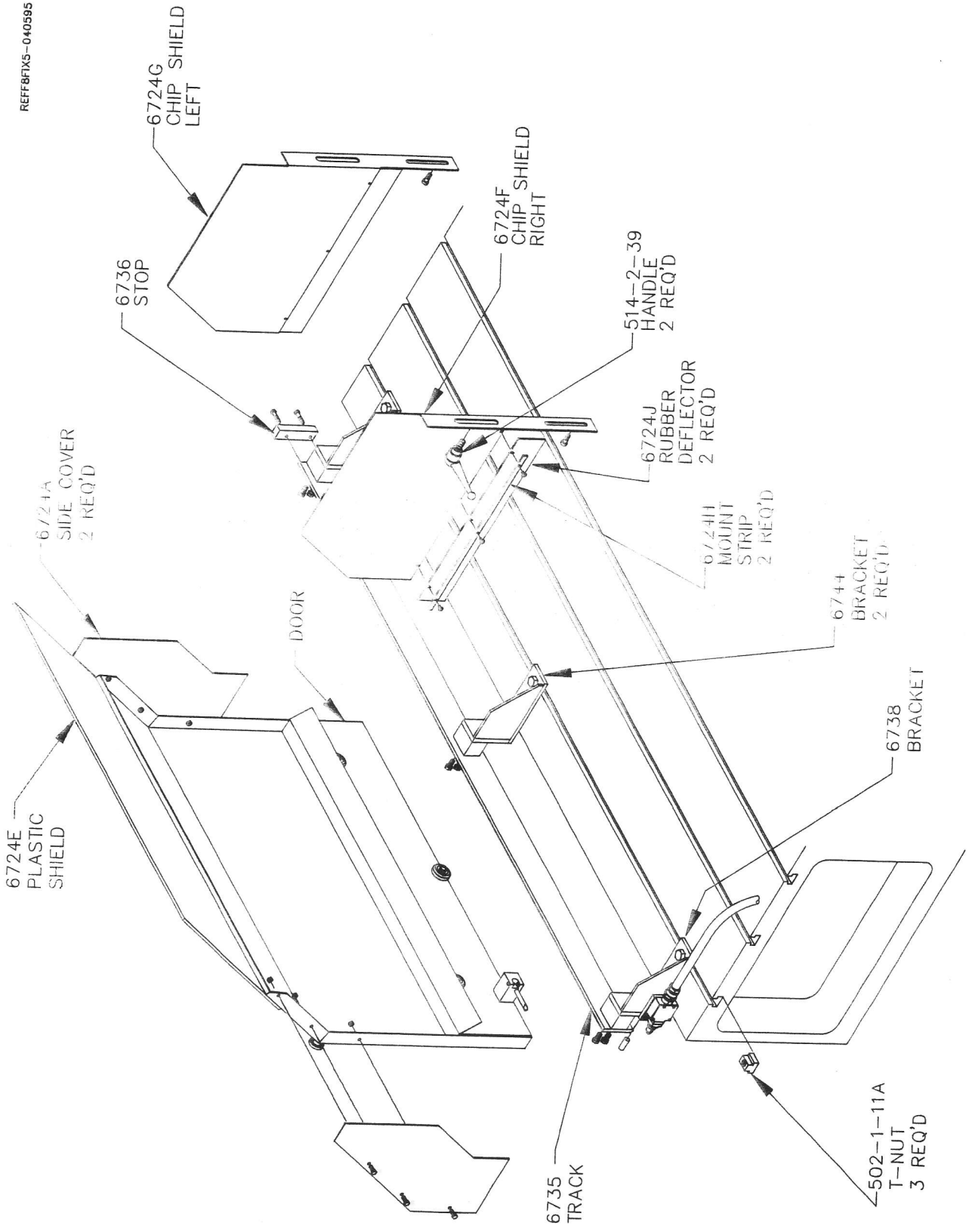


LINE BORING
V-FIXTURE
6756P ASS'Y

Door Assembly, Double Door

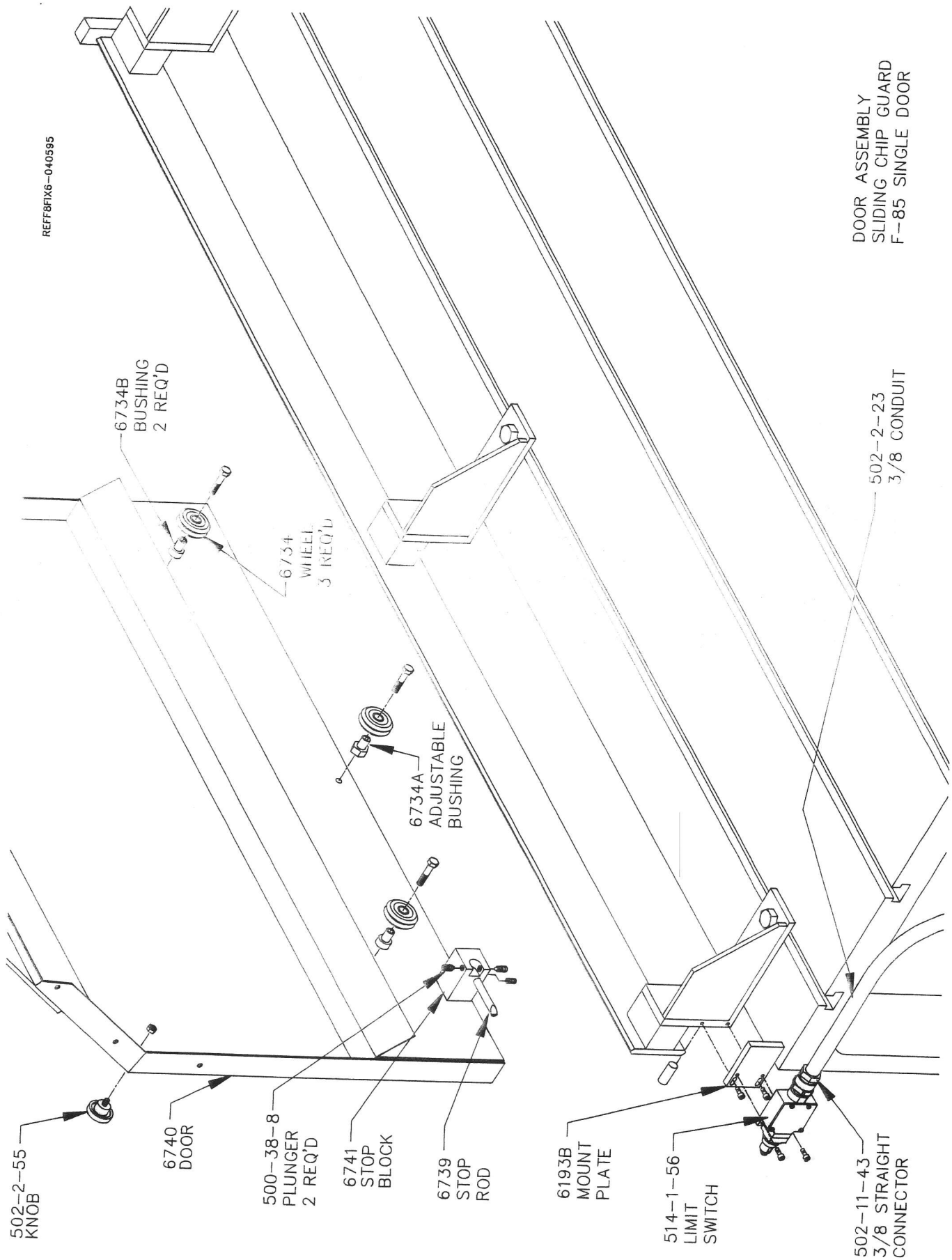


Sliding Chip Guard F-85 Single Door



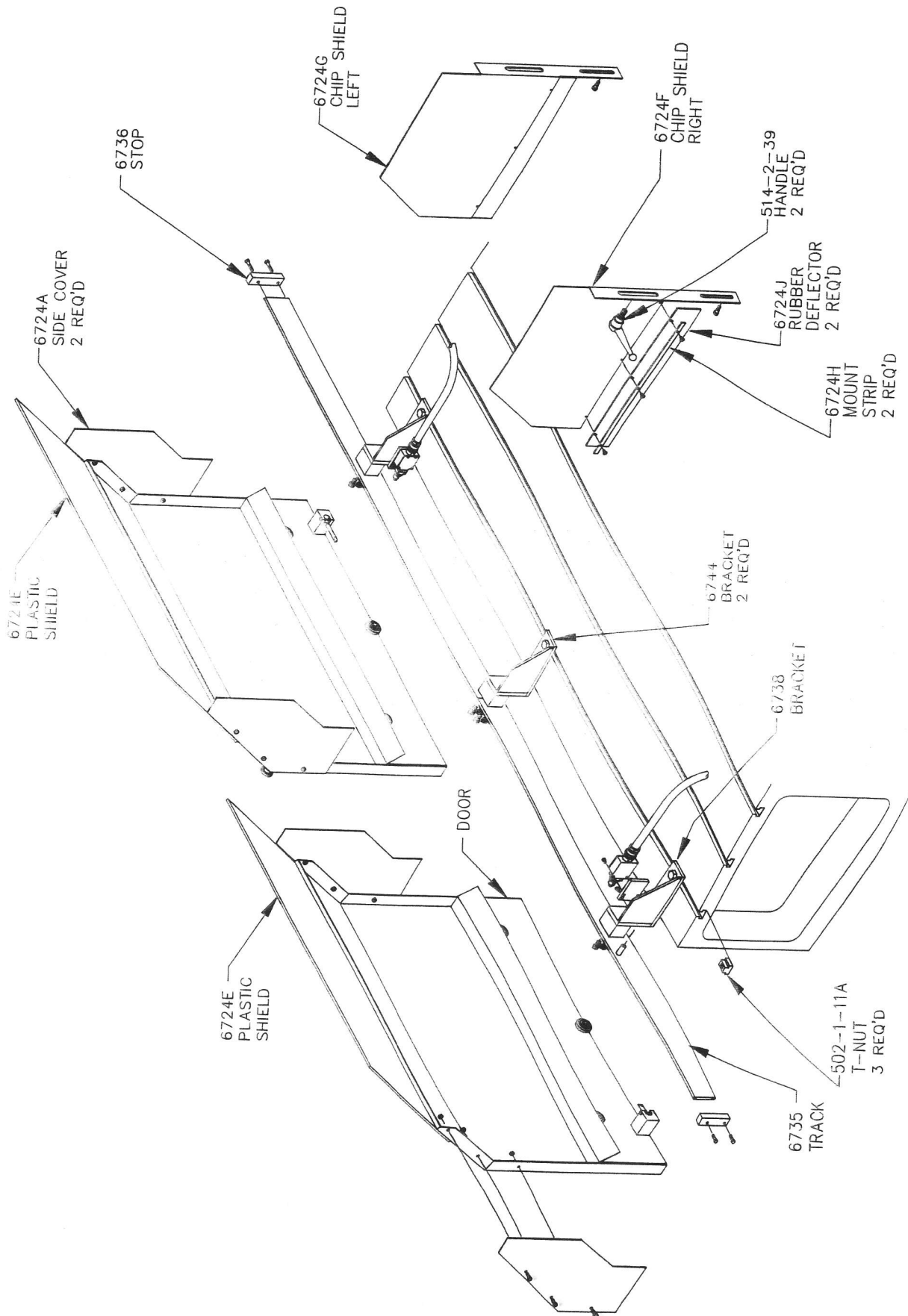
SLIDING CHIP GUARD
F-85 SINGLE DOOR

Door Assembly, Single Door



Sliding Chip Guard F-85 Double Door

REF: 6724G-040595



SLIDING CHIP GUARD
F-85 DOUBLE DOOR