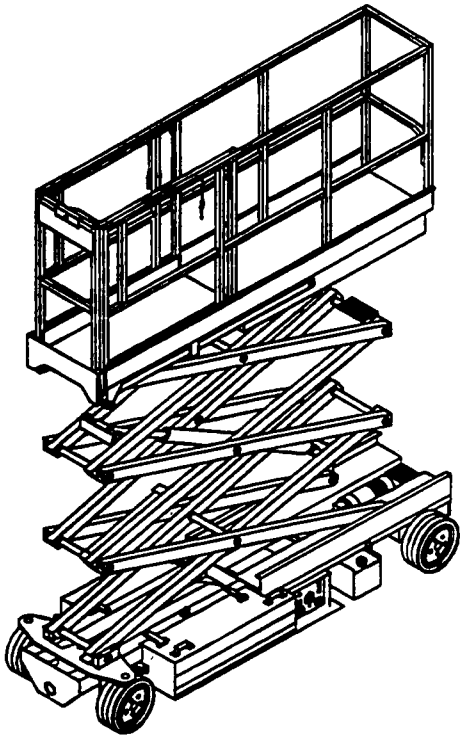
MARKLIFT

SCISSOR

SERVICE

MANUAL



17243

GENERAL INFORMATION

SECTION 2

DESCRIPTION	PAGE NO.
GENERAL SERVICE INFORMATION	2 - 1
RECEIVING A NEW MACHINE	2 - 2
MACHINE STORAGE	2 - 3
PREPARATION FOR COMPONENT OVERHAUL	2 - 5
WELDING INSTRUCTIONS	2 - 6
SPECIFICATIONS	2 - 7
TORQUE RATINGS, GENERAL	2 - 10
TORQUE CHART, QUICK REFERENCE	2 - 12
CAPSCREW OR BOLT REPLACEMENT	2 - 12
RECOMMENDED SPARE PARTS LIST	2 - 13
MAJOR COMPONENT IDENTIFICATION	2 - 16
ABBREVIATIONS	2 - 17

GENERAL INFORMATION

GENERAL SERVICE INFORMATION

Keep parts in order when large components are disassembled, particularly so when it has a great number of similar parts. Loosely reassemble assemblies whenever possible to prevent small parts from being lost. Keep sub-assembly parts together, but be careful not to get right and left hand parts mixed up.

When an assembly is removed to correct only one difficulty, it is good practice to recondition the whole assembly at that time to avoid repetition of work at a later date.

Bolts and nuts should be placed into their respective holes when removing guards, cases, etc. so that the proper bolts will be on hand for reassembling.

Safety should always be the first consideration when performing maintenance or service to equipment.

Always be conscious of a component's weight. Never attempt to move a heavy part without a proper lifting device. Ensure that adequate support is provided and that objects are set in a stable position.

Any hydraulic component disassembly or reassembly must be done in a clean, enclosed environment by personnel familiar with hydraulic systems and cleanliness procedures.

GENERAL INFORMATION

RECEIVING A NEW MACHINE

Before removing a new machine from the delivery vehicle:

1. Check and follow the Operation & Maintenance Manual for unloading procedure.
2. Check battery/batteries for cracks and for proper water level (if applicable).
3. Check for bent, broken or otherwise damaged functional components
4. Check for sufficient oil levels, both hydraulic and engine (if applicable).
5. Check for fluid leaks in hydraulic or fuel delivery systems.
6. Check lug nuts for looseness.

Upon receipt of a new machine the customer must:

1. Remove all packing materials and inspect for any damage incurred during transport.
2. Complete the NEW EQUIPMENT CONDITION REPORT
3. Complete the WARRANTY REGISTRATION.
4. If your machine is an export model, the export preservative must be removed.

EXPORT PRESERVATIVE REMOVAL

Before an export machine leaves the factory the exterior surfaces are given a coating designed to protect the paint from the environment encountered when shipping items overseas or for great distances. This coating can be removed using **warm soapy water.**

Do not use a steam cleaner to clean or wash this machine.

Do not spray water directly on **any** control panels or electrical compartments.

This preservative is applied to **export machines only.**

GENERAL INFORMATION

MACHINE STORAGE

Machines being placed in storage must be adequately protected from deterioration during the period of idleness. This will ensure that they can be restored to active service with a minimum effort.

Before removing this aerial lift from service for extended periods, it should be prepared for storage as prescribed in the following paragraphs. The specific procedure to be followed depends upon the expected period of storage.

SHORT TERM STORAGE - 30 DAYS OR LESS

Short term storage requires minimal preparation.

The **AERIAL LIFT** should be thoroughly cleaned, lubricated in accordance with Section 3, and painted surfaces retouched where the paint has deteriorated. Exposed portions of all hydraulic cylinders should be coated with multipurpose grease. Coat unpainted metal surfaces with multipurpose grease after removing any rust accumulations.

LONG TERM STORAGE - 30 DAYS OR MORE

Long term storage requires greater preparation than short term storage and must be undertaken with greater care.

The **MACHINE** should be prepared as follows:

1. Perform the short term machine storage preparation, making certain that All points with grease fittings are liberally lubricated.

2. Drain and refill the hydraulic reservoir. Refer to page 3 - ? when servicing the reservoir.

3. Distribute the new hydraulic fluid to all parts of the system by operating all functions.

4. The battery charger may be left connected to the batteries and should be turned on for a full charge period once a month. In extremely cold conditions it may be necessary to charge more frequently. After each charge cycle the charger should be checked to insure that it has turned off. Severe overcharging and possible damage to the batteries could result if the charger remains on for prolonged periods of time.

5. If the batteries are to be removed for storage, disconnect the charger from the batteries and clean and tape the battery cables.

6. Fill the hydraulic reservoir to the top *AFTER THE MACHINE IS PARKED IN ITS STORAGE SPOT.*

8. Coat exposed cylinder rods with grease.

RESTORING AERIAL LIFT TO SERVICE

Remove the **AERIAL LIFT** from storage via the following procedure:

1. Remove preservative lubricants from all surfaces.

2. Check all fluid levels, adding or draining as required.

3. If the batteries have been removed for storage, then install the batteries and reconnect the battery charger.

4. Perform all maintenance and lubrication of the aerial lift in accordance with the maintenance chart on pages 3 - 2 and 3 - 3.

GENERAL INFORMATION

NOTES

GENERAL CLEANING, INSPECTION & PREPARATION FOR MAJOR COMPONENT OVERHAUL

A. Clean parts having ground and polished surfaces, such as gears, bearings, and shafts with solvent type cleaners such as emulsion cleaners, or petroleum solvents excluding gasoline. Do not clean these parts in a hot tank solution or sodium hydroxide, orthosilicates or phosphates. When cleaning, remember to clean and/or replace breathers if applicable.



⚠CAUTION

Exercise extreme care to avoid skin rashes, fire hazards and inhalation of vapors when using solvent-type cleaners.

B. Rough parts such as gear case housings may be cleaned hot solution tanks with mild alkali solutions providing these parts are not ground and polished. The parts should remain in the tank long enough to be thoroughly cleaned and heated through. This will aid and speed up the evaporation of the cleaning solution and the rinse water.



⚠CAUTION

Exercise care to avoid skin rashes and inhalation of vapors when using alkali cleaners.

Parts cleaned in solution tanks or with alkali cleaners should be thoroughly rinsed after cleaning to remove all traces of alkali.

C. Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lint-free absorbent paper towels or wiping rags free of abrasive material such as lapping compound, metal filings or contaminated oil. Bearings should never be dried by spinning with compressed air.

D. To prevent corrosion, parts that have been cleaned and dried, then inspected, should be reassembled immediately and coated with a light film of oil.

E. It is impossible to overstress the importance of careful and thorough *inspection* of component parts prior to reassembly. Thorough visual inspection for indications of wear or stress, and the replacement of such parts as are necessary will eliminate costly and avoidable unit failure.

1. Inspect all bearings and replace any that are worn, pitted or damaged in any way. Remove parts needing replacement with a suitable puller or in a press with sleeves. Avoid the use of drifts and hammers, as they may easily mutilate or severely distort component parts.

2. Inspect all gears for wear or damage. Gears which are scored, pitted, ridged or worn should be replaced.

F. If repair is evident, replace all worn or damaged parts. Hex nuts with rounded corners, all lock washers, oil seals, o-rings and gaskets should all be replaced at the time of overhaul.

WELDING INSTRUCTIONS



When doing repair welding on your aerial lift take precaution attaching your ground to the component being repaired. This will eliminate the chance of arcing through a bearing, cylinder, etc., damaging the component. Paint should be removed from the surface to be used as the "ground" (earth).



Use necessary precaution when welding around fuel tanks, oil reservoir, batteries, tubing and pressure systems.



When welding close to glass, cylinder rods, or any polished surface, provide adequate protection from splatter.



Always disconnect the battery cables and applicable grounds before welding. If equipped with an engine, never weld when the engine is running.



Do not weld on wet surfaces since this will cause hydrogen embrittlement of the weld.



Always have a fire extinguisher on hand in case of fire. Adequate ventilation and dry area are necessary. Protective clothing should be used and all persons in the welding area should have protection for their eyes.

AWS CLASS E7018 Low hydrogen rod for normal repairs on low allow to medium carbon steel. All position welding, good penetration and crack resisting up to 80,000 yield. Also suitable for repair of previous intershield welds.

AWS CLASS E11018G Low hydrogen rod for repair on high strength allow steel such as T-1, 80,000 to 100,000 yield. All position welding, good penetration and high tensile strength up to 110,000.

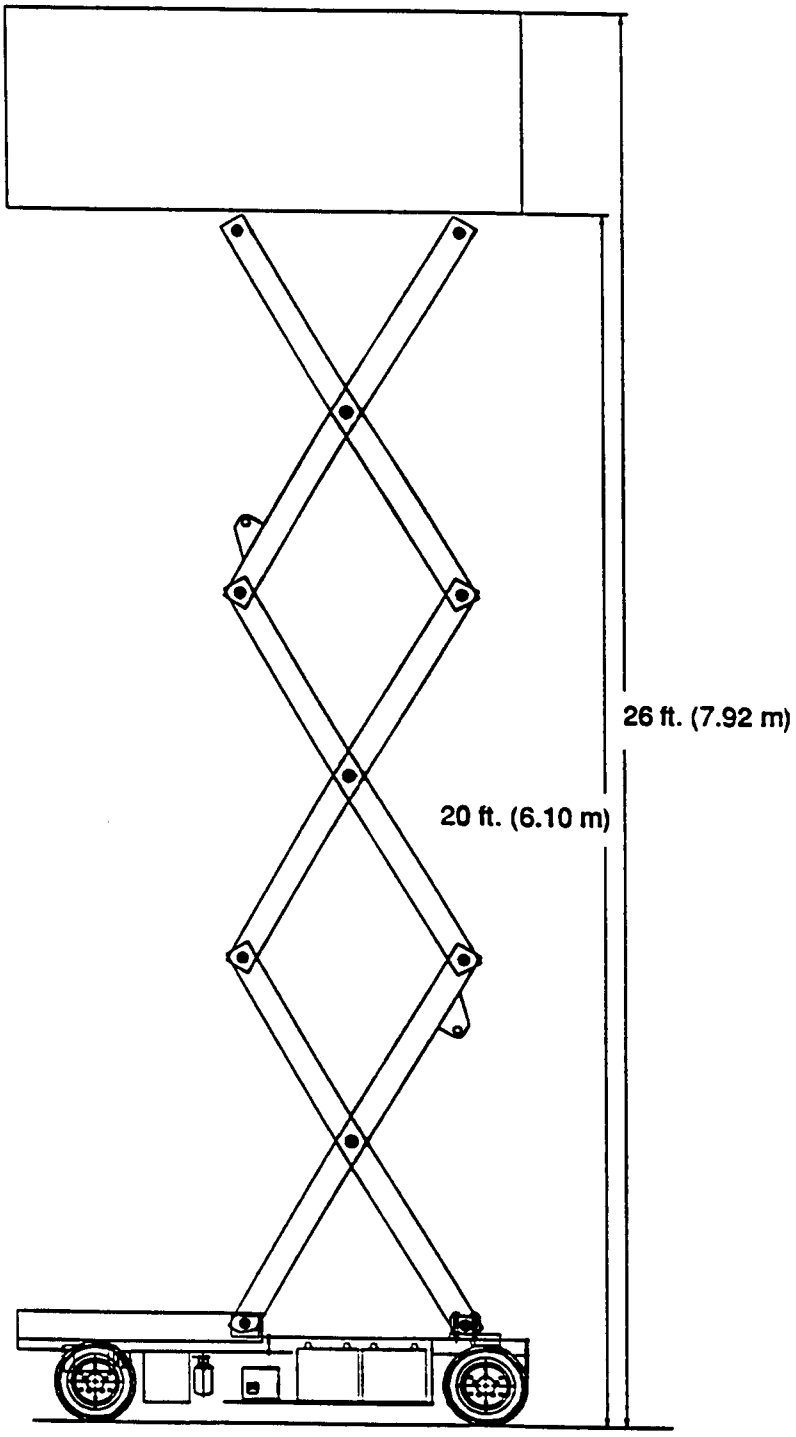
NOTE: Low hydrogen rod E7018 must be used within four (4) hours upon removal from a freshly opened container or from a storage oven.

Low hydrogen rod E11018G must be used within 1/2 hour upon removal from its container or from a storage oven.

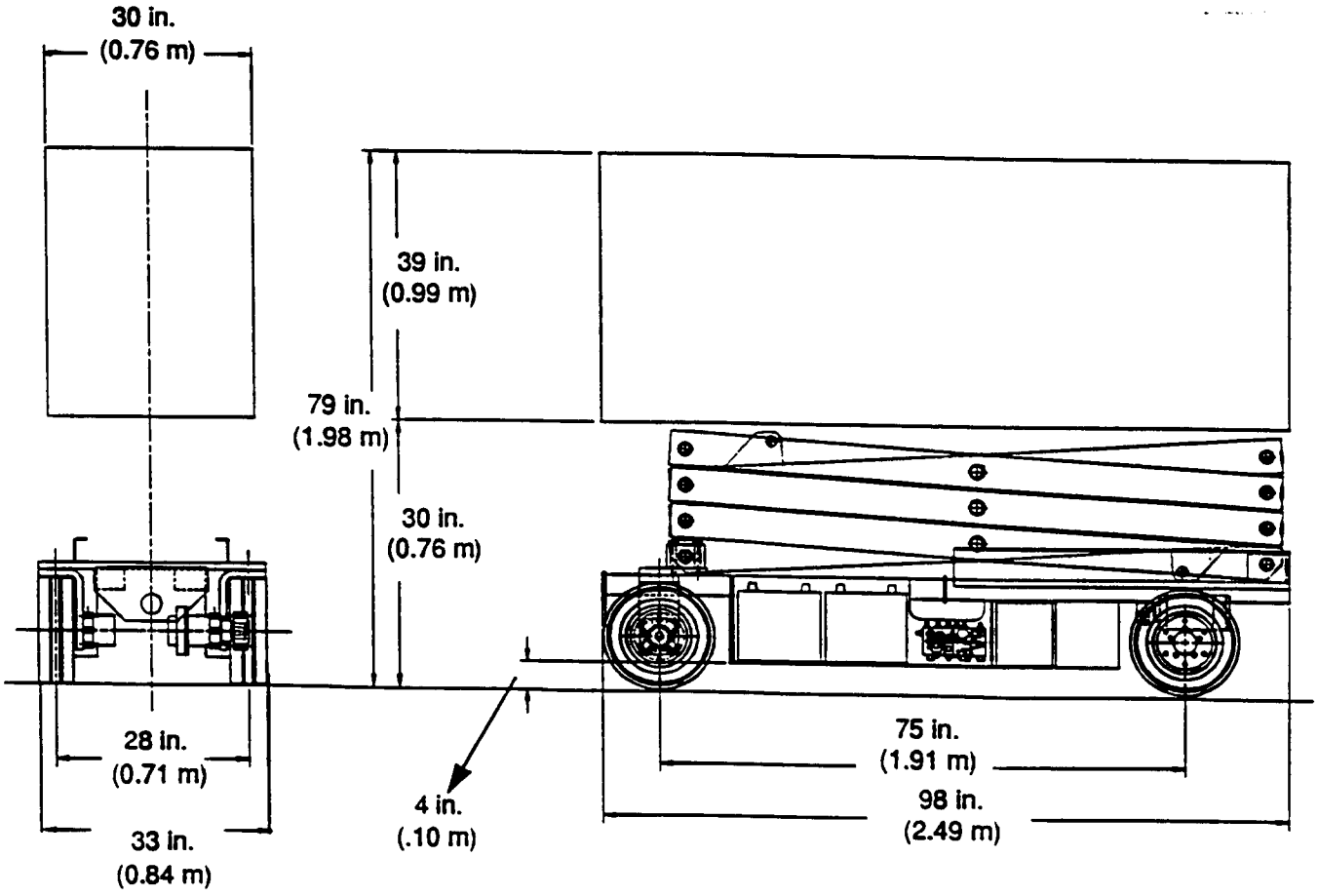
SPECIFICATIONS

Working Height (maximum)	26 ft. (7.92 m)
Platform Height (maximum)	20 ft. (6.10 m)
Platform (minimum - ground to platform)	30 in. (0.76 m)
Stowed Height	79 in. (1.98 m)
Length (overall)	98 in. (2.49 m)
Width (overall)	33 in. (0.84 m)
Platform — Dimensions (outside) — Guard rails (non-removable) — Toe plate — Extendable platform	 30 in. x 98 in. (0.76 x 2.49 m) 39 in. (0.99 m) 6 in. (.15 m) 36 in. (.91 m) forward
Load Capacity (maximum weight)	750 lbs. (340.2 kg) Incl. Occupants
Rated Number of Occupants	3 Occupants
Load Allowed on EP Deck (maximum)	250 lbs (113.4 kg)
Wheelbase	75 in. (1.91 m)
Wheel Track	28 in. (0.71 m)
Wheel Load (Per Wheel)	120 psi (84,372 kg/sq-m)
Wheel Load (Area)	1.60 psi (1.125 kg/sq-m)
Turning Radius (inside curb)	5 ft. 4 in. (1.63 m)
Drive Speed (No Load) — Low — High — Gradeability	1.25 m.p.h. (2.01 km/h) 2.5 m.p.h. (4.02 km/h) 10%
Lift/lower Speed (maximum load)	37/30 sec.
Power system (24 VDC) — Battery Voltage — Battery Capacity — Battery Weight	4 @ 6 VDC 220 amp/hr (4) 65 lbs. (29.51 kg) - per battery
Hydraulic Tank Capacity	12 gal. (45.4 l)
Battery Charger	24 VDC 40 amp
Tire Size	4.00 x 8.00 solid tire
Hydraulic Working Pressure (maximum)	2500 psi (173 bar)
Ground Clearance	4 in. (.10 m)
Approximate Shipping Weight (with EP)	3300 lbs. (1497 kg)

GENERAL INFORMATION



GENERAL INFORMATION



TORQUE RATINGS

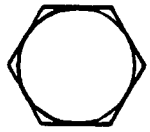
ES - 100.0
TORQUE RATINGS
FOR
DRY - UNCOATED FASTENERS

TORQUE VALUES TO BE WITHIN ± 5%
ALL FIGURES IN FOOT POUND

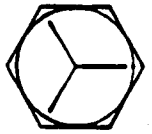
THIS TABLE DOES NOT APPLY TO HYDRAULIC CONNECTIONS. WHEN TORQUING HYDRAULIC CONNECTIONS REFER TO ES-100.1

NOM. DIA. IN.	GRADE 2	GRADE 5	GRADE 8
1/4	6 - *4	8	12
5/16	12 - *7	20	25
3/8	20 - *12	30	45
7/16	35 - *20	50	75
1/2	50 - *30	80	110
9/16	75 - *45	115	160
5/8	100 - *60	160	225
3/4	180 - *110	280	400
7/8	175	450	640
1	265	680	970
1-1/8	375	840	1,380
1-1/4	530	1,200	1,930
1-3/8	700	1,570	2,540
1-1/2	930	2,080	3,380
1-3/4	1,460	2,090	5,300
2	2,200	3,200	7,990
2-1/4	3,200	5,350	11,690
2-1/2	4,400	7,300	15,990

BOLT HEAD MARKING



GRADE 2



GRADE 5



GRADE 8

The above information was compiled for U.N.C. Threaded Fasteners.

NOTE: If threads are not lubricated prior to assembly or are not plated use Torque Spec. ES-100.0

** = Torque Values for Bolts and Screws longer than 6"*

Fasteners as supplied by the vendor are considered not lubricated.

TORQUE RATINGS

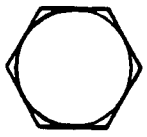
ES - 100.1
TORQUE RATINGS
FOR
LUBRICATED OR PLATED FASTENERS

TORQUE VALUES TO BE WITHIN ± 5%
ALL FIGURES IN FOOT POUND

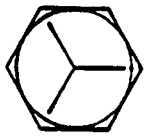
REFER TO THIS TABLE WHEN TORQUING HYDRAULIC CONNECTIONS (Piping & Cylinders).

NOM. DIA. IN.	GRADE 2	GRADE 5	GRADE 8
1/4	5 - * 3	7	10
5/16	9 - * 5	14	20
3/8	16 - * 9	25	35
7/16	25 - * 15	40	55
1/2	40 - * 20	60	85
9/16	55 - * 30	85	120
5/8	75 - * 45	120	170
3/4	135 - * 80	210	300
7/8	130	340	485
1	200	515	720
1-1/8	280	635	1,030
1-1/4	400	890	1,450
1-3/8	520	1,175	1,900
1-1/2	695	1,560	2,530
1-3/4	1,100	1,825	3,980
2	1,650	2,750	6,000
2-1/4	2,400	4,000	8,760
2-1/2	3,300	5,500	12,000

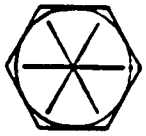
BOLT HEAD MARKING



GRADE 2



GRADE 5



GRADE 8

The above information was compiled for U.N.C. Threaded Fasteners.

NOTE: If threads are not lubricated prior to assembly or are not plated use Torque Spec. ES-100.0

** = Torque Values for Bolts and Screws longer than 6"*

Fasteners as supplied by the vendor are considered not lubricated.

TORQUE CHART

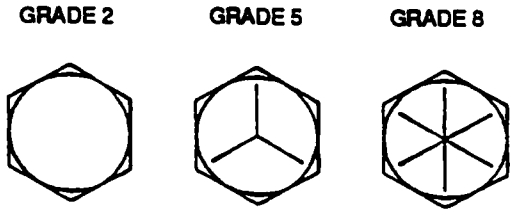
The following table contains many of the more common torques used when perfoming service or maintenance on the machine, and may be used as a quick reference

Table 1:

AREA	TORQUE
WHEEL NUTS (ALL WHEELS)	90 - 95 FT.LBS.
DRIVE MOTOR CASTLE NUTS	190 FT. LBS. (MINIMUM)
BRAKE HOUSING BOLTS	55 - 60 FT. LBS.
STEERING CYLINDER PISTON NUT	75 - 85 FT. LBS.
LIFT CYLINDER PISTON NUT	650 FT. LBS.

NOTE: CAPSCREW OR BOLT REPLACEMENT: Any bolt or capscrew replacement should be of the same grade or greater than the original. Grade markings are shown below:

BOLT HEAD MARKING



RECOMMENDED SPARE PARTS LIST: MARKLIFT MODEL CH20NEP/CH26WEP

(1 MACHINE, 1 YEAR OPERATION)

NOTE: 1 THE KINDS OF PARTS AND QUANTITIES INDICATED IN THIS LIST SHOULD ENABLE RELATIVELY UNINTERRUPTED OPERATION OF 1 (ONE) MARKLIFT CHALLENGER MODEL CH20NEP/CH26WEP SCISSOR LIFT FOR A PERIOD OF APPROXIMATELY 1 YEAR. THIS LIST IS NOT INTENDED TO BE ALL INCLUSIVE—OTHER PARTS MAY BE REQUIRED DUE TO UNFORSEEN CIRCUMSTANCES. THE PART NUMBERS INDICATED IN THIS LIST ARE SUBJECT TO CHANGE AS A CONSEQUENCE OF THE CONTINUED DEVELOPMENT OF THIS PRODUCT.

Ref.	Part No.	Description	Qty	Remarks
1.	3900-115	PAINT, SPRAY, WHITE	2	
2.	3900-131	PAINT, SPRAY, BLUE	1	
3.	181111	DECAL, FRONT OF EXTENDABLE DECK	1	
4.	181312	DECAL, RATED WORK LOAD	3	3 REQUIRED
5.	181313	DECAL, SERVICE STAND	3	3 REQUIRED
6.	183402	DECAL, HYDRAULIC-SYSTEM FLUID	1	
7.	130949	DECAL, TIRE REPLACEMENT	4	4 REQUIRED
8.	181112	DECAL, BATTERY BOX	2	2 REQUIRED
9.	181824	DECAL, FORKLIFT BOOT	2	2 REQUIRED
10.	160137	TAPE, YELLOW W/BLACK STRIPE	2	2 FEET REQUIRED
11.	182815	DECAL, AERIAL-CONTROL BOX	1	
12.	181825	DECAL, EMERGENCY-LOWERING VALVE	1	
13.	182778	DECAL, GROUND-CONTROL PANEL	1	
14.	20481	TOGGLE SWITCH, LIFT/LOWER	2	2 REQUIRED
15.	20482	TOGGLE SWITCH, DRIVE-SPEED SELECT	1	
16.	70646	SWITCH, EMERGENCY-STOP "CONTACTS"	1	
17.	70645	BUTTON, EMERGENCY-STOP "ACTUATOR"	1	
18.	70780	SWITCH, CONTROLS-ENABLE "CONTACTS"	1	
19.	70645	BUTTON, CONTROLS-ENABLE "ACTUATOR"	1	
20.	69443	SWITCH, DRIVE/STEER OPER.	2	P/N 70778 CONTROLLER
21.	69944	BOOT, DRIVE/STEER CONTROLLER	1	P/N 70778
22.	70781	INDICATOR LAMP, UNSTABLE-CONDITION WARNING	1	
23.	70259	ALARM, BUZZER, UNSTABLE CONDITION WARNING	1	

RECOMMENDED SPARE PARTS LIST

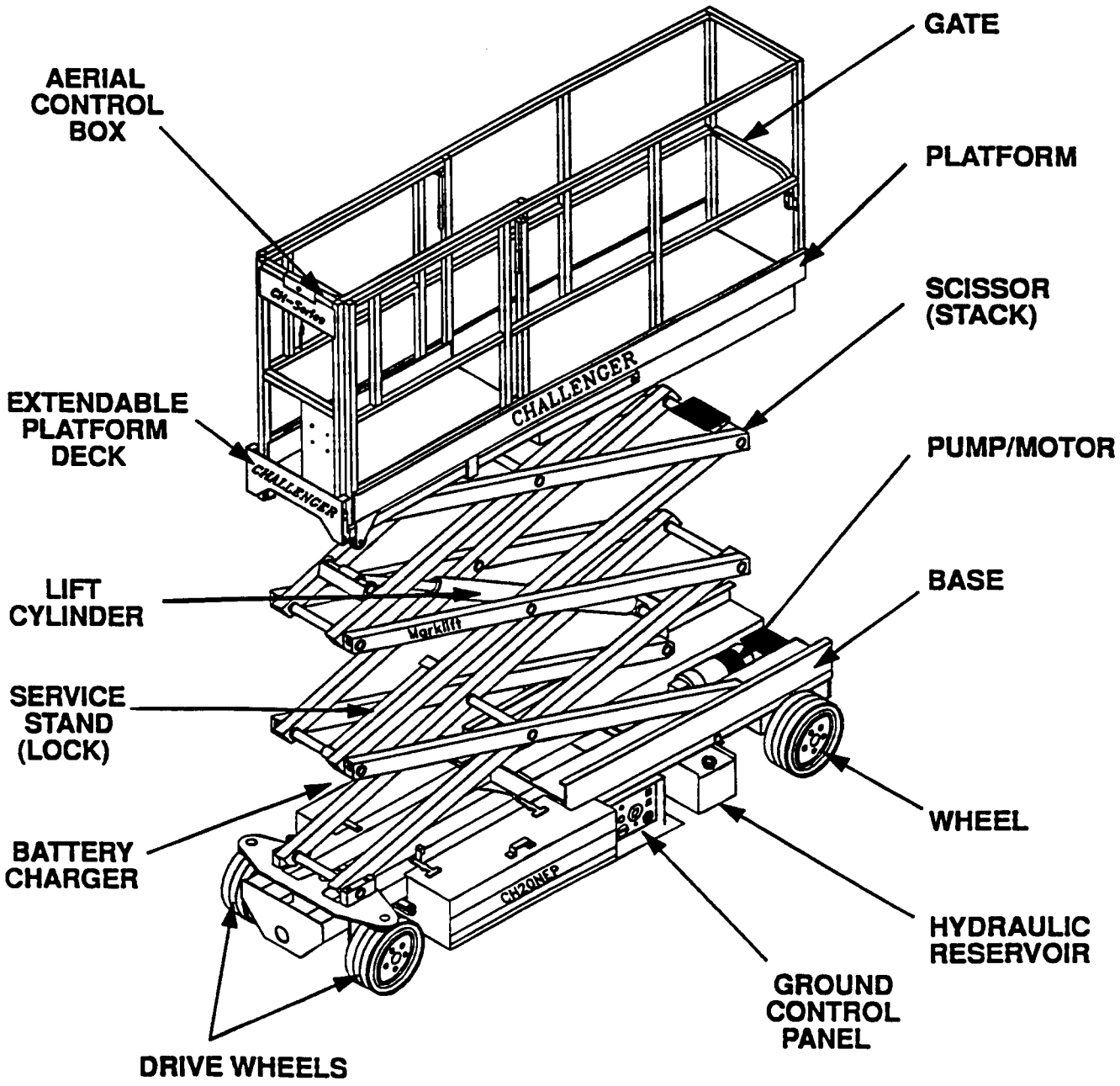
Ref.	Part No.	Description	Qty	Remarks
24.	4011	PUSH-BUTTON SWITCH, DESCENT OVERRIDE	1	
25.	70373	BOOT, DESCENT-OVERRIDE SWITCH	1	FOR P/N 4011
26.	441 6834	PROXIMITY SWITCH, SPEED/LOWERING	1	
27.	441 6835	CABLE, PROXIMITY SWITCH	1	
28.	65124	PIN, "BALL-LOK DETENT" (SECURE CONTROL BOX)	1	
29.	65669	LANYARD ASSEMBLY	1	FOR USE WITH P/N 65124
30.	372 3041	LATCH, BATTERY/COMPONENT BOX COVER	2	
31.	69734	KIT, ELECTRONIC TIMER	1	P/N 70789 CHARGER
32.	600270	RELAY, TIMER KIT	1	FOR P/N 69734
33.	66726	FUSE ASSEMBLY	1	P/N 70789
34.	69733	DIODE ASSEMBLY, WITH HEAT SINK	1	P/N 70789
35.	69748	FILTER ELEMENT, HYDRAULIC-FLUID RETURN	5	
36.	70362	RELAY, PUMP-MOTOR OPERATION	1	
37.	2717	KEY SWITCH	1	
38.	66961	KEY, "SPARE"	1	FOR P/N 70610
39.	70785	BOOT, CIRCUIT BREAKER	1	P/N 20562
40.	70606	RELAY, DRIVE/LIFT/LOWER/HIGH SPEED ENABLE	2	
41.	70593	RELAY BASE	1	FOR P/N 70590
42.	70784	RELAY HOLD-DOWN SPRING	1	FOR P/N 70590
43.	31074	SLOPE SENSOR	1	
44.	68164	BRUSH SET, PUMP MOTOR	1	P/N 67836 (2 REQ.)
45.	68518	SEAL KIT, HYDRAULIC PUMP	1	P/N 67835
46.	69442	SEAL KIT, CONTROL VALVE	1	
47.	69229	SOLENOID VALVE, PLATFORM LIFT/DRIVE SPEED/ETC.	1	
48.	69339	COIL, SOLENOID VALVE, STEER/LIFT ETC.	1	

RECOMMENDED SPARE PARTS LIST

Ref.	Part No.	Description	Qty	Remarks
49.	69339	COIL, SOLENOID VALVE, DRIVE	1	
50.	135231	SOLENOID VALVE, PLATFORM LOWERING (IN LIFT CYLINDER)	1	
51.	69945	COIL, SOLENOID VALVE	1	P/N 135231
52.	69753	SEAL KIT, DRIVE MOTOR, LEFT HAND	1	P/N 135144
53.	69752	SEAL KIT, DRIVE MOTOR, RIGHT HAND	1	P/N 135143
54.	600533	SEAL KIT, BRAKE	1	P/N 135204
55.	69735	SEAL KIT, STEERING CYLINDER	1	P/N 135246
56.	61316	LUG NUT	5	20 REQUIRED
57.	69809	SEAL KIT, LIFT CYLINDER	1	P/N 135096-1
58.	160311	"GRIP," PLATFORM-EXTENSION HANDLE	1	
59.	20562	CIRCUIT BREAKER (20 AMP)	1	

GENERAL INFORMATION

MAJOR COMPONENT IDENTIFICATION



ABBREVIATIONS

AC	ALTERNATING CURRENT	"	INCHES
ADPTR	ADAPTER	INT	INTERNAL
AMP	AMPERE	INV	INVERTED
APPROX	APPROXIMATELY	LG	LENGTH
AR	AS REQUIRED	LH	LEFT HAND
ASSY	ASSEMBLY	MAX	MAXIMUM
AVAIL	AVAILABLE	MIN	MINIMUM
BRG	BEARING	MM	MILLIMETER
BRKT	BRACKET	MTG	MOUNTING
CCW	COUNTER CLOCKWISE	P/N	PART NUMBER
CFM	CUBIC FEET PER MINUTE	NO	NUMBER
CHRG	CHARGING	NSS	NOT SOLD SEPARATELY
CTSK	COUNTERSUNK	OD	OUTSIDE DIAMETER
CVR	COVER	PTO	POWER TAKE-OFF
CW	CLOCKWISE	#	POUND
CYL	CYLINDER	QTY	QUANTITY
°	DEGREE	RD	ROUND
DC	DIRECT CURRENT	REF	REFERENCE
DIA	DIAMETER	RH	RIGHT HAND
DRV	DRIVE	ROT	ROTATION
ENG	ENGINE	RPM	REVOLUTIONS PER MINUTE
EXH	EXHAUST	SL	SLOTTED
EXT	EXTERNAL	SM	SMALL
FT	FEET	SPD	SPEED
GAL	GALLON	STD	STANDARD
GR	GRADE	T	TOOTH
GSK	GASKET	THK	THICK
HD	HEAD	THRU	THROUGH
HEX	HEXAGON	TEMP	TEMPERATURE
HP	HORSEPOWER	V	VOLT
HSG	HOUSING	VAC	VOLTS ALTERNATING CURRENT
HT	HEAT TREATED	VARI	VARIABLE
HYD	HYDRAULIC	VS	VARIABLE SPEED
HZ	HERTZ	W/	WITH
ID	INSIDE DIAMETER	W/0	WITHOUT
INCL	INCLUDES		

GENERAL INFORMATION

NOTES

SERVICE & ADJUSTMENTS

SECTION 4

DESCRIPTION	PAGE NO.
INTRODUCTION	4 - 0 - 1
SERVICE STAND "LOCK"	4 - 0 - 2
HUB & WHEEL ASSEMBLY	4 - 1 - 1
HUB ASSEMBLY	4 - 1 - 2
STEERING & DRIVE ASSEMBLY	4 - 2 - 1
DRIVE MOTORS	4 - 3 - 1
DISC BRAKE	4 - 3 - 12
STEERING CYLINDER	4 - 4 - 1
PUMP/MOTOR	4 - 5 - 1
HYDRAULIC ASSEMBLY	4 - 6 - 1
CONTROL VALVE	4 - 7 - 1
PRESSURE SETTING & ADJUSTMENTS	4 - 8 - 1
LIFT CYLINDER	4 - 9 - 1
GROUND CONTROL PANEL	4 - 10 - 1
AERIAL CONTROL BOX	4 - 11 - 1
BATTERY CHARGER	4 - 12 - 1
BATTERIES	4 - 13 - 1

MAINTENANCE & LUBRICATION

SECTION 3

DESCRIPTION	PAGE NO.
INTRODUCTION	3 - 1
MAINTENANCE SCHEDULE	3 - 2
RECOMMENDED LUBRICANTS	3 - 4
OWNER'S INSPECTION RECORD	3 - 5
MAINTENANCE PROCEDURES	3 - 6
BATTERIES	3 - 6
BATTERY CHARGING	3 - 9
HYDRAULIC SYSTEM	3 - 12
HYDRAULIC RESERVOIR & FILTER	3 - 12
HYDRAULIC CYLINDERS	3 - 12

MAINTENANCE & LUBRICATION

INTRODUCTION

In addition to the "Before Operation Checks" described in the "Operator's Manual" a regular program of periodic preventive maintenance is essential to prolong aerial lift life, maximize efficient service and minimize downtime. This section details a series of checks and procedures which are to be performed at daily, weekly, monthly and semi-annual intervals.

Even if the operator is not directly responsible for the maintenance of the aerial lift, the operator should perform daily, all of the inspections listed in the "Before Operation Check", Section 5 of the "Operator's Manual".

NOTE: Replace all worn or damaged parts, or decals discovered during the "Before Operation Check". The operator should be assured that the aerial lift has been properly maintained and inspected before operating it.

MAINTENANCE SCHEDULE

The checks prescribed for longer intervals include all the checks required for the shorter intervals. Thus, the weekly check includes all items in the daily check, the monthly check includes weekly and daily checks, and so on through the semi-annual check, which includes the quarterly, monthly, weekly and daily checks.

This maintenance schedule is a guide which ensures that basic preventive maintenance requirements will be met under average operating conditions. Conditions which impose greater wear, loads or strain on the aerial lift may dictate reduced check intervals. Before altering the maintenance schedule, reevaluate aerial lift operation and review the owner's inspection records. Consider all factors involved and develop a revised schedule adequate to meet routine maintenance requirements.

OWNER'S INSPECTION RECORD

Periodic maintenance of the aerial lift is the responsibility of the owner. The "Aerial Lift Inspection Report" shown on page 3-3 is to be used for recording the date of each inspection, person(s) performing the inspection, any deficiencies found, and corrective action.

This record also serves as a tool detecting problem areas and reanalyzing maintenance requirements.



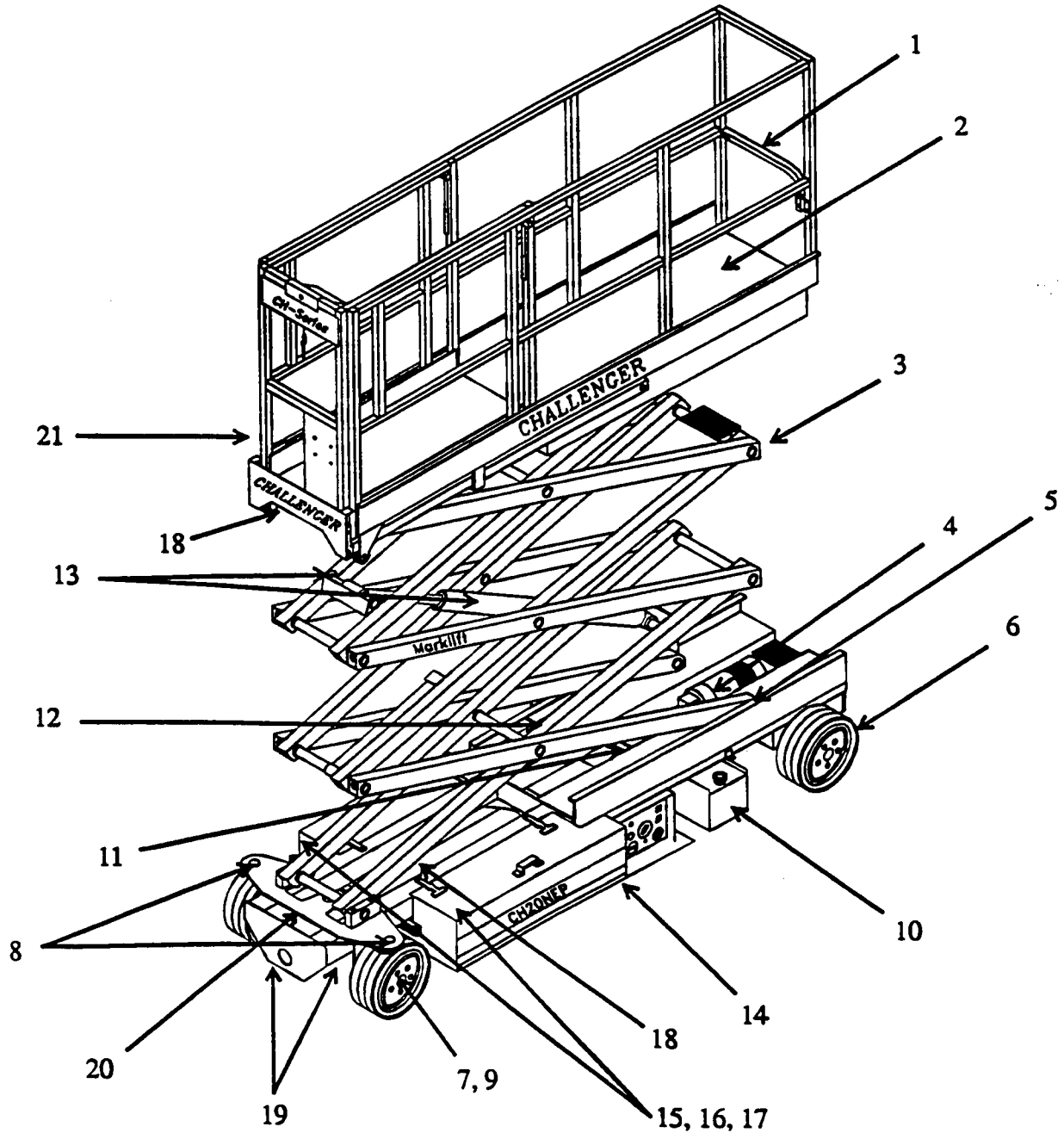


DO NOT REACH THROUGH SCISSORS OR WORK BENEATH THE PLATFORM WITH OUT THE SERVICE STAND PROPERLY POSITIONED AND MECHANICALLY LOCKED. FAILURE TO DO THIS MAY RESULT IN DEATH OR SERIOUS INJURY.

REFER TO PAGE 4 - 0 - 1 FOR PROCEDURE.

MAINTENANCE & LUBRICATION

RECOMMENDED INSPECTION AND MAINTENANCE



MAINTENANCE & LUBRICATION

Table 1: **RECOMMENDED INSPECTION AND MAINTENANCE SCHEDULE**

ITEM #	ITEM DESCRIPTION	SERVICE FREQUENCY
1	Platform Gate	Inspect Daily
2	Platform Deck	Inspect Daily
3	Collars on Scissor-pivot Pins	Inspect Daily
4	Hydraulic Pump	Inspect Daily
5	Wear (Slide) Pads	Inspect Daily
6	Tires and Wheels	Inspect Daily
7	Wheel Bearings	Lubricate Every 12 Months
8	Wheel Kingpins	Lubricate Every 12 Months
9	Wheel Lug Nuts	Inspect Daily Check Torque After First 40 Hours Check Torque Every 6 Months
10	Hydraulic Reservoir Fluid	Check Daily / Change Yearly
11	Hydraulic-fluid Inlet Strainer	Inspect and Clean Yearly
12	Hydraulic-fluid Return Filter	Change Every 100 Hours or Quarterly
13	Lift Cylinder and Pins	Inspect Daily
14	Hydraulic Valve	Inspect Daily
15	Batteries	Inspect Water Level Daily
16	Battery Housings	Inspect Daily
17	Battery Tops, Terminals, and Cables	Inspect Daily
18	Limit Switches (Proximity)	Inspect Daily
19	Drive Motors	Inspect Daily
20	Steering Cylinder and Pins	Inspect Daily
21	Extendable Platform Deck (Slide, Roller, and Handle Assemblies)	Inspect Daily

Check each of the above items for secure fasteners, leaks, missing or damaged hardware, or evidence of cracks. **Check** all visible electric wiring and hydraulic hoses for cracking, loose connections, or excessive wear. If a problem is found with any of the following items, **do not operate** the aerial lift until a qualified aerial-lift mechanic makes the necessary repairs.

MAINTENANCE & LUBRICATION

RECOMMENDED LUBRICATION TYPES

ITEM	ITEM DESCRIPTION	LUBRICANT TYPE
1	Hydraulic Oil	Dexron II
2	Wheel Bearings	General (Multi) Purpose EP2 Grease —High-pressure Injection
3	Wheel Kingpin	General (Multi) Purpose EP2 Grease —High-pressure Injection

MIXING

Various companies use different additives which, when mixed together, may cause problems in a hydraulic system. This type of problem is rare but can cause sludge which can plug the oil filters or acid which will etch the pump. Any of the above conditions can result in the warranty being voided. If, knowing all this, you still choose to add oil different from the initial fill, stay with a single brand as this will minimize the likelihood of problems occurring. Then at the first complete oil change, you may switch to the brand you prefer to use.

If hydraulic oil needs to be added, the aerial lift owner must be contacted to find out what brand and viscosity of oil is being used. Use the same brand and viscosity of oil that is current in the aerial lift when adding additional oil.

HYDRAULIC OIL

Check the hydraulic oil level on a daily basis. The oil level is checked using the dipstick which is attached to the filler cap located on top of the hydraulic tank The oil level must be between the "FULL" and "LOW" marks on the dipstick. Add oil as needed in the filler cap opening of the hydraulic tank. The hydraulic system was filled at the factory with Nortran automatic transmission fluid (equivalent to Dexron II). Any oil used in this aerial lift's hydraulic system must meet the specifications of Dexron II.

Mark Industries

Return To: **Mark Industries**
106 12th Street S.E.
Waverly, IA 50677-9466

AERIAL LIFT INSPECTION REPORT

PRE-DELIVERY ☐ DELIVERY ☐ 30-DAY INSPECTION ☐ YEARLY INSPECTION ☐

MACHINE: SCISSOR LIFT ☐ BOOM LIFT ☐ KNUCKLE BOOM ☐

DEMO ☐ RENTAL ☐ OWNED ☐

DISTRIBUTOR _____ ENGINE S/N _____

ADDRESS _____ MODEL _____ SERIAL NO. _____

CUSTOMER _____ HOUR METER _____

MACHINE LOCATION _____ DATE DELIVERED _____

Scissors - Inspections	OK	NOT OK	N/A
1. Platform Gate Latch	☐	☐	☐
2. Platform Gate	☐	☐	☐
3. Platform Deck	☐	☐	☐
4. Collars on Scissor-pivot Pins	☐	☐	☐
5. Hydraulic Pump	☐	☐	☐
6. Wear (Slide) Pads	☐	☐	☐
7. Tires and Wheels	☐	☐	☐
8. Wheel Bearings	☐	☐	☐
9. Wheel Kingpins	☐	☐	☐
10. Wheel Lug Nuts	☐	☐	☐
11. Hydraulic Reservoir Fluid	☐	☐	☐
12. Hydraulic-fluid Inlet Strainer	☐	☐	☐
13. Hydraulic-fluid Return Filter	☐	☐	☐
14. Lift Cylinder and Pins	☐	☐	☐
15. Hydraulic Valve	☐	☐	☐
16. Batteries	☐	☐	☐
17. Battery Housings	☐	☐	☐
18. Battery Tops, Terminals, and Cables	☐	☐	☐
19. Limit Switches (Proximity)	☐	☐	☐
20. Drive Motors	☐	☐	☐
21. Steering Cylinder and Pins	☐	☐	☐
22. Extendable Platform Deck (Slide, Roller, and Handle Assemblies)	☐	☐	☐
23. Hoses	☐	☐	☐
24. Electrical Wiring	☐	☐	☐
35. Decals	☐	☐	☐
26. Operation and Maintenance Manual in Platform	☐	☐	☐

Booms - Inspections	OK	NOT OK	N/A
1. Platform Gate Latch	☐	☐	☐
2. Platform Gate	☐	☐	☐
3. Platform Deck	☐	☐	☐
4. Boom Pivot Pin	☐	☐	☐
5. Air Filter	☐	☐	☐
6. Engine Oil	☐	☐	☐
7. Torque Hub	☐	☐	☐
8. Torque Ring-gear Bolts	☐	☐	☐
9. Boom	☐	☐	☐
10. Platform Rotator	☐	☐	☐
11. Tie Rod Pin	☐	☐	☐
12. Steering-yoke King Pins	☐	☐	☐
13. Steering Cylinder	☐	☐	☐
14. Fuel Tank	☐	☐	☐
15. Return-line filter	☐	☐	☐
16. Hydraulic Reservoir Fluid	☐	☐	☐
17. Hydraulic Pump	☐	☐	☐
18. Hydraulic Valve	☐	☐	☐
19. Wheel Lug Nuts	☐	☐	☐
20. Extend-cable Equalizer Bracket	☐	☐	☐
21. Extend Cable	☐	☐	☐
22. Limit Switches (Proximity)	☐	☐	☐
23. Boom-lift Cylinder Pins	☐	☐	☐
24. Boom-lift cylinder	☐	☐	☐
25. Rotation Gear Box	☐	☐	☐
26. Power Track	☐	☐	☐
27. Operation and Maintenance Manual in Platform	☐	☐	☐
28. Guard Rail	☐	☐	☐
29. Toe Plate Mesh	☐	☐	☐
30. Tires	☐	☐	☐
31. Decals	☐	☐	☐
32. Electrical Wiring	☐	☐	☐

INSPECTED BY: _____ DATE: _____ TITLE: _____

Explain any deficiencies found, corrective action taken, and identification of the person(s) performing the repair: _____

MAINTENANCE & LUBRICATION

BATTERY-WATER LEVEL



⚠ WARNING

TO AVOID SERIOUS BURNS, EXTREME CARE SHOULD BE USED WHEN HANDLING OR WORKING NEAR BATTERIES.

Avoid Battery Hazards!

- **Batteries produce flammable and explosive gasses. Keep** electric arcs, sparks, flames, and lit cigarettes (pipes, cigars, etc.) away from batteries.
- **Battery acid will damage eyes or skin on contact. Always** wear a face shield during battery maintenance to avoid getting acid in eyes. **Always** wear rubber gloves and protective clothing to keep acid off skin.
- **Never** check the battery by placing a metal object across the posts. Serious burns or an explosion can result.

Battery Fill Instructions

Water or Acid Loss to Batteries

Water loss from the battery is mainly due to evaporation brought on by temperature rises during heavy charging cycles. A very small amount of water is lost due to hydrogen and oxygen formed during charging. Acid is lost if the case becomes cracked or if the battery is allowed to tip over. Therefore, acid is seldom needed.

Checking the Water level

When checking the water level, don't allow dirt to enter into the battery cells once the caps have been removed. Take particular care to avoid setting the battery-cell caps down on a dirty surface. Replace the caps immediately after checking the water level.

MAINTENANCE & LUBRICATION

BATTERY-WATER LEVEL

MATERIALS AND EQUIPMENT REQUIRED

1. Battery Filler Bottle

2. Distilled Water

3. Hydrometer

FILLING THE BATTERY

Use a hydrometer to see how much charge the battery has. A reading of 1.260 or more in all cells indicates a fully-charged condition. (See chart on following page.) If the battery is fully charged, add water up to the level indicator.
If the battery's water level is below the lead plates, add only enough water to barely cover the plates.

Note: Either excessive overcharge or moderate undercharge can shorten battery life. With proper attention to water level, charging time, and hydrometer readings, the batteries should have a long, useful life.

Note: Cold temperatures have a numbing effect on the electrical action of the battery, greatly reducing its capacity. Therefore, it is highly recommended that the battery be kept fully charged during cold weather.

MAINTENANCE & LUBRICATION

BATTERY-WATER LEVEL

Temperature/Specific Gravity Correction Table For Batteries
Actual Hydrometer Reading At Actual Temperature*
Table 1:

80°F (27°C)	0°F (-18°C)	-10°F (-23°C)	-20°F (-29°C)	-30°F (-34°C)	-45°F (-43°C)	-65° (-54°C)	Approx. State of Charge —%
1.280	1.312	1.316	1.320	1.324	1.330	1.338	100
1.250	1.282	1.286	1.290	1.294	1.300	1.308	75
1.220	1.252	1.256	1.260	1.264	1.270	1.278	50
1.190	1.222	1.226	1.230	1.234	1.240	1.248	25
1.160	1.192	1.192	1.200	1.204	1.210	1.218	0

Table 2: Specific Gravity

Corrected to 80°F (17°C)	Freezing Temperatures
1.280	-90°F (-68°C)
1.250	-62°F (-52°C)
1.200	-16°F (-27°C)
1.150	+05°F (-15°C)
1.000	+19°F (-07°C)

MAINTENANCE & LUBRICATION

CHARGING BATTERIES

CHARGING BATTERIES

1. Lower platform completely.
2. Open battery cover.
3. Remove caps, check fluid level and, if needed, fill to cover plates.
4. Reinstall caps before charging.
5. Plug charger into 120 VAC, 60 Hz power source.
6. Turn timer clockwise to ON position.
7. Charge until meter reads in finish area or near zero (0). (Charger will turn off automatically when timer runs out.)
8. Unplug charger.
9. Check that fluid level is up to split rings and reinstall caps.

CHARGING NOTES:

1. The surrounding temperature has a great effect on the power reserve in a battery.

   A. A battery 100% charged at 80°F:
   - drops to 65% at 32°F.
   - drops to 40% at 0°F.

   B. A battery 46% charged at 80°F:
   - drops to 32% at 31°F.
   - drops to 21% at 0°F.

2. When battery temperature reaches 125°F, battery should be taken off charge and cooled to room temperature or the charging rate should be lowered.
3. Battery should be brought to full charge as soon as possible after continuous use. (Hydrometer reading of 1.265 at 80°F or 26.6°C.) Lead plates in discharged batteries become hardened and sulfated. The battery eventually will not deliver its rated capacity or come up to a full change.

NORMAL OPERATION

1. Provide adequate ventilation for both batteries and charger. The convection-cooled design requires an unobstructed flow of cooling air for proper operation.
2. Connect charger DC output cord to batteries.
3. Turn timer to "ON" for will discharged batteries of to "7" for lightly discharged batteries. Charger shuts off automatically at end of set period.

The state of discharge of the batteries will be slightly different each time they are put on charge, but the charger varies automatically the initial charge rate, and taper of charge rate over the charge period. For well discharged batteries the charge rate at the start of the charge period should correspond to the "DC AMPS" rating on the charger nameplate. The rate should then taper gradually down to a lower finish rate. Normal charging at the low finish rate during the last 1-3 hours is necessary to achieve equalization of all battery cells. This equalization period allows the specific gravity of the battery electrolyte solution to rise to its full charge value. Since the taper of the charging rate (in amps. as indicated by the ammeter needle) is controlled by the rising voltage of the batteries being charged, proper performance of the charger and resulting good battery life is dependent upon the following factors:

MAINTENANCE & LUBRICATION

CHARGING BATTERIES

A. An adequate AC line to handle the power required (See "Initial Installation"). Request your electrician or power company to survey your installation.

B. All cells of the batteries must be good, rising to approximately 2.5 DC volts per cell while still on charge or near the end of a charging period. When in doubt, check each cell with a single cell voltmeter while still on charge. If a low reading is obtained, check the low cells with a temperature corrected hydrometer. NOTE: Hydrometer float must be thoroughly clean to obtain accurate specific gravity readings.

C. Connections on the battery terminals and connector wiring must be clean and tight.

The necessity of adding water more frequently than two of three weeks, and/or hot battery cases at the end of the charging cycle, indicates the finish rate is too high, due to one or both of the following:

A. One or more bad cells in the batteries.

B. Batteries are starting to age to the point where hours of charge should be reduced gradually to obtain prolonged battery life.

4. To determine approximate full charge at start of day's use, turn timer knob to "1". Drop of ammeter needle to the low finish rate within 15 minutes indicates full charge.

5. Always turn timer to "OFF" before disconnecting charger from batteries.

PROPER CARE OF MOTIVE POWER BATTERIES

1. New batteries should be given a full charge before their first use because it is difficult to know how long the batteries have been in storage without a charge.

2. Limit use of new batteries between charges for the first 5 cycles. New batteries and older batteries which have been in storage are not capable of their rated output until they have been discharged and charged a number of times.

3. During the first month of use, particularly when temperatures are below 60°F, new batteries should be given an extra full charge once a week. The ampere-hours of energy that batteries can deliver and their charge acceptance varies directly with battery temperature.

4. As long as the charger tapers down to the specified finish charge rate near the end of the charge cycle, the batteries should be given a full charge. All cells in a set of batteries do not react identically to the same discharge, and charge current. In a normal charge, the last 1 to 3 hours at the low finish charge rate equalize the cells for better battery life.

5. When batteries age to the point where the charge rate will no longer taper into the low finish rate area, reduce the hours of charge progressively. Reducing the charge period will prevent excessive battery heating and the resultant high water use rate.

6. Prior to each day's use, turn the charger on and check to see if charger ammeter needle jumps smartly upward and then tapers down to the finish rate area within 15 minutes. This will provide a

CHARGING BATTERIES

very simple means of verifying that the batteries were charged.

7. Add water carefully to the proper level in cells as required after they have been fully charged. Do not fill them so high that they bubble over while charging. New batteries require very little addition of water, whereas very old batteries may need additional water two or three times a week. Water (electrolyte) level in the cells settles when batteries are discharged and rises during charge. The probability of overfilling can be reduced by adding water when batteries are fully charged.

8. When the temperature falls below 65°F, batteries should be placed on charge as soon after use as possible. In these low temperatures a 4 hour equalizing charge once a week will improve state of charge and battery life.

9. Keep tops of batteries and battery hold-downs clean and dry at all times. This will reduce the amount of current leakage between batteries and the frame.

MAINTENANCE & LUBRICATION

HYDRAULIC SYSTEM

HYDRAULIC RESERVOIR CHECK & FILL

1. Lower platform completely.
2. Remove filler cap and check fluid in reservoir. The oil level is checked using the dipstick which is attached to the filler cap. The oil level must be between the "FULL" and "LOW" marks on the dipstick. Refer to page 3-4 for oil specifications.
3. Fill to proper level.
4. Replace cap.

HYDRAULIC SYSTEM FILTER

The spin-on oil filter in the hydraulic system should be changed every 100 hours or quarterly.

HYDRAULIC SYSTEM BLEEDING

The hydraulic system is self-bleeding. After the hydraulic system has been drained, such as during the replacement of a hydraulic system component, raise and lower the platform three complete cycles. Recheck the oil level and fill as required.

HYDRAULIC CYLINDER INSPECTION

Wash the cylinder bore and all the components with solvent and make the following inspections:

CYLINDER BORE For signs of scoring and deep scratches. In the event of any defects, reassemble the entire cylinder and contact your distributor.

CYLINDER SHAFT For dents, deep scratches, or damaged chrome plating. File any sharp edges on ends of shaft to protect the seals upon reassembly. Always protect the shaft finish when clamping in a vice or when welding against weld splatter.

PISTON RINGS For cracks or other damage. Particularly check the interlocking ends that they are not missing or broken.

PISTON SEALS For signs of severe damage. Do not remove unless replacement is necessary.

PISTON & HEAD GLAND It is not normally necessary to replace the piston, piston rings, or head gland.

SERVICE & ADJUSTMENTS

SECTION 4

DESCRIPTION	PAGE NO.
INTRODUCTION	4 - 0 - 1
SERVICE STAND "LOCK"	4 - 0 - 2
HUB & WHEEL ASSEMBLY	4 - 1 - 1
HUB ASSEMBLY	4 - 1 - 2
STEERING & DRIVE ASSEMBLY	4 - 2 - 1
DRIVE MOTORS	4 - 3 - 1
DISC BRAKE	4 - 3 - 10
STEERING CYLINDER	4 - 4 - 1
PUMP/MOTOR ASSEMBLY	4 - 5 - 1
PUMP	4 - 5 - 2
HYDRAULIC ASSEMBLY	4 - 6 - 2
CONTROL VALVE - CH20NEP (w/o Proportional Drive)	4 - 7 - 1
CONTROL VALVE - CH20WEP, CH26NEP, CH26WEP (Proportional Drive Machines)	4 - 7A - 1
PRESSURE SETTING & ADJUSTMENTS	4 - 8 - 1
LIFT CYLINDER	4 - 9 - 1
GROUND CONTROL PANEL	4 - 10 - 1
AERIAL CONTROL BOX	4 - 11 - 1
BATTERY CHARGER	4 - 12 - 1
BATTERIES	4 - 13 - 1

SERVICE & ADJUSTMENTS

CONTROL VALVE

FUNCTION CONTROL VALVE P/N 81451 (ALL CH20/CH26 MODELS)

Refer to the Function Control Valve "fold-out" located after page 4-7-6 of this section.

1. SYSTEM RELIEF VALVE (RV1) P/N 69920

The relief valve is installed parallel to the pump inlet ("press") and return ("tank") ports. The purpose of the relief valve is to protect the pump and limit the pressure of the system. When flow produced by the pump is blocked, pressure builds. If it is higher than the force required to open a spring controlled "poppet" inside the valve, inlet flow is dumped to tank, limiting pressure in the system to that of the spring. The valve only opens if the pressure becomes higher than the spring pressure, at no other time will affect the operation of the system.

2. STEERING FLOW REGULATOR VALVE (FR1) P/N 69931

The steering flow regulator diverts some of the flow into the system for steering operation. It passes through a small hole ("orifice") in a spring operated piston ("poppet") inside the flow regulator. The orifice only allows a small amount of flow to pass, limiting the steering speed. Flow unable to go through the orifice passes downstream to be used for other functions. The force of the fluid against the poppet causes it to be pushed back against the spring, exposing a passageway allowing it to go around the flow regulator.

The amount flow going around the flow regulator is based on the difference in pressure between fluid to the steering circuit versus that passing downstream. This is "sensed" across a passage in the poppet of the flow regulator and is called "pressure compensation". It makes sure that steering speed remains constant even if pressure against the face of the poppet changes because pressure changes on the downstream side of the circuit.

3. STEERING DIRECTIONAL CONTROL VALVE (SV1) P/N 69925

The steering directional control valve is a 2 position 4 way, spool type, solenoid operated valve. When no electrical power is applied to either coil, flow through "FR1" is able to pass downstream to be used for other operations. Applying electrical power to a coil creates a magnetic field operating the solenoid controlling the "spool" (device used to direct flow through the valve). The distance that the spool moves ("stroke") results in flow being diverted out to either the "S1" or "S2" ports. At the same time fluid pushed out of the cylinder (as it operates) is able to pass back across the spool for use downstream. It combines with flow going around "FR1" providing full pump flow for drive operations. The result is that drive speed is not drastically affected whenever steering is operated. The interruption of power to the coil allows a spring inside the valve to push the spool back to its normal position. The fluid in the steering cylinder becomes "trapped" by the spool. The steering cylinder remains extended or retracted to the length it was operated. Flow to the valve through "FR1" passes across the spool again and downstream for use in other operations.

SERVICE & ADJUSTMENTS

CONTROL VALVE

4. STEERING RELIEF VALVES (RV2 & RV3) P/N 69922 & 69924

The steering relief valves operate the same as "RV1" but the force necessary to open them is far less. Both valves are in parallel so that pressure on one side (for example "S1") dumps to the opposite side ("S2) and vice versa. Pressure in the steering circuit must be limited to enable "FR1" to operate. If pressure on the spring controlled side of "FR1" became as high as the setting of "RV1", the poppet inside would seal off the passage that allows flow to go around it. This would cause drive to stop whenever the steering cylinder reached the end of its stroke. The relief valves limit the "back pressure" against the pressure compensated side of the regulator and enables the poppet to pass flow unable to go through the orifice. The full amount flow produced by the pump is then able to go downstream and travel speed is not affected.

5. LOW SPEED DRIVE FLOW REGULATOR (FR2) P/N 69933

The low speed drive flow regulator operates the same as "FR1" but here flow determines the maximum drive speed in low. The full flow from the pump tries to go through the orifice in the poppet of the flow regulator. The orifice is sized so only the amount of flow needed for slow travel speed is able to go through, this regulates the speed at which the motors turn. Flow unable to pass through the orifice goes around the flow regulator back to the hydraulic tank. The flow regulator is pressure compensated so flow to the motors remains the same, even though pressure in the circuit changes due to differences in the amount of drive force needed.

6. DRIVE ENABLE SOLENOID VALVE (SV3) P/N 69929

The drive enable solenoid valve is a 2 position 2 way, normally open, poppet type, solenoid valve. Applying electrical power to the coil generates a magnetic field and operating a solenoid that pushes against a pin, closing a drain hole in a poppet. Pressure then rises inside the poppet which is held open by a spring. The pressure overcomes the spring pushing the poppet down closing the valve. Flow going through the orifice in "FR2" is blocked from going to tank and diverted to "SV2". interrupting the power to the coil allows the spring to push the poppet open again and flow to pass across the valve.

7. DRIVE DIRECTIONAL CONTROL VALVE (SV2) P/N 69927

The drive directional control valve operates the same as "SV1" except that the spool blocks inlet flow when it is not operating. Turning it on diverts the flow from "FR1" and being blocked by "SV3" out either the "M1" or "M2" motor ports. At the same time fluid coming back from the motors is able to return back to tank. But unlike "SV1" fluid on the "outlet" (motor) side of the spool is not blocked. This allows fluid displaced by the motors, as they coast to a stop, to return to the tank. This enables pressure in the drive circuit to drop immediately letting the brakes apply.

SERVICE & ADJUSTMENTS

CONTROL VALVE

8. PARKING BRAKE SHUTTLE VALVE (LS1) P/N 69918

The parking brake shuttle valve is a "caged" ball parallel to the "S1" and "S2" ports. This enables it to respond to flow diverted into the drive circuit by "SV2". flow into one side pushes the ball against the opposite side blocking the inlet on that side. This results in flow being diverted to the parking brake release port ("brake"). When drive operation is reversed the inlet flow will enter on the opposite side of the circuit and the ball will be pushed to the other side. As long as their is a drive operation the flow into this circuit will continue to generate the pressure needed to hold the parking brake released.

9. COUNTERBALANCE/"DYNAMIC BRAKING" VALVE (CB1 & CB2) P/N 69917

The counterbalance valves create "back-pressure" on the tank side of the drive motors to provide "hydro-static" braking. The back pressure acts as an equivalent of the brake shoes on conventional brakes, eliminating the need to have large mechanical brakes. A spring inside holds a poppet closed that blocks return flow, from the drive motors, to tank. Spring tension is adjustable, enabling control of dynamic braking by varying the amount force needed to open the poppet. Less force allows the machine to coast while more force results in quicker stopping.

Flow diverted into the "M1" or "M2" passage by "SV2" goes through the counterbalance valve across an internal "one-way" check valve. As it returns on the tank side of the circuit it isn't able to go through the other counterbalance valve in the same way. The flow from "SV2" into the circuit creates a pressure signal, that is used to "pilot" open the poppet in the counterbalance valve blocking the return flow. This enables it to return to tank under very little back-pressure. As long as there is flow into the circuit the pilot signal continues to be generated and flow through the circuit is not hampered.

When "SV2" stops operating the pilot signal goes away and the valve closes, but momentum continues to push the machine and turning the motors. Since some fluid is still contained in the drive circuit there is still flow returning to tank. When the counterbalance valve closes pressure rises against the poppet. It rises enough to overcome the spring pushing the poppet open and allowing flow to dump back to tank. The "back pressure" that is created by doing this causes the motors to slow down. As they turn slower there is less flow. With less flow less pressure is generated and the poppet is not opened as long. The amount of pressure needed to open the poppet eventually becomes higher than which can be generated, and the machine comes to a complete stop.

The sequence of events that operate both counterbalance valves in creating a dynamic braking system remain the same in both directions of travel, the only difference is the direction of the fluid through the circuit.

SERVICE & ADJUSTMENTS

CONTROL VALVE

10. PARKING BRAKE CONTROL/"FREEWHEELING" VALVE (FC1) P/N 69937

The parking brake control valve enables adjustment of the speed that the parking brake applies. Flow diverted by "LS1" passes out to the "brake" port across an internal a "one-way" check valve. As soon as there is enough pressure to release the brake, the drive operation begins. As long as drive is operating pressure in the drive circuit continues to hold the brake "off". When drive is stopped the brake release pressure tries to fall off back across the brake control valve. But the one way check valve only allows fluid to flow "in" not back out. Pressure is only able to "bleed off" across an orifice inside the brake control valve. The orifice size controls how quickly pressure drops to a point at which the brake begins to apply. The larger the size of the orifice the quicker the pressure drops, the smaller its size the slower the pressure drops. The size of the orifice is changed by turning the handle of the valve.

Turning the handle clockwise until it "bottoms out" closes the orifice completely. This holds pressure in the brake release circuit to provide "freewheeling" (no parking brake application) of the machine. As long as the minimum amount of pressure needed to hold the brake off is held in the circuit the brake will not apply. Turning the handle slightly counterclockwise once again creates an orifice, allowing pressure to bleed off and the brake to apply. The parking brake control valve must always remain open unless it is necessary to freewheel the machine!

11. HIGH SPEED TRAVEL SOLENOID VALVE (SV4) P/N 69929

The high speed travel solenoid valve is the same as "SV3". turning the valve on closes it, so that the flow going around "FR2" is blocked from returning back to the tank. It is then available for use in the high speed operation of the drive function.

12. REGENERATIVE CHECK VALVE (CV1) P/N 69937

The regenerative check valve enables flow blocked by "SV4" to be added back into the drive circuit to regenerate flow from "FR2". the combination of two provides full pump flow for high speed drive operation. The speed at which the motors turn are a result of the rate of flow. Since full pump flow is being diverted by "SV2" the machine now travels at its highest rate of speed.

13. PLATFORM LIFT SOLENOID VALVE (SV5) P/N 69929

The platform lift solenoid valve is the same as "SV3" and "SV4". turning it "on" results in it closing and blocking pump flow from returning back to tank. Blocking the tank return passage results in flow being diverted out the "lift" port to the lift cylinder. When the valve is not in operation it returns to its normally open position. This allows fluid exhausted from the lift cylinder as the platform lowers to return back to tank.

SERVICE & ADJUSTMENTS

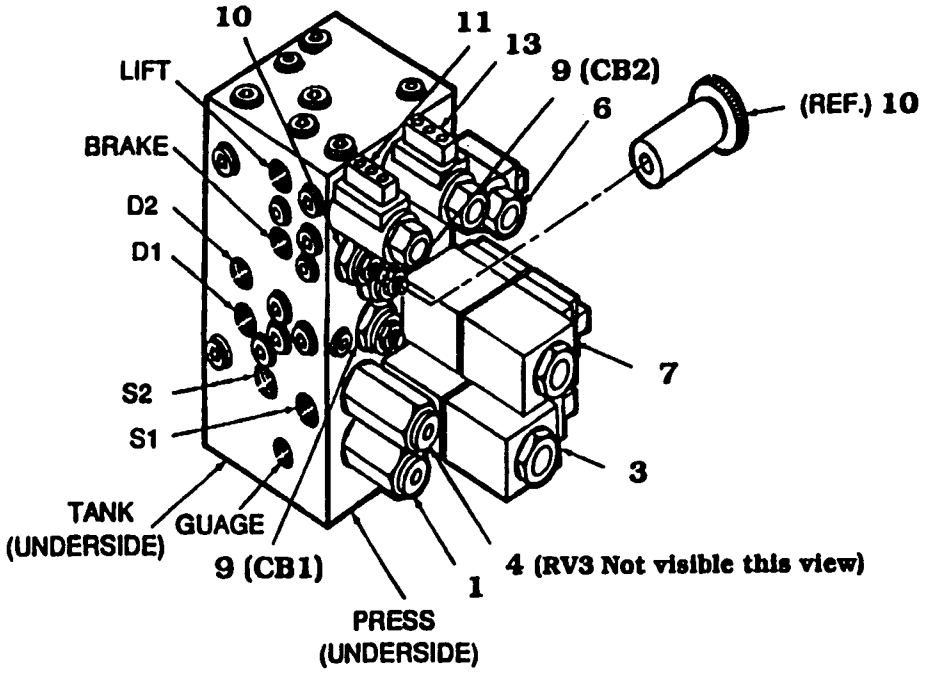
CONTROL VALVE

14.PLATFORM LOWERING SPEED FLOW REGULATOR (FR3) P/N 69934

The platform lowering speed flow regulator controls the maximum lowering speed of the platform. It is placed in the lift circuit so that flow "in" is able to push the spring controlled poppet inside the valve open without being restricted. When the platform is lowered fluid exhausted from the lift cylinder tries to pass back across the poppet. The spring causes it acts like a one way check valve holding the poppet closed. Flow can only pass back to the tank through an orifice in the poppet, limiting the lowering speed of the platform.

SERVICE & ADJUSTMENTS

NOTES

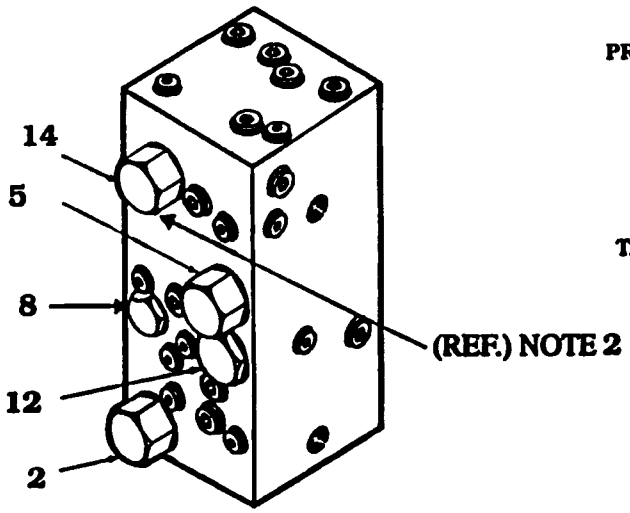


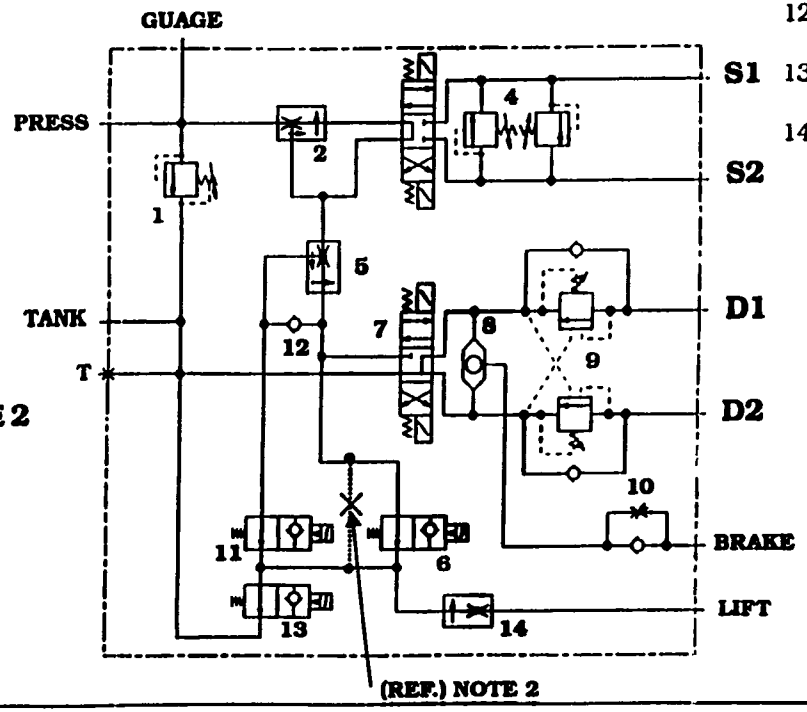
Note 1: Illustration is only representative. Actual appearance of components may vary.

Note 2: Pipe plug installed inside valve body behind SAE plug.

Component Description

1. System Relief Valve. (RV1)
2. Steering Flow Regulator. (FR1)
3. Steering Directional Control-Valve. (SV1)
4. Steering Relief Valve—Piston Side—(RV2), (RV3).
5. Low Speed Drive Flow Regulator. (FR2)
6. Drive Enable Solenoid Valve. (SV3)
7. Drive Directional Control Valve. (SV2)
8. Parking Brake Shuttle Valve. (LS1)
9. Counterbalance/Dynamic Braking Valve
   —Forward Direction. (CB2)
   —Reverse Direction. (CB1)
10. Parking Brake Control/ Freewheeling Valve. (FC1)
11. High Speed Travel Solenoid Valve. (SV4)
12. Regenerative Check Valve. (CV1)
13. Platform Lift Solenoid Valve. (SV5)
14. Platform Lowering Speed Flow Regulator. (FR3)



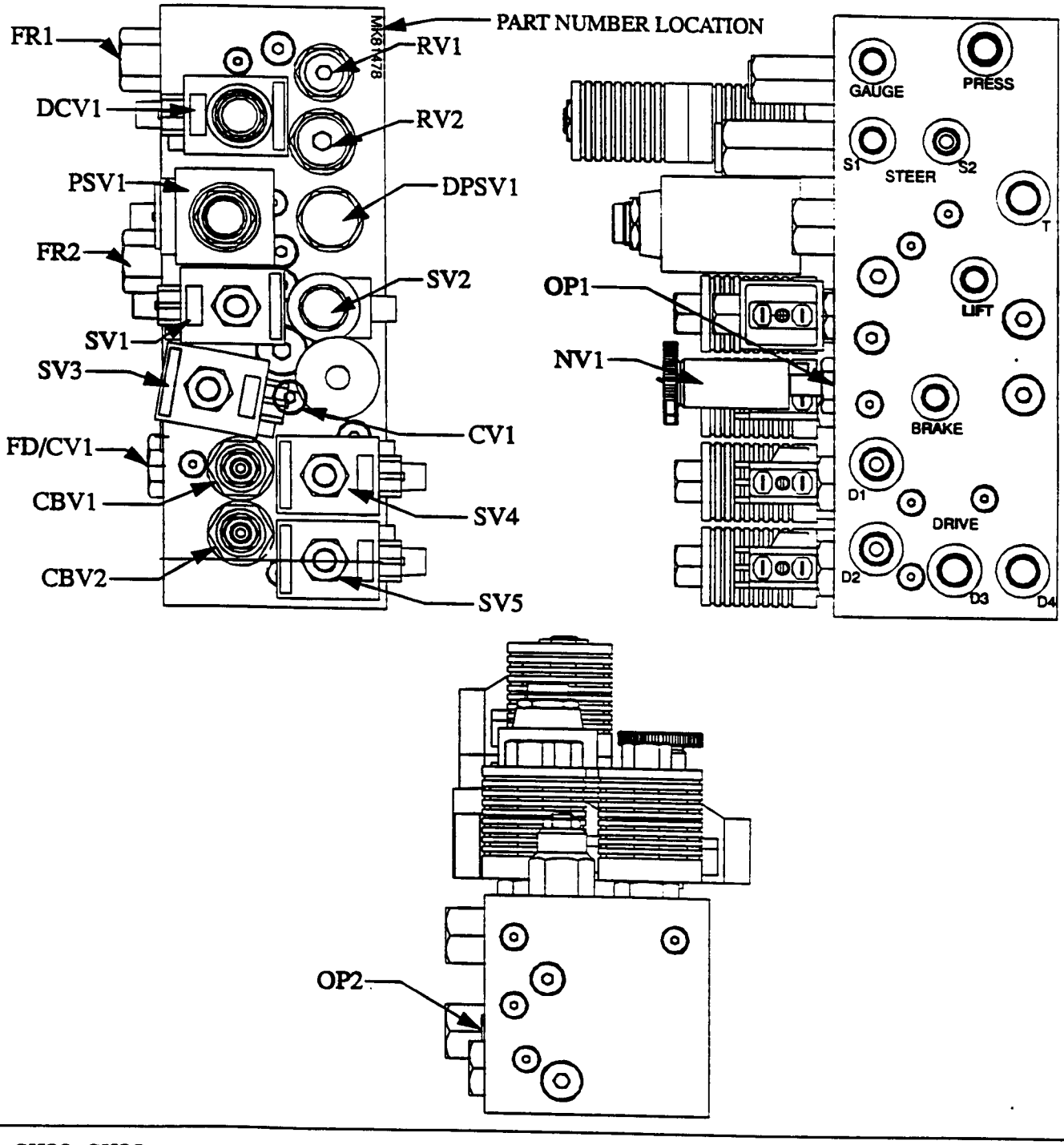


Function Control Valve
P/N 81451
CH20/CH26 SERIES

SERVICE & ADJUSTMENTS

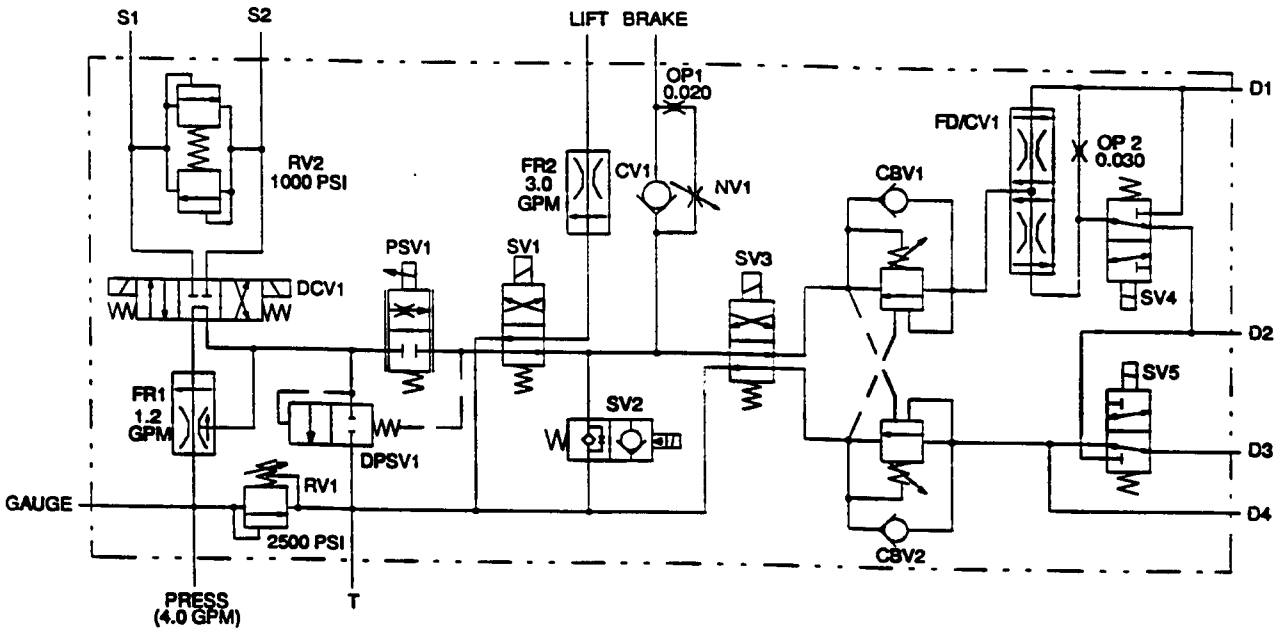
CONTROL VALVE ASSY. P/N 81478 (CH20WEP, CH26NEP & CH26WEP)

(Used on all machines with proportional drive)



SERVICE & ADJUSTMENTS

CONTROL VALVE ASSY. P/N 81478 (cont.)



KEY:

RV1.....SYSTEM RELIEF VALVE
FR1.....STEERING FLOW REGULATOR
DCV1.....STEERING DIRECTIONAL CONTROL VALVE
RV2.....STEERING RELIEF VALVE
DPSV1.....DIFFERRENTIAL PRESSURE SENSING VALVE
PSV1.....PROPORTIONAL SOLENOID VALVE
SV1.....PLATFORM LIFT SOLENOID VALVE
FR2.....PLATFROM LOWERING SPEED FLOW REGULATOR
SV2.....DRIVE ENABLE SOLENOID VALVE
CV1.....PARKING BRAKE RELEASE CHECK VALVE
OP1.....PARKING BRAKE APPLICATION ORIFICE PLUG
NV1.....PARKING BRAKE "FREE-WHEELING" VALVE
SV3.....DRIVE DIRECTIONAL CONTROL SOLENOID VALVE
CBV1.....COUNTERBALANCE VALVE "DYNAMIC BRAKING" FWD
CBV2.....COUNTERBALANCE VALVE "DYNAMIC BRAKING" REV
FD/CV1.....FLOW DIVIDER/COMBINER VALVE
OP2.....ORIFICE PLUG FLOW DIVIDER/COMBINER "BYPASS"
SV4.....HIGH SPEED DRIVE -"SERIES/PARALLEL" VALVE
SV5.....HIGH SPEED DRIVE -"SERIES/PARALLEL" VALVE

SERVICE & ADJUSTMENTS

CONTROL VALVE ASSY. P/N 81478 (cont.)

Refer to the control valve illustration and schematic on page 4-7A-1 and 4-7A-2 of this section.

RV1 (SYSTEM RELIEF VALVE) P/N 67981

The system relief valve (RV1) is located "across" (parallel) the "PRESS" (inlet) and "T" (tank return) passage. Its main purpose is to protect the pump. In doing so it also limits the operating pressure of the entire hydraulic system. The relief valve utilizes a spring controlled piston that is pushed open when fluid pressure exceeds that of the spring (2500 PSI). When the relief valve opens inlet flow passes back to tank limiting the maximum operating pressure of the system to the amount of force required to override the spring. Under normal conditions the relief valve opens only when inlet pressure exceeds spring pressure, at no other time does it affect the operating pressure of the system.

FR1 (STEERING FLOW REGULATOR) P/N 67982

The steering flow regulator (FR1) establishes the steering speed by limiting the volume of fluid available to the steering circuit. Flow into the valve assembly encounters a spring controlled piston with a small hole in its center in the flow regulator. The hole limits the amount fluid able to pass (2.5 GPM) controlling the operating speed of the cylinder. Flow unable to pass generates pressure against the piston compressing the spring. This opens a passage that allows flow to "bypass" FR1 and continue "downstream". The amount of flow bypassing FR1 is determined by the difference in the pressure against the piston and that needed to steer the machine. If pressure on the inlet side falls below that of the spring, the piston moves back reducing the size of the opening and limiting the amount bypassed. This establishes a constant rate of flow into the steering circuit independent of the pressure at the inlet. This feature is called "pressure compensation".

DCV1 (STEERING DIRECTIONAL CONTROL VALVE) P/N 67341

The steering directional control valve (DCV1) directs flow through FR1 out of "S1" (left steer) or "S2" (right steer). It is a 3 position, 4 way solenoid operated valve. When no electrical power is applied to either "solenoid" (coil) inlet flow passes downstream, while fluid on the opposite side is "trapped". Applying power to a solenoid creates a magnetic field, operating a plunger that pushes the "spool" (device that directs flow) against a spring which keeps it "centered". The coil being operated controls the distance the spool moves determining wether fluid is directed out S1 or "S2". This determines if the cylinder "extends" (steers left) or retracts (steers right). As the cylinder operates fluid in the end opposite of that which flow enters, passes back across the spool where it is combined with flow bypassing FR1. This assures that the full amount of flow produced by the pump is available for driving while steering is in operation. The loss of power to the coil enables the centering spring to return the spool to its normal position holding the cylinder to the direction operated and passing flow through FR1 downstream again.

SERVICE & ADJUSTMENTS

CONTROL VALVE ASSY. P/N 81478 (cont.)

RV2 (STEERING RELIEF VALVE) P/N 67984

The steering relief valve (RV2) limits the pressure in the steering circuit. It operates in principal very similar to RV1 but its construction is different. It is "bidirectional" (two directions) which enables it to respond to pressure on either side of the circuit in which it is situated. Additionally the amount of force required to compress the spring is less than that of RV1. It is positioned across S1 and S2. Excessive pressure on either side will cause it to open, "dumping" flow to the opposite (lower pressure). Pressure in the steering circuit must be limited to enable FR1 to operate. Too high a pressure on the "spring" (pressure compensated) side of FR1 would cause it to close shutting off the bypass flow. This would cause the drive to stop when the steering cylinder reached the end of its travel. Limiting "back pressure" on the cylinder side of FR1 enables it to bypass flow unable to go through the orifice. The full flow produced by the pump is then able to go downstream and drive is not affected.

DPSV1 (DIFFERENTIAL PRESSURE SENSING VALVE) P/N 67024

The differential pressure sensing valve (DPSV1) operates in conjunction with "PSV1" (proportional solenoid valve) to regulate flow for drive and platform lift operation. It serves as a "pilot" operated variable flow regulator enabling pump flow limited passage across PSV1 to return back to tank, at a pressure slightly higher (approximately 150 PSI) than that needed to operate the drive or platform lift function. When PSV1 is not in operation inlet flow generates pressure against a spring controlled piston inside DPSV1 pushing it open. This exposes a passage enabling flow to pass back to tank at a much lower pressure than that of RV1. When PSV1 is in operation the resistance to flow "downstream" (on the pressure compensated side of DPSV1) generates a "pilot signal". This adjusts the opening of the piston inside to limit the flow dumped to tank. The opening is "sized" to maintain a 150 PSI pressure difference between the inlet and downstream side of PSV1. This feature enables DPSV1 to approximate a variable displacement pump in a very rudimentary fashion, by dumping off "excess flow from the pump" (the pump has a "fixed" displacement) according to the "demand" sensed downstream of PSV1. As the pressure needed to operate the drive or platform lift function rises the pilot signal pressure increases forcing the piston inside DPSV1 to close further. This results in an increased flow across PSV1. As pressure "falls" the pilot signal pressure "drops" and pressure at the inlet pushes the piston open further reducing the flow directed against PSV1.

PSV1 (PROPORTIONAL SOLENOID VALVE) P/N 68877

The proportional solenoid valve (PSV1) regulates flow for the drive operation. The application of electrical power to the coil causes a magnetic field to be generated. The extent of the magnetic field is determined by the amount of power applied. This is controlled by the distance that the "joystick" controller in the aerial control box is moved "off center". The greater the power applied the stronger the field. The magnetic field drives the solenoid which is attached to the spool. The spool "travel" (stroke) controls the rate of flow. The greater the stroke of the spool greater the volume of fluid able to pass across PSV1. Proportional control of PSV1 is limited to that of the drive operation. When lifting the platform PSV1 is opened completely and full pump flow passes to SV1 (lift solenoid valve). Whenever power to the coil is interrupted (the drive controller or platform lift/lower switch is released) a spring forces the spool back to its normal position and flow across PSV1 is once again blocked.

SERVICE & ADJUSTMENTS

CONTROL VALVE ASSY. P/N 81478 (cont.)

SV1 (PLATFROM LIFT SOLENOID VALVE) P/N 68876

The platform lift solenoid valve (SV1) controls the platform lift operation. It is a 2 position, 4 way, solenoid valve. When SV1 is not in operation flow passing through is directed downstream to the drive circuit. The application of electrical power to the coil generates a magnetic field. The magnetic field operates a solenoid that is "coupled" to a spool inside SV1, The spool blocks flow into the drive circuit and redirects it out to the LIFT port. The interruption of power to the coil allows a spring to push the spool back to its normal position so that once again flow passes across SV1 into the drive circuit.

FR2 (PLATFORM LOWERING SPEED FLOW REGULATOR) P/N 66841

The platform lowering speed flow regulator (FR2) controls the maximum lowering speed of the platform. It is situated in the platform lift/lower circuit and affects only the platform lowering speed. Flow across SV1bypasses FR2 by pushing open the spring controlled poppet inside. The fluid exhausted from the lift cylinder whenever the platform is lowered (the lowering valve in the lift cylinder is operated) must pass back across FR2 to return to tank The poppet which is spring controlled to close now acts as a one way check valve, limiting the flow returning back to the tank through a small hole in its center. The lowering speed of the platform is then limited to the amount of fluid able to pass through the hole at any one time.

SV 2 (DRIVE ENABLE SOLENOID VALVE) P/N 67986

The drive enable solenoid valve (SV2) ensures that flow across PSV1 is directed into the drive circuit. It is a 2 position, 2 way, normally open, poppet type, solenoid valve. Applying electrical power to the coil generates a magnetic field operating a solenoid that pushes against a pin inside SV1, The pin operates a "poppet" (small piston) enabling flow through SV2 to enter inside the poppet through a small hole. This results in pressure rising behind the poppet pushing it down and overcoming the spring that holds it open. Flow going through "PV 1" is prevented from going to tank and diverted downstream for operation of the drive function. The interrupting of power to the coil enables the spring to push the poppet open. This allows "trapped" fluid to pass back to the tank ensuring that pressure drops rapidly in the drive circuit when the operation is stopped.

CV1 (PARKING BRAKE RELEASE CHECK VALVE) P/N 67988

The parking brake release check valve (CV1) enables flow into the drive circuit to be directed out to the BRAKE port to release the parking brakes. It is a "caged" ball type valve that enables pressure to rise rapidly at the parking brake by-passing NV1 and OP1. As the drive operation stops the fluid attempting to return from the brake is blocked by the ball and the "rate" (speed/time) at which pressure at the parking brake drops is determined by OP1.

SERVICE & ADJUSTMENTS

CONTROL VALVE ASSY. P/N 81478 (cont.),

OP1 (PARKING BRAKE APPLICATION ORIFICE PLUG) P/N 68871

The parking brake application orifice plug (OP1) controls the "rate" (time or speed) of the parking brake application. The parking brakes are released by the pressure generated by flow passing across CV1. The absence of pressure results in them reapplying automatically. The rate of application is determined by how rapidly pressure drops below the minimum needed to hold them released (see brake section for specifics). Stopping the drive operation results in no more flow across CV1. The parking brakes force fluid trapped behind OP1 back out through a small hole in its center across NV1 when it is open. The rate of application is determined by the size of the hole in OP1.

NV1 (PARKING BRAKE"FREEWHEELING" VALVE) P/N 68875

The parking brake "freewheeling" valve permits disabling the parking brakes to enable "winching" the machine should it be required for loading or unloading (see operators manual for specifics). The pressure "bleeding" off through OP1 that holds the brakes released must pass through NV1 to enable the brakes to apply. Turning the knob clockwise until "bottoming out" closes this passage off trapping pressure in the parking brake circuit. The pressure held in the circuit provides "freewheeling" (no parking brake application) of the machine. As long as the minimum amount of pressure needed to hold the brake "off" is held in, the brakes will not apply. Turning the handle counterclockwise opens NV1 allowing pressure to "decay" and the parking brakes to apply. The parking brake free-wheeling valve must always remain open unless it is necessary to freewheel the machine!

SV3 (DRIVE DIRECTIONAL CONTROL SOLENOID VALVE) P/N 68876

The drive directional control solenoid valve (SV3) diverts flow through the drive circuit to provide forward or reverse drive operation. It is a 2 position, 4 way, solenoid operated valve. It operates identically to SV1. However it is situated in the drive circuit. When SV3 is not in operation (no power applied to the coil) flow passing across SV1 passes across SV3 out to the motors in a path that provides drive in the forward direction. Applying electrical power to the coil generates a magnetic field operating the spool inside. This diverts flow out in a path to provide reverse drive. Simultaneously the spool allows flow from the motors to return back to tank regardless of the direction the motors are turning.

SERVICE & ADJUSTMENTS

CONTROL VALVE ASSY. P/N 81478 (cont.)

CBV1 & CBV2 (COUNTERBALANCE VALVE "DYNAMIC BRAKING" FWD & REV) P/N 68874

The counterbalance valves (CBV1/CBV2) function as the equivalent of service brakes. By creating "back-pressure" on the drive motors sufficient force for "dynamic" (live/moving) braking is generated, eliminating the need for large mechanical brakes. There are two counterbalance valves one for each direction of travel. While driving the valve on the return side of the circuit is held open so as not to impede return flow. The braking distance/force is determined by the adjustment of a spring operating against a piston. Inlet flow across SV3 passes across CBV1/CBV2 through an internal one-way check valve and out too the motors. Simultaneously a "pilot" (pressure) signal is generated which "acts" upon a pilot piston in the "opposite" (return side) valve. The resulting force in conjunction with that created by return flow from the motors generates the pressure necessary to open CBV1/CBV2. As long as flow occurs into the drive circuit the pilot signal is generated and flow back to tank across CBV1/CBV2 encounters very little resistance. The loss of the pilot signal results in CBV1/CBV2 attempting to close, which is opposed by flow retuning back from the motors. Momentum continues to turn the motors in effect making them pumps. Consequently fluid continues to be displaced fluid to tank. The pressure generated against the piston inside CBV1/CBV2 forces it to open allowing flow to "dump" back to tank. The resulting back pressure slows down the motor. Without inlet flow the motor "stalls" resulting in a complete stop.

FD/CV1 (FLOW DIVIDER/COMBINER VALVE) P/N 68873

The flow divider/combiner valve (FD/CV1) ensures continued travel whenever surface conditions result in a loss of ground contact with one of the driving wheels. It regulates flow too and from each motor independently based upon the difference in pressure needed to turn it. The division or combination of flow depends upon the direction being driven. The valve consists of two pistons that move independently but are mechanically linked to enable operation of one another. These contain openings for fluid to pass, the size of which is varied by the movement of the piston. The extent of the movement is determined by springs responding to the difference in pressure across both sides of the circuit. As a flow "divider" inlet flow passes through the center of the valve where it "splits" with approximately an equal amount going to each motor. While the force needed to turn each motor remains the same (both wheels on the ground) no pressure difference occurs across FD/CV1. But when travel over an uneven surface results in less force needed to turn a raised wheel, the motor turns faster creating a pressure drop across the piston servicing the motor. This causes the center spring to move the piston to the low pressure side. The size of the opening across the piston is reduced limiting flow to the motor. If the extent of piston movement was great enough the link between the two moves the piston on the opposite side as well. The movement in this case is toward the center consequently increasing the size of the opening. This enables more flow to be directed to the drive motor needing higher pressure to operate. This creates greater tractive effort and consequently travel is not affected. When the wheel once again contacts the ground the force needed to turn the motor increases and the pistons resume their "normal" position. The operation of FD/CV1 and its effect on motor operation is similar on the "combiner" side, except the "outboard" springs operate the pistons causing them to move toward the center. The size of the opening however is still decreased limiting flow across the piston.

SERVICE & ADJUSTMENTS

CONTROL VALVE ASSY. P/N 81478 (cont.)

OP2 (ORIFICE PLUG FLOW DIVIDER/COMBINER "BYPASS") P/N 67349

The flow divider/combiner by-pass orifice plug (OP2) enables flow to bypass FD/CV1 whenever the drive motors are connected in "series" (high speed travel). Turning while driving in high speed results in higher pressure at the motor on the "inside" of the turn due its slower speed. This difference causes FD/CV1 to increase flow to the motor requiring the greater force to turn and reduce flow to the opposite (outside) motor. Extremely sharp turns can result in a substantial difference in pressure and consequently cause a significant loss of speed, since the inside motor cannot turn any faster. The orifice plug (OP2) reduces the effects of FD/CV1 during the high speed travel operation by enabling flow to "bypass" the valve. The size of the hole in OP2 limits the flow bypassing FD/CV1 sufficiently low enough so as not to affect the tractive effort of the motor.

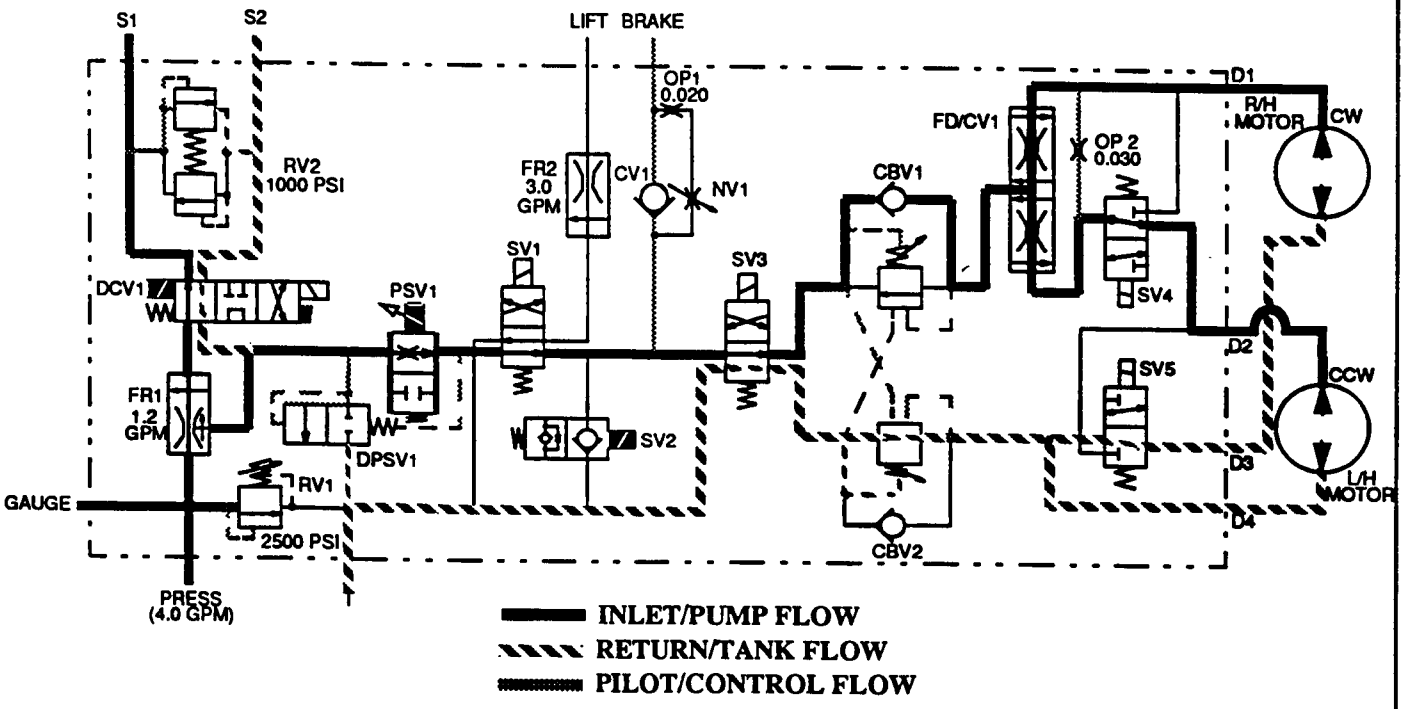
SV4 & SV5 (HIGH SPEED DRIVE - "SERIES/PARALLEL VALVE) P/N 67346

The high speed drive or "series/parallel" valves (SV4/SV5) operate in unison directing flow through the drive motors to provide a maximum "high" (series) or "low" (parallel) travel speed. They are both 2 position, 2 way, solenoid operated valves and are situated so as to affect flow into or out of each "paired" (D1 and D3/D2 and D4) set of motor ports. The application of electrical power to the coils generates a magnetic field. The magnetic field operates a solenoid that is "coupled" to spools inside, The spools direct flow though the drive circuit so that the motors are connected in either a parallel or series circuit. Flow in the forward direction in low speed is divided by FD/CV1 and passes out D1 and across SV4 out D2. This results in a separate flow out to each motor, with return flow going coming back through D3, passing across SV5 and recombining downstream with that from D4. In the reverse direction flow passes divides upstream of SV5 to pass out D3 and D4 and returns through D2 and D1. Flow through D2 is blocked by SV5 and is diverted across SV4 to be combined with flow from D1 across FD/CV1. When high speed is selected electrical power is applied to both coils. In the forward direction with both SV4 and SV5 in operation flow divided by FD/CV1 passes out D1 but is blocked on the opposite side by SV4. The blocked flow recombines with that on the opposite side of FD/CV1 by passing through OP2. This results in flow only passing out of D1 and only to one motor. Return flow from the motor enters through D3 and is diverted back out D2 by SV5. This is directed to the other motor and returns back through D4. In the reverse direction flow passes out D4, comes back through D2 and being blocked by SV4, is diverted by SV5 back out D3 to the opposite motor. Return flow comes passes back through D1 and bypasses the combiner effect of FD/CV1 across OP2.

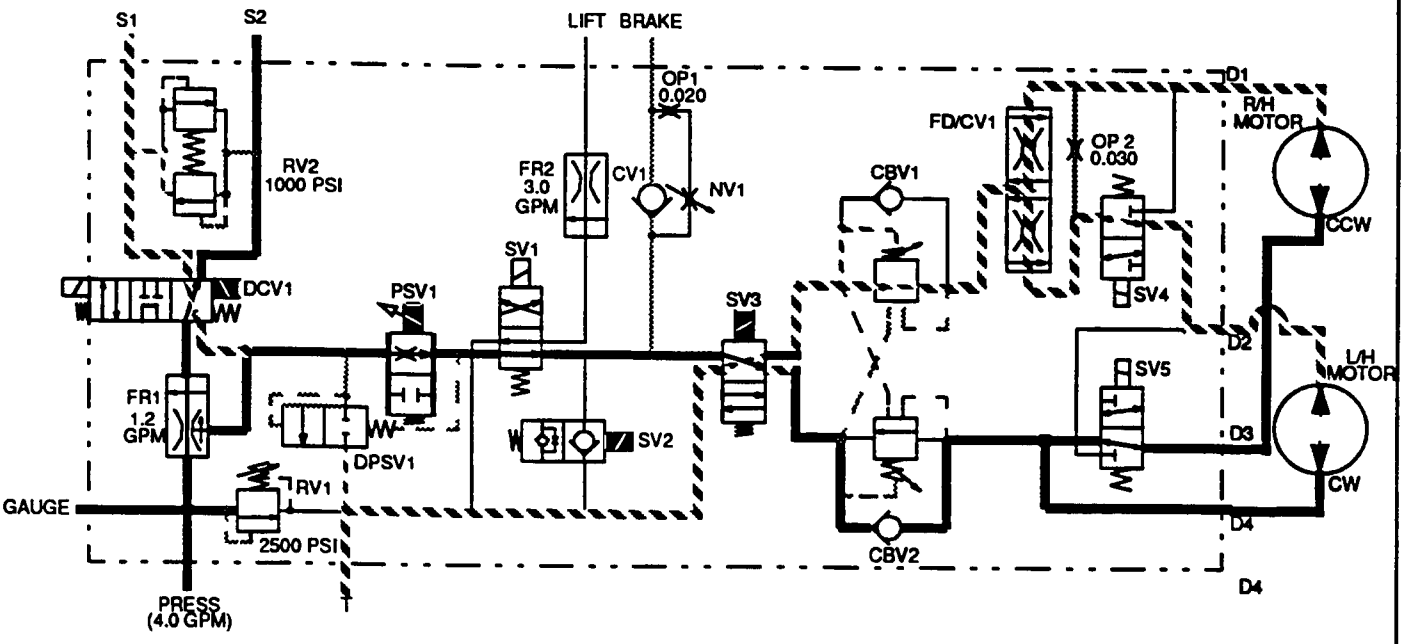
SERVICE & ADJUSTMENTS

P/N 81478 VALVE ASSEMBLY

FLOW IN "LOW SPEED" (PARALLEL) FORWARD TRAVEL& STEER RIGHT



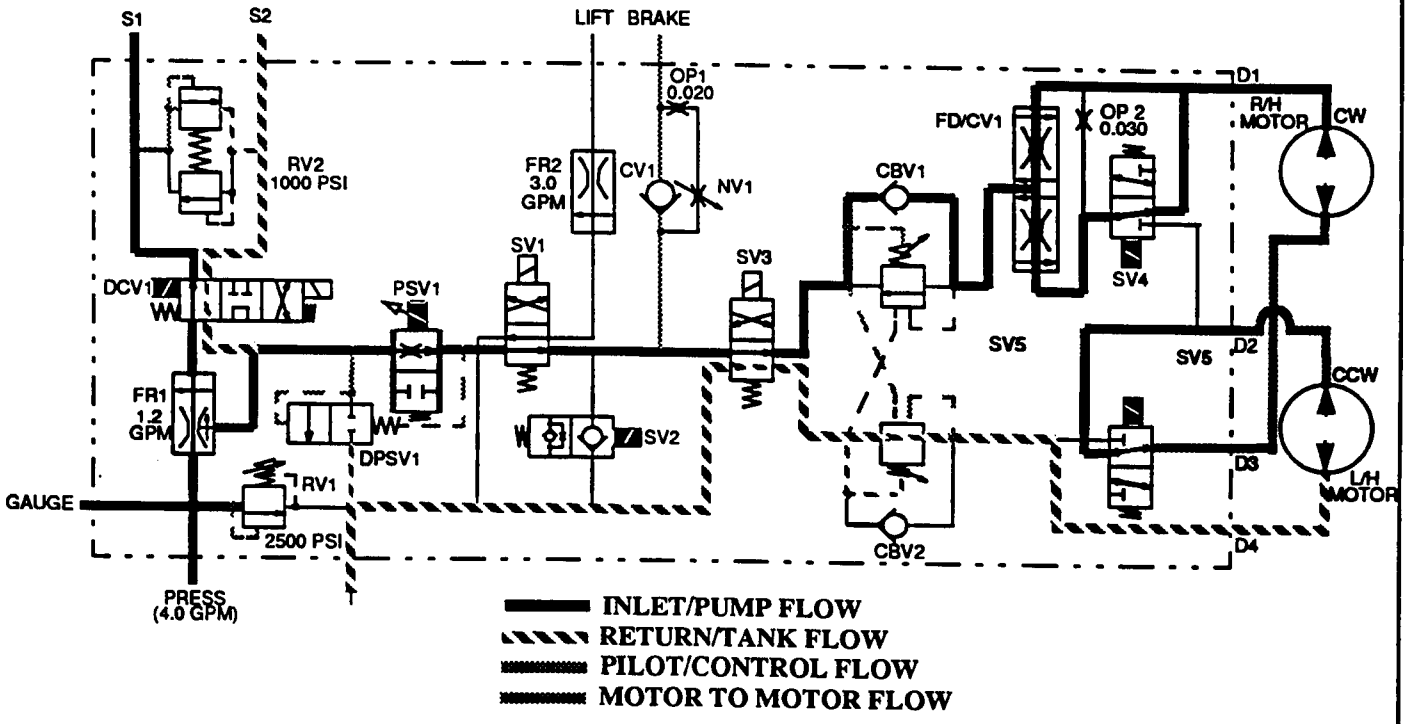
FLOW IN "LOW SPEED" (PARALLEL) REVERSE TRAVEL& STEER LEFT



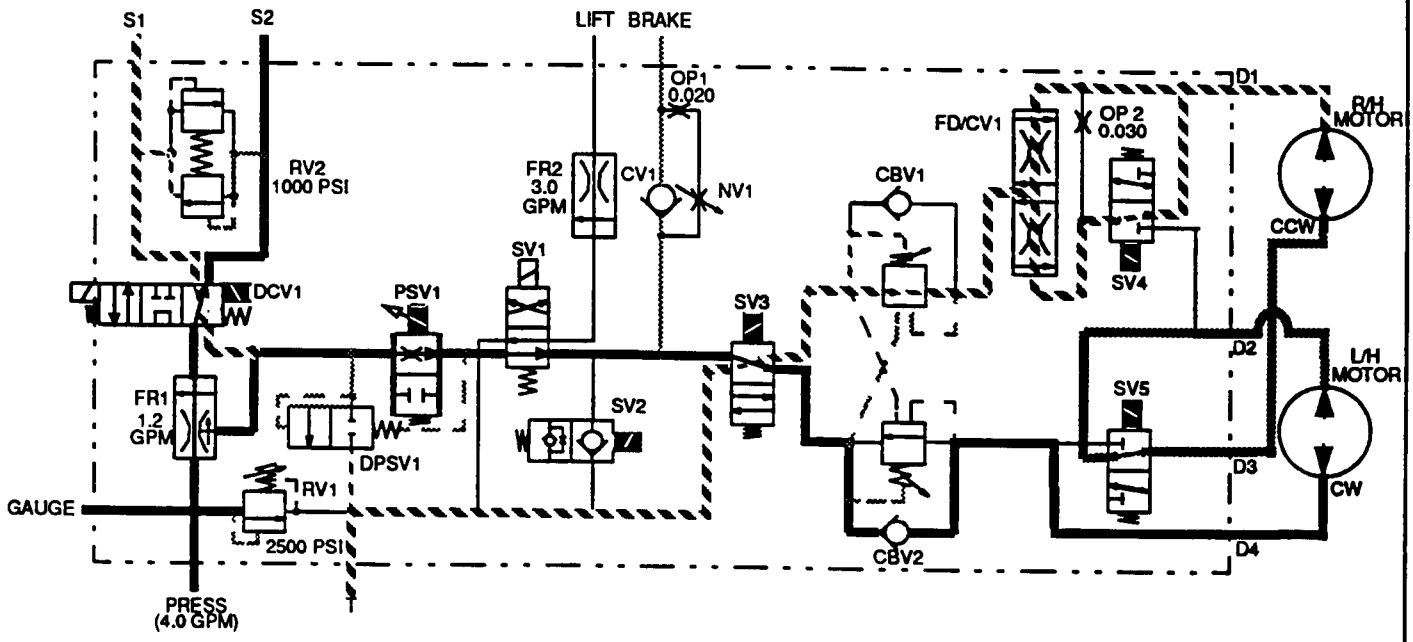
SERVICE & ADJUSTMENTS

P/N 81478 VALVE ASSEMBLY (CONT.)

FLOW IN "HIGH SPEED" (SERIES) FORWARD TRAVEL& STEER RIGHT



FLOW IN "HIGH SPEED" (SERIES) REVERSE TRAVEL& STEER LEFT



SERVICE & ADJUSTMENTS

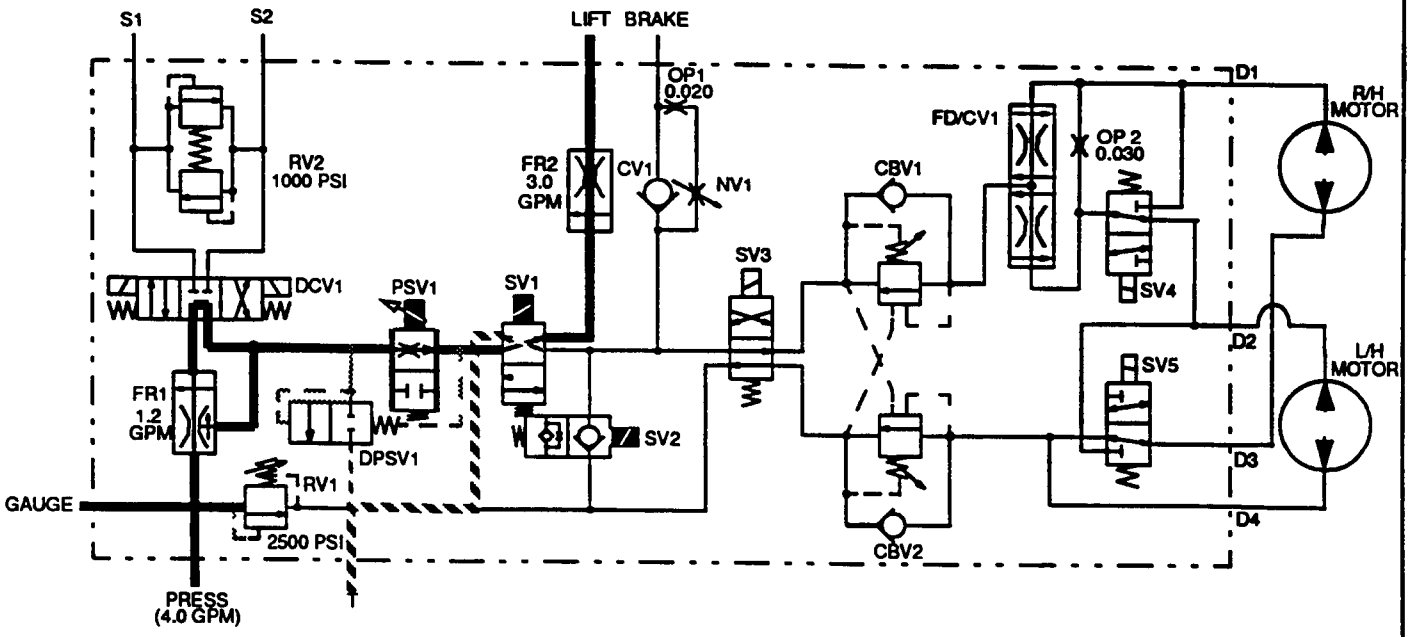
P/N 81478 VALVE ASSEMBLY (CONT.)

PLATFORM LIFT FLOW

INLET/PUMP FLOW

RETURN/TANK FLOW

PILOT/CONTROL FLOW



SERVICE & ADJUSTMENTS

PRESSURE SETTING & ADJUSTMENTS
P/N 81451 CONTROL VALVE (CH20 & CH26 MODELS)

Refer to the Function Control Valve "fold-out" located on the previous page.

TOOLS REQUIRED:

1 each pressure gauge 0 (zero) to 3000 PSI minimum
1 each socket head ("Allen") wrench - 3/16 inch, 5/32 inch
1 each open end wrench - 1/2 inch
1 each P/N 80028-03 fitting ("#4 straight run swivel tee")

ADJUSTING SYSTEM RELIEF VALVE (RV1)

1. Install pressure gauge on pressure test fitting ("quick disconnect at "gauge" port).

2. Remove cap (3/16" socket head) from relief valve (note: valve body may contain hydraulic fluid).

3. Raise platform until lift cylinder reaches end of stroke, hold switch "on" and note pressure on gauge.

4. Adjust cap (3/16" socket head) inside valve body:

   to increase pressure - turn clockwise
   to decrease pressure - turn counterclockwise

   NOTE: Do not exceed the pressure setting on the identification plate on the machine.

5. Reinstall socket head cap and remove pressure gauge.

ADJUSTING STEERING RELIEF VALVE (RV2/RV3)

1. With "tee" fitting install pressure gauge on fitting in "S1" to adjust relief valve for left steer or "S2" to adjust relief valve for right steer.

2. Remove cap (3/16" socket head) from relief valve ("RV1" for steer right or "RV3" for steer left)

   (NOTE: Valve body may contain hydraulic fluid).

3. Operate steering right or left until cylinder reaches end of stroke, hold switch "on" and note pressure on gauge.

4. Adjust cap (3/16" socket head) inside valve body:

   to increase pressure - turn clockwise
   to decrease pressure - turn counterclockwise

   NOTE: Do not exceed the setting indicated on the hydraulic schematic of the machine.

5. Reinstall socket head cap and remove pressure gauge.

ADJUSTING COUNTERBALANCE/"DYNAMIC BRAKING" VALVE (CB1/CB2)

NOTE: These adjustments must always be performed on a level area free of "hazards"; slopes, "drop offs", objects with which collisions may occur.

1. Place an object on the ground or mark a line to serve as a reference point.

2. Turn the parking brake control valve ("FC1") clockwise until it is "bottomed out" (fully closed").

3. With the drive speed selector switch in "high" operate the drive controller "full-on" in the forward direction.

4. Drive the machine in a straight line approximately a distance of 10 feet to achieve maximum travel speed.

5. Release the drive controller as the front wheel passes the reference mark.

6. Measure the distance from the center of the wheel to the reference mark, this is the dynamic braking distance.

7. Loosen the locking nut fastening the threaded shaft of the "CV1" counterbalance valve and turn it:

   a. Clockwise to lengthen the braking distance
   b. Counterclockwise to shorten the braking distance

   NOTE:evaluate job-site conditions and adjust braking accordingly, the maximum distance should never be more than 3 feet!

SERVICE & ADJUSTMENTS

8. For reverse travel braking adjustment repeat steps 1 - 7, operate drive controller in reverse adjust counterbalance valve "CV2" to obtain desired braking distance.

9. Re-tighten the lock nut and open the parking brake control valve (see "adjusting the parking brake control valve).

ADJUSTING PARKING BRAKE CONTROL VALVE (FC1)

NOTE: These adjustments must always be performed on a level area free of "hazards"; slopes, "drop offs", objects with which collisions may occur.

1. Mark a line on the ground and select a wheel to act as a reference when crossing the mark.

2. Turn the handle of the parking brake control valve clockwise until it is "bottomed out" (fully closed").

3. Place the drive speed selector switch in "high".

4. Operate the drive controller "full-on" in the forward direction, driving a distance of at least 10 feet in order to achieve the maximum travel speed.

5. Release the drive controller when the reference wheel passes the mark.

6. The distance measured from the center of the wheel to the reference mark is the dynamic braking distance.

7. Turn the brake control valve counterclockwise (in 1/4 turn increments) until the machine stops in a slightly shorter distance than that measured in step 6.

8. Turn the brake control valve clockwise (in 1/8 turn increments) until the machine stops in the same distance as that measured in step 6.

SERVICE & ADJUSTMENTS

NOTES

TROUBLESHOOTING

INTRODUCTION

Aerial lift longevity and low-cost performance depend on Periodic Maintenance, Troubleshooting and proper Service and Adjustment procedures.

It is responsibility of the owner, user, and operator to detect any unusual, sounds, odors, or other signs of abnormal performance that could indicate trouble ahead.

By detecting any problems in their early stages, you can save yourself unnecessary downtime and your employer a lot of money! Therefore, it is also your responsibility to use good judgment in detecting failures in quickly and repairing them. If you don't, one failure can lead to another.

NOTE: THE SERVICE AND MAINTENANCE PROCEDURES PROVIDED IN THIS MANUAL SHOULD ONLY BE PERFORMED BY A QUALIFIED AERIAL LIFT MECHANIC.

Before attempting a repair yourself, ask yourself if you have the RIGHT TOOLS, IF you have the PROPER TEST EQUIPMENT and IF you can accurately DIAGNOSE the cause of the problem.

If you can't answer YES to all three questions, rely on your Distributor Serviceman. He has the right tools, testing equipment and service knowledge to pin-point the problem in minutes instead of the hours consumed in hit-or-miss methods. TIME IS MONEY! He will save it for you.

If you decide to attempt a repair yourself, follow a logical TROUBLE SHOOTING PROCEDURE. Don't simply replace parts until the trouble is found.

Once the cause of problem or malfunction has been diagnosed, take the corrective action specified in this manual. Follow the procedures given for the specific problem. If the difficulty is not covered, consult your Mark Distributor, or the Mark Industries Product Support Department.

GENERAL TROUBLESHOOTING

The troubleshooting section contained in this manual is intended to serve only as a general guide, in diagnosing a finite number of "possible" causes for specific malfunctions, they are not all inclusive! There could easily be more than one possible fault or condition affecting the operation, or lack of operation, of a function. There is no substitute for a solid working knowledge of both the electrical and hydraulic system of the marklift challenger scissorlift. The "professional" knows the importance of being able to read and understand electrical and hydraulic schematics. He employs them as the valuable tools they are, to quickly focus on and identify the root cause of most of the malfunctions which are typically encountered. Without schematics system diagnosis is often time consuming and can turn into "a hit or miss affair".

All of the controls on the marklift challenger scissorlift are electrically actuated, while the functions themselves are all hydraulically operated. As a consequence it is extremely important to be able to determine first if the cause of a malfunction is electrical in nature, or hydraulic. The answer to this single question can reduce the number of possibilities by half!

It should always be remembered that when trouble shooting any system, a systematic approach of trouble shooting must be used. If components are switched around or circuits altered to determine the nature of a malfunction, be sure to return them back to their original location or configuration if it failed to correct the problem. The practice of failing to do this after performing a number of such tests, eventually leads to the condition known as "not seeing the forest for the trees". Troubleshooting a system in which there are inter-relationships between components can be difficult enough on its own, without inadvertently altering the original operation of any of the circuits.

Correct any deficiencies or faults that are detected, before continuing on with the diagnosis. In

TROUBLESHOOTING

some instances correcting an apparently unrelated fault could result in the correction or a reduction in the effects of the original fault. Remember sometimes the most basic approach is the most effective. Most conditions in which electrical controls fail to operate are due to an open in the circuit. Check for loose wires and/or connectors. Don't assume that a connection is tight because it appears to be connected, check and make sure!

As a rule the condition which accounts for slow speed of a function in hydraulic systems, are typically due to a loss flow in circuit. **Pressure, or the lack of pressure**, does not make a motor turn faster! Pressure only creates the force that is required to make the cylinder or motor perform some type of work; I.E., Drive the machine or lift the platform. The speed at which these function operate is dependant on the amount of hydraulic fluid flowing in the circuit controlling these functions.

Adjusting a relief valve to attempt to compensate for low pressure in a hydraulic system has no effect if the drop is due to a loss in the rate of flow. The relief valve is not the cause of the problem, the pressure drop is an effect of the loss of hydraulic fluid in the circuit. Correct the cause of the loss of flow and pressure will rise back to the original setting of the relief valve.

Try to remain objective in your troubleshooting approach, being an effective trouble shooter is not an inborn skill nor is it magic. Develop a system that encompasses as many aspects and components of the circuit in which the fault is occurring, and then by a process of elimination reduce the number of components to one. It isn't important to be able to state exactly why a particular component creates a specific effect on the operation of a circuit. The very fact that this component can be identified as the cause of the malfunction, and by removing it eliminates the effect, enables you to be an effective troubleshooter.

There is an effect for every cause, and the correct identification of which is which ensures that every repair you make is a lasting one. If it were possible to list every possible condition for every possible effect, this manual would attempt to do so. However a troubleshooting guide of this scope is simply not possible. Only each new additional "insight" you gain, in the pursuit of a cause for each malfunction, will enable you to make a more rapid diagnosis, than that which could be accomplished from selecting a probable cause from a list of options. Good luck and good learning!

TROUBLESHOOTING

ELECTRICAL SYSTEM TROUBLESHOOTING

FAULT: NO CONTROLS OPERATE AT EITHER GROUND OR AERIAL STATION

1. GROUND CONTROL EMERGENCY STOP SWITCH PUSHED IN OR DEFECTIVE.
2. MASTER SWITCH (SW1) NOT TURNED ON OR DEFECTIVE.
3. BATTERIES LOW.
4. OPEN CIRCUIT (WIRE #37) BATTERIES TO CIRCUIT BREAKER (CB1).
5. OPEN CIRCUIT (WIRE #30) CIRCUIT BREAKER (CB1) TO EMERGENCY STOP SWITCH.
6. OPEN CIRCUIT (WIRE #40) EMERGENCY STOP SWITCH TO MASTER SWITCH (S1).
7. LOW VOLTAGE INTERRUPT ENERGIZED (SEE ITEM #3).

FAULT: PUMP MOTOR DOES NOT OPERATE

1. OPEN CIRCUIT (WIRE #37) TO PUMP MOTOR RELAY (R1).
2. PUMP MOTOR RELAY (R1) DEFECTIVE.
3. PUMP MOTOR DEFECTIVE.
4. OPEN CIRCUIT (WIRE #20) TO PUMP MOTOR RELAY (R1).
5. OPEN CIRCUIT (WIRE #59) PUMP MOTOR RELAY (R1) TO PUMP MOTOR.
6. OPEN CIRCUIT (WIRE #1) PUMP MOTOR TO BATTERY NEGATIVE (-).
7. PUMP MOTOR VOLTAGE TOO LOW (LOOSE CABLES BETWEEN BATTERIES).

TROUBLESHOOTING

FAULT: PLATFORM DOES NOT LIFT "OR" LOWER FROM GROUND STATION

1. OPEN CIRCUIT (WIRE #3) MASTER SWITCH (S1) TO LIFT/LOWER SWITCH (S2).

FAULT: PLATFORM DOES NOT LIFT FROM GROUND STATION

1. OPEN CIRCUIT (WIRE #37) LIFT/LOWER SWITCH (S2) TO PUMP MOTOR RELAY (R1).
2. PLATFORM LIFT/LOWER SWITCH (SW2) DEFECTIVE.
3. OPEN CIRCUIT (WIRE #17) LIFT/LOWER SWITCH (SW2) TO SLOPE SENSOR RELAY (R2).
4. SLOPE SENSOR RELAY (R2) DEFECTIVE OR ENERGIZED (11 & 3 OPEN).
5. OPEN CIRCUIT (WIRE #27) SLOPE SENSOR RELAY (R2) TO LIFT VALVE (SV1).
6. LIFT COIL (SV1) DEFECTIVE.
7. OPEN CIRCUIT (WIRE #1) LIFT VALVE (SV1) TO GROUND.

FAULT: PLATFORM DOES NOT LOWER FROM GROUND STATION

1. OPEN CIRCUIT (WIRE #13) PLATFORM LIFT/LOWER SWITCH (S2) TO LOWERING VALVE (SV2).
2. LOWERING COIL (SV2) DEFECTIVE.
3. OPEN CIRCUIT (WIRE #1) LOWERING VALVE (SV2) TO "GROUND".

TROUBLESHOOTING

FAULT: NO CONTROLS OPERATE AT AERIAL STATION

1. AERIAL CONTROL EMERGENCY STOP SWITCH PUSHED IN OR DEFECTIVE.
2. SCISSOR ARM CABLE CONNECTOR AT REAR OF GROUND CONTROL BOX LOOSE.
3. QUICK DISCONNECT AT BOTTOM OF AERIAL CONTROL BOX LOOSE.
4. OPEN CIRCUIT (WIRE #3) TO PIN "C" OF QUICK DISCONNECT.
5. OPEN CIRCUIT (WIRE #3) PIN "C" TO AERIAL CONTROL EMERGENCY STOP SWITCH.
6. OPEN CIRCUIT (WIRE #50) EMERGENCY STOP SWITCH TO CONTROLS ENABLE SWITCH.
7. OPEN CIRCUIT (WIRE #60) CONTROLS ENABLE SWITCH TO CONNECTION ON FUNCTION CONTROL SWITCHES.
8. DEFECTIVE CONTROLS ENABLE SWITCH.

FAULT: PLATFORM DOES NOT LIFT OR LOWER FROM AERIAL STATION

1. OPEN CIRCUIT (WIRE #60) TO DRIVE ENABLE SWITCH (S5) ON DRIVE/STEER JOYSTICK.
2. DRIVE ENABLE SWITCH (S5) DEFECTIVE OR INOPERATIVE.
3. OPEN CIRCUIT (WIRE #70) DRIVE ENABLE SWITCH (S5) TO PLATFORM LIFT/LOWER SWITCH (SW5).

FAULT: PLATFORM DOES NOT LIFT FROM AERIAL STATION

1. LIFT FUNCTION INOPERATIVE DUE POTENTIALLY UNSTABLE CONDITION (INSTABILITY ALARM LIGHT AND BUZZER ON).
2. PLATFORM LIFT/LOWER SWITCH (SW5) DEFECTIVE.

3. LIFT COIL (SV1) DEFECTIVE

4. SLOPE SENSOR RELAY (R2) DEFECTIVE OR ENERGIZED (11 & 3 OPEN).

5. OPEN CIRCUIT (WIRE #4) LIFT/LOWER SWITCH (SW5) TO DRIVE ENABLE RELAY (R4).

6. DRIVE ENABLE RELAY (R4) DEFECTIVE OR ENERGIZED (1 & 10 OPEN).

7. OPEN CIRCUIT (WIRE #17) LIFT/LOWER SWITCH (SW5) TO SLOPE SENSOR RELAY (R2).

8. OPEN CIRCUIT (WIRE #27) SLOPE SENSOR RELAY (R2) TO LIFT VALVE (SV1).

9. OPEN CIRCUIT (WIRE #1) LIFT VALVE (SV1) TO "GROUND".

10. DRIVE FUNCTION OPERATING (WHEN DRIVING LIFTING IS DISABLED).

FAULT: PLATFORM DOES NOT LOWER FROM AERIAL STATION

1. EXTENDABLE DECK NOT COMPLETELY RETRACTED.

2. OPEN CIRCUIT (WIRE #7) PLATFORM LIFT/LOWER SWITCH (SW5) TO DECK EXTEND RELAY (R5).

3. OPEN CIRCUIT (WIRE #13) DECK EXTEND RELAY (R5) TO LOWERING VALVE (SV2).

4. LOWERING COIL (SV2) DEFECTIVE.

5. OPEN CIRCUIT (WIRE #1) LOWERING VALVE (SV2) TO "GROUND".

6. DECK EXTENSION RELAY (R5) DEFECTIVE OR ENERGIZED (6 & 10 OPEN).

7. OPEN CIRCUIT (WIRE #60) TO PROXIMITY SENSOR ON EXTENDABLE DECK.

TROUBLESHOOTING

8. PROXIMITY SENSOR ON EXTENDABLE DECK DEFECTIVE OR OPEN CIRCUIT TO "GROUND".

9. OPEN CIRCUIT (WIRE #14) PROXIMITY SENSOR UNDER EXTENDABLE DECK TO DECK EXTEND RELAY (R5).

FAULT: PLATFORM DOES NOT LOWER WITH DECK EXTENDED

1. DESCENT OVER-RIDE SWITCH NOT DEPRESSED.

2. OPEN CIRCUIT (WIRE #7) PLATFORM LIFT/LOWER SWITCH (SW5) TO DESCENT OVER-RIDE SWITCH.

3. OPEN CIRCUIT (WIRE #13) DESCENT OVER-RIDE SWITCH TO LOWERING VALVE (SV2).

FAULT: NO DRIVE IN FORWARD OR REVERSE DIRECTION

1. DRIVE ENABLE SWITCH (S5) DEFECTIVE.

2. OPEN CIRCUIT (WIRE #60) TO DRIVE ENABLE SWITCH (S5) ON DRIVE/STEER JOYSTICK.

3. OPEN CIRCUIT (WIRE #6) DRIVE ENABLE SWITCH (S5) TO DRIVE ENABLE RELAY (R4).

4. DRIVE ENABLE RELAY (R4) DEFECTIVE OR NOT ENERGIZED (5 & 9 OPEN).

5. OPEN CIRCUIT (WIRE #3) MASTER SWITCH (SW1) TO DRIVE ENABLE RELAY (R4).

6. OPEN CIRCUIT (WIRE (#1) DRIVE ENABLE RELAY (R4) "GROUND".

TROUBLESHOOTING

FAULT: NO DRIVE IN FORWARD DIRECTION

1. OPEN CIRCUIT (WIRE #60) TO SWITCH FOR FORWARD TRAVEL (S4) ON DRIVE/STEER JOYSTICK.
2. FORWARD TRAVEL DIRECTION CONTROL SWITCH (S4) DEFECTIVE OR INOPERATIVE.
3. OPEN CIRCUIT (WIRE #10) TO FORWARD COIL OF DRIVE DIRECTIONAL CONTROL VALVE (SV5).
4. OPEN CIRCUIT (WIRE (#1) "GROUND" FOR FORWARD COIL OF DRIVE DIRECTIONAL CONTROL VALVE (SV5).
5. FORWARD COIL (SV5) DRIVE DIRECTIONAL CONTROL VALVE DEFECTIVE.

FAULT: NO DRIVE IN REVERSE DIRECTION

1. OPEN CIRCUIT (WIRE #60) TO SWITCH FOR REVERSE TRAVEL (S3) ON DRIVE/STEER JOYSTICK.
2. REVERSE TRAVEL DIRECTION CONTROL SWITCH (S3) DEFECTIVE OR INOPERATIVE.
3. OPEN CIRCUIT (WIRE #11) TO REVERSE COIL OF DRIVE DIRECTIONAL CONTROL VALVE (SV6).
4. OPEN CIRCUIT (WIRE (#1) "GROUND" FOR REVERSE COIL OF DRIVE DIRECTIONAL CONTROL VALVE (SV6).
5. REVERSE COIL (SV6) DRIVE DIRECTIONAL CONTROL VALVE DEFECTIVE.

TROUBLESHOOTING

FAULT: NO HIGH SPEED DRIVE

1. OPEN CIRCUIT (WIRE #60) TO HIGH SPEED SELECTOR SWITCH.
2. HIGH SPEED CUT-OUT FUNCTIONING (HIGH SPEED DRIVE IS DISABLED WHENEVER THE PLATFORM IS ELEVATED HIGHER THAN 7 FEET).
3. HIGH SPEED SELECTOR SWITCH OPEN (HIGH SPEED NOT SELECTED) OR DEFECTIVE.
4. OPEN CIRCUIT (WIRE #16) HIGH SPEED SELECTOR SWITCH TO HIGH SPEED CUT-OUT PROXIMITY SWITCH (SENSOR #1) MOUNTED ON FRAME.
5. OPEN CIRCUIT (WIRE #26) HIGH SPEED CUT-OUT PROXIMITY SWITCH (SENSOR #1) TO HIGH SPEED RELAY (R3).
6. HIGH SPEED CUT-OUT PROXIMITY SWITCH (SENSOR #1) DEFECTIVE OR NOT "GROUNDED".
7. HIGH SPEED RELAY (R3) DEFECTIVE OR ENERGIZED (5 & 9 OPEN).
8. OPEN CIRCUIT (WIRE #3) TO TERMINAL #5 OF HIGH SPEED RELAY (R3).
9. OPEN CIRCUIT (WIRE #31) TO HIGH SPEED SOLENOID VALVE (SV7).
10. OPEN CIRCUIT TO "GROUND" (WIRE #1) OF HIGH SPEED RELAY (R3).
11. HIGH SPEED SOLENOID VALVE (SV7) COIL DEFECTIVE.
12. OPEN CIRCUIT TO "GROUND" (WIRE #1) OF HIGH SPEED SOLENOID VALVE (SV7) COIL.

FAULT: STEERING DOES NOT OPERATE "UNLESS" DRIVE IS OPERATED

1. OPEN CIRCUIT (WIRE #60) TO STEERING PUMP MOTOR CONTROL SWITCH (S6).
2. DEFECTIVE OR INOPERATIVE STEERING PUMP MOTOR CONTROL SWITCH (S6).

3. OPEN CIRCUIT (WIRE #4) "JUMPER" TO PLATFORM LIFT/LOWER SWITCH (SW5).

4. OPEN CIRCUIT "JUMPER" (WIRE #60) TO STEERING LEFT CONTROL SWITCH (S2).

FAULT: STEERING DOES NOT OPERATE TO THE RIGHT

1. OPEN CIRCUIT "JUMPER" (WIRE #60) TO STEERING RIGHT CONTROL SWITCH (S1).

2. DEFECTIVE OR INOPERATIVE STEERING RIGHT CONTROL SWITCH (S1).

3. OPEN CIRCUIT (WIRE #5) TO STEERING RIGHT SOLENOID VALVE COIL (SV4).

4. DEFECTIVE STEERING RIGHT SOLENOID VALVE COIL (SV4).

5. OPEN CIRCUIT (WIRE #1) TO "GROUND" OF STEERING RIGHT SOLENOID VALVE COIL (SV4).

FAULT: STEERING DOES NOT OPERATE TO THE LEFT

1. DEFECTIVE OR INOPERATIVE STEERING LEFT CONTROL SWITCH (S2).

2. OPEN CIRCUIT (WIRE #15) TO STEERING LEFT SOLENOID VALVE COIL (SV3).

3. DEFECTIVE STEERING LEFT SOLENOID VALVE COIL (SV3).

4. OPEN CIRCUIT (WIRE #1) TO "GROUND" OF STEERING LEFT SOLENOID VALVE COIL (SV3).

TROUBLESHOOTING

HYDRAULIC SYSTEM TROUBLE SHOOTING

FAULT: NO PRESSURE AT PRESSURE TEST (GAUGE) PORT.

1. HYDRAULIC FLUID LEVEL LOW.
2. INLET STRAINER INSIDE RESERVOIR PLUGGED OR PUMP INLET BLOCKED.
3. PUMP "BY-PASSING" OR DEFECTIVE.
4. COUPLING BETWEEN PUMP AND MOTOR BROKEN OR WORN.
5. SYSTEM RELIEF VALVE (RV1) STUCK OPEN.

FAULT: SYSTEM AT PRESSURE TEST PORT BUT NO OPERATIONS.

1. PUMP "BY-PASSING".
2. STEERING FLOW REGULATOR (FR1) STUCK CLOSED OR BLOCKED.
3. BLOCKAGE IN PASSAGE TO STEERING DIRECTIONAL CONTROL VALVE (SV1).
4. LOW SPEED DRIVE FLOW REGULATOR (FR2) STUCK OR PASSAGE BLOCKED.

FAULT: NO STEERING OPERATION.

1. STEERING DIRECTIONAL CONTROL VALVE MALFUNCTIONING OR DEFECTIVE.
2. STEERING FLOW REGULATOR (FR1) MALFUNCTIONING OR BLOCKED.
3. STEERING CYLINDER "BY-PASSING".
4. BINDING (MECHANICAL) IN STEERING ASSEMBLY.

TROUBLESHOOTING

FAULT: NO STEERING RIGHT OPERATION.

1. STEERING DIRECTIONAL CONTROL VALVE (SV1) MALFUNCTIONING.
2. STEERING CYLINDER "BY-PASSING".
3. STEERING RELIEF VALVE (RV2) ON "ROD" SIDE OF CYLINDER STUCK OPEN.
4. BINDING (MECHANICAL) IN STEERING ASSEMBLY.FAULT: NO STEERING LEFT OPERATION.

FAULT: NO STEERING LEFT OPERATION.

1. STEERING DIRECTIONAL CONTROL VALVE (SV1) MALFUNCTIONING.
2. STEERING RELIEF VALVE (RV1) ON "PISTON" SIDE OF CYLINDER STUCK OPEN.

FAULT: NO DRIVE OPERATION.

1. DRIVE ENABLE SOLENOID VALVE (SV3) MALFUNCTIONING.
2. DIRECTIONAL CONTROL VALVE (SV2) MALFUNCTIONING.
3. PARKING BRAKE(S) NOT RELEASING.

FAULT: NO LOW SPEED DRIVE OPERATION.

1. PUMP BYPASSING.
2 DRIVE MOTORS WORN OR LEAKING INTERNALLY.
3. LOW SPEED FLOW REGULATOR (FR2) MALFUNCTIONING OR BLOCKED.
4. LOW SPEED FLOW REGULATOR BY-PASS CHECK VALVE (CV1) MALFUNCTIONING.
5. PARKING BRAKE RELEASE SHUTTLE VALVE (LS1) LEAKING.
6. DRIVE ENABLE SOLENOID VALVE (SV3) LEAKING.

TROUBLESHOOTING

FAULT: NO HIGH SPEED DRIVE OPERATION.

1. HIGH SPEED DRIVE SOLENOID VALVE (SV4) MALFUNCTIONING.
2. LOW SPEED FLOW REGULATOR (FR2) MALFUNCTIONING.

FAULT: NO DRIVE FORWARD OPERATION.

1. DRIVE DIRECTIONAL CONTROL VALVE (SV2) MALFUNCTIONING.
2. DYNAMIC BRAKING COUNTER-BALANCE VALVE (CB1) MALFUNCTIONING.
3. PARKING BRAKE RELEASE SHUTTLE VALVE (LS1) MALFUNCTIONING.

FAULT: NO DRIVE REVERSE OPERATION.

1. DRIVE DIRECTIONAL CONTROL VALVE (SV2) MALFUNCTIONING.
2. DYNAMIC BRAKING COUNTER-BALANCE VALVE (CB2) MALFUNCTIONING.
3. PARKING BRAKE RELEASE SHUTTLE VALVE (LS1) MALFUNCTIONING.

FAULT: PARKING BRAKE(S) DOES NOT RELEASE.

1. PARKING BRAKE RELEASE SHUTTLE VALVE (SV1) MALFUNCTIONING OR BLOCKED.
2. PARKING BRAKE CONTROL/"FREE-WHEELING" VALVE (FC1) MALFUNCTIONING OR BLOCKED.
3. PARKING BRAKE MALFUNCTION (SEE TROUBLESHOOTING PARKING BRAKE).

FAULT: PARKING BRAKE(S) DOES NOT APPLY.

1. PARKING BRAKE RELEASE SHUTTLE VALVE (SV1) BLOCKED.
2. PARKING BRAKE CONTROL/"FREE-WHEELING" VALVE (FC1) MALFUNCTIONING OR BLOCKED.
3. PARKING BRAKE MALFUNCTION (SEE TROUBLESHOOTING PARKING BRAKE).

TROUBLESHOOTING

FAULT: NO PLATFORM LIFT OPERATION.

1. PUMP BY-PASSING.
2. LIFT SOLENOID VALVE (SV5) MALFUNCTIONING.
3. PLATFORM LOWERING SPEED FLOW REGULATOR (FR3) MALFUNCTIONING.
4. PLATFORM LOWERING SOLENOID VALVE MALFUNCTIONING.
5. DRIVE OPERATING (WHEN DRIVING LIFTING IS DISABLED).

FAULT: PLATFORM LIFTS SLOW OR ONLY PART WAY.

1. PUMP BY-PASSING.
2. PLATFORM LOWERING SPEED FLOW REGULATOR (FR3) MALFUNCTIONING.
3. PLATFORM LOWERING SOLENOID VALVE MALFUNCTIONING.
4. LIFT SOLENOID VALVE (SV5) MALFUNCTIONING.
5. LIFT CYLINDER BY-PASSING.
6. HYDRAULIC FLUID RESERVOIR LEVEL TOO LOW.
7. BREATHER IN RESERVOIR FILLER CAP PLUGGED.
8. BINDING (MECHANICAL) IN SCISSOR ASSEMBLY.

FAULT: PLATFORM DOES NOT REMAIN ELEVATED.

1. PLATFORM LOWERING SOLENOID VALVE MALFUNCTIONING.
2. CABLE FOR MANUAL LOWERING OPERATION BINDING.
3. LIFT CYLINDER BYPASSING.

TROUBLESHOOTING

FAULT: UNIT DOES NOT CLIMB GRADE (10%).

1. PUMP BY-PASSING.
2. DRIVE MOTORS BY-PASSING.
3. PARKING BRAKE(S) "DRAGGING" (NOT RELEASING FULLY).
4. DYNAMIC BRAKING COUNTERBALANCE VALVES (CB1 & CB2) ADJUSTED TOO "HIGH" (TOO TIGHT).
5. PARKING BRAKE RELEASE SHUTTLE VALVE (LS1) LEAKING.
6. LOW SPEED FLOW REGULATOR MALFUNCTIONING.

FAULT: HYDRAULIC FLUID IN RESERVOIR EXTREMELY HOT.

1. RELIEF VALVE (RV1) STUCK OPEN OR SET TOO LOW.
2. HIGH WATER CONTENT IN HYDRAULIC FLUID.
3. SUSTAINED OPERATION FOR EXCESSIVE TIME PERIOD OR NEAR "PEAK" OPERATING PRESSURE.

FAULT: PUMP SQUEALS OR IS EXCESSIVELY NOISY.

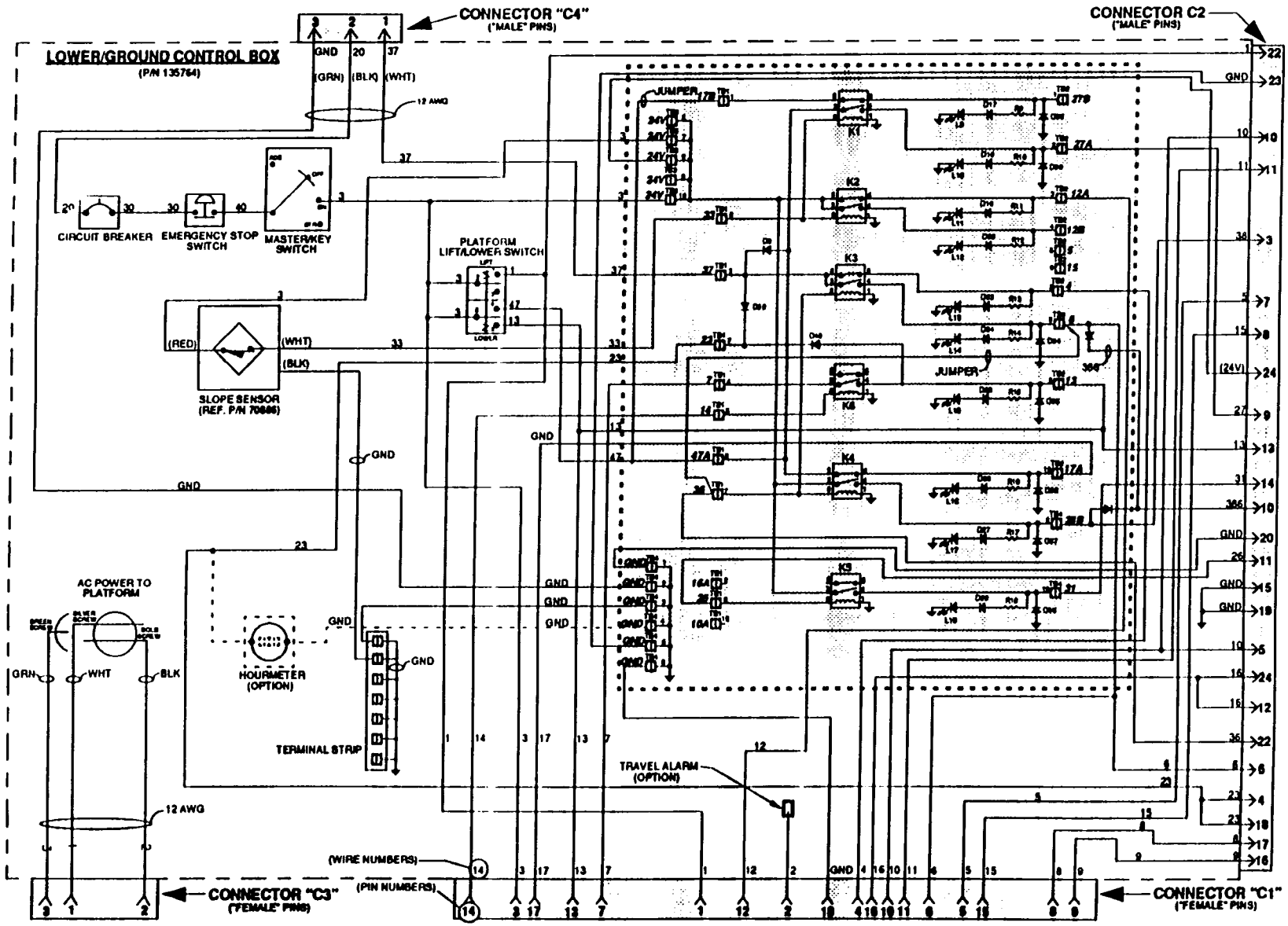
1. FLUID LEVEL IN RESERVOIR TOO LOW (PUMP CAVITATING).
2. BREATHER IN FILLER CAP PLUGGED (PUMP CAVITATING).
3. WATER IN HYDRAULIC FLUID.
4. PUMP INLET SUCKING AIR (AERATION).
5. BY-PASS VALVE IN RETURN LINE FILTER STUCK OPEN.

TROUBLESHOOTING

NOTES

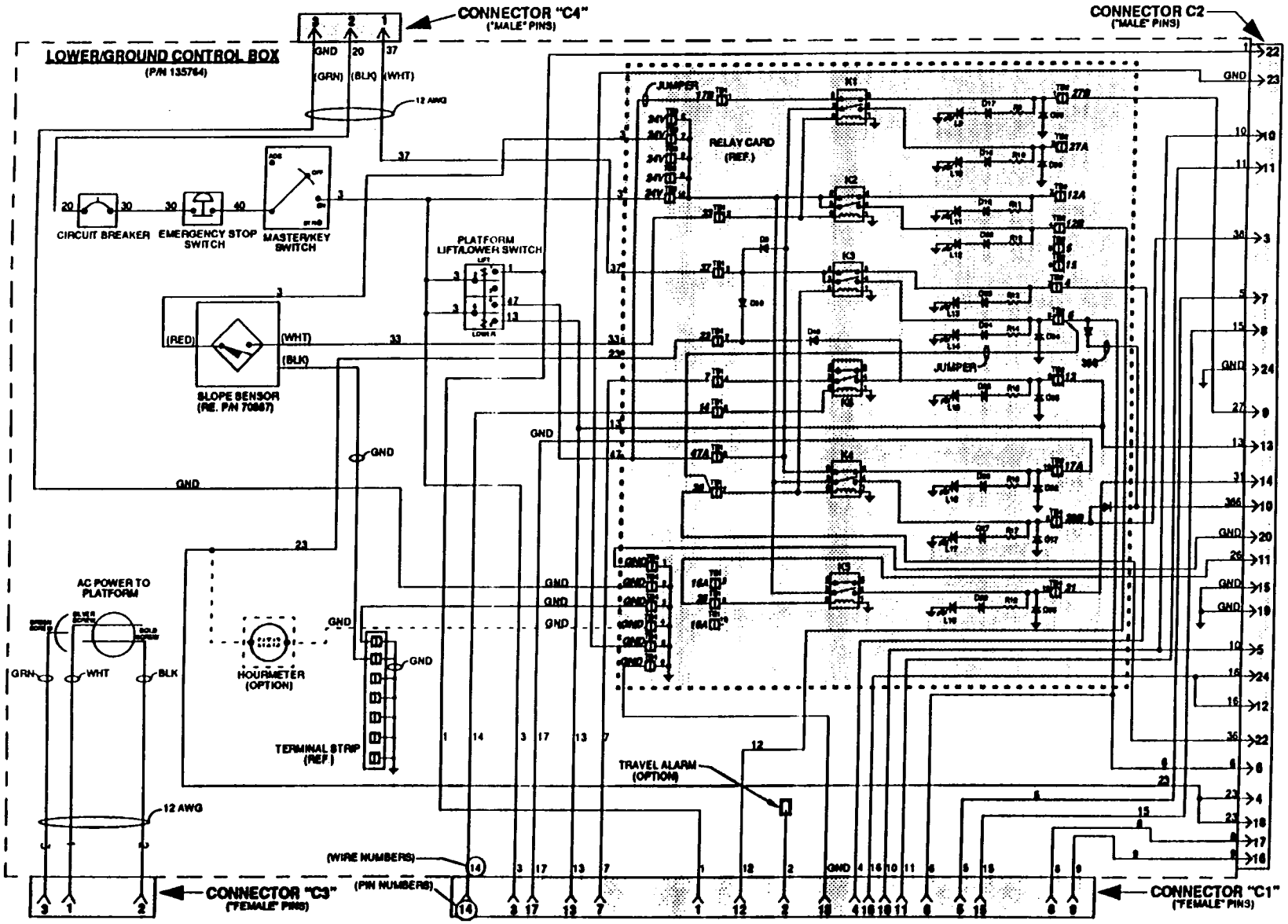
SCHEMATIC: GROUND CONTROL BOX "CH" MODELS

WITH NORMALLY CLOSED SLOPE SENSOR ("SUBSEQUENT TO GROUND CONTROL BOX S/N 195")



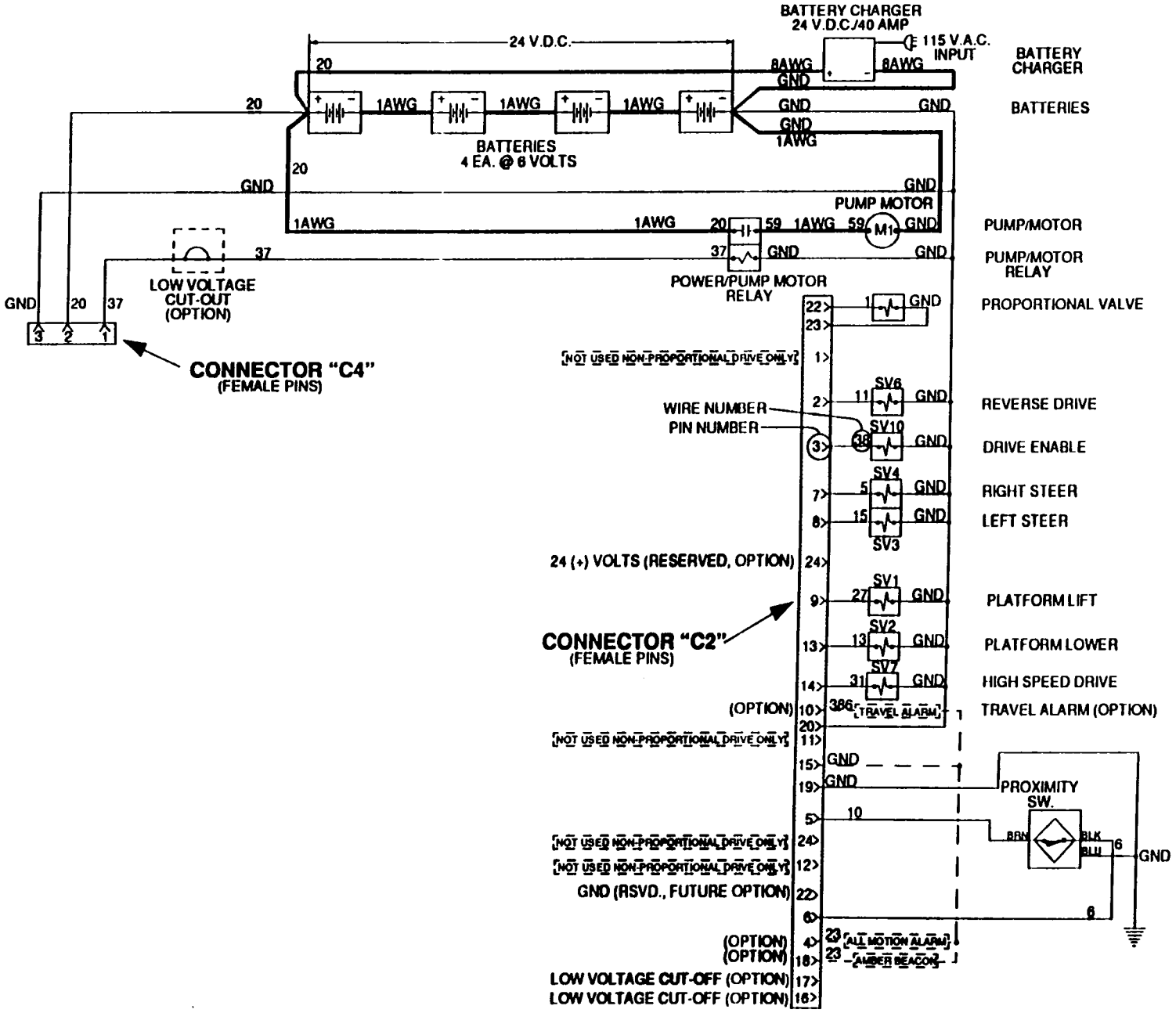
SCHEMATIC: GROUND CONTROL BOX "CH" MODELS

WITH NORMALLY OPEN SLOPE SENSOR ("PRIOR TO GROUND CONTROL BOX S/N 195")



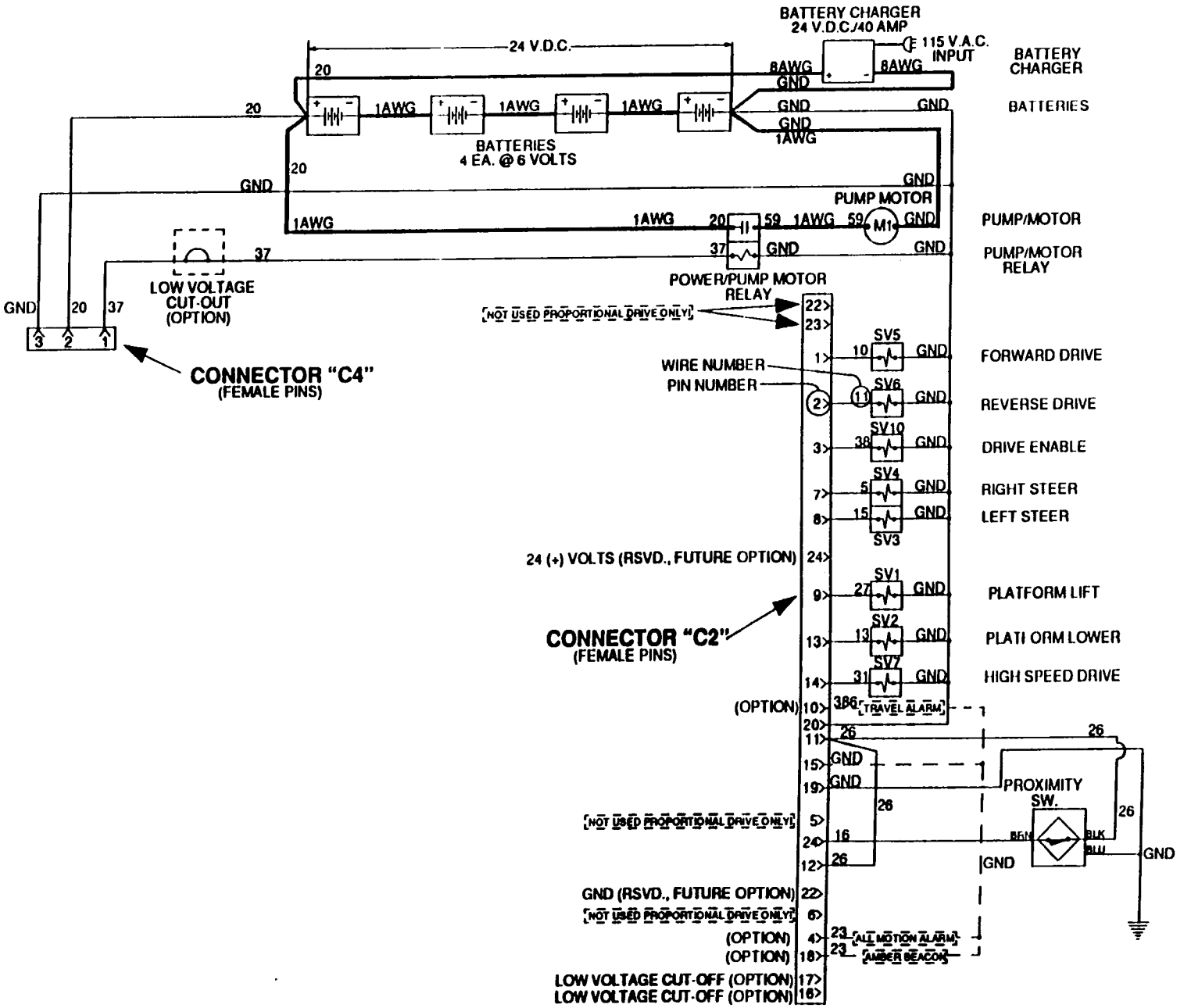
SCHEMATIC: VALVE & CHASSIS WIRING

"CH" MODELS W/PROPORTIONAL DRIVE



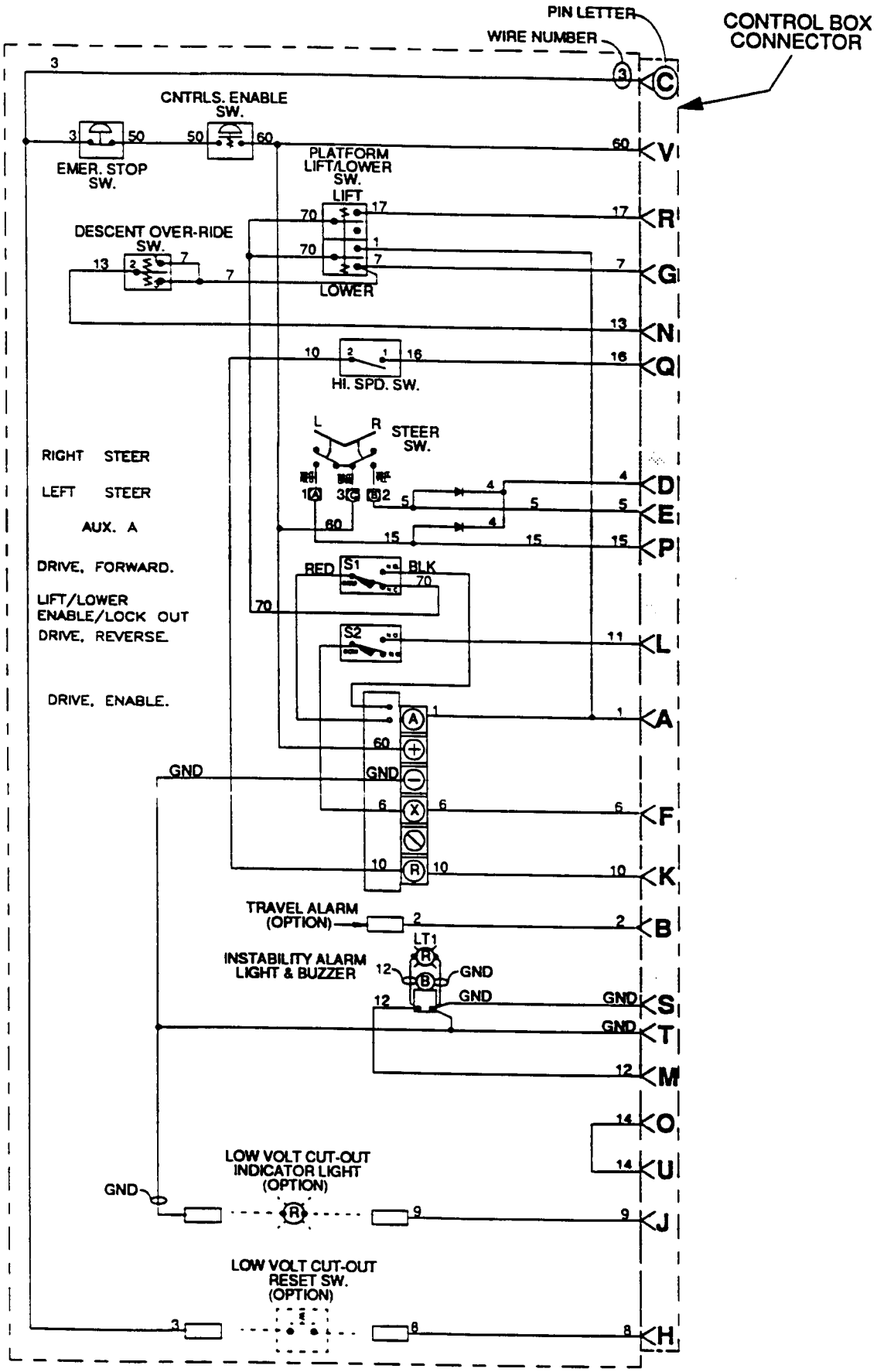
SCHEMATIC: VALVE & CHASSIS WIRING

"CH" MODELS W/NON-PROPORTIONAL DRIVE



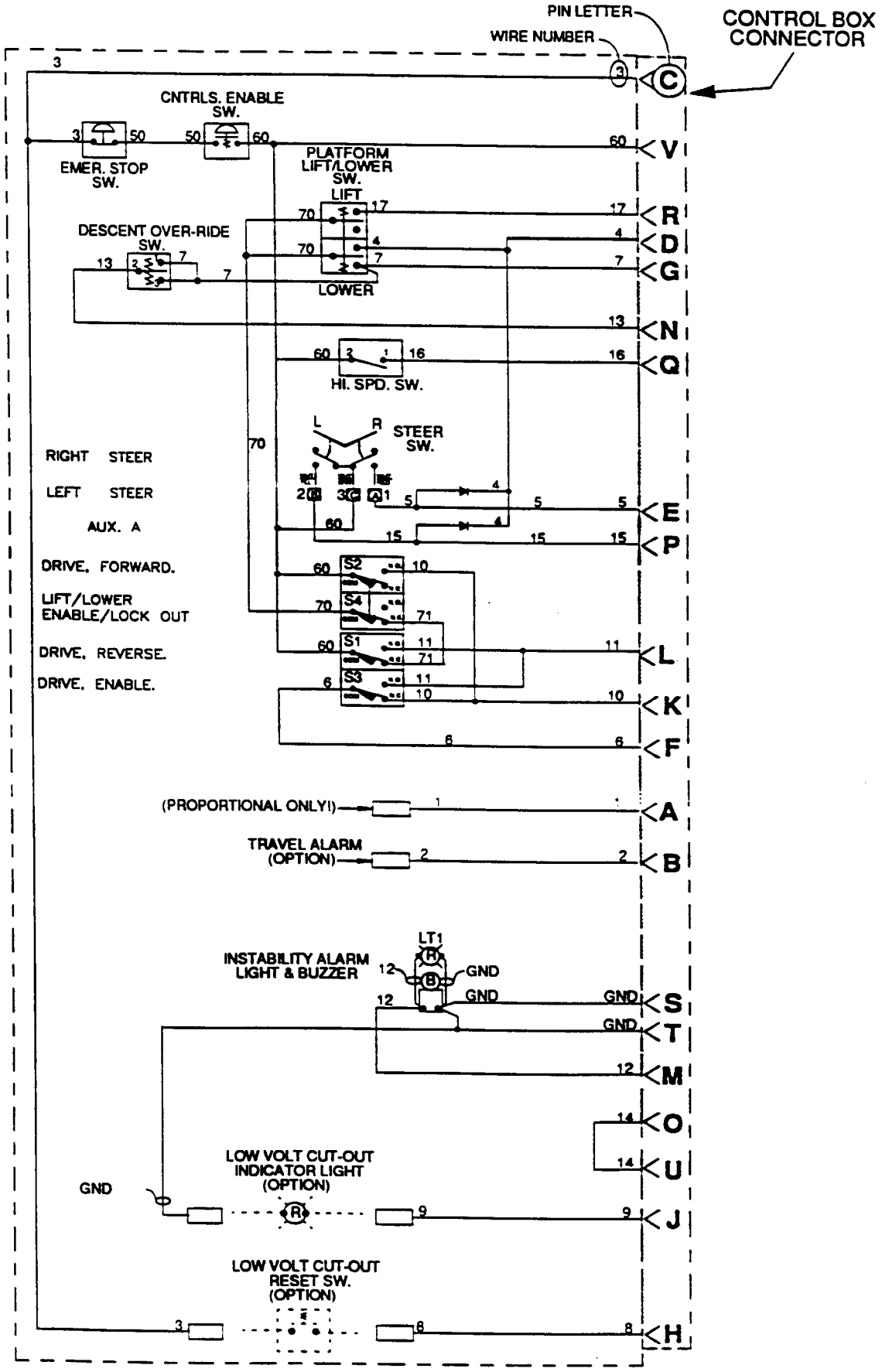
SCHEMATIC: AERIAL CONTROL BOX

P/N 135765 "CH" MODELS W/PROPORTIONAL DRIVE



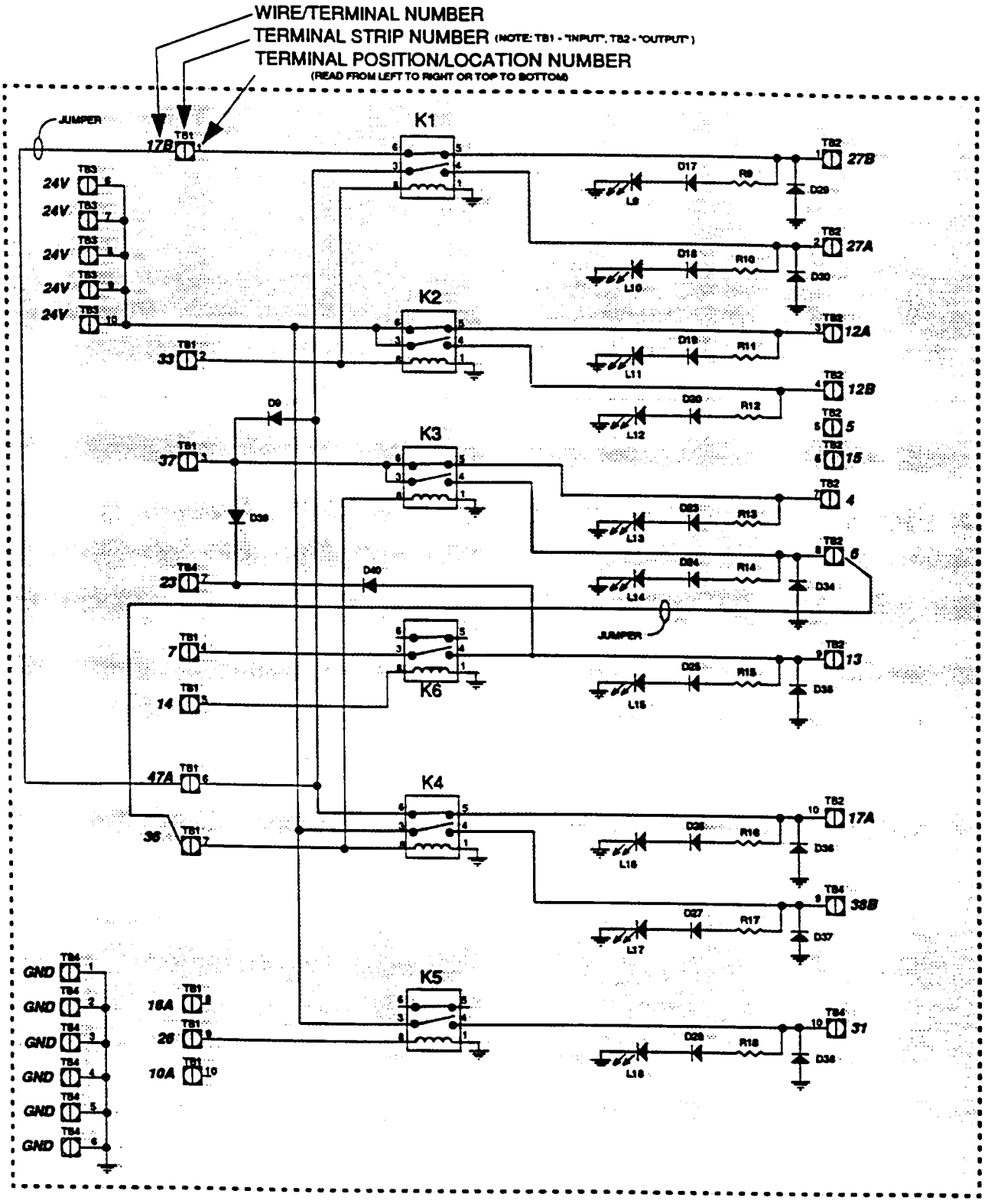
SCHEMATIC: AERIAL CONTROL BOX

P/N 135763 "CH" MODELS W/NON-PROPORTIONAL DRIVE

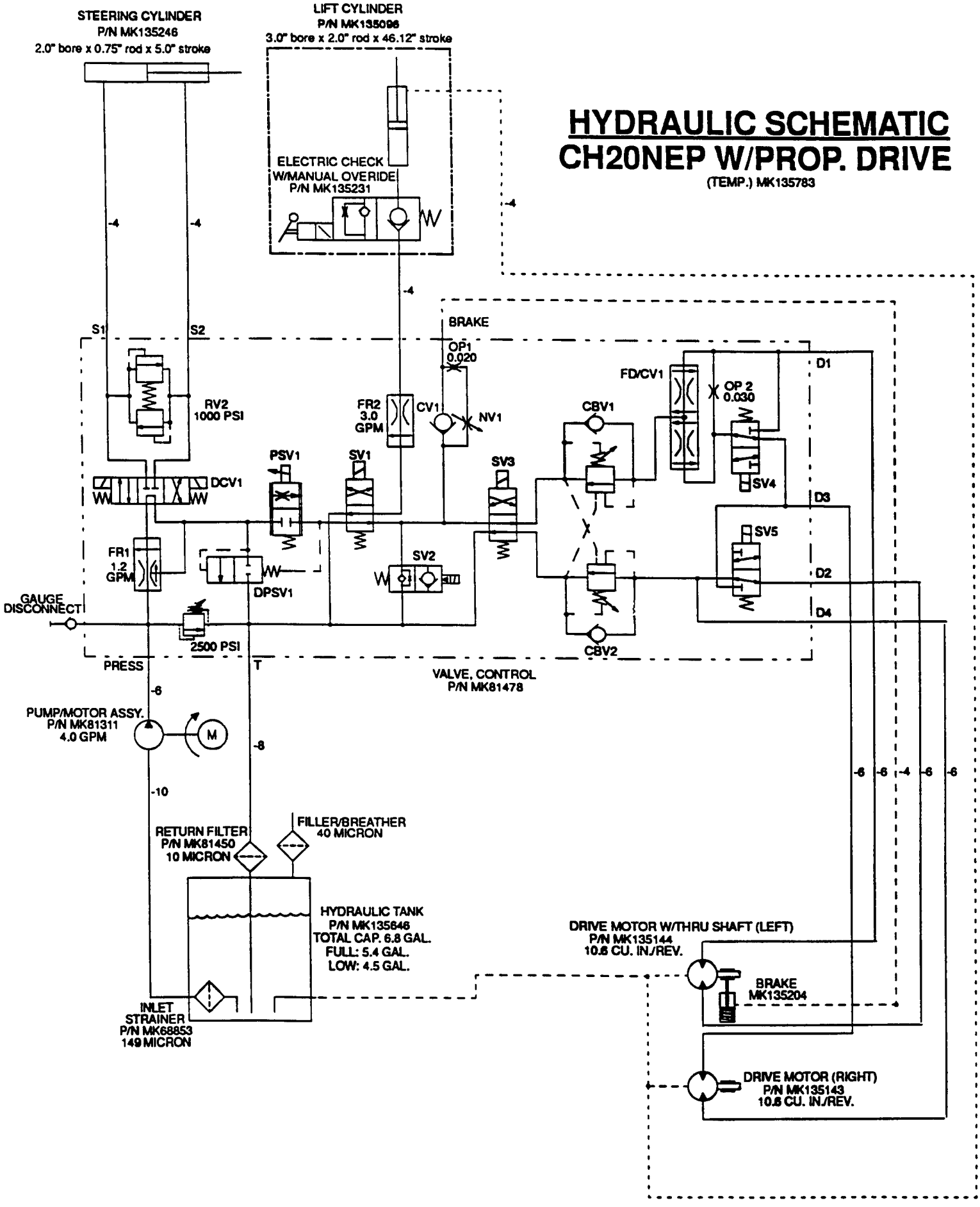


SCHEMATIC: RELAY CARD DETAIL

(LOCATED INSIDE P/N 135764 GROUND CONTROL BOX)



HYDRAULIC SCHEMATIC
CH20NEP W/PROP. DRIVE
(TEMP.) MK135783



HYDRAULIC SCHEMATIC
CH20WEP/CH26NEP/CH26WEF

(TEMP.) MK135624

