HL-3
OWNER/OPERATOR MANUAL

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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.

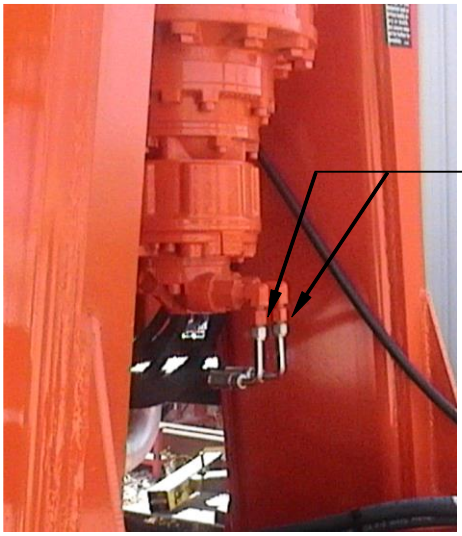
Model HA36 Rotary Actuator, Restrictor Size = .056
Model SAI Rotary Actuator, Restrictor Size = .110

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

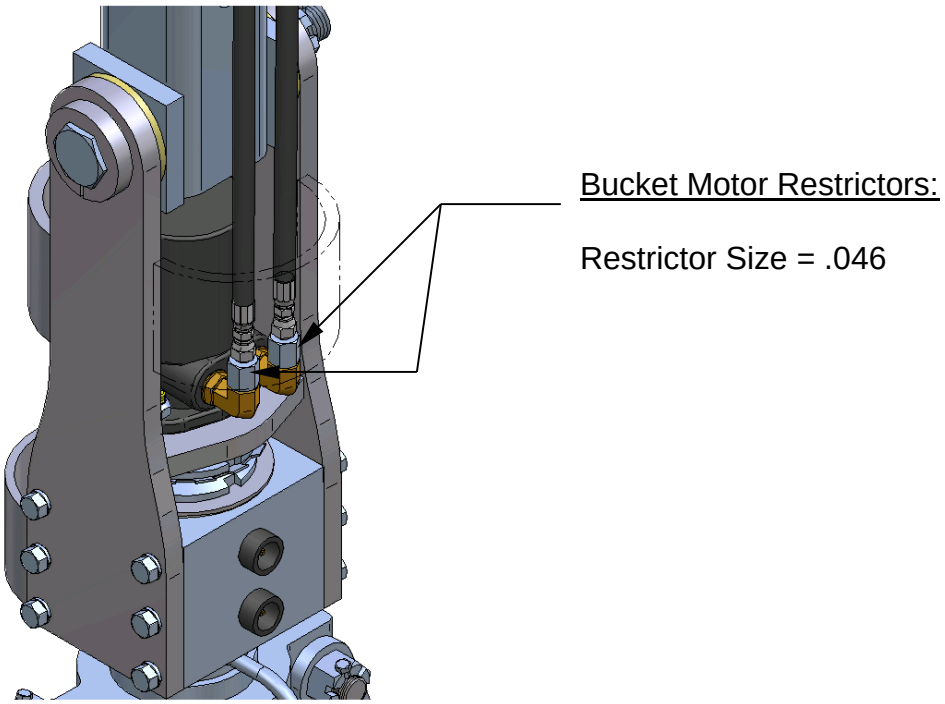
Gearbox Actuator Restrictor Size = .110

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 cartridge 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.

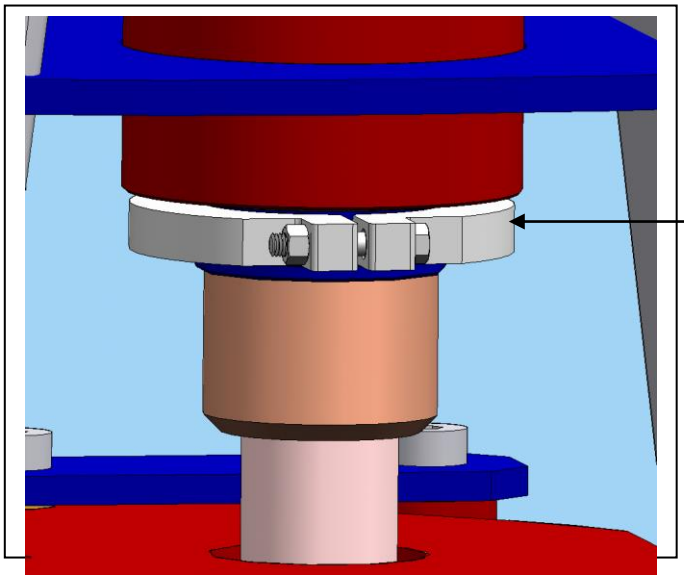
- Excessively packing the load with the boom. Evidence of this may be the bulkhead of the body may be bowed outward.

- 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 the Head and Pedestal Diagram found 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.

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)

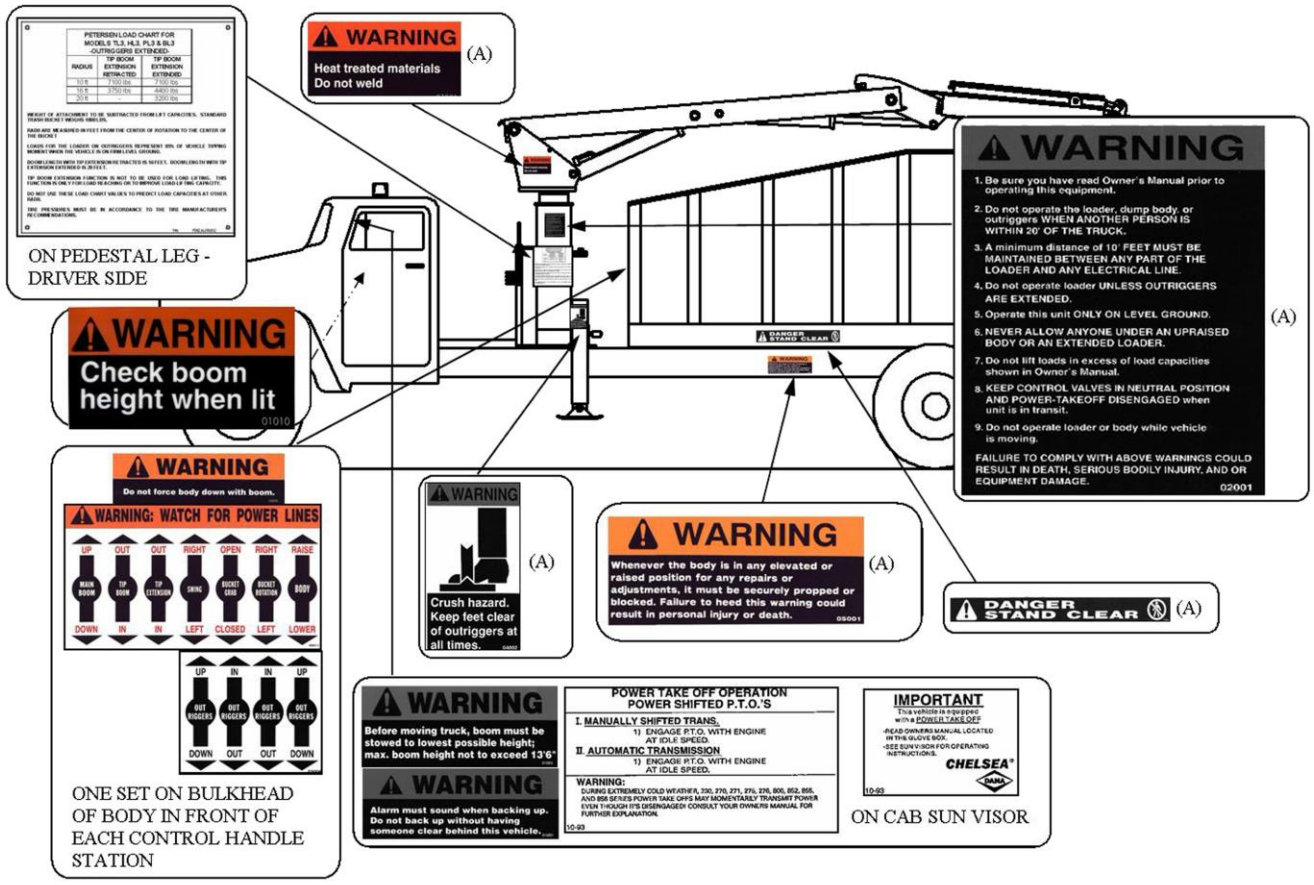
The following definitions for identifying hazard levels are provided with their respective signal words.

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.

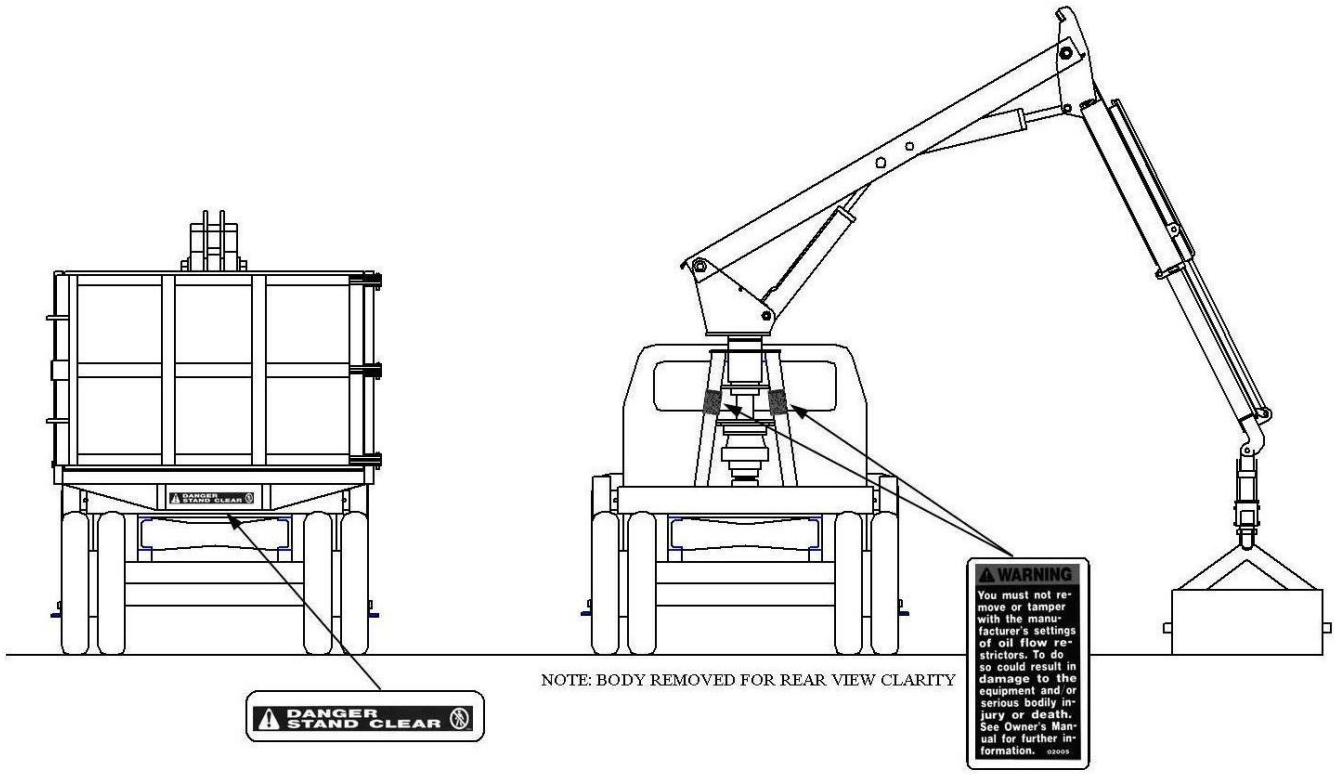
CAUTION Hazards or unsafe practices which COULD result in minor personal injury or product or property damage.

MODEL TL-3 TRASH LOADER - REQUIRED SAFETY DECALS



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

MODEL TL-3 TRASH LOADER - REQUIRED SAFETY DECALS



NOTE: BODY REMOVED FOR REAR VIEW CLARITY

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

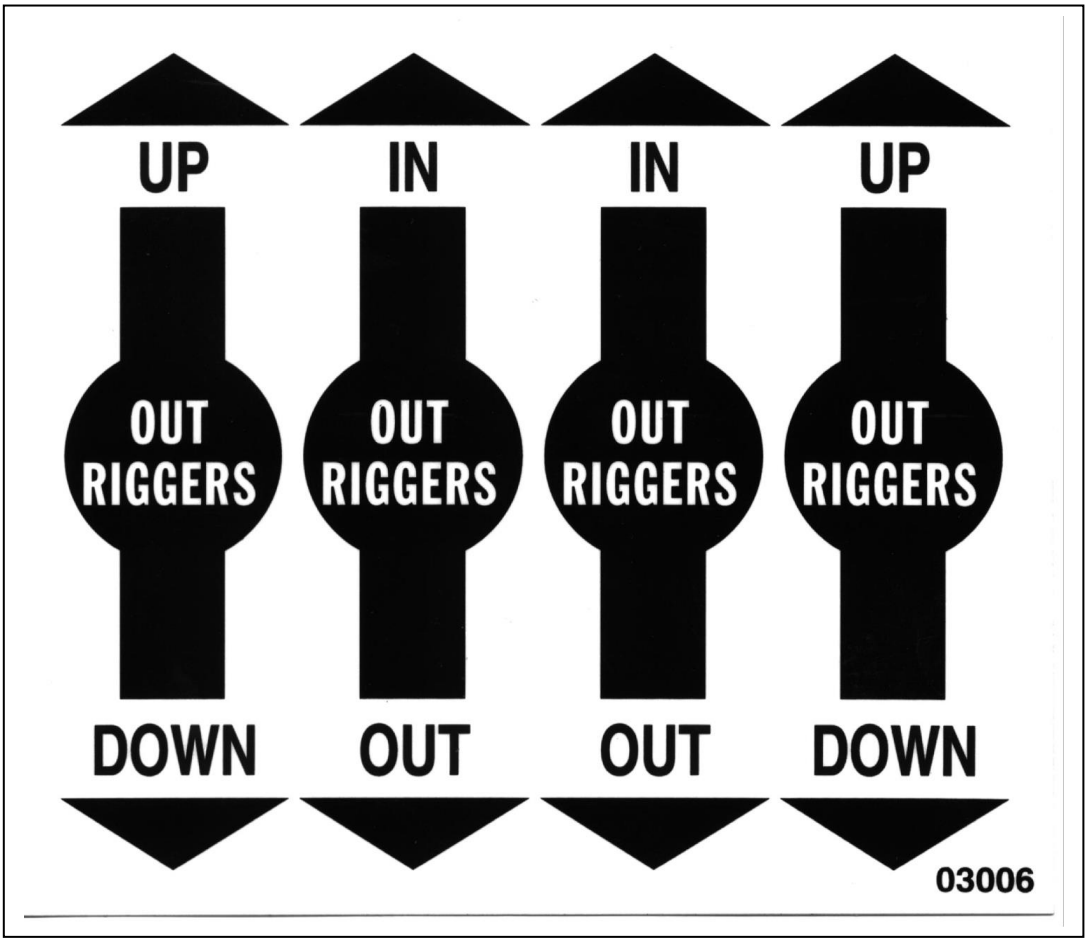
The truck brake must be set before leaving the cab for any reason.

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, bucket rotation, and body dump. The outrigger placard gives visual instructions for horizontal outrigger in/out, and vertical outrigger up/down.

Outriggers:

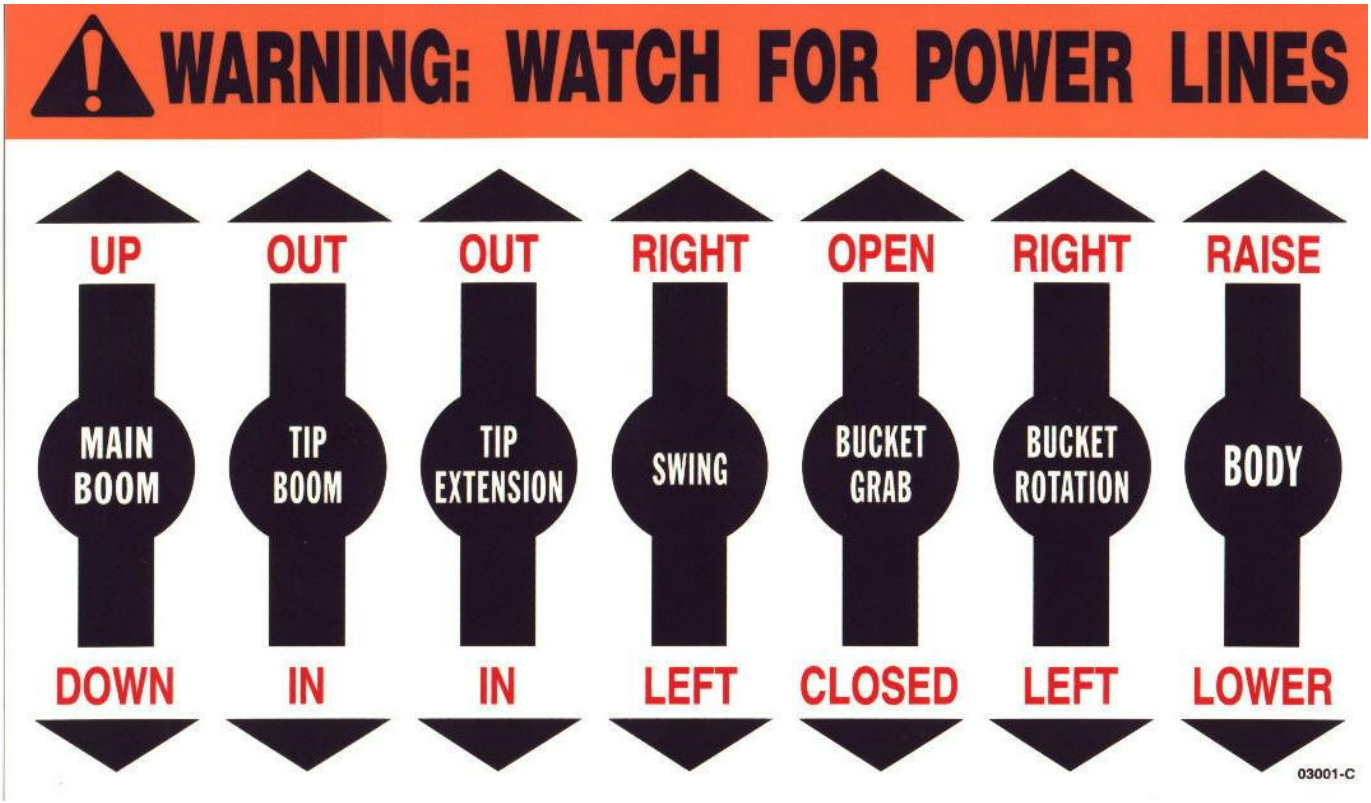
The Model TL3 Loader has outrigger handles mounted below the other control handles. There is a set of four (4) handles on each side of the work platform on loaders with dual walk thru controls, and they are configured the same on each side of the platform. In the four (4) handle configuration, the two (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.



Loader and Dump Body:

The standard Model TL3 has seven (7) control handles that activate the loading and dumping 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.

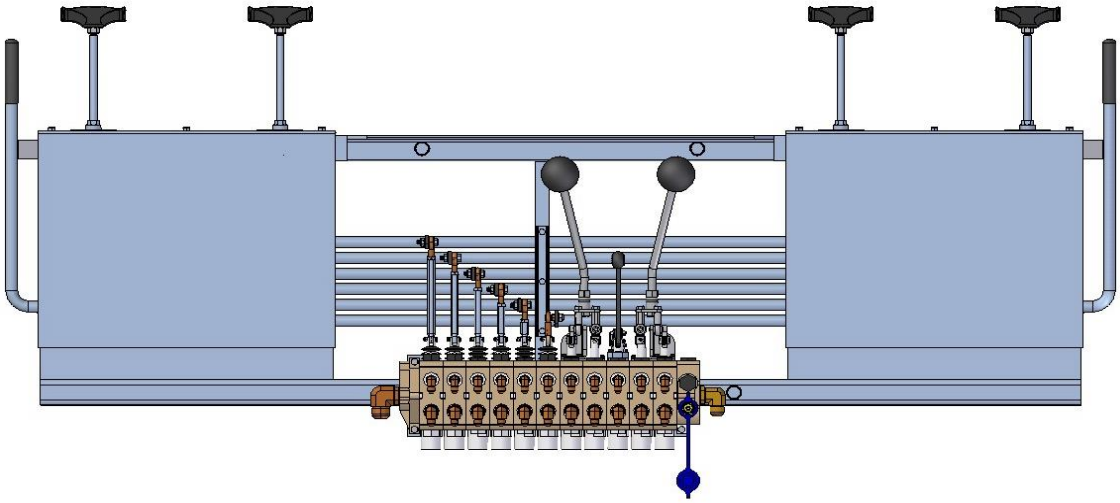


On units equipped with dual controls, always operate the loader on the side closest to the debris being loaded. Do not store any collectibles on the operator's platform, as they can create a tripping hazard or become lodged in the controls.

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.

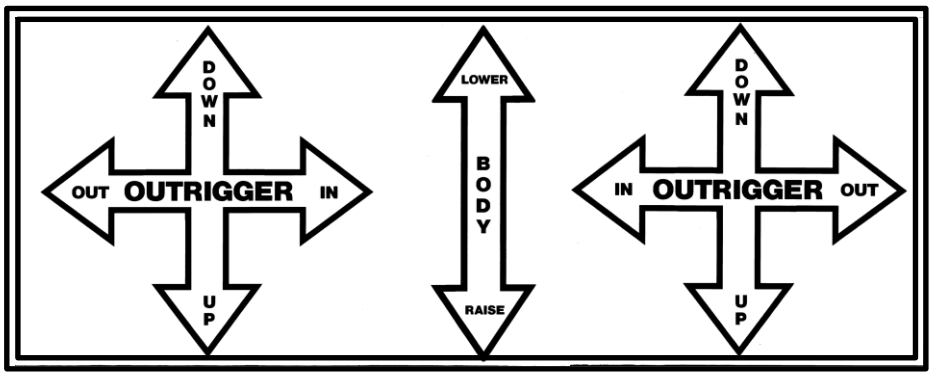


At the center of the work platform are three (3) control handles. The two handles with the round knobs are the outrigger control handles. The round knob on the left controls the left outrigger, and the round knob on the right controls the right outrigger. The handle between the outrigger control handles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

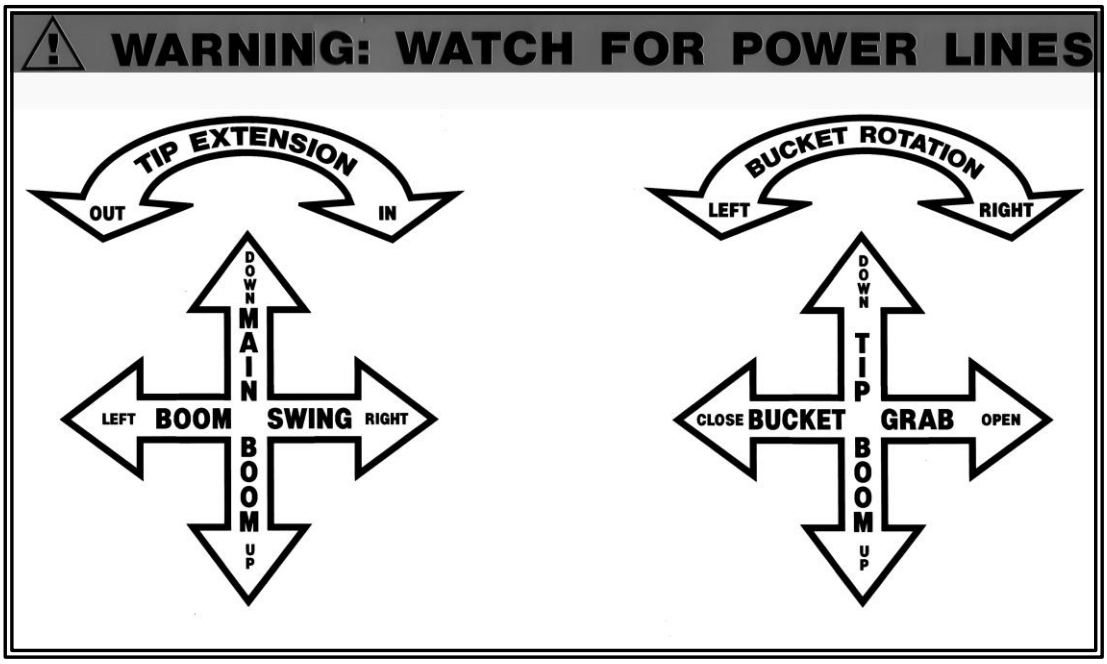
Right Outrigger Handle:

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 of 1400 revolutions per minute.

<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 cover the load:

When using a Petersen manufactured and installed load cover, please follow these procedures:

1. Knuckle the bucket to the front of the dump body.

2. Hook the tarp chain to the hook on the bucket.

3. Extend the boom to cover the debris, and rest the bucket on the 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.

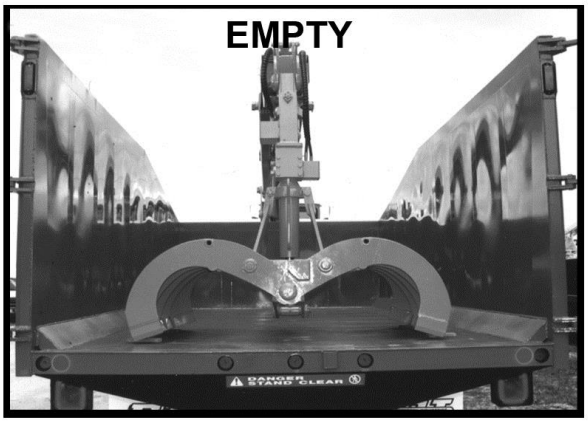
5. Simultaneously boom down and swing the boom to the street side until the boom tip and at least half of the bucket are below top of body sides. Ensure that no part of the loader or load is over legal height of 13 ft. 6 in.

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: Dumping the Load

As you prepare to dump the load, 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.

2. Open the rear dump body doors and latch them back. Use caution when opening doors, as items placed against doors could fall suddenly when doors are opened and cause injury.

3. Engage the power-take-off and turn on the loader switch if you applicable.

4. Extend the outrigger on both sides and lower to within six to eight inches of the ground. This allows for emergency stabilization, and movement of the truck.

5. If your load is covered with a tarp, as discussed in "Covering the Load", retract the tarp.

6. Raise the main boom to the maximum elevation and keep it centered over the dump body during the entire dumping procedure.

7. Place the tip boom in a position so that it will not contact the bulkhead of the dump body when the dump body is raised. Do not swing the boom to either side during the dumping procedure, as the outriggers are not fully lowered.

8. Activate the body dump handle. Slowly raise the body to empty the load. Make sure you avoid contact between the main boom and tip boom, and the dump body.

9. If the emptied pile prevents complete dumping of body contents, disengage the PTO. SLOWLY move the truck forward to complete dumping of the body. Remember, the outriggers are partially down and the boom is raised. Extreme caution should be used during this procedure.

   This is not a procedure to force debris out of the dump body. If there is debris stuck in the dump body, lower the dump body and dislodge the debris with the loader.

10. When you have finished dumping the load, lower the dump body. Stow the boom and bucket in the dump body with bucket open and resting on body floor.

11. Retract and raise the outriggers, and disengage the power-take-off. Turn off the loader switch if applicable.

12. Close and lock body rear doors.

Safety Precautions Regarding Dumping Procedure:

- Do not use the loader boom to force the dump body down when lowering the dump body.
- Do not dump the load until the rear body doors are latched open. The doors and body hinges can be damaged if doors are allowed to swing freely during the dumping procedure.
- Do not travel with rear body doors open. They must be closed and locked for travel.

Part 9: Loading and Off-Loading the Loader Unit

To Load HL3 Loader Onto Hook-Lift Mechanism:

1. Extend the truck hook lift mechanism to a position approximately equal in height to that of the hook eye of the HL3 Loader.

2. Back the truck to a position to engage the truck hook with the hook eye while aligning the longitudinal rails of the HL3 Loader with the flanged rollers of the hook lift mechanism.

3. Engage the hook with the hook eye and retract the hook lift mechanism forward to pull the HL3 Loader up onto the hook lift rollers. Make sure that the longitudinal rails are centered on the flanged rollers of the hook lift mechanism. Once the loader rails are properly aligned on the rollers, place the truck's drive train into the "N", neutral position, and continue the hook lift's loading cycle until the loader is completely onto the hook lift frame. During this loader procedure, the hook lift mechanism will pull the truck backward as the loader loads onto the frame.

4. Before making any hydraulic connections, you must disengage the truck PTO or turn off the truck engine. You do not want hydraulic fluid flowing through the hydraulic lines during the connection procedure. Hot hydraulic fluid under pressure can cause serious personal injury.

5. Connect the quick connect couplers to the mating connections on the hook lift.

6. Connect the electrical pigtail, shown on right in photograph below, from the HL3 Loader to truck's electrical system. Connect the case drain hose (SAI only) shown on left. These connections are located adjacent to the hydraulic quick connect hoses.

7. Start the truck engine and engage the truck PTO (when no separate PTO switch, use the mode button on automatic engines). If the system is a hydraulic tie in you must also activate the loader switch to divert fluid to the loader system. Hydraulic fluid pressure will now be available to the HL3 valve bank. Engage the hydraulic frame lock mechanism to lock the HL3 Loader to the truck frame. The control handle for this function is the single handle located at the valve bank on the operator's platform.

8. Make sure outriggers are fully retracted before moving the truck.

9. The HL3 Loader is now ready to operate.

To Off-Load HL3 Loader:

Note: Before beginning the off-loading procedure, the dump body of the HL3 Loader must be empty.

1. Make sure that the outriggers are extended laterally so that the footpads will clear the truck during the off-loading procedure.

2. Disengage the frame lock mechanism.

3. Either disengage the truck PTO or turn off the truck engine. If your system has a hydraulic tie in turn off the loader switch. Remember, do not disconnect hydraulic lines under pressure, as hot hydraulic fluid can cause serious personal injury.

4. Disconnect the quick connect couplers from the hook lift, and cap the hoses.

5. Disconnect the electrical pigtail connection.

6. Start the truck engine and engage the truck PTO. Engage the hook lift mechanism to off-load the HL3 Loader. When the under-ride bumper of the HL3 Loader makes contact with the ground, place the truck's drive train into the "N", neutral position, and continue the hook lift's unloading cycle until the loader is at rest and supported by its under-ride bumper and outrigger foot pads.

7. Make sure that the hook of the hook lift mechanism is completely free of the hook eye of the HL3 Loader, and that the hook lift mechanism is fully retracted before driving the truck away.

Part 1: Safety Procedures and Precautions for Service and Repair

A regular schedule of maintenance is essential to keep your unit at peak operating efficiency. Operators or service personnel responsible for the care of the unit must be completely familiar with the type and frequency of inspections, maintenance, and lubrication operations to be performed.

Always keep the loader free from sand and other foreign particles to ensure trouble-free operation and to avoid excessive wear. Air entering the oil tank carries with it small quantities of impurities and moisture. The hydraulic oil should be drained at least once a year to rid the system of any contamination and condensation.

The hydraulic circuit diagram is included in the “Dia. & Drawings” section of this manual for service or maintenance information.

Make sure you observe the following procedures and precautions when performing maintenance and/or repairs on your equipment.

Safety Procedures and Precautions for Service and Repair
➢ Do not perform any work on the loader unless you are qualified and authorized to do so. ➢ Loader is placed where it will cause the least interference with other equipment or operations in the area. ➢ All controls at the off position and all operating features in neutral position. ➢ Do not attempt to clean, oil or service a loader when the power-take-off is engaged. ➢ Deactivate means for starting. Use lockout-tagout procedure. See lock-out/tag-out procedures on following page. ➢ Bucket and boom at rest on ground or floor of dump body. ➢ Do not disconnect hydraulic connections under pressure. Hot hydraulic fluid can cause serious injury. Stay clear of hydraulic leaks as high pressure and hot hydraulic fluid can cause serious injury. ➢ Always use dump body prop(s) before servicing or repairing body or hoist. Never leave the body raised or partly raised while vehicle is unattended or

while performing maintenance or service under the body, unless the body is braced to prevent accidental lowering.

Lock-out/Tag-out Procedure (LOTO)

1. With the vehicle parked on level firm ground, set the parking brake and chock the wheels.

2. Place operating equipment at lowest potential energy level or position so as not to be subject to possible free fall, and/or install additional blocking device(s) to prevent this potential for any raised or elevated equipment such as bodies, tail or side gates, booms, bucket or other attachments.

3. If work on the bucket is required, place the bucket outside the body by first setting the outriggers, second, positioning the bucket over the side of the truck and finally, lowering the boom until the bucket is on the ground.

4. If it is necessary to raise the body during LOTO, the body prop must be in place to secure the body from falling.

5. Disengage the PTO and shut down the truck engine.

6. Remove the key from the ignition.

7. Using a non-reusable fastener, secure a LOTO tag to the steering wheel indicating the vehicle is out of service.

8. Relieve stored energy from the hydraulic components by moving each control handle back and forth several times. Cylinders equipped with either pilot operated check or counterbalance valves will not function unless under hydraulic power.

Modification to any part of the loader can create a safety hazard and therefore shall not be made without the manufacturer's written approval. It is important that you use factory replacement parts to ensure that size and capacity are as the original parts.

It is important that hydraulic components be rated at proper flow and pressure. If your loader is rebuilt or remounted, mounting procedures and retesting is required in accordance with factory instructions.

Disconnecting, removing, or disabling any part or component which controls the speed of the loader is a misuse of the loader.

The following lists inspections and maintenance which are to be conducted on your unit to help assure it is operating properly and safely. These inspections are in addition to any inspections previously listed, such as daily inspections. Check all items at the frequency listed and make necessary repairs prior to operating.

The following are minimum service requirements. Hard use or dirty operating conditions dictate more frequent inspection and maintenance.

After service adjustment, and repairs, the loader shall not be returned to service until all guards have been reinstalled, trapped air removed from the hydraulic system if required, safety devices reactivated, and maintenance equipment removed.

Part 2: Service:

AFTER FIRST 40 HOURS OF OPERATION (BREAK IN SERVICE)	
Re-torque boom swing actuator bolts.	To 500 ft. lbs (HA36) To 160 ft. lbs (Planetary Gearbox)
Replace return filter.	
Change oil in planetary gearbox (If applicable)	Drain existing oil from swing gearbox and replace with 7 quarts of 80W Gearlube

EVERY 40 HOURS OR WEEKLY	
Grease all fittings.	See Grease and Maintenance Diagram in the “Dia. & Drawings” section of this manual. Grease fittings that are worn and will not hold the grease gun, or those that have a stuck check ball, must be replaced. Grease = EP2 (Extreme Pressure)
Check hydraulic hoses for cuts or abrasions, or any evidence of binding or leakage.	Replace any damaged hoses.
Check all hydraulic fittings to make sure they are in place and do not show signs of leakage.	Replace any missing, damaged or modified fittings.
Tighten bucket brake pads.	If brake pads show excessive wear, replace. Tighten gimbal rotator bolt and tip boom gimbal bolt, if needed.
Check oil level.	All oil levels are to be checked with the loader parked on a level surface in transport position, and while the oil is cold, unless otherwise specified. Oil level should be two to three (2 to 3) inches from top of tank. Planetary Gearbox Oil should be visible on site glass. Hydraulic Oil = AW32 Gear Oil = 80W Gearlube

EVERY 40 HOURS OR WEEKLY	
Check engine overspeed control for proper setting.	Check by reving the engine to 350 RPM above the preset rpm on the remote throttle switch, at which point the PTO light should turn off if the engine overspeed is properly set. Reset if necessary.
Check the engine throttle control for proper setting.	Refer to the throttle control section of this manual for preset setting
Check lock collar for excess clearance.	Lock collar must be tight against bottom of spindle bearing housing with maximum gap of one-quarter inch (1/4").
Check back-up and boom-up alarms to make sure they are working properly.	Repair or replace if needed.

EVERY 80 HOURS OR EVERY 2 WEEKS *(These requirements are in addition to the 40 hour service requirements)*	
Re-torque boom swing actuator bolts.	To 500 ft. lbs (HA36) To 160 ft. lbs (Planetary Gearbox)
Re-torque bucket rotator bolts.	To 110 ft. lbs. - dry threads

EVERY 160 HOURS OR MONTHLY *(These requirements are in addition to the 80 hour service requirements)*	
Examine all loader pivot points (head and pedestal, main boom, tip boom, bucket and body) for visible play.	If visible play is observed at pivot points, bushings and/or pins must be replaced as needed.
Chassis - Check truck frame for cracks, loose or missing bolts, rivets, damaged springs or loose shackles.	See truck manufacturer's service manual for service and repair instructions.
Structural - Visually inspect complete loader for damage, especially cracks in weldments.	It is necessary for your loader to clean of oil and grease for these inspections to be made. The Petersen rotating head assembly has special high strength steel components that are welded together. After welding, the entire assembly receives post-weld heat treatment. **Do not** weld on the rotating head assembly. Welding on the rotating head could reduce its load bearing

	capacity and fatigue life.
Fasteners - Check all pins, sheaves, retainers, bolts and nuts.	Replace damaged or missing parts.
EVERY 160 HOURS OR MONTHLY *(These requirements are in addition to the 80 hour service requirements)*	
Retighten main boom and tip boom connecting bolts.	Replace if needed.

EVERY 160 HOURS OR MONTHLY *(These requirements are in addition to the 80 hour service requirements)*	
Re-torque loader tie-down bolts.	To 400 ft. lbs. - dry threads
Decals - Check for presence and legibility.	Check decal listing in “Part 3: Safety Devices – Safety Symbols” of this manual for required operational and safety decals. Replace missing or illegible decals.

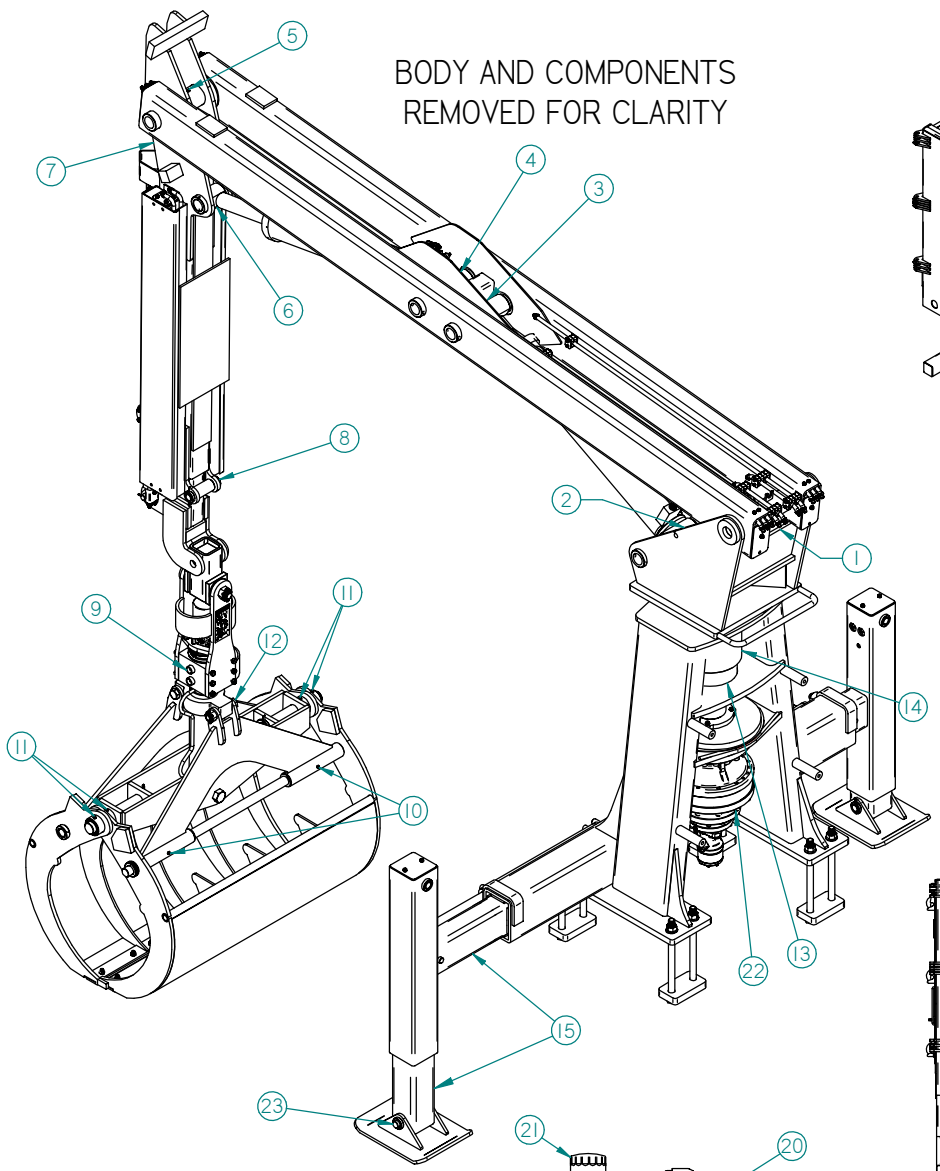
EVERY 600 HOURS OR 6 MONTHS *(These requirements are in addition to the 160 hour service requirements.)*	
Replace return line filter, replace breather. Note that breather may be integral with the oil tank cap.	

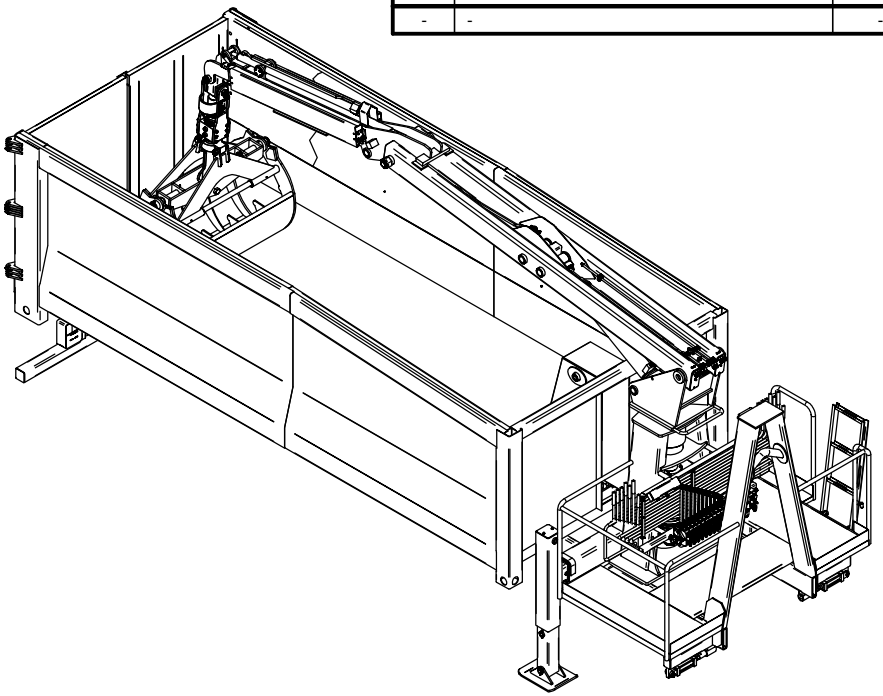
EVERY 3000 HOURS OR 12 MONTHS *(These requirements are in addition to the 600 hour service requirements.)*	
Change oil in planetary gearbox (if applicable)	Drain existing oil from swing gearbox and replace with 7 quarts of 80W Gearlube
Change hydraulic oil	

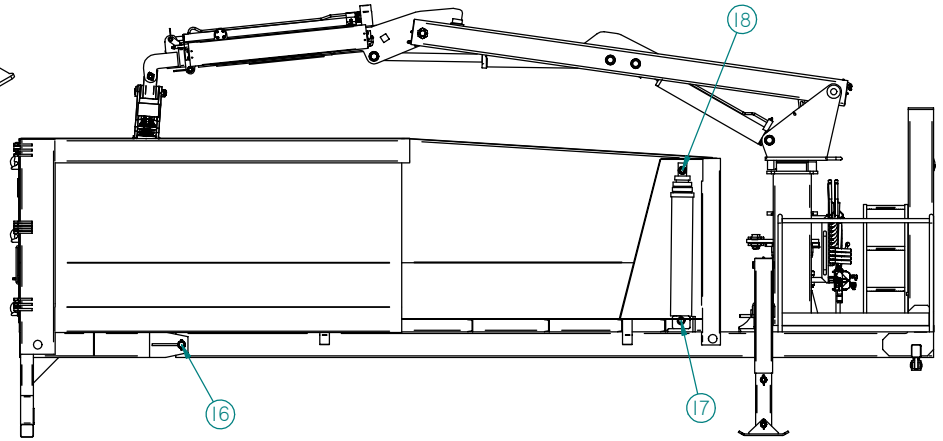
010 LUBRICATION POINTS

REV	DESCRIPTION	DATE	BY
-	-	-	-

BODY AND COMPONENTS
REMOVED FOR CLARITY







THIS IS A PI OIL TANK BUT THIS SYSTEM MAY BE TIED INTO THE ROLL OFF HYDRAULIC SYSTEM. IF THE PI SYSTEM IS TIED INTO THE ROLL OFF HYDRAULIC SYSTEM THE SAME REQUIREMENTS APPLY TO THE BREATHER, FLUID AND OIL FILTER BUT WITH THE ROLL OFF SYSTEM TANK.

TOLERANCES

1 DEC.	± 0.100
2 DEC.	± 0.025
3 DEC.	± 0.005
ANGLE:	± 1.000°
FRACTION:	± 1/32"
DIM. UNITS:	INCHES
SURFACE FINISH:	125/32

UNLESS OTHERWISE SPECIFIED

DEC. = DECIMAL PLACE(S)

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

TITLE: HL, ASSEMBLY LUBRICATION POINTS

PART NUMBER:	SCALE:
01 00 00 063 0	1:60

DRAWN BY:	APPROVED BY:	DATE:	SHEET:
SWB		07/16/2020	1 OF 2

Point Number	Maintenance Description	Number of Points	Lubricant	Application Method	Frequency
1	Main Lift Pivot	1	Grease	Pressure	40 Hours
2	Main Lift Cylinder Base End	1	Grease	Pressure	40 Hours
3	Main Lift Cylinder Rod End	1	Grease	Pressure	40 Hours
4	Tip Cylinder Base End	1	Grease	Pressure	40 Hours
5	Tip Boom to Main Pivot	1	Grease	Pressure	40 Hours
6	Tip Cylinder Rod End	1	Grease	Pressure	40 Hours
7	Tip Extension Tube	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	80 Hours
16	Rear Body Hinge	2	Grease	Pressure	40 Hours
17	Hoist Cylinder Lower Pivot	2	Grease	Pressure	40 Hours
18	Hoist Cylinder Upper Pivot	2	Grease	Pressure	40 Hours
19	Hydraulic Tank	1	ISO 32 Hyd Oil	Fill to Max Level	40 Hours
20	Hydraulic Filter	1	0T03008	Replace	1000 Hours
21	Hydraulic Tank Breather	1	0T05007	Replace	1000 Hours
22	Gearbox (if applicable)	1	80w Gearlube	Replace	3000 Hours
23	Outrigger Foot	2	Grease	Pressure	40 Hours

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TITLE: HL, ASSEMBLY LUBRICATION POINTS

PART NUMBER: 01 00 00 063 0

SCALE: NA

DRAWN BY: SWB

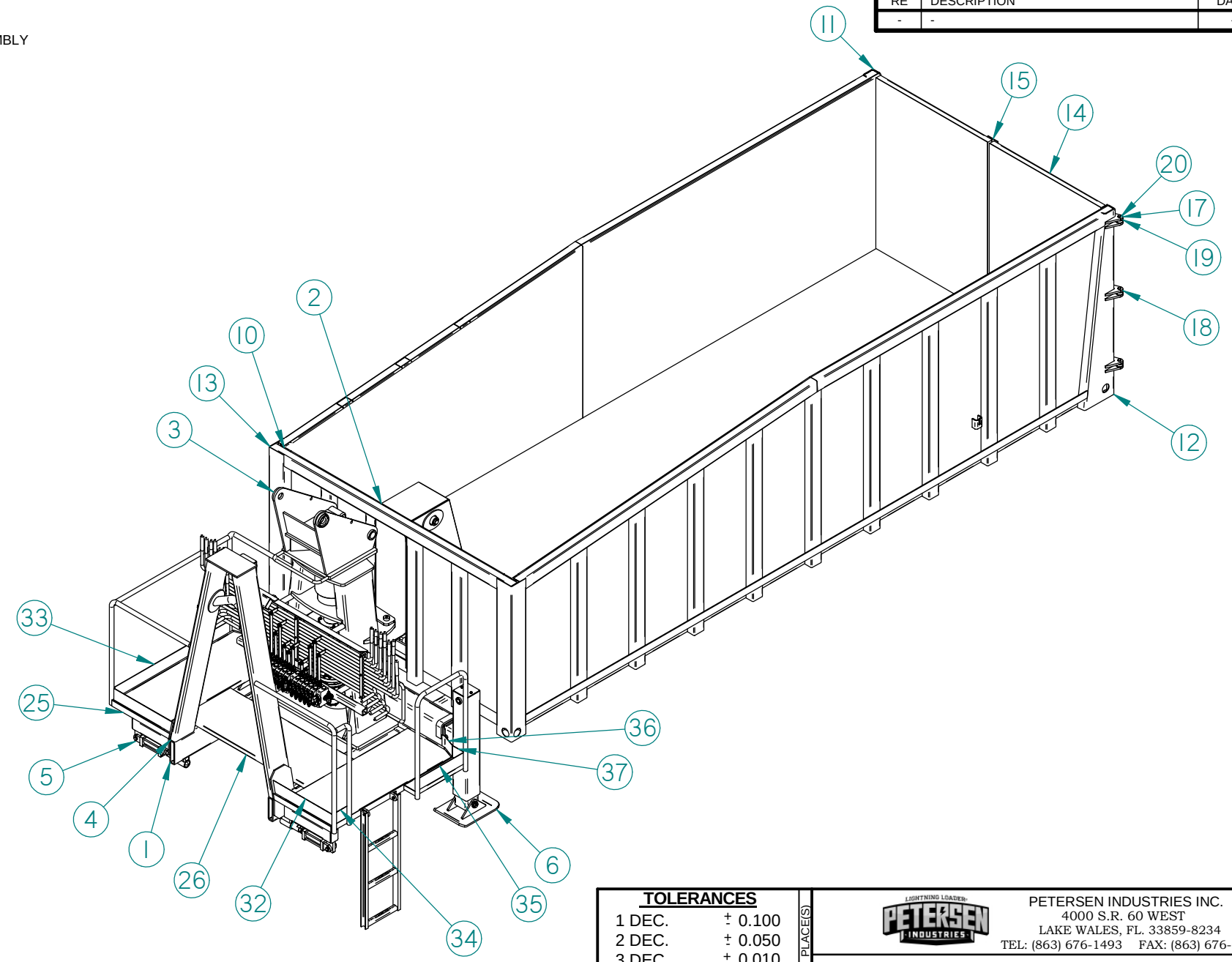
APPROVED BY:

DATE: 07/16/2020

SHEET: 2 OF 2

RE	DESCRIPTION	DATE	BY
-	-	-	-

010 ASSEMBLY



TOLERANCES

1 DEC.	± 0.100
2 DEC.	± 0.050
3 DEC.	± 0.010
ANGLE:	± 1.000°
FRACTION:	± 1/32"
DIM. UNITS:	INCHES
SURFACE FINISH:	125/32

UNLESS OTHERWISE SPECIFIED

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

TITLE: HL, 20 FT ASSEMBLY

PART NUMBER: 32 05 16 021 0 / 119499

SCALE: 1:40

DRAWN BY: SWB

APPROVED BY:

DATE: 01/07/2019

SHEET: 1 OF 4

Item #	Title	Document #	MACOLA	Qty
1	HL, 20 FT FLOOR WELDMENT	32 05 16 019 0	119496	1
2	HL, DOG HOUSE WELDMENT	32 05 16 009 0	119344	1
3	PEDESTAL, HL GEARBOX ASSEMBLY	22 02 17 002 0	106154	1
4	HL, A FRAME WELDMENT	32 05 16 017 0	119596	1
5	HL, FRAME LOCK ASSEMBLY	32 05 16 001 0	119342	2
6	TL3 MODEL 3 OUTRIGGER VERTICAL LEG ASSEMBLY	22 06 04 013 0	113119	2
7*	CYLINDER, FRONT MOUNT PARKER - HL	CY08002	CY08002	1
8*	OUTRIGGER IN/OUT CYLINDER	CY05001	CY05001	2
9*	STANDARD CONTROL FOR VB WITH MID INLET ASSEMBLY	22 07 01 003 0	129150	1
10	HL, HEADBOARD WELDMENT	32 05 16 014 0	119350	2
11	BODY, TBS 2026 SIDE WALL, CURB SIDE, HL WELDMENT	32 05 16 022 0	119623	1
12	BODY, TBS 2026 SIDE WALL, STREET SIDE, HL WELDMENT	32 05 16 023 0	119624	1
13	BODY, TBS HEADBOARD, TOP RAIL, HL	42 05 16 074 0	119622	1
14	BODY, TRASH, STD 18FT X 24CU.YD., DS DOOR WELDMENT	32 05 07 002 0	119110	1
15	BODY, TRASH, STD 18FT X 24CU.YD., PS DOOR WELDMENT	32 05 07 001 0	119114	1
16*	BODY, 1824 BARN DOOR LOCK ASSEMBLY	32 05 07 006 0	119123	1
17	BODY DOOR HINGE BASE	41 05 14 007 2	119287 / ACI215	12
18	FLAT WASHER 3/4 USS	WAF12U5	WAF12U5	12
19	BODY, DOOR HINGE STRAP	41 05 14 008 0	119288	6
20	CLEVIS PIN 3/4 X 2-3/4	42 05 09 019 0	FA011244	6
21*	HL, DUMP HINGE PIN	42 05 16 075 0	119657	1
22*	HEX BOLT 3/8-16 X 3.00 USS G5	BL306048U516	BL306048U516	2
23*	NUT HEX 3/8 -16 UNC STOVERLOCK	NUS06U	NUS06U	2
24	HL, RH PLATFORM WELDMENT	32 05 16 018 0	119652	1
25	HL, LH PLATFORM WELDMENT	32 05 16 024 0	119753	1

Item #	Title	Document #	MACOLA	Qty
26	HL, PLATFORM GRIP STRUT, CENTER	42 05 16 070 0	119651	1
27	HL, HAND RAILS, LEFT SIDE	42 05 16 054 0	119534	2
28	HL, HAND RAIL, RIGHT SIDE	42 05 16 057 0	119537	1
29	HL, HAND RAIL TUBE, STRAIGHT	42 05 16 061 0	119597	1
30	HL, HAND RAIL TO LADDER, LEFT SIDE	42 05 16 055 0	119535	1
31	HL, HANDRAIL STREET SIDE	42 05 16 084 0	119758	1
32	PLATFORM, HL, FRONT KICK PANEL	42 05 16 080 0	119754	2
33	PLATFORM, HL, LH SIDE KICK PANEL	42 05 16 081 0	119755	1
34	PLATFORM, HL RH KICK PANEL 1	42 05 16 082 0	119756	1
35	PLATFORM, HL RH KICK PANEL 2	42 05 16 083 0	119757	1
36	HL, RH EXTENSION KICK PLATE 2	42 05 16 087 0	119762	1
37	HL, RH EXTENSION KICK PLATE 1	42 05 16 086 0	119761	1

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TITLE: HL, 20 FT ASSEMBLY

PART NUMBER: 32 05 16 021 0 / 119499

SCALE: NA

DRAWN BY: SWB

APPROVED BY:

DATE: 01/07/2019

SHEET: 4 OF 4

010 ASSEMBLY

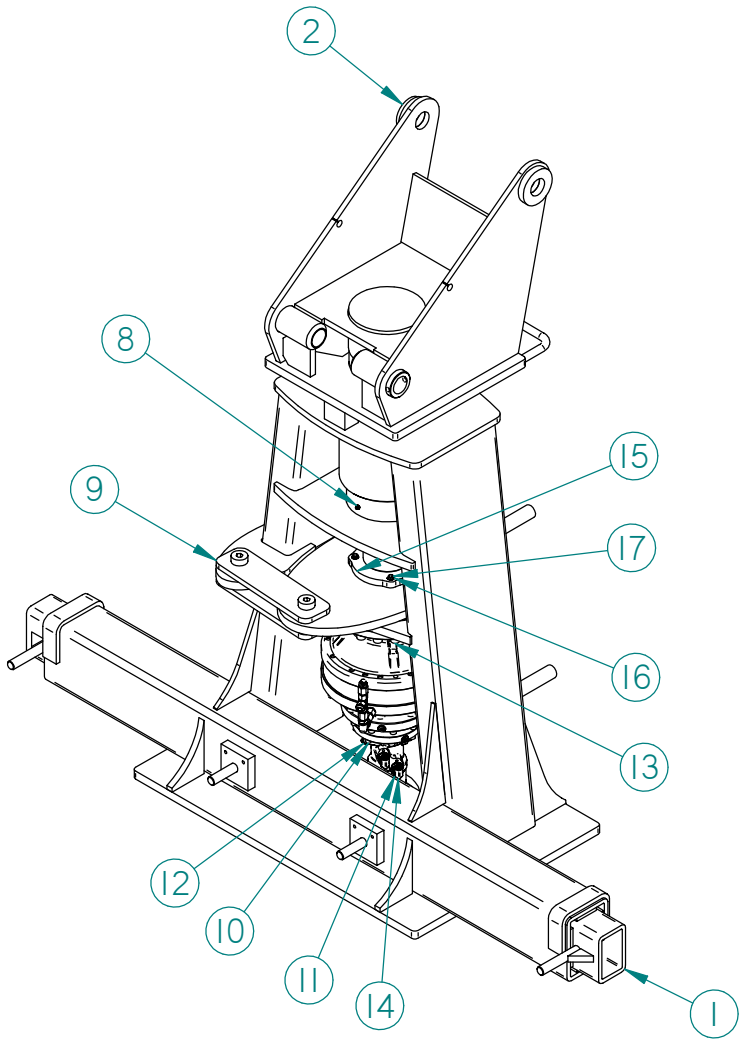
REV.	DESCRIPTION	DATE	BY

TORQUE SPECIFICATIONS:

- GEARBOX BOLTS SCAI032C
  BOLTS SHOULD BE OIL FREE
  & HAVE RED LOCK TIGHT APPLIED.
  TORQUE TO 160 FT-LB.

- MOTOR BOLT FAIII2MM28
  TORQUE TO 60 FT-LB & INSTALL
  LOCK CLIPS & SNAP RINGS.

Item #	Title	Document #	MACOLA	Qty
1	PEDESTAL, HL GEARBOX WELDMENT	22 02 17 001 0	106153	1
2	HEAD WELDMENT FOR GEARBOX	31 01 06 005 1	107105	1
3"	TRASH HEAD-PEDESTAL SPACER	41 02 15 001 2	106210	1
4"	TRASH HEAD PEDESTAL NYLATRON SPACER	41 02 15 027 0	BU510002	1
5"	TRASH HEAD LOCK - COLLAR	41 01 06 004 0	117103	2
6"	BOLT HEX 1/2-13 X 3.00 USS G5	BL308048U513	BL308048U513	2
7"	HEX NUT 1/2-13 STOVERLOCK	NUS08U	NUS08U	2
8	HYDRAULIC, .125 STRAIGHT GREASE FITTING	HF2002S	HF2002S	2
9	GEARBOX TORQUE ARM ASSEMBLY - INLINE	31 02 07 002 4	114101	1
10	DINAMIC OIL SLEWING GEARBOX	HC01005	HC01005	1
11	HYDRAULIC MOTOR	HC01006	HC01006	1
12	MOTOR LOCKING BOLT	FAA1112MM28	FA1112MM28	2
13	GEARBOX MOUNTING BOLT	SCAI032C	SCAI032C	20
14	HYDRAULIC, #6 JIC X #10 M OR 90	HF10610JM9	HF10610JM9	2
15	TORQUE ARM, DEBRIS COVER	42 02 13 011 0	114206	1
16	WASHER FLAT 5/16 USS	WAF05U5	WAF05U5	4
17	HEX BOLT 5/16-18 X 1.50 USS G5	BL305024U518	BL305024U518	4



TOLERANCES

1 DEC.	± 0.100
2 DEC.	± 0.050
3 DEC.	± 0.010
ANGLE:	± 1.000°
FRACTION:	± 1/32"
DIM. UNITS:	INCHES
SURFACE FINISH:	125/32

UNLESS OTHERWISE SPECIFIED

DEC. = DECIMAL PLACE(S)

LIGHTNING LOADER: PETERSEN INDUSTRIES

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

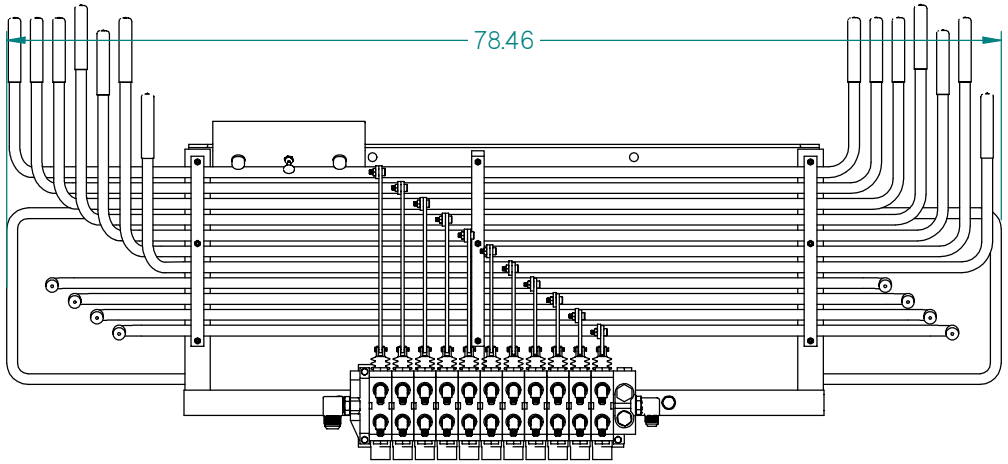
TITLE: PEDESTAL, HL GEARBOX ASSEMBLY

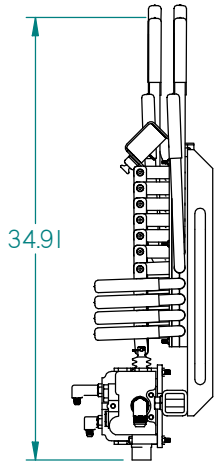
PART NUMBER:	SCALE:
22 02 17 002 0 / 106154	1:20

DRAWN BY:	APPROVED BY:	DATE:	SHEET:
SWB		04/12/2018	1 OF 1

010 ASSEMBLY

REV.	DESCRIPTION	DATE	BY
-	-	-	-





TOLERANCES

1 DEC.	± 0.100
2 DEC.	± 0.050
3 DEC.	± 0.010
ANGLE:	± 1.000°
FRACTION:	± 1/32"
DIM. UNITS:	INCHES
SURFACE FINISH:	125/32

UNLESS OTHERWISE SPECIFIED

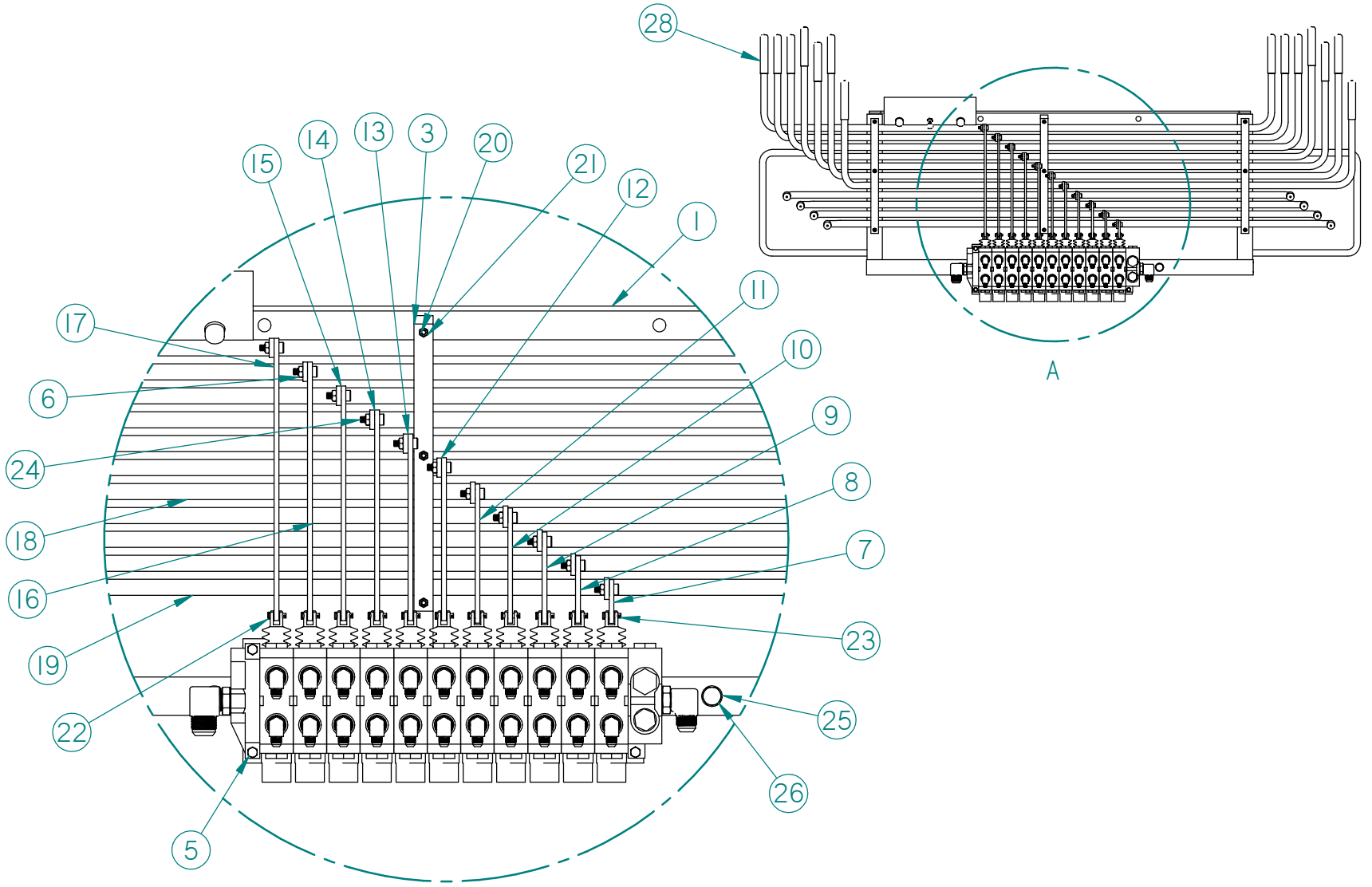
DEC. = DECIMAL PLACE(S)

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

TITLE: STANDARD CONTROL ASSEMBLY - GEARBOX

PART NUMBER:	SCALE:
22 07 01 001 0 / 129100	1:15

DRAWN BY:	APPROVED BY:	DATE:	SHEET:
SWB		04/22/2016	1 OF 3



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

TITLE: STANDARD CONTROL ASSEMBLY - GEARBOX

PART NUMBER:	SCALE:
22 07 01 001 0 / 129100	1:20

DRAWN BY:	APPROVED BY:	DATE:	SHEET:
SWB		04/22/2016	2 OF 3

Item #	Title	Document #	MACOLA	Qty
1	CONTROLS, CONTROL HANDLE SUB-WELDMENT	32 07 01 001 1	129259	1
2*	VALVE HANDLE BEARING	42 07 01 025 1	129238	6
3	VALVE HANDLE BEARING SUPPORT	42 07 01 023 1	129237	3
4*	CONTROL, DCV 11 VALVE SPOOL ASSEMBLY	32 07 01 005 0	129235	1
5	HEX BOLT 5/16-18 X 3 USS G5	BL305048U518	BL305048U518	3
6	HEX NUT 5/16-24 SAE STOVERLOCK	NUS05S	NUS05S	14
7	CONTROL HANDLE VALVE LINK 1	42 07 01 044 1	129254	1
8	CONTROL HANDLE VALVE LINK 2	42 07 01 043 1	129253	1
9	CONTROL HANDLE VALVE LINK 3	42 07 01 042 1	129252	1
10	CONTROL HANDLE VALVE LINK 4	42 07 01 041 1	129251	1
11	CONTROL HANDLE VALVE LINK 5	42 07 01 040 1	129250	1
12	CONTROL HANDLE VALVE LINK 6	42 07 01 039 1	129248	1
13	CONTROL HANDLE VALVE LINK 7	42 07 01 038 1	129247	1
14	CONTROL HANDLE VALVE LINK 8	42 07 01 037 1	129246	1
15	CONTROL HANDLE VALVE LINK 9	42 07 01 036 1	129245	1
16	CONTROL HANDLE VALVE LINK 10	42 07 01 035 1	129244	1
17	CONTROL, HANDLE VALVE LINK 11	42 07 01 034 1	129243	1
18	CONTROL MAIN LEVER WELDMENT	32 07 01 006 0	129266	7
19	CONTROL OUTRIGGER LEVER WELDMENT	32 07 01 007 0	129268	4
20	HEX BOLT 1/4-20 X 2-1/4 USS G5	BL104036U820	BL104036U820	9
21	HEX NUT 1/4-20 STOVERLOCK USS	NUS04U	NUS04U	9
22	CLEVIS PIN 1/4 X 7/8	FA010614	FA010614	11
23	COTTER PIN 3/32 X 1/2	FA020108	FA020108	11
24	SHOULDER BOLT 3/8 X 1/2	BL406008U5	BL406008U5	11
25	LOCK WASHER 5/8 SPLIT GR8	WAS108	WAS108	2

Item #	Title	Document #	MACOLA	Qty
26	HEX BOLT .625-11 X 3.00 USS G5	BL310048U511	BL310048U511	2
27*	ACCESSORY, CAP PLUG T 5X	AC0254	AC0254	22
28	DUAL WALK THRU HANDLE GRIP	VA06H1005	VA06H1005	22
29*	CONTROL BRACKET WELDMENT	31 07 01 001 0	129118	1
30*	ELECTRICAL, PUSH BUTTON SWITCH	EL01013	EL01013	2
31*	ELECTRICAL, SWITCH PUSH/PULL	EL01006	EL01006	1

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

TITLE: STANDARD CONTROL ASSEMBLY - GEARBOX

PART NUMBER: 22 07 01 001 0 / 129100

SCALE: NA

DRAWN BY: SWB

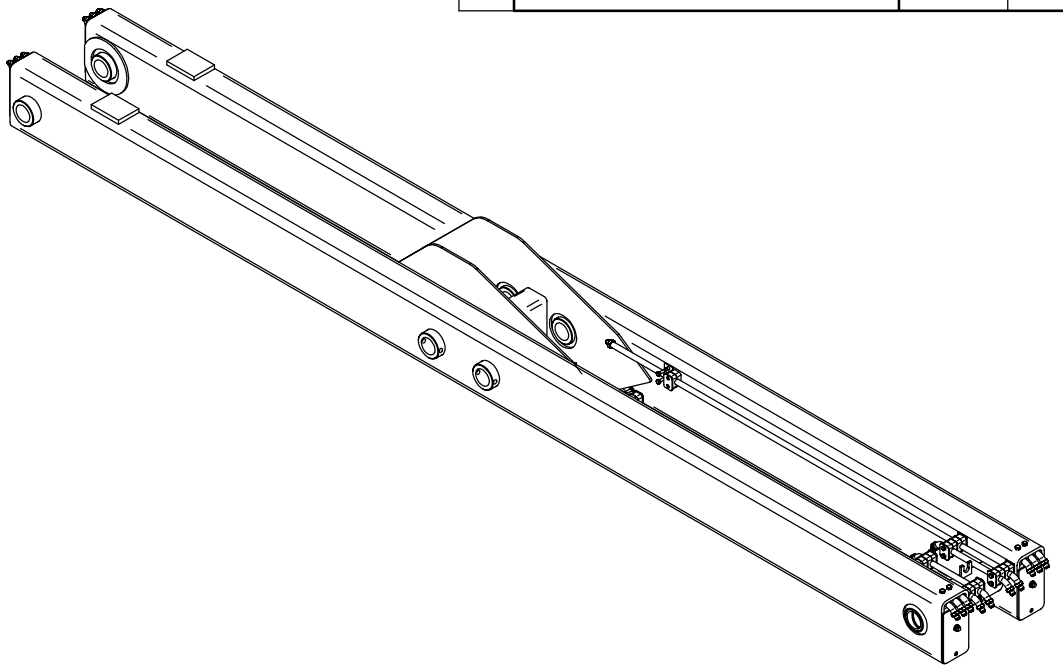
APPROVED BY:

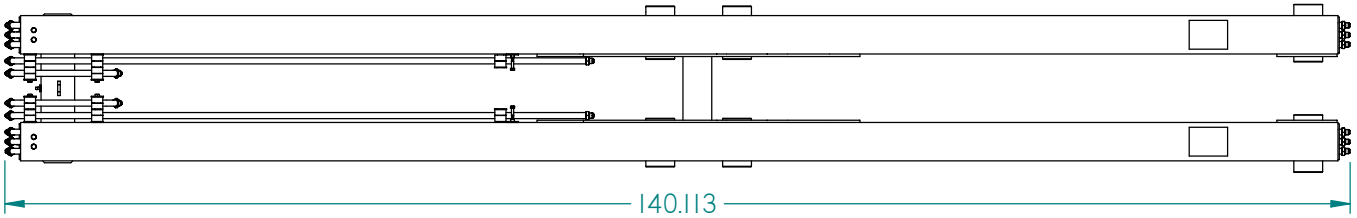
DATE: 04/22/2016

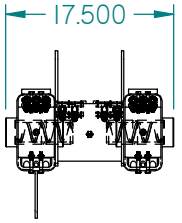
SHEET: 3 OF 3

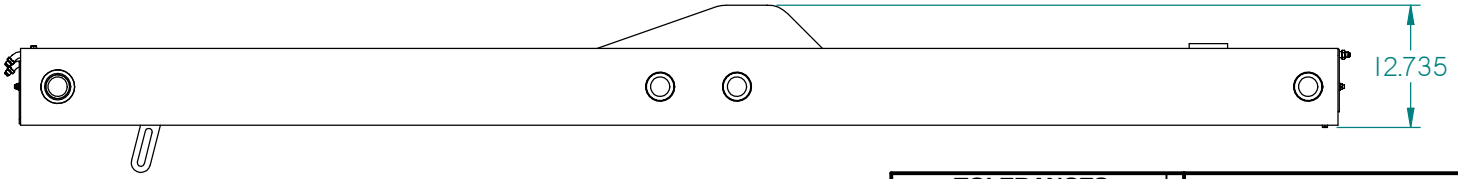
REV.	DESCRIPTION	DATE	BY
-	-	-	-

010 ASSEMBLY









TOLERANCES

1 DEC.	± 0.100
2 DEC.	± 0.050
3 DEC.	± 0.010
ANGLE:	± 1.000°
FRACTION:	± 1/32"
DIM. UNITS:	INCHES
SURFACE FINISH:	125/32

UNLESS OTHERWISE SPECIFIED

DEC. = DECIMAL PLACE(S)

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

TITLE: MAIN BOOM TL3 ASSEMBLY

PART NUMBER: 12 03 04 001 0 / 108103

SCALE: 1:20

DRAWN BY: OJ

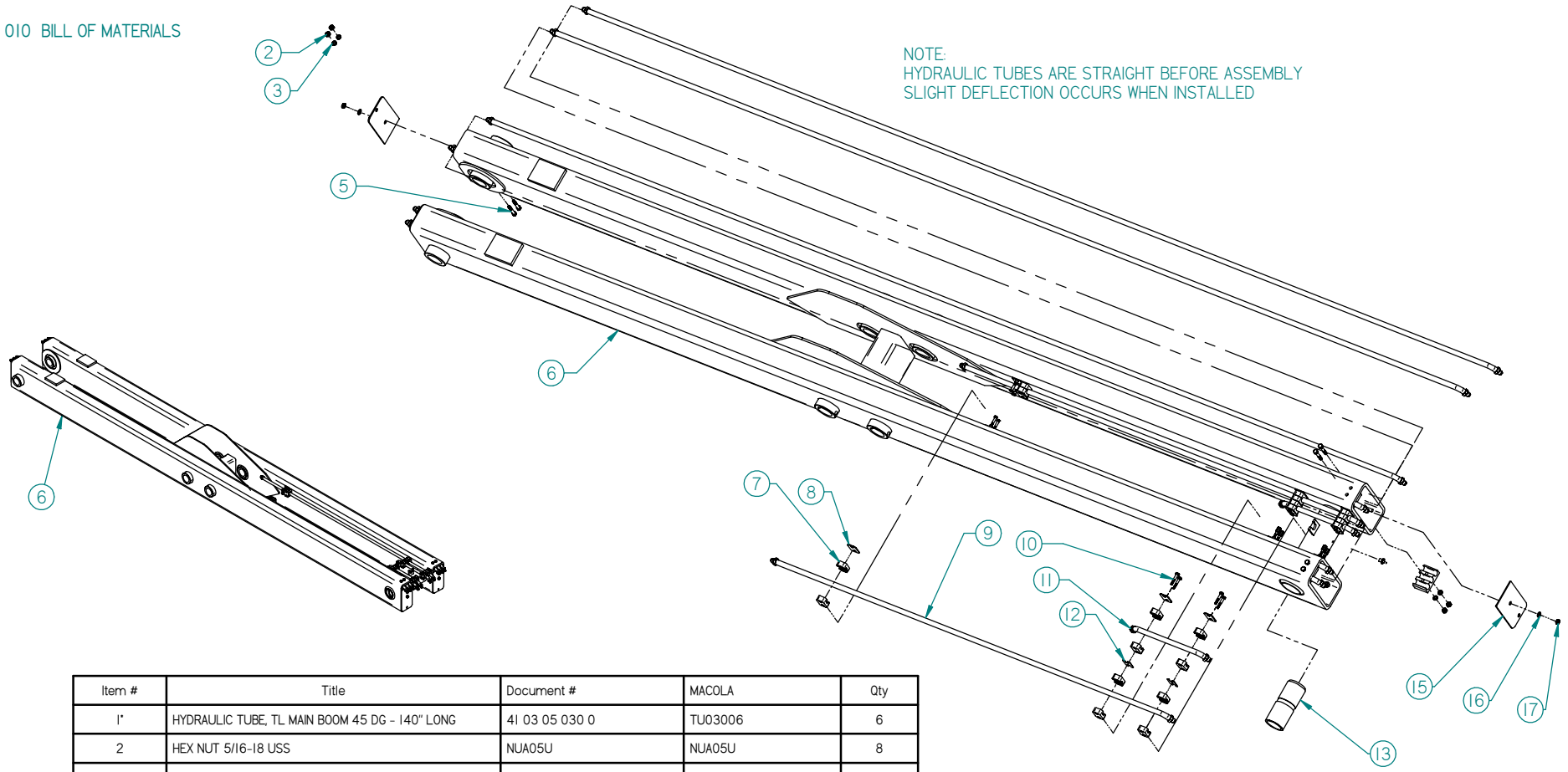
APPROVED BY:

DATE: 08/04/2006

SHEET: 1 OF 2

010 BILL OF MATERIALS

NOTE:
HYDRAULIC TUBES ARE STRAIGHT BEFORE ASSEMBLY
SLIGHT DEFLECTION OCCURS WHEN INSTALLED



Item #	Title	Document #	MACOLA	Qty
1*	HYDRAULIC TUBE, TL MAIN BOOM 45 DG - 140" LONG	41 03 05 030 0	TU03006	6
2	HEX NUT 5/16-18 USS	NUA05U	NUA05U	8
3	WASHER LOCK 5/16 SPLIT	WAS055	WAS055	8
4*	3 HOLE CLAMP NYLATRON	40 00 00 066 0	CLT3N	4
5	HEX BOLT 5/16-18 X 2 UNC G5	BL305032U518	BL305032U518	8
6	TL MAIN BOOM WELDMENT	21 03 05 002 2	108152	1
7	CLAMP, PLASTIC (1-HOLE) (1 SET)	CLP210	CLP210	10
8	CLAMP, TOP PLATE ONLY (1-HOLE)	CL5G215	CL5G215	6
9	HYDRAULIC TUBE, TL MAIN BOOM 45 DG - 62" LONG	41 03 05 029 0	TU02002	2
10	BOLT HEX 1/4-20 X 1-1/2 UNC G5	BL304024U520	BL304024U520	8
11	HYDRAULIC TUBE, TL MAIN BOOM45 DG - 12" LONG	41 03 05 020 0	TU03002	2
12	CLAMP SAFETY PLATE	CL5G211	CL5G211	4
13	BUSHING, 2-1/2" X 2" X 6" NYLATRON	41 03 05 028 2	BU503004	2
14*	1/8" STRAIGHT GREASE FITTING	HF2002S	HF2002S	1
15	TL MAIN BOOM END CAP	41 03 05 007 2	108225	4
16	WASHER LOCK 3/8 SPLIT	WAS065	WAS065	4
17	HEX NUT 3/8 -16 USS	NUA06U	NUA06U	4

PETERSEN INDUSTRIES INC.
4000 S.R. 60 WEST
LAKE WALES, FL. 33859-8234
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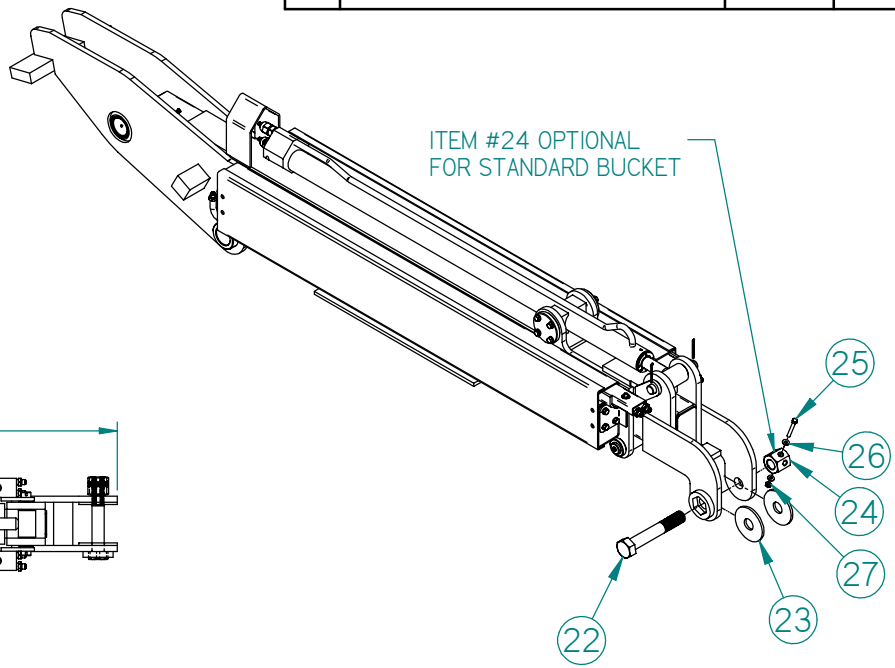
TITLE: MAIN BOOM TL3 ASSEMBLY

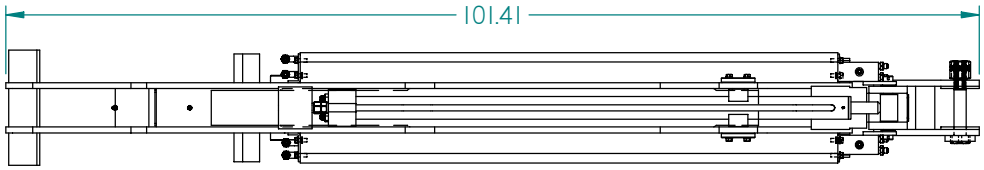
PART NUMBER:	SCALE:
12 03 04 001 0 / 108103	1:20

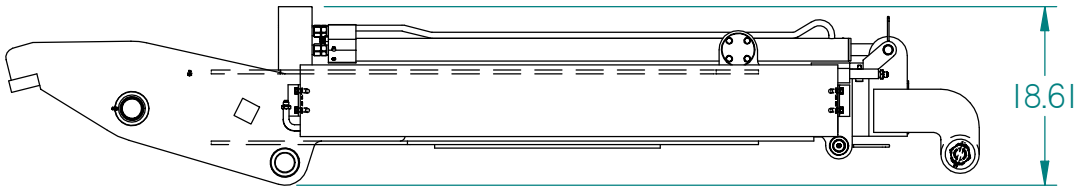
DRAWN BY:	APPROVED BY:	DATE:	SHEET:
OJ		08/04/2006	2 OF 2

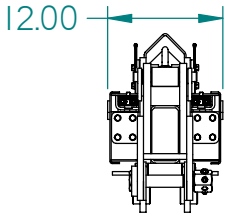
010 ASSEMBLY

REV.	DESCRIPTION	DATE	BY
-	-	-	-









TOLERANCES

1 DEC.	± 0.100
2 DEC.	± 0.050
3 DEC.	± 0.010
ANGLE:	± 1.000°
FRACTION:	± 1/32"
DIM. UNITS:	INCHES
SURFACE FINISH:	125/32

UNLESS OTHERWISE SPECIFIED

DEC. = DECIMAL PLACE(S)

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

TITLE: TL3 TIP BOOM ASSEMBLY

PART NUMBER: 12 04 04 002 1 / 109103

SCALE: 1:20

DRAWN BY: BRB

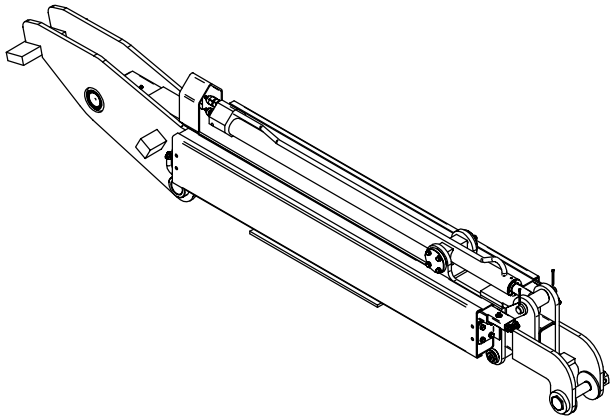
APPROVED BY:

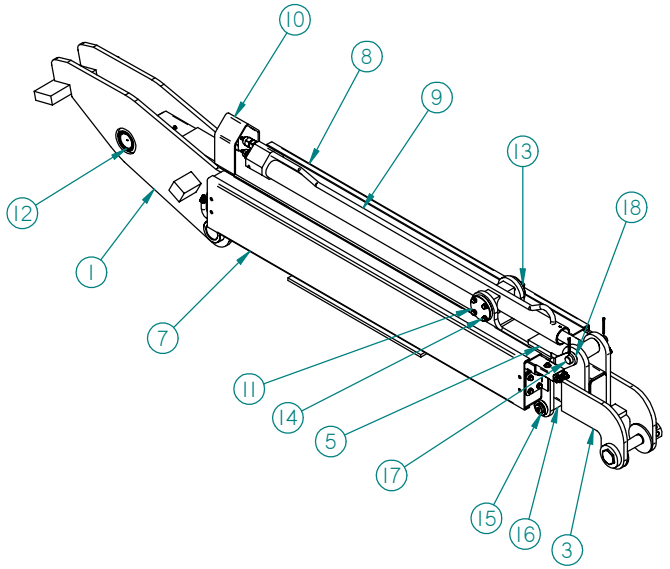
DATE: 10/26/2016

SHEET: 1 OF 2

010 BILL OF MATERIALS

Item #	Title	Document #	MACOLA	QTY
1	TL3 TIP BOOM OUTER WELDMENT	21 04 04 011 1	109152	1
2*	TL3 TIP BOOM SIDE WEAR PAD 2-7/8 X 5	41 04 04 041 0	BU303003	2
3	TL3 TIP EXTENSION INNER TUBE WELDMENT	21 04 04 010 3	109153	1
4*	TIP EXTENSION SQUARE WEAR PUCK	41 04 04 028 1	109210	10
5	TIP EXTENSION WEAR PLT RTNR / RTRCT STOP PLT ASSEMBLY	21 04 04 009 0	109154	1
6*	TL3 TIP BOOM TOP WEAR PAD 2-7/8 X 4	41 04 04 040 0	BU303002	1
7	HOSE RECOIL BOX ASSEMBLY - RIGHT	21 04 04 012 1	123122	1
8	HOSE RECOIL BOX ASSEMBLY - LEFT	21 04 04 013 1	123121	1
9	TIP EXTENSION CYLINDER SHAFT ASSEMBLY	22 14 01 010 2	121105	1
10	TIP BOOM TIP EXTENSION GUARD	41 04 04 027 1	109238	1
11	TRUNION TIP EXTENSION CYLINDER MOUNT	41 04 04 004 1	109205	2
12	BUSHING, 2 1/2 X 2 X 2 NYLATRON	41 11 09 022 5	BU502008	2
13	WASHER LOCK 3/8 SPLIT	WAS065	WAS065	8
14	HEX BOLT 3/8-16 X 1.00 USS G5	BL306016U516	BL306016U516	8
15	PIN, CONNECT	41 04 04 018 0	PI18105F	1
16	TIP BOOM, SUPPORT ROLLER WITH BUSHINGS	31 04 04 008 0	109235	1
17	PIN, CONNECT	41 04 04 012 0	PI16112F	1
18	WASHER, BUSHING 1.00 X 1.50	WAB1624	WAB1624	2
19*	PIN, COTTER .187 X 2	FA020332	FA020332	2
20*	COTTER PIN 5/16 X 3	FA020548	FA020548	1
21*	HYDRAULIC, .125 STRAIGHT GREASE FITTING	HF2002S	HF2002S	3
22	HEX BOLT 1-1/4-7 X 7-3/4 GR8	BL120124U87	BL120124U87	1
23	BUCKET BRAKE WASHER 4 X 1-5/16 X 1/4	WAF642004	WAF642004	2
24	BUCKET BOLT NUT	40 00 00 053 1	102454	1
25	HEX BOLT 5/16-18 X 2.50 USS G5	BL305040U518	BL305040U518	1
26	WASHER FLAT 5/16 USS	WAF05U5	WAF05U5	2
27	HEX NUT 5/16-24 SAE STOVERLOCK	NUS05S	NUS05S	1





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

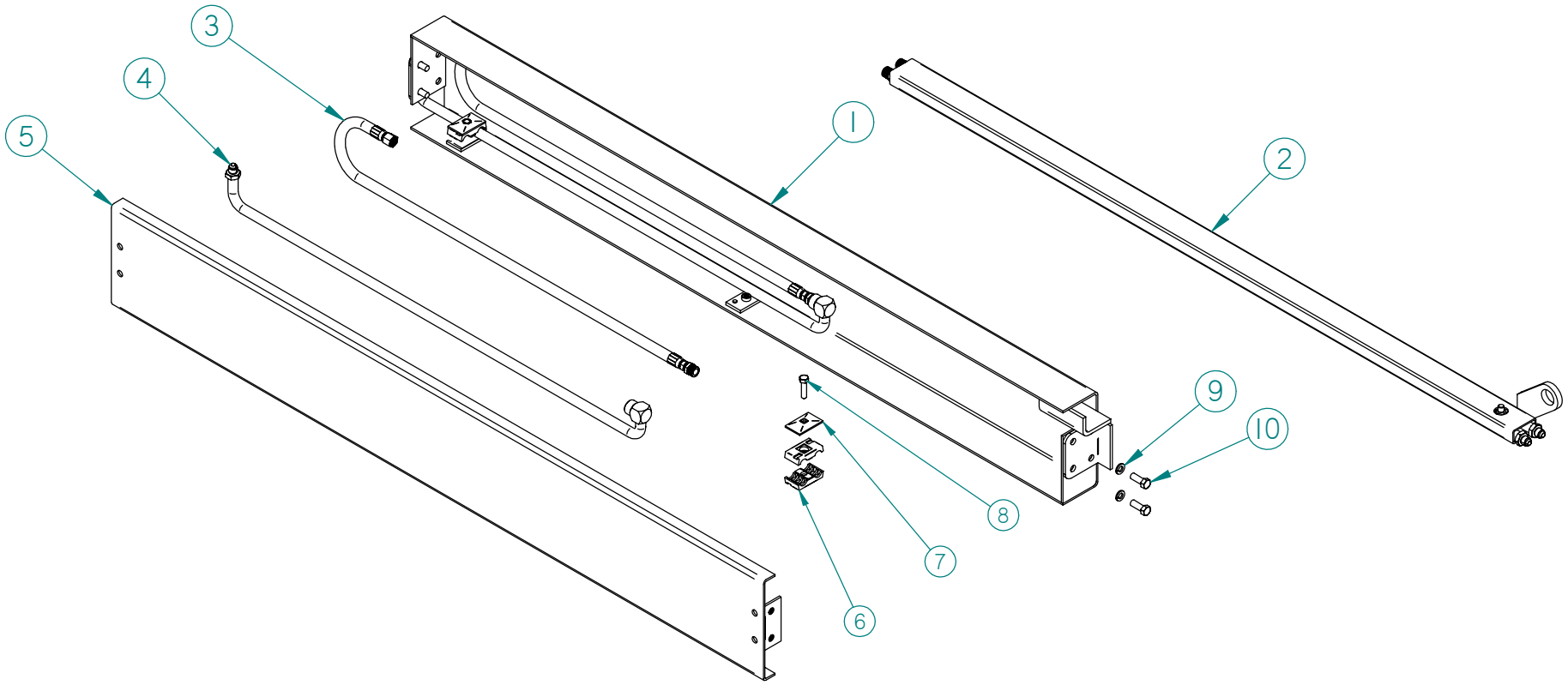
TITLE: TL3 TIP BOOM ASSEMBLY

PART NUMBER:	SCALE:
12 04 04 002 1 / 109103	1:24

DRAWN BY:	APPROVED BY:	DATE:	SHEET:
BRB		10/26/2016	2 OF 2

010 ASSEMBLY

REV.	DESCRIPTION	DATE	BY
1	CHANGED RECOIL SLIDE TO TUBING FROM CHANNEL	07/30/2008	RB



Item #	Title	Document #	MACOLA	Qty
1	HOSE RECOIL, HOUSING ASSEMBLY - RIGHT	21 04 04 016 0	123126	1
2	TIP BOOM, HOSE RECOIL SLIDE ASSY RH	21 04 04 014 1	123124	1
3	HOSE CUT 36" #6-S RECOIL BOX	HSI0576FS	HSI0576FS	2
4	TUBE, TL3 HOSE RECOIL BOX - CURVED	41 04 04 043 0	TU04004	2
5	HOSE RECOIL, COVER ASSEMBLY	21 04 04 018 0	123127	1
6	CLAMP, PLASTIC ONLY (2-HOLE) (1 SET)	CLP220	CLP220	2
7	CLAMP, TOP PLATE ONLY (2-HOLE)	CL5G225	CL5G225	2
8	BOLT, HEX HD, 5/16 - 18 UNC 1.250 LG	BL305012U518	BL305020U518	2
9	WASHER LOCK 3/8 SPLIT	WAS065	WAS065	4
10	HEX BOLT 3/8-16 X 1.00 USS G5	BL306016U516	BL306016U516	4

TOLERANCES

1 DEC.	± 0.100
2 DEC.	± 0.050
3 DEC.	± 0.010
ANGLE:	± 1.000°
FRACTION:	± 1/32"
DIM. UNITS:	INCHES
SURFACE FINISH:	125/32

UNLESS OTHERWISE SPECIFIED

DEC. = DECIMAL PLACE(S)

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

TITLE: HOSE RECOIL BOX ASSEMBLY - RIGHT

PART NUMBER: 21 04 04 012 1 / 123122

SCALE: 1:8

DRAWN BY: RB

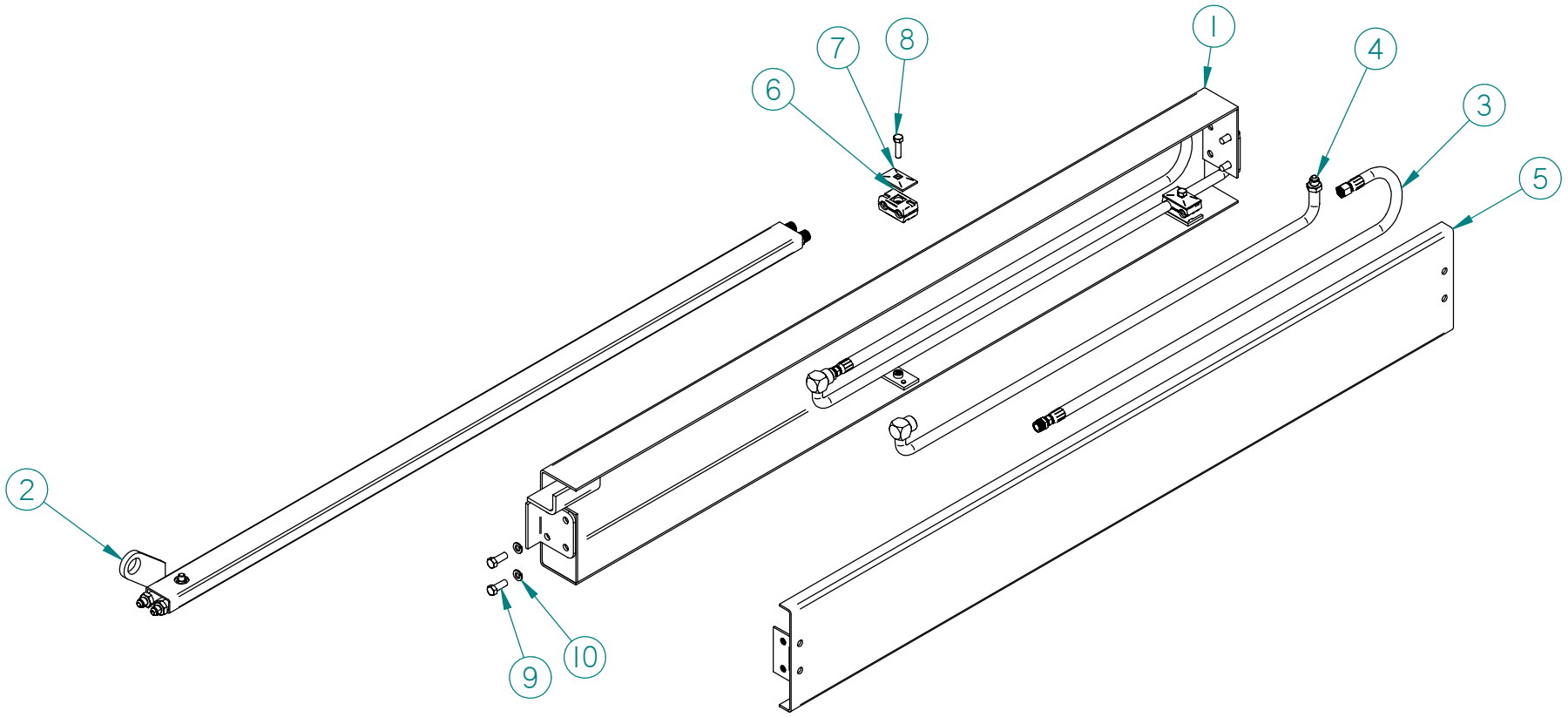
APPROVED BY:

DATE: 07/30/2008

SHEET: 1 OF 1

010 ASSEMBLY

REV.	DESCRIPTION	DATE	BY
1	CHANGED RECOIL SLIDE TO TUBING FROM CHANNEL	07/30/2008	RB



Item #	Title	Document #	MACOLA	Qty
1	HOSE RECOIL, HOUSING ASSEMBLY - LEFT	21 04 04 017 0	123125	1
2	TIP BOOM, HOSE RECOIL SLIDE ASSY LH	21 04 04 015 1	123123	1
3	HOSE CUT 36" #6-S RECOIL BOX	HS10576FS	HS10576FS	2
4	TUBE, TL3 HOSE RECOIL BOX - CURVED	41 04 04 043 0	TU04004	2
5	HOSE RECOIL, COVER ASSEMBLY	21 04 04 018 0	123127	1
6	CLAMP, PLASTIC ONLY (2-HOLE) (1 SET)	CLP220	CLP220	2
7	CLAMP, TOP PLATE ONLY (2-HOLE)	CL5G225	CL5G225	2
8	BOLT, HEX HD, 5/16 - 18 UNC 1.250 LG	BL305012U518	BL305020U518	2
9	HEX BOLT 3/8-16 X 1.00 USS G5	BL306016U516	BL306016U516	4
10	WASHER LOCK 3/8 SPLIT	WAS065	WAS065	4

TOLERANCES

1 DEC.	± 0.100
2 DEC.	± 0.050
3 DEC.	± 0.010
ANGLE:	± 1.000°
FRACTION:	± 1/32"
DIM. UNITS:	INCHES
SURFACE FINISH:	125/32

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

TITLE: HOSE RECOIL BOX ASSEMBLY - LEFT

PART NUMBER: 21 04 04 013 1 / 123121

SCALE: 1:10

DRAWN BY: RB

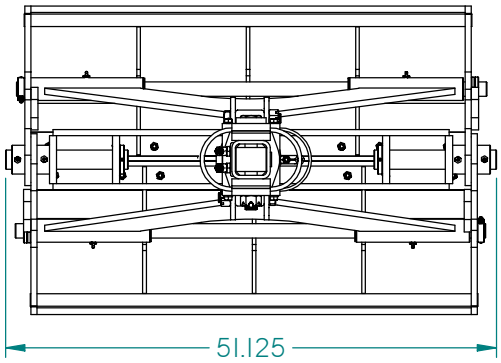
APPROVED BY:

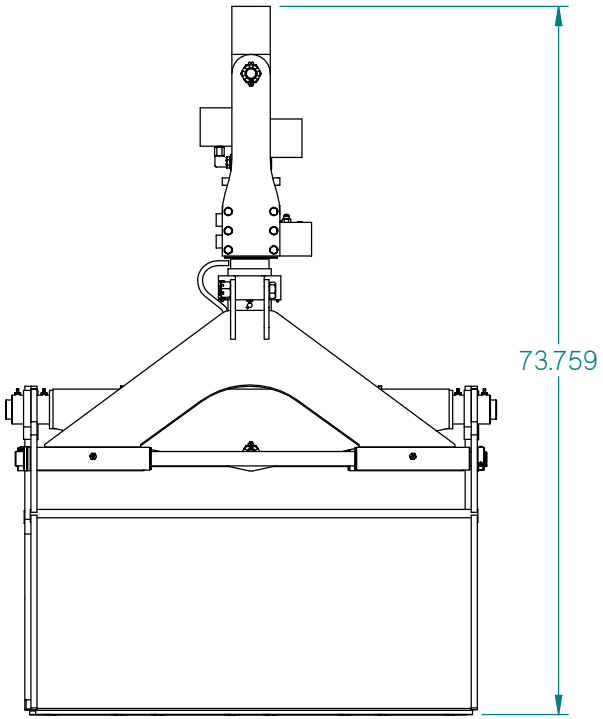
DATE: 07/30/2008

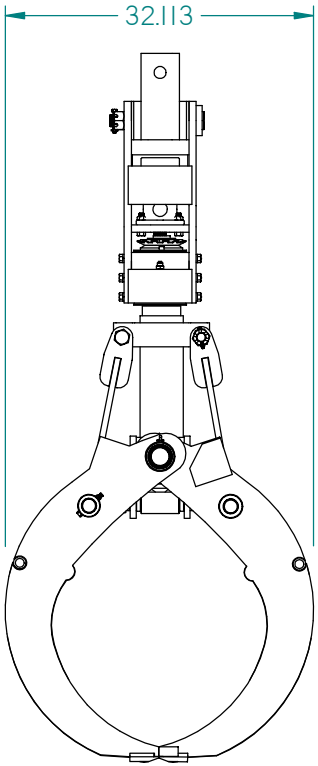
SHEET: 1 OF 1

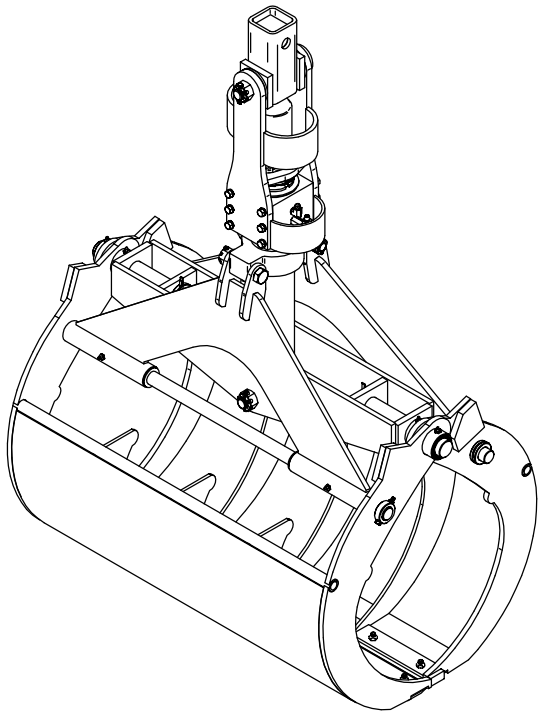
REV.	DESCRIPTION	DATE	BY
1	CHANGED TO NEW BUCKET DESIGN	11/15/05	OJ

010 ASSEMBLY









NOTE: STANDARD BUCKET WEIGHS 1010 LBS.

TOLERANCES

1 DEC.	± 0.100
2 DEC.	± 0.050
3 DEC.	± 0.010
ANGLE:	± 1.000°
FRACTION:	± 1/32"
DIM. UNITS:	INCHES
SURFACE FINISH:	125/32

UNLESS OTHERWISE SPECIFIED

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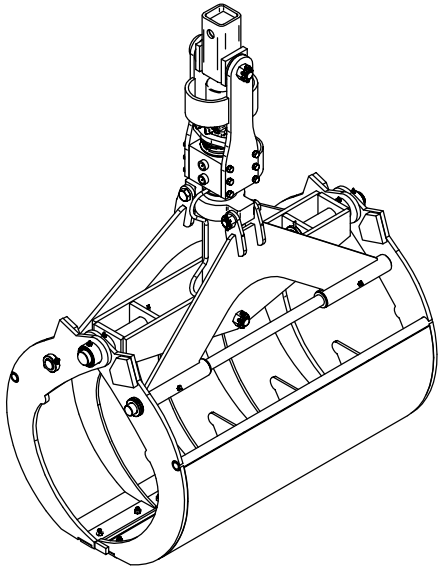
PETERSEN INDUSTRIES INC.
4000 S.R. 60 WEST
LAKE WALES, FL. 33859-8234
TEL: (863) 676-1493 FAX: (863) 676-6844

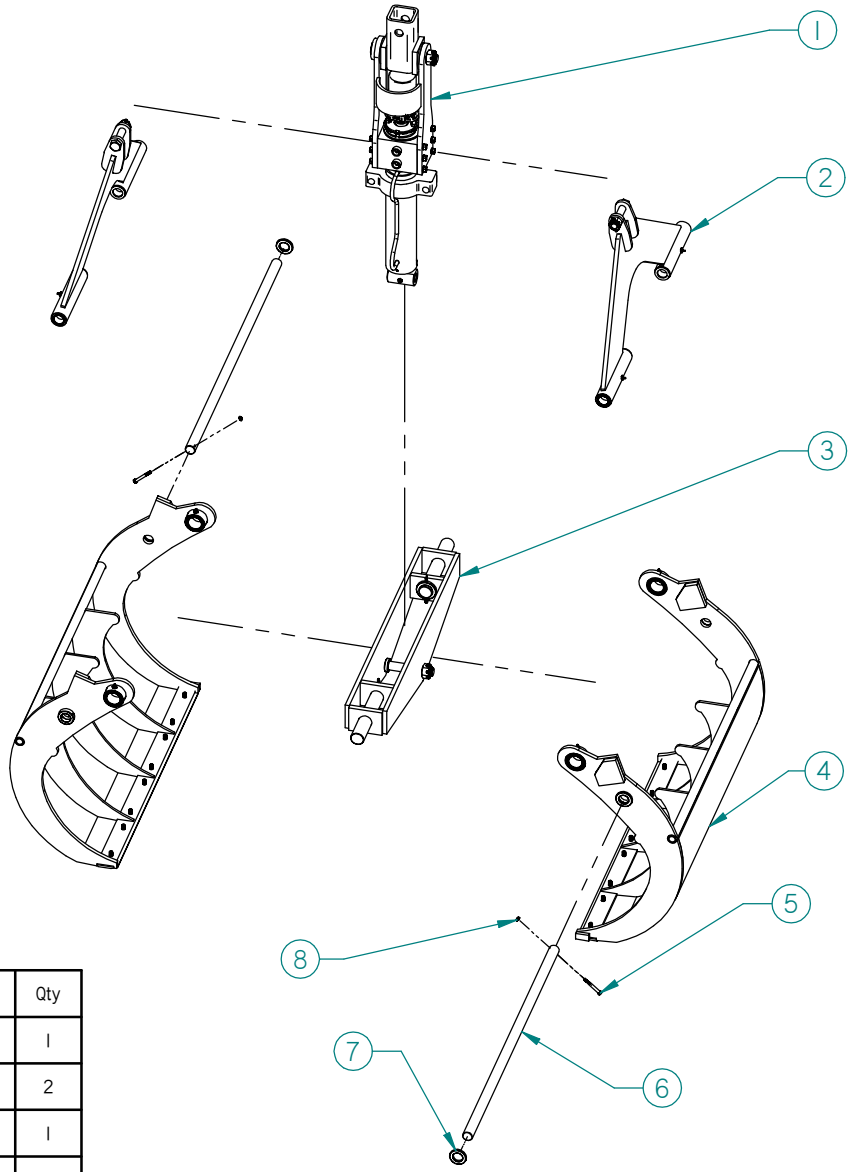
TITLE: STANDARD TRASH BUCKET ASSEMBLY

PART NUMBER:	SCALE:
11 11 01 0011 / 102101	1:20

DRAWN BY:	APPROVED BY:	DATE:	SHEET:
EB		12/20/2000	1 OF 3

010 BILL OF MATERIALS





Item #	Title	Document #	MACOLA	Qty
1	BUCKET CYLINDER ROTATOR ASSEMBLY (RE MOTOR)	22 11 01 010 0	102124	1
2	STANDARD BUCKET A FRAME ASSEMBLY	22 11 01 001 2	102130	2
3	BUCKET SADDLE ASSEMBLY	22 11 01 003 0	102129	1
4	TRASH BUCKET JAW ASSEMBLY	22 11 01 002 5	102132	2
5	BOLT HEX 3/8-16 UNC X 3 G8	BL108048U816	BL108048U816	2
6	STD BUCKET A FRAME SHAFT	42 11 01 011 1	102173	2
7	STD BUCKET A FRAME COLLAR	41 11 09 019 1	116106	2
8	NUT HEX 3/8 -16 UNC STOVERLOCK	NUS06U	NUS06U	2

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

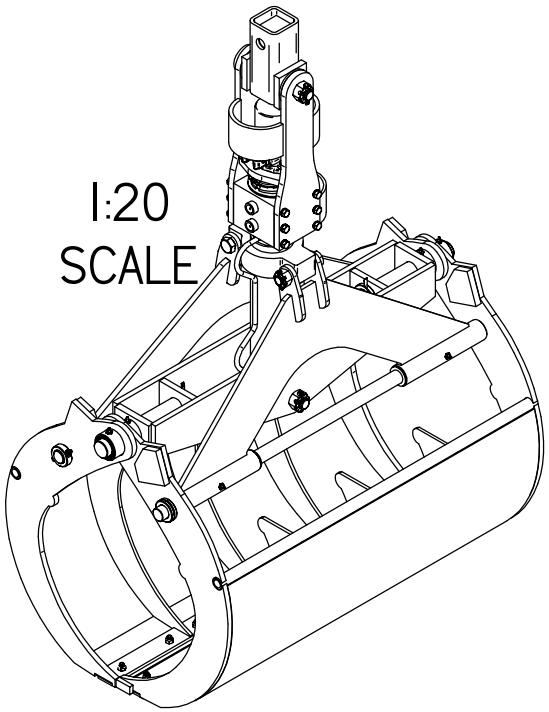
TITLE: STANDARD TRASH BUCKET ASSEMBLY

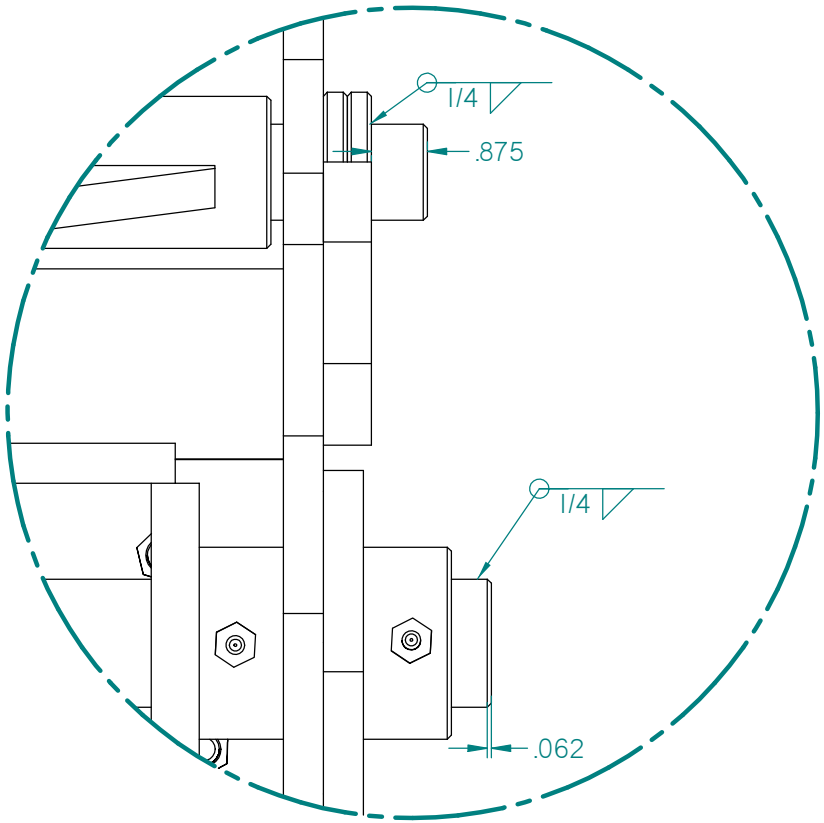
PART NUMBER:	SCALE:
11 11 01 001 1 / 102101	1:28

DRAWN BY:	APPROVED BY:	DATE:	SHEET:
EB		12/20/2000	2 OF 3

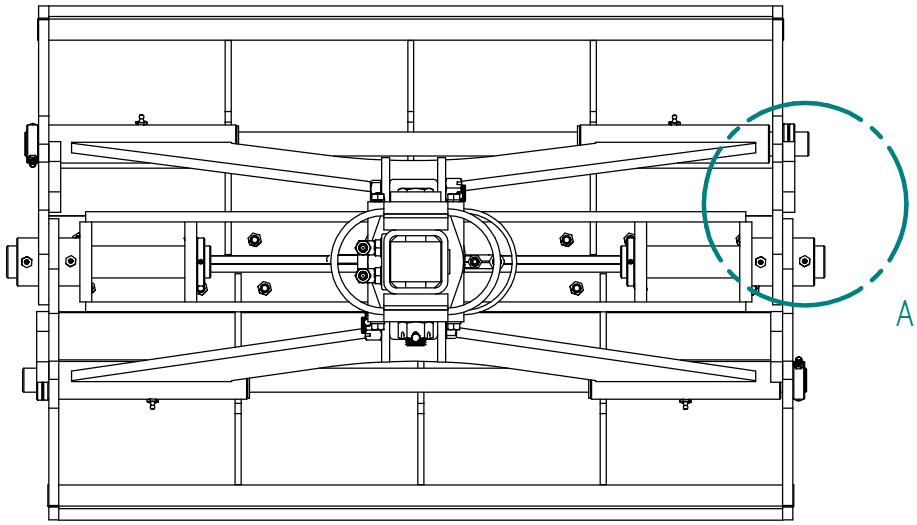
010 WELDMENT
020 WELD AS SHOWN IN (DETAIL A)
030 REPEAT FOR OPPOSITE SIDE

1:20
SCALE





DETAIL A



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

TITLE: STANDARD TRASH BUCKET ASSEMBLY

PART NUMBER:	SCALE:
11 11 01 001 1 / 102101	1:12

DRAWN BY:	APPROVED BY:	DATE:	SHEET:
EB		12/20/2000	3 OF 3

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: _____

4000 SR 60 West
Lake Wales, Florida 33859
(863) 676-1493
www.petersenind.com

Trash Lightning Loader® Warranty

Petersen Industries, Inc. ("Petersen") warrants each new Lightning Loader® and/or Trash Body it manufactures and each new part and component sold by Petersen (except those excluded by Section 5 below) to be free from defects in material and workmanship, provided the Lightning Loader® parts and components are operated and maintained in accordance with Petersen's published operating and maintenance instructions applicable thereto. This warranty is subject to the terms and conditions stated below.

1. Warrantor: This warranty is granted by Petersen Industries, Inc. 4000 SR 60 West, Lake Wales, Florida 33859. All warranty work must be accomplished by Petersen Industries, Inc. at its factory in Lake Wales, Florida or by such other facility specifically authorized by Petersen. All warranty work performed by a facility other than Petersen must be approved by Petersen in writing prior to commencement of said work.

2. Parties to Whom Warranty is Extended: This warranty shall be extended to any buyer and to any person to whom this product is transferred during the duration of this warranty.

3. Duration of Warranty: The time periods applicable to the warranty of the specified component parts of this Lightning Loader® are as follows:
   a) Lightning Loader® Major Structural Component Parts - 3 years
   b) Non-hydraulic Replacement Parts - 1 year
   c) Hydraulic Components - 1 year
   d) Dynamic Oil Heavy Duty Rotary Actuator * - 2 years *Does not apply to SAI or HA36*

4. Parts and component parts installed by Petersen are covered by this warranty except those parts and component parts excluded by Section 5 below.

5. Parts and Components Not Covered: The following parts and components are not covered by the warranty:
   a) any part or component not installed by Petersen Industries, Inc.;
   b) any part of the vehicle cab, chassis, tires or engine (any warranty of these parts and components is provided by the original manufacturer);
   c) any part or component that shall have been subject to misuse, negligence, or accident;
   d) any part or component that shall have deteriorated from extraordinary wear or exposure;
   e) expendable items that would normally be replaced within the warranty period (e.g. hydraulic hoses on end of boom, brake washers between bucket and boom, oil, filters, light bulbs).

6. Procedure for Obtaining Performance Under this Warranty: In order to qualify under this warranty, the owner must notify Petersen Industries, Inc. within thirty (30) days of discovery of the defect and promptly deliver the Lightning Loader® or defective part to Petersen Industries, Inc. at its factory in Lake Wales, Florida, or if requested by Petersen to such other authorized facility designated by Petersen.

Upon receipt of such Lightning Loader®, part or component, if it is found not to be defective in material or workmanship, Petersen shall notify the owner of such fact and request instructions for the return of such Lightning Loader®, part or component to the owner.

All costs of transporting Lightning Loader®(s) to and from Petersen Industries, Inc. or such other authorized facility designated by Petersen shall be paid by owner.

7. Remedy: If, within the duration of this warranty, a part or component covered by this warranty proves to be defective in material or workmanship, then the sole and exclusive remedy and Petersen's sole responsibility shall be at Petersen's option, the repairing of the defective part or component or replacing of the same. Parts and labor shall be at the expense of Petersen. The replacement part or component supplied pursuant to this warranty shall be warranted only for the remainder of the warranty period applicable to the defective part or component.

8. Design Changes: Petersen reserves the right to make changes in the design or material of its products without incurring any obligation to incorporate such changes in any product previously manufactured.

9. Exclusion and Disclaimers: This warranty does not extend to normal maintenance services such as cleaning, greasing, mechanical adjustments and maintenance inspections or to any defect due to the negligence of others, failure to operate or maintain the Lightning Loader® in accordance with the published operating and maintenance instructions furnished by Petersen, unreasonable use, accidents, alteration or wear and tear.

[NO OTHER WARRANTY WHETHER OF MERCHANTABILITY, FITNESS OR OTHERWISE, EXPRESS OR IMPLIED IN FACT OR BY LAW, IS GIVEN BY PETERSEN WITH RESPECT TO ANY NEW LIGHTNING LOADER®, PART OR COMPONENT, OR WITH RESPECT TO ANY WORK, AND NO OTHER OR FURTHER OBLIGATION OR LIABILITY SHALL BE INCURRED BY PETERSEN BY REASON OF THE MANUFACTURE, SALE, OR LEASE OF ANY LIGHTNING LOADER®, PART, OR COMPONENT OR OF ITS USE, WHETHER FOR BREACH OF WARRANTY, NEGLIGENCE OF MANUFACTURE OR OTHERWISE.]

In the event that the provision relieving Petersen of liability for negligence should for any reason be held ineffective, the remainder of this paragraph shall remain in full force and effect.

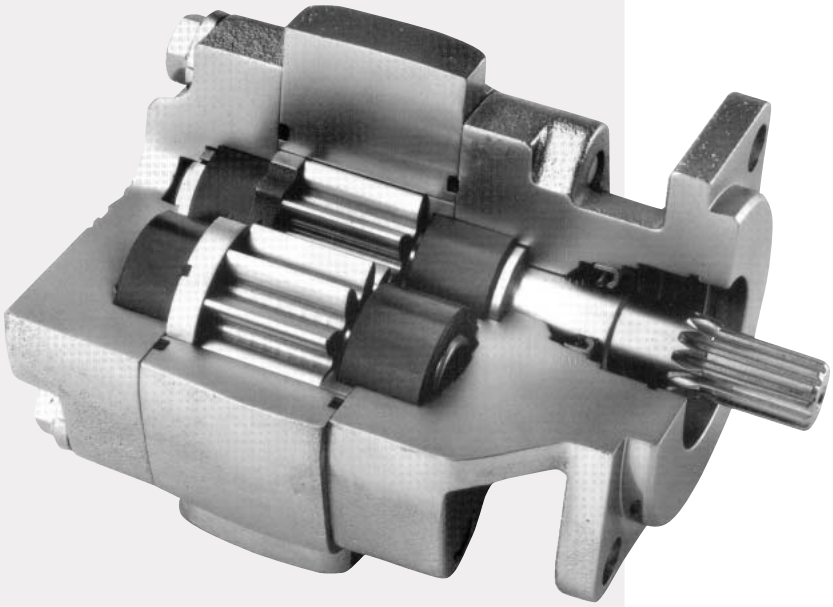
The obligation of Petersen set forth in Section 7 above shall be the exclusive remedy for any breach of warranty. In no event shall Petersen be liable for any general, consequential, or incidental damages relating to property damages or economic loss, including without limitation any damages for loss of use or loss of profits. No distributor, dealer, agent or employee of Petersen is authorized to extend any other or further warranty or incur any additional obligation on Petersen's behalf in connection with the sale of its products.

Service Manual HY09-SM020/US

Service Manual
PGP020™

Effective: July 1, 2006
Supersedes: All Others

PGP020 Series



The Parker Hannifin Gear Pump Division Assures:

- Consistent quality
- Technical innovation
- Premier customer service

Worldwide Sales and Service

Parker operates sales and service centers in major industrial areas worldwide. Call 1-800-C-PARKER for more information, or for a synopsis of the Gear Pump Division, contact a Parker representative.

The Gear Pump Division's ability to engineer specialty products for unique applications has kept us at the forefront of technology, and ensured our position as the industry leader. Our success has come from providing a quality product with excellent sales and service support.

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.

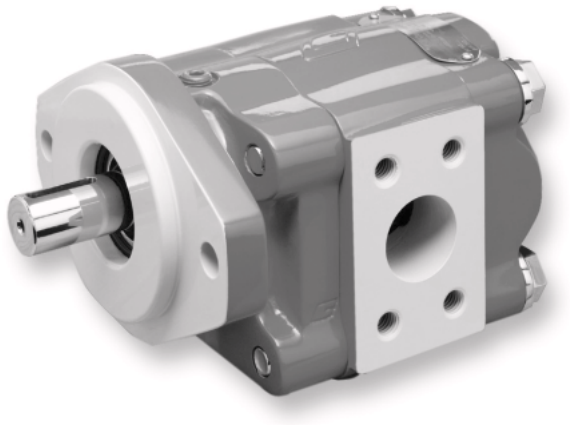
The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

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".

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.

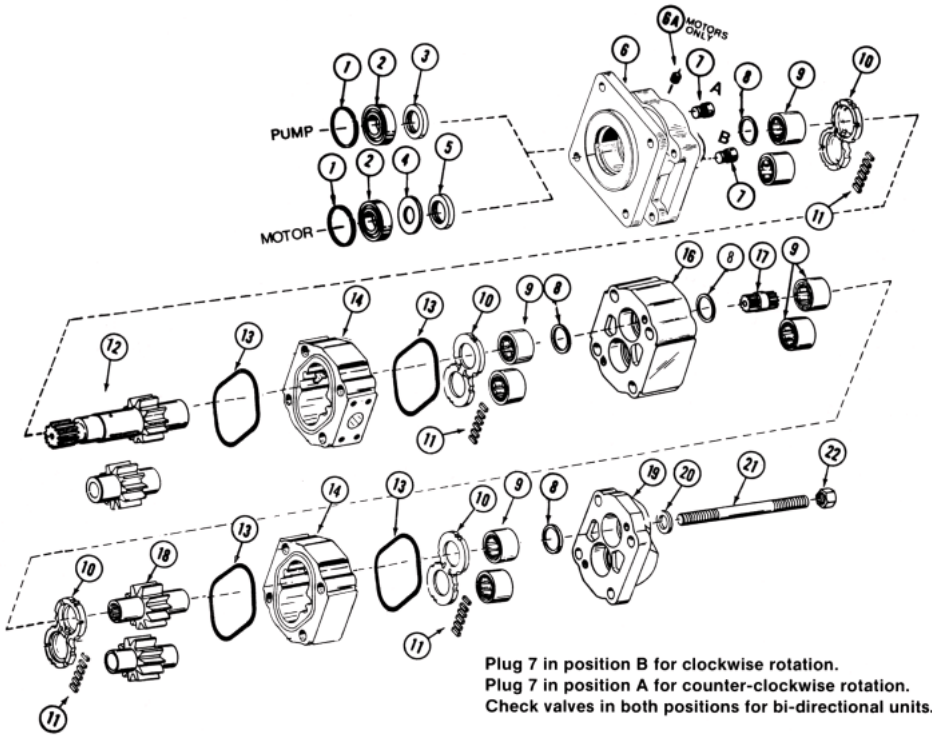
4) Gears are closely matched, therefore, they must be kept together as a set when removed from the unit. Handle with care to avoid damage to the journals, faces and teeth.

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.

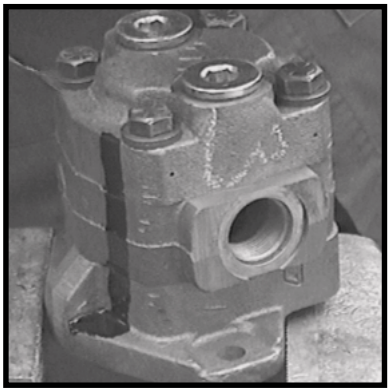
Parker Hannifin Corporation
Gear Pump Division
Youngstown, Ohio USA

PGP020™ Disassembly Instructions

STEP 1

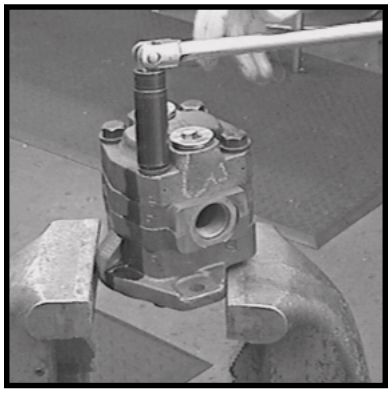
Place the pump in a vise with the drive shaft pointing down. Clamp unit on the sides of the mounting flange. Do not clamp on the pilot diameter as it may damage the sealing surface.

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



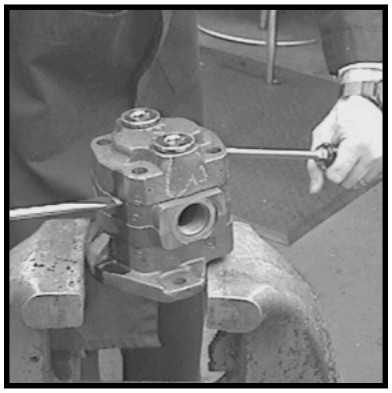
Loosen and remove the four, cap screws and washers with a 13/16” socket and wrench.

STEP 4.1

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

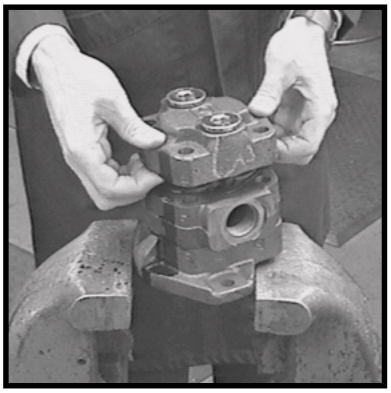
4.1 Place the point of a large, screwdriver or a chisel on the parting line between the port end cover casting and the gear housing casting. Gently tap until a slight separation between the castings is detected.

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

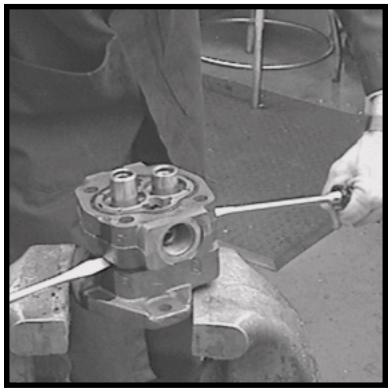


4.3 Lift off the port end cover subassembly.

Parker Hannifin Corporation
Gear Pump Division
Youngstown, Ohio USA

PGP020™ Disassembly Instructions

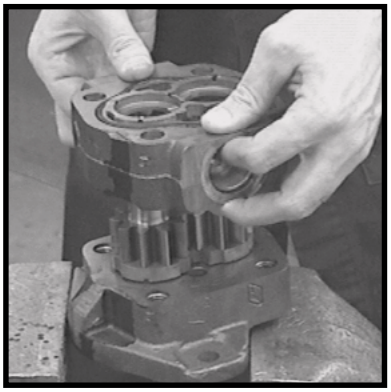
STEP 5.1



Remove the gear housing subassembly using steps 5.1 - 5.3:

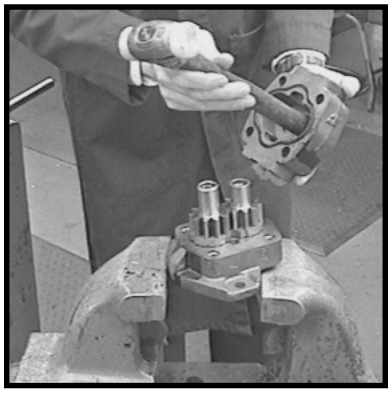
5.1 Place the two, large, flat-bladed screwdrivers into the separation notches and pry up the gear housing until loose. BE CAREFUL not to nick, mar or scratch the machined casting faces.

STEP 5.2



5.2 Lift off the gear housing subassembly.

STEP 5.3

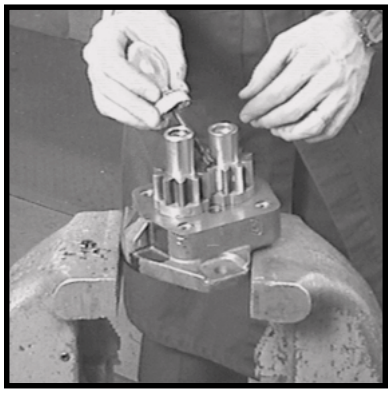


5.3 Remove the thrust plate from the housing. It may be necessary to gently tap the thrust plate with the handle of a hammer or screwdriver. Be careful not to bend or score the thrust plate. Remove and discard the six, small, rubber pocket seals from the thrust plate.

STEP 6

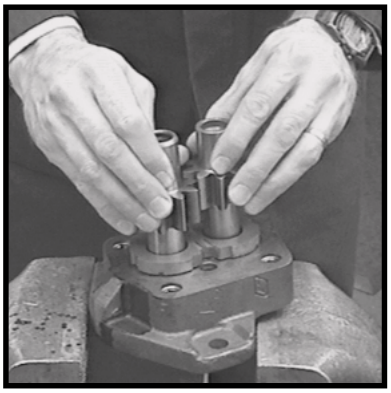
Remove and discard the rubber section seals from the top and bottom gear housing faces.

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.

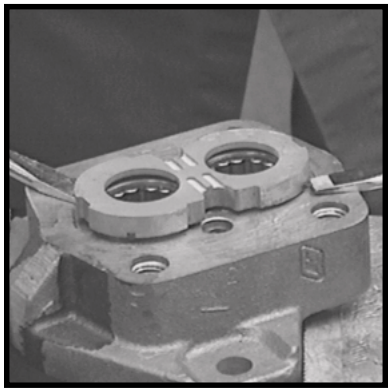
STEP 8



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.

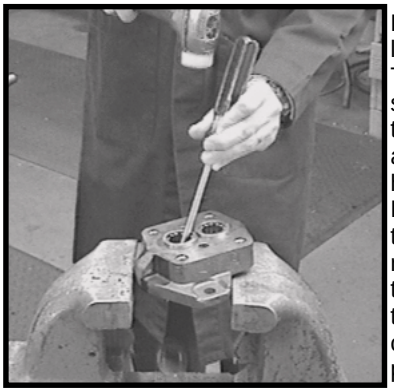
PGP020™ Disassembly Instructions

STEP 9



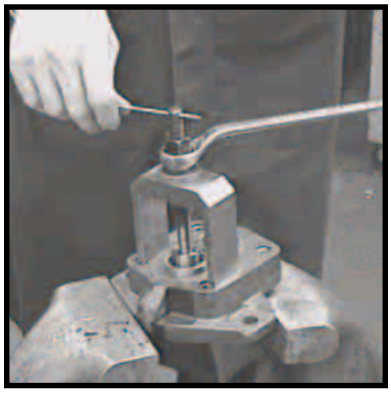
Gently lift off the thrust plate. Be careful not to bend or score the plate and mating surface of the casting. Remove and discard the six, rubber pocket seals from the back of the thrust plate.

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

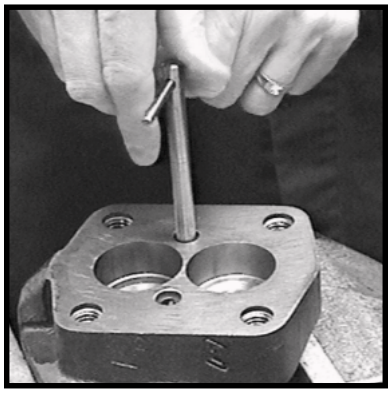


Use a bearing puller to remove the roller bearings. Note: This step is optional depending on the condition of the bearings.

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.

Parker Hannifin Corporation
Gear Pump Division
Youngstown, Ohio USA

PGP020™ Assembly Instructions

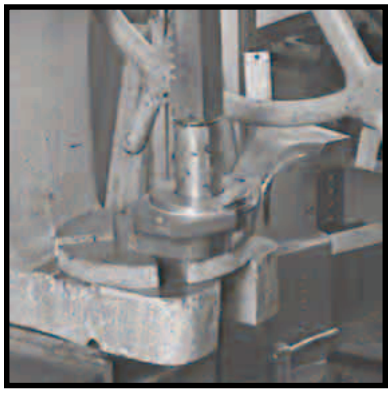
STEP 1

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

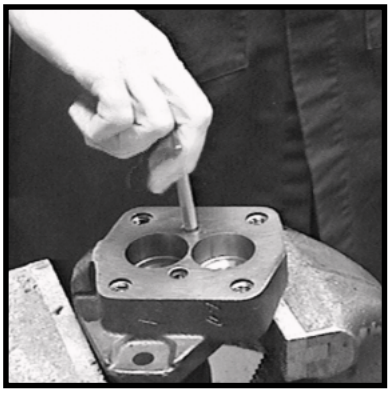
Coat the outside diameter of the lip seal with Permatex Aviation Form-A-Gasket No.3 Non-Hardening Sealant or equivalent. Be careful not to get Permatex on the inner lip of the seal as it will cause a lip seal leak.

STEP 3



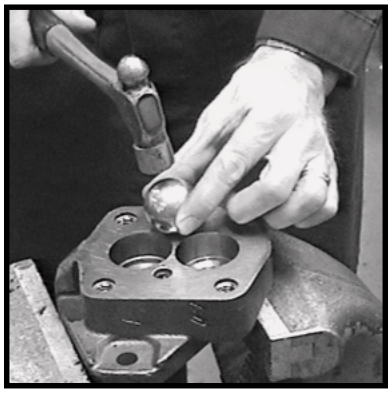
Place the shaft end cover on an arbor press with the pilot facing up. Place lip seal with the shoulder of the seal up, at the top of the seal bore. Press the lip seal into the shaft end cover with a lip seal installation bar (see Tool List on Page 11). The seal should be pressed in so it is flush with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

STEP 4



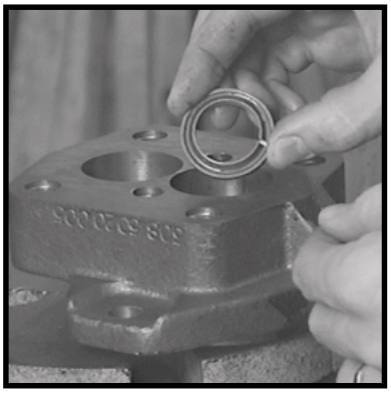
Apply Loctite® No.262 to the threaded check holes in the shaft end casting. Install the checks in the shaft end cover using the check tool (see Tool List on Page 11). The checks must bottom out in the casting.

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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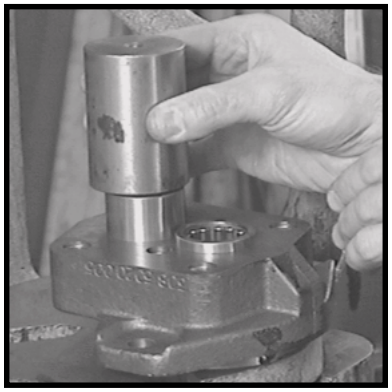
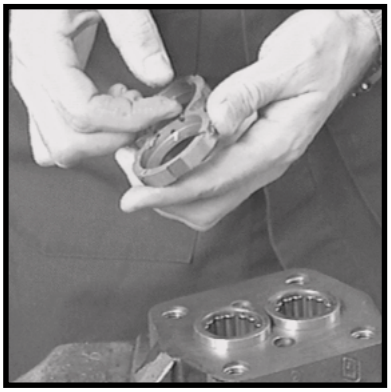
STEP 7



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

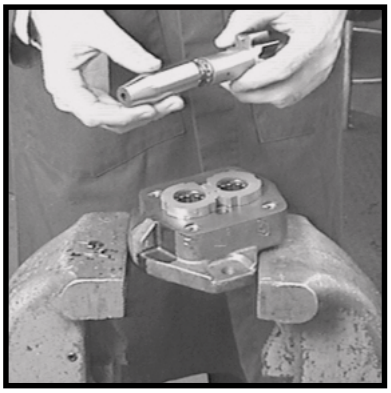


Grip the shaft end cover in a vise with the mounting face down. Cut two, pocket seals 7/32” long from the pocket seal strip. Grease the seals well and insert them into the center slots on the reverse side of the thrust plate.

STEP 9

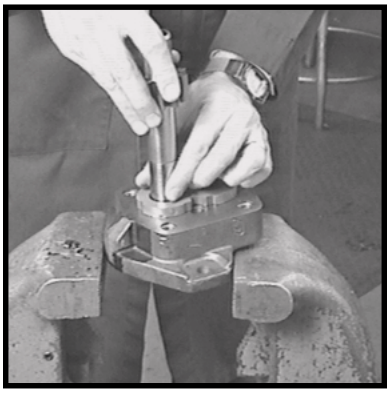
With the pocket seals facing down, place thrust plate over the bearings. Tap the thrust plate with a soft-faced hammer around the edge until the thrust plate is about 1/32” from the casting surface. Do not tap the center of the plate. Cut four pocket seals 1/4” long from the seal strip. Push a pocket 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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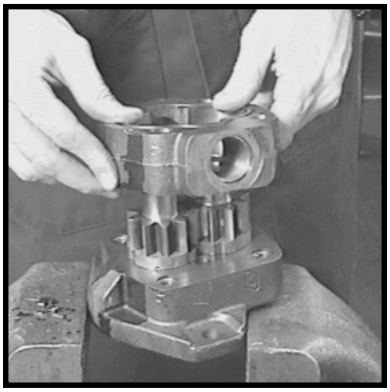
STEP 12

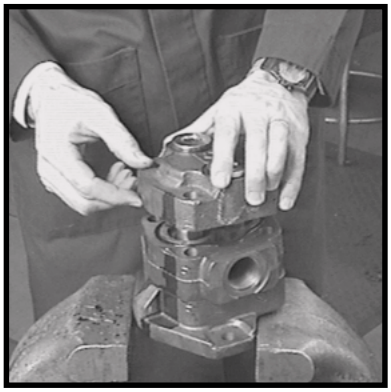
Apply a light coating of grease to the new section seals and place them into the machined grooves on both sides of the gear housing. Check the section seals for proper fit.

STEP 13



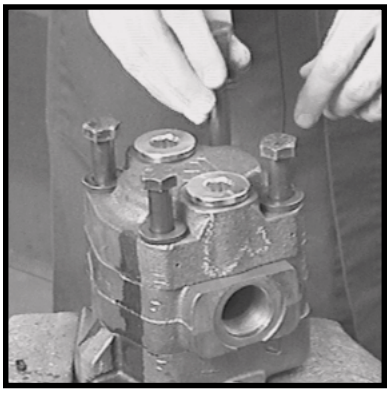
Locate the orientation mark on the gear housing and line it up with the mark on the shaft end cover. Slide the gear housing over gear set. Make sure the gear housing rests tightly against shaft end cover. Be careful not to pinch the section seal. Squirt clean, hydraulic oil over the gear shaft and the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

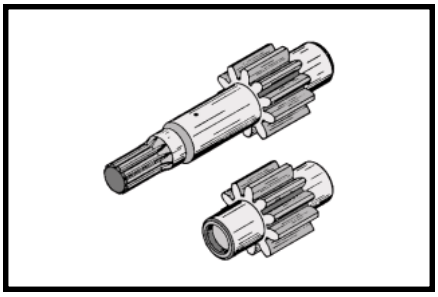


Thread the four, cap screws with the washers into the shaft end cover and tighten them in a cross-corner pattern. Rotate the gear shaft of the pump with a 6” wrench to make certain there is no binding in the pump.

STEP 16

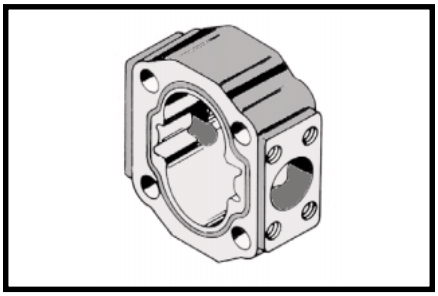
After the cap screws are tightened, make certain there is no internal binding of the gear set by rotating the gear shaft, then tighten the cap screws in a cross-corner pattern to a final torque of 2400 in. lbs. (200 ft. lbs.).

Part Replacement Guide



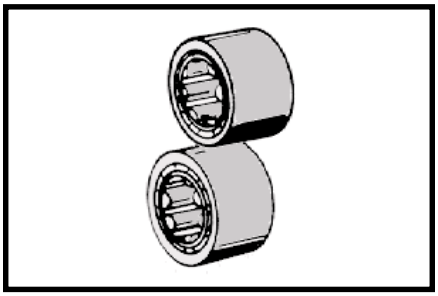
If the gear set contains any of the following defects, it should be replaced:

- 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.

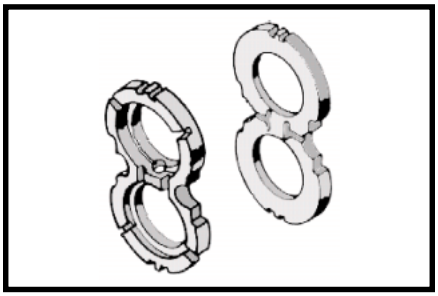


Wear in excess of .005” cut-out necessitates replacement of the gear housing. Place a straight-edge across the bore. If you can slip a .005” feeler gage in the cut-out area, replace the gear housing.

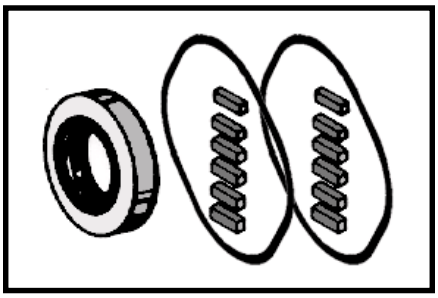
Where the cut-out is moderate, .005” or less, the gear housing is still in good condition. If the housing has equal size ports or no ports, the housing may be rotated 180°, exchanging ports, and reused.



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.



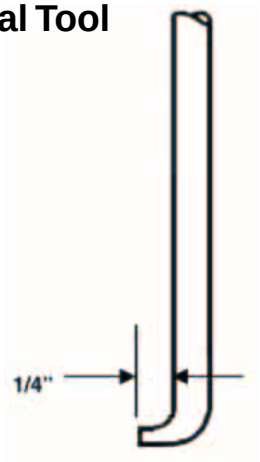
Replace all rubber and polymer seals whenever reassembling the pump. This includes lip seal, pocket seal strips and section seals.

Tool List

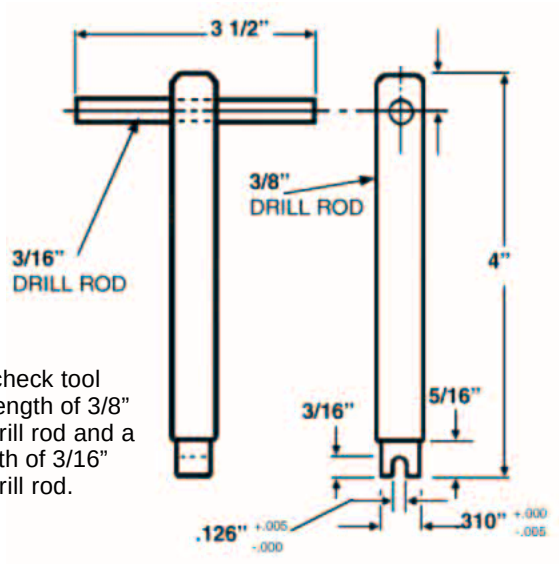
- Arbor press
- Permanent marker or an awl
- Bearing puller (Owatonna Tool Co. MD-956 or equivalent)
- Clean, lint-free cloths
- Deburring tool (a file with the cutting teeth ground off)
- Machinist hammer
- Soft-faced hammer
- Permatex Aviation Form-A-Gasket No.3 Non-hardening Sealant or equivalent
- 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.

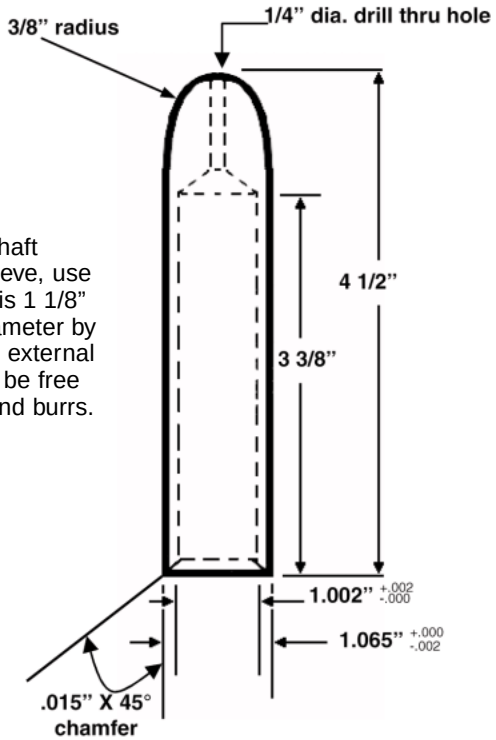


Check Tool



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.

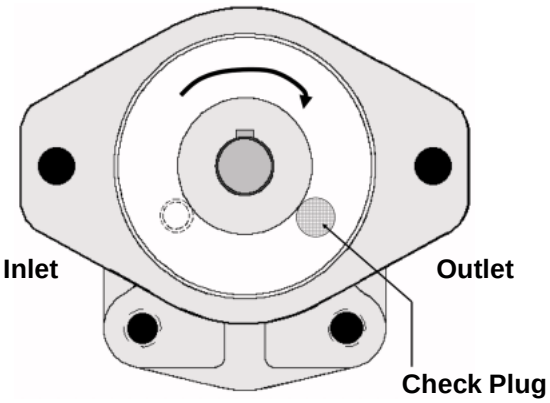
5) Remove the gear housing and the gear set. Keep the gears together because they are a matched set.

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

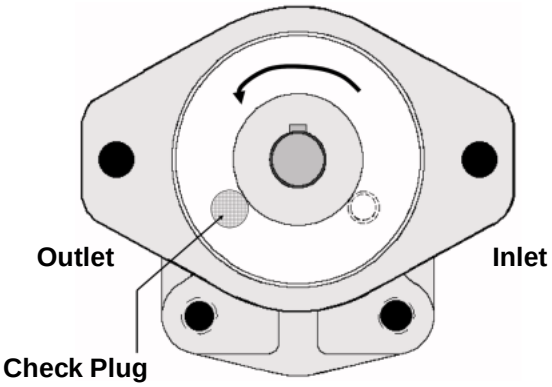
Note: Care should be taken to avoid losing the small, rubber pocket seals fitted in the thrust plate pocket seal grooves.

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

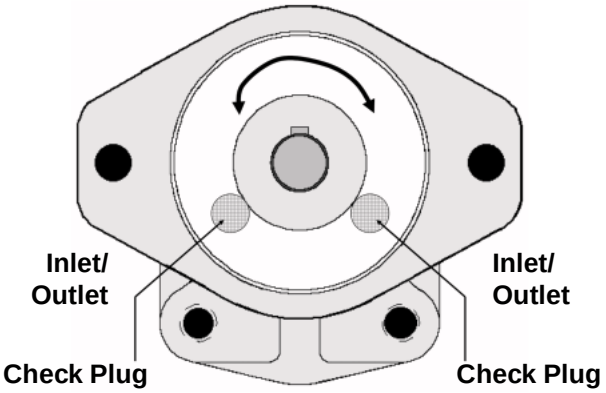
7) Remove the check plug in the shaft end cover with a screwdriver and then install it in the opposite drain hole. Screw in tightly and stake the check plug with a punch at both edges of the screwdriver slot. For a single-rotation pump, the check plug is always located on the high pressure (outlet) side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



CW



CCW



Bi-rotational

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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.

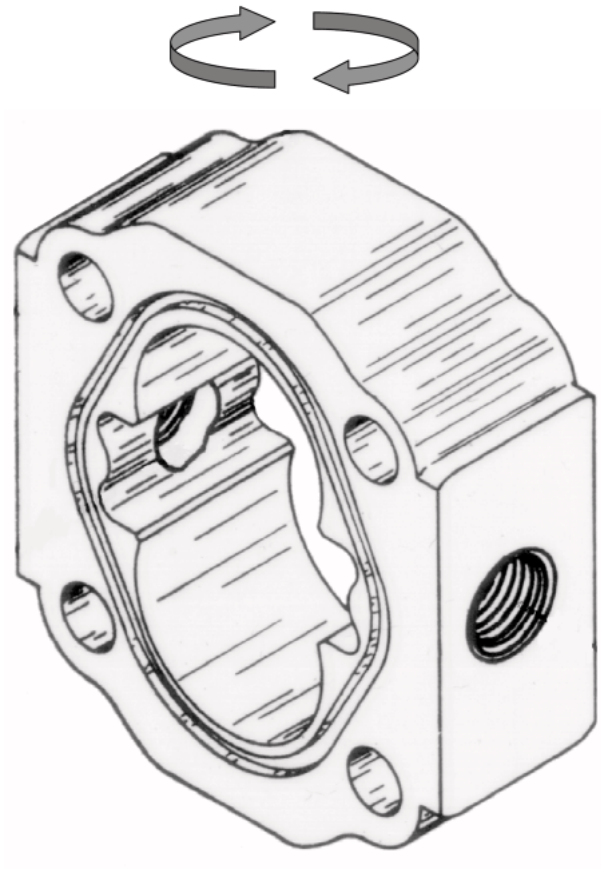
Note: If the bearing carrier has an L-shaped porting configuration, it cannot be used. A new bearing carrier will have to be machined with the proper configuration.

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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Notes

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Notes

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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.

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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.

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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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Parker Hannifin Corporation

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

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.

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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.

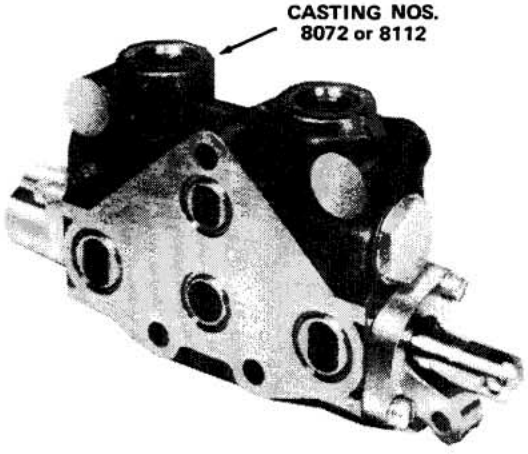
If further assistance is required, contact:

Your Gresen Distributor or Representative.

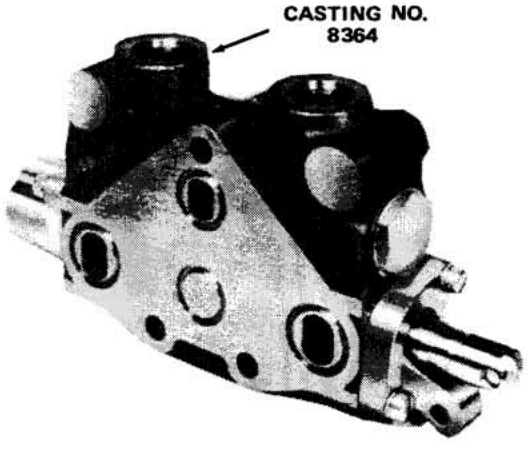
WARNING

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.



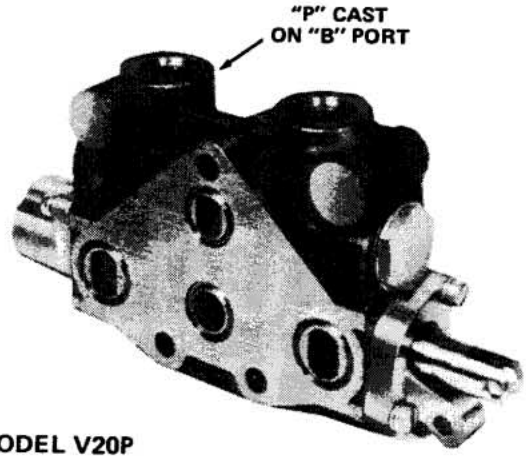
Model V20C
Work Section.

SECTION II
DESCRIPTION

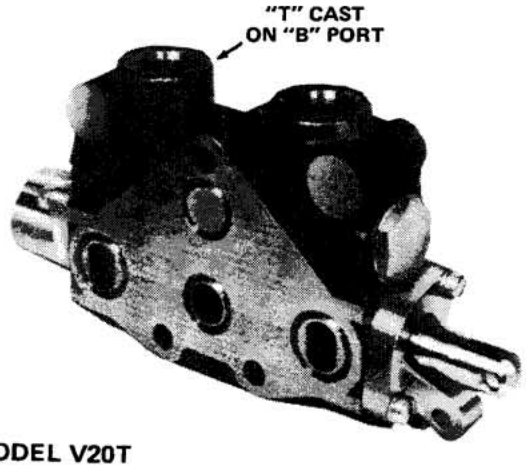
Gresen Model V20 Directional Control Valves may be purchased with five different valve sections, plus various options, to meet the desired job specification.

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.

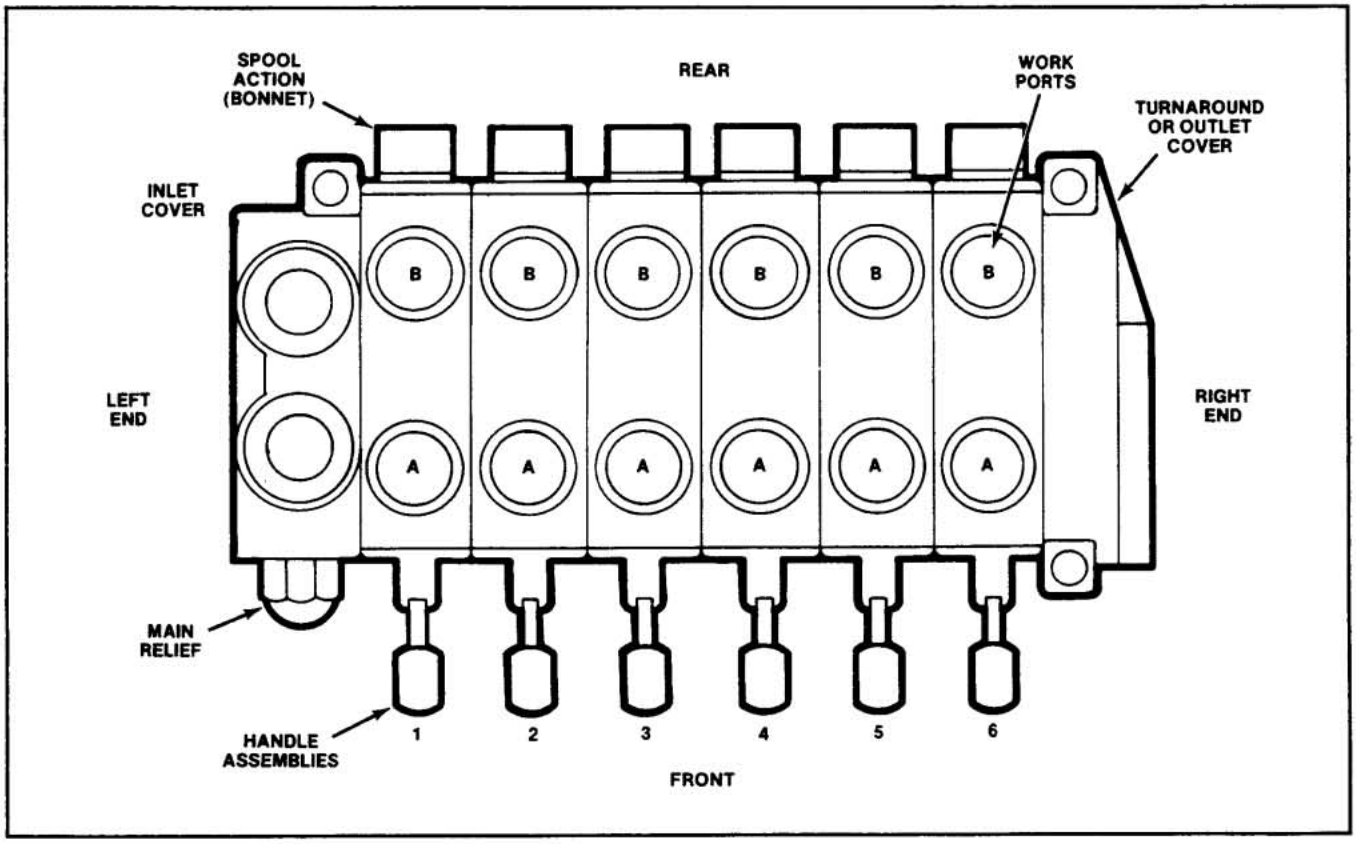


Figure 3-1. Schematic-View of Typical Control Valve Assembly.

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.

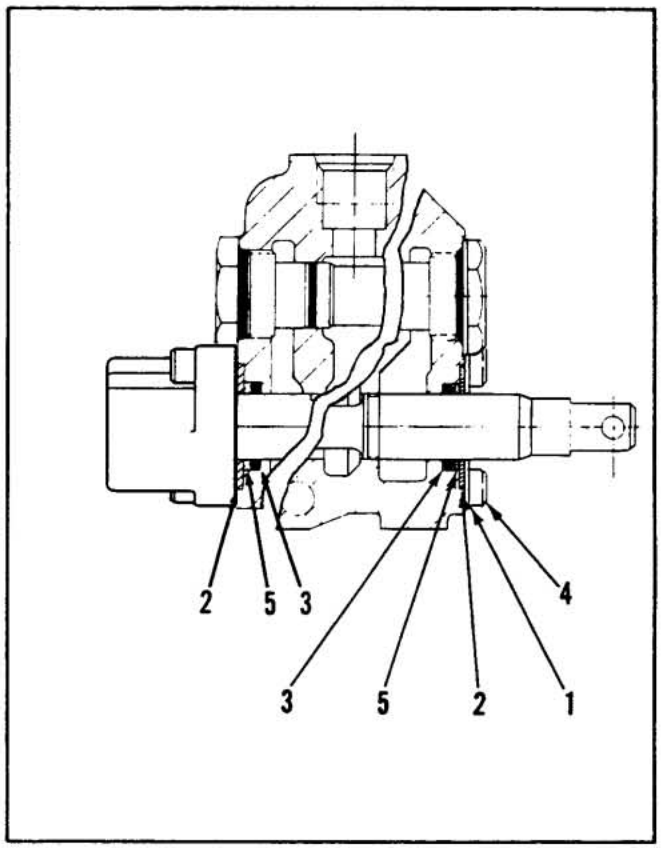


Figure 3-2. Spool Seal Assembly

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.

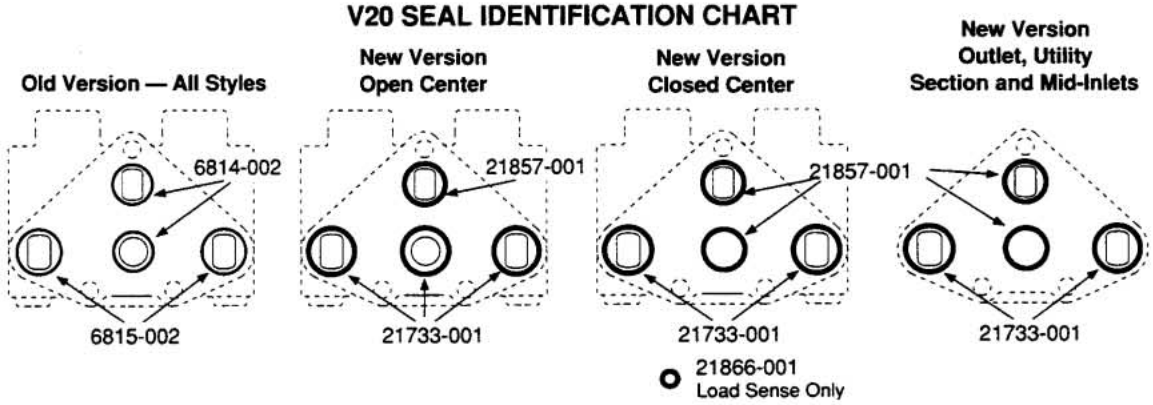
5. Lightly oil new seals. Slide over valve spool and insert in seal counterbore.

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



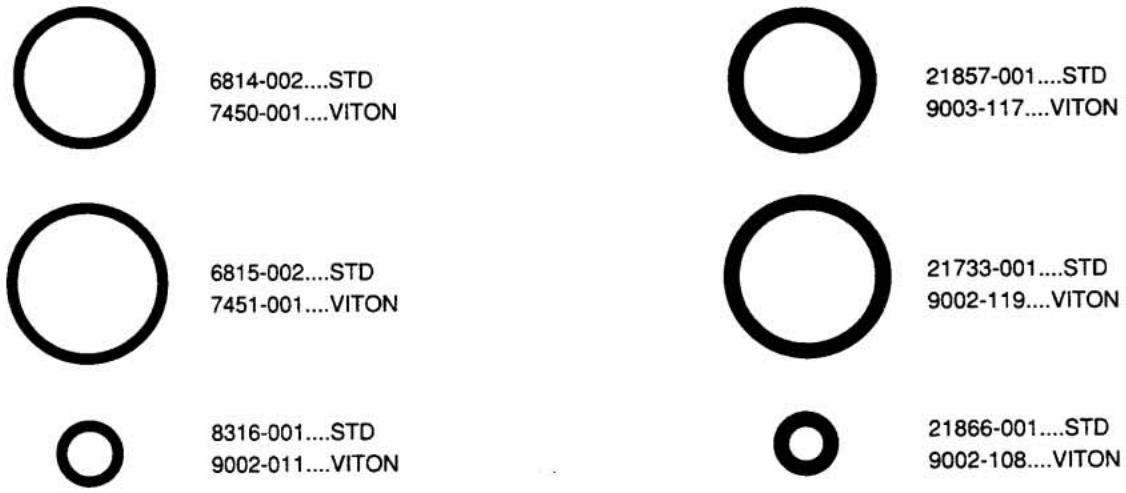
The following section seals are included in the Kits:

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.

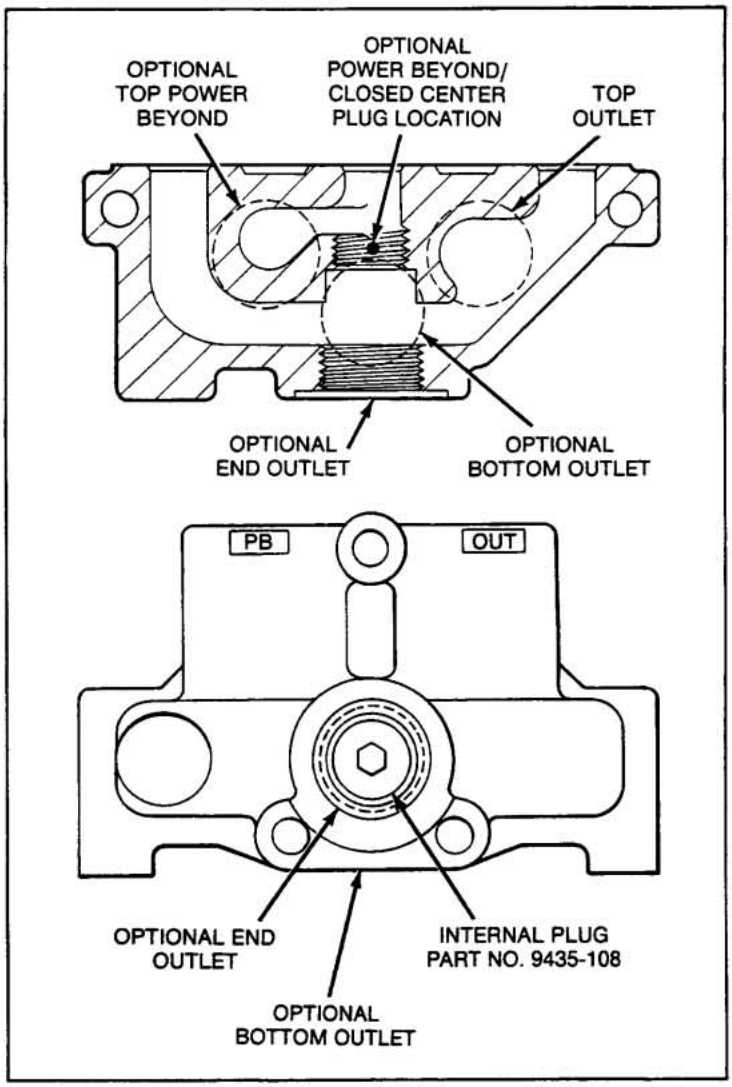


Figure 3-3. Outlet Cover Part No. 8644

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.

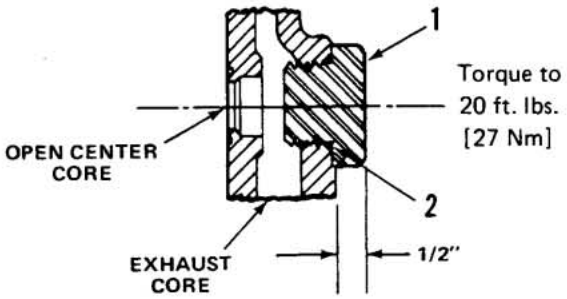
Outlet Cover, Part No. 6770.

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.



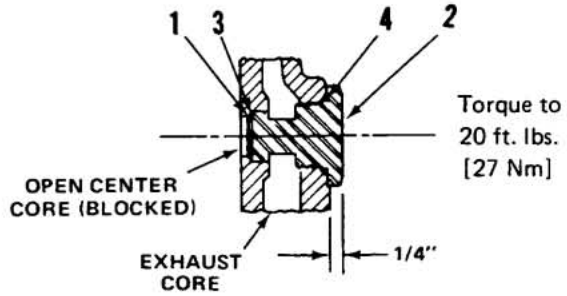
SERVICE KIT K-6016

(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.



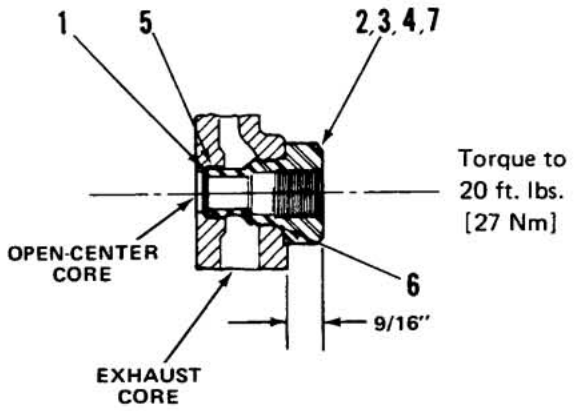
SERVICE KIT K-6015

(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

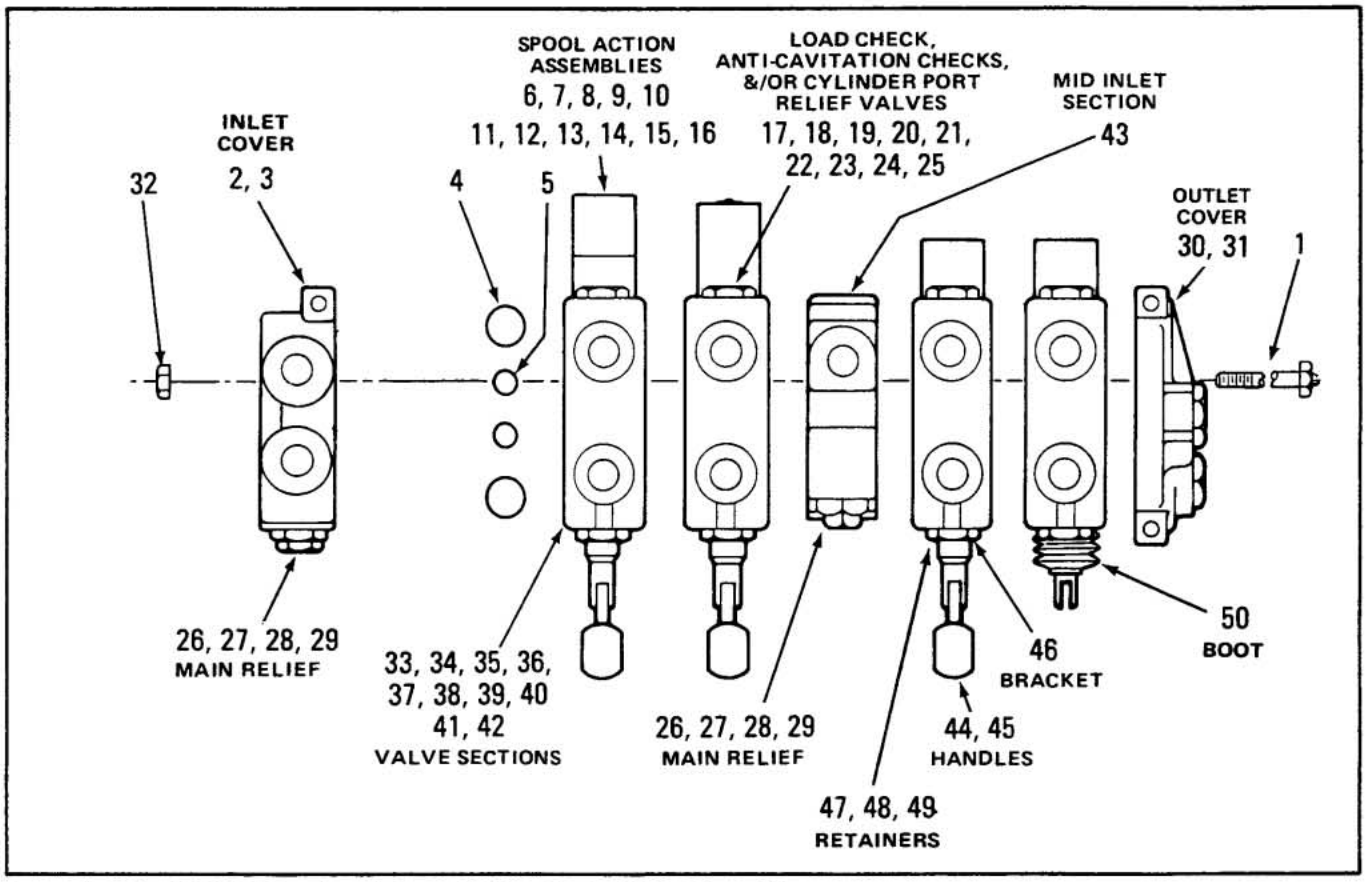


Figure 4-1. Model V20 Directional Control Valve, Typical Main Assembly.

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.

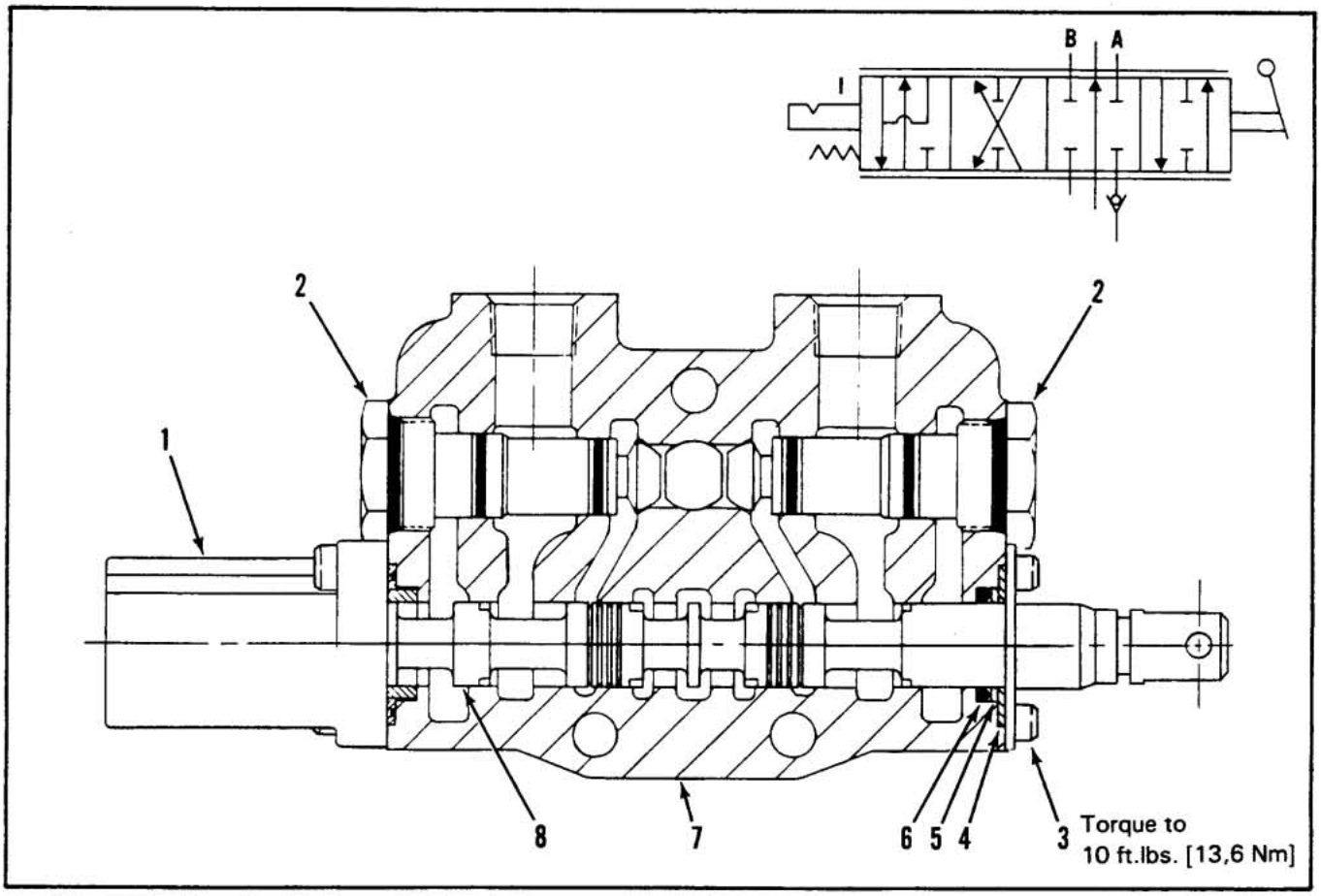


Figure 4-2. 4-Way, 4-Position Float Valve Section.

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.

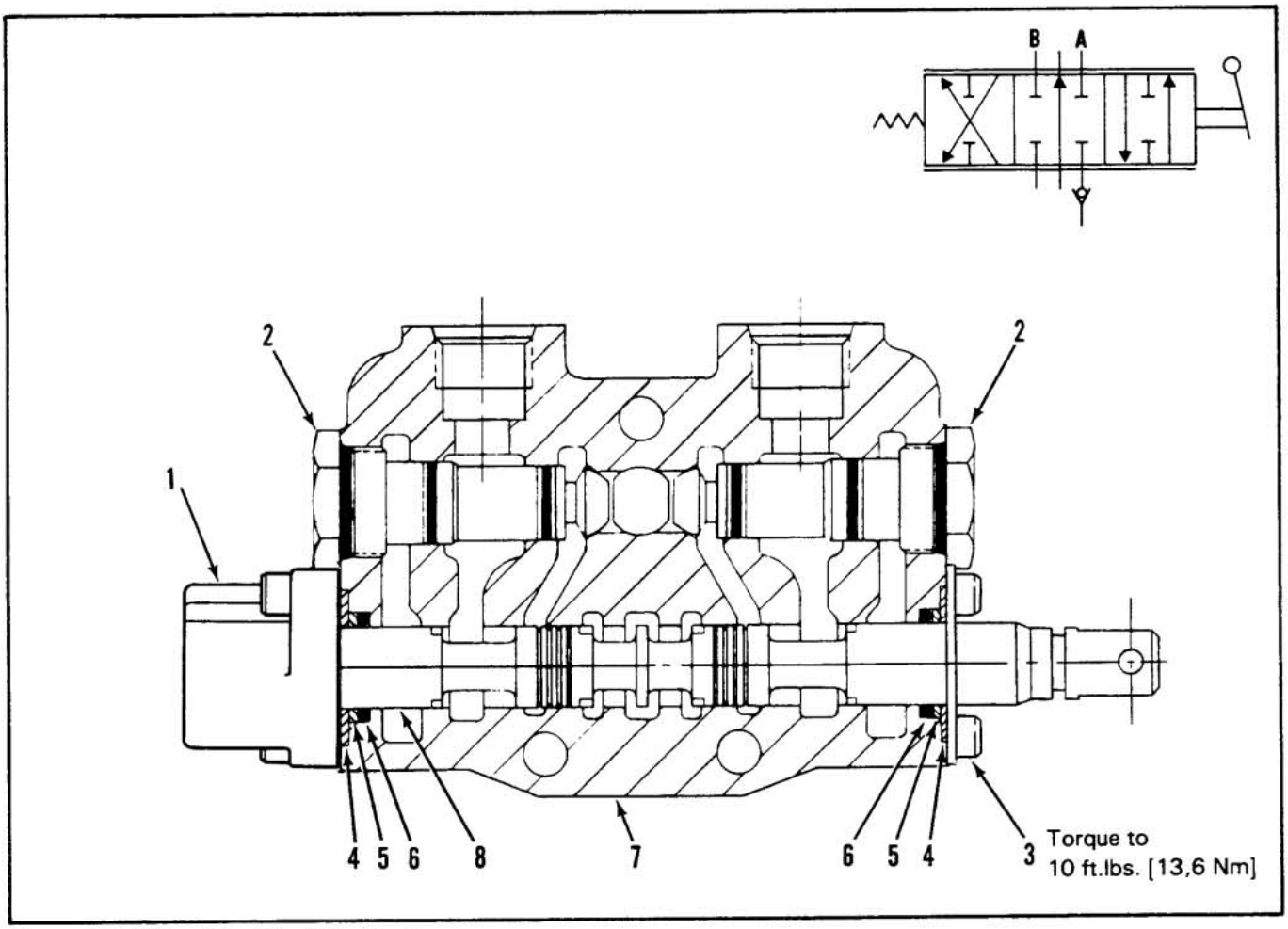


Figure 4-3. 4-Way, 3-Position Valve Section.

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.

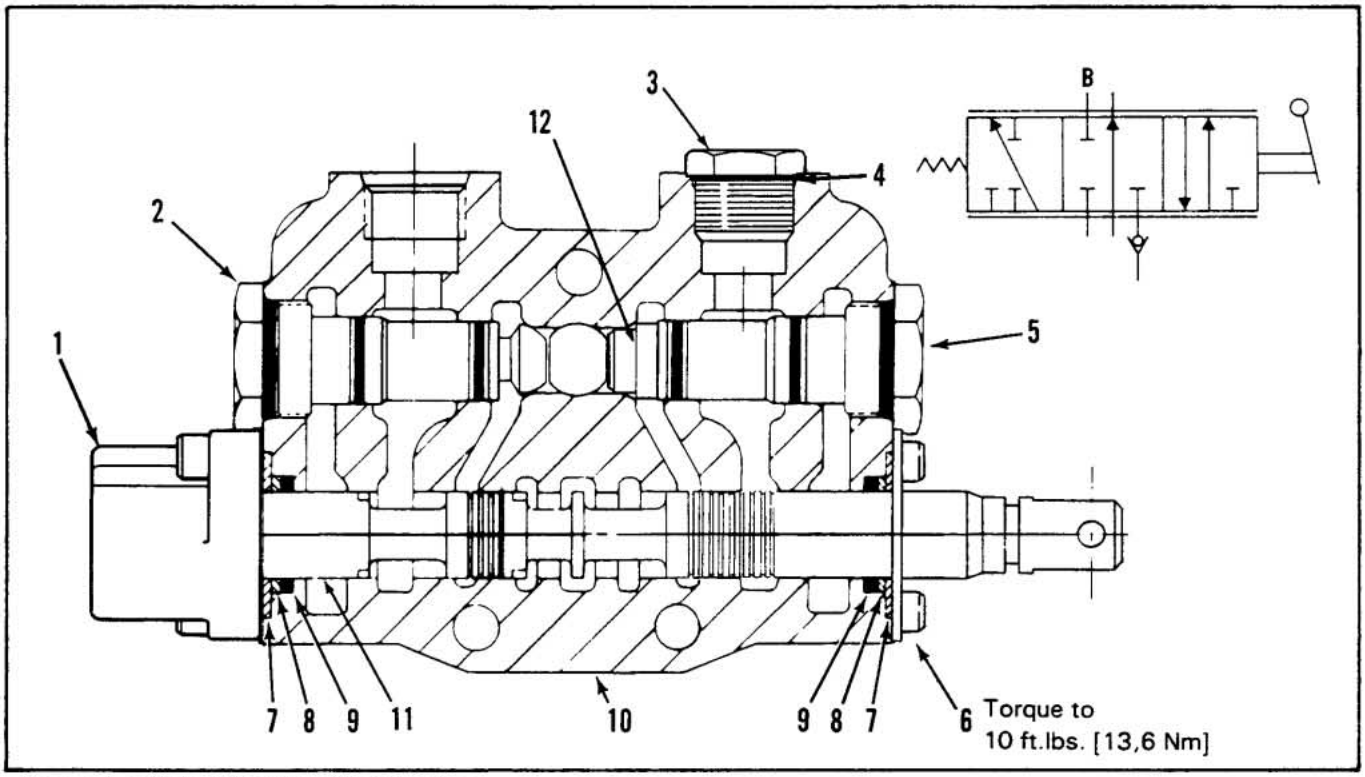


Figure 4-4. 3-Way, 3-Position Valve Section.

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.

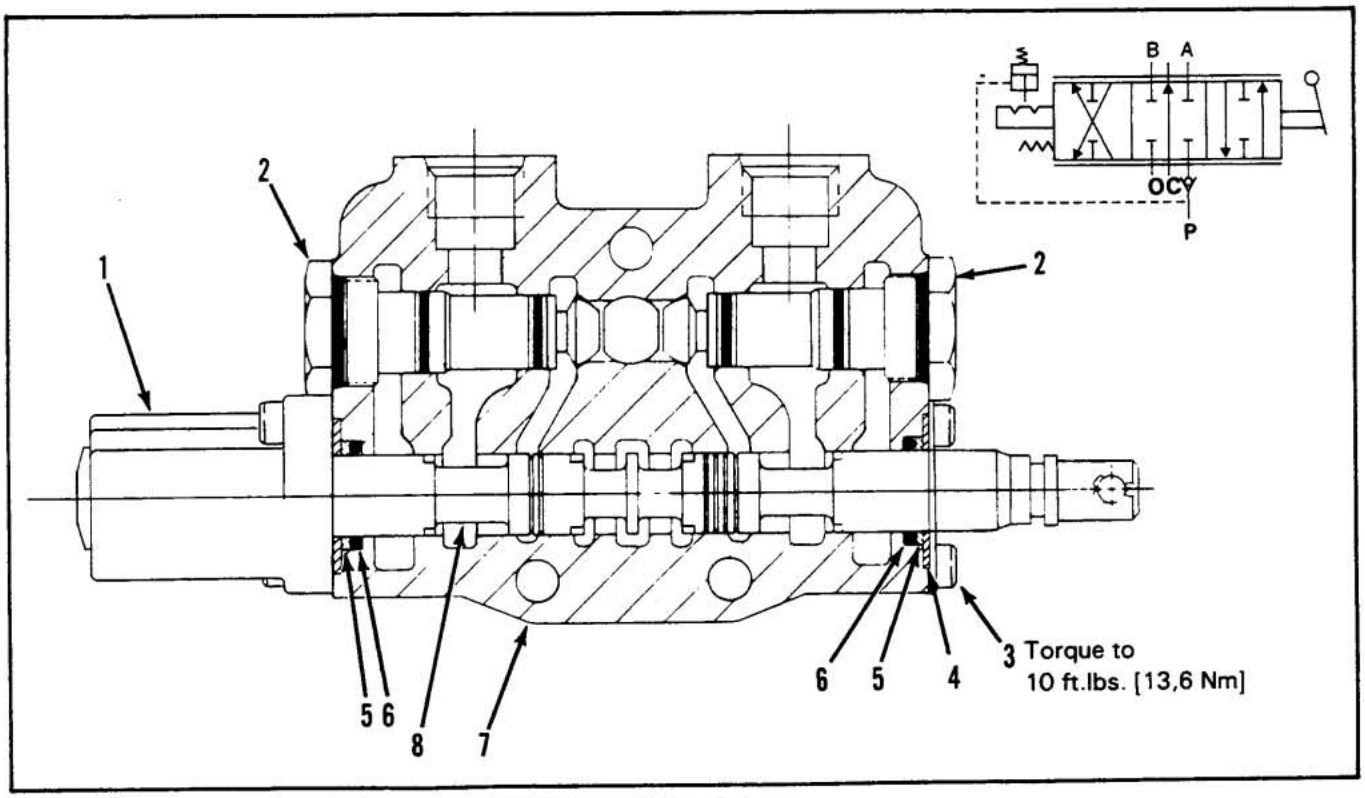


Figure 4-5. 4-Way, 3-Position Valve Section with Pressure Detent Release.

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.

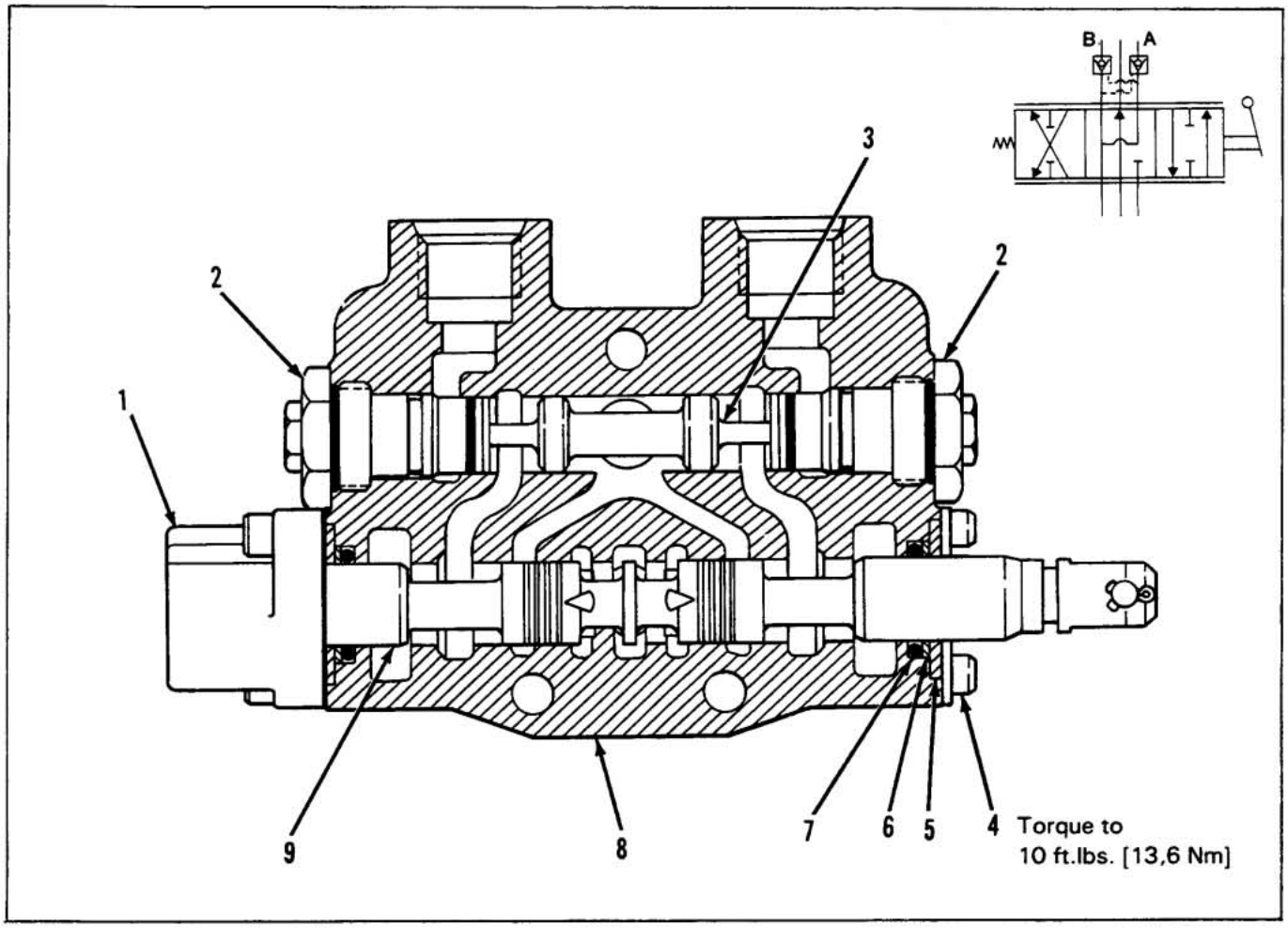


Figure 4-6. 4-Way, 3-Position Lockout Valve Section.

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.

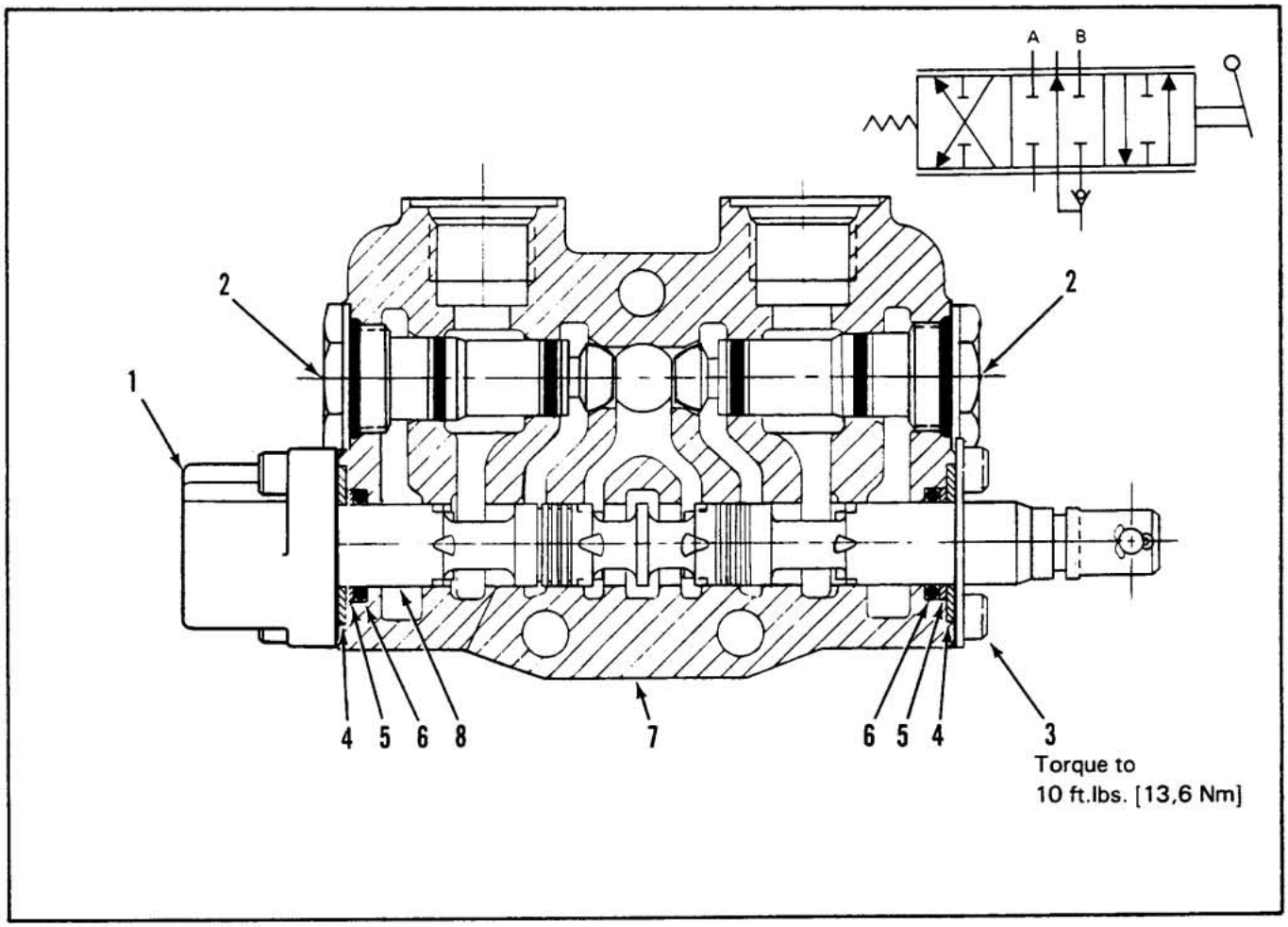


Figure 4-7. 4-Way, 3-Position Tandem Valve Section (shown with 4-way spool).

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.

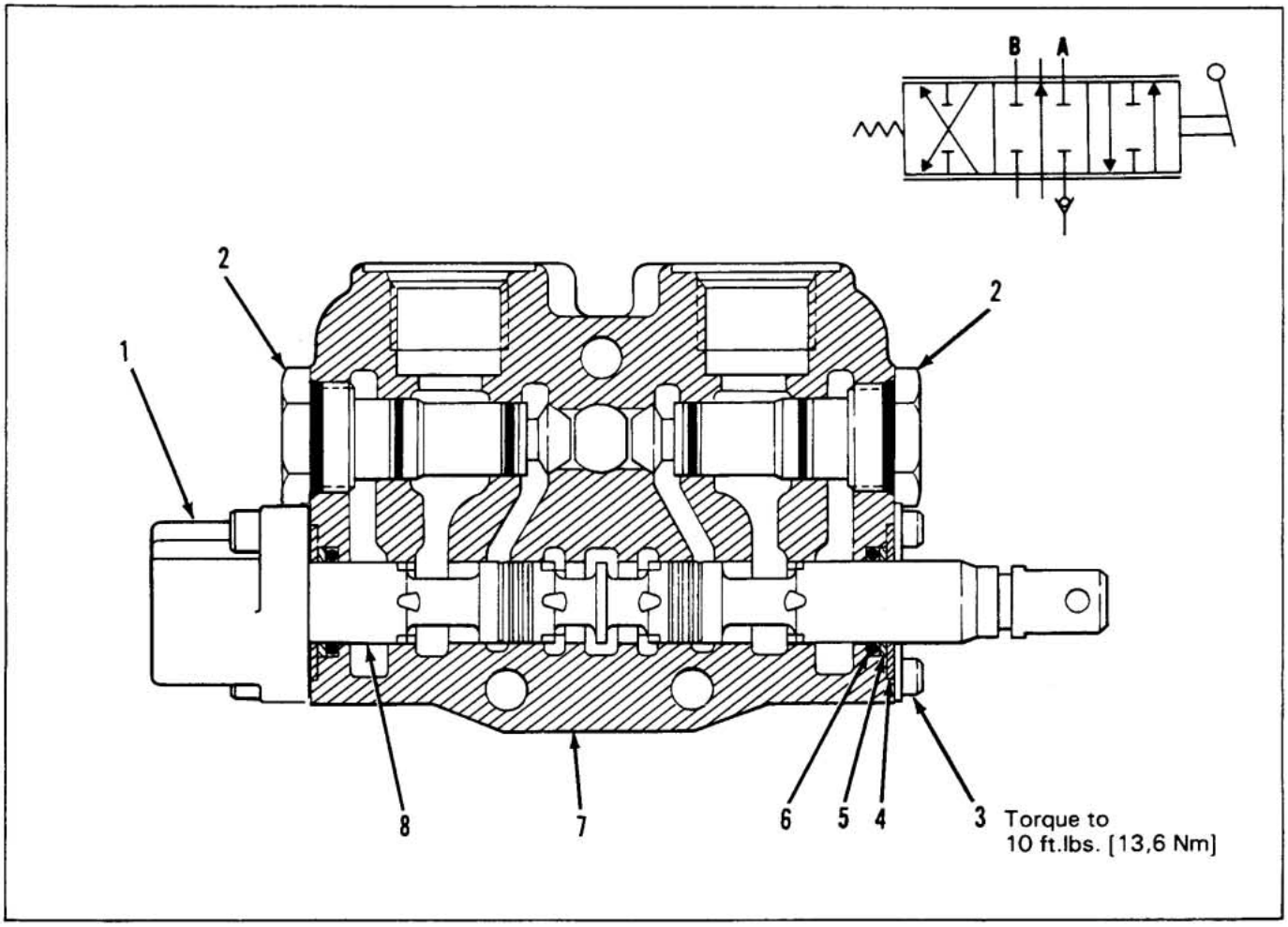


Figure 4-8. 4-Way, 3-Position, Low Pressure Drop Valve Section.

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.

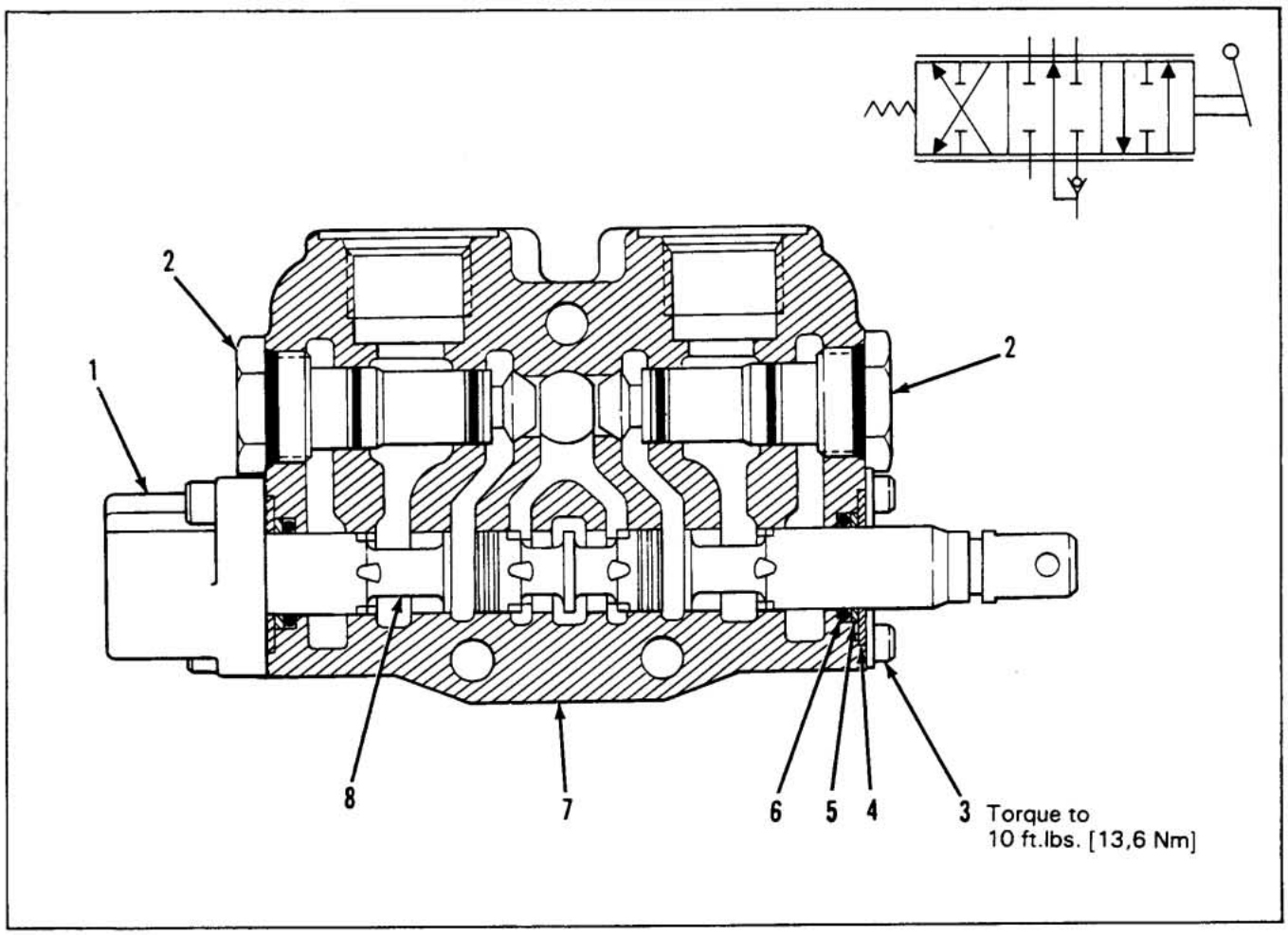


Figure 4-9. 4-Way, 3-Position, Tandem, Low Pressure Drop Valve Section.

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.

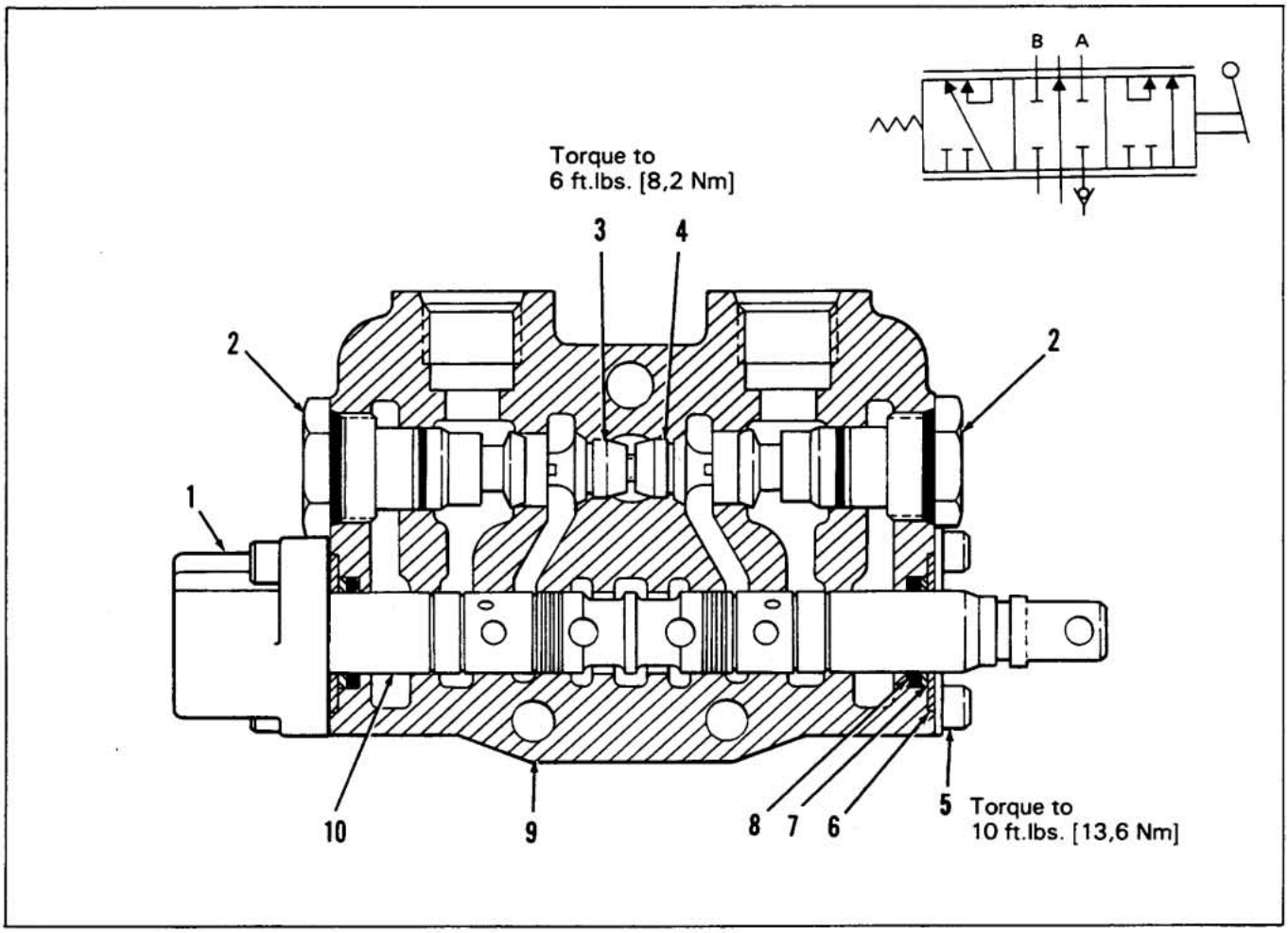


Figure 4-10. 4-Way, 3-Position, Series Valve Section.

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.

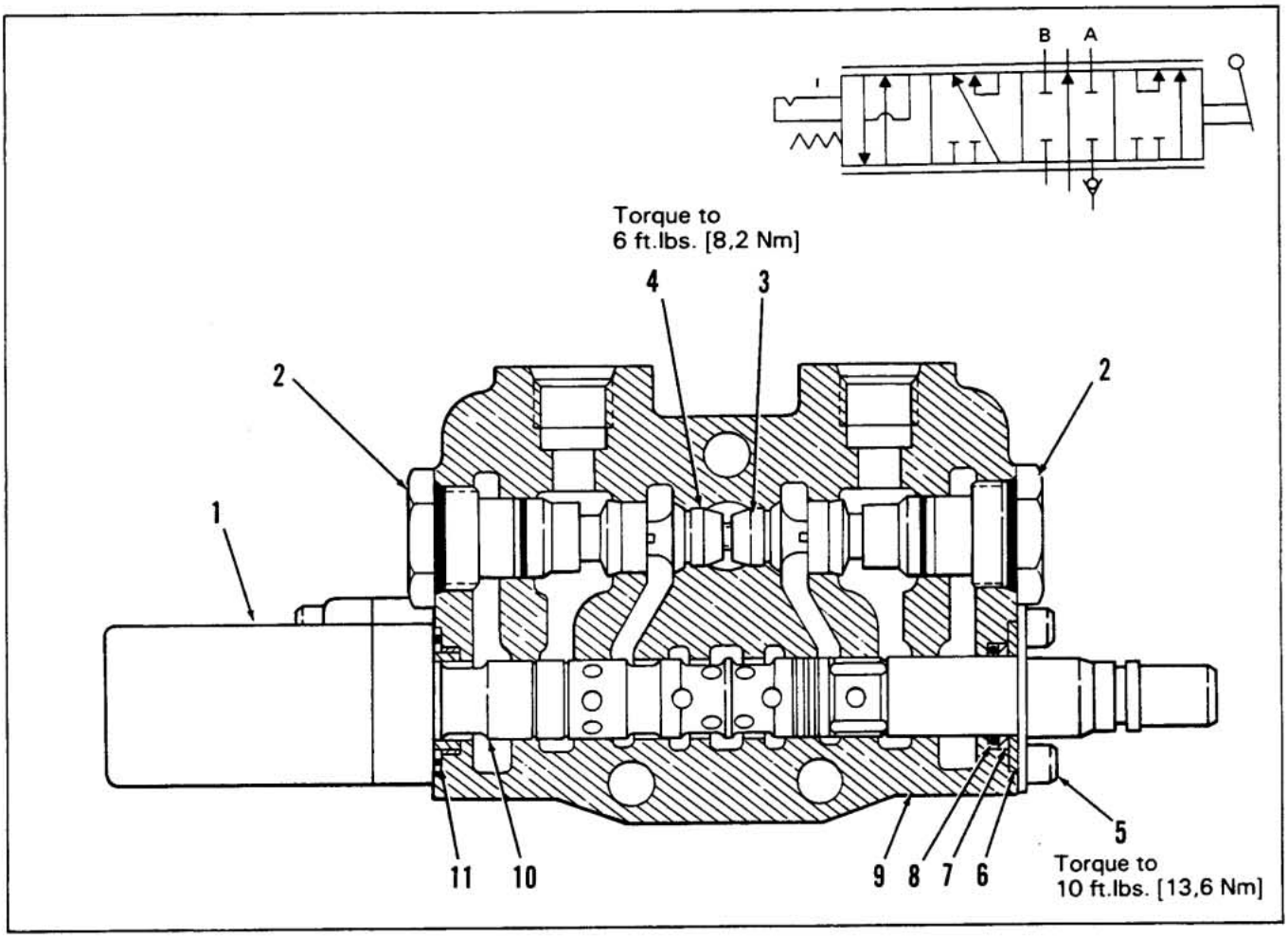


Figure 4-11. 4-Way, 4-Position Float, Series Valve Section.

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.

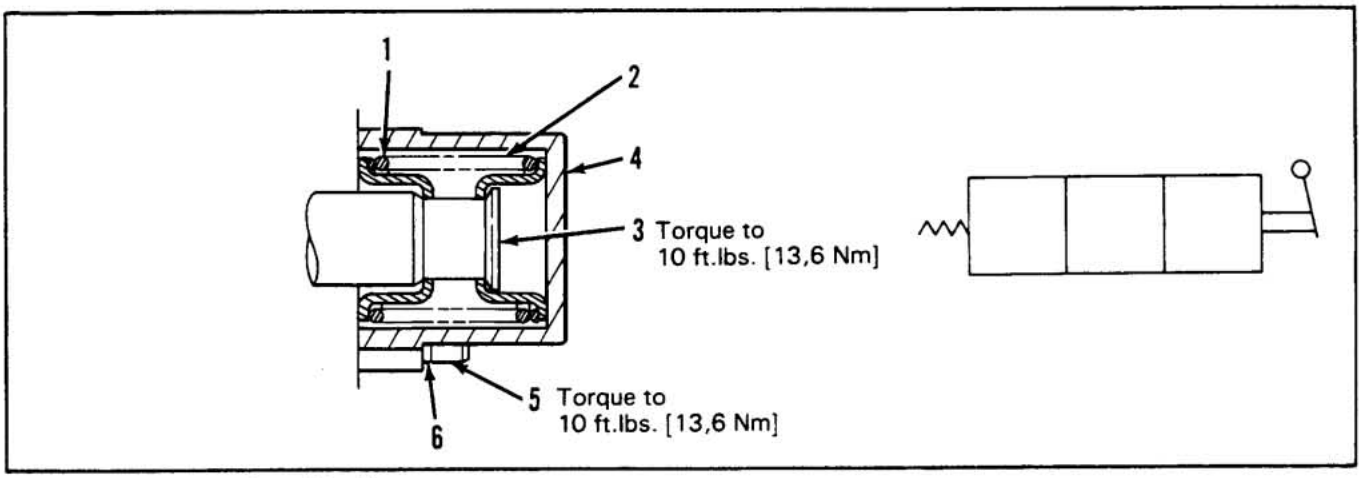


Figure 4-12. Standard Spool Positioner.

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

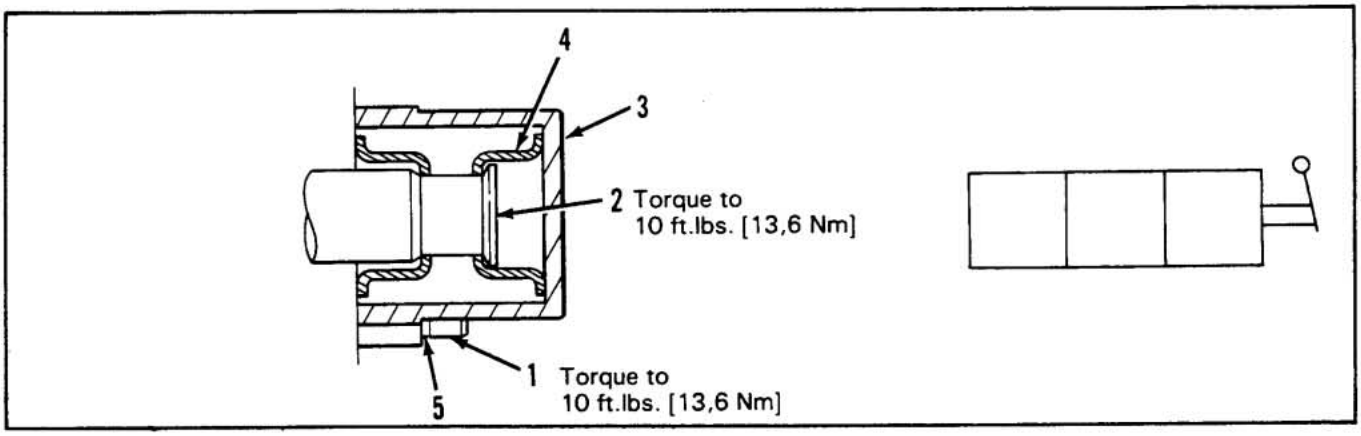


Figure 4-13. Manual Spool Positioner.

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

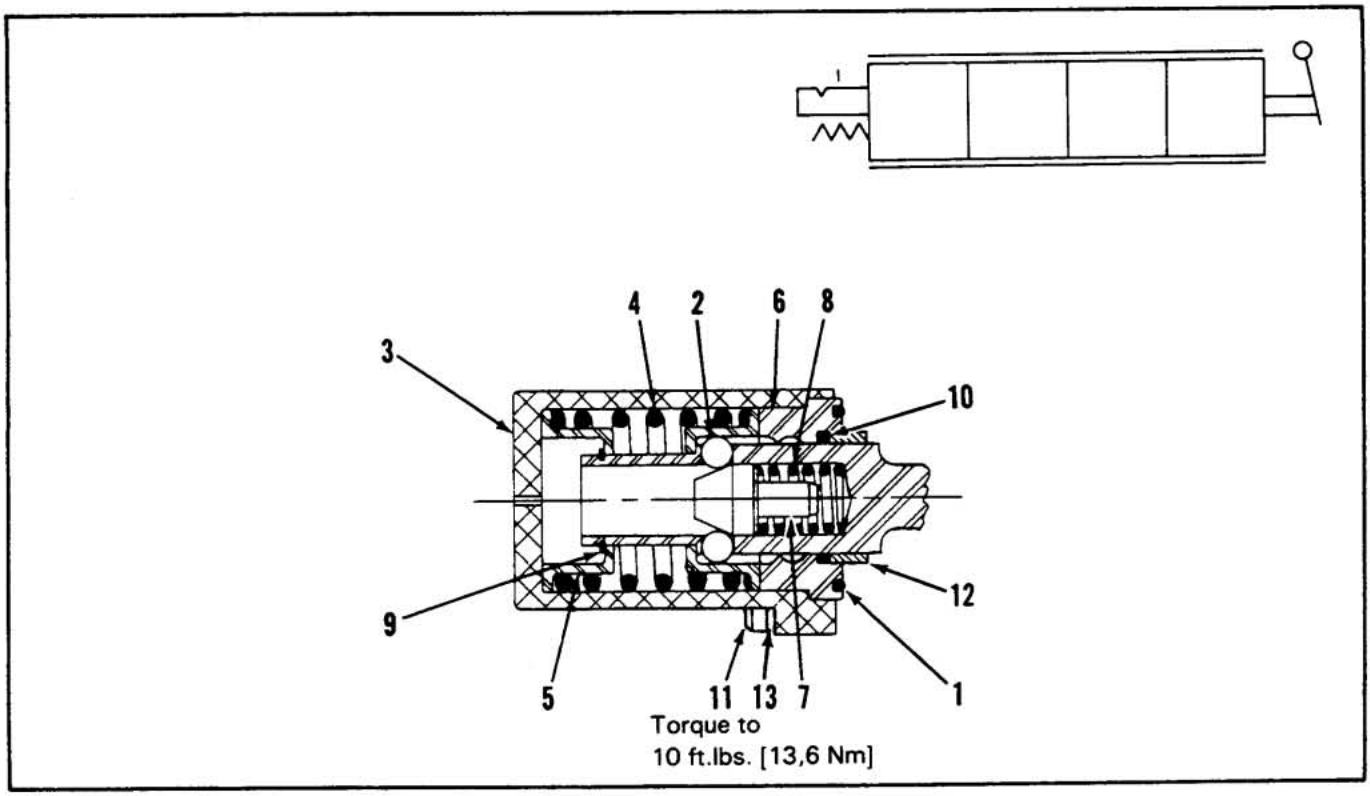


Figure 4-14. 4-Way, 4-Position Float Detent Positioner.

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.

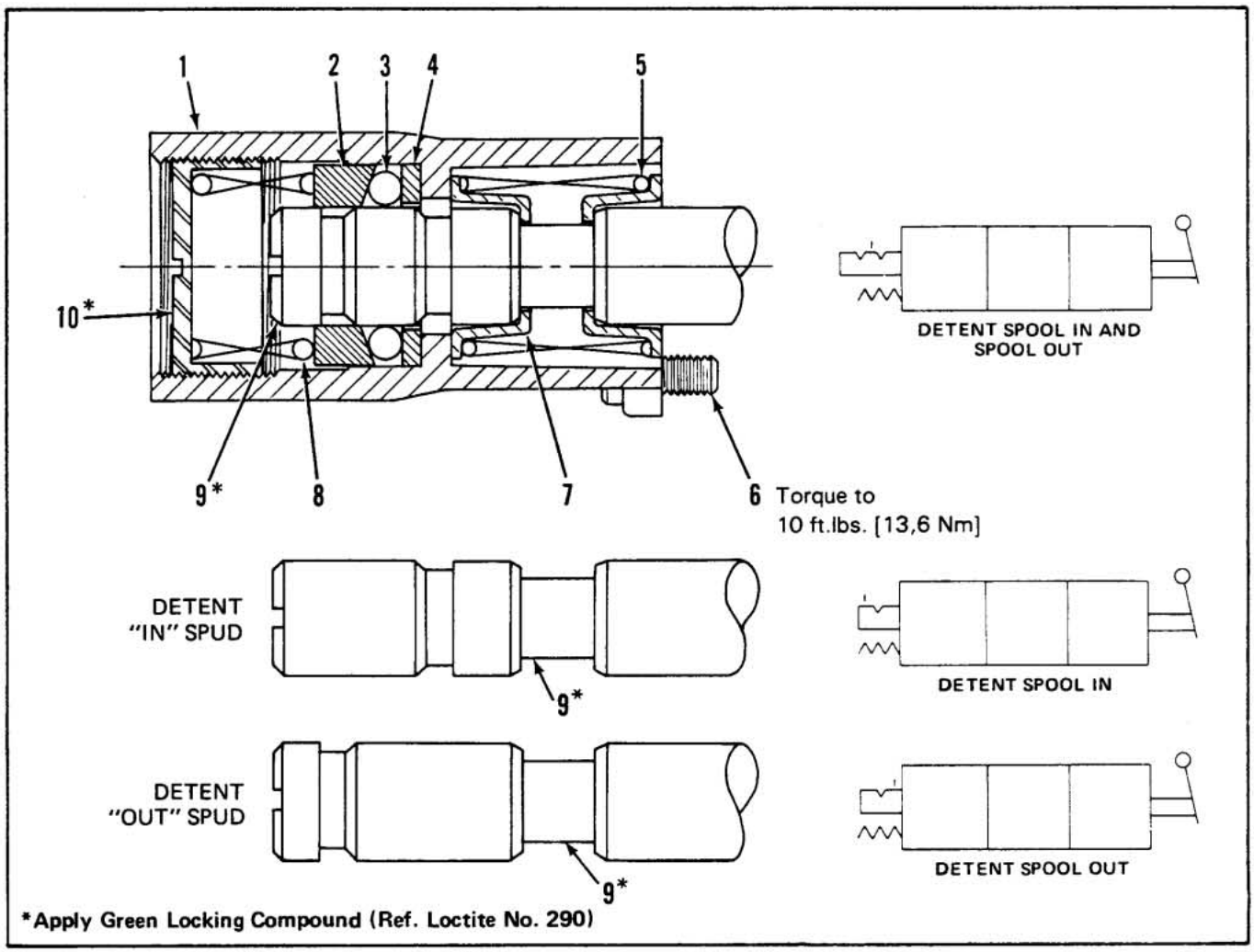


Figure 4-15. Option "R" Detent with Spring Return to Neutral.

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

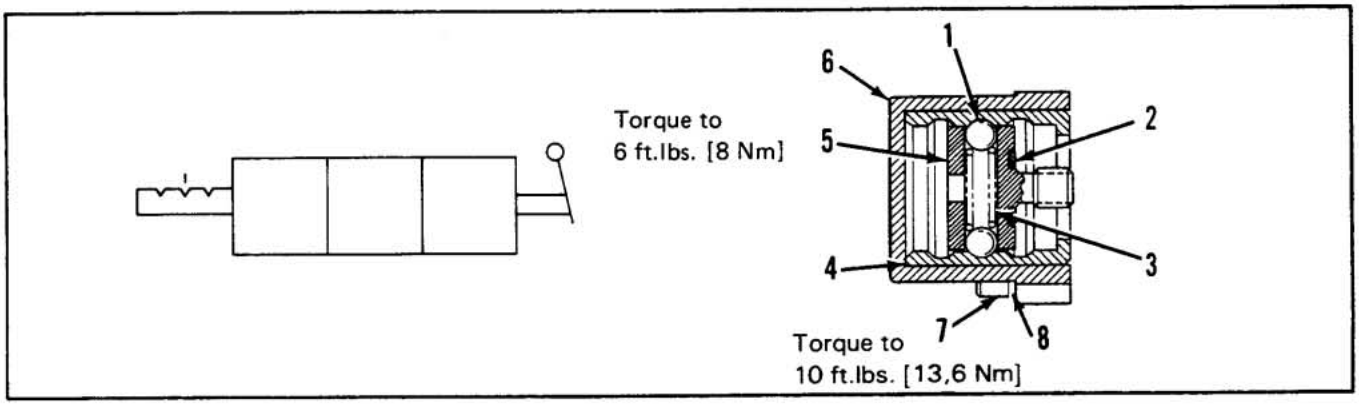


Figure 4-16. Option "D" 3-Position Detent Spool.

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

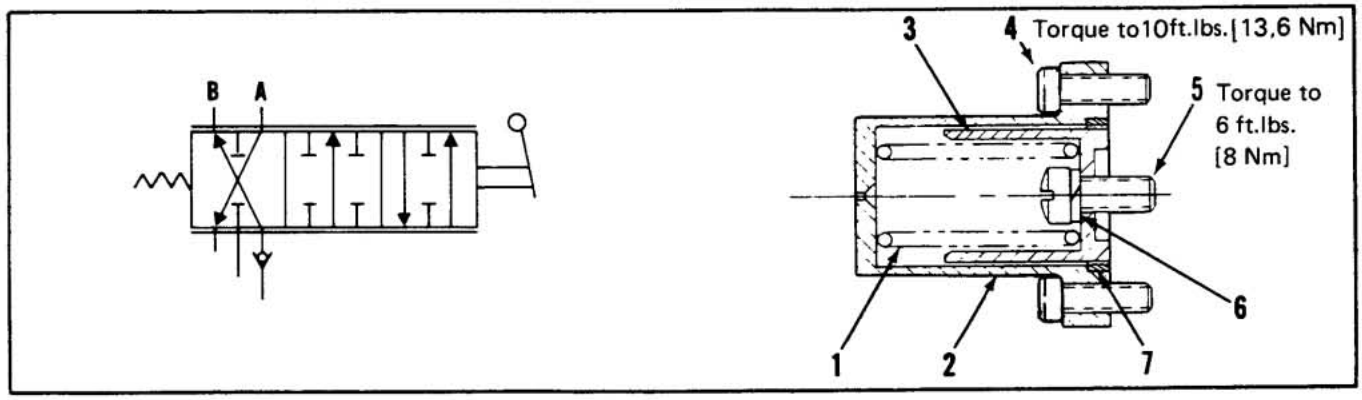


Figure 4-17. Option "A" Spring, Extended Spool.

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

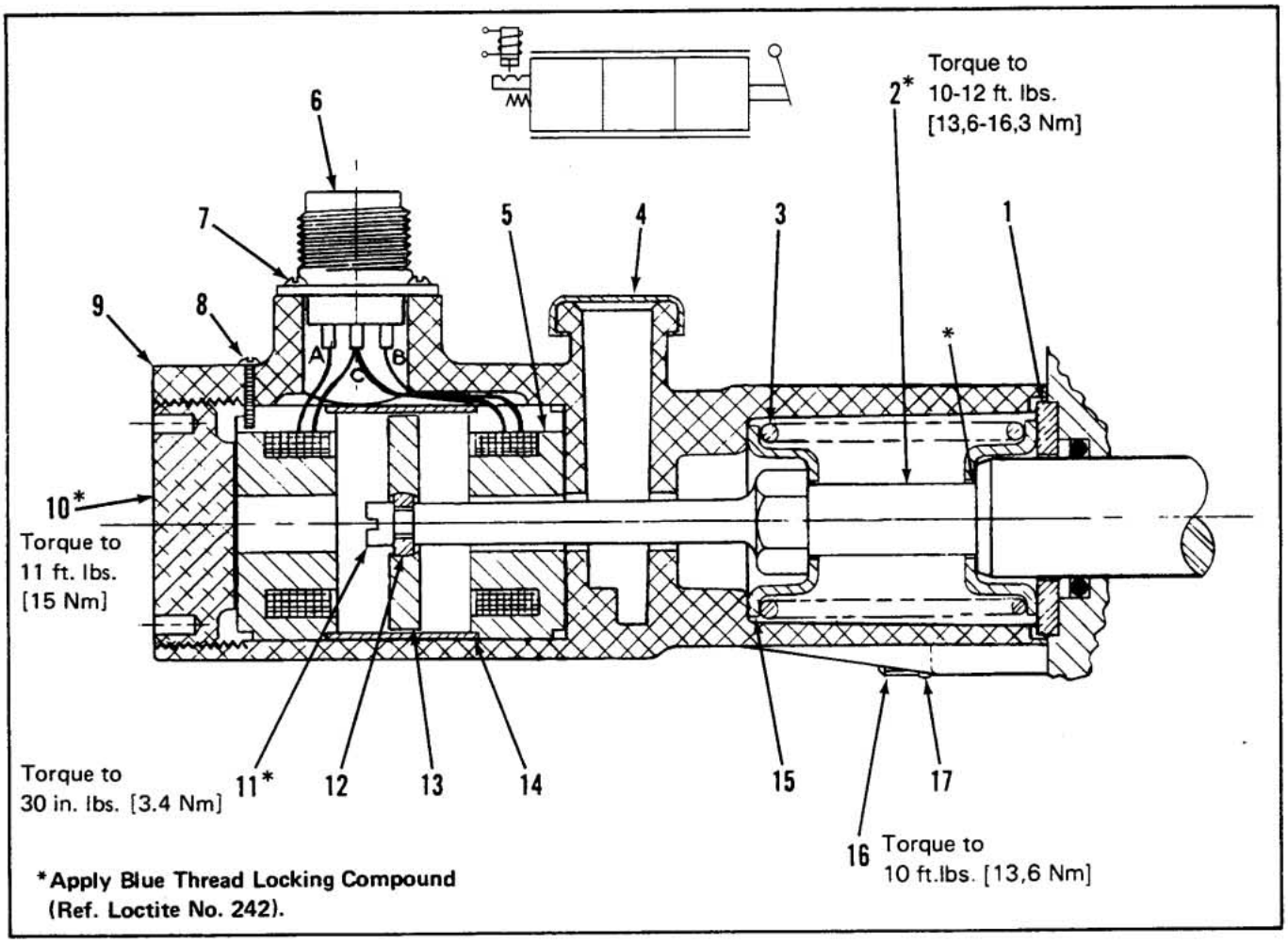


Figure 4-18. Electro-Magnetic Spool Release Positioner.

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

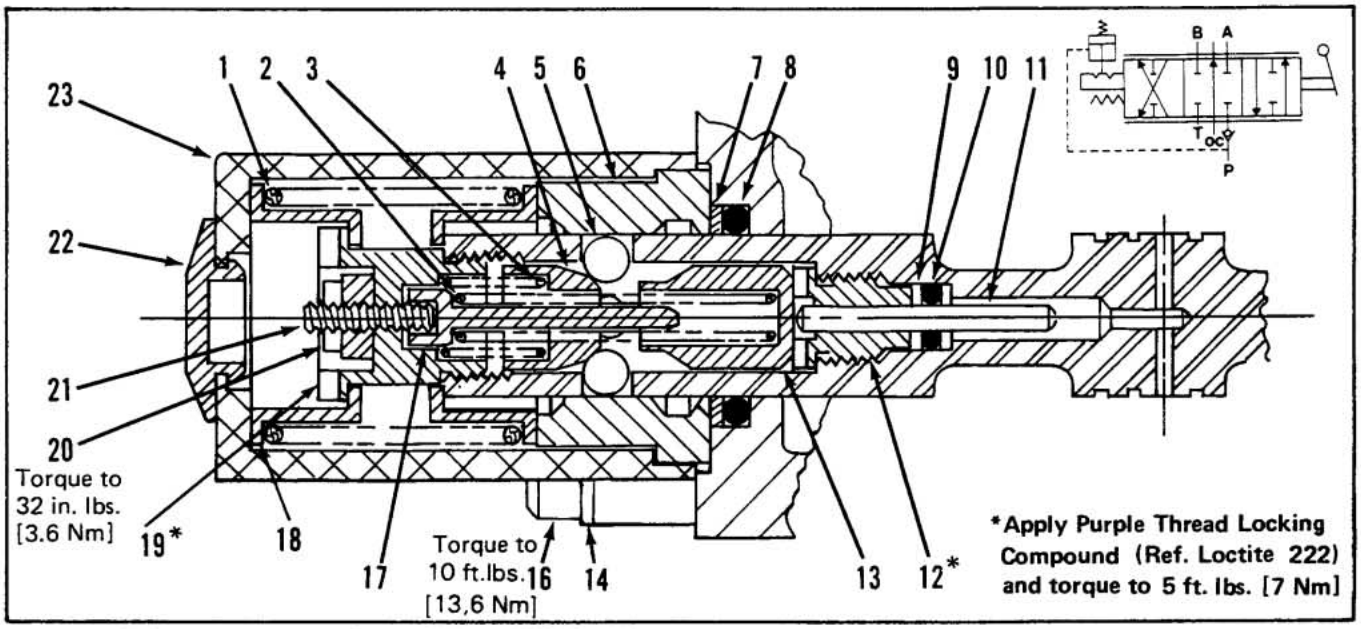


Figure 4-19. Optional Pressure Detent Release (KO) Positioner.

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.

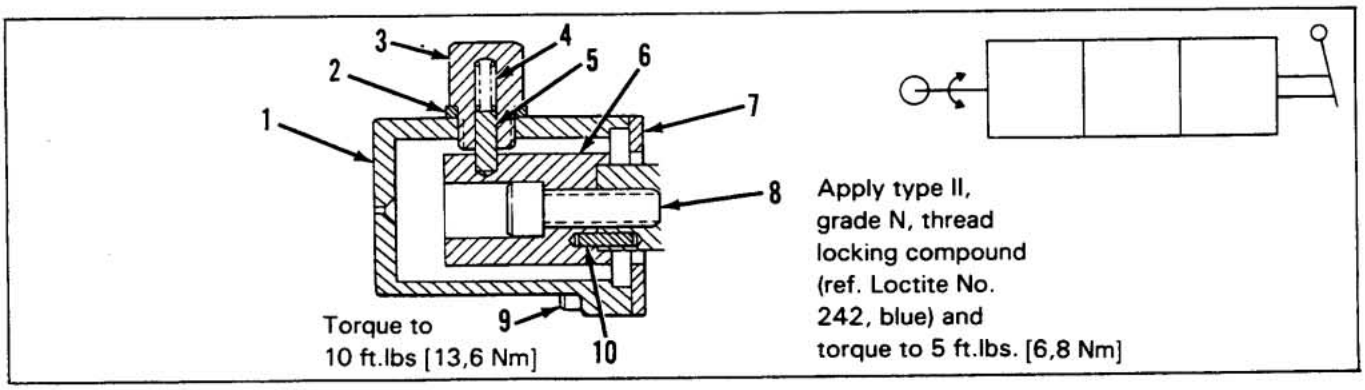


Figure 4-20. Option "W" Rotary Spool Positioner.

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.

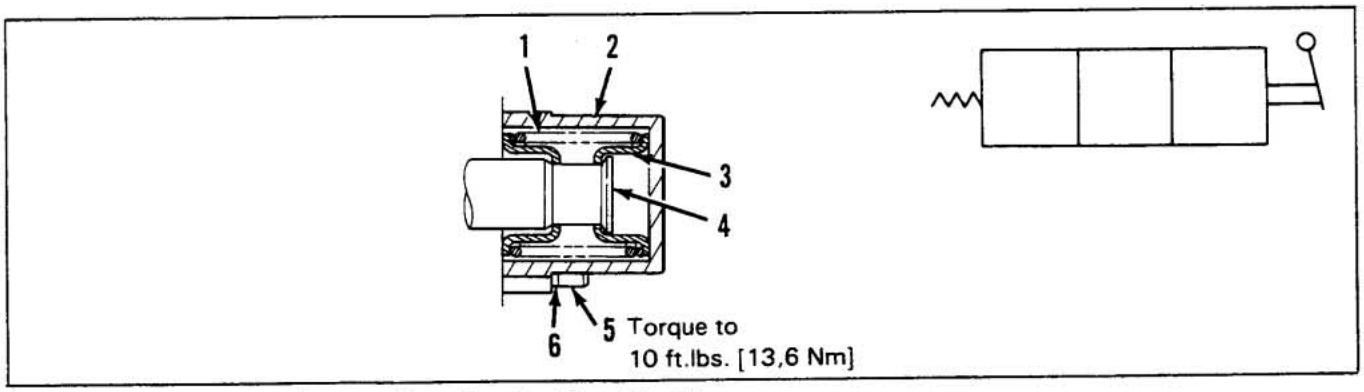


Figure 4-21. Series or Low Pressure Drop, Standard Spool Positioner.

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

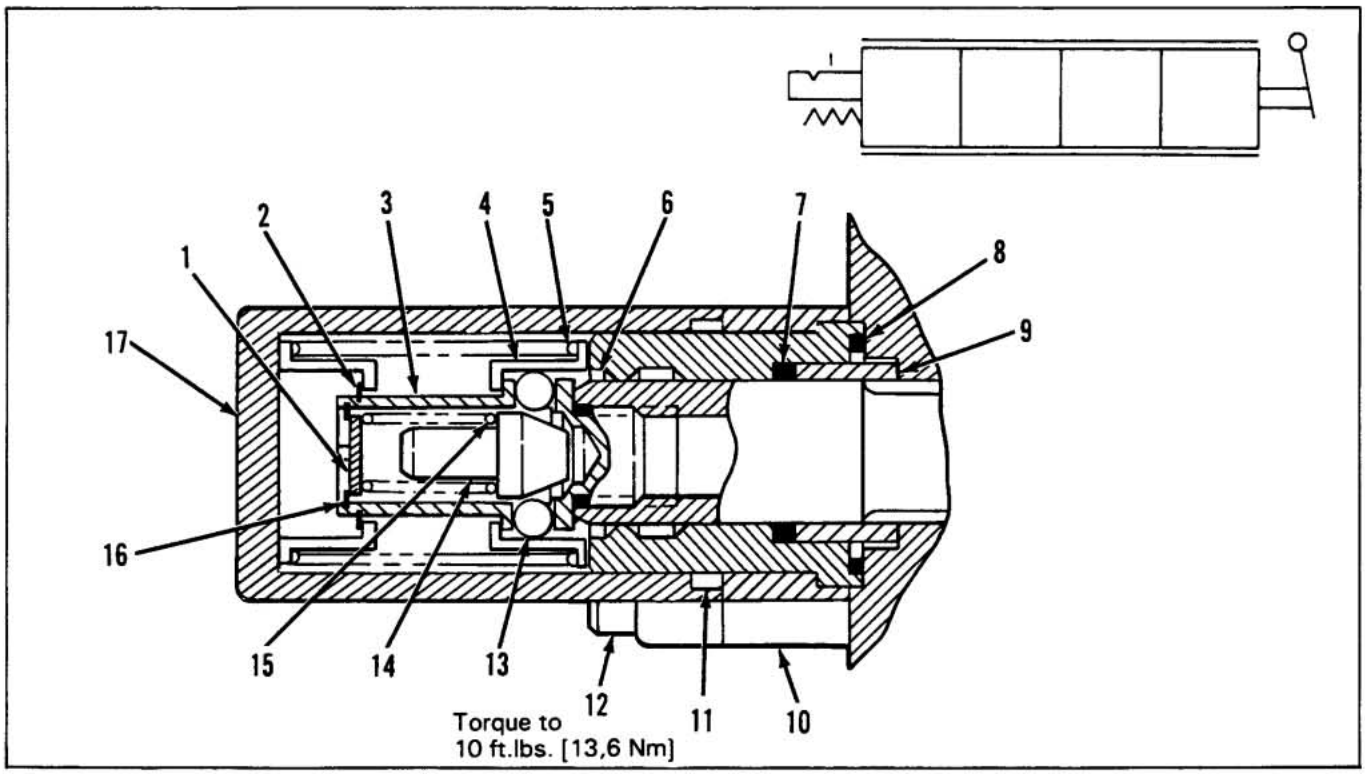


Figure 4-22. V20S 4-Way, 4-Position Float (out) Detent Positioner.

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.

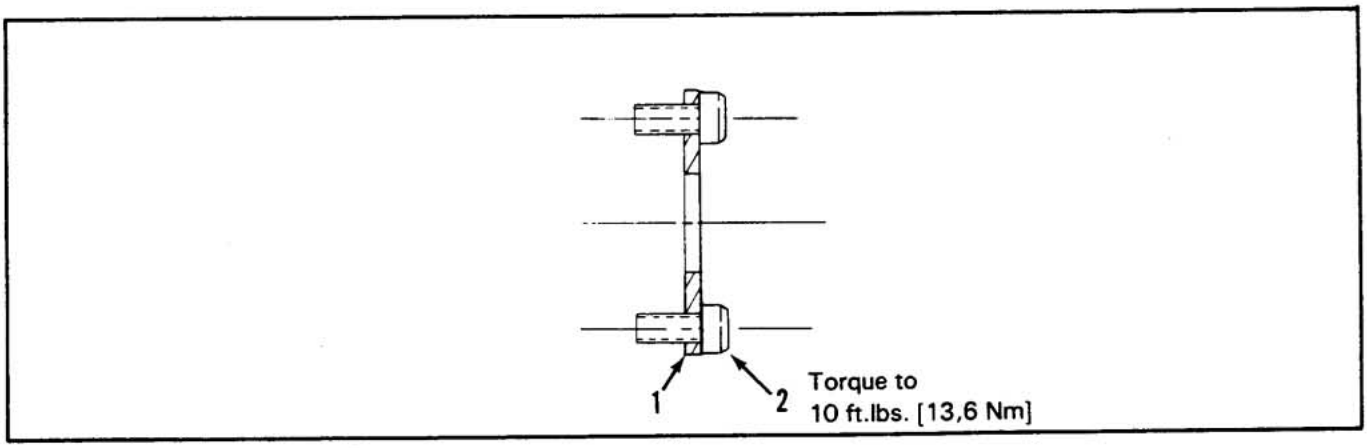


Figure 4-23. Standard Seal Retainer.

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

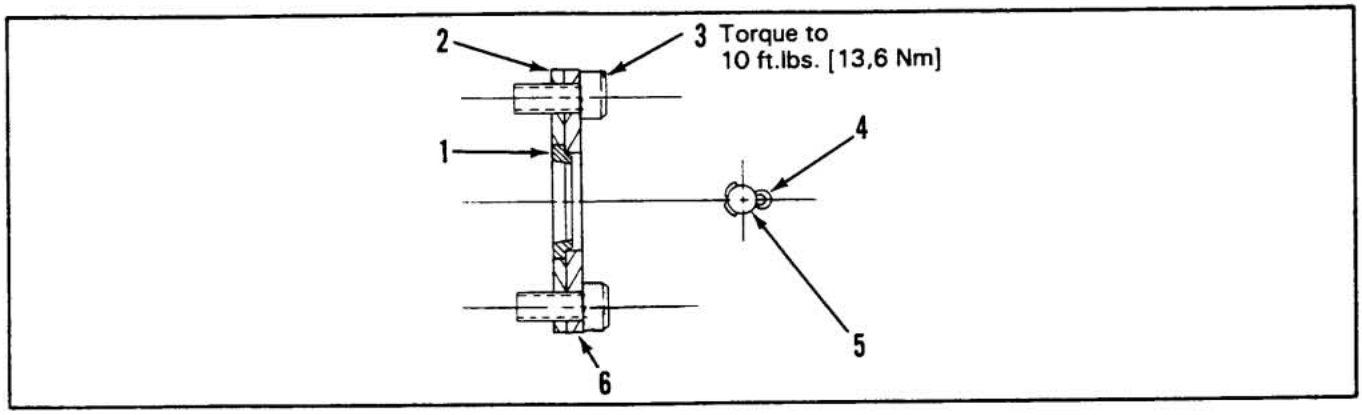


Figure 4-24. Optional Heavy Duty Seal Retainer.

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

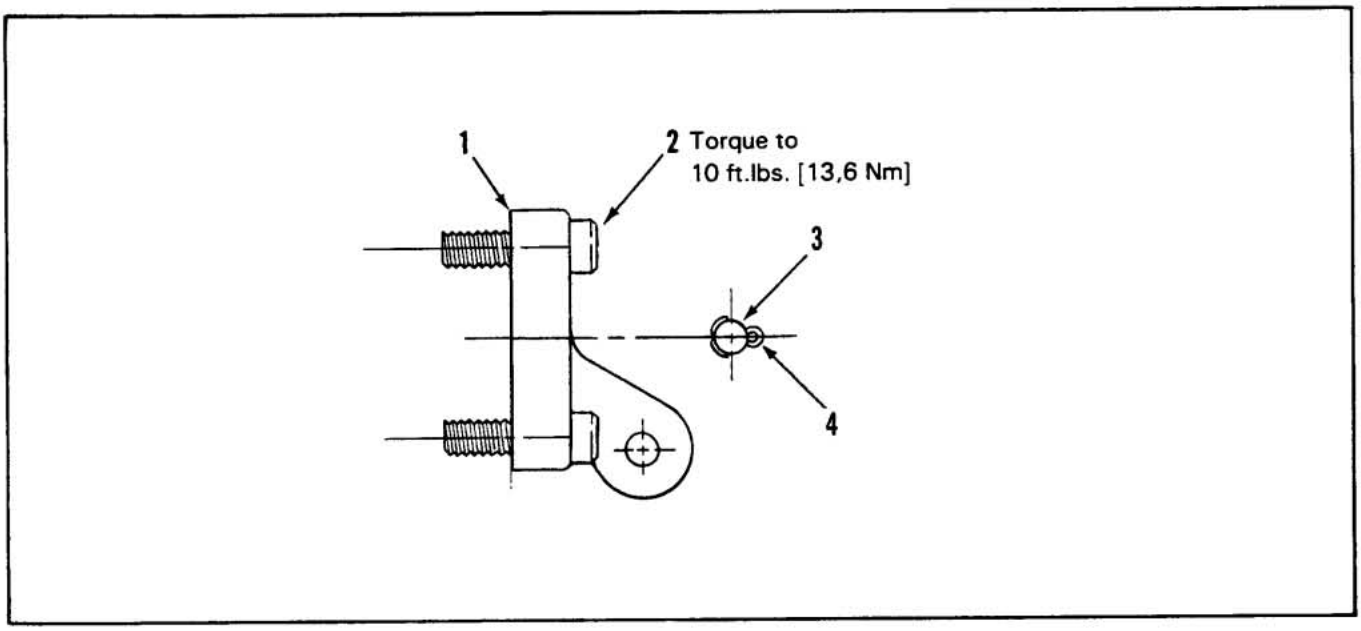


Figure 4-25. Handle Bracket Assembly.

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

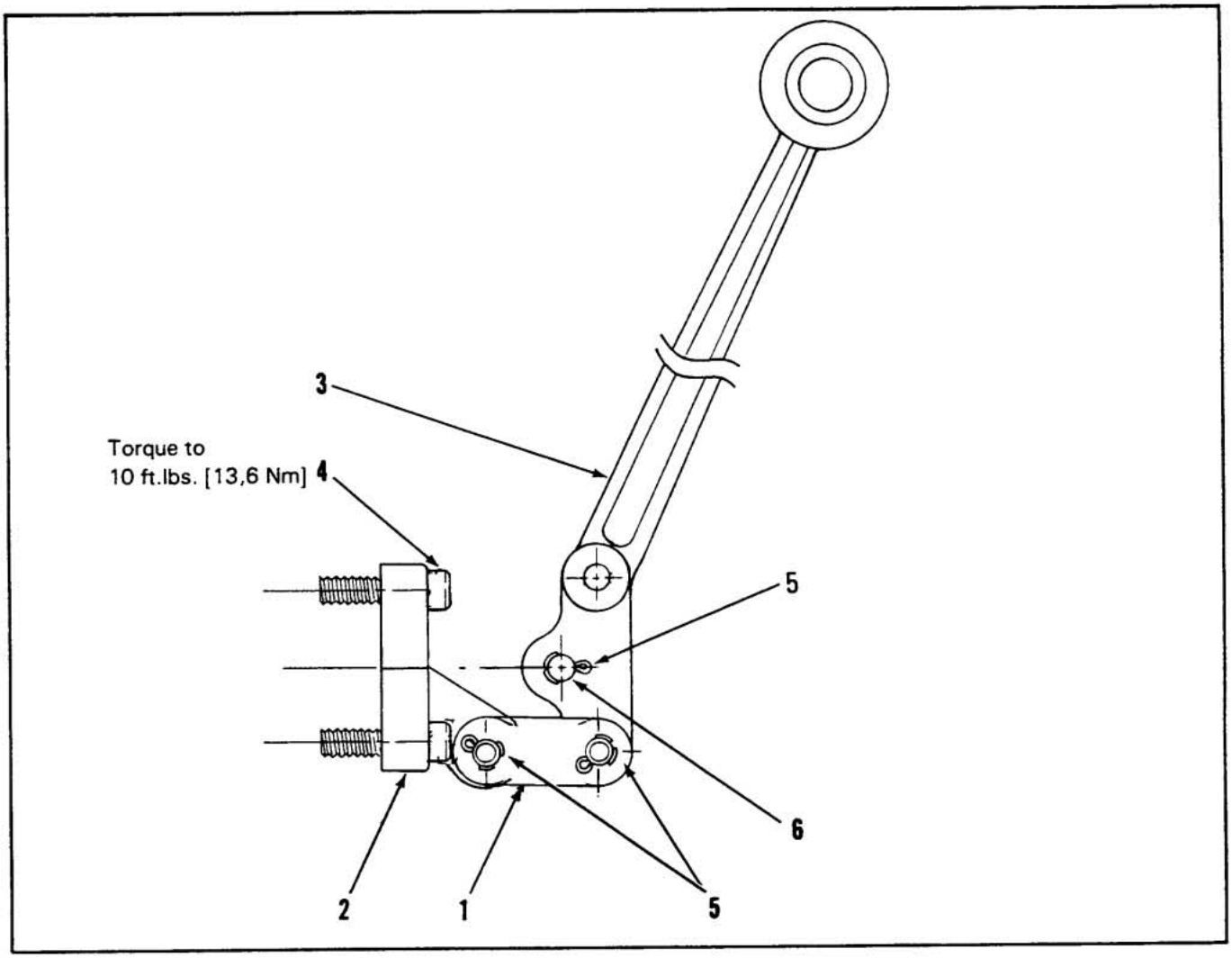


Figure 4-26. Optional Vertical Handle and Bracket Assembly.

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

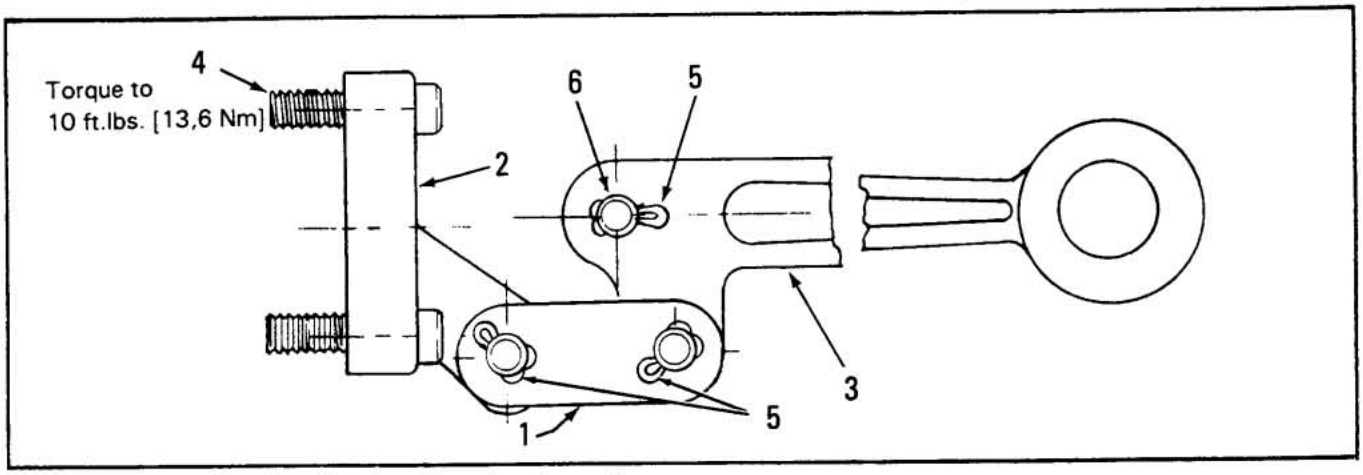


Figure 4-27. Optional Horizontal Handle and Bracket Assembly.

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

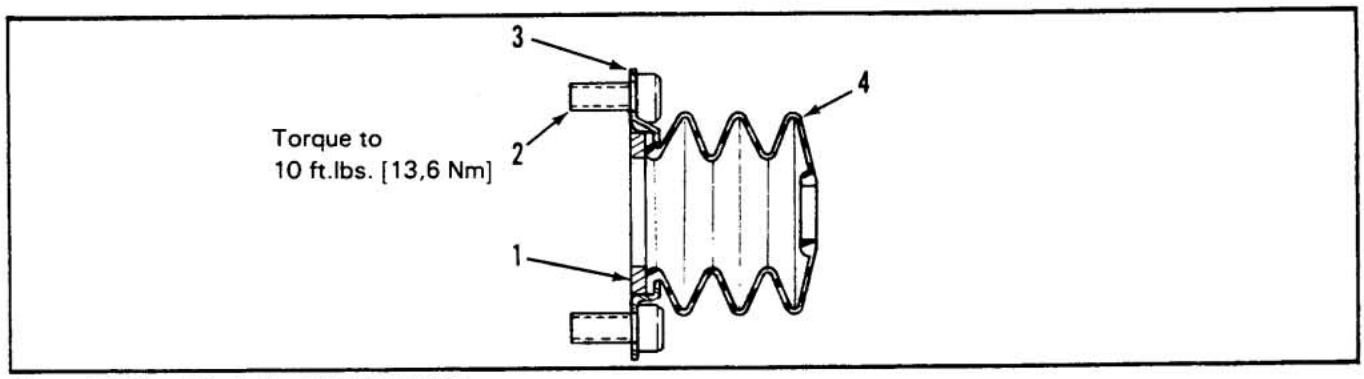


Figure 4-28. Spool Protective Boot Assembly.

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

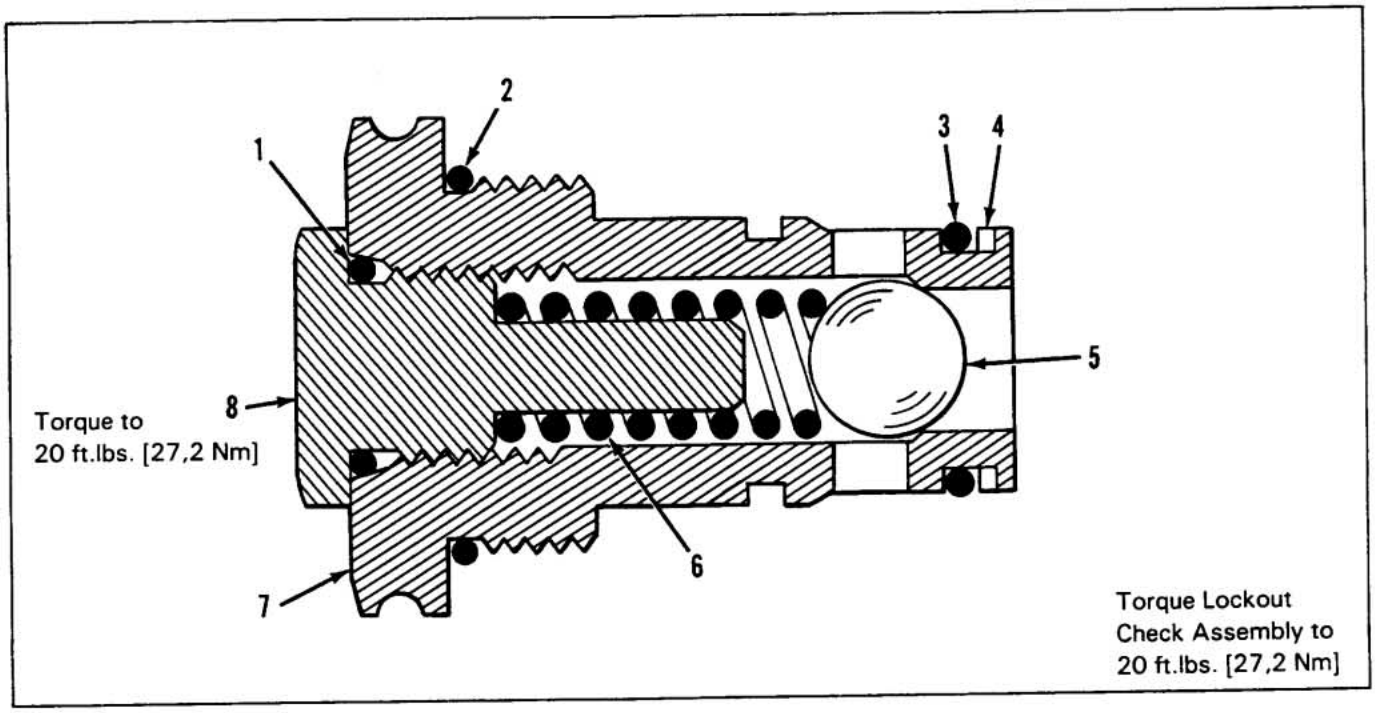


Figure 4-29. Lockout Check Assembly.

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.

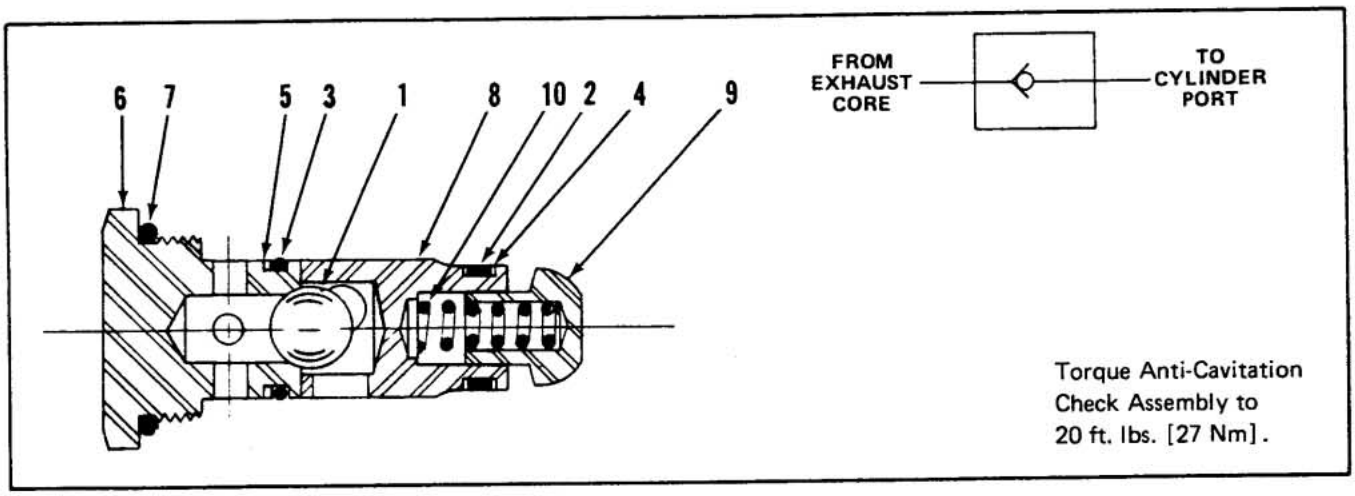


Figure 4-30. Optional Anti-Cavitation Check Assembly.

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.

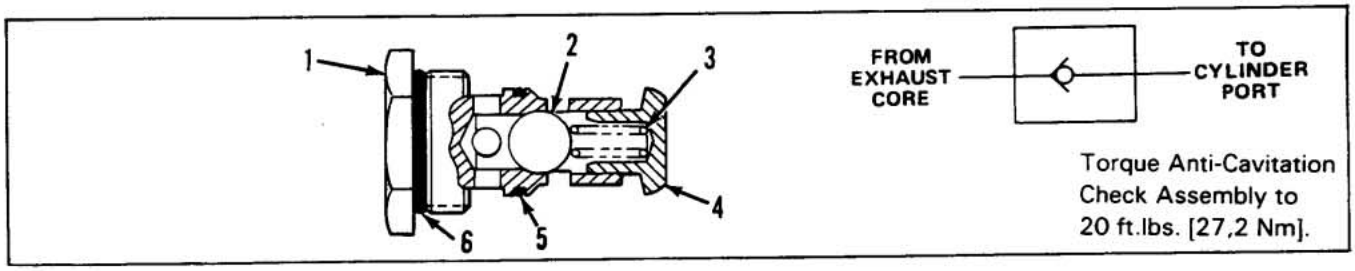


Figure 4-31. Optional, V20S Anti-Cavitation Check Assembly.

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.

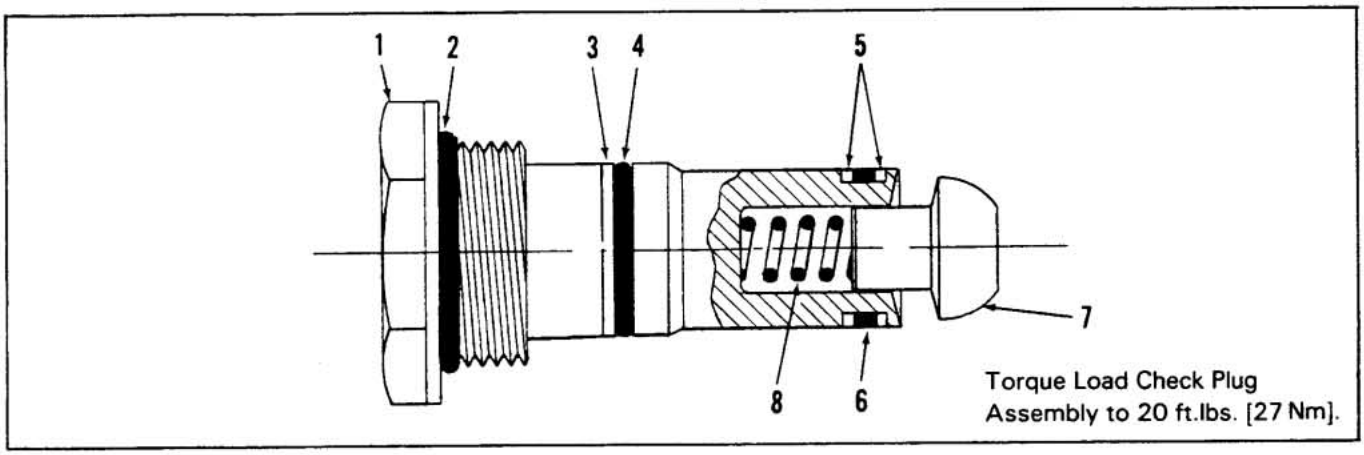


Figure 4-32. Load Check Plug Assembly.

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.

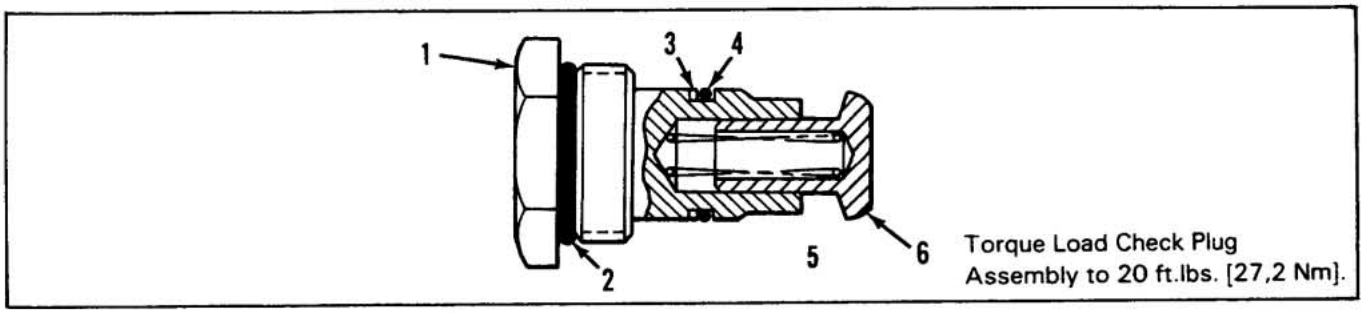


Figure 4-33. V20S Load Check Plug Assembly.

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.

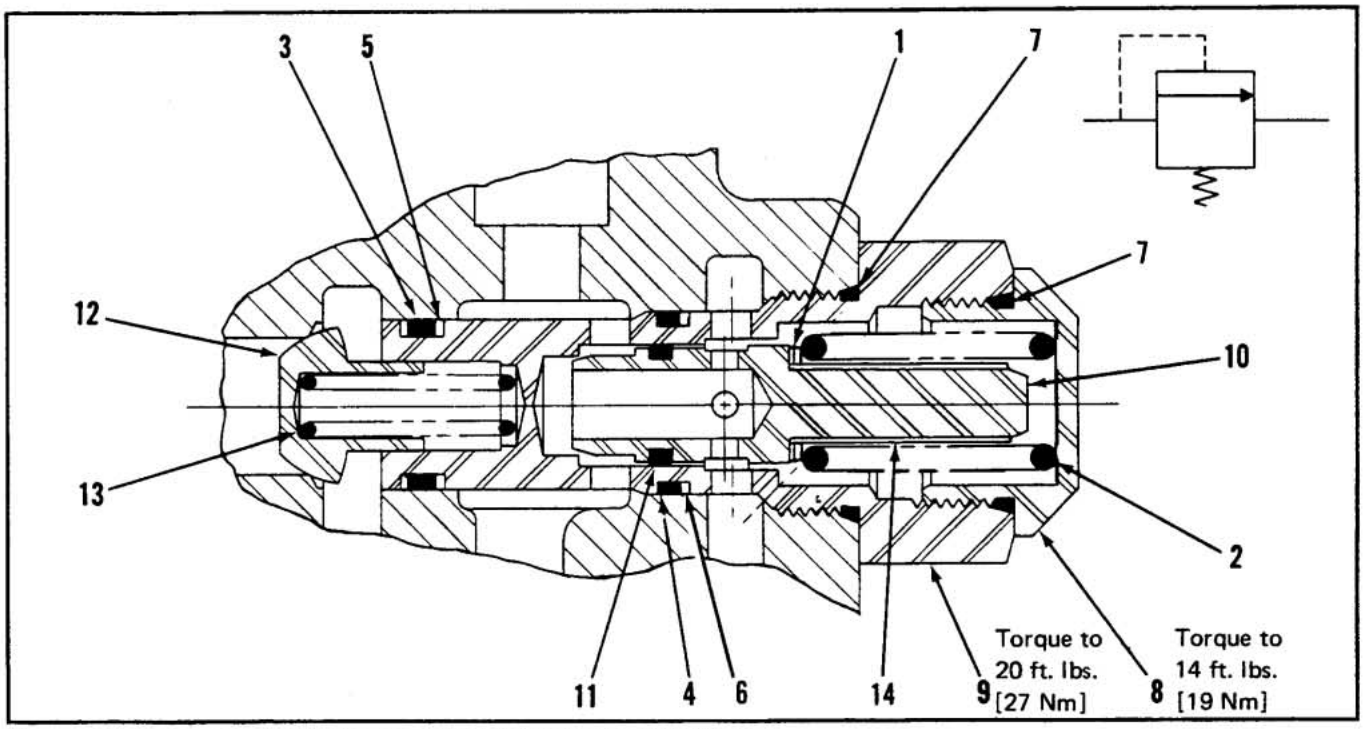


Figure 4-34. Optional Model RC Cylinder Port Relief (non-adjustable type).

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.

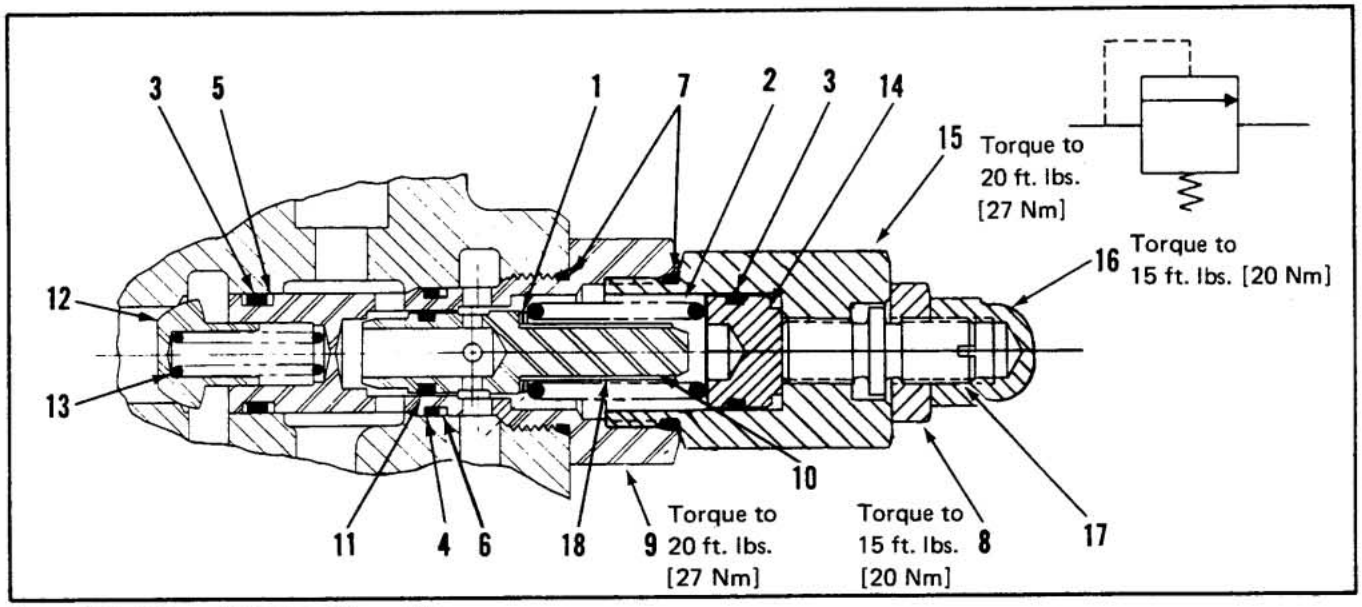


Figure 4-35. Optional RCA Relief Assembly.

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.

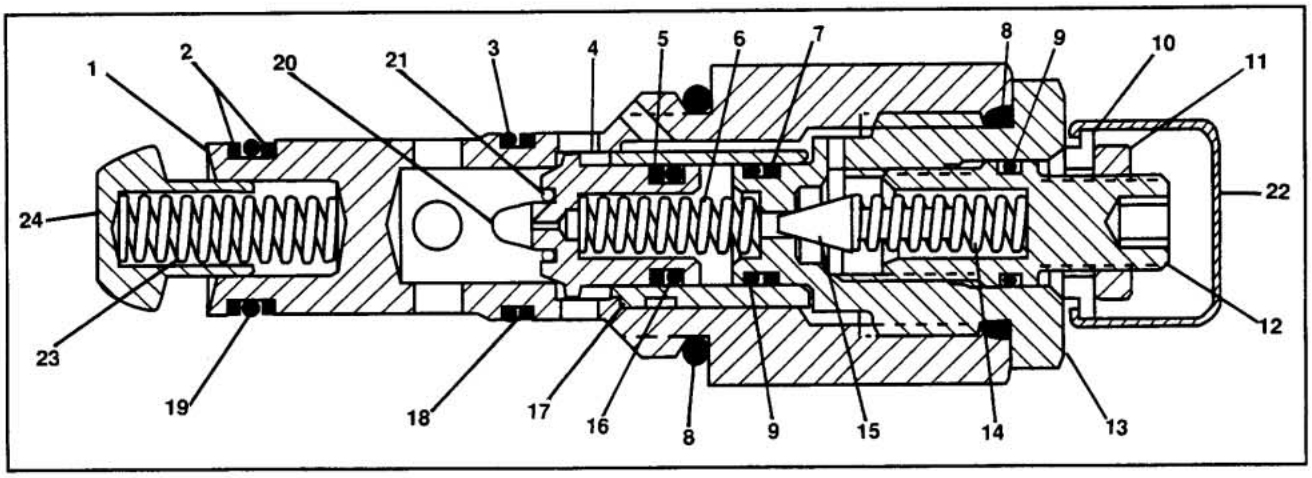


Figure 4-36. Optional RP 20-N Relief Assembly.

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.

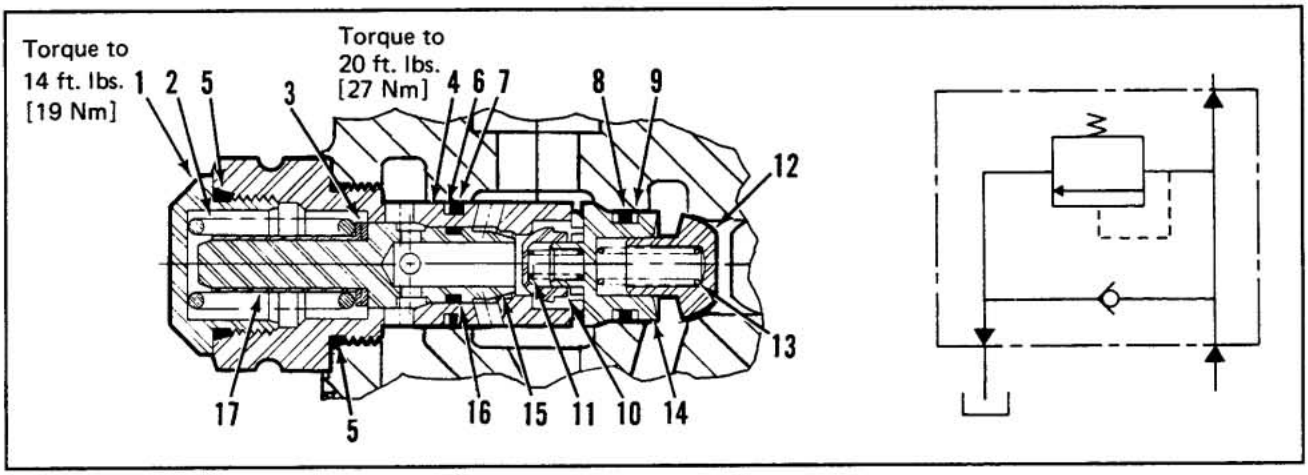


Figure 4-37. Optional Combination Relief and Anti-Cavitation Check Assembly (CRA)

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.

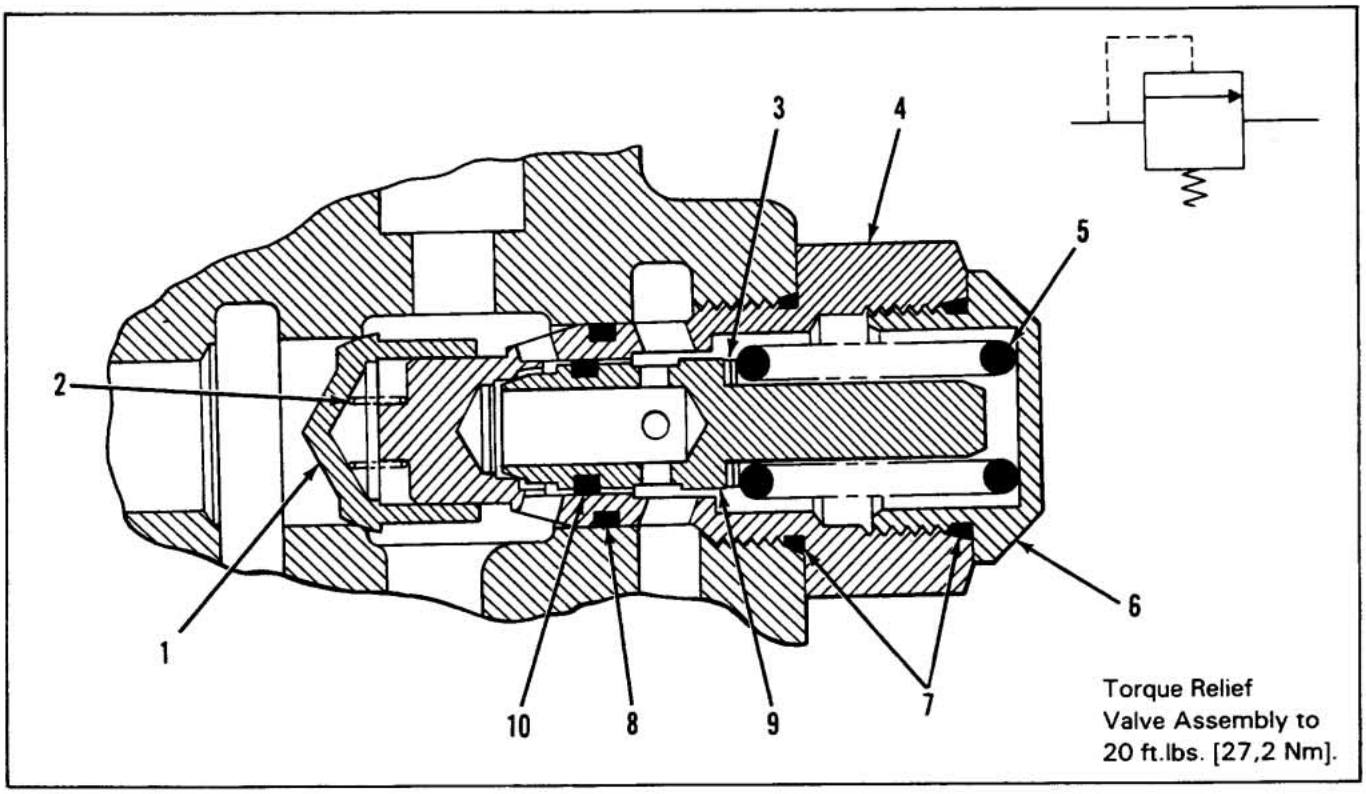


Figure 4-38. Optional V20S Work Port Relief. Model RCS (Non-Adjustable).

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.

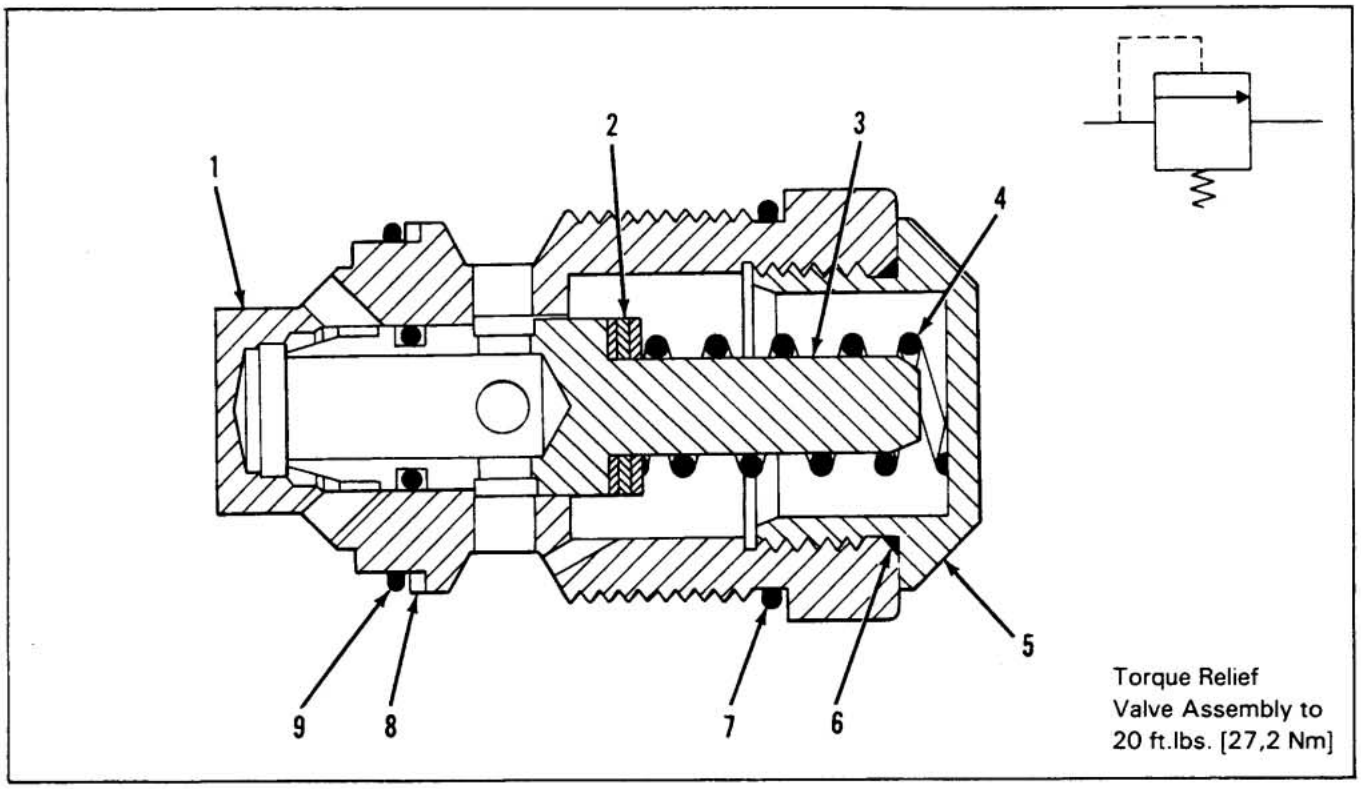


Figure 4-39. Model WH Differential Popper Main Relief Valve (Non-Adjustable).

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.

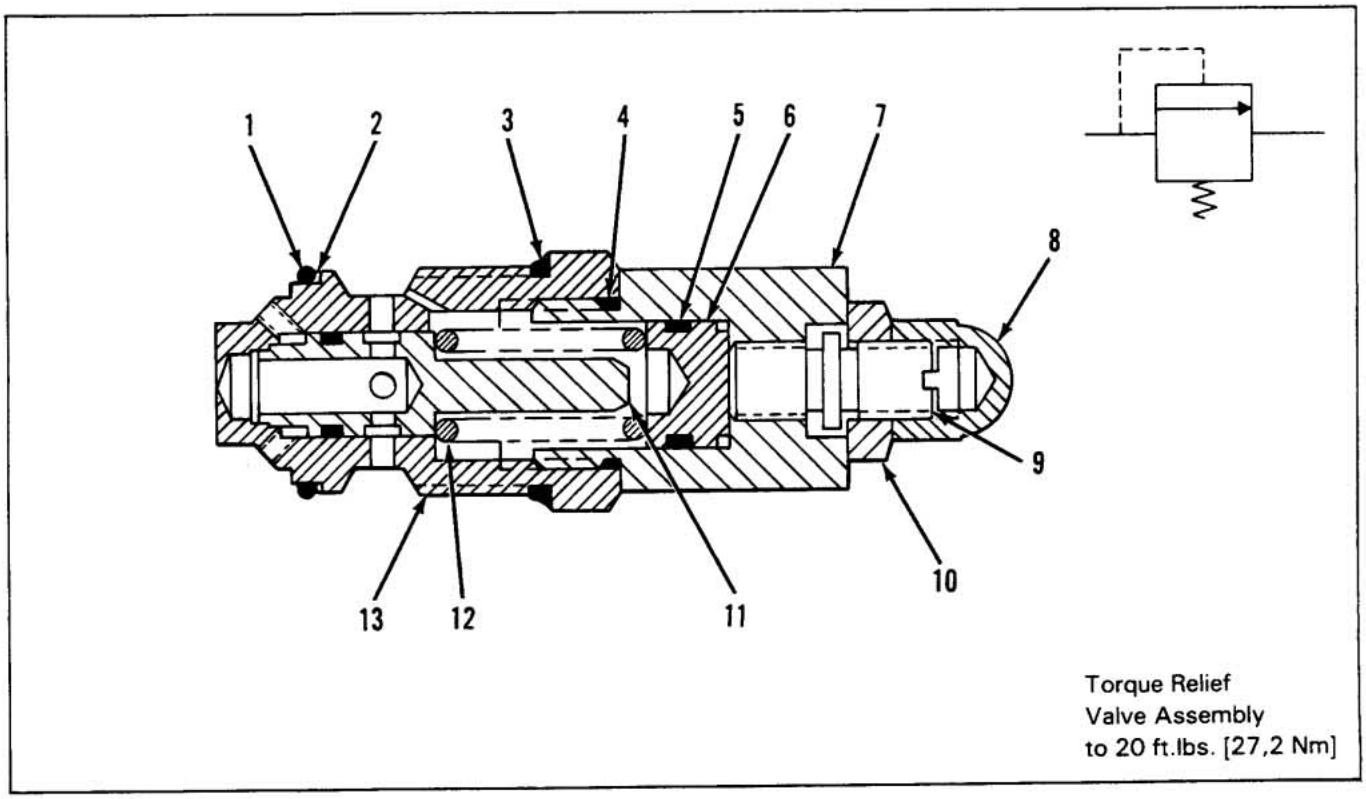


Figure 4-40. Model WHA Differential Poppet Main Relief Valve (Adjustable within the spring range).

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.

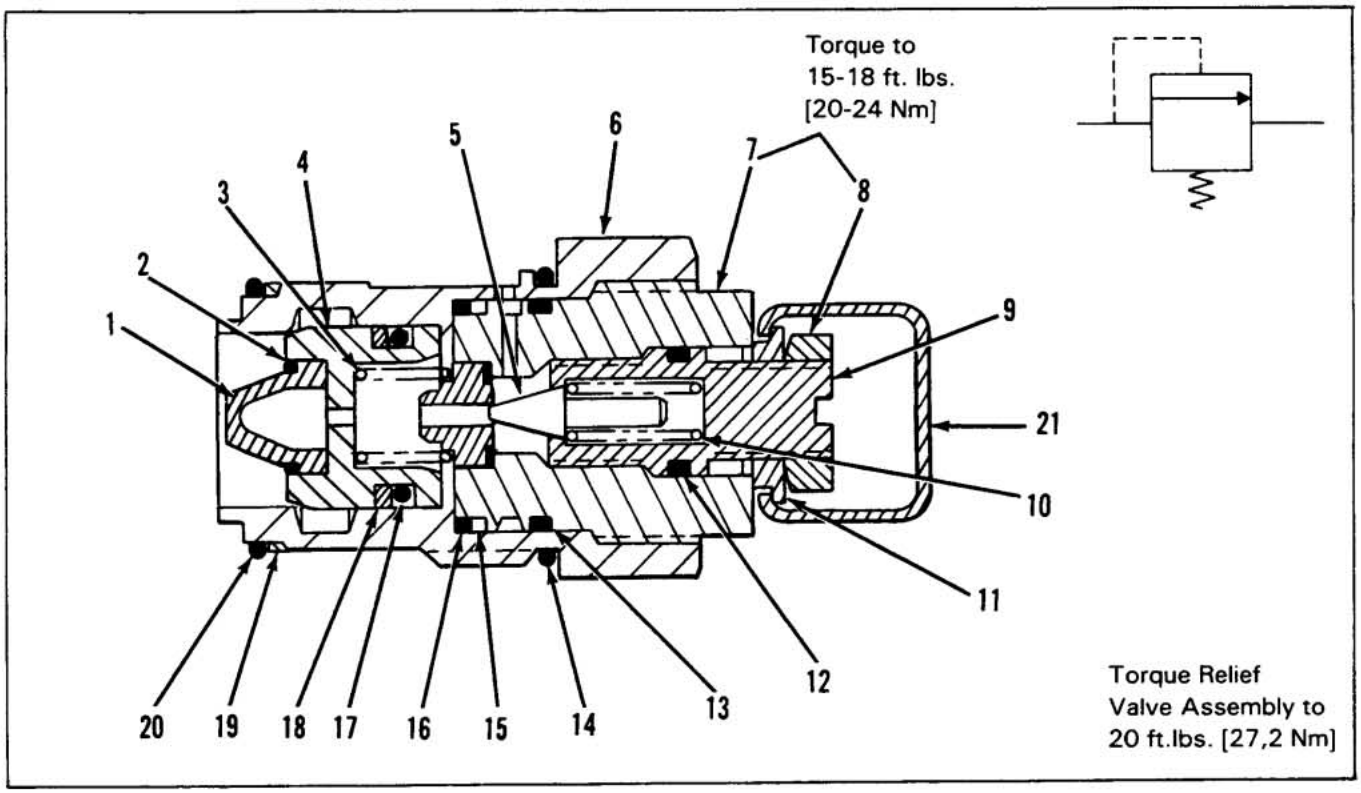


Figure 4-41. Model RP51 Pilot Operated Main Relief Valve.

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.

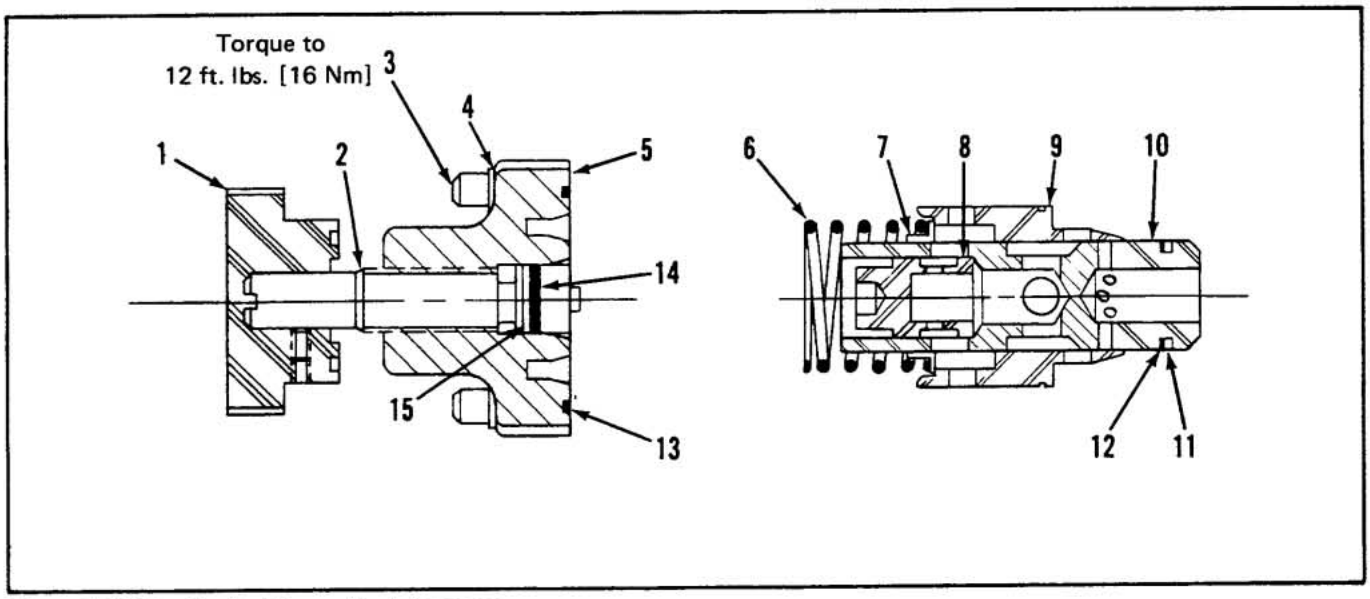


Figure 4-42. Flow Control Assembly, Inlet Cover.

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]	1
	7740-001	PISTON, Control, 8-25 GPM [30-95 litres/min]	1
	7483-001	PISTON, Control, 13-21 GPM [49-79 litres/min]	1
9	3891-001	SLEEVE, Metering, 3-16 GPM [11-60 litres/min]	1
	7484-001	SLEEVE, Metering, 8-25 and 13-21 GPM [30-95 and 49-79 litres/min]	1
10	3888-001	GUIDE, Sleeve, 3-16 GPM [11-60 litres/min]	1
	7485-001	GUIDE, Sleeve, 8-25 and 13-21 GPM [30-95 and 49-79 litres/min]	1
11	1821-001	WASHER, Back-Up	1
12	1819-001*	SEAL, O-Ring	1
13	3911-001	SEAL, O-Ring	1
14	9001-012	SEAL, O-Ring	1
15	3908-001	WASHER, Back-Up	1
16	10957-001	BOOT (Not shown, cannot be used with knob)	1

(See Note — items 8 through 10)

(Not sold separately. Order K-6065 — items 11 through 15)

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.

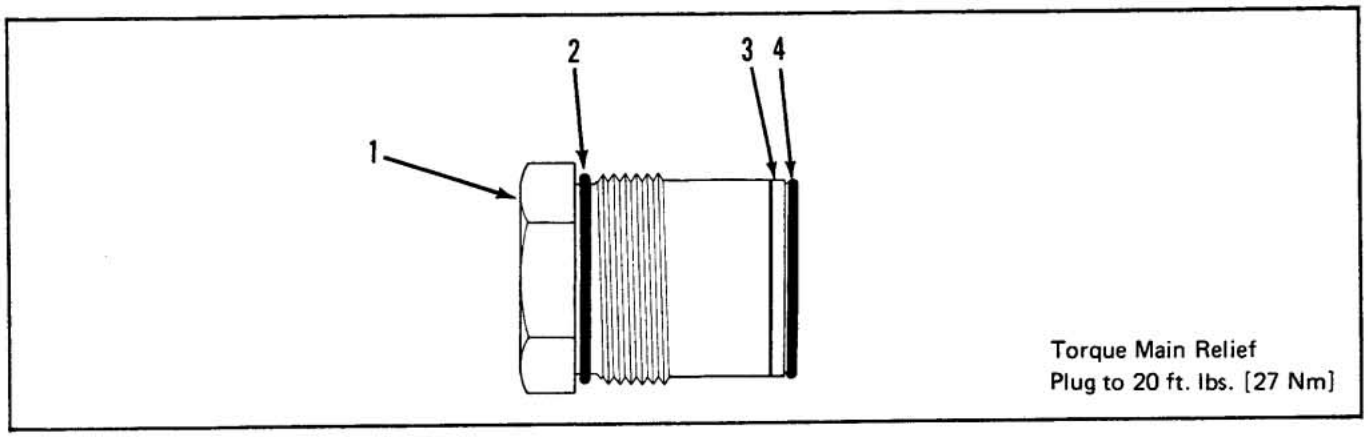


Figure 4-43. Main Relief Plug.

"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.

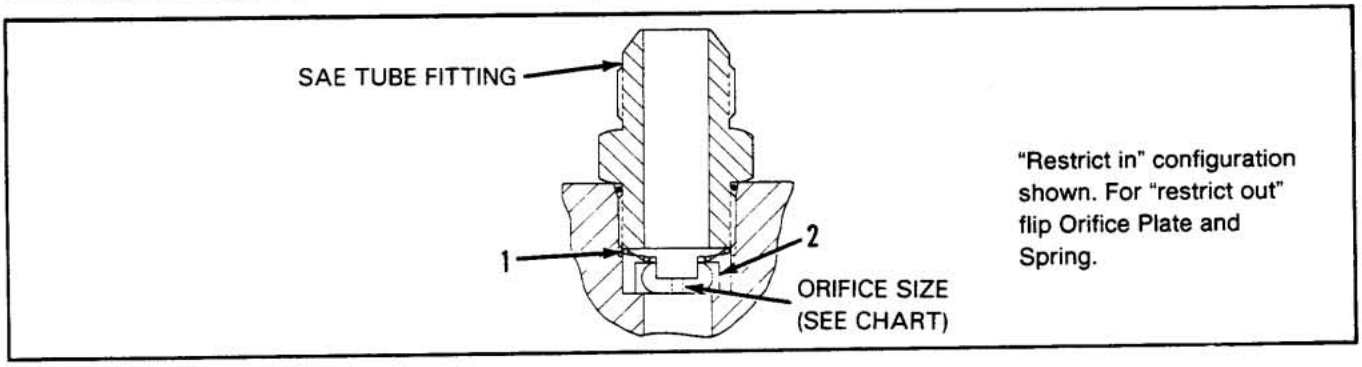


Figure 4-44. Work Port Restrictors.

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

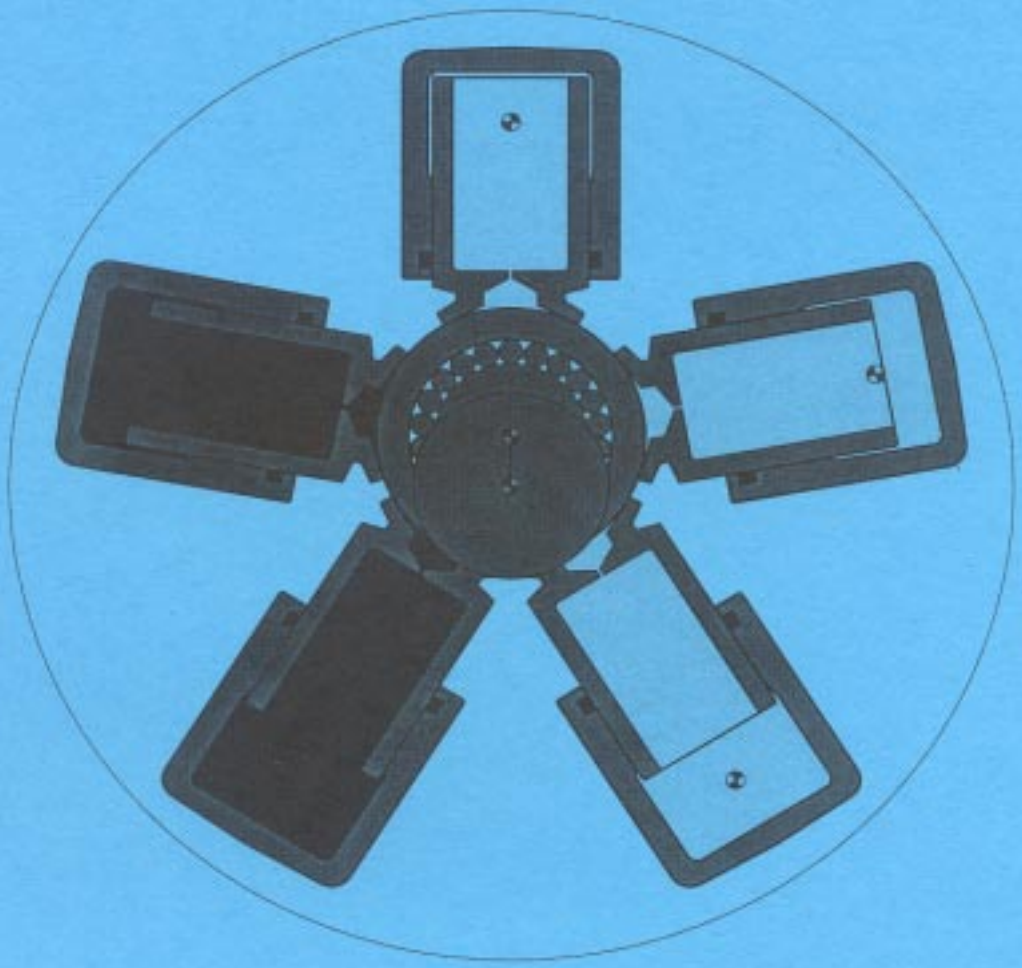
Buna-N Kit No.	Viton Kit No.	Application
K-6001-A	None	
K-6002-A	None	
K-6005-A	K-6041	RC Relief
K-6017-B	K-6053-A	Power Beyond (1/2 NPTF)
K-6018-B	K-6054-A	Power Beyond (SAE 8)
K-6019-B	K-6055-A	Power Beyond (SAE 10)
K-6021-A	K-6043	Anti-Cavitation Check
K-6027-A	K-6046	Section Seal, 3-Way, 4-Way
K-6028-C	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
Hydraulic Valve Division
520 Ternes Avenue
Elyria, Ohio, USA 44035
Tel: (440) 366-5200
Fax: (440) 366-5253
www.parker.com/hydraulicvalve

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

SAI Hydraulics, Inc.

GM SERIES MAINTENANCE MANUAL



SAI *Hydraulics, Inc.*
3905 W. 9th Street
Trainer, PA 19061
(610) 497-0190 Fax (610) 497-0194

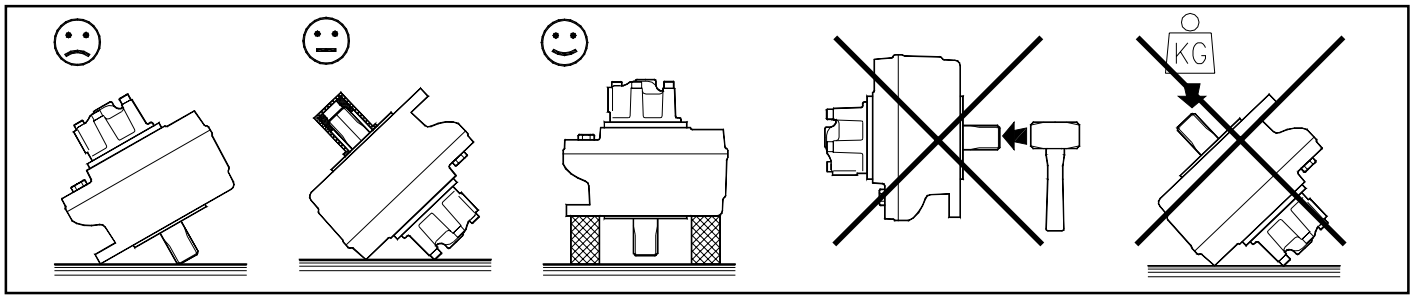
SAI *Hydraulics Canada Ltd.*
6105 Boulevard Couture
St. Leonard, PQ H1P3G7
(514) 323-4552 Fax (514) 323-8780

GM Series Maintenance Manual

TABLE OF CONTENTS PAGE

SPARE PARTS:

PACKING, HANDLING, TRANSPORTING AND STORING MOTORS



Make sure that the shaft of the motor is not loaded in any way and is protected from knocks.

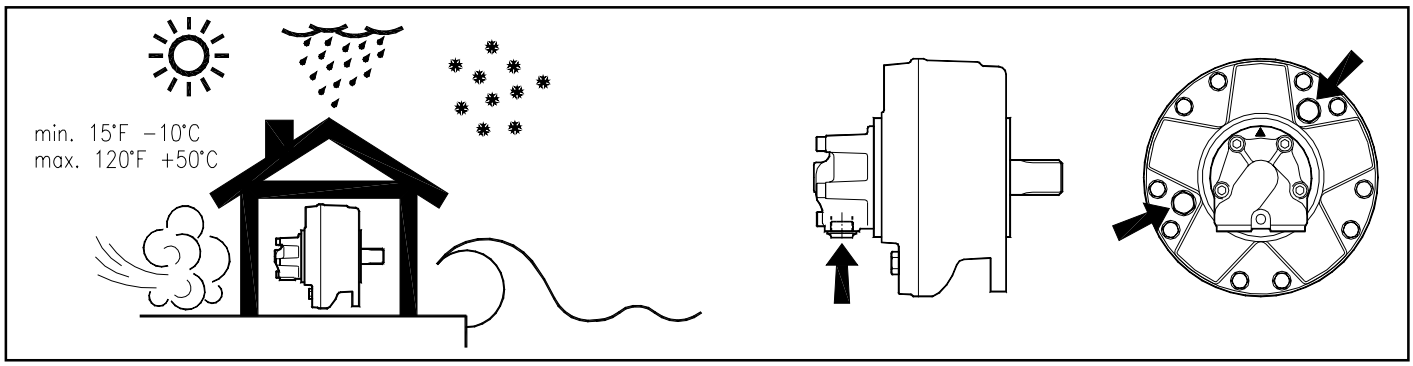
Axial loads or shocks may easily damage the bearings inside the motor.

Knocks or contact with hard surfaces may damage the shaft or otherwise damage the motor.

-Cover the shaft with a protective layer or element (e.g. cover the shaft with tape, or use a tubular element or cover made of plastic or metal).

-Do not pack or store the motors with the shaft pointing downwards so that the weight of the motor is on the shaft.

-Pack the motors in closed crates or boxes so that they are immobilized inside the crate; do not wedge the shaft against any other surface.



Make sure that all the oil supply, discharge, drainage or other motor ports are closed.

If the ports are not tightly sealed, dirt, water or other materials may penetrate inside the motor and possibly damage the working surfaces of the motor.

Rusting of the internal surfaces of the motor make the motor unusable; rust ruins the working surfaces and rust particles dislodged enter into the hydraulic circuit, contaminating the oil.

-Tightly close all ports using suitable plastic plugs or other system suitable for this purpose.

-Store the motors in a dry environment, protected from extreme temperatures and corrosive substances (e.g. salt).

-If the motor has to be stored for long periods or is exposed to unfavorable conditions during transport, completely fill the motor with hydraulic oil (fill motor casing as well as the cylinders and oil supply channels).

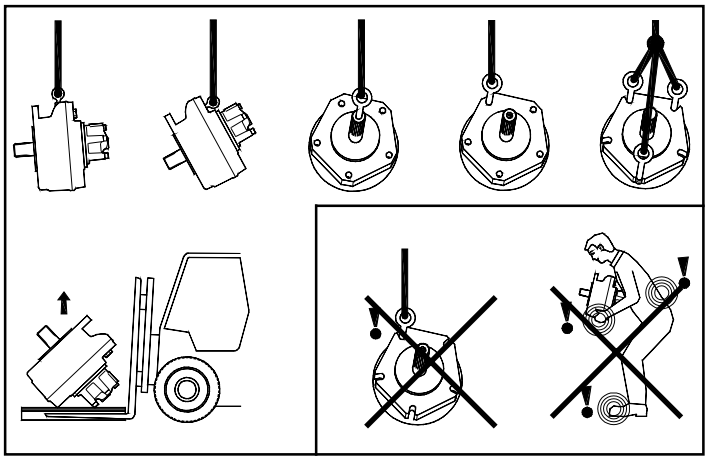
Observe safety precautions during handling.

The round shape of the motors means they roll if placed on sloping surfaces and their weight is such that they may cause serious injury to persons or damage to things during handling.

-Lift and move the motors using appropriate lifting and handling equipment, making sure the motors are not free to move unrestrained.

-Use eyebolts screwed into available holes in the motor flange, the motor cover, or eyebolt holes provided on the side of the motor.

-Do not handle the motors manually.



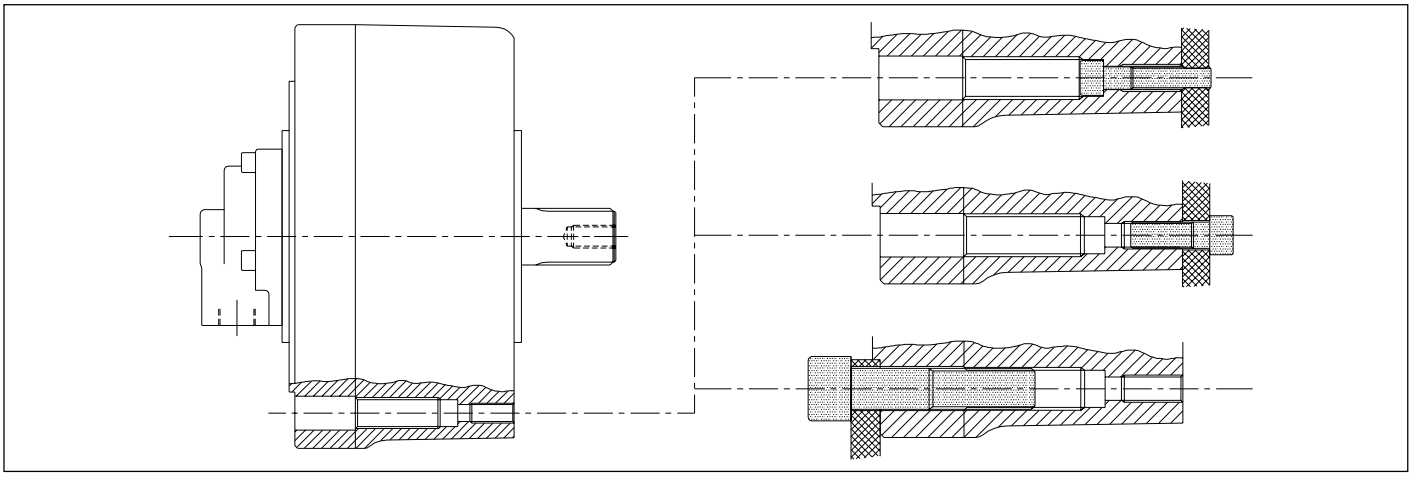
INSTALLATION

Before installing any motor ensure that it has not been damaged during transport. The design fo the GM-Series Motors enables a number of methods to be used to fix the motor to the chassis. NOTE: the thru bolt holes are not required for closing the motor body and cover. The diagram shows three possible methods for fixing the motor to a chassis.

1.) Bolt passing through motor from the distributor side screwed into a flange on the shaft side of the motor.

2.) Bolt passing through flange on the shaft side of the motor and screwed into the shaft side fillet of the motor.

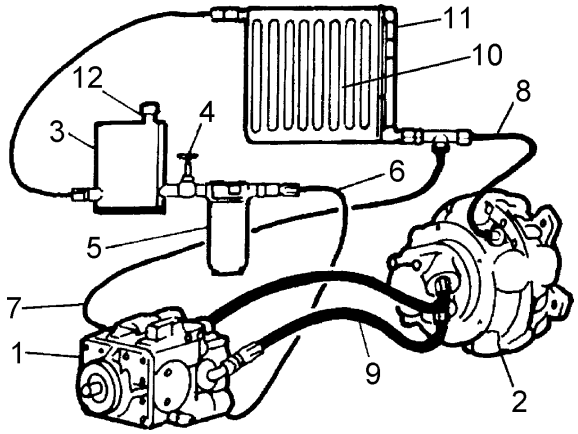
3.) Bolt passing through flange on the distributor side of the motor and screwed into the distributor side fillet of the motor.



NOTE: Installation type 1.) P05 and GM05 Series, with thru bolt M10, use washer size 10.5x18x2.

TYPICAL INSTALLATION OF A VARIABLE

1 Pump
2 Motor
3 Tank
4 Shut-off valve
5 Filter
6 Pump inlet
7 Pump drain
8 Motor drain
9 High pressure lines
10 Heat exchanger
11 By-pass
12 Tank filler cap



PIPING AND PIPE CONNECTIONS

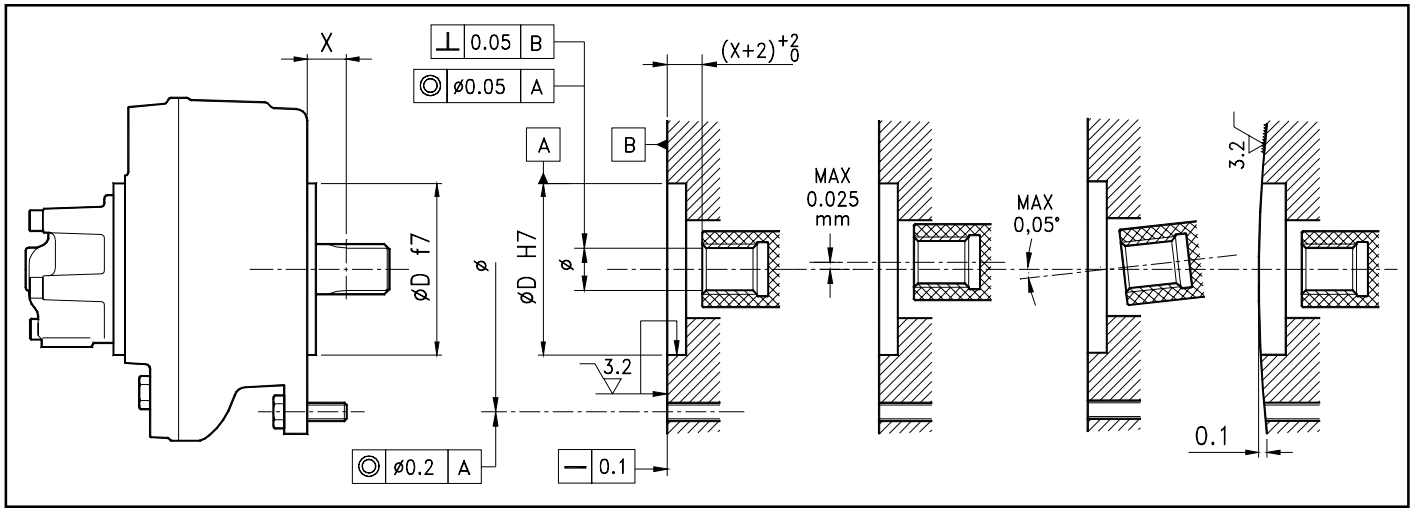
SAI recommends the use of high quality pipes and pipe connections for high pressure hydraulic applications.
Use only BSPP/GAS parallel thread connections; do not use tapered thread connections or water piping on all motor drain-lines. Follow manufacturer's recommendations for pipe sizing; do not use pipe sizes that are smaller than the port connections; to reduce the effects of oil compressibility use pipes with minimum length, minimum diameter and maximum rigidity; to reduce effects of pressure loss, avoid sharp corners, restrictions and high flow velocity.

PRESSURE LINES

SAI recommends the use of high quality flexible or rigid pressure pipelines. Follow pipe manufacturer's recommendations on appropriate sizes for different flow velocities, pressures and resistances. To minimize the effects of oil compressibility, pipelines should be kept to a minimum length, minimum diameter and maximum rigidity.

MOUNTING THE MOTOR

The motor must be mounted onto a rigid structure capable of withstanding the weight of the motor, the torque reaction forces and the vibrations during operation. The diagram below indicates the recommended tolerances of the mounting flange to which the motor is fixed.



DRAIN-LINE POSITIONING

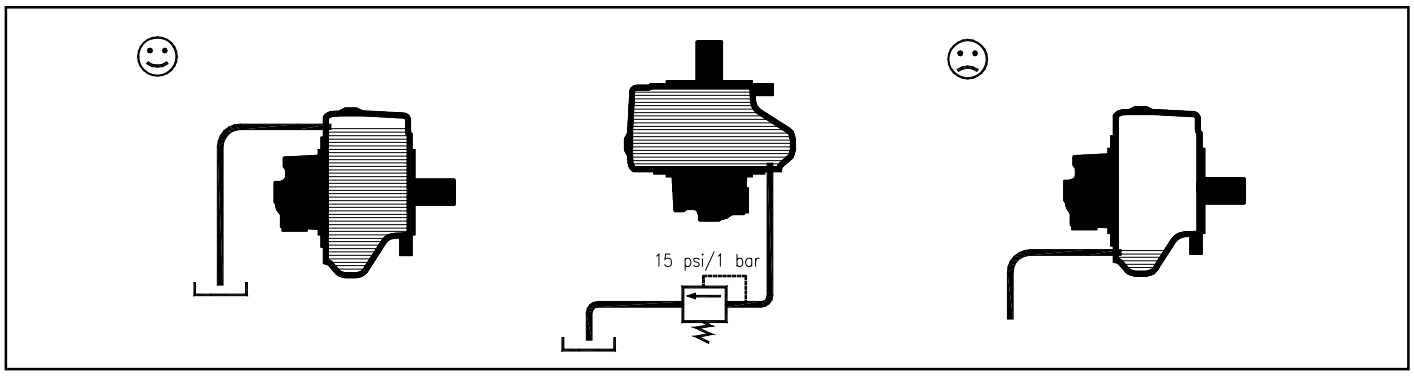
The drain-line must be positioned in such a way that there is always sufficient oil in the casing for the lubrication of the dynamic components in the motor.

If the motor is installed with the shaft in a horizontal position, the drain-line should be connected to the uppermost drain-line port.

If the motor is installed with the shaft pointing downwards, the drain-line can be connected to either of the two drain-line ports.

If the motor is installed with the shaft pointing upwards, the motor casing has to be entirely filled with oil before being installed and the drain-line connected in such a way that no air can enter into the motor casing so causing the front bearing to run dry. This is especially important if the motor operates at very low speeds or remains inactive for long periods. For alternative systems, contact your SAI representative.

The drain-line should be of a diameter corresponding to the size of the drain line port and flow must not be obstructed by sharp corners, restrictions, etc.

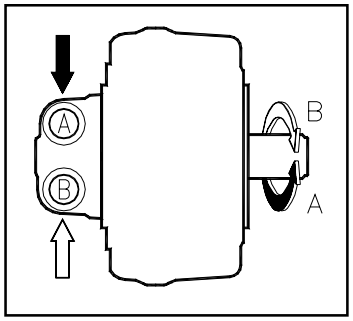


DIRECTION OF SHAFT ROTATION

All motors are bidirectional.

The direction of shaft rotation is determined by the direction of oil flow.

Standard motors are supplied so that flow entering in port A causes the shaft to rotate clockwise (as seen from the shaft side of the motor). Flow entering port B causes anticlockwise rotation. To invert the direction of rotation of the shaft, invert the direction of the flow, or invert port A and port B tube connections, or invert the phase of the distributor (see motor order codes, see the maintenance manual or contact SAI).



HYDRAULIC FLUIDS

For the choice of hydraulic fluid SAI recommends the use of high quality mineral-based hydraulic oil, containing anti-wear, anti-foaming, anti-oxidation and extreme pressure additives.

Allowable oil temperature range: 0°F to 175°F (-20°C to 80°C)
Operating viscosity range: optimal 40 cSt to 60 cSt
allowable 20 cSt to 150 cSt

Choice of hydraulic oil should be made so that the viscosity is within the given range at its normal operating temperature.

Recommeded hydraulic oils:

Temperature	TEXACO	B.P.	ESSO	SHELL	MOBIL	ISO rating
70 - 100°F	RANDO	HLP 32	NUTO H32	TELLUS 37	DTE 24	32
100 - 120°F	RANDO HD46	HLP 46	NUTO H46	TELLUS 46	DTE 25	46
120 - 140°F	RANDO HD68	HLP 68	NUTO H68	TELLUS 68	DTE 26	68
140 - 160°F	RANDO HD100	HLP 100	NUTO H100	TELLUS 100	DTE 26	100

FILTRATION

SAI recommends max. 25 μm filters, preferrably of 10 μm. Clean oil and therefore efficient filters are essential for the correct functioning of all the components in the hydraulic system. The efficiency of the filters is impaired by the gradual accumulation of particles intercepted and filters should therefore be regulary inspected. Special attention is required when the hydraulic system is first put into operation or when any of the components are replaced or have become worn through use. The relative efficiency of a filter may be measured, for example, by taking regular readings of the pressure drop across the filter. Follow filter manufacturer's recommendations for filter element lifetimes and cleaning or substitution cycles.

START UP

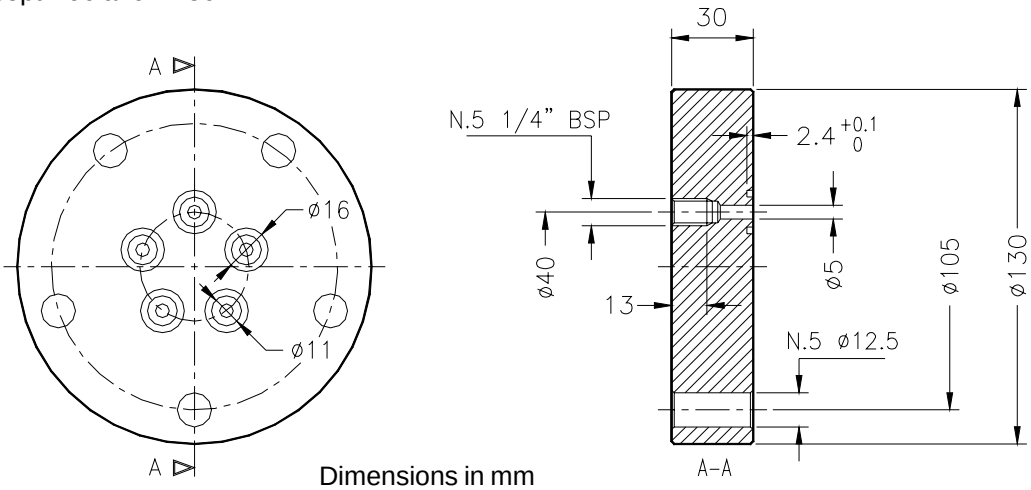
Before connecting any tubes ensure that they are thoroughly clean, any excess material that could work loose should be removed and there should not be any oxidation of surfaces that come into contact with the oil. Make sure the motor casing is filled with oil. Before starting work, the hydraulic circuit should be purged of air. This can be achieved by running the motor without load for 10-20 minutes, during which time checks should be made for leakages from connections. During the first few hours of working under load checks should be made for leakages from connections and ensure that all components remain firmly fixed to their supports. The motors are factory tested and do not require to be run in.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	REMEDY
Excessive noise levels	Mechanical vibrations	Repair worn or damaged components
	Motor incorrectly aligned	Align correctly
	Air in the circuit	Bleed circuit
	Cavitation	Install anti-cavitation valves
	Insufficient back pressure	Pressurize return line
Motor overheating	Motor or cylinder seals worn	Overhaul motor
	Oil viscosity too low	Reduce temperature or replace oil
	Inadequate cooling system	Check or improve system
Inadequate torque	Motor displacement too small	Replace w/ larger displacement motor
	Pressure relief valve set incorrectly	Set correctly
	Inadequate pump	Replace pump
Inadequate speed	Motor displacement too large	Replace with smaller motor
	Excessive drainage	Overhaul motor
	Inadequate pump	Replace pump
Pulsating drainage	One or more cylinder seals worn	Replace seals
Continuous excessive drainage	All cylinder seals worn	Overhaul motor
	Seized distributor	Replace distributor
Excessive pressure or speed fluctuation	Defective flow regulators	Adjust or replace
	Air in the circuit	Bleed circuit
	Instability of relief valves	Adjust or replace
Pressure in drain line or burst shaft seal	Drainage connected to return line	Connect directly to reservoir
	Drain line pinched or too small	Replace drain line
	Excessive motor drainage	Overhaul motor
Incorrect sense of rotation or shaft	Tubes connected incorrectly	Reverse the connection
	Distributor assembled incorrectly	Change distributor phase

CYLINDER LEAKAGE TEST

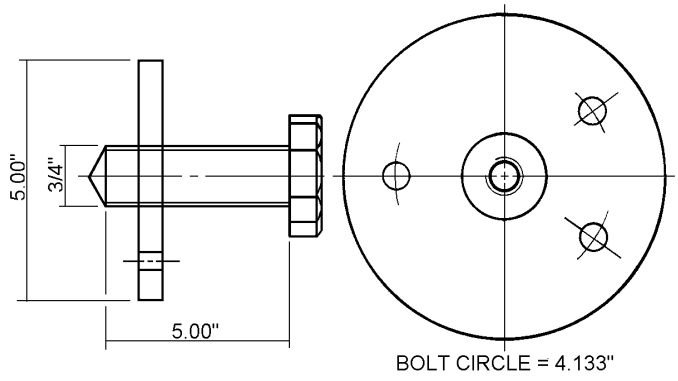
The flange shown below may be used to test the efficiency of individual cylinders by measuring their leakage rates under pressure. The flange is fixed to the motor in place of distributor. This flange may be used in place of all current distributors except D90 and D250.



Dimensions in mm
[1 in = 25.4 mm]

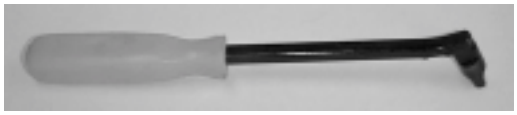
MOTOR STRIP-DOWN & ASSEMBLY TOOLS

TOOL #1 - JACKING PLATE



TOOL #2 - EXTRACTOR JACKS

TOOL #3 - LEVER



MOTOR STRIP-DOWN PROCEDURE

NOTE: On assembly at the factory one of the distributor closing bolts is lead sealed. The number on the seal is a factory reference number and should not be removed. The guarantee, where applicable, on motors returned for repairs is only valid if this seal is intact.

1. PRELIMINARY STEPS

Drain the motor casing of oil. In order to be able to re-assemble the distributor in the same position it is advisable to mark the alignment of the distributor ports with respect to the drain-line holes. To help with fault diagnosis it is advisable to mark also the position of the motor cover with respect to the motor body and, after step 3, the position of each of the cylinders with respect to the motor body.

2. REMOVING THE DISTRIBUTOR

Remove the 5 closing bolts of the distributor. Lift off the distributor cover and the distributor rotary [1]. Take out the distributor drive pin and the distributor centering bush [2]. If the distributor is of the type with the bronze bearing disc, remove also the two locating pins.

1

2

3

See Tool #1 on page 7.

>> The working surfaces of distributor rotary, distributor disc & motor cover must not be scratched or damaged in any way.

3. REMOVING THE MOTOR COVER

Remove motor cover closing bolts. With an appropriate jacking plate, using the distributor bolt holes and levering on the shaft through the distributor drive pin hole, lift off the motor cover [3]. Remove the motor cover/body seals and locating pins.

4. REMOVING THE REAR RETAINING RINGS

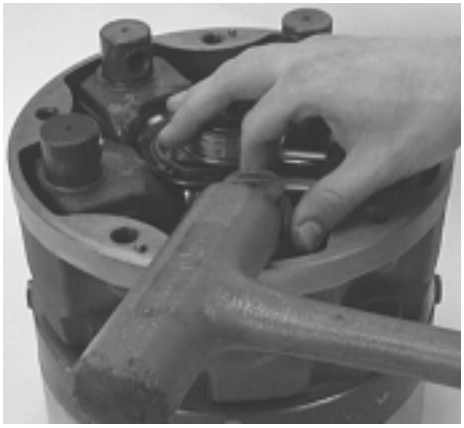
Using appropriate snap ring pliers, remove the retaining clip [4]. Take off the spring and the retaining ring.

5. REMOVING THE CYLINDERS

Rotate the shaft so that the piston of the cylinder to be removed is fully extended. By hooking a finger under the piston lift up the piston, tapping the cylinder trunnion with a rubber hammer to loosen the piston from the shaft. Lift out the cylinder and piston [5]. The piston may be extracted for inspection of seals and working surfaces.

4

5



6. REMOVING THE SHAFT

It is advisable to place a protective covering over the spline of the shaft (e.g., tape) before extraction to avoid damaging the shaft seal.

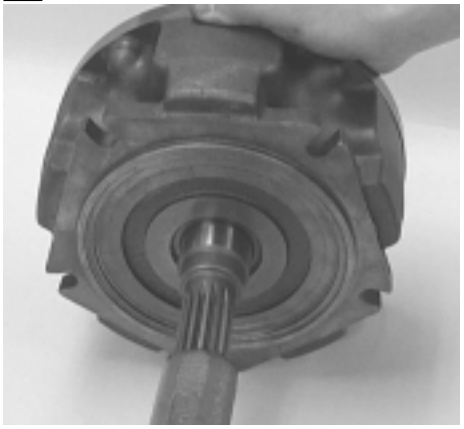
Motors with roller bearings: lift out the shaft.
Motors with ball bearings: remove the shaft by tapping on the end of the shaft with a rubber hammer [6].

7. REMOVING THE SHAFT BEARINGS

If it is necessary to replace the shaft bearings, the bearing races can be removed from the shaft or from the motor cover or body using appropriate extractor jacks [7].

>> If the bearings do not need to be replaced it is recommended that the bearing races are not removed from the motor cover or body.

6



7

See Tool #2 on page 7.

MOTOR ASSEMBLY PROCEDURE

With GM-series motors the shaft and cylinder sub-assemblies are mounted on the motor cover and not in the motor body as with M-series motors. Before proceeding with the reassembly of the motor:
- Ensure that the lubrication channels in the cylinder trunnion seats of both motor body and cover are clean;
- Check that the distribution plane on top of the motor cover is perfectly flat and smooth.

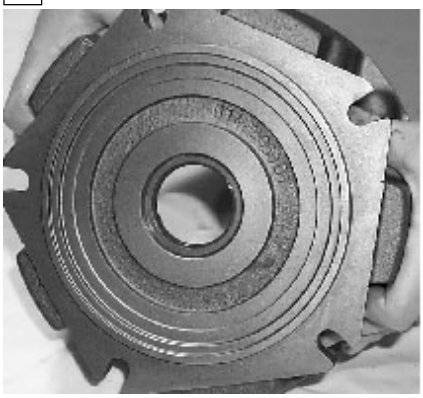
1. SHAFT SEAL

Ensure that the shaft seal in the motor body has not been damaged. Replace if necessary [8].

2. BEARING ASSEMBLY

To avoid the possibility of damage to the bearing seat in the motor cover or the motor body caused by edges on the external diameter of the bearing race the motor body or cover should be heated to a temperature of 80°C before inserting the bearing. Alternatively smooth down any edges, even slight ones and especially in the area of the corner fillets, that may have remained after the machining processes. Roller bearings: to avoid the possibility of axial shocks the outer bearing race should be placed in the motor cover or body and the inner race should be assembled to the shaft [9]. Ball bearings: these should be inserted in the motor body or cover (and not assembled to the shaft).

8



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10

3. SHAFT ASSEMBLY

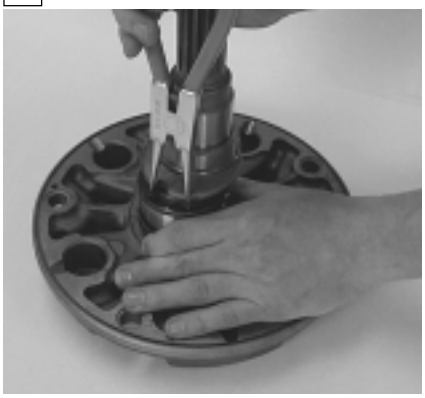
Replace the piston retaining ring, spring and C-clip to the rear-side of the piston support ring [10].
Dislodge the C-clip from the front-side of the piston support ring [11].

Insert the shaft in the bearing seat in the motor cover, in the case of ball bearings using a rubber hammer to tap it home [12]. (Keep shaft shoulder 0.250 away from bearing race.)

4. CYLINDER ASSEMBLY

Insert O-ring and plastic slipper seal in the cylinders [13]. Insert O-ring, plastic ring seal, steel ring and shaped insert into the cylinder trunnions. Insert the pistons in the cylinders.

11



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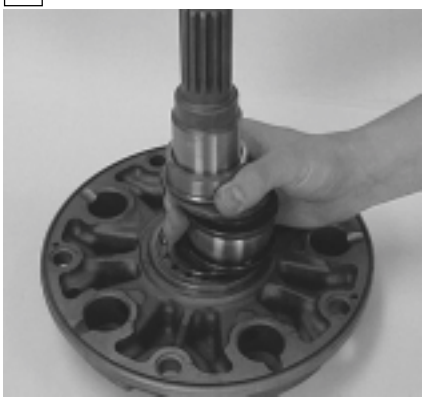

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4. CYLINDER ASSEMBLY (Continued)

Place the longer cylinder trunnion containing the seal into the trunnion seat in the motor cover. Slide the piston out onto the piston support ring and place the lip of the piston foot between the piston retaining ring and the piston support ring [14]. Using an appropriate lever ensure that the piston foot comes into full contact with the piston support ring. It may be necessary to lift the cylinder and shaft out of their seats a little to facilitate the operation. Repeat for all five cylinders. Position the front retaining ring and spring over the piston feet and insert C-clip [15]. By tapping lightly with a rubber hammer on the cylinder trunnions and shaft-end ensure that cylinders and shaft are properly seated.

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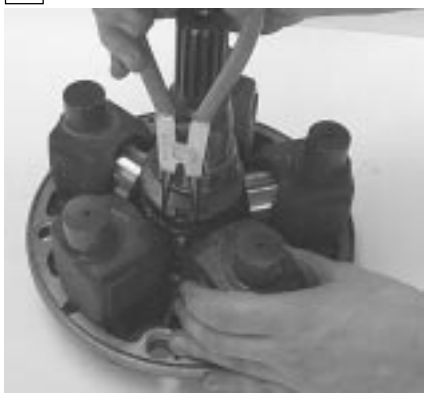

5. MOTOR BODY AND COVER ASSEMBLY

Grease all the motor cover and body O-ring seats, position O-rings [16], and insert the locating pins. Position the motor body aligning the trunnion seats with the cylinder trunnions and gently lower the motor body into place, taking care not to damage the shaft seal [17]. For motors with the O-rings between the cover and body, it is advisable to insert the bolts in the cover to ensure that the O-rings are correctly positioned when closing the motor. Turn the motor over so that the shaft points downwards, insert and tighten the motor cover closing bolts

.

IMPORTANT: Do not hammer the distribution surface in the center of the motor cover. Using an appropriate lever inserted in the distributor drive-pin slot ensure the shaft rotates through 360 °without excessive or variable resistance [18].

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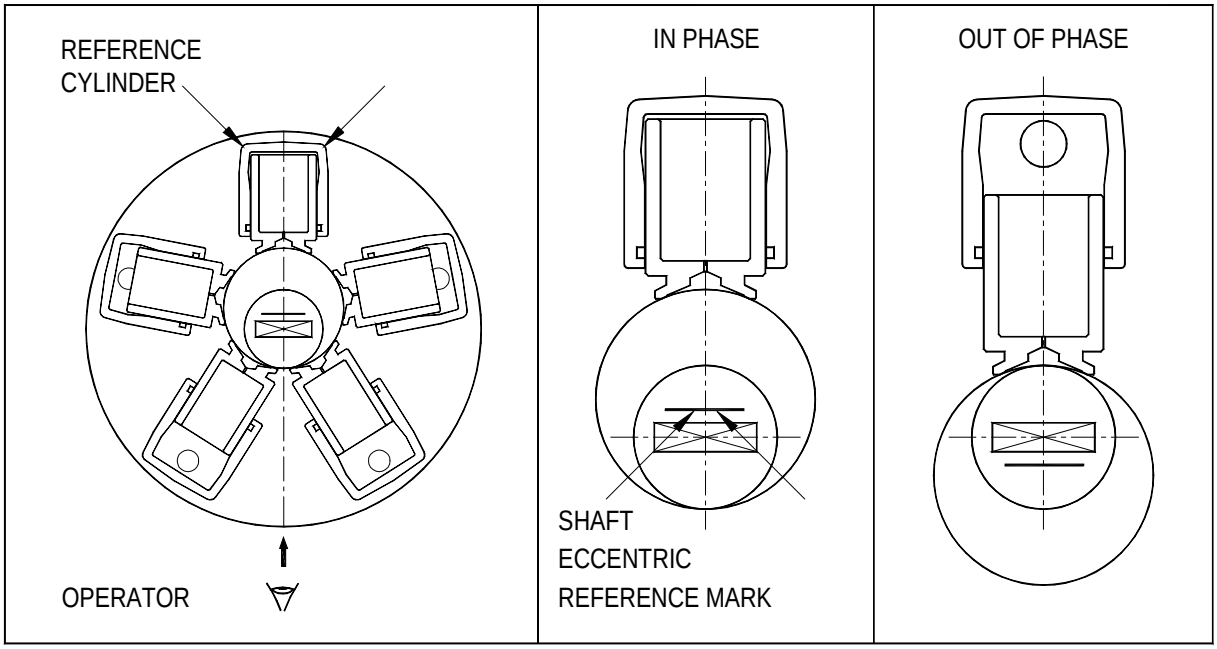
See Tool #3 on page 7.

6. SETTING THE DIRECTION OF MOTOR SHAFT ROTATION

For the motor shaft to rotate as described in the section “Direction of Shaft Rotation” on page 4, the motor has to be put “in phase” before the distributor is assembled.

To set the motor “in phase”: Choose any one of the cylinders of the motor (termed the “reference cylinder”). Rotate the motor so that in relation to the center of the motor and the viewpoint of the operator, the reference cylinder is on the opposite side of the motor and in line with the operator. With an appropriate lever inserted in the distributor drive pin slot in the end of the shaft, rotate the shaft until the reference mark to one side of the slot is positioned on the same side as the reference cylinder. Keeping note of the reference cylinder proceed with the assembly of the distributor.

To set the motor "out of phase": Position the reference cylinder as described above. Rotating the shaft so that the reference mark is on the opposite side and in line with the reference cylinder (rotated180° from the in phase position) the motor will be out of phase and the shaft will rotate in the opposite direction from that indicated above.



If there are no reference marks on the shaft: Position the reference cylinder as described before. Rotate the shaft so that the distributor drive pin slot is perpendicular to the line between the center of the motor and the reference cylinder. Closing one of the cylinder feed channels to the left of the reference cylinder, rotate the shaft a quarter turn anti-clockwise. The motor is in phase if suction of the cylinder is felt with a finger. The motor is out of phase if the cylinder compression is felt with a finger. Return the lever to the starting position. If the motor was out of phase, rotate the shaft 180Bto put it in phase, or vice-versa [19].

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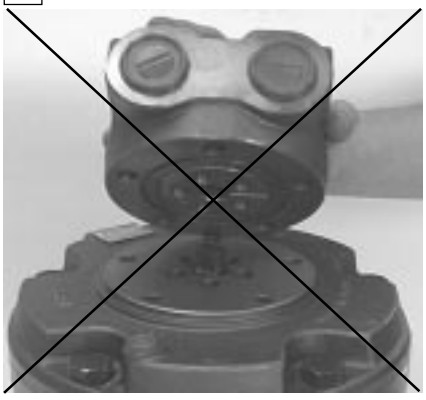

See Tool #3 on page 7.

7. DISTRIBUTOR ASSEMBLY

IMPORTANT: To avoid seriously damaging the motor, do not attempt to place a distributor cover pre-assembled with rotary valve and disc directly onto the motor cover [20]. The internal components of the distributor must be assembled separately from the distributor cover.

IMPORTANT: Ensure that no objects (e.g., locating pins) fall into cylinder feed holes in the motor cover. If this happens it will be necessary to dismantle the motor to remove the object.

7. DISTRIBUTOR ASSEMBLY (Continued)

ROTARY VALVE SUB-ASSEMBLY: Insert the O-ring [21] and plastic slipper [22] with the concave side on the O-ring side in the seat in the top side of the distributor rotary. The plastic seal should be assembled by first placing the positioning lug in its seat [23]. For versions with the steel ring; first place the O-ring, then the plastic seal (without lug) and then the steel ring.

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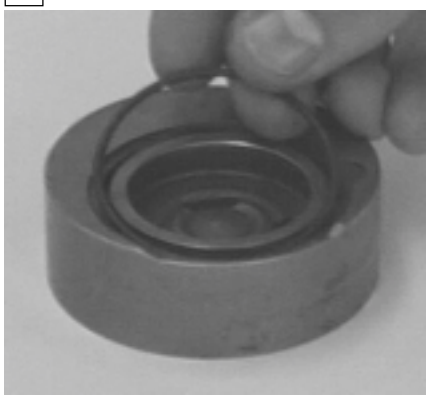

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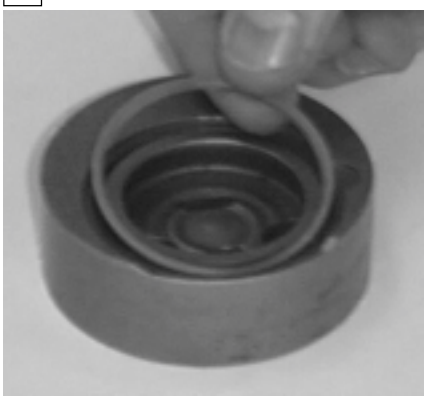

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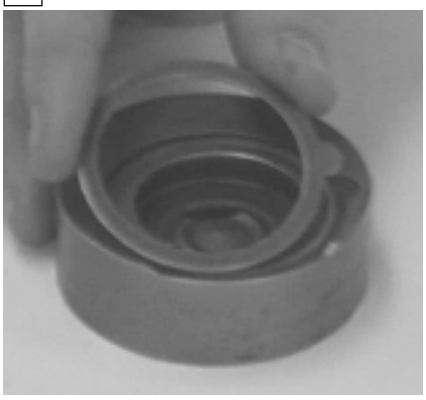
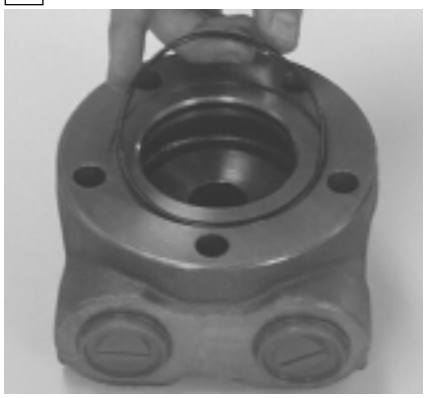


DISTRIBUTOR COVER SUB-ASSEMBLY: Insert the distributor/motor cover O-ring in the seat in the bottom of the distributor cover [24]. For distributors with the bronze disc; insert the O-ring [25] and the plastic slipper [26] with the chamfer on the side of the bottom of the distributor.

24



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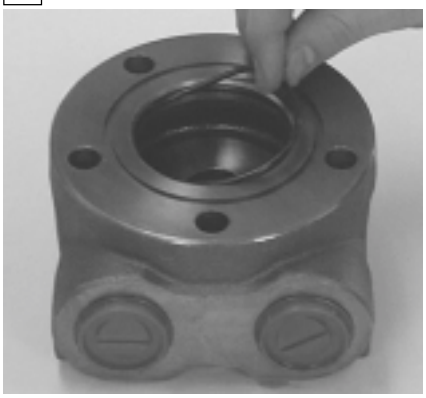

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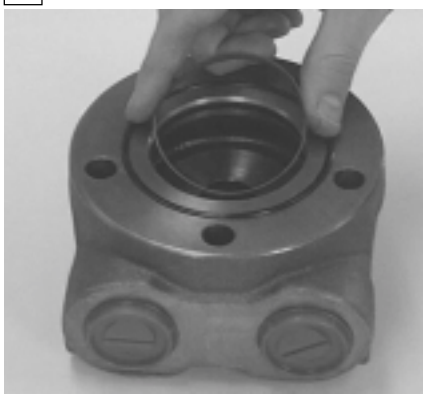

ROTARY GROUP ASSEMBLY: Insert distributor drive pin in shaft through the central hole in motor cover [27].
NOTE: Ensure that no objects fall into cover. If this happens it will be necessary to dismantle the motor to remove the objects. Insert the locating pins in their holes in the motor cover [28].

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7. DISTRIBUTOR ASSEMBLY (Continued)

Place the disc on cover, positioning it with the locating pins [29]. Motors without the disc do not have locating pins.
Note: Motors produced before 7/87 used .236 inch pins. Motors produced after 7/87 use .196 inch pins. A certain number of discs produced have holes for both types of pin and it is important when placing the disc that it is positioned using the correct holes. The disc must sit flush with the motor cover. It does not need to be pressed on and the five oil feed holes must line up with the holes in the motor cover. Once positioned it must not be able to rotate or to move laterally. Insert the centering bush in the disc [30]. Position the distributor rotary on the disc with the side containing the seals on top and with the three radial holes to the left of the reference cylinder and the three axial holes to the right [31].

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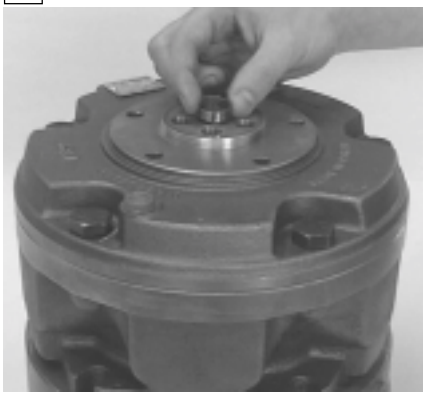

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DISTRIBUTOR COVER ASSEMBLY: Place the distributor cover over the rotary, aligning the bolt holes in the distributor cover and the motor cover [32]. The distributor can be placed in any one of the five positions. Screw in and tighten the five bolts [33].

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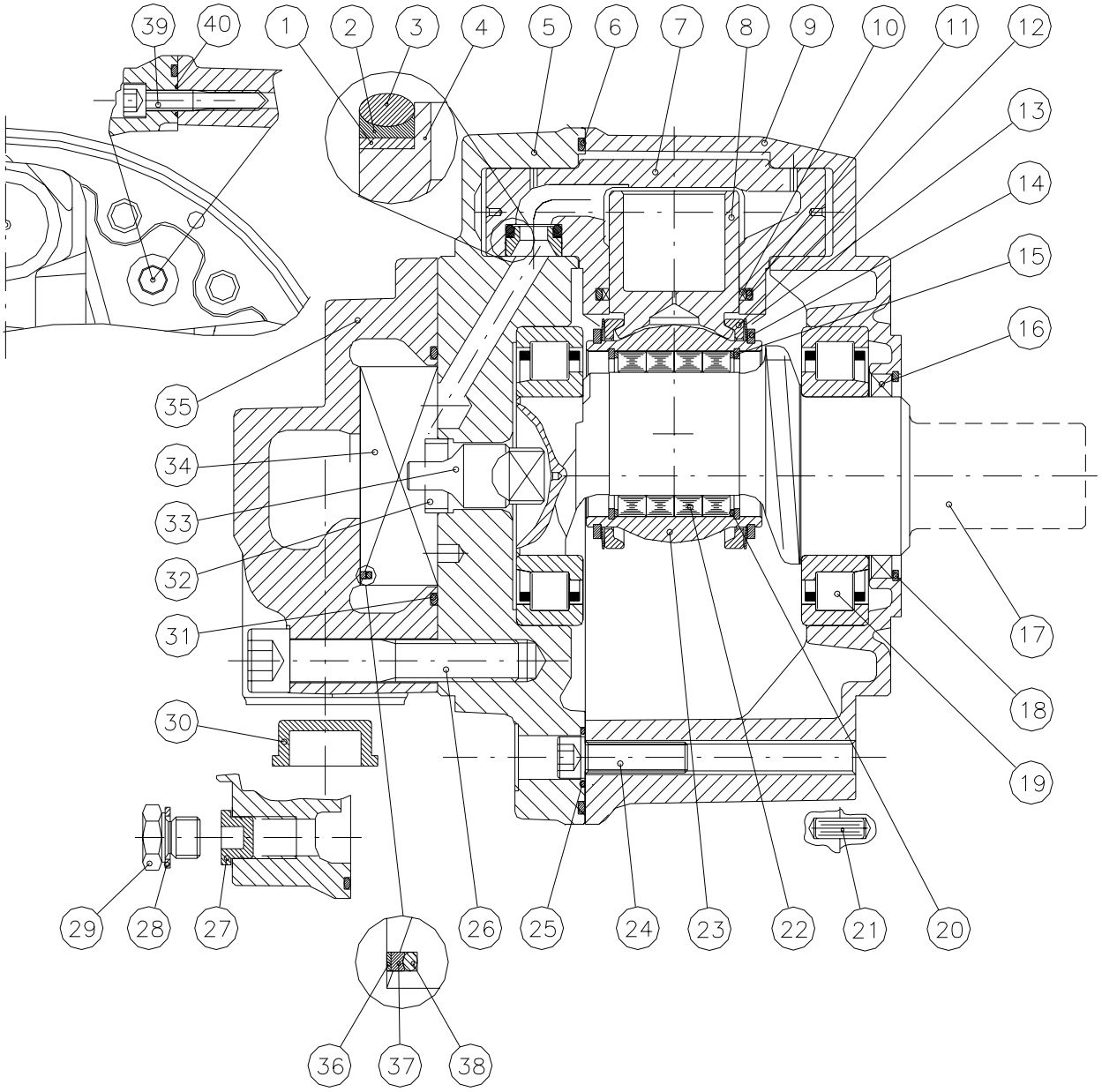
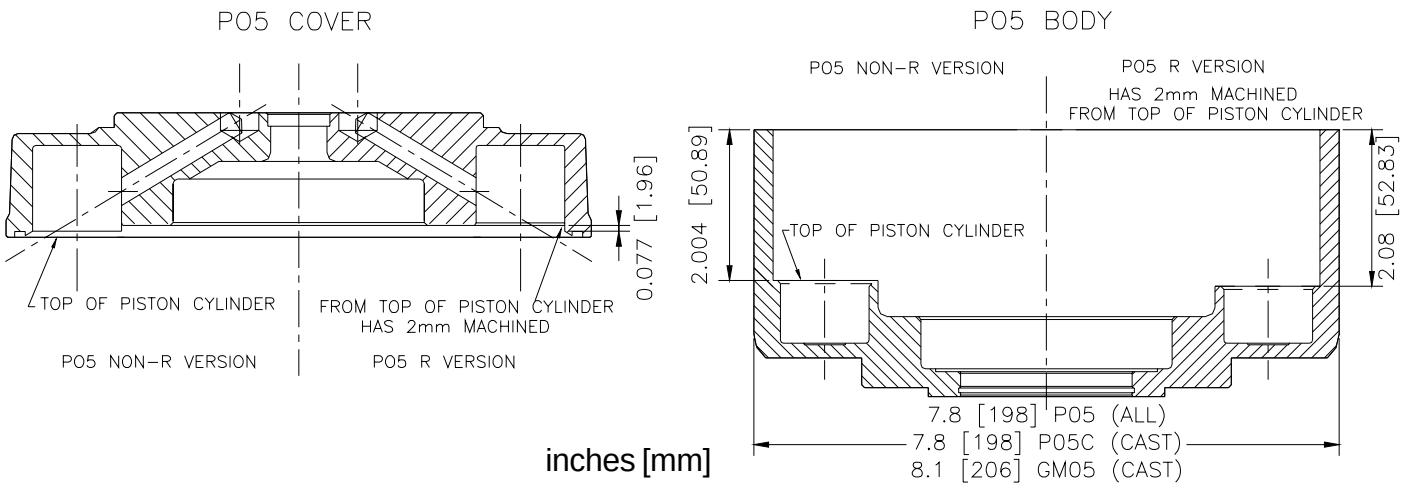
ALUMINUM BODY & COVER





inches [mm]

TABLE 1 - GM05 SPARE PARTS

#	DESCRIPTION	QTY	PART #
1	STEEL RING	5	0010301133
**2	PLASTIC ANTI-EXTR	5	0010001120
**3	O-RING 2-111	5	0010012271
4	STEEL SEAL	5	0164110108
5A	COVER (ALUM-P05)	1	0164001002
5B	COVER (CAST)	1	0164108102
5C	COVER (ALUM)	1	0164003002
5D	COVER (CAST R)	1	0164113102
**6	O-RING SEAL 2-169	1	0010012059
7	CYLINDER	5	SEE TAB. 2
8	PISTON	5	SEE TAB. 2
9A	BODY (ALUM-P05)	1	0164102001
9B	BODY (CAST)	1	0164113101
9C	BODY (ALUM R)	1	0164111101
9D	BODY (CAST R)	1	SEE TAB. 2
*10	CYLINDER SEAL	5	SEE TAB. 2
*11	CYLINDER O-RING	5	0106102211
12	PISTON RET. RING	2	0106100220
13	RETAINING SPRING	2	0010001013
14	SNAP RING	2	0010001109
15	RETAINING RING	2	0010002066
**16	SHAFT SEAL	1	SEE TAB. 3
17	SHAFT	1	0010001066
18	RETAINING RING	1	0010001013
19	SHAFT BEARINGS	2	0010002066
20	SPACER RING	2	0010318065
21	LOCATING PIN 5x8	2	0010020048
22	ROLLER	84	0010020026
23	SPHER. SUPPORT RING	5	0106120210
24	CLOSING BOLT 12x50	5	0010025342
**25	O-RING SEAL 2-015	5	0010012287
26	DIST. BOLT	5	SEE DIST.
27	PLASTIC PLUG 1/2"	1	0010023064
28	ALUM. WASHER	1	0010018094
29	ZINC DRAIN PLUG	1	0010023051
30	PLASTIC PLUG	1	SEE DIST.
**31	O-RING SEAL	1	SEE DIST.
32	CENTER BUSHING	1	0140000012
33	DRIVE PIN	1	SEE DIST.
34	ROTARY DISTRIBUTOR	1	SEE DIST.
35	DISTRIBUTOR	1	SEE DIST.
36	STEEL SEAL	1	SEE DIST.
37	PLASTIC SEAL	1	SEE DIST.
**38	O-RING SEAL	1	SEE DIST.
39A	CLOSING SCREW (P05)	1	0010025443
39A	CLOSING SCREW (GM05)	1	0010250077
**40	CLOSING O-RING	1	0010012022

*** ITEM INCLUDED IN CYLINDER SEAL KIT**
**** ITEM INCLUDED IN MOTOR SEAL KIT**

TABLE 2 - PISTONS/CYLINDERS
SUB ASSEMBLY Item #7, 8, 10, 11

DIA	DISP.	DESCRIPTION	PART #
Ø25	60	Sub Assembly	0164111286
		*Cylinder Seal	0010038046
		No O-Ring	
		***CYLINDER SEAL KIT #0400-V025**	
Ø28	75	Sub Assembly	0164112286
		*Cylinder Seal	0010038001
		*O-Ring	0010012194
		***CYLINDER SEAL KIT #0400-V128**	
Ø35	110	Sub Assembly	0164117186
		*Cylinder Seal	0010038002
		*O-Ring	0010012214
		***CYLINDER SEAL KIT #0400-V135**	
Ø37	130	Sub Assembly	0164116186
		*Cylinder Seal	0010038019
		*O-Ring	0010012137
		***CYLINDER SEAL KIT #0400-V137**	
Ø40	150	Sub Assembly	0164114286
		*Cylinder Seal	0010038004
		*O-Ring	0010012035
		***CYLINDER SEAL KIT #0400-V140**	
Ø42	170	Sub Assembly	0164108086
		*Cylinder Seal	0010038108
		*O-Ring	0010012126
		***CYLINDER SEAL KIT #0400-V142**	
Ø45	200	Sub Assembly	0164109186
		*Cylinder Seal	0010038104
		No O-Ring	
		***CYLINDER SEAL KIT #0400-V045**	
***CYLINDER SEAL KIT - Item #10, 11**			

TABLE 3 - SHAFTS Item #17

DESCRIPTION	STROKE	SHAFT	ASSEMBLY
MALE DIN [7]	16	0103105204	0103105294
	24	0104150204	0104150294
MALE UNI [1]	16	0103102204	0103102294
	24	0104102204	0104102294
PARALLEL [8]	24	0104122204	0104122294
SPLINED [17]	24	0104164204	0104164294
FEMALE DIN [9]	16	0103104204	0103104294
	24	0104160204	0104160294
FEMALE UNI [3]	16	0103112204	0103112294
	24	0104132204	0104132294
TAPERED [2]	24	0104180204	0104180294
KEYED [28]	24	0104161204	0104161294
SPLINED [77]	24	0104167204	0104167294

TABLE 4 - SHAFT BEARINGS Item #19

BALL BEARINGS	0010007033
ROLLER BEARINGS	0010007150

MOTOR SEAL KIT # 0050-ORK1

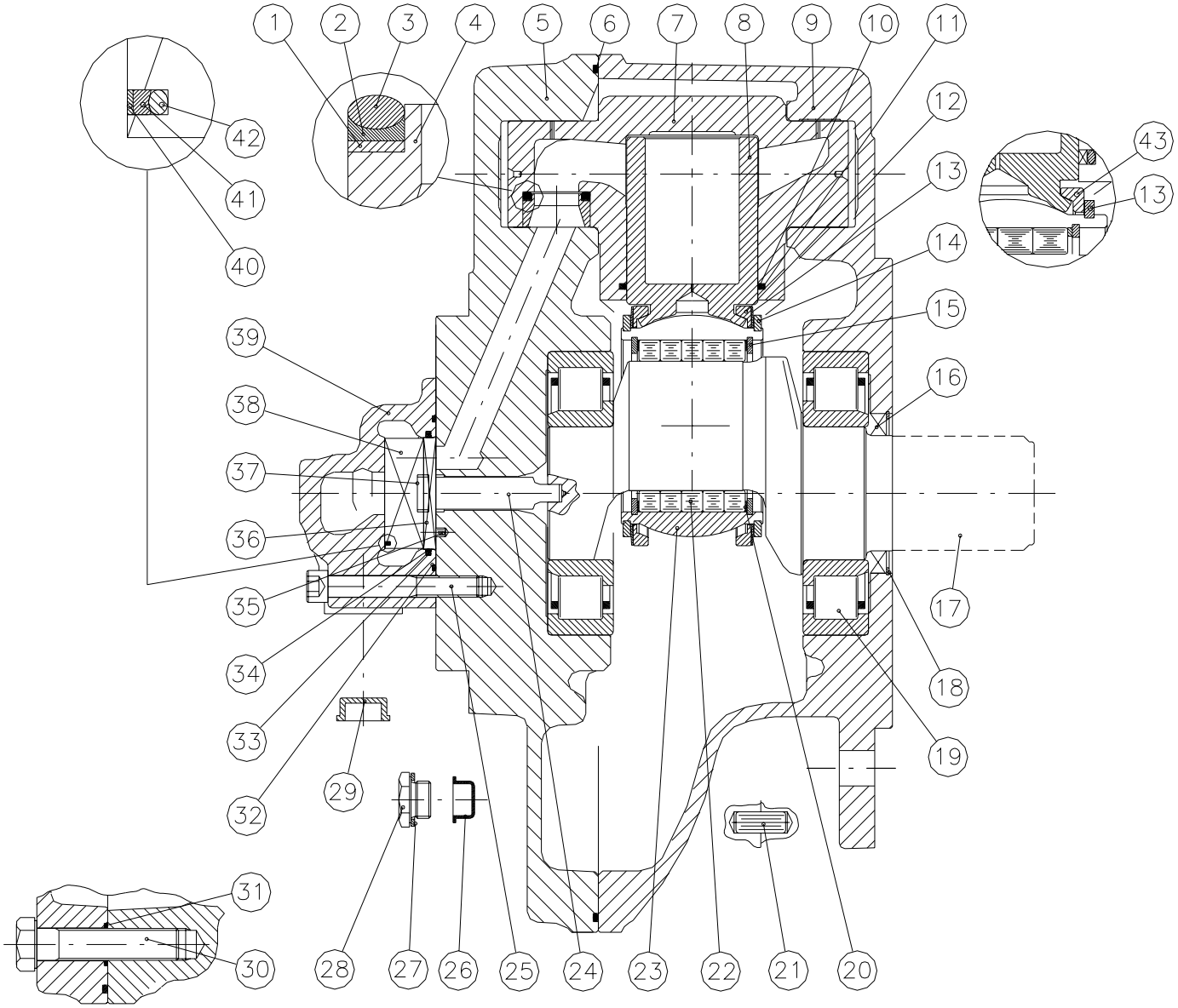

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TABLE 1 - GM1 SPARE PARTS

#	DESCRIPTION	QTY	PART #
1	STEEL RING	5	0010301136
**2	PLASTIC ANTI-EXTR RING	5	0010001121
**3	O-RING	5	0010012065
4	STEEL SEAL	5	0148002108
5	COVER	1	0148105002
**6	O-RING SEAL	1	0010012336
7	CYLINDER	5	SEE TAB. 2
8	PISTON	5	SEE TAB. 2
9	BODY	1	0148109001
*10	CYLINDER SEAL	5	SEE TAB. 2
*11	CYLINDER O-RING	5	SEE TAB. 2
12	PISTON RET. RING	2	0106102211
13	PISTON RET. SPRING	2	0106100220
14	INT. RETAINING C-CLIP	2	0010001109
15	EXT. RETAINING C-CLIP	2	0010001013
**16	SHAFT SEAL	1	0010002066
17	SHAFT	1	SEE TAB. 3
18	RETAINING C-CLIP	1	0010001066
19	SHAFT BEARINGS	2	SEE TAB. 4
20	SPACER RING	2	0010318065
21	LOCATING PIN 12x28	2	0010020048
22	ROLLER	84	0010020026
23	SPHER. SUPPORT RING	1	0106120210
23A	SUPPORT W/O SPRING	1	0100130210
24	DRIVE PIN	1	0106103109
25	SKTHD BOLT (M12x65)	5	SEE DIST.
26	PLASTIC PLUG 1/2"	1	0010023064
27	ALUM. WASHER 1/2"	1	0010018094
28	ZINC DRAIN PLUG 1/2"	1	0010023051
29	PLASTIC PLUG	2	0010023063
30	HXHD BOLT 8.8 (M14x35)	5	0010025213
**31	O-RING SEAL 1.78 #2.016	5	0010022237
32	O-RING	1	SEE DIST.
33	O-RING	1	SEE DIST.
34	SLIPPER PLAS. SEAL	1	SEE DIST.
35	DOWEL PIN 6x8	2	SEE DIST.
36	DISC BRONZE WP	1	SEE DIST.
37	BUSHING	1	SEE DIST.
38	ROTARY DISTRIBUTOR	1	SEE DIST.
39	DISTRIBUTOR COVER	1	SEE DIST.
40	STEEL RING	1	SEE DIST.
41	SLIPPER SEAL	1	SEE DIST.
**42	O-RING	1	SEE DIST.

*** ITEM INCLUDED IN CYLINDER SEAL KIT**
**** ITEM INCLUDED IN MOTOR SEAL KIT**

TABLE 2 - PISTONS/CYLINDERS
SUB ASSEMBLY Item #7, 8, 10, 11

DIA	DISP.	DESCRIPTION	PART #
Ø28	100	Sub Assembly	0148102086
		*Cylinder Seal	0010038001
		*O-Ring	0010012194
		***CYLINDER SEAL KIT #0400-V128**	
Ø35	150	Sub Assembly	0148001086
		*Cylinder Seal	0010038002
		*O-Ring	0010012214
		***CYLINDER SEAL KIT #0400-V135**	
Ø37	175	Sub Assembly	0148004086
		*Cylinder Seal	0010038019
		*O-Ring	0010012137
		***CYLINDER SEAL KIT #0400-V137**	
Ø40	200	Sub Assembly	0148003186
		*Cylinder Seal	0010038004
		*O-Ring	0010012035
		***CYLINDER SEAL KIT #0400-V140**	
Ø44	250	Sub Assembly	0148001186
		*Cylinder Seal	0010038005
		*O-Ring	0010012205
		***CYLINDER SEAL KIT #0400-V144**	
Ø48	300	Sub Assembly	0148002186
		*Cylinder Seal	0010038007
		*O-Ring	0010012217
		***CYLINDER SEAL KIT #0400-V148**	
Ø50	320	Sub Assembly	0148000186
		*Cylinder Seal	0010038008
		*O-Ring	0010012218
		***CYLINDER SEAL KIT #0400-V150**	
***CYLINDER SEAL KIT - Item #10, 11**			

TABLE 3 - SHAFTS Item #17

DESCRIPTION	STROKE	SHAFT	ASSEMBLY
MALE DIN [7]	32	0106103204	0106103294
MALE UNI [1]	32	0106102204	0106102294
TAPERED [2]	32	0106180204	0106180294
FEMALE DIN [9]	32	0106133204	0106133294
FEMALE UNI [3]	32	0106132204	0106132294
PARALLEL [8]	32	0106120204	0106120294
SPLINED [37]	32	0106167204	0106167294
KEYED [38]	32	0106162204	0106162294
KEYED 1-1/2"[48]	32	0106163204	0106163294
KEYED 1-1/4"[58]	32	0106160204	0106160294
KEYED 1-1/2"[68]	32	0106161294	0106161294

TABLE 4 - SHAFT BEARINGS Item #19

BALL BEARINGS	0010007033
ROLLER BEARINGS	0010007160

MOTOR SEAL KIT # 0051-ORK1

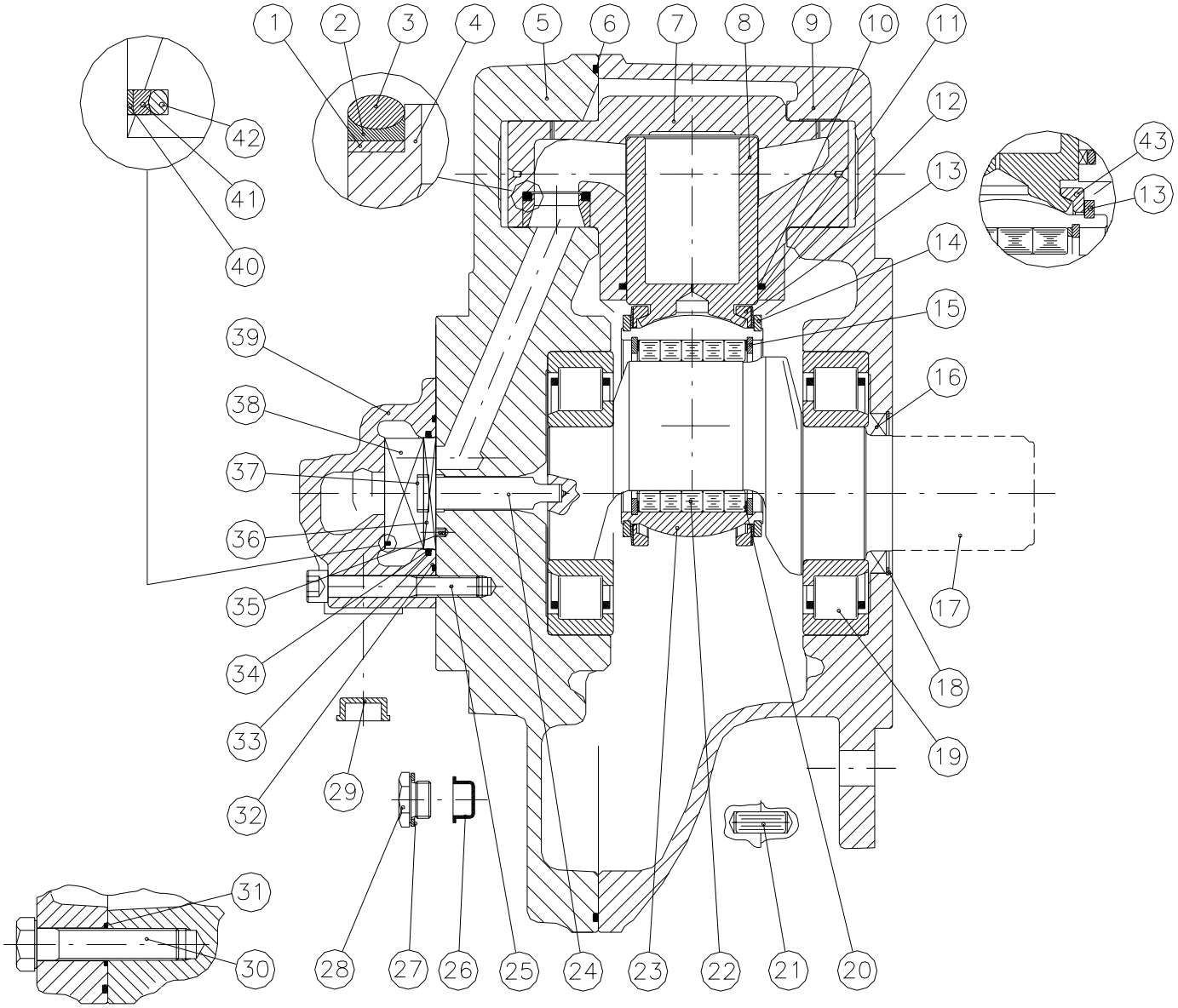
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TABLE 1 - GM2 SPARE PARTS

#	DESCRIPTION	QTY	PART #
1	STEEL RING	5	0010301137
****2**	PLASTIC ANTI-EXTR RING	5	0010001117
****3**	O-RING (2.62 2-115)	5	0010012062
4	STEEL SEAL	5	0150002108
5	COVER	1	0150105002
****6**	O-RING (CD2.62 D286)	1	0010012277
7	CYLINDER	5	SEE TAB. 2
8	PISTON	5	SEE TAB. 2
9	BODY	1	0150105001
***10**	CYLINDER SEAL	5	SEE TAB. 2
***11**	CYLINDER O-RING	5	SEE TAB. 2
12	PISTON RET. RING	2	0128102311
13	PISTON COMP. SPRING	2	0131102220
14	INT. RETAINING C-CLIP	2	0010001059
15	EXT. RETAINING C-CLIP	2	0010001086
****16**	SHAFT SEAL	1	0010012032
17	SHAFT	1	SEE TAB. 3
18	RETAINING C-CLIP	1	0010001040
19	SHAFT BEARINGS	2	SEE TAB. 4
20	SPACING WASHER	2	0010318042
21	LOCATING PIN 12x28	2	0010022036
22	ROLLER	17	0010020026
23	SPHER. SUPPORT RING	1	0128110210
24	DRIVE PIN	1	0112100109
25	SKTHD BOLT (M12x65)	5	SEE DIST.
26	PLASTIC PLUG 1/2"	1	0010023015
27	ALUM. WASHER 1/2"	1	0010018095
28	ZINC DRAIN PLUG 1/2"	1	0010023047
29	PLASTIC PLUG	2	0010023016
30	HXHD BOLT 8.8 (M12x50)	10	0150002108
****31**	O-RING SEAL (1.78 2-15)	10	0010012287
****32**	O-RING (2.8 ID 69.4)	1	SEE DIST.
33	O-RING (2.62 101.27)	1	SEE DIST.
34	SLIPPER PLAS. SEAL	1	SEE DIST.
35	DOWEL PIN 6x8	2	SEE DIST.
36	DISC BRONZE WP	1	SEE DIST.
37	BUSHING	1	SEE DIST.
38	ROTARY DISTRIBUTOR	1	SEE DIST.
39	DISTRIBUTOR COVER	1	SEE DIST.
40	STEEL RING	1	SEE DIST.
41	SLIPPER SEAL	1	SEE DIST.
****42**	O-RING (1.78 66.4 2-38)	1	SEE DIST.
43	PISTON RET. RING	2	0128103311

*** ITEM INCLUDED IN CYLINDER SEAL KIT**
**** ITEM INCLUDED IN MOTOR SEAL KIT**

TABLE 2 - PISTONS/CYLINDERS
SUB ASSEMBLY Item #7, 8, 10, 11

DIA	DISP.	DESCRIPTION	PART #
Ø35	**192**	Sub Assembly	0150006186
		*Cylinder Seal	0010038002
		*O-Ring	0010012214
		***CYLINDER SEAL KIT #0400-V135**	
Ø40	**250**	Sub Assembly	0150007186
		*Cylinder Seal	0010038001
		*O-Ring	0010012035
		***CYLINDER SEAL KIT #0400-V140**	
Ø44	**300**	Sub Assembly	0150003186
		*Cylinder Seal	0010038005
		*O-Ring	0010012205
		***CYLINDER SEAL KIT #0400-V144**	
Ø47	**350**	Sub Assembly	0150005186
		*Cylinder Seal	0010038007
		*O-Ring	0010012217
		***CYLINDER SEAL KIT #0400-V147**	
Ø52	**420**	Sub Assembly	0150004186
		*Cylinder Seal	0010038010
		*O-Ring	0010012037
		***CYLINDER SEAL KIT #0400-V152**	
Ø56	**500**	Sub Assembly	0150002186
		*Cylinder Seal	0010038024
		*O-Ring	0010012180
		***CYLINDER SEAL KIT #0400-V156**	
Ø60	**600**	Sub Assembly	0150000186
		*Cylinder Seal	0010038035
		*O-Ring	0010012039
		***CYLINDER SEAL KIT #0400-V160**	
Ø63	**600**	Sub Assembly	0153000086
		*Cylinder Seal	0010038014
		*O-Ring	0010012040
		***CYLINDER SEAL KIT #0400-V163**	
***CYLINDER SEAL KIT - Item #10, 11**			

TABLE 3 - SHAFTS Item #17

DESCRIPTION	STROKE	SHAFT	ASSEMBLY
MALE DIN [7]	20	0128150204	0128150294
MALE UNI [1]	20	0128100204	0128100294
TAPERED [2]	20	0128180204	0128180294
FEMALE DIN [9]	20	0128131204	0128131294
FEMALE UNI [3]	20	0128130204	0128130294
PARALLEL [8]	20	0128132204	0128132294
KEYED [18]	20	0128160204	0128160294

TABLE 4 - SHAFT BEARINGS Item #19

BALL BEARINGS	0010007037
ROLLER BEARINGS	0010007009

MOTOR SEAL KIT # 0052-ORK1

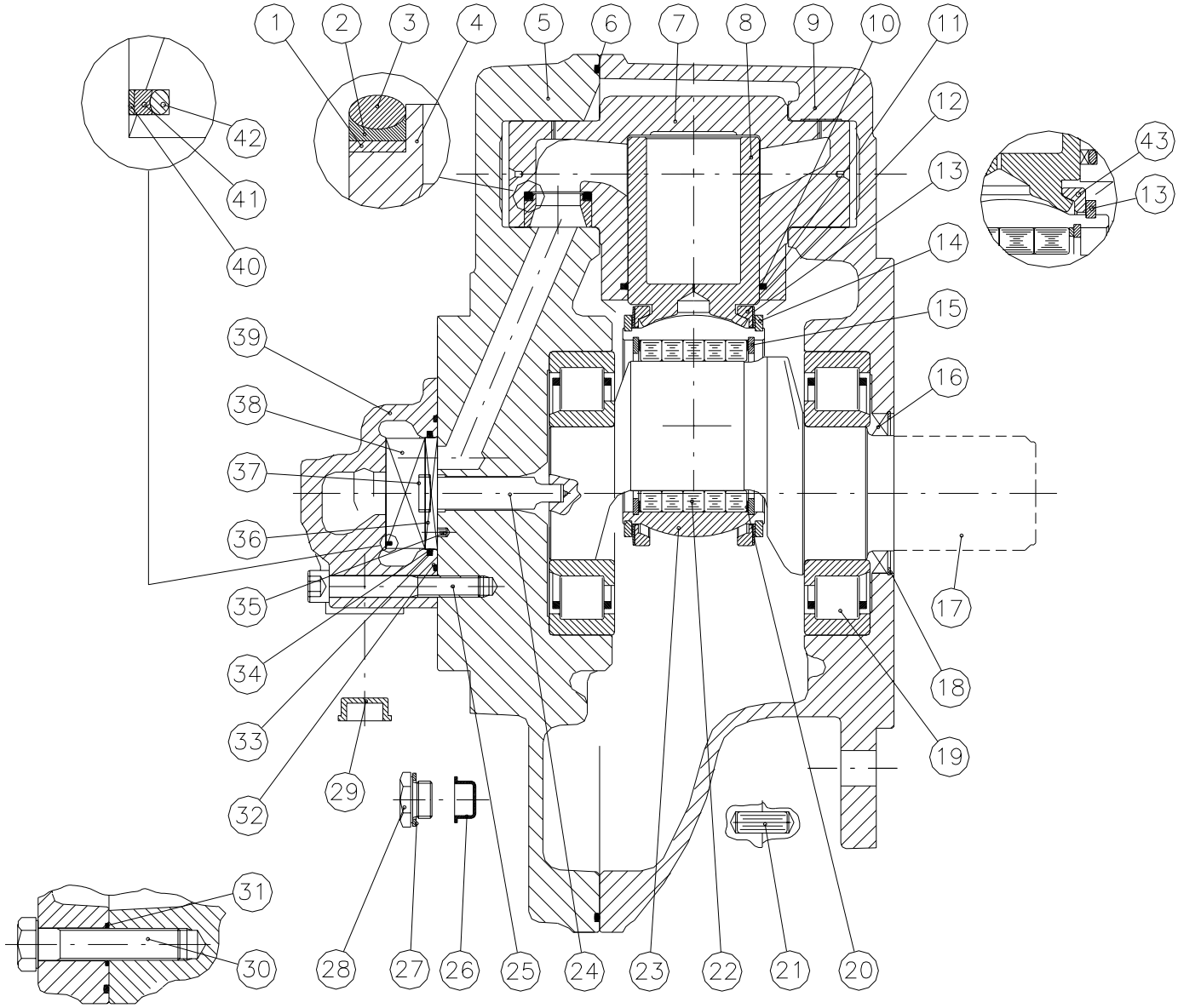
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TABLE 1 - GM3 SPARE PARTS

#	DESCRIPTION	QTY	PART #
1	STEEL RING	5	0010301138
****2**	PLASTIC ANTI-EXTR RING	5	0010001143
****3**	O-RING (2.62 2-119 ID23.47)	5	0010012171
4	STEEL SEAL	5	0153000108
5	COVER	1	0153100102
****6**	O-RING (3.53 ID355.12 2-280)	1	0010012178
7	CYLINDER	5	SEE TAB. 2
8	PISTON	5	SEE TAB. 2
9	BODY	1	0153100101
***10**	CYLINDER SEAL	5	SEE TAB. 2
***11**	CYLINDER O-RING	5	SEE TAB. 2
12	PISTON RET. RING	2	0131120211
13	PISTON COMP. SPRING	2	0131102220
14	INT. RETAINING C-CLIP	2	0010001068
15	EXT. RETAINING C-CLIP	2	0010001081
****16**	SHAFT SEAL	1	0010012032
17	SHAFT	1	SEE TAB. 3
18	RETAINING C-CLIP	1	0010001061
19	SHAFT BEARINGS	2	SEE TAB. 4
20	SPACING WASHER	2	0010318066
21	LOCATING PIN 12x28	2	0010022036
22	ROLLER	100	0010020045
23	SPHER. SUPPORT RING	1	0131120010
24	DRIVE PIN	1	0192000009
25	SKTHD BOLT (M12x65)	5	SEE DIST.
26	PLASTIC PLUG 1/2"	1	0010023015
27	ALUM. WASHER 1/2"	1	0010318066
28	ZINC DRAIN PLUG 1/2"	1	0010023047
29	PLASTIC PLUG	2	0010023016
30	HXHD BOLT 8.8 (M14x60)	10	0010025276
****31**	O-RING SEAL (2.62 2-116)	10	0010012062
****32**	O-RING	1	SEE DIST.
33	O-RING	1	SEE DIST.
34	SLIPPER PLAS. SEAL	1	SEE DIST.
35	DOWEL PIN	2	SEE DIST.
36	DISC BRONZE WP	1	SEE DIST.
37	BUSHING	1	SEE DIST.
38	ROTARY DISTRIBUTOR	1	SEE DIST.
39	DISTRIBUTOR COVER	1	SEE DIST.
40	STEEL RING	1	SEE DIST.
41	SLIPPER SEAL	1	SEE DIST.
****42**	O-RING	1	SEE DIST.
43	PIST. RET. RING (NO SPRING)	2	0128103311

TABLE 2 - PISTONS/CYLINDERS
SUB ASSEMBLY Item #7, 8, 10, 11

DIA	DISP.	DESCRIPTION	PART #
Ø40	**350**	Sub Assembly	0153103086
		*Cylinder Seal	0010038004
		*O-Ring	0010012217
		***CYLINDER SEAL KIT #0400-V140**	
Ø44	**425**	Sub Assembly	0153107086
		*Cylinder Seal	0010038005
		*O-Ring	0010012205
		***CYLINDER SEAL KIT #0400-V144**	
Ø47	**500**	Sub Assembly	0153101086
		*Cylinder Seal	0010038007
		*O-Ring	0010012217
		***CYLINDER SEAL KIT #0400-V147**	
Ø50	**550**	Sub Assembly	0153106086
		*Cylinder Seal	0010038008
		*O-Ring	0010012218
		***CYLINDER SEAL KIT #0400-V150**	
Ø52	**600**	Sub Assembly	0153105086
		*Cylinder Seal	0010038010
		*O-Ring	0010012037
		***CYLINDER SEAL KIT #0400-V152**	
Ø56	**700**	Sub Assembly	0153102186
		*Cylinder Seal	0010038024
		*O-Ring	0010012180
		***CYLINDER SEAL KIT #0400-V156**	
Ø60	**800**	Sub Assembly	0153104086
		*Cylinder Seal	0010038035
		*O-Ring	0010012039
		***CYLINDER SEAL KIT #0400-V160**	
Ø63	**900**	Sub Assembly	0153000086
		*Cylinder Seal	0010038014
		*O-Ring	0010012040
		***CYLINDER SEAL KIT #0400-V163**	
Ø67	**1000**	Sub Assembly	0153000086
		*Cylinder Seal	0010038017
		*O-Ring	0010012219
		***CYLINDER SEAL KIT #0400-V167**	
***CYLINDER SEAL KIT - Item #10, 11**			

TABLE 3 - SHAFTS Item #17

DESCRIPTION	STROKE	SHAFT	ASSEMBLY
MALE DIN [7]	38	0135165204	0135165294
MALE UNI [1]	38	0135111204	0135111294
FEMALE DIN [9]	38	0135169204	0135169294
FEMALE UNI [3]	38	0135112304	0135112394
PARALLEL [8]	38	0135186294	0135186204

TABLE 4 - SHAFT BEARINGS Item #19

ROLLER BEARINGS	0010007093
SPHERICAL BEARINGS	0010007138

MOTOR SEAL KIT # 0053-ORK1

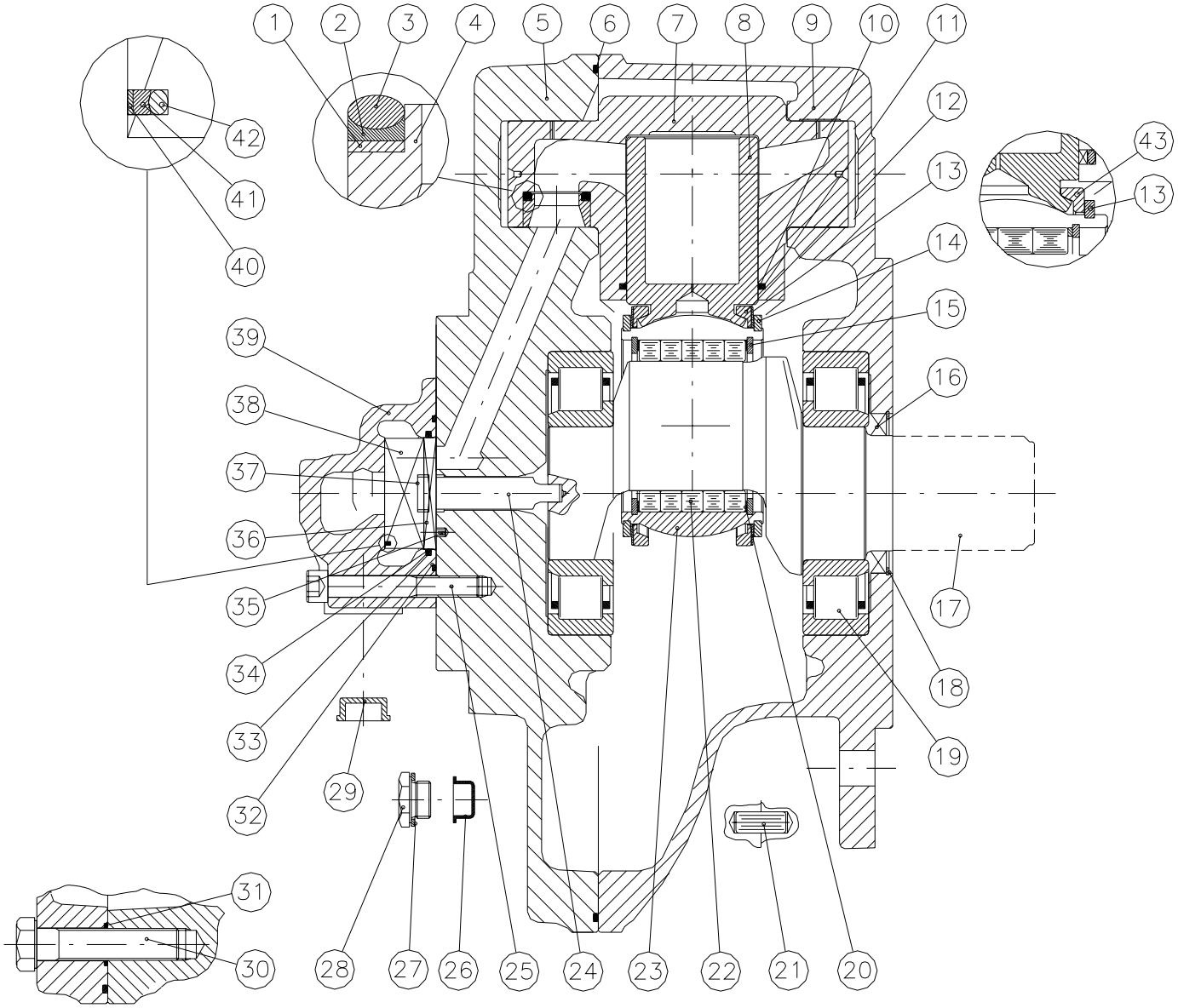
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TABLE 1 - GM4 SPARE PARTS

#	DESCRIPTION	QTY	PART #
1	STEEL RING	5	0010301138
**2	PLASTIC ANTI-EXTR RING	5	0010001143
**3	O-RING (2.62 2-119 ID23.47)	5	0010012171
4	STEEL SEAL	5	0153000108
5	COVER	1	0154000102
**6	O-RING (2.62 2-175)	1	0010012331
7	CYLINDER	5	SEE TAB. 2
8	PISTON	5	SEE TAB. 2
9	BODY	1	0154000001
*10	CYLINDER SEAL	5	SEE TAB. 2
*11	CYLINDER O-RING	5	SEE TAB. 2
12	PISTON RET. RING	2	0133101311
13	PISTON COMP. SPRING	2	0115100220
14	INT. RETAINING C-CLIP	2	0010001015
15	EXT. RETAINING C-CLIP	2	0010001058
**16	SHAFT SEAL	1	SEE TAB. 4
17	SHAFT	1	SEE TAB. 3
18	RETAINING C-CLIP	1	0010301138
19	ROLLER BEARINGS ("E")	2	0010007090
19	ROLL. BEARINGS (Standard)	2	0010007102
20	SPACING WASHER	2	0010318037
21	LOCATING PIN 12x28	2	0010022036
22	ROLLER	150	0010020047
23	SPHER. SUPPORT RING	1	0133100310
24	DRIVE PIN	1	0192000009
25	SKTHD BOLT (M14x110)	5	SEE DIST.
26	PLASTIC PLUG 1/2"	1	0010023015
27	ALUM. WASHER 1/2"	1	0010018095
28	ZINC DRAIN PLUG 1/2"	1	0010023047
29	PLASTIC PLUG	2	0010023054
30	HXHD BOLT 8.8 (M16x60)	10	0010025275
**31	O-RING (1.78 ID17.17 2-17)	10	0010012270
**32	O-RING	1	SEE DIST.
33	O-RING	1	SEE DIST.
34	SLIPPER PLAS. SEAL	1	SEE DIST.
35	DOWEL PIN 6x8	2	SEE DIST.
36	DISC BRONZE WP	1	SEE DIST.
37	BUSHING	1	SEE DIST.
38	ROTARY DISTRIBUTOR	1	SEE DIST.
39	DISTRIBUTOR COVER	1	SEE DIST.
40	STEEL RING	1	SEE DIST.
41	SLIPPER SEAL	1	SEE DIST.
**42	O-RING	1	SEE DIST.
43	PIST. RET. RING (NO SPRING)	1	0128103311

TABLE 3 - SHAFTS Item #17

DESCRIPTION	STROKE	SHAFT	ASSEMBLY
MALE DIN [7]	58	0133100304	0133100394
MALE UNI [1]	58	0133180304	0133180394
PARALLEL [8]	58	0133110304	0133110394
FEMALE DIN [9]	58	0133103304	0133103394
FEMALE UNI [3]	58	0133106304	0133106394
TAPERED [2]	58	0133105304	0133105694

TABLE 2 - PISTONS/CYLINDERS
SUB ASSEMBLY Item #7, 8, 10, 11

DIA	DISP.	DESCRIPTION	PART #
Ø52	600	Sub Assembly	0154052186
		Nitrated Sub Assy	T154052186
		*Cylinder Seal	0010038010
		*O-Ring	0010012037
		***CYLINDER SEAL KIT #0400-V152**	
Ø56	700	Sub Assembly	0154056186
		Nitrated Sub Assy	T154056186
		*Cylinder Seal	0010038024
		*O-Ring	0010012180
		***CYLINDER SEAL KIT #0400-V156**	
Ø59	800	Sub Assembly	0154059186
		Nitrated Sub Assy	T154059186
		*Cylinder Seal	0010038013
		*O-Ring	0010012039
		***CYLINDER SEAL KIT #0400-V159**	
Ø63	900	Sub Assembly	0154063186
		Nitrated Sub Assy	T154063186
		*Cylinder Seal	0010038014
		*O-Ring	0010012040
		***CYLINDER SEAL KIT #0400-V163**	
Ø67	1000	Sub Assembly	0154067186
		Nitrated Sub Assy	T154067186
		*Cylinder Seal	0010038017
		*O-Ring	0010012219
		***CYLINDER SEAL KIT #0400-V167**	
Ø70	1100	Sub Assembly	0154070186
		Nitrated Sub Assy	T154074186
		*Cylinder Seal	0010038100
		*O-Ring	0010012220
		***CYLINDER SEAL KIT #0400-V170**	
Ø74	1250	Sub Assembly	0154074186
		Nitrated Sub Assy	T154074186
		*Cylinder Seal	0010038023
		*O-Ring	0010012064
		***CYLINDER SEAL KIT #0400-V174**	
Ø76	1300	Sub Assembly	0154076186
		Nitrated Sub Assy	T154076186
		*Cylinder Seal	0010038122
		*O-Ring	0010012043
		***CYLINDER SEAL KIT #0400-V176**	
***CYLINDER SEAL KIT ITEM - #10, 11**			

*** ITEM INCLUDED IN CYLINDER SEAL KIT**
**** ITEM INCLUDED IN MOTOR SEAL KIT**

TABLE 4 - MOTOR SEAL KIT

SEAL KIT	SHAFT SEAL - Item #16
0054-ORK1	0010002033
0054-ORK1-SK	0010002083
0054-ORK1-FT	0010002036

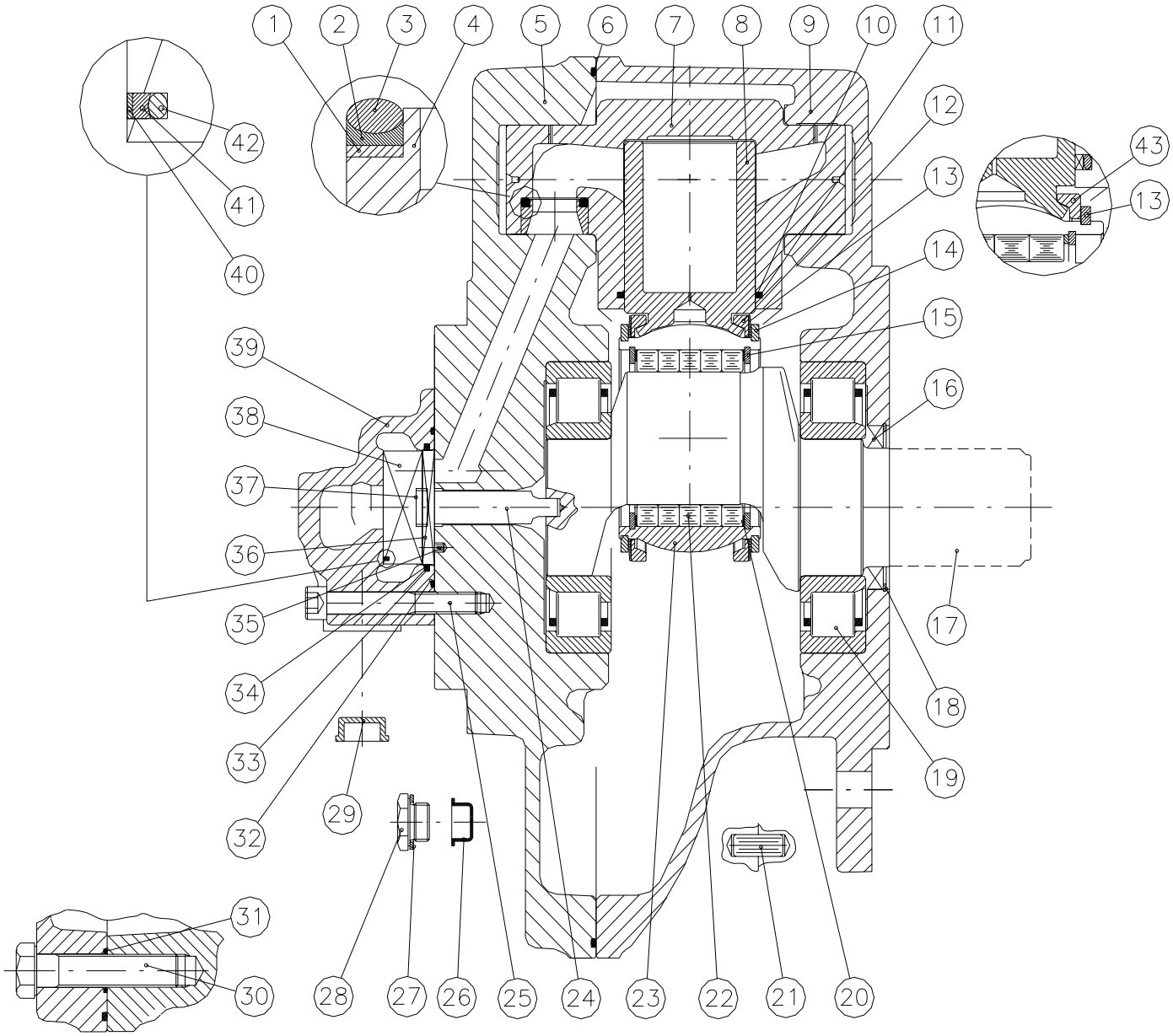
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TABLE 1 - GM5 SPARE PARTS

#	DESCRIPTION	QTY	PART #
1	STEEL RING	5	0010301131
****2**	PLASTIC ANTI-EXTR RING	5	0010001138
****3**	O-RING (3.53 ID31.34 2-218)	5	0010012106
4	STEEL SEAL	5	0185000108
5	COVER	1	0156000002
****6**	O-RING (2.62 2-284 ID456.06)	1	0010012333
7	CYLINDER	5	SEE TAB. 2
8	PISTON	5	SEE TAB. 2
9	BODY	1	0156130001
***10**	CYLINDER SEAL	5	SEE TAB. 2
***11**	CYLINDER O-RING	5	SEE TAB. 2
12	PISTON RET. RING	2	SEE #43
13	PISTON COMP. SPRING	2	NONE
14	INT. RETAINING C-CLIP	2	0010001083
15	EXT. RETAINING C-CLIP	2	0010001084
****16**	SHAFT SEAL	1	SEE TAB. 4
17	SHAFT	1	SEE TAB. 3
18	RETAINING C-CLIP	1	0010001089
19	ROLLER BEARINGS	2	0010007103
19	SPHERICAL BEARINGS	2	0010007149
20	SPACING WASHER	2	0010318073
21	LOCATING PIN 12x28	2	0010022036
22	ROLLER	110	0010020035
23	SPHER. SUPPORT RING	1	0115130210
24	DRIVE PIN	1	0156103109
25	SKTHD BOLT (M12x65)	5	SEE DIST.
26	PLASTIC PLUG 1/2"	1	0010023015
27	ALUM. WASHER 1/2"	1	0010318095
28	ZINC DRAIN PLUG 1/2"	1	0010023047
29	PLASTIC PLUG	2	0010023016
30	HXHD BOLT	15	0010025299
****31**	O-RING SEAL (2.62 2-116)	10	0010012253
****32**	O-RING	1	SEE DIST.
33	O-RING	1	SEE DIST.
34	SLIPPER/PLASTIC SEAL	1	SEE DIST.
35	DOWEL PIN	2	SEE DIST.
36	DISC BRONZE WP	1	SEE DIST.
37	BUSHING	1	SEE DIST.
38	ROTARY DISTRIBUTOR	1	SEE DIST.
39	DISTRIBUTOR COVER	1	SEE DIST.
40	STEEL RING	1	SEE DIST.
41	SLIPPER SEAL	1	SEE DIST.
****42**	O-RING	1	SEE DIST.
43	PIST. RET. RING	2	0115130211

*** ITEM INCLUDED IN CYLINDER SEAL KIT**
**** ITEM INCLUDED IN MOTOR SEAL KIT**

TABLE 2 - PISTONS/CYLINDERS
SUB ASSEMBLY Item #7, 8, 10, 11

DIA	DISP.	DESCRIPTION	PART #
Ø52	**800**	Sub Assembly	0156052186
		*Cylinder Seal	0010038010
		*O-Ring	0010012037
		***CYLINDER SEAL KIT #0400-V152**	
Ø59	**1000**	Sub Assembly	0156059186
		*Cylinder Seal	0010038013
		*O-Ring	0010012039
		***CYLINDER SEAL KIT #0400-V159**	
Ø63	**1200**	Sub Assembly	0156063186
		*Cylinder Seal	0010038014
		*O-Ring	0010012040
		***CYLINDER SEAL KIT #0400-V163**	
Ø67	**1300**	Sub Assembly	0156067186
		*Cylinder Seal	0010038017
		*O-Ring	0010012219
		***CYLINDER SEAL KIT #0400-V167**	
Ø70	**1450**	Sub Assembly	0156070286
		*Cylinder Seal	0010038100
		*O-Ring	0010012220
		***CYLINDER SEAL KIT #0400-V170**	
Ø74	**1600**	Sub Assembly	0156074186
		*Cylinder Seal	0010038023
		*O-Ring	0010012064
		***CYLINDER SEAL KIT #0400-V174**	
Ø78	**1800**	Sub Assembly	0156078286
		*Cylinder Seal	0010038028
		*O-Ring	0010012043
		***CYLINDER SEAL KIT #0400-V178**	
Ø82	**2000**	Sub Assembly	0156082186
		*Cylinder Seal	0010038090
		*O-Ring	0010012044
		***CYLINDER SEAL KIT #0400-V182**	
***CYLINDER SEAL KIT - Item #10, 11**			

TABLE 3 - SHAFTS Item #17

DESCRIPTION	STROKE	SHAFT	ASSEMBLY
MALE DIN [7]	38	0135165204	0135165294
MALE UNI [1]	38	0135111204	0135111294
FEMALE DIN [9]	38	0135169204	0135169294
FEMALE UNI [3]	38	0135112304	0135112394
PARALLEL [8]	38	0135186294	0135186204
TAPERED [2]	38	0135190204	0135190294

TABLE 4 - MOTOR SEAL KIT

SEAL KIT	SHAFT SEAL - Item #16
0055-ORK1	0010002114
0055-ORK1-SK	0010002083
0055-ORK1-FT	0010002036

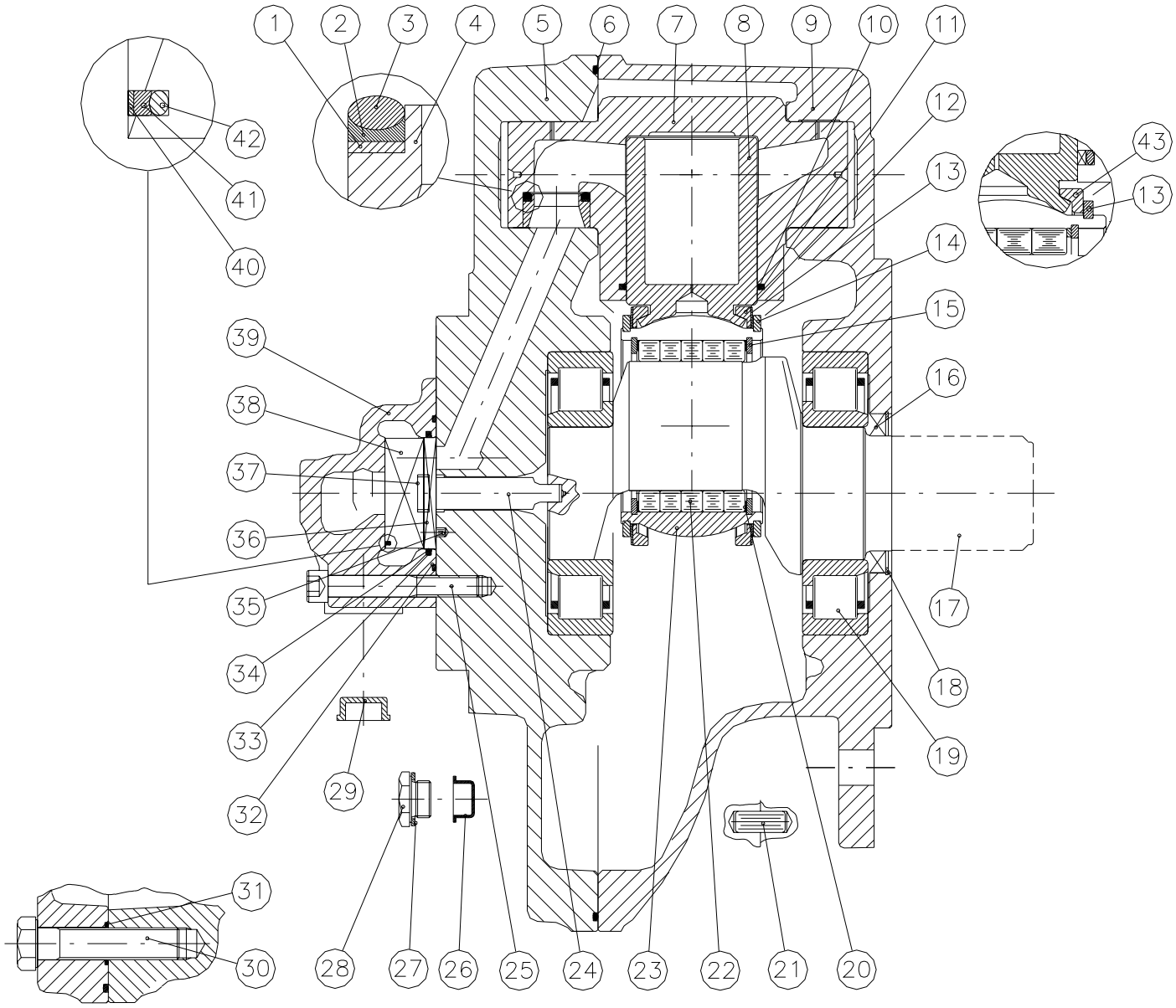
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TABLE 1 - GM6 SPARE PARTS

#	DESCRIPTION	QTY	PART #
1	STEEL RING	5	0010301131
****2**	PLASTIC ANTI-EXTR RING	5	0010001138
****3**	O-RING (3.53 2-218)	5	0010012106
4	STEEL SEAL	5	0185000108
5	COVER	1	0185100102
****6**	O-RING (3.53)	1	0010012315
7	CYLINDER	5	SEE TAB. 2
8	PISTON	5	SEE TAB. 2
9	BODY	1	0185100101
***10**	CYLINDER SEAL	5	SEE TAB. 2
***11**	CYLINDER O-RING	5	SEE TAB. 2
12	PISTON RET. RING	2	SEE #43
13	PISTON COMP. SPRING	2	NONE
14	INT. RETAINING C-CLIP	2	0010001122
15	EXT. RETAINING C-CLIP	2	0010001027
****16**	SHAFT SEAL	1	SEE TAB. 4
17	SHAFT	1	SEE TAB. 3
18	RETAINING C-CLIP	1	0010001042
19	ROLLER BEARINGS	2	0010007095
19	SPHERICAL BEARINGS	2	0010007167
20	SPACING WASHER	2	0010318090
21	LOCATING PIN 12x28	2	0010022036
22	ROLLER 15x152	126	0010020017
23	SPHER. SUPPORT RING	1	0185000210
24	DRIVE PIN	1	0185102109
25	SKTHD BOLT (M12x65)	5	SEE DIST.
26	PLASTIC PLUG 1/2"	1	0010023015
27	ALUM. WASHER 1/2"	1	0010318095
28	ZINC DRAIN PLUG 1/2"	1	0010023047
29	PLASTIC PLUG	2	0010023054
30	HXHD BOLT (M20x80)	15	0010025226
****31**	O-RING SEAL (2.62 2-119)	10	0010012171
****32**	O-RING	1	SEE DIST.
33	O-RING	1	SEE DIST.
34	SLIPPER/PLASTIC SEAL	1	SEE DIST.
35	DOWEL PIN	2	SEE DIST.
36	DISC BRONZE WP	1	SEE DIST.
37	BUSHING	1	SEE DIST.
38	ROTARY DISTRIBUTOR	1	SEE DIST.
39	DISTRIBUTOR COVER	1	SEE DIST.
40	STEEL RING	1	SEE DIST.
41	SLIPPER SEAL	1	SEE DIST.
****42**	O-RING	1	SEE DIST.
43	PIST. RET. RING	2	0185000211

*** ITEM INCLUDED IN CYLINDER SEAL KIT**
**** ITEM INCLUDED IN MOTOR SEAL KIT**

TABLE 2 - PISTONS/CYLINDERS
SUB ASSEMBLY Item #7, 8, 10, 11

DIA	DISP.	DESCRIPTION	PART #
Ø82	**1700**	Sub Assembly	0185100186
		*Cylinder Seal	0010038090
		*O-Ring	0010012043
		***CYLINDER SEAL KIT #0400-V182**	
Ø92	**2100**	Sub Assembly	0185110186
		*Cylinder Seal	0010038089
		*O-Ring	0010012297
		***CYLINDER SEAL KIT #0400-V192**	
Ø100	**2500**	Sub Assembly	0185000186
		*Cylinder Seal	0010038061
		*O-Ring	0010012047
		***CYLINDER SEAL KIT #0400-V1100**	
Ø110	**3000**	Sub Assembly	0185000086
		*Cylinder Seal	0010038101
		*O-Ring	0010012049
		***CYLINDER SEAL KIT #0400-V1110**	
***CYLINDER SEAL KIT - Item #11, 12**			

TABLE 3 - SHAFTS Item #17

DESCRIPTION	STROKE	SHAFT	ASSEMBLY
MALE DIN [7]	32	0185100194	0185100294
MALE UNI [1]	32	0185100104	0185100294
FEMALE DIN [9]	32	0185114204	0185114294
PARALLEL [8]	32	0185113204	0185113294

TABLE 4 - MOTOR SEAL KIT

SEAL KIT	SHAFT SEAL - Item #16
0056-ORK1	0010002078

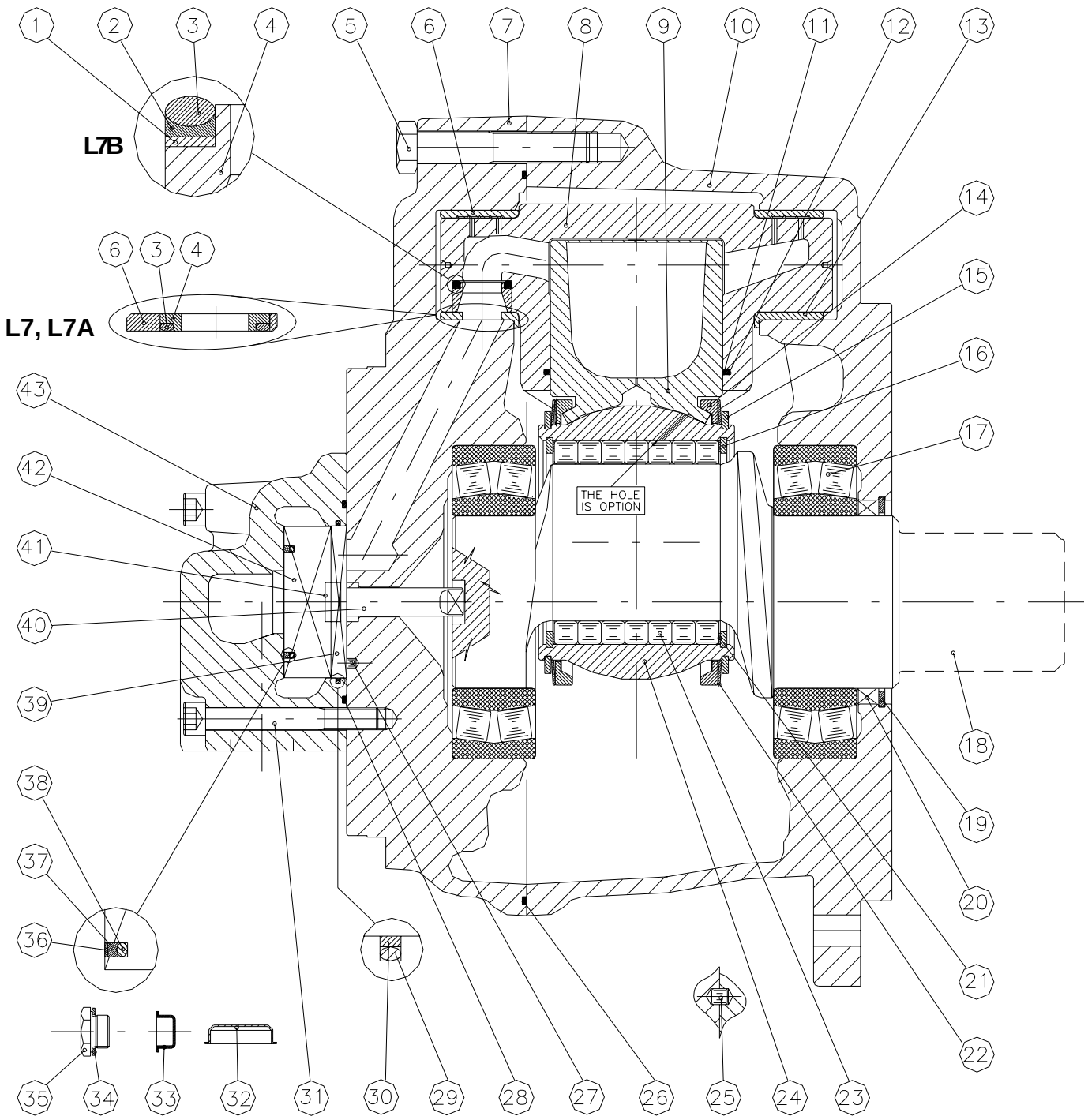
L7B
L7, L7A
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TABLE 1 - L7, L7A, L7B SPARE PARTS

#	DESCRIPTION	QTY	PART #
1	STEEL RING (L7)	0	NONE
	STEEL RING (L7A)	0	NONE
	STEEL RING (L7B)	5	0010301131
****2**	ANTI-EXTR RING (L7)	0	NONE
	ANTI-EXTR RING (L7A)	0	NONE
	ANTI-EXTR RING (L7B)	2	0010001119
****3**	O-RING (L7)	5	0010012260
	O-RING (L7A)	5	0010012260
	O-RING (L7B)	5	0010012106
4	BUSHING SEAL (L7)	5	0010038060
	BUSHING SEAL (L7A)	5	0010038060
	STEEL SEAL (L7B)	5	0010012106
5	MOTOR CLOSING BOLT	15	0010025355
6	COVER BUSHING (L7,L7A)	5	0190000112
	COVER BUSHING (L7B)	5	0185000112
7	MOTOR COVER (L7)	1	0190000002
	MOTOR COVER (L7A)	1	0190102102
	MOTOR COVER (L7B)	1	0190105102
8	CYLINDER	5	SEE TAB. 2
9	PISTON	5	SEE TAB. 2
10	MOTOR BODY (L7)	1	0190000001
	MOTOR BODY (L7A)	1	0190004001
	MOTOR BODY (L7B)	1	0190004001
***11**	CYLINDER SEAL	5	SEE TAB. 2
***12**	O-RING	5	SEE TAB. 2
13	MOTOR BODY BUSHING	5	0190000012
14	RETAINING RING	2	0190000011
15	EXT. RETAINING C-CLIP	2	0010001093
16	INT. RETAINING C-CLIP	2	0010001070
17	SPHERICAL BEARING	1	0010007095
18	SHAFT	1	SEE TAB. 3
19	RETAINING CLIP	1	0010001070
****20**	SHAFT SEAL	1	0010002078
21	SPACER RING	2	0010318080
22	RETAINING SPRING	2	0190000220
23	ROLLER	168	0010020017
24	SPHER. SUPPORT RING	1	0190000010
25	ROLLER	4	0010010045
****26**	O-RING (L7)	1	0190000018
	O-RING (L7A, L7B)	1	0010012165
27	LOCATING PIN	1	SEE DIST.
****28**	O-RING		SEE DIST.
****29**	O-RING		SEE DIST.
30	SLIPPER SEAL		SEE DIST.
31	SKTHD BOLT		SEE DIST.
32	PLASTIC PLUG	2	0010023054
33	PLASTIC SEAL	1	0010018022
34	ALUMINUM WASHER	1	SEE DIST.
35	DRAIN PLUG 1/2"	1	SEE DIST.
36	STEEL RING	1	SEE DIST.
37	SLIPPER SEAL	1	SEE DIST.
****38**	O-RING	1	SEE DIST.
39	DISC BRONZE WP	1	SEE DIST.
40	DRIVE PIN	1	0190000009
41	BUSHING	1	SEE DIST.
42	ROTARY DISTRIBUTOR	1	SEE DIST.
43	DISTRIBUTOR COVER	1	SEE DIST.

TABLE 2 - PISTONS/CYLINDERS SUB ASSEMBLY Item #8, 9, 11, 12

DIA	DISP.	DESCRIPTION	PART #
Ø82	**1400 2000**	Sub Assembly	0190002186
		*Cylinder Seal	0010038048
		*O-Ring	0010012043
		***CYLINDER SEAL KIT #0400-V182**	
Ø100	**2000 3000**	Sub Assembly	0190000186
		*Cylinder Seal	0190000305
		*O-Ring	00100120047
		***CYLINDER SEAL KIT #0400-V1100**	
Ø110	**2500 3600**	Sub Assembly	0190001086
		*Cylinder Seal	0010038101
		*O-Ring	0010012049
		***CYLINDER SEAL KIT #0400-V1110**	
Ø120	**4300**	Sub Assembly	0190000086
		*Cylinder Seal	0010038049
		*O-Ring	0010012051
		***CYLINDER SEAL KIT #0400-V1120**	
Ø125	**4700**	Sub Assembly	0190104186
		*Cylinder Seal	0010038115
		*O-Ring	0010002273
		***CYLINDER SEAL KIT #0400-V1125**	
***CYLINDER SEAL KIT - Item #11, 12**			

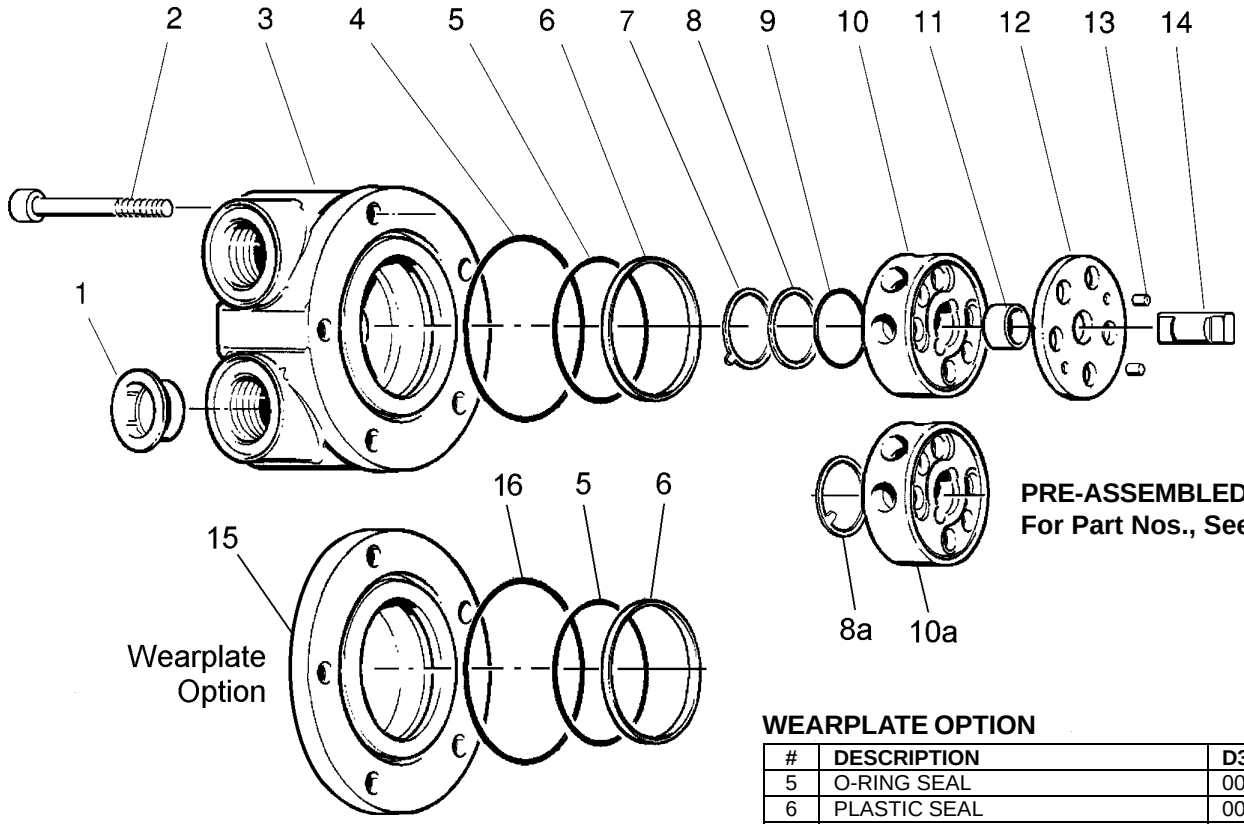
TABLE 3 - SHAFTS Item #18

DESCRIPTION	STROKE	SHAFT	ASSEMBLY
MALE DIN [7]	26	0190010104	0190010194
	38	0190006104	0190006194
MALE UNI [1]	26	0190002104	0190002194
	38	0190000104	0190000194
PARALLEL [8]	38	0190000004	0190000094
FEMALE DIN [9]	26	0190007104	0190007194
	38	0190003104	0190003194

TABLE 4 - MOTOR SEAL KIT

0030-ORK1**
0030-GK1

*** ITEM INCLUDED IN CYLINDER SEAL KIT**
**** ITEM INLCUDED IN MOTOR SEAL KIT**

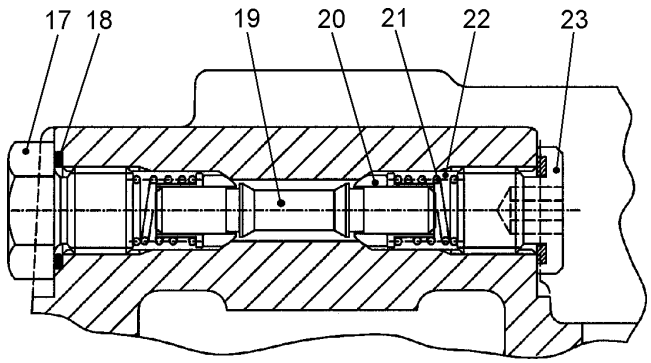


PRE-ASSEMBLED ROTARY
For Part Nos., See Page 31

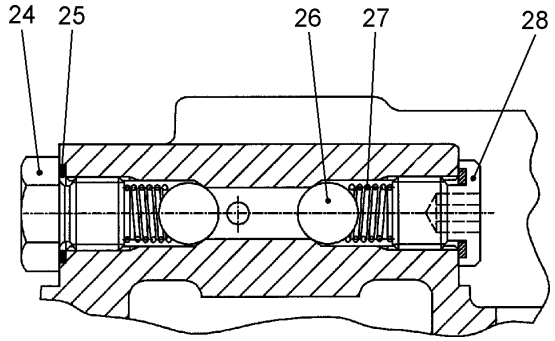
WEARPLATE OPTION

#	DESCRIPTION	D3...
5	O-RING SEAL	0010012040
6	PLASTIC SEAL	0010038054
15	INTER. SPACER FOR WEARPLATE	0140002250
16	O-RING SEAL	0010012043

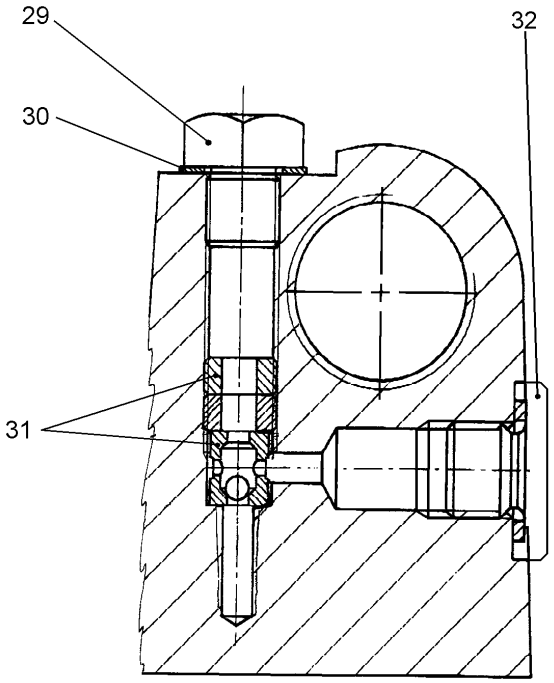
D311A, D312A, D317A PURGE VALVE



D314A ANTI-CAVITATION VALVE



D313A, D315A, D318A SHUTTLE VALVE



DISTRIBUTORS

Pre-Assembled Rotary with Steel Ring (Includes Item #7, 8, 9 10)

DISTRIBUTORS	ASSEMBLY PART #
D3..., D4...	0140003087
D90A	0190003087
D250A	0195120187

Pre-Assembled Rotary without Steel Ring (Includes Item #8a, 9, 10a)

DISTRIBUTORS	ASSEMBLY PART #
D3..., D4...	0140000087
D90A	0190000087

Distributors (without built-in wearplate)

D30A

#	SUB ASSEMBLY	0140030083
1	PLASTIC PLUG	0010023063
2	BOLT (5) M12X30	0010035335
3	DIST. COVER	0140030003
4	O-RING SEAL	0010012043
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0140000012
13	LOCATING PINS	0010020048
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D30-KA W/O STEEL RING		
SEAL KIT #0140-D30-KB W/ STEEL RING		
SEAL KIT #0140-D30A-KB W/ STEEL RING		

D31A

#	SUB ASSEMBLY	0140031383
1	PLASTIC PLUG	0010023063
2*	BOLT (1) M12X70	0010025175
2	BOLT (4) M12X45	0010025244
3	DIST. COVER	0140031303
4	O-RING SEAL	0010012313
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0140000012
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D31-KA W/O STEEL RING		
SEAL KIT #0140-D31-KB W/ STEEL RING		
SEAL KIT #0140-D31A-KB W/ STEEL RING		

D36A

#	SUB ASSEMBLY	0140131083
1	PLASTIC PLUG	0010023063
2*	BOLT (1) M12X70	0010025175
2	BOLT (4) M12X45	0010025244
3	DIST. COVER	0140131003
4	O-RING SEAL	0010012313
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0140000012
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D31-KA W/O STEEL RING		
SEAL KIT #0140-D31-KB W/ STEEL RING		
SEAL KIT #0140-D31A-KB W/ STEEL RING		

D37A

#	SUB ASSEMBLY	0140037083
1	PLASTIC PLUG	0010023063
2*	BOLT (1) M12X70	0010025175
2	BOLT (4) M12X45	0010025244
3	DIST. COVER	0140037083
4	O-RING SEAL	0010012313
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0140000012
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D37-KA W/O STEEL RING		
SEAL KIT #0140-D37-KB W/ STEEL RING		
SEAL KIT #0140-D37A-KB W/ STEEL RING		

D310A

#	SUB ASSEMBLY	0140031083
1	PLASTIC PLUG	0010023016
2*	BOLT (1) M12X70	0010025175
2	BOLT (4) M12X45	0010025244
3	DIST. COVER	0140031003
4	O-RING SEAL	0010012313
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0140000012
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D31-KA W/O STEEL RING		
SEAL KIT #0140-D31-KB W/ STEEL RING		
SEAL KIT #0140-D31A-KB W/ STEEL RING		

D316A

#	SUB ASSEMBLY	0140131183
1	PLASTIC PLUG	0010023016
2*	BOLT (1) M12X70	0010025175
2	BOLT (4) M12X45	0010025244
3	DIST. COVER	0140131103
4	O-RING SEAL	0010012313
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0140000012
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D31-KA W/O STEEL RING		
SEAL KIT #0140-D31-KB W/ STEEL RING		
SEAL KIT #0140-D31A-KB W/ STEEL RING		

* Bolt length with wearplate option (D3... distributors only)

Distributors (with wearplate)

D416A

#	SUB ASSEMBLY	0140008083
1	PLASTIC PLUG	0010023016
2	BOLT (5) M12X80	0010035343
3	DIST. COVER	0140008003
4	O-RING SEAL	0010012043
6	PLASTIC SEAL	0010038054
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0140000012
12	BRONZE DISC	0140000250
13	LOCATING PINS	0010020048
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D416-KA W/O STEEL RING		
SEAL KIT #0140-D416-KB W/ STEEL RING		
SEAL KIT #0140-D416A-KB W/ STEEL RING		

D40A

#	SUB ASSEMBLY	0140003083
1	PLASTIC PLUG	0010023016
2	BOLT (5) M12X80	0010035343
3	DIST. COVER	0140003003
4	O-RING SEAL	0010012043
6	PLASTIC SEAL	0010038054
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0140000012
12	BRONZE DISC	0140000250
13	LOCATING PINS	0010020048
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D40-KA W/O STEEL RING		
SEAL KIT #0140-D40-KB W/ STEEL RING		
SEAL KIT #0140-D40A-KB W/ STEEL RING		

D47A

#	SUB ASSEMBLY	0140047083
1	PLASTIC PLUG	0010023016
2	BOLT (1) M12X80	0010035343
3	DIST. COVER	0140047003
4	O-RING SEAL	0010012043
5	O-RING SEAL	0010012040
6	PLASTIC SEAL	0010038054
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038063
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0140000012
12	BRONZE DISC	0140000250
13	LOCATING PINS	0010020048
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D47-KA W/O STEEL RING		
SEAL KIT #0140-D47-KB W/ STEEL RING		
SEAL KIT #0140-D47A-KB W/ STEEL RING		

Distributors (with purge valve)

D311A

#	SUB ASSEMBLY	0140031683
1	PLASTIC PLUG	0010323063
2	BOLT	0010025309
3	DIST. COVER	0140031603
4	O-RING SEAL	0010012043
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010023056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
14	DIST. DRIVE PIN	SEE TAB 1
17	SPEC. PLUG BSP	0010323007
18	O-RING SEAL	0010012287
19	SPOOL	0142000013
20	BUSHING	0142000012
21	VALVE SPRING	0142000011
22	BUSH. SPT. SPRING	0142000010
23	SKTHD PLUG	0010023056
32	PLASTIC PLUG	0010023064
SEAL KIT #0140-D31-KA W/O STEEL RING		
SEAL KIT #0140-D31-KB W/ STEEL RING		
SEAL KIT #0140-D31A-KB W/ STEEL RING		

D312A

#	SUB ASSEMBLY	0140031883
1	PLASTIC PLUG	0010323063
2*	BOLT (1) M12X70	0010025175
2	BOLT (4) M12X45	0010025244
3	DIST. COVER	0140031803
4	O-RING SEAL	0010012313
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010023056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
14	DIST. DRIVE PIN	SEE TAB 1
17	SPEC. PLUG BSP	0010323007
18	O-RING SEAL	0010012287
19	SPOOL	0142000013
20	BUSHING	0142000012
21	VALVE SPRING	0142000011
22	BUSH. SPT. SPRING	0142000010
23	SKTHD PLUG	0010023056
32	PLASTIC PLUG	0010023064
SEAL KIT #0140-D31-KA W/O STEEL RING		
SEAL KIT #0140-D31-KB W/ STEEL RING		
SEAL KIT #0140-D31A-KB W/ STEEL RING		

D317A

#	SUB ASSEMBLY	0140131283
1	PLASTIC PLUG	0010023016
2*	BOLT (1) M12X70	0010025175
2	BOLT (4) M12X45	0010025244
3	DIST. COVER	0140031203
4	O-RING SEAL	0010012313
6	PLASTIC SEAL	0010038054
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
14	DIST. DRIVE PIN	SEE TAB 1
17	SPEC. PLUG BSP	0010323007
18	O-RING SEAL	0010012287
19	SPOOL	0142000013
20	BUSHING	0142000012
21	VALVE SPRING	0142000011
22	BUSH. SPT. SPRING	0142000010
23	SKTHD PLUG	0010023056
32	PLASTIC PLUG	0010023064
SEAL KIT #0140-D31-KA W/O STEEL RING		
SEAL KIT #0140-D31-KB W/ STEEL RING		
SEAL KIT #0140-D31A-KB W/ STEEL RING		

* Bolt length with wearplate option (D3... distributors only)

Distributors (with shuttle valve)

D313A

#	SUB ASSEMBLY	0140131883
1	PLASTIC PLUG	0010023016
2*	BOLT (1) M12X70	0010025175
2	BOLT (4) M12X45	0010025244
3	DIST. COVER	0140031803
4	O-RING SEAL	0010012313
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0142000012
14	DIST. DRIVE PIN	SEE TAB 1
29	HXHD PLUG	0010023048
30	Cu WASHER	0010018034
31	SHT.VLV.SET SCREW	0010039004
32	PLASTIC PLUG	0010023064
SEAL KIT #0140-D31-KA W/O STEEL RING		
SEAL KIT #0140-D31-KB W/ STEEL RING		
SEAL KIT #0140-D31A-KB W/ STEEL RING		

D315A

#	SUB ASSEMBLY	0140131583
1	PLASTIC PLUG	0010023016
2*	BOLT (1) M12X70	0010025175
2	BOLT (4) M12X45	0010025244
3	DIST. COVER	0140131503
4	O-RING SEAL	0010012313
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0142000012
14	DIST. DRIVE PIN	SEE TAB 1
29	HXHD PLUG	0010023048
30	Cu WASHER	0010018034
31	SHT.VLV.SET SCREW	0010039004
32	PLASTIC PLUG	0010023064
SEAL KIT #0140-D315-KA W/O STEEL RING		
SEAL KIT #0140-D315-KB W/ STEEL RING		
SEAL KIT #0140-D315A-KB W/ STEEL RING		

D318A

#	SUB ASSEMBLY	0140031783
1	PLASTIC PLUG	0010023016
2*	BOLT (1) M12X70	0010025175
2	BOLT (4) M12X45	0010025244
3	DIST. COVER	0140031703
4	O-RING SEAL	0010012313
6	PLASTIC SEAL	0010038054
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0142000012
14	DIST. DRIVE PIN	SEE TAB 1
29	HXHD PLUG	0010023048
30	Cu WASHER	0010018034
31	SHT.VLV.SET SCREW	0010039004
32	PLASTIC PLUG	0010023064
SEAL KIT #0140-D31-KA W/O STEEL RING		
SEAL KIT #0140-D31-KB W/ STEEL RING		
SEAL KIT #0140-D31A-KB W/ STEEL RING		

Distributors (with anti-cavitation valve)

D314A

#	SUB ASSEMBLY	0140031983
1	PLASTIC PLUG	0010023016
2*	BOLT (1) M12X70	0010025175
2	BOLT (4) M12X45	0010025244
3	DIST. COVER	0140031603
4	O-RING SEAL	0010012287
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0142000012
14	DIST. DRIVE PIN	SEE TAB 1
24	SPEC. PLUG	0010323007
25	O-RING SEAL	0010012287
26	STEEL BALLS	0010021008
27	VALVE SPRING	0142000011
28	SKTHD PLUG 1/4"	0010023056
32	PLASTIC PLUG	0010023064
SEAL KIT #0140-D31-KA W/O STEEL RING		
SEAL KIT #0140-D31-KB W/ STEEL RING		
SEAL KIT #0140-D31A-KB W/ STEEL RING		

Distributors

D90A

#	SUB ASSEMBLY	0190000083
1	PLASTIC PLUG	0010023054
2	BOLT (5) M14X110	0010025452
3	DIST. COVER	0190000003
4	O-RING SEAL	0010012079
6	PLASTIC SEAL	0010038058
7	ANTIEXTR. RING	0190000013
8	PLASTIC SEAL	0010038059
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012254
10	ROTARY DIST.	0190003007
10a	ROTARY DIST.	0190000007
11	BUSHING	0190000212
12	BRONZE DISC	0190000250
13	LOCATING PINS	0010020048
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D90-KA W/O STEEL RING		
SEAL KIT #0140-D90-KB W/ STEEL RING		
SEAL KIT #0140-D90A-KB W/ STEEL RING		

D250A

#	SUB ASSEMBLY	0195102183
1	PLASTIC PLUG	0010023068
2	BOLT (5) M30X150	0010025449
3	DIST. COVER	0195102103
4	O-RING SEAL	0010012079
5	O-RING	0010012054
6	PLASTIC SEAL	0010038114
7	ANTIEXTR. RING	0195003013
8	PLASTIC SEAL	0010038113
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012047
10	ROTARY DIST.	0195120107
11	BUSHING	0195000312
12	BRONZE DISC	K195102250
13	LOCATING PINS	0010022036
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D250-KA W/O STEEL RING		
SEAL KIT #0140-D250-KB W/ STEEL RING		
SEAL KIT #0140-D250A-KB W/ STEEL RING		

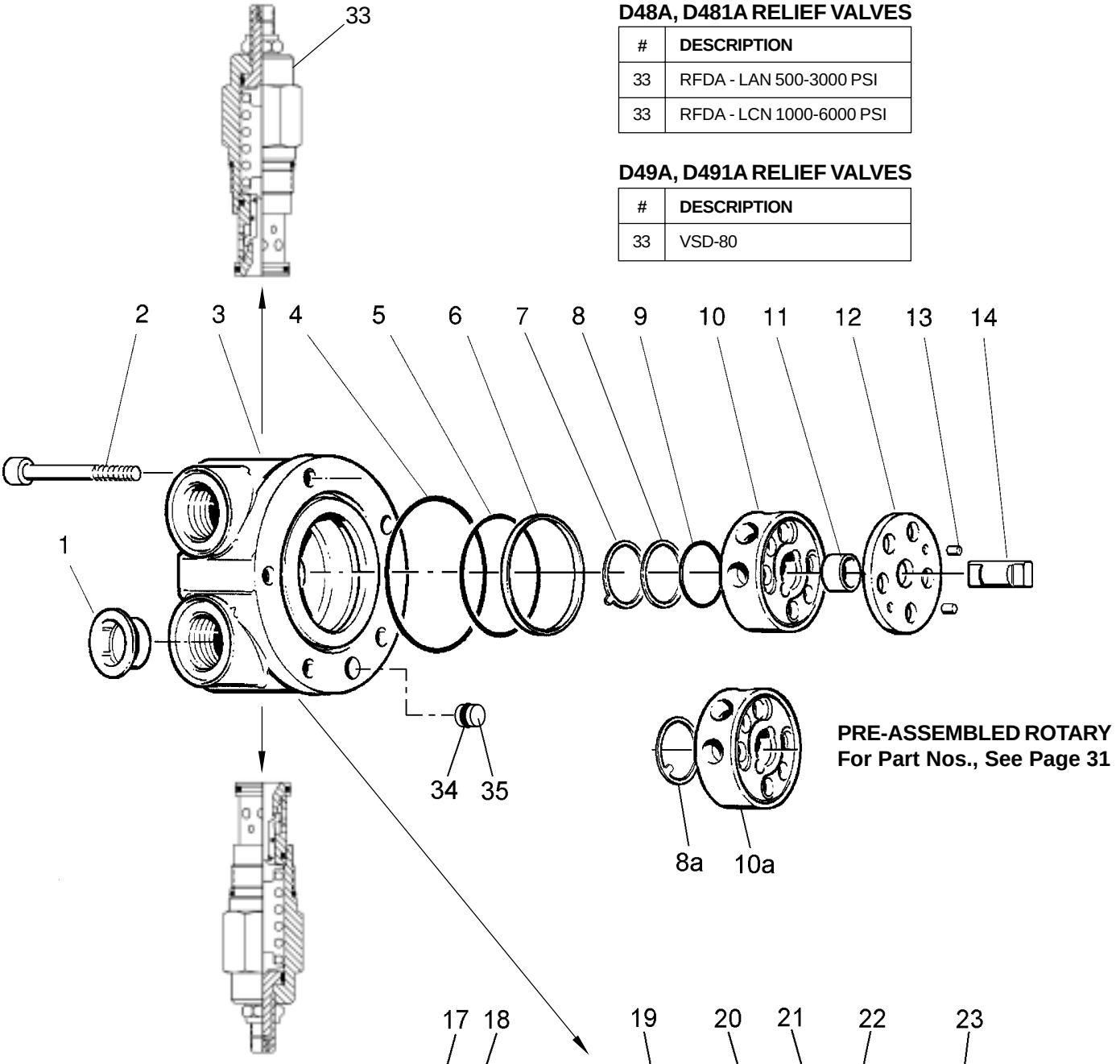
* Bolt length with wearplate option (D3... distributors only)

D48A, D481A RELIEF VALVES

#	DESCRIPTION
33	RFDA - LAN 500-3000 PSI
33	RFDA - LCN 1000-6000 PSI

D49A, D491A RELIEF VALVES

#	DESCRIPTION
33	VSD-80



PRE-ASSEMBLED ROTARY
For Part Nos., See Page 31

D481A, D491A PURGE VALVE

Distributors (with cross-over relief valve)

D48A

#	SUB ASSEMBLY	0140048683
1	PLASTIC PLUG	0010023011
2	BOLT (5) M12X60	0010025309
3	DIST. COVER	0140048603
4	O-RING SEAL	0010012220
5	O-RING SEAL	0010012040
6	PLASTIC SEAL	0010038054
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140003087
11	BUSHING	0140000012
12	BRONZE DISC	K140000250
13	LOCATING PINS	0010020048
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D48A-KA W/O STEEL RING		
SEAL KIT #0140-D48A-KB W/ STEEL RING		

D49A

#	SUB ASSEMBLY	0140049083
1	PLASTIC PLUG	0010023016
2	BOLT (5) M12X60	0010025309
3	DIST. COVER	0140049003
4	O-RING SEAL	0010012064
5	O-RING SEAL	0010012040
6	PLASTIC SEAL	0010038054
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0140000012
12	BRONZE DISC	0140000250
13	LOCATING PINS	0010020048
14	DIST. DRIVE PIN	SEE TAB 1
SEAL KIT #0140-D49-KA W/O STEEL RING		
SEAL KIT #0140-D49-KB W/ STEEL RING		
SEAL KIT #0140-D49A-KB W/ STEEL RING		

Distributors (with cross-over relief valve/purge valve)

D481A

#	SUB ASSEMBLY	0140048783
1	PLASTIC PLUG	0010023016
2	BOLT (4) M12X60	0010025309
3	DIST. COVER	0140048783
4	O-RING SEAL	0010012064
5	O-RING SEAL	0010012040
6	PLASTIC SEAL	0010038054
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0140000012
12	BRONZE DISC	0140000250
13	LOCATING PINS	0010020048
14	DIST. DRIVE PIN	SEE TAB 1
17	ZINC PLUG	0010023051
18	O-RING SEAL	0010012287
19	SPOOL	0142000013
20	CNTRG WASHER 1/4"	0010018094
21	VALVE SPRING	0142000011
22	SPACING PLUG	0142000014
23	SKTHD PLUG	0010023056
33	CARTRIDGE VS80N	0010039001
34	O-RING SEAL	0010012025
35	DIST. VALVE PLUG	0142000014
SEAL KIT #0140-D481-KA W/O STEEL RING		
SEAL KIT #0140-D481-KB W/ STEEL RING		

D491A

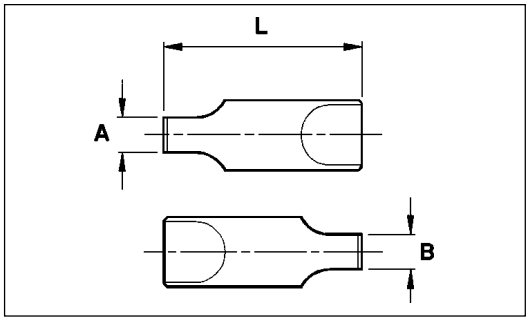
#	SUB ASSEMBLY	0140048783
1	PLASTIC PLUG	0010023016
2	BOLT (4) M12X60	0010025309
3	DIST. COVER	0140048783
4	O-RING SEAL	0010012064
5	O-RING SEAL	0010012040
6	PLASTIC SEAL	0010038054
7	ANTIEXTR. RING	0140000013
8	PLASTIC SEAL	0010038056
8a	PLASTIC SEAL	0010038111
9	O-RING SEAL	0010012256
10	ROTARY DIST.	0140003007
10a	ROTARY DIST.	0140000007
11	BUSHING	0140000012
12	BRONZE DISC	0140000250
13	LOCATING PINS	0010020048
14	DIST. DRIVE PIN	SEE TAB 1
17	ZINC PLUG	0010023051
18	O-RING SEAL	0010012287
19	SPOOL	0142000013
20	CNTRG WASHER 1/4"	0010018094
21	VALVE SPRING	0142000011
22	SPACING PLUG	0142000014
23	SKTHD PLUG	0010023056
33	CARTRIDGE VS80N	0010039001
34	O-RING SEAL	0010012025
35	DIST. VALVE PLUG	0142000014
SEAL KIT #0140-D481-KA W/O STEEL RING		
SEAL KIT #0140-D481-KB W/ STEEL RING		
SEAL KIT #0140-D481A-KB W/ STEEL RING		

TAB. 1 - DRIVE PINS

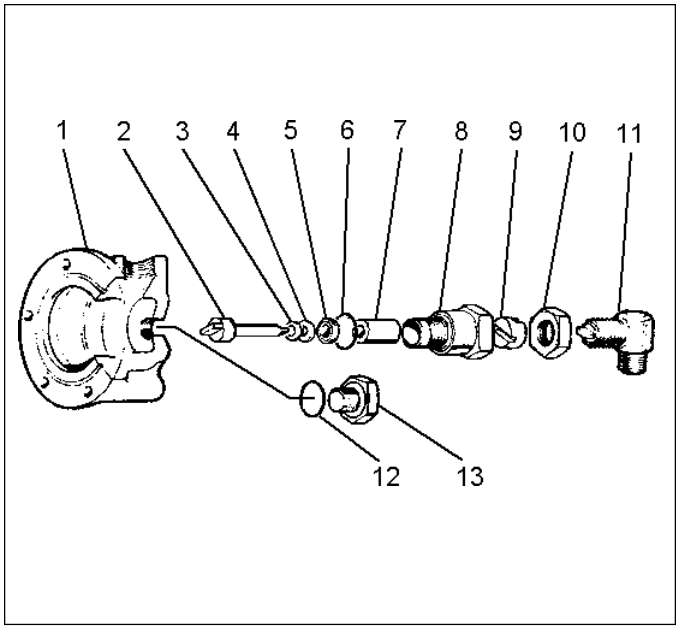
MOTOR TYPE	D3..., D4...				D90				D250	
	with WEARPLATE		without WEARPLATE		with WEARPLATE		without WEARPLATE		with WEARPLATE	
	DP#	PART #	DP#	PART #	DP#	PART #	DP#	PART #	DP#	PART #
M05-P05	**P3**	0106103109	**P25**	0164000109						
GM05	**P1**	0106102109	**P3**	0106103109						
M1-P1	**P1**	0106102109	**P3**	0106103109						
GM1	**P1**	0106102109	**P3**	0106103109						
GM1-G	**P26**	0155100109	**P24**	0155000109						
M2-P2	**P2**	0112103109	**P9**	0112100109						
GM2-G	**P7**	0115101109	**P11**	0112100109						
M3	**P2**	0112103109	**P9**	0112100109						
GM3	**P33**	0153100109	**P14**	0192000009	**P29**	0153102109				
M4	**P7**	0115101109	**P11**	0115100109	**P14**	0192000009				
GM4	**P14**	0192000009	**P36**	0154100109	**P37**	0154101109				
M5	**P7**	0115101109	**P11**	0115100109	**P14**	0192000009				
M5 (D43)	**P12**	0115110109								
GM5	**P30**	0185100109	**P38**	0156103109	**P6**	0190000009				
L1	**P26**	0155100109	**P24**	0155000109						
L1 OLIO	**P2**	0115100109	**P9**	0112100109						
L2	**P2**	0112103109	**P9**	0112100109						
L3	**P2**	0112103109	**P9**	0112100109						
L5	**P7**	0115101109	**P11**	0115100109	**P14**	0192000009				
P6					**P30**	0185100109	**P29**	0185101109	**P31**	0185000109
GM6					**P27**	0190100109			**P41**	0185104109
L7A					**P6**	0190000109	**P16**	0190000109		
L7B					**P27**	0190100109	**P30**	0185100109	**P28**	0190101109
S7B									**P32**	0195100109
S7B RAPP									**P35**	0190102109
L9									**P40**	0195000109

TAB. 2 - DRIVE PINS - Dimensions in mm

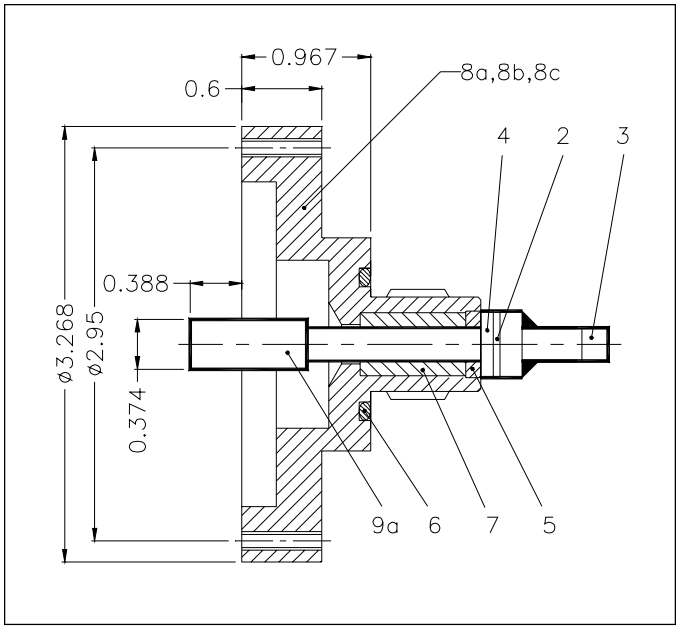
DP#	PART #	A	L	B	DP#	PART #	A	L	B	DP#	PART #	A	L	B
P1	0106103109	10	50	8	**P14**	0192000009	10	64	10	**P33**	0153100109	10	71	10
P2	0112103109	10	54	10	**P15**	0193000009	10	56	10	**P34**	0185101109	10	100	10
P3	0106103109	10	43	8	**P16**	0190000109	10	80	10	**P35**	0190102109	10	119.5	15
P4	0190100109	10	45	10	**P17**	0106100109	10	43	8	**P36**	0154100109	10	57	10
P5	0192000109	10	72.5	10	**P24**	0185000109	10	47	8	**P37**	0154101109	10	69	10
P6	0190000009	10	90	10	**P25**	0164000109	10	38	10	**P38**	0156103109	10	78	10
P7	0115101109	10	59	10	**P26**	0155100109	10	54	8	**P39**				
P8	0112102109	10	58	8	**P27**	0190100109	10	95	10	**P40**	0195000109	15	141	15
P9	0112100109	10	47	10	**P28**	0190101109	10	107	15	**P41**	0185104109	10	95	15
P10	0112101109	10	62	10	**P29**	0153102109	10	76	10	**P42**				
P11	0115100109	10	52	10	**P30**	0185100109	10	85	10	**P43**				
P12	0115110109	10	67	10	**P31**	0185000109	10	98	15	**P44**				
P13	0191000009	10	45	8	**P32**	0195100109	15	112.5	15	**P45**				



MECHANICAL TACHOMETERS



JB2, JB3,JB4 TACH DRIVE MOUNT



TAB. 1

#	DESCRIPTION	PART #
1	DISTRIBUTOR COVER	SEE TAB. 2
2	TACH DRIVE PIN	SEE TAB. 2
3	VESPEL SPACER	0106100126
4	HARDER WASHER	0106100127
5	RING SEAL	0010012001
6	O-RING SEAL	0010012171
7	BUSHING	0106100129
8	TACH SUPPORT	0112100225
8a	TACH SUPPORT JB2	0112100725
8b	TACH SUPPORT JB3	0112100825
8c	TACH SUPPORT JB4	0112100925
9	COUPLING	0106100130
9a	COUPLING	0106100730
10	NUT	0010008010
11	ANGLE GEAR	0010005001
12	O-RING SEAL	0010012171
13	PLUG	0106100122

TAB. 2

DISTR.	COVER	TACH DRIVE PIN	SUB ASSEMBLY
D250	0135102103	0135001128	0135102183
D30	N/A	N/A	N/A
D31	0140031403	0131000128	0140031483
D310	0140031103	0131000128	0140031183
D311	N/A	0131000128	N/A
D312	N/A	0131000128	N/A
D313	0140131703	0131000128	0140131783
D314	N/A	0131000128	N/A
D315	0140141003	0131000128	0140141083
D316	0140131303	0131000128	N/A
D317	0140131603	0131000128	0140131683
D318	N/A	0131000128	N/A
D36	N/A	0131000128	N/A
D37	0140037403	0131000128	0140037483
D40	0140004003	0140000128	0140004083
D47	0140047103	0140000128	0140047183
D48A	N/A	0142000128	N/A
D481A	N/A	0142000128	N/A
D49	0140049103	0142000128	0140049183
D491	0140049503	0142000128	0140049583
D90	0190000103	0190000128	0190000183

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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.

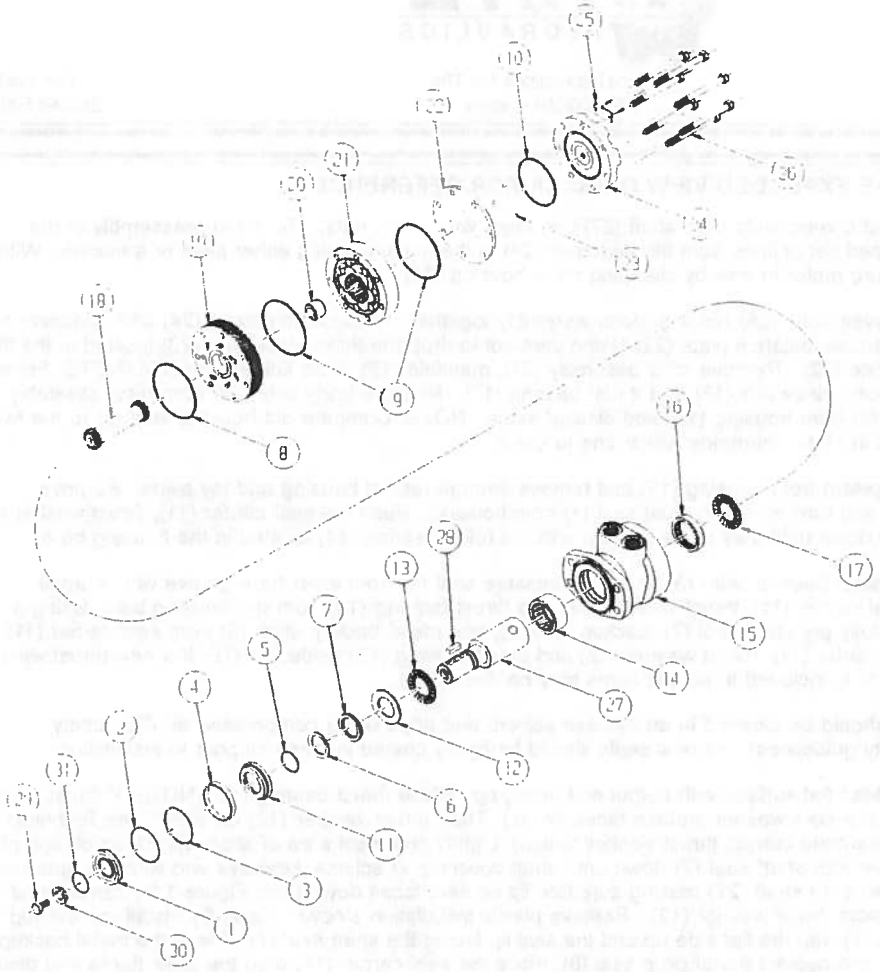
G) With pilot side facing up, place housing (15) on spacers to raise housing approximately .250 above work surface (NOTE: Spacers should allow shaft to contact work surface). Place shaft/seal carrier assembly into housing (15). Install high pressure seal (4) into groove in housing. Install metal backup 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

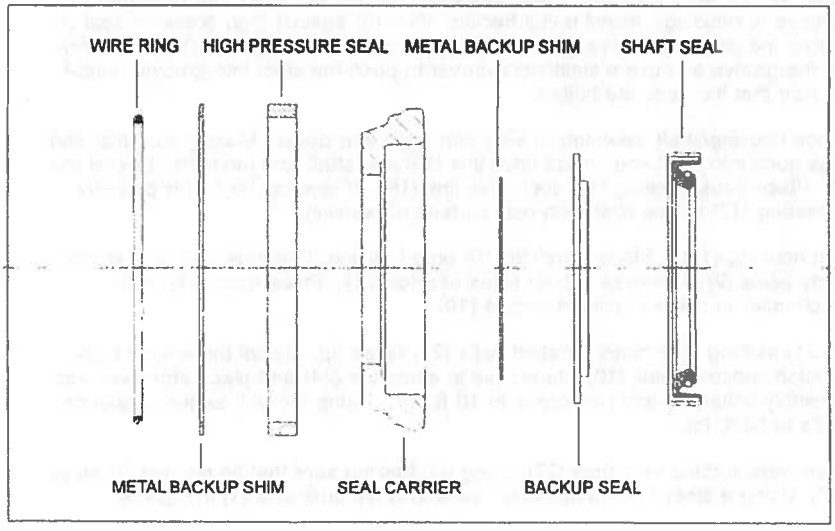


FIGURE 1

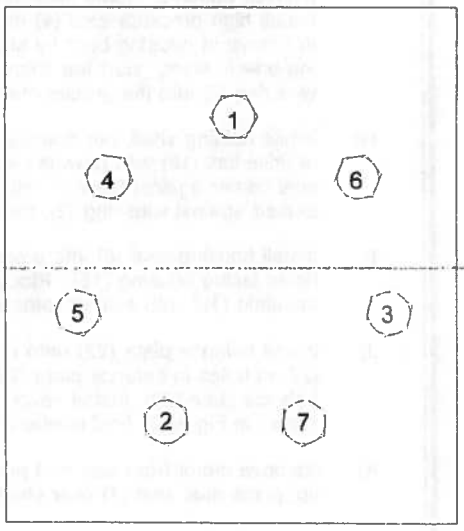
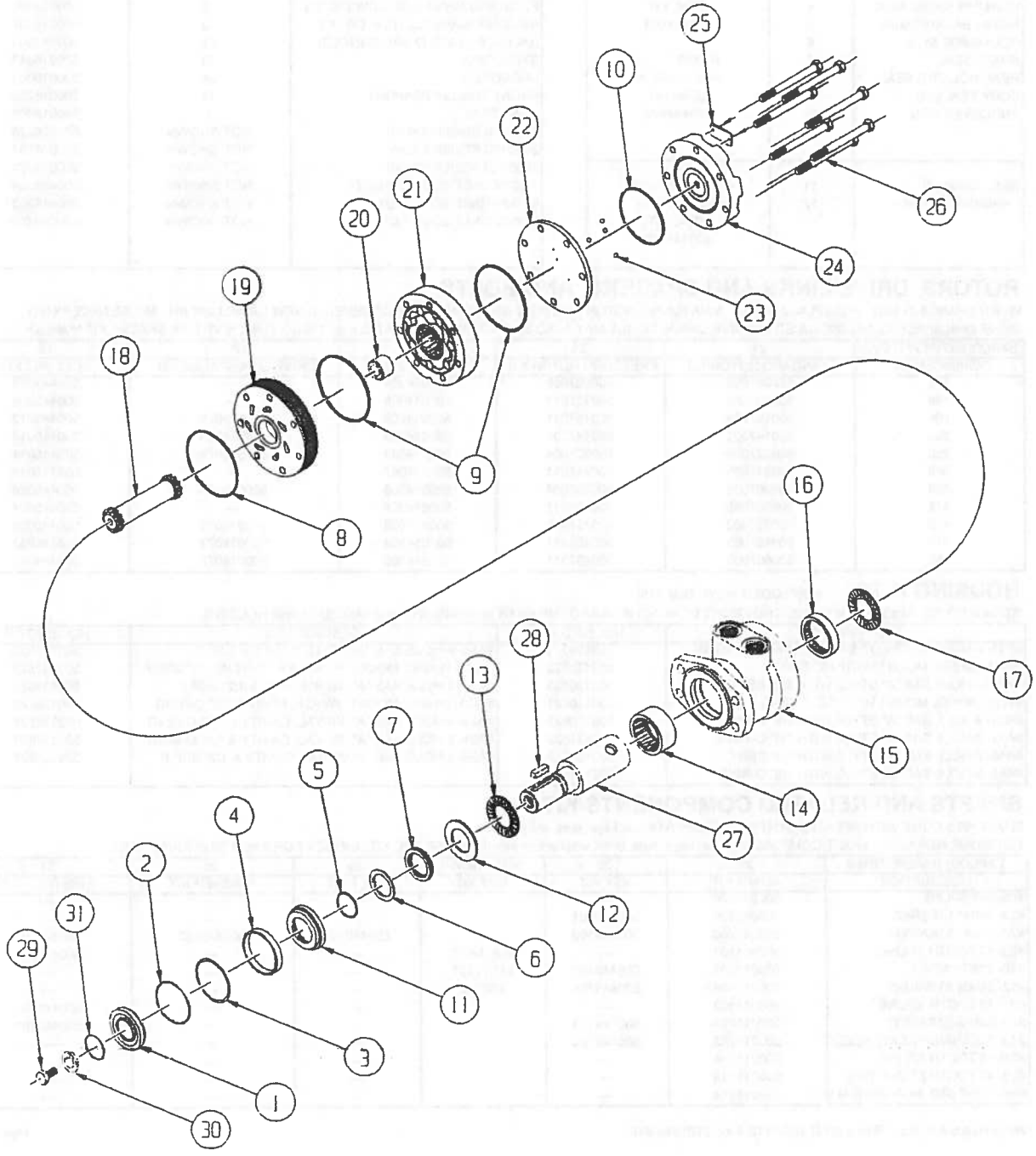


FIGURE 2

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.

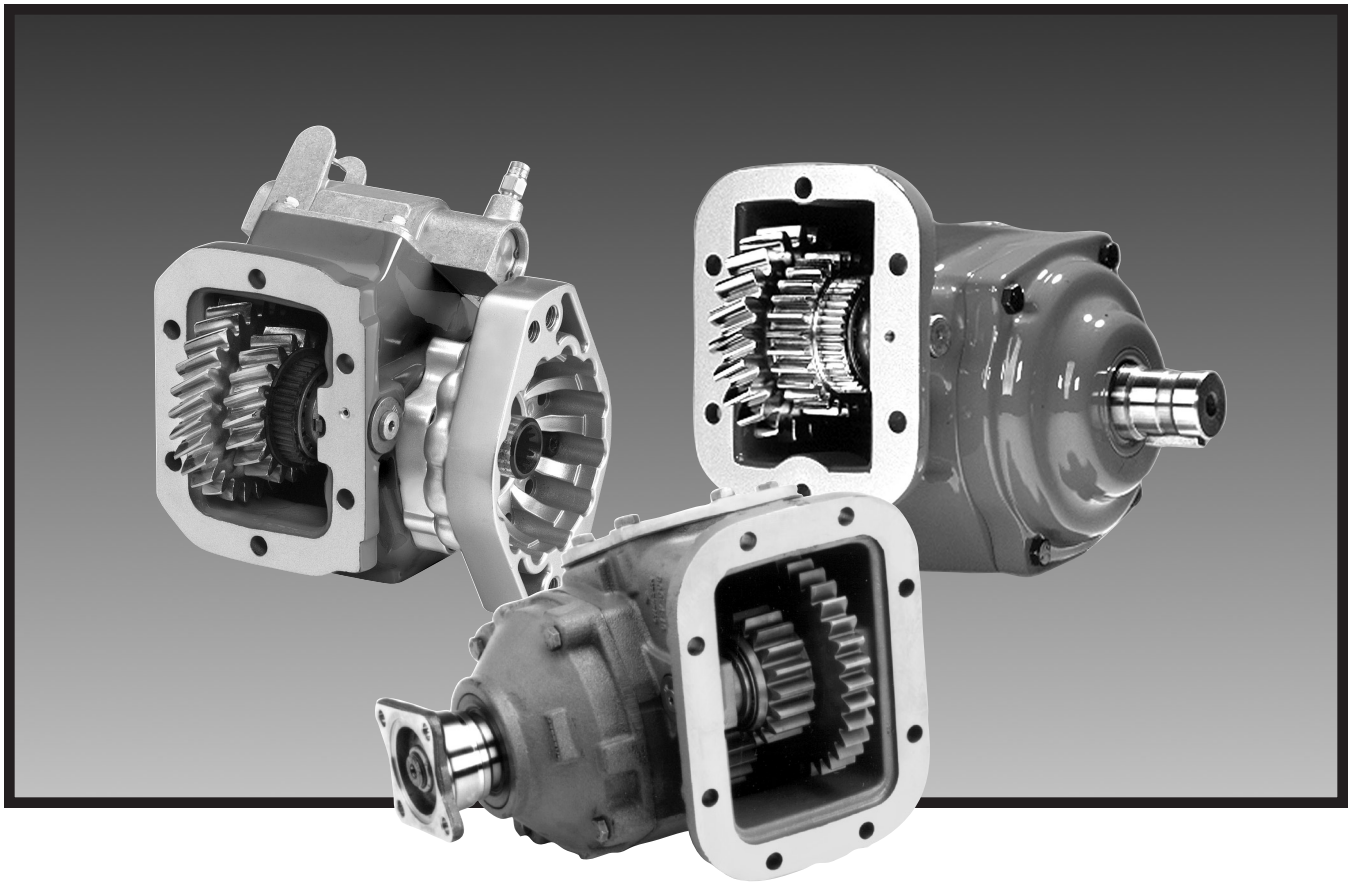
EXPLODED VIEW ITEM #	27	28	NOT SHOWN	29	30	31
DESCRIPTION	SHAFT KIT	KEY KIT	NUT KIT	BOLT KIT	WASHER KIT	WIRE RING KIT
#02- 6-B SPLINE	500011600	—		—	—	—
#22- 1-1/4" TAPERED	500011300	500449101		—	—	—
#20- 1-1/4" STRAIGHT	500011200	500449102		500449301	500449302	500449201
#23- 14 TOOTH SPLINE	500011101	—	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	—		—	—	—

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

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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.

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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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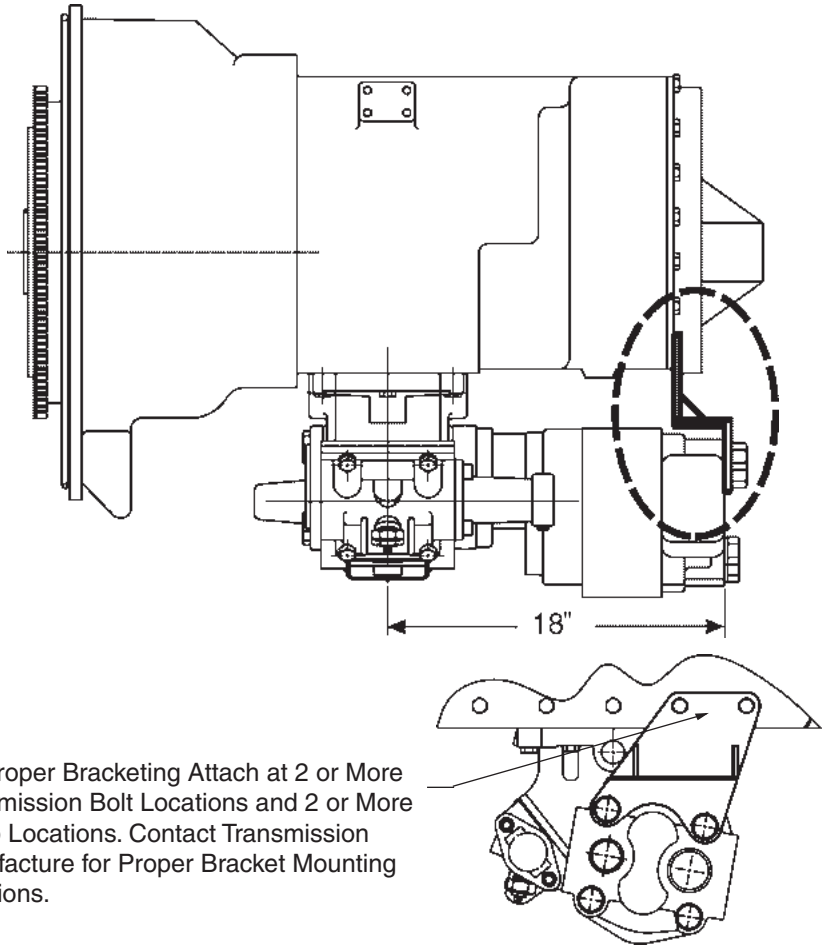
Direct Mount Pump Support Recommendations



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

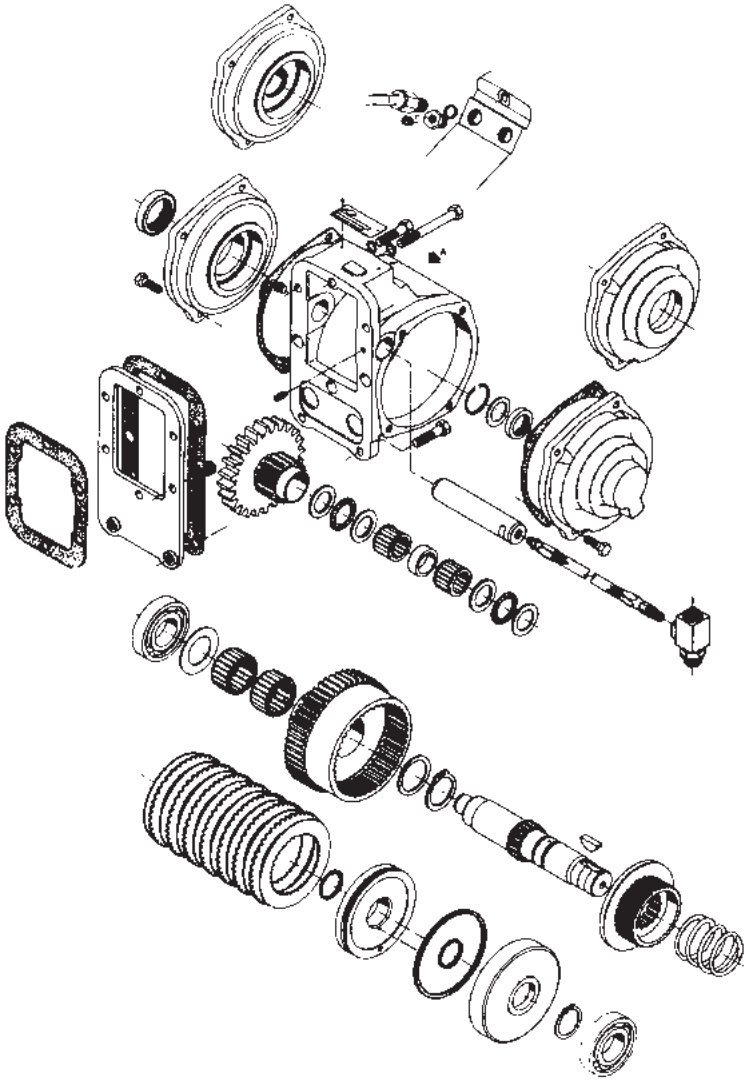
Foreword

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.

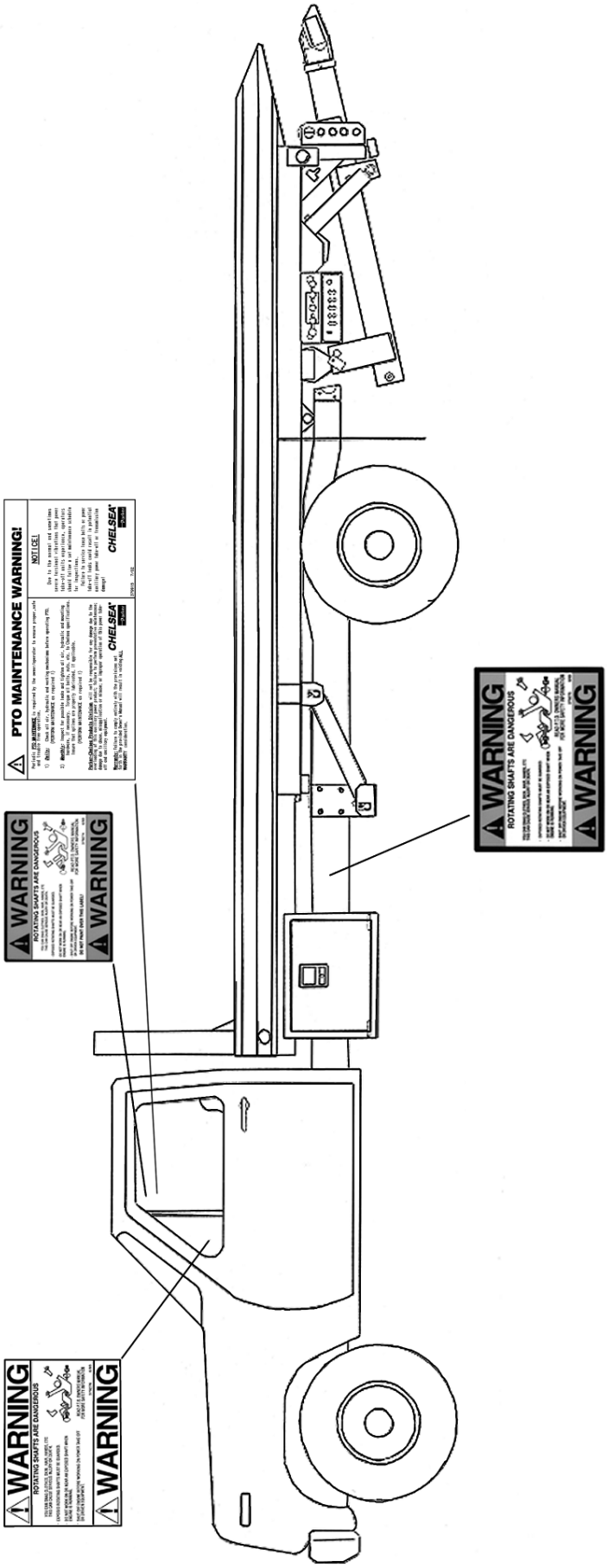
2. Place the one (1) black and orange on white 3.5" x 5" pressure sensitive vinyl label, part number 379275, on the visor nearest the operator of the vehicle, this must be placed near the P.T.O. visor label.

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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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

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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**).

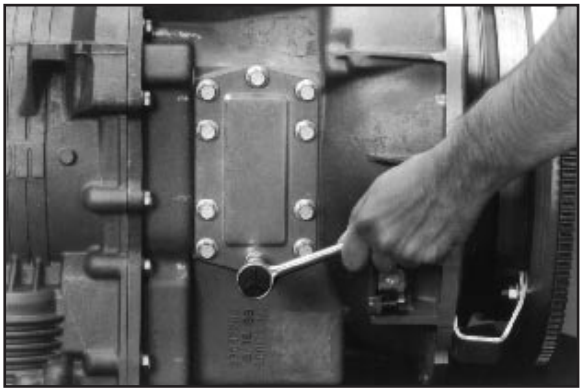
Fig. 2

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

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

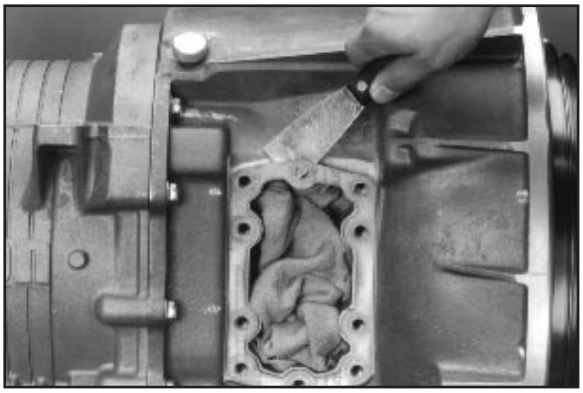
Fig. 3

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.

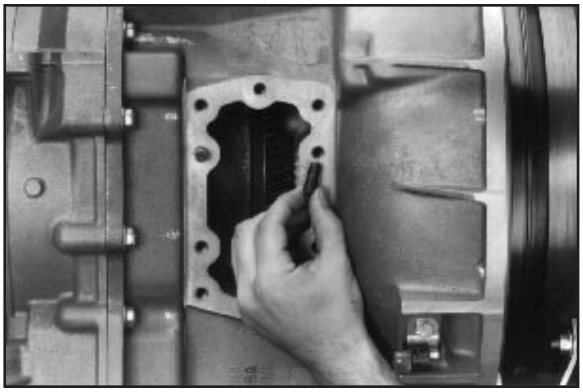
Fig. 4

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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.

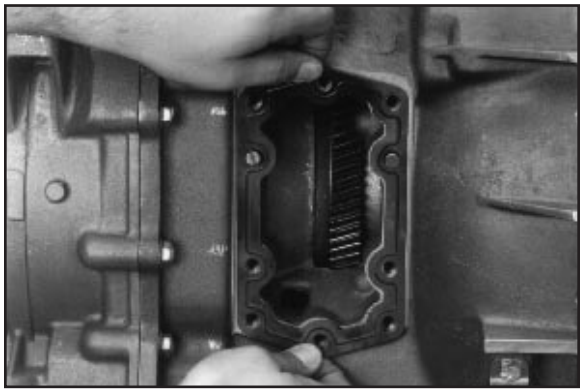

Fig. 5

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

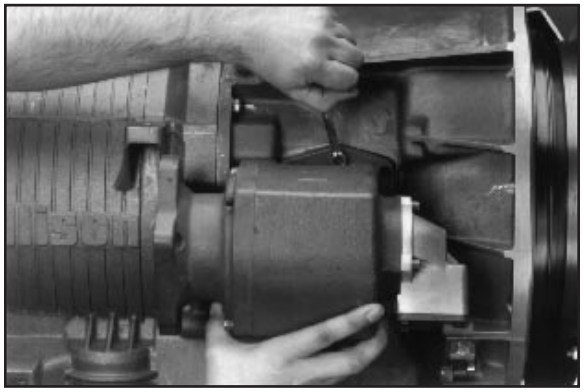

Fig. 6

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**).

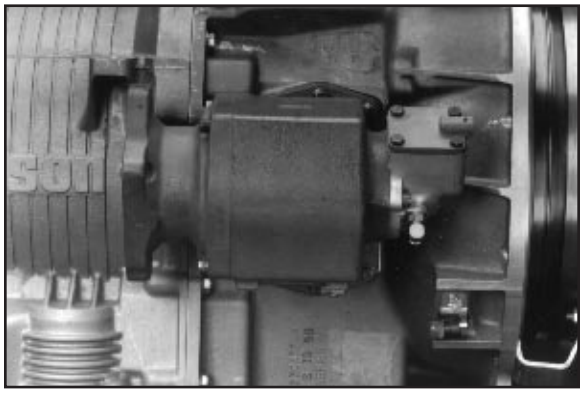

Fig. 7

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

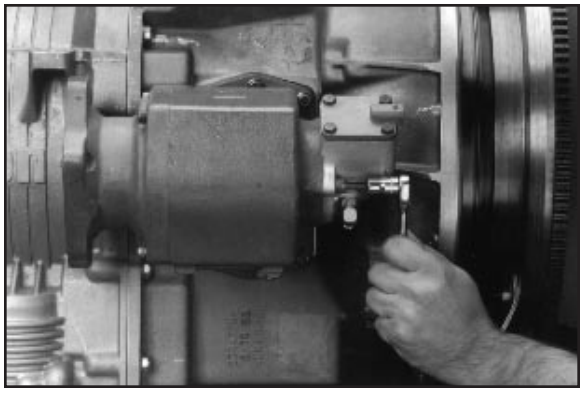

Fig. 8

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**).

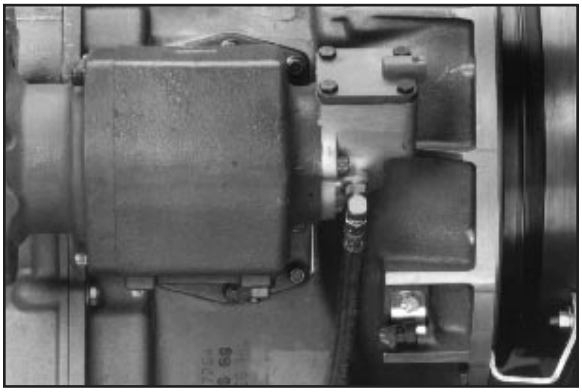

Fig. 10

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.

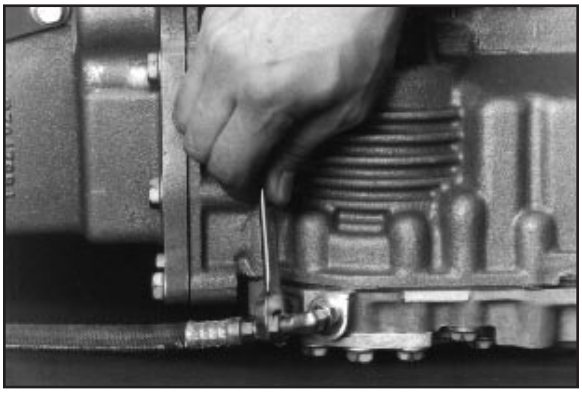

Fig. 11 (Left side)

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

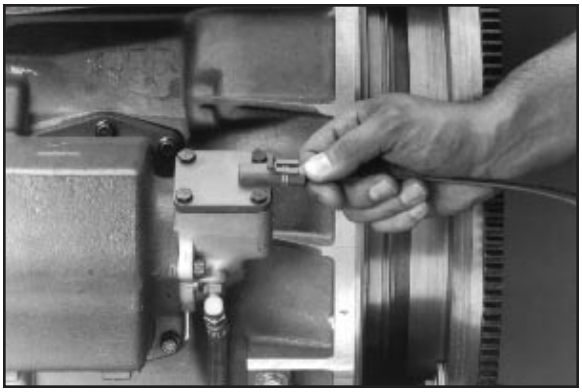

Fig. 12

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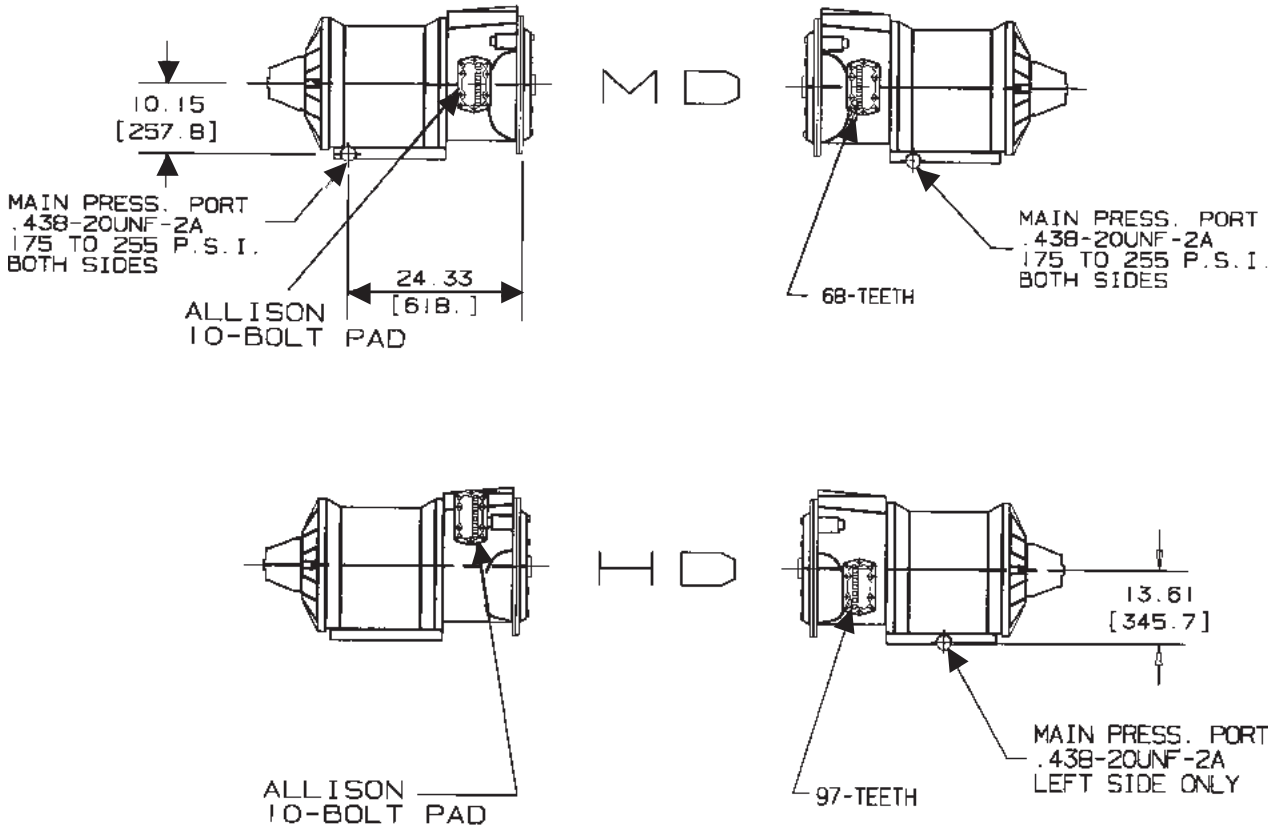
Pressure Port and Aperture Opening Identification

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

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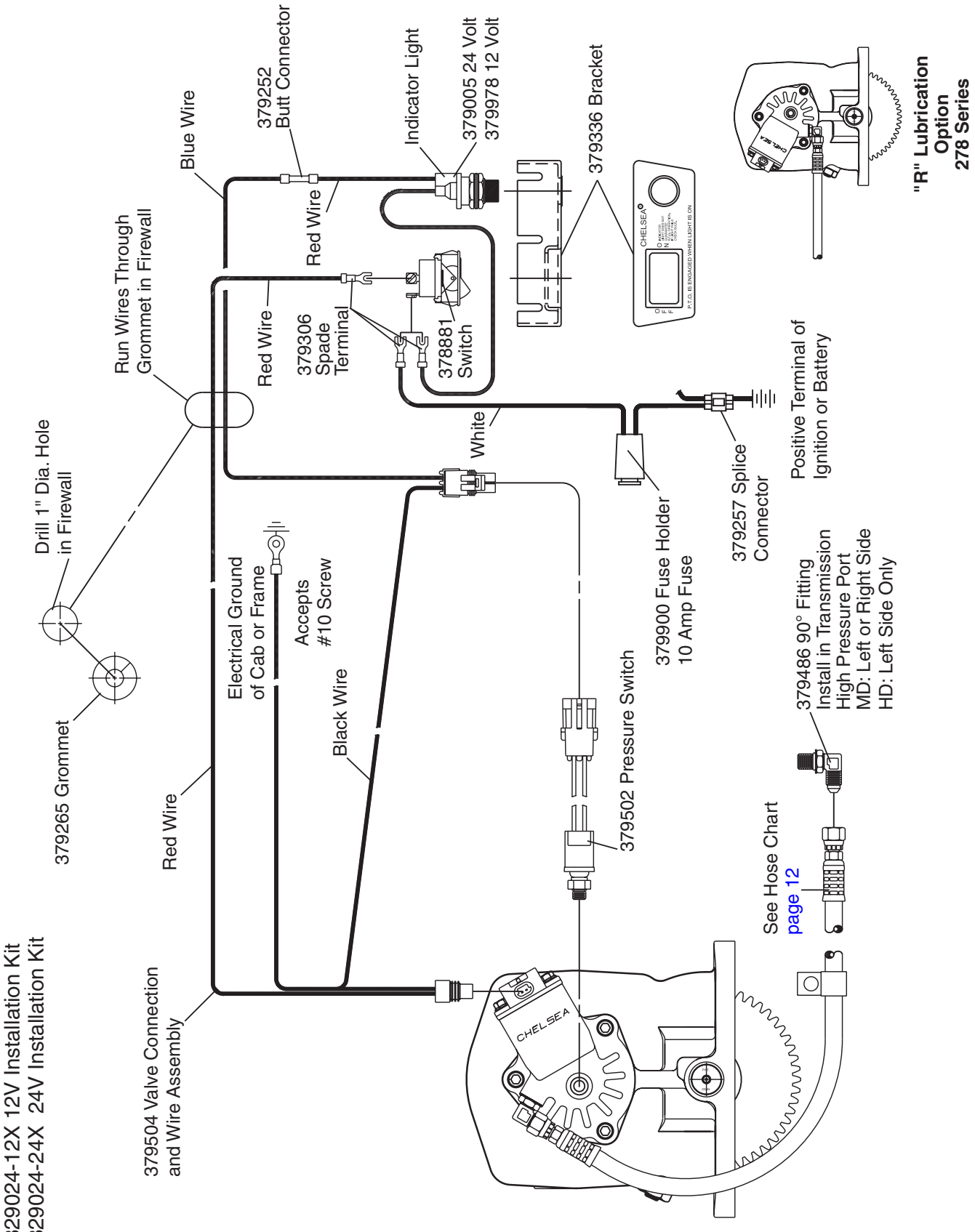
Shift Installation Kit 277, 278 & 859 Series without Electronic Overspeed Control (SK-347 Rev C) (Old Style)



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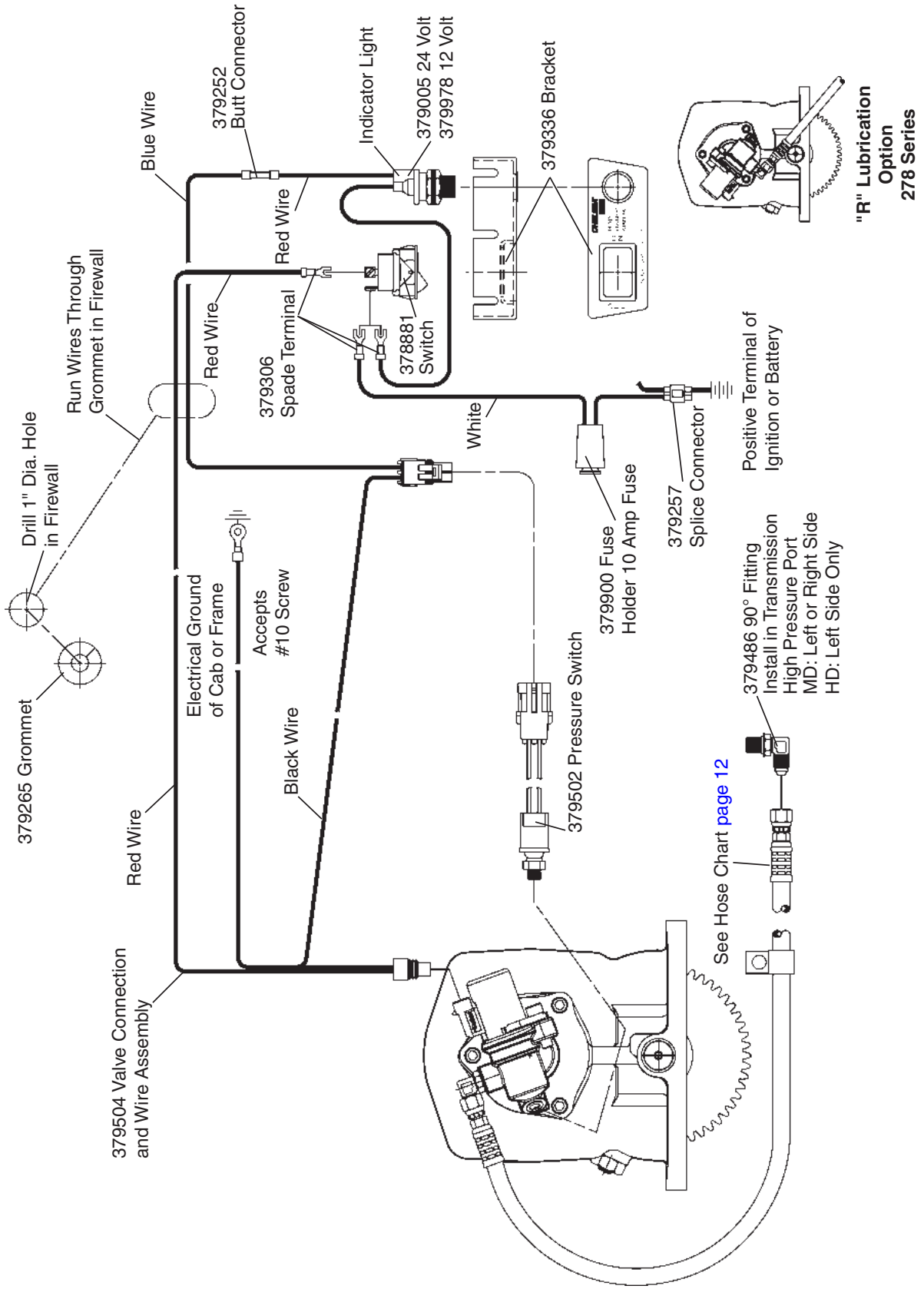
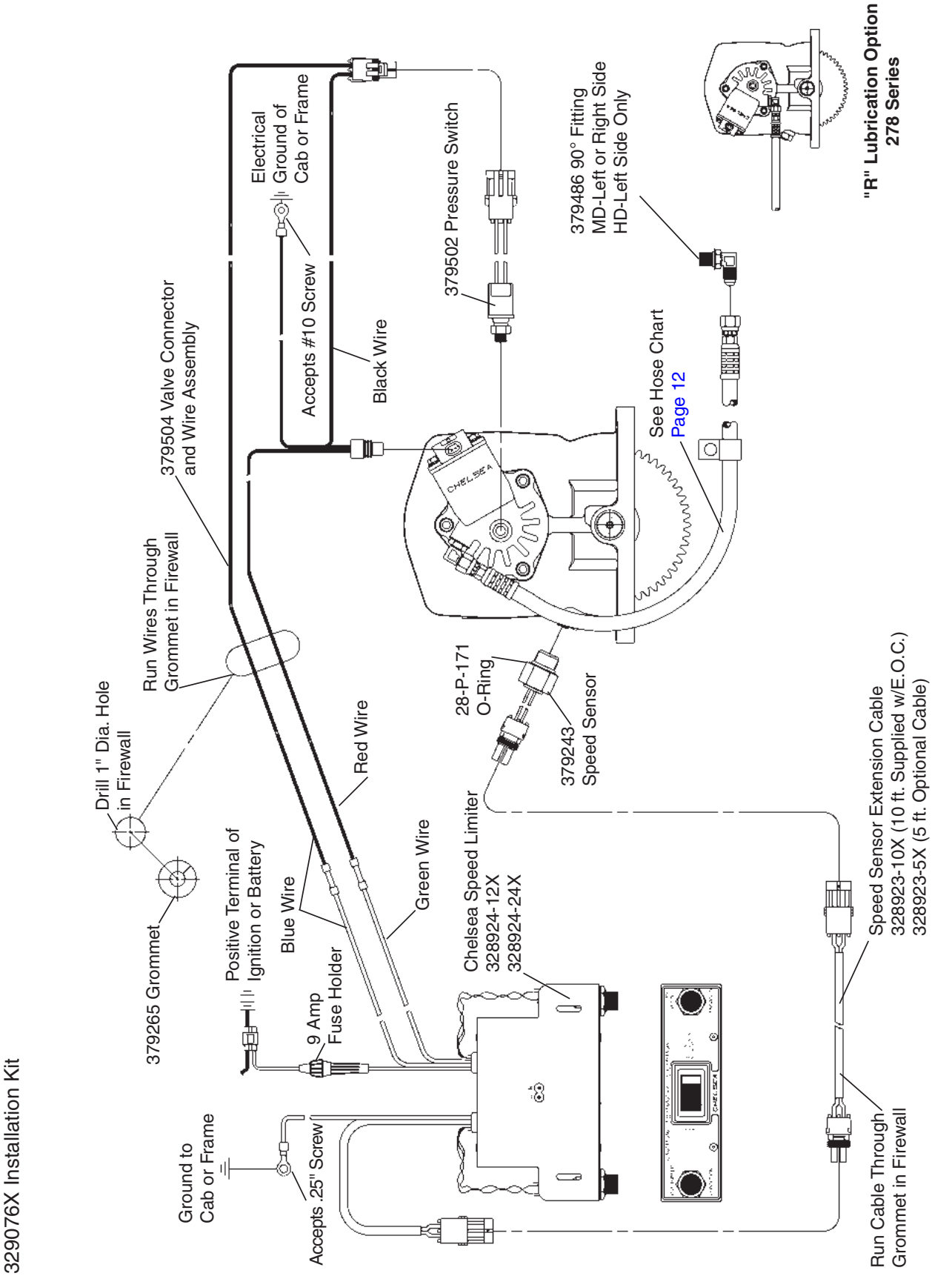
Shift Installation Kit 277, 278 & 859 Series without Electronic Overspeed Control (SK-347 Rev D) (New Style)



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

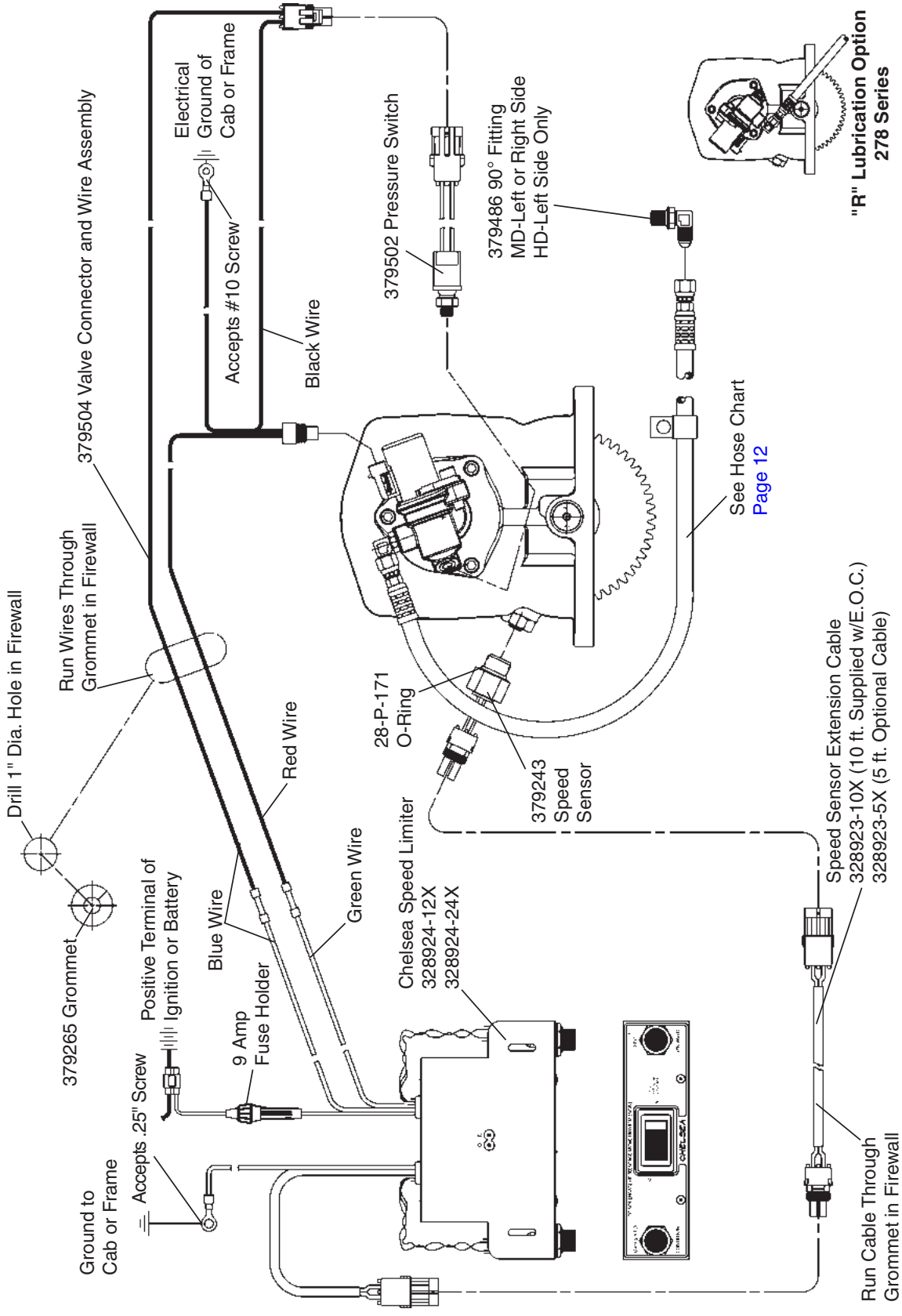
Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

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



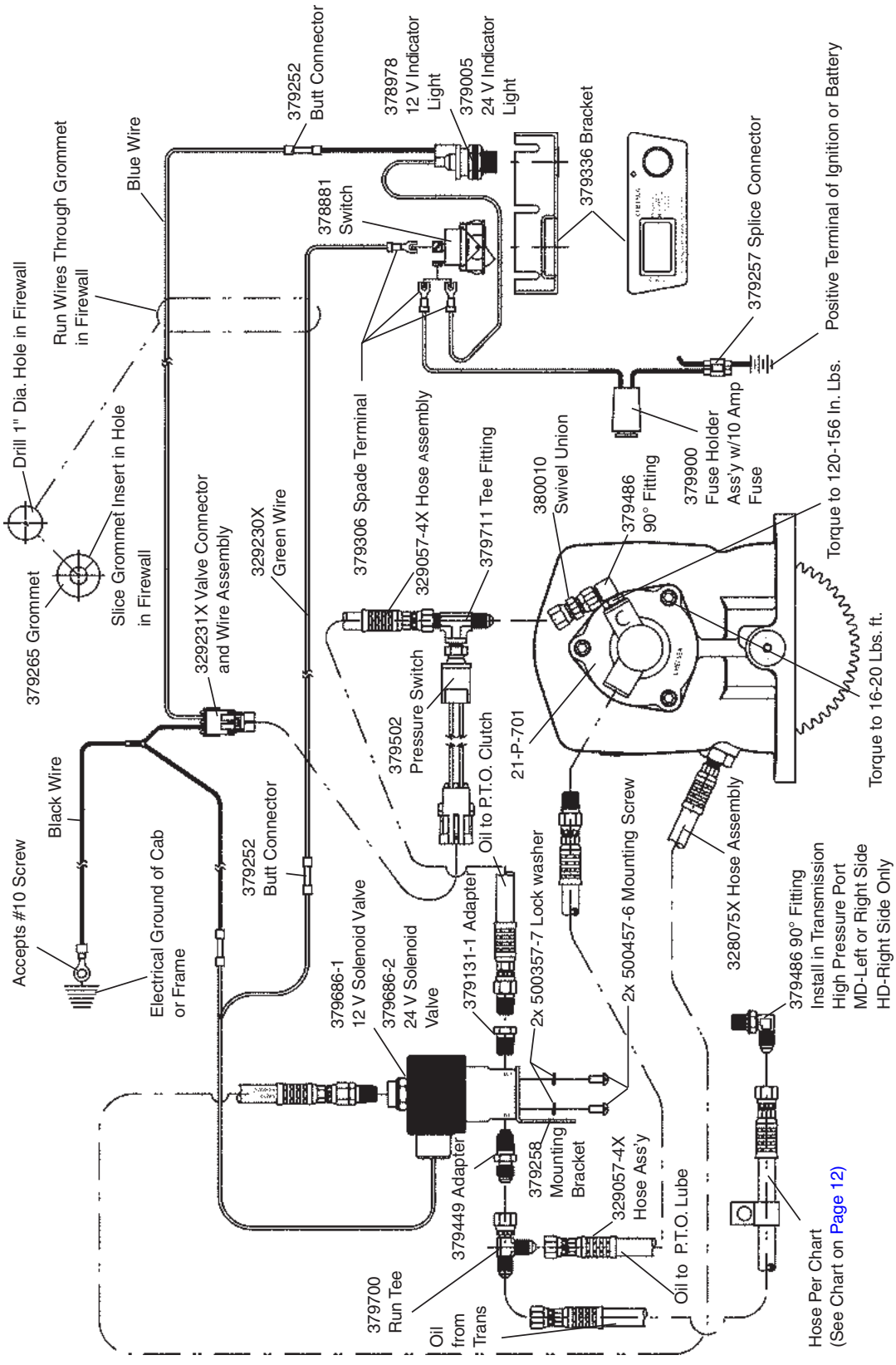
Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

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



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

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

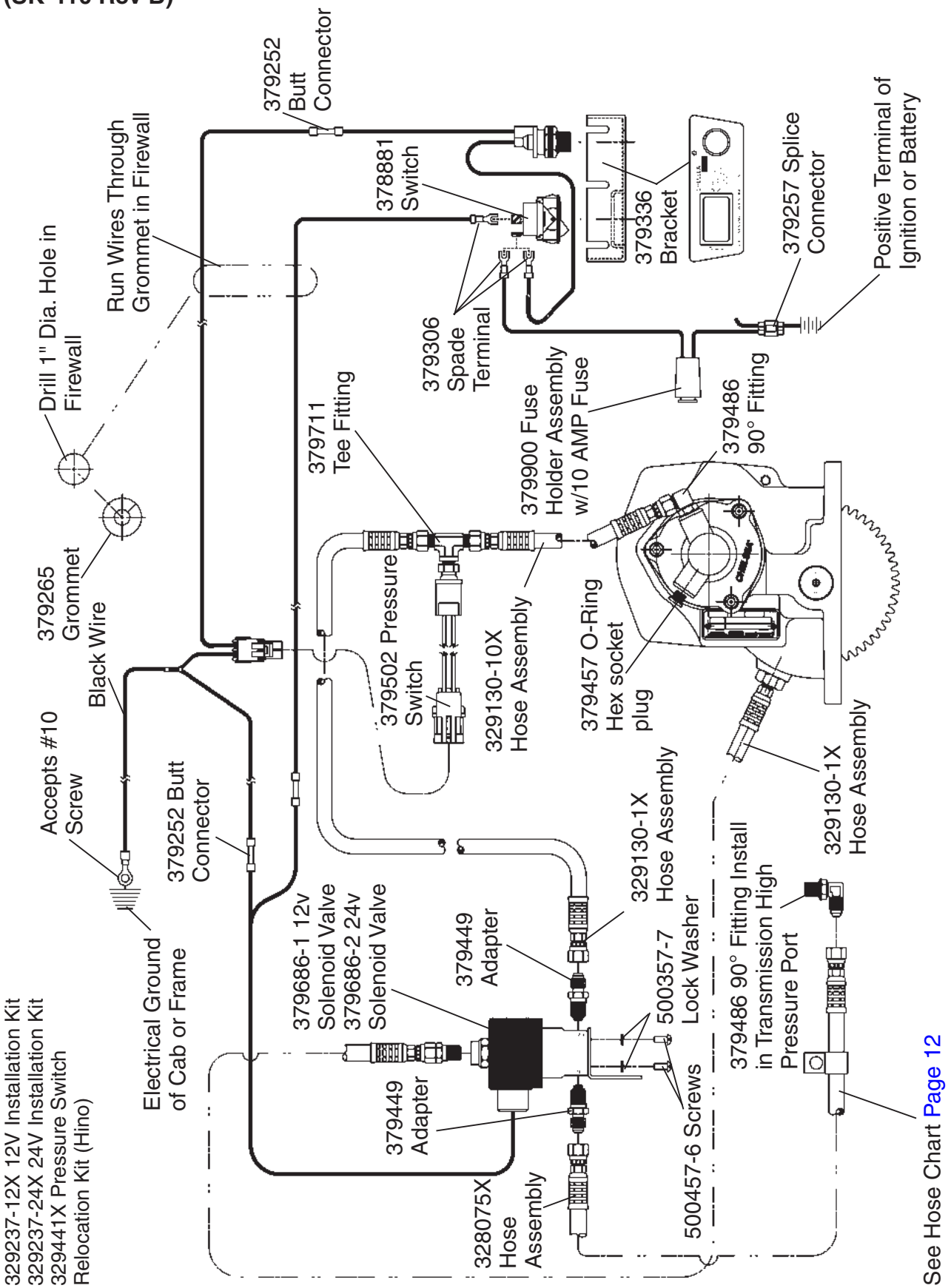


329237-12X 12V Installation Kit
329237-24X 24V Installation Kit

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

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

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



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

GMT C Series Trucks

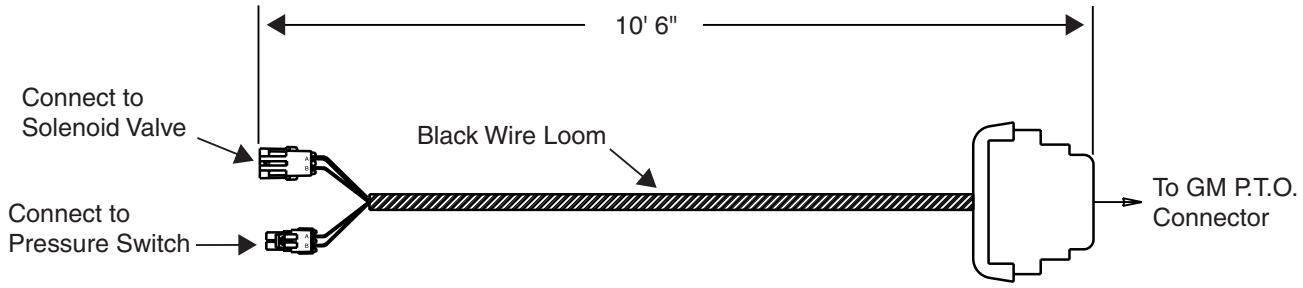
For model year 2003 GM C Series 4500, 5500, 6500, 7500 and 8500 trucks may be equipped with the Allison World (MD) transmission. In these vehicles GM Truck has integrated a P.T.O. connector, located in the right hand engine compartment area. A Power Take-Off switch has also been incorporated into the 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.

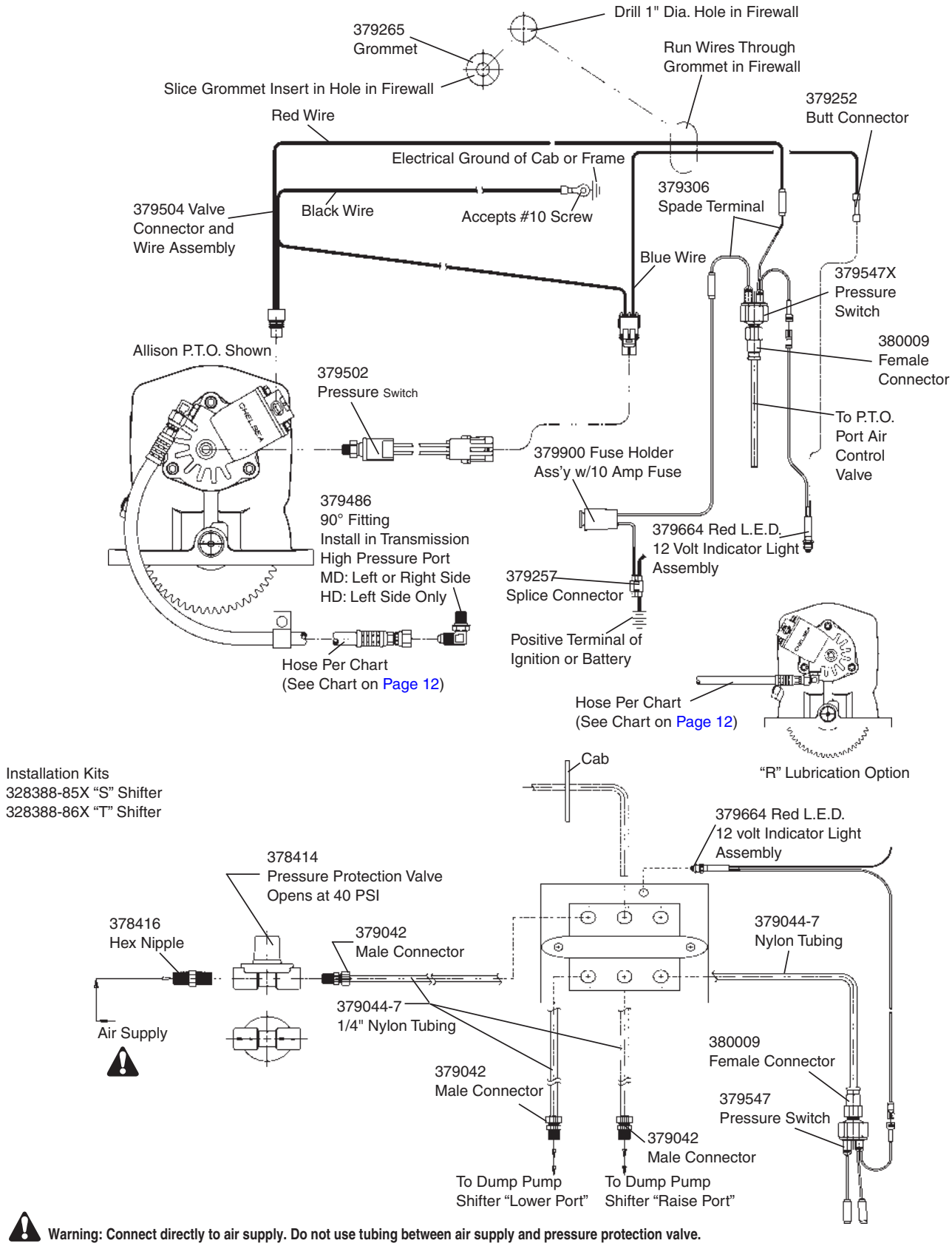
See wiring harness part number 379926 for the 277, 278 and 859 Series Power Take-Offs.

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



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

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

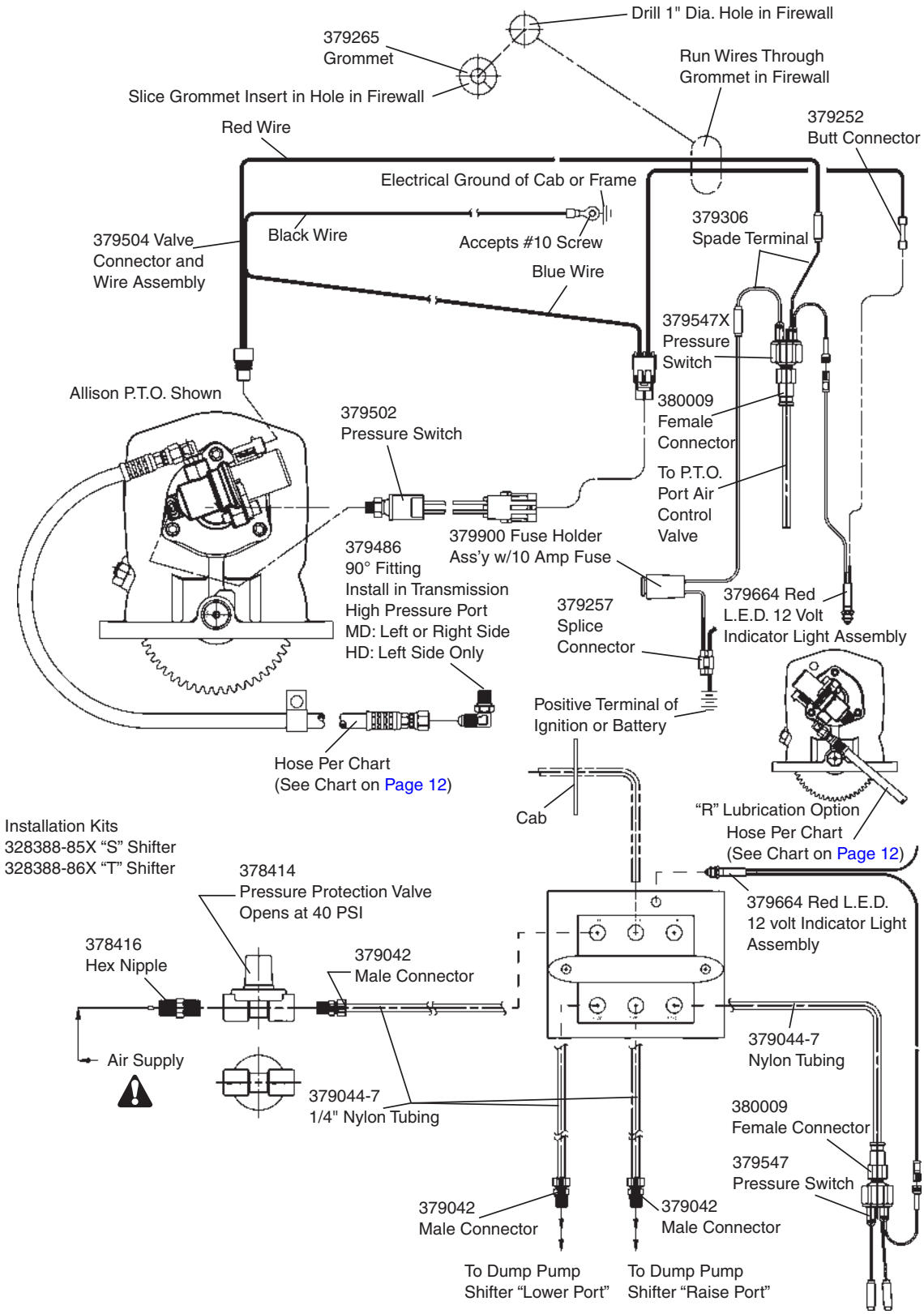


Warning: Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.

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**).

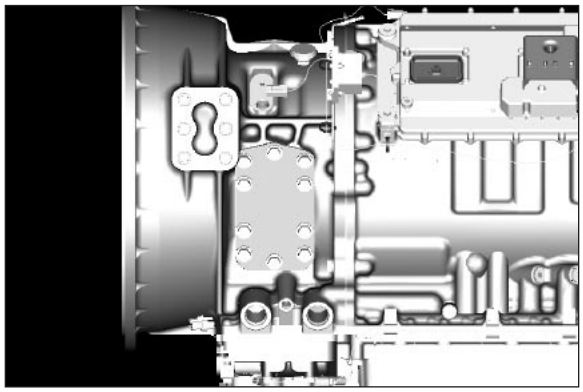


Fig. 1

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

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

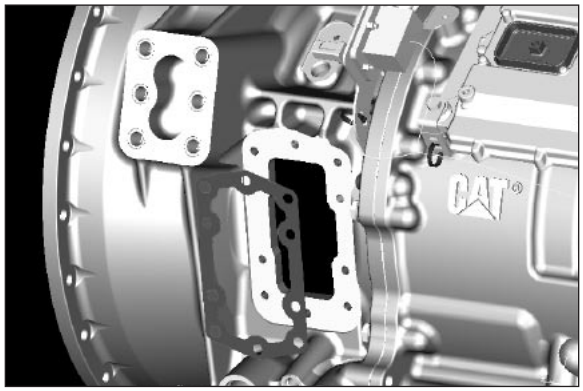


Fig. 2

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.

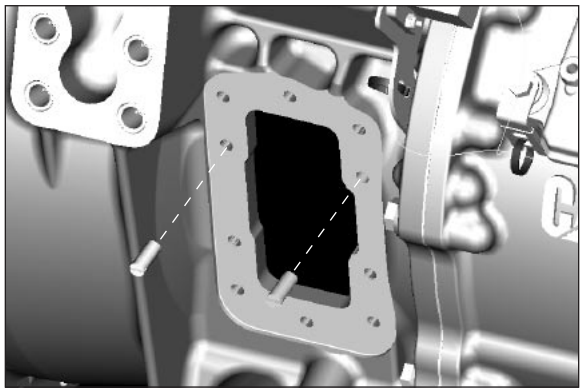


Fig. 3

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.

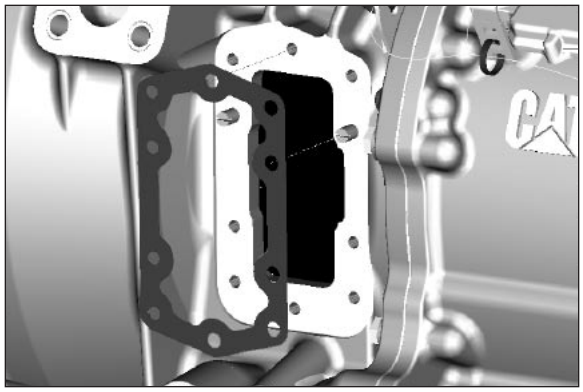


Fig. 4

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Chelsea Products Division
Olive Branch, MS 38654 USA

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

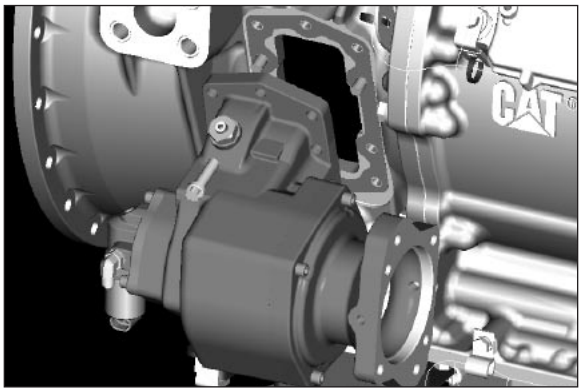


Fig. 5

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

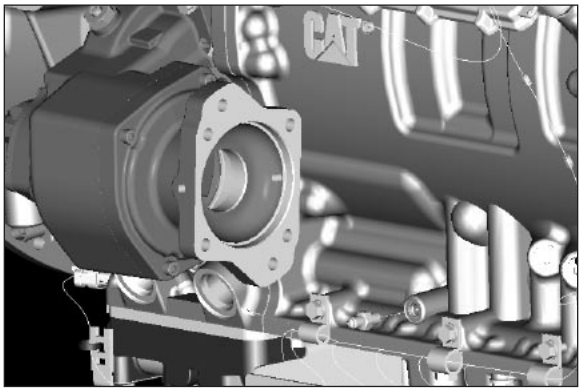


Fig. 6

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**).

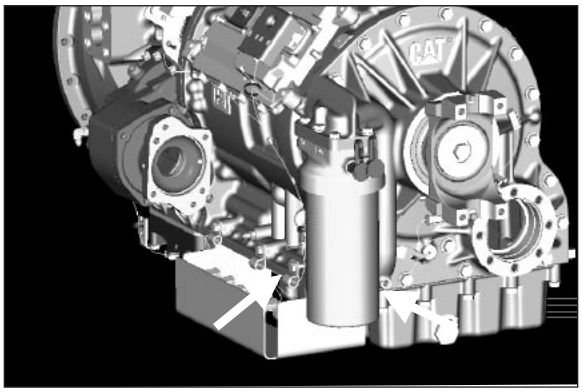


Fig. 7

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

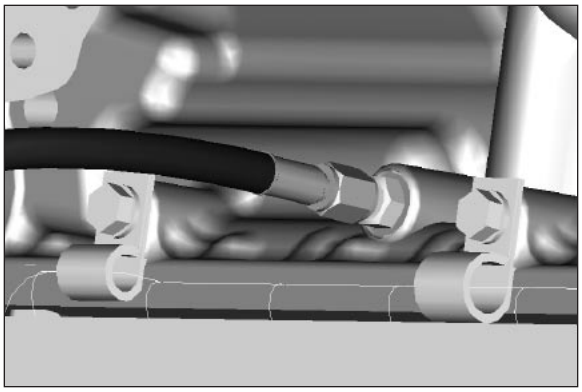


Fig. 8

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**).

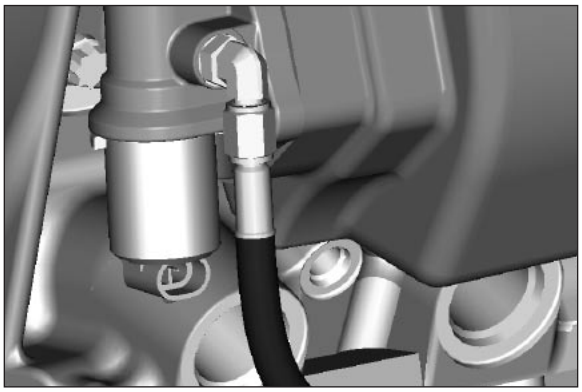


Fig. 9

9. Complete the assembly by installing the electrical connection (**Fig. 10**).

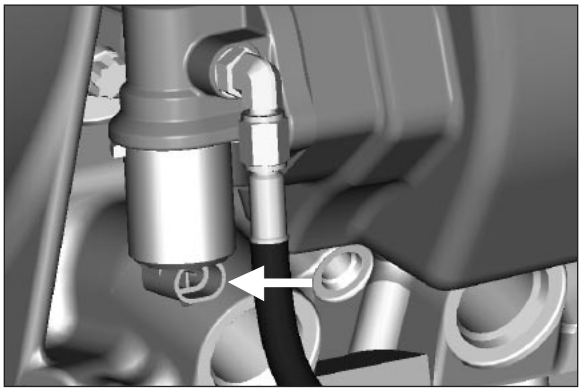
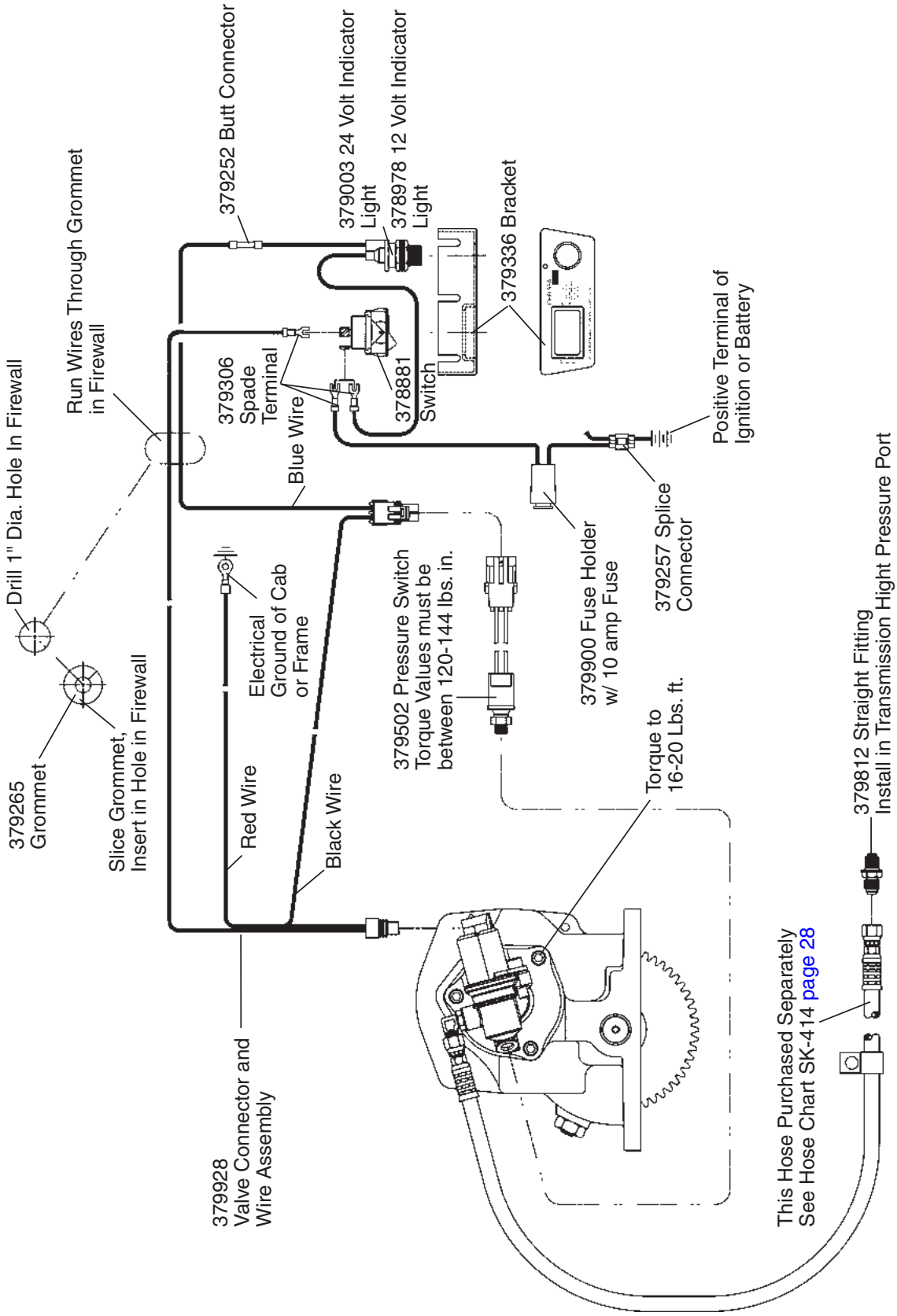


Fig. 10

NOTE: See page 25-27 for electrical connection drawings.

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

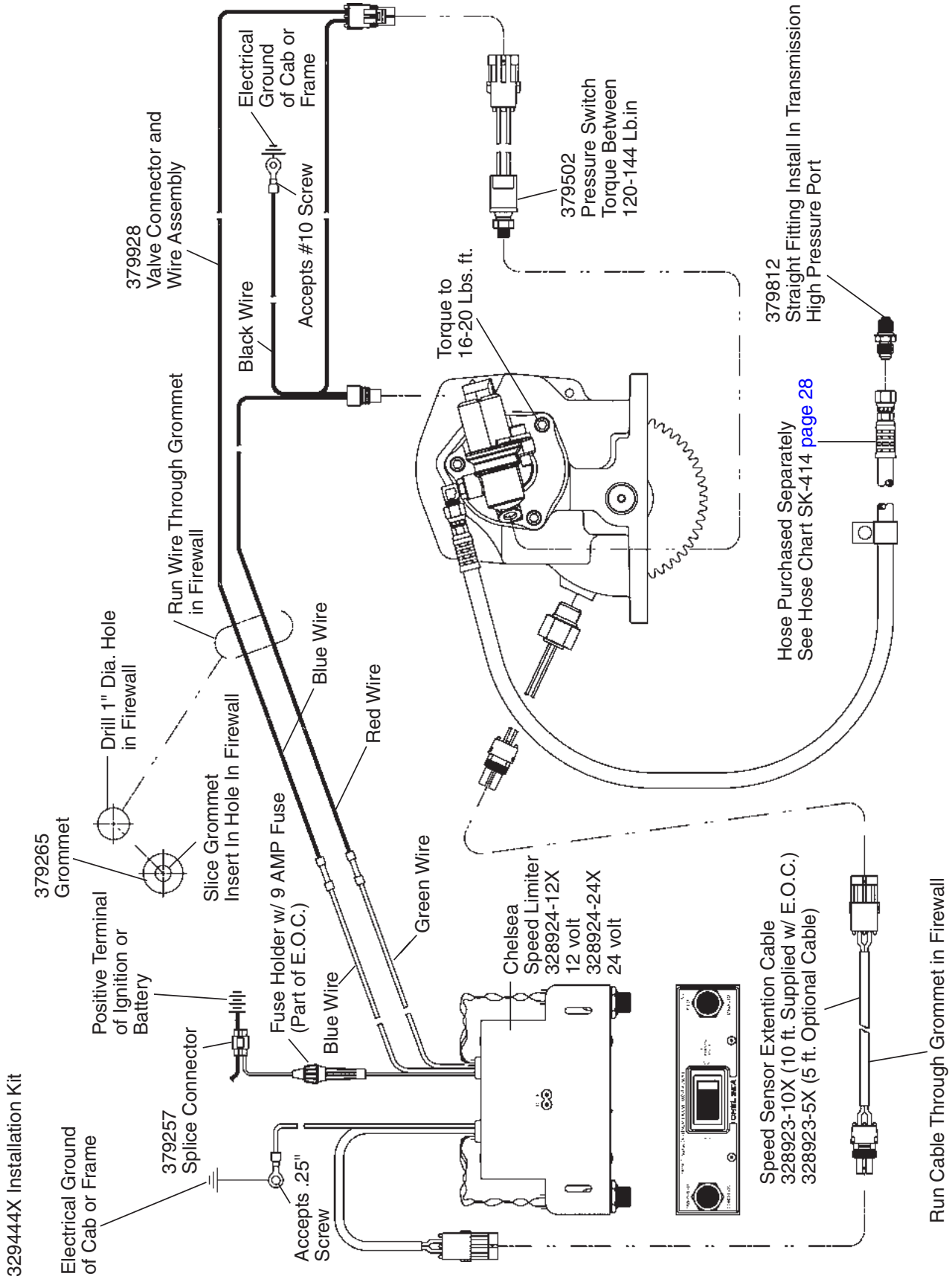
Shift Installation Kit 277, 278 and 859 Series Without Electronic Overspeed Control (SK-411 Rev A)



329443-12X - For 12V Installation Kit
329443-24X - For 24V Installation Kit

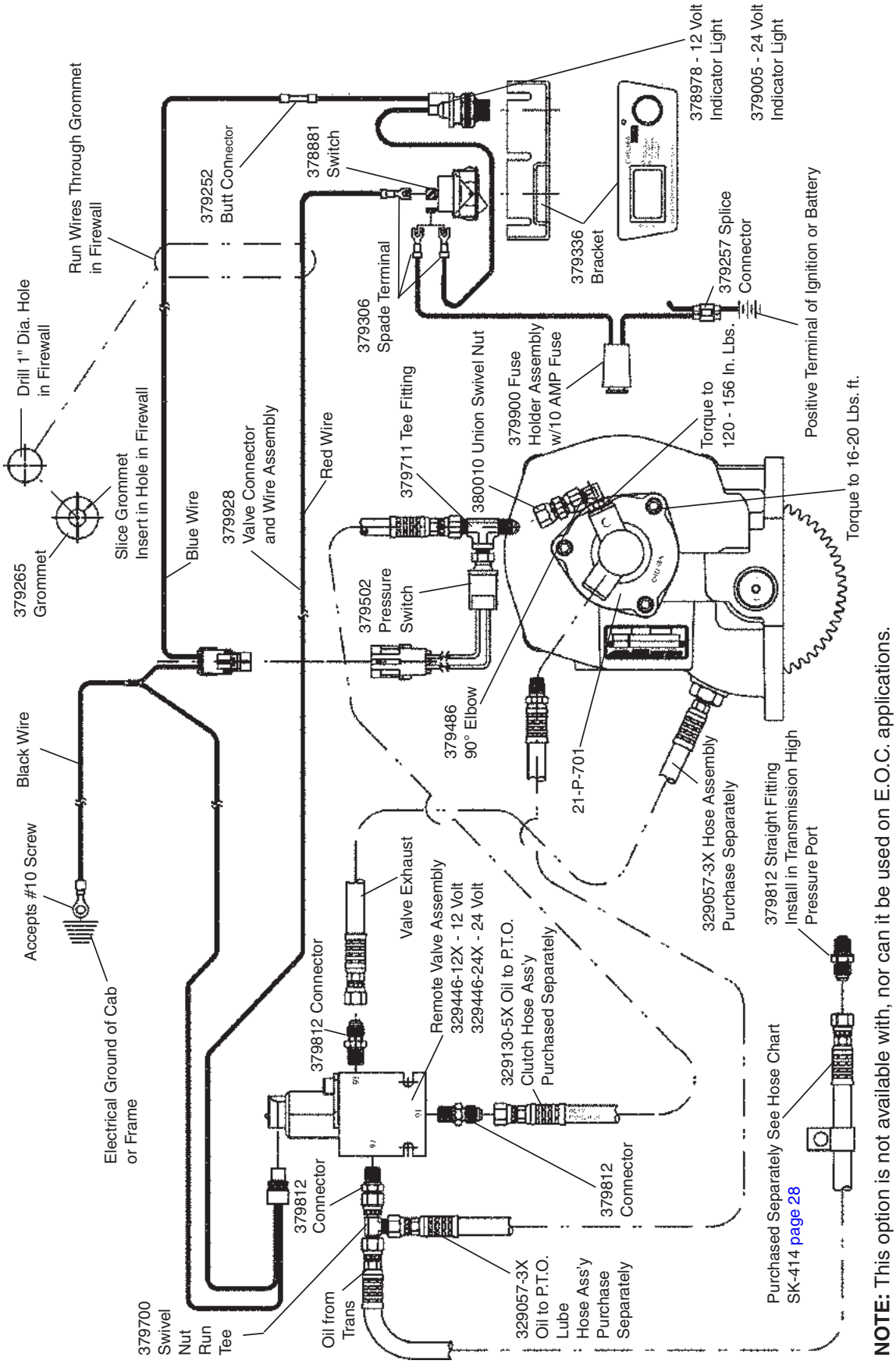
Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

Electronic Overspeed Control Installation Sketch for 277, 278 and 859 Series (SK-412 Rev A)



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

Remote Mount Installation Sketch for 277, 278 and 859 (SK-413 Rev C)

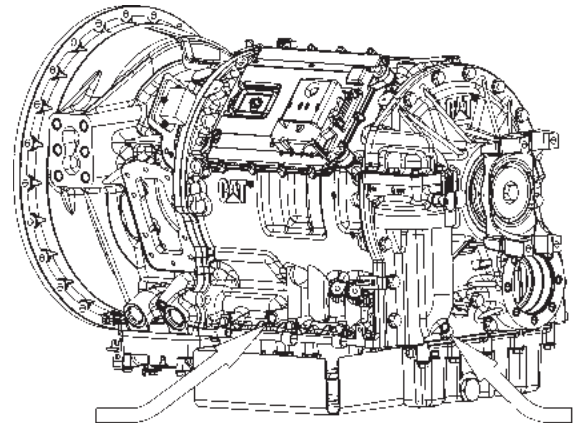


NOTE: This option is not available with, nor can it be used on E.O.C. applications.

329445-12X 12V Installation Kit
329445-24X 24V Installation Kit

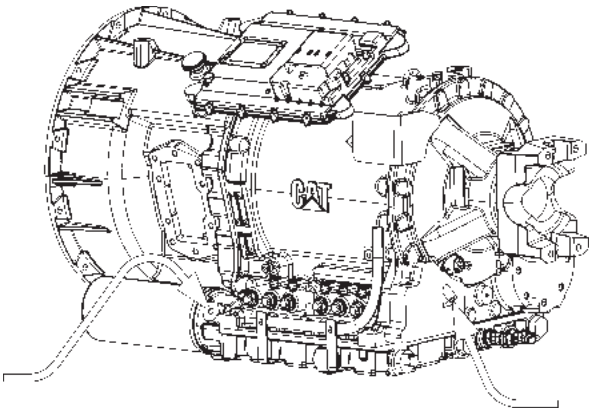
Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

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

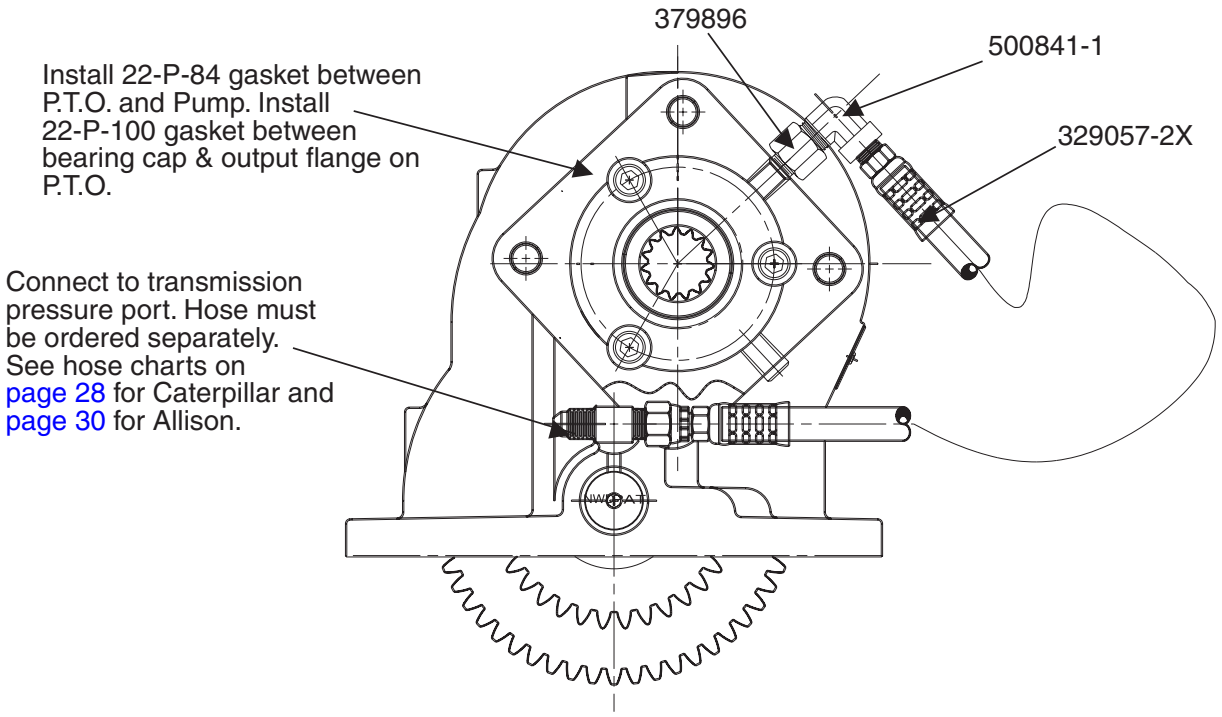
LHS = Left Side of Transmission, 8 o'clock position
RHS = Right Side of Transmission, 1 o'clock position

NOTES:

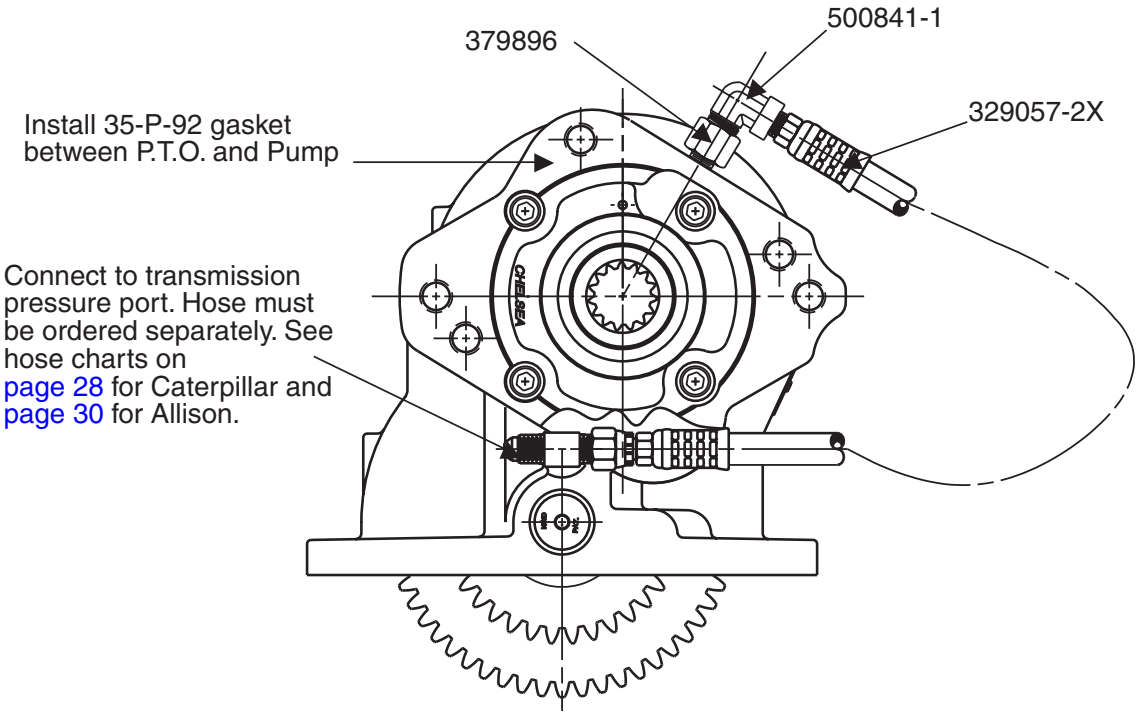
1. P.T.O. Fitting 379486 and Transmission Fitting 379812 included with the P.T.O. Unit. If Using 379486 in Transmission it Must be Purchased Separately
2. Hoses to be Purchased Separately
3. 379486 Elbow Will Not Install on Left Hand (Driver) Side Oil Port Due to Transmission Interference
4. If 379486 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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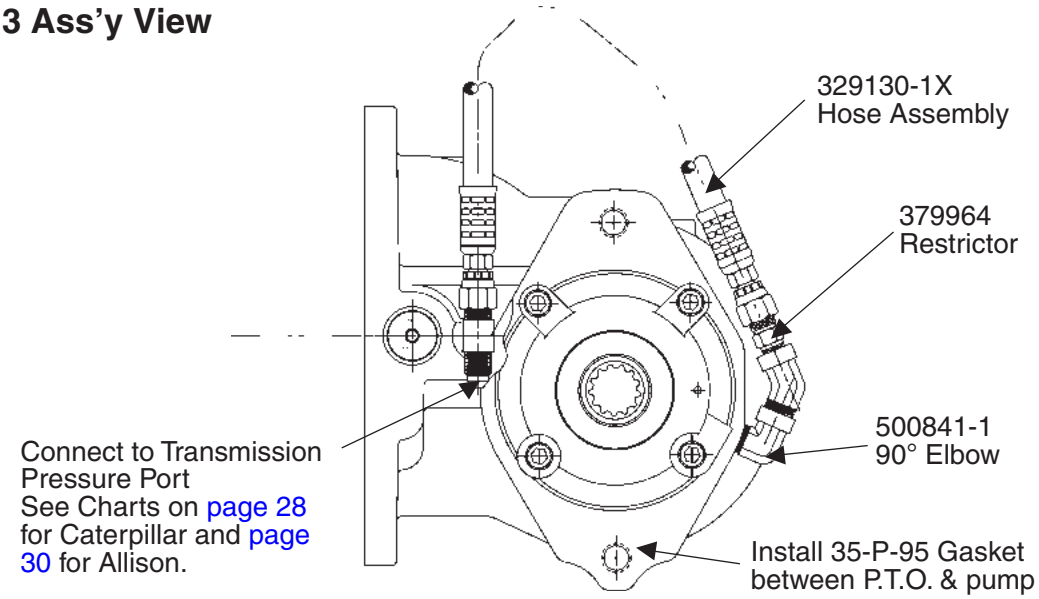
Olive Branch, MS 38654 USA

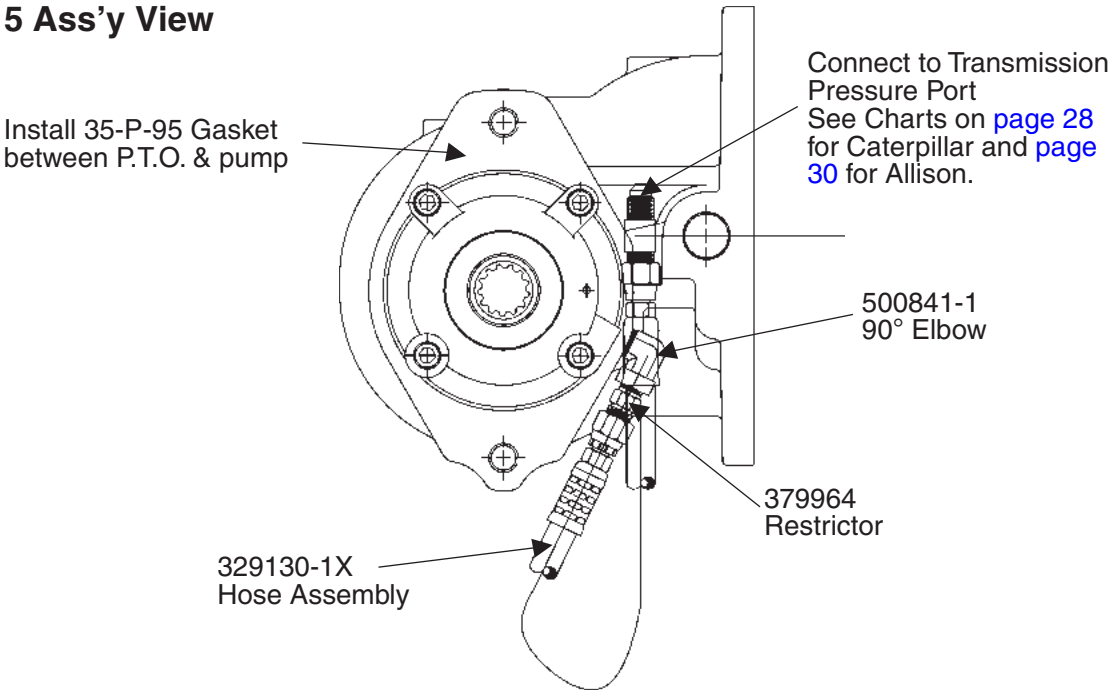
Installation "AK" Wet Spline 267 Series (SK-378 Rev A)

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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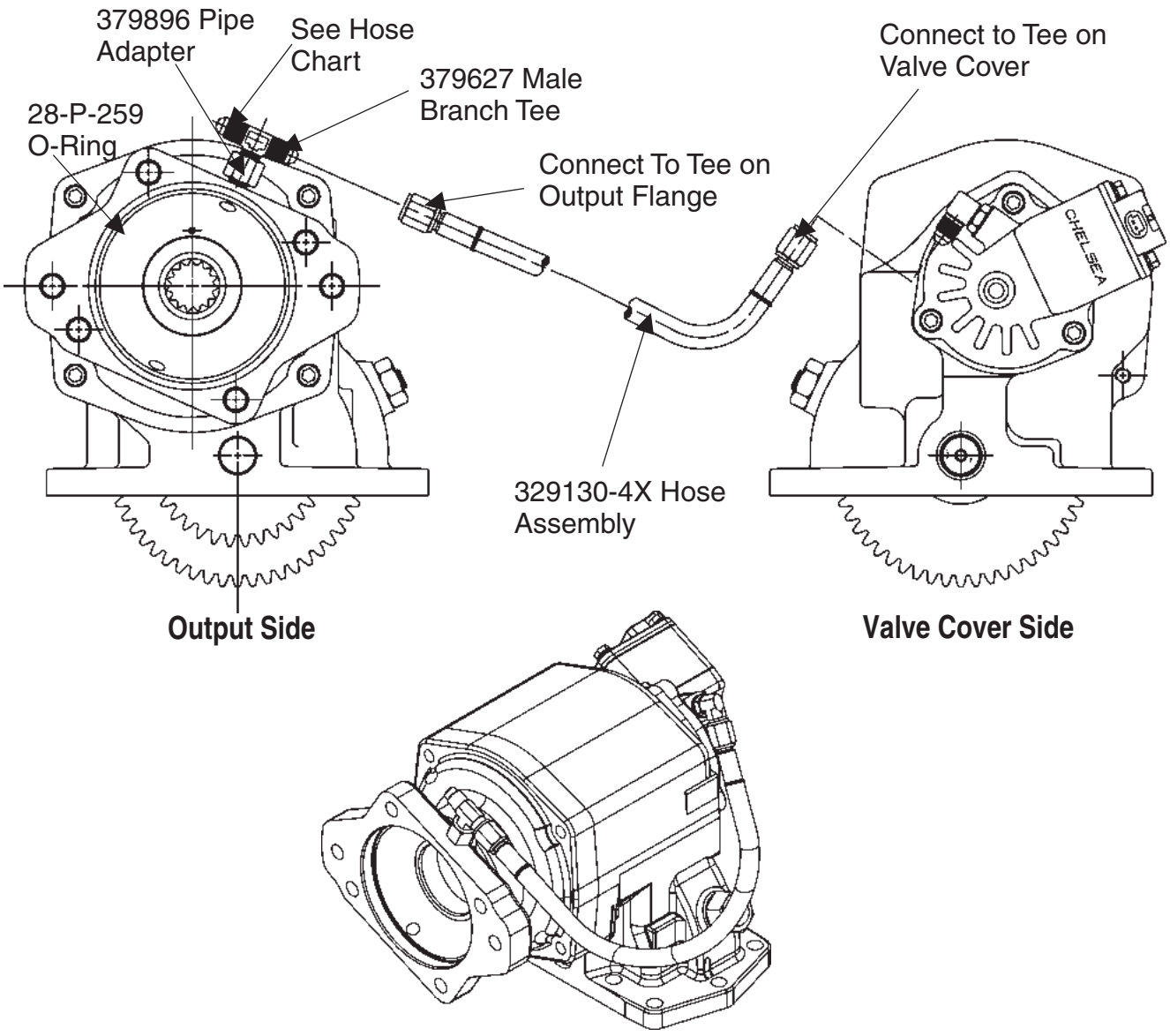
Olive Branch, MS 38654 USA

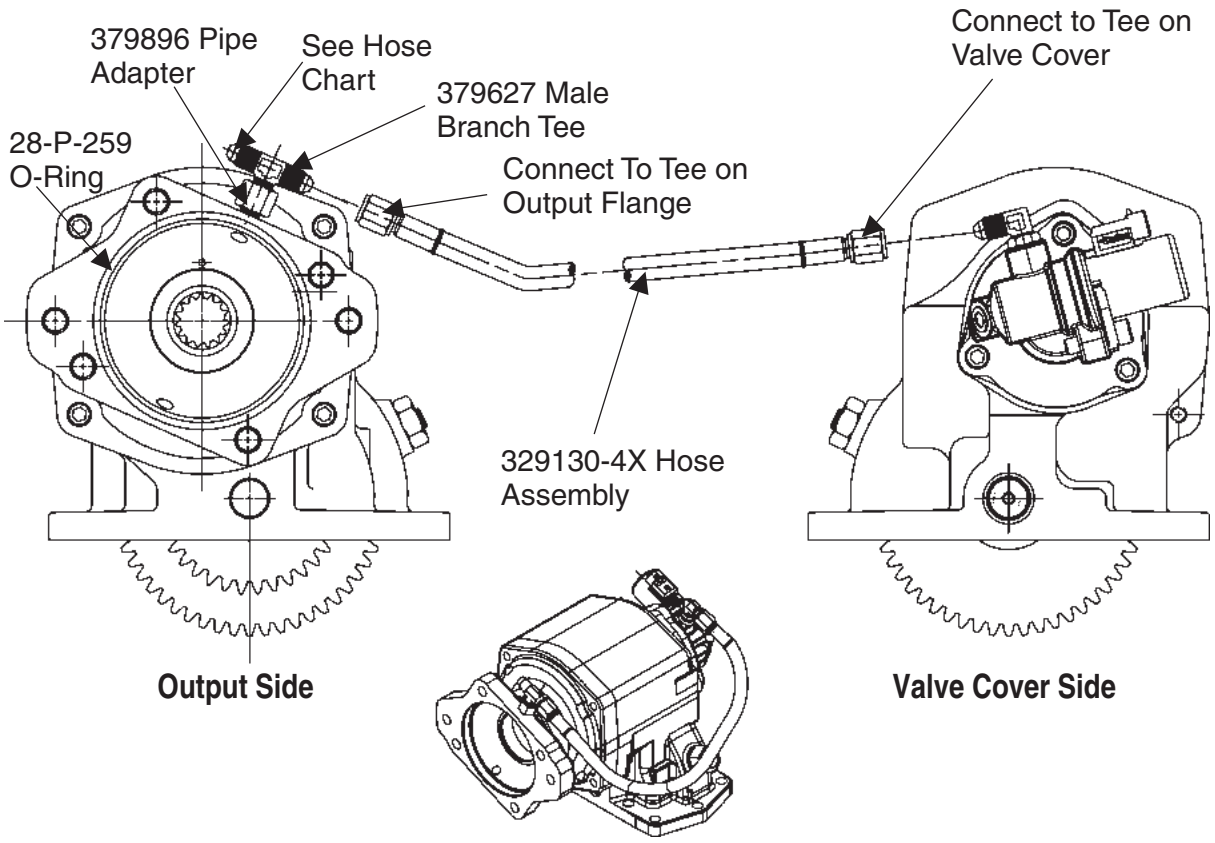
Installation "AF" Wet Spline 277 & 278 Series (SK-383 Rev B) (Old Style)



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

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

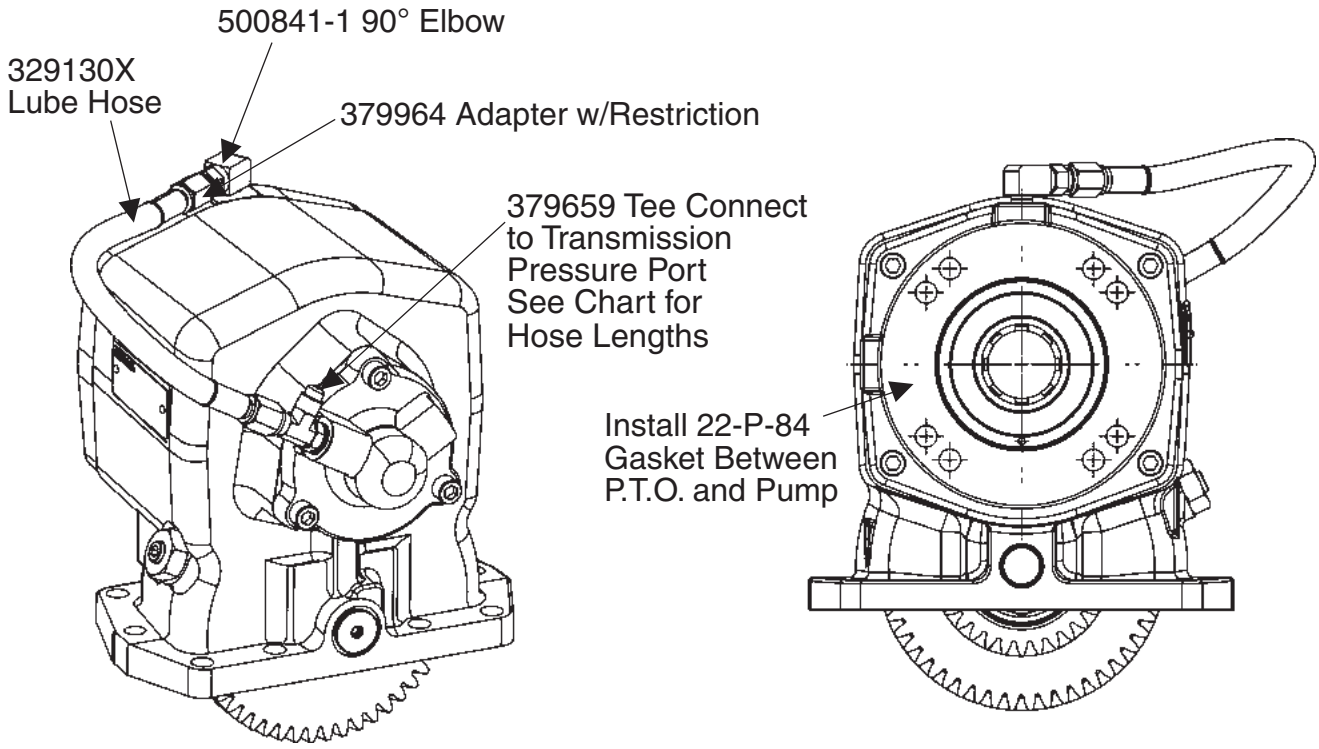
Installation "AF" Wet Spline 277 & 278 Series (SK-383 Rev C) (New Style)

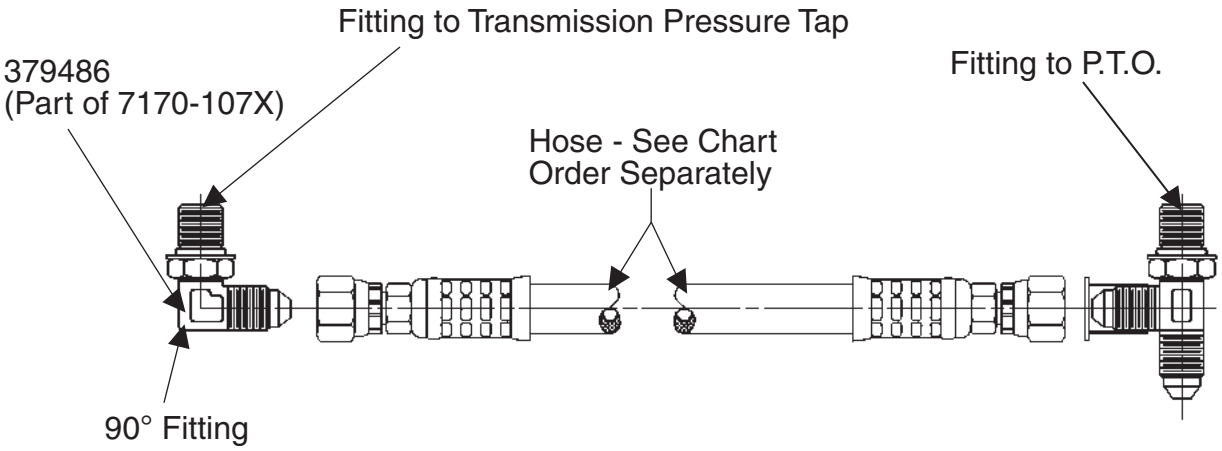


Pressure Hose Chart (Transmission to P.T.O.)		
Trans	**Location**	**Hose**
MD	Left	329130-1X
MD	Right	329075-1X
HD	Left	329130-1X
HD	Right	329075-2X

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

Installation "XY" Wet Spline 269 Series (SK-416 Rev B)

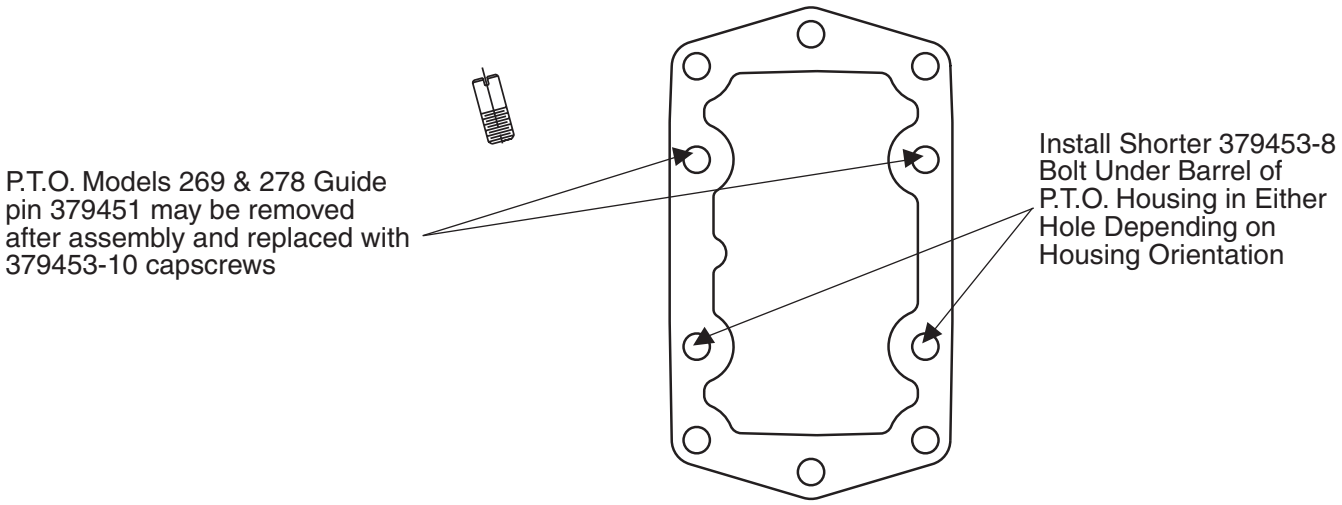




Pressure Hose Chart (Transmission to P.T.O.)		
Trans	**Location**	**Hose**
MD	Left	329130-5X
MD	Right	329075-1X
HD	Left	329075-4X
HD	Top Right	329075-2X

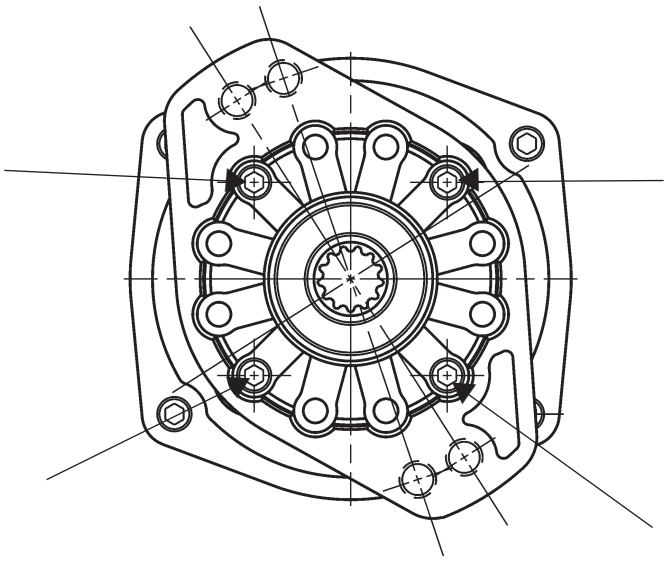
Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

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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Notes

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Olive Branch, MS 38654 USA

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.

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

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.

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Parker Chelsea

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