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Part 1: A Word to Owner, Operator, and Service Personnel About Safety

⚠ WARNING

FAILURE TO READ THIS BOOKLET IS A MISUSE OF THE EQUIPMENT. ANYONE WHO WILL OPERATE, SERVICE OR WORK AROUND THIS LOADER MUST FIRST READ THIS BOOKLET. DEATH OR SERIOUS INJURY MAY RESULT FROM IMPROPER USE OR MAINTENANCE OF THIS LOADER.

Introduction

Anyone who will operate, service or work around the loader should first read this manual. It is important that all workers understand the safety, operational, service, and repair requirements of the loader. Death or serious injury can result from improper use or maintenance of the loader.

As an owner or employer, it is your responsibility to know the specific requirements, governmental regulations, precautions, and work hazards that exist. You should make these known to all personnel working with the equipment or in the area. It is your responsibility to instruct the operator in the safe operation of the equipment and to provide the operator with properly maintained equipment.

It is the operator's responsibility to operate the loader with skill, good judgment and caution. Following recognized safety procedures helps to avoid accidents.

Do not allow untrained personnel, even on a temporary basis, to operate this equipment. Operators must be trained by an experienced trash loader operator who is familiar with all aspects of operation, safety, and maintenance of this equipment. Keep children, visitors and untrained personnel away from the equipment.

Modifications to any part of this loader can create a safety hazard and therefore shall not be made without the manufacturer's written approval. Use only factory approved parts to repair or maintain this equipment. If this equipment is rebuilt or remounted, mounting procedures and retesting is required in accordance with factory instructions.

⚠ WARNING

DO NOT OPERATE THE LOADER UNDER ANY CIRCUMSTANCE IF THERE IS REASON TO BELIEVE THE UNIT IS BROKEN OR MALFUNCTIONING. DO NOT ATTEMPT TO PLACE THE BOOM OF A BROKEN OR MALFUNCTIONING UNIT IN THE BODY OF THE LOADER UNIT WITHOUT ASSISTANCE FROM ANOTHER CRANE OR LIFTING DEVICE. ANY ATTEMPT TO USE OR MOVE THE BROKEN OR MALFUNCTIONING UNIT COULD RESULT IN SERIOUS BODILY INJURY OR DEATH.

Part 2: Daily Inspections - Before Leaving the Storage Facility

One of the most important factors in the prevention of accidents is a positive attitude towards safety. The habit of anticipating possible problems normally prevents many accidents from occurring.

Each morning, prior to leaving the storage facility or lot, the following inspections should be made:

1. Check oil level and battery.

2. Check the brakes and backup alarm. The backup alarm must always be sounding prior to backing up. If your unit is equipped with any additional alarms or warning lights, check these items also for proper operation.

3. Check rearview mirrors and adjust if necessary.

4. Check tires for proper inflation, cuts, and loose wheel nuts.

5. Check head and taillights, strobes, and flashers for proper operation.

6. Check the hydraulic system for any unusual conditions such as pools of hydraulic fluid or lubricating oil under the chassis, any outrigger which may have crept down, or any signs of damage or improper maintenance. The hydraulic hoses should be free from cuts and abrasions and there should be no evidence of binding or leakage.

7. Ensure that outriggers are fully retracted and the bucket is open and resting on the floor of the body. If the body contains debris, the bucket should be closed and at rest on the load. Ensure that most of the bucket and boom tip are below top of body.

Consult the truck manufacturer's manual for vehicle checks recommended by them.

Any insufficiencies found during this inspection must be corrected prior to use of the equipment.

Part 3: Safety Devices

We will now discuss some of the components designed into the loader system to ensure that safe loader control is maintained. There are hydraulic system flow devices designed into the loader system to control the flow of hydraulic fluid. Loader control and speed are essential to the safe operation of, and longevity of the loader.

To maintain safe loader control you must ensure that proper engine speed is observed, all oil flow restrictors are in place and have not been modified, and all valves are operating properly. You must not remove, or tamper with the manufacturer's recommended settings of oil flow devices.

Excessive operating speed causes erratic operation of the loader. Excessive operating speed decreases operator control and increases the stresses on the loader's supporting structures, which could cause unexpected component failure. The result of unexpected component failure could be damage to the equipment and/or serious bodily injury or death.

FLOW RESTRICTORS

Swing Actuator Restrictors: - The swing actuator flow restrictors control the swing speed of the loader boom. These restrictors are located on the swing drive motor, one on each port. These restrictors are factory preset and must not be removed or drilled out.

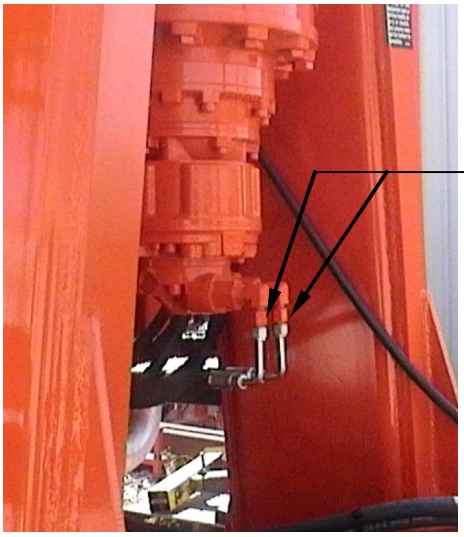
Model HA36 Rotary Actuator, Restrictor Size = 0.056
Dinamic Oil Rotary Actuator, Restrictor Size = 0.110

Some signs of restrictor removal or modification are:

1. Excessive boom swing speed. Full travel time should be 20 seconds, ±3 seconds, from head stop to head stop.

2. Broken or bent head (swing) stops. Catastrophic actuator damage will result if head stops are damaged or missing.

3. Excessive swing speed causes excessive wear on the main boom/tip boom connecting bolt.



Swing Actuator Restrictors:

HA36 Actuator Restrictor Size = .056

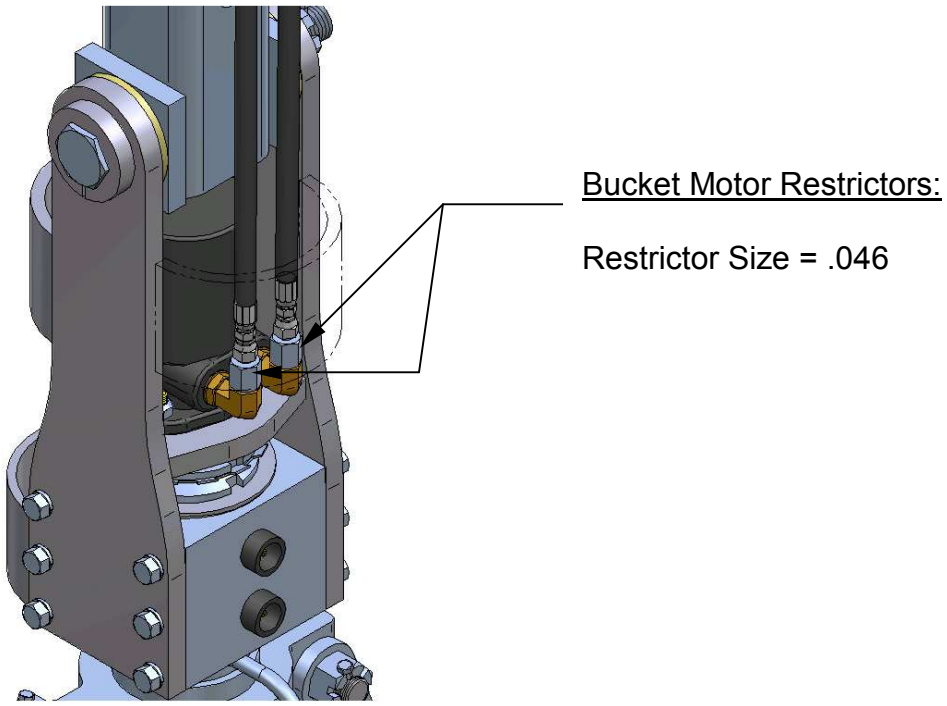
Dinamic Oil Actuator Restrictor Size = .110

Bucket Motor Restrictors: The bucket motor restrictors control the speed of the bucket rotation. These restrictors are located on the motor ports. These restrictors are factory preset and must not be removed or drilled out.

Restrictor Size: .046

Some signs of restrictor removal or modification are:

1. Excessive bucket rotation speed. Bucket rotation must not exceed 15 RPM.
2. Broken bucket rotator motor mounting bolts.
3. Broken bucket motor shaft and/or housing.



LOAD CONTROL VALVES

The load control valves are either a part of or plumbed directly onto load holding cylinders. These valves are found on the main boom lift cylinder, tip cylinder, tip extension, and the outrigger cylinders.

Main Boom Lift, Tip, and Tip Extension Cylinders:

Counter-balance Valves: - The counter-balance valve is a cartridge type valve, mounted directly into a housing that is welded to the lift, tip, and tip extension cylinders. These valves hold the load until hydraulic pressure is applied to it causing the valve to open. This ensures the load is held in case of hose rupture, or other hydraulic system failure.

Notice to Operators: If load control valve(s) malfunction, do not attempt to adjust valves, and/or continue to use the loader. Return to the maintenance facility for repair.

Counter-balance valve adjustment is not normally needed after initial installation. However, if adjustment is needed, first release load from valve and rest bucket on ground or floor of body. Turn valve screw far enough out so that valve will hold load when control valve is opened and truck PTO is off. The PTO should be off when adjusting the screw, back on to lift the boom, and off again to test load holding capability of the valve.

If the counter-balance valve is replaced, you must first release the load from the valve. This means the boom must be at rest in the floor of the body or on the ground, prior to removing the cartridge valve.

⚠ WARNING

FAILURE TO FOLLOW THE PRECEDING INSTRUCTIONS REGARDING COUNTER-BALANCE VALVE ADJUSTMENT AND/OR REPLACEMENT, COULD RESULT IN THE BOOM FALLING ONCE THE CARTRIDGE VALVE IS REMOVED, WHICH COULD RESULT IN DAMAGE TO THE EQUIPMENT OR SERIOUS PERSONAL INJURY OR DEATH.

If the operator experiences hydraulic failure while on route, first try to get the hydraulic system working again. If you cannot get the hydraulic system working, we recommend that you call for the assistance of an auxiliary service vehicle that can provide a power source for the loader hydraulic system. The connections from the auxiliary power source should be made at the appropriate loader valve bank. Hydraulic pressure from the power source should go to the **"in"** at the loader valve bank, and return to the power source should come from the **"out"** at the loader valve bank. Using the auxiliary power source to run the hydraulics, replace all loader components to the travel position, and then return the loader to the shop for repair.

Outrigger Cylinders:

Pilot Operated Check Valve: - The outrigger cylinders use pilot operated check valves which are part of the cylinders. In the event of hose failure, these valves hold the load until hydraulic pressure is applied, causing the valve to open.

These valves are factory preset and are not serviceable.

If you need to remove this valve, make sure the load is released from the cylinder prior to removing the valve.

LOCK COLLAR

The lock collar is an integral part of the trash loader that holds the head and spindle assembly in the pedestal. The lock collar must be in place and the lock collar bolts properly torqued prior to use of the trash loader. The lock collar must be tight against the bottom of the spindle bearing housing with a maximum gap of one-quarter inch (1/4").

Under normal operating conditions, there is very little load applied to the lock collar. However, the following improper operating practices could put excess stress on the lock collar and therefore must be avoided.

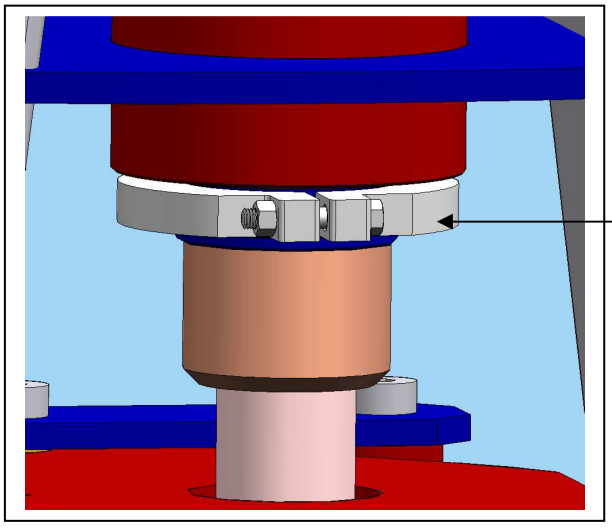
- Excessively packing the load with the boom. Evidence of this may be the bulkhead of the body may be bowed outward.

- Forcing the dump body down with the boom. Evidence of this may be the bulkhead of the body is dented down.

- Improper positioning of the boom prior to raising the dump body. Evidence of this may be the underside of the main boom will be dented and scarred.

Improper lock collar installation and/or the improper operating practices listed above, could result in the head assembly being pulled up out of the pedestal assembly. The separation of these two loader components will result in equipment damage, and could result in serious personal injury or death.

Maintenance and shop personnel must continuously check for the above listed signs of abuse, and must report their observations to the person responsible for the operation practices of the trash loader operators. Corrective measures must be taken to stop abusive loading practices.



Lock Collar

(Also shown on Diagram No. 1300 in “Dia. & Drawings” Section of this manual (see Item No. 9).

BACK-UP ALARM

All truck mounted loaders have back-up alarms that must sound any time the gear shift selector is in reverse “R”. The back-up alarm is on the daily checklist of items to be checked prior to leaving the storage facility. If the back-up alarm is not working, it must be repaired prior to putting the vehicle in service.

⚠ WARNING

ALARM MUST SOUND WHEN BACKING UP. DO NOT BACK UP WITHOUT HAVING SOMEONE CLEAR BEHIND THIS VEHICLE.

It is the operator’s responsibility to make sure that the area behind the loader is clear before backing up.

“BOOM-UP” ALARM

A warning system that alerts the loader operator when the boom is not stowed properly for travel. A sensor is installed on the boom, and an audible alarm and light in the truck cab. When the operator enters the truck cab after using the loader, the warning light and audible alarm will alert him if the boom travel height exceeds 13 feet.

This system should be viewed as a tool to help operators measure the height of their boom, but more importantly, to warn the loader operators that their boom is above safe height for travel. It is not intended to replace an operator’s good judgment on safe travel height of their boom.

Operators should always be aware that some routes may have streets, roads, alleys, etc., that do not comply with the legal height requirement of 13’6”, and should conduct their operations accordingly.

⚠ WARNING

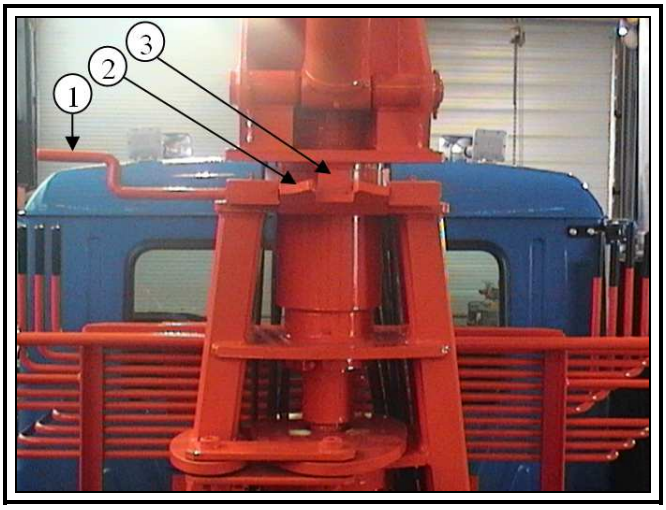
BEFORE MOVING TRUCK, BOOM MUST BE STOWED TO LOWEST POSSIBLE HEIGHT; MAX. BOOM HEIGHT NOT TO EXCEED 13’6”.

This boom-up warning system became a standard feature of our loader in April, 2002. If you have an older model Lightning Loader® that does not have this boom-up warning system, you can contact our Parts Department and order a retro-fit kit to install this system.

SWING LOCK

It is intended that the Petersen Model BL Loader is used as a part of a system that includes a roll-off container in which the bucket and boom are stowed for travel. Because it is possible for the loader vehicle to travel without a roll-off container, your loader has a mechanical swing lock mechanism that locks the main boom in place when engaged.

When traveling without the roll-off container, the bucket must be resting between the roll-off rails, and the swing lock engaged. **Failure to follow these instructions could create a safety hazard which could result in property damage and/or personal injury or death.**



Locking Procedure:

1. Center the main boom over roll-off frame. Positioning of the boom may require minor adjustments to engage lock.

2. Once proper alignment is made, rotate swing lock handle (1) to engage lock. The retainer plate (2), when rotated, will engage the head stop (3), and lock the boom in place.

3. Lower boom and rest closed bucket between roll-off rails. Bucket must be at rest on a support structure that prevents the bucket from damaging any hydraulic or electric connections.

SAFETY SYMBOLS

Your loader has required safety decals (see following pages) that alert those operating, working around, or performing maintenance on the loader of certain safety hazards. The safety decals are used to show the consequence of human interaction with a hazard in terms of:

1. The degree of severity.
   (minor injury, severe injury, death)

2. The probability of severity.
   (WILL result in, COULD result in)

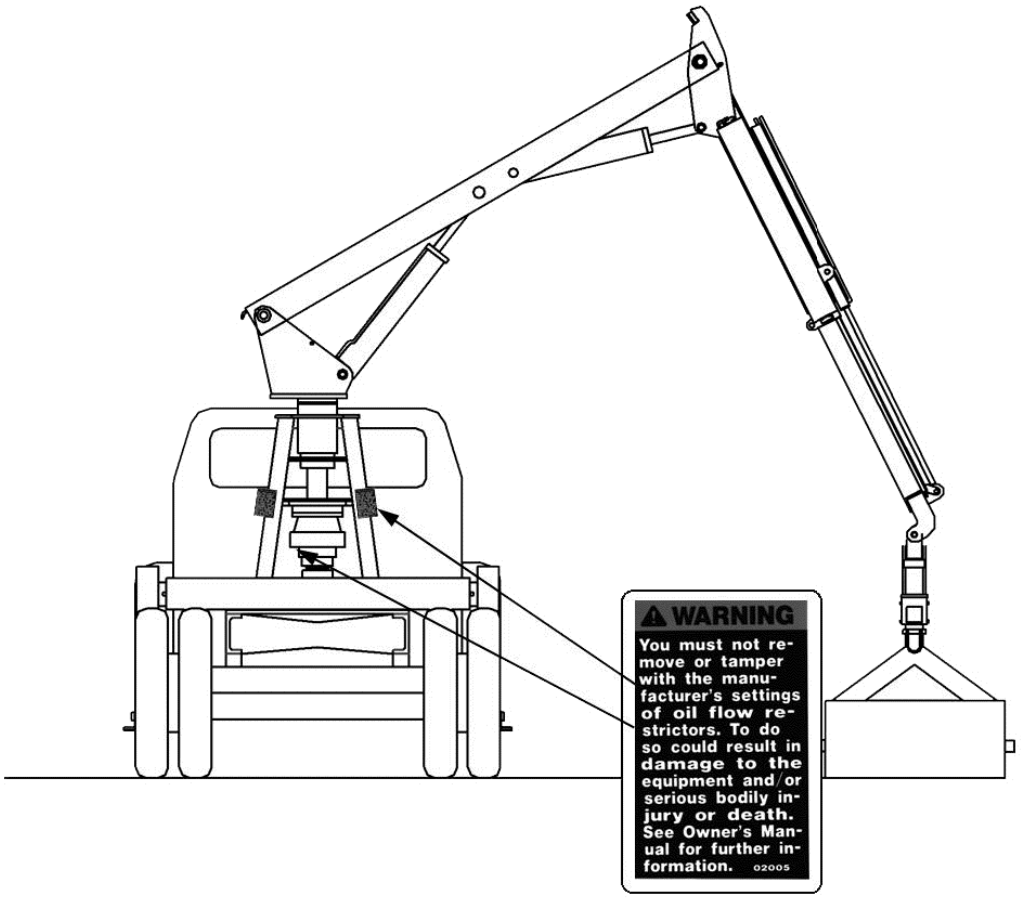
The following definitions for identifying hazard levels are provided with their respective signal words.

DANGER Immediate hazards which WILL result in severe personal injury or death.

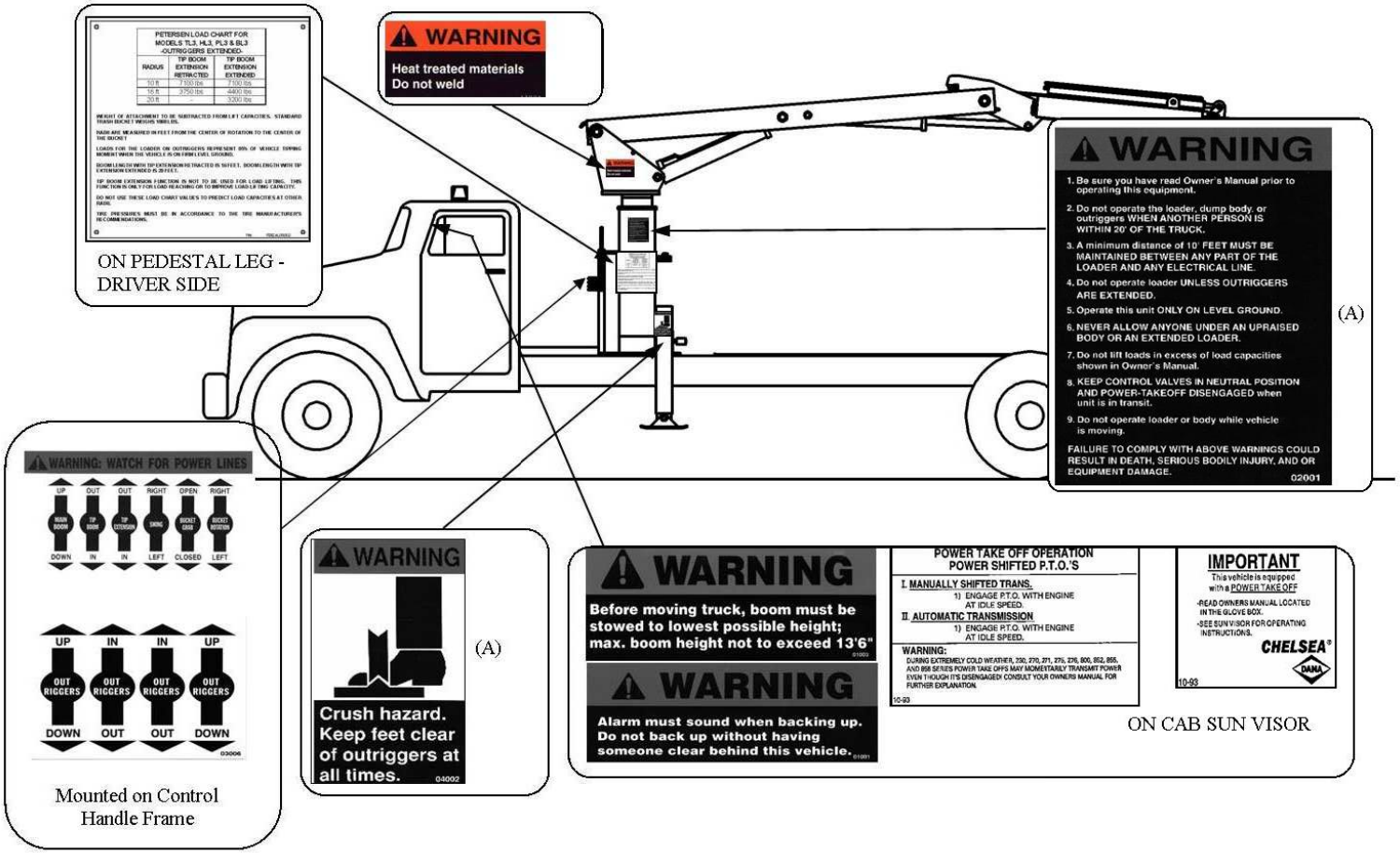
WARNING Hazards or unsafe practices which COULD result in severe personal injury or death.

CAUTION Hazards or unsafe practices which COULD result in minor personal injury or product or property damage.

MODEL BL-3 TRASH LOADER - REQUIRED SAFETY DECALS



MODEL BL-3 TRASH LOADER - REQUIRED SAFETY DECALS



(A) ONE DECAL ON EACH SIDE OF LOADER IN LOCATION SHOWN

Part 4: Controls

THROTTLE CONTROL

Throttle controls are installed for loaders mounted on a truck chassis. For loaders mounted on trucks with mechanical engines, either a manual throttle or a Muncie Hydrothrottle is installed. For loaders mounted on trucks with electronically controlled engines, a manual switch is used to advance the engine speed. The engine speed is advanced to the preset RPM, thus increasing the volume of oil available for loader functions. The hydraulic system is designed for maximum oil flow of 18 gallons per minute. Note that some hydraulic systems do not require throttle advance and will generate 18 GPM at idle speed, if your truck doesn't have a throttle advance switch then the loader should only be operated at idle. DO NOT USE SOME OTHER MEANS TO INCREASE RPM'S AS THIS WILL OVERHEAT THE HYDRAUILC SYSTEM.

Exceeding preset RPM will cause excess oil flow, which may cause unsafe operating speeds, excessive oil temperature, undue wear and tear on the loader and chassis.

Some signs of throttle control mal-adjustment or tampering are:

1. Leaking hydraulic seals caused by excess heat.

2. Prematurely worn loader components caused by excess operating speed.

3. Sticks, bricks, rocks, etc. found in the truck cab may indicate the loader operator has purposely intended to exceed preset engine RPM by jamming the truck accelerator.

PTO OVER-SPEED CONTROL

The over-speed control is a device that disconnects the PTO or diverts the flow of oil back to tank rather than to the loader valves.

The purpose of this control device is to prevent excess oil flow to the hydraulic system, which could happen if the throttle control device is altered or over-ridden.

<u>Power Take-Off Manual Transmission:</u>

Manual Shift Control – The PTO is engaged when the knob on the dash or floor is pulled out and disengaged when the knob is pushed in. The truck gear shift lever must be in neutral, parking brake set, and the clutch depressed whenever the knob is moved.

Air Shift Control – The PTO is engaged when the switch is moved to apply air to PTO, the “On” position. The PTO is disengaged when the switch is in the “Off” position. The truck gear shift lever must be in neutral, the parking brake set, and the clutch depressed when the switch is moved.

Power Take-Off Automatic Transmission:

Electrical Shift Control – The recommended procedure is to bring the vehicle to a full stop, place the truck gear shift lever in the neutral position, set the parking brake, and then engage the PTO. At the completion of loading operations, disengage the PTO, apply the service brakes, disengage the parking brake, and then select the appropriate transmission gear.

Hydraulic Tie-in System

This type of system utilizes one of the section valves on the roll off hoist to divert oil to the Petersen Loader valve. With the PTO running a switch on the dash is activated to turn on this valve. This valve is wired thru the TCM to provide an overspeed setting which will act to turn off this valve if the engine rpms go over a certain speed. Since pto ratios and pump displacements are different, this setting can vary. Check with a Petersen representative to determine this setting.

PARK BRAKE

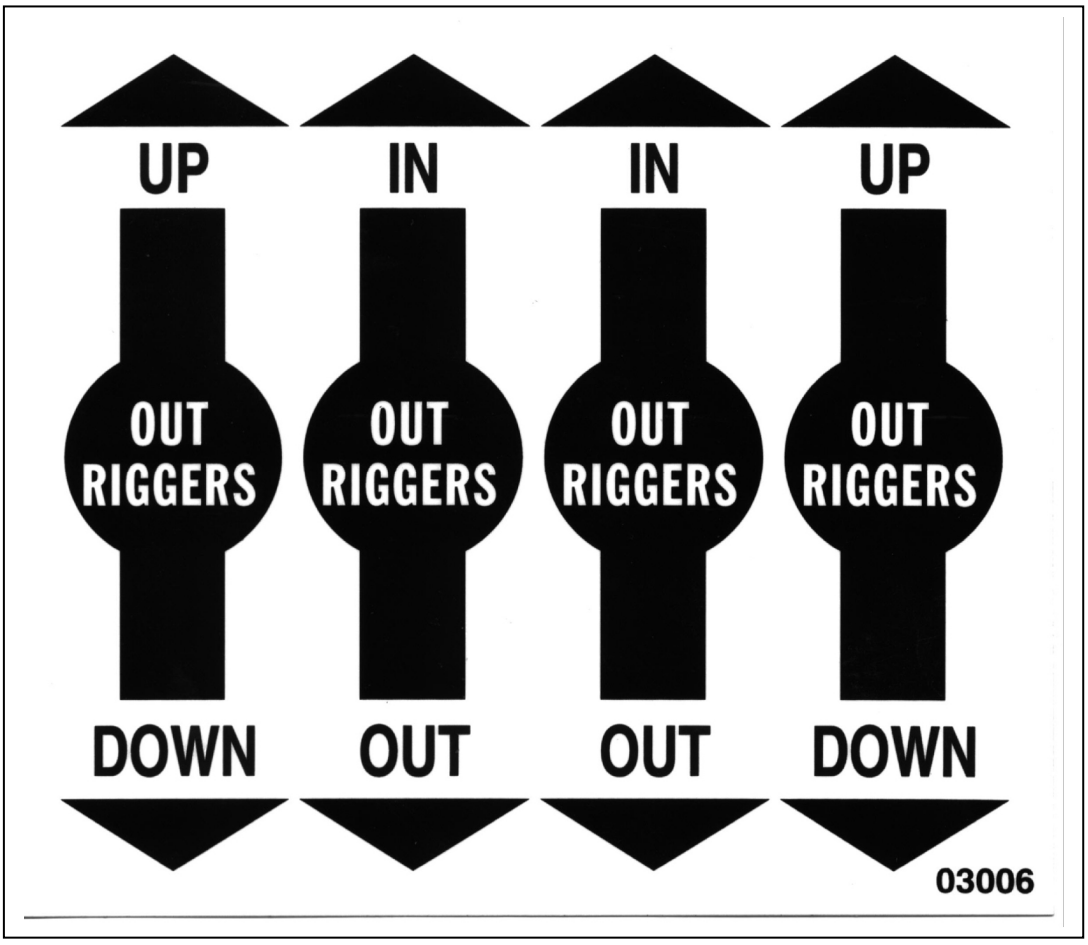
The truck brake must be set before leaving the cab for any reason.

STANDARD LOADER CONTROLS

The loader control placards indicate the direction to actuate the control handles for various unit functions. The loader placard gives visual instructions for boom elevation, boom swing, tip boom elevation, tip boom extension, bucket grab, and bucket rotation. The outrigger placard gives visual instructions for horizontal outrigger in/out, and vertical outrigger up/down.

Outriggers:

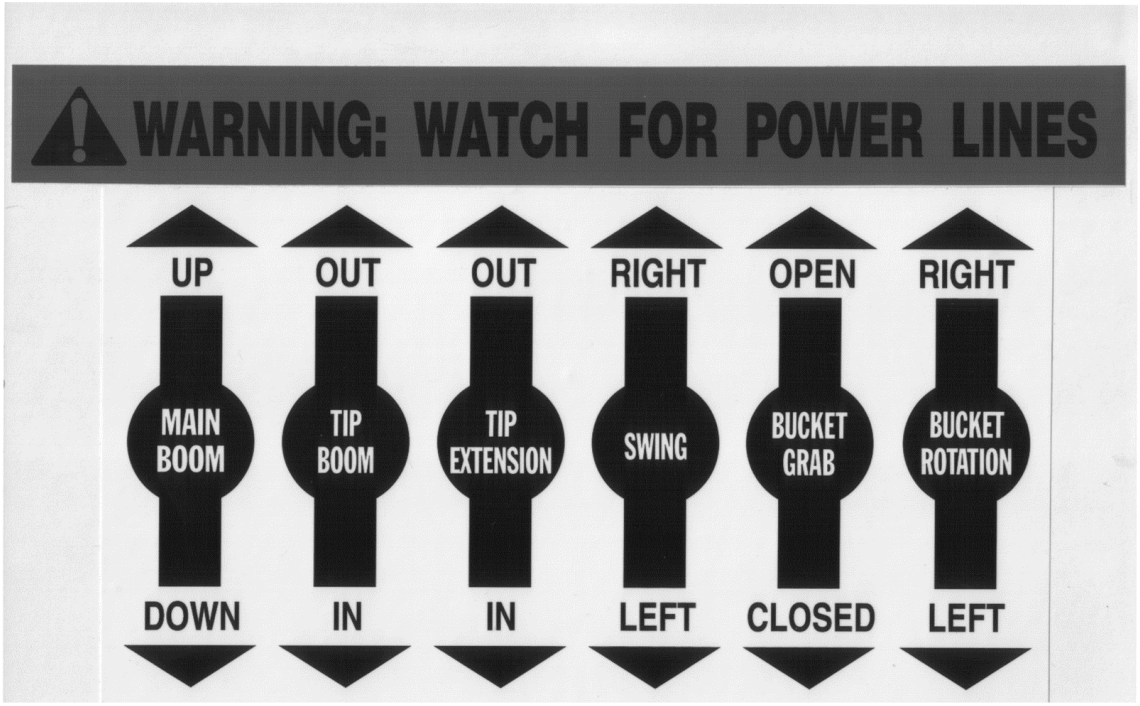
The Model BL3 Loader has outrigger handles mounted below the other control handles. There is a set of four (4) handles on each side of the work platform on loaders with dual walk thru controls, and they are configured the same on each side of the platform. In the four (4) handle configuration, the two (2) handles on the right operate the right outrigger, and the two (2) handles on the left operate the left outrigger. The following decal shows the control handle configuration, and the arrows indicate the direction to push or pull the handle for each function.



Standard Controls

The standard Model BL3 has six (6) control handles that activate the loading operations of the loader. The following decal shows the control handle configuration, and the arrows indicate the direction to push or pull the handle for each function.

The control handle configuration is the same at both operator stations on loaders with dual walk thru controls.

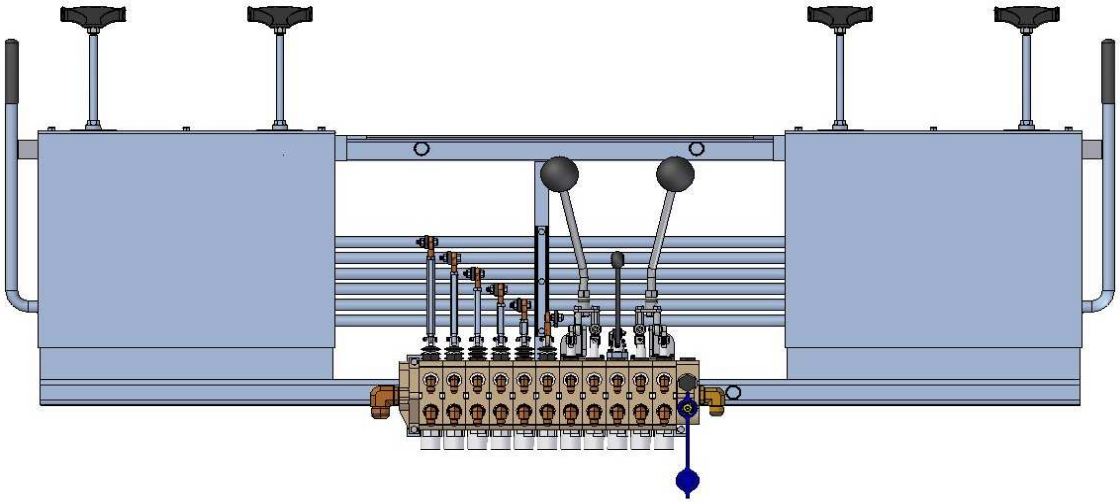


On units equipped with dual controls, always operate the loader on the side closest to the debris being loaded. Do not store any collectibles on the operator's platform, as they can create a tripping hazard or become lodged in the controls.

During all operations, the controls should be feathered when beginning or terminating a movement to prevent sudden starting or stopping which imposes undue shock loads on the equipment. Feather the controls by moving the valve handle smoothly from the neutral position to start motion. After a slow, smooth start, move the valve handle control to extreme for full speed. Just before stopping movement, move valve handle control smoothly back to the neutral position.

Quadstick Controls

There are two (2) joystick handles on each side of the operator's platform. The operating functions of the two sides are identical, so the operator uses the same movements on either side to control the boom elevation, boom swing, tip boom extension, bucket grab, and bucket rotation.

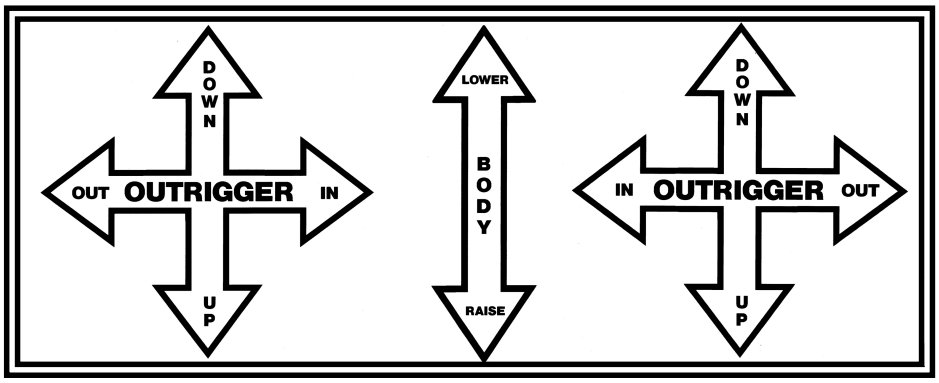


At the center of the work platform are three (3) control handles. The two handles with the round knobs are the outrigger control handles. The round knob on the left controls the left outrigger, and the round knob on the right controls the right outrigger. The handle between the outrigger control handles is the body dump handle.

The optimum, safe method of operating the controls is by feathering. **Do not jerk the control levers to full speed, or from one extreme to another.** Feather the controls by moving the joystick smoothly from the neutral position to start motion. After a slow, smooth start, move the joystick control to extreme for full speed. Just before stopping movement, move the joystick control smoothly back to the neutral position.

On units equipped with dual controls, always operate the loader on the side closest to the debris being loaded. Do not store any collectibles on the operator's platform, as they can create a tripping hazard or become lodged in the controls.

Outriggers and Dump Body



Left Outrigger Dump Body Right Outrigger

Left Outrigger Handle:

Move the handle to the left to extend the left horizontal outrigger.
Move the handle to the right to retract the left horizontal outrigger.
Push the handle forward to lower the left vertical outrigger foot.
Pull the handle back to raise the left vertical outrigger foot.

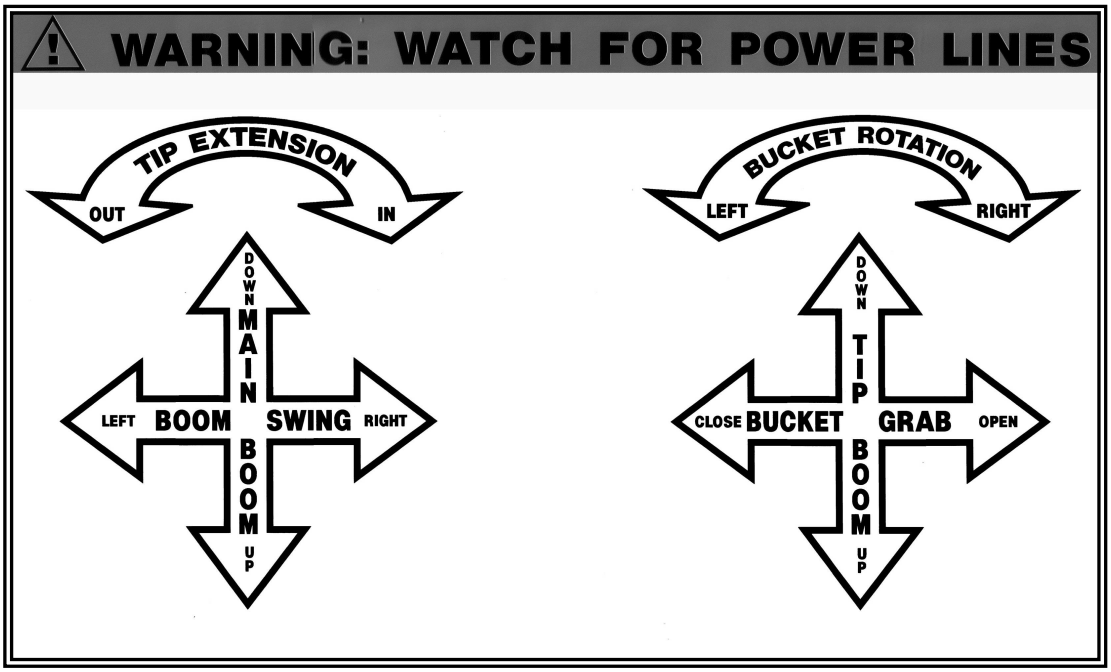
Right Outrigger Handle:

Move the handle to the right to extend the right horizontal outrigger.
Move the handle to the left to retract the right horizontal outrigger.
Push the handle forward to lower the right vertical outrigger foot.
Pull the handle back to raise the right vertical outrigger foot.

Body Dump:

Pull the handle back to raise the dump body.
Push the handle forward to lower the dump body.

Quadstick Controls



Left Joystick:

Boom Swing: Move handle right to make boom swing right.
Move handle left to make boom swing left.

Main Boom: Pull handle back to raise boom.
Push handle forward to lower boom.

Tip Ext.: Twist handle counter-clockwise to extend tip extension out.
Twist handle clockwise to retract tip extension in.

Right Joystick:

Tip Boom: Pull the handle back to raise tip boom.
Push handle forward to lower tip boom.

Bucket Grab: Move handle right to open bucket.
Move handle left to close bucket.

Bucket Rot.: Twist handle clockwise to rotate bucket right (clockwise).
Twist handle counter-clockwise to rotate bucket left (counter-clockwise).

Part 5: Training

All members of the crew must become thoroughly familiar with the operation of controls, the correct operating procedures, maximum lifting capacities, and safety precautions before operating the loader. Operator training is essential. Always be prepared for an emergency. The following pages contain numerous safety precautions, information, and operating instructions that must be observed while performing work operations.

The health, safety and well-being of each member of the crew is of primary importance. Consequently, each member has an obligation to himself, and to his fellow workers, to make sure safe operating procedures are followed. All operating regulations recommended by the manufacturer, the employer and by municipal, state and federal agencies must be observed. The operating procedures set up in this manual are Petersen's recommendations and do not necessarily cover employer and governmental regulations. Each operator must know and observe those regulations.

Become familiar with all equipment checks. You should make daily equipment inspections and be able to spot any abnormality or malfunctions before beginning an assigned task, while working or after completing the task. There is a high degree of reliability built into your equipment, but there is always a possibility of mechanical failure or power failure due to incomplete service or abnormal wear. An operator should never take another's word. He should always thoroughly check the equipment himself.

Each crew member must receive thorough instructions on the care and maintenance of this machine, thus enabling him to identify and anticipate any problems that may occur. Knowing how the equipment operates will help you recognize when it is not operating properly and that repairs or adjustments are required.

Part 6: Setting Up at the Job Site

An important prerequisite to proper setting up at the job site is to thoroughly plan the lift before positioning the vehicle.

Always seek the best possible work site when parking the vehicle. An ideal parking location at a job site is firm, level dry ground or pavement, located in close proximity to the work station. Avoid uneven, rocky or muddy terrain, or steep grades. Location should be selected such that outriggers can be fully extended and the outrigger pad comes down on a firm, level surface. In the event that it is necessary to use the loader on an inclined surface, extreme care should be used. Loader slewing torque, stability, lifting capacity and other loader control functions may be affected adversely. Particular caution must be exercised with the swing function since a "downhill" inclined surface will increase the slewing speed and lengthen the time it takes to stop the motion. Your vehicle should be positioned in an area free from overhead obstructions and to allow performance of the entire task without repositioning, if possible. The operator must be familiar with the swing arc of the loader. You should position your vehicle so that the load is well within this arc. The swing arc is controlled by positive stops. Damaged or missing head and pedestal stops poses an unsafe condition by allowing the boom to swing too far resulting in damage to the swing actuator, which could also result in loss of boom swing control. Once the vehicle is in position for loading, please follow these precautions and procedures for loading:

<u>Precautions and Procedures for Loading:</u>

- Before leaving the cab, engage all safety lights, place the transmission in neutral, and set the truck brake.

- Always be aware of traffic conditions. Extreme caution should be taken when operating extendible outriggers where there is traffic. The operator should consider the possible safety hazard and take necessary precautions, such as using safety cones to mark the outriggers. The operator should also consider using safety cones to mark the vehicle, if the loading position interferes with traffic flow, or other conditions make the vehicle not easily visible.

- Before commencing work, make sure the debris you are going to load does not conceal any fixed objects, such as fire hydrants, guy wires, etc.

- The vehicle should be positioned so that it is impossible for any portion of the equipment to come within the minimum required safe distance to any energized power line. Maintain a clearance of at least 10 feet between any part of the loader and any electrical line. Remember, power lines deflect in winds and additional clearances must be allowed. Death or serious injury may result from contact or arcing due to inadequate clearance to anyone

working on or around the loader. All overhead wires should be considered energized until the electrical utility authorities verify that they are not and the wires are visibly grounded.

- Do not operate the loader during electrical storms, when high wind conditions exist, or in poorly lighted conditions.

- Your loading area must be clear of people. Do not operate the loader, outriggers, or dump body if another person is within twenty feet of the equipment.

- Do not allow any person under a raised body or extended loader.

- If your model loader uses a ladder for access to the loader station, use provided handholds and steps. Face the steps when getting on and off. Never use controls as handholds. Do not mount the machine if handholds or steps are broken or missing. Repair them first.

Failure to heed these instructions can result in serious personal injury or death.

Part 7: Loading Procedures

Engage the power-take-off. For cold weather operation, allow the loader hydraulic system to reach operating temperature before commencing work.

Before conducting any boom operations, extend all outriggers to level the loader side to side. When extending outriggers out and down, ensure that the vehicle is stabilized. To develop rated load capacity, the outriggers should be fully extended. Provide blocks, if necessary, to level the unit on sloping ground or bearing pads if the outriggers tend to sink into soft terrain. Some concrete surfaces are relatively thin and cannot withstand outrigger loading. Concrete can break through and cause instability.

Remember this safety information regarding the outriggers:

- Keep feet clear of outriggers at all times to avoid serious crushing injury.
- Failure to use the outriggers when loading may create an unstable condition, including the loader overturning, that could result in serious personal injury or death.

Do you know the load capacity of the loader? Refer to the "Load Capacity Chart" in this manual for information regarding load capacities. The “Load Capacity Chart” is also riveted to the pedestal of the loader. Do not attempt to lift more than the capacities shown on the load chart for your model loader at the correct radius.

For loaders with manual throttle controls, set the throttle control to desired RPM, depending on loading conditions. Remember, DO NOT exceed the preset throttle control setting.

<u>To make the lift:</u>

1. Raise boom from inside of dump body and swing to trash pile. Use tip extension, if needed, and rotate bucket so that it is aligned with trash.
2. Open the bucket, lower around trash, and close the bucket so that you have a firm grip on the trash. Raise the boom slightly and activate the bucket grab once again to make sure you have a firm grip on the trash.
3. Lift and swing the load over the dump body. In order to minimize the height and stress on the boom, it is recommended that the tip extension be retracted prior to swinging the load. It is recommended to load the front of the body first.

When loading the dump body, please follow these precautions:

- **Do not** use the bucket to crowd the load to the front of the dump body as you can damage the bucket and other loader components.
- **Do not** overload the dump body. You must have room to stow the bucket within the body sides for travel.
- **Do not** allow limbs or other debris to protrude from the dump body.
- **Do not** excessively pack the load. Excess packing could result in dump body floor damage and loader damage.

Continue the loading procedure until all trash is loaded. If it is necessary for the operator to manually rake any remaining trash into a smaller pile, the boom must be stowed in the dump body or on the ground, and the PTO disengaged when the operator leaves the control station.

Please follow these additional loading precautions at all times:

- Do not leave a load suspended when the operator is away from the control station.
- Only operate the loader from the operator's station. Do not attempt to operate the loader from any position other than the operator's station.
- Never climb on operator controls or other loader components.
- Do not sit or stand at operator control station when truck is in motion. The control station is to be manned only when the vehicle has been parked and the procedures we previously discussed have been followed for setting up to load.
- Do not attempt to lift loads exceeding manufacturer's recommended safe working capacity.
- Do not impose lateral loads on the boom.
- Do not use stability to determine safe working load.

To stow the boom and bucket:

There are two proper ways to stow the bucket in the dump body. In each case the bucket sides should be parallel to sides of the dump body. The operator can either stow the bucket in the opened position on the body floor, or roll the closed bucket over on top of the load. In both cases it is necessary for the operator to leave room in the dump body to stow the boom and bucket. Always ensure that at least half of the bucket and tip of the boom are below the top of the body sides before travel.

Bucket Roll Method:

The rear of the dump body must be at least half full in order to use the bucket roll method for stowing the boom and bucket.

1. Use the control handles on the curb side.

2. Close the bucket and rotate until bucket sides are parallel to body sides.

3. Move the bucket to the curb side rear inside corner of the dump body.

4. Rest the bucket on the load.

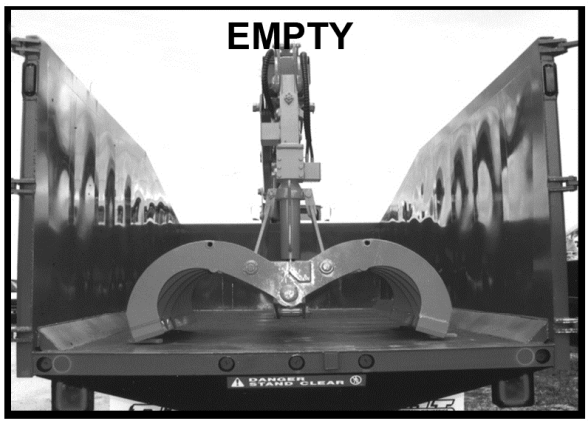
5. Simultaneously boom down and swing the boom to the street side until the boom tip and at least half of the bucket are below top of body sides. Ensure that no part of the loader or load is over legal height of 13 ft. 6 in.

Please see illustrations on the following page for examples of correct and incorrect ways to stow the bucket for travel.

WARNING! – Failure to stow the boom and bucket as instructed could allow the boom to slew (swing) and the bucket to fall outside of the body. Loss of boom control with the bucket outside of the dump body could result in damage to objects in the vicinity of the grapple truck, and/or serious injury or death to people in the vicinity of the grapple truck.

Once the bucket has been properly stowed for travel, retract all outriggers, disengage the PTO, and pickup any safety cones or markers that were used. Release the parking brake, and you're ready to travel to the dump site.

CORRECT METHODS OF STOWING THE BOOM & BUCKET



- BUCKET OPEN AND AT REST ON DUMP BODY FLOOR.

NOTE: FOR ILLUSTRATION PURPOSES REAR DUMP BODY DOORS ARE SHOWN OPEN. REAR DUMP BODY DOORS MUST BE CLOSED AND LOCKED EXCEPT WHEN DUMPING THE LOAD

- BUCKET ROLLED OVER WITH JAWS TO RIGHT REAR OF DUMP BODY
- BOOM AT SAFE TRAVEL HEIGHT & BOOM TIP BELOW TOP OF BODY SIDES
- MORE THAN 1/2 OF BUCKET MUST BE BELOW TOP OF BODY SIDES
- LOAD COVER DEPLOYED

INCORRECT METHODS OF STOWING THE BOOM & BUCKET

- BUCKET NOT CONFINED INSIDE OF DUMP BODY
- DEBRIS HANGING OUTSIDE OF DUMP BODY
- BOOM OVER LEGAL HEIGHT OF 13 FT. 6 IN.

- BOOM OVER LEGAL HEIGHT OF 13 FT. 6 IN.
- BUCKET NOT CONFINED INSIDE OF DUMP BODY
- DEBRIS HANGING OUTSIDE OF DUMP BODY

Part 8: Off-Loading/On-Loading the Roll-Off Container

As you prepare to off-load or on-load the roll-off container, it is important that you choose a level, firm area. Each of the following steps must be followed precisely and in sequence. The procedure must not be done in a hurried manner.

1. Set the parking brake, place the transmission in neutral, and engage the PTO.

2. Extend the outriggers out and down to within six to eight (6" – 8") inches from the ground. This allows stabilization of the vehicle when the main boom is in the raised position, and also allows for movement of the vehicle if necessary.

3. Raise the main boom to maximum elevation, and keep centered over truck frame. Tip boom is retracted and horizontal, and the bucket is open.

   Note: The roll-off container, roll-off frame, and its operating system were installed after your unit left our manufacturing facility. Therefore, follow the instructions provided by the roll-off container vendor for on-loading or off- loading the container. If the loading procedure requires movement of the vehicle, remember to release the parking brake.

4. Once the roll-off container has been placed on the roll-off frame, and has been secured, lower the main boom and bucket into the roll-off container. The bucket should be open and at rest on the floor of the container. Raise and retract the outriggers.

   Remember, if you off-load the roll-off container and do not on-load another container, the boom and bucket must be stowed and secured as instructed in the "Part 3: Safety Devices – Swing Lock" section of this manual.

5. Disengage to PTO.

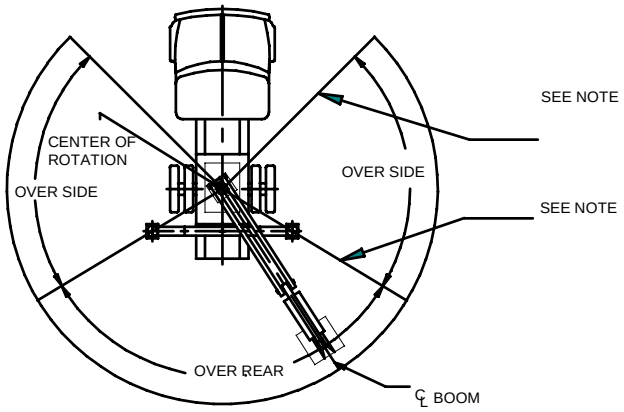
MODEL TL 2		
RADIUS	No. 1 OUTRIGGERS	No. 3 OUTRIGGERS
10 ft	5320 lb *	7100 lb
16 ft	2650 lb *	3750 lb

MODELS TL 3, PL 3, HL 3, BL 3 & DL 3 OUTRIGGERS EXTENDED		
RADIUS	TIP EXTENSION RETRACTED	TIP EXTENSION EXTENDED
10 ft	7100 lb	7100 lb
16 ft	3750 lb	4400 lb
20 ft	-	3200 lb

MODEL RL 2 WITH OUTRIGGERS EXTENDED		
RADIUS	OVER SIDE	OVER REAR
10 ft	5500 lb *	7100 lb
16 ft	3100 lb *	3750 lb

MODEL RL 3 WITH OUTRIGGERS EXTENDED			
RADIUS	OVER SIDE	OVER REAR	
		TIP EXTENSION RETRACTED	TIP EXTENSION EXTENDED
10 ft	5500 lb *	7100 lb	7100 lb
16 ft	3100 lb *	3750 lb	4400 lb
20 ft	1800 lb *	-	3200 lb

RADIUS	MODEL SL 2	MODEL SL 3	
		TIP EXTENSION RETRACTED	TIP EXTENSION EXTENDED
10 ft	7100 lb	7100 lb	7100 lb
16 ft	3750 lb	3750 lb	4400 lb
20 ft	-	-	3200 lb



NOTE: THESE LINES DETERMINE THE LIMITING POSITION OF ANY LOAD FOR OPERATION WITHIN WORKING AREAS INDICATED

LOAD DIAGRAM FOR MODELS RL 2 & RL 3

Weight of attachment to be subtracted from lift capacities. Standard Trash bucket weighs 1000 lbs.

Radii are measured in feet from the center of rotation to the center of the bucket

Loads marked with (*) are limited by the stability of the loader.

Loads for the loader on outriggers represent 85% of vehicle tipping moment when the vehicle is on firm level ground.

Boom length with tip extension retracted is 16 feet. Boom length with tip extension extended is 20 feet.

Tip Boom Extension function is not to be used for load lifting. This function is only for load reaching or to improve load-lifting capacity.

Do not use these load chart values to predict load capacities at other radii.

Tire pressures must be in accordance to the tire manufacturer's recommendations.

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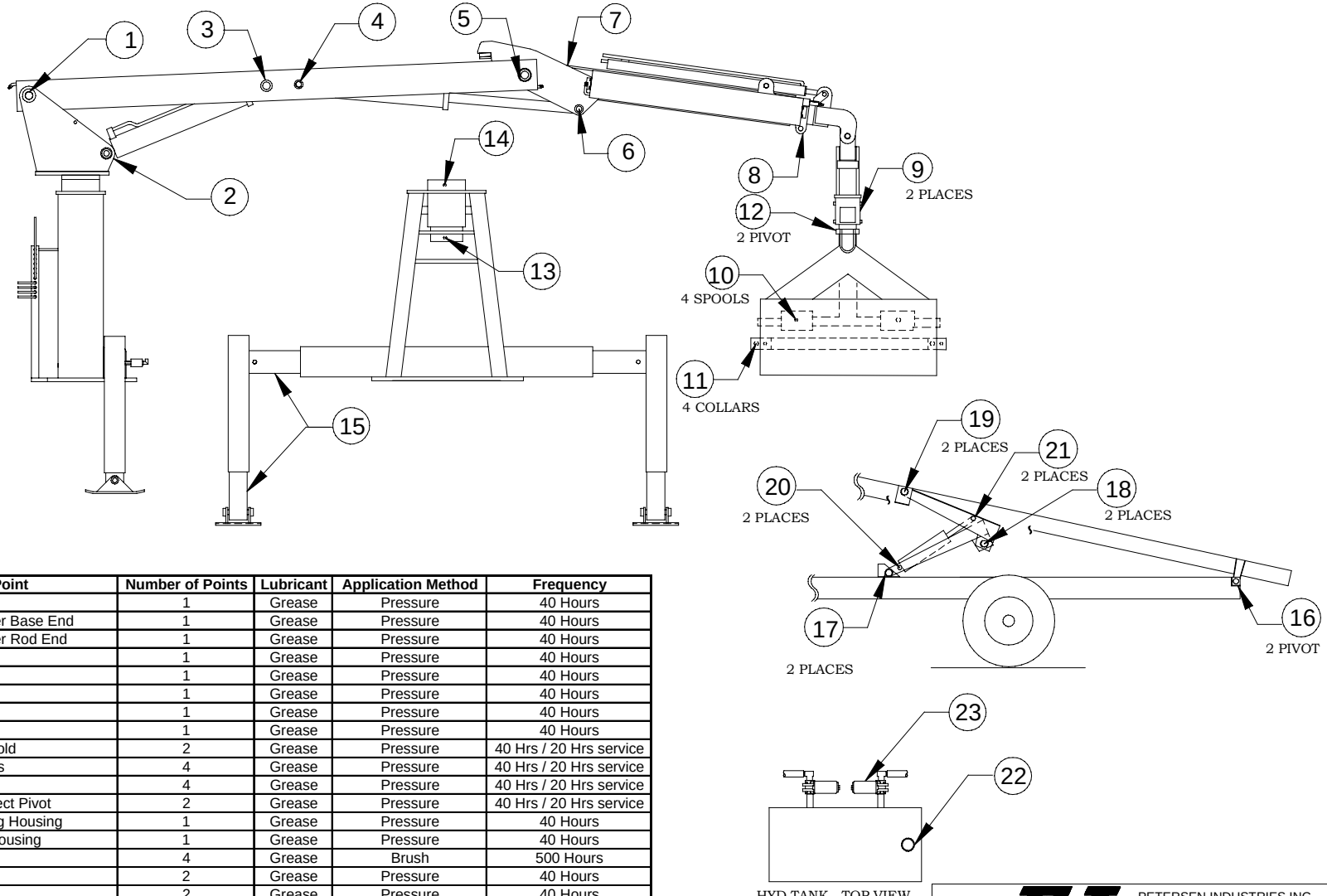
TITLE:			
LOAD CHART FOR TRASH LOADERS			
CAD NO.: 01 00 00 003 4	PART NO.:		SCALE: N/A
DRAWN BY: EJB	APPROVED:	DATE: 8/31/99	SHEET: 1 OF 1



HYD TANK - TOP VIEW

Point Number	Grease Point	Number of Points	Lubricant	Application Method	Frequency
1	Main Boom Pivot	1	Grease	Pressure	40 Hours
2	Main Boom Lift Cylinder Base End	1	Grease	Pressure	40 Hours
3	Main Boom Lift Cylinder Rod End	1	Grease	Pressure	40 Hours
4	Tip Cylinder Base End	1	Grease	Pressure	40 Hours
5	Tip Boom Main Pivot	1	Grease	Pressure	40 Hours
6	Tip Cylinder Rod End	1	Grease	Pressure	40 Hours
7	Tip Extension	1	Grease	Pressure	40 Hours
8	Tip Extension Roller	1	Grease	Pressure	40 Hours
9	Rotator Housing Manifold	2	Grease	Pressure	40 Hrs / 20 Hrs service
10	Bucket A Frame Spools	4	Grease	Pressure	40 Hrs / 20 Hrs service
11	Bucket Main Pivot	4	Grease	Pressure	40 Hrs / 20 Hrs service
12	Bucket A Frame Connect Pivot	2	Grease	Pressure	40 Hrs / 20 Hrs service
13	Spindle Bottom Bearing Housing	1	Grease	Pressure	40 Hours
14	Spindle Top Bearing Housing	1	Grease	Pressure	40 Hours
15	Outrigger Inner Tubes	4	Grease	Brush	500 Hours
16	Body, Chassis Pivot	2	Grease	Pressure	40 Hours
17	Hoist Lower Pivot	2	Grease	Pressure	40 Hours
18	Hoist Scissors Pivot	2	Grease	Pressure	40 Hours
19	Hoist Upper Pivot	2	Grease	Pressure	40 Hours
20	Hoist Cylinder Lower Pivot	2	Grease	Pressure	40 Hours
21	Hoist Cylinder Upper Pivot	2	Grease	Pressure	40 Hours
22	Hydraulic Tank	1	Oil	Fill to Max. Level	40 Hours
23	Hydraulic Filters	2	-	Replace	1000 Hours

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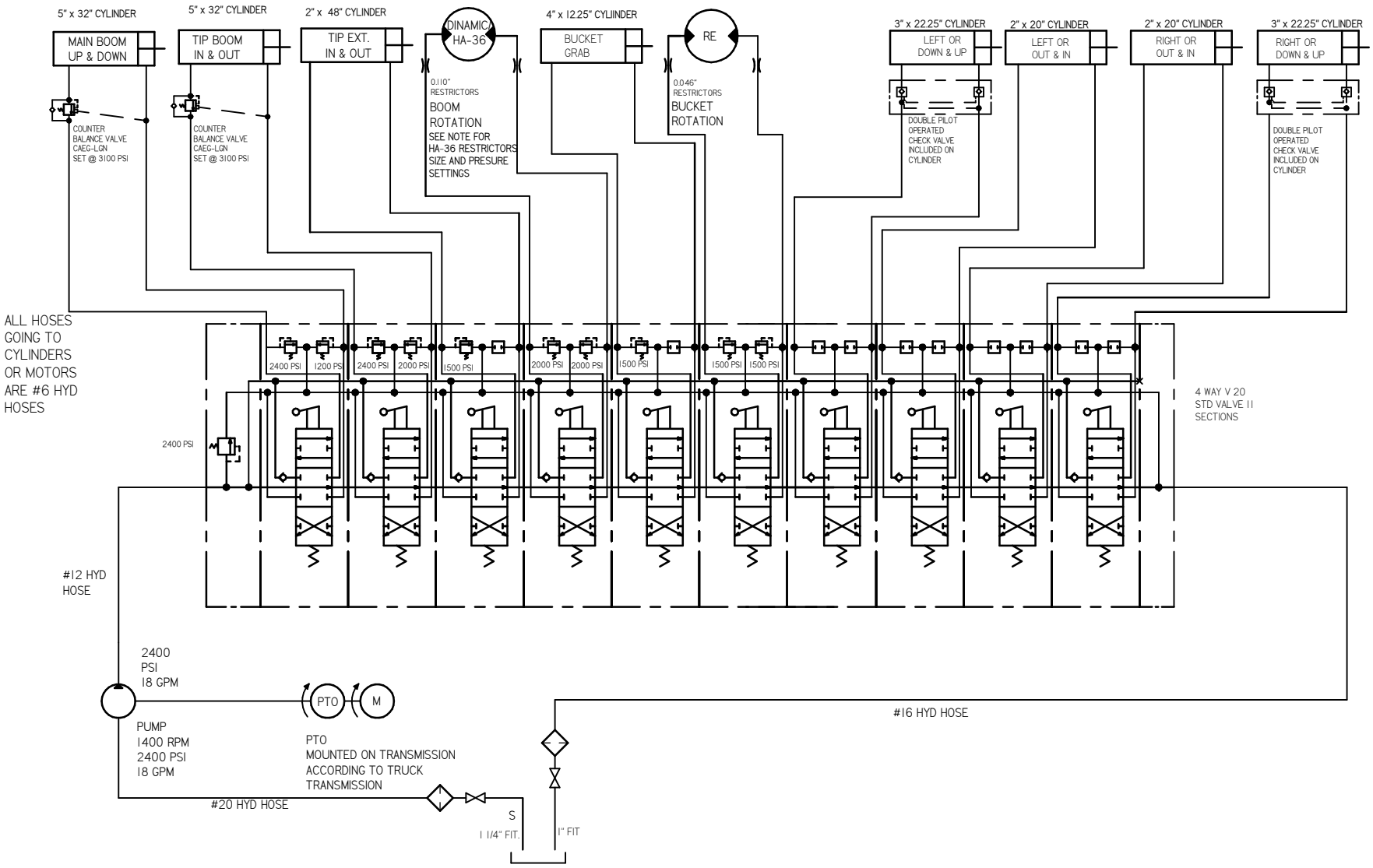
TITLE: LOADER LUBRICATION POINTS

CAD NO.:	PART NO.:	SCALE
01 00 00 001 4	N/A	N/A

DRAWN BY:	APPROVED:	DATE:	SHEET:
E.B.		8/06/99	1 OF 1

INSERT WIRING DIAGRAMS HERE



NOTE: WHEN USING HA36 INSTEAD OF , USE .056" RESTRICTORS AND USE 2400 PSI PORT RELIEF VALVES ON THE P 20 VALVES. WORKING PRESSURE IS 2400 PSI

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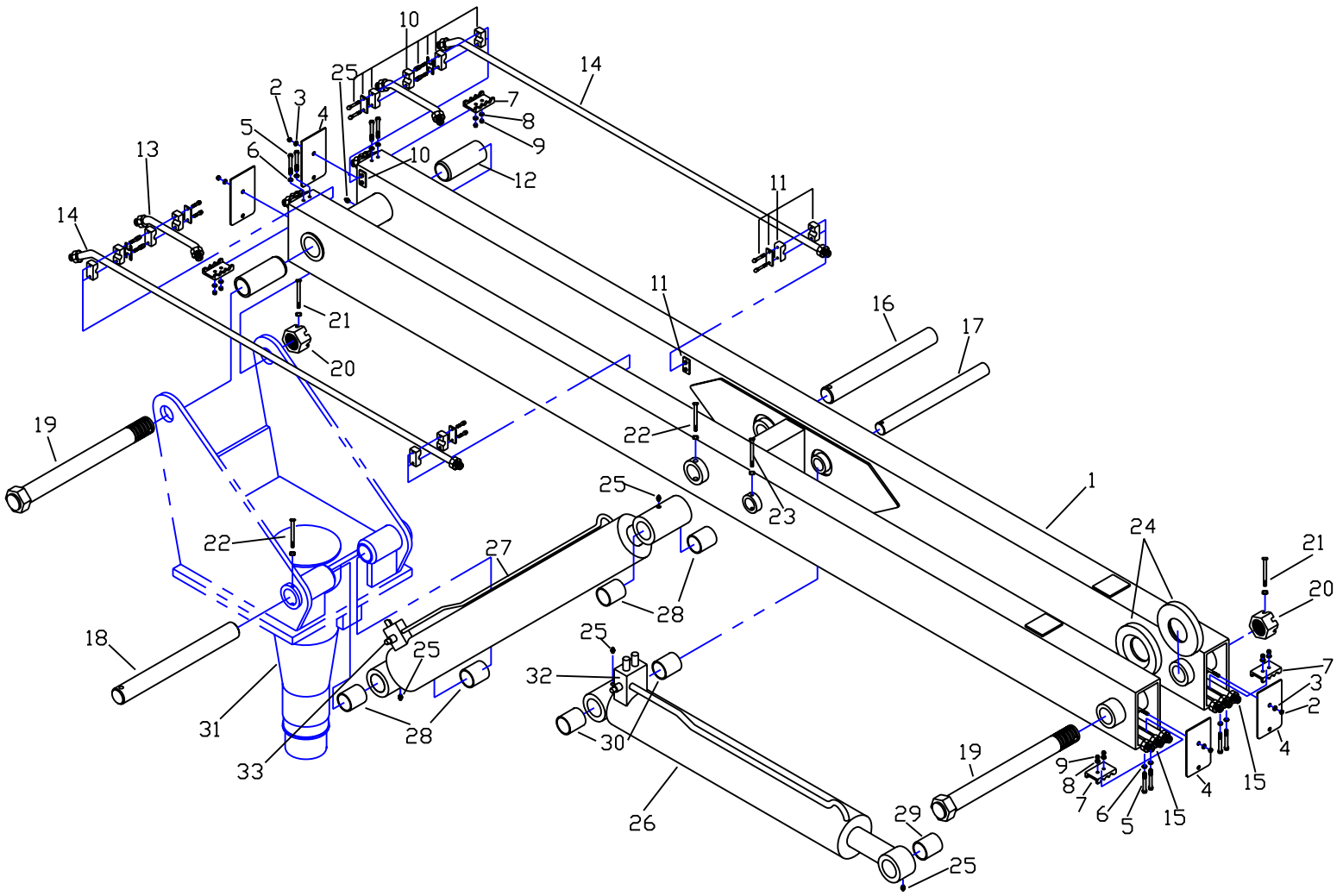
TITLE: HYDRAULIC CIRCUIT FOR BL - 3

CAD NO.:	PART NO.:	SCALE
52 07 15 001 0		N/A

DRAWN BY:	APPROVED BY:	DATE:	SHEET:
London, W.		03/17/2004	1 OF 1



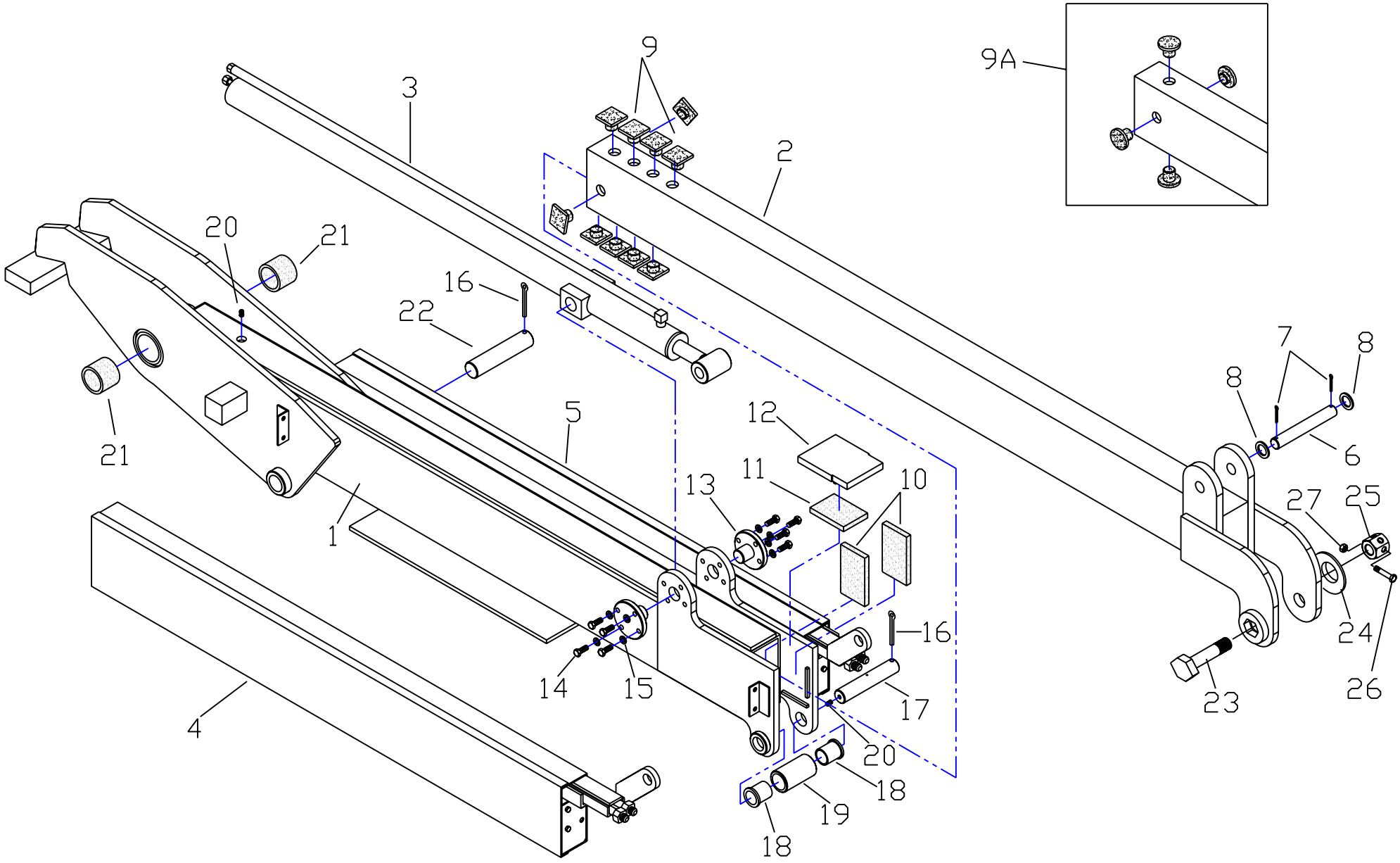
PETERSEN INDUSTRIES INC.
4000 S.R. 60 WEST
LAKE WALES,FL.33859-8234
(863) 676 1493 FX (863) 676 6844

TITLE: TL3 MAIN BOOM ASSEMBLY

CAD NO:	DIAGRAM No.	SCALE
02 03 04 001 4	3100	N/A

DRAWN BY:	APPROVED:	DATE:	SHEET:
E.J.B.		06/18/97	1 OF 1

Dia. No.		Part Name	Order By This Part No.
TL3 MAIN BOOM ASSEMBLY: (DIAGRAM #3100)			
1	*	Main Boom Weldment	108152
2		Nut, 3/8 - 16	NUA06U
3		Lockwasher, 3/8	WAS065
4		End Cap	108225
5		Bolt, 5/16 - 18 x 2"	BL305032U518
6		Flat Washer, 5/16	WAF05U5
7		3-Hole Pipe Clamp	CLP3C
8		Lock Washer, 5/16	WAS055
9		Nut, 5/16-18	NUA05U
10		1-Hole Stacking Hose/Pipe Clamp Assembly	CL5G210
11		1-Hole Hose/Pipe Clamp Assembly	CLH1AP
12		Bushing, Main Boom Pivot	BU503004
13		Boom Tube, 12-45	TU03002
14		Boom Tube, 62-45	TU02002
15		Boom Tube, 140-45	TU03006
16		Pin, Lift Cylinder Rod End	PI30274F
17	*	Pin, Tip Cyl Base End, 2" x 17 1/8"	PI30274F
	*	Pin, Tip Cyl Base End, 1 1/2" x 17"	PI22272F
18		Pin, Lift Cylinder Base End	PI30302F
19	*	Bolt, Main/Tip Pivot, 2" x 20"	BL132320U845
	*	Bolt, Main/Tip Pivot, 2" x 20 5/8"	BL132330U845
20		Nut, Main Boom & Tip Boom Pivot	NUB32HU
21	*	Cotter Pin, 7/16 x 4"	FA020764
	*	Bolt, 7/16" x 4" USS GR8	BL307064U814
	*	Nut, 7/16" USS Stover Lock Nut	NUS07U
22	*	Cotter Pin, 1/2 x 4"	FA020864
	*	Bolt, 7/16" x 4" USS GR8	BL307064U814
	*	Nut, 7/16" USS Stover Lock Nut	NUS07U
23	*	Cotter Pin, 5/16 x 3" for 1 1/2" Pin	FA020548
	*	Bolt, 5/16" x 4" USS GR5 for 1 1/2" Pin	BL305064U518
	*	Nut, 5/16" USS Stover Lock Nut for 1 1/2" Pin	NUS05U
	*	Bolt, 7/16" x 4" USS GR8 for 2" Pin	BL307064U814
	*	Nut, 7/16" USS Stover Lock Nut for 2" Pin	NUS07U
24	*	Thrust Washer, 7/8" Thick	BU507004
	*	Thrust Washer, 5/8" Thick	BU507008
25		Grease Fitting, 1/8" 90 Degree	HF20029
26	*	Cylinder, 5" Tip Boom (Requires 2" Pin)	121102
	*	Cylinder, 5" Tip Boom (Requires 1 1/2" Pin)	CY02008
27		Cylinder, 5" Main Boom Lift	121101
28		Bronze Bushing, Lift Cylinder	121166
29	*	Bronze Bushing, Tip Cyl Rod End, 2"	121167
	*	Bronze Bushing, Tip Cyl Rod End, 1 1/2"	121168
30	*	Bronze Bushing, Tip Cyl Base End, 2"	121166
	*	Bronze Bushing, Tip Cyl Base End, 1 1/2"	BU402014
31		Head & Spindle Assy for HA36 Actuator	107104
		Head & Spindle Assy for SS40 or SAI Actuator	107105
32	*	Cartridge Valve, Tip Boom Cylinder	VA0780T01
	*	Cartridge Valve, Tip Boom Cylinder	VA0780T02
33		Cartridge Valve, Main Boom Cylinder	VA0780T02
	*	Main Boom Assembly Less Pins & Cylinders	108103
	*	NOTE: Item numbers with an asterisk (*) may have part numbers and prices	
		different than what is shown on this pricelist. Please consult with the Petersen	
		Parts Department to help correctly identify these parts for your loader. You	
		may contact our Parts Department at 800/930-5623, ext. 229.	



PETERSEN INDUSTRIES INC.
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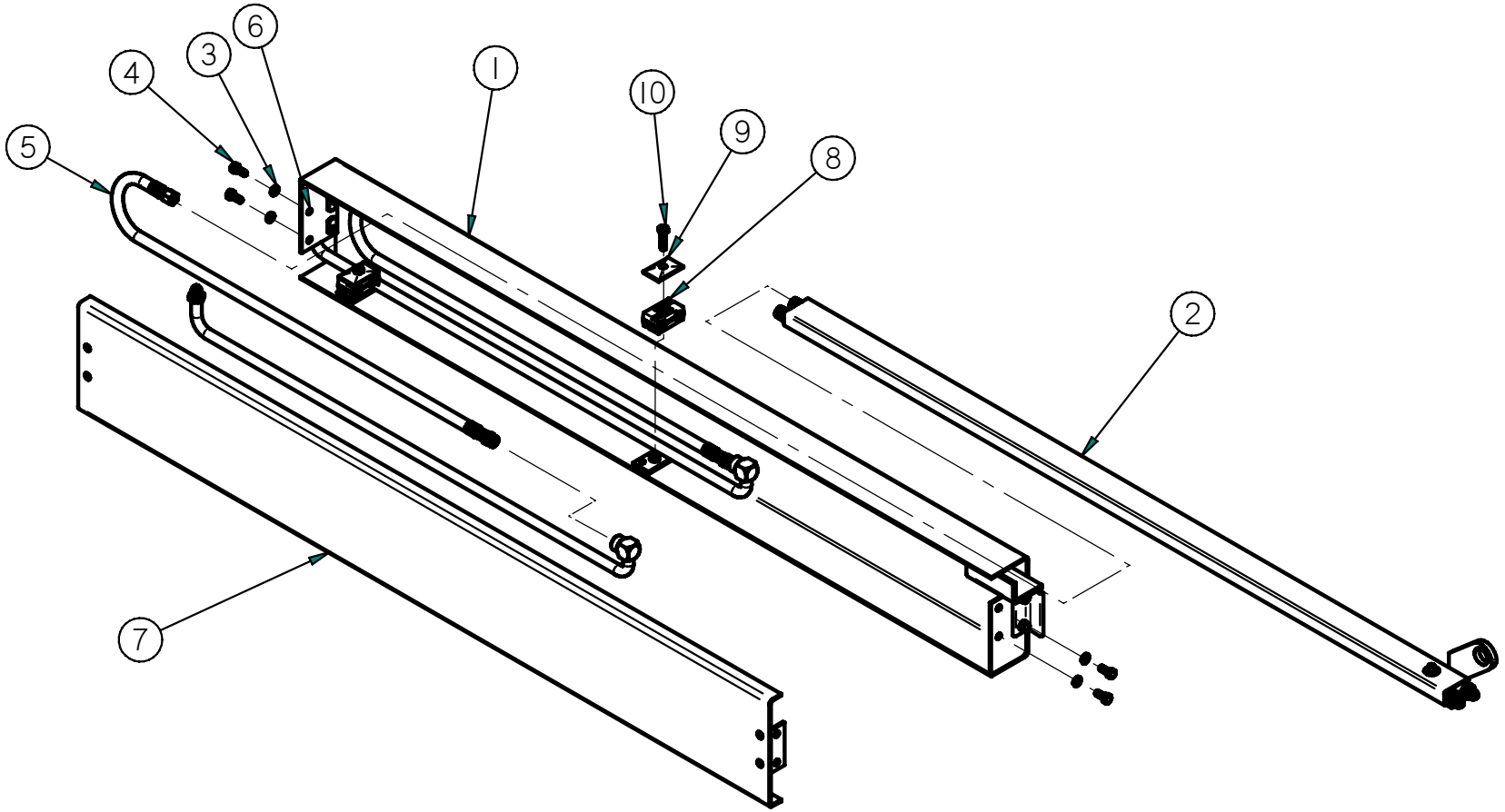
LAKE WALES, FL. 33859-8234
(863) 676 1493 FX (863) 676 6844

TITLE: TL 3 TIP BOOM ASSEMBLY

CAD NO:	DIAGRAM No.	SCALE
02 04 04 001 2	3202	N/A

DRAWN BY:	APPROVED:	DATE:	SHEET:
E.B.		10/5/98	1 OF 1

Dia. No.		Part Name	Order By This Part No.
TL3 TIP BOOM ASSEMBLY (DIAGRAM #3202)			109103
1	*	TL3 Tip Boom Outer Weldment	109152
2	*	TL3 Tip Boom Inner Extension Weldment	109153
3		Tip Extension Cylinder	121105
4		Hose Recoil Box Assy. - Right Side	123122
5		Hose Recoil Box Assy. - Left Side	123121
6		Pin, Tip Extension Cylinder/Recoil Box	PI16112F
		Slide Mount	
7		Cotter Pin, Recoil Box Slide Mount Pin	FA020332
8		Washer, Recoil Box Slide Mount Pin	WAB1624
9	*	Wear Pad, Tip Ext Weldment (Square)	109210
9A	*	Wear Pad, Tip Ext Weldment (Round)	BU202001
10		Wear Pad, Tip Extension Outer Side	BU303003
11		Wear Pad, Tip Extension Outer Top	BU303002
12		Tip Extension Wear Plate Retainer Weldment	109154
13		Trunnion, Tip Extension Cylinder	109205
14		Bolt, Trunnion	BL306016U516
15		Lockwasher, Trunnion	WAS065
16		Cotter Pin, Tip Extension Roller/Tip Cylinder	FA020548
		Rod End	
17		Pin, Tip Extension Roller	PI18105F
18		Bushing, Tip Extension Roller	BU402007
19		Spool, Tip Extension Roller Support	115131
20		Grease Fitting, 1/8" Straight	HF2002S
21		Bushing, Tip Boom Connecting Spool	BU502008
22	*	Pin, Tip Cyl/R Connecting, 2" x 6 3/4"	PI30108F
	*	Pin, Tip Cyl/R Connecting, 1 1/2" x 6 3/4"	PI22108F
23		Bolt, Tip Boom Gimbal	BL120124U87
24		Spacer, Tip Boom Gimbal	WAB2030
25		Nut, Tip Boom Gimbal	102454
26		Bolt, 5/16-18 x 2 1/2 USS G5	BL305040U518
27		Nut, 5/16 USS Stover	NUS05U
	*	NOTE: Item numbers with an asterisk (*) may have part numbers and prices	
		different than what is shown on this price list. Please consult with the	
		Petersen Parts Department to help correctly identify these parts for your	
		loader. You may reach our Parts Department at 800/930-5623, ext. 229.	



Item Number	Title	Part Number	Quantity
1	HOSE RECOIL, HOUSING ASSEMBLY - RIGHT	123126	1
2	TIP BOOM, HOSE RECOIL SLIDE ASSY RH	123124	1
3	WASHER LOCK 5/16 SPLIT	WAS055	4
4	HEX BOLT 5/16-18 X 3/4 USS G5	BL305012U518	4
5	HOSE CUT 36" #6-S RECOIL BOX	HS10576FS	2
6	TUBE, TL3 HOSE RECOIL BOX - CURVED	TU04004	2
7	HOSE RECOIL, COVER ASSEMBLY	123127	1
8	CLAMP, PLASTIC ONLY (2-HOLE) (1 SET)	CLP220	2
9	CLAMP, TOP PLATE ONLY (2-HOLE)	CL5G225	2
10	HEX BOLT 5/16-18 X 1-1/4 UNC G5	BL305020U518	2

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LAKE WALES, FL. 33859-8201
TEL: (863) 676-1493 FAX: (863) 676-6844

TITLE: HOSE RECOIL BOX ASSEMBLY - RIGHT

PART NUMBER: 21 04 04 012 1 / 123122

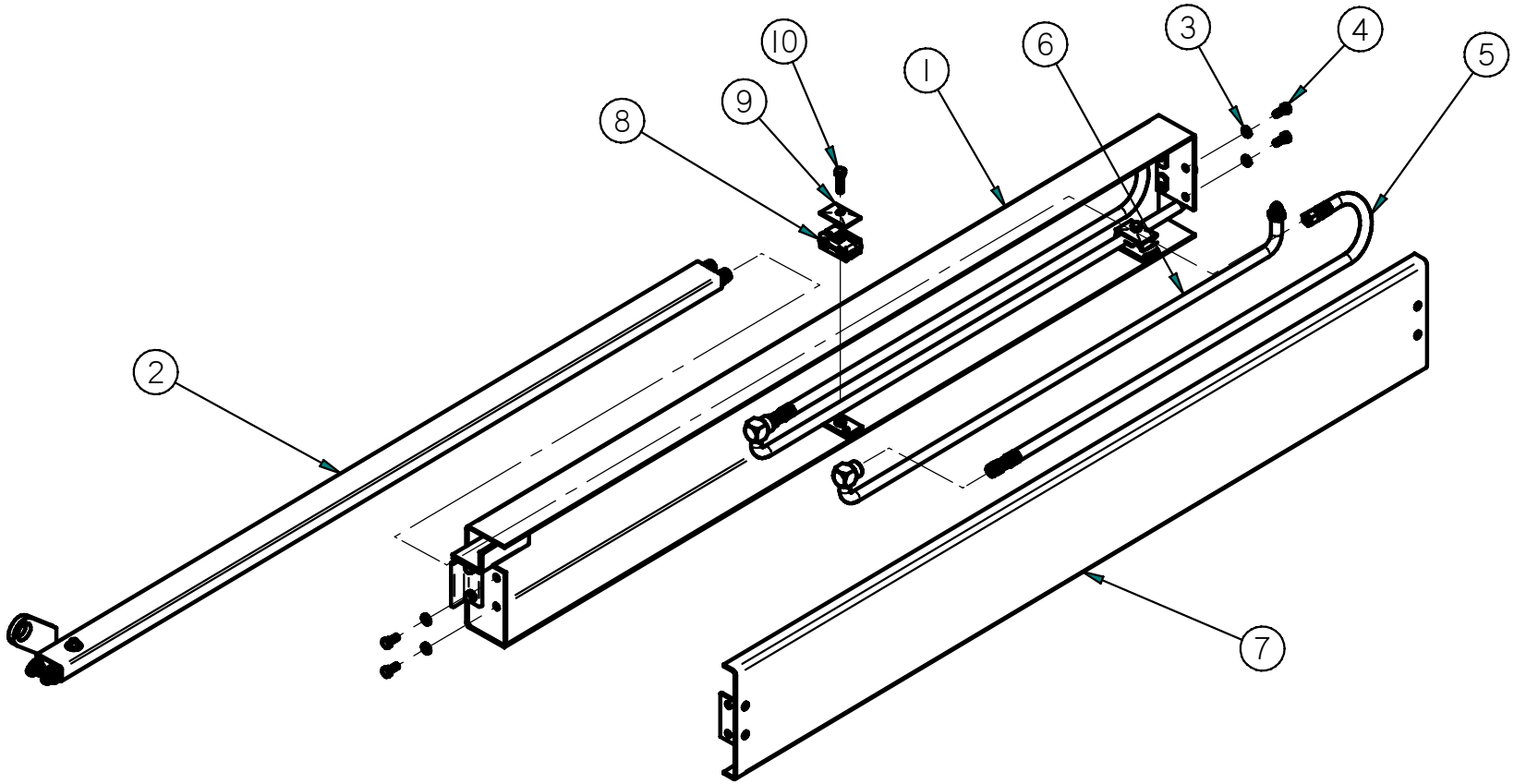
SCALE: NA

DRAWN BY: RB

APPROVED BY:

DATE: 08/05/08

SHEET: 1 OF 1



Item Number	Title	Part Number	Quantity
1	HOSE RECOIL, HOUSING ASSEMBLY - LEFT	123125	1
2	TIP BOOM, HOSE RECOIL SLIDE ASSY LH	123123	1
3	WASHER LOCK 5/16 SPLIT	WAS055	4
4	HEX BOLT 5/16-18 X 3/4 USS G5	BL305012U518	4
5	HOSE CUT 36" #6-S RECOIL BOX	HS10576FS	2
6	TUBE, TL3 HOSE RECOIL BOX - CURVED	TU04004	2
7	HOSE RECOIL, COVER ASSEMBLY	123127	1
8	CLAMP, PLASTIC ONLY (2-HOLE) (1 SET)	CLP220	2
9	CLAMP, TOP PLATE ONLY (2-HOLE)	CL5G225	2
10	HEX BOLT 5/16-18 X 1-1/4 UNC G5	BL305020U518	2

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TEL: (863) 676-1493 FAX: (863) 676-6844

TITLE: HOSE RECOIL BOX ASSEMBLY - LEFT

PART NUMBER: 21 04 04 013 1 / 123121

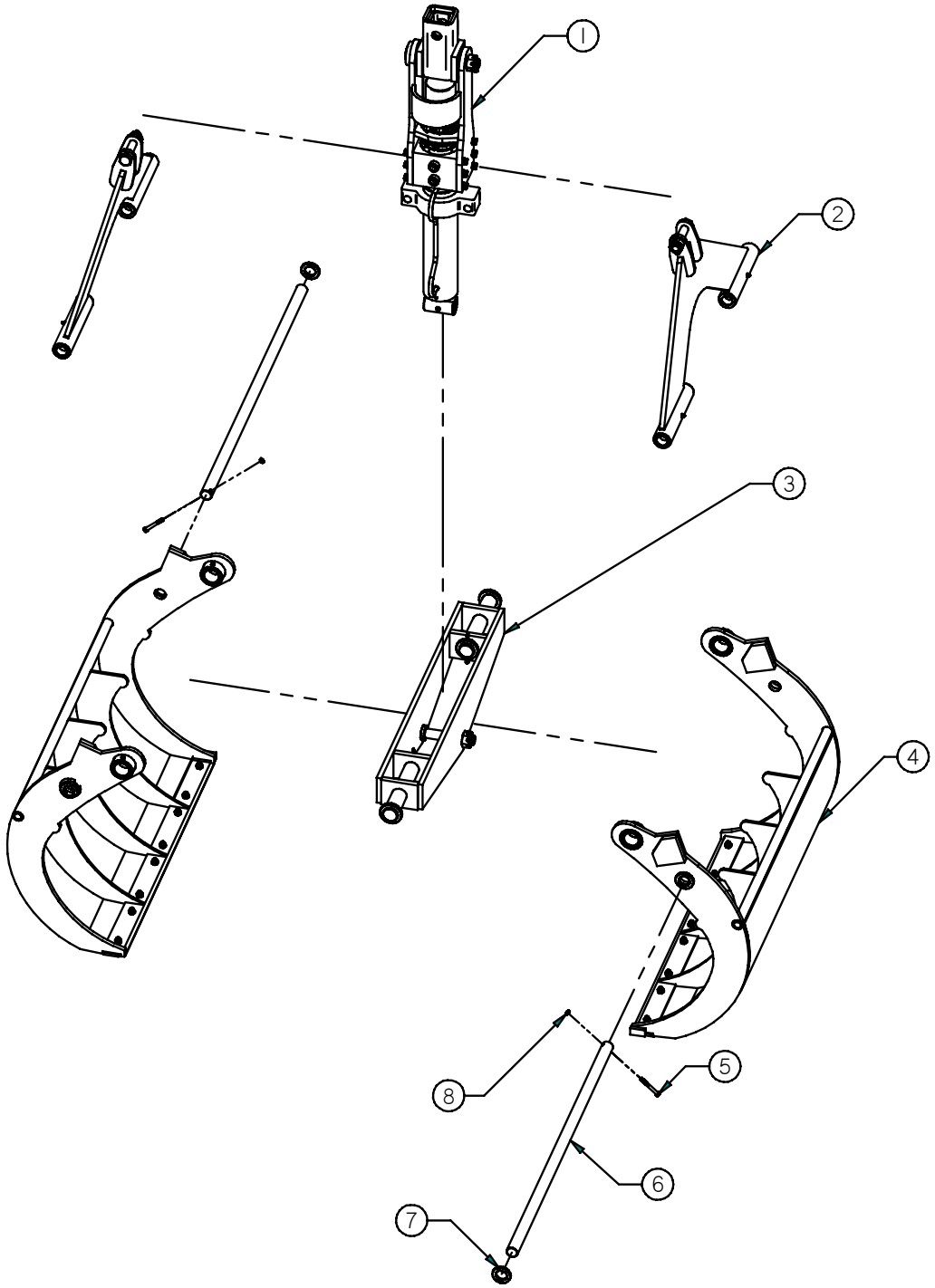
SCALE: NA

DRAWN BY: RB

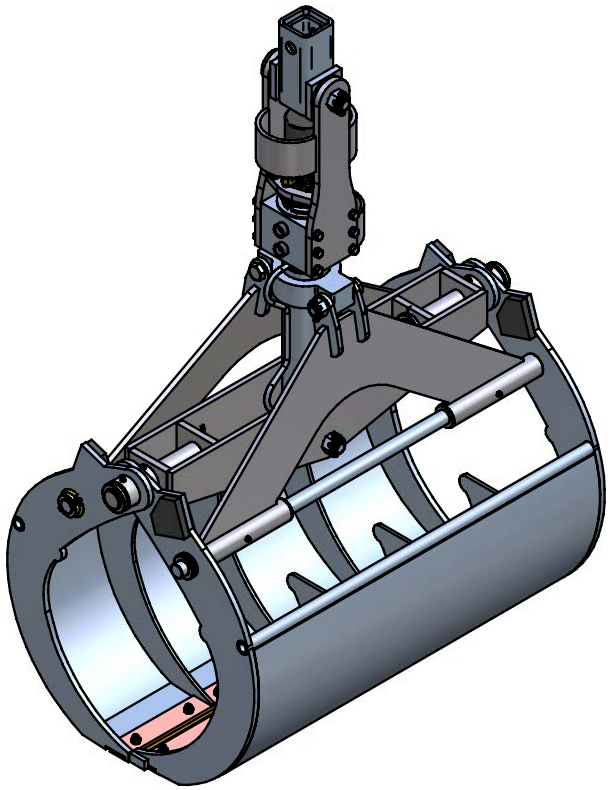
APPROVED BY:

DATE: 08/05/08

SHEET: 1 OF 1



Item Number	Title	Part Number	Quantity
1	BUCKET CYLINDER ROTATOR ASSEMBLY (RE MOTOR)	102124	1
2	STANDARD BUCKET A FRAME ASSEMBLY	102130	2
3	BUCKET SADDLE ASSEMBLY	102129	1
4	TRASH BUCKET JAW ASSEMBLY	102132	2
5	BOLT HEX 3/8-16 UNC X 3 G8	BL108048U816	2
6	STD BUCKET A FRAME SHAFT	102173	2
7	COLLAR SPACER 1 1/2 X 2 1/2 X 1/2_3/8	116106	2
8	NUT HEX 3/8 -16 UNC STOVERLOCK	NUS06U	2



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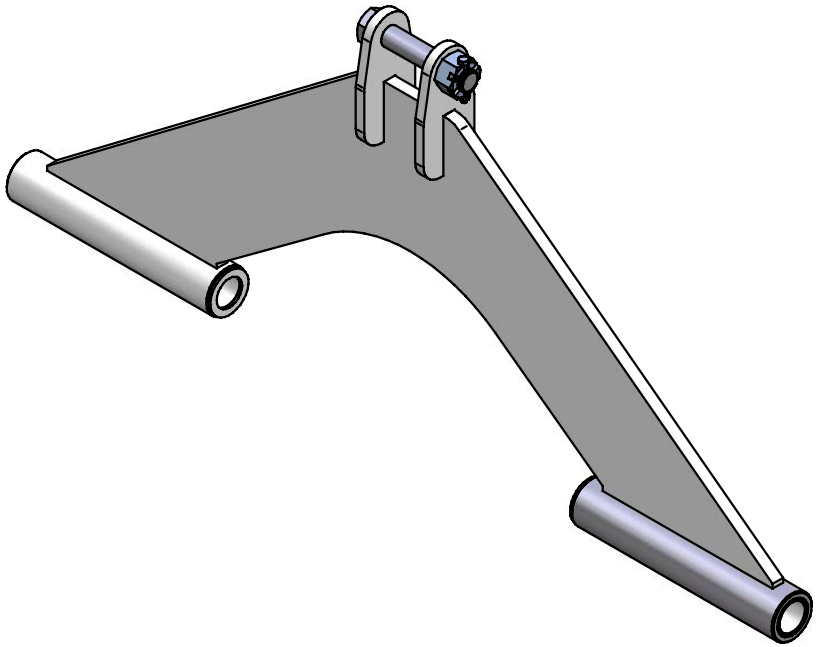
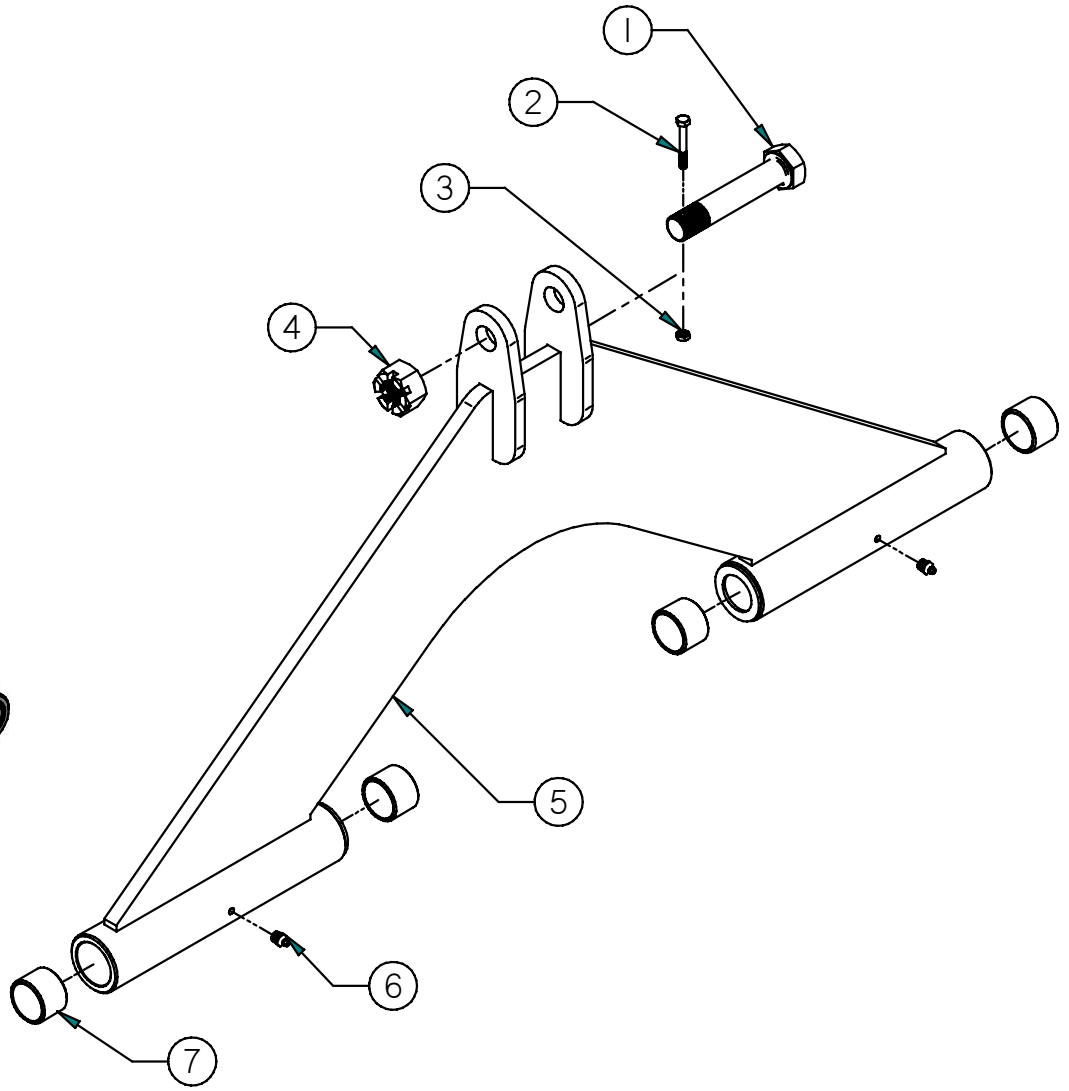
TEL: (863) 676-1493 FAX: (863) 676-6844

TITLE: STANDARD TRASH BUCKET ASSEMBLY

PART NUMBER:	SCALE:
11 11 01 0011 / 102101	N/A

DRAWN BY:	APPROVED BY:	DATE:	SHEET:
E. B.		12/20/2000	1 OF 1





Item Number	Title	Part Number	Quantity
1	BOLT HEX 1-14 X 5 1/4 SAE HOLE	BL116084S8H1400	1
2	BOLT HEX 1/4-20 X 2 USS G5	BL304032U520	1
3	NUT STOVERLOCK 1/4 USS	NUS04U	1
4	NUT SLOTTED 1-14 SAE GR5	NUB16S5	1
5	STANDARD BUCKET A FRAME WELDMENT	102172	1
6	GREASE NIPPLE 1/8" STRAIGHT	HF2002S	2
7	A FRAME BUCKET SPOOL BUSHING	BU402012	4

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TEL: (863) 676-1493 FAX: (863) 676-6844

TITLE: STANDARD BUCKET A FRAME ASSEMBLY

PART NUMBER: 22 11 01 001 2 / 102130

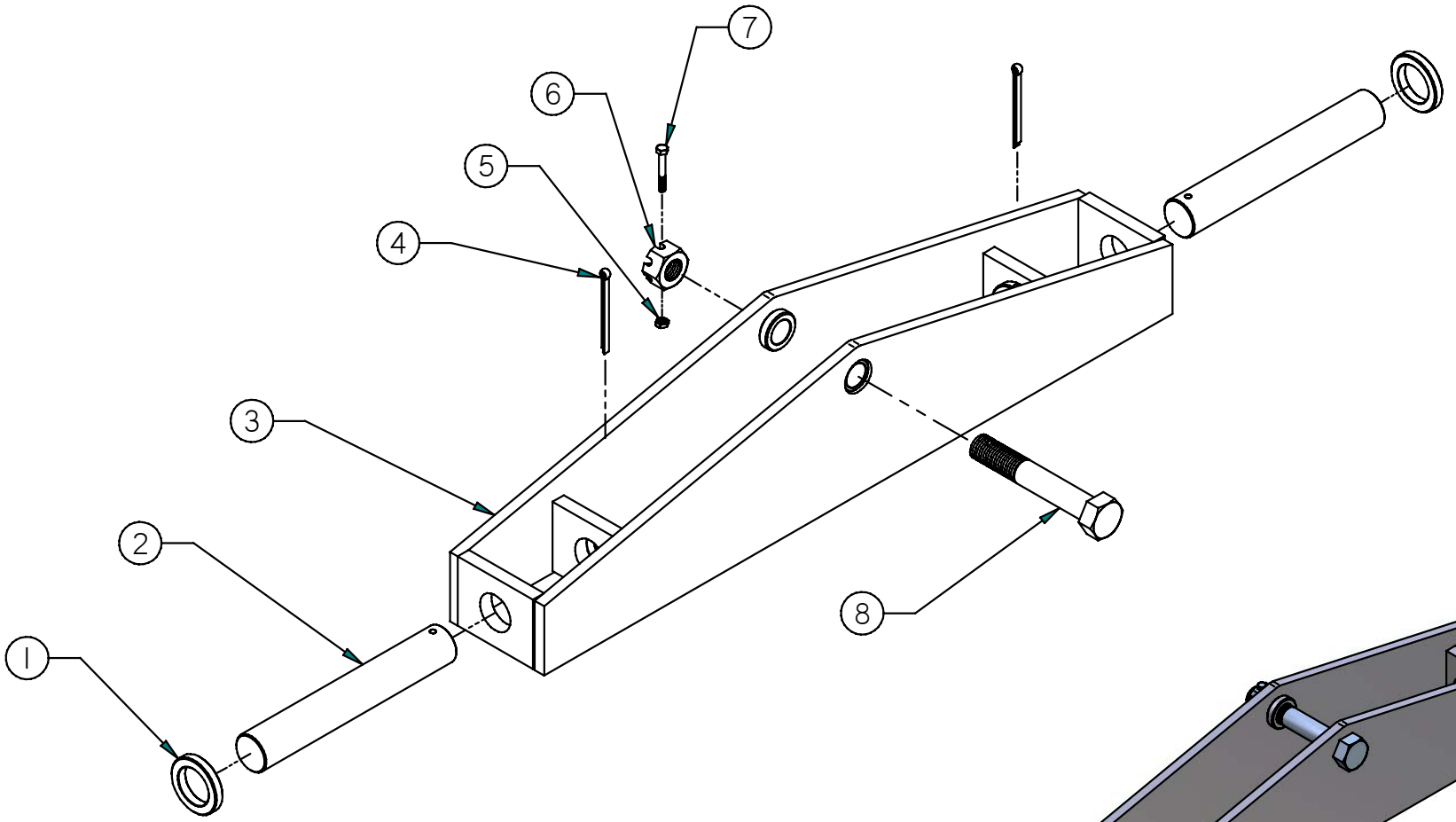
SCALE: N/A

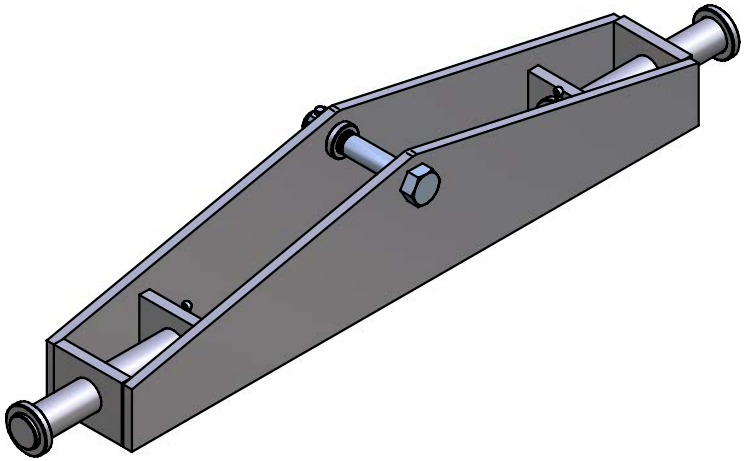
DRAWN BY: E.B.

APPROVED BY:

DATE: 2/23/99

SHEET: 1 OF 1





Item Number	Title	Part Number	Quantity
1	BUCKET SADDLE PIVOT COLLAR	116107	2
2	BUCKET SADDLE PIVOT PIN	PI30204FC	2
3	BUCKET SADDLE WELDMENT	102178	1
4	COTTER PIN 5/16 X 4	FA020564	2
5	HEX NUT 5/16-18 USS STOVERLOCK	NUS05U	1
6	SLOTTED NUT 1-1/4 UNC GR5	NUB20U	1
7	HEX BOLT 5/16-18 X 2-1/4 UNC GR5	BL305036U518	1
8	HEX BOLT 1-1/4-7 X 7-3/4 GR8	BLI20124U87	1

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4000 S.R. 60 WEST
LAKE WALES, FL. 33859-8234
TEL: (863) 676-1493 FAX: (863) 676-6844

TITLE: BUCKET SADDLE ASSEMBLY

PART NUMBER: 22 11 01 003 0 / 102129

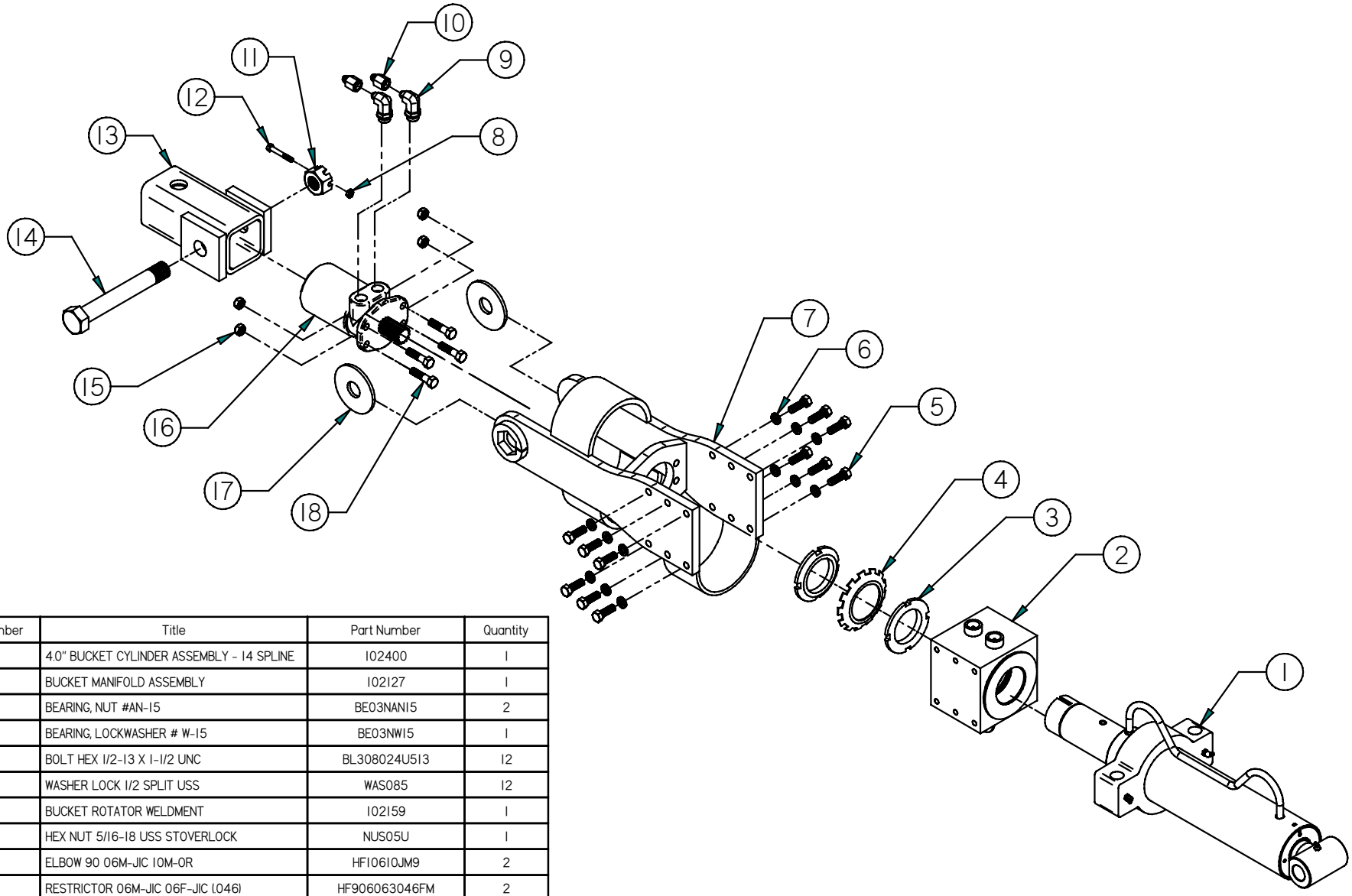
SCALE: N/A

DRAWN BY: E.B.

APPROVED BY:

DATE: 11/13/2000

SHEET: 1 OF 1



Item Number	Title	Part Number	Quantity
1	4.0" BUCKET CYLINDER ASSEMBLY - 14 SPLINE	102400	1
2	BUCKET MANIFOLD ASSEMBLY	102127	1
3	BEARING, NUT #AN-15	BE03NAN15	2
4	BEARING, LOCKWASHER # W-15	BE03NW15	1
5	BOLT HEX 1/2-13 X 1-1/2 UNC	BL308024U513	12
6	WASHER LOCK 1/2 SPLIT USS	WAS085	12
7	BUCKET ROTATOR WELDMENT	102159	1
8	HEX NUT 5/16-18 USS STOVERLOCK	NUS05U	1
9	ELBOW 90 06M-JIC 10M-OR	HF10610JM9	2
10	RESTRICTOR 06M-JIC 06F-JIC (046)	HF906063046FM	2
11	SLOTTED NUT 1-1/4 UNC GR5	NUB20U	1
12	HEX BOLT 5/16-18 X 2-1/4 UNC GR5	BL305036U518	1
13	GIMBAL WELDMENT 4 X 5-1/2	102119	1
14	BOLT - ROTATOR GIMBAL, TRASH	102158	1
15	HEX NUT 1/2-13 STOVERLOCK	NUS08U	4
16	HYD MOTOR RE-32-08-05-0 (14 SPLINE)	HC03004	1
17	BUCKET BRAKE WASHER 4 X 1-5/16 X 1/4	WAF642004	2
18	BOLT HEX 1/2-13 X 2 UNC GR8	BL108032U813	4

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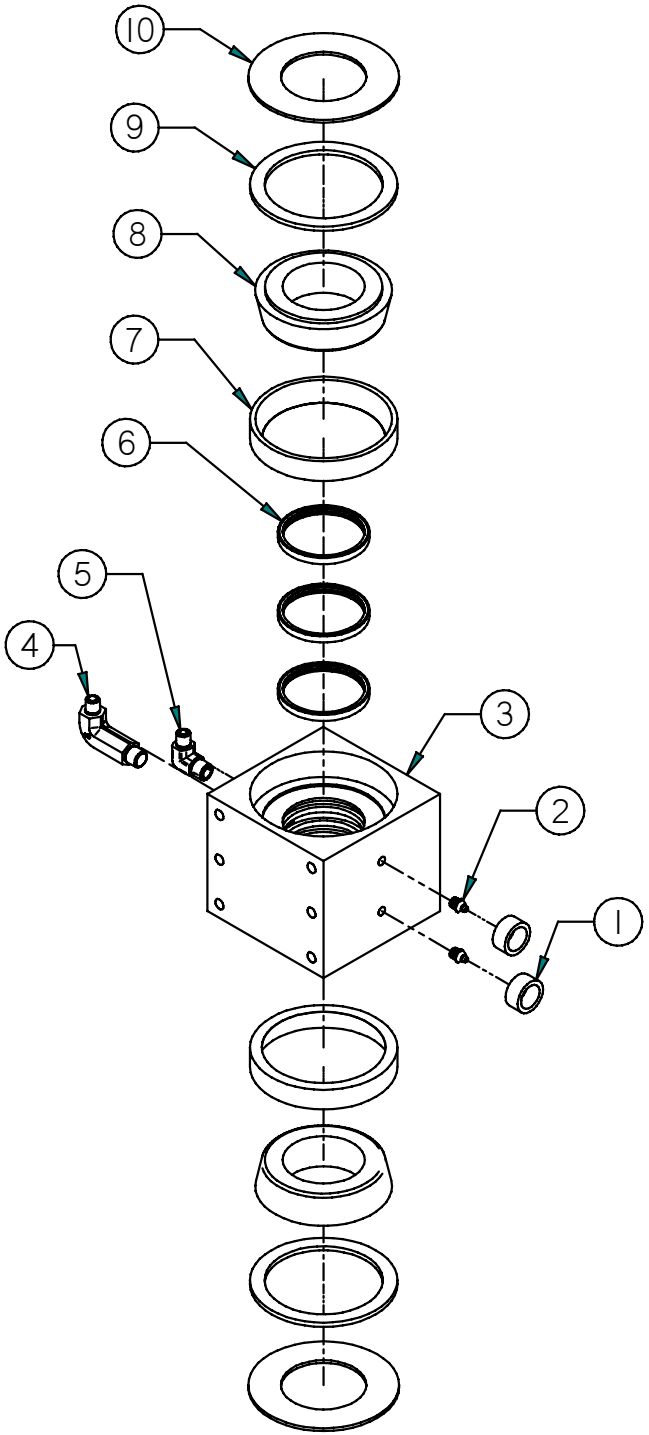
TITLE: BUCKET CYLINDER ROTATOR ASSEMBLY (RE MOTOR)

PART NUMBER:	SCALE:
22 11 01 010 0 / 102124	N/A

DRAWN BY:	APPROVED BY:	DATE:	SHEET:
Olvera, J.		11/9/2005	1 OF 1



Item Number	Title	Part Number	Quantity
1	BUCKET MANIFOLD GREASE FITTING COVER	102151	2
2	GREASE NIPPLE 1/8" STRAIGHT	HF2002S	2
3	BUCKET MANIFOLD HOUSING	102443	1
4	ELBOW 90 06M-JIC 06M-JIC LONG	HF806069ML	1
5	ELBOW 90 06M-JIC 06M-JIC	HF806069M	1
6	SEAL KIT TR-035	HPKTR035	3
7	BEARING RACE #493	BE03N493	2
8	TIMKEN ROLLER BEARING #495-A	BE03N495A	2
9	ROTATOR FELT WASHER	WAL866902	2
10	CONTINUOUS ROTATOR THRUST WASHER	WAF885002	2

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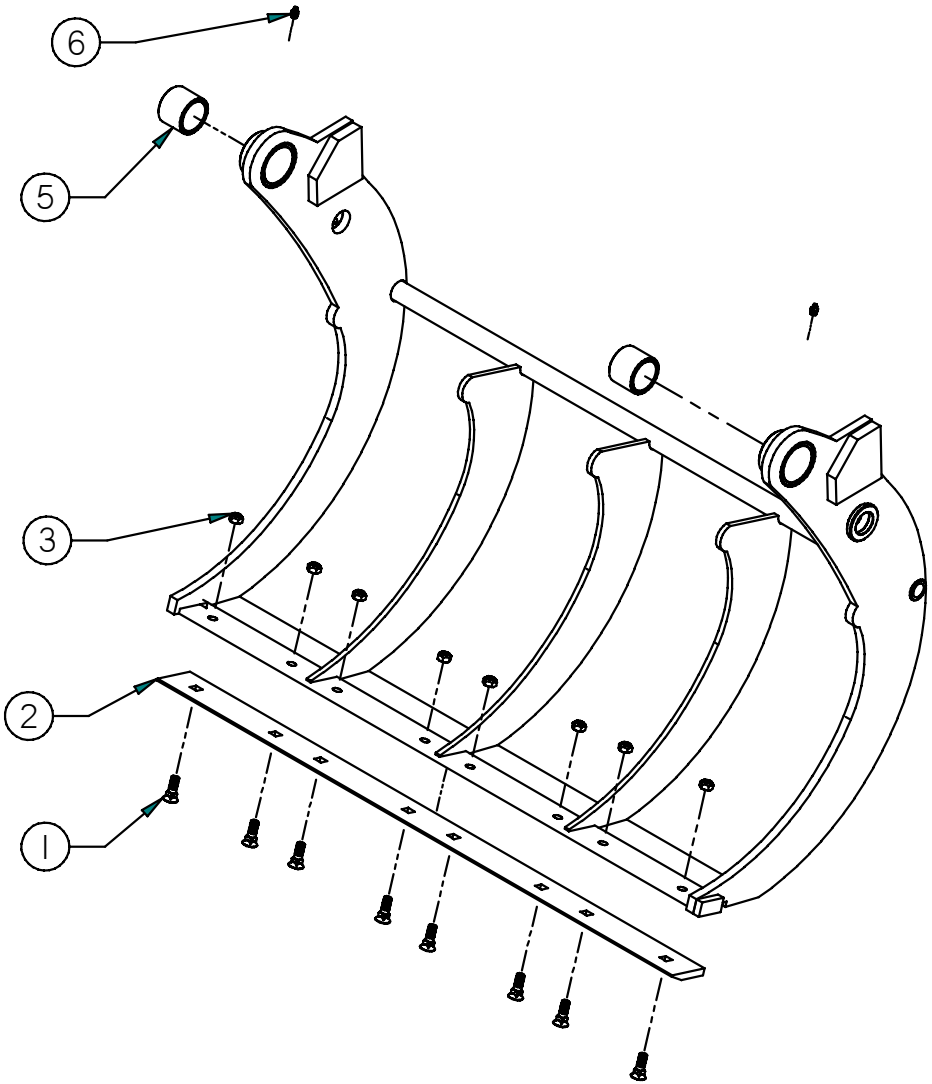
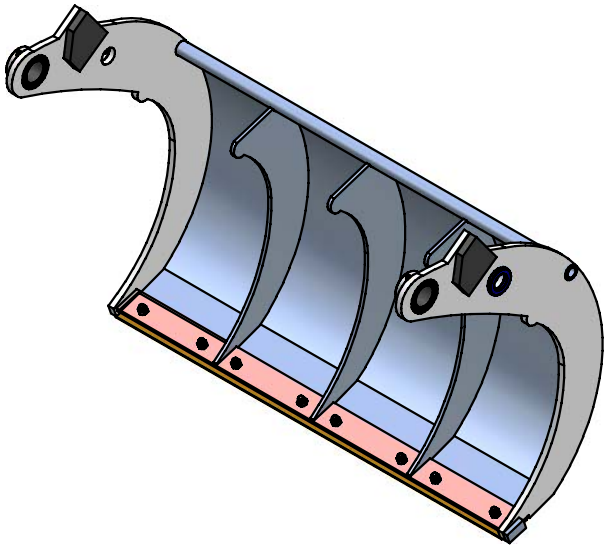
LAKE WALES, FL. 33859-8234
TEL: (863) 676-1493 FAX: (863) 676-6844

TITLE: BUCKET MANIFOLD ASSEMBLY

PART NUMBER:	SCALE:
21 11 09 002 2 / 102127	N/A

DRAWN BY:	APPROVED BY:	DATE:	SHEET:
E. B.		12/14/2000	1 OF 1





Item Number	Title	Part Number	Quantity
1	FLAT HEAD PLOW BOLT 1/2-13 X 1-1/2 #3 G5	BL6080243513	8
2	BUCKET, TL JAW BLADE	102171	1
3	HEX NUT 1/2-13 STOVERLOCK	NUS08U	8
5	BUSHING, 2 1/2 X 2 X 2 NYLATRON	BU502008	2
6	GREASE NIPPLE 1/8" STRAIGHT	HF2002S	2

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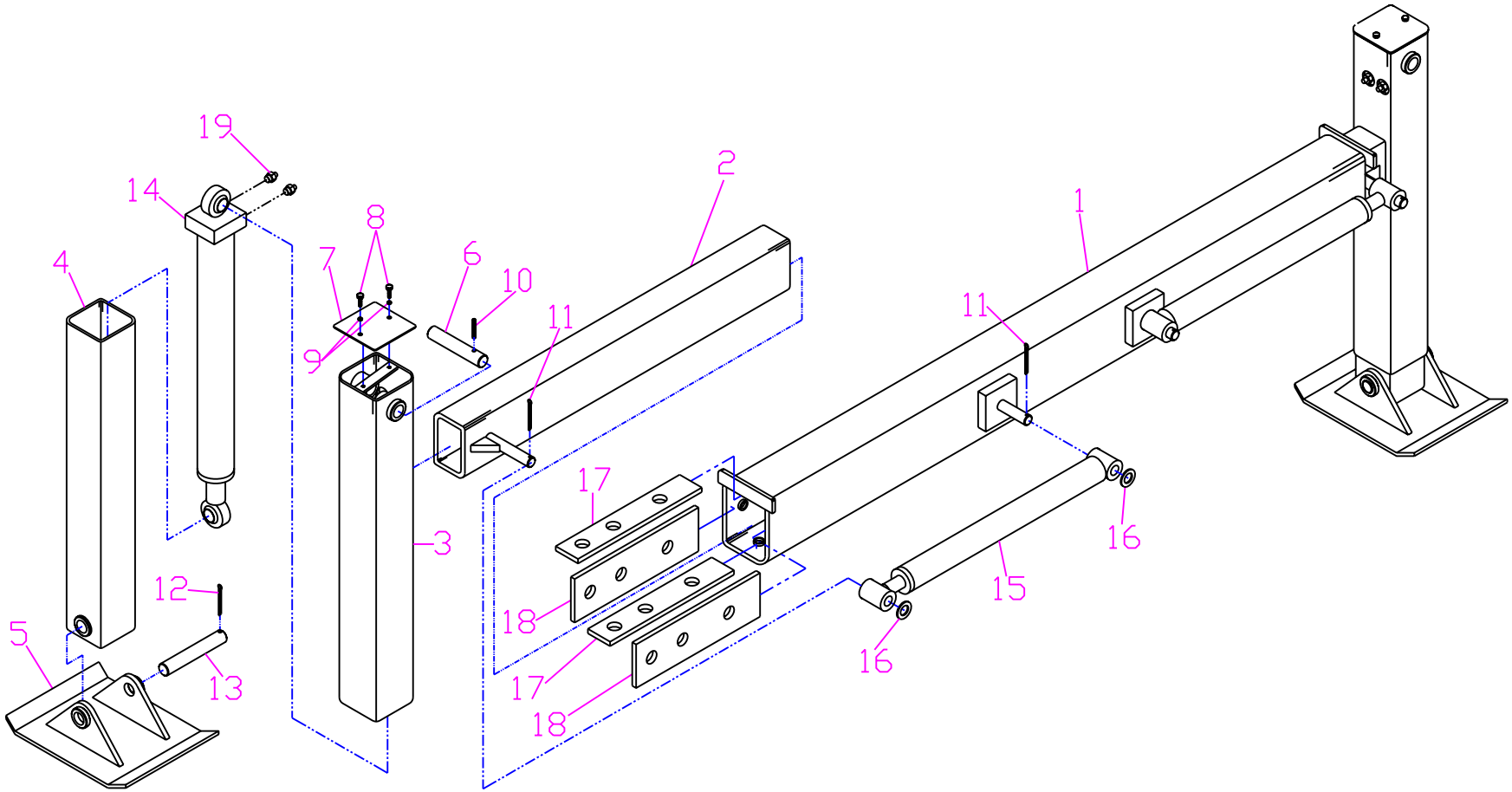
4000 S.R. 60 WEST
LAKE WALES, FL. 33859-8234
TEL: (863) 676-1493 FAX: (863) 676-6844

TITLE: TRASH BUCKET JAW ASSEMBLY			
PART NUMBER: 22 11 01 002 5 / 102132			SCALE: N/A
DRAWN BY: E.B.	APPROVED BY:	DATE: 8/28/00	SHEET: 1 OF 1



PETERSEN INDUSTRIES INC.
4000 S.R. 60 WEST
LAKE WALES,FL.33859-8201
(863) 676 1493 FX (863) 676 6844

TITLE: MODEL # 3 OUTRIGGER ASSEMBLY

CAD NO:	PART NO:	SCALE
02 06 04 001 1		1:20

DRAWN BY:	APPROVED:	DATE:	SHEET:
E.J.B.		5/18/99	1 OF 1

Dia. No.		Part Name	Order By This Part No.
MODEL3A OUTRIGGER ASSEMBLY: (DRAWING #02 06 04 001 0)			
1		Outer Horizontal Leg Weldment	Not Sold Separately
2		Inner Horizontal Leg Weldment	113114
3		Outer Vertical Leg Weldment	113104
4		Inner Vertical Leg Weldment	113105
5		Foot Weldment	113106
6		Pin, Vertical Cylinder - Base End	PI18106F1
7		Cover Plate, Vertical Leg	113107
8		Bolt, Cover Plate	BL305016U518
9		Washer, Cover Plate Bolt	WAS055
10		Roll Pin, 5/16" x 2"	FA040532
11		Cotter Pin, 3/16" x 2"	FA020332
12		Cotter Pin, 5/16" x 3"	FA020548
13		Pin, Vertical Cylinder - Rod End	PI18122F
14		Cylinder, Vertical Leg Extension	CY05003
15		Cylinder, Horizontal Leg Extension	CY05001
16		Washer	WAB1624
17		Wear Plate	113602
18		Wear Plate	113603
19		Hydraulic Fitting, 1/8 90 Degree	HF20029
		Vertical Leg Assembly (One Side Only)	113103

NOTIFICATION OF TRANSFER OF OWNERSHIP

TO: Petersen Industries, Inc.
4000 SR 60 West
Lake Wales, FL 33859
Telephone: 800/930-5623, Ext. 256

FROM: _____

_____

_____

This is to advise you that our organization is no longer the owner of the Petersen loader listed below. We have listed the name and address of the subsequent owner. Would you please change your records accordingly.

Petersen Loader Serial Number: _____

VIN: _____

Name and Address of New Owner:

_____

_____

_____

Phone:_____

Contact: _____

BY: _____
(Name)

Date: _____

Bulletin HY14-2705-M3/US
Service and Parts Bulletin

Model V20

Effective: August 1, 2002
Supersedes: Cat. No. GSD-1102 dated 2/92

Sectional Body Directional Control Valve

⚠ WARNING

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

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bul2705-m3.p65, bl

Parker Hannifin Corporation
Hydraulic Valve Division
Elyria, Ohio, USA

Contents

List of Illustrations

SECTION I
INTRODUCTION

This manual contains pertinent step-by-step maintenance instructions plus parts ordering information and a complete part and service kit listing for the Model V20 Directional Control Valve.

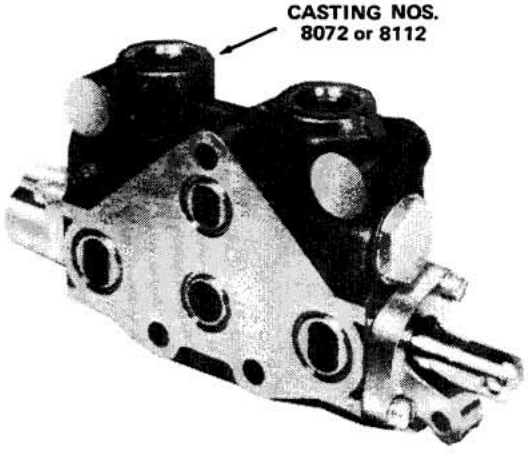
If further assistance is required, contact:

Your Gresen Distributor or Representative.

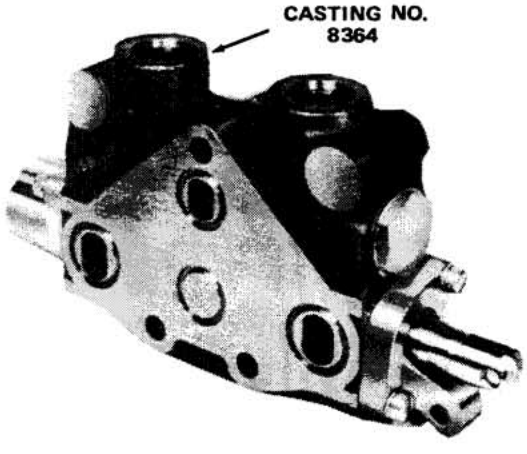
WARNING

There is a visual similarity between Gresen's Model V20 Directional Control Valve covered in this manual and Gresen's V20C Closed Center Directional Control Valve.

Work sections for these two valve assemblies should *NEVER* be *intermixed* or *interchanged* without prior consultation with the factory. Intermixing a V20C closed center work section with a V20P or V20T work section will convert the complete valve bank to closed center operation and in some cases, could render the valve assembly inoperable and cause damage to components in the hydraulic circuit.



Model V20P or V20T
Work Section.



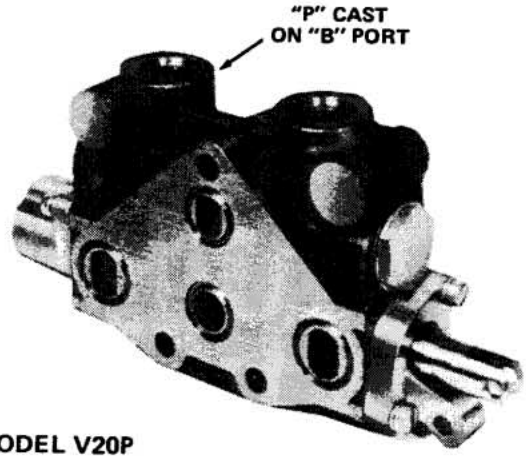
Model V20C
Work Section.

SECTION II
DESCRIPTION

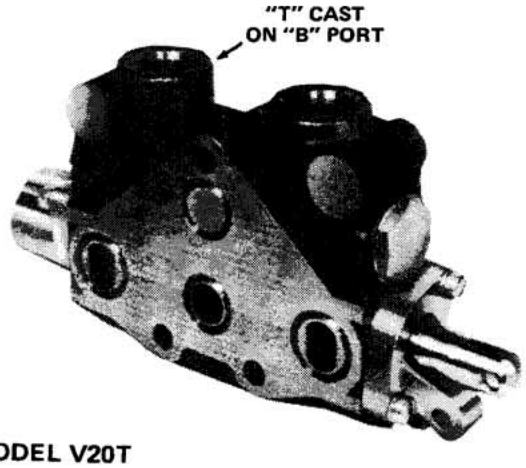
Gresen Model V20 Directional Control Valves may be purchased with five different valve sections, plus various options, to meet the desired job specification.

The following paragraphs describe the five sections and any options with reference to the parts illustrations in Section IV in this manual.

Gresen's Models CP, CT, V20P and V20T work sections are interchangeable and may be intermixed within a complete directional control valve assembly. When Models CP or CT work sections are used, maximum pressure is limited to 2500 PSI.



MODEL V20P



MODEL V20T

Figure 2-1. Model V20P (Parallel Circuit) and Model V20T (Tandem Circuit) Work Sections.

Table 2-1. Casting Part Numbers

Description	Model CP/CT	Model V20
Parallel Center Section	7697-	8072-
Tandem Center Section	7698-	8112-
Series Center Section	—	11483-
V20R Center Section	—	10954-
V20R Tandem Center Section	—	10762-
LO Center Section	6732-	11571-
Mid-Inlet Section	6825-	6825-
Inlet Cover (Standard)	1815-	8398-
Inlet Cover (Top Ports)	1862-	8398-
Inlet Cover w/Flow Control	7736-	7736-
Outlet Cover (End Outlet)	6770-	6770-
Outlet Cover (Top Outlet)	8644-	8644-

Numbers shown for sections and covers are base casting numbers, not ordering numbers. Refer to Parts Ordering Information, Section III, for ordering information.

MODEL V20P

4-WAY, 3-POSITION VALVE SECTION

This section provides control of double-acting cylinders without the floating action plus hydraulic motor start, stop and reverse control where free-wheeling is NOT required. Cylinder ports are blocked in neutral position.

MODEL V20P

3-WAY, 3-POSITION VALVE SECTION

This section provides control of single acting cylinders or start and stop of non-reversable hydraulic motors where free-wheeling of motor is not required. The cylinder port is blocked in neutral position.

MODEL V20P

4-WAY, 3-POSITION VALVE SECTION WITH PRESSURE DETENT RELEASE

This section provides automatic return to neutral position as soon as work cycle is completed.

The spool is held in either power position by a detent assembly until released. When pressure in the power circuit reaches a predetermined setting, the detent assembly releases and the centering spring returns the spool to neutral.

MODEL V20P

4-WAY, 4-POSITION, FLOAT VALVE SECTION

This section provides control of double-acting cylinders requiring a floating action such as: loaders, dozers, snow plows, etc.

Incorporated into the valve section is a 4-position float positioner. Three positions are standard double-acting with spring return to neutral. The fourth position is detented to hold control in float (both cylinder ports open to tank).

MODEL V20-T

TANDEM (PRIORITY) SECTION, 3-WAY, 4-WAY, OR 4-WAY FLOAT

This section allows any upstream valve sections to have priority. Only when the upstream sections are in neutral or metering position will oil be available to this section.

SPOOL ACTION OPTIONS:

A. SPRING RETURN TO NEUTRAL, (Standard).

Spool will return to neutral position from A or B power position when handle is released.

B. "R" OPTION, Detent with Spring Return to Neutral

Can be used on either 3-way, 4-way or free flow spool. Has detent position for either spool "in", spool "out" or 2-position detent for both spool "in" and spool "out" positions, with spring return to neutral position.

Recommended for hydraulic motors where the motor operates continuously in one direction (detent position) with only intermittent operation in the opposite direction.

C. "D" Option, 3-Position Detent

Used when manual placement (NO spring return to neutral) is desired in any of three positions—spool in, spool out, and neutral. An optional detent stop (part no. 1889-001) may be used to convert spool action to "neutral" and "spool out" positions only or for "neutral" and "spool in" position only, thus giving a two-position spool action.

D. "A" OPTION, Spring Extended Spool

This feature eliminates spring return to neutral. The spring returns to the spool "out" position only, usually used for cam operation of spool.

Customer must supply cam follower mechanism.

HANDLE ASSEMBLIES

Provides choice of either horizontal or vertical handle assemblies.

INLET and OUTLET COVERS (Refer to Section III, Parts Ordering Information

CYLINDER PORT CHECK and RELIEF VALVE OPTION (Refer to Figures 4-30 through 4-42)

SECTION III
MAINTENANCE

REPLACING, ADDING OR REMOVING SECTION ASSEMBLIES

NOTE

For clarification, we shall call the inlet cover containing the main relief the left side of the valve assembly. Refer to Figure 3-1.

1. Before disassembly, it is suggested that each valve section be marked numerically to avoid incorrect reassembly.
2. Remove three assembly stud nuts (Item 32, Figure 4-1) from the left end section using a 9/16" thin wall socket.
3. Remove valve sections by sliding from assembly studs (Item 1, Figure 4-1).
4. If valve sections are to be added or removed, use the proper length assembly studs from the chart below.

No. of Sections	Assembly Stud Kit No.*
1	K-6104-D
2	K-6105-D
3	K-6106-D
4	K-6107-D
5	K-6108-C
6	K-6109-C
7	K-6110-C
8	K-6111-C
9	K-6112-C

*Each Kit contains 3 assembly studs and 3 9310-006 hex nuts.

NOTE: When using 8644 Right End Cover, add one section to assure proper stud length.

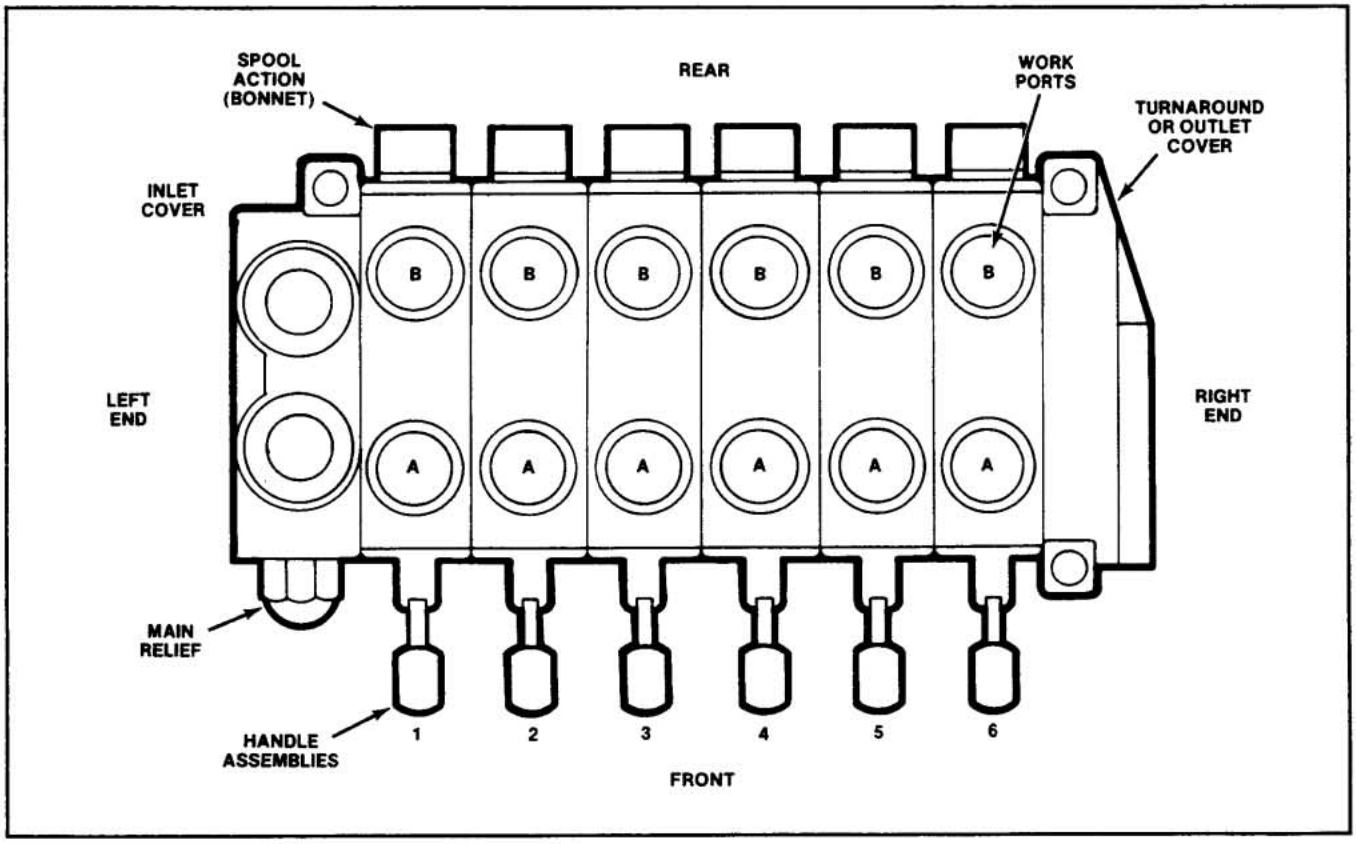


Figure 3-1. Schematic-View of Typical Control Valve Assembly.

NOTE

Use assembly nuts (part no.9310-006), 3 required, with all assembly studs. NO LOCK WASHERS! All studs are stress-proof material and should be replaced only with original equipment replacement parts.

5. Thoroughly clean O-ring counterbores and ground surfaces of each section.

6. Replace the four O-rings. For closed center sections use two 21733-001 (new) and two 21857-001 seals per section. For open center, use three 21733-001 and one 21857-001. For closed center, load sensing, sections use two 21857-001, two 21733-001 and one 21866-001. Buna-N seals are standard. For optional viton seals, see cross-reference chart on pg. 4-37. See chart on pg. 3-2 for old seal numbers.

7. Replace valve sections on assembly studs in the same order in which they were removed. O-ring counterbores should be to the left when facing "A" port-end of valve.

NOTE

Use care in replacing valve sections to avoid dislodging O-rings from counterbores.

8. When all valve sections are positioned on assembly studs, replace stud nuts and tighten evenly to 32 ft. lbs. [43 Nm] torque.

CAUTION

If stud nuts are not tightened to the proper torque, valve spools may bind or stick, or cause section seals to extrude.

REPLACING SPOOL SEALS

Valve sections and covers are identified by numbers cast into the body. Refer to Table 2-1, page 2-0.

Figure 3-2 shows spool assembly—less the complete handle assembly. When handle bracket is furnished, retainer plates and screws (items 1 and 4, Figure 3-2) are omitted. Seal assembly is retained by the handle bracket which will also retain the optional wiper seal.

1. Remove bonnet assembly parts from back of valves and keep in order of disassembly.

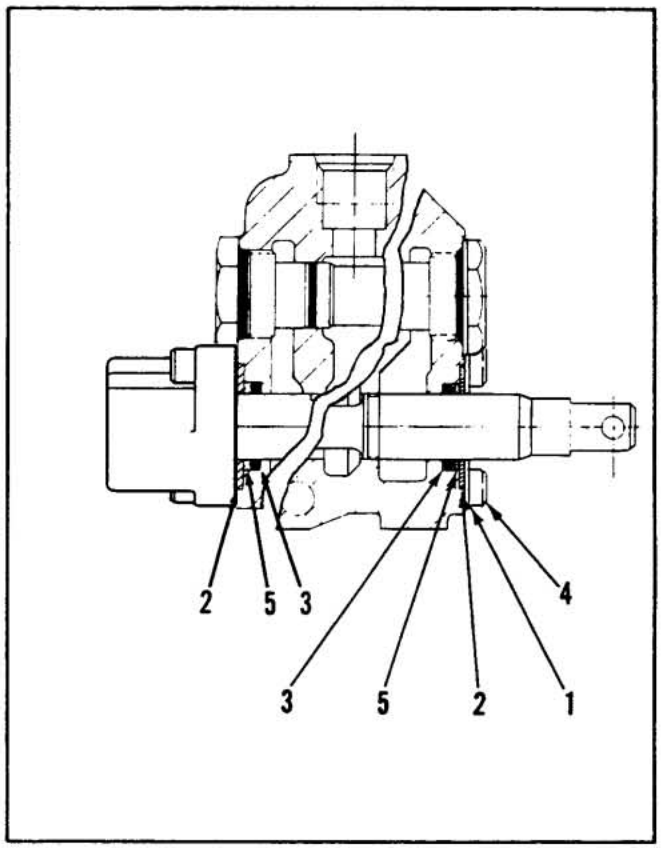


Figure 3-2. Spool Seal Assembly

2. Remove all parts connected to the spool on the front of the valve, either the complete handle bracket assembly, or the seal retainer assembly if a handle bracket is not furnished.

NOTE

DO NOT REMOVE the spool as the seals can be replaced externally. Prevent spool from turning or moving by inserting a screw driver through clevis slot, or running a rod through the pin hole and using as a handle. DO NOT hold the spool with a wrench. This will destroy the finish.

3. Remove retainer plate (Item 1, Figure 3-2), retainer plate washers (Item 2), back-up washers (Item 5), and spool seals (Item 3).

4. Thoroughly clean counterbore.

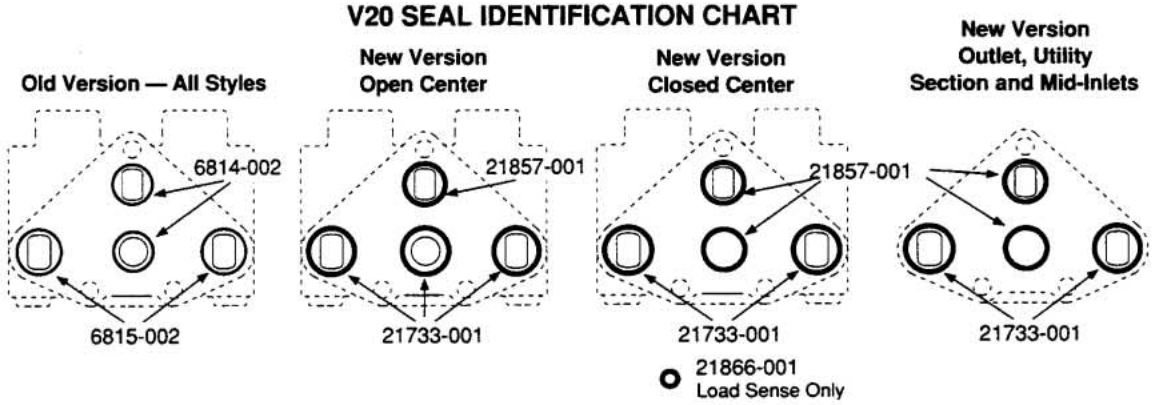
5. Lightly oil new seals. Slide over valve spool and insert in seal counterbore.

PARTS ORDERING INFORMATION

As of April 1, 1991, the section seals for the V20 changed. The new versions have larger cross section (old was .070, new is .103) and different configurations for open center and closed center sections. The old design utilized the same seals for all versions (two .801 I.D. and two .926 I.D.). The new design uses one configuration for open center (three .924 I.D. and one .799I.D.) and another configuration for closed center, load sensing and all outlet covers (two .924 I.D. and two .799 I.D., with one .237 I.D. for load sensing).

The following chart is provided to aid in selection of the proper seals. It is important to note that the seal kits include all O-rings (new and old), therefore there will be some left unused.

V20 SEAL IDENTIFICATION CHART



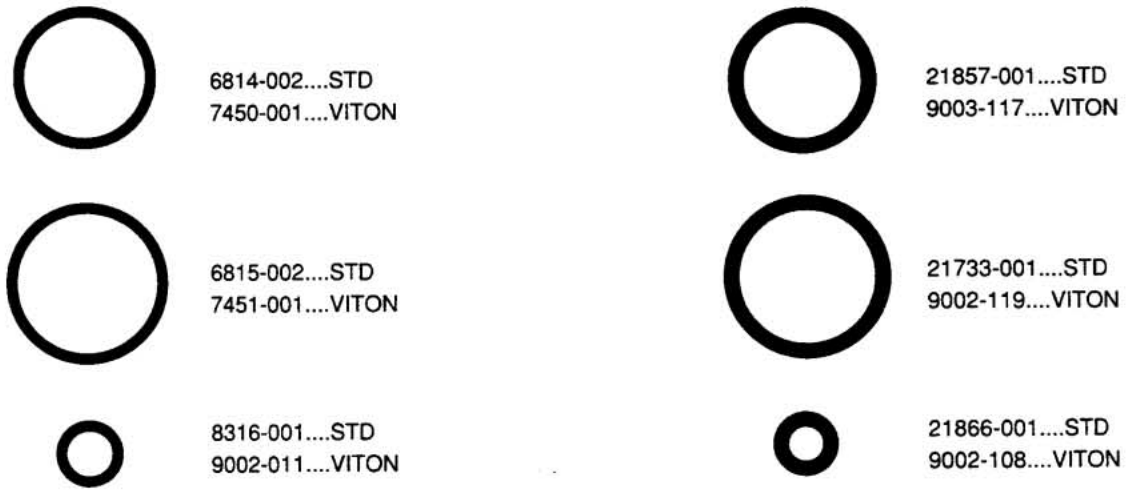
The following section seals are included in the Kits:

Standard Kits		Viton Kits	
Old	New	Old	New
(2)6814-002	(2)21857-001	(2)7450-001	(2)9003-117
(2)6815-002	(3)21733-001	(2)7451-001	(3)9002-119
Load sensing kits (additional seals)			
(1)8316-001	(1)21866-001	(1)9002-011	(1)9002-108

Seal kit changes.

K-6121 Section Seal Kit, One Section
K-6027 Complete Seal Kit, 3 or 4 Way Section
K-6028 Complete Seal Kit, 4 Way Float Section
K-6209 Complete Seal Kit, Series 3 or 4 Way Section
K-6210 Complete Seal Kit, Series 4 Way Float Section
K-6154 Complete Seal Kit, Load Sensing 4 Way Float
K-6155 Complete Seal Kit, Load Sensing 3 or 4 Way Section
K-6156 Section Seal Kit, Load Sensing-One Section
K-6160 Viton Section Seal Kit, One Section

* Complete Seal Kits include spool seals and O-rings for check plugs.



THESE SEALS ARE NOT INTERCHANGEABLE. OLD AND NEW STYLE SECTIONS MAY BE USED IN THE SAME ASSEMBLY PROVIDED THE CORRECT SEALS ARE USED FOR EACH SECTION.

INLET COVERS — Two Inlet Covers are available. All inlet covers are machined to accept the Model WH differential poppet relief cartridge or Model RP51 pilot-operated relief cartridge. If an outlet port is not used in the inlet cover, the outlet port in the right end cover of the valve must be used for tank return line. The inlet cover may be machined with several different combinations of port sizes and locations. NPT and SAE threads cannot be intermixed in the same casting.

Use the following porting charts to arrive at the desired machining modification number.

Inlet Cover, Part No. 8398

Port Location	NPT*						SAE					
End Inlet	1/2	3/4	1/2	—	3/4	—	12	12	—	10	10	—
Top Inlet**	1/2	3/4	1/2	1/2	3/4	3/4	12	12	12	10	10	10
Top Outlet**	1/2	3/4	1/2	1/2	3/4	3/4	12	12	12	10	10	10
End Outlet	1/2	3/4	—	—	—	—	12	—	—	10	—	—
SAE 4 Gage Port	—	—	—	—	—	—	No	Yes	Yes	No	Yes	No
1/4" Gage Port	No	No	No	Yes	Yes	No	—	—	—	—	—	—
Machining Modification Number	018	014	019	012	023	016	008	025	013	024	021	002

* Pipe ports not recommended for pressures over 2000 PSI [138 bar].

** Top ports are cored and will be plugged if end inlet and outlet are specified.

Inlet Cover, Part No. 7736 With Flow Control

Inlet cover, part number 7736, is equipped with an adjustable flow control assembly. Refer to Figure 4-42 for complete parts breakdown.

A Power Beyond option in this cover will allow excess flow to be used downstream only when upstream valve is activated and controlled flow is being used. When upstream valve is in neutral position, all flow is directed through the open center.

Port Location		NPT*	SAE		
End In		3/4	10	12	10
Top In		3/4	10	12	10
End Out		3/4	10	12	12
Machining Modification Number	Without Power Beyond	011	016	009	—
	With Power Beyond	013	—	012	017

* Pipe ports not recommended for pressures over 2000 PSI [138 bar].

ORDERING EXAMPLE FOR INLET COVERS WITH FLOW CONTROL

7736 **003** **RP51 2000PSI CRACK** **13 to 21 GPM**

BASIC CASTING PART NO.

COVER MACHINING MODIFICATION NO.

RELIEF VALVE DETAILS*

FLOW CONTROL RANGE (Flow control only)

Flow Control Ranges

(For inlet cover with flow control only)

3 to 16 GPM [11 to 60 litres/min]
8 to 25 GPM [30 to 95 litres/min]
13 to 21 GPM [49 to 79 litres/min]

*Specify model number of relief valve to be installed; either WH or RP51.

Specify relief setting required **OR**
Specify "NR" (no relief) plug installed **OR**
Specify plastic shipping plug, installed in relief cavity.

Example: If a left inlet cover with a SAE 10 inlet, a SAE 12 outlet, with RP51 relief set at 2000 PSI [138 bar] crack and flow control range of 13-21 GPM [49-79 litres/min] is required, order 7736-003-RP51 2000 PSI [138 bar] crack — 13-21 GPM [49-79 litres/min].

OUTLET COVERS — Two Outlet Covers are available. Outlet covers may be machined with several different combinations of port sizes and locations. NPT and SAE threads cannot be intermixed in the same casting. If an outlet port is not used in the outlet cover, the outlet port in the left end cover must be used for tank return line.

Use the following porting charts to arrive at the desired machining modification number.

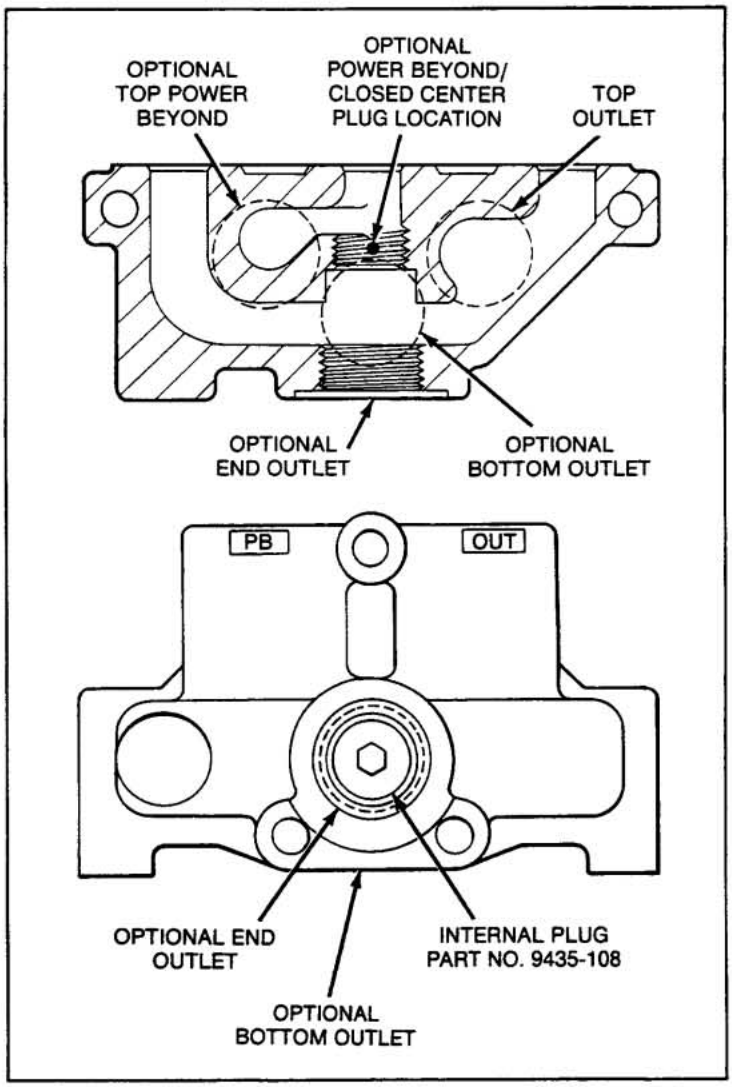


Figure 3-3. Outlet Cover Part No. 8644

Outlet Cover, Part No. 8644

Standard machining provides an outlet port (top, end or bottom) for open center applications. Closed center or top power beyond options are available. For power beyond, the top power beyond port is machined, and the core between the open center and exhaust passages is tapped and plugged. Plugging the power beyond port (and the internal core) converts the cover to closed center.

Port Location	NPT			SAE				
Top Outlet*	3/4	3/4	3/4	12	12	12	12	12
End Outlet	—	—	3/4	—	—	12	12	12
Bottom Outlet	—	3/4	—	—	12	—	—	12
Top Power Beyond	—	—	3/4	—	—	10	12	12
Machining Modification Number	008	005	006	007	010	012	004	013

*Top outlet is cored and will be plugged if end or bottom outlet is specified.

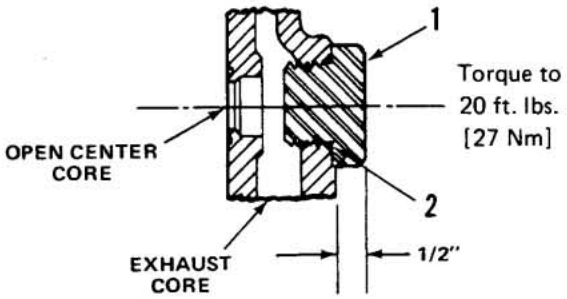
Outlet Cover, Part No. 6770.

Port Size Available	End Outlet Port Only	Machined for Power Beyond Sleeve, Closed Center Plug or Conversion Plug.	
		With End Outlet	No End Outlet
1/2-14 NPT	6770-004	6770-009	6770-007
3/4-14 NPT	6770-001	6770-005	
SAE 10 (7/8-14 UNF)	6770-002	6770-006	
SAE 12 (1-1/16 12 UNF)	6770-003	6770-013	

6770 OUTLET COVER OPTIONS

No. 1727 Conversion Plug

Provides for conversion from "Power Beyond" or "Closed-Center" usage to "Open-Center" or vice-versa.



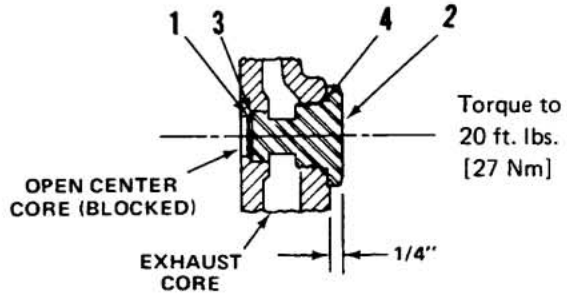
SERVICE KIT K-6016

(Contains 1 Each of Items 1 and 2)

Item No.	Part No.	Description	No. Required
1	1727-001	Conversion Plug	1
2	2709-001*	O-Ring Seal	1

No. 1830 Closed-Center Plug Option.

Provides a "Closed-Center" System by plugging the open-center flow passage. It is normally used with a variable displacement pump.



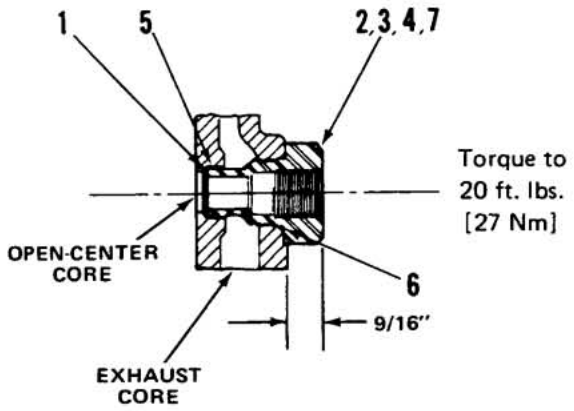
SERVICE KIT K-6015

(Contains 1 Each of Items 1, 2, 3 and 4)

Item No.	Part No.	Description	No. Required
1	1721-001*	Seal	1
2	1830-001	Closed-Center Plug	1
3	9020-017	Back-Up Washer	1
4	2709-001*	O-Ring Seal	1

No. 1833, 1835 or 1836 Power Beyond Sleeve Options.

Provides for proper hook-up of an additional valve "down-stream". The Power Beyond Sleeve prevents subjecting the exhaust core of the valve to back pressure.



SERVICE KITS

K-6017-B* (1/2 NPT – Contains 1 Each of Items 1, 2, 5, 6)
K-6018-B* (SAE 8 – Contans 1 Each of Items 1, 3, 5, 6)
K-6019-B* (SAE 10 – Contans 1 Each of Items 1, 4, 5, 6)
K-6060-B(SAE 16 – Contains 1 Each of Items 1, 5, 6, 7)

Item No.	Part No.	Description	No. Required
1	1721-001*	Seal	1
2	1833-001	P.B. Sleeve (1/2-14 NPT)	1
3	1835-001	P.B. Sleeve SAE 8 (3/4-16 UNF)	1
4	1836-001	P.B. Sleeve SAE 10 (7/8-14 UNF)	1
5	9020-017	Back-Up Washer	1
6	2709-001*	O-Ring Seal	1
7	7706-001	P.B. Sleeve SAE 16 (1" Tube) Male Fitting	1

NOTE

To convert from Power Beyond usage to "Open-Center" usage, NEVER ATTEMPT TO PLUG THE POWER BEYOND SLEEVE, as this would convert to "Closed-Center" Valve.

ORDERING EXAMPLE FOR RIGHT COVER PLATE: **6770** **006** **Cover with SAE 8 Power Beyond Sleeve Installed**

BASIC CASTING

COVER MACHINING MODIFICATION

OPTION DETAILS

Example: If a right cover with a SAE 10 outlet and a SAE 8 power beyond sleeve was required, then order: per the above description.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on Page 4-37.

V20P, V20T and V20S VALVE CENTER SECTIONS

The following information is necessary for proper specification for each V20P, V20T or V20S Valve Center Section:

1. Function of Section
2. Options
3. Work port sizes
4. Work port "A" Options
5. Work port "B" Options
6. Handle end Options

The chart shown below will help in identifying the Options available and the information needed for proper ordering. Refer to product catalog No. PC-1106 for complete information on options available.

CIRCUIT	PARALLEL – V20P ☐ Casting No. 8072 (See Page 2-0) TANDEM – V20T ☐ Casting No. 8112 (See Page 2-0) SERIES – V20S ☐ Casting No. 11483 (See Page 2-0)
FUNCTION OF SECTION	FUNCTION OF SECTION (Check one for each section) • 3-Way (Work port on handle end will be plugged) ☐ • 4-Way ☐ • 4-Way Float (K) ☐ • _____ ☐
OPTIONAL FEATURES	ADDITIONAL OPTIONS • Free Flow (F) ☐ • 3-Position Detent (D) ☐ • _____ ☐ • _____ _____
WORK PORT SIZES	"A" and "B" WORK PORT SIZES 3/8, 1/2 NPT; SAE 8, 10
WORK PORT "A" OPTIONS	OPTIONS AVAILABLE (Specify) • Relief (RC or RCA*) _____ • Anti-Cavitation (A-C) _____ • Combination Relief and Anti-Cavitation (CRA) _____ Specify Relief Setting, Crack or Full Flow *RCA cannot be used with valve handle or bracket.
WORK PORT "B" OPTIONS	OPTIONS AVAILABLE (Specify) • Relief (RC or RCA*) _____ • Anti-Cavitation (A-C) _____ • Combination Relief and Anti-Cavitation (CRA) _____ Specify Relief Setting, Crack or Full Flow *RCA cannot be used with valve handle or bracket.
HANDLE-END OPTIONS	Location: "A" Work Port End ☐ "B" Work Port End ☐ Handle Type: No. 1802, Vert. ☐ No. 3249, Horiz. ☐ Less Complete Handle Assy (LCHA) ☐ Less Handle Only (LHO) ☐ Handle Bracket Only (HBO) ☐ Bracket: No. 1801 ☐ No. 7355 ☐ Rotate 180° From Standard ☐ Float Section: Pull Handle to Float ☐ Push Handle to Float ☐ Heavy Duty Retainer ☐ Spool Protector Boot ☐ Spool Wiper ☐

SECTION IV
PARTS LISTING

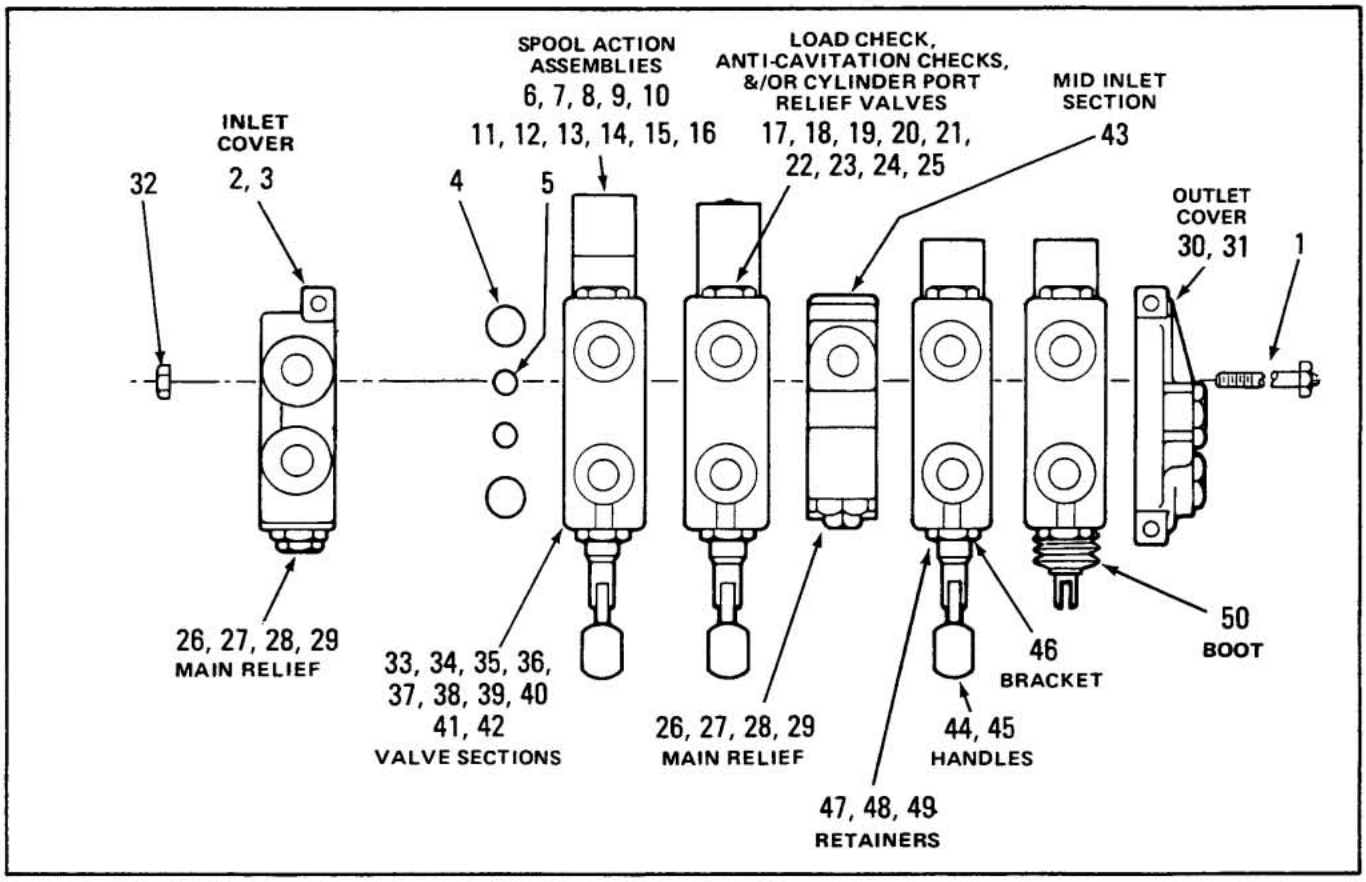


Figure 4-1. Model V20 Directional Control Valve, Typical Main Assembly.

MODEL V20 DIRECTIONAL CONTROL VALVE, TYPICAL MAIN ASSEMBLY

Item No.	Part No.	Description			Quantity Per Assembly
1	K-6104-D	STUD KIT, 1-Section	Each Stud Kit Contains 3 Assembly Studs and 3 Stud Nuts	Note: Torque Stud Nuts to 32 ft. lbs. [43.5 Nm]	1
	K-6105-D	STUD KIT, 2-Section			1
	K-6106-D	STUD KIT, 3-Section			1
	K-6107-D	STUD KIT, 4-Section			1
	K-6108-C	STUD KIT, 5-Section			1
	K-6109-C	STUD KIT, 6-Section			1
	K-6110-C	STUD KIT, 7-Section			1
	K-6111-C	STUD KIT, 8-Section			1
	K-6112-C	STUD KIT, 9-Section			1
2	8398-	COVER, Left (Refer to Page 3-3)			1
3	7736-	COVER, Left, with flow control (Refer to Page 3-3 and Figure 4-43)			1
4	21733-001*	O-RING, Exhaust, Large (new)			**
	6815-002*	O-RING, Exhaust, Large (old)			**

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

**All old versions include two exhaust and two small O-rings. All new open center versions include three large and one small O-ring. Other new versions including outlet, utility section and mid-inlets contain two of each.

MODEL V20 DIRECTIONAL CONTROL VALVE, TYPICAL MAIN ASSEMBLY (Continued)

Item No.	Part No.	Description	Quantity Per Assembly
5	21857-001*	O-RING, Pressure, Small (new)	**
	6814-002*	O-RING, Pressure, Small (old)	**
	21866-001*	O-RING, Load Sensing (new)	**
	8316-001*	O-RING, Load Sensing (old)	**
6		POSITIONER, Standard Spool (See Figure 4-12)	A/R
7		POSITIONER, Manual Spool (See Figure 4-13)	A/R
8		POSITIONER, Float Detent, 4-Way, 4-Position (See Figure 4-14)	A/R
9		DETENT, Option "R", With Spring Return To Neutral (See Figure 4-15)	A/R
10		DETENT, Option "D", 3-Position (See Figure 4-16)	A/R
11		SPRING EXTENDED SPOOL, Option "A" (See Figure 4-17)	A/R
12		ELECTRO-MAGNETIC SPOOL RELEASE (See Figure 4-18)	A/R
13		POSITIONER, Pressure Detent Release (See Figure 4-19)	A/R
14		POSITIONER, Rotary, Option "W" (See Figure 4-20).	A/R
15		POSITIONER, Standard Spool, V20S or V20R (See Figure 4-21)	A/R
16		POSITIONER, Float Detent, 4-Way, 4-Position, V20S (See Figure 4-22)	A/R
17		CHECK, Lockout (See Figure 4-29)	A/R
18		CHECK, Anti-Cavitation (See Figure 4-30)	A/R
19		CHECK, Anti-Cavitation, V20S (See Figure 4-31)	A/R
20		PLUG, Load Check, (See Figure 4-32)	A/R
21		PLUG, Load Check, V20S (See Figure 4-33)	A/R
22		RELIEF, Work Port, Model RC (See Figure 4-34)	A/R
23		RELIEF, Work Port, Model RCA (See Figure 4-35)	A/R
24		RELIEF/ANTI-CAVITATION CHECK, Work Port, Model CRA (See Figure 4-37)	A/R
25		RELIEF, Work Port, Model RCS (See Figure 4-38)	A/R
26		RELIEF, Main, Model WH (See Figure 4-39)	A/R
27		RELIEF, Main, Model WHA (See Figure 4-40)	A/R
28		RELIEF, Main, Model RP51 (See Figure 4-41	A/R
29		PLUG, No Main Relief (NR) (See Figure 4-43)	A/R
30	6770-	COVER, Right (See pages 3-3 & 3-4)	1
31	8644-	COVER, Right (See page 3-3)	1
32	9310-006	NUT, Stud (Not sold separately. See Item No. 1)	
33	8072-	VALVE SECTION, 4-Way, 4-Position, Float (See Figure 4-2)	A/R
34	8072-	VALVE SECTION, 4-Way, 3-Position (See Figure 4-3)	A/R
35	8072-	VALVE SECTION, 3-Way, 3-Position (See Figure 4-4)	A/R
36	8072-	VALVE SECTION, 4-Way, 3-Position, With Pressure Detent Release (See Figure 4-5)	A/R
37	11571-	VALVE SECTION, 4-Way, 3-Position, With Pilot Operated Checks (See Figure 4-6)	A/R
38	8112-	VALVE SECTION, Tandem (See Figure 4-7)	A/R
39	10954-	VALVE SECTION, Low Pressure Drop (See Figure 4-8)	A/R
40	10762-	VALVE SECTION, Tandem, Low Pressure Drop (See Figure 4-9)	A/R
41	11483-	VALVE SECTION, Series (See Figure 4-10)	A/R
42	11483-	VALVE SECTION, Series, 4-Way, 4-Position, Float (See Figure 4-11)	A/R
43	6825-001	MID-INLET SECTION, Split Flow, Top Inlet 3/4—14 NPT	A/R
	6825-004	MID-INLET SECTION, Split Flow, Top Inlet 1/2—14 NPT	A/R
	6825-007	MID-INLET SECTION, Split Flow, Top Inlet SAE 12 (1-1/16—12 UNF)	A/R
	6825-011	MID-INLET SECTION, Split Flow, Top Inlet SAE 10 (7/8—14 UNF)	A/R
	6825-005	MID-INLET SECTION, Combined Flow, Top Inlet 3/4—14 NPT	A/R
	6825-008	MID-INLET SECTION, Combined Flow, Top Inlet 1/2—14 NPT	A/R
	6825-013	MID-INLET SECTION, Combined Flow, Top Inlet SAE 10 (7/8—14 UNF)	A/R
	6825-016	MID-INLET SECTION, Combined Flow, Top Inlet SAE 12 (1-1/16—12 UNF)	A/R
	6825-002	MID-INLET SECTION, Top Cored Hole Plugged with 3/8—18 NPT Plug	A/R
44		HANDLE ASSEMBLY, Vertical (See Figure 4-26)	A/R
45		HANDLE ASSEMBLY, Horizontal (See Figure 4-27)	A/R
46		BRACKET, Standard Handle (See Figure 4-25)	A/R
47	K-6033-B	RETAINER, Seal, Standard (See Figure 4-23)	A/R
48	K-6029-B	RETAINER, Seal, Heavy Duty (See Figure 4-24)	A/R
50	K-6056-B	BOOT ASSEMBLY, Spool Protective (See Figure 4-28)	A/R

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

**All old versions include two exhaust and two small O-rings. All new open center versions include three large and one small O-ring. Other new versions including outlet, utility section and mid-inlets contain two of each.

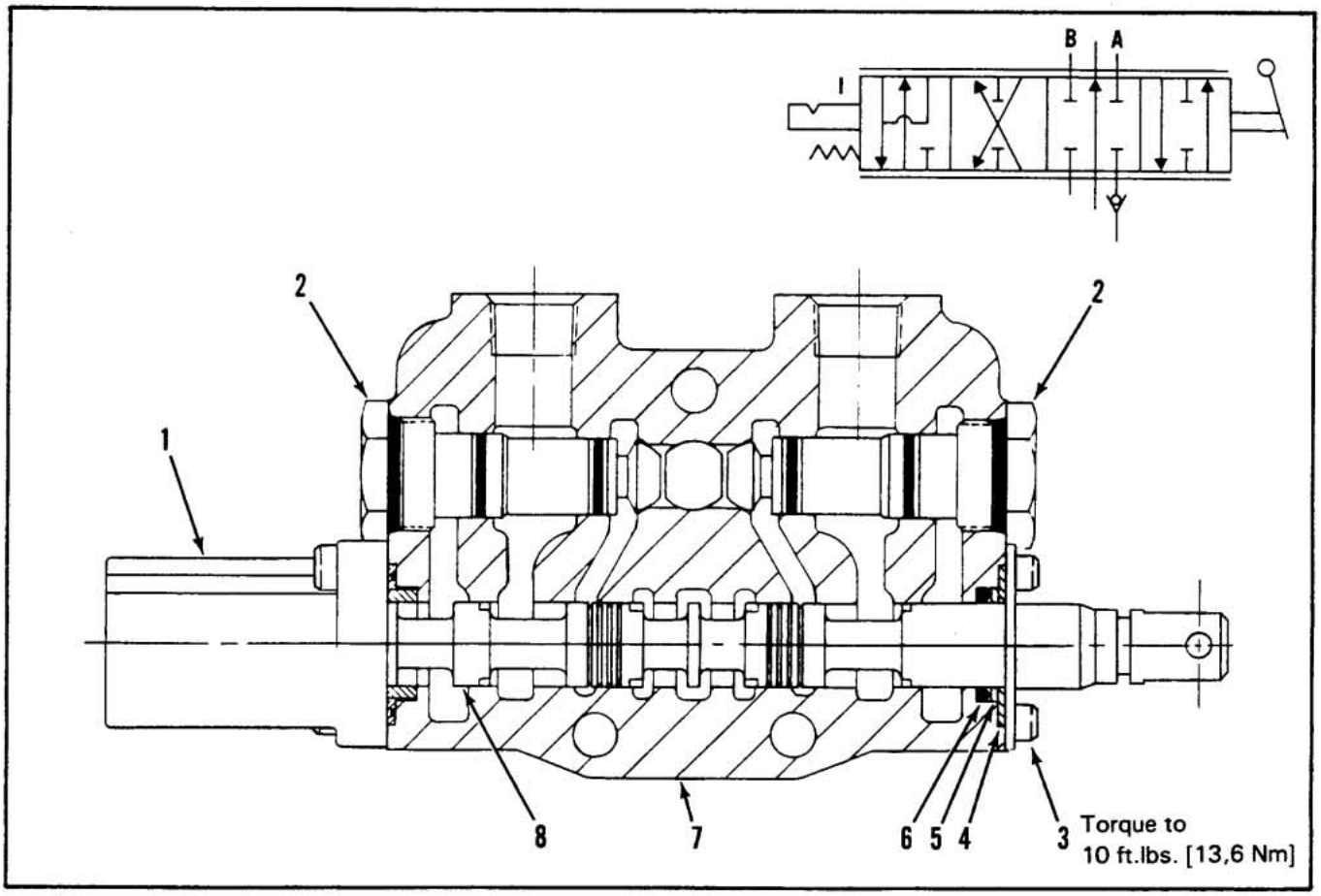


Figure 4-2. 4-Way, 4-Position Float Valve Section.

4-WAY, 4-POSITION FLOAT VALVE SECTION

Item No.	Part No.	Description		Quantity Per Section
1	K-6127-A	POSITIONER, Float (See Figure 4-14)		1
2	K-6030-C	CHECK, Load (See Figure 4-32)		2
3	K-6033-B	RETAINER ASSEMBLY, Standard, Includes Screws (See Figure 4-23. See Figures 4-24 through 4-28 for optional assemblies.)		1
4	6752-001	RETAINER, Plate Washer		1
5	3265-001	WASHER, Back-Up	See Note 1	1
6	7700-001*	SEAL, O-Ring	See Note 1	1
7	8072-	HOUSING, V20 Valve	See Note 2	1
8	8085-001	SPOOL, Float	See Note 2	1

Notes:

1. Seal and washer not sold separately. Order Seal Kit No. K-6035-A.

2. These are matched parts and are not sold separately. Refer to Ordering Instructions, page 3-6 for complete section.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

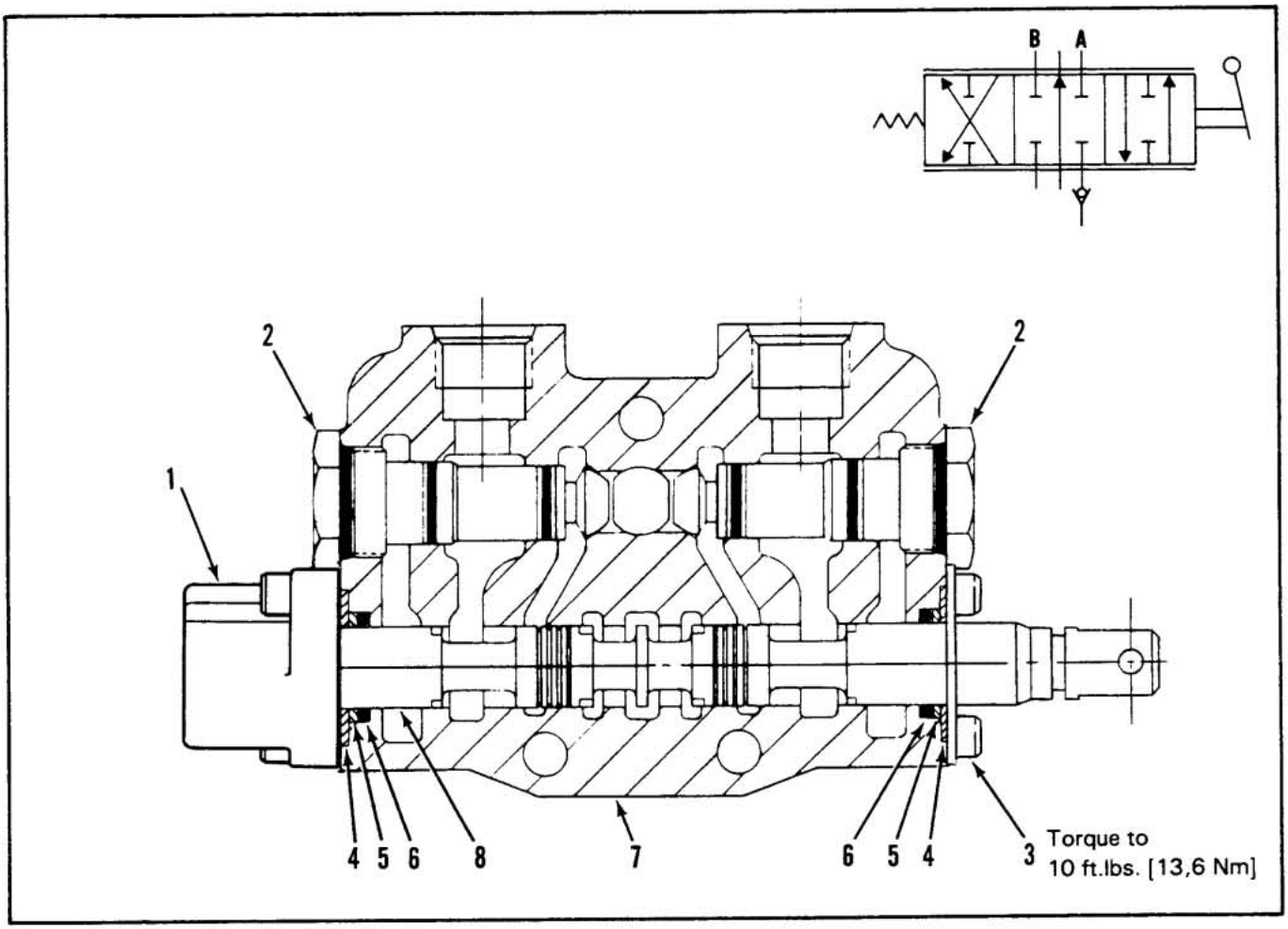


Figure 4-3. 4-Way, 3-Position Valve Section.

4-WAY, 3-POSITION VALVE SECTION

Item No.	Part No.	Description	Quantity Per Section
1	K-6125-B	POSITIONER, Spool, Standard (See Figure 4-12)	1
2	K-6030-C	CHECK, Load (See Figure 4-32)	2
3	K-6033-B	RETAINER ASSEMBLY, Standard, Includes Screws (See Figure 4-23. See Figure 4-24 thru 4-28 for optional assemblies.)	1
4	6752-001	RETAINER, Plate Washer	2
5	3265-001	WASHER, Back-Up } See Note 1	2
6	7700-001*	SEAL, O-Ring } See Note 1	2
7	8072-	HOUSING, Standard } See Note 2	1
8	8084-001	SPOOL, 4-Way } See Note 2	1

Notes:

1. Seal and washer not sold separately. Order Seal Kit No. K-6035-A.

2. These are matched parts and are not sold separately. Refer to Ordering Instructions, page 3-6 for complete section.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

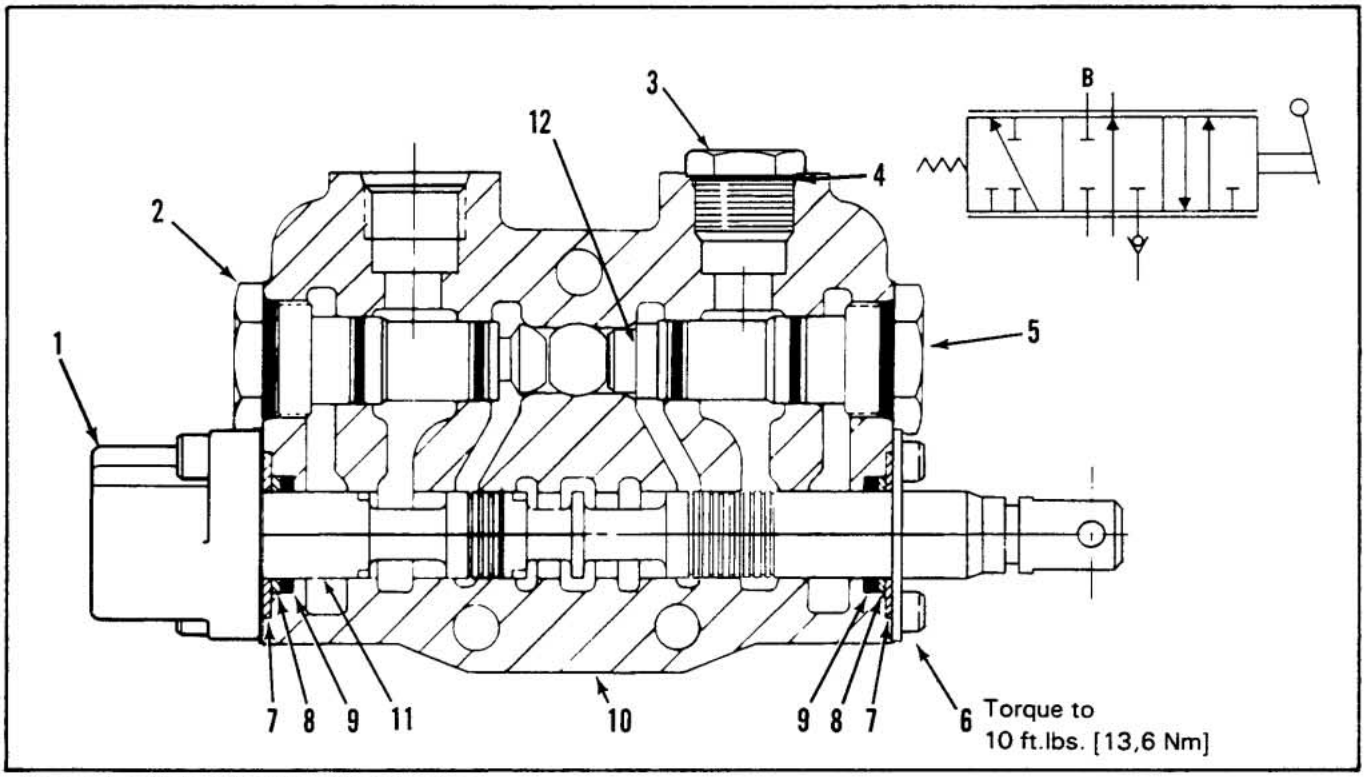


Figure 4-4. 3-Way, 3-Position Valve Section.

3-WAY, 3-POSITION VALVE SECTION

Item No.	Part No.	Description	Quantity Per Assembly
1	K-6125-B	POSITIONER, Spool, Standard (See Figure 4-12)	1
2	K-6030-C	CHECK, Load (See Figure 4-32)	1
3	2684-001	PLUG, 3-Way Conversion, SAE 8 (3/4"–16 UNF)	A/R
	1458-001	PLUG, 3-Way Conversion, SAE 10(7/8"–14 UNF)	A/R
	0073-001	PLUG, 3-Way Conversion, 3/8"–18 NPT	A/R
	0947-001	PLUG, 3-Way Conversion, 1/2"–14 NPT	A/R
4	2706-001	SEAL, O-Ring, SAE 8 Plug	A/R
	2707-001	SEAL, O-Ring, SAE 10 Plug	A/R
5	K-6030-C	PLUG, Check (Load Check and Spring are not used)	1
6	K-6033-B	RETAINER ASSEMBLY, Standard, Includes Screws (See Figure 4-23. See Figures 24 thru 4-28 for optional assemblies)	1
7	6752-001	RETAINER, Plate Washer	2
8	3265-001	WASHER, Back-Up } See Note 1	2
9	7700-001*	SEAL, O-Ring } See Note 1	2
10	8072-	HOUSING } See Note 2	1
11	8083-001	SPOOL, 3-Way } See Note 2	1
12	6754-001	PLUG, 3-Way	1

Notes:

1. Seal and washer not sold separately. Order Seal Kit No. K-6035-A.

2. These are matched parts and are not sold separately. Refer to Ordering Instructions, page 3-6 for complete section.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

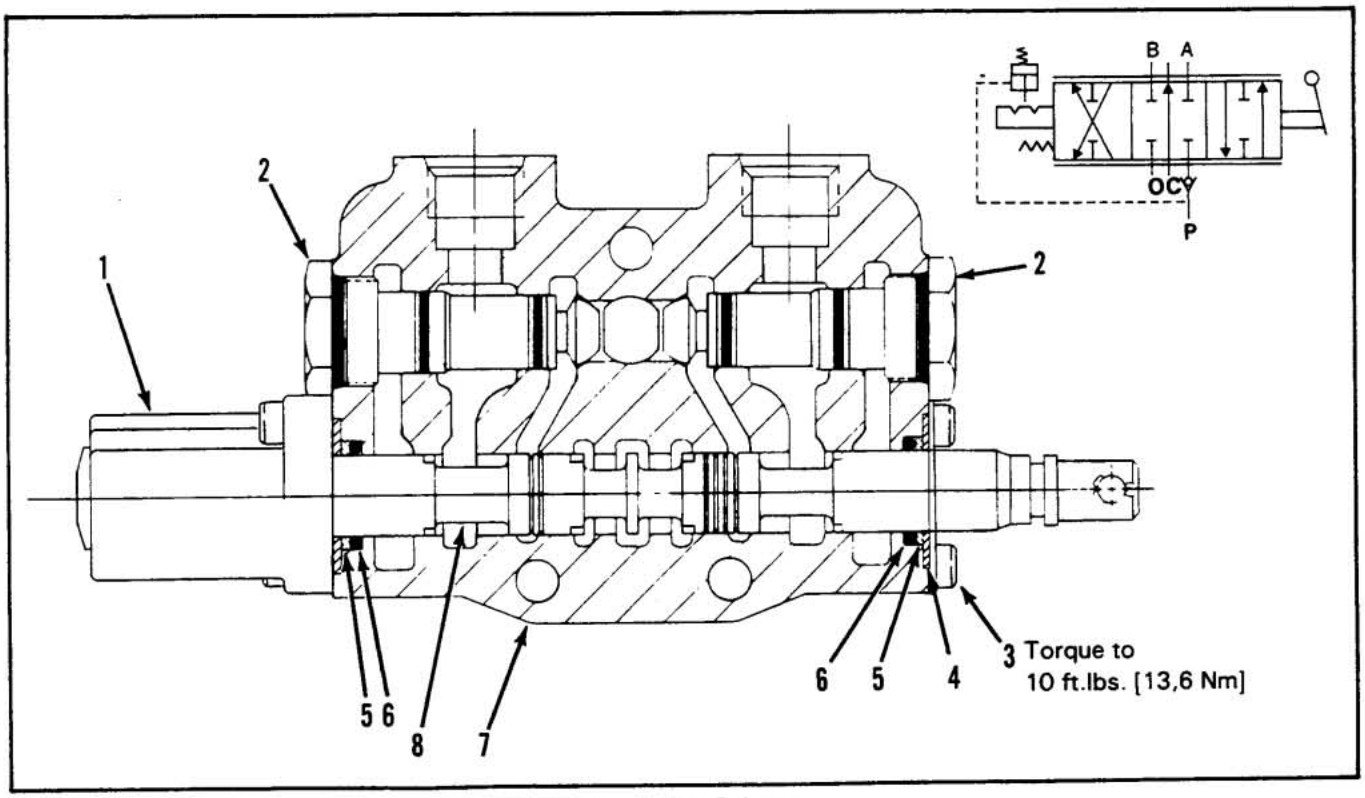


Figure 4-5. 4-Way, 3-Position Valve Section with Pressure Detent Release.

4-WAY, 3-POSITION VALVE SECTION WITH PRESSURE DETENT RELEASE (KO)

Item No.	Part No.	Description	Quantity Per Section
1		POSITIONER, Pressure Detent Release (See Figure 4-19)	1
2	K-6030-A	CHECK, Load (See Figure 4-32)	2
3	K-6033-B	RETAINER ASSEMBLY, Standard, Includes Screws, (See Figure 4-23. See Figures 4-24 thru 4-28 for optional assemblies.)	1
4	6752-001	RETAINER, Plate Washer	1
5	3765-001	WASHER, Back-Up } See Note 1	2
6	7700-001*	SEAL, O-Ring } See Note 1	2
7	8072-	HOUSING } See Note 2	1
8	8534-001	SPOOL, 4-Way } See Note 2	1

Notes:

1. Seal and washer not sold separately. Order Seal Kit No. K-6035-A.

2. These are matched parts and are not sold separately. Refer to Ordering Instructions, page 3-6 for complete section.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

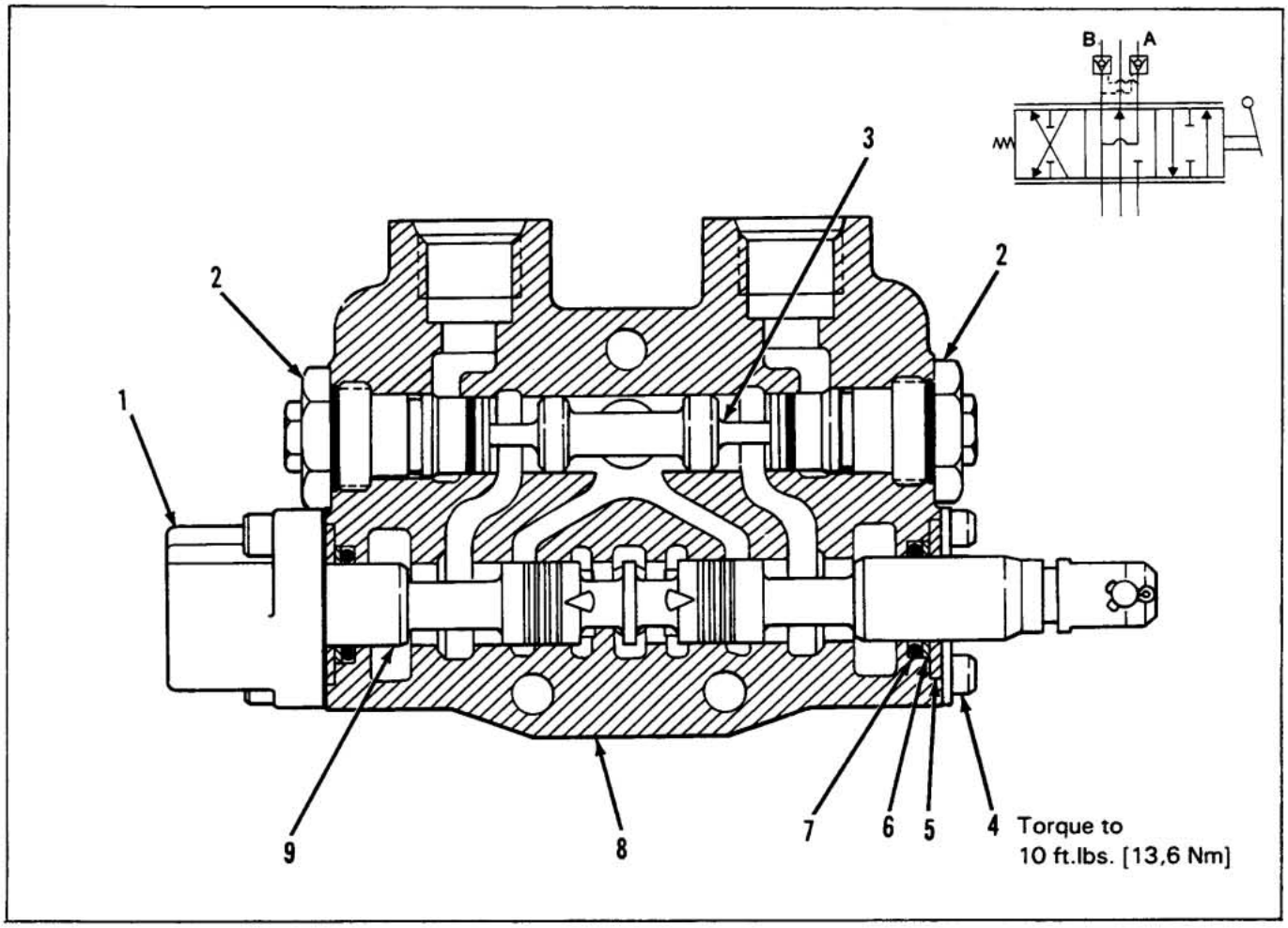


Figure 4-6. 4-Way, 3-Position Lockout Valve Section.

4-WAY, 3-POSITION LOCKOUT VALVE SECTION

Item No.	Part No.	Description	Quantity Per Section
1	K-6125-B	POSITIONER, Spool, Standard (See Figure 4-12)	1
2	K-6024-D	CHECK, Lockout (See Figure 4-29)	2
3	8648-001	PISTON, Unlocking	1
4	K-6033-B	RETAINER ASSEMBLY, Standard, Includes screws (See Figure 4-23. See Figure 4-24 thru 4-28 for optional assemblies.)	1
5	6752-001	RETAINER, Plate Washer	2
6	3265-001	WASHER, Back-Up } Not sold separately. Order K-6035-A	2
7	7700-001*	SEAL, O-Ring }	2
8	11571-	HOUSING, V20 Lockout } See Note	1
9	8397-001	SPOOL, Modified 4-Way Free Flow }	1

Note: These are matched parts and are not sold separately. Refer to Ordering Instructions, page 3-6 for complete section.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

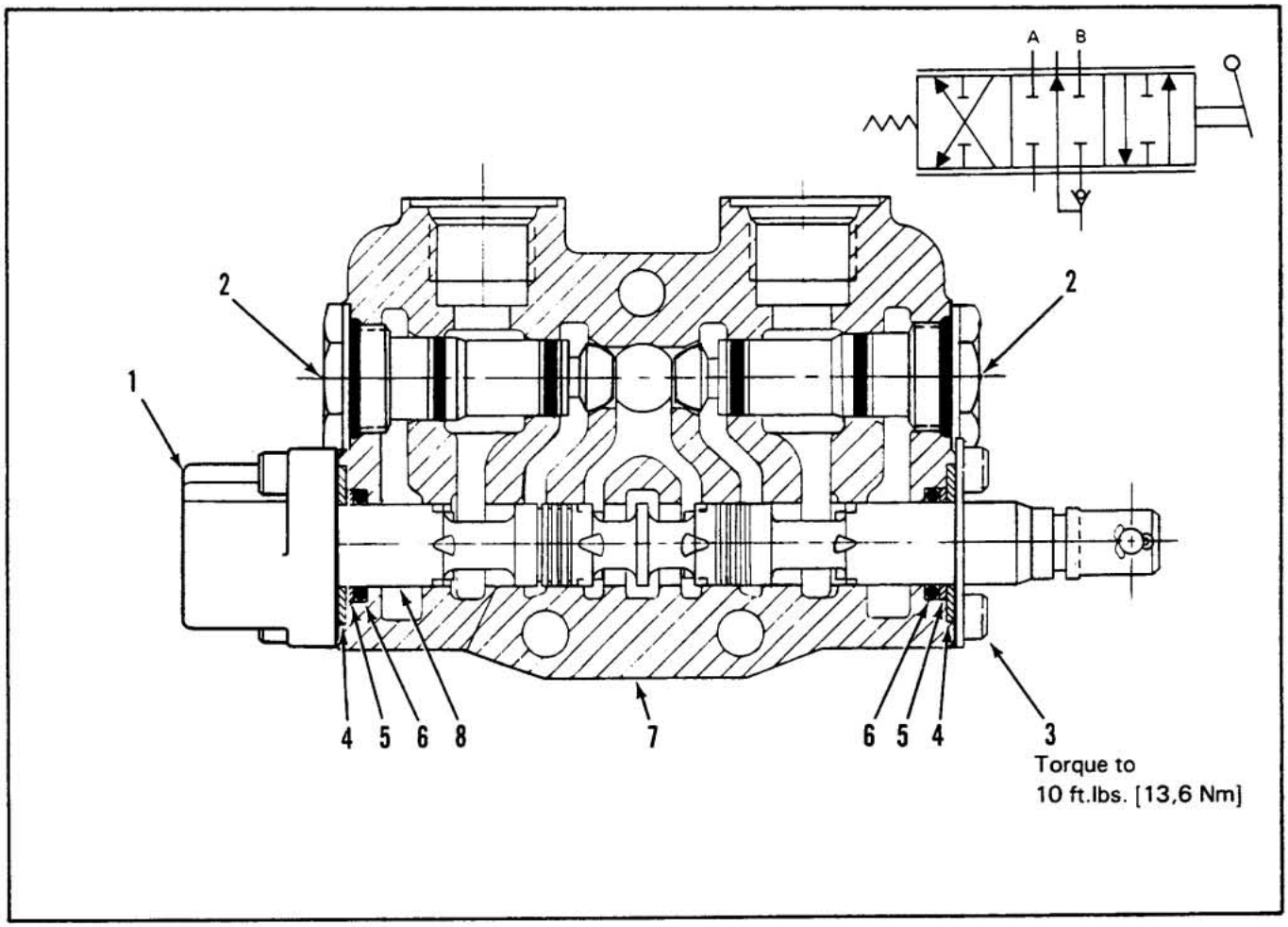


Figure 4-7. 4-Way, 3-Position Tandem Valve Section (shown with 4-way spool).

4-WAY, 3-POSITION TANDEM VALVE SECTION

Item No.	Part No.	Description		Quantity Per Section
1	K-6125-B	POSITIONER, Spool, Standard (See Figure 4-12)		1
2	K-6030-C	CHECK, Load (See Figure 4-32)		2
3	K-6033-B	RETAINER ASSEMBLY, Standard, Includes Screws (See Figure 4-23. See Figures 4-24 thru 4-28 for optional assemblies.)		1
4	6752-001	RETAINER, Plate Washer		2
5	3265-001	WASHER, Back-Up	See Note 1	2
6	7700-001*	SEAL, O-Ring	See Note 1	2
7	8112-	HOUSING	See Note 2	1
8	8084-001	SPOOL, 4-Way	See Note 2	1

Notes:

1. Seal and washer not sold separately. Order Seal Kit No. K-6035-A.

2. These are matched parts and are not sold separately. Refer to Ordering Instructions, page 3-6 for complete section.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

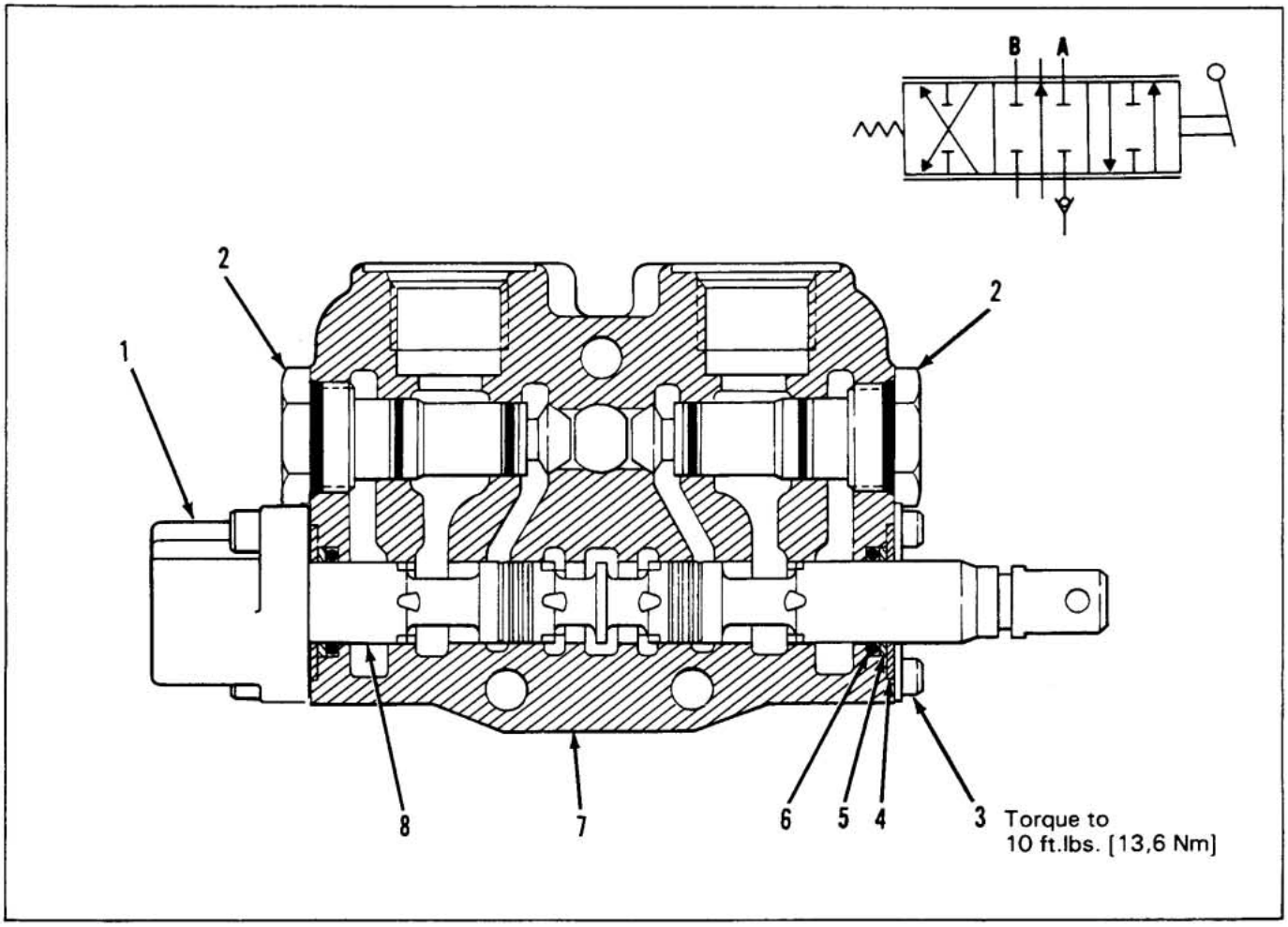


Figure 4-8. 4-Way, 3-Position, Low Pressure Drop Valve Section.

4-WAY, 3-POSITION, LOW PRESSURE DROP VALVE SECTION

Item No.	Part No.	Description	Quantity Per Section
1	K-6207-A	POSITIONER, Spool, Standard (See Figure 4-21)	1
2	K-6030-C	CHECK, Load (See Figure 4-32)	2
3	K-6033-B	RETAINER ASSEMBLY, Standard, Includes screws (See Figure 4-23. See Figure 4-24 thru 4-28 for optional assemblies.)	1
4	6752-001	RETAINER, Plate Washer	2
5	3265-001	WASHER, Back Up } Not Sold separately. Order K-6035-A	2
6	7700-001*	SEAL, O-Ring }	2
7	10954-	HOUSING, V20 Low Pressure Drop } See Note	1
8	8084-001	SPOOL, 4-Way }	1

Note: These are matched parts and are not sold separately. Refer to Ordering Instructions, page 3-6 for complete section.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

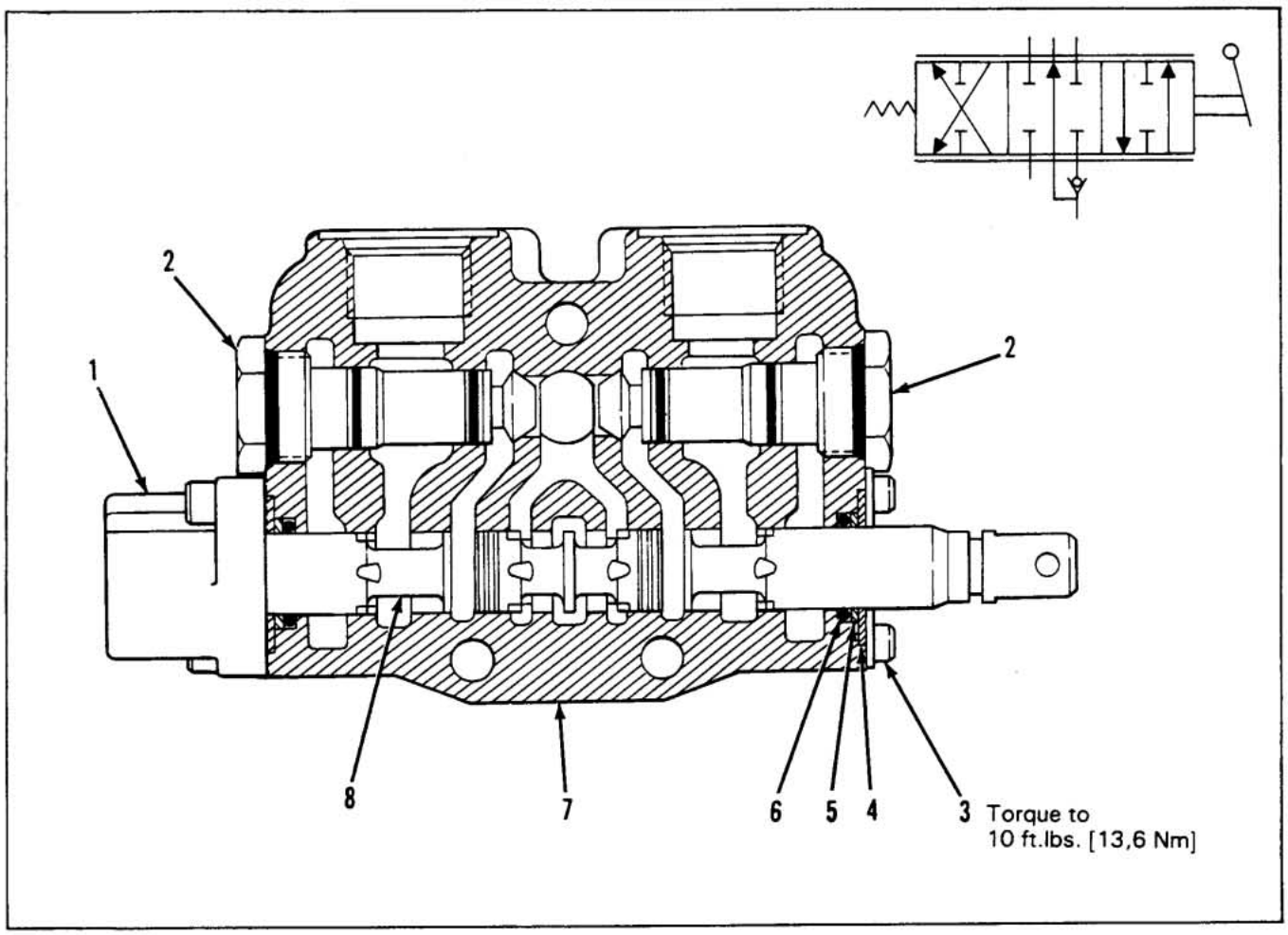


Figure 4-9. 4-Way, 3-Position, Tandem, Low Pressure Drop Valve Section.

4-WAY, 3-POSITION, TANDEM, LOW PRESSURE DROP VALVE SECTION

Item No.	Part No.	Description	Quantity Per Section
1	K-6207-A	POSITIONER, Spool, Standard (See Figure 4-21)	1
2	K-6030-C	CHECK, Load (See Figure 4-32)	2
3	K-6033-B	RETAINER ASSEMBLY, Standard, Includes screws (See Figure 4-23. See Figure 4-24 thru 4-28 for optional assemblies.)	1
4	6752-001	RETAINER, Plate Washer	2
5	3265-001	WASHER, Back-Up } Not Sold separately. Order K-6035-A	2
6	7700-001*	SEAL, O-Ring } Not Sold separately. Order K-6035-A	2
7	10762-	HOUSING, Tandem, Low Pressure Drop } See Note	1
8	8084-001	SPOOL, 4-Way } See Note	1

Note: These are matched parts and are not sold separately. Refer to Ordering Instructions, page 3-6 for complete section.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

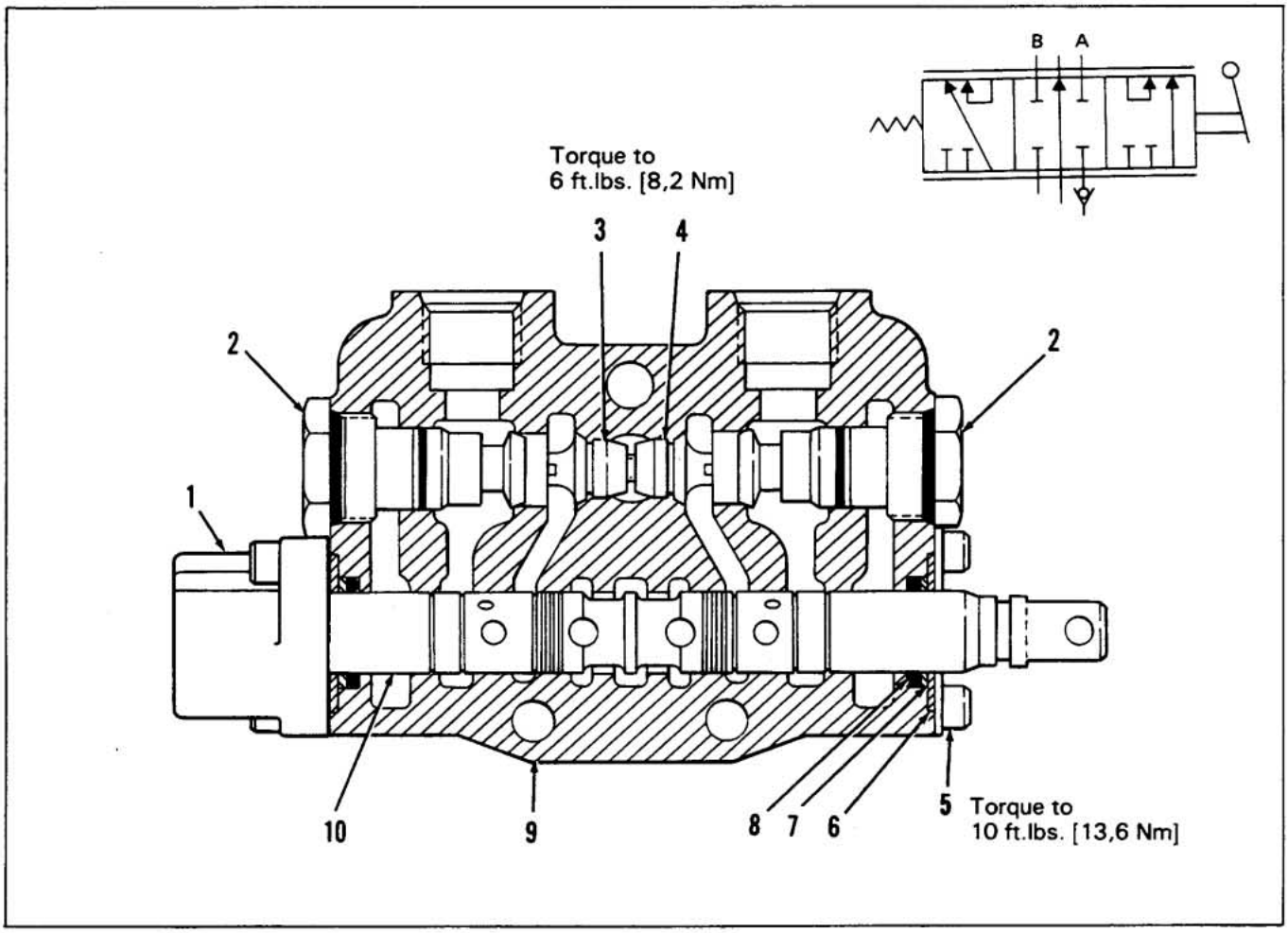


Figure 4-10. 4-Way, 3-Position, Series Valve Section.

4-WAY, 3-POSITION, SERIES VALVE SECTION

Item No.	Part No.	Description	Quantity Per Section
1	K-6207-A	POSITIONER, Spool, Standard (See Figure 4-21)	1
2	K-6203	CHECK, Load (See Figure 4-33)	2
3	11246-001	PLUG, Power Core } See Note 1	1
4	11716-001	PLUG, Power Core }	1
5	K-6033-B	RETAINER ASSEMBLY, Standard, Includes screws (See Figure 4-23. See Figure 4-24 thru 4-28 for optional assemblies.)	1
6	6752-001	RETAINER, Plate Washer	2
7	3265-001	WASHER, Back-Up } Not Sold separately. Order K-6035-A	2
8	7700-001*	Seal, O-Ring }	2
9	11483-	HOUSING, V20 Series } See Note 2	1
10	11245-001	SPOOL, Series, 4-Way }	1

Notes:

1. Parts not sold separately. Order K-6200-A. Power core plug assembly is only used in Series housings manufactured prior to May 1, 1985 (Series housing #8072).
2. These are matched parts and are not sold separately. Refer to Ordering Instructions, page 3-6 for complete section.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

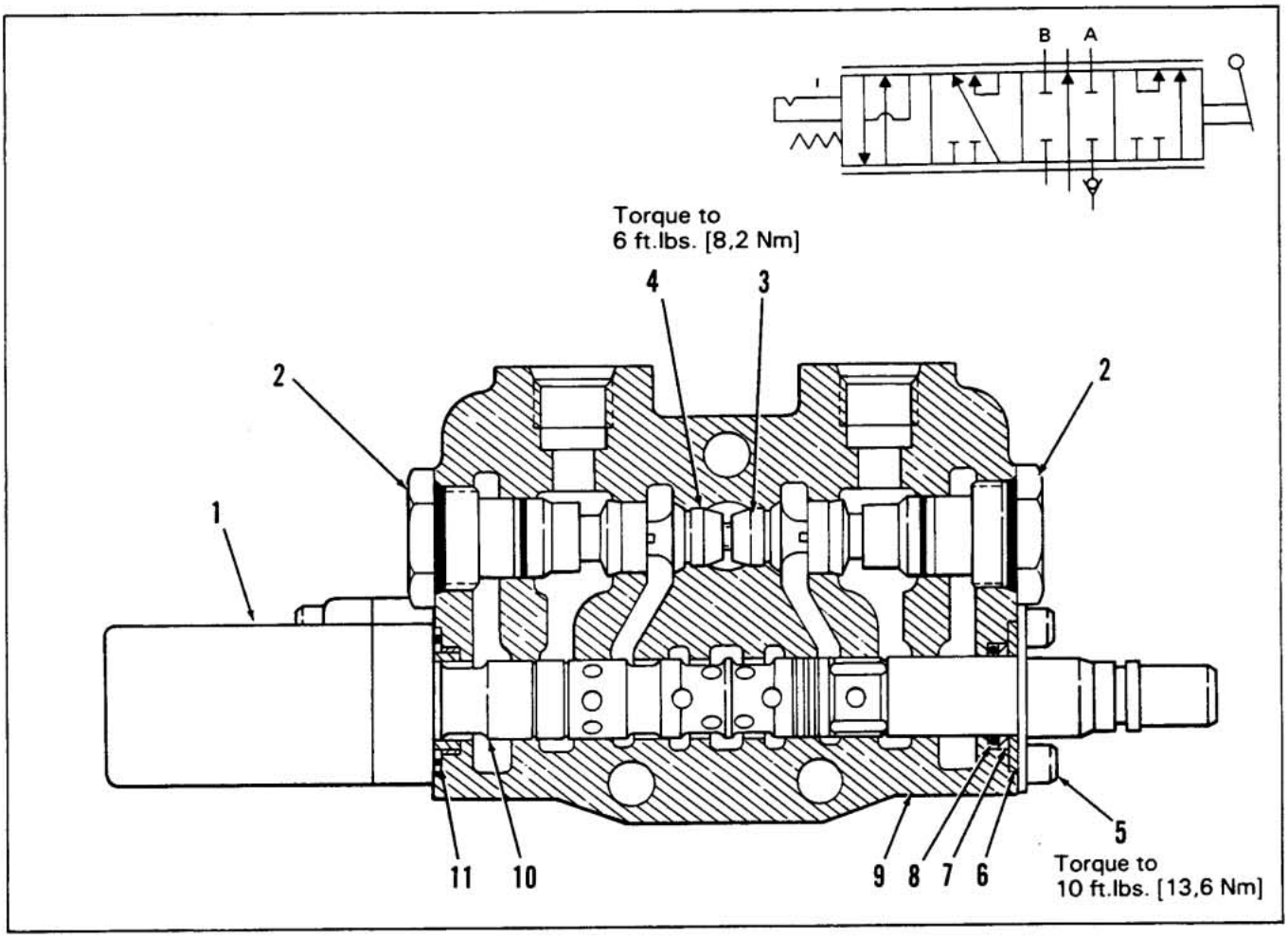


Figure 4-11. 4-Way, 4-Position Float, Series Valve Section.

4-WAY, 4-POSITION FLOAT, SERIES VALVE SECTION

Item No.	Part No.	Description	Quantity Per Section
1	K-6208	POSITIONER, Float Out (See Figure 4-22)	1
2	K-6203	CHECK, Load (See Figure 4-33)	2
3	11246-001	PLUG, Power Core } See Note 1	1
4	11716-001	PLUG, Power Core }	1
5	K-6033-B	RETAINER ASSEMBLY, Standard, Includes screws (See Figure 4-23. See Figure 4-24 thru 4-28 for optional assemblies.)	1
6	6752-001	RETAINER, Plate Washer	1
7	3265-001	WASHER, Back-Up } Not sold separately. Order K-6035-A	1
8	7700-001*	SEAL, O-Ring }	1
9	11483-	HOUSING, V20 Series } See Note 2	1
10	11377-001	SPOOL, Series, Float }	1
11		SPOOL SEAL ASSEMBLY (See Figure 4-22)	1

Notes:

1. Parts not sold separately. Order K-6200-A. Power core plug assembly is only used in Series housings manufactured prior to May 1, 1985 (series housing #8072).
2. These are matched parts and are not sold separately. Refer to Ordering Instructions, page 3-2 for complete section.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

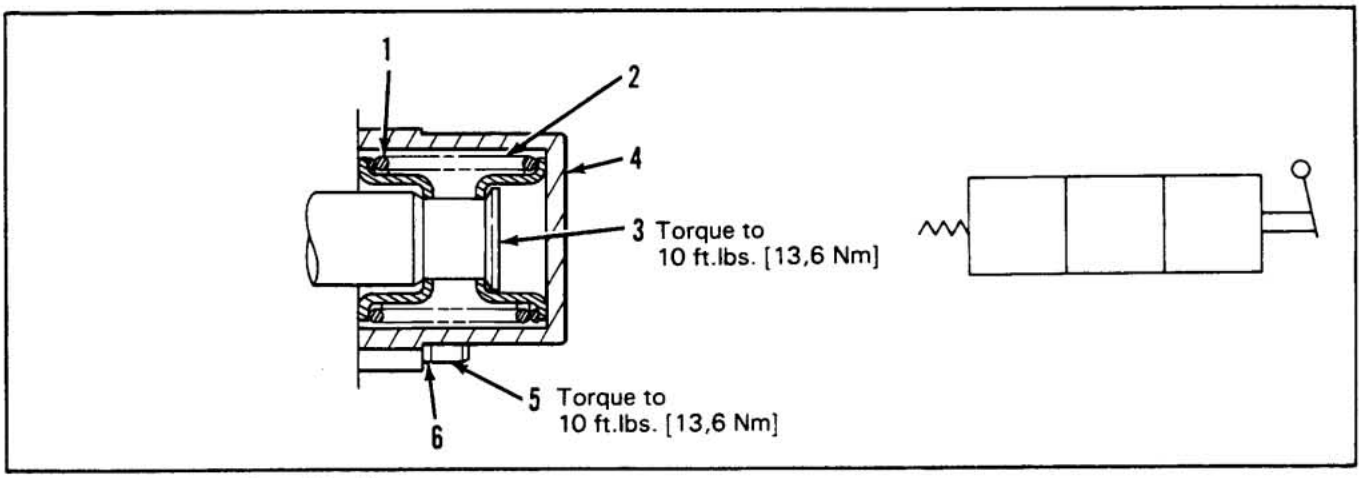


Figure 4-12. Standard Spool Positioner.

STANDARD SPOOL POSITIONER

Item No.	Part No.	Description	Quantity
	K-6125-B	REPLACEMENT KIT (Contains all items listed below)	
1	7433-001	Spring, Return	1
2	1809-001	COLLAR, Spring	2
3	10892-001	COLLAR, Spool	1
4	1811-001	BONNET	1
5	3731-101	SCREW, HSHC, 1/4-20 x 7/8 inch long	2
6	0563-001	WASHER, Lock	2

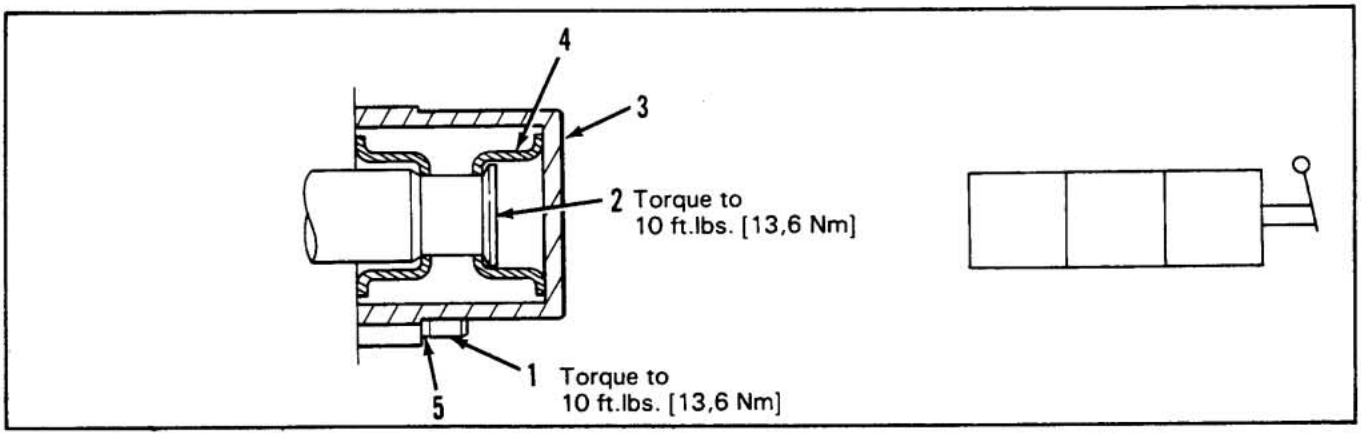


Figure 4-13. Manual Spool Positioner.

MANUAL SPOOL POSITIONER

Item No.	Part No.	Description	Quantity
1	3731-101	SCREW, HSHC, 1/4-20 x 7/8 inch long	2
2	10892-001	COLLAR, Spool	1
3	1811-001	BONNET	1
4	1809-001	COLLAR, Stop	2
5	0563-001	WASHER, Lock	2

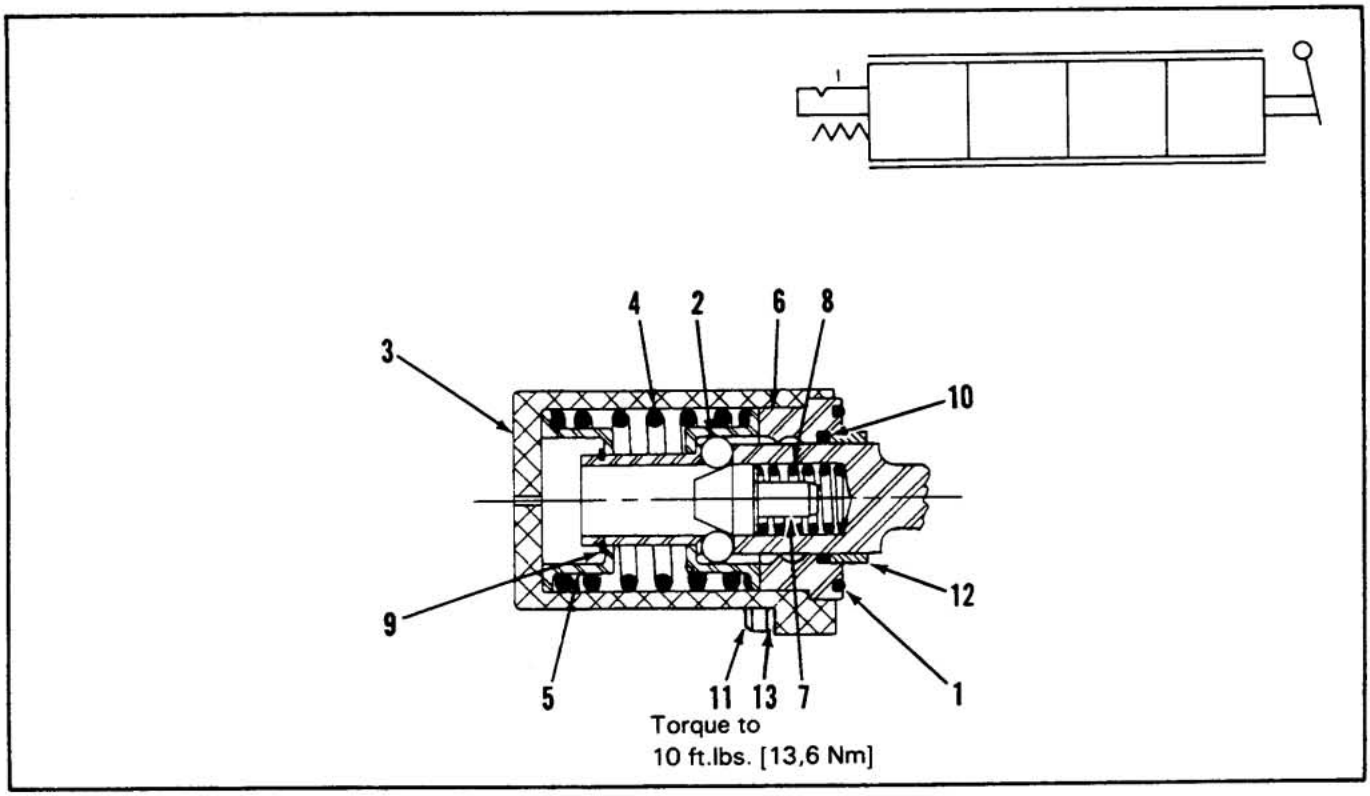


Figure 4-14. 4-Way, 4-Position Float Detent Positioner.

4-WAY, 4-POSITION FLOAT DETENT POSITIONER

Item No.	Part No.	Description	Quantity
	K-6127-B	REPLACEMENT KIT (Contains all items listed below)	
1	21047-001*	O-RING, Seal	1
2	1700-001	BALL, Detent	4
3	8082-001	BONNET, Float	1
4	8099-001	SPRING, Centering (See Note)	1
5	1826-001	COLLAR, Stop	2
6	8077-001	SLEEVE, Detent	1
7	1828-001	FOLLOWER, Detent Ball	1
8	8098-001	SPRING, Detent (See Note)	1
9	1852-001	RING, Retaining	1
10	1853-001*	SEAL, Spool	1
11	3731-101	SCREW, HSHC, 1/4-20 x 7/8 inch long	2
12	8079-001	SLEEVE, Retainer	1
13	0563-001	WASHER, Lock	2

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

Note:

Springs shown are standard. Heavy duty springs are available:

Order No. 3091-001 Heavy Duty Centering Spring.

Order No. 1829-001 Heavy Duty Detent Spring.

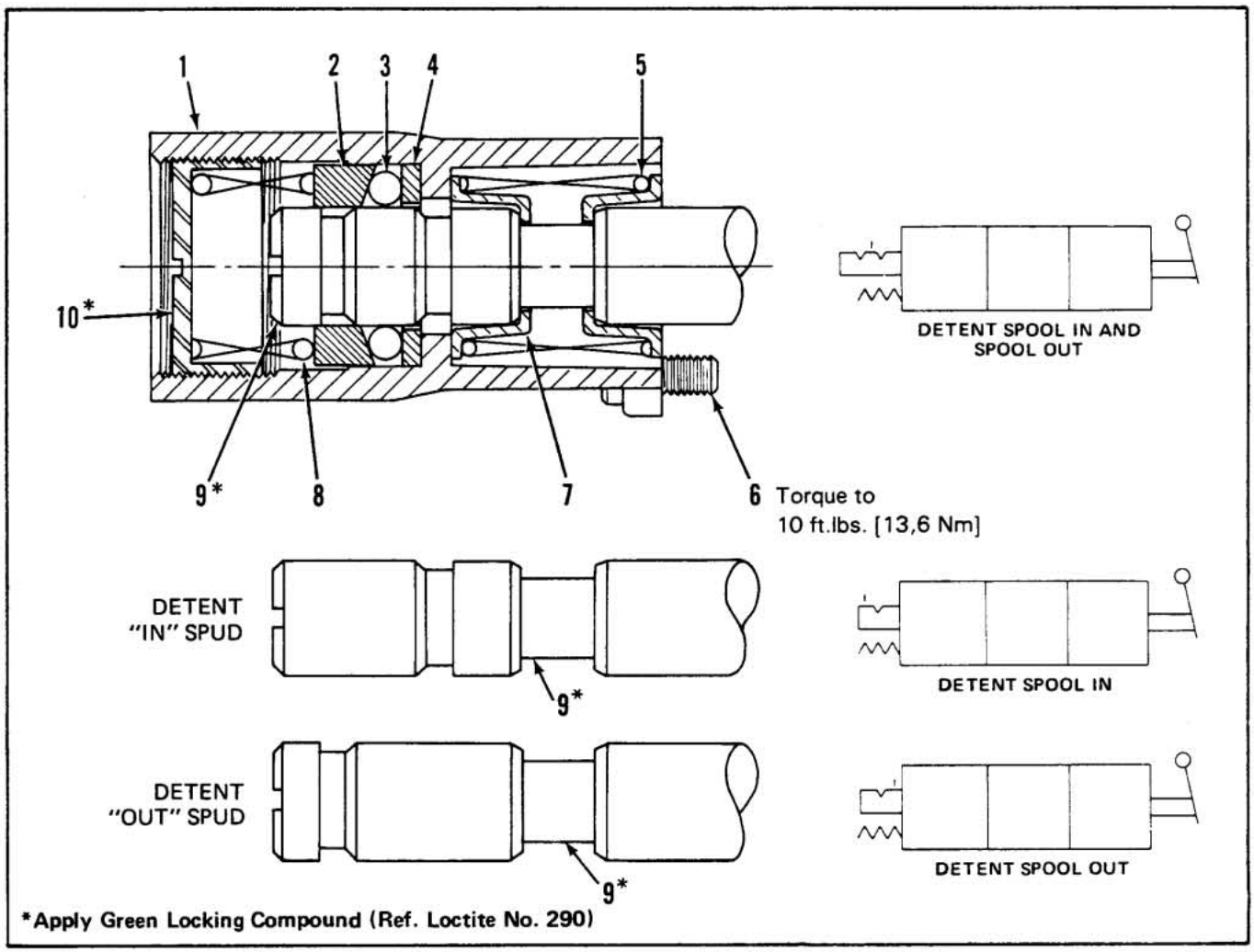


Figure 4-15. Option "R" Detent with Spring Return to Neutral.

OPTION "R" DETENT with SPRING RETURN TO NEUTRAL

Item No.	Part No.	Description	Quantity
	K-6152-A	REPLACEMENT KIT, Detent Spool "IN" position only	
	K-6151-A	REPLACEMENT KIT, Detent Spool "OUT" position only	
	K-6153-A	REPLACEMENT KIT, Detent Spool "IN" and "OUT" positions (Replacement Kits contain all of the items listed below with the correct spud (item 9) for each kit)	
1	8325-001	BONNET, R Detent	1
2	8571-001	RACE, Ball	1
3	1700-001	BALL, Steel	12
4	7994-001	PLATE, Thrust	1
5	3250-001	SPRING, Centering	1
6	3731-099	SCREW, HSHC, 1/4-20 by 5/8 inch long	2
7	1809-001	COLLAR, Spring	2
8	3252-001	SPRING	1
9	8573-001	SPUD, R Detent "IN"	1
	8572-001	SPUD, R Detent "OUT"	1
	8574-001	SPUD, R Detent "IN" and "OUT"	1
10	20443-001	CAP, Adjusting	1

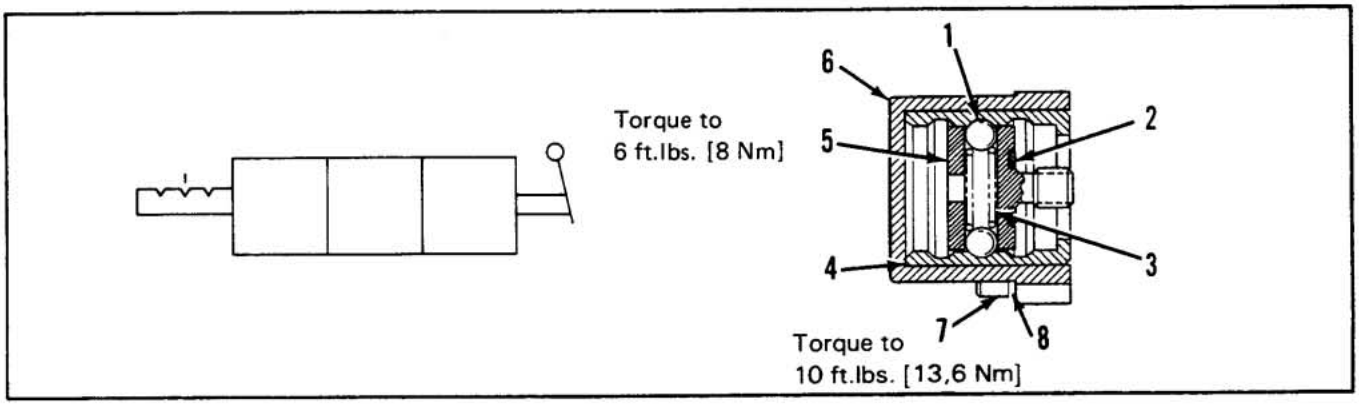


Figure 4-16. Option "D" 3-Position Detent Spool.

OPTION "D" 3-POSITION DETENT SPOOL

Item No.	Part No.	Description	Quantity
	K-6012-E	REPLACEMENT KIT (Contains all items listed below except item 8)	
1	0023-001	BALL, Detent	2
2	1837-001	WASHER, Lock	1
3	1838-001	SPRING, Detent	1
4	6812-001	SLEEVE, Detent, 3-position	1
5	1840-001	HOLDER, Detent	1
6	1811-001	BONNET	1
7	3731-101	SCREW, HSHC, 1/4-20 x 7/8 inch long	2
8	0563-001	WASHER, Lock	2
9	1889-001	STOP, Detent, optional (not shown)	1

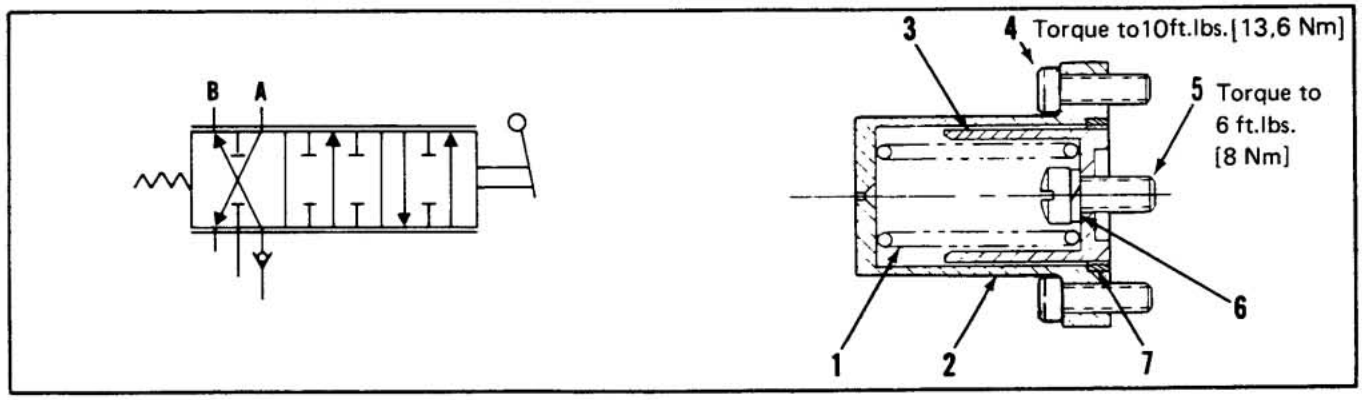


Figure 4-17. Option "A" Spring, Extended Spool.

OPTION "A" SPRING, EXTENDED SPOOL

Item No.	Part No.	Description	Quantity
	K-6150-A	REPLACEMENT KIT (Contains all items listed below)	
1	8666-001	SPRING, Return	1
2	1824-001	BONNET	1
3	1860-001	COLLAR, Stop	1
4	9161-407	SCREW, HSHC, 1/4-20 by 7/8 inch long	2
5	1812-001	SCREW, Cap	1
6	1813-001	WASHER, Lock	1
7	6756-001	SLEEVE, Bonnet	1

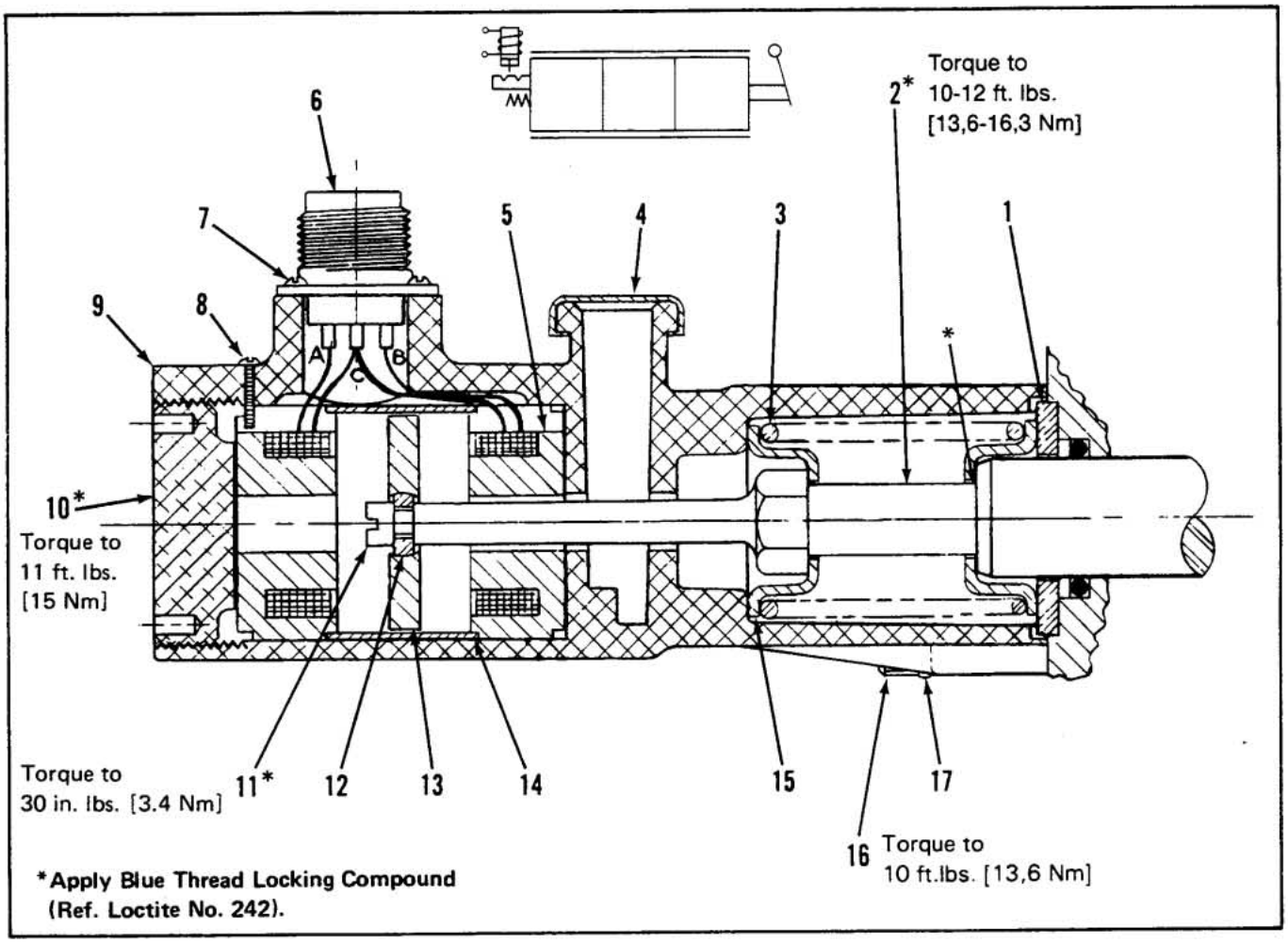


Figure 4-18. Electro-Magnetic Spool Release Positioner.

ELECTRO-MAGNETIC SPOOL RELEASE POSITIONER

Item No.	Part No.	Description	Quantity
	K-6064-A	REPLACEMENT KIT (Contains Items 2, 5, 11, 12, 13)	
1	7572-001	RETAINER, Spool Seal	1
2	7954-001	SPUD, Positioner	1
3	3250-001	SPRING, 1.114 OD x 0.095 WD	1
4	7589-001	CAP, Seal	1
5	7752-001	ELECTRO-MAGNET	2
6	7955-001	CONNECTOR, Electrical	1
7	7593-001	SCREW, Thread-Cutting	4
8	7956-001	SCREW, Thread-Cutting	1
9	7583-004	BONNET, Electric Detent	1
10	7957-001	PLUG, Bonnet	1
11	7756-001	SCREW, Shoulder, .188 x 0.156 inch long	1
12	7755-001	WASHER, Alignment	1
13	8555-001	ARMATURE	1
14	7958-001	SPACER	1
15	7573-001	COLLAR, Spring	2
16	3731-103	SCREW, Housing, .250 x 1.25 inches long	2
17	0563-001	WASHER, Lock, 0.250 ID	2

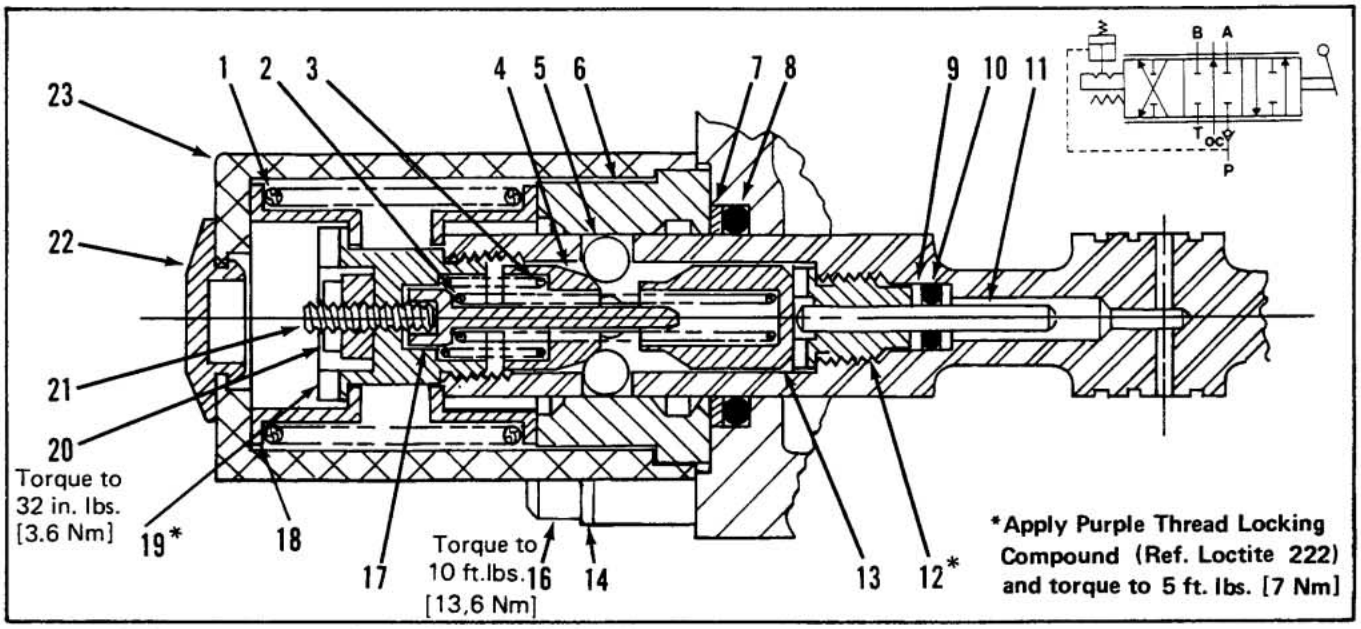


Figure 4-19. Optional Pressure Detent Release (KO) Positioner.

OPTIONAL PRESSURE DETENT RELEASE (KO) POSITIONER

Item No.	Part No.	Description	Quantity
	K-6061-B	SEAL KIT (Contains items 7, 8, 9 and 10 listed below)	
1	7433-001	SPRING, Centering	1
2	8047-001	SPRING, Standard (500-1600 PSI [35-110 bar] Crack)	1
	8010-001	SPRING, Optional (1601-2400 PSI [111-165 bar] Crack)	1
	8538-001	SPRING, Optional (2401-3000 PSI [166-207 bar] Crack)	1
	8537-001	SPRING, Optional (3001-3500 PSI [166-207 bar] Crack)	1
3	7898-001	SPRING, 0.385 O.D.x.054 W.D.	1
4	7897-001	FOLLOWER, Ball	1
5	1700-001	BALL, Steel	4
6	8007-001	SLEEVE, Detent	1
7	3265-001	RING, Back-Up } Not Sold	1
8	7700-001*	SEAL, O-Ring } Separately	1
9	7907-001	RING, Back-Up } Order K-6061-B	2
10	3328-001	SEAL, O-Ring }	1
11	7908-001	ROLLER, Needle	1
12	7906-001	GUIDE, Piston	1
13	7896-001	PLUNGER, Knockout	1
14	7904-001	PLATE, Bearing	2
16	9161-407	SCREW, HSHC, 1/4-20 by 7/8 inch long	2
17	7899-001	GUIDE, Spring	1
18	8536-001	COLLAR, Spring	2
19	8535-001	COLLAR, Spool	1
20	6229-001	LOCKNUT	1
21	8014-001	SCREW, Hex Set, No. 10-24x0.62	1
22	7902-001	PLUG, Button, Flush Head	1
23	1824-002	BONNET	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

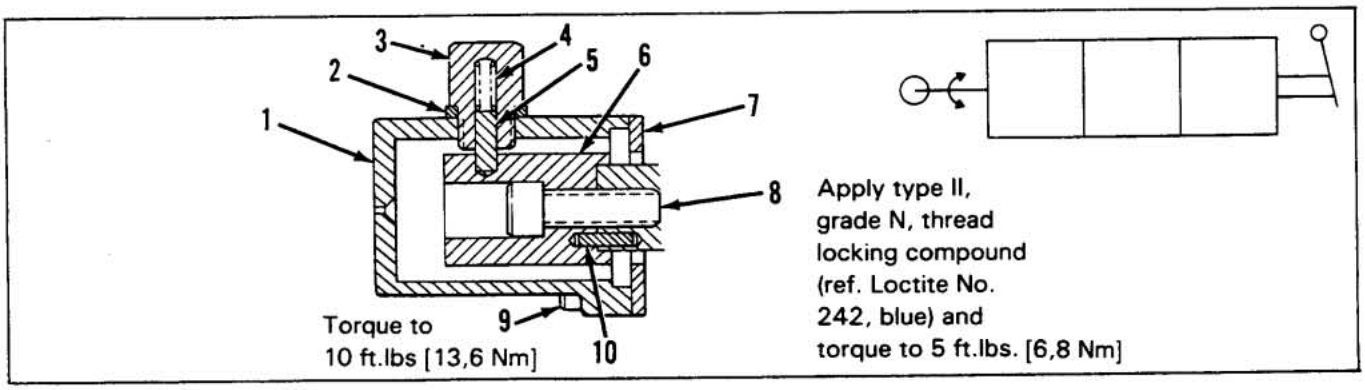


Figure 4-20. Option "W" Rotary Spool Positioner.

OPTION "W" ROTARY SPOOL POSITIONER

Item No.	Part No.	Description	Quantity
	K-6141-C	REPLACEMENT KIT (Contains all items listed below)	
1	1824-006	BONNET, Rotary	1
2	8743-001	WASHER, Detent Cap	1
3	8744-001	CAP, Rotary Detent	1
4	8808-001	SPRING, Detent	1
5	2676-001	PIN, Detent	1
6	8746-001	BODY, Rotary Cam	1
7	6552-001	PLATE, Seal Retainer	1
8	3731-150	SCREW, HSHC, 5/16-18 by 1 inch long	1
9	9161-407	SCREW, HSHC, 1/4-20 by 7/8 inch long	2
10	0888-001	PIN, Dowel	1

NOTE: Apply heavy duty, general purpose grease to the helical groove of Cam Body (Item 6) and Pin (Item 5). For standard assembly, hole in spool clevis must be horizontal with valve spool in neutral.

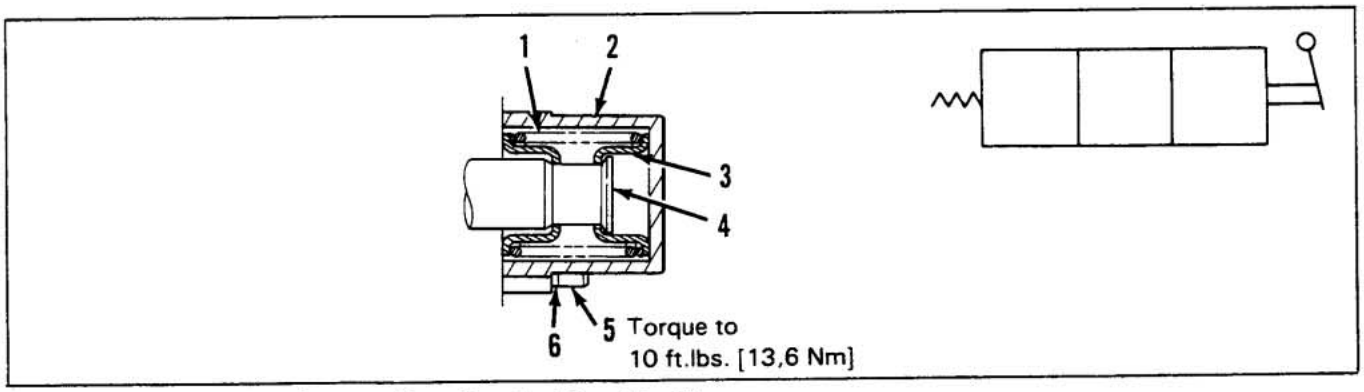


Figure 4-21. Series or Low Pressure Drop, Standard Spool Positioner.

SERIES OR LOW PRESSURE DROP, STANDARD SPOOL POSITIONER

Item No.	Part No.	Description	Quantity
	K-6207-A	REPLACEMENT KIT (Contains all items listed below)	
1	10956-001	SPRING, Return	1
2	1811-001	BONNET	1
3	1809-001	COLLAR, Spring	2
4	10892-001	COLLAR, Spool	1
5	3731-101	SCREW, HSHC, 1/4-20 x 7/8 inch long	2
6	0563-001	WASHER, Lock	2

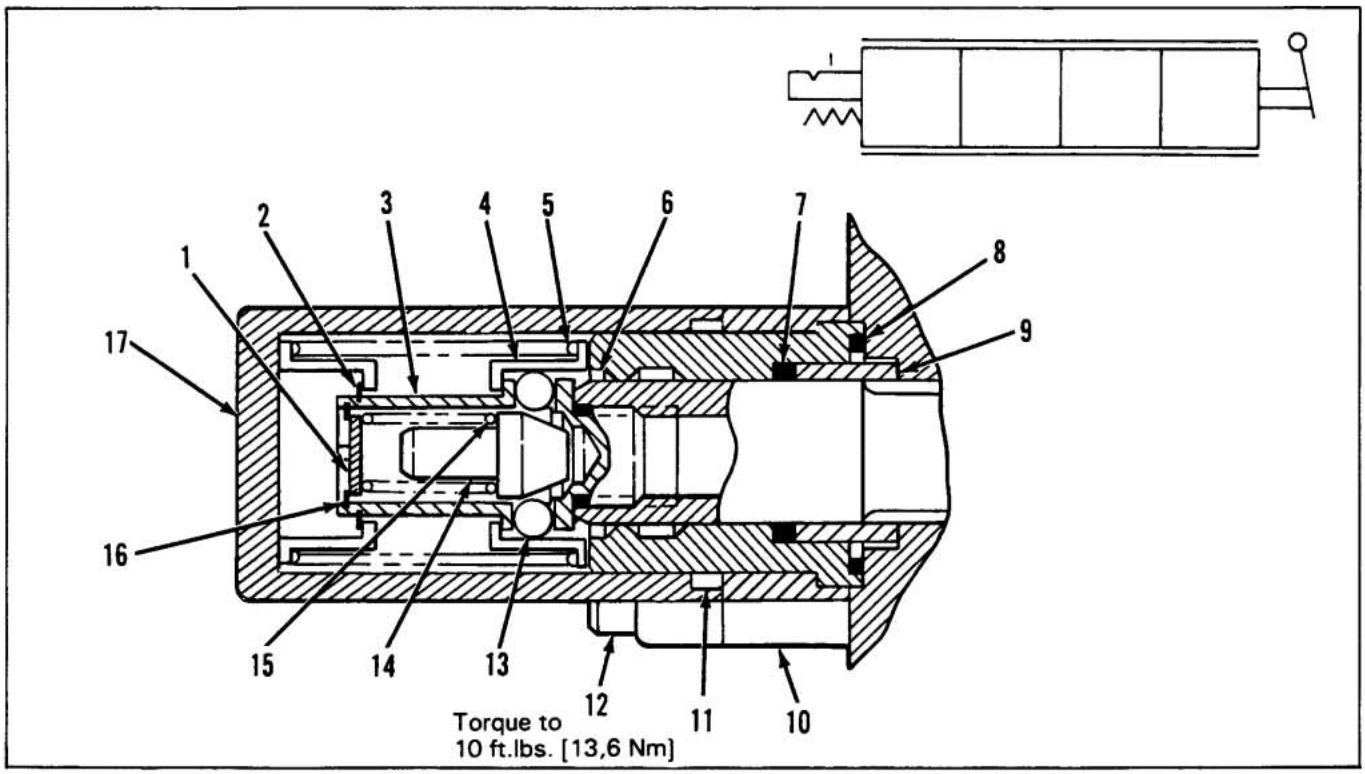


Figure 4-22. V20S 4-Way, 4-Position Float (out) Detent Positioner.

V20S 4-WAY, 4-POSITION FLOAT (OUT) DETENT POSITIONER

Item No.	Part No.	Description	Quantity
	K-6208	REPLACEMENT KIT (Contains all items listed below)	
1	11371-001	SHIM	1
2	1852-001	RING, Retaining	1
3	11373-001	COLLAR, Spool	1
4	1826-001	COLLAR, Spring	2
5	1807-001	SPRING, Centering	1
6	0449-001*	SEAL, O-Ring	1
7	1853-001*	SEAL, Four Lobed	1
8	21047-001*	SEAL, O-Ring	1
9	8079-001	SLEEVE, Retainer	1
10	7905-001	SPACER, Bonnet	1
11	11372-001	SLEEVE, Detent	1
12	9161-412	SCREW, HSHC, 1/4-20 by 1½ inch long	2
13	1700-001	BALL, Detent	4
14	1828-001	FOLLOWER, Ball	1
15	1829-001	SPRING, Detent	1
16	9320-016	RING, Retaining	1
17	8082-001	BONNET	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

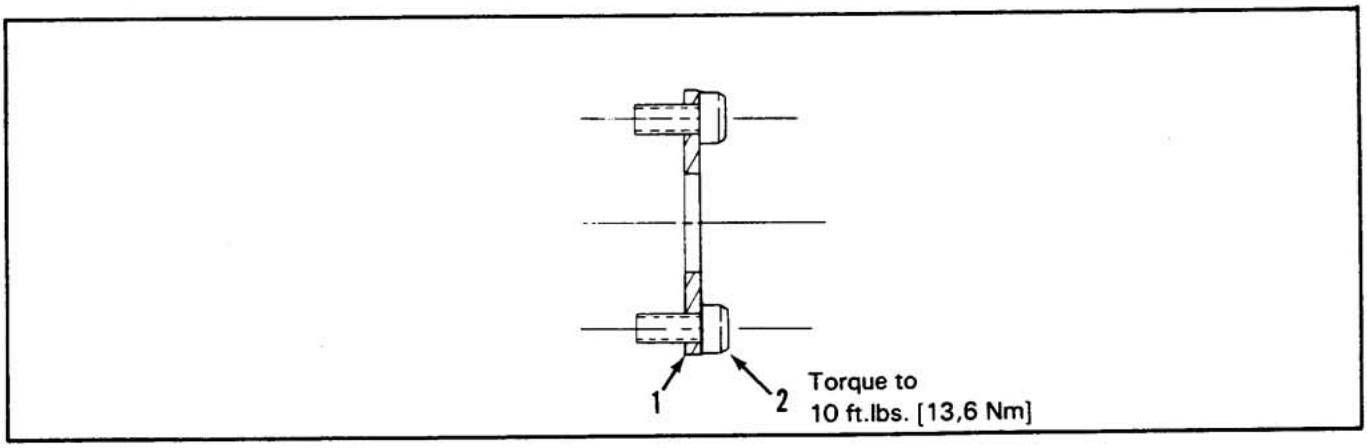


Figure 4-23. Standard Seal Retainer.

STANDARD SEAL RETAINER

Used when handle bracket is not furnished and tank line pressures are below 200 PSI [14 bar].

Item No.	Part No.	Description	Quantity
	K-6033-B	REPLACEMENT KIT (Contains items 1 and 2)	
1	6552-001	PLATE	1
2	3731-098	SCREW, HSHC, 1/4-20 by 1/2 inch long	2

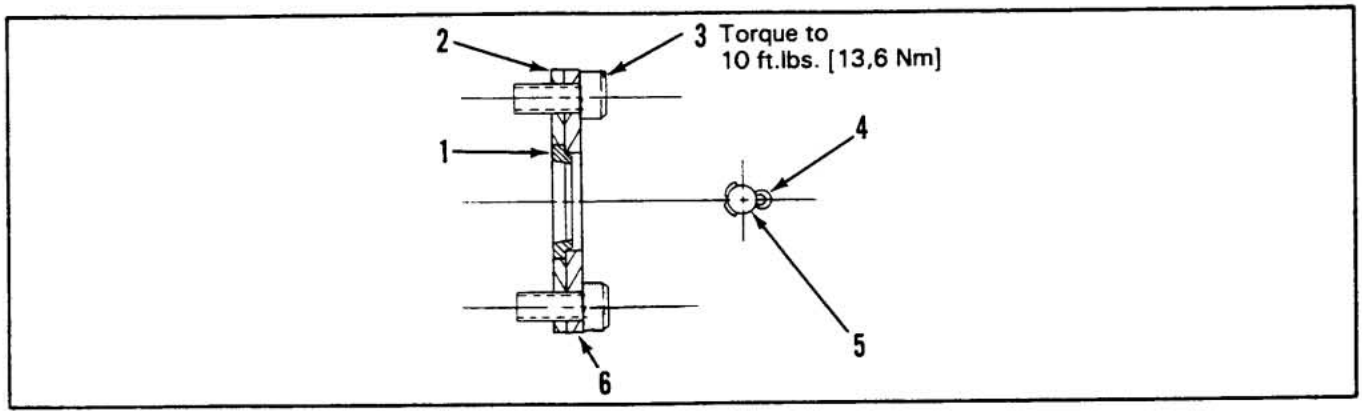


Figure 4-24. Optional Heavy Duty Seal Retainer.

OPTIONAL HEAVY DUTY SEAL RETAINER WITH OPTIONAL SPOOL WIPER

Used when handle bracket is not furnished and tank line pressure is below 1000 PSI, [69 bar], and when wiper seal is desired.

Item No.	Part No.	Description	Quantity
	K-6029-B	REPLACEMENT KIT (Contains all items listed below)	
1	1800-001	WIPER, Spool (Optional)	1
2	6802-001	PLATE, Seal	1
3	3731-098	SCREW, HSHC, 1/4-20 by 1/2 inch long	2
4	0086-001	PIN, Cotter	1
5	1857-001	PIN	1
6	6552-001	PLATE	1

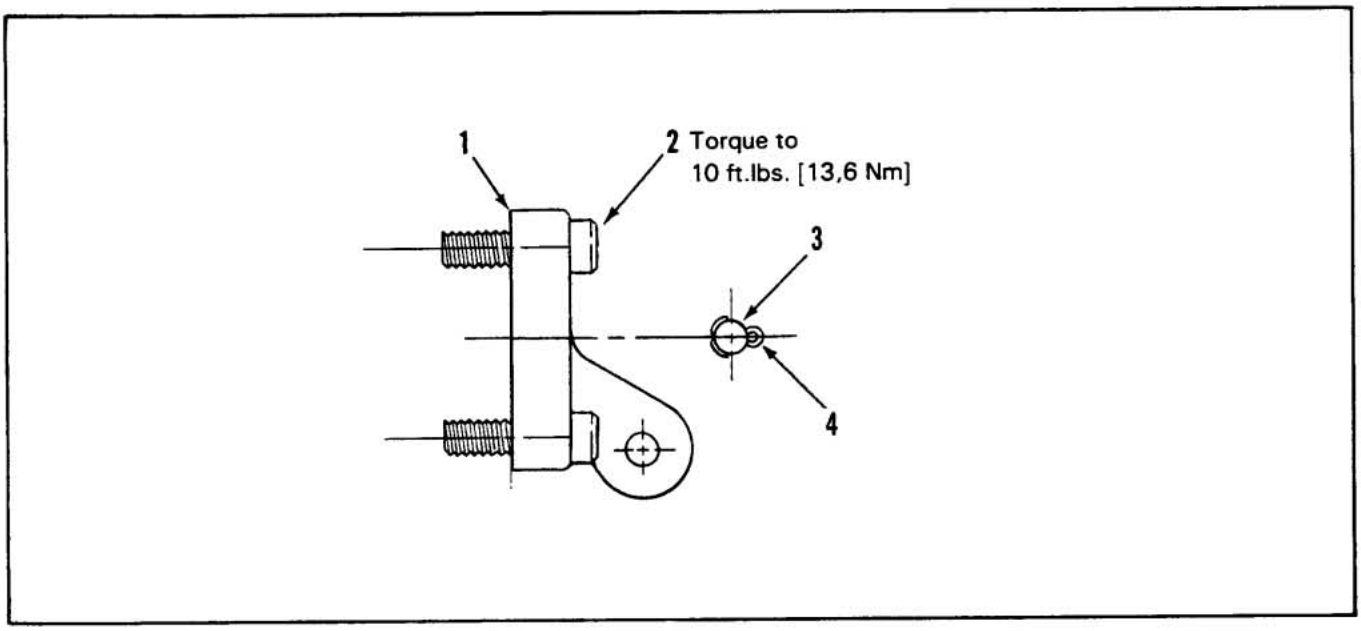


Figure 4-25. Handle Bracket Assembly.

HANDLE BRACKET ASSEMBLY

Item No.	Part No.	Description	Quantity
	K-6031-A	REPLACEMENT KIT, Standard, (Contains items 1, 2, 3 and 4)	
	K-6037-A	SERVICE KIT, Heavy Duty, (Contains items 1 and 2)	
1	1801-001	BRACKET, Die Cast (Standard)	1
	1801-002	BRACKET, Die Cast (Optional, for use with CRA Relief)	1
	7355-001	BRACKET, Cast Iron (Optional, Heavy Duty)	1
2	9161-407	SCREW, HSHC, 1/4-20 by 7/8 inch long	2
3	1857-001	PIN	1
4	0086-001	PIN, Cotter	1
5	1800-001	SEAL, Wiper, optional (not shown)	1

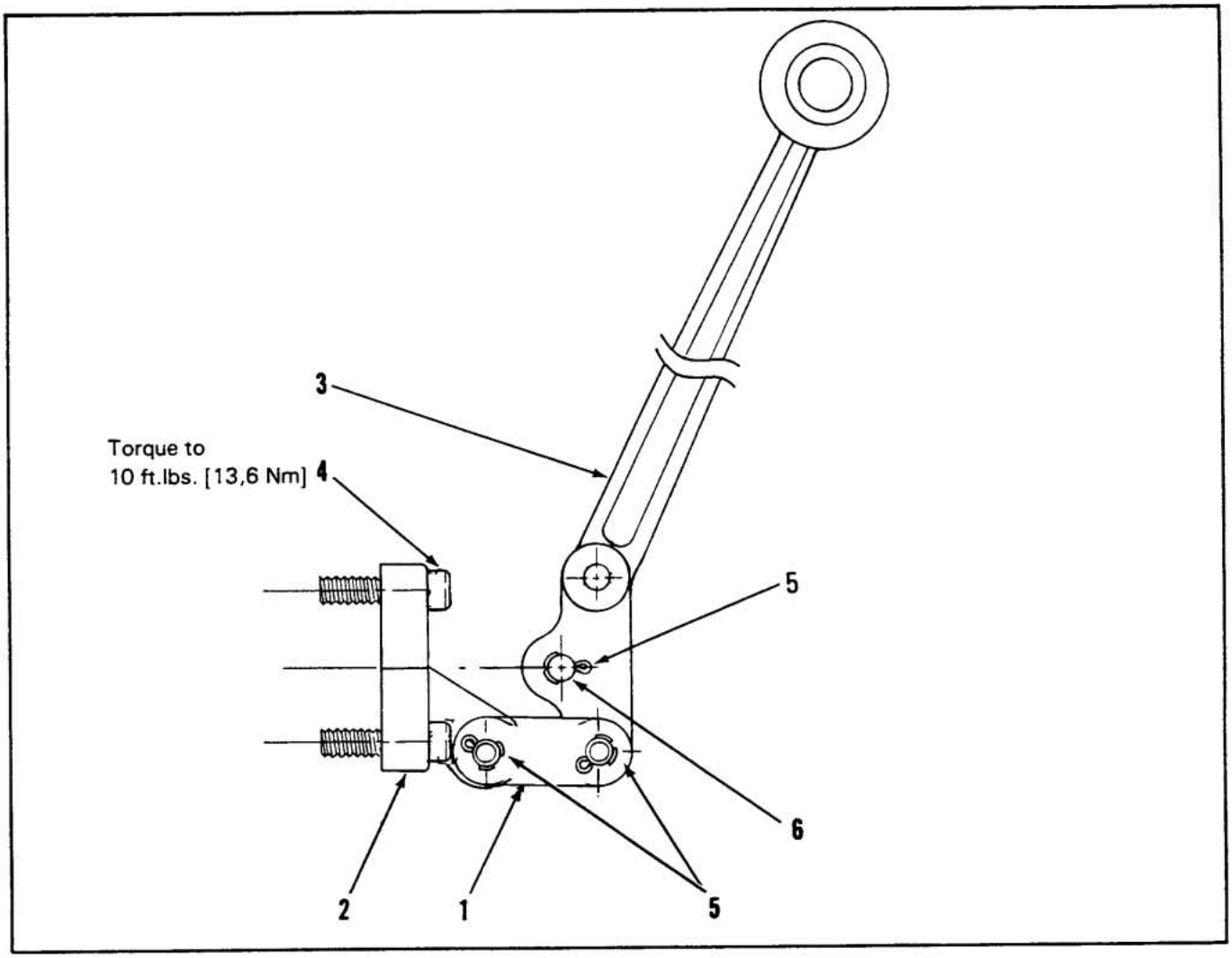


Figure 4-26. Optional Vertical Handle and Bracket Assembly.

OPTIONAL VERTICAL HANDLE and BRACKET ASSEMBLY

Item No.	Part No.	Description	Quantity
	K-6004-B	REPLACEMENT KIT, Standard (Black plastic coated handle)	
	K-6137-A	REPLACEMENT KIT, Optional (Plain handle)	
		All Replacement Kits contain all items listed below except No. 7355-001, Bracket	
1	11393-001	LINK	1
	11392-001	PLATE, Link	1
2	1801-001	BRACKET, Die Cast (Standard)	1
	7355-001	BRACKET, Cast Iron (Optional, Heavy Duty)	1
3	1802-001	HANDLE, Standard Vertical, Black plastic coated	1
	1802-003	HANDLE, Optional Vertical, Plain	1
4	9161-407	SCREW, HSHC, 1/4-20 by 7/8 inch long	2
5	0086-001	PIN, Cotter	3
6	1857-001	PIN	1
7	1800-001	SEAL, Wiper, optional (not shown)	1

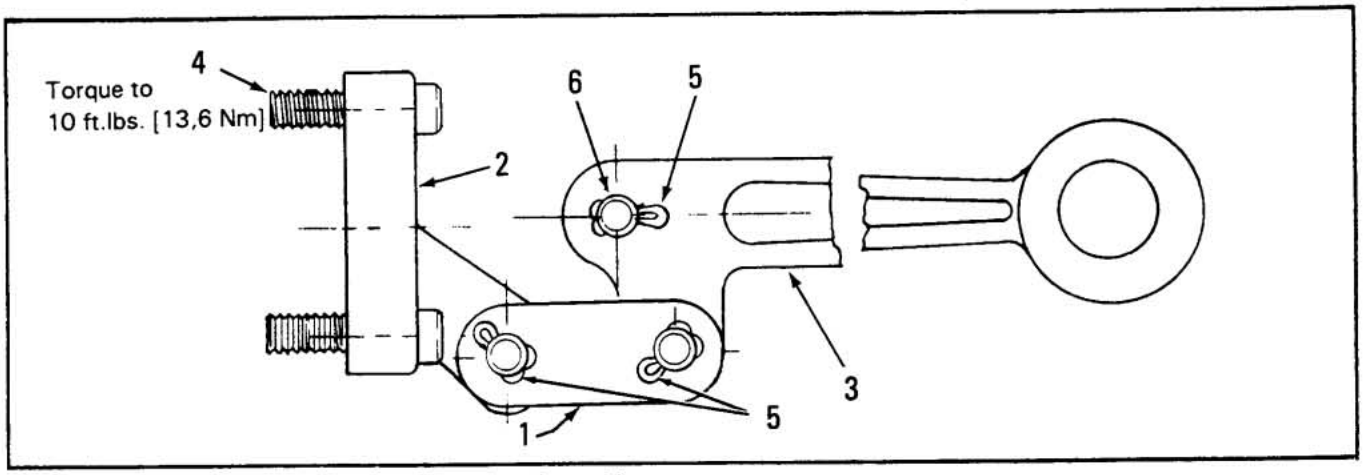


Figure 4-27. Optional Horizontal Handle and Bracket Assembly.

OPTIONAL HORIZONTAL HANDLE and BRACKET ASSEMBLY

Item No.	Part No.	Description	Quantity
	K-6007-B	REPLACEMENT KIT, Standard (Black plastic coated handle)	
	K-6139-A	REPLACEMENT KIT, Optional (Plain handle)	
		All Replacement Kits contain all items listed below except No. 7355-001, Bracket	
1	11393-001	LINK	1
	11392-001	PLATE, Link	1
2	1801-001	BRACKET, Die Cast (Standard)	1
	7355-001	BRACKET, Cast Iron (Optional Heavy Duty)	1
3	3249-001	HANDLE, Standard Horizontal, Black plastic coated	1
	3249-003	HANDLE, Optional Horizontal, Plain	1
4	9161-407	SCREW, HSHC, 1/4-20 by 7/8 inch long	2
5	086-001	PIN, Cotter	3
6	1857-001	PIN	1
7	1800-001	SEAL, Wiper, optional (not shown)	1

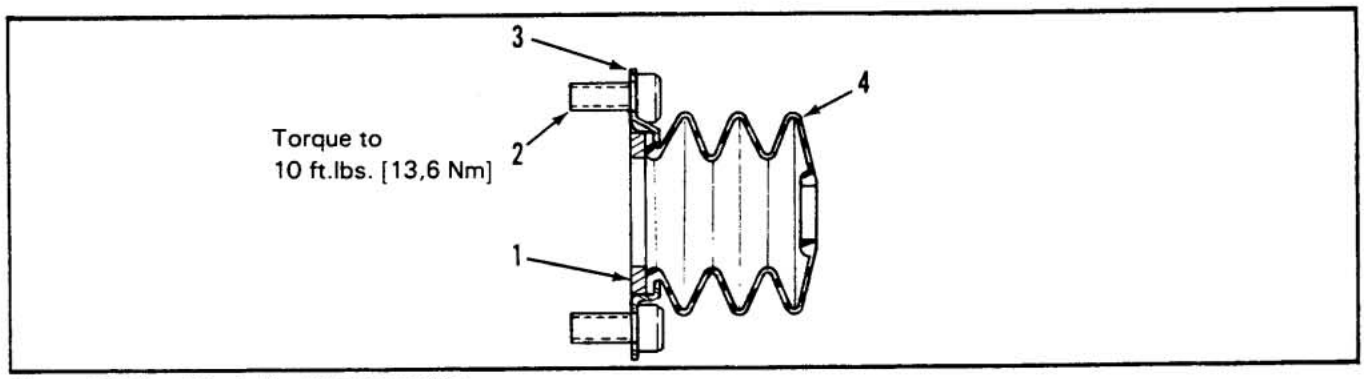


Figure 4-28. Spool Protective Boot Assembly.

SPOOL PROTECTIVE BOOT ASSEMBLY

Item No.	Part No.	Description	Quantity
	K-6056-B	REPLACEMENT KIT (Contains all items listed below)	
1	7624-001	WASHER, Breather	1
2	3731-098	SCREW, HSHC, 1/4-20 by 1/2 inch long	2
3	7623-001	RETAINER, Boot	1
4	7622-001	BOOT	1

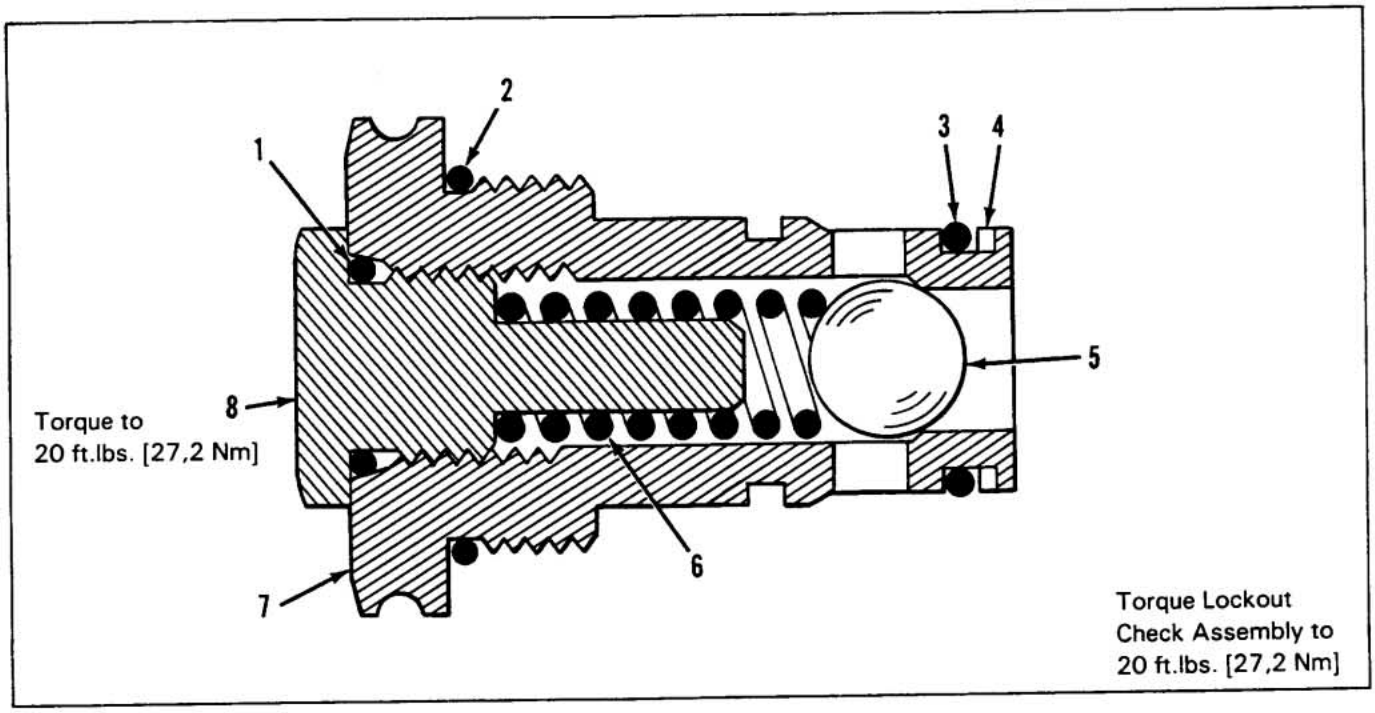


Figure 4-29. Lockout Check Assembly.

LOCKOUT CHECK ASSEMBLY

Item No.	Part No.	Description	Quantity Per Check
	K-6024-D*	REPLACEMENT KIT (Contains all items listed below)	
	K-6039*	SEAL KIT (Contains items 1 thru 4)	
1	0449-001*	SEAL, O-Ring	1
2	2707-001*	SEAL, O-Ring	1
3	1818-001*	SEAL, O-Ring	1
4	3092-001	RING, Back-Up, Cut	1
5	0071-001	BALL, Steel	1
6	1571-001	SPRING	1
7	11466-001	BODY, Check	1
8	0216-001	CAP, Check	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

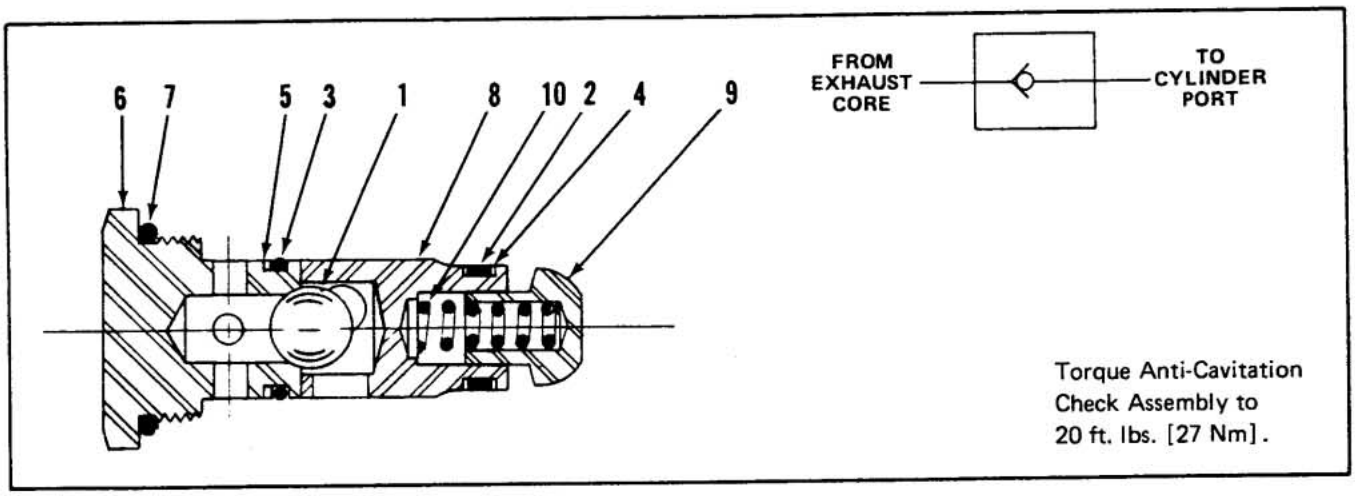


Figure 4-30. Optional Anti-Cavitation Check Assembly.

OPTIONAL ANTI-CAVITATION CHECK ASSEMBLY

Item No.	Part No.	Description		Quantity Per Check
	K-6021-A*	REPLACEMENT ANTI-CAVITATION ASSEMBLY (Contains all items listed below)		
	K-6032*	SEAL KIT (Contains items 2, 3, 4, 5 and 7 listed below)		
1	0071-001	BALL, Steel, 7/16 inch	Not Sold Separately Order K-6032	1
2	1818-001*	SEAL, O-Ring		1
3	1819-001*	SEAL, O-Ring		1
4	1820-001	WASHER, Back-Up, inner, Check Plug		2
5	1821-001	WASHER, Back-Up, Outer, Check Plug		1
6	1822-001	BODY, Check, Anti-Cavitation		1
7	2707-001*	SEAL, O-Ring		1
8	1823-001	RETAINER, Ball, Check		1
9	2781-001	CHECK, Steel		1
10	1868-001	SPRING, Check		1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

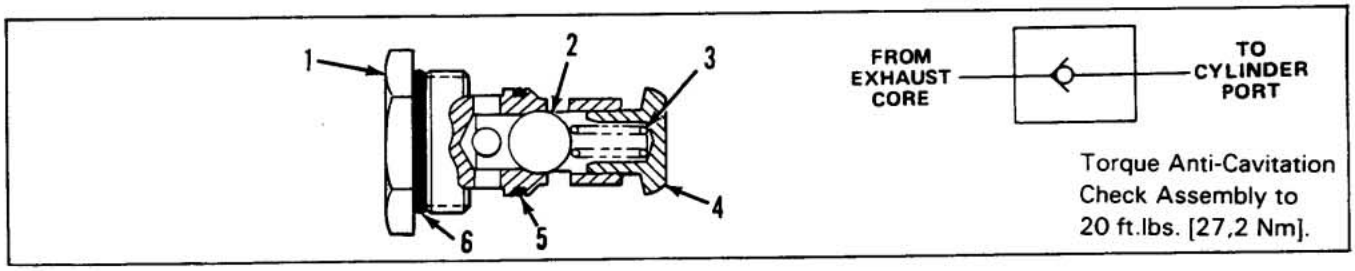


Figure 4-31. Optional, V20S Anti-Cavitation Check Assembly.

OPTIONAL, V20S ANTI-CAVITATION CHECK ASSEMBLY

Item No.	Part No.	Description		Quantity Per Check
	K-6205*	REPLACEMENT KIT (Contains all items listed below)		
	K-6206*	SEAL KIT (Contains items 5 and 6)		
1	11340-001	BODY, Check		1
2	0071-001	BALL, Steel, 7/16 inch		1
3	11343-001	SPRING, Check		1
4	7791-002	POPPET, Check		1
5	1819-001*	SEAL, O-Ring	Not sold separately. Order K-6206	1
6	2707-001*	SEAL, O-Ring		1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

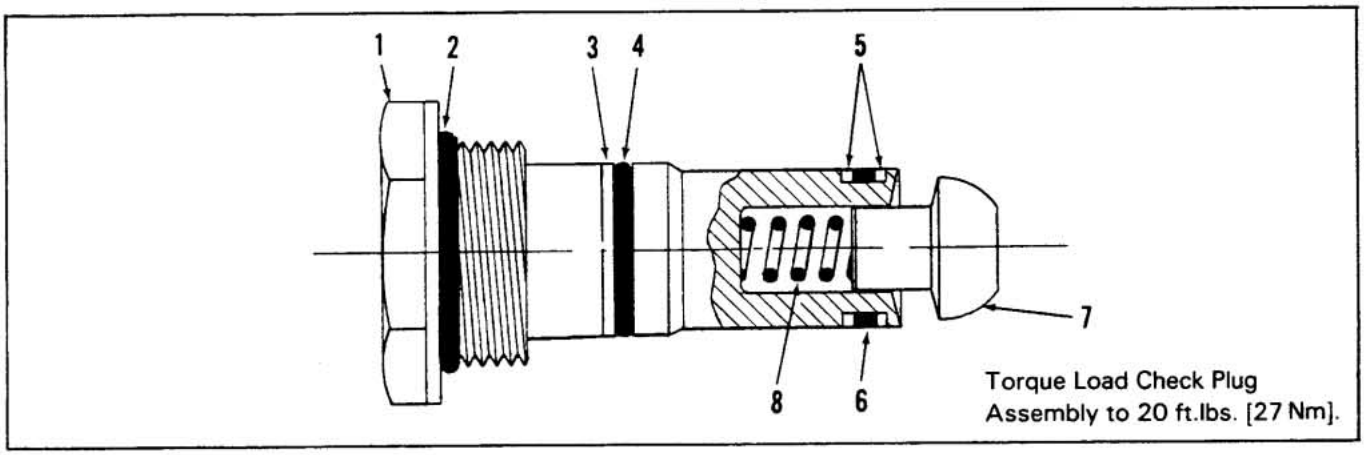


Figure 4-32. Load Check Plug Assembly.

LOAD CHECK PLUG ASSEMBLY

Item No.	Part No.	Description		Quantity Per Plug Assembly
	K-6030-A*	REPLACEMENT LOAD CHECK PLUG ASSEMBLY.		
	K-6032*	SEAL KIT, (Contains items 2, 3, 4, 5 and 6)		
1	3411-001	Plug, Lift Check, Steel (Heavy Duty)		1
2	2707-001*	SEAL, O-Ring	Not Sold Separately Order K-6032	1
3	1821-001	WASHER, Back-Up, Outer		1
4	1819-001*	SEAL, O-Ring, Outer		1
5	1820-001	WASHER, Back-Up, Inner		2
6	1818-001*	SEAL, O-Ring		1
7	2781-001	POPPET, Lift Check		1
8	1868-001	SPRING, Lift Check		1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

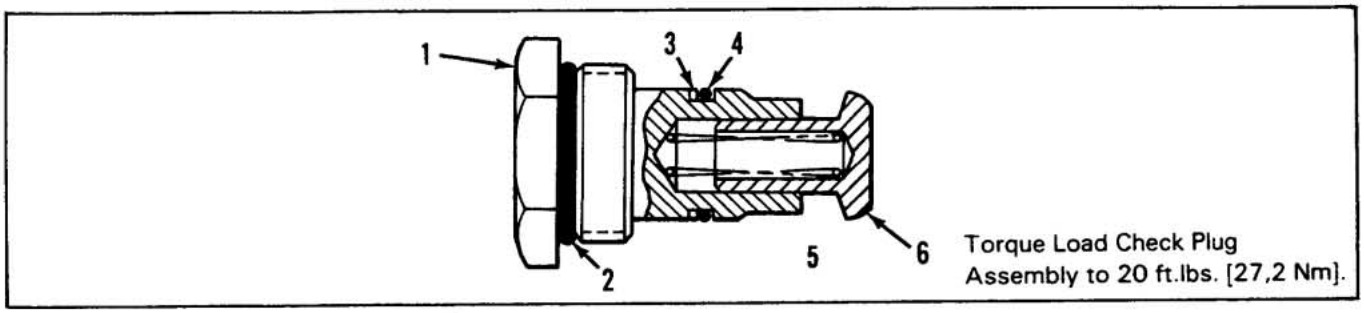


Figure 4-33. V20S Load Check Plug Assembly.

V20S LOAD CHECK PLUG ASSEMBLY

Item No.	Part No.	Description		Quantity Per Plug Assembly
	K-6203*	REPLACEMENT KIT (Contains all items listed below)		
	K-6204*	SEAL KIT (Contains items 2, 3 and 4)		
1	11241-001	PLUG, Load Check		1
2	2707-001*	SEAL, O-Ring	Not sold separately. Order K-6204	1
3	1821-001	RING, Back-Up		1
4	1819-001*	SEAL, O-Ring		1
5	1868-001	SPRING, Load Check		1
6	7791-001	POPPET, Load Check		1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

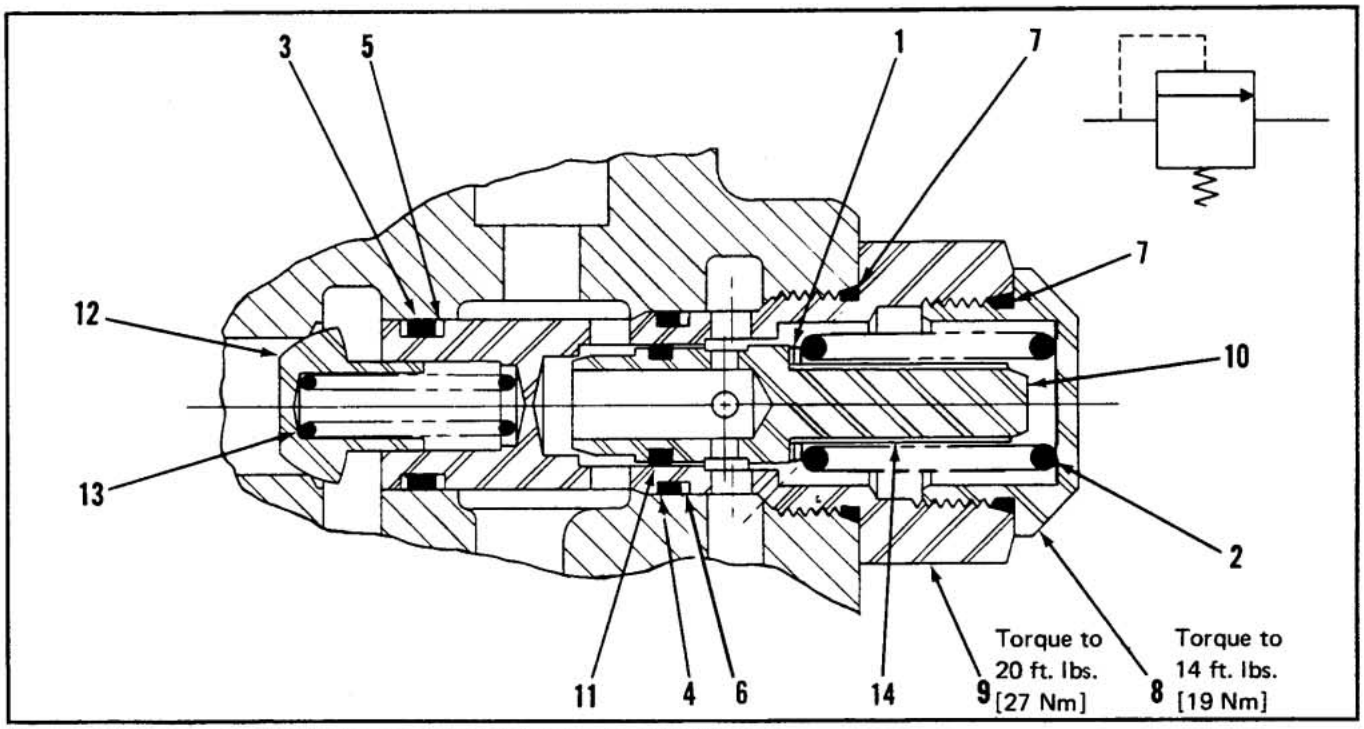


Figure 4-34. Optional Model RC Cylinder Port Relief (non-adjustable type).

OPTIONAL MODEL RC CYLINDER PORT RELIEF (Non-Adjustable Type)

For replacement Model RC Relief Cartridge, specify pressure setting required.

Item No.	Part No.	Description	Quantity Per Relief
	K-19002	SERVICE KIT (Contains items 10 and 11)	
	K-6005A*	SEAL KIT (Contains all seals - items 3, 4, 5, 6 and 7)	
1	0458-001	SHIM (.040 inch [1,0 mm] thick)	A/R
	0459-001	SHIM (.020 inch [0,5 mm] thick)	A/R
	0462-001	SHIM (.010 inch [0,25 mm] thick)	A/R
2	1450-001	SPRING (500-1350 PSI [35-93 bar] Crack)	1
	1869-001	SPRING (500-1249 PSI [34-86 bar] Crack)	1
	7638-001	SPRING (1250-1749 PSI [86-121 bar] Crack)	1
	7078-001	SPRING (1750-1999 PSI [121-138 bar] Crack)	1
	1870-001	SPRING (2000-2599 PSI [138-179 bar] Crack)	1
3	1818-001*	SEAL, O-Ring — Not Sold Separately Order K-6005A	1
4	1819-001*	SEAL, O-Ring — Not Sold Separately Order K-6005A	1
5	1820-001	WASHER, Back-Up, Inner, Check Plug — Not Sold Separately Order K-6005A	2
6	1821-001	WASHER, Back-Up, Outer, Check Plug — Not Sold Separately Order K-6005A	1
7	2707-001*	SEAL, O-Ring — Not Sold Separately Order K-6005A	2
8	1880-001	CAP, Relief	1
9	1884-001	BODY, Relief	1
10	1881-001	POPPET, Relief — Not Sold Separately Order K-19002	1
11	1883-001	RING, Piston — Not Sold Separately Order K-19002	1
12	2781-001	CHECK, Steel	1
13	1868-001	SPRING, Check	1
14	7874-001	SLEEVE, Dampening (Not to be used with 1450-001 and 1451-001 Springs)	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

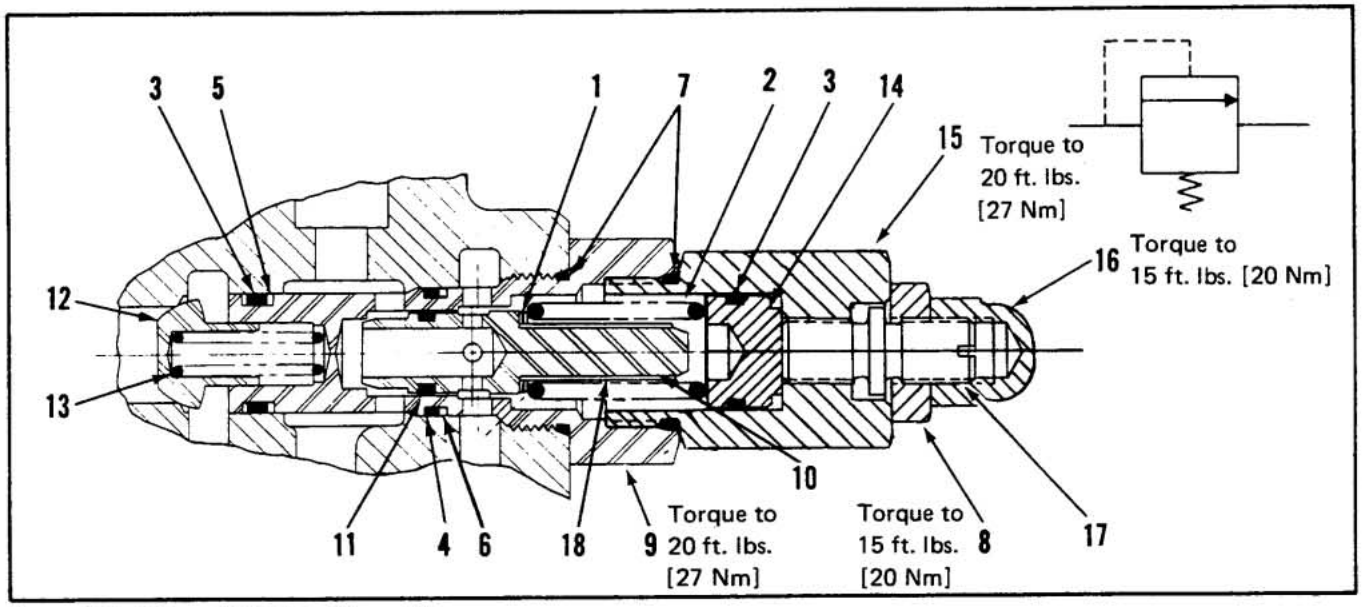


Figure 4-35. Optional RCA Relief Assembly.

OPTIONAL RCA RELIEF ASSEMBLY

All V20 Valves are machined to accept this assembly without modification. Simply remove load check assembly and install RCA combination.

Model RCA cannot be used on handle end of valve section with No. 1802-001 Vertical Handle due to interference.

Item No.	Part No.	Description	Quantity Per Relief
	K-19002	SERVICE KIT (Contains items 10 and 11)	
	K-6005A*	SEAL KIT (Contains all seals, items 3, 4, 5, 6 and 7)	
1	0458-001	SHIM (.040 inch [1,0 mm] thick)	A/R
	0459-001	SHIM (.020 inch [0,5 mm] thick)	A/R
	0462-001	SHIM (.010 inch [0,25 mm] thick)	A/R
2	7638-001	SPRING, S.S., 750-1500 PSI [52-103 bar]	1
	7078-001	SPRING, S.S., 1250-2000 PSI [86-138 bar]	1
	1870-001	SPRING, S.S., 1500-2500 PSI [103-172 bar]	1
	7497-001	SPRING, S.S., 2000-3000 PSI [138-207 bar]	1
3	1818-001*	SEAL, O-Ring	2
4	1819-001*	SEAL, O-Ring	1
5	1820-001	WASHER, Back-Up, Inner	2
6	1821-001	WASHER, Back-Up, Outer	1
7	2707-001*	SEAL, O-Ring	2
8	3500-001	NUT, Jam	1
9	1884-001	BODY, Relief	1
10	1881-001	POPPET, Relief	1
11	1883-001	RING, Piston	1
12	2781-001	CHECK, Steel	1
13	1868-001	SPRING, Check	1
14	11481-001	PISTON	1
15	3498-001	CAP, Adjustable Relief	1
16	3497-001	NUT, Acorn	1
17	3496-001	STEM, Adjustable	1
18	7874-001	SLEEVE, Dampening (Not to be used with 1450-001 or 1451-001 Springs)	1

Items 3, 4, 5, 6, 7: Not Sold Separately Order K-6005A

Items 10, 11: Not Sold Separately Order K-19002

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

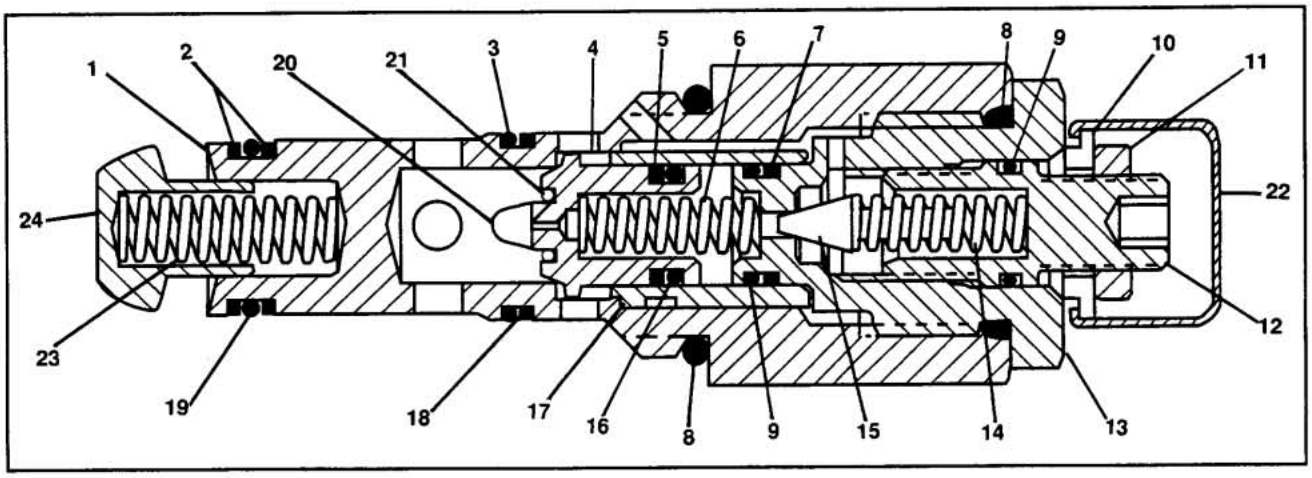


Figure 4-36. Optional RP 20-N Relief Assembly.

OPTIONAL RP 20-N CYLINDER PART RELIEF

All V20 valves are machined to accept this assembly without modification. Simply remove load check assembly and install RCA combination.

Item No.	Part No.	Description	Quantity Per Relief
	K-6192	SEAL KIT (Contains items 2, 3, 5, 7, 8, 9, 16, 18 and 19)	
1	20497-001	BODY, Relief	1
2	1820-001	RING, Back-Up	2
3	01819-001*	SEAL, O-Ring	1
4	20499-001	POPPET, Main	1
5	21581-001	RING, Back-Up	1
6	20503-001	SPRING	1
7	21582-001	RING, Back-Up	1
8	02707-001*	SEAL, O-Ring	2
9	09001-012*	SEAL, O-Ring	2
10	10035-001	WASHER	1
11	09302-006	NUT, Hex Jam	1
12	08956-001	SCREW, Adjustment	1
13	20500-001	BODY, Pilot	1
14	10059-001	SPRING	1
15	08475-001	POPPET, Relief	1
16	07830-001*	SEAL, O-Ring	1
17	20125-001	SLEEVE, Relief	1
18	01821-001	RING, Back-Up	1
19	01818-001*	SEAL, O-Ring	1
20	11839-001	SCREEN, Filter	1
21	11840-001	RING, Retaining	1
22	10034-001	COVER, Tamper Proof	1
23	01868-001	SPRING	1
24	02781-001	POPPET	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

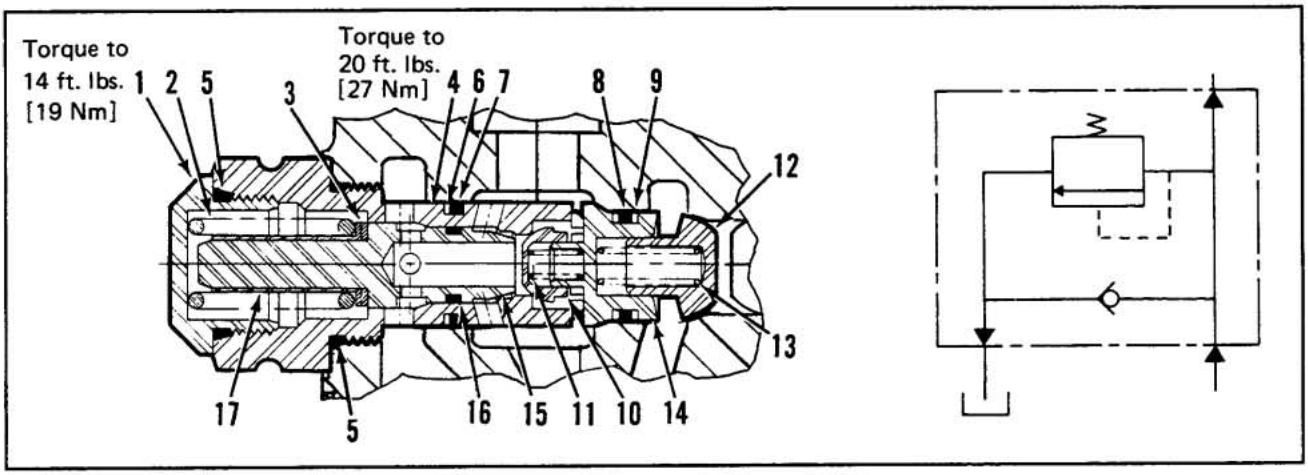


Figure 4-37. Optional Combination Relief and Anti-Cavitation Check Assembly (CRA)

OPTIONAL COMBINATION RELIEF and ANTI-CAVITATION CHECK ASSEMBLY (CRA)

All V20 Valves are machined to accept this assembly without modification. Simply remove load check assembly and install RCA combination.

Item No.	Part No.	Description	Quantity Per Relief
	K-19002	SERVICE KIT (Contains items 15 and 16)	
	K-6005A*	SEAL KIT (Contains items 5, 6, 7, 8 and 9)	
1	1880-001	CAP, Relief	1
2	1869-001	SPRING (500-1249 PSI [34-86 bar] Crack)	1
	7638-001	SPRING (1250-1749 PSI [86-121 bar] Crack)	1
	7078-001	SPRING (1750-1999 PSI [121-138 bar] Crack)	1
	1870-001	SPRING (2000-2599 PSI [138-179 bar] Crack)	1
3	0458-001	SHIM (.040 inch [1,0 mm] thick)	A/R
	0459-001	SHIM (.020 inch [0,5 mm] thick)	A/R
	0462-001	SHIM (.010 inch [0,25 mm] thick)	A/R
4	7741-001	BODY, Combination	1
5	2707-001*	SEAL, O-Ring (Not Sold Separately Order K-6005A)	2
6	1821-001	WASHER, Back-Up Outer (Not Sold Separately Order K-6005A)	1
7	1819-001*	SEAL, O-Ring (Not Sold Separately Order K-6005A)	1
8	1818-001*	SEAL, O-Ring (Not Sold Separately Order K-6005A)	1
9	1820-001	WASHER, Back-Up Inner (Not Sold Separately Order K-6005A)	2
10	7743-001	POPPET, Anti-Cavitation	1
11	7744-001	SPRING, Anti-Cavitation	1
12	6015-001	POPPET (See Note)	1
13	6016-001	SPRING, Check (See Note)	1
14	7742-001	RETAINER, Poppet	1
15	1881-001	POPPET, Relief (Not Sold Separately Order K-19002)	1
16	1883-001	RING, Piston (Not Sold Separately Order K-19002)	1
17	7874-001	SLEEVE, Dampening (not to be used with 1450-001 or 1451-001 Springs)	1

Notes:

1. Replacement Model CRA Cartridge includes items 12 and 13. Specify pressure setting.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

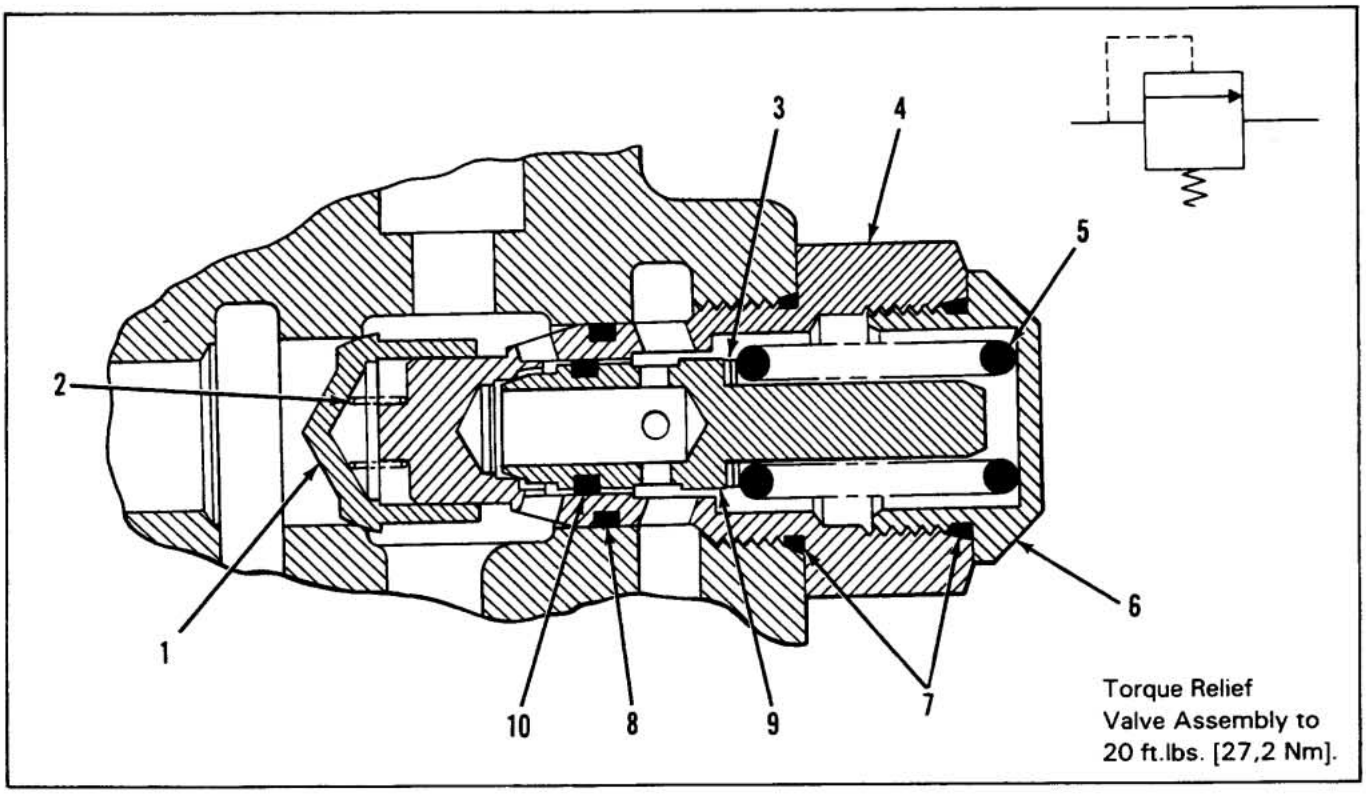


Figure 4-38. Optional V20S Work Port Relief. Model RCS (Non-Adjustable).

OPTIONAL V20S WORK PORT RELIEF, MODEL RCS (Non-Adjustable)

Item No.	Part No.	Description	Quantity Per Relief
	K-19002	SERVICE KIT (Contains items 9 and 10)	
	K-6206*	SEAL KIT (Contains items 7 and 8)	
1	11469-001	POPPET, Check	1
2	11470-001	SPRING, Check	1
3	0458-001	SHIM (.040 inch [1,0 mm] thick)	A/R
	0459-001	SHIM (.020 inch [0,5 mm] thick)	A/R
	0462-001	SHIM (.010 inch [0,25 mm] thick)	A/R
4	11471-001	BODY, RCS Relief	1
5	1869-001	SPRING (500-1249 PSI [35-86 bar] Crack)	1
	7638-001	SPRING (1250-1749 PSI [86-121 bar] Crack)	1
	7078-001	SPRING (1750-1999 PSI [121-138 bar] Crack)	1
	1870-001	SPRING (2000-2599 PSI [138-179 bar] Crack)	1
6	1880-001	CAP, Relief	1
7	2707-001*	SEAL, O-Ring } Not sold separately.	1
8	1819-001*	SEAL, O-Ring } Order K-6206	1
9	1881-001	POPPET, Relief } Not sold separately.	1
10	1883-001	RING, Piston } Order K-19002	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

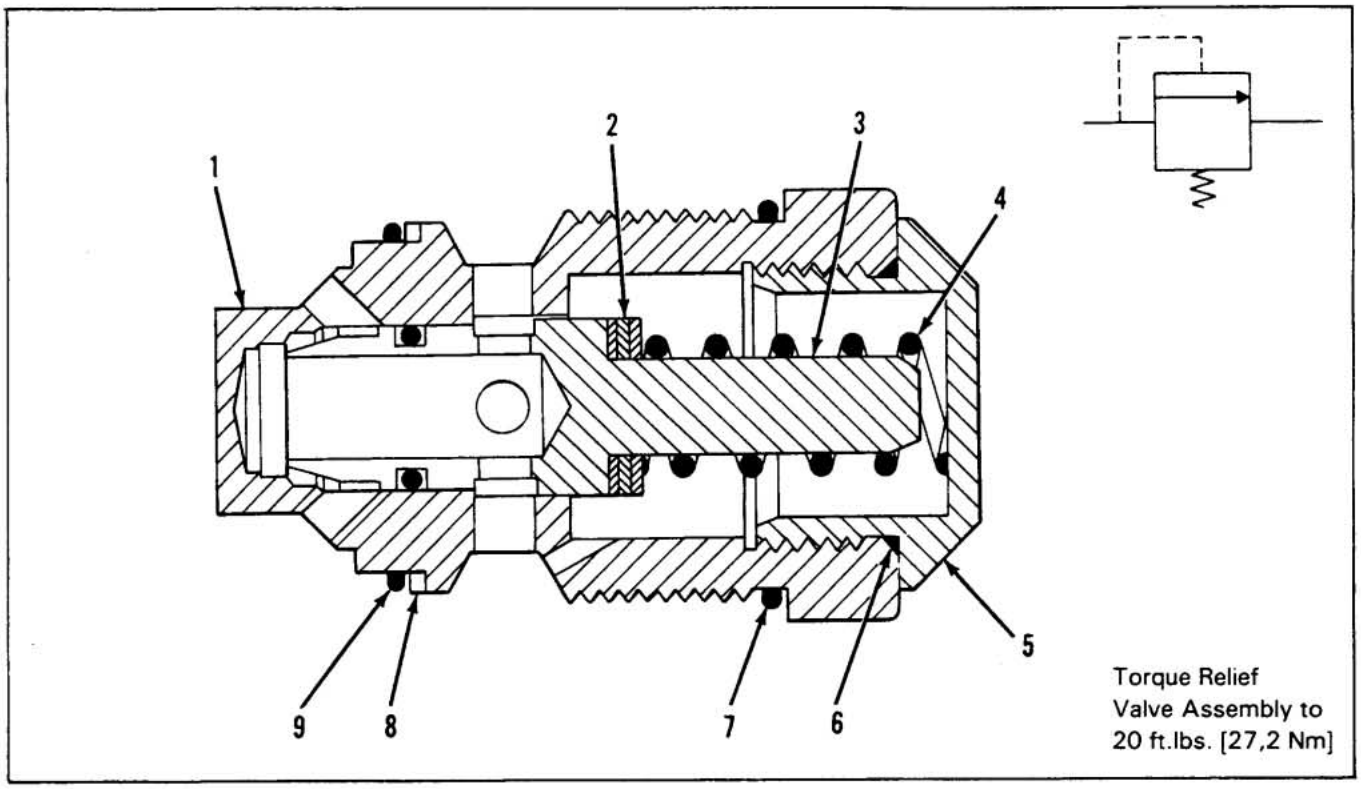


Figure 4-39. Model WH Differential Popper Main Relief Valve (Non-Adjustable).

MODEL WH DIFFERENTIAL POPPET MAIN RELIEF VALVE (Non-Adjustable)

Item No.	Part No.	Description	Quantity Per Relief
	K-19003-A*	SEAL KIT (Contains items 6 thru 9)	
1	6533-001	BODY, WH Relief	1
2	0458-001	SHIM (.040 inch [1,0 mm] thick)	A/R
	0459-001	SHIM (.020 inch [0,5 mm] thick)	A/R
	0462-001	SHIM (.010 inch [0,25 mm] thick)	A/R
3	3936-001	POPPET	1
4	1869-001	SPRING (500-1249 PSI [35-86 bar] Crack)	1
	7638-001	SPRING (1250-1749 PSI [86-121 bar] Crack)	1
	7078-001	SPRING (1750-1999 PSI [121-138 bar] Crack)	1
	1870-001	SPRING (2000-2599 PSI [138-179 bar] Crack)	1
5	1880-001	CAP, Relief	1
6	2707-001*	SEAL, O-Ring	1
7	1615-001*	SEAL, O-Ring	1
8	9020-022	RING, Back-Up	1
9	1718-001*	SEAL, O-Ring	1

Not sold separately. Order K-19003-A

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

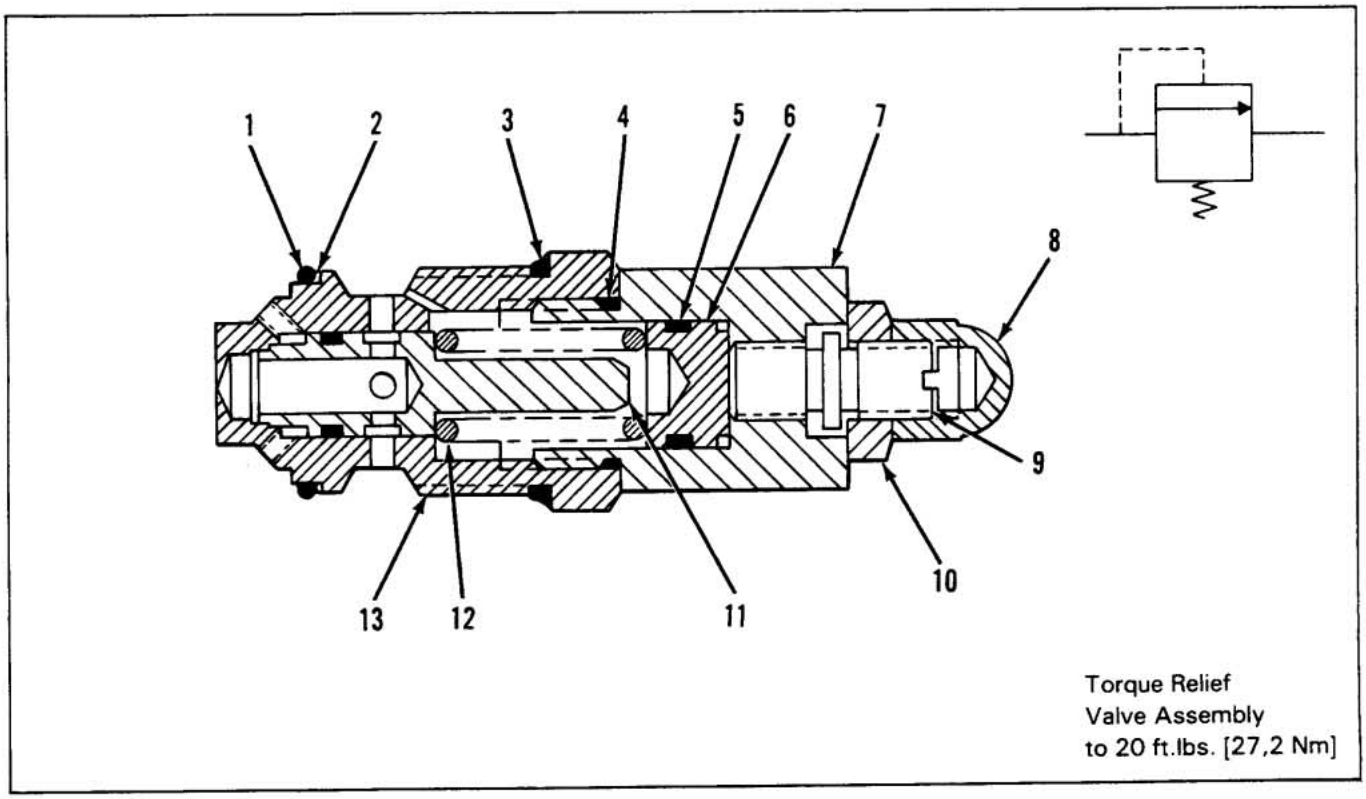


Figure 4-40. Model WHA Differential Poppet Main Relief Valve (Adjustable within the spring range).

MODEL WHA DIFFERENTIAL POPPET MAIN RELIEF VALVE (Adjustable within the spring range)

Item No.	Part No.	Description	Quantity Per Relief
	K-19012*	SEAL KIT (Contains items 1 thru 5)	
1	1718-001*	SEAL, O-Ring } Not sold separately. Order K-19012	1
2	9020-022	RING, Back-Up }	1
3	1615-001*	SEAL, O-Ring }	1
4	2707-001*	SEAL, O-Ring }	1
5	1818-001*	SEAL, O-Ring }	1
6	3495-001	PISTON	1
7	3498-001	CAP	1
8	3497-001	NUT, Acorn	1
9	3496-001	STEM, Adjusting	1
10	3500-001	NUT, Hex Jam	1
11	3936-001	POPPET	1
12	7638-001	SPRING, S.S., 750-1500 PSI [52-103 bar] Crack	1
	7078-001	SPRING, S.S., 1250-2000 PSI [86-138 bar] Crack	1
	1870-001	SPRING, S.S., 1500-2500 PSI [103-172 bar] Crack	1
	7497-001	SPRING, S.S., 2000-3000 PSI [138-207 bar] Crack	1
13	6533-001	BODY, WH Relief	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

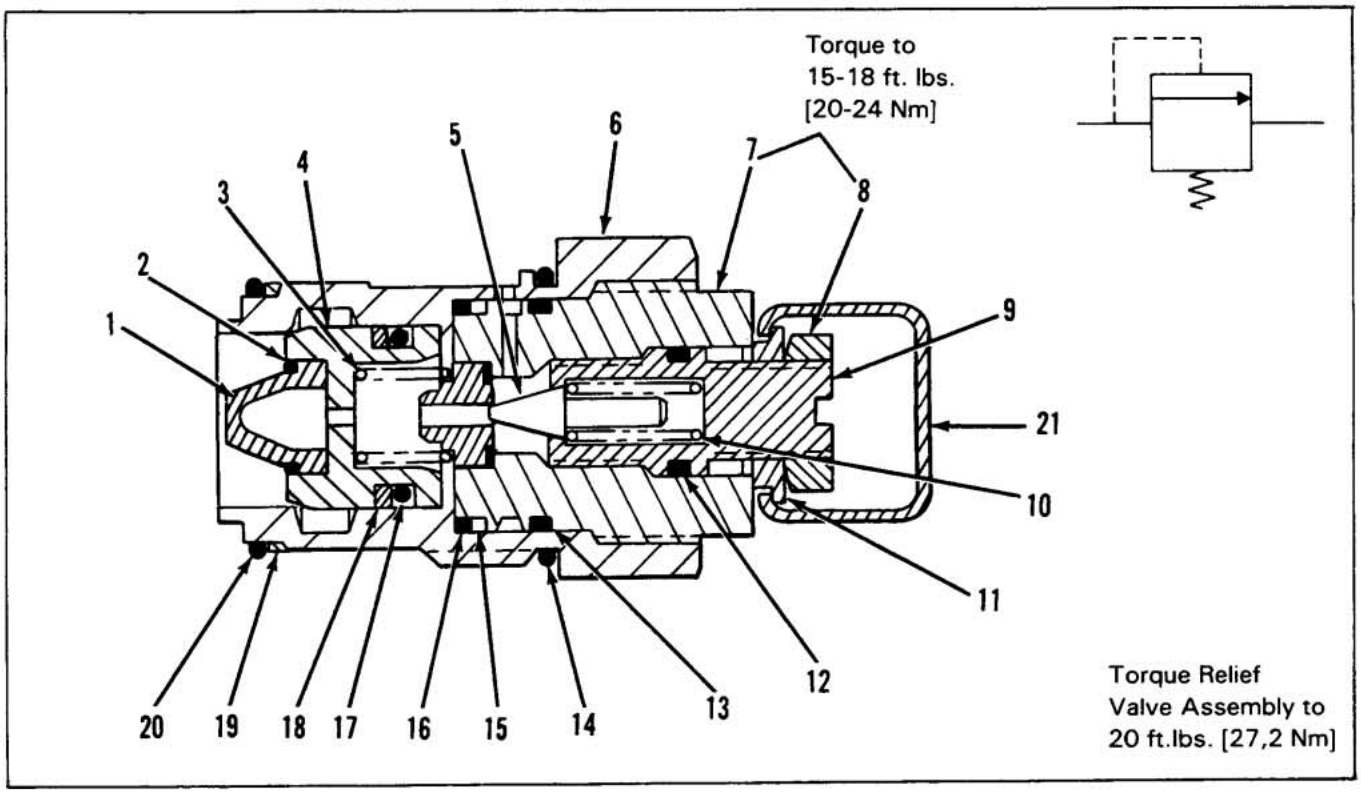


Figure 4-41. Model RP51 Pilot Operated Main Relief Valve.

MODEL RP51 PILOT OPERATED MAIN RELIEF VALVE

Item No.	Part No.	Description	Quantity
	K-19005*	SEAL KIT (Contains items 12-20)	
1	12675-001	FILTER	1
2	10298-001	RING, Retaining	1
3	20254-001	SPRING	1
4	20209-001	POPPET, Main	1
5	8475-001	POPPET, Relief	1
6	8954-001	BODY, Relief Valve	1
7	11059-001	BODY, Pilot Assembly	1
8	9302-006	NUT, Hex Jam	1
9	8956-001	SCREW, Adjustment	1
10	10059-001	SPRING, Pilot	1
11	10035-001	WASHER, RP51-N (Shown)	1
	10852-001	WASHER, ID, RP51-A (Not Shown)	1
12	6884-001*	SEAL, O-Ring	1
13	6814-002*	SEAL, O-Ring	1
14	1615-001*	SEAL, O-Ring	1
15	9020-019	RING, Back-Up	1
16	1660-001*	SEAL, O-Ring	1
17	9000-113*	SEAL, O-Ring	1
18	20903-001	RING, Back-Up	1
19	9020-022	RING, Back-Up	1
20	1718-001*	SEAL, O-Ring	1
21	10034-001	COVER, Tamperproof (RP51-N only)	1

Not sold separately. Order K-19005

NOTE

Due to close tolerances on working parts, Model RP51 is not field serviceable. If service other than seal replacement is required, contact the factory.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

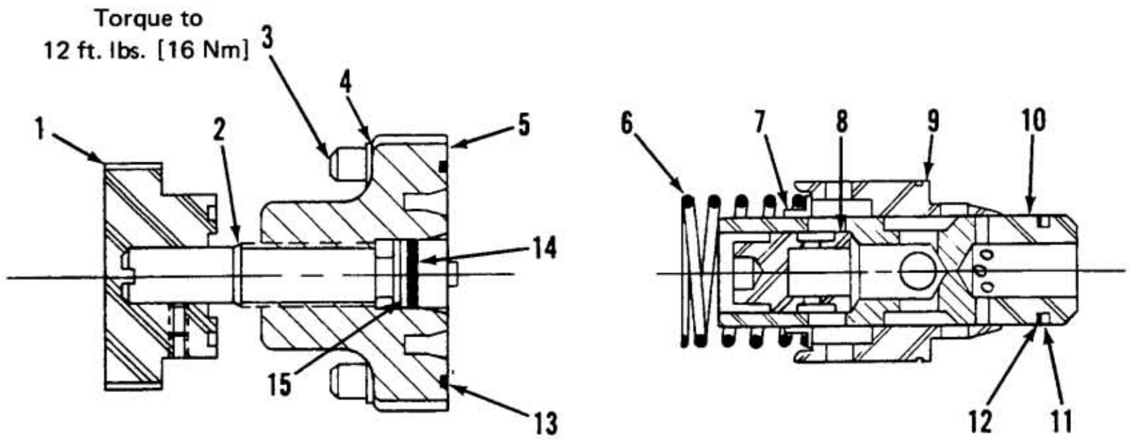


Figure 4-42. Flow Control Assembly, Inlet Cover.

FLOW CONTROL ASSEMBLY, INLET COVER

Item No.	Part No.	Description		Quantity
	K-6066-C	REPLACEMENT KIT, Actuator (Contains items 1 thru 5 and 13 thru 15)		
	K-6067-A	REPLACEMENT KIT, Flow Control, 3-16 GPM [11-60 litres/min]		
	K-6068-A	REPLACEMENT KIT, Flow Control, 8-25 GPM [30-95 litres/min]		
	K-6069-A	REPLACEMENT KIT, Flow Control, 13-21 GPM [49-79 litres/min]		
		(Flow Control Replacement Kits contain items 6 thru 12)		
	K-6065	SEAL KIT (Contains items 11 thru 15)		
1	3236-001	KNOB		1
2	6309-001	ADJUSTER, Flow (Standard)		1
	3902-001	ADJUSTER, Flow (Optional, 3-inch [76 mm] stem)		1
3	3731-101	SCREW, Hex Head		4
4	0563-001	WASHER, Lock		4
5	3906-001	CAP, Control		1
	3906-002	CAP, Control (For use with optional dust boot)		1
6	3882-001	SPRING, Control		1
7	6665-001	COLLAR		
8	3897-001	PISTON, Control 3-16 GPM [11-60 litres/min]	See Note	1
	7740-001	PISTON, Control, 8-25 GPM [30-95 litres/min]	See Note	1
	7483-001	PISTON, Control, 13-21 GPM [49-79 litres/min]	See Note	1
9	3891-001	SLEEVE, Metering, 3-16 GPM [11-60 litres/min]	See Note	1
	7484-001	SLEEVE, Metering, 8-25 and 13-21 GPM [30-95 and 49-79 litres/min]	See Note	1
10	3888-001	GUIDE, Sleeve, 3-16 GPM [11-60 litres/min]	See Note	1
	7485-001	GUIDE, Sleeve, 8-25 and 13-21 GPM [30-95 and 49-79 litres/min]	See Note	1
11	1821-001	WASHER, Back-Up	Not sold separately. Order K-6065	1
12	1819-001*	SEAL, O-Ring	Not sold separately. Order K-6065	1
13	3911-001	SEAL, O-Ring	Not sold separately. Order K-6065	1
14	9001-012	SEAL, O-Ring	Not sold separately. Order K-6065	1
15	3908-001	WASHER, Back-Up	Not sold separately. Order K-6065	1
16	10957-001	BOOT (Not shown, cannot be used with knob)		1

Note:

These are matched parts and are not sold separately. Order appropriate Replacement Kit for required GPM flow control.

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

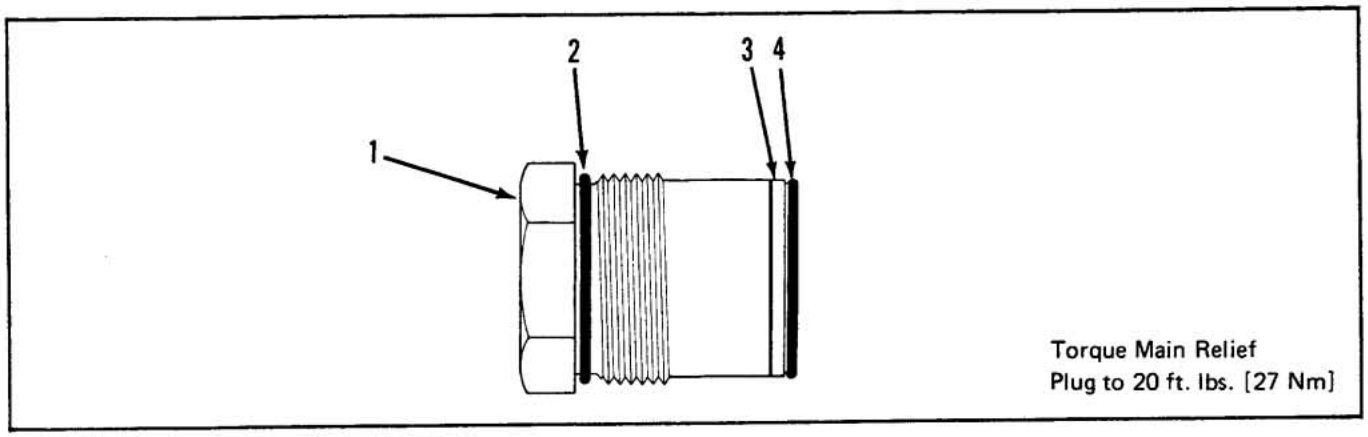


Figure 4-43. Main Relief Plug.

"NR" MAIN RELIEF PLUG

Item No.	Part No.	Description	Quantity
	K-6132-A	REPLACEMENT PLUG ASSEMBLY (Contains all items listed below)	
	K-28062-A	SEAL KIT (Contains items 2, 3 and 4)	
1	6760-001	PLUG, Relief	1
2	1615-001*	SEAL, O-Ring } Not Sold	1
3	9020-022	WASHER, Back-Up } Separately	1
4	1718-001	SEAL, O-Ring } Order K-28062	1

*Buna-N seals are standard for all Gresen valve assemblies. Optional Viton seals are available. See Cross Reference Tables on page 4-37.

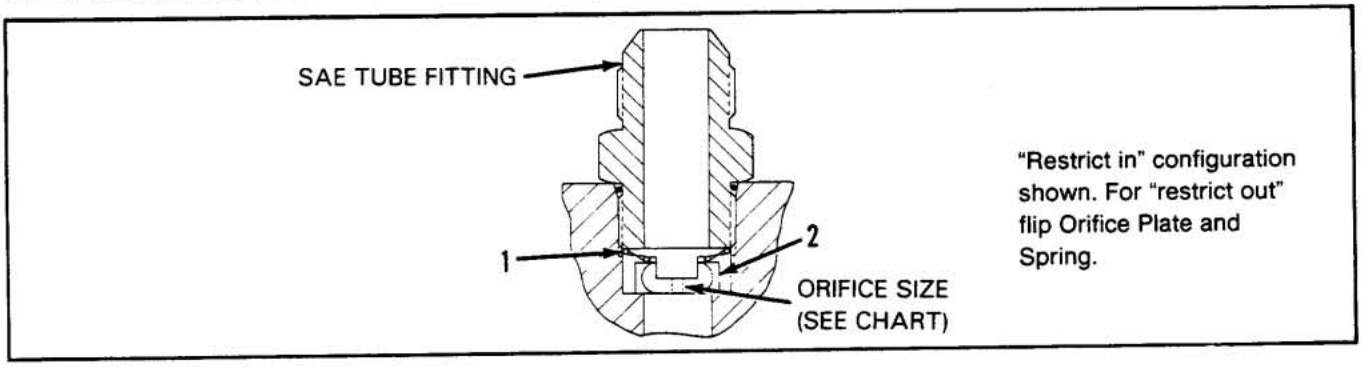


Figure 4-44. Work Port Restrictors.

WORK PORT RESTRICTORS

Item No.	Port No.	Description	Quantity
	11031-xxx*	RESTRICTOR ASSEMBLY, SAE 8 Port (Contains items 1 and 2)	
	10098-xxx*	RESTRICTOR ASSEMBLY, SAE 10 Port (Contains items 1 and 2)	
1	10821-001	SPRING, Conical (SAE 8 Port)	1
	10064-001	SPRING, Conical (SAE 10 Port)	1
2	10817-xxx*	PLATE, Orifice (SAE 8 Port)	1
	10063-xxx*	PLATE, Orifice (SAE 10 Port)	1

*The last three digits of the Restrictor Assembly and Orifice Plate part numbers are the same as the orifice hole size. Example: .062 hole is part number XXXXX-062.

ORIFICE HOLE SIZES AVAILABLE

SAE 8 PORT	SAE 10 PORT
015, 028, 032, 046, 055, 062, 074, 082, 095, 109, 125, 141, 156, 172, 189, 220	015, 032, 037, 047, 053, 062, 070, 076, 082, 086, 095, 109, 125, 141, 156, 189, 203, 220, 281

Standard Buna-N Seals and O-Rings

All standard Gresen products utilize Buna-N seals which are compatible with petroleum base, water-in-oil emulsions, and water-glycol fluids. Phosphate ester type fire-resistant fluids will cause Buna-N seals to swell. This swelling is not normally detrimental to static seals, but will be a problem for dynamic seals such as valve spool seals. Swelling of these seals can result in binding. The temperature range of Buna-N seals is −40°F to +200°F [−40°C to +93°C].

Table 4-1. Cross Reference For Seals and O-Rings, Buna-N to Viton

Buna-N Part No.	Viton Part No.	Application
1129-001	None	
1615-001	7447-001	Section Seal, Exhaust
1718-001	7446-001	WC Relief, NR Plug
1721-001	7612-001	Power Beyond Sleeve, Inner
1800-001	None	
1818-001	7444-001	Inner Check Plug Seal
1819-001	7445-001	Outer Check Plug Seal
1853-001	7613-001	Quad Seal, Float
2706-001	None	
2707-001	7448-001	Check Plug Seal
2709-001	6277-001	Power Beyond Sleeve, Outer
6806-001	None	
21857-001	9003-117	Section Seal, Pressure (new)
6814-002	7450-001	Section Seal, Pressure (old)
21733-001	9002-119	Section Seal, Exhaust (new)
6815-002	7451-001	Section Seal, Exhaust (old)
21866-001	9002-108	Section Seal, Load Sensing (new)
8316-001	9002-011	Section Seal, Load Sensing (old)

Optional Viton Seals and O-Rings

Viton seals are recommended for most applications that use phosphate-ester type fluids. Viton seals are also recommended for applications that have a continuous operating temperature of +200°F [+93°C] or more.

Table 4-2. Cross Reference For Seal Kits, Buna-N to Viton

Buna-N Kit No.	Viton Kit No.	Application
K-6001-A	None	
K-6002-A	None	
K-6005-A	K-6041	RC Relief
K-6017-B	K-6053-A	Power Beyond (1/2 NPTF)
K-6018-B	K-6054-A	Power Beyond (SAE 8)
K-6019-B	K-6055-A	Power Beyond (SAE 10)
K-6021-A	K-6043	Anti-Cavitation Check
K-6027-A	K-6046	Section Seal, 3-Way, 4-Way
K-6028-C	K-6049-A	Section Seal, Float
K-6030-C	K-6047	Check Plug
K-6032	K-6041	Load Check, Anti-Cav. Check, RC Relief
K-6034-D	None	
K-6035-A	K-6048	Spool Seal
K-6039	None	
K-6040-C	None	

Parker Hannifin Corporation
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Tel: (440) 366-5200
Fax: (440) 366-5253
www.parker.com/hydraulicvalve

Bulletin HY14-2705-M3/US,
3C, 8/02, PHD

Repair of Hyd-ro-ac Actuators

HA Model
OVERHAUL INSTRUCTIONS

HA-36

Read the entire contents of these instructions before installing the actuator and before making any connections to the actuator. These instructions must be followed in all respects to avoid damage to the actuator and associated components and/or injury to personnel.

For further information contact:

Micro-Precision TEXTRON

Micro-Precision Operations Inc./Subsidiary of Textron Inc.
525 Berne Street
Berne, Indiana 46711

Phone: 260-589-2136
Fax: 260-589-8966
email: actuators@tac.textron.com
web address: www.rotachydroac.com

INTRODUCTION.

This technical manual provides overhaul instructions with an illustrated parts list for standard HA-36 Hyd-ro-ac Rotary Actuators. Do not attempt to overhaul an actuator without having a seal kit on hand. Refer to the applicable parts List for information regarding seal kits. The Parts List should also be used as a specific guide in determining the parts used in a particular assembly.

SPECIAL TOOLS.

The following special tools are recommended for use during reassembly of a HA Series Actuator. Alternate procedures, for use when the tools are not available, are provided herein but are not recommended. See figure 2 also.

PART NUMBER	NOMENCLATURE
220038-HA	Shaft Seal Protector
220039-HA	Abutment Seal Protector
220041-HA	Vane Seal Protector

NOTE- The procedures. herein apply to all HA Series Actuators. The differences in construction between the various units do not affect the overhaul instructions unless a notation restricts the instruction to a particular HA Series Actuator.

DISASSEMBLY.

Disassembly is in the same order as the key index numbers assigned to the exploded view illustration, figure S. Complete instructions are listed in the following steps.

a. Use a holding fixture that simulates normal actuator mounting to hold the actuator during disassembly. Do not hold the actuator in a vise unless special precautions are taken to avoid marring or distorting the end or body.

b. Pull V-ring (1) from end of the wingshaft. Unscrew and remove cap screws (2). Tap around the periphery of end & bushing assembly (3) until the end is loose, then remove it from body & bushing assembly (19).

c. Remove hub seal (5), hub wavy ring (6), and hub seal spring (7) from end (3). Take shaft seal (b) and shaft seal ring (9) out of the groove in end (3). If necessary, remove dowels (4) from end (3) or body (19).

d. Bushing(10)in end(3)is a "DX" type and replacement should be governed by the following criteria.

1. Bushings should not be replaced unless worn or damaged.

2. If replacement is required, Bushings must be machined Out of the end. Care must be taken to avoid damaging the end.

3 "DX" bushings are normally installed at the factory as they are a press fit in the ends and must be machined after installation to match the wingshaft diameter with a diametrical clearance of 0.0005 to 0.0020 inches. Figure 1.

4 End (3) supplied as a spare part contains a "DX" bushing and is machined to match the wingshaft diameter.

Remove end seal 0-ring(11)from body(19).

Important. Do not allow the wingshaft to cock as it may nick the sharp edges on the body. abutment or wingshaft.

e. Use a-straight, even pull and remove the wingshaft (12) from the body (19). Take vane seal (13). vane seal 0-ring (14), and vane seal spacer (14a) out of the groove in the wingshaft vane.

f. Pull abutment (15) out of body (19). It is not necessary remove abutment dowels (16). The dowel pins are usually a light press fit in the abutments and a clearance fit in the ends.

Important: Do not nick the sharp edges on the body cavity and hub seal bores as this may cause internal leakage after reassemble.

g. Remove abutment seal (17) and abutment seal 0-ring

h. Take hub seal (5). hub seal ring (6). and hub seal spring (7) out of body (19). Remove shaft seal (8) and shaft seal 0-ring (9) from body (19).

i. Removal of bushing (10) from body (19) should be governed by the replacement criteria listed under step d.

j. It is not necessary to remove nameplate(21)unless it is damaged and requires replacement. To remove the nameplate. pull out drive screws (20).

k. On all standard HA. Series Actuators, ports are contained in body (19). Ports should always contain shipping plugs to prevent the entry of foreign material.

CLEANING

Clean all parts by degreasing in a suitable solvent and dry thoroughly.

INSPEC'TION.

a. Visually inspect wingshaft (12), end (3). body (19). and abutment (IS) for cracks. nicks or scratches.

b. Visually inspect bushings (10) in end (3) and body (19) or scoring or wear.

c. Inspect the inner diameter of abutment (15). the inner faces and diameters of end (3) and body (19), and the outer diameters of wingshaft (12) for evidence of scratches. scoring, or galling.

d. Inspect all threads for condition and cleanliness.

REPAIR OR REPLACEMENT.

a. Minor scratches may be removed by hand stoning the affected areas. Stone just enough to remove rough edges or bum. If the scratches are deep enough to form leakage paths. the affected parts should be replaced.

b. Replace all parts in the seal kit: V-rings (1), 0-rings (9), (11). (14), (18), hub seals (5), shaft seals (8), vane seal (13). and abutment seal (17).

c. Replace all broken or damaged parts.

LUBRICATION.

Lubricate all 0-rings sparingly with petroleum jelly or other suitable lubricant compatible with the 0-ring material. and with hydraulic fluid being used.

REASSEMBLY.

NOTE: Special tools should be used to prevent damage to seals during reassembly. Alternate methods for use when the tools are not available are listed herein. The alternate methods are not recommended and are listed only for convenience in the event of an emergency.

a. If bushings (10) were removed, press new "DX" bushings into the end and/or body and then machine to match the wingshaft diameter with a diametrical clearance of 0.0005 to 0.0020 inches and concentric with the shaft bore within 0.001. If facilities are not available for machining, procure an end (3) and body (19) with installed bushings (see Parts List).

NOTE: Bushings must be fully seated and must not protrude into the hub seal area.

b. Install body (19) on a holding fixture. Lubricate shaft -ring (9) sparingly with lubricant and install it and seal 0 shaft seal (8) in body (19). Avoid ripples or wrinkles in the installed shaft seal. Place hub seal spring (7) and hub seal ring (6) in body (19). Install hub seal (5). The hub seal should fit snuggly. Note that the hub seal is free to move in an axial direction under pressure of hub seal spring (7).

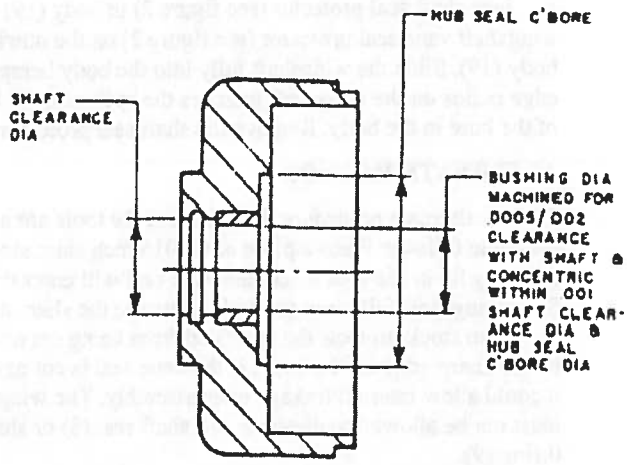

Figure 1. Bushing Machining Requirements

Caution : Abutment (15), abutment seal wingshaft (12). and wingshaft vane seal (13) must be installed so that the edge radius on the parts matches the radius on the bottom of the body bore.

c. Assemble the vane seal 0-ring (14) on to the vane seal spacer (14a) followed by the vane seal (13). This is best accomplished while holding the vane seal spacer against a clean flat surface. Install this vane seal assembly in the groove in wingshaft (12) noting that the edge radius on seal (13) and wingshaft (12) are on the same side. Coat seal (13) liberally with lubricant.

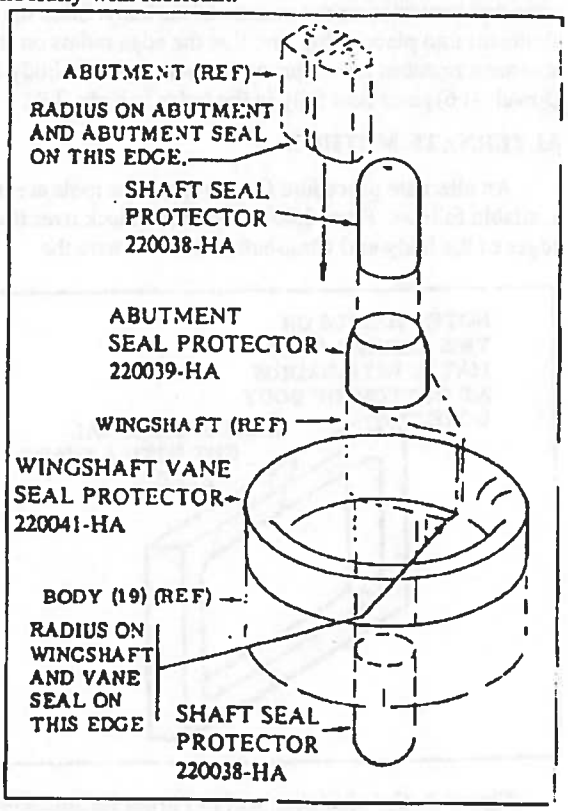

Figure 2. Special Assembly Tools Used to Protect Seals

d lace shaft seal protector (see figure 2) in body (19) and wingshaft vane seal protector (see figure 2) on the outside of body (19). Slide the wingshaft fully into the body being sure the edge radius on the wingshaft matches the radius on the bottom of the bore in the body. Remove the shaft seal protector.

ALTERNATE METHOD

d-1. An alternate procedure for use when the tools are not available follows: Place a piece of 0.0015 inch shim stock over the body lip in the area where the vane seal will enter the body. Slide wingshaft fully into the body. Remove the shim stock. The shim stock protects the vane seal from being cut or abraded by the sharp edge on the body. If the vane seal is cut or abraded it could allow internal leakage after assembly. The wingshaft must not be allowed to distort or tell shaft seal (8) or shaft seal 0-ring (9).

Caution: Sharp edges on shim stock can be dangerous. Use extreme care when handling.

e If removed. install dowels (I 6) in abutment (I 5). Stretch 0-ring (I 8) around the abutment and seat in the seal groove. Make a centrally located diagonal cut through the side of abutment seal (I 7) that contacts the body (see figure 3). Use a razor blade to make the cut. Place the abutment seal (17) in position on abutment (151 The diagonal cut must be on the side of the abutment next to the body. and the edge radius on the abutment seal and abutments must coincide. Apply a liberal coating of lubricant to the abutment seal. Place abutment vane seal protector (see figure 2) on the wingshaft and wingshaft vane seal protector on the outside of the body. Slide the abutment into place being sure that the edge radius on the abutment matches the radius on the bottom of the body bore. Dowels (I 6) must seat fully in the holes in body (I 9).

ALTERNATE METHOD.

e- 1. An alternate procedure for use when the tools are not available follows: Place 0.0015 'rich shim stock over the sharp edges of the body and wingshaft hub area where the abutment seal will enter. Slide the abutment into position and remove the shim stock. The shim stock protects the abutment seal from cuts or scratches that would allow internal leakage.

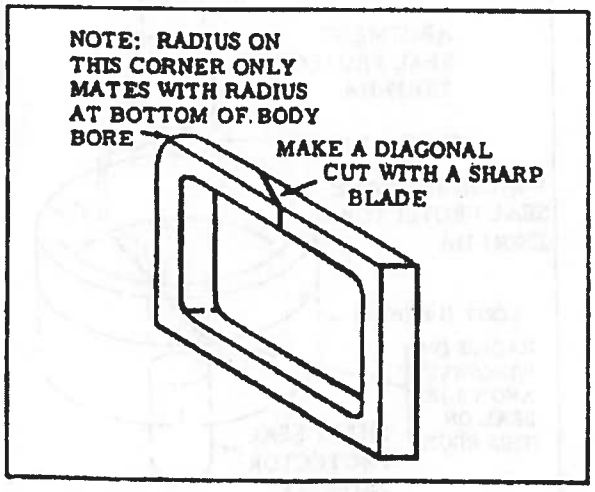

Figure 3. Cut abutment seal to Permit installation on abutment.

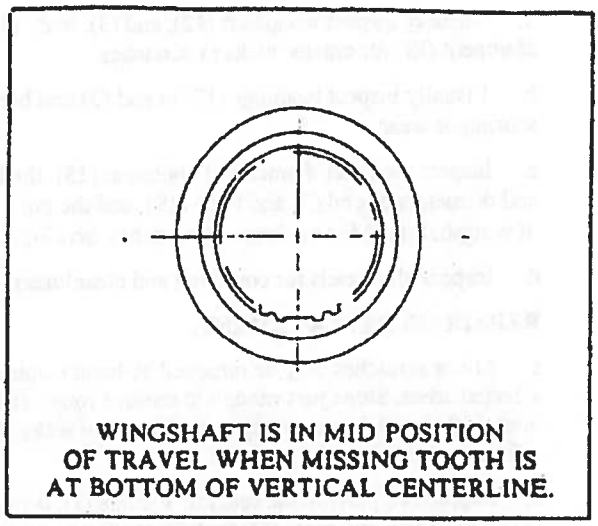

figure 4. Wingshaft and body assembly relationship.

f Install end seal 0-ring (I 1) on the outer lip of body (I 9) and lubricate sparingly.

g Install shaft seal 0-ring (9) and shaft seal (8) in end (3).

h Place hub seal spring (7). hub seal ring (6). and hub seal (5) in end (3) being sure that hub seal (5) fits snuggly and that it is free to move axially under the pressure of hub seal spring (7). Apply a heavy coating of lubricant around hub seal (5). The lubricant must keep the hub seal correctly positioned when end (3) is turned over to install it on body) (19). Place shaft seal protector (see figure 2) on the end of wingshaft (12). Position end (3) over body (19) and h ft (12) and press it onto the body being sure the wings a capscrew and dowel pin holes are aligned. Remove the shaft seal protector from the wingshaft. If the shaft seal protector is not available. use caution to avoid tearing or distorting shaft seal (8) by the wingshaft.

i Apply a small amount of Loctite to the first three threads of capscrew (2), install capscrews in end (3). tighten all capscrews lightly. Using a 'star pattern' tighten -of 120 foot pounds. Install capscrews evenly to a torque dowels (4). If either body or end are new and if necessary, ream the dowel holes .6250/.6245 diameter by 2'Z, inches deep to permit insulation of the dowels.

j If removed, replace nameplate (21) and secure to body (I 9) with drive screws (20).

k Install V-ring (1) on end of the wingshaft, work the V-ring onto the wingshaft being careful to avoid cutting the inner diameter with the sharp edges on the wingshaft.

Table 1. -Trouble Shooting Chart

□TROUBLE	PROBABLE CAUSE	'REMEDY
External Leakage at Shaft -	Defective shaft seal S) (8) or 0-ringf., (9).	Replace defective parts.
	Wingshaft (12) scored or worn. Bushings (10) defective	Repair wingshaft or replace. defective parts.
External Leakage at Joint Between End (3) and Body (19).	defective 0-ring (11), or damaged sealing. surface on end (3) or body (19).	Replace defective 0-ring Repair or replace damaged parts
Wingshaft Binds'	Foreign material in actuator working chambers.	Disassemble and clean thoroughly
	Improperly seated abutment seal (17), vane seal (13) and/or hub seal(s) (5).	Disassemble and replace improperly seated seal making sure it seals property at assembly.
Excessive Internal Leakage	Defective abutment seal (17), vane seal (13), . 0-ring (18) and/or vane seal 0-ring (14).	Replace defective parts
	Defective hub seal (5), hub seal ring (6), or hub seal spring (7).	Replace defective parts.
	Worn or scratched end faces in end (3) or body(19).	Repair or replace.
	Deep scratches in body (19).	Repair or replace.
	Worn bushings (10).	Replace bushings.
	Cap screws (2) not tightened sufficiently.	Tighten to recommended torque.
	Vane seal not seated properly (applicable to units immediately after overhaul only).	Operate through full cycles for a few □minutes to attempt to seat seals. L

TEST PROCEDURE.

a Apply 50 psi air or hydraulic pressure (normal operating fluid) to one of the inlet ports. The applied pressure should move the wingshaft until it is stopped by the abutment. If the actuator fails to move under the applied pressure it indicates that the wingshaft is binding.

b . Lock the wingshaft in the center of its angular travel and pressurize one of the ports with hydraulic fluid at operating pressure. Check- for internal leakage by measuring the flow 'out of the opposite port. Leakage should not exceed the value shown in Table 11. Reverse the hydraulic connections and check leakage at the opposite port. Leakage should not exceed the value listed in Table 11. Pressurize both ports simultaneously to operating pressure and check for external leakage. No external leakage is allowed

Table 11. Maximum Allowable Internal Leakage Values

MODEL	Maximum Breakaway Torque required in PSI	Test Pressure in PSI	Maximum Bypass Leakage per min.	
			Cubic Inches	cc
HA-36	50	2200 PSI	37	600

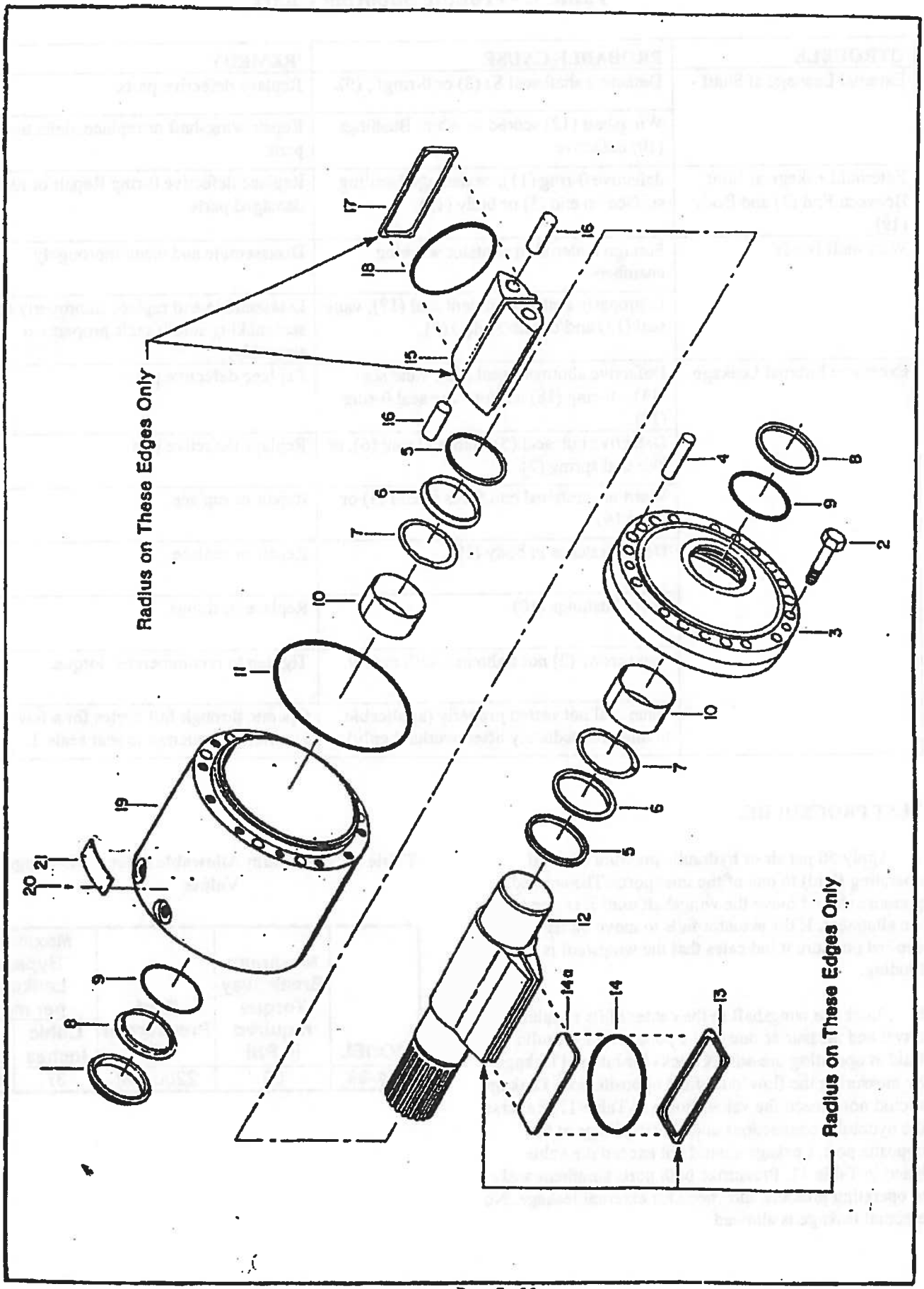

Figure 5. HA 36 Rotary Actuator Assembly, Exploded View

INSTALLATION INSTRUCTIONS

Important Hydraulic Features

1. The standard unit is designed to operate in the temperature range of -40 to +225 degrees F when filled with any filtered petroleum or mineral base fluid that has viscosity value of 70-250 SSU at 150 degrees F.

2. Standard units are fitted with Nitrile (Buna N) seals. Fluorocarbon rubber (viton) and ethylene propylene seals are available for special fluids and high temperature applications. Filtered and lubricated air may also be used; however, the temperature should not exceed 150 degrees F.

3. THE FLUID PRESSURE APPLIED TO THE HYD-RO-AC MUST NOT EXCEED THE RATED MAXIMUM PRESSURE GIVEN ON THE NAMEPLATE ("MAX. P.S.I"). IN NO CASE IS THE RATED PRESSURE PERMITTED TO BE GREATER THAN 3000 P.S.I. A relief valve must be installed in the supply line to restrict system pressure. The hydraulic system must be designed to eliminate pressure surges that could exceed the actuator design pressure. Relief valves must be installed between the control valve and the HYD-RO-AC to eliminate the surge pressure in the actuator which may be caused by attempting to stop a high inertial load. These valves must be adequately sized and installed as close as possible to the actuator and between any control or shutoff valve and the actuator.

Important Installation Considerations

1. It is essential that no end loads be transmitted to the output shaft of the actuator. To insure maximum life for any installation, side loading and bending movements caused by improper alignment should be eliminated by use of shims. If side loads cannot be avoided, consideration should be given to provide outboard pillow blocks and/or flexible couplings. However, where side loads cannot be avoided, recommendations should be obtained from the factory.

2. In the installation of an END MOUNT actuator it is essential that the two untapped holes in the mounting flange be reamed and fitted with press fit dowels to take the torque. Do not try to carry the torque load on the threads of the four mounting bolts or the friction under the heads of these mounting bolts alone. In the installation of a foot mount actuator, it is essential that fasteners be used in each of the four mounting holes.

3. All mounting bolts must be tight and of sufficient strength. The actuator must be aligned properly and attached to sufficiently rigid structure to assure that there are no unrecognized side loads applied to the HYD-RO-AC shaft or bearings. Use shims where necessary to maintain alignment.

4. The adapter connecting the HYD-RO-AC output shaft to the mechanism should be machined for a slip fit with minimum backlash, and all linkages must be snug to assure proper response. No end loads should be transmitted to the actuator.

5. Hydraulic lines must be at least as large as the ports of the HYD-RO-AC and as short as possible to minimize hydraulic pressure drop problems.

6. If the actuator is mounted with ports other than at the top of the unit, or if only a small portion of the stroke is utilized, a method for bleeding air out of the system must be provided.

CAUTION: THE INTERNAL STOPS IN THE ACTUATORS ARE NOT DESIGNED TO ABSORB DYNAMIC LOADS. EXTERNAL STOPS MUST BE USED TO LIMIT OUTPUT SHAFT TRAVEL. VANES STRIKING ABUTMENTS WILL RESULT IN PREMATURE ACTUATOR FAILURE.

7. Angular travel. Total shaft travel for a standard unit is 280 degrees +/- 5 degrees for single vane and 100 degrees +/- 5 degrees for double vane. Position the output shaft correctly prior to connecting it to the mechanism to insure full angular rotation.

8. The mid-position of travel of each HYD-RO-AC equipped with a standard spline is readily obtainable by positioning the missing tooth area of the spline 180 degrees opposite the centerline of the hydraulic connecting ports for single vane units, and 90 degrees clockwise from a centerline between the two ports for double vane units. These positions are located while facing the splined end of the actuator. The mid-travel position for each HYD-RO-AC with a standard keyway is readily obtainable by positioning the keyway between the hydraulic connection ports.

HYD-RO-AC WARRANTY

The Company warrants, to the original purchaser, that this product is free from defects in materials and workmanship if properly installed, serviced and operated under normal conditions according to the Company's instructions. The Company's obligation under said warranty and its total legal obligation under this contract is expressly limited to correcting, without charge at its factory, any unit or parts thereof returned to its factory, transportation charges prepaid, for a defect which occurred during the first 6 months of operation or 12 months from date of shipment to the original purchaser, whichever occurs first; and which upon examination shall disclose to the company's satisfaction to have been originally defective. Corrections of such defects by repair to, or supplying of replacements for defective parts, shall constitute fulfillment of all obligations to the original purchaser. This warranty shall not apply to any of the Company's products which must be replaced because of normal wear, which have been subject to misuse, negligence or accident or which shall have been repaired or altered outside the Company's factory unless authorized in writing by the Company. The Company assumes no liability for injury, loss, damage, or expense directly or indirectly resulting form the use of this product or from any other cause. THIS WARRANTY SUPERSEDES, AND IS IN LIEU OF, ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND OF ALL OTHER LIABILITIES OR OBLIGATIONS ON THE PART OF THE COMPANY. No distributor, agent, or dealer is authorized to give any other warranties on behalf of the Company nor to assume for the Company any other liability in connection with any of its products. UNDER NO CIRCUMSTANCE WILL THE COMPANY BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL, OR ANY OTHER DAMAGE IN CONNECTION WITH THE USE OF ANY INFORMATION OR MATERIAL CONTAINED HEREIN. THE COMPANY DISCLAIMS ALL WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

White Hydraulics, Inc.
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WHITE HYDRAULICS

PI444002
9/01

Service Instructions For The
RE (500/501) Series

For Use With
Seal Kit 500444002

*****USE EXPLODED VIEW ON BACK FOR REFERENCE*****

A) Remove all shaft related components from shaft (27) (i.e. keys, wire rings, nuts). To aid in reassembly of the motor, make a "V" shaped set of lines from the endcover (24) to the housing using either paint or a marker. With shaft facing down, secure motor in vise by clamping on to housing (15).

B) Loosen and remove seven bolts (26) holding motor assembly together. Remove endcover (24) and endcover seal (10). Discard seal. Remove balance plate (22) taking care not to drop the three steel balls (23) located in the three holes in the balance plate (22). Remove rotor assembly (21), manifold (19), drive link spacer (20) (NOTE: Some motors do not use spacer), drive link (18) and thrust bearing (17). Remove body seals (9) from rotor assembly (21) and housing seal (8) from housing (15) and discard seals. (NOTE: Compare old housing seal (8) to the two housing seals included in kit to determine which one to use.)

C) Gently tap shaft (27) upward from housing (15) and remove through rear of housing and lay aside. Remove housing (15) from vise and turn over. Pry dust seal (1) from housing. Push the seal carrier (11), thrust washer (12) and thrust bearing (13) down until they make contact with the roller bearing (14) located in the housing bore.

D) Remove wire ring (2), steel backup shim (3) and high pressure seal (4) from inner bore groove with a small screwdriver Lift our seal carrier (11), thrust washer (12) and thrust bearing (13) from the housing bore. Using a small screwdriver, carefully pry shaft seal (7), backup seal (6), and metal backup shim (5) from seal carrier (11) and discard. Lay seal carrier (11), thrust washer (12) and thrust bearing (13) aside. (NOTE: If a new thrust washer (12) and seal carrier (11) is included in kit, old items may be discarded).

E) At this point, all parts should be cleaned in an oil-base solvent and dried using compressed air (For safety, observe all OSHA safety guidelines). All new seals should be lightly coated in clean oil prior to installation.

F) Place shaft (27) on a clean flat surface with output end facing up. Place thrust bearing (13) (NOTE: If thrust bearing has integral washer, make sure washer surface faces down.) Then thrust washer (12) on shaft (See Technical Bulletin PI444004 to determine correct thrust washer to use). Lightly coat seal area of shaft with clean oil and place plactic installation sleeve with shaft seal (7) down onto shaft covering all splines, keyways and wire ring grooves. Slide shaft seal (7) down onto shaft (27) making sure that lip on seal faces down (See Figure 1 for correct seal orientation) until it contacts thrust washer (12). Remove plastic installation sleeve. Carefully install the backup seal (6) onto the shaft (27) with the flat side up and the seal lip facing the shaft seal (7). Place the metal backup shim (5) onto the shaft and against the backup seal (6). Place the seal carrier (11) onto the shaft (large end down) and carefully press the seal carrier (11) down onto the seal assembly using an arbor press and sleeve to compress the seal into the carrier.

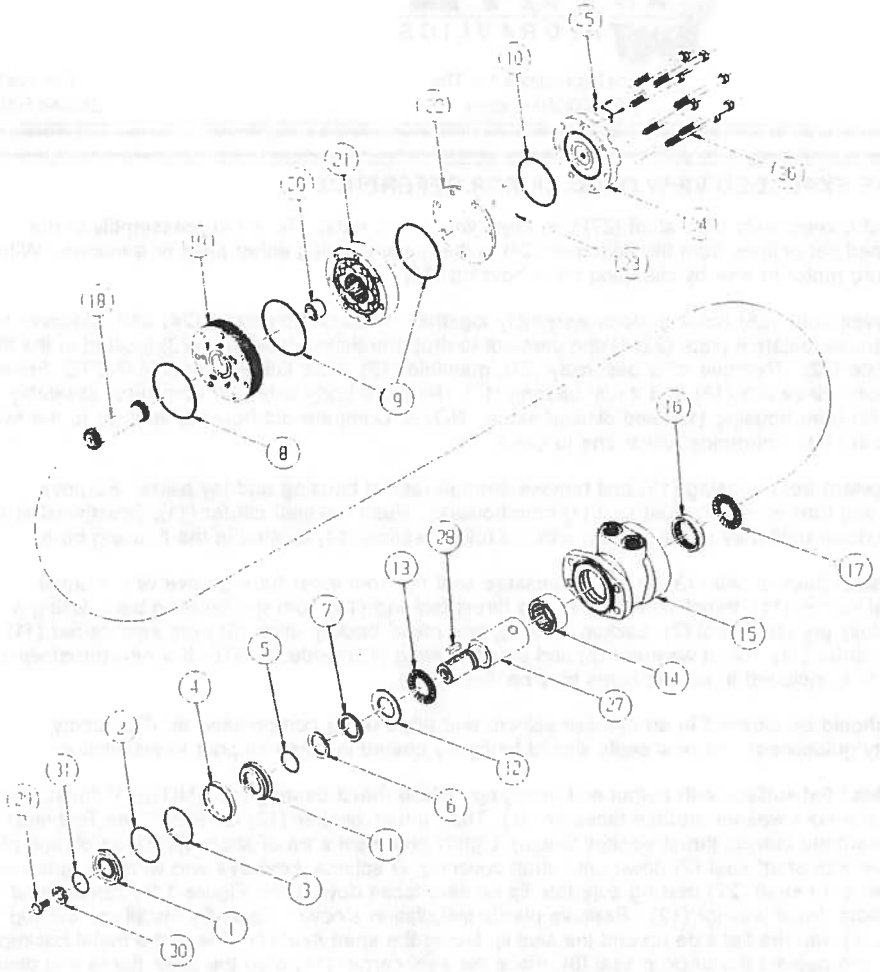
G) With pilot side facing up, place housing (15) on spacers to raise housing approximately .250 above work surface (NOTE: Spacers should allow shaft to contact work surface). Place shaft/seal carrier assembly into housing (15). Install high pressure seal (4) into groove in housing. Install metal backup shim (3) against high pressure seal (4) in groove in housing bore by squeezing the shim (3) between thumb and forefinger to bow shim. While maintaining bow in shim, start the shim into the groove and use a small screwdriver to push the shim into groove. Install wire ring (2) into the groove making sure that the ends are butted.

H) While holding shaft into housing, place housing/shaft assembly in vise with shaft end down. Making sure that end of drive link (18) with crowned splines goes into shaft end, install drive link (18) into shaft and tap lightly to seat the seal carrier against the wire ring (2). Place thrust bearing (17) over drive link (18). If seal carrier (11) is properly seated against wire ring (2), thrust bearing (17) will be flush with rear surface of housing.

I) Install housing seal (8) into groove in housing (15). Place manifold (19) onto housing, (15) side with only seven holes facing housing (15). Place body seals (9) in grooves in both sides of rotor (21). Place rotor (21) onto manifold (19) with side of rotor with chamfer in splines facing manifold (19).

J) Install balance plate (22) onto rotor (21) making sure holes for steel balls (23) faces up. Install three steel balls (23) in holes in balance plate (22). Install endcover seal (10) into groove in endcover (24) and place endcover onto balance plate (22). Install seven assembly bolts (26) and pre-torque to 10 ft. lbs. Using the bolt torque sequence shown in Figure 2, final torque all bolts to 50 ft. lbs.

K) Remove motor from vise and place on work surface with shaft (27) facing up. Making sure that lip on seal (1) faces up, place dust seal (1) over shaft (27). Using a sleeve and a hammer, carefully drive dust seal (1) into place.



RE (500/501) Series Motor Components

1. Dust Seal
2. Split Wire Ring
3. Metal Backup Shim
4. High Pressure Seal
5. Metal Backup Shim
6. Backup Seal
7. Shaft Seal
8. Housing Seal
9. Body Seals (2)
10. Endcover Seal
11. Seal Carrier
12. Thrust Washer
13. Front Thrust Bearing
14. Front Housing Bearing
15. Housing
16. Rear Housing Bearing
17. Rear Thrust Bearing
18. Drive Link
19. Manifold
20. Drive Link Spacer
21. Rotor Assembly
22. Balance Plate
23. Steel Balls (3)
24. Endcover
25. I.D. Tag Assembly
26. Assembly Bolts (7)
27. Shaft
28. Shaft Key
29. Shaft Bolt
30. Lock Washer
31. Wire Ring

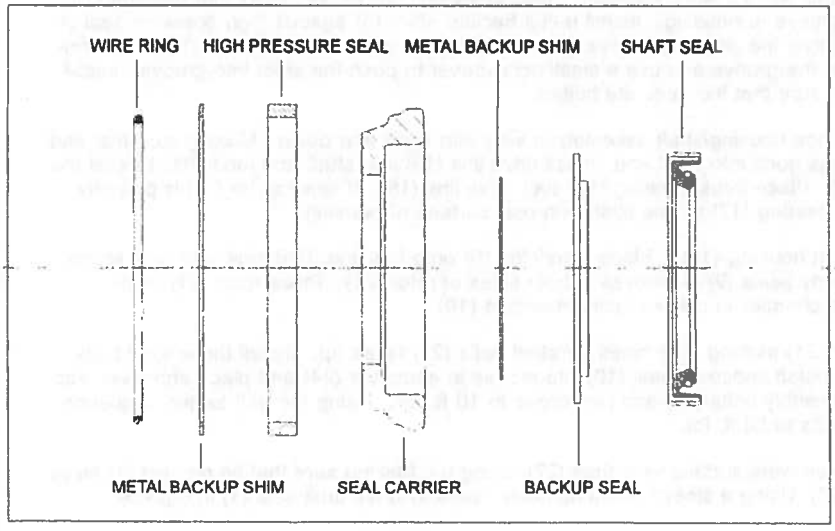


FIGURE 1

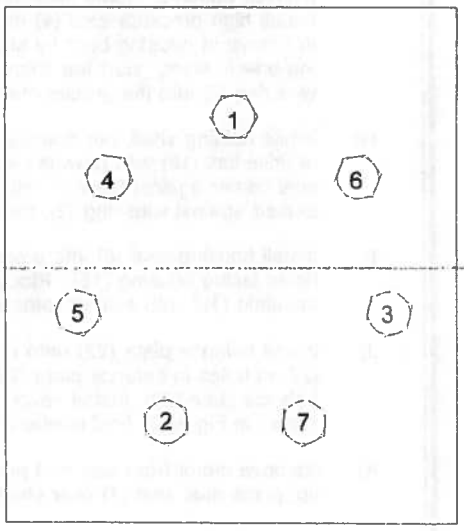
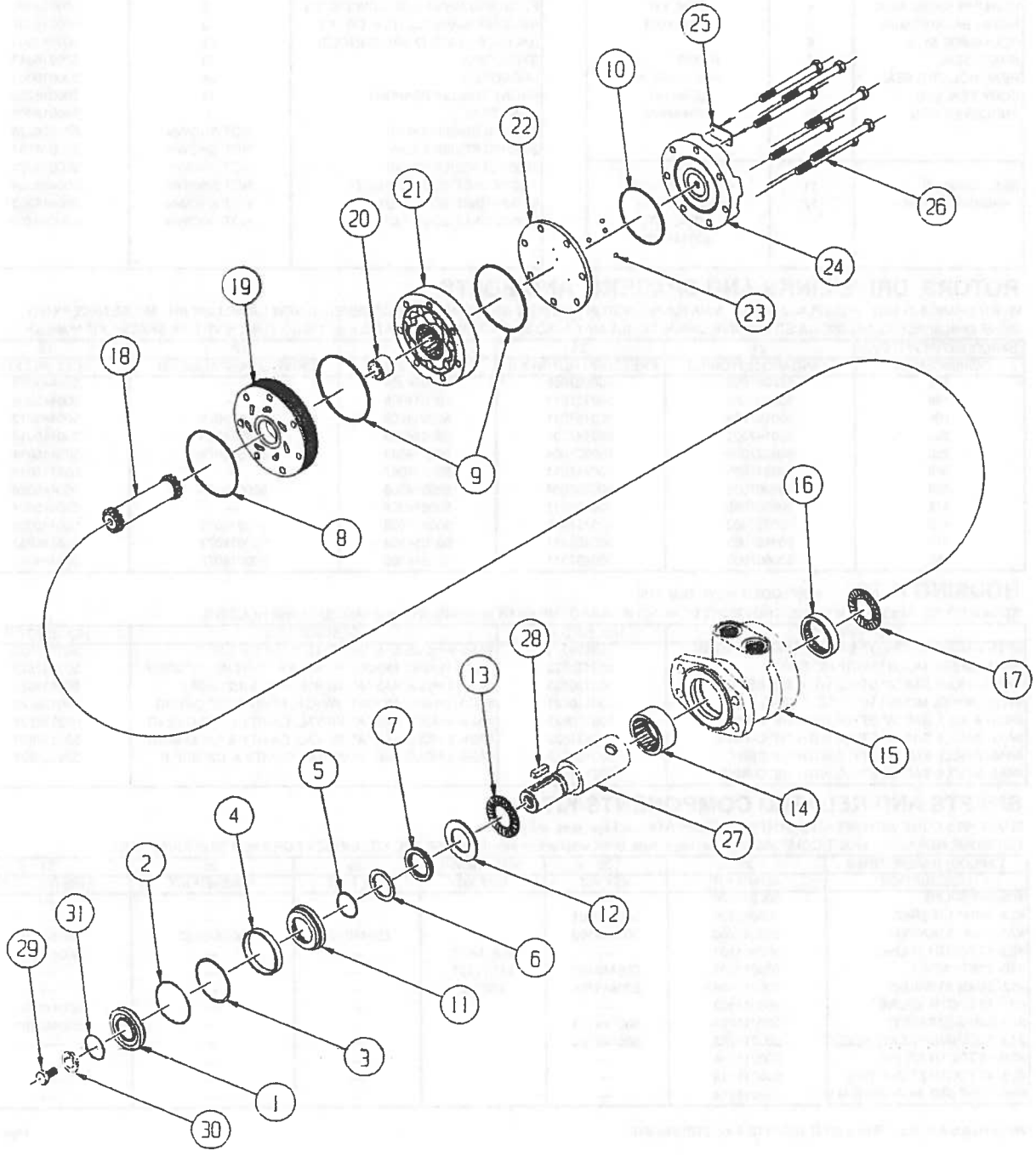


FIGURE 2

RE (500) Series



RE (500) SERIES MOTOR COMPONENTS

SEAL KIT 500444001

DESCRIPTION	EXP VIEW ITEM #	KIT #
DUST SEAL	1	
HOUSING SEAL	2	ITEMS # 1-12
METAL BACKUP SHIM	3	INCLUDED IN
HIGH PRESSURE SEAL	4	SEAL KIT
METAL BACKUP SHIM	5	500444001
POLYAMIDE SEAL	6	
SHAFT SEAL	7	ITEMS # 1-10
REAR HOUSING SEAL	8	INCLUDED IN
BODY SEALS (2)	9	SEAL KIT
ENDCOVER SEAL	10	500444002
SEAL CARRIER	11	ITEMS #11-12
THRUST WASHER	12	INCLUDED IN SEAL KIT 500444003

MISCELLANEOUS KITS

DESCRIPTION	EXPLODED VIEW ITEM #	KIT
REAR THRUST BEARING	17	500018059
FRONT HOUSING BEARING (1" WIDE)	14	500018003
REAR HOUSING BEARING (.5" WIDE)	16	500018002
FORWARD MANIFOLD (CCW OR "0")	19	500015006
REVERSE MANIFOLD (CW OR "1")	19	500015007
BALANCE PLATE (3 BALLS INCLD)	22	500012001
STEEL BALL	23	500018048
ENDCOVER	24	500016001
FRONT THRUST BEARING	13	500018252
DUST SEAL	1	500018006
1000 PSI RELIEF VALVE	NOT SHOWN	500018228
2000 PSI RELIEF VALVE	NOT SHOWN	500018231
3000 PSI RELIEF VALVE	NOT SHOWN	500018221
1.00-20 UNEF SLOTTED NUT	NOT SHOWN	500449304
1.00-20 UNEF SOLID NUT	NOT SHOWN	500449303
1.00-20 UNEF LOCK NUT	NOT SHOWN	300339303P

ROTORS, DRIVE LINKS AND SPACERS, AND BOLTS

WHEN CHANGING MOTOR DISPLACEMENTS, A MATCHING ROTOR AND BOLT SET KIT MUST BE ORDERED. A NEW DRIVE LINK KIT MAY BE NECESSARY. DRIVE LINK SPACERS ARE INCLUDED IN DRIVE LINK KITS, BUT MAY ALSO BE ORDERED SEPERATELY BY USING THE DRIVE LINK SPACER KIT NUMBER.

EXPLODED VIEW ITEM #	21	21	18	20	26
DISPLACEMENT	STANDARD ROTOR KIT	FREETURN ROTOR KIT	DRIVE LINK KIT	DRIVE LINK SPACER KIT	BOLT SET KIT
120	500087005	500087008	500014009	—	500445006
160	500137005	500137011	500014009	—	500445006
200	500167004	500167011	500014009	500018075	500445012
230	500147002	500147004	500014009	500018185	500445014
260	500227000	500227004	500014009	500018076	500445014
300	500247005	500247011	500014007	—	500445018
350	500207000	500207004	500014008	500018076	500445026
375	500307005	500307011	500014008	—	500445024
470	500357003	500357005	500014008	500018076	500445026
540	500407005	500407011	500014008	500018077	500445032
750	500607005	500607011	500014008	500018078	500445045

HOUSING KITS (EXPLODED VIEW ITEM #15)

STANDARD HOUSING KITS INCLUDE THE FRONT BEARING (#14) AND THE REAR BEARING (#16) INSTALLED IN THE HOUSING.

DESCRIPTION	HOUSING KIT	DESCRIPTION	HOUSING KIT
#F31- 4-HOLE W/O PILOT & RS 4-HOLE BOLT PTRN.	500130223	#A58- 6-HOLE SAE "A" STYLE WITH 1/2" BSP.F	500131923
#W38- WHEEL MOUNT WITH 1/2" BSP.F	500130523	#W38- WHEEL MOUNT W/ RELIEF PORT W/ 1/2" BSP.F	500133523
#A38- 4-HOLE SAE "A" STYLE WITH 1/2" BSP.F	500130623	#A38- 4-HOLE SAE "A" W/ RLF. PRT & 1/2" BSP.F	500133623
#W31- WHEEL MOUNT WITH 7/8" O-RING	500130723	#W31- WHEEL MOUNT W/ RLF. PORT & 7/8" O-RING	500133723
#A31- 4-HOLE SAE "A" STYLE WITH 7/8" O-RING	500130823	#A31- 4-HOLE SAE "A" W/ VAL. CAVITY & 7/8" O-RING	500133823
#A11- 2-HOLE SAE "A" STYLE WITH 7/8" O-RING	500131623	#A51- 6-HOLE SAE "A" W/ VAL. CAVITY & 7/8" O-RING	500134823
#A18- 2-HOLE SAE "A" STYLE WITH 1/2" BSP.F	500131723	#A58- 6-HOLE SAE "A" W/ VAL. CAVITY & 1/2" BSP.F	500134923
#A51- 6-HOLE SAE "A" STYLE WITH 7/8" O-RING	500131823		

SHAFTS AND RELATED COMPONENTS KITS

SHAFT KITS COME WITH RELATED SHAFT COMPONENTS (i.e. keys, nuts, etc.)
TO ORDER INDIVIDUAL SHAFT COMPONENTS (i.e. keys, nuts, bolts, washers or wire rings) USE THE KIT NUMBER FOR EACH INDIVIDUAL PART.

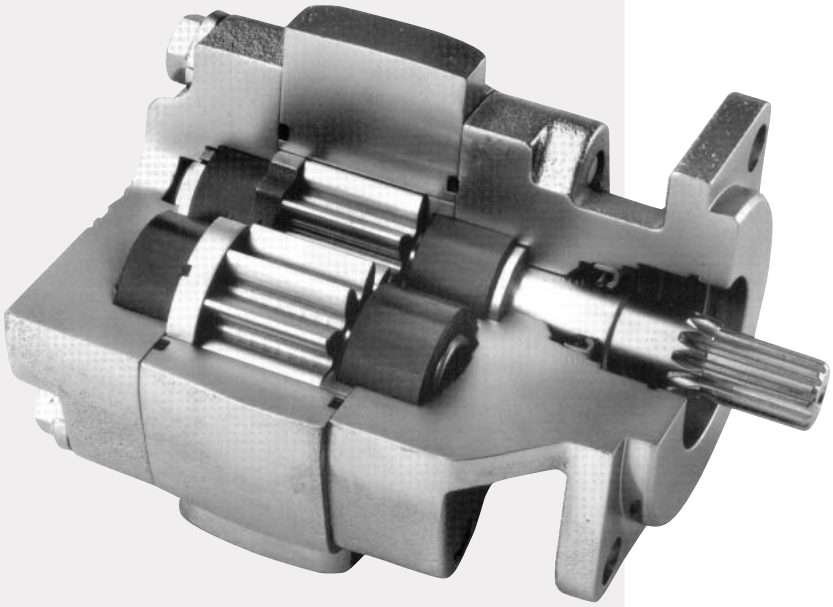
EXPLODED VIEW ITEM #	27	28	NOT SHOWN	29	30	31
DESCRIPTION	SHAFT KIT	KEY KIT	NUT KIT	BOLT KIT	WASHER KIT	WIRE RING KIT
#02- 6-B SPLINE	500011600	—		—	—	—
#22- 1-1/4" TAPERED	500011300	500449101		—	—	—
#20- 1-1/4" STRAIGHT	500011200	500449102		500449301	500449302	500449201
#23- 14 TOOTH SPLINE	500011101	—	SEE MISC.	—	—	500449201
#10- 1" STRAIGHT	500011201	500449100	KITS LIST	—	—	—
#12- 25MM STRAIGHT	500011109	500449104	ABOVE	—	—	—
#24- 19 TOOTH SPLINE	500011102	—		—	—	500449201
#21- 32MM STRAIGHT	500011203	500449103		—	—	500449201
#19- 1" STRAIGHT EXTENDED	500011202	500449100		—	—	—
#01- 13 TOOTH SPLINE	500011114	—		—	—	—
#29- 12 TOOTH SPLINE (BK)	500011116	—		—	—	—
#26- 1-1/4" STR. NON-ANNEALE	500011214	—		—	—	—

Service Manual HY09-SM020/US

Service Manual
PGP020™

Effective: July 1, 2006
Supersedes: All Others

PGP020 Series



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- Technical innovation
- Premier customer service

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We manufacture hydraulic components for a wide range of industries including:

- Construction
- Refuse/dump truck
- Material handling
- Forestry
- Agriculture
- Industrial

WARNING

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

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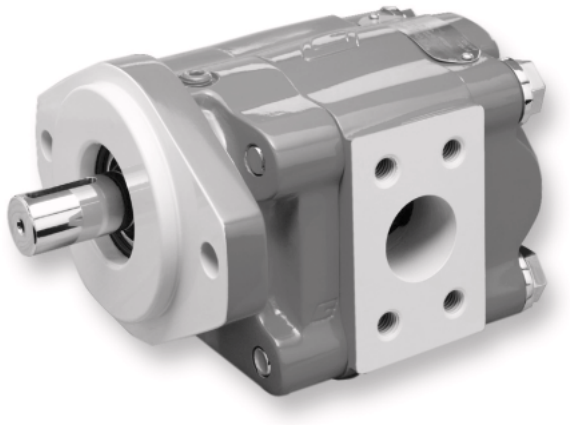
The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated in the "Offer of Sale".

Parker Hannifin Corporation
Gear Pump Division
Youngstown, Ohio USA

Index



Pump Service Instructions

General Instructions

These service instructions will:

- familiarize you with the PGP020 series roller bearing pump, its component parts and their relative position;
- show the proper methods for disassembly and assembly;
- advise appropriate care and use of this hydraulic pump.

Following these instructions can prolong the life of your pump, and help achieve optimal performance.

We recommend you read this entire set of instructions before attempting any repair.

To ensure damage did not occur during shipment, check all replacement parts closely before installation.

Cleanliness

Dirt is the enemy of any hydraulic system, so keeping equipment clean is a crucial maintenance requirement.

MAKE SURE YOU DISASSEMBLE AND ASSEMBLE YOUR HYDRAULIC EQUIPMENT IN A CLEAN AREA.

TO PREVENT PERSONAL INJURY, SAFETY GLASSES AND STEEL TOE SHOES SHOULD BE WORN.

Cautions

1) Parker replacement parts are made to original equipment standards. For assured quality of material and workmanship and for compatibility in assembly, **USE ONLY GENUINE Parker REPLACEMENT PARTS**.

2) If it becomes necessary to pry apart castings, use extreme caution not to mar or damage the machined surfaces. Excessive force while prying can result in misalignment and seriously damage parts.

3) If component assembly is difficult, do not force items and never employ an iron hammer. For a complete list of recommended tools, see Page 11.

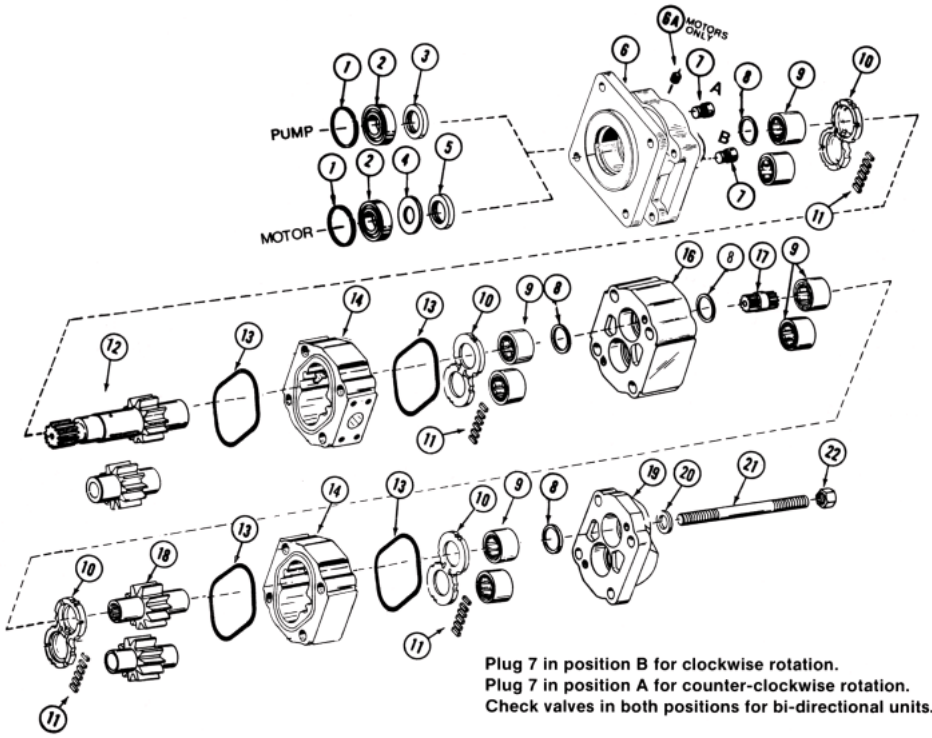
4) Gears are closely matched, therefore, they must be kept together as a set when removed from the unit. Handle with care to avoid damage to the journals, faces and teeth.

5) Never hammer roller bearings into bores. Use only an arbor press or other suitable tool.

6) It is important to airblast all parts and wipe them with a clean, lint-free cloth before assembly.

Exploded View and Parts List

Item No.	Description	Required	Ten Digit No. (TDN)
1	Snap Ring	1	391-2686-063
2	Outboard Bearing	1	391-0381-040
	Outboard Spacer	1	391-3383-069
3	Lip Seal (pump)	1	391-2883-058
4	Seal Retainer (motor)	1	391-3381-040
5	Lip Seal (motor)	1	391-2883-119
6	Shaft End Cover	1	308-50XX-XXX
6A	Drain Plug (motor)	1	391-2282-XXX
7	Check Assemblies for Motors & Bi-Rotational Pumps	2	391-3681-001
	Plugs (pumps only)	1	391-2286-004
8	Ring Seals (per gear section)	2	391-2585-006
9	Roller Bearings (per gear section)	4	391-0381-906
10	Thrust plates (motor) (per gear section)	2	391-2185-913
	Thrust plates (pump) (per gear section)	2	391-2185-913
11	Pocket Seals (per gear section)	1 strip	391-2882-022 (Viton) 391-2882-051 (Buna)
12	Drive Shaft Gear Set	1 Set	312-29XX-XXX
13	Gasket Seals (per gear section)	2	391-2884-019
14	Gear Housing	1	308-8XXX-XXX
16	Bearing Carrier	-	308-7XXX-XXX
17	Connecting Shaft	-	312-1133-001
18	Gear Set	set	312-28XX-XXX
19	Port End Cover	1	308-3XXX-XXX
20	Washers	4	391-3782-146
21	Cap Screws (single units)	4	391-1401-XXX
	Studs (multiple units)	4	391-1425-XXX
22	Nuts (multiple units)	4	391-1451-115



Plug 7 in position B for clockwise rotation.
Plug 7 in position A for counter-clockwise rotation.
Check valves in both positions for bi-directional units.

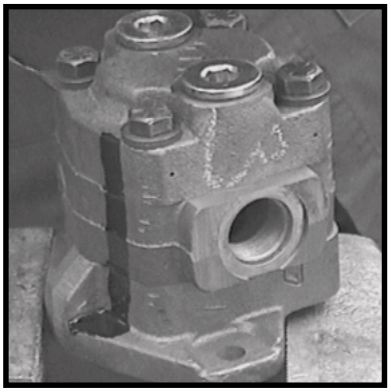
Parker Hannifin Corporation
Gear Pump Division
Youngstown, Ohio USA

PGP020™ Disassembly Instructions

STEP 1

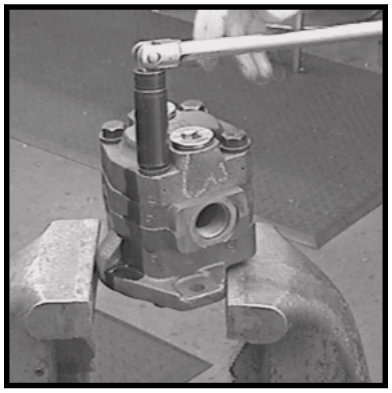
Place the pump in a vise with the drive shaft pointing down. Clamp unit on the sides of the mounting flange. Do not clamp on the pilot diameter as it may damage the sealing surface.

STEP 2



Mark each casting in the assembly with machinist ink or a prick punch to orient the castings, so that the unit can be reassembled later in the proper position.

STEP 3



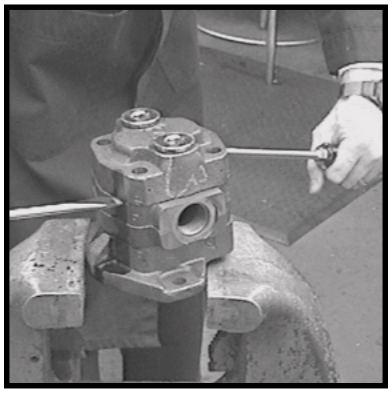
Loosen and remove the four, cap screws and washers with a 13/16” socket and wrench.

STEP 4.1

Remove the port end cover subassembly using steps 4.1 - 4.3:

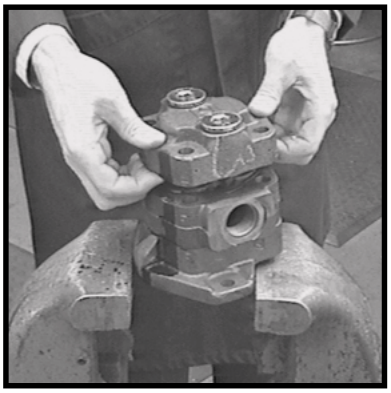
4.1 Place the point of a large, screwdriver or a chisel on the parting line between the port end cover casting and the gear housing casting. Gently tap until a slight separation between the castings is detected.

STEP 4.2



4.2 Place two, large, flat-bladed screwdrivers into the separation notches and pry up the port end cover until loose. BE CAREFUL not to nick, mar or scratch the machined casting faces.

STEP 4.3



4.3 Lift off the port end cover subassembly.

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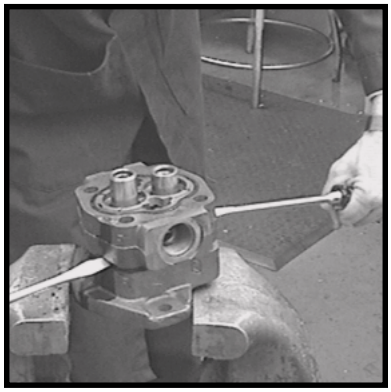
PGP020™ Disassembly Instructions

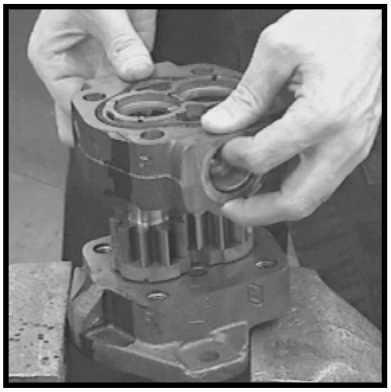
STEP 5.1



Remove the gear housing subassembly using steps 5.1 - 5.3:

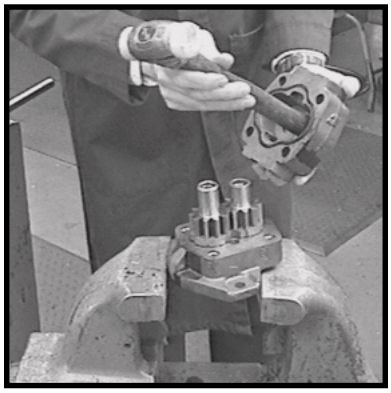
5.1 Place the two, large, flat-bladed screwdrivers into the separation notches and pry up the gear housing until loose. BE CAREFUL not to nick, mar or scratch the machined casting faces.

STEP 5.2



5.2 Lift off the gear housing subassembly.

STEP 5.3

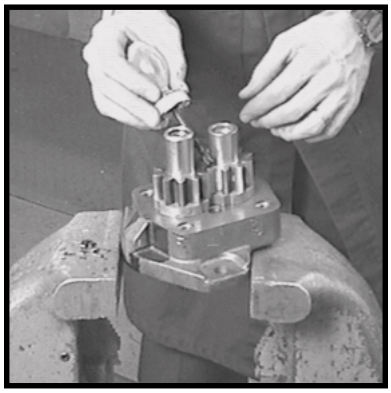


5.3 Remove the thrust plate from the housing. It may be necessary to gently tap the thrust plate with the handle of a hammer or screwdriver. Be careful not to bend or score the thrust plate. Remove and discard the six, small, rubber pocket seals from the thrust plate.

STEP 6

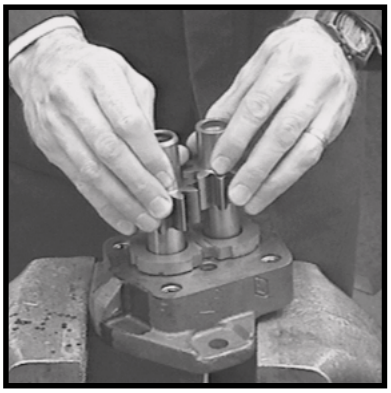
Remove and discard the rubber section seals from the top and bottom gear housing faces.

STEP 7



Wipe the gear face surface dry with a clean, lint-free cloth. Mark the teeth of the drive and driven gears (the gear set) at their mesh point with machinist ink or quick-dry marker. This is to index the gear set for proper orientation during reassembly.

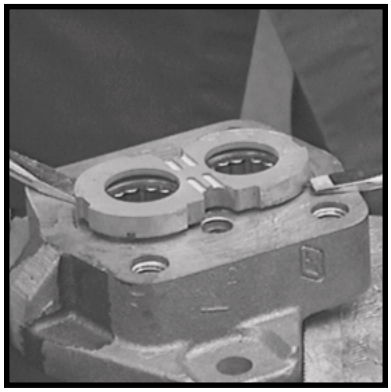
STEP 8



Remove the idler gear and the gear shaft. Keep them together as they are a matched set. Handle with care to avoid damage to the journals, faces and teeth.

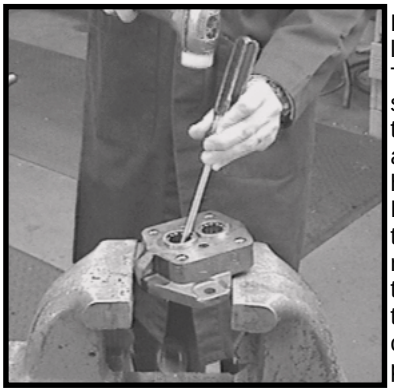
PGP020™ Disassembly Instructions

STEP 9



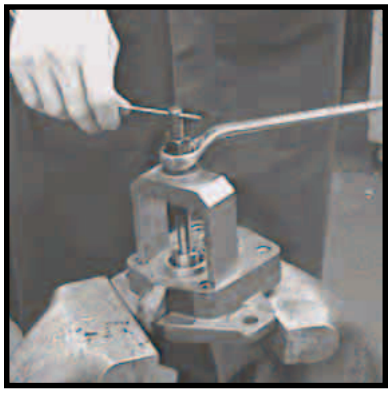
Gently lift off the thrust plate. Be careful not to bend or score the plate and mating surface of the casting. Remove and discard the six, rubber pocket seals from the back of the thrust plate.

STEP 10



Remove lip seal. Place a lip seal removal tool (see Tool List P11) or a screwdriver tip against the inside of the lip seal and tap the screwdriver handle with a hammer. Be careful not to damage the roller bearing or the ring seal with screwdriver tip. Note: If bearings are to be removed from the casting, then step can be performed after Step 12.

STEP 11

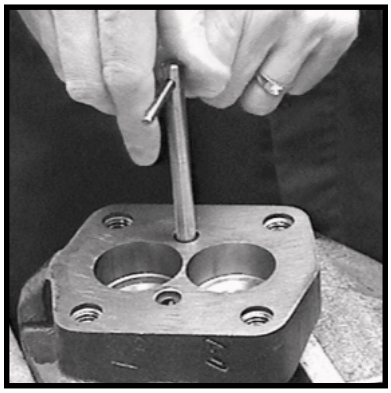


Use a bearing puller to remove the roller bearings. Note: This step is optional depending on the condition of the bearings.

STEP 12

Remove the bronze ring seal from the gear shaft bearing bore in the shaft end cover and the port end cover castings.

STEP 13



Remove the checks from the shaft end cover casting with the check tool (see Tool List on Page 11).

CAUTION: Failure to follow the recommended assembly instructions can result in poor performance or failure of the product. Product should be thoroughly tested to ensure proper operation before the unit is put back into service.

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Youngstown, Ohio USA

PGP020™ Assembly Instructions

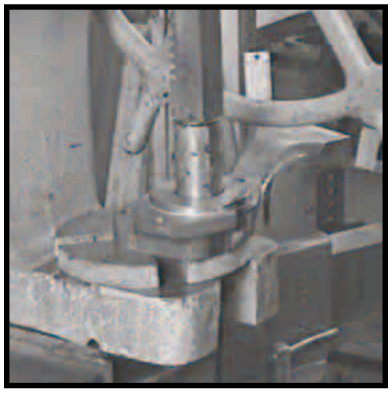
STEP 1

Stone all machined casting surfaces with a medium-grit carborundum stone. If the bearings were removed, deburr the bearing bore using a deburring tool. Rinse all parts in a solvent fluid. Air blast all parts and wipe them with a clean, lint-free cloth before starting the assembly.

STEP 2

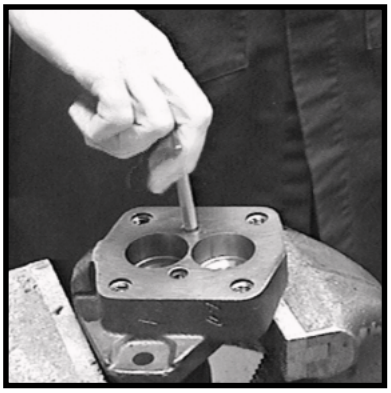
Coat the outside diameter of the lip seal with Permatex Aviation Form-A-Gasket No.3 Non-Hardening Sealant or equivalent. Be careful not to get Permatex on the inner lip of the seal as it will cause a lip seal leak.

STEP 3



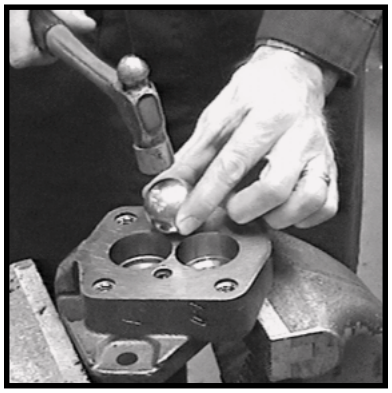
Place the shaft end cover on an arbor press with the pilot facing up. Place lip seal with the shoulder of the seal up, at the top of the seal bore. Press the lip seal into the shaft end cover with a lip seal installation bar (see Tool List on Page 11). The seal should be pressed in so it is flush with the recessed face in the shaft end cover casting.

STEP 4



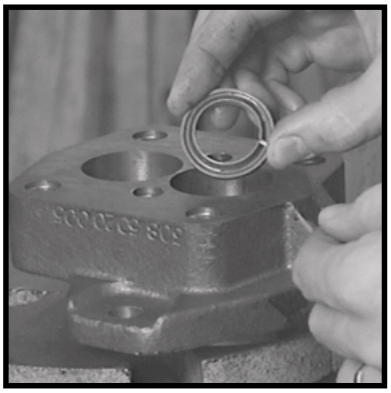
Apply Loctite® No.262 to the threaded check holes in the shaft end casting. Install the checks in the shaft end cover using the check tool (see Tool List on Page 11). The checks must bottom out in the casting.

STEP 5



Peen over the check holes in the shaft end cover with a 1½" steel ball and a hammer. This will insure the checks do not back out of the check holes during operation.

STEP 6



If the ring seals were removed from the shaft end cover or the port end cover, they should be replaced at this time. Place the ring seals in the bottom of the drive gear bearing bores. Be sure that the flat side of the ring seal is against the mating surface in the casting. Ring seals are placed behind the drive gear bearings only.

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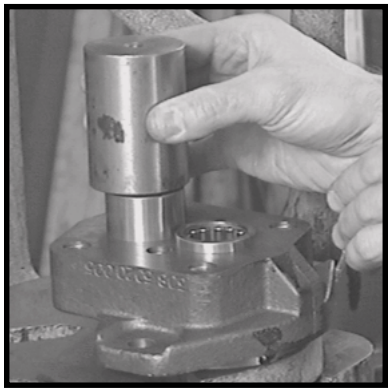
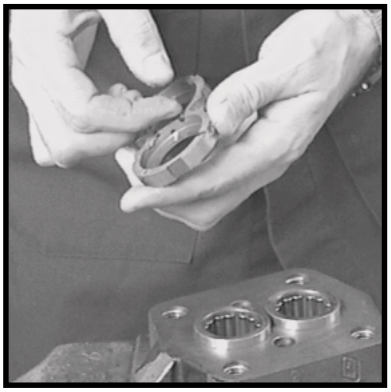
PGP020™ Assembly Instructions

STEP 7



Install the bearings in the shaft end cover and the port end cover. Use an arbor press to press the bearings into the bottom of the bearing bores. Check to make sure the ring seals move freely under the drive gear bearings.

STEP 8

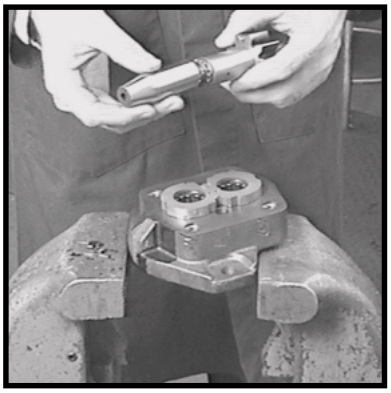


Grip the shaft end cover in a vise with the mounting face down. Cut two, pocket seals 7/32” long from the pocket seal strip. Grease the seals well and insert them into the center slots on the reverse side of the thrust plate.

STEP 9

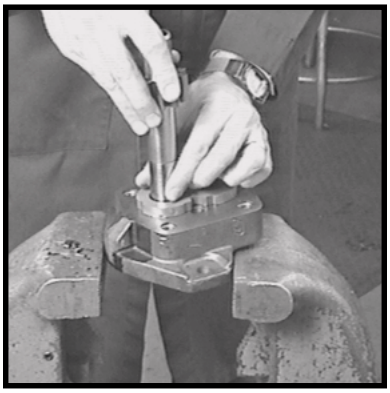
With the pocket seals facing down, place thrust plate over the bearings. Tap the thrust plate with a soft-faced hammer around the edge until the thrust plate is about 1/32” from the casting surface. Do not tap the center of the plate. Cut four pocket seals 1/4” long from the seal strip. Push a pocket seal into each of the remaining slots in the thrust plate until it touches the bearing wall. Use a razor blade to trim the exposed portion of the pocket seals. The pocket seals should be flush with the outside diameter of the plate.

STEP 10



Insert the external drive end of the gear shaft into the shaft installation sleeve (see Tool List on Page 11). Lightly grease the gear shaft and sleeve.

STEP 11



Insert the gear shaft with the shaft installation sleeve into the shaft end cover using a twisting motion. Be careful not to damage the lip seal. Push down carefully until the gear rests against the thrust plate face. Remove the shaft installation sleeve. Insert the idler gear into its bearing bore, matching the orientation marks on the teeth of the gear set as previously marked (see Step 7 on Page 5).

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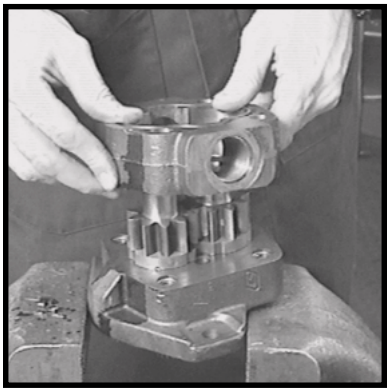
PGP020™ Assembly Instructions

STEP 12

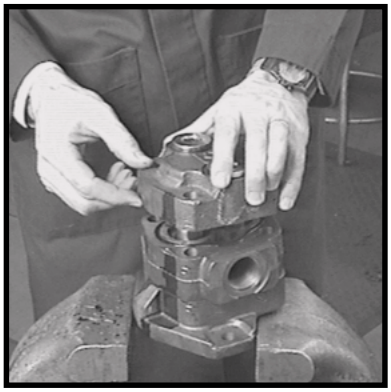
Apply a light coating of grease to the new section seals and place them into the machined grooves on both sides of the gear housing. Check the section seals for proper fit.

STEP 13



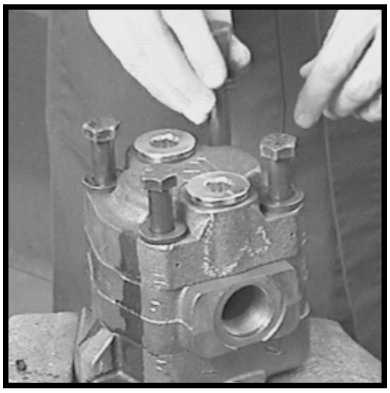
Locate the orientation mark on the gear housing and line it up with the mark on the shaft end cover. Slide the gear housing over gear set. Make sure the gear housing rests tightly against shaft end cover. Be careful not to pinch the section seal. Squirt clean, hydraulic oil over the gear shaft and the idler gear to provide initial lubrication when the pump is started.

STEP 14



Insert the pocket seals into the thrust plate and install onto the port end cover following the previous instructions in steps 8 & 9. Then place port end cover over the gear journals. The orientation mark on port end cover must line up with the mark on the gear housing. Also, be sure bearing bore holding the ring seal goes over the drive gear journal. Apply pressure to the casting with your hand or tap lightly with a soft-faced hammer until the port end cover rests tightly against the gear housing.

STEP 15

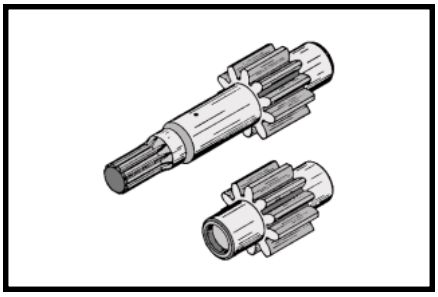


Thread the four, cap screws with the washers into the shaft end cover and tighten them in a cross-corner pattern. Rotate the gear shaft of the pump with a 6” wrench to make certain there is no binding in the pump.

STEP 16

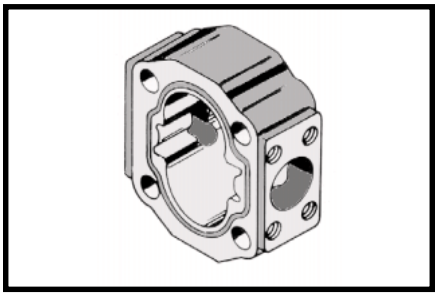
After the cap screws are tightened, make certain there is no internal binding of the gear set by rotating the gear shaft, then tighten the cap screws in a cross-corner pattern to a final torque of 2400 in. lbs. (200 ft. lbs.).

Part Replacement Guide



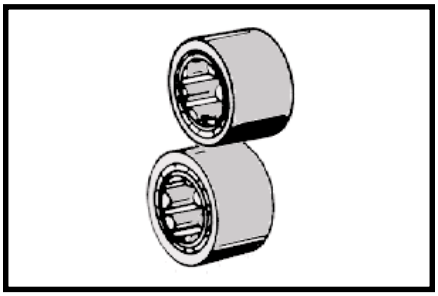
If the gear set contains any of the following defects, it should be replaced:

- Wear on the hubs or in the seal areas detectable by touch or in excess of .002”.
- Score marks, grooves or burrs on the outside diameter of the teeth.
- Nicks, grooves or fretting of the teeth surfaces.
- Wear or damage to the drive spline, key or keyway.

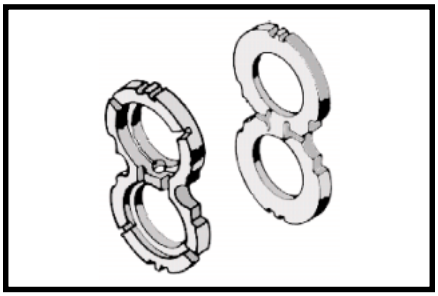


Wear in excess of .005” cut-out necessitates replacement of the gear housing. Place a straight-edge across the bore. If you can slip a .005” feeler gage in the cut-out area, replace the gear housing.

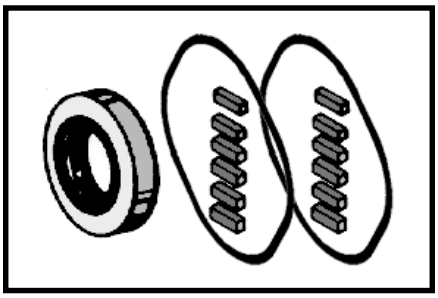
Where the cut-out is moderate, .005” or less, the gear housing is still in good condition. If the housing has equal size ports or no ports, the housing may be rotated 180°, exchanging ports, and reused.



If the gears are replaced, then the bearings must be replaced also. Bearings should fit into the bores with a light press fit.



Any scratches, grooves, erosion or pitting on the thrust plate face, which is the area that comes in contact with the gear faces, requires the replacement of the thrust plates.



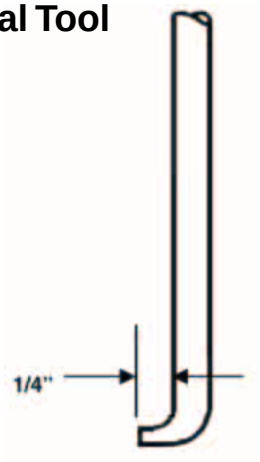
Replace all rubber and polymer seals whenever reassembling the pump. This includes lip seal, pocket seal strips and section seals.

Tool List

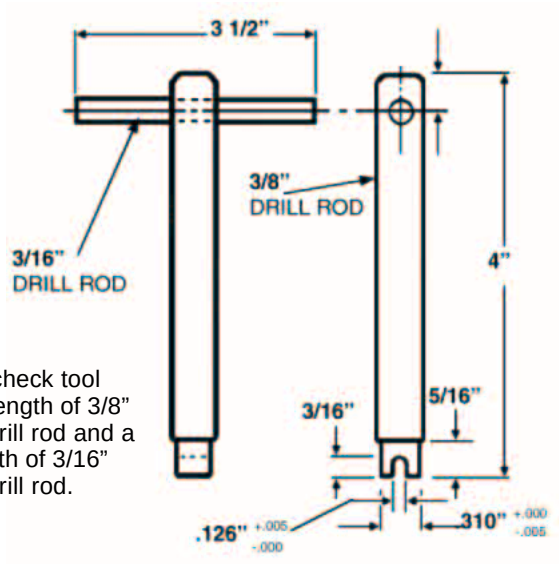
- Arbor press
- Permanent marker or an awl
- Bearing puller (Owatonna Tool Co. MD-956 or equivalent)
- Clean, lint-free cloths
- Deburring tool (a file with the cutting teeth ground off)
- Machinist hammer
- Soft-faced hammer
- Permatex Aviation Form-A-Gasket No.3 Non-hardening Sealant or equivalent
- Medium-grit carborundum stone
- Hydraulic oil and grease
- Prick punch or machinists ink
- Sharp, razor blade
- Scale (1/32” or 1/64” graduations)
- Feeler gauges
- Small, flat-head screwdriver
- Large, flat-headed screwdrivers
- Torque wrench
- 13/16” socket
- 1½” steel ball
- Loctite® No.262
- Vise with a 6” minimum open spread
- Lip seal installation bar (1 3/4” X 2”)
- Shaft installation sleeve (steel)
- Lip seal removal tool
- Check tool
- 6” wrench

Lip Seal Removal Tool

A seal removal tool can be made easily from an old screwdriver. Heat the tip and bend as shown. Grind off the tip to fit the notch behind the lip seal.

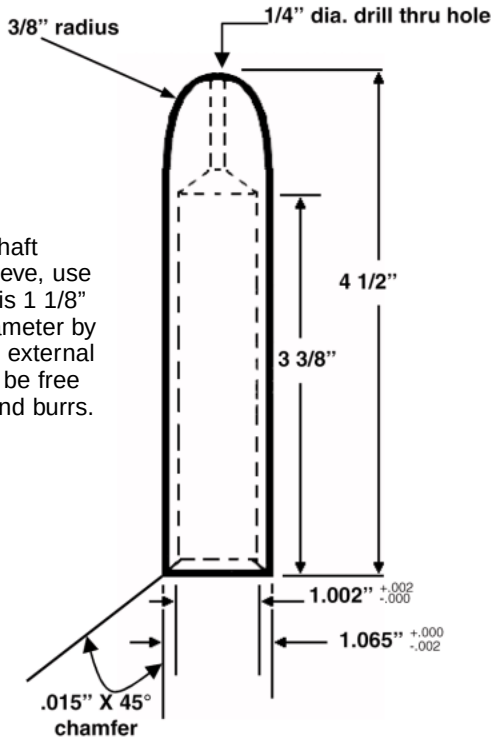


Check Tool



Make the check tool from a 4” length of 3/8” diameter drill rod and a 3 1/2” length of 3/16” diameter drill rod.

Shaft Installation Sleeve (Steel)



To make the shaft installation sleeve, use bar stock that is 1 1/8” or 1 1/4” in diameter by 4 5/8” long. All external surfaces must be free of scratches and burrs.

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Lubrication and Oil Recommendations

All parts, with the exception of the outboard bearing, are lubricated by the hydraulic oil in the circuit. Particular attention must be paid to keep the oil in the system clean. Whenever there is a pump or motor failure and there is reason to suspect that metal particles may be in the system, the oil must be drained, the entire system flushed clean and any filter screens thoroughly cleaned or replaced. New oil should be supplied for the entire system. Oil suitable and recommended for use in circuits involving Commercial Hydraulics' pumps and motors should meet the following specifications:

Viscosity:
- 50 SSU minimum @ operating temperature
  7500 SSU maximum @ starting temperature
- 150 to 225 SSU @ 100º F (37.8º C) (generally)
  44 to 48 SSU @ 210º F (98.9º C) (generally)

Approximate SSU at . . .		
Oil Grade	**100 F (37. 8° C)**	**210° F (98.9° C)**
SAE 10	150	43
SAE 20	330	51

Viscosity Index: 90 minimum

Aniline Point: 175 minimum

Recommended Additives: Foam Depressant
Rust and Oxidation Inhibitors

Other Desirable Characteristics:
- Stability of physical and chemical characteristics.
- High demulsibility (low emulsibility) for separation of water, air and contaminants.
- Resistant to the formation of gums, sludges, acids, tars and varnishes.
- High lubricity and film strength.

General Recommendations:

A good-quality, hydraulic oil conforming to the characteristics listed above is essential to the satisfactory performance and long life of any hydraulic system.

Oil should be changed on a regular schedule in accordance with the equipment manufacturer's recommendations, and the system should be periodically flushed.

Oil temperature in reservoir must not exceed 200º F (93.3º C) with a maximum temperature of 180º F (82.2º C) recommended. Higher temperatures will result in rapid oil deterioration.

Reservoir capacity should equal in gallons the pump output in gpm or the total gpm of all pumps where there is more than one in the system.

Normal Temperatures: 0º F (-18º C) to 100º F (37.8º C) Ambient
100º F (37.8º C) to 180º F (82.2º C) System
Be sure your oil is suitable for the temperatures you expect to encounter.

Cold Weather Operation:

Oils for use in cold weather should have a viscosity that does not exceed 7500 SSU at the minimum start-up temperature. A pour point of at least 20º F below start-up temperature is recommended. Start-up procedures should allow for a gradual warm-up until the oil reaches a reasonably fluid state.

Lubrication and Oil Recommendations

The Use of Other Oils:

- Diesel Fuel or Kerosene (Coal Oil): These are sometimes used as dilutants for cold weather operations but are not recommended as they are not sufficiently refined products.
- Fire-Resistant Fluids: Of the several different types, only the inverted emulsion types may be used without switching to a special seal, packing, gasket, hose, etc., compositions. Their use may substantially reduce pump life. Experience indicates that the use of fire-resistant fluids can be disastrous unless certain precautions are followed. **DO NOT USE ANY FIRE RESISTANT FLUIDS OR NON-PETROLEUM OILS WITHOUT CONSULTING OUR PRODUCT SUPPORT DEPARTMENT.**
- These suggestions are intended as a guide only. **OBTAIN YOUR FINAL OIL RECOMMENDATIONS FROM YOUR OIL SUPPLIER.**

Recommended Start-up Procedure for New or Rebuilt Pump or Motor

Before installing a new or a rebuilt pump or motor, back out the main relief valve until the spring tension on the adjusting screw is relaxed. This will avoid the possibility of immediate damage to the replacement unit in the event that the relief valve setting had been increased beyond the recommended operating pressure prior to removing the old unit.

Before connecting any lines to the pump or to the motor, fill all ports with clean oil to provide initial lubrication. This is particularly important when the unit is located above the oil reservoir.

After connecting the lines and mounting the replacement unit, operate the pump or the motor for at least two minutes at zero pressure at the lowest possible rpm. During this break-in period, the unit should run free and not develop an excessive amount of heat. If the unit operates properly, the speed and the pressure can then be increased to the normal operating settings.

Reset the main relief valve to its proper setting while the pump is running at the maximum operating engine (motor) speed for the vehicle.

ALWAYS USE AN ACCURATE GAGE WHEN ADJUSTING THE RELIEF VALVE PRESSURE SETTING.

Test Procedure Recommended

Be sure there is an adequate supply of oil for the pump; at least one gallon of oil for each gpm of pump capacity.

If one section of a tandem pump is being tested, make sure all other sections which are not being tested, are adequately supplied with oil. If any of the other sections run dry or if plugs are left in ports, serious and permanent damage will result.

The oil should be a good-quality, hydraulic oil rated at 150 SSU at 100º F with the oil temperature held at 120º F plus or minus 5º F. (Test procedures are described in detail in SAE handbooks; see Hydraulic Power Pump Test Procedure SAE J745c.)

The inlet line must be an adequate size with no more than 5" mercury vacuum adjacent to the pump inlet. As a rule, the inlet line must provide an inlet flow velocity that is not in excess of 8 feet per second.

Hot oil drawn into a cold pump could cause it to seize. Switching the pump on and off in short bursts could help prevent seizure.

Operate the pump at least two minutes at zero pressure and at moderate speed (not over 1500 rpm).

If pump becomes hot to touch, it is binding and could seize. This rarely occurs, but if it does, the pump will have to be disassembled and be rebuilt, taking extra care to remove burrs and to assure freedom from binding.

Gradually increase the pressure on a pump until the desired test pressure has been reached. This should take about five minutes.

Delivery should run close to the rated, catalog performance figures which are averaged from the testing of several pumps. A 5% lower reading may be used as a rated minimum, if new or relatively new parts have been used. When rebuilding the pump, reuse only those parts which appear to be in satisfactory condition. A 10% or 15% lower reading is permitted for the rebuilt pump, depending upon the performance expected from the equipment. Your individual experience is the best guide.

Many repairmen measure the output at the normal operating speed, at zero pressure, then at 1000 psi (or the operating pressure of the equipment), and allow a volume decrease approximating the listing below. The table listing shows the drop off in flow that can be expected at various operating pressures for a pump rebuilt with used parts.

PGP020 pumps are generally tested to 2000 psi.

GPM Delivery at 1800rpm	**GPM Drop Off At...**			
100 psi	**1000 psi/70 bar**	**1500 psi/105 bar**	**2000 psi/140 bar**	**2500 psi/175 bar**
5 - 14	2 to 3	21/2 - 31/2	3 to 4	31/2 - 41/2
15 - 25	21/2 to 31/2	3 - 4	31/2 to 5	4 - 51/2
26 - 50	3 to 4	4 - 5	4 to 6	41/2 - 61/2

At test speeds other than 1800 rpm, gpm delivery will vary almost proportionately, but the same (drop-off) figures should be used.

Be sure to run the pump in the direction for which it was designed and built. Driving the pump in the wrong direction will build up pressure behind the lip seal, causing damage to the pump and necessitating its replacement.

Since it is rarely feasible to test motors on dynamometers, the practical procedure is to test them as pumps, running complete testing procedures in each direction.

After completing the testing procedures, the pump is ready for installation and immediate duty operation on equipment. It must be reinforced that to prevent seizure, hot oil must not be drawn into a cold pump.

Instructions for Change of Rotation

The PGP020 series pump can be assembled for clockwise (CW), counterclockwise (CCW), or bi-rotational operation. The direction of rotation is determined by looking at the pump with the drive shaft facing you and the idler gear down. If the pump has unequal porting and the larger port is on the left side, then the pump is set up for CW operation. If the larger port is on the right side of the pump, then it is set up for CCW operation. Bi-rotational pumps that can be run in either direction, will have equal size ports.

DISASSEMBLY

1 If the unit has a keyed shaft, remove the key.

2) Clamp the unit in a vise on the outside diameter of the mounting flange with the drive shaft down.

3) Remove the cap screws on single units or hex nuts and studs on multiple units.

4) Remove the port (rear) end cover.

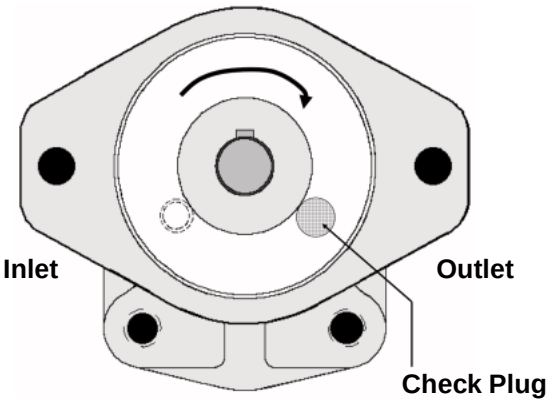
5) Remove the gear housing and the gear set. Keep the gears together because they are a matched set.

   For multiple units: Remove the bearing carrier and the next gear housing and gear set until all that remains is the shaft end cover.

Note: Care should be taken to avoid losing the small, rubber pocket seals fitted in the thrust plate pocket seal grooves.

6) Lift the thrust plate off of the shaft end cover. Do not lose the pocket seals.

7) Remove the check plug in the shaft end cover with a screwdriver and then install it in the opposite drain hole. Screw in tightly and stake the check plug with a punch at both edges of the screwdriver slot. For a single-rotation pump, the check plug is always located on the high pressure (outlet) side of the pump. If the shaft end cover has two check plugs, the pump is already set-up for double rotation.



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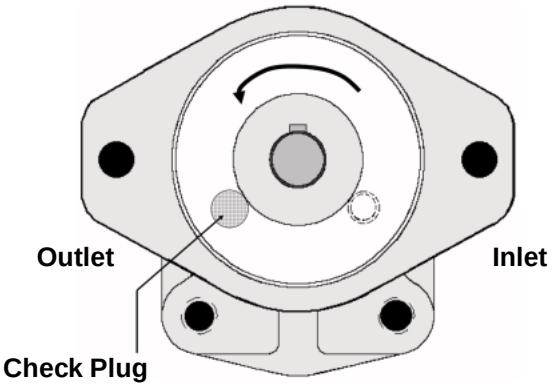

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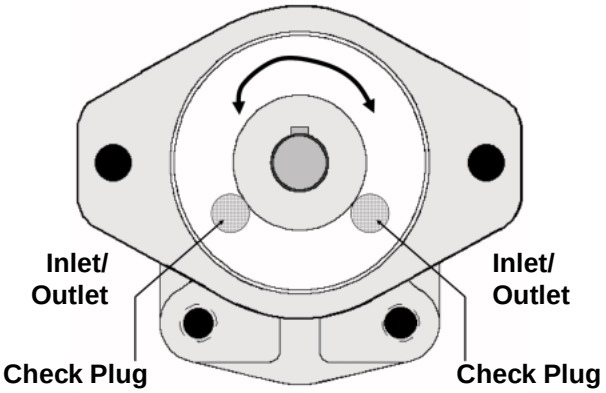


Bi-rotational

Parker Hannifin Corporation
Gear Pump Division
Youngstown, Ohio USA

ASSEMBLY

1) Before assembling the unit, stone off the machined surfaces. This will remove any nicks or burrs that may have resulted from the disassembly.

2) Air blast all parts and wipe them with a clean, lint-free cloth before starting the assembly.

Note: PGP020 series thrust plates are designed for bi-rotational operation and do not have to be rotated.

3) Place one thrust plate with pocket seals over the shaft end cover bearings. Be sure the pocket seals are properly fitted in the thrust plate pocket seal grooves.

4) Insert the gear shaft with the shaft installation sleeve into the shaft end cover with a twisting motion. Insert the idler gear.

5) Rotate the gear housing 180° and carefully slide over the gear set. Make sure both section seals stay in the seal grooves during assembly. Keep the drive gear and idler gear in the same gear bore as previously marked.

6) For multiple units: Place the thrust plates with pocket seals over the bearings on both sides of the bearing carrier. Be sure the pocket seals are properly fitted in the thrust plate pocket seal grooves.

7) Rotate the bearing carrier 180° and install over the gear set and gear housing.

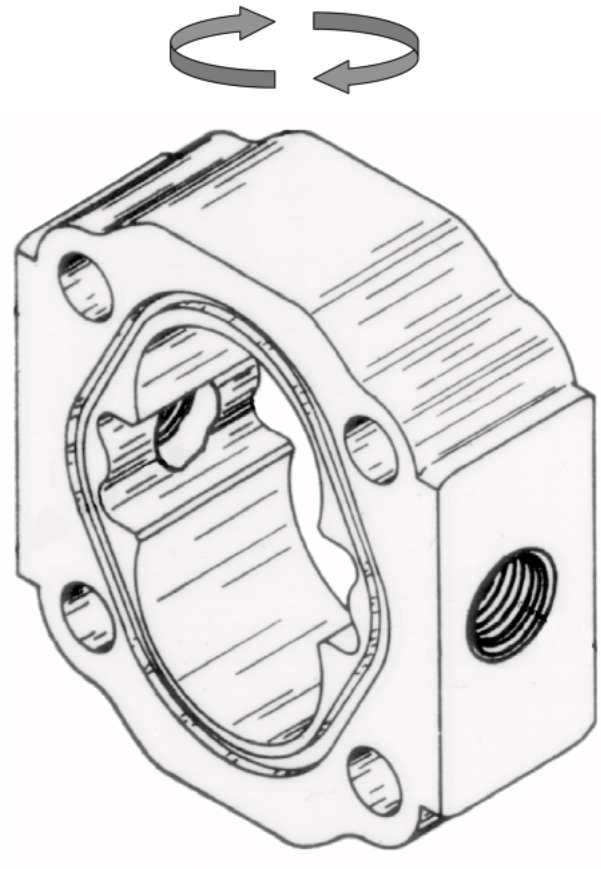
Note: If the bearing carrier has an L-shaped porting configuration, it cannot be used. A new bearing carrier will have to be machined with the proper configuration.

8) Insert the gears into the bearing carrier.

9) Rotate the gear housing 180° and carefully slide over the gear set. Make sure both section seals stay in the seal grooves during assembly.

10) Place the port end cover with the thrust plate over the gear set. If the port end cover is ported, it must be inverted.

11) Insert the cap screws or the studs into the unit and torque in a cross-corner pattern to 2400 in. lbs (200 ft. lbs).



Gear Housing

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Gear Pump Division
Youngstown, Ohio USA

Notes

Parker Hannifin Corporation
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Youngstown, Ohio USA

Notes

Parker Hannifin Corporation
Gear Pump Division
Youngstown, Ohio USA

Offer of Sale

The items described in this document are hereby offered for sale at prices to be established by Parker Hannifin Corporation, its subsidiaries and its authorized distributors. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Parker Hannifin Corporation, its subsidiary or an authorized distributor ("Seller") verbally or in writing, shall constitute acceptance of this offer.

1. Terms and Conditions of Sale: All descriptions, quotations, proposals, offers, acknowledgments, acceptances and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions stated herein. Buyer's acceptance of any offer to sell is limited to these terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to. No such additional, different or inconsistent terms and conditions shall become part of the contract between Buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditional upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer. Acceptance of Seller's products shall in all events constitute such assent.

2. Payment: Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.

3. Delivery: Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

4. Warranty: Seller warrants that the item sold hereunder shall be free from defects in material or workmanship for a period of 547 days from the date of shipment to Buyer, or 3,000 hours of use, whichever expires first. **THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED.**

NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRANTIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY, TO BUYERS DESIGNS OR SPECIFICATIONS.

5. Limitation of Remedy: SELLER'S LIABILITY ARISING FROM OR IN ANY WAY CONNECTED WITH THE ITEMS SOLD OR THIS CONTRACT SHALL BE LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE ITEMS SOLD OR REFUND OF THE PURCHASE PRICE PAID BY BUYER, AT SELLER'S SOLE OPTION IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL OR SEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS ARISING FROM OR IN ANY WAY CONNECTED WITH THIS AGREEMENT OR ITEM SOLD HEREUNDER, WHETHER ALLEGED TO ARISE FROM BREACH OF CONTRACT, EXPRESS OR IMPLIED WARRANTY, OR IN TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, FAILURE TO WARN OR STRICT LIABILITY.

6. Changes, Reschedules and Cancellations: Buyer may request to modify the designs or specifications for the items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

7. Special Tooling: A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

8. Buyer's Property: Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Taxes: Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

10. Indemnity For Infringement of Intellectual Property Rights: Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets (hereinafter 'Intellectual Property Rights'). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said time so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgments resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

11. Force Majeure: Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter 'Events of Force Majeure'). Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carriers or suppliers, shortages of materials and any other cause beyond Seller's control.

12. Entire Agreement/Governing Law: The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

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Fax: (216) 896-4000
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Parker Hannifin Corporation

About Parker Hannifin Corporation

Parker Hannifin is a leading global motion-control company dedicated to delivering premier customer service. A Fortune 500 corporation listed on the New York Stock Exchange (PH), our components and systems comprise over 1,400 product lines that control motion in some 1,000 industrial and aerospace markets. Parker is the only manufacturer to offer its customers a choice of hydraulic, pneumatic, and electromechanical motion-control solutions. Our Company has the largest distribution network in its field, with over 7,500 distributors serving more than 350,000 customers worldwide.

Parker's Charter

To be a leading worldwide manufacturer of components and systems for the builders and users of durable goods. More specifically, we will design, market and manufacture products controlling motion, flow and pressure. We will achieve profitable growth through premier customer service.

Product Information

North American customers seeking product information, the location of a nearby distributor, or repair services will receive prompt attention by calling the Parker Product Information Center at our toll-free number: 1-800-C-PARKER (1-800-272-7537). In the UK, a similar service is available by calling 0500-103-203.

The Aerospace Group is a leader in the development, design, manufacture and servicing of control systems and components for aerospace and related high-technology markets, while achieving growth through premier customer service.

The Climate & Industrial Controls Group designs, manufactures and markets system-control and fluid-handling components and systems to refrigeration, air-conditioning and industrial customers worldwide.

The Fluid Connectors Group designs, manufactures and markets rigid and flexible connectors, and associated products used in pneumatic and fluid systems.

The Seal Group designs, manufactures and distributes industrial and commercial sealing devices and related products by providing superior quality and total customer satisfaction.

The Hydraulics Group designs, produces and markets a full spectrum of hydraulic compnents and systems to builders and users of industrial and mobile machinery and equipment.

The Filtration Group designs, manufactures and markets quality filtration and clarification products, providing customers with the best value, quality, technical support, and global availability.

The Automation Group is a leading supplier of pneu-matic and electro-mechanical components and systems to automation customers worldwide.

The Instrumentation Group is a global leader in the design, manufacture and distribution of high-quality critical flow components for worldwide processinstrumentation, ultra-high-purity, medical and analytical applications.

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http://www.parker.com/gearpump

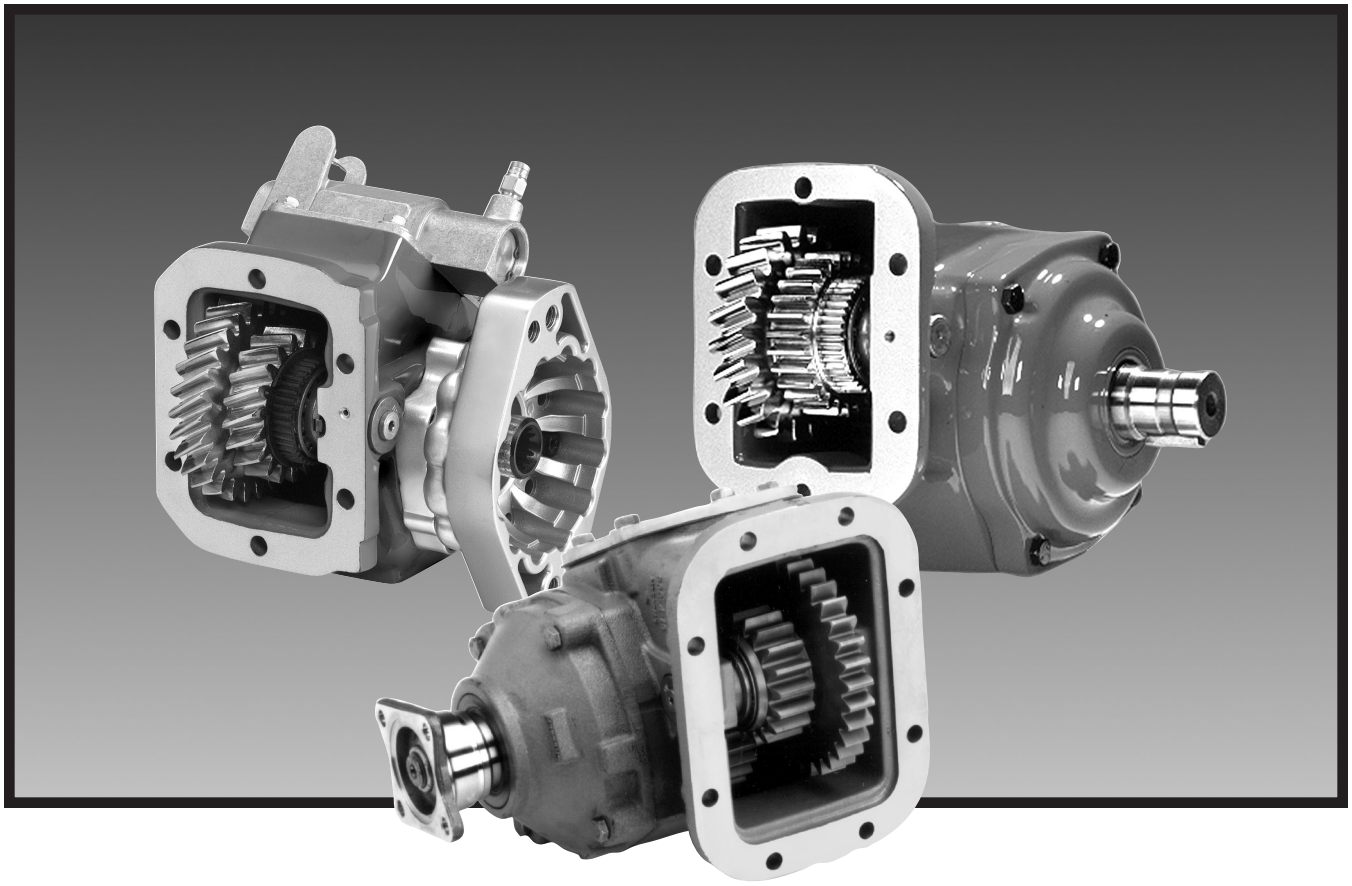
Service Manual
HY09-SM020/US
2.5M, 07/06, T&M

CHELSEA®

Bulletin HY25-1380-M1/US

Owner's Manual
Power Take-Offs

Effective: April 2008
Supersedes: HY25-1380-M1/US March 2008



267 Series
269 Series
277 Series
278 Series
859 Series
867 Series

Parker

⚠ WARNING

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

Offer of Sale

The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated in the "Offer of Sale".

Patent Information

The Chelsea® Power Take-Off or its components shipped with this owner's manual may be manufactured under one or more of the following U.S. patents:
4610175 5228355 4597301 5645363 6151975 6142274 6260682 7159701 B2
Other patents pending.

Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

Continued on Next Page

Parker Hannifin Corporation
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Safety Information

These instructions are for your safety and the safety of the end user. Read them carefully until you understand them.

General Safety Information

To prevent injury to yourself and/or damage to the equipment:

- Read carefully all owner's manuals, service manuals, and/or other instructions.
- Always follow proper procedures, and use proper tools and safety equipment.
- Be sure to receive proper training.
- Never work alone while under a vehicle or while repairing or maintaining equipment.
- Always use proper components in applications for which they are approved.
- Be sure to assemble components properly.
- Never use wornout or damaged components.
- Always block any raised or moving device that may injure a person working on or under a vehicle.
- Never operate the controls of the Power Take-Off or other driven equipment from any position that could result in getting caught in the moving machinery.

Proper Matching of P.T.O.

WARNING: A Power Take-Off must be properly matched to the vehicle transmission and to the auxiliary equipment being powered. An improperly matched Power Take-Off could cause severe damage to the vehicle transmission, the auxiliary driveshaft, and/or to the auxiliary equipment being powered. **Damaged components or equipment could malfunction causing serious personal injury to the vehicle operator or to others nearby.**

To avoid personal injury and/or equipment damage:

- Always refer to Chelsea catalogs, literature, and owner's manuals. Follow Chelsea recommendations when selecting, installing, repairing, or operating a Power Take-Off.
- Never attempt to use a Power Take-Off not specifically recommended by Chelsea for the vehicle transmission.
- Always match the Power Take-Off's specified output capabilities to the requirements of the equipment to be powered.
- Never use a Power Take-Off whose range of speed could exceed the maximum.

Cold Weather Operation of Powershift P.T.O.

WARNING: During extreme cold weather operation [32°F (0°C) and lower], a disengaged Powershift Power Take-Off can momentarily transmit high torque that will cause unexpected output shaft rotation. This is caused by the high viscosity of the transmission oil when it is extremely cold. As slippage occurs between the Power Take-Off clutch plates, the oil will rapidly heat up and the viscous drag will quickly decrease.

The Power Take-Off output shaft rotation could cause unexpected movement of the driven equipment resulting in serious personal injury, death, or equipment damage.

To avoid personal injury or equipment damage:

- Driven equipment must have separate controls.
- The driven equipment must be left in the disengaged position when not in operation.
- Do not operate the driven equipment until the vehicle is allowed to warm up.

This symbol warns of possible personal injury.

Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

Safety Information (Continued)

Rotating Auxiliary Driveshafts

WARNING:

- Rotating auxiliary driveshafts are dangerous. You can snag clothes, skin, hair, hands, etc. This can cause serious injury or death.
- Do not go under the vehicle when the engine is running.
- Do not work on or near an exposed shaft when the engine is running.
- Shut off the engine before working on the Power Take-Off or driven equipment.
- Exposed rotating driveshafts must be guarded.

Guarding Auxiliary Driveshafts

WARNING: We strongly recommend that a Power Take-Off and a directly mounted pump be used to eliminate the auxiliary driveshaft whenever possible. If an auxiliary driveshaft is used and remains exposed after installation, it is the responsibility of the vehicle designer and P.T.O. installer to install a guard.

Using Set Screws

WARNING: Auxiliary driveshafts may be installed with either recessed or protruding set screws. If you choose a square head set screw, you should be aware that it will protrude above the hub of the yoke and may be a point where clothes, skin, hair, hands, etc. could be snagged. A socket head set screw, which may not protrude above the hub of the yoke, does not permit the same amount of torquing as does a square head set screw. Also, a square head set screw, if used with a lock wire, will prevent loosening of the screw caused by vibration. Regardless of the choice made with respect to a set screw, an exposed rotating auxiliary driveshaft must be guarded.

Important: Safety Information and Owner's Manual

Chelsea Power Take-Offs are packaged with safety information decals, instructions, and an owner's manual. These items are located in the envelope with the P.T.O. mounting gaskets. Also, safety information and installation instructions are packaged with some individual parts and kits. **Be sure to read the owner's manual before installing or operating the P.T.O.** Always install the safety information decals according to the instructions provided. Place the owner's manual in the vehicle glove compartment.

WARNING: Operating the P.T.O. with the Vehicle in Motion

Some Power Take-Offs may be operated when the vehicle is in motion. To do so, the P.T.O. must have been properly selected to operate at highway speeds and correctly matched to the vehicle transmission and the requirements of the driven equipment.

If in doubt about the P.T.O. specifications and capabilities, avoid operating the P.T.O. when the vehicle is in motion. Improper application and/or operation can cause serious personal injury or premature failure of the vehicle, the driven equipment, and/or the P.T.O.

Always remember to disengage the P.T.O. when the driven equipment is not in operation.

Pump Installation Precautions

Use a bracket to support the pump to the transmission if:

- The pump weighs **40 pounds [18.4 kg]** or more.
- The combined length of the P.T.O. and pump is **18 inches [45.72 cm]** or more from the P.T.O. centerline to the end of the pump.

This symbol warns of possible personal injury.

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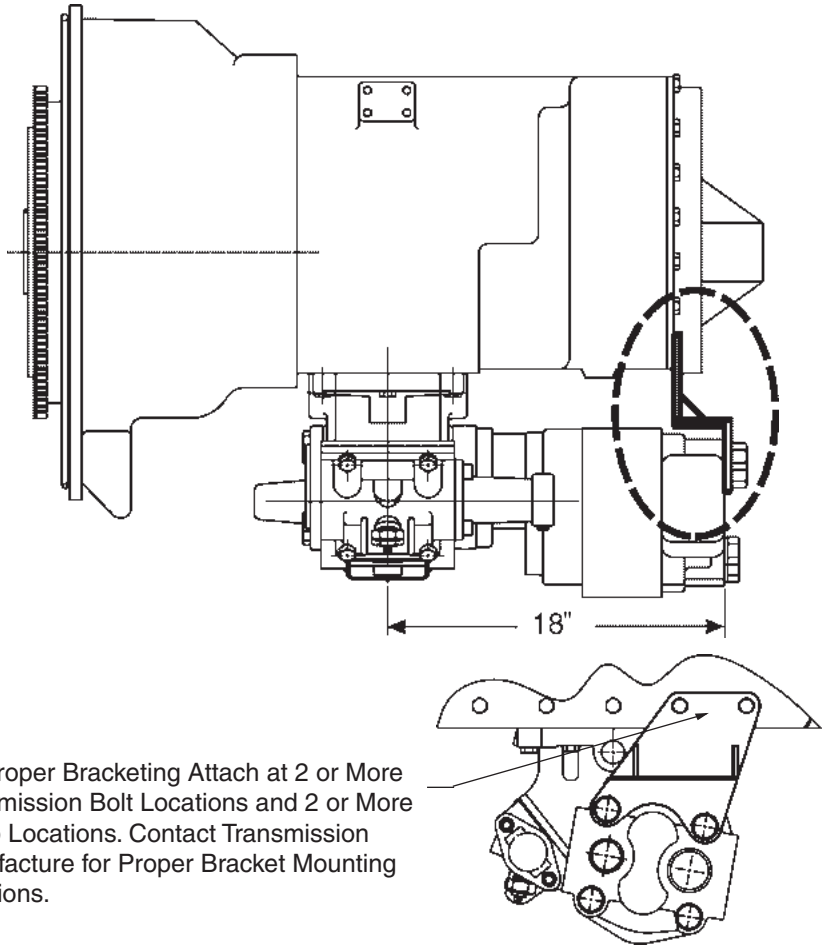
Olive Branch, MS 38654 USA

Direct Mount Pump Support Recommendations



NOTE: For Proper Bracketing Attach at 2 or More Transmission Bolt Locations and 2 or More Pump Locations. Contact Transmission Manufacture for Proper Bracket Mounting Locations.

Use caution to ensure that bracket does not pre-load pump/P.T.O. mounting

Chelsea strongly recommends the use of pump supports (Support Brackets) in all applications. P.T.O. warranty will be void if a pump bracket is not used when:

1) The combined weight of pump, fittings and hose exceed **40 pounds [18.14 kg]**.
2) The combined length of the P.T.O. and pump is **18 inches [45.72 cm]** or more from the P.T.O. centerline to the end of the pump.

ALSO: Remember to pack the female pilot of the P.T.O. pump shaft with grease before installing the pump on the P.T.O. (reference Chelsea grease pack 379688)

This symbol warns of possible personal injury.

Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

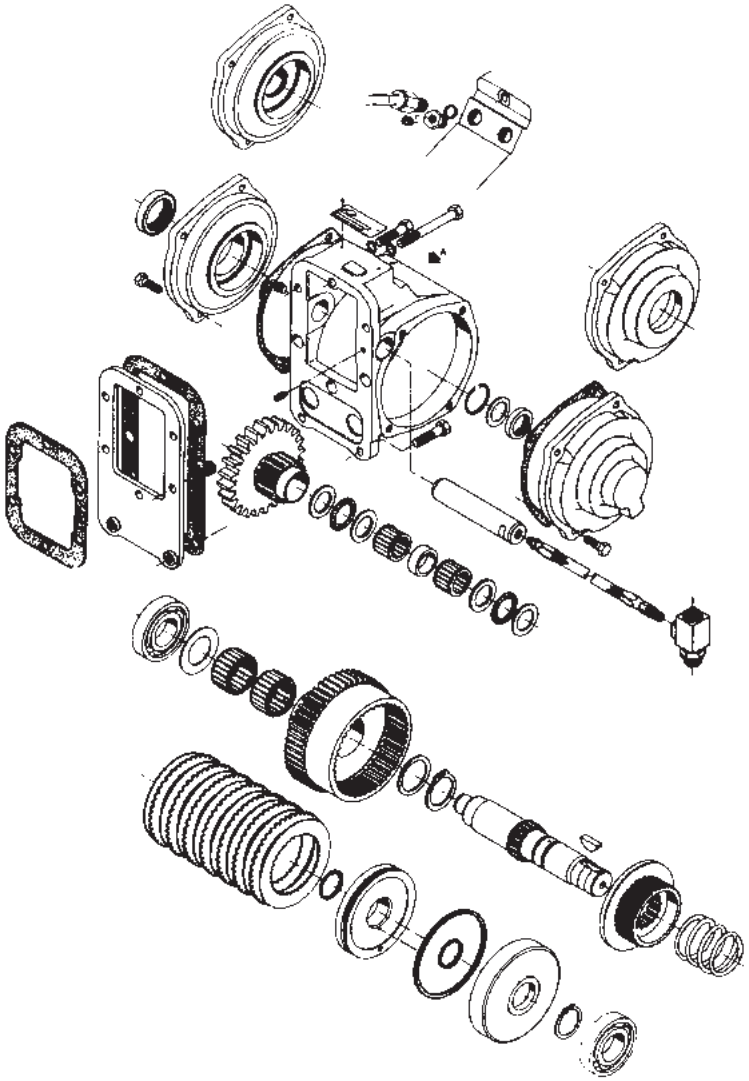
Foreword

Since our major objective is to show you how to get additional and more profitable miles from truck, tractor and trailer components, we want to provide you with information on the installation of Chelsea Power Take-Offs.

We all realize that an inadequate transmission will overwork any Power Take-Off in a very short period of time. In addition, a mismatched transmission/P.T.O. combination can result in unsatisfactory performance of the equipment right from the start.

Before you order new trucks, be sure you're getting the right transmission/P.T.O. combination. It is of vital importance for efficient performance to have adequate power. To help you select the proper type, size and design of P.T.O. it is advisable to discuss your specific requirements with Chelsea P.T.O. specialists. They know their products and have easy access to manufacturers of equipment, transmissions and Power Take-Offs. They can inform you about everything you need to know about power, at the right time, before you specify components.

Exploded View of a Typical Powershift P.T.O.



Chelsea P.T.O. Safety Label Instructions

1. The two black and orange on white 5" x 7" pressure sensitive vinyl labels, part number 379274; must be placed on the vehicle frame rails (one (1) on each side), in a position that would be **HIGHLY** visible to anyone that would go under the truck near the P.T.O. rotating shaft. If the vehicle is to be painted after these labels are installed, cover them with two (2) blank masking covers. Remove the masking covers after painting.

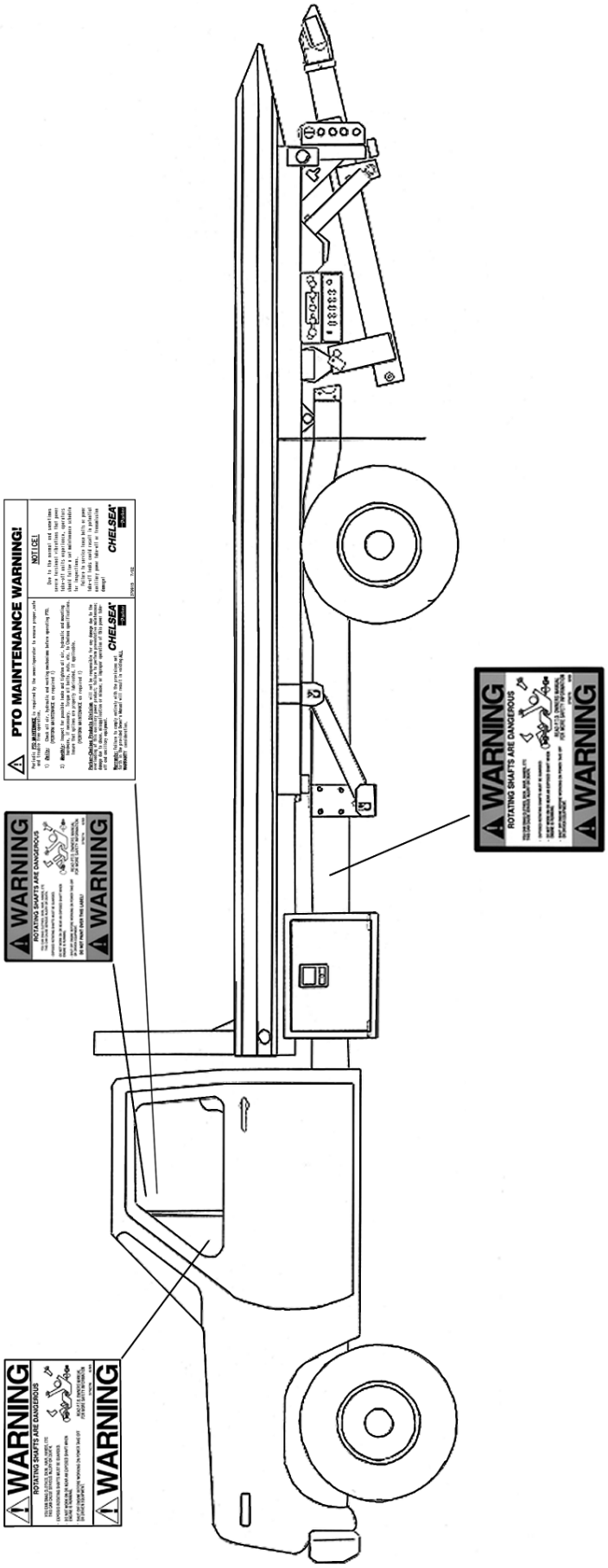
2. Place the one (1) black and orange on white 3.5" x 5" pressure sensitive vinyl label, part number 379275, on the visor nearest the operator of the vehicle, this must be placed near the P.T.O. visor label.

3. Place the one (1) red and white with black lettering 3.5" x 7.5" pressure sensitive vinyl label, part number 379915, on the opposite side of the visor from the above label # 379275.

4. Place the one (1) white and black heavy duty card, part number 379276, in the vehicle glove box. Again in a position highly visible to the operator, for example: try to place this card on top of whatever may be in the glove box.

If you require labels, please order part number 328946X at no charge from your local Chelsea Warehouse or send request direct to:

Parker Hannifin Corporation
Chelsea Products Division
8225 Hacks Cross Road
Olive Branch, MS 38654
Customer Service: (662) 895-1011



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Olive Branch, MS 38654 USA

Function of Auxiliary Power Shafts

An auxiliary power shaft transmits torque from the power source to the driven accessory. The shaft must be capable of transmitting the maximum torque and R.P.M. required of the accessory, plus any shock loads that develop.

An auxiliary power shaft operates through constantly relative angles between the power source and the driven accessory, therefore, the length of the auxiliary power shaft must be capable of changing while transmitting torque. This length change, commonly called "slip movement", is caused by movement of the power train due to torque reactions and chassis deflections.

Joint operating angles are very important in an auxiliary power joint application. In many cases, the longevity of a joint is dependent on the operating angles. (See chart below)

This information is limited to 1000 through 1310 series applications. For applications requiring a series larger than 1310, contact your local Chelsea distributor**.**

Determining Shaft Type

1) Solid or tubular?
   a) In applications requiring more than 1000 R.P.M. or where the application necessitates a highly balanced auxiliary power shaft, a tubular shaft should be used.
   b) Spicer's solid shafting auxiliary power joints are designed for 1000 or less R.P.M. intermittent service such as:

      Driving small hydraulic pumps

      Driving winches

      Driving low speed product pumps
2) Joint Series should be determined using the chart on the following page.

Spicer® Universal Joint Operating Angles			
Prop. Shaft R.P.M.	**Max. Normal Operating Angle**	**Prop. Shaft R.P.M.**	**Max. Normal Operating Angle**
3000	5° 50'	1500	11° 30'
2500	7° 00'	1000	11° 30'
2000	8° 40'	500	11° 30'

Above based on angular acceleration of 100 RAD/SEC^2

Parker Hannifin Corporation
Chelsea Products Division
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Spicer® Universal Joint Engineering Data

Joint Series	1000	1100	1280	1310
Torque Rating				
Automotive (Gas or Diesel Engine) Lbs. ft.				
Continuous	50	54	95	130
Tubing				
Diameter	1.750	1.250	2.500	3.00
Wall Thickness	.065	.095	.083	.083
W = Welded S = Seamless	W	S	W	W
Flange Diameter (Swing Diameter)				
Rectangular Type	3.500	3.500	3.875	3.875
Bolt Holes - Flange Yoke				
Circle	2.750	2.750	3.125	3.125
Diameter	.312	.312	.375	.375
Number	4	4	4	4
Male Pilot Dia.	2.250	2.250	2.375	2.375
Distance Across Lugs				
Snap Ring	2.188	2.656	3.469	3.469
Construction				
Bearing Diameter	.938	.938	1.062	1.062

Maximum Operating Speed * By Tube Size, Solid Shaft Size, and Length
***(For speed below 500 R.P.M. or over 2500 R.P.M., contact your Chelsea Distributor)**

Tubing Dia. & Wall Thickness Joint & Shaft (W=Welded S=Seamless)	Max. Installed Length in Inches for Given R.P.M. Centerline to Centerline of Joints for a Two Joint Assembly or Centerline of Joint to Centerline of Center Bearing for a Joint & Shaft R.P.M. - Revolutions per Minute				
	500	**1000**	**1500**	**2000**	**2500**
1.750" X .065" W	117"	82"	67"	58"	52"
1.250" X .095" S	91"	64"	52"	45"	40"
2.500" X .083" W	122"	87"	70"	62"	55"
3.000" X .083" W	-	-	-	85"	76"
Solid Shaft Diameter					
.750"	60"	42"	35"	30"	27"
.812"	62"	44"	36"	31"	28"
.875"	65"	46"	37"	32"	29"
1.000"	69"	49"	40"	35"	31"
1.250"	77"	55"	45"	39"	35"

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Mounting the P.T.O. on the Transmission

When installing a P.T.O., always wear protective clothing and safety glasses.

1. Begin by draining the oil from the transmission. Use caution, since the oil may be hot (**Fig. 1**).

Fig. 1

2. Remove the P.T.O. aperture plate with a 15mm socket (**Fig. 2**).

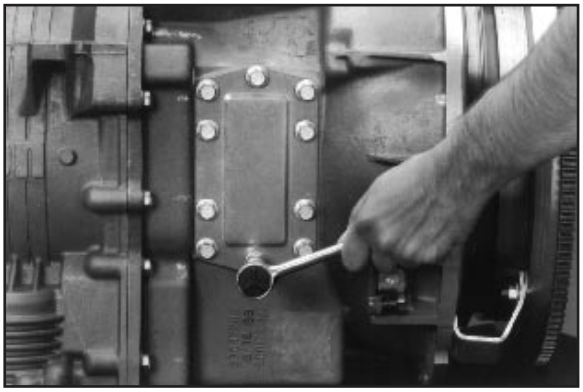
Fig. 2

3. Remove the gasket and clean the aperture surface (**Fig. 3**).

NOTE: Do not reuse the gasket that comes with the transmission.

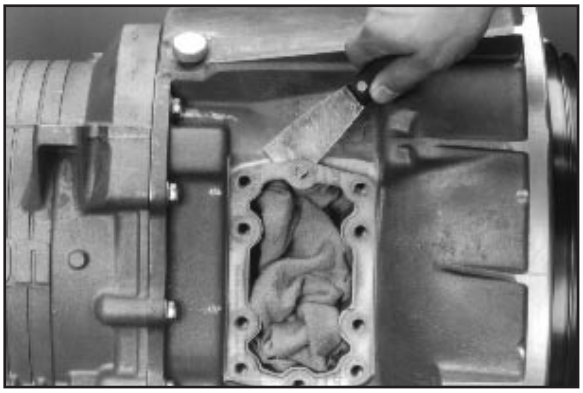
Fig. 3

4. Using a screwdriver, install the guide pins until they bottom out (**Fig. 4**) (Refer to Page 34 for 269 & 278 Series).

NOTE: Do not use sealing compounds because they are generally incompatible with automatic transmission fluid.

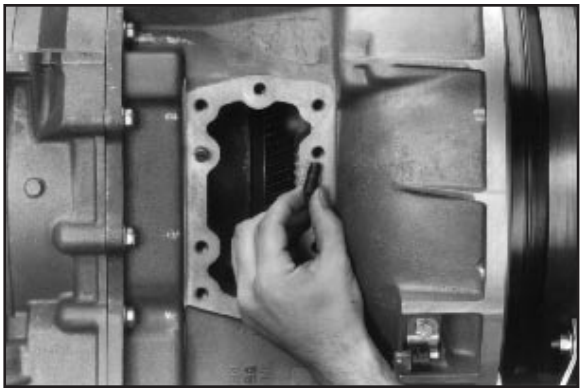
Fig. 4

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Mounting the P.T.O. on the Transmission (Continued)

5. Install the special gasket over the guide pins. The ribbed surface should face outward, toward the installer (**Fig. 5**).

NOTE: To insure proper backlash and sealing of P.T.O. to transmission only use gasket furnished with the P.T.O.

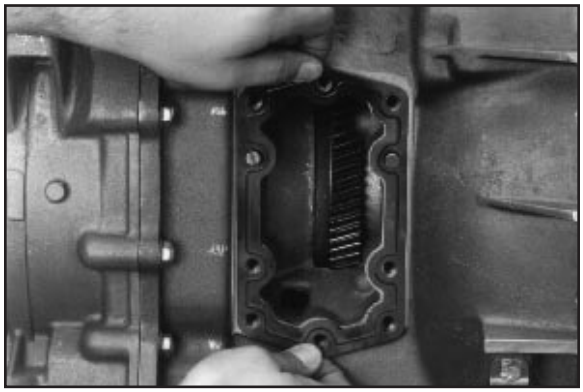

Fig. 5

6. Position the P.T.O. and secure it with the top capscrew (**Fig. 6**).

NOTE: Refer to page 34 for proper capscrew installation for the 269 & 278 Series

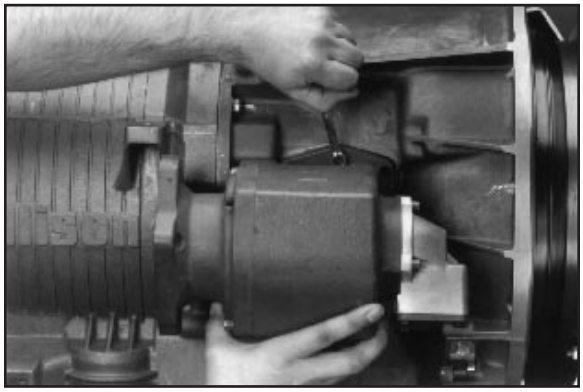

Fig. 6

7. Install the remaining capscrews. Torque all to 40 - 50 Lbs. ft. (54 - 68 N.m. or 5.5 - 6.9 Kg.m) (**Fig. 7**).

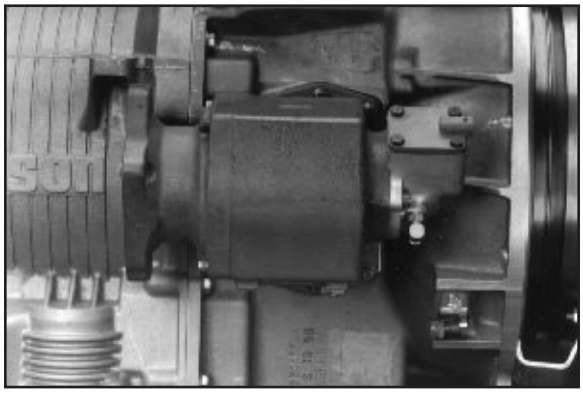

Fig. 7

8. Rotate the valve cap to one of two positions to provide maximum clearance (**Fig. 8**).

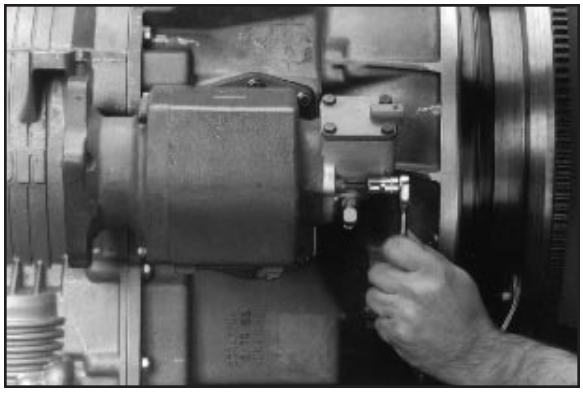

Fig. 8

Mounting the P.T.O. on the Transmission (Continued)

9. After selecting the best position for the application, torque the valve cap bolts to 16 - 20 Lbs. ft. (22 - 27 N.m. or 2.2 - 2.8 kg) (**Fig. 9**).

NOTE: If using a rotatable flange see page 34 for bolt torque specifications.

Fig. 9

10. Securely attach the high pressure line to the valve (**Fig. 10**).

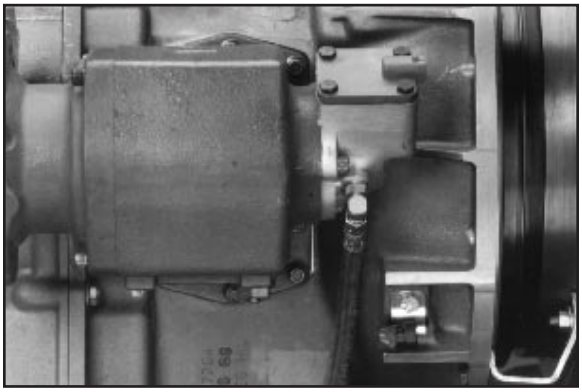

Fig. 10

11. Use the special fitting to securely attach the high pressure line to the transmission. This fitting is included with the P.T.O. (**Fig. 11**). See the chart on page 12 for the correct hose specifications. With the hose and P.T.O. securely connected, refill the transmission to the manufacturer's suggested specifications.

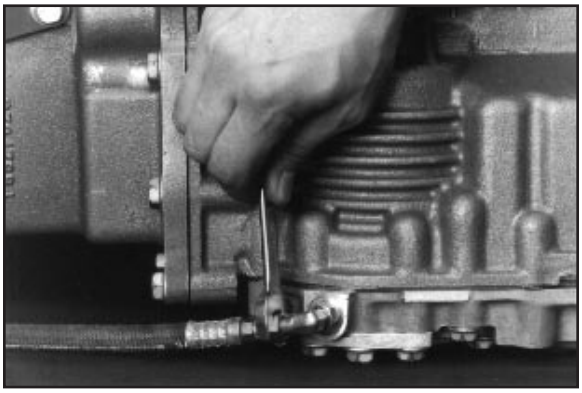

Fig. 11 (Left side)

12. Complete the assembly by installing the electrical connection (**Fig. 12**).

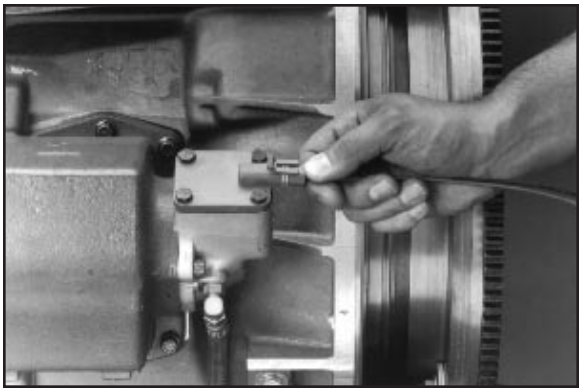

Fig. 12

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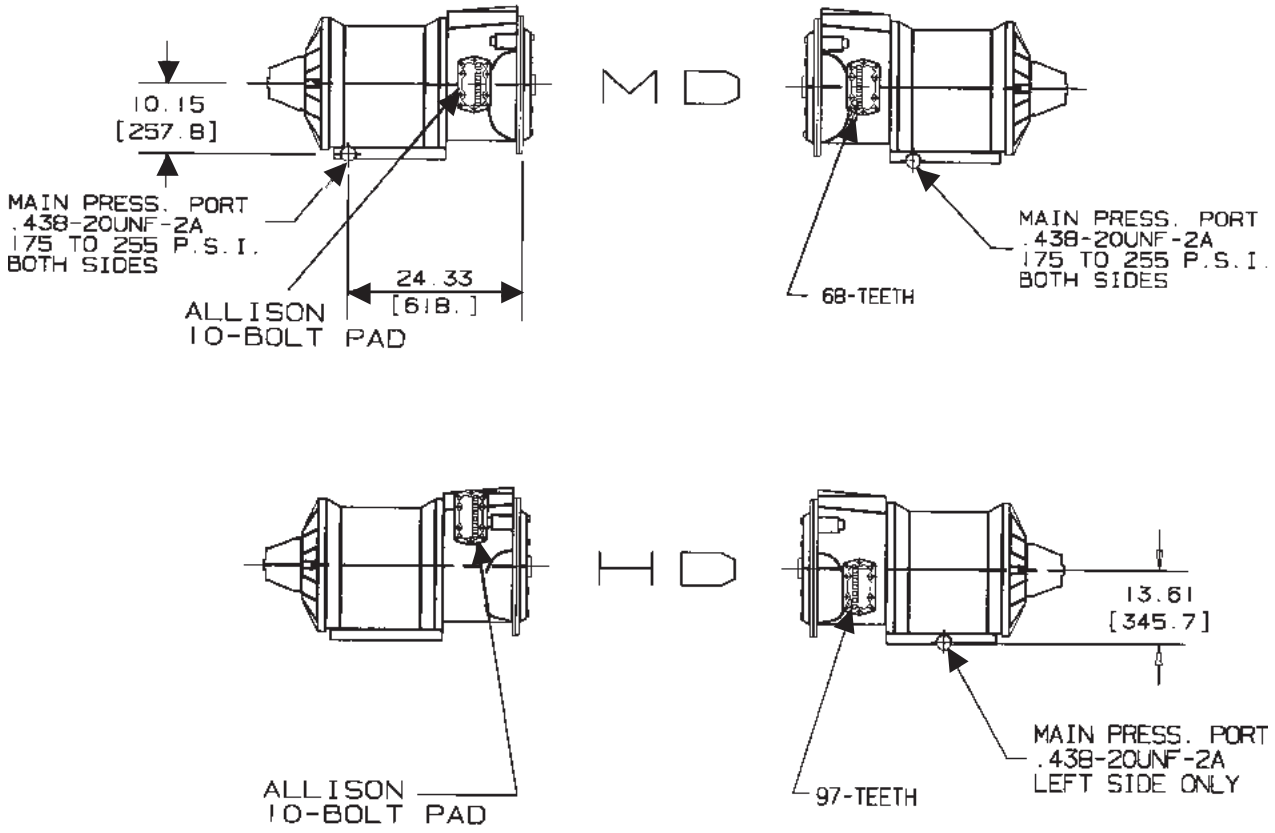
Pressure Port and Aperture Opening Identification

1. These drawings represent left and right views of the MD and HD pressure ports on the transmission.



Hose Specifications by Transmission

TRANS.	LOCATION	267 Series	277 Series	278 Series	859 Series
MD	L.H. Side (Left Press. Port)	329130-1X	329130-5X	329130-5X	329130-5X
MD	R.H. Side (Right Press. Port)	329130-4X	329075-1X	329075-1X	329075-1X
HD	Top Right (Left Press. Port)	329130-6X	329075-2X	329075-2X	329075-2X
HD	L.H. Side (Left Press. Port)	329130-1X	329130-4X	329075-4X	329130-4X
HD[1,2]	L.H. Side (Left Press. Port)	—	329130-5X	329130-5X	329130-5X
HD[1,2]	Top Right (Right Press. Port)	—	329130-4X	329075-4X	329130-4X
MD[1,2]	L.H. Side (Left Press. Port)	—	329130-5X	329130-5X	329130-5X
MD[1,2]	R.H. Side (Right Press. Port)	—	329075-1X	329075-1X	329075-1X

An HD with 2 P.T.O.'s requires a 379556 "T" fitting and a 379703 swivel nut 90 degree elbow to attach 2 hoses to the single port on the left side.

1 Lubrication Option "R", shifter Options "G" and "H" for 277 and 859 Series

2 Lubrication Option "R" for 278 Series

Parker Chelsea

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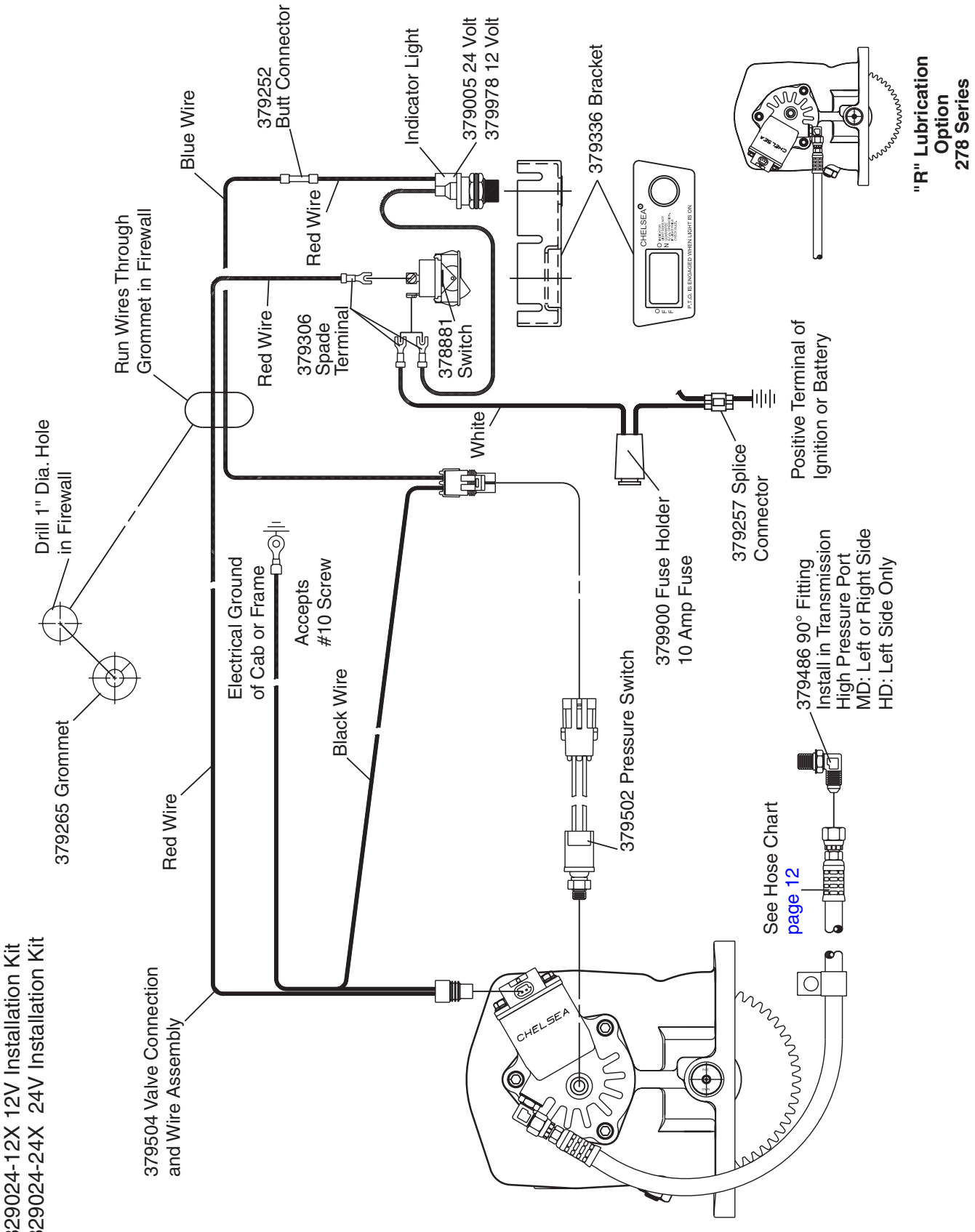
Chelsea Products Division
Olive Branch, MS 38654 USA

Shift Installation Kit 277, 278 & 859 Series without Electronic Overspeed Control (SK-347 Rev C) (Old Style)



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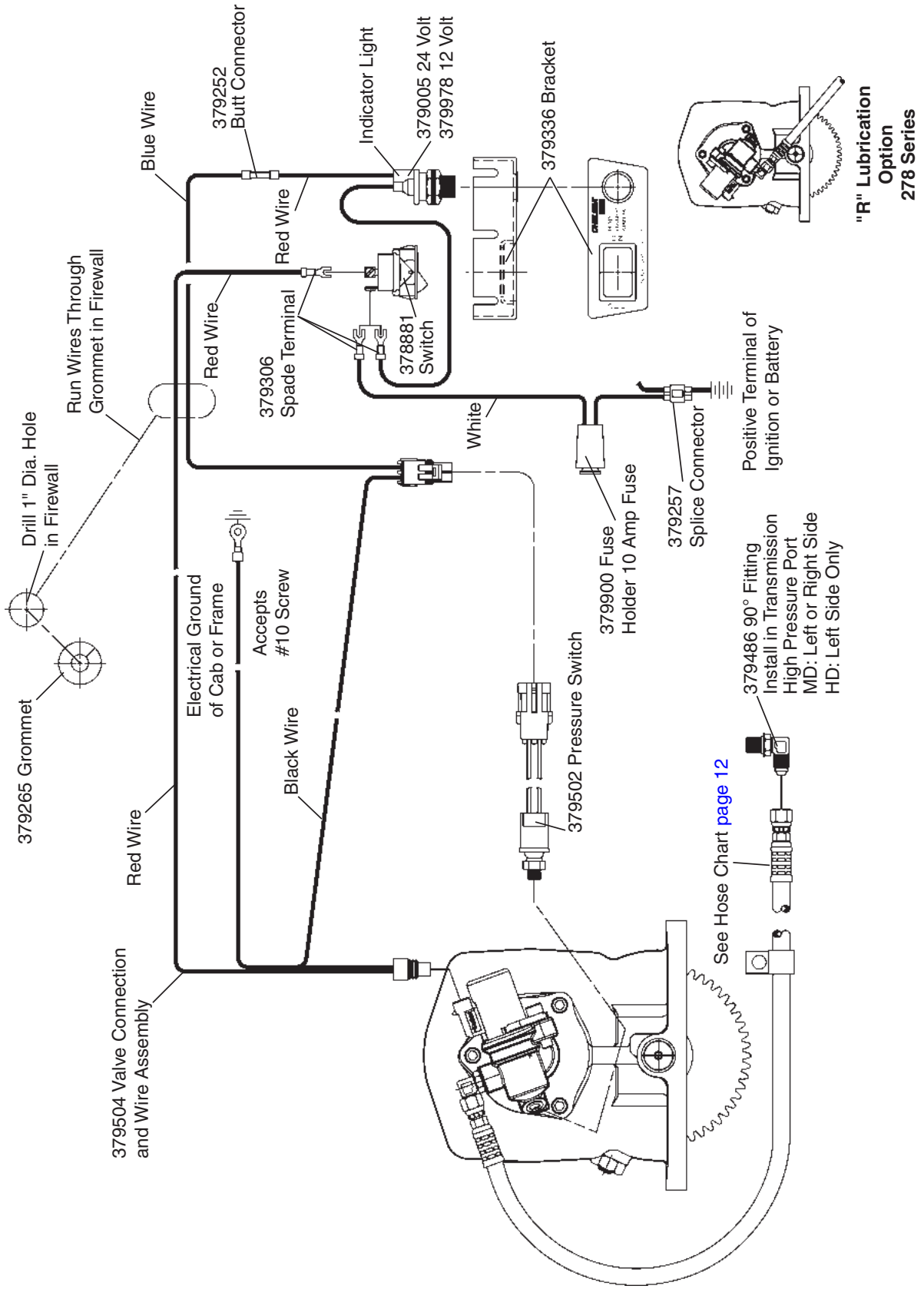
Shift Installation Kit 277, 278 & 859 Series without Electronic Overspeed Control (SK-347 Rev D) (New Style)



329024-12X 12V Installation Kit
329024-24X 24V Installation Kit

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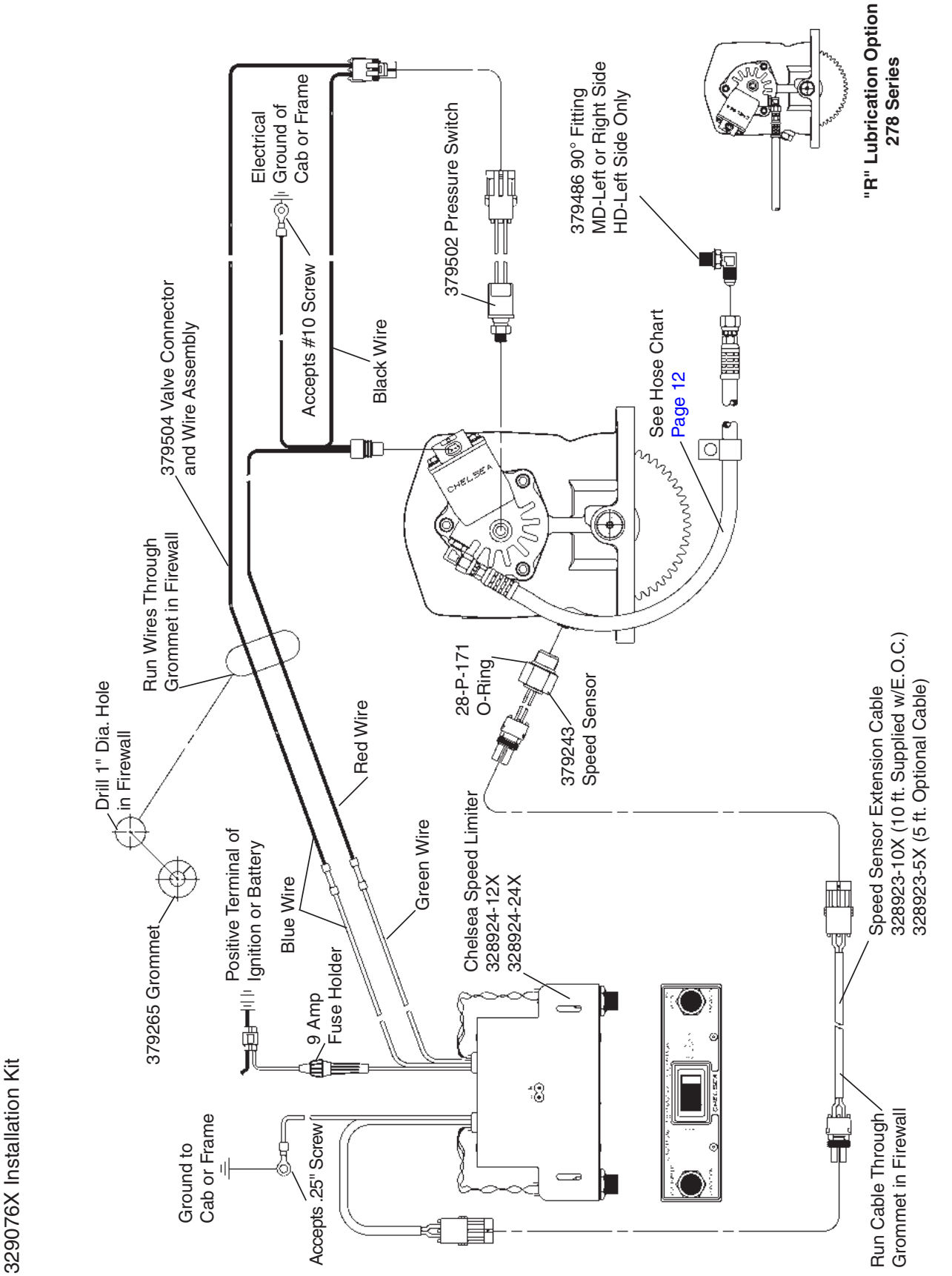
Chelsea Products Division
Olive Branch, MS 38654 USA

Shift Installation Kit 277, 278 & 859 Series with Electronic Overspeed Control (SK-348 Rev B) (Old Style)



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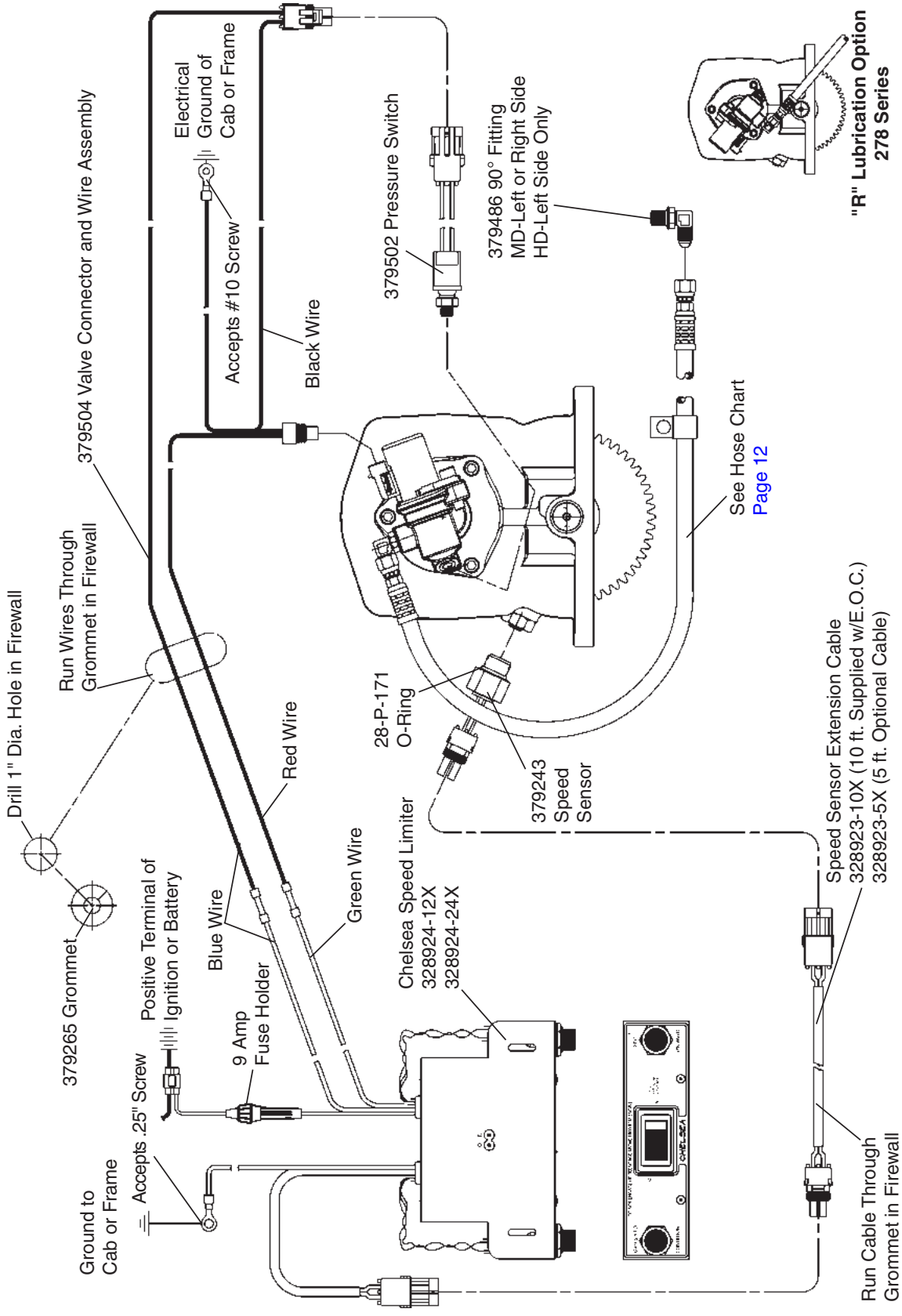
Shift Installation Kit 277, 278 & 859 Series with Electronic Overspeed Control (SK-348 Rev C) (New Style)



Parker Hannifin Corporation
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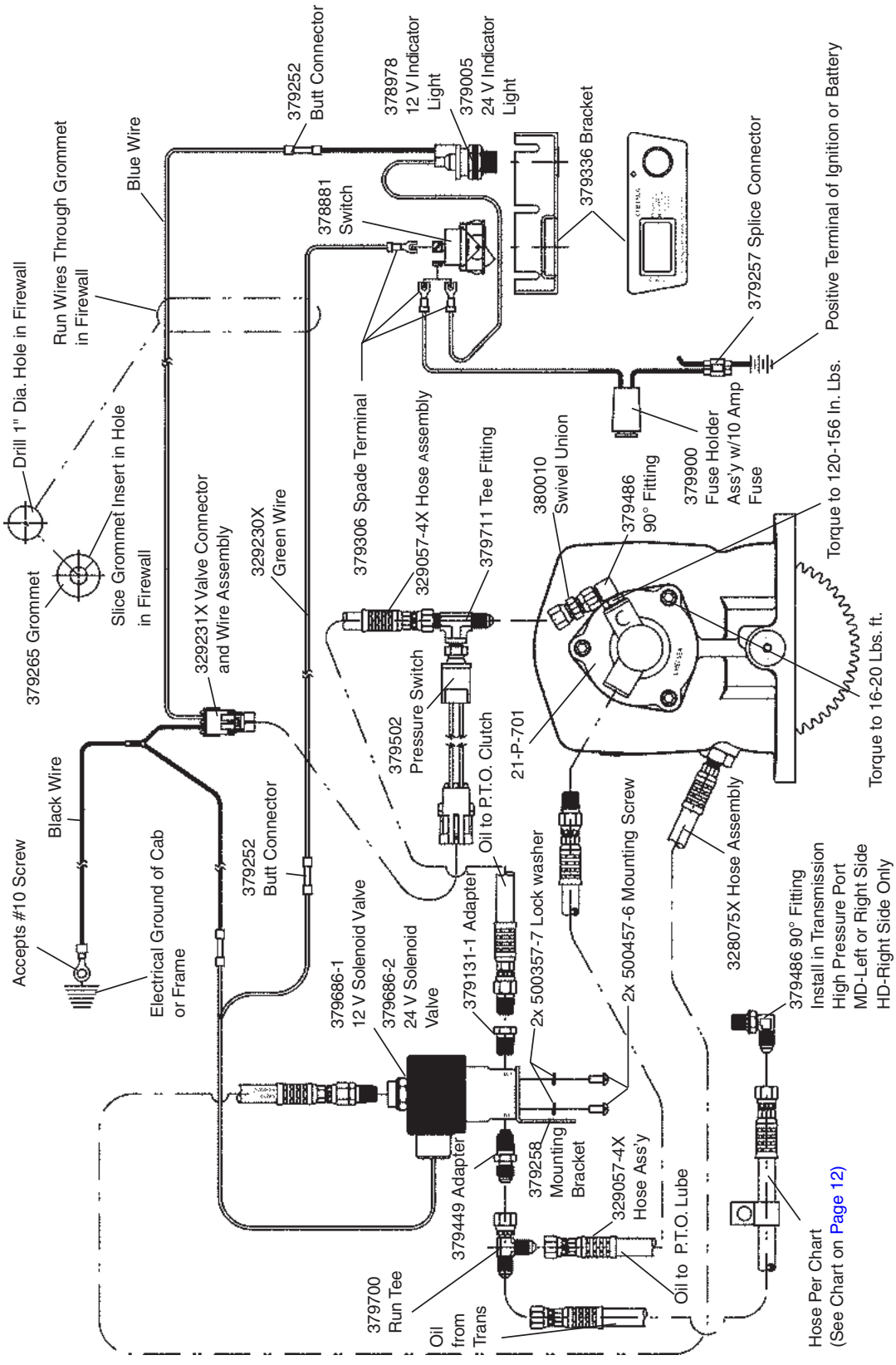
Olive Branch, MS 38654 USA

Shift Installation Kit 277, 278, & 859 Series with Remote Mount Solenoid (SK-432 Rev B)



329237-12X 12V Installation Kit
329237-24X 24V Installation Kit

NOTE: This option is not available with nor can it be used on E.O.C. applications.

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Chelsea Products Division
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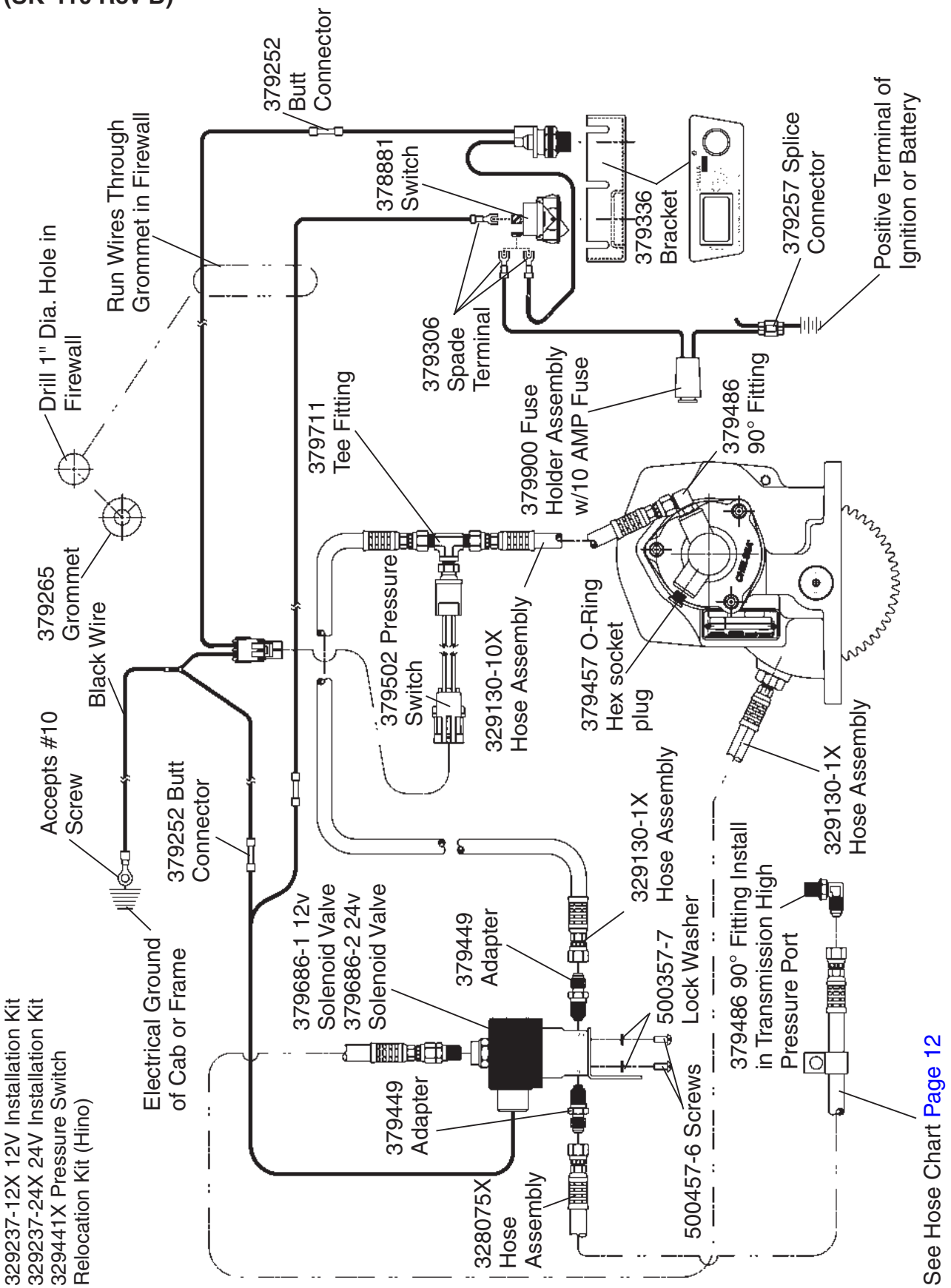
Shift Installation Kit 277 Series with Remote Mount Solenoid for Hino Model 338 (SK-410 Rev B)



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Olive Branch, MS 38654 USA

GMT C Series Trucks

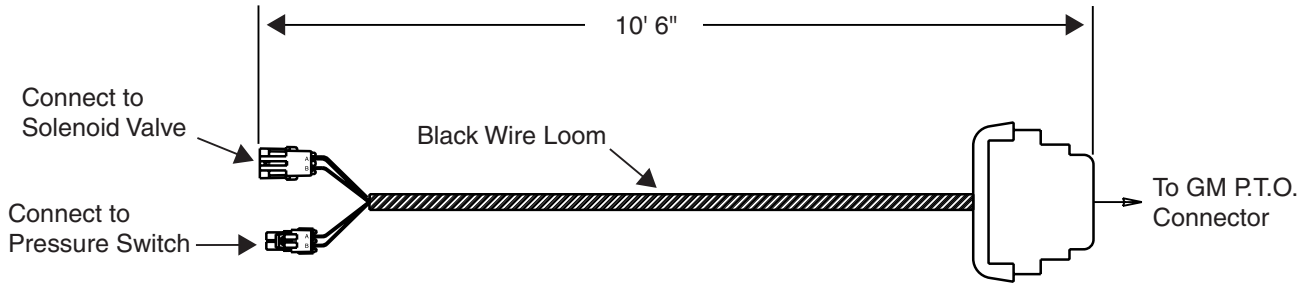
For model year 2003 GM C Series 4500, 5500, 6500, 7500 and 8500 trucks may be equipped with the Allison World (MD) transmission. In these vehicles GM Truck has integrated a P.T.O. connector, located in the right hand engine compartment area. A Power Take-Off switch has also been incorporated into the GM dash panel to control P.T.O. operation. With the P.T.O. option ordered on the truck, the P.T.O. connector and in-dash switch simplify the interface for the body builder.

In order for the customer to utilize the full capability of the P.T.O./transmission, Chelsea has design a wiring harness that must be used between the GM P.T.O. connector and the Chelsea Power Take-Off. These are for P.T.O. Non E.O.C. applications only.

On the Allison World (MD) transmission the P.T.O. drive gear is engine driven. The wiring harness is not "required" for the Power Take-Offs listed on the chart, but must be used if the GM supplied in-dash P.T.O. switch is to be utilized.

See wiring harness part number 379926 for the 277, 278 and 859 Series Power Take-Offs.

2003 GM "C" Series Wiring Harness for 277, 278 and 859 Series
Part Number 379926



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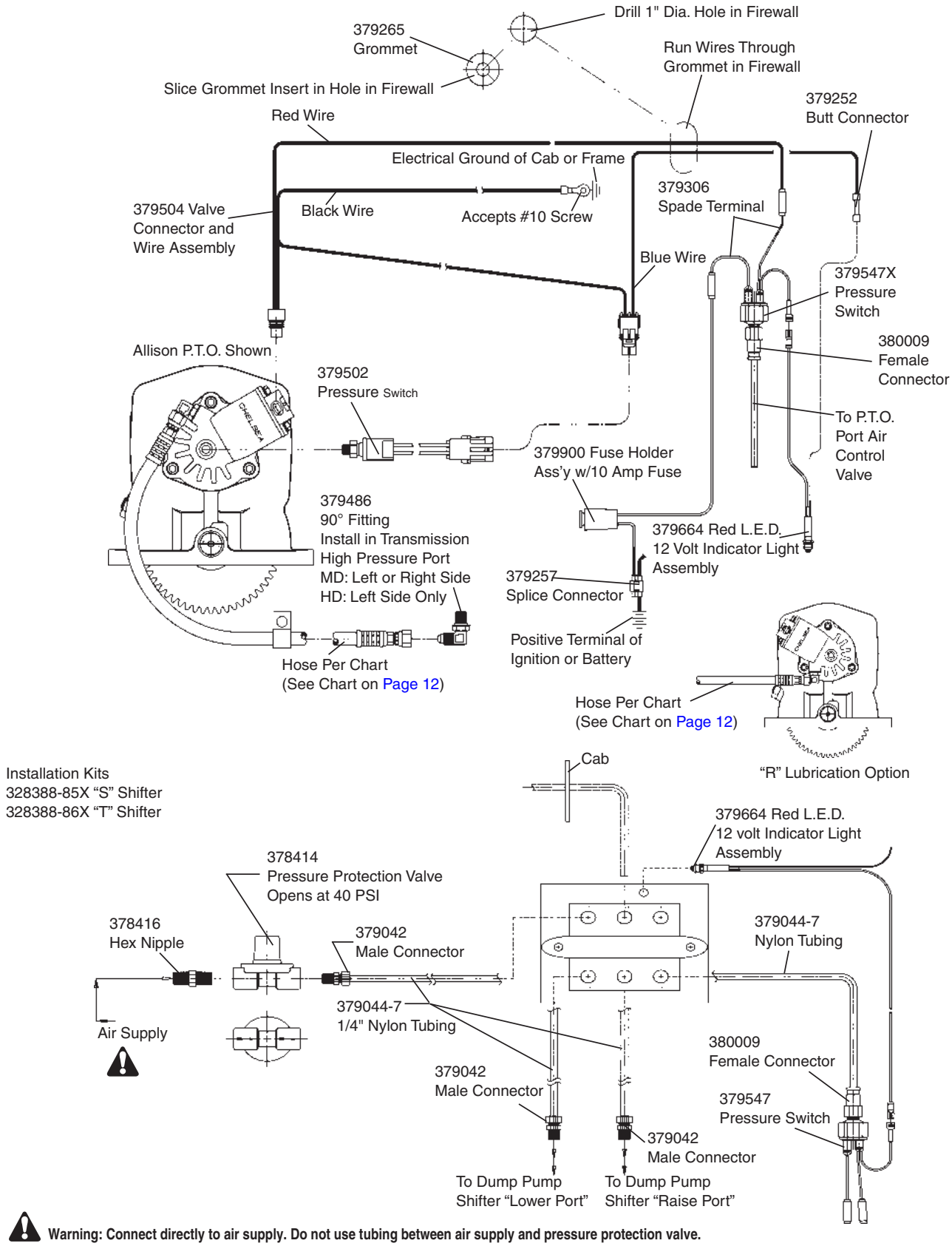
Chelsea Products Division
Olive Branch, MS 38654 USA

P.T.O. Combo Valve Installation Sketch, 277/278 Series (SK-427 Rev B) (Old Style)

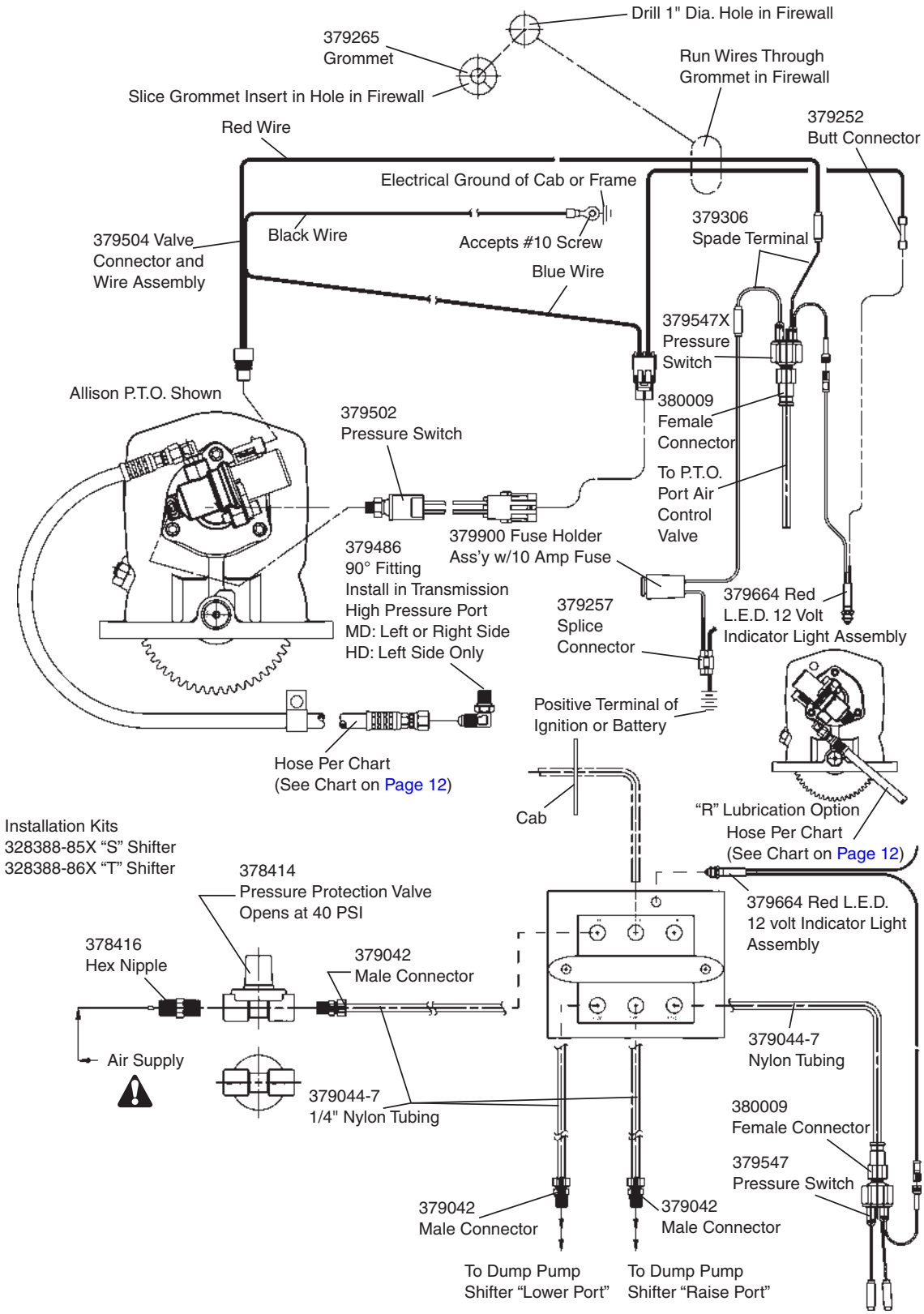


Warning: Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.

Caution: When installing nylon tubing avoid sharp angles, exhaust and manifold systems.

Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

P.T.O. Combo Valve Installation Sketch, 277/278 Series (SK-427 Rev C) (New Style)



Warning: Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.

Caution: When installing nylon tubing avoid sharp angles, exhaust and manifold systems.

Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

Mounting the P.T.O. on the Transmission

When installing a P.T.O., always wear protective clothing and safety glasses.

1. Remove the P.T.O. aperture plate with a 16mm socket (**Fig. 1**).

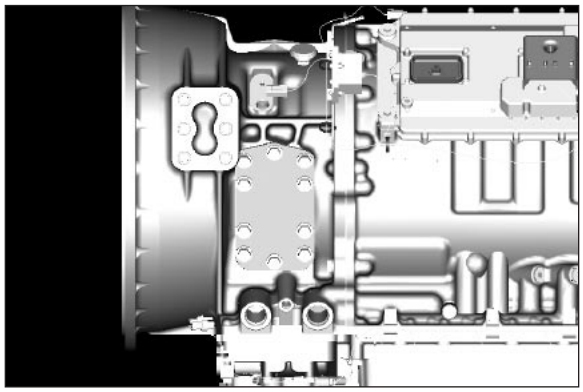


Fig. 1

2. Remove the gasket and clean the aperture surface (**Fig. 2**).

NOTE: Do not reuse the gasket that comes with the transmission.

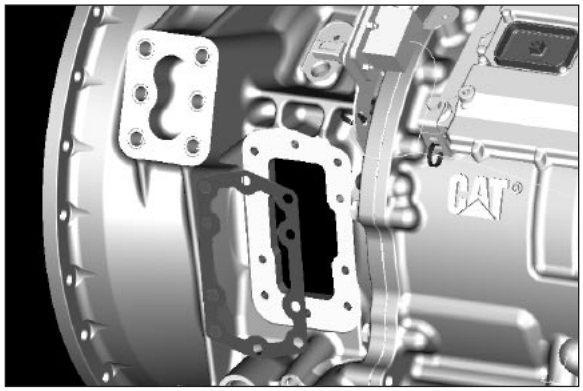


Fig. 2

3. Using a screwdriver, install the guide pins until they bottom out (**Fig. 3**) (see page 34).

NOTE: Do not use sealing compounds because they are generally incompatible with automatic transmission fluid.

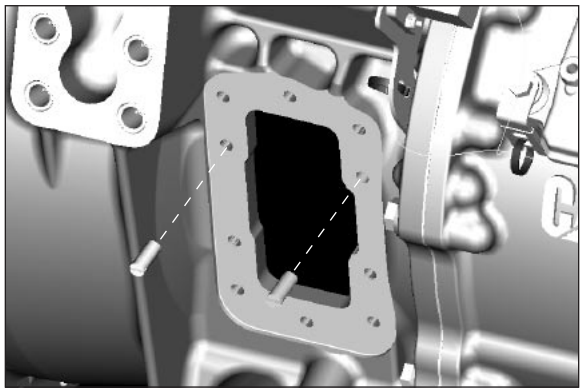


Fig. 3

4. Install the special gasket over the guide pins. The ribbed surface should face outward, toward the installer (**Fig. 4**).

NOTE: To insure proper backlash and sealing of the P.T.O. to the transmission, only use Gasket furnished with the P.T.O.

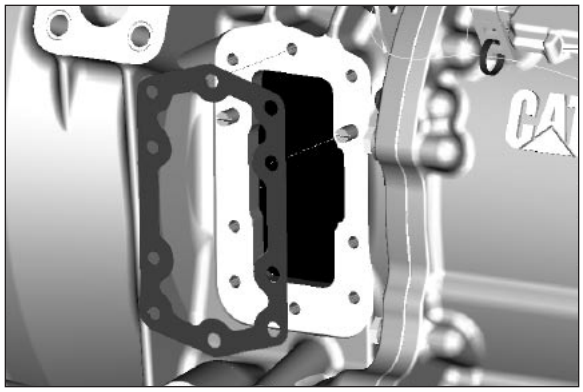


Fig. 4

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Mounting the P.T.O. on the Transmission (Continued)

5. Position the P.T.O. and secure it with the top capscrew provided. (**Fig. 5**)

NOTE: Refer to page 34 for proper capscrew installation for the 269 & 278 Series

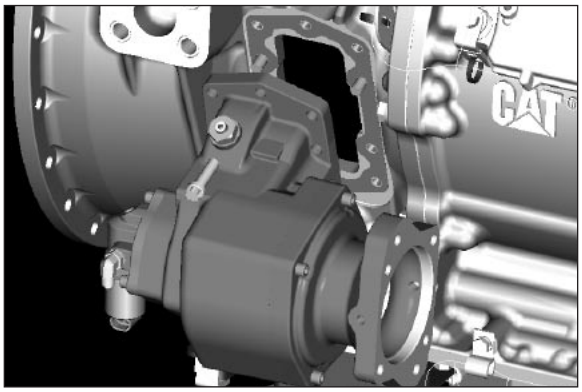


Fig. 5

6. Install the remaining capscrews. Torque them to 37-44 Lbs. ft. [50-60 N.m.] (**Fig. 6**).

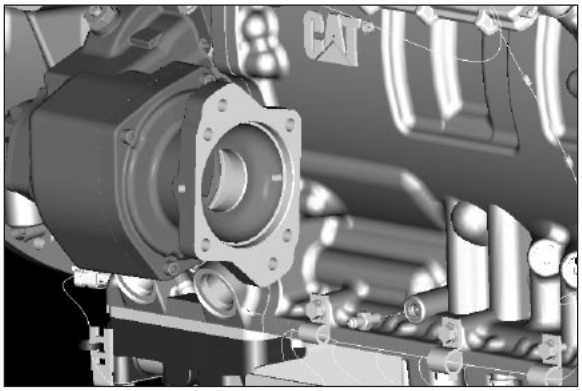


Fig. 6

NOTE: There are two (2) high pressure ports available. Use the port located on the driver's side of the transmission unless there is an interference issue with a pump or driven object (**Fig. 7**).

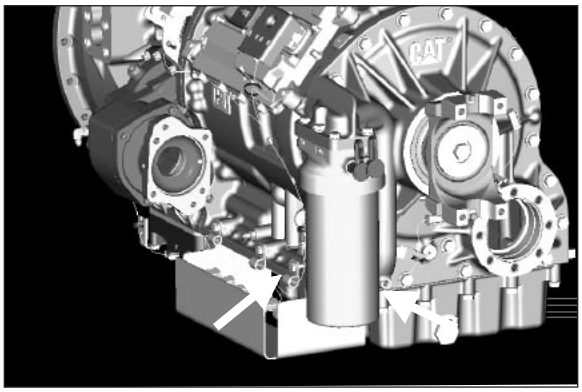


Fig. 7

7. Using the special fitting (379812) to securely attach the high pressure line to the transmission. This fitting is included with the P.T.O. Tighten to 8 - 10 Lbs. ft. [11.0 - 13.5 N.m.] (**Fig. 8**).

   See the hose chart on page 28 for the correct hose specifications. Tighten hose end fitting 2 flats from finger tight

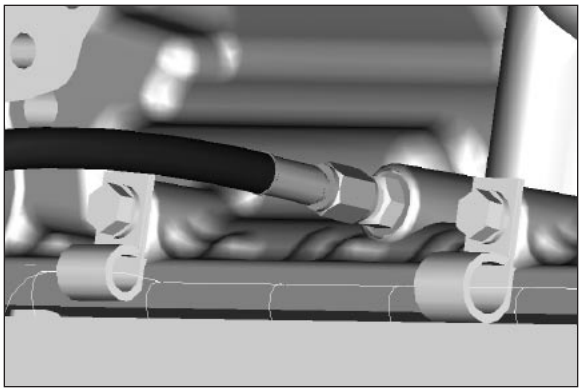


Fig. 8

Mounting the P.T.O. on the Transmission (Continued)

8. Securely attach the high pressure line to the valve. Tighten hose end fitting 2 flats from finger tight (**Fig. 9**).

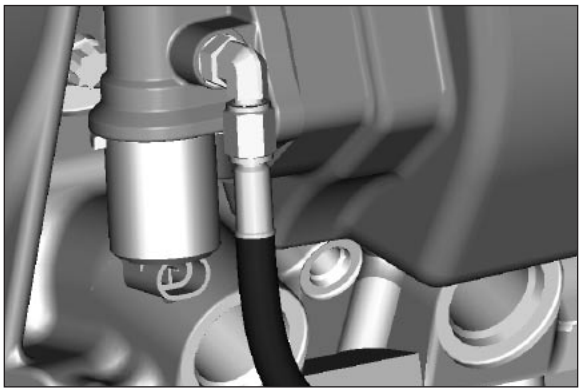


Fig. 9

9. Complete the assembly by installing the electrical connection (**Fig. 10**).

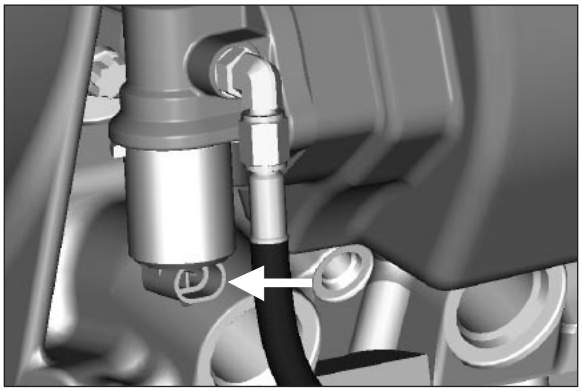
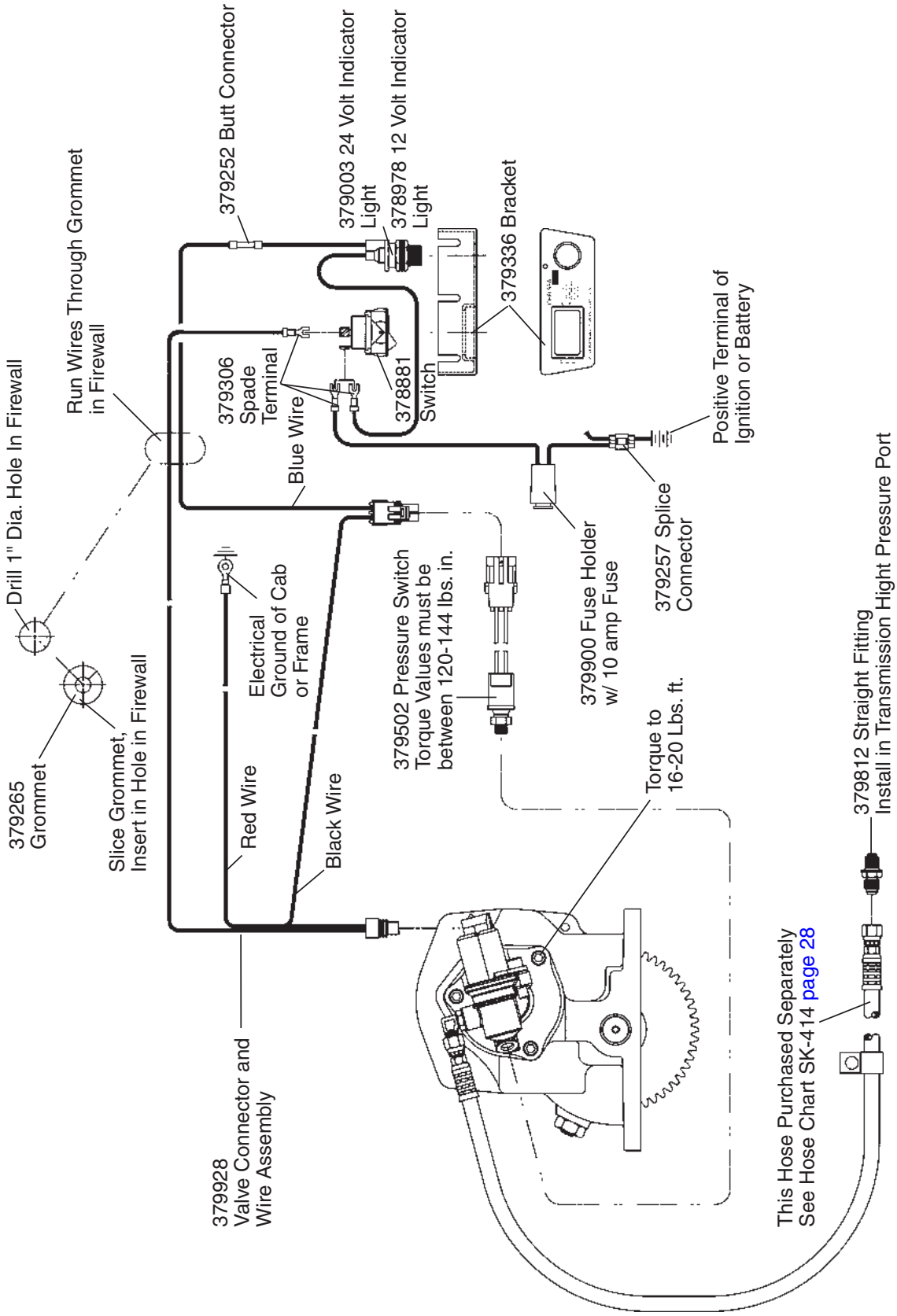


Fig. 10

NOTE: See page 25-27 for electrical connection drawings.

NOTE: If using a rotatable flange, see page 34 for bolt torque.

Shift Installation Kit 277, 278 and 859 Series Without Electronic Overspeed Control (SK-411 Rev A)



329443-12X - For 12V Installation Kit
329443-24X - For 24V Installation Kit

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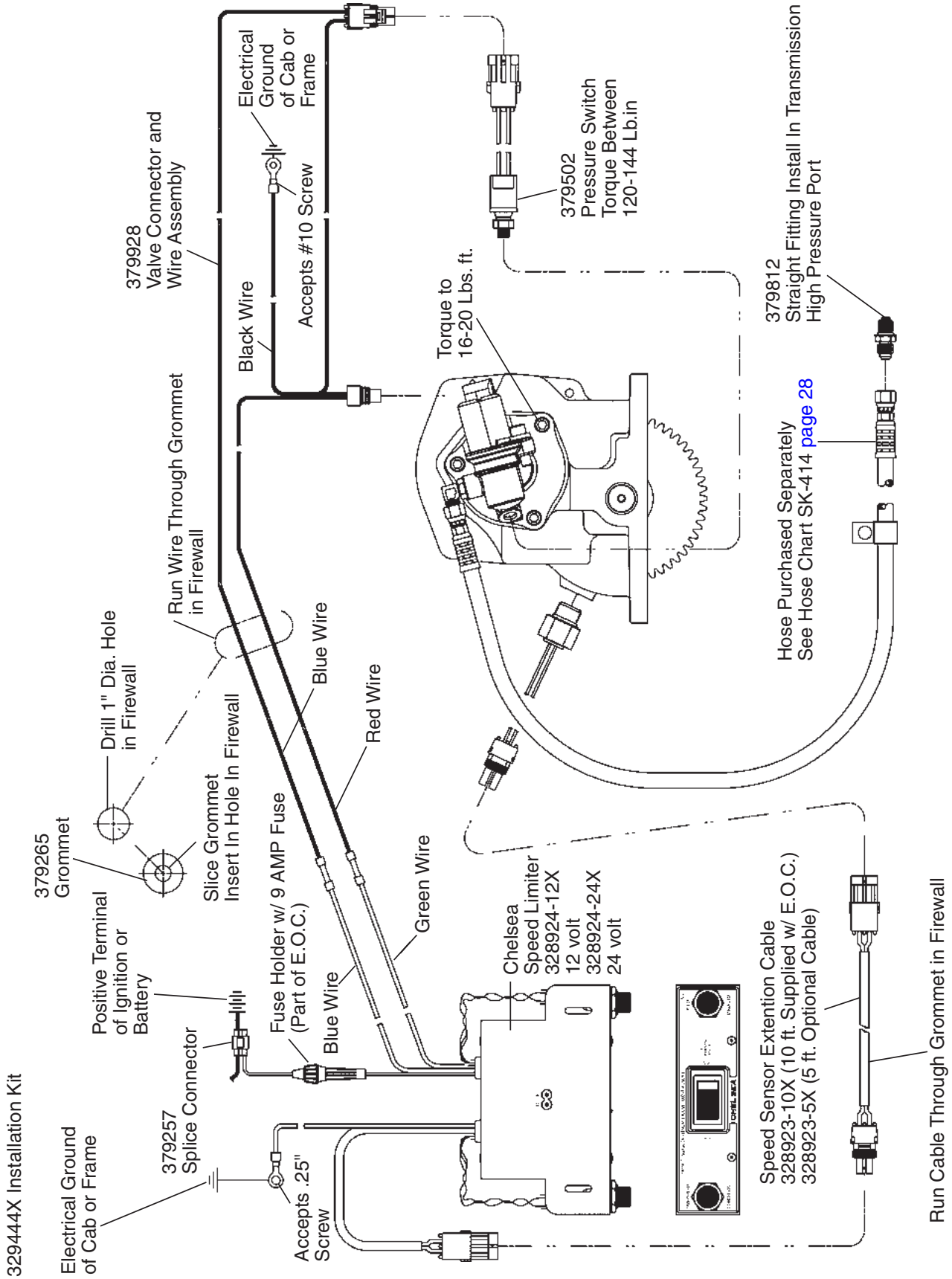
Olive Branch, MS 38654 USA

Electronic Overspeed Control Installation Sketch for 277, 278 and 859 Series (SK-412 Rev A)



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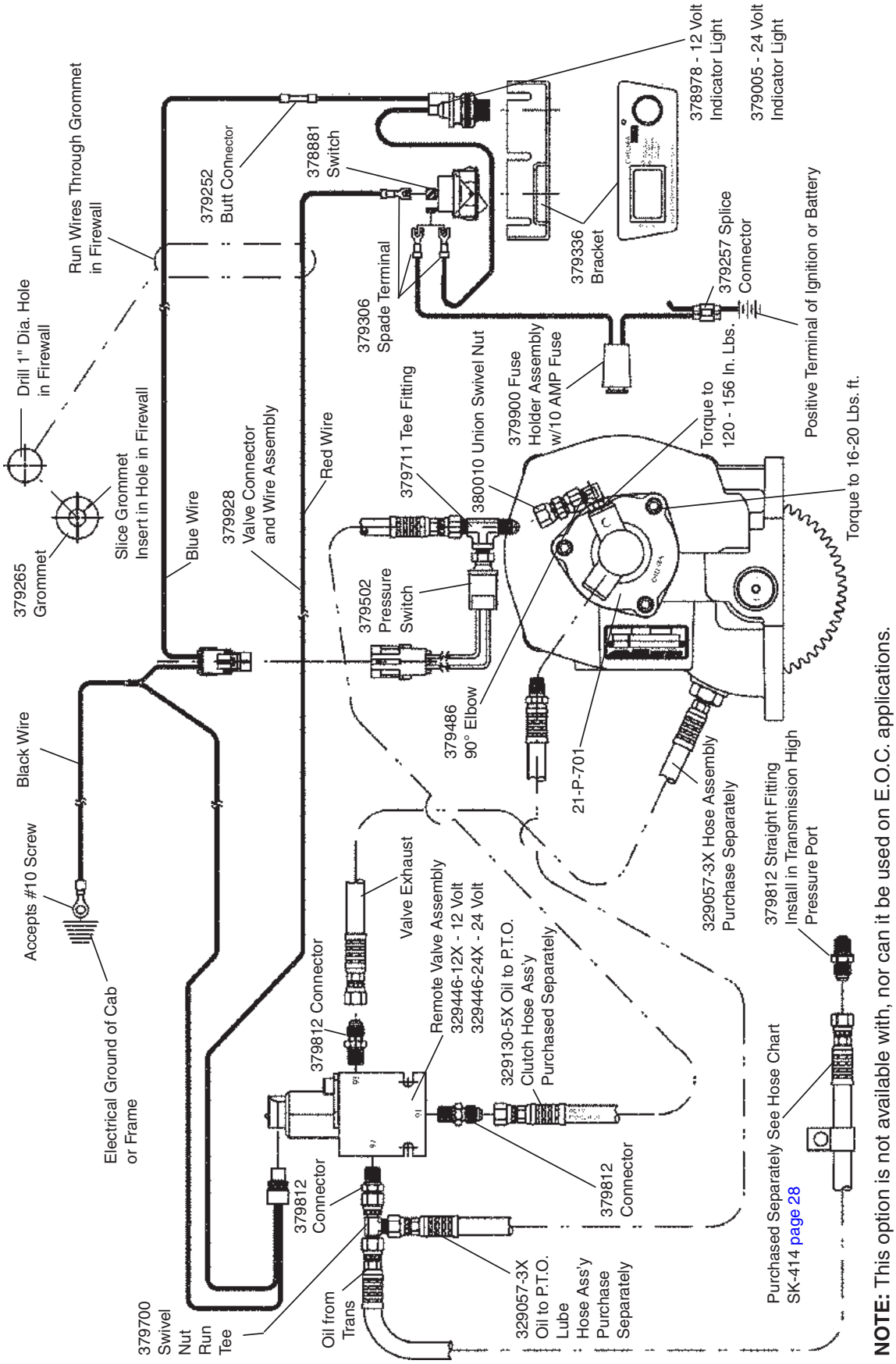
Remote Mount Installation Sketch for 277, 278 and 859 (SK-413 Rev C)

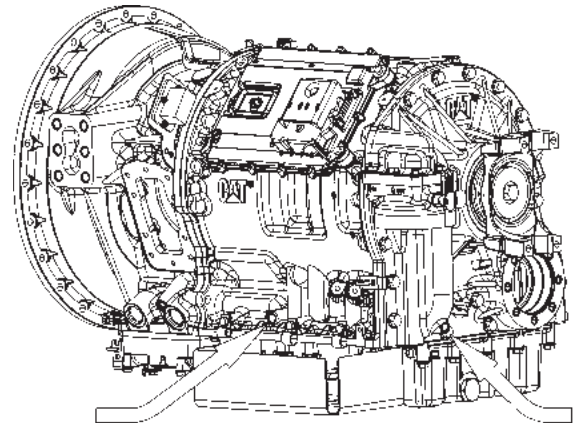


NOTE: This option is not available with, nor can it be used on E.O.C. applications.

329445-12X 12V Installation Kit
329445-24X 24V Installation Kit

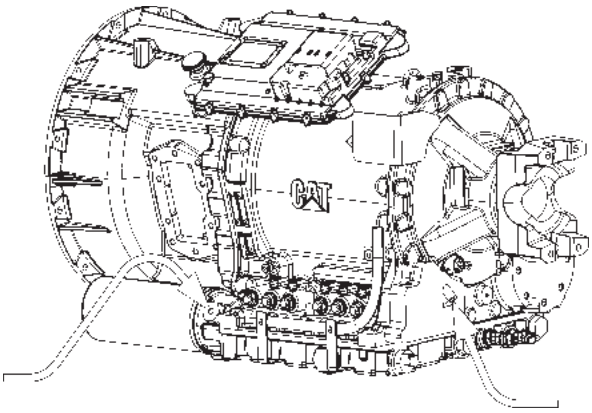
Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

Pressure Port Locations & Hose Chart (SK-414 Rev B)



Left Side Port Rear Port

CX31
(Filter Removed for Clarity)



Left Side Port Rear Port

CX28

Both High Pressure Connections are -4 O-Ring Boss

HOSE CHART							
Trans.	**P.T.O.**	**P.T.O. Location**	**High Oil Pressure Location**	**P.T.O. Valve Location**	**P.T.O. Fitting**	**Trans. Fitting**	**Trans.-P.T.O. Valve Hose #**
CX31 CX28	277, 278 859	Driver (LHS)	LHS	Attached	379486	379812	329075-1X
		Driver (LHS)	Rear				329075-5X
		Pass. (RHS)	LHS				329075-2X
		Pass. (RHS)	Rear			379486	329075-5X
		Driver (LHS)	LHS	Remote	379486	379812	329130-6X
		Driver (LHS)	Rear				329130-6X
		Pass. (RHS)	LHS				329130-6X
		Pass. (RHS)	Rear				329130-6X
	267	Driver (LHS)	LHS	N/A	379486	379812	329130-3X
		Driver (LHS)	Rear			379486	329075-5X
		Pass. (RHS)	LHS			379812	329075-2X
		Pass. (RHS)	Rear			379812	329075-5X
	867	Driver (LHS)	LHS	N/A	379486	379812	329130-3X
		Driver (LHS)	Rear				329075-5X
		Pass. (RHS)	LHS				329075-2X
		Pass. (RHS)	Rear			379486	329075-5X

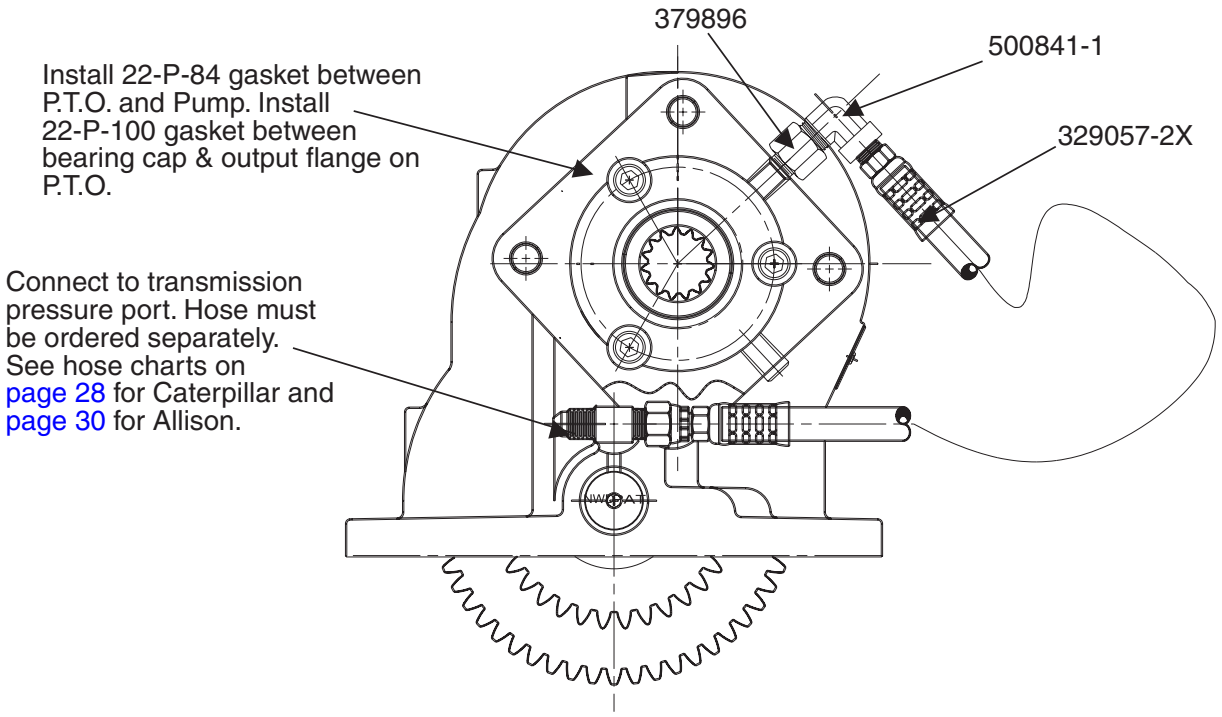
LHS = Left Side of Transmission, 8 o'clock position
RHS = Right Side of Transmission, 1 o'clock position

NOTES:

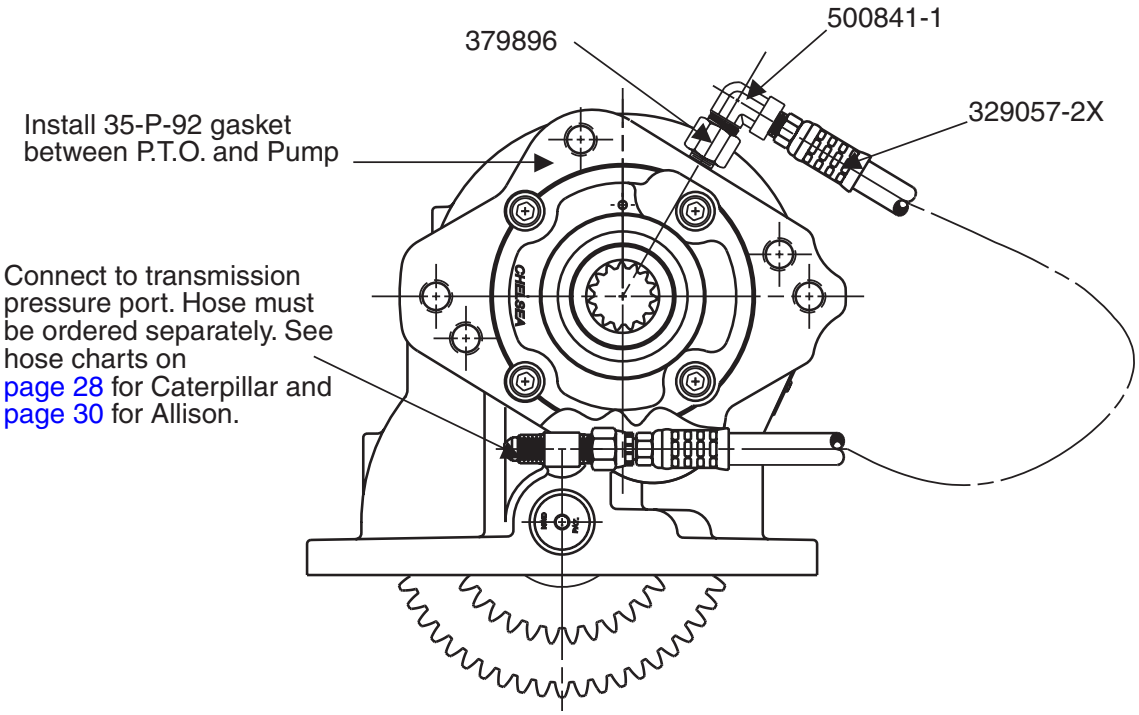
1. P.T.O. Fitting 379486 and Transmission Fitting 379812 included with the P.T.O. Unit. If Using 379486 in Transmission it Must be Purchased Separately
2. Hoses to be Purchased Separately
3. 379486 Elbow Will Not Install on Left Hand (Driver) Side Oil Port Due to Transmission Interference
4. If 379486 is Listed as Transmission Fitting for Rear Location, Route Hose Along Right Hand (passenger) Side of Transmission and Under Transmission Output Yoke

CAUTION: Wet Spline Options Must be used with a Pump that has a Contiguous Sealing surface to Ensure a proper seal between Pump and P.T.O.

Installation "RY" Wet 267 Series (SK-351 Rev C)



Installation "AF" Wet Spline 267 Series (SK-350 Rev C)



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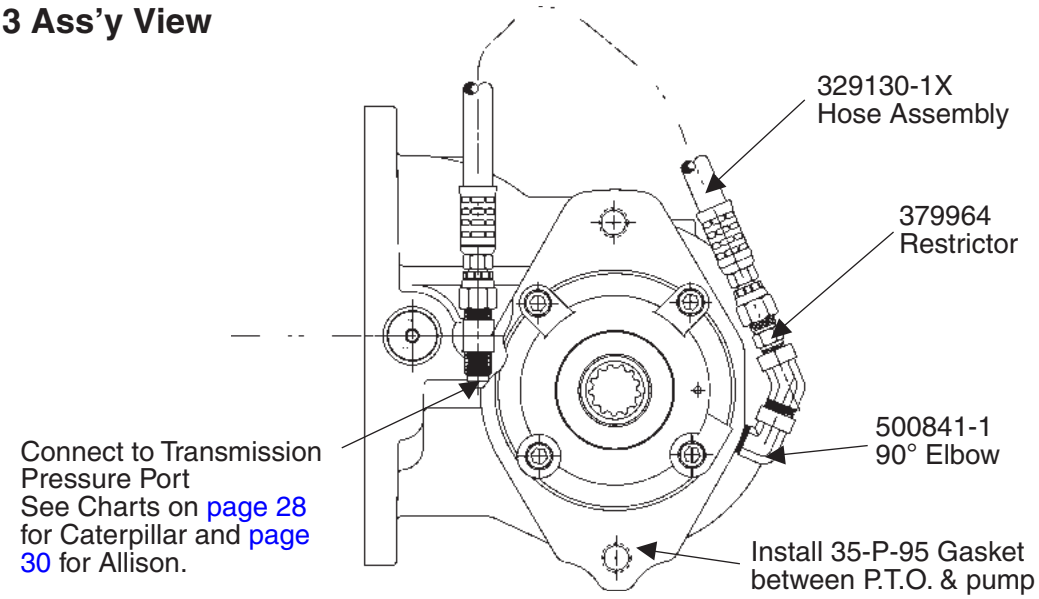
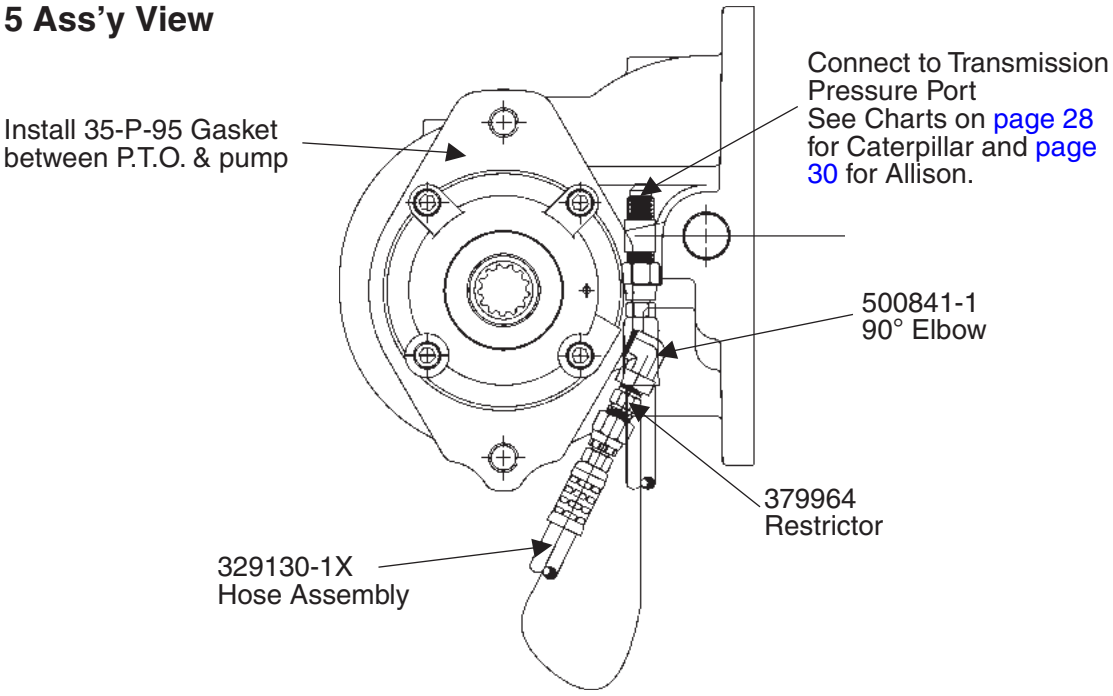
Installation "AK" Wet Spline 267 Series (SK-378 Rev A)

3 Ass'y View



Kit #329406X for Wet Spline
Installation Components

5 Ass'y View



Pressure Hose Chart (Transmission to P.T.O.)		
Trans	**Location**	**Hose**
MD	Left	329130-5X
MD	Right	329130-4X
HD	Left	329130-5X
HD	Top Right	329130-8X

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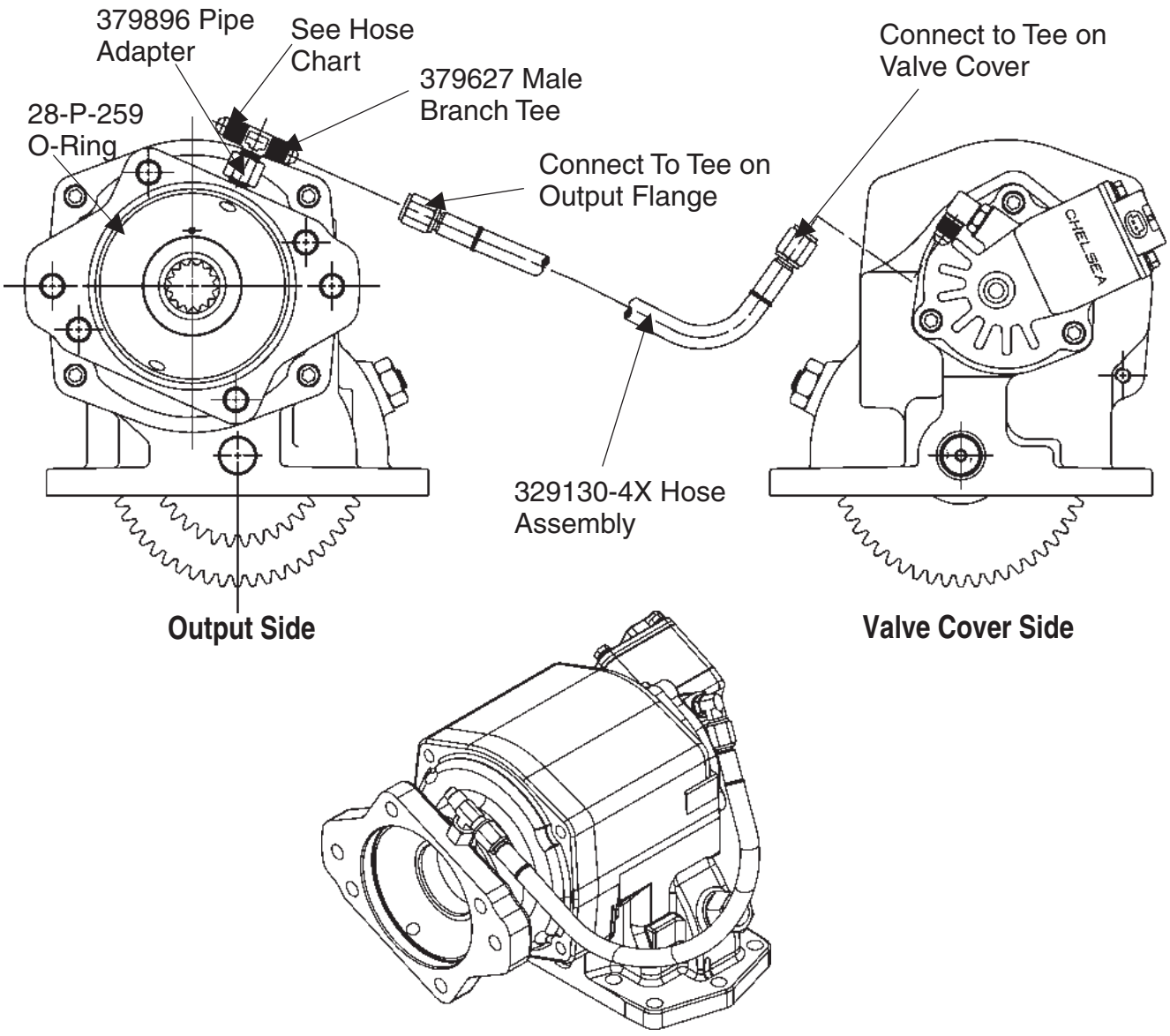
Installation "AF" Wet Spline 277 & 278 Series (SK-383 Rev B) (Old Style)



Pressure Hose Chart (Transmission to P.T.O.)		
Trans	**Location**	**Hose**
MD	Left	329130-1X
MD	Right	329075-1X
HD	Left	329130-1X
HD	Right	329075-2X

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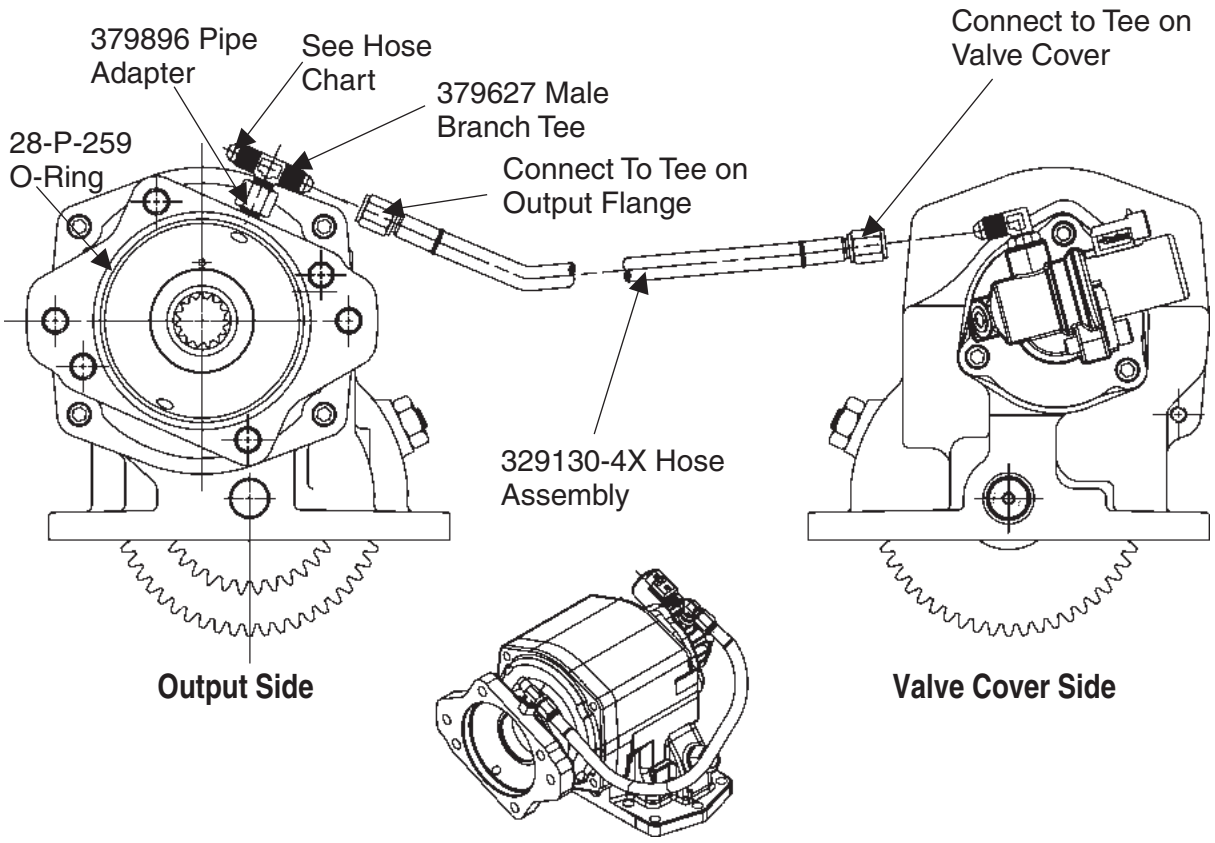
Installation "AF" Wet Spline 277 & 278 Series (SK-383 Rev C) (New Style)



Pressure Hose Chart (Transmission to P.T.O.)		
Trans	**Location**	**Hose**
MD	Left	329130-1X
MD	Right	329075-1X
HD	Left	329130-1X
HD	Right	329075-2X

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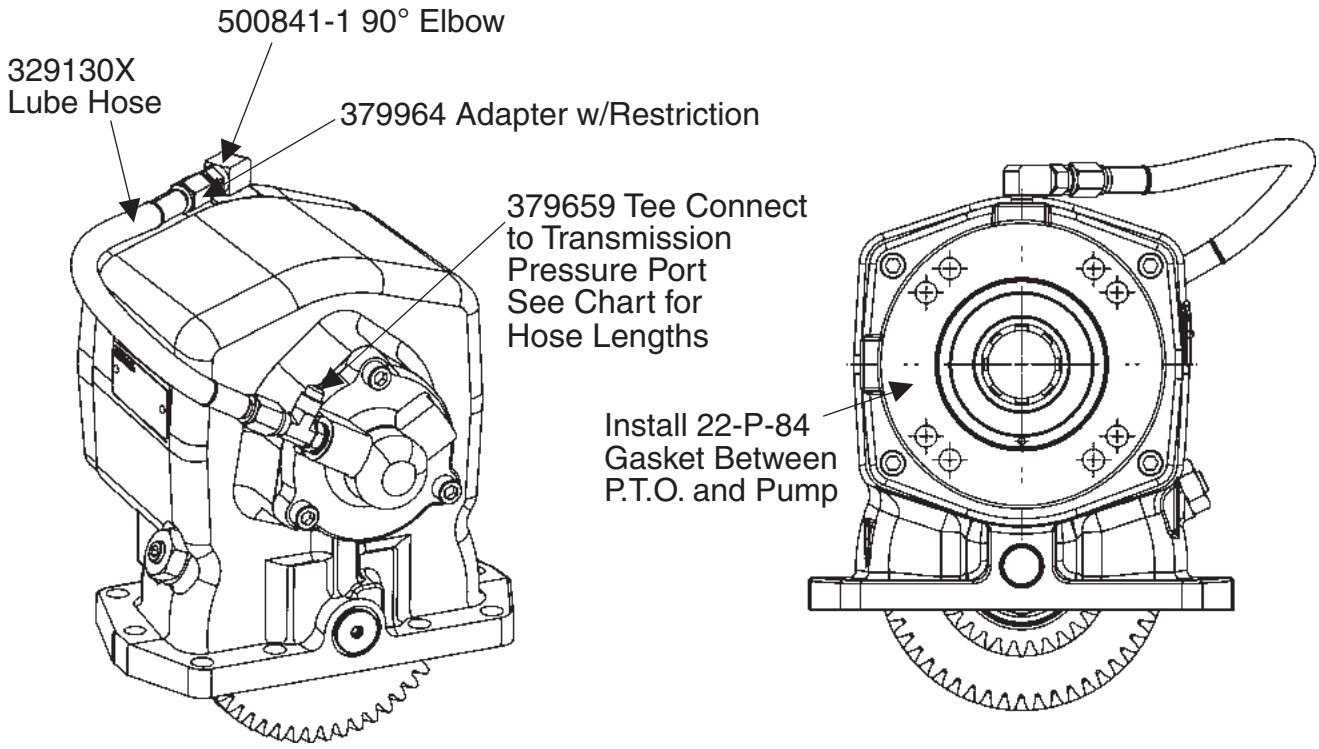
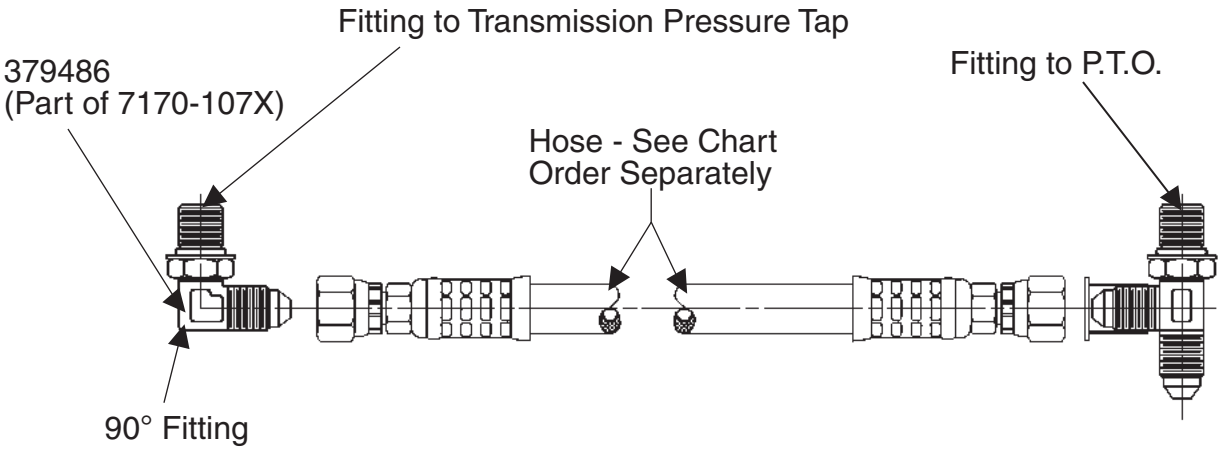
Installation "XY" Wet Spline 269 Series (SK-416 Rev B)





Pressure Hose Chart (Transmission to P.T.O.)		
Trans	**Location**	**Hose**
MD	Left	329130-5X
MD	Right	329075-1X
HD	Left	329075-4X
HD	Top Right	329075-2X

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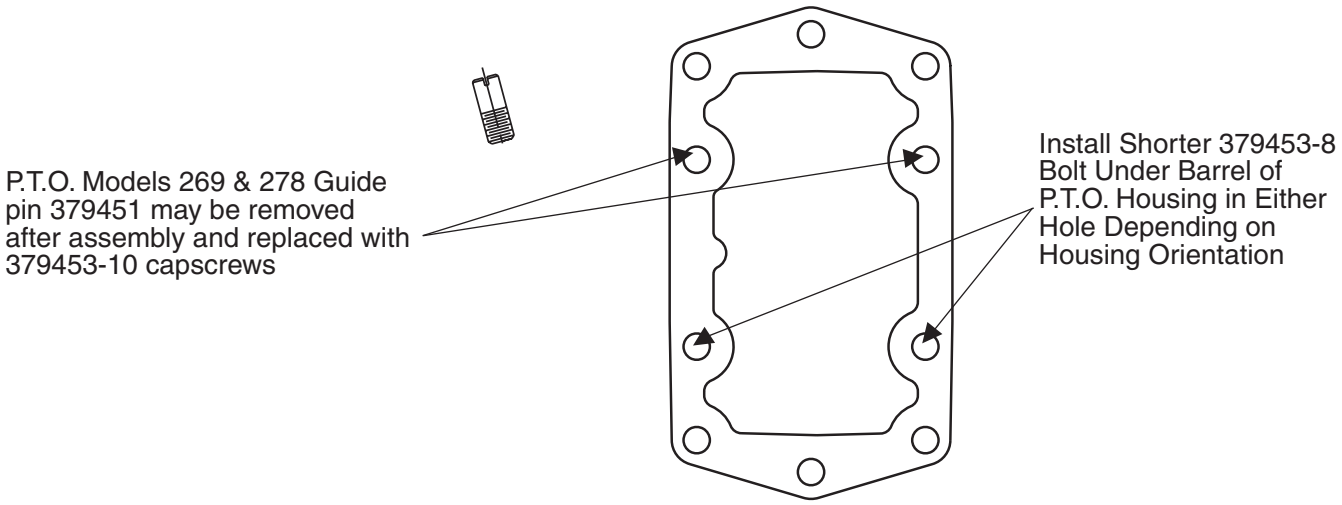
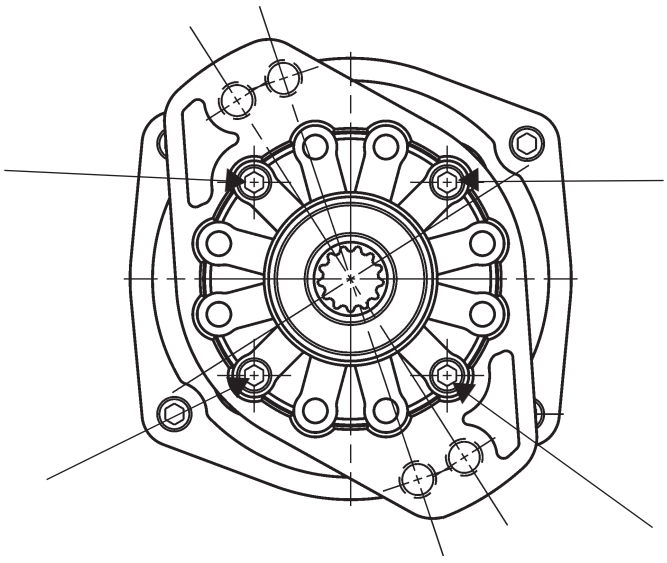
269 & 278 Series Installation Mounting Kit Instructions (SK-355 Rev A)



Installing Rotatable Flanges

The rotatable flange is shipped loose with the P.T.O. units for ease of installation. After determining the flange position, attach the flange to the P.T.O. bearing cap using the capscrews provided in the bag kit. Bag kit number 328170-207X (6-bolt family) will contain (3) capscrews (378447-6) and 328170-208X (277 Series) will contain (4) capscrews for attaching the flange to the P.T.O. bearing cap.
After installing the capscrews make sure to torque the screws to 16-20 Lbs. ft.
Consideration should be taken on the size and weight of the pump being installed. (see pages 3 and 4)



RA Flange Shown

NOTE: Reinstalling or tightening of a rotatable flange after it has become loose is not recommended. If a P.T.O. has run for a length of time after the flange has become loose, the flange and / or bearing cap may not be to manufacturing tolerance.

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P.T.O. Shifting Procedure & Precautions

CAUTION: This vehicle is equipped with a Power Take-Off. Shut engine off before working on the Power Take-Off or getting below the vehicle. Consult the operating instructions before using the P.T.O. (See sun visor.)

POWER TAKE-OFF OPERATION — VEHICLE STATIONARY

Automatic Transmission with Powershift P.T.O.s

Engage the P.T.O. with the engine at idle speed.

NOTE: Powershift P.T.O.s: The engine must be at idle or below 1000 R.P.M. when the P.T.O. is engaged. See the transmission manufacturer's instructions for special procedures.

IMPORTANT:

Failure to follow the proper shifting or operating sequences will result in premature P.T.O. failure with possible damage to other equipment.

Warning: Cold Weather Operation of Powershift P.T.O.s

During extreme cold weather operation [32° F (0° C) and lower], a disengaged Powershift Power Take-Off can momentarily transmit high torque that will cause unexpected output shaft rotation. This is caused by the high viscosity of the transmission oil when it is extremely cold. As slippage occurs between the Power Take-Off clutch plates, the oil will rapidly heat up and the viscous drag quickly decreases.

The Power Take-Off output shaft rotation could cause unexpected movement of the driven equipment, resulting in serious personal injury, death, or equipment damage.

To avoid personal injury or equipment damage:

- Driven equipment must have separate controls.
- Driven equipment must be left in the disengaged position when not in operation.
- Driven equipment must not be operated until the vehicle is allowed to warm up.

This symbol warns of possible personal injury.

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Notes

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Power Take-Off Maintenance

Due to the normal and sometime severe torsional vibrations that Power Take-Off units experience, operators should follow a set maintenance schedule for inspections. Failure to service loose bolts or Power Take-Off leaks could result in potential auxiliary Power Take-Off or transmission damage.

Periodic P.T.O. MAINTENANCE is required by the owner/operator to ensure proper, safe and trouble free operation.

Daily: Check all air, hydraulic and working mechanisms before operating P.T.O. Perform maintenance as required.

Monthly: Inspect for possible leaks and tighten all air, hydraulic and mounting hardware, if necessary. Torque all bolts, nuts, etc. to Chelsea specifications. Insure that splines are properly lubricated, if applicable. Perform maintenance as required.

With regards to the direct mounted pump splines, the P.T.O. requires the application of a specially formulated anti-fretting, high pressure, high temperature grease. The addition of the grease has been proven to reduce the effects of the torsional vibrations, which result in fretting corrosion on the P.T.O. internal splines as well as the pump external splines. Fretting corrosion appears as a "rusting and wearing" of the pump shaft splines. Severe duty applications, which require long P.T.O. running times and high torque may require more frequent regreasing. Applications such as Utility Trucks that run continuously and are lightly loaded also require frequent regreasing due to the sheer hours of running time. It is important to note that service intervals will vary for each and every application and is the responsibility of the end user of the product. Chelsea also recommends that you consult your pump owners manuals and technical services for their maintenance guidelines. Fretting corrosion is caused by many factors and without proper maintenance; the anti-fretting grease can only reduce its effects on components.

Chelsea offers the grease to our customers in two packages. The first is a 5/8 fluid ounce tube (379688), which is included with every applicable P.T.O., and the second is a 14-ounce grease cartridge (379831). Chelsea also offers greaseable shafts for most all output designators.

Warranty: Failure to comply entirely with the provisions set forth in the appropriate Owner's Manual will result in voiding of ALL Warranty consideration.

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Offer of Sale

The items described in this document and other documents or descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors are hereby offered for sale at prices to be established by Parker Hannifin Corporation, its subsidiaries and its authorized distributors. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any such items, when communicated to Parker Hannifin Corporation, its subsidiary or an authorized distributor ("Seller") verbally or in writing, shall constitute acceptance of this offer.

1. Terms and Conditions of Sale: All descriptions, quotations, proposals, offers, acknowledgments, acceptances and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions stated herein. Buyer's acceptance of any offer to sell is limited to these terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to. No such additional, different or inconsistent terms and conditions shall become part of the contract between Buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditional upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer, Acceptance of Seller's products shall in all events constitute such assent.

2. Payment: Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Amounts not timely paid shall bear interest at the maximum rate permitted by law for each month or portion thereof that the Buyer is late in making payment. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.

3. Delivery: Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

4. Warranty: Seller warrants that the items sold hereunder shall be free from defects in material or workmanship for a period of:

(A) All Power Take-Off units one (1) year from date of installation.

(B) Except 267, 277, 278, 242, 244, 246, 250, 251 and 859 series two (2) years from date of installation. **THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED. NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRANTIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY, TO BUYER'S DESIGNS OR SPECIFICATIONS.**

5. Limitation Of Remedy: SELLER'S LIABILITY ARISING FROM OR IN ANY WAY CONNECTED WITH THE ITEMS SOLD OR THIS CONTRACT SHALL BE LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE ITEMS SOLD OR REFUND OF THE PURCHASE PRICE PAID BY BUYER, AT SELLER'S SOLE OPTION. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS ARISING FROM OR IN ANY WAY CONNECTED WITH THIS AGREEMENT OR ITEMS SOLD HEREUNDER, WHETHER ALLEGED TO ARISE FROM BREACH OF CONTRACT, EXPRESS OR IMPLIED WARRANTY, OR IN TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, FAILURE TO WARN OR STRICT LIABILITY.

6. Changes, Reschedules and Cancellations: Buyer may request to modify the designs or specifications for the items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

7. Special Tooling: A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

8. Buyer's Property: Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property, Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Taxes: Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

10. Indemnity For Infringement of Intellectual Property Rights: Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. Patents, U.S. Trademarks, copyrights, trade dress and trade secrets (hereinafter 'Intellectual Property Rights'). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgments resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

11. Force Majeure: Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter 'Events of Force Majeure'). Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carriers or suppliers, shortages of materials and any other cause beyond Seller's control.

12. Entire Agreement/Governing Law: The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain there/to. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

1/06-P

Parker Chelsea

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