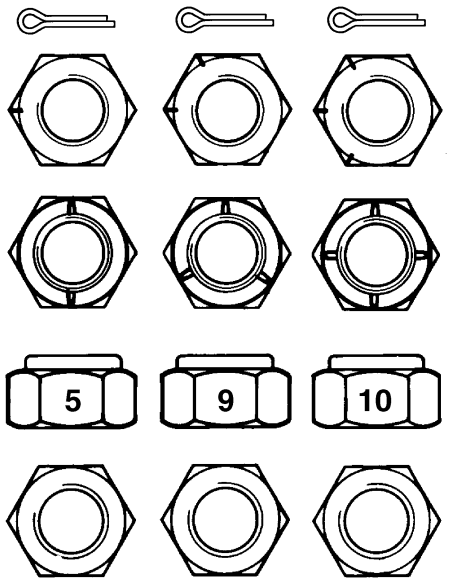
Yale®

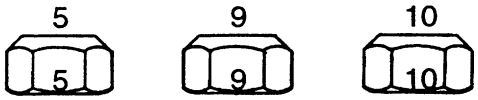
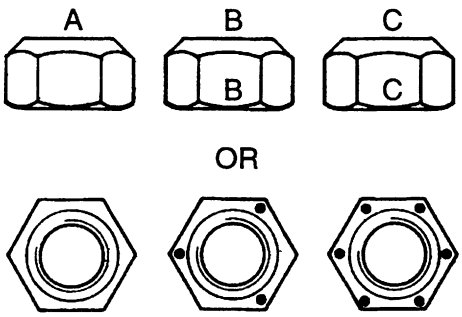
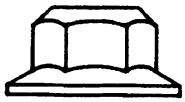
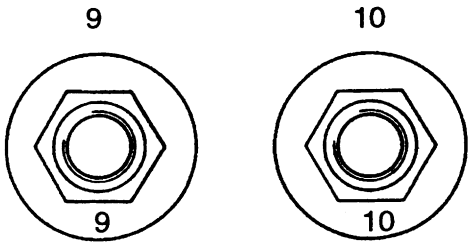
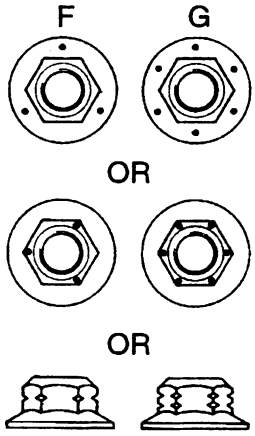
Maintenance

METRIC AND INCH (SAE) FASTENERS



HM210064

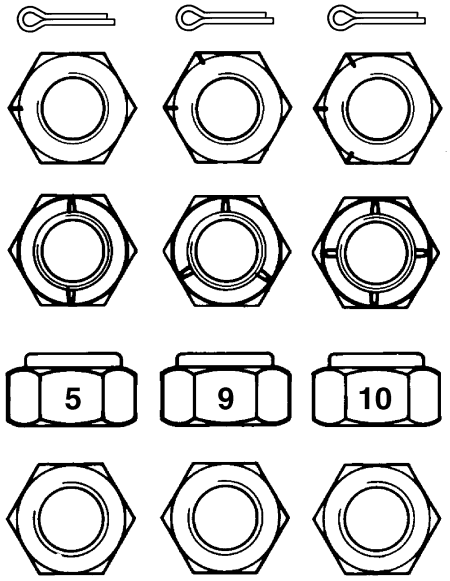
Table 3. Torque Nuts

TYPE OF FASTENER	METRIC FASTENERS STRENGTH LEVELS: PROPERTY CLASS	INCH FASTENERS STRENGTH LEVELS: SAE GRADES
 ALL METAL PREVAILING TORQUE NUTS		
 ALL METAL PREVAILING TORQUE FLANGE NUTS		 HM210068

Yale®

Maintenance

METRIC AND INCH (SAE) FASTENERS



HM210064

FASTENER TORQUE TABLES

*Table 5. Torque Values for Metric Fasteners**

Size and Pitch	Property Class 5.8[1]		Grade 8.8[2]		Grade 10.9[3]	
	N•m	lbf ft	N•m	lbf ft	N•m	lbf ft
M3 × 0.5 M3.5 × 0.6 M4 × 0.7 M5 × 0.8 M6 × 1	0.62 0.97 1.44 2.91 4.94	0.5 0.7 1.1 2.1 3.6	0.99 1.55 2.30 4.65 7.90	0.7 1.1 2.1 3.6 6	1.34 2.11 3.13 6.33 10.8	1.0 1.6 2.3 4.7 8
M8 × 1.25 M8 × 1 M10 × 1.5 M10 × 1.25	12.0 12.8 23.8 25.1	9 9 18 19	19.2 20.5 38.0 40.1	14 15 28 30	26.1 27.9 52 55	19 21 38 41
M12 × 1.75 M12 × 1.25 M14 × 2 M14 × 1.5	41.4 45.3 66 72	31 33 49 53	66 72 105 115	49 53 77 85	90 98 145 155	66 72 105 115
M16 × 2 M16 × 1.5 M20 × 2.5 M20 × 1.5	105 110 200 225	77 81 150 165	165 175 320 355	122 130 235 260	225 240 435 485	165 175 320 360
M24 × 3 M24 × 2 M27 × 3 M27 × 2	345 375 505 550	255 275 370 405	555 605 810 875	410 445 600 645	755 820 1,100 1,190	560 605 810 880
M30 × 3.5 M30 × 3 M30 × 2 M33 × 3.5 M33 × 2	690 715 765 940 1,030	510 530 565 695 760	1,100 1,140 1,220 1,500 1,640	810 840 900 1,100 1,210	1,500 1,550 1,660 2,040 2,240	1,100 1,140 1,230 1,510 1,660
M36 × 4 M36 × 3 M39 × 4 M39 × 3	1,200 1,280 1,560 1,640	885 945 1,150 1,210	1,930 2,040 2,490 2,630	1,430 1,510 1,840 1,940	2,620 2,780 3,390 3,570	1,940 2,050 2,500 2,640
M42 × 4.5 M42 × 3 M45 × 4.5 M45 × 3 M48 × 5 M48 × 3	1,930 2,070 2,410 2,580 2,900 3,160	1,430 1,530 1,780 1,910 2,140 2,330	3,080 3,320 3,850 4,120 4,630 5,040	2,280 2,450 2,840 3,040 3,420 3,720	4,200 4,510 5,240 5,610 6,300 6,860	3,100 3,330 3,870 4,140 4,650 5,060

* Unless otherwise specified [1] Approximately equal to Grade 2 [2] Approximately equal to Grade 5 [3] Approximately equal to Grade 8

TABLE OF CONTENTS

This section is for the following models:

Brush Replacement

1. Motor brushes must be replaced before they are worn enough to damage the surface of the commutator. Move the brush spring and remove a brush from its brush holder. Install new brushes as a set if length of any brush is worn to a minimum length. See Table 3. If the brush lead is fastened to the brush with a rivet, install a new set of brushes if it is worn to within 3 mm (0.118 in.) of the rivet. If a brush does not move easily in its holder, a new set of brushes must be installed.

The lead wire for some brushes is installed directly into the carbon compound of the brush. New brushes must be installed before the lead wire cuts a groove in the commutator. Install a new brush set when a brush is worn to a short length.

Brushes are made to different specifications for motors used in different applications. Use only new brushes approved by Yale Company for that motor.

Table 3. Brush Wear Replacement Guide

Brush Height	17 mm (0.67 in.)	22 mm (0.87 in.)	28 mm (1.10 in.)	30 mm (1.18 in.)	31 mm (1.22 in.)	32 mm (1.26 in.)	40 mm (1.57 in.)
Wear	8 mm (0.31 in.)	12 mm (0.47 in.)	14 mm (0.55 in.)	15 mm (0.59 in.)	16 mm (0.63 in.)	16 mm (0.63 in.)	16 mm (0.63 in.)
Worn Brush Height	9 mm (0.35 in.)	10 mm (0.39 in.)	14 mm (0.55 in.)	15 mm (0.59 in.)	15 mm (0.59 in.)	16 mm (0.63 in.)	20 mm (0.79 in.)

NOTE: For some models of lift trucks, the battery does not need to be removed to access the electric motors. Other models will require the removal of the battery before gaining access to the electric motors.

2. Remove battery as necessary for your lift truck. See **How To Remove Battery** in the **Operating Manual** or the YRM section **Periodic Maintenance** for your lift truck.

WARNING

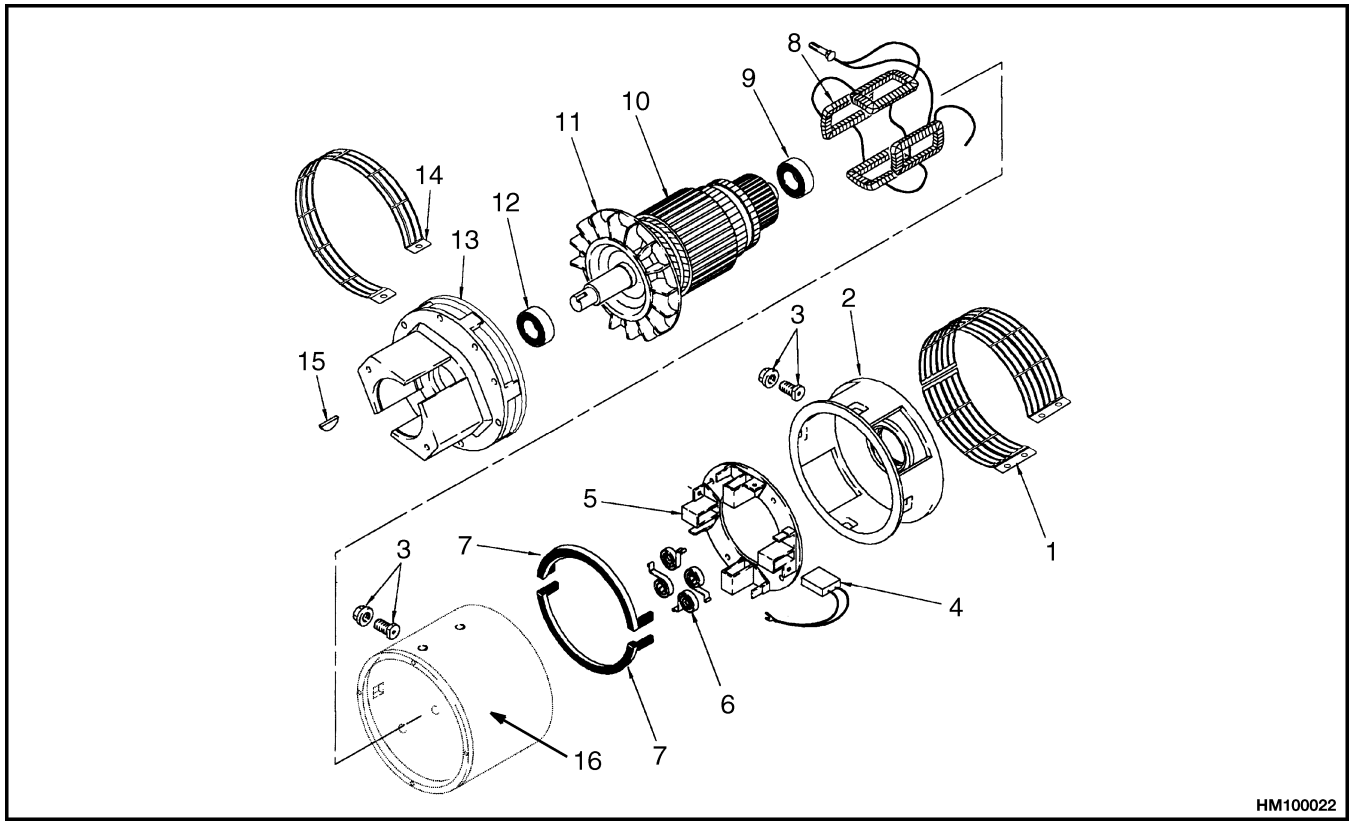
Compressed air can move particles so they cause injury to the user or to other personnel. Verify the path of the compressed air is away from all personnel. Wear protective goggles of a face shield to prevent injury to the eyes.

3. Remove access plate to motors. Remove brush covers to motor. See Figure 2. Wear eye protection. Use a vacuum cleaner or compressed air to remove dirt and brush dust from commutator area.

4. Make a note of the arrangement and connections of the brush assembly. See Figure 4. The new brushes must be installed in the same positions from which the worn brushes were removed.

5. Loosen screw that fastens brush wire to its terminal. Remove brush springs and brushes.

6. Inspect brush holders for burns and damage. Make sure brush holders are fastened tightly to brush mounting plate at end of motor. Make sure new brushes will move freely and smoothly in brush holders. Check that brush mounting plate is holding brush holder so it does not move.



1. BRUSH COVER
2. COMMUTATOR END FRAME
3. TERMINAL
4. BRUSH
5. BRUSH HOLDER
6. BRUSH SPRING (8)
7. BUSH CONNECTOR (2)
8. FIELD COILS
9. BEARING
10. ARMATURE
11. FAN
12. BEARING
13. DRIVE END FRAME
14. FAN COVER
15. WOODRUFF KEY
16. FIELD FRAME

Figure 11. Typical Hydraulic Pump Motor (Example 1)

Battery Selection

NOTE: The capacity of the battery can be found on the lift truck's Nameplate. See the **Frame** section or **Operating Manual** for your lift truck for the location of the Nameplate.

The battery needed to operate a period of 8 hours depends on many conditions. Operations that require the lift truck to go up ramps or require the use of additional attachments increase the use of power from the battery. Some work conditions require that more than one battery must be used during a work period. The number of 8-hour work periods per day is normally equal to the number of batteries needed. For example, for three work periods, you need three batteries. The capacity of the battery you need is found as follows:

- The size of the lift truck and the attachments.
- The type of work. Heavy-duty operation or normal operation for one 8-hour work period.

Lift trucks are available in various voltage ranges. See Figure 8. The small "walkie" lift trucks are normally 12 or 24 volts. The larger sit-down rider lift trucks are normally 24, 36, 48, 72, or 80 volts. The number of cells in a lead-acid battery gives the battery voltage. See Figure 9. A fully charged cell has a potential difference of approximately 2 volts. See Figure 8. This potential difference does not change with size of the cell.

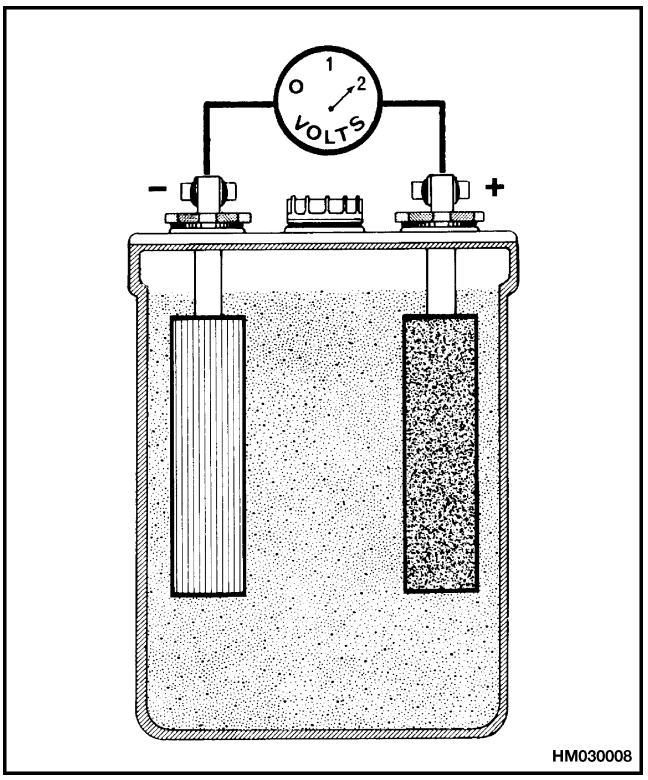


Figure 8. Cell Voltage

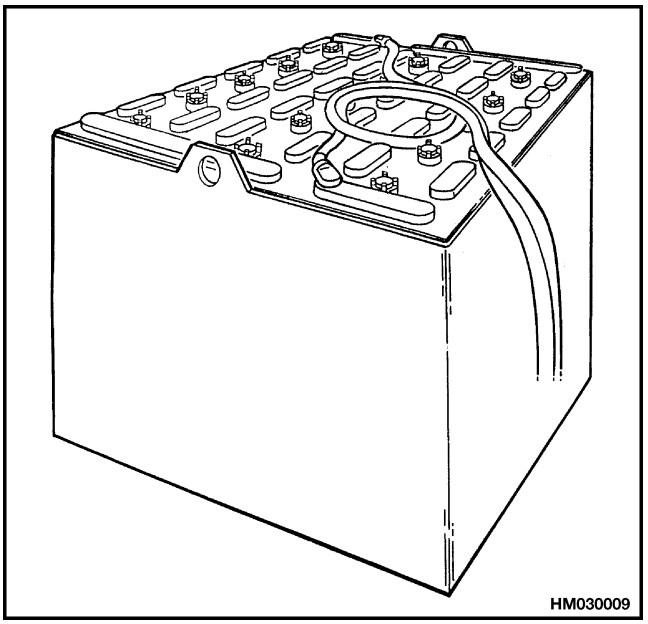
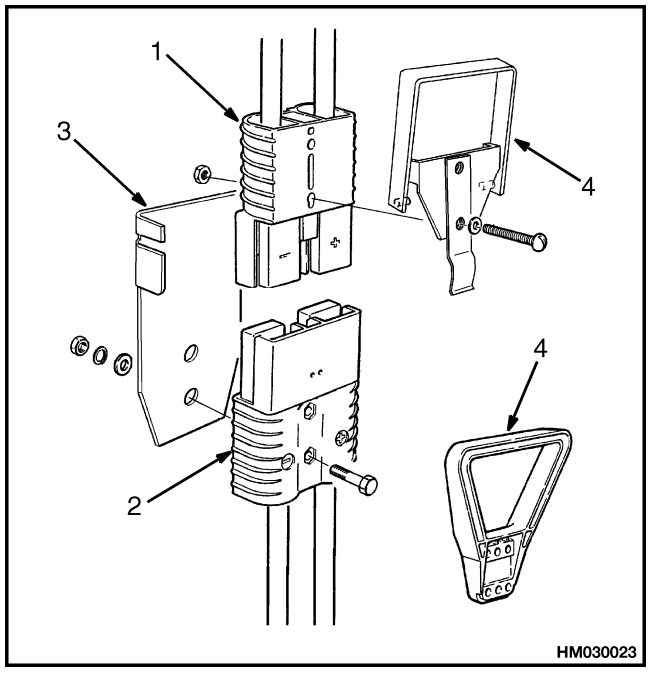


Figure 9. Multicell Battery for Electric Lift Truck

- Install a NO SMOKING sign in the service area
- Keep the charger in a clean, dry area with good ventilation

BATTERY CONNECTORS

A special heavy-duty connector is used to connect the battery to the electrical system of the lift truck. See Figure 22 and Figure 23. When a connector has a handle and is within the operator's reach, the connector is also a safety device that can be used to quickly disconnect the battery in an emergency. Most connectors have a handle to connect the two halves of the connector. The connector can be quickly disconnected by pulling the handle upward. This action separates the two halves of the connector. The connector and its attached handle must be kept in good repair so that it will function correctly. The battery connector must be disconnected when maintenance is done on the lift truck that does not require electric power. The SBE, SBX, and FEM or DIN 12- volt battery connectors are shown in Figure 23.



1. SB CONNECTOR FOR BATTERY CABLES
2. SB CONNECTOR FOR POWER CABLES TO LIFT TRUCK
3. BRACKET
4. CONNECT AND DISCONNECT HANDLES

Figure 22. SB Battery Connector

BATTERY CARE

1. Keep batteries clean. Remove any spilled electrolyte.

2. DO NOT overcharge the battery. This action will damage the battery.

3. DO NOT discharge the battery to less than the recommendation. A deep discharge will shorten the battery life.

4. Charge batteries in an area with good ventilation to remove explosive gases and acid fumes.

5. Keep the electrolyte at the correct level. Check the electrolyte level before and after charging the battery. Use distilled water. Do not add acid.

6. Prevent batteries from freezing.

7. Keep batteries charged. A discharged battery in storage will shorten the battery life.

8. Use a battery charger that is correct for the battery. A battery charger that is set for an ampere-hour rate that is too high will cause a high internal heat and damage the battery. A low ampere-hour rate setting on a battery charger can require a longer charging time but will not damage the battery.

9. When batteries are moved, make sure a short circuit does not occur. See the Safety Procedures in Battery Maintenance of this section.

General

This section describes how to select and do the maintenance for large batteries used in electric lift trucks. This information is for service personnel that must do the maintenance on large lead-acid batteries. Battery repair requires special training and equipment. Do not try to repair a battery unless you have the correct tools, equipment, and experience. Most battery repairs are done by a special repair service. Some batteries have a nameplate attached to the face of the battery cover. This nameplate communicates specific information about the battery including the name of the battery manufacturer, battery type, serial number, nominal voltage, capacity in amperes at the five-hour rate, and service mass (with ballast if used to compensate for lack of battery mass).

Battery Type

LEAD-ACID BATTERIES

A lead-acid battery converts chemical energy into electrical energy. See Figure 1. Chemical changes within the battery give the electrical energy. When the chemical reaction has occurred so the battery will not give its rated voltage and current, the battery is discharged. A reverse chemical action must occur so the battery can be used again. The batteries described in this section can be charged again by an electric voltage and current from an outside source so there is a reverse chemical action. The lead-acid chemicals store the electric energy until the electric energy is needed to operate an electric device.

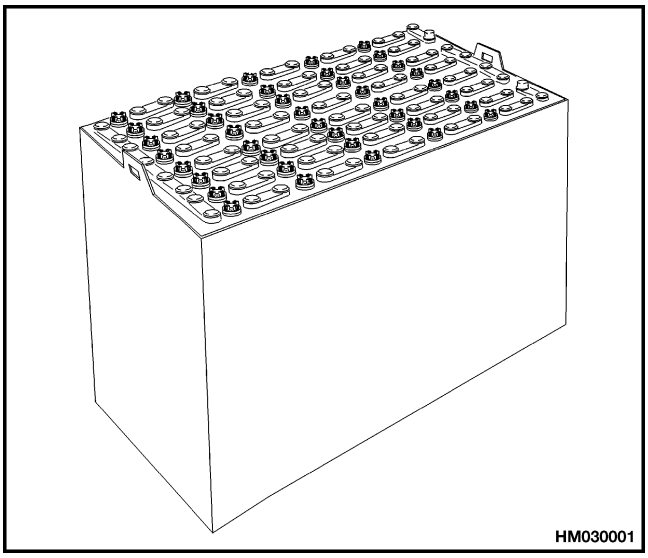
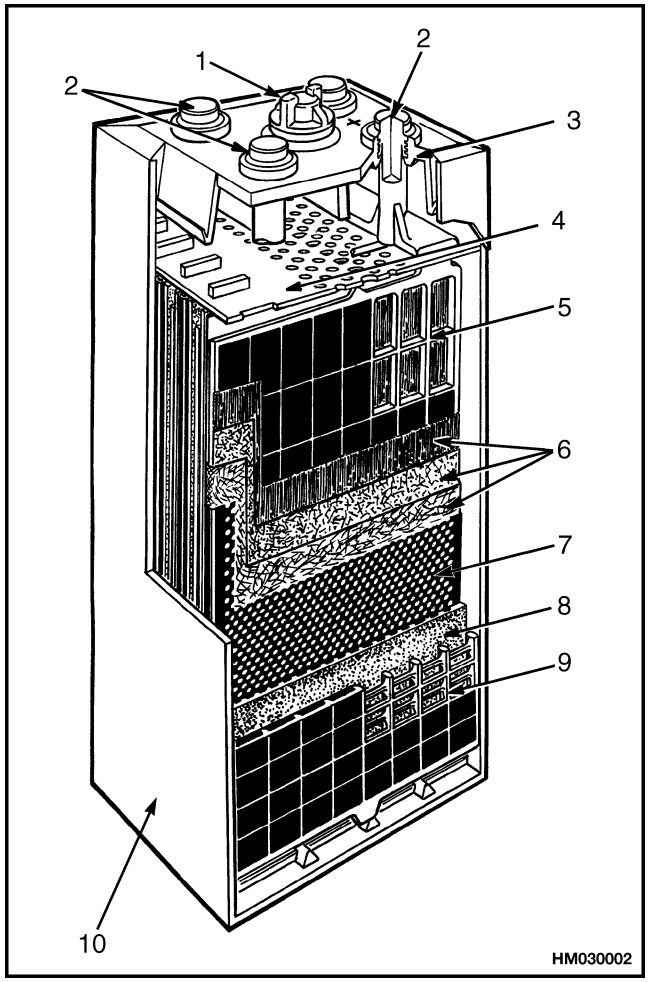


Figure 1. Lead-Acid Industrial Battery

A lead-acid battery is made from several lead-acid batteries called cells. Each cell has positive and negative plates with dielectric spacers between each plate. All of the plates are within a solution of electrolyte. See Figure 2.



1. VENT AND FILL CAP
2. POST
3. POST SEAL
4. PLATE PROTECTOR (SHIELD)
5. POSITIVE PLATE
6. EXPANSION MATS
7. RETAINER
8. SEPARATOR
9. NEGATIVE PLATE
10. BATTERY JAR

Figure 2. Battery Cell

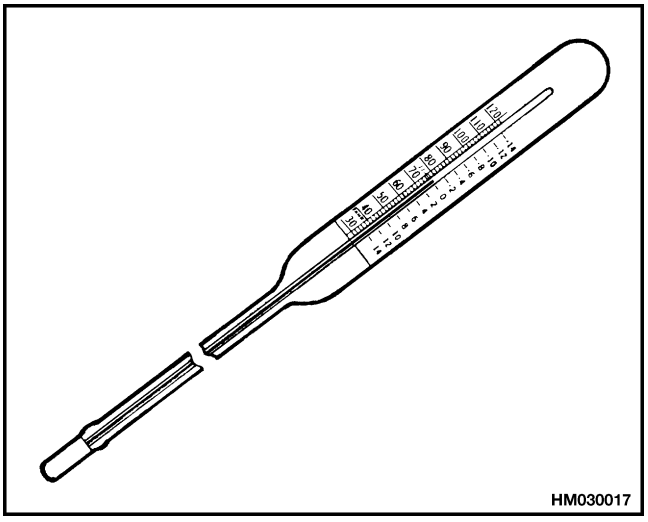


Figure 16. Battery Thermometer

CHARGING BATTERY

NOTE: There can be one of two types of batteries. One type has removable cell caps. The other type has sealed cells. The sealed batteries require a different charger. The electrolyte level or specific gravity cannot be checked, and water cannot be added to the electrolyte of these sealed batteries.

WARNING

The acid in the electrolyte can cause injury. If electrolyte is spilled, use water to flush the area. Make the acid neutral with a solution of sodium bicarbonate.

Batteries generate explosive fumes when they are being charged. Keep fire, sparks, and burning material away from the battery charger area. Prevent sparks from the battery connectors.

Charge batteries only in the special area for charging batteries. When charging the batteries, keep the vent caps clean. The battery charger area must have ventilation so that explosive fumes are removed. Open the hood over the battery or remove the cover if the battery has a cover.

Disconnect the battery when doing cleaning and maintenance.

If the lift truck has been operated with a low battery, check the contactors for welded contacts before a charged battery is connected. The circuit will not reset and lift truck operation cannot be controlled if the contacts are welded. To check the contacts, see the Contactor inspection procedure for your lift truck.

CAUTION

Use only battery chargers approved by the battery manufacturer or dealer.

CAUTION

NEVER connect the battery charger plug to the plug of the lift truck. You can damage the traction control circuit. Make sure the charger voltage is the correct voltage for the battery.

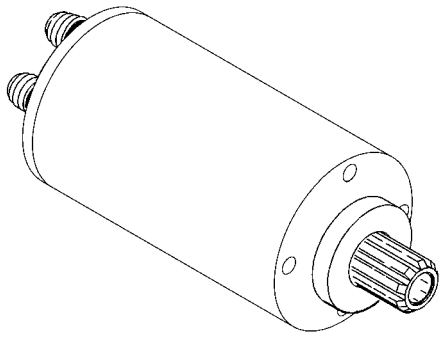
Correct use of the hydrometer (see Figure 14) and proper operation of the battery charger is important. Also see Figure 15. Follow the instructions of the charger manufacturer. NEVER let the battery discharge below the minimum value given by the battery manufacturer. A fully charged battery will have a specific gravity of 1.265 to 1.310 at 25°C (77°F). See Figure 15. NEVER charge a battery at a rate that will raise the electrolyte temperature above 49°C (120°F). Never let a battery stay discharged for long periods.

Types of Battery Charges

1. NORMAL CHARGE. This charge is usually given to a battery that is discharged from normal operation. This is often an 8-hour charge. Many customers charge the battery at regular intervals that depend on use. This procedure will keep the battery correctly charged if the battery is not discharged below the limit. Always use a hydrometer to check the battery if the battery is charged at regular intervals. Frequent charging of a battery that has a 2/3 or more charge can decrease the life of the battery.

STEERING HOUSING AND CONTROL UNIT

ERC20-30AGF (ERC040-065RG/ZG) [E108];
ERC/P16-20AAF (ERC030-040AG/BG) [A814];
ERP20-30ALF [B216];
GC/GLC030-040AF [B809];
GLP/GDP16-20AF
(GP/GLP/GDP030-040AF) [B810];
GP/GLP/GDP2.00-3.00RF/TF
(GP/GLP/GDP040-060RG/TG/ZG) [A875];
GC/GLC040-065RG/TG/ZG [E187];
ERP20-30ALF (ERP040-060DH) [D216];
ERP20-32ALF (ERP040-065DH) [E216];
ERC/P16-20AAF (ERC030-040AH) [B814];
ERC20-32AGF (ERC040-065GH) [A908];
ERC35-55HG (ERC70-120HH) [B839/C839]



HM220005

11. Remove the tilt stop screw located at the bottom left side of the steering column bracket.

12. Remove the capscrews, lockwashers, and lock plates that fasten the steering column to the pivots on the lift truck. Remove the steering column from the lift truck. Make sure the electric wires and the hydraulic hoses are not damaged as the steering column is removed.

13. Remove the four capscrews that hold the steering column to the bracket. Remove the four capscrews or nuts that fasten the steering control unit to the steering column.

STEERING CONTROL UNIT, DISASSEMBLE

1. Place the steering pump into a soft jaw vise with the splined shaft facing down.

2. Remove the hydraulic fittings and the special screws, and rotate the steering pump 90 degrees sideways in the vise. Discard the O-rings. See Figure 7.

3. Remove the end cover, spacer, gear housing, and gear from the steering pump. Discard the O-rings.

4. Remove the cardan shaft from the spool assembly.

5. Remove the check ball, ball stop, and emergency steering ball from the pump housing.

6. Remove the spool assembly from the pump housing.

NOTE: To help with installation of the thrust bearing assembly, note the positions of the thrust washers on either side of the thrust bearing while performing Step 7.

7. Remove the thrust bearing assembly from the shaft end of the spool assembly.

8. Remove the retaining ring from the spool assembly.

9. Press the cross pin out of the spool assembly.

10. Press the spool from the sleeve and remove the springs from the spool. Press the spool from the sleeve and remove the springs from the spool.

11. Remove the shaft seals from the pump housing. Discard the seals.

STEERING CONTROL UNIT, CLEAN

WARNING

Cleaning solvents can be flammable and toxic and can cause skin irritation. When using cleaning solvents, always follow the solvent manufacturer's recommended safety precautions.

WARNING

Compressed air can move particles so that they cause injury to the user or to other personnel. Make sure that the path of the compressed air is away from all personnel. Wear protective goggles or a face shield to prevent injury to the eyes.

Clean all the parts in solvent. Dry the parts with compressed air. Do not dry the parts with a cloth. Make sure all surfaces are free of scratches and sharp edges.

STEERING CONTROL UNIT, ASSEMBLE

1. Using a seal installer, install the shaft seals in the pump housing.

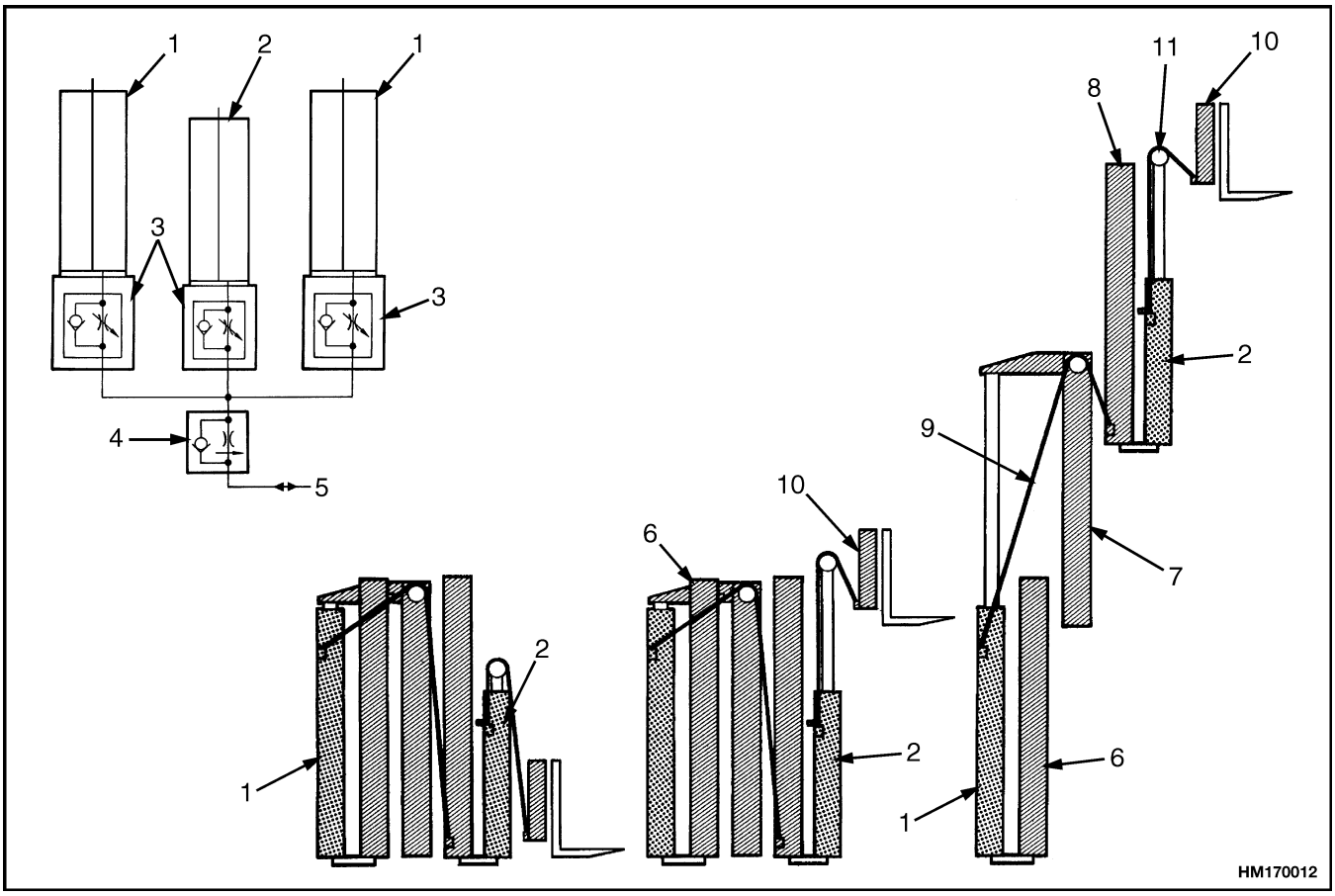
2. Install the spool into the sleeve with the key slots opposite each other.

3. Insert the curved springs between the flat springs. See Figure 7. Install the spring set into the spool assembly.

TABLE OF CONTENTS

This section is for the following models:

GP/GLP/GDP16-20AF/BF (GP/GLP/GDP030-040AF/BF) [A810];
GC/GLC030-040AF [B809];
GLP/GDP16-20AF (GP/GLP/GDP030-040AF) [B810];
ERC/P16-20AAF (ERC030-040AF, ERC030-040AG/BG) [A814];
ERP20-30ALF [B216];
GC/GLC040-065RG/TG/ZG [E187];
ERC20/25/30AGF (ERC040-065RF/ZF, ERC040-065RG/ZG) [E108];
GP/GLP/GDP20-30RF/TF (GP/GLP/GDP040-060RG/TG/ZG) [A875];
ERP030-040TGN [E807];
ERP20-30ALF (ERP040-060DH) [D216];
ERP20-32ALF (ERP040-065DH) [E216];
ERC20-32AGF (ERC040-065GH) [A908];
ERC/P16-20AAF (ERC030-040AH) [B814/C814];
ERP1.60-1.80-2.0ATF (ERP030-040TH) [F807]



1. LIFT CYLINDER
2. FREE-LIFT CYLINDER
3. LOWERING CONTROL VALVE (INTERNAL)
4. LOWERING CONTROL VALVE (EXTERNAL)
5. TO/FROM MAIN CONTROL VALVE
6. OUTER WELDMENT
7. INTERMEDIATE WELDMENT
8. INNER WELDMENT
9. MAIN LIFT CHAIN
10. CARRIAGE
11. FREE-LIFT CHAIN

Figure 11. Operation of Three-Stage Mast, Full Free-Lift (FFL)

Four-Stage Mast

DESCRIPTION AND OPERATION

The full free-lift, four-stage mast has four mast uprights: outer, inter#2, inter#3, and inner. See Figure 12. Two single-stage main lift cylinders and a free-lift cylinder are used to raise the carriage and extend the mast uprights. It is called a full free-lift mast because the carriage can travel to the top of the inner mast without extending the inner mast.

The mast uprights are telescopic and use load rollers and strip bearings to keep them in alignment. The load rollers are installed at the top of the outer, inter#2, and inter#3 masts. Load rollers are also used at the bottom of the inter#2, inter#3, and the inner mast. These load rollers travel along the flanges of the masts. The angle of the load rollers permits them to control the forces from the front, back, and sides of the mast. The strip bearings are installed at the top of the outer, inter#2, and inter#3 masts and help keep the correct clearance between the masts. The load rollers and strip bearings are adjustable with shims.

TABLE OF CONTENTS

This section is for the following models:

ERC20-30AGF (ERC040-065GH) [A908];
ERC20-30AGF (ERC040-065RF/ZF, ERC040-065RG/ZG) [E108]

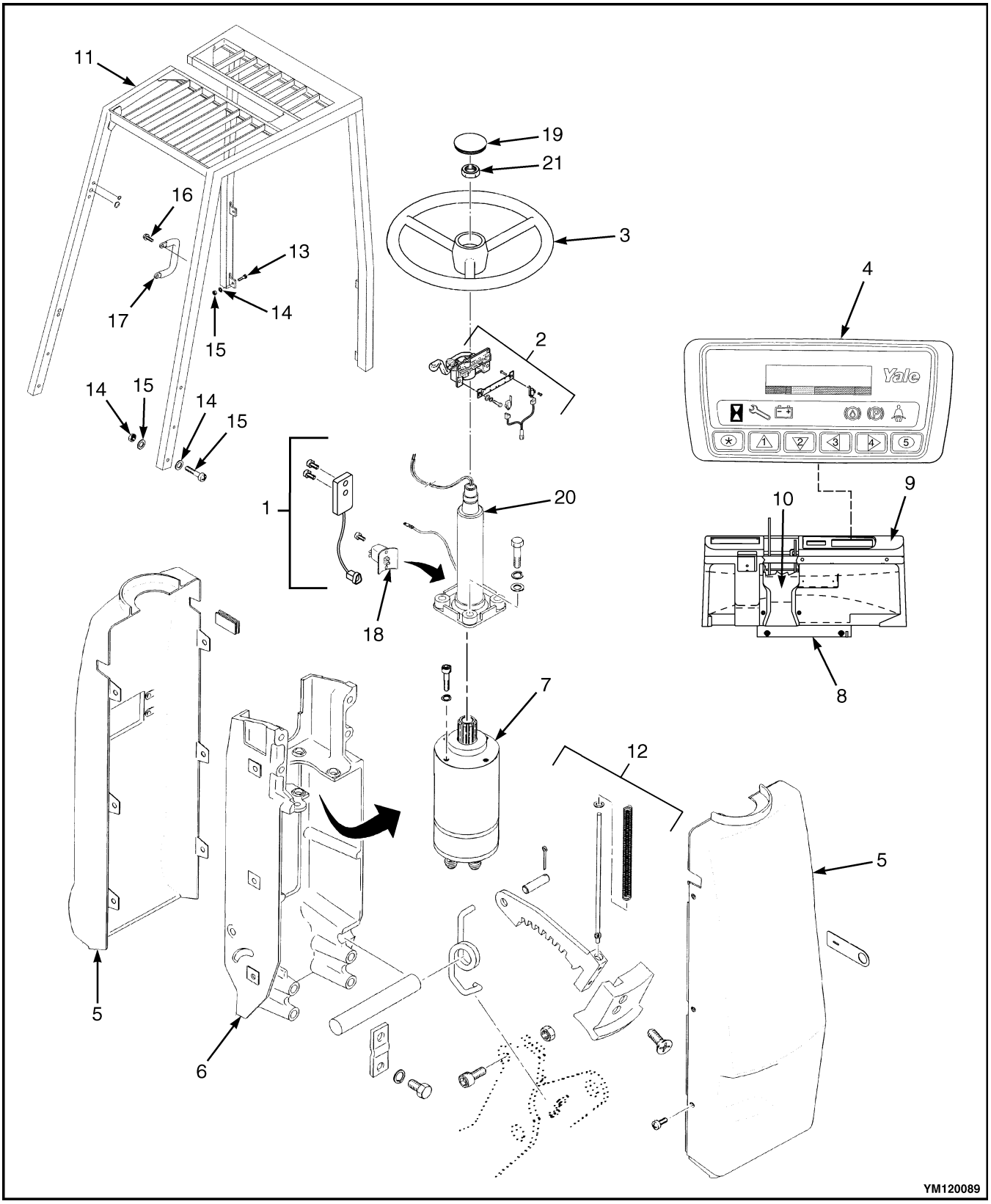
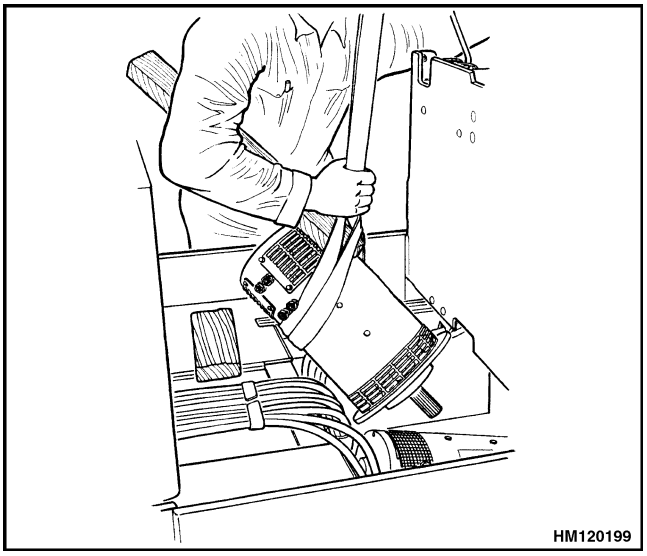


Figure 7. Overhead Guard, Steering Column, and Display Panel, Truck Models ERC20-30AGF (ERC040-065GH) (A908)



NOTE: TRACTION MOTOR FOR MODELS ERC20-30AGF (ERC40-065RF/ZF, ERC40-065RG/ZG) (E108) SHOWN. TRACTION MOTOR FOR ERC20-30AGF (ERC040-065GH) (A908) IS SIMILAR.

Figure 22. Use Crane to Lift Traction Motor

INSTALL

1. If the truck has a seat brake, install the brake assembly on the traction motor as described in the section **Brake System** 1800 YRM 574. For lift truck models ERC20-30AGF (ERC40-065RF/ZF, ERC40-065RG/ZG) (E108), install the bracket, lever, and spring for the brake. Install a sling to lift the traction motor. Use a wood block and a board under the sling to control the traction motor during installation. See Figure 22.

2. Lower the traction motor into position in the lift truck. Align the traction motor with the speed reducer. See Figure 23.

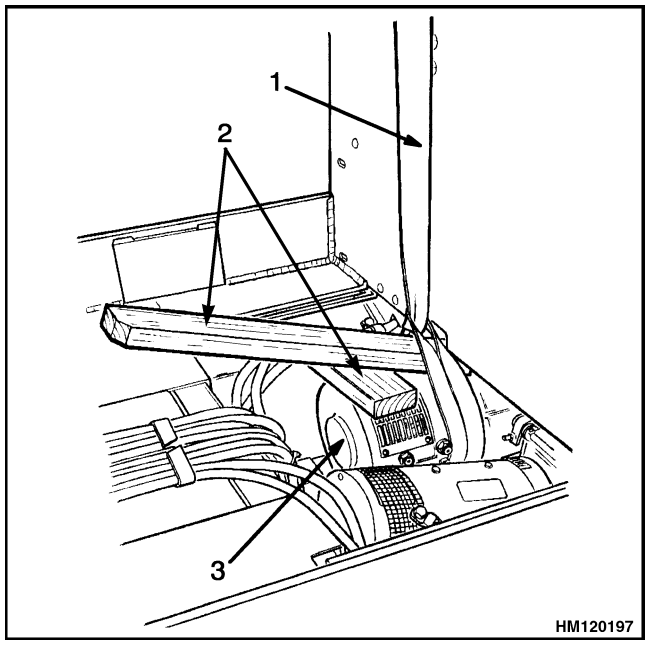
3. Use a board or pry bar as necessary to push the traction motor into the speed reducer.

4. Align the bolt holes in the speed reducer and the motor housing. Install the bolts that hold the traction motor to the speed reducer. Tighten the bolts to 38 N•m (28 lbf ft).

5. Remove the sling and install the traction motor mount. If equipped, install the ball of the ball joint on the lever for the seat brake.

6. Install the power cables and the access and floor plates. Tighten the power cable connectors to 21 to 25 N•m (15 to 18 lbf ft).

7. See **How to Change Battery** in your vehicle's **Periodic Maintenance** or **Operating Manual**. Install the battery into the truck.



NOTE: TRACTION MOTOR FOR MODELS ERC20-30AGF (ERC40-065RF/ZF, ERC40-065RG/ZG) (E108) SHOWN. TRACTION MOTOR FOR ERC20-30AGF (ERC040-065GH) (A908) IS SIMILAR.

1. SLING
2. BOARD AND WOOD BLOCK
3. TRACTION MOTOR

Figure 23. Align Traction Motor With Speed Reducer

Yale Materials Handling Corp.
1400 Sullivan Dr., Greenville, NC 27834-2011

100 YRM 558

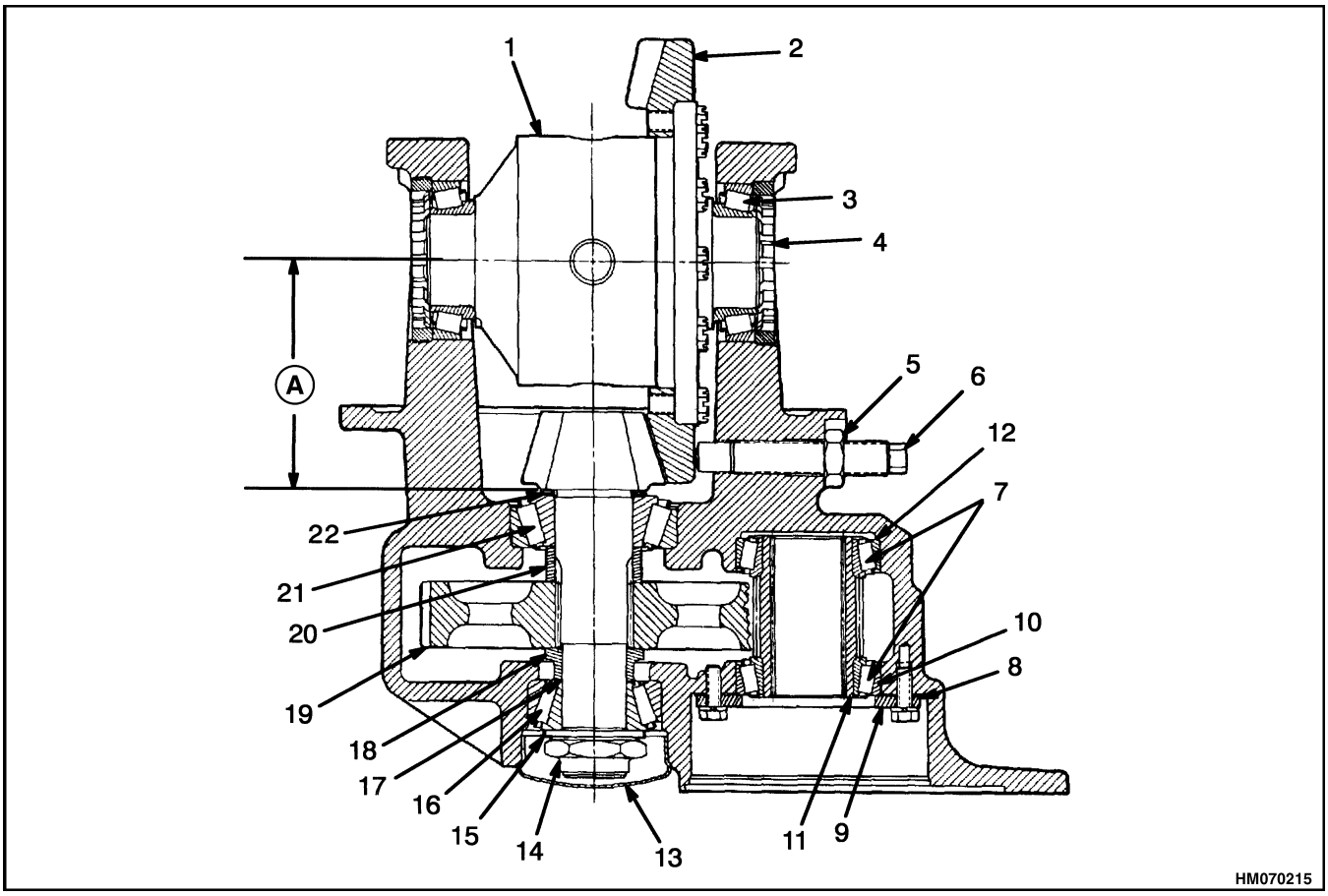
11/07 (1/06)(7/05)(6/04)(5/04)(11/03)(7/03) Printed in U.S.A.

ASSEMBLE

Speed Reducer and Differential, Assemble

Input Gear Assembly, Install

1. If removed, install the inner bearing cup in the end of the bore in the speed reducer housing. Use a press to install bearing cones on each end of the input gear. Install the input gear and bearings into the speed reducer housing. See Figure 4. Install the outer bearing cup.
2. Install the shims and the bearing retainer. Install the four M8 × 1.25 × 25 capscrews and washers. Tighten the capscrews to 19 N•m (14 lbf ft). Check the bearing clearance. Add or remove shims to adjust for zero bearing clearance. The input gear must turn smoothly with a maximum rotation torque of 0.133 N•m (1.2 lbf in).



A. THE GAUGE DISTANCE IS 129.20 mm (5.087 in.) PLUS OR MINUS THE VARIATION SHOWN ON THE END OF THE PINION. THE ADJUSTMENT MUST BE WITHIN ±0.0254 mm (0.001 in.) OF THE ACTUAL DISTANCE.

1. DIFFERENTIAL ASSEMBLY
2. RING GEAR
3. BEARING
4. ADJUSTER NUT
5. JAM NUT
6. THRUST SCREW
7. BEARING (2)
8. SHIM
9. RETAINER
10. OUTER BEARING CUP
11. INPUT GEAR
12. INNER BEARING CUP
13. HUB CAP
14. SPECIAL NUT
15. WASHER (KEYED)
16. BEARING
17. SHIM
18. SPACER
19. GEAR
20. SPACER
21. BEARING
22. SHIMS

Figure 4. Differential and Speed Reducer Assembly

Yale Materials Handling Corp.
1400 Sullivan Dr., Greenville, NC 27834-2011

1400 YRM 285

6/10 (1/06)(5/04)(11/03)(7/03) Printed in U.S.A.

CLEAN

WARNING

DO NOT use an oil solvent to clean the master cylinder, wheel cylinder, or the brake linings. Use a solvent approved for cleaning of brake parts. Do not permit oil or grease in the brake fluid or on the brake linings. Oil and grease will cause damage and leaks in the seals of a brake system. The brakes will not operate correctly if oil, grease, or brake fluid is on the brake linings.

Cleaning solvents can be flammable and toxic and can cause skin irritation. When using cleaning solvents, always follow the safety instructions of the solvent manufacturer.

1. Do not release brake lining dust from brake linings into air when brake drum is removed.
2. Use a solvent approved for cleaning of brake parts to wet brake lining dust. Follow instructions and cautions of manufacturer for use of solvent. If a solvent spray is used, do not create brake lining dust with spray.
3. When brake lining dust is wet, clean parts. Put any cloth or towels in a plastic bag or an airtight container while they are still wet. Put a DANGEROUS FIBERS warning label on plastic bag or airtight container.

CAUTION

Do not permit oil or grease on the brake linings. Use a brake cleaning fluid as necessary to clean linings that will not be replaced.

4. Any cleaning cloths that will be washed must be cleaned so that fibers are not released into the air.

INSPECT

1. Inspect bore of wheel cylinder for holes or scratches. Replace wheel cylinder assembly if there is any damage.
2. Inspect return springs for wear or damage. Inspect back plate for wear where brake shoes touch back plate. Replace a worn or damaged back plate.

WARNING

The brake shoes on both wheels must be replaced if any shoe is damaged. The brake performance on both ends of an axle must be equal or the lift truck can be difficult to steer when the brakes are applied.

3. Inspect brake shoes for cracks or damage. If linings or shoes are worn or damaged, replace brake shoes. Maximum wear is to within 1 mm (0.025 in.) of contact with rivets or metal shoe on bonded linings. Brake shoes must be replaced in complete sets. Inspect brake drums for cracks or damage. Replace any damaged parts.

NOTE: If grooves must be removed from the brake drums, do not grind more than 1.5 mm (0.060 in.) from the internal diameter of the brake drum. The maximum limit of the internal diameter of the brake drum is 311.7 mm (12.27 in.). If the internal diameter is larger than the limit, replace brake drum.

4. Inspect brake drum for deep grooves or other damage.
5. The teeth of the adjuster wheel must not be worn. The adjuster wheel must turn freely. Check adjuster links for damage.
6. Make sure parking brake cables are in good condition.
7. Check grease seals and surfaces of seals for wear or damage.

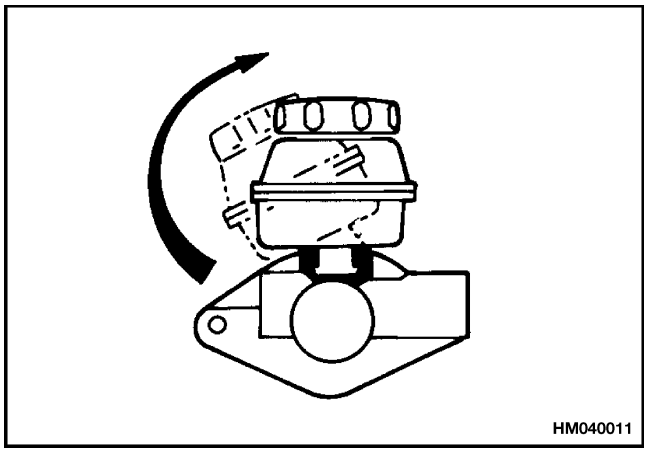
ASSEMBLE AND INSTALL

1. If wheel cylinder was disassembled for repair, assemble wheel cylinder. See Figure 6. Use only YALE APPROVED parts.
2. Install wheel cylinder on back plate and tighten two capscrews to 18 to 27 N•m (13 to 20 lbf ft). Connect brake line to wheel cylinder.
3. Install parking brake lever. See Figure 5. Use pivot pin, spring washer, and retainer to fasten parking brake lever to brake shoe. Close the ends of the retainer to fasten the pivot pin in position.
4. Install anchor and spacer in brake shoe. Install adjuster wheel actuator in brake shoe.
5. Fasten adjuster actuator spring to adjuster wheel actuator and brake shoe.
6. Put an antiseize compound on threads of adjuster wheel. Turn adjuster wheel into adjuster nut so adjuster assembly is in its shortest position. This action permits brake drum to be easily installed over the brake shoes.

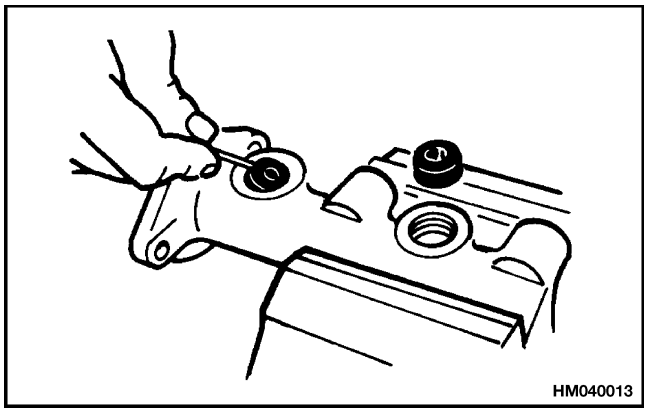
DISASSEMBLE

The disassembly procedures for the master cylinder are in the following steps:

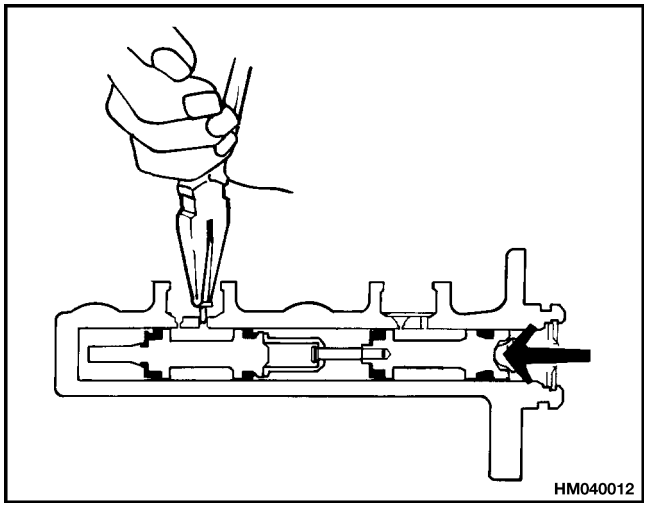
STEP 1.
Remove the fluid reservoir. Apply force in the direction of the arrow and pull the reservoir from the master cylinder.



STEP 2.
Be careful to not scratch the surfaces. Use a tool (screwdriver with a flat tip) that has a smooth and rounded end to remove the reservoir seals.



STEP 3.
Push the primary piston into the bore as shown in the illustration. Remove the pin at the secondary piston through the port for the secondary reservoir.



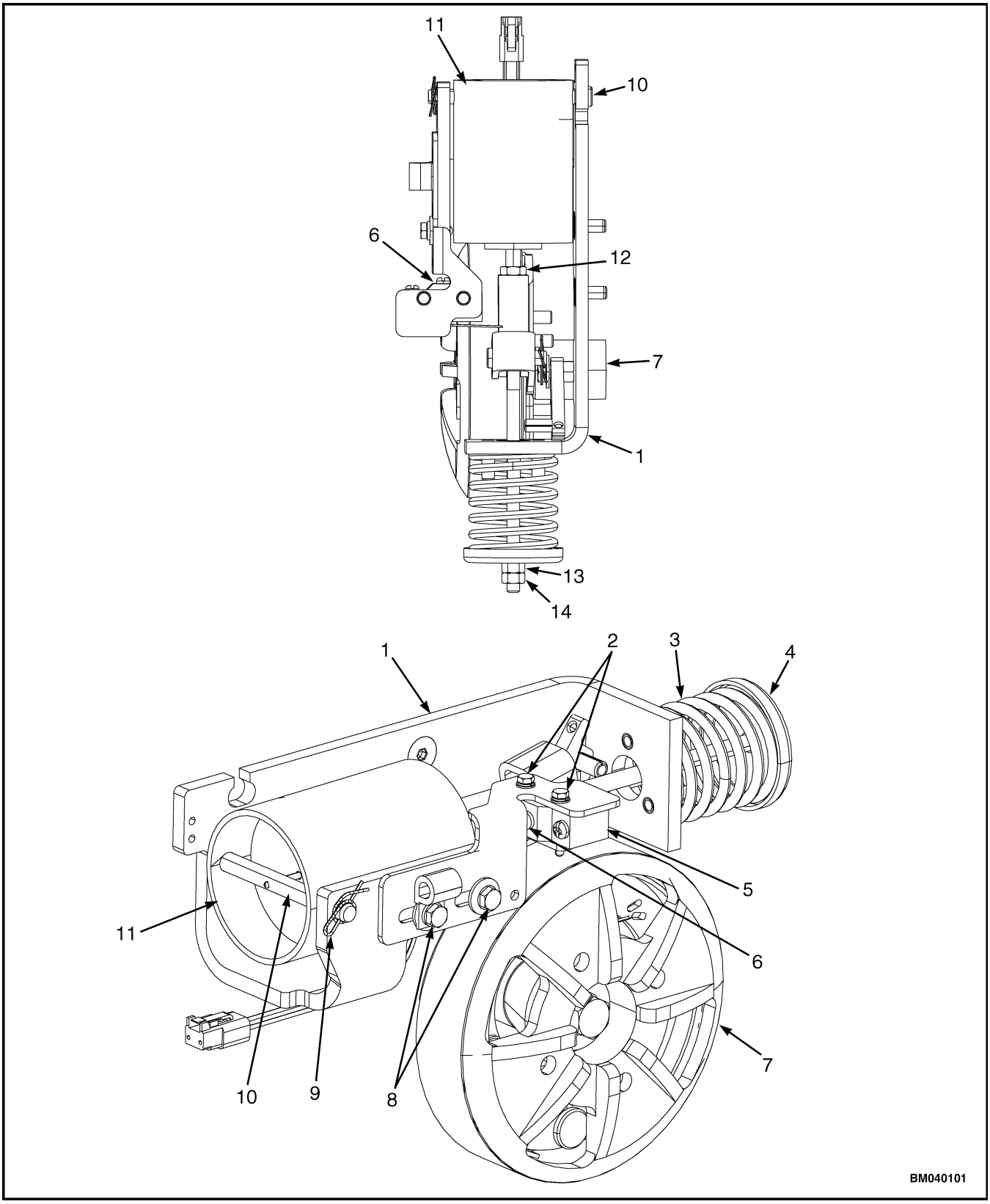


Figure 19. Traction Cutoff Switch Adjustment

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **YALE APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

NOTE: The following symbols and words indicate safety information in this manual:

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury and property damage.

On the lift truck, the WARNING symbol and word are on orange background. The CAUTION symbol and word are on yellow background.

Operation

HYDRAULIC SYSTEM

The hydraulic pump causes oil to flow from the tank to the main control valve. See Figure 8, Figure 9, or Figure 10. The main control valve controls the flow of oil to the lift cylinders, tilt cylinders, traverse cylinder, rotary actuator, and auxiliary functions when applicable. A relief valve on the main control valve keeps pressure within the design limits of the hydraulic system. A test port for checking the pressure when the relief valve opens is on the main control valve.

Some auxiliary functions require less pressure than the lift function. A secondary relief valve on the main control valve provides lower pressure for auxiliary functions.

The steering pump causes oil to flow from the tank to the steering control unit. The steering control unit is a metering pump actuated by the steering wheel. When the steering wheel is turned, oil flows to actuate the steering cylinder. Oil returns from the steering control unit to the main control valve. A relief valve in the pump keeps pressure within the design limits of the steering system.

The oil returns from the main control valve and flows through a filter in the hydraulic tank. The filter removes small particles from the oil. The filter has a bypass valve so that the oil can flow through the system if the filter becomes too dirty.

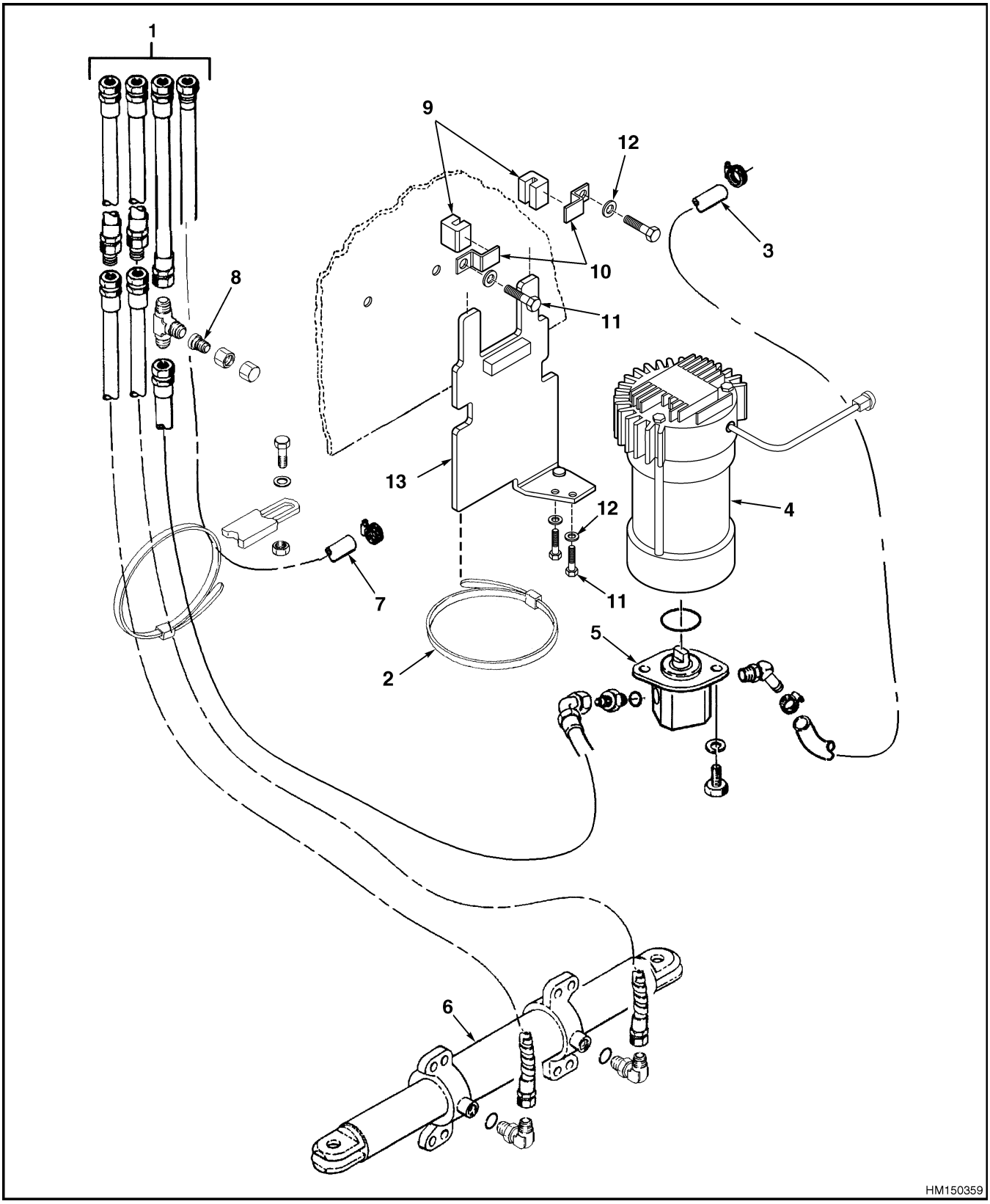


Figure 14. Steering Pump and Hydraulic Circuit for ERP20-30ALF (ERP040-060DH) (D216), ERP20-32ALF (ERP040-065DH) (E216) and ERC20-32AGF (ERC040-065GH) (A908) Lift Truck Models

Filter Replacement

ALL LIFT TRUCKS EXCEPT [ERC35-55HG (ERC70-120HH) (B839/C839); ERP20-32ALF (ERP040-065DH) (E216); AND ERC20-32AGF (ERC040-065GH) (A908)]

Remove

WARNING

The hydraulic oil is HOT at operating temperature. Do not permit the hot oil to contact the skin and cause a burn.

CAUTION

Do not permit dirt to enter the hydraulic system when the oil level is checked or the filter is changed. Dirt can cause damage to components of the hydraulic system.

Never operate the pump without oil in the hydraulic system. The operation of the hydraulic pump without oil will damage the pump.

1. Turn key to the **OFF** position and remove key.
2. On the ERC/P16-20AAF (ERC030-040AF - AG/BG) (A814) and ERC20-30AGF (ERC040-065RF/ZF - RG/ZG) (E108) trucks, remove the floor plates. See Figure 21 and Figure 22. On the ERP20-30ALF (D216) trucks, open the hood for access to the filter. See Figure 23. Clean the hydraulic filter and hoses at the filter.

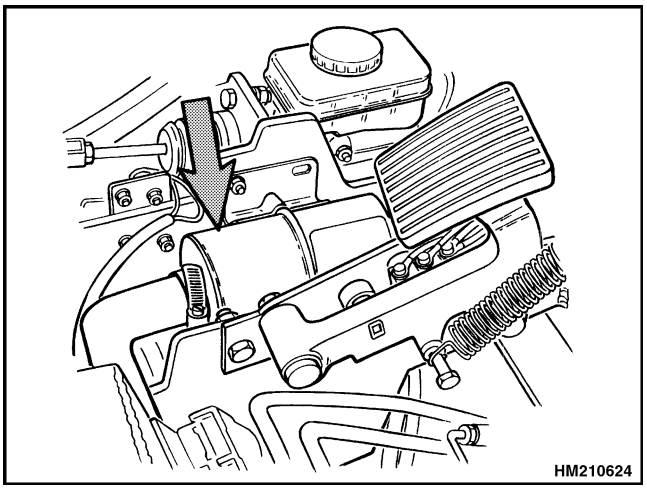
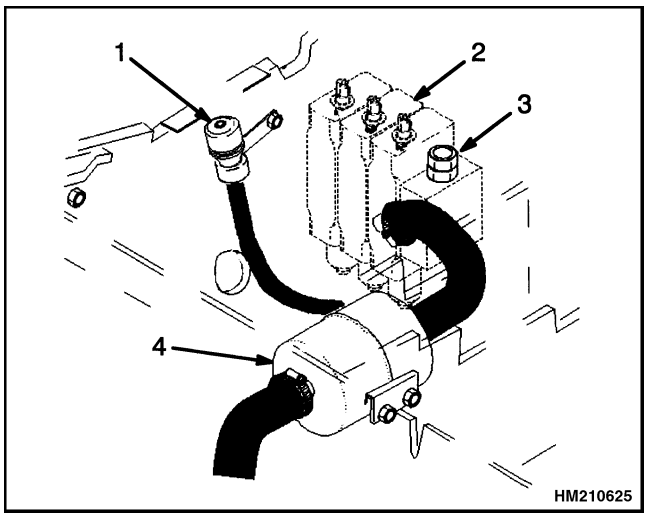


Figure 21. Hydraulic Filter for ERC/P16-20AAF (ERC030-040AF - AG/BG) (A814)

3. Loosen the hose clamp at the filter for the hose from the control valve. Lift the filter as high as possible, and remove the hose from the filter. Tip the filter up to let the oil drain into the hydraulic tank.



1. BREATHER
2. MAIN CONTROL VALVE
3. RELIEF VALVE
4. FILTER

Figure 22. Hydraulic Filter for ERC20-30AGF (ERC040-065RF/ZF - RG/ZG) (E108)

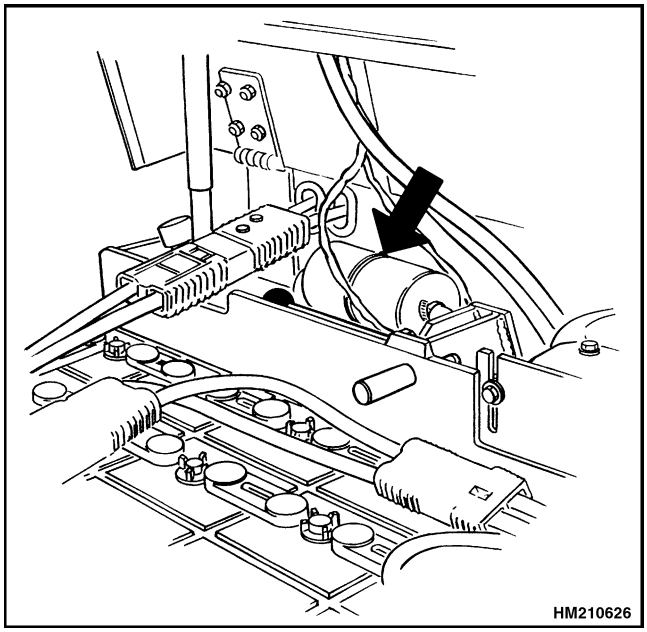


Figure 23. Hydraulic Filter for ERP20-30ALF (D216)

Legend for Figure 30

NOTE: ASSEMBLY SHOWN IS FOR ERC/P16-20AAF (ERC030-040AF, AG/BG) (A814), AND ERC20-30AGF (ERC040-065RF/ZF, RG/ZG) (E108) AND IS SIMILAR TO ERP20-30ALF (B216), ERP20-30ALF (ERP040-060DH) (D216), ERC/P16-20AAF (ERC030-040AH) (B814/C814), AND ERC20-32AGF (ERC040-065GH) (A908).

NOTE: MOUNT BRACKET (3) INSTALLED FACING OTHER DIRECTION ON ERP20-30ALF (B216), ERP20-30ALF (ERP040-060DH) (D216), ERC/P16-20AAF (ERC030-040AH) (B814/C814), AND ERC20-32AGF (ERC040-065GH) (A908) UNITS.

NOTE: PUMP AND MOTOR CAN BE DIFFERENT THAN SHOWN.

A. MOTOR USED ON ERP20-30ALF (B216)
B. MOTOR USED ON ERP20-30ALF (ERP040-060DH) (D216), ERC/P16-20AAF (ERC030-040AH) (B814/C814), AND ERC20-32AGF (ERC040-065GH) (A908)

1. PUMP
2. FLEXIBLE COUPLING
3. PIVOT MOUNT BRACKET [E2.00-3.20XM (E45-65XM, E45-65XM$_2$)(F108)][ERC20-30AGF (ERC040-065RF/ZF, RG/ZG) (E108)]
   3A. PIVOT MOUNT BRACKET [ERC/P16-20AAF (ERC030-040AF, AG/BG) (A814)]
4. RUBBER BUSHING (2)
5. WASHER (2)
6. PIVOT PIN
7. CLAMP ASSEMBLY
8. MOTOR
9. SUPPORT [ERC20-30AGF (ERC040-065RF/ZF, RG/ZG) (E108) AND ERC20-35AGF (ERC040-065GH) (A908)]

HYDRAULIC PUMP AND MOTOR, INSTALL [ERC/P16-20AAF (ERC030-040AF, AG/BG) (A814); ERC20-30AGF (ERC040-065RF/ZF, RG/ZG) (E108); ERC20-32AGF (ERC040-065GH) (A908); ERC/P16-20AAF (ERC030-040AH) (B814/C814); AND ERC35-55HG (ERC70-120HH) (B839/C839)]

1. Apply Loctite™ 243 to threads of the capscrews and connect pivot mount bracket to motor. Tighten capscrews to 16 N•m (142 lbf in). Make sure bracket is installed so tube of bracket is on pump side NOT motor side as shown in Figure 30. Connect sling and crane to motor. See Figure 28. Make sure crane and sling have a capacity of approximately 50 kg (110 lb) or more. Use crane to lift hydraulic pump and motor into correct position in motor compartment. Connect power cables as marked during removal.

NOTE: Tighten connections for power cables at M8 × 1.25 or 5/16 UNC terminals on General Electric motors to 18 to 22 N•m (159.3 to 195.0 lbf in). Tighten all other connections for power cables as follows:

5/16 UNC threads - 13.5 to 17.5 N•m (119.5 to 155.0 lbf in)
1/4 UNC threads - 4.0 to 6.0 N•m (35.4 to 53.1 lbf in)
#6 UNC threads - 0.73 to 1.02 N•m (6.5 to 9.0 lbf in)
M8 × 1.25 threads - 13.5 to 17.5 N•m (119.5 to 155.0 lbf in)
M10 × 1.5 threads - 15.0 to 18.0 N•m (132.8 to 159.3 lbf in)

NOTE: If rubber bushings of pivot mount bracket were removed, use soap or rubber lubricant to install bushings. Do NOT use oil. The oil will soften bushings and they will need replacement.

2. Keep motor vertical. Install clamps on rear bulkhead of battery compartment to mount pump and motor. Align pivot mount bracket of motor. See Figure 30. Install clamps over pin in pivot mount bracket. Make sure to install washers and wire (ground connection) between mount and clamp brackets.

3. Remove cap on pressure hose. Install pressure hose on outlet of pump. Remove plug in inlet hose and quickly connect inlet hose at pump. Leave fittings loose.

4. If oil was drained from hydraulic system, make sure drain plug is installed in tank. If necessary, turn steering wheel for a full left turn for access to drain plug near front of right rear wheel. If drained, fill hydraulic tank with type and quantity of hydraulic oil shown in the **Service Manual** section Install battery tray and battery and close hood. See one of the following **Service Manual** sections below for battery install procedure.

Periodic Maintenance 8000 YRM 552 for the ERC/P16-20AAF (ERC030-040AF, AG/BG)

Steering Control Unit Replacement

NOTE: See the section **Steering Housing and Control Unit** 1600 YRM 512 or **Steering Housing and Control Unit** 1600 YRM 720 to repair the steering control unit. The following is the correct procedure to remove and install the steering control unit.

NOTE: The repair procedures for the instrument cluster are in the sections **Electrical System**, **Replacement, Checks, and Adjustments Trucks with EV-100/200ZX or SR (SEM) and SP Motor Controllers** 2200 YRM 560 for models ERC/P16-20AAF (ERC030-040AF, AG/BG) (A814), ERP20-30ALF (B216), and ERC20-30AGF (ERC040-065RF/ZF, RG/ZG) (E108).

For models ERP20-30ALF (ERP040-060DH) (D216), ERP20-32ALF (ERP040-065DH) (E216), ERC/P16-20AAF (ERC030-040AH) (B814/C814), ERC20-32AGF (ERC040-065GH) (A908), and ERC35-55HG (ERC70-120HH) (B839/C839) see the section **Electrical System (Trucks With AC Controllers)** 2200 YRM 1055 for the repair procedures for the display panel.

REMOVE

1. Disconnect battery connector. Move steering column to forward position. Remove panel under steering column for access to hoses of steering control unit.

2. Remove front and rear covers for steering column. Install tags and disconnect wires for horn connector and if installed, on-demand power steering and forward/reverse switches. If installed, remove parts for on-demand power steering and forward/reverse switches and lever. See the section **Steering System for Electric Lift Trucks** 1600 YRM 485 for models ERC/P16-20AAF (ERC030-040AF, AG/BG) (A814), ERP20-30ALF (B216), and ERC20-30AGF (ERC040-065RF/ZF, RG/ZG) (E108). See the section **Steering System for AC Electric Lift Trucks** 1600 YRM 1054 for models ERP20-30ALF (ERP040-060DH) (D216), ERP20-32ALF (ERP040-065DH) (E216), ERC/P16-20AAF (ERC030-040AH) (B814/C814), ERC20-32AGF (ERC040-065GH) (A908), and ERC35-55HG (ERC70-120HH) (B839/C839). Also see the section **Steering Housing and Control Unit** 1600 YRM 512 or **Steering Housing and Control Unit** 1600 YRM 720.

WARNING

The hydraulic hoses MUST be connected to the correct ports or the steering system will not operate as expected. This operation that is not expected can cause damage or personal injury. Make sure the hoses are identified and connected correctly.

3. Put tags for identification on hydraulic hoses at steering control unit so they can be connected correctly during assembly. Disconnect hydraulic hoses at bottom of steering control unit. Install plugs at all hose fittings and control unit ports to prevent dirt from entering steering hydraulic system.

4. Hold steering column and remove capscrews that hold steering column and pivot shaft to bracket. See Figure 37, Figure 38, or Figure 39, depending on your model of lift truck. Remove two plates, pivot shaft, and return spring. Remove steering column assembly. Do not lose push rod, washer, and spring for latch.

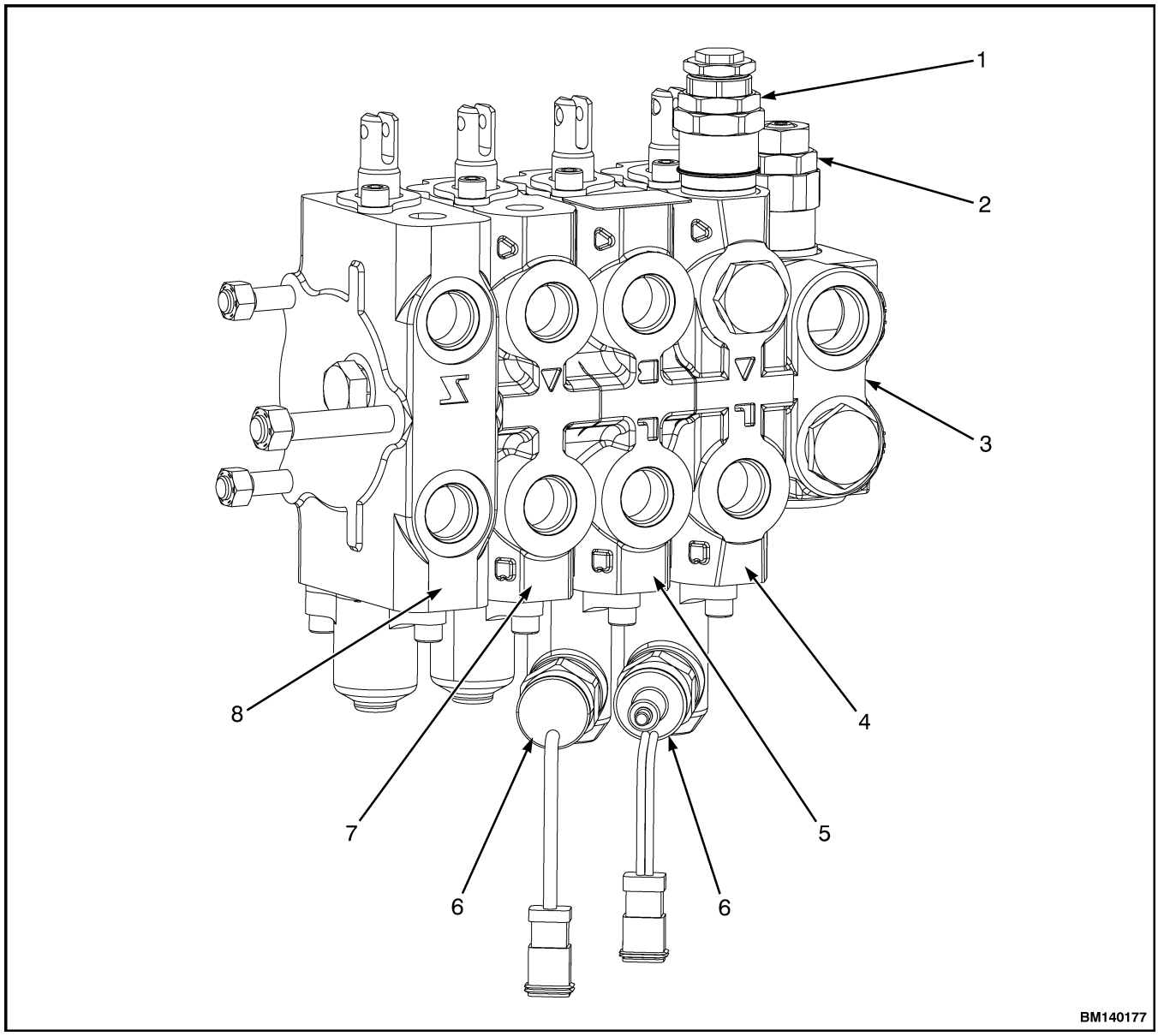
5. Make a note of the alignment of the steering control unit in the bracket for correct installation. Remove four capscrews that fasten steering shaft assembly and steering control unit in steering column bracket. Do not let steering control unit or steering wheel and shaft assembly fall. Do not let washers fall. It is not necessary to remove steering wheel or on-demand steering parts from shaft.

INSTALL

1. Install steering control unit in bracket. See Figure 37, Figure 38, or Figure 39, depending on your model of lift truck. Make sure it is in correct alignment, as noted during removal, so hoses can be correctly connected. Install washers, spacers, steering shaft assembly, and capscrews to hold all parts in bracket.

2. Hold bracket assembly in alignment and install pivot shaft, return spring, plates, washers, and capscrews to hold assembly on mount. Install spring, washer, and push rod for latch. Install column tilt lever on latch. Install Allen screw and nut.

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
The output of the pump is less than specifications.	See **Possible Cause** for the **Problem** *The pump makes more noise than normal* above.	See the section **Capacities and Specifications** 8000 YRM 561 for trucks ERP20-30ALF (B216) and ERC20-30AGF (ERC040-065RF/ZF, RG/ZG) (E108); **Capacities and Specifications** 8000 YRM 621 for the ERC/P16-20AAF (ERC030-040AF, AG/BG) (A814) trucks; **Capacities and Specifications** 8000 YRM 1061 for ERP20-30ALF (ERP040-060DH) (D216); and **Capacities and Specifications** 8000 YRM 1083 for ERC20-32AGF (ERC040-065GH) (A908) and ERC/P16-20AAF (ERC030, 040AH) (B814) trucks, and **Capacities and Specifications** 8000 YRM 1202 for ERC35-55HG (ERC70-120HH) (B839/C839) lift trucks **Capacities and Specifications** 8000 YRM 1227 for lift truck models ERP20-32ALF (ERP040-065DH) (E216) for the correct lifting speeds of your lift truck model and mast. If the relief pressure is correct and the lift speeds are too slow, the pump is worn or has damage or there is a problem in other parts of the lift system. If the pump is worn, it will usually make more noise than normal.
The pump has leaks.	The fittings or hoses on the outlet side of the pump are loose or damaged.	Tighten fittings. Install new parts as necessary.
	The capscrews that hold the pump together are loose.	Tighten capscrews to specified torque.
	The seals in the pump are damaged.	Install new seals or new pump.
The pressure for the steering system is below specifications.	The relief valve at the pump is not adjusted correctly.	Adjust or install new relief valve.
	The relief valve has damage.	Repair or install new relief valve.
	The pump is worn.	Repair or install new pump.



1. SECONDARY RELIEF VALVE
2. PRIMARY RELIEF VALVE
3. INLET SECTION
4. LIFT SECTION
5. TILT SECTION
6. OPS SOLENOID
7. AUXILIARY I SECTION
8. AUXILIARY II SECTION

Figure 2. Main Control Valve with OPS, Lift Truck Models ERC/P16-20AAF (ERC030-040AH) (C814)

Install [ERC/P16-20AAF (ERC030-040AF, AG/BG) (A814); ERC/P16-20AAF (ERC030-040AH) (B814/C814); ERC20-30AGF (ERC040-065RF/ZF, RG/ZG) (E108); and ERC20-32AGF (ERC040-065GH) (A908)]

1. Install the control valve on the mount plate. See Figure 7. Be sure to install the mounting capscrew at the back of the control valve. Do not tighten the capscrew or nuts.

2. Follow the procedures described in the section Control Valve Linkage Repair and install the linkage on the mount plate.

3. Adjust the position of the control valve to obtain dimension A as shown in Figure 10. Tighten the capscrew and nuts for the control valve.

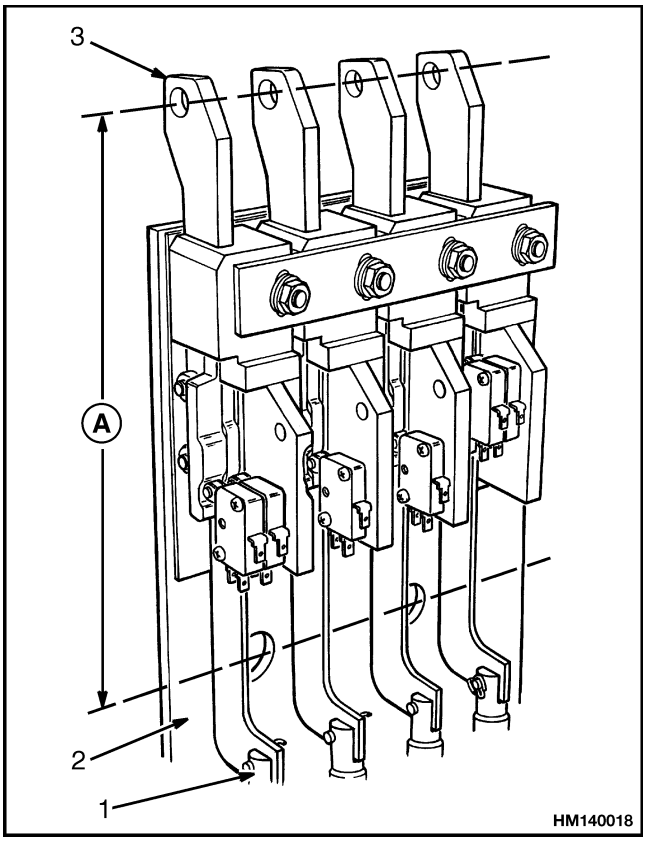


Figure 10. Control Valve Linkage for ERC/P16-20AAF (ERC030-040AF, AG/BG) (A814); ERC/P16-20AAF (ERC030-040AH) (B814/C814); ERC20-30AGF (ERC040-065RF/ZF, RG/ZG) (E108); and ERC20-32AGF (ERC040-065GH) (A908) Lift Trucks

Legend for Figure 10

NOTE: DIMENSION A = 195 ±0.5 mm (7.68 ±0.02 in.) WITH STANDARD HOOD AND 227 ±0.5 mm (8.94 ±0.02 in.) WITH OPTIONAL (HIGHER) HOOD.

1. CONTROL VALVE
2. MOUNT PLATE (CONTROL VALVE)
3. LOWER LINK

4. Install the rubber bushings in the mount plate. Install the mount plate in the mounts on the battery box. Install and tighten the nuts and bolts at the center of the mount plate.

5. Connect the hydraulic lines at the control valve. Connect the linkages for the control levers.

6. Add the hydraulic oil to the tank. See the section **Periodic Maintenance** for the correct specifications.

7. Operate the system and check for leaks and correct operation. If necessary, adjust the relief valves as described in Pressure Relief Valve Check and Adjustment.

Install [ERP20-30ALF (B216), ERP20-30ALF (ERP040-060DH) (D216) and ERP20-32ALF (ERP040-065DH) (E216)]

1. Install the control valve on the bracket. See Figure 8.

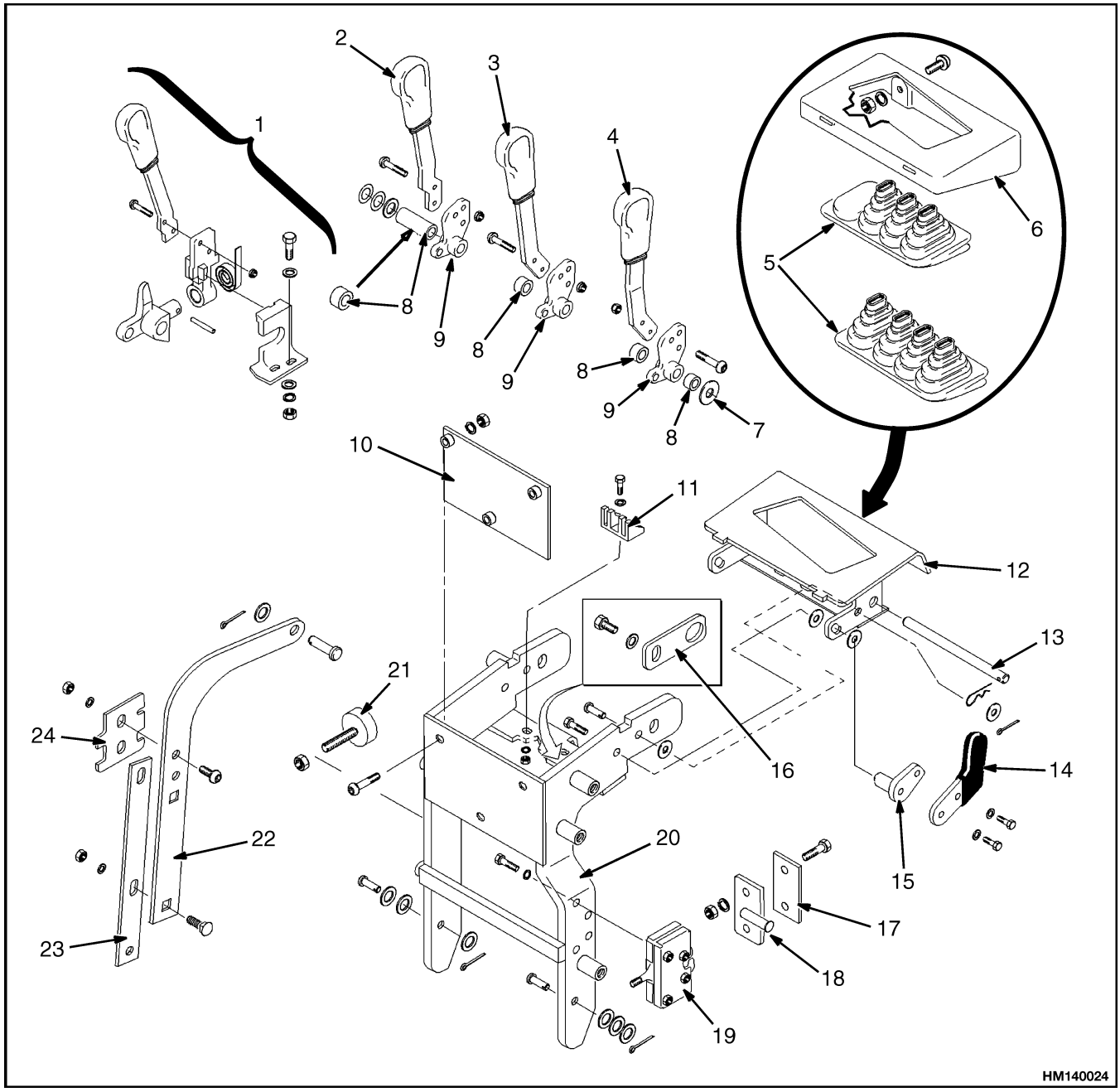
2. Install the rubber bushings in the bracket. Install the bracket and control valve at the front of the battery box. Install the capscrews, washers, and nuts for the bushings.

3. Install the isolators on the control valve bracket. Install the brackets for the isolators.

4. Connect the hydraulic lines at the control valve. Connect the linkages for the control levers.

5. Add the hydraulic oil to the tank. See the section **Periodic Maintenance** for the correct specifications.

6. Operate the system and check for leaks and correct operation. If necessary, adjust the relief valves as described in Pressure Relief Valve Check and Adjustment.



1. THIRD OR FOURTH FUNCTION LEVER WITH DETENT
2. THIRD FUNCTION LEVER WITHOUT DETENT
3. TILT LEVER
4. LIFT/LOWER LEVER
5. BOOT
6. COVER
7. SHIM
8. SPACER
9. CRANK
10. PRINTED CIRCUIT BOARD
11. GUIDE
12. HAND LEVER BRACKET
13. SHAFT
14. ADJUSTMENT LEVER
15. ADJUSTER
16. KEEPER
17. PLATE
18. STRIKER
19. LATCH
20. HAND LEVER SUPPORT
21. STOP SCREW
22. UPPER LINK
23. LOWER LINK
24. SWITCH PLATE

Figure 18. Control Lever Linkage


Yale

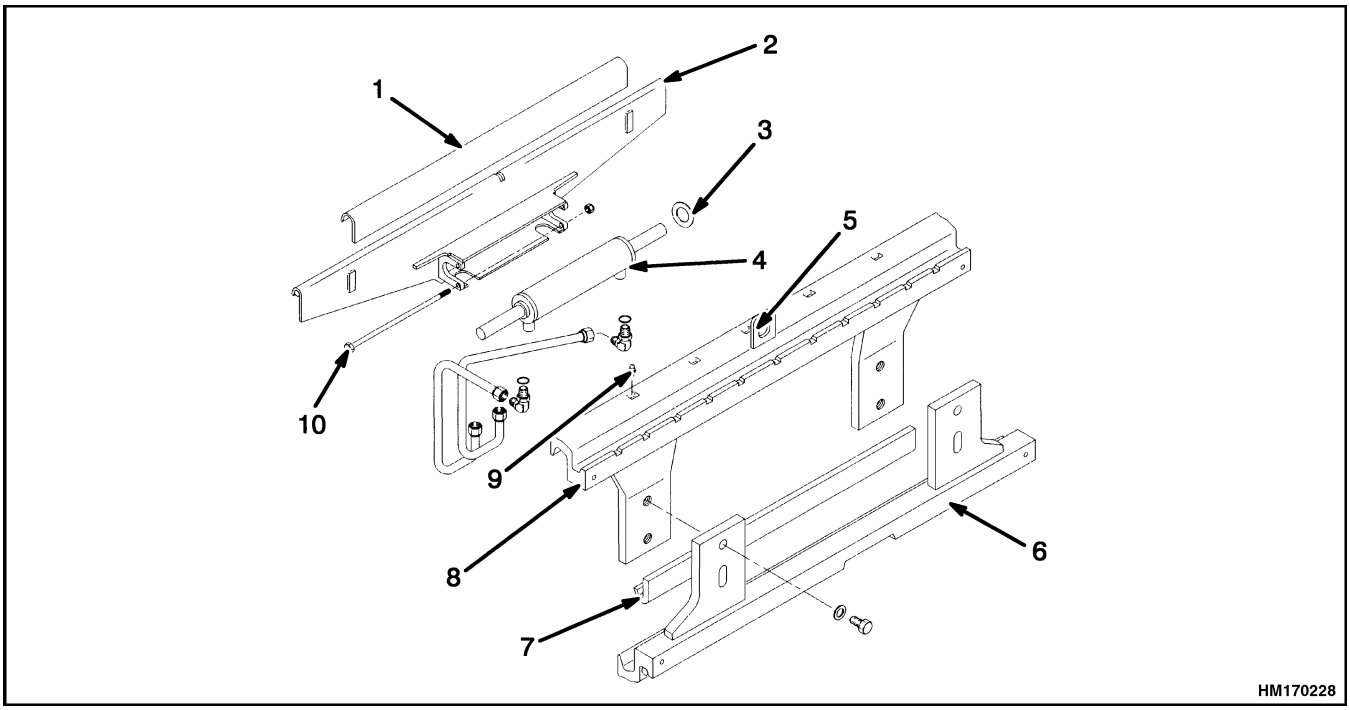
WARNING

Make sure that the carriage has stability when the inner weldment is above the load rollers of the carriage.

4. Use lift cylinders to raise inner weldment. If the hydraulic system cannot be used, connect crane to top of inner weldment. Carefully raise inner weldment until it is above load rollers of carriage.
5. Move lift truck away from carriage. Completely lower inner weldment so it cannot move.
6. Connect lifting device to carriage. Remove load from forks with another lift truck. Lower carriage to floor so load rollers are up.
7. If forks are removed, use lifting device to put carriage on floor so load rollers are up.

Sideshift Carriage

1. Lower carriage completely and remove forks.
2. Connect lifting device to lifting eye on sideshift carriage. The sideshift carriage weighs approximately 200 kg (441 lb).
3. Remove two upper capscrews from bottom carriage bar. Slowly loosen two bottom capscrews, but do not remove them. The slotted holes will allow the bottom carriage bar to move down so that the sideshift carriage can be removed. Carefully lift sideshift carriage from standard carriage. The sideshift cylinder mounting bracket and cylinder will stay on the standard carriage. Remove bushings. See Figure 12.
4. Disconnect hydraulic lines at sideshift cylinder. Put caps on open lines. Remove cylinder mounting bracket from carriage. If necessary, remove threaded rods and shims to remove sideshift cylinder.



1. TOP BUSHING
2. CYLINDER MOUNTING BRACKET
3. SHIM
4. SIDESHIFT CYLINDER
5. LIFTING EYE
6. BOTTOM CARRIAGE BAR
7. BOTTOM BUSHING
8. TOP CARRIAGE BAR
9. GREASE FITTING
10. BOLT

Figure 12. Sideshift Carriage

Legend for Figure 21

1. HOSE
2. HOSE SHEAVE
3. STUB SHAFT WELDMENT
4. WASHER
5. CAPSCREW
6. CHAIN GUARD
7. SPACER
8. CHAIN SHEAVE
9. SNAP RING
10. PIN
11. CROSSHEAD
12. ALIGNMENT PIN
13. FREE-LIFT CYLINDER
14. STRAP
15. TUBE SPACER
16. BRACKET
17. LOWERING CONTROL VALVE FITTING
18. BEARING

ASSEMBLE

NOTE: Assembly of the main lift cylinders and the free-lift cylinder is similar. All of the lift cylinders are assembled from the rod end of the cylinder shell.

1. Lubricate all internal parts of lift cylinder with clean hydraulic oil or packing lubricant, Yale Part No. 504234269. Use new O-rings, seals, and wear rings. See Figure 22 and Figure 23.

2. On the main lift cylinders, do the following:

a. Install rod wiper and rod seal in retainer. Install O-ring on outside of retainer. Install retainer on rod.

b. Install O-ring and backup ring on piston for right-hand cylinder. If a spacer is used, install it on rod. Install piston in rod. Tighten piston to 170 to 200 N•m (125 to 150 lbf ft).

3. Install check valve and O-ring in base of piston of free-lift cylinder and left-hand lift cylinder. Make sure arrow on check valve is toward base of piston. Install washer and snap ring for check valve. See Figure 22.

⚠ CAUTION

A difficult and important step in assembling lift cylinders is the correct installation of the seals. Most lift cylinder maintenance is caused by seal leaks. Do not damage any parts during assembly.

4. Install backup ring, piston seal, and wear ring onto piston. On the main lift cylinders, install seal ring.

5. Carefully push piston and rod assembly into shell.

6. Before installing retainer, pour 150 cc (5 oz) of hydraulic oil into free-lift cylinder shell.

7. On the free-lift cylinder, install rod wiper and rod seal in retainer. Install O-ring and backup ring on outside of retainer. See Figure 23.

8. Carefully engage threads and tighten retainer in shell. Use a correct spanner. Do not hit retainer with a hammer and driver. Tighten retainer on free-lift cylinder to 475 to 540 N•m (350 to 400 lbf ft). Tighten retainer on main cylinder to 340 to 410 N•m (250 to 300 lbf ft).

9. Install lowering control valve in port at base of left-hand, main lift cylinder. See Figure 24. Make sure special washer and spring are installed correctly. The special washer is next to the cylinder shell. A wrong installation can cause the load to lower too fast.

10. Install fitting at base of free-lift cylinder. This is a special fitting that limits flow of the hydraulic oil.

Lift and Tilt System Leaks Check

LIFT CYLINDERS LEAKS CHECK

WARNING

During the test procedures for the hydraulic system, use chains to fasten the load to the carriage to prevent it from falling. Keep all people away from the lift truck during the tests.

Do not try to find hydraulic leaks by putting your hand on hydraulic components under pressure. Hydraulic oil can be injected into the body by the pressure.

1. Operate hydraulic system. Put capacity load on forks. Use safety chain to hold load to carriage. Raise and lower load several times. Lower load and tilt mast forward and backward several times. Check for leaks.

2. Raise carriage and load 1 m (3 ft). If carriage slowly lowers when control valve is in **NEUTRAL** position, there are leaks in hydraulic system. The maximum speed the carriage is allowed to lower is 50 mm (2 in.) per 10 minutes when hydraulic oil is 30°C (90°F). If oil temperature is 70°C (160°F), the maximum speed the carriage can lower is 150 mm (6 in.) per 10 minutes.

3. Check lift cylinders for internal leaks. Remove load from forks. Install gate valve in supply line between main control valve and mast. Put capacity load on forks again. Raise carriage 1 m (3 ft). Close gate valve. If carriage or mast weldments lower slowly, seals in lift cylinders have leaks.

4. If carriage does not move, open gate valve and check movement again. If carriage lowers when gate valve is open, check for leaks in hydraulic lines and fittings. If no leaks are found, main control valve can be worn or damaged. Remove load from forks.

TILT CYLINDERS LEAKS CHECK

1. Put capacity load on forks. Use safety chain to hold load to carriage. Raise load approximately 2.5 m (8 ft). Put mast in vertical position.

2. Measure distance that rod for tilt cylinder extends from shell. Check distance the rod moves in five or ten minutes. The maximum tilt rate with the oil at 20°C (68°F) is 1.0 mm/min (0.04 in./min). The maximum tilt rate with the oil at 60°C (140°F) is 6.8 mm/min (0.30 in./min).

3. If the tilt rate is greater than the specifications, lower mast and remove load from forks. Install gate valve between port at front of tilt cylinder and hydraulic line. Put load on forks again. Close valve. Tilt mast forward just past vertical position. If mast continues to tilt slowly forward, seals on piston are leaking.

4. If mast does not move, open gate valve and check movement again. If mast moves forward when gate valve is open, check for leaks in hydraulic lines and fittings. If no leaks are found, main control valve can be worn or damaged. Remove load from forks when checks are complete.

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **YALE APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

NOTE: The following symbols and words indicate safety information in this manual:

WARNING

Indicates a condition that can cause immediate death or injury!

CAUTION

Indicates a condition that can cause property damage!

Legend for Figure 6

NOTE: TOP VIEW SHOWN

A. ERP20-30ALF (ERP040-060DH) (D216) AND ERP20-32ALF (ERP040-065DH) (E216)
B. ERC20-32AGF (ERC040-065GH) (A908), AND ERC35-55HG (ERC70-120HH) (B839/C839)
C. ERC/P16-20AAF (ERC030-040AH) (B814/C814)

1. DC HYDRAULIC MOTOR
2. HYDRAULIC TANK
3. STEERING MOTOR

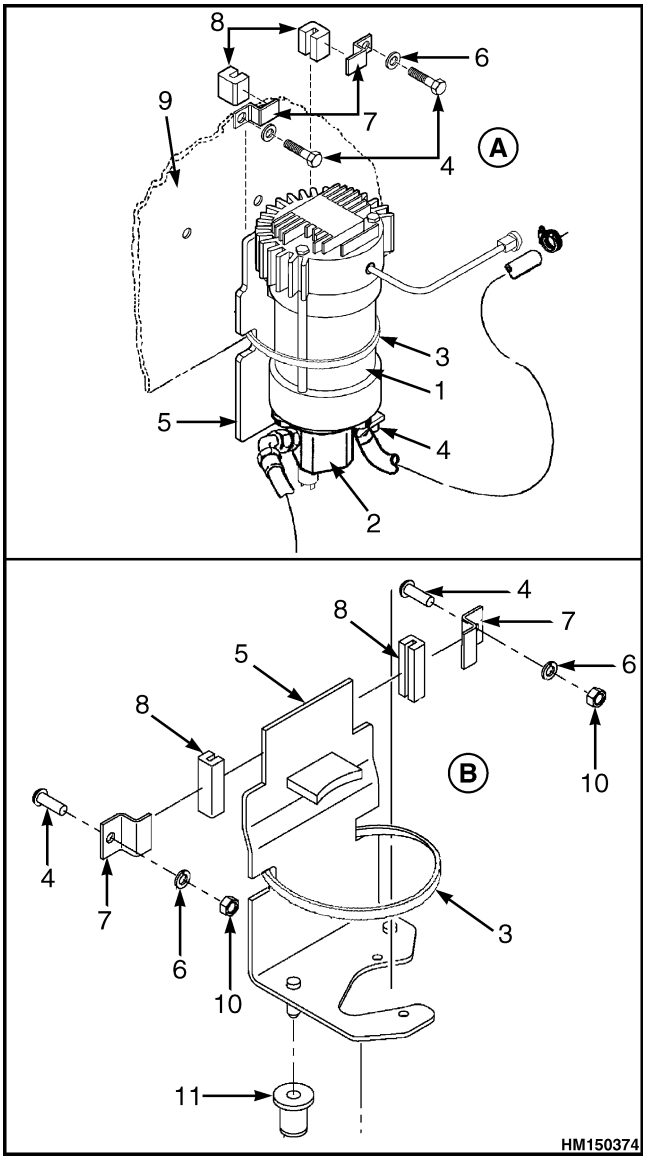


Figure 7. Steering Pump and Motor

Legend for Figure 7

A. STEERING MOTOR AND PUMP MOUNTING BRACKET AND HARDWARE FOR ERC20-32AGF (ERC040-065GH) (A908), ERC/P16-20AAF (ERC030-040AH) (B814/C814), ERP20-30ALF (ERP040-060DH) (D216) AND ERP20-32ALF (ERP040-065DH) (E216) TRUCKS SHOWN
B. STEERING MOTOR AND PUMP MOUNTING BRACKET AND HARDWARE FOR ERC35-55HG (ERC70-120HH) (B839/C839) TRUCKS SHOWN

1. STEERING MOTOR
2. STEERING PUMP
3. METAL STRAP
4. CAPSCREW
5. BRACKET WELDMENT
6. WASHER
7. BRACKET
8. RUBBER CHANNEL
9. TRUCK FRAME
10. NUT
11. GROMMET

WARNING

Never put tools or other metal objects on the battery. Metal on the battery can cause a short circuit and possible damage or injury.

4. Open the hood and install a cardboard or plywood cover on the top of the battery to prevent accidental short circuits.

5. Remove the cover panel from the left side of the battery.

6. Remove the cover from the top of the counterweight.

7. On ERC/P16-20AAF (ERC030-040AH) (B814/C814), ERC20-32AGF (ERC040-065GH) (A908), and ERC35-55HG (ERC70-120HH) (B839/C839), remove the floor boards.

8. Remove the suction hose at the pump. Quickly put plugs in the end of the hose and the pump port to keep oil from draining and dirt from entering the system.

9. Disconnect the pressure hose from the steering pump. Install a plug at the fitting for the hose and the pump port.

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **YALE APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

NOTE: The following symbols and words indicate safety information in this manual:

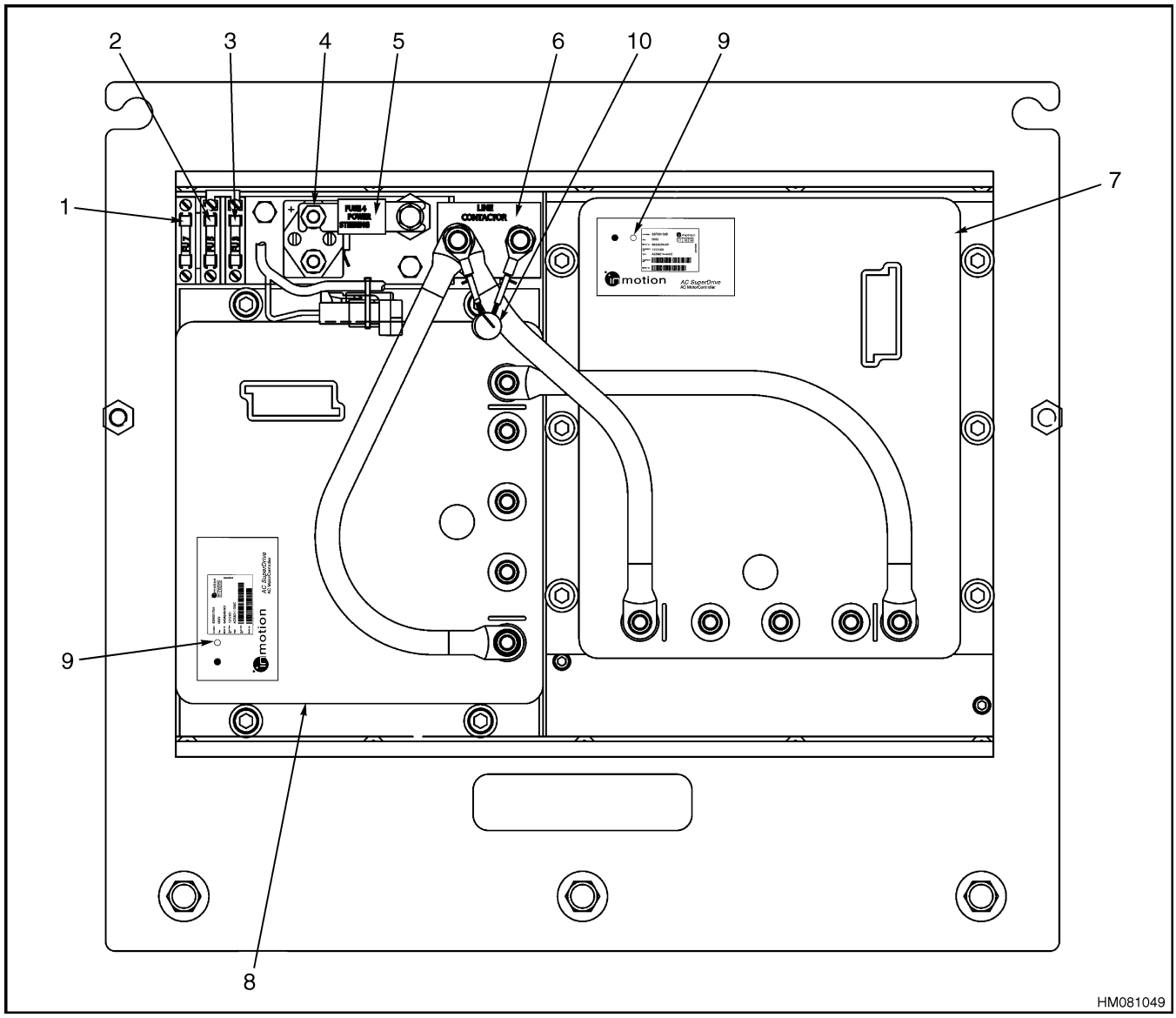
WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

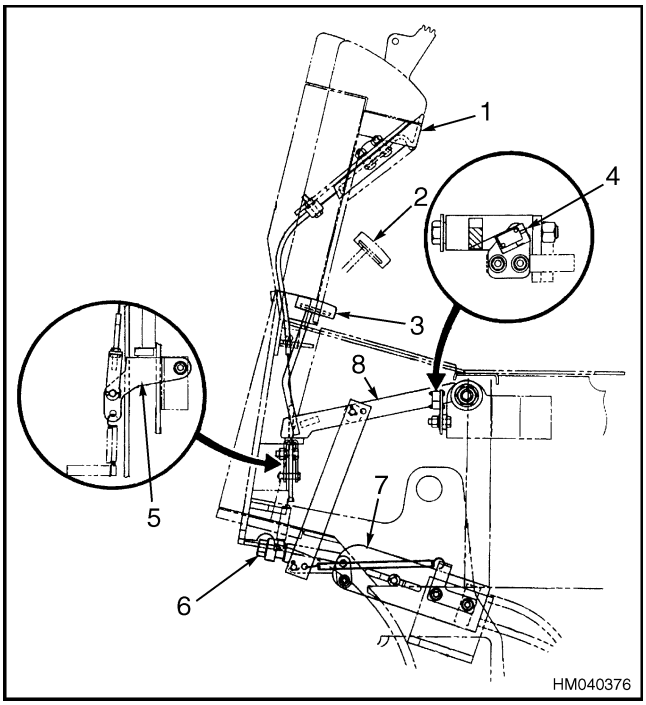
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury and property damage.

On the lift truck, the WARNING symbol and word are on orange background. The CAUTION symbol and word are on yellow background.



1. FUSE 7 (15A) AUXILIARY TERMINAL STRIP
2. FUSE 5 (15A) LIGHTS
3. FUSE 3 (5A) KEYSWITCH
4. POWER STEERING CONTACTOR
5. FUSE 4 (40A) POWER STEERING
6. LINE CONTACTOR
7. AC TRACTION MOTOR CONTROLLER
8. AC PUMP MOTOR CONTROLLER
9. LED INDICATOR
10. POSITIVE TEMPERATURE COEFFICIENT RESISTOR (PTC)

Figure 6. AC Traction and Pump Motor Controllers (72v/80v) (Gen IV) for Early ModelERP20-30ALF (ERP040-060DH) (D216) and ERC20-32AGF (ERC040-065GH) (A908) Lift Trucks



1. RELEASE KNOB
2. PARKING BRAKE PEDAL IN RELEASED POSITION
3. PARKING BRAKE PEDAL IN APPLIED POSITION
4. PARKING BRAKE INDICATOR SWITCH
5. LINKAGE
6. ADJUSTMENT NUT
7. LEVER ASSEMBLY
8. PARKING BRAKE PEDAL ASSEMBLY

Figure 16. Parking Brake Assembly for ERC/P16-20AAF (ERC030-040AH) (B814/C814) Lift Trucks

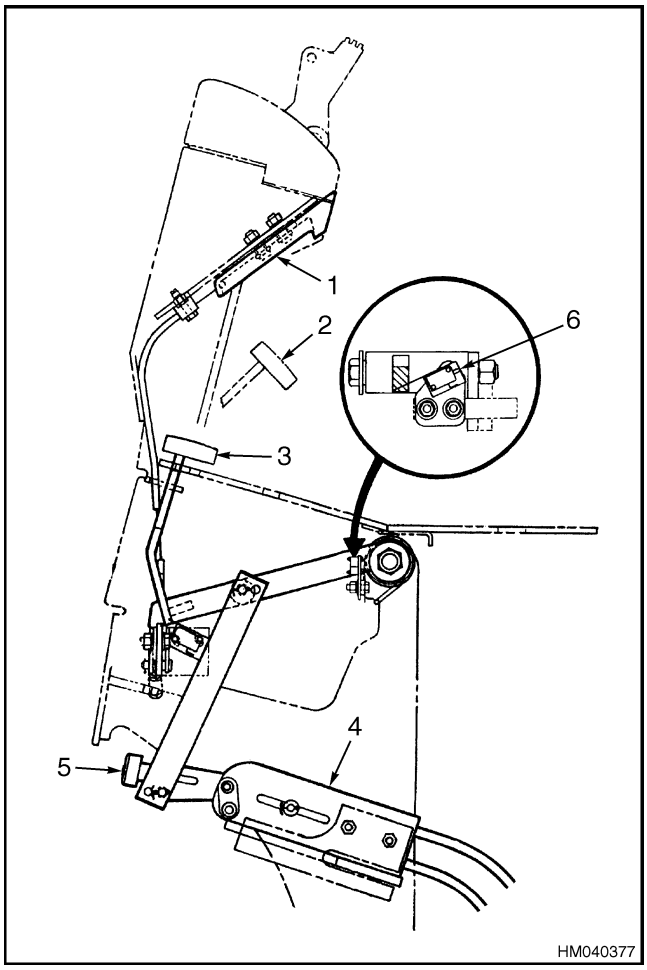
2. Install blocks on each side of a steering wheel to prevent movement of the lift truck. Release the parking brake.

NOTE: For lift truck models ERC35-55HG (ERC70-120HH) (B839/C839) go to Step 4.

3. Remove the floor plate under the parking brake pedal.

4. Remove the screws and nuts that fasten the switch to the bracket. Do not lose the screws, nuts, or washers.

5. Turn the switch so that you can see the terminals. Make a note of the wires fastened to the switch terminals for correct connection during installation. Remove the wires from the switch terminals. Connect the wires to the replacement switch as disconnected during removal.



1. RELEASE KNOB
2. PARKING BRAKE PEDAL IN RELEASED POSITION
3. PARKING BRAKE PEDAL IN APPLIED POSITION
4. LEVER ASSEMBLY
5. ADJUSTMENT NUT
6. PARKING BRAKE INDICATOR SWITCH

Figure 17. Parking Brake Assembly for ERC20-32AGF (ERC040-065GH) (A908) Lift Trucks

6. Install the replacement switch using the same screws, nuts, or washers. Do not damage the leaf of the switch during installation. Tighten the screws and nuts.

7. Check for correct operation and, if necessary, adjust the switch as described in Parking Brake Switch Adjustment.

Legend for Figure 24

NOTE: INCANDESCENT BRAKE, TAIL AND REVERSE LIGHT ASSEMBLY SHOWN.

NOTE: SPOT LIGHTS ARE NOT INSTALLED IN THE UNITED STATES OR CANADA.

NOTE: TOP MOUNTED STROBE LIGHT SHOWN. SEE FIGURE 25 FOR REAR MOUNTED STROBE LIGHT.

NOTE: SEE THE SECTION **ELECTRICAL DIAGRAMS**, **AC MOTOR CONTROL SYSTEM** 8000 YRM 1059 FOR LIFT TRUCK MODELS ERC20-32AGF (ERC040-065GH) (A908), ERC/P16-20AAF (ERC030-040AH) (B814/C814), AND ERP20-30ALF (ERP040-060DH) (D216) OR THE SECTION **ELECTRICAL DIAGRAMS**, **AC MOTOR CONTROL SYSTEM** 8000 YRM 1225 FOR LIFT TRUCK MODEL ERP20-32ALF (ERP040-065DH) (E216) FOR THE CORRECT CONNECTIONS.

1. STROBE LIGHT
2. HEADLIGHTS
3. SPOTLIGHT
4. REVERSE/BRAKE LIGHT
5. BACKUP ALARM
6. BATTERY VOLTAGE TO 12-VDC CONVERTER*
7. SPOTLIGHT HARNESS
8. HEADLIGHT HARNESS
9. LIGHT SWITCH CONNECTOR
10. MAIN HARNESS
11. WIRE 3
12. WIRE 13J
13. WIRE 13
14. WIRE 13A
15. LIGHT HARNESS

*CONVERTER POSITION SHOWN IS FOR LIFT TRUCK MODELS ERP20-30ALF (ERP040-060DH) (D216), ERP20-32ALF (ERP040-065DH) (E216) FOR CONVERTER POSITION ON LIFT TRUCKS ERC20-32AGF (ERC040-065GH) (A908) AND ERC/P16-20AAF (ERC030-040AH) (B814/C814) LIFT TRUCKS, SEE FIGURE 29 AND FOR ERC35-55HG (ERC70-120HH) (B839/C839) LIFT TRUCKS, SEE FIGURE 30.

LED Assembly - Remove

NOTE: The LED brake, tail and reverse light assemblies (see Figure 25) used on these trucks are non-repairable. If an assembly is broken, it must be replaced as a complete unit (see the **Parts Manual** for replacement parts). The procedures below outline how to replace the LED assembly as a complete unit.

1. Disconnect the battery and discharge the capacitors by holding the horn button down until the horn stops making a sound. Attach a tag to truck battery connector stating DO NOT CONNECT BATTERY. Remove the key.

2. Remove the two screws, washers, and lock nuts that hold the LED assembly to the mounting bracket. See Figure 26. Disconnect the LED light from the rear light harness.

3. Remove LED light from the mounting bracket.

4. If the LED mounting bracket must be removed from the overhead guard leg, remove the plug and screw holding the bracket to the overhead guard leg and remove the bracket from the overhead guard leg.

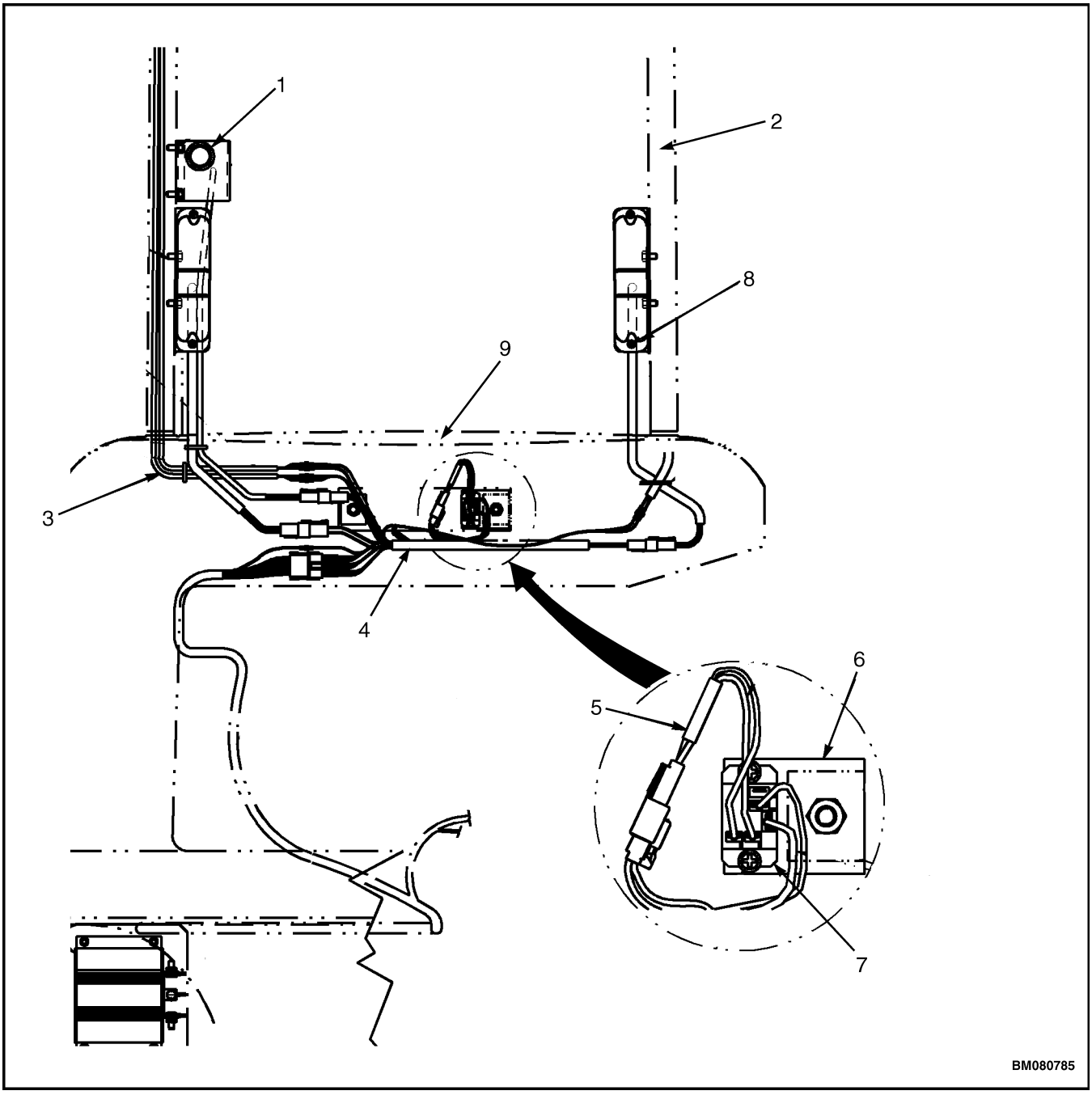
LED Assembly - Install

1. If the mounting bracket was removed, install it onto the overhead guard leg. Align the bracket holes with the holes in the overhead guard leg and insert the plug and screw to attach mounting bracket to overhead guard leg.

2. Connect the LED light to the rear light harness.

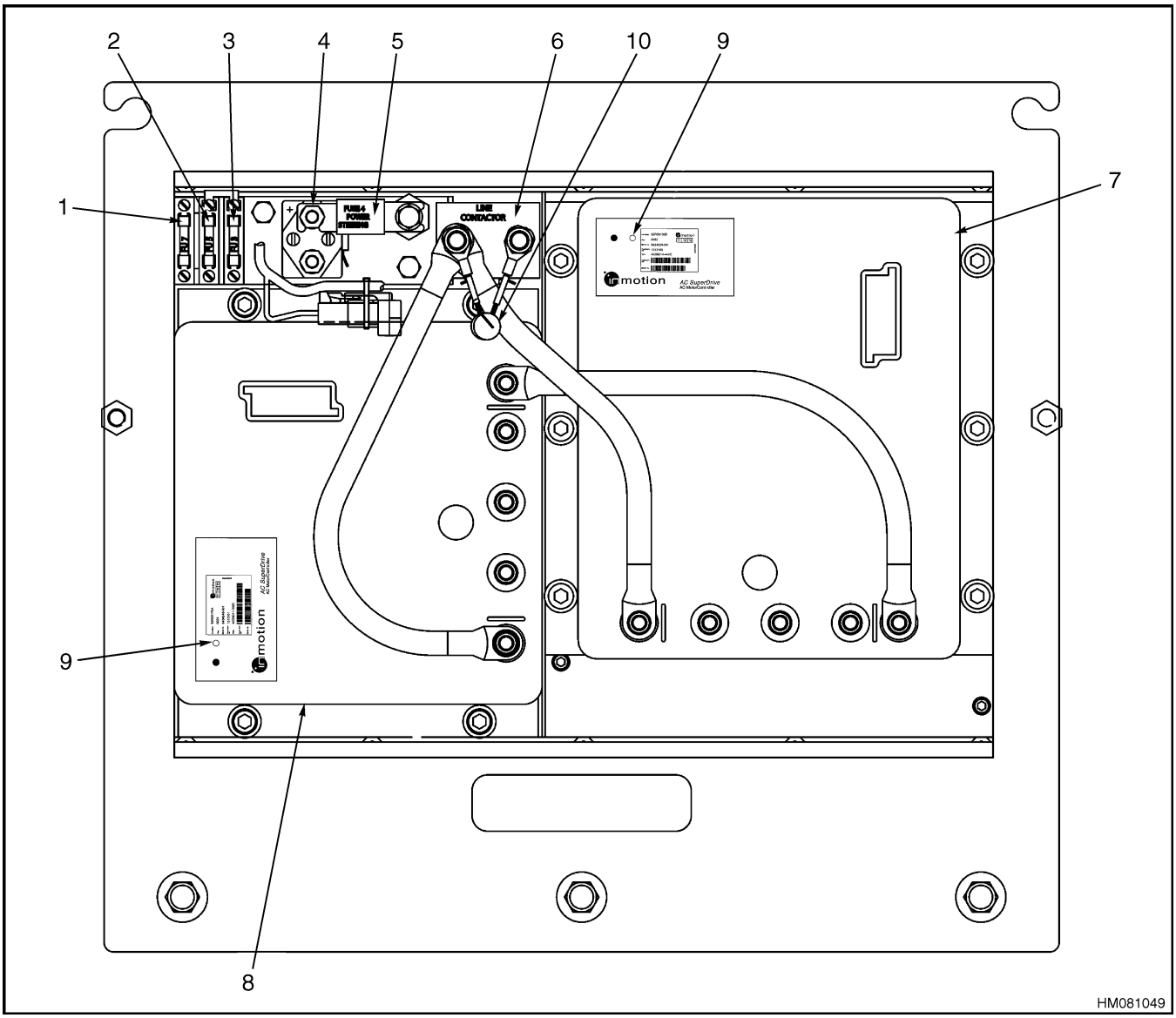
3. Place LED light on mounting bracket and insert the two screws, washers, and lock nuts and install the LED light assembly to the mounting bracket. See Figure 26.

4. Remove the DO NOT CONNECT BATTERY tag from truck battery connector and reconnect the battery.



1. ALARM MODULE
2. OVERHEAD GUARD
3. LIGHT HARNESS
4. REAR LIGHT HARNESS
5. RELAY HARNESS
6. BRACKET
7. REVERSE RELAY
8. BRAKE/BACKUP LIGHTS
9. COUNTERWEIGHT

Figure 31. Reverse Relay Location



1. FUSE 7 (15A) AUXILIARY TERMINAL STRIP
2. FUSE 5 (15A) LIGHTS
3. FUSE 3 (5A) KEYSWITCH
4. POWER STEERING CONTACTOR
5. FUSE 4 (40A) POWER STEERING
6. LINE CONTACTOR
7. AC TRACTION MOTOR CONTROLLER
8. AC PUMP MOTOR CONTROLLER
9. LED INDICATOR
10. POSITIVE TEMPERATURE COEFFICIENT RESISTOR (PTC)

Figure 41. AC Traction and Pump Motor Controllers (72v/80v) (Gen IV) for Early Model ERP20-30ALF (ERP040-060DH) (D216) and ERC20-32AGF (ERC040-065GH) (A908) Lift Trucks

Yale Materials Handling Corp.
1400 Sullivan Dr., Greenville, NC 27834-2011

2200 YRM 1055 10/09 (11/07)(3/06)(1/06)(7/05)(3/05)(5/04)(1/04)(11/03)(3/03) Printed in U.S.A.

NOTE: The deceleration rate is less when the pedal is not fully depressed.

Function Number 7 AUTO DECELERATION

(Range 0-100)

Function 7 determines the maximum deceleration rate when the accelerator pedal is released. The strength of auto deceleration is a percentage of the regen braking strength determined by **Function 6**.

A **Function 7** setting of **zero** will turn off auto deceleration completely, and a setting of **100** will give auto deceleration the same strength as regen braking.

Function Number 8 BDI ADJUSTMENT

(Range 0-100)

Function 8 allows for adjustment to improve the accuracy of the **Battery Discharge Indicator** in the dash display. Increasing the setting will cause the gage to show **empty** at a higher specific gravity or battery voltage.

A setting of 30 is the recommended starting point for flooded cell batteries, and a setting of 50 for maintenance-free batteries. Further adjustments may be used to fine-tune the BDI accuracy.

Function Number 9 LIFT INTERRUPT

(Enable or Disable)

Function 9 enables or **disables** the lift interrupt feature. The lift interrupt feature stops hoist operation when the BDI reads **empty** to protect the battery from excessive discharge and possible damage.

NOTE: Trucks are shipped from the factory with this feature **enabled**.

Function Number 10 POWER STEERING TIME DELAY

(Range 0-100)

Function 10 sets the time delay for the power steering contactor to open after the seat switch opens. The setting range is 1.5 to 65 seconds. Opening the key switch will open the power steering contactor with no delay.

Function Number 11 SERVICE REMINDER

(Set Next Hourmeter)

Function 11 can be used by the service technician to show a **Status Code 99** when the truck is due for service.

To use this feature, set this function to the hourmeter reading that the service is to occur. When that hourmeter is reached, the dash display will display **Status Code 99** for 10 seconds each time the key is turned **ON**. After 20 hours of operation, the truck will slow to half speed and the code will display continuously until the service is performed. After servicing the truck, **Function 11** should be set to the next service hourmeter reading to regain full performance.

NOTE: A setting of **zero** will disable this feature.

Function Number 12 CUSTOM

(Range 0-100)

Function 12 is not used **except for special functions** required for special applications. Normally, this function is set to **zero**.

A setting value of 1 will change auto deceleration to work even with a partial release of the accelerator pedal. Normally, auto deceleration only works when the accelerator pedal is **fully** released.

A setting value of 2 will cause the maximum lift speed and pump motor acceleration rate to change with the performance mode selected. Normally, only traction speeds and acceleration rates change with the performance mode selected.

A setting value of 3 will combine the changes described for setting values of 1 and 2.

A setting value of 4 directs the master controller to output forward and reverse signals that are compatible with wire guided trucks.

Function Number 13 PUMP SPEED 1

NOTE: This function does not apply for lift trucks that are equipped with the e-hydraulics option.

(Range 0-100)

Function 13 determines the hydraulic pump motor **low speed**. **Low speed** is used for **tilt** and some auxiliary operations (sideshift).

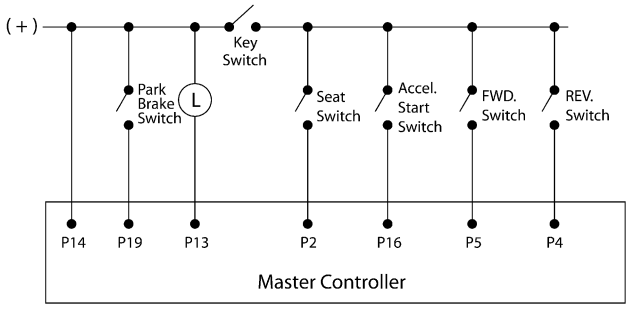
Status Code	Description	Memory Recall	Circuit
3	The reverse switch is closed before key or seat switch closes.	No	Traction

Symptom

Lift truck does not operate.

Possible Causes and Test Procedures

- A directional switch is closed when the key switch is turned to the **ON** position. This violates the Static Return to Off (SRO) Startup Procedure, move the directional lever to the neutral position, and then select a direction.
- A directional switch is failed closed or out of adjustment.



HM080916

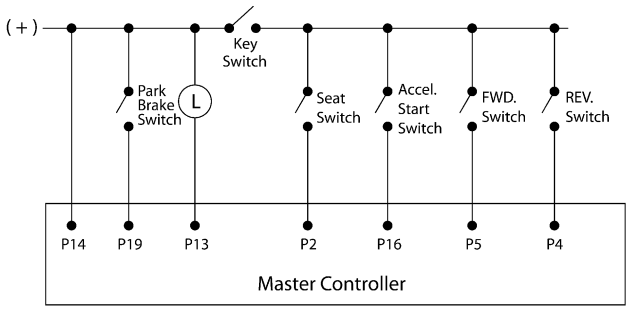
Status Code	Description	Memory Recall	Circuit
4	Park brake applied while the key switch is in the **ON** position.	No	Traction

Symptom

Lift truck does not move.

Possible Causes and Test Procedures

- Park brake is applied.
  Truck will not operate with park brake applied. Release the park break.
- Park brake switch is out of adjustment or is shorted.



HM080916

Status Code	Description	Memory Recall	Circuit
52	Traction or pump motor speed sensor error.	No	Traction

Symptom

Traction or pump motor operates very slowly and jerky.

Possible Causes and Test Procedures

- Disconnected or broken sensor wires between motor and motor controller.
- Malfunction of motor encoder bearing.

Status Code	Description	Memory Recall	Circuit
53	Traction controller does not respond to master controller.	No	Traction

Symptom

Lift truck does not move.

Possible Causes and Test Procedures

- Malfunction of motor controller.
  Check key switch input to motor controller.
  See Controller Status Light Emitting Diodes (LEDs).
- CANbus communication between motor controller and master controller is not working.
  Check for loose or broken wires.
- Open connection between motor controller pin 13 (ground) and pin 12 and/or pin 20. See the **Electrical Diagrams** manual for your lift truck model. Pins 12 and 20 are truck I.D. pins.
- A code may appear when the master controller does not detect the key turning **OFF**, but the pump controller does detect the key turning **OFF**. This is caused when there is a voltage on the key switch circuit that is greater that 3 volts and less than 10 volts with the key turned **OFF**.

Status Code	Description	Memory Recall	Circuit
54	Pump controller does not respond to master controller.	No	Pump

Symptom

Hydraulic pump motor does not operate.

Possible Causes and Test Procedures

- Malfunction of motor controller.
  Check key switch input to motor controller.
  See Controller Status Light Emitting Diodes (LEDs).
- CANbus communication between motor controller and master controller is not working
  Check for loose or broken wires.
- This status code may appear on trucks with contactor controlled DC pump motors. The master controller senses the presence of a contactor by a voltage on pin 40. If there is no voltage on pin 40, the master controller assumes an AC pump motor controller is present, but not able to communicate.
  Check for voltage at the pump contactor coil.
  Check wiring from pump contactor coil to master controller, pin 40.
- A code may appear when the master controller does not detect the key turning **OFF**, but the pump controller does detect the key turning **OFF**. This is caused when there is a voltage on the key switch circuit that is greater that 3 volts and less than 10 volts with the key turned **OFF**.

Hydraulics Operate Normally, Traction Does Not Operate Correctly, and Dash is Operational but no Status Codes are Present

Possible reasons include:
- The master controller is not detecting input from the accelerator sensor.
- **ERP20-32ALF (ERP040-065DH) [E216] Only -** A brake pressure sensor is faulty.

Troubleshoot as follows:
- Using the dash display or ETACC, check the throttle potentiometer voltage as the accelerator is depressed.
- **ERP20-32ALF (ERP040-065DH) [E216] Only -** If the lift truck is equipped with brake lights, check that the brake lights are **OFF** when the brake pedal is released. If the brake lights remain **ON** after the brake pedal is released, the master controller will not command the traction controller to move.
- **ERP20-32ALF (ERP040-065DH) [E216] Only -** If the lift truck is not equipped with brake lights but is equipped with a light wire harness, install relay 580035738 and suppression module 580034404, if required. Use an ohmmeter across the NO to COM contacts to make sure that the relay releases when the brake pedal is released.
- **ERP20-32ALF (ERP040-065DH) [E216] Only -** It the lift truck does not have a light harness, locate the main accessory harness connector and install a 20,000 to 25,000 ohm 1/2 watt or larger resistor between pins 2 (wire 10R) and 5 (wire 84C), and make sure that there is no voltage when the brake pedal is released.

Traction Operates Normally, Hydraulics do Not Operate Correctly, and Dash is Operational but no Status Codes are Present

Possible reasons include:
- There is no switch input from the hand levers.
- The master controller has incorrectly defined the lift truck due to a corrupt register in the traction control.

Troubleshoot as follows:
- Using the dash display or ETACC, check that the switch inputs as the hydraulic levers are actuated.
- If the lift truck has contactor hydraulics, connect the pump AC controller connector to the traction control. Turn the key switch **ON** then **OFF**, then reconnect the traction controller connector. Update the master controller software when the problem has been corrected.

AC Transistor Motor Controller Replacement

GENERAL

NOTE: In Figure 8 through Figure 12, the terms Gen IV and Gen V refer to Generation IV and Generation V respectively. Controller and contactor panels labeled Gen IV are used in early model lift trucks and controller and contactor panels labeled Gen V are used in later model lift trucks.

The assembly of the AC traction motor controller with optional AC pump motor controller is shown in Figure 8, Figure 9, and Figure 10. The assembly of the AC Traction Motor controller with contactor for DC Lift Pump Motor is shown in Figure 11 and Figure 12. There are NO internal parts of these motor controllers that can be repaired. Each of these motor controllers must be replaced if an internal malfunction occurs.

THERMAL SENSORS

The thermal sensors for AC motors are embedded in the motor windings and are continuously monitored by the motor controllers. They are part of the motor and cannot be replaced or repaired.

MOTOR CONTROLLER, REPLACE

Make sure the battery is disconnected and the capacitor is discharged. Discharge the capacitor by holding down the horn button until the horn stops making a sound. Put a **DO NOT CONNECT** tag on the battery connector. Replace the motor controller as described in the following procedure.

1. Make an identification for correct connection of the power cables on the power terminals of the motor controller. Disconnect the power cables and the connector plug for the control wires.

2. Remove the eight (traction) or six (pump) mounting screws that fasten the plate of the motor controller to the lift truck heat sink. Carefully remove the motor controller.

CAUTION

DO NOT remove the small screws that fasten the cover of the motor controller.

Make sure there is no dirt between the plate of the motor controller and the mount surface of the lift truck heat sink.

3. Put an even coat of the silicone compound (Yale P/N 504223239) or equivalent on the plate of the motor controller. Make sure there are no air spaces between the plate and mount surface of the lift truck heat sink. The plate of the motor controller must make full contact with the heat sink. Install the mount screws that fasten the motor controller to the heat sink.

4. Install the power cables at the power terminals of the motor controller as identified during removal. Install the connector plug for the control wires on the connector of the motor controller.

5. Remove the **DO NOT CONNECT** tag from battery connector and reconnect the battery.

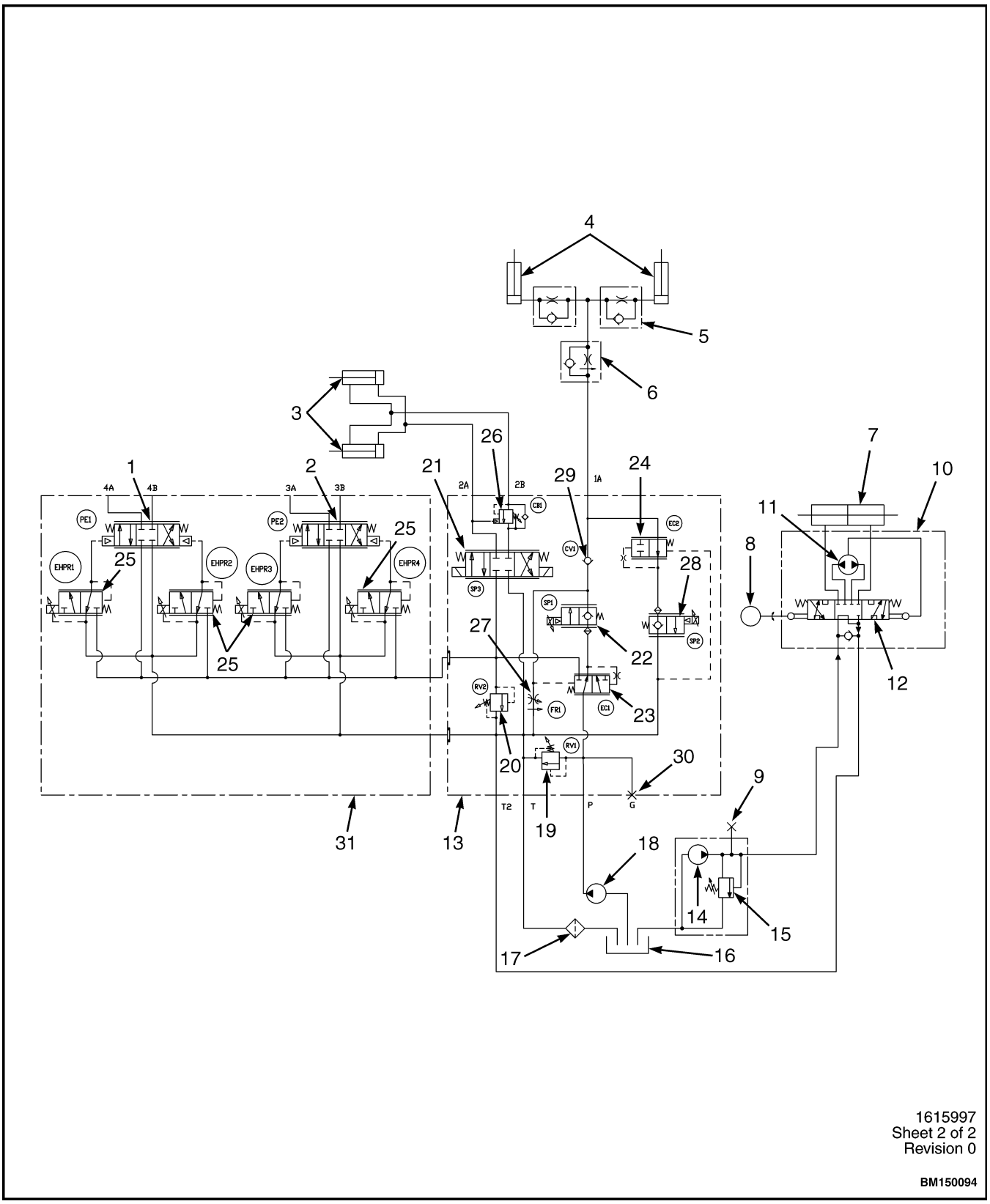


Figure 26. Electro-Hydraulic Control Valve Schematic (High Flow) for Lift Truck Models ERP20-32ALF (ERP040-065DH) (E216), ERC/P16-20AAF (ERC030-040AH), (C814), ERC020-032AGF (ERC040-065GH) (A908)

General

The information contained in this manual gives the user a brief overview of the Electric Truck AC Controls Program. This manual also explains the common drop-down menu features for the user that are listed under the **File** menu, the **Reports** menu, the **Tools** menu, and the **Help** menu.

A personal computer (PC) can be used to set the traction motor and pump motor controller functions, read status codes, and perform numerous diagnostic and troubleshooting functions.

COMPUTER REQUIREMENTS

The PC must have the following minimum configuration:

1. **Microsoft Windows 2000™** or later operating system must be installed.
2. There must be an open Universal Serial Bus (USB) port available on the computer to connect to the lift truck.
3. There must be a compact disk read-only-memory (CD-ROM) drive installed on the computer.
4. **Microsoft Internet Explorer™ Version 5.01** or later must be installed on the computer.
5. The display screen resolution should be set to 800×600 pixels.

SOFTWARE, INSTALL

NOTE: See instructions included with CD, Yale part number 524187015 (Initial Installation), and/or **readme.txt** file on the CD for additional instructions and possible password requirements.

NOTE: You must have **Administrator** rights to install this software on a PC. After installation, folders "EVS" and "Program Files/ETACC YALE/" and their sub-folders must have their security permissions set to allow full control.

NOTE: When installing the software on a PC with **Microsoft Windows 2000** or a later Operating System, make sure that the computer is setup with **Administrator** rights on the computer.

NOTE: In the following examples, the **D:** drive represents the CD-ROM drive. The CD-ROM drive could be a different letter on the computer.

To run the setup program, follow these steps:

1. Place the CD in the CD-ROM drive. Installation will start automatically if the computer is set for automatic startup. If the computer is not set for automatic startup, go to Step 2.
2. Click **Start**.
3. Select **Run** and in the **Open** line enter **D:\disk1\setup.exe**.
4. Click **OK**. The setup program will guide you through the rest of the steps to install the Electric Truck AC Controls Program Yale on the computer.

It is recommended that the program is installed to the default directories.

LANGUAGE SELECTION

1. When the program is first installed the language setup screen will appear. Click on the down arrow to see the languages to be selected. Select the desired language from the list. See Figure 1. The Electric Truck AC Controls Program Yale text will appear in the selected language.

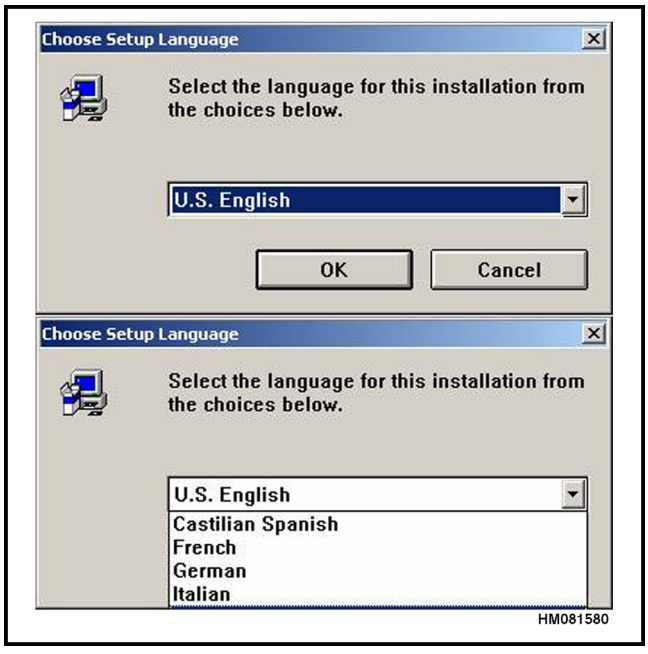


Figure 1. Language Selection

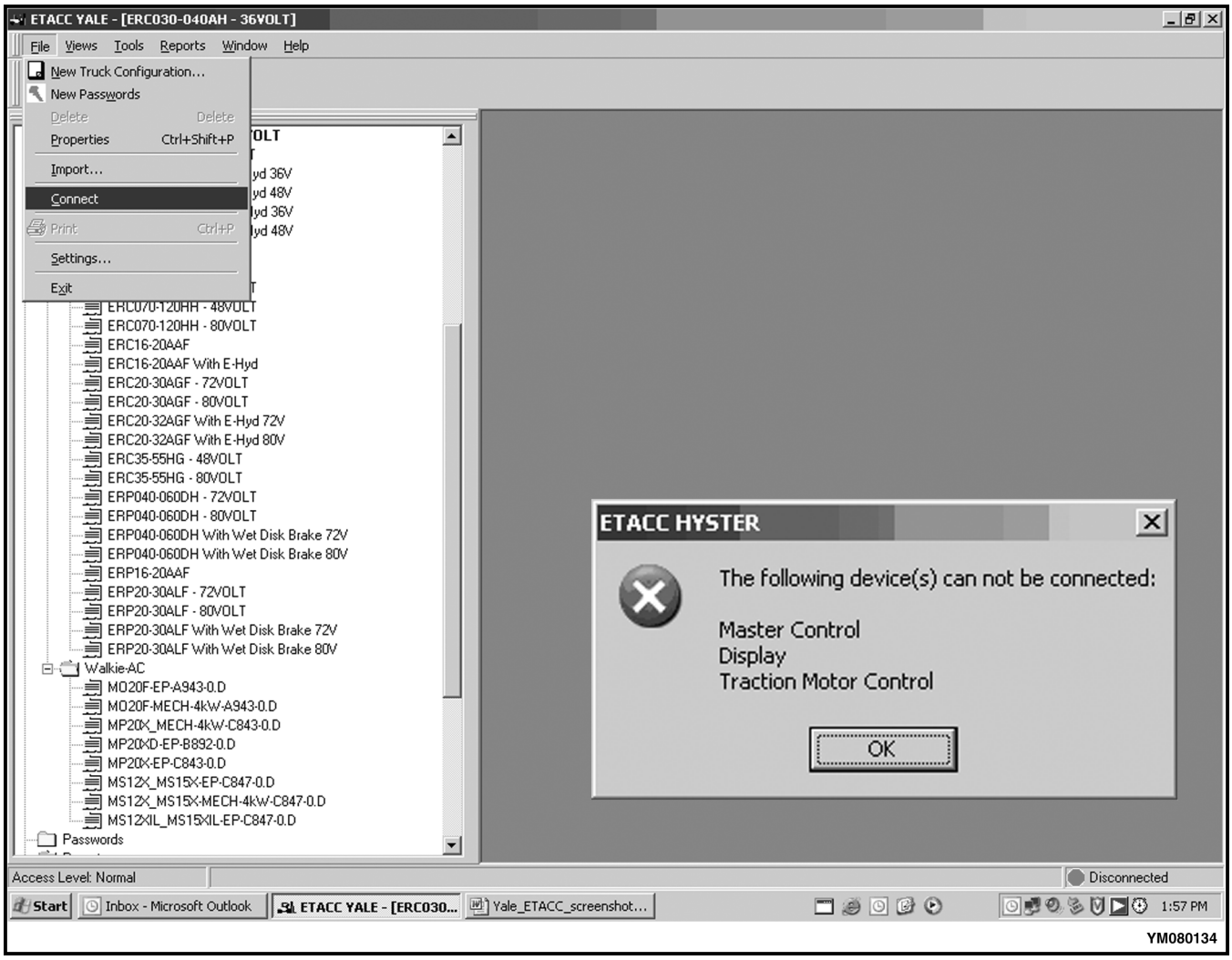


Figure 11. Communication Error PC to Lift Truck

NOTE: The new file name appears in the **Custom Configuration** file folder. For example, the **4-Wheel Special** is displayed in the **Custom Configuration** file folder. See Figure 21.

7. Select the new Custom Configuration file in the **Custom Configuration** folder.

8. Connect the Interface Cable to the three-pin connector, located behind the dashboard cowl liner cutout under the dash display, to the lift truck to be customized.

9. Enter the customized information for the lift truck. See Setting Factory Default Values or Changing Lift Truck Parameters.

10. Click the **Connect/Disconnect** icon to connect the computer to the lift truck.

LIFT TRUCK CONFIGURATION PROPERTIES

There are various lift truck properties that can be viewed on the computer. These properties are: **Lift Truck Configuration Properties** and **Password Properties**. This section will deal only with **Lift Truck Configuration Properties**. To view **Password Properties**, go to Password Properties.

1. Select a lift truck in **Custom Configurations** folder or **Factory Configurations** folder. See Figure 22.

2. Select **Properties** from the **File** menu or right-click the mouse and select **Properties** from the pop-up box. See Figure 22.

The **Properties** dialog box pops up and contains the following information on the lift truck. See Figure 23.

File Name: Identifies the name of the Truck Configuration File. For example, **ERP16-20AAF** is the truck configuration file.

Location: Identifies the directory path to the Truck Configuration File.

Truck Type: Identifies the truck configuration's reference to a lift truck model.

Article Number: Indicates the control types and software numbers used on the lift truck.

Passwords File: Refers to the current password file associated with the lift truck configuration.

3. To change the **Password File**, select a different password from the drop-down list and click **OK**. For example, **4-Wheel Special** is selected. See Figure 24.

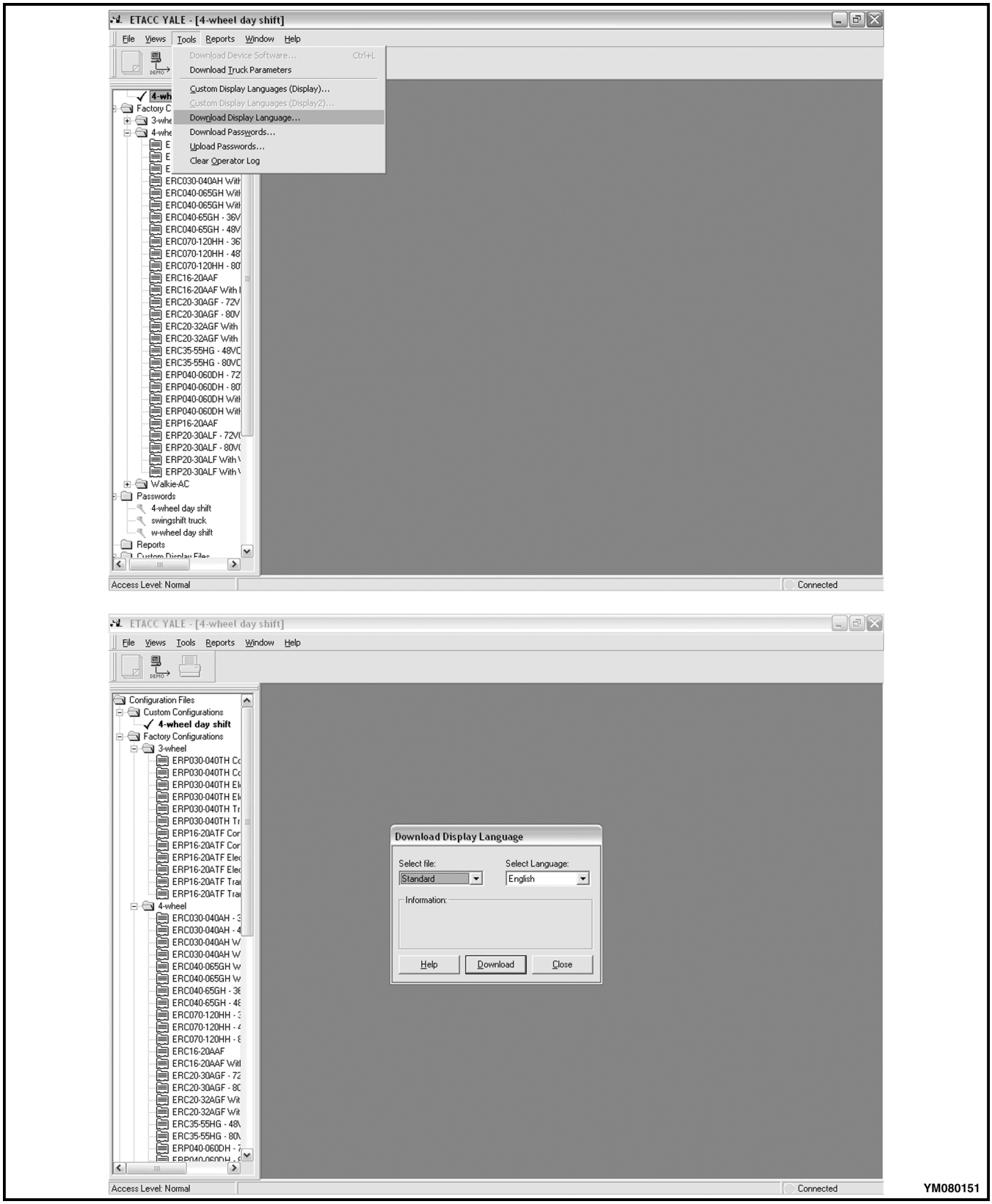


Figure 30. Download Display Language

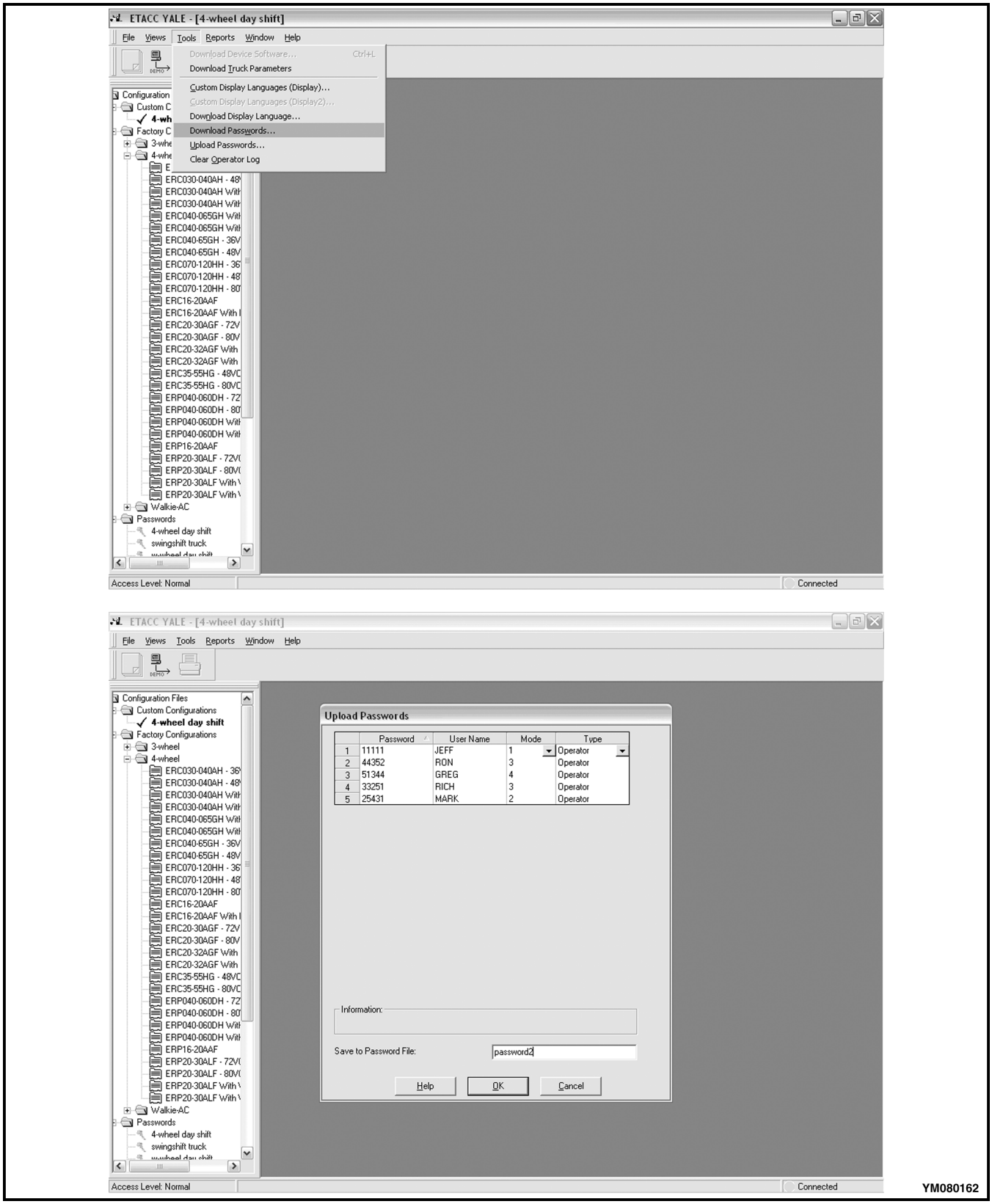


Figure 40. Tools Menu, Upload Passwords

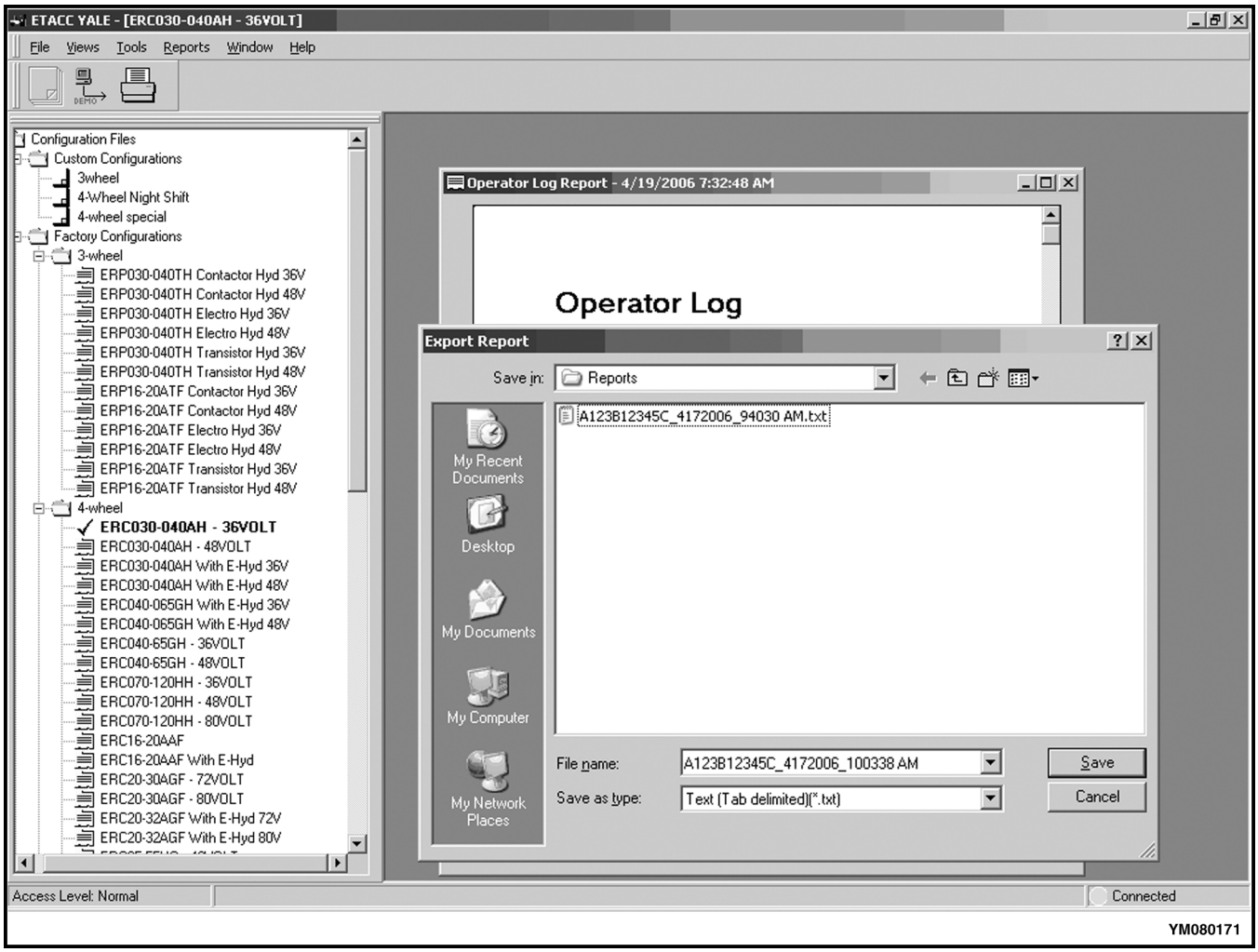


Figure 50. Operator Log Export Report

CURRENT SETTINGS REPORT

Select **Current Settings** on the **Reports** menu. See Figure 51.

A **Current Settings Report - Connected** dialog box pops up and contains the following information on the lift truck. See Figure 52.

NOTE: If the computer is **NOT** connected to the lift truck, the available stored files will be displayed.

Serial Number: Represents the serial number of the lift truck that is currently connected to the computer.

NOTE: The master controller is the location where all of the maintenance hours are stored on the lift truck. This includes: secure hours, traction hours, and pump hours.

Secure Hours: Represents the total traction motor hours that have accumulated on the lift truck. If the traction motor hours have been reset, there will be a difference between the traction motor hours and secure hours. Secure hours **cannot** be reset. Secure hours are **only** reset to zero when the master controller is replaced.

NOTE: ERP1.60-1.80-2.00ATF (ERP030-040TH) models will only reset secure hours to zero if both the controller and dash display are replaced with new components at the same time.

Traction Hours: Represents the number of operating hours that have accumulated on the traction motor. The traction motor hours are tracked from the time the operator is seated in the lift truck and turns the key switch to the **ON** position.

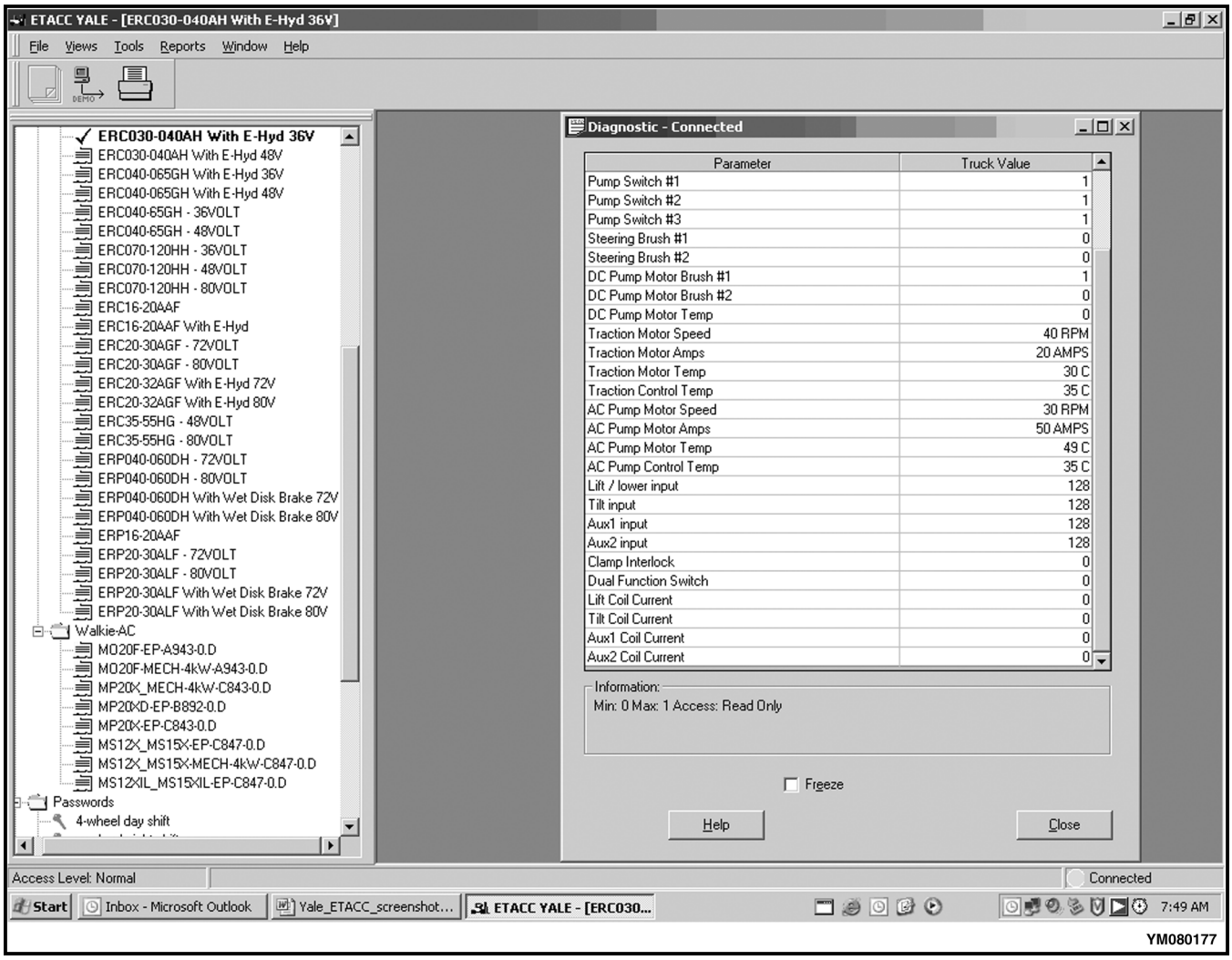


Figure 60. Diagnostic Screen With Lift Truck Communication

For example, if the **Park Brake** is set, a **1** value will appear in the **Truck Value** column of the **Park Brake** row. If the **Park Brake** is not set, a **0** value will appear in the **Truck Value** column of the **Park Brake** row. If the operator sets the **Park Brake** while the **Truck Value** is displayed on screen, the value will change from a **0** value or the **OFF** condition to the **1** value or **ON** condition in the **Park Brake** row. See Figure 60. If the **Truck Value** does not change on screen, there could be a problem with the park brake switch or the adjustment of the switch.

Freeze button: This button locks the **Diagnostic - Connected** dialog box in the current state. Any changes made to the lift truck **WILL NOT** be shown in the **Truck Value** column.

To show the new values that have been applied to the **Truck Value** column:

1. Click **Update**.
2. The new values will appear in the **Truck Value** column.

If further troubleshooting is required due to Status Codes displayed on the Dash Panel, see the **AC Motor Controllers/Display Panel** section for your lift truck.


Yale

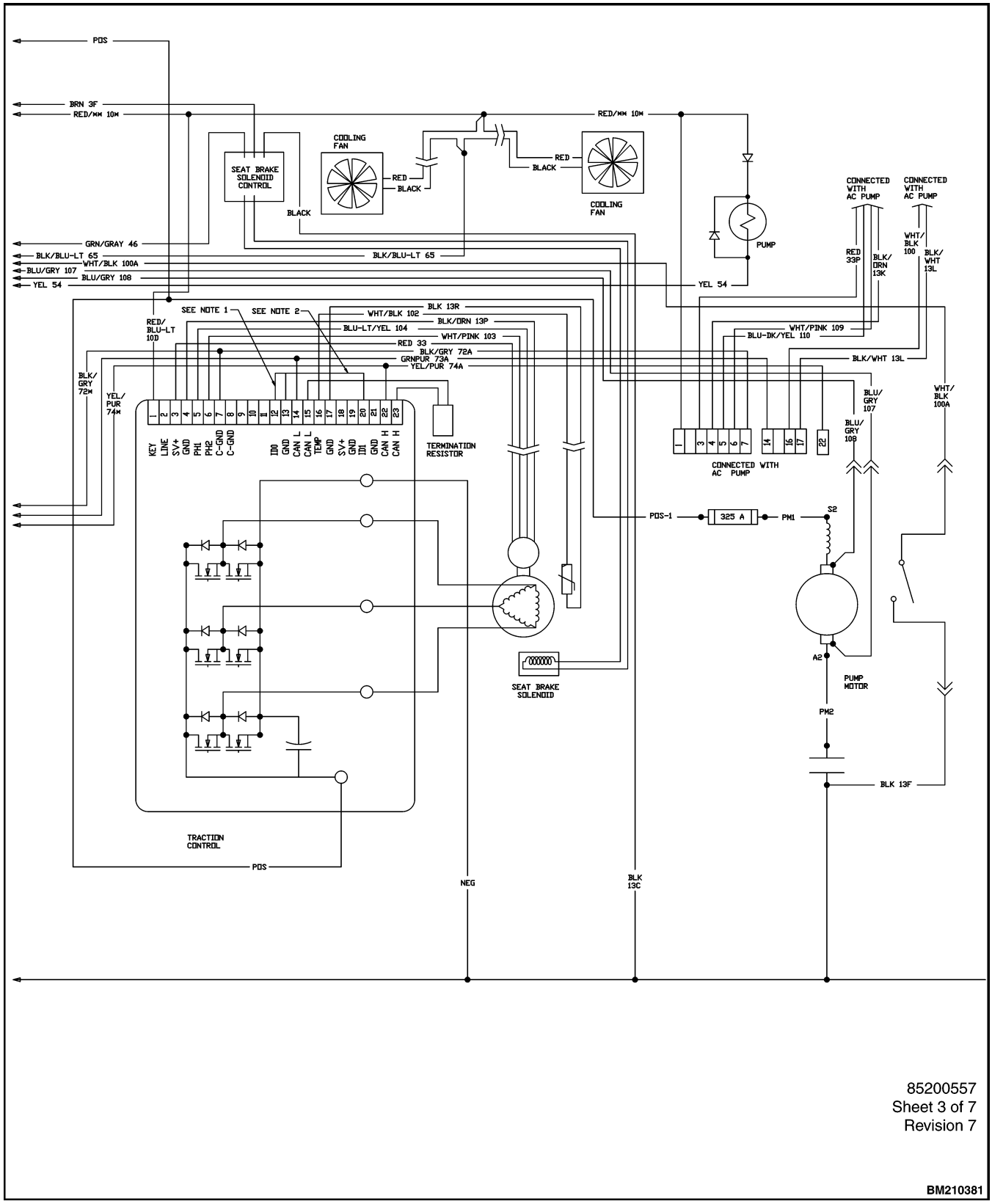


Figure 2. Wiring Schematic Diagram With Manual Hydraulics for ERC20-32AGF (ERC040-065GH) (A908), 36v/48v Lift Trucks With Manual Hydraulic Control Valve (Sheet 3 of 7)

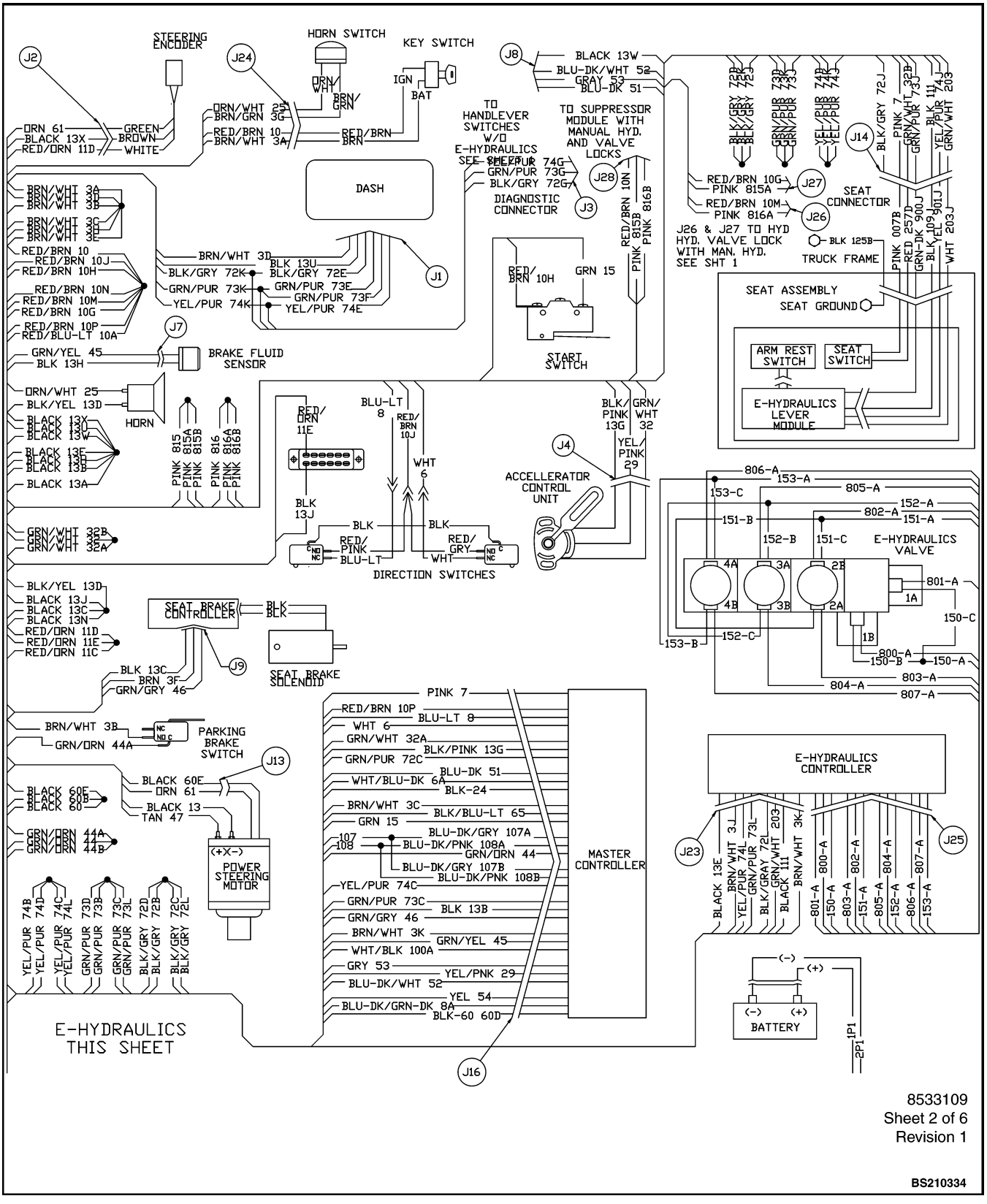


Figure 4. Wiring Diagram for ERC20-32AGF (ERC040-065GH) (A908), 36v/48v Lift Trucks With Electro-Hydraulic Control Valve (Sheet 2 of 6)

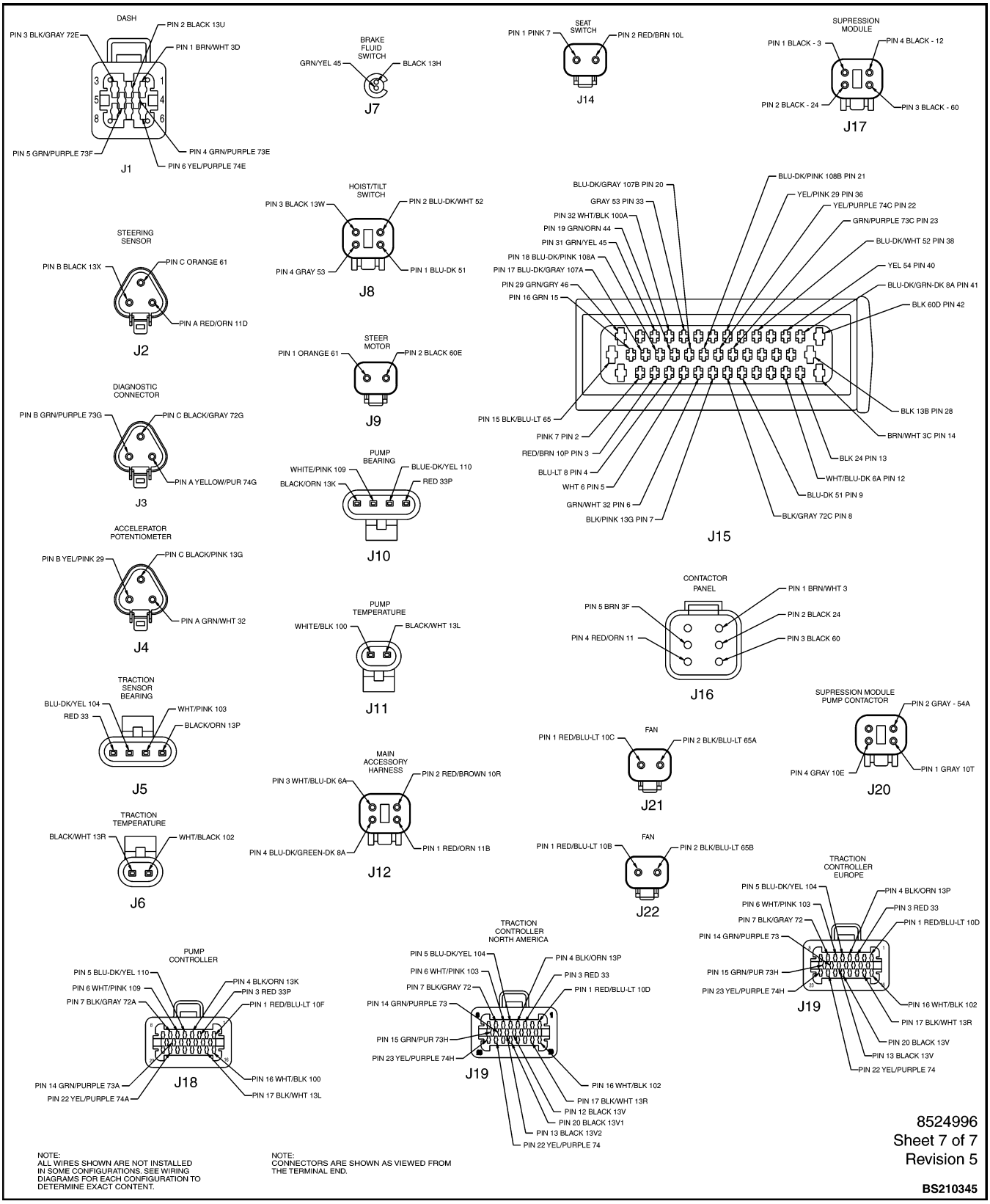


Figure 5. Wiring Schematic Diagram for ERC/P16-20AAF (ERC030-040AH) (B814), 36v/48v Lift Trucks (Sheet 7 of 7)

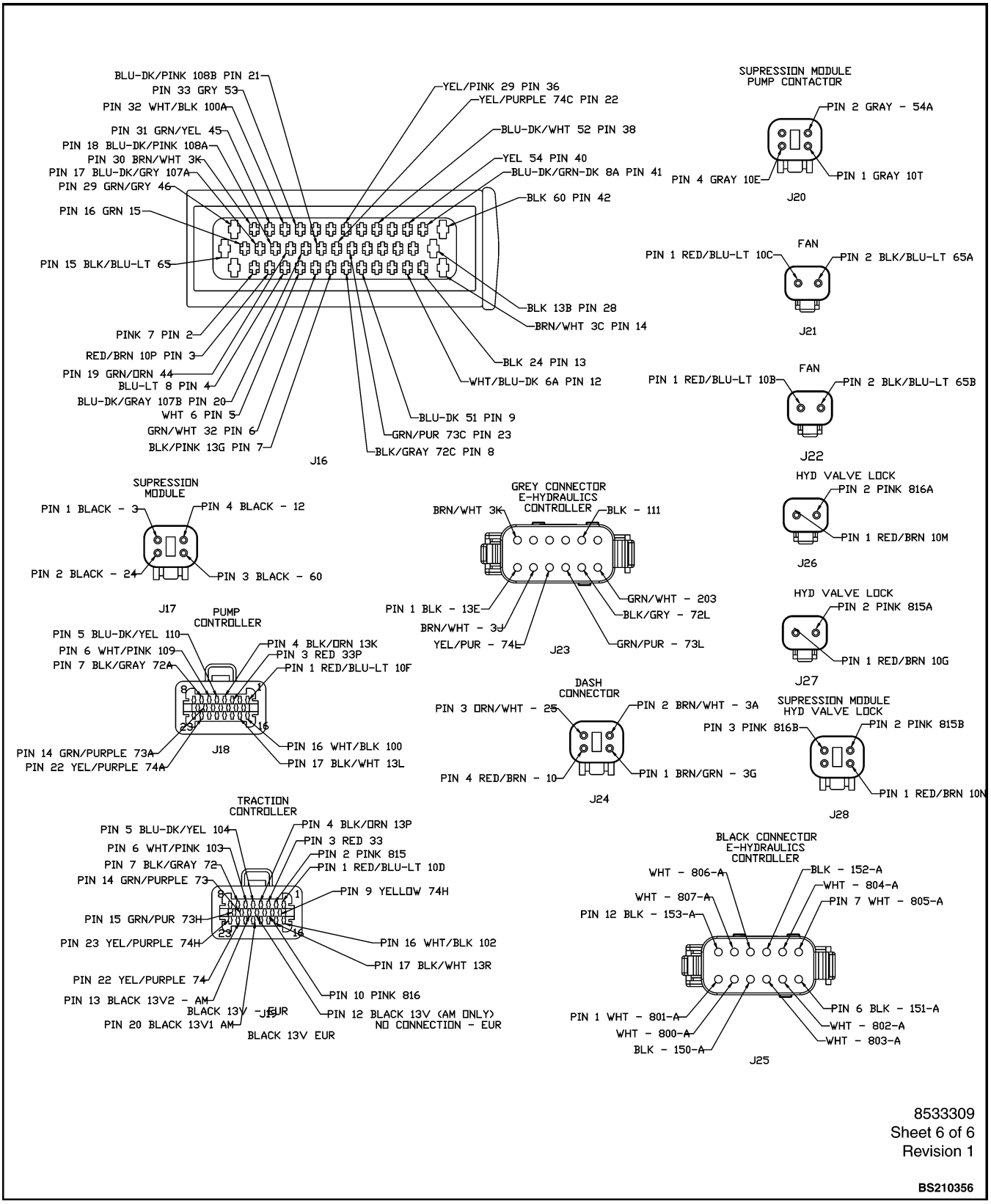


Figure 7. Wiring Diagrams With Electro-Hydraulics for ERC/P16-20AAF (ERC030-040AH) (C814) (Sheet 6 of 6)

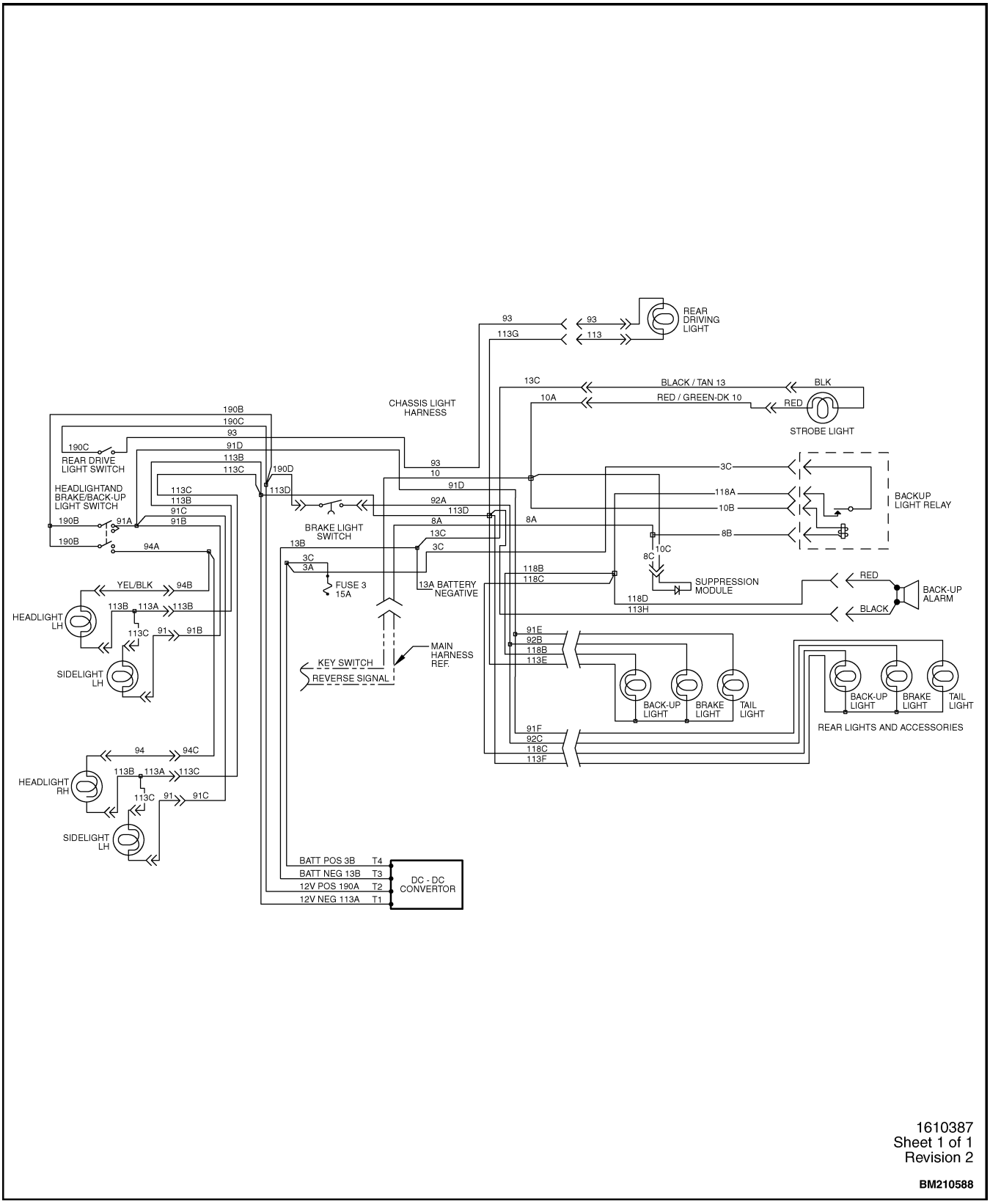
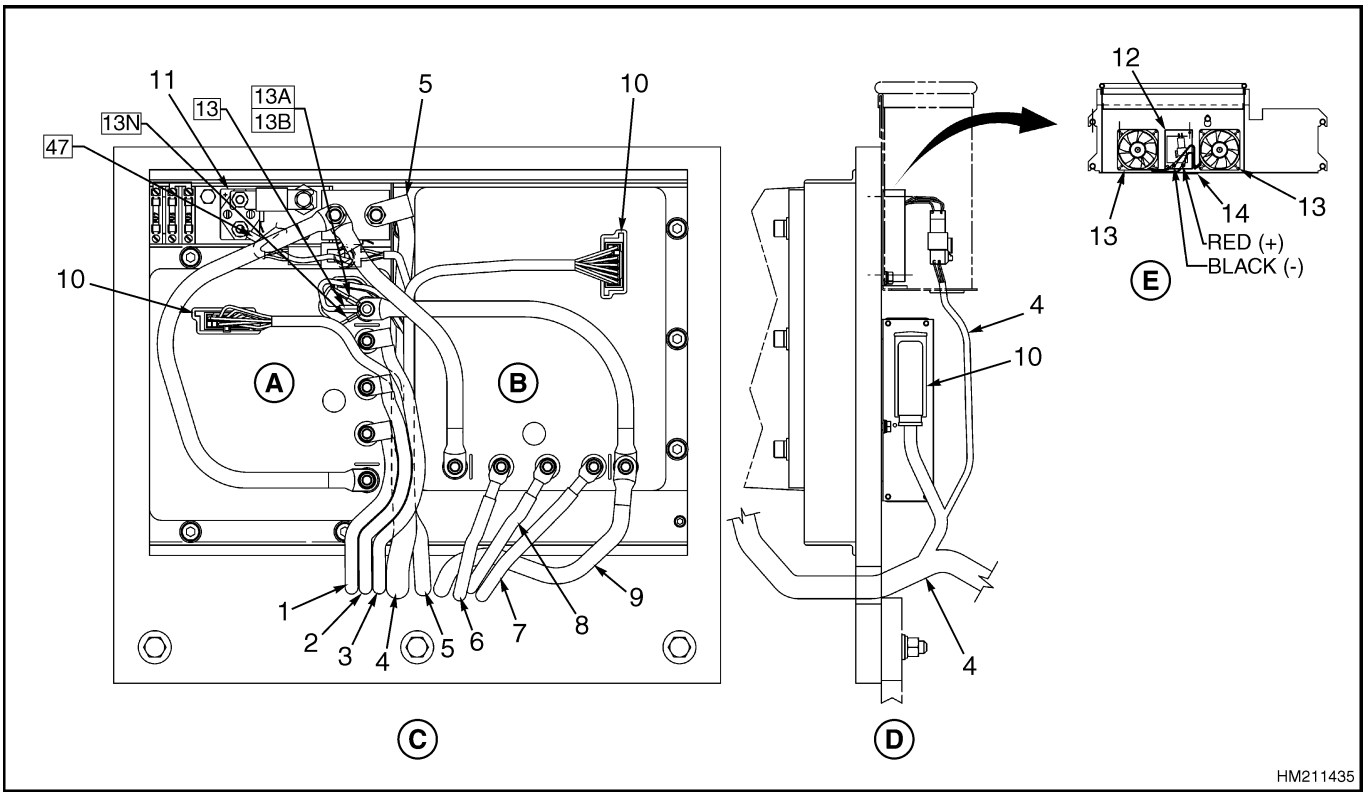


Figure 11. Main Accessory Schematic ERC/P16-20AAF (B814/C814) and ERC20-32AGF (A908)



A. HYDRAULIC PUMP
B. TRACTION PUMP
C. FRONT VIEW
D. SIDE VIEW
E. TOP VIEW OF COOLING FANS

1. HYDRAULIC PUMP CABLE (U)
2. HYDRAULIC PUMP CABLE (V)
3. HYDRAULIC PUMP CABLE (W)
4. CABLE FROM MAIN HARNESS
5. BATTERY POSITIVE (+) CABLE
6. TRACTION MOTOR CABLE (U)
7. TRACTION MOTOR CABLE (W)
8. TRACTION MOTOR CABLE (V)
9. BATTERY NEGATIVE (−) CABLE
10. CONNECTOR PLUG ON WIRE HARNESS
11. POWER STEERING CONTRACTOR
12. FAN POWER SUPPLY (48 VOLTS)
13. FAN
14. GROMMET

Figure 18. Control Compartment Wiring (AC Hydraulic Pump Motor)

TABLE OF CONTENTS (Continued)

This section is for the following models:

ERC20-32AGF (ERC040-065GH) [A908];
ERC/P16-20AAF (ERC030, 040AH) [B814/C814];
ERP20-30ALF (ERP40-60DH) [D216]

Table 1. Maintenance Schedule (Continued)

Item No.	Item	8 hr/ 1 day	250 hr/ 6 wks	500 hr/ 3 mo	1000 hr/ 6 mo	2000 hr/ 1 yr	Procedure or Quantity	Specification
	Seat Plate and Seat Brake Pivots				L			Use Silicone spray (Yale Part Number 504236201) See NOTE 2
	Hood Latch or Battery Restraint	X					Check operation	
	Steering Column Tilt Mechanism	X					Lubricate as necessary	Use Silicone Spray (Yale Part Number 504236201)
	Lift and Tilt Controls	X					Lubricate as necessary	Use Silicone Spray (Yale Part Number 504236201)
	Moving Parts Attachment S/N D210N/E210				X		Clean all moving parts	
	Structural Assemblies Attachment S/N D210N/E210				X		Check structural assemblies and check bolts for tightness	
	Attachment Assembly Attachment S/N D210N/E210	X					Visually check attachment assembly	

NOTE 1: Multipurpose grease with 2 to 4% Molybdenum Disulfide.

NOTE 2: Recommended service intervals are based on a normal application in a clean environment. Applications involving contaminated environments such as high levels of air borne debris (dust and waste paper); chemical or abrasive compounds; poor ground conditions; intensive usage at high performance levels; or other abnormal conditions will require more frequent servicing. At your request your Yale dealer will advise you of the appropriate service intervals based on an application survey.

NOTE 3: Lubricate lower spindle bearings at 1000 hours and upper bearings during assembly. If truck is used outdoors or on wet floors, lubricate lower spindle bearings at 250 hours.

NOTE 4: If lift truck is used outdoors or on wet floors, reduce service interval to 500 hours.

NOTE 5: Equalization charge is required approximately each month.

NOTE 6: Replace Hydraulic filter after first 100 hours.

NOTE 7: Lubricate if dry or at first sign of visible surface rust

X=Check C=Change L=Lubricate CIL=Check Indicator Light during operation

Maintenance Procedures Every 250 Hours or 6 Weeks

NOTE: Perform the 8-hour checks prior to performing the procedures in this section.

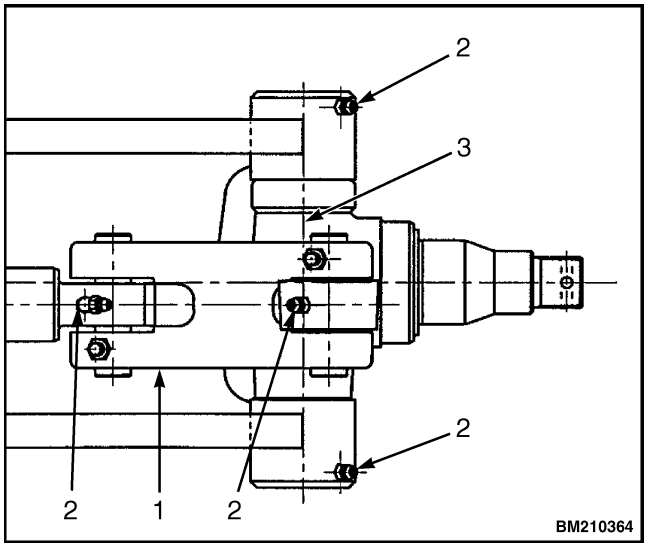
STEERING KING PINS ERC/P16-20AAF (B814/C814) TRUCKS ONLY

Lubricate the king pins with multipurpose grease. See the Maintenance Schedule for more information on lubricating these parts. See Figure 19.

STEERING TIE RODS AND SPINDLES

NOTE: Lubricate steering tie rods at 250 hours for model ERC/P16-20AAF (B814/C814) only.

Lubricate the steering tie rods with multipurpose grease (see Maintenance Schedule). More frequent lubrication may be required if the lift truck operates in dirty or difficult conditions. See Figure 19.



NOTE: MODEL ERC/P16-20AAF SHOWN.

1. TIE ROD
2. LUBE FITTING (8)
3. KING PIN

Figure 19. Lubricate Steering Tie Rods

Maintenance Procedures Every 500 Hours or 3 Months

NOTE: Perform the 8-hour and 250-hour checks prior to performing the procedures in this section.

DIFFERENTIAL AND SPEED REDUCER ERC20-32AGF (ERC040-065GH) (A908) AND ERC/P16-20AAF (ERC030-040AH) (B814/C814) LIFT TRUCKS

WARNING

Do not work under a raised carriage. Lower the carriage or use a chain to prevent the carriage and the inner or intermediate weldments from lowering when doing maintenance. Make sure that the moving parts are attached to parts that cannot move.

Check the oil level at fill plug. If oil level is low, add oil slowly at the fill plug. See Figure 20 for ERC20-32AGF (ERC040-065GH). See Figure 21 for ERC/P16-20AAF (ERC030-040AH). Fill until oil just starts to flow out the fill plug hole. The oil must flow through the bearings to the speed reducer, so filling slowly is necessary to indicate the correct level.

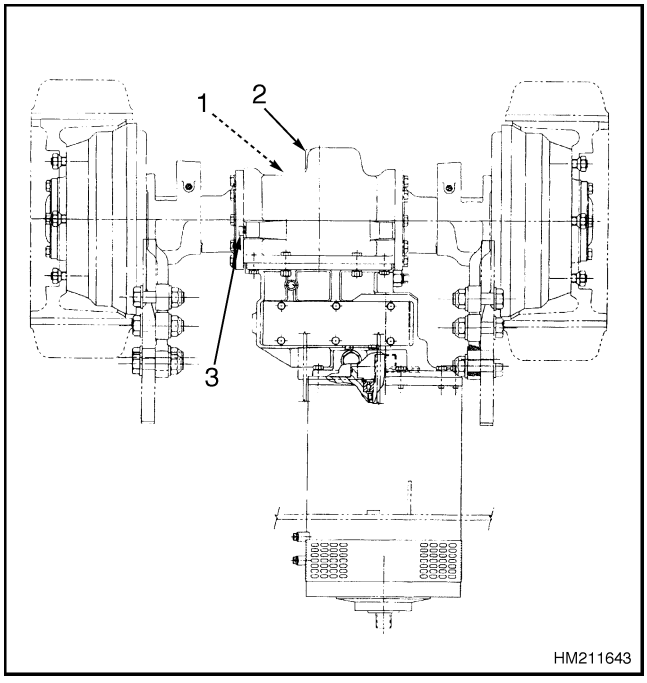


Figure 20. Differential for ERC20-32AGF (ERC040-065GH) Lift Trucks

BRAKE FLUID ERP20-30ALF (ERP040-060DH) (D216) LIFT TRUCK MODELS

WARNING

Loss of fluid from the master cylinder indicates a leak. This condition can cause brake failure. The result can be material damage or personal injury. Repair the brake system before the lift truck is used. Replace the brake fluid in the system if there is dirt, water, or oil in the system.

CHECK THE INDICATOR LIGHT DURING OPERATION. There is an indicator light on the display panel for low brake fluid. The red light is **ON** for approximately eight to ten seconds when the key is first moved to the **ON** position. The light comes on during operation when brake fluid is low.

Check the brake fluid in the reservoir for the master cylinder. The reservoir is under the floor plate near the brake pedal. Add brake fluid as necessary. Use the brake fluid shown in the Maintenance Schedule.

OTHER LUBRICATION

Lubricate hinges, pins, linkages, cables, pedals, and levers as necessary. See the Maintenance Schedule.

ELECTRICAL INSPECTION

WARNING

Disconnect the battery connector to prevent injury from electric shock before you make any inspections or repairs.

Discharge the capacitors when you make any electrical inspections or repairs inside of the electrical compartment.

The ERC20-32AGF (ERC040-065GH) (A908); ERC/P16-20AAF (ERC030, 040AH) (B814/C814); and ERP20-30ALF (ERP040-060DH) (D216) lift trucks are equipped with a standard DC hydraulic pump motor. A DC hydraulic pump motor, is optional for the V30ZMD (D210/E210) lift trucks. The contactors and motor brushes for the DC hydraulic pump motor can be checked and repaired as described below. See Figure 36 or Figure 37. The AC hydraulic pump motor is optional for J2.00-3.20XM (J40-65Z) (A416); E1.50-2.00XM (E25-35Z, E40ZS) (E114); and E2.00-3.20XM (E45-65Z) (G108) and is standard for V30ZMD (D210/E210).

Contactors

NOTE: Replace the contactors when the thickness is 30% of a new contact. See **AC Motor Controllers/ Display Panel**, **Description, Checks, Adjustments, and Troubleshooting** 2200 YRM 1056.

The contacts are made of a special silver alloy. The contacts will look black and rough from normal operation. This condition does not cause problems with the operation of the lift truck. Cleaning is not necessary. DO NOT USE A FILE ON THE CONTACTS. DO NOT LUBRICATE THE CONTACTS. Always replace the contacts in sets.

Motor Brushes (DC Pump)

CHECK THE INDICATOR LIGHT DURING OPERATION. If the motor brushes are worn and need replacement, the status code number 95, will appear on the LCD screen on the display panel.

Motor Brushes, General

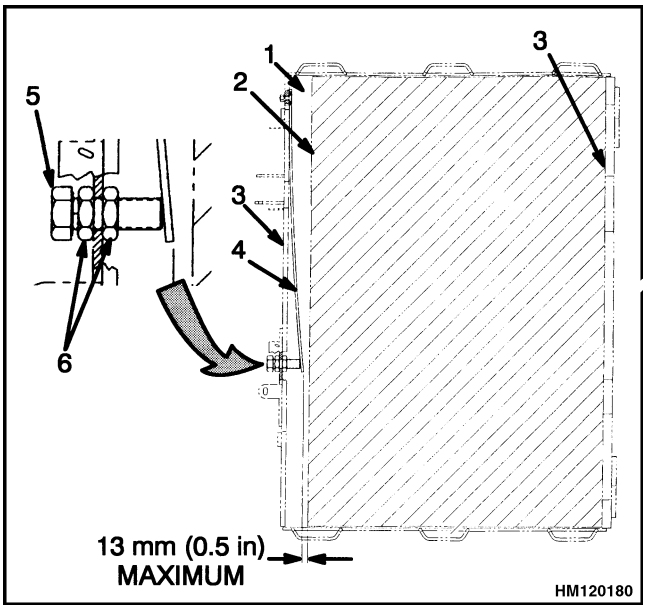
NOTE: For ERP20-30ALF (ERP040-060DH) (D216) models, the DC hydraulic pump motor is behind the battery. Open the hood for access to the motor. See Figure 35

NOTE: For ERC20-32AGF (ERC040-065GH) (A908) and ERC/P16-20AAF (ERC030-040AH) (B814/C814) models, the DC hydraulic motor is located under the battery tray. See Figure 35.

Legend for Figure 35

A. ERP20-30ALF (ERP040-060DH) (D216)
B. ERC20-32AGF (ERC040-065GH) (A908)
C. ERC/P16-20AAF (ERC030-040AH) (B814/C814)

1. DC HYDRAULIC MOTOR
2. HYDRAULIC TANK
3. STEERING MOTOR



1. BATTERY COMPARTMENT
2. BATTERY
3. BULKHEAD
4. SPACER PLATE
5. ADJUSTMENT CAPSCREW
6. JAM NUTS

Figure 44. Battery Compartment Spacer Plate for ERP20-30ALF (ERP040-060DH) (D216) and ERC20-32AGF (ERC40-065GH) (A908) Lift Truck Models

HOW TO CHANGE BATTERY FOR ERC20-32AGF (ERC040-065GH) (A908) AND ERC/P16-20AAF (ERC030, 040AH) (B814/C814) LIFT TRUCKS

General

WARNING

Batteries are heavy and can cause an injury. Use care to avoid injury. Do NOT put hands, arms, feet, and/or legs between the battery and a solid object.

Make sure the capacity of the crane and spreader bar is greater than the weight of the battery. The weight of the battery is normally shown on the battery case. The maximum battery weight is shown on the lift truck Nameplate. The spreader bar must NOT be made of metal or it must have insulated straps.

The replacement battery must fit the battery area correctly. Adjust the spacer plate to prevent the battery from moving forward or backward in the battery compartment.

Make sure that the battery voltage and weight of the replacement battery is correct as shown on the Nameplate.

Make sure the battery restraint is locked in the down position before the lift truck is operated.

Before connecting the battery, make sure the key is in the OFF position and the parking brake is set.

CAUTION

Batteries must be discarded according to local environmental regulations.

Observe previous **WARNING** and **CAUTION** before changing batteries.

1. Move the steering column to the fully forward position and make sure it is latched. Slide the hood latch to the right and lift hood. Raise the hood and seat to the fully-raised position as shown in Figure 45. Disconnect the battery connector and move it to a position so it will not be damaged during battery removal.

2. Use a spreader bar and crane to lift the battery from the lift truck. See Figure 46. When a replacement battery is installed, make sure the battery fits the battery compartment width with a maximum of 13 mm (0.5 in.) clearance. Adjust the spacer plate to prevent the battery from moving more than a total of 13 mm (0.5 in.) forward or backward. See Figure 44 or Figure 47. There must be enough clearance for battery removal.

3. Connect the battery connector. Lower the hood. Slide the hood latch to the left. Try to raise the hood using only the lift handle to make sure the hood will not raise. Move the steering column back and make sure it is latched.

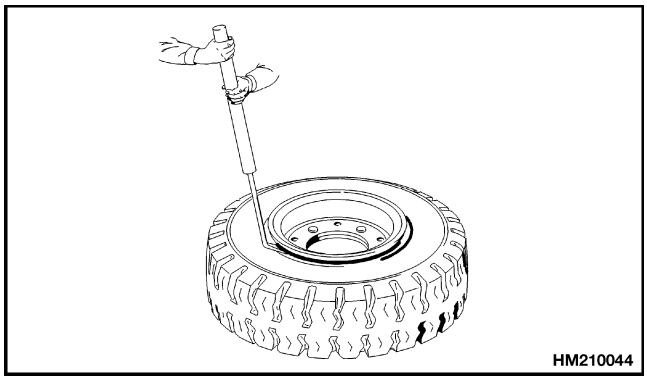
Remove Wheel From Pneumatic Tire

WARNING

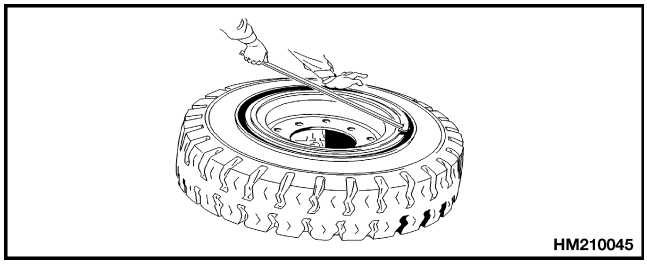
Make sure all of the air pressure is removed from the tire before a wheel is disassembled. Air pressure in the tires can cause the tire and rim parts to explode, causing serious injury or death.

Keep tire tools in firm contact with the wheel parts. If the tool slips, it can move with enough force to cause an injury.

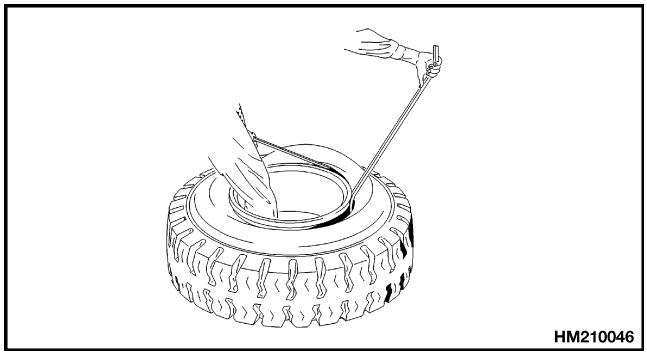
STEP 1.
Loosen the tire bead from the side flange.


HM210044

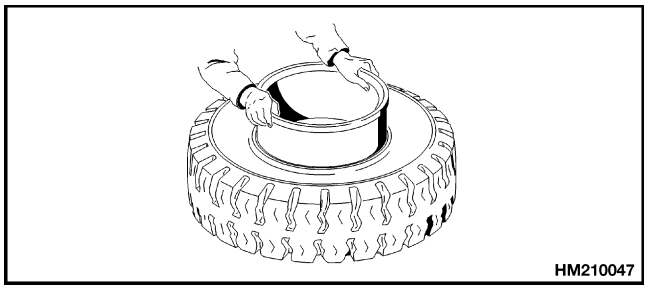
STEP 2.
Put the tire tool into the slot between the lock ring and wheel rim. Remove the lock ring and side flange. If there is a flange seat, remove it.


HM210045

STEP 3.
Loosen the bead from the other side of the wheel rim. Remove the valve stem from the wheel. If there is a washer, keep it for installation during assembly.


HM210046

STEP 4.
Remove the wheel rim from the tire.


HM210047

Mast Speeds

ERC20-30AGF (ERC040-065GH) MAST SPEEDS (36 OR 48 VOLT) AMERICAS

AC/DC Motor With Standard Pump										
Model	Mast	V	Lifting				Lowering			
			Rated Load		No Load		Rated Load		No Load	
			m/sec	ft/min	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min
ERC040GH	Two-Stage LFL	36 48	0.310 0.417	61 82	0.513 0.625	101 123	0.559	110	0.508	100
	Two-Stage FFL	36 48	0.315 0.417	62 82	0.472 0.625	93 123	0.508	100	0.457	90
	Three-Stage FFL	36 48	0.310 0.406	61 80	0.462 0.610	91 120	0.528	104	0.467	92
	Four-Stage FFL	36 48	0.300 0.417	59 82	0.508 0.640	100 126	0.432	85	0.391	77
ERC050GH	Two-Stage LFL	36 48	0.284 0.376	56 74	0.513 0.625	101 123	0.574	113	0.508	100
	Two-Stage FFL	36 48	0.295 0.381	58 75	0.472 0.625	93 123	0.538	106	0.457	90
	Three-Stage FFL	36 48	0.290 0.381	57 75	0.462 0.610	91 120	0.549	108	0.467	92
	Four-Stage FFL	36 48	0.279 0.391	55 77	0.508 0.640	100 126	0.462	91	0.391	77

LFL = Limited Free Lift
FFL = Full Free Lift
Oil temperature 54 to 66°C (130 to 150°F). Lifting speeds (valve fully open) ±10% acceptable. No Load lowering speeds are minimum values. Rated Load lowering speeds are maximum values.
N/A = Not Available.

TABLE OF CONTENTS

This section is for the following models:

ERC20-32AGF (ERC040-065GH) [A908];
ERC/P16-20AAF (ERC030-040AH) [B814/C814];
ERC35-55HG (ERC70-120HH) [B839/C839]

Yale Materials Handling Corp.
1400 Sullivan Dr., Greenville, NC 27834-2011

620 YRM 1098

3/10 (11/06)(3/06)(7/05)(3/05)(6/04)(11/03) Printed in U.S.A.

DISASSEMBLE

NOTE: The following steps have detailed disassembly instructions. Perform only those steps required to repair the tilt cylinder.

NOTE: Note the position of the rod end and number of turns used to remove the rod end.

1. Place the tilt cylinder in a soft jaw vise. Remove the rod end and, if equipped, tilt spacer from the rod.

See Figure 3 for lift truck models

- ERC20-32AGF (ERC040-065GH) (A908)
- ERC35-55HG (ERC70-120HH) (C839)
- GLP/GDP16VX, GLP/GDP18VX, GLP/GDP20SVX (GP/GLP/GDP030VX, GP/GLP/GDP035VX, GP/GLP/GDP040SVX) (C810)
- GLP/GDP20-35VX (GP/GLP/GDP040-070VX) (B875)
- GLP/GDP40VX5/VX6; GLP/GDP45SVX5, GLP/GDP45VX6, GLP/GDP50-55VX (GP/GLP/GDP080, 090, 100, 110, 120VX) (F813, G813, H813, J813)
- GLP/GDP20-25LX (GLP/GDP050LX) (A974)
- ERP20-32ALF (ERP040-065DH) (E216)
- GC/GLC030VX, GC/GLC035VX, GC/GLC040SVX (C809)
- GLC20-35VX (GC/GLC040-070VX, GC/GLC055SVX) (A910)
- GLC40, 45, 55VX; GLC55SVX; (GC/GLC080, 100, 120VX; GC/GLC080, 100VXBCS; GC/GLC120SVX; GC/GLC120VXPRS) (E818, F818)
- GLC050LX (A967)

See Figure 4 for lift truck models

- ERC/P16-20AAF (ERC030-040AH) (B814/C814)
- ERP040-040TH (ERP16-20ATF) (F807)

2. Using a pin-type spanner wrench, remove the gland from the tilt cylinder. Remove the rod and piston assembly from the cylinder.

NOTE: To prevent damage to sealing surfaces, use brass tools when removing seals and O-rings.

3. Remove and discard the O-ring, backup ring, seal, and wiper from the gland.

NOTE: Perform Step 4 only if the piston or rod has been damaged.

4. Place the rod in a soft-jaw vise and remove the nut and piston from the rod.

5. Remove and discard the O-ring and piston seal from the piston. See Figure 3.

GLP/GDP16VX. GLP/GDP18VX, GLP/GDP20SVX (GP/GLP/GDP030VX, GP/GLP/GDP035VX, GP/GLP/GDP040SVX) (C810)

- GLC20-35VX (GC/GLC040-070VX, GC/GLC055SVX) (A910)
- GLP/GDP20-35VX (GP/GLP/GDP040-70VX) (B875)
- ERC/P16-20AAF (ERC030-040AH) (B814, C814)
- ERC20-32AGF (ERC040-065GH) (A908)
- ERP20-32ALF (ERP040-35DH) (E216)
- ERP1.60-1.80-2.00ATF (ERP030-040TH) (F807)

Mast Repairs (S/N A513, A514, A613, A614, A702, A703, A704, A705, A706, A707, A751, A752, B513, B514, B586, B587, B588, B589, B590, B591, B749, B750, B751, B752, B753, B754) 4000YRM1250 for lift truck models shown below:

- GLP/GDP40VX5/VX6, GLP/GDP45SVX5, GLP/GDP45VX6, GLP/GDP50-55VX (GP/GLP/GDP080-120VX) (F813, G813, H813, J813)
- GLC40-55VX, GLC55SVX (GC/GLC080-120VX, GC/GLC080-100VXBCX, GC/GLC120SVX, GC/GLC120VXPRS) (E818, F818)
- ERC35-55HG (ERC70-120HH) (C839)

Mast Repair (S/N A698, A699, B551) 4000YRM1431 for lift truck models shown below:

- GLC050LX (A967)
- GLP/GDP20-25LX (GLP/GDP050LX) (A974)

NOTE: Perform Step 2 only if working on a lift truck equipped with a two- or three-stage mast. Perform Step 3 if working on a lift truck equipped with a four-stage mast.

2. Raise the mast until it is almost fully extended.

- On the two-stage mast, use safety chains to connect the bottom crossmember of the inner mast section to the top crossmember of the outer mast section.
- On the three-stage mast, use safety chain to connect the bottom crossmember of the intermediate mast section to the top crossmember of the outer mast section. Use another safety chain to connect the bottom crossmember to a crossmember on the intermediate or outer mast section.

Lower the mast so the safety chains hold the weight of the mast sections.

3. Raise the mast until it is almost fully extended. Use a safety chain to connect middle crossmember of first intermediate mast section to top crossmember on outer mast section. Lower mast so safety chain holds weight of the mast sections.

WARNING

Be careful when removing or install snap rings. These snap rings can come loose during removal or installation with enough force to cause an injury. Always use the correct snap ring pliers and wear eye and face protection during removal or installation.

4. If working on a two or three-stage mast, the snap ring and shims (washers) at the top of the cylinder are to be reomved.

5. If working on a four-stage mast, on the left lift cylinder, remove the snap ring from top of the cylinder rod. On right lift cylinder, remove spacer and retainer from cylinder rod.

WARNING

Hydraulic oil is hot after system operation and can cause burns. DO NOT disconnect any hydraulic hoses until the oil in the hydraulic system is cool.

6. Put a drain pan under the area of the hydraulic fittings. Disconnect and cap the hydraulic lines at the cylinder. Retract the rod into the lift cylinder.

7. Remove the nut, washer, spacer, and capscrew at the mounting plate. On two or three-stage mast, disconnect the main lift chain at the mount. See Figure 8.

8. Use a lifting device, as necessary, to remove lift cylinder from mast. Remove the lift cylinder from the front of the mast. On a lift cylinder being removed from a four-stage mast, keep shims from top of left cylinder with cylinder.

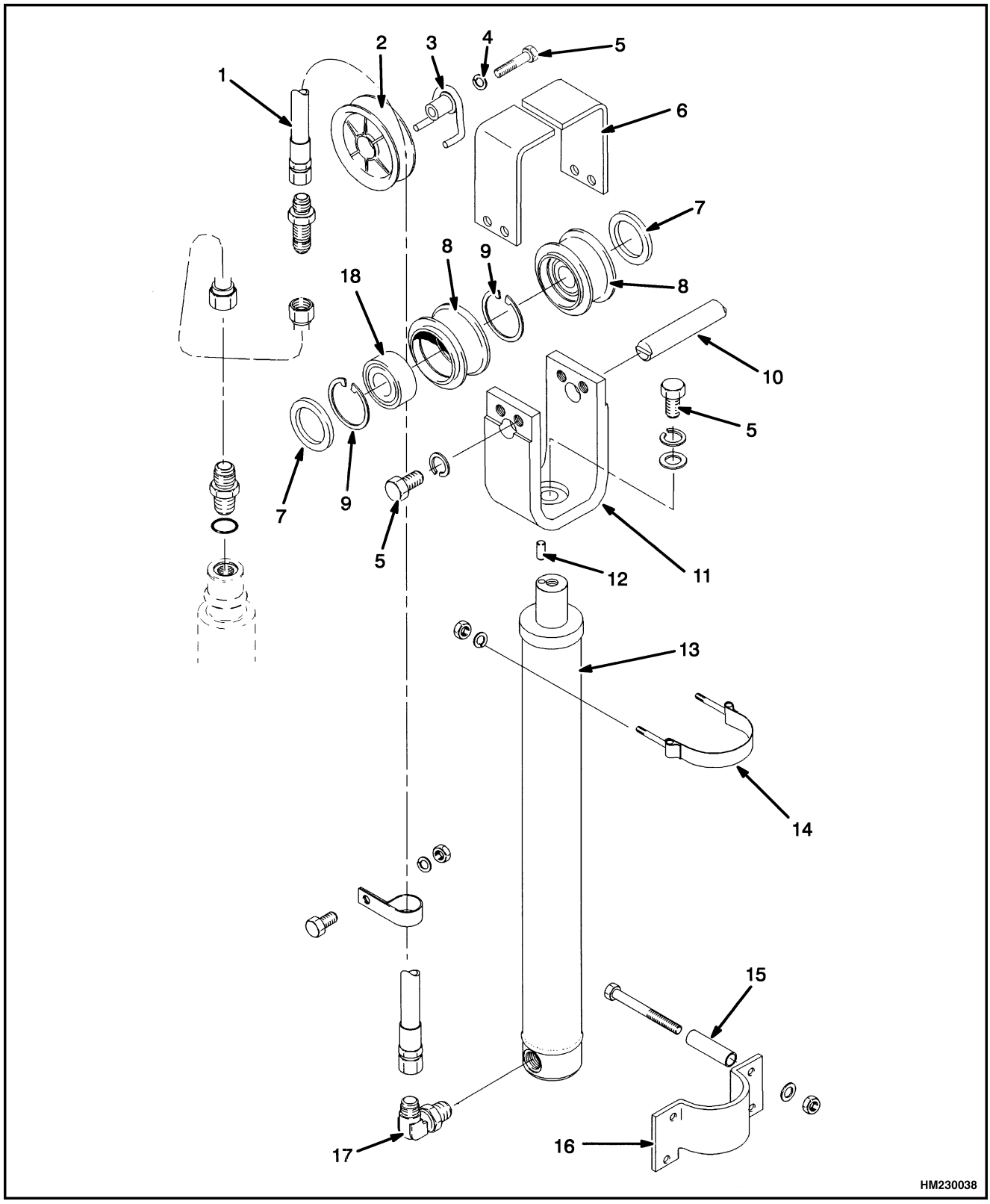


Figure 14. Crosshead and Four-Stage Free-Lift Cylinder Assembly, For Lift Truck Models GLC20-35VX (GC/GLC040-070VX, GC/GLC055SVX) (A910)

2. Open forks all the way, then close the forks. Watch for unequal fork movement.

3. To increase the speed of forks opening, turn flow restrictor counterclockwise in 1/2 turn increments. To decrease the speed of forks closing, turn flow restrictor clockwise in 1/2 turn increments. See Figure 19.

4. Open and close the forks again. If fork movement is not equal, repeat Step 2 and Step 3.

5. If fork movement is equal, tighten jam nut on flow restrictor. See Figure 19.

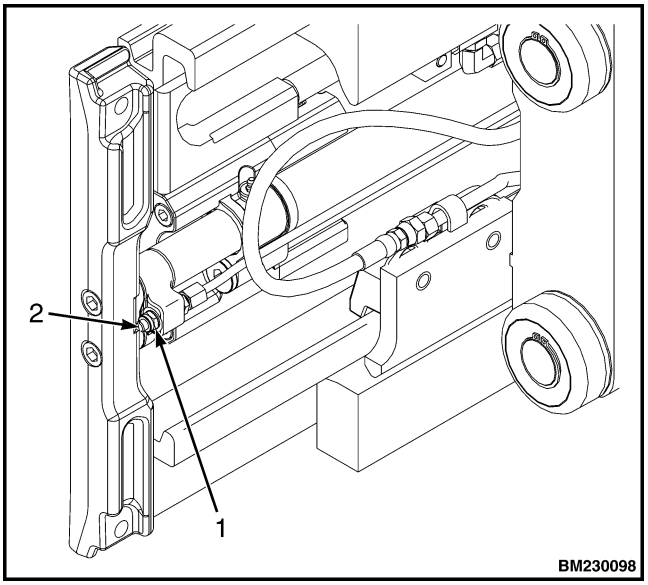


Figure 19. Fork Positioner Cylinder Adjustment

Legend for Figure 19

NOTE: BACK (DRIVER'S) VIEW SHOWN. LEFT FLOW RESTRICTOR SHOWN.

1. JAM NUT
2. FLOW RESTRICTOR

TORQUE SPECIFICATIONS

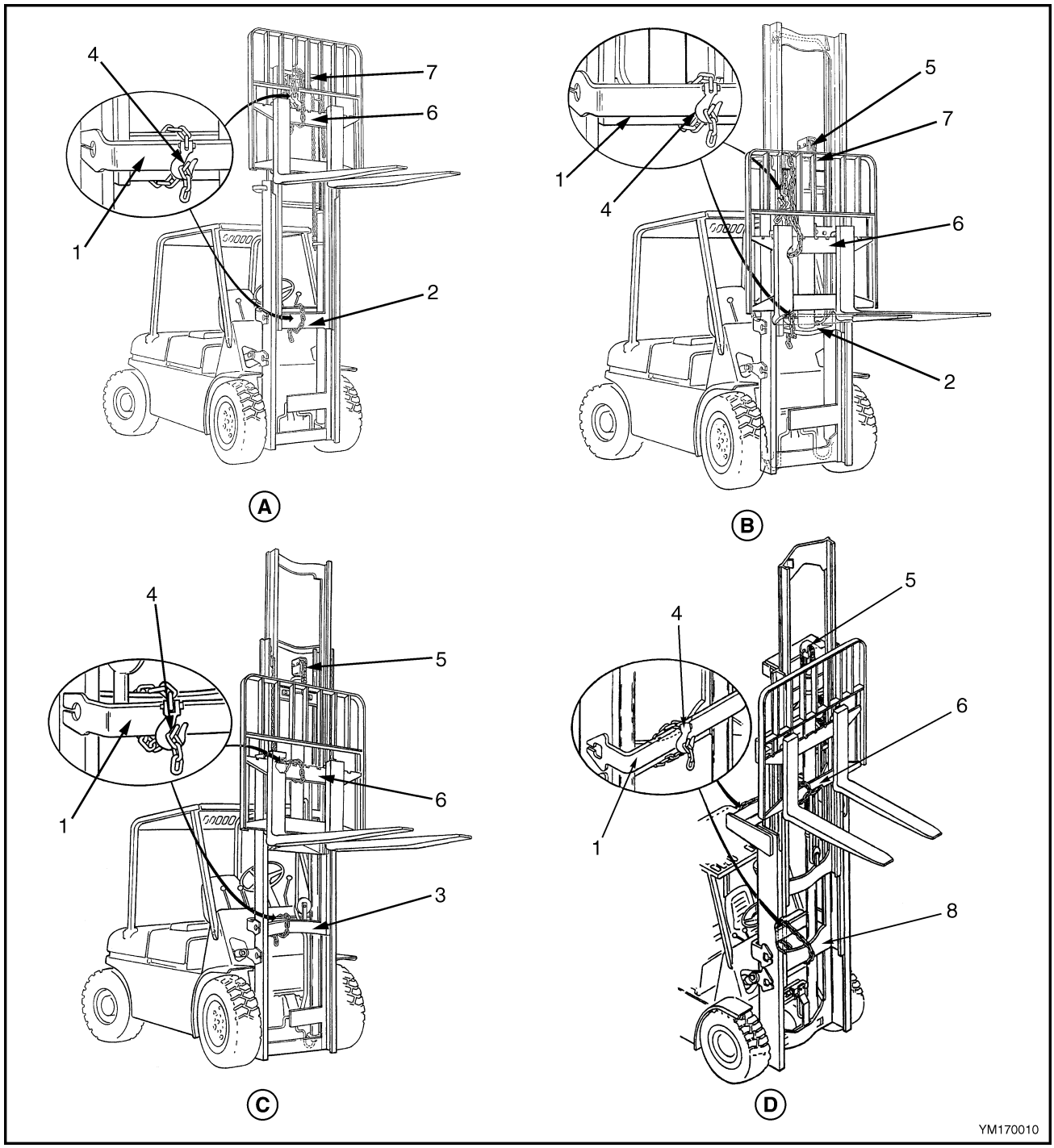
Cylinder Rod Retainer
165 N•m (120 lbf ft)

Fork Positioner Cylinder Mounting Capscrews
65 N•m (50 lbf ft)

Cylinder Rod Anchor Plug
65 N•m (50 lbf ft)

Fork Carrier Capscrews
35 N•m (25 lbf ft)

Hose Guide Capscrews
17 N•m (150 lbf in)



A. TWO-STAGE LFL MAST
B. TWO-STAGE FFL MAST
C. THREE-STAGE FFL MAST
D. FOUR-STAGE FFL MAST

1. OUTER MAST
2. INNER MAST
3. INTERMEDIATE MAST
4. HOOK
5. FREE-LIFT CYLINDER
6. CARRIAGE BAR
7. CROSSMEMBER
8. FIRST INTERMEDIATE MAST

Figure 1. Safety Chaining the Mast

2. Connect a crane [the capacity of the crane must be at least 681 kg (1501 lb)] to the lifting eye on the sideshift carriage. See Figure 12.

3. Remove the two upper capscrews from the lower apron. Slowly loosen the two bottom capscrews, but do not remove them. The slotted holes will allow the lower apron to move down so the sideshift carriage can be removed.

4. Carefully lift the sideshift carriage from the standard carriage. The sideshift cylinder support bracket and cylinder will stay on the standard carriage. Remove the bearings.

WARNING

Always wear the proper protective equipment including eye protection and petroleum-resistant gloves when handling hydraulic oil. Thoroughly wash oil from exposed areas of skin as soon as possible.

The hydraulic oil is hot at normal operating temperatures. Be careful when draining the oil.

Never check for leaks by putting hands on hydraulic lines or components under pressure. Hydraulic oil under pressure can be injected into the skin.

CAUTION

Protect the hydraulic system from dirt and contaminants when servicing the hydraulic system.

5. Disconnect the hydraulic lines at the sideshift cylinder. Put caps on the open hydraulic lines. Remove the cylinder support bracket from the standard carriage. If necessary, remove the threaded rods and shims in order to remove the sideshift cylinder.

STANDARD CARRIAGE AND HANG-ON SIDESHIFT CARRIAGE, REPAIR

NOTE: The carriage can have four or six load rollers. When the carriage has four load rollers, shims are used behind all of the load rollers. When the carriage has six load rollers, shims are installed on the bottom and middle rollers only.

1. If any of the load rollers must be replaced, make a note of the location and number of the shims. Install the shims, load rollers, and snap rings. See Carriage Adjustments for correct adjustment of the load rollers.

2. If the carriage aprons have any protruding welds or damaged notches, repair by grinding, filing, or welding.

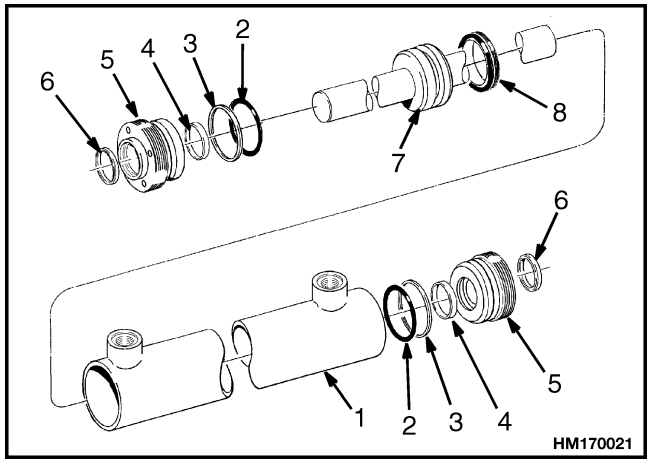
3. The repair procedure for the sideshift cylinder is as follows (see Figure 12 and Figure 13):

   a. Remove the retainers from the shell. Pull the rod from the shell.

   b. Replace seals, O-rings, or backup rings as necessary. Use the installation guides to prevent damage to the seals.

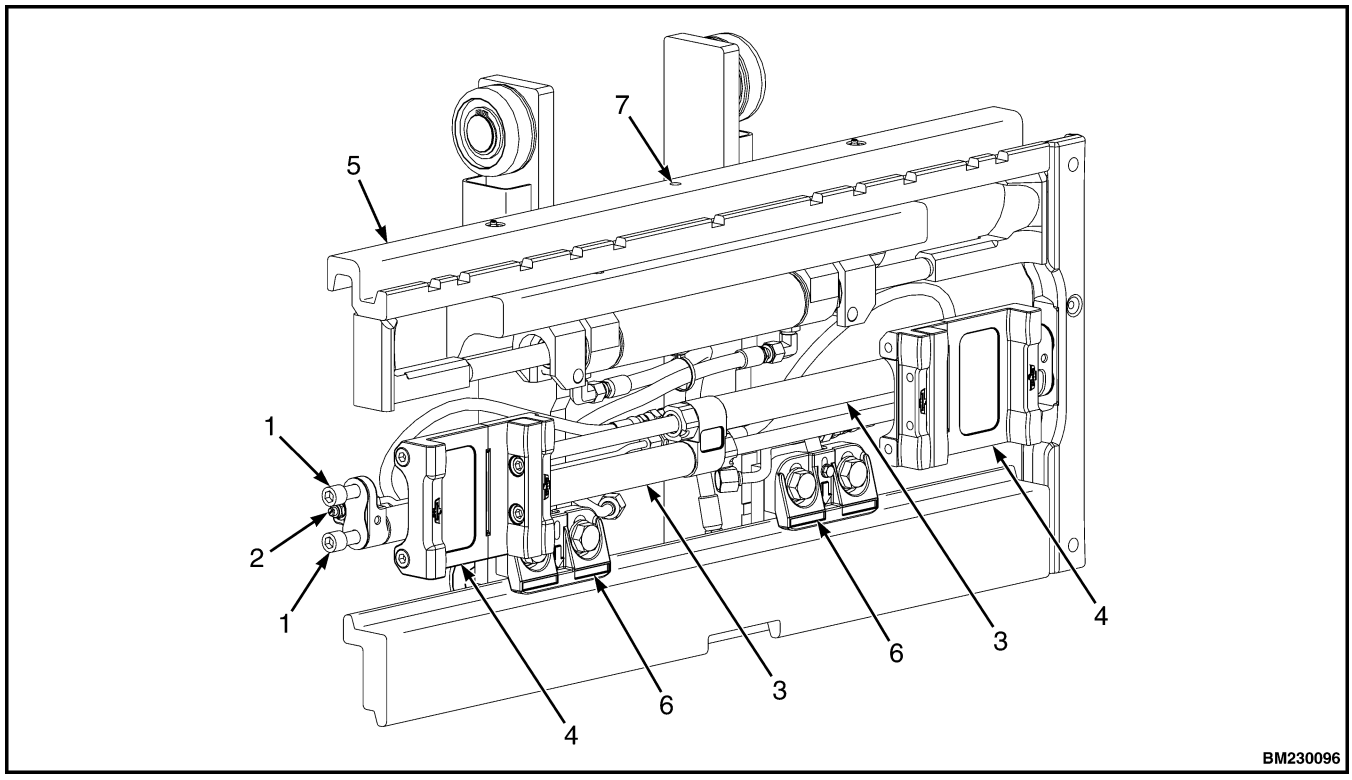
   c. Lubricate all internal parts with clean hydraulic oil.

   d. Install the piston and rod in the shell. Apply Loctite® 242 to the threads of the retainers. Install the retainers and tighten them to 27 N•m (20 lbf ft).



1. SHELL
2. O-RING
3. BACKUP RING
4. ROD SEAL
5. RETAINER
6. WIPER
7. PISTON AND ROD
8. PISTON SEAL

Figure 13. Sideshift Cylinder



NOTE: RIGHT INTEGRAL SIDESHIFT CARRIAGE BAR REMOVED FOR CLARITY. THREE STAGE FFL INTEGRAL SIDESHIFT CARRIAGE SHOWN. HOSE GUIDE OMITTED FOR CLARITY.

NOTE: FRONT VIEW SHOWN.

1. CAPSCREW AND LOCK WASHER
2. SHIM
3. FORK POSITIONER CYLINDER
4. FORK CARRIER
5. INTEGRAL SIDESHIFT CARRIAGE ASSEMBLY
6. LOWER HOOK
7. TAPPED HOLE FOR LIFT EYE

Figure 20. Fork Positioner Cylinder Removal

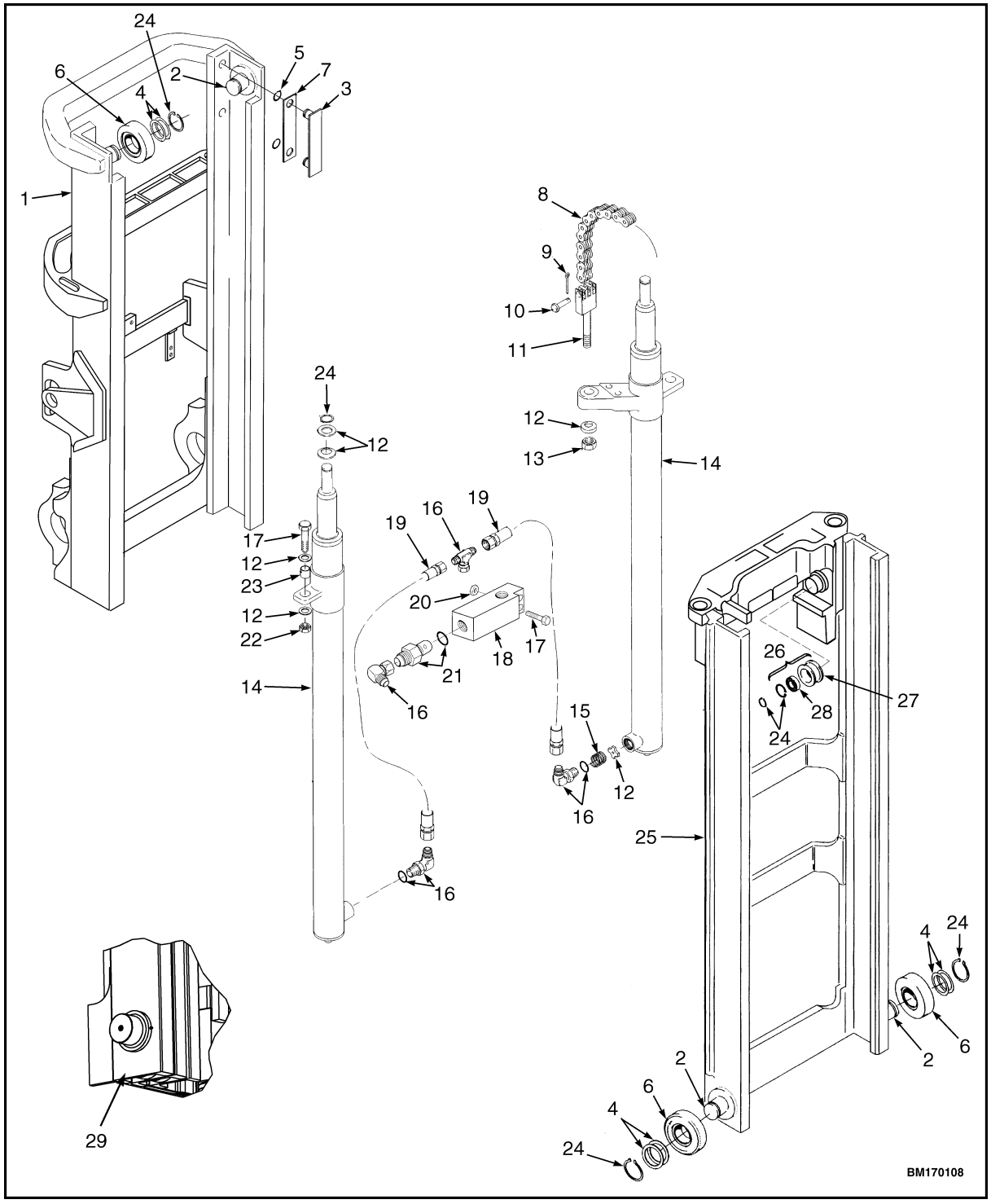


Figure 32. Two-Stage, Limited Free-Lift (LFL) Mast for Lift Truck Models GC/GLC030-035VX, GC/GLC040SVX (C809); ERC/P16-20AAF (ERC030-040AH) (B814/C814); ERP1.60-1.80-2.00ATF (ERP030-040TH) (F807); and GLP/GDP16-18VX, GLP/GDP20SVX (GP/GLP/GDP030-035VX, GP/GLP/GDP040SVX) (C810)

Legend for Figure 38

1. OUTER MAST
2. LOAD ROLLER
3. SHIM
4. SNAP RING
5. O-RING
6. SHIM(S)
7. STRIP BEARING
8. WASHER
9. MAIN LIFT CYLINDER
10. LIFT CHAIN
11. NUT
12. HOSE
13. VELOCITY FUSE
14. HOUSING
15. LOWERING CONTROL VALVE
16. CHAIN SHEAVE
17. INTERMEDIATE MAST
18. HOSE
19. HOSE SHEAVE
20. CHAIN ANCHOR
21. INNER MAST
22. FREE-LIFT CYLINDER
23. BRACKET
24. CAPSCREW
25. SPACER
26. FLOW CONTROL ASSEMBLY
27. CROSSHEAD
28. CHAIN GUARD
29. FREE-LIFT CHAIN

4. Install the housing for the lowering control valve on the outer mast. Tighten the nuts for the lowering control valve to 18 N•m (13 lbf ft). Install the lowering control valve in the housing. Connect the hydraulic lines and fittings between the housing and the main lift cylinders.

5. Install new tilt rod bushing into outer mast. See Figure 43.

6. On the lift truck models listed below, install the chain sheaves at the intermediate mast. Be sure to install both pins that hold the shaft for the chain sheave in position.
   - GLC20-35VX (GC/GLC040-070VX, GC/GLC055SVX) (A910)
   - GLP/GDP20-35VX (GP/GLP/GDP040-070VX) (B875)
   - ERP20-32ALF (ERP040-065DH) (E216)
   - ERC20-32AGF (ERC040-065GH) (A908)

7. On the lift truck models listed below, install the chain sheaves at the intermediate mast. Be sure to install the snap rings that hold the chain sheave to the shaft for the correct position.
   - GC/GLC030-035VX, GC/GLC040SVX (C809)
   - ERC/P16-20AAF (ERC030-040AH) (B814/C814)
   - ERP1.60-1.80-2.00ATF (ERP030-040TH) (F807)
   - GLP/GDP16-18VX, GLP/GDP20SVX (GP/GLP/GDP030-035VX, GP/GLP/GDP040SVX) (C810)

8. Connect a crane with a capacity of at least 907 kg (2000 lb) to the center of the inner mast. Slide the inner mast into the intermediate mast so the stub shafts are seen at the top and bottom of both.

NOTE: Use multipurpose grease #2 with 2 to 4% Molybdenum Disulfide for normal operations.

NOTE: The load rollers must be in place before bearing strips can be shimmed.

9. Install the strip bearings and the shims on the channels of the intermediate mast. Apply grease to the bearing surfaces. Install the load rollers and the shims on the intermediate and inner masts. Before doing the next step, adjust the inner mast as described in Carriage Adjustments.

10. Connect the main lift chains to the chain anchors at the main lift cylinder mounts. Put the lift chains over the chain sheaves and connect them to the anchors at the bottom of the inner mast.

Legend for Figure 50

NOTE: SOME COMPONENTS OMITTED FOR CLARITY.

1. SNAP RING
2. BEARING
3. CHAIN SHEAVE
4. SECOND INTERMEDIATE MAST
5. O-RING
6. SHIM(S)
7. STRIP BEARING
8. INNER MAST
9. LOAD ROLLER
10. SHIMS
11. COTTER PIN
12. NUT
13. WASHER
14. CHAIN ANCHOR
15. ANCHOR PIN
16. LIFT CHAIN
17. FREE-LIFT CHAIN

4. Install the tilt cylinders and main lift cylinders. For two, three, and four-stage FFL mast, install the free-lift cylinder. See service manual **Cylinder Repair (Mast S/N A551, A555, A559, A661, A662, A663, A66, B507, B508, B509, B551, B555, B559, B562, B563, B564, B661, B662, B663, C515, C551, C555, C559, D507, D508, D509, D515, D562, D563, D564, E509, and E564)** 2100YRM1139 for procedures.

5. Install carriage and forks as described in the procedures for the and Fork Replacement.

6. Connect hydraulic hoses as tagged during removal. See Header Hose Arrangement for procedures on installing and adjusting header hoses.

WARNING

Never check for leaks by putting hands on hydraulic lines or components under pressure. Hydraulic oil under pressure can be injected into the skin.

7. Check tilt cylinder adjustment as described in **Cylinder Repair (Mast S/N A551, A555, A559, A661, A662, A663, A66, B507, B508, B509, B551, B555, B559, B562, B563, B564, B661, B662, B663, C515, C551, C555, C559, D507, D508, D509, D515, D562, D563, D564, E509, and E564)** 2100YRM1139. Operate mast and check for leaks and correct operation. Check lift chains as described in .

NOTE: Before checking for mast side kicking and adjusting the chain anchors on the main lift cylinders for lift trucks equipped with either a three or four-stage FFL mast, the mast must be fully assembled to include the carriage, forks, load backrest and any attachments if the lift truck is equipped with one.

8. If lift truck is equipped with a three-stage FFL mast, adjust chain anchors on the main lift cylinders until the tops of the inner and outer mast are at the same level within ±1.5 mm (0.06 in.).

   See Figure 38 for lift truck models

   - GLC2035VX (GC/GLC040-070VX, GC/GLC055SVX) (A910)
   - GLP/GDP20-35VX (GP/GLP/GDP040-070VX) (B875)
   - ERP20-32ALF (ERP040-065DH) (E216)
   - ERC20-32AGF (ERC040-065GH) (A908)

   See Figure 39 for lift truck models

   - GC/GLC030-035VX, GC/GLC040SVX (C809)
   - ERC/P16-20AAF (ERC030-040AH) (B814/C814)
   - ERP1.60-1.80-2.00ATF (ERP030-040TH) (F807)
   - GLP/GDP16-18VX, GLP/GDP20SVX (GP/GLP/GDP030-035VX, GP/GLP/GDP040SVX) (C810)

   See Figure 40 for lift truck models below, equipped with optional mast

   - GLP/GDP20-35VX (GP/GLP/GDP040-070VX) (B875)

9. For lift trucks equipped with a four-stage FFL mast, adjust chain anchors on the outer mast until the tops of the second intermediate and outer mast are at the same level within ±1.5 mm (0.06 in.). See Figure 45 or Figure 51. Adjust chain anchors on the first intermediate mast until the tops of the inner and outer mast are at the same level within ±1.5 mm (0.06 in.).

10. Raise the mast, without a load to its full height and check for side kicking. Mast side kicking is when the mast moves either to the right or left as it is being raised. If the mast is side kicking, see the Mast Adjustments section for procedures to correct mast side kicking.

NOTE: The load rollers and sheaves have sealed bearings and do not need additional lubrication.

11. Lubricate sliding surfaces and load roller surfaces along full length of channels as shown in Figure 62. Apply lubricant only to surfaces indicated.

Legend for Figure 67

1. GROUND LEVEL
2. BOTTOM OUTER CHANNEL
3. VISE
4. TOP OUTER CHANNEL
5. HOSE

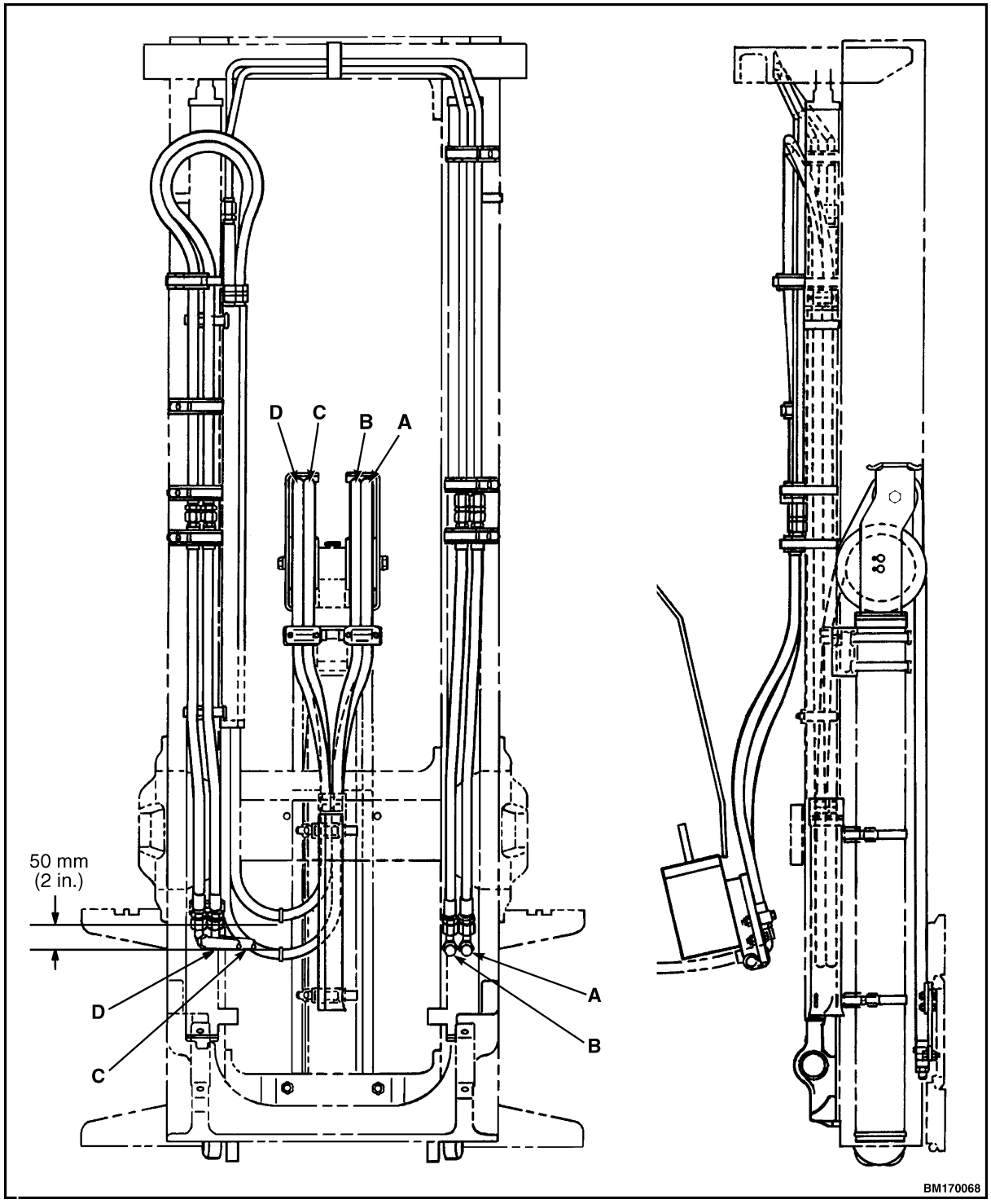


Figure 72. Header Hose Alignment for Two-Stage Full Free-Lift Mast, Lift Truck Models GLC20-35VX (GC/GLC040-070VX, GC/GLC055SVX) (A910); GLP/GDP20-35VX (GP/GLP/GDP040-070VX) (B875); ERP20-32ALF (ERP040-065DH) (E216); and ERC20-32AGF (ERC040-065GH) (A908)

Table 8. Pneumatic Tire Trucks

* Metric Formulas (All Dimensions are in Millimeters)
Dimension E = (Y + Z + 204) × 0.98
Example: Dimension E = (Y + Z + 204) × 0.98 **Step 1.** Dimension E = (1840 + 135 + 204) × 0.98 **Step 2.** Dimension E = 2179 × 0.98 **Step 3.** Dimension E = 2135

* Inch Formulas (All Dimensions are in Inches)
Dimension E = (Y + Z + 8.0) × 0.98
Example: Dimension E = (Y + Z + 8.0) × 0.98 **Step 1.** Dimension E = (72.4 + 5.3 + 8.0) × 0.98 **Step 2.** Dimension E = 85.7 × 0.98 **Step 3.** Dimension E = 84.0
*All measurements are made with mast vertical and fully lowered.

Table 9. Cushion Tire Trucks

* Metric Formulas (All Dimensions are in Millimeters)
Dimension E = (Y + Z + 204) × 0.98
Example: Dimension E = (Y + Z + 204) × 0.98 **Step 1.** Dimension E = (1840 + 91+ 204) × 0.98 **Step 2.** Dimension E = 2179 × 0.98 **Step 3.** Dimension E = 2135

* Inch Formulas (All Dimensions are in Inches)
Dimension E = (Y + Z + 8.0) × 0.98
Example: Dimension E = (Y + Z + 8.0) × 0.98 **Step 1.** Dimension E = (72.4 + 3.6 + 8.0) × 0.98 **Step 2.** Dimension E = 85.7 × 0.98 **Step 3.** Dimension E = 84.0
*All measurements are made with mast vertical and fully lowered.

* Metric Formulas (All Dimensions are in Millimeters)
Class II Mast Type (2.0 - 2.5 Ton Capacity)

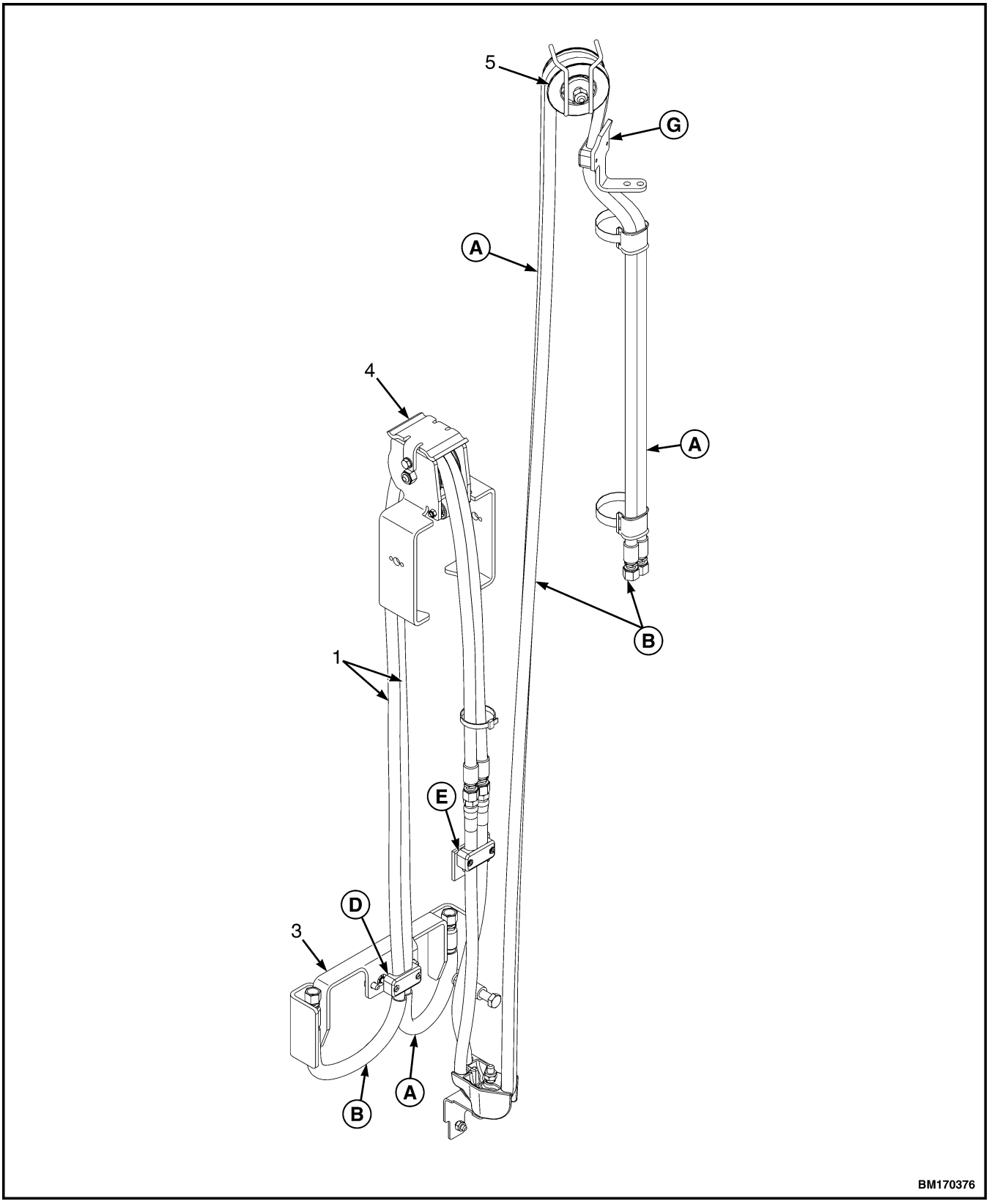


Figure 80. Header Hose Arrangement for Three-Stage Full Free-Lift Mast (Sheet 3 of 3)

Legend for Figure 83

1. HOSE
2. CLAMP
3. CLAMP
4. CAPSCREW
5. CLAMP
6. NUT
7. LOCK NUT
8. SPACER
9. SHEAVE
10. STUB SHAFT
11. WASHER
12. CAPSCREW
13. STUB SHAFT
14. CAPSCREW
15. HOSE GUARD
16. HOSE GUARD
17. STUB SHAFT
18. ROLLER
19. SPACER
20. IDLER
21. CABLE
22. WASHER
23. SPRING
24. NUT
25. COTTER PIN
26. PIN
27. BLOCK
28. CAPSCREW
29. LOCKWASHER
30. CAPSCREW
31. WASHER
32. HOSE GUARD (RH INNER)
33. HOSE GUARD (RH OUTER)
34. CAPSCREW
35. WASHER
36. NUT
37. CLAMP
38. STRAP CLAMP
39. BRACKET
40. CAPSCREW
41. PLATE
42. SNAP RING
43. WASHER
44. STUB SHAFT
45. GUARD
46. WASHER
47. CAPSCREW
48. CAPSCREW
49. CLAMP

6. Install bottom hose clamps as shown in Figure 82. Put some grease on bottom of brackets so hoses can slip to equalize the pressure. Ensure that the inside hose goes through the rear of the bracket and tracks to the inside. The outside hose goes through the front of the bracket and becomes the outside. Tighten capscrews and nuts of bracket to 18 N•m (13 lbf ft). **DO NOT** tighten capscrews and nuts for strap clamps at this time.

7. If the crosshead of the free-lift cylinder does not have hose guides, remove chain guard brackets, chains, and chain sheaves. Install hose guides (flare toward outside) and snap rings to chain sheaves. Install free-lift sheaves, chains, and chain guard brackets as shown in Figure 82 and Figure 84.

8. Install hoses over free-lift cylinder with marks **E** aligned with top edge of clamp of middle hose clamp assemblies. Tighten capscrews and nuts of clamps to 8 N•m (71 lbf in). Refer to Figure 78, Figure 74 Sheet 3 or Figure 75, Figure 75 Sheet 3.

9. Pass hoses under lower hose clamps and install strap clamps on hoses. Align marks **G** to bottoms of lower hose clamps. Tighten capscrews and nuts of strap clamps to 18 N•m (13 lbf ft).

10. Install hoses on hose sheaves (Figure 82) with loops long enough to install on floating hose sheaves. Tighten axle capscrews and nuts of sheaves to 53 N•m (39 lbf ft).

11. Partially assemble floating sheaves as shown in Figure 82 and Figure 83. Install loops of hoses under sheaves. Then install roller guide assemblies over hoses and between hose guards. See Figure 82 and Figure 84. Tighten roller guide capscrews and nuts to 8 N•m (71 lbf in).

12. Fasten looped ends of cables of floating sheaves to cable mount blocks. Use pins, washers, and cotter pins to fasten cable loops. See Figure 83. If necessary, install mount blocks on bottom crossmember of intermediate channel using capscrews and washers. Tighten capscrews to 18 N•m (13 lbf ft).

13. Make sure cables are in grooves of idler wheels and under formed feature of hose guards of floating sheaves. Install ends of cables in brackets so there is spring tension on cables. Make sure axle capscrews and nuts of sheaves are tightened to 53 N•m (39 lbf ft).

14. Slowly operate hydraulic system so lift chains are tight. Remove chains that fasten carriage and channel weldment. Slowly raise carriage using hydraulic system. Make sure hoses move through all sheaves correctly.

15. Slowly operate mast through a few cycles to make sure hoses track correctly. Tighten strap clamps at bottom hose clamps to 18 N•m (13 lbf ft). Fasten hose assemblies to main cylinders using hose clamps and screw clamps as shown in Figure 82 and Figure 83.

NOTE: When chain adjustment are complete, make sure the threads on the nuts of the chain anchors are completely engaged. Inspect the torque of the prevailing torque nut (locknut) used to adjust the chain anchor with every lift chain adjustment. After carriage and or mast section(s) are adjusted for proper ground clearance, prevent the carriage and or mast section(s) from fully lowering (See Safety Procedures When Working Near Mast). With slack chain(s), check locknut torque. If 122.5 N•m (22.1 lbf in) for ½-20 nuts, 4.5 N•m (39.8 lbf in) for 5/8-18 nuts, or 6.0 N•m (53.1 lbf in) for 3/4-16 nuts, torque cannot be reached, replace locknut. The chain anchors, after adjustment, must be able to move on their mountings.

NOTE: Prior to performing adjustment procedures make sure the forklift truck is parked on a level surface and the mast is in the vertical position.

NOTE: When adjusting the lift chains on forklift trucks equipped with either pin or hook-type forks installed, go to Step 1. If the forklift truck is normally equipped with a hook-type carriage and has an attachment without forks, go to Step 2. If the forklift truck is normally equipped with a pin-type carriage and has an attachment without forks, go to Step 3.

1. Adjust the chain anchors that support the carriage, until the bottom of the fork heal is 12.0 +3.0/-6.0 mm (0.47 +0.12/-0.24 in.) above the floor. See Figure 88.

2. Adjust the chain anchors that support the carriage, until the bottom of the lower carriage bar is above the floor level as shown in Table 16. Adjust the chain anchors that support the carriage, until the bottom of the lower carriage bar is 88.5 +3.0/-6.0 mm (3.50 +0.12/-0.24 in.) above the floor level. See Figure 89.

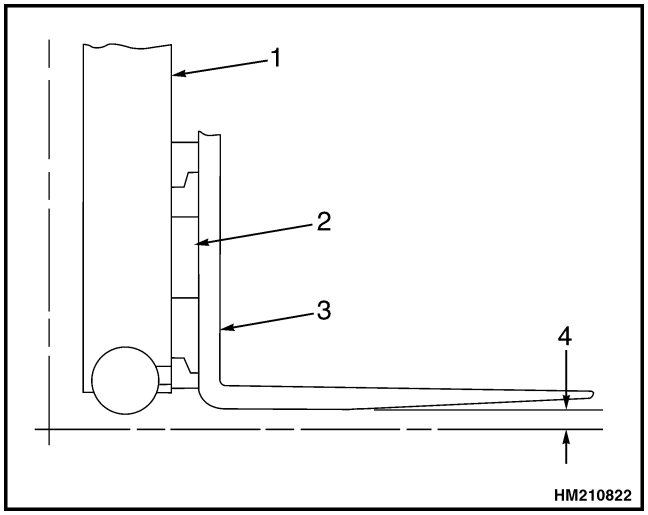
3. Adjust the chain anchors, which support the carriage, until the center line of the fork pin is above the floor level as shown in Table 17. See Figure 90.

Table 16. Chain Adjustment with Attachment Installed

Class II and III	88.5 +3.0/-6.0 mm (3.50 +0.12/-0.24 in.)
Class IV	139.5 +3.0/-6.0 mm (5.50 +0.12/-0.24 in.)

Table 17. Pin-Type Carriage Chain Adjustment

GP070-090LJ	551.0 +3.0/-6.0 mm (21.7 +0.12/-0.24 in.)
GP100-120MJ	714.0 +3.0/-6.0 mm (28.12 +0.12/-0.24 in.)
GP135-155CA	913.0 +3.0/-6.0 mm (36.0 +3.0/-6.0 in.)



1. MAST
2. CARRIAGE
3. FORK
4. HEAL OF FORK IS 12.0 +3.0/-6.0 mm (0.47 +0.12/-0.24 in.) ABOVE THE FLOOR.

Figure 88. Lift Chain Adjustment, Forks

TABLE OF CONTENTS

This section is for the following models:

ERP20-32ALF (ERP040-065DH) [E216];
ERC/P16-20AAF (ERC30, 40AH) [C814];
ERC20-32AGF (ERC040-065GH) [A908];
ERC35-55HG (ERC70-120HH) [C839]

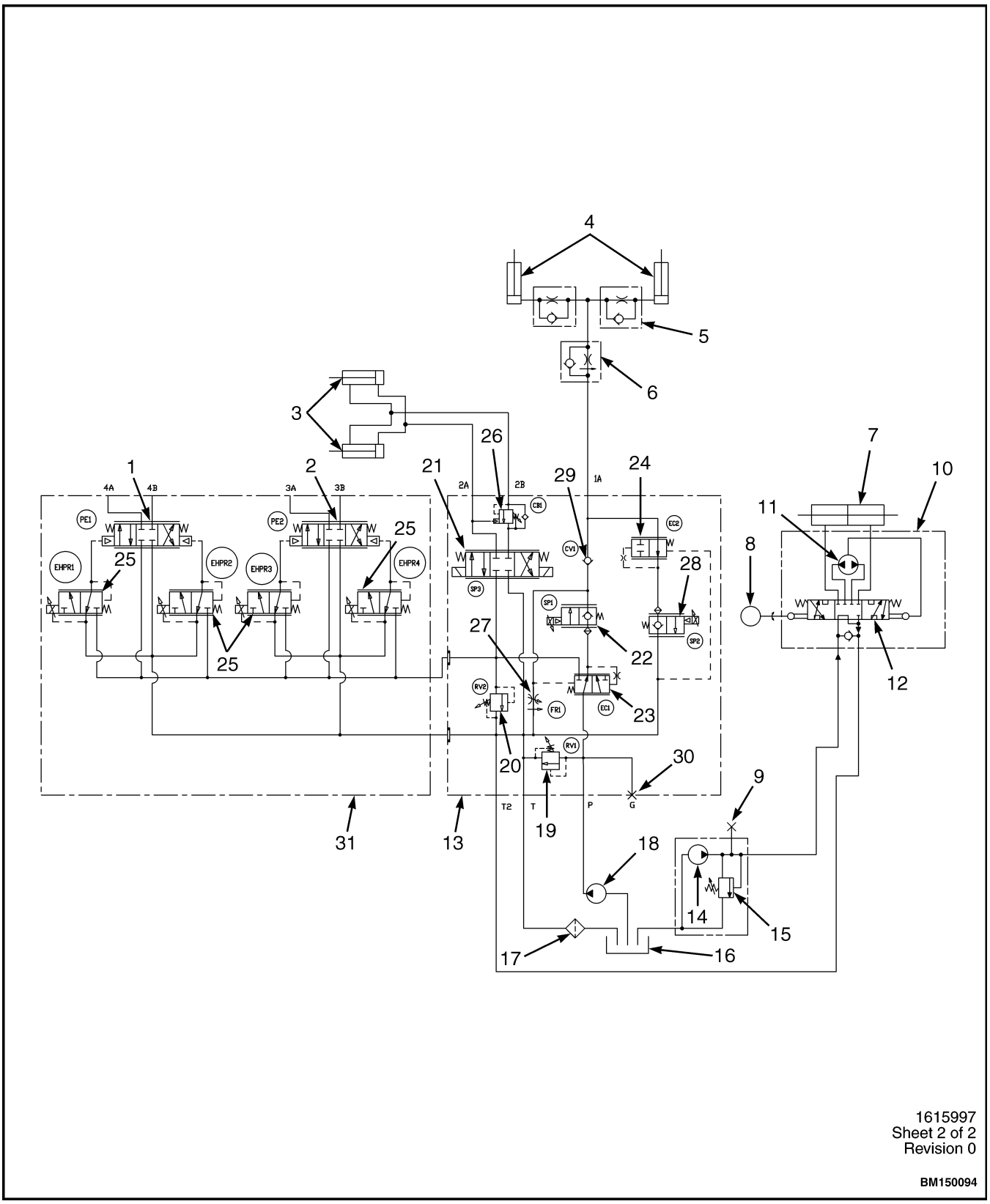
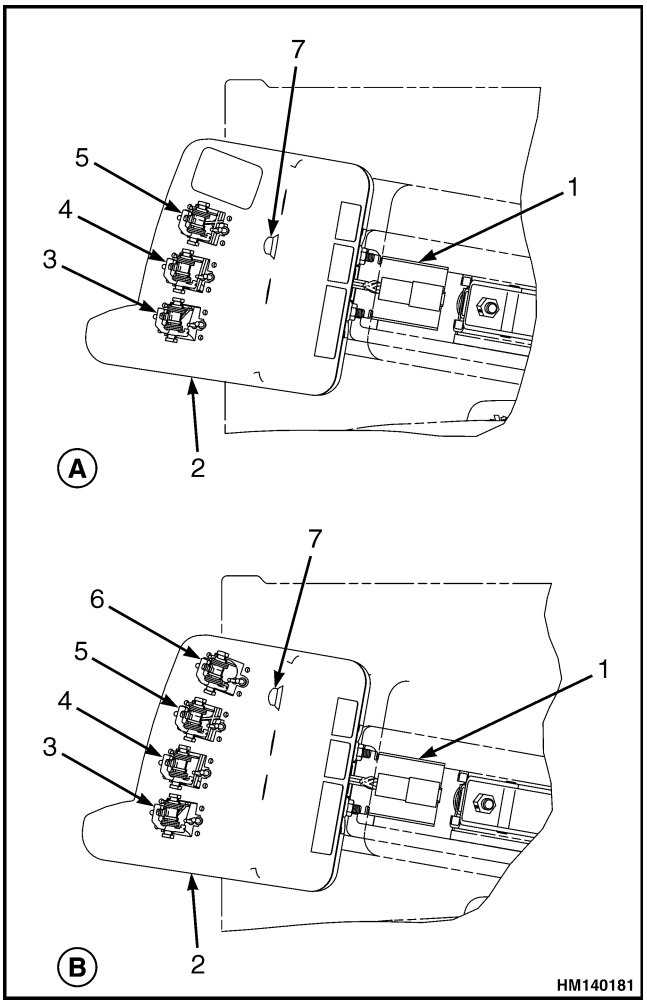


Figure 8. Electro-Hydraulic Control Valve Schematic (High Flow) for Lift Truck Models ERC20-30AGF (ERC040-065GH) (A908), ERC/P16-20AAF (ERC030-040AH) (C814), and ERP20-30ALF (ERP040-060DH) (E216)



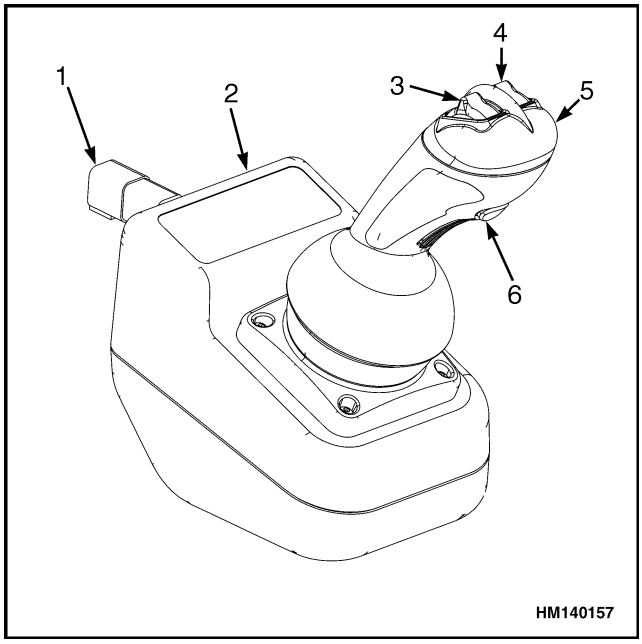
A. 3 FUNCTION CONSOLE WITH CLAMPING
B. 4 FUNCTION CONSOLE WITH CLAMPING

1. CONNECTOR
2. MINI-LEVER MODULE
3. LIFT MINI-LEVER
4. TILT MINI-LEVER
5. AUXILIARY FUNCTION MINI LEVER
6. AUXILIARY FUNCTION MINI-LEVER
7. PUSH BUTTON SWITCH

Figure 24. Mini-Lever Module

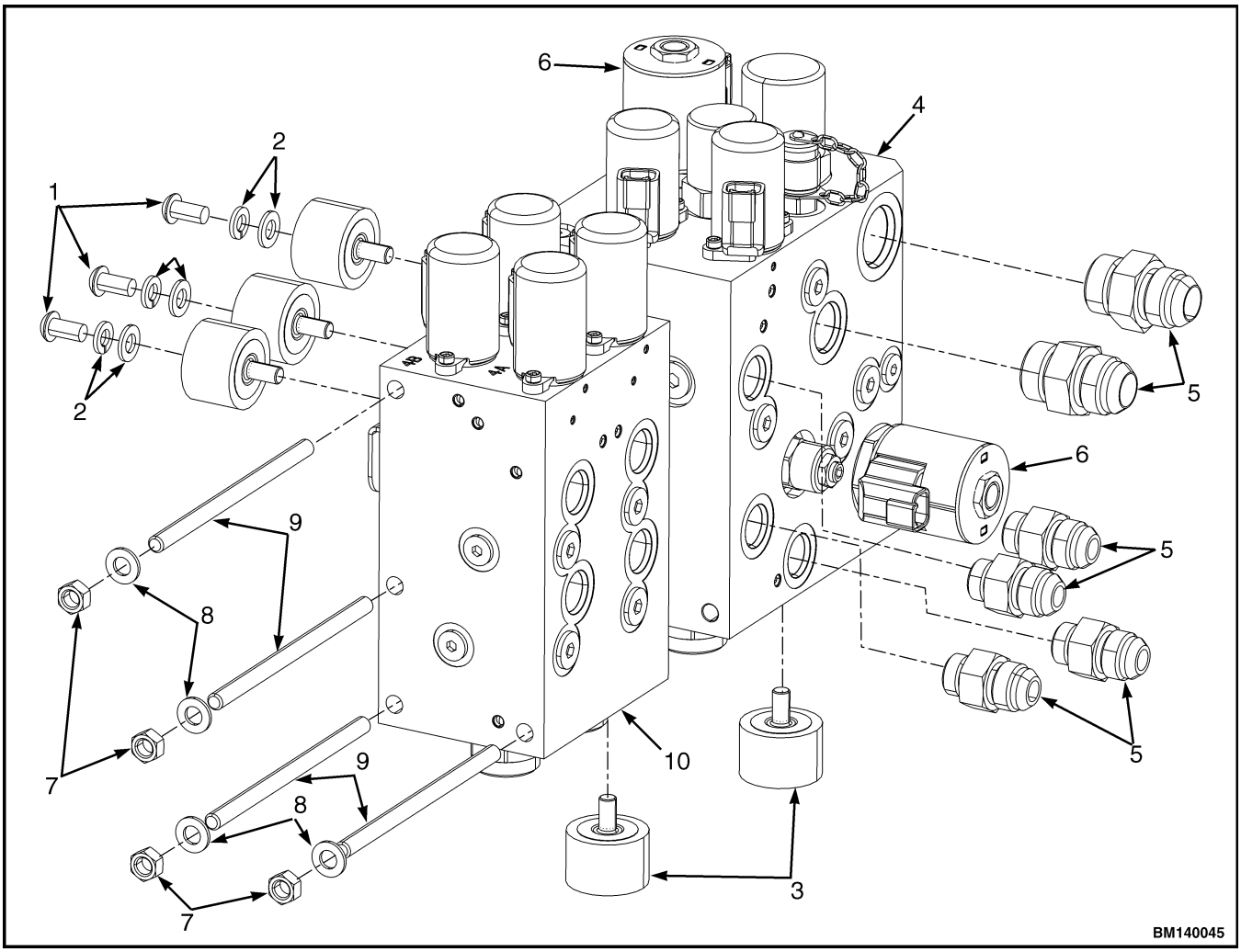
JOYSTICK

A joystick option may also be available and is also located on the right side armrest of the seat. See Figure 25. The forward and rearward movement of the joystick controls the lift and lower functions. The left and right movement of the joystick controls the tilt function. The joystick may also have either a single thumb roller or dual thumb rollers to control auxiliary functions.



1. CONNECTOR
2. JOYSTICK CONSOLE
3. AUXILIARY FUNCTION
4. AUXILIARY FUNCTION
5. JOYSTICK
6. RELEASE BUTTON

Figure 25. Joystick Console



1. SCREW
2. WASHERS
3. VALVE MOUNT
4. CONTROL VALVE MAIN SECTION
5. HOSE NIPPLE
6. PROPORTIONAL SOLENOID VALVE (SP1 AND SP2)
7. NUT
8. FLAT WASHER
9. CONNECTING ROD
10. AUXILIARY SECTION (FOURTH FUNCTION SHOWN)

Figure 35. Electro-Hydraulic Control Valve (High Flow Control Valve) for Lift Truck Model ERC35-55HG (ERC70-120HH) (C839)