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MILLENIUM SERIES 3

OPERATION MANUAL

MODELS
15 30/40/50/70/90

OLINPUMP

GROUT – SHOTCRETE – CONCRETE – PRESSURE GROUTING AND SPECIAL APPLICATION PUMPS

OLINPUMP

OPERATIONS MANUAL

THIS MANUAL MUST BE READ AND FULLY UNDERSTOOD BEFORE OPERATING THIS EQUIPMENT.

INTRODUCTION

OLINPUMPS are designed with the upmost attention toward dependability and easy maintenance. Close attention to the information and instructions in this manual will ensure a minimum of maintenance and maximum productivity and safety during operation.

Prior to pump start-up, the operator must thoroughly familiarize himself with the material contained herein in order that the pump can be operated in a safe manner.

For safe operation of this equipment, the qualifications for, and the conduct of, the operator should be as follows:

ELIGIBILITY

1. The operator must have read and fully understand the "safety" manual provided by his employer, and taken part in all "safety" training programs provided by his employer.

2. The operator must have taken part in some concrete pump operators training programs provided by "THE AMERICAN CONCRETE PUMPING ASSOCIATION" and have been certified.

3. Equipment should be operated only by experienced operators, or a trainee under the direct supervision of an experienced operator, and no unauthorized person should be permitted to assist or remain in the immediate vicinity of the equipment while it is in operation or during the performance of any maintenance, inspection, cleaning, repair or make-ready operation.

4. Equipment should not be operated by individuals who cannot read and understand the signs, notices and operating instructions that are part of the equipment (in the language in which printed).

5. Equipment should not be operated by anyone under the age of 18 years.

6. Equipment should not be operated by anyone with seriously defective eyesight or hearing, and physical or mental impairment (such as epilepsy, heart disease, or progressive neuro-muscular deterioration), and that this is verified by a physical examination at least annually.

7. Equipment should not be operated while the operator is eating, reading or is more than six (6) feet in distance from the controls.

8. Equipment should not be operated by an operator who has been asked to be relieved because he feels physically or mentally unfit.

9. Equipment should not be operated at any new site, or at the start of a new shift, until a visual inspection is made of the condition of the equipment and the concrete delivery system.

10. Equipment should have a sign-off sheet attached to the equipment where the operator can report any damage, defect, problems or accidents to the next shift operator and work supervisor.

11. The operator of the equipment must not be under the influence of alcohol or drugs when operating the equipment.

12. Remote cable and/or radio are provided for the use of the "hose man" only, the pump operator must be no more than six (6) feet from the pump during its operation.

BEFORE WORKING ON PUMP:

1. REMOVE KEYS TO ENSURE THAT THE PUMP CANNOT BE STARTED.

2. DISCONNECT BATTERY CABLE.

SWING TUBE MODELS ONLY

SAFETY PRECAUTIONS

Any personnel assigned to repair, troubleshoot, or operate the equipment must first be thoroughly familiar with the operation instruction manual. The operator's safety and the safety of others is, at all times, of the upmost importance. To work safely, the operator must understand the job he does.

During operation, repair, or troubleshooting, problems may arise that seem singular, but may be due to several causes. The information in the manual should assist in finding these causes. If more information is needed, please consult your local distributor or the factory.

1. Never place any body parts or other objects in the hopper of the pump while the engine is running.

2. Never work on any part of the pump or engine while the engine is running. The operator should take the time to stop the power system for his protection.

3. Hydraulic oil systems can be dangerous. The operator should know the circuit he is repairing —it may have very high pressure and injury could occur. The operator should stop the entire pump, and engine, and allow sufficient time for the oil pressure to drop to zero. He should check the system pressure gauge(s). Caution must be used when opening the circuits or components. Pressurized oil can cause severe injury.

4. The operator should never open any part of the material delivery system without stopping the pump, and releasing the pressure.

5. The operator must wear protective eye, ear, and head equipment.

Note: For optimum performance, attention should be given to the pump positioning. The tongue end of the pump should sit level, or slightly lower, during pumping operations.

FOR USE WITH "SWING TUBE" PUMPS ONLY

1. PRE START-UP

Choose the correct concrete delivery system for the type of mix that is to be pumped. Set up the concrete delivery system avoiding tight bends, sharp objects and extremely rough surfaces. Make sure the system is securely anchored. Make sure the clean out door is tightly fitted, and all clamps are locked. Hopper should have at least enough water to cover the material cylinders.

2. START-UP

Start the engine and let run at low speed for five (5) to ten (10) minutes before increasing engine speed to desired operating RPM. Set the FORWARD/REVERSE switch to FORWARD position. Set the pump flow control to maximum output, and lock. Turn pump ON, and pump water into the discharge line. On Models 15 30 and 15 40, adjust swing tube sequencing valve at this time, before concrete enters pump. Adjust to achieve FULL SWING TUBE shift without more than 500 psi spike at end of each shift. If slurry is not to be delivered by "ready mix", operator must prepare at least ten (10) gallons of priming slurry, depending on diameter and length of delivery system he is pumping through. Slurry may consist of a high cement/sand mixture, bentonite clay, or other suitable high fine ingredient. Priming slurry is most effective when poured directly into system at Swing tube outlet or as near as possible. Before concrete is discharged into the hopper, make sure remixer (if fitted) is rotating in a clockwise direction as viewed from operator side of pump. Check delivery ticket, as well as visually in the truck, to make sure the mix is of a pump design, and at a suitable slump for pumping. Turn on as concrete enters the hopper and make sure concrete is discharged into hopper fast enough to avoid the pump taking in air. If this occurs, compressed air may explode up from the hopper creating a dangerous, as well as messy, condition. DO NOT shut off the pump before concrete has reached the point of delivery. Adjust pump to desired output, and, on models 15 30 and 15 40 re- adjust sequence valve if necessary so that the swing tube is shifting fully (closing too much will cause erratic cycling and pressure spikes). It is not necessary to run engine at a higher RPM than is necessary to develop horsepower and/or speed required for the given job; however, avoid over "lugging" the engine.

Note: There are a number of grease points on the pump. Pump a good quality waterproof grease into these points after every job, or every 50 cubic yards on large jobs. It is **not** possible to over grease; the more the better.

3. CLEARING BLOCKAGES

If a blockage occurs, either in the pump, or in the delivery system, IMMEDIATELY set the FORWARD/REVERSE switch to the reverse position, allowing the pump to stroke at least two (2) or three (3) times before returning to the forward position. If blockage still exists, reverse the pump for three (3) or more strokes, and shut down. Check for kinks in the delivery system or reducer blockage. After locating, carefully "kick" apart coupling on the pump side of the blockage, keeping face turned away. DO NOT allow anybody to stand near while carrying out this operation. USE CAUTION AT ALL TIMES WHEN OPENING ANY DELIVERY SYSTEM. Once blockage has been cleared and all couplings have been locked in place,

4. STANDING TIME

If the pump is stopped and concrete left in the system, stroke the pump at least once on each cylinder so as not to allow concrete to set. Repeat as often as necessary. Use remixer (if fitted) to assure that the mix does not separate. DO NOT ALLOW CONCRETE TO SIT IN THE PUMP OR DELIVERY SYSTEM FOR MORE THAN TEN (10) MINUTES WITHOUT STROKING, OR AT ALL IF CONCRETE IS "HOT" OR WET TO THE POINT OF SEPARATING. WHEN SHUTTING DOWN BETWEEN CONCRETE TRUCKS, ALWAYS LEAVE ENOUGH CONCRETE IN THE HOPPER TO ALLOW INTERMITTENT STROKING OF THE PUMP.

5. WASHING OUT

Pump remaining material from hopper. Fill hopper with water, and pump out delivery system at high speed. Pump at least two (2) more hoppers full of water through the delivery system at MAXIMUM stroking speed. Shut off the engine. Open the clean out door in the bottom of the hopper, wash out any remaining material left in the hopper, removing any build-up as well. Close the clean out door, checking the integrity of the door gasket before securing.

CAUTION: DO NOT PUT HANDS INSIDE THE HOPPER WHILE ENGINE IS RUNNING.

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6. CLEANING YOUR PUMP

At the end of each day clean your pump thoroughly, checking for leaks, and noting its general condition. REPAIR OR REPLACE ALL WORN OR DAMAGED PARTS AT THIS TIME. DO NOT OPERATE THE PUMP WITH WORN, DAMAGED, OR UNSAFE PARTS. At this time, check engine oil level. Check wash box oil level. Oil should be half-way up the chrome cylinder rods. Any water entering the piston box will settle to the bottom after pump sits for 24 hours. Drain this accumulated water weekly, before start-up on the next job. Add hydraulic oil if necessary. Grease all grease points.

NOTE: Never use acid, hammer, or chipping gun near chrome material cylinders, "swing tube" cylinder rod, or main hydraulic cylinder rods. Severe damage may be incurred, causing downtime and repair expense.

FOR USE WITH SWING TUBE PUMPS ONLY

GENERAL MAINTENANCE ALL SWING TUBE MODELS

1. REPLACING MATERIAL CYLINDERS SEALS (Poly Paks)
Remove piston box cover, and remove drain plug from bottom of piston box.
Manually stroke one material piston, using the STROKE switch on the control panel, all the way towards the front of the pump. AUTO/MANUAL switch must first be switched to MANUAL.
Remove the four (4) Allen head bolts and remove the two (2) halves of the clamp. Take out the coupler and material piston. Remove the old poly paks, and clean the grooves in the piston. Fit new poly paks with the lips facing away from each other.

Refit the piston into the material cylinder using oil to lubricate the poly paks and the inside of the material cylinder.
Before installing clamp halves, make sure all surfaces are clean of dirt and/or burrs which may prevent proper tightening.
Refit the clamp halves and tighten the four (4) bolts in a repetitive pattern to ensure tightness.
Replace the other side using the same method.
Refit drain plug, and refill the piston box, until the level is half-way up the chrome rods.
Refit the piston box cover, tighten wing nut.

2. CHANGING THE HYDRAULIC OIL FILTER
Change at 50 hours on a new machine, then every 100 hours thereafter.
Remove the bolts on top of the filter housing and lift out the old filter element.
Fit new filter element and refit the lid.
CAUTION: Make sure O' ring is in place, do not over tighten the bolts.

3.REPLACING "SWING TUBE" CUTTING RING AND SPECTACLE PLATE

1. Remove clevis pin from shifting arm.
2. Remove safety pin and castle nut from drive shaft.
3. Remove spacer washer, shifting arm and thrust washer from drive shaft.
4. Remove outlet flange and bearing housing from the discharge end of swing tube at rear of hopper. Remove rear plate.
5. Work swing tube backwards, a few inches, rotate 180o, and remove thru the rear of the hopper.
6. Remove nuts from the engine side of the hopper to facilitate removal of the spectacle plate. Clean surfaces thoroughly, and reverse or replace as required. Apply silicone to mating surfaces and refit bolts and tighten nuts.
7. Remove cutting ring and thrust ring. Inspect and replace parts as necessary. Wear ring may be rotated if wear is not excessive. Also note; cutting ring may be reversed, however you should always replace the thrust ring. Clean cavity inside the swing tube thoroughly before re-installing.

8. Inspect swing tube outlet seal housing for wear. Replace outlet seal and housing as necessary.
9. Re-install swing tube assembly.

10. Reinstall thrust washer, shifting arm, spacer washer, castle nut.
11. Install rear plate, outlet seal, seal housing, and outlet flange. Use grease liberally.
12. Tighten castle nut just enough to pull the end of the swing tube outlet away from the outlet flange, so that they do-not touch. Install safety pin, and tighten shifting arm to drive shaft. Connect shifting cylinder rod by inserting clevis pins and retainer clips.
13. Grease all fittings.

4. ENGINE SERVICE

Follow the service program supplied by the engine manufacturer.

PERIODIC MAINTENANCE

After the first 250 hours, and every 500 hours thereafter, it is recommended changing the hydraulic oil.

NOTE: Trailer wiring color code (if fitted).

Brown.....Ground
Blue.....Electric brakes
Red.....Tail lights
Yellow.....Left turn and stop light
Green.....Right turn and stop light

ELECTRICAL TROUBLESHOOTING FOR ALL **SWING TUBE** *MODELS*

SPECIAL NOTE: Disconnect stroke counter, and radio remote (if installed) before carrying Out the following checks.

PROBLEM: Pump will not cycle.

1. Check all wire connections.

2. Check the fuse located on the Pump Control Board, hereafter referred to as the PCB.

3. If the fuse is "OK", then using a test light, with the engine ignition switch turned ON, (you do not have to have the engine running (check that power is being supplied to terminal # 15 on the PCB connector strip. If there is NO power, then you may have to replace the ignition switch, however to get the pump cycling you can "hot wire" from the positive terminal of the battery to terminal # 15 on the PCB connector strip.

Using a test light, carry out the following tasks;

4. Check for power at center terminal of the ON/OFF/REMOTE switch, if none, replace PCB.

5. Check for power at bottom terminal of the ON/OFF/REMOTE switch, in none, then replace the switch.

6. Check for power at center terminal of the AUTO/MANUAL switch, if none, replace the PCB.

7. Check for power at top and bottom terminals of the AUTO/MANUAL switch, if none at either terminals, replace the switch.

8. Check for power at the center terminal of the STROKE/STROKE switch, if none, then replace the PCB.

9. Check for power at the top and bottom terminals of the STROKE/STROKE switch, if none, replace it.

1. If Pump cycles in MANUAL, but will not cycle in AUTO, go to the next section, If the pump still does not cycle at all, then proceed to step 6 in the following section.

PROBLEM: Pump will not cycle in auto.

1. Remove the "wash box" lid, hold it upside down.

2. With the ignition switch in the ON position, (you do not have to have the engine running) the ON/OFF/REMOTE switch in the ON position, AUTO/MANUAL switch in the AUTO position, check to see if the *green* lights are lit on both "shifting sensors". If both *greens* are not lit, then check terminal # 10 on the PCB. If power is OK replace the sensor cable. If both *greens* are lit then, using a metal object to test the shifting sensors, touch the metal object to the face of the shifting sensors one at a time, checking to see if the *yellow* light is lit on the shifting sensor *when* the metal object is touched to the face of the shifting sensor. If one or both lights fail to light, then replace the shifting sensor that does *not* light-up.

3. If light does *not* go out when the metal object is removed for the face of the shifting sensor, replace the sensor.

4. If lights are working correctly check to see if the relay (marked RH2LB on the PCB) is *latching* from side to side as the metal object is moved from the face of one sensor to the other. (Points are *making* and *breaking* contact), if not, then replace the cycling relay (marked RH2LB on the PCB board.

5. I f relay is OK, then check for power at terminals # 2 and 3. If no power at either one, then replace the PCB.

6. Using a test light, check for power at the Directional valve coil wires (located inside the terminal box). If no power, then replace the cable from the PCB to the Directional valve. If OK, then check that the coils are being actuated when power is supplied to them, if a coil is *not* being actuated, replace the coil. If both coils are OK, then proceed to the HYDRAULIC TROUBLESHOOTING SECTION of the manual.

PROBLEM: Pump will not cycle in reverse.

1. Using a test light, check that the FORWARD/REVERSE switch is working, replace if necessary.

2. Check if the reversing relay opens/closes as the FORWARD/REVERSE switch is switched. If not, then replace the relay (RB4BU). If it still dose not open/close, and the switch is OK, then replace the PCB.

HYDRAULIC TROUBLESHOOTING FOR ALL **SWING TUBE** *MODELS.*

PROBLEM: Pump will not build hydraulic pressure.

1. Check the hydraulic oil level, add oil if necessary.

2. Start the engine and set R.P.M. to at least half throttle.

3. Set hydraulic pump output to at least 50%.

4. Push in on the Directional valve *palm buttons* (overrides on the D01 coil ends). I f no pressure is developed, then push in on the opposite button, if still no pressure, then go to # 5.

5. **STOP ENGINE,** remove the end caps on the main body of the directional valve, (Note the position of the springs and washers. Check spool for free movement. If spool will not move, remove the directional valve, remove spool from the valve body and try to clean the inside of the valve body and spool with emery cloth (when removing spool note which end of the spool goes at which end of the valve body) , if you are unable to repair the valve then replace it.

6. Remove the pilot pressure check valve cartridge at the hydraulic pump pressure flange, and check for debris or obstruction in the cartridge, clean or replace as necessary.

7. Remove pressure relief cartridge from the directional valve's sub plate, check for debris or damage to the cartridge or to the O' rings. Replace O' rings if required or the complete valve if necessary.

8. Remove the hydraulic pump and check the pump *drive* plate spline and pump input shaft, replace as required.

9. Have the hydraulic pump checked out by an Authorized service center.

SWING TUBE TROUBLESHOOTING

PROBLEM; Slow swing tube shift - accumulator models only

1. Check I D plate inside control box for Maximum swing tube circuit pressure(models vary). Using 'stroke' switch in 'manual' mode, check Max s/t circuit pressure*. If ok, go to 2. If not, go to 3.

2. Using an accumulator charging kit, check accumulator nitrogen pre-charge(1000 psi, 70 bar). Re-charge or replace bladder if necessary. If ok, go to 3.

3. Plug shift cylinder hoses, one at a time, and check pressure. If pressure comes up, repair or replace shift cylinder(s) as necessary. If no change, go to 4.

4. Remove, disassemble, and inspect gear pump for worn housing and thrust plates. Repair or replace as necessary. If pump looks good, go to 5.

5. Remove and inspect relief valve for debris or damaged/missing o'ring(s). Repair or replace as necessary. If ok, go to 6.

6. Remove, disassemble, and inspect D03 pilot valve for excessive spool/body clearance. Replace if necessary. If ok, do same to D08 directional valve.

PROBLEM; Incomplete swing tube shift.

1. Does swing tube shift too far in one direction, and short in the other? If so, disassemble and check for worn/twisted shaft.

2. Does swing tube shift short in both directions? If so, disassemble and check for worn shaft and/or flanged bearing, cylinder clevis pins and holes, or broken pinch bolt on shifting arm, or worn/damaged square shaft hole in shifting arm. If ok, go through steps 1-6 above for accumulator models, or 1,3 and 6 for single source models.

* Note; when checking max system pressure, also compare pressure from side to side as well as maximum. On single source units, turn main hydraulic volume down to about 10% of max flow, when checking max pressure.

SHORT STROKING

SHORT STROKING IS DEFINED AS AN ABNORMAL RAPID CYCLING OF THE PUMP, AND A SIMULTANEOUS LOSS OF PUMP OUTPUT.

THERE ARE TWO TYPES OF SHORT STROKES THAT CAN OCCUR.

1. Hydraulic short stroke;
   This occurs when hydraulic oil slowly leaks from the HIGH pressure side of the hydraulic piston to the LOW pressure side, typically resulting in a gradual increase in cycle rate and a relative decrease in pump output.
   To solve this problem, place the AUTO/MANUAL switch in 'Manual' position, and use the STROKE switch to cycle in one direction and hold for several seconds. Now return to 'Auto'. Should the pump now cycle normally for a period of time, but again start to "short stroke", repeat the above procedure. Repeat again if necessary. If this process does not resolve the problem, rebuilding of the hydraulic cylinders may be necessary, or replacement of cylinder check valves located toward front of pump.
   Hydraulic "short stroking" will normally not occur when the pump is cycling empty. NOTE: Spiking on the hydraulic pressure gauge at each shift may also indicate the need for cylinder rebuild, or replacement of cylinder check valve(s) located at washbox end of cylinders.

2. Electrical short stroke;
   This occurs when the cycling relay or shifting sensor has failed, and normally happens instantly .
   To check that it's an electrical "short stroke" problem, manually pressure out the pump on both sides, then run the pump in "AUTO". If the pump still "short strokes", the problem is electrical. Replace the cycling relay. Should this not solve the problem then you may have to replace one of the shifting sensors.
   Electrical "short stroking" will occur even when the pump is cycling empty. Refer to 'Electrical Troubleshooting' portion of manual.

shortstroke

SAMPLE STRUCTURAL CONCRETE MIXES
FOR SWING TUBE PUMPS
TO BE USED AS A GUIDE ONLY

NOTE; WEIGHTS MAY NEED ADJUSTING, DEPENDING UPON ACTUAL COARSE AGGREGATE SIZE AND MOISTURE CONTENT OF SAND.

ONE-YARD BATCH WEIGHTS FOR NATURAL OCCURRING AGGREGATE MOISTURE CONTENTS

Mix: 45% Sand, 16% No. 8, 39% No. 57 3000 PSI

	SSD Weights	Batch Weights
Cement	517 lbs.	517 lbs.
Sand	1420 lbs.	1472 lbs. @ 5.0% total moisture
No. 8 Stone	505 lbs.	511 lbs. @ 2.0% total moisture
No. 57 Stone	1235 lbs.	1251 lbs. @ 2.0% total moisture
Water	275 lbs. (33 gal.)	201 lbs. (24 gal.)

Mix: 45% Sand, 16% No. 8, 39% No. 57 3000 PSI

	SSD Weights	Batch Weights
Cement	611 lbs.	611 lbs.
Sand	1320 lbs.	1368 lbs. @ 5.0% total moisture
No. 8 Stone	500 lbs.	506 lbs. @ 2.0% total moisture
No. 57 Stone	1220 lbs.	1236 lbs. @ 2.0% total moisture
Water	275 lbs. (33 gal.)	205 lbs. (25 gal.)

Mix: 45% Sand, 16% No. 8, 39% No. 57 4000 PSI

	SSD Weights	Batch Weights
Cement	650 lbs.	650 lbs.
Sand	1310 lbs.	1358 lbs. @ 5.0% total moisture
No. 8 Stone	495 lbs.	501 lbs. @ 2.0% total moisture
No. 57 Stone	1210 lbs.	1226 lbs. @ 2.0% total moisture
Water	280 lbs. (34 gal.)	210 lbs. (25 gal.)

Note; Pump above mixes at 4" to 5" slump, and use appropriate diameter delivery system. Increase in line pressure may reduce the slump at the point of placement.

AGGREGATE TESTS

Coarse Aggregate - No. 57

Gradation

Percent Finer Than:

1-1/2 Inch Sieve	100
1 Inch Sieve	100
3/4 Inch Sieve	89
1/2 Inch Sieve	43
3/8 Inch Sieve	13
U.S. No. 4 Sieve	1
U.S. No. 8 Sieve	1
U.S. No. 200 Sieve	0.8

Specific Gravity

Bulk Specific Gravity, SSD:	2.80
Absorption, %:	0.7

Unit Weight

Dry Loose Unit Weight:	93.2 lbs./cu.ft.
Dry Rodded Unit Weight:	106.7 lbs./cu.ft.

Coarse Aggregate - No. 8

Gradation

Percent Finer Than:

1/2 Inch Sieve	100
3/8 Inch Sieve	91
U.S. No. 4 Sieve	18
U.S. No. 8 Sieve	4
U.S. No. 16 Sieve	2
U.S. No. 30 Sieve	2
U.S. No. 50 Sieve	2
U.S. No. 100 Sieve	2
U.S. No. 200 Sieve	1.5

Specific Gravity

Bulk Specific Gravity, SSD:	2.78
Absorption, %:	0.8

Unit Weight

Dry Loose Unit Weight:	94.2 lbs./cu.ft.
Dry Rodded Unit Weight:	102.6 lbs./cu.ft.

All concretes don't pump equally well. In fact, some don't pump at all. But if the supplier gives special attention to control of the material properties and amounts of materials used in his concrete he can produce pumpable mixes. Pumpability is related to several other properties of fresh concrete.

PROPERTIES OF FRESH CONCRETE

Concrete contains cement, water, fine aggregate or sand and coarse aggregate, usually gravel or crushed stone. Admixtures such as air-entraining agents, fly ash or water-reducing agents may also be added. How the fresh concrete behaves depends on properties and proportions of the materials used. Some of the factors that affect pumpability are:

- Slump—The slump test measures the ability of a concrete to flow. Higher-slump concretes that are still cohesive flow more readily and are easier to pump. To get a higher slump more water can be put into the mix, less aggregate can be used or a water-reducing admixture can be added. Adding water, though, to increase slump will also decrease concrete strength if no additional cement is used.

  NOTE: *When slump tests are to be made on a pumped concrete job and a maximum permissible slump is specified, the specifications should state where the slump test is to be run—at the pump hopper or at the end of the pumpline. Concrete can lose slump as it passes through the line, especially if the aggregates are absorptive. A concrete could have a 6-inch slump at the hopper but only a 3-inch slump after it is discharged from the line.*

- Trowelability—A concrete that is easy to finish will generally also be easier to pump. Trowelability or finishability is affected primarily by

the amount of fine sand, cement and other fines such as fly ash in the mix. Up to a point, the more fines and the higher the mortar volume, the lower the line pressure will be if slump is held constant.

- Segregation—Segregation is separation of coarse aggregate from mortar or separation of cement paste from aggregate in freshly mixed concrete. Mixes that segregate easily will be harder to pump.
- Harshness—Harsh concrete mixtures don't have enough mortar or aggregate fines and because of this they lack cohesion. They are more likely to segregate, aren't as trowelable and are more difficult to pump than mixes that have enough mortar. The slump test can be helpful in detecting harsh mixes. If the slumped concrete breaks off (Figure 2-1) or falls apart when lightly tapped with the tamping rod (Figure 2-2), the mix lacks cohesion and probably won't be pumpable.

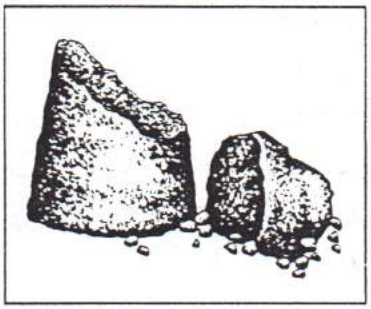

Figure 2-1. If a part of the concrete used in a slump test shears off or falls away, the concrete is probably not pumpable.

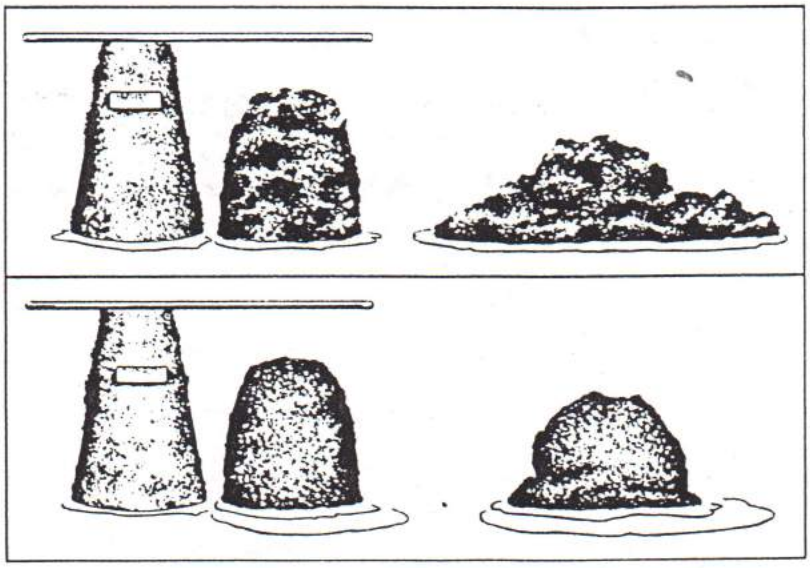

Figure 2-2. Tap the side of a slump specimen with the tamping rod. A harsh mix (top drawing) will crumble. A mix with adequate cohesion (bottom drawing) will hold together.

- Bleeding—Bleeding is movement of water to the top surface of concrete as heavier materials settle. Mixes that bleed excessively are difficult to pump. Even on jobs where the concrete isn't pumped the use of these mixes should be avoided because finishing will be delayed, flatwork surfaces will be less durable, secondary flooring such as tile may not adhere properly, and sand streaking will occur on vertical surfaces.

WHAT MAKES CONCRETE PUMPABLE?

Pumpable concrete can be pushed under pressure through a pipeline system that may include flexible hose as well as smooth steel line. In a pipeline, concrete moves in the form of a cylinder or slug separated from the pipe wall by a lubricating layer of water, cement and fine sand particles. The concrete slug must be able to pass through tapered sections (reducers) between the pump discharge port and the pipeline, slide along pipe walls and go around bends in the line. Cohesive mixes will deform as they go through bends or reducers. If the mix is harsh and doesn't deform readily, too much friction may develop between the concrete and the pipe walls and create a blockage or rock jam.

When concrete is pumped, water in the mix transmits the pump pressure to the cement and aggregates. But if spaces between aggregates are too large or the cement-water paste is too thin and runny,

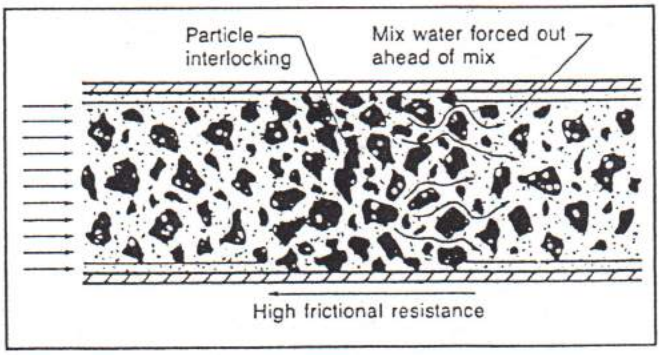

Figure 2-3. If pump pressure forces water out ahead of the mix a rock jam occurs. Friction between the aggregate and the pipe wall increases and the concrete stops moving.
DRAWING: AMERICAN CONCRETE INSTITUTE

pump pressures cause segregation, forcing water out ahead of the mix. When this happens the lubricating layer is lost, coarse particles interlock, friction between the particles and the pipe wall increases and the concrete stops moving in the line (Figure 2-3). To keep this from happening, spaces between aggregate particles in the concrete must be made smaller so that the pressure at which segregation occurs is greater than the pressure needed to pump the concrete. Voids or spaces between aggregate particles are reduced in size by using a range of particle sizes from coarse to fine and by putting enough cement or other fines in the mix.

Concrete mixes that have *too many* fines may also be difficult to pump. Here, the problem isn't segregation. The mix is cohesive but friction between the concrete and the line may be so great that pump pressure isn't high enough to move the concrete. This type of pumping problem is more common with high strength concretes or with concretes containing a high proportion of very fine materials such as rock dust. These concretes are sticky and additional pressure is needed to overcome adhesion between the mortar and the pipe walls. Increasing the amount of well-graded coarse aggregate in these mixes will help to reduce the fines content and improve pumpability. Use of a coarser sand is also recommended.

EFFECT OF AGGREGATE ON PUMPABILITY

The important properties of coarse aggregates that affect pumpability are maximum size, shape and surface texture, and grading—the range of particle sizes present. If the porosity of the aggregate is exceptionally high, water absorption can also affect pumpability.

Maximum size of the coarse aggregate is considered when choosing line diameter. In a report entitled "Placing Concrete by Pumping

Methods" the American Concrete Institute (ACI) makes the following recommendations:

- The maximum size of angular coarse aggregate such as crushed stone should be limited to one-third of the smallest inside diameter of the hose or pipe.
- For well-rounded aggregate such as river run gravels the maximum size should be limited to 40 percent of the pipe or hose diameter.

Using these guidelines, a 4-inch-diameter line would be adequate for crushed stone concretes with up to 1-inch maximum size aggregate and gravel concretes with up to 1½-inch maximum size aggregate. Experienced pumpers have sometimes found that they get better results if maximum size for angular coarse aggregate doesn't exceed ¼ of the pipe diameter and maximum size for rounded coarse aggregate doesn't exceed ⅓ of the pipe diameter.

Shape and surface texture of coarse aggregate have an effect on mix proportions although concretes with angular or rounded and rough or smooth particles can be pumped satisfactorily. Concretes made with angular, rough particles usually have to have a higher sand content to be pumpable.

Grading of coarse aggregate used in concrete to be pumped can be the same as for concrete to be placed by other methods. Coarse aggregate grading requirements published by the American Society for Testing and Materials (ASTM) are shown in Table 2-1. With regard to pumping, grading of the combined coarse and fine aggregate is more important than grading of the coarse aggregate by itself.

Porosity of the coarse aggregate can affect pumpability if a significant amount of mix water is absorbed by the aggregate during

pumping. When absorption causes problems, one solution is to thoroughly wet down the aggregate stockpiles before batching the concrete.

TABLE 2-1. GRADING REQUIREMENTS FOR COARSE AGGREGATES (ASTM C 33)

	Size No. 467 1½ in. to No. 4	Size No. 57 1 in. to No. 4	Size No. 67 ¾ in. to No. 4	Size No. 7 ½ in. to No. 4
SIEVE SIZE	PERCENT PASSING			
2-in.	100	100	100	100
1½-in.	95 to 100	100	100	100
1-in.	—	95 to 100	100	100
¾-in.	35 to 70	—	90 to 100	100
½-in.	—	25 to 60	—	90 to 100
⅜-in.	10 to 30	—	20 to 55	40 to 70
No. 4	0 to 5	0 to 10	0 to 10	0 to 15
No. 8	—	0 to 5	0 to 5	0 to 5

Fine aggregate properties have a greater effect on pumpability than do coarse aggregate properties. Grading is most critical and of particular importance is the portion of the fine aggregate that passes a No. 50 sieve. Fine aggregate grading requirements given in ASTM C 33, Standard Specifications for Concrete Aggregates, are shown in Table 2-2. Tighter limits may be necessary when concrete is to be placed by pumping; ACI Committee 304 recommends that 15 to 30 percent of the sand pass the No. 50 sieve and that 5 to 10 percent pass the No. 100 sieve. Low-cement-content concretes made with coarser sands bleed more and are harder to pump. Adding more sand to these mixes won't help pumpability.

If available sands are deficient in the finer sizes they can be blended with selected finer sands or an admixture such as fly ash or stone dust can be added to make up the deficiency in fines.

TABLE 2-2. GRADING REQUIREMENTS FOR FINE AGGREGATES (ASTM C 33)

SIEVE SIZE	PERCENT PASSING
3/8-in.	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

Too many fines can also cause problems. Finer materials have more surface area that has to be coated with the cement-water paste. So if there is too much fine sand or stone dust in a mix, more water will be needed to get the required slump. This extra water has several harmful effects:

- It reduces strength.
- It increases shrinkage.
- It makes concrete less watertight.
- It may cause dusting of floors.

As mentioned earlier, mixes with too much fine material may also develop excessive friction in the pipeline. For this reason, high strength concretes that have high cement contents may pump better when coarser sands are used.

LIGHTWEIGHT AGGREGATE CONCRETES FOR PUMPING

Lightweight aggregate concretes are frequently pumped. The lightweight aggregates usually absorb considerably more water than

hardrock (normal weight) aggregates and under pressure in a pumpline this absorption is even greater. When line pressure forces mixing water into the aggregate pores, the resulting slump loss makes concrete pumping more difficult and sometimes impossible.

NOTE: *Pumped lightweight aggregate concretes generally require the use of lower line pressures than are used for hardrock concretes. This minimizes slump loss. When bidding lightweight concrete pumping jobs, the contractor should remember that he usually won't be able to achieve as high a pumping rate in cubic yards per hour as he could with hardrock concrete.*

Presoaking of the aggregate by sprinkling stockpiles for several days prior to batching will help to minimize absorption problems. A 48-hour minimum soaking period is recommended and longer periods are desirable. The stockpiles should be turned over frequently, using an end-loader, to make sure that wetting is uniform. To compensate for slump loss caused by absorption, it is usually also necessary to increase the slump of the concrete going into the pump.

Two very effective methods for presoaking aggregates are sometimes used at lightweight aggregate production plants. One uses a vacuum tank in which aggregate voids are filled with water. The other uses immersion of heated aggregate in water during the production process to fill the voids. Aggregates treated by either process reportedly respond to pumping in much the same way as normal-weight aggregates. Aggregates treated by either of these methods cost more than dry aggregates but are less likely to cause pumping problems. During cold weather, when sprinkling stockpiles may cause them to freeze, use of vacuum or thermally saturated aggregates is particularly advantageous.

On lightweight pumping jobs, a maximum permissible unit weight

may be specified. Before the job starts, the point at which unit weight tests will be run should be established. Water absorbed by the aggregates during pumping can increase the unit weight by as much as 2 pounds per cubic foot. Tests run at the pump hopper might indicate a unit weight of 115 pcf while tests at the end of the line could yield a unit weight of 117 pcf. To avoid disputes about compliance with specifications, the concrete producer needs to know in advance where the tests will be made.

ADMIXTURES FOR PUMPED CONCRETE

Admixtures are commonly used in most concrete, regardless of how the concrete is to be placed. However, many of the admixtures will affect pumpability as described below.

Air-entraining admixtures incorporate a large number of very small bubbles in the concrete. The main reason for putting entrained air in the mix is to improve resistance to deterioration caused by freezing and thawing. However, the air also increases pumpability because of improved plasticity, less bleeding and less segregation. Especially with crushed aggregates, too little air increases line friction and makes start-ups after pumping delays more difficult. About 3 to 5 percent air by volume of the concrete is the best amount for pumping purposes. Too much air can decrease pumping efficiency by absorbing some of the pump stroke energy as the air compresses.

Water-reducing admixtures can be used to increase slump without adding water. Or they can be used to reduce the amount of water needed to get a desired slump. High-range water reducers or superplasticizers can increase the slump of a concrete by as much as 6 inches without increasing the chance that segregation will occur. They have been used successfully on many pump jobs, especially for

high-rise construction. However, water reducers will not by themselves make an unpumpable concrete pumpable.

Fly ash is a fine material which can be added to concrete either as an admixture or as a partial cement replacement. The additional fines reduce the void content of the solid materials and make the mix more pumpable. Because of their smooth surface and rounded shape, fly ash particles also reduce bleeding and internal friction without increasing the water required to keep the slump constant. Fly ash may make concrete set more slowly; this can delay finishing and increase the time period during which vertical forms must withstand maximum form pressures.

Pumping aids are admixtures with the sole function of improving pumpability. They do this by making the water in the concrete thicker or more viscous. This makes the water less likely to be forced out of the concrete under pressure.

Accelerators are added to concrete to make it set and gain strength faster. If accelerators are used in pumped concrete, delays are a problem to be avoided because the concrete may lose slump faster or even set up in the lines. Accelerators are **not** antifreeze agents. If pumping lines are exposed to freezing temperatures, the concrete will freeze regardless of whether an accelerator has been added to it. Calcium chloride is the most commonly used and the least expensive accelerator. However, many specifications prohibit the use of calcium chloride in concrete because it increases the chance that reinforcing steel will corrode.

Retarders make concrete set more slowly. They may help the pumping operation under hot weather conditions, when very long pipelines are used or when the placing rate is very slow.

MIX DESIGNS FOR PUMPABLE CONCRETE

Selection of concrete mix proportions is not usually the contractor's responsibility. There are several good sources of information for those interested in learning more about mix design and these are listed at the end of the chapter. There are also computer programs and portable hand-held computers available for use in selecting proportions for concrete that is to be pumped. Regardless of the mix design method used, trial mixes of concrete intended for pumping should first be prepared and tested in a laboratory. Tests and observations will indicate whether the slump, cohesiveness, finishability and strength are acceptable.

Even if it looks good in the laboratory, pumpability of the proposed mix for more complex projects should preferably be verified with a full-scale pumping test under field conditions. There's no worse place to find out that a mix won't pump than on a jobsite with fifteen laborers and finishers standing around waiting for the concrete.

Testing a concrete mix for pumpability involves duplicating anticipated job conditions. The batching and truck mixing should be the same, the same pump and operator should be present and the pumpline layout should be similar to ones that will be used on the actual job. Making the effort to do this is worth the time and money. A job-proved mix prevents a lot of headaches and problems, especially on the first few pours for a project.

EFFECT OF CHANGES IN MIX PROPORTIONS

Uniform concrete from batch to batch is essential to a smooth-running pump operation. If concrete properties change frequently during a pour the pumping characteristics are also likely to

change. The pump operator must recognize changes in the mix that could affect pumpability. The following general observations about pump mixes may help the pump operator to make judgments about the effect of mix changes on pumpability.

- Enough mortar (sand plus cement plus water) is needed in the concrete to ensure good pumpability. If pumping has been progressing satisfactorily on a job and the mix changes to a rocky or harsh appearance, pumping problems may develop.
- A sufficient amount of fines (cement, fly ash, fine sand or stone dust) is needed to ensure good pumpability. Increased bleeding is one good indicator that there aren't enough fines in the concrete. Mixes that are already starting to bleed in the pump hopper aren't likely to pump well.
- A high enough slump is needed to ensure good pumpability. If the mix doesn't have enough water in it and is too stiff it may not feed properly into the pumping cylinder and will not be as pumpable. Adding water at the jobsite is usually permitted but care should be taken not to add too much. Water should be added in increments of one gallon per cubic yard until the correct slump is reached. The concrete must be thoroughly mixed after water is added.
- If the slump is too high, concrete pumpability may decrease. Although some concretes containing superplasticizers may pump well at slumps as high as 8 or 9 inches, concretes without admixtures at slumps greater than 6 inches are very likely to segregate in the pumpline and create rock jams.
- On lightweight pumping jobs, if the slump hasn't changed at the hopper but the labor foreman starts calling for more water,

absorption of water is probably the problem. Check with the plant to see if they're using aggregate from a dry part of the stockpile. Periodic unit weight checks on the coarse aggregate by the concrete producer can help him to detect changes in aggregate moisture content. He can then make needed adjustments in mix proportions.

One of the operator's best tools for evaluating the concrete is his pump. The pump gauges and even the sound of the pump will indicate variations in pressure required to move each batch. Changes in material composition, aggregate gradings and mixing efficiency can all cause the variations; erratic changes in line pressure for a pump in good repair indicate quality control problems with the concrete.

EFFECT OF WEATHER EXTREMES

Hot and cold weather concreting using pumps presents some special problems. In hot weather, concrete sets faster. If delays are anticipated, slow or intermittent pumping is necessary even if it means wasting some concrete. A little wasted concrete is much preferable to risking a blockage that requires disassembling and cleaning to free the line. It's also very important to have tight joints in the pumpline so that no grout leaks out. Under extremely hot conditions it may be necessary to wrap the lines in wet burlap so that they are cooled by evaporation.

In cold weather the main danger is freezing of the concrete in exposed lines. Often this can be avoided by running the vertical line and as much of the horizontal line as possible inside the heated enclosure where concrete is being placed. Line exposed to the cold can be wrapped with insulation to retain heat and reduce the effect of wind chill. Remember that accelerators won't prevent concrete from freezing in the lines.

DON'T SAVE PENNIES AND LOSE DOLLARS

Although some concretes are harder to pump than others, the difficulty can often be traced to a correctable cause and taken care of early in the job.

- If the aggregate size is too big for the line size used, changing to a larger diameter line, perhaps from 4-inch to 5-inch line, may solve the problem.
- If there aren't enough fines in the concrete, adding cement or fly ash may help.
- If the mix is bleeding too much and jams in the line because of this, a different sand, more cement, entrained air or fly ash may cut down on the bleeding and eliminate the blockage problem.
- If the mix is being pumped at too high a slump, changes can be made at the batch plant or water additions at the jobsite can be stopped.

The important thing to do is identify the problem and then act. More cement may increase the cost of the concrete and a larger diameter pipe may increase the cost of the line system. But a few dollars spent in advance to accommodate pumped concrete requirements will often deliver consistent savings in manpower and equipment costs throughout the life of the project.

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MILLENIUM SERIES 3

PARTS LIST

MODELS
15 40/50/70/90

ALWAYS SPECIFY MODEL, DATE OF MANUFACTURE, & PRODUCT I D No WHEN ORDERING PARTS

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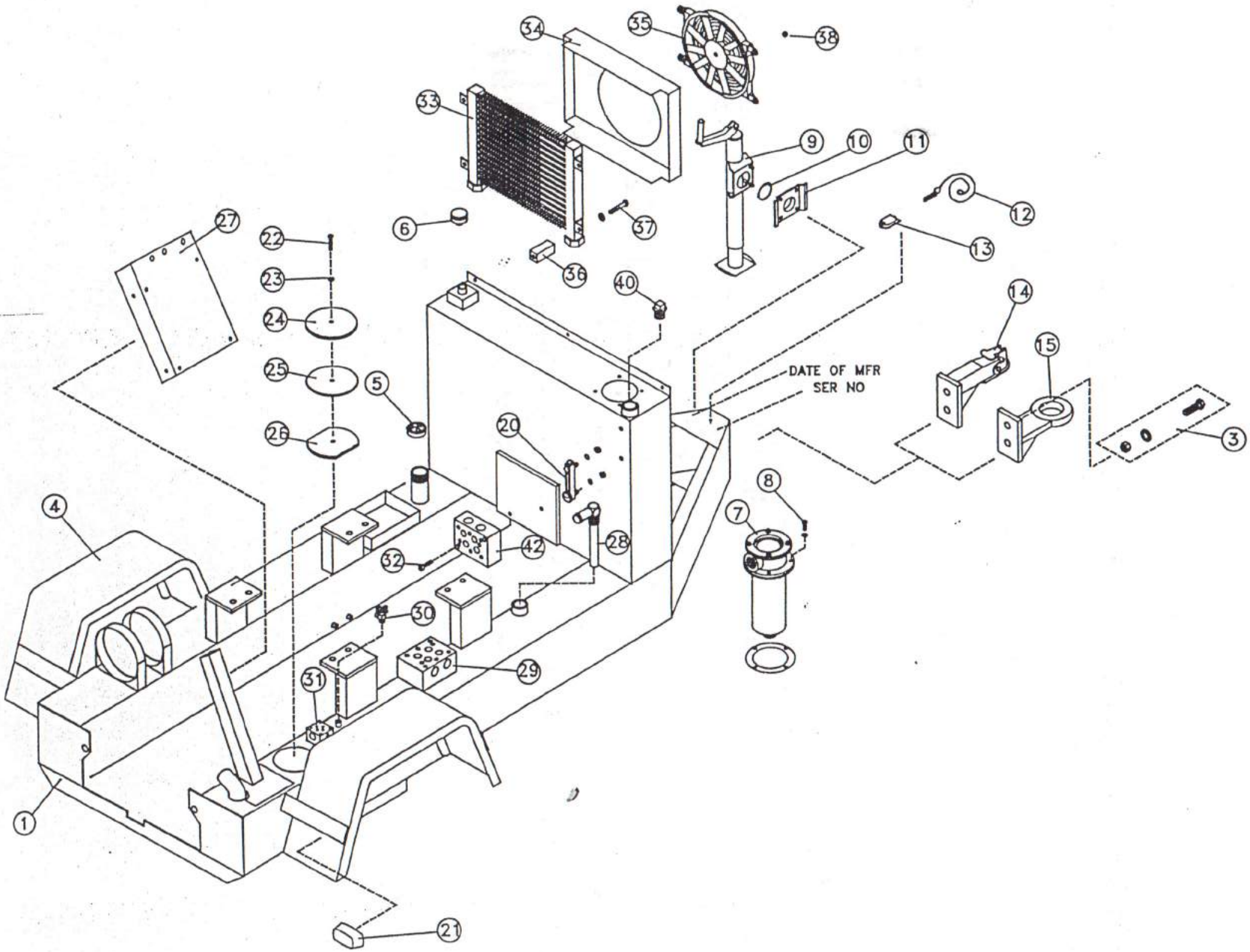
GROUT – SHOTCRETE – CONCRETE – PRESSURE GROUTING AND SPECIAL APPLICATION PUMPS


DATE OF MFR
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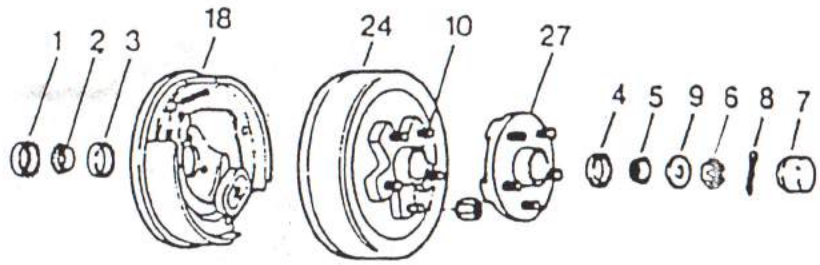
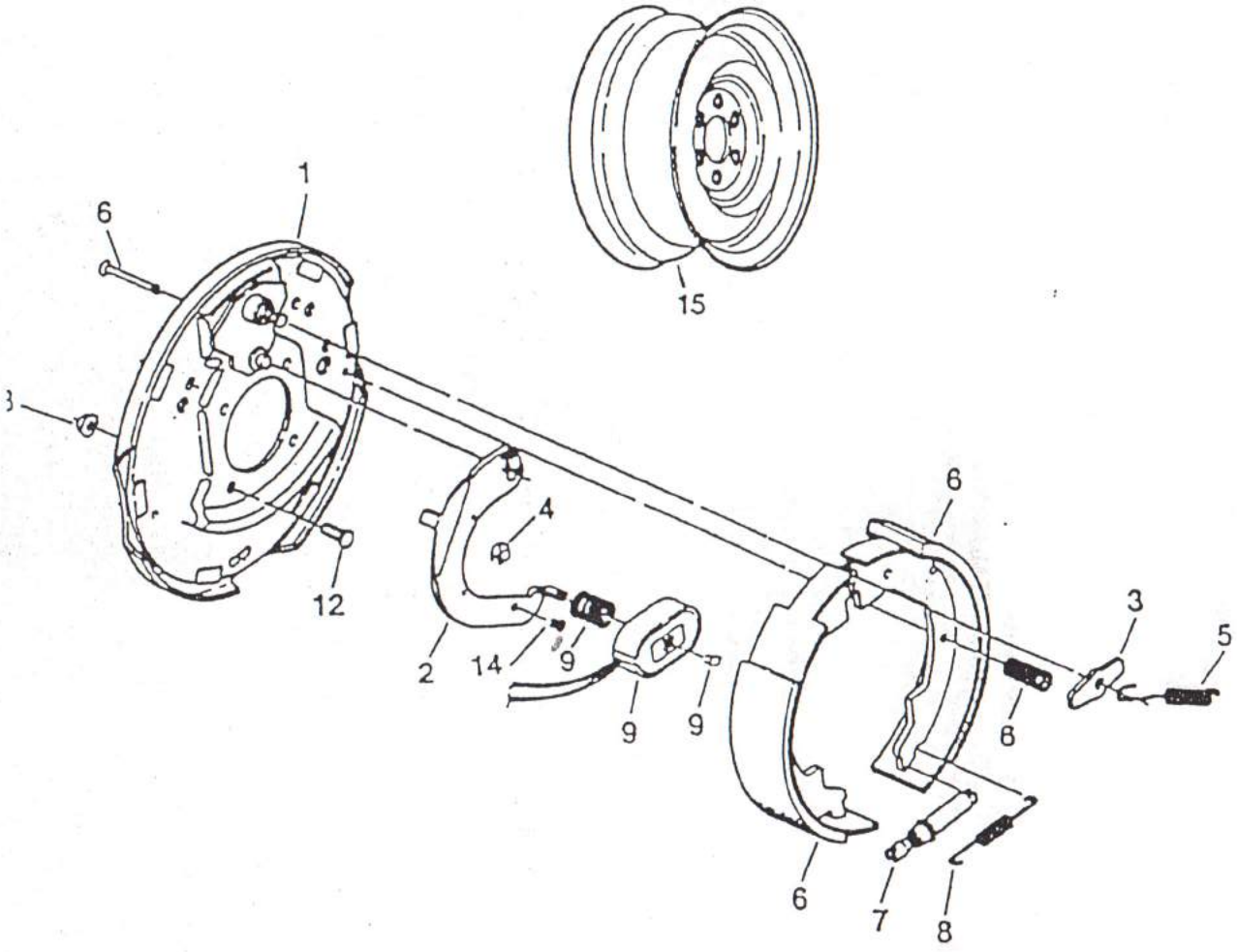
PARTS LIST: MODELS 15 30/15 40/15 50/15 70

GROUP 1

ITEM #	PART #	DESCRIPTION	# REQ	FOR MODEL (S)
1	02012	FRAME	1	15 30/15 40/15 50
	02013	FRAME	1	15 70
3	02285	HITCH BOLT & NUT	2	ALL MODELS
4	02060	FENDER (NON OPERATORS SIDE)	1	15 30/15 40/15 50
	02060-0	FENDER (OPERATORS SIDE)	1	15 30/15 40/15 50
	02061	FENDER (NON OPERATORS SIDE)	1	15 70
	02061-0	FENDER (OPERATORS SIDE)	1	15 70
5	02081	FUEL CAP	1	ALL MODELS
6	02100	OIL PRESSURE BREATHER	1	ALL MODELS
7	02120	HYDRAULIC OIL FILTER ASSEMBLY	1	ALL MODELS
	02140	HYDRAULIC OIL FILTER ELEMENT	1	ALL MODELS
	02160	BOLT & WASHER	4	ALL MODELS
9	02180	JACK STAND	1	ALL MODELS
10	02200	SNAP RING	1	ALL MODELS
11	02220	STAND BRACKET	1	ALL MODELS
12	02240	BREAKAWAY CABLE	1	ALL MODELS
13	02260	BREAKAWAY SWITCH	1	ALL MODELS
14	02280	COUPLER, 2" BALL TYPE	1	AS REQUIRED
	02281	COUPLER, 2 5/16" BALL TYPE	1	AS REQUIRED
15	02300	COUPLER, PINTLE TYPE	1	AS REQUIRED
20	02320	LEVEL/TEMP GAUGE	1	ALL MODELS
21	02340	LIGHT ASSEMBLY	2	ALL MODELS
22	02455	BOLT	1	ALL MODELS
23	02456	SEALING WASHER	1	ALL MODELS
24	02457	TOP PLATE	1	ALL MODELS
25	02458	GASKET	1	ALL MODELS
26	02459	BOTTOM PLATE	1	ALL MODELS
	02460	MAGNET	1	ALL MODELS
27	02449	CONTROL PANEL MOUNTING BRACKET	1	ALL MODELS
30	10420	BLEED VALVE	1	ALL MODELS
32	10020	BOLT & WASHER	2	ALL MODELS
33	10600	OIL COOLER & FAN HOUSING	1	ALL MODELS
35	10610	FAN	1	ALL MODELS
36	10612	SPACER	4	ALL MODELS
37	10613	BOLT & WASHER	4	ALL MODELS
38	10620	NUT, LOCKING	4	ALL MODELS
40	02465	OIL FILLER PLUG	1	ALL MODELS
42	10021	SUB PLATE	1	ALL MODELS
29	10024	SUB PLATE	1	ALL MODEL
28	02465	SUCTION ASSEMBLY	1	WHEN INSTALLED
	10022-2	SUB PLATE (REMIXER)	1	WHEN INSTALLED



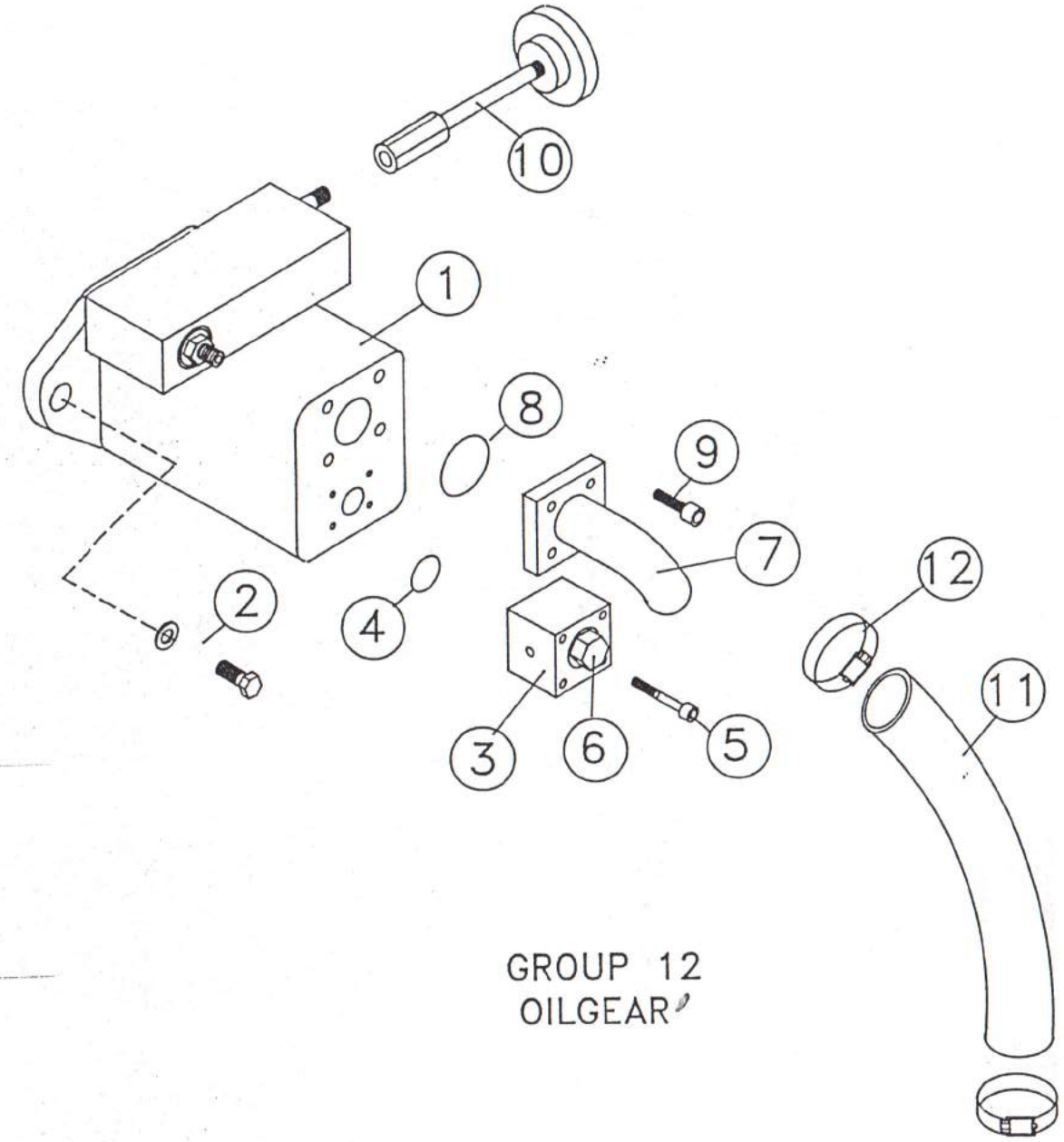


GROUP 05

PARTS LIST: MODELS 15 30/15 40/15 50/15 70

GROUP 05

ITEM #	PART #	DESCRIPTION	# REQ	FOR MODEL (S)
	05260	AXLE		ALL MODELS
1	05001-1	GREASE SEAL		ALL MODELS
2	05020	INNER BEARING CONE		ALL MODELS
3	05040	INNER BEARING CUP		ALL MODELS
4	05060	OUTER BEARING CUP		ALL MODELS
5	05080	OUTER BEARING CONE		ALL MODELS
6	05100	SPINDLE NUT		ALL MODELS
7	05120	GREASE CAP (Z-E LUB)		ALL MODELS
8	05140	COTTER PIN		ALL MODELS
9	05160	SPINDLE WASHER		ALL MODELS
10	05180	WHEEL STUD		ALL MODELS
24	05200	HUB & DRUM (WITHOUT BEARING, SEALS AND GREASE CAP)		ALL MODELS
30	05240	LUG NUT		ALL MODELS
		BRAKE GROUP		
18	05400	BACKING PLATE, COMPLETE WITH BRAKES (OPERATORS SIDE)		ALL MODELS
18	05420	BACKING PLATE, COMPLETE WITH BRAKES (NON OPERATORS SIDE)		ALL MODELS
2	05460	ACTUATING LEVER (OPERATORS SIDE)		ALL MODELS
2	05480	ACTUATING LEVER (NON OPERATORS SIDE)		ALL MODELS
3	05500	WASHER		ALL MODELS
4	05520	WIRE CLIP		ALL MODELS
5	05540	RETRACTOR SPRING		ALL MODELS
6	05560	BRAKE SHOE KIT		ALL MODELS
7	05580	ADJUSTER		ALL MODELS
8	05600	ADJUSTER SPRING		ALL MODELS
9	05620	MAGNET KIT (SPECIFY OPERATORS OR NON OPERATORS SIDE)		ALL MODELS
12	05640	BACKING PLATE MOUNTING BOLTS		ALL MODELS
13	05660	NUTS		ALL MODELS
14	05680	GROMMET		ALL MODELS
15	05800	WHEELS (WHITE) WITH TIRE		ALL MODELS
16	05803	WHEELS (CHROME) WITH TIRE		ALL MODELS

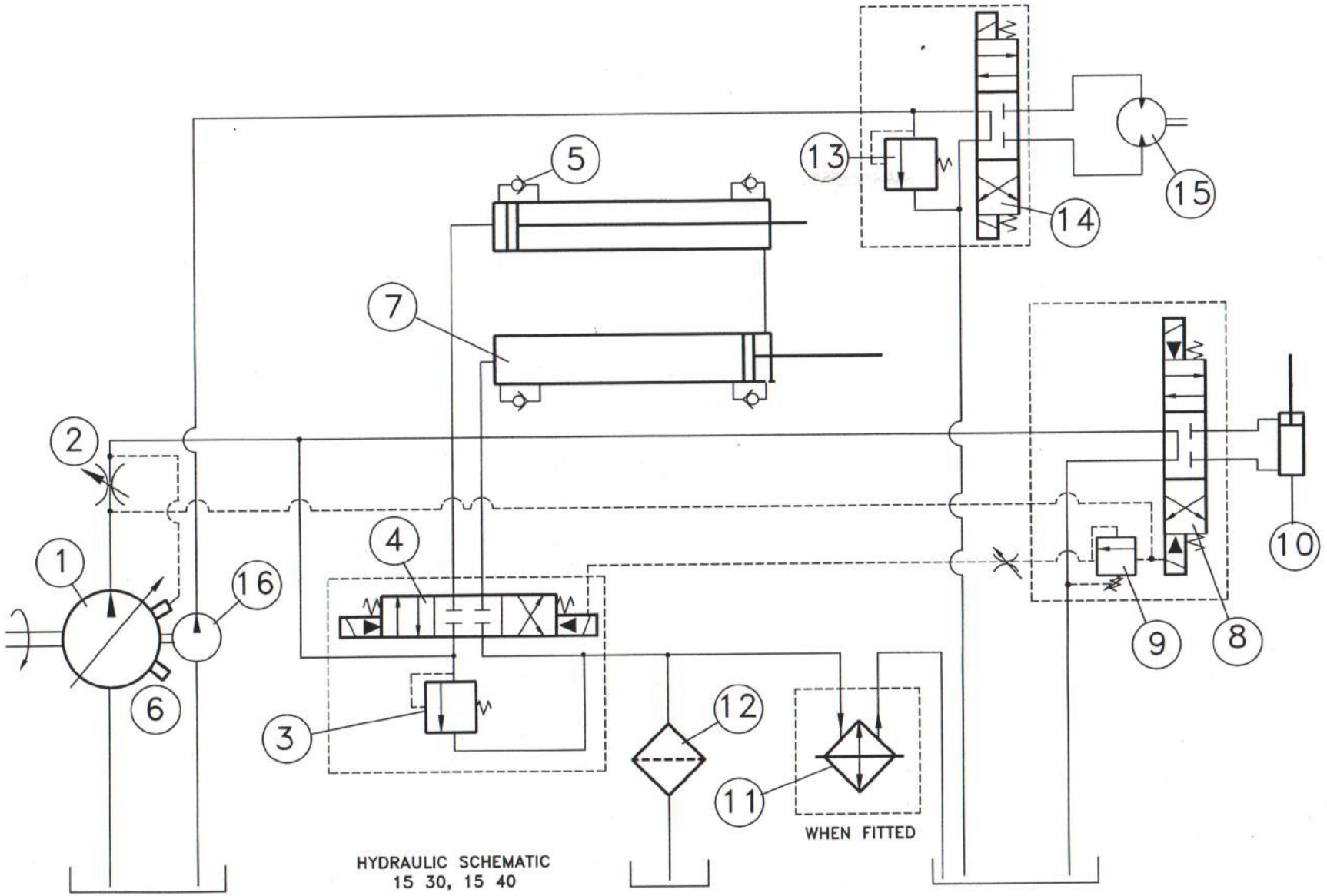


GROUP 12
OILGEAR

PARTS LIST: MODELS 15 30/15 40/15 50/15 70

GROUP 12

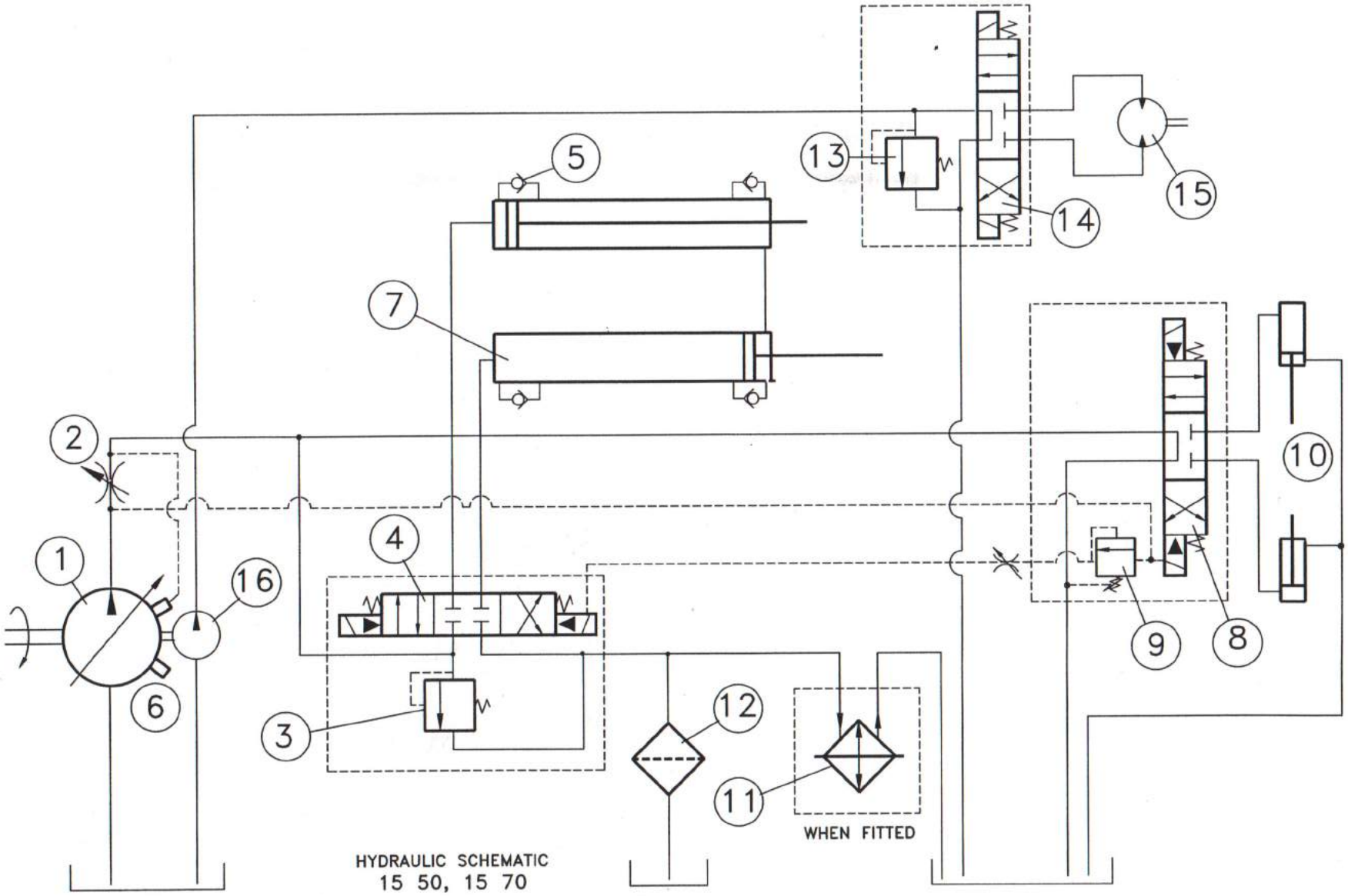
ITEM #	PART #	DESCRIPTION	# REQ	FOR MODEL (S)
1	12540	HYDRAULIC PUMP	1	15 30
	12541	HYDRAULIC PUMP	1	15 40/15 50
	12542	HYDRAULIC PUMP	1	15 70
	12502-2	BOLT & WASHER	2	ALL MODELS
3	12139	PRESSURE FLANGE	1	15 30
	12139	PRESSURE FLANGE	1	15 40/15 50/15 70
	12435-2	O' RING	1	15 30
	12435-7	O' RING	1	15 40/15 50/15 70
	12435-8	BOLT	4	ALL MODELS
			1	ALL MODELS
7	12042	SUCTION FLANGE ASSEMBLY	1	15 30/15 40/15 50
	12042	SUCTION FLANGE ASSEMBLY	1	15 70
8	12042-1	O' RING	1	15 30/15 40/15 50
	12044-1	O' RING	1	15 70
9	12042-2	BOLT	4	15 30/15 40/15 50
	12044-2	BOLT	4	15 70
10			1	ALL MODELS
	10030	OUTPUT CONTROL CARTRIDGE	1	ALL MODELS
11	12002	SUCTION HOSE	1	ALL MODELS
12	12020	CLAMP	2	ALL MODELS
	12200	PRESSURE GAUGE	1	ALL MODELS



HYDRAULIC SCHEMATIC
15 30, 15 40

PARTS LIST: MODELS 15 30/15 40/15 50/15 70 GROUP 13

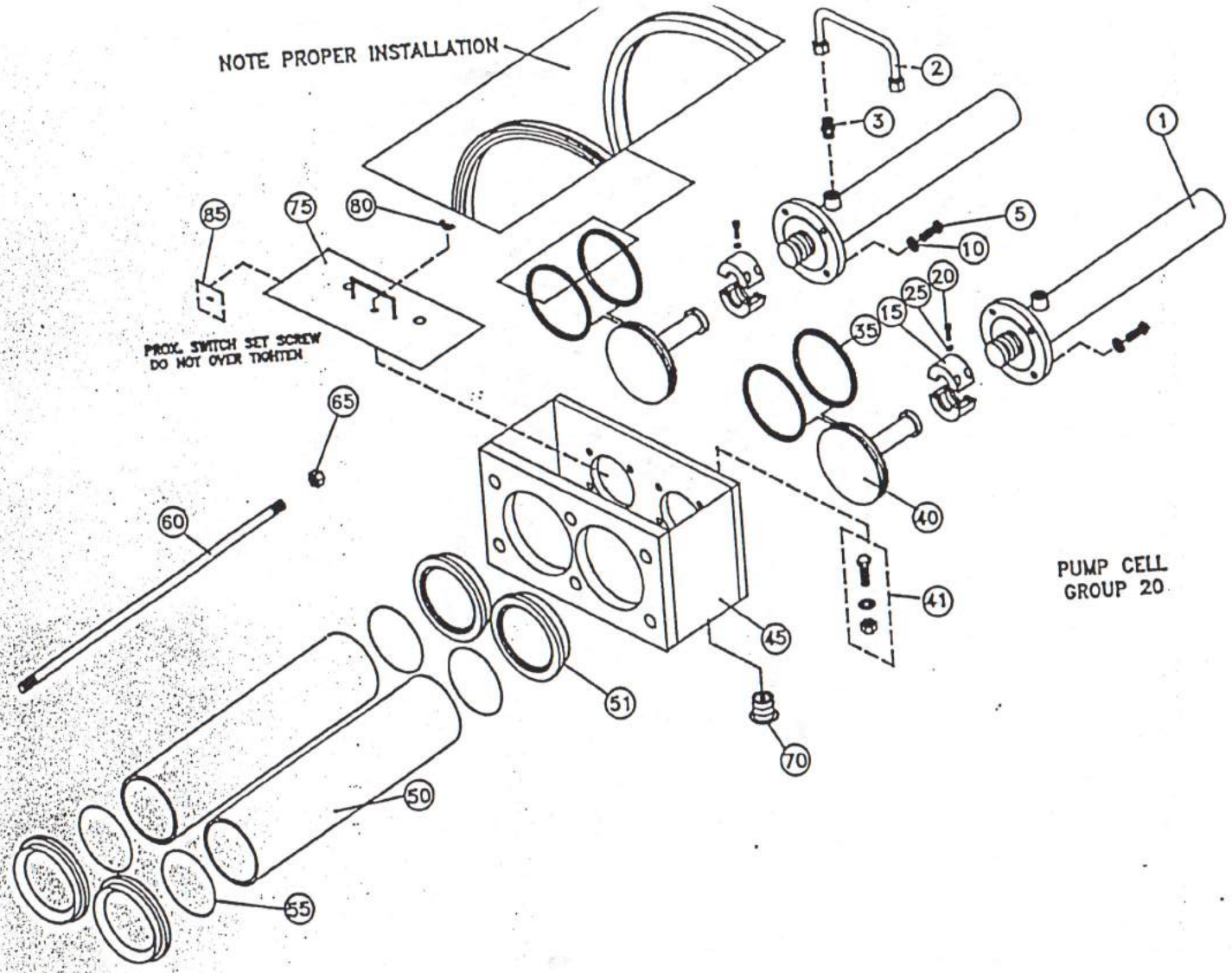
ITEM #	PART #	DESCRIPTION	# REQ	FOR MODEL (S)
3	12640	RELIEF VALVE	2	ALL MODELS
4	10002	4 WAY VALVE	1	ALL MODELS
5	10430	CHECK VALVE	4	ALL MODELS
6	10420	BLEED VALVE	1	ALL MODELS
7	20003	HYDRAULIC CYLINDER (2 ½" X 24")	2	15 30
	20005	HYDRAULIC CYLINDER (3 ½" X 24")	2	15 40/15 50
	20006	HYDRAULIC CYLINDER (3 ½" X 36")	2	15 70
8	10001	4 WAY VALVE	1	ALL MODELS
10	50160	SHUTTLE CYLINDER	1/2	ALL MODELS
	50165-1	CYLINDER SEAL KIT	1/2	ALL MODELS
	50161	PIN ASSEMBLY	2/4	ALL MODELS
13	12641	RELIEF CARTRIDGE (REMIXER)	1	WHEN INSTALLED
14	10009	4 WAY VALVE (REMIXER)	1	WHEN INSTALLED
15	61000	REMIXER MOTOR	1	WHEN INSTALLED
16	12516	GEAR PUMP (REMIXER)	1	WHEN INSTALLED 15 30/15 40
	12516L	GEAR PUMP (REMIXER)	1	WHEN INSTALLED 15 50/15 70
17	10430	CHECK VALVE	1	ALL MODELS
		HYDRAULIC CYLINDER REBUILD PARTS REQUIRED PER CYLINDER		
	2 1/" X 24"			
	20002A	PISTON REBUILD KIT	1	
	20002B	ROD BEARING REBUILD KIT	1	
	20002C	PISTON, WITHOUT SEAL KIT	1	
	20002D	ROD BEARING, WITHOUT SEAL KIT	1	
	20003E	CYLINDER ROD WITH ROD END	1	
	3 ½" X 24"			
	3 ½" X 36"			
	20005A	PISTON REBUILD KIT	1	
	20005B	ROD BEARING RE BUILD KIT	1	
	20005C	PISTON, WITHOUT SEAL KIT	1	
	20005D	ROD BEARING, WITHOUT SEAL KIT	1	
	3 ½ X 24" ONLY			
	20005E	CYLINDER ROD, WITHOUT ROD END	1	
	3 ½" X 36" ONLY			
	20006E	CYLINDER ROD, WITHOUT ROD END	1	



HYDRAULIC SCHEMATIC
15 50, 15 70

PARTS LIST: MODELS 15 30/15 40/15 50/15 70 GROUP 13

ITEM #	PART #	DESCRIPTION	# REQ	FOR MODEL (S)
3	12640	RELIEF VALVE	2	ALL MODELS
4	10002	4 WAY VALVE	1	ALL MODELS
5	10430	CHECK VALVE	4	ALL MODELS
6	10420	BLEED VALVE	1	ALL MODELS
7	20003	HYDRAULIC CYLINDER (2 ½" X 24")	2	15 30
	20005	HYDRAULIC CYLINDER (3 ½" X 24")	2	15 40/15 50
	20006	HYDRAULIC CYLINDER (3 ½" X 36")	2	15 70
8	10001	4 WAY VALVE	1	ALL MODELS
10	50160	SHUTTLE CYLINDER	1/2	ALL MODELS
	50165-1	CYLINDER SEAL KIT	1/2	ALL MODELS
	50161	PIN ASSEMBLY	2/4	ALL MODELS
13	12641	RELIEF CARTRIDGE (REMIXER)	1	WHEN INSTALLED
14	10009	4 WAY VALVE (REMIXER)	1	WHEN INSTALLED
15	61000	REMIXER MOTOR	1	WHEN INSTALLED
16	12516	GEAR PUMP (REMIXER)	1	WHEN INSTALLED 15 30/15 40
	12516L	GEAR PUMP (REMIXER)	1	WHEN INSTALLED 15 50/15 70
17	10430	CHECK VALVE	1	ALL MODELS
		HYDRAULIC CYLINDER REBUILD PARTS REQUIRED PER CYLINDER		
	2 1/" X 24"			
	20002A	PISTON REBUILD KIT	1	
	20002B	ROD BEARING REBUILD KIT	1	
	20002C	PISTON, WITHOUT SEAL KIT	1	
	20002D	ROD BEARING, WITHOUT SEAL KIT	1	
	20003E	CYLINDER ROD WITH ROD END	1	
	3 ½" X 24"			
	3 ½" X 36"			
	20005A	PISTON REBUILD KIT	1	
	20005B	ROD BEARING RE BUILD KIT	1	
	20005C	PISTON, WITHOUT SEAL KIT	1	
	20005D	ROD BEARING, WITHOUT SEAL KIT	1	
	3 ½ X 24" ONLY			
	20005E	CYLINDER ROD, WITHOUT ROD END	1	
	3 ½" X 36" ONLY			
	20006E	CYLINDER ROD, WITHOUT ROD END	1	

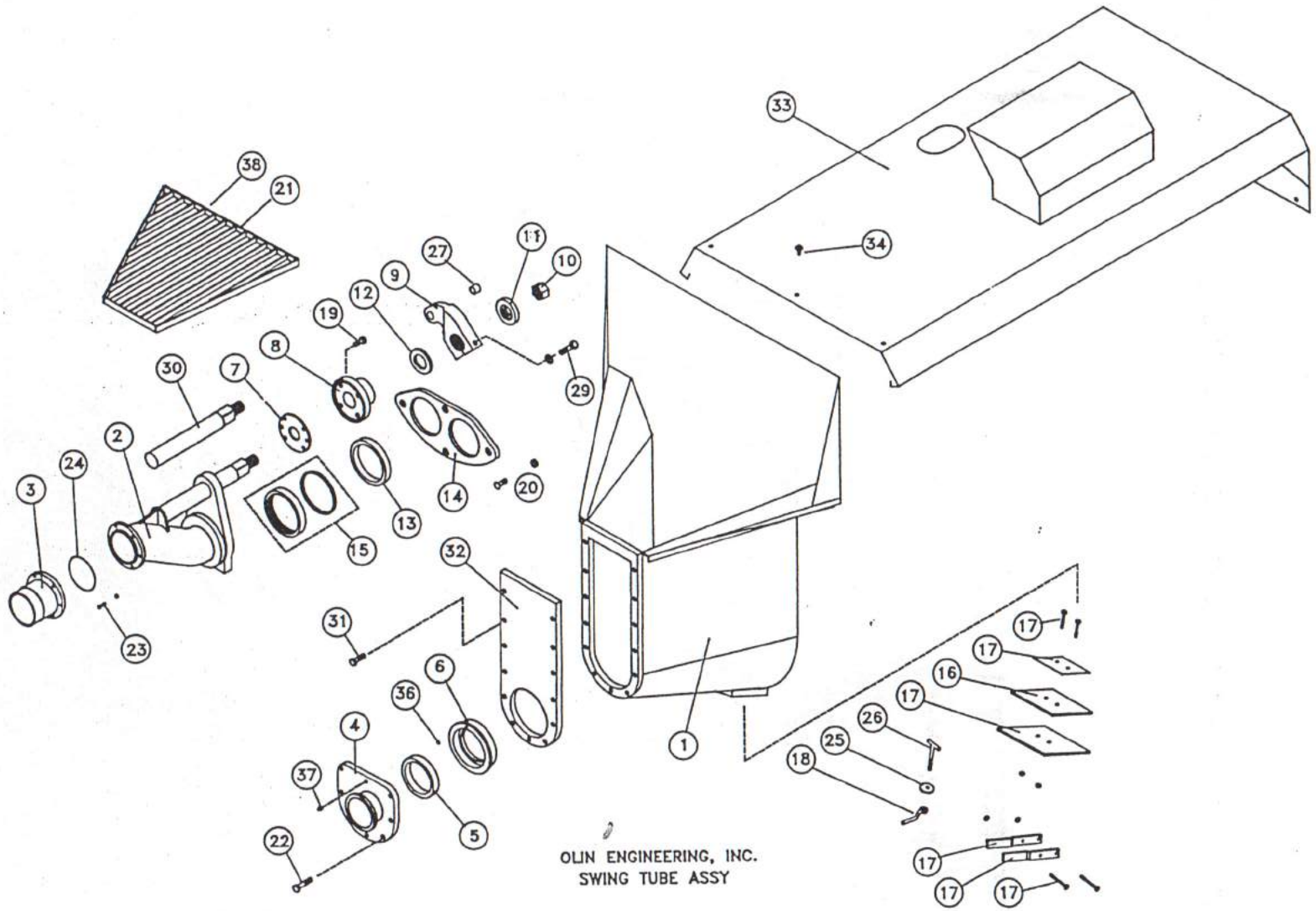


PUMP CELL
GROUP 20

PARTS LIST: MODELS 15 30/15 40/15 50/15 70

GROUP 14

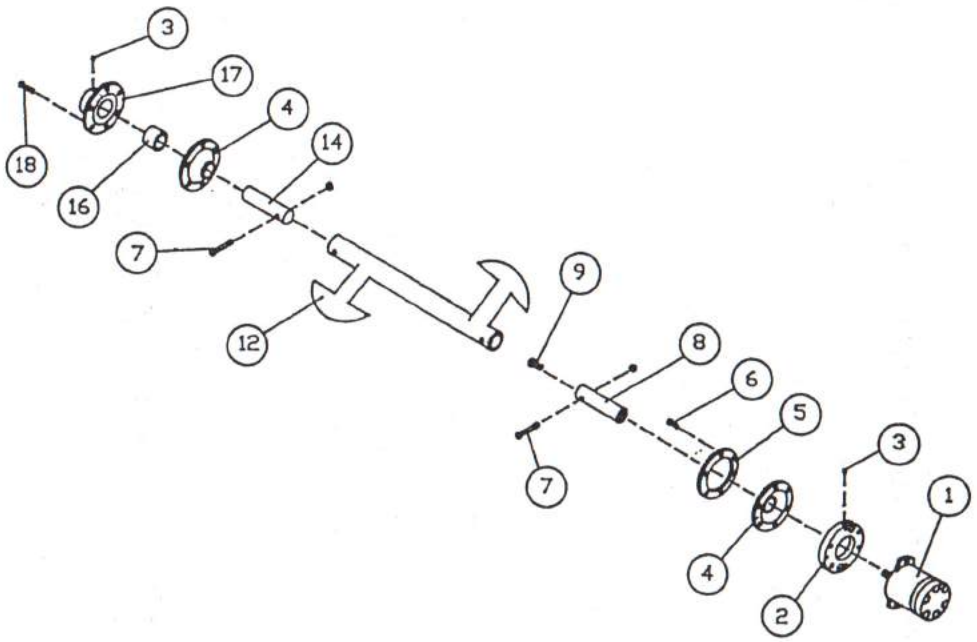
ITEM #	PART #	DESCRIPTION	# REQ	FOR MODEL (S)
2	10081	LOOP PIPE	1	ALL MODELS
3	73720	HYDRAULIC FITTING	2	ALL MODELS
5	20020	BOLT	16	ALL MODELS
10		NOT USED		
15	20060	CLAMP	2	ALL MODELS
20	20080	SOCKET HEAD CAP SCREW	8	ALL MODELS
25	20100	LOCK WASHER	8	ALL MODELS
35	20120	POLY PAK (5")	4	15 30
	20123	POLY PAK (6")	4	15 40/15 50
	20121	POLY PAK (7")	4	15 70
40	20140	PISTON (5") WITH COUPLER	2	15 30
	20123	PISTON (6") WITH COUPLER	2	15 40/15 50
	20141	PISTON (7")	2	15 70
41	20160	BOLT, WASHER & NUT	2	ALL MODELS
45	20181	WASH BOX WELDMENT	1	ALL MODELS
50	20201	MATERIAL CYLINDER (5" X 26")	2	15 30
	20206	MATERIAL CYLINDER (6"X 26")	2	15 40/15 50
	20202	MATERIAL CYLINDER (7" X 36")	2	15 70
51	20207-1	ADAPTOR (7" X 5" COMPLETE WITH O' RING)	2	15 30
	20208-1	ADAPTOR (7" X 6" COMPLETE WITH O' RING)	2	15 40/15 50
60	20241	TIE ROD	6	15 30/15 40/15 50
	20242	TIE ROD	6	15 70
65	20260	NUT	12	ALL MODELS
70	20280	DRAIN PLUG	1	ALL MODELS
75	20310	WASH BOX COVER	1	ALL MODELS
85	20370	SOCKET HEAD CAP SCREW	2	ALL MODELS
	74025	HYDRAULIC FITTING	2	15 30
	74030	HYDRAULIC FITTING	2	15 40/15 50/15 70
	20110	PISTON COUPLER	2	15 70
	20050	ROD END	2	15 40/15 50/15 70


OLIN ENGINEERING, INC.
SWING TUBE ASSY

PARTS LIST: MODELS 15 30/15 40/15 50/15 70

GROUP 15

ITEM #	PART #	DESCRIPTION	# REQ	FOR MODEL (S)
1	50001	HOPPER (STANDARD)	1	ALL MODELS
	50002	HOPPER (HARSH-MIX)	1	OPTIONAL ON ALL MODELS
2	50005C	SWING TUBE	1	15 30/15 40/15 50
	50006C	SWING TUBE	1	15 70
3	50010	OUTLET	1	ALL MODELS
4	50015	OUTLET FLANGE	1	ALL MODELS
5	50020	OUTLET SEAL	1	ALL MODELS
6	50025	OUTLET SEAL HOUSING	1	ALL MODELS
7	50027	SHAFT SEAL	1	ALL MODELS
8	50030	FLANGE BEARING	1	ALL MODELS
9	50035	CRANK ARM	1	15 30/15 40
	50035D	CRANK ARM	1	15 50/15 70
10	50040	CASTLE NUT	1	ALL MODELS
11	50045	SPACER WASHER	1	ALL MODELS
12	50050	THRUST WASHER	1	ALL MODELS
13	50058	CUTTING RING (OLINTUF)	1	15 30
	50059	CUTTING RING (OLINTUF)	1	15 40/15 50/15 70
14	50061	SPECTACLE PLATE 5" (OLINTUF)	1	15 30
	50062	SPECTACLE PLATE 6" (OLINTUF)	1	15 40
	50063	SPECTACLE PLATE 6 ½" (OLINTUF)	1	15 50/15 70
15	50065	THRUST RING COMPLETE WITH RETAINER	1	ALL MODELS
16	50070	CLEAN OUT DOOR GASKET	1	ALL MODELS
17	50075	CLEAN OUT DOOR ASSEMBLY	1	ALL MODELS
	50132	LATCH BOLT (3 1/8")	1	ALL MODELS
18	50131	EASY GRIP HANDLE	1	ALL MODELS
19	50090	SOCKET HEAD BOLT	4	ALL MODELS
20	50100	SOCKET HEAD BOLT	4	ALL MODELS
21	50105	SCREEN, STANDARD HOPPER FOR 1 ½" MATERIAL	1	AS REQUIRED
	50106	SCREEN, STANDARD HOPPER FOR ½" MATERIAL		AS REQUIRED
38	50107	SCREEN, HARSH-MIX HOPPER FOR 1 ½" MATERIAL		AS REQUIRED
	50108	SCREEN, HARSH-MIX HOPPER FOR ½" MATERIAL		AS REQUIRED
22	50110	BOLT	8	ALL MODELS
23	50115	BOLT	6	ALL MODELS
24	50120	O' RING, OUTLET	1	ALL MODELS
25	50125	WASHER	1	ALL MODELS
26	50130	LATCH BOLT (4 1/8")	1	ALL MODELS
29	50145	BOLT	1	ALL MODELS
31	50151	BOLT & WASHER	6	ALL MODELS
32	50152	REAR PLATE	1	ALL MODELS
33	40041	HOOD	1	15 30/15 40/ 15 50
	40040	AIR SCOOP	1	15 30/15 40
	40042	HOOD	1	15 70
36	50026	O' RING	1	ALL MODELS

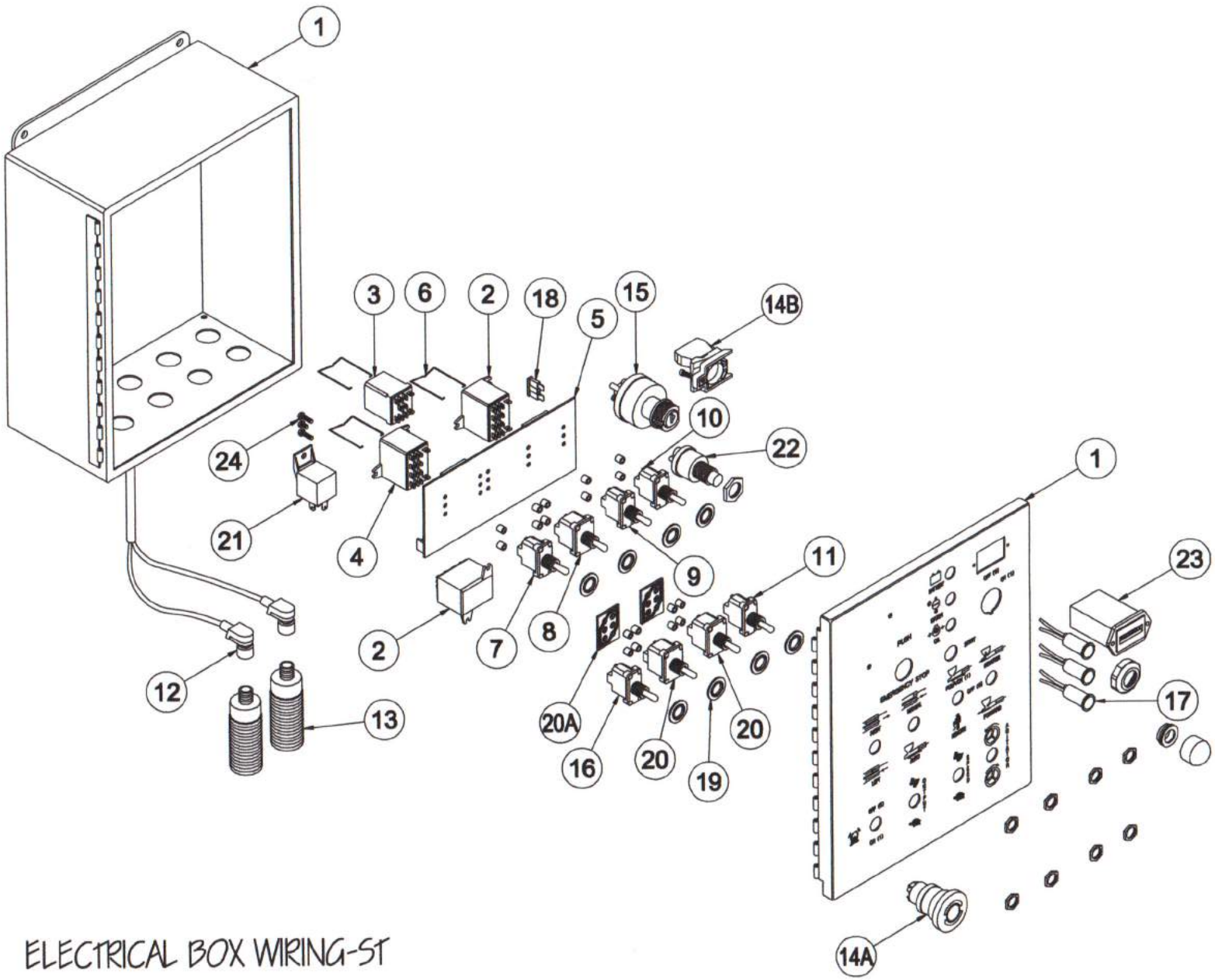


GROUP 61 STD S/T HOPPER

PARTS LIST: MODELS 15 30/15 40/15 50/15 70

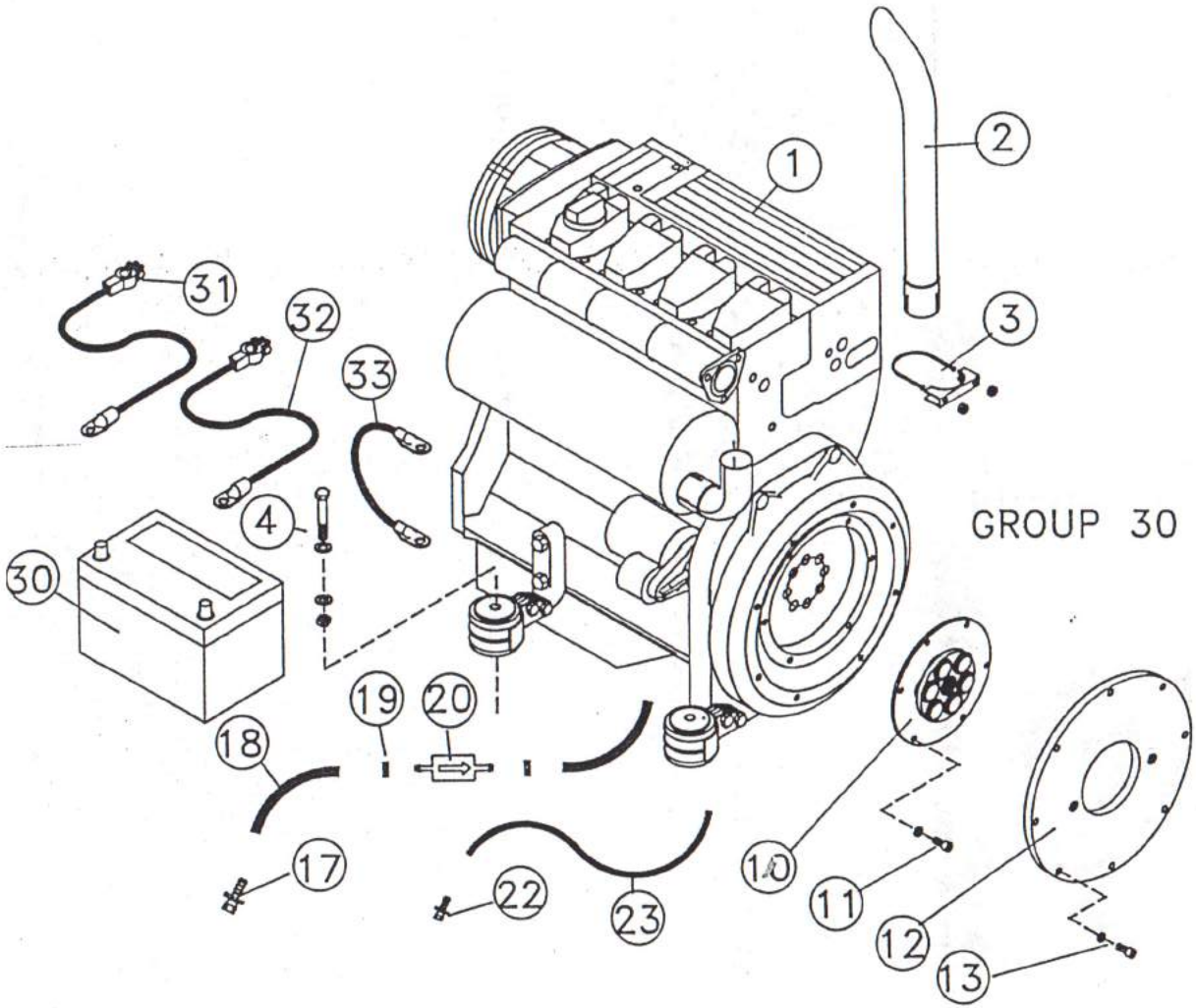
GROUP 61

ITEM #	PART #	DESCRIPTION	# REQ	FOR MODEL (S)
1	61000	REMIXER MOTOR	1	WHEN INSTALLED
	6100-1	REMIXER MOTOR SEAL KIT		AS REQUIRED
2	61005	MOUNTING PLATE	1	WHEN INSTALLED
3	61010	GREASE FITTING		AS REQUIRED
4	61015	GREASE BOOT COMPLETE WITH O' RING	2	WHEN INSTALLED
5	61202	RETAINER PLATE	1	WHEN INSTALLED
6	61025	BOLT & LOCK WASHER	6	WHEN INSTALLED
7	61030	SHEAR BOLT	1	WHEN INSTALLED
8	61035	DRIVE SHAFT	1	WHEN INSTALLED
9	61040	RETAINING BOLT	1	WHEN INSTALLED
12	61044	REMIXER, STANDARD HOPPER	1	WHEN INSTALLED
	61045	REMIXER, HARSH-MIX HOPPER	1	WHEN INSTALLED
14	61050	IDLE SHAFT	1	WHEN INSTALLED
16	61055	BRASS BUSHING	1	WHEN INSTALLED
17	61060	BUSHING HOUSING	1	WHEN INSTALLED
18	61065	BOLT & LOCK WASHER	1	WHEN INSTALLED



ELECTRICAL BOX WIRING-ST

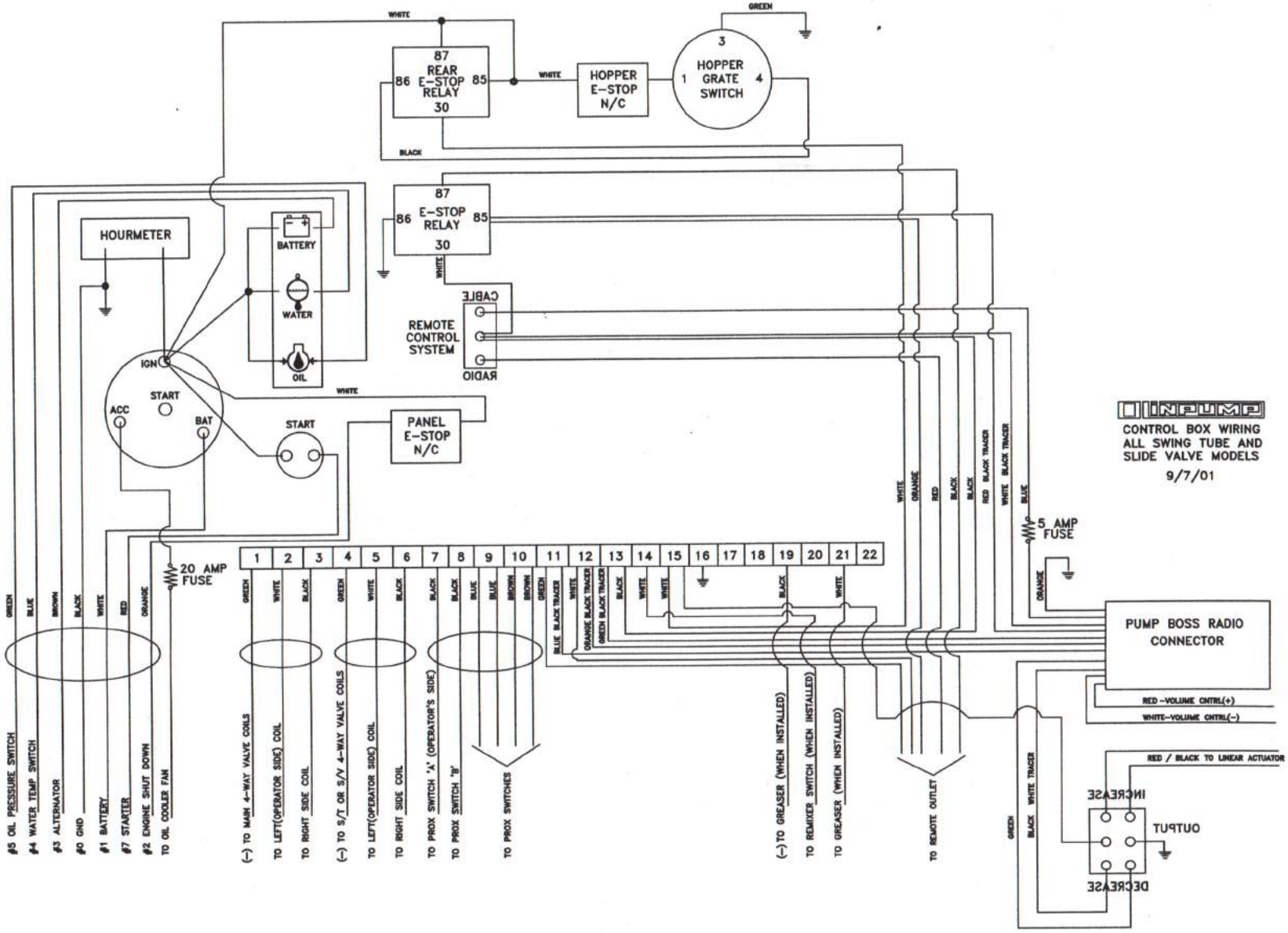
ITEM #	PART #	DESCRIPTION	# REQ	FOR MODEL (S)
1	15001	CONTROL BOX ONLY	1	ALL
1	15003	CONTROL BOX COMPLETE	1	ALL
2	15041	RELAY RH4	3	ALL
3	15045	RELAY RH2L CYCLING	1	ALL
4	15040	RELAY RH2 REMOTE EARLY	1	ALL EARLY
5	15037	CIRCUIT BOARD	1	ALL
6	15046	CLIP, RELAY	3	ALL
7	15020	SWITCH, STROKE	1	ALL
8	15025	SWITCH, AUTO/MANUAL	1	ALL
9	15030	SWITCH, PANEL/OFF/REMOTE	1	ALL
10	15032	SWITCH, FORWARD/REVERSE	1	ALL
11	15031	SWITCH, REMIXER	1	ALL
12	15101	CABLE, PROXIMITY SWITCH	2	ALL
12	15100	SWITCH, PROXIMITY	2	ALL
14	15395	E-STOP SWITCH COMPLETE	1	ALL
14A	15396	CONTACT, E-STOP	1	ALL
14B	15397	BUTTON, E-STOP	1	ALL
15	15005	SWITCH, KEY	1	ALL
16	15032	SWITCH, VIBRATOR	1	ALL
17	15010	LIGHT, RED	1	ALL
	15011	LIGHT, GREEN	1	ALL
	15012	LIGHT, BLUE	1	ALL
18	15039	FUSE, 20A, PLUG IN	1	ALL
19	15007	WASHER, SEALING	1/SWITCH	ALL
20	15262	SWITCH, OUTPUT	1	ALL
20	15262	SWITCH, OUTPUT	1	ALL
20A	15263	CIRCUIT BOARD, SWITCH	1/SWITCH	ALL
21	15398	RELAY, E-STOP	1	ALL
22	15006	SWITCH, PUSH BUTTON	1	ALL
23	15016	HOURMETER	1	ALL
24	15402-1	SCREW, SWITCH, LONG		ALL
25	15402-2	SPACER, SWITCH SCREW		ALL
	15402	SCREW W/SPACER		ALL
	15400	BUSHING, CABLE, W/NUT (MEDIUM)		ALL
	15401	BUSHING, CABLE, W/NUT (LARGE)		ALL
	15403	PLUG, BLACK CLIP-IN (SMALL)		ALL
	15404	PLUG, BLACK CLIP-IN (MED)		ALL
	15405	PLUG, BLACK CLIP-IN (LARGE)		ALL
		0		



GROUP 30

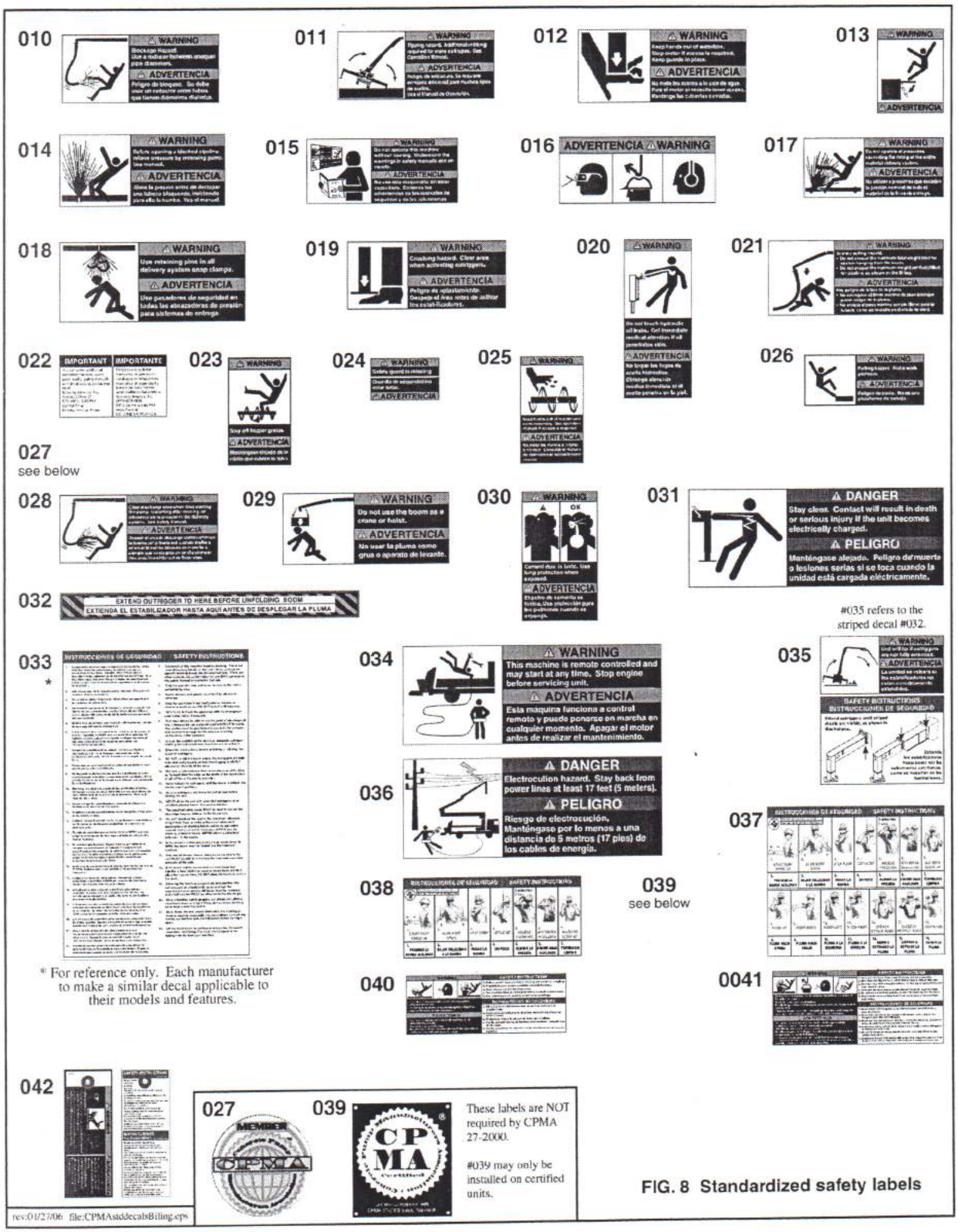
PARTS LIST: MODELS 15 30/15 40/15 50/15 70 GROUP 30

ITEM #	PART #	DESCRIPTION	# REQ	FOR MODEL (S)
	30261	ENGINE	1	15 30
	30261A	ENGINE, USED WHEN REMIXER IS INSTALLED		OPTIONAL
	30262	ENGINE	1	15 40
	30262A	ENGINE, USED WHEN REMIXER IS INSTALLED		OPTIONAL
	30263	ENGINE	1	15 50
	30263A	ENGINE, USED WHEN REMIXER IS INSTALLED		OPTIONAL
	30265	ENGINE	1	15 70
	30265A	ENGINE, USED WHEN REMIXER IS INSTALLED		OPTIONAL
	30060	MUFFLER ASSEMBLY	1	15 40
	30061	MUFFLER MOUNTING BRACKET	2	15 40
	30065	MUFFLER ASSEMBLY	1	15 50/15 70
	30068	MUFFLER MOUNTING BRACKET	2	15 50/15 70
	30066	HEAT SHIELD COMPLETE WITH MOUNTING BRACKETS	1	15 50/15 70
4	30100	BOLT & WASHER	4	ALL MODELS
	30191	THROTTLE CABLE	1	ALL MODELS
	30192	CABLE PIVOT	1	ALL MODELS
	30196	CABLE HUB KIT	1	ALL MODELS
	30193	THROTTLE ARM	1	ALL MODELS
	30198	LINEAR THROTTLE ACTUATOR	1	15 30/15 40
	30199	LINEAR THROTTLE ACTUATOR	1	15 50/15 70
	30198-1	THROTTLE ARM FOR LINEAR ACTUATOR	1	ALL MODELS
	30198-3	MOUNT FOR LINEAR ACTUATOR	1	15 50/15 70
	30250	PUMP MOUNT/DRIVE ASSEMBLY	1	15 30
	30219	PUMP MOUNT/DRIVE ASSEMBLY	1	15 40
	30230	PUMP MOUNT/DRIVE ASSEMBLY	1	15 50/15 70
11	30280	BOLT & WASHER	8	ALL MODELS
13	30340	BOLT & WASHER	8	ALL MODELS
	99505	FUEL FILTER ELEMENT	1	15 50/15 70
30	30671	BATTERY	1	ALL MODELS
31	30700	POSITIVE CABLE	1	ALL MODELS
32	30730	NEGATIVE CABLE	1	ALL MODELS
	30081	AIR CLEANER	1	15 50/15 70
	30081-1	AIR CLEANER ELEMENT	1	15 50/15 70
	30081-3	MOUNTING BAND	1	15 50/15 70
	30081-4	HUMP HOSE	1	15 50/15 70
	30081-5	CLAMP	1	15 50/15 70


WHITE
87
REAR
86 E-STOP RELAY 85
30
WHITE
HOPPER
E-STOP
N/C
GREEN
3
1 HOPPER GRATE SWITCH 4
BLACK
87
86 E-STOP RELAY 85
30
WHITE
HOURMETER
BATTERY
WATER
OIL
IGN
START
ACC
BAT
START
WHITE
PANEL
E-STOP
N/C
CABLE
REMOTE
CONTROL
SYSTEM
RADIO
INPUMP
CONTROL BOX WIRING
ALL SWING TUBE AND
SLIDE VALVE MODELS
9/7/01
5 AMP
FUSE
20 AMP
FUSE
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
PUMP BOSS RADIO
CONNECTOR
RED --VOLUME CNTRL(+)
WHITE--VOLUME CNTRL(-)
RED / BLACK TO LINEAR ACTUATOR
INCREASE
OUTPUT
DECREASE
#5 OIL PRESSURE SWITCH
#4 WATER TEMP SWITCH
#3 ALTERNATOR
#0 GND
#1 BATTERY
#7 STARTER
#2 ENGINE SHUT DOWN
TO OIL COOLER FAN
(-) TO MAIN 4-WAY VALVE COILS
TO LEFT(OPERATOR SIDE) COIL
TO RIGHT SIDE COIL
(-) TO S/T OR S/V 4-WAY VALVE COILS
TO LEFT(OPERATOR SIDE) COIL
TO RIGHT SIDE COIL
TO PROX SWITCH 'A' (OPERATOR'S SIDE)
TO PROX SWITCH "B"
TO PROX SWITCHES
(-) TO GREASER (WHEN INSTALLED)
TO REMIXER SWITCH (WHEN INSTALLED)
TO GREASER (WHEN INSTALLED)
TO REMOTE OUTLET

THE FOLLOWING PAGE CONTAINS A LIST OF THE STANDARDIZED SAFETY LABELS POSTED ON YOUR PUMP AT THE TIME OF MANUFACTURE OR REFURBISHMENT.

USE IT TO ORDER REPLACEMENTS FROM OLINPUMP OR YOUR OLIN DEALER.



#035 refers to the striped decal #032.

* For reference only. Each manufacturer to make a similar decal applicable to their models and features.

FIG. 8 Standardized safety labels

STABILITY CALCULATION
FOR
OLIN TRAILER MOUNTED PUMPS

BECAUSE WEIGHTS AND DIMENSIONS VARY BETWEEN DIFFERENT MODELS AND MODEL YEARS AND DUE TO AVAILABLE OPTIONS AND CUSTOMER MODIFICATIONS, THE FOLLOWING FORMULA WILL ALLOW YOU TO CALCULATE YOUR MACHINE'S CENTER OF GRAVITY. A TRUCK WHEEL SCALE OR FREIGHT SCALE AND A MEASURING DEVICE WILL BE NECESSARY.
THIS WORKS ON SINGLE OR TANDEM AXLE UNITS.

1. **WEIGH EACH TIRE OF EACH AXLE, ONE AT A TIME, TO FIND THE TOTAL WEIGHT ON EACH AXLE.**

2. **MEASURE FORWARD FROM THE CENTER OF EACH SPINDLE OF EACH AXLE TO THE FORWARDMOST POINT OF THE PUMP.**

3. **WEIGH THE JACK STAND ON THE TONGUE OF THE PUMP, AND MEASURE THE DISTANCE OF IT'S CENTER TO THE SAME POINT AT THE FRONT.**

4. **MULTIPLY THE WEIGHT OF EACH AXLE BY IT'S CORRESPONDING DISTANCE FROM THE POINT UP FRONT. WE'LL CALL THIS TOTAL M1 FOR A SINGLE OR REAR AXLE, AND M2 FOR THE SECOND AXLE IF EQUIPPED.**

5. **MULTIPLY THE JACK'S WEIGHT BY IT'S RELATIVE DISTANCE. WE'LL CALL THIS TOTAL M3.**

6. **ADD THESE 2 OR 3 TOTALS TOGETHER (M1+M2+M3), AND DIVIDE THAT TOTAL BY THE WEIGHT OF THE PUMP ITSELF(AXLE WEIGHT PLUS JACK WEIGHT). THE RESULTING NUMBER IS THE CENTER OF GRAVITY(MASS) IN WHATEVER UNIT OF MEASURE YOU USED, FROM THE POINT AT THE FRONT OF THE PUMP.**

EXAMPLE:
MODEL 5 45
WEIGHT ON AXLE=3930 LBS, DISTANCE=100"

WEIGHT ON JACKSTAND=230 LBS, DISTANCE=22"

M1=3930 X 100=393,000
M3=230 X 22=5,060
M1+M3=398,060

3930+230=4,160, TOTAL PUMP WEIGHT

398,060/4,160=95.7

THE CTR OF GRAVITY IS 95.7" BACK FROM THE POINT AT THE FRONT OF THE PUMP.