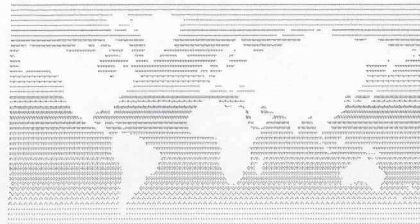


ROTTLER
MANUFACTURING

HP5
HONING MACHINE

MACHINE SERIAL NUMBER

OPERATIONS AND MAINTENANCE
MANUAL



MANUFACTURED BY:

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**NOTE: WHEN ORDERING REPLACEMENT PARTS,
PLEASE GIVE THE MODEL AND SERIAL NUMBER.**

**ORDER TAKEN 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 HP5 honing machine read this manual. Pay close attention to the chapter concerning safety.

Description:

The model HP5 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 HP5 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 day period are the customers responsibility.

Safety Information:

CAUTION:

This machine is capable of causing severe bodily injury.

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 HP5 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 HP5 Honing Machine.

Rottler HP5 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 HP5 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 HP5 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 (514-3-3D). 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 HP5 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 HP5 machine the air supply must be moisture free. If there is any doubts about the air supply install a water trap

Power Supply:

Disconnect all power before servicing this machine.

This machine requires 208-230 volt AC three phase 50 or 60 Hertz power. (see the wiring diagram for the HP5 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 three phase hookup).

CAUTION:

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

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).

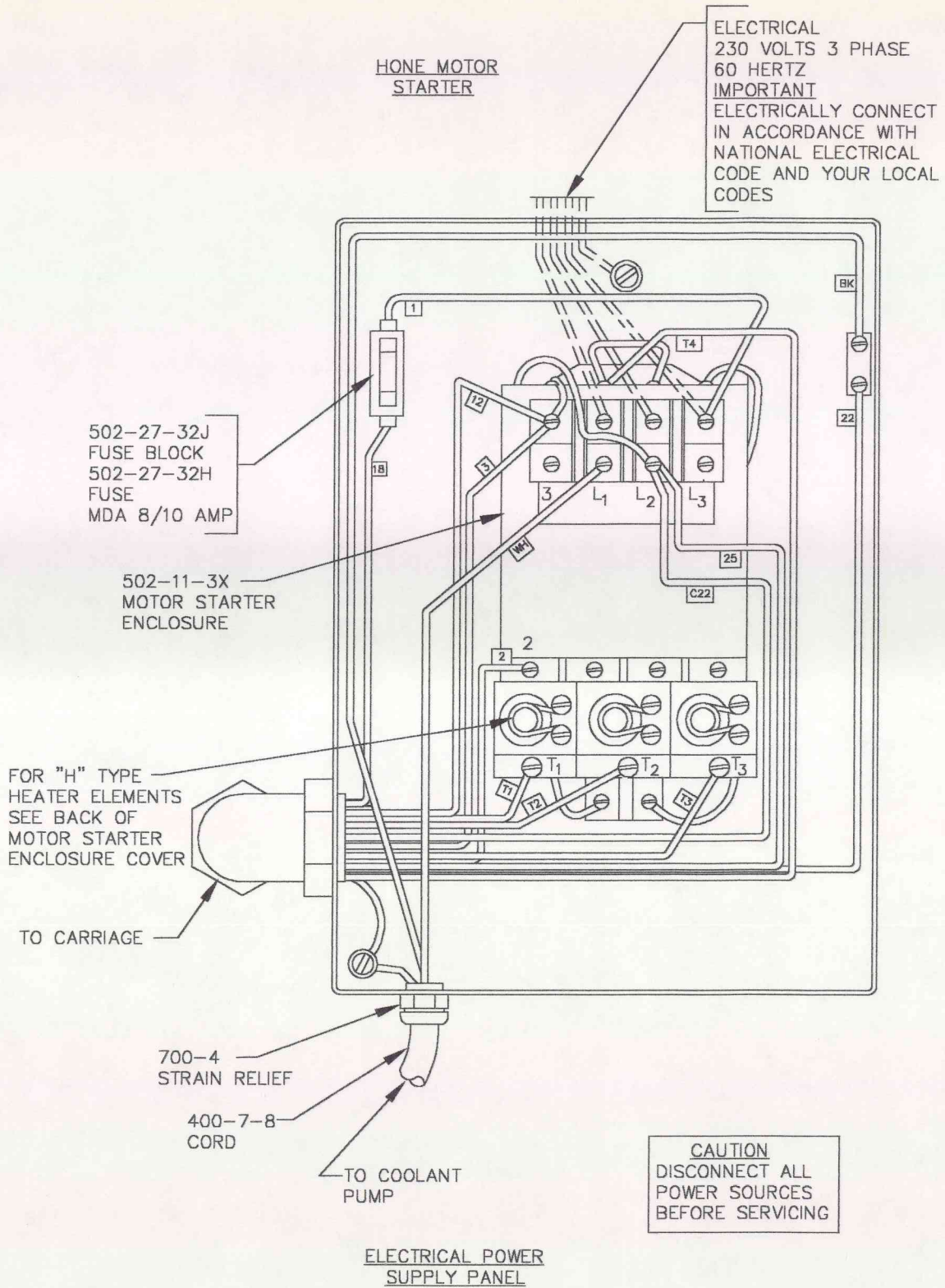
Coolant Pump System:

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

* * * * *

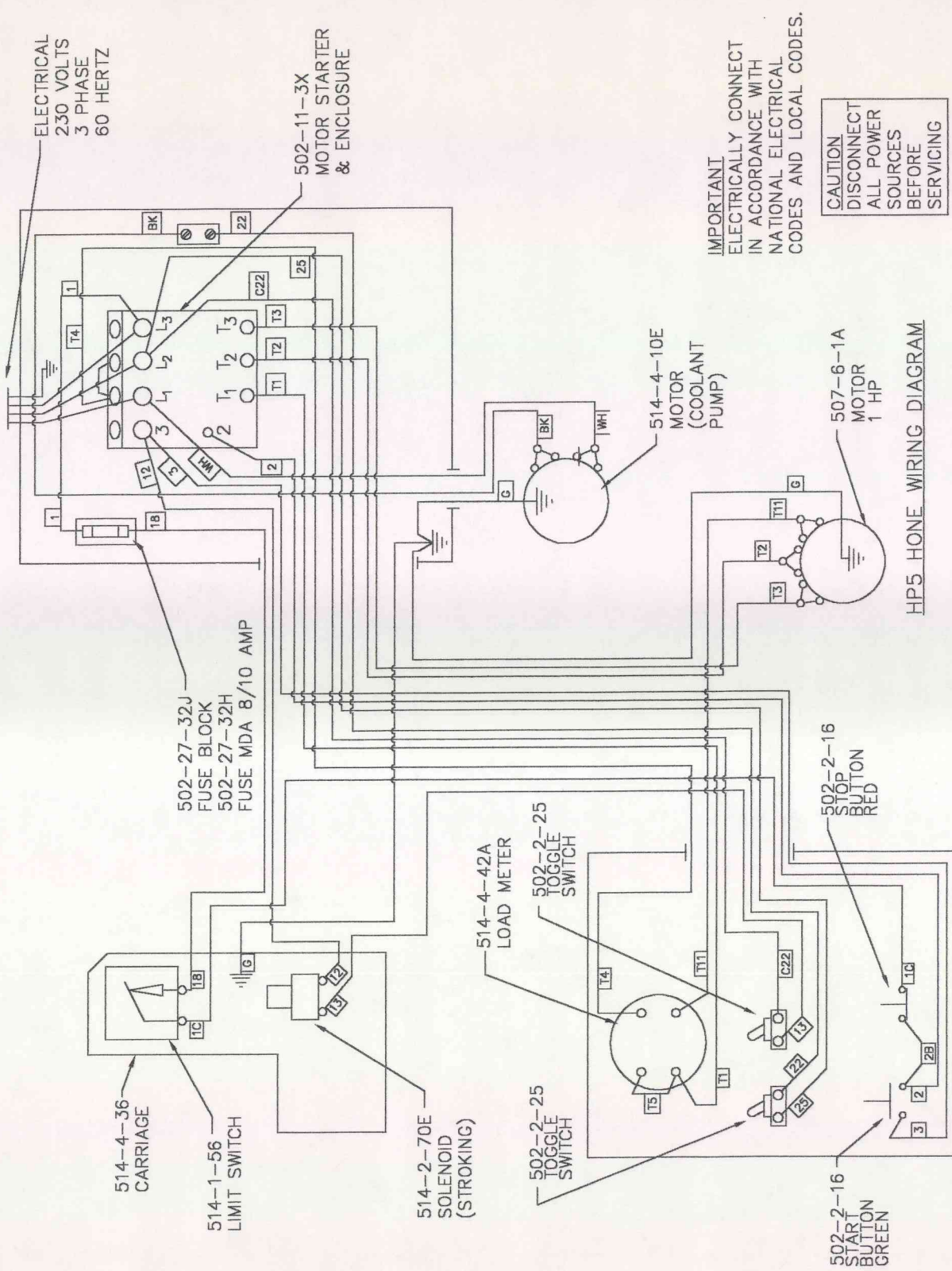
Three Phase Electrical Hook-up:

REFINES-36-012098



Wiring Diagram:

REFHMS-35--012098



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

CAUTION
DISCONNECT
ALL POWER
SOURCES
BEFORE
SERVICING

HP5 HONE WIRING DIAGRAM

The following information describes the sequence of control actions.

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.

Start / Stop Buttons:

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

Stroking Toggle Switch:

Switching the stroking toggle 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 toggle is switched, or the 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 reservoirs 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.

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, located on the right side of the carriage, 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.

Coolant Toggle Switch:

The coolant toggle switch is located on the control panel. This toggle switch 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.

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 handwheel, at the end of the rocker arm. This is a numbered band around the handwheel. With the number 1 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.

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.

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.

NOTE:

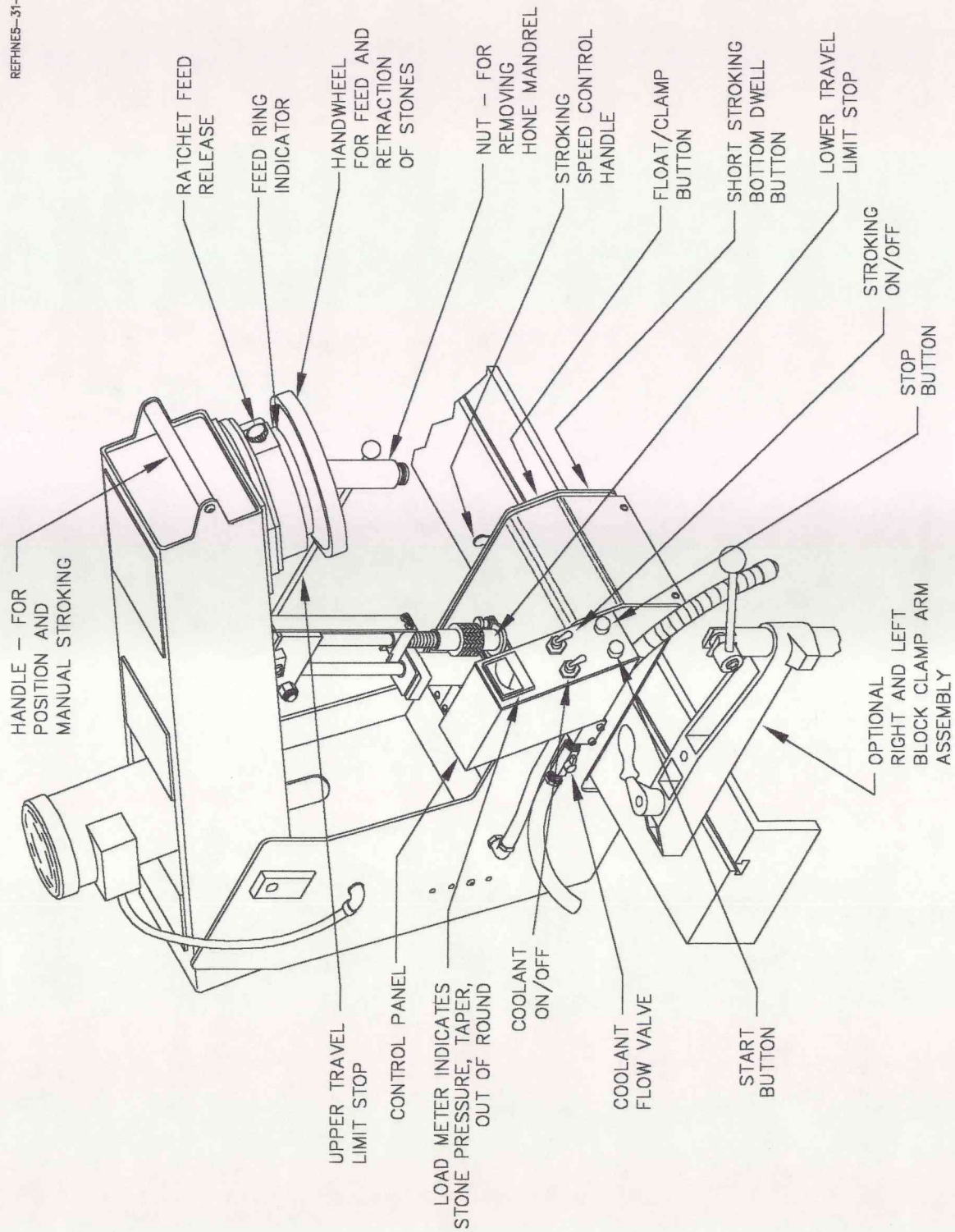
The lower limit lever must be set first.

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

* * * * *

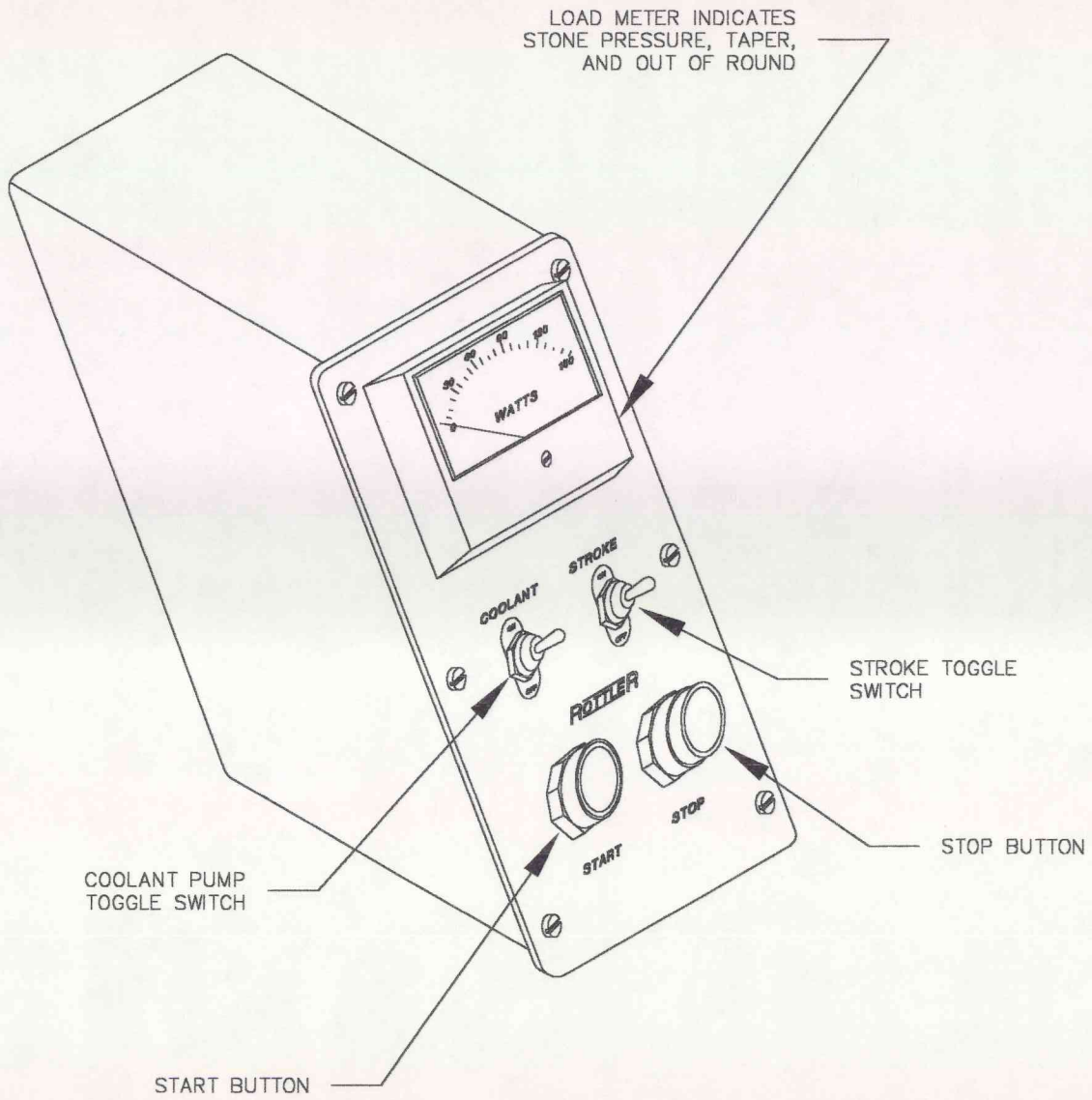
Control Illustration:

REFHNS-31-012098



Control Panel Illustration:

REFINED-41-012888



Operating The HP5:

Honing in General

The Rottler HP5 hone is designed to remove approximately .0012" diameter from a 4" diameter x 6" long cast iron bore, in about 30 seconds. Finer grit stones should be used if you require better than a 20 micro inch finish.

To remove more stock from the cylinder bore, change to 80 grit stones. Eighty grit stones should remove about .004" dia. per minute in a 4" dia. x 6" long cast iron bore.

Many cylinders have obstructions that will prevent the proper hone stone extension. You must have at least 1/2" of hone stone extending past the bottom of the cylinder bore. Be sure all cylinder bores are completely clear of webs or other obstructions. *Grind them away if necessary.*

The stones and guides will become tapered if they do not stroke through the bore by at least 1/2". Allow 3/4" to 1" of the stones to stroke past the top of the cylinder bore also. The stones and guides can be trued up straight again, if they are not too badly tapered, by honing a fresh bored hole using proper top and bottom extension.

While the HP5 is running, pay attention to the load meter. Control your power stroking with dwelling to stabilize the load meter. You will find the load meter provides excellent information on sizing the bore. A fluctuation of the meter indicates a small area in the bore. The highest reading indicates the tightest spot. For example: if the stroke is at the bottom of the bore and the meter reads higher than when it is at the middle or top of the bore, it means the hole is a slightly smaller diameter near the bottom. The same is true for the top and middle of the bore.

If the meter indicates a bore is small at the bottom, hold down the button 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 meter indicates a bore is small at the top, switch the stroke toggle to turn off the stroking at the top of the bore. The hone head will continue to turn. Switch the stroke toggle 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 the stroking speed back up to the desired speed.

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

A barrel shaped bore can usually be eliminated by using 3" stones. Four inch stones can easily be trimmed down. Remove 1" from the top of the stones with a bench grinder.

Generally these stone grits will produce the following micro finish in a cast iron cylinder block.

Grit	R.M.S.
80	80-95
180	30-35
220	20-26
320	18-22
400	10-15
600	5-10

Honing Procedures:

Block Loading:

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. Place supports flat for blocks with main bearing caps recessed above the pan rail.

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. The workpiece should be level across the head mounting surface. 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.

Hone Head Positioning:

Press float button to float the hone carriage. Position hone head over the first hole. Release float button to clamp.

Lower Travel Limit Setting:

Expand or contract the stone assembly to the approximate bore size. To expand; turn handwheel

counter clockwise (looking from the top). To contract; pull and turn ratchet feed release, turn handwheel clockwise (looking from the top).

Check for possible interference points in the lower part of all cylinders. Release both upper and lower stop levers. Lower hone head into a cylinder and position at lowest point of stroke.

NOTE:

Stones and guides should have approximately 3/4" through stroke. If there is interference the over travel can be reduced.

At this position expand stones lightly against cylinder walls to hold rocker arm. Raise the lower stop until it rests on the rocker arm. then clamp it.

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

CAUTION:

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

Upper Travel Limit Setting:

Release stone pressure by pulling and turning ratchet feed release, then turn hand wheel clockwise. Raise hone head until stones extend about 1" out of the top of the block. Lock upper stroke limit. Do not over tighten.

Feed Indicator Ring:

Set the total amount of material to be removed, by using the feed ring located above the handwheel. Just below the handwheel 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 operating range*).

Each mark on the feed ring represents .001 of the diameter of the bore. Each ratchet click also represents .001 on the diameter. Turn the feed ring to the number corresponding to the amount of material you want to remove, after the motor load is brought up to desired load. The movement of the feed ring will give an indication of how much material has been removed and how much is still to be removed.

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

NOTE:

When using the optional precision hone head (see page 6.9) each mark on the feed ring and each ratchet advance is .0003 on diameter

The following honing examples were taken in a GMC block with a 4" diameter bore and a 5-7/8" length of bore. This test was done using a standard hone head. These results will vary with stone hardness, honed material etc.

Rough honing, .010 stock diameter removal, 80 grit stones in a cast iron block. Feed ring was set to 17.

Finish honing, .002 diameter stock removal, 180 grit stones in a cast iron block. Feed ring was set to 3.

Start Honing:

Press start button. This will start the hone head turning. Using the hand wheel feed out the stones until there is some pressure in the cylinder. Switch the coolant toggle, be sure the coolant is flowing directly into the hole being honed. Switch the stroke toggle, as the machine is stroking, bring the motor load up to the desired load using the motor load meter. (Approximately 60% to start with). After the machine is brought to the desired load, set the stroking speed, by turning the handle on the right

side of the carriage.

To operate the feed, grasp the handwheel and turn it counter clockwise.

Motor Load:

To start with try to keep the motor load at around the 60 - 70 percent range. (This is done by adjusting the stone feed out pressure). As the experience level increases the operator will get a feel for where the optimum motor load is, for your particular circumstances. If the motor load goes too high, pull the ratchet feed release knob and turn the hand wheel clockwise slightly to reduce motor load. It is undesirable to let the motor load go too high, as the hone head will jam into the cylinder.

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.

Checking the Size of the Bore:

To check bore size, first reduce stone pressure. Press the 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.

Hone Cycle Complete:

After the bore is finished, reduce the stone pressure. Press the stop button, the machine will stop at the top of the stroke. Release the stone pressure fully. Place left hand on rocker arm handle release upper travel limit lever. Press float button to float and move to next cylinder. Repeat honing operation for all remaining cylinders.

Finish Plateau:

If a plateau is required after bore is brought to size, continue honing for approximately 6 to 10 strokes at a 20% reduction in stone pressure.

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 switch the stroke toggle. Use the start / stop buttons 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 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 screw driver 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.

The heavy duty head loses 1/8" of the over-travel with the stone jacket making the situation more difficult.

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.

* * * * *

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. There is a grease fitting located inside the handwheel at the top. 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 *F2 multipurpose grease*, or *Unoba F1 grease*, or equivalent.

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 rear of the gear housing. The oil level should be up to this hole. If oil is needed, lower rocker arm and add oil to this hole. Use *Valvoline 30 weight 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 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 *shell oil 'Tellus #32'* or *Mobil S.T.E., light oil*. Or *any equivalent, highly refined, turbine, or hydraulic S.A.E #10 or lighter petroleum oil (non-detergent) with a medium aniline point (astm oil #2)*.

CAUTION:

Only use an 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.

Inline Air Filter

A disposable inline air filter is installed in the air control circuit line. Remove and replace this filter when the element turns a red color.

NOTE:

Install new filter with arrow pointed in direction of air flow.

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 30 gallons max. of Mobil Met 33 or Upsilon or any equivalent light honing oil.***

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 5.15)

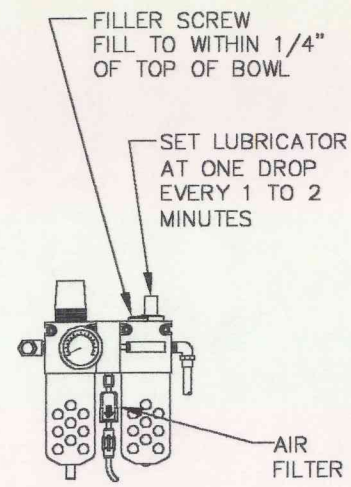
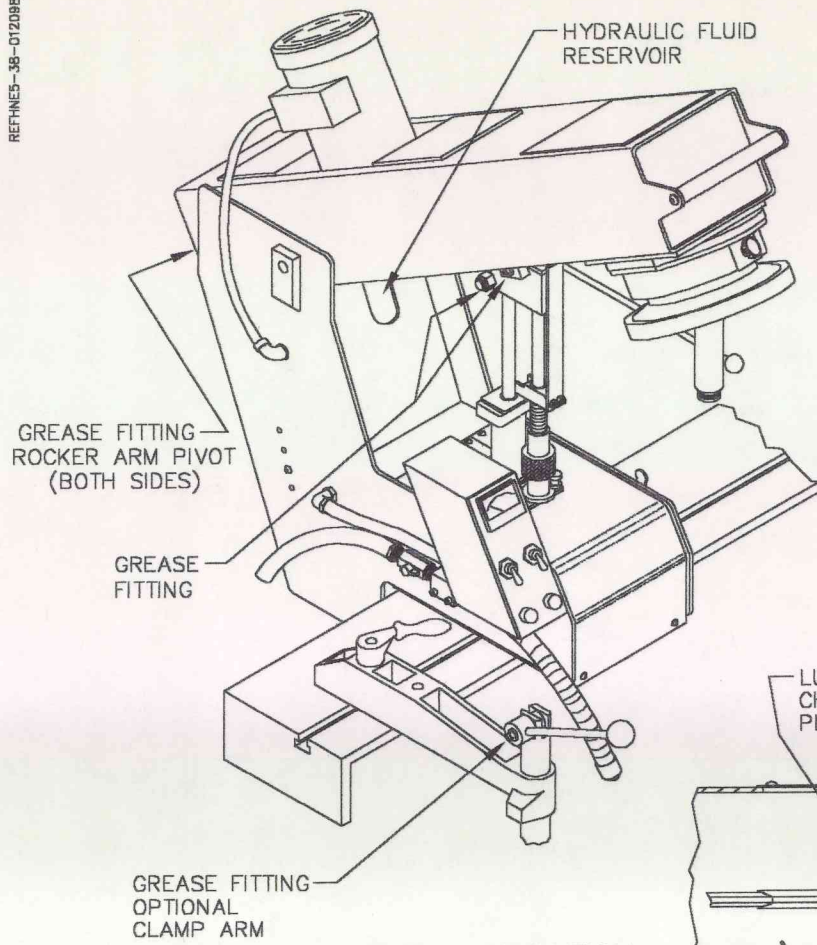
The exhaust muffler, on the main stroking system, must be replaced periodically. If hone loses power in the stroking operation it could be caused by a dirty exhaust muffler.

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.

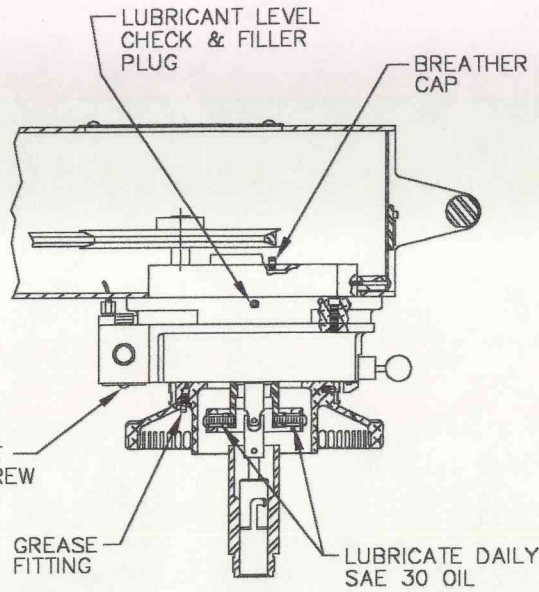
NOTE: Older models have 2 brass mesh exhaust mufflers, located inside the rear of the carriage. These filters may be removed, rinsed with denatured alcohol, and reinstalled.

Lubrication Illustration:

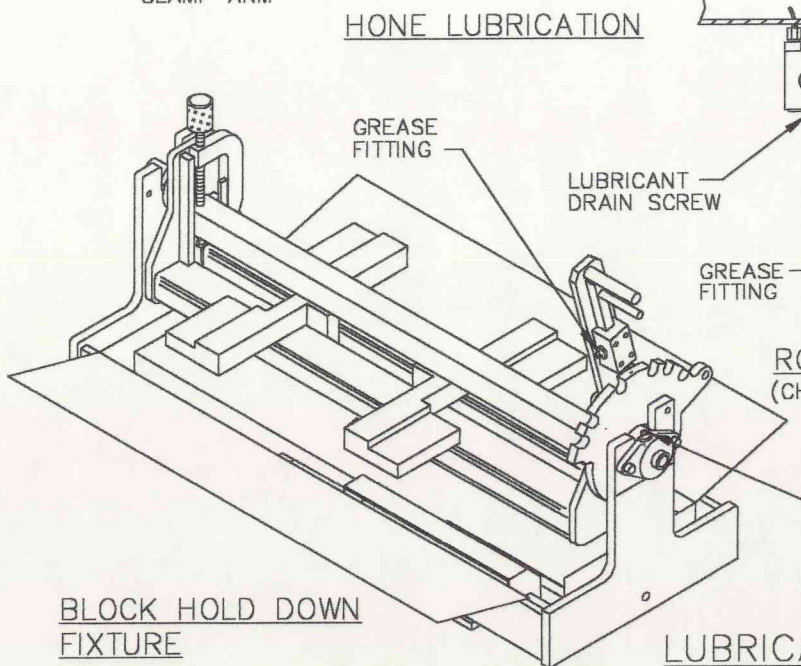
REFINES-38-D1Z098



REGULATOR & LUBRICATOR



ROCKER ARM GEAR BOX
(CHECK IN HORIZONTAL POSITION)



BLOCK HOLD DOWN FIXTURE

LUBRICATION

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

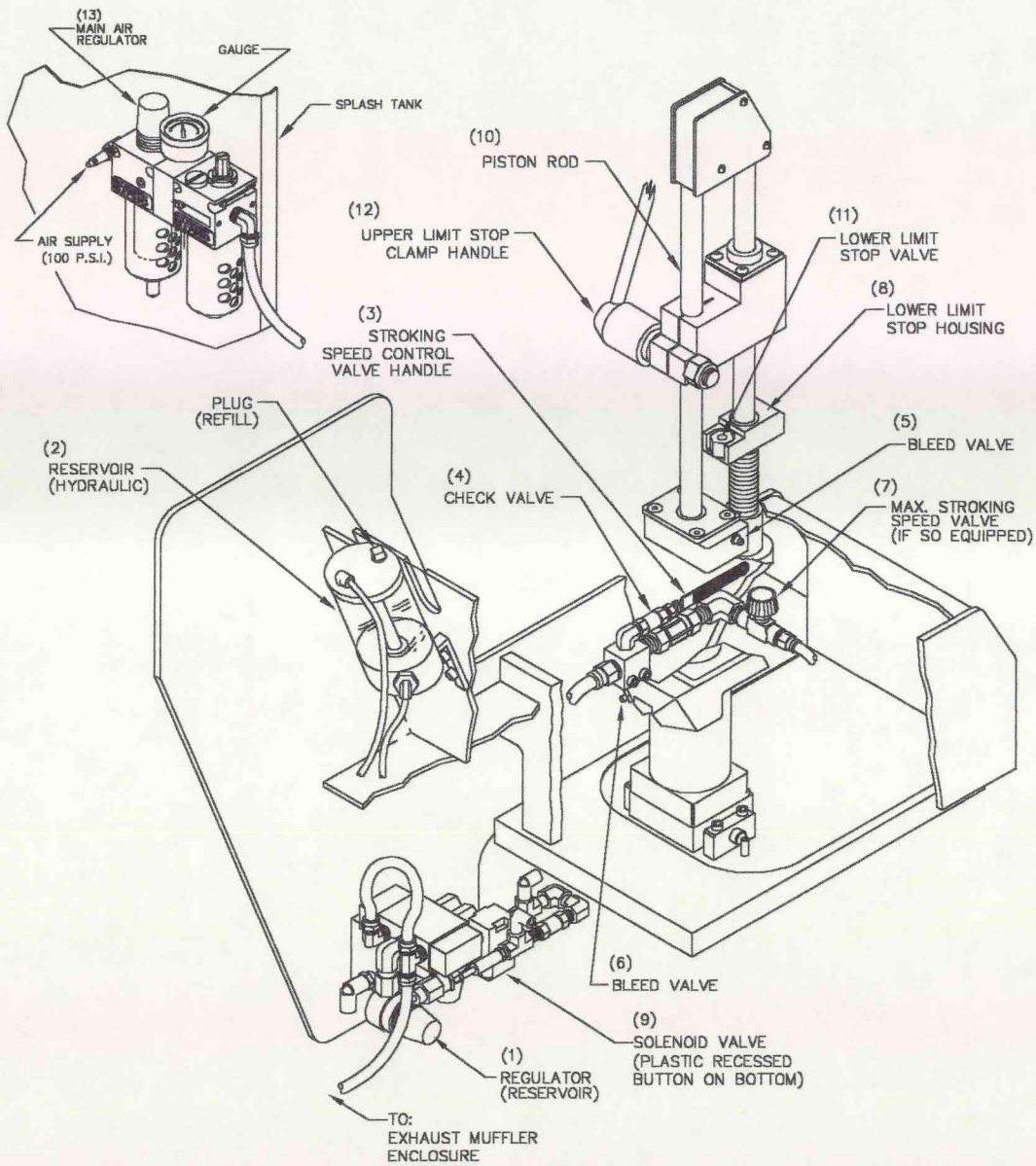
pressing the float button on the side of the carriage. Relock regulator by pushing in.

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:

REF-115-4-110897



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 conduit clamp on the left side at the back of the rocker arm. 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:

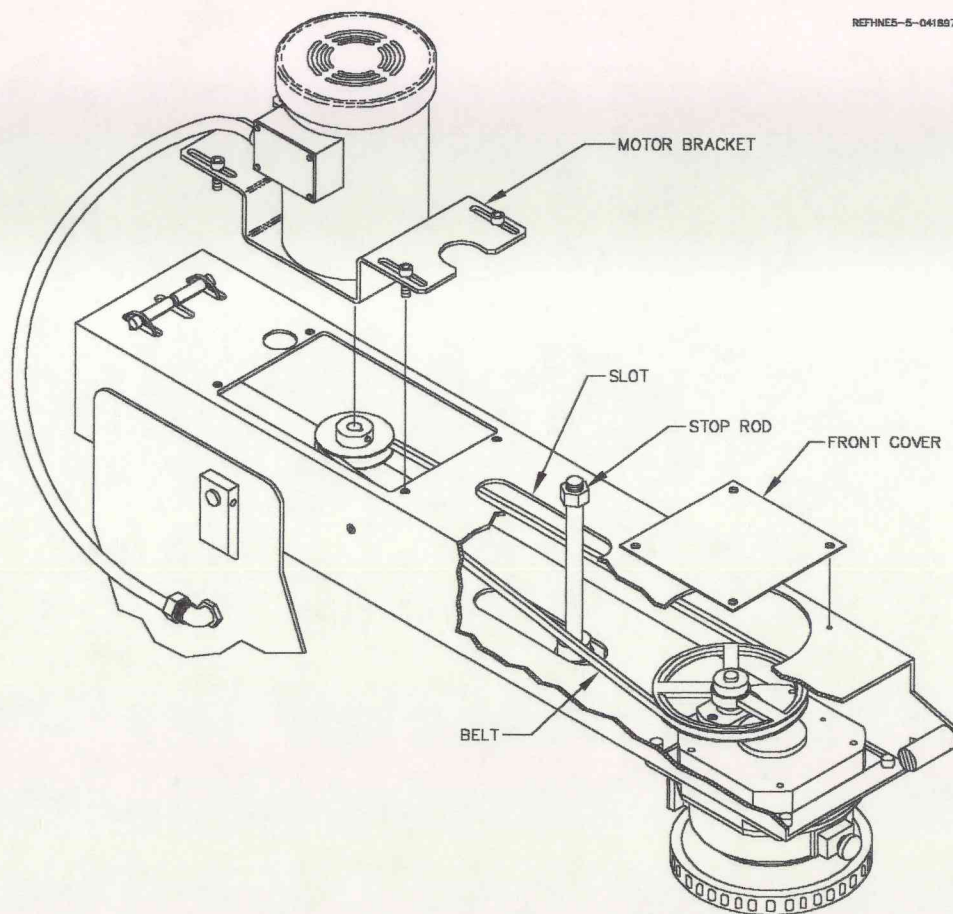
Do not over tighten belt.

Tighten the motor mounting plate. Tighten the conduit clamp. 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 conduit clamp on the left side at the back of the rocker arm. 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 handwheel.

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" button head capscrews. On reassembly of the universal joint make sure all screws are tight.

Remove the six socket head capscrews 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 handwheel, 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 screw in the handwheel hub. Remove handwheel 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 handwheel.

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

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.

Reassembly is the reverse. 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.

* * * * *

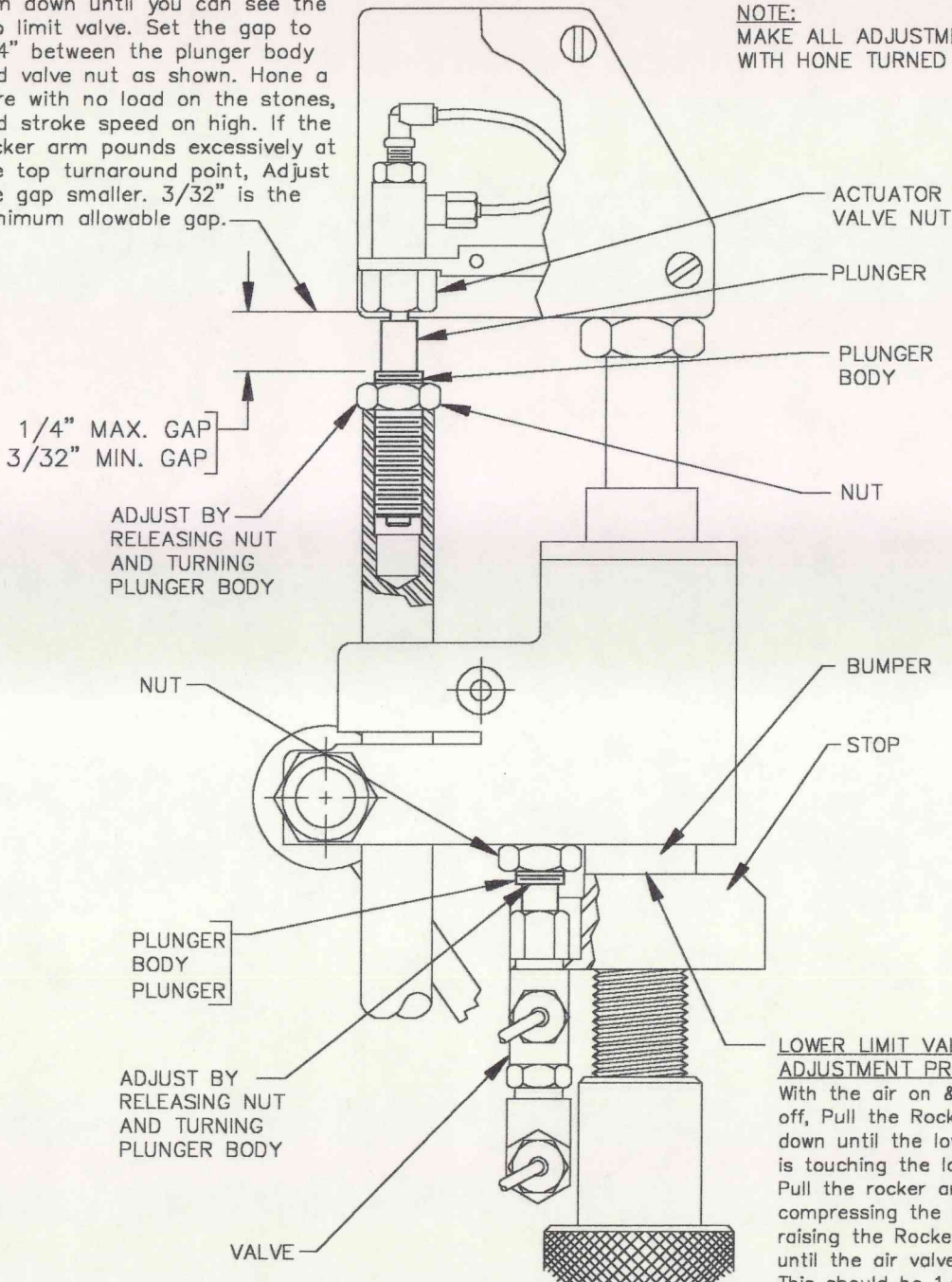
Upper and Lower Limit Valves Adjustment: (With Lower Bumper Spring)

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.

REFINES-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

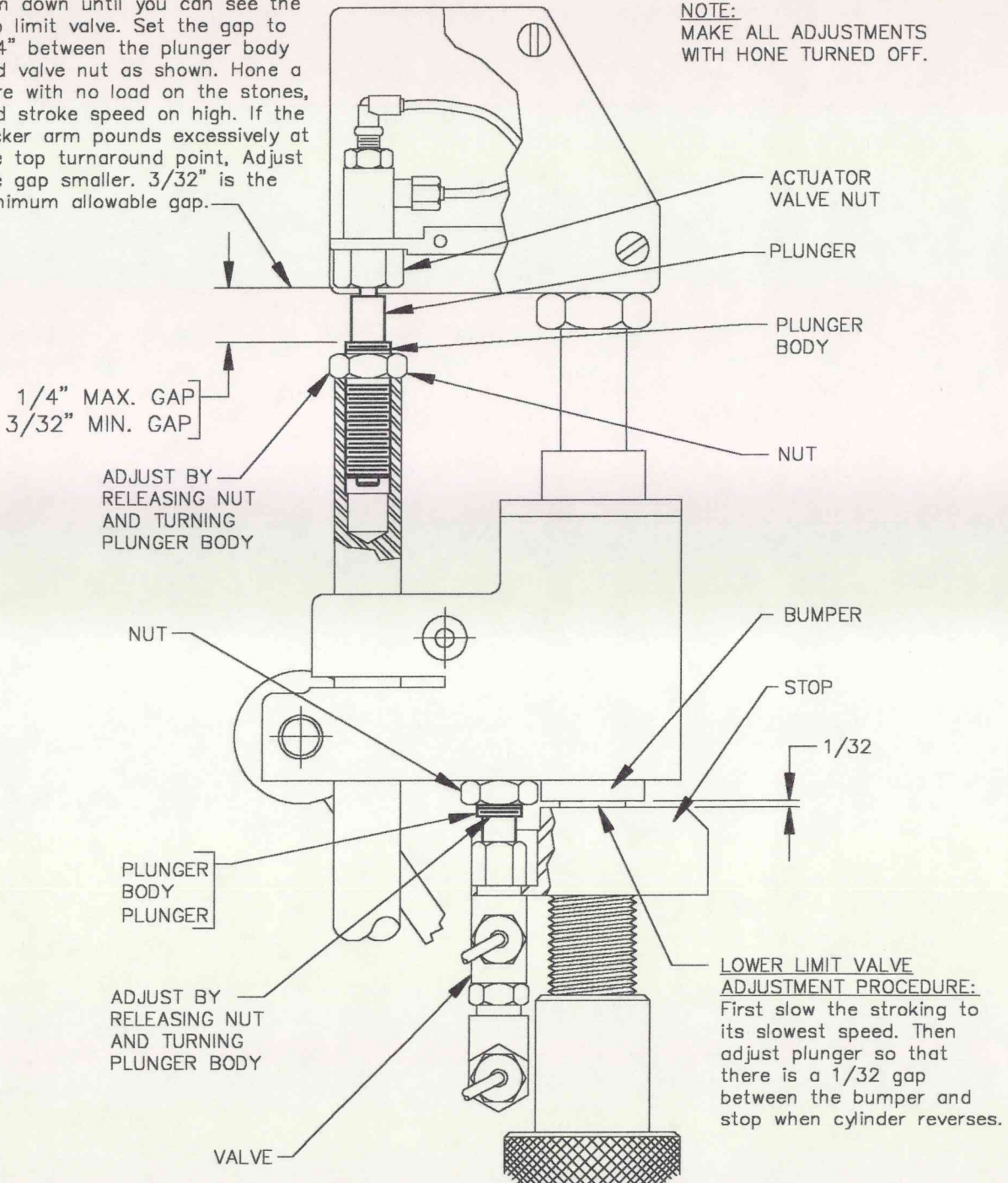
Upper and Lower Limit Valves Adjustment: (Without Lower Bumper Spring)

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.

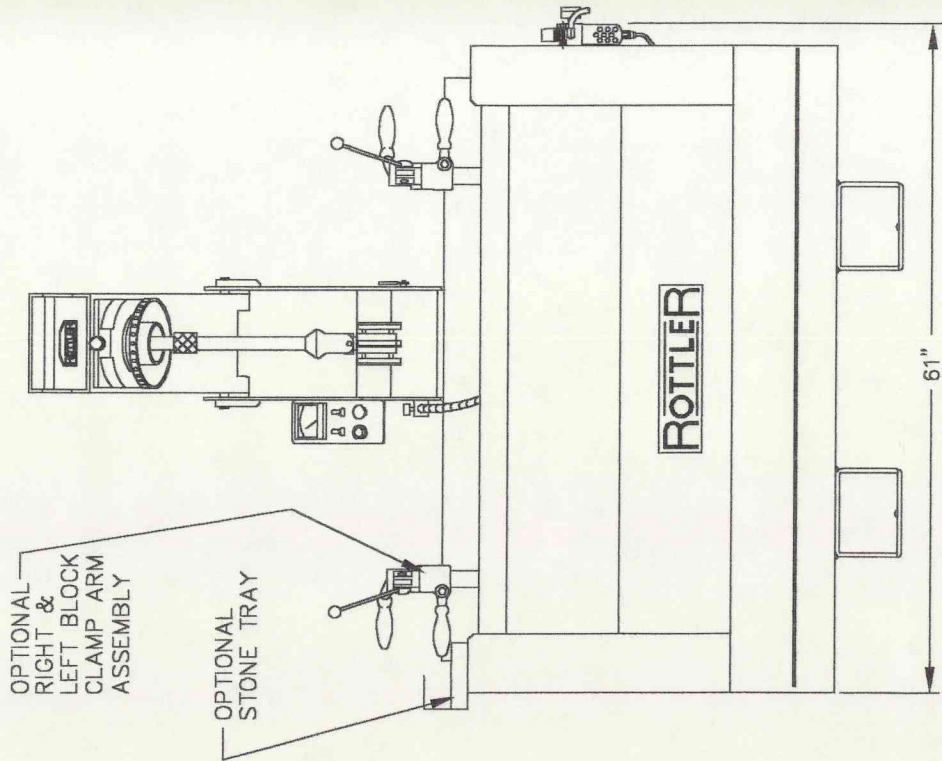
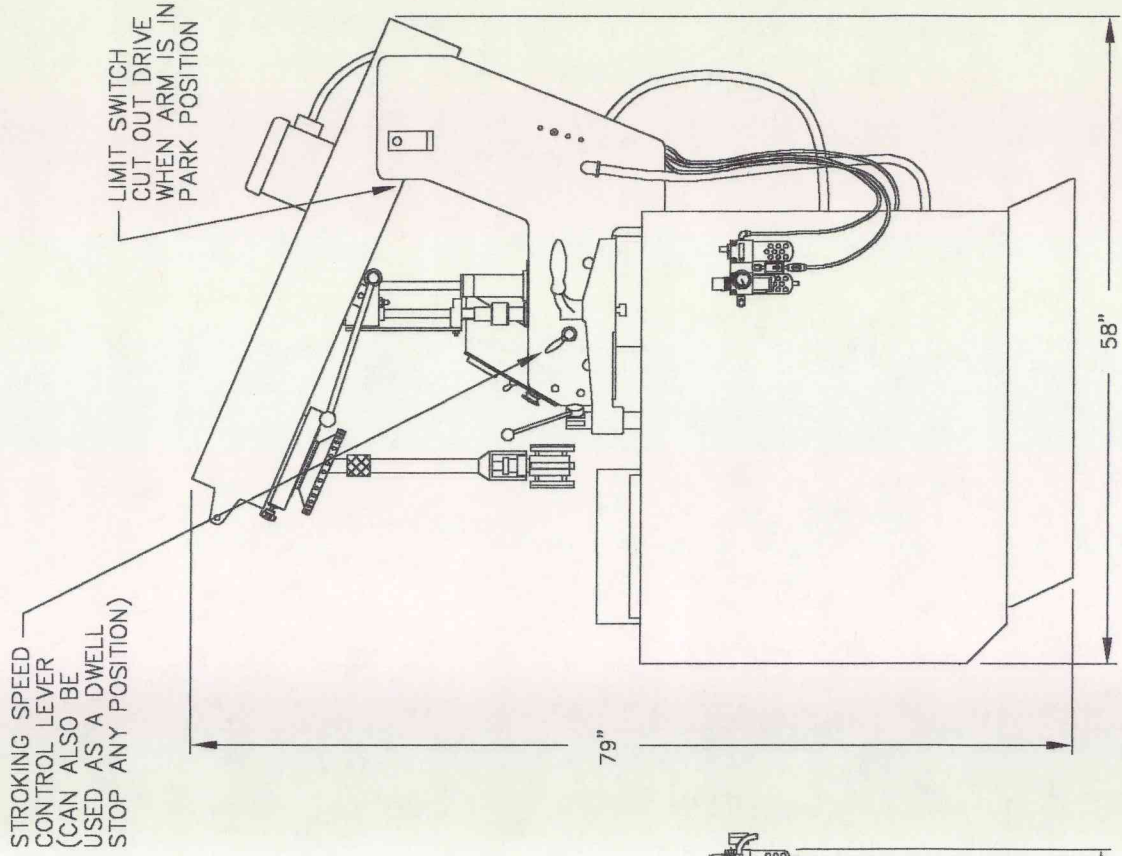
REFINES-6-041897



UPPER AND LOWER
LIMIT VALVES ADJUSTMENT
WITHOUT LOWER BUMPER SPRING

Front / Right Side View:

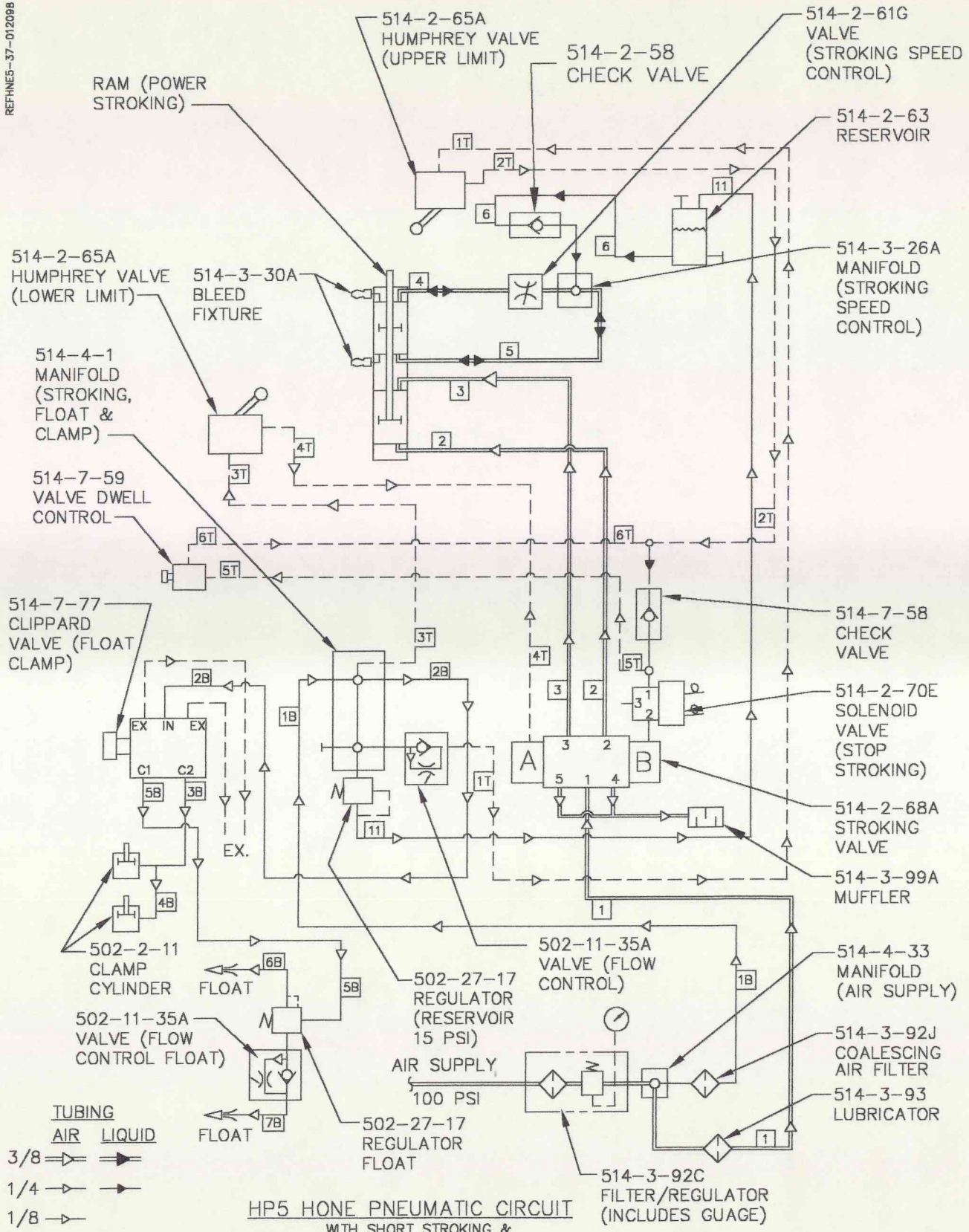
REFHNE5-26-011898



HP5 HONE

Pneumatic Circuit Diagram:

REFHNE5-37-012098



HP5 HONE PNEUMATIC CIRCUIT
WITH SHORT STROKING &
CLIPPARD (FLOAT/CLAMP)

TUBING

AIR LIQUID

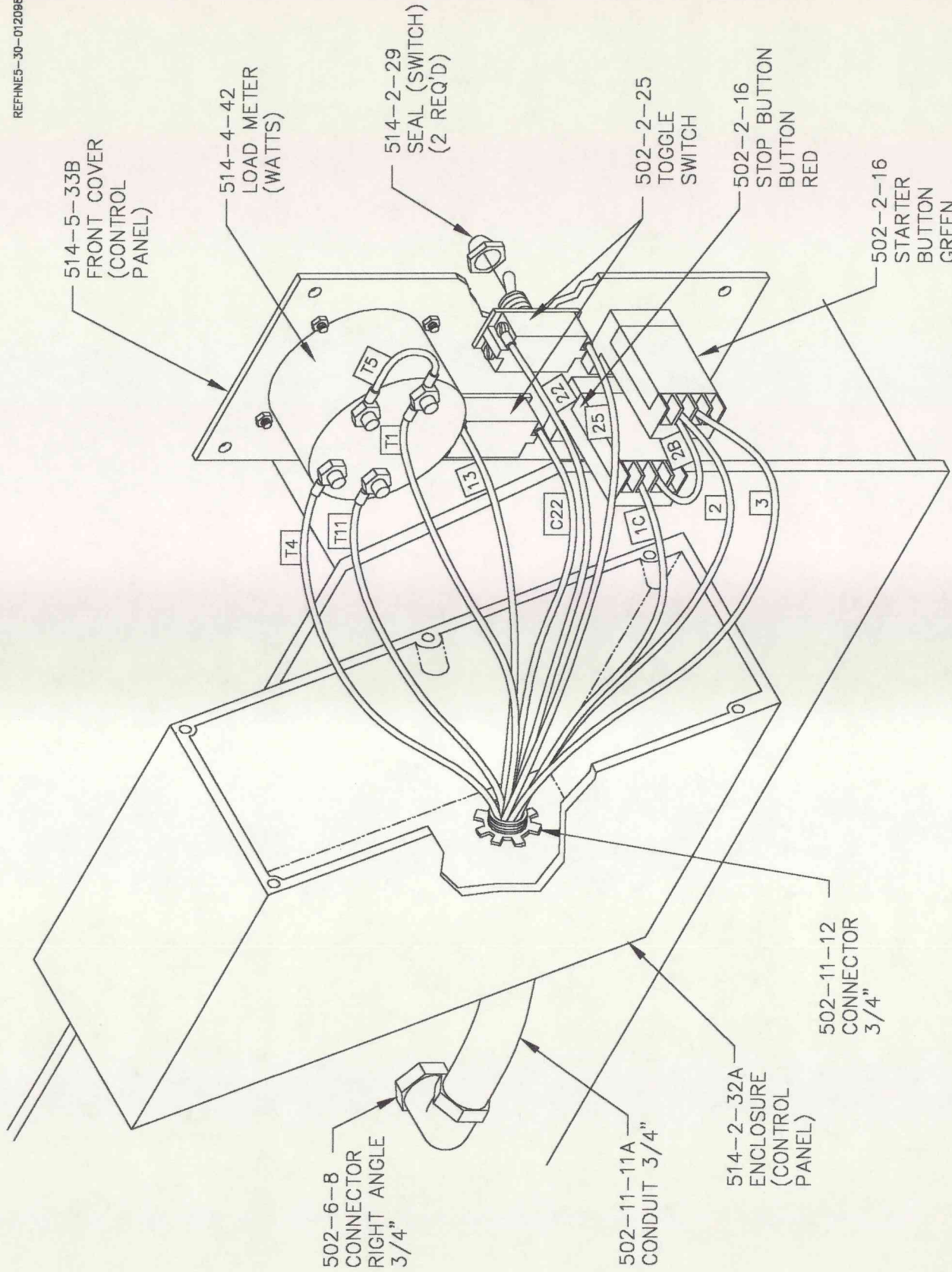
3/8 —> —>

1/4 —> —>

1/8 —> —>

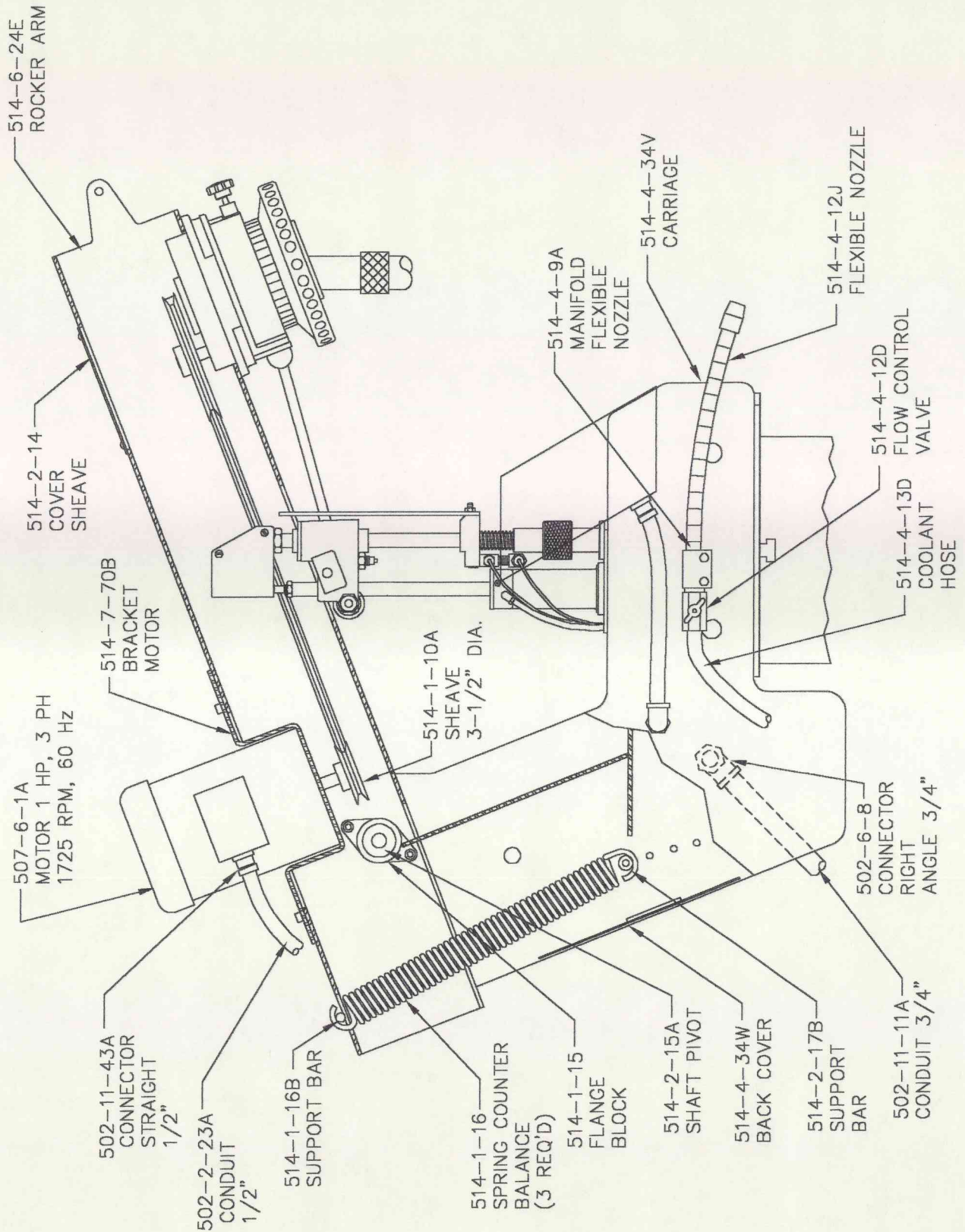
Control Panel:

REFINE5-30-012098



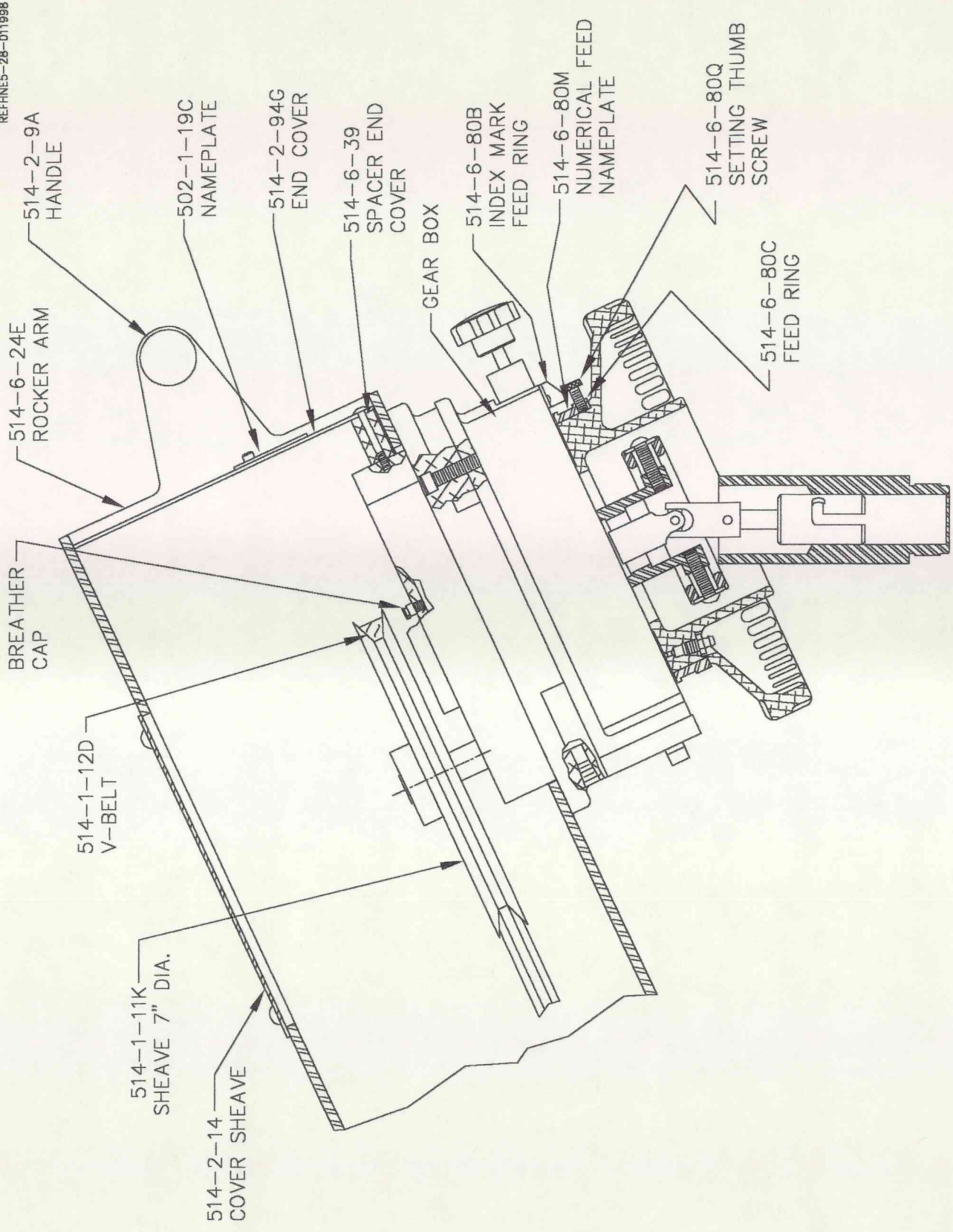
Carriage:

REFHNE5-29-011998



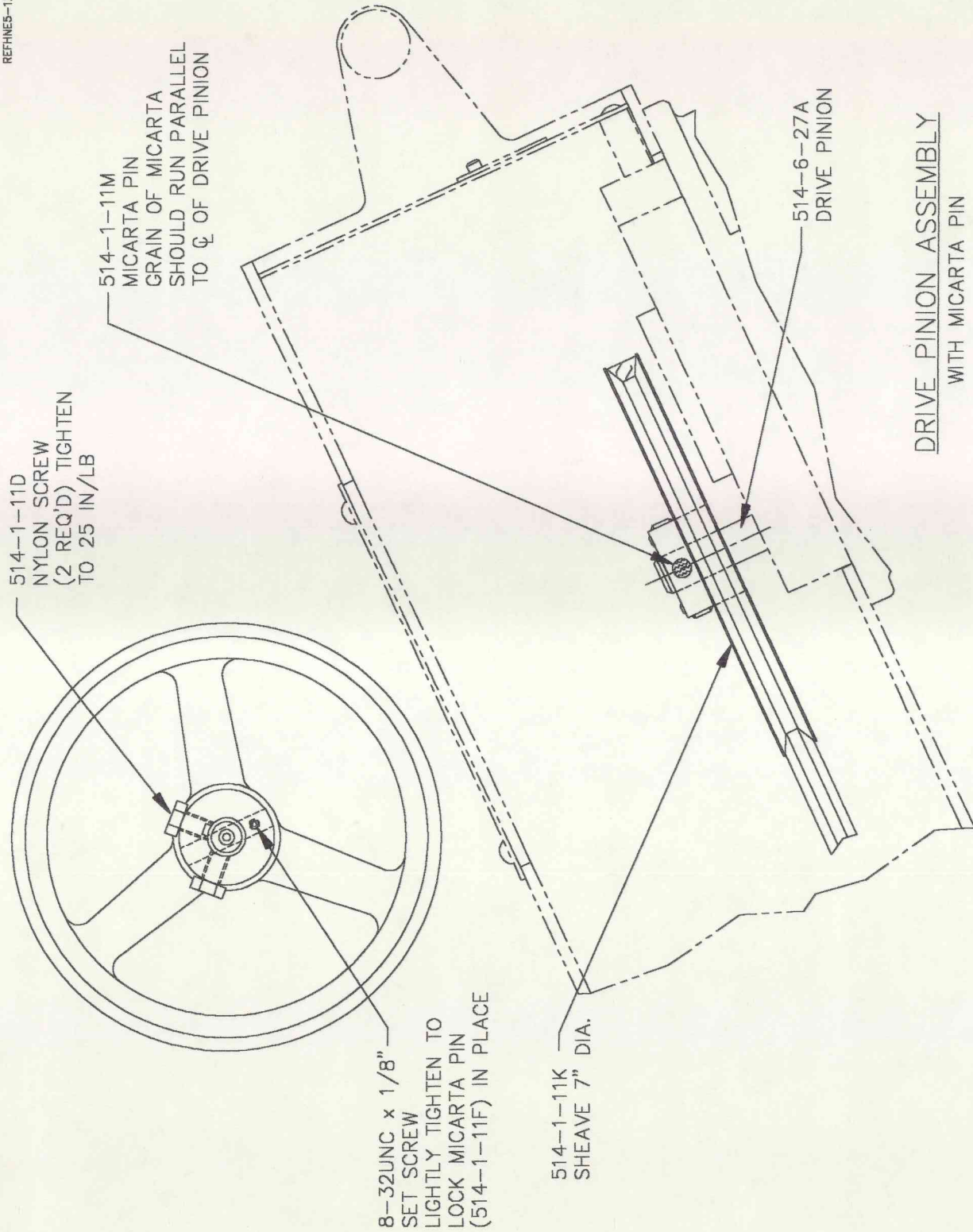
Front Section Rocker Arm:

REFINED-28-011998



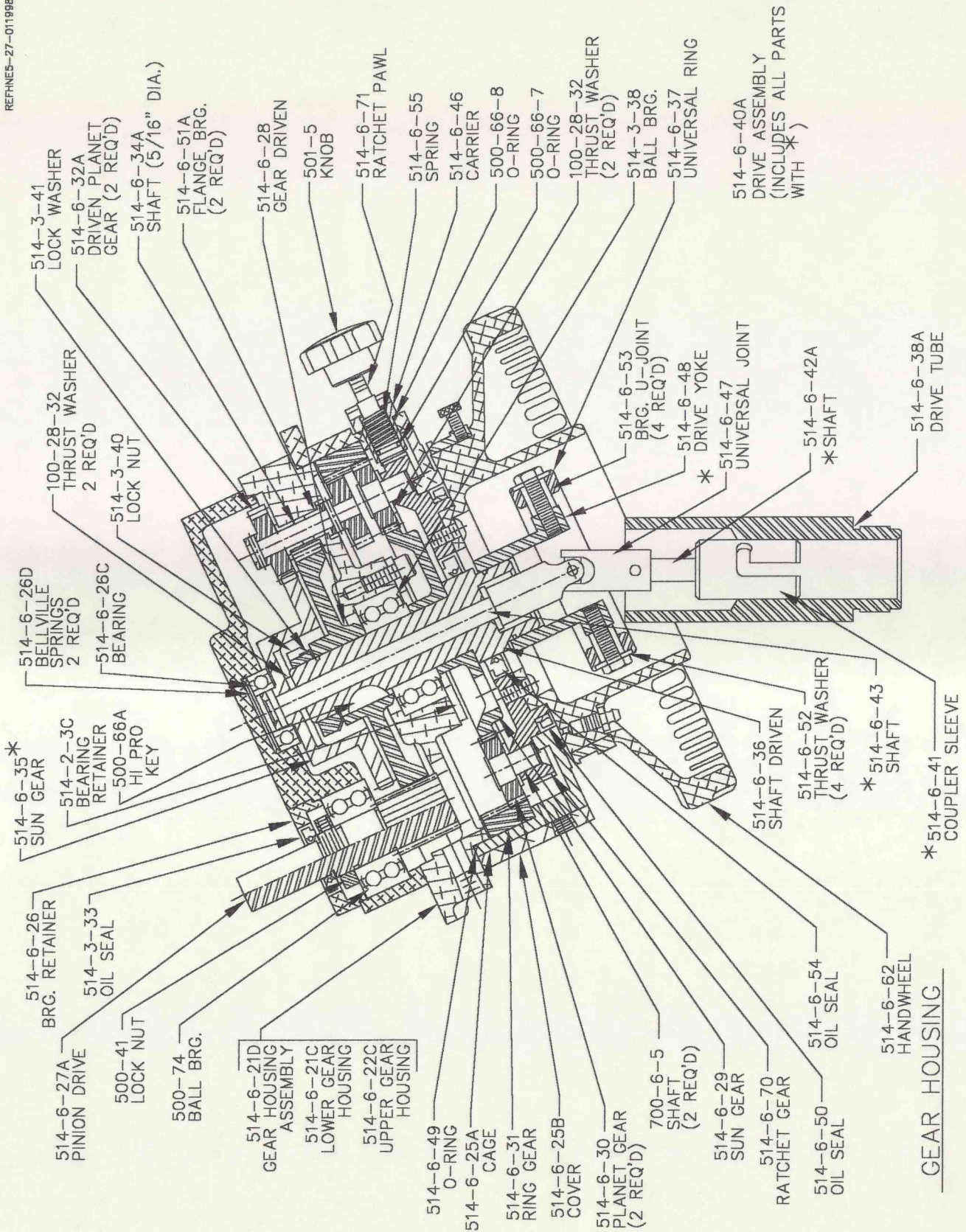
Drive Pinion Assembly:

REFINES-12-042887



Gear Housing Section:

REFHNS-27-011998

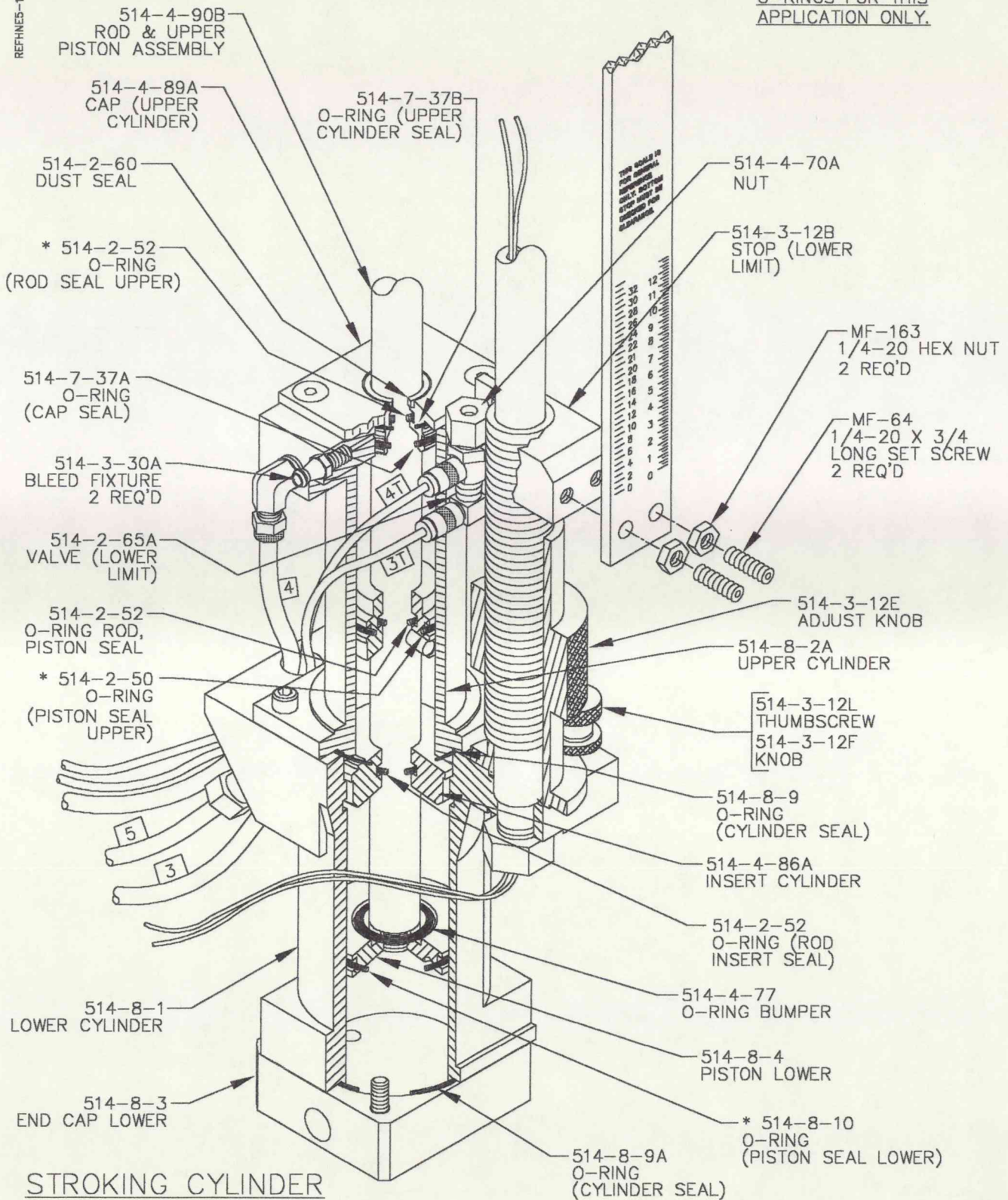


GEAR HOUSING

Stroking Cylinder:

REFHES-17-020298

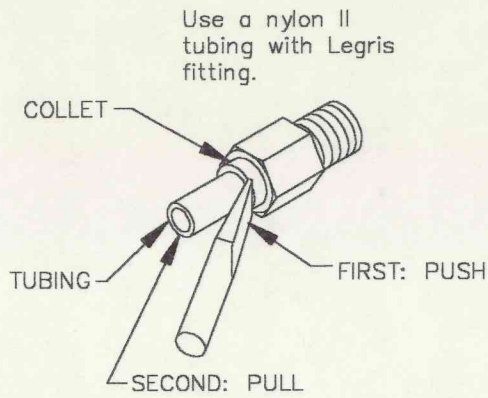
* DO NOT SUBSTITUTE THESE ARE SPECIAL O-RINGS FOR THIS APPLICATION ONLY.



STROKING CYLINDER

Stroking Cylinder:

REF:NE5-18-051297

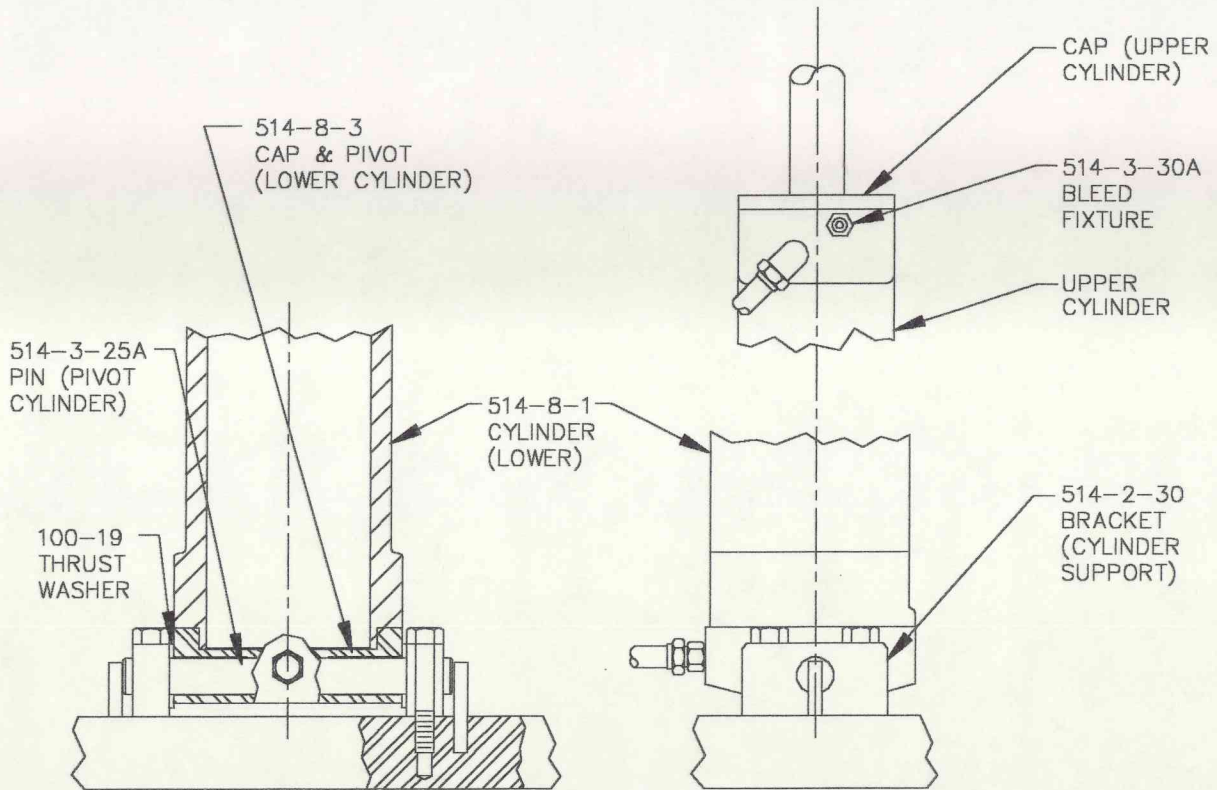


LEGRIS TUBE FITTINGS

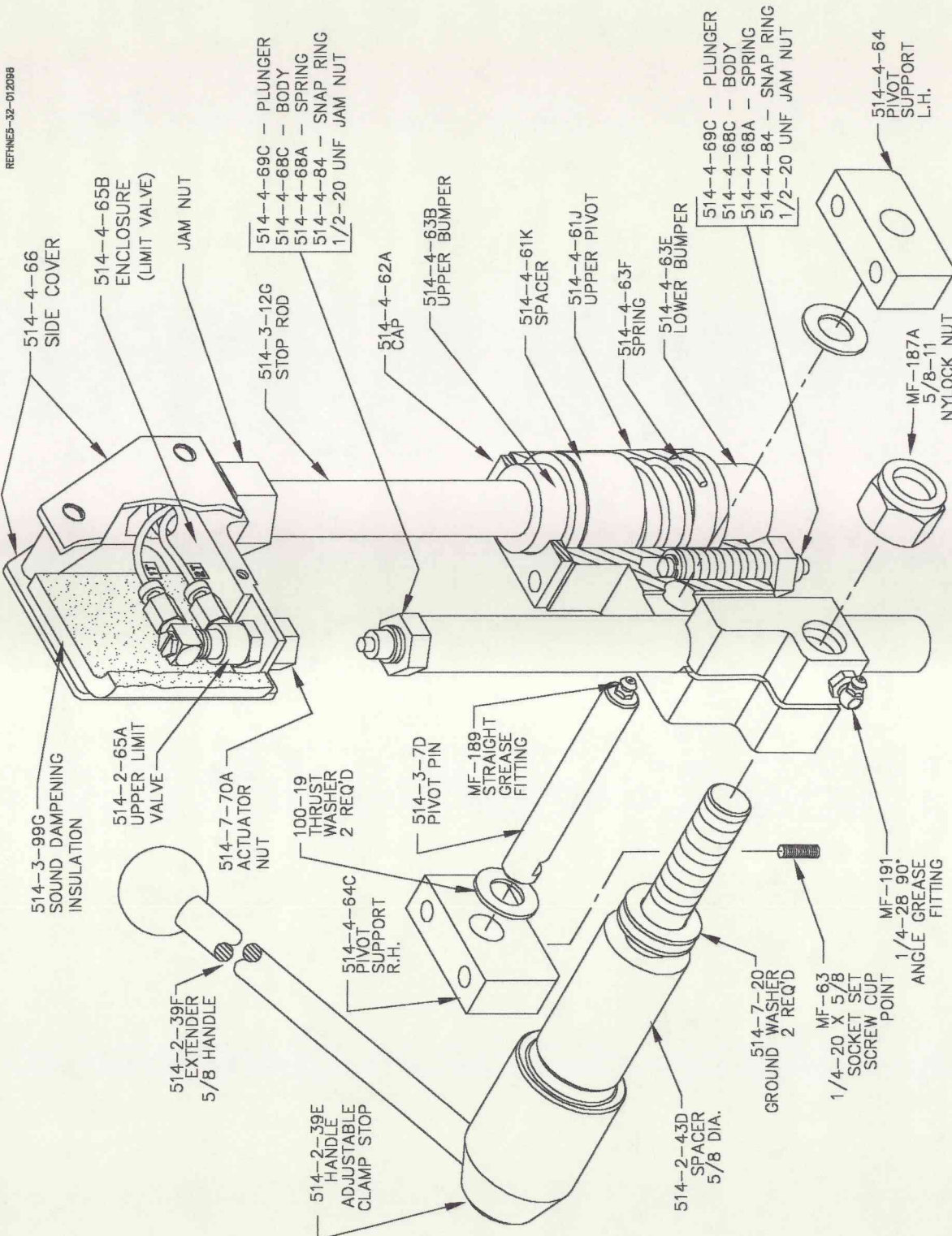
To Disconnect Tubing from Legris fitting—push collet with a screwdriver then pull tubing.

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.

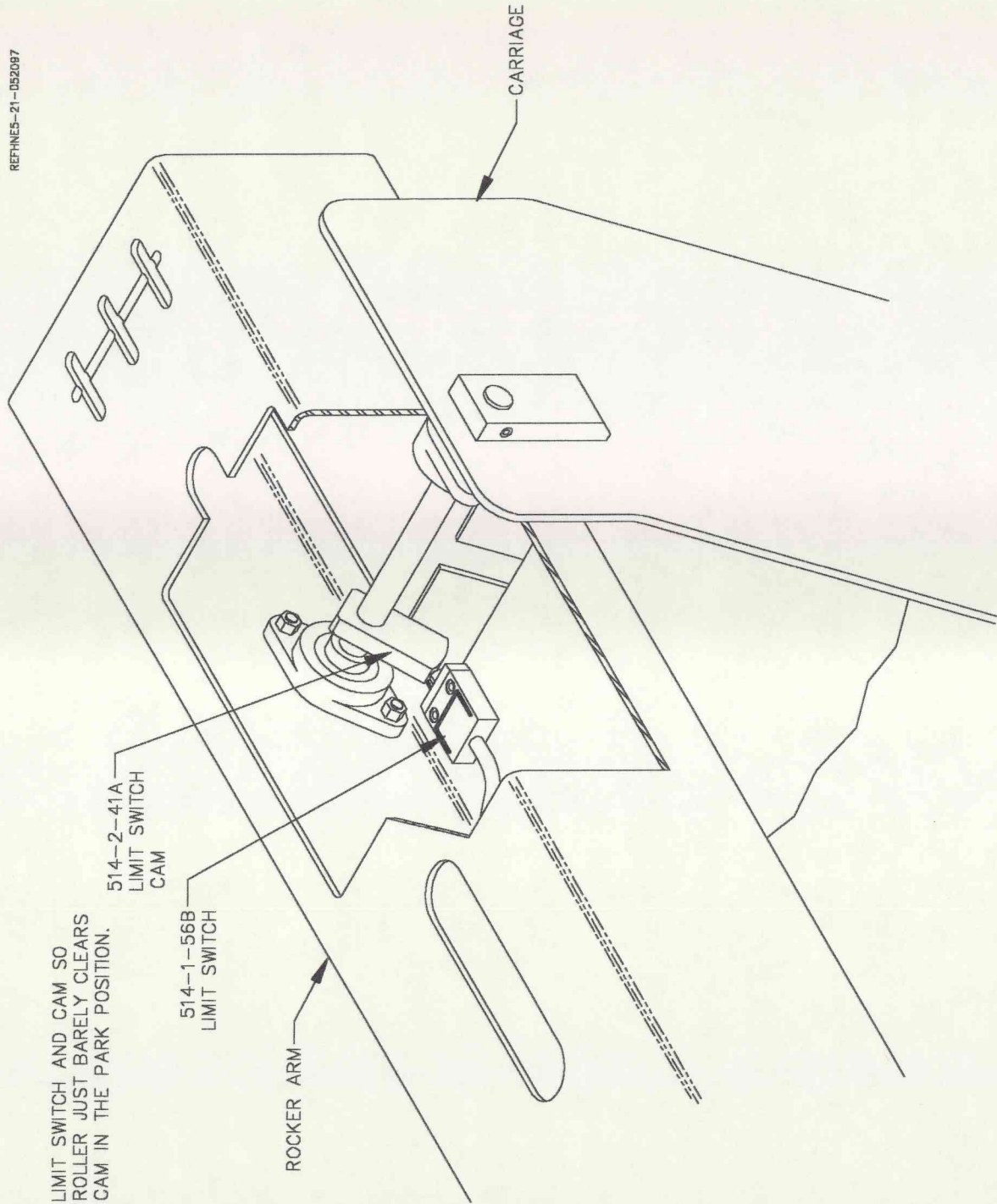


Upper Limit Valve:



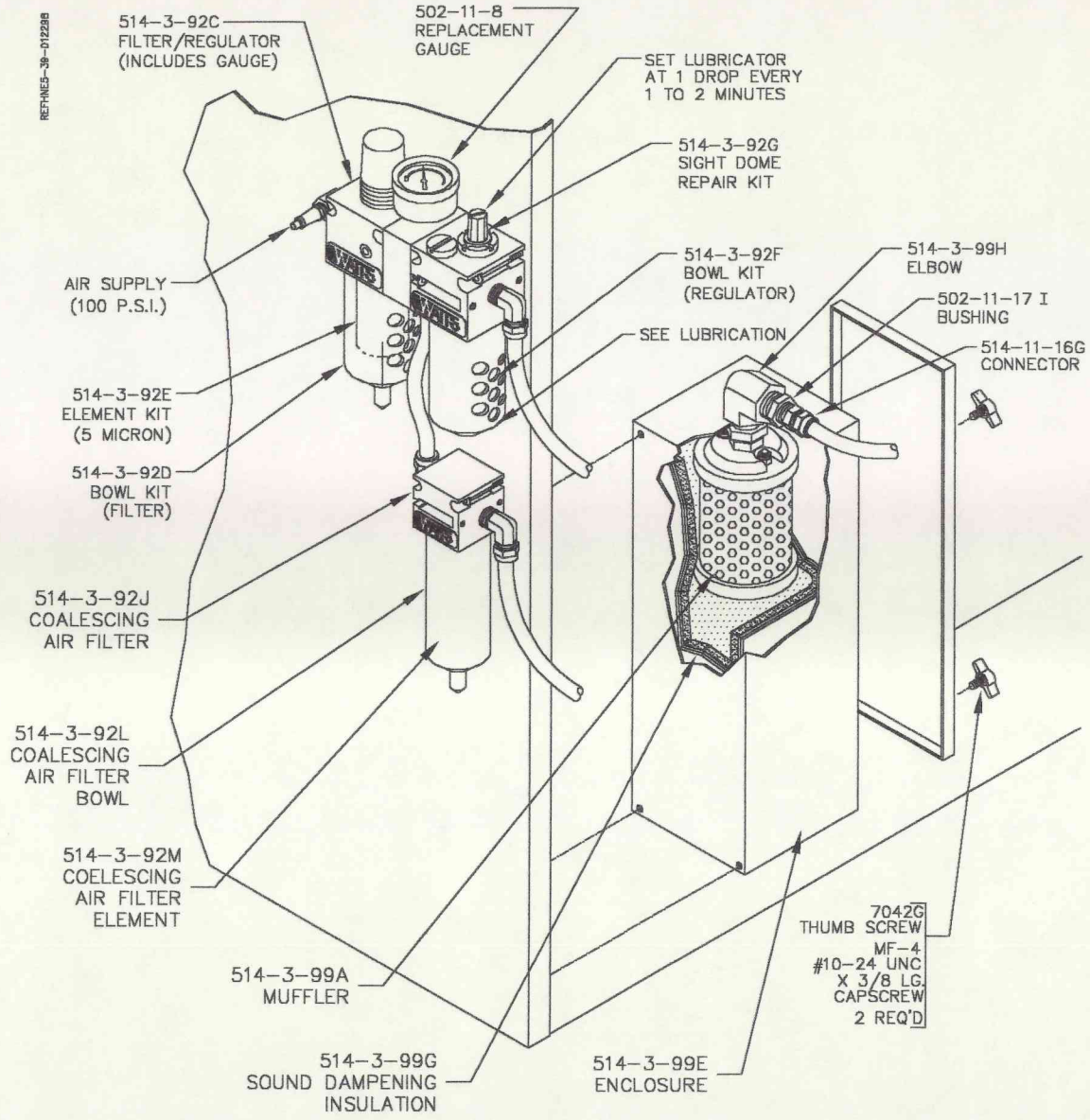
Motor - Safety Switch:

REFINES-21-052097



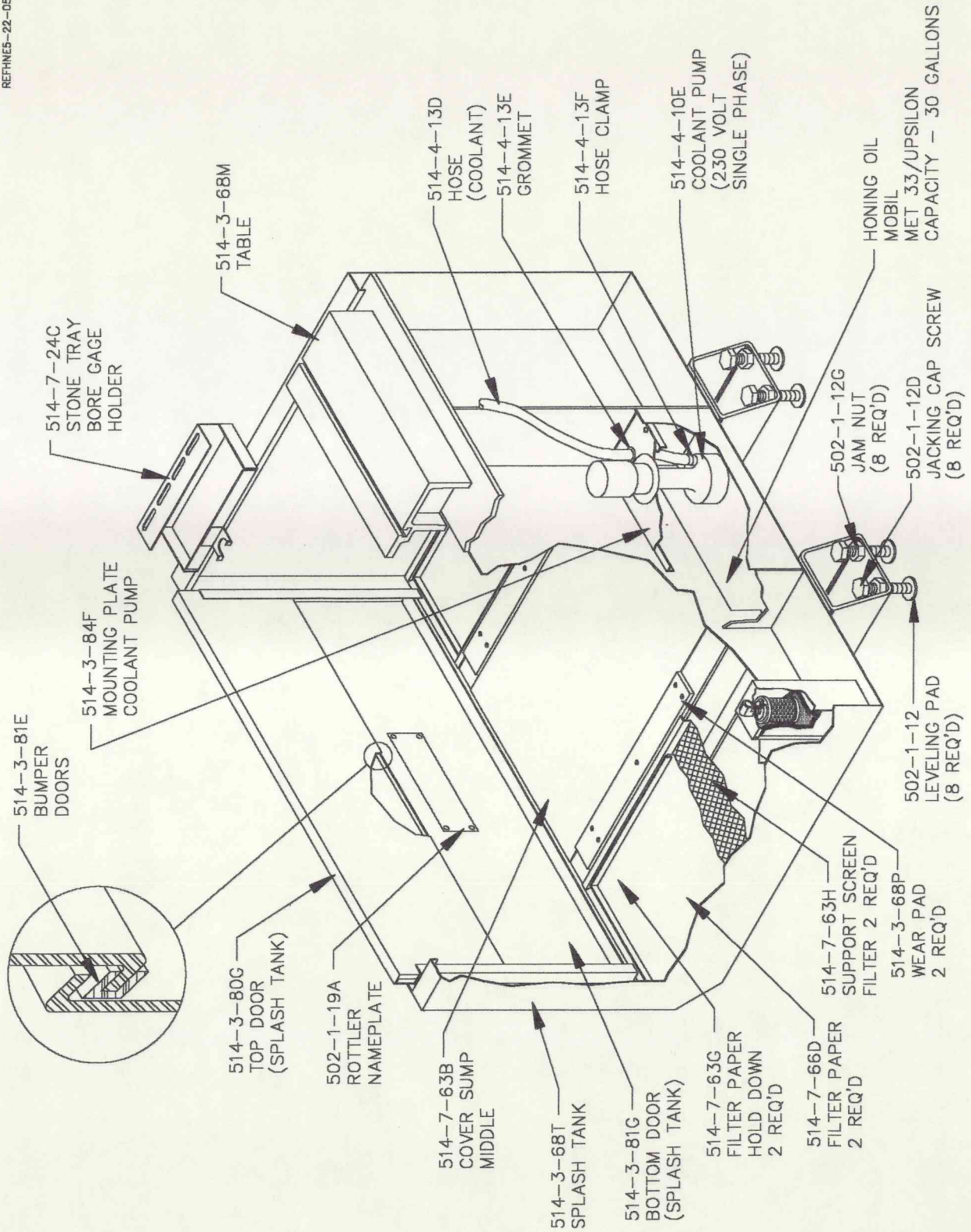
SET LIMIT SWITCH AND CAM SO THE ROLLER JUST BARELY CLEARS THE CAM IN THE PARK POSITION.

Pneumatic Power Supply:



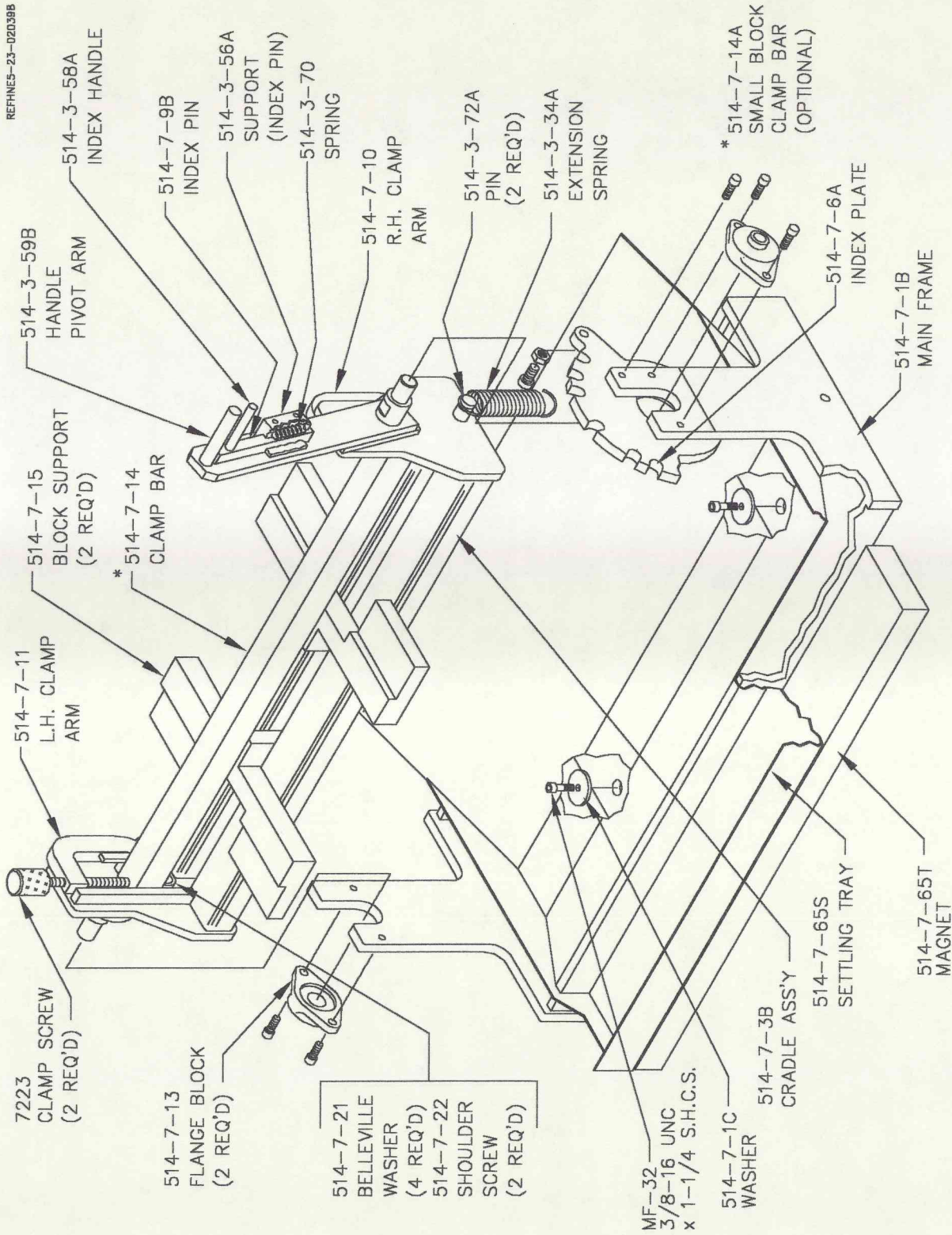
Splash Tank / Coolant System:

REFHNE5-22-052197

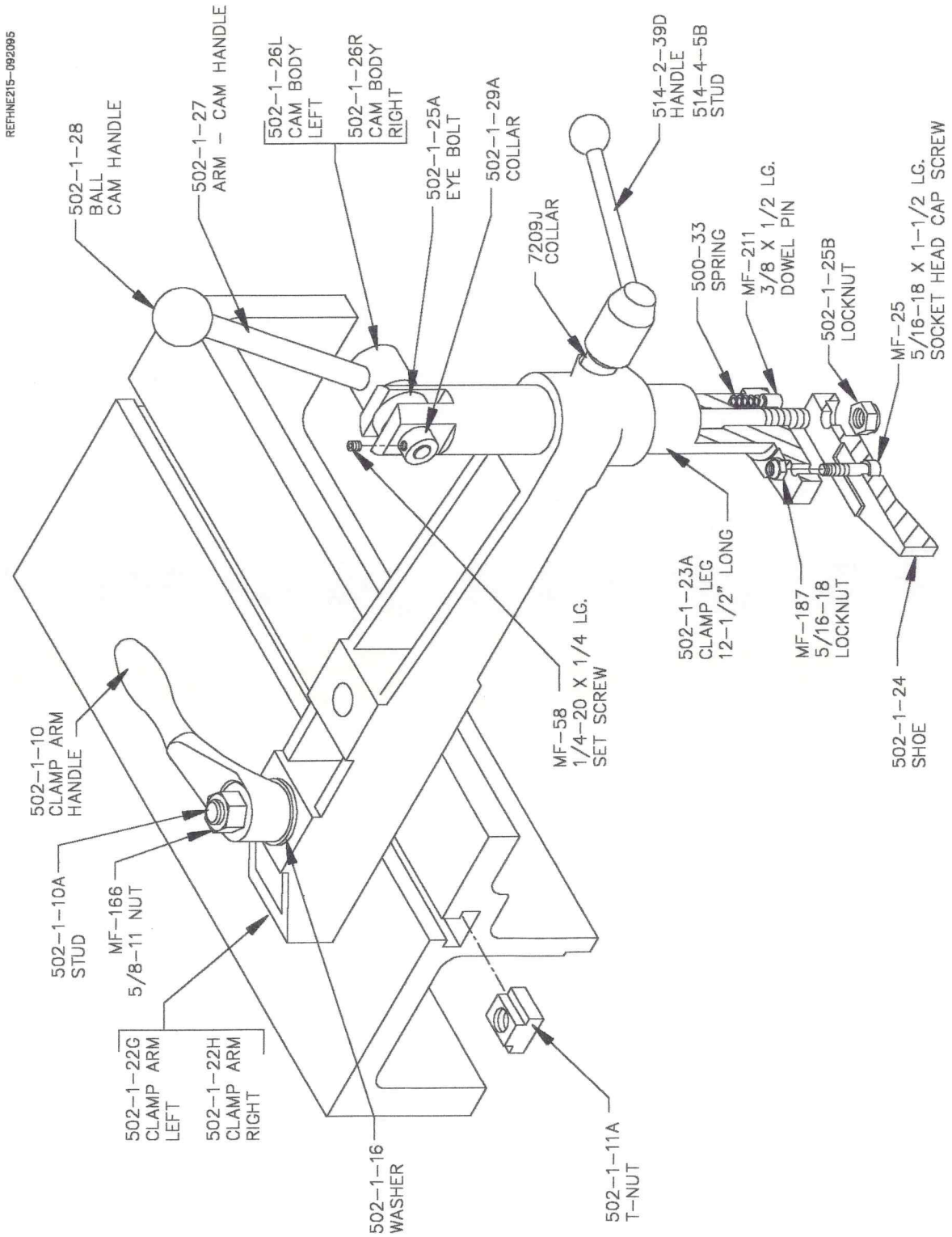


Block, Hold Down - Fixture Assembly:

REFINES-23-020396

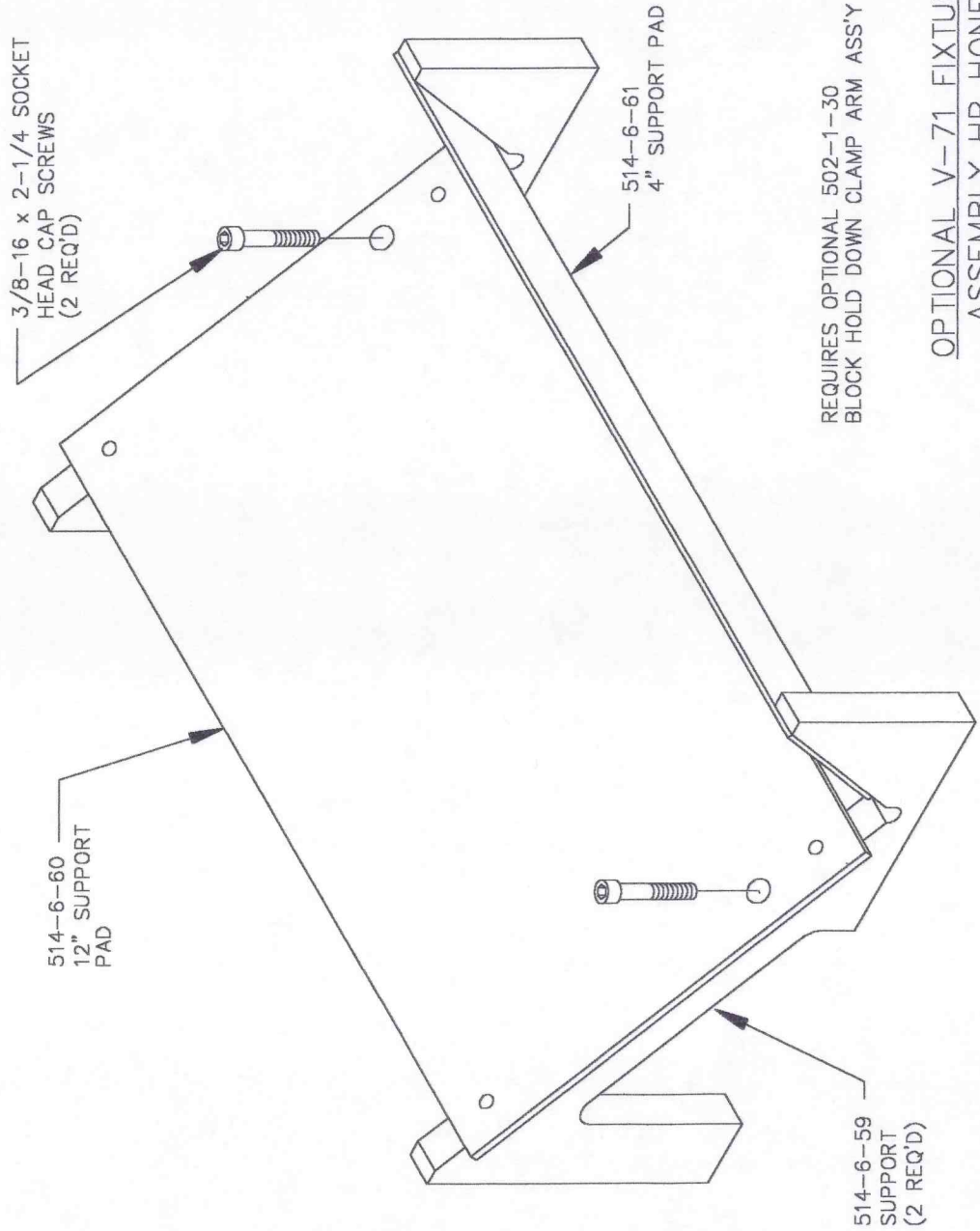


Optional - Block, Hold Down - Clamp Assembly:



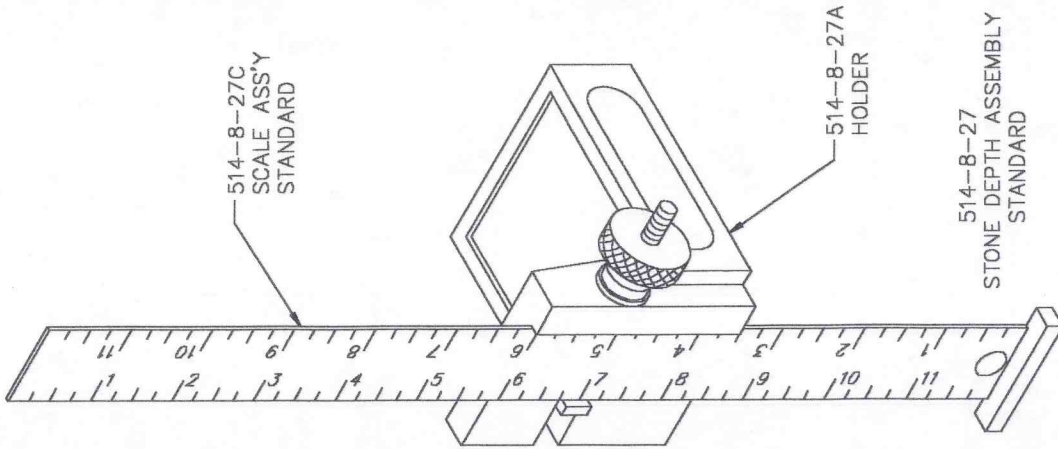
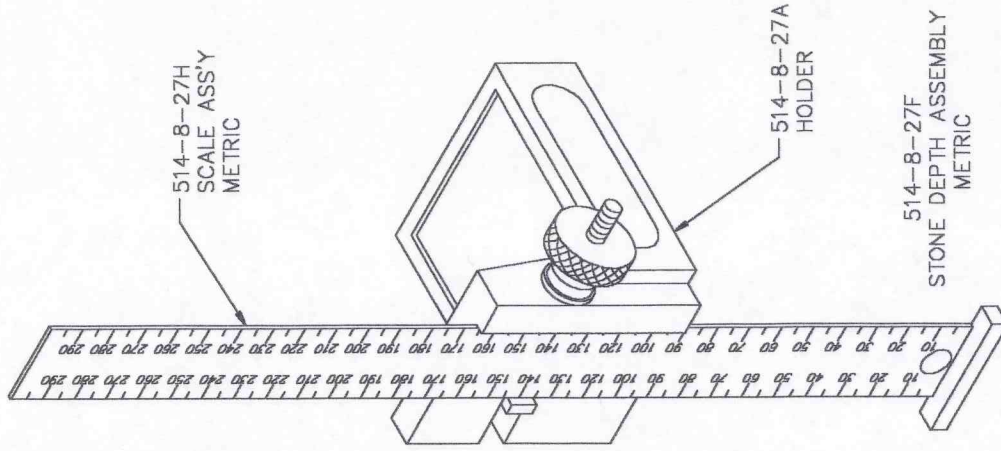
Optional - V-71 Fixture:

REFHNE2-092095



Optional - Stone Depth Assembly

REF: 141-082095



OPTIONAL STONE DEPTH ASSEMBLY

Stone Depth Assembly Set-up:

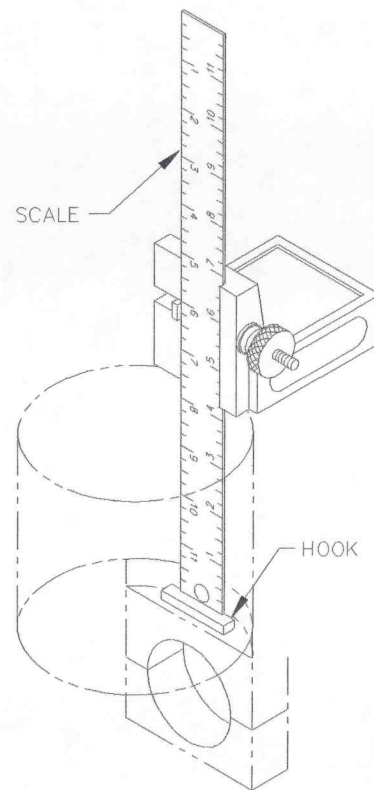
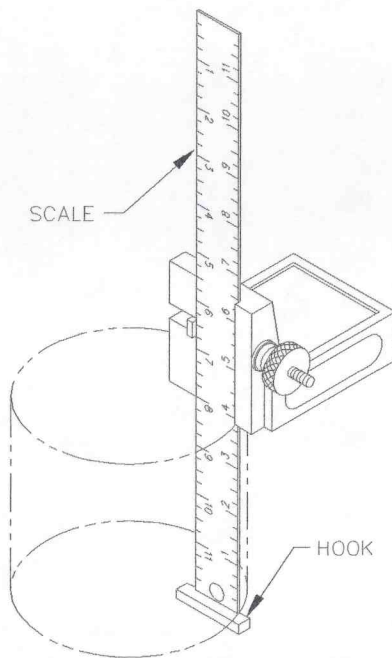
Setting lower travel limit:

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 $\frac{3}{4}$ " 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.

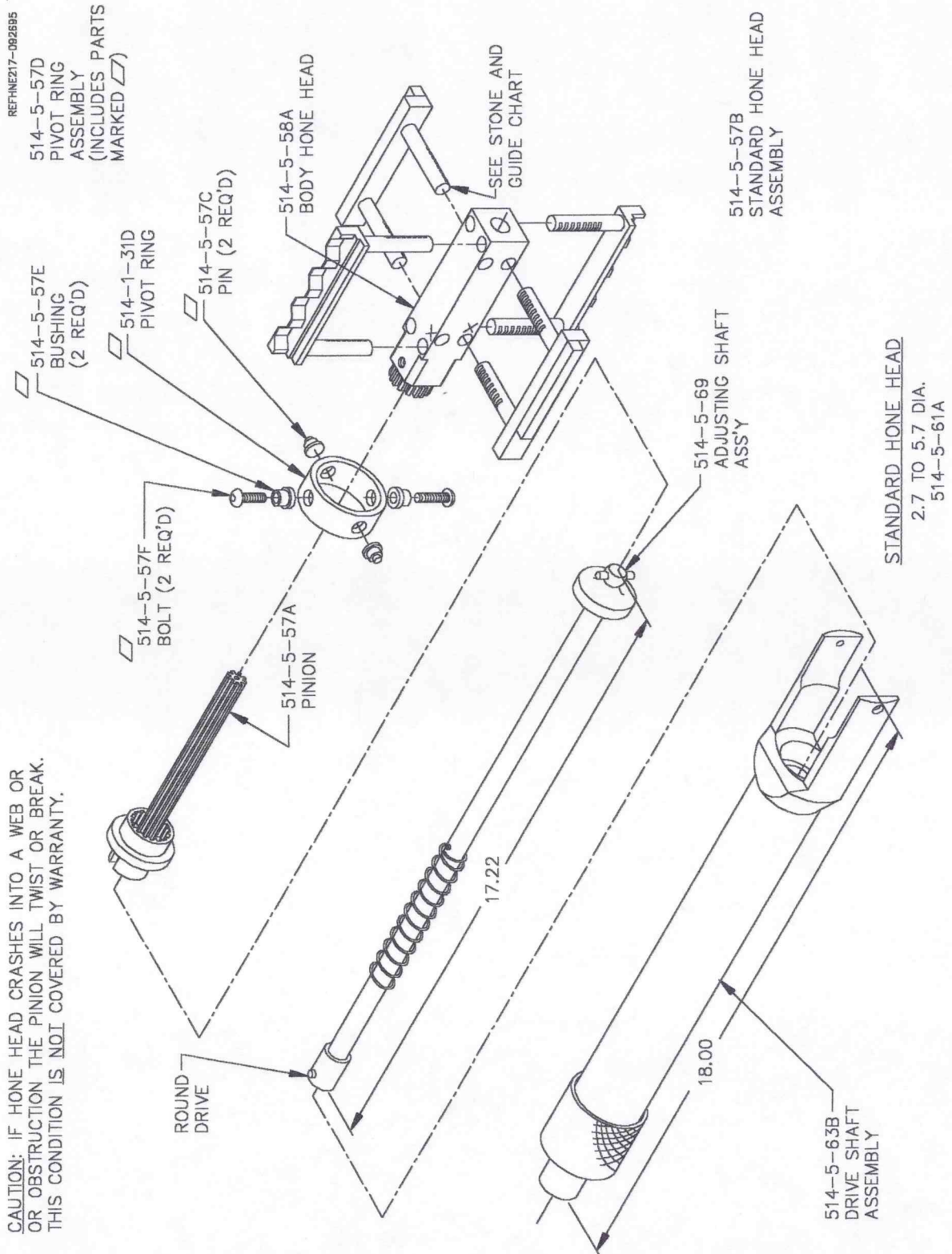
Setting lower travel limit with obstructions:

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

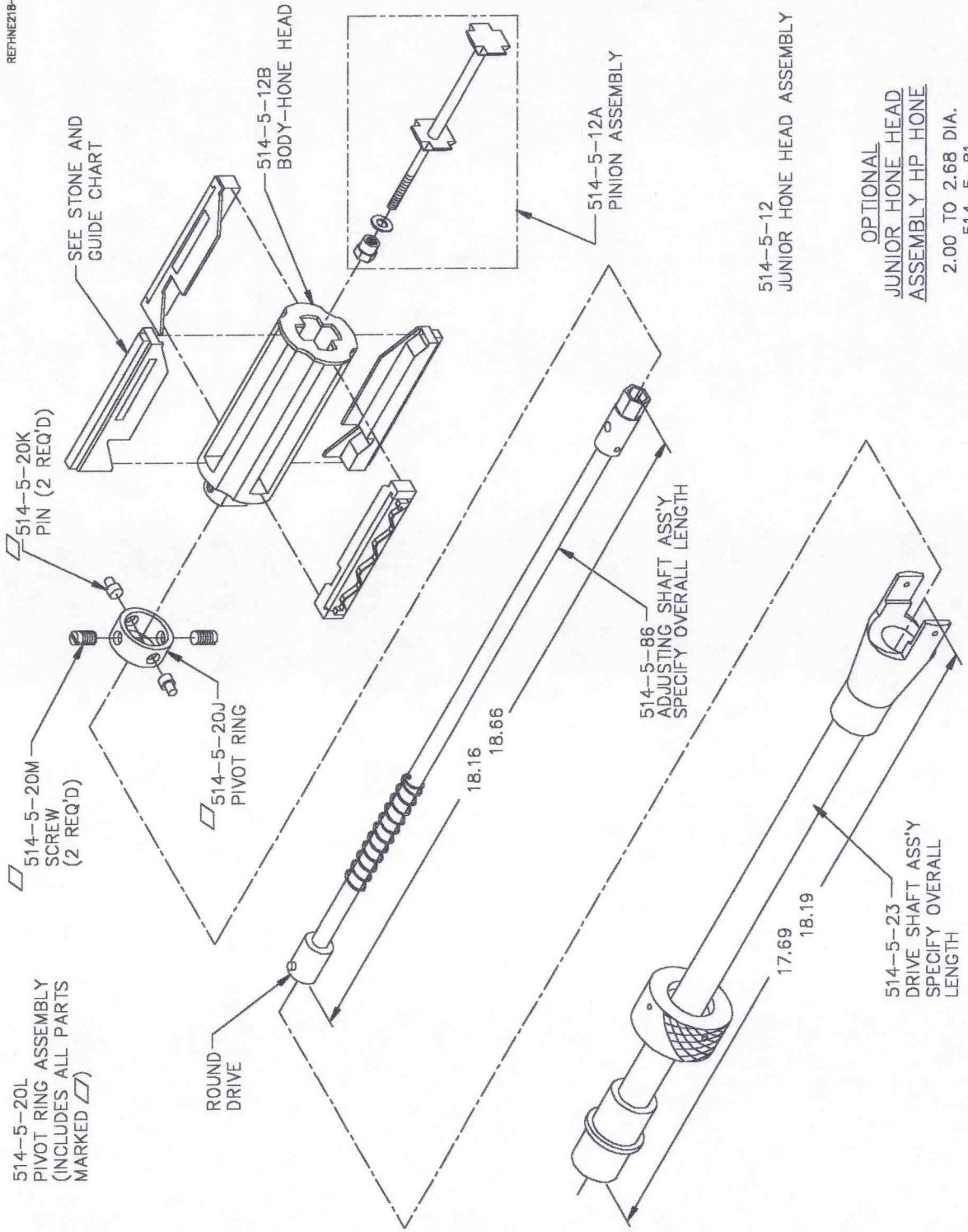


Standard Hone Head Assembly:



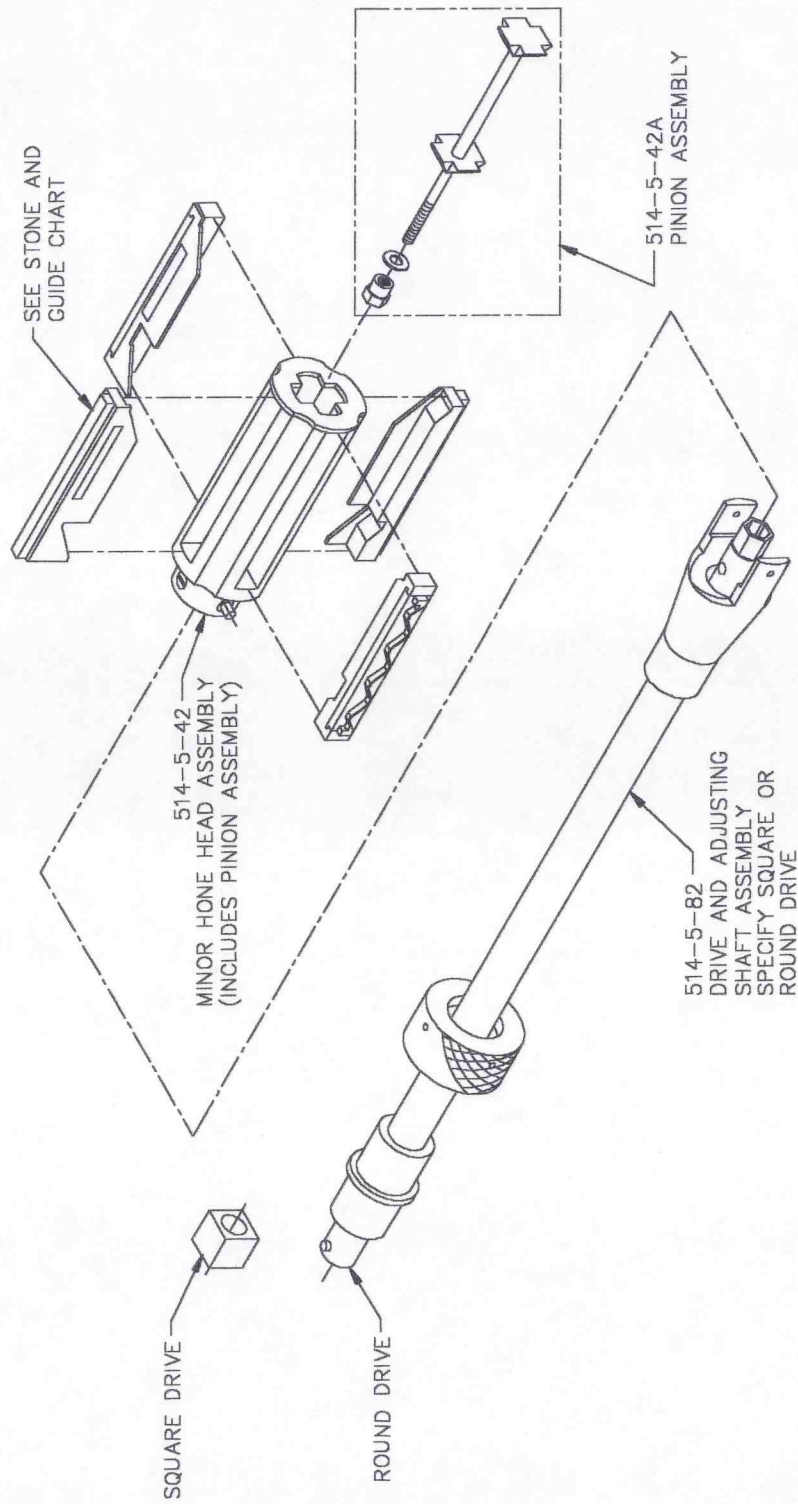
Optional - Junior Hone Head Assembly:

REFHNE21B-082595



Optional - Minor Hone Head Assembly:

REFHNE35-082185



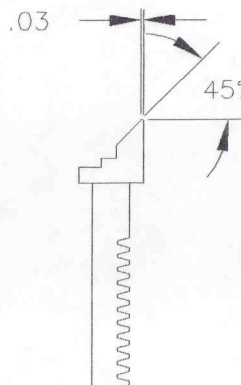
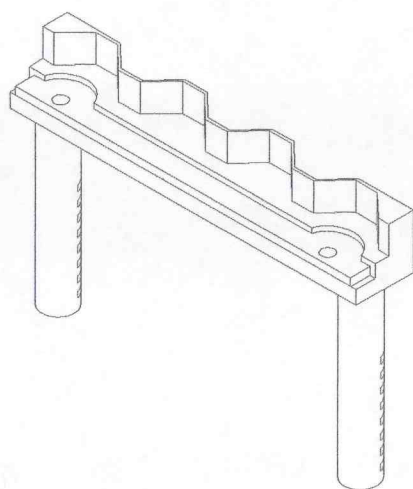
OPTIONAL
MINOR HONE HEAD
ASSEMBLY HP HONE
1.50 TO 2.00 DIA.
514-5-83

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.

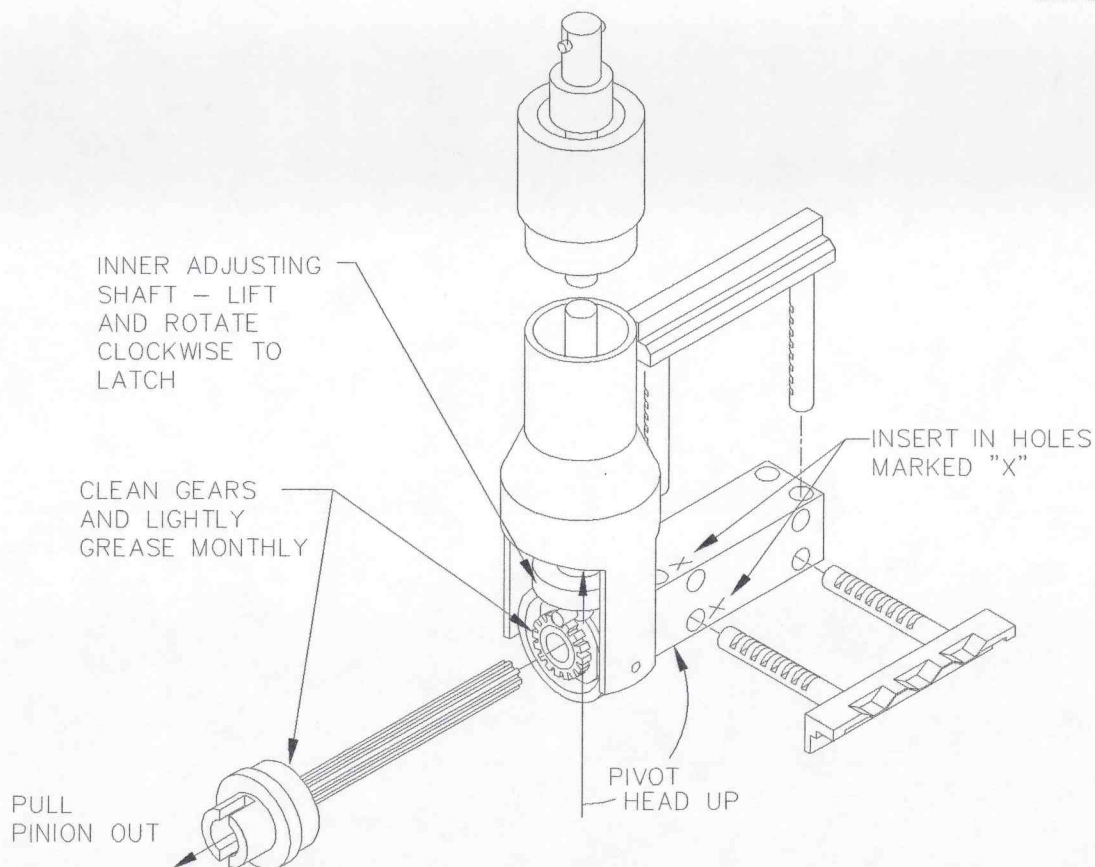
NOTE:

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.

REFPNE-41-020298



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"

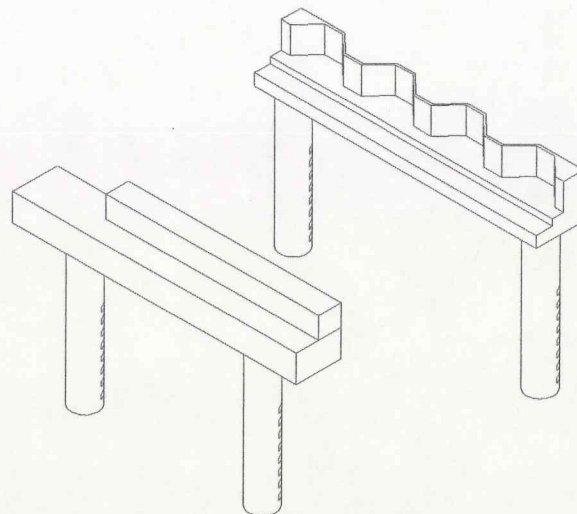
Rottler #

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



REFHNESSA-020398

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

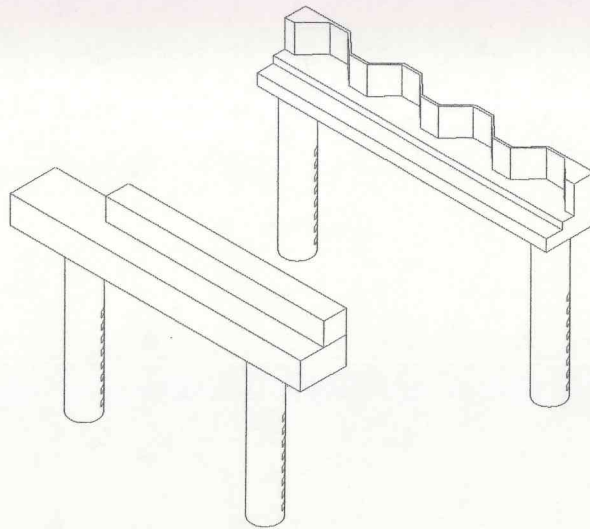
****All orders subject to stock availability****

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****

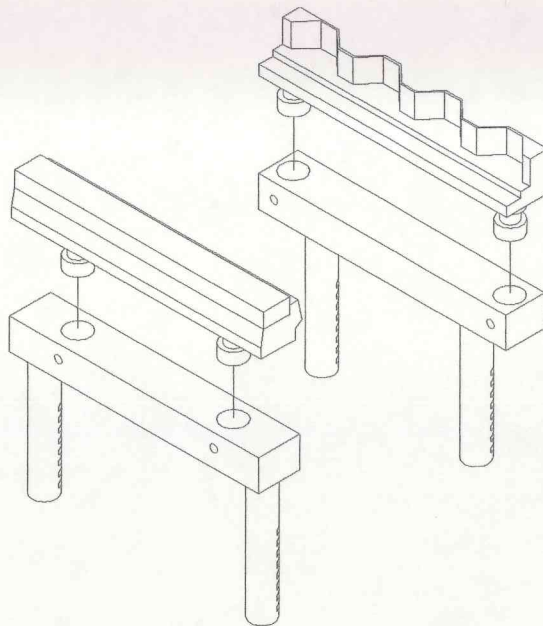
Grits may be mixed for quantity breaks.
(PT2F numbers only)

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

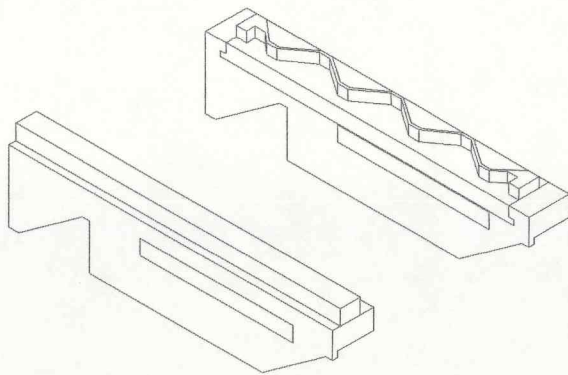


REFHNE89B-020398

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"

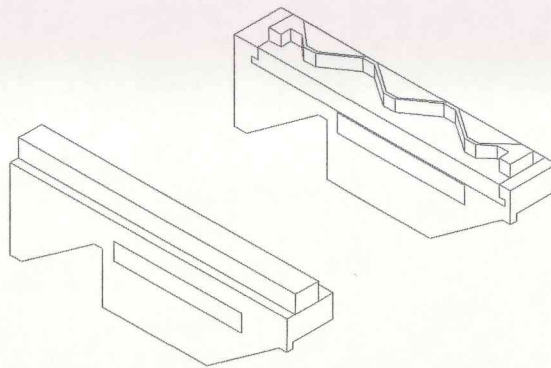


REFHNE89C-020398

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 customers 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 stones 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./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. 12 strokes per feed out. At .0003 in./007mm per feed out a stock removal rate of .0015 in./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./01mm max. for second step finish hone. 60 strokes per minute. 6 strokes per feed out. At .0003 in./007mm per feed out a stock removal rate of .003 in./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./007 mm per feed out a stock removal rate of .0015 in./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.

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

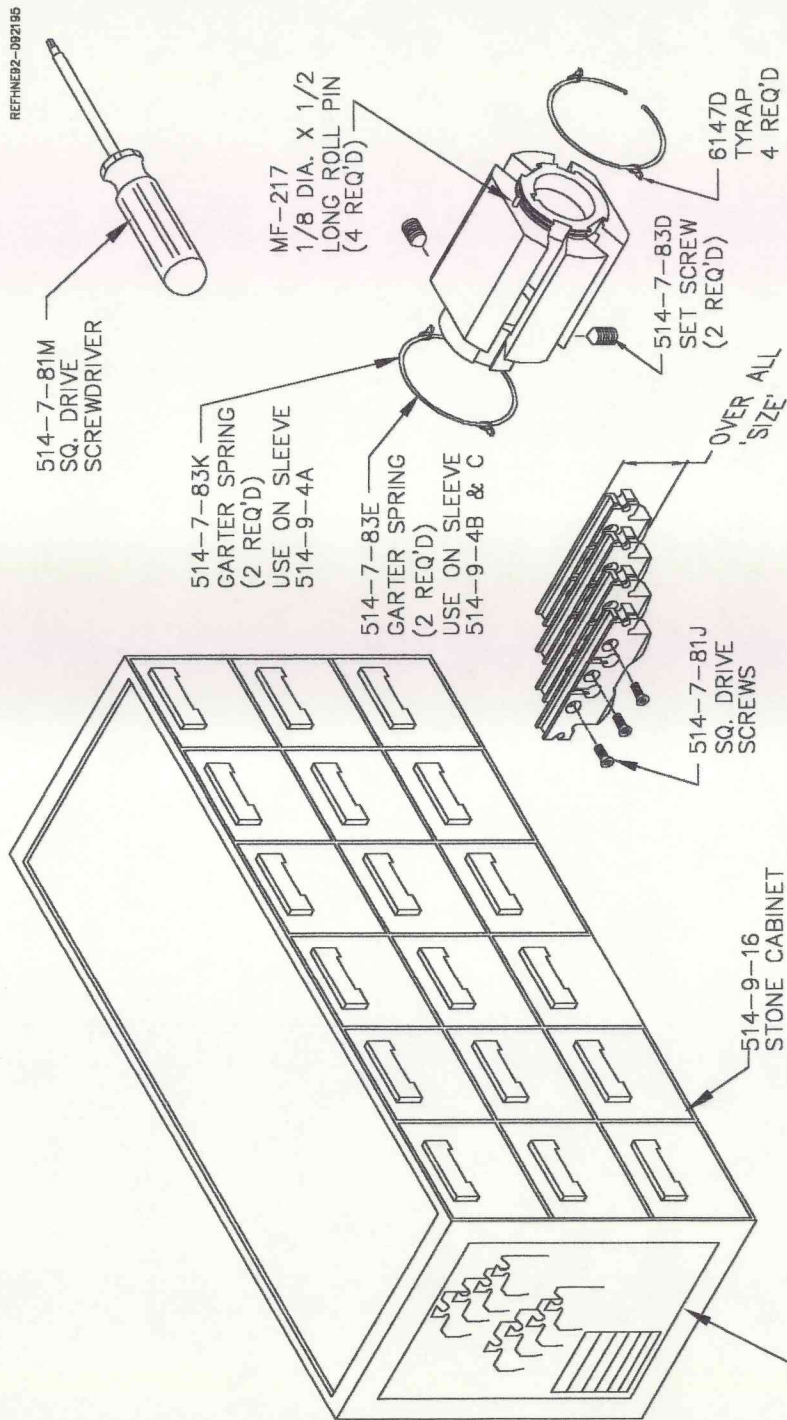
Diamond Abrasives use a metal bond to hold the individual diamond particles. After honing 30 - 70 blocks you may find that increased pressure is required to remove stock or the stock removal rate slows down significantly. This is caused by the diamond abrasive dulling or the bond not breaking down. This 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	

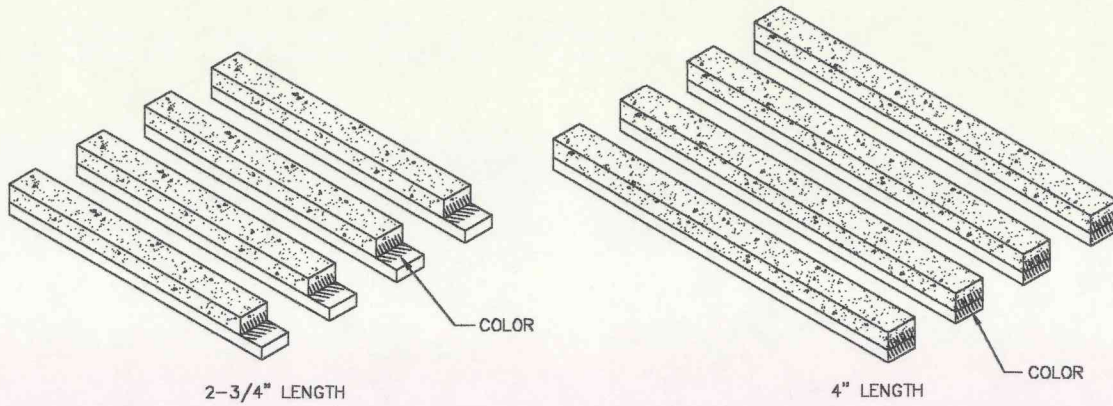
Stone Holder - Sleeve Sets:



STONE HOLDER SET		SLEEVE			
SIZE	PART NUMBER	RANGE (DIA.)	SIZE	PART NUMBER	RANGE (DIA.)
1-04	514-9-6J	* 2.900/3.090	A,B,J	514-9-4A	* 2.75/3.56
1-1/8	514-9-6A	3.050/3.312	A,B,J	514-9-4A	2.75/3.56
1-1/4	514-9-6B	3.250/3.562	C-E	514-9-4B	3.50/4.32
1-3/8	514-9-6C	3.500/3.812	F-H	514-9-4C	4.25/6.06
1-1/2	514-9-6D	3.750/4.062	K-N		
1-5/8	514-9-6E	4.000/4.312			
1-3/4	514-9-6F	4.250/4.562			
1-7/8	514-9-6G	4.500/4.812			
2	514-9-6H	4.750/5.062			
2-1/8	514-9-6K	5.000/5.312			
2-1/4	514-9-6L	5.250/5.562			
2-3/8	514-9-6M	5.500/5.812			
2-1/2	514-9-6N	5.750/6.062			

* MINIMUM 2.750 WITH SPECIAL 1/4 HIGH STONE.

Stone Sets:



REFINERS-COLORS

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:

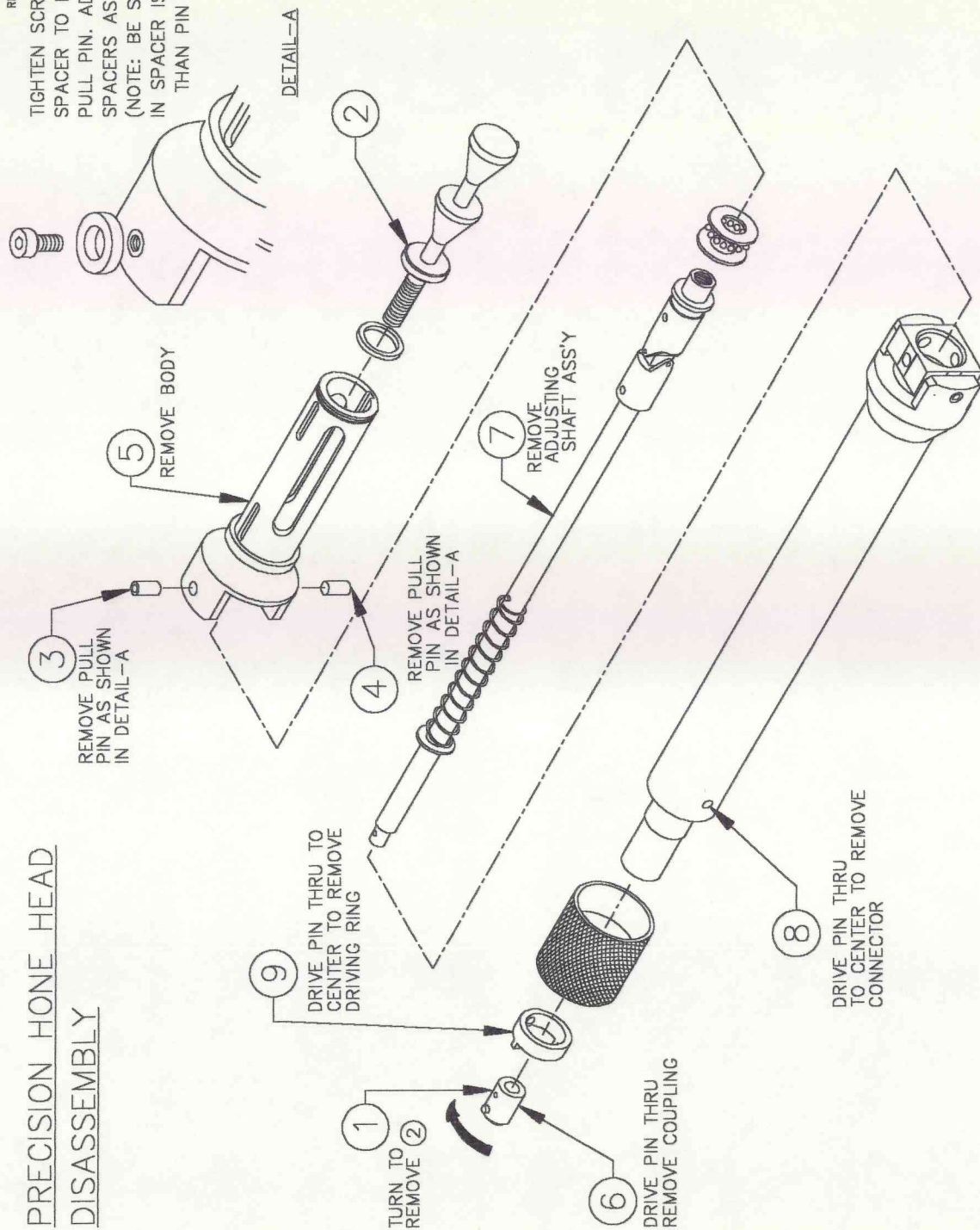
Hardness designation:

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

Disassembly Instructions:

REF:NE36-092195

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



***** 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
 Viscosity at 100 F, SUS: 62.0
 Viscosity at 210 F, SUS: 35.1
 Flash point F (C): >325 (163)
 Melting point F(C): NA
 Boiling point (F(C): > 600 (316)
 Relative density, 15/4 C: 0.849
 Vapor pressure-MM HG 20C: < .1
 Odor: Mild
 at 40 C, CS: 10.2
 at 100 C, CS: 2.7
 (ASTM D-92)
 Pour point F(C): 30 (-1)
 Solubility in water: Negligible
 PH: NA
 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.

MOBILMET UPSILON

665554

Page 4 of 4

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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

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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 defat the skin.

Wash skin contact areas with soap and water.

Laundry 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)

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D.O.T. Shipping name: Not applicable

D.O.T. Hazard class: Not applicable

MATERIAL SAFETY DATA SHEET

SECTION I

<u>Product name or number</u> (as it appears on label) YUMATE SC-870C		<u>Date</u> March, 1995
<u>Manufacturer's Name</u> Yuma Industries Incorporated		<u>Emergency Phone #</u> 800-424-9300
<u>Address (Number, Street, City, State, & 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

CAS Registry #	Wt%	Chemical Name(s)	Listed as a carcinogen in NTP, IARC, or OSHA 1910(z) (specify)
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/m ³ , STEL=15mg/m ³	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> Not available	<u>Specific Gravity</u> (H ₂ O=1) @ 20°C 1.07	<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> 10% solution 8.5	<u>Material is</u> Liquid
<u>Appearance & Odor</u> Fluorescent with mild odor	<u>Volatile Organic Compounds (VOC)</u> Not available	

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SECTION IV – FIRE AND EXPLOSION HAZARD DATA

<u>Flash Point</u>	<u>Method Used</u>	<u>Flammable Limits</u>	<u>Auto-Ignition Temperature</u>
None		LEL/UEL Not available	(°C) 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 Rotes 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 ₂ , NO _x and SO _x .			

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	
<u>VENTILATION: Local Exhaust (specify rate)</u>	
Special	_____
Not normally required.	None
<u>Mechanical (general) (specify rate)</u>	
Other	_____
General room ventilation should be sufficient.	
None	None
<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