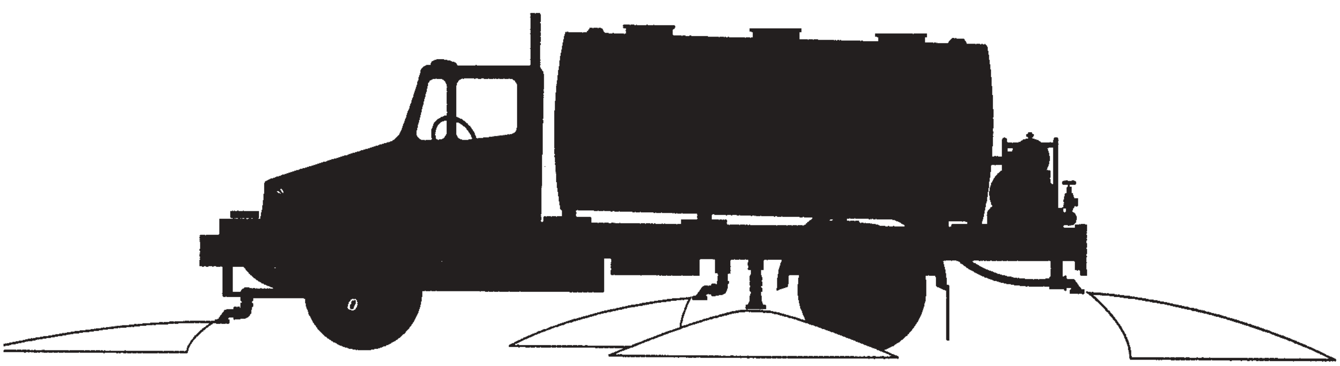
M-802-97

for units with Serial Number L-2270 and up

Street Flusher

OPERATION, MAINTENANCE, PARTS and SAFETY MANUAL

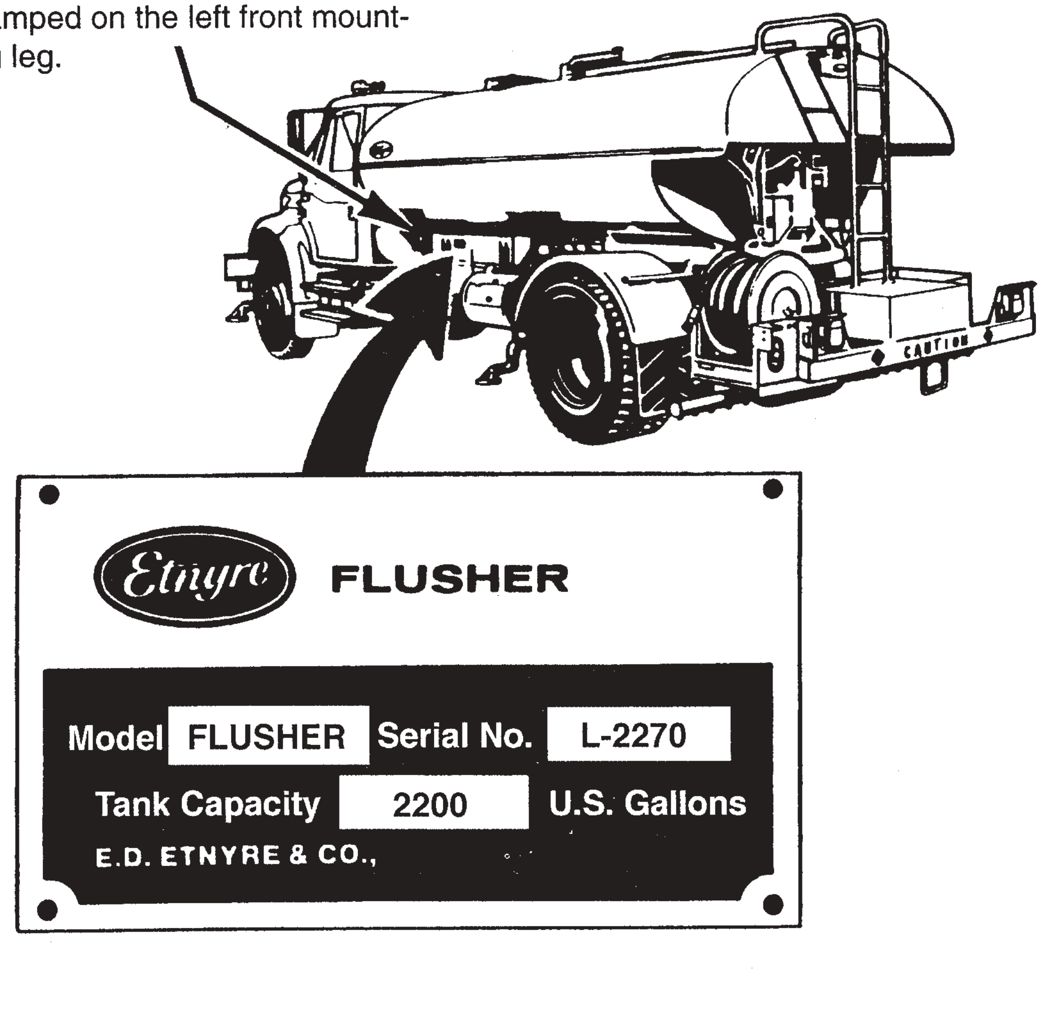


E. D. ETNYRE & CO., Oregon, Illinois 61061

The Serial Number Plate is a brass plate located on the left side of the vehicle frame.

Generally, the serial number has a letter prefix followed by a four digit number.

The Serial Number is also stamped on the left front mounting leg.



STREET FLUSHER

OPERATION, MAINTENANCE, PARTS and SAFETY MANUAL

M-802-97

For Units Starting with Serial Number L-2270

HOW TO ORDER PARTS

To assure prompt delivery when ordering parts, please furnish the following information: **1)** Complete name and address of consignee. **2)** Method of shipment preferred. **3)** Is shipment to be prepaid or collect? **4)** Serial numbers of units to which parts apply. **5)** Complete part numbers and descriptions. **6)** Any special instructions. Part numbers beginning with 9250000 are category numbers and must include descriptive term to complete the order (such as, length, color, etc.). These items when listed in the parts manual will indicate what information must be included.

Specify unit serial number when ordering parts!

WARRANTY

E.D. Etnyre & Co. warrants to the original Purchaser, it's new product to be free from defects in material and workmanship for a period of twelve (12) months after date of delivery to original Purchaser. The obligation of the Company is limited to repairing or replacing any defective part returned to the Company and will not be responsible for consequential damages or any further loss by reason of such defect.

The company excludes all implied warranties of merchantability and fitness for a particular purpose. There are no warranties, express or implied, which extend beyond the description of the goods contained in this contract.

This warranty does not obligate the Company to bear the cost of machine transportation in connection with the replacement or repair of defective parts, nor does it guarantee repair or replacement of any parts on which unauthorized repairs or alterations have been made or for components not manufactured by the Company except to the extent of the warranty given by the original Manufacturer.

This warranty does not apply to:

(1) Normal start-up services, normal maintenance services or adjustments usually performed by the selling dealer, factory service representative or customer personnel.

(2) Any product manufactured by E.D. Etnyre & Co. purchased or subjected to rental use.

(3) Any product or part thereof which shows improper operation, improper maintenance, abuse, neglect, damage or modification after shipment from factory.

(4) Any product or part thereof damaged or lost in shipment. Inspection for damage should be made before acceptance or signing any delivery documents releasing responsibility of the de livering carrier.

This warranty and foregoing obligations are in lieu of all other obligations and liabilities including negligence and all warranties of merchantability or otherwise, express or implied in fact or by law.

E. D. ETNYRE & CO., Oregon, Illinois 61061-9778

1333 South Daysville Road Phone: 815/732-2116 Fax: 815-732-7400

Introduction

This manual is divided into six sections... 1) Introductory Pages, 2) Operating Instructions, 3) Trouble Shooting, 4) Maintenance, 5) Illustrations and Complete Serviceable Parts List, and 6) Numerical Index.

The Introductory Pages contain Ordering Procedure, Warranty, Unit Specification, Table of Contents, and Introduction Page.

The Operating Instructions were prepared for the operator to aid him in starting, operating and adjusting his unit to attain satisfactory flushing results.

A trouble shooting section is provided to aid the dealer, customer, and the operator in locating and correcting Street Flusher malfunctions.

The maintenance section gives the recommended procedure for proper lubrication and maintenance of the Street Flusher, which, if followed, will save costly and premature failure of system components.

The individual parts in each illustration are shown in their normal relationship to one another. Reference numbers are used on each illustration and should not be used when ordering parts. A parts list accompanies each illustration.

A numerical index at the rear of the manual contains a listing of all part numbers with page numbers showing where each part is listed and described.

CALIFORNIA
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Please note this warning and remember -

Always start and operate the engine in a well-ventilated area;
If in an enclosed area, vent the exhaust to the outside;
Do not modify or tamper with the exhaust system.

Specification Check List

Unit Serial No. ______________________________

Nominal Capacity ______________________________

Tank Size ____________ x ____________ x ____________ Lg.

Model ______________________________

Hydraulic Motor Serial No. ______________________________

Hydraulic Pump Serial No. ______________________________

Water Pump Serial No. ______________________________

Hose, H.P. Length ______________ Part No. ______________

Hose, Med Press Length ______________ Part No. ______________

Drive Tube Length ______________________________

Table Of Contents

⚠ WARNING

Unsafe operation of equipment may cause injury.

Read, understand and follow the manuals when operating or performing maintenance.

Remain clear of all moving parts.

⚠ CAUTION

Make certain everyone is clear of machine before starting engine or operation.

Always have shields, covers and guards in place when operating.

Keep loose clothing away from rotating parts.

Do Not Run when pump is dry or when filling.

⚠ IMPORTANT

Keep nozzles clean. Any foreign material in nozzles causes spray to split.

Take nozzles off to clean. Clean by pushing foreign matter back, not by forcing through slot.

Keep nozzle slot surfaces smooth. Avoid scratching or hitting slot edges. Polish if necessary.

Turn pumping unit off when tank is empty. Do not operate pumping unit at engine idling speed.

Do not run when pump is dry or when filling.

Drain unit throughly before storing in temperatures below freezing.

Clean valves after storing for a long period.

Clean fill line strainer regularly.

Reporting Safety Defects

If you believe that your vehicle has a defect which could cause a crash or could cause injury or death you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying E. D. Etnyre & Co.

If NHTSA receives similar complaints, it may open an investigation, and if it finds that a safety defect exists in a group of vehicles, it may order a recall and remedy campaign. However, NHTSA cannot become involved in individual problems between you, your dealer, or D. Etnyre & Co.

To contact NHTSA, you may either call the Auto Safety Hotline toll-free at 1-800-424-9393 (or 366-0123 in Washington, D.C. area) or write to: NHTSA, U.S. Department of Transportation, Washington, D.C. 20696. You can also obtain other information about motor vehicle safety from the hotline.

Safety Precautions, Hazard Seriousness Level

You will find safety information boxes throughout this manual. These boxes contain information alerting you to situations or actions to avoid.

Signal words (DANGER, WARNING and CAUTION) are used to identify levels of hazard seriousness. Their selection is based on the likely consequence of human interaction with a hazard. Definitions of hazard levels are as follows.

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.

IMPORTANT

The following instructions are in OPERATION SEQUENCE.

1. Check Oil.

Reference Figure 1.

Hydraulic oil should always be visible in the oil level site glass in the side of the hydraulic oil reservoir. If air or foam in oil is visible check Trouble Shooting Section, Item No.3.

2. Pre-Filling.

Reference Figure 1.

Close all drains. They are located as follows: Two drain cocks (20) on each water control valve (19), one 3/8 inch drain valve on bottom of water pump and one drain cock on bottom of pressure transfer diaphragm (21) located at the rear center of the discharge header. NOTE: Do not remove hex plug located in top of diaphragm.

There is one drain cock (20) on the bottom of each of the 2 inch pipe elbows in flushing water line below the water control valve (19).

On units equipped with a rear hose reel, close the line valve (26) (1-1/2 inch Ball) and the one drain cock (20) in the inlet elbow to the hose reel.

3. Fill Tank.

Reference Figure 1.

Fill tank with water from a hydrant using a filling hose equipped with connectors that will accept both the tank and hydrant threads. A 2-1/2 inch ID x 16 foot large fill hose equipped with a coupling to fit tank connection is provided as standard equipment. The standard fill connection is provided as standard equipment.

The standard fill hose is furnished less coupling on one end for the customer to apply a coupling suitable to accommodate the hydrant.

The fill strainer (22) at the rear of the tank will back flush when the fill hose is disconnected from the hydrant.

The amber full lamp (23) on the rear of the tank will light when the tank is approximately 95 percent full. The overflow pipe will carry off the water when the tank is completely full. The full lamp will remain lit until the water level drops below the 95 percent full mark.

⚠ WARNING

Filling should be done only through the fill line. The manhole is designed for inspection and maintenance only.

4. Activate Hydraulic Svstem

Engage the P.T.O. by pushing or pulling the knob marked "Pump". This will begin operation of the hydraulic pump. See P.T.O. Operating Instructions.

⚠ CAUTION

Make certain everyone is clear of machine before starting engine or operation.

Always have shields, covers and guards in place when operating.

Keep loose clothing away from rotating parts.

5. Flushing Pressure Selection.

Reference Figure 1.

With the trasmission in neutral, accelerate the truck engine to provide 1500-1800 R.P.M. on the engine tachometer.

Select the desired flushing pressure using the discharge Pressure Selection valve (8) located on right hand side of the control panel. Rotate the knob of the valve until desired pressure is obtained. Turning the knob clockwise increases the pressure; turning the knob counterclockwise decreases the pressure.

The valve is equipped with a locking nut. Be sure the locking nut is released before adjusting pressure. This pressure is read on the Pre-determined Operating Pressure gauge (9) located in the control panel.

6. Water Pump Start Up.

Reference Figure 1

> **⚠ CAUTION**
>
> **Do not run when pump is dry.**

The ignition switch must be on and all control panel switches off (down position).

Turn on the red System Power switch (11) in the control panel. The amber System Power pilot light (17) will now be on. (Note: The following sequence applies to a stationary or moving vehicle) With the hydrostatic pump operating at 1500-1800 R.P.M., press the white System Activate switch (12). This is a momomentary contact switch. The green System Activate pilot light (15) will come on at the time the white switch (12) is closed.

At this time the white switch (12) may be released. The amber pilot light (17) will go out and the green pilot light (15) will remain lit.

The water pressure in the discharge header will increase to the pre-determined pressure and the operating water pressure gauge (10) and the pre-determined operating pressure gauge (9) should indicate the same pressure.

If the engine R.P.M.is decreased to a point where the header water pressure drops below the set pressure, the engine speed is increased, the water discharge from system will not be operating at a speed sufficient to discharge much water. However, as soon as the the pump will be evident from the nozzles.

When the system is turned off, or if the tank water level is lowered to the cutout point, the system will drop out automatically and the start-up sequence must be repeated to put the system back into operation.

7. Nozzle Operation

Reference Figure 1

Water pressure is now available for flushing. Either turn on the Master Nozzle Switch (1) and select each nozzle switch (2, 3, 5, 6) as desired or pre-select all nozzles to be used and then turn on the master nozzle switch. (1) When using the master switch all the nozzles selected will operate at the same time.

During the flushing operation additional nozzle/s may be turned on or any nozzles already in service may be turned off and the system will automatically maintain the pre-determined pressure.

At intersections or other locations as desired, if the transmission is shifted into neutral and the engine speed is maintained, the water discharged from the nozzles will be continued until the Master Switch (1) or Nozzle Switches (2, 3, 5, 6) are turned off.

> **⚠ IMPORTANT**
>
> **Keep nozzles clean. Any foreign material in nozzles causes spray to split.**
>
> **Take nozzles off to clean. Clean by pushing foreign matter back, not by forcing through slot.**

8. Nozzle Adjustment.

Reference Figure 1

The spray should strike the pavement from 5 to 8 feet in front of the nozzle. Whether a unit is equipped with 3 or 4 nozzles, the side nozzles (28) and (29) should always be adjusted so the inside edge of the spray fans just miss the front wheels of the truck.

When a unit is equipped with 3 nozzles and flushing only the right side of street is desired, the left hand front nozzle (30) should be adjusted toward the right so that the left edge of spray fan is directed straight forward. When a unit is equipped with 3 nozzles and flushing the entire street is desired, adjust the left hand front nozzle straight ahead so that the spray fan is equally distributed on either side of the center of the street.

When a unit is equipped with 4 nozzles and flushing only the right hand side of the street is desired, set the right hand front nozzle (31) so that the left hand edge of spray fan is directed straight ahead. The left hand front nozzle is not used in this case.

When a unit is equipped with 4 nozzles and flushing the entire street is desired, both the left hand (30) and the right hand (31) front nozzles should be adjusted so that the inside edges of the spray fans intersect each other just before they reach the street surface.

⚠ CAUTION

Do not run when pump is dry.

9. Automatic Shut Down.

Reference Figure 1

When the red Low Water Warning light is activated it indicates that there is only a short period remaining before the pressure system drop-out occurs.

When system drop-out occurs the green pilot light (15) will go out and the amber pilot light (17) will relight. The tank will have to be refilled (Ref. Section 3) for further operation.

10. Operational Speeds

The recommended ground speeds for flushing are from 4 to 12 M.P.H.

Most flushing will be accomplished in first gear. If gear changing occurs, the system pressure may drop and the water discharged from the nozzles will diminish. As soon as the engine speed is resumed, the water pressure and nozzle flow will be as before.

11. Hydraulic System Caution.

Reference Figure 1

The unit is equipped with a tank type oil cooler and the red Hydraulic Oil Overheat pilot light (16) should never be lit.

If the red light comes on, shut down the system immediately to prevent damage to the hydraulic components. Refer to maintenance section of this manual.

12. Auxiliary Equipment.

Reference Figure 1

1. Spray Bar and Sprinkler Nozzle. Pressure selection for the bar (27) or the sprinkler is accomplished in the same manner as it is for the flushing nozzles (Section 5). The bar (27) or sprinkler operation is selected with the black switch marked "Auxiliary"(4) on the control panel. The Master Switch (1) must be on.

2. Hose Reel, Manual and Electric. Pressure selection for the hose reels is accomplished in the same manner as for the flushing nozzles (Section 5).

Hose reel (24) operation is usually accomplished with the unit in a stationary position thus the truck hand throttle will have to be used to obtain hydraulic pump R.P.M. The hose reel is equipped with a wind lock (25). Be sure this lock has been released before unwinding the hosefrom the reel.

To operate hose turn ball valve handle 90 degrees (parallel with flow is open). The ball valve (26) is located on the heft hand side of the hose reel. To wind hose back on a manual reel, use crank provided.

When the unit is equipped with an electric reel, use push button located at the left hand bottom of the reel .

13. Draining System.

Reference Figure 1

To drain the water from the unit to prevent freezing damage, all the valves described in section 2 must be opened.

The residual water in the tank may be drained more quickly and all settled debris which have accumulated in the system may be removed by removing the 3 inch drain plug in bottom of the pump suction header.

⚠ CAUTION

Remain clear of all rotating drives (truck and hydraulic pump propeller shafts and water pump drive) during operation or maintenance.

P.T.O. OPERATION

Automatic Transmission

On automatic transmissions, the gears in the transmission turn when the transmission is in neutral, therefore, gear clashing will occur if the power take-off is shifted into gear at this time.

To operate power take-off properly:

1. Shift transmission lever into any of the drive positions (This will stop transmission gears from turning).

2. Shift power take-off into gear.

3. Shift transmission into neutral (This will start transmission gears turning).

This procedure should eliminate gear clash.

Mechanical Transmission

1. A power take-off is, and should be, operated as an integral part of the main transmission.

2. Before shifting the power take-off into or out of gear . . . disengage the clutch and wait for transmission or P.T.O. gears to stop rotating.

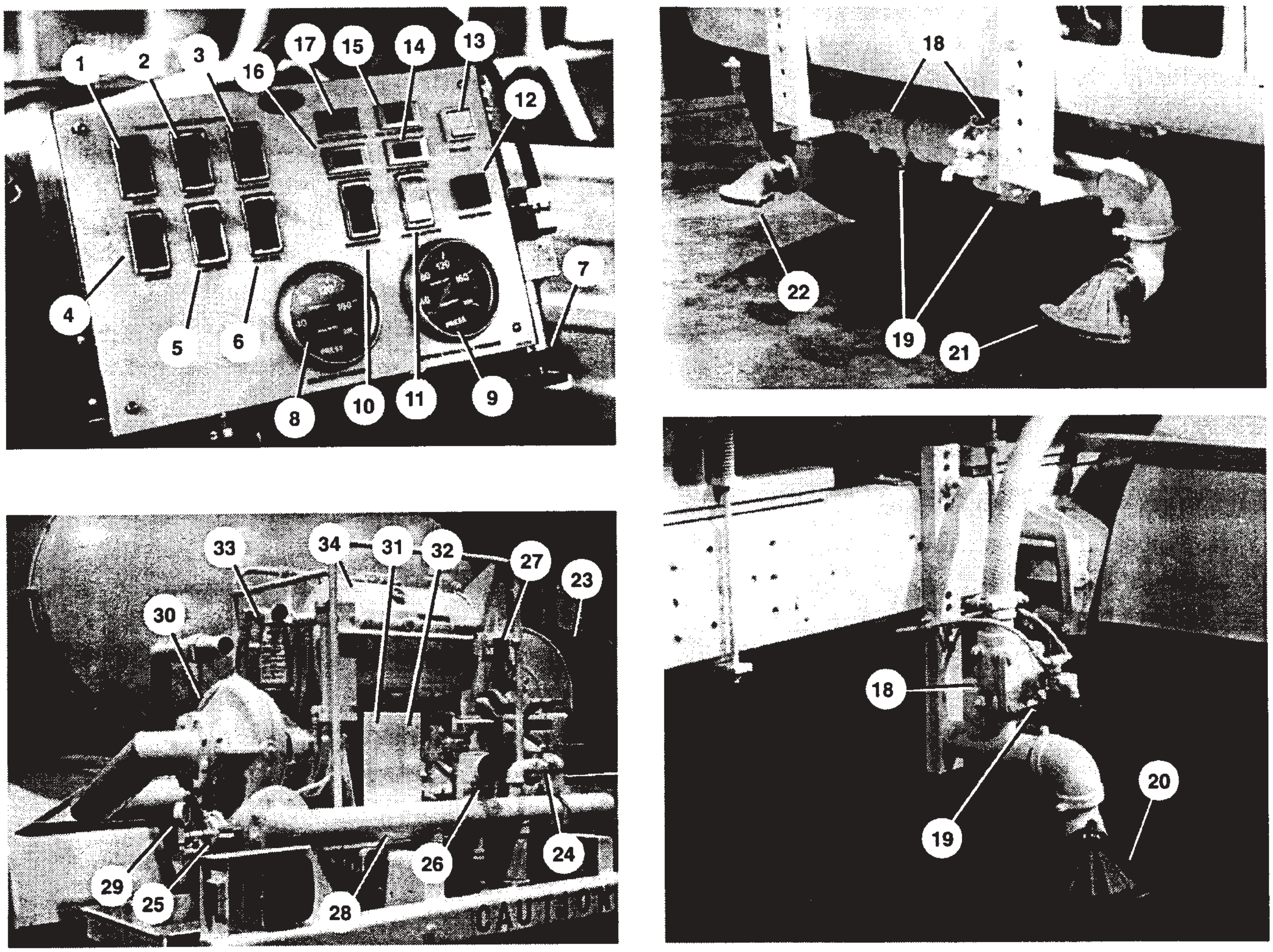


Figure 1. General Identification

1. Master Switch, Nozzles
2. Left Front Nozzle
3. Right Front Nozzle
4. Auxiliary Switch
5. Left Side Nozzle
6. Right Side Nozzle
7. Discharge Pressure Selection Valve
8. Pressure Gauge, Predetermined Operating
9. Operating Water Pressure Gauge. Discharge Header
10. System Power Switch
11. System Activate Switch
12. System Fuse
13. Fill Lamp Fuse
14. System Activate Pilot Light
15. Hydraulic Oil Overheated Pilot Light
16. System Power Pilot Light
17. Low Water Warning Light
18. Water control Valves
19. Drain cocks
20. Left Side Nozzle
21. Left Hand Front Nozzle
22. Right Hand Front Nozzle
23. Hose Reel (optional)
24. Hose Reel Line Valve
25. Pressure Transfer Diaphragm
26. Fill Connection
27. Full Lamp
28. Discharge Header
29. Vacuum Gauge
30. Water Pump
31. Drive Coupling
32. Hydraulic Motor
33. Filter, 10 Micron
34. Oil Reservoir, Hydraulic System

Maintenance

1. Lubricate water pump every 90 operating days. Use lithium base general purpose grease. Grease is applied through the zerk fitting located on bearing and shaft housing of the pump. A zerk type grease gun must be used to apply grease.

2. Monthly check and tighten if necessary all tank and pump base mountings, tie downs and fasteners.

3. Monthly check to be sure the 4 inch overflow is clean. This may be done by removing manhole cover and visually inspecting the hole in the overflow pipe for obstructions.

4. Weekly check vacuum gauge attached to hydraulic filter. This check should be made with the hydraulic oil warm (100° F. min) and unit at operating speed. If the vacuum gauge reads in the red, change the filter.

5. If the unit is equipped with a hose reel, lubricate the reel bearings. This should be done twice a year under normal conditions.

IMPORTANT

6. Keep nozzles clean. Any foreign material in nozzles causes spray to split.

7. Take nozzles off to clean. Clean by pushing foreign matter back, not by forcing through slot.

8. Keep nozzle slot surfaces smooth. Avoid scratching or hitting slot edges. Polish if necessary.

9. Drain unit throughly before storing in temperatures below freezing.

10. Clean valves after storing for a long period.

11. Clean fill line strainer regularly.

12. Daily check oil level in hydraulic reservoir. Oil should be visible in sight glass located on the outside of the reservoir. If oil is low add suffix "A" transmission fluid until oil level reaches top of the sight glass.

13. At intervals of no more than four months (120 days) enter the tank through the manhole and carefully inspect the rust preventive coating covering the inside surface of the tank for scratches, chipping or other damage that could allow the tank to rust.

Any area where the coating is damaged should be cleaned, sanded, and recovered wih the same type material as the original.

14. Monthly check and tighten, if necessary, the studs, nuts, and bolts attaching the power take-off to the main truck transmission.

Troubleshooting

⚠ WARNING

Make certain everyone is clear of machine before starting engine or operation.
Keep loose clothing away from rotating parts.
Remain clear of all moving parts.

Malfunction	Probable Cause	How To Determine	Corrective Action
Mechanical Drive System			
1. Noisy drive line (Hyd Pump/PTO) (Water Pump/ Hyd Mtr).	Worn Universal Joints	Sharp thud on Acceleration or Deceleration of Drive Line.	Replace Universal Joint.
2. Noisy P.T.O.	Too much backlash	Rumble	Tighten bolts or remove gaskets until proper backlash is obtained.
	Too little backlash	Whine	Place additional spacer gaskets between P.T.O. and transmission opening.
	Worn bearing or gear	Rumble - Remove and inspect.	Replace if necessary.
Electrical System-Lighting (See Wiring Diagram Figure 10. And Parts Page)			
1. Will Not Light-Tail clearance, marker, license plate, back-up rotating beacon and brake lights.	Bulb burnt out	Remove lens & check.	Replace if necessary.
	Fuse blown	Visibly check fuse in panel in truck cab.	Replace if fuse is blown. Again find short circuit and correct.
	Loose connection	Check terminations with a 1 2V test light.	Reconnect or cut out existing terminal and replace.
	Defective switch	With switch on check with test light.	Remove and replace if necessary.
2.Turn signal will not light	Bulb burnt out	Remove lens & check.	Replace if necessary.
	Fuse blown	Visibly check fuse in panel in truck cab.	Replace if fuse is blown. Again find short circuit and correct.
	Loose connection	Check terminations with a 1 2V test light.	Reconnect or cut out existing terminal and replace.

Malfunction	Probable Cause	How To Determine	Corrective Action
	Defective Switch	When all other possibilities have been exhausted and the switch is determined as the problem, consult your manual or truck dealer.	Replace
	Defective Flasher	Check flasher socket with test light. If power is present try new flasher.	Replace
3. Rotating beacon will light but not rotate.	Defective motor or drive	Visually observe.	Replace drive, motor or entire beacon.

Water System (See Wiring Diagram Figure 11. And Parts Pages)

WARNING Remaln clear of all movlng parts.

CAUTION Make certain everyone is clear of machine before Starting engine or operation.
Keep loose clothing away from rotating parts.
Do Not Run when pump is dry or when filling.

1. Clayton valve will not open	Solenoid does not operate	Turn switch on and listen for solenoid to click.	Replace coil or entire solenoid.
	Switch is defective	Check switch - If pilot light operates, switch is alright.	Replace Switch
	Loose Connections	Check terminations with test light.	Reconnect or replace terminals.
2. Clayton valve will not close	Plugged valve strainer	Remove strainer and visually check.	Blow or wipe strainer clean and reinstall.
3. Pump suddenly stops pumping	Clogged impeller	Visual-No discharge, Hydraulic motor high pressure relief valve will clatter.	Clean out debris.
4. Excessive leakage around the pump shaft.	Worn seal	Visual	Install new seal.
5. Poor water pump performance	Worn Impeller	Will not maintain desired discharge pressure - Check operating pressure gauge.	Replace Impeller.
	Hydraulic pump or motor problems		See hydraulic trouble shooting section.

Malfunction	Probable Cause	How To Determine	Corrective Action
6. Noisy water pump operation	Low discharge head	Water pump chatters or rattles.	Speed up pump if possible
	Debris lodged in impellers	Water pump rattles	Remove cover and clean out debris.
7. Nozzle plugged	Debris lodged in nozzle slot.	When nozzle is turned on spray will split or no water at all will come out of nozzle.	Clean nozzle - remove nozzle and push foreign material back through slot being careful not to scratch or nick nozzle spraying surface. Never force debris out of nozzle slot from inside.
8. Spray pattern split (Nozzle not plugged)	Scratches or nicks in nozzle slot surfaces.	Observe	File and polish all nicks and scratches from nozzle slots.

WARNING: Never Run Water Pump Dry

Hydraulic Drive System

1. Loss of Oil. Inspect for external leakage under load *	Fittings	Check for loose hose fittings or damaged "0" ring.	Tighten fittings or replace "0" ring.
	Hose or Tubing	Check for cracked or worn spots in hose or tubing.	Replace hose or tubing.

*If oil loss is due to gaskets, seals or "0" rings of the hydraulic pump or motor consult dealer or qualified service personnel.

2. Loss of Control **	Low Oi Levell	Check reservoir.	Replenish to proper level.
	Plugged Oil Filter	If filter is plugged vacuum gauge will read in the red. Remove filter housing and check filter.	Replace filter element.
	Insufficient oil supply	Check for plugged lines or dirty filter. If filter is plugged vacuum gauge will read in the red.	Clean or replace as necessary.
		Check oil level in reservoir.	Add oil as necessary.
	Relief valve malfunction		See "Loss of pressure" (Section 5).

**If loss of control is due to check valves or charge pump malfunction or pump housing control assembly, "0" ring or other internal failures, consult dealer or qualified service personnel.

WARNING Remain clear of all moving parts.

Malfunction	Probable Cause	How To Determine	Corrective Action

CAUTION Make certain everyone is clear of machine before starting engine or operation. Keep loose clothing away from rotatingparts. Remain clear of all moving parts.

Malfunction	Probable Cause	How To Determine	Corrective Action
3. Excessive noise, cavitation and internal damage	Filter	Check for dirty filter. If filter is plugged vacuum gauge will read in the red.	Replace filter.
	Suction Lines	Check inlet line for collapsed wall or other restrictions.	Clean hose or replace as necessary.
	Oil	Check oil for excessive viscosity .	Replace as necessary.
		Check for water in oil.	Replace as necessary Check heat exchanger for possible leaks.
	Contamination	Check case drain line for steel or brass particles.	Unit probably beyond field repair. Remove and overhaul.
	Air in oil	Check inlet line for leaks. Oil will appear milky or foamy and system pressure may be low.	Tighten fittings or replace as necessary.
		Check oil level in reservoir	Add oil as necessary. Maintain oil level to sight glass.
	Low pressure relief valve (Contact Etnyre Field Service Representative)	Check low pressure on loop circuit. Should be 175 to 200 P.S.I.	Adjust or replace as necessary.
4. Overheating	Excessive internal wear (Contact Etnyre Field Service Representative)	Check case drain of pump and motor. Volume should not exceed 1/2 G.P.M. per 1000 P.S.I. working pressure per unit	Unit probably beyond field repair. Remove and overhaul or replace.
	High Pressure Relief valve(Contact Etnyre Field Service Representative)	Check relief valve setting.	Set relief valves a mini mum of 500 P.S.1. above normal operating pressure.
	Heat exchanger	Check for plugged oil lines or excessive external corrosion or paint coating.	Clean or replace as necessary.

Malfunction	Probable Cause	How To Determine	Corrective Action
5. Loss of Pressure	High Pressure relief valve malfunction (See "Hydrostatic Pumps and Motors" in Maintenance.	Check pressure with motor stalled. Pressure should be within 100 P.S.1. of value on name plate.	Adjust relief valve or replace as necessary.

CAUTION

1. Throughout the entire operation, hands, parts, tools and immediate area must be kept clean. Introduction of foreign material into the system may damage or hinder its operation.

2. Do not operate the hydraulic motor at maximum by-pass pressure for extended periods of time since this will cause overheating of hydraulic oil and result in system damage.

Control System

(See Wiring Diagram Figure 11. And Parts Pages)

WARNING — Remain clear of all moving parts.

CAUTION — Be sure operating instructions are fully understoocl before attempting to operate or troubleshoot this system.
Make certain everyone Is clear of machine before starting engine or operation.

Malfunction	Probable Cause	How To Determine	Corrective Action
1. Fill light inoperative	Fuse	Visual Inspection.	Replace - 1 Amp Max.
	Bulb/s	Visual or Continuity Check.	Replace
	Jumper/Main Terminals Loose or Broken.	Visual or Continuity Check.	Tighten/Repuair/Replace.
	Defective Switch.	Visual or Multi-meter.	Replace
2. No 'Select" Presure	Regulator out of Adjustment.	Gauge remains at zero.	Loosen locknut, turn stem clockwise to correct pressure.
	Hydraulic Pump not operating.	Visual	Engage P.T.O.
	Hydraulic pump operating slowly.	Check speed	Increase speed.
	Dirty/inoperative Reg. valve.	Gauge doesn't respond.	Rework valve or replace valve.

Malfunction	Probable Cause	How To Determine	Corrective Action
	Inoperative Gauge	Gauge remains at one pressure.	Replace
Trouble in Hydraulic Systom/ No oil pressure available . See Hydraulic drive System Troubles.			
3. No electric power in Panel. No amber pilot light.	Truck ignition not turned on.	Visual	Turn on ignition .
	Main fuse blown Red fuse Holder.	Visual	Replace Fuse 7. 5A.
	Loose connections Power cord to truck power panel.	Visual	Tighten
	Burned out pilot bulb	Multi-meter	Replace
	Bad Switch	Multi-meter	Replace
4.Low-Water pilot won't light.	Tank full of water	Visual	Lower level of water.
	Pilot bulb burnt out	Multi-meter	Replace
	Jumper / Main Cable Terminals Loose / Broken circuit.	Visual or Continuity Check.	Tighten / Repair / Replace.
	Float switch inoperative	Visual or Multi-meter	Replace switch, Replace float on switch stem.
5. Low-Water pilot stays lit.	Low water level in tank	Visual	Add water (100 Gal. Min.)
	Float switch contacts stuck in closed position, Float is off stem.	Visual and Multi-meter	Replace switch, Replace float on switch.
	Jumper / Main Cable Wires shorted.	Multi-meter	Repair
6 Oil temp pilot light stays lit.	Defective thermoswitch in oil reservoir.	Multi-meter	Replace
	Shorted wires at thermo switch or terminals.	Visual/Multi-meter	Repair/Replace
	Oil overheated 200º F.	Check dial thermometer in tank.	Stop system - Refer to hydraulic system (over heated).
7. Water pump won't speed up.	No "Select Press"	Visual	See "No Select Press" section.
	Solenoid not operating.	Listen, Check circuit with multi-meter.	Repair circuit / replace solenoid.
	Modulator Asm inoperative (See Figure 8 and	*Visual:Coupling-Control arm asm. doesn't travel from	Remove Asm-Drain *oil frombellows-Check bello-

Malfunction	Probable Cause	How To Determine	Corrective Action
	Accompaning Instructions).	end to end when activate switch is closed.	frams for easy operation- Re-assemble/Replace.
8. System won't lock in. System won't stay locked in.System surges when Activate switch is depressed.	Main Cable / Jumper wires loose.	Visual and Multi-meter	Clean / Repair / Tighten
	Interlock float switch inoperative, clip missing and float missing.	Multi-meter, Visual	Replace switch or Replace float & retaining wire clip.
9. System won't lock in but operates ok if Activate Button is held down.	Transfer Bellows Asm. Trouble (Out of oil, plugs loose or out,broken hose, gauge ruptured, bellows collapsed loose outer clamp).	Visual Inspection. Remove hex plug. Insert Probe. No flicker in Pilot Lights.	Repair/Replace. Tighten fittings. Replace oil in closed system.
10. No green pilot light	Light burnt out.	Multi-meter	Replace
	Broken white switch.	Multi-meter	Replace
11. Discharge pressure doesn't match selected pressure.	Hydraulic pump not operating fast enough.	Visual	Increase Hydraulic Pump R.P.M.
	Select pressure set too high.	Visual	Decrease select press.
	Water flow too great.	Visual	Turn off nozzle-Check for open hose allowing free flow of water.
	Gauge broken.	Visual-Gauge doesn't return to zero.	Replace
	Hydraulic Oil Cold.	Sluggish, slow response.	Warm system
	Modulator Trouble.	Visual Inspection (Refer to Section 8).	Check oil level in bellows- Tighten plugs *Repar/ Replace.

IMPORTANT

Do not force move the modulator assembly coupling in either direction with oil in bellows. This action will collapse the belloframs and make the unit inoperative.

If this happens, the assembly must be removed from the hydraulic pump, the oil drained, and new bellofram unit installed. The assembly coupling must move freely back and forth with air only in the bellows.

With the bellows assembly complete, remount the assembly on the hydraulic pump, refill the system with hydraulic oil and seal the system with the 1/4 inch pipe plugs.

See figure 8 for details.

Malfunction	Probable Cause	How To Determine	Corrective Action
12. Discharge pressure won't remain constant as nozzles are opened or closed.	Water demand at pressure selected is greater than input speed of P.T.O. will deliver.	Visual	Reduce flow and pressure or increase pump speed.

Malfunction	Probable Cause	How To Determine	Corrective Action
	Modulator Malfunction	Visual-Pump won't return to Neutral and stop.	* Repair/Replace Refer to Section 8).
13. Electric hose reel won't operate	Fuse	Visual	Replace (3A)
	Switch	Multi-meter / Jumper	Replace
See Wiring Diagram	Solenoid	Multi-meter / Jumper	Replace
	Motor	Multi-meter / Serviceman	Repair / Replace
	Elbow and Line Frozen or broken.	Visual	Replace / Drain water .

START-UP AND MAINTENANCE

Fluids

Hydraulic fluids used with Sauer-Sundstrand products should be carefully selected with assistance from a reputable supplier.

Start-Up Procedure

The following start-up procedure should always be followed when starting-up a new Series 90 installation, or when restarting an installation in which either the pump or motor has been removed from the system.

1. Prior to installing the pump and/or motor, inspect the units for damage incurred during shipping and handling. Fnsure all system components (hoses, valves, fittings, etc.) are clean prior to filling with fluid.

2. Fill the reservoir with recommended hydraulic fluid which should be passed through a 10-micron (nominal, no bypass) filter prior to entering the reservoir. The use of contaminated fluid will cause damage to the components.

3. The inlet line from the reservoir to the pump must be filled prior to start-up. Check inlet line for properly tightened fittings, and ensure it is free of restrictions and air leaks.

CAUTION

Be sure to fill the pump and/or motor housing with clean hydraulic fluid prior to start-up. Failure to hhed this caution will result in damage to the hydraulic pump and/or motor.

4. Fill the pump and/or motor housing by pouring filtered oil into the upper case drain port.

5. Install a 0 to 500 psi (35 BAR) pressure gauge in the charge pressure gauge port to monitor charge pressure during start-up.

6. Disconnect control linkage from pump to ensure pump remains in neutral position.

CAUTION

Do not start prime mover unless pump is in neutral position. Damage to equipment may result.

7. "Jog" or slowly rotate the prime mover (engine) until the charge pressure starts to rise. Start the prime mover and run at the lowest possible RPM until charge pressure has been established. Excess air may be bled from the high pressure lines through the high pressure gauge ports.

8. Once charge pressure has been established, increase speed to normal operating RPM. Charge pressure should be 320 PSI (23 BAR) minimum. If charge pressure is incorrect, shut down system and determine cause for improper pressure.

WARNING

Inadequate charge pressure will affect the operator's ability to control pump output.

9. Shut down engine and connect pump control linkage. Start engine and check to be sure pump remains in neutral position. With engine at normal operating speed, slowly check forward and reverse functions of pump and/or motor.

10. Charge pressure should remain at 320 to 340 PSI (23 to 24 BAR) minimum during forward and reverse operation. Continue to cycle slowly between forward and reverse for at least five (5) minutes.

11. Shut down engine, remove gauges and plug ports. Check reservoir and add fluid as necessary.

Maintenance

To insure optimum service life from Series 90 products, regular maintenance of the fluid and filter must be performed.

Check the reservoir daily for the following:

1. Proper fluid level.

2. The presence of water (indicated by cloudy or mill:y appearance or free water in the bottom of the reservoir).

3. Rancid fluid odor (indicating excessive heat).

It is recommended that the fluid and filter be changed per the following schedule:

1. System with a sealed reservoir: Every 2000 hours.

2. System with a breathing type reservoir: Every 500 hours.

It may be necessary to change the fluid more frequently than the above intervals if the fluid becomes contaminated with foreign matter (dirt, water, grease, etc.) or if the fluid has been subjected to temperatures higher than the maximum recommended. Never reuse hydraulic fluid.

The filter should be changed whenever the fluid is changed, or whenever the filter indicator shows that it is necessary to change the filter.

TROUBLESHOOTING

Gauge Installation

Various pressure and vacuum gauge readings can be helpful in troubleshooting problems 'with the Series 90 hydraulic components.

It will be necessary to install a high pressure gauge into the ststern pressure gauge ports to check the high pressure setting of the multi-function valves.

Measuring the charge pump inlet vacuum will help locate restrictions in the inlet lines, filter, etc.

Case pressure readings can help locate restrictions in the return lines, oil cooler, and return filter.

NOTE: Snubbers are recommended to protect pressure gauges. Frequent gauge calibration is necessary to insure accuracy.

GAUGE INSTALLATION

A	System Pressure Port "A"	Gauge: 10,000 PSI (690 BAR) Fitting: 9116 - 18 0-Ring
B	System Pressure Port "B"	Gauge: 10,000 PSI (690 BAR) Fitting: 9116 - 18 0-Ring
C	Charge Pressure	Gauge: 500 PSI (35 BAR) Fitting : 9116 - 18 0-Ring or Tee into Charge Pressure Filter Outlet Line
D	Case Pressure	Gauge: 500 PSI (35 BAR) Fitting: See Chart Below
E	Charge Pump Inlet Vacuum	Gauge: Vacuum Fitting : 9/16 - 18 0-Ring or Tee into Charge Pressure Filter Outlet Line
F	Servo Pressure	Gauge: son PSi (35 BAR) Fitting : 9/16 - 18 0-Ring or 7/16 - 20 O-Ring
G	Servo Pressure	Gauge: 500 PSI (35 BAR) Fitting : 9/16 - 18 O-Ring or 7/16 - 20 O-Ring

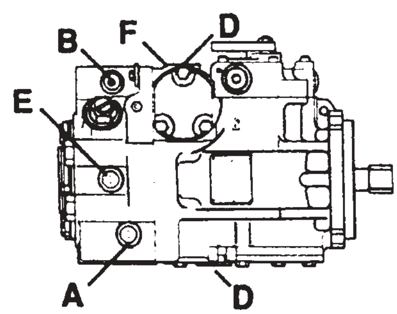


Figure 2. Gauge Connections - Variable Pump with Radial Port End Cap

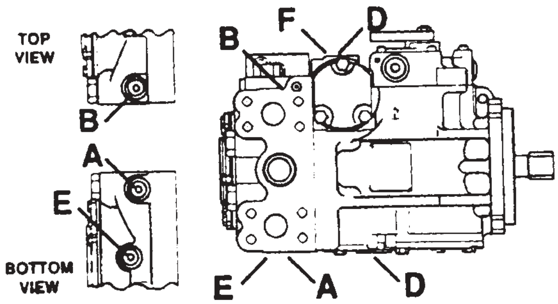


Figure 3. Gauge Connections - Variable Pump with Twin Port End Cap

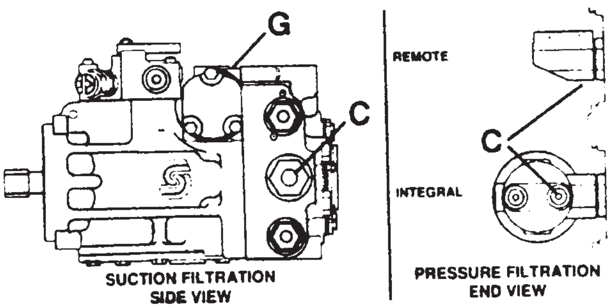


Figure 4. Gauge Connections - Variable Pump

Figure 5. Gauge Connections - Fixed Motor

Case Drain Port Sizes

Frame Size	Pump	Motor
030	7/8 - 14 0-Ring Fitting	-
042	7/8 - 14 0-Ring Fitting	-
055	1-1/16-12 0-Ring Fitting	7/8-14 0-Ring Fitting
075	1-1/16 - 12 0-Ring Fitting	1-1/16 - 12 0-Ring Fitting
100	1-1/16 - 12 0-Ring Fitting	1-1/16 - 12 0-Ring Fitting
130	1-5/16-12 0-Ring Fitting	1-5/16-12 0-Ring Fitting

INSPECTIONS AND ADJUSTMENTS

Manual Displacement Control (MDC)

There are no adjustable elements in the manual displacement control. All functions are preset at the factory.

Hydraulic Displacement Control (HDC) Neutral Adjustment

The neutral adjustment is the only adjustment that can be made on the hydraulic displacement control; all other functions are preset at the factory. The neutral adjustment of this control must be made on a test stand or on the vehicle with the engine operating.

⚠ WARNING

To prevent severe injury from becoming entangled in machinery, stand clear of rotating drives.

1. Install two (2) 500 PSI (35 BAR) gauges in the servo gauge ports (one on each side). Start the engine and operate at normal speed.

2. For earlier production controls, loosen the lock nut on the neutral shaft with a 17 mm hex wrench. For later production controls, loosen the lock nut on the neutral adjusting screw with a 10 mm hex wrench.

3. Use a 5 mm internal hex wrench to turn the neutral shaft on earlier production controls, or a 3 mm internal hex wrench to turn the neutral adjusting screw on later production controls.

4. Rotate the neutral adjusting shaft or the neutral adjusting screw clockwise until the pressure increases in one of two pressure gauges. Note the location "A' (angular position) of the internal hex wrench.

5. Without removing the internal hex wrench, rotate the neutral shaft or adjusting screw counterclockwise until the pressure increases in the other gauge. Note the location 'B" (angular position) of the internal hex wrench.

6. Rotate the neutral shaft or adjusting screw clockwise half the distance between locations "A' and "B". The control should now be in neutral. In this position both gauges should read the same pressure (case pressure).

7. While holding the neutral shaft or adjusting screw stationary with the internal hex wrench, tighten the neutral shaft lock nut (earlier production controls) to 16 ft. lbs. (22 Nm), or the neutral adjusting screw lock nut (later production controls) to 60 in. lbs. (7 Nm). Do not over-torque the locknut.

8. With the neutral position set, stop the engine, remove the gauges and install the gauge port plugs.

Electric Displacement Control (EDC) Neutral Adjustment

The adjustment procedures for the Electric Displacement Control are the same as the procedures for adjusting the hydraulic displacement control listed above.

Hydraulic Fluid Quality Requirements

The ability of a hydrostatic transmission to maintain desired performance for the expected life depends on the quality of fluid being circulated in the units. Fluid quality can be measured in three general categories: lubricity, contaminants, and temperature. Obtaining satisfactory values in these three areas depends on the fluid and the circuit in which it is used.

Sauer-Sundstrand field experience indicates that most transmission failures result from a breakdown of fluid quality. Primary causes are solid particle contamination and overheating. Water or air in the fluids are also significant contributors. These problems are usually the result of insufficient system design or poor maintenance. Sometimes fluid selection can lessen the impact of unusual environmental factors.

This Bulletin outlines Sauer-Sundstrand's requirements for fluid which is used in piston hydraulic units. Contact Sauer-Sundstrand if questions of suitability exist.

HYDRAULIC FLUID REOUIREMENTS

The catalog ratings and performance data for SauerSundstrand products are based on operating with good quality petroleum-based fluids. Premium hydraulic fluids containing high quality rust, oxidation and foam inhibitors are required. These include premium turbine oils, API CD engine oils per SAE J183, M2C33F or G automatic transmission fluid CFype F), power shift transmission fluids meeting Allison C-3 or Caterpiller TO-2, and certain specialty agricultural tractors fluids. Fire-resistant fluids are also suitable at modified conditions as described in this bulletin.

Although fluids containing anti-wear additives are not necessary for the satisfactory performance of Sauer-Sundstrand piston units, they are often required for associated equipment. When used, the fluids must possess good thermal and hydrolytic stability to prevent wear, erosion and corrosion of the internal components.

Where water contamination is likely due to condensation, operation in a damp environment or frequent splashing, a fluid with outstanding hydrolytic stability is recommended. Consult Sauer-Sundstrand for recommendations for these fluids. Avoiding the use of Dexron II transmission fluids which do not meet Allison C-3 specification is recommended.

VISCOSITY AND TEMPERATURE REQUIREMENTS

The fluid must have sufficient viscosity to maintain an oil film at the bearing surfaces. This depends on fluid selection and on operating temperature. Recommended viscosity for best life and efficiency, and minimum for intermittent and continuous operation is listed below.

FLUID ViSCOSITY LIMITS
For Petroleum Based Fluids

	Series 30	Other Piston Units
Maximum Continuous SUS (cSt)	500(110)	500(110)
Optimum Viscosity SUS (cSt)	70(13)	70(13)
Minimum Continuous SUS (cSt)	47 (6.4)	55 (9.0)
Minimum Inlemittent SUS (cSt)	42 (5.0)	47 (6.4)

Viscosity index improved (multi-viscosity) fluids may noticeably shear down in service when used in hydrostatic transmissions. This will lower the operating viscosity below the originally specified value. The lowest expected viscosity must be used when selecting fluids. Consult your fluid supplier for details on viscosity sheardown.

Fluid temperature affects the viscosity of the fluid and resulting lubricity and film thickness. High temperatures can also limit seal life, as most non-metallic materials are adversely affected by use at elevated temperature. Also, fluids may break down or oxidize at high temperatures, reducing their lubricity and resulting life of the unit. Cavitation is more likely at high temperature. Recommended limits for operating temperatures are tabulated below.

FLUID TEMPERATURE LIMITS
For Petroleum Based Fluids

	Series 30	Other Piston Units
Continuous limit	220ºF	180ºF
Intermittent Limit	240ºF	22ºF

These temperature limits apply at the hottest point in transmission, which is normally the case drain.

Heat exchangers should be sized to keep the fluid within these limits. This is normally done by selecting the worst continuous operating condition, and sizing for all the transmission loss being cooled in the hottest ambient environment, at the continuous temperature rating. For many machines, this occurs at the highest transmission output speed obtainable. Testing to verify that these temperature limits are maintained is recommended.

Heat problems sometimes occur because of problems with one of the circuit components. Circuit designs should avoid depending on high pressure relief valves as part of the control system as frequent operation of these relief valves will generate intolerable heat. Circuit components with high internal leakage also contribute to heat problems. Also, circuits containing flow control valves such as flow dividers are susceptible to heat generation as they function by restricting oil flow with a pressure drop.

Cold oil will generally not affect durability of Sauer-Sundstrand transmission components, but it may affect the ability to flow oil and transmit power. In general, cold starts may be made at a temperature 300F wanner than the pour point of the fluid. Some period of time may be required to initiate motor shaft movement, but the fluid will warm rapidly after this occurs. Operation of units at high speed without oil flowing in the circuit may damage the units and should be avoided.

FIRE-RESISTANT FLUIDS

Fire-resistant fluids require special considerations in application of Sauer-Sundstrand units. Materials used in elastomeric seals, metal and plastic parts may be attacked by these fluids, which may require modification or render the unit unsuitable. System designers must verify that these conditions are satisfactory for each individual application. Consult ANSI B93.5, your fluid supplier and SauerSundstrand for information on use of fire-resistant fluids.

Because of high specific gravity, these fluids are more susceptible to pump inlet condition problems and generally require reduced vacuum. Also, because of poor air release properties, larger reservoirs are recommended to increase dwell time and reduce aeration of fluids.

Filters can be affected by water-based fluids to reduce the pore size and restrict flow. It is advisable to provide increased filter flow capacity and verify that the pressure drop will stay within required limits.

Fluids with water content may require grounding the hydraulic units in order to prevent galvanic action.

Fluid and system maintenance is more critical when using fire-resistant fluids than with petroleum-based fluid. These fluids can change in composition and viscosity over time and affect the ability of hydraulic units and associated equipment to function properly. Frequent monitoring of the fluid properties is required as well as timely maintenance procedures.

It is necessary to modify operating parameters of transmissions when used with non-petroleum based fluids. Modified parameters are suggested below. Assuming proper maintenance, and that conditions of material compatibility, inlet condition, and filter suitability are satisfied, these are estimated to produce the life normally expected with petroleum-based fluids.

As operating conditions and fluid properties may vary, testing is required to verify actual unit life of hydraulic units operating with fire-resistant fluids. Contact Sauer-Sundstrand if there are questions regarding use of fire-resistant fluids.

MODIFIED OPERATiNG PARAMETERS
For Fire-Resistant Fluids

Fluid Type	Speed1 (% Catalog)	Pressure 1 (% Catalog)	Maximum Temperature
Phosphate Ester or Ester WIOIl	100%	100%	180º
Polyolester	85%	85%	150º
Invert Emulsion (60 oil/40 water)	65%	70%	140º
Water Glycol (60/40)	65%	60%	140º
HWCF (95 water/S oil)	65%	40%	122º

Consult Sauer-Sundstrand Bulletin BLN-9884 "Pressure and Speed Limits" for information on ratings and Unit life. Contact Sauer-Sundstrand prior to using a V11 40 bent axis variable motor in a system using fire-resistant fluids.

Phosphate Ester or Ester with Oil

Phosphate ester or ester with oil requires Viton or EPR seals in dynamic locations. Consult the fluid manufacturer to obtain a recommendation for the particular fluid used. These fluids attack some plastics, zinc, and cadmium. The high specific gravity of these fluids requires an inlet vacuum of 2 in. Hg maximum. Use an elevated reservoir and increased inlet line size for these fluids. Some of these fluids have caused high wear of aluminum parts in transmissions.

Polyolester Fluids

Polyolester Fluids have been used successfully with standard units. Some fluids are prone to an increase in acid number and this condition must be monitored closely. This class of fluid sometimes produces unusually rapid wear of metal on bearing surfaces, especially in the presence of high temperature and pressure or speed. Certain controls may require hardened parts to achieve acceptable life.

Invert Emulsion

Invert Emulsion fluids can break down with repeated freezing and thawing. Also, heating above 1500F can cause emulsion breakdown. High specific gravity requires an inlet vacuum of 3 in. Hg maximum. Use an elevated reservoir and increased inlet line size. Monitoring the fluid water content is necessary; frequent additions may be necessary in order to overcome evaporation losses. These fluids also show poor vapor phase corrosion inhibition.

Water Glycol

Water glycol attacks zinc and cadmium, and produces solvent action on some paints. Wear of aluminum in transmission parts sometimes occurs in the presence of these fluids. Their high specific gravity requires an increase in absolute inlet pressure. Keep inlet vacuum below 2 in. Hg. Use an elevated reservoir and increased inlet line size. Stability regarding pH and water content can be a problem.

HWCF (95-5)

HWCF (95.5) has been used successfully at the reduced operating parameters indicated above. There can be bacterial control problems and corrosion problems. Fluid pH stability can be a problem and can cause wear and chemical reaction with aluminum. Aiso, there may be a solvent action on some paints. A positive head reservoir is required to maintain a positive inlet pressure when operating, and to keep air out of internal passageways when shut down.

CONTAMINATION LEVELS

Clean fluid implies the absence of impurities such as solid particles, water and air. Contamination control includes proper design, installation, and maintenance of hydraulic components.

Reservoirs must be designed to limit entry of contamination during servicing and operation. A sealed reservoir with a low pressure relief valve will reduce the introduction of contaminants while maintaining inlet and case drain pressure below the maximum recommended.

Hoses, pipes, and fluid couplings must be designed to prevent the entry of air and must be of adequate size. Excessive turbulence 'will cause air and fluid vapor bubbles to be released, causing cavitation and erosion and associated life reduction.

The purpose of the filter in a system is to clean the oil at initial start-up and to maintain acceptable levels of particle con tammants as they are ingested or generated during operation of the system. Filtration is a matter of controlling the particle sizes and their respective quantities to appropriate levels so as to avoid degradation of the system components and thereby assure the desired life.

Fluid contaminant profile requirements for Sauer-Sundstrand hydraulic units have been determined empirically based on measuring fluid quality in successful applications. and in laboratory tests designed to evaluate hydraulic unit contaminant sensitivity. General contaminant levels have been developed based on this experience and are shown on Figure 6.

Acceptable contamination levels at machine start-up for the system loop should be equal or better than Curve D, Figure 6. The machine may be exercised to 500 PSI but should not be worked (')ressure over 500 PSI) until the oil cleanliness level meets or exceeds Curve C. The machine may be shipped at this level.

The machine should clean up during a relatively short period of normal operation to meet the oil cleanliness level of Curve A or Curve B. A system that meets Curve A will provide the user with a longer trouble-free operating life than one that meets Curve B. The Curve A cleanliness level should be met in systems exceeding the continuous pressure limit for 1000 hours/year machine use, listed in Table 1 of Bulletin BLN-9884, "Pressure and Speed Limits".

Some control valves may require better contamination limits than specified in Figure 6. Controls with small area screens or low force level values may be susceptible to malfunction from contamination. Consult Sauer-Sundstrand for assistance if this condition exists.

The contaminant sensitivity of components generally increases with higher pressure, temperature or speed. A better fluid contaminant profile may be required for systems which operate near the extremes of their ratings. Short life or infrequent operation requirements may increase allowable contaminants.

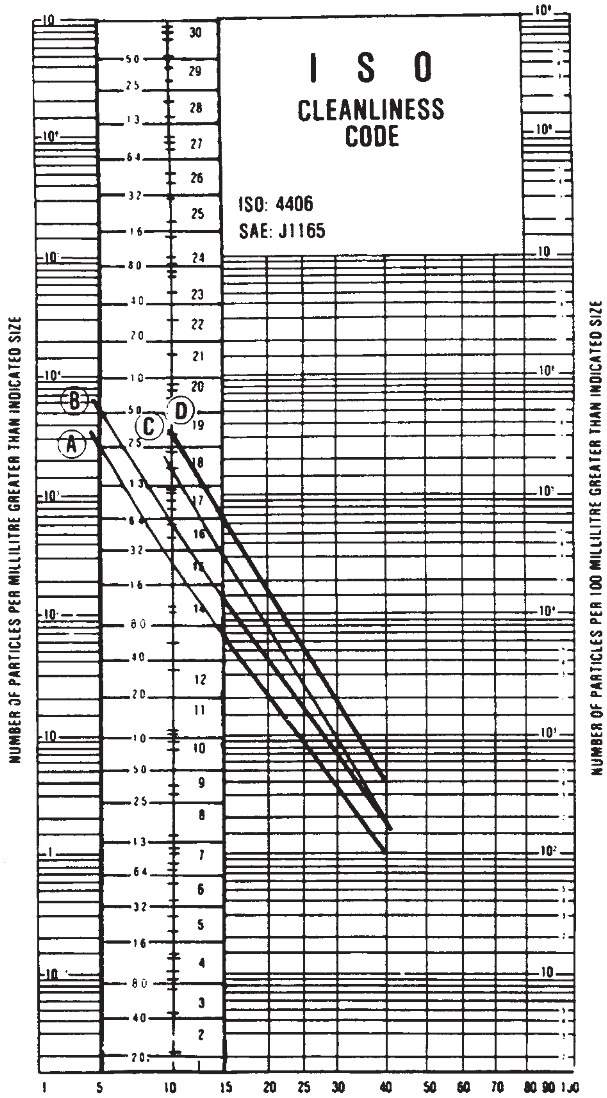
The selection of a filter depends on a number of factors including the contaminant ingression rate, the generation of contaminants in the system, the required fluid cleanliness, and the desired maintenance interval. Filters are selected to meet the above requirements using rating parameters of efficiency and capacity.

Filter efficiency may be measured with a Beta ratio. (2) For simple closed circuit transmissions with controlled reservoir ingression, a filter 'with a Beta 10 ratio of 1.5 to 2 has been found to be satisfactory. For some open circuit systems, and closed circuits with cylinders being supplied from the same reservoir, a considerably higher filter efficiency is recommended. This also applies to systems with gears or clutches using a common reservoir. For these systems, Beta 10 ratios of 10 to 20 are typically required.

The filter capacity required depends on the amount of contaminants ingressed and retained in the filter and the desired maintenance interval. As a rough guide, a capacity in grams equal to twice the charge flow in GPM has been found to be satisfactory for many closed circuit systems.

Since each system is unique, the filtration requirement for that system 'will be unique and must be determined by test in each case. It is essential that monitoring or prototypes and evaluation of components and performance throughout the test program be the final criteria for judging the adequacy of the filtration system.

(2) Filter Beta ratio is a measure of fitter efficiency defined by ISO 4572. It is determined by dividing contaminant paflicte density upstream of the filter by downstream density. The Ceta rating uppliea at specific paflicte size, measured in microns.



PARTICLE Size, micrometres

Curve A

Desired limit
for longer life
(3500 PSI
continuous system
pressure - reference)

Curve B

Continuous
operating
limit
(2000 PSI
Continuous system
pressure - reference)

Curve C

Limit at machine ship
and new fluid added
to transmission

Curve D

Limit at machine
start-up

Figure 6. Fluid Contamination Levels

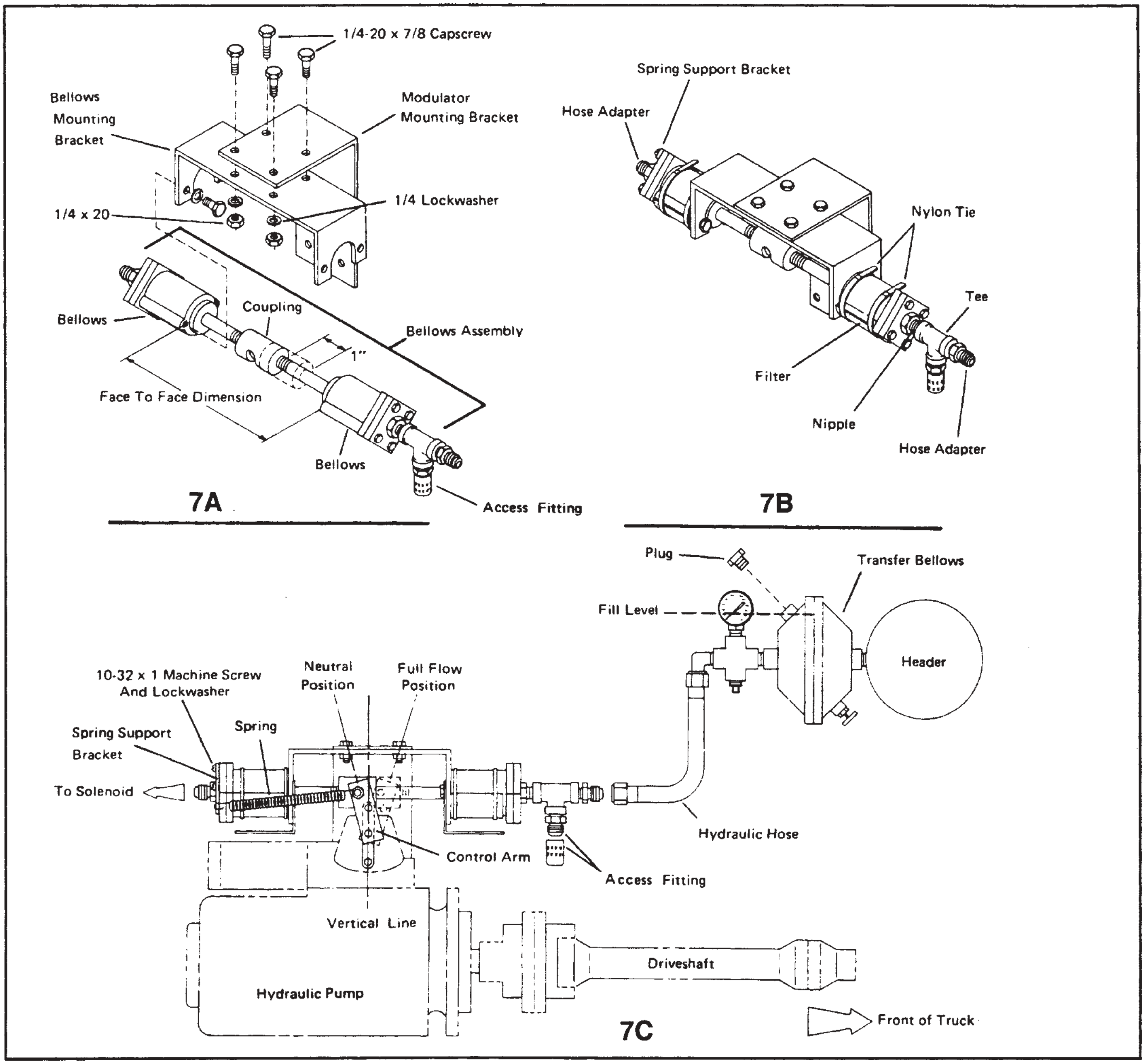


Figure 7. Modulator Assembly

⚠ CAUTION

The bellows assembly is a rugged, precision piece of equipment but there are some precautions to be observed when assembling or servicing.

The shaft will not stand any twisting because the bellows will be damaged. Therefore, the shaft coupling must be able to rotate freely at all times.

Modulator Assembly

(Ref. Figure 7A)

Lightly screw two bellows assemblies together using the brass coupling. The face to face dimension with one bellows extended and the other retracted should be approximately 5-1/2 inches.

Center the brass coupling on the shafts and adjust the face to face dimension of the bellows to match the face to face dimension of the mounting bracket. The bellows assemblies must be mounted with the vent holes down. The modulator mounting bracket must be assembled to the bellow mounted bracket using (4) 1/4-20 x 7/8 capscrews, lockwashers and nuts. Assemble as shown (Figure 7A). Tighten bellows assembly to mounting bracket using (4)1/4-20 x 7/8 capscrews and lockwashers. The bellows shafts and coupling must slide back and forth freely when both bellows are tight on the bracket. If the shafts do not move freely, shims must be added until they do. Ref. Figure 7B.

Cover the vent hole in each bellows with a filter pad and secure each pad with two nylon ties. The inner tie must be tight against the bellows mounting bracket, otherwise it will cover the vent hole and impede the free movement of the shaft.

Remove the bellows mounting screws one end at a time and install the mud shield as shown in Figure 7B. Next assemble the hose adapters, pipe tee, nipple and access port fitting, using hydraulic grade locktite. Ref. Figure 7C.

The spring support bracket is mounted to the end cap of bellows as shown. Replace the existing screws with (2) 10-32 x 7/8 machine screws and 3/16 lockwashers.

Installation: The Modulator assembly is mounted to the hydraulic pump as follows. Remove the (4) 1/4-20 x 5/8 capscrews from the cover plate of the swash plate control housing on the top of the pump and discard them. These are on the opposite end from the swash plate control arm. Attach the modulator assembly to the hydraulic pump with (4) 1/4-20 x 7/8 Grade 5 capscrews and lockwashers. The bellows with the pipe tee is mounted toward the front or drive line end of tile pump.

Remove the 5/16 lock nut holding the swash plate adjusting lever onto the hydraulic pump control shaft Also remove and discard the flat washer. Insert the control arm thru the shaft coupling and attach the adapter plate assembly to the face of the swash plate adjusting lever. A 1/4-20 x 3/4 capscrew with locknut goes thru the end of the swash plate lever and the middle hole in the adapter plate. Replace the 5/16 locknut and tighten. The spring is attached between the end of the spring support bracket and the end of the control arm. this will hold the swash plate adjusting lever in the neutral position. The 5/16 nut and the 1/4 attaching capscrew should be in a vertical line. Connect the hydraulic hose from the pressure transfer bellows assembly to the pipe tee in the modulator bellows The hydraulic hose from the solenoid is connected to the bellows on the opposite side.

Remove the hex head plug from the top of the transfer bellows.

Remove the brass seal cap from the schrader type access valve.

Connect a charging hose to the access valve and add hydraulic oil until the system is full to the top of the transfer bellows assembly. Remove the charging hose and replace the brass seal cap onto the access valve. Tighten a 1/4 hex head plug into the transfer bellows case.

This will seal this system from the atmosphere so it can perform properly. If this procedure is not followed and the system is not kept sealed, the system will not function. After an operating period of 5-10 hours, check the oil level in the transfer bellows and add oil if necessary to bring oil level to top. The entire hydraulic system should now be ready to operate. Be sure the main system is full of hydraulic oil.

Adjustment: Engage the P.T.O. and operate the hydraulic pump. Observe the hydraulic motor/water pump combination. The pump should not be rotating in either direction. Turn on the control system in the truck cab and depress the white "activate" switch. Follow the Operating Instructions for operating the control panel - except, this is a dry run to check water pump rotation only.

⚠ CAUTION

Make certain everyone is clear of machine before starting engine or operation.

Check to see that the water pump rotates in a counterclockwise direction (looking from suction side of pump). A creep of one revolution in 4-5 seconds in the proper direction is permissible.

⚠ WARNING

Remain clear of all moving parts.

This is the proper operation mode. If the pump does not stop but continues to rotate in either direction when the controls are turned off, the following modulator adjustment will have to be made.

If the pump rotates rapidly in the wrong direction, the main hoses are connected improperly. This must be corrected immediately. This trouble is not just a control problem but is a basic pump/ motor flow problem.

To stop the slow rotation of the water pump that occurs when the system is turned off, adjust the modulator as follows:

Refer back to assembly directions for installing the control arm to the swash plate lever.

Remove the 5/16 locknut and the 1/4-20 x 3/4 capscrew from the adaptor plate. Remove the control arm from the shaft connector coupling. Gently rotate the brass coupling 1/2 to 2 turns as needed to put the swash plate control arm in the neutral position. Moving the coupling towards the back end of the hydraulic pump will slow down or stop the forward rotation of the water pump.

If the coupling is too far towards the back end at the original setting the pump will rotate slowly in the reverse direction when the control system is turned off. Moving the coupling forward will correct this condition.

Reinsert the control arm into the coupling and refasten the adapter plate to the swash plate control lever.

Recheck the running and stopping of the Water Pump.

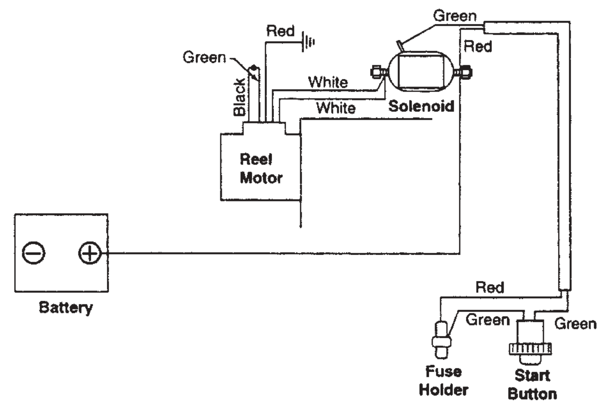


Figure 8. Electric Hose Reel Wiring Diagram

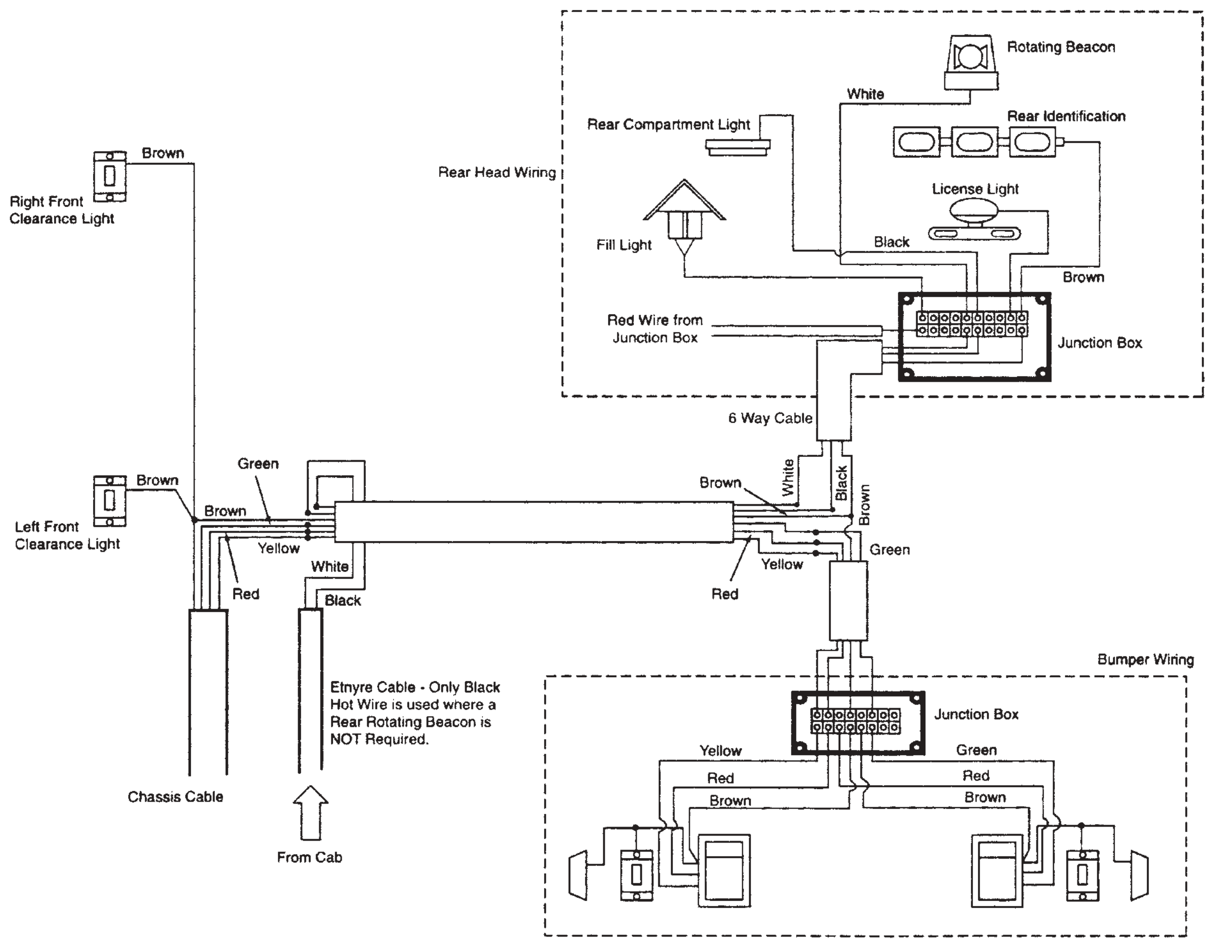
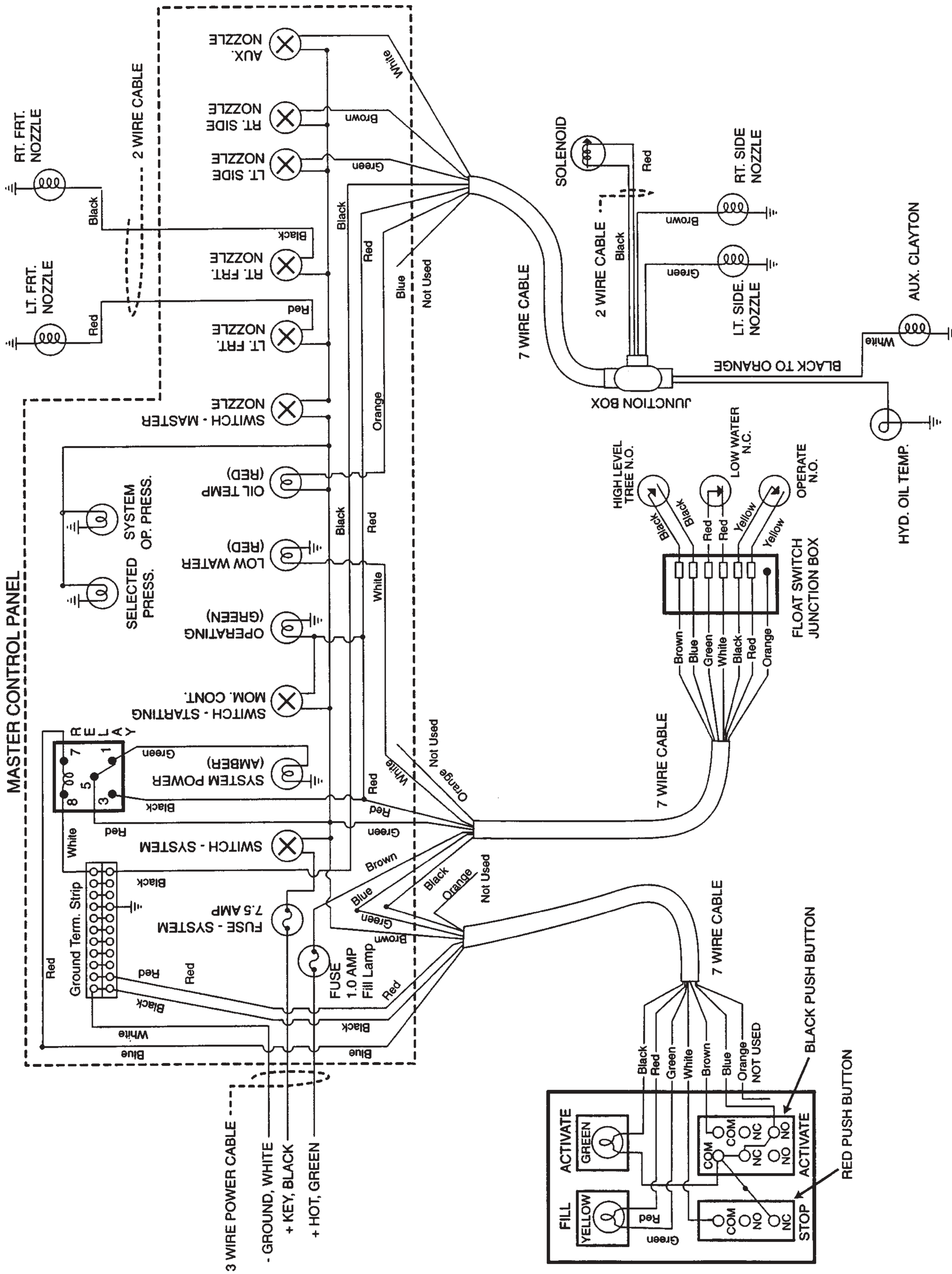
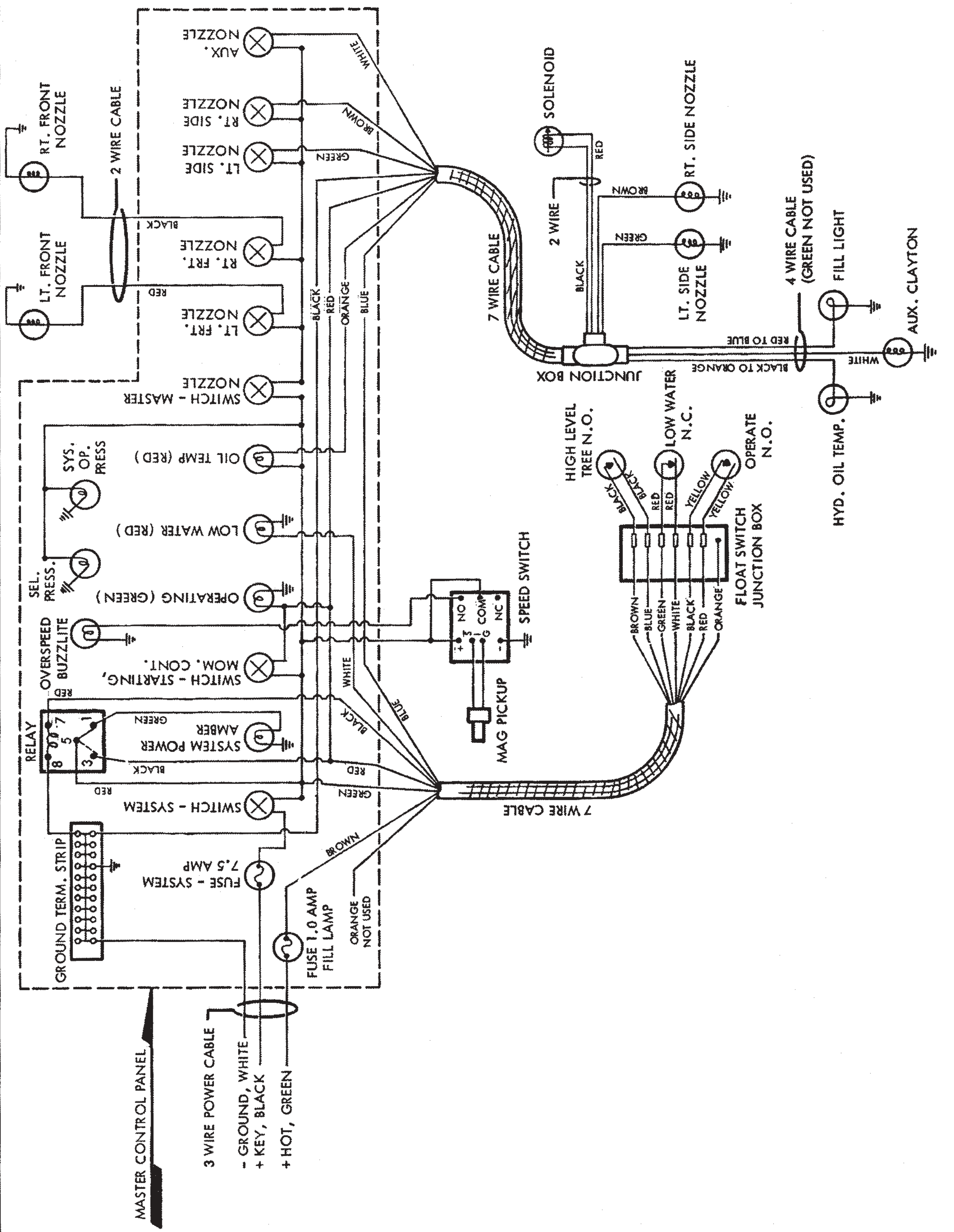


Figure 9. Wiring Diagram - Flusher Lighting

Wiring Diagram - Water Control System With Self Fill

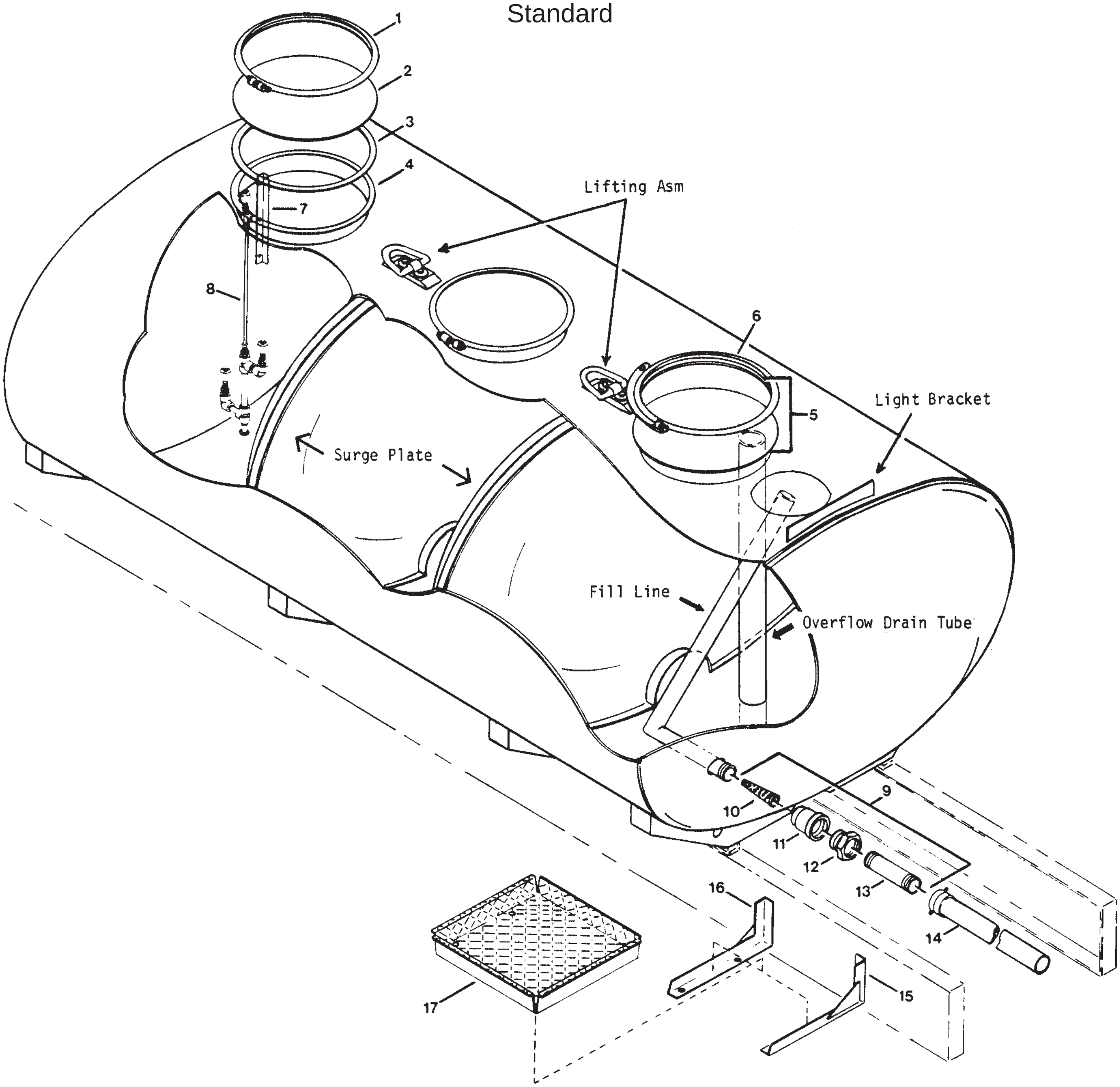


Wiring Diagram - Water Control System Without Self Fill



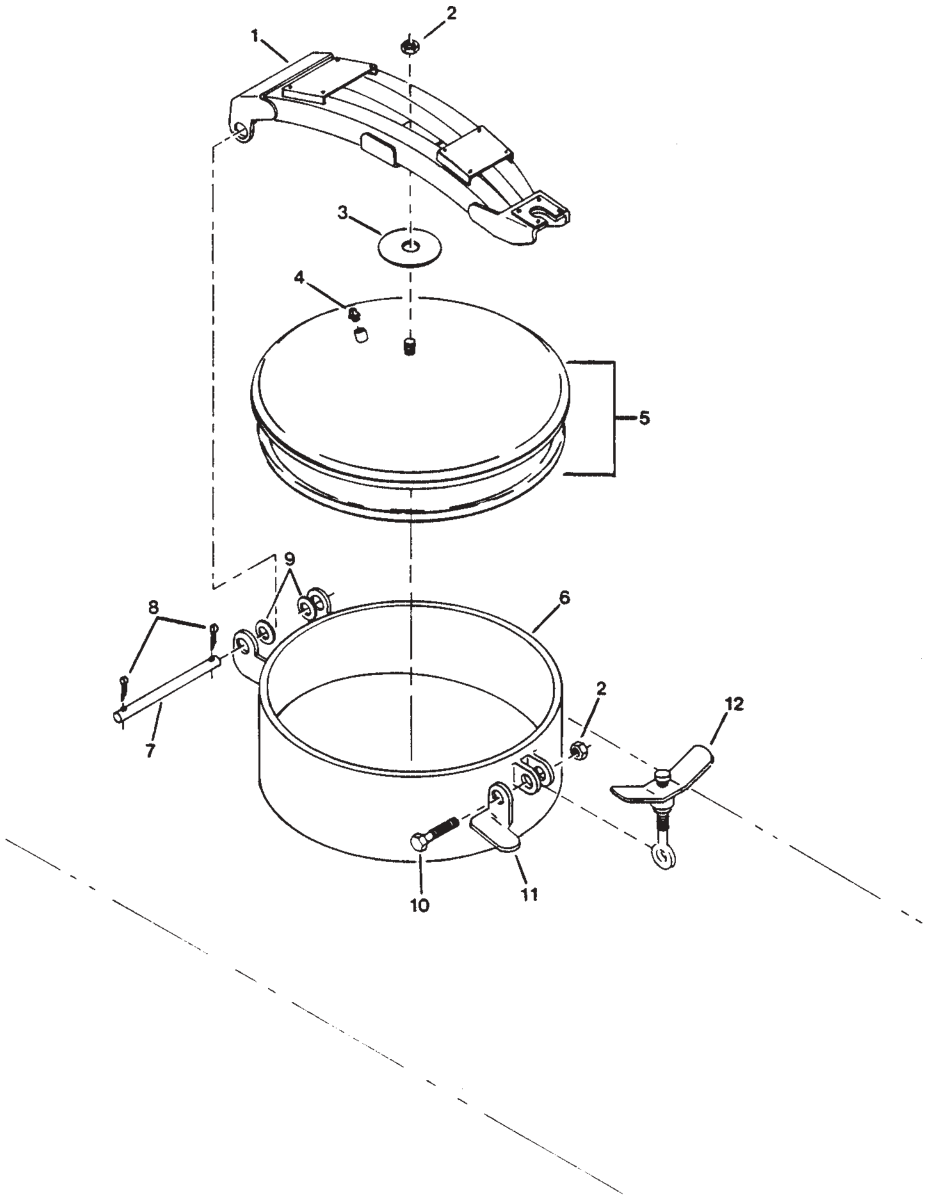
SPECIFY UNIT SERIAL NO., PART NO., & PART DESCRIPTION

Tank Assembly & Fill Line Attachments
Standard



REF.	PART NO.	QTY.	DESCRIPTION
1	2910339	2	Band Asm-Clamp
2	2910335	3	Cover
3	2910334	3	Gasket
4	2910380	3	Collar
5	7230289	1	Manhole Kit
6	2910340	1	Band-Quick Clamp
7	2900111	1	Angle-Mt., Float
8	2960183	1	Tree Asm-Level Indicator
9	7210135	1	Kit-Replacement, Strainer
10	2940030	1	Strainer
11	2940372	1	Retainer
12	6200041	1	Bushing-PP, 3.00 x 2.50 NPT,PN
13	6200116	1	Nipple-PP, Sch 40, 2.50 x 7.00 PN
14	6601095	1	Hose-Fill, 2.50 NPT
15	2910379	1	Bracket Asm-Mtg.-Hose Box, RH
16	2910384	1	Bracket Asm-Mtg.-Hose Box, LH
17	2910231	1	Hose Box

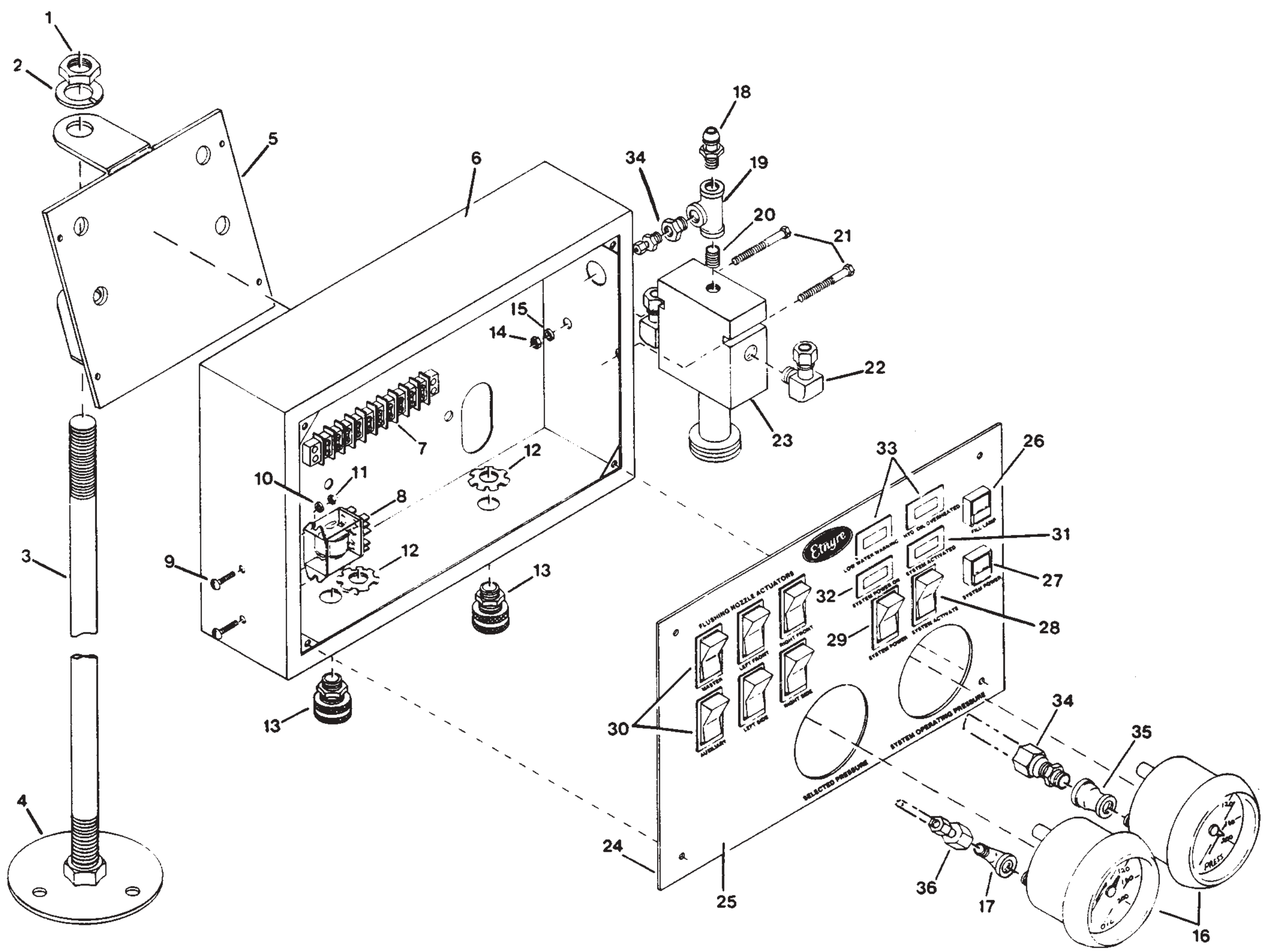
Manhole Assembly
2990113 - Optional



REF.	PART NO.	QTY.	DESCRIPTION
1	2700244	1	Strongback Asm
2	9411727	2	Nut-Hex, Lock, 0.50NC,EA,PD
3	2700241	1	Reinforcer-Cover
4	0444867	1	Plug-Auto, Hex Sock, 0.38NPTF,PD
5	2700545	1	Cover Asm-20"
	2700248	1	Gasket
6	3301279	1	Collar-20" Alum
7	2700233	1	Shaft-Hinge
8	0137204	2	Pin-Cotter, 0.12 x 1.50,PD
9	6100376	AR	Washer-Wave
10	0122459	1	Screw-Hex, 0.50NC x 2.00,GR2,PD
11	2700234	1	Prop-Cover
12	2700243	1	Hold Down Asm

AR - AS REQUIRED

Control Panel Assembly



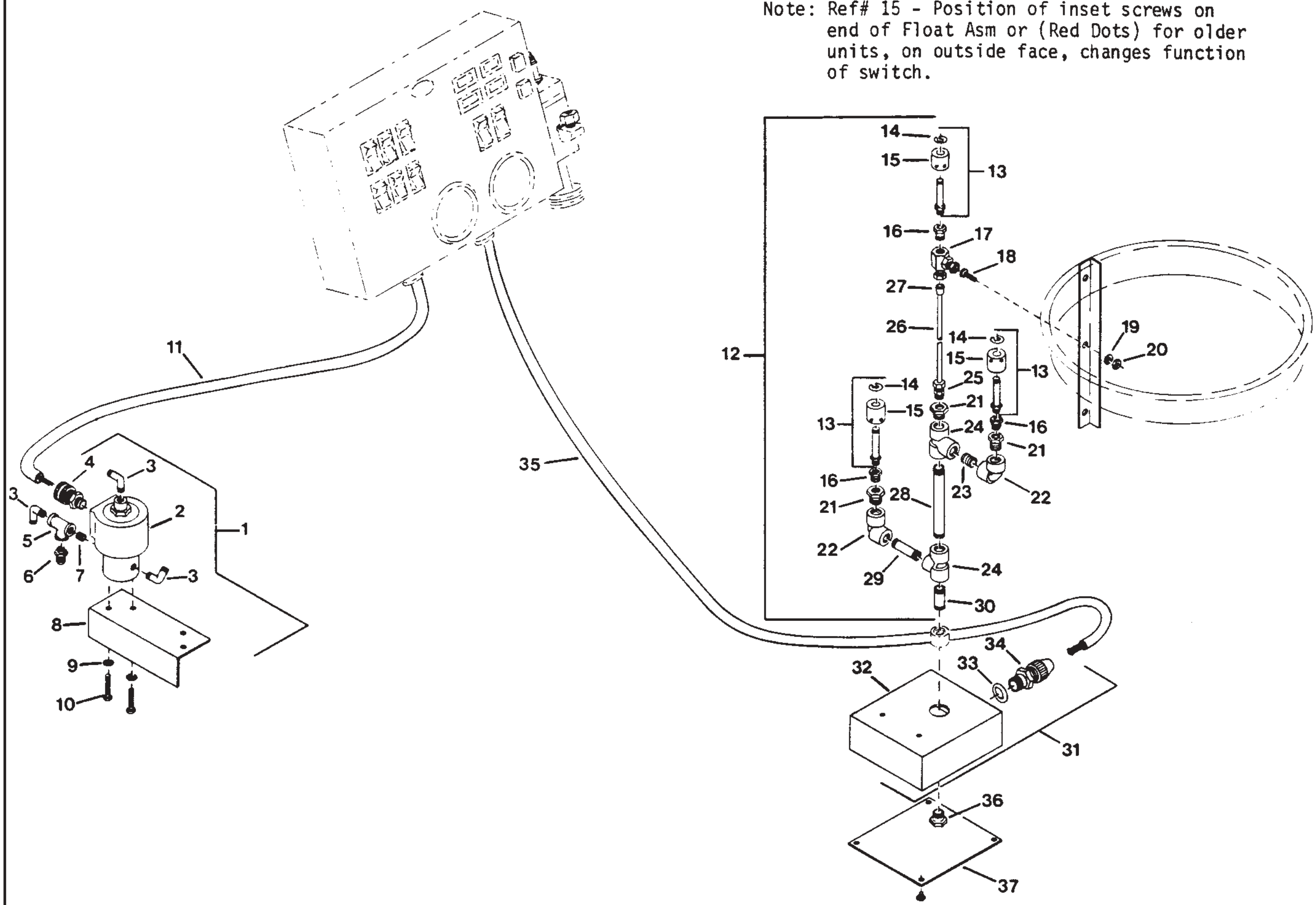
REF.	PART NO.	QTY.	DESCRIPTION
1	0124589	AR	Nut-Hex, 0.62NC,PD
2	0121574	AR	Washer-Lock, 0.62, Spring,PD
3	3361224	1	Leg-Tach & Bit. Mt.Control
4	3361221	1	Foot Asm
5	2960205	1	Bracket Asm
6	2960122	1	Box-Panel
7	6700306	2	Strip-Terminal
8	2960184	1	Relay Asm
9	0436665	6	Screw-Mach, PNSL,06NC x 0.50,PD
10	0120382	6	Washer-Lock, 0.38, Spring,PD
11	0120377	6	Nut-Hex, 0.38NC,PD
12	6700904	2	Nut-Lock, 0.50, Electric
13	6700607	2	Cord Grip, 0.50
14	0120375	2	Nut-Hex, 0.25NC,PD
15	0120380	2	Washer-Lock, 0.25, Spring,PD
16	6400127	2	Gauge-Pressure, 200 PSI
17	0105422	1	Elbow-PP, 90, St, 0.12NPT,PN
18	0118750	1	Adp-Auto, St, 04MP-06MS
19	0105417	1	Tee-Pipe, 0.25NPT,PN
20	0105405	1	Nipple-Sch 40, 0.25 x 0.87CL,PN
21	0121940	2	Screw-Hex, 0.25NC x 1.75,GR2,PD
22	6600832	2	Elbow-ARBK, 90, 04MP-06MT
23	6601011	1	Valve-Control Pressure Noz
24	2960408	1	Back Plate
25	6001273	1	Master Panel
26	6700822	1	Holder-Fuse, Fill Light
27	6700823	1	Holder-Fuse, System Power
28	6700817	1	Switch-Rocker, Activate
29	6700818	1	Switch-Rocker, Power
30	6700819	6	Switch-Rocker, Flushing Control
31	6700815	1	Light-Pilot, Green
32	6700814	1	Light-Pilot, Amber
33	6700816	2	Light-Pilot, Red
34	6600831	2	Adp-ARBK, St, 04MP-06MT
35	0105420	1	Coupling-PP, 0.25 x 0.12NPT,PN
36			Included with Ref# 16

AR - AS REQUIRED

SPECIFY UNIT SERIAL NO., PART NO., & PART DESCRIPTION

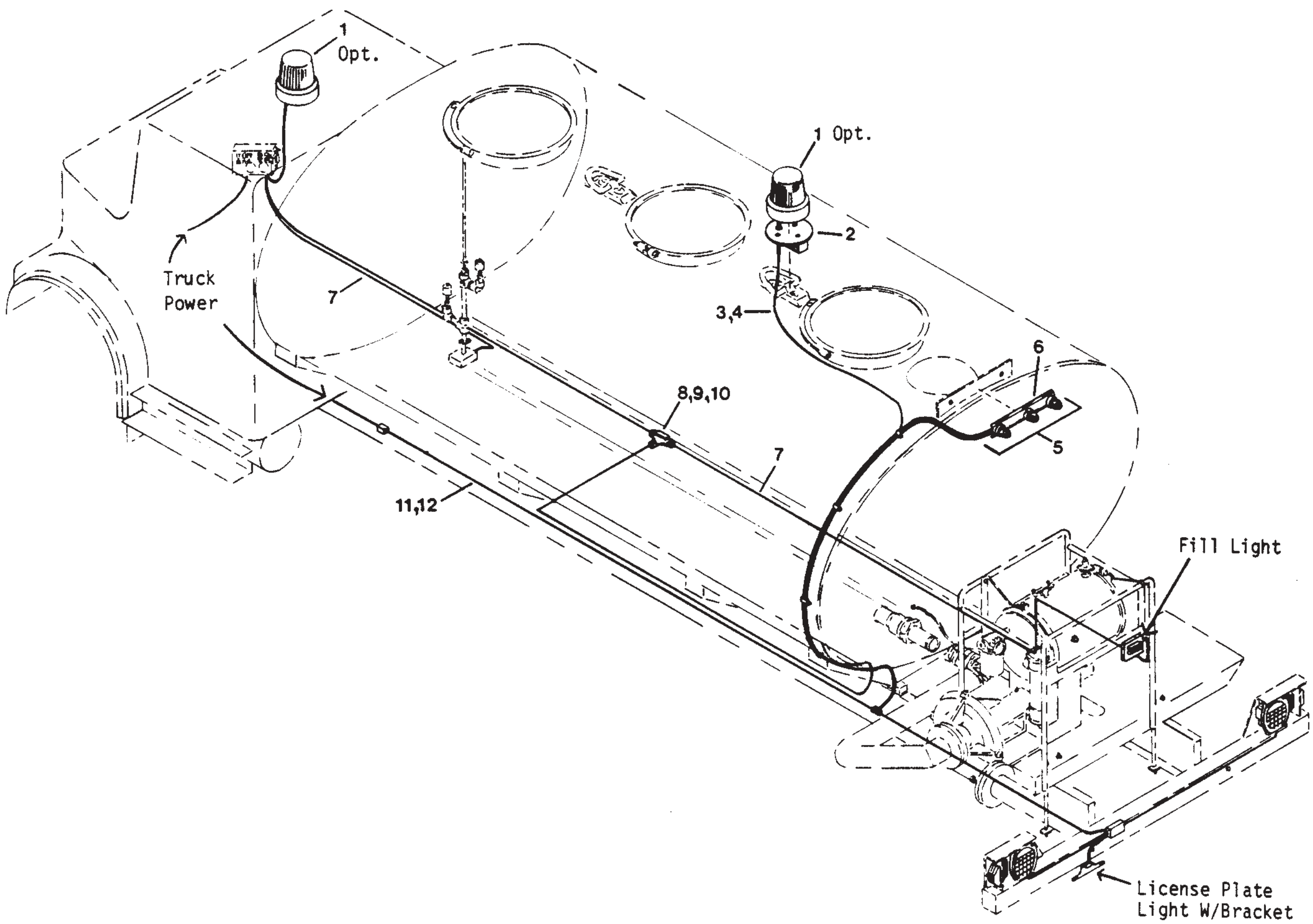
Control System - Electrical

Note: Ref# 15 - Position of inset screws on end of Float Asm or (Red Dots) for older units, on outside face, changes function of switch.



REF.	PART NO.	QTY.	DESCRIPTION
1	2960128	1	Sol. Asm-Pressure Control
2	6601020	1	Valve-Sol. Act 12VDC, 175 PSI
3	0118755	3	Elbow-Auto, 90, 04MP-06MS
4	6700858	1	Cord Grip-Male, 0.50 x 0.38
5	0105417	1	Tee-Pipe, 0.25NPT,PN
6	0118750	1	Adp-Auto, St, 04MP-06MS
7	0105405	1	Nipple-Sch 40, 0.25 x 0.87CL,PN
8	2960185	1	Bracket-Sol. Mt.
9	0120217	2	Washer-Lock, #10, Spring,PD
10	0436750	2	Screw-Mach, PNSL, 10NF x 0.50,PD
11	6700898	1	Cable, 2-18
12	2960183	1	Tree Asm-Level Indicator Univ.
13	6700190	3	Switch Indicator Asm
14	6000921	3	Snap Ring
15	7520001	3	Float-Switch Level
16	0112877	3	Bushing-PP, Hex, 0.13 x 0.25NPT,BR
17	6601170	1	Tee-Run, 04FP x 06MN x 06MN, Brass
18	6601172	1	Montie-Fitting, 6T2212B, Brass
19	0120380	1	Washer-Lock, 0.25, Spring,PD
20	0113739	1	Nut-Hex, 0.25NC, Brass
21	6601015	3	Bushing-PP, 0.50 x 0.25NPT,PVC
22	6601014	2	Elbow-PP, 90, 0.50NPT,PVC, Sch 80
23	6601018	1	Nipple-Sch 80, 0.50 x CL,PVC
24	6601012	2	Tee-PP, 0.50NPT, Sch 80,PVC
25	6600831	1	Adp-ARBK, St, 04MP-06MT
26	6309162	3.5	Tubing-Nylon, 0.38 OD
27	6601171	1	Insert-Ferrule. 06 Tube. 6T23UIB
28	6601016	1	Nipple-PP, Sch 80, 0.50 x 6.00,PVC
29	6601017	1	Nipple-PP, Sch 80, 0.50 x 3.00,PVC
30	0192077	1	Nipple-PP, Sch 40, 0.50 x 2.50,PD
31	2960163	1	Box Asm-Float Switch Junction
32	2960166	1	Box-Junction Float Switch
33	0274249	1	O Ring-Tube Fitting, 3/4
34	6700894	1	Relief-Strain Cord Liq-Tight
35	6700825	15'	Cable, 7-18
36	6700829	1	Nipple-Chase Non-Insulated, 0.50
37	6700834	1	Cover

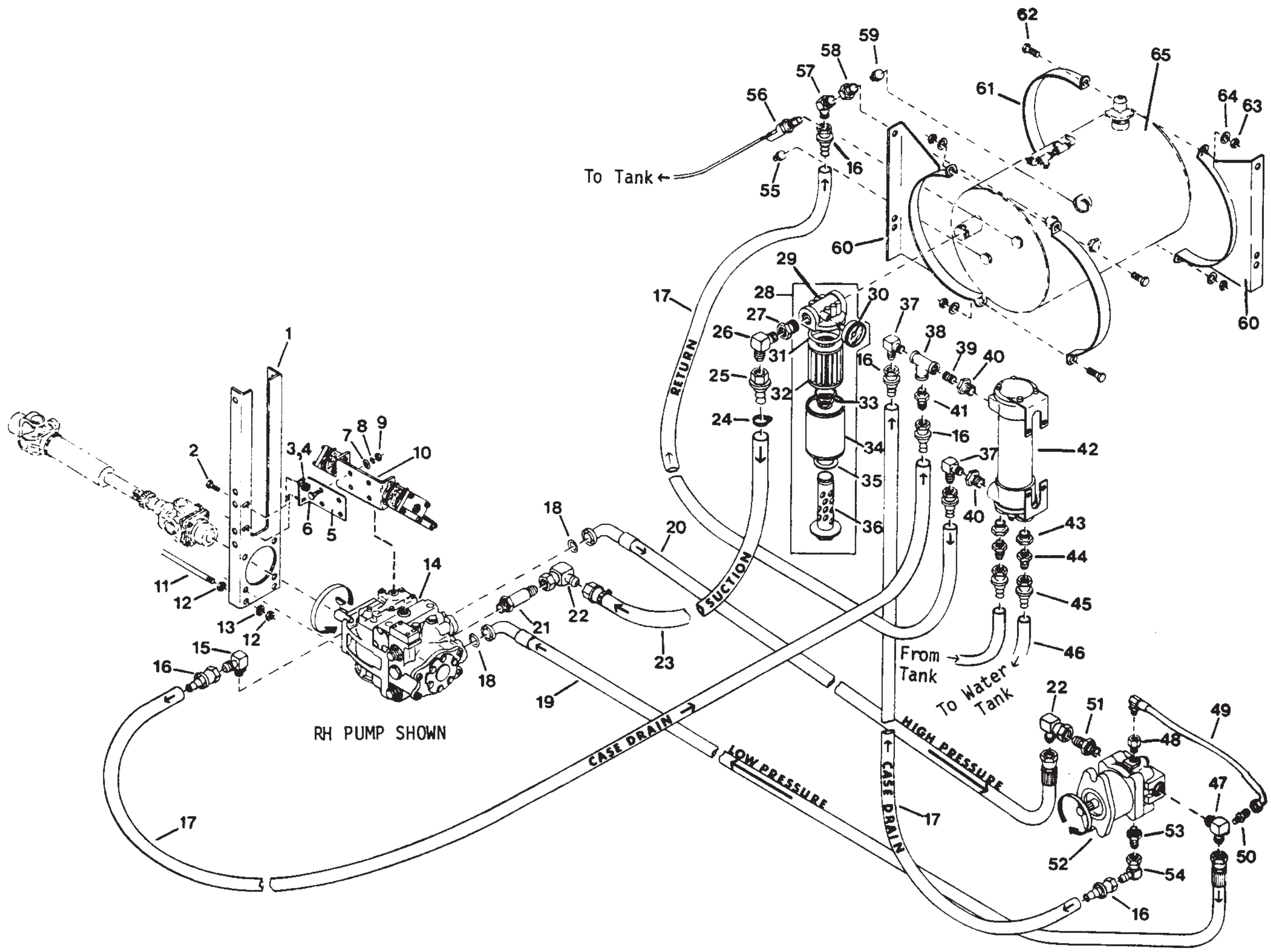
Lights & Wiring

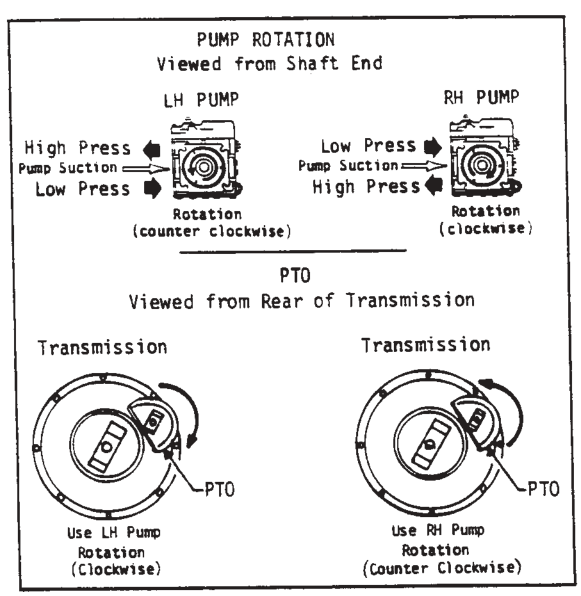


REF.	PART NO.	QTY.	DESCRIPTION
1	6700856	AR	Rotating Beacon, 2 Beam
2	2970071	AR	Bracket Asm
3	6700120	AR	Wire-14 Ga, White
4	6000107	AR	Loom-Fibre, 1/4"
5	3370755	1	Marker Light W/12' Pigtail, Loom
6	6702225	1	Triple Bar Light
7	6700825	AR	Cable, 7-18
8	2970024	AR	Unilet-Tee
9	6700023	1	Gasket-5"
10	6700925	3	Cord Grip-Male
11	6700110	AR	Cable-6 Way
12	6000106	AR	Loom-Fibre, 3/16"

AR - AS REQUIRED

Hydraulic Drive System
PTO With Sundstrand Pump





SPECIFY UNIT SERIAL NO., PART NO., & PART DESCRIPTION

Hydraulic Drive System

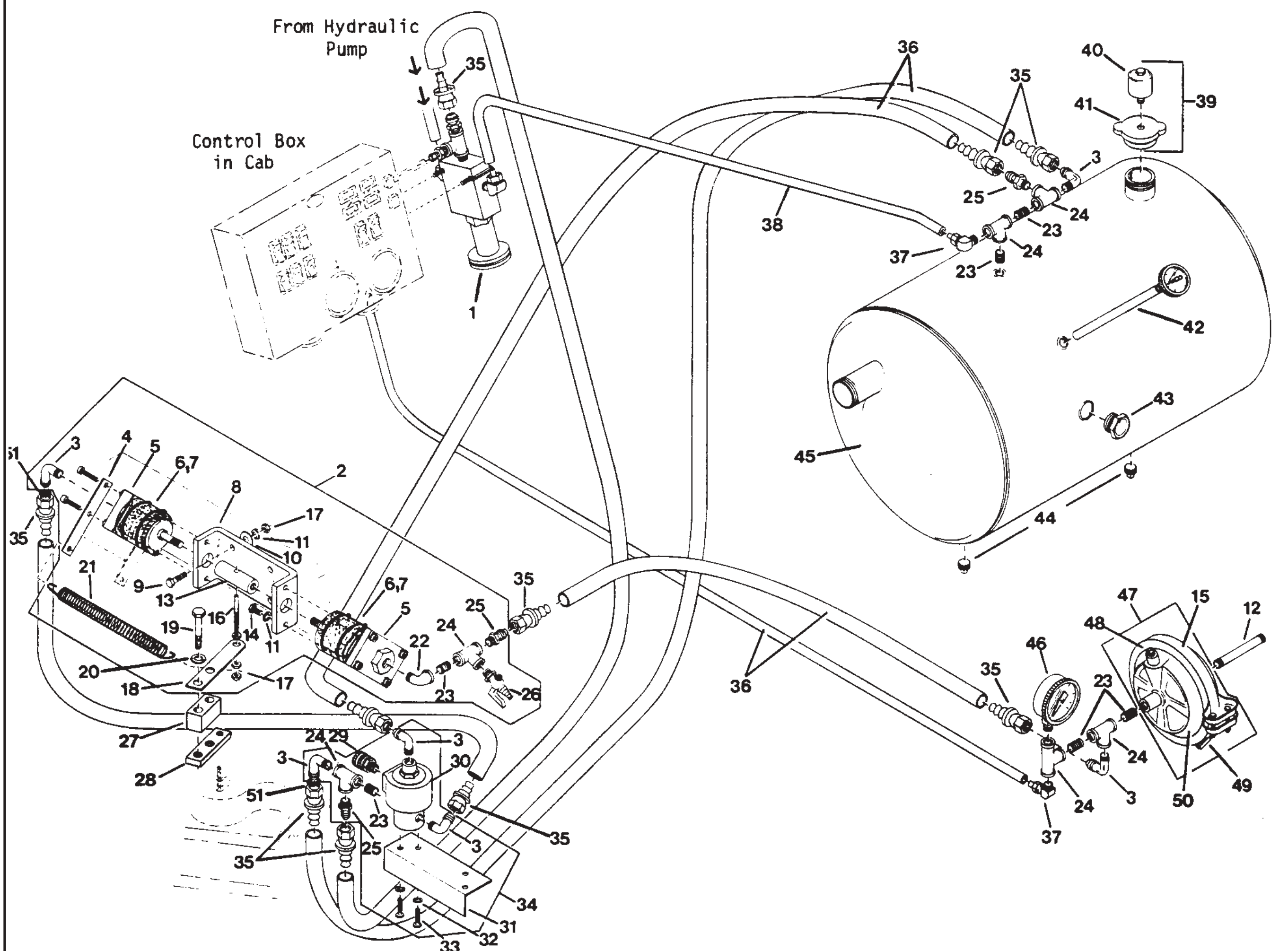
PTO With Sundstrand Pump

REF.	PART NO.	QTY.	DESCRIPTION
1	3321323	1	Support Bracket
2	0120918	2	Screw-Hex, 0.38NC x 1.50,GR2,PD
3	0120382	2	Washer-Lock, 0.38, Spring,PD
4	0120377	2	Nut-Hex, 0.38NC,PD
5	3321314	1	Mtg. Brkt. Modulator Asm
6	0121926	4	Screw-Hex, 0.25NC x 1.50,GR2,PD
7	0120386	4	Washer-Flat, 0.25(0.31 x 0.73)PD
8	0120380	4	Washer-Lock, 0.25, Spring,PD
9	0120375	4	Nut-Hex, 0.25NC,PD
10	3321329	1	Modulator Asm
11	6303119	AR	Round-0.50 CR (Specify Length)
12	0120378	2	Nut-Hex, 0.50NC,PD
13	0120384	1	Washer-Lock, 0.50, Spring,PD
14	6602120	1	Pump-4.57, RT, Man., No Pad
	6602121	1	Pump-4.57, LT, Man., No Pad
15	9410979	1	Elbow-Hyd, 90, 12MB-12MJ
16	6600648	6	Hose End-12 x 12FJX, ST, PUSH-LOK
17	6600646	AR	Hose Self Grip
18	0274253	2	O Ring-Tube Fitting, 1.50
19	9250608	1	Hose Asm-L.P. 16FJX-16FL90X
20	9250607	1	Hose Asm-H.P. 16FJX-16FL90X
21	9410233	1	Adp-Hyd, ST, 16MB-16MJ Long
22	9410285	1	Elbow-Hyd, 90, 16FJX-16MJ
23	6601564	AR	Hose-Suction 1.0 ID (Specify Length)
24	6000792	1	Clamp-Hose, Worm Dr., 1.06 to 2.00
25	6601566	2	Hose End, 16-16FJX, ST
26	6601135	1	Elbow-Hyd, 90, 16MJ-16MP
27	0125915	1	Bushing-Pipe, 1.25 x 1.00NPT,PN
28	6600225	1	Filter-GRESEN
29	7420136	1	Head Casting W/Plug
30	7420042	1	Indicator-Filter
31	7420004	1	O Ring
32	7420007	1	Element
33	7420046	1	Spring-Conical
34	7420076	1	Housing
35	7420008	1	Gasket
36	7420009	1	Post-Center
37	9402867	2	Elbow-Hyd, 90, 12MJ-12MP
38	0125988	1	Tee-Pipe, 0.75NPT,PN
39	0144613	1	Nipple-Sch 40, 0.75 x 1.38CL,PN
40	0128003	2	Bushing-Pipe, 1.00 x 0.75NPT,PN
41	9402711	1	Adp-Hyd, 12MJ-12MP
42	6602153	1	Cooler-Hyd Oil, 2 Pass
43	0142263	2	Bushing-Pipe, 1.00 x 0.38NPT,PN
44	6601504	2	Adp-Hyd, St, 06MP-06MJ
45	6600306	2	Hose End-06 x 06FJX, ST, LPSP
46	6600324	AR	Hose-3/8 Per/Ft
47	2960213	1	Elbow, 90, 16MB-16MJ Tapped
48	9409287	1	Adp-Hyd, ST, 06FP-08MB
49	2960210	1	Hose Asm-06MP90 x 04FJX
50	2960203	1	Adapter Fitting-0.55 Orifice
51	9410207	1	Adapter, St, 16MB-16MJ
52	6602129	1	Motor-Hyd, 2.8 Cir, Axial, Fixed
53	6600897	1	Adp-Hyd, ST, 08MB-12MJ
54	9410283	1	Elbow-Hyd, 90, 12FJX-12MJ
55	0219301	1	Plug-Pipe, SqHd, 0.75NPT,PN
56	6600237	1	Switch-Thermo
57	9402828	1	Elbow-Hyd, 45, 12MJ-12MP
58	0128003	1	Bushing-Pipe, 1.00 x 0.75NPT,PN
59	0219303	1	Plug-Pipe, SqHd, 1.00NPT,PN
60	3321373	2	Brkt. Asm-Mtg. Hyd Tank
61	3320325	2	Clamp-Mtg.
62	0428217	4	Screw-Hex, 0.63NC x 1.50,GR2,PD
63	0124589	4	Nut-Hex, 0.62NC,PD
64	0121574	4	Washer-Lock, 0.62, Spring,PD
65	L2267AF	1	Tank Asm-Hyd, 16 x 28, 20 Gal

Note: When ordering Hydraulic Pump, Ref# 14, please specify if LH or RH pump.

AR - AS REQUIRED

Hydraulic System

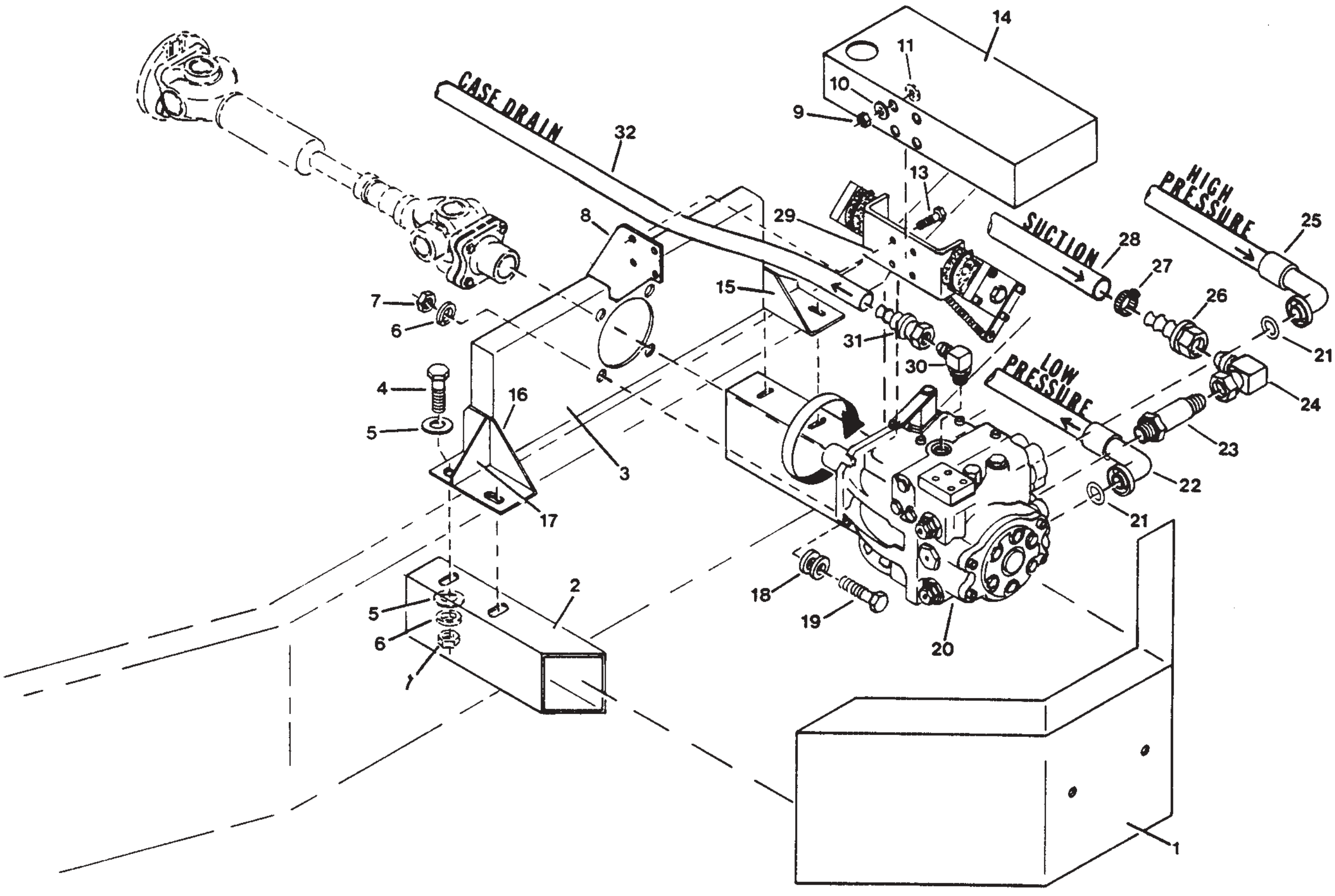


REF.	PART NO.	QTY.	DESCRIPTION
1	6601011	1	Valve Control-Pressure
2	3321329	1	Modulator Asm
3	0118755	6	Elbow-Auto, 90, 04MP-06MS
4	2960148	1	Support-Spring
5	6601009	2	Actuator-Bellofram
6	2960152	2	Filter-Bellows
7	6700169	4	Tie-Plt-4 Scp-0, Black, Extra Lg.
8	2960199	1	Brkt. Mt., Bellows
9	0121926	4	Screw-Hex, 0.25NC x 1.50,GR2,PD
10	0120386	4	Washer-Flat, 0.25A(0.31 x 0.73),PD
11	0120380	8	Washer-Lock, 0.25,Spring,PD
12	0121209	1	Nipple-Sch 40, 0.25 x 3.00,PN
13	2960149	1	Coupling-Shaft
14	0180021	4	Screw-Hex, 0.25NC x 0.88,GR5,PD
15	6601007	1	Clamp Ring Asm
16	3321320	1	Pin-Drive
17	0120375	7	Nut-Hex, 0.25NC,PD
18	3321315	1	Lever-Pump Stroker
19	0122052	2	Screw-Hex, 0.31NC x 1.75,GR2,PD
20	0120214	2	Washer-Lock, 0.31, Spring,PD
21	6100261	1	Spring-Extend
22	0105413	1	Elbow-PP, 90, 0.25NPT,PN
23	0105405	5	Nipple-Sch 40, 0.25 x 0.87CL,PN
24	0105417	6	Tee-PP, 0.25NPT,PN
25	0118750	3	Adapter-Auto, St, 04MP-06MS
26	6601086	1	Valve-Cock
27	2940422	1	Spacer-Pump
28	9301218	1	Pump Lever (Tapping)
29	6700858	1	Cord Grip-Male, 0.50 x 0.375
30	6601020	1	Valve-Sol. 12V, 175 PSI
31	2960185	1	Brkt-Angle Mt.
32	0120217	2	Washer-Lock, #10, Spring,PD
33	0436750	2	Screw-Mach, PNSL, 10NF x 0.50,PD
34	2960128	1	Solenoid Asm
35	6600306	10	Hose End-06 x 06FSX, St, LPSP
36	6600326	AR	Hose-3/8 Per Ft.
37	6600832	2	Elbow-ARBK, 90, 04MP-06MT
38	6309162	AR	Tubing-Nylon, 0.38 OD
39	2920110	1	Cap Asm
40	6600223	1	Breather
41	2920109	1	Cap
42	6500039	1	Thermometer-2" Dial, 9" Dual
43	6600224	1	Plug-Eye Site
44	0219199	2	Plug-PP, SqHd, 0.50NPT,PN
45	L2267AF	1	Tank Asm-Hyd, 16 x 28, 20 Gal.
46	6600168	1	Gauge-Pressure, 2.5", 0-150 PSIG
47	2960126	1	Bellows Asm-Transfer, Pressure
48	0219189	1	Plug-PP, SqHd, 0.25NPT,PN
49	6600162	1	Drain Cock
50	6601005	2	Pressure Plate
51	2960157	2	Disk-Orfice, Restrictor

AR - AS REQUIRED

Hydraulic Pump Drive - Crankshaft Drive

With Sundstrand Pump - Optional

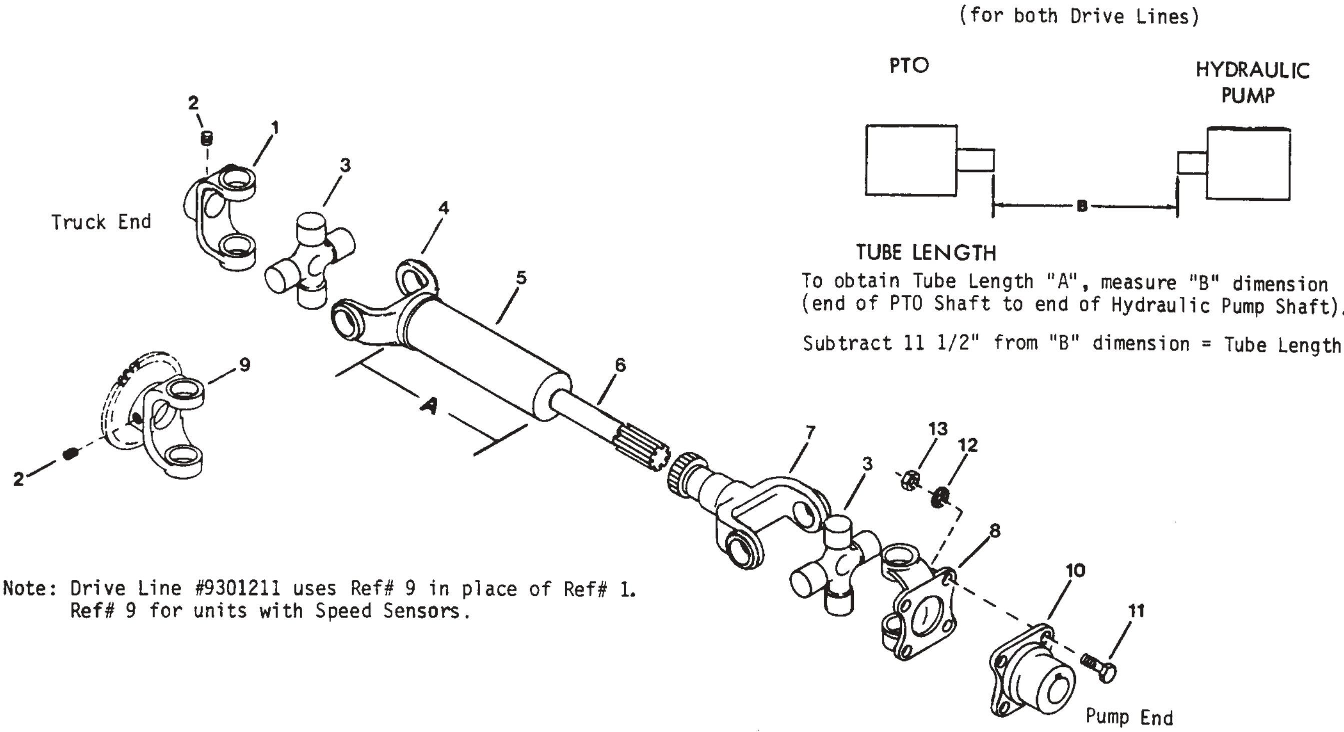


REF.	PART NO.	QTY.	DESCRIPTION
1	3321425	1	Bumper
2	3321421	2	Channel-5"
3	3321422	1	Channel-Mtg.
4	0122433	4	Screw-Hex, 0.50NC x 1.50,GR2,PD
5	0120390	8	Washer-Flat, 0.50A(0.56 x 1.38)
6	0120384	8	Washer-Lock, 0.50,Spring,PD
7	0120378	8	Nut-Hex, 0.50NC,PD
8	2960211	1	Bracket-Pump Stroker
9	0120375	4	Nut-Hex, 0.25NC,PD
10	0120380	4	Washer-Lock, 0.25,Spring,PD
11	0120386	12	Washer-Flat, 0.25A(0.31 x 0.73)
12	9413946	4	Nut-Hex, Lock, 0.25NC,EA,PD
13	0121926	4	Screw-Hex, 0.25NC x 1.50 GR2,PD
14	2920130	1	Cover
15	3321424	1	Mtg.-Angle, LH
16	3321426	1	Mtg.-Angle, RH
17	3321332	2	Gusset
18	6100057	8	Washer-Mach,Bushing,0.88 x 0.50 x 0.12
19	0122459	4	Screw-Hex, 0.50NC x 2.00, GR2,PD
20	6602121	1	Pump-4.57, LT, MAN, NO PAD
21	0274253	2	O Ring-Tube Fitting, 1.50
22	9250608	1	Hose Asm-L.P., 16FJX-16FL90X
23	9410233	1	Adp-Hyd, ST, 16MB-16MJ Long
24	9410285	1	Elbow-Hyd, 90, 16FJX-16MJ
25	9250607	1	Hose Asm-H.P., 16FJX-16FL90X
26	6601566	1	Hose End, 16-16FJX,ST
27	6000792	1	Clamp-Hose, Worm Dr., 1.06 to 2.00
28	6601564	AR	Hose-Suction,1.00 ID (Specify Length)
29	3321329	1	Modulator Asm
30	9410979	1	Elbow-Hyd, 90, 12MB-12MJ
31	6600648	1	Hose End-12 x 12FJX, ST, PUSH-LOK
32	6600646	AR	Hose Self Grip

AR - AS REQUIRED

Drive Lines - PTO

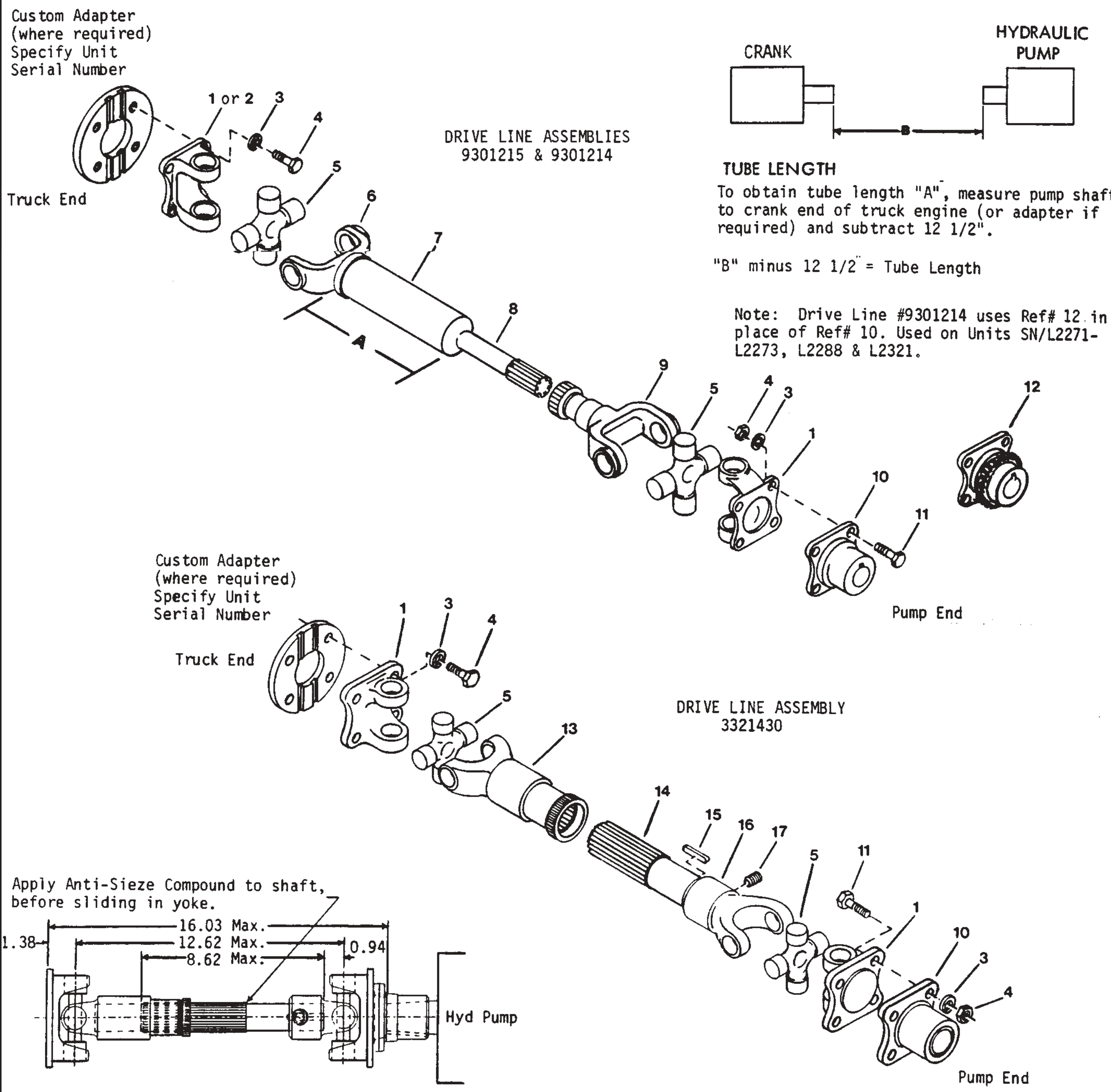
Sundstrand Pump 90 Series



Note: Drive Line #9301211 uses Ref# 9 in place of Ref# 1.
Ref# 9 for units with Speed Sensors.

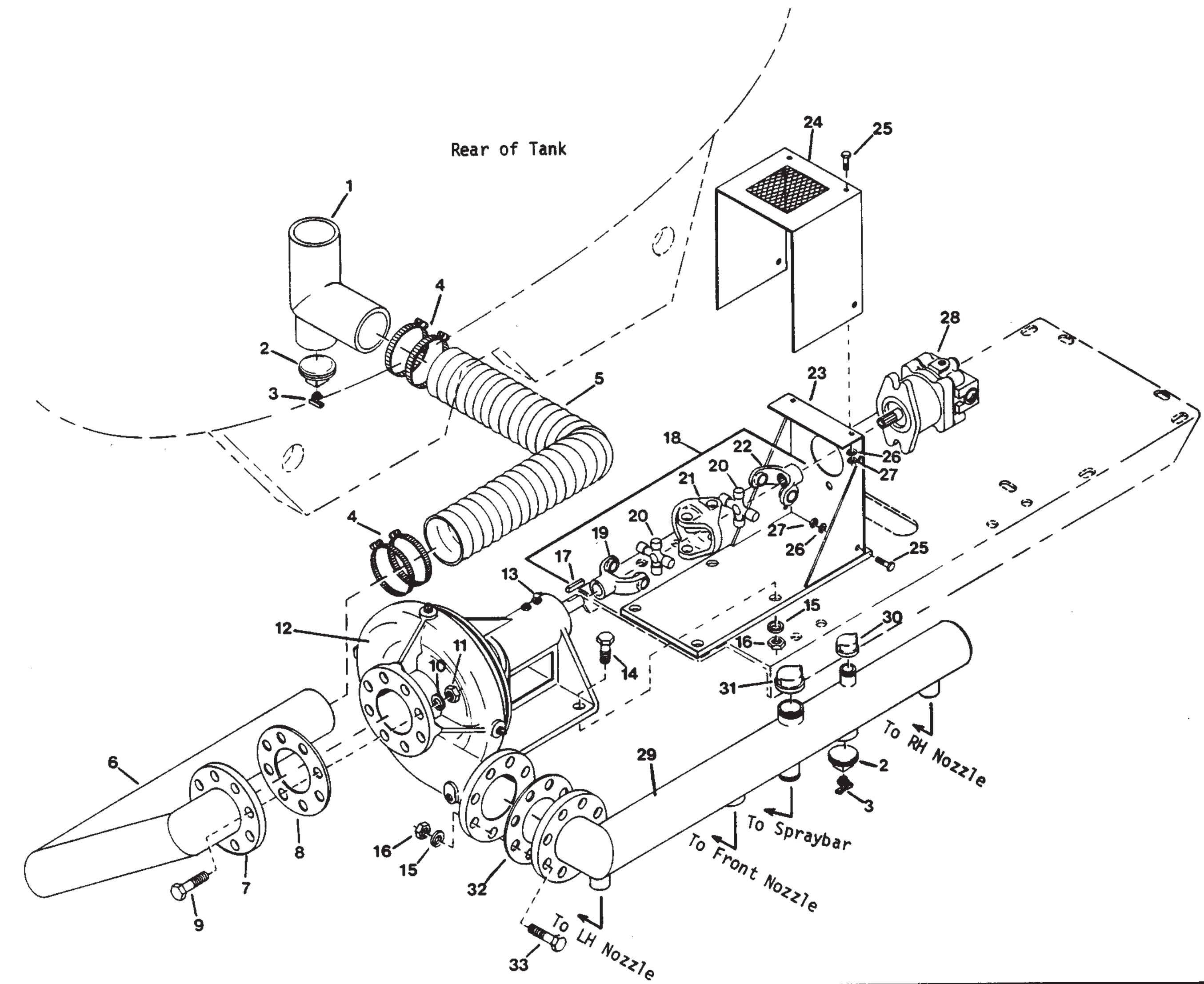
REF.	PART NO.	QTY.	DESCRIPTION	REF.	PART NO.	QTY.	DESCRIPTION
1	6440170	1	Yoke-End, Round Hole, 1.25 Bore				
2	0102615	1	Screw-Sock, 0.50NC x 0.50, CUP,PN				
3	3170013	2	Journal & Bearing Kit				
4	6440164	1	Yoke-Stub				
5	6303278	AR	Tubing-2.00 x 14 Ga.				
6	6440199	1	Shaft-Slip Stub				
7	3110034	1	Yoke-Sleeve				
8	3170021	AR	Yoke-Flange				
9	2910226	1	Sprocket & Hub Asm 40T				
10	6440162	1	Flange-Companion, Taper Hole				
11	0186679	4	Screw-Hex, 0.38NC x 1.25,GR8,PD				
12	0120382	8	Washer-Lock, 0.38, Spring,PD				
13	0120377	4	Nut-Hex, 0.38NC,PD				
14	0454904	4	Screw-Hex, 0.38NC x 0.75,GR8,PD				AR - AS REQUIRED

Drive Lines - Crankshaft



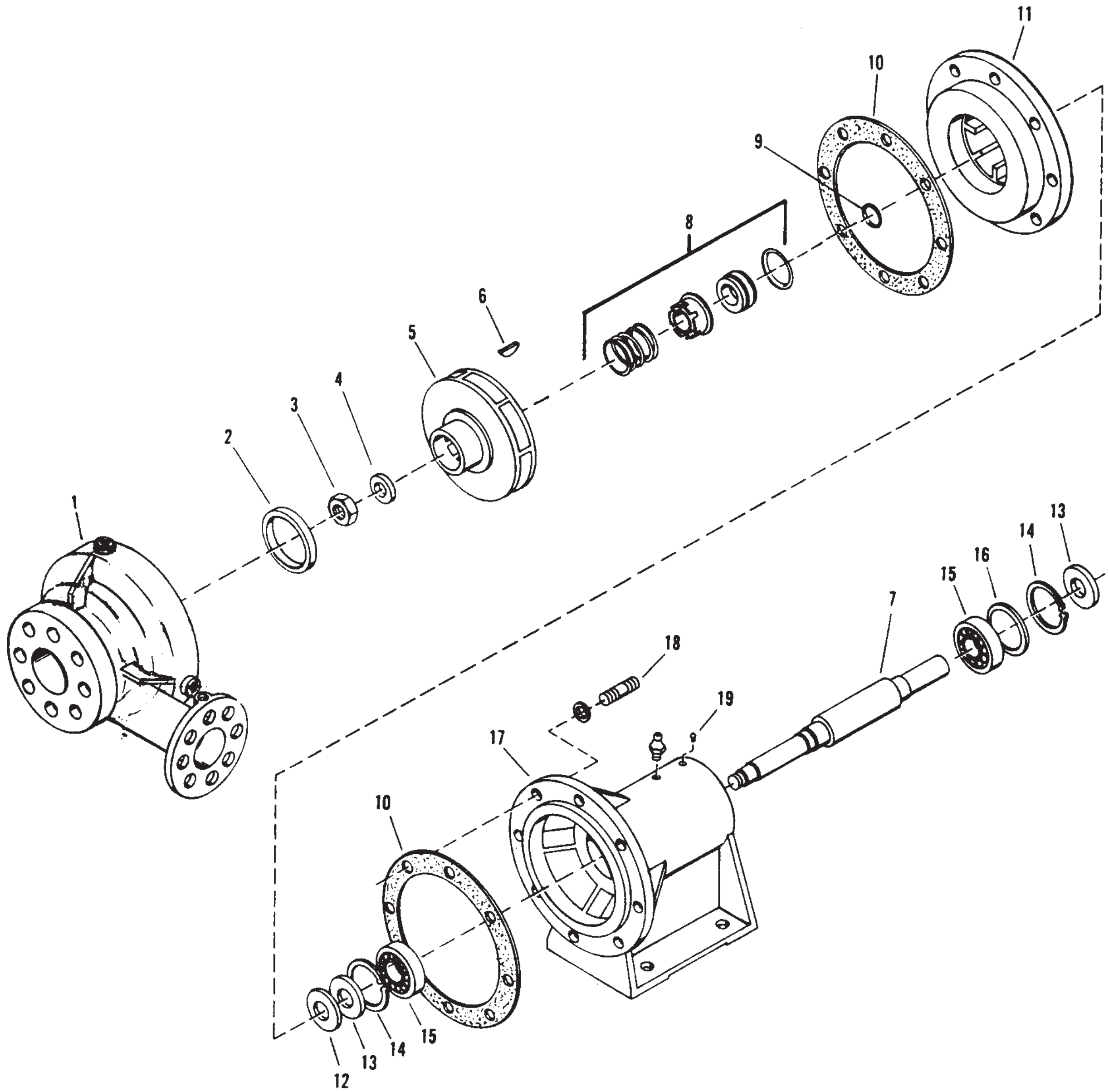
REF.	PART NO.	QTY.	DESCRIPTION
1	3170021	2	Yoke-Flange
2	6440172	1	Yoke-Flange
3	0120382	8	Washer-Lock, 0.38NC,PD
4	0454904	4	Screw-Sock, 0.38NC x 0.75, GR5,PD
5	3170013	2	Journal & Bearing Kit
6	6440164	1	Yoke-Stub
7	6303278	AR	Tubing-2.00 x 14 Ga
8	6440199	1	Shaft-Slip Stub
9	3110034	1	Yoke-Sleeve
10	6440162	1	Flange Companion, Taper
11	0186679	4	Screw-Hex, 0.38NC x 1.25, GR8,PD
12	2910228	1	Sprocket & Flange Asm
13	6440165	1	Yoke Asm, Splined
14	3321429	1	Shaft
15	6000161	1	Key, 0.31 x 0.31 x 1.50 Lg.
16	6440170	1	End Yoke-1.25" Bore
17	0102615	1	Screw-Sock, 0.50NC x 0.50 Lg, CUP,PT

Pumping Unit Assembly



REF.	PART NO.	QTY.	DESCRIPTION
1	2900148	1	Line Asm-Suction,Tank
2	2940421	2	Plug-3" Pipe W/Tap
3	6600162	2	Cock-Drain, 0.25
4	6000872	4	Clamp-Hose
5	6000950	1	Hose-Suc, 5.5 x 25.0
6	2940380	1	Suction Elbow Asm
7	2940214	1	Flange-Elbow Asm, 5"
8	2940054	1	Gasket-5" Flange
9	0428781	8	Screw-Hex, 0.75NC x 3.00,GR2,PD
10	0131046	8	Washer-Lock, 0.75, Spring,PD
11	0220086	8	Nut-Hex, 0.75NC,PD
12	6600998	1	Pump-Water
13	9411010	1	Fitting-Lube,ST,0.12 x 0.69
14	0428691	4	Screw-Hex, 0.62NC x 2.00,GR2,PD
15	0121574	12	Washer-Lock, 0.62, Spring,PD
16	0124589	12	Nut-Hex, 0.62NC,PD
17	6000161	1	Key-0.31 x 0.31CR x 1.50
18	2920129	1	Joint Asm
19	6440157	1	Yoke-End, 1.38 Bore x 0.32 Keyway
20	3170013	2	Journal & Brg, Kit-Spicer 5-200x
21	6440158	1	Yoke-Center, Spicer
22	6440200	1	Yoke-End, 1.00-15 Tooth Invol.
23	2940413	1	Base Asm-Pump & Motor
24	2910333	1	Guard Asm
25	0121887	4	Screw-Hex, 0.25NC x 0.75,GR2,PD
26	0120380	4	Washer-Lock, 0.25, Spring,PD
27	0120375	4	Nut-Hex, 0.25NC,PD
28	6602129	1	Motor-Hyd, 2.8 CIR,AXIAL, FIXED
29	2940625	1	Discharge Header Asm
30	0187373	1	Cap-Pipe, 1.50NPT,PN
31	6200052	1	Cap-Pipe, 2.50NPT,PN
32	2940053	1	Gasket-Reducing Flange
33	0428697	8	Screw-Hex, 0:62NC x 2.50,GR2,PD

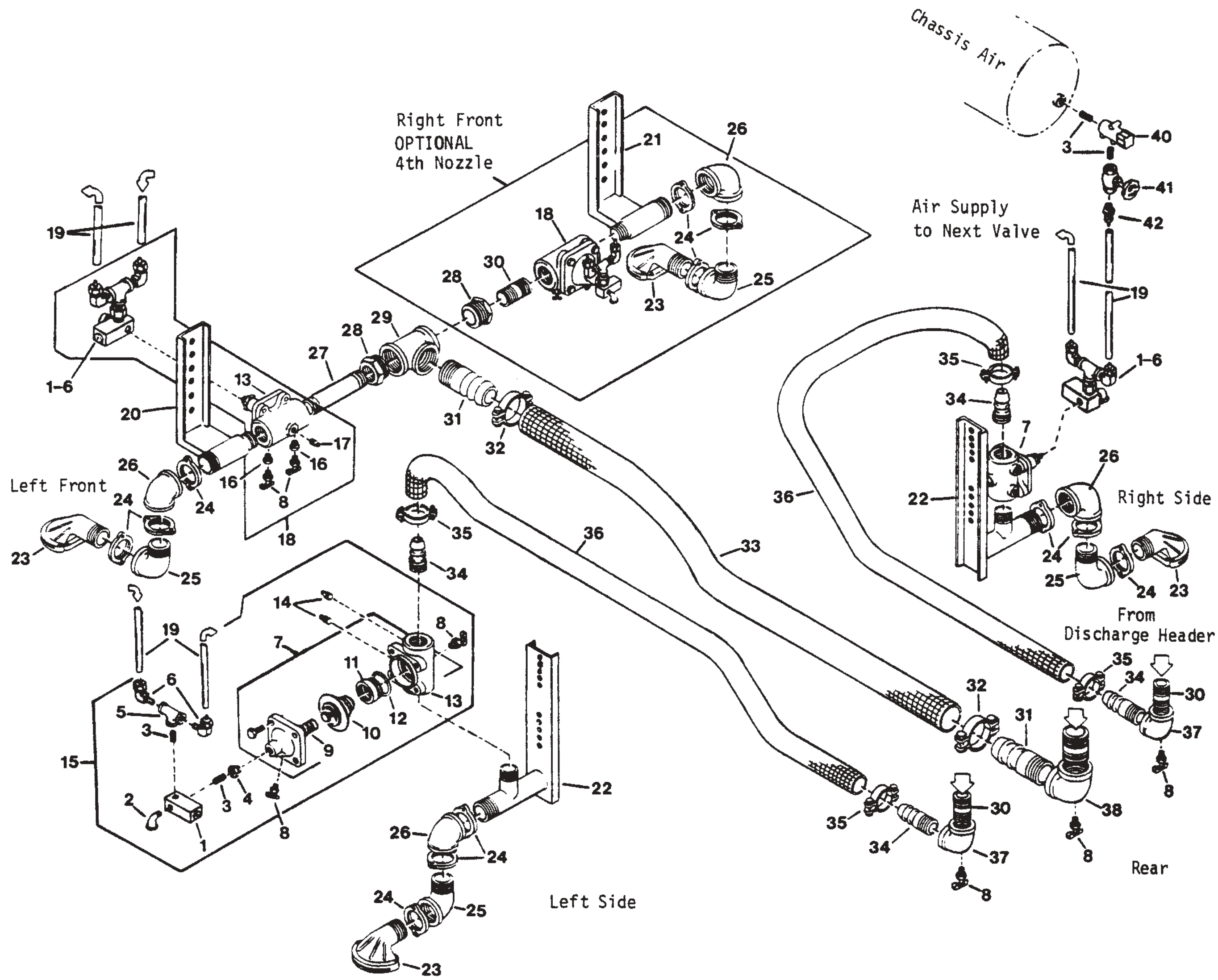
Water Pump
6600998



REF.	PART NO.	QTY.	DESCRIPTION
1	7020191	1	Volute-5 x 4 Flanged
2	7020121	1	Ring-Wear
3	7020192	1	Nut-Impeller
4	7020141	1	Washer
5	7020144	1	Impeller-C/I
6	7020134	1	Key
7	7020200	1	Shaft-Bore, Taper Imp
8	7020193	1	Seal Asm-1.38
9	7020194	1	Gasket-O Ring
10	7020195	2	Gasket-Volute to Plate
11	7020196	1	Plate-Seal
12	7020198	1	Slinger-Water
13	7020203	2	Cap-Dust, Bearing
14	7020205	2	Ring-Retaining
15	7020199	2	Bearing-Ball, Sgl Row, Sgl Shld
16	7020202	AR	Shim-Bearing, .005 thick
17	7020201	1	Bearing Housing & Lantern-FR
18	7020197	16	Stud-0.38, 16 x 2
19	7020204	1	Fitting-0.125, Relief

AR - AS REQUIRED

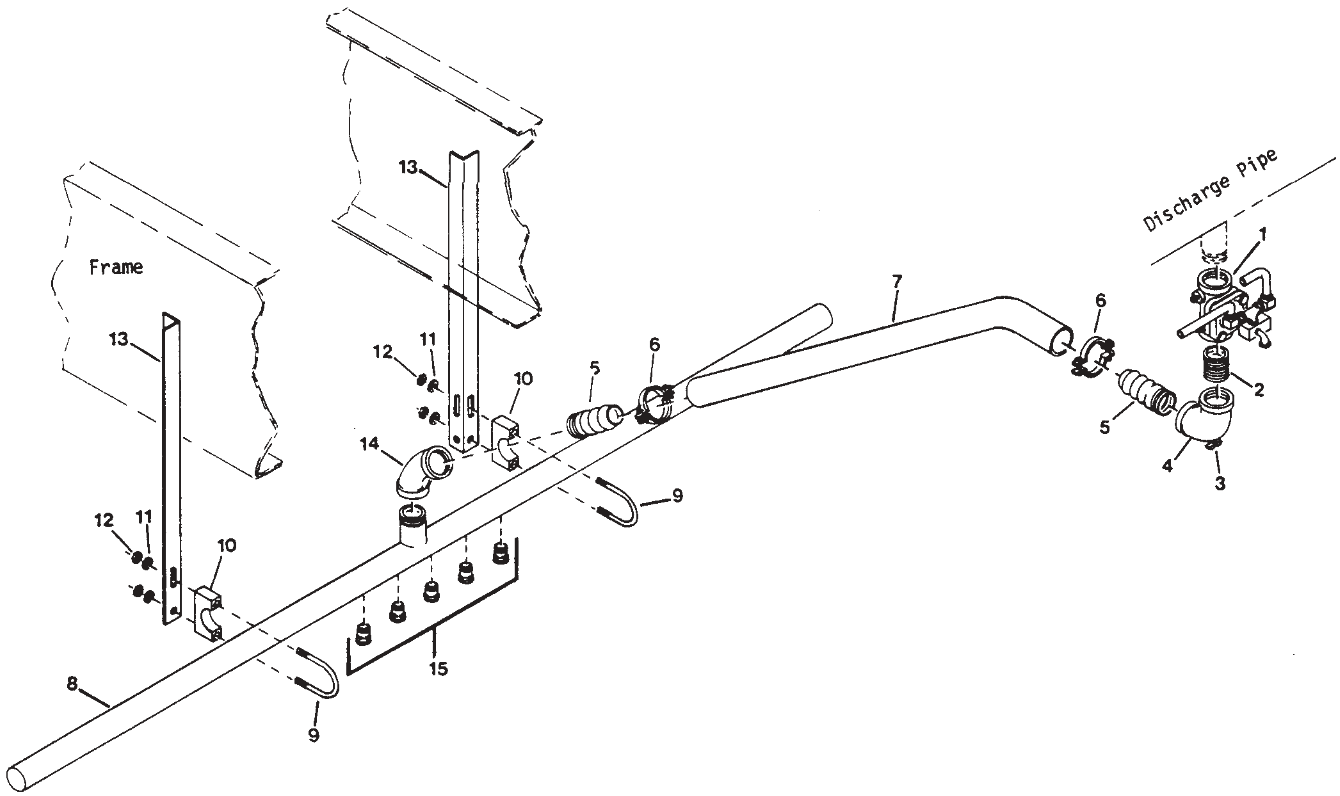
Discharge Piping - Air Control Nozzle Assemblies



REF.	PART NO.	QTY.	DESCRIPTION
1	6602188	1	Valve-Sol., 12 VDC
2	0105423	1	Elbow-PP, ST, 0.25NPT,PN
3	0105405	2	Nipple-Sch 40, 0.25 x 0.87CL,PN
4	0144045	1	Bushing-PP, 0.50 x 0.25NPT,PN
5	0105417	1	Tee-Pipe, 0.25NPT,PN
6	6600832	2	Elbow-ARBK, 90, 04MP-06MT
7	2940055	1	Valve-CLAYTON, 2"
8	6600162	2	Drain Cock, 0.25"
9	7430042	1	Spring
10	7430218	1	Diaphram Asm & Disc 2"
11	7430071	1	Seat-Bronze
12	7430233	1	O Ring-Seat
13	7430076	1	Body-Valve
14	0219191	2	Plug-Pipe, SqHd, 0.38NPT,PN
15	2940387	AR	Valve Asm-Vert. 2"
16	0144036	2	Bushing-PP, 0.38 x 0.25NPT,PD
17	0219190	1	Plug-Pipe, SqHd, 0.25PD
18	2940386	AR	Valve Asm-Horz. 2"
19	6309162	AR	Tubing-Nylon, 0.380D/Ft.
20	2940339	1	Bracket Asm-Front Nozzle LT
21	2940340	1	Bracket Asm-Front Nozzle RT
22	2940345	2	Bracket Asm-Side Nozzle MT
23	2940006	AR	Nozzle Asm, Brass
24	2940005	AR	Locking Ring
25	2940014	AR	Elbow, ST, Galvanized
26	2940013	AR	Elbow-Galvanized, Faced
27	0219539	1	Nipple-PP, Sch 40, 2.00 x 8.00PN
28	6200040	AR	Bushing-PP, 3.00 x 2.00NPT,PN
29	6200163	1	Tee-Pipe, 3.00NPT,PN
30	0219501	1	Nipple-PP, Sch 40, 2.00 x 2.50PN
31	6200575	2	Nipple-Comb, 3.0 Hose x 3.0NPT
32	6000946	2	Clamp-Hose, 3.50 ID Double Bolt
33	6309223	AR	Hose-3.00, Water
34	6200526	4	Nipple-Comb, 2.00, Type SCP
35	6000870	AR	Clamp, 2.5 ID, DBL
36	6309186	AR	Hose-2", Water
37	2910376	2	Elbow-Pipe, 90, 2.00NPT,PN,Tapped
38	2910375	1	Elbow-Pipe, 90, 3.00NPT,PN, Tapped
39	6200122	1	Nipple-PP, Sch 40, 3.00 x 2.50PN
40	6600304	1	Valve-Pressure Regulator
41	6600303	1	Valve-Globe, ST, 0.25 Disc
42	6600831	1	Adp-ARBK, ST, 04MP-06MT

AR - AS REQUIRED

Spray Bar Assembly
Air Control - Optional

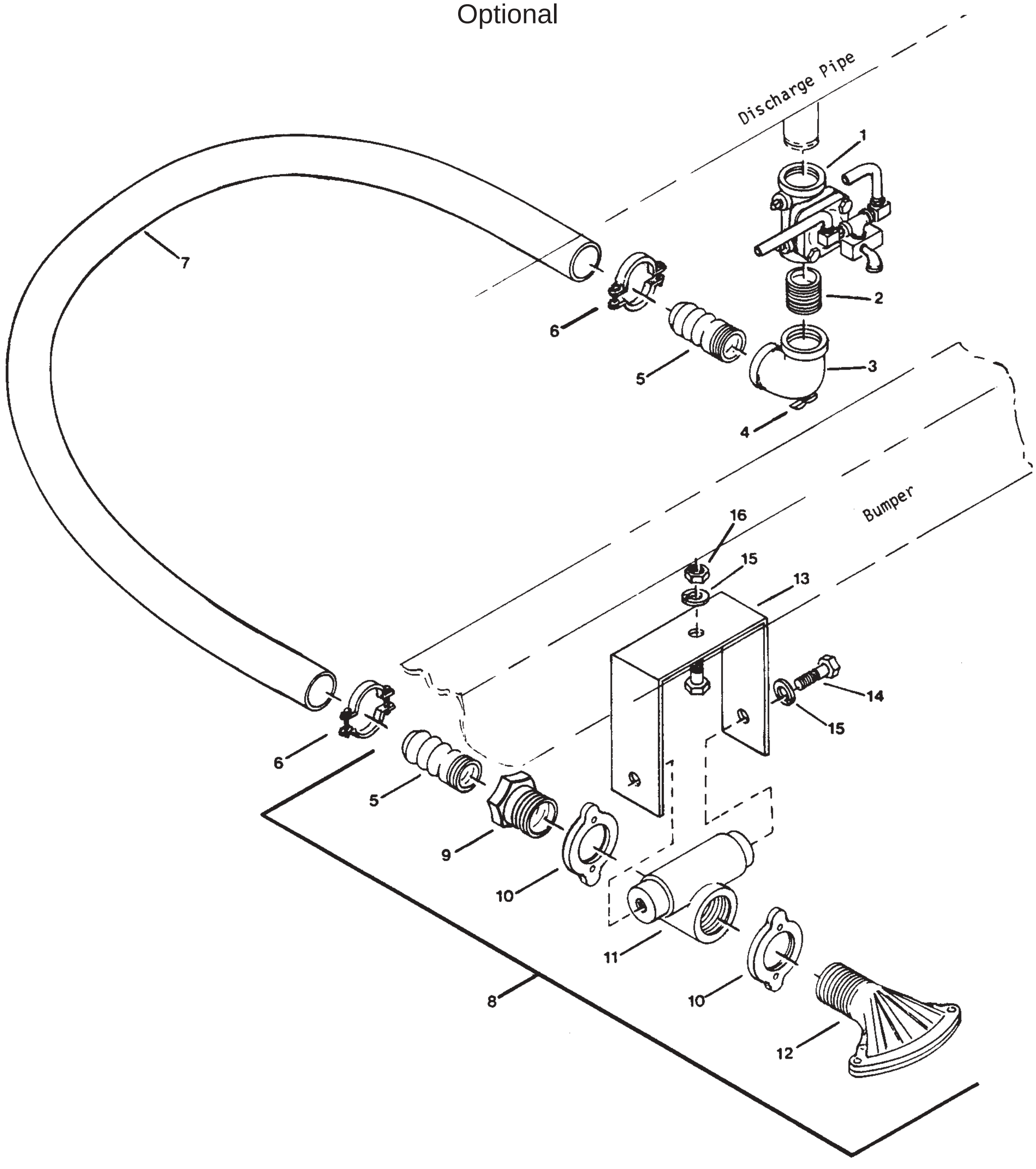


REF.	PART NO.	QTY.	DESCRIPTION
1	2940387	1	Valve Asm-Air Clayton Vert. 2"
2	0219400	1	Nipple-Sch 40, 2.00 x 2.00CL,PN
3	2910376	1	Elbow-PP, 90, 2.00NPT,Tapped
4	6600162	1	Drain Cock, 0.25
5	6200526	2	Nipple-Comb, 2.00 Type SCP
6	6000870	2	Clamp-Hose 2.50 ID, Double Bolt
7	6309186	AR	Hose-2.00, Water
8	2940077	1	Section Asm-Center
9	3390085	2	Clip-2.00 Pipe
10	6300001	2	Saddle-2"
11	0120382	4	Washer-Lock, 0.38,Sp,PD
12	0120377	4	Nut-Hex, 0.38NC,PD
13	2940305	2	Angle-Hanger
14	0187406	1	Elbow-PP, 45, 2.00NPT,PN
15	3352205	24	Nozzle-V Type, Nominal 3.5 GPM

AR - AS REQUIRED

Sprinkler Nozzle Assembly

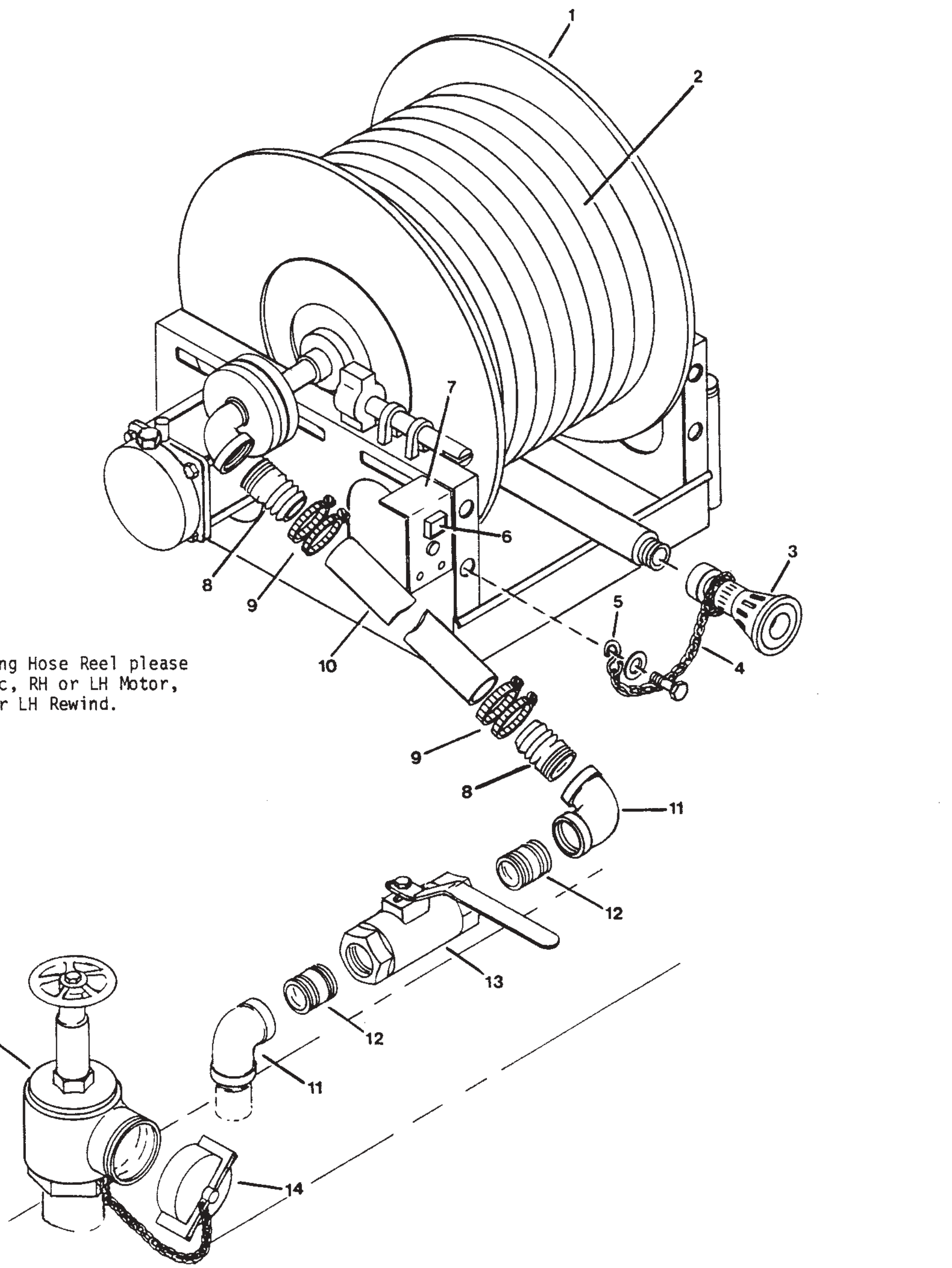
Optional



REF.	PART NO.	QTY.	DESCRIPTION	REF.	PART NO.	QTY.	DESCRIPTION
1	2940387	1	Valve Asm-Air Clayton Vert. 2"	15	0121574	3	Washer-Lock, 0.62,Sp,PD
2	0219400	1	Nipple-Sch 40, 2.00 x 2.00CL,PN	16	0124589	1	Nut-Hex, 0.62NC,PD
3	2910376	1	Elbow-PP, 90, 2.00NPT,Tapped				
4	6600162	1	Drain Cock, 0.25				
5	6200526	2	Nipple-Comb, 2.00, Type SCP				
6	6000870	2	Clamp-Hose, 2.50 ID, Double Bolt				
7	6309186	AR	Hose-2.00, Water				
8	2980014	1	Nozzle Asm-Complete				
9	6200039	1	Bushing-PP, 2.50 x 2.00NPT,PN				
10	2940005	2	Ring-Locking				
11	2980012	1	Bracket-Nozzle Mt.				
12	2940006	1	Nozzle Asm				
13	2980013	1	Yoke-Hanger				
14	0428211	3	Screw-Hex, 0.63 x 1.25,GR2,PD				AR - AS REQUIRED

Hose Reel Assembly - Fire Fighting Attachment

Optional

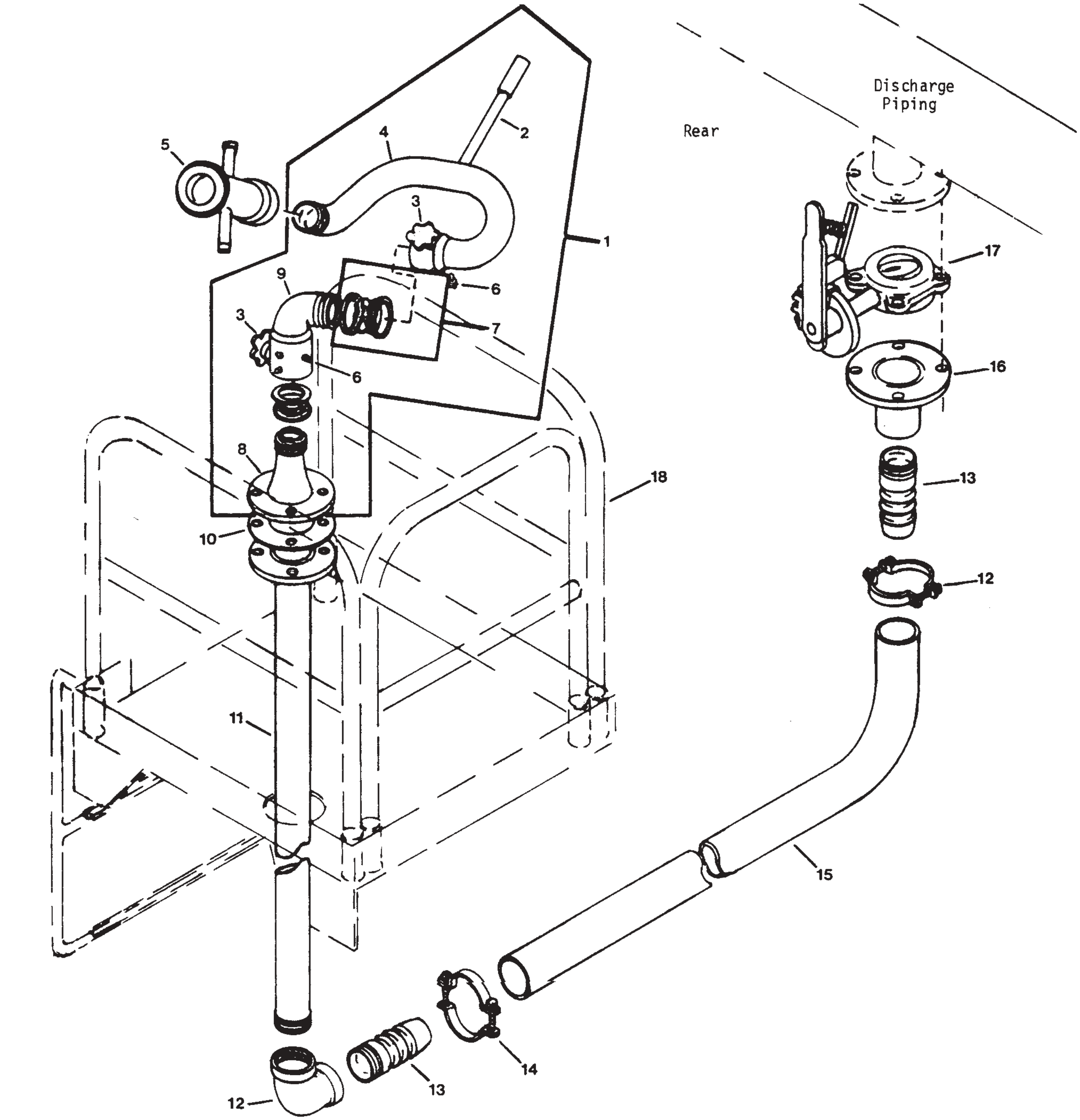


Note: When ordering Hose Reel please specify if Electric, RH or LH Motor, or if Manual, RH or LH Rewind.

REF.	PART NO.	QTY.	DESCRIPTION
1	6000875	1	Electric Hose Reel, RH Motor
	6001275	1	Electric Hose Reel, LH Motor
	6000874	1	Manual Hose Reel, LH Rewind
	6001274	1	Manual Hose Reel, RH Rewind
2	6000873	1	Hose Asm-1.00 x 150 Ft., W/M&F Ends
	6601037	1	Hose Asm-1.50 x 100 Ft., W/M&F Ends
3	6000877	1	Nozzle-1.00NPT
	6601036	1	Nozzle-1.50NPT
4	2940402	1	Chain Asm
5	6000404	1	S-Hook
6	6700823	1	Fuse Holder System, Power
	6700821	1	Fuse-7.5 AMP. 230 VAC, 3 AG, Glass
7	2970017	1	Bracket-Switch & Fuse Mt.
8	6200527	2	Nipple-Comb-1.50, Type SCP
9	6000871	4	Clamp-Hose, Worm Gear
10	6309187	2Ft.	Hose-1.50", Water
11	0187558	2	Elbow-Pipe, 90, 1.50NPT,PN
12	0216341	2	Nipple-Sch 40, 1.50 x 1.75,CL,PN
13	6200528	1	Valve-Ball, 1.50"
14	6600172	1	Cap-Hose, 2.50"
15	6600171	1	Valve-Undwr, 2.50"

Water Cannon Assembly

Optional



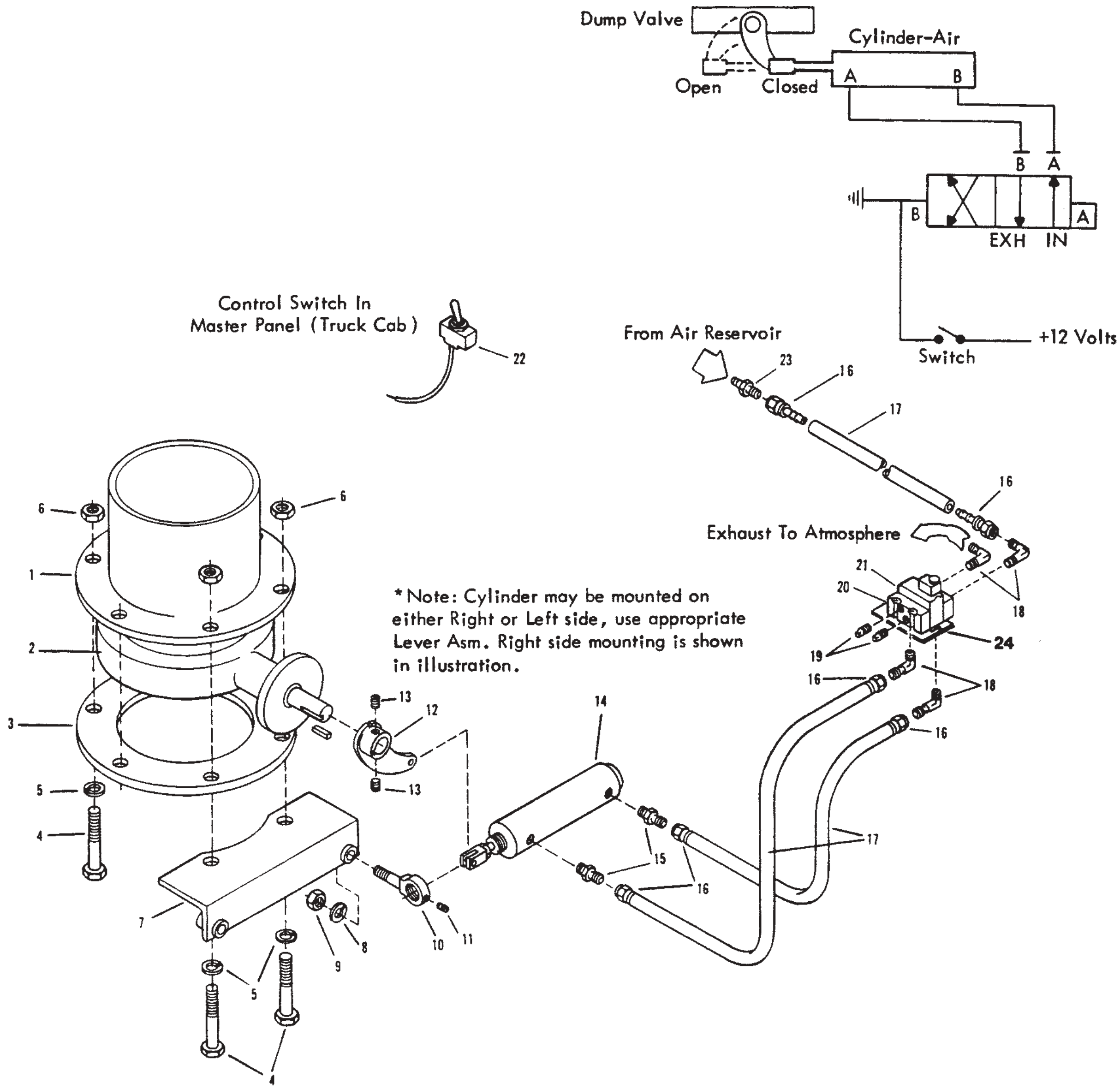
REF.	PART NO.	QTY.	DESCRIPTION
1	L217801	1	Water Monitor, Manual, 2.5", 750 GPM
2	100256-8	1	Grip
3	102537-1	2	Lock Knob Asm
4	103316-101	1	Upper Ell Asm
5	L217802	1	Nozzle
6	100112-2	2	Grease Zerk
7	7420281	1	Swivel Repair Kit
8	100682-21	1	Inlet 4"
9	101221-3	1	Lower Ell
10	L2271AE	1	Flange
11	L2271AF	1	Pipe Asm
12	6200072	1	Elbow-Pipe, 90, 2.50NPT,PN
13	6200559	2	Nipple-Comb., 2.5 Hose x 2.5NPT
14	6000915	2	Hose Clamp, 2.5, Dbl Bolt
15	6309211	AR	Water Hose P1196, 2.50/Ft.
16	L2332BZ	1	Flange Asm, 2.50NPT
17	L227103	1	Butterfly Valve, 2.50 W/Handle
18	L2332BF	1	Platform Asm

AR - AS REQUIRED

SPECIFY UNIT SERIAL NO., PART NO., & PART DESCRIPTION

Butterfly Dump Valve - Air Controlled - 10 Inch

Optional

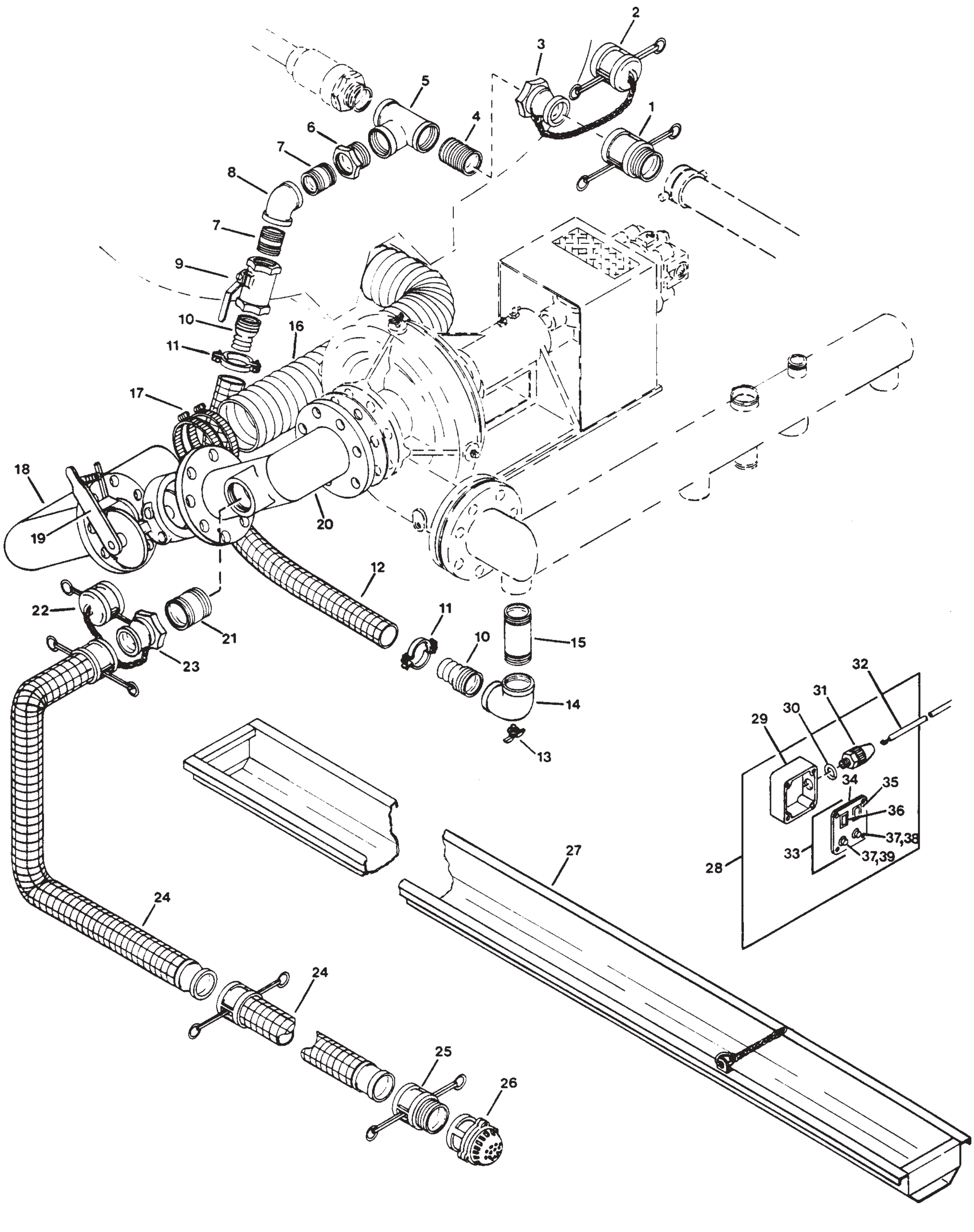


REF.	PART NO.	QTY.	DESCRIPTION
1	2940405	1	Flange Asm-10"
2	6602114	1	Valve-Butterfly, 10"
3	2940388	1	Flange-10"
4	0428889	6	Screw-Hex, 0.88NC x 5.00,GR2,PD
5	0131047	6	Washer-Lock, 0.88, Spring,PD
6	0220087	6	Nut-Hex, 0.88NC,PD
7	2940407	1	Angle Asm-Cyl Mt, 10"
8	0121574	1	Washer-Lock, 0.62, Spring,PD
9	0124589	1	Nut-Hex, 0.62NC,PD
10	3380570	1	1.38 Cylinder Mtg. Bolt Asm
11	0102570	1	Screw-Sock, 0.25NC x 0.38, CUP,PN
12	2940411	1	Lever Asm-10" DUMP VALVE, RH
	2940410	1	Lever Asm-10" DUMP VALVE, LH
13	0102617	2	Screw-Set, 0.50NC x 0.75, CUP,PN
14	6602092	1	Cylinder-Air, 2.5B x 8 DBL. Acting
15	6601164	2	Adp-ARBK, ST, 06MP-06MT
16	6600306	6	Hose End-06 x 06FSX,ST,LPSP
17	6600324	AR	Hose-0.38, Per Foot
18	0118755	4	Elbow-Auto. 90. 04MP-06MS

REF.	PART NO.	QTY.	DESCRIPTION
19	0219189	2	Plug-Pipe, SqHd, 0.25NPT,PN
20	6601456	2	Plate-End, Control Valve
21	6601455	1	Valve-Air, 2 Pos 4 Vay, 12VDC
22	6700255	1	Switch-Toggle, SPST, 2 Pos
	6700939	1	Switch-Rocker, 3 Pos, Center OFF
23	0118750	1	Adp-Auto, ST, 04MP-06MS
24	2910381	1	Bracket

AR - AS REQUIRED

Self Filling Attachments



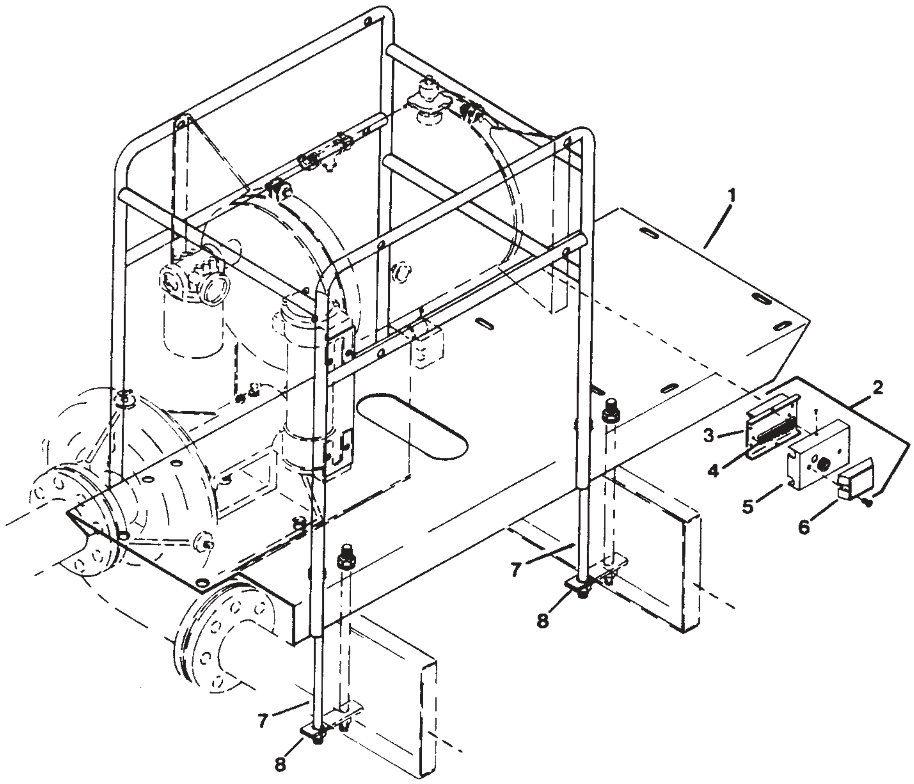
SPECIFY UNIT SERIAL NO., PART NO., & PART DESCRIPTION

Self Filling Attachments

REF.	PART NO.	QTY.	DESCRIPTION
1	6601101	1	Coupler-2.5 EVERTITE, Part B
2	6601100	1	Cap-Dust 2.5 EVERTITE W/Chain
3	6601154	1	Adptr-2.5 EVERTITE, Part F
4	6200108	1	Nipple-Short, 2.5
5	6200162	1	Tee-Pipe, 2.5NPT,PN
6	6200039	1	Bushing-Pipe, 2.50 x 2.00NPT,PN
7	0219501	2	Nipple-PP, Sch 40, 2.00 x 2.50,PN
8	0189777	1	Elbow-Pipe, 90, 2.00
9	6601839	1	Valve-Ball, 2.00
10	6200526	2	Nipple-Comb, 2.00, Type SCP
11	6000870	2	Clamp-Hose, 2.50 ID, Double Bolt
12	6309186	AR	Hose-2.00, Water P-1196/Ft.
13	6600162	1	Drain Cock, 0.25
14	2910376	1	Elbow-PP, 90, 2.00NPT,PN, Tapped
15	0219538	1	Nipple-PP, Sch 40, 2.00 x 7.00,PN
16	6000950	1	Hose-Suc, 5.50 x 25.0
17	6000872	4	Clamp-Hose #M96 Worm Gear
18	2940436	1	Elbow Asm-Tank End Suc, S-F
19	6601097	1	Valve-Butterfly 5 In.
20	2940434	1	Flange Asm-Suc, S-F, Frame PU
21	6200122	1	Nipple-PP, Sch 40, 3.00 x 2.50,PN
22	6600281	1	Cap-Dust, 3 In, Alum, W/Chain
23	6600277	1	Adapt-3 In, Alum, Part A, EVERTITE
24	6601098	2	Hose Asm-Suc W/M & F Ends
25	6600278	1	Cplr-3 In, Alum Part B, EVERTITE
26	6200561	1	Valve-Foot, 3 In NPT
27	2910219	AR	Trough Asm-Hose, Alum, 12 Ft.
28	2960195	1	Box Asm
29	2960178	1	Box
30	0274249	2	O-Ring, Tube Fitting, 0.75
31	6700894	2	Relief-Strain, Cord, Liq. Tight
32	6700825	AR	Cable, 7-18
33	2970047	1	Cover Asm
34	2960177	1	Cover
	2960175	1	Decal
35	6700815	1	Light-Pilot, Green
36	6700814	1	Light-Pilot, Amber
37	6700916	2	Facenut-Switch, Ele, PB
38	6700915	1	Switch-PB, Ele, DPDT, Blank
39	6700914	1	Switch-PB, Ele, SPDT, Red

AR - AS REQUIRED

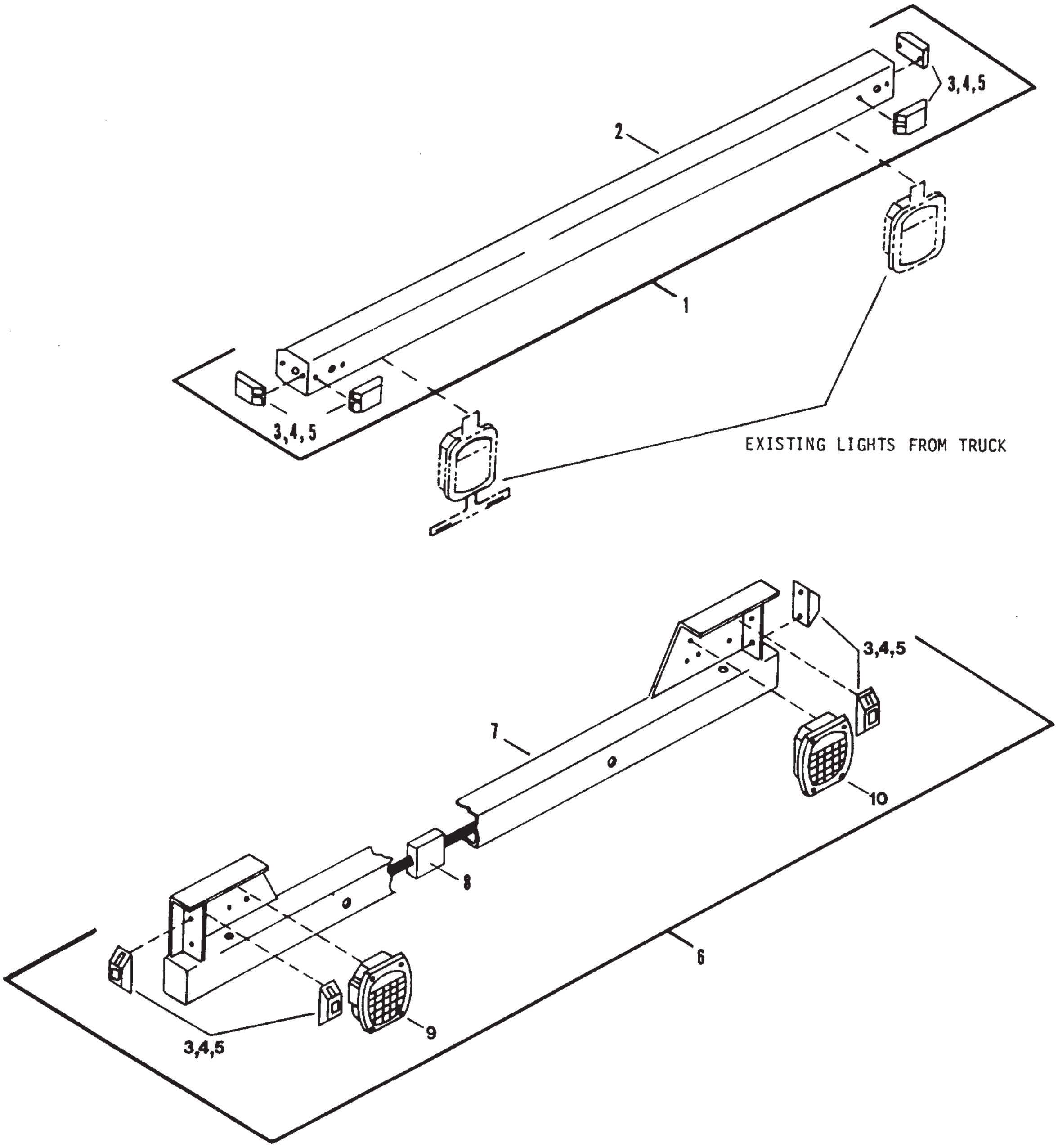
Base Assembly With Fill Light



REF.	PART NO.	QTY.	DESCRIPTION
1	2940429	1	Base Asm
2	2970067	1	Fill Light Asm
3	2970066	1	Base Asm-Fill Light
4	6700839	1	Terminal Strip-10 Bar
5	2970065	1	Cover
6	6700855	1	Light-Clear W/Reflect Amber
7	3300336	8	Tie Down Stud-18"
	3300337	8	Tie Down Stud-16"
8	3310932	4	Tie Down Plate

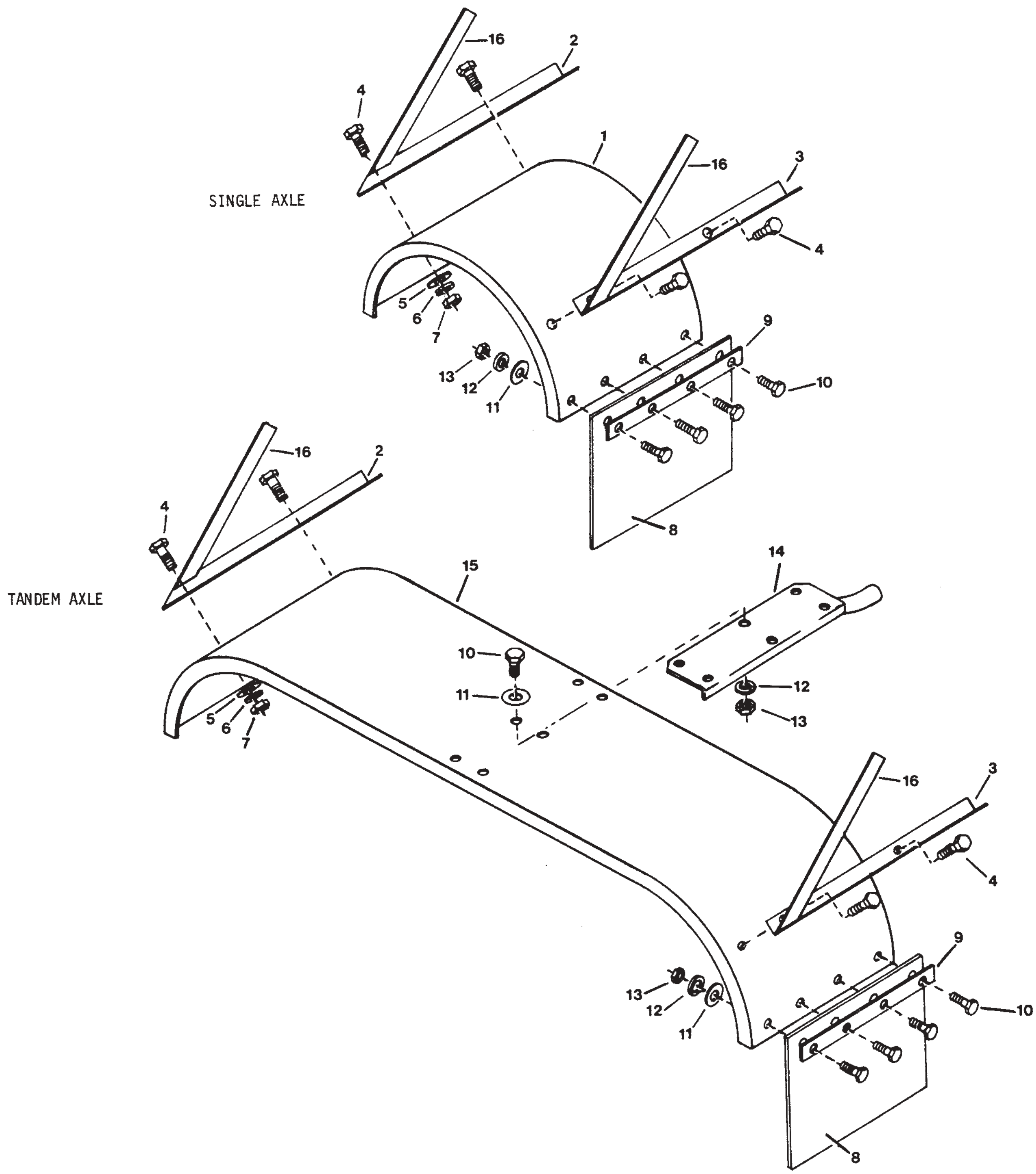
REF.	PART NO.	QTY.	DESCRIPTION

Bumper Assemblies



REF.	PART NO.	QTY.	DESCRIPTION	REF.	PART NO.	QTY.	DESCRIPTION
1	3311340	1	Bumper Asm-Complete, Econo				
2	3311339	1	Bumper Asm				
3	6700854	4	Light-Clearance W/Reflector Red				
4	6000721	4	Grommet-Rubber				
5	0447835	AR	Screw-Tap, PNSL, 10NF x 0.50,F,PD				
6	2910165	1	Bumper Asm-Complete				
7	2910164	1	Bumper Asm-Flusher, Universal				
8	3370050	1	Cover-Term Blk Box, Loom Bumper				
	2910156	1	Junction Box				
	6700837	1	Strip, Term, 10 Bar				
9	6700865	1	Light-Stop, Turn + Tail, Lt, Flusher				
10	6700866	1	Light-Stop, Turn + Tail, Rt, Flusher				AR=AS REQUIRED

Fenders

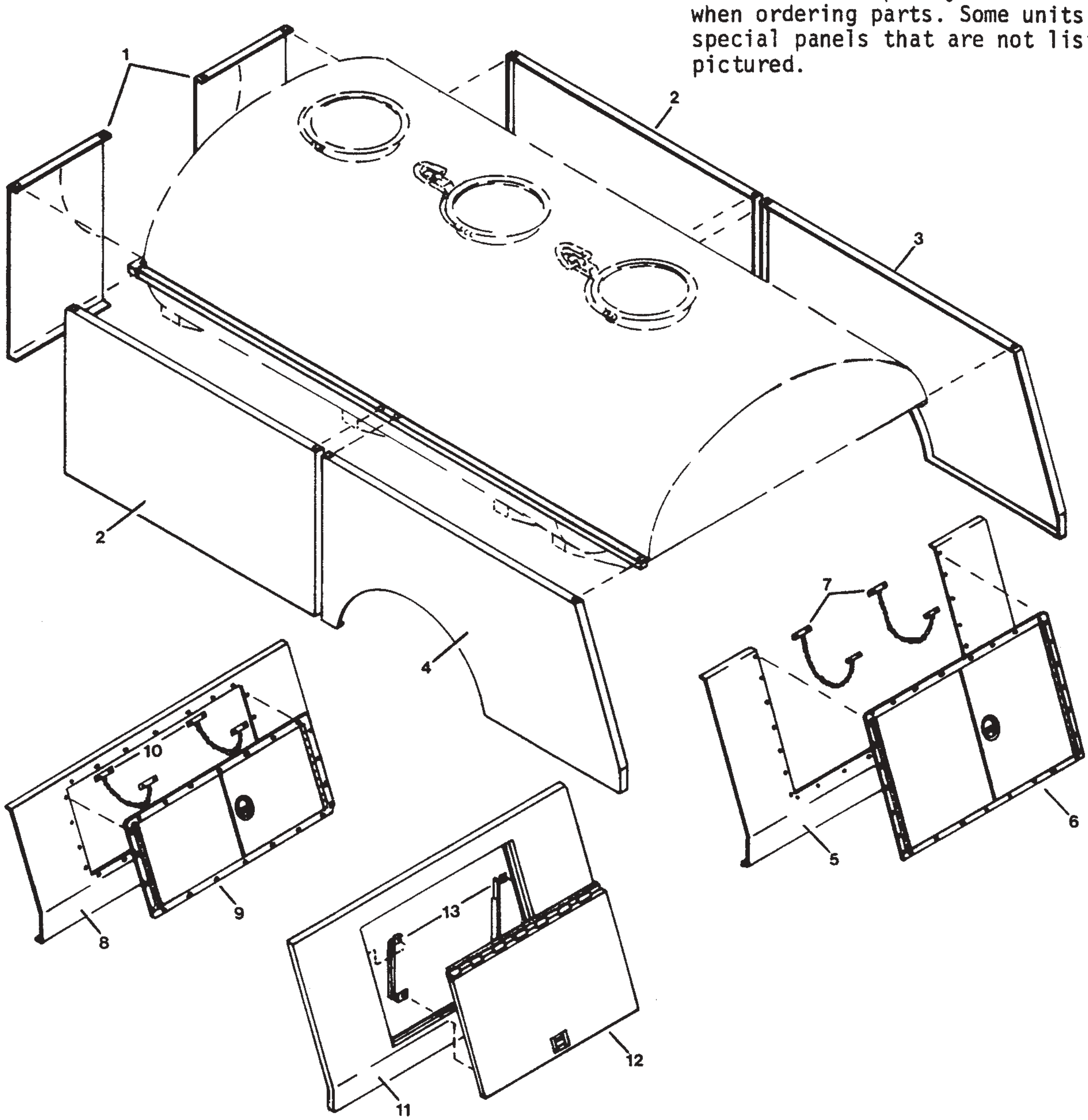


REF.	PART NO.	QTY.	DESCRIPTION
1	3380581	2	Fender-Steel-Single
2	3311550	2	Brace-LH
3	3311551	2	Brace-RH
	3311299	2	Brace-TDM
4	0122007	8	Screw-Hex, 0.31NC x 0.75,GR2,PD
5	0446363	8	Washer-Flat, 0.31A(0.38 x 0.88)
6	0120214	8	Washer-Lock, 0.25, Spring,PD
7	0120376	8	Nut-Hex, 0.31NC,PD
8	6450095	2	Splash Guard, 24 x 20
9	2710001	2	Mud Flap
10	0121900	20	Screw-Hex, 0.25NC x 1.00,GR2,PD
11	0120386	20	Washer-Flat, 0.25A(0.25 x 0.56)
12	0120380	20	Washer-Lock, 0.25, Spring,PD
13	0120375	20	Nut-Hex, 0.25NC,PD
14	2750589	2	Brace Asm, 28", Short
15	3380580	2	Fender-Steel-Tandem
	3311491	2	Fender-Alum-Tandem Long
16	2750717	4	Stiffener

SPECIFY UNIT SERIAL NO., PART NO., & PART DESCRIPTION

Skirting
Optional

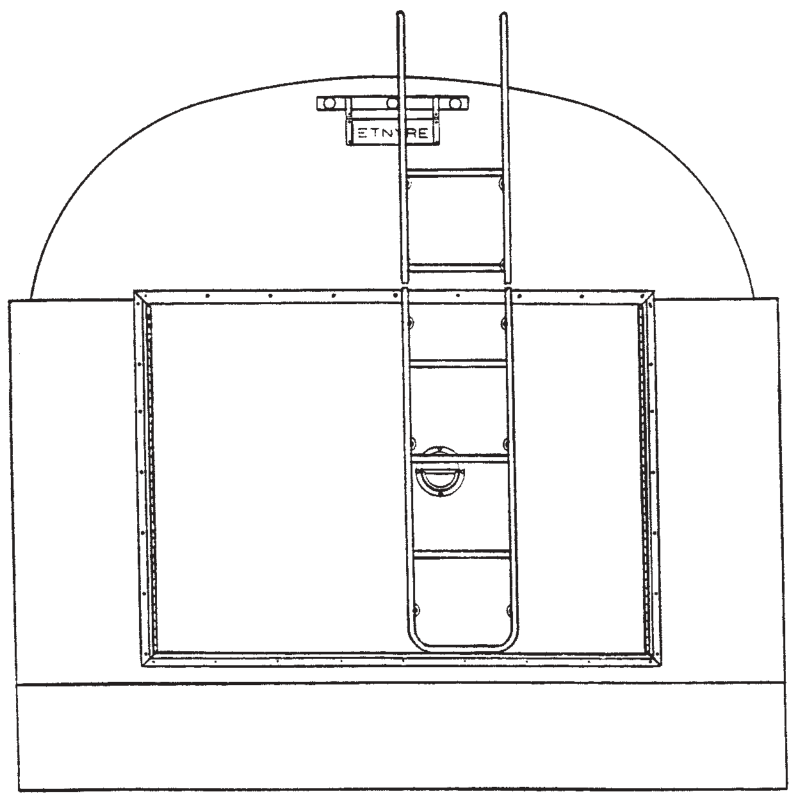
NOTE: Please specify Unit Serial Number when ordering parts. Some units may have special panels that are not listed or pictured.



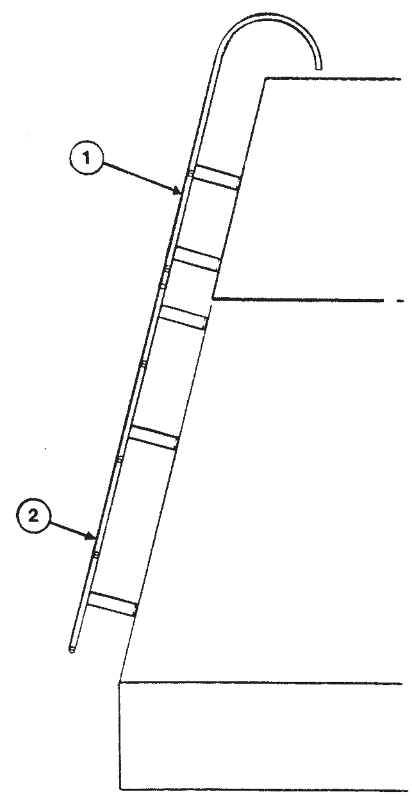
REF.	PART NO.	QTY.	DESCRIPTION
1	2910196	2	Front Panel
2	2910216	2	Panel Asm-Front Side (Single Axle)
	2910217	2	Panel Asm-Front Side (Tandem Axle)
3	2910182	1	Pannel Asm-Right Rear, Universal
4	2910183	1	Panel Asm-Left Rear, Universal
5	2910308	1	Panel Asm-Rear, Large
6	2910318	1	Door & Frame Asm, Large
7	3311574	2	Chain Asm
8	2910295	1	Panel Asm-Rear
9	2910306	1	Door & Frame Asm
10	6000346	2	Chain Asm
11	2910185	1	Panel Asm-Rear
12	2910211	1	Door & Hinge Asm
13	6100155	2	Door Prop

Ladder Assembly Over Skirting
Optional - Oval 64 x 90

NOTE: Please specify Unit Serial Number when ordering a Ladder Assembly. The part number listed is for an oval 64 x 90 only. Other oval sizes will have different part numbers.



Rear View



Side View

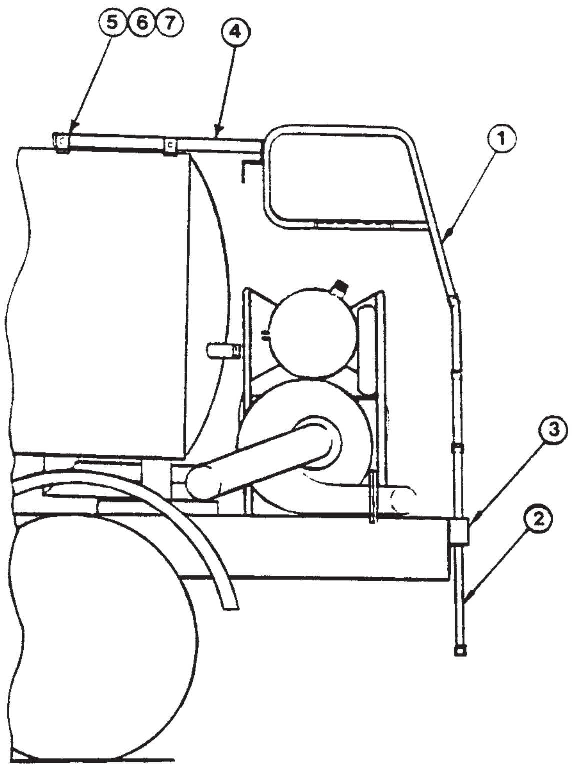
REF.	PART NO.	QTY.	DESCRIPTION	REF.	PART NO.	QTY.	DESCRIPTION
1	2910348	1	Ladder Asm-Top, 64 x 90				
2	2910350	1	Ladder Asm-Bottom, Large Door				

SPECIFY UNIT SERIAL NO., PART NO., & PART DESCRIPTION

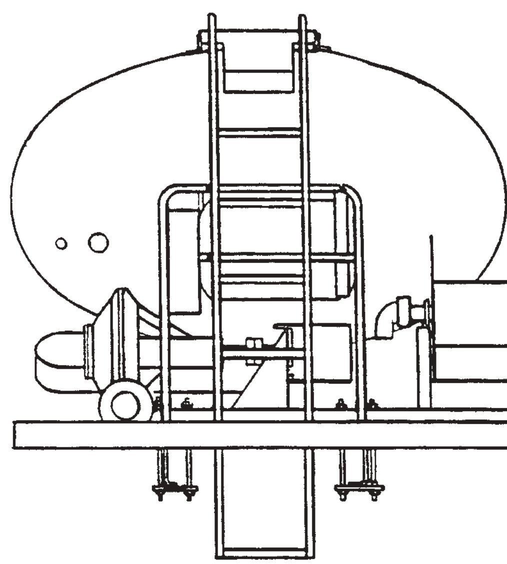
Ladder Assembly

Optional - Oval 50 x 83

NOTE: Please specify Unit Serial Number when ordering a Ladder Assembly. The part number listed is for an oval 50 x 83 only. Other oval sizes will have different part numbers.



Side View



Rear View

REF.	PART NO.	QTY.	DESCRIPTION	REF.	PART NO.	QTY.	DESCRIPTION
1	L2270AP	1	Ladder Asm				
2	3301197	1	Step Asm				
3	3311340	1	Bumper Asm				
4	3301311	1	Walkway & Light Brkt. Asm				
5	3301310	4	Mounting Bracket				
6	0122119	8	Screw-Hex, 0.38NC x 0.75 Lg.				
7	0274993	8	Nut-Hex, Lock, 0.38NC				

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