TORO®

Commercial Products

Hydroject®

3000/4000

Troubleshooting Guide

RED IRON™ Training

PART NO.97928SL, Rev. A

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Use of This Manual

The information contained in this manual is supplementary to material found in other sources, it is not a replacement for them. You should always consult Service Manuals, Service Bulletins, Operator's Manuals and Parts Books when necessary.

Service Manual Updates and Service Bulletins can be found on the internet at:
www.toro.com/golf/custsvc.html

This Manual and the training program, which it supports, are both designed to help you gain knowledge of the product, and to inform you of when and why to make the necessary repairs. We have also included tips for performing those repairs.

This program is designed for you. Your input and participation is appreciated.

There is plenty of space in this manual for you to add your own notes and observations


JECT 3000


TORO

The Hydroject® is a patented machine that aerates the ground with “water jets”.

These jets are pulses of high velocity water, released at regular intervals.

For this machine to operate properly, the owner or operator should understand the individual components and their relationship to the complete system.

The Hydroject® 3000 is a hydrostatic driven walk aerator. The unit needs to be connected to a clean water supply to aerate.

The Hydroject® 4000 is a pull behind aerator. The higher transport speeds make the 4000 suitable for tees and problem areas on the fairway. The Hydroject® 4000 usually gets its water from a tank on the towing vehicle.

NOTES

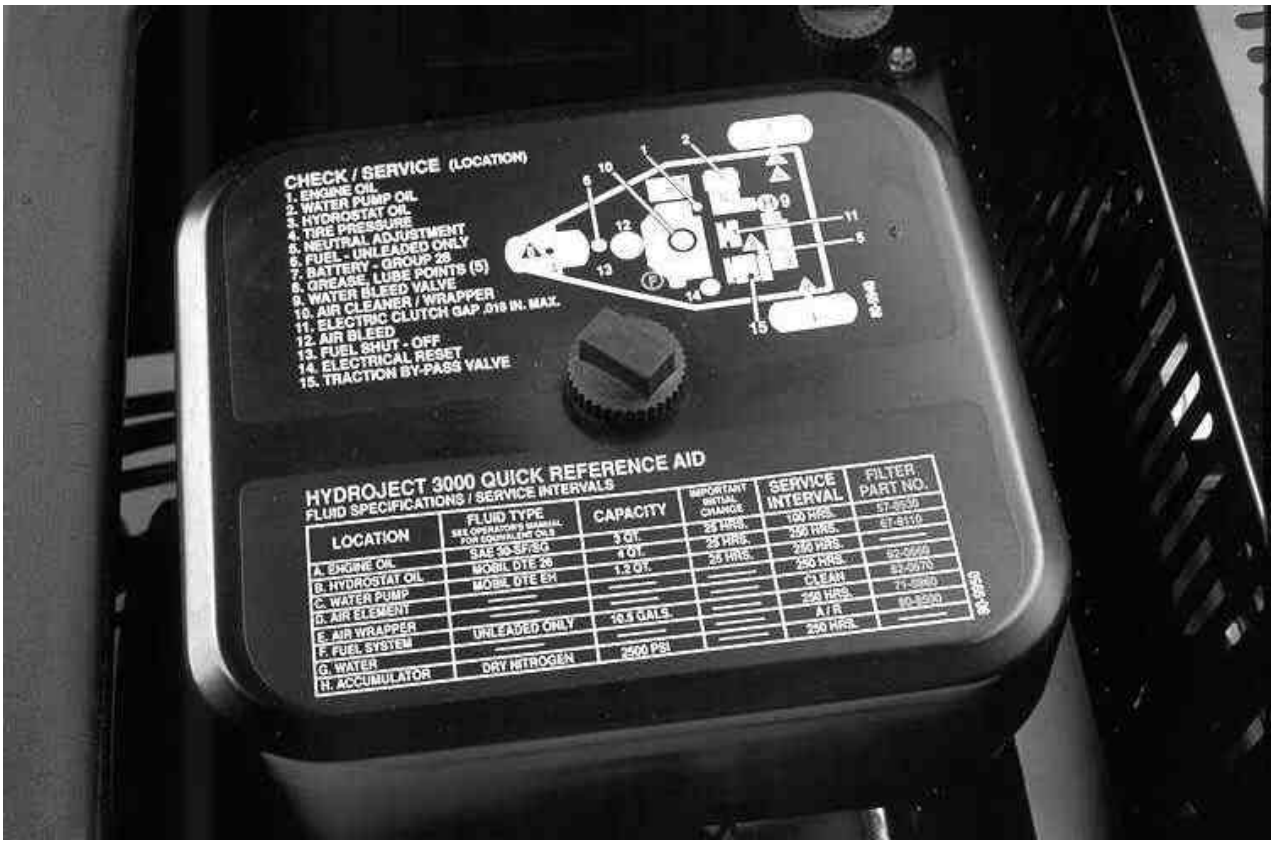
Comparison	Hydroject 3000	Hydroject 4000
2 cylinder Onan Engine	✓	✓
Quick Coupler	✓	✓
5 Micron inlet Filter	✓	✓
Pressure Switch	✓	✓
Pressure Gauge	✓	✓
Engine driven water pump	✓	✓
Accumulator	✓	✓
Accumulator charge pressure switch	✓	✓
5000 psi relief valve	✓	✓
Cycling valve (water valve)	✓	✓
Rollers	✓	
Roller washer	✓	
High pressure aeration nozzles	✓	✓
Drain valve	✓	✓
Hydrostatic drive	✓	
Boost Pump		✓
Boost pump relief valve		✓
25 micron pre-filter	✓	✓
Regulator Valve	✓	

The Hydroject® 3000/4000 aerators use most of the same components in the water injection system.

While there are differences in the machine drive, the main water injection system is the same.

The chart on the previous page shows the similarities and differences between the two units.

NOTES


CHECK / SERVICE (LOCATION)
1. ENGINE OIL
2. WATER PUMP OIL
3. HYDROSTAT OIL
4. TIRE PRESSURE
5. NEUTRAL ADJUSTMENT
6. FUEL - UNLEADED ONLY
7. BATTERY - GROUP 28
8. GREASE LUBE POINTS (5)
9. WATER BLEED VALVE
10. AIR CLEANER / WRAPPER
11. ELECTRIC CLUTCH GAP .018 IN. MAX.
12. AIR BLEED
13. FUEL SHUT - OFF
14. ELECTRICAL RESET
15. TRACTION BY-PASS VALVE
HYDROJECT 3000 QUICK REFERENCE AID
FLUID SPECIFICATIONS / SERVICE INTERVALS
LOCATION
FLUID TYPE
SEE OPERATOR'S MANUAL FOR EQUIVALENT OILS
CAPACITY
IMPORTANT INITIAL CHANGE
SERVICE INTERVAL
FILTER PART NO.
A. ENGINE OIL
SAE 30 SF/CD
3 QT.
25 HRS.
100 HRS.
57-8050
B. HYDROSTAT OIL
MOBIL DTE 25
4 QT.
25 HRS.
250 HRS.
67-8110
C. WATER PUMP
MOBIL DTE EH
1.2 QT.
250 HRS.
92-0668
D. AIR ELEMENT
CLEAN
93-0670
E. AIR WRAPPER
77-3860
F. FUEL SYSTEM
UNLEADED ONLY
10.5 GALS.
A/R
250 HRS.
93-3930
G. WATER
H. ACCUMULATOR
DRY NITROGEN
2500 PSI


GASOLINE ONLY

Engine

The Hydroject® is powered by an Onan, 24 HP, air cooled, twin cylinder, electric start, gas engine. The engine is equipped with solid state ignition, and powers the water pump, water valve, and on the 3000, the hydrostatic transmission.

The engine uses 3 quarts of 30-weight engine oil and the oil should be changed every 100 hours, after the initial 25-hour change.

Oil Filter PN. 57-8530

The air filter should be serviced every 100 hrs, and the filter element replaced every 200 hrs.
Air Filter foam pre-cleaner PN 82-0670.
Air Filter element PN. 82-0670.

During aeration, operate the Hydroject® at full engine RPM.

Proper engine idle speeds.

Low idle 1500 - 1800 RPM.
High Idle 3500 ± 50 RPM.

Fuel

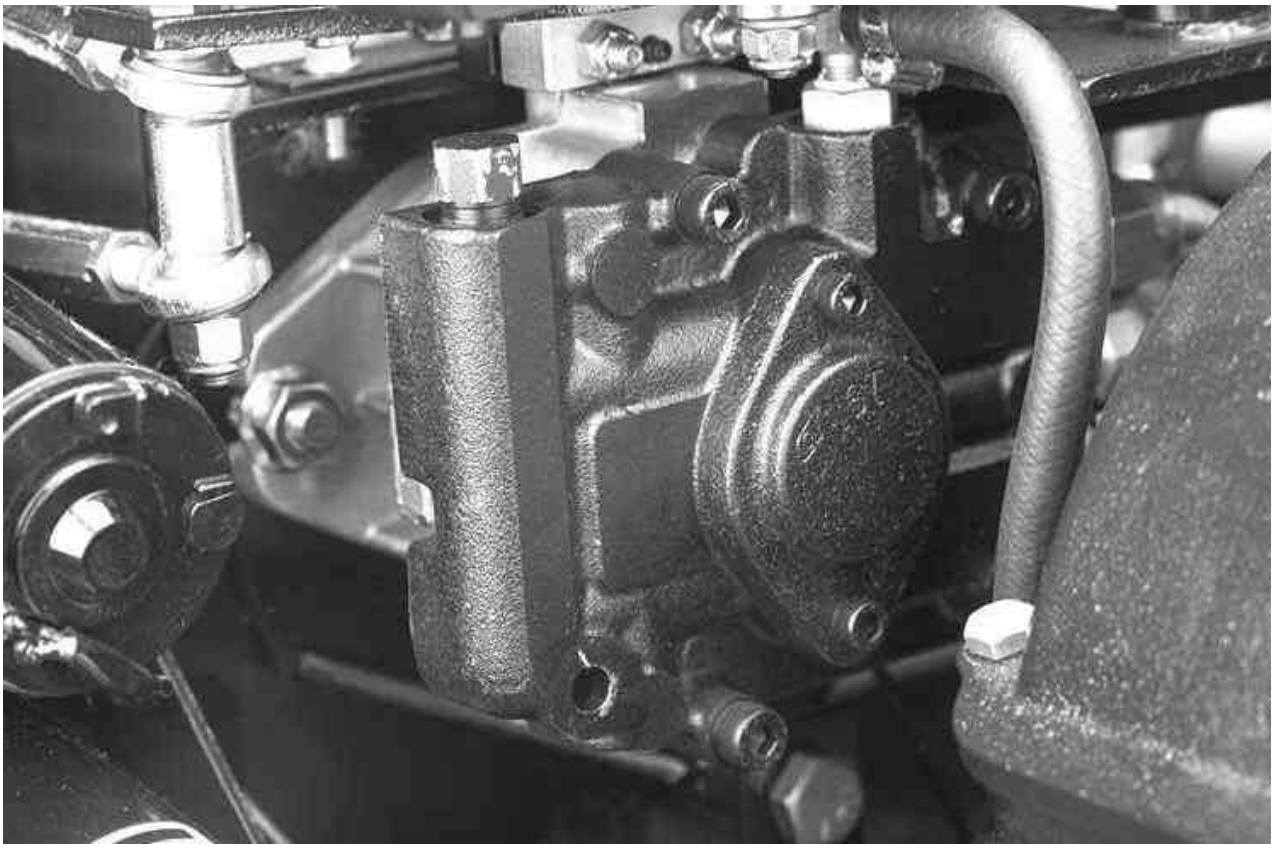
The fuel tank holds 10 gallons of regular unleaded gasoline (9 gallons on the Hydroject® 4000) and should operate the unit for approximately 4 hours. There is a fuel shut off valve located below the fuel tank and this valve should be closed during periods of non-use.

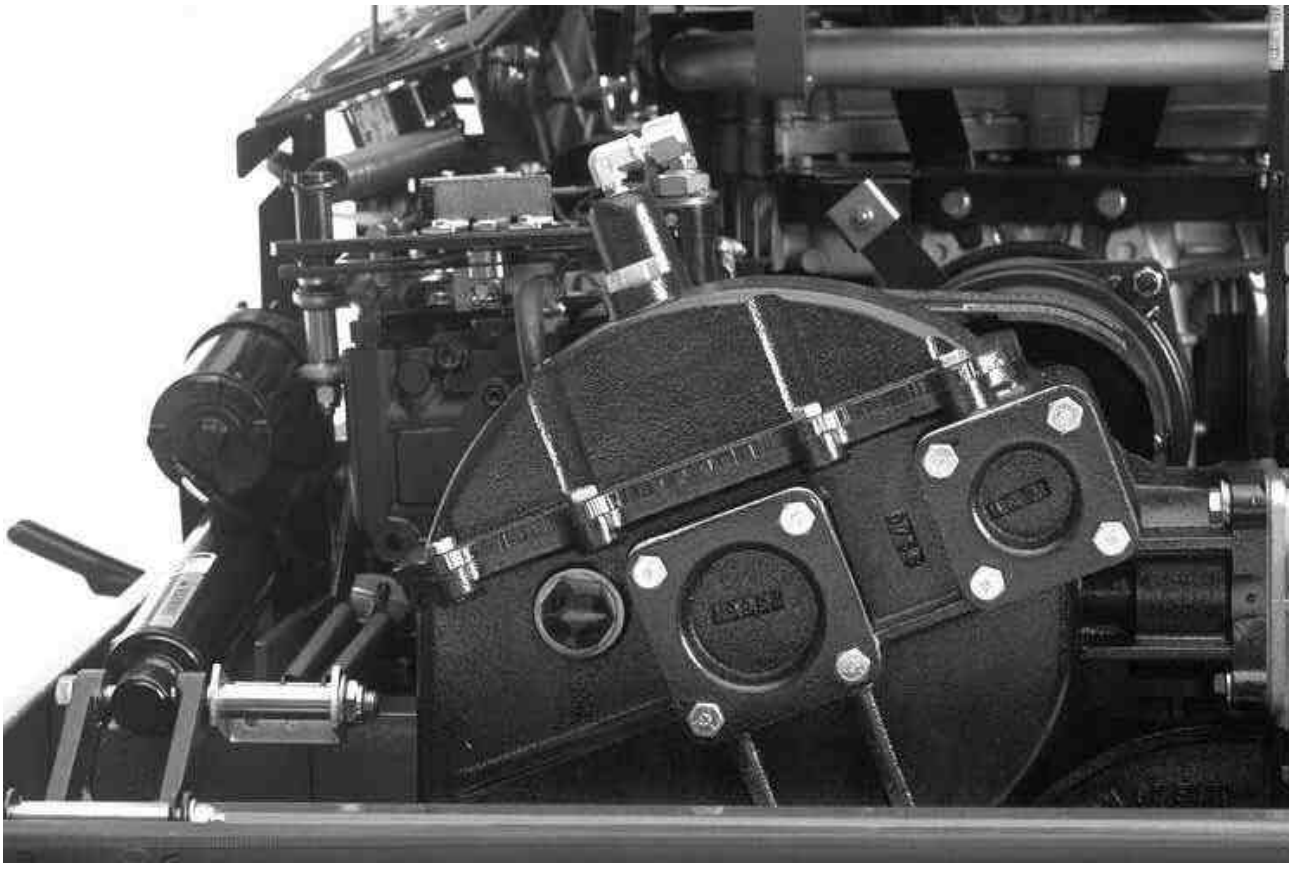
NOTE: Take care in filling any fuel tank, and fill the tank to 1 inch below the top of the tank. Always wipe up any spilled fuel to prevent a fire hazard.

The Fuel Filter should be replaced every 200 hrs.

Fuel Filter PN. 71-5960.

NOTES





Hydrostatic Pump (3000 Hydroject® Only)

The Sundstrand, series 70 hydrostatic pump, is belt driven and provides variable oil flow to operate the traction wheel motor, the traction bail, located on the tiller handle, is connected to the swash plate in the hydrostatic pump and provides speed and directional control. The unit aerates in both directions.

NOTE: There is a bypass valve located on top of the hydrostatic pump, this valve provides for limited movement of the unit with the engine off.

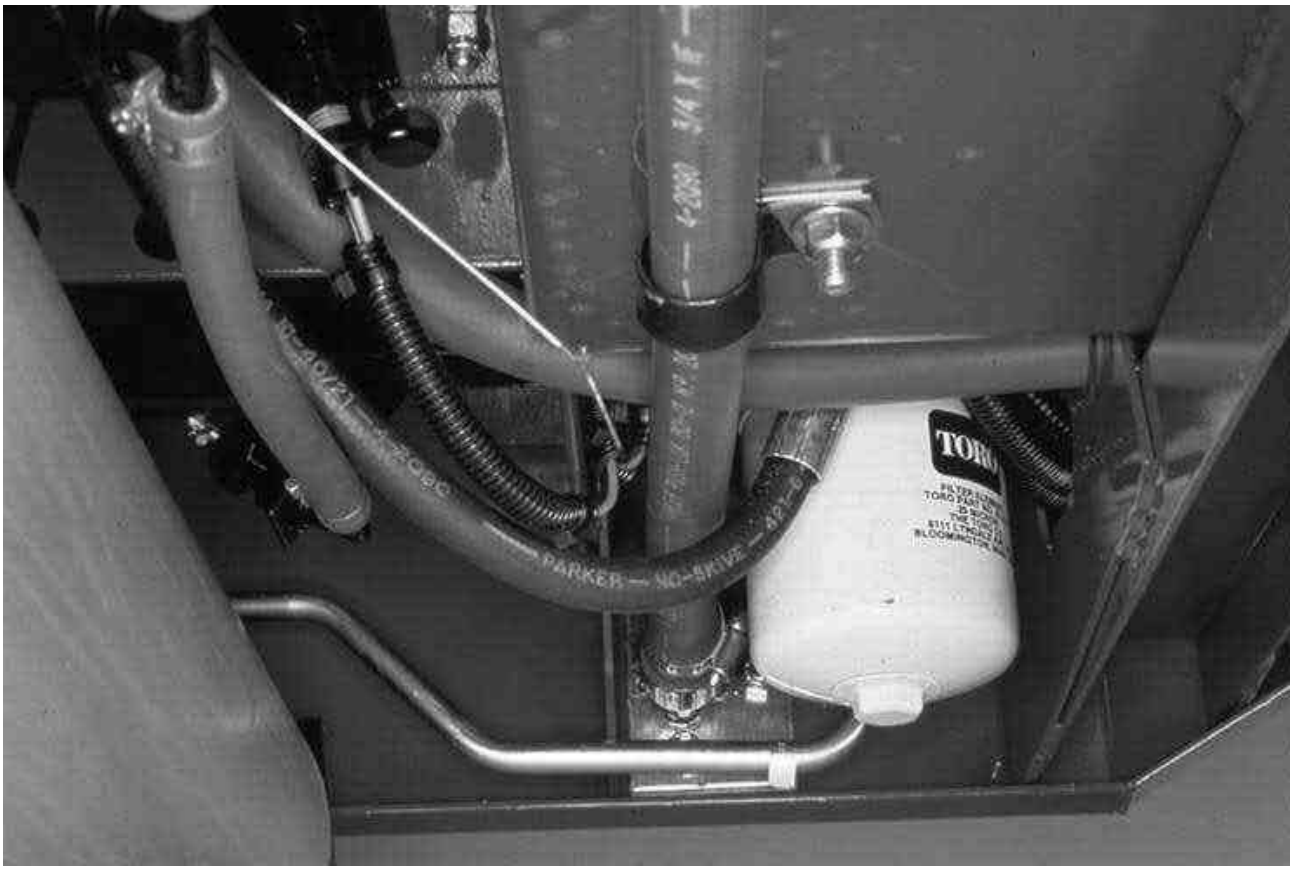
Cam Gear Box

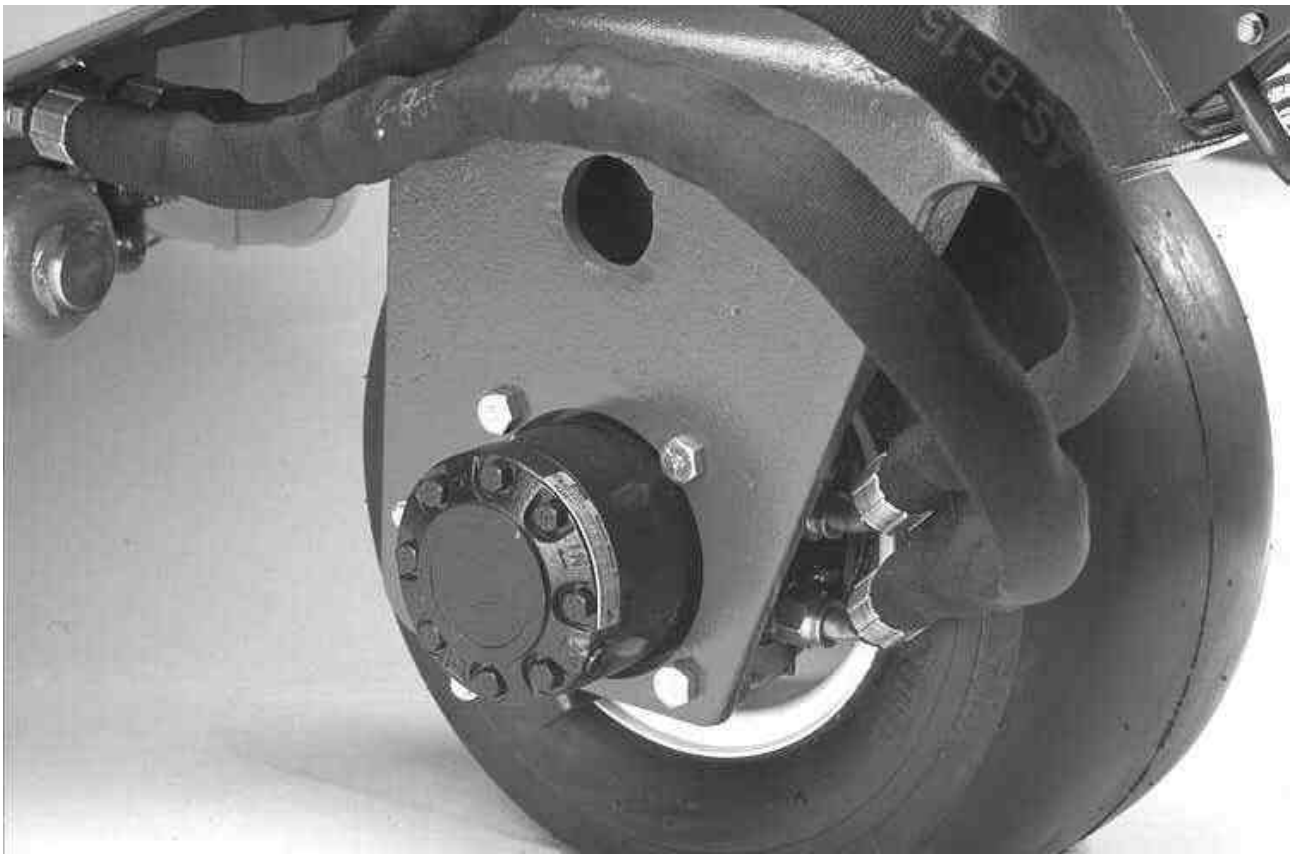
The cam gearbox operates the cycling valve and also serves as the hydrostatic oil reservoir, on the Hydroject® 3000.

The hydrostatic transmission uses 5 quarts of DTE 26.

NOTE: The oil level can be checked through the sight glass on the side of the reservoir.

NOTES


PARKER — NO-SKIVE



Transmission Filter (3000 Hydroject® Only)

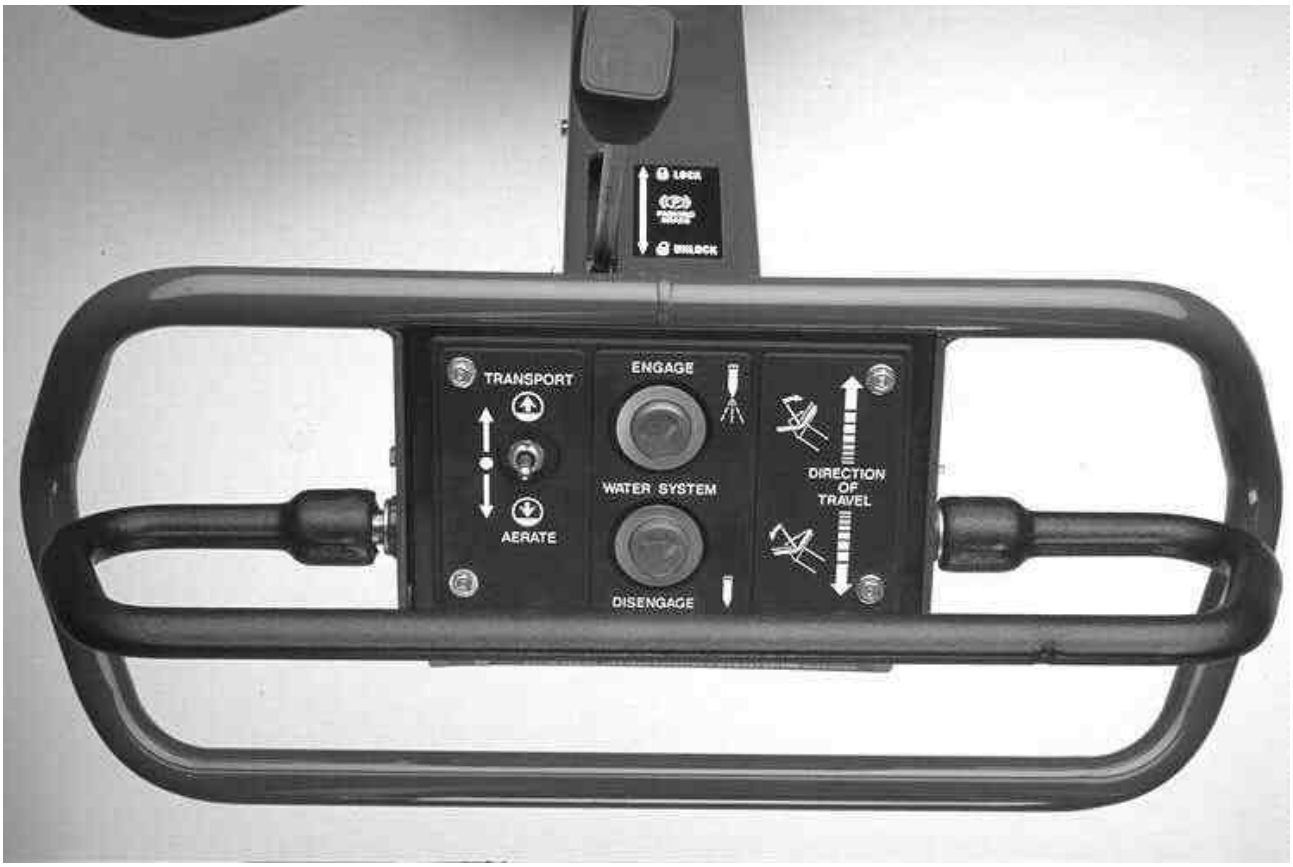
A 25-micron filter, located below the frame, filters the transmission oil.

NOTE: The transmission filter should be changed at 25 hours and then every 250 hours after that.
Prefill the filter before installation.
Transmission filter PN. 67-8110.

Wheel Motor (3000 Hydroject® Only)

The hydrostatic wheel motor is a low speed, high torque, bi-directional motor, which propels the unit and provides smooth directional changes.

NOTES


LOCK
UNLOCK
TRANSPORT
AERATE
ENGAGE
WATER SYSTEM
DISENGAGE
DIRECTION OF TRAVEL


ENGAGE
FAST
SLOW
ENGINE SPEED
ON
CHOKE
DISENGAGE
WATER SYSTEM
OFF
ON
START
IGNITION

Tiller Controls (3000 Hydroject® Only)

The tiller handle contains some controls for aerating. These controls include traction direction, aerate-transport switch, and water systems start and stop buttons, and the parking brake lever.

NOTE: The parking brake is connected to a limit switch that activates an alarm if the unit is moved while the parking brake is engaged.

NOTE: The traction handle moves the swash plate on the hydrostat, controlling direction and speed.

NOTE: The raise and lower switch positions the transport wheels in aerate or transport.

NOTE: The ENGAGE (Green) and DISENGAGE (Red) buttons start and stop the water pump and cycling valve. Holding the ENGAGE button down will energize the water system, overriding the neutral delay, allowing multiple shots at one location.

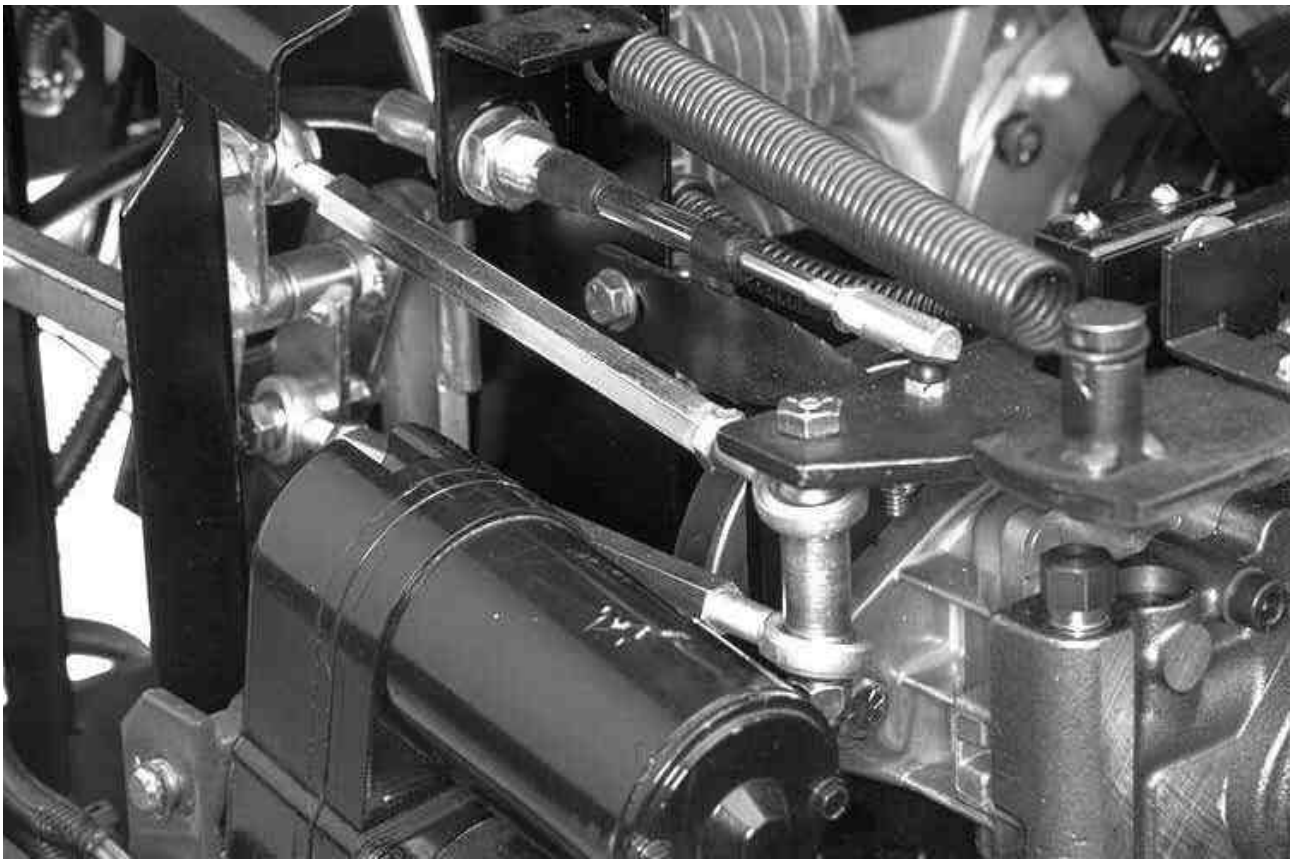
Remote Control Panel (4000 Hydroject® Only)

The remote control panel for the Hydroject® 4000 contains the controls for aerating.
These controls include:

1. The key switch.
2. The engine choke switch.
3. The engine low\high idle switch.
4. The water system, start and stop buttons.

NOTE: The ENGAGE (Green) and DISENGAGE (Red) buttons start and stop the water pump and cycling valve.

NOTES




WARNING
HOT
OFF
ON
IGNITION
START
HOLE SPACING
CIRCUIT BREAKER
push to reset
THROTTLE
TORO

Traction Linkage (3000 Hydroject® Only)

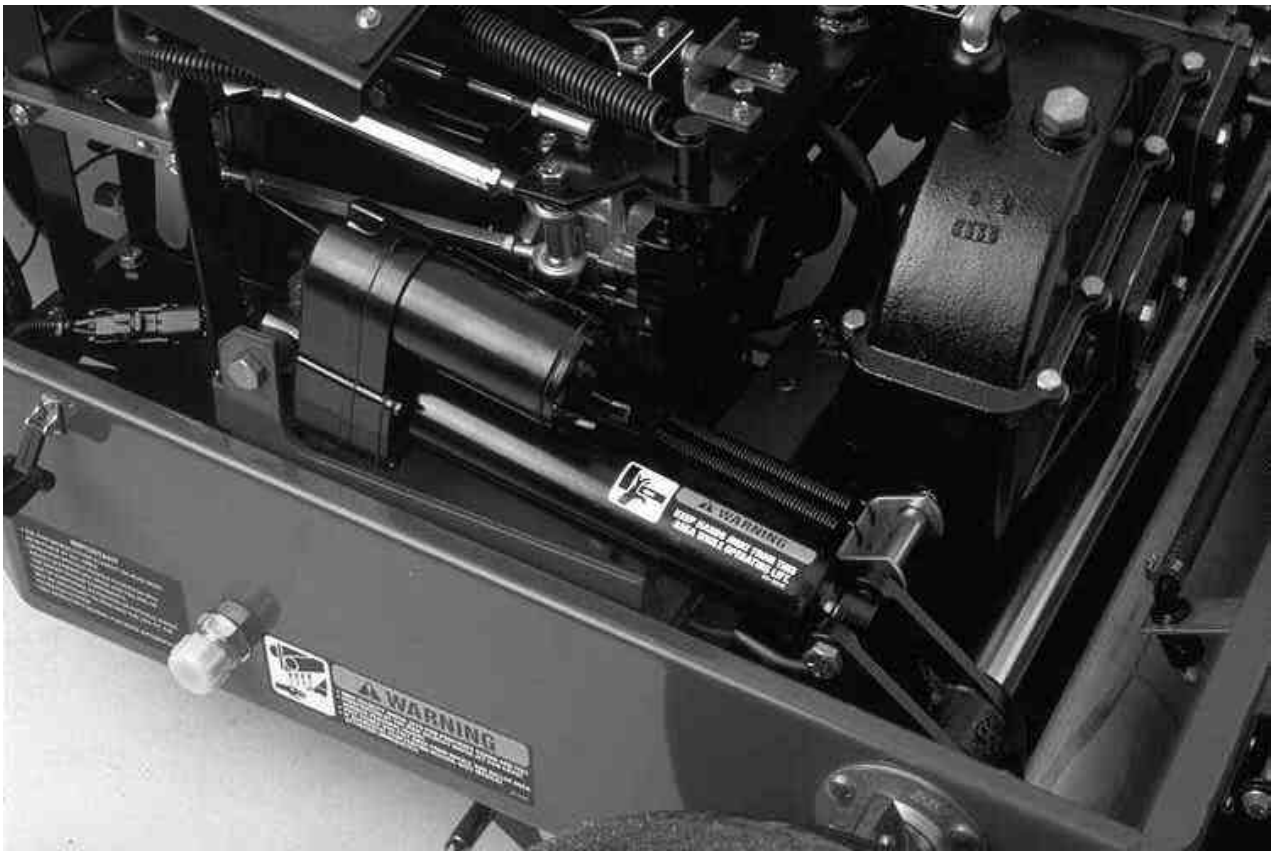
The traction linkage connects the traction bail to the swash plate. During aeration, a steel cable pulls the left link toward the hole spacing lever, limiting swash plate movement to the required speed. In this mode, the hole spacing lever is spring-loaded and will snap towards the key switch when removed from the indexing latches.

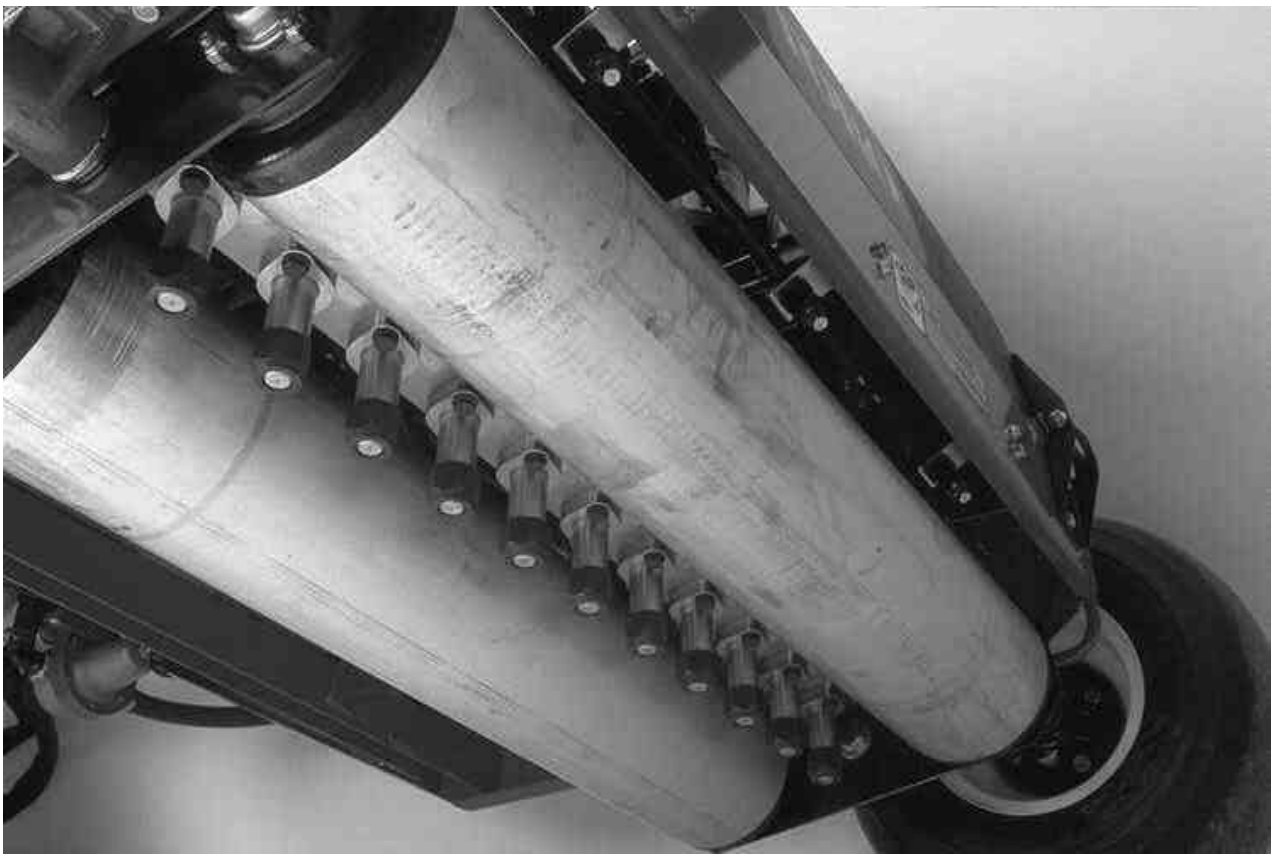
NOTE: Do not adjust hole spacing with out lowering the unit.

Control Panel (3000 Hydroject® shown)

The control panel controls or monitors the Hydroject® functions. The controls, (from right to left) include: hourmeter, throttle, hole spacing lever, ignition key switch, 20 amp circuit breaker reset, inlet water pressure gauge, spray roller wash knob and choke.

NOTES


WARNING



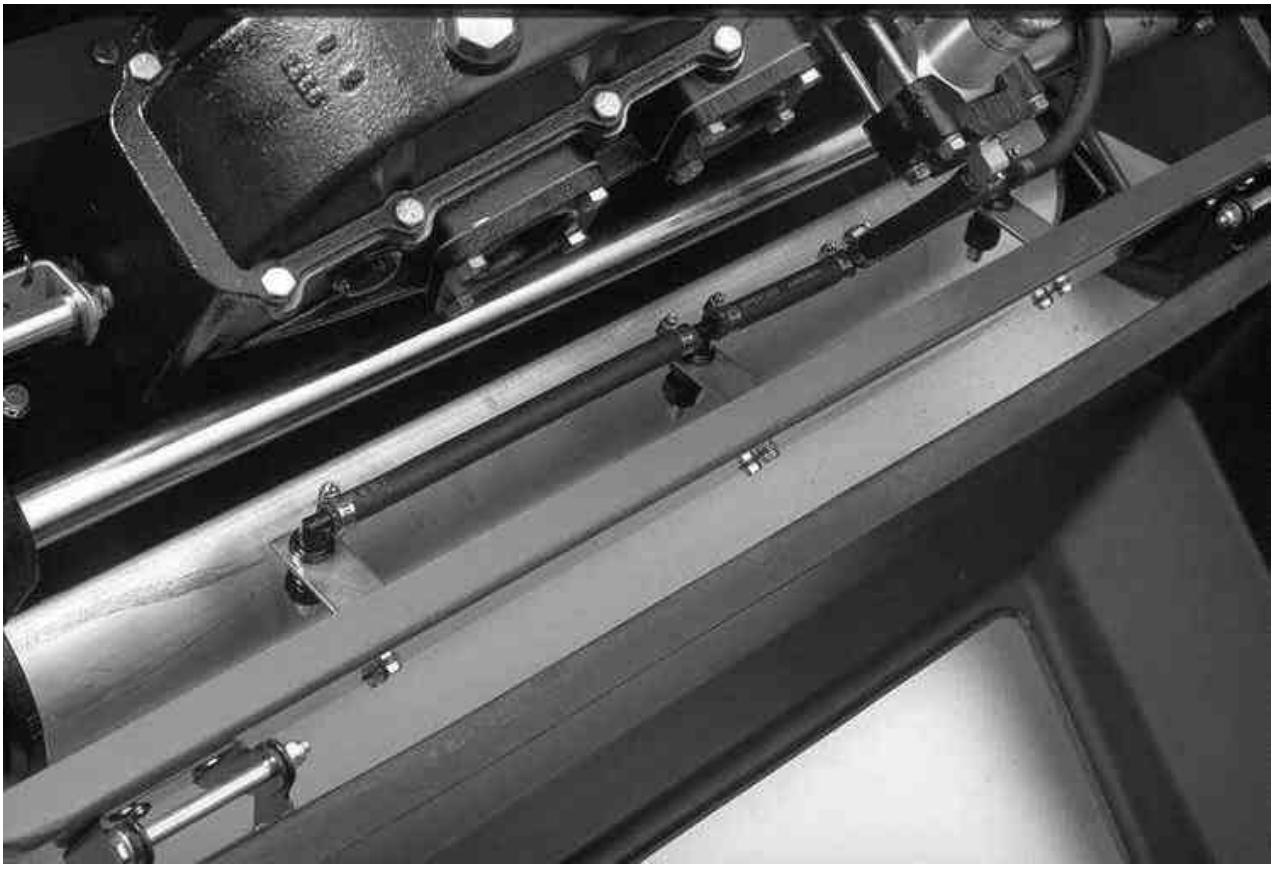
Lift Mechanism (3000 Hydroject® Only)

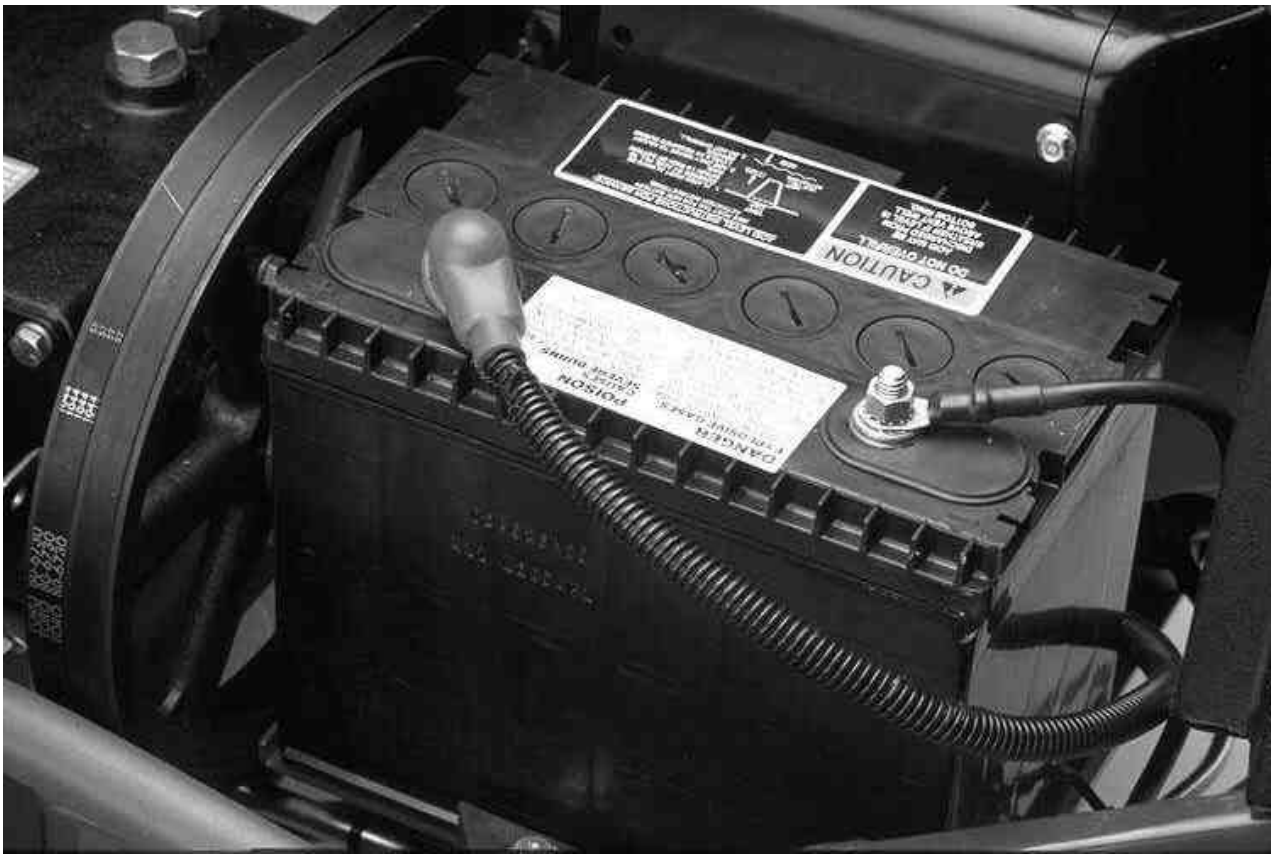
A 12-volt, Warner electric, linear screw actuator with a 6-inch stroke, accomplishes transport lift. The actuator raises and lowers the transport wheels and activates the hole spacing control. A safety switch prevents aeration during transport.

Rollers (3000 Hydroject® Only)

The two large aluminum rollers support the Hydroject® 3000 during aeration. These rollers smooth down the turf after aeration and protect the operator from the high velocity water jet blasts.

NOTES




CAUTION
DANGER
POISON

Roller Cleaning System (3000 Hydroject® Only)

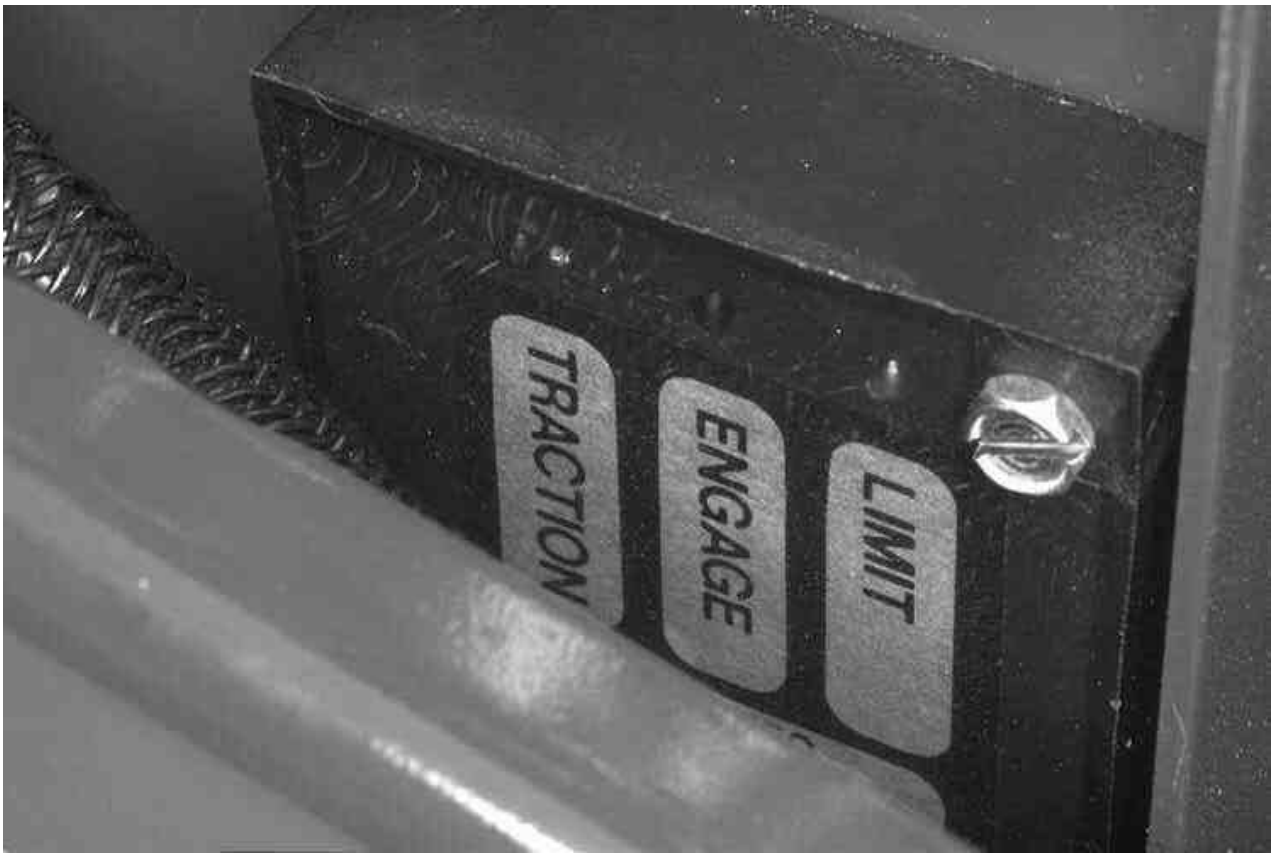
The spray wash nozzles prevent debris buildup on the rollers. A knob on the instrument panel regulates the volume of water going to these nozzles. Pulling or pushing the spray wash knob increases or decreases the spray rate. These nozzles also help purge air from the water system after connecting the water supply.

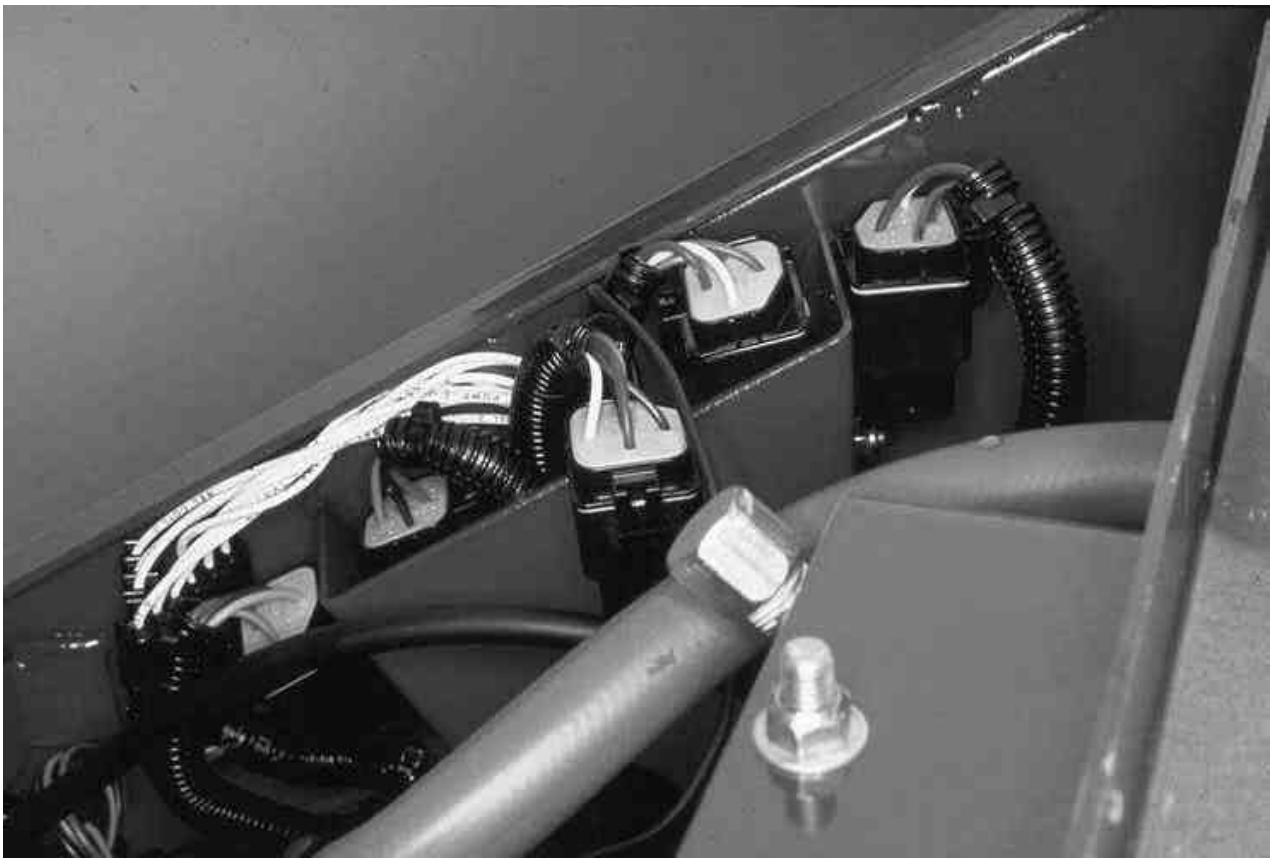
Battery

The battery is specially designed to withstand vibration. It is a group 28 with 525 cold cranking amps.

NOTE: The battery is shipped dry.

NOTES


TRACTION
ENGAGE
LIMIT



Controller

The controller is a solid state timing device used to regulate/monitor the input functions. 3 colored lights monitor these functions. (Red, Yellow and Green).

Hydroject® 3000

NOTE: The RED LED illuminates when the Hydroject® is moving, (transmission not in neutral). The micro switch that controls this function in normally closed.

NOTE: The YELLOW LED illuminates when the transport wheels are up, the accumulator nitrogen pressure is above 1800 PSI*, and the water pressure (after the filter) is adequate (15-20 PSI). This light stays illuminated during aeration. *(Switch is not on early production units)

NOTE: The GREEN LED illuminates when the aeration start button is depressed. This light stays illuminated during aeration.

Hydroject® 4000

NOTE: The RED LED illuminates, when the water pressure (after the filter) is adequate (15-20 PSI). This light stays illuminated during aeration.

NOTE: The YELLOW LED illuminates when the accumulator nitrogen pressure is above 1800 PSI.

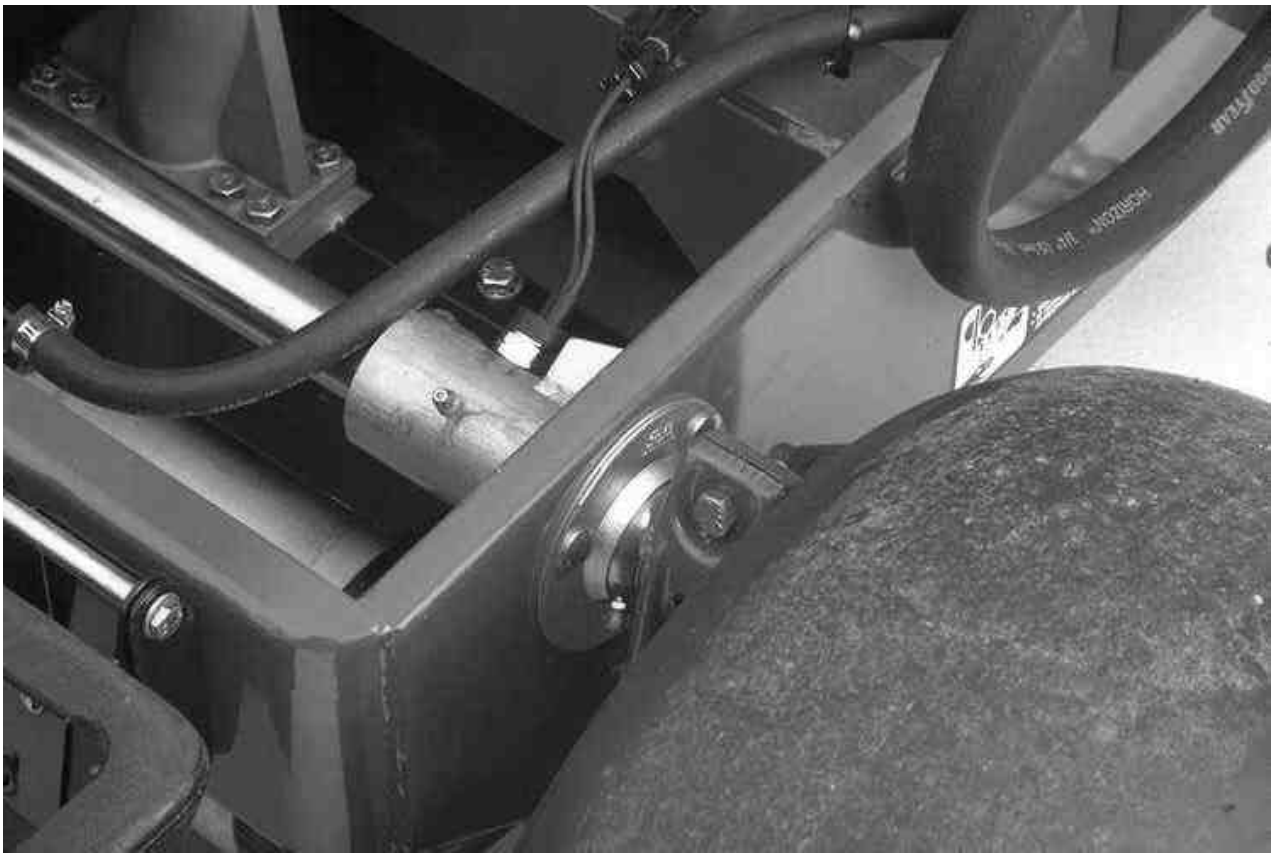
NOTE: The GREEN LED illuminates when the aeration start button is depressed. This light stays illuminated during aeration.

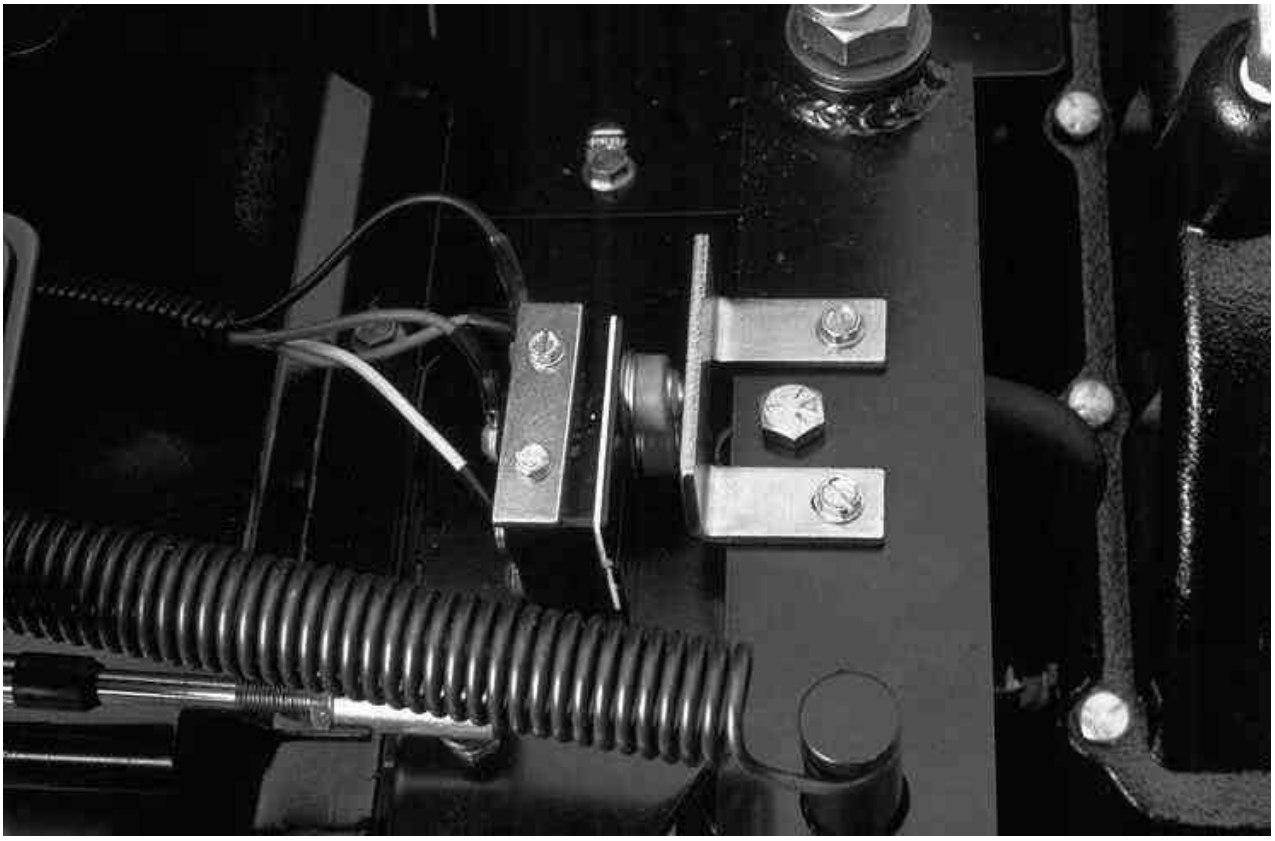
Relays

The relays are used to energize specific components including:

1. The starter.
2. The pump clutch.
3. The cycling valve clutch.
4. The lift raise. (3000 Hydroject® Only).
5. The lift lower. (3000 Hydroject® Only).

NOTES





Transport Limit Switch (3000 Hydroject® Only)

The transport limit switch signals the controller when the wheels are in the transport position.

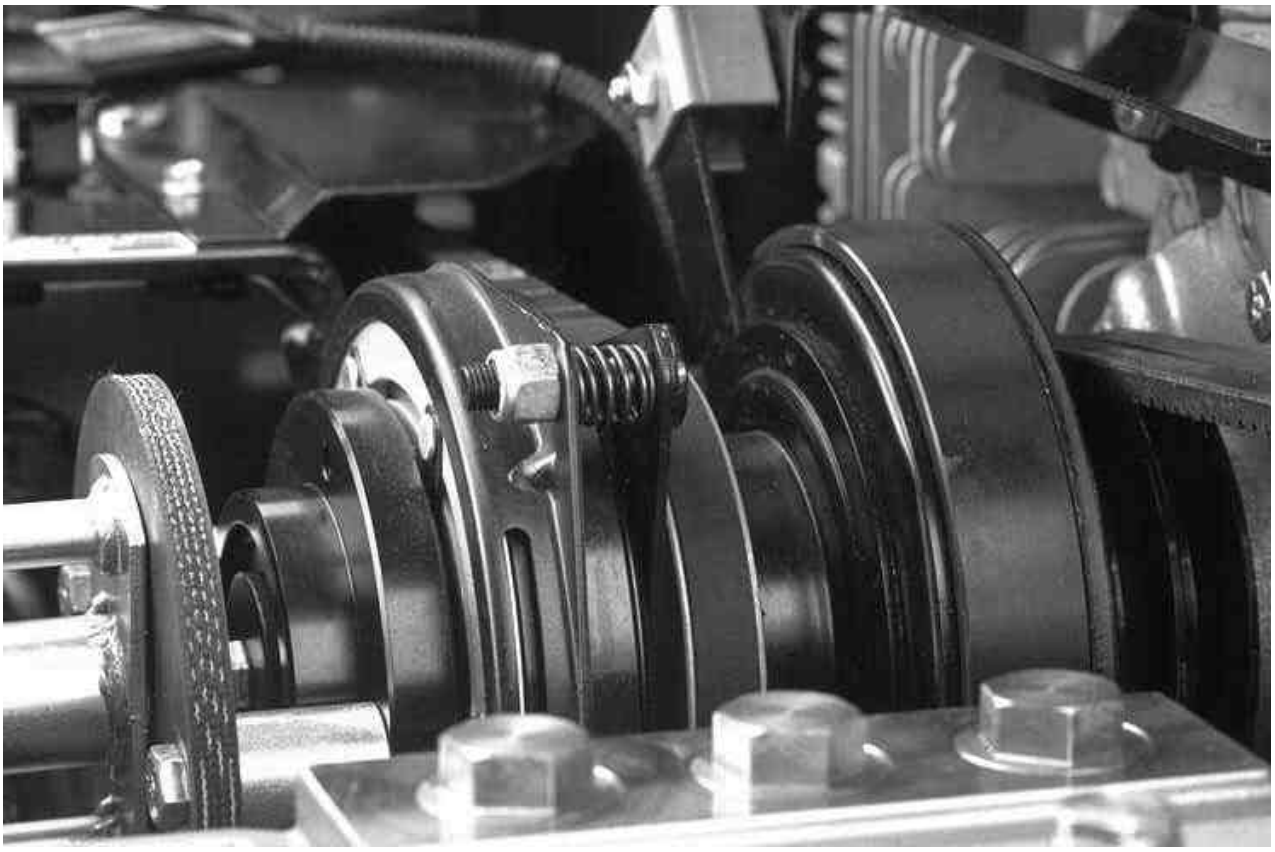
In the transport position (wheels down) the switch is closed.
In the aerate position (wheels up) the switch is open.

NOTE: On earlier units, there were 2 switches for this function.

2 Transmission Switches (3000 Hydroject® Only)

The top switch is normally open, and closes to enables the engine to start when the hydrostatic control is in the neutral position.
The lower switch is normally closed and is connected to the controller. If the Hydroject® is pumping water and the operator leaves the traction drive in neutral, this switch signals the controller to shut down the high-pressure pump and the cycling valve after 4 seconds.

NOTES




WARNING
• HIGH PRESSURE VESSELS CAN CAUSE PERSONAL INJURY IF DISASSEMBLED INCORRECTLY.
• DISCHARGE ALL WATER PRESSURE AT BLEED VALVE BEFORE DISASSEMBLING ANY FASTENER OR PLUG FROM THIS COMPONENT.
SEE OPERATOR'S MANUAL FOR COMPLETE PROCEDURE.

2 Electric Clutches

There are two electric clutches that connect the engine to the water pump and the cycling valve.

When the operator depresses the ENGAGE button, the first clutch energizes, engaging the water pump.

After the water pump builds the required pressure, the control module engages the second clutch, engaging the cycling valve and starting the aeration cycle.

If at any time the water supply pressure drops below 15-20 PSI or if the traction unit stops, the water pump clutch and cycling valve will disengage.

Electric Clutch Testing and Adjustment

Both clutches should measure 3 Ohms of resistance across the coil when tested with an Ohmmeter.

For the clutches to operate properly the correct air gap must be maintained.
The air gap is checked with a feeler gauge and set to .018”.

NOTES


WARNING
IMPORTANT
• THE FIVE MICRON FILTER ELEMENT (66-3620) MUST BE IN PLACE AT ALL TIMES.
• OPERATION WITHOUT PROPER FILTRATION WILL RESULT IN PREMATURE WEAR AND FAILURE OF THE WATER SYSTEM COMPONENTS.
• USE OF ADDITIONAL FILTRATION OR POTABLE WATER MAY BE NECESSARY TO PROLONG THE LIFE OF THE FILTRATION SYSTEM.
SEE OPERATOR'S MANUAL FOR MORE INFORMATION.


IMPORTANT

Pre-filter

The Hydroject® aerators use a water inlet pre-filter.

The pre-filter is a “spin down, swirl type” sediment pre-filter.

The filter has a reusable polyester 100-mesh (150-micron) screen.
Screen PN 86-9140

The clear bowl allows the operator to see when the pre-filter needs to be flushed or cleaned.

NOTE: Early units were not equipped with a pre-filter.
A kit is available to install one on older units, if water conditions warrant.
Kit Number 92-9544.

Flush Valve

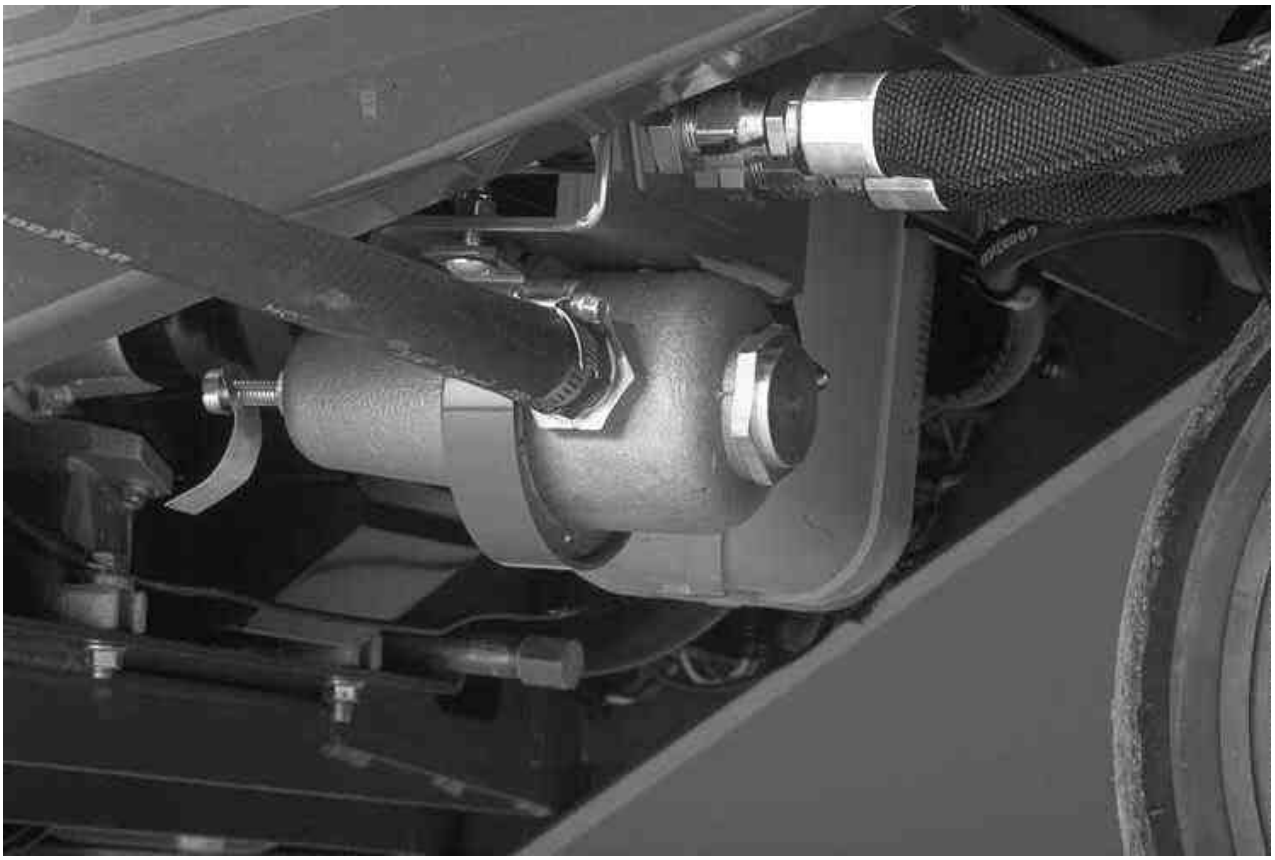
When dirt or debris accumulates in the pre-filter, the filter needs to be flushed or cleaned.

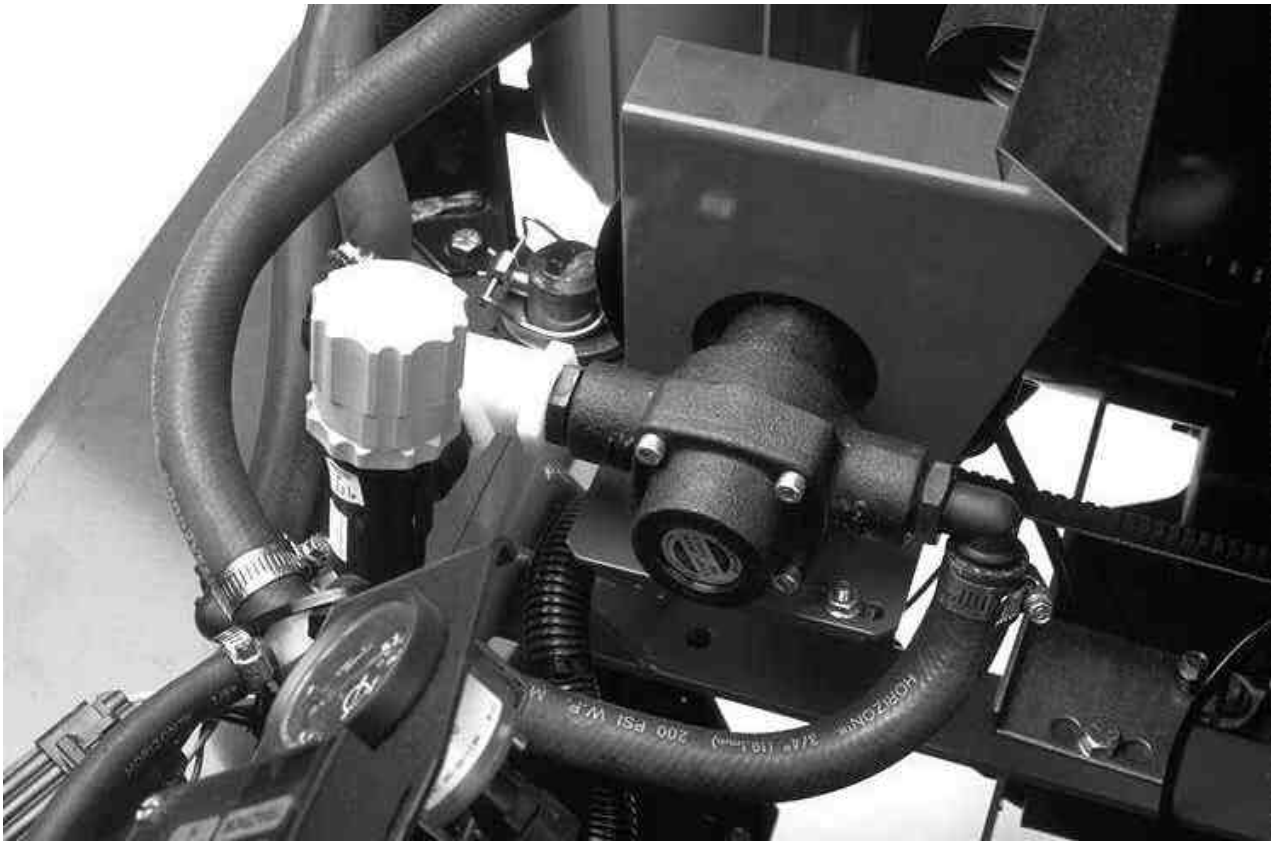
To flush the pre-filter, open the flush valve while the water is connected to the unit. This will clean the collected debris from the bottom of the pre-filter.

NOTE: In areas with high levels of water contamination, the flush valve can be left slightly open while operating the Hydroject® to keep the pre-filter clean.

NOTE: Opening the flush valve after initially connecting the supply hose will bleed air from the supply hose.

NOTES





Pressure Regulator Valve (3000 Hydroject® Only)

The pressure regulator valve is used to reduce the inlet water pressure, to protect the water filter and the rest of the water system from high-pressure water spikes.

Early units were not equipped with the pressure regulator but it can be installed.

NOTE: The pressure regulator is set to 90 PSI.

NOTE: Kit number for the pressure regulator\pre-filter kit. (92-9541).

NOTE: This kit also includes the pre-filter and all necessary water fittings.

Boost Pump (4000 Hydroject® Only)

The 4000 Hydroject® uses a boost pump to supply water to the system.

NOTE: There is a 90-PSI relief valve connected into the circuit to protect the system components.

NOTES

Water Filter

The water filter is a replaceable 5-micron cartridge filter located in a blue plastic housing.
It is located under the machine on the Hydroject® 3000 and on the top left side on the Hydroject® 4000.

NOTE: NEVER OPERATE THE MACHINE WITH OUT THIS FILTER. The filter stops harmful particles from entering the high-pressure water system.
Filter Element PN. 86-8630.
O-Ring PN. 92-9543.

Water Filter Replacement

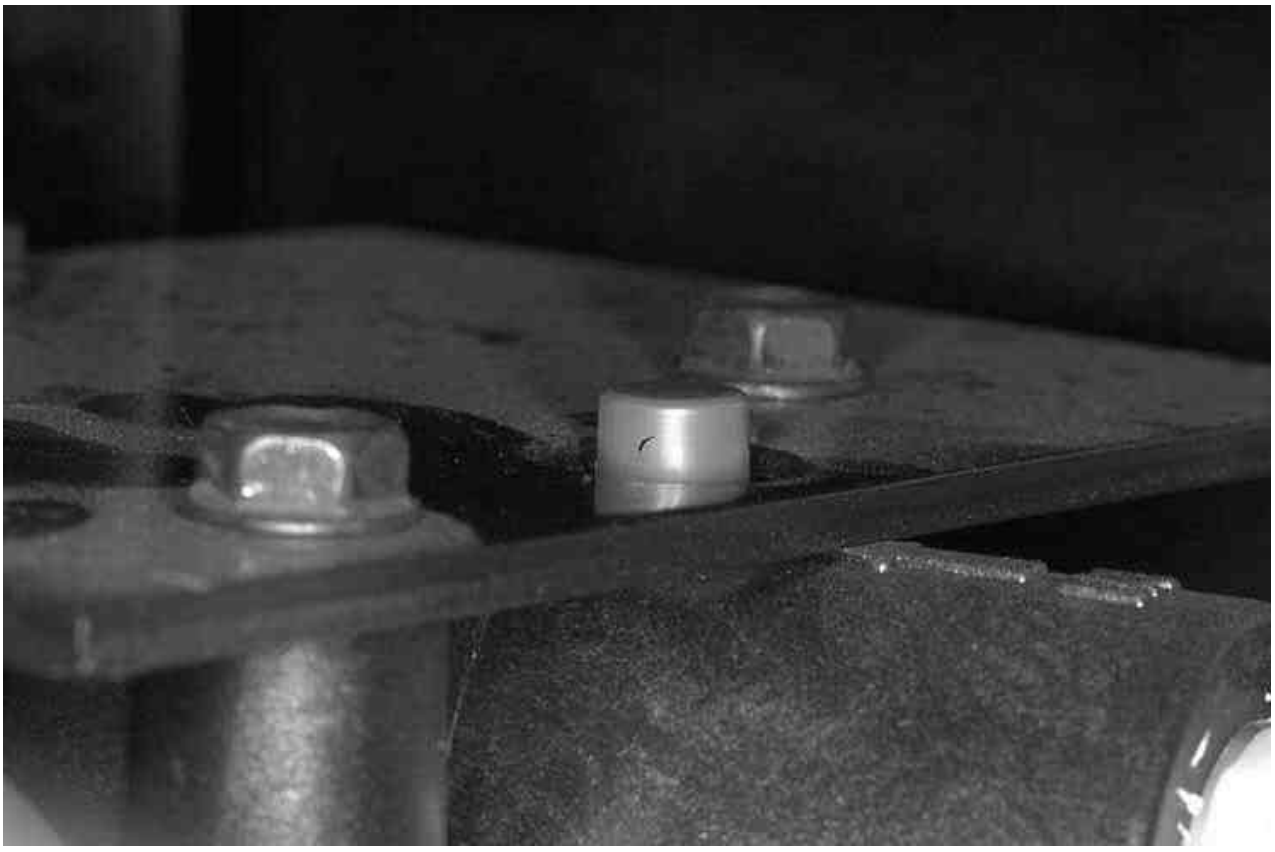
When the water pressure gauge reads low water pressure, this indicates that the water filter needs to be serviced.

Remove the filter body with the filter wrench and discard the old filter element.
Thoroughly clean the body and inspect the sealing O-Ring.
Install a new filter and lubricate the sealing O-Ring with a light coat of petroleum jelly.
Thread the filter body into the filter head, and hand tighten.

NOTE: Water quality will affect the service life of the filter.

NOTE: A filter wrench is included with each machine.

NOTES




0
20
40
60
80
100
PSI
kPa
300
600

Bleed Valve

Located on the top of the filter is a red water filter bleed valve. This valve is used to bleed air from the system after changing the filter or prior to aerating.

NOTE: The air must be bled from the system each time the water system is initially connected to, or reconnected to the supply hose.

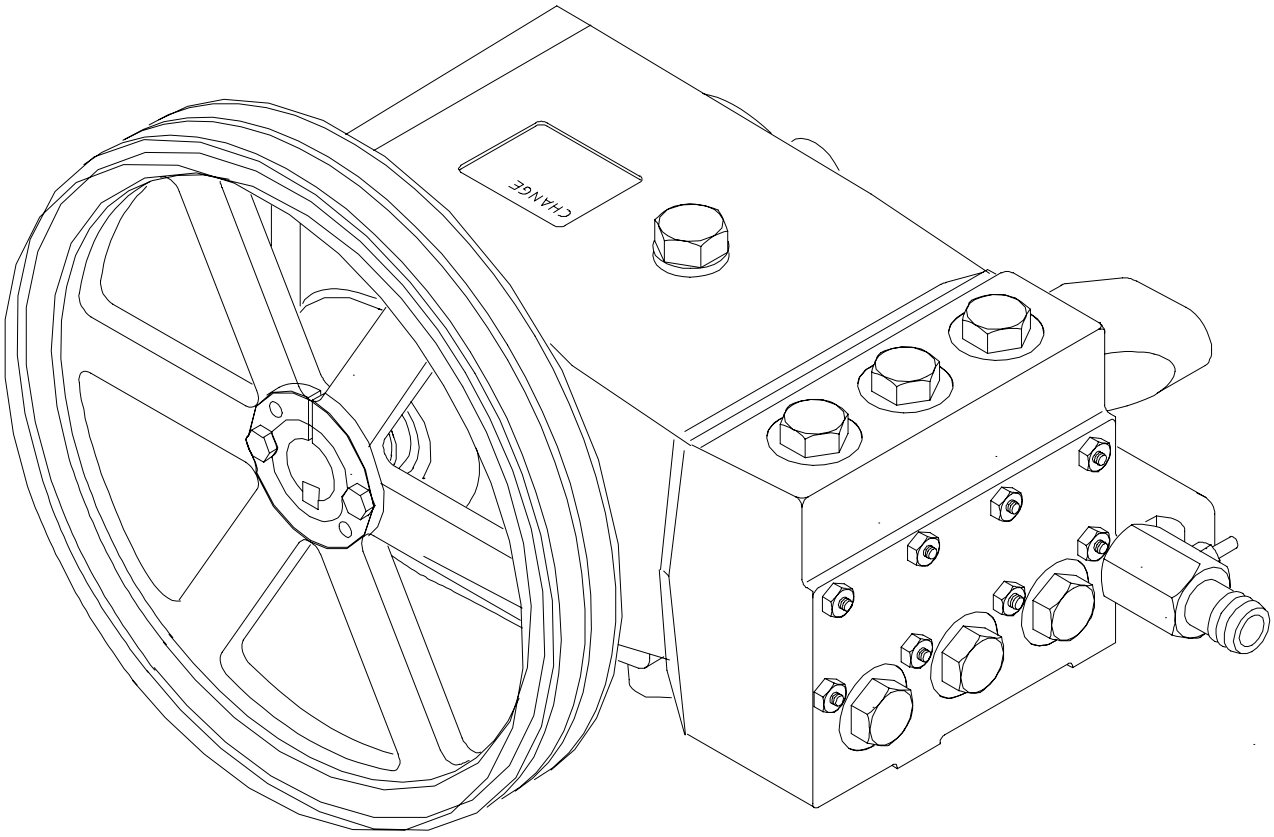
Water Pressure Gauge

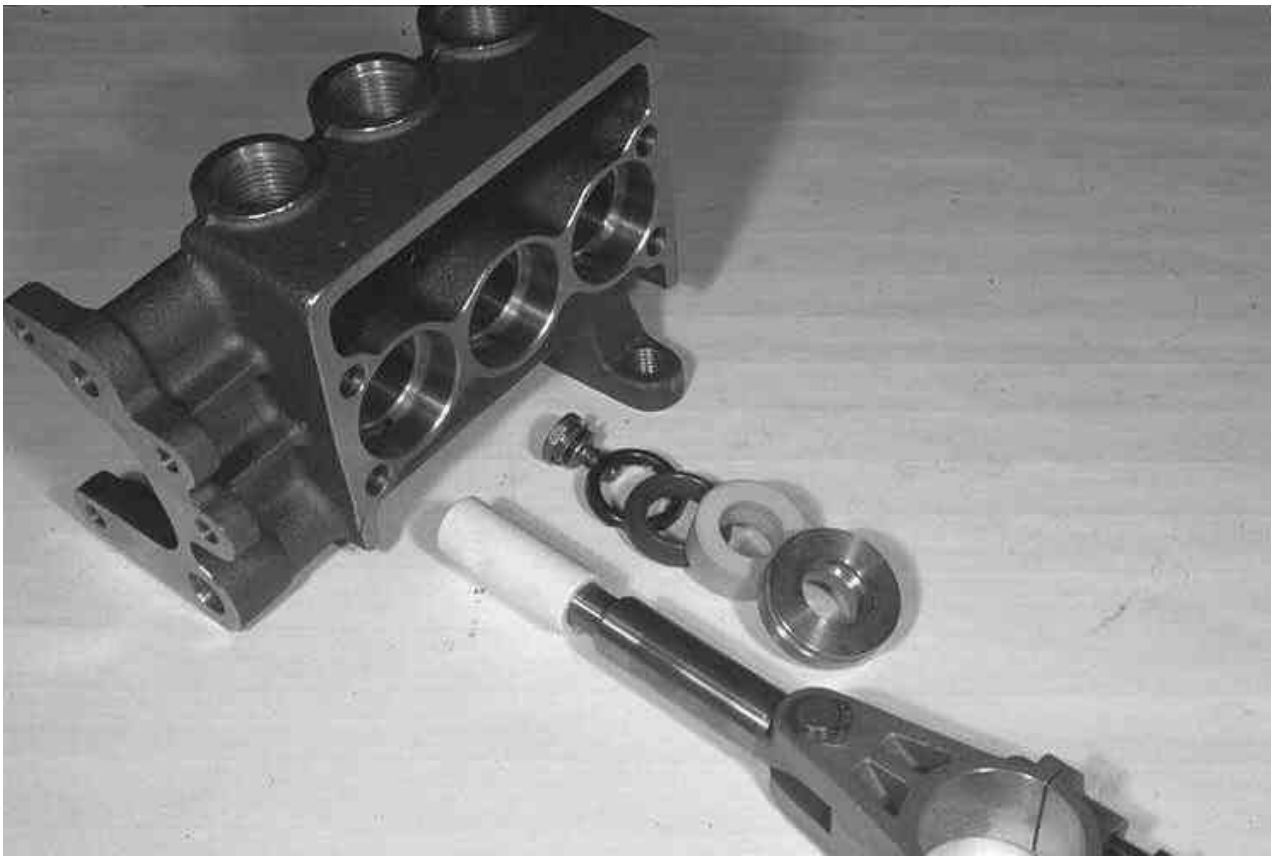
The water pressure supply gauge displays the water pressure available after the filter. Check this gauge to ensure the water system is pressurized. Check the gauge during operation to observe the pressure drop across the filter.

This gauge also includes a pressure sender. If the water inlet pressure drops below 20 PSI the sender will shut the water system down. (This prevents cavitation of the high-pressure water pump).

NOTE: A plugged pre-filter or water filter will cause the water pressure to drop below 20 PSI. This will shut the water system down.

NOTES


CHANGE



Water Pump

The current water pump is a Toro designed water pump. The pump supplies the pressurized water, which is stored in the accumulator.

The pump requires 3.4 to 4.0 GPM supply water flow to pressurize the system to 5000 PSI and maintain adequate water flow.

NOTE: The pump uses non-detergent 40-wt oil. Mobil (DTE EXTRA HEAVY).

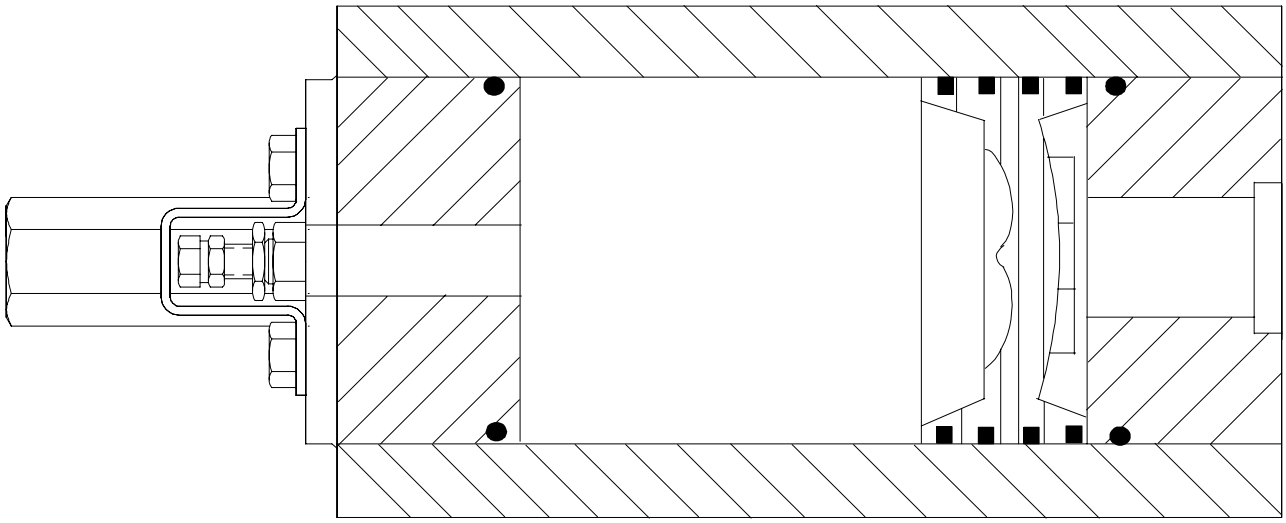
Water Pump Head

This is the internal components of the water pump head.

A steel sleeve with a sprayed on ceramic coating has replaced the ceramic sleeve on the end of the piston rod. (Longer life and less maintenance).

NOTES


DANGER



Piston Type Accumulator

The piston type accumulator stores high pressure water from the water pump.
The water is stored until it is needed for the injection cycle.
When the cycling valve opens, the high volume discharge is directed to the injection nozzles.

NOTE: The accumulator is precharged with 2500-PSI Dry Nitrogen.
NO SUBSTITUTE.

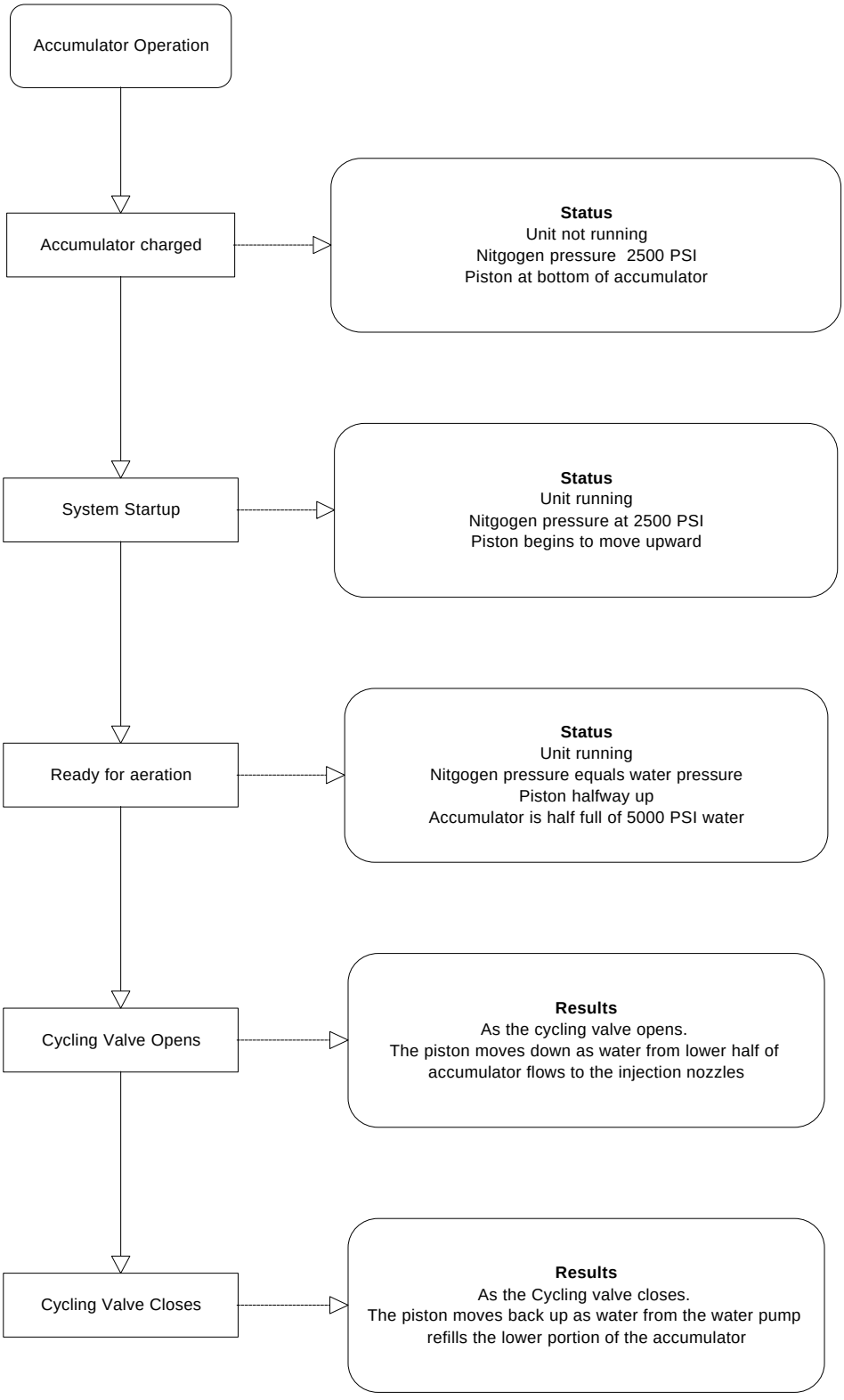
NOTE: Later units are equipped with a low nitrogen pressure switch.
This switch will not allow the water system to start, if the nitrogen precharge is below 1800 PSI.

Accumulator Components

The accumulator consists of the following components.

1. Accumulator body.
2. Top cap.
3. Bottom cap.
4. Piston and seals.
5. Nitrogen service valve. (test and recharge).
6. Low nitrogen switch.

NOTES


Accumulator Operation
Accumulator charged
Status
Unit not running
Nitgogen pressure 2500 PSI
Piston at bottom of accumulator
System Startup
Status
Unit running
Nitgogen pressure at 2500 PSI
Piston begins to move upward
Ready for aeration
Status
Unit running
Nitgogen pressure equals water pressure
Piston halfway up
Accumulator is half full of 5000 PSI water
Cycling Valve Opens
Results
As the cycling valve opens.
The piston moves down as water from lower half of accumulator flows to the injection nozzles
Cycling Valve Closes
Results
As the Cycling valve closes.
The piston moves back up as water from the water pump refills the lower portion of the accumulator

Accumulator Operation

Charged accumulator.

1. The accumulator will have a nitrogen pre-charge of 2500 PSI.
2. The piston is at the bottom the cylinder.
3. There is very little water in the bottom end.

Start up.

1. As the water pump begins to pump, water is forced into the accumulator.
2. The piston moves upwards as water is forced into the accumulator, compressing the nitrogen gas.
3. The nitrogen pressure and the water pressure are the same.

Ready for aeration.

1. The piston in the accumulator is about half way up.
2. The water pressure and the nitrogen pressure are the same. (approximately 5000-PSI) (relief valve setting).

Cycling valve opens.

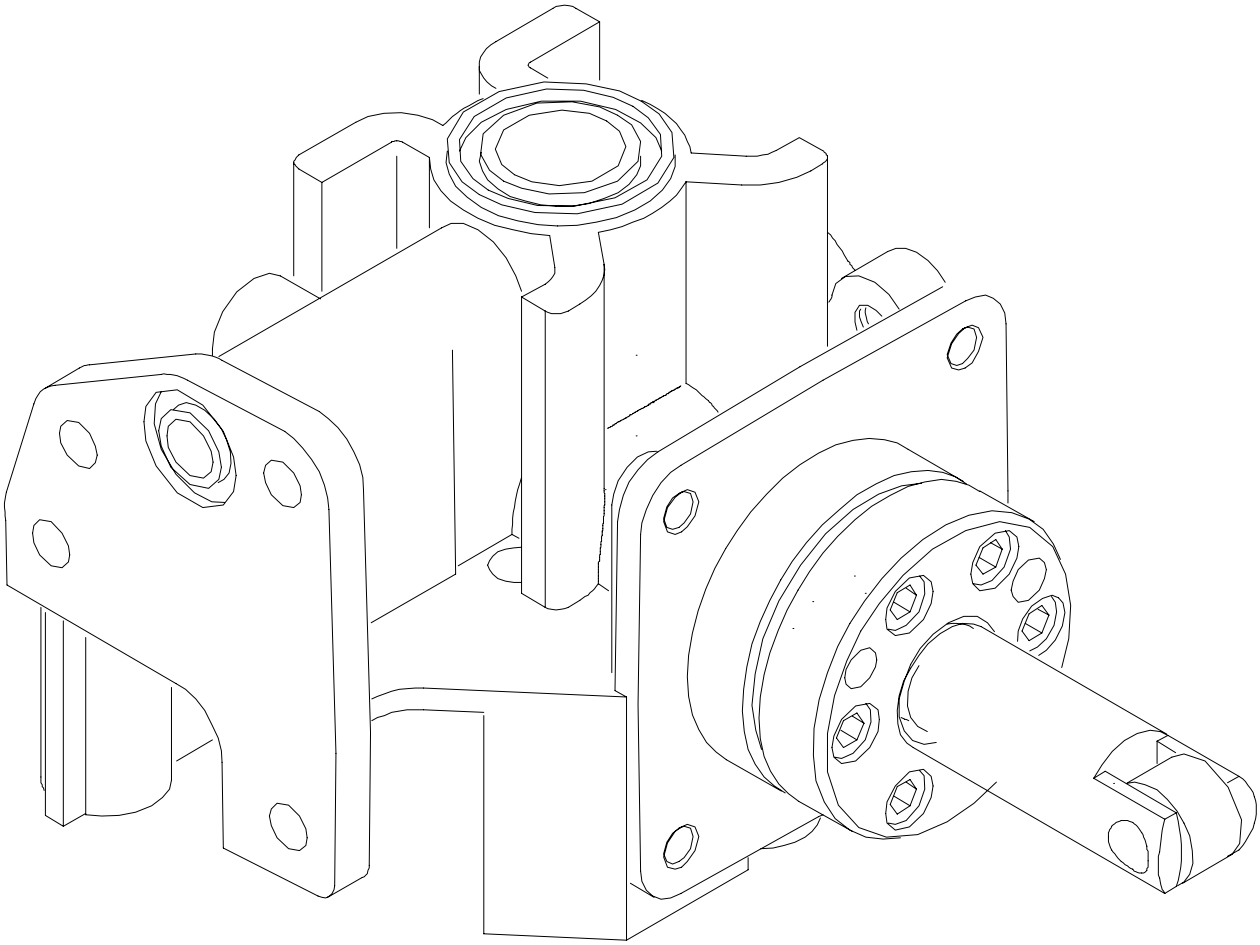
1. As the cycling valve opens water is discharged to the injection nozzles.
2. The piston moves downward. (approximately 1/4 in).

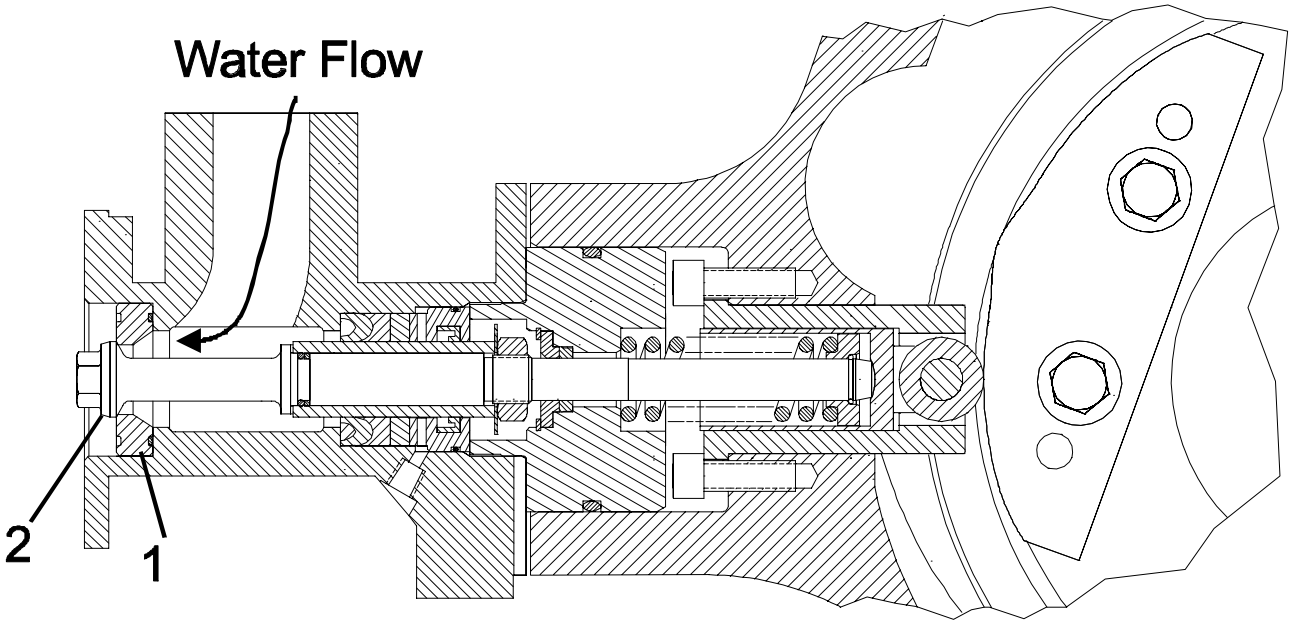
Cycling valve closes.

1. As the cycling valve closed the water stop flowing to the nozzles.
2. The water from the water pump, flows into the accumulator and the piston moves up.

The cycle begins again (5.3 times a second).

NOTES




Water Flow
2
1

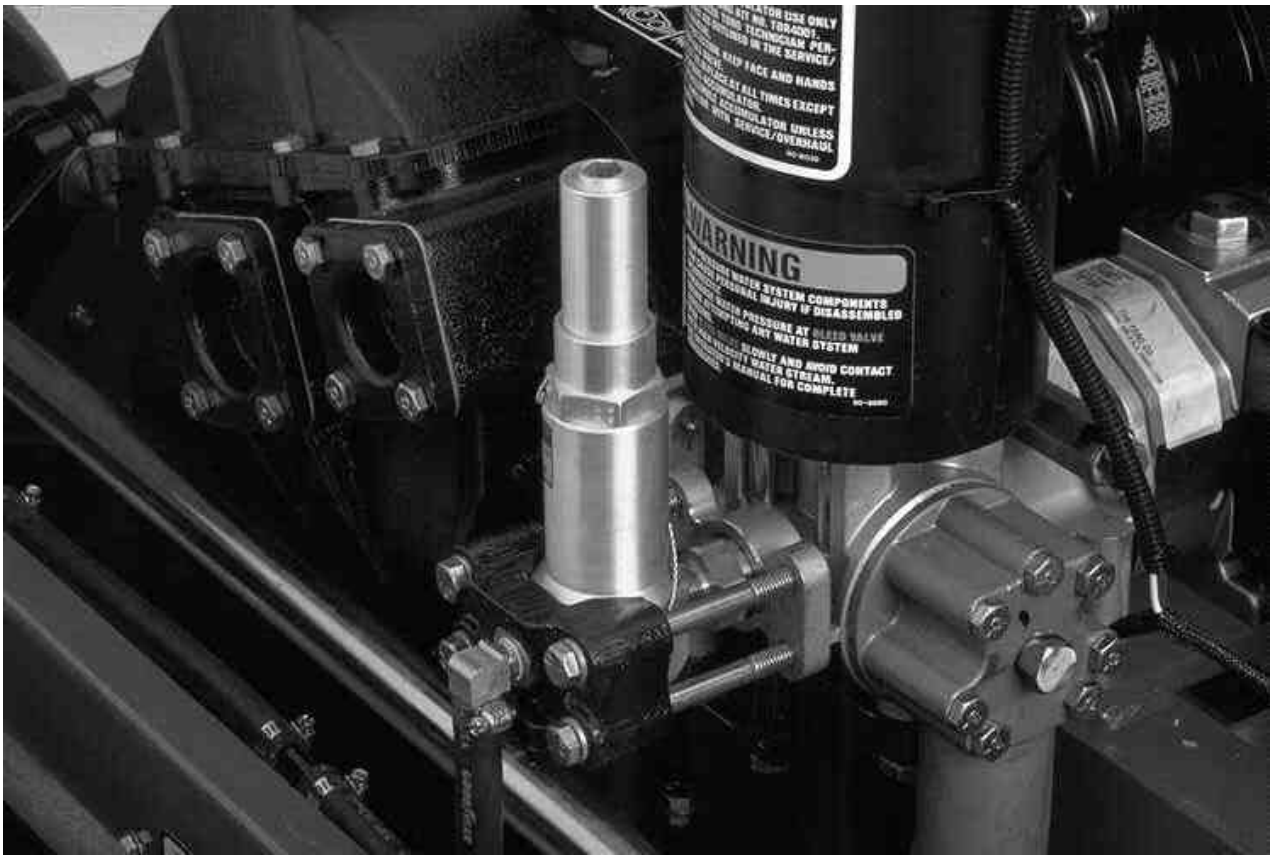
Water Cycling Valve

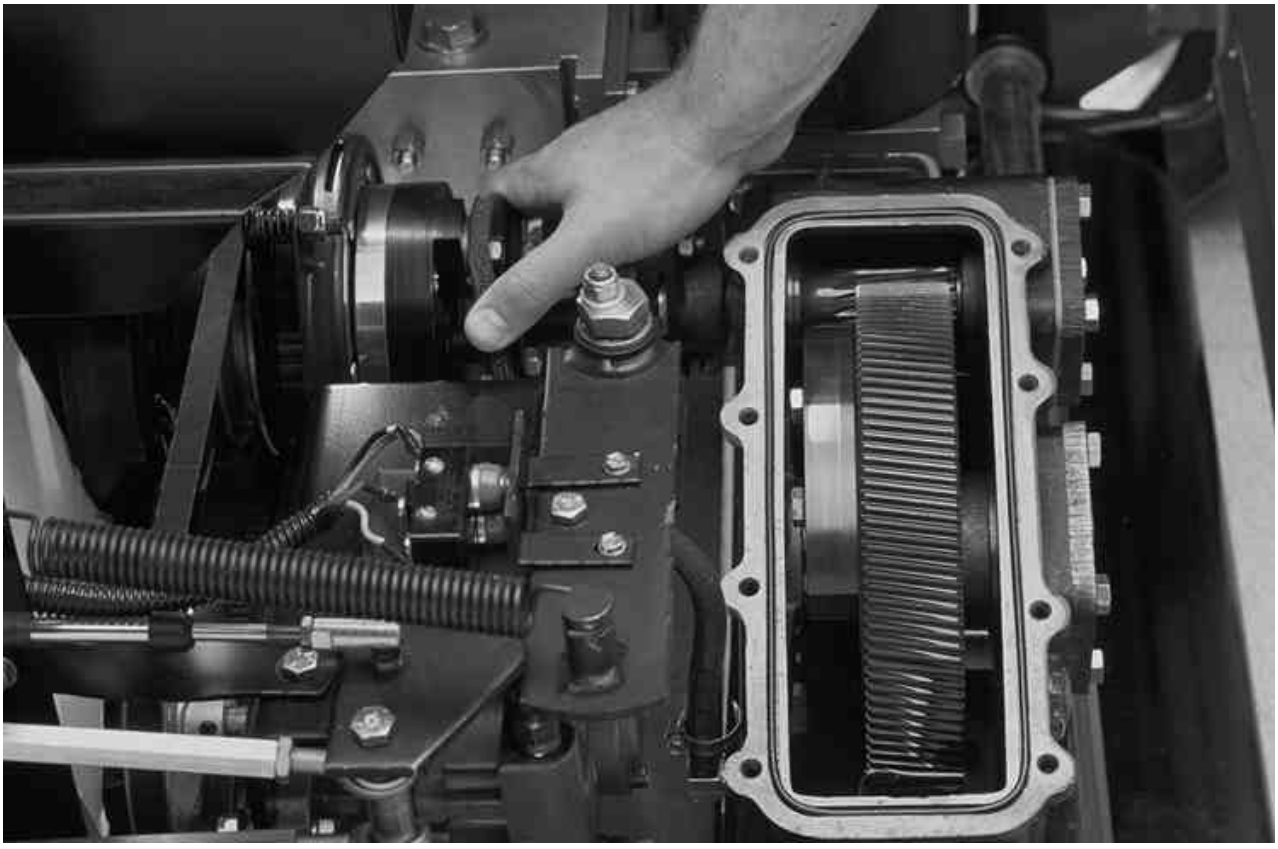
The water cycling valve is connected to the bottom of the accumulator.

The cycling valve is a cam driven valve.
The cycling valve releases the high-pressure water to the injection nozzles. The cycling valve opens at a rate of 5.3 times a second.

NOTE: The water is released as the spool, Item 2, lifts off the seat, Item 1.

NOTES


WARNING



Relief Valve

The relief valve limits the water pressure to 5000 PSI.

On the 3000, the extra water is bled off through the roller wash circuit.

On the 4000 the extra water is returned to the water inlet circuit.

NOTE: There is a complete rebuild kit available to rebuild the valve.
Part number 86-8550.

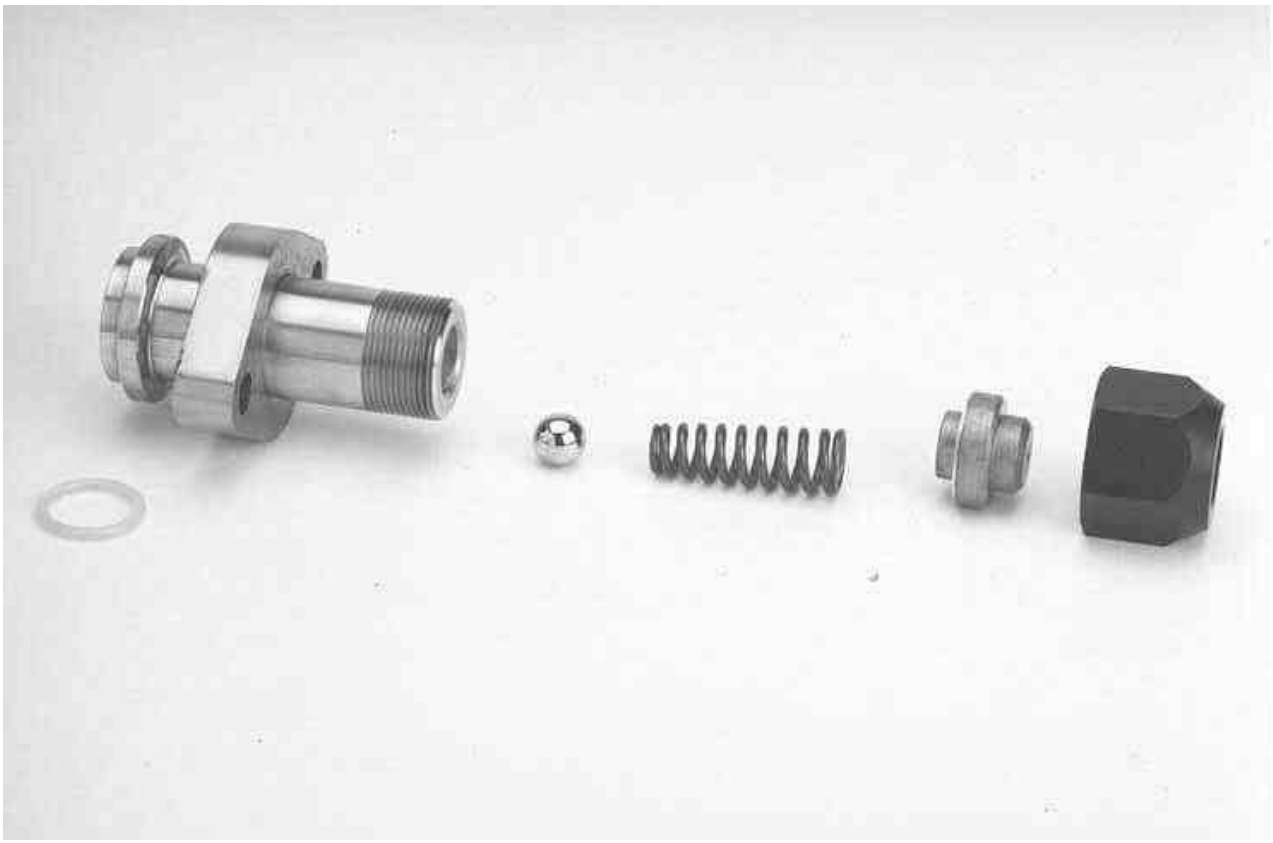
Gear Box

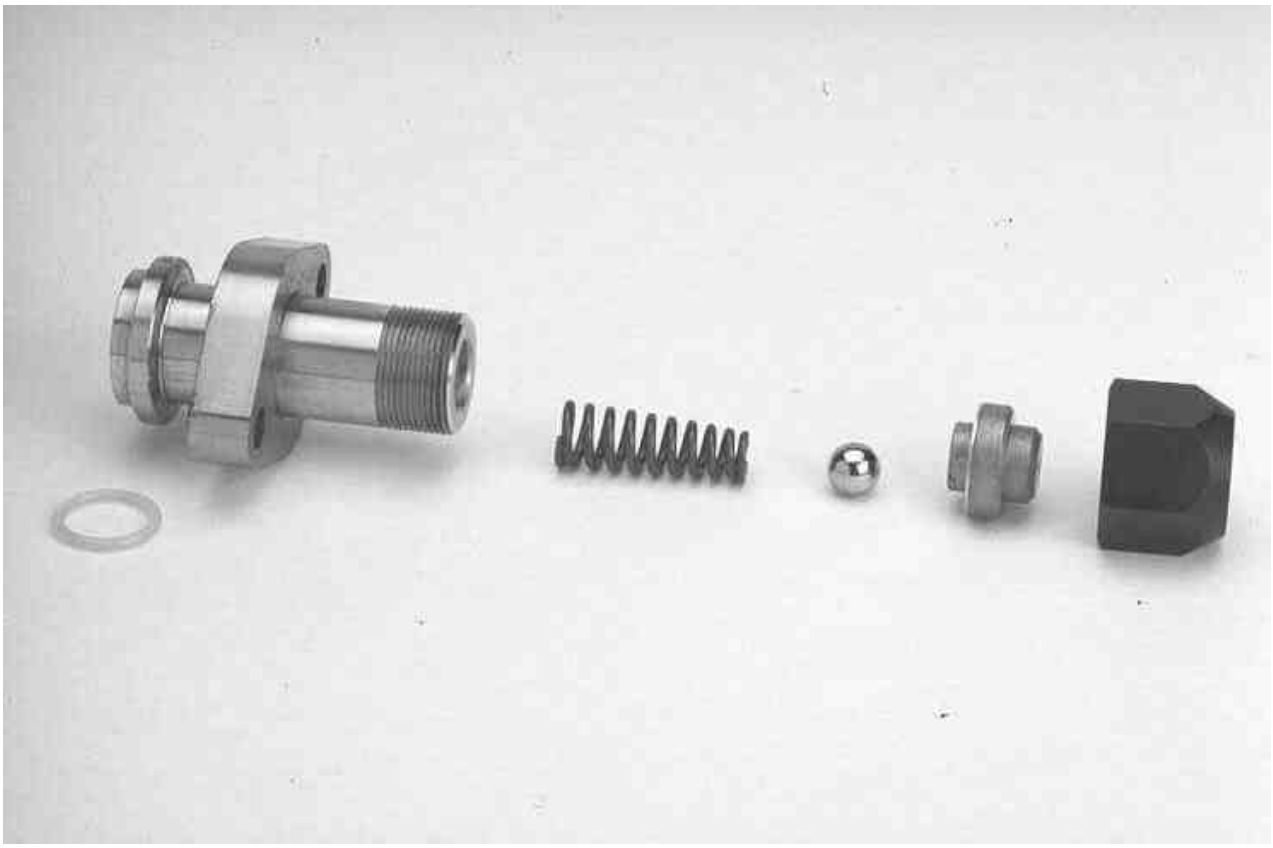
An engine driven cam gearbox operates the cycling valve.
The gearbox has a cam mounted to the face of the gear, which actuates the spool and opens the valve, releasing the high-pressure water.

The driven gear RPM is 320.

NOTE: The cam gearbox also serves as the oil reservoir for the hydrostatic transmission.
on the 3000 Hydroject®.

NOTES





Injection Nozzles

The Hydroject® is equipped with 11 injection nozzles. These nozzles convert the high pressure, high volume water into a high-pressure water jet that aerates the turf.

The injection nozzle consists of the nozzle body, check ball, spring, nozzle tip and nut.

The function of the ball and spring is the keep the high pressure manifold full of water between injection cycles. The check ball is unseated when the injection pressure reaches 110 PSI.

NOTE: Whenever a nozzle is removed or replaced, a new sealing washer should be used where the nozzle mounts to the manifold.

NOTE: With the new style nozzle, the nut is torqued to 70-80 ft.lbs.

Blocked Nozzle

Depending on the desired nozzle spacing and configuration, some nozzles may need to be blocked. This is done by disassembling the nozzle and reversing the ball and spring. By locating the ball at the bottom of the nozzle, this prevents water flow through the nozzle.

NOTES

Maintenance Parts

Air Filter	**82-0660**
Air Filter Foam Pre-cleaner	**82-0670**
Engine Oil Filter	**57-8530**
Fuel Filter	**71-5960**
Water Filter	**86-8630**
Water Filter Sealing O-Ring	**92-9543**
Pre-Filter screen	**86-9140**
Hydro Filter (3000 only)	**67-8110**

Helpful Hints

1. When servicing the air filter Pre-cleaner, add 1 tablespoon of engine oil to the foam and squeeze to remove excess.
2. Verify engine RPM to insure proper operation.
- Low Idle 1500 to 1800 RPM.
- High Idle 3450 to 3550 RPM.
3. Fluid Capacities.
- Engine oil 3 quarts No 30 wt oil.
- Cam gearbox, 4 to 5 quarts of mobile DTE 26 hydraulic oil.
- Water Pump, Approx. 40 ounces Mobile DTE extra heavy oil.
- Fuel Tank 10.5 gal. (9 gal. on Hydroject® 4000).

Review Questions

1. Excess water from the relief valve on the Hydroject® 3000 is routed to the:

A. Water inlet circuit.
B. Roller wash circuit.
C. Water filter.
D. Accumulator.

2. The Regulator limits water inlet pressure to:

A. 150 PSI.
B. 5000 PSI.
C. 90 PSI.
D. 2500 PSI.

3. Accumulator Precharge pressure is:

A. 150 PSI.
B. 5000 PSI.
C. 90 PSI.
D. 2500 PSI.

4. The boost pump relief valve on the Hydroject® 4000 is set at:

A. 150 PSI.
B. 5000 PSI.
C. 90 PSI.
D. 2500 PSI.

5. The accumulator is Pre-charged with:

A. Air.
B. Water.
C. Liquid Helium.
D. Dry Nitrogen.

6. The main water filter should be cleaned when dirty:

A. True.
B. False.

7. What is the correct air gap for the electric clutches:

A. .250 inch.
B. .018 inch.
C. 1 inch.
D. .0018 inch.

8. The hydrostatic drive on the Hydroject® 3000 has a separate oil reservoir:

A. True.
B. False.

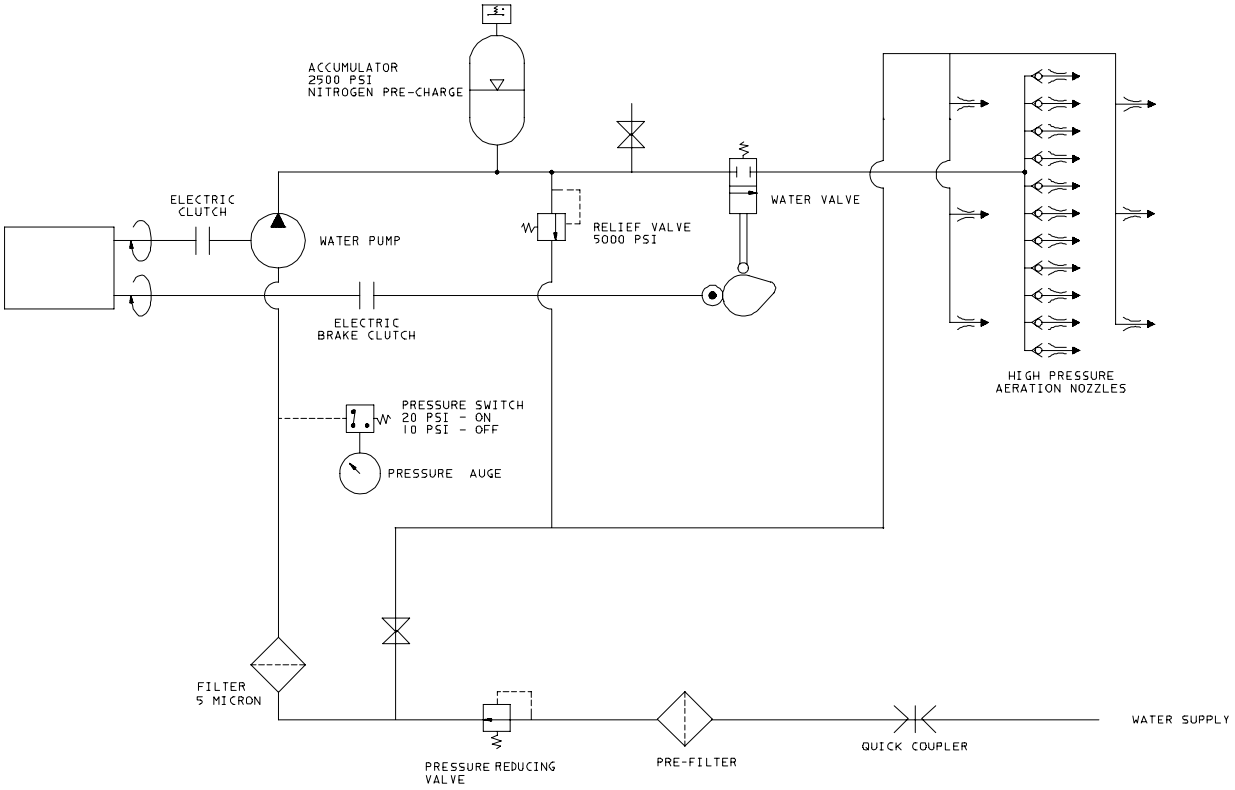
9. Hole spacing on the Hydroject® 4000 is controlled by the hole spacing lever:

A. True.
B. False.

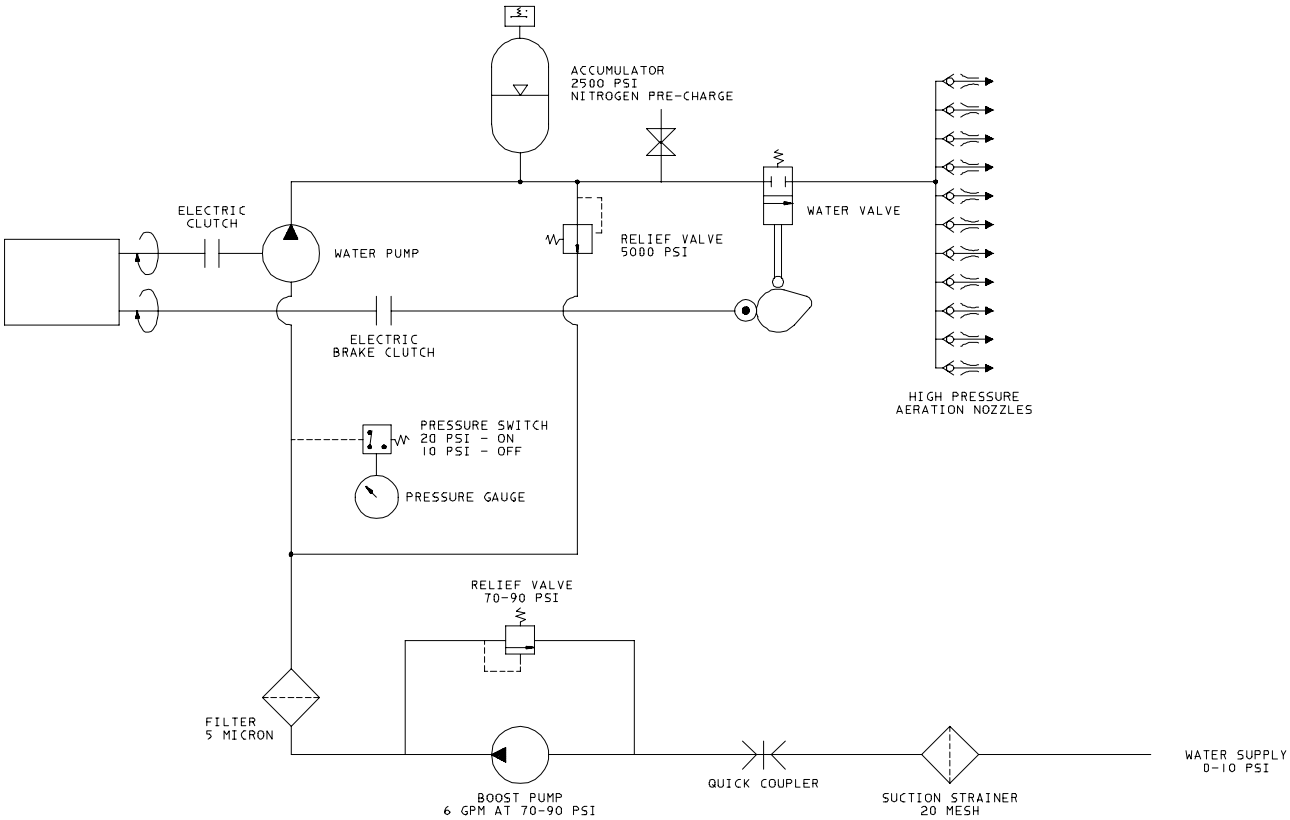
10. On the Hydroject® 3000, which machine function control is not located in the tiller handle:

A. Aerate engage.
B. Aerate disengage.
C. Hole spacing.
D. Hydrostatic drive direction.
E. Transport / aerate switch. (lift and lower).

Hydroject® 3000



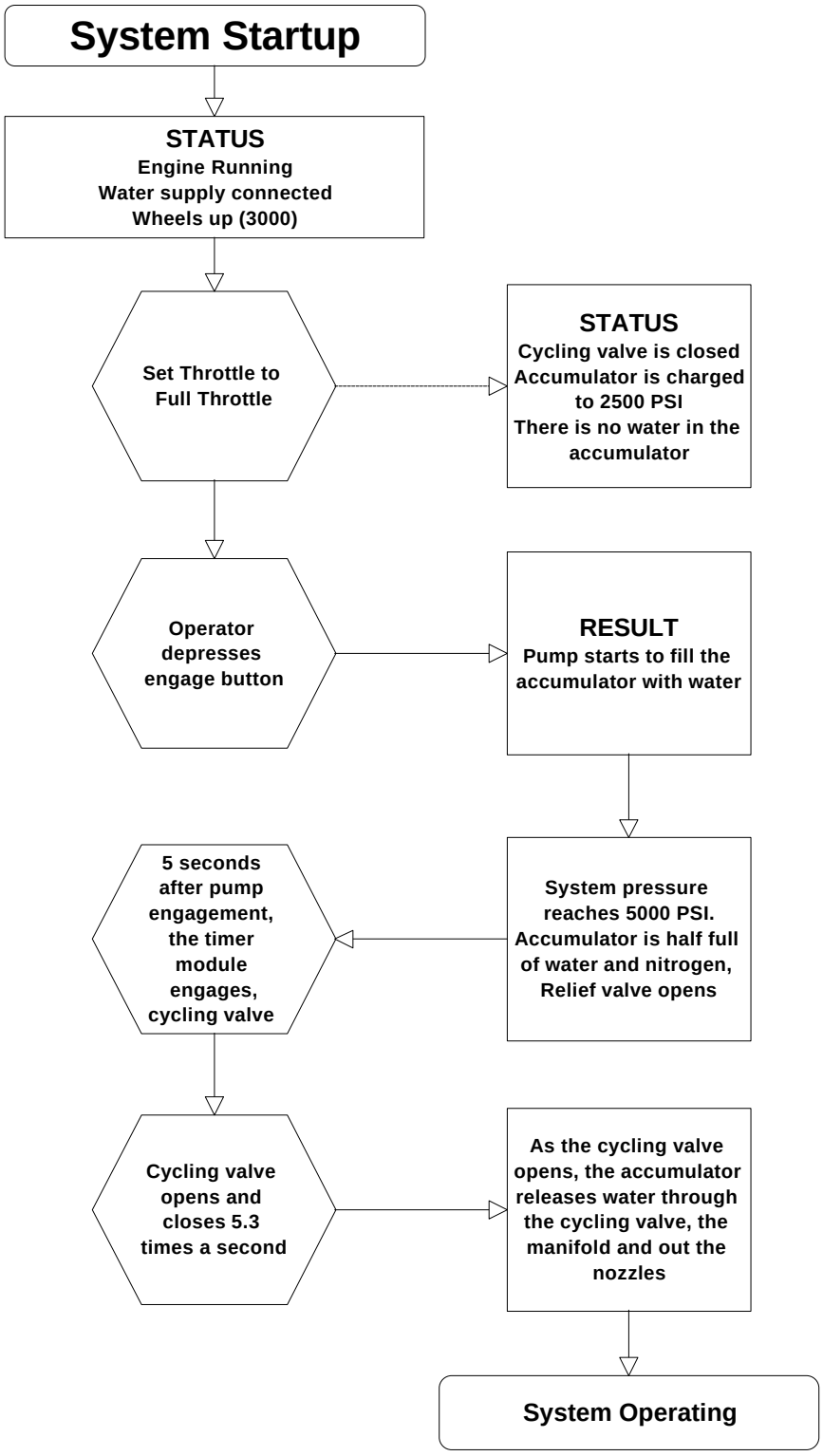
Hydroject® 4000



System Operation

1. Water is supplied to the unit by a water supply hose or a portable water supply tank.
2. The water passes through the pre-filter
3. On the Hydroject® 3000 the inlet water flows to the pressure-reducing valve, where the water pressure is reduced to 90 PSI.
4. The Hydroject® 4000 does not have the pressure-reducing valve, it is replaced by a water boost pump. The boost pump supplies water to the unit.
5. The water then flows through the main 5-micron inlet filter.
6. The water then flows to an engine driven water pump. The water pump is capable of delivering water in excess of 5000 PSI.
7. The water is then pumped to the accumulator. The accumulator stores the high-pressure water until it is needed at the aeration nozzles.
8. The relief valve limits the water pressure to 5000 PSI.
9. The water valve (cycling valve) is a cam-operated valve driven by the unit's engine. This valve opens and closes to direct the high-pressure water stream to the aeration nozzles.
10. From the cycling valve the water flows to the aeration nozzles, the nozzles contain a spring-loaded check ball which prevents water from leaking out of the manifold and air getting in the system.

NOTES


System Startup
STATUS
Engine Running
Water supply connected
Wheels up (3000)
Set Throttle to Full Throttle
STATUS
Cycling valve is closed
Accumulator is charged to 2500 PSI
There is no water in the accumulator
Operator depresses engage button
RESULT
Pump starts to fill the accumulator with water
5 seconds after pump engagement, the timer module engages, cycling valve
System pressure reaches 5000 PSI.
Accumulator is half full of water and nitrogen,
Relief valve opens
Cycling valve opens and closes 5.3 times a second
As the cycling valve opens, the accumulator releases water through the cycling valve, the manifold and out the nozzles
System Operating

System Startup

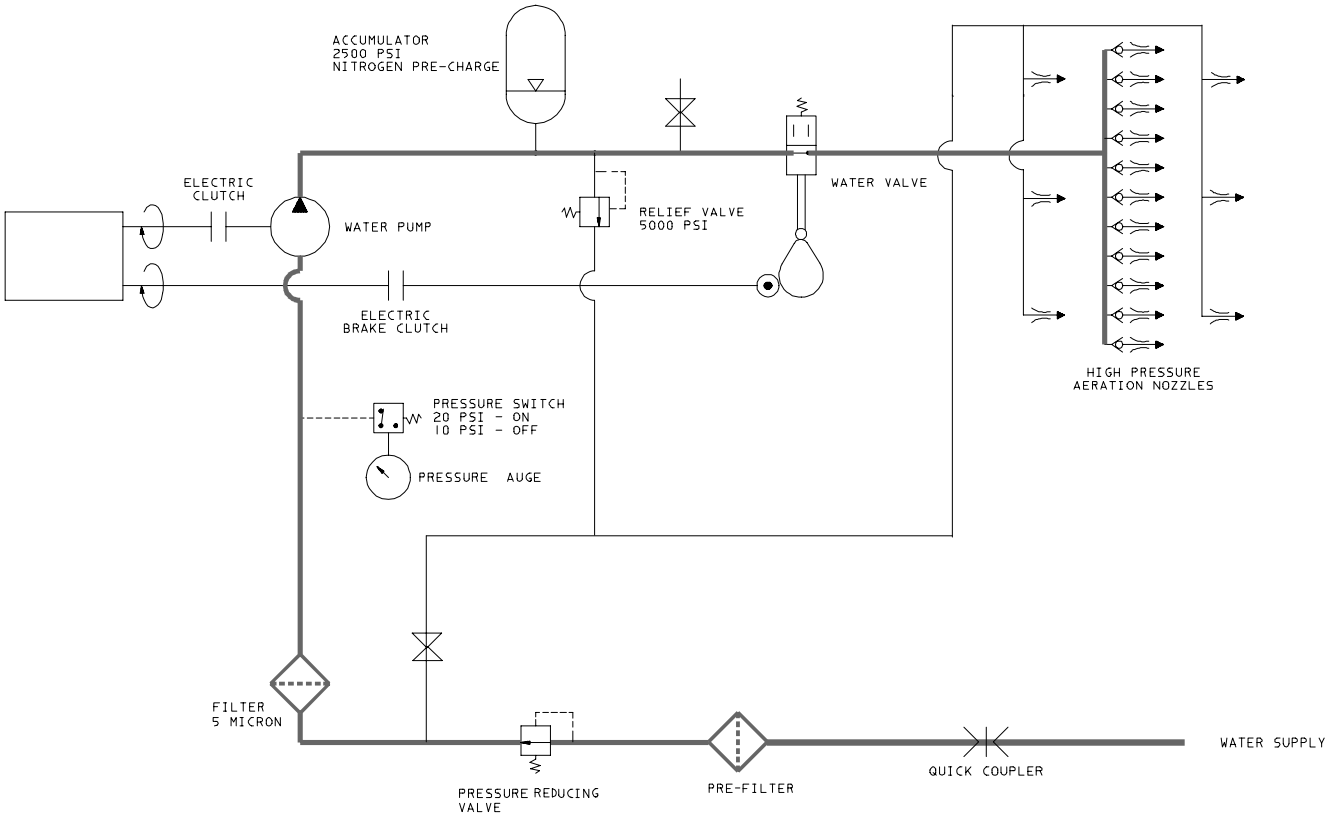
1. With the engine running, water supply connected
- The transport wheels up (3000 only).
- The accumulator is charged to 2500 PSI.
- The cycling valve is closed.

2. The operator must set the throttle to high idle. 3500 ± 50

3. The operator presses the red engage button.
- When the engage switch is pushed the pump starts to pump.
- The cycling valve is closed so the pump forces water into the accumulator.
- The accumulator is half full of nitrogen and water.
- The water pressure builds to 5000 PSI and the relief valve opens.

4. The timer module engages the cycling valve clutch after about 5 seconds.
- The cycling valve open about 5.3 times a second.
- Water flows through the cycling valve to the high-pressure manifold and out the nozzles.

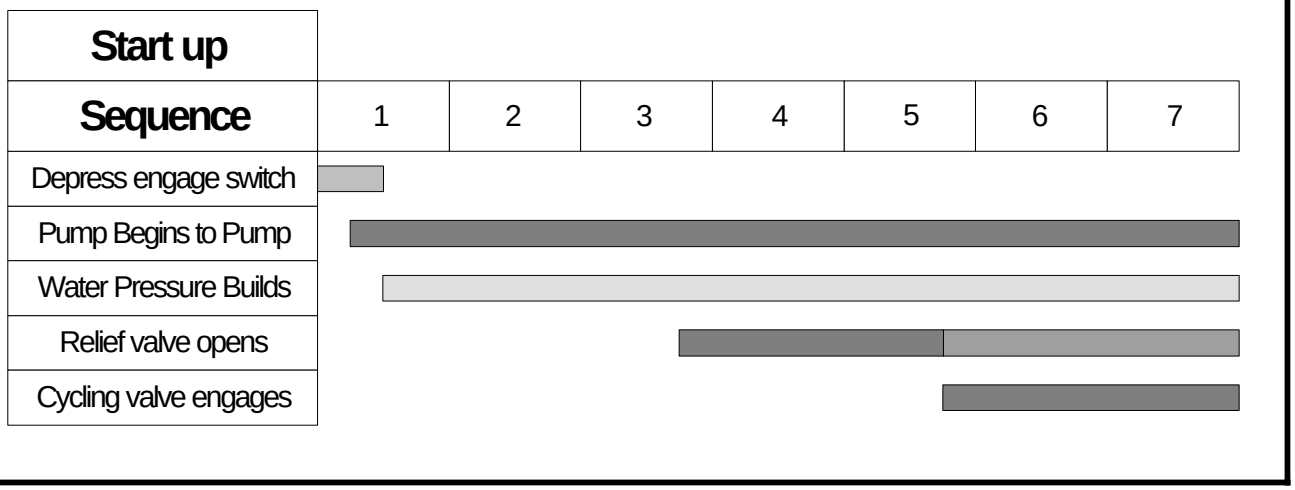
NOTES

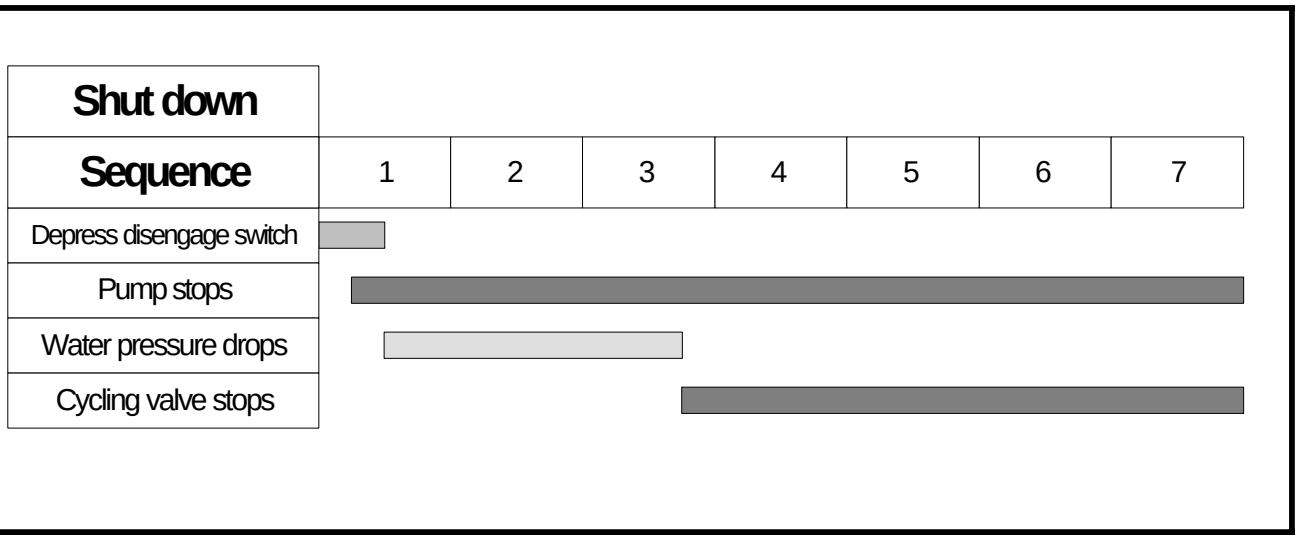

ACCUMULATOR
2500 PSI
NITROGEN PRE-CHARGE
ELECTRIC
CLUTCH
WATER PUMP
RELIEF VALVE
5000 PSI
WATER VALVE
ELECTRIC
BRAKE CLUTCH
HIGH PRESSURE
AERATION NOZZLES
PRESSURE SWITCH
20 PSI - ON
10 PSI - OFF
PRESSURE AUGE
FILTER
5 MICRON
PRESSURE REDUCING
VALVE
PRE-FILTER
QUICK COUPLER
WATER SUPPLY

Water Flow Through the System

1. Water enters the unit through the pre-filter.
2. The water then flows to the engine driven pump.
3. The water flow is stopped at the cycling valve and is forced into the accumulator.
4. When the cycling valve opens, the water is allowed to flow to the nozzles.

NOTES


Start up
Sequence
1
2
3
4
5
6
7
Depress engage switch
Pump Begins to Pump
Water Pressure Builds
Relief valve opens
Cycling valve engages


Shut down
Sequence
1
2
3
4
5
6
7
Depress disengage switch
Pump stops
Water pressure drops
Cycling valve stops

Start Up Sequence

1. When the engage switch is depressed.
2. The pump begins to pump.
3. Water pressure starts to build almost immediately.
4. After about three seconds, the water pressure reaches about 5000 PSI and the relief valve opens.
5. After about five seconds, the timer module engages the cycling clutch, and the cycling valve begins to open. (The relief valve opens and closes to limit maximum pressure to 5000 PSI).

Shut Down Sequence

1. The operator depresses the disengage switch.
2. The pump stops.
3. Water pressure begins to drop (the pump has stopped but the cycling valve continues to operate).
4. After about 3 seconds the cycling valve clutch is disengaged and the cycling valve stops.
   (The cycling valve continues to run after the pump stops, to bleed some of the pressure from the water circuit).

NOTES

Section Review

1. Inlet water quality is extremely important to the overall life of the water system.

2. During the initial start up, the pump will operate for 5 seconds before the cycling valve opens. During these 5 seconds, the pressure should initially go up to 4500-5000 PSI and then the relief valve should open.

3. On the Hydroject® 3000, when the relief valve opens, you should hear water spraying from the roller wash nozzles.

4. High-pressure water supplied by the pump, is stored in the accumulator until needed.

5. After about 5 seconds the cycling valve opens and aeration starts.

Review Questions

1. During start up, the components start in this order:

A. Cycling valve, relief valve, water pump.
B. Water pump, relief valve, cycling valve.
C. Relief valve, cycling valve, water pump.
D. Water pump, cycling valve, relief valve.

2. The engagement of the cycling valve is controlled by the accumulator pressure switch.

A. True.
B. False.

3. The water pump is engaged when:

A. The water pressure reaches 90 PSI.
B. The operator depresses the engage switch.
C. 4 seconds after the cycling valve engages.
D. When the unit is in neutral.

4. The cycling valve is engaged when:

A. The water pressure reaches 90 PSI.
B. The operator depresses the engage switch.
C. 4 seconds after the Water pump engages.
D. When the unit is in neutral.

5. When aerating the unit is operated at :

A: Low idle.
B. High idle 3500 RPM.
C. Mid idle 2800 RPM.

6. High pressure water is stored in the accumulator until needed.

A. True.
B. False.

7. The cycling valve opens:

A. 1 time per second.
B. 7.1 times per second.
C. Whenever the engine is running.
D. 5.3 times a second.

8. During shut down the components stop in this order:

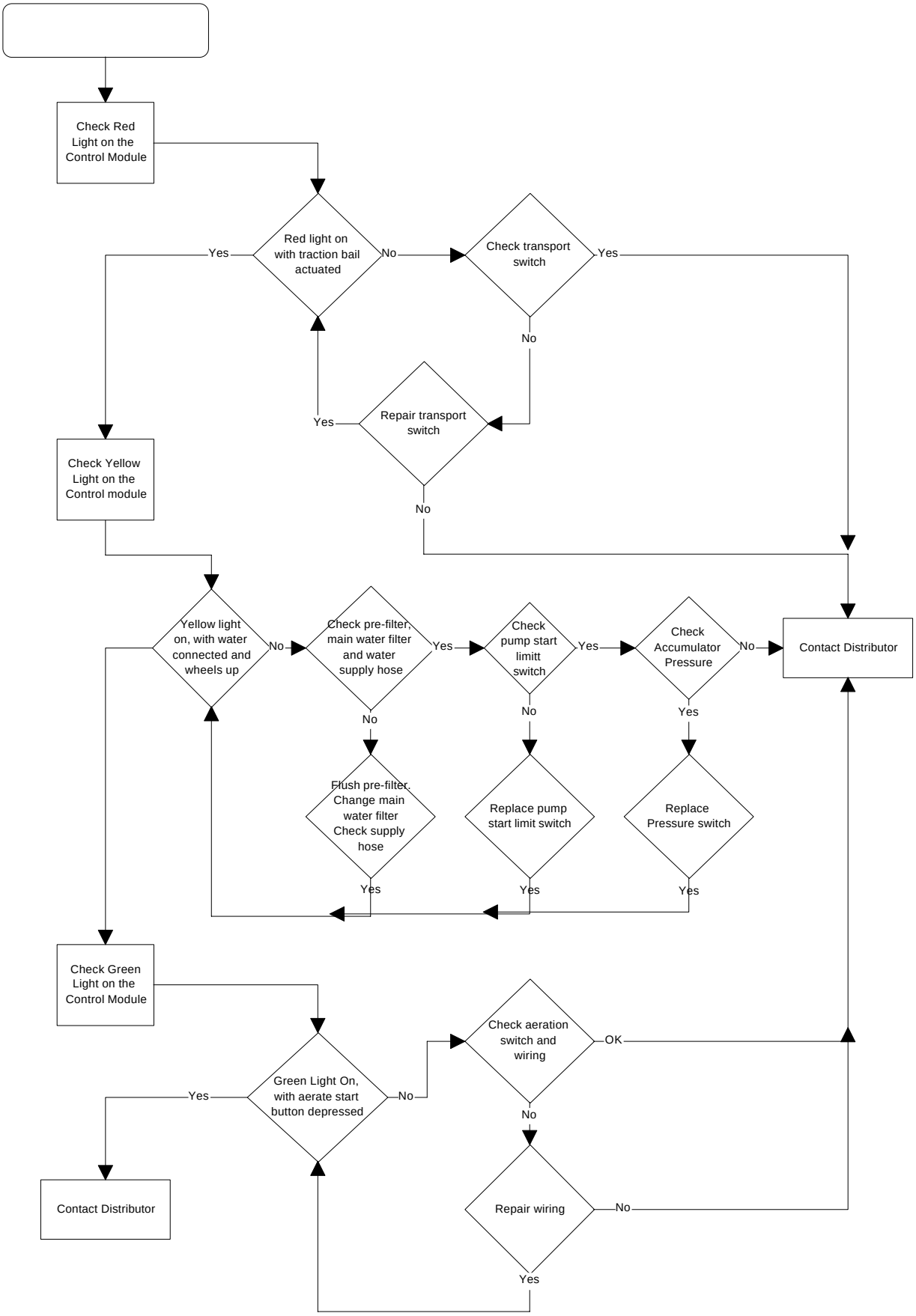
A. Cycling valve, relief valve, water pump.
B. Water pump, relief valve, cycling valve.
C. Relief valve, cycling valve, water pump.
D. Water pump, cycling valve, relief valve.

9. The timer control module controls aeration start up and shut down.

A. True.
B. False.

10. During shutdown, the cycling valve runs after the water pump stops:

A. True.
B. False.


Check Red Light on the Control Module
Red light on with traction bail actuated
Yes
No
Check transport switch
Yes
No
Repair transport switch
Yes
No
Check Yellow Light on the Control module
Yellow light on, with water connected and wheels up
No
Check pre-filter, main water filter and water supply hose
Yes
Check pump start limitt switch
Yes
Check Accumulator Pressure
No
Contact Distributor
No
Yes
No
Flush pre-filter. Change main water filter Check supply hose
Replace pump start limit switch
Replace Pressure switch
Yes
Yes
Yes
Check Green Light on the Control Module
Green Light On, with aerate start button depressed
Yes
No
Check aeration switch and wiring
OK
No
Contact Distributor
Repair wiring
No
Yes

Operational Checks, 3000

1. Check red light on the control module.
   - The red light is on whenever the unit is moving, or the traction control linkage is not in neutral.
   - The red light is on while the unit is aerating.

If the red light is not on, check the transport switch, and the switch wiring. This is the bottom switch on the hydrostatic pump control lever. Repair or replace the switch or wiring as needed. If the switch and wiring is OK, contact your distributor.

2. Check the yellow light on the control module.
   - The yellow light is on whenever the following conditions are met.
   - Water supply pressure over 20 psi.
   - Wheels up.
   - Accumulator pressure over 1800 psi.

If the yellow light is not on, check the water inlet pressure at the pressure gauge. If pressure is inadequate, check the pre-filter, main water filter, and supply hose. If the water pressure is adequate check the pump start limit switch, this is the switch on the transport axle. The switch should be closed when the wheels are up, (unit down).

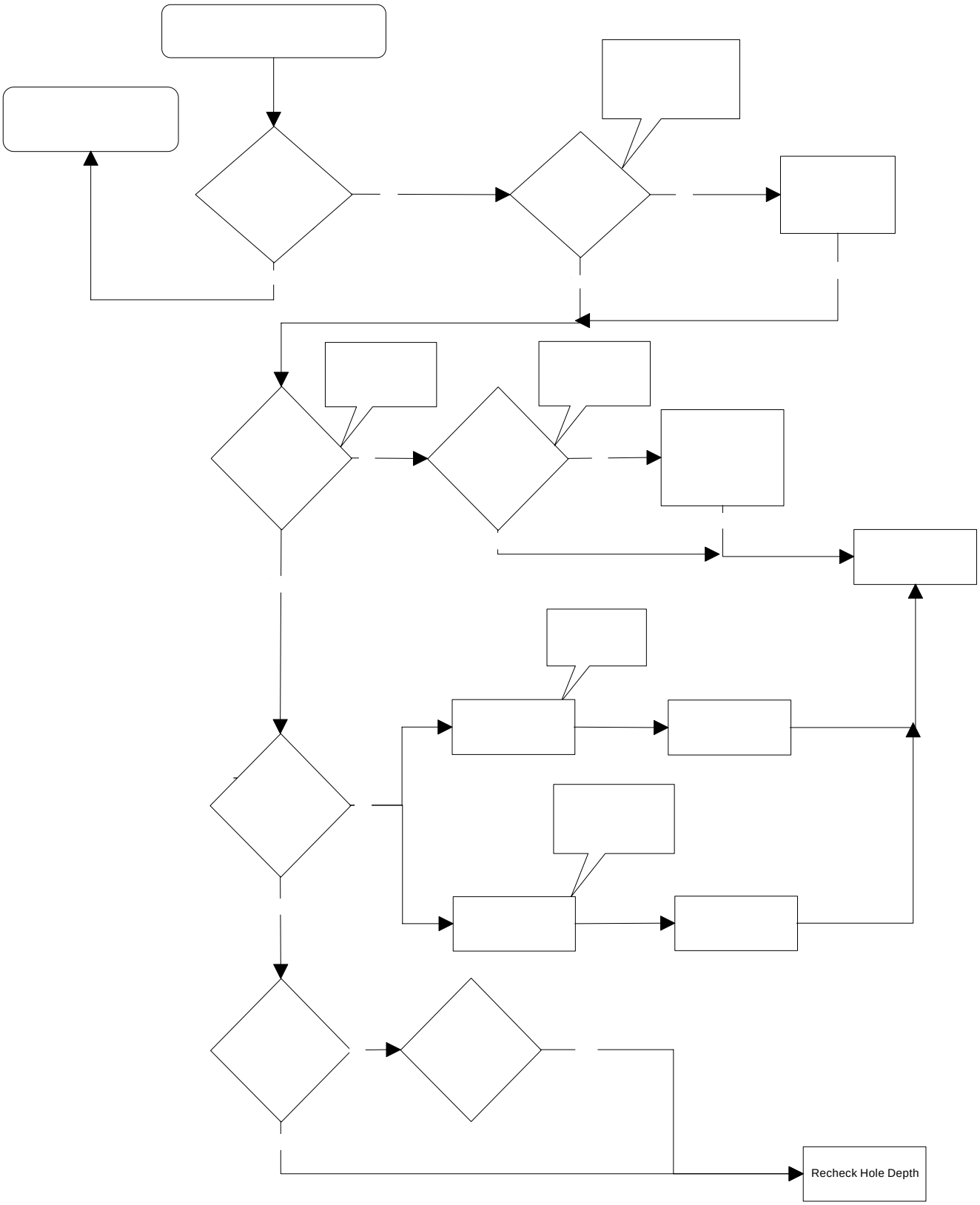
Replace switch as needed.

The final check is the accumulator pressure. If accumulator pressure is below 1800 psi the accumulator switch will be open and the light will not be on. Contact your distributor to have accumulators checked or serviced.

3. Check the Green light on the control module.
   - The green light is on when the aerate switch is pressed.
   - This light stays on while the unit is aerating.

If this light does not light when the aerate switch is depressed check the switch and wiring. Repair or replace as necessary.

NOTES


Recheck Hole Depth

Complaint: Shallow Hole Depth

1. Test high pressure water.
   - Low water pressure can be an indication of a faulty relief valve or water pump.
     - To check the high pressure water circuit, disconnect the wire to the cycling valve and remove the return hose from the relief valve.
     - With the pressure gauge connected to the water system, engage the water system and check the pressure. Should be 5000 psi.
     - If the pressure is low, repair or replace the relief valve.

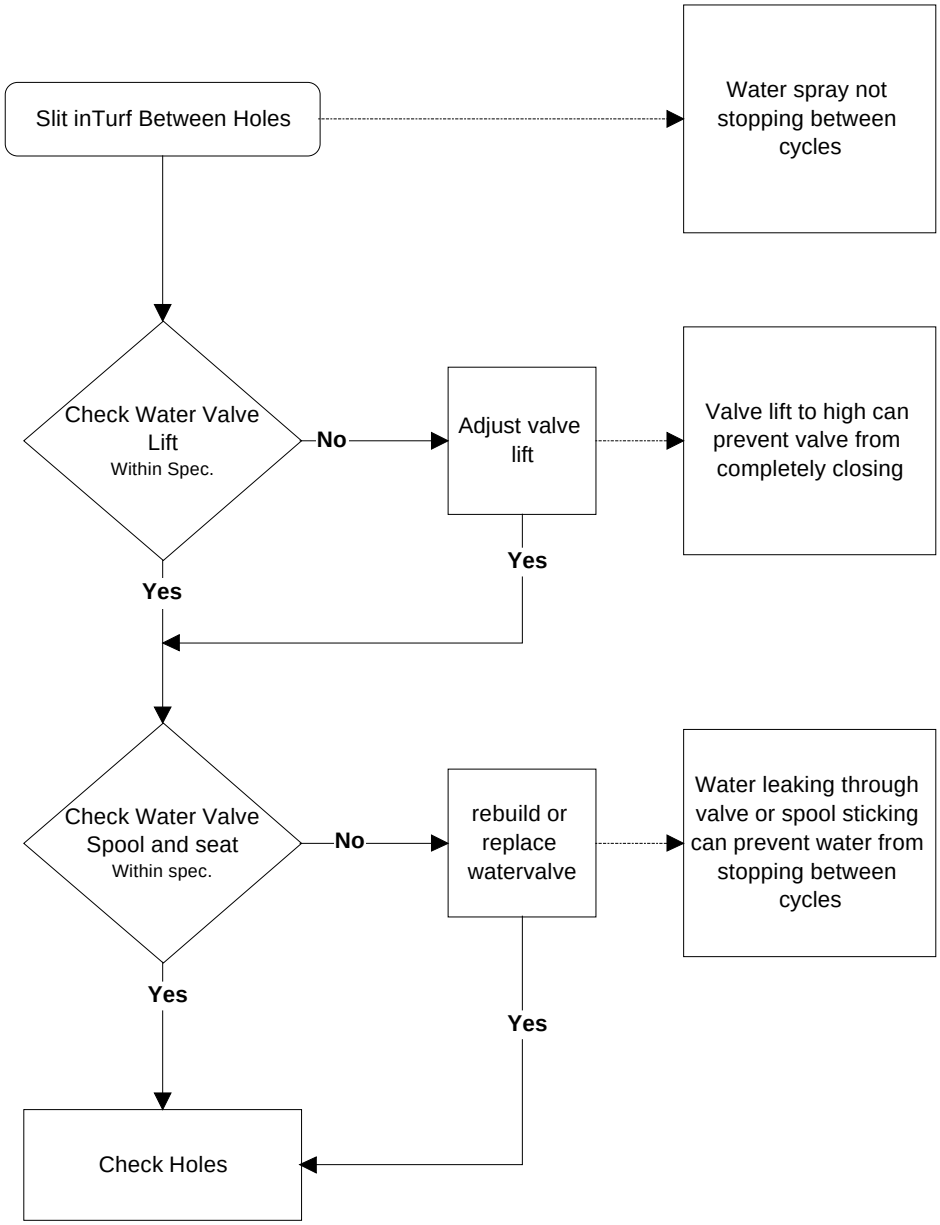
2. Test water flow.
   - Low water flow can be an indication of a water supply problem or a pump problem. If there is a water supply problem the yellow light on the control module will be off. If the light is on there is adequate water supply and the problem could be with the pump.
   - Repair or replace the pump as necessary.

.

3. Test accumulator pressure.
   - The accumulator stores high pressure water until the cycling valve opens.
   - Accumulator pressure effects the water available for delivery.
     - Low pressure caused by nitrogen leaking from the accumulator.
     - High pressure caused by water leaking past the O-Rings. (trapped on top of the pistons).

4. Check nozzle hole size.
   - Worn aeration nozzles will increase water flow and decrease the aeration pressure.

NOTES

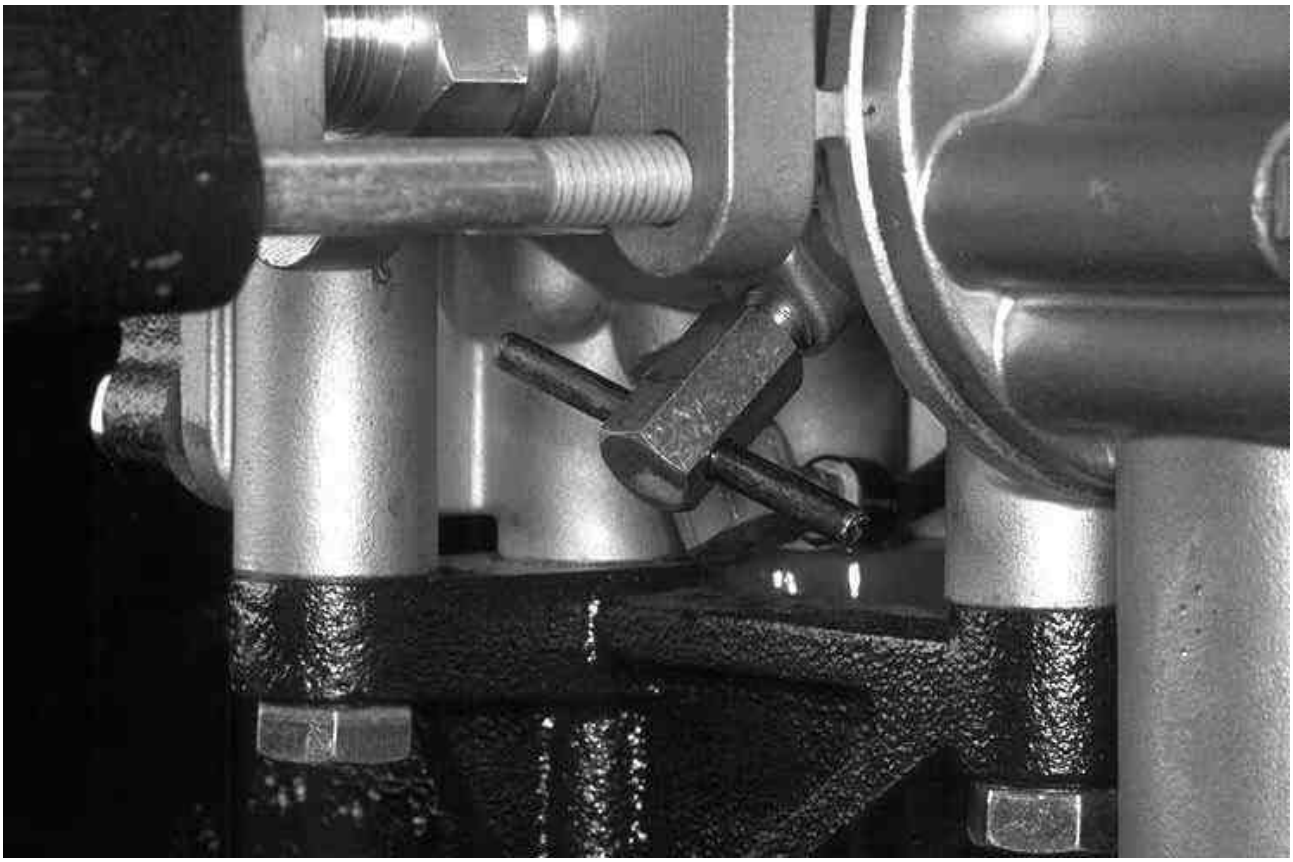

Slit inTurf Between Holes
Water spray not stopping between cycles
Check Water Valve Lift
Within Spec.
No
Adjust valve lift
Valve lift to high can prevent valve from completely closing
Yes
Yes
Check Water Valve Spool and seat
Within spec.
No
rebuild or replace watervalve
Water leaking through valve or spool sticking can prevent water from stopping between cycles
Yes
Yes
Check Holes

Complaint: Slit in Turf Between Holes

1. Check water valve lift.
   - If the valve lift is too high, the valve may stay open too long and this makes the water injection cycle too long.
   - Adjust the valve lift height.

2. Check valve.
   - A bad seat or spool can cause the valve to leak or continue to spray after the valve has closed.
   - A sticking valve spool can cause water to continue to spray when the valve should be closed.
   - The valve needs to be repaired or replaced.

NOTES

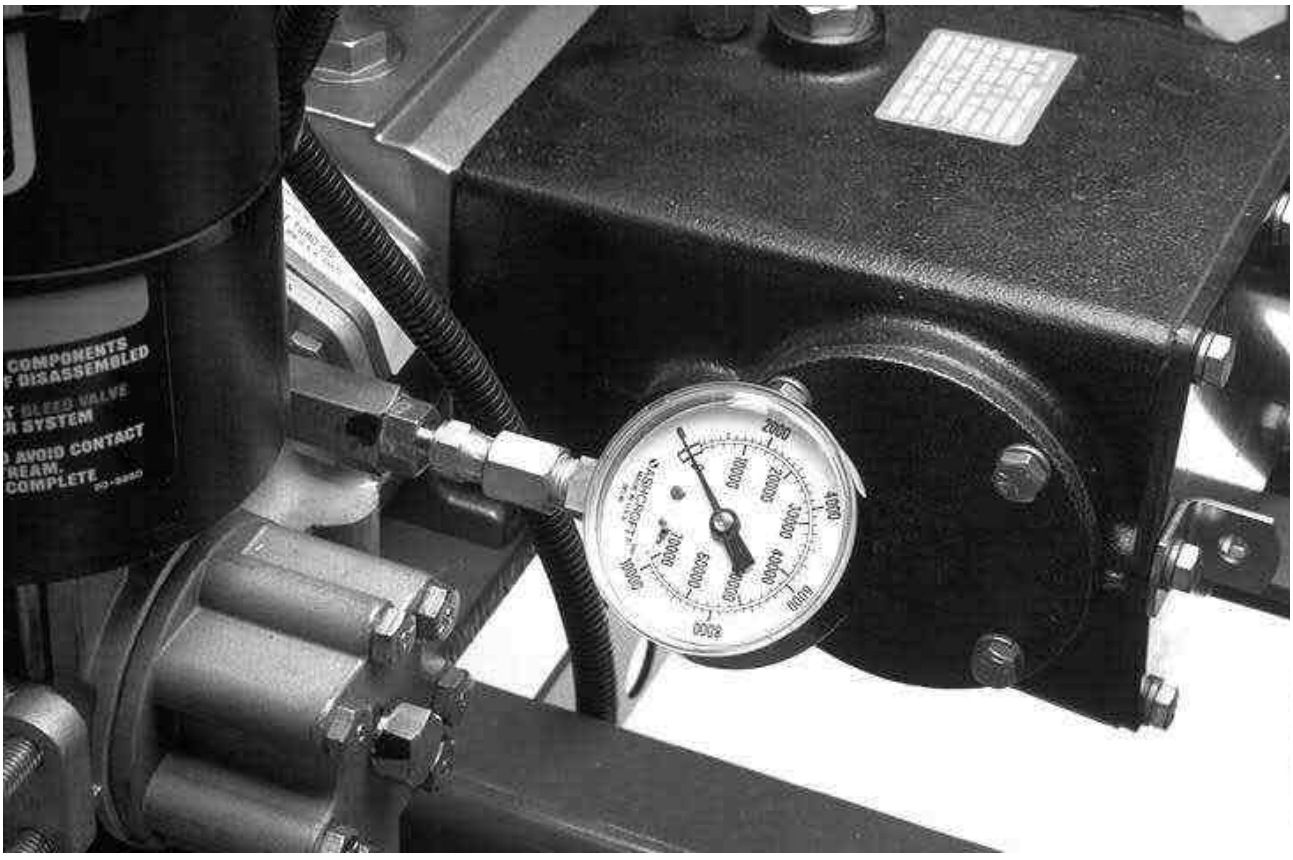


Servicing high pressure water components can cause personal injury if the system pressure is not relieved before servicing any components.

To bleed the high pressure water, open the bleed valve, and slowly relieve the water pressure. Avoid contact with the high pressure water stream.

NOTES


ASHCROFT
2000
4000
6000
8000
10000
20000
30000
40000
50000
60000
70000


COMPONENTS
DISASSEMBLED
BLEED VALVE
SYSTEM
AVOID CONTACT
STREAM.
COMPLETE
ASHCROFT

Water Pressure Test

Install the water system pressure gauge (TOR4005) into the port in the water valve housing.

NOTE: Operating the machine for an extended period of time with the gauge installed can damage the gauge.

Interpreting Test Results and Operational Effects

High water pressure. (exceeds 5000 PSI).

Cause:

Relief valve sticking or misadjusted.

Effect:

Engine kills (high horsepower requirements).
Pump damage.
Shortened drive belt life.

Low Water Pressure.

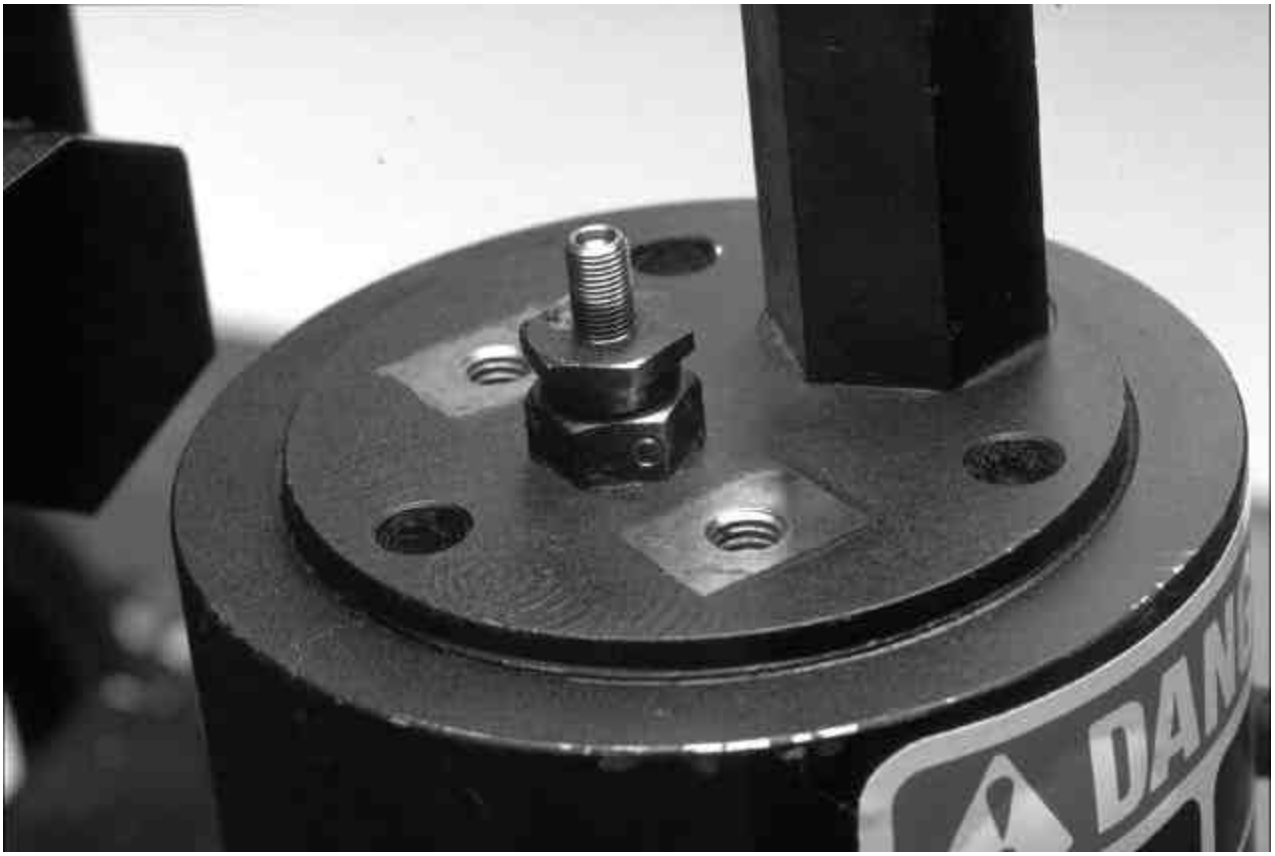
Cause:

Leaking relief valve.
Leaking cycling valve.
Worn pump seals.
Low water supply.
Air in the system.

Effect:

Shallow hole depth.

NOTES


DANG

Performing the Accumulator Pressure Test

1. With the unit shut off, and the pressure relieved from the high-pressure water circuit.
2. Remove the protective cover from the accumulator service valve.
3. Connect the accumulator charging tool.
4. Verify that both shut-off valves are closed.
5. Turn the valve jam nut counter clockwise approximately 2 turns.
6. Read pressure on the gauge.
7. Pressure should be 1800 to 2800 PSI (when recharging, charge the accumulator to 2500 PSI).

NOTES

Interpreting Test Results and Operational Effects

Low Accumulator Pressure.

Cause:

Leaking piston O-Rings.
Leaking accumulator service valve.
Normal operational leakage.

Effect:

Low accumulator pressure decreases the water available for delivery to the aeration nozzles.

If the accumulator is completely discharged (0 Psi) the water forced into the accumulator will not be forced out when the cycling valve opens. The only water available to the nozzles is the water from the pump.

High Accumulator Pressure

Cause:

Accumulator over charged with nitrogen.
Water leaking past the O-rings. (Water collecting on top of the piston, decreasing the available area for nitrogen).

Effect:

With the higher accumulator pressure, the area in the accumulator to store the water from the pump decreases and the capacity of the accumulator is decreased.

NOTES


CAL
RATE
GPI

Water Flow Test

Connect the flow meter (TOR4006) to the water inlet.

Water flow with the unit operating and the spray wash closed, should be more than 3.4 GPM.

Low Water Flow

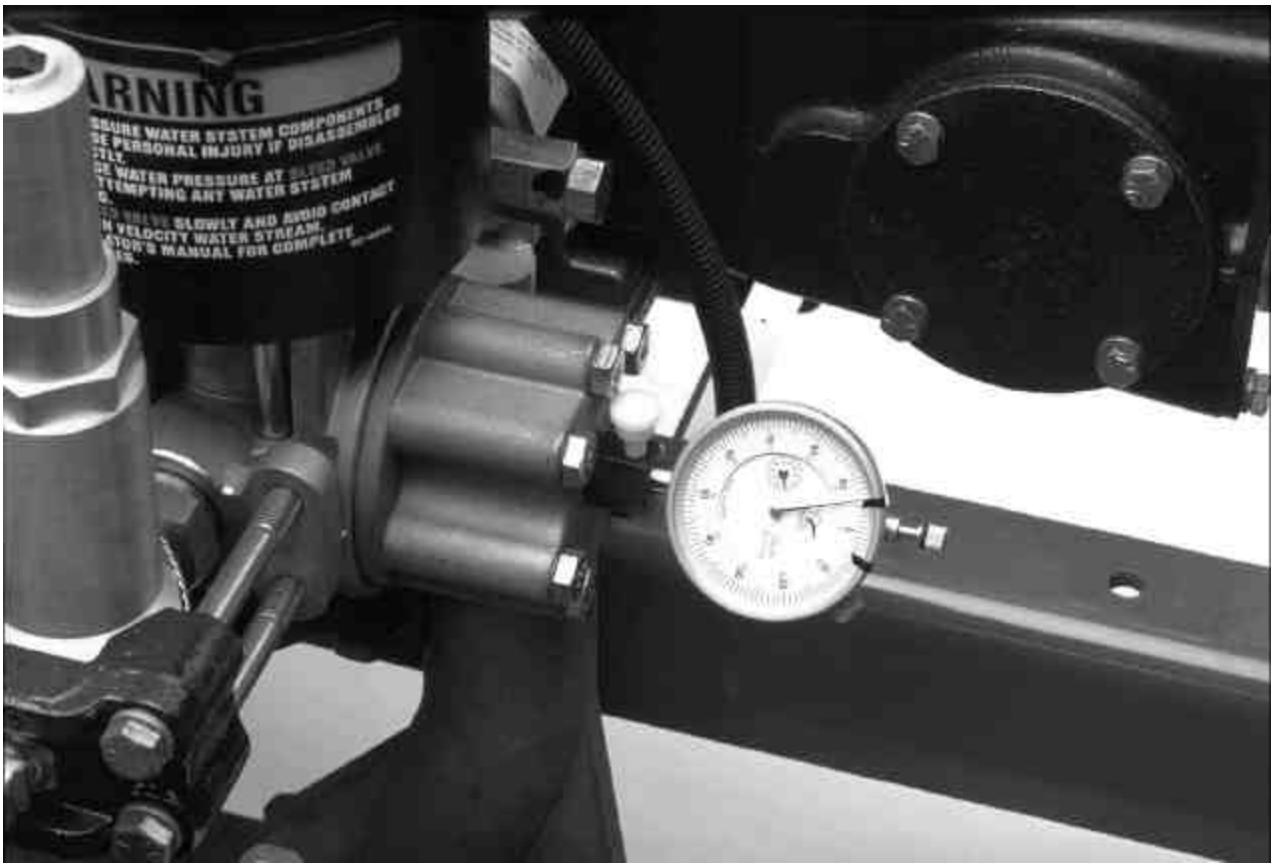
Cause:

Leaking waterpump valves.

Effect:

Low water flow through the system can cause shallow penetration depth, because the accumulator may not adequately fill between injection cycles.

NOTES


RNING
SURE WATER SYSTEM COMPONENTS
E PERSONAL INJURY IF DISASSEMBLED
WATER PRESSURE AT
TEMPTING ANY WATER SYSTEM
SLOWLY AND AVOID CONTACT
H VELOCITY WATER STREAM.
TOR'S MANUAL FOR COMPLETE

Valve Lift Test

Remove the test cap from the feeder manifold and install the valve lift indicator (TOR4007). Make sure that the dial indicator contacts the water valve.

Zero out the dial indicator.

Rotate the engine drive coupling and watch the dial indicator. The proper valve lift should be 0.090 to 0.102.

Valve lift too high.

Cause:

Water valve housing not correctly shimmed the cam housing.

Effect:

Water valve is open longer than necessary.
May leave slits between aeration holes.

Valve lift to low.

Water valve housing not correctly shimmed to the cam housing.
Worn cam lobe or valve roller.

Effect:

Short pulse duration does not release adequate water and hole depth can be affected.
Relief valve opens frequently, wasting energy.
Excessive clearance between cam and valve can cause stress on the valve.

NOTES

Test Equipment

1. Accumulator Test/Recharge tool. TOR4001
2. Water system pressure gauge. TOR4005
3. Water flow meter. TOR4006
4. Valve lift indicator. TOR4007

Troubleshooting Tips

1. **Before connecting any test equipment to the water system, fully relieve water pressure by opening the water system drain valve.**
2. Troubleshooting the system consists of performing logical tests along the path of the water.
3. If any test is incorrect, the component must be repaired before continuing with the test.
4. The most important test equipment is the flow meter and the water system pressure gauge. Bleed air form the system and operate the unit at high idle.
5. Operating a correct unit is very helpful to understand how it works and what it sounds like.
6. 4 seconds after startup the cycling valve clutch is engaged. The minimum operating pressure should be no less than 3500 PSI and should be closer to 4000 PSI.
7. If the pressure cycles down to 0 PSI within 10-15 seconds, pump input flow is low or nozzle output flow is high.
8. If the gauge swings wildly (from 0-5000 PSI) the accumulator precharge is very low or empty.

Review Questions

1. Minimum water system inlet flow is:

A. 4.3 GPM.
B. 3.4 GPM.
C. 5.4 GPM.
D. 1.1 GPM.

2. Accumulator pre-charge pressure is:

A. 5000 PSI.
B. 1000 PSI.
C. 90 PSI.
D. 2500 PSI.

3. Maximum water system relief valve pressure setting is:

A. 5000 PSI.
B. 1000 PSI.
C. 90 PSI.
D. 2500 PSI.

4. Correct valve lift is:

A. .125 .250.
B. .090 - .102.
C. .009 - .0102.
D. .0125 - .0250.

5. Low accumulator pre-charge pressure is cause by:

A. Water leaking past the seals and collecting on top of the piston.
B. Accumulator overcharged with nitrogen.
C. Leaking water relief valve.
D. Accumulator undercharged with nitrogen.

6. Low water system pressure is caused by :

A. Leaking relief valve.
B. Low water supply flow.
C. Low pump output.
D. Worn injection nozzles.
E. All of the above.
F. None of the above.

7. Normal operating pressure of the water system while aerating is:

A. 5000 to 5500 PSI.
B. 3500 to 4000 PSI.
C. 2500 to 3500 PSI.
D. 1000 to 3000 PSI.

8. Low valve lift is caused by:

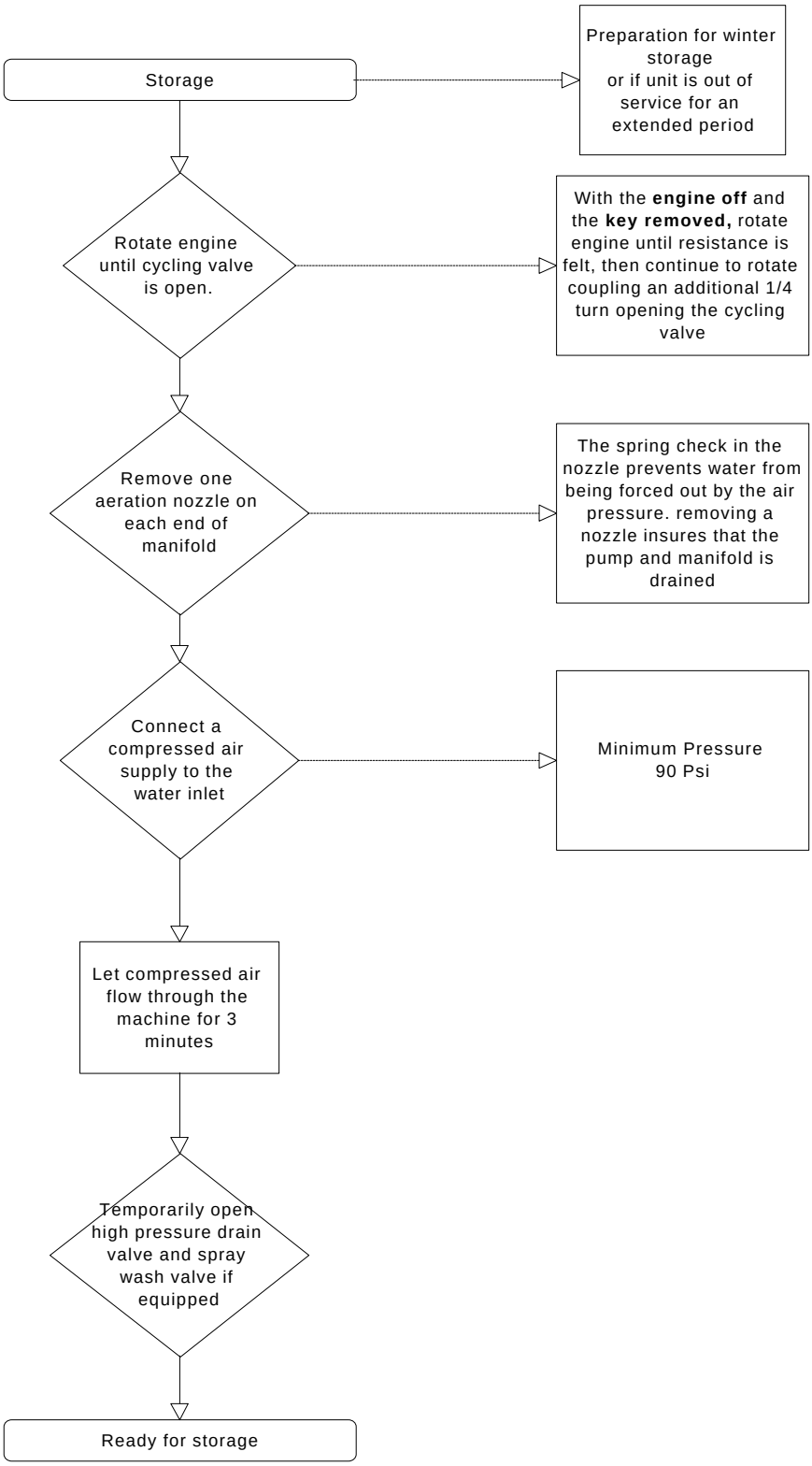
A. Water valve housing not correctly shimmed to cam housing.
B. Worn cam lobe.
C. None of the above.
D. All of the above.

9. High accumulator pressure is caused by:

A. Water leaking past the seals and collecting on top of the piston.
B. Accumulator overcharged with nitrogen.
C. Leaking water relief valve.
D. Accumulator undercharged with nitrogen.
E. Both A & B.

10. The Accumulator pre-charge may decrease because of normal operational losses.

A. True.
B. false.


Storage
Preparation for winter storage or if unit is out of service for an extended period
Rotate engine until cycling valve is open.
With the **engine off** and the **key removed,** rotate engine until resistance is felt, then continue to rotate coupling an additional 1/4 turn opening the cycling valve
Remove one aeration nozzle on each end of manifold
The spring check in the nozzle prevents water from being forced out by the air pressure. removing a nozzle insures that the pump and manifold is drained
Connect a compressed air supply to the water inlet
Minimum Pressure 90 Psi
Let compressed air flow through the machine for 3 minutes
Temporarily open high pressure drain valve and spray wash valve if equipped
Ready for storage

Storage

The unit must be properly prepared for storage. If the unit is being stored for the winter the water must be drained to prevent freezing and damage to the components.

Due to varying water quality and the use of “gray water” the water should also be drained from the unit if the unit will be out of service for an extended period of time.

Preparation for Storage.

1. With the engine off and the key removed, rotate the engine until resistance is felt, than continue to rotate the engine an additional 1/4 turn. This opens the cycling valve.
2. Using the appropriate fittings, connect a compressed air supply to the water inlet of the machine. (Maximum pressure 150 PSI - Minimum 90 PSI).
3. Remove one aeration nozzle from each end of the nozzle manifold . (see service bulletin **Specialty #08-07**.). The spring check in the nozzle prevents water from being forced out by the air pressure. Removing the nozzles insure that the pump and manifold is drained.
4. Let the compressed air flow through the system for three minutes.
5. Temporarily open the high-pressure drain valve and the spray wash valve if equipped.

NOTES

HYDROJECT® 3000 / 4000 Maintenance Schedule

Minimum Recommended Maintenance Intervals:

Maintenance Procedure	Maintenance Interval & Service			
	Every 50hrs *A Level Service*	Every 100hrs *B Level Service*	Every 200hrs *C Level Service*	Every 400hrs *D Level Service*
Check Battery Fluid Level				
Check Battery Cable Connections				
Lubricate All Grease Fittings				
† Change Engine Oil				
† Replace Engine Oil Filter				
Clean Engine Pre-cleaner (Air Filter)				
Replace Air Filter Element				
Replace Fuel Filter				
Adjust Water System Cam-Valve Clearance				
Clean Engine Crankcase Breather				
† Change Gear Case Oil (and Filter 3000 Only)				
† Change Pump Case Oil				
† Torque Wheel Lug Nuts				
Service Accumulator				
Adjust Parking Brake (3000 Only)				
Calibrate Aeration Traction Speed (3000 Only)				
Service Injection Nozzles and Springs				
Replace Spark Plugs				
Decarbon Combustion Chambers				
‡ Torque Head and Adjust Valves				
‡ Check Engine RPM (idle and full throttle)				
† Initial break in at 25 hours				
‡ Initial break in at 50 hours				
Replace Moving Hoses				
Replace Safety Switches				
Fuel Tank - Drain/Flush				
Hydraulic Tank - Drain/Flush				

Annual Recommendations:
Items listed are recommended every 1000 hours or 2 years whichever occurs first.

(See Operator's and Service Manual for specifications and procedures)

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