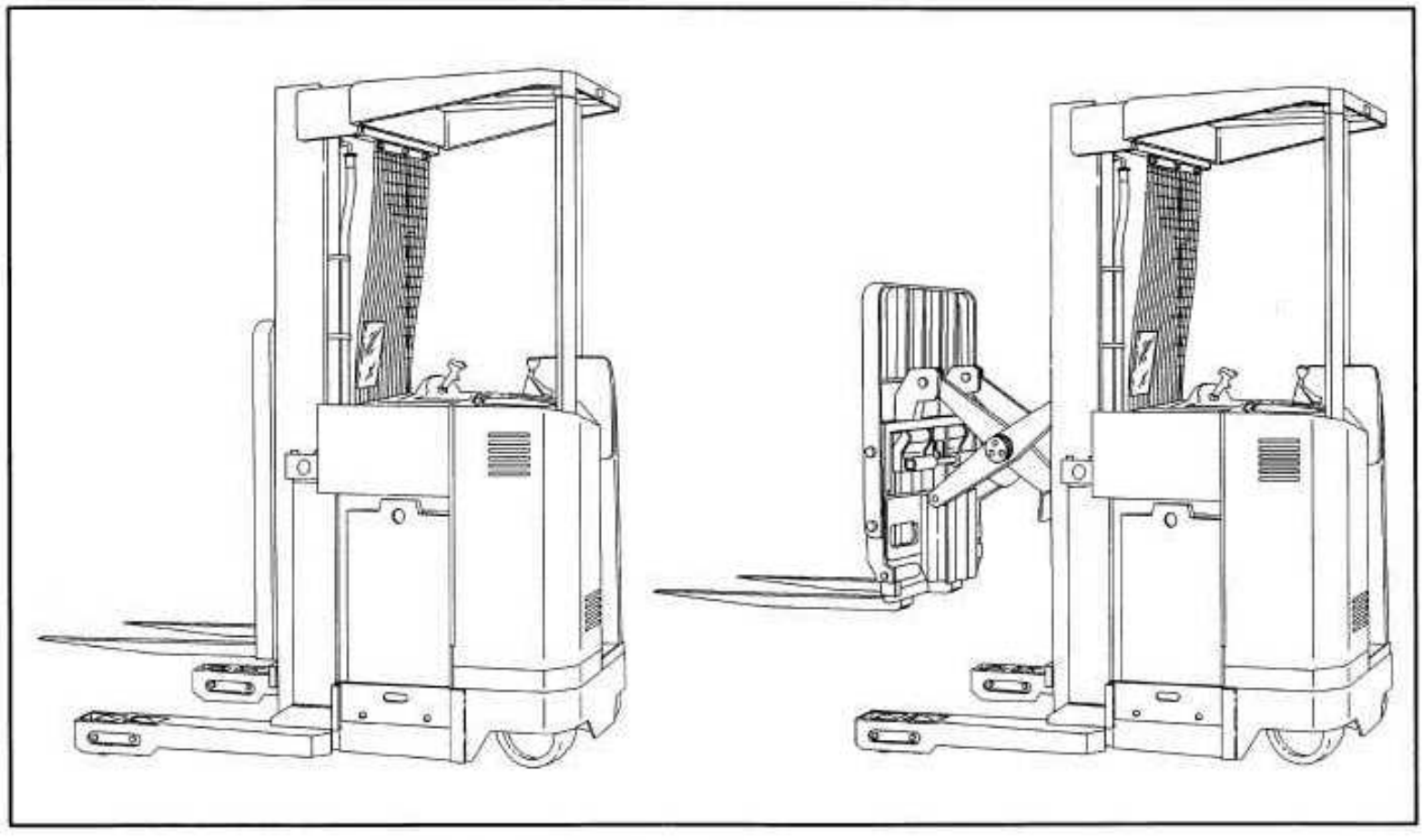
MAINTENANCE MANUAL

For Models

NR 035/040/045 AD
NDR 030 AD
(B815)

NS 040/050 AE
(B816)



For Service & Parts Contact

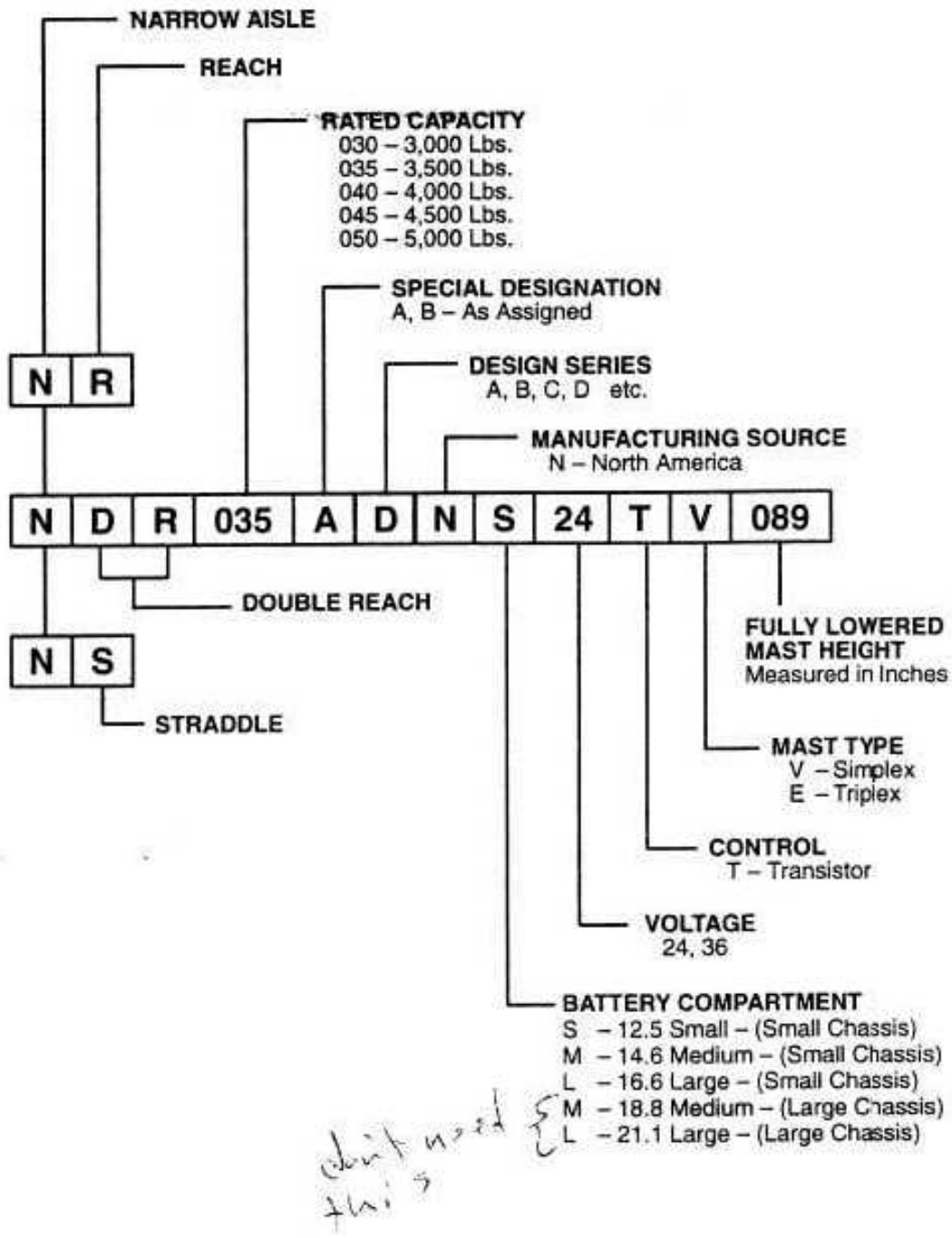
Authorized Dealer

Yale Materials Handling Corp
1400 Sullivan Drive
Caller No. 12011
Greenville, NC 27834-2011

5203717-05
1705

Yale
Industrial Trucks

EXPLANATION OF MODEL CODE



To verify that this manual is correct for this truck compare the model code, as explained above, with the nameplate on the truck. Refer to Table of Contents for nameplate location and information. If the model code in this manual does not agree with the information on the nameplate contact your Yale industrial truck dealer.

SPECIAL NOTE

This Maintenance Manual contains complete and accurate information available at the time of publication for the components and systems listed. Yale Materials Handling Corporation reserves the right to make changes to its product at any time and the possibility exists that later changes are not included in this manual. If your lift truck is equipped with special options that are not covered in this Maintenance Manual, you should contact your local Yale industrial truck dealer for additional information.

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This Maintenance Manual is divided into major sections which are listed on this page. Quick reference to these sections can be made by placing the right thumb on the tab of the desired section, bending the book back and thumbing the pages to the corresponding tab.

SECTIONS

Yale
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SECTION 1

1 OPERATING INSTRUCTIONS

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SECTION 1 – CONTENTS

INTRODUCTION

OPERATING INSTRUCTIONS–GENERAL

Before attempting to operate this truck, carefully read and understand these operating procedures.

Make sure the truck is in proper operating condition. Visually inspect the entire truck for any damage that may have occurred during shipment.

NOTE: Throughout this manual the terms right, left, front and rear relate to the viewpoint of an operator riding on the truck with the forks trailing.

Familiarize yourself with the information contained on the nameplate which is located in the operator's compartment. Information on this nameplate is shown in Figure 1-1 and as follows:

A. Serial Number

This is an identification number assigned to this particular truck and should be used when ordering service parts or when requesting any information from your Yale industrial truck dealer. The serial number is a six digit number preceded by a letter and is stamped on the lift truck frame and on the nameplate.

B. Model Code

The model number and the serial number should be used when requesting information. An explanation of the model code is located on Page B of this manual.

C. Truck Weight

This is the approximate weight of the truck without a load on the forks. This weight plus the weight of the load to be moved must be considered when operating on elevated floors or elevators.

D. Capacity Rating

This rating shows the maximum load capacity of this truck. Personal injury and damage to the truck can occur if the capacity rating is exceeded.

This truck meets all applicable mandatory requirements of ANSI B56.1 Safety Standard for Powered Industrial Trucks at the time of manufacture. In addition, these trucks are classified by Underwriters' Laboratories, Inc. and/or approved by Factory Mutual Engineering Corporation for the type designation. Consult UL Index of Classified Products and FM Approval Guide.

No additions, omissions or modifications should be made that will affect compliance to the previously stated requirements or in any way minimize the effectiveness of the safety devices.

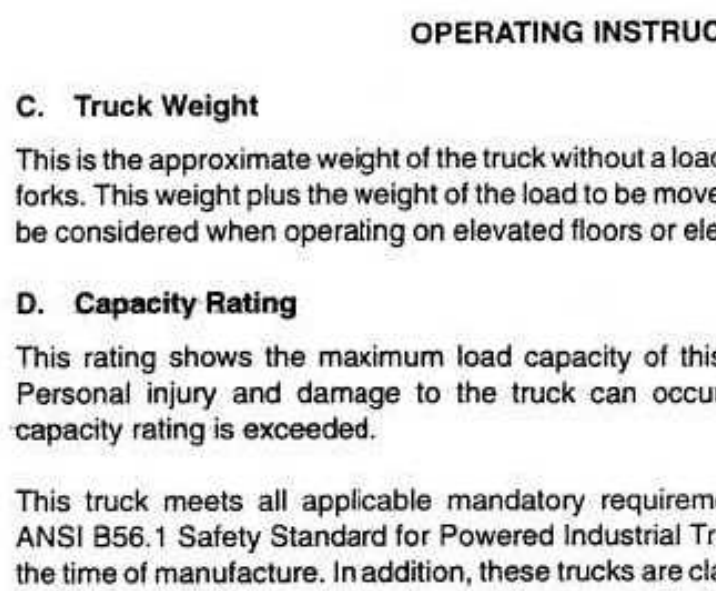
Safety and informational labels are located in conspicuous locations on this truck and should be strictly followed. Check the nameplate of each truck before operation. These safety and informational labels must be replaced immediately if missing or defaced. Labels will vary with type of truck and equipment installed. Refer to the Parts Manual for part number and location for all labels.

NOTICE TO USER

The U.S.A. Occupational Safety and Health Act of 1970 and other national safety codes require a new plate if this unit is equipped other than as stated on plate. Obtain the correct plate from your authorized dealer.

To remove pull here

If a truck is shipped incomplete from the factory, the nameplate will be covered by the label shown above. Do not operate the lift truck until you obtain a complete nameplate from your Yale industrial truck dealer.



Capacities and cautions contained on this nameplate must be strictly followed.

Figure 1-1 – Nameplate Information

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SAFETY LABELS

A definition of the safety labels used on the motorized lift trucks is listed below.

⚠ DANGER

DANGER: Identified by a Red Label, immediate hazards which WILL result in severe personal injury or death.

⚠ WARNING

WARNING: Identified by a Orange Label, hazards or unsafe practices which MAY result in personal injury or death.

⚠ CAUTION

CAUTION: Identified by a Yellow Label, hazards or unsafe practices which may result in minor personal injury, product or property damage.

THE READER MAY FIND ANY OR ALL OF THE FOLLOWING LABELS USED IN THIS PUBLICATION. AN UNDERSTANDING OF THEIR USE, AS GIVEN BELOW WILL AID THE READER.

NOTE

An advisory procedure, practice, condition, etc., which is essential to emphasize.

⚠ CAUTION

Directs attention to hazards or unsafe practices which may result in minor personal injury, product or property damage if the proper precautions are not taken.

⚠ WARNING

Directs attention to unsafe practices which could result in personal injury or death if proper precautions are not taken.

⚠ DANGER

Directs attention to unsafe practices and/or existing hazards which WILL result in severe personal injury or death if proper precautions are not taken.

OPERATOR PRE-CHECKS AND INSPECTION

Before each shift, every 8 hours or before beginning truck operation it is the operator's responsibility to carry out the following checks and inspections. Do not operate the truck if it is in need of repair, if it is in an unsafe condition, or might contribute to an unsafe condition. Remove the key and report the condition to the proper authority. If the truck becomes unsafe in any way while you are operating it, **STOP** operating the lift truck and report the matter immediately to the proper authority.

Basic maintenance information and the Recommended Schedule of Maintenance are in the Operating Manual, Part Number 5203717-03, located in the document holder on the mast screen. Also refer to Section 2 of this manual.

1. Make sure overhead guard, load backrest extension, mast screens and all other safety devices are attached.

2. Make sure all capacity, safety and informational plates or labels are attached. This truck is not considered safe to use without a legible, properly filled out nameplate.

Contact Yale Materials Handling Corporation or your local dealer for Yale industrial trucks if the nameplate is not present and legible. See parts manual for label page with label and plate locations.

3. Inspect truck for any damage that might have occurred during the previous shift.

4. Inspect truck for any signs of external leaking of the battery, steering system or hydraulic system.

5. Check hydraulic hoses for leaking, chafing, cuts or reinforcement showing through the outside of the hose.

6. Make sure chains are not damaged or kinked. Check for excess slack or mistracking on the sheaves.

7. Make sure all latches are adjusted (if necessary) and fastened.

8. Operate brake, hydraulic controls, lift, tilt and auxiliary and steering. Make sure all controls operate correctly and return to their proper positions. See section on Operating Controls for detailed descriptions.

9. Inspect condition of wheels and tires.

10. Inspect forks for damage. Make sure they are correctly attached and locking clips are in their proper position.

11. Test horn, lights, gauges and meters. Make sure they work correctly.

12. Make sure any unusual noises are investigated immediately.

OPERATING PROCEDURE–GENERAL

■ Read and understand the Operating Manual supplied with the lift truck. Notify your supervisor if the manual is not available.

■ Keep hands, feet and other parts of your body inside the designated operator's compartment. Parts of your body outside the truck can be injured when passing obstructions.

■ Do not permit passengers to ride on the truck.

■ Observe and comply with instructions concerning floor loadings. Know the weight of your truck and load combined. Truck weight information is located on the nameplate.

■ Travel with the load lowered and where possible, tilted back. Do not elevate the load except during stacking.

■ The operator can change the direction of travel while the lift truck is moving, by moving the direction control lever in the opposite direction. The truck will come to a stop and then accelerate in the opposite direction, unless the control lever is released. This is called plugging.

■ Look in the direction of travel and keep a clear view of the path of travel.

■ If visibility is impaired by the load, operate truck with the forks trailing and always look in the direction of travel.

■ Start, stop, travel, steer and brake smoothly. Slow down for turns and on uneven or slippery surfaces that could cause truck to overturn or slide.

■ Watch clearances around forks. The driver must be aware that the forks can sometimes extend beyond the load. This may cause the forks to hit an object or lift another load.

■ Watch out for any obstructions, especially those overhead. Check clearances.

■ Do not run over objects on the roadway surface as truck stability and steering may be adversely affected.

■ When approaching cross aisles, slow down, sound horn and keep to the right side of aisle.

■ Operate truck under all conditions at a speed that will permit it to be brought to a stop in a safe manner.

■ Narrow Aisle trucks are designed for use on smooth, hard floors with minimal grades.

■ Operate a loaded truck with the load upgrade. Operate an unloaded truck with the lifting mechanism downgrade.

■ Do not push loads with the truck.

■ Watch out for pedestrians at all times. Do not drive up to anyone standing in front of an object.

■ Observe all traffic regulations, including authorized plant speed limits. Under normal traffic conditions, keep to the right. Maintain a safe distance from the truck ahead (approximately three truck lengths), and keep the truck under control at all times.

■ Yale lift trucks are not intended for use on public roads.

■ When leaving truck unattended, lower the lifting mechanism, shut off power and remove key. Chock wheels if truck is parked on an incline.

■ Report all accidents involving personnel, building structures and equipment to the proper authority.

■ Check all gauges and indicator lights for correct operation. Frequent reading of the instrument panel should become a habit.

■ Avoid any abrupt moves. Be a professional. **"HANDLE WITH CARE."**

■ Follow the Recommended Schedules of Maintenance. Maintain your lift truck for dependable and economical operation.

SHUT DOWN PROCEDURE

When leaving truck unattended, fully lower forks, shut off power, set brake, set coast control to off (when equipped), neutralize controls and remove key. If you park the truck on an incline, chock the wheels.

FORK ADJUSTMENT

Forks should be spaced as far apart on the fork carriage as the load being moved will allow. Both forks should always be the same distance from the center of the fork carriage.

Check for the presence and condition of studs at each end of the carriage upper fork clip slide. If studs are damaged or missing they should be repaired or replaced before the forks are adjusted.

To adjust the forks, raise them a few inches off the floor. Lift up on the keeper pin and slide the forks along the carriage by pushing them away from you. Do not pull the forks toward you. When the forks are set to the desired position, make sure the keeper pin is down in a slot on the top of the fork carriage plate.

SAFETY AND OPERATIONAL CHECK LIST

A "Daily Check List" similar to the one shown on the next page should be used every day before operating the truck. The check lists are available in tablet form with 50 sheets per tablet and can be obtained from your local Yale Industrial Truck Dealer for a nominal fee.

Both this manual and the Operating Manual contain the Recommended Schedules of Maintenance which should be used as a guide along with the Lubrication Instructions.

A professional operator should also be familiar with the information contained in the American National Safety Standard for Powered Trucks – ANSI B56.1, Part II.

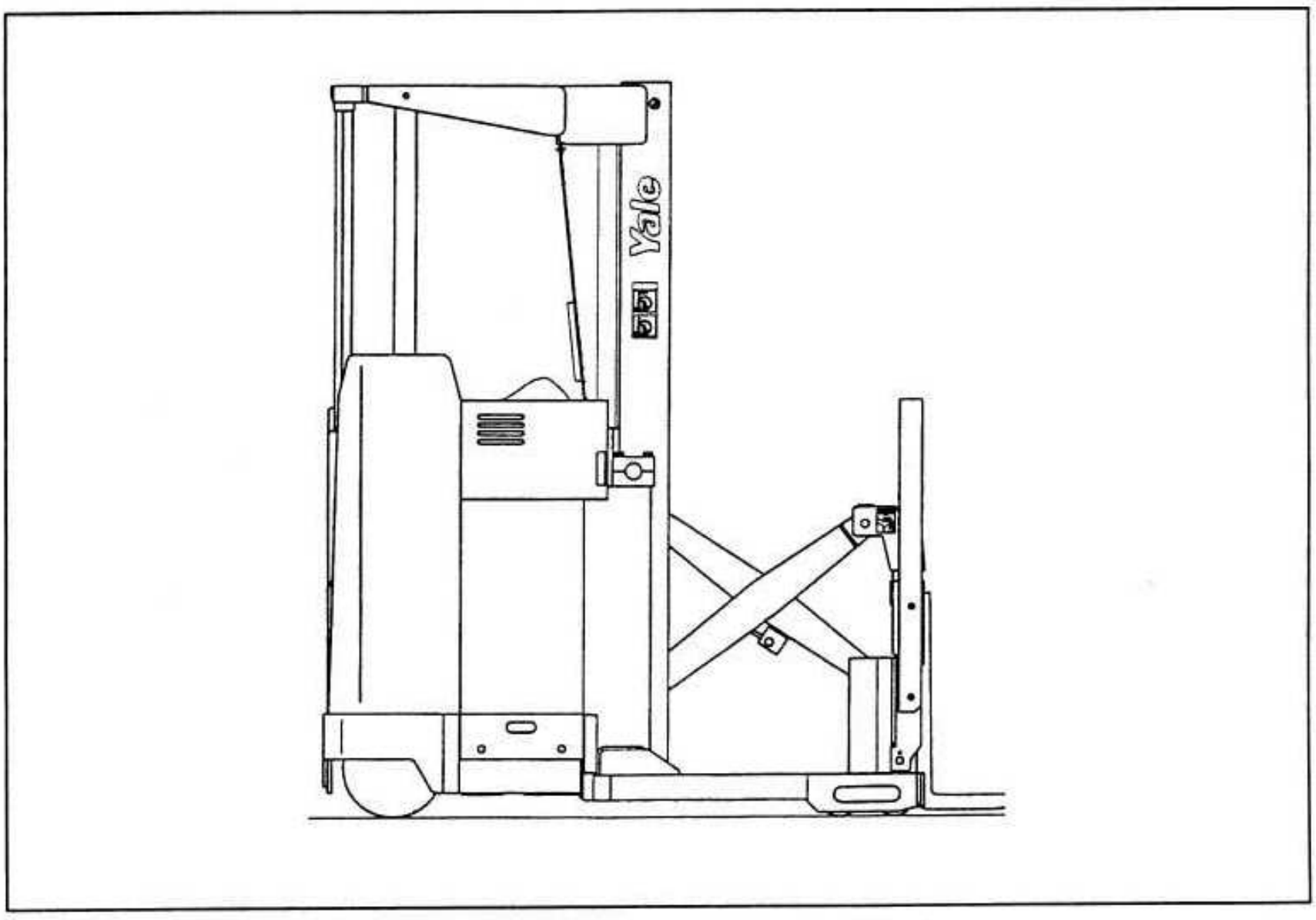

Figure 1-2 – Typical Narrow Aisle Electric Lift Truck

NOTE: This **Daily Check List** is available for the Operator. **Some items on this list may not be applicable to your truck.** This convenient check list is in tablet form and can be ordered through your Yale Industrial Truck Dealer. Form Number **944-6418-A.**

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Daily pre-shift inspection is an OSHA requirement. We recommend that you document that these inspections have been made.

Operator's Daily Check List
Electric Truck

Record of Fluid Added

Date	Operator	Battery Water
Truck Number	Model Number	Hydraulic Oil
Department	Serial Number	
Shift	Drive Hour Meter Reading	Hoist Hour Meter Reading

SAFETY AND OPERATIONAL CHECKS (Prior to each shift)

Have a **qualified** mechanic correct all problems	(O.K.✓)	Need Maintenance
Leaks – Hydraulic Oil, Battery		
Tires – Condition and Pressure		
Forks, Top Clip Retaining Pin and Heel – Check Condition		
Load Backrest/Extension – Securely Attached		
Hydraulic Hoses, Mast Chains and Stops – Check Visually		
Finger Guards – Attached		
Overhead Guard – Attached		
Safety Warnings – Attached (Refer to Parts Manual for Location)		
Internal Checks:		
Battery – Check Water/Electrolyte Level and Charge		
Hydraulic Fluid Level – Check Level		
Drive Unit Fluid Level – Check Level		
Operator's Compartment:		
Operating Manual – in Container		
Nameplate – Attached and information matches model, serial number and attachments		
Battery Restraint System – Adjusted and Securely Fastened		
Seat Belt, Buckle and Retractors – Functioning Smoothly		
Brake Fluid – Check Level		
Controls (Turn Truck On) Unusual Noises Must Be Investigated Immediately:		
Accelerator Linkage – Functioning Smoothly		
Parking Brake – Functioning		
Service Brake – Functioning Smoothly		
Steering Operation – Functioning Smoothly		
Drive Control – Forward/Reverse – Functioning Smoothly		
Tilt Control – Forward and Back – Functioning Smoothly		
Hoist and Lowering Control – Functioning Smoothly		
Attachment Control – Operation		
Horn and Lights – Functioning		
Gauges: Hour Meter/Battery Discharge Indicator – Functioning		
Instrument Monitors – Functioning		

Form 944-6418-A (5/93)

MODEL AND OPERATING INFORMATION

The NR-AD (reach), NDR-AD (double reach) and NS-AE (straddle) narrow aisle electric lift trucks have lifting capacities of 1362 kg (3,000 lbs) to 2270 kg (5,000 lbs) with a 609.6 mm (24 in) load center.

These trucks feature operator comfort, low noise and vibration levels and ease of brake and control handle efforts. The large operator compartment is designed for flexible side stance position. Yale Hi-Vis Simplex and Triplex masts provide excellent visibility for these models.

No additions, omissions, changes or modifications should be made that will affect compliance to the previously stated requirements or in any way minimize the effectiveness of the safety devices.

Before attempting to operate this truck, carefully read and understand these operating procedures. Make sure the truck is in proper operating condition. Be sure all safety devices such as the overhead guard, mast screen and the load backrest extension are in place and properly secured.

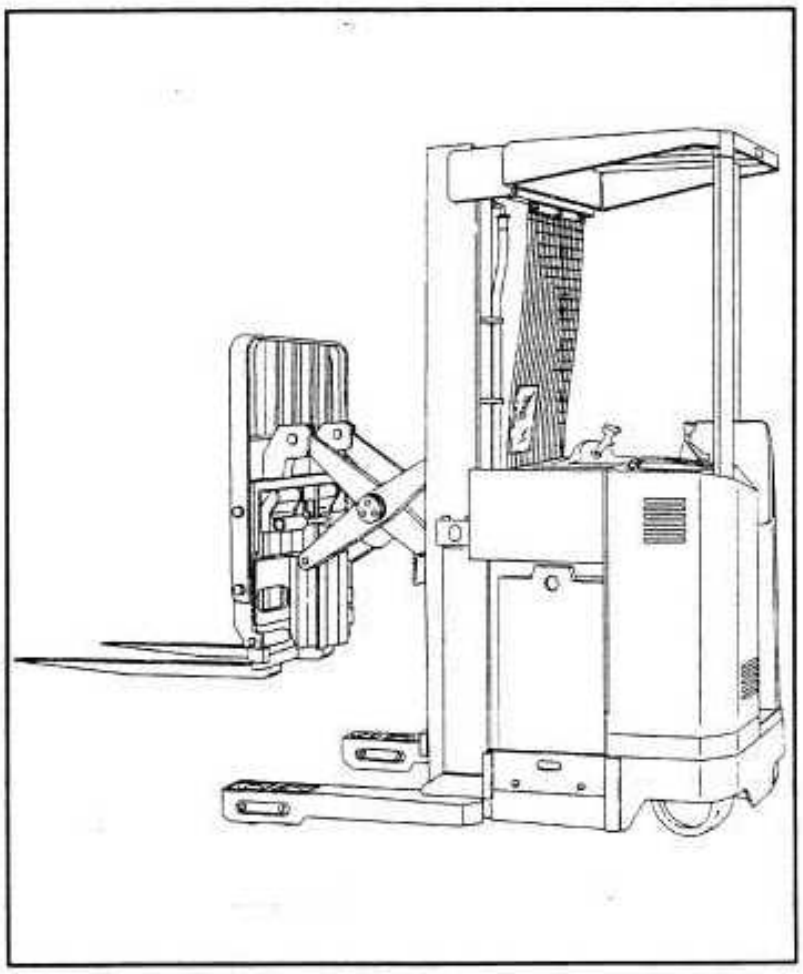

Figure 1-3 – Narrow Aisle Electric Lift Truck

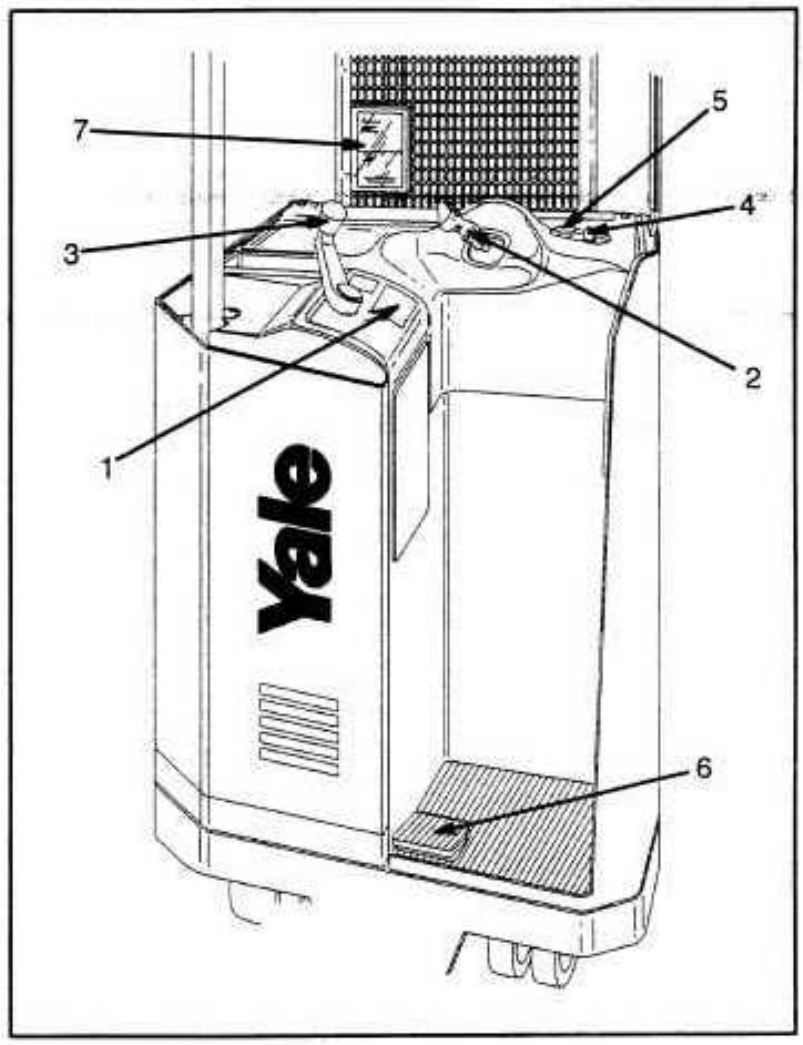

Figure 1-4 – Operating Controls

1. The **Instrument Display** is located near the steering tiller and has the following features:

   A. The **Battery Indicator** has a 10 bar green, yellow and red light emitting diode (LED) to indicate battery charge status. As power is used the LEDs will turn off, starting with green. The red LED, second from the bottom, will flash indicating a nearly discharged battery. The bottom red LED will alternately flash with the LO-Batt indicator LED (a crossed battery symbol), indicating a discharged battery. The lift function will be locked out at this point.

   B. The **Message Center** is a 16 character, dot matrix, liquid crystal display (LCD) with green back light. There are four yellow and one red/yellow LED indicators. The 16 character, alpha-numeric display shows the hourmeter readings, truck performance status, and a warning or fault condition. When a warning message is received, the warning/fault indicator will blink as a yellow light. When a fault message is received, the warning/fault indicator will blink as a red light.

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SECTION 2 – CONTENTS

GENERAL TRUCK AND LUBRICATION

GENERAL

This manual covers the repair and maintenance of the NR-AD (reach), NDR-AD (double reach) and NS-AE (straddle) narrow aisle electric lift trucks have lifting capacities of 1362 kg (3,000 lbs) to 2270 kg (5,000 lbs) with a 609.6 mm (24 in) load center.

The manual has been subdivided into various sections which contain instructions for removal, disassembly, inspection, assembly, installation and adjustment of the major components. Additionally this manual includes, within this section, the recommended schedules of maintenance and lubrication schedule. Troubleshooting charts and recommended specifications are also included within the sections.

Various components that are not covered in specific sections are covered in this section. Some of these components must be opened or removed to complete maintenance or repairs covered in other sections.

FRAME

The lift truck frame is a sturdy one piece structure fabricated from steel incorporating mounting points for the mast, hydraulic controls, electrical controls, pumps and motors.

LOAD BACKREST AND FORKS

Two different arrangements are used on these lift trucks for attaching the load backrest and forks. One arrangement is for units supplied with shaft type forks (standard) while the other arrangement has hook type forks. The removal and assembly will depend upon the type of forks used. See Section 9, MAST for the recommended removal and assembly for the LOAD BACKRESTS AND FORKS.

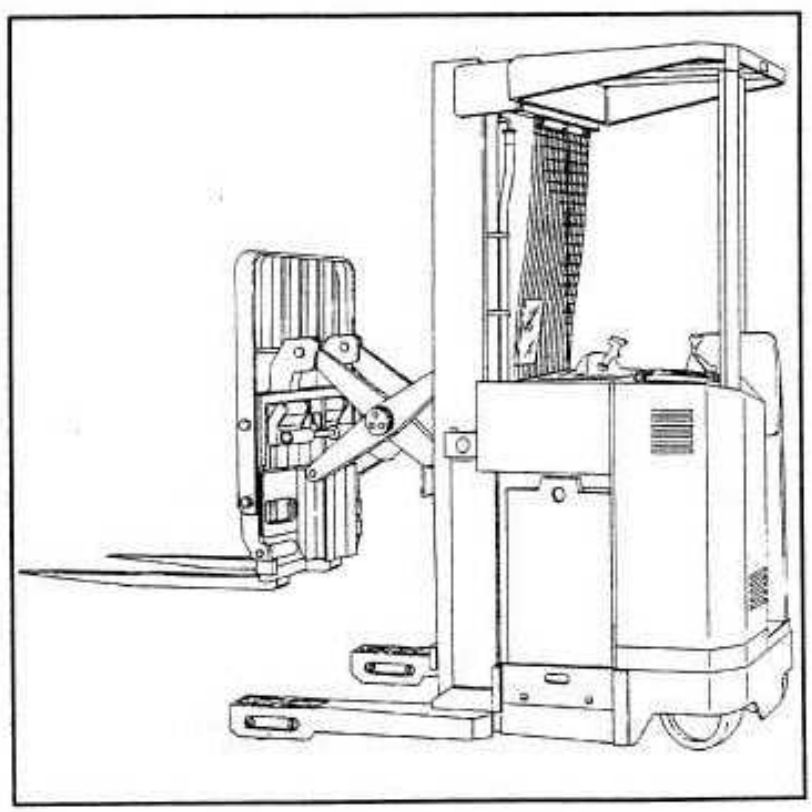


Figure 2-1 – NR Lift Truck

MAST SCREEN

A mast screen is provided to prevent fingers or hands from being placed into the mast area. **The lift truck should never be operated without the mast screen.** The mast screen may be removed for servicing the lift truck by removing the four attaching capscrews. Two of the capscrews retain the top of the mast screen to the overhead guard, while the bottom two capscrews retain the mast screen to the lift truck frame. The operating manual holder is located on the mast screen.

ACCESS DOOR AND COVERS

The drive unit access door is mounted on a hinge and secured by a single capscrew and latch at the rear of the lift truck. Turn the capscrew one-half turn to unlock the drive unit access door.

The battery compartment cover is made of molded plastic. It covers the compartment above the battery compartment. To remove the cover, remove the five retaining screws, one of which is common with the drive unit compartment cover.

The drive unit compartment cover is located over the drive unit compartment and adjacent to the steering tiller. The cover is attached with a single retaining screw and one screw that is common with the battery compartment cover. To remove the cover, remove the two screws and move the cover from its mounting points. To install the cover, position the cover under the battery compartment cover and align with the mounting holes. Install the two screws.

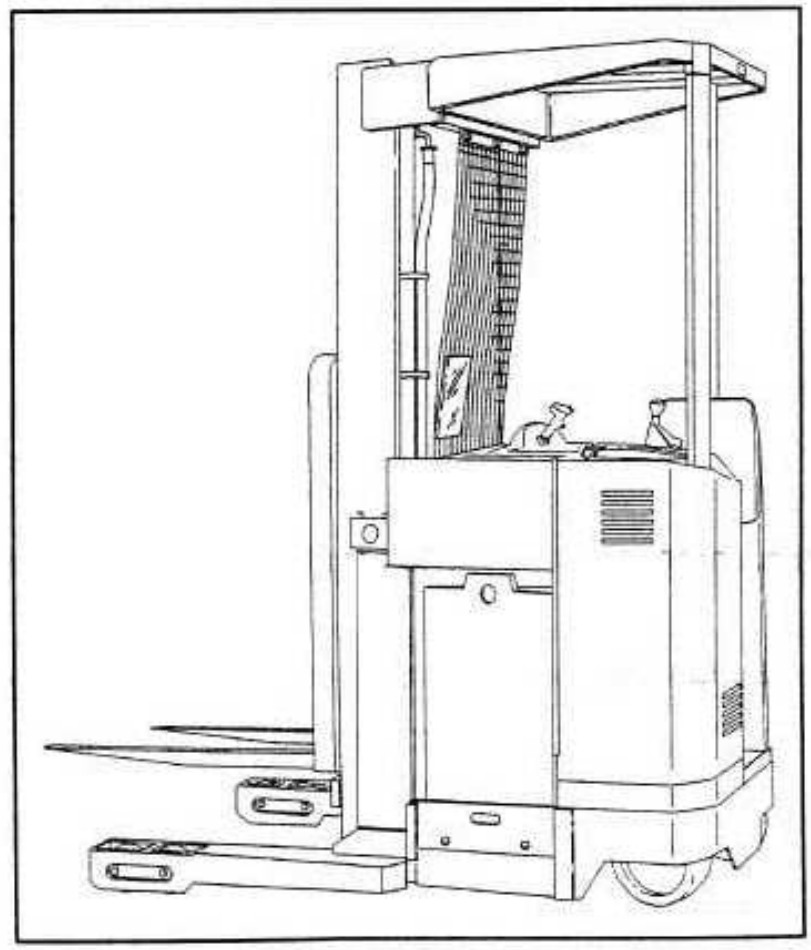


Figure 2-2 – NS Lift Truck

The contactor panel area cover is located in the operator's compartment on the right hand side of the lift truck. It covers the contactor panel and the PMC controller. The bottom edge of this cover fits in a slot on the frame weldment. Two capscrews and self retaining "U" nuts retain the top of the cover to the frame. To remove the contactor panel area cover, remove the two screws from the top of the cover and lift the cover out of the slot. To replace the cover, install the bottom tab into the slot located in the frame. Align and install the two screws to retain the cover to the frame.

The floor plate located in the operator's compartment is not attached. To remove the floor plate, lift the plate up off the frame and disconnect the connector for the operator sensing switch connector, then remove the floor plate from the lift truck. To install the floor plate, connect the connector to the main harness and position the floor plate in the frame of the operator's compartment.

OVERHEAD GUARD

The overhead guard consists of the overhead guard weldment and two supporting posts. The overhead guard weldment is attached to the mast with six capscrews and hardened washers. The bottom left hand post is attached to the lift truck frame with a capscrew and washer in the drive unit compartment, while the top slides into the overhead guard weldment. The bottom right hand post slides into a slot provided in the frame and the top is attached to the overhead guard weldment with a capscrew and washer.

The overhead guard is furnished in three different sizes, depending upon the battery compartment size. The length of the posts will also vary depending upon the size of the mast furnished with the lift truck.

To remove the overhead guard from the truck, open the drive unit compartment and remove the capscrew and lockwasher retaining the post to the frame. Hold the post while removing the hardware so that the post does not slide out of the slot in the overhead guard weldment. Remove the capscrew and lockwasher retaining the right hand post to the overhead guard weldment. Slide the post out of the slot in the lift truck frame. Attach a sling and lifting device to the overhead guard weldment. Remove the six capscrews and hardened washers retaining the overhead guard weldment to the mast and lower the overhead guard weldment to the floor.

To replace the overhead guard weldment, use a sling and lifting device to raise the overhead guard weldment. Align the weldment and the mast and install the six capscrews and hardened washers. Tighten the capscrews to 149 N•m (110 lbf ft). Slide the right hand post into the slot located in the frame. Align the top of the post with the weldment and install the capscrew and lockwasher. Align the left hand post with the slot in the overhead weldment and slide the post into the opening. Align the lower portion of the post with the frame in the drive unit compartment and install the capscrew and washer to retain the left hand post.

BATTERY COMPARTMENT

The battery compartment is furnished in five sizes, depending on lift truck model and capacity. Refer to Table 2-1.

Battery retainers are located on both sides of the lift truck. They can be removed by raising them up using the hand opening and moving them away from the frame weldment. A battery may be installed or removed by moving the battery on the rollers provided in the bottom of the battery compartment.

NOTE: Complete information relating to the care and maintenance of batteries can be found in the literature shipped with the battery.

NOTE: Your company, industry and government safety regulations should be reviewed to help reduce accidents and damage to equipment.

NOTE: It is recommended that the battery be removed from the right hand side of the lift truck to reduce the possibility of damaging the battery cables and the connector.

WARNING: Never operate the lift truck without both battery retainers in place. Spacers must also be used, as required, to maintain a maximum of 12.7 mm (0.50 in) between the battery and the side plates or retainers.

MODEL	CAPACITY	BATT. COMPT.	VOLTAGE
NR-AD	3500	318 × 986 × 800 mm (12.5 × 39 × 31.5 in)	24
	4000		
NR-AD	3500	371 × 986 × 800 mm (14.6 × 39 × 31.5 in)	24 OR 36
	4000		
	4500		
NR-AD	3500	422 × 986 × 787 mm (16.6 × 39 × 31.5 in)	24 OR 36
	4000		
	4500		
NDR-AD	3000	371 × 986 × 800 mm (14.6 × 39 × 31.5 in)	24 OR 36
	3000	422 × 986 × 787 mm (16.6 × 39 × 31.5 in)	
NS-AE	4000	318 × 986 × 800 mm (12.5 × 39 × 31.5 in)	24
	4000	371 × 986 × 800 mm (14.6 × 39 × 31.5 in)	24 OR 36
	5000	422 × 986 × 787 mm (16.6 × 39 × 31.5 in)	

Table 2-1 – Battery Compartment

CHANGING THE BATTERY

WARNING: If a different size battery is installed in the lift truck the battery spacers must be changed. See the parts manual for the correct battery spacer arrangement.

WARNING: To prevent personal injury and unexpected battery movement, the battery must be level when it is moving. Make sure the battery stand is on a level surface and is aligned and adjusted as described in the following procedure.

WARNING: Batteries are heavy. Use care to avoid injury

1. Make sure the key is in the OFF position. Disconnect the battery. Move the connector and cables so that they will not be damaged when the battery is moved.

2. Remove the battery panel.

3. Align the battery stand with the battery so that the end of the stand is against the roller frame of the lift truck. Adjust the capscrew legs of the battery stand so that the tops of the rollers are level and at the same height as the bottom of the battery. Attach the puller cable to the battery case. Stand on the base of the battery puller and pull the battery onto the battery stand.

4. If the battery is lifted use a spreader bar and crane to lift the battery from the battery stand.

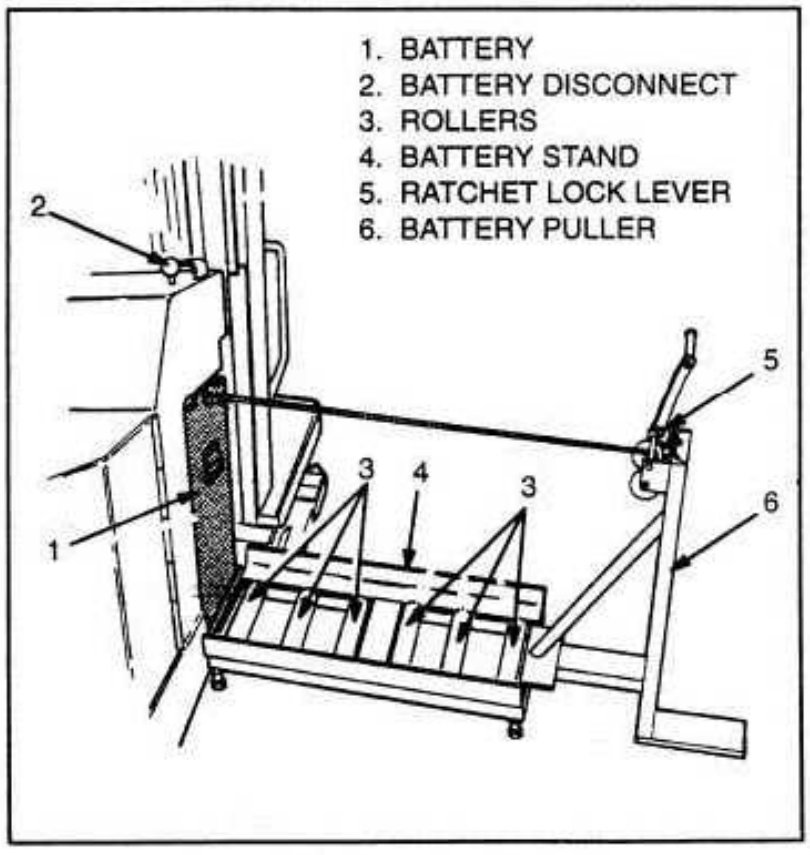


Figure 2-3 – Changing the Battery

WARNING: Make sure the capacity of the crane and the 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.

WARNING: 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.

5. Before installing the battery, make sure the battery is cleaned and painted. Refer to BATTERY AND CHARGING, Section 9.

6. When a replacement battery is installed, make sure the battery fits the battery compartment. Use spacers to prevent the battery from moving more than 0.5 in. (13 mm) in any horizontal direction.

7. Make sure the weight of the replacement battery is within the maximum and minimum weight shown on the nameplate.

8. The battery must be installed so that the battery connector will connect to the lift truck connector without pulling on the cables.

TIRES AND WHEELS

1. Check the tires for damage. Inspect the tread and remove any objects that will cause damage.

2. Smooth any cuts or tears to prevent further damage. Check for bent or damaged rims. Check for loose or missing parts. Remove any wire, straps or other material that may have wrapped around the axle.

Standard tire sizes are listed in Table 2-2 for both drive/steer, caster and load wheels. For lift trucks equipped with special tires consult your nearest authorized Yale industrial truck dealer.

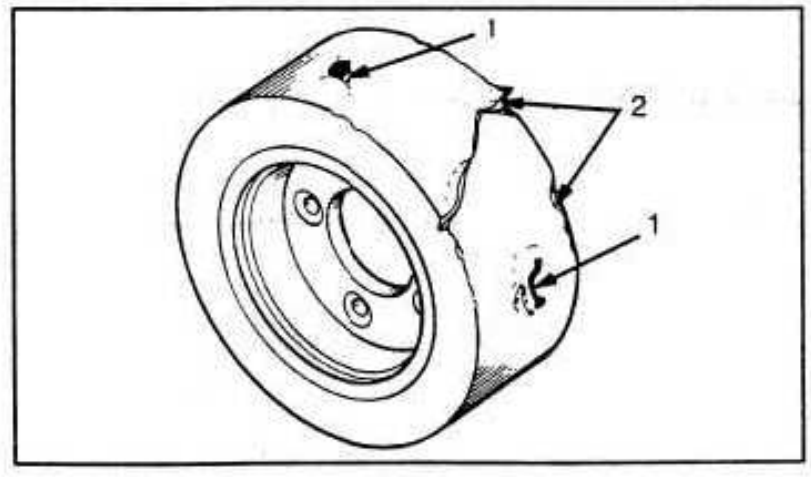


Figure 2-4 – Inspecting Tires

MODEL	DRIVE/STEER TIRES	CASTER WHEELS	LOAD WHEELS
NR035AD NR040AD NR045AD	12×5.5×8 Low Profile Rubber Plain Tread	8×2 Polyurethane Dual Articulating	5×3.9 Polyurethane Tandem Articulating
NDR030AD	12×5.5×8 Low Profile Rubber Plain Tread	8×2 Polyurethane Dual Articulating	5×3.9 Polyurethane Tandem Articulating
NS040/050AE	12×5.5×8 Low Profile Rubber Plain Tread	8×2 Polyurethane Dual Articulating	4×3.9 Polyurethane Tandem Articulating

Table 2-2 – Tire Sizes

SOLID TIRES

Remove the One Piece Wheel and Tire

WARNING: Wheels must be changed and tires replaced by trained personnel only. Always wear safety glasses.

NOTE: To change cushion tires, the wheel must be pressed out of the rim. The proper tools, equipment and press ring must be used. Do not attempt to change tires (rims) or wheels unless you have the proper tools, equipment and experience.

1. Loosen the wheel lug nuts. Put the lift truck on blocks as described in HOW TO PUT THE LIFT TRUCK ON BLOCKS, Section 1, this manual.

WARNING: The lifting and carrying of solid tires is not recommended because their weight could be in excess of 45 kg (100 lb). Where applicable use a wheel or tire dolly to assist in the removal and installation of the wheel.

2. Remove the wheel nuts and remove the wheel from the lift truck.

3. The correct tools, equipment and a press ring must be used for each size of wheel. Use a press to push the wheel hub from the tire.

Install the Tire on the One Piece Wheel

1. Make sure the wheel hub is the correct size for the tire. Do not mix types of tires, types of tire treads, or wheels of different manufacturers on any one lift truck.

2. Tire sizes listed in Table 2-2 are for both drive and steer tires.

3. Position the new tire in the press. See Figure 2-5. Align the wheel and tire assembly removed from the truck on top of the new tire. Make certain the wheels are aligned. Make certain the tires are level. Position a press ring on top of the wheel hub.

4. Carefully apply hydraulic pressure until the wheel hub is forced from the old tire into the new tire. The new tire, when properly seated, will be flush to the inner or outer edge of the wheel hub. See Figure 2-6 and Figure 2-7.

INSTALL THE WHEELS ON THE LIFT TRUCK

1. Install the tire and wheel on the hub. Tighten the lug nuts to 136 N•m (100 lbf ft) torque.

2. Raise the lift truck high enough to remove the blocks. Lower the lift truck to the floor.

CAUTION: Check all wheel nuts after 2 to 5 hours of operation: when new lift trucks begin operation and on all lift trucks when the wheels have been removed and installed. Tighten the nuts in a cross pattern to 136 N•m (100 lbf ft) torque. When the nuts stay tight for eight hours, the interval for checking the torque can be extended to 350 hours.

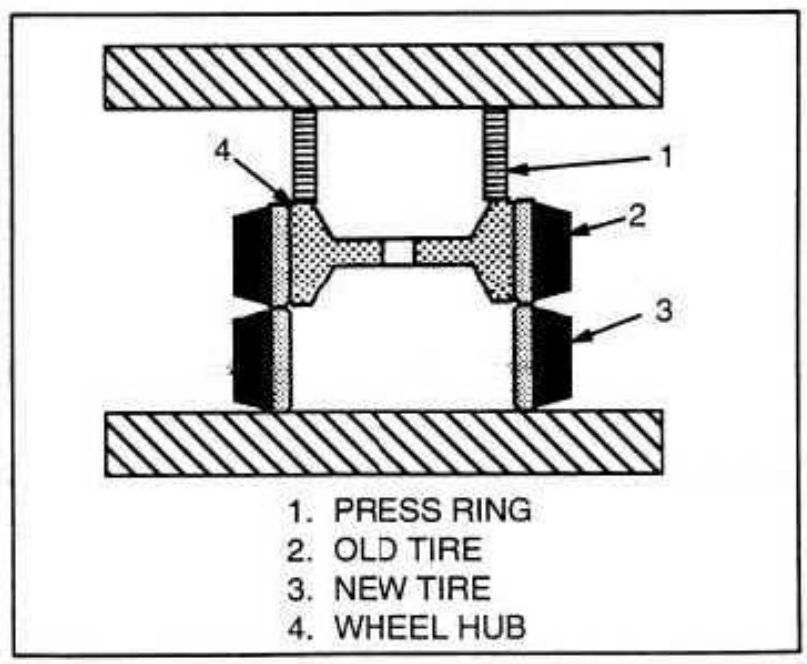


Figure 2-5 – Position Tire on Wheel

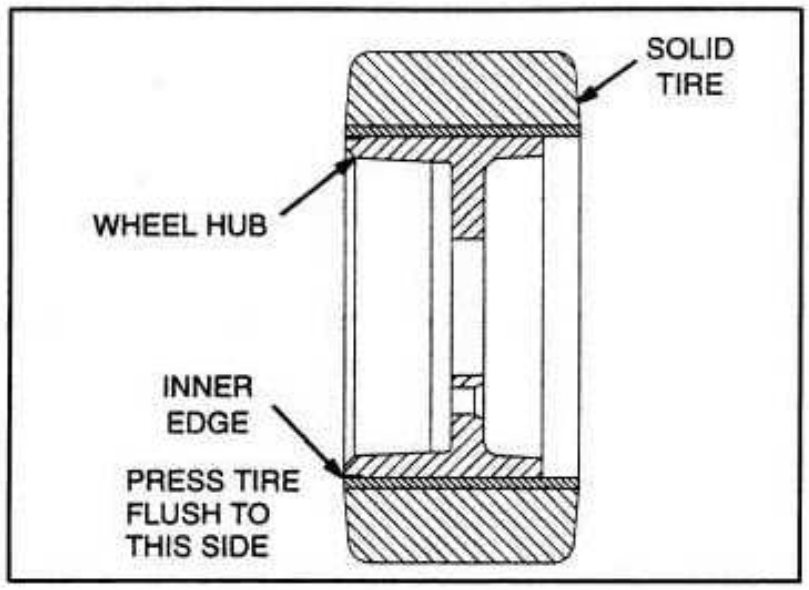


Figure 2-6 – 12 × 5.5 Solid Tire Pressed onto Wheel

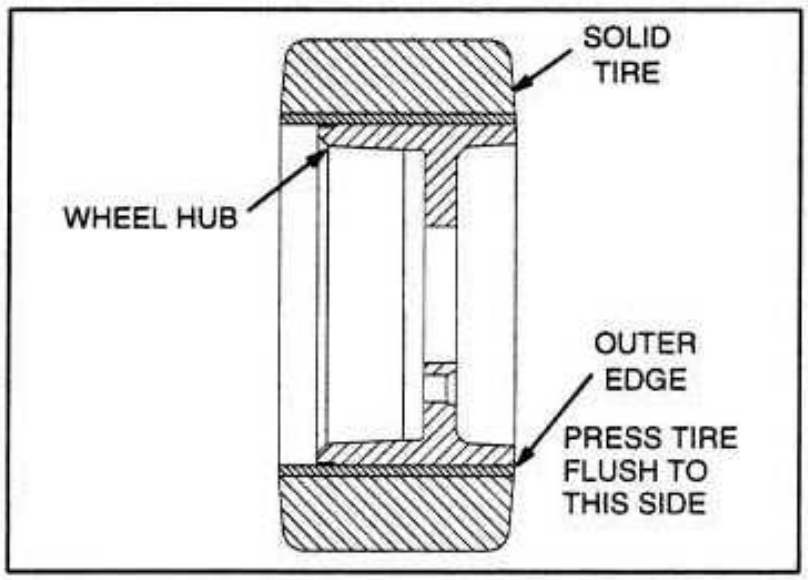


Figure 2-7 – 13.5 × 5.5 Solid Tire Pressed onto Wheel

TANDEM LOAD WHEELS

Removal–Tandem Load Wheels

NOTE: The load wheels are held in place by the load wheel brackets. For easier installation, remove and install one load wheel before removing the next load wheel.

1. Put the lift truck on blocks as described in HOW TO PUT THE LIFT TRUCK ON BLOCKS, Section 1, this manual.

2. Remove the axle nut, axle shaft, washers, bearings and load wheel. Remove the axle sleeve from the load wheel.

Installation–Tandem Load Wheels

1. Pack the new load wheel with the recommended grease listed in the LUBRICATION SCHEDULE, this section. Install the new load wheel, axle shaft, axle sleeve, bearings, washers and axle nut. See Figure 2-8.

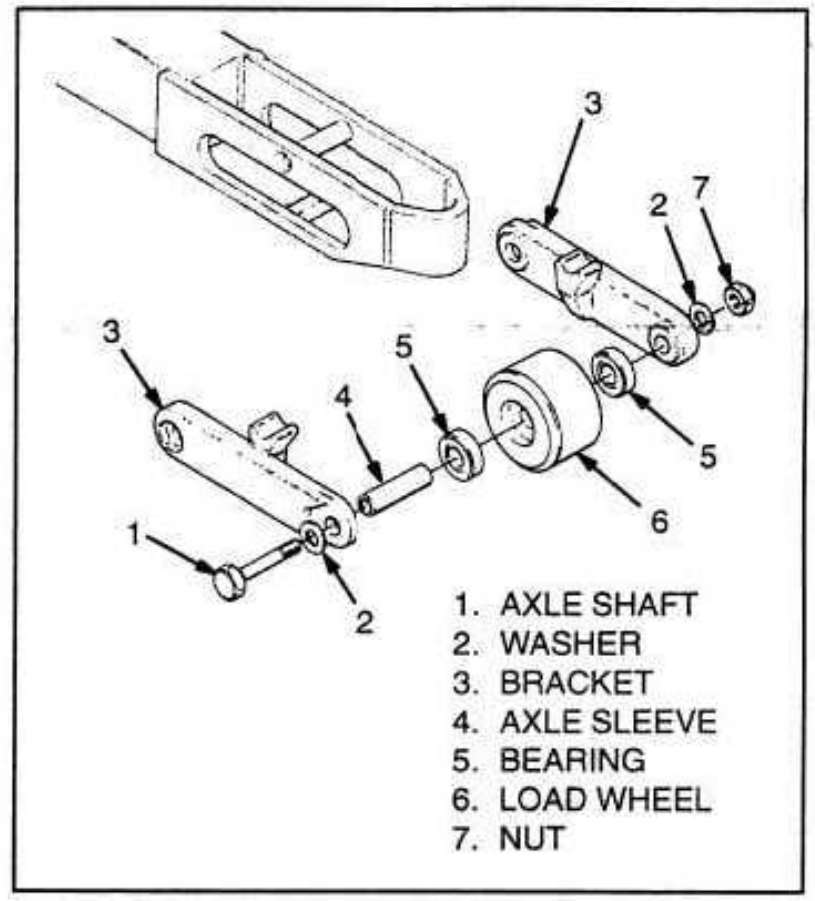


Figure 2-8 – Tandem Load Wheels

NOTE: On lift trucks used in freezer applications, apply the recommended Anti-Seize Lubricant listed in the LUBRICATION SCHEDULE, this section, to the load wheel axle shaft.

2. Remove the blocks from under the lift truck.

SINGLE LOAD WHEELS

Removal–Single Load Wheels

NOTE: Single load wheels are optional.

1. Put the lift truck on blocks as described in HOW TO PUT THE LIFT TRUCK ON BLOCKS, Section 1, this manual.

2. Using a drift, drive the roll pins through the top of the base arm, until the axle is released.

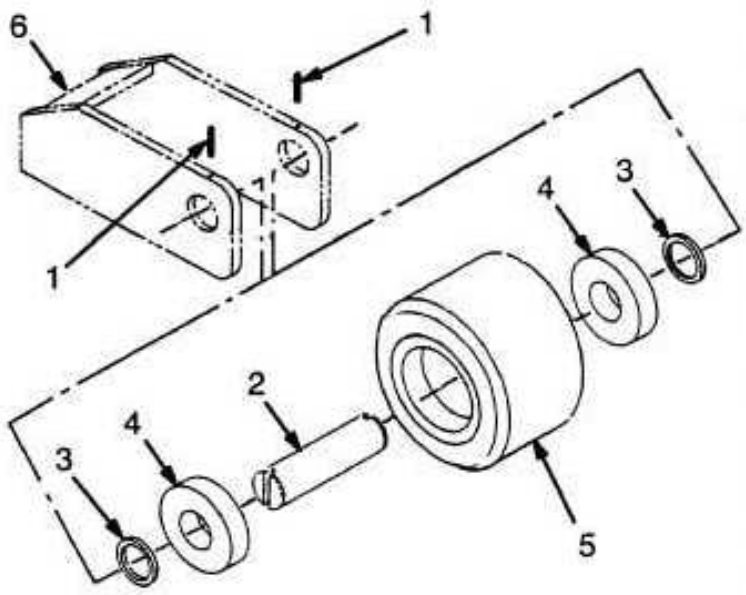
3. Remove the axle, spacers and load wheel. Remove the roll pins from the axle. Remove the bearings from the load wheel.

SINGLE LOAD WHEELS

Installation–Single Load Wheels

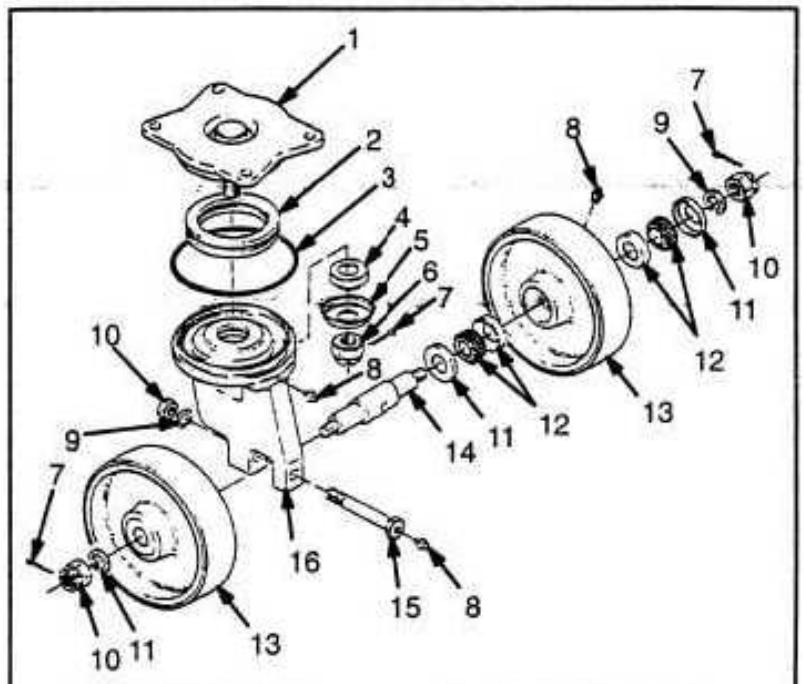
1. Install bearings in the new load wheel. Pack the wheel with the recommended grease listed in the LUBRICATION SCHEDULE, this section.

2. Align the spacers and position the new load wheel. Install the axle through the base arm. See Figure 2-9.



1. ROLL PIN
2. AXLE
3. SPACER
4. BEARING
5. LOAD WHEEL ASSEMBLY
6. BASE ARM

Figure 2-9 – Single Load Wheels



1. SWIVEL PLATE
2. THRUST BEARING
3. O-RING
4. ROLLER BEARING
5. GUARD WASHER
6. NUT
7. COTTER PIN
8. LUBE FITTING
9. LOCKWASHER
10. SELF-LOCKING NUT
11. GUARD WASHER
12. ROLLER BEARING
13. WHEEL
14. AXLE SHAFT
15. CAPSCREW
16. SWIVEL FORK

Figure 2-10 – Caster Wheels

3. Align the slots in the axle with the roll pin holes in the base arm. Install the roll pins until they are flush with the top of the base arm.

4. Remove the blocks from under the lift truck.

CASTER AND CASTER WHEELS

Description

The caster is on the right hand end of the articulating axle weldment. The caster is one support for the rear of the lift truck. The drive wheel on the master drive unit is the other support at the left hand end of the articulating axle weldment. The axle of the caster is an articulated axle. The articulation of the axle permits both wheels of the caster to always have equal weight on each wheel. Caster operation and wheel wear are improved with this design. The caster is attached to the articulating axle weldment by four capscrews and lockwashers. The complete caster can be replaced as a unit or the wheels can be replaced. Always replace the wheels as a set for better caster operation and wheel wear. A single new wheel will wear rapidly.

Removal–Caster

1. Put the rear of the lift truck on blocks. See HOW TO RAISE THE DRIVE/STEER TIRE AND CASTER WHEELS, Section 1. Make sure the blocks are in a location to permit removal of the caster from the right hand side of the lift truck.

2. Remove the four capscrews and lockwashers that retain the caster to the articulating axle weldment. Remove the caster.

Installation–Caster

1. Align and install the replacement caster on the articulating axle weldment using the capscrews and lockwashers. Tighten the capscrews to 68 N•m (50 lbf ft) torque.

2. Remove the blocks from under the lift truck.

Removal–Caster Wheels

NOTE: Always replace the wheels as a set. Replacing only one wheel causes more wear on the new wheel. The caster also will not operate correctly when a single wheel is replaced, causing more wear or caster damage.

1. Put the rear of the lift truck on blocks. See HOW TO RAISE THE DRIVE/STEER TIRE AND CASTER WHEELS, Section 1.

Apply lithium base, multi-purpose No. 2 grease with a high pressure gun to the following fittings. Clean lube fittings before and after lubricating.

Location of Lube Fittings	No. of Fittings
1. Master Drive Unit Bearing	2
2. Articulation Shaft	1
3. Caster Wheel Assembly	4
4. Thrust Rollers – Reach Frame/Fork Carriage	2
5. Reach Cylinder Pivot Pins – Upper and Lower	4
6. Reach Arms – NR	6
7. Reach Arms – NDR	12
8. Articulating Chain Anchors – NS (Triplex Mast)	2

Apply lithium base, multi-purpose No. 2 grease to the following surfaces:

9. Mast Load Roller Wear Plugs Sliding Surfaces

10. Reach Load Roller Radial and Thrust Wear Surfaces

Apply silicone spray lubricant to all of the following friction points:

11. Lift Chain Sheaves

Apply engine oil (SAE 30) to all friction points of the following:

12. Master Drive Unit Chain Assembly

13. Upper Steering Chain and Sprockets

14. Lift Chains – Wipe off all old oil using a clean cloth, then use compressed air to blow off chains. With a clean brush, apply SAE 30 weight oil to the full length of chain. Oil must penetrate chain joints.

Apply anti-seize lubricating compound to all friction points of the following:

15. Articulation Stop Hardware

16. Articulation Shaft Retaining Bolt and Ends of Shaft

17. Drive Wheel Lug Nuts

18. Load Wheel Axle Bolts

19. Brake Rods and Brake Drum Splines

20. Door Latch Capscrew and Hinge Pin

21. Control Handle Torsion Springs

WARNING: The articulation stops must be adjusted every 350 hours or whenever a drive wheel tire or caster wheel tire is replaced. Failure to adjust these stops properly can reduce stability as well as traction. Refer to the ARTICULATION ADJUSTMENT, Section 4, this manual for the adjustment procedure and proper clearance dimensions.

22. Brake Master Cylincer – The brake fluid reservoir is mounted to the inside of the drive unit compartment door. Remove cap from reservoir and check fluid level. Correct level is 6.35 mm (0.25 in) from top of reservoir. Add brake fluid if necessary. Use SAE J1703 hydraulic brake fluid, Federal Motor Vehicle Safety Standard – FMVSS 116 (DOT 3). The capacity of the reservoir is 0.45 litre (0.12 gal.).

23. Hydraulic Oil Level – Remove and wipe dipstick. With forks fully lowered and oil at normal operating temperature, (above 100°F), measure oil level with dipstick. Add hydraulic oil, if necessary, to the "full" mark on the dipstick. Remove and clean breather/filler assembly and the breather with solvent. Blow dry with compressed air, replace and tighten. Replace the breather/filler assembly and breather if they cannot be cleaned or they are damaged. **DO NOT OVERFILL.**

24. Drive Unit Oil Level – Park truck on a level floor. Remove oil level/fill plug. Oil level should be at the bottom edge of the hole. If low, fill with SAE 80W-90 weight gear oil until oil runs out of the oil level/fill hole. Replace plug. **DO NOT OVERFILL.**

NOTE: The manufacturer recommends draining and refilling the drive unit oil after the first 500 hours of use on all new trucks. Park truck on a level floor. Remove drain plug. Drain gear oil into a suitable container and discard in accordance with local regulations. Replace drain plug and fill with gear oil through level/fill hole. Drive truck slowly to circulate oil. **Drive Unit Capacity** 2.6 litres (0.69 gallons) for AD/AE models.

EVERY 2000 HOURS

25. Brake Master Cylinder – Drain and flush system. Fill the system with new hydraulic brake fluid. After filling, bleed the brake system. **Brake System Capacity** 0.45 litres (0.12 gallons).

26. Hydraulic Oil Strainer – Remove dipstick and breather/filler assembly. Remove hydraulic oil strainer. Clean strainer with solvent and blow dry with compressed air. Replace strainer if dirt cannot be removed. Replace the breather/filler assembly.

27. Hydraulic Oil Filter – Lower mast. Replace hydraulic oil filter, located in drive unit compartment, at each oil change.

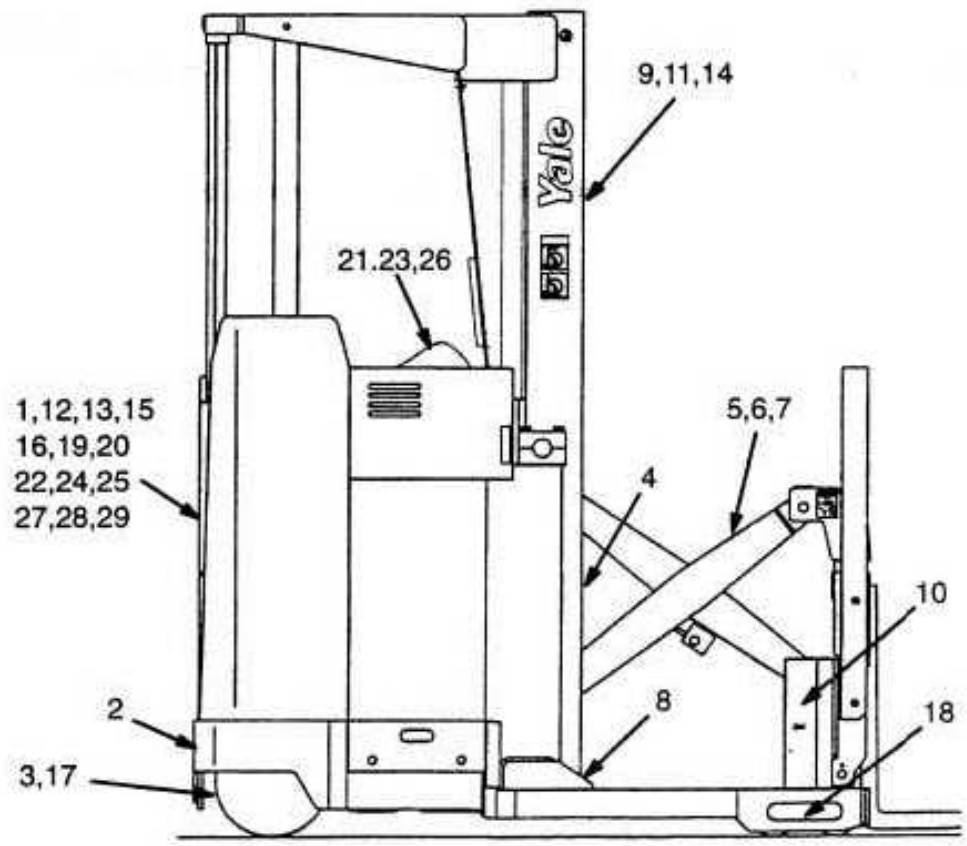


Figure 2-13 – Lubrication Points

28. Hydraulic System – Lower mast. There is no drain plug in this hydraulic tank. The hydraulic tank is drained at the supply hose. (The hose and tubing between the bottom of the hydraulic tank and the main hydraulic pump.) Put a shallow pan with a capacity equal to the hydraulic system of the truck under the end of the hose. See hydraulic tank capacities below. Disconnect the hose at the pump and drain the oil. Pour the oil into a suitable container and discard in accordance with local regulations.

BATTERY COMPARTMENT SIZE	OIL TANK CAPACITY TO FULL MARK
317.5 mm (12.5 in)	17.6 litres (4.64 gal)
370.8 mm (14.6 in)	19.5 litres (5.16 gal)
421.6 mm (16.6 in)	21.5 litres (5.67 gal)
477.5 mm (18.8 in)	25.3 litres (6.68 gal)
535.9 mm (21.1 in)	25.3 litres (6.68 gal)
Hydraulic System = Tank Capacity +4.01 litres (1.06 gallons) in lines	

Table 2-4 – Hydraulic Oil Tank Capacities

Clean hydraulic tank with solvent and dry with compressed air. Connect the hose to the tube and tighten the hose clamp. Remove the breather cap and fill the tank with hydraulic oil. Raise and lower mast, operate tilt control and reach mechanism (if equipped), to expel air from hydraulic system.

NOTE: If hydraulic system is contaminated contact your authorized Yale industrial truck dealer for assistance.

29. Drive Unit – Park truck on a level floor. Remove drain plug. Drain gear oil into a suitable container and discard in accordance with local regulations. Replace drain plug and fill with gear oil through level/fill hole. Drive truck slowly to circulate oil. **Drive Unit Capacity** 2.6 litres (0.69 gallons) for AD/AE models.

NOTE: Do not expose bearings or hydraulic system to foreign particles.

LEGEND

A – Every 8 Hours
B – Every 350 Hours
C – Every 2000 Hours

X –Visually Inspect, Test and Adjust as Required
O –Drain and Fill
R –Replacement
IR –Initial Replacement
CO–Complete Overhaul

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SAFETY AND OPERATIONAL CHECKS (Prior to each shift) Only the 8 hour checks are to be performed by the operator. Have a **qualified** mechanic correct all problems in accordance with appropriate **YALE** maintenance instructions.	A	B	C
Leaks – Hydraulic Fluid	X		
Tires – Condition	X		
Forks, Top Clip Retaining Pin and Heel – Condition	X		
Load Backrest – Attached	X		
Hydraulic Hoses, Mast Chains and Stops – Check Visually	X		
Finger Guards – Attached	X		
Overhead Guard – Attached	X		
Safety Labels – Attached (Refer to Parts/Operating Manual for Locations)	X		
Internal Checks:			
Battery – Water/Electrolyte Level and Charge	X		
Hydraulic Tank Fluid Level – Dipstick	X		O
Operator's Compartment:			
Operating Manual – In Container	X		
Nameplate Attached – Information matches model, serial number, attachments	X		
Battery Restraint – In Place	X		
Brake Fluid – Check Level	X		O
Controls: (Turn Truck On) Immediately Check Noises that are not Normal			
Accelerator Linkage – Operates Correctly	X		
Brake – Operates Correctly	X		
Steering Operation – Operates Smoothly and Correctly	X		
Drive Control, Forward/Reverse – Operates Correctly	X		
Tilt Control – Operates Smoothly and Correctly	X		
Lift and Lower Control – Operates Smoothly and Correctly	X		
Reach Control – Operates Smoothly and Correctly	X		
Attachment Control – Operates Smoothly and Correctly	X		
Horn – Operates Correctly	X		
Lights – Operate Correctly	X		
Gauges:			
Hour Meter – Operates Correctly	X		
Battery Indicator – Operates Correctly	X		
Instrument Monitors – Operates Correctly	X		

NOTE: The following inspections and necessary corrections are the responsibility of the user.

LUBRICATION CHECK: Use compressed air to clean and inspect for damage.	A	B	C
Lubricate – Chassis (All Fittings)		X	
All Linkage		X	
Friction Surfaces on Mast		X	
Friction Surfaces on Attachment		X	
Lift Chains – Clean and Lubricate		X	
Wheel Bearings – Clean and Repack with Grease			X
Brake Fluid (Master Cylinder)		X	O
Hydraulic Oil Filter Element		IR	R
Hydraulic Tank Breather		X	R
Drive Unit Oil Level (Initial drain and refill at 500 hours)		X	O

HYDRAULIC SYSTEM CHECK:	A	B	C
Lift, Tilt, Reach & Power Steer Cylinders for Leaks and Correct Operation		X	
Tilt Cylinder Rod End Adjustment		X	
Hydraulic Pump for Noise and Operation		X	
Power Steer Pump for Noise and Correct Operation		X	
Hydraulic Control Valve for Leaks and Correct Operation		X	
Relief Valve Settings		X	
All Hoses, Tubing and Fittings for Wear and Leaks		X	
Attachment – Correct Operation		X	
Attachment Cylinder for Leaks		X	
General Leaks		X	
Accumulators			X

DRIVE UNIT CHECK:	A	B	C
Brake Adjustment		X	
Brake Drums and Linings for Wear		X	
Electric Motor and Drive Train Mounting Bolts (Torque to Specifications)		X	
Wheel Bolts or Nuts (Torque to Specifications)		X	
Wheel Brake Bolts (Torque to Specifications)		X	
Mast and Trunnion Cap Bolts (Torque to Specifications)		X	

ELECTRICAL SYSTEM CHECK:	A	B	C
Clean all Controls		X	
Interlock Switches – Check Operation		X	
Accelerator Switch and Potentiometer – Check Operation		X	
Electronic Card – Check Operation		X	
Time Delay – Check Operation		X	
Direction Switch – Check Operation		X	
Drive Resistor (Magnetic Control) – Check Operation		X	
Valve Lift and Tilt Switches – Check Operation		X	
All Motors – Clean with Compressed Air		X	
All Motors – Check Brushes and Springs		X	
All Motors – Check Power Wire Terminals		X	
Battery Box and Connectors – Neutralize and Clean		X	
Battery Condition – Physical and Electrical		X	
All Wire Connections			X
Contactors – Tips and Wire Connectors			X

MAST - CARRIAGE - ATTACHMENT CHECK:	A	B	C
Mast and Carriage Safety Stops		X	
Mast Flange Wear		X	
Mast Rollers and Wear Plugs		X	
Carriage Rollers and Wear Plugs		X	
Chain Anchors		X	
Chain for Wear or Cracks (Use Wear Indicator 5180968-69)		X	
Pallet/Forks/Platform (Visual)		X	
Forks (See Note 2)			X
Attachment – Sliding Surface Wear		X	
Attachment – Rotating Parts and Torque Bolts		X	

GENERAL CHECK:	A	B	C
Steering – King Pins and Knuckles – Tightness		X	
Steering – Tie Rods and Wheel Alignment		X	
Steering – Drag Links		X	
Steering – Bellcrank		X	
All Bolts, Nuts, Cotter Pins, Etc.		X	
Overhead Guard and Load Backrest – Cracks, Mounting, Etc.			X
Articulation Adjustment		X	

ROAD AND LOAD TEST TRUCK: At initial installation and after every maintenance inspection or repair. Test the rated load in a clear area (See Notes 3 and 4). Report any questionable functions or unusual noises.
Steering
Brake System
Horn, Lights
Emergency Disconnect
Drive Power – Acceleration
Mast – Verify All Stops are Installed and Limit Switches are Functioning Properly
Lift – Full Lift and Lower (Do not tilt forward) (See Note 3)
Tilt – With Load Lowered Operate Full Forward and Backward (See Note 4)
Attachment – Operate all Functions

NOTES:

1. Tires – Condition affects Stability, Safety and Load Capacity that can be handled safely.

2. Use Magnaglo or equivalent Fatigue Crack Detector to test forks. Refer to Service News Bulletin SE-643 for Procedure on Field Testing Load Forks. The Bulletin also defines minimum acceptable fork tine thickness due to wear.

3. With the mast vertical and with a rated load at 609.6 mm (24in) load center, check lift cylinder drift. Lift drift must not exceed 25.4 mm (1.0 in) in 2 minutes, oil at 26°C (79°F). Refer to Service Bulletin SE-1077 for Procedure to Measure Hydraulic Drift.

4. With a rated load at 609.6 mm (24 in) load center, check tilt cylinder, if equipped, for drift. Tilt drift must not exceed 25.4 mm (1.0 in) in 2 minutes, oil at 26°C (79°F). Refer to Service Bulletin SE-1077 for procedure to measure hydraulic drift.

5. The presence of hydraulic fluid on cylinder rods and fittings does not necessarily indicate a lead.

6. Recycle all waste oils.

To obtain more information on the above reference Service Bulletin, contact your nearest authorized Yale industrial truck dealer.

HYDRAULIC OILS

Type	For All Hydraulically Actuated Equipment	
Ambient Air Temp.	**Normal**	**Freezer**
Anticipated Ambient Air Temp. Range	0° to +110°F (–18° to +44°C)	0° to –60°F (–18° to –52°C)
Actual Useable Operation Oil Temperature Range	+18° to +148°F (–8° to +65°C)	–55° to +65°F (–49° to +18°C)
ASTM Viscosity Grade Number/Index (Ref.)	S-215/92 Minimum	S-75/200 Minimum
Pour °F Maximum	–20°F (–29°C)	–75° F (–60°C)
MIL–Specifications		MIL - H-5606
APPROVED SOURCES		
American (Amoco)	Rykon Number 21	No Product
Atlantic Richfield/Arco	Duro AW-46	No Product
Burmah-Castrol	Hyspin AWH-46	No Product
Chevron Oil Company	Chevron AW Hyd. Oil 46	Aviation Hyd. Fluid A
Cities Service (Citco)	Pacemaker XD-20	No Product
Exxon	Nuto H 46	Univis J-43
Fiske Brothers	Lubriplate HO-1	No Product
Gulf	Harmony 48AW	No Product
Houghton & Company	Hydro Drive HP 200	No Product
Keystone (Pennwalt)	KLC Number 5	No Product
Mobil Oil Co. (Mobil)	DTE 25	AERO-HFA
Pennzoil Oil Co.	Pennzoil AW 46	No Product
Phillips Petroleum	Magnus A-215	No Product
Shell	Tellus 46	Aeroshell Fluid 4
Solene Ind. Lubricant	H-205-B	No Product
Sun Oil Co. (Sunoco)	Sunvis 821 WR	No Product
Texaco	Rando HD-46	Aircraft Hyd "BB"
Valvoline Oil Co.	Anti-Wear Number 20	No Product

Field Personnel Note: The hydraulic oils, as listed herein, are approved **YALE** Materials Handling Corporation sources that meet or exceed the specifications annotated. The use of hydraulic oils other than the suppliers and products listed is unauthorized.

GEAR OILS

YALE PART NO.	3101530-34	3101530-38
Application	**Standard Application**	**Special Application**
SAE Grade	80W–90	75W–90
Type	Multi-Purpose EP	Multi-Purpose EP
Base Oil	Conventional Petroleum	Synthetic
MIL–Spec. No.	MIL-L-2105C	MIL-L-2105C
API Service Classification	GL-5	GL-5
Anticipated Ambient Temperature	–15° to +100°F (–26° to +38°C) Most **Yale** lift truck operations will fall within this temperature range.	As low as –60°F (–51°C) Primarily intended for cold storage and/or arctic conditions; can be used as high as +90°F (+32°C). **Note:** This oil is a synthetic formulation.
APPROVED SOURCES		
Burmah-Castrol	HYPOY C80W/90	No Product
Century Hulburt Inc.	No Product	No Product
Chevron	Chevron Universal Gear Lube 80W/90	No Product
Exxon	Exxon Gear Oil GX 80W/90	No Product
Mobil	Mobilube HD 80W/90	Mobilube SHC 75W/90
Pennzoil	Pennzoil MP 4092	No Product
Phillips 66	Philube SMP Gear Oil 80W/90	No Product
Solene Lub. Inc	Solene Gear Oil #905	No Product
Sun	Sunfleet GL-5 Gear Lube 80W/90	No Product
Union 76	Unocal MP Gear Lube LS 80W/90	No Product
Field Personnel Note: The gear oils, as listed herein, are approved **YALE** Materials Handling Corporation sources that meet or exceed the specifications annotated. The use of gear oils other than the suppliers and products listed is unauthorized.		

BRAKE FLUID

YALE PART NUMBER	0227768-00
SAE Type	J1703 – FMVSS 116 (DOT 3)
Anticipated Ambient Air Temp. Range	–40°to +401°F (–40°+250°C)
Type of Fluid	Non-Petroleum
APPROVED SOURCES	
Any Supplier whose Product Meets or Exceeds the Above Specifications.	

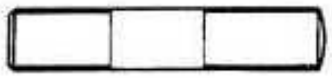
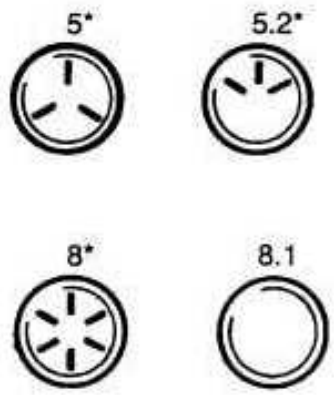
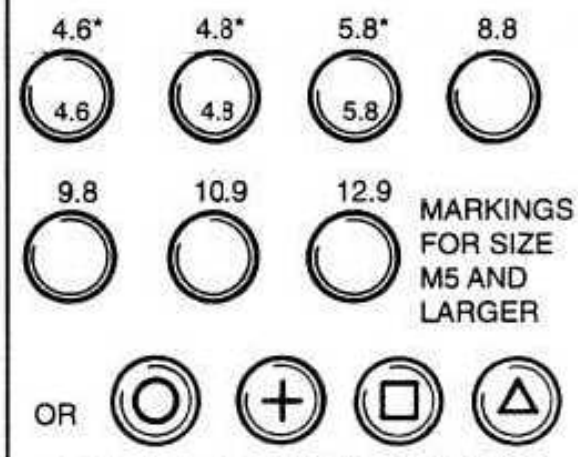
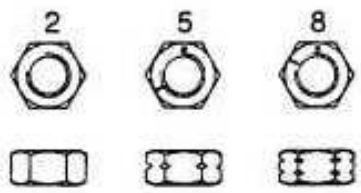
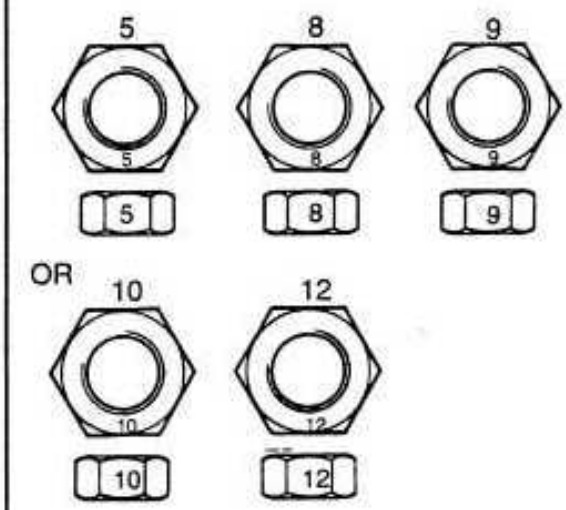
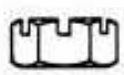
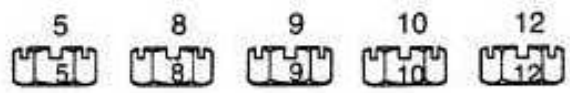
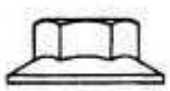
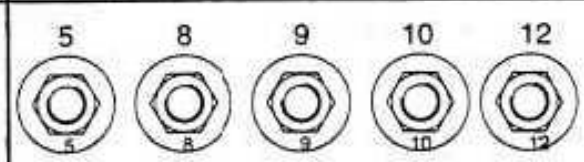
TYPE OF FASTENERS	INCH FASTENERS STRENGTH LEVELS: SAE GRADES * MARKINGS NOT REQUIRED	METRIC FASTENERS STRENGTH LEVELS: PROPERTY CLASS * MARKINGS NOT REQUIRED
 STUDS	 5* 5.2* 8* 8.1	 4.6* 4.8* 5.8* 8.8 9.8 10.9 12.9 MARKINGS FOR SIZE M5 AND LARGER OR OPTIONAL GEOMETRIC SYMBOLS FOR SIZES M5 THRU M11 ONLY.
 HEX NUTS	 OR 2 5 8	 5 8 9 OR 10 12
 HEX SLOTTED NUTS	MARKINGS NOT REQUIRED	 5 8 9 10 12
 HEX FLANGE NUTS	MARKINGS NOT REQUIRED	 5 8 9 10 12

Table 2-7 – Studs and Nuts

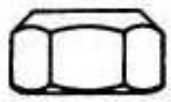
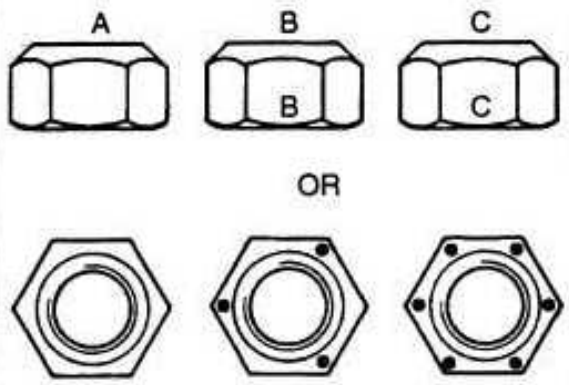
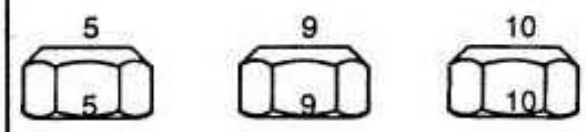
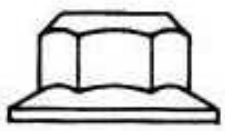
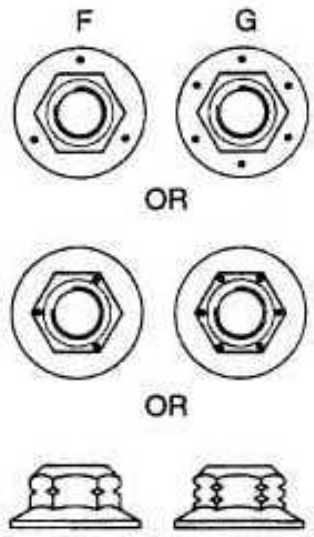
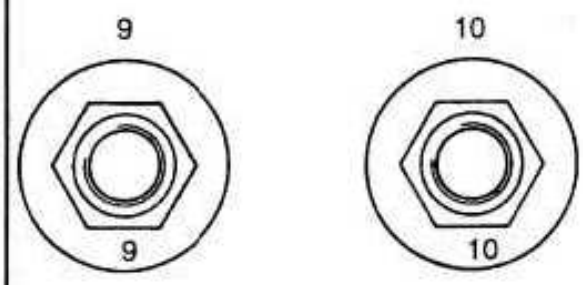
TYPE OF FASTENER	INCH FASTENERS STRENGTH LEVELS: SAE GRADES	METRIC FASTENERS STRENGTH LEVELS: PROPERTY CLASS
 ALL METAL PREVAILING TORQUE NUTS		
 ALL METAL PREVAILING TORQUE FLANGE NUTS		

Table 2-8 – Torque Nuts

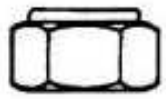
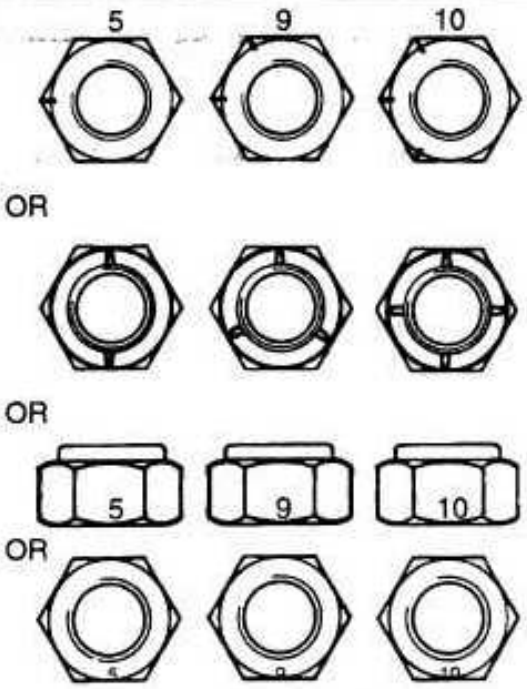
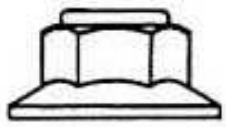
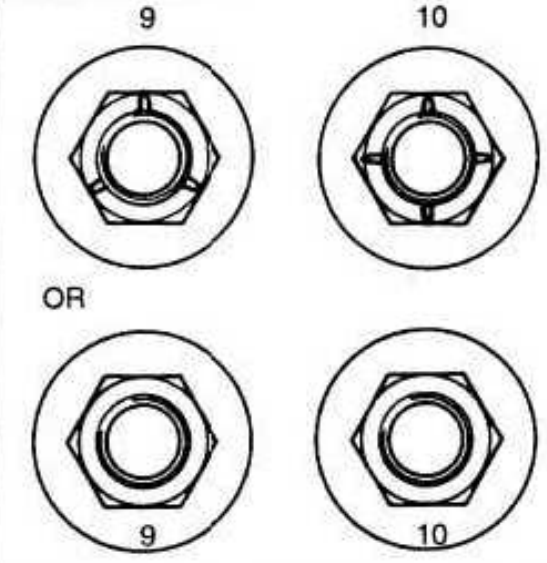
TYPE OF FASTENER	INCH FASTENERS STRENGTH LEVELS: SAE GRADES	METRIC FASTENERS STRENGTH LEVELS: PROPERTY CLASS
 NYLON INSERT PREVAILING TORQUE NUTS	MARKINGS NOT REQUIRED	
 NYLON INSERT PREVAILING TORQUE NUTS	MARKINGS NOT REQUIRED	

Table 2-9 – Torque Nuts with Nylon Inserts

Marking		No Mark		3 Marks		6 Marks		Socket Head		12 Pt. – Flanged	
SAE Grade		2		5		8		1960 Series		1936 & 60 Series	
Size (in)	Thread	Dry	Lub.	Dry	Lub.	Dry	Lub.	Dry	Lub.	Dry	Lub.
1/4	20	6	4	8	6	12	9	13	10	16	12
1/4	28	6	7	10	7	14	10	15	11	18	14
5/16	18	11	8	17	13	25	18	28	20	33	25
5/16	24	12	9	19	14	25	20	30	22	36	27
3/8	16	20	15	30	23	45	35	48	36	58	44
3/8	24	23	17	35	25	50	35	55	41	65	49
7/16	14	30	24	50	35	70	55	77	58	93	70
7/16	20	35	25	55	40	80	60	86	65	104	78
1/2	13	50	35	75	55	110	80	118	89	142	106
1/2	20	55	40	90	65	120	90	132	99	160	120
9/16	12	70	55	110	80	150	110	170	127	205	153
9/16	18	80	60	120	90	170	130	189	141	228	171
5/8	11	100	75	150	110	220	170	235	176	283	212
5/8	18	110	85	170	130	240	180	267	200	320	240
3/4	10	175	130	260	200	380	280	417	313	501	376
3/4	16	195	145	300	220	420	320	467	350	559	420
7/8	9	165	125	430	320	600	460	672	504	707	530
7/8	14	185	140	470	350	660	500	741	562	778	584
1	8	250	190	640	480	900	680	1006	756	1060	795
1	12	270	200	700	530	1000	740	1125	833	—	—
1	14	340	260	750	580	1030	785	1230	883	1190	892
1-1/8	7	350	270	800	600	1280	960	1283	966	1702	1276
1-1/8	12	400	300	880	660	1440	1080	1425	1066	1908	1431
1-1/4	7	500	380	1120	840	1820	1360	1600	1200	2162	1621
1-1/4	12	550	420	1240	920	2000	1500	1800	1350	2660	1995
1-3/8	6	660	490	1460	1100	2380	1780	2382	1782	—	—
1-3/8	12	740	560	1680	1260	2720	2040	2708	2033	—	—
1-1/2	6	870	650	1940	1460	3160	2360	2800	2100	4177	3133
1-1/2	12	980	730	2200	1640	3560	2660	3000	2260	4700	3525

NOTES:

1. The term lub. includes the application of high stress lubrication to the fastener, and fasteners that have a cadmium plating.
2. Dry values include screws that only have a thin film of oil to prevent rust.
3. The torque values are minimum. Values to 20% higher are permitted.
4. Fasteners with zinc plating must have a 10% higher torque than dry value.

Table 2-10 – General Guide to Torque Values

Grade		JIS F4T		ISO 8.8 or JIS F8T		ISO 10.9 or JIS F11T		ISO 12.9	
Marking		None		8.8 or F8T or 8T		10.9 or F11T or 11T		12.9	
Size	Pitch	N•m	lbf ft	N•m	lbf ft	N•m	lbf ft	N•m	lbf ft
M4	0.7	—	—	2.9	2	4.1	3	4.9	3.5
M5	0.8	—	—	6	4	8.5	6	10	7
M6	1.0	4.3	3	10	7	14	10	17	12
M8	1.25	10	7	25	18	35	25	41	30
M8	1.0	10	7	27	20	38	28	45	33
M10	1.5	20	15	49	35	69	50	83	60
M10	1.25	20	15	52	38	73	53	88	64
M12	1.75	35	25	86	62	120	87	145	105
M12	1.25	35	25	95	69	135	98	160	116
M14	2.0	57	41	135	98	190	137	230	166
M14	1.5	57	41	150	108	210	152	250	181
M16	2.0	88	64	210	152	295	213	355	257
M16	1.5	88	64	225	163	315	228	380	275
M18	2.5	—	—	—	—	405	300	—	—
M20	2.5	172	124	410	297	580	420	690	499
M20	1.5	172	124	460	333	640	463	770	557
M24	3.0	297	215	710	514	1000	723	1200	868
M24	2.0	297	215	780	564	1100	796	1300	940
M30	3.5	591	427	1450	1049	2000	1447	2400	1736
M30	2.0	591	427	1600	1157	2250	1627	2700	1953

NOTES:

1. Reduce the torque values approximately 20% when high stress lubrication is applied to the fastener, or fasteners that have a cadmium plating.
2. Dry values include screws that only have a thin film of oil to prevent rust.
3. The torque values are minimum. Values to 20% higher are permitted.
4. Fasteners with zinc plating must have a 10% higher torque than dry value.
5. Marking not required on M5 and smaller fasteners.

Table 2-11 – General Guide to Torque Values

JIC FLARED TYPE AND SAE STRAIGHT THREAD O-RING FITTINGS				SWIVEL ADAPTER UNIONS			
DASH SIZE	THREAD SIZE	MAXIMUM TORQUE N•m (lbf ft)		DASH SIZE	PIPE SIZE	MAXIMUM TORQUE N•m (lbf ft)	
		SWIVEL NUT	LOCKNUT			FEMALE PIPE	MALE PIPE
-2	5/16"-24	8 (6)	8 (6)	-2	1/8"-27	18 (13)	16 (12)
-3	3/8"-24	8 (6)	8 (6)	–	–	–	–
-4	7/16"-20	14 (10)	11 (8)	-4	1/4"-18	27 (20)	34 (25)
-5	1/2"-20	20 (15)	14 (10)	–	–	–	–
-6	9/16"-18	27 (20)	18 (13)	-6	3/8"-18	34 (25)	54 (40)
-8	3/4"-16	41 (30)	28 (21)	-8	1/2"-14	64 (47)	73 (54)
-10	7/8"-14	54 (40)	456 (33)	–	–	–	–
-12	1-1/16"-12	95 (70)	65 (48)	-12	3/4"-14	114 (84)	106 (78)
-14	1-3/16"-12	108 (80)	76 (56)	–	–	–	–
-16	1-5/16"-12	122 (90)	85 (63)	-16	1"–11-1/2	175 (129)	152 (112)
-20	1-5/8"-12	163 (120)	–	-20	1-1/4"-11-1/2	206 (152)	209 (154)
-24	1-7/8"-12	178 (131)	–	-24	1-1/2"-11-1/2	206 (152)	286 (211)
-32	2-1/2"-12	407 (300)	–	-32	2"-11-1/2	407 (300)	407 (300)

NOTE: Values shown are for zinc plated fittings. Values for cadmium plated fittings may vary slightly, but not enough to be of any appreciable difference.

*Torque Values furnished by Air-Way Manufacturing Co., Olivet, Michigan

Table 2-12 – Recommended Maximum Torque Values for Hydraulic Fittings*

MULTIPLY	BY	TO GET	MULTIPLY	BY	TO GET
AREA					
inches^2 (in^2)	× 6.452	= centimeters^2 (cm^2)	centimetres^2 (cm^2)	× 0.155	= inches^2 (in^2)
feet^2 (ft^2)	× 0.093	= meters^2 (m^2)	metres^2 (m^2)	× 10.764	= feet^2 (ft^2)
LINEAR					
inches (in)	× 25.4	= millimeters (mm)	millimetre (mm)	× 0.039	= inches (in)
feet (ft)	× 0.305	= meters (m)	metre (m)	× 3.281	= feet (ft)
yards (yd)	× 0.914	= meters (m)	metre (m)	× 1.094	= yards (yd)
miles (mi)	× 1.609	= kilometers (km)	kilometre (km)	× 0.621	= miles (mi)
MASS					
ounces (oz)	× 28.35	= grams (g)	grams (g)	× 0.035	= ounces (oz)
pounds (lb)	× 0.454	= kilograms (kg)	kilograms (kg)	× 2.205	= pounds (lb)
tons (2,000 lb)	× 907.18	= kilograms (kg)	kilograms (kg)	× 0.001	= tons (2,000 lb)
tons (2,000 lb)	× 0.907	= metric ton (t)	metric tonne (t)	× 1.102	= tons (2,000 lb)
POWER					
horsepower (hp)	× 0.746	= kilowatts (kW)	kilowatts (kW)	× 1.34	= horsepower (hp)
PRESSURE					
pounds/in^2 (psi)	× 6.895	= kilopascal (kPa)	kilopascal (kPa)	× 0.145	= pounds/in^2 (psi)
pounds/in^2 (psi)	× 0.007	= megapascal (MPa)	megapascal (MPa)	× 145.04	= pounds/in^2 (psi)
TEMPERATURE					
(°Fahrenheit–32)	× 0.56	= °Celsius (C)	(°Celsius x 1.8) + 32		= °Fahrenheit
TORQUE					
pound inches (lbf in)	× 0.113	= Newton meter (N•m)	Newton metre (N•m)	× 8.851	= pound inches (lbf in)
pound feet (lbf ft)	× 1.356	= Newton meter (N•m)	Newton metre (N•m)	× 0.738	= pound feet (lbf ft)
VELOCITY					
miles/hour (mph)	× 1.609	= kilometer/hour (km/h)	kilometre/hr (km/h)	× 0.621	= miles/hour (mph)
VOLUME					
inches^3 (in^3)	× 16.387	= centimeters^3 (cm^3)	centimetres^3 (cm^3)	× 0.061	= inches^3 (in^3)
inches^3 (in^3)	× 0.016	= litres (l)	litres (l)	× 61.024	= inches^3 (in^3)
quarts, U.S. (qt)	× 0.946	= litres (l)	litres (l)	× 1.057	= quarts, U.S. (qt)
quarts, U.S. (qt)	× 0.83	= quarts, Imp. (qt)	quarts, Imp. (qt)	× 1.205	= quarts, U.S. (qt)
gallons, U.S. (gal)	× 3.785	= litres (l)	litres (l)	× 0.264	= gallons, U.S. (gal)
gallons, U.S. (gal)	× 0.83	= gallons, Imp. (gal)	gallons, Imp. (gal)	× 1.205	= gallons, U.S. (gal)
ounces (oz)	× 29.57	= milliliter (ml)	milliliter (ml)	× 0.034	= ounces (oz)

Table 2-13 – Conversion Table for Metric and English Units

Yale
Industrial Trucks

SECTION 3

3	ELECTRICAL SYSTEM

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
35	RESET TO NEUTRAL BEFORE OPERATING	25	WARNING	MIB

CONDITION

Traction or hydraulic control (multi-function control handle) is not in "NEUTRAL" position when the operator steps into the truck and presses the brake pedal and the operator sensing switch.

TRUCK RESPONSE

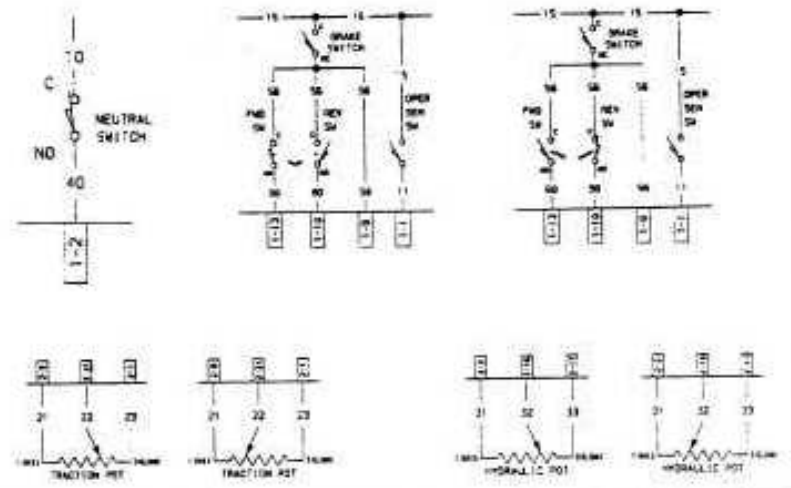
Yellow "WARNING" indicator illuminates.
Travel and hydraulic functions are disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Multi-function control handle not in "NEUTRAL".
  Reset multi-function control handle to "NEUTRAL".

IF MULTI-FUNCTION CONTROL HANDLE IS IN "NEUTRAL":

- FORWARD, REVERSE or NEUTRAL (hydraulic) switch signal to MIB is inappropriate in relation to multi-function control handle position.
  Check forward, reverse and neutral switch adjustment.
  Check forward, reverse and neutral switches for shorted condition.
  Check for short circuit in forward. reverse or neutral switch circuit.
- Traction, or hydraulic potentiometer defective or out of adjustment.
  Check, replace and/or adjust potentiometers.



LOGIC

Displayed when greater than 14 volts is present at J1-2 before battery voltage is present at J1-1 and J1-9.
Displayed when battery voltage is simultaneously supplied to J1-9 and J1-10 or J1-9 and J1-13 with battery voltage present at J1-1. (Forward or reverse switch closed before brake switch.)
Displayed when the voltage at J2-16 or J2-21 is above or below approximately 2.5 volts (neutral voltage) before battery voltage is present at J1-1 and J1-9.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
36	STEP ON PLATFORM BEFORE OPERATING	24	WARNING	MIB

CONDITION

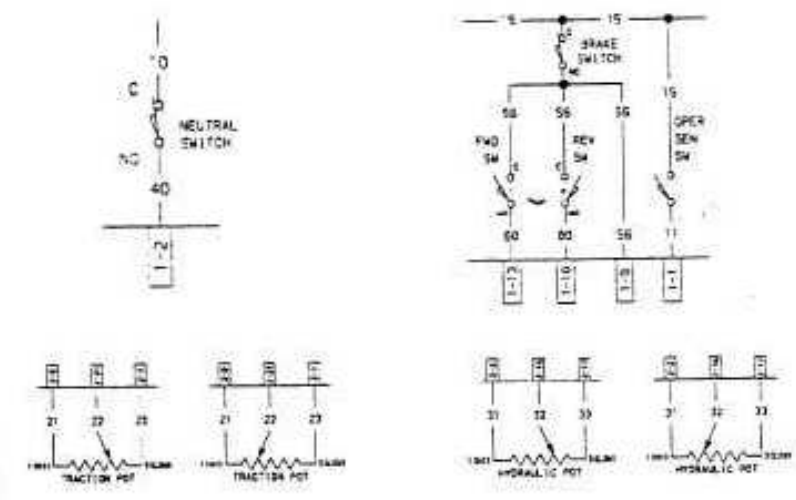
Operator sensing switch not closed and operator tries to travel or perform hydraulic function. (This only applies when the operator initially steps onto the lift truck. After the operator sensing pedal and the brake pedal have both been actuated, the operator sensing pedal can be released, as long as the brake pedal is not released.)

TRUCK RESPONSE

Yellow "WARNING" indicator illuminates.
Travel and hydraulic functions are disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Operator sensing switch is not closed.
  Stand in the operator compartment to close operator sensing switch. Reset multi-function control handle to neutral position.
- Operator sensing switch defective.
  Replace operator sensing switch.
- Open in operator sensing switch circuit.
  Disconnect the battery and MIB J plugs. Check continuity between MIB plug terminal J1-1 and wire #11 at switch connector X-13. Check continuity between wire #15 at X-13 and wire 15 at fuse 6. Repair any open circuits in the operator sensing switch circuit.



LOGIC

Displayed when greater than 14 volts is present at J1-2, J1-10 or J1-13 with battery voltage present at J1-9 and near 0 volts present at J1-1.
Displayed when the voltage at J2-16 or J2-21 is above or below approximately 2.5 volts (neutral voltage) with battery voltage present at J1-9 and near 0 volts present at J1-1.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
37	BRAKE PEDAL UP	23	WARNING	MIB

CONDITION

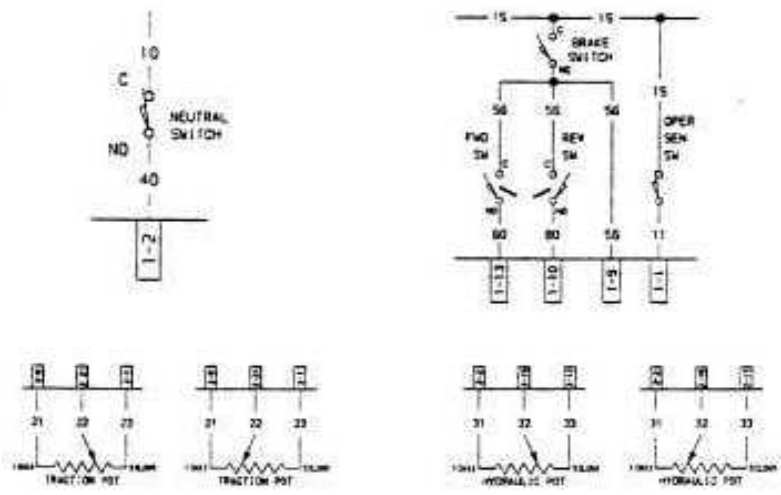
Brake switch not closed and operator moves the multi-function control handle to travel or perform a hydraulic function.

TRUCK RESPONSE

Yellow "WARNING" indicator illuminates.
Travel and hydraulic functions are disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Brake switch not closed.
  Stand on the platform and press the brake pedal to close the brake switch. Reset the multi-function control handle to neutral.
- Brake switch out of adjustment or defective.
  Adjust or replace the brake switch.
- Open in the brake switch circuit.
  Disconnect the battery and MIB J plugs. Check continuity between MIB plug terminal J1-9 and wire #56 at the brake switch. Check continuity between wire #15 at fuse FU6 and the brake switch. Repair any open circuits in the brake switch circuit.



LOGIC

Displayed when greater than 14 volts is present at J1-2 with battery voltage present at J1-1 and near 0 volts present at J1-9. Displayed when the voltage at J2-16 or J2-21 is above or below approximately 2.5 volts (neutral voltage) with battery voltage present at J1-1 and near 0 volts present at J1-9.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
38	MUST BE ON TRUCK BEFORE OPERATING	22	WARNING	MIB

CONDITION

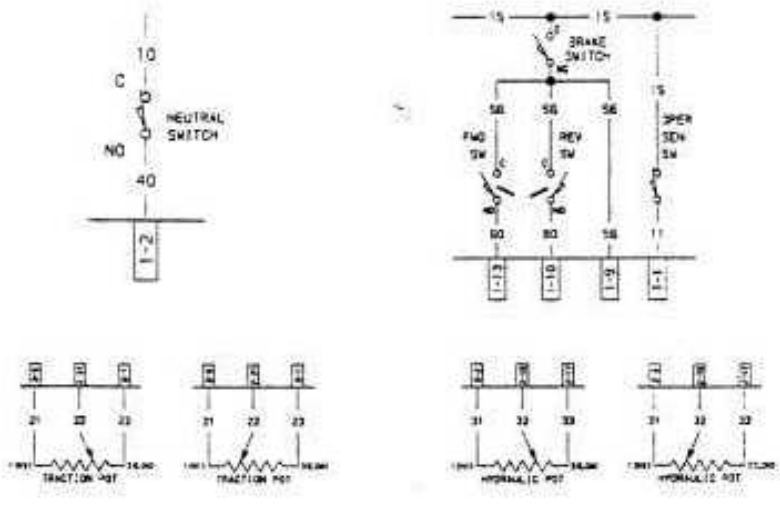
Brake switch and operator sensing switch are not closed and operator tries to travel or perform hydraulic function.

TRUCK RESPONSE

Yellow "WARNING" indicator illuminates.
Travel and hydraulic functions are disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Operator sensing switch and brake switch are not closed.
  Stand in the operator compartment to close operator sensing switch and brake switch. Reset traction and/or hydraulic controls to neutral position.
- Operator sensing switch and brake switch out of adjustment or defective.
  Adjust or replace operator sensing switch and brake switch.
- Open in operator sensing switch and brake switch circuit.
  Disconnect the battery and MIB J plugs.
  Check continuity between MIB plug terminal J1-1 and wire #11 at switch connector X-13. Check continuity between wire #15 at switch connector X-13 and wire 15 at fuse FU6. Repair any opens in the operator sensing switch circuit.
  Check continuity between MIB plug terminal J1-9 and wire #56 at the brake switch. Check continuity between wire #15 at fuse FU6 and the brake switch. Repair any open circuits in the brake switch circuit.



LOGIC

Displayed when greater than 14 volts is present at J1-2 with near 0 volts present at J1-1 and J1-9.
Displayed when the voltage at J2-16 or J2-21 is above or below approximately 2.5 volts (neutral voltage) with near 0 volts present at J1-1 and J1-9.

FAULT CODES

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
XX40	CHECK FAULT CODE NO REACH	18	FAULT	MIB

CONDITION

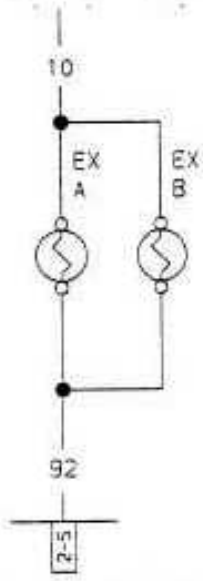
"REACH" button is pressed and the multi-function control handle is moved to the "EXTEND" or "RETRACT" position.

TRUCK RESPONSE

Red "FAULT" indicator illuminates. "REACH" is disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Shorted "EX" (reach) solenoid coil.
  Disconnect the battery. Remove wires #10 and #92 from the "EX" (reach) solenoids located on the mast. Measure the resistance of each "EX" (reach) solenoid coil. If the coil resistance measures outside of specifications, replace the coil. Coil resistance @ 21°C (70°F) = 39 ± 4 ohms.
- Shorted "EX" (reach) solenoid coil circuit.
  Disconnect the battery. Disconnect the J2 plug from the MIB. Disconnect wires #10 and #92 from the "EX" (reach) solenoids. Check resistance between wires #10 and #92. There should not be continuity. If continuity (low ohms) is measured, wires #10 and #92 are shorted together somewhere in the harness. Locate and repair the short.



LOGIC

Displayed when higher than normal current is sensed in the "EX" (reach) solenoid circuit.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
XX41	CHECK FAULT CODE NO REACH	18	FAULT	MIB

CONDITION

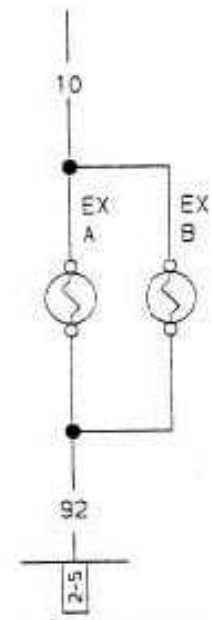
"REACH" button is pressed and the multi-function control handle is moved to the "EXTEND" or "RETRACT" position.

TRUCK RESPONSE

Red "FAULT" indicator illuminates. "REACH" is disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Open "EX" (reach) solenoid coil.
  Disconnect the battery. Remove wires #10 and #92 from the "EX" (reach) solenoids located on the mast. Measure the resistance of each "EX" (reach) solenoid coil. If the coil resistance measures outside of specifications, replace the coil. Coil resistance @ 21°C (70°F) = 39 ± 4 ohms.
- Open "EX" (reach) solenoid coil circuit.
  Disconnect the battery. Disconnect the J2 plug from the MIB. Check the continuity from pin J2-5 to wire #92 at the "EX" (reach) solenoid and from wire #10 at the solenoid to wire #10 at the "ER" (enable relay) on the contactor panel. Both circuits should test near 0 ohms. Greater than 0 ohms indicates an open. Locate and repair any open circuits.
- Failed MIB (open power FET in "EX" (reach) circuit).
  A short in the "EX" (reach) solenoid coil circuit can cause a power FET to fail open. If the FET fails open the condition will be reported as a code XX41. Troubleshoot as in MIB CODE XX40. If the XX41 fault does not clear replace the MIB.



LOGIC

Displayed when lower than normal current is sensed in the "EX" (reach) solenoid circuit.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
XX42	CHECK FAULT CODE NO SIDESHIFT	17	FAULT	MIB

CONDITION

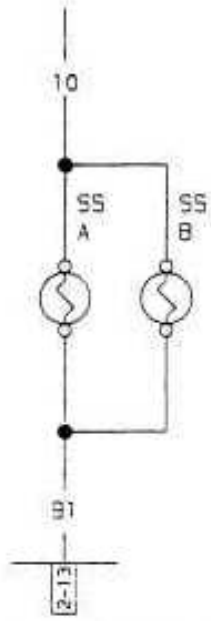
"SIDESHIFT" button is pressed and the multi-function control handle is moved to the "SIDESHIFT RIGHT" or "SIDESHIFT LEFT" position.

TRUCK RESPONSE

Red "FAULT" indicator illuminates. Sideshift is disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Shorted "SIDESHIFT" solenoid coil.
  Disconnect the battery. Remove wires #10 and #91 from the sideshift solenoids located on the mast. Measure the resistance of each solenoid coil. If the coil resistance measures outside of specifications, replace the coil. Coil resistance @ 21°C (70°F) = 39 ± 4 ohms.
- Shorted "SIDESHIFT" solenoid coil circuit.
  Disconnect the battery. Disconnect the J2 plug from MIB. Disconnect wires #10 and #91 from the sideshift solenoids. Check resistance between wires #10 and #91. There should not be continuity. If continuity (low ohms) is measured, wires #10 and #91 are shorted together somewhere in the harness. Locate and repair the short.



LOGIC

Displayed when higher than normal current is sensed in the "SIDESHIFT" solenoid circuit.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
XX43	CHECK FAULT CODE NO SIDESHIFT	17	FAULT	MIB

CONDITION

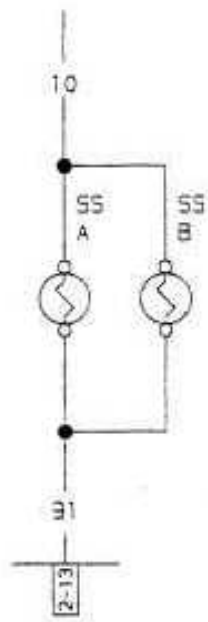
"SIDESHIFT" button is pressed and the multi-function control handle is moved to the "SIDESHIFT RIGHT" or "SIDESHIFT LEFT" position.

TRUCK RESPONSE

Red "FAULT" indicator illuminates. Sideshift is disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Open "SIDESHIFT" solenoid coil.
  Disconnect the battery. Remove wires #10 and #91 from the sideshift solenoids located on the mast. Measure the resistance of each sideshift solenoid coil. If the coil resistance measures outside of specifications, replace the coil. Coil resistance @ 21°C (70°F) = 39 ± 4 ohms.
- Open "SIDESHIFT" solenoid coil circuit.
  Disconnect the battery. Disconnect the J2 plug from the MIB. Check the continuity from pin J2-13 to wire #91 at the sideshift solenoid and from wire #10 at the solenoid to wire #10 at the "ER" (enable relay) on the contactor panel. Both circuits should test near 0 ohms. Greater than 0 ohms indicates an open. Locate and repair any open circuits.
- Failed MIB (open power FET in "SIDESHIFT" circuit).
  A short in the sideshift solenoid coil circuit can cause a power FET to fail open. If the FET fails open the condition will be reported as a code XX43. Troubleshoot as in MIB CODE XX42. If the XX43 fault does not clear replace the MIB.



LOGIC

Displayed when lower than normal current is sensed in the "SIDESHIFT" solenoid circuit.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
XX44	CHECK FAULT CODE NO AUX FUNCTIONS	16	FAULT	MIB

CONDITION

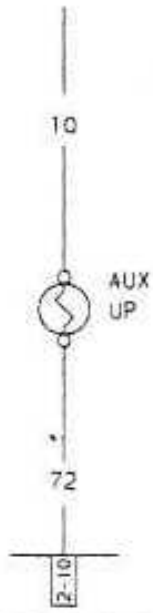
Any "AUXILIARY" function button is pressed and the multi-function control handle is moved up.

TRUCK RESPONSE

Red "FAULT" indicator illuminates. "EXTEND", "TILT UP" and "SIDESHIFT RIGHT" functions are disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Shorted "AUX UP" (auxiliary up) solenoid coil.
  Disconnect the battery. Remove wires #10 and #72 from the "AUX UP" solenoid. Measure the resistance of the "AUX UP" solenoid coil. If the coil resistance measures outside of specifications, replace the coil. Coil resistance @ 21°C (70°F) = 1.8 ± 0.2 ohms.
- Shorted "AUX UP" solenoid coil circuit.
  Disconnect the battery. Disconnect the J2 plug from MIB. Disconnect wires #10 and #72 from the "AUX UP" solenoid. Check the resistance between wires #10 and #72. There should not be continuity. If continuity (low ohms) is measured, wires #10 and #72 are shorted together somewhere in the harness. Locate and repair the short.



LOGIC

Displayed when higher than normal current is sensed in the "AUX UP" (auxiliary up) solenoid circuit.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
XX45	CHECK FAULT CODE NO AUX FUNCTIONS	16	FAULT	MIB

CONDITION

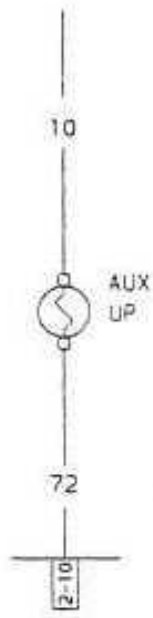
Any "AUXILIARY" function button is pressed and the multi-function control handle is moved up.

TRUCK RESPONSE

Red "FAULT" indicator illuminates. "EXTEND", "TILT UP" and "SIDESHIFT RIGHT" functions are disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Open "AUX UP" (auxiliary up) solenoid coil.
  Disconnect the battery. Remove wires #10 and #72 from the "AUX UP" solenoid. Measure the resistance of the solenoid coil. If the coil resistance measures outside of specifications, replace the coil. Coil resistance @ 21°C (70°F) = 1.8 ± 0.2 ohms.
- Open "AUX UP" solenoid coil circuit.
  Disconnect the battery. Disconnect the J2 plug from the MIB. Check continuity from pin J2-10 to wire #72 at the "AUX UP" solenoid and from wire #10 at the solenoid to wire #10 at the "ER" (enable relay) on the contactor panel. Both circuits should test near 0 ohms. Greater than 0 ohms indicates an open. Locate and repair any open circuits.
- Failed MIB (open power FET in "AUX UP" circuit).
  A short in the "AUX UP" solenoid coil circuit can cause a power FET to fail open. If the FET fails open the condition will be reported as a code XX45. Troubleshoot as in MIB CODE XX44. If the XX45 fault does not clear replace the MIB.



LOGIC

Displayed when lower than normal current is sensed in the "AUX UP" (auxiliary up) solenoid circuit.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
XX46	CHECK FAULT CODE NO AUX FUNCTIONS	15	FAULT	MIB

CONDITION

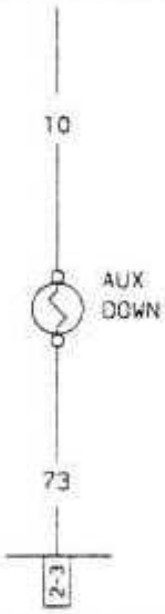
Any "AUXILIARY" function button is pressed and the multi-function control handle is moved down.

TRUCK RESPONSE

Red "FAULT" indicator illuminates. "RETRACT", "TILT DOWN", and "SIDESHIFT LEFT" functions are disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Shorted "AUX DOWN" (auxiliary down) solenoid coil.
  Disconnect the battery. Remove wires #10 and #73 from the "AUX DOWN" solenoid. Measure the resistance of the "AUX DOWN" solenoid coil. If the coil resistance measures outside of specifications, replace the coil. Coil resistance @ 21°C (70°F) = 1.8 ± 0.2 ohms.
- Shorted "AUX DOWN" solenoid coil circuit.
  Disconnect the battery. Disconnect the J2 plug from MIB. Disconnect wires #10 and #73 from the solenoid. Check resistance between wires #10 and #73. There should not be continuity. If continuity (low ohms) is measured, wires #10 and #73 are shorted together somewhere in the harness. Locate and repair the short.



LOGIC

Displayed when higher than normal current is sensed in the "AUX DOWN" (auxiliary down) solenoid circuit.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
XX47	CHECK FAULT CODE NO AUX FUNCTIONS	15	FAULT	MIB

CONDITION

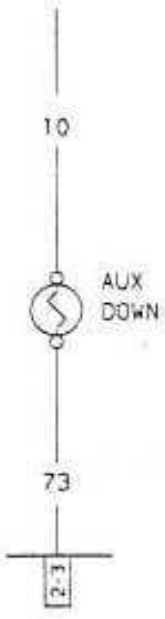
Any "AUXILIARY" function button is pressed and the multi-function control handle is moved down.

TRUCK RESPONSE

Red "FAULT" indicator illuminates. "RETRACT", "TILT DOWN", and "SIDESHIFT LEFT" functions are disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Open "AUX DOWN" (auxiliary down) solenoid coil.
  Disconnect the battery. Remove wires #10 and #73 from the "AUX DOWN" solenoid. Measure the resistance of the solenoid coil. If the coil resistance measures outside of specifications, replace the coil. Coil resistance @ 21°C (70°F) = 1.8 ± 0.2 ohms.
- Open "AUX DOWN" solenoid coil circuit.
  Disconnect the battery. Disconnect the J2 plug from the MIB. Check continuity from pin J2-3 to wire #73 at the "AUX DOWN" solenoid and from wire #10 at the solenoid to wire #10 at the "ER" (enable relay) on the contactor panel. Both circuits should test near 0 ohms. Greater than 0 ohms indicates an open. Locate and repair any open circuits.
- Failed MIB (open power FET in "AUX DOWN" circuit).
  A short in the "AUX DOWN" solenoid coil circuit can cause a power FET to fail open. If the FET fails open the condition will be reported as a code XX47. Troubleshoot as in MIB CODE XX46. If the XX47 fault does not clear replace the MIB.



LOGIC

Displayed when lower than normal current is sensed in the "AUX DOWN" (auxiliary down) solenoid circuit.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
0648	**CHECK FAULT CODE NO LIFT**	14	FAULT	MIB

CONDITION

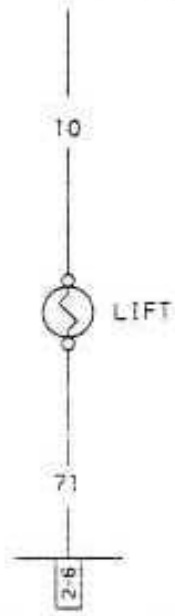
Multi-function control handle positioned for "LIFTING".

TRUCK RESPONSE

Red "FAULT" indicator illuminates. "LIFT" function is disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Shorted "LIFT" solenoid coil.
  Disconnect the battery. Remove wires #10 and #71 from the "LIFT" solenoid. Measure the resistance of the "LIFT" solenoid coil. If the coil resistance measures outside of specifications, replace the coil. Coil resistance @ 21°C (70°F) = 6.5 ± 0.5 ohms.
- Shorted "LIFT" solenoid coil circuit.
  Disconnect the battery. Disconnect the J2 plug from MIB. Disconnect wires #10 and #71 from the solenoid. Check resistance between wires #10 and #71. There should not be continuity. If continuity (low ohms) is measured, wires #10 and #71 are shorted together somewhere in the harness. Locate and repair the short.



LOGIC

Displayed when higher than normal current is sensed in the "LIFT" solenoid circuit.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
0649	**CHECK FAULT CODE NO LIFT**	14	FAULT	MIB

CONDITION

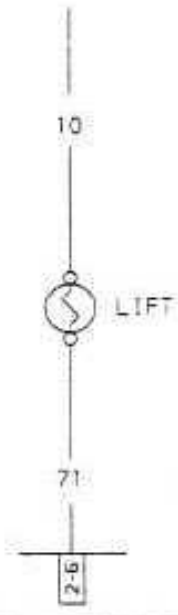
Multi-function control handle positioned for "LIFTING".

TRUCK RESPONSE

Red "FAULT" indicator illuminates. "LIFT" function is disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Open "LIFT" solenoid coil.
  Disconnect the battery. Remove wires #10 and #71 from the "LIFT" solenoid. Measure the resistance of the solenoid coil. If the coil resistance measures outside of specifications, replace the coil. Coil resistance @ 21°C (70°F) = 6.5 ± 0.5 ohms.
- Open "LIFT" solenoid coil circuit.
  Disconnect the battery. Disconnect the J2 plug from the MIB. Check continuity from pin J2-6 to wire #71 at the "LIFT" solenoid and from wire #10 at the solenoid to wire #10 at the "ER" (enable relay) on the contactor panel. Both circuits should test near 0 ohms. Greater than 0 ohms indicates an open. Locate and repair any open circuits.
- Failed MIB (open power FET in "LIFT" circuit).
  A short in the "LIFT" solenoid coil circuit can cause a power FET to fail open. If the FET fails open the condition will be reported as a code XX49. Troubleshoot as in MIB CODE XX48. If the XX49 fault does not clear replace the MIB.



LOGIC

Displayed when lower than normal current is sensed in the "LIFT" solenoid circuit.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
0750	CHECK FAULT CODE NO LIFT/LOWER	13	FAULT	MIB

CONDITION

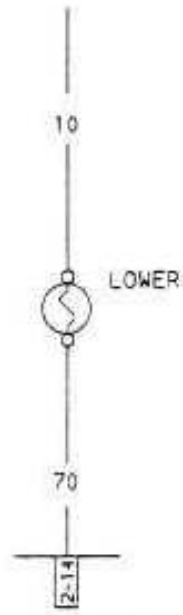
Multi-function control handle positioned for "LOWERING".

TRUCK RESPONSE

Red "FAULT" indicator illuminates. "LIFT" and "LOWER" functions are disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Shorted "LOWER" solenoid coil.
  Disconnect the battery. Remove wires #10 and #70 from the "LOWER" solenoid. Measure the resistance of the "LOWER" solenoid coil. If the coil resistance measures outside of specifications, replace the coil. Coil resistance @ 21°C (70°F) = 6.5 ± 0.5 ohms.
- Shorted "LOWER" solenoid coil circuit.
  Disconnect the battery. Disconnect the J2 plug from MIB. Disconnect wires #10 and #70 from the solenoid. Check resistance between wires #10 and #70. There should not be continuity. If continuity (low ohms) is measured, wires #10 and #70 are shorted together somewhere in the harness. Locate and repair the short.



LOGIC

Displayed when higher than normal current is sensed in the "LOWER" solenoid circuit.

MIB CODE	DASH DISPLAY MESSAGE	PRIORITY LEVEL	CODE TYPE	SIGNAL SOURCE
0751	CHECK FAULT CODE NO LIFT/LOWER	13	FAULT	MIB

CONDITION

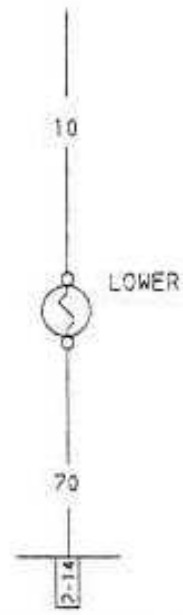
Multi-function control handle positioned for "LOWERING".

TRUCK RESPONSE

Red "FAULT" indicator illuminates. "LIFT" and "LOWER" functions are disabled.

POSSIBLE CAUSES AND TEST PROCEDURES

- Open "LOWER" solenoid coil.
  Disconnect the battery. Remove wires #10 and #70 from the "LOWER" solenoid. Measure solenoid coil resistance. If the coil resistance measures outside of specifications, replace the coil. Coil resistance @ 21°C (70°F) = 6.5 ± 0.5 ohms.
- Open "LOWER" solenoid coil circuit.
  Disconnect the battery. Disconnect the J2 plug from the MIB. Check continuity from pin J2-14 to wire #70 at the "LOWER" solenoid and from wire #10 at the solenoid to wire #10 at the "ER" (enable relay) on the contactor panel. Both circuits should test near 0 ohms. Greater than 0 ohms indicates an open. Locate and repair any open circuits.
- Failed MIB (open power FET in "LOWER" circuit).
  A short in the "LOWER" solenoid coil circuit can cause a power FET to fail open. If the FET fails open the condition will be reported as a code XX51. Troubleshoot as in MIB CODE XX50. If the XX51 fault does not clear replace the MIB.



LOGIC

Displayed when lower than normal current is sensed in the "LOWER" solenoid circuit.

Diagnostics Menu

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
0, 1	"Any Message"	COMMUNICATION ERROR WITH CONTROLLER PRESS SCROLL DOWN TO ATTEMPT TO RESTART PROGRAMMER FAULT

CONDITION

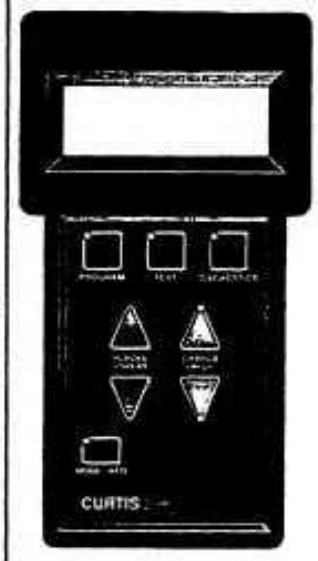
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position.

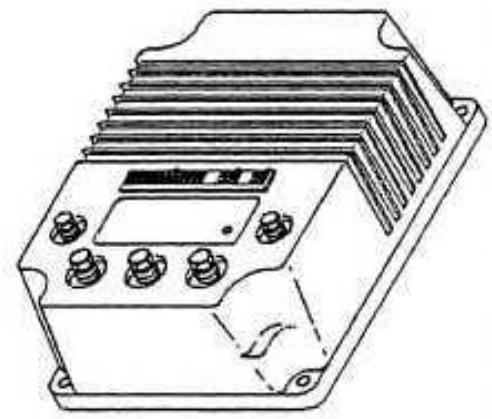
TRUCK RESPONSE

Traction may or may not function normally.

POSSIBLE CAUSES AND TEST PROCEDURES

- Brake pedal is pressed when programmer handset is connected.
  Turn key switch to the "OFF" position. Release the brake pedal. Turn the key switch to the "ON" position.
- Interface cable between traction motor controller and programmer hand set is defective.
  Replace the interface cable.





LOGIC

Initial communication between the traction motor controller and the programmer hand set is not valid.

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
0, 1	"Any Message"	NO KNOWN FAULTS NO KNOWN FAULTS HAVE OCCURRED

CONDITION

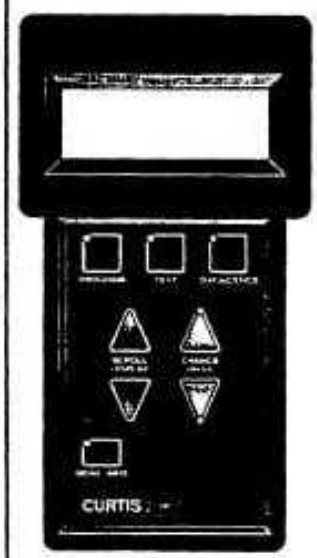
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

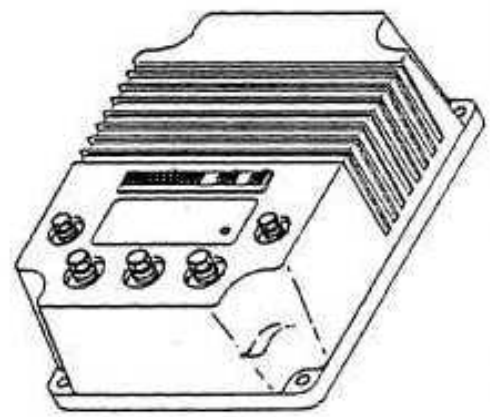
TRUCK RESPONSE

Traction functions normally.

POSSIBLE CAUSES AND TEST PROCEDURES

- No faults that are diagnosable by the traction motor controller exist.





LOGIC

Displayed when no known faults are present.

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
"Any LED Code"	"Any Message"	PROGRAMMER FAULT

CONDITION

Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

TRUCK RESPONSE

Traction may or may not function normally.

POSSIBLE CAUSES AND TEST PROCEDURES

- Caused by a defective hand set.
  Replace the hand set.

LOGIC

Displayed when the internal check logic of the traction motor controller does not get the correct communication from the programmer hand set.

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
4, 3	DRIVE CTRL LIMIT SPEED REDUCED	THERMAL CUTBACK THERMAL CUTBACK DUE TO OVER/UNDER TEMP

CONDITION

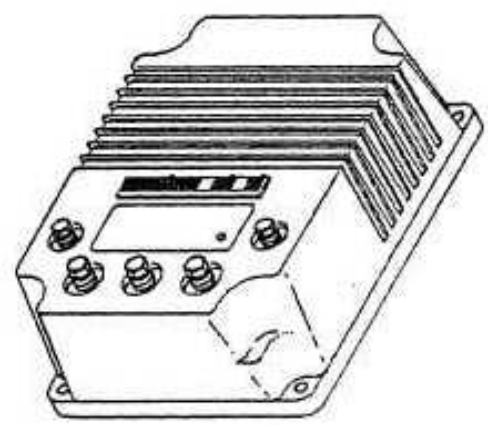
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

TRUCK RESPONSE

Traction speed is reduced.

POSSIBLE CAUSES AND TEST PROCEDURES

- Temperature of the traction motor controller is greater than 85° C (185 °F) or less than −25° C (−13°F).
  Determine the cause of the out of range temperature and correct (low battery, overloading etc.).
  Can be caused by excessive load on vehicle, operation in extreme environments, or improper mounting of controller. When controller cools off or warms up normal operation will resume.
  If controller is improperly mounted, remount according to specifications. See TRACTION MOTOR CONTROLLER INSTALLATION.



LOGIC

Displayed when the internal temperature of the traction motor controller is beyond the operating range of −25° to +85° C. The internal temperature can be read by accessing the test menu on the hand set.

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
2, 2	"Any Message"	SRO STATIC RETURN TO OFF ACTIVATED

CONDITION

Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

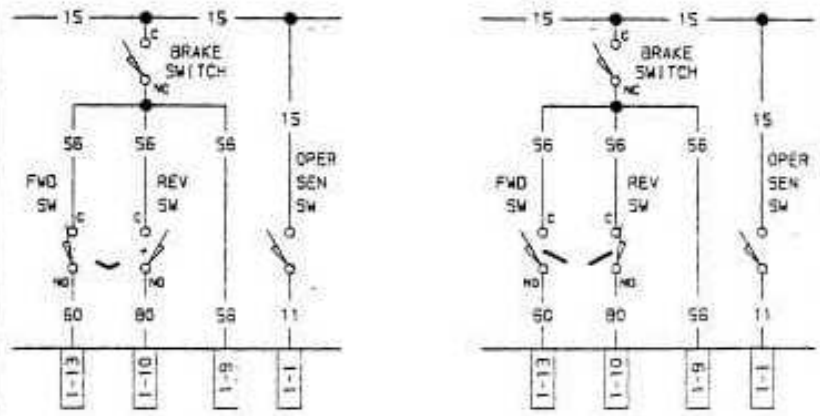
TRUCK RESPONSE

Traction is disabled until fault condition is corrected.

POSSIBLE CAUSES AND TEST PROCEDURES

- Forward or reverse direction is selected before the brake is released (operator is on the truck, initial start-up only).
  Check brake switch for proper operation, an open brake switch can cause this fault.
  Check direction switches for proper operation, a shorted direction switch can also cause this fault.

  NOTE: The brake can be released while traveling, if the operator presses the brake pedal within three seconds SRO will not be activated. If the operator waits more than three seconds, SRO will be activated and the handle will have to be returned to neutral to resume normal operation of the truck.



LOGIC

Displayed when battery volts is simultaneously supplied to terminals 2 and 10 or terminals 2 and 11.

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
2, 3	"Any Message"	HPD HIGH PEDAL DISABLE ACTIVATED

CONDITION

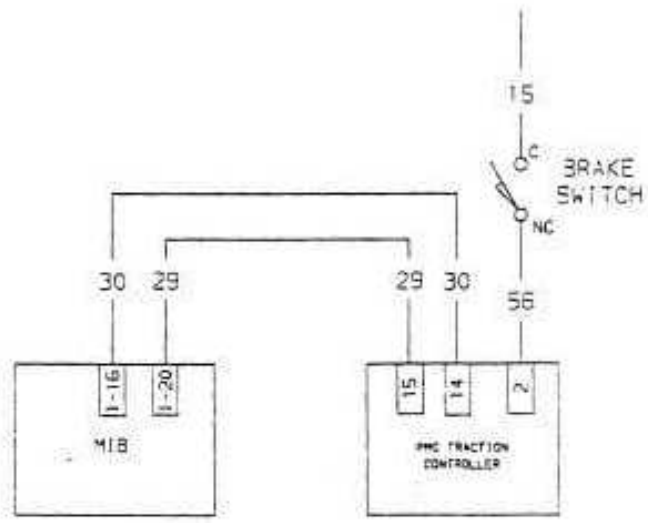
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

TRUCK RESPONSE

Traction is disabled until fault condition is corrected. (The HPD function has a three second delay during normal operation.)

POSSIBLE CAUSES AND TEST PROCEDURES

- Throttle greater than 25% before the brake pedal is pressed.
  Check multi-function control handle to ensure it is in the neutral position.
  Check for approximately 0.2 volts at pin 14 and pin 15 at the traction motor controller with the multi-function control handle in neutral.
- Traction potentiometer out of adjustment.
  Check traction potentiometer adjustment. Refer to TRACTION POTENTIOMETER SET-UP.
- MIB failed.
  Check the MIB for proper operation. The MIB provides the throttle position signal to the traction motor controller via wire #29 (J1-20) and a throttle reference voltage via wire #30 (J1-16). With the multi-function control handle in neutral pin 15 and pin 14 should measure approximately 0.2 volts.



LOGIC

Displayed when voltage at pin 14 or pin 15 is above about 1.25 volts with 0 volts at pin 2.
[5.00 volts (full speed throttle voltage) × 25% =1.25 volts]

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
1, 3	DRIVE CTRL FAULT	M– FAULT

CONDITION

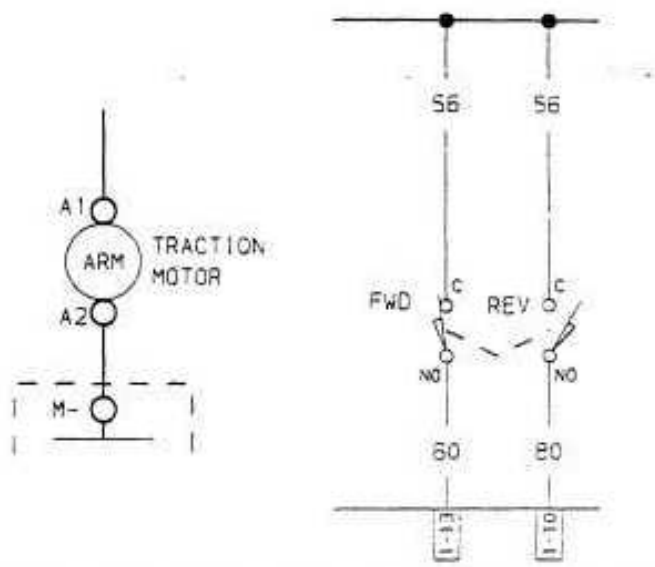
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

TRUCK RESPONSE

Traction is disabled until fault condition is corrected.

POSSIBLE CAUSES AND TEST PROCEDURES

- M – output shorted or internal short in the traction motor.
  Verify voltage between battery – and M – to be 10% less than battery volts with the multi-function control handle in neutral.
- Traction motor shorted.
  Check traction motor for shorted condition.
- Forward or reverse switch circuitry shorted.
  Pin 13 and pin 10 should measure near zero volts with multi-function control handle in neutral. Pin 13 (forward) or pin 10 (reverse) should measure near battery voltage with corresponding direction selected.



LOGIC

M – bus bar should measure approximately 10% less than battery volts. Pin 13 and pin 10 should measure near zero volts with multi-function control handle in neutral. Pin 13 (forward) or pin 10 (reverse) should measure near battery voltage with corresponding direction selected.

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
4, 2	"Any Message"	OVERVOLTAGE OVERVOLTAGE

CONDITION

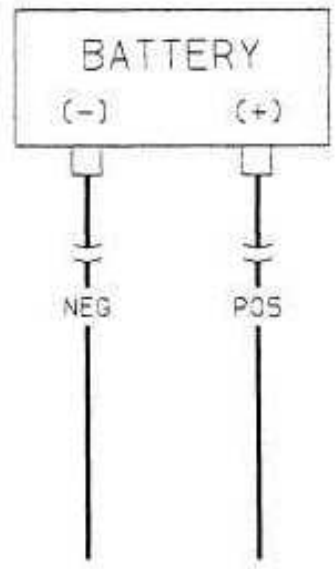
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

TRUCK RESPONSE

Traction is disabled until fault condition is corrected.

POSSIBLE CAUSES AND TEST PROCEDURES

- Truck voltage greater than 45 volts.
  Check to ensure proper battery is in the truck.
- Plugging the charger into the truck instead of the battery can also cause this fault.
  Check to ensure the proper battery charging procedure is followed.



LOGIC

Traction controller is designed to operate with 24 and 36 volt batteries only.

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
3, 1	DRIVE CTRL FAULT	CONT DRVR OC CONTACTOR DRIVER OVERCURRENT

CONDITION

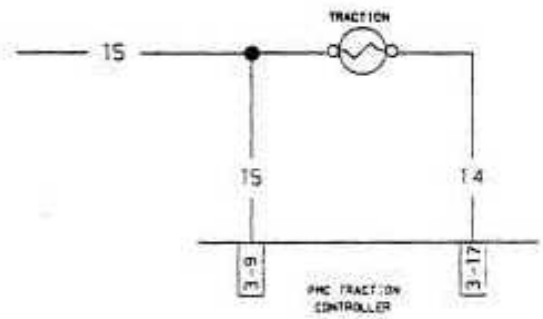
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

TRUCK RESPONSE

Traction is disabled until fault condition is corrected.

POSSIBLE CAUSES AND TEST PROCEDURES

- Traction contactor coil shorted.
  Check traction contactor coil for a shorted condition. Contactor coil should measure approximately 17 ∓ 1 ohms.
- Shorted wire between the traction motor controller and the contactor coil.



LOGIC

Displayed when higher than normal current is sensed in the traction contactor coil.

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
1, 2	DRIVE CTRL FAULT	HW FAILSAFE HARDWARE FAILSAFE ACTIVATED

CONDITION

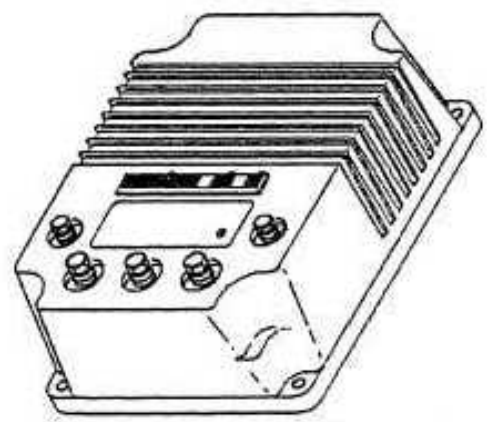
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

TRUCK RESPONSE

Traction is disabled until fault condition is corrected.

POSSIBLE CAUSES AND TEST PROCEDURES

- Defective traction motor controller.
  Replace traction motor controller.



LOGIC

Displayed when the internal check logic of the traction motor controller determines an internal failure of the traction motor controller.

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
4, 1	LOW BATTERY VOLTAGE	LOW BATTERY VOLTAGE

CONDITION

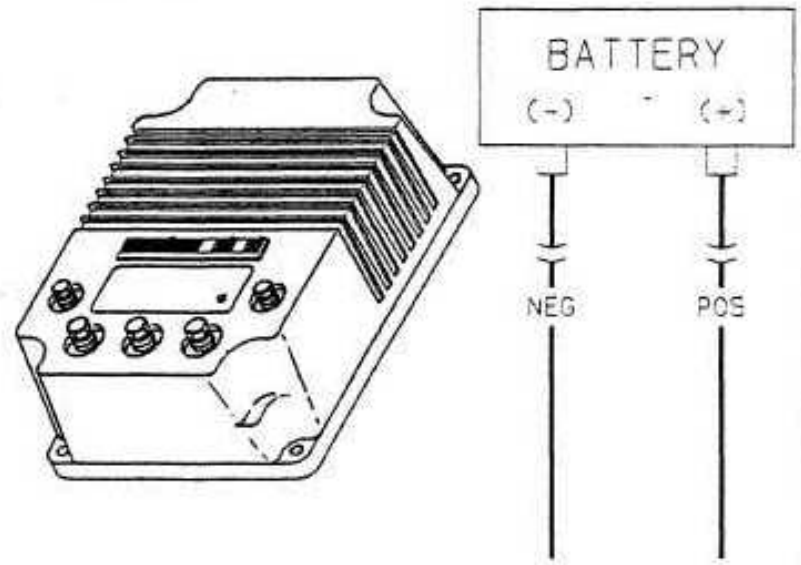
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

TRUCK RESPONSE

Traction is disabled until fault condition is corrected.

POSSIBLE CAUSES AND TEST PROCEDURES

- Battery voltage less than 16 volts.
  Check battery voltage to ensure proper voltage for truck. Check for loose or corroded connections between the battery and the traction motor controller.



LOGIC

B+ bus bar on traction motor controller should measure near truck battery voltage. Connections should be tight and corrosion free.

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
"Any or No LED Code"	DRIVE CTRL FAULT	PROC/WIRING FAULT PROCEDURE OR WIRING FAULT

CONDITION

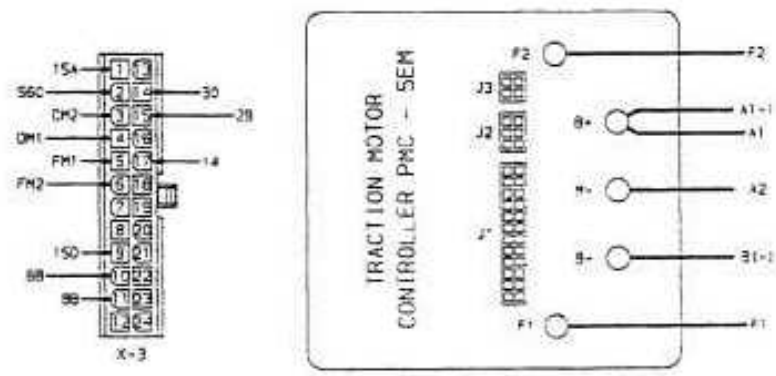
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

TRUCK RESPONSE

Traction is disabled until fault condition is corrected.

POSSIBLE CAUSES AND TEST PROCEDURES

- Traction motor controller is not wired properly or is missing required inputs.
  Check controller connections. See WIRING SCHEMATICS AND DIAGRAMS.



LOGIC

Displayed when internal logic of the traction motor controller detects improper inputs.

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
3, 4	DRIVE CTRL FAULT	MISSING CONTACTOR MISSING CONTACTOR

CONDITION

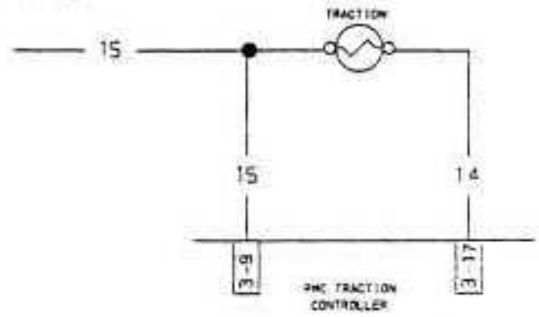
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

TRUCK RESPONSE

Traction is disabled until fault condition is corrected.

POSSIBLE CAUSES AND TEST PROCEDURES

- Traction contactor missing or contactor coil open.
  Check traction contactor coil for open condition. Contactor coil should measure approximately 17 ∓ 1 ohms. If contactor coil is open, replace it.
- Open wire between the traction motor controller and the contactor coil.
  Check for continuity between pin 17 at the traction motor controller and wire #14 at the contactor coil.
  Check for continuity between pin 9 at the traction motor controller and wire #15 at the contactor coil.
  These checks should read near zero ohms, if they do not, locate the open and repair it.



LOGIC

Displayed when lower than normal current is sensed in the traction contactor coil.

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
2, 1	DRIVE CTRL FAULT THROTTLE FAULT	THROTTLE FAULT 1 THROTTLE INPUT FAULT (OUT OF RANGE)

CONDITION

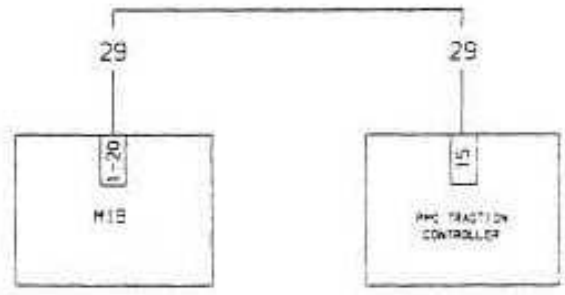
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

TRUCK RESPONSE

Traction is disabled until fault condition is corrected.

POSSIBLE CAUSES AND TEST PROCEDURES

- Throttle input voltage (pin 15, wire #29) out of range.
  Check wire #29 for short to B− or B+.
  Check for continuity between J1-20 (wire #29) at the MIB and pin 15 (wire #29) at the traction motor controller. You should read near zero ohms, if this wire is open find the open and repair it.
- MIB failed.
  Check the MIB for proper operation. The MIB provides the throttle position signal to the traction motor controller via wire #29 (J1-20). With multi-function control handle in neutral pin 15 (wire #29) should measure approximately 0.2 volts. As the handle is moved in a "FORWARD" or "REVERSE" direction the voltage should increase to near 5 volts.



LOGIC

Pin 15 at the traction motor controller is above (approximately) 5.0 volts (full speed reference voltage) or below (approximately) 0.2 volts (neutral reference voltage).

LED CODE	DASH DISPLAY MESSAGE	PROGRAMMER HAND SET DISPLAY MESSAGE
2, 4	DRIVE CTR FAULT THROTTLE FAULT	THROTTLE FAULT 2 THROTTLE LOW INPUT FAULT

CONDITION

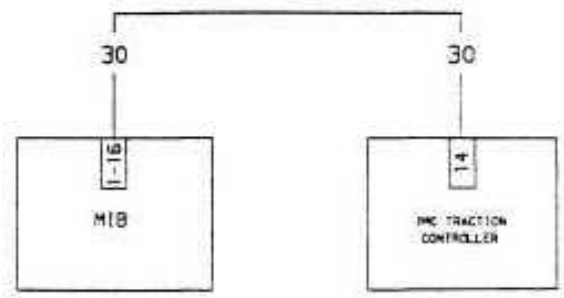
Hand set is plugged into the traction motor controller. Key switch is in the "ON" position. Diagnostic menu is selected.

TRUCK RESPONSE

Traction is disabled until fault condition is corrected.

POSSIBLE CAUSES AND TEST PROCEDURES

- Throttle reference voltage (pin 14, wire #30) open or shorted.
  Check wire #30 (pin 14 at the traction motor controller) for a short to B− or B+.
  Check continuity between pin 14 (wire #30) at the traction motor controller and J1-16 (wire #30) at the MIB. You should read near zero ohms. If the wire is open, find the open and repair it. Wire #30 (pin 14 at the traction motor controller) should measure approximately 0.2 volts.
- MIB failed.
  Check the MIB for proper operation. The MIB provides the throttle reference signal to the traction motor controller via wire #30 (J1-16). With the key switch on pin 14 should measure approximately 0.2 volts. As the handle is moved in a "FORWARD" or "REVERSE" direction the voltage should remain at approximately 0.2 volts.



LOGIC

Pin 14 at the traction motor controller is above or below (approximately) 0.2 volts (reference voltage).

Test Menu

Menu Item	TEST MENU (Neutral position shown)		OPERATING RANGE
	Scroll display until THROTTLE % is shown on the top line	*For Additional Information: Press* MORE INFO	
1	THROTTLE % 0	THROTTLE INPUT % 0	0% to 100% 0 with multi-function control handle in neutral. 100 with multi-function control handle positioned for full speed travel (forward or reverse). Throttle % should gradually increase as the multi-function control handle is moved from the neutral position to the full speed position (forward and reverse).
Throttle signal is generated by the MIB and dependant on the throttle pot position. Displays throttle reading in percent of full as seen by the traction motor controller.			

Menu Item	TEST MENU		OPERATING RANGE
	Scroll display until ARM CURRENT is shown on the top line	*For Additional Information: Press* MORE INFO	
2	ARM CURRENT	ARM CURRENT AMPS 0	
Indicates traction motor armature current.			

Menu Item	TEST MENU		OPERATING RANGE
	Scroll display until FIELD CURRENT is shown on the top line	*For Additional Information: Press* **MORE INFO**	
3	FIELD CURRENT	FIELD CURRENT 0	
Indicates traction motor field current.			

Menu Item	TEST MENU (24 volt truck shown)		OPERATING RANGE
	Scroll display until BATT VOLTAGE is shown on the top line	*For Additional Information: Press* **MORE INFO**	Approximately 20.76 to 26.4 ..... 24 volt truck Approximately 31.14 to 39.6 ..... 36 volt truck
4	BATT VOLTAGE 24	BATTERY VOLTAGE, VOLTS 24	(average 1.73 volts per cell discharged) (average 2.2 volts per cell charged)
Indicates actual battery voltage to the traction motor controller.			

Menu Item	TEST MENU 22°C (71.5°F) shown		OPERATING RANGE
	Scroll display until HEATSINK °C is shown on the top line	*For Additional Information: Press* **MORE INFO**	Between −25°C (−13°F) and 85 °C (185 °F)
5	HEATSINK °C 22	HEATSINK TEMPERATURE °C 22	
Indicates traction motor controller heatsink temperature.			

Menu Item	TEST MENU (Multi-function control handle positioned for forward travel.)		OPERATING RANGE
	Scroll display until FORWARD INPUT is shown on the top line	*For Additional Information: Press* **MORE INFO**	Forward switch "OPEN" ..... **OFF** Forward switch "CLOSED" ..... **ON**
6	FORWARD INPUT ON	FORWARD INPUT IS ON	
Shows status of forward switch input at traction motor controller. Output of MIB.			

Menu Item	TEST MENU (Multi-function control handle positioned for reverse travel.)		OPERATING RANGE
7	*Scroll display until REVERSE INPUT is shown on the top line* REVERSE INPUT ON	*For Additional Information: Press* MORE INFO REVERSE INPUT IS ON	Reverse switch "OPEN" ..... OFF Reverse switch "CLOSED" ..... ON
Shows status of reverse switch input at traction motor controller. Output of MIB.			

Menu Item	TEST MENU		OPERATING RANGE
8	*Scroll display until INTRLCK INPUT is shown on the top line* INTRLCK INPUT ON	*For Additional Information: Press* MORE INFO INTERLOCK INPUT ON	Interlock (brake switch) input ..... ON
Shows status of interlock (brake) switch.			

Menu Item	TEST MENU		OPERATING RANGE
9	*Scroll display until MAIN CONT is shown on the top line* MAIN CONT OPEN	*For Additional Information: Press* MORE INFO MAIN CONTACTOR DRIVER IS ON	
Shows status of main (traction) contactor.			

Menu Item	TEST MENU		OPERATING RANGE
10	*Scroll display until FAULT 1 OUTPUT is shown on the top line* FAULT 1 OUTPUT ON	*For Additional Information: Press* MORE INFO FAULT 1 OUTPUT ON	Fault 1 output low ..... ON Fault 1 output high ..... OFF
Shows status of fault 1 output.			

Menu Item	TEST MENU		OPERATING RANGE
	Scroll display until FAULT 2 OUTPUT is shown on the top line	*For Additional Information: Press* MORE INFO	Fault 2 output low ..... ON Fault 2 output high ..... OFF
11	FAULT 2 OUTPUT ON	FAULT 2 OUTPUT ON	
Shows status of fault 1 output.			

Menu Item	TEST MENU (Rabbit mode shown)		OPERATING RANGE
	Scroll display until MODSEL 1 is shown on the top line	*For Additional Information: Press* MORE INFO	Turtle Mode ..... ON Mid Mode ..... OFF Rabbit Mode ..... OFF
12	MODSEL 1	MODSEL 1 IS OFF	
Controlled by the drive mode switch on the dash display.			

Menu Item	TEST MENU (Rabbit mode shown)		OPERATING RANGE
	Scroll display until MODSEL 2 is shown on the top line	*For Additional Information: Press* MORE INFO	Turtle Mode ..... OFF Mid Mode ..... ON Rabbit Mode ..... OFF
13	MODSEL 2	MODSEL 2 IS OFF	
Controlled by the drive mode switch on the dash display.			

DASH DISPLAY ASSEMBLY

Description/Features

The dash display interfaces with the MIB and the traction controller and is located on the panel adjacent to the steering tiller.

Two versions of the dash display are available:
Standard ..... −25° to 70°C (−13° to 158° F)
Freezer ..... −40° to 70°C (−40° to 158° F)

The dash display contains the following features:

- Three "button-selectable" drive modes
- Sixteen character English LCD Message Center display for status, warning, and fault messages
- Three "button-selectable" hourmeters (Traction, Lift and Total Hours)
- Four hydraulic function selection lights
- Ten bar LED battery state of charge indication
- Low battery lift interrupt indication and permissive output

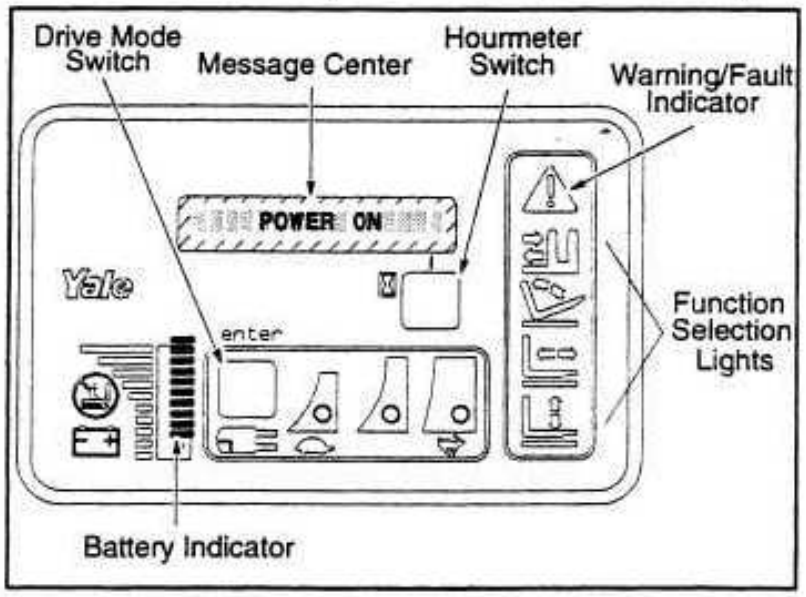


Figure 3-24 – Dash Display Assembly

Operation

The Dash Display is energized when the key switch is on and the battery disconnect switch is closed. An internal back-up battery provides memory retention of the battery indicator and hourmeter readings when the battery is disconnected from the truck.

The Drive Mode Switch allows the operator to select the level of traction motor controller performance most suited to the application. Indicators on the dash display change to correspond to the level of performance selected. The three indicators are as follows: The "Turtle" indicates slowest acceleration, reduced top speed, and maximized energy efficiency. The "Rabbit" indicates maximum acceleration and maximum top speed. The middle setting is a compromise between the turtle and rabbit settings and indicates reduced acceleration, but with maximum top speed. When the key switch is turned to off, the selected drive mode is retained. When the battery is disconnected, the drive mode defaults to the Rabbit mode when battery power is restored.

The Message Center is a 16 character, alpha-numeric, liquid crystal display (LCD), with green back-lighting. Hourmeter readings, truck performance status messages, warning messages and fault messages are shown on the Message Center.

The Hourmeter Switch is used to display hourmeter information in the Message Center . The switch is marked with an hour glass symbol. Press once to display truck hours to 1/10 of an hour. Press twice to display drive motor hours. Press three times to display the lift motor hours. Press four times to return to the current operational status display. After 30 seconds, the display defaults to the current operational status of the truck.

The Warning/Fault Indicator blinks to alert the operator to check the Message Center. When a *warning* message is displayed, the Warning/Fault Indicator blinks yellow. When a *fault* message is displayed, the Warning/Fault Indicator blinks red.

The Function Selection Lights are for the display of Lift, Reach, Tilt and Sideshift operations.

The Battery Indicator has a 10 bar green, yellow and red light emitting diode (LED) to indicate battery state of charge. As battery power is used, the LEDs will turn off in sequence, starting with green. The red LED second from the bottom flashes to indicate when the battery is nearly discharged. The red LED on the bottom of the display will alternately flash with the low-battery indicator LED (a crossed battery symbol) to indicate that the battery is discharged and the hoist function is disabled.

REMOVAL

The dash display is located on the panel adjacent to the steering tiller in the operator's compartment. The dash display assembly cannot be repaired and must be replaced if defective.

1. Move the lift truck to a safe level area. Turn the key switch off and remove the key. Put a "DO NOT OPERATE" tag on the multi-function control handle. Put blocks under the drive wheels to keep the lift truck from moving. See Section 1 – HOW TO PUT A LIFT TRUCK ON BLOCKS.

WARNING: Disconnect the battery and separate the connector before opening the compartment cover or inspecting/repairing the electrical system. If a tool causes a short-circuit, the high current flow from the battery can cause an injury or parts damage.

2. Disconnect and separate the battery connector.

3. Remove the hydraulic tank dipstick.

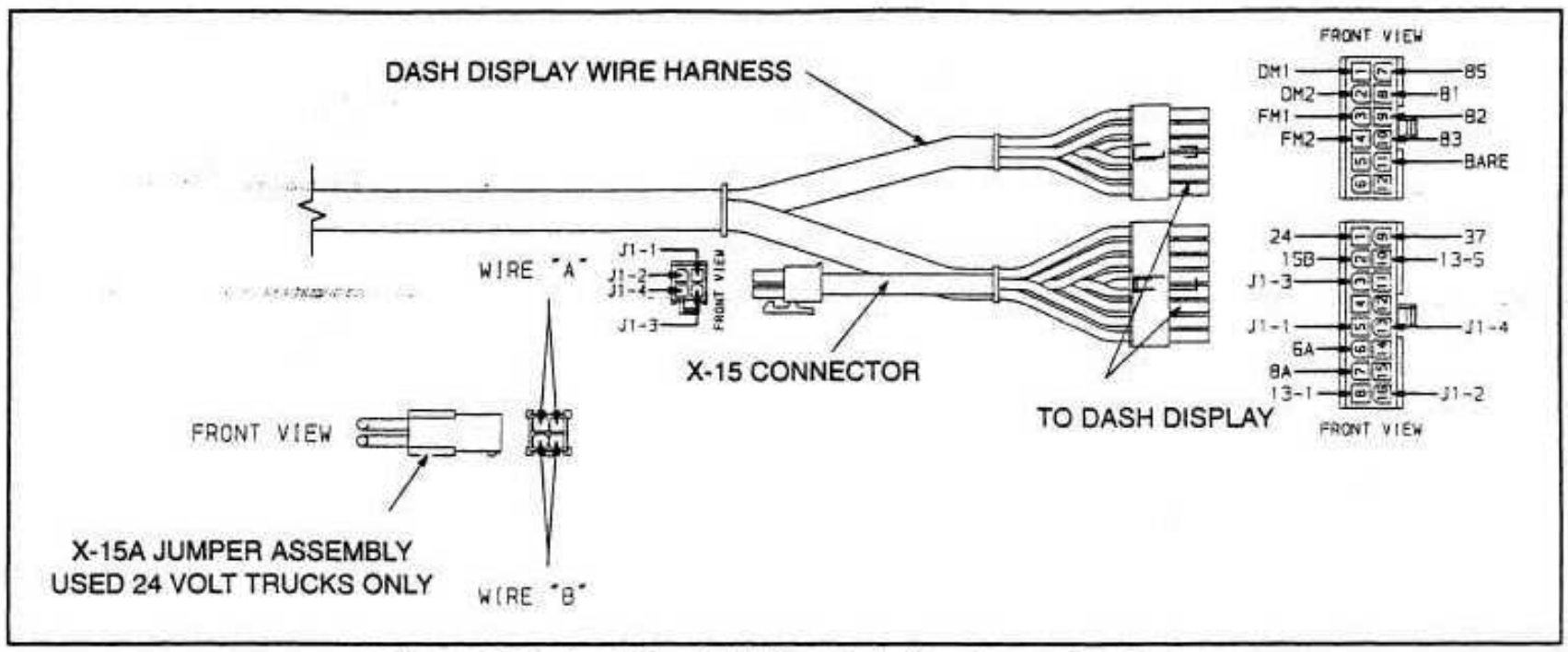


Figure 3-25 – Dash Display Voltage Selection Jumper Location

4. Remove the socket head capscrews retaining the battery compartment cover and the drive unit cover. Remove the covers. Open the drive unit compartment door.

5. Disconnect the two plugs from the rear of the dash display assembly.

6. Remove the two thumbscrews and the retainers securing the dash display assembly to the instrument panel. Remove the dash display assembly.

INSTALLATION

1. Adjust the pots on the rear of the dash display assembly. See DASH DISPLAY ASSEMBLY, ADJUSTMENT.

2. Connect the two plugs to the rear of the dash display.

3. Position the dash display assembly in the instrument panel. Install the retainers and the thumbscrews to retain the dash display assembly to the instrument panel.

4. Install the drive unit cover and the battery cover. Close and secure the drive unit compartment door.

5. Install the hydraulic tank dipstick.

6. Connect the battery.

7. Remove the blocks from under the drive wheels, remove the "DO NOT OPERATE" tag and install the key.

Voltage Selection

Voltage selection (24 or 36 volt battery) is achieved by means of an "X-15A" jumper assembly. The "X-15A" jumper assembly is plugged into the "X-15" connector for 24 volt battery operation only. No jumper is used for 36 volt battery operation. The jumper assembly, when used, is located in the main truck wire harness beneath the dash display assembly. See Figure 3-25.

DASH DISPLAY ADJUSTMENT

The dash display assembly has two potentiometers located between the connectors on the back of the assembly. The potentiometers are set at the factory and should not require adjustment.

The RESET potentiometer sets the level to which the battery must be charged before the battery indicator resets. The RESET potentiometer is set at the factory to B. At the factory setting, the battery must have open circuit voltage greater than 2.09 volts per cell to cause the battery indicator to reset. The battery must be disconnected for a minimum of 15 seconds (before a charged battery is connected) for the RESET function to operate.

The DISCHARGE potentiometer sets the level at which LIFT interrupt occurs. The DISCHARGE potentiometer is set at the factory to L. At the factory setting, the battery must have open circuit voltage of approximately 1.63 volts per cell to cause the lift interrupt function to occur. Adjustment of the DISCHARGE potentiometer from L toward K allows the battery to discharge more before lift interrupt occurs. Adjustment of the DISCHARGE potentiometer from L toward P allows the battery to discharge less before lift interrupt occurs.

Adjust the settings, if necessary, by inserting a small screwdriver through the access hole in the rear of the dash display and into the long slot in each adjustment screw. Rotate the screwdriver fully clockwise, then counterclockwise until the dotted end of the slot is aligned to the desired setting. See Figure 3-26.

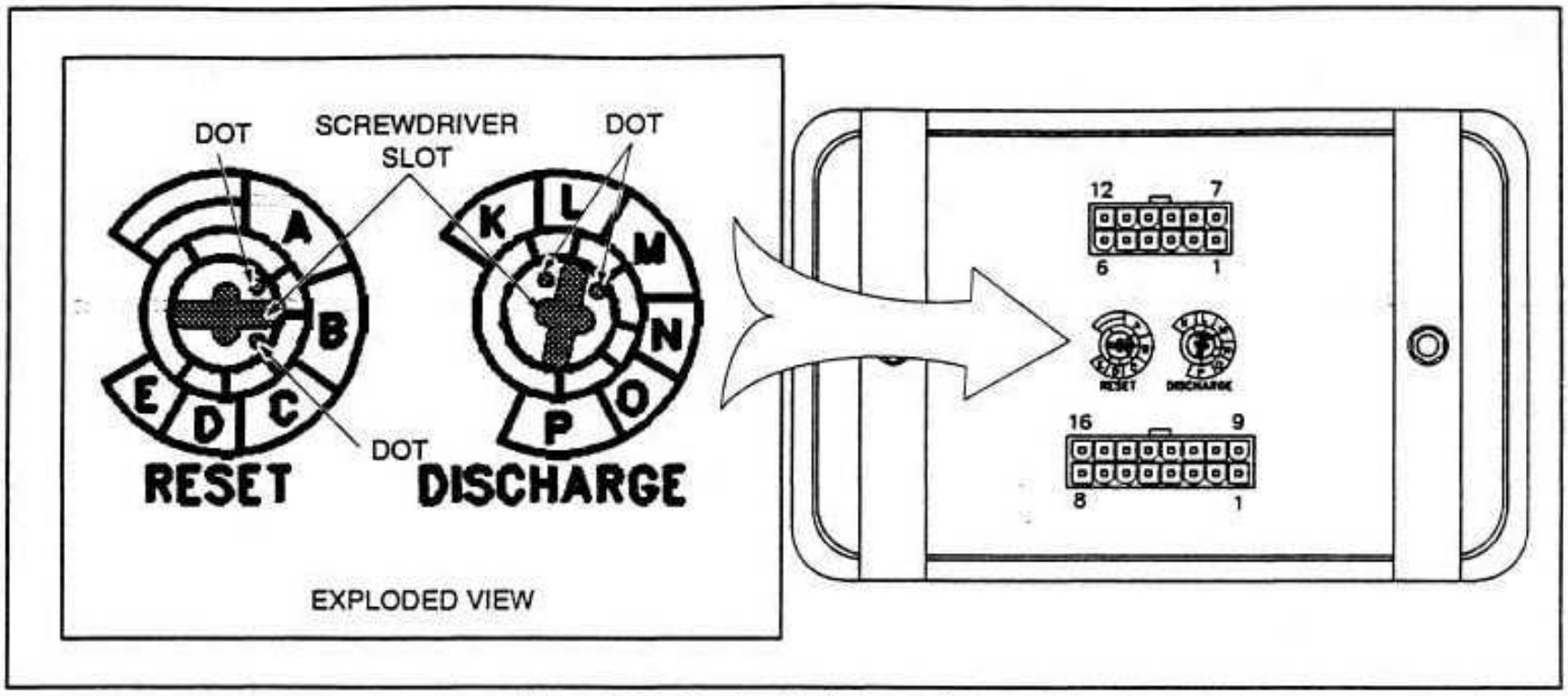


Figure 3-26 – Battery Indicator Adjustment

RESET Pot Position	Approximate Average Volts per Cell Required for Reset
–	2.00
A	2.06
B (factory setting)	2.09
C	2.12
D	2.15
E	2.18

Table 3-14 – Battery Indicator RESET Potentiometer Adjustment

DISCHARGE Pot Position	Approximate Average Volts per Cell at Lift Interrupt
K	1.56
L (factory setting)	1.63
M	1.68
N	1.73
O	1.78
P	1.82

Table 3-15 – Battery Indicator DISCHARGE Potentiometer Adjustment

TROUBLESHOOTING

Inoperative Dash Display Assembly

If the dash display is blank (no display, no LEDs) with the key switch on and the battery disconnect switch closed, check the following: Verify that the battery disconnect switch is closed by measuring for battery voltage on both sides of the switch. Check fuses 4, 5, and 6. Check for battery voltage at the MIB at J2-15 and J2-23 (wire #15). Check J2-7 and J2-8 (wire #13) for B–. Check for battery voltage at the dash display at X4-2 (wire #15). Wires X4-8 and X4-10 at the dash display should be B–. If all of these conditions are correct, the dash display or the MIB could be defective.

Inoperative Drive Mode Selection

If pressing the mode selection button causes the green LED mode indicators to change, but truck performance appears unchanged, check the communication from the dash display to the traction motor controller as follows:

Troubleshooting the Dash Display with a Programmer Hand Set

Using the Programmer Hand Set, enter the TEST MENU. Check the MODE SELECT INPUT 1 and the MODE SELECT INPUT 2. See Table 3-16 for the correct inputs.

FUNCTION		RECOMMENDATION			ALLOWED RANGE	
No.	Description	Default			Min. / Max. Value	Min./Max. Range (Approximate)
		Function Value	Circuit Amps	Range (Approximate)		
01	Model Code Default Values	11	–	24 volt NR040AD	11/11	11/11
02	Lift–Minimum Rate	20	.66	0% to 1%	2/22	–
03	Lift–Maximum Rate	08	1.41	100% lift speed	2/10	–
04	Lower–Minimum Rate	15	.46	0% to 1%	2/17	–
05	Lower–Maximum Rate	09	1.32	100% lower speed	2/10	–
06	Extend–Minimum Rate	41	1.33	0% to 1%	37/46	–
07	Extend–Maximum Rate	23	2.23	3.0 seconds	15/35	2.5 to 6.0 seconds
08	Retract–Minimum Rate	40	1.26	0% to 1%	36/45	–
09	Retract–Maximum Rate	26	2.33	3.0 seconds	15/35	2.5 to 6.0 seconds
10	Tilt Up–Minimum Rate	42	1.33	0% to 1%	38/47	–
11	Tilt Up–Maximum Rate	25	2.29	3.0 seconds	15/35	2.0 to 6.0 seconds
12	Tilt Down–Minimum Rate	43	1.35	0% to 1%	39/48	–
13	Tilt Down–Maximum Rate	24	2.26	2.0 seconds	15/25	2.0 to 6.0 seconds
14	Sideshift Right–Minimum Rate	43	1.35	0% to 1%	39/48	–
15	Sideshift Right–Maximum Rate	25	2.29	2.0 seconds	15/30	2.0 to 6.0 seconds
16	Sideshift Left–Minimum Rate	43	1.35	0% to 1%	40/49	–
17	Sideshift Left–Maximum Rate	25	2.29	2.0 seconds	15/30	2.0 to 6.0 seconds
18	Hydraulic Function–Starting Rate	10	–	–	5/20	–
19	Hydraulic Function–Stopping Rate	10	–	–	5/20	–
20	Maximum Travel Speed–Mast Elevated	70	–	70% max. speed	25/70	25% to 70%
21	Model Code–MTVFD	84	–	–	84/84	**Do Not Adjust**
22	Model Code–MTVRD	97	–	–	97/97	**Do Not Adjust**
23	Power Steering Contactor–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
24	Power Steering Contactor–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
25	Lift Pump Contactor–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
26	Lift Pump Contactor–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
27	Auxiliary Function Coils–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
28	Auxiliary Function Coils–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
29	Steer Pump Time Delay	30	–	3.0 seconds	30/30	**Do Not Adjust**
30	EXIT and SAVE NEW VALUES ..... Depress buttons "B" and "C" together to EXIT.					
31	ERASE ..... Enter number "75", then depress buttons "B" and "D" together to ERASE ALL VALUES.					
32	Hydraulic Potentiometer Set-up	Calibrates the MIB to the hydraulic potentiometer.				
34	Traction Potentiometer Set-up	Calibrates the MIB to the traction potentiometer.				
57	Hydraulic Auxiliary Function Damping	Sets delay for fine-tuning auxiliary hydraulic functions; do not adjust.				

Table 3-20 – MIB Function Code Values – 24 Volt NR040AD Model Trucks

FUNCTION		RECOMMENDATION			ALLOWED RANGE	
No.	Description	Default			Min. / Max. Value	Min./Max. Range (Approximate)
		Function Value	Circuit Amps	Range (Approximate)		
01	Model Code Default Values	12	–	36 volt NR035AD	12/12	12/12
02	Lift–Minimum Rate	20	.66	0% to 1%	2/22	–
03	Lift–Maximum Rate	08	1.41	100% lift speed	2/10	–
04	Lower–Minimum Rate	15	.46	0% to 1%	2/17	–
05	Lower–Maximum Rate	09	1.32	100% lower speed	2/10	–
06	Extend–Minimum Rate	45	1.40	0% to 1%	41/50	–
07	Extend–Maximum Rate	27	2.37	3.0 seconds	15/35	2.5 to 6.0 seconds
08	Retract–Minimum Rate	44	1.36	0% to 1%	40/49	–
09	Retract–Maximum Rate	26	2.33	3.0 seconds	15/35	2.5 to 6.0 seconds
10	Tilt Up–Minimum Rate	42	1.33	0% to 1%	38/47	–
11	Tilt Up–Maximum Rate	25	2.29	3.0 seconds	15/35	2.0 to 6.0 seconds
12	Tilt Down–Minimum Rate	43	1.35	0% to 1%	39/48	–
13	Tilt Down–Maximum Rate	24	2.26	2.0 seconds	15/25	2.0 to 6.0 seconds
14	Sideshift Right–Minimum Rate	43	1.35	0% to 1%	39/48	–
15	Sideshift Right–Maximum Rate	25	2.29	2.0 seconds	15/30	2.0 to 6.0 seconds
16	Sideshift Left–Minimum Rate	44	1.36	0% to 1%	40/49	–
17	Sideshift Left–Maximum Rate	25	2.29	2.0 seconds	15/30	2.0 to 6.0 seconds
18	Hydraulic Function–Starting Rate	10	–	–	5/20	–
19	Hydraulic Function–Stopping Rate	10	–	–	5/20	–
20	Maximum Travel Speed–Mast Elevated	50	–	50% max. speed	25/50	25% to 50%
21	Model Code–MTVFD	87	–	–	87/87	**Do Not Adjust**
22	Model Code–MTVRD	99	–	–	99/99	**Do Not Adjust**
23	Power Steering Contactor–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
24	Power Steering Contactor–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
25	Lift Pump Contactor–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
26	Lift Pump Contactor–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
27	Auxiliary Function Coils–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
28	Auxiliary Function Coils–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
29	Steer Pump Time Delay	30	–	3.0 seconds	30/30	**Do Not Adjust**
30	EXIT and SAVE NEW VALUES ..... Depress buttons "B" and "C" together to EXIT.					
31	ERASE ..... Enter number "75", then depress buttons "B" and "D" together to ERASE ALL VALUES.					
32	Hydraulic Potentiometer Set-up	Calibrates the MIB to the hydraulic potentiometer.				
34	Traction Potentiometer Set-up	Calibrates the MIB to the traction potentiometer.				
57	Hydraulic Auxiliary Function Damping	Sets delay for fine-tuning auxiliary hydraulic functions; do not adjust.				

Table 3-21 – MIB Function Code Values – 36 Volt NR035AD Model Trucks

FUNCTION		RECOMMENDATION			ALLOWED RANGE	
No.	Description	Default			Min. / Max. Value	Min./Max. Range (Approximate)
		Function Value	Circuit Amps	Range (Approximate)		
01	Model Code Default Values	13	–	36 volt NR040AD	13/13	13/13
02	Lift–Minimum Rate	20	.66	0% to 1%	2/22	–
03	Lift–Maximum Rate	08	1.41	100% lift speed	2/10	–
04	Lower–Minimum Rate	15	.46	0% to 1%	2/17	–
05	Lower–Maximum Rate	09	1.32	100% lower speed	2/10	–
06	Extend–Minimum Rate	45	1.40	0% to 1%	41/50	–
07	Extend–Maximum Rate	27	2.37	3.0 seconds	15/35	2.5 to 6.0 seconds
08	Retract–Minimum Rate	44	1.36	0% to 1%	40/49	–
09	Retract–Maximum Rate	26	2.33	3.0 seconds	15/35	2.5 to 6.0 seconds
10	Tilt Up–Minimum Rate	42	1.33	0% to 1%	38/47	–
11	Tilt Up–Maximum Rate	25	2.29	3.0 seconds	15/35	2.0 to 6.0 seconds
12	Tilt Down–Minimum Rate	43	1.35	0% to 1%	39/48	–
13	Tilt Down–Maximum Rate	24	2.26	2.0 seconds	15/25	2.0 to 6.0 seconds
14	Sideshift Right–Minimum Rate	43	1.35	0% to 1%	39/48	–
15	Sideshift Right–Maximum Rate	25	2.29	2.0 seconds	15/30	2.0 to 6.0 seconds
16	Sideshift Left–Minimum Rate	44	1.36	0% to 1%	40/49	–
17	Sideshift Left–Maximum Rate	25	2.29	2.0 seconds	15/30	2.0 to 6.0 seconds
18	Hydraulic Function–Starting Rate	10	–	–	5/20	–
19	Hydraulic Function–Stopping Rate	10	–	–	5/20	–
20	Maximum Travel Speed–Mast Elevated	50	–	50% max. speed	25/50	25% to 50%
21	Model Code–MTVFD	82	–	–	82/82	**Do Not Adjust**
22	Model Code–MTVRD	94	–	–	94/94	**Do Not Adjust**
23	Power Steering Contactor–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
24	Power Steering Contactor–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
25	Lift Pump Contactor–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
26	Lift Pump Contactor–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
27	Auxiliary Function Coils–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
28	Auxiliary Function Coils–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
29	Steer Pump Time Delay	30	–	3.0 seconds	30/30	**Do Not Adjust**
30	EXIT and SAVE NEW VALUES ..... Depress buttons "B" and "C" together to EXIT.					
31	ERASE ..... Enter number "75", then depress buttons "B" and "D" together to ERASE ALL VALUES.					
32	Hydraulic Potentiometer Set-up	Calibrates the MIB to the hydraulic potentiometer.				
34	Traction Potentiometer Set-up	Calibrates the MIB to the traction potentiometer.				
57	Hydraulic Auxiliary Function Damping	Sets delay for fine-tuning auxiliary hydraulic functions; do not adjust.				

Table 3-22 – MIB Function Code Values – 36 Volt NR040AD Model Trucks

FUNCTION		RECOMMENDATION			ALLOWED RANGE	
No.	Description	Default			Min. / Max. Value	Min./Max. Range (Approximate)
		Function Value	Circuit Amps	Range (Approximate)		
01	Model Code Default Values	14	–	36 volt NR045AD	14/14	14/14
02	Lift–Minimum Rate	20	.66	0% to 1%	2/22	–
03	Lift–Maximum Rate	08	1.41	100% lift speed	2/10	–
04	Lower–Minimum Rate	15	.46	0% to 1%	2/17	–
05	Lower–Maximum Rate	09	1.32	100% lower speed	2/10	–
06	Extend–Minimum Rate	45	1.40	0% to 1%	41/50	–
07	Extend–Maximum Rate	27	2.37	3.0 seconds	15/35	2.5 to 6.0 seconds
08	Retract–Minimum Rate	44	1.36	0% to 1%	40/49	–
09	Retract–Maximum Rate	26	2.33	3.0 seconds	15/35	2.5 to 6.0 seconds
10	Tilt Up–Minimum Rate	42	1.33	0% to 1%	38/47	–
11	Tilt Up–Maximum Rate	25	2.29	3.0 seconds	15/35	2.0 to 6.0 seconds
12	Tilt Down–Minimum Rate	43	1.35	0% to 1%	39/48	–
13	Tilt Down–Maximum Rate	24	2.26	2.0 seconds	15/25	2.0 to 6.0 seconds
14	Sideshift Right–Minimum Rate	43	1.35	0% to 1%	39/48	–
15	Sideshift Right–Maximum Rate	25	2.29	2.0 seconds	15/30	2.0 to 6.0 seconds
16	Sideshift Left–Minimum Rate	44	1.36	0% to 1%	40/49	–
17	Sideshift Left–Maximum Rate	25	2.29	2.0 seconds	15/30	2.0 to 6.0 seconds
18	Hydraulic Function–Starting Rate	10	–	–	5/20	–
19	Hydraulic Function–Stopping Rate	10	–	–	5/20	–
20	Maximum Travel Speed–Mast Elevated	50	–	50% max. speed	25/50	25% to 50%
21	Model Code–MTVFD	80	–	–	80/80	**Do Not Adjust**
22	Model Code–MTVRD	92	–	–	92/92	**Do Not Adjust**
23	Power Steering Contactor–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
24	Power Steering Contactor–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
25	Lift Pump Contactor–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
26	Lift Pump Contactor–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
27	Auxiliary Function Coils–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
28	Auxiliary Function Coils–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
29	Steer Pump Time Delay	30	–	3.0 seconds	30/30	**Do Not Adjust**
30	EXIT and SAVE NEW VALUES ..... Depress buttons "B" and "C" together to EXIT.					
31	ERASE ..... Enter number "75", then depress buttons "B" and "D" together to ERASE ALL VALUES.					
32	Hydraulic Potentiometer Set-up	Calibrates the MIB to the hydraulic potentiometer.				
34	Traction Potentiometer Set-up	Calibrates the MIB to the traction potentiometer.				
57	Hydraulic Auxiliary Function Damping	Sets delay for fine-tuning auxiliary hydraulic functions; do not adjust.				

Table 3-23 – MIB Function Code Values – 36 Volt NR045AD Model Trucks

FUNCTION		RECOMMENDATION			ALLOWED RANGE	
No.	Description	Default			Min. / Max. Value	Min./Max. Range (Approximate)
		Function Value	Circuit Amps	Range (Approximate)		
01	Model Code Default Values	15	–	24 volt NDR030AD	15/15	15/15
02	Lift–Minimum Rate	20	.66	0% to 1%	2/22	–
03	Lift–Maximum Rate	08	1.41	100% lift speed	2/10	–
04	Lower–Minimum Rate	15	.46	0% to 1%	2/17	–
05	Lower–Maximum Rate	09	1.32	100% lower speed	2/10	–
06	Extend–Minimum Rate	44	1.36	0% to 1%	37/49	–
07	Extend–Maximum Rate	26	2.33	3.0 seconds	15/35	2.5 to 6.0 seconds
08	Retract–Minimum Rate	44	1.36	0% to 1%	36/49	–
09	Retract–Maximum Rate	31	2.33	3.0 seconds	15/35	2.5 to 6.0 seconds
10	Tilt Up–Minimum Rate	42	1.33	0% to 1%	38/47	–
11	Tilt Up–Maximum Rate	25	2.29	3.0 seconds	15/35	2.0 to 6.0 seconds
12	Tilt Down–Minimum Rate	43	1.35	0% to 1%	39/48	–
13	Tilt Down–Maximum Rate	24	2.26	2.0 seconds	15/25	2.0 to 6.0 seconds
14	Sideshift Right–Minimum Rate	43	1.35	0% to 1%	39/48	–
15	Sideshift Right–Maximum Rate	25	2.29	2.0 seconds	15/30	2.0 to 6.0 seconds
16	Sideshift Left–Minimum Rate	44	1.36	0% to 1%	40/49	–
17	Sideshift Left–Maximum Rate	25	2.29	2.0 seconds	15/30	2.0 to 6.0 seconds
18	Hydraulic Function–Starting Rate	10	–	–	5/20	–
19	Hydraulic Function–Stopping Rate	10	–	–	5/20	–
20	Maximum Travel Speed–Mast Elevated	70	–	70% max. speed	25/70	25% to 70%
21	Model Code–MTVFD	99	–	–	99/99	**Do Not Adjust**
22	Model Code–MTVRD	99	–	–	99/99	**Do Not Adjust**
23	Power Steering Contactor–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
24	Power Steering Contactor–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
25	Lift Pump Contactor–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
26	Lift Pump Contactor–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
27	Auxiliary Function Coils–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
28	Auxiliary Function Coils–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
29	Steer Pump Time Delay	30	–	3.0 seconds	30/30	**Do Not Adjust**
30	EXIT and SAVE NEW VALUES ..... Depress buttons "B" and "C" together to EXIT.					
31	ERASE ..... Enter number "75", then depress buttons "B" and "D" together to ERASE ALL VALUES.					
32	Hydraulic Potentiometer Set-up	Calibrates the MIB to the hydraulic potentiometer.				
34	Traction Potentiometer Set-up	Calibrates the MIB to the traction potentiometer.				
57	Hydraulic Auxiliary Function Damping	Sets delay for fine-tuning auxiliary hydraulic functions; do not adjust.				

Table 3-24 – MIB Function Code Values – 24 Volt NDR030AD Model Trucks

FUNCTION		RECOMMENDATION			ALLOWED RANGE	
No.	Description	Default			Min. / Max. Value	Min./Max. Range (Approximate)
		Function Value	Circuit Amps	Range (Approximate)		
01	Model Code Default Values	16	–	36 volt NDR030AD	16/16	16/16
02	Lift–Minimum Rate	20	.66	0% to 1%	2/22	–
03	Lift–Maximum Rate	08	1.41	100% lift speed	2/10	–
04	Lower–Minimum Rate	15	.46	0% to 1%	2/17	–
05	Lower–Maximum Rate	09	1.32	100% lower speed	2/10	–
06	Extend–Minimum Rate	48	1.54	0% to 1%	43/53	–
07	Extend–Maximum Rate	30	2.55	3.0 seconds	15/35	2.5 to 6.0 seconds
08	Retract–Minimum Rate	48	1.54	0% to 1%	43/53	–
09	Retract–Maximum Rate	31	2.33	3.0 seconds	15/35	2.5 to 6.0 seconds
10	Tilt Up–Minimum Rate	42	1.33	0% to 1%	38/47	–
11	Tilt Up–Maximum Rate	25	2.29	3.0 seconds	15/35	2.0 to 6.0 seconds
12	Tilt Down–Minimum Rate	43	1.35	0% to 1%	39/48	–
13	Tilt Down–Maximum Rate	24	2.26	2.0 seconds	15/25	2.0 to 6.0 seconds
14	Sideshift Right–Minimum Rate	43	1.35	0% to 1%	39/48	–
15	Sideshift Right–Maximum Rate	25	2.29	2.0 seconds	15/30	2.0 to 6.0 seconds
16	Sideshift Left–Minimum Rate	44	1.36	0% to 1%	40/49	–
17	Sideshift Left–Maximum Rate	25	2.29	2.0 seconds	15/30	2.0 to 6.0 seconds
18	Hydraulic Function–Starting Rate	10	–	–	5/20	–
19	Hydraulic Function–Stopping Rate	10	–	–	5/20	–
20	Maximum Travel Speed–Mast Elevated	50	–	50% max. speed	25/50	25% to 50%
21	Model Code–MTVFD	97	–	–	97/97	**Do Not Adjust**
22	Model Code–MTVRD	99	–	–	99/99	**Do Not Adjust**
23	Power Steering Contactor–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
24	Power Steering Contactor–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
25	Lift Pump Contactor–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
26	Lift Pump Contactor–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
27	Auxiliary Function Coils–Minimum Current	03	0.10	–	03/03	**Do Not Adjust**
28	Auxiliary Function Coils–Maximum Current	60	2.04	–	60/60	**Do Not Adjust**
29	Steer Pump Time Delay	30	–	3.0 seconds	30/30	**Do Not Adjust**
30	EXIT and SAVE NEW VALUES ..... Depress buttons "B" and "C" together to EXIT.					
31	ERASE ..... Enter number "75", then depress buttons "B" and "D" together to ERASE ALL VALUES.					
32	Hydraulic Potentiometer Set-up	Calibrates the MIB to the hydraulic potentiometer.				
34	Traction Potentiometer Set-up	Calibrates the MIB to the traction potentiometer.				
57	Hydraulic Auxiliary Function Damping	Sets delay for fine-tuning auxiliary hydraulic functions; do not adjust.				

Table 3-25 – MIB Function Code Values – 36 Volt NDR030AD Model Trucks

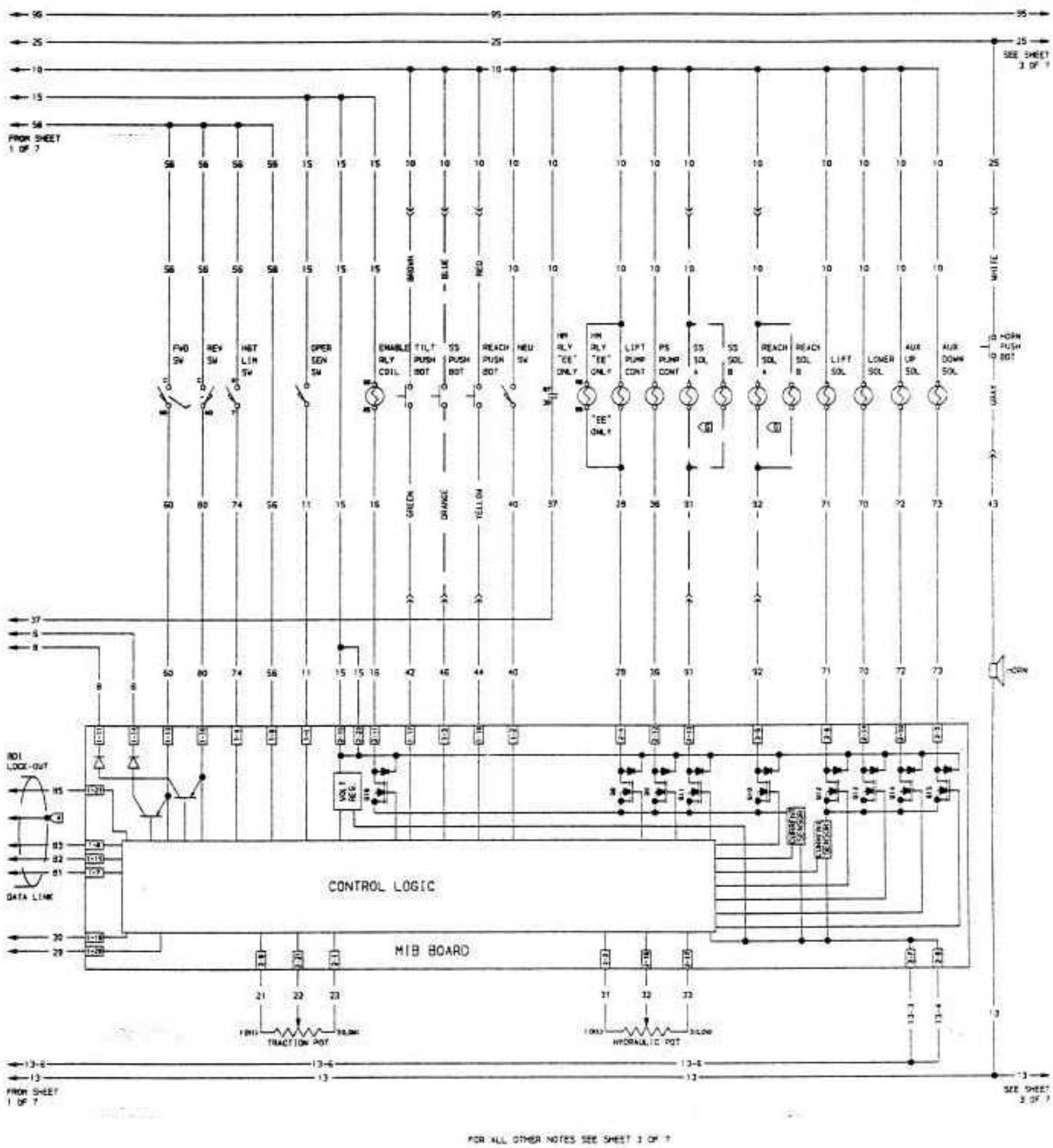


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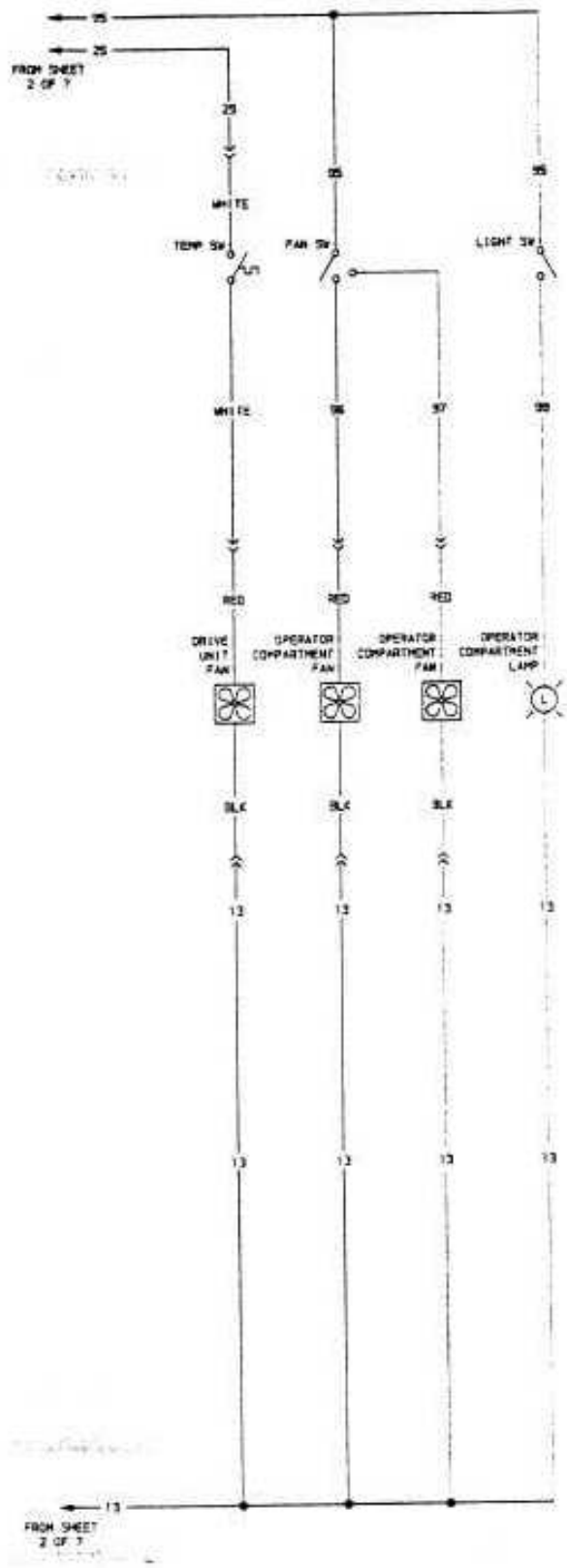
Figure 3-43 – Wiring Schematic 5241353-87 – NR/NDR/NS (Continued)



NOTES:

1. ALL SWITCHES ARE SHOWN IN THE STATIC TRUCK POSITION.
2. FOR ALL SPLICE DETAILS SEE SHEET 3 OF 7.
3. ALL CONNECTORS ARE SHOWN FROM THE FRONT VIEW AND ARE ENLARGED FOR CLARITY.

(4) SHIELDED CABLE.

(5) CONNECTOR X-15A (JUMPER ASSY) TO BE USED ON 24 VOLTS TRUCKS ONLY.

(6) SIDE SHIFT AND REACH SELECTOR VALVES ARE NOT USED ON NS-40 MODEL TRUCK.

7. BROKEN LINES ARE FOR OPTIONS ONLY.
8. ABBREVIATIONS FOR COMPONENT ARE SHOWN IN PARENTHESES ON WIRING DIAGRAM.

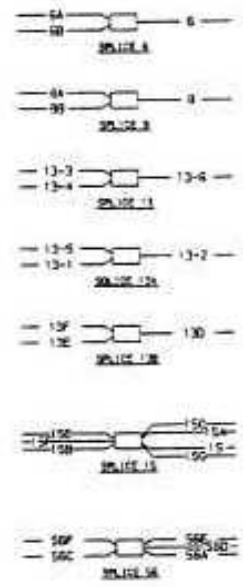


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Figure 3-44 – Options Schematic 5241353-87 – NR/NDR/NS

NOTES

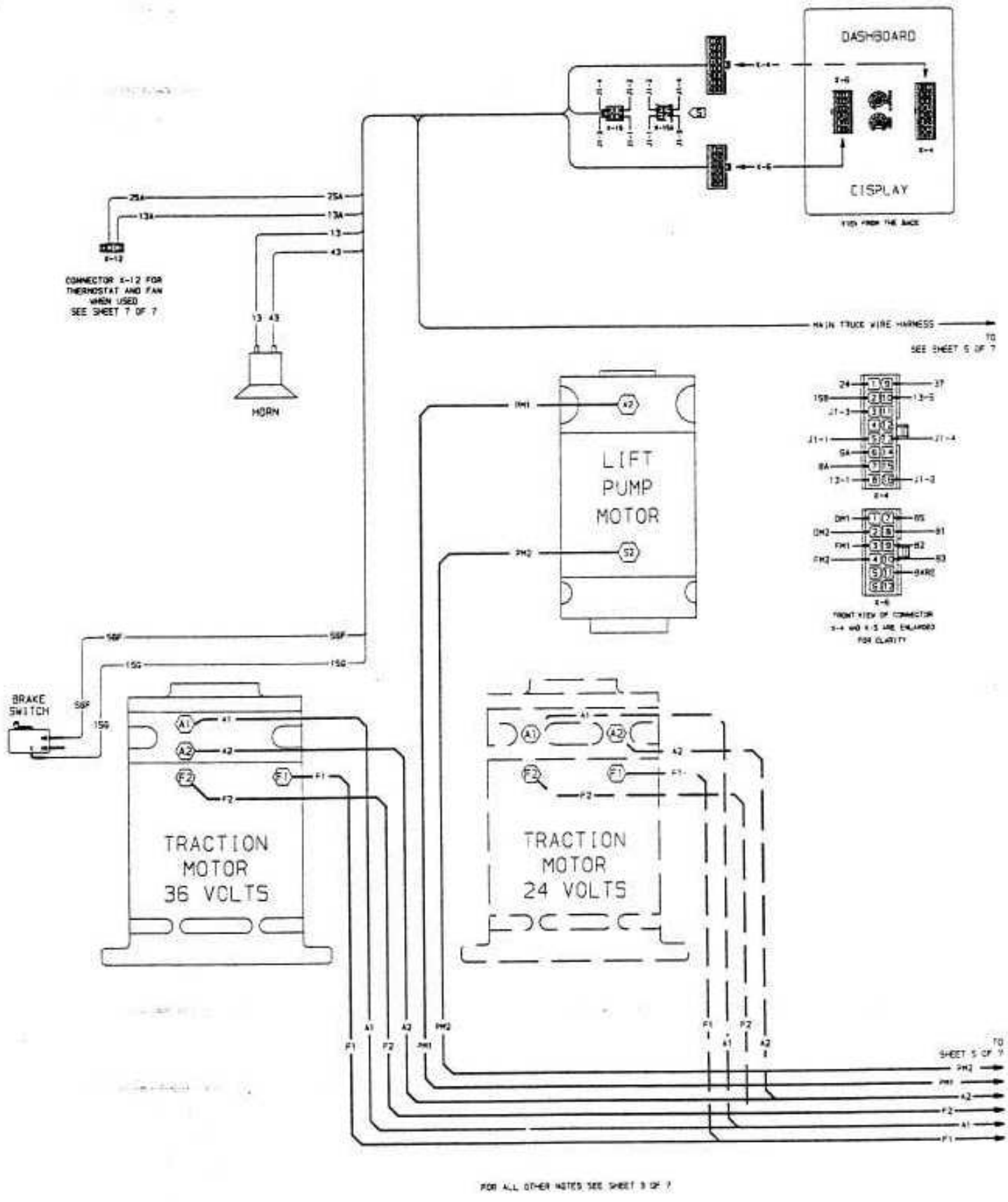

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Figure 3-45 – Wiring Diagram 5241353-87 – NR/NDR/NS

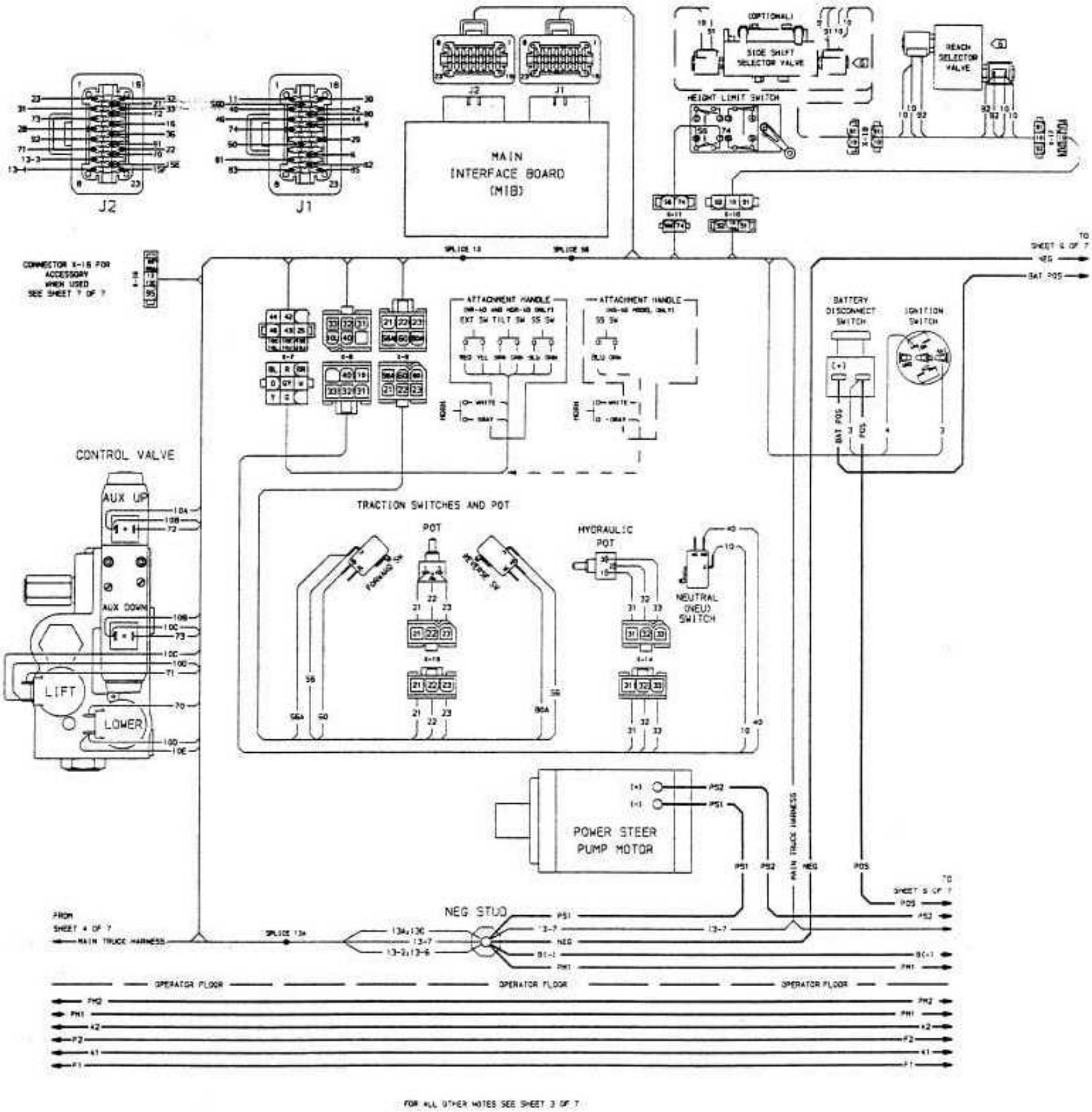

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Figure 3-45 – Wiring Diagram 5241353-87 – NR/NDR/NS (Continued)

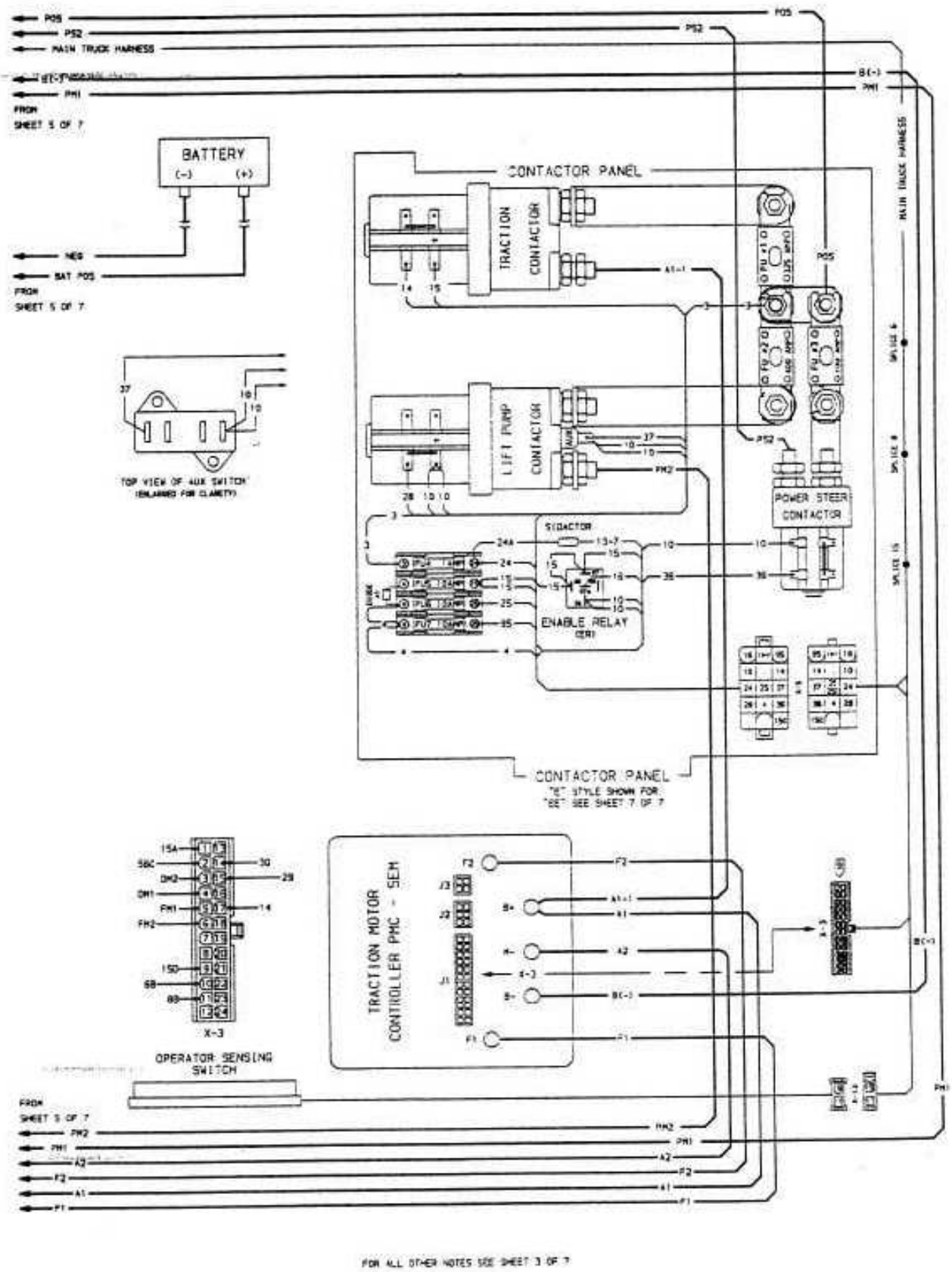

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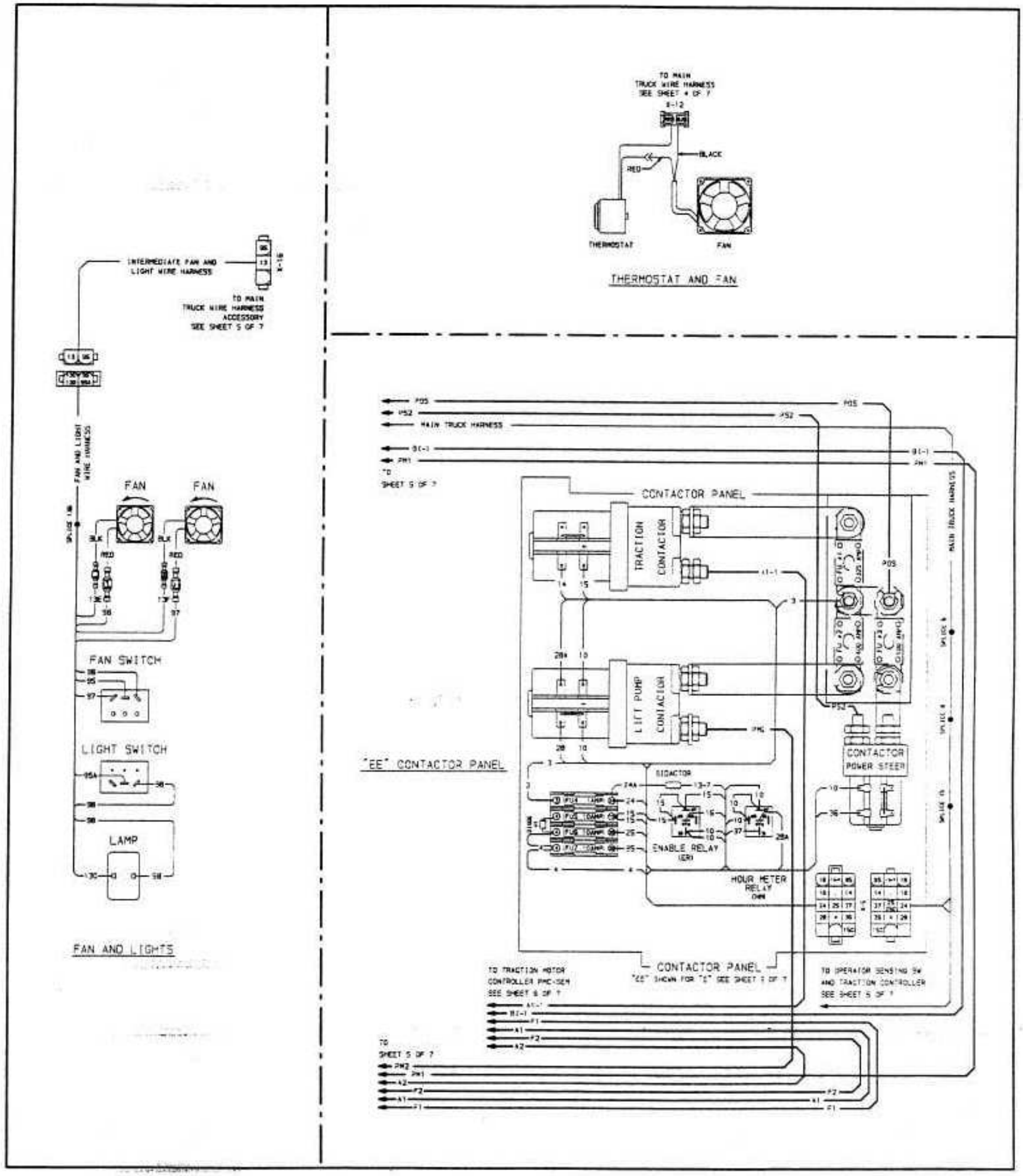
Figure 3-45 – Wiring Diagram 5241353-87 – NR/NDR/NS (Continued)



FOR ALL OTHER NOTES SEE SHEET 3 OF 7

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Figure 3-46 – Options Diagram 5241353-87 – NR/NDR/NS

NOTES

Yale
Industrial Trucks

SECTION 4

4	DRIVE UNIT

Yale
Industrial Trucks

SECTION 4 – CONTENTS

DRIVE UNIT

GENERAL

This section has a description and the repair and adjustment procedures for the parts of the Master Drive Unit (MDU). The final drive ratio of the MDU is 14.5:1. The traction motor, steering and brake repair procedures are in separate sections. The main parts of the MDU are the case, pinion (motor) and large gear set, the pinion and spiral bevel gear set, bearings, and the axle and wheel. The large ball bearing for steering is part of the upper housing of the MDU.

The traction motor fastens to an adapter ring that is attached to an articulating axle. This adapter ring is part of the large ball bearing and allows the MDU to turn on the axis of the traction motor. The traction motor does not turn with the MDU.

The articulating axle is fabricated from metal components and provides the proper spacing between the MDU, caster wheels and axle shaft locations. A pivot pin passes through the center of the articulating axle weldment and is supported by two trunnion blocks, the upper halves of which are welded to the lift truck frame. This mounting provides the articulating capability to allow for floor variations between the drive wheel and the caster wheel. The amount of variation is limited by the adjustable articulation stops. Both articulation stops are located in the drive unit compartment, providing for easy access.

NOTE: The manufacturer recommends draining and refilling the drive unit oil after the first 500 hours of use on all new trucks. See LUBRICATION INSTRUCTIONS, Section 2, this manual.

DESCRIPTION
(See Figure 4-1 and Figure 4-3)

Six capscrews fasten the large ball bearing and MDU to the articulating axle. The bearing lets the MDU turn for steering. There is a small helical pinion on the motor armature shaft. This pinion turns a large helical gear attached to the bevel pinion shaft in the MDU. The bevel pinion shaft turns the bevel gear attached to the axle shaft to turn the drive wheel. The brake is fastened to the top end of the motor shaft to stop rotation of the shaft. The brake action works through the gears to stop the unit.

ARTICULATION STOP ADJUSTMENT

The stability and traction will also be affected if the drive unit articulation stops are not adjusted properly.

The articulation stop screws must be adjusted to the proper setting as listed in the ARTICULATION CHART, at the following times:

1. Every 350 hours during routine maintenance.
2. When a drive and/or caster wheel is changed.
3. When any repairs are carried out on the articulation axle.

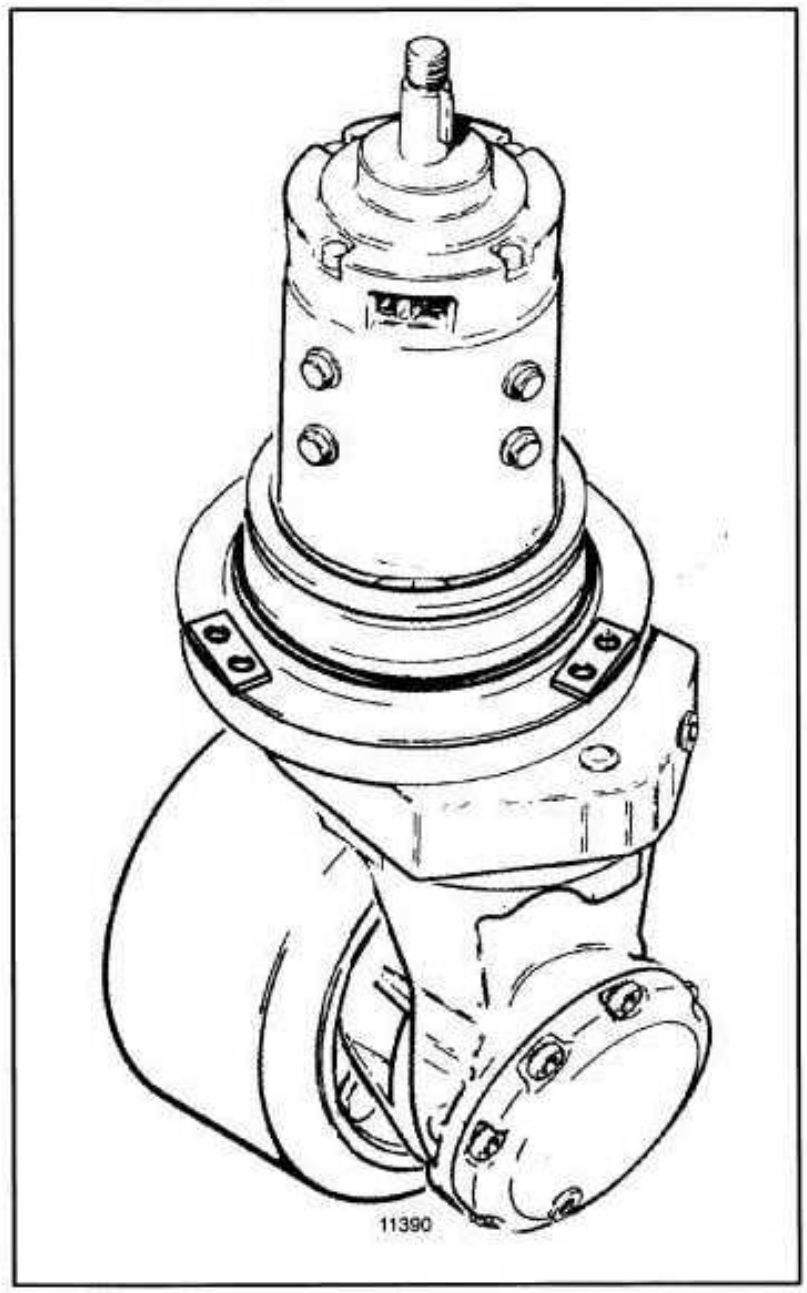


Figure 4-1 – Master Drive Unit with Wheel and Traction Motor

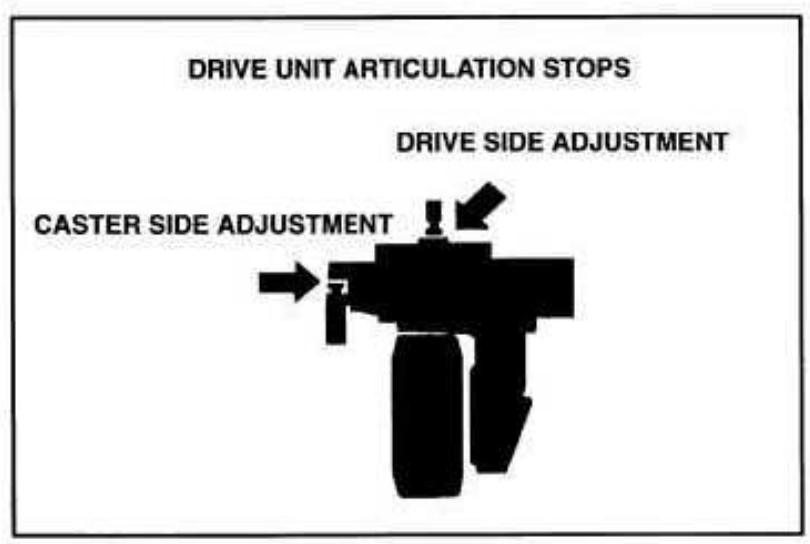


Figure 4-2 – Drive Unit Articulation Stops Nameplate

STOP SETTING	MAX. FORK HEIGHT	
	BELOW 6147 mm (242 in)	6147 mm (242 in) AND ABOVE
DRIVE SIDE	4.8-6.4 mm (0.19-0.25 in)	1.6-3.2 mm (0.06-0.125 in)
CASTER SIDE	4.8-6.4 mm (0.19-0.25 in)	4.8-6.4 mm (0.19-0.25 in)

Table 4-1 – Articulation Chart

NOTE: The articulation stop settings are also listed on the nameplate.

ARTICULATION ADJUSTMENT PROCEDURE

1. Position the truck on a flat, level floor.

2. Disconnect the battery.

3. Open the drive unit compartment door, after turning the latch capscrew one-half of a turn to unlock the door.

4. Check the articulation stop clearance on both the drive and caster stop screws. If the clearance between the stops are not within the range listed in the ARTICULATION CHART, loosen the locknuts and adjust the stop screws to the correct setting.

5. Tighten the locknuts and torque to 108 N•m (80 lbf ft).

6. Close and lock the compartment door.

AXLE ASSEMBLY

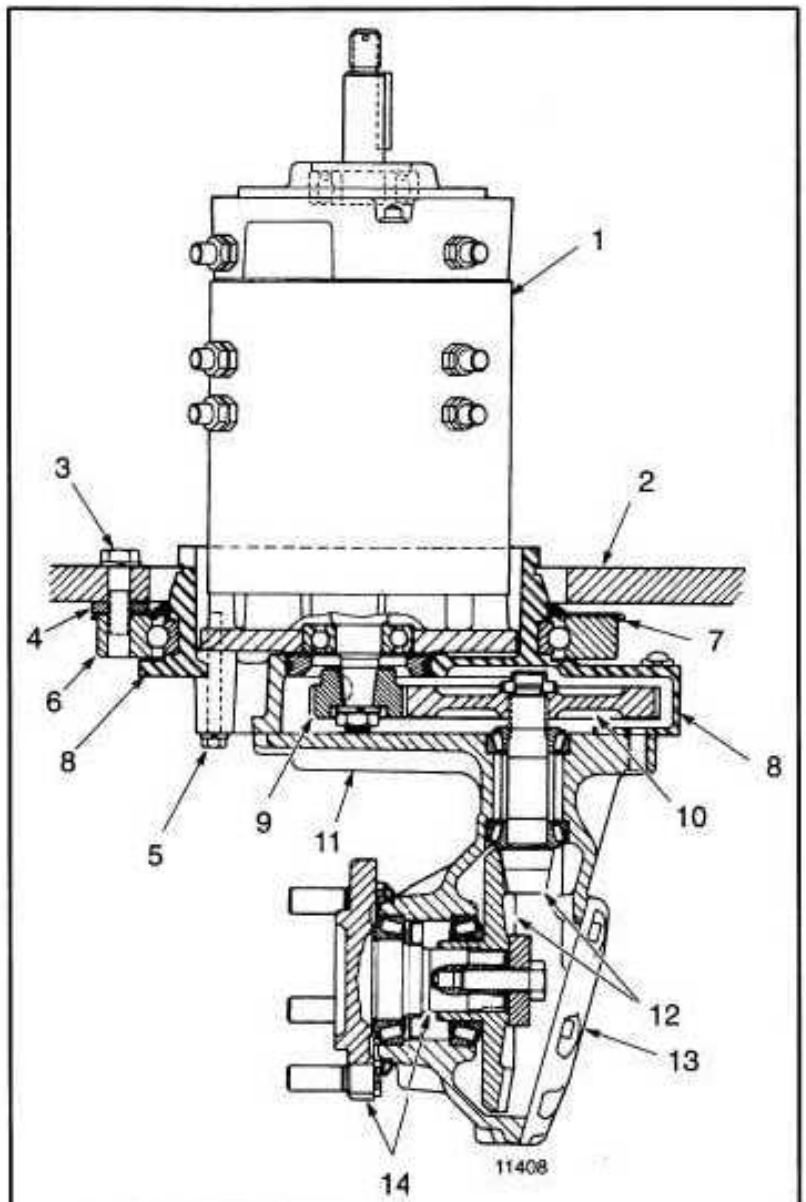
The axle assembly consists of an axle weldment which is the mount for the master drive unit (MDU), the hydraulic steering motor and the caster. The traction motor fastens to the top of the MDU near the left end of the axle weldment. The MDU is attached to the bottom of the axle weldment and rotates on a large bearing. The traction motor supplies the power to turn the drive wheel. The hydraulic steering motor rotates the MDU for steering. The caster supports the right end of the axle weldment. The axle weldment assembly is fastened to the lift truck by an articulating shaft. The articulating axle assembly pivots on the shaft.

TRACTION MOTOR

The traction motor is not part of the steering system. The motor is part of the MDU assembly and must be removed to remove the axle assembly from the lift truck.

Removal

1. Disconnect the battery. Open the drive unit compartment door.



1. TRACTION MOTOR
2. ARTICULATING AXLE
3. CAPSCREW TO FASTEN BEARING AND MDU
4. ADAPTER PLATE
5. CAPSCREW TO FASTEN MOTOR
6. LARGE BALL BEARING
7. BEARING SHIELD
8. TOP CASE
9. HELICAL PINION (MOTOR)
10. HELICAL GEAR
11. HOUSING
12. BEVEL PINION SHAFT AND GEAR SET
13. COVER
14. AXLE SHAFT

Figure 4-3 – Traction Motor and MDU

2. Tag the power cables of the traction motor for correct installation during installation. The motor terminals are identified on the motor as A1, A2, F1 and F2. Remove the power cables from the terminals of the traction motor. Fasten the cables in a location to prevent damage during motor removal.

3. Tag and disconnect the wires to the brake switch.

CAUTION: Brake fluid damages paint. Immediately remove any brake fluid that is on a painted surface.

4. Position a container under the slave cylinder to catch the brake fluid and remove the hose assembly. Cap the hose assembly. Allow the brake fluid to drain from the slave cylinder.

5. Make an identification mark on the motor housing and the axle weldment for correct motor alignment during installation. Remove the six M8 capscrews and lockwashers retaining the flange of the traction motor to the MDU upper housing.

WARNING: The traction motor is heavy. Be sure that all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the traction motor. The traction motor can weigh approximately 40 kg (85 lbs).

6. Use a sling around the traction motor and an overhead crane to carefully lift the traction motor. Do not damage the drive gear on the motor shaft or the brake assembly on the top of the motor. Position the motor on its side so that the gear and the brake assembly are not damaged.

Installation

1. Install a new O-ring on the traction motor housing. Use O-ring lubricant on the O-ring.

WARNING: The traction motor is heavy. Be sure that all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the traction motor. The traction motor can weigh approximately 40 kg (85 lbs).

2. Use an overhead crane and a sling to carefully lift the traction motor into the correct position on the MDU upper housing. Do not damage the drive gear or the brake assembly. Make sure that the motor and the MDU are aligned with the mark made during removal before the motor is completely lowered onto the upper housing.

3. Install and tighten the six capscrews and lockwashers using a crisscross pattern to 20 N•m (15 lbf ft) torque.

4. Connect the power cables to the motor terminals.

CAUTION: See Section 5 of this manual to remove the air from the brake system. Do not operate the lift truck without removing the air from the brake system.

CAUTION: Brake fluid damages paint. Immediately remove any brake fluid that is on a painted surface.

5. Remove the cap from the brake line from the master cylinder and attach the line to the slave cylinder. Add brake fluid to the brake reservoir. Bleed the air from the brake system. See Section 5.

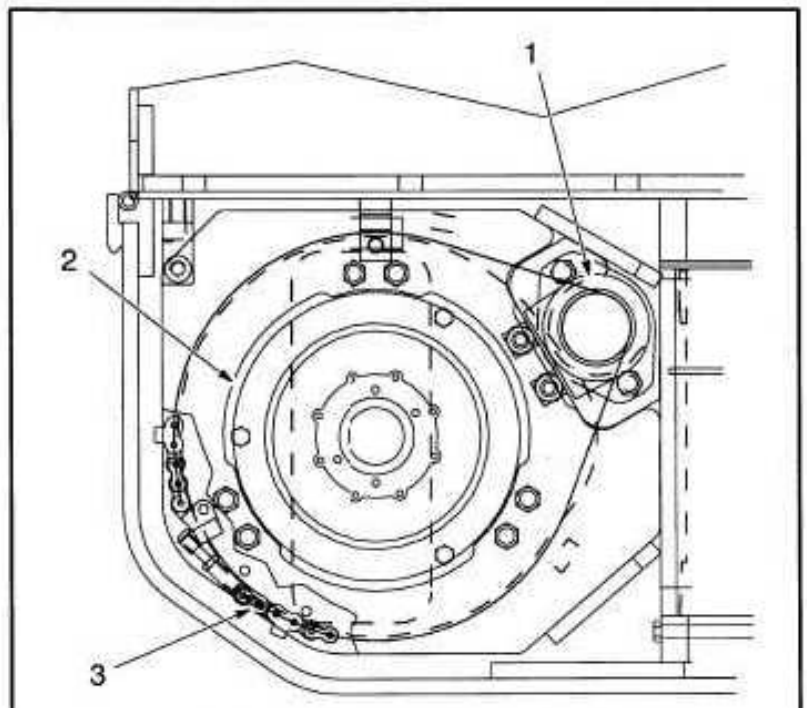
6. Install the wires to the brake switch.

7. Close the drive unit compartment door. Connect the battery.

HYDRAULIC STEERING MOTOR

Description

Lift truck steering is achieved when the hydraulic steering motor rotates the master drive unit (MDU) using a steering chain. See Figure 4-4. The hydraulic steering motor uses a rotor assembly to change hydraulic energy into mechanical energy. The rotor assembly has a fixed rotor with seven vanes and a stator. There is hydraulic pressure between the vanes and stator. The pressure makes the stator rotate in the rotor.



1. HYDRAULIC STEERING MOTOR
2. MASTER DRIVE UNIT (MDU)
3. STEERING CHAIN

Figure 4-4 – Hydraulic Steering System

Removal

1. Use the steering system to move the master drive unit for access to the chain anchor of the steering chain. Disconnect the battery and open the drive unit compartment cover.

2. Remove the steering chain from the sprocket of the hydraulic motor. To remove the chain, first make a mark on the chain anchor and the MDU upper housing at the chain anchor. Remove the cotter pin from the end of one offset pin at the chain anchor. Remove the link pin and chain. Remove the chain from the sprocket of the hydraulic motor. Use wire to fasten the chain so that it does not fall.

41. Insert the wheel shaft into the housing and engage the splines of the shaft into the bevel gear. Remove excess Loctite with a clean cloth.

42. Secure the bevel gear on the wheel shaft using the M16 capscrew and special washer. Prevent the axle from turning. Tighten the M16 capscrew to 245 N•m (332 lbf ft) torque.

43. Coat the flat housing surface with Loctite No. 574 before mounting the housing cover. Apply one drop of Loctite No. 243 to the threads of each of the housing cover mounting bolts and install the bolts.

NOTE: If the tapped holes in the bottom of the lower housing extend through the housing, completely seal the capscrews with Loctite to prevent oil from leaking from around the threads.

44. Tighten the housing cover capscrews to 9.5 N•m (7 lbf ft) torque.

45. Inspect the upper part of the MDU. The upper part of the MDU must be replaced if:

a. The caulked cover plate on the trunnion bearing has separated. Check visually.

b. The trunnion bearing is difficult to turn or binds. Check manually.

c. The maximum trunnion bearing clearance is exceeded. Check as described below.

46. Clamp the upper part of the MDU to an assembly table. Install three eyebolts into the outer race of the trunnion bearing and rotate the bearing several times. See Figure 4-20.

47. Install a cable in each eye bolt. Position three dial indicators on the trunnion bearing and set the indicators to zero. Mark the position of one dial indicator on the trunnion bearing with a marking pen.

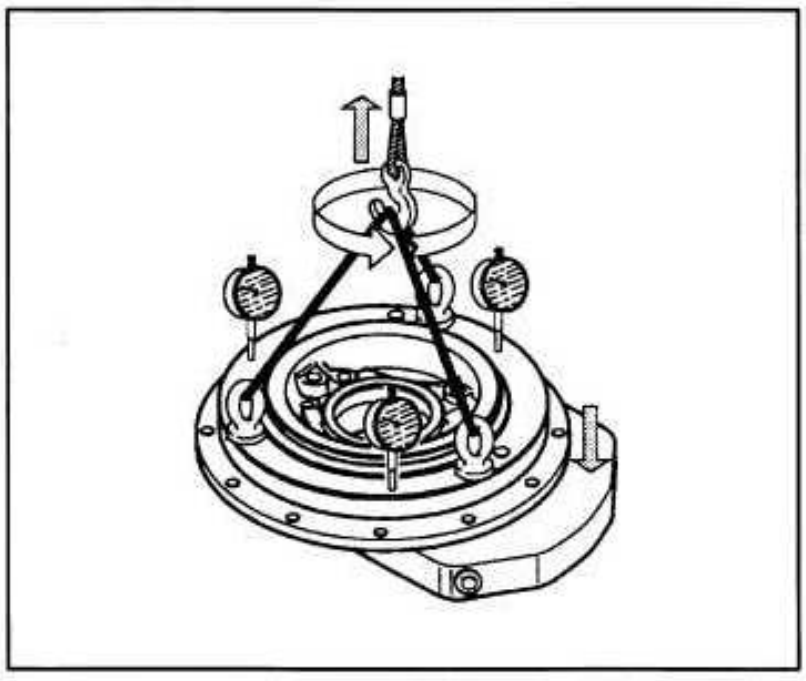


Figure 4-20 – Check Trunnion Bearing

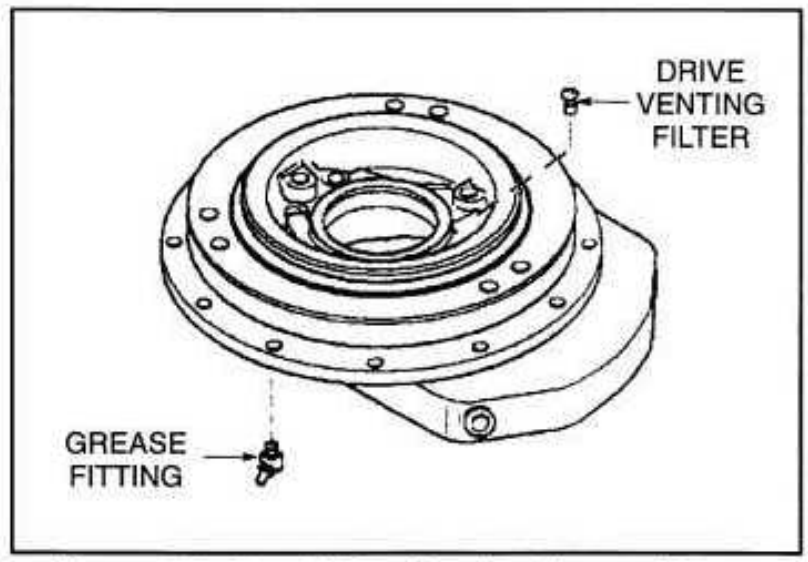


Figure 4-21 – Install Drive Venting Filter and Grease Fitting

48. Raise the upper housing using a lifting device and a spring balance to obtain approximately 50 kg (110 lb) of force. Rotate the trunnion bearing several times and position at the mark again. The maximum bearing clearance is 0.03 mm (0.0012 in). If the bearing clearance is more than the recommended clearance, the trunnion bearing and upper housing must be replaced.

NOTE: The large ball bearing is part of the upper housing. The upper housing and the ball bearing are replaced as a unit.

49. Install the drive venting filter as far as possible into the upper part of the MDU. See Figure 4-21.

50. Install grease fitting. See Figure 4-21.

51. Use Loctite 574 to install the upper housing on the lower housing. Make sure the upper housing is aligned correctly and use a punch to install the two dowels, if removed. Install the capscrews. Tighten the 8 mm capscrews to 23 N•m (17 lbf ft) torque. Tighten the 10 mm capscrews to 46 N•m (34 lbf ft) torque. Install the Allen head capscrews and the washers and nuts. Tighten the nuts to 23 N•m (17 lbf ft) torque.

52. Install the wheel and the lug nuts. Tighten the nuts in a cross pattern to one-half the torque value specified in Section 2. Tighten the lug nuts again using the cross pattern to obtain the proper torque.

53. Lubricate trunnion bearing using the recommended grease listed in Section 2. Add the grease through both fittings. Slowly rotate the MDU while filling the fittings with grease. A dry bearing will take approximately 55 g (0.12 lb) of grease to fill the bearing completely.

54. Fill the MDU to the level/fill plug using the recommended oil listed in Section 2. Add the oil slowly. The oil must go through the bearings to the lower part of the MDU. Fill until the oil just starts to run out. Install the plug and tighten to 22 N•m (17 lbf ft).

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE
Lift truck will not move.	Traction motor not operating.
	Damaged gears or bearings.
Master drive unit makes noise.	There is not enough lubricant or the wrong lubricant has been used.
	Dry or damaged bearings.
	Wrong bearing or gear adjustment.
	Worn or damaged gears.
Oil leaks at the housing cover.	Housing cover is not sealed or prcperly seated.
	Capscrews not sealed off or not tightened to specified torque.
Oil leaks at the wheel shaft.	Shaft seal incorrectly mounted or damaged.
	Surface of axle shaft damaged.
Oil leaks at the filler plug or drain plug.	Dirt between sealing ring and housing.
	Plugs not tightened to specified torque.
Oil leakage between lower and upper housings.	Sealing surface not sealed off.
	Capscrews not tightened to specified torque.
Oil leaks in motor compartment.	Too much oil in MDU.
	Breather defective.
	Traction motor seal defective.
Banging noise at helical gears.	Teeth on the helical gear or helical pinion damaged.
Ringing noise.	Helical gear and pinion running without lubrication.
Grinding noise.	Bearing preload or backlash not properly adjusted.
Trunnion bearing difficult to turn, binds or exceeds maximum clearance.	The centering ring has separated and dirt has penetrated into the bearing.
	Cage segments are damaged.
	Deformation of the balls or ball races.
	Bearing not properly lubricated.

Yale
Industrial Trucks

SECTION 5 – CONTENTS

BRAKE SYSTEM

GENERAL

This section has the description and the repair procedures for the brake assembly.

NOTE: Many of the procedures need the compartment door open. To open the door, turn the capscrew that fastens the door one quarter turn and open the door.

The brake assembly is a mechanical brake mechanism that is installed on the top of the traction motor. The brake assembly has a brake drum, two brake shoes, a cam and cam lever and the return spring for the brake shoes. The cam moves the brake shoes against the brake drum. A spring and linkage operates the cam lever to apply the brake. A hydraulic slave cylinder moves this same linkage to release the brake. The brake drum rotates with the armature of the traction motor. The brake shoe assembly and the linkage are fastened to the traction motor housing.

A master cylinder and brake pedal assembly is fastened to the frame under the operator compartment. The brake pedal extends through the floor plate and is foot operated. There is a hydraulic line between the master cylinder and the slave cylinder. The master cylinder assembly operates the slave cylinder using hydraulic pressure from the master cylinder and pedal operation. A reservoir for the brake fluid is mounted on the traction motor compartment door.

The brake is a normally ON type of mechanism. The brake is fully applied when the brake pedal is in the UP position. Releasing the brake pedal permits a spring to move the cam lever and apply the brake shoes against the brake drum. A brake switch prevents the operation of the traction system when the brake pedal is released to apply the brake.

To RELEASE the brake, the operator must step on the brake pedal. The brake pedal moves the push rod of the master cylinder to apply hydraulic pressure to the slave cylinder. The push rod pushes the control bar against the brake spring to release the brake shoes. The shoe springs move the brake shoes away from the brake drum. The brake shoes will be gradually released as the brake pedal is depressed. The brake pedal must be depressed as far as possible to completely release the brake. Movement of the control bar operates the brake switch when the brake pedal is depressed to release the brake. The brake switch must be ON before the traction system can operate.

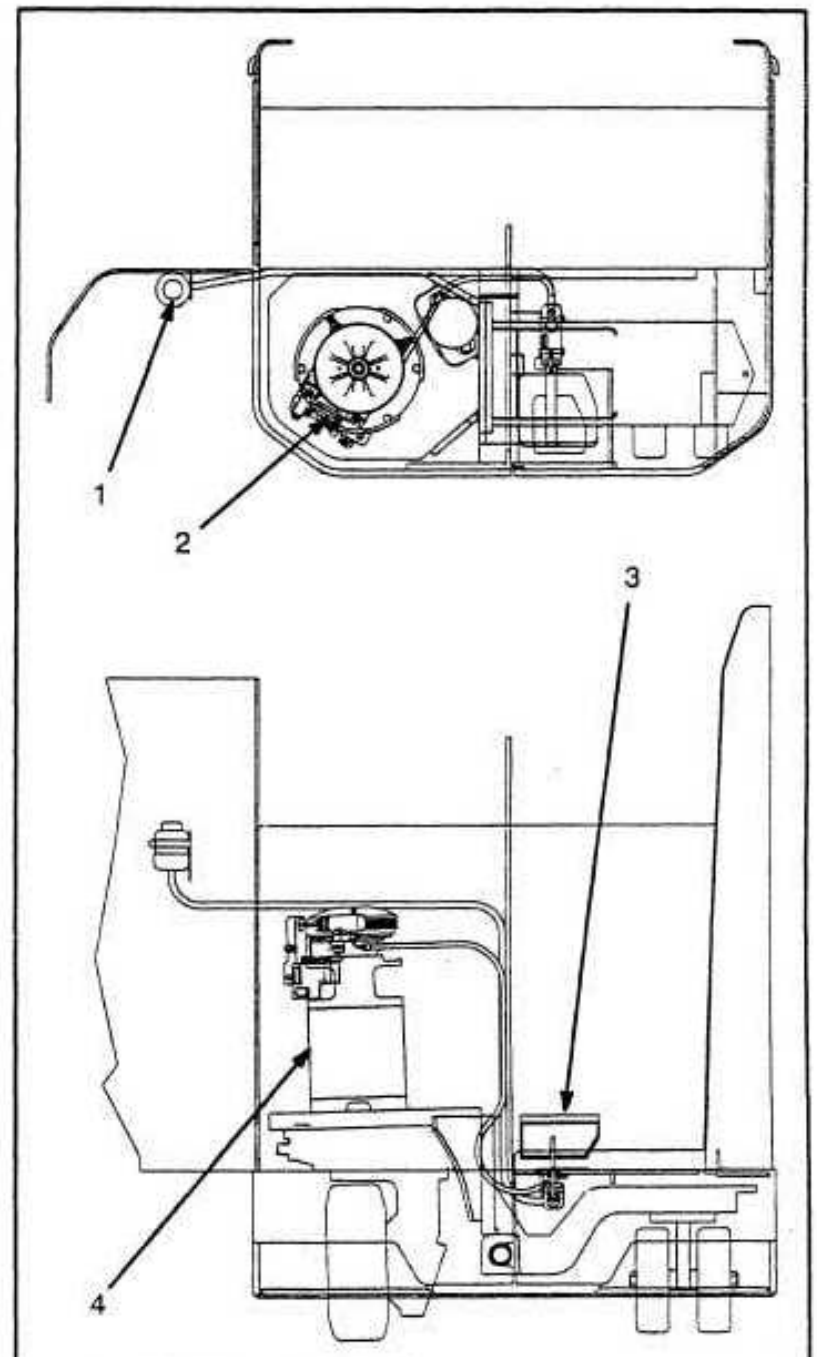
BRAKE ASSEMBLY

NOTE: Turn the screw that fastens the door one-half turn and open the door.

Removal and Disassembly (See Figure 5-1 and Figure 5-3)

NOTE: The complete brake assembly normally does not need to be removed to make repairs. Remove only the parts necessary to make the repair.

1. Disconnect the battery. Put blocks on each side of the drive wheel to prevent movement of the lift truck. Open the motor compartment door for access to the brake assembly.



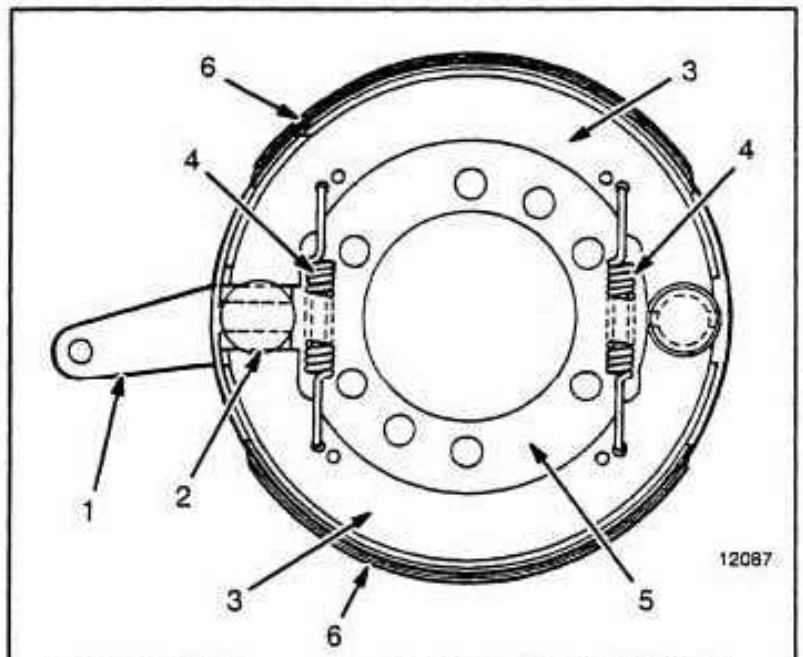
1. BRAKE RESERVOIR
2. BRAKE ASSEMBLY
3. BRAKE PEDAL AND MASTER CYLINDER
4. TRACTION MOTOR

Figure 5-1 – Brake Arrangement

WARNING: Put a "DO NOT OPERATE" tag in the operator's compartment and remove the key as a warning to prevent operation. To help prevent injury or damage, do not operate the lift truck without a brake.

2. Remove the nut that attaches the brake drum to the armature shaft of the traction motor. Remove the hardened washer. Depress and hold the brake pedal to release the brake shoes. Remove the brake drum from the armature shaft.

3. Check for damaged or broken parts. Replace any damaged or broken parts. Replace both brake shoes if the minimum thickness of either brake lining is 2.4 mm (0.09 in) or less. Disconnect the shoe return springs to remove the brake shoes. See Figure 5-2. The maximum allowable inside diameter of the brake drum is 153.2 mm (6.032 in). Replace the brake drum if the maximum inside diameter exceeds the maximum allowable inside diameter.



1. CAM LEVER
2. CAM
3. BRAKE SHOE
4. SHOE RETURN SPRING
5. SUPPORT PLATE
6. BRAKE LINING

Figure 5-2 – Brake Assembly

WARNING: Do not allow brake fluid, grease or oil to get on the brake linings or shoes.

4. Loosen the locknut on the actuation rod. Remove the jam nut and lockwasher retaining the actuation rod to the cam lever on the brake assembly. Remove the two socket head capscrews and lockwashers retaining the brake assembly to the brake mounting bracket. Be certain to note the position that the capscrews are assembled in. Remove the brake assembly.

CAUTION: Brake fluid damages paint. Immediately remove any brake fluid that is on a painted surface.

5. Loosen the jam nut retaining the set screw and push rod to the slave cylinder. Remove the capscrew, lockwasher and hose clamp retaining the hose assembly. Back off on the set screw far enough to remove the push rod. Position a container under the slave cylinder to catch any excess brake fluid. Remove the hose assembly. Cap the hose assembly. Remove the capscrew and lockwashers retaining the slave cylinder to the brake mounting bracket. Refer to SLAVE CYLINDER –DISASSEMBLY AND ASSEMBLY if the slave cylinder requires repairs.

6. Tag and remove the wires to the brake switch. Remove the two screws, lockwashers, nut plate and insulator retaining the brake switch to the brake mounting bracket.

WARNING: The spring has tension and can release with enough force to cause an injury.

7. Use a drift pin to drive the groove pin retaining the spring guide to the control bar. Remove the control bar, bushings and brake spring.

8. Remove the locknut, tube, bearing and actuation rod from the control bar.

9. Remove the shoulder screw, bushings, flat washer and nut to remove the control bar from the brake mounting bracket.

10. Remove the four socket head capscrews and lockwashers retaining the brake mounting bracket to the traction motor. Remove the brake mounting bracket, brake drum spacer and the brake assembly spacer.

11. Check for damaged or broken parts. Replace any damaged or broken parts.

Assembly and Installation
(See Figure 5-3 and Figure 5-4)

1. Align the brake assembly spacer and brake mounting bracket on the traction motor. Position the brake assembly on the spacer and install the four socket head capscrews and lockwashers. Tighten the capscrews to 23 N•m (17 lbf ft) dry.

2. Install the bushings for the spring guide in the control bar. Position the brake spring on the spring guide, align the spring guide and spring with the control bar and install the groove pin.

3. Install the bushings for the shoulder screw in the control bar. Align the control bar with the brake mounting bracket. The spring guide must be located so the guide will fit through the opening in the brake mounting bracket. Position the flat washer between the control bar and the brake mounting bracket and install the shoulder screw and jam nut. The control bar must be free to move.

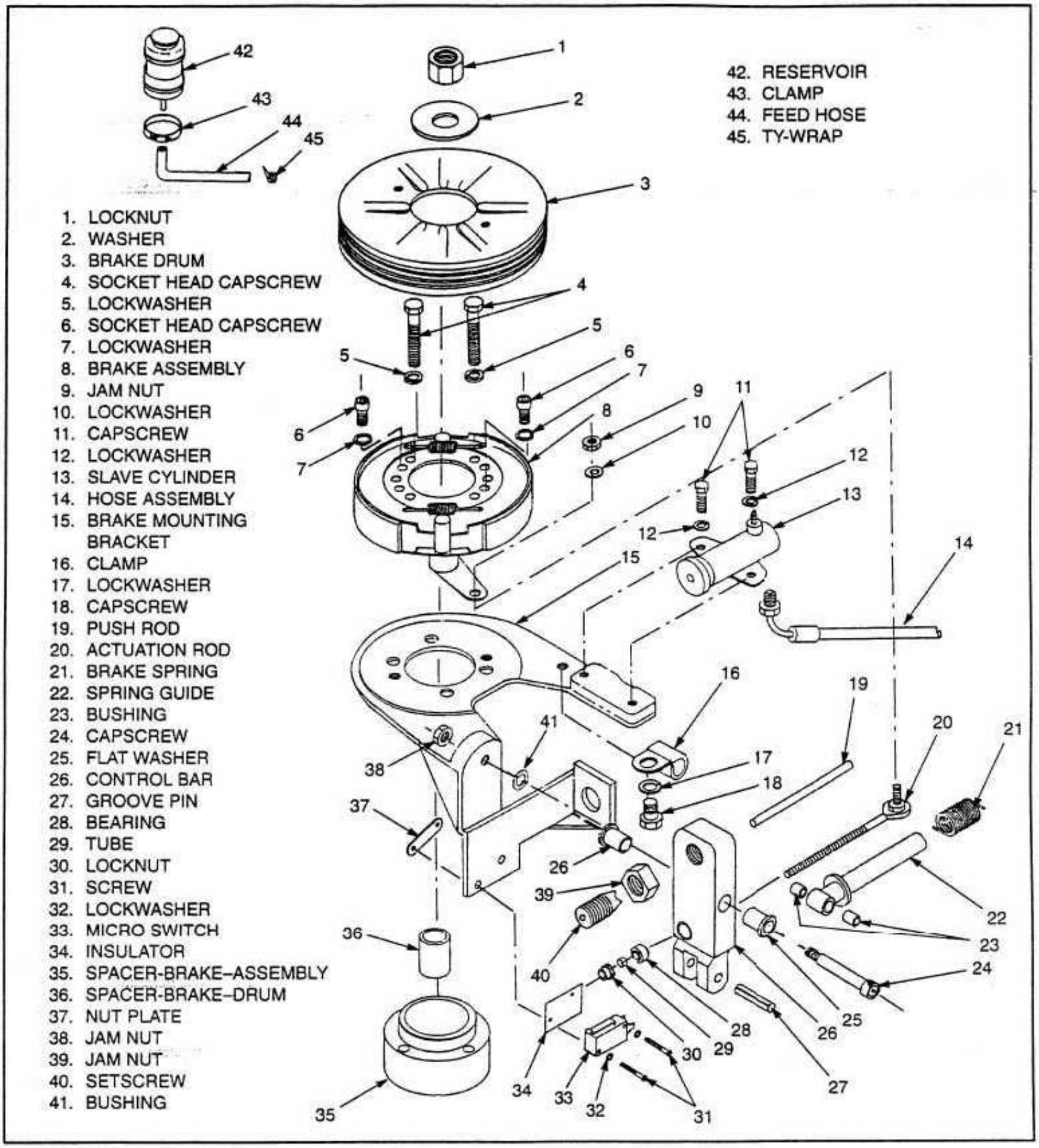


Figure 5-3 – Brake Assembly

4. Install the bushing for the actuation rod in the control rod. Install the actuation rod in the control rod. Install the tube and locknut on the actuation rod. Install the two socket head capscrews and lockwashers to retain the brake assembly to the brake mounting bracket. Align the cam lever of the brake assembly and the actuation rod and install the jam nut and lockwasher.

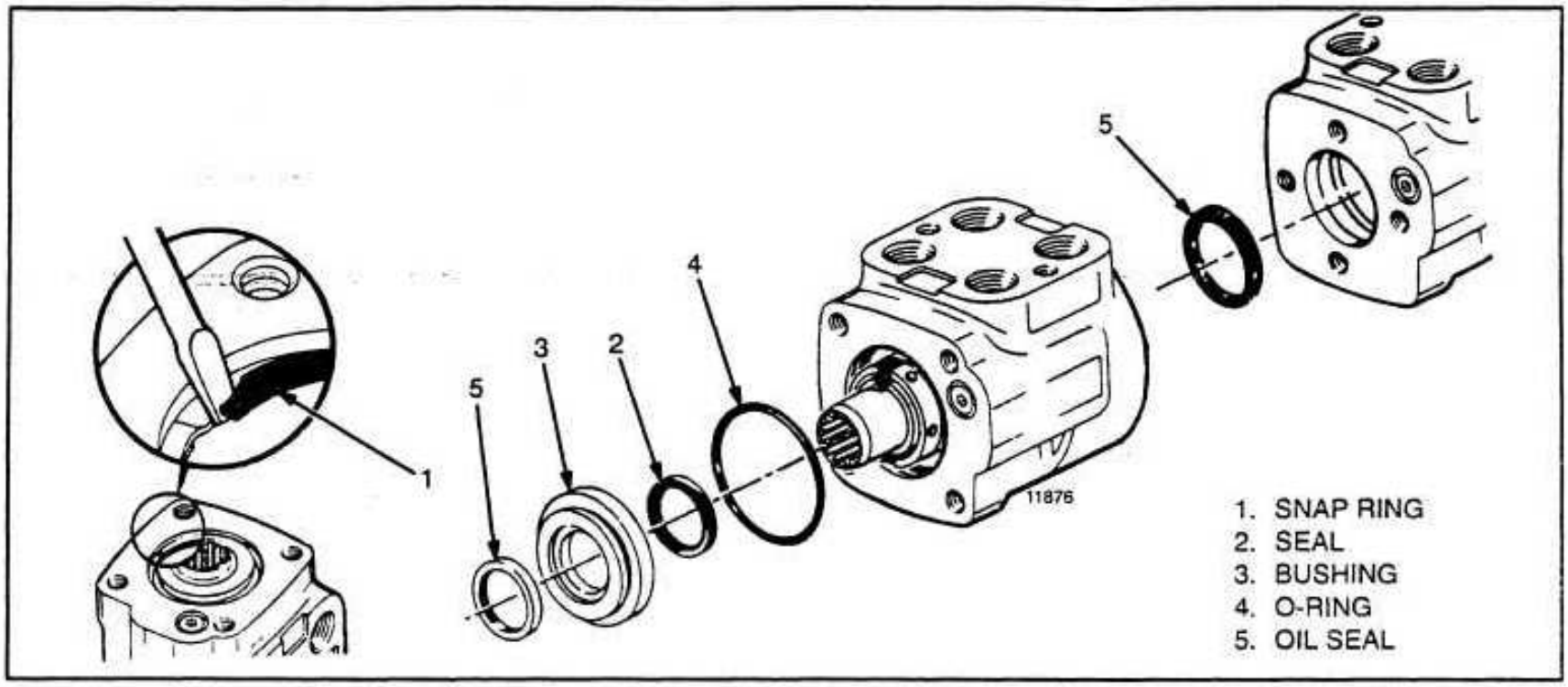


Figure 6-10 – Oil Seal and Bushing Removal

Cleaning

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.

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.

Assembly

Use new seals, O-rings and neutral position springs during assembly. Lubricate all parts with clean hydraulic oil.

1. Install the dust seal.

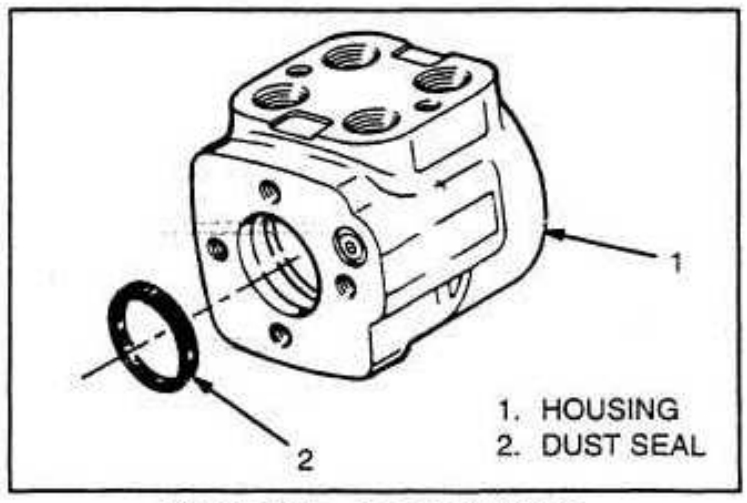


Figure 6-11 – Seal Installation

2. Put the spool (3) on the work bench then put the housing (6) onto the spool as shown. Install the guide ring (2) with the O-ring (1) on the end of the spool. Put a large thrust washer (4, see STEP 4) on top of the guide ring and O-ring assembly. Use a socket or tube (5) to push on the washer and install the O-ring and guide ring in the housing. Carefully remove the washer, tube and spool from the housing. Install the housing as described in the FRAME Section.

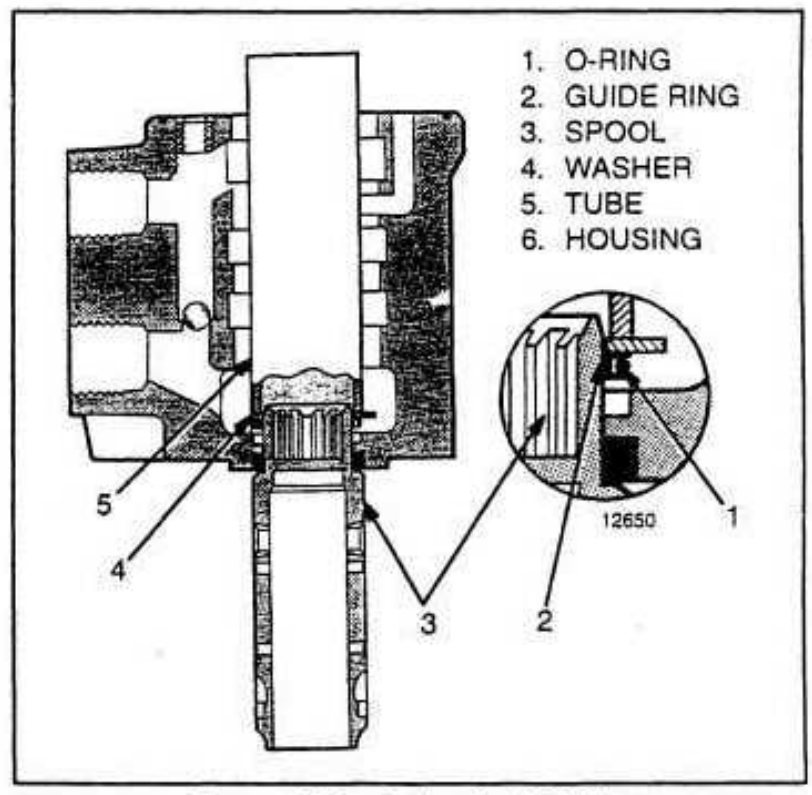


Figure 6-12 – O-ring Installation

3. Carefully assemble the spool and sleeve. Make sure the spool rotates freely in the sleeve.

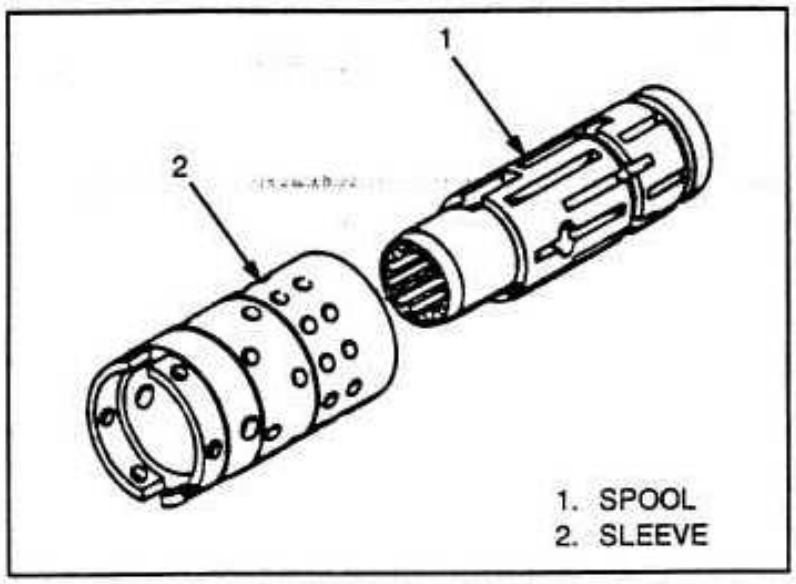


Figure 6-13 – Spool and Sleeve Assembly

4. Assemble the neutral position springs then push them into position in the spool (4). Make sure the flat springs (1) are installed to the outside of the curved springs (2). Install the center pin (3). Install the ring (5) on the sleeve (over the neutral position springs). The ring must turn freely on the sleeve.

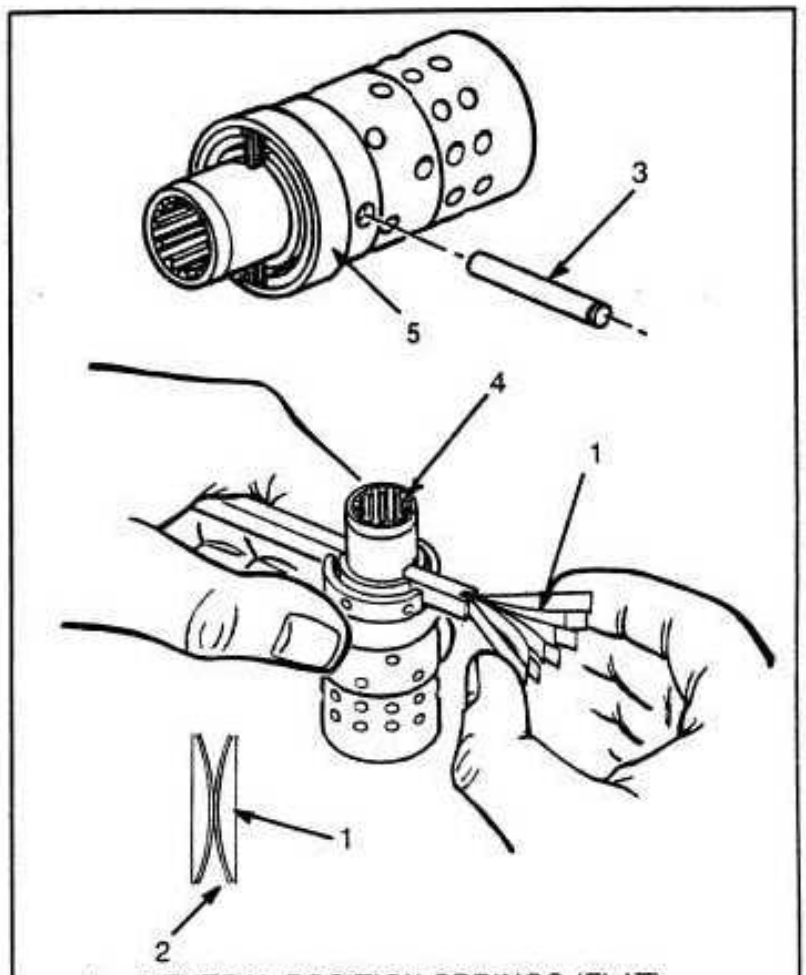


Figure 6-14 – Spring Installation

5. Install the thrust washers and thrust bearing on the spool. Carefully install the spool and sleeve assembly in the housing. Install the dust seal (9) in the bushing (6). Install the bushing (6), seal (8) and the O-ring (3) in the housing. Use the snap ring (7) to hold the bushing in position. Make sure the sleeve rotates freely in the housing.

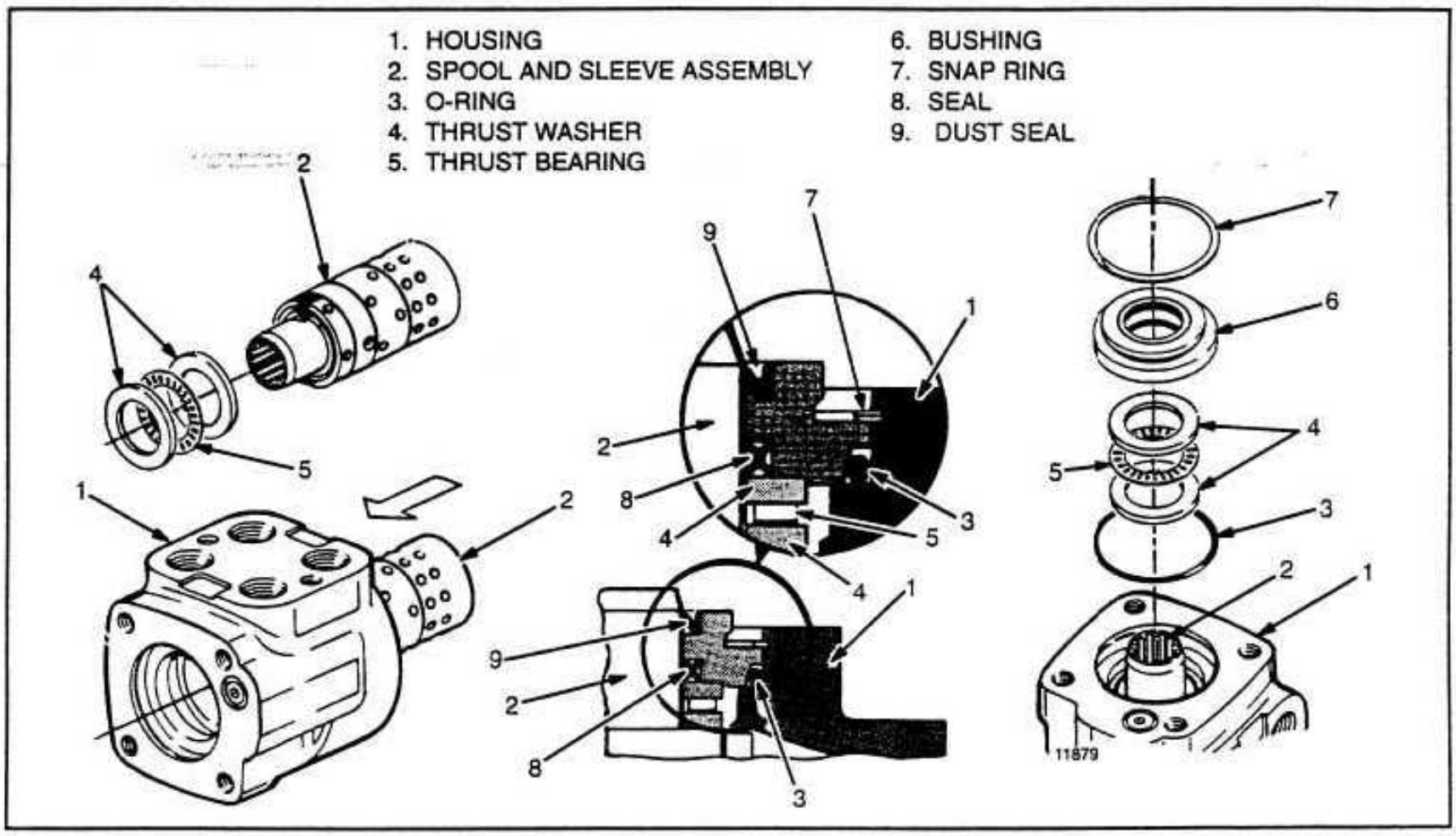


Figure 6-15 – Spool and Housing Assembly

6. Install the check ball and sleeve. Make sure the sleeve is even with or below the surface of the housing (2). Lubricate the O-ring (3) and install the O-ring and port plate (4). Align the holes in the port plate with the holes in the housing.

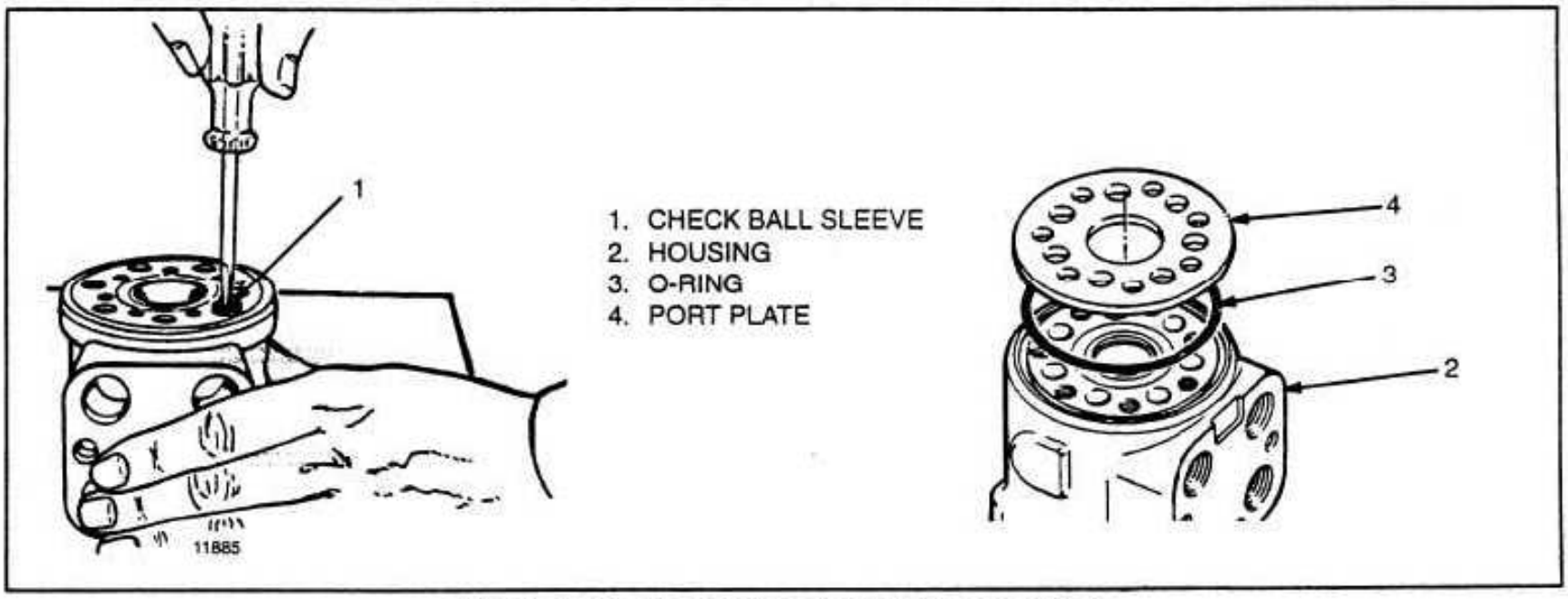


Figure 6-16 –Check Ball and Port Plate Installation

7. Install the center shaft (1) so that it engages with the center pin (2) in spool and sleeve assembly. Make sure the center pin is still parallel to the surface with the ports. Install the rotor (3) on the center shaft. Make sure that a valley in the rotor aligns with the slot (center pin) in the center shaft. Install the O-ring (5) and stator (4). Make sure to align the marks made during disassembly.

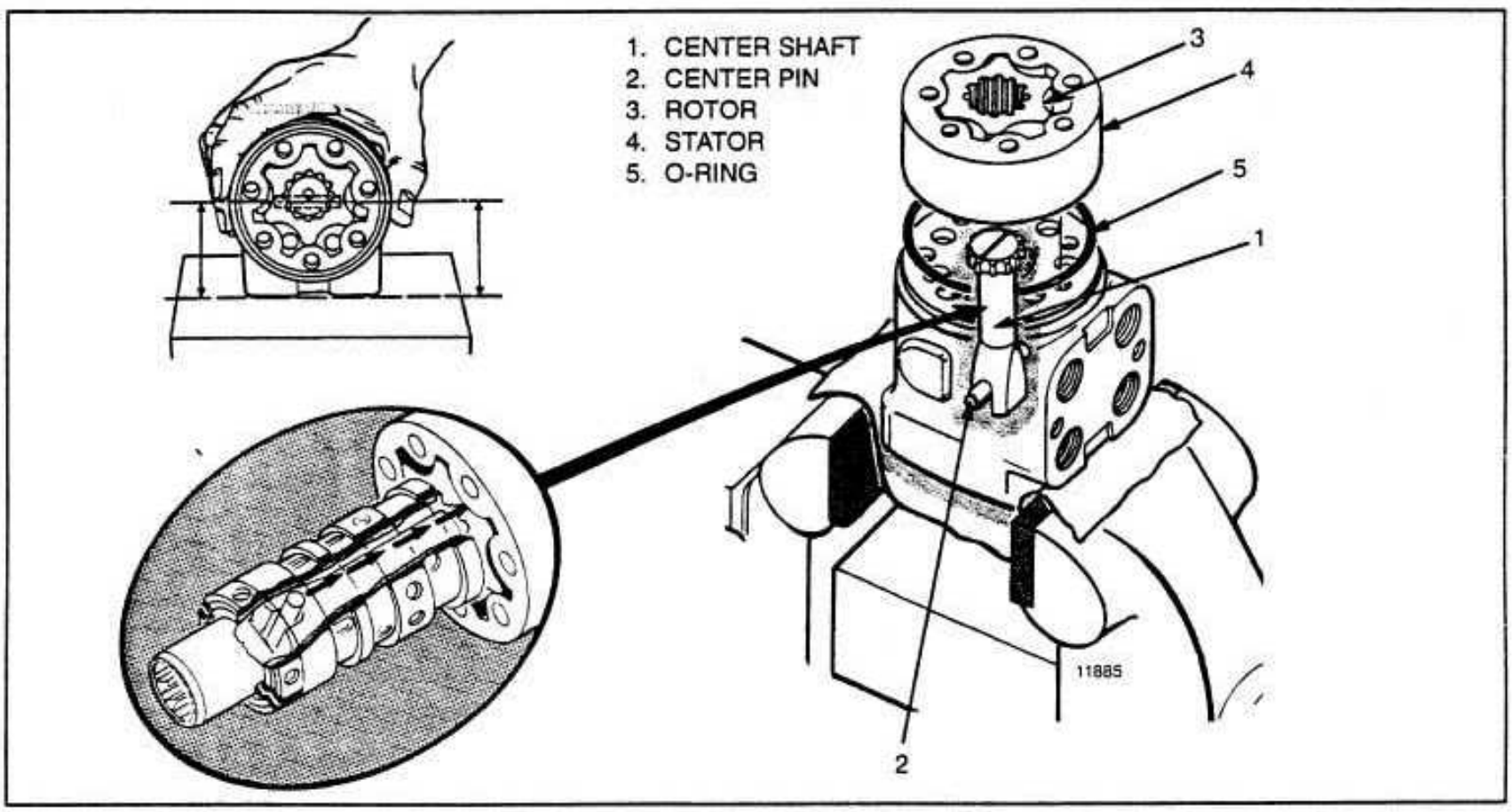


Figure 6-17 – Stator and Rotor Assembly

8. Install the spacer plate (1). Install the O-ring (2) and the end cap (3). Tighten the capscrews for the end cap in the sequence shown to 17 N•m (150 lbf in), then tighten them to 30 N•m (265 lbf in). Make sure the capscrew (4) with the pin fits in the hole for the check ball (5).

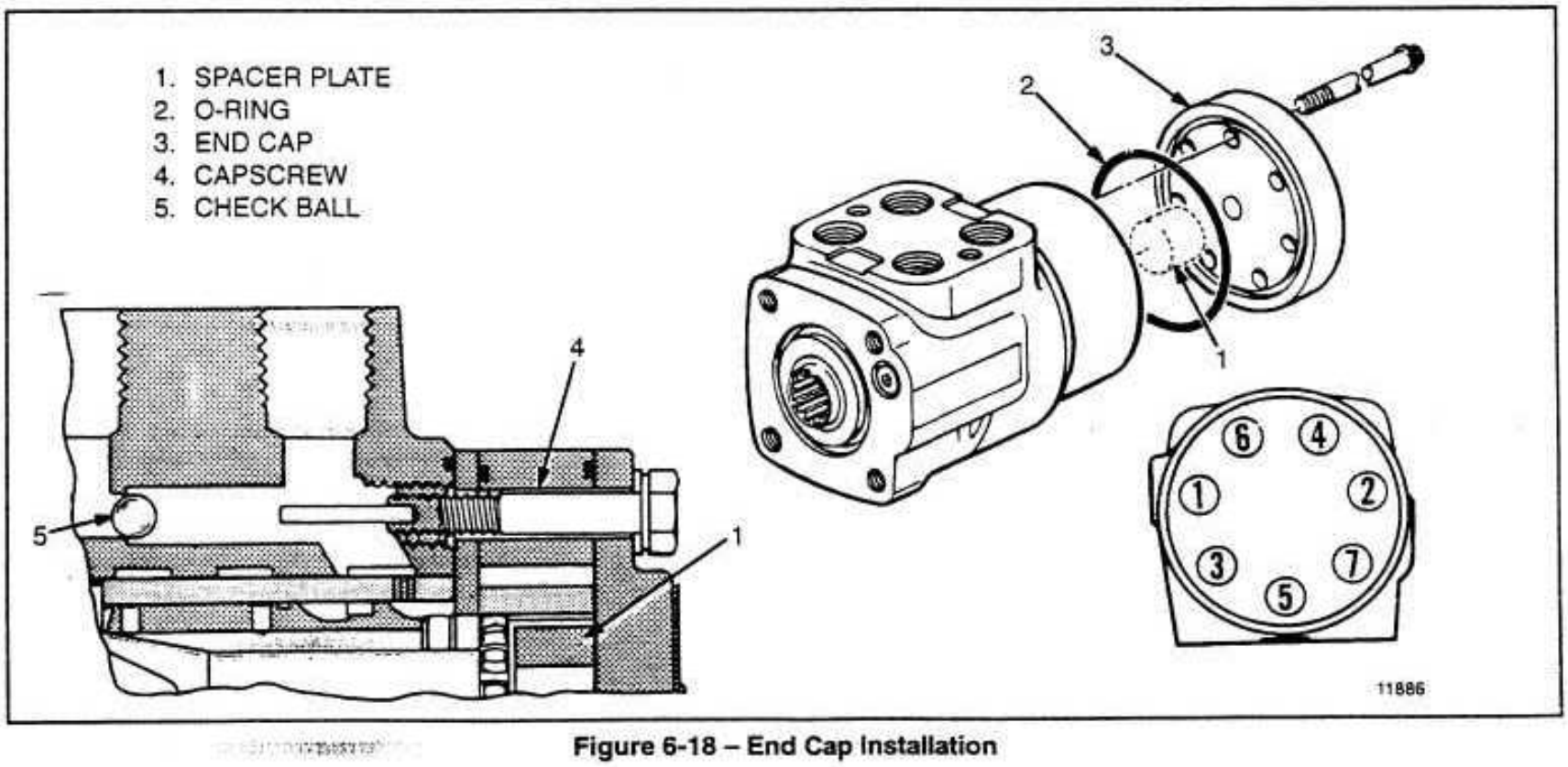


Figure 6-18 – End Cap Installation

9. Install the steering column on the steering control unit. Make sure the spines are aligned.

STEERING TILLER MOUNTING BRACKET ASSEMBLY

Removal and Disassembly

WARNING: Make sure the brake pedal is released and the brake is applied. Put blocks on both sides (front and back) of the drive/steer tire and the caster wheels to prevent movement of the lift truck. Put a block on each side (front and back) of the load wheels to prevent movement of the lift truck.

1. Disconnect the battery. Block the drive/steer tires, caster wheels and load wheels on both sides to prevent movement of the lift truck. Open the drive unit compartment cover. Remove the battery compartment cover and the drive unit cover.

2. Remove the socket head capscrew, lockwasher and nut retaining the steering tiller to the shaft. Remove the tiller.

3. Remove the capscrews, hardened washers and nut plate retaining the steering tiller mounting bracket assembly to the lift truck frame.

WARNING: Be careful when removing or installing 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 and installation.

4. Remove the snap ring retaining the socket to the tiller shaft. Remove the sprocket and woodruff key from the tiller shaft. Remove the second snap ring and remove the back-up washer. Remove the tiller shaft.

5. Remove the bearings from the bracket.

Assembly and Installation

1. Install the bearings in the mounting bracket.

2. Install the tiller shaft through the mounting bracket and bearings.

WARNING: Be careful when removing or installing 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 and installation.

3. Use a pair of snap ring pliers and install the snap ring to retain the tiller shaft in the mounting bracket. Install the back-up washer.

4. Install the sprocket, woodruff key and the second snap ring to retain the sprocket on the tiller shaft.

5. Install the mounting bracket on the lift truck frame using the two capscrews, hardened washers and nut plate.

6. It may be necessary to loosen the capscrews retaining the steering column and steering control unit mounting bracket to the lift truck frame to adjust the steering chain. Then use a 3/8 drive ratchet placed in the mounting bracket slot and rotate clockwise to adjust the steering chain. The steering chain should have a 4.06 to 3.05 mm (0.16 to 0.12 in) deflection on the slack side at midpoint. Tighten the capscrews to 31 N•m (23 lbf ft) torque after the steering chain has been properly adjusted.

7. Install the drive unit cover and the battery compartment cover. Remove the blocks from the tires and wheels. Connect the battery and test the steering control unit. Close the drive unit compartment cover.

8. Install the center shaft (1) so that it engages with the center pin (2) in spool and sleeve assembly. Make sure the center pin is still parallel to the surface with the ports. Install the rotor (3) on the center shaft. Make sure that a valley in the rotor aligns with the slot (center pin) in the center shaft. Install the O-ring (5) and stator (4). Make sure to align the marks made during disassembly.

STEERING PUMP AND MOTOR

Steering Pump Specifications

Pump Relief Valve Setting: 8.4 ± 0.35 MPa (1200 ± 50 psi)

Hydraulic Steering Pump Flow Rate: 11.7 l/min (3.1 gpm) at 2000 rpm

Removal–Pump and Motor

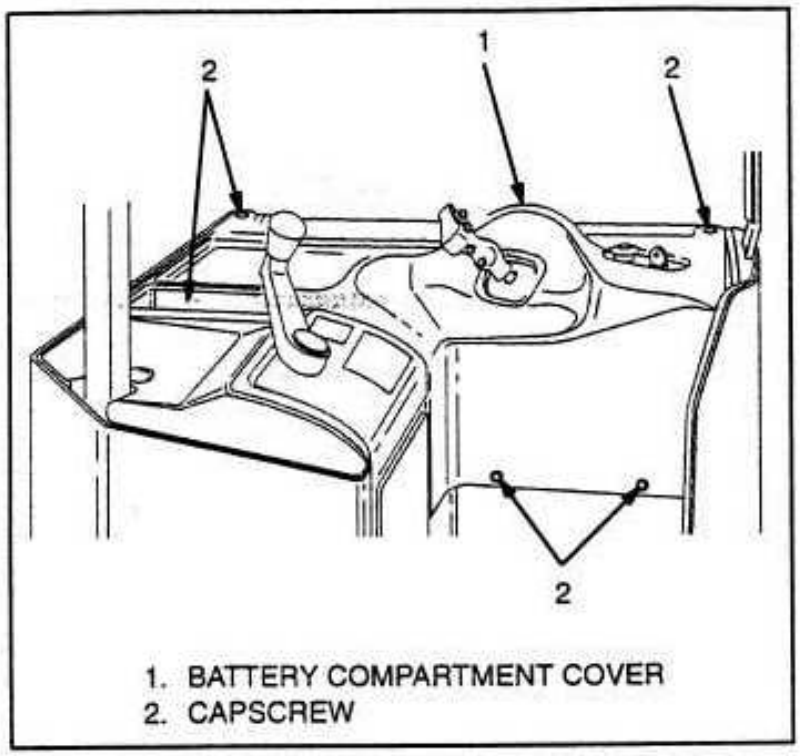
WARNING: Make sure the brake pedal is released (in the UP position) and the brake is applied. Put blocks on both sides (front and back) of the drive/steer tire and the caster wheels. Put a block on each side (front and back) of the load wheels to prevent movement of the lift truck.

NOTE: The recommended maintenance and repairs for the steering pump motor is covered in MOTOR MAINTENANCE, Section 3, this manual.

1. Disconnect and remove the battery. Refer to CHANGING THE BATTERY, Section 2, this manual.

2. Remove the battery compartment cover by removing the five capscrews that retain the cover to the frame.

3. Identify and tag the power cables on the terminals of the motor for correct connection during installation. Disconnect the cables from the motor.



1. BATTERY COMPARTMENT COVER
2. CAPSCREW

Figure 6-19 – Battery Compartment Cover Removal

4. Install labels on the hydraulic lines for proper installation at assembly. Disconnect the hydraulic lines and install caps on the lines and fittings.

WARNING: The motor and pump assembly has a weight of approximately 27 kg (60 lb). The steering pump motor has ceramic magnets. Do not let the motor fall. The magnets can be damaged.

5. Remove the four capscrews, lockwashers, brackets and rubber channel mounts. Remove the pump and motor assembly from the lift truck frame.

6. Remove and inspect the motor brushes. Refer to MOTOR MAINTENANCE, Section 3, this manual.

NOTE: If the motor must be disassembled for cleaning or repairs, remove the pump so a new oil seal can be installed in the motor.

7. Remove the mounting plate from the motor.

8. Mark the pump mounting flange and the motor housing for alignment during assembly. Mark the parts of the motor housing for proper orientation during assembly.

9. Remove the two capscrews and lockwashers retaining the pump to the motor.

Assembly and Installation–Pump and Motor

1. Install a new seal in the motor end housing.

2. Coat the splines of the pump shaft with the recommended multi-purpose grease listed in the LUBRICATION SCHEDULE, Section 2, this manual.

3. Align the pump shaft with the opening in the motor. Align the marks made during disassembly.

4. Install the pump on the motor using the two capscrews and lockwashers.

WARNING: The motor and pump assembly has a weight of approximately 27 kg (60 lb). The steering pump motor has ceramic magnets. Do not let the motor fall. The magnets can be damaged.

5. Install the mounting plate on the motor.

6. Install the pump and motor assembly in the truck using the four capscrews, lockwashers, brackets and rubber channel mounts.

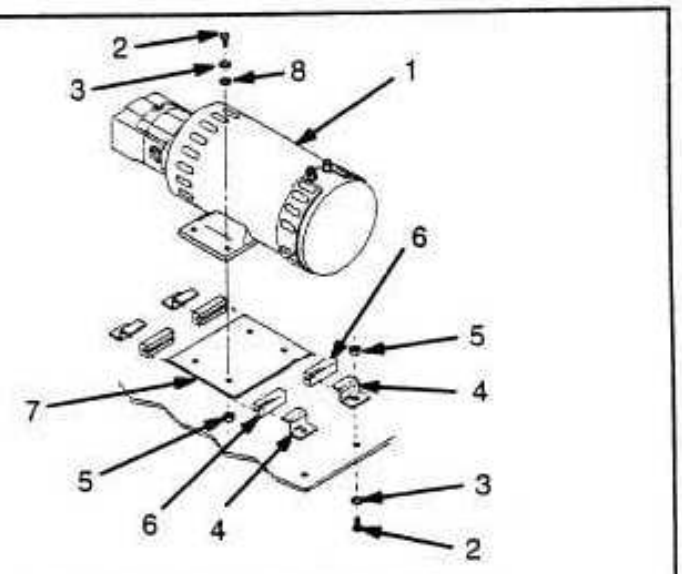
7. Remove the caps from the hydraulic lines and fittings. Connect the hydraulic lines to the fittings identified during removal.

8. Connect the power cables to the proper motor terminals.

9. Install the battery compartment cover using the five capscrews that retain the cover to the frame.

10. Install and connect the battery. Refer to CHANGING THE BATTERY, Section 2, this manual.

11. Check the oil level in the hydraulic tank. Remove blocks from wheels. Test operate the steering system and check for leaks.



1. PUMP AND MOTOR ASSEMBLY
2. CAPSCREW
3. LOCKWASHER
4. BRACKET
5. NUT
6. RUBBER CHANNEL MOUNT
7. MOUNTING PLATE
8. FLAT WASHER

Figure 6-20 – Steering Pump and Motor Mounting

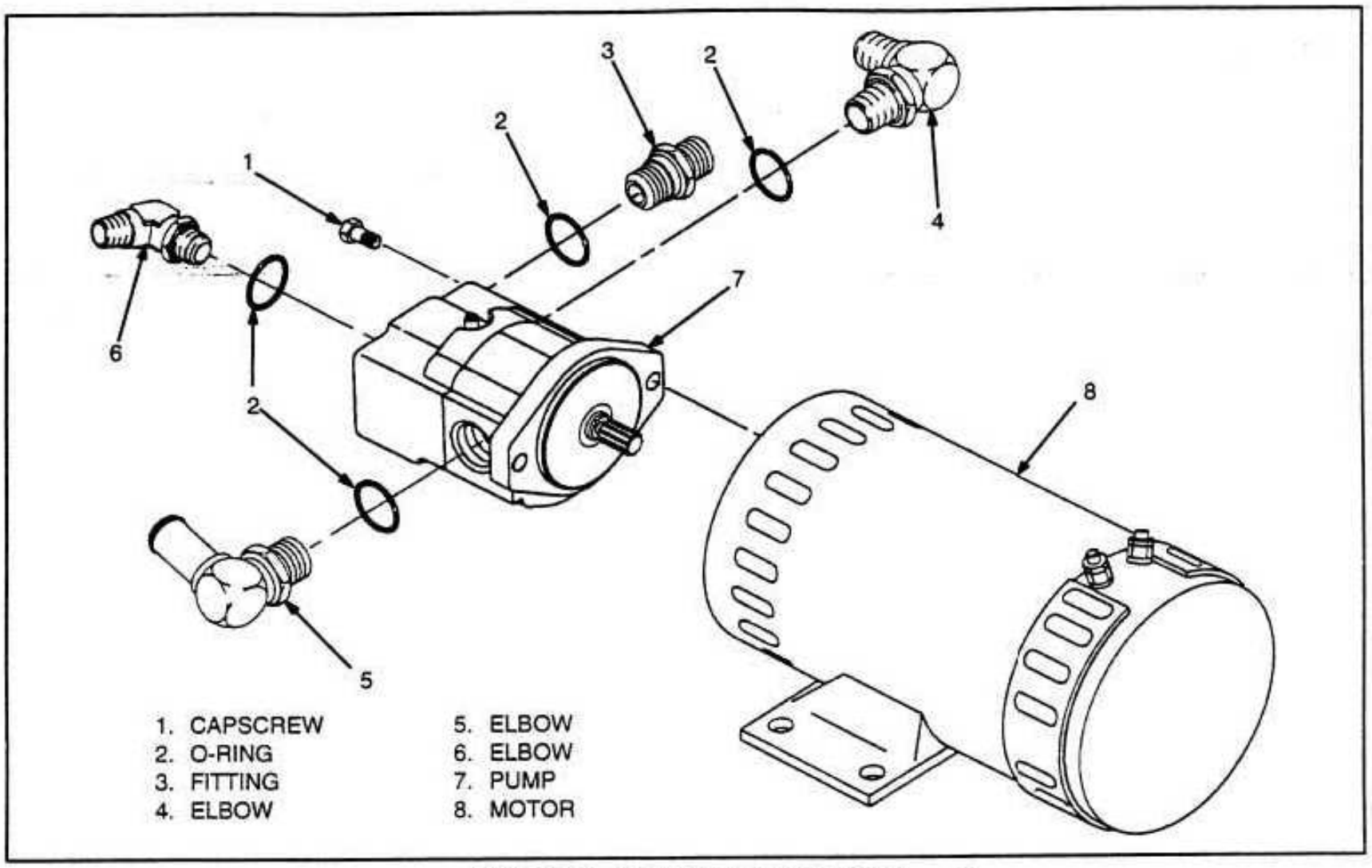


Figure 6-21 – Steering Pump and Motor

Disassembly–Steering Pump

1. Disassemble the fittings, elbows and O-rings from the pump body. Disassemble the pressure relief valve from the pump body.

WARNING: Be careful when removing or installing 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 and installation.

2. Use a pair of snap ring pliers and remove the snap ring retaining the shaft seal to the drive gear shaft. Remove the shaft seal.

3. Mark the flange, pump body and load sensing valve assembly for orientation during assembly.

4. Remove the four capscrews from the pump body. Separate the mounting flange and the end cover from the pump body. Remove the back-up rings, seals,bushings and O-rings.

5. Remove the idler gear and drive gear.

6. Inspect the drive gear, idler gear and the pump body for damage. If any of these parts are damaged, the pump must be replaced with a new pump. All seals, O-rings, back-up rings, and snap ring must be replaced if the present pump is to be used.

NOTE: The manufacturer does not recommend servicing the individual components within the load sensing valve assembly.

Yale
Industrial Trucks

SECTION 7

7 HYDRAULIC SYSTEM

Yale
Industrial Trucks

SECTION 7 – CONTENTS

HYDRAULIC SYSTEM

HYDRAULIC SYSTEM–INTRODUCTION

The hydraulic system for these lift trucks is comprised of three separate sub-systems. These sub-systems are:

- Main Hydraulic – Lift and Lower
- Auxiliary Hydraulic – Reach, Tilt and Optional Sideshift
- Power Steering

NOTE: The hydraulic system on the NS series of lift trucks differs because there is no reach mechanism used.

The hydraulic system includes two pumps. The hoist pump will only operate when the control handle is moved to start the hoist function. The hoist pump and motor is located in the drive unit compartment. The steering pump operates when the key switch is turned on and the operator is in the proper position in the operator's compartment. The steering pump provides hydraulic oil for the auxiliary functions and the power steering function. The steering pump has a built in priority valve to insure priority flow to the power steering. When both the power steering and auxiliary functions are used at the same time, the priority valve will insure that full flow is provided to the power steering. The steering pump is located in the compartment above the battery. See Section 6 for information on the steering pump.

The main and auxiliary hydraulic functions are controlled by an electro-hydraulic control valve. This valve is custom designed to provide full proportional control of the Hoist, Reach, Tilt and Sideshift functions. To provide maximum control, each function is operated electronically using an electro proportional EPV Series Valvistor® valve. The valve also provides proportional control for the auxiliary functions. Separate hoist and auxiliary relief valves are provided to allow operation at different pressures and minimize energy consumption.

The electro-hydraulic control valve is actuated by the control handle. The multi-function control handle is a two axis control, used for both hydraulic and traction operation. Each auxiliary function, Reach, Tilt and Sideshift (optional) has a separate switch located on the control handle. There is also a switch for the horn. Not all functions are used on each lift truck and the location of the functions may vary between lift truck models. See Figure 7-1 and Table 7-1.

The control handle is moved horizontally for forward and reverse travel. Up and down movement while pressing an auxiliary function switch, controls the auxiliary hydraulic functions. Up and down movement without pressing an auxiliary function switch operates the lift function, up for lift, down for lower. Once the handle is moved from the neutral position the switch can be released. The function will be locked until the handle is returned to the neutral position.

NOTE: Diagonal movement of the handle will control both travel and a hydraulic function simultaneously.

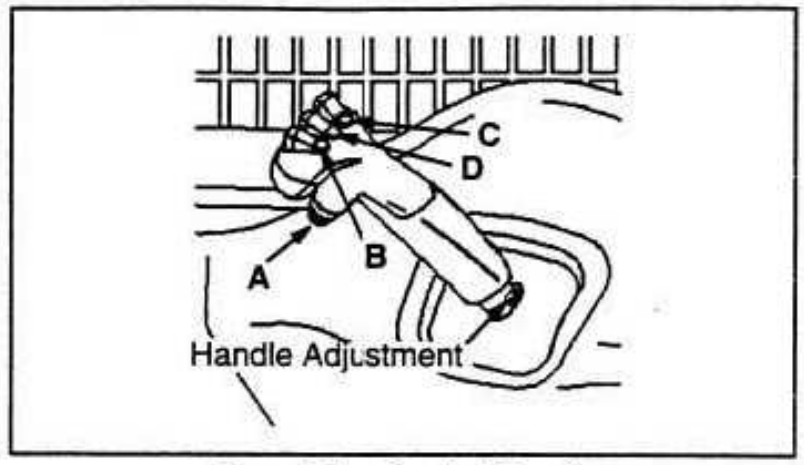


Figure 7-1 – Control Handle

Switch	Truck Model	
	NS	NR/NDR
A	Horn	Horn
B	Sideshift (If so equipped)	Extend
C	Not Available	Sideshift (If so equipped)
D	Not Available	Tilt

Table 7-1 – Control Handle Switch Locations

If the operator wants to perform an auxiliary function in one direction, immediately followed by the reverse direction (example: extend then retract), the reach auxiliary function switch should be pressed and held until the handle is moved from the extend (up) position, through the neutral position into the retract (down) position. If the switch is not held while moving through the neutral position the control will select the lowering function and mast lowering will occur.

WARNING: Unintentional mast lowering can cause damage or injury.

The power steering system is controlled by the movement of the steering tiller. Turning the steering tiller will direct the flow of hydraulic oil to the steering control unit and the steering motor. The steering tiller will turn from lock to lock in five revolutions and provide 180° of steering angle at the drive/steer wheel.

The hoist system features a single pump and motor. The motors that drive the hoist or steering pumps can be 24 or 36 volts. The 24 volt hoist pump motor is rated at 7.9 hp while the 36 volt motor is rated at 14.5 hp. The 24 volt power steering/auxiliary function pump motor is rated at 2.5 hp and the 36 volt motor is rated at 2.4 hp. See Section 3 for additional information concerning the motors.

The hydraulic system also includes a molded plastic tank. The tank is common for all hydraulic functions. The size of the tank is determined by the size of the battery compartment. See Table 7-2.

BATTERY COMPARTMENT SIZE	OIL TANK CAPACITY TO FULL MARK
317.5 mm (12.5 in)	17.6 litres (4.64 gal)
370.8 mm (14.6 in)	19.5 litres (5.16 gal)
421.6 mm (16.6 in)	21.5 litres (5.67 gal)
Hydraulic System = Tank Capacity +4.01 litres (1.06 gallons) in lines	

Table 7-2 – Hydraulic Oil Tank Capacities

The hydraulic level dipstick is externally mounted and may be accessed without opening any covers. The compartment cover must be removed to service the hydraulic tank. There is a breather/filler screwed onto the top of the tank to cover the fill spout and strainer. The strainer and breather/filler assembly are mounted in the fill spout. A second breather is also screwed into the top of the hydraulic tank. There is a 10 micron spin on filter located in the return line to the hydraulic tank. The breather/filler assembly, strainer, breather and filter should be serviced in accordance with the recommended lubrication charts found is Section 2.

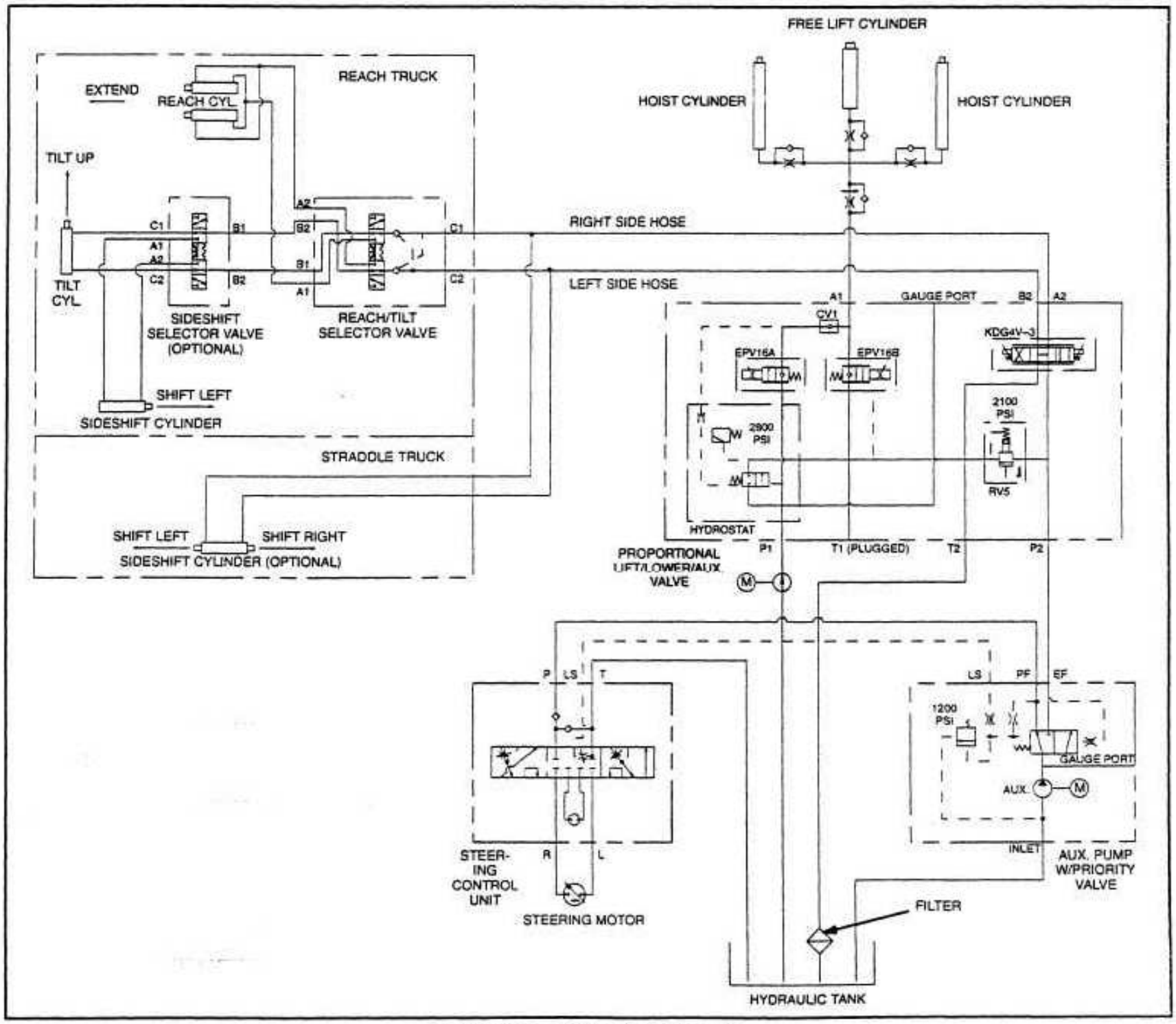


Figure 7-2 – Hydraulic Schematic

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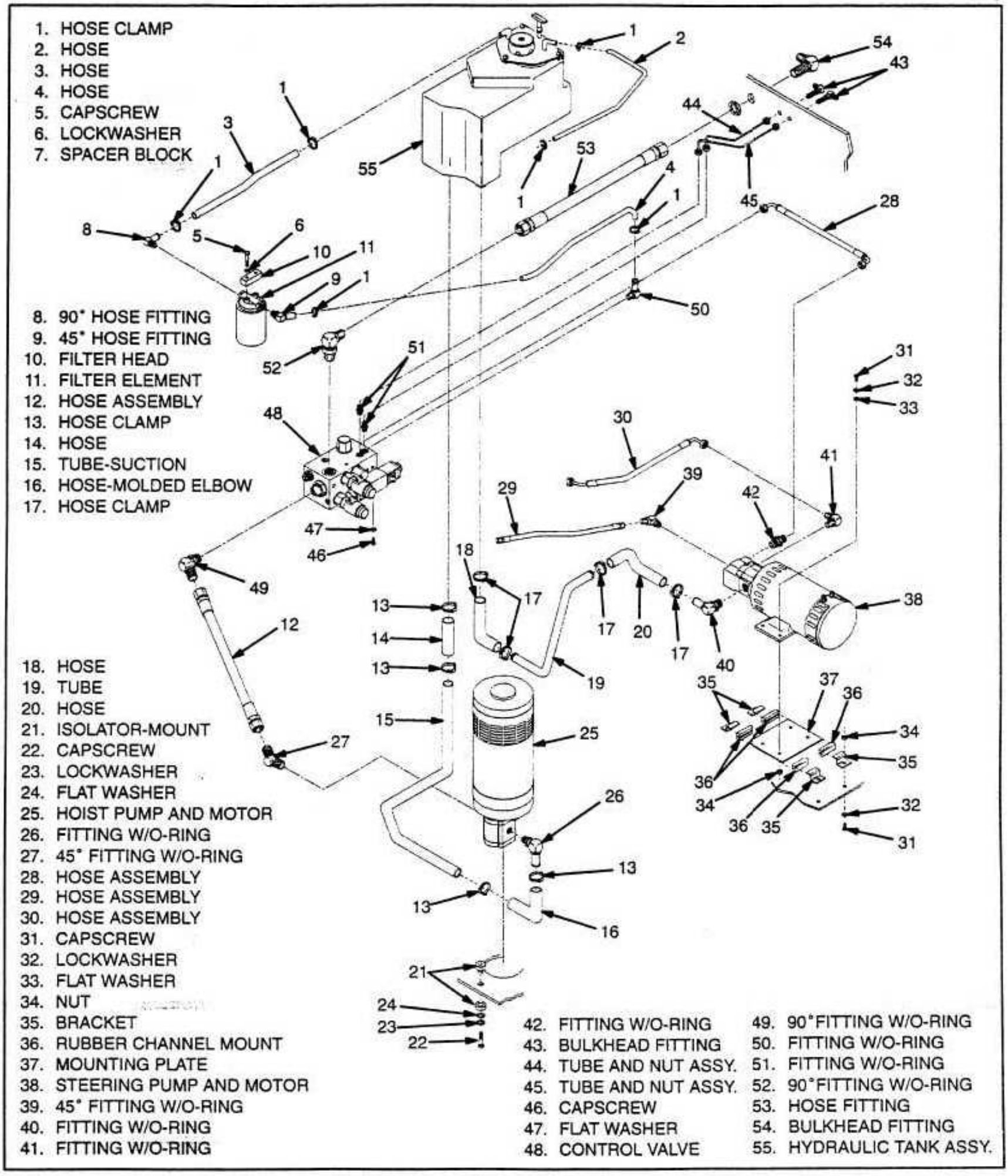


Figure 7-3 – Hydraulic System

SPECIFICATIONS

Electro-hydraulic Control Valve

NOTE: The port identification for all the ports is stamped on the body of the Electro-Hydraulic Control Valve.

Hoist Relief Valve Setting ..... 2800 ± 100 psi

Auxiliary Relief Valve Setting ..... 2100 ± 50 psi

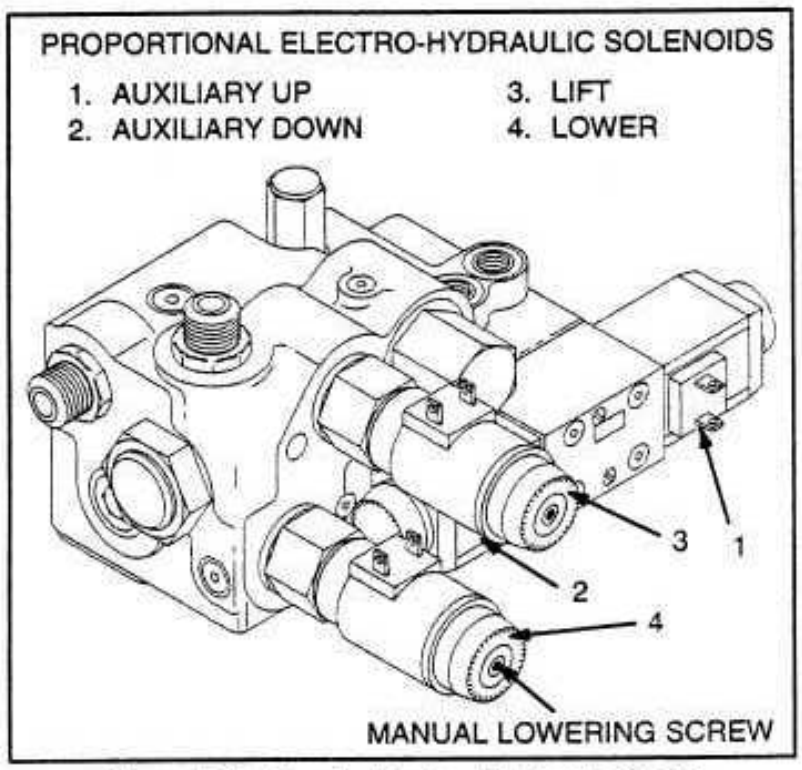


Figure 7-4 – Electro-Hydraulic Control Valve

Electro-hydraulic Control Valve–Manual Lowering

WARNING: Allow no one under or near the lift mechanism or load during the manual lowering procedure.

A provision is provided on the lowering valve to allow manual lowering of the forks if necessary. Manual lowering is accomplished by inserting an 1/8 inch allen wrench into the manual lowering screw (located in the center of the lowering Valvistor) and slowly turning it clockwise until the forks begin to lower. See Figure 7-4. Be sure to return the screw to the original position once the manual lowering process is complete by slowly turning the screw counterclockwise until it stops.

WARNING: Failure to return the manual lowering screw to the full counterclockwise position will cause the forks to lower unexpectedly.

Hoist Pump

The rated flow for the hoist pump for the 24 volt lift trucks is 26.8 l/min (7.1 gpm) at 2000 rpm.

The rated flow for the hoist pump for the 36 volt lift trucks is 42.4 l/min (11.2 gpm) at 2000 rpm.

Steering Pump

Pump Relief Valve Setting: 8.4 ± 0.35 MPa (1200 ± 50 psi)

HOIST PUMP AND MOTOR

Removal

WARNING: Make sure the brake pedal is released (in the UP position) and the brake is applied. Put blocks on both sides (front and back) of the drive/steer tire and the caster wheels to prevent movement of the lift truck. Put a block on each side (front and back) of the load wheels to prevent movement of the lift truck.

1. Turn the key switch to OFF. Disconnect the battery.

2. Open the drive unit compartment door. Position a drain pan under the hoist pump. Loosen and disconnect the feed and return lines to the hoist pump. Install plugs in the hydraulic lines to prevent dirt from entering the system and to prevent hydraulic oil from draining out.

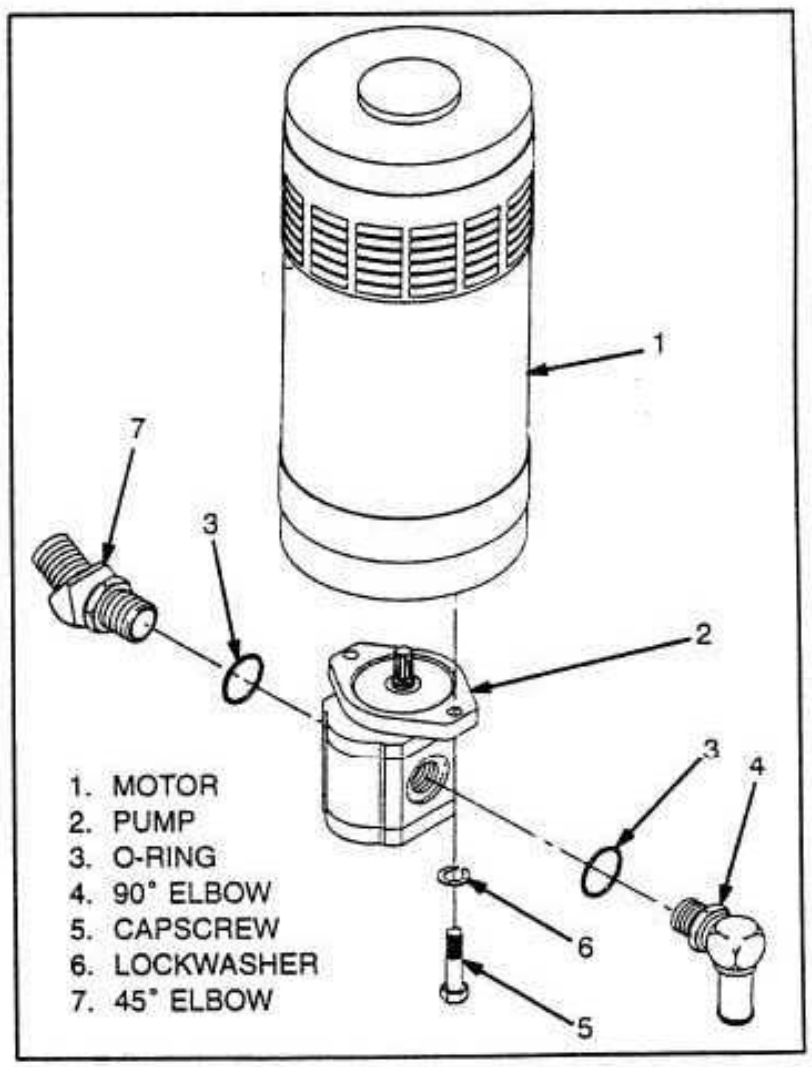


Figure 7-5 – Hoist Pump and Motor

WARNING: The hoist pump and motor is heavy. Be sure that all lifting devices (lifts, cables, chains, or slings) are suitable and of adequate capacity to lift the hoist pump and motor. The hoist pump and motor assembly can weigh approximately 253.6 kg (115 lb).

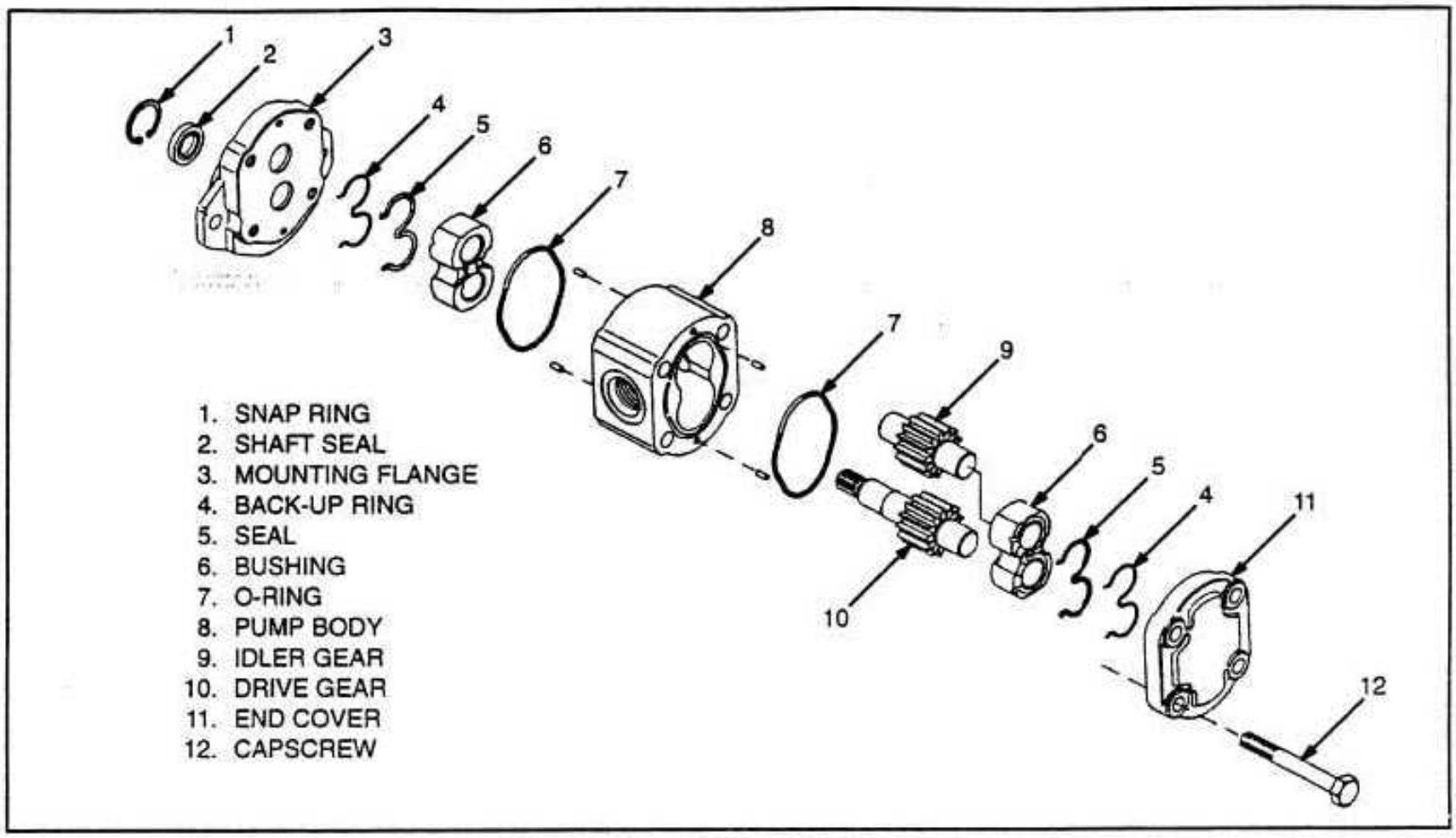


Figure 7-6 – Hoist Pump Disassembled

3. Position a lifting device around the hoist pump motor. Remove the four capscrews, lockwashers, flat washers and isolator mounts retaining the hoist pump and motor to the lift truck frame.

4. Move the hoist pump and motor to a clean work area to disassemble the hoist pump and motor.

NOTE: The recommended maintenance and repairs of the hoist pump motor is covered in Section 3.

Installation

WARNING: The hoist pump and motor is heavy. Be sure that all lifting devices (lifts, cables, chains, or slings) are suitable and of adequate capacity to lift the hoist pump and motor. The hoist pump and motor assembly can weigh approximately 253.6 kg (115 lb).

1. Align the hoist pump and motor with the mounting holes in the frame using a lifting device.

2. Install the four isolator mounts, flat washers. lockwashers and capscrews.

3. Remove the plugs from the hydraulic lines. Install the hydraulic lines on the hoist pump.

4. Remove the blocks from under the drive/steer wheel, caster wheels and load wheels. Check the hydraulic level. Connect the battery.

HOIST PUMP

Disassembly

1. Remove the two capscrews and lockwashers that retain the hoist pump to the motor. Separate the pump from the hoist motor. See Section 3 for repairs on the hoist pump motor.

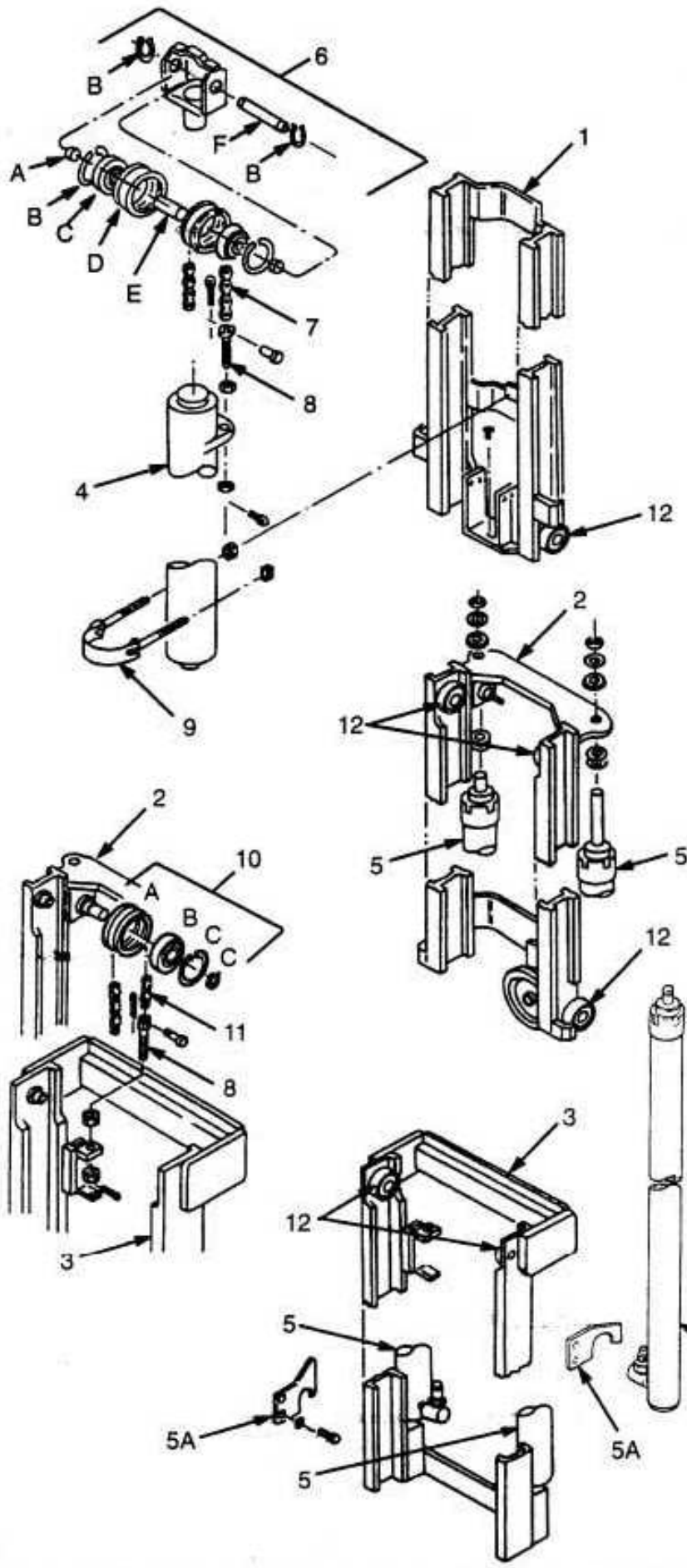
2. Disassemble the elbows and O-rings from the pump body.

WARNING: Be careful when removing or installing 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 and installation.

3. Use snap ring pliers and remove the snap ring from the pump drive gear shaft. Remove the shaft seal.

4. Remove the four capscrews from the pump body. Separate the mounting flange and the end cover from the pump body. Remove the back-up rings, seals, bushings and O-rings.

5. Remove the idler gear and drive gear.



1. INNER WELDMENT
2. INTERMEDIATE WELDMENT
3. OUTER WELDMENT
4. FREE LIFT CYLINDER
5. MAIN LIFT CYLINDER
   - A. LOCK PLATE
   - B. RETAINER
6. SHEAVE SUPPORT ASSEMBLY
   - A. SPACER
   - B. SNAP RING
   - C. BALL BEARING
   - D. CHAIN SHEAVE
   - E. SPACER (NS ONLY)
   - F. SHAFT
7. FREE LIFT CHAIN
8. CHAIN ANCHOR
9. CLAMP
10. CHAIN SHEAVE ASSEMBLY (RH)
    - A. CHAIN SHEAVE
    - B. BALL BEARING
    - C. SNAP RING
11. MAIN LIFT CHAIN
12. LOAD ROLLER
13. FREE LIFT HOSE SHEAVE
14. FLOW REGULATOR HOUSING
15. HYDRAULIC TUBE (MAIN LIFT)
16. HYDRAULIC HOSE (MAIN LIFT)
17. TRUNNION STUB SHAFT
18. TO TRUCK CONTROL VALVE

REAR VIEW
HOSE ROUTING – LIFT

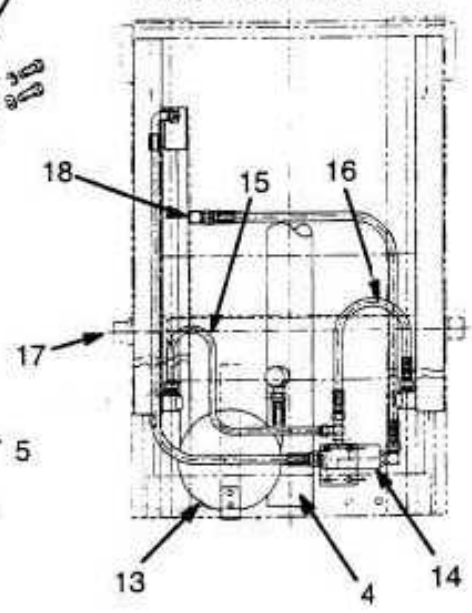


Figure 8-25 – Triplex Mast Assembly

2. Inspect the sliding and rolling surfaces of the channels for damage (dents) and wear (grooves). Inspect all welds for cracks.

Free Lift Cylinder–Removal and Installation (See Figure 8-25, Figure 8-28 and Figure 8-28)

NOTE: Cylinder seals can be replaced without removing the cylinder from the mast assembly.

NOTE: The following procedure describes how to remove the free lift cylinder without removing the reach or carriage and mast assembly from the lift truck. If the reach or carriage assembly has been removed, do only Steps 4 through12 to remove and install the cylinder.

1. On NR or NDR units, operate the REACH/RETRACT control handle to fully retract the forks. Use safety chains to fasten the parts of the reach assembly so that the forks cannot extend.

2. Raise the reach approximately 60 cm (2 ft). Use safety chains between the reach assembly and inner weldment to prevent the reach assembly from lowering. Operate the LIFT/LOWER control handle to retract the free lift cylinder.

3. Remove the load backrest extension as described in LOAD BACKREST EXTENSION–REMOVAL AND INSTALLATION.

4. Fasten the free lift chains so that they cannot move over the sheaves. Remove the cotter pins from the pins that fastens each free lift chain to the chain anchor at the free lift cylinder. Carefully remove these pins. This removal procedure will not change the chain adjustment.

5. If there are also hose and cable sheaves in the sheave support, disconnect the hoses at the free lift cylinder. Install caps on the hydraulic fittings. Disconnect the spring of the cable tension device. See Figure 8-27.

6. Lift the sheave support assembly out of the free lift cylinder and put the lift chains, hoses, cable and sheave support over the carriage or reach assembly or fasten them out of the way.

7. Hold the LIFT/LOWER control lever in the LOWER position for approximately five seconds to fully retract the free lift cylinder rod and to remove all hydraulic pressure. It can be necessary to push the rod into the cylinder while the control lever is in the LOWER position.

WARNING: Make sure that the power is off and the key is removed. Put a "DO NOT OPERATE" tag in the operator's compartment. Disconnect the battery and put a tag or lock on the battery connector.

8. Loosen, but do not remove, the nuts for the main lift chains at the chain anchors near the top of the outer weldment. The inner weldment will lower so that the free lift hose does not have tension.

9. Disconnect the hydraulic hose from the free lift cylinder and install caps on the fittings.

10. Remove the cylinder strap. Use a crane and sling to lift the free lift cylinder off the locating screw and out of the inner weldment. If the free lift cylinder must be disassembled, see the HYDRAULIC SECTION.

11. Reverse the procedure to install the cylinder. Make sure the locating screw for the base of the free lift cylinder is installed before installing the cylinder. Use a crane and sling to install the cylinder on the inner weldment.

12. Adjust the main lift chains. Check for hydraulic leaks and correct operation after the cylinder is installed. See CHECKS AND ADJUSTMENTS.

Main Cylinders–Removal and Installation (See Figure 8-25)

NOTE: It is necessary to remove the mast assembly from the truck to remove the main cylinders.

1. Remove the mast assembly as described in TRIPLEX MAST ASSEMBLY–REMOVAL.

2. Remove the safety chains that fasten the mast weldments together and use a prybar to carefully and slowly move the intermediate weldment approximately 75 mm (3 in) out of the outer weldment.

3. Install a sling and crane to support the cylinder. Remove the capscrews, washers and lock plate at the base of one main cylinder.

WARNING: Be careful when removing or installing snap rings. These snap rings are large and 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. Remove the snap ring, back-up washer, rubber bushing and shims (if applicable) that fasten the cylinder rod to the intermediate weldment. If shims are used, make a note of the shim arrangement. Normally, the shim arrangement for the replacement cylinder will be similar.

5. Remove the hose or tube between the main cylinder and the flow regulator. If necessary, use a prybar to carefully move the reach assembly or carriage assembly and mast weldments for access. Install a cap on the regulator fitting to prevent leakage.

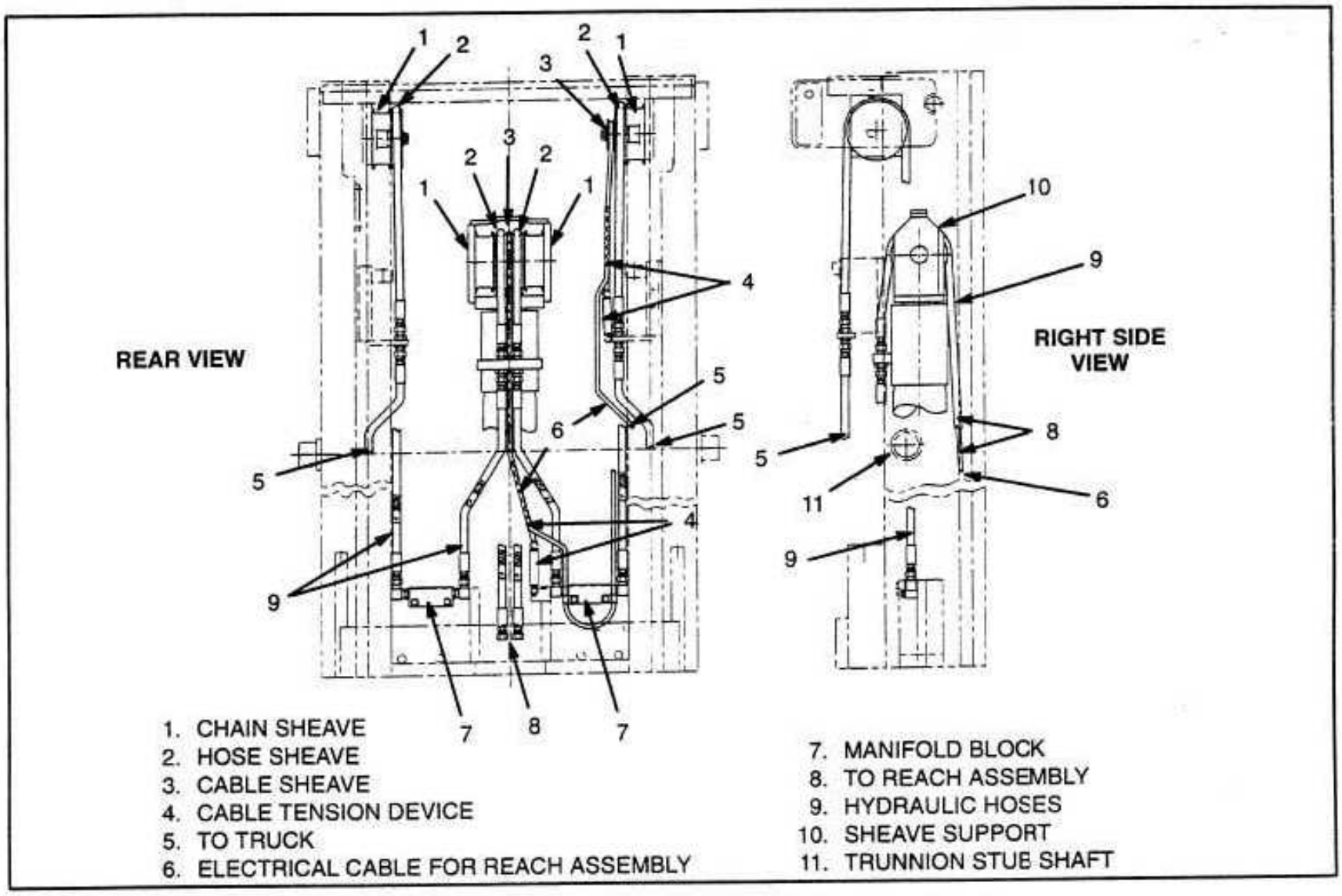
6. Remove the main cylinder retainer, capscrews and washers.

7. Repeat the Steps 2 through 7 to remove the other main cylinder.

NOTE: See the HYDRAULIC SECTION to disassemble and repair the cylinder.

8. Reverse the procedure to install the main cylinders.

9. Push the cylinder toward the top of the mast assembly to move the main cylinder off the locating dowel pin. Continue to push the cylinder so that the rod moves into the cylinder to allow removal from the intermediate weldment.



1. CHAIN SHEAVE
2. HOSE SHEAVE
3. CABLE SHEAVE
4. CABLE TENSION DEVICE
5. TO TRUCK
6. ELECTRICAL CABLE FOR REACH ASSEMBLY
7. MANIFOLD BLOCK
8. TO REACH ASSEMBLY
9. HYDRAULIC HOSES
10. SHEAVE SUPPORT
11. TRUNNION STUB SHAFT

Figure 8-26 – Triplex Hose Routing for Sideshift or Reach Carriage

Inner and Intermediate Mast Assemblies–Removal and Installation
(See Figure 8-25, Figure 8-27, and Figure 8-28)

1. The load rollers and wear plugs must be removed to remove the inner or intermediate weldments. See LOAD ROLLERS AND WEAR PLUGS–REMOVAL AND INSTALLATION.

2. The lift chains, hoses and electrical cable must also be removed to remove the inner or intermediate weldments. To remove the lift chains, hoses and sheaves, see TRIPLEX LIFT CHAINS–REMOVAL AND INSTALLATION, HOSES–REPLACE, TRIPLEX CHAIN SHEAVES–DISASSEMBLY AND ASSEMBLY and HOSES AND CABLE SHEAVES–REPLACE.

3. Use safety chains to fasten the intermediate weldment to the outer weldment. Use a crane or lifting device to support the inner weldment while sliding it out of the intermediate weldment.

4. Remove the safety chains that fasten the intermediate weldment to the outer weldment. Use a crane or lifting device to support the intermediate weldment while sliding it out of the outer weldment.

5. Reverse the removal procedure to install both the intermediate and inner weldments into the outer weldment. install the load rollers and wear plugs during assembly of the mast weldments.

Hoses–Replace
(See Figure 8-27 and Figure 8-28)

1. To replace any hydraulic hoses, fully lower the carriage or reach assembly. Make sure that the system does not have

hydraulic pressure. Hold the control lever (for each function) in the forward position for approximately five seconds to release the pressure. Make sure the hydraulic pump does NOT operate. Move the key to the **OFF** position. Disconnect the battery and put a tag or lock on the battery connector.

NOTE: Access can be difficult for some fittings. If necessary, operate the system to move mast weldments or the carriage or reach assembly. Make sure to follow the SAFETY PROCEDURES after moving components BEFORE starting work. Also make sure the system does not have pressure as described in Step 1.

2. Disconnect hoses, drain any excess oil into a container and install caps to prevent dirt from entering the hydraulic system.

3. Replace the hose. Operate the system to remove all the air from the oil and to check for leaks.

Hose and Cable Sheaves Replace (See Figure 8-27 and Figure 8-28)

NOTE: The following procedures describe how to replace the hose and cable sheaves without removing the carriage or reach assembly or mast assembly from the lift truck. If the mast assembly has been removed, carefully move the carriage or reach assembly, inner or intermediate weldments using a prybar as necessary.

WARNING: The mast weldments can move and cause an injury even if the mast assembly has been removed from the lift truck. Make sure the mast assembly is level to prevent the components from moving without being moved. Use safety chains to prevent movement after components are in the correct position.

Free Lift Hose Sheave

Remove the sheave, for the hose to the free lift cylinder, as follows:

1. Fully retract the forks if the reach assembly is installed. Move the key to the **OFF** position. Disconnect the battery and put a tag or lock on the battery connector. Install safety chains between the tops of the inner and outer reach weldments of the reach assembly to prevent reach operation.

2. Operate the LIFT/LOWER control lever to raise the inner weldment. Use safety chains to fasten the reach assembly or carriage assembly and inner weldment so that they cannot move and the bottom of the inner weldment is approximately 60 cm (2 ft) off the floor.

3. Lower the carriage or reach assembly so that the safety chains are the support for the carriage or reach assembly and inner weldment. The lift hose for the free lift cylinder must not have tension.

4. Remove the snap ring, washer, free lift hose sheave and spacer at the bottom of the intermediate weldment.

5. Follow the reverse procedure to install the hose sheave for the free lift cylinder.

Carriage or Reach Sheaves–Removal and Replacement

Remove the sheaves, for the hoses and cable to the carriage or reach assembly as follows:

1. Fully lower the carriage or reach assembly. Fully retract the forks if the reach assembly is installed. Install safety chains between the tops of the inner and outer weldments of the reach assembly to prevent reach operation.

CAUTION: Do NOT use steam to clean the lift chains, sheaves or load rollers. The sheaves and roller bearings are sealed and permanently lubricated. Do not use compressed air on the bearings. The air can force the lubricant out of the bearings.

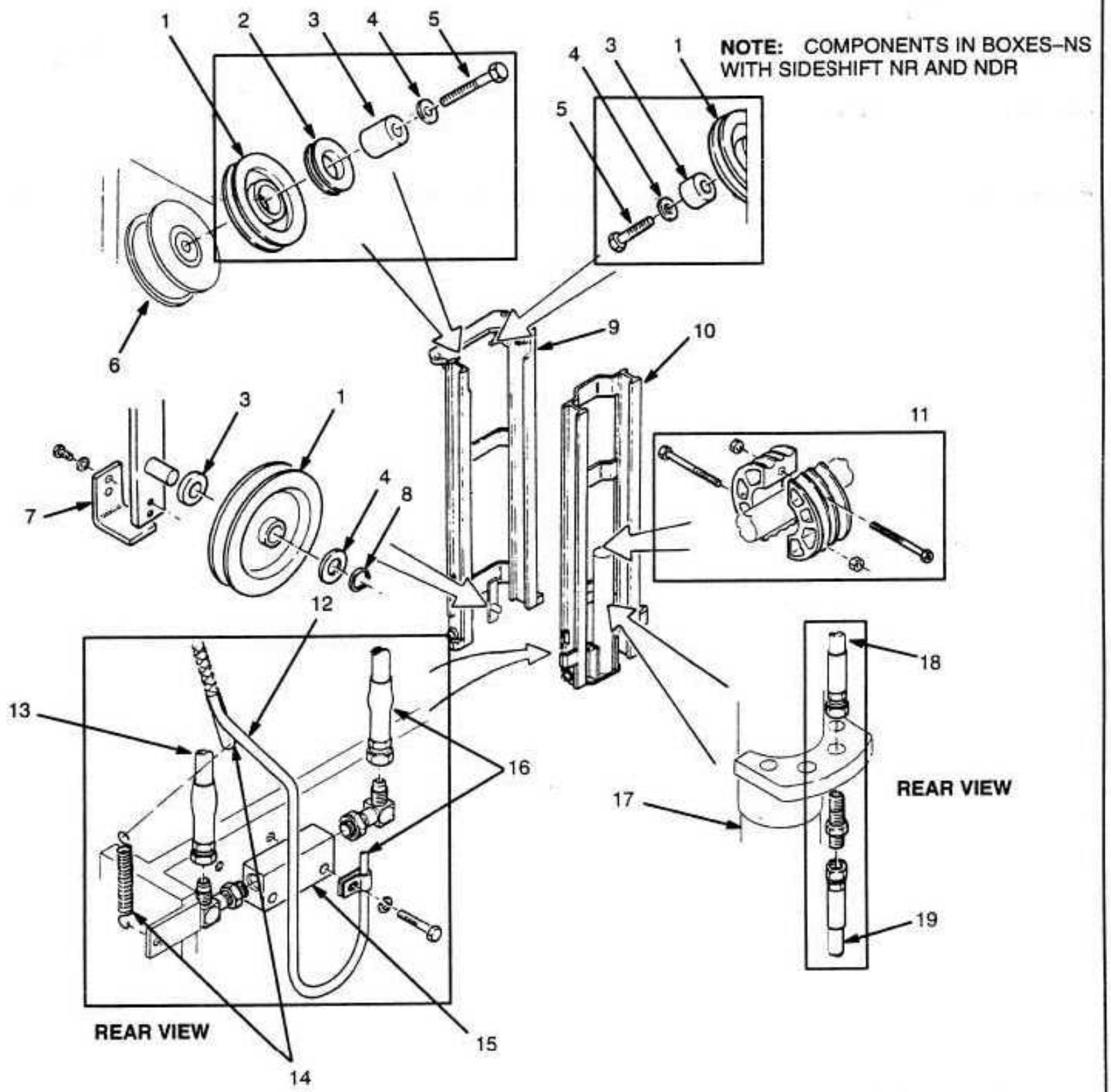
WARNING: The mast weldments can move and cause an injury. Make sure the mast assembly is level with the carriage or reach assembly side on top to prevent unexpected movement of the mast weldments.

2. Make sure that the system does not have hydraulic pressure. Hold the control lever (for each function) in the forward position for approximately five seconds to release the pressure. Make sure the hydraulic pump does NOT operate. Move the key to the **OFF** position. Disconnect the battery and put a tag or lock on the battery connector.

3. Fasten the carriage or reach assembly hoses. Install the reach assembly electrical cable to the top of the sheave support at the free lift cylinder. Disconnect or remove the hoses at the carriage or reach assembly. Install caps to prevent dirt from entering the hydraulic system.

4. Install tags on the connectors and wires of the electrical cable at the reach assembly for correct connection later. Disconnect the electrical cable.

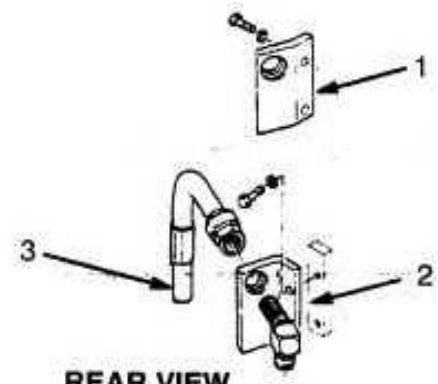
5. Install tags on the hydraulic hoses at the reach assembly for correct connection later. Disconnect the hoses and install caps to prevent dirt from entering the hydraulic system.



1. HOSE SHEAVE
2. ELECTRICAL CABLE SHEAVE
3. SPACER
4. WASHER
5. CAPSCREW
6. CHAIN SHEAVE FOR MAIN LIFT
7. HOSE GUARD
8. SNAP RING
9. INTERMEDIATE WELDMENT
10. INNER WELDMENT
11. HOSE AND CABLE SHEAVE ASSEMBLY AT SHEAVE SUPPORT
12. ELECTRICAL CABLE (REACH ONLY)
13. TO SHEAVE SUPPORT AND CARRIAGE OR REACH ASSEMBLY
14. TENSION DEVICE FOR ELECTRICAL CABLE
15. MANIFOLD BLOCK
16. TO TRUCK
17. FREE LIFT CYLINDER
18. HYDRAULIC HOSE FROM SHEAVE SUPPORT
19. HYDRAULIC HOSE TO CARRIAGE

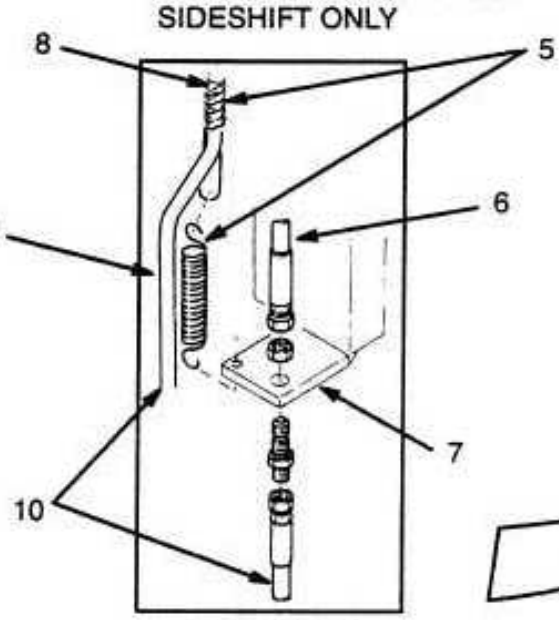
Figure 8-27 – Hose and Cable Assemblies–Inner and Intermediate Weldments

1. HOSE BRACKET (NR OR NDR)
2. HOSE BRACKET (NS)
3. TO FLOW REGULATOR
4. TO FREE LIFT CYLINDER
5. TENSION DEVICE
6. HOSE TO MANIFOLD BLOCK (EACH SIDE OF WELDMENT)
7. HOSE BRACKET (EACH SIDE OF WELDMENT)

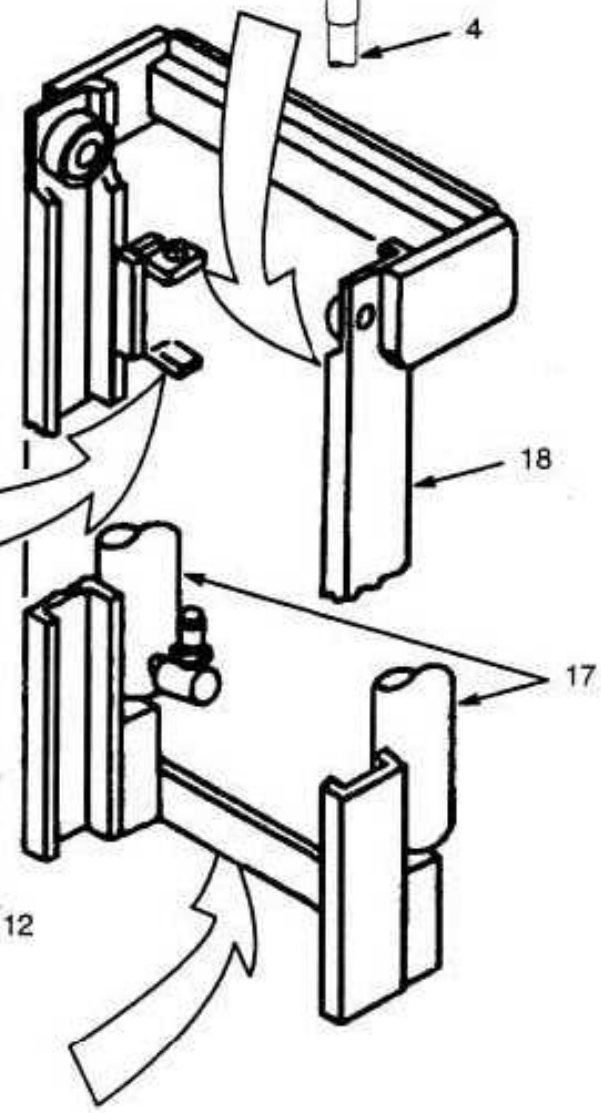


REAR VIEW

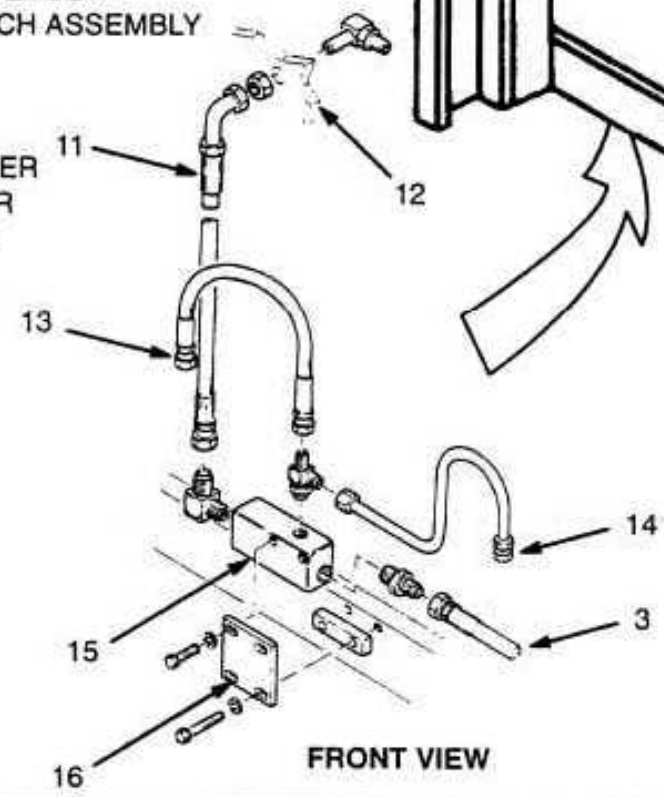
REACH OR CARRIAGE ASSEMBLY
SIDESHIFT ONLY



REAR VIEW



8. TO REACH OR CARRIAGE ASSEMBLY
9. ELECTRICAL CABLE FOR REACH ASSEMBLY
10. TO LIFT TRUCK
11. HYDRAULIC HOSE (LIFT)
12. LIFT TRUCK FRAME
13. HOSE TO RIGHT MAIN CYLINDER
14. TUBE TO LEFT MAIN CYLINDER
15. FLOW REGULATOR HOUSING
16. REGULATOR MOUNT PLATE
17. MAIN LIFT CYLINDERS
18. OUTER WELDMENT



FRONT VIEW

Figure 8-28 – Hose and Cable Assemblies–Outer Weldment

6. Remove the two capscrews and nuts that fasten the two halves of the hose and cable sheave together. See Figure 8-27. Do not let the sheave halves fall.

7. Carefully remove the capscrews that fasten the hose and cable sheaves at the top of the intermediate weldment. Do not let any of the parts fall. These capscrews fasten to the stub shafts of the chain sheaves.

8. Follow the reverse procedure to install the hose and cable sheave for the carriage. Make sure to operate the carriage hydraulic function(s) and check for leaks after the hoses are connected.

Triplex Lift Chain Removal and Installation (See Figure 8-25)

WARNING: Keep control of the lift chains when disconnecting them from the chain anchor. This procedure will prevent the lift chains from falling and causing injury or damage.

WARNING: Never replace just the worn section of a lift chain. Replace the complete chain. Never replace just one chain of a chain pair. Replace both chains.

Free Lift Chains

1. Operate the LIFT/LOWER control lever to raise the carriage. Use safety chains to fasten the carriage so that it cannot move and the forks are approximately 60 cm (2 ft) off the floor.

2. Lower the carriage so that the safety chains are the support for the carriage and the lift chains do not have tension.

NOTE: Removing the pins, at the chain anchors, will disconnect the lift chains without changing the chain adjustment. Always adjust the chains if new lift chains or other components are installed.

3. Fasten both free lift chains so that they cannot move over the sheaves of the sheave support. Remove the chain anchor pins at each end of both free lift chains. Hold each chain to keep it from moving too fast and carefully remove them.

4. Inspect the free lift chains as described in CHECKS AND ADJUSTMENTS. Replace the free lift chains if necessary.

5. Reverse the procedure to install the free lift chains.

6. Adjust the free lift chains as described in CHECKS AND ADJUSTMENTS.

Main Lift Chains

1. Raise the mast until the lower chain anchors are visible on the inner weldment.

2. Use safety chains to fasten the inner weldment so that it cannot move. Operate the LOWER control lever to lower the masts until the safety chains are a support for the inner weldment and lift chains do not have tension.

NOTE: Removing the pins, at the chain anchors, will disconnect the lift chains without changing the chain adjustment. Always adjust the chains if new lift chains or other components are installed.

3. Fasten both main lift chains so that they cannot move over the sheaves. Remove the chain anchor pins at each end of both main lift chains. Hold each chain to keep it from moving too fast and carefully remove them.

4. Inspect the main lift chains as described in CHECKS AND ADJUSTMENTS. Replace the main lift chains if necessary.

5. Reverse the procedure to install the main lift chains.

6. Adjust the main lift chains as described in CHECKS AND ADJUSTMENTS.

Triplex Chain Sheaves–Disassembly and Assembly (See Figure 8-25)

Free Lift Chain Sheaves

1. If necessary, remove the free lift chains as described in TRIPLEX LIFT CHAINS–REMOVAL AND INSTALLATION.

WARNING: Be careful when removing or installing snap rings. These snap rings are large and 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.

2. Remove the snap ring from the shaft in the sheave support.

3. Use a drift to tap the shaft out of the sheave support.

4. Remove the sheaves and spacers as a group. Inspect all components for wear or damage. Replace any part that is worn or damaged.

5. Reverse the procedure to install the chain sheaves.

Main Lift Chain Sheaves

1. If necessary, remove the main lift chains as described in TRIPLEX LIFT CHAINS–REMOVAL AND INSTALLATION.

2. Remove both pins from the chain anchors at the rear of the free lift cylinder. Remove each lift chain from the sheaves.

WARNING: Be careful when removing or installing snap rings. These snap rings are large and 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.

3. Remove the snap ring from the chain sheave bracket.

4. Use a prybar to remove the chain sheave from the bracket. Inspect all components for wear or damage. Replace any item that is worn or damaged.

5. Reverse the procedure to install the chain sheaves.

Load Rollers and Wear Plugs–Removal and Installation (See Figure 8-29)

1. Remove the mast assembly as described in TRIPLEX MAST ASSEMBLY REMOVAL. Remove the free lift cylinder as described in FREE LIFT CYLINDER–REMOVAL AND INSTALLATION. Remove the main lift cylinders as described in MAIN CYLINDERS–REMOVAL AND INSTALLATION. The mast assembly must be horizontal with the carriage or reach assembly side on top.

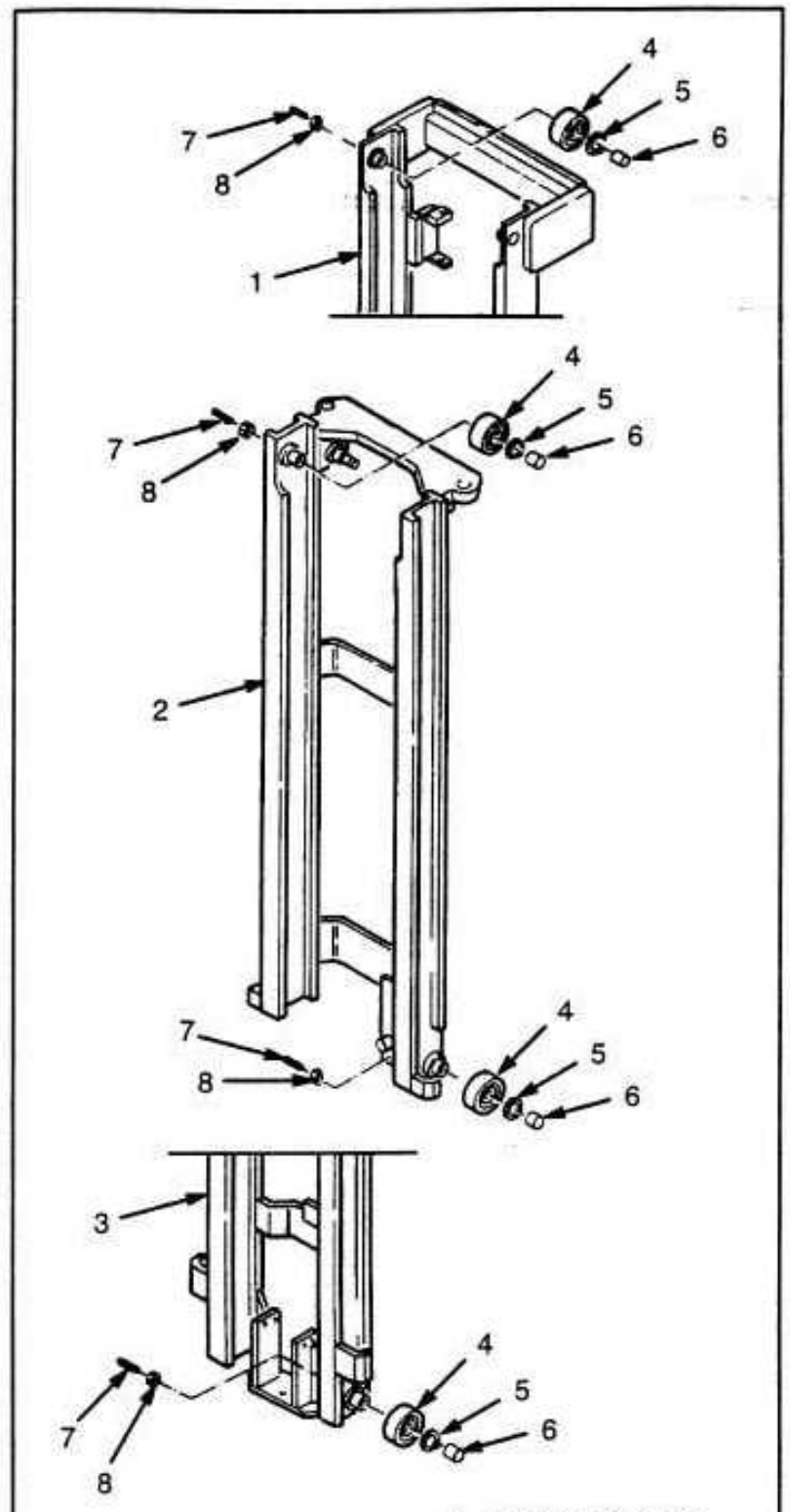
WARNING: The mast weldments can move and cause an injury even if the mast assembly has been removed from the lift truck. Make sure the mast assembly is level to prevent the components from moving without being moved. Use safety chains to prevent movement after components are in the correct position.

2. Remove the safety chains that fasten the mast weldments together and use a prybar to carefully and slowly move the correct mast weldment for access to the load rollers. The inner weldment load rollers are at the bottom. The load rollers for the outer weldment are at the top. The load rollers for the intermediate weldment are at the top and the bottom of the weldment. Use safety chains to fasten the inner weldment to the outer weldment so that they do not separate completely.

NOTE: If the inner weldment and the intermediate weldment will be disassembled from the outer weldment, do not install the load rollers at this time.

WARNING: Be careful when removing or installing snap rings. These snap rings are large and 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.

3. Always install safety chains to prevent the weldments from moving BEFORE starting to replace any load roller. Remove the snap rings that fasten the load rollers.



1. OUTER WELDMENT
2. INTERMEDIATE WELDMENT
3. INNER WELDMENT
4. LOAD ROLLER
5. SNAP RING
6. WEAR PLUG
7. SET SCREW
8. JAM NUT

Figure 8-29 – Triplex Load Rollers

NOTE: Replace wear plugs at this time to save the cost of removal and disassembly of the mast assembly for wear plug replacement.

4. Use a prybar to remove the load roller from the mast weldment.

5. Use a cloth to clean each load roller. Inspect the load rollers for cracks, flat spots or bearings that do not turn freely. Replace any roller that shows wear or is damaged.

6. Reverse the procedure to install the load rollers.

7. Adjust the wear plugs after all load rollers and wear plugs are replaced. See CHECKS AND ADJUSTMENTS. The wear plugs are adjusted after the mast assembly is installed on the lift truck.

Triplex Mast Assembly–Installation

NOTE: If the carriage or reach assembly is installed on the mast, it must have a safety chain installed as described in SAFETY PROCEDURES.

WARNING: Do not install the triplex mast assembly unless it is completely assembled. Mast parts can move and cause an injury if not fastened together during assembly.

NOTE: The inner and intermediate mast assemblies must be in a position to allow access to the mount capscrews at the bottom of the outer weldment. Use safety chains to keep the mast assembly from moving as described in SAFETY PROCEDURES.

1. Use the crane or lifting device to lift the mast assembly and move it close enough to the truck to make the necessary connections. Make sure the truck and mast assembly cannot move.

2. Install and tighten the mast and carriage or reach assembly hoses on their correct bulkhead fittings according to the labels installed during removal.

3. Move the mast assembly into position. Lower the mast assembly so that the outer weldment is aligned with the trunnion blocks on the lift truck frame.

NOTE: Make sure all hoses and the electrical cable are not between a mast crossmember and the truck.

4. Align the trunnion caps according to the marks made during removal. Install the capscrews, but leave them loose.

5. Connect all the wires of the electrical cable according to the labels made during removal.

CAUTION: Install tape on all electrical wires for the reach assembly if the wires are not connected to the reach assembly. If the wires are not connected, they can make a short-circuit and cause damage.

6. Operate the LIFT/LOWER control handle to raise the inner and intermediate weldments high enough for access to the bottom of the outer weldment.

7. Install safety chains between the outer, intermediate and inner weldments to keep the intermediate and inner weldments from moving.

8. Use a prybar to align and install the four mount capscrews and the nut plates that fasten the bottom of the mast to the truck frame. Move the bottom of the weldment in or out and add shims until the mast is adjusted between vertical to $^1/_2$ degree of back tilt.

9. Tighten the four mount capscrews to 203 N•m (150 lbf ft) torque.

10. Install the hose clamps and hose bracket. Operate the LIFT/LOWER control handle to raise the inner weldment high enough to carefully remove the safety chains. Remove the safety chains.

11. Tighten the four trunnion cap capscrews to 203 N•m (150 lbf ft) torque. Use the crane to lower the inner and intermediate weldments until the chain and crane are no longer the support. Remove the chain and crane.

12. Install the mast guard and capscrews that fasten the rear legs to the overhead guard.

13. Make all adjustments and test the operation of the mast assembly before returning the truck to service. See CHECKS AND ADJUSTMENTS.

REACH CYLINDERS

Removal
(See Figure 8-30)

NOTE: Fully extend the reach mechanism. If the scissor arms and outer frame are installed, use clamps and blocks to prevent the scissor arms from retracting. Install the clamps and blocks on the channels of the inner frame and the outer frame or apron. Install the blocks under the load bearings. See Figure 8-30. Tighten the clamps so that the blocks cannot move.

1. If necessary, remove the cable bracket and manifold block.

2. If necessary, remove the stops, shims and stop supports. Install labels for correct installation of the shims sets in the same positions. When the new stops are installed, the shim arrangement will normally be the same or similar.

Cleaning and Inspection

WARNING: Cleaning solvents can be flammable and toxic, and can cause skin irritation. Wear protection for eyes and skin. When using cleaning solvents, always follow the recommendations of the manufacturer.

8. If necessary, remove the snap rings that fasten the sheaves to the shafts.

9. Hold the selector valve and remove the two capscrews and lockwashers that fasten the selector valve to the inner frame.

Disassembly

1. Remove all fittings from the selector valve. See Figure 8-38.

2. If necessary, carefully remove the solenoids, check valves, relief valve and spools.

3. Remove and discard all O-rings from the valve and fitting parts.

Cleaning and Inspection

WARNING: Cleaning solvents can be flammable and toxic, and can cause skin irritation. Wear protection for eyes and skin. When using cleaning solvents, always follow the recommendations of the manufacturer.

Clean all of the parts of the selector valve with solvent. Dry the parts with compressed air. Inspect the parts of the selector valve for damage and wear. Replace all parts that are worn or damaged. Replace all O-rings.

Assembly

1. Use O-ring lubricant and install new O-rings on the parts of the selector valve.

2. Install the parts in the valve block as shown in Figure 8-38.

Installation

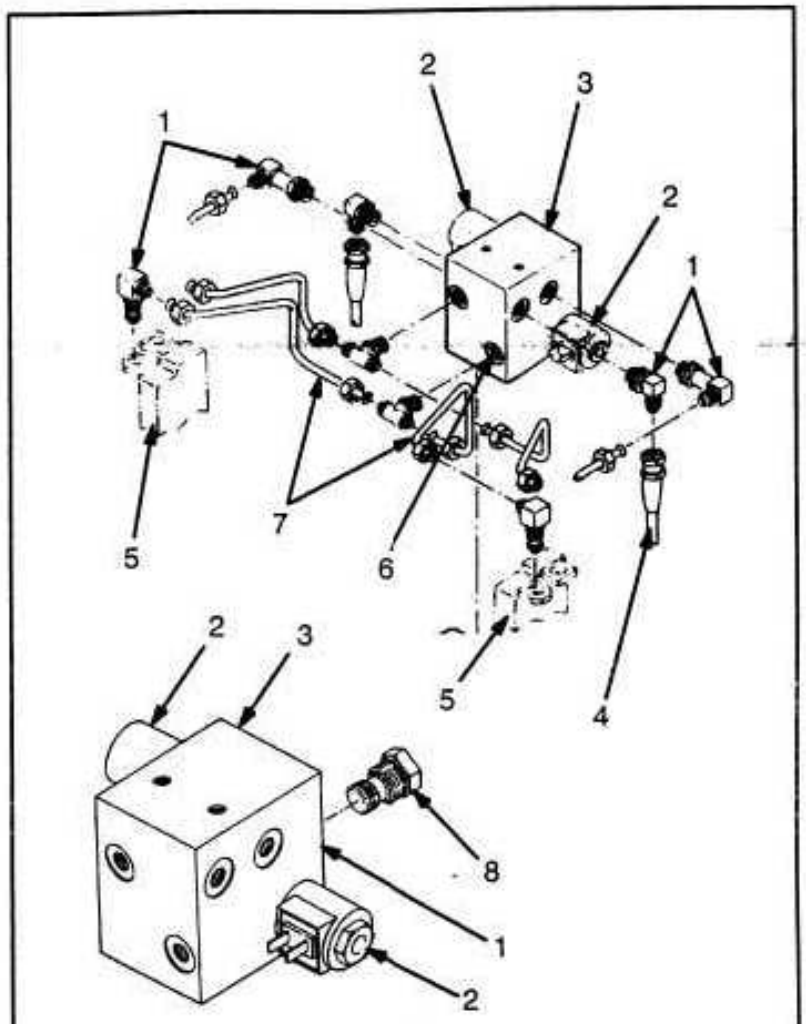
1. Hold the selector valve in the correct position on the frame and install the two capscrews and lockwashers.

2. Connect the hydraulic lines as marked during disassembly. Always use new O-rings on the O-ring fittings. If necessary to connect the hydraulic lines, see Figure 8-38. Connect the electrical wires to the solenoids. Install new cable ties at the original locations for clearance of hoses and electrical cables during operation.

CAUTION: Do NOT operate the tilt or sideshift functions if the outer frame has been removed. Hydraulic oil can come out of the hoses.

3. Remove the safety chains from the scissor arms of the reach assembly. Operate the REACH, TILT and SIDESHIFT functions to check for leaks and correct operation.

4. Remove the air from the system as described in CHECKS AND ADJUSTMENTS.



1. HYDRAULIC FITTING
2. SOLENOID
3. VALVE BODY
4. HOSE
5. INNER FRAME
6. PORT
7. TUBES
8. CHECK VALVE ASSEMBLY

Figure 8-38 – Reach/Tilt Selector Valve

TILT/SIDESHIFT SELECTOR VALVE

Removal

NOTE: The tilt/sideshift selector valve is installed even if there is no sideshift function. If there is no sideshift function there is no electrical cable or solenoids. Plugs are installed at the solenoid and cylinder ports.

NOTE: The selector valve can be removed with the outer frame installed or removed from the scissor arms. Do Steps 1 through 4 only if the outer frame is installed. The outer frame must be removed to remove the selector valve from the outer frame. Remove the outer frame as described in OUTER FRAME–REMOVAL.

WARNING: There are pinch points on the mast that can cause an injury. Use safety chains on the inner frame and mast weldments to keep the inner frame and mast weldments from moving. Install the safety chains as described in SAFETY PROCEDURES.

1. If the outer frame is installed, operate the REACH/RETRACT control handle to fully extend the forks.

2. Move the key to the **OFF** position and disconnect the battery.

WARNING: There are pinch points on the outer frame that can cause an injury. Use clamps and blocks to prevent the scissor arms from moving. Install the clamps and blocks at the channels of the inner frame to make sure that the load bearings cannot move in the channel. See Figure 8-32.

3. If necessary, install labels for correct connection during installation and remove the hoses at the top of the outer frame. See Figure 8-39. Install caps on the hydraulic lines of the solenoid valve to prevent dirt from entering the system.

WARNING: The outer frame is heavy and can cause an injury if it tips or falls. Make sure the frame is stable. If the frame is NOT on the floor with the fork side down for stability, use a crane and chains to raise the frame. Install a solid 100 mm (4 in) block under each fork heel and near each fork tip. Lower the frame so that the forks are on the blocks and install a capacity load on the forks. You can also use safety chains to fasten the frame to an object that cannot tip or fall.

4. Install labels on all hoses connected to the selector valve for correct connections during installation.

5. Remove the hose and cable guide and the solenoid valve body.

Disassembly

1. Remove all fittings from the selector valve.

2. If necessary, carefully remove the solenoids, check valves, relief valve and spools.

3. Remove and discard all O-rings from the valve and fitting parts.

Cleaning and Inspection

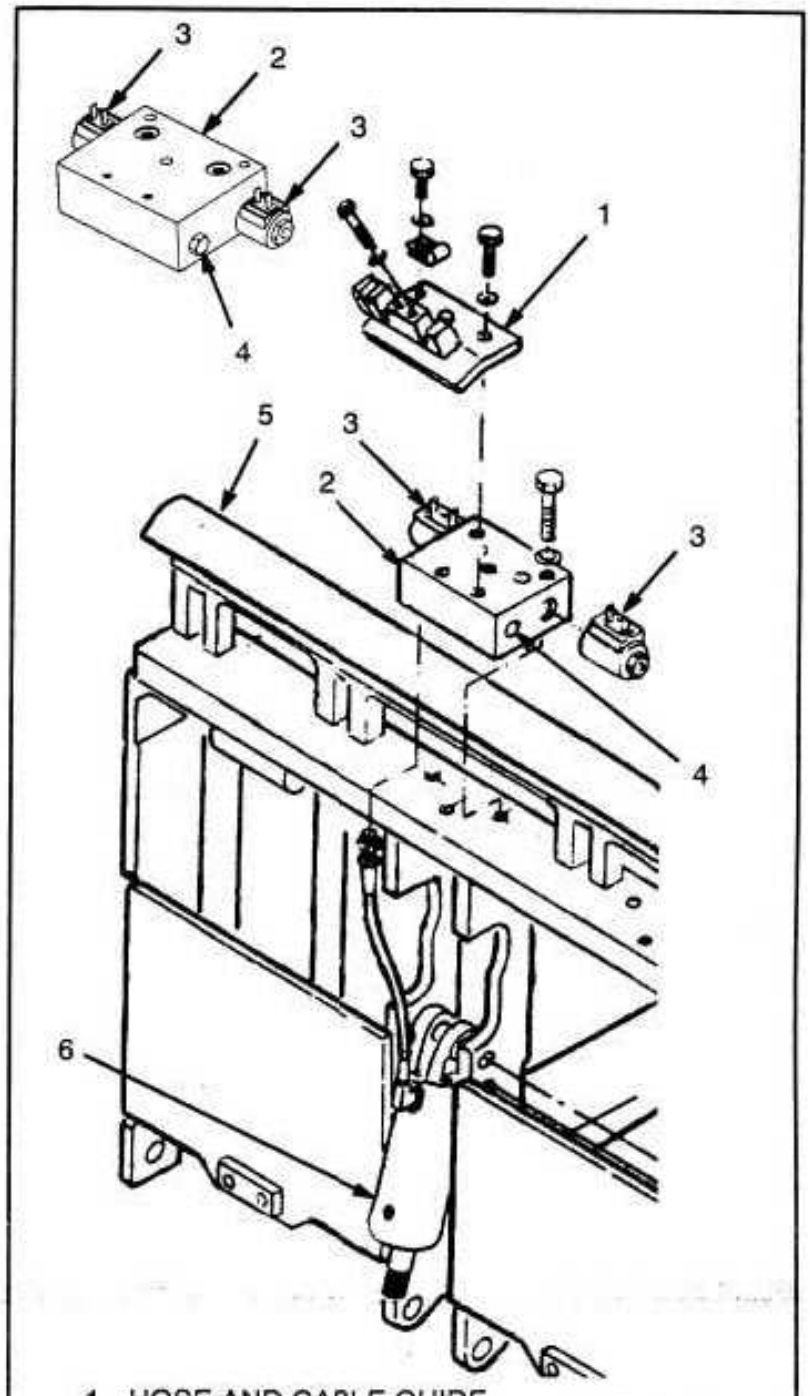
WARNING: Cleaning solvents can be flammable and toxic, and can cause skin irritation. Wear protection for eyes and skin. When using cleaning solvents, always follow the recommendations of the manufacturer.

Clean all of the parts of the selector valve with solvent. Dry the parts with compressed air. Inspect the parts of the selector valve for damage and wear. Replace all parts that are worn or damaged. Replace all O-rings.

Assembly

1. Use O-ring lubricant and install new O-rings on the parts of the selector valve.

2. Install the parts in the valve block as shown in Figure 8-39.



1. HOSE AND CABLE GUIDE
2. VALVE BODY
3. SOLENOID (1 OF 2) (SIDESHIFT ONLY)
4. PLUG
5. OUTER FRAME
6. TILT CYLINDER

Figure 8-39 – Tilt/Sideshift Selector Valve

Installation

WARNING: There are pinch points on the mast that can cause an injury. Use safety chains on the inner frame and mast weldments to keep the inner frame and mast weldments from moving. Install the safety chains as described in SAFETY PROCEDURES.

1. If the outer frame or outer frame are installed, operate the REACH/RETRACT control handle to fully extend the forks.

WARNING: There are pinch points on the outer frame that can cause an injury. Use clamps and blocks to prevent the scissor arms from moving. Install the clamps and blocks at the channels of the inner frame to make sure that the load bearings cannot move in the channel. See Figure 8-32.

2. Move the key to the **OFF** position and disconnect the battery.

3. Hold the hose and cable guide and the selector valve in the correct position on the frame and install the two capscrews and lockwashers.

4. Connect the hydraulic lines as marked during disassembly. Always use new O-rings on the O-ring fittings. If necessary to connect the hydraulic lines, see Figure 8-39.

5. Operate the TILT and SIDESHIFT functions to check for leaks and correct operation.

6. Remove the clamps and blocks from all channels for the load bearings. Remove the air from the system as described in CHECKS AND ADJUSTMENTS.

CHECKS AND ADJUSTMENTS

Check Mast Operation

WARNING: Do not try to locate hydraulic leaks by putting hands on pressurized hydraulic components. Hydraulic oil can be injected into the body by pressure.

1. Check for leaks in the hydraulic system. Check the condition of the hydraulic hoses and tubes.

2. Slowly raise and lower the mast several times without a load. The mast components must raise and lower smoothly in the correct sequence.

NOTE: Some parts of the mast move at different speeds during raising and lowering.

3. The weldments and the carriage or reach assembly must lower completely.

4. Check that the controls for the carriage and reach assembly operate the functions installed on the lift truck. See the symbols by each of the controls and refer to the OPERATING MANUAL for your lift truck. Make sure all of the hydraulic lines are connected correctly and do not leak.

Remove Air from Hydraulic System

NOTE: When you are removing the air from the hydraulic system, make sure that all of the hydraulic fittings are tight and do not leak. Also make sure that the level of the oil in the hydraulic tank is correct.

CAUTION: The reach assembly must be completely assembled and installed on the lift truck before doing this procedure.

Operate the reach, the tilt and the sideshift functions to remove the air from the hydraulic system. Fully extend and retract each cylinder rod. When the cylinder rod reaches the end of its stroke, hold the control handle for approximately two seconds. Repeat the procedure as many times as necessary for each cylinder until the operation of all cylinders is smooth.

Check for Leaks in Hydraulic System

1. Slowly raise and lower the mast several times without a load. On NR or NDR trucks, operate the reach assembly functions several times. Put a capacity (see the Nameplate) load on the forks and raise and lower the load several times. On NR or NDR trucks, operate the reach assembly functions several times. Lower the load. Check for leaks and repair as necessary.

2. On all models, raise the reach or carriage assembly and the capacity load one metre (3 ft). If the reach or carriage assembly lowers slowly with the control handle in a NEUTRAL position, there are leaks inside the hydraulic system. The maximum speed that the reach or carriage assembly is allowed to lower is 50 mm (2 in) in 10 minutes when the hydraulic oil is 30° C (90° F). If the oil temperature is 70° C (160° F), the maximum speed that the reach or carriage assembly can lower is 150 mm (6 in) per 10 minutes.

3. Check the lift cylinders for internal leaks. Remove the load from the forks. Install a gate valve in each of the supply lines between the electro-mechanical control valve and the mast. Put a capacity load on the forks again. Raise the carriage one meter (3 ft). Close both gate valves. If the reach or carriage assembly or inner mast lowers slowly, the seals in the lift cylinders have leaks.

4. If the reach or carriage assembly does not move, open both gate valves and check the movement again. If the reach or carriage assembly lowers when the gate valves are open, check for leaks in the hydraulic lines and fittings. If no leaks are found, the electro-mechanical control valve can have a defect. Remove the load from the forks.

5. On NR or NDR trucks, slowly tilt the forks forward. If the forks continue to slowly tilt forward when the control handle is in

BATTERY AND CHARGING SYSTEM–GENERAL

This section describes selection and maintenance of large batteries used in electric lift trucks. This information pertains to the service personnel that maintain industrial truck batteries.

SAFETY TIPS FOR HANDLING INDUSTRIAL TRUCK BATTERIES

1. **WARNING:** Disconnect the battery from the lift truck when doing maintenance and repair work.

Why – The live current may cause arcing or a short circuit with attendant damage to equipment or injury.

2. **WARNING:** Wear rubber apron, gloves, boots and goggles, when handling, checking, filling, charging or repairing batteries.

Why – To protect yourself against burns resulting from accidental spillage of electrolyte – a mixture of sulfuric acid and water.

3. **WARNING:** Keep open flames away from batteries – do not check electrolyte level with a cigarette lighter or match. USE A FLASHLIGHT OR PERMANENT LIGHT. Do not smoke or create sparks.

Why – The space between the underside of the cover and the top of the electrolyte in the cell usually contains a hydrogen oxygen mixture which is explosive when ignited.

4. **WARNING:** Be sure water is readily available in case electrolyte accidentally splashes on your skin or clothing. Extreme care should be taken in flushing electrolyte from the eye. Use plain water only and obtain medical attention immediately.

Why – Volumes of water applied quickly and continuously will prevent serious injury to the skin. Quick medical attention is necessary to assure proper care and treatment.

5. **WARNING:** Apply strong neutralizer such as baking soda when acid is spilled on the floor and clean up promptly.

Why – Baking soda will neutralize the acid and make it safe to clean or flush from the floor.

6. **WARNING:** Take proper care in melting the sealing compound when preparing to seal a battery. Avoid puncturing the hard surface of partially melted compound with a screwdriver or other sharp tool. Compound may ignite if it is heated too rapidly.

Why – The hot liquid may squirt up and burn your hand, face or body. If it should catch fire it creates the hazard of an open flame. Burning consumes oil in the compound and impairs its useful characteristics.

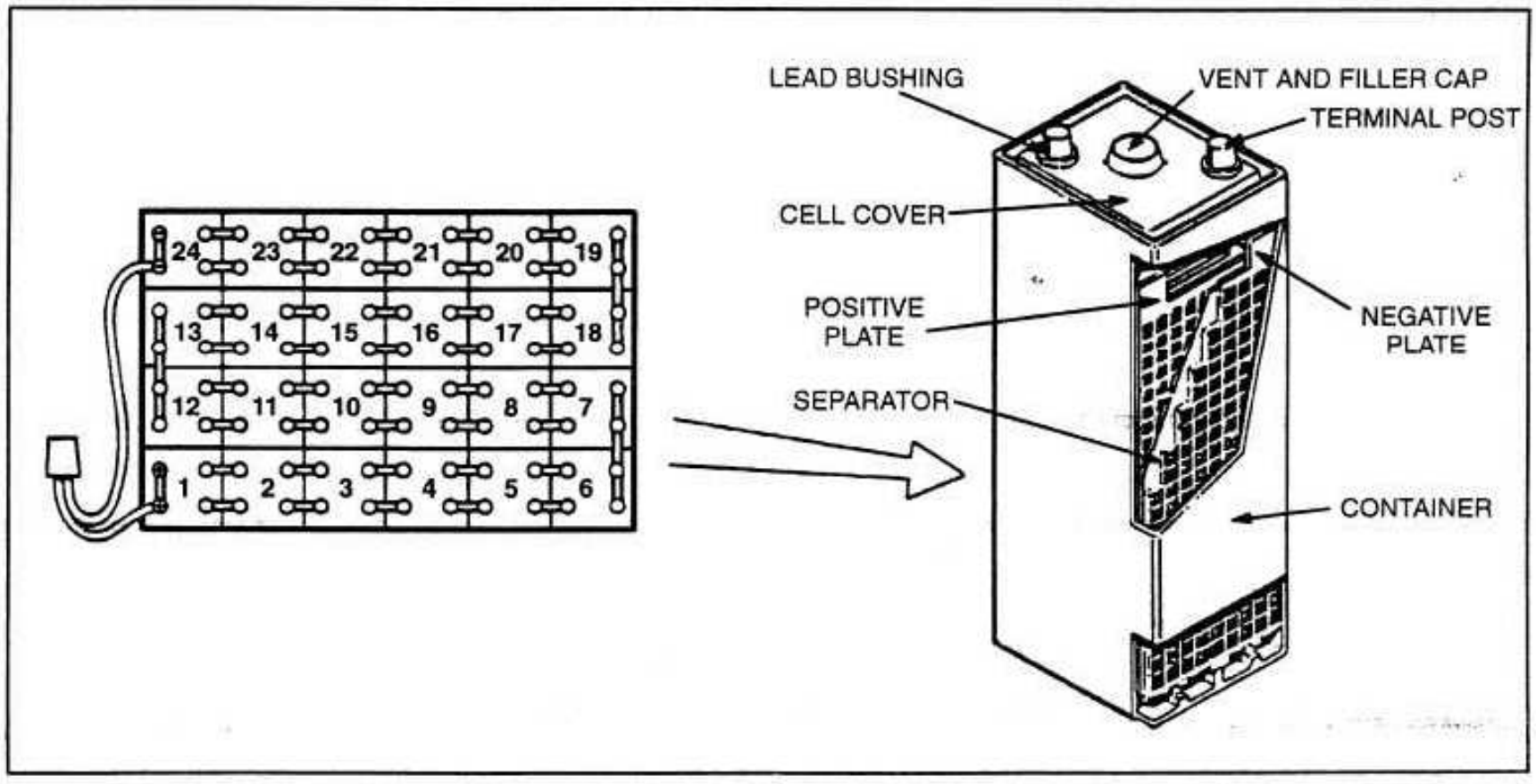


Figure 9-1 – Lead-Acid Industrial Truck Battery

7. Remove vent caps from nearby cells when preparing to assemble a repaired cell into the battery. Cover the vent holes with layers of damp cloth before using lead burning equipment on the intercell connectors in order to integrate the cell into the battery circuit. Also, use dark glasses to protect the eyes.

Why – To prevent a possible hydrogen oxygen concentration from exploding when a flame is lit.

8. Be sure to shut off the power when changing or repairing plugs or receptacles that are connected to the charging equipment. This will prevent a short circuit and arcing.

Why – A short circuit may injure you. Arcing may cause explosion and fire.

9. Before removing the terminal lugs from the receptacle when repairing a damaged or dirty plug or receptacle connected to a battery, the battery circuit must be opened or "broken".

Why – The leads which terminate in the receptacle are live or "hot" with the total voltage of the battery existing across the terminals. If the terminal lugs are accidentally touched together a short circuit or arcing will occur with its attendant danger.

10. **WARNING:** When mixing acid to prepare electrolyte, ALWAYS POUR ACID SLOWLY INTO WATER and never water into acid. Always store acid in plastic or glass container.

Why – If water should be added to acid it will not readily mix and will splash the acid due to the great difference in the specific gravity of the two liquids. The effect of splashed acid is dangerous.

11. **WARNING:** Always lift batteries with mechanical equipment such as a hoist, crane or lift truck. Move batteries horizontally with power tracks, conveyors or rollers. Make sure that hoist hooks, spreader bars and other tools are of ample strength and properly installed. Cover top of battery with rubber mat or other insulating material to prevent external short circuits from chains or cables falling on top of battery.

Why – Batteries are a heavy concentrated load and might easily cause painful strains or injury to your feet or hands. Batteries may be seriously damaged or electrolyte spilled if the battery is dropped.

12. Make sure that charging plugs and receptacle are properly locked and all other connections tight, secure and free from friction.

Why – A loose connection may mean sparking or even arcing with attendant danger of gas explosion.

13. Allow only authorized personnel (qualified by training and experience) in the battery room.

Why – An untrained or inexperienced person may unknowingly break normal rules for proper handling, causing injury to themselves and damage to batteries and equipment.

14. Enclose all bare wires and buss bars in the battery room by wire guards, guard rails or other means of isolation from general plant traffic.

Why – Any open high current transmission equipment is a possible hazard to you, other workers and equipment.

15. Never lay metal tools such as wrenches or other material on top of an open battery.

Why – Sparking and short circuiting will occur and the battery will quickly be discharged or may explode.

16. Check batteries for cracks or leaks. Repair at once.

Why – Electrolyte will spill on floor or equipment, causing corrosion of the steel tray and related equipment. Continuous flow of leaking electrolyte can cause a ground bath that reduces battery life and capacity.

17. When batteries are disposed of as scrap at the end of useful life, they should be sent to a authorized recycling center or salvage dealer.

Why – Even an old battery no longer capable of useful life may have enough residual voltage left to cause a spark if filled with electrolyte.

18. Familiarize yourself as completely as possible with batteries and the proper rules for their charging, handling and maintenance.

Why – Full knowledge of batteries and the dangers of improper handling will pay dividends in the elimination of injuries and damage.

CAUTION: Keep vent plugs in the cells at all times, except when taking hydrometer readings, adjusting specific gravity and electrolyte levels, troubleshooting or assembling a repaired cell.

NOTE: Your company, industry and government safety regulations should be reviewed to help reduce accidents and damage to equipment.

NOTE: If batteries are not in use, keep them charged. Check specific gravities monthly and give a freshening charge (3 to 4 hours at the finish rate) if the gravities have fallen 30 points (.030) or more, otherwise, give freshening charge every three months.

BATTERY TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTION
Battery Overheats On Discharge	Over discharge	Limit discharge to 1.110 specific gravity. Put more batteries into service. Set up more frequent charging schedule.
	Excessive load	Determine cause of overload and correct. Put more batteries into service if equipment requirements exceed battery capacity.
	Not fully charged prior to work assignment, resulting in over discharge	Needs more frequent and complete charging.
	Electrolyte levels low	Add water as required. Do not assign battery to work if levels are below top of plates.
	When overheating is confined to few cells, nearby operating equipment may be source	Install heat insulating material between equipment cells with air circulating space between.
	Operating in high ambient temperatures	Provide cool location for charging and good ventilation.
Low Electrolyte Level	Broken or cracked jar	Replace jar.
	Water additions neglected or cell missed in previous water addition.	Better maintenance supervision. Add water as required to all cells.
	Overcharging a. Voltage relay set for many cells b. Timer set for too many hours c. Voltage change rate relay operating	Adjust charging equipment. a. Connect relay for proper number of cells. b. Reduce time. c. Reduce voltage value at which voltage relay operates.
Specific Gravity Between Cells Not Uniform	Overfilled with water	Do not fill above high level – give equalizing charge and adjust acid.
	Operating cell with cracked jar	Replace jar and adjust acid.
	Acid not adjusted properly after jar change	Adjust acid specific gravity.
	Vent caps removed during operation	Keep vent caps securely in place. Give equalizing charge and adjust acid.
	Electrolyte leaking through sealing compound	Reseal and adjust acid.
	Operating battery with broken coil cover	Replace cover and adjust acid.
	Neutralizing agent in cell	Keep vent caps in place at all times except when adding water. Keep battery clean.
	Unequal cell voltages	Refer to Unequal Cell Voltages
Unequal Cell Voltages	Over discharge. Also more than .020 points spread in specific gravity from average	Give an equalizing charge and do not discharge below 1.110.
	Lack of equalizing charges	Give an equalizing charge periodically.
	Internal shunt	Make internal inspection of low voltage cell and correct cause. Check for split separator and moss short.

1. Keep batteries clean and free of acid spills.

2. Do not over-discharge. Excessive discharge shortens battery life.

3. Do not overcharge. Overcharging produces corrosion of positive grids and excessive gassing, which loosens the active material of the plates.

4. Charge batteries in a well ventilated area to remove the explosive gases and acid fumes.

5. Maintain electrolyte at the proper level. If low, add water. Before charging, make sure tops of plates are covered; after charge, fill to recommended level. Do not add acid.

6. Keep batteries from freezing.

7. Keep batteries in a charged state.

8. Do not charge a battery with a charger that has an ampere-hour rating higher than that of the battery. This will give too high a charging current and excessive heating. Charging with a lower ampere-hour charger will cause no harm, but may require longer than 8 hours to fully charge.

Maintenance Records

Always complete the Battery Inspection Report and the Daily Battery Report.

NOTE: Follow the same sequence when you record the cell number. Always begin the record with a positive cell. Follow a sequence so that the last cell is always the cell for the negative cable.

Record the beginning ampere reading of the charger each time the battery is charged. Any difference in the daily ampere reading can indicate a problem with the battery or the charger.

Battery Inspection Report

Battery No. _____ Date _____
Battery Type _____ Dept. Used In _____
Serial No. _____ M-F-S _____
Reading on Charge at _____ Amperes Date Time _____
Charger No. _____

CELL NO.	CELL VOLTS	POSITIVE CADMIUM	SPECIFIC GRAVITY	TEMP.
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

CELL NO.	CELL VOLTS	POSITIVE CADMIUM	SPECIFIC GRAVITY	TEMP.
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				

Figure 9-8 – Battery Inspection Report

Daily Battery Record

Battery No. _____ Month _____ Year _____

Battery Type _____ MFR. _____

Serial No. _____ Date Bought _____

Total Cycles For Month _____ Total Cycles To Date _____

DATE	TRUCK NO.	SPECIFIC GRAVITY IN	SPECIFIC GRAVITY OUT	TEMP. PILOT CELL	TIME ON CHARGE	TIME OFF CHARGE	INITIAL AMPS	WATER ADDED	OPERATOR

Figure 9-9 – Daily Battery Record

Cleaning the Battery

Keep the battery compartment clean and dry. Use a clean cloth to wash the battery with water. Dry with compressed air.

CAUTION: Do not clean the battery with steam or hot water. Do not use a high pressure hose.

Remove any electrolyte from the battery compartment to prevent corrosion. If there is electrolyte on the top of the battery, apply a solution of bicarbonate of soda. Mix a solution containing 1.1 lb (0.5 kg) of soda for every 4.22 qts (4 litres) of water. Apply the solution, then flush the solution from the battery with clean water. Wash the battery and battery compartment as needed. Six months between cleaning is the maximum recommended interval.

NOTE: If the top of the battery is wet from electrolyte, check to see if the electrolyte level is too high or the battery charger is not operating correctly.

Adding Water

Some water is lost from the electrolyte of each cell during the charge and discharge cycle when the battery is in service. Check the electrolyte level daily. Some service persons check some of the cells each day so that all of the cells are checked each week. If the level of the electrolyte goes below the level of the top of the separators for the plates, the cell can be damaged.

NOTE: Keeping the electrolyte level within the correct limits is the most important item of battery maintenance. Always use distilled water. If you add distilled water, wait five minutes before measuring the specific gravity with a hydrometer. Do not add distilled water to a cell during the charging cycle. The electrolyte can flow out of the cell through the fill hole. Figure 9-10 shows a general rule for the incorrect electrolyte level. See the instructions from the manufacturer of your battery for the operating level of the electrolyte.

CELL HEIGHT	DIMENSION "A"
Less than 38 cm (15 in)	3 mm (1/8 in)
38 – 61 cm (15 – 24 in)	6 mm (1/4 in)
Greater than 61 cm (24 in)	12 mm (1/2 in)

Table 9-1 – Electrolyte Level

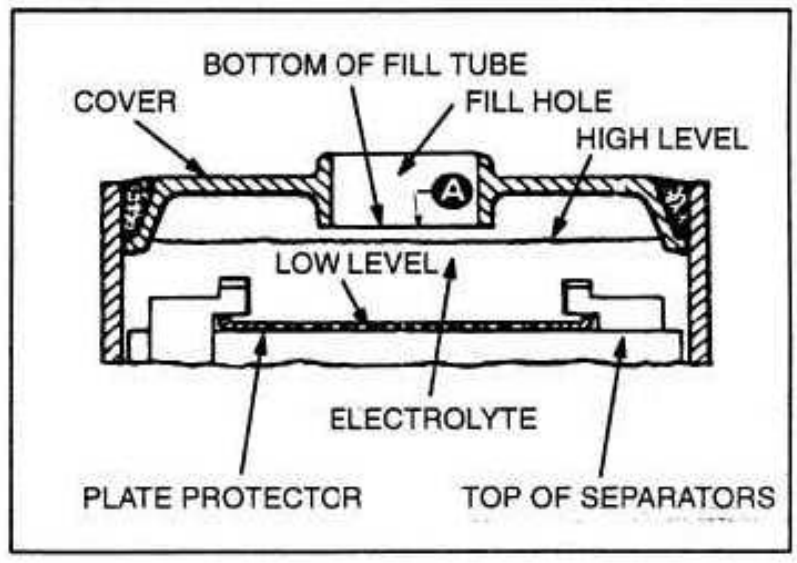


Figure 9-10 – Electrolyte Level

Hydrometer

Use a hydrometer to measure the specific gravity of the battery. Make sure there is enough electrolyte in the battery cells. A high level or low level of the electrolyte can change the specific gravity measurement. When the electrolyte level is low, the

percent of sulfuric acid in the electrolyte increases. When the electrolyte level decreases by 3 mm (0.12 in) the specific gravity measurement can increase by 3 to 5 points.

When using the hydrometer, make sure there is enough liquid in the barrel to let the float move freely. The float must not touch the side, top, or bottom of the barrel for the correct method of reading the hydrometer.

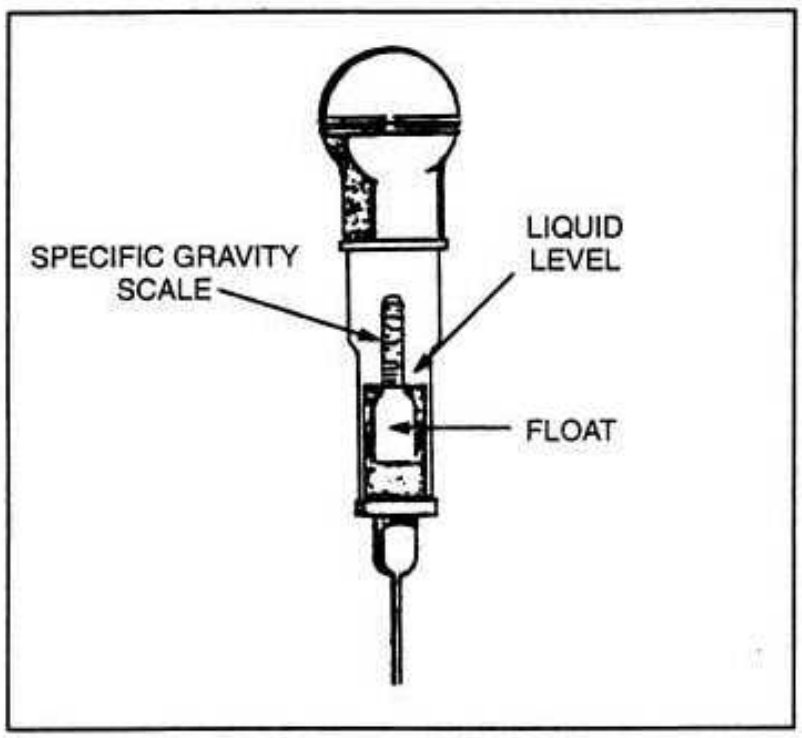


Figure 9-11 – Hydrometer

Battery Temperature

The temperature of the electrolyte will change the reading of the specific gravity. When the temperature increases approximately 6° C (10° F), the specific gravity will decrease by 0.003 points. Refer to Figure 9-12 for making specific gravity corrections.

SPECIFIC GRAVITY READING	ELECTROLYTE TEMP.	CORRECTION POINTS	CORRECT VALUE
1.210	31° C (87° F)	+0.003	1.213
1.210	27° C (80° F)	+0.001	1.211
1.210	25° C (77° F)	+0.000	1.210
1.210	18° C (64° F)	–0.004	1.206
+0.001 for each 1.7° C (3° F) from the 25° C (77° F) Base Value Degrees C + 17.8 × 1.8 = Degrees F.			

Table 9-2 – Specific Gravity Corrections

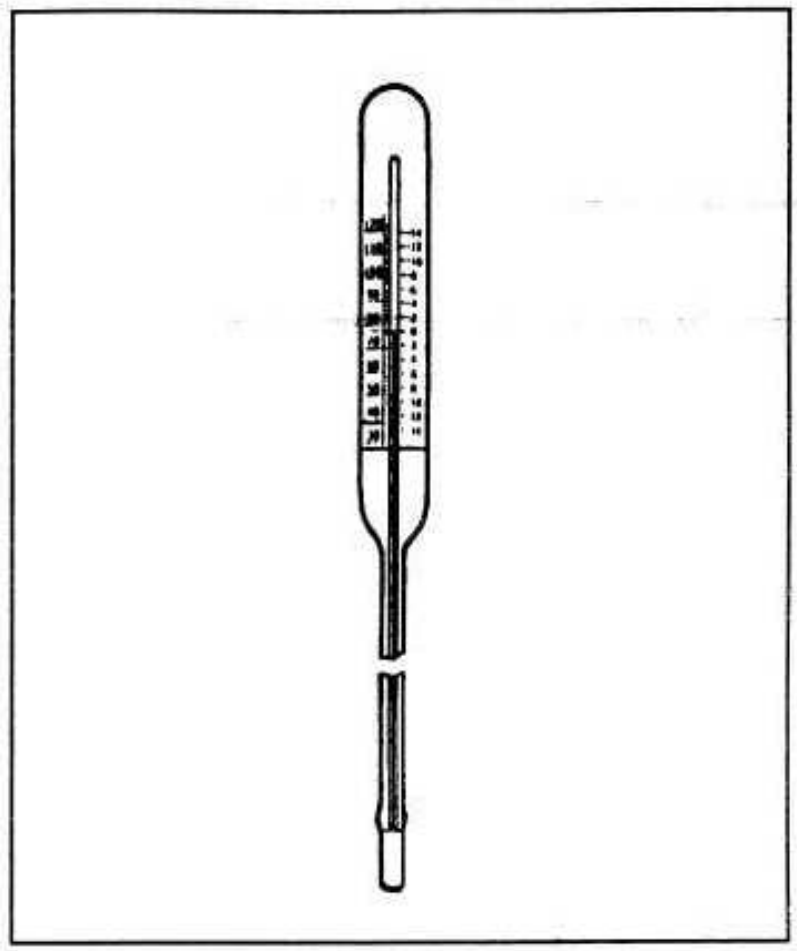


Figure 9-12 – Battery Thermometer

Never charge or discharge a battery at a rate that will raise the temperature of the electrolyte above 50° C (120° F). A temperature above this amount will damage the battery. The cells in the center of the battery are normally at the highest temperature. If the battery temperature is too hot, make sure the ventilation of the battery is increased and make sure that the charge or discharge rate is not too high. A recommendation for a battery in service is 8 hours of use (discharge), followed by 8 hours of cooling, followed by 8 hours of charging.

The normal electrolyte temperature is 25° C (77° F). At this temperature the electrolyte has a specific gravity of 1.285-1.295 with no correction for temperature. If the hydrometer you are using does not have a temperature correction, you will have to use a thermometer. Special battery thermometers are available that will indicate the correction factor directly and add or subtract the correct number of points.

CHARGING THE BATTERY

WARNING: Batteries produce explosive hydrogen gas when charging. Always open the battery cover or hood and provide good ventilation when charging.

To charge the battery, a direct current must pass through the cells in the opposite direction to the discharging current. The ampere-hours must be equal to the discharging ampere-hours plus the energy lost as heat. This additional amount of charge will vary according to the battery and the temperature, but the

NOTES

Yale
Industrial Trucks

SECTION 11

11	ALPHABETICAL INDEX

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