



**THE  
CUTTING  
EDGE**

**HP5A**  
MULTI PURPOSE MACHINING CENTER  
MACHINE SERIAL NUMBER

---

OPERATIONS AND MAINTENANCE  
MANUAL



MANUFACTURED BY:

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PLEASE GIVE THE MODEL AND SERIAL NUMBER.

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



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## Introduction:

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

It is required that the new user of the HP5A honing machine read this manual. Pay close attention to the chapter concerning safety.

## Description:

The model HP5A Honing Machine is a wet, complete cylinder block and general purpose honing machine. Hone rotating power is supplied by a totally enclosed AC motor driving a belt and gear reduction drive mounted within a rocker arm arrangement. The honing head is driven through a universal joint.

An air cylinder with a hydraulic check system provides stroking power. Stroking may also be manually operated.

The support carriage is air floated and clamped to provide simple and easy hole-to-hole setup.

Convenient devices are provided to properly control honing operations and provide easy handling.

A 'V' fixture is provided, which efficiently holds V-6/V-8, and in-line blocks for honing. Optional clamps are available to clamp most any kind of in-line block or similar workpiece.

A splash tank is located within the main frame and a coolant pump tank is located under the machine. A switch is provided on the control panel to operate the coolant system.

## Limited Warranty:

Rottler manufacturing company model HP5A 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 instruction in this manual.*

Standard air and electric components are warranted by their respective manufacturers (NOTE: their individual warranty periods may vary significantly 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 days period are the customers responsibility.

## Safety Information:

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### CAUTION:

*This machine is capable of causing severe bodily injury.*

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As with all machine 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 hone head area.

The operator and nearby personnel should be familiar with the location and operation of the off switch.

**Electrical Power:**

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

**Machine Operator:**

Operator of this HP5A Honing 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 HP5A Honing Machine.

Rottler HP5A Honing equipment has the following areas of exposed moving parts that you must train yourself to respect and stay away from when they are in motion:

1. **Work Clamping** - Be sure work is clamped securely in accordance with the instructions.
2. **Lower Stop** - Set lower limit carefully so that webs or other obstructions, in the bore, do not interfere with the guides or stones.
3. **Hone Head Area** - Keep hands completely away from the rotating honing head at *ALL* times.
4. **Power Stroking** - Do not operate power stroking without upper travel limit lever locked.
5. **Operator Controls** - Familiarize yourself with the exact location of the stop button so you can immediately react to an emergency.
6. **Honing** - Do not engage rotation power when hone is out of a cylinder.

**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 to a great extent on its proper initial installation, particularly the means by which cylinder blocks are lifted into the machine as well as the material handling to and from other operations in your shop.

The proper loading arrangement and location for your HP5A machine is extremely important.

A slow travel (6' to 10' per min.) 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 some production honing with this machine is anticipated, and the cylinder blocks are not directly loaded and unloaded from a conveyor, we would recommend considerable attention be given to the crane so that it covers an adequate area to allow the operator to back up and remove cylinder blocks without cluttering up his own area. If two machines are to be operated by one operator, we recommend that the open faces be placed at right angles to each other, with the machines approximately three feet apart.

**Unpacking**

Carefully uncrate the HP5A Machine. Remove all equipment in splash tank except the 'V' fixture frame.

Completely clean these articles as well as the machine's upper table with solvent, also clean the lower travel limit stop rods, Rust inhibitor is applied to the machine at the time of shipment and must be removed before operating the machine.

**Shipping Hold Down Bolt**

(Refer to illustration on page 5.9)

The hone carriage is shipped with the hold-down system locked. This system must be unlocked. Remove the cover (514-3-3G). Remove the cotter pin in the castle nut. Loosen the nut all the way. Tighten the nut back down with just your fingers. Loosen the nut 1/4 turn. Insert cotter pin.

**Leveling**

Four cap screws and jam nuts are provided with the machine for leveling. Insert the screws from the bottom of the base. Place the jam nuts on top of the threaded hole in the base.

Using a precision level, level the upper table within .002" per foot in both directions (Except favor the high setting to the front for best coolant return).

**Air Supply:**

The HP5A machine requires 5.7 cubic feet/minute at 100 P.S.I. compressed air (a minimum 1 HP air compressor output).

Attach air supply to the filter regulator on the right side of the splash tank. Push and hold the float clamp button located on the front of the carriage. While holding the push button adjust the air regulator to 100 P.S.I. (located on the right side of the splash tank). (Push regulator knob down to set, pull up to lock).

---

**NOTE:**

***To assure a long service life for your HP5A machine the air supply must be moisture free. If there is any doubts about the air supply install a water trap***

---

**Power Supply:**

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Disconnect all power before servicing this machine.

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This machine requires 208-240 volt AC single phase 50 or 60-Hertz power. (See the wiring diagram for the HP5A Hone).

Electrically connect in accordance with the National Electrical code and your local codes. Note: this machine requires the use of an electrical disconnect switch.

Attach wiring to the terminals on the terminal strip in the rear enclosure. (See hook up illustrations: page 1.4 for single phase hookup).

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**CAUTION:**

*This machine cannot be run on 440 volts. A transformer must be installed if 440 volts must be used.*

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**Coolant Types and Selection:**

- When using vitrified honing stones you must use a petroleum based coolant. Such as Mobil Met 33 or Upsilon or any equivalent light honing oil. This is required since vitrified honing stones are not compatible with water based synthetic coolants.
- Diamond stones will work with oil or water based coolants, but work most efficiently with water based synthetic coolants. Rottler recommends the use of YUMA: Yumate water based, synthetic coolant for diamond only applications. This coolant works best when mixed to a 3% to 5% solution (5% = 20 gal. water/ 1 gal. concentrate).

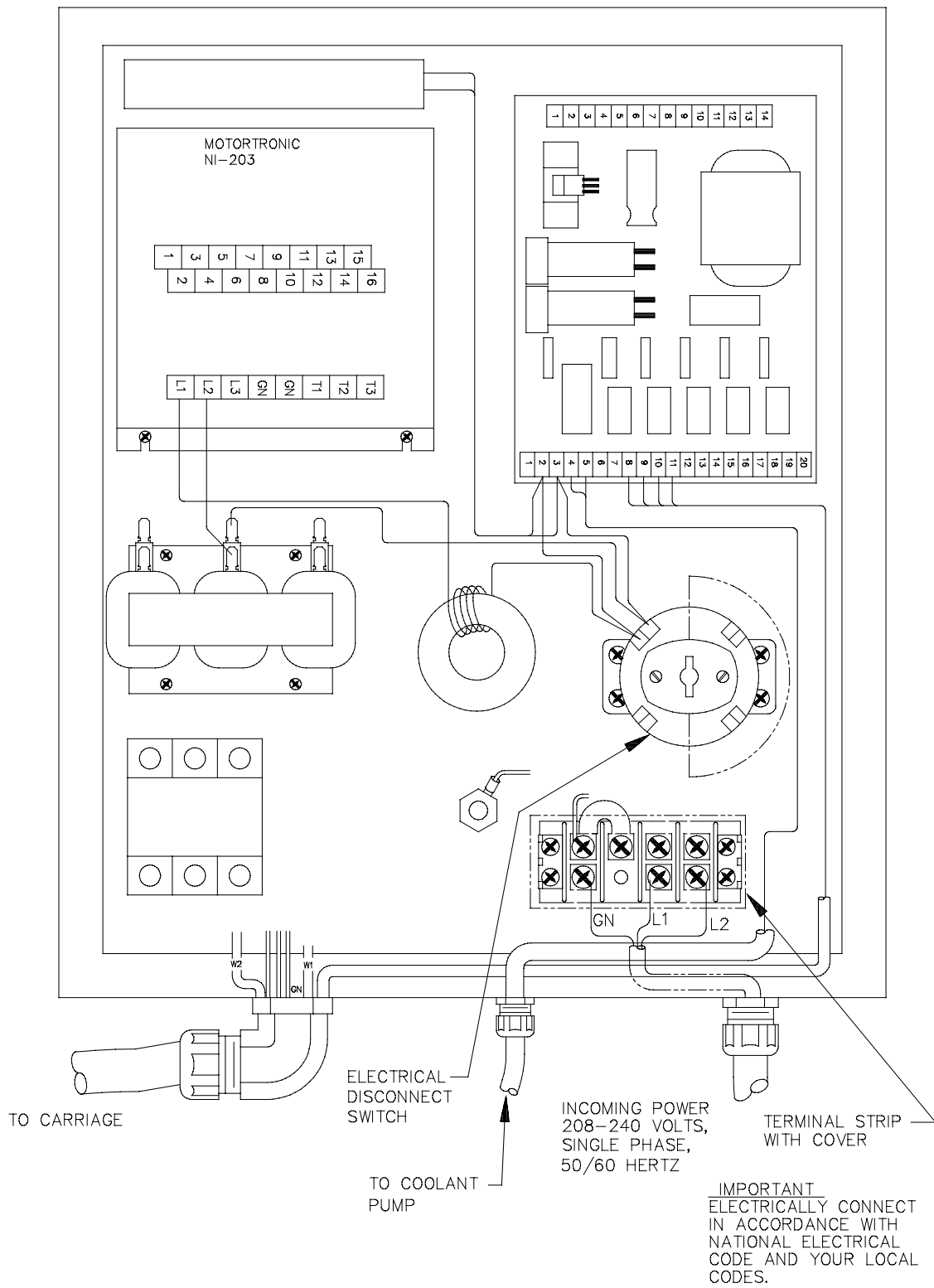
**Coolant Pump System:**

The coolant tank will hold a maximum of 50 gallons of selected coolant.

\* \* \* \* \*

# Single Phase Electrical Hook-up:

REFINES-20-051497





The following information describes the sequence of control actions.

### **Emergency Stop Button:**

Pressing the E-Stop Button cuts the power to the display circuit board, and cuts power to the various relays throughout the machine. All machine functions are stopped. If the machine is stroking when the E-Stop button is pressed, it may continue stroking until it reaches the top of the travel, depending on the load on the hone stones.

To restart, turn the E-Stop button counter clockwise, and it will 'pop' out. The machine will take approx. 5 seconds to reset, before it will be ready to run again.

### **Park Position Limit Switch:**

An electrical limit switch is located on the carriage under the rocker arm pivot. This switch is hooked up by both the normally open and normally closed terminals. The switch is activated by a cam on the rocker arm. When the rocker arm is lowered into its working range, the switch is activated and it allows the air control solenoid valve and the motor starter to be energized. When the rocker arm is raised back up to the park position the switch is deactivated and the electrical control circuit loses power and the motor load display blanks out. The two display areas will then read PARK.

### **Start / Stop Button:**

Press the Start/Stop button to start spindle motor. The spindle motor drives the hone head, through a V-belt and a gear reduction box. The spindle motor will not operate unless the park limit switch has been contacted (the rocker arm is pulled down and locked into operating position).

Press the Start/Stop button again to stop machine operation. The machine rotation, stroking, and auto feed cycles will all stop.

### **Stroke Button:**

Pressing the stroke button energizes a solenoid valve. This valve provides air pressure from the upper limit valve, to shift the spool of the stroking valve. The upper limit valve is mechanically held open by a plunger on the end of the piston rod. The stroking valve allows air pressure to flow to the upper part of the lower cylinder driving the piston and rocker arm down. As the piston rod moves away from the upper limit valve, it closes and exhausts the air from this control line.

The upper pivot, of the rocker arm, continues down until its actuating screw strikes the lower limit valve. This valve opens and allows air to flow to the opposite air pilot port of the reciprocating valve.

This air pilot shifts the spool of the reciprocating valve, which exhausts air from the upper port of the lower cylinder and allows air pressure to flow to the bottom port of the lower cylinder. This will drive the piston and rocker arm up.

As the actuating screw moves away from the lower limit valve, it closes and exhausts air from this control line.

These actions continue seamlessly causing the rocker arm to stroke up and down continuously, until the stroke button is pressed, or the start/stop button is pressed.

### **Stroking Speed Control:**

The upper cylinder, of the arm, provides smooth control of the stroking motion, and stroking speed control. This hydraulic cylinder pumps liquid back and forth through a ball valve, which is located on the right side of the carriage.

By opening and closing this valve, stroking speed can be changed. The current strokes per minute is displayed on the control panel. The strokes per minute can be changed at any time during the honing process.

A reservoir is located on the carriage under the rocker arm pivot. This reservoir compensates for volume change due to temperature variations. The reservoir liquid is fed through a check valve, located on top of the ball valve.

A regulator is located on back of the carriage to regulate the air pressure (15 P.S.I.) to the reservoir.

### **Hone Head RPM Control:**

A potentiometer is located on the left hand side of the control panel used to vary the speed at which the hone head rotates. This potentiometer connects to an AC, 3 HP Inverter drive. The hone head has a variable speed between 85 and 285 RPM's. The optimal head speed for a correct cross hatch pattern is roughly 195 RPM's. Turn the potentiometer clockwise to increase speed and counter clockwise to decrease speed.

### **Short Stroking Bottom Dwell:**

A check valve is attached between the stroking valve and the upper limit valve. A jump air line is routed around the check valve and a push button control valve is located on this line.

When this push button control valve is pressed, air can get through the check valve only, then it is trapped in the air line. This keeps the spool in the stroking valve shifted to down stroke only.

Then the lower limit valve is actuated. Its higher pressure shifts the spool in the stroking valve to up stroke, but as soon as the pivot arm moves away from the limit valve and exhausts its air, the air trapped in the other control line causes the spool to shift to down stroke again.

### **Strokes Per Minute Display:**

This counts and displays the strokes per minute of the rocker arm while the machine is stroking.

---

### **NOTE:**

*The counter requires a minimum of two strokes to obtain an accurate reading of the speed. The function of this display remains the same in both modes of operation.*

---

### **Coolant Push Button:**

The coolant push button is located on the control panel. This push button turns on and off the coolant pump motor. The lever on the left side of the carriage, regulates the coolant flow. When the park position limit switch is disengaged (rocker arm moved up to home position) the coolant flow will stop.

### **Manual Feed Button:**

This button has two (2) separate functions, one in standard operational mode and one in programming mode.

#### **Standard Operation:**

Press this button to feed the hone stones out manually. One press of the button feeds the stones out .001" on the Standard, Junior, and Minor hone heads, and .0003" on the Precision hone head.

#### **Programming Mode:**

Press this button to save any changes made to the operating program, otherwise all changes will return to the last saved value.

### **Auto Feed Button:**

This button has two (2) separate functions, one in standard operational mode and one in programming mode.

#### **Standard operation:**

The Auto Feed button is used in conjunction with the strokes per feed display. Press the Auto Feed button and the machine will automatically feed one 'feed out' per the set number of strokes. This is a programmable function of the HP5A. After running the machine a while you should get a feel for how many strokes at a given motor load it takes to remove a given amount of metal. This auto feed

function can be set up to automatically cycle, that number of times, then feed the stones out. It will continue this cycle until one of the following stop functions is activated.

The Auto Feed button is pressed again. The machine will stop counting strokes per feed, and feeding out, however, it will continue to stroke and turn. The auto feed cycle can be started again if desired.

The start/stop button is pressed. The start/stop button stops all machine functions. The auto stop function is activated. This stops all machine functions automatically.

**Programming Mode:**

Pressing this button will display the current Address Code you are working with in the Strokes Per Minute display. Releasing this button will display the data stored across both LED displays.

**Strokes Per Feed Display:**

This button has three (3) separate functions, two (2) in standard operational mode and one in programming mode.

**Standard Operation :**

Standard operation has two modes it can be operated in, Manual and Automatic Load, to change between modes refer to Modes of Operation later in this chapter.

**Manual:**

This displays the number of strokes left until the next feed out of the hone head. This value is set by pressing the 'Inc. +' button to increase the value, or the 'Dec. -' button to decrease the value. As the machine is running, in auto feed, this display is always counting down. To see what the strokes per feed is set at, while the display is counting down, press the 'Inc. +' and the 'Dec. -' buttons simultaneously.

**Automatic Load:**

This displays the set Target Load. The machine will automatically feed out every stroke until this load is reached. When the Auto stop sensor is activated it will display the set Finish Load. The Target and Finish Loads may be changed when the machine is idle or when in operation by pressing the 'Inc. +' or 'Dec. -' buttons respectively.

**Programming Mode:**

This display reads out data stored in the Address Codes (refer to Programming later in this chapter).

**Shut Off Delay Knob:**

This knob will add or subtract to the machines automatic calculated stop times. If the rotation of the head continues to long or stops early minor adjustment to the automatic stop time can be made by adjusting this knob. When the knob is at mid range the machine will use the automatically calculated stop times. Above and below the mid range will add or subtract respectively from the calculated time.

**Motor Load Display:**

The motor load display is divided into two parts. The single bar of lights across the bottom edge is the load bar. This light bar flashes out and back representing the average load along its scale, as the machine is honing. Motor load is measured and displayed as indication of tight and loose areas within a cylinder bore. Tight areas, areas where the bore is small, will cause the load bar to increase.

The rest of the display shows graphically the shape of the cylinder represented by the percent of motor load on the stones. As the machine is stroking, the series of lights in this section of the display, will show higher in the tight areas, and lower in the loose areas, creating a curve of the actual shape of the bore.

**Clamp Float Button:**

This button is located on the right side of the carriage. The carriage is by default always in clamp. Press and hold the clamp float button to float the carriage. This allows air to flow through a valve to a regulator, then out two ports of the regulator. Air from one port flows through the right orifice on the bottom of the

float plate. Air from the other port flows through a flow control valve then to the left side of the float plate and out the orifice on the bottom of the float plate.

**Auto Stop:**

The auto stop feature, automatically stops the machine or switches to Finish Load when a predetermined amount of material has been removed.

The auto stop is located on the feed ring, above the hand wheel, at the end of the rocker arm. This is a numbered band around the hand wheel. With the number '0' lined up on the pointer, the sensor trip button, will line up directly across from the sensor, on the back side. This is the position in which the machine will be shut off or switch to Finish Load.

To program for a certain amount of stock removal, rotate the feed ring to the desired amount and every time the hone head feeds out a click the sensor trip button will move closer to the sensor. After the desired stock removal the sensor will trip, turning off the machine or switching to Finish Load.

---

**NOTE:**

*In order to start the machine the feed ring must be rotated off the stop position.*

---

**Lower Limit Lever:**

The lower limit is attached to a threaded shaft. This threaded shaft supports the switch that signals the stroke to go back up. Pull the rocker arm down to a point where the hone stones have the proper extension through the bottom of the cylinder bore. Loosen the lock knob, allowing the adjustment knob to be turned. Turn the adjustment knob to its correct position and lock down firmly with lock knob to avoid slippage.

When the machine is running the arm will go down until it hits the lower limit, reverse and go back up.

**Upper Limit Lever:**

The upper limit lever is on the right side of the rocker arm. Tightening this lever, clamps the rocker arm linkage to the stroke cylinder. The rocker arm is brought to the position where the hone stones are at the proper upper travel limit. The upper limit lever is then tightened and the rocker arm stays in position.

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**NOTE:**

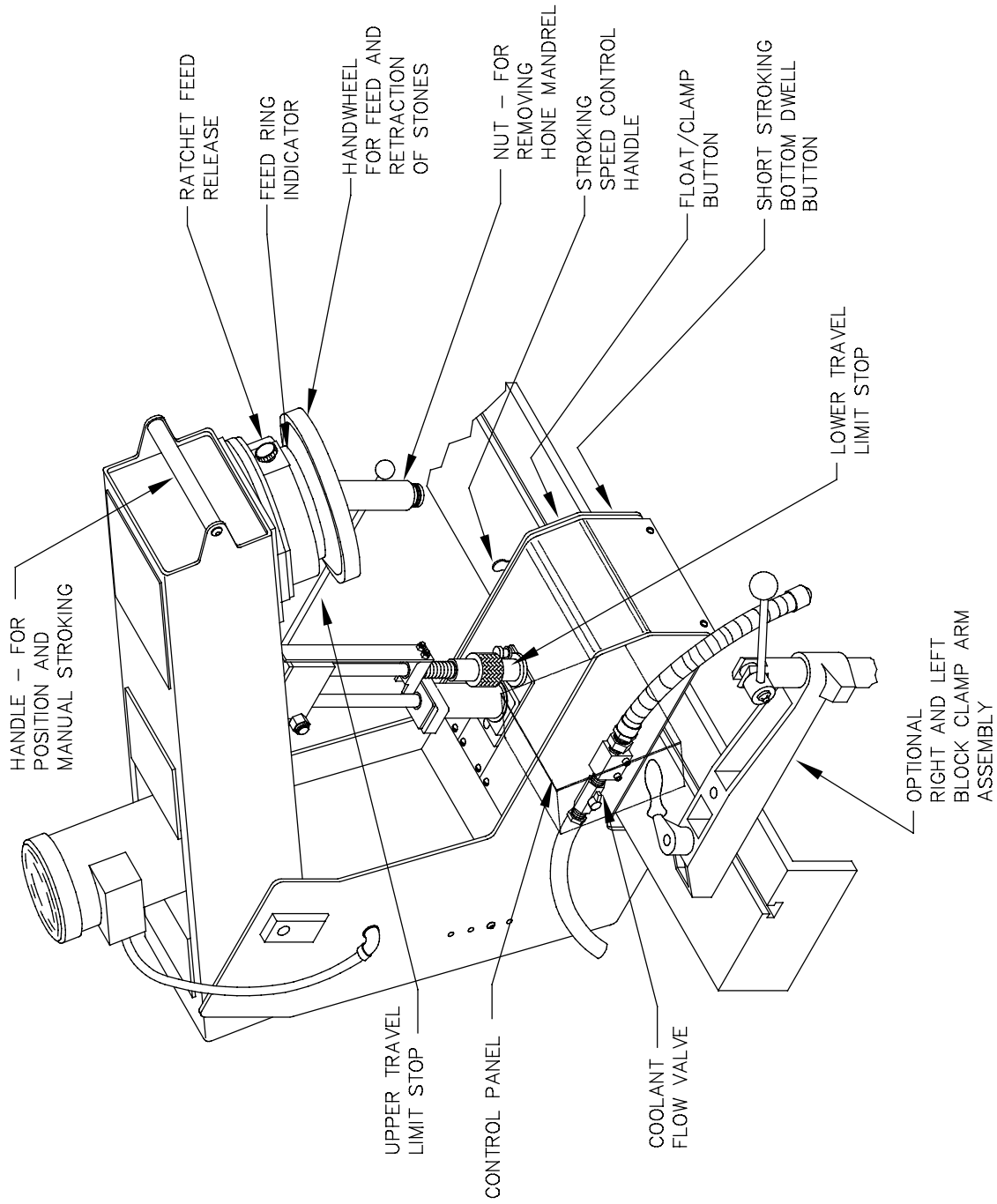
*The lower limit lever must be set first.*

---

When stroke is started, the stroke cylinder pulls the rocker arm up and down.

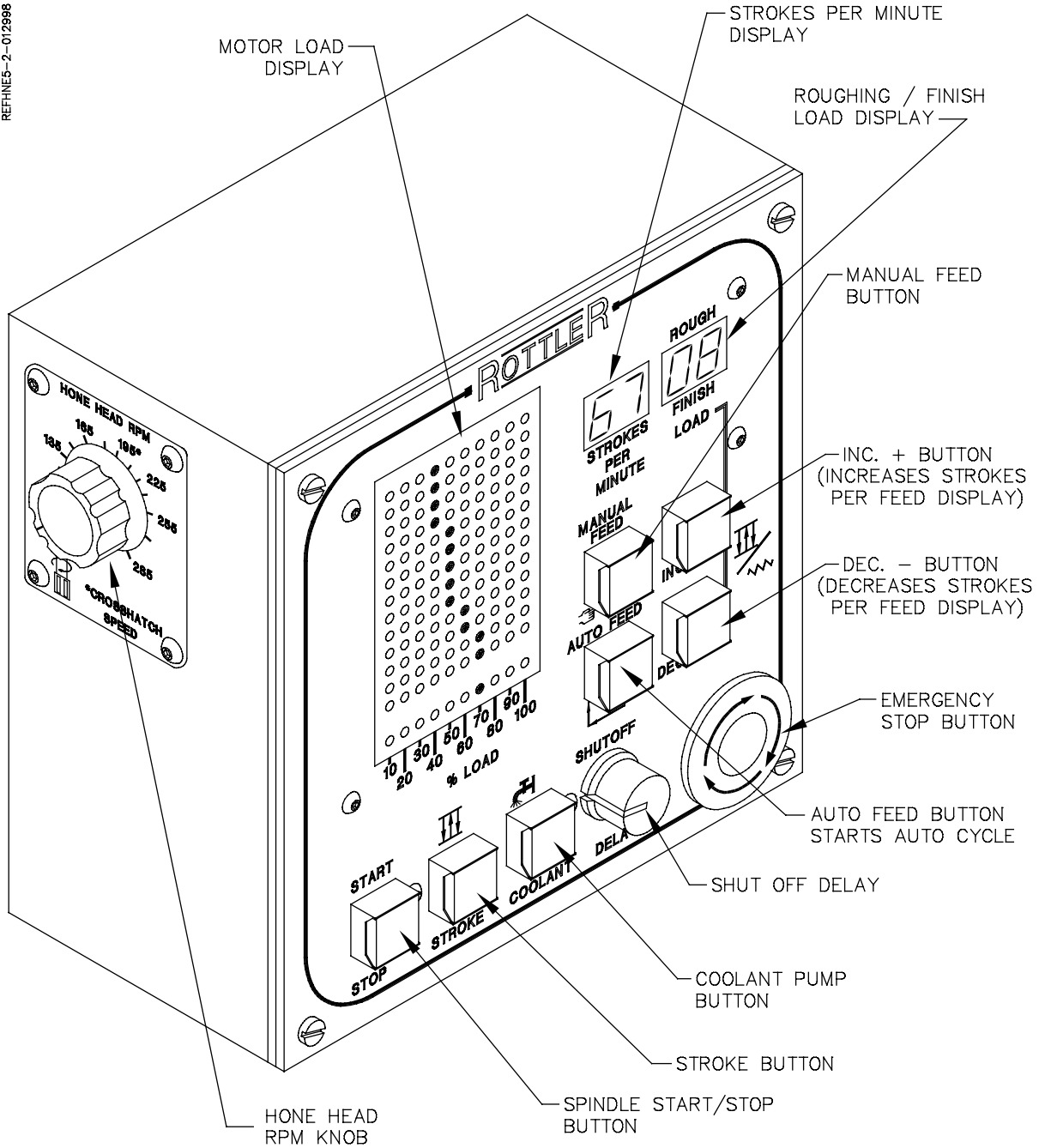
### Control Illustration:

HNE5-1-020298



### Control Panel Illustration:

REFHNS-2-012998



## Operating the HP5A: Honing in General

Please read Rottler Mfg. information on honing prior to operating this machine. The information guide along with the information below will allow you to maximize the potential of the Rottler HP5A hone.

Many cylinders have obstructions that will prevent the proper hone stone extension. You will obtain maximum performance if the lower stop is set to allow 1/2" of hone stone extending past the bottom (over stroke) of the cylinder bore. Be sure all cylinder bores are completely clear of webs or other obstructions. *Grind them away if possible.*

If less than 1/2" over stroke is obtained at the bottom of the cylinders the stones and guides may become tapered. The stones and guides can be trued up straight again by honing a fresh bored cylinder using proper top and bottom over stroke.

The upper stop should be set with the same amount of over stroke as the lower stop.

When through stroke extension is limited, you will find 3" length stones will require less attention to achieve an accurate bore.

If you are not able to eliminate a barrel shaped bore by adjusting the over stroke length try using shorter stones.

While the HP5A is running, pay attention to the display (upper left on the control panel). This display measures the actual motor current and displays it in percentages of rated motor current. As the machine is honing, the display takes current measurements from the motor throughout the length of the cylinder, and displays them with the lights. The farther to the right the lights go the smaller the bore is in that area. For example, if the lights operating near the bottom of the display move farther over than the rest of the lights, it means the hole is a slightly smaller diameter near the bottom. The same is true for the top and middle of the bore.

The HP5A is capable of honing a cylinder very accurately with very little or no work by the operator. The goal of the operator should be to set the upper and lower stop, select the proper stone length, and honing pressure that will allow the machine to hone the cylinder to size.

If the display indicates a bore is small at the bottom, press the short stroke button located on the right side of the carriage. This is the dwell button. The machine will stroke very short at the bottom of the bore. This will enlarge just that area of the bore. If the display indicates a bore is small at the top, press the stroke button on the control panel. This will stop the stroking at the top of the bore, but the hone head will continue to turn. Press the stroke button again to start stroking again. If it is necessary to remove material, from a bore, between the top and the bottom, use the stroking speed control lever on the right side of the carriage. Turn the lever to slow the stroking speed until it stops in the area you want to dwell in. Turn stroking speed back up to desired speed.

## Honing Procedure: Block Loading

The block hold down fixture can be used for inline, 'V', and 'Y' blocks. Move hone carriage to the far right of the main base.

Place block supports onto cradle with key engaged into slot (see page 5.18) Place supports on edge for blocks with exposed main bearing caps (V-block). Place supports flat for blocks with main bearing caps recessed above the pan rail (Y-block).

---

**NOTE:**

***Main bearing caps must be "ON".***

---

Place clamp bar through main bearings of block.

Rotate clamp screw out of the way.

Lower the block into the fixture. Align the clamp bar with the front clamp bar guides on the cradle ends. Pull the block toward you after the bar engages the front guides. The clamp bar will rotate into its clamping position. Allow the clamp bar to slide down these guides as the block is lowered.

Rotate clamp screws forward and clamp the bar *evenly*.

Squeeze the index handle on the right side of the fixture to allow the fixture to rotate. Release the handle allowing the stop block to fall into the appropriate slot in the index plate. After honing the first bank of a V-block, simply squeeze the handle and rotate the fixture so the other bank is in position for honing.

**Setting the Bottom and Upper Stops:**

Check for possible interference points in the lower part of all cylinders. Push the Clamp/Float button on the side of the hone carriage and move the machine to the cylinder that has the highest interference point. The bottom stop should be set in this cylinder.

Measure the distance from the top of the cylinder to the bottom of the cylinder to obtain the cylinder length. The over stroke distance should be approximately  $\frac{3}{4}$ ". Less if there is interference. Add the cylinder length and over stroke length to obtain the bottom stop length.

Expand or contract the stone assembly to the approximate bore size. To expand, turn hand wheel counter clockwise (looking from the top). To contract, pull and turn ratchet feed release, turn hand wheel clockwise (looking from the top).

Use the handle to pull the stroking arm down and to touch the bottom of the stone to the top of the engine block. Lock the stroking arm in this position using the upper stop lever.

Rotate the lower stop to the correct bottom stop length (cylinder length plus over stroke) using the bottom stop scale and the bottom of the pivot block.

---

**NOTE:**

***The bottom stop scale contains errors and should be used for reference only.***

---

Unlock the stroking arm and pull the stroking arm down against the bottom stop. **Make sure you pull hard enough to collapse the lower stop bumper.** At this position rotate the hone head one turn to make sure there are no obstructions. Adjust the bottom stop and re-check for obstructions if required.

Bottom stop setting will not have to be changed in this block unless there is an obstruction in one of the other cylinders.

---

**CAUTION:**

*If the hone head crashes into a web or obstruction the pinion will twist or break. This condition is not covered by warranty.*

---

Raise hone head until stones extend about 1" out of the top of the block. Lock the upper stop in this position. Do not over tighten.



## Automatic Cycle Operation

### Automatic Load:

When operating in Automatic Cycle the machine will maintain a set motor load percentage until the desired amount of material has been removed from the bore. The Rough and Finish Load is set using the "Inc +" and "Dec -" buttons on the control panel and can be changed during an Automatic Cycle.

### Rough Load:

When the feed ring is on any number other than zero and the machine is in Automatic operation the control will automatically maintain the load value set in the control display. The rough load is commonly set between 60% and 90% percent.

### Finish Load:

When zero is reached on the feed ring in Automatic Cycle operation the machine will automatically switch the target load to a preset finish load and continue stroking until this value is reached. Refer to the Programming section later in this chapter to set the Finish Load. Once the finish load is activated by the feed ring, the value can be change while operating. The finish load value has a large effect on the finish cylinder accuracy. Thin wall cylinders generally require a lower finish load for accuracy than thick walled cylinders. The finish load is commonly set between 20 and 40% depending on the accuracy required.

### Start Honing:

Press start / stop button once. This will start the hone head turning. Using the hand wheel feed out the stones until the load meter reads the same as the value set for the finish load. When this value is obtained engage the "ratchet feed release" to prevent the hand wheel from turning. Now turn the feed ring for the desired stock removal.

The machine is now ready to begin an automatic cycle. Press the coolant button, be sure the coolant is flowing directly into the hole being honed. Press the stroke button to start the stroking. Press the Auto Cycle button and the machine will automatically feed out until the set rough load is reached. Once the rough load is reached, the machine will automatically maintain the load until "0" is reached on the feed out wheel. When "0" is reached the machine will display the finish load and continue to hone until the finish load is reached. When the finish load is reached the machine will stop at the top of the stroke.

## Manual Operation

### Feed Indicator Ring:

Set the total amount of material to be removed, by using the feed ring located above the hand wheel. Just below the hand wheel release knob, there is an indicator. Position the feed ring, so the number indicating the total amount of material to be removed is lined up with the indicator. (*This must be set after stroking is started and motor load is brought up to the finish load*).

Due to stone break down it will be somewhat less than indicated by the feed ring.

### Start Honing:

Press start / stop button once. This will start the hone head turning. Using the hand wheel feed out the stones until there is some pressure in the cylinder. Press the coolant button, be sure the coolant is flowing directly into the hole being honed. Press the stroke button, as the machine is stroking bring the motor load light bars up to the desired load. (Approximately 60% to start with).

### Manual Feed:

You can operate the feed manually, by pressing the manual feed button. Each press of the button feeds the stones out one graduation on the feed ring. This can also be accomplished by grasping the hand wheel and turning it counter clockwise. When using manual feed be aware of the feed ring. As you press

the manual feed button and the hand wheel turns, eventually the feed ring will reach zero, which will activate the auto feed stop and stop the machine.

### **Dwell Button (Short Stroke):**

The dwell button is located on the right side of the hone carriage. This button forces the hone to short stroke at the bottom of the bore. This is used for opening a bore that may be too tight at the bottom. Be sure that the stroking speed is in the normal speed range (above 40 strokes per minute) before using short stroking feature, if the stroke speed is set too low the machine may stall.

The length of the short stroke can be varied by varying the stroking speed. Slowing the stroking speed will shorten the short stroke distance, increasing the speed will lengthen the stroke distance.

The hone can be dwelled at the top of the bore also, by pressing the stroke button, which will stop the stroke. When pressing the stroke button, the machine will always finish the current stroke and stop at the top of the bore no matter when the button is pressed.

### **Checking the Size of the Bore:**

To check bore size, first reduce stone pressure. Press the start/stop button. Place left hand on rocker arm handle. Release upper travel limit lever. Move hone head out of the way. After checking size, place hone head back in position, reset upper travel limit lever, and resume honing as normal.

### **Manual Stroking:**

For some jobs you may wish to manually stroke the hone. This is done the same as any other honing sequence except, don't lock the upper travel limit lever, and don't press the stroke button. Use the start/stop button to start and stop the hone head rotation. Pump the rocker arm up and down by the handle on the end.

Do not operate the power stroking without upper travel limit lever locked. If the stroke is started, and this lever is not locked, the piston will go down and stay there.

To return it, press the start/stop button to stop spindle rotation. Be sure upper travel limit lever is completely unlocked. Keep your hands well clear of all mechanisms. Manually bring the rocker arm down to the lower stop or use a pencil or screwdriver to depress the lower limit valve. The cylinder will return to the top.

### **Limited Over Travel and Blind Holes:**

A problem with stock removal with hone heads exists on the Chevrolet 350 block. There is a maximum over-stroke at the bottom of 3/8 to 7/16 and an often worse condition created by a remnant pad at the bottom that extends about 1/4" beyond the main bore.

If the lower remnant pads require stock removal there is almost no way to hone properly without using a die grinder, portable grinder, or a boring bar to relieve the pads.

In order to achieve the best possible bore that is near blind (that is without relief) hone may be dwelled at the bottom, by turning the stroke speed control all the way down. Stone lengths can be shortened to 2-1/2" or 2-1/4" by cutting off at the top end. It may be necessary to occasionally redress stones by honing a bore that has a minimum of 1" over travel at the bottom of bore.

The bottom short stroke may be used, but care must be exercised to avoid a barrel effect near the bottom.

### **Strokes per Minute Display:**

When the machine is running this digital counter shows the actual strokes per minute. By turning the lever on the right side of the carriage the strokes per minute can be changed at any time during the hone cycle. Since the stroke rate will slow down a small amount with a heavy load, the strokes per minute should be

adjusted when the machine is operating with a motor load equal to the finish load the machine has been set at.

The strokes per minute number is used to determine the cross hatch angle of the honed cylinder, using the chart given on page 3.8 (or the full size fold-out included with this manual).

Select the bore diameter, for our example we will use 4" dia.

Follow across to the desired crosshatch angle, (27 degrees). *The crosshatch angle for our purposes is measured from a horizontal plane, for example the top deck of the engine block.*

Follow straight up to the 5.25" stroke length line.

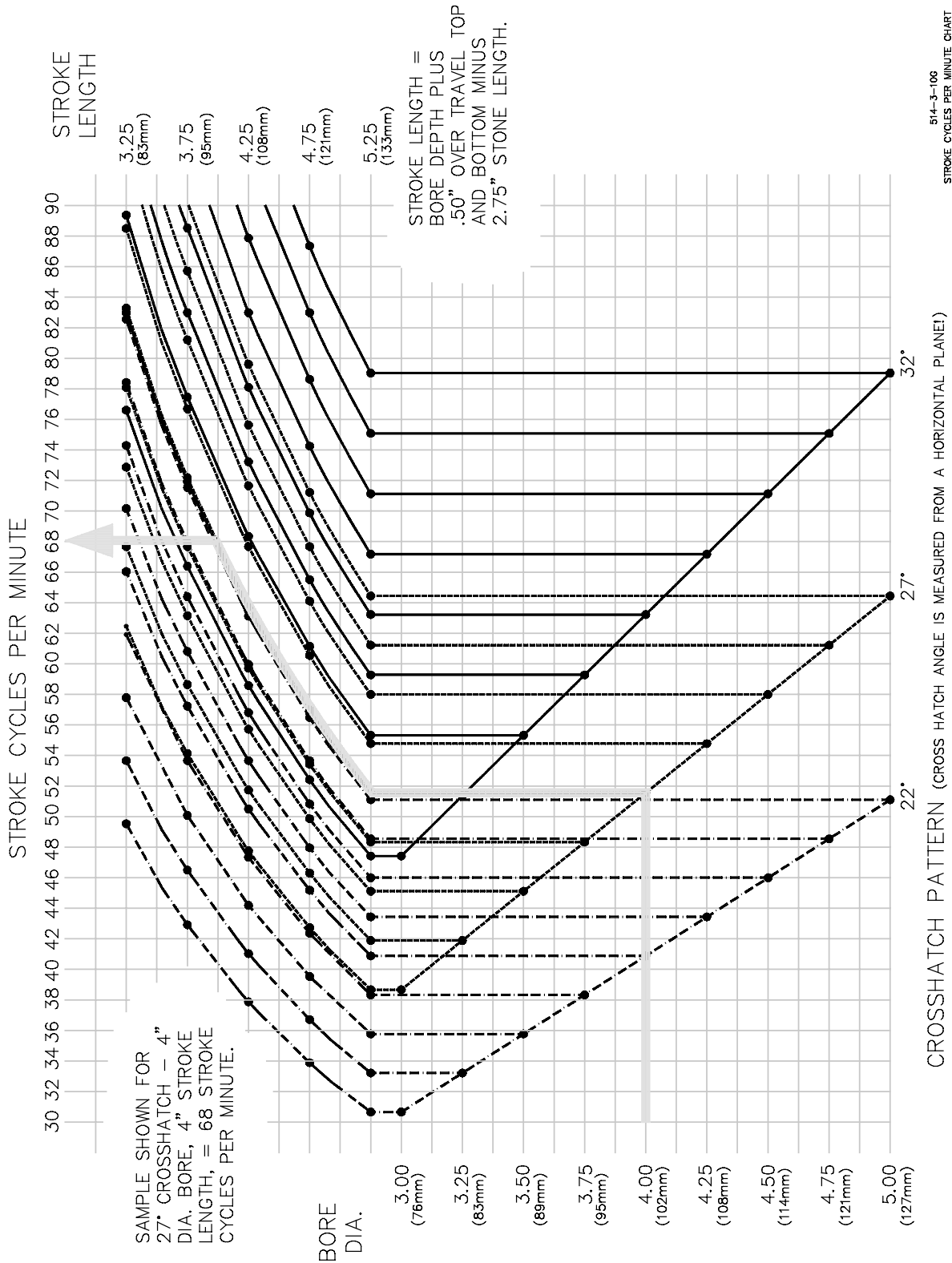
Follow the approximate curve to the correct stroke length, (4.00").

*[Stroke length is measured as this example: 5.75 (bore depth) plus 1" (.50" over travel top and bottom) equals 6.75". Subtract 2.75" (stone length) equals 4.00" total stroke length]*

Follow straight up from this point to determine the correct cycles per minute setting to obtain the desired crosshatch, (68 strokes per minute).

\* \* \* \* \*

### Crosshatch Pattern Chart:



## Lubrication:

Refer to illustrations on page 4.3

### Grease Fittings

There are two grease fittings located on the rocker arm pivot bearings. There is a grease fitting located on the upper cylinder pivot pin. On the block hold down fixture there are three grease fittings. Each optional clamp arm assembly has one grease fitting.

**Every 175 hours**, these grease fittings should be greased, using ***Unoba EP 2 Multi-purpose grease, or equivalent NLGI-2 grease.***

### Gear Housing

The gear housing is located at the front end of the rocker arm. The gear housing is what drives and adjusts the hone head.

**Every 1,000 hours**, check the oil level in the gear housing. The arm must be in the horizontal position. Remove the plug on the upper left side of the gear housing. The oil level should be up to this hole. If oil is needed, add to this hole. ***Use any 30-weight (ISO VG-) non-detergent motor oil.***

---

### CAUTION:

***DO NOT OVER FILL!!***. *If over-filled, oil will spill out of breather cap. To drain oil, remove the plug at the bottom of the gear housing.*

---

### Universal Joint

The universal joint connects the hone head adjusting shaft assembly to the gear housing.

**Every 8 hours**, Lubricate the hinge points of the universal joint with 30 weight (ISO VG-) machine oil.

### Automatic Lubricator

The oil lubricator is located on the back of the main base. The oil lubricator lubricates the stroking cylinder.

**When needed**, add hydraulic oil to the reservoir. ***Use Mobil DTE 25 hydraulic oil, or any equivalent, highly refined, turbine , or hydraulic S.A.E #10 (ISO VG-46) or lighter petroleum oil (non -detergent) with a medium aniline point (ASTM oil #2).***

---

### CAUTION:

***Only use oil that is compatible with nitril seals, and will not cause them to swell.***

---

DO NOT use compounded oils containing graphite, silicones, soaps or fillers. Hydraulic fluids containing phosphate esters (skydrol, fyrouel, pydraul, etc.) or fire resistant oils containing phosphate esters.

---

### NOTE:

***Plastic bowl and sight dome must be cleaned only with household soap.***

---

Set lubricator at one drop every (1) to (2) minutes.

### Air Filter / Regulator

To maintain maximum filtering and efficiency and to avoid excessive pressure drop, the filter regulator must be kept clean. Erratic regulator operation or loss of regulation is most always due to dirt in the disc area. If the air supply is kept clean the regulator should provide long periods of uninterrupted service.

**As needed**, Depressurize and disassemble the filter / regulator (remove the \*bowl, filter and disc assembly). Clean parts with denatured alcohol and blow out body with compressed air. When reassembling, make sure disc stem fits into its center hole of diaphragm assembly. If diaphragm

assembly is replaced, make sure disc stem fits into its center. Tighten bonnet slightly more than finger tight (50 inch pounds).

Wash porous filter elements with denatured alcohol.

\*Clean plastic bowl only with household soap.

### **Coalescing Air Filter**

A coalescing air filter is installed in the air control circuit line. This filter is designed to remove the smallest contaminants in the air. Periodically, drain the coalescer by turning the knob on located on the bottom of the bowl. It will become necessary to change the filter.

Remove air supply, and drain air system completely. Unscrew the plastic bowl under the coalescing filter. Unscrew the fastener holding the filter paper. Replace filter and reassemble.

### **Coolant Pump Honing Oil**

The coolant pump is located in the back of the splash tank. The coolant drains under the block fixture into a sump under the machine.

***Every 8 hours***, change the filter paper. Change the honing oil when it gets dirty. When changing oil, completely clean tank and filter screen. ***Use 50 gallons max. of Mobilmet Upsilon or any equivalent light honing oil (ISO).***

### **Hydraulic System**

This system is used to regulate the stroking speed.

***Every 175 hours***, check the hydraulic liquid level in the back of the carriage under the pivot arm. ***If liquid is needed, add two parts distilled water to one part Ethylene glycol (Prestone) to the plugged hole on top of the reservoir.*** Fill to mark on reservoir.

### **Muffler Exhaust**

(See page 5.16)

The exhaust muffler, on the main stroking system, must be replaced periodically. If hone loses power in the stroking operation it could be caused by a dirty exhaust muffler.

The exhaust muffler is located at the rear of the machine. Remove the mount screws from the side of the splash tank, remove the enclosure. Unscrew the muffler and replace with a new filter.

---

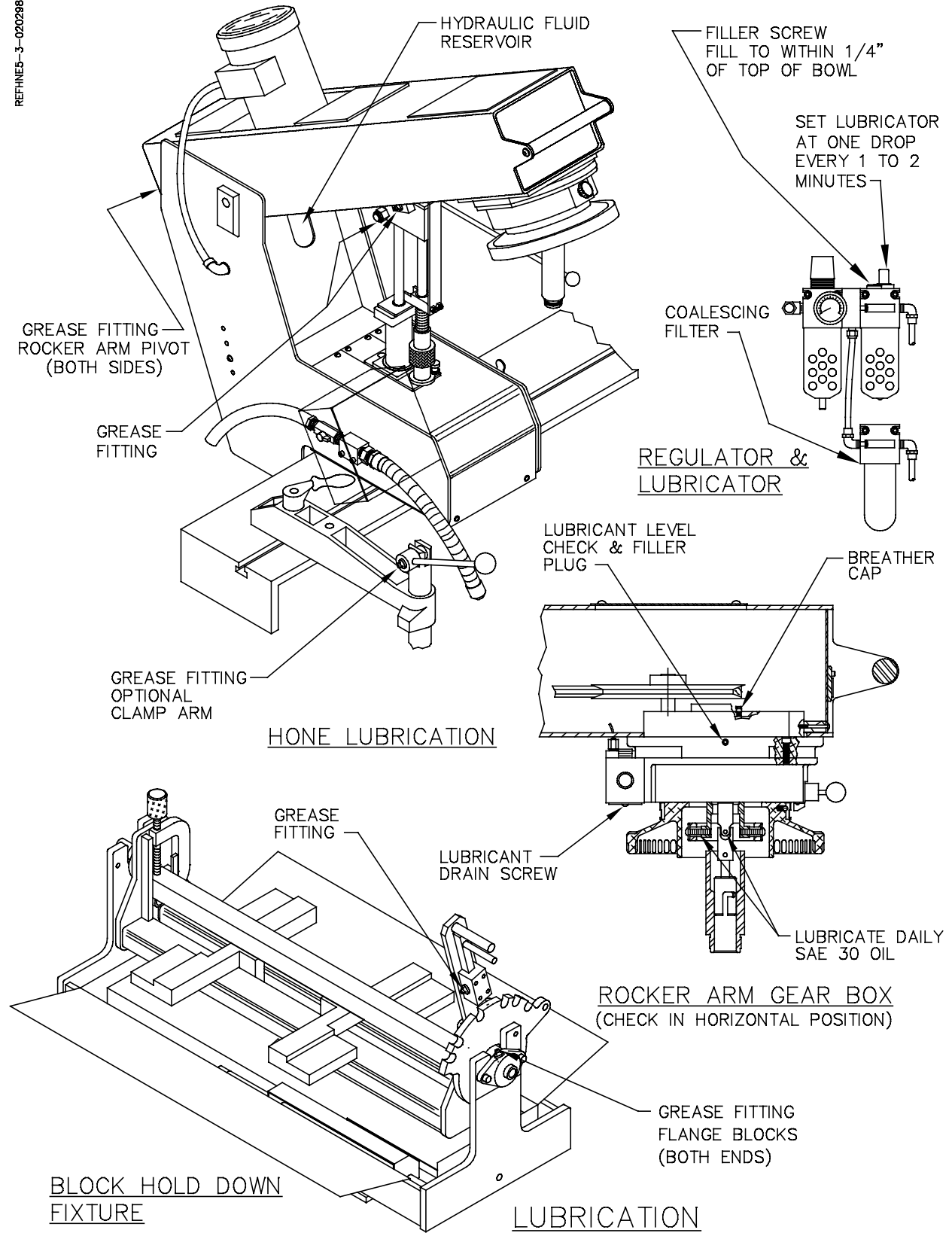
### **NOTE:**

***Older models have 2 brass mesh exhaust mufflers, located inside the rear of the carriage. These filters may be removed, rinsed with denatured alcohol, and reinstalled.***

---

### Lubrication Illustration:

REFHINES-3-020298



## Hydraulic System:

### System Check

With the machine running, watch the pivot arm and see if there is any jerking or bouncing when the pivot arm is changing directions, slow down the stroking speed to see. Jerking and bouncing indicate air in the hydraulic system.

---

### NOTE:

*At very slow stroking speeds, there may be some bouncing of the pivot arm at the bottom of the stroke. This is normal. Increase the stroking speed slightly to see it more clearly.*

---

### System Refilling And Bleeding

The following procedure assumes a drained hydraulic system. Start at step number 6, if your hydraulic system is already filled and has been in operation.

---

### CAUTION:

*Reduce the main air regulator (13) to 30 P.S.I. To reduce (Pull out the knob and turn counter-clockwise.) Check air pressure in system by pressing float button on side carriage.*

---

### NOTE:

*Do not turn air completely off.*

---

1. Turn off air flow from the reservoir air regulator (1). (*Pull out the knob and turn counter-clockwise*)
2. Remove plug from the top of the reservoir (2). Fill the reservoir with two parts distilled water, to one part ethylene glycol (Prestone). Fill to mark on reservoir.
3. Open the stroking speed control valve (3) all the way. (*This is the handle on the right side of the carriage, turn handle horizontal.*) **Note:** *Leave the hydraulic make up valve (4) closed. (Hydraulic make up valve (4) deleted on late model machines)*

---

### NOTE:

*If equipped with a max. stroking speed valve (7), Do not adjust, it is preset at the factory. If adjustment is necessary set to 65 strokes/minute with a 3" stroke at the honehead.*

---

4. Turn the reservoir air regulator (1) all the way open. (*Pull the knob straight out and turn clockwise all the way.*) When the fluid level is near the bottom of the reservoir, turn off the air flow from the reservoir regulator (1). (*Pull the knob straight out and turn counter-clockwise.*) Watch the fluid level in the reservoir (2), do not let it run completely out.
5. Repeat steps 1 and 2 to refill reservoir.

### System Bleed Only

6. Turn the reservoir air regulator (1) all the way open. (*Pull the knob straight out and turn clockwise all the way.*) The reservoir (2) should remain at least half full, if it drains below half, repeat steps 1 and 2.
7. Check the system for any leaks.
8. Slip a length of hose on to the bleed valves (5) & (6). Run the other end of the hose into a can with some water in it.
9. Open the top bleed valve (5). Fluid and air will bleed into the can. Close the bleed valve when the air bubbles stop.



---

**IMPORTANT:**

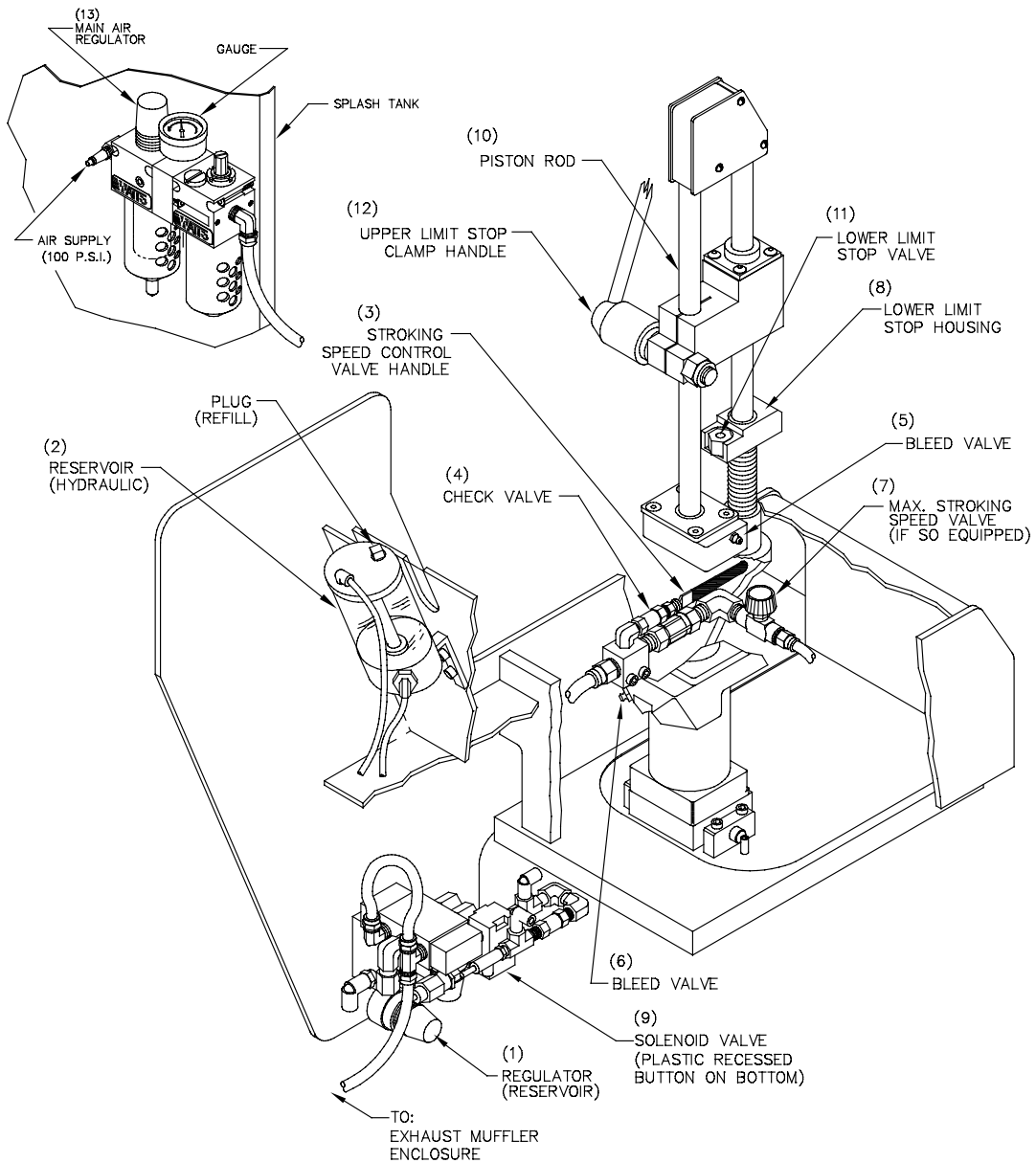
***Do not allow fluid reservoir to drain completely. When the level gets low, refill following steps 1 and 2.***

---

10. Open the bottom bleed valve (6). Fluid and air will bleed into the can. Close the bleed valve when the air bubbles stop.
11. Set the lower stop limit housing (8) as far down as it will go.
12. Release the upper stop clamp handle (12).
13. Push the little plastic recessed button on the bottom of solenoid (9). The piston rod (10) will go down.  
**Note:** *The rocker arm will come down with the piston rod.*
14. Repeat steps 9 and 10, filling reservoir (2) when needed.
15. Depress lower limit stop valve (11), the piston rod will go back up. **Note:** *The rocker arm will also go up.* You will need a small screwdriver or an Allen wrench to push on the small recessed button that will actuate the valve.
16. Repeat steps 9 & 10 again to be sure no air remains in the system.
17. Reset the main air regulator (13) to 100 P.S.I. To increase pressure (*Pull out the knob and turn clockwise.*) Check air pressure in system by pressing the float button on the side of the carriage. Relock regulator by pushing in.
18. With the reservoir (2) full, turn off air flow from the reservoir regulator (1) (*Pull out the knob and turn counter-clockwise*). Now reset the reservoir regulator (1) pressure to approx. 15 P.S.I. by turning clockwise 3 full turns.
19. With the machine running, watch the pivot arm and see if there is any jerking or bouncing when the pivot arm is changing directions, slow down the stroking speed to see. Jerking and bouncing indicate air in the hydraulic system.

### Bleeding Illustration:

REFNEB-4-110697



## V-Belt / Adjustment - Removal:

**CAUTION:**

*Disconnect all electrical and air power before making any repairs.*

**V-Belt Adjustment**

Remove the cover on top of the rocker arm at the front. Loosen the 4 motor bracket mounting screws from the top of the rocker arm. Push the motor back until there is approximately 1/2 inch deflection of the v-belt. Measure deflection midway between the motor and the gear housing.

**CAUTION:**

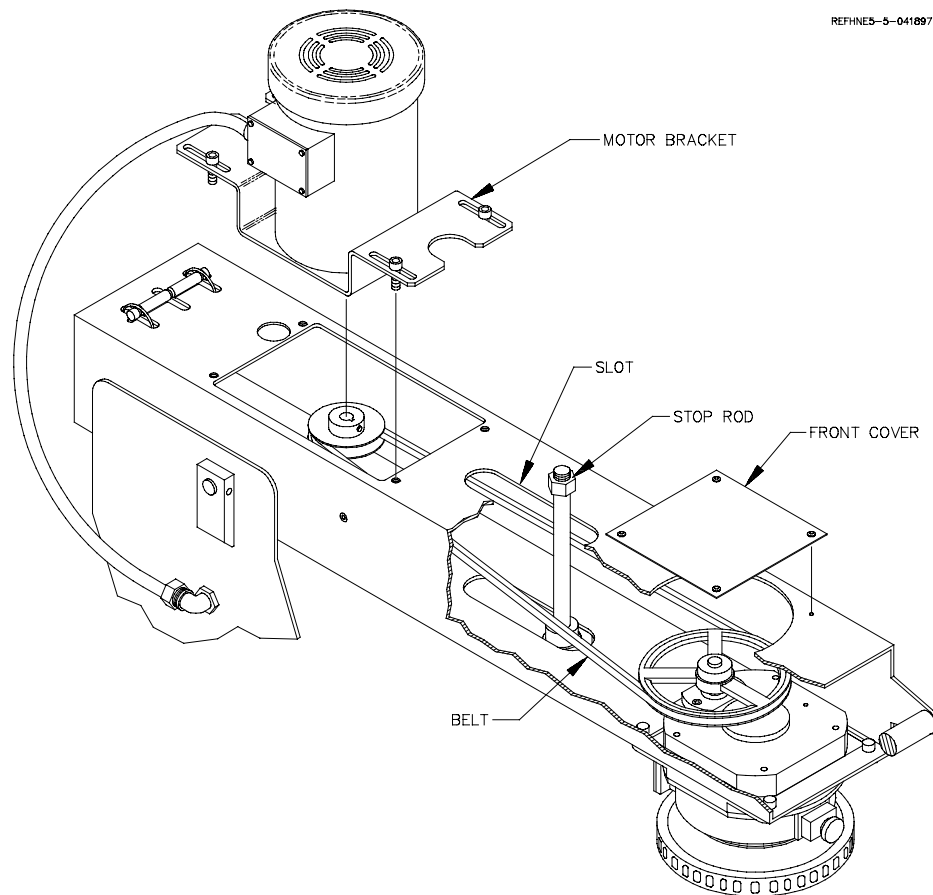
*Do not over tighten belt.*

Tighten the motor mounting plate. Replace the front cover and tighten its screws.

**V-Belt Removal**

Remove the cover on top of the rocker arm at the front. Loosen the 4 motor bracket mounting screws from the top of the rocker arm. Slide the motor forward. Remove V-belt through the stop rod slot in the top of the rocker arm.

Installation of the new belt is the reverse. See above for V-belt adjustment.



---

## **Gear Housing Removal:**

---

### **CAUTION:**

*Disconnect all electrical and air power to hone before making any repairs.*

---

Remove the hone head, at drive tube nut. The drive tube nut is located near the adjusting hand wheel.

Remove the drive belt as described on page 4.6.

Remove two 1/4" socket head cap screws in the front cover of the rocker arm.

Remove the four gear housing mounting screws, from inside the rocker arm.

---

### **NOTE:**

*Use care as the gear housing will be free to drop when all of the screws are removed.*

---

## **Gear Housing Disassembly:**

(Refer to page 5.8)

Drain oil. Remove the oil drain screw located on the back of the gear housing toward the bottom.

Remove drive tube and drive yoke by holding pinion drive shaft, and unscrewing the drive tube.

To disassemble universal joint, remove its four 1/4" cap screws. On re-assembly of the universal joint make sure all screws are tight.

Remove the six socket head cap screws on top of upper gear housing. Remove upper half of gear housing.

Remove bearing retainer (514-6-26), from the upper gear housing. Press pinion and bearing out of the housing. Loosen the socket set screw in the nut, on the pinion shaft. Remove the nut. Press the bearing off of the shaft.

Remove the four screws securing the lower gear housing to the cage. Remove the cage and hand wheel, carefully. When reassembling be careful not to damage the oil seal. Note the o-ring on the outer lip of cage. Ring gear can be lifted out of cage. Remove the four socket head screws in the hand wheel hub. Remove hand wheel and ratchet gear.

Remove sun gear 514-6-35, from the gear housing assembly. Press out the 1/8" spring pin. The adjusting shaft 514-6-43, and the thrust washers can be removed by sliding down. Press out the spring securing the driven planet gears 514-6-32A. Remove the gears.

Locate the locknut on top of the driven shaft 514-6-36. Bend the tabs of the lockwasher out of the way. Remove the locknut washer. Press the driven gear 514-6-28 off of the driven shaft. Remove the three screws in the bearing retainer 514-2-3C. You must align the access holes in the sun gear 514-6-29 in order to get an allen wrench on the screws. Press the shaft and bearing out of the upper housing. Press the bearing and the sun gear off of the driven shaft.

To remove the planet gears from the ratchet gear, press the shafts 700-6-5 out of the ratchet gear.

Remove the feed ring 514-6-80C by pulling it off of hand wheel.

Remove ratchet feed assembly from cage by removing one 1/4" socket head mounting cap screw.

---

### **NOTE:**

***O-ring, seal around hub.***

---

Disassemble ratchet feed assembly by removing knob and pressing out 1/8" spring pin. Ratchet pawl, spring and o-ring can then be removed from carrier.

Disassemble ratchet feed assembly by removing knob and pressing out 1/8" spring pin. Ratchet pawl, spring and o-ring can then be removed from carrier.

Remove auto feed up housing (see page 5.11). Remove the four screws holding the auto feed housing to the ratchet gear cage. Disassemble auto feed unit. Unscrew the drag pin housing 514-7-33, remove the spring and the pin. Remove the two screws and the cover 514-7-39. Remove the shoulder screw 514-7-32 from the shifter spool 514-7-26. Pivot the ratchet pawl 514-7-29 out and remove the pivot pin 514-7-31. Remove the ratchet pawl. Pivot the retraction arm 514-7-30 back inline with the spool. Lift the retraction arm straight out through the slot in the housing. Remove the three screws securing the slot in the housing. Remove the three screws securing the cylinder 514-7-28 to the housing.

Once the cylinder is removed the piston 514-7-27 and the shifting spool 514-7-26 can be pulled out from the end.

Reassembly is the reverse. The drag pin assembly should be tightened until spring is fully compressed, then loosen approximately 1/4 turn. Reassemble the auto feed housing onto the ratchet gear cage, The upper gear housing must be removed so the ratchet pawl can be seen while being assembled, and the spring loaded ratchet pawl can be attached.

Adjust the engagement of the pawl to the ratchet wheel by loosening the auto feed housing mounting screws, and moving the housing sideways. Ratchet pawl must just miss one ratchet tooth then fully engage the next.

## **Float and Clamp:**

### **Float**

Press the air float button, located on the front cover of the carriage. The air flows from the valve to the float regulator then to holes in both sides of the float plate. This allows the carriage to float on a cushion of air. To adjust the air float system, adjust the air float regulator 502-27-18 (see page 5.2) until hone unit floats freely over the whole length of main base.

---

### **NOTE:**

***Hone will not float correctly unless carriage clamp is adjusted properly.***

---

### **Clamp**

Release the air float button. The air flows from the valve to the air clamp cylinder. This cylinder lifts the clamp lever which pulls up on key in t-slot. It may be necessary to adjust the air clamp system.

Remove the four screws securing the carriage cover plate. Remove the cover. Disconnect the air supply. Inside the carriage remove cotter pin from slotted nut. Back the nut off and then hand tighten. Loosen nut approximately 1/4 turn. Insert cotter pin. Reconnect air supply. If the rod of the cylinder sticks in the up position, turn nut one notch looser or tighter until rod operates freely.

\* \* \* \* \*

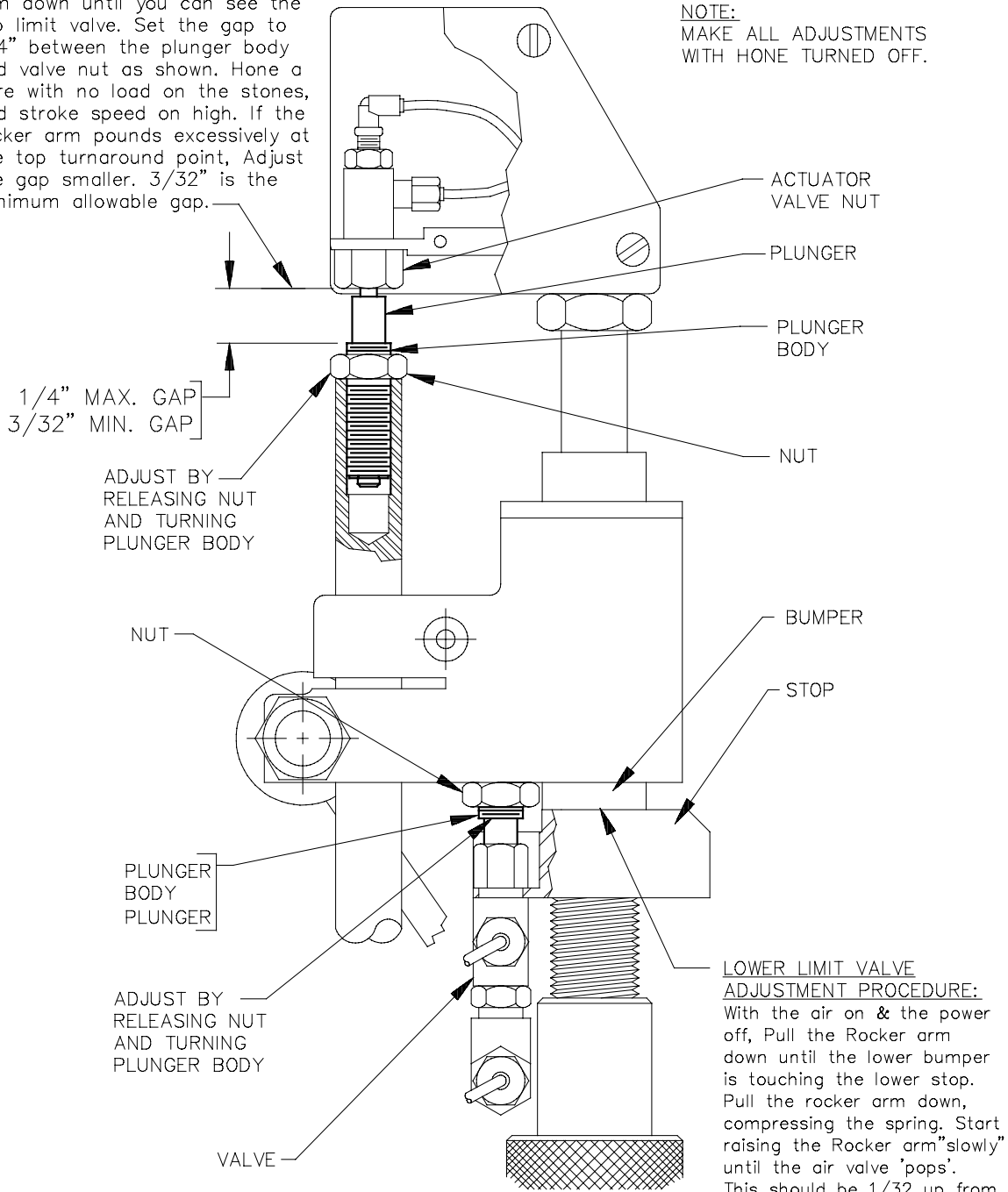
## Upper and Lower Limit Valves Adjustment: (With Lower Bumper Spring)

UPPER LIMIT VALVE  
ADJUSTMENT PROCEDURE:

The stroking cylinder should be in the park position. Pull the rocker arm down until you can see the top limit valve. Set the gap to 1/4" between the plunger body and valve nut as shown. Hone a bore with no load on the stones, and stroke speed on high. If the rocker arm pounds excessively at the top turnaround point, Adjust the gap smaller. 3/32" is the minimum allowable gap.

**NOTE:**  
MAKE ALL ADJUSTMENTS  
WITH HONE TURNED OFF.

REFHNE5-7-042197



ADJUST BY  
RELEASING NUT  
AND TURNING  
PLUNGER BODY

ADJUST BY  
RELEASING NUT  
AND TURNING  
PLUNGER BODY

LOWER LIMIT VALVE  
ADJUSTMENT PROCEDURE:  
With the air on & the power off, Pull the Rocker arm down until the lower bumper is touching the lower stop. Pull the rocker arm down, compressing the spring. Start raising the Rocker arm "slowly" until the air valve "pops". This should be 1/32 up from the full down position.

UPPER AND LOWER  
LIMIT VALVES ADJUSTMENT  
WITH LOWER BUMPER SPRING

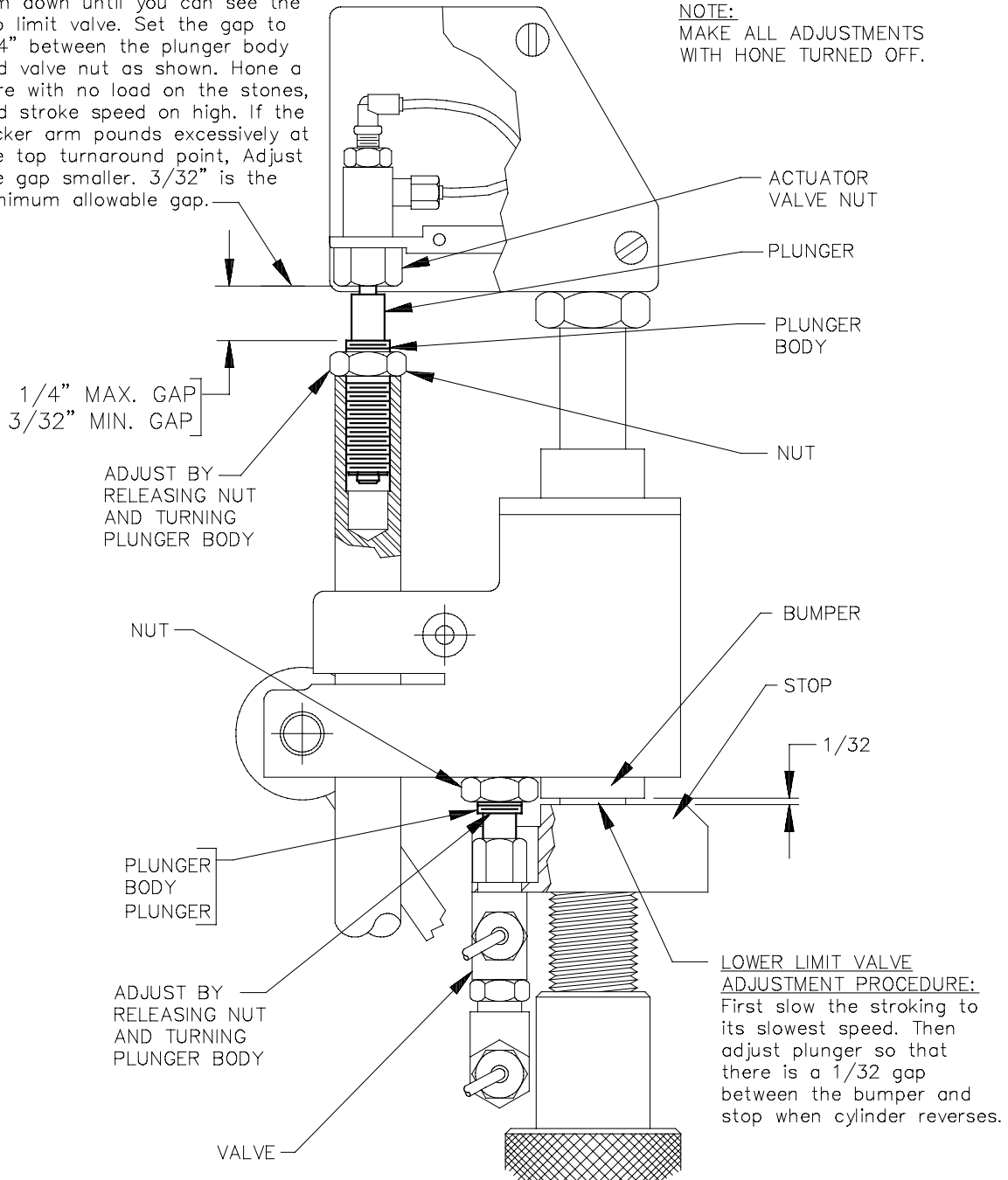
## Upper and Lower Limit Valves Adjustment: (Without Lower Bumper Spring)

UPPER LIMIT VALVE  
ADJUSTMENT PROCEDURE:

The stroking cylinder should be in the park position. Pull the rocker arm down until you can see the top limit valve. Set the gap to 1/4" between the plunger body and valve nut as shown. Hone a bore with no load on the stones, and stroke speed on high. If the rocker arm pounds excessively at the top turnaround point, Adjust the gap smaller. 3/32" is the minimum allowable gap.

NOTE:  
MAKE ALL ADJUSTMENTS  
WITH HONE TURNED OFF.

REFHNE5-6-041897



1/4" MAX. GAP  
3/32" MIN. GAP

ADJUST BY  
RELEASING NUT  
AND TURNING  
PLUNGER BODY

NUT

PLUNGER  
BODY  
PLUNGER

ADJUST BY  
RELEASING NUT  
AND TURNING  
PLUNGER BODY

VALVE

ACTUATOR  
VALVE NUT

PLUNGER

PLUNGER  
BODY

NUT

BUMPER

STOP

1/32

LOWER LIMIT VALVE  
ADJUSTMENT PROCEDURE:  
First slow the stroking to  
its slowest speed. Then  
adjust plunger so that  
there is a 1/32 gap  
between the bumper and  
stop when cylinder reverses.

UPPER AND LOWER  
LIMIT VALVES ADJUSTMENT  
WITHOUT LOWER BUMPER SPRING

RT201A1B HP6A  
Error codes

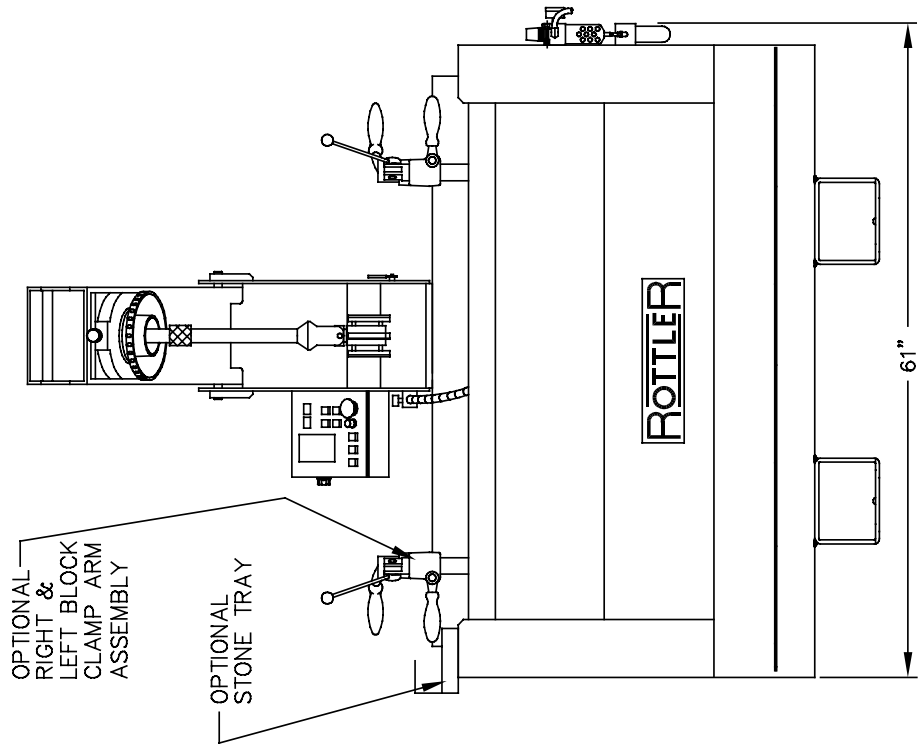
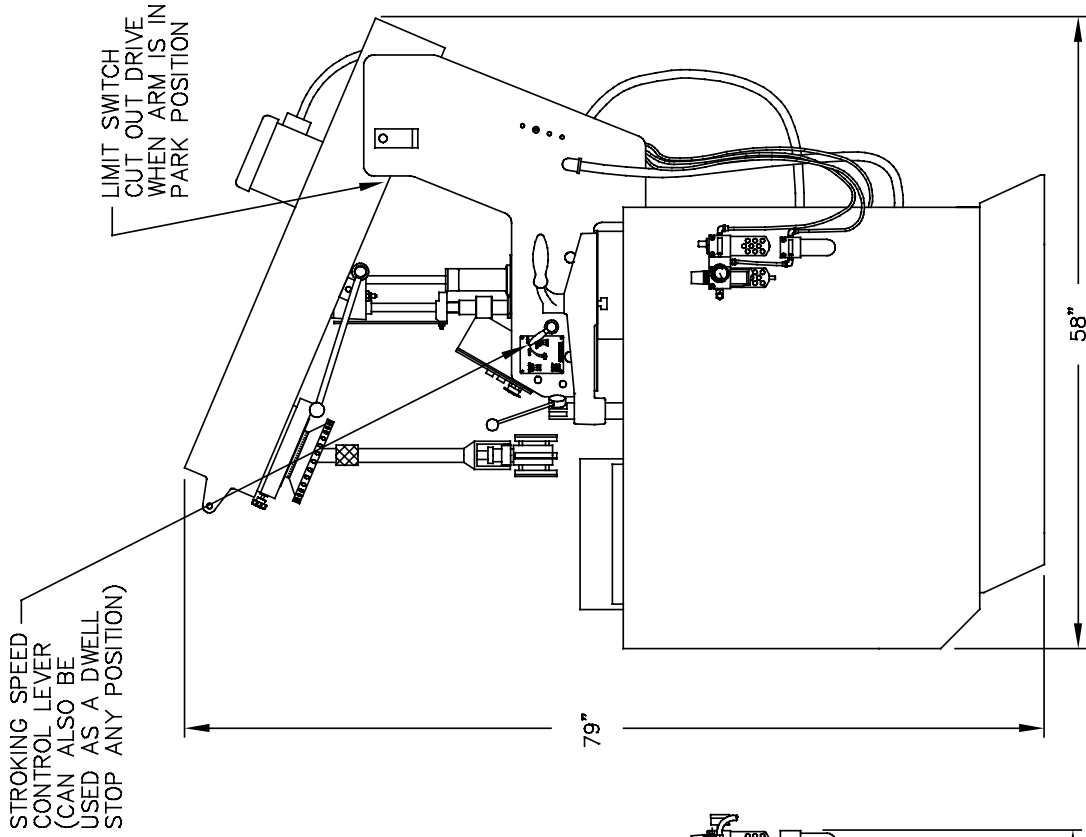
ER01	Watchdog, cpu fault
ER02	LENZ motor drive fault
ER03	Input volts too low
ER04	Input volts too high
ER05	Park limit switch NO/NC transition fault





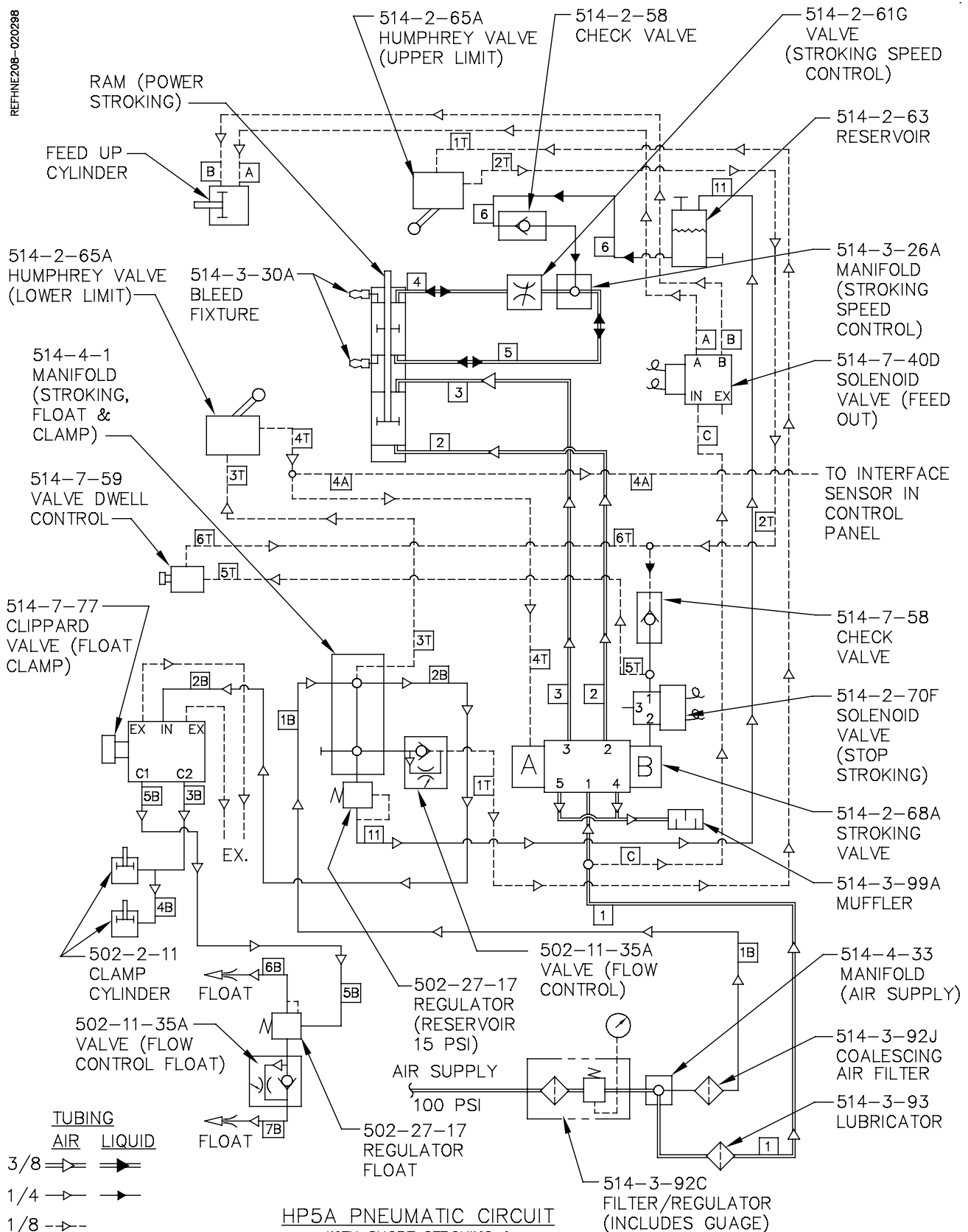
### Front / Right Side View:

REFPHES-8-033198



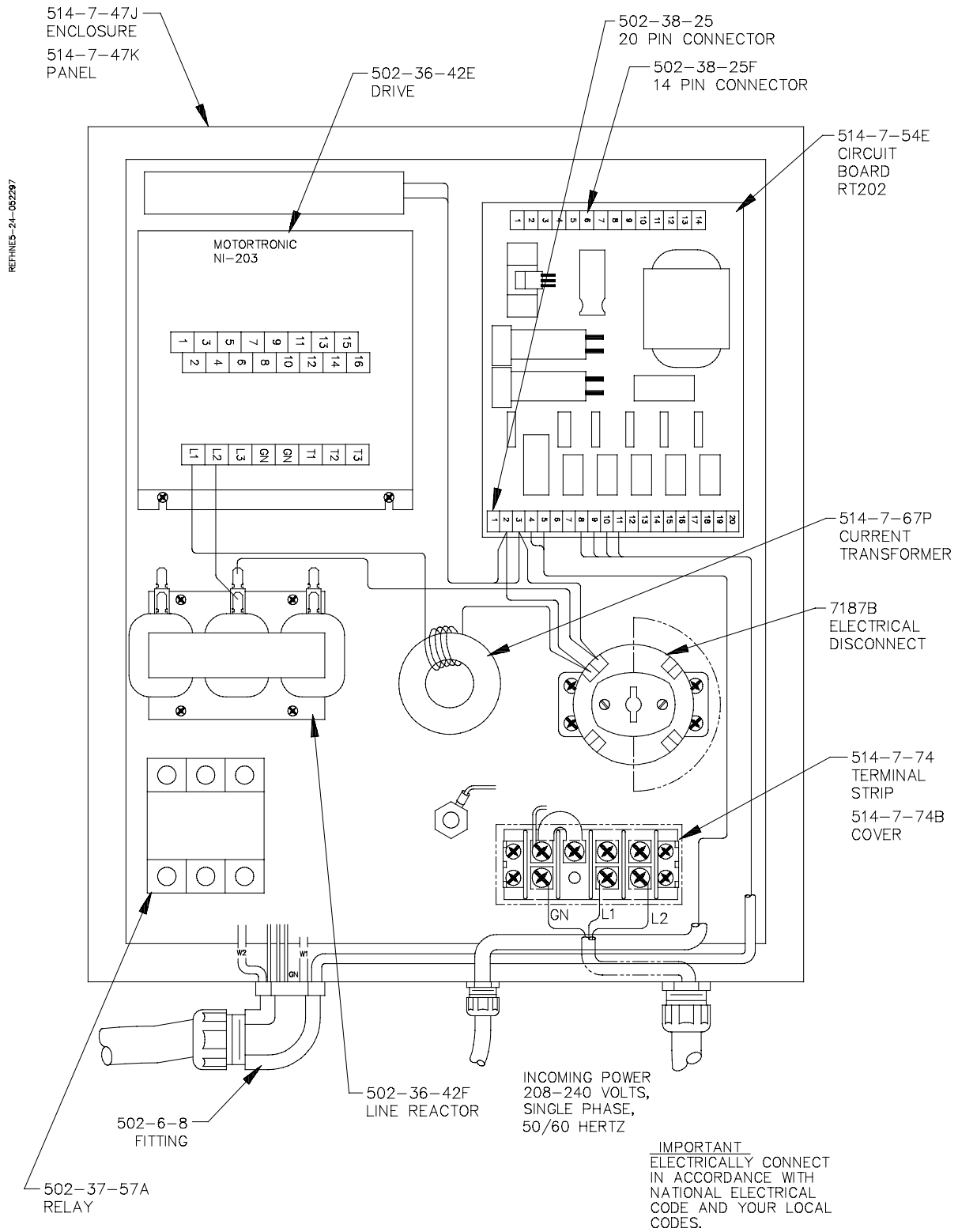
# Pneumatic Circuit Diagram:

REFHNE206-020298



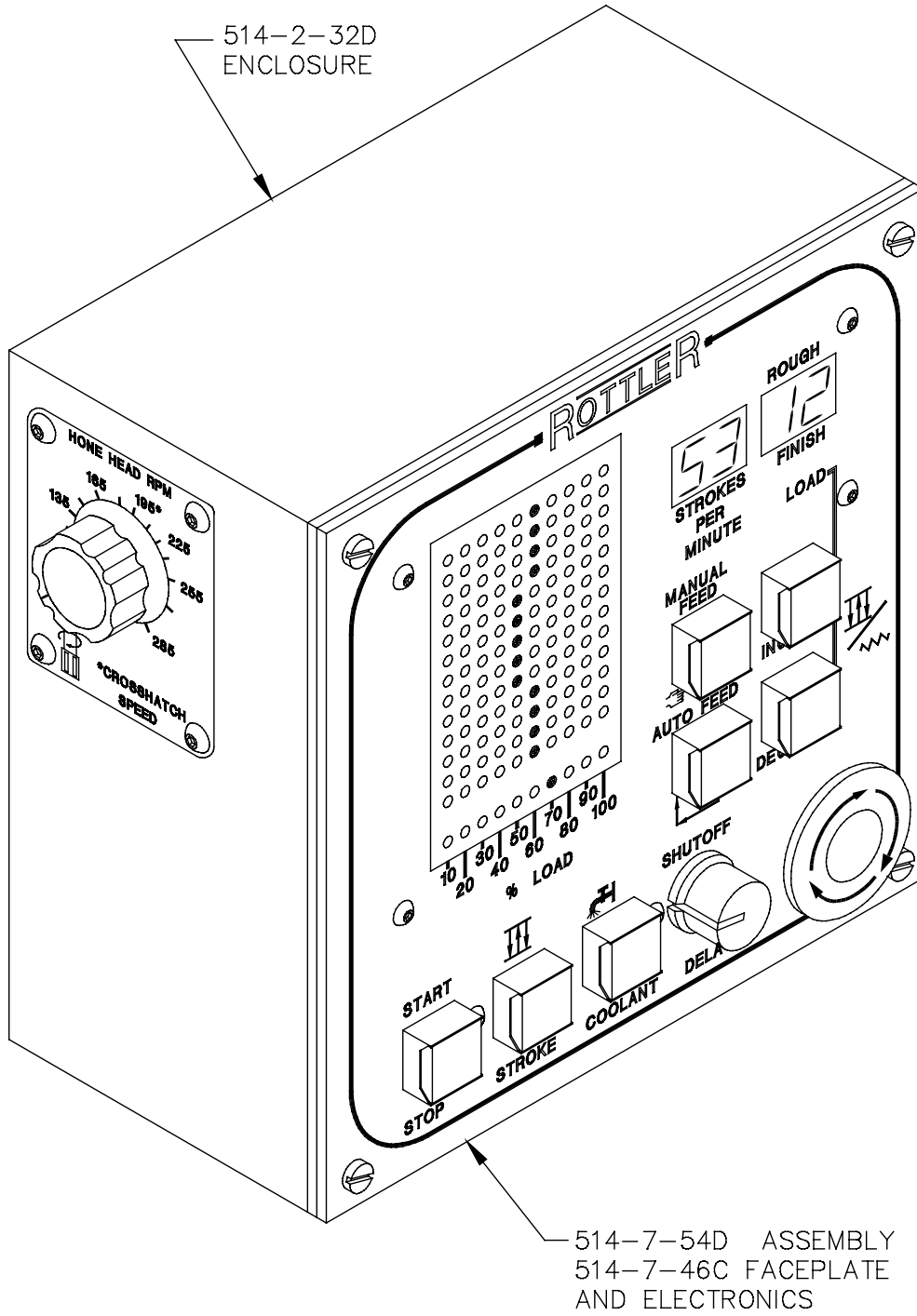
HP5A PNEUMATIC CIRCUIT WITH SHORT STROKING & CLIPPARD (FLOAT/CLAMP)

# Electrical Power Supply Enclosure:



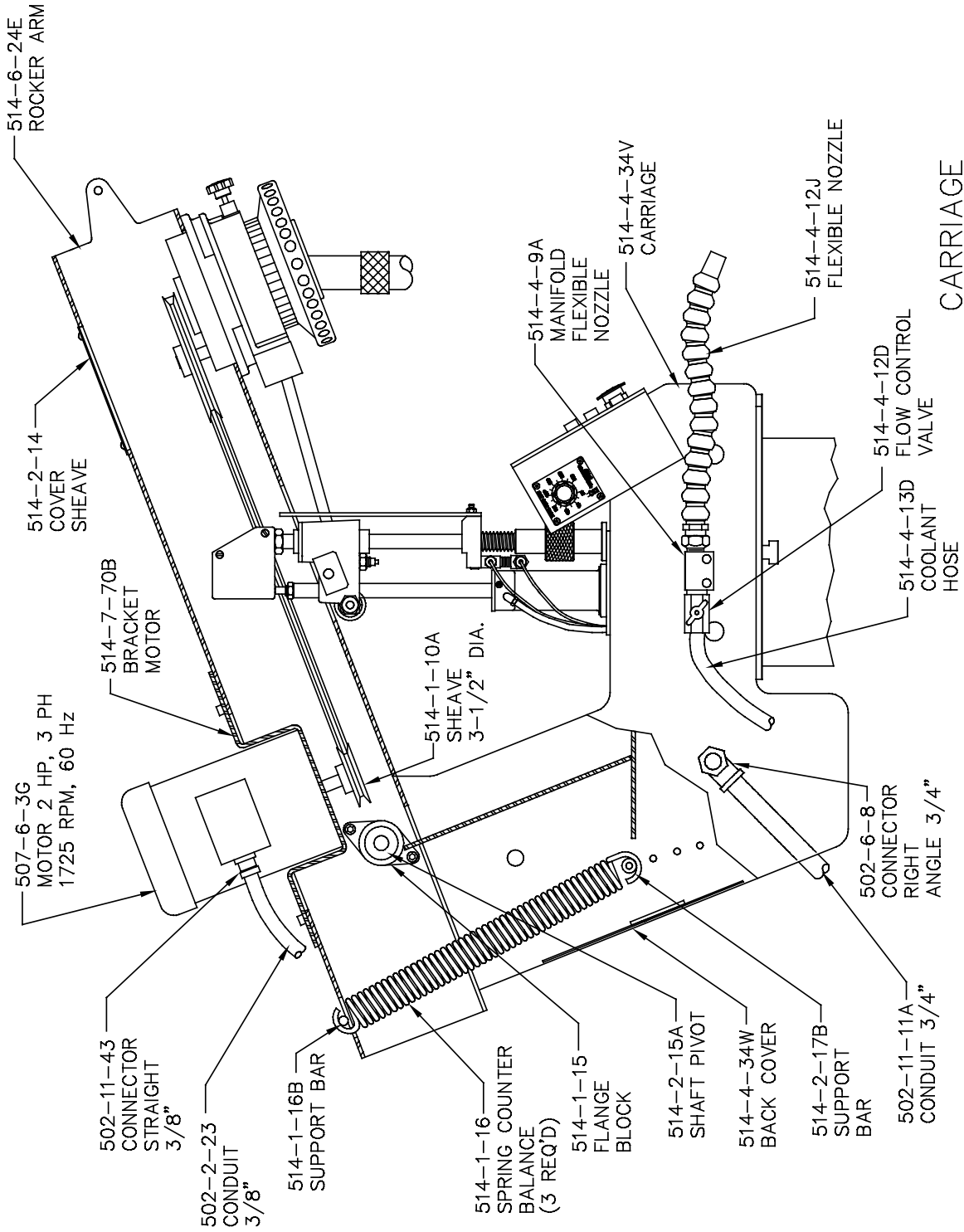
### Control Panel:

REFHNE5-9-01298B

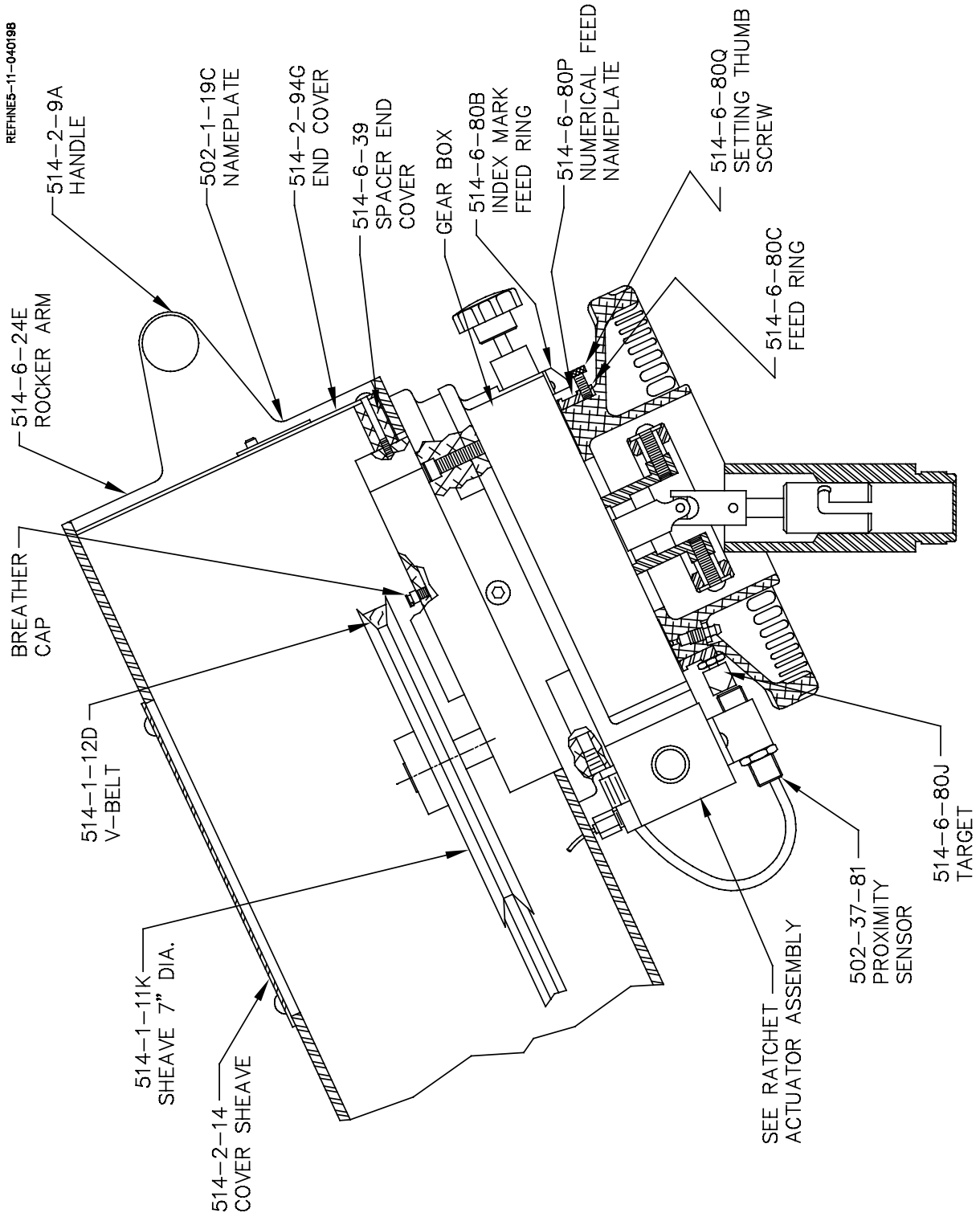


# Carriage:

REFINE5-10-040197

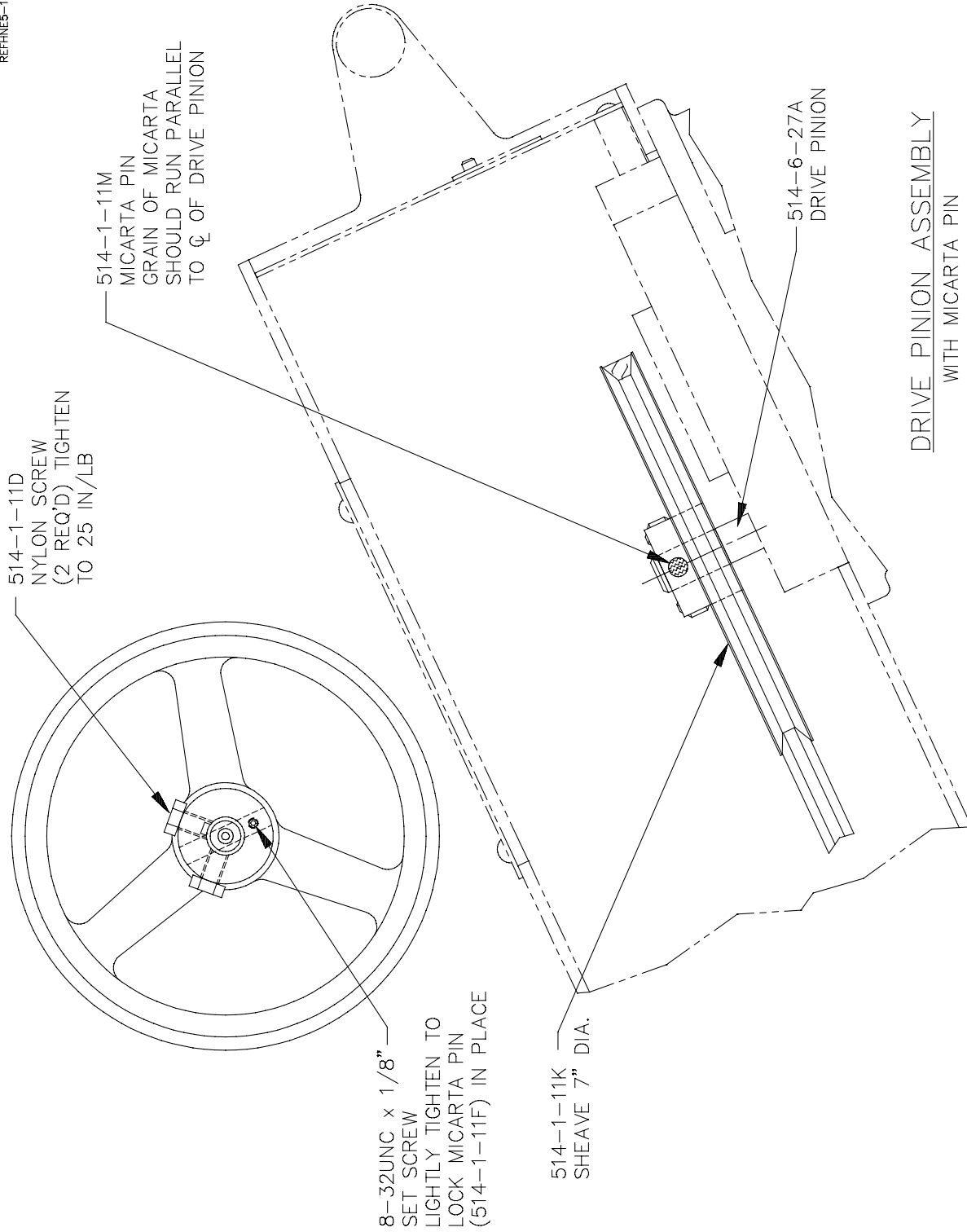


### Front Section Rocker Arm:



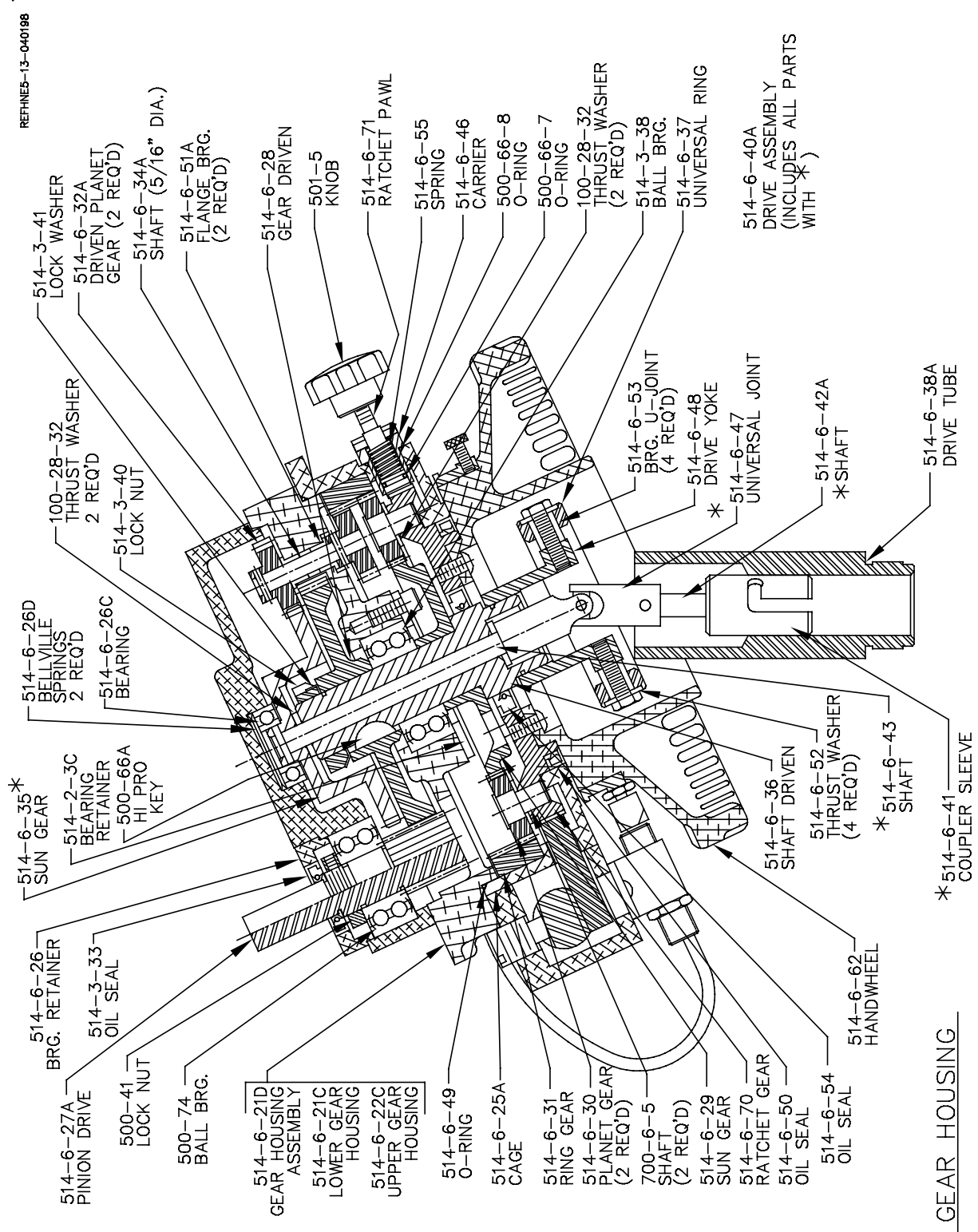
### Drive Pinion Assembly:

REFHNE5-12-042897





### Gear Housing Section:

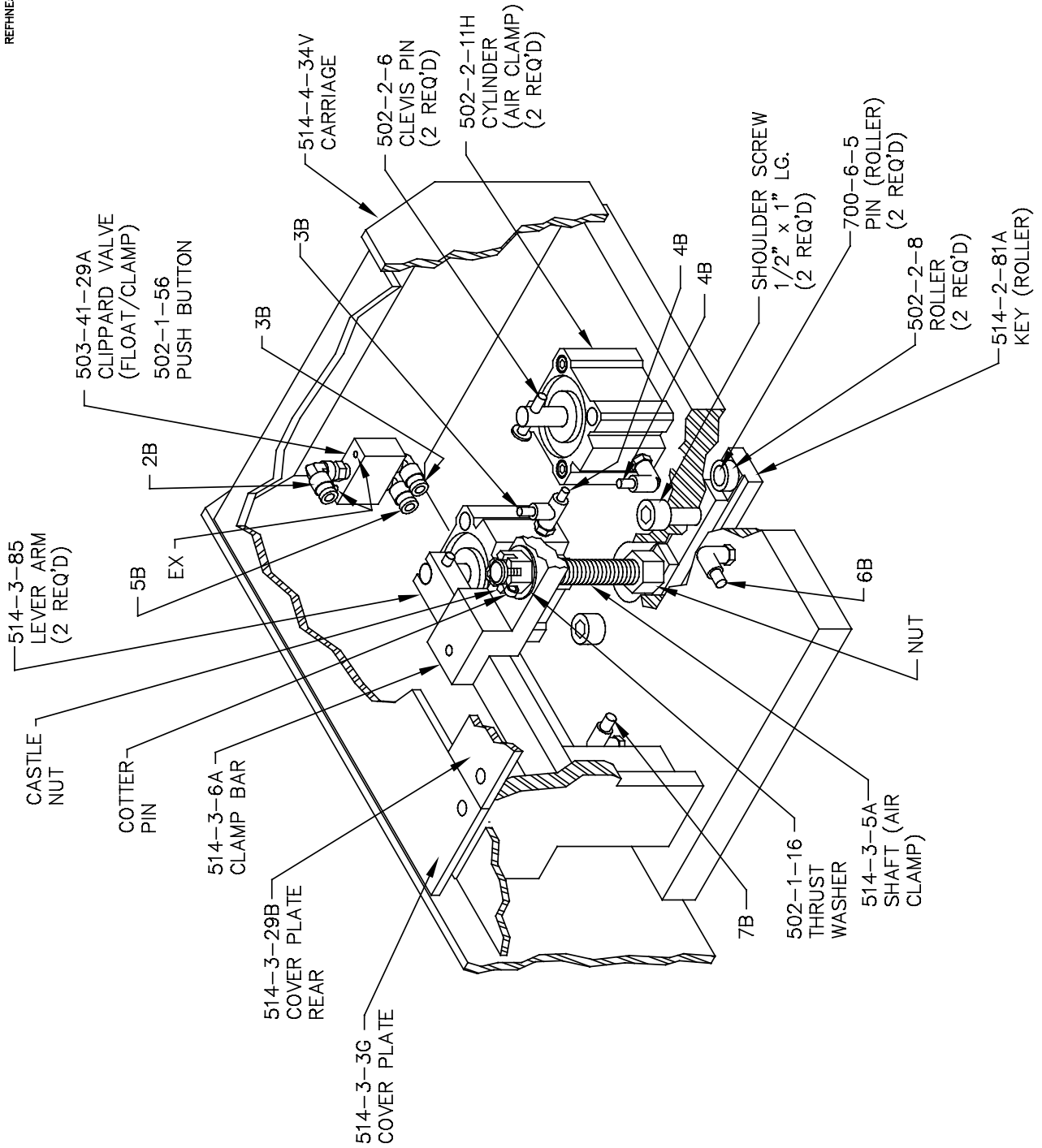


GEAR HOUSING

\* 514-6-41 COUPLER SLEEVE

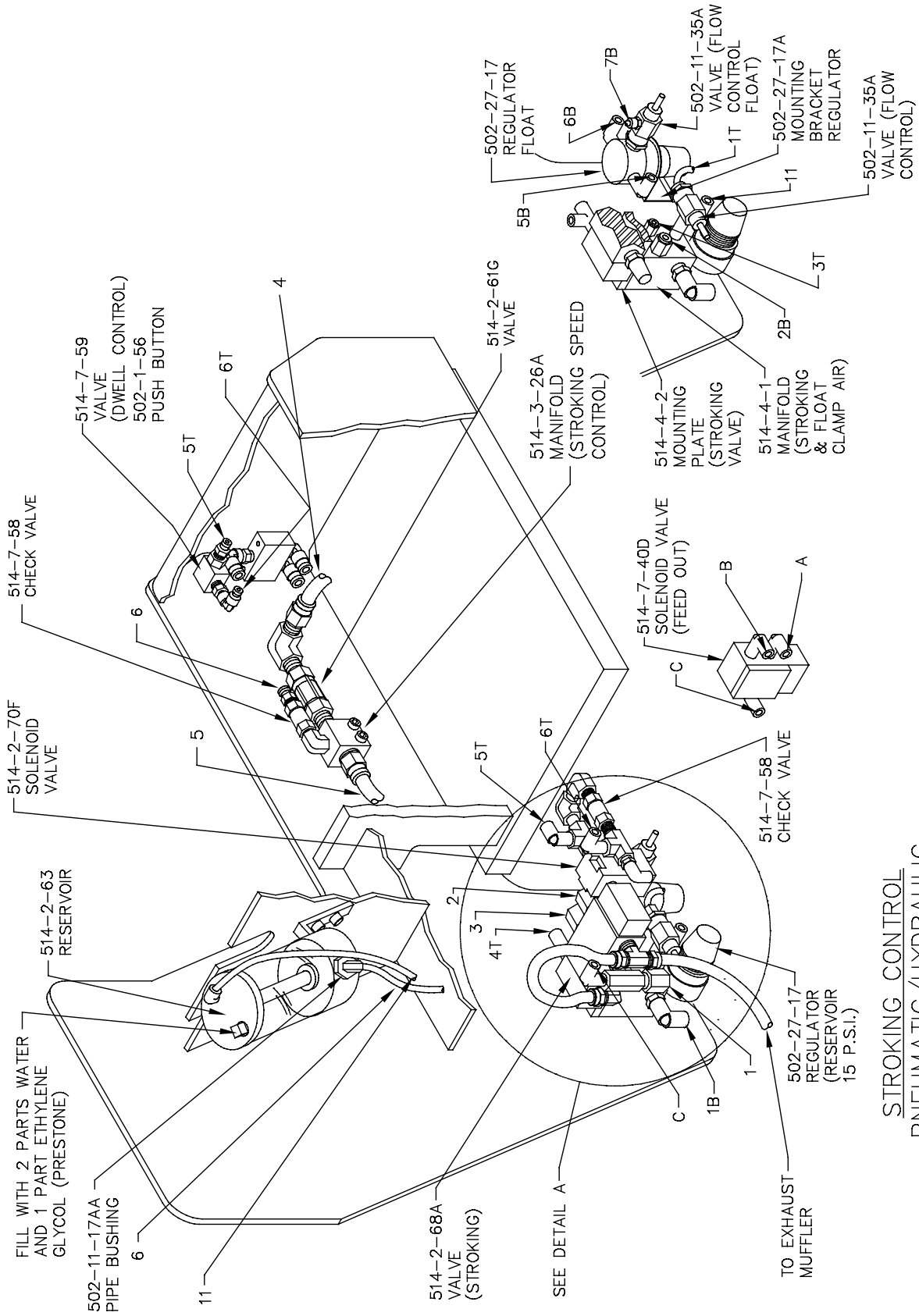
### Carriage Float / Clamp:

REFHNE5-14-04208B



# Stroking Control - Air:

REFHNE5-34-012098



DETAIL A

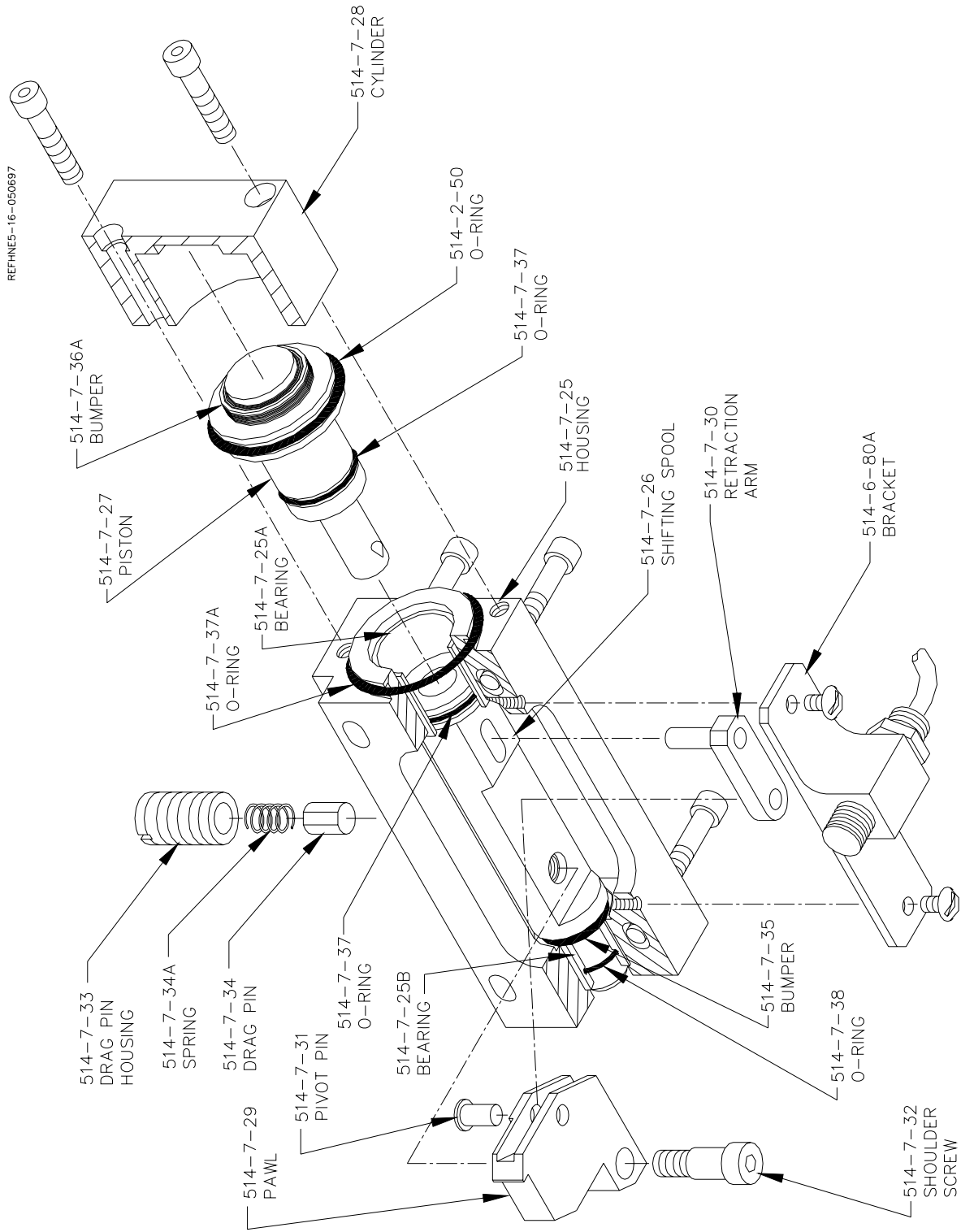
**STROKING CONTROL**  
**PNEUMATIC/HYDRAULIC**  
 (WITH BOTTOM SHORT STROKING)

FILL WITH 2 PARTS WATER  
 AND 1 PART ETHYLENE  
 GLYCOL (PRESTONE)

TO EXHAUST  
 MUFFLER

SEE DETAIL A

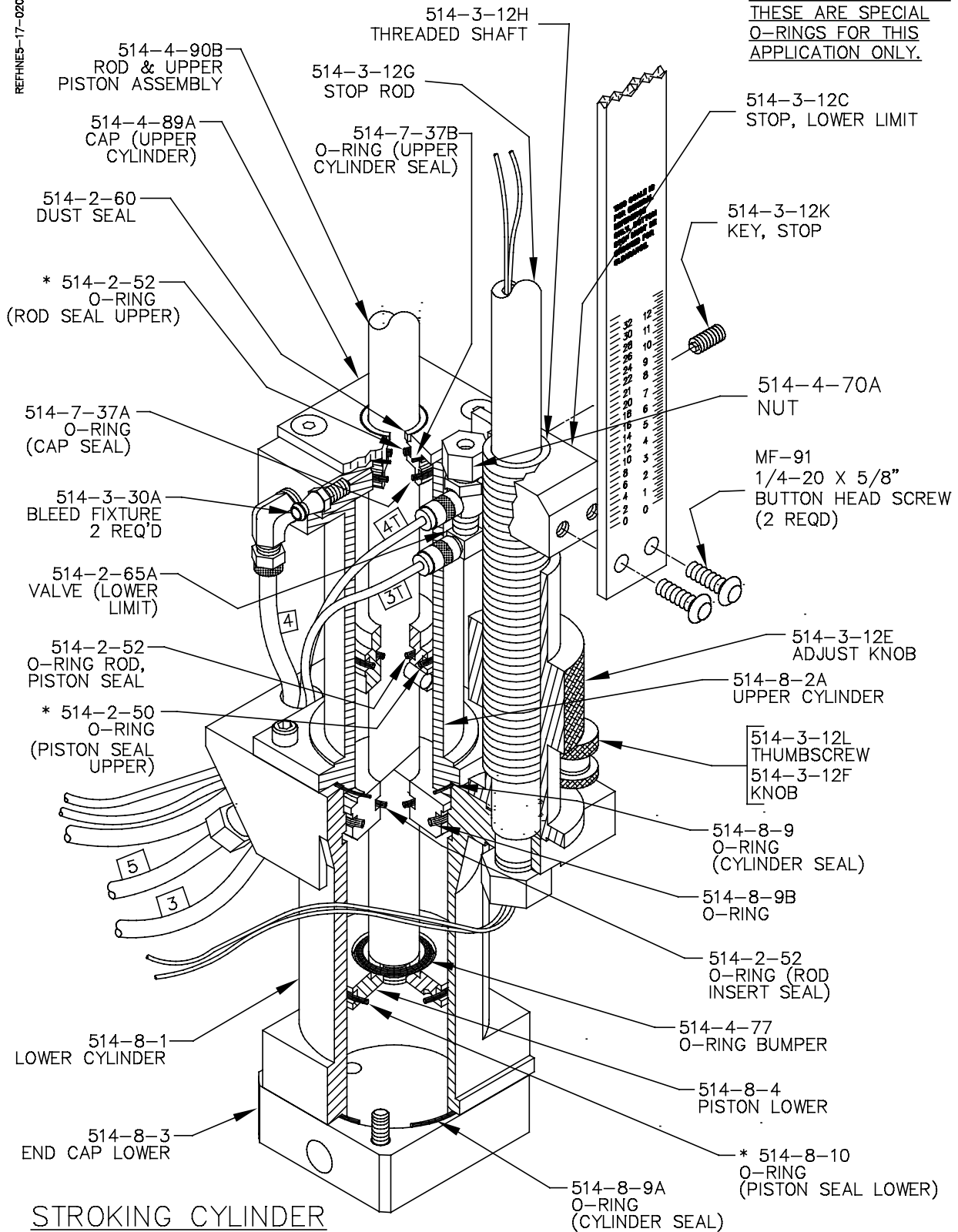
### Ratchet Actuator Assembly:



# Stroking Cylinder:

REFINES-17-020298

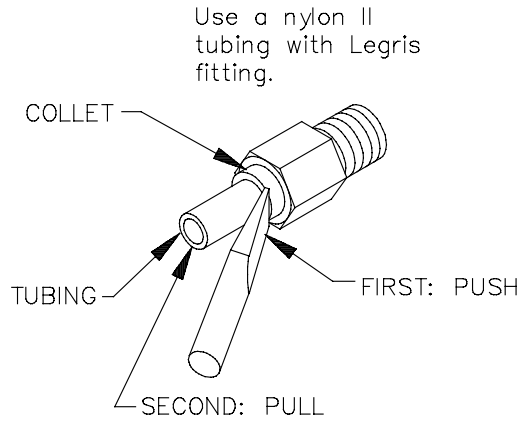
\* DO NOT SUBSTITUTE THESE ARE SPECIAL O-RINGS FOR THIS APPLICATION ONLY.



STROKING CYLINDER

# Stroking Cylinder:

REFHNE5-18-051297

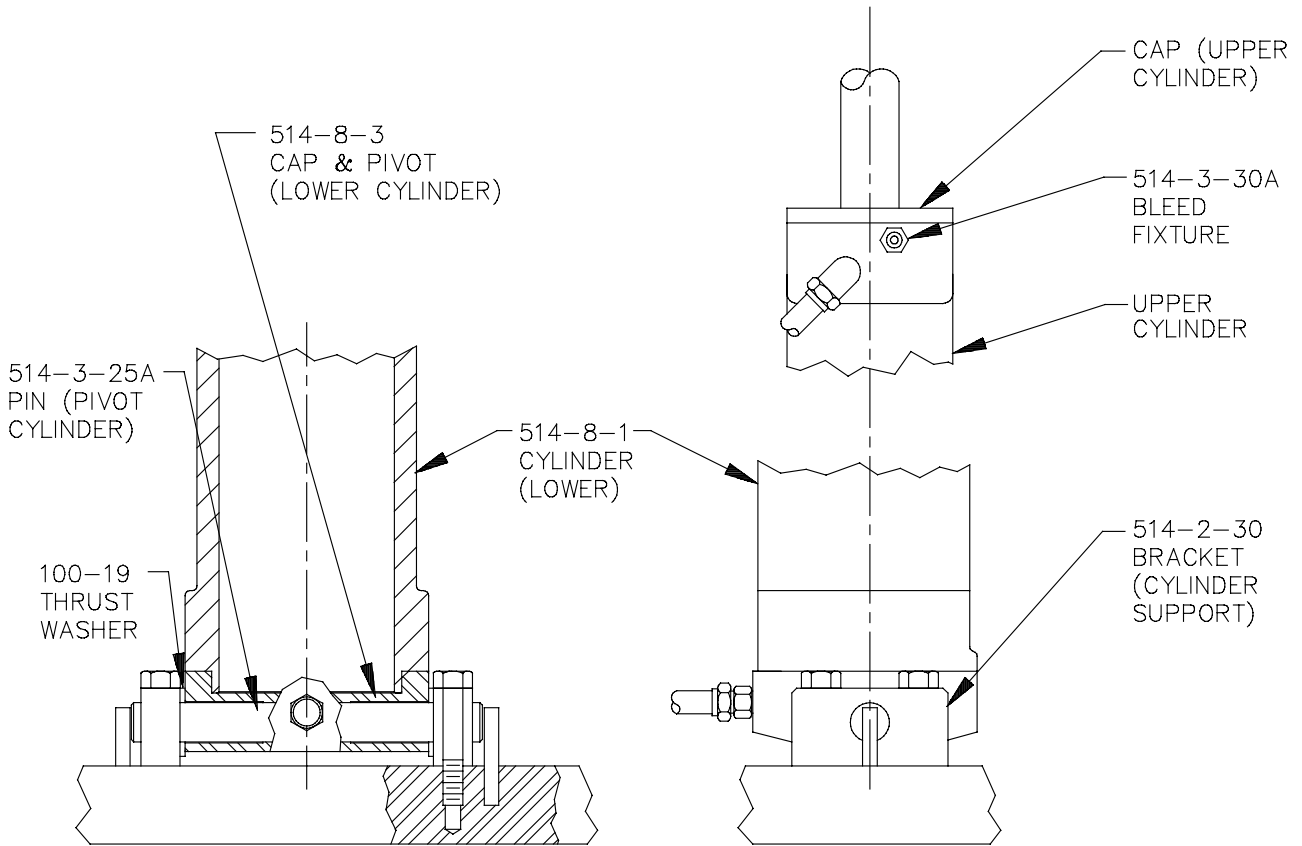


### LEGRIS TUBE FITTINGS

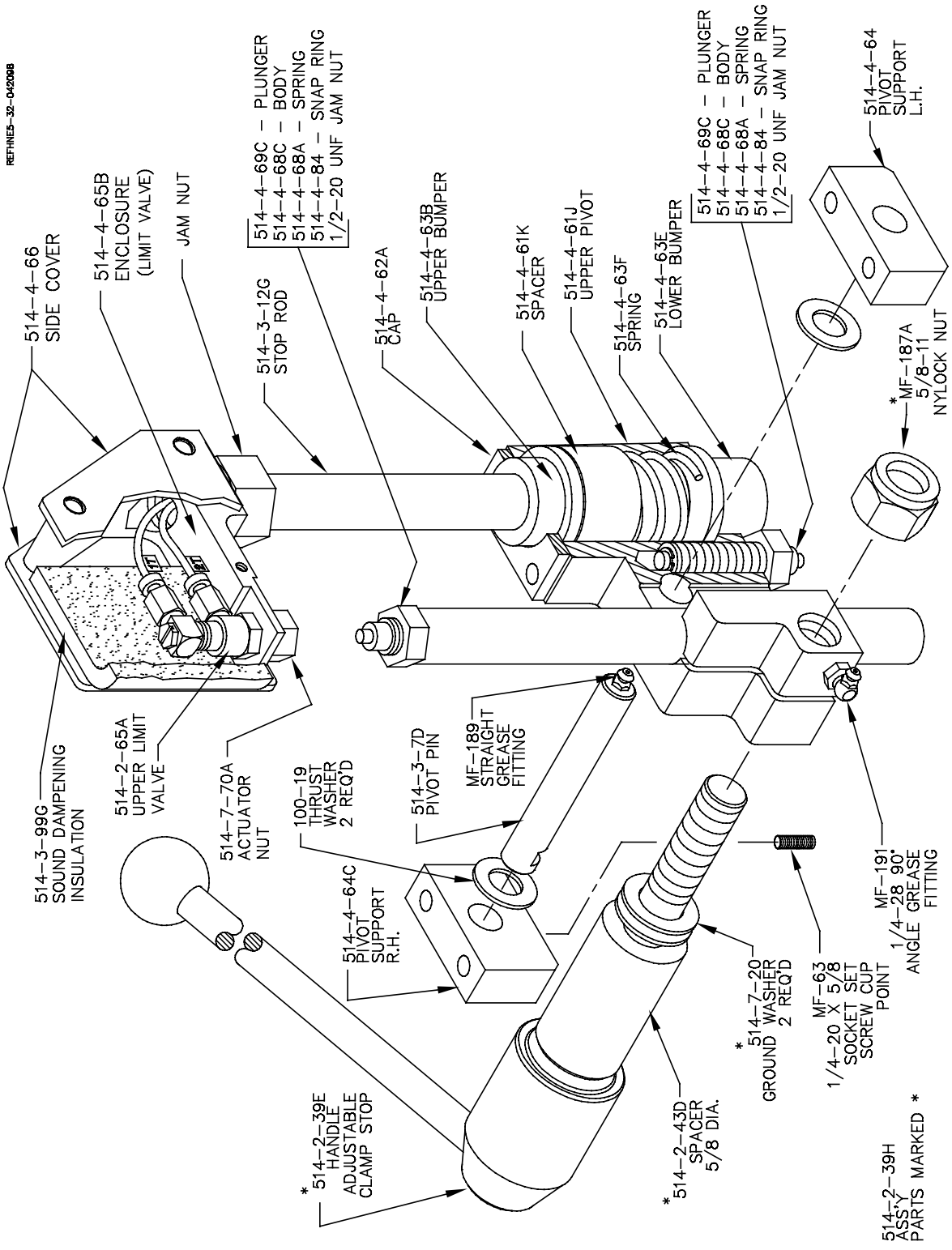
To Disconnect Tubing from Legris fitting—push collet with a screwdriver then pull tubing.

To connect tubing to Legris fittings just push tubing into fitting.

NOTE: Tubing must be all the way in to seal tubing. First past a gripping ridge then thru an O-ring.

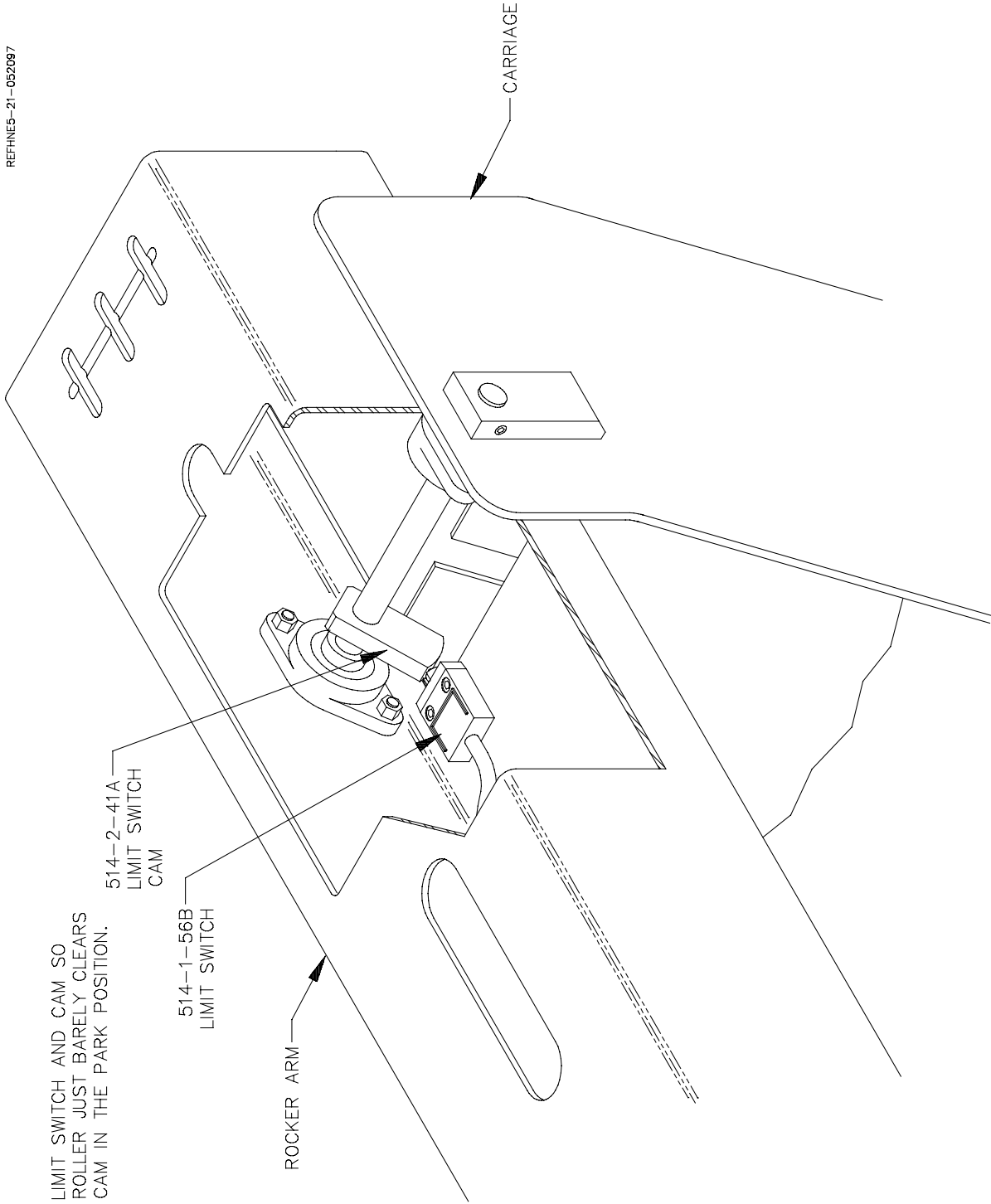


# Upper Limit Valve:



### Motor - Safety Switch:

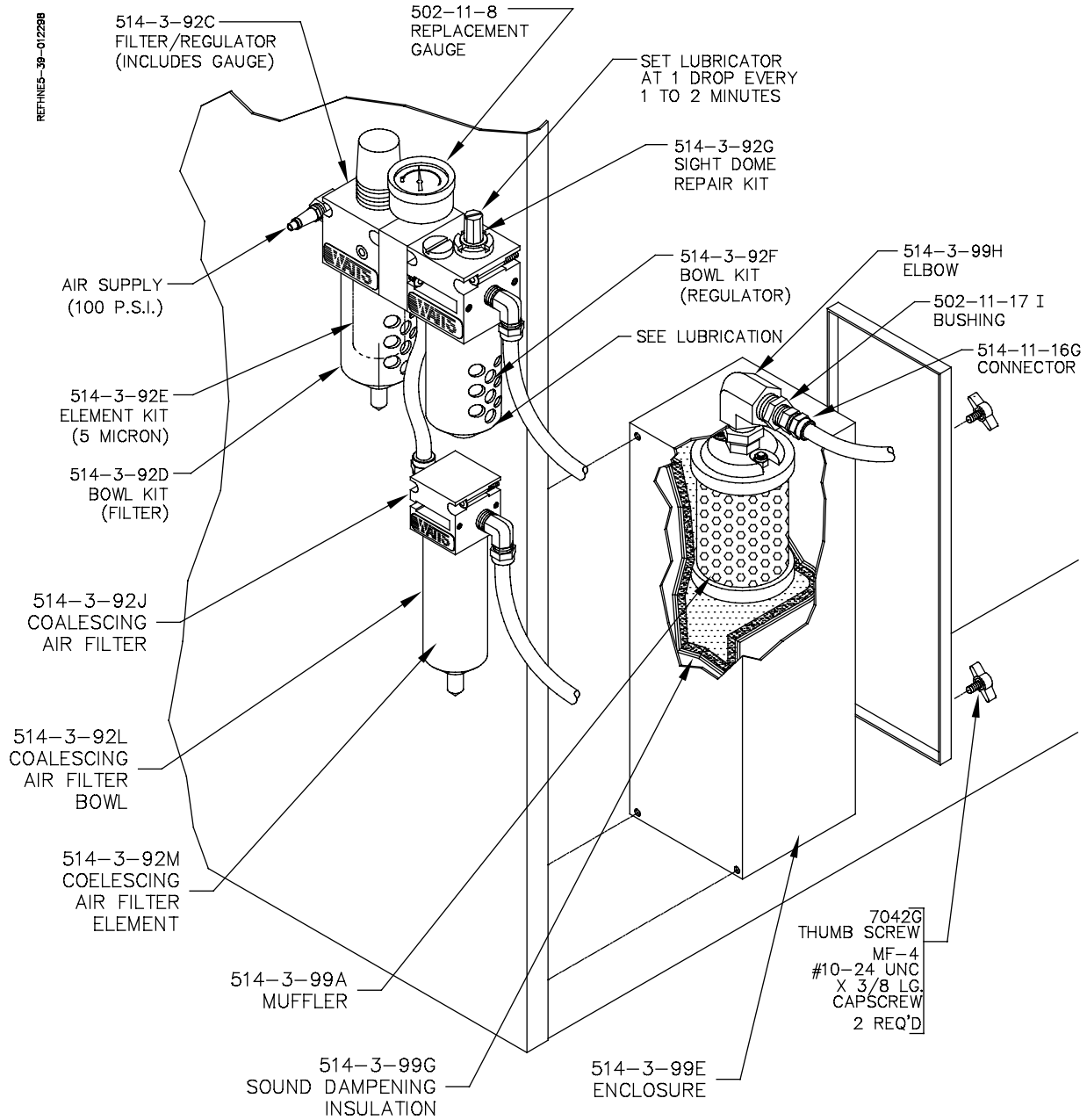
REFINES-21-052097



SET LIMIT SWITCH AND CAM SO THE ROLLER JUST BARELY CLEARS THE CAM IN THE PARK POSITION.

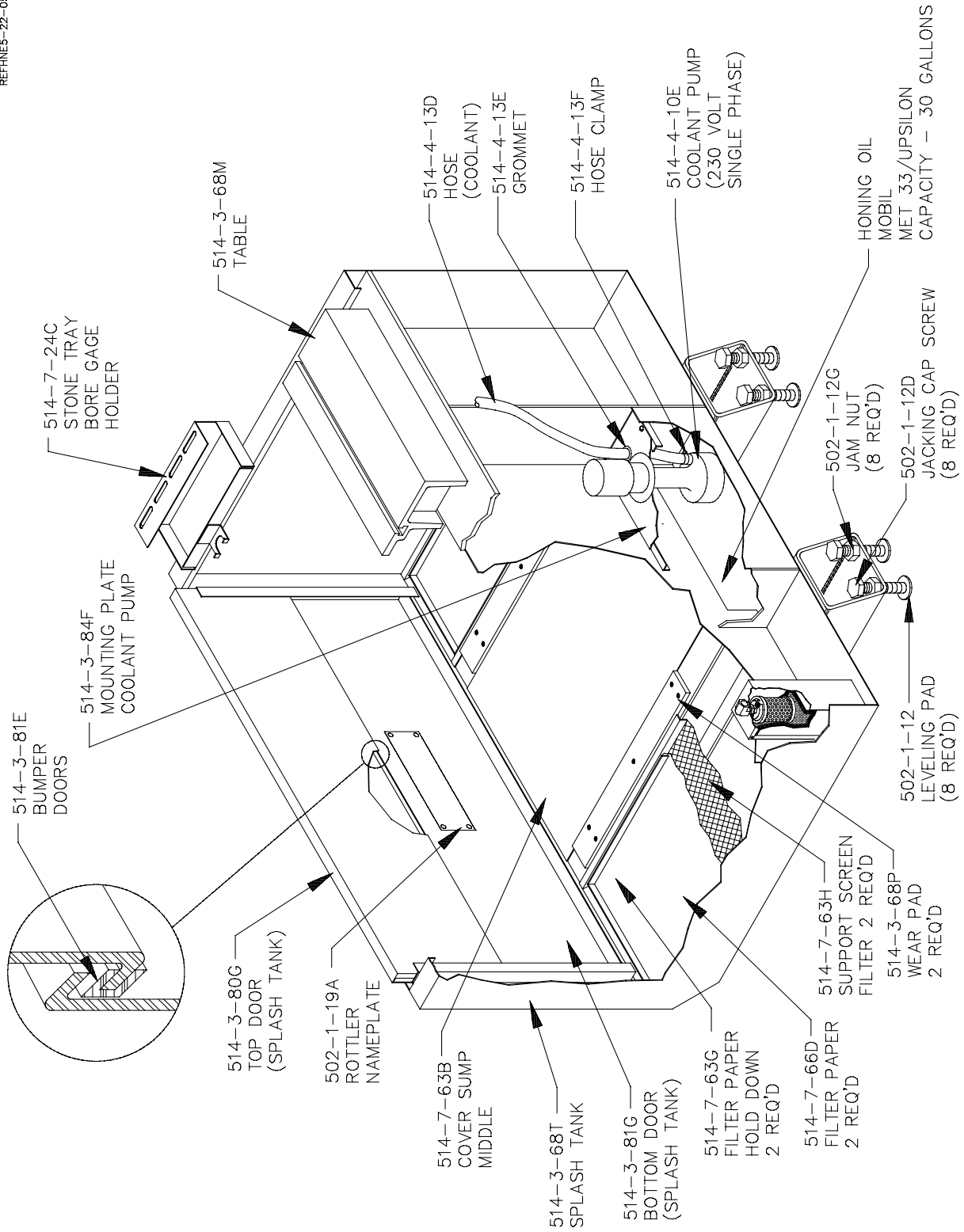


# Pneumatic Power Supply:

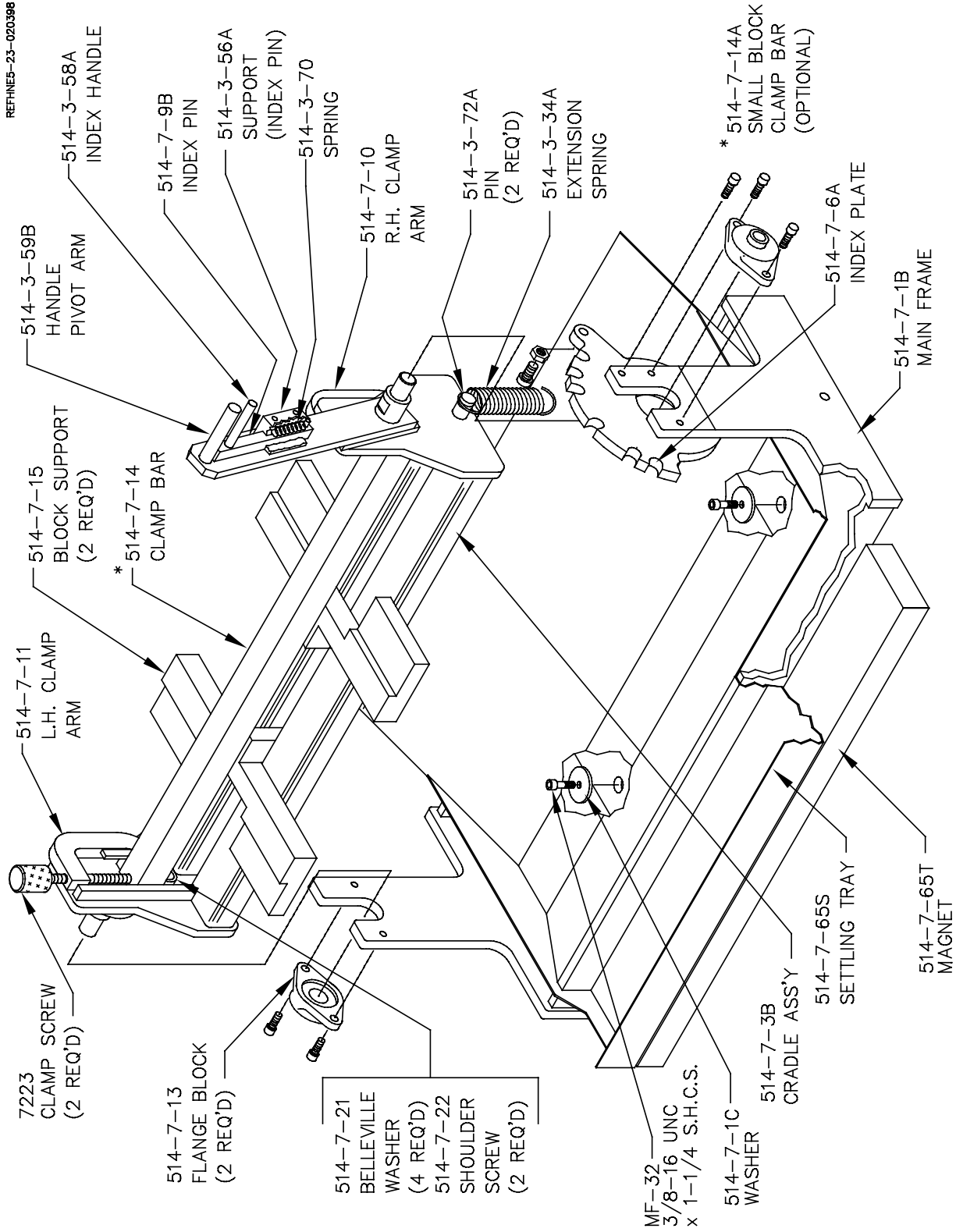


# Splash Tank / Coolant System:

REFHNE5-22-052197

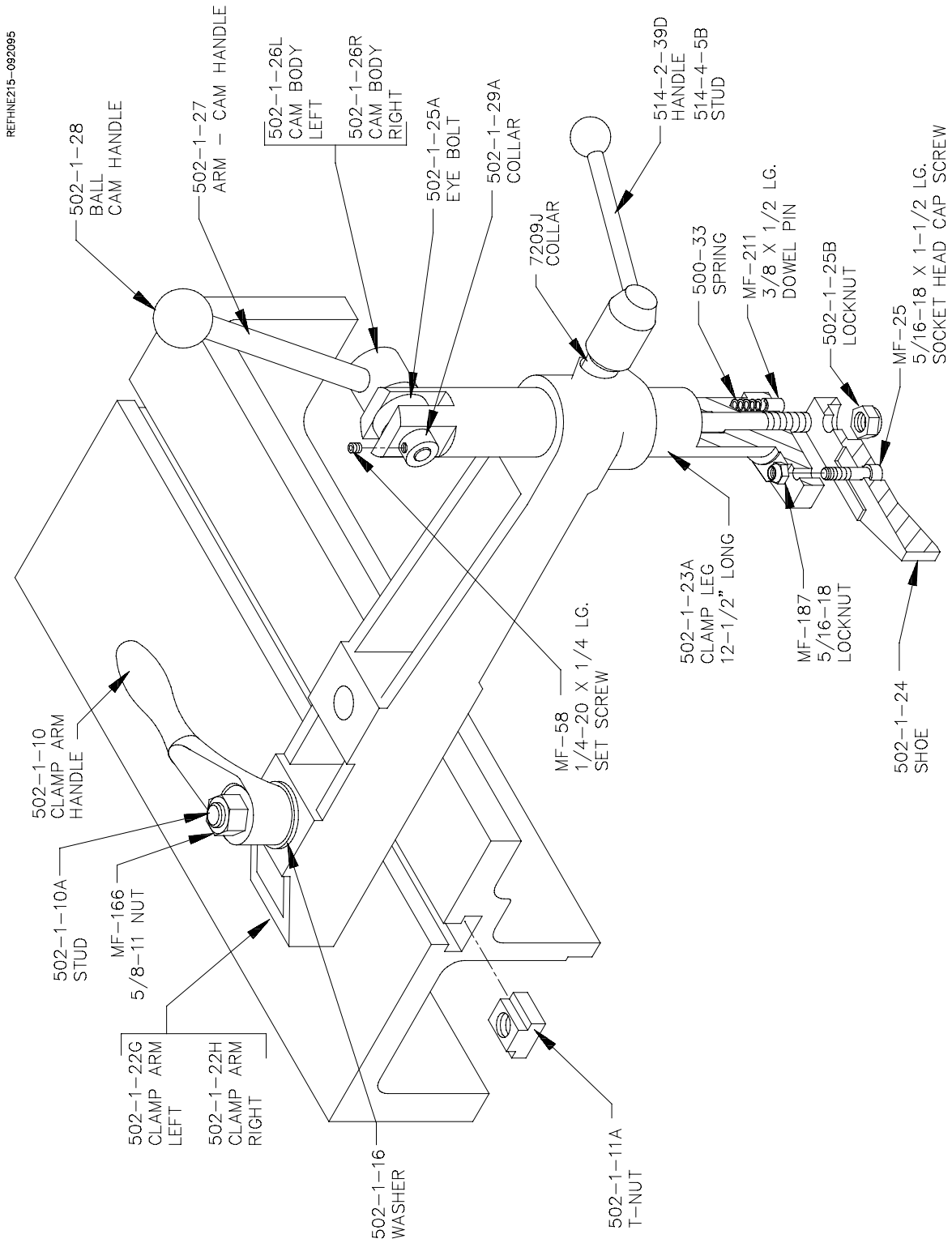


### Block, Hold Down - Fixture Assembly:



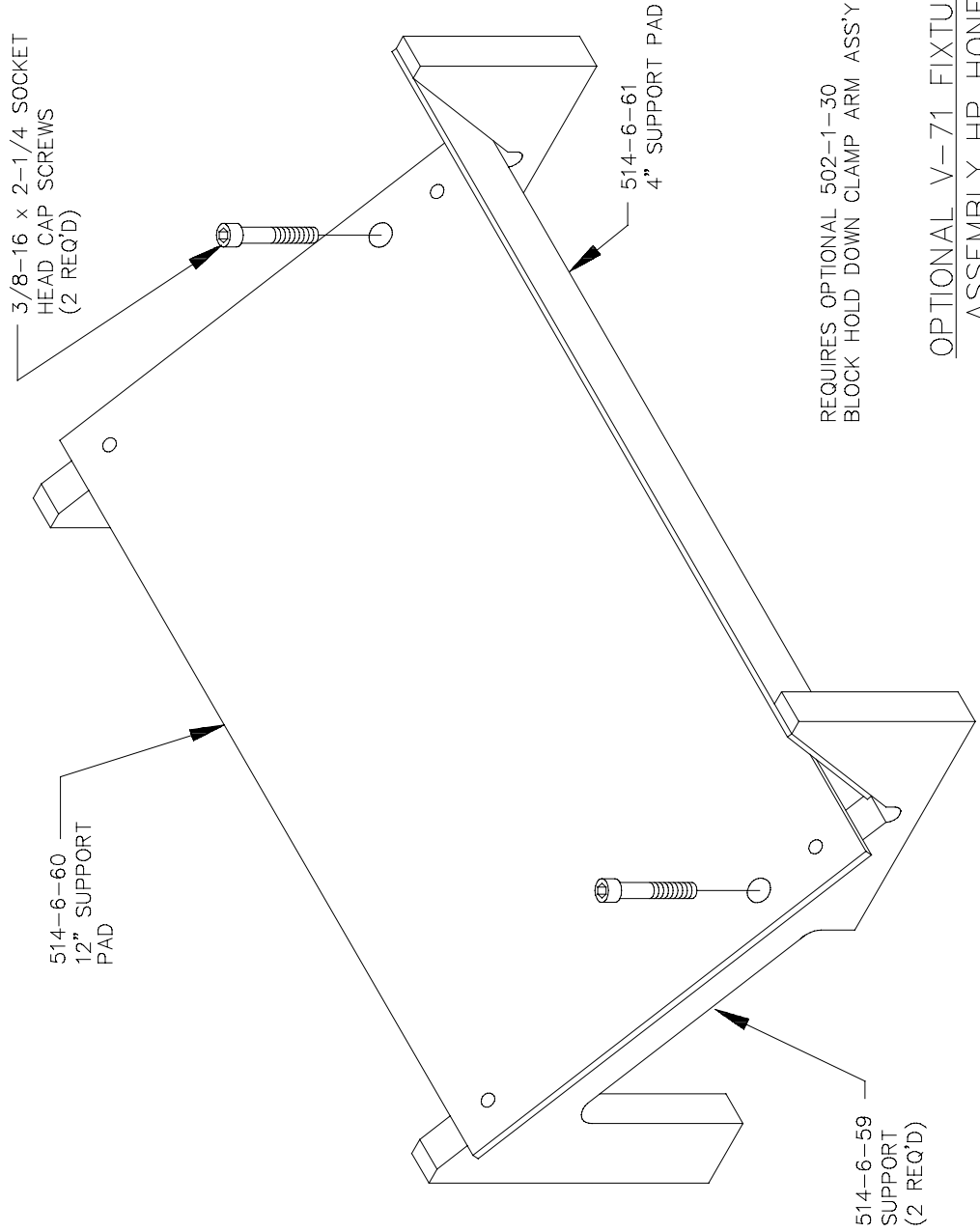
REFHNE5-23-020398

### Optional - Block, Hold Down - Clamp Assembly:



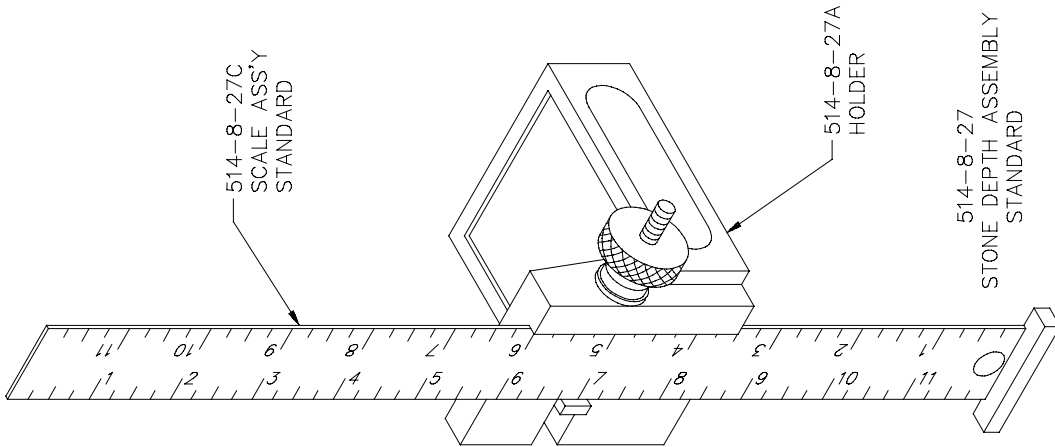
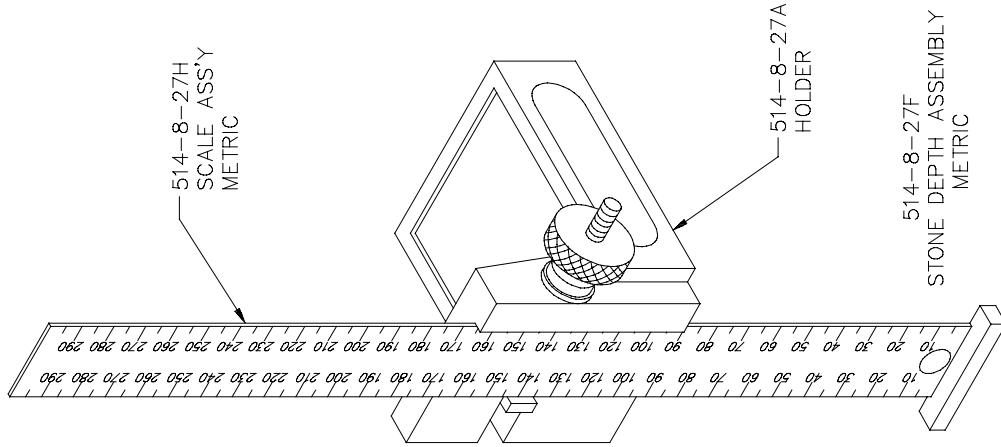
### Optional - V-71 Fixture:

REFHNE52-092095



# Optional - Stone Depth Assembly

REF#NE141-092095



OPTIONAL STONE DEPTH  
ASSEMBLY

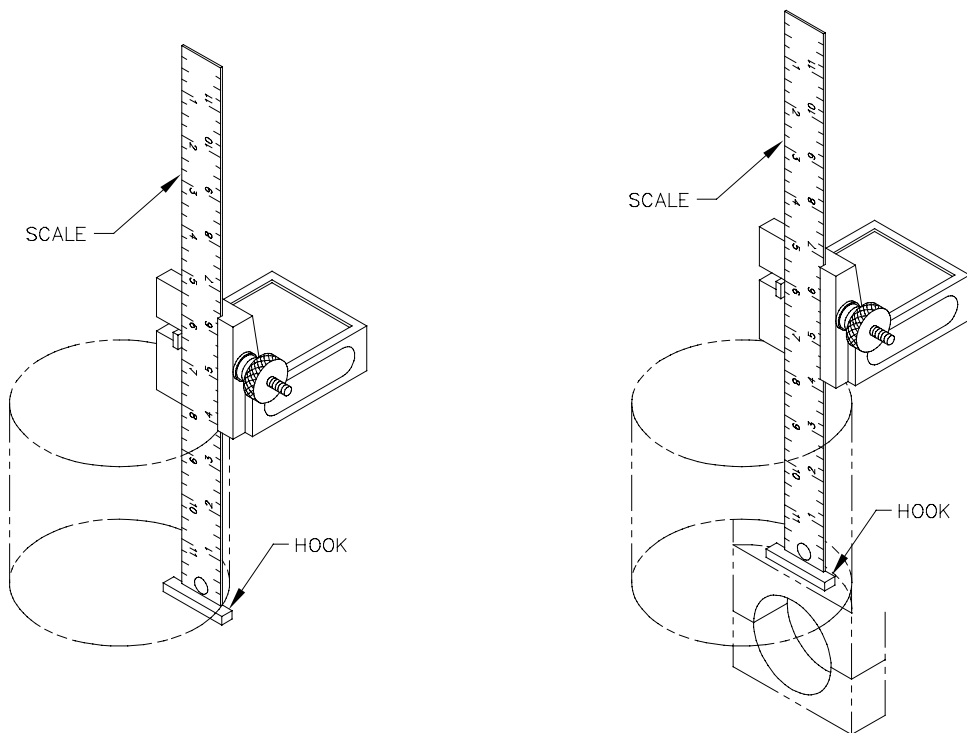
## Stone Depth Assembly Set-up: Setting lower travel limit:

1. Place stone depth setting assembly on deck surface of block with scale in cylinder.
2. Lower scale to touch upper surface of hook on deepest point of cylinder wall.
3. Read depth on scale, then lower scale  $3/4"$  to  $1"$  (19mm to 25mm). Lock scale.
4. Lower hone head into cylinder and touch the bottom of the stones to the upper surface of the hook. Lock this lower limit setting in the stroking cylinder.

## Setting lower travel limit with obstructions:

1. Place stone depth setting assembly on deck surface of the block with the scale in the cylinder.
2. Lower scale until bottom of the hook touches the highest point of the obstruction (main bearing web, etc....).
3. Lower hone head into cylinder and touch the bottom of the stones to the upper surface of the hook. Lock this lower limit setting on the stroking cylinder.

REFHNE142-020298



# Standard Hone Head Assembly:

REFHNE217-092695

514-5-57D  
PIVOT RING  
ASSEMBLY  
(INCLUDES PARTS  
MARKED )

514-5-57E  
BUSHING  
(2 REQ'D)

514-1-31D  
PIVOT RING

514-5-57C  
PIN (2 REQ'D)

514-5-58A  
BODY HONE HEAD

SEE STONE AND  
GUIDE CHART

514-5-57B  
STANDARD HONE HEAD  
ASSEMBLY

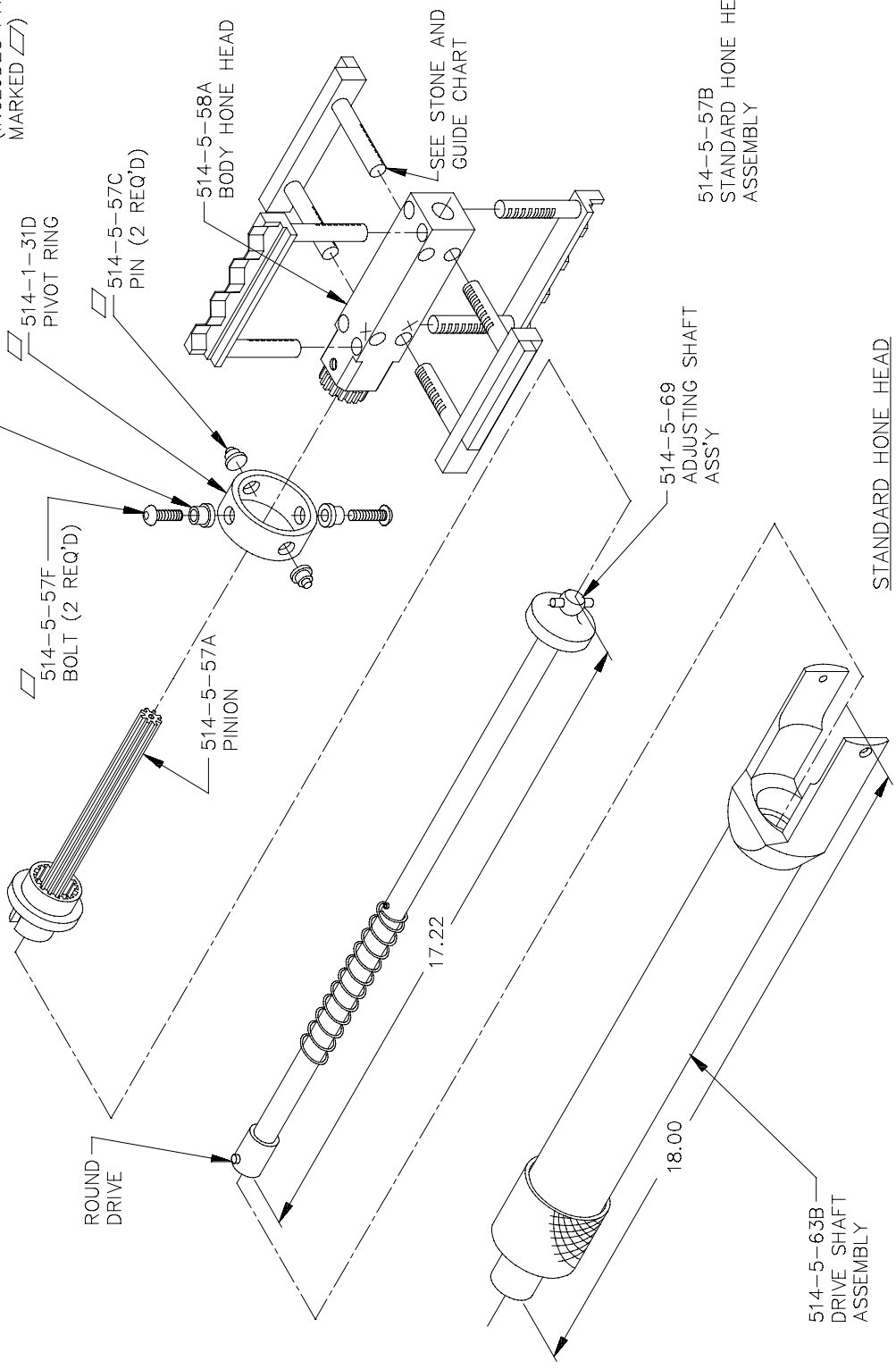
514-5-57F  
BOLT (2 REQ'D)

514-5-57A  
PINION

514-5-69  
ADJUSTING SHAFT  
ASS'Y

STANDARD\_HONE\_HEAD  
2.7 TO 5.7 DIA.  
514-5-61A

CAUTION: IF HONE HEAD CRASHES INTO A WEB OR  
OR OBSTRUCTION THE PINION WILL TWIST OR BREAK.  
THIS CONDITION IS NOT COVERED BY WARRANTY.

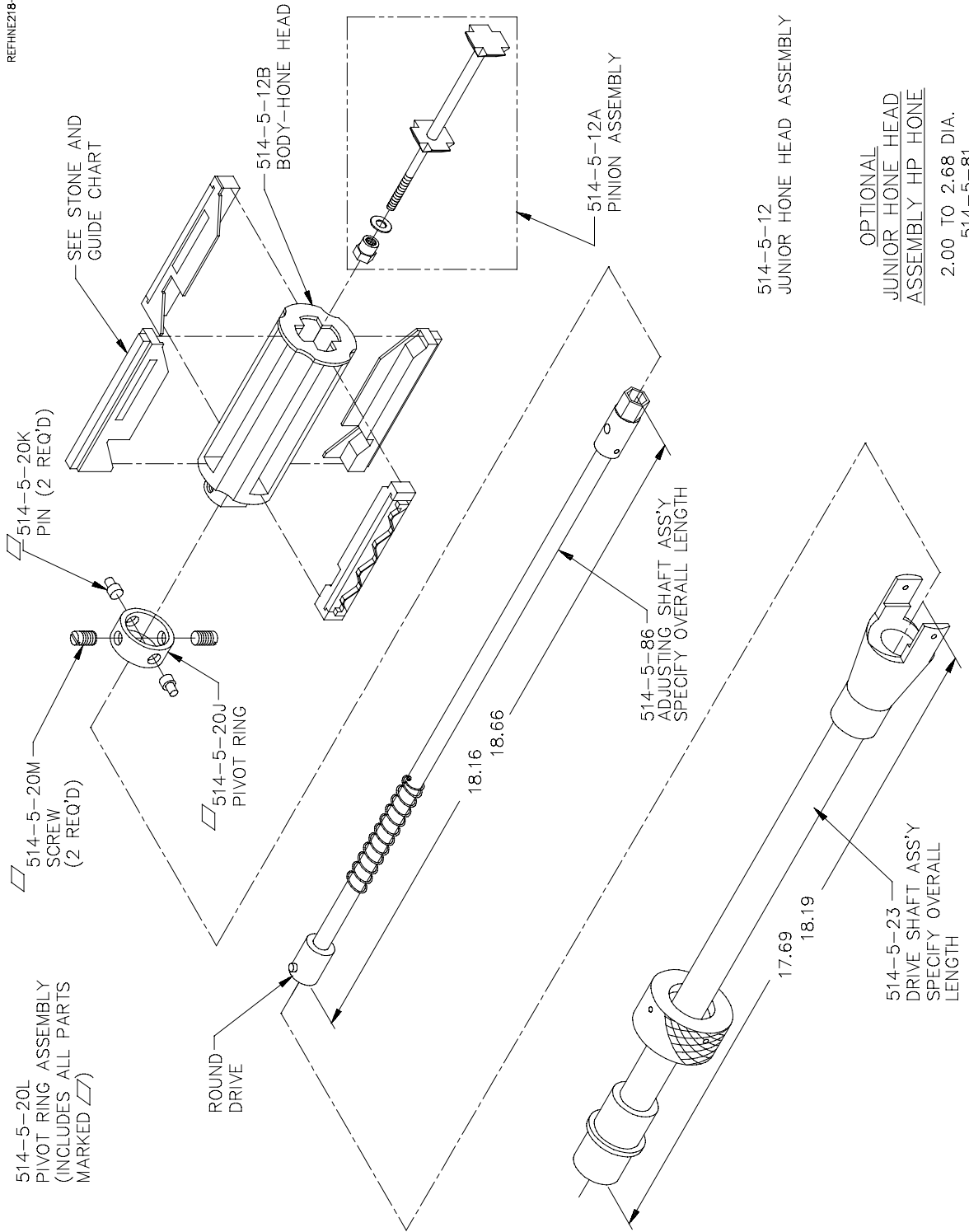


514-5-63B  
DRIVE SHAFT  
ASSEMBLY



### Optional - Junior Hone Head Assembly:

REFHNE218-092695

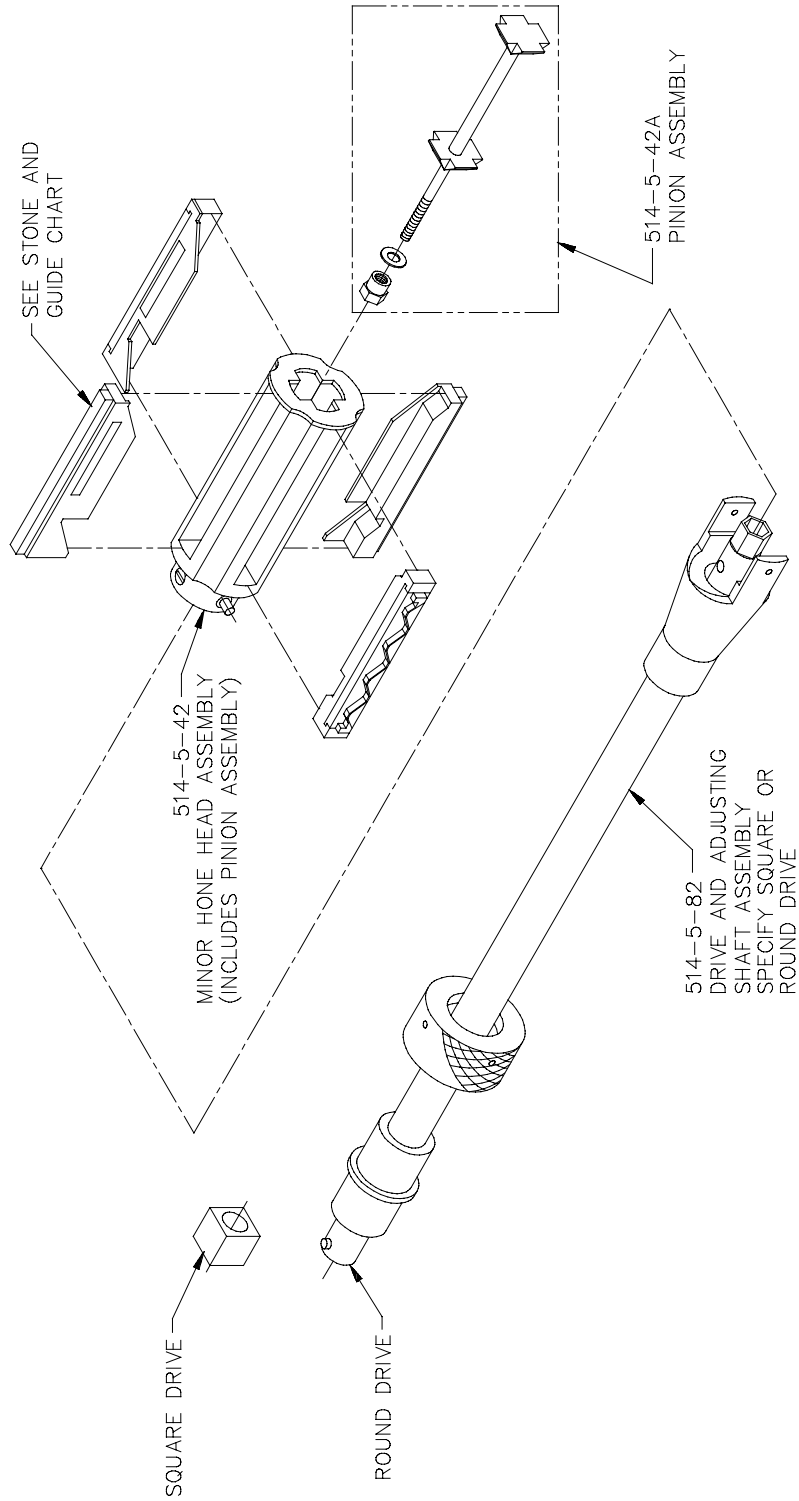


514-5-12 JUNIOR HONE HEAD ASSEMBLY

OPTIONAL JUNIOR HONE HEAD ASSEMBLY HP HONE 2.00 TO 2.68 DIA. 514-5-81

### Optional - Minor Hone Head Assembly:

REFHNE35-092195



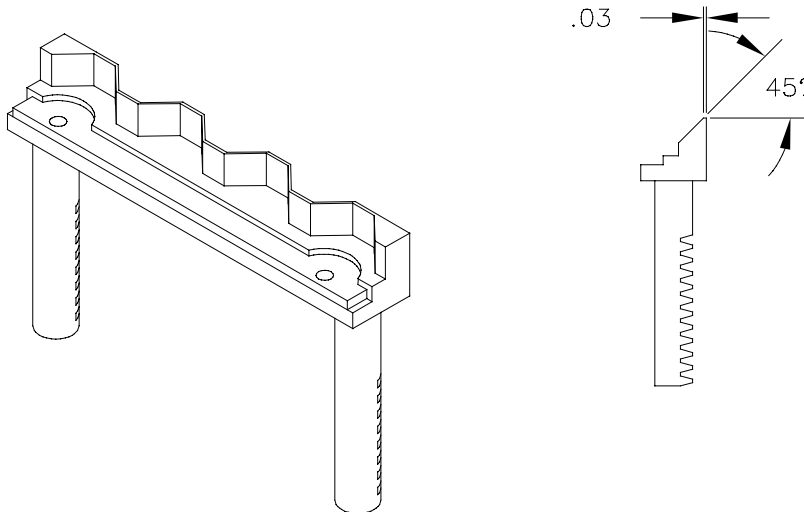
OPTIONAL  
MINOR HONE HEAD  
ASSEMBLY HP HONE  
1.50 TO 2.00 DIA.  
514-5-83

## Important Facts:

The hone head will sometimes chatter or squeal, when the stones wear down. This problem is caused by too much pressure on the guides. To correct this problem, remove the guides and dress them as shown in the illustration below.

The heat generated in honing will expand the bore diameter beyond its room temperature size, with more expansion in the thin wall mid-section. Expect approximately a .005" reduction in size after cooling to room temperature.

REFHME-40-020298



## Stone and Guide Installation:

### To install new stones:

Lift inner adjusting shaft, and rotate clockwise to latch. Pivot hone head 90 degrees (horizontal) so that the pinion can be removed.

### NOTE:

***Stones and guides are free to fall out when adjusting pinion is removed, be sure you are holding on to them.***

Insert stones and guides into holes marked with 'X'. The rack teeth must face the center of the hone head.

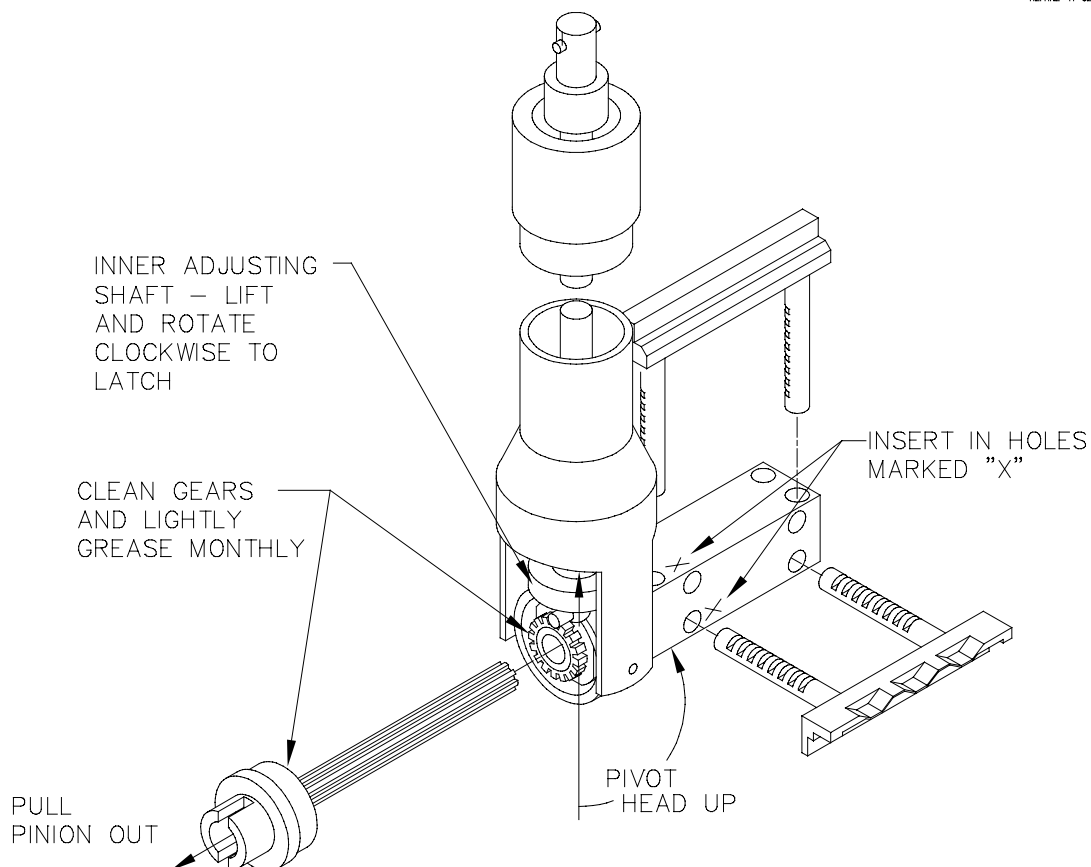
While holding stones and guides in, pivot hone head 90 degrees (horizontal). Insert adjusting pinion into head and pivot the head back to the vertical position. Unlatch and lower the inner adjusting shaft into its position in the pinion.

### NOTE:

***Used stones and guides that are to be reused must be kept in sets.***

Sometimes it is necessary to expand or contract the stone assembly a large distance. Lift inner adjusting shaft at hone head and rotate clockwise till it is latched, Lift adjusting pinion of hone head off of its gear and rotate pinion to expand or contract stones.

Be sure to re-engage the gear of the centering pinion. Lift and turn inner adjusting shaft counter-clockwise to unlatch.



## Stone and Guide Sets:

### For Rottler Standard Hone Head:

All S.N. listed - Grits and overall stone lengths may be mixed for quantity breaks.

#### Range 2.7" to 4.1"

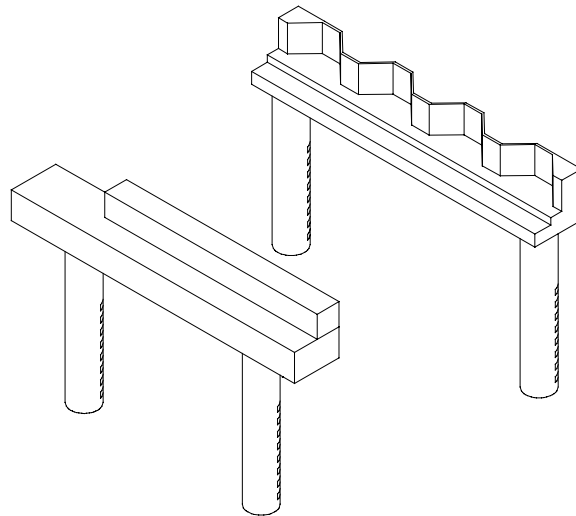
Rottler #

514-5-52B	SN100	80 Grit	4" overall stone length
514-5-52C	SN100	80 Grit	3" overall stone length
514-5-53D	SN200	180 Grit	4" overall stone length
514-5-53E	SN200	180 Grit	3" overall stone length
514-5-54B	SN300	220 Grit	4" overall stone length
514-5-54C	SN300	220 Grit	3" overall stone length

#### Range 3.4375" to 5.75"

Rottler #

514-5-52	SN101	80 Grit	4" overall stone length
514-5-52A	SN101	80 Grit	3" overall stone length
514-5-53B	SN201	180 Grit	4" overall stone length
514-5-53C	SN201	180 Grit	3" overall stone length
514-5-54	SN301	220 Grit	4" overall stone length
514-5-54A	SN301	220 Grit	3" overall stone length



REFINE89A-020398

## Optional Stone and Guide Sets, for Rottler Standard Hone Head.

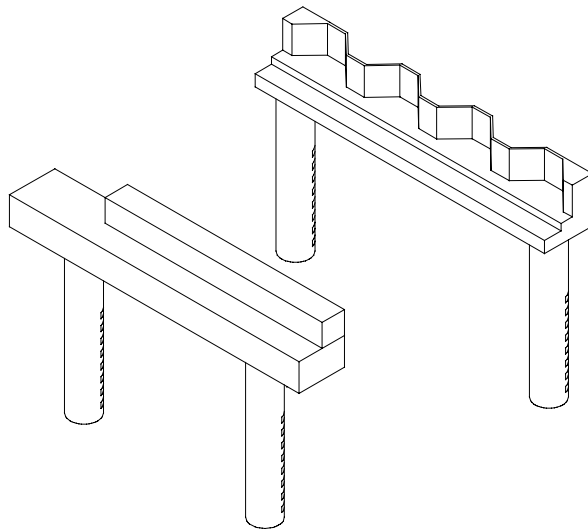
\*\*All orders subject to stock availability\*\*

Grits may be mixed for quantity breaks.  
(M2F numbers only)

**Range 2.68" to 4.25"**

Rottler #

514-1-33	M2F2F	120 Grit
514-1-34	M2F3F	180 Grit
514-5-6	M2F4F	220 Grit
514-5-6A	M2F6F	320 Grit
514-5-8	M2F0F	60 Grit



REFHNE89A-020398

## Optional Stone and Guide Sets for Rottler Standard Hone Head.

\*\*All orders subject to stock availability\*\*

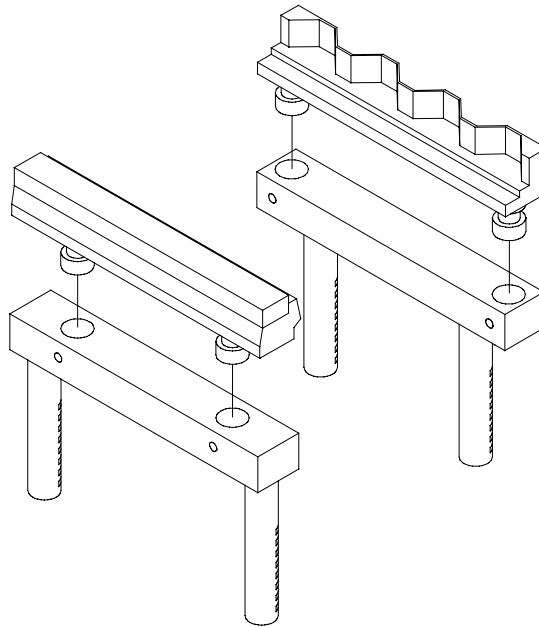
Grits may be mixed for quantity breaks.  
(PT2F numbers only)

**Range 3.75" to 5.00"** (Requires PTN  
stone carrier 514-1-37)

**Range 4.75" to 7.00"** (Requires PTN  
stone carrier 514-1-37A)

Rottler #

514-1-35	P2F2F	120 Grit
514-1-36	P2F3F	180 Grit
514-5-7	P2F4F	220 Grit
514-5-7A	P2F6F	320 Grit
514-5-9	P2F0F	60 Grit

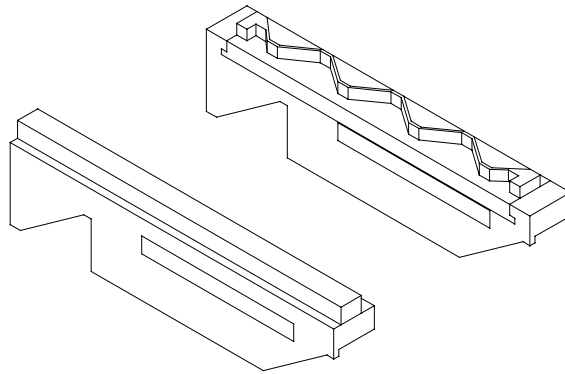


REFHNE89B-020398

## For Rottler Junior Hone Head.

All TF, UF, and VF numbers listed -  
Grits and ranges may be mixed for  
quantity breaks.

Rottler #			Description
514-5-14	TF2F	120 Grit	2.0 " to 2.20"
514-5-15	UF2F	120 Grit	2.20 " to 2.40"
514-5-16	VF2F	120 Grit	2.40 " to 2.68"
514-5-17	TF3F	180 Grit	2.0 " to 2.20"
514-5-18	UF3F	180 Grit	2.20 " to 2.40"
514-5-19	VF3F	180 Grit	2.40 " to 2.68"
514-5-17A	TF4F	220 Grit	2.0 " to 2.20"
514-5-18A	UF4F	220 Grit	2.20 " to 2.40"
514-5-19A	VF4F	220 Grit	2.40 " to 2.68"
2.0 " to 2.20"	TF6F	320 Grit	2.0 " to 2.20"
2.20 " to 2.40"	UF6F	320 Grit	2.20 " to 2.40"
2.40 " to 2.68"	VF6F	320 Grit	2.40 " to 2.68"



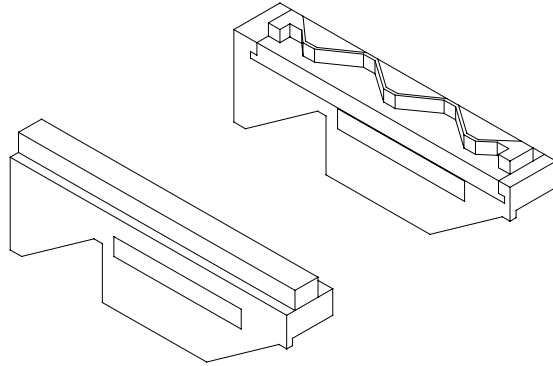
REFHNE89C-020398



## For Rottler Minor Hone Head.

All 28F and 29F numbers listed -  
Grits and ranges may be mixed for  
quantity breaks.

Rottler #			Description
514-5-43	28F2F	120 Grit	1.50 " to 1.75"
514-5-44	28F3F	180 Grit	1.50 " to 1.75"
514-5-45	29F2F	120 Grit	1.75 " to 2.00"
514-5-46	29F3F	180 Grit	1.75 " to 2.00"



REFHNE89D-020398

## PRECISION HONE HEAD

INSTRUCTIONS FOR PURCHASING AND OPERATION OF THE ROTTLER MODEL 514-9 AND 514-9B HONE HEAD

### Purchasing

#### Read the information on operations before purchasing

The Precision Hone Head can be purchased as a complete assembly to cover a 2.75 - 5.06 diameter size range (514-9B) (**not available for Sunnen**), a partial assembly to cover the commonly used bore range of 3.50" - 4.32" (514-9), or it can be ordered as a custom package to fit specific customer requirements.

When purchasing a custom package the 514-9A (514-7-80R for Sunnen) Hone Head Drive Assembly must be purchased. Then the desired sleeves and stone holders can be added to fit the customer's diameter requirements.

If the customer is using a two step honing process additional stone holders should be purchased for the additional stone grits. It is not recommended to constantly change stone grits between stone holders. Example: If a customer uses 180, 320, and 600 grit stones in the 2.75 - 3.06 bore range, three sets of 514-9-6J holders should be purchased.

### Choosing the Best honing Process

Whether using vitrified or diamond abrasives, the honing process should be studied to maximize productivity and minimize labor while providing the desired end result. Following is an example of two different ways to accomplish the same end result on an 18-22 Ra finish. The customer requires .003 in./0.076mm stock removal for honing after boring.

#### Single Step Honing

Process:

Abrasive: Diamond 500 Grit.

Set machine stop to hone to size. 60-strokes per minute. 12 strokes per feed out. At .0003 in./0.0076mm per feed out a stock removal rate of .0015 in./0.0381mm per minute is achieved. The result is 2 minutes of honing time per cylinder. During this time the machine is running unattended allowing the operator to accomplish other tasks.

Total honing time for a V8 block = 16 minutes.

#### Two Step Honing

Process:

1st Step

Abrasive: Diamond 270 Grit

Set machine stop to hone leave .0005 in./0.0127mm max. for second step finish hone. 60 strokes per minute. 6 strokes per feed out. At .0003 in./0.0076mm per feed out a stock removal rate of .003 in./0.0762mm per minute is achieved. The result is 55 seconds of honing per cylinder. During this time the machine is running unattended allowing the operator to accomplish other tasks.

Honing time for a V8 block = 7.3 minutes

2nd Step

Abrasive: Diamond 500 Grit.

Set machine to hone to size. 60 strokes per minute. 12 strokes per feed out. At .0003 in./0.0076mm per feed out a stock removal rate of .0015 in./0.0381mm per minute is achieved. The result is 24 seconds of honing time per cylinder.

Honing time for a V8 block = 3.2 minutes

Total honing time for 2-step process = 10.5 minutes

**Comments:**

When looking at actual honing time only, the two step process is 5.5 minutes faster than the single step process. Because the operator must change abrasives in the two-step process 1-2 minutes should be added for two abrasive changes. Considering the operator must position the machine in each cylinder two times for the two-step process, the time difference between the two methods is slight. The single step process allows for more operator uninterrupted free time. The single step process would allow the operator to easily run two machines at one time.

The two step process becomes more effective as the ending surface finish requirement becomes smoother. If a 12 - 16 Ra finish was required, the honing time for a single step process would become approximately 24 minutes and the honing time for the two-step process would remain near 10.5 minutes.

The above calculations should be made to determine the best method for the customer's particular requirements.

**Operation**

Important - Read this and study carefully **before** operating the precision head to implement the full capability of the precision head.

The precision head provides a very stiff back-up of the abrasives. This in turn provides rapid bore correction with very little material removal. The four cutting stones provide more abrasive area and cutting capability than two-stone heads and should perform 10 to 25% faster with less abrasive cost. You must, however, have the proper combination of cutting fluid, abrasive bond hardness, stone grit, hone pressure and feed rate. As with all machines, patience is necessary initially so that you organize and become familiar with the mesh of these variables. Blending them and proper adaptation to switching holders for the size changing will increase your productivity.

1. Care must be exercised in starting honing operations in a tapered hole since the stiffness of the abrasives can easily lock the hone head in tight bore. If the hone is started in the large end of a tapered hole the hone head could bind by the time it reaches the small end of the tapered hole.
2. Carefully study how to switch holders for size ranges. Once you have adequate abrasives loaded in the holders and you keep them stored properly in the file, size changes can be made in a minute. If it is necessary to change sleeves to a new range, that will take a minute more.
3. Abrasive grades are available for most any finish you want to achieve. Two or three bond hardnesses are available with most grits. The right bond hardness will break down gradually, losing approximately .1 to .2 of the abrasive as the material you remove.
4. Bond hardness will act differently with different cutting oils. Too soft a bond will lose abrasive excessively. Too hard a bond will chatter and start glazing the bore, with rapid heating and poor stock removal.
5. Faster spindle rotation and light pressures will make abrasive act harder. Faster stroke speed and heavy pressures will make abrasive act softer.
6. The precision hone head expands .0003" (.008 mm) with every wheel graduation or up-feed. Ten feed-ups will remove .003" (.08 mm) of stock, less abrasive wear, if the load meter remains constant.
7. Automotive bores often require a good deal of attention at the bottom of cylinders which allow limited lower over-stroke. Use the part 514-8-27, stone depth scale assembly, to maximize over-strokes. Shortening abrasive sticks and use of the lower short stroke control can be used for limited over-stroke. Slowing the stroke rate will provide a (shorter) lower short stroke.
8. Abrasive should wear relatively evenly and parallel to the shim support. If you encounter uneven abrasive wear, the cause may be a damaged universal drive joint, unmatched stones, or misalignment of hone drive with cylinder bore.
9. General finishes with vitrified abrasives. See Abrasive list for additional information.

Rottler Part#	Abrasive	Grit	Length	Color	Finish Ra	Notes
514-9-18	Vitrified	80	2-3/4"	Red	80-95Ra	Roughing
514-9-18A	Vitrified	180	2-3/4"	Green	30-35Ra	
514-9-18B	Vitrified	180	2-3/4"	Blue	30-35Ra	
514-9-18C	Vitrified	220	2-3/4"	Yellow	20-26Ra	
514-9-18D	Vitrified	320	2-3/4"	White	18-22Ra	
514-9-18F	Vitrified	400	2-3/4"	Black	10-15Ra	
514-9-18G	Vitrified	600	2-3/4"	Orange	5-10Ra	
514-9-20	Vitrified	80	4"	Red	80-95Ra	
514-9-20A	Vitrified	180	4"	Green	30-35Ra	
514-9-20B	Vitrified	180	4"	Blue	30-35Ra	
514-9-20C	Vitrified	220	4"	Yellow	20-26Ra	
514-9-20D	Vitrified	320	4"	White	18-22Ra	
514-9-20E	Vitrified	400	4"	Black	10-15Ra	
514-9-20F	Vitrified	600	4"	Orange	5-10Ra	

10. Diamond Abrasives can be used with standard honing oils as well as synthetic water based coolants. The water base coolants have the advantage of much better cooling properties as well as reduced environmental liability and easier cleaning. Standard Vitrified abrasives **can not** be used in synthetic or water base coolants. When compared with vitrified abrasives diamond abrasives are approximately 1/5 of the cost per cylinder.

## Using Diamond Abrasives.

### General

In the proper application, diamond abrasives are very effective for cylinder honing. The Rottler Precision Hone Head brings the cost of diamond honing down to a range that is much more affordable. Competitive hone heads require the purchase of multiple hone heads to cover the same size range as the Precision Head. The Rottler system is approximately 1/5 the cost.

Because of the long life of diamond abrasives the cost per hole of diamond abrasives is approximately 1/5 of the vitrified abrasives.

Diamond abrasives in combination with the Rottler Precision Honing Head make a very rigid honing head. The system will do an excellent job of truing tapered or out of round holes with little or no operator attention. A skilled operator can set the machine for the proper number of stone feed outs and expect the machine to hone the cylinder to size unattended with little or no attention. It is important to use proper stone pressure when using diamond abrasives. Motor load reading should be in the 60 - 80% area. If the stones are over loaded excessive bore distortion will occur.

### Coolant

Synthetic water base coolants can be used with diamond abrasives rather than petroleum based honing oils. The synthetic water base coolants provide much better cooling of the work piece. The synthetic water base coolant is much easier to clean from the engine block and is easier to dispose of environmentally. The disadvantage of synthetic water base coolant is you can not use vitrified abrasives with it. You must be fully committed to using diamond abrasives if you are going to use synthetic coolant. Diamond abrasives can be used with petroleum based honing oils so vitrified and diamond abrasives could be used in the same machine.

### Breaking In A New Set of Diamond Abrasives.

Rottler diamond abrasives are pre-radiuses to minimize the breaking in period. When a new set of diamonds is installed the surface finish obtained on the first few blocks will be 5-10 Ra rougher than after the break in period. You must hone 2 - 5 blocks before the surface finish stabilizes.

### Dressing Diamond Abrasives

Diamond Abrasives use a metal bond to hold the individual diamond particles. After honing 30 - 70 blocks you may find that increased pressure is required to remove stock or the stock removal rate slows down significantly. This is caused by the diamond abrasive dulling or the bond not breaking down. This is a normal occurrence and is easily corrected by removing the holder/abrasive assembly and use a wire brush to dress the abrasive.

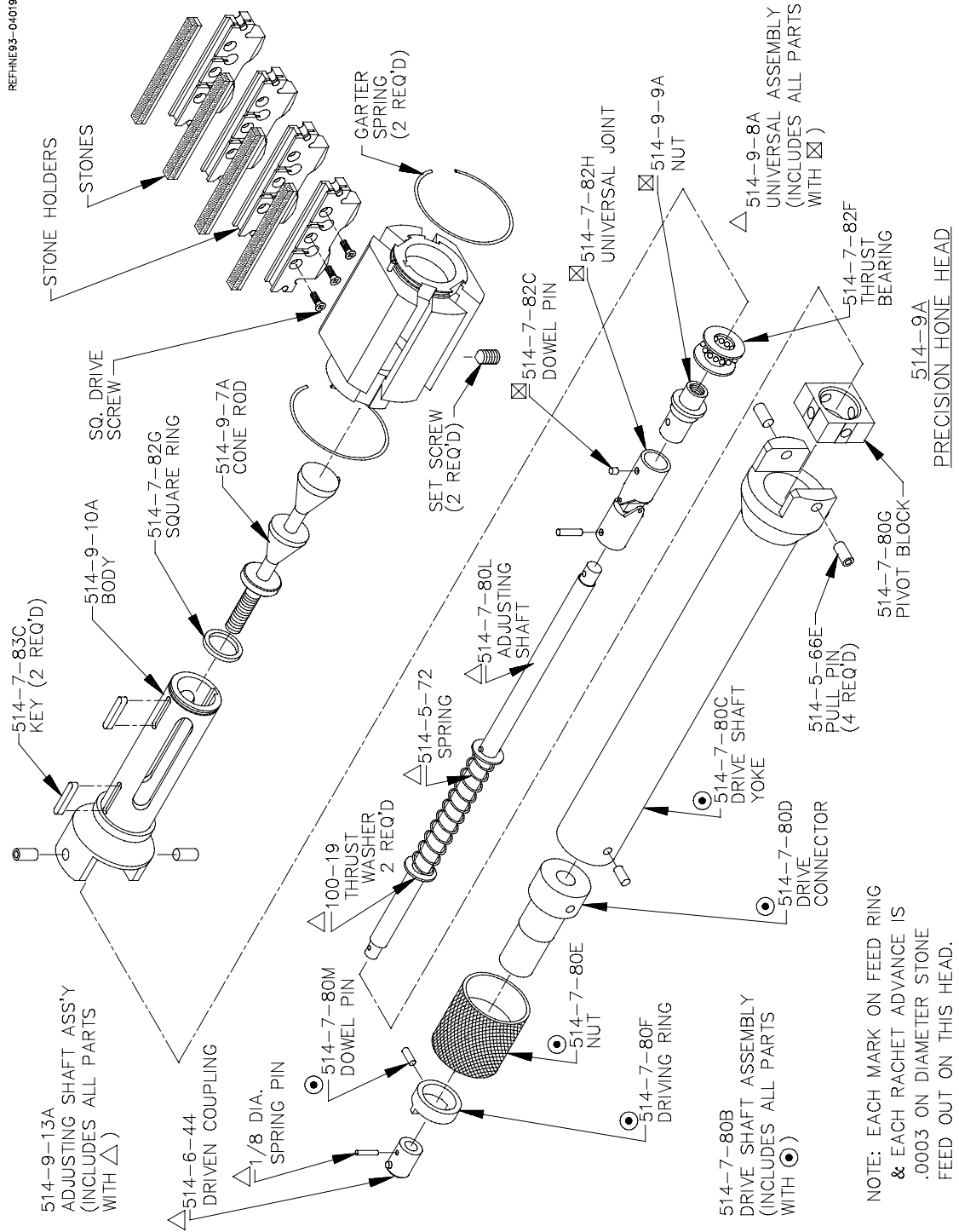
### Diameter Range

Because the diamond abrasives break down very slowly a single set of stones is limited in its diameter range, One set of diamonds should be used for each stone holder range. A set of diamonds can not be constantly changed from one stone holder size to another. The stones would constantly be in the break-in process and very poor performance or finishes will result.

514-9-14C	Diamond	500	3 1/2"		18-22Ra	
514-9-14D	Diamond	500	3"		18-22Ra	Required for bores under 2.8" dia.
514-9-14E	Diamond	325/400	3 1/2"		24-30Ra	
514-9-14F	Diamond	80	3-1/2"		90Ra	Stock removal .004/min.
514-9-14G	Diamond	600	3-1/2"		12-16Ra	
514-9-14J	Diamond	270/325	3-1/2"		50-55Ra	
514-9-14K	Diamond	170/200	3-1/2"		40-50Ra	

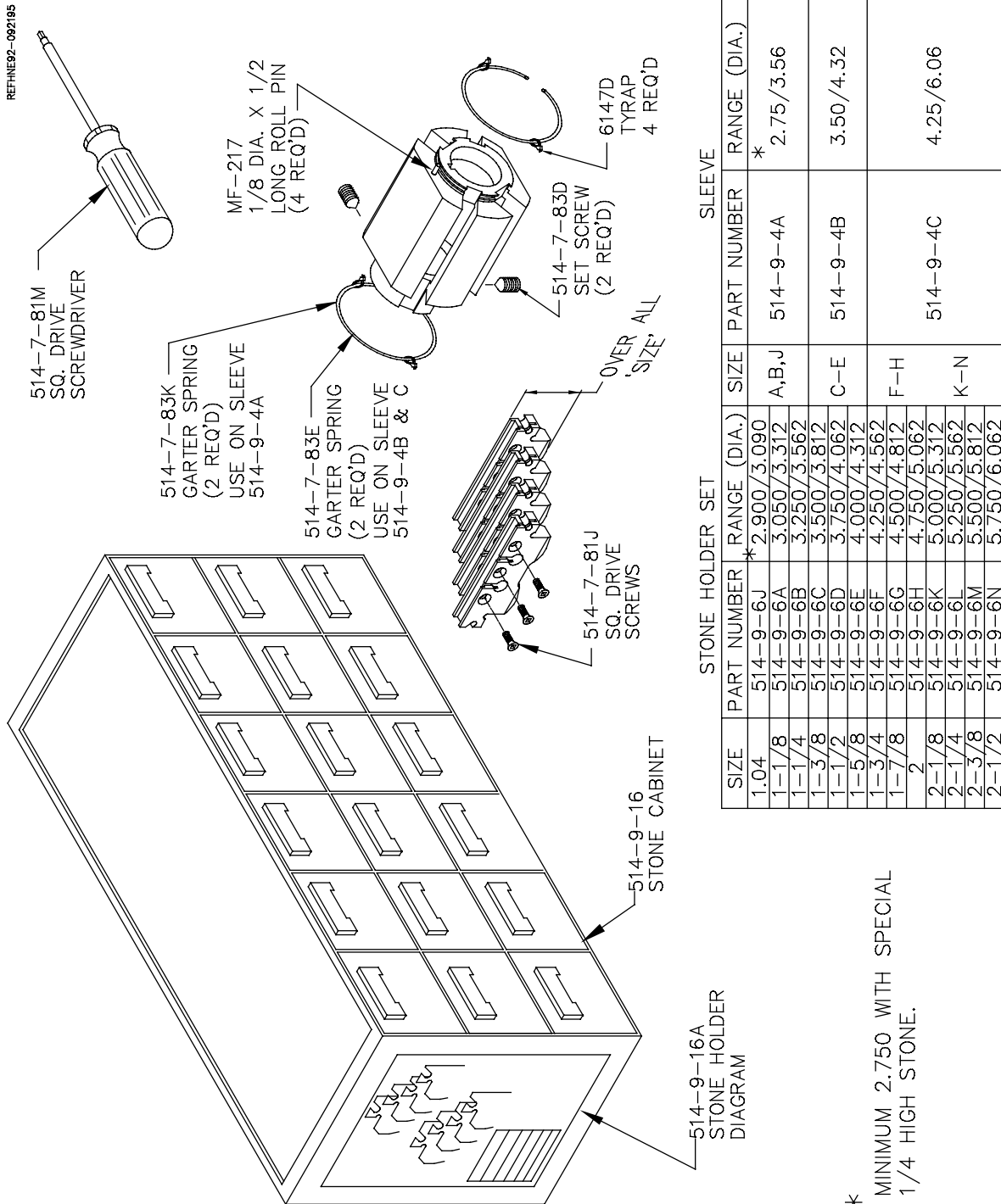
### Precision Hone Head:

REFHNE93-040196



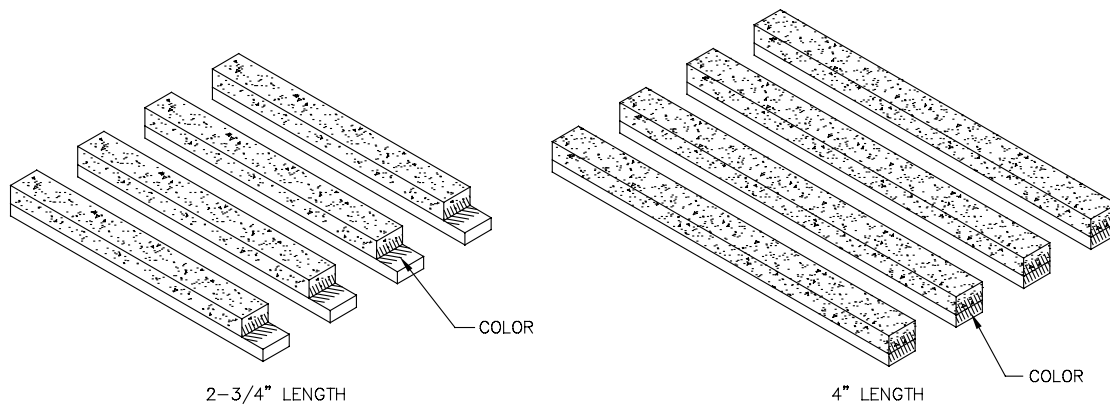
NOTE: EACH MARK ON FEED RING & EACH RACHET ADVANCE IS .0003 ON DIAMETER STONE FEED OUT ON THIS HEAD.

### Stone Holder - Sleeve Sets:



\* MINIMUM 2.750 WITH SPECIAL 1/4 HIGH STONE.

### Stone Sets:



REF:HEB-020396

Rottler Part No.	Abrasive	Grit	Length	Color	Finish Ra.	Notes
514-9-18	Vitrified	80L	2-3/4"	Red	80-95 Ra	Roughing
514-9-18A	Vitrified	180L	2-3/4"	Green	30-35 Ra	
514-9-18B	Vitrified	180M	2-3/4"	Blue	30-35 Ra	
514-9-18C	Vitrified	220L	2-3/4"	Yellow	20-26 Ra	
514-9-18D	Vitrified	320M	2-3/4"	White	18-22 Ra	
514-9-18F	Vitrified	400L	2-3/4"	Black	10-15 Ra	
514-9-18G	Vitrified	600L	2-3/4"	Orange	5-10 Ra	
514-9-20	Vitrified	80L	4"	Red	80-95 Ra	
514-9-20A	Vitrified	180L	4"	Green	30-35 Ra	
514-9-20B	Vitrified	180M	4"	Blue	30-35 Ra	
514-9-20C	Vitrified	220L	4"	Yellow	20-26 Ra	
514-9-20D	Vitrified	320M	4"	White	18-22 Ra	
514-9-20E	Vitrified	400L	4"	Black	10-15 Ra	
514-9-20F	Vitrified	600L	4"	Orange	5-10 Ra	
514-9-14C	Diamond	500	3-1/2"		18-22 Ra	
514-9-14D	Diamond	500	3"		18-22 Ra	Required for bores under 2.8" dia.
514-9-14E	Diamond	325 / 400	3-1/2"		24-30 Ra	
514-9-14F	Diamond	80	3-1/2"		90 Ra	Stock Removal .004/min.
514-9-14G	Diamond	600	3-1/2"		12-16 Ra	
514-9-14J	Diamond	270 / 325	3-1/2"		50-55 Ra	

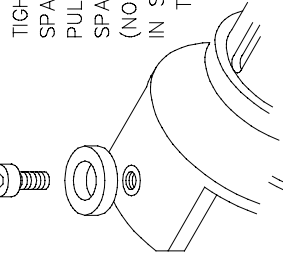
Note:  
 Hardness designation:  
 The lower the alphabetical designation the softer the bond. For example, 'L' is softer than 'M'.



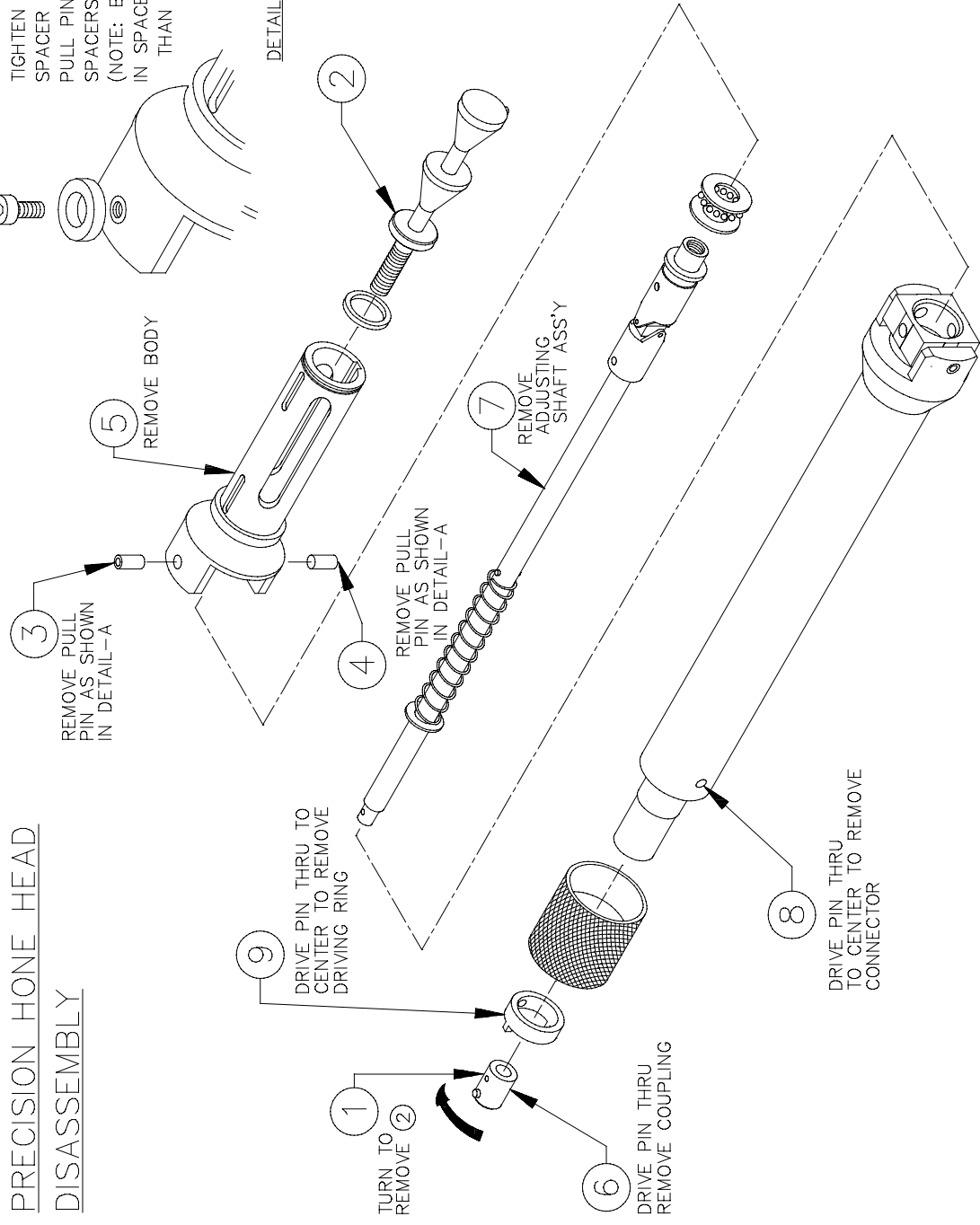
# Disassembly Instructions:

REFHNE96-092195

TIGHTEN SCREW OVER SPACER TO REMOVE PULL PIN. ADD SPACERS AS NEEDED (NOTE: BE SURE HOLE IN SPACER IS LARGER THAN PIN DIA.)



DETAIL-A



## PRECISION HONE HEAD DISASSEMBLY

1  
TURN TO REMOVE 2

6  
DRIVE PIN THRU REMOVE COUPLING

9  
DRIVE PIN THRU TO CENTER TO REMOVE DRIVING RING

8  
DRIVE PIN THRU TO CENTER TO REMOVE CONNECTOR

4  
REMOVE PULL PIN AS SHOWN IN DETAIL-A

3  
REMOVE PULL PIN AS SHOWN IN DETAIL-A

5  
REMOVE BODY

7  
REMOVE ADJUSTING SHAFT ASS'Y

# ROTTLER

## MANUFACTURING

## JUNIOR PRECISION HONE HEAD

INSTRUCTIONS FOR PURCHASING AND OPERATION  
OF THE ROTTLER MODEL 514-10 HONE HEAD.

### Purchasing

**Read the information on operations before purchasing**

The Junior Precision Hone Head can be purchased as a complete assembly to cover a 2.25 – 3.03 diameter size range.

If the customer is using a two step honing process additional stone holders should be purchased for the additional stone grits. It is not recommended to constantly change stones grits between stone holders. Example: If a customer uses 180, 320, and 600 grit stones in the 2.58 – 2.83 bore range, three sets of 514-10-9C holders should be purchased.

### Common Surface Finishes

Today's modern engines are demanding smoother and more precise surface finishes. There are two commonly used surface finishes used in automotive engine cylinder bore finishing today. Each of the three finishes below are being used in engine rebuilding on a regular basis with success. Below is a description of each. Finishes for high performance engine applications will differ from what is described below. If the engine manufacturer recommends a particular finish the engine manufacturers specifications should be followed.

#### **Non-Plateau**

The typical Ra finishes used for a Non-Plateau finish should be in the 14-24 range. A 16-24 Ra finish leaves adequate peaks to be knocked off during the engine break in period yet is not so rough as to cause oil burning problems before the cylinder walls have been plateaued by the rings. During initial start up of the engine the rings will create the plateau by knocking off the peaks of a non-plateau finish.

#### **Plateau – with rigid abrasive second step**

The Plateau finish has become very popular. One of its purposes is to minimize the break-in or ring seating period. A plateau finish involves the use of a roughing stone followed by a finer grit finishing stone. When the finishing stone is used, only a few strokes are required to create the plateau. If you were to continue honing with the finer grit stone you would eventually eliminate the plateau effect and create a simple non-plateau finish equal in roughness to the finish stone.

There are sophisticated measuring devices able to measure the details of a plateau finish. Although the cost of these devices have lowered significantly in the last few years, they are still cost prohibitive to the average shop. Following is a method to achieve a plateau finish using a simple surface tester that is capable of measuring Ra only.

#### **Step One**

Using an aggressive abrasive, hone the cylinder to the minimum diameter of the finish tolerance. This abrasive should leave you a finish in the 35 - 50 Ra area.

#### **Step Two**

Install a finishing abrasive that would give 5 - 12 Ra finish if a plateau finish was not being made. Make 5 - 10 strokes with this abrasive. It should not remove more than a .0001 or .0002 of material on the diameter. When this is complete the surface finish should be in the 13 - 18 Ra area. If it is smoother than 13 Ra reduce the number of strokes you take. If it is rougher than 18 Ra increase the number of strokes you take. A brush hone can be used for this process if desired. The above Ra values are based on test using sophisticated measuring devices capable of measuring Rvk and Rpk. In the test the Ra values were in the above ranges when the Rvk and Rpk were within specification.

#### **Plateau – with brush abrasive second step**

This Plateau finish has become very popular. It has the advantage of being able to use a more aggressive grit than would be used in a non-plateau finish (stock removal is faster than the non-plateau finish). Although it may not provide the optimum plateau finish, it is a finish that is proven to work well. The second step can accomplish very fast with a brush and drill motor separate from the machine. This may be the most productive way to finish a cylinder. This method allows time for the operator to accomplish other tasks when the machine is operating.

### Step One

Using an aggressive abrasive, hone the cylinder to the minimum diameter of the finish tolerance. This abrasive should leave you a finish in the 25 – 35 Ra area. The brush abrasive is very flexible and is only able to exert light pressures on the cylinder wall compared with a ridged abrasive. Therefore the first step finish when using the brush abrasive must be smoother than the first step finish when using the ridged abrasive method.

### Step Two

Install a finishing brush abrasive that would give 5 – 12 Ra finish if a plateau finish was not being made. Make 5 – 10 strokes with this abrasive. It should not remove more than a .0001 or .0002 of material on the diameter. When this is complete the surface finish should be in the 16 – 22 Ra area. If it is smoother than 16 Ra reduce the number of strokes you take. If it is rougher than 22 Ra increase the number of strokes you take. The brush may be installed in the honing machine or a hand drill for this process.

The above Ra values are based on tests using sophisticated measuring devices capable of measuring Rvk and Rpk. In the test the Ra values were in the above ranges when the Rvk and Rpk were within the specification.

## **Productivity**

Whether using vitrified or diamond abrasives, the honing process should be studied to maximize the productivity of the work center while providing the desired end result. Following is an example of two different ways to accomplish the same end result of an 18-22 Ra non-plateau finish. The customer requires .003 in./0.07mm stock removal for honing after boring.

### **Single Step Honing**

Process:

Abrasive: Diamond 500 Grit.

Set machine stop to hone to size. 60-strokes per minute. Set the roughing load at 85%. Set the finishing load between 25 and 35%. At .0003 in./0.007mm per feed out a stock removal rate of .0015 in./0.038mm per minute is achieved. The result is 2 minutes of honing time per cylinder. During this time the machine is running unattended allowing the operator to accomplish other tasks.

Total honing time for a V8 block = 16 minutes.

### **Two Step Honing**

Process:

1st Step

Abrasive: Diamond 270 Grit

Set machine stop to hone leave .0005 in./0.01mm max. for second step finish hone. 60 strokes per minute. 6 strokes per feed out. At .0003 in./0.007mm per feed out a stock removal rate of .003 in./0.076mm per minute is achieved. The result is 55 seconds of honing per cylinder. During this time the machine is running unattended allowing the operator to accomplish other tasks.

Honing time for a V8 block = 7.3 minutes

2nd Step

Abrasive: Diamond 500 Grit.

Set machine to hone to size. 60 strokes per minute. 12 strokes per feed out. At .0003 in./0.007 mm per feed out a stock removal rate of .0015 in./0.038mm per minute is achieved. The result is 24 seconds of honing time per cylinder.

Honing time for a V8 block = 3.2 minutes

Total honing time for 2-step process = 10.5 minutes

### **Comments:**

When looking at actual honing time only, the two step process is 5.5 minutes faster than the single step process. Because the operator must change abrasives in the two-step process 1-2 minutes should be added for two abrasive changes. Considering the operator must position the machine in each cylinder two times for the two-step process, the time difference between the two methods is slight. The single step process allows for more operator uninterrupted free time. The single step process would allow the operator to easily run two machines at one time or perform work other than honing.

The two step process becomes more effective as the ending surface finish requirement becomes smoother. If a 12 - 16 Ra finish was required, the honing time for a single step process would become approximately 24 minutes and the honing time for the two-step process would remain near 10.5 minutes. The two step process becomes more productive when more than .003 material must be removed.

The above calculations should be made to determine the best method for the customer's particular requirements. Actual times will vary depending on the engine block material, stock removal required, and the desired accuracy. The purpose of the above comparison help the user understand different methods may be used to obtain the same result and that there is a significant difference in potential productivity when comparing the different methods.

## Operation

### General

Important - Read this and study carefully **before** operating the precision head to implement the full capability of the precision head.

The precision head provides a very stiff back-up of the abrasives. This in turn provides rapid bore correction with very little material removal. The four cutting stones provide more abrasive area and cutting capability than two-stone heads and should perform 10 to 25% faster with less abrasive cost. You must, however, have the proper combination of cutting fluid, abrasive bond hardness, stone grit, hone pressure and feed rate. As with all machines, patience is necessary initially so that you organize and become familiar with the mesh of these variables. Blending them and proper adaptation to switching holders for the size changing will increase your productivity.

Care must be exercised in starting honing operations in a tapered hole since the stiffness of the abrasives can easily lock the hone head in tight bore. If the hone is started in the large end of a tapered hole the hone head could bind by the time it reaches the small end of the tapered hole.

Carefully study how to switch holders for size ranges. Once you have adequate abrasives loaded in the holders and you keep them stored properly in the file, size changes can be made in a minute. If it is necessary to change sleeves to a new range, that will take a minute more.

The precision hone head expands .0003" (.008 mm) with every wheel graduation or up-feed. Ten feed-ups will remove .003" (.08 mm) of stock, less abrasive wear, if the load meter remains constant.

Automotive bores often require a good deal of attention at the bottom of cylinders which allow limited lower over-stroke. Use the part 514-8-27, stone depth scale assembly, to maximize over-strokes. Use 3" abrasives and make sure the lower stop is set as low as possible without interfering with lower bore obstructions. The finish load percentage has a large affect on lower bore and thin wall cylinder geometry. Generally lowering the finish load percentage will increase the accuracy of the lower bore area.

### Vitrified Abrasives

Abrasive grades are available for most any finish you want to achieve. Two or three bond hardnesses are available with most grits. The right bond hardness will break down gradually depending on the grit used. Too soft a bond will lose abrasive excessively. Too hard a bond will chatter and start glazing the bore, with rapid heating and poor stock removal.

Finer grit stones generally break down much faster than coarse grit does. They must break down quickly to prevent the stone from loading or glazing.

Bond hardness will act differently with different cutting oils. Rottler abrasives were designed to be used with Rottler honing oils or equivalent. In general Rottler honing oil is of low Sulfur content. Using other honing oils may have an adverse effect on the abrasive performance. Faster spindle rotation and light pressures will make abrasive act harder. Faster stroke speed and heavy pressures will make abrasive act softer.

Abrasive should wear relatively evenly and parallel to the shim support. If you encounter uneven abrasive wear, the cause may be a damaged universal drive joint, unmatched stones, or misalignment of hone drive with cylinder bore.

Standard Vitrified abrasives **can not** be used in synthetic or water base coolants.

## Using Diamond Abrasives.

### General

In the proper application, diamond abrasives are very effective for cylinder honing. The Rottler Precision Hone Head brings the cost of diamond honing down to a range that is much more affordable. Competitive hone heads require the purchase of multiple hone heads to cover the same size range as the Precision Head. The Rottler system is approximately 1/5 the cost.

Because of the long life of diamond abrasives the cost per hole of diamond abrasives is approximately 1/5 of the vitrified abrasives.

Diamond abrasives in combination with the Rottler Precision Honing Head make a very rigid honing head. The system will do an excellent job of truing tapered or out of round holes with little or no operator attention. A skilled operator can set the machine for the proper number of stone feed outs and expect the machine to hone the cylinder to size unattended with little or no attention. It is important to use proper stone pressure when using diamond abrasives. The roughing motor load setting should be in the 70 - 90% range. Generally the higher the motor load reading the faster the stock removal.

Synthetic water base coolants can be used with diamond abrasives rather than petroleum based honing oils. The synthetic water base coolants provide much better cooling of the work piece. The synthetic water base coolant is much easier to clean from the engine block and is easier to dispose of environmentally. The disadvantage of synthetic water base coolant is you can not use vitrified abrasives with it. You must be fully committed to using diamond abrasives if you are going to use synthetic coolant. Diamond abrasives can be used with petroleum based honing oils so vitrified and diamond abrasives could be used in the same machine. When using the synthetic coolant supplied by Rottler Mfg. the ratio of water to additive should be 20:1. Adding too much additive will cause the hone head and other parts to become sticky and eventually cause problems with the operation of the machine. Adding too much water will allow rust to form on both the machine and the parts being hone as well as not provide proper lubrication for the honing process.

### Scratching

Scratching in the cylinder looks as though a single grit of a larger abrasive particle has lodged between the cylinder wall and the hone head. Often the scratch will be less than one revolution of the hone head and it will follow the cross hatch angle of the honing machine. Several things can cause this problem.

Improper coolant mix.

Unacceptable synthetic coolant brand.

Lack of abrasive dressing.

Dirty Coolant.

### Breaking In A New Set of Diamond Abrasives

Rottler diamond abrasives are pre-radiuses to minimize the breaking in period. When a new set of diamonds is installed the surface finish obtained on the first few blocks will be 5-10 Ra rougher than after the break in period. You must hone 2 - 5 blocks before the surface finish stabilizes.

### Dressing Diamond Abrasives

Diamond Abrasives use a metal bond to hold the individual diamond particles. After honing 30 - 70 blocks you may find that increased pressure is required to remove stock or the stock removal rate slows down significantly. This is caused by the diamond abrasive dulling or the bond not breaking down. The edge of the stone will also become very sharp. This is a normal occurrence and is easily corrected by removing the holder/abrasive assembly and use a wire brush to dress the abrasive. A common method is to remove the stone holder from the hone head. Leave the stone in the stone holder and move the stone through a bench grinder wire wheel. The brush rotation should be across the narrow width of the stone. Turn the holder over and pass the stone through the wheel again. This process will return the abrasive to a like new cutting condition and put a slight radius on the edge of the abrasive stick (approx. .005 inch.)

### Torn Metal

This is often caused by improper coolant mix, lack of dressing, or the use of high honing pressure during the finishing process. The Rottler hone head is capable of very high loads. If problems with torn metal are encountered verify the

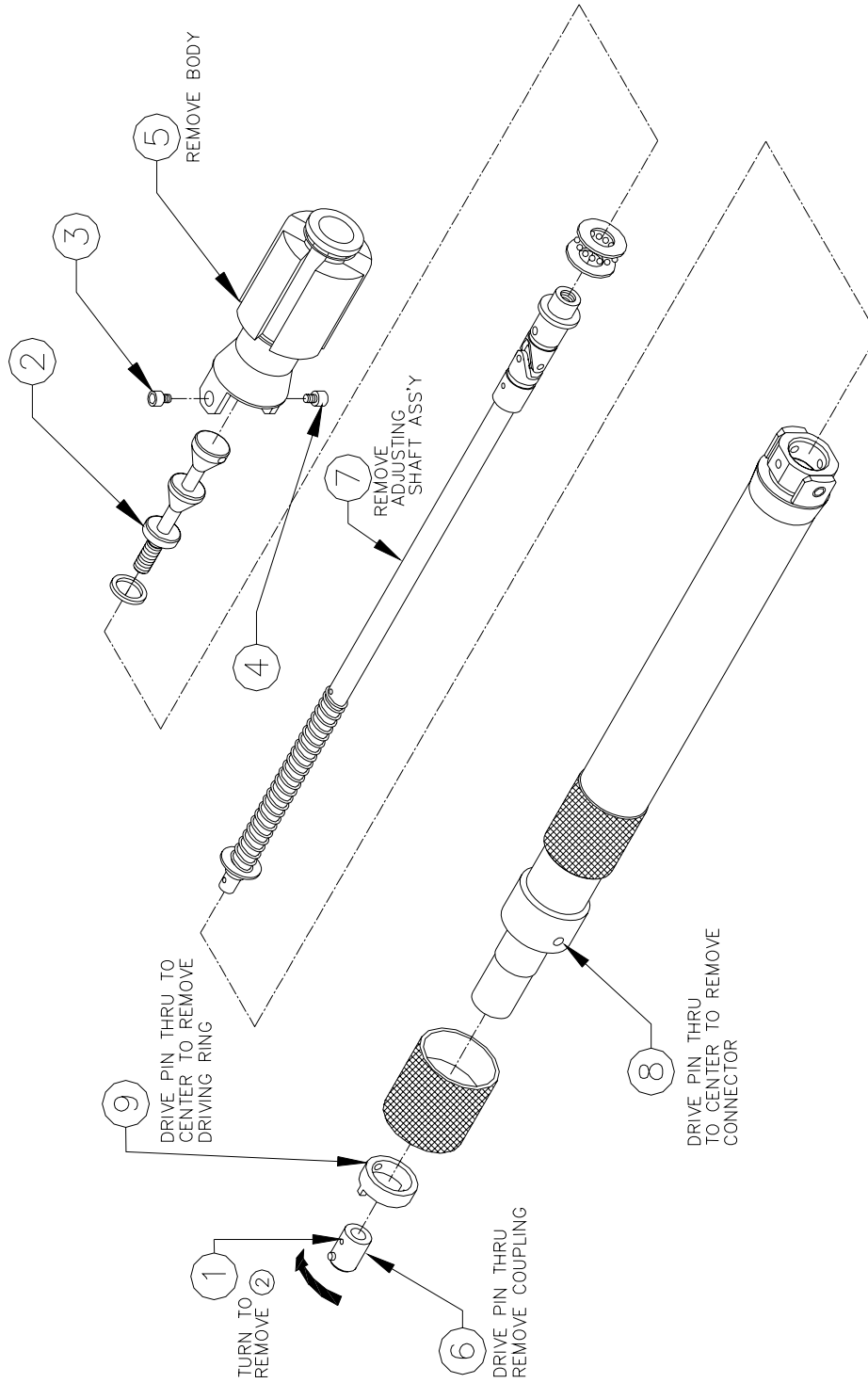
coolant mix, proper dressing of the abrasives, and reduce the finishing load during the final hone stage. If required make several strokes by hand with minimum stone pressure (10-20%).

**Diameter Range**

Because the diamond abrasives break down very slowly a single set of stones is limited in its diameter range. One set of diamonds should be used for each stone holder range. A set of diamonds can not be constantly changed from one stone holder size to another. The stones would constantly be in the break-in process and very poor performance or finishes will result.

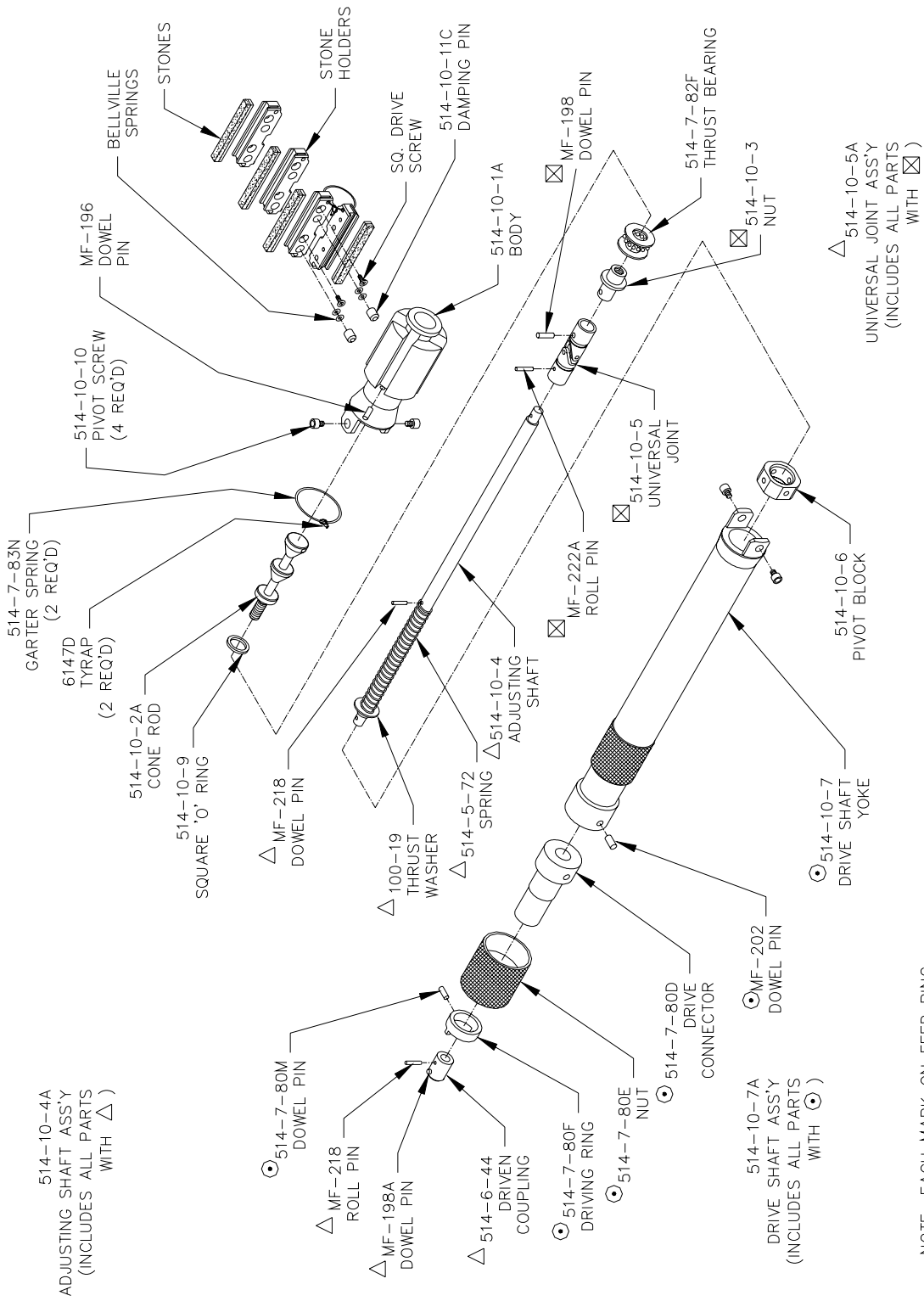
# 514-10A JR. PRECISION HONE HEAD (ASSEMBLY)

REFHNE5-44-092898



# JR PRECISION HONE HEAD

REF: 45-02298





\*\*\*\*\* I. PRODUCT IDENTIFICATION \*\*\*\*\*  
 MOBILMET UPSILON

Supplier:	Mobil Oil Corp	Health emergency telephone:	(212) 883-4411
Chemical names and synonyms:	Pet. Hydrocarbons and additives	Transport emergency telephone:	(800) 424-9300 (CHEMTREC)
Use or description:	Cutting fluid		

\*\*\*\*\* II. TYPICAL CHEMICAL AND PHYSICAL PROPERTIES \*\*\*\*\*

Appearance: ASTM 5.0 liquid	Odor: Mild	PH: NA
Viscosity at 100 F, SUS: 62.0	at 40 C, CS: 10.2	
Viscosity at 210 F, SUS: 35.1	at 100 C, CS: 2.7	
Flash point F (C): >325 (163)	(ASTM D-92)	
Melting point F(C): NA	Pour point F(C): 30 (-1)	
Boiling point (F(C)): > 600 ( 316)		
Relative density, 15/4 C: 0.849	Solubility in water: Negligible	
Vapor pressure-MM HG 20C: < .1		
NA = Not applicable	NE = Not established	D= decomposes

For further information contact your local marketing office.

\*\*\*\*\* III. INGREDIENTS \*\*\*\*\*

	WT PCT (Approx.)	EXPOSURE MG/M3	LIMITS PPM	SOURCES (and notes)
Hazardous ingredients:	None			
Other ingredients:	Refined mineral oils		>95	
	Additives and/or other ingredients		< 5	

Key to sources: A = ACGIH-TLV, A\* = suggested – TLV, M = Mobil, O = OSHA  
 Note: Limits shown for guidance only. Follow applicable regulations.

\*\*\*\*\* IV. HEALTH HAZARD DATA \*\*\*\*\*

Threshold limit value: 5.00 MG/M3 Suggested for oil mist  
 Effects of overexposure: Prolonged repeated skin contact with low viscosity oils may lead to irritation caused by dissolving of the natural oils from the skin. Slight skin irritation.

\*\*\*\*\* V. EMERGENCY AND FIRST AID PROCEDURE \*\*\*\*\*

Eye contact: Flush with water.  
 Skin contact: Wash contact areas with soap and water.  
 Inhalation: Not expected to be a problem.  
 Ingestion: Do not induce vomiting. Administer vegetable oil. Get medical assistance.  
 (Note to physician: Material if aspirated into the lungs may cause chemical pneumonitis.  
 Treat appropriately)

## \*\*\*\*\* VI. FIRE AND EXPLOSION HAZARD DATA \*\*\*\*\*

Flash point F(C): > 325 ( 163) (ASTM D-92)

Flammable limits. LEL: .6 UEL: 7.0

Extinguishing media: Carbon dioxide, foam, dry chemical and water fog. Special fire fighting procedures:

Firefighters must use self-contained breathing apparatus.

Unusual fire and explosion hazards: None

NFPA hazard ID: Health: 0, Flammability: 1, Reactivity: 0

## \*\*\*\*\* VII. REACTIVITY DATA \*\*\*\*\*

Stability (thermal, light, etc.): Stable

Conditions to avoid: extreme heat

Incompatibility (materials to avoid): Strong oxidizers

Hazardous decomposition products: Carbon monoxide.

Hazardous polymerization: Will not occur

## \*\*\*\*\* VIII. SPILL OR LEAK PROCEDURE \*\*\*\*\*

Environmental impact: Report spills as required to appropriate authorities. U.S. Coast Guard regulations require immediate reporting of spills that could reach any waterway including intermittent dry creeks. Report spill to Coast Guard toll free number 800-424-8802.

Procedures if material is released or spilled: Adsorb on fire retardant treated sawdust, diatomaceous earth, etc. Shovel up and dispose of at an appropriate waste disposal facility in accordance with current applicable laws and regulations, and product characteristics at time of disposal.

Waste management: Product is suitable for burning in an enclosed, controlled burner for fuel value or disposal by supervised incineration. Such burning may be limited pursuant to the Resource Conservation and Recovery Act. In addition, the product is suitable for processing by an approved recycling facility or can be disposed of at any government approved waste disposal facility. Use of these methods is subject to user compliance with applicable laws and regulations and consideration of product characteristics at time of disposal.

## \*\*\*\*\* IX. SPECIAL PROTECTION INFORMATION \*\*\*\*\*

Eye protection: No special equipment required.

Skin protection: If prolonged or repeated skin contact is likely, oil impervious gloves should be worn.

Good personal hygiene practices should always be followed.

Respiratory protection: No special requirements under ordinary conditions of use and with adequate ventilation.

Ventilation: No special requirements under ordinary conditions of use and with adequate ventilation.

## \*\*\*\*\* X. SPECIAL PRECAUTIONS \*\*\*\*\*

Storage: See Appendix for precautionary label. CL-402

## \*\*\*\*\* XI. TOXICOLOGICAL DATA \*\*\*\*\*

## --- ACUTE ---

Oral toxicity (rats): LD50: > 5 G/KG slightly toxic (estimated) --- based on testing of similar products and/or the components.

Dermal toxicity (rabbits) LD50: > 2 G/KG slightly toxic (estimated) – based on testing of similar products and/or the components.

Inhalation toxicity (rats): LC50: >5 MG/L for 4 hours. 0/10 rats died at this dosage level. Practically nontoxic.

Eye irritation (rabbits): Caused no significant irritation to rabbits. Eye irritation scores: 2.3 at 1 hour, 0.1 at 24 hours, 0 at 7 days.

Skin irritation (rabbits) Slightly irritating to rabbits. Primary irritation score: 1.6/8

## --- OTHER DATA ---

\*\*\*\*\*This mixture or a similar mixture did not result in any fatalities to rats at concentrations (see inhalation toxicity above) substantially higher than the 5 MB/M3 TLV suggested for oil mists.

## \*\*\*\*\* XII. REGULATORY INFORMATION \*\*\*\*\*

TSCA inventory status: All components registered.

D.O.T. shipping name: Not applicable

D.O.T. hazard class: Not applicable

US OSHA Hazard Communication Standard: Product assessed in accordance with OSHA CFR 1910.1200 and determined to be hazardous.

RCRA information: The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, part 261D); does not exhibit the hazardous characteristics of ignitability, corrosivity, or reactivity, and is not formulated with the metals cited in the EP toxicity test. However, used product may be regulated.

The following product ingredients are cited on the lists below:

CHEMICAL NAME	CASE NUMBER	LIST CITATIONS
(OIL MIST)		2,10,11

## --- KEY TO LIST CITATIONS ---

1 = OSHA Z,	2 = ACGIH,	3 = IARC,	4 = NTP,	5 = NCI,
6 = EPA CARC,	7 = NFPA 49,	8 = NFPA 325M,	9 = DOT HMT,	10 = CA RTK,
11 = IL RTK,	12 = MA RTK	13 =MN RTK	14 = NJ RTK,	15 = MI 293,
16 = FL RTK,	17 = PA RTK.			

Information given herein is offered in good faith as accurate, but without guarantee. Conditions of use and suitability of the product for particular uses are beyond our control; all risks of use of the product are therefore assumed by the user and we expressly disclaim all warranties of every kind and nature, including warranties of merchantability and fitness for a particular purpose in respect to the use or suitability of the product. Nothing is intended as a recommendation for uses, which infringe valid patents or as extending license under valid patents. Appropriate warnings and safe handling procedures should be provided to handlers and users.

Prepared by: Mobil Oil Corporation

Environmental Affairs and Toxicology Department, Princeton, NJ

For further information, contact:

Mobil Oil Corporation, Product Formulation and Quality Control, 3225 Gallows Road, Fairfax, VA 22037 (703) 849-3265

\*\*\*\*\* APPENDIX \*\*\*\*\*

For Mobil use only: (fill no: MTJ354\*M201) MHC: 1\* 1\* 0 0 1 PPEC: A US86-089 approve revised 04/18/86

Precautionary label text for packaged products:

Contains low viscosity oil

Caution

May cause skin irritation on prolonged, repeated skin contact.

Avoid prolonged or repeated contact that could effect the skin. Wash skin contact areas with soap and water.

Launder contaminated clothing before reuse. Avoid wearing of clothing soaked with fluid. Avoid prolonged inhalation of mists or vapors.

When use conditions are likely to result in excessive misting (greater than 5 MG/M3), provide adequate local ventilation or respiratory protection.

For industrial use only, not intended or suitable for use in or around a household or dwelling.

Attention:

Empty containers may contain product residue, including flammable or explosive vapors. Do not cut, puncture or weld on or near container. All label warnings and precautions must be observed until the container has been thoroughly cleaned or destroyed.

Refer to Product Material Safety Data Bulletin for further safety and handling information.

Mobil Oil Corporation, New York, NY 10017 CL-402 (1/86)

D.O.T. Shipping name: Not applicable

D.O.T. Hazard class: Not applicable

## YUMATE KC-663 PRODUCT DATE SHEET

### GENERAL DESCRIPTION:

YUMATE KC-663 is truly a revolutionary new water miscible synthetic coolant formulated for use in honing, grinding and machining of aluminum, cast iron and steel. YUMATE KC-663 has the lubricating properties of micro-emulsion products but does not contain oil!! This technology break through allows YUMATE KC-663 the great characteristics of a synthetic but the cutting lubricity of micro-emulsions. YUMATE KC-663 is highly recommended where the demand for a dependable low maintenance coolant is a must. YUMATE KC-663 is a great choice for general machining operations because of its excellent detergency, anti-corrosion and stable performance characteristics. YUMATE KC-663 is completely safe for machining aluminum and is non-staining, while exhibiting excellent tramp oil resistance and anti-foaming ability.

### BENEFITS OF USE:

1. Increased tool life.
2. Excellent detergency – low foaming formulation.
3. Excellent anti-corrosion properties.
4. Non-staining on aluminum.
5. More environmentally friendly – ease of disposal.
6. Low maintenance.
7. User friendly.

### USING PROCEDURES:

1. Machining	Aluminum	4% - 6%
	Cast Iron	4% - 6%
2. Grinding	Aluminum	2% - 4%
	Cast Iron	2% - 4%
	Steel	2% - 4%

### PROPERTIES:

Appearance (Concentrate).....Light Yellow Liquid.  
 (Diluted Solution).....Clear.  
 Solubility in Water.....100%.

## MATERIAL SAFETY DATA SHEET

### SECTION I

<u>Product name or number</u> (as it appears on label) YUMATE KC-663	<u>Date</u> October, 1999
<u>Manufacturer's Name</u> Yuma Industries Incorporated	<u>Emergency Phone #</u> YUMA 317-398-9862 CHEMTREC 800-424-9300
<u>Address (Number, Street, City, State, &amp; Zip Code)</u> 783 W. Mausoleum Road, Shelbyville, IN 46176-9720	
<u>Hazardous material description, proper shipping name, haz. class, haz. ID#</u> None	
<u>Additional hazard classes (as applicable)</u> None	
<u>Chemical family</u> Water miscible cutting and grinding fluid concentrate	<u>Formula</u> See Section II

### SECTION II - INGREDIENTS

<u>CAS Registry #</u>	<u>Wt%</u>	<u>Chemical Name(s)</u>	<u>Listed as a carcinogen in NTP, IARC, or OSHA1910(z) (specify)</u>
102-71-6	1-9	Triethanolamine ACGIH(TLV): TWA=5mg/m3,	Not listed
Balance classified as non-hazardous Ingredients			

### SECTION III – PHYSICAL DATA

<u>Boiling Point</u> Not available	<u>Specific Gravity</u> (H <sub>2</sub> O=1) @ 20°C 1.02	<u>Odor Threshold (ppm)</u> Not available
<u>Vapor Pressure</u> Not available	<u>Percent Volatile (Vol. %)</u> Not available	<u>Percent Solid (Wt. %)</u> Not available
<u>Vapor Density</u> Not available	<u>Evaporation Rate</u> Not available	<u>Freezing Point (°C)</u> Not available
<u>Solubility in Water</u> 100%	<u>pH</u> (4%) 9.6	<u>Material is</u> Liquid
<u>Appearance &amp; Odor</u> Yellow with mild odor	<u>Volatile Organic Compounds (VOC)</u> Not available	

**SECTION IV – FIRE AND EXPLOSION HAZARD DATA**

<u>Flash Point</u>	<u>Method Used</u>	<u>Flammable Limits</u>	<u>Auto-Ignition Temperature (°C)</u>
None		LEL/UEL Not available	Not available
<u>Extinguishing Media</u>			
As appropriate for surrounding fire			
<u>Special Fire Fighting Procedures</u>			
None			
<u>Unusual Fire and Explosion Hazards</u>			
None			

**SECTION V – HEALTH HAZARD DATA**

<u>Threshold Limit Value</u>			
See Section II			
<u>Effects of Overexposure – Conditions to avoid</u>			
Transient eye irritation. Possible skin defatting and subsequent irritation on repeated or prolonged contact.			
<u>Primary Routes of Entry</u>	Inhalation : :	Eye Contact: :	
	Skin Contact: X:	Ingestion : :	
<u>Emergency and First Aid Procedures</u>			
Eyes: Flush with cool, clean water for at least 15 minutes Skin: Wash with soap and warm water Inhalation: Remove to fresh air. Ingestion: If large quantities are ingested, pump stomach			
In every case get medical attention as required			

**SECTION VI – REACTIVITY DATA**

<u>Stability</u>	Unstable : :	Hazardous	May occur : :
	Stable : X :	Polymerization	Will not occur : X :
<u>Conditions to Avoid</u>			
None			
<u>Incompatibility (material to avoid)</u>			
Avoid strong oxidizing agents, strong acid and nitrites.			
<u>Hazardous Decomposition Products</u>			
Thermal decomposition may produce CO, CO <sub>2</sub> , NO <sub>x</sub> and SO <sub>x</sub> .			

**SECTION VII - SPILL OR LEAK PROCEDURES**

<u>Steps to be Taken in Case Material is Released or Spilled</u>	
Mop up or use dry absorbent.	
<u>Waste Disposal Method</u>	
Dispose in accordance with local, state and federal regulations	

### SECTION VIII – SPECIAL PROTECTION INFORMATION

<u>Respiratory Protection (specify type)</u>		
None		
VENTILATION:	<u>Local Exhaust (specify rate)</u>	<u>Special</u> _____
	<u>Not normally required</u>	<u>None</u> _____
	<u>Mechanical (general) (specify rate)</u>	<u>Other</u> _____
	<u>General room ventilation should be sufficient.</u>	<u>None</u> _____
<u>Protective Gloves (specify type)</u>	<u>Eye Protection (specify type)</u>	
None	Safety glasses	
<u>Other Protective Equipment</u>		
None		

### SECTION IX – SPECIAL PRECAUTIONS

<u>Precautions to be Taken in Handling and Storing</u>
Keep container closed.
Wash thoroughly after handling.
<u>Other Precautions</u>
None



# MATERIAL SAFETY DATA SHEET

## SECTION I

<u>Product name or number</u> (as it appears on label)		<u>Date</u>
YUMATE SC-870C		March, 1995
<u>Manufacturer's Name</u>		<u>Emergency Phone #</u>
Yuma Industries Incorporated		CHEMTREC 800-424-9300
<u>Address (Number, Street, City, State, &amp; Zip Code)</u>		
783 W. Mausoleum Road, Shelbyville, IN 46176-9720		
<u>Hazardous material description, proper shipping name, haz. class, haz. ID#</u>		
None		
<u>Additional hazard classes (as applicable)</u>		
None		
<u>Chemical family</u>		<u>Formula</u>
Water miscible cutting and grinding fluid concentrate		See Section II

## SECTION II - INGREDIENTS

<u>CAS Registry #Wt%</u>	<u>Chemical Name(s)</u>	<u>Listed as a carcinogen in NTP, IARC, or OSHA 1910(z) (specify)</u>
9003-11-6	20-39 Polyalkylenglycol	Not listed
102-71-6	10-19 Triethanolamine	Not listed
67254-79-9	10-19 Fatty acids	Not listed
141-43-5	1-9 Monoethanolamine ACGIH-TLV/TWA=8mg/m3, STEL=15mg/m3	Not listed
9002-98-6	1-9 Polyethyleneimine	Not listed
11113-50-1	1-9 Boric acid	Not listed
34375-28-5	1-9 2 [(hydroxymethyl) amino] ethanol	Not listed
Balance Water		

## SECTION III – PHYSICAL DATA

<u>Boiling Point</u>	<u>Specific Gravity</u>	<u>Odor Threshold (ppm)</u>
Not available	(H <sub>2</sub> O=1) @ 20°C 1.07	Not available
<u>Vapor Pressure</u>	<u>Percent Volatile (Vol. %)</u>	<u>Percent Solid (Wt. %)</u>
Not available	Not available	Not available
<u>Vapor Density</u>	<u>Evaporation Rate</u>	<u>Freezing Point (°C)</u>
Not available	Not available	Not available
<u>Solubility in Water</u>	<u>pH=</u>	<u>Material is</u>
100%	10% solution 8.5	Liquid
<u>Appearance &amp; Odor</u>	<u>Volatile Organic Compounds (VOC)</u>	
Fluorescent with mild odor	Not available	

**SECTION IV – FIRE AND EXPLOSION HAZARD DATA**

<u>Flash Point</u>	<u>Method Used</u>	<u>Flammable Limits</u>	<u>Auto-Ignition Temperature (°C)</u>
None		LEL/UEL Not available	Not available
<u>Extinguishing Media</u>			
As appropriate for surrounding fire			
<u>Special Fire Fighting Procedures</u>			
None			
<u>Unusual Fire and Explosion Hazards</u>			
None			

**SECTION V – HEALTH HAZARD DATA**

<u>Threshold Limit Value</u>
See Section II
<u>Effects of Overexposure – Conditions to avoid</u>
Transient eye irritation. Possible skin defatting and subsequent irritation on repeated or prolonged contact.
<u>Primary Routes of Entry</u>
Inhalation : :                      Eye Contact: : Skin Contact: X:                      Ingestion : : :
<u>Emergency and First Aid Procedures</u>
Eyes: Flush with cool, clean water for at least 15 minutes Skin: Wash with soap and warm water Inhalation: Remove to fresh air. Ingestion: If large quantities are ingested, pump stomach
In every case get medical attention as required

**SECTION VI – REACTIVITY DATA**

<u>Stability</u>	Unstable : :                      Hazardous                      May occur : : Stable : X :                      Polymerization                      Will not occur : X :
<u>Conditions to Avoid</u>	
None	
<u>Incompatibility (material to avoid)</u>	
Avoid strong oxidizing agents, strong acid and nitrites.	
<u>Hazardous Decomposition Products</u>	
Thermal decomposition may produce CO, CO <sub>2</sub> , NO <sub>x</sub> and SO <sub>x</sub> .	

**SECTION VII - SPILL OR LEAK PROCEDURES**

<u>Steps to be Taken in Case Material is Released or Spilled</u>
Mop up or use dry absorbent.
<u>Waste Disposal Method</u>
Acid – Alum split: Dispose of in accordance with local, state and federal regulations

### SECTION VIII – SPECIAL PROTECTION INFORMATION

<u>Respiratory Protection (specify type)</u>		
None		
VENTILATION:	<u>Local Exhaust (specify rate)</u>	<u>Special</u> _____
	Not normally required	<u>None</u> _____
	<u>Mechanical (general) (specify rate)</u>	<u>Other</u> _____
	General room ventilation should be sufficient.	<u>None</u> _____
<u>Protective Gloves (specify type)</u>	<u>Eye Protection (specify type)</u>	
None	Safety glasses	
<u>Other Protective Equipment</u>		
None		

### SECTION IX – SPECIAL PRECAUTIONS

<u>Precautions to be Taken in Handling and Storing</u>
Keep container closed. Wash thoroughly after handling.
<u>Other Precautions</u>
None