Maintenance Manual

SIDEWINDER™
Omni-Directional™ Lift Truck

ATX-3000

Part No. 32025100
SERIAL NUMBER DESCRIPTION

Model Code

The four digit model code tells the service department which bill of material (BOM) was used to produce the lift truck. The main purpose for the model code is to identify the proper replacement parts for that particular lift truck.

Build Number

The six digit build number is a serial number that identifies, through numeric order, the actual production order that the lift trucks are built. The example serial number below shows that this lift truck is the fourteenth lift truck built.

NOTE: The lift truck model and serial numbers are indicated on the nameplate.

Figure 1: SERIAL NUMBER IDENTIFICATION
SAFETY PRECAUTIONS

• When lifting parts or assemblies, make sure that all slings, chains, or cables are correctly fastened and that the load being lifted is balanced. Make sure that the crane, cables, and chains have the capacity to support the weight of the load.

• Do not lift heavy parts by hand. Use a lifting mechanism.

• Wear safety glasses.

• DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks.

• Always fasten a DO NOT CONNECT BATTERY tag to the battery connector when making repairs or if the unit needs repairs. The tag must not be removed until the repairs are completed.

• Always use correct blocks to prevent the unit from rolling or falling. See “How To Put The Lift Truck On Blocks” in the GENERAL LIFT TRUCK INFORMATION AND LUBRICATION SCHEDULE section of this manual.

• Keep the unit and working area clean and in order.

• Use the correct tools for the job and keep the tools clean and in good condition.

• Always use Airtrax™ approved parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.

• Make sure that all nuts, bolts, circlets, and other fastening devices are removed before using force to remove parts.

• Read all instructions before proceeding with any repairs. Make sure you follow the WARNING, CAUTION, and NOTES in the instructions.

• Wear a rubber apron, gloves, boots, and goggles or a face shield when doing maintenance on batteries.

• Batteries generate hydrogen gas when they are being charged. Keep open fire away from batteries. Do not check the electrolyte level with a match or a lighter. Do not smoke and do not create sparks. Make sure the area has ventilation. If the battery is charged in the lift truck, open the hood.

• Lift batteries correctly with a crane or equipment designed for the job. Always use a spreader bar designed and adjusted for the battery. Move batteries with a lift truck, or a conveyor or rollers designed for that purpose. If the battery does not have a cover, a rubber mat or insulating material must be put over the top of the battery to prevent a short-circuit with other equipment. Make sure the lifting equipment has enough capacity for the job. Do not use chain or wire rope slings.

• Never put metal materials or tools on a battery.

• When maintenance on the battery or the battery charger is required, disconnect both the AC and DC power. If new battery connectors must be installed, make sure the positive and negative terminals and cables are kept separate and insulated from each other. Even a momentary short-circuit can cause an explosion and damage the battery.

• Keep water readily available to flush spilled electrolyte. Electrolyte in the eyes must be flushed with water immediately and then quickly get medical attention. Special showers and eye wash systems are required in areas where battery maintenance is done.

• If electrolyte is spilled on a work surface or the floor, flush the area with water and use a solution of soda (sodium bicarbonate) to neutralize the acid.

• Only trained persons are permitted to do maintenance on batteries and battery chargers. Make sure that the regulations by government safety agencies, government insurers, private insurers, and private organizations are followed when doing maintenance on batteries.

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

⚠️ WARNING
Indicates a condition that can cause death or injury!

⚠️ CAUTION
Indicates a condition that can cause property damage!
SUPPORT INFORMATION

To assist every user to maintain your Airtrax™ lift truck in a safe, reliable condition, contact your local authorized Airtrax™ lift truck dealer.

PUBLICATIONS

Technical Publications

To assist every user to maintain your Airtrax™ lift truck in a safe, reliable condition, a parts manual supplements this service maintenance manual. The parts manual provides complete replacement parts identification.

The complete set of manuals are available using the following part numbers from your lift truck dealer:

• Operator’s Manual - 32025000
• Parts/Maintenance Manual - 32025100

Operator’s Manual

To provide instructions for safely operating and servicing your lift truck, each truck is furnished with an Operator’s Manual. The Operator’s Manual describes the various operating techniques and safety warnings for the operator. The Operator’s Manual also contains a guide to safe maintenance practices, removing of basic components such as covers and floor plates, and recommended schedules for maintenance. If the Operator’s Manual is missing from your lift truck, it should be replaced. Replacement copies are available from your lift truck dealer for a nominal fee.

Maintenance Manual

The Maintenance Manual provides comprehensive details on removal and installation of components for your Airtrax™ lift truck.

Parts Manual

The Parts Manual provides lists of parts with corresponding drawings of all replaceable parts for your Airtrax™ lift truck.

CONSUMABLES

NOTE: For safe handling information on consumable products, consult the Material Safety Data Sheet (MSDS).

Recommended Cleaners

Painted Surfaces and Plastic Components

When cleaning painted surfaces or plastic components, use a soft cloth, warm water, and a mild detergent.

• Do not use strong detergent, abrasive cleaners, solvent, fuel, or petroleum-based cleaners.
• Do not wipe dirt off the lift truck when the lift truck is dry.
• Do not use hot water or steam to clean these surfaces.

Parts

⚠️ CAUTION

Never use compounds or solvents that are not recommended for use on buna-n (nitrile rubber) and Viton seal materials.

The cleaning of parts is an essential part of lift truck maintenance and repair operations. The manufacturer of this lift truck recommends the use of mineral spirit-based solvents to clean parts.

Thread Locker

Loctite 242 is designed for the locking and sealing of threaded fasteners which require normal disassembly with standard hand tools. The product cures when confined in the absence of air between close fitting metal surfaces and prevents loosening and leakage from shock and vibration.

• Use only where specified in this manual.
• Do not substitute another product when instructed to use Loctite 242.
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SAFETY PROCEDURES

When Inspecting The Lift Truck

A WARNING
Do not operate a lift truck that needs repairs. Immediately report the need for repairs. If repair is necessary, put a DO NOT OPERATE tag in the operator's area. Remove the key from the key switch.

NOTE: The parking brakes on the SIDEWINDER™ ATX-3000 are automatically set when the key switch is turned to the OFF position. The service brakes are applied when the traction joystick is placed into the neutral position. When the traction joystick is released, it will automatically return to the neutral position and the service brakes will be applied.

DO NOT make repairs or adjustments unless specifically authorized to do so.

ALWAYS put the lift truck on a level surface prior to performing any repairs or adjustments.

ALWAYS lower the carriage and forks or follow the steps outlined in the WHEN WORKING NEAR THE MAST section when the mast cannot be lowered.

ALWAYS apply the parking brake by turning the key switch to OFF.

ALWAYS remove the access covers and floor plates (see COVERS/FLOOR PLATE in Operator's Manual). Inspect for leaks and conditions that are not normal. Clean any oil spills. Make sure that lint, dust, paper, and other materials are removed from the compartments.

Safety Procedures When Working Near The Mast

This lift truck meets all applicable mandatory requirements and safety standards for powered industrial lift trucks at the time of manufacture.

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.

The following procedures must be used when inspecting or working near the mast. Additional precautions and procedures can be required when repairing or removing the mast.

A WARNING
Never work on the mast with a load on the forks or attachment in the raised position, without supports or while anyone is near the lift truck joystick controls.

A WARNING
Mast parts are heavy and can move. Distances between parts are small. Serious injury or death can result if part of the body is hit by parts of the mast or the carriage.

A WARNING
Never put any part of the body into or under the mast or carriage unless all parts are completely lowered or a safety chain is installed. Also make sure that the power is off and the key is removed.

A WARNING
Put a DO NOT OPERATE tag in the operator's compartment. Disconnect the battery on electric lift trucks and put a tag or lock on the battery connector.

A WARNING
Be careful of the forks. When the mast is raised, the forks can be at a height to cause an injury.

A WARNING
DO NOT climb on the mast or lift truck at any time. Use a ladder or personnel lift to work on the mast.

A WARNING
Mast repairs require disassembly and removal of parts and can require removal of the mast or carriage. Follow the repair procedures in the MAST section of this manual.

A WARNING
The battery cover and its latch mechanism must operate correctly before the lift truck is operated.
When Working Near the Mast

1. Lower the mast and carriage completely. Push the hydraulic control joystick to make sure there is no movement in the mast. Make sure that all parts of the mast that move are fully lowered.

2. If parts of the mast must be in a raised position, install a safety chain to restrain the moving parts of the mast. Connect moving parts to a part that does not move. Follow these procedures:
   a. Put the mast in a vertical position.
   b. Raise the mast to align the bottom crossmember of the weldment that moves in the outer weldment with a crossmember on the outer weldment. On the two-stage and free-lift mast, the moving part is the inner weldment. On the three-stage mast it is the intermediate weldment.
   c. Use a 3/8-inch minimum safety chain with a hook to fasten the crossmembers together so that the movable member cannot lower. Put the hook on the back side of the mast. Make sure the hook is completely engaged with a link in the chain. Make sure the safety chain does not touch lift chains or chain sheaves, tubes, hoses, fittings, or other parts on the mast.
   d. Lower the mast until there is tension in the safety chain and the free-lift cylinder (free-lift and three-stage masts only) is completely retracted. Install a DO NOT REMOVE tag on the safety chain(s).
   e. Install another safety chain (3/8-inch minimum) between the top or bottom crossmember of the carriage and a crossmember on the outer weldment.

3. After lowering or restraining the mast, shut off the power and remove the key.

4. Put a DO NOT OPERATE tag in the operator's compartment.

5. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect the battery.

Figure 1: APPLYING SAFETY CHAIN
How to Put a Lift Truck on Blocks

**WARNING**
The lift truck must be put on blocks for some types of maintenance and repair. The removal of the following assemblies will cause large changes in the center of gravity: mast, transaxle assembly, battery, and the counterweight. When the lift truck is put on blocks, put additional blocks in the following positions:

- **Before removing the mast and front transaxle assembly**, put blocks under the rear of the frame so that the lift truck cannot fall backward or to the side.
- **Before removing the battery, counterweight, or rear transaxle assembly**, put blocks under the mast assembly so that the lift truck cannot fall forward or to the side.

**WARNING**
Put the lift truck on blocks only if the surface is solid, even, and level. Make sure that any blocks used to support the lift truck are solid, one piece units. Put blocks in front and back of the Omni-Directional™ Wheels to prevent movement of the lift truck.

**NOTE:** Some lift trucks have lifting eyes. These lift points can be used to raise the lift truck so that blocks can be installed.

---

How to Raise the Front Omni-Directional™ Wheels

1. Set the parking brakes by placing the key switch in the OFF position.
2. Put blocks on each side (front and back) of the rear Omni-Directional™ Wheels to prevent movement of the lift truck.

**WARNING**
Make sure that the hydraulic jack has a capacity rating equal to at least half the weight of the lift truck. See the capacity nameplate.

3. Use a hydraulic jack under the side of the frame near the front to lift the lift truck.
4. Place the blocks under each outer mast channel.
5. Place additional blocks under the frame behind the front Omni-Directional™ Wheels.
How to Raise the Rear Omni-Directional™ Wheels

1. Set the parking brakes by placing the key switch in the OFF position.
2. Put blocks on each side (front and back) of the front Omni-Directional™ Wheels to prevent movement of the lift truck.

⚠️ WARNING
Make sure that the hydraulic jack has a capacity rating equal to at least half the weight of the lift truck. See the capacity nameplate.

3. Use a hydraulic jack under the side of the frame near the rear to lift the lift truck.
4. Place blocks under the ends of the rear counterweight.
5. Place additional blocks under the frame in front of the rear Omni-Directional™ Wheels.

HOW TO MOVE A DISABLED LIFT TRUCK

The Airtrax™ SideWinder™ ATX-3000 cannot be towed. The lift truck’s parking brakes will be set and steering will be disabled in the event of an electrical system failure. In order to move the disabled lift truck, another lift truck with sufficient load capability must be used to lift and move the disabled lift truck to a area where electrical troubleshooting and repair can be performed.

⚠️ WARNING
Never carry a disabled lift truck unless the lift truck MUST be moved and cannot be towed. The lift truck used to carry the disabled lift truck MUST have a rated capacity equal to or greater than the weight of the disabled lift truck. The capacity must be for a load center equal to half the width of the disabled lift truck. See the capacity on the nameplate of the disabled lift truck for the approximate total weight. The forks must extend the full width of the disabled lift truck. Center the weight of the disabled lift truck on the forks and be careful not to damage the underside of the lift truck.

⚠️ WARNING
Whenever a disabled lift truck is being moved by another lift truck, utilize a ground guide to prevent accidents from occurring.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect the battery.
2. Ensure the lift truck that is being used to move the disabled lift truck has the proper capacity rating.
3. Position the lift truck forks under the center of the disabled lift truck and the carriage against the side.
4. Raise the disabled lift truck until slightly off the ground. Tilt the mast back to ensure that the disabled lift truck cannot slide around.
5. With the aid of a ground guide, move the disabled lift truck to a maintenance area for repairs.
The Maintenance Schedule has two time periods in which the mechanic can perform the maintenance. For lift trucks operated less than eight hours each day, use the 1 DAY, 2 MONTH, and 1 YEAR period schedule. For lift trucks operated more than eight hours each day, use the 8 HOUR, 500 HOUR, and 2000 HOUR schedule.

The maintenance schedules are made according to the maximum service intervals for average conditions. Inspect and lubricate more frequently when operating in dirty or difficult conditions.

* Recommended service intervals are based on a normal application in a clean environment. Applications involving contaminated environment, poor ground conditions, intense usage at high performance levels, or other abnormal conditions will require more frequent servicing. At your request, your Airtrax™ dealer will advise you of the appropriate service interval on an application survey.

### Table 1: Maintenance Schedule

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<td></td>
<td>Check Level Inspect Check Operation</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>CLEAN BATTERY</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>BATTERY CABLES AND CONNECTOR</td>
<td></td>
<td>X</td>
<td></td>
<td>Check Condition</td>
<td></td>
</tr>
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<td>9</td>
<td>SEAT ASSEMBLY: CONTROLS SEAT RAILS PRESSURE SWITCH</td>
<td>X</td>
<td>X</td>
<td>L</td>
<td>Check Condition Check Operation Lubricate Check Operation</td>
<td>Multi-Purpose Grease</td>
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<td>10</td>
<td>SEAT BELT</td>
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<td></td>
<td>X</td>
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<td>Check Operation</td>
</tr>
<tr>
<td>11</td>
<td>ARM AND HIP RESTRAINTS</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>Check Condition</td>
</tr>
<tr>
<td>12</td>
<td>KEY SWITCH</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>Check Operation</td>
</tr>
<tr>
<td>13</td>
<td>LCD DASH DISPLAY</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>Check Operation</td>
</tr>
<tr>
<td>14</td>
<td>HORN AND ALARM</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>Check Operation</td>
</tr>
<tr>
<td>15</td>
<td>LIGHTS (if equipped)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>Check Operation</td>
</tr>
<tr>
<td>16</td>
<td>COOLING FANS</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>Check Operation</td>
</tr>
<tr>
<td>17</td>
<td>SAFETY LABELS</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>Inspect See Parts Manual</td>
</tr>
<tr>
<td>ITEM NO.</td>
<td>ITEM</td>
<td>8 Hr. or Daily</td>
<td>500 Hr. or 2 mo.*</td>
<td>2000 Hr. or 1 yr.</td>
<td>PROCEDURE or QUANTITY</td>
<td>SPECIFICATION</td>
</tr>
<tr>
<td>---------</td>
<td>-------------------------------------------</td>
<td>----------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>------------------------</td>
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</tr>
<tr>
<td>18</td>
<td>OVERHEAD GUARD</td>
<td>X</td>
<td></td>
<td></td>
<td>Check Condition</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>OMNI-DIRECTIONAL WHEELS</td>
<td>X</td>
<td></td>
<td></td>
<td>Check Condition</td>
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<tr>
<td>20</td>
<td>LUG NUT TORQUE</td>
<td>X</td>
<td></td>
<td></td>
<td>Check torque</td>
<td>125 ft-lb (169 N•m)</td>
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<td>21</td>
<td>COUNTERWEIGHT</td>
<td>X</td>
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<td>Check Condition</td>
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<td>22</td>
<td>BUMPER</td>
<td>X</td>
<td></td>
<td></td>
<td>Check Condition</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>FORKS AND RELEASES</td>
<td>X</td>
<td></td>
<td></td>
<td>Inspect</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>CARRIAGE</td>
<td>X</td>
<td></td>
<td></td>
<td>Inspect</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>LIFT CHAINS: CHAIN TENSION</td>
<td>X</td>
<td></td>
<td>X</td>
<td>Check Condition</td>
<td>Chain Nut Torque 50 to 70 ft-lb (68 to 95 N•m)</td>
</tr>
<tr>
<td>26</td>
<td>UPRIGHT</td>
<td>X</td>
<td></td>
<td></td>
<td>Check Operation</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>MAST: SLIDING SURFACES LIFT CHAINS</td>
<td></td>
<td>L</td>
<td>L</td>
<td></td>
<td>Multi-Purpose Grease or Kendall SR-12X SAE 40W or Bowman Heavy Load Red Grease</td>
</tr>
<tr>
<td>28</td>
<td>TRACTION JOYSTICK CONTROLS</td>
<td>X</td>
<td></td>
<td></td>
<td>Check Operation</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>HYDRAULIC JOYSTICK CONTROLS</td>
<td>X</td>
<td></td>
<td></td>
<td>Check Operation</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>PARKING BRAKE</td>
<td>X</td>
<td></td>
<td></td>
<td>Check Operation</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>SERVICE BRAKES</td>
<td>X</td>
<td></td>
<td></td>
<td>Check Operation</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>BRAKE ROTORS THICKNESS</td>
<td>X</td>
<td></td>
<td></td>
<td>Check Condition</td>
<td>Minimum 7.5 mm Maximum 11.0 mm</td>
</tr>
<tr>
<td>33</td>
<td>BRAKE AIR GAP</td>
<td></td>
<td>A</td>
<td></td>
<td>Inspect</td>
<td>0.25 to 0.4 mm</td>
</tr>
<tr>
<td>34</td>
<td>TRANSMISSIONS AND TRACTION MOTOR</td>
<td>X</td>
<td></td>
<td></td>
<td>Inspect</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>HYDRAULIC MOTOR AND GEAR PUMP</td>
<td></td>
<td></td>
<td></td>
<td>Inspect</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>INVERTERS/HEAT SINKS</td>
<td>X</td>
<td></td>
<td></td>
<td>Inspect</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>WIRING</td>
<td>X</td>
<td></td>
<td></td>
<td>Check Condition</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>VCM (VEHICLE CONTROL MODULE)</td>
<td>X</td>
<td></td>
<td></td>
<td>Inspect</td>
<td></td>
</tr>
</tbody>
</table>

X = Check   L = Lubricate   C = Change   A = Adjust
EVERY 8 HOURS OR DAILY

Maintenance Procedures

Your Airtrax™ lift truck dealer has the facilities and trained personnel to do the maintenance. A complete program of inspection, lubrication, and maintenance will help your lift truck perform efficiently and operate over a longer period of time.

Some users have service personnel and facilities to do the items listed in the Maintenance Schedule.

Inspect the lift truck every eight hours or daily before use. Put the lift truck on a level surface. Lower the carriage and forks and set the parking brakes by placing the key-switch in the OFF position. If repair is required, attach a tag on the battery connector stating DO NOT CONNECT BATTERY and disconnect the battery. DO NOT operate a lift truck until the problems are corrected.

Make the following checks before operating:

1. Oil level in the hydraulic tank.
2. State of charge, electrolyte, and specific gravity of the battery.
3. Make sure the battery is clean and the correct size and weight for the lift truck.
4. Operation of the battery cover and latch mechanism. Ensure that the gas shocks hold the cover in the open position.
5. Condition of the Omni-Directional™ Wheels.
6. Condition of the forks, fork release clips, carriage, mast, and overhead guard.
7. Leaks of the battery and the hydraulic system.

Hydraulic System

WARNING
Hydraulic oil is HOT at operating temperature. Do not permit the oil to contact the skin and cause a burn.

CAUTION
Do not permit dirt to enter the hydraulic system when the oil level is checked or the filter is changed.

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

1. Check the hydraulic oil level when the oil is at operating temperature, the carriage is lowered, and the key switch is OFF. Add hydraulic oil only as needed. If more hydraulic oil is added than the FULL level, hydraulic oil will leak from the breather during operation. The oil level indicated by the dipstick is most accurate when the oil temperature is 130 to 200°F (54 to 93°C).
2. Inspect for leaks in the hydraulic system. Inspect the condition of the hydraulic hoses on the lift truck and on the mast.
3. Check the hydraulic system for leaks, damaged, or loose components.

Battery

WARNING
Always set the parking brakes by placing the key switch in the OFF position before connecting the battery. If the lift truck was operated with a discharged battery, check all contacts for welded tips before a charged battery is connected. Do not put tools on the battery.

WARNING
The acid in the electrolyte can cause injury. If the electrolyte is spilled, use water to flush the area. Make the acid neutral with a solution of sodium bicarbonate (soda). Acid in the eyes must be flushed with water immediately.

WARNING
Batteries generate explosive fumes. Keep the vents in the caps clean. Keep sparks or open flames away from the battery area. Do not make a spark from the battery connections. Disconnect the battery when doing maintenance.

CAUTION
Keep the battery case, top cover, and the area for the battery clean and painted. Leakage and corrosion from the battery can cause a malfunction in the electric controls of the lift truck. Use a water and sodium bicarbonate solution (soda) to clean the battery and the battery area. Keep the top of the battery clean, dry, and free of corrosion.

NOTE: When performing maintenance or cleaning the battery, always complete the Battery Inspection Report and the Daily Battery Report. See the MAINTENANCE RECORDS procedure in this manual.

1. Make sure the battery voltage and the battery weight is within the maximum and minimum weight shown on the capacity plate.
2. Make sure the battery is charged and has the correct voltage and ampere hour rating for the lift truck (see the Capacity nameplate).

3. Inspect the battery case, connector, and cables for damage, cracks, or breaks. Contact local battery dealer to repair any damage.

⚠️ CAUTION
Add only distilled water.

4. Check the level of the electrolyte daily on a minimum of one cell. The correct level is halfway between the top of the plates and the bottom of the fill hole. See the ADDING APPROVED OR DISTILLED WATER procedure in this manual.

**Battery Cover**

⚠️ WARNING
When working around battery cover, keep fingers clear of pinch points. Failure to comply may result in injury to personnel.

**NOTE:** The battery cover is also utilized as a battery restraint. The function of the battery restraint, when the battery cover is correctly locked to the frame, is to hold the battery in the battery compartment if an accident causes the lift truck to tip over. A sliding latch mechanism on the front of the battery cover locks the battery cover to the frame for lift truck operation. The sliding latch unlocks the battery cover from the frame so that the battery cover can be raised to the open position for access to the battery. The battery cover is also the support for the seat. When opened, two gas shocks hold the battery cover in the open position.

1. Make sure the latch mechanism operates correctly. Check that the latch is not worn and fully engages the frame. The battery cover must be locked in the closed position when the lift truck is operated. Try to raise the seat and hood when the battery cover is locked in the closed position.

2. Inspect the entire battery cover for damage.

3. Position the battery cover in the opened position and ensure that the gas shocks hold the battery cover open.

4. The battery cover is mounted to the rear uprights of the overhead guard. Check the mount hardware for security of attachments.

**Operator Restraint System**

**NOTE:** The seat, seat belt, and carrier arm assemblies are all part of the operator restraint system. These items are designed to help hold the operator in the seat if an accident occurs. Each item must be checked to make sure it is fastened correctly, functioning properly, and no damage is evident.

1. Make sure the seat rails are fastened correctly at the battery cover. The seat must lock in position on the seat rails, but the seat must freely slide on the seat rails when it is unlocked.

2. The seat belt must latch correctly. Make sure the seat belt extends and retracts smoothly and is not worn or damaged. If you cannot pull the seat belt from the retractor assembly, replace the seat belt and retractor assembly.

3. The armrests must slide up and down smoothly when adjusting and must be free of any damage.

4. The left-side and right-side carrier arm assemblies are in place to help hold the operators hips and torso on the lift truck if a tip over occurs. Inspect both carrier arm assemblies to ensure the mounting hardware is secure and no damage is found.

5. The left-side carrier arm assembly raises to allow easy access when climbing on and off of the lift truck. Operate the release lever on the front of the carrier arm assembly and guide it through the full range of motion up and down. Ensure that the carrier arm assembly locks in the up and down positions. When in a locked position, the release lever will have to be engaged.

**Mast, Forks, and Lift Chains**

⚠️ WARNING
When working on or near the mast or carriage, see SAFETY PROCEDURES WHEN WORKING NEAR THE MAST at the front of this section.

⚠️ WARNING
Do not try to correct fork tip alignment by bending the forks or adding shims. Replace damaged forks.

- Never repair damaged forks by heating or welding. Forks are made of special steel using special procedures. Replace damaged forks.
- Do not try to move a fork without a lifting device. Each fork can weigh 77 to 88 lb (35 to 40 kg).

1. Inspect the welds on the mast and carriage for cracks. Make sure that the capscrews and nuts are tight.

2. Inspect the channels for wear in the areas where the rollers travel. Inspect the rollers for wear or damage.

3. Inspect the load backrest extension for cracks and damage.
4. Inspect the forks for cracks and wear. Check the alignment of the fork tips. The fork tip alignment must be within 13 mm. Check that the bottom of the fork is not worn.

5. Replace any damaged or broken parts that are used to keep the forks locked in position.

1. TIP ALIGNMENT = 1/2 in (13 mm)
2. CRACKS
3. LATCH DAMAGE
4. HEEL OF FORK (MUST BE 90% OF DIMENSION X)
5. HEEL WEAR

Figure 3: MAST FORKS - INSPECTION

6. Lubricate the lift chains with SAE 40 wt. oil or Bowman Heavy Load Red Grease.

7. Inspect the lift chains for cracks or broken links and pins.

8. Inspect the chain anchors and pins for cracks and damage.

Lift Chain Adjustments

The lift function for the mast is provided by two lift chains. To operate correctly, the lift chains on the mast must be adjusted periodically. See the MAIN LIFT CHAIN - ADJUSTMENT and the FREE LIFT CHAIN - ADJUSTMENT procedures in this manual.

When correctly adjusted:

- The tension will be the same on each chain of the chain set. Check tension by pushing on both chains at the same time.
- The chain length will be correct.
- The chains must travel freely through the complete cycle.

1. Put a load equal to 80 to 90% of the capacity load on the forks. Lower the forks as much as possible. Tilt the mast fully backward.

2. Check the amount that the bottom carriage roller extends below the inner channel of the mast. The carriage roller must not extend more than 1.3 in (33 mm) below the mast channel. If the adjustment is not correct, adjust the chain anchors. Make sure each chain anchor is adjusted the same amount.
3. Remove the load from the forks. Check the clearance of the carriage when the mast is fully extended. The carriage stops must not touch the stop on the top crossmember of the inner weldment. The chains are too tight if the carriage touches the crossmember. Put the mast in a vertical position and lower the carriage completely. If the forks do not just touch the surface, the chains are too tight. If the chains are too tight, adjust the chain anchors. Make sure each anchor is adjusted the same amount.

**CAUTION**

When a Omni-Directional™ Wheel has been installed, check all wheel lug nuts after 2 to 5 hours of operation. Tighten the lug nuts in a criss-cross pattern to the correct torque value shown in the MAINTENANCE SCHEDULE table of this manual. After the first torque, the interval for checking the torque can be extended to 500 hours.

---

**NOTE:** When the chain adjustments are complete, make sure that the threads on the nuts of the chain anchors are completely engaged. Make sure that the nuts on the chain anchors are not tight against the mounts. The chain anchors must be free to move in their sockets.

4. Three-stage mast chain adjustment: Adjust the main lift chains so that the top of the inner weldment is even with the top of the intermediate weldment within +/- 0.06 in (1.5 mm).

**Omni-Directional™ Wheel Assemblies**

1. Inspect the Omni-Directional™ Wheel assemblies for wire, rocks, glass, pieces of metal, holes, cuts, and other damage. Remove any object that will cause damage.
2. Check for loose or missing hardware.

---

**WARNING**

Make sure the key switch is OFF and the park brake is set before connecting the battery.

Connect the battery, sit on the seat, turn the key switch to ON, and check the following operations:

- Horn and alarms
- LCD dash display
- Parking and service brakes
- Hydraulic control joystick
- Traction control joystick
- Lights (if equipped)
- Emergency stop switch
Controls and Display

NOTE: Inspect the following items to ensure correct operation, that there is no damage to equipment, and all hardware is secure.

1. The key switch should operate smoothly and turn with little effort involved.
2. The light switches (if equipped) should be secured in the dash and operate the appropriate lights.
3. All lights (if equipped) should operate properly, be securely mounted, and all lenses free from cracks and damage.
4. The emergency stop switch must shut the lift truck OFF immediately when pressed. Ensure that the switch is mounted correctly and secure.

NOTE: The LCD dash display has many functions, however, you need only concern yourself with the basic functions at this time.

5. Check the LCD dash display for damage, securely mounted to the dash, and that it is operating properly:
   a. Turn the key switch to the OFF position, wait 10 seconds, and turn the key switch to the ON position.
   b. The first item to be viewed on the LCD dash display will be the hour meter for five seconds.
   c. After the hour meter times out, the battery indicator LED graph will display and remain on until the key switch is turned to the OFF position.
   d. Ensure that the battery LED graph is showing proper voltage in the battery.
6. There are nine dash LED icon lights. These lights will illuminate for 5 seconds when the key switch is turned to the ON position. After 5 seconds, the only lights that should be on are the seat belt (until the seat belt is fastened) and the park brake indicator. The park brake indicator will go out when the lift truck is moved. If any other LED icon lights are on, the lift truck must be repaired immediately.
7. Inspect the hydraulic control joystick for damage, that it is securely mounted, and all functions work when operated (including the trigger switch function).
8. Inspect the traction control joystick for damage, that it is securely mounted, and all functions work when operated (including the trigger switch function).
9. Operate the lift truck in all four traction performance modes. Ensure that the traction performance switches and indicators are functioning properly.

Lift System Operation

⚠️ WARNING
When working on or near the mast or carriage, see SAFETY PROCEDURES WHEN WORKING NEAR THE MAST at the front of this section.

⚠️ WARNING
Never allow anyone under a raised carriage. Do not put any part of your body in or through the lift mechanism unless all parts of the mast are completely lowered, the key removed, and the battery disconnected.

⚠️ 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 and cause personal injury or death.

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. The carriage raises first, then the inner weldment and the intermediate weldment (three-stage masts only).

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

3. The inner weldment(s) and the carriage must lower completely.
4. Raise the mast three feet (one meter) with a capacity load. The inner weldment(s) and carriage must raise smoothly. Lower the mast. All moving components must lower smoothly.
5. With the load lowered, tilt the mast backward and forward. The mast must tilt smoothly and both tilt cylinders must stop evenly.
6. Check that the controls for the attachments (if equipped) operate the functions of the attachment. Make sure all of the hydraulic hoses and cylinders are connected correctly and do not leak.
General Lift Truck and Lubrication Schedule

Service Brakes

NOTE: The service brakes are operated with the traction control joystick. The traction control joystick is moved in the direction of travel to move the lift truck. Each time the traction control joystick is returned to the neutral position, the service brakes are applied.

1. Move the lift truck in several directions and observe the operation of the service brakes when returning the traction control joystick to the neutral position.

2. Operate the lift truck in all traction performance modes. The service brakes should stop the lift truck smoothly and efficiently regardless of speed.

Parking Brake

NOTE: The parking brakes on the SideWinder™ ATX-3000 are automatically set when the key switch is turned to the OFF position.

1. Check the operation of the parking brake. The parking brake, when in good condition and correctly adjusted, will hold the lift truck with a capacity load on a 15% grade.

2. If the parking brake is not holding or not releasing properly, see the BRAKE AIR GAP - ADJUSTMENT procedure in this manual.

Traction Control System

NOTE: The steering of the SideWinder™ ATX-3000 is controlled with the traction control joystick.

1. Check that the traction control system operates smoothly and gives good steering control.

2. Check for unusual noise in the Omni-Directional™ Wheel assemblies as the lift truck is operated. Report and repair any unusual noise.

Every 500 Hours or Two Months

NOTE: Do these procedures in addition to the 8 hour checks.

Hydraulic Tank Breather

The hydraulic tank breather is located on the top of the hydraulic tank next to the hydraulic tank filter. Inspect the hydraulic tank breather. Clean or replace the breather when it is dirty and will not permit the easy passage of air. See the PARTS MANUAL for replacement parts.

Wheel Nut Torques

Check the Omni-Directional™ Wheel lug nuts for the proper torque. Torque the Omni-Directional™ Wheel lug nuts in a cross pattern to the correct torque value shown in the MAINTENANCE SCHEDULE table of this manual.

Access Covers and Floor Plates

Remove the access covers and floor plates to gain access for inspection. For removal procedures, see COVERS/FLOOR PLATE procedure in the Operator's Manual.

WARNING

After a long period of operation, transmission oil becomes very hot. Use heat resistant gloves to protect against serious burns and other injuries.

1. Inspect transaxle assembly and traction motors for leaks and damage.

2. Check controllers for damage and loose mounting hardware.

3. Inspect the hydraulic motor and gear pump for leaks, damage, and loose attachments.

4. Check all wiring for damage, security at components, and ensure wiring is secured away from any rub points. If needed, secure wiring away from rub points with wire ties.

5. Inspect all hydraulic hoses for security, leaks, chafing, and damage. If needed, secure hydraulic hoses away from rub points with wire ties.

Mast

⚠️ WARNING
When working on or near the mast or carriage, see SAFETY PROCEDURES WHEN WORKING NEAR THE MAST at the front of this section.

⚠️ WARNING
Do not work under a raised carriage. Lower the carriage or use a safety chain to prevent the carriage from lowering when doing maintenance on the mast and lift chains.

⚠️ WARNING
Cleaning solvents can be flammable and toxic, and can cause skin irritation. When using cleaning solvents, always follow the recommendations of the manufacturer.

⚠️ WARNING
Be careful when cleaning with steam. Steam can cause serious burns. Wear protective clothing, eye protection, and gloves. Never expose your skin to steam.

⚠️ CAUTION
DO NOT use steam or high pressure water to clean the load rollers or the lift chains. Steam and high pressure water can remove the lubrication from the bearings in the load rollers. Water in the bearings of the sheaves and the link pins of chains can also shorten the service life of these parts.

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

1. Inspect load rollers for excessive wear or damage. Rollers with visible flat spots or cracks should be replaced.
2. Inspect the load roller bearings by turning the rollers on their stub shafts. Rollers with roughness or noticeable restrictions to turning should be replaced.
3. Inspect the load roller stub shafts. If they are damaged or have cracks at the base, the upright rail must be replaced or repaired.
4. Lubricate the load roller surfaces along the full length of the channels. Apply lubricant only to the indicated surfaces.
5. Inspect the outer upright thrust plugs. If the wear surface is worn to less than 1/16 in (1.6 mm), they should be replaced.

Clean Battery

⚠️ 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 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 0.88 gal. (four liters) of water. Apply the solution and flush the solution from the battery using clean water. Wash the battery and the battery compartment as needed.

NOTE: When performing maintenance or cleaning the battery, always complete the Battery Inspection Report and the Daily Battery Report. See the MAINTENANCE RECORDS procedure in this manual.

NOTE: 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.

Keep the battery compartment clean and dry. Use a clean cloth to wash the battery with water. Dry with compressed air.
Lift Chains

WARNING
When working on or near the mast or carriage, see SAFETY PROCEDURES WHEN WORKING NEAR THE MAST at the front of this section.

WARNING
Do not work under a raised carriage. Lower the carriage or use a safety chain to prevent the carriage from lowering when doing maintenance on the mast and lift chains.

NOTE: Each pair of chains has been factory-lubricated using heat and pressure to force the lubricant thoroughly into the chain links. Avoid removal or contamination of this factory applied lubricant. Do not wash, sand blast, etch, steam clean, or paint the chains on initial mast installation.

1. The chains must be adjusted with equal tension to ensure proper load distribution and mast operation. To determine equal tension, extend the unloaded mast to put the chains under tension. Press the center of a strand of chain with your thumb, then press at the same place on the other chain of the pair. Each chain in a pair should have equal "give". If tension is not equal, see the MAIN LIFT CHAIN - ADJUSTMENT and FREE LIFT CHAIN - ADJUSTMENT procedures in this manual.

2. Inspect the chains. If inspection reveals that one strand of a pair of chains requires replacement, both strands of the pair should be replaced.
   a. Check for rust and corrosion.
   b. Check for cracked side plates. If you find cracked side plates, replace both strands of chain.
   c. Check for tight joints. If tight joints are caused by rust or corrosion, loosen them with SAE 40 wt. oil or penetrating oil. If they cannot be loosened, or if the tight joints are caused by bent pins or plates, or by a peened plate edge, replace both strands of the chain.
   d. Check for protruding or turned pins. Replace both strands of the chain.
   e. Check for chain side wear. If pins and outside plates show signs of wear, check for misalignment of sheaves, anchors, or other components. Correct the misalignment. If wear is excessive, replace both strands of chain.

3. If a section of chain is 3% longer than a similar section of new chain, the chain is worn and must be replaced. If a chain scale is available, check the lift chains as in the following figure. If a chain scale is not available, measure 20 links of chain. Measure from the center of a pin to the center of another pin 20 pitches away. Compare the length with the chart in the figure. Replace the chain if the length of 20 links of the worn section is more than the maximum wear limit.

<table>
<thead>
<tr>
<th>Pitch (mm)</th>
<th>Total length of 20 links (mm)</th>
<th>Wear Limit: Max. Links (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.7</td>
<td>254.0</td>
<td>261.6</td>
</tr>
<tr>
<td>15.9</td>
<td>317.5</td>
<td>327.0</td>
</tr>
<tr>
<td>19.1</td>
<td>381.0</td>
<td>392.4</td>
</tr>
<tr>
<td>25.4</td>
<td>508.0</td>
<td>523.25</td>
</tr>
<tr>
<td>31.8</td>
<td>635.0</td>
<td>654.1</td>
</tr>
<tr>
<td>44.5</td>
<td>889.0</td>
<td>915.7</td>
</tr>
<tr>
<td>50.8</td>
<td>1016.0</td>
<td>1046.5</td>
</tr>
</tbody>
</table>

Figure 8: CHAIN - INSPECTION
Forks

⚠️ WARNING
Never repair damaged forks. Do not heat, weld, or bend the forks. Forks are made of special steel using special methods. Replace damaged forks.

⚠️ WARNING
Do not try to move a fork without a lifting device. Each fork can weigh 77 to 88 lb (35 to 40 kg).

1. Check the heel and attachment points of the forks with a penetrant or magnetic particle inspection.
2. Inspect the forks for cracks and wear. Check the alignment of the fork tips. The fork tip alignment must be within 1/2 in (13 mm). Check that the bottom of the fork is not worn.

Safety Labels

⚠️ WARNING
Safety labels are installed on the lift truck to give information about operation and possible hazards. It is important that all safety labels are installed on the lift truck and can be read.

1. Make sure that the safety labels are clearly readable.
2. Install new and correct safety labels if necessary. For replacement instructions, see the SAFETY LABELS - REPLACEMENT procedure in this manual. Refer to the PARTS MANUAL for label locations and part numbers.
3. Inspect the nameplate on the dash to confirm that it contains the proper information (including information for any attachments that may be installed) and is free of damage.
2000 HOURS OR YEARLY

NOTE: Do these procedures in addition to the 8 HOUR/DAILY and the 500 HOUR/TWO MONTHS checks.

Change the Hydraulic Oil Filter
1. Replace the filter element after the first 50 hours of operation on a new lift truck. Replace the oil filter every 2000 hours or yearly after the first 50 hours.
2. Clean the hydraulic tank breather.

Change the Hydraulic Fluid

⚠️ WARNING
Hydraulic oil can become very hot. Ensure that hydraulic oil has cooled prior to performing this procedure.

1. Put the lift truck on a level surface. Lower the mast.
2. Drain all hydraulic fluid from the hydraulic system into a drain pan.
3. Fill the hydraulic tank with the recommended oil described in the MAINTENANCE SCHEDULE table of this manual.
4. Be sure to wipe up any oil that may have been spilled on the lift truck.

Brake Rotor - Inspection

⚠️ WARNING
The traction motor must be at standstill when checking the brake rotor thickness.

⚠️ CAUTION
The brake rotor must be carefully protected from grease and oils. Small amounts of lubricants will reduce the braking power.

NOTE: To gain access to inspect the right front brake rotor, the left front traction motor must first be removed. See TRACTION MOTOR - REMOVAL in this manual.

1. COVER SEAL
2. ARMATURE PLATE
3. BRAKE ROTOR
4. FRICTION PLATE
5. STATOR

Figure 10: BRAKE ROTOR INSPECTION

1. Remove the dust cover seal from the brake assembly.
2. Measure the rotor thickness using a caliper gauge. Be sure to observe the flared flange at the outer diameter of the friction plate.

NOTE: If the rotor thickness measurement is less than the minimum measurement, the rotor must be replaced.

3. Compare the measured rotor thickness with the minimum permissible rotor thickness described in the MAINTENANCE SCHEDULE table of this manual.
4. Repeat procedures until all four brake assemblies have been checked.
Brake Air Gap

**WARNING**
The traction motor must be at standstill when checking the brake air gap.

**CAUTION**
The brake rotor must be carefully protected from grease and oils. Small amounts of lubricants will reduce the braking power.

**NOTE:** To gain access to check the right front brake assemblies air gap, the left front traction motor must first be removed. See the TRACTION MOTOR - REMOVAL procedure in this manual.

1. Remove the cover seal from the brake assembly.
2. Energize the brake by placing the key switch in the ON position.
3. Measure the air gap between the armature plate and stator using a feeler gauge.
4. Compare the measured air gap with the permissible air gap described in the MAINTENANCE SCHEDULE table of this manual.
5. Repeat these procedures until all four brake assemblies have been checked.
6. If the air gap is out of adjustment, perform the following procedures:

   **NOTE:** Turning the threaded sleeve 1/6 turn will change the width of the air gap by approximately 0.15 mm.

   a. Loosen the three capscrews.
   b. Slightly turn the threaded sleeve using a wrench.
   • If the air gap is too large, then turn the threaded sleeve into the stator.
   • If the air gap is too small, then turn the threaded sleeve out of the stator.
   c. Tighten the three capscrews and torque the three capscrews to 18 ft-lb (24 N•m).
7. Check the air gap again, and if necessary, repeat adjustment procedures in Step 6.
8. Install the cover seal on the brake assembly.

*Figure 11: BRAKE AIR GAP ADJUSTMENT*
Controls and Display

**NOTE:** The LCD dash display has many functions, however you need only concern yourself with the diagnostic and battery curve checks at this time.

1. Perform diagnostic mode check on LCD dash display for any fault code.
2. Press and hold the yellow performance button. Then, each press and release of the green performance button will display the text “Show Error #”.
3. By releasing the yellow performance button, the display will get the requested error code from the CANION device.

**NOTE:** If fault codes are present, the lift truck must be taken out of service and repaired. See ELECTRICAL SYSTEM in this manual for troubleshooting procedures.

4. A time-out time of 4 seconds is implemented. Only after the time-out is complete will the display return to normal operation.
5. Perform battery curve check on LCD dash display.
6. Press and hold the green performance button. Then, press and release of the yellow performance button will display the text “Show Actual Battery Curve”.
7. Each press and release of the yellow performance button will display the text “Install New Battery Curve #”.
8. By releasing the green performance button, the command is executed.

**NOTE:** Ensure that the proper Battery Curve is set at this time.

9. A time-out time of 4 seconds is implemented. Only after the time-out is complete will the display return to normal operation.

Check for Leaks in the Lift and Tilt System

**WARNING**

Never allow anyone under a raised carriage. Do not put any part of your body in or through the lift mechanism unless all parts of the mast are completely lowered, the key removed, and the battery disconnected.

**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 and cause personal injury or death.

**WARNING**

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

**Lift System**

1. Operate the hydraulic system. Put a capacity load on the forks and raise and lower the load several times. Lower the load and tilt the mast forward and backward several times. Check for leaks.
2. Raise the carriage and the load 3 ft (1 m). If the carriage lowers slowly with the control valve in a neutral position, there are leaks inside the hydraulic system. The maximum speed that the carriage is allowed to lower is 1.2 in (33 mm) per 10 minutes when the hydraulic oil is 86°F (30°C). If the oil temperature is 140°F (60°C), the maximum speed that the carriage can lower is 5.7 in (145 mm) per 10 minutes.
3. Check the lift cylinder for internal leaks. Remove the load from the forks. Install a gate valve in the supply line between the main control valve and the mast. Put a capacity load on the forks again. Raise the carriage 3 ft (1 m). Close the gate valve. If the carriage or mast weldments lower slowly, the seals in the lift cylinders have leaks.
4. If the carriage does not move, open the gate valve and check for movement again. If the carriage lowers when the valve is open, check for leaks in the hydraulic lines or fittings. If no leaks are found, the main control valve might be damaged. Remove the load from the forks.

**Tilt System**

1. Put a capacity load on the forks. Slowly tilt the mast forward. If the mast continues to slowly tilt forward when the control valve is in a neutral position, there are leaks inside the hydraulic system. The maximum speed that the mast is allowed to tilt forward when there are internal leaks in the lift system is 1.6 degrees in 10 minutes. This maximum speed is measured when the temperature of the hydraulic oil is 86°F (30°C).
2. If the leak rate is greater than specifications, remove the load from the mast. Install a valve between the port at the front of the tilt cylinder and the hydraulic line. Put the load on the forks again. Close the valve. If the mast tilts slowly forward, the cylinder seals are leaking.
3. If the mast does not move, open the gate valve and check for movement again. If the mast moves forward when the gate valve is open, check for leaks in the hydraulic lines or fittings. If no leaks are found, the main control valve might be damaged. Remove the load from the forks.
The SIDEWINDER™ ATX-3000 features a 48-volt AC power system with state-of-the-art control technology. The power is distributed from the battery to the lift truck with a key switch and contactor/fuse assembly. Other components in the electrical system consist of the back-up alarm, cooling fans, horn, emergency cut-out switch, joysticks, vehicle master controller, interface board, LCD dash display, motor controllers, pump motor, traction motors, CAN communication bus, and optional lighting components.

The Controller Area Network (CAN) is the logical step toward a more functional and cost-effective design for communication between components of the lift truck. CANopen is a lean and powerful software implementation of all the lift truck CAN communication functions. The adoption of the CAN communications protocol represents a major opportunity for providing functional improvements on the lift truck, while at the same time reducing costs.

Added features of the CAN bus system are easily installed with less wiring, increased vehicle control, and new functionality together with higher reliability and improved safety.

The vehicle master controller, interface board, motor controllers, LCD dash display, traction motors, and pump motor are all integrated into the CANopen communication bus, allowing reliable monitoring and communication between the different components.

Figure 1: ELECTRICAL SYSTEM COMPONENTS
Figure 2: CONTROLLER AREA NETWORK (CAN) COMPONENTS
DESCRIPTION

Vehicle Master Controller

The heart of the SIDEWINDER™ ATX-3000 electrical system is the vehicle master controller. The vehicle master controller is a general purpose controller that communicates using the CANopen protocol. With its analog digital I/O and communications facilities, the vehicle master controller is well suited to manage the lift truck motion, I/O, operator controls and display.

The vehicle master controller greatly enhances features, safety, and allows for advanced new features.

Interface Board

An interface board is installed in the lift truck to handle translation between the vehicle master controller and other components in the CANopen system. The interface board also provides a physical connection to the network for programming and diagnostic purposes.

Motor Controller

The lift truck is equipped with one pump motor controller, which commands the hydraulic pump motor and four traction motor controllers that command each traction motor.

The motor controllers allow full control of the performance characteristics of the different operating parameters of the lift truck. Top speed, acceleration, and braking can be programmed through the CANopen communications bus by the Airtrax™ dealer and tailored to suit different working situations and applications.

LCD Dash Display

The LCD dash display uses standard CANopen interface for simple and reliable communication. The LCD dash display is typically used as an interface for the lift truck user for driving functions, diagnostics, and setup programming and designed with two-level functionality for normal user or service user.

Operators normally only change performance modes and use information given as display messages. A service user can access the menu system with functions for diagnostics.

Key Switch

The key switch provides 48 volts of power to the contactor/fuse assembly when turned to the ON position and discontinues the 48 volts of power to the contactor/fuse assembly when turned to the OFF position.

Contactor/Fuse Assembly

The contactor/fuse assembly distributes 48 volts of power to the lift truck when activated by the key switch. The electrical system is protected by a 500-amp fuse at the contactor/fuse assembly.

Joysticks

The joysticks control the hydraulic and traction functions of the lift truck.

Cooling Fans

Three cooling fans are provided to help cool the pump motor, pump motor controller, traction motors, and the traction motor controllers. One is located at the front traction motor compartment and two in the rear compartment.

Back-Up Alarm

The lift truck is equipped with a back-up alarm located behind the pump motor. Since the lift truck has Omni-Directional™ Technology, the alarm will sound when making any movements past 90° to either side and back.

Optional Lighting

The lift truck is equipped for optional lighting equipment that consists of a 12-Vdc converter, work lights, tail/brake lights, and a strobe light.
MAINTENANCE PROCEDURES

Horn - Removal

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**NOTE:** The horn and mount bracket are one assembly.

1. Attach a tag on the battery connector stating **DO NOT CONNECT BATTERY**. Disconnect battery.
2. Disconnect the wire connector from the horn.
3. Remove the capscrew, lock washer, and nut from the horn mount bracket and the cowl.
4. Remove the horn assembly from the lift truck.

![Figure 3: HORN - REMOVE/INSTALL](image)

Horn - Installation

1. Align the horn mount bracket on the cowl and secure with one capscrew, lock washer, and nut.
2. Connect the wire connector to the horn.
3. Remove the tag from the battery connector and connect the battery.
4. Test the horn to confirm proper operation.

**Back-Up Alarm - Removal**

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating **DO NOT CONNECT BATTERY**. Disconnect battery.
2. Remove the rear cover from the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.
3. Tag and mark all wiring prior to removal to ensure proper installation.
4. Disconnect two wire connectors from the back-up alarm wire terminals.
5. Remove two capscrews, lock washers, and washers from the back-up alarm and the lift truck frame.
6. Remove the back-up alarm from the lift truck frame.

![Figure 4: BACK-UP ALARM - REMOVE/INSTALL](image)
Back-Up Alarm - Installation

⚠️ CAUTION
The frame weldment has pre-tapped holes for easy installation. Avoid damaging these threaded holes by starting all capscrews into the frame weldment by hand.

**NOTE:** Remove the negative grounding strap from the back-up alarm prior to installation.

1. Align the back-up alarm on the lift truck frame. The alarms speaker must face the rear of the lift truck.
2. Secure the back-up alarm with two washers, lock washers, and capscrews.
3. Connect the wire connectors to the back-up alarm wire terminals as marked during the removal procedure.
4. Install the rear cover on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.
5. Remove the tag from the battery connector and connect the battery.
6. Test the back-up alarm to confirm proper operation.

Key Switch - Removal

⚠️ WARNING
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Remove and secure the key from the key switch.
3. Remove the mount ring from the key switch and dash cover. Pull the key switch from the back-side of the dash cover.
4. Tag and mark all wiring prior to removal to ensure proper installation.
5. Disconnect the wire connectors from the key switch.
6. Remove the key switch.

Key Switch - Installation

1. Connect the wire connectors to the key switch as marked during removal.
2. Align the key switch through the back-side of the dash. Install the mount ring on the key switch and secure the mount ring.
3. Install the key in the key switch.
4. Remove the tag from the battery connector and connect the battery.
5. Operate the key switch to confirm proper operation.

LCD Dash Display - Removal

⚠️ WARNING
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
CAUTION
Use care when disconnecting and connecting the wire connectors at this component, as terminals can bend and break easily. Failure to comply can result in damage to this component.

2. Disconnect the wire connector from the LCD dash display.

3. Remove two nuts and the mount bracket from the back-side of the LCD dash display and the dash cover.

4. Slide the LCD dash display free from the dash cover.

5. Perform a function test on the LCD dash display to confirm proper operation.

Traction joystick - Removal

WARNING
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

2. Remove two screws (one from each side) from the right-side carrier arm assembly.

3. Pivot the right-side carrier arm assembly up to gain access to the bottom of the assembly. Disconnect the wire connectors from the traction joystick.

4. Remove four screws from the traction joystick and the right-side carrier arm assembly.

5. Guide the traction joystick and wiring from the right-side carrier arm assembly.

Figure 6: LCD DASH DISPLAY - REMOVE/INSTALL

LCD Dash Display - Installation

1. Insert the LCD dash display into the dash cover.

2. Install the mount bracket on the back-side of the LCD dash display and the dash cover. Secure the mount bracket with two nuts.

CAUTION
Use care when disconnecting and connecting the wire connectors at this component, as terminals can bend and break easily. Failure to comply can result in damage to this component.

3. Connect the wire connector to the LCD dash display.

4. Remove the tag from the battery connector and connect the battery.

Figure 7: TRACTION JOYSTICK - REMOVE/INSTALL
Traction joystick - Installation
1. Install the traction joystick into the right-side carrier arm assembly and secure the traction joystick with four screws.
2. Connect the wire connectors to the traction joystick.
3. Pivot the right-side carrier arm assembly down to normal operating position and secure with two screws.
4. Install a new traction decal on the traction joystick. Refer to the PARTS MANUAL for traction decal.
5. Remove the tag from the battery connector and connect the battery.
6. Operate the lift truck to confirm proper operation of the traction joystick.

Emergency Cut-Out Switch - Removal

**WARNING**
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.
1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Remove two lower screws (one from each side) from the right-side carrier arm assembly.
3. Pivot the right-side carrier arm assembly up to gain access to the bottom of the assembly. Disconnect the wire connector.
4. Pull the red button from the emergency cut-out switch.
5. Remove the plastic nut from the emergency cut-out switch.
6. Remove the emergency cut-out switch from the bottom of the right-side carrier arm assembly.

Emergency Cut-Out Switch - Installation
1. Install the emergency cut-out switch through the bottom of the right-side carrier arm assembly.
2. Secure the emergency cut-out switch with the plastic nut.
3. Install the red button on the emergency cut-out switch.
4. Connect the wire connector to the emergency cut-out switch.
5. Pivot the right-side carrier arm assembly down to normal operating position and secure with two screws.
6. Remove the tag from the battery connector and connect the battery.
7. Operate the emergency cut-out switch to confirm proper operation.
Hydraulic Joystick - Removal

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

2. Pivot the left-side carrier arm assembly to the upright position.

3. Remove six screws and the bottom cover from the left-side carrier arm assembly.

4. Disconnect the wire connectors from the hydraulic joystick.

5. Remove four screws from the hydraulic joystick and the left-side carrier arm assembly.

6. Guide the hydraulic joystick and wiring from the left-side carrier arm assembly.

Hydraulic Joystick - Installation

1. Install the hydraulic joystick into the left-side carrier arm assembly and secure the hydraulic joystick with four screws.

2. Connect the wire connectors to the hydraulic joystick.

3. Install the bottom cover on the left-side carrier arm assembly and secure with six screws.

4. Pivot the left-side carrier arm assembly down to the normal operating position.

5. Install a new hydraulic decal on the hydraulic joystick. Refer to the PARTS MANUAL for hydraulic decal.

6. Remove the tag from the battery connector and connect the battery.

7. Operate the lift truck to confirm proper operation of the hydraulic joystick.

Micro Switch - Removal

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

**NOTE:** Visual access to the micro switch is achieved through the opening in the back of the carrier arm post by removing the boot from the left-side carrier arm assembly.

2. Remove two screws, lock washers, and the boot retainer from the carrier arm post.
3. Remove the boot from the carrier arm post.

5. Tighten the two capscrews on the micro switch mount bracket and carrier arm post.

6. Connect the wire connector to the micro switch.

7. Install the boot on the left-side carrier arm post and align the mounting holes.

8. Position the retainer on the boot and secure the boot with two screws and lock washers.

9. Remove the tag from the battery connector and connect the battery.

**NOTE:** The left-side carrier arm assembly must be in the locked down position to operate this lift truck.

10. Confirm that the micro switch is functioning properly:
   a. Position the left-side carrier arm assembly in the locked 90° position. The lift truck should not operate.
   b. Next, position the left-side carrier arm assembly in the locked down position. The lift truck should function properly.

**Fan (Front) - Removal**

1. **WARNING** Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

2. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

3. Remove the floor plates from the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.

4. Tilt the mast forward as far as possible to gain access to the fan mounting plate.

5. Disconnect the wire connector from the fan.

6. Remove four screws, washers, lock washers, and nuts from the fan mounting plate and the lift truck frame.

7. Slide the fan mounting plate and fan out of the front of the lift truck frame.

8. Position the left-side carrier arm assembly in the locked 90° position. The lift truck should not operate.

**NOTE:** Place a mark on the mounting plate at the point where the wiring comes out of the fan to ensure proper installation.

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**Figure 11: MICRO SWITCH - REMOVE/INSTALL**

4. Disconnect the wire connector from the micro switch.

5. Remove two capscrews, washers, lock washers, and nuts from the micro switch mount bracket and the carrier arm post.

6. Carefully remove the micro switch and mount bracket through the front opening in the carrier arm post.

7. Remove two screws, washers, lock washers, and nuts from the micro switch and mount bracket.

8. Remove the micro switch from the mount bracket.

**Micro Switch - Installation and Adjustment**

1. Align the micro switch on the mount bracket and secure the micro switch with two screws, washers, lock washers, and nuts.

2. Slide the micro switch and mount bracket through the front opening in the carrier arm post. Align the mounting holes.

3. Secure the micro switch mount bracket to the carrier arm post with two capscrews, washers, lock washers, and nuts. Hand tighten the capscrews at this time.

**NOTE:** Visual access to the micro switch is achieved through the opening in the back of the carrier arm post. This access is necessary when adjusting the micro switch lever on the centerline of the latch pin.

4. Align the micro switch lever on the centerline of the latch pin. Ensure that the micro switch lever is in the depressed position.
7. Remove four screws, washers, lock washers, and nuts from the fan mounting plate and the fan.

8. Remove the fan from the fan mounting plate.

**Fan (Front) - Installation**

1. Align the fan on the mounting plate with the mark that was made during the removal procedure.

2. Secure the fan to the mounting plate with four screws, washers, lock washers, and nuts.

3. Install the mounting plate on the lift truck frame and secure with four screws, washers, lock washers, and nuts.

4. Connect the wire connector to the fan.

5. Install the floor plates on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.

6. Remove the tag from the battery connector and connect the battery.

7. Operate the lift truck to confirm proper operation of the fan.

**Fan (Rear) - Removal**

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

2. Remove the rear cover from the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.

3. Disconnect the wire connector from the fan.

4. Remove two capscrews, washers, lock washers, and nuts from the fan mounting plate and lift truck frame.

5. Remove the fan mounting plate from the lift truck frame.

**NOTE:** Place a mark on the mounting plate at the point where the wiring comes out of the fan to ensure proper installation.

6. Remove four screws, washers, lock washers, and nuts from the fan mounting plate and the fan.

7. Remove the fan from the fan mounting plate.

**Fan (Rear) - Installation**

1. Align the fan on the mounting plate with the mark that was made during the removal procedure.

2. Secure the fan to the mounting plate with four screws, washers, lock washers, and nuts.

3. Install the mounting plate on the lift truck frame and secure with two capscrews, washers, lock washers, and nuts.

4. Connect the wire connector to the fan.
5. Install the rear cover on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.

6. Remove the tag from the battery connector and connect the battery.

7. Operate the lift truck to confirm proper operation of the fan.

Enclosure - Removal

⚠️ WARNING

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

2. Remove the left-side, right-side, and front covers from the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.

3. Remove four capscrews, lock washers, and washers from the enclosure and lift truck frame.

4. Tag and mark all wiring prior to removal to ensure proper installation.

⚠️ CAUTION

Use care when disconnecting and connecting the wire connectors at this component, as terminals can bend and break easily. Failure to comply can result in damage to this component.

1. Position the enclosure on the floor plates so that the wire connections can be accessed.

⚠️ CAUTION

Use care when disconnecting and connecting the wire connectors at this component, as terminals can bend and break easily. Failure to comply can result in damage to this component.

3. Align the enclosure on the lift truck frame mounting holes and secure with four washers, lock washers, and capscrews.

5. Remove the tag from the battery connector and connect the battery.

6. Operate the lift truck to confirm proper operation.

Enclosure - Installation

1. Position the enclosure on the floor plates so that the wire connections can be accessed.

2. Connect the wire connectors to the interface board as marked during removal.

3. Connect the wire connectors to the interface board as marked during removal.

4. Install the front, right-side, and left-side covers on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.

5. Remove the tag from the battery connector and connect the battery.

6. Operate the lift truck to confirm proper operation.
Interface Board - Removal

1. Remove the enclosure from the lift truck. See the ENCLOSURE - REMOVAL procedure in this manual.
2. Place the enclosure on a clean, dry, and solid work surface.

⚠️ CAUTION

Use care when disconnecting and connecting the wire connectors at this component, as terminals can bend and break easily. Failure to comply can result in damage to this component.

3. Disconnect the wire connector from the interface board.
4. Remove four screws and lock washers from the interface board and the enclosure.
5. Remove the interface board from the enclosure.

NOTE: Perform this step only if the interface board is being replaced.

6. Remove four nuts, lock washers, and standoffs from the interface board.

Interface Board - Installation

NOTE: Perform this step only if the interface board is being replaced.

1. Secure four nuts, lock washers, and standoffs to the interface board.
2. Align the interface board on the enclosure and secure the interface board with four screws and lock washers.

⚠️ CAUTION

Use care when disconnecting and connecting the wire connectors at this component, as terminals can bend and break easily. Failure to comply can result in damage to this component.

3. Connect the interface boards wire connector.
4. Install the enclosure on the lift truck. See the ENCLOSURE - INSTALLATION procedure in this manual.
5. Operate the lift truck to confirm proper operation.

Figure 15: INTERFACE BOARD - REMOVE/INSTALL
Vehicle Master Controller - Removal

1. Remove the enclosure from the lift truck. See the ENCLOSURE - REMOVAL procedure in this manual.
2. Place the enclosure on a clean, dry, and solid work surface.

⚠️ CAUTION
Use care when disconnecting and connecting the wire connectors at this component, as terminals can bend and break easily. Failure to comply can result in damage to this component.

3. Disconnect the wire connector from the vehicle master controller.
4. Remove three screws, washers, lock washers, and nuts from the vehicle master controller and the enclosure.
5. Remove the vehicle master controller from the enclosure.

Contactor/Fuse Assembly - Removal

⚠️ WARNING
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Remove the rear cover from the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.
3. Tag and mark the electrical cables and the wires prior to removal to ensure proper installation.
4. Disconnect three electrical cables and two wires from the contactor/fuse assembly.
5. Remove two capscrews, washers, and lock washers from the contactor/fuse assembly and the lift truck frame.
6. Remove the contactor/fuse assembly from the lift truck frame.
Contactor/Fuse Assembly - Disassembly

1. Place the contactor/fuse assembly on a clean, dry, and solid work surface.
2. The diode can be removed by gently pulling the diode from the contactor.
3. Loosen the capscrew, lock washers, washers, and nut from the positive bus bar and fuse.
4. Loosen the nut, lock washer, and washer, from the fuse and the standoff insulator.
5. The fuse can now be removed by lifting the left-side off the standoff insulator and pulling the fuse from the positive bus bar.
6. Unscrew and remove the standoff insulator from the mounting plate.
7. Remove one nut, lock washer, and washer from the positive bus bar. Remove the positive bus bar from the contactor.
8. Remove two capscrews, lock washers, and washers from the contactor and mounting plate. Remove the contactor from the mounting plate.
9. Remove two screws and lock washers from the relay block. Remove the relay block from the mounting plate.

Contactor/Fuse Assembly - Assembly

1. Align the relay block on the mounting plate and secure the relay block with two screws and lock washers.
2. Install the contactor on the mounting plate and secure with two capscrews, lock washers, and washers.
3. Install the positive bus bar on the contactor and install one nut, lock washer, and washer. Hand tighten at this time.
4. Install the capscrew, lock washers, washers, and nut on the positive bus bar. The nut should be on the mounting plate side of the positive bus bar. Hand tighten at this time.
5. Screw the standoff insulator on the mounting plate. Ensure that there are four copper washers and then a washer, lock washer, and nut on the standoff insulator at this time.
6. Install the fuse on the positive bus bar between the washer and the positive bus bar on the capscrew side. Slide the other end of the fuse on the standoff insulator between the four copper washers and the washer, lock washer, and nut.
7. Secure all hardware on the ends of the fuse and tighten the nut that secures the positive bus bar to the contactor.
8. Check all screws and nuts for tightness.
9. Install the diode on the contactor.

Traction Inverter - Removal

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**NOTE:** There are four traction inverters on this lift truck and the removal procedures are the same for all four traction inverters.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Remove the rear cover from the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator’s Manual.
3. Tag and mark the electrical cables prior to removal to ensure proper installation.

**CAUTION**

Use care when disconnecting and connecting the wire connectors at this component, as terminals can bend and break easily. Failure to comply can result in damage to this component.

4. Disconnect the wire harness from the traction inverter’s wire connector.
5. Remove five capscrews and lock washers from the traction inverter. Disconnect five electrical cables from the traction inverter.
6. Remove one capscrew, lock washer, and the fuse from the traction inverter.
7. If needed, cut and remove any wire ties that are holding the wire harness in the way of the traction inverter.
8. Remove four capscrews, lock washers, and washers from the traction inverter and lift truck frame. Remove the traction inverter from the lift truck.

Contactor/Fuse Assembly - Installation

**CAUTION**

The frame weldment has pre-tapped holes for easy installation. Avoid damaging these threaded holes by starting all capscrews into the frame weldment by hand.

1. Align the contactor/fuse assembly on the lift truck frame and secure with two capscrews, washers, and lock washers.
2. Connect three electrical cables and two wires to the contactor/fuse assembly as marked during the removal procedure.
3. Install the rear cover on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator’s Manual.
4. Remove the tag from the battery connector and connect the battery.
5. Operate the lift truck to confirm proper operation.
Figure 20: TRACTION INVERTER - REMOVE/INSTALL

Traction Inverter - Installation

⚠️ CAUTION
The frame weldment has pre-tapped holes for easy installation. Avoid damaging these threaded holes by starting all capscrews into the frame weldment by hand.

1. Position the traction inverter on the lift truck frame and secure with four capscrews, lock washers, and washers. Torque the four capscrews to 10 ft-lb (14 N•m).

⚠️ CAUTION
The traction inverter’s fuse must be a 150 amp rated fuse. Failure to comply may result in damage to electrical components.

2. Align the fuse on the traction inverter and secure the top of the fuse with one capscrew and lock washer. Hand tighten the capscrew at this time.

3. Install five electrical cables to the traction inverter as marked during the removal procedure. Secure the five electrical cables with five capscrews and lock washers.

4. Torque the five capscrews that secure the electrical cables and the capscrew that secures the fuse to 11 ft-lb (15 N•m).

⚠️ CAUTION
Use care when disconnecting and connecting the wire connectors at this component, as terminals can bend and break easily. Failure to comply can result in damage to this component.

5. Connect the wire harness to the traction inverter’s wire connector.

6. Secure the wire harness as needed with wire ties.

7. Install the rear cover on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator’s Manual.

8. Remove the tag from the battery connector and connect the battery.

9. Operate the lift truck to confirm proper operation.

Hydraulic Inverter - Removal

⚠️ WARNING
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

2. Remove the rear cover from the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator’s Manual.

3. Tag and mark the electrical cables prior to removal to ensure proper installation.

⚠️ CAUTION
Use care when disconnecting and connecting the wire connectors at this component, as terminals can bend and break easily. Failure to comply can result in damage to this component.

4. Disconnect the wire harness from the hydraulic inverter’s wire connector.

5. Remove five capscrews and lock washers from the hydraulic inverter. Disconnect five electrical cables from the hydraulic inverter.

6. Remove one capscrew, lock washer, and the fuse from the hydraulic inverter.
7. If needed, cut and remove any wire ties that are holding the wire harness in the way of the hydraulic inverter.

8. Remove four capscrews, lock washers, and washers from the hydraulic inverter and lift truck frame. Remove the hydraulic inverter from the lift truck.

Figure 21: HYDRAULIC INVERTER - REMOVE/INSTALL

Hydraulic Inverter - Installation

⚠️ CAUTION
The frame weldment has pre-tapped holes for easy installation. Avoid damaging these threaded holes by starting all capscrews into the frame weldment by hand.

1. Position the hydraulic inverter on the lift truck frame and secure with four capscrews, lock washers, and washers. Torque the four capscrews to 10 ft-lb (14 N•m).

⚠️ CAUTION
The hydraulic inverter's fuse must be a 175 amp rated fuse. Failure to comply may result in damage to electrical components.

2. Align the fuse on the hydraulic inverter and secure the top of the fuse with one capscrew and lock washer. Hand tighten the capscrew at this time.

3. Install five electrical cables to the hydraulic inverter as marked during the removal procedure.

4. Secure the five electrical cables with five capscrews and lock washers.

5. Torque the five capscrews that secure the electrical cables and the capscrew that secures the fuse to 11 ft-lb (15 N•m).

⚠️ CAUTION
Use care when disconnecting and connecting the wire connectors at this component, as terminals can bend and break easily. Failure to comply can result in damage to this component.

6. Connect the wire harness to the hydraulic inverter's wire connector.

7. Secure the wire harness as needed with wire ties.

8. Remove the tag from the battery connector and connect the battery.


10. Operate the lift truck to confirm proper operation.
**FAULT CODES**

The Airtrax™ lift truck is equipped with diagnostic capabilities to monitor and self-diagnostics the systems of the lift truck.

**NOTE:** If an over-temperature error is observed, shut down the lift truck immediately and allow the lift truck to cool. If a low DC bus fault code appears, it could be a low or bad battery. Stop the lift truck and charge or change the battery as needed.

**NOTE:** If any other fault codes appear, record the fault code and report to the maintenance authority.

<table>
<thead>
<tr>
<th>Value</th>
<th>Fault/Problem</th>
<th>Location</th>
<th>Action</th>
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<td>Error</td>
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<tr>
<td>02</td>
<td>Drive DC Bus Too High (Shut-down)</td>
<td>AC Super Drive</td>
<td>Error</td>
</tr>
<tr>
<td>03</td>
<td>Drive DC Bus Too Low (Shut-down)</td>
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<td>04</td>
<td>Drive Power-Up Charge Circuit Error</td>
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<td>Error</td>
</tr>
<tr>
<td>05</td>
<td>Drive Too Many Communication Errors</td>
<td>AC Super Drive</td>
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<tr>
<td>06</td>
<td>Motor Maximum Temperature Reached (Shut-down)</td>
<td>Motor</td>
<td>Error</td>
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<td>07</td>
<td>Motor Feedback Sensor Error</td>
<td>Motor</td>
<td>Error</td>
</tr>
<tr>
<td>08</td>
<td>Drive</td>
<td>AC Super Drive</td>
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<tr>
<td>09</td>
<td>Motor</td>
<td>Motor</td>
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<td>Drive Over Current or Short Circuit on Power Stage</td>
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<td>Drive Commands from CANION are Contradictory</td>
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<td>Drive Maximum Current Limited Due to Over Temperature</td>
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<td>Motor Maximum Current Limited Due to Over Temperature</td>
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<td>Warning</td>
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<td>Drive Heatsink Temperature Sensor Short Circuit</td>
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<td>Value</td>
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<td>CANOpen PDO Watchdog Timeout</td>
<td>ACSD / VMC20</td>
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<td>Right Joystick Values Out of Range</td>
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<td>32</td>
<td>Left Joystick Values Out of Range</td>
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<td>CANOpen Cyclic Over Run</td>
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<td>Low DC Bus Voltage</td>
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<td>General Warning</td>
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<td>CANOpen SDO Watchdog Timeout</td>
<td>ACSD / VMC20</td>
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<td>41</td>
<td>CANOpen Communication Initialization Failed</td>
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<td>CANOpen No Initial SDO Response</td>
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<td>CANOpen Emergency Exception Message</td>
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VMC20 AND INTERFACE BOARD SCHEMATIC
EMO, ARM, HORN AND JOYSTICK MODE SCHEMATIC

Figure 1: ELECTRICAL SCHEMATIC SHEET 3
Figure 2: ELECTRICAL SCHEMATIC SHEET 4
Figure 3: ELECTRICAL SCHEMATIC SHEET 5
BATTERY

Figure 1: LEAD-ACID LIFT TRUCK BATTERY

General

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

⚠️ WARNING
Always disconnect the battery from the lift truck when doing any maintenance or repair work on the lift truck.

⚠️ WARNING
Wear rubber apron, gloves, boots, and gloves when handling, checking, filling, charging, or replacing batteries.

⚠️ WARNING
Keep open flames away from batteries. Do not check electrolyte level with a cigarette lighter or a match. USE A FLASHLIGHT OR A PERMANENT LIGHT. Do not smoke or create sparks while working with batteries.

⚠️ 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 eyes. Use plain water only and obtain medical attention immediately.

⚠️ WARNING
Apply a strong neutralizer, such as baking soda, when acid is spilled on the floor. Clean up promptly.

⚠️ WARNING
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.

⚠️ WARNING
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”.

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

⚠️ WARNING
Always lift the 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 the top of the battery with a rubber mat or other insulating material to prevent external short circuits from chains or cables falling on top of the batteries.

⚠️ WARNING
Make sure that charging plugs and receptacles are properly locked and all other connections are tight, secure, and free from friction.
**WARNING**
Allow only authorized personnel (qualified by training and experience) in the battery room.

**WARNING**
Enclose all bare wires and buss bars in the battery room using wire guards, guard rails, or other means of isolation from general plant traffic.

**WARNING**
Never lay any metal tools, such as wrenches or other material, on top of an open battery.

**WARNING**
Check batteries for cracks or leaks. If leaks are found, notify maintenance.

**WARNING**
When batteries are disposed of as scrap at the end of useful life, they should be sent to an authorized recycling center or salvage dealer.

**WARNING**
Familiarize yourself as completely as possible with batteries and the proper rules for their charging, handling, and maintenance.

**CAUTION**
Keep vent plugs in the cells at all times, except when taking hydrometer readings, adjusting specific gravity, or checking electrolyte levels.

**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 the specific gravities monthly and give a freshening charge (3 to 4 hours at the finish rate) if the gravities have fallen 30 percentage points (0.030) or more; otherwise, give a freshening charge every three months.

**Lead-Acid Batteries**

A lead-acid battery converts chemical energy into electrical energy. The battery is discharged when the chemical reaction has occurred and the battery will not supply its rated voltage and current. A reverse chemical action must occur so that the battery can be used again.

The batteries can be charged by an electrical voltage and current from an outside source to provide the reverse chemical reaction. The lead-acid battery chemicals store the electrical energy until needed. A lead-acid battery is made up of several cells. Each cell has positive and negative plates with dielectric spacers between each plate. All the plates are in a solution of electrolyte.

**Specific Gravity**

The strength of the electrolyte is measured in points of specific gravity. For example, a solution of sulfuric acid has a specific gravity of 1.835. Water has a specific gravity of 1.000. Electrolyte is 27% acid and 73% water and has a specific gravity of 1.275.

**CAUTION**
NEVER pour water into acid. The quick production of heat can cause the acid to boil and splash out of the container. ALWAYS pour acid into water when making a diluted solution of acid.

**Chemical Reaction**

The cell generates a voltage (potential difference) when two different types of metal are in the electrolyte. The two metals in a lead-acid cell are lead peroxide (PbO3) for positive plates, and sponge lead (Pb) for negative plates. A potential difference of approximately two volts per cell is generated. The potential difference does not vary according to the size of the cell.
During the discharging of the cell, lead peroxide and sponge lead mix with the sulfuric acid to make lead sulfate (PbSO₄) on both plates. This action decreases the voltage in the cell. Specific gravity decreases when the sulfuric acid is removed from the electrolyte. The potential difference of a discharged cell is approximately 1.75 volts.

CAUTION
Disposal of batteries must meet local environmental regulations.

In a fully charged cell, the electrolyte has a specific gravity of 1.270 to 1.130. NEVER discharge a battery below a specific gravity of 1.130. The battery may become permanently damaged if discharged below 1.130.

How to Select a Battery

Selecting the right battery needed to operate for a period of eight hours depends on many conditions. Operations requiring the lift truck to go up ramps or the use of any additional attachments will increase the use for power from the battery. Some work conditions require that more than one battery must be used during a work period. The number of eight-hour work periods per day is normally equal to the number of batteries needed. The capacity of the battery required can be determined as follows:
The size of the lift truck and the attachments.

The type of work; heavy-duty operation or normal operation for one eight hour period.

The battery voltage needed is determined as follows:

- Will your lift truck operate on more than one voltage?
- If you have more than one lift truck in operation, do the battery voltages need to be the same?

Lift trucks are available in various voltage ranges. The motorized hand trucks are normally 24 volts. Larger sit-down lift trucks are normally 48 volts.

**Electrical Terms**

- **Voltage** - an electromotive force (EMF) (also called potential difference) caused by the difference in electric charge between two points.
- **Ampere** - a measurement of electric current.
- **Watt** - a measurement of electric power. The number of watts is equal to the number of volts multiplied by the number of amperes. A kilowatt/hour is 1000 watts of electric power used in one hour.
- **Ohms** - the measurement of electrical resistance.
- **Polarity** - the electric current is shown to flow from the positive terminal to the negative terminal.
- **Direct Current (DC)** - the voltage between the two terminals is always the same polarity.
- **Alternating Current (AC)** - the polarity of voltage between two terminals is changing between positive and negative at a quick and constant rate.

**Voltage of a Battery**

To reach the necessary battery voltage, the cells are connected in series. For example, 48 volt batteries are made up of 24 cells connected in series.

**Battery Ratings**

The ratings of batteries are measured in ampere/hours and kilowatt/hours at a constant rate of discharge. The number and size of plates increases the ampere/hour rating. A rating of six hours is standard. Ampere/hours is the measurement of battery capacity. To calculate the ampere/hours, multiply amperes by hours. For example: 5 amperes x 5 hours = 25 ampere/hours. The potential difference of a cell cannot be changed. The ampere/hour rating can be changed by increasing the number of plates in a cell or by installing larger plates. The constant rate of discharging can be compared to a measurement of the battery capacity and ampere/hours. For example, a battery with a rating of 600 ampere/hours during a 6 hour work period will generate 100 amperes per hour for 6 hours. (The same battery cannot generate 300 amperes for two hours. The heat generated will damage the battery.)

**Kilowatt/Hours**

A kilowatt is 1000 watts. A watt is a measurement of electric power. The capacity in kilowatt/hours is the total power generated by the battery. Watt/hours are measured by multiplying the voltage by ampere/hours. To measure the kilowatt/hours, divide the watt hours by 1000.

\[
\text{Volts} \times \text{ampere} \times \text{hours} = 1000
\]
To calculate the kilowatt/hours for a battery that has a formula of 600 ampere/hours and a 48-volt system, use this formula:

\[
48 \times 600 + 1000 = 28.8 \text{ kwh}
\]

(Power available from a fully charged battery)

All the electrical operations figure specific watt/hours in electrical energy. These operations include distances, loads, ramps, lifting heights, attachments, etc. The watt/hours can be converted to kilowatt/hours to indicate the battery needed for the operation. Always select the correct type of battery. Remember that a battery that has a rating of 300 ampere/hours will not do the same job as a battery that has a rating of 600 ampere/hours. Do not permit the specific gravity to go below the limits shown in the battery manual.

The Battery as a Counterweight

On electric lift trucks that use the battery as part of the counterweight, the battery is part of the capacity of the lift truck to lift loads. The minimum weight of the battery is shown on the nameplate. If the battery is not the minimum weight, the capacity of the lift truck is reduced. If the battery used in the lift truck is less than the size of the battery compartment, blocks and spacers must be installed to hold the battery in position. The maximum allowable movement of a battery is 0.5 in. (12.7 mm) from side to side and 0.5 in. (12.7 mm) fore and aft. (Also refer to local government restrictions.)

The New Battery

Inspect every new battery for damage. Make certain the electrolyte in each of the cells is at the correct level. Charge the battery for six hours or until the specific gravity is correct. Some new batteries may require cycling 7 to 10 times before the battery will accept a full charge. (Cycling is charging and then discharging the battery at the prescribed rate. Refer to the instructions shipped with the battery.)

Make sure the battery is correctly installed in the lift truck. Use a correct spreader bar with slings to lift and move the battery.

⚠️ CAUTION
Always use a spreader bar and straps that lift vertically on the lifting eyes of the battery. DO NOT use a chain or strap without a spreader bar or you will damage the battery.
BATTERY AND CHARGER

Battery Connectors

Figure 8: CONNECTOR

A special heavy-duty connector is used to connect the battery to the electrical system of the lift truck. When a connector has a handle and is within the operator’s reach, the connector is also a safety device that can be used to quickly disconnect the battery in an emergency. The connector and its attached handle must be kept in good repair so that it will function correctly. The battery connector must be disconnected when maintenance is done on the lift truck that does not require electric power.

BATTERY MAINTENANCE

General

Battery maintenance must include a good battery charger, a clean battery, keeping the electrolyte at the correct level, and keeping a record of the battery.

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 the batteries in a well-ventilated area to remove the explosive gasses and acid fumes.
5. Maintain electrolyte at the proper level. If low, add water. Before changing, make sure the tops of the plates are covered. After charging, fill to the recommended level. Do not add acid.
6. Keep batteries from freezing.
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 of a charging current and cause 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

When performing maintenance, always complete the Battery Inspection Report and the Daily Battery Report.

NOTE: Follow the same sequence when recording 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.

Cleaning the Battery

⚠️ 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 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 0.88 gal. (four liters) of water. Apply the solution and flush the solution from the battery using clean water. Wash the battery and the battery compartment as needed.

Keep the battery compartment clean and dry. Use a clean cloth to wash the battery with water. Dry with compressed air.

**NOTE:** 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.

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 personnel check some of the cells daily 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.

### Table 1: Electrolyte Level

<table>
<thead>
<tr>
<th>CELL HEIGHT</th>
<th>DIMENSION “A”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 15 in. (38 cm)</td>
<td>0.12 in. (3 mm)</td>
</tr>
<tr>
<td>15 to 24 in. (38 to 61 cm)</td>
<td>0.25 in. (6 mm)</td>
</tr>
<tr>
<td>Greater than 24 in. (61 cm)</td>
<td>0.50 in. (13 mm)</td>
</tr>
</tbody>
</table>

**NOTE:** Keeping the electrolyte level within the correct limits is the most important item of battery maintenance. Always use approved or distilled water. If you add approved or distilled water, wait 5 minutes before measuring the specific gravity with a hydrometer. Do not add approved or distilled water to a cell during the charging cycle. The electrolyte can flow out of the cell through the fill hole. Refer to the instructions from the manufacturer of your battery for the proper operating level of the electrolyte.

### 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 a low level of the electrolyte can change the specific gravity measurement. When the electrolyte level is low, the percentage of sulfuric acid in the electrolyte increases. When the electrolyte level decreases by 0.12 in. (3 mm), 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 a correct reading of the hydrometer.

The temperature of the electrolyte will change the reading of the specific gravity. When the temperature increases approximately 10°F (6°C), the specific gravity will decrease by 0.003 points. Refer to the following table for making specific gravity corrections.

The normal electrolyte temperature is 77°F (25°C). At this temperature, the electrolyte has a specific gravity of 1.285 to 1.295 with no correction for temperature. If the hydrometer being used does not have a temperature correction, a thermometer should be used. Special battery thermometers are available that will indicate the correction factor directly and will add or subtract the correct number of points.

<table>
<thead>
<tr>
<th>SPECIFIC GRAVITY READING</th>
<th>ELECTROLYTE TEMPERATURE</th>
<th>CORRECTION POINTS</th>
<th>CORRECT VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.210</td>
<td>87°F (31°C)</td>
<td>+ 0.003</td>
<td>1.213</td>
</tr>
<tr>
<td>1.210</td>
<td>80°F (27°C)</td>
<td>+ 0.001</td>
<td>1.211</td>
</tr>
<tr>
<td>1.210</td>
<td>77°F (25°C)</td>
<td>+ 0.000</td>
<td>1.210</td>
</tr>
<tr>
<td>1.210</td>
<td>64°F (18°C)</td>
<td>- 0.004</td>
<td>1.206</td>
</tr>
</tbody>
</table>

+0.001 for each 3°F from the 77°F (25°C)

Base Value °C + 17.8 x 1.8 =°F
CHANGING THE BATTERY

**WARNING**
Be careful not to short out battery terminals. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**
Batteries are heavy. Use care to avoid injury.

**WARNING**
The replacement battery must fit the battery area correctly. Use blocks and spacers to prevent the battery from moving in the battery compartment.

**WARNING**
Make sure the weight of the replacement battery is within the maximum and minimum weights shown on the capacity plate.

**WARNING**
Make sure the key switch is OFF before connecting the battery.

**CAUTION**
Make sure the capacity of the crane and spreader bar is greater than the weight of the battery. The weight of the battery is normally shown on the capacity plate (nameplate) and battery case. The spreader bar must NOT be made of metal or it must have insulated straps.

---

1. Position the lift truck so that an approved lifting device can be used to remove the battery.
2. Move the seat forward to the front position.
3. Unlatch and lift the battery cover assembly. Make sure the battery cover is secured in the upright position.
4. Disconnect the battery connector.
5. Remove the lift truck battery cables from the battery and position them out of the way so the battery can be removed.

**CAUTION**
Make sure the lifting device is correctly positioned on the battery and has clearance in the battery lift slot located in the overhead guard.

6. Apply the lifting device to battery.
7. Carefully lift the battery from the lift truck and place in a designated cleaning or charging area.
8. Make sure that the battery compartment is clean and dry.
9. Apply the lifting device to replacement battery.

**CAUTION**
Make sure the lifting device is correctly positioned on the battery and has clearance in the battery lift slot located in the overhead guard.
NOTE: Use the correct blocks or spacers to hold the battery in position in the lift truck.

10. Carefully lift and position the replacement battery above the battery compartment.

11. Lower the replacement battery into the battery compartment, making sure all framework and cables are clear of the battery while being lowered.

12. Remove the lifting device and move the lifting device clear of the lift truck.

13. Install the lift truck battery connector to the replacement battery connector. Be sure the connectors are fully engaged and locked into place.

**WARNING**

Extreme care should be taken when accessing the battery as the cover has several pinch points. Failure to comply may result in injury to personnel.

14. Carefully lower the battery cover assembly and secure the latch.

15. Confirm that the LCD dash display is working and battery charge is sufficient. For proper operating steps, refer to OPERATING PROCEDURES in the Operators Manual.

CHARGING THE BATTERY

General

**WARNING**

Always connect the positive cable to the positive terminal and connect the negative cable to the negative terminal. Any other connection will cause personal injury and damage to equipment.

**WARNING**

Always charge the battery at the end of the work period (shift). Never let the specific gravity reach a level less than the limits shown in the manual.

**WARNING**

Always de-energize (shut off) the charger before you connect or disconnect the charger from 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 a 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 average additional charge is 12%. When the battery is nearly charged, the final charging must be at a low rate. A charging rate that is too high will cause heating in the battery and a high loss of water from the electrolyte. The charging of the battery must be done correctly or the service life of the battery will be decreased.

NEVER discharge a battery to a specific gravity below 1.130 to 1.110. Discharging a battery beyond the design limits will decrease the service life of the battery.

If lift truck operation results in only partial discharges (50% or less) and specific gravities are 1.210 to 1.220 or more at the end of a shift, recharging may be deferred and the battery used for another shift providing the work load is not expected to increase. Hydrometer readings and experience will disclose the frequency of charge intervals under these circumstances.

**CAUTION**

A battery should always be recharged immediately following a complete discharge. Never allow it to remain in a discharged condition, since permanent damage may result.
CAUTION
All of the vent caps must be in position when the battery is in service. If the vent caps are not installed, the electrolyte will leak, causing corrosion of the battery case and in the battery compartment.

NOTE: Many customers have battery chargers that can follow a program to automatically charge the battery according to the recommendations of the battery manufacturer. Use the recommendations of the battery manufacturer for charging the battery. Use only battery chargers approved by the battery manufacturer or dealer.

Battery Charging Area
To increase the service life and reduce the maintenance, a special area is needed for charging the batteries. The following information should be considered when setting up an area.

1. Location of power supply.
2. Ventilation - hydrogen gas is expelled from the batteries during charging.
3. Drains for cleaning the batteries.
4. Type and size of the batteries.
5. Type of lift truck.
6. Distances that the lift truck must travel for service.
7. Safety regulations and instructions.

Equipment Required
- A lifting device to remove the battery from the lift truck.
- Racks to hold the batteries during charging and storage. These racks must be made of wood and must not be metal unless the metal racks are covered with an insulating material.
- A battery charger that will charge your batteries.
- Tools for maintenance.
- An area with a drain for cleaning the batteries and battery components.
- Distilled water.
- Air and water supplies for cleaning the batteries.
- Maintenance records.
- A workbench.
- Spare parts and repair equipment.
- Protective clothing and safety equipment for handling batteries.
- Water sources for washing eyes and preventing acid burns.
- Install a NO SMOKING sign in the service area.
- Keep the charger in a clean, dry area with good ventilation.

Types Of Battery Charges
1. DAILY CHARGE - This type of charge is normally eight hours and will keep the battery fully charged if the battery is not fully discharged below the limit.
2. EQUALIZING CHARGE - This charge is at a low rate and balances the charge in all cells. The equalizing charge is normally given approximately once per week and is three hours at a low rate, which is in addition to the regular charging cycle. The most accurate specific gravity measurements for a charged battery will be after an equalizing charge.

NOTE: Sometimes the capacity of a battery is not enough to complete a work period. Check for the following conditions:
- The battery is too small for the job.
- The battery is not fully charged.
- The battery charger is not operating correctly.
- The battery is near the end of its service life.

Methods of Charging
There are three methods of charging a battery.

1. GRADUAL CHARGE - This method uses a solid state automatic battery charger. The charging rate begins at 20 to 25 amp/100 amp/hours and decreases to less than 5 amp/100 amp/hours when the battery is 80% charged. The charging current decreases when the voltage across the cell increases during the charging cycle. The increase in the voltage from the charger is approximately the same as the increase in the specific gravity in the cells.

2. MODIFIED CONSTANT VOLTAGE - This method uses a generator to generate a constant voltage that is controlled by a resistor. When the charging current decreases, the voltage across the resistor causes an increasing voltage at the battery terminals. This charging method is similar to the gradual charge. The resistor must be correctly set or the charging rate will be wrong.

3. TWO RATE CHARGE - This method also uses a high charging rate at the beginning, followed by a lower rate. Two resistors control the charging rate. One resistor controls the charging rate at the beginning of the cycle and a second resistor reduces the charging rate when the voltage in the cells reaches 2.37 volts. A relay automatically controls the second resistor.

How to Charge the Battery

WARNING
If the lift truck was operated with a low battery, check all contactors for welded contacts before a charged battery is connected.
BATTERY AND CHARGER

**A WARNING**
Always set the parking brakes by placing the key switch in the OFF position before connecting the battery.

**A WARNING**
Do not put tools on the battery.

**A WARNING**
The acid in the electrolyte can cause injury. Use water to flush the area and make the acid neutral with a water and soda solution. Acid in the eyes must be flushed with water.

**A WARNING**
Batteries generate explosive fumes when they are being charged. Keep fire, sparks, and burning material away from the battery charger area. Avoid sparks from the battery connections.

**A WARNING**
Charge batteries only in the special area for charging batteries. When the battery is being charged, keep the vent caps clear. The battery charger area must have ventilation so that explosive fumes are removed. Open the battery cover on a covered battery.

**A CAUTION**
Never connect the battery charger to anything on the lift truck other than the disconnected battery. Damage to the lift truck electrical system can occur. Make sure the battery charger voltage is the correct voltage for the battery.

1. Correct use of the hydrometer and proper operation of the battery charger is important. Follow the instructions of the charger manufacturer. Never let the battery discharge below the minimum value given by the battery manufacturer. A fully charged battery will have a specific gravity of 1.255 to 1.310 at 77°F (25°C). Never charge a battery at a rate that will raise the electrolyte temperature above 120°F (49°C). Never let a battery stay discharged for long periods.

2. NORMAL CHARGE: This charge is the charge that is normally given to a battery that is discharged from normal service. Many users give this charge at a regular interval based on usage. This practice will keep the battery fully charged if the battery is not discharged below the limit. Always use a hydrometer to check the battery if the interval charge cycle is used. Frequent charging of a battery that has a 2/3 or more charge can decrease battery life.

### Figure 15: BATTERY SPECIFIC GRAVITY

<table>
<thead>
<tr>
<th>SPECIFIC GRAVITY READING</th>
<th>ELECTROLYTE TEMP.</th>
<th>CORRECTION POINTS</th>
<th>CORRECT VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.270</td>
<td>(87°F) 31°C</td>
<td>+0.003</td>
<td>1.213</td>
</tr>
<tr>
<td>1.210</td>
<td>(80°F) 27°C</td>
<td>+0.001</td>
<td>1.211</td>
</tr>
<tr>
<td>1.210</td>
<td>(77°F) 25°C</td>
<td>0.000</td>
<td>1.210</td>
</tr>
<tr>
<td>1.210</td>
<td>(64°F) 18°C</td>
<td>-0.004</td>
<td>1.206</td>
</tr>
</tbody>
</table>

+0.001 or -0.001 for each 2 degrees C from the 25 degree base value.

3. Do not give an equalizing charge more than once a week. The most accurate specific gravity measurements for a charged battery will be after an equalizing charge. If the specific gravity difference is more than 0.020 between cells of the battery after and equalizing charge, there may be a defective cell. Consult your local battery dealer.

**How to Know When the Battery is Fully Charged**

1. During charging, the voltage increases slowly. When the battery is fully charged, the voltage level is constant.

2. Remove the vent cap and look in the opening. If you see bubbles in the electrolyte, the battery is either fully charged or in the final stage of charging.

3. The specific gravity reading is constant and within the limits of a charged battery. If the temperature increases after the battery is charged, the specific gravity will decrease a small amount.

4. Constant meter indications on the charger will indicate the end of the charging cycle.
5. When you are sure the charger is off, disconnect the battery from the charger. Before connecting the battery connector to the lift truck connector, make sure the lift truck controls are in neutral and that the connector is firmly in place.

**Specific Gravity Compared to Charging Time**

Never discharge a battery below the limits shown. Discharging a battery beyond the design limits will decrease the service life of the battery.

**NOTE:** Sometimes the capacity of a battery is not enough to complete a work period. Check for the following conditions:

- The battery is too small for the job.
- The battery is not fully charged.
- The battery charger is not operating correctly.
- The battery is near the end of its service life.

**Troubleshooting the Charger**

**WARNING**

Always connect the positive cable to the positive terminal and connect the negative cable to the negative terminal. Any other connection will cause personal injury and damage to equipment.

**WARNING**

Always charge the battery at the end of the work period (shift). Never let the specific gravity reach a level less than the limits shown in the manual.

**WARNING**

Always de-energize (shut off) the charger before you connect or disconnect the charger from the battery.

Battery chargers normally operate automatically without constant attention. It is necessary to make a periodic check to determine if the charger is operating correctly. Check for the following conditions:

1. Battery temperature too high - The temperature in a battery will not normally rise more than 25°F (14°C) during an eight hour charging period. Higher temperatures indicate that the charging rate needs adjustment.
2. Continuous operation of the charger - Check the automatic controls on the charger. Check the charging rate. A low charging rate can be the problem.
3. Continuous operation of a charger at a high rate - Normally, the charging rate begins at a high rate and decreases as the battery becomes charged. If the rate does not decrease, the control needs repair or adjustment.

**Storing the Battery**

**CAUTION**

Batteries should be placed on a wooden pallet and stored in a dry, moderately cool area. Lead-acid batteries will slowly “self-discharge” over a period of time due to their chemical make-up. This “self-discharge” is due to a chemical reaction. That chemical reaction can be accelerated by heat, resulting in a more rapid “self-discharge”.

Do the steps that follow when placing a battery in storage or when not in operation for more than 30 days.

**CAUTION**

Keep vent plugs in the cells at all times, except when taking hydrometer readings, adjusting specific gravity and electrolyte levels, troubleshooting, or reassembling a repaired cell.

1. Give an equalizing charge prior to placing new batteries in storage. Used batteries are to be fully charged and allowed to balance for approximately three more hours.
2. Neutralize and clean the battery using a solution of 16 ounces of baking soda to 1 gallon of water.
3. Store the battery in a cool, dry location.
4. Check each cell in the battery at least once every 30 days and boost charge when the specific gravity falls below 1.240.
5. Protect the battery from ambient contamination.
6. If a greasy film forms on the top of a battery, it is acid. It must be neutralized using the solution described above.
7. Battery chargers should be disconnected from the AC power source when not in use.
<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>CORRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Battery Overheats on Discharge</strong></td>
<td>Over-discharge.</td>
<td>Limit discharge to 1.110 specific gravity. Put more batteries into service. Set up more frequent charging schedule.</td>
</tr>
<tr>
<td></td>
<td>Excessive load.</td>
<td>Determine cause of overload and correct. Put more batteries into service if equipment requirements exceed battery capacity.</td>
</tr>
<tr>
<td></td>
<td>Not fully charged prior to work assignment, resulting in over-discharge.</td>
<td>Needs more frequent and complete charging.</td>
</tr>
<tr>
<td></td>
<td>Electrolyte levels low.</td>
<td>Add water as required. Do not assign battery to work if levels are below top of plates.</td>
</tr>
<tr>
<td></td>
<td>When overheating is confined to a few cells, nearby operating equipment may be the source.</td>
<td>Install heat insulating material between equipment cells with air circulating space between.</td>
</tr>
<tr>
<td></td>
<td>Operating in high ambient temperatures.</td>
<td>Provide cool location and good ventilation for charging.</td>
</tr>
<tr>
<td><strong>Low Electrolyte Level</strong></td>
<td>Broken or cracked jar.</td>
<td>Replace jar.</td>
</tr>
<tr>
<td></td>
<td>Water additions neglected or cell missed when distilled water was previously added.</td>
<td>Better maintenance supervision. Add water as required to all cells.</td>
</tr>
</tbody>
</table>
|                              | Overcharging  
  a. Voltage relay set for too 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. |
<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>CORRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overfilled with water.</td>
<td>Do not fill above high level. Give equalizing charge and adjust acid.</td>
<td></td>
</tr>
<tr>
<td>Operating cell with cracked jar.</td>
<td>Replace jar and adjust acid.</td>
<td></td>
</tr>
<tr>
<td>Vent caps removed during operation.</td>
<td>Keep vent caps securely in place. Give an equalizing charge and adjust acid.</td>
<td></td>
</tr>
<tr>
<td>Electrolyte leaking through sealing compound.</td>
<td>Reseal and adjust acid.</td>
<td></td>
</tr>
<tr>
<td>Operating battery with broken cell cover.</td>
<td>Replace cover and adjust acid.</td>
<td></td>
</tr>
<tr>
<td>Neutralizing agent in cell.</td>
<td>Keep vent caps in place at all times except when adding distilled water. Keep battery clean.</td>
<td></td>
</tr>
<tr>
<td>Unequal cell voltages.</td>
<td>Refer to “Unequal Cell Voltages” in this table.</td>
<td></td>
</tr>
<tr>
<td>Over-discharge. Also, more than 0.020 points spread in specific gravity from average.</td>
<td>Give an equalizing charge and do not discharge below 1.110.</td>
<td></td>
</tr>
<tr>
<td>Lack of equalizing charge.</td>
<td>Give an equalizing charge periodically.</td>
<td></td>
</tr>
<tr>
<td>Internal shunt.</td>
<td>Make internal inspection of low voltage cell and correct cause. Check for split separator and moss shunt.</td>
<td></td>
</tr>
<tr>
<td>Dirty battery top.</td>
<td>Neutralize and clean top of battery.</td>
<td></td>
</tr>
<tr>
<td>Cells operated with low electrolyte level.</td>
<td>Add water as required. Give equaling charge.</td>
<td></td>
</tr>
<tr>
<td>Low specific gravity of fully charged cell.</td>
<td>Adjust acid after equalizing charge.</td>
<td></td>
</tr>
<tr>
<td>Sediment space limited.</td>
<td>Replace battery.</td>
<td></td>
</tr>
<tr>
<td>Half tap on cells for lower voltage circuit.</td>
<td>Remove tap and connect load to battery terminals through resistance.</td>
<td></td>
</tr>
<tr>
<td>External source heating certain cells.</td>
<td>Install heat insulating material between heat source and battery.</td>
<td></td>
</tr>
<tr>
<td>Impurities in cell.</td>
<td>Add only distilled or approved water to electrolyte.</td>
<td></td>
</tr>
<tr>
<td>Variation in charge rate.</td>
<td>Take readings when charge rate is constant.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 3: Battery Troubleshooting (Continued)

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>CORRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uneven cell voltages.</td>
<td></td>
<td>Give an equalizing charge.</td>
</tr>
<tr>
<td>Low electrolyte levels.</td>
<td></td>
<td>Refer to “Low Electrolyte Level” in this table.</td>
</tr>
<tr>
<td>Battery not charged before work cycle.</td>
<td></td>
<td>Check charging schedules. Do not assign discharged battery to work.</td>
</tr>
<tr>
<td>One or more jars leaking electrolyte.</td>
<td></td>
<td>Replace broken jars.</td>
</tr>
<tr>
<td>Incorrect battery (number of cells) assigned to equipment.</td>
<td></td>
<td>Install battery with correct voltage and capacity for equipment.</td>
</tr>
<tr>
<td>Fully charged specific gravity below normal.</td>
<td></td>
<td>Adjust specific gravity to normal.</td>
</tr>
<tr>
<td>Impurities in electrolyte.</td>
<td></td>
<td>Add only distilled or approved water to electrolyte.</td>
</tr>
<tr>
<td>Inexperienced operator.</td>
<td></td>
<td>Instruct operator on power conservation.</td>
</tr>
<tr>
<td>Load excessive.</td>
<td></td>
<td>Use larger battery or reduce load.</td>
</tr>
<tr>
<td>Wheels, axles, and bearings need lubrication.</td>
<td></td>
<td>Plan lubrication schedule.</td>
</tr>
<tr>
<td>Brakes dragging.</td>
<td></td>
<td>Adjust brakes properly.</td>
</tr>
<tr>
<td>Series field in motor shorted or grounded.</td>
<td></td>
<td>Replace field and remove ground.</td>
</tr>
<tr>
<td>Armature needs repair.</td>
<td></td>
<td>Replace or repair armature.</td>
</tr>
<tr>
<td>Ground on equipment.</td>
<td></td>
<td>Find ground and insulate.</td>
</tr>
<tr>
<td>Excessive grades.</td>
<td></td>
<td>Use larger battery or revise battery charge schedule.</td>
</tr>
<tr>
<td>Capacity or equipment assigned to job. Reassigned equipment is inadequate.</td>
<td></td>
<td>Reassign equipment.</td>
</tr>
</tbody>
</table>
GENERAL

The Omni-Directional™ Wheels used on this lift truck replace the standard wheels used on other lift trucks and allow for travel in any direction. Each wheel has twelve rollers; two on each roller shaft. The six roller shafts are offset from vertical and are attached to a wheel hub.

There are two different Omni-Directional™ Wheels used on the lift truck. The offset design permits the lift truck to move in any direction. The Omni-Directional™ Wheels are either a TYPE I or a TYPE II design. TYPE I Omni-Directional™ Wheels are used on the left front and the right rear of the lift truck. TYPE II Omni-Directional™ Wheels are used on the right front and the left rear. Mounting the Omni-Directional™ Wheels in the wrong position will cause the lift truck to operate incorrectly. Mounting position marks are cast onto the wheel hubs to ensure that the Omni-Directional™ Wheels are mounted in the proper position.

ALWAYS check the mounting position marks on the Omni-Directional™ Wheels prior to removing them from the lift truck. This will identify the Omni-Directional™ Wheels for proper installation during assembly.

Figure 1: WHEEL ASSEMBLIES
**DESCRIPTION**

**Omni-Directional™ Wheels**

The **SIDEWINDER™ ATX-3000** features both Omni-Directional™ Technology and a four wheel drive system.

The Omni-Directional™ Wheels consist of a high strength steel hub with six hardened steel roller axles and twelve specially designed polyurethane coated rollers. The rollers rotate freely, providing Omni-Directional™ Movement of the vehicle based on the speed and direction of each Omni-Directional™ Wheel.

**Transaxles**

The transaxles on this lift truck have been lubricated with synthetic fluid and sealed for life. This results in the transaxles being maintenance free.

The transaxles are designed so that they mount directly to the lift truck frame and the AC motors and brake assemblies mount to the transaxles. This makes the whole drive assembly very compact and simplifies maintenance.

**Transaxle Hub**

The transaxle hub is a geared housing that connects the transaxle, lift truck frame, and Omni-Directional™ Wheel assembly. The transaxle hubs are also prelubricated, sealed for life, and maintenance free.

**Spacer Plates**

The spacer plates are special metal plates that have been designed to allow various positions to mount the transaxles to the traction motors. This technology gives the **SIDEWINDER™ ATX-3000** the ability to use the same parts for all four drive positions.

**Traction Motors**

There are four traction motors on the lift truck; one to drive each transaxle. The traction motors are brushless and maintenance free. Their rugged design ensures protection against dust, water, and physical damage. These AC motors are less complex and experience less wear, which dramatically reduces the need for maintenance. They are also extremely efficient, which results in quicker acceleration and substantially shorter braking distance.

**Brake Assembly**

Each transaxle is equipped with a 48 volt brake assembly that is spring-operated and electromagnetically released. The spring-operated brake is a single disc brake with two friction surfaces.

The brake torque is generated by several compression springs pressing the armature plate into the asbestos-free friction lining. When power is supplied to the electromagnet, the armature plate is pulled away from the friction lining and the brake is released.

---

**Figure 2:** DRIVE COMPONENTS


MAINTENANCE PROCEDURES

Roller • Removal

⚠️ WARNING

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

NOTE: There are four Omni-Directional™ Wheel assemblies on the lift truck and each Omni-Directional™ Wheel assembly has 12 rollers. All rollers remove and install the same.

1. Move the lift truck to a level area.
2. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
3. Use a jack to raise the lift truck high enough so that the Omni-Directional™ Wheel assembly is off the ground. Install appropriate blocks to support the raised lift truck.

![Diagram of roller removal process]

Figure 3: ROLLER - REMOVE/INSTALL

- **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.

1. Clean the roller shaft using a recommended cleaning solvent and inspect the roller for damage.
2. Align the roller on the roller shaft. Carefully move the roller onto the roller shaft.
3. Apply Loctite 242 to the nut. Install the washer and nut onto the roller shaft and tighten the nut finger tight at this time.
4. Ensure that the roller turns freely on the roller shaft. Torque the nut to 125 ft-lb (169 N•m).
5. After the nut has been torqued, place a mark with black permanent ink on the nut and roller shaft. This will aid in identifying which rollers have been torqued.
6. Install the hubcap on the end of the roller.
7. Remove the blocks, jack, and chocks from the lift truck.
8. Remove the tag from the battery connector and connect the battery.
Omni-Directional™ Wheel Assembly - Removal

**WARNING**
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**
Due to the weight of the Omni-Directional™ Wheel assembly, use only the special wheel tool for removal and installation procedures.

**NOTE:** There are two types of Omni-Directional™ Wheel assemblies that are used on the lift truck. The part number and mounting position marks are permanently cast on the wheel hub.

1. Move the lift truck to a level area.
2. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
3. Use a jack to raise the lift truck high enough so that the Omni-Directional™ Wheel assembly is off the ground. Install appropriate blocks to support the raised Omni-Directional Wheel assembly.

**WARNING**
Chocks should be placed in front and rear of the Omni-Directional™ Wheel assembly that is contacting the floor. Position wheel chocks on the opposite side of the lift truck.

4. Remove the hubcap.
5. Use a floor jack to align and attach the special wheel tool to the Omni-Directional™ Wheel assembly.
6. Remove six lug nuts from the wheel hub.
7. Remove the Omni-Directional™ Wheel assembly from the transaxle hub.

---

Figure 5: WHEEL ASSEMBLY - REMOVE/INSTALL
Omni-Directional™ Wheel Assembly - Installation

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

**WARNING**
Due to the weight of the Omni-Directional™ Wheel assembly, use only the special wheel tool for removal and installation procedures.

**CAUTION**
Mounting a wheel hub in the wrong position on the lift truck will prevent the lift truck from functioning properly and could damage components of the lift truck.

**NOTE:** There are two types of Omni-Directional™ Wheel assemblies that are used on the lift truck. The part number and mounting position marks are permanently cast on the wheel hub.

1. Inspect the wheel hub for any evidence of grime, dirt, or damage that would prevent the wheel hub from seating properly on the transaxle hub. Clean as needed with a recommended cleaning solvent.

2. Use the floor jack and special tool to align the Omni-Directional™ Wheel assembly with the transaxle hub. Slide the Omni-Directional™ Wheel assembly onto the transaxle hub.

3. Mount the Omni-Directional™ Wheel assembly to the transaxle hub with six lug nuts. Hand tighten at this time.

4. Move the floor jack and the wheel removal tool out of the way. Tighten the lug nuts in a criss-cross pattern and torque the six lug nuts to 125 ft-lb (170 N•m).

5. Install the hubcap.

6. Remove the blocks and jack from the lift truck.

7. Remove the tag from the battery connector and connect the battery.

8. Remove the wheel chocks.

---

Figure 6: WHEEL ASSEMBLY - REMOVE/INSTALL

Figure 7: WHEEL ASSEMBLY TORQUE SEQUENCE
Transaxle Hub - Removal

**WARNING**
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**
The lift truck must be placed on blocks for some types of maintenance and repair. The surface must be solid, even, and level when the lift truck is put on blocks. Verify that any blocks used to support the lift truck are solid, one piece units. Place steel plates on top of the blocks.

1. Move the lift truck to a level area.
2. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
3. Place the lift truck on blocks. See the HOW TO PUT A LIFT TRUCK ON BLOCKS procedure in this manual.
4. Remove the Omni-Directional™ Wheel assembly from the transaxle hub. See OMNI-DIRECTIONAL™ WHEEL ASSEMBLY - REMOVAL in this manual.
5. Remove 10 capscrews and lock washers from the transaxle hub.
6. Remove the transaxle hub from the lift truck frame and transaxle assembly.

Figure 8: TRANSAXLE HUB - REMOVE/INSTALL
Transaxle Hub - Installation

⚠️ 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.

⚠️ CAUTION
Mounting an Omni-Directional™ Wheel assembly in the wrong position on the lift truck will prevent the lift truck from functioning properly and could damage components of the lift truck.

NOTE: There are two capscrews through the lift truck frame that hold the transaxle in place when the transaxle hub is removed. The transaxle hub must line-up properly on these capscrews so that the transaxle hub seats flush onto the lift truck frame.

1. Align two countersunk holes on the transaxle hub with two capscrews on the lift truck frame.
2. Install 10 capscrews and lock washers in the transaxle hub. Torque 10 capscrews to 65 ft-lb (88 N•m).
3. At this time, inspect all studs on the transaxle hub. If any studs are found to be damaged, replace the damaged studs. Torque studs to 125 ft-lb (170 N•m).
4. Install the Omni-Directional™ Wheel assembly on the transaxle hub. See OMNI-DIRECTIONAL™ WHEEL ASSEMBLY - INSTALLATION in this manual.
5. Inspect the wheel hub for any evidence of grime, dirt, or damage that would prevent the wheel hub from seating properly on the transaxle hub. Clean as needed with a recommended cleaning solvent.
6. Remove the blocks and jack from the lift truck.
7. Remove the tag from the battery connector and connect the battery.
8. Remove the wheel chocks.
9. Test drive the lift truck to ensure proper operation.

![Figure 9: TRANSAXLE HUB - REMOVE/INSTALL](image-url)
Traction Motor - Removal

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

NOTE: Both rear traction motors and the left front traction motor can be removed from the lift truck as a component. To remove the right front traction motor, the left front transaxle assembly must be removed first. If removal of the right front traction motor is needed, refer to the TRANSAXLE ASSEMBLY - REMOVAL procedure in this manual.

NOTE: To access the rear traction motors the rear cover must be removed. For access to the front traction motors, remove the floor plates. Procedures for removal of the rear cover and floor plates can be found in the COVERS/FLOOR PLATES section of the Operator's Manual.

1. Move the lift truck to a level area.
2. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

3. Tag and mark all wires prior to removal to ensure correct installation.
4. Remove three nuts, wires, and washers from the traction motor terminals.

NOTE: The spacer plate, traction motor, and the transaxle assembly must be marked prior to disassembly to ensure proper installation.

5. Place a mark on the transaxle assembly, spacer plate, and traction motor that shows the position of the spacer plate in relation to the transaxle assembly and the traction motor.
6. Install a lifting strap around the traction motor and connect a lifting device to the strap.
7. Remove three capscrews from the traction motor.
8. Twist slightly and pull the traction motor free from the transaxle assembly. Remove the traction motor from the transaxle assembly.
9. Place the traction motor on a clean work surface.
10. Remove six capscrews from the spacer plate and remove the spacer plate from the traction motor.

Figure 10: TRACTION MOTOR - REMOVE/INSTALL

Figure 11: SPACER PLATE ALIGNMENT MARK
Traction Motor - Installation

**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.

1. Inspect the spacer plate for any evidence of grime, dirt, or damage that would prevent the spacer plate from seating properly on the traction motor or transaxle assembly. Clean as needed with a recommended cleaning solvent.

2. Align the spacer plate on the traction motor with the marks made during the removal procedure and install the spacer plate.

3. Apply Loctite 242 to the threads of six capscrews.

4. Secure the spacer plate to the traction motor with six capscrews. Torque six capscrews to 65 ft-lb (88 N·m).

5. Install a lifting strap around the traction motor and connect a lifting device to the strap.

6. Install the traction motor on the transaxle assembly and align the marks made during the removal procedure.

7. Apply Loctite 242 to the threads of three capscrews.

8. Secure the traction motor to the transaxle assembly with three capscrews. Torque three capscrews to 65 ft-lb (88 N·m).

9. Install three washers, wires, and nuts to the traction motor terminals. Ensure that the wires are installed as marked during the removal procedure.

10. Install the rear cover or floor plates as needed. Procedures for installation of the rear cover and floor plates can be found in the COVERS/FLOOR PLATES section of the Operator's Manual.

11. Remove the tag from the battery connector and connect the battery.

12. Test drive the lift truck to ensure proper operation.
Transaxle Assembly - Removal

**WARNING**
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**
The lift truck must be placed on blocks for some types of maintenance and repair. The surface must be solid, even, and level when the lift truck is put on blocks. Verify that any blocks used to support the lift truck are solid, one piece units. Place steel plates on top of the blocks.

**NOTE:** The overhead guard must be removed to gain access to the front transaxle assemblies. See OVERHEAD GUARD - REMOVAL in this manual.

**NOTE:** To gain access for removal of the left front transaxle assembly, the right front transaxle assembly must be removed first.

**NOTE:** To access the rear transaxle assemblies the rear cover must be removed. For access to the front transaxle assemblies, remove the floor plates. Procedures for removal of the rear cover and floor plates can be found in the COVERS/FLOOR PLATES section of the Operator’s Manual.

1. Move the lift truck to a level area.
2. Place the lift truck on blocks. See HOW TO PUT A LIFT TRUCK ON BLOCKS procedure in this manual.

![Figure 14: TRANSAXLE ASSEMBLY - REMOVE/INSTALL](image-url)
3. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

4. Remove the Omni-Directional Wheel assembly. See OMNI-DIRECTIONAL™ WHEEL ASSEMBLY - REMOVAL procedure in this manual.

5. Remove the transaxle hub. See TRANSAXLE HUB - REMOVAL procedure in this manual.

6. Tag and mark all wires prior to removal to ensure correct installation.

7. Remove three nuts, wires, and washers from the traction motor terminals.

8. Disconnect the wire connector from the brake assembly.

9. Attach a strap around the transaxle assembly and a suitable lifting device to the strap.

10. Mark the position of the two capscrews on the lift truck frame and the transaxle prior to removal, to ensure proper installation.

11. Remove two capscrews and lock washers from the lift truck frame and the transaxle assembly.

12. Carefully lift the transaxle assembly from the lift truck. Place the transaxle on a solid and clean work surface.
Transaxle - Disassembly

NOTE: This procedure covers the break down of the transaxle assembly with the transaxle assembly removed from the lift truck.

NOTE: There are several ways for the spacer plate to mount between the traction motor and the transaxle assembly. The spacer plate, traction motor, and the transaxle assembly must be marked prior to disassembly to ensure proper installation.

Figure 15: SPACER PLATE ALIGNMENT MARK

1. Traction Motor - Removal
   a. Place a mark on the transaxle assembly and spacer plate that shows the position of the spacer plate in relation to the transaxle, to ensure proper installation.
   b. Install a lifting strap around the traction motor and connect a lifting device to the strap.
   c. Remove three capscrews from the traction motor.
   d. Twist slightly and pull the traction motor free from the transaxle assembly. Remove the traction motor from the transaxle assembly.

2. Spacer Plate - Removal
   a. Place a mark on the traction motor and spacer plate that shows the position of the spacer plate in relation to the traction motor, to ensure proper installation.
   b. Remove six capscrews from the spacer plate.
   c. Remove the spacer plate from the traction motor.

3. Brake Assembly - Removal
   a. Prior to removal of the brake assembly, mark the brake assembly in relation to the transaxle to ensure proper installation.
   b. Remove three capscrews from the brake assembly.
   c. Remove the brake assembly from the transaxle assembly by twisting slightly and pulling the brake assembly from the gear on the transaxle.

Figure 16: TRACTION MOTOR - REMOVE/INSTALL

4-14
DRIVE COMPONENTS

Transaxle - Assembly

NOTE: This procedure covers the assembly instructions of the transaxle assembly with the transaxle assembly removed from the lift truck.

1. Brake Assembly - Installation
   a. Position the brake assembly onto the transaxle gear and slide the brake assembly on the transaxle until flush.
   b. Align the brake assembly on the transaxle with the marks made during the removal procedure.
   c. Secure brake assembly with three capscrews. Torque three capscrews to 18 ft-lb (24 N•m).

2. Spacer Plate - Installation
   a. Align the spacer plate on the traction motor with the marks made during the removal procedure.
   b. Apply Loctite 242 to the threads of six capscrews.
   c. Secure the spacer plate to the traction motor with six capscrews. Torque six capscrews to 65 ft-lb (88 N•m).

3. Traction Motor - Installation
   a. Install the traction motor on the transaxle and align marks made during the removal procedure.
   b. Apply Loctite 242 to the threads of three capscrews.
   c. Secure the traction motor to the transaxle with three capscrews. Torque three capscrews to 65 ft-lb (88 N•m).
Transaxle Assembly - Installation

1. Attach a strap around the transaxle assembly and a suitable lifting device to the strap.
2. Carefully lower the transaxle assembly into the lift truck.
3. Align the transaxle assembly mount holes with the lift truck frame as marked during the removal procedure.
4. Secure the lift truck frame to the transaxle assembly with two cap screws and lock washers. Torque two cap screws to 65 ft-lb (88 N•m).

⚠️ CAUTION
The wire connector for the brake assembly must only be connected when no voltage is applied to the wire connector. Failure to comply may result in damage to the brake assembly.

5. Connect the wire connector to the brake assembly.
6. Install washers on each traction motor terminal. These washers help protect the wiring from grounding out on the motor housing and must be in place before connecting the wiring.
7. Install three wires and nuts to traction motor terminals as marked during removal procedure. Torque three nuts to 6 ft-lb (8 N•m).
8. Install the transaxle hub. See TRANSAXLE HUB - INSTALLATION procedure in this manual.
10. Install the rear cover or floor plates as needed. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.
11. Remove the blocks, jack, and chocks from the lift truck.
12. Remove the tag from the battery connector and connect the battery.
13. Test drive the lift truck to ensure proper operation.
Brake Assembly - Removal

The brake assemblies cannot be removed from the lift truck without first removing the transaxle assembly. To remove any of the four brake assemblies, see the TRANSAXLE ASSEMBLY - REMOVAL procedure in this manual.

For instructions on removal of the brake assembly from the transaxle assembly, refer to the TRANSAXLE - DISASSEMBLY procedure in this manual.

Brake Assembly - Installation

For instructions on installation of the brake assembly on the transaxle assembly, see the TRANSAXLE - ASSEMBLY procedure in this manual.

After the brake assembly installation is complete, the transaxle can be reinstalled, if no other repairs are needed. See the TRANSAXLE ASSEMBLY - INSTALLATION procedure in this manual.

Brake Assembly Releasing Voltage - Check

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Observe the brake air gap during operation. The brake air gap must be zero.

2. Measure DC voltage at the brake during operation. It must be the same as the voltage indicated on the nameplate. A 10% deviation is permissible.

Brake Rotor - Inspection

**WARNING**

The traction motor must be at standstill when checking the brake rotor thickness.

**CAUTION**

The brake rotor must be carefully protected from grease and oils. Small amounts of lubricants will reduce the braking power.

**NOTE:** To gain access to inspect the right front brake rotor, the left front traction motor must first be removed. See the TRACTION MOTOR - REMOVAL procedure in this manual.

1. Remove the cover seal from the brake assembly.

**NOTE:** The minimum rotor thickness is 7.5 mm and the maximum thickness is 11.0 mm. If the rotor thickness measurement does not meet these specifications, then the rotor must be replaced.

2. Measure the rotor thickness using a caliper gauge. Be sure to observe the flared flange at the outer diameter of the friction plate.
Brake Rotor - Replacement

**WARNING**
The brake assembly must be free from voltage to perform this procedure.

**CAUTION**
The brake rotor must be carefully protected from grease and oils. Small amounts of lubricants will reduce the braking power.

1. The brake assemblies cannot be removed from the lift truck. To remove a brake assembly, the transaxle assembly must first be removed. See the TRANSAXLE ASSEMBLY - REMOVAL procedure in this manual.

2. Remove the cover seal from the brake assembly.

3. Disconnect the wire connector from the brake assembly.

4. Loosen the three capscrews evenly until all three capscrews are removed.

5. Remove the stator from the brake assembly.

6. Pull the brake rotor off the hub.

7. Inspect the hub for damage. If any damage is found, then the hub must be replaced.

8. Inspect the friction plate and stator for damage. If damage is found, then replace the brake assembly.

9. Carefully push the stator back onto the hub and align the mounting holes.

10. Install three capscrews and torque capscrews to 17 ft-lb (23 N•m).

11. Adjust the brake air gap. See BRAKE AIR GAP - ADJUSTMENT procedure in this manual.

**CAUTION**
The wire connector for the brake assembly must only be connected when no voltage is applied to the wire connector. Failure to comply may result in damage to the brake assembly.

12. Install the cover seal on the brake assembly and connect the wire connector.

Figure 21: BRAKE ROTOR - REPLACEMENT
Brake Air Gap - Adjustment

⚠️ WARNING
The traction motor must be at standstill when checking the brake air gap.

⚠️ CAUTION
The brake rotor must be carefully protected from grease and oils. Small amounts of lubricants will reduce the braking power.

NOTE: To gain access to check the right front brake assembly air gap, the left front traction motor must first be removed. See TRACTION MOTOR - REMOVAL procedure in this manual.

1. Remove the cover seal from the brake assembly.
2. Energize the brake by placing the key switch in the ON position.

NOTE: The proper brake assembly air gap is 0.25 mm to 0.4 mm.

3. Measure the air gap between the armature plate and stator using a feeler gauge.
4. If the air gap is out of adjustment, perform the following procedures:

NOTE: Turning the threaded sleeve 1/6 turn will change the width of the air gap by approximately 0.15 mm.

   a. Loosen the three capscrews.
   b. Slightly turn the threaded sleeve using a wrench.
   • If the air gap is too large, then turn the threaded sleeve into the stator.
   • If the air gap is too small, then turn the threaded sleeve out of the stator.
   c. Tighten the three capscrews and torque the three capscrews to 18 ft-lb (24 N•m).

5. Check the air gap again, and if necessary, repeat adjustment procedures in Step 4.
6. Install the cover seal on the brake assembly.

Figure 22: BRAKE AIR GAP ADJUSTMENT
<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake does not release, air gap is not zero</td>
<td>Coil is interrupted</td>
<td>• Measure the coil resistance using a multimeter: If the resistance is too high, replace the entire stator.</td>
</tr>
<tr>
<td></td>
<td>Coil has contact to ground or between the windings</td>
<td>• Measure the coil resistance using a multimeter: Compare measured resistance to rated resistance. If the resistance is too low, replace the entire stator.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check coil for contact to ground using a multimeter: In case of contact to ground, replace the entire stator.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check brake voltage.</td>
</tr>
<tr>
<td>Wiring wrong or defective</td>
<td></td>
<td>• Check and correct wiring.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check cable for continuity using a multimeter: Replace defective cable.</td>
</tr>
<tr>
<td>Rectifier defective or wrong</td>
<td></td>
<td>• Measure DC voltage at the rectifier using a multimeter: If DC voltage is zero:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Measure AC voltage at the rectifier:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If AC voltage is zero: Apply voltage, check fuse, check wiring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If AC voltage is o.k.: Check rectifier, replace defective rectifier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If DC voltage is too low: Check rectifier (Half-wave rectifier used instead of bridge rectifier). Install bridge-rectifier. If diode is defective, use suitable new rectifier.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check coil for contact to ground or between the phases.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If rectifier defect occurs several times, replace the entire stator, even if a contact to ground or between the windings cannot be measured. The fault may occur only in the warm state.</td>
</tr>
<tr>
<td>Incorrect wiring of micro switch</td>
<td>Check the wiring of the micro switch and correct it.</td>
<td></td>
</tr>
<tr>
<td>Incorrect setting of micro switch</td>
<td>Replace the stator.</td>
<td></td>
</tr>
<tr>
<td>Air gap too large</td>
<td>Check and adjust air gap.</td>
<td></td>
</tr>
<tr>
<td>Rotor cannot rotate freely</td>
<td>Air gap too small</td>
<td>Check and adjust air gap.</td>
</tr>
</tbody>
</table>
### Table 1: Drive Components Troubleshooting (Continued)

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotor thickness too small</td>
<td>Rotor was not replaced in time</td>
<td>Replace rotor.</td>
</tr>
<tr>
<td>Voltage is not zero when checking the operation</td>
<td>Incorrect wiring of micro switch</td>
<td>Check the wiring of the micro switch and correct it.</td>
</tr>
<tr>
<td></td>
<td>Defective micro switch or incorrect setting</td>
<td>Replace the entire stator and return it to the manufacturer.</td>
</tr>
<tr>
<td>Voltage too high</td>
<td>Brake voltage does not match with rectifier</td>
<td>Adapt rectifier and brake voltage to each other.</td>
</tr>
<tr>
<td>Voltage too low</td>
<td>Brake voltage does not match with rectifier</td>
<td>Adapt rectifier and brake voltage to each other.</td>
</tr>
<tr>
<td></td>
<td>Defective rectifier diode</td>
<td>Replace rectifier with a suitable new one.</td>
</tr>
<tr>
<td>AC voltage is not mains voltage</td>
<td>Fuse missing or defective</td>
<td>Select connection where fuse has not been removed and is o.k.</td>
</tr>
<tr>
<td></td>
<td>Incorrect wiring of micro switch</td>
<td>Check the wiring of the micro switch and correct it.</td>
</tr>
<tr>
<td></td>
<td>Defective micro switch or incorrect setting</td>
<td>Replace the entire stator and return it to the manufacturer.</td>
</tr>
</tbody>
</table>

### Table 2: Drive Components Specifications

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OMNI-DIRECTIONAL™ WHEEL ASSEMBLY:</strong></td>
<td></td>
</tr>
<tr>
<td>• Lug Nut Torque</td>
<td>125 ft-lb (169 N•m)</td>
</tr>
<tr>
<td>• Axle Shaft Retainer Nut Torque</td>
<td>600 ft-lb (813 N•m)</td>
</tr>
<tr>
<td>• Roller Nut Torque</td>
<td>125 ft-lb (169 N•m)</td>
</tr>
<tr>
<td><strong>BRAKE ASSEMBLY:</strong></td>
<td></td>
</tr>
<tr>
<td>• Brake Rotor Thickness</td>
<td>7.5 mm (minimum) to 11.0 mm (maximum)</td>
</tr>
<tr>
<td>• Air Gap</td>
<td>0.3 mm</td>
</tr>
</tbody>
</table>
This section describes the hydraulic system for the Airtrax™ SIDI£N£R™ ATX-3000 lift trucks. The hydraulic system consists of a hydraulic oil tank, hydraulic motor, gear pump, electro-hydraulic control valve, oil filter, mast components, and the hydraulic controller. Read and follow these guidelines when working on the hydraulic system.

ALWAYS disconnect the battery at the connector before starting to work on the lift truck. DO NOT pull on the battery cables attached to the connector.

ALWAYS use the specified hydraulic fluid when replacing or adding fluid to the hydraulic oil tank.

ALWAYS refer to the applicable procedure when performing maintenance procedures.

ALWAYS observe absolute cleanliness when filling the hydraulic oil tank or working on the hydraulic system.

ALWAYS be sure that the hydraulic components are repaired on a clean workbench.

NEVER operate the lift truck with hydraulic fluid leaks, low hydraulic fluid in the hydraulic oil tank, or with damaged or chafed hydraulic hoses.

Figure 1: HYDRAULIC COMPONENTS

1. ELECTRO-HYDRAULIC CONTROL VALVE
2. FILTER
3. HYDRAULIC TANK
4. HYDRAULIC MOTOR
5. GEAR PUMP
DESCRIPTION

The hydraulic system of the lift truck provides independent control circuits for the lift, tilt, and auxiliary functions.

Lift System

The hydraulic lift system provides the lifting and lowering function for the mast. The system consists of an electric motor, hydraulic pump, a proportional joystick control handle, and the mast assembly. The maintenance and repair instructions for the mast assembly are covered in the MAST section of this manual.

Tilt System

The hydraulic tilt system provides the tilting function of the mast. The system is supplied with hydraulic fluid from the hydraulic gear pump and is controlled by the proportional joystick control handle. Two paired, double acting hydraulic cylinders, secured between the truck frame and the mast assembly, provide the tilt action of the mast.

The forward and backward tilt angle of the mast assembly depends on the type of mast assembly fitted to the lift truck, and is factory set to comply with safety regulations.

The tilt cylinders furnished with the lift truck must not be changed in any way to alter the tilt angles and, if replaced, must maintain the correct tilt as applicable to the mast assembly furnished with the lift truck.

Auxiliary Functions

These lift trucks can also be furnished with a third and/or fourth auxiliary function. These auxiliary functions are also controlled using the proportional joystick control handle. The third function is used for extend and retract operations and requires the use of an additional hydraulic cylinder to perform this function. The fourth function is used for side-shift, swing or rotating, as required by the end user.

Hydraulic Oil Tank

The hydraulic oil tank is located in a compartment adjacent to the operator on the left-hand frame of the lift truck. The hydraulic oil tank supplies hydraulic fluid for the hydraulic gear pump, which directs the hydraulic fluid to the electro-hydraulic control valve and the other functions furnished with the lift truck.

The hydraulic fluid from the proportional joystick control handle returns to the hydraulic oil tank through a hydraulic filter. The filter is a 10-micron screw-on type oil filter. The hydraulic filter is located on the return hose to the hydraulic oil tank.

The hydraulic fluid level is checked using a bayonet type dipstick gauge fitted to the breather cap. Wipe the dipstick clean using a lint free cloth. Replace and remove the dipstick to check the hydraulic fluid level. BE SURE the load forks are fully lowered before checking the hydraulic level.

Figure 2: HYDRAULIC DESCRIPTION
MAINTENANCE PROCEDURES

Hydraulic Oil Filter - Replace

⚠️ WARNING

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

⚠️ WARNING

Hydraulic fluid can become very hot. Ensure that hydraulic fluid has cooled prior to performing this procedure.

NOTE: Any replacement hydraulic oil filters must be spin on type with a ten micron rating.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Remove the left-hand side cover. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.

⚠️ WARNING

Make sure the mast is fully lowered before continuing. If a hydraulic hose is opened while the mast is raised, the mast can suddenly lower and cause personal injury or death.

3. Remove the pressure in the hydraulic system.
4. Using a filter wrench, spin off the hydraulic filter.
5. Wipe a small amount of clean hydraulic fluid onto the seal of the new hydraulic filter.
7. Fill hydraulic system as needed.
8. Remove the tag from the battery connector and connect the battery.

Figure 3: HYDRAULIC OIL FILTER - REPLACEMENT
Hydraulic Gear Pump - Removal

**WARNING**
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**
Hydraulic fluid can become very hot. Ensure that hydraulic fluid has cooled prior to performing this procedure.

**CAUTION**
After removing any hydraulic hoses, allow the hydraulic fluid to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminates into the system and damage equipment.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Remove front bulkhead cover and the left-hand side cover. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.

**WARNING**
Make sure the mast is fully lowered before continuing. If a hydraulic hose is opened while the mast is raised, the mast can suddenly lower and cause personal injury or death.

3. Remove the pressure in the hydraulic system.
4. Have a container available to catch any hydraulic fluid that is in the hydraulic hoses that will be removed.
5. Remove the pressure hose at the elbow fitting on the top of the hydraulic gear pump.
6. Remove the hose clamp and the suction hose at the elbow fitting on the bottom of the hydraulic gear pump.
7. Remove two capscrews and lock washers retaining the hydraulic gear pump to the hydraulic motor.

**NOTE:** The hydraulic gear pump has a splined shaft that extends into the hydraulic motor.

8. Remove the hydraulic gear pump from the hydraulic motor.

9. Drain any hydraulic fluid that may be left in the hydraulic gear pump into a container.

---

**Figure 4: HYDRAULIC GEAR PUMP - REMOVE/INSTALL**
Hydraulic Gear Pump - Installation

**NOTE:** If replacement parts are needed, refer to the PARTS MANUAL.

**NOTE:** If a new hydraulic gear pump is being installed, the elbow fittings must be removed from the old hydraulic gear pump and reinstalled into the new hydraulic gear pump. Ensure the elbow fittings are turned in the proper direction so the hoses will connect properly.

1. Apply multi-purpose grease to the hydraulic gear pump splined shaft.

2. Align the hydraulic gear pump splined shaft with the hydraulic motor and position the hydraulic gear pump onto the hydraulic motor.

3. Secure hydraulic gear pump with two capscrews and lock washers. Torque two capscrews to 65 ft-lb (88 N·m).

4. Install the suction hose to the elbow fitting on the bottom of the hydraulic gear pump. Secure the suction hose with the hose clamp.

5. Install the pressure hose to the elbow fitting on top of the hydraulic gear pump.

6. Check the level of the hydraulic fluid in the hydraulic oil tank and fill as needed.

7. Remove the tag from the battery connector and connect the battery.

8. Operate the lift truck to check the operation of the hydraulic system and check for leaks.

9. Recheck the level of the hydraulic fluid in the hydraulic oil tank and fill as needed.

10. Install the left-hand side cover on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.

![Diagram of Hydraulic Gear Pump - Remove/Install](image-url)
HYDRAULIC MOTOR - REMOVAL

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**

Hydraulic fluid can become very hot. Ensure that hydraulic fluid has cooled prior to performing this procedure.

**CAUTION**

After removing any hydraulic hoses, allow the hydraulic fluid to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminates into the system and damage equipment.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

2. Remove rear cover and the left-hand side cover. Refer to the COVERS/FLOOR PLATES procedure in the Operator’s Manual.

**WARNING**

Make sure the mast is fully lowered before continuing. If a hydraulic hose is opened while the mast is raised, the mast can suddenly lower and cause personal injury or death.

3. Remove the pressure in the hydraulic system.

4. Have a container available to catch any hydraulic fluid that is in the hydraulic hoses that will be removed.

5. The hydraulic gear pump must be removed before the hydraulic motor can be removed. See the HYDRAULIC GEAR PUMP - REMOVAL procedure in this manual.

6. Tag and mark all wires prior to removal to ensure correct installation.

7. Remove three nuts, washers, and wires from the hydraulic motor terminals.

8. Remove four capscrews, lock washers, and washers from the mounting bars and lift truck frame.

9. Remove the hydraulic motor from the lift truck frame and place on a clean work surface.

10. Remove four nuts, lock washers, and washers from the hydraulic motor and the insulators.

11. Remove the two mounting bars and four insulators from the hydraulic motor.

Figure 6: HYDRAULIC MOTOR - REMOVE/INSTALL
Hydraulic Motor - Installation

NOTE: Inspect the insulators for damage prior to installation. Refer to the PARTS MANUAL for replacement parts.

1. Place the hydraulic motor upside down on a clean work surface.
2. Position four insulators and two mounting bars on the hydraulic motor.
3. Secure the two mounting bars and four insulators to the hydraulic motor with four washers, lock washers, and nuts. Torque four nuts to 65 ft-lb (88 N•m).
4. Position the hydraulic motor on the lift truck frame and align the mounting holes.
5. Secure the mounting bars to the lift truck frame with four capscrews, lock washers, and washers. Torque four capscrews to 65 ft-lb (88 N•m).
6. Install three wires to the hydraulic motor terminals as marked during removal.
7. Install three nuts and washers to the hydraulic motor terminals. Torque three nuts to 6 ft-lb (8 N•m).
8. Install the hydraulic gear pump to the hydraulic. See the HYDRAULIC GEAR PUMP - INSTALLATION procedure in this manual.
9. Check the level of the hydraulic fluid in the hydraulic oil tank and fill as needed.
10. Remove the tag from the battery connector and connect the battery.
11. Operate the lift truck to check the operation of the hydraulic system and check for leaks.
12. Recheck the level of the hydraulic fluid in the hydraulic oil tank and fill as needed.
13. Install the left-hand side cover and rear cover to the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.

Figure 7: HYDRAULIC MOTOR - REMOVE/INSTALL
Hydraulic Oil Tank - Removal

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**

Hydraulic fluid can become very hot. Ensure that hydraulic fluid has cooled prior to performing this procedure.

**WARNING**

Do not use tools that generate sparks, heat, or static electricity around the hydraulic oil tank. The vapors in the hydraulic oil tank can cause an explosion.

**CAUTION**

Do not attempt to repair a cracked or damaged hydraulic oil tank. The hydraulic oil tank must be replaced.

**CAUTION**

After removing any hydraulic hoses, allow the hydraulic fluid to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminates into the system and damage equipment.

---

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Remove the rear cover and the left-hand side cover. Refer to the COVERS/FLOOR PLATE procedure in the Operator's Manual.
3. Remove the pressure in the hydraulic system.

---

**WARNING**

Make sure the mast is fully lowered before continuing. If a hydraulic hose is opened while the mast is raised, the mast can suddenly lower and cause personal injury or death.

3. Remove the pressure in the hydraulic system.
4. Have a container available to catch any hydraulic fluid that is in the hydraulic hoses that will be removed.

5. Loosen the hose clamp retaining the return hose to the hydraulic oil tank and remove the return hose.

6. Loosen the hose clamp retaining the suction hose to the hydraulic oil tank and remove the suction hose.

**NOTE:** The hydraulic filter assembly and hydraulic gear pump pressure hose must be removed and positioned away from the hydraulic oil tank.

7. Remove two capscrews, washers, lock washers, and nuts from the hydraulic filter mount bracket. Move the hydraulic oil filter away from the hydraulic oil tank.

8. Disconnect the pressure hose from the top of the hydraulic gear pump. Position the pressure hose away from the hydraulic oil tank.

9. Remove three capscrews, washers, lock washers and nuts from the hydraulic oil tank and lift truck frame.

10. Carefully lift the hydraulic oil tank from the lift truck frame.

11. Allow the hydraulic fluid from the hydraulic oil tank to drain into a container.
Hydraulic Oil Tank - Installation
1. Slide the hydraulic oil tank down into the lift truck frame and align mounting holes.
2. Secure the hydraulic oil tank to the lift truck frame with three capscrews, washers, lock washers, and nuts. Torque three capscrews to 35 ft-lb (47 N•m).
3. Align the hydraulic filter mount bracket on the lift truck frame and secure with two capscrews, washers, lock washers, and nuts. Torque two capscrews to 10 ft-lb (14 N•m).
4. Connect the pressure hose to the top of the hydraulic gear pump.
5. Install the suction hose to the hydraulic oil tank. Secure the suction hose with the hose clamp.
6. Install the return hose to the hydraulic oil tank. Secure the return hose with the hose clamp.
7. Secure hydraulic hoses as needed with wire ties to prevent hydraulic hoses from rubbing on other components.
8. Check the level of the hydraulic fluid in the hydraulic oil tank and fill as needed.
9. Remove the tag from the battery connector and connect the battery.
10. Operate the lift truck to check the operation of the hydraulic system and check for leaks.
11. Recheck the level of the hydraulic fluid in the hydraulic oil tank and fill as needed.
12. Install the left-hand side cover on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.

Figure 9: HYDRAULIC OIL TANK - REMOVE/INSTALL
Electro-hydraulic Control Valve - Removal

⚠️ WARNING
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

⚠️ WARNING
Hydraulic fluid can become very hot. Ensure that hydraulic fluid has cooled prior to performing this procedure.

⚠️ CAUTION
After removing any hydraulic hoses, allow the hydraulic fluid to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminates into the system and damage equipment.

NOTE: There are three types of electro-hydraulic control valves that are used on the Airtrax™ lift truck. Depending on which functions the mast has installed will determine which electro-hydraulic control valve is installed. The only items this will effect during removal and installation procedures is the number of hydraulic hoses and wires that connect to the electro-hydraulic control valve.

---

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Remove the left-hand side cover. Refer to the COVERS/FLOOR PLATE procedure in the Operator's Manual.

⚠️ WARNING
Make sure the mast is fully lowered before continuing. If a hydraulic hose is opened while the mast is raised, the mast can suddenly lower and cause personal injury or death.

3. Remove the pressure in the hydraulic system.
4. The battery must be removed before the electro-hydraulic control valve can be removed. See the BATTERY - REMOVAL procedure in this manual.
5. Have a container available to catch any hydraulic fluid that is in the hydraulic hoses that will be removed.
6. Disconnect the electro-hydraulic control valve wire connector from the wiring harness.
7. Cut and remove any wire ties that are securing the wiring between the wire connector and the electro-hydraulic control valve.

8. Remove the pressure hose and return hose from the fittings on the top of the electro-hydraulic control valve.

9. Remove the mast supply hoses from the electro-hydraulic control valve.

10. Remove four capscrews that secure the electro-hydraulic control valve to the lift truck frame.

11. Remove the electro-hydraulic control valve from the lift truck frame.

Electro-hydraulic Control Valve - Disassembly and Assembly

NOTE: The fittings must be removed from the old electro-hydraulic control valve and installed into the new electro-hydraulic control valve. Be sure that the fittings are oriented properly when installing them in the new electro-hydraulic control valve.

1. Lay the old and the new electro-hydraulic control valves side-by-side on a clean work surface.

⚠️ CAUTION

DO NOT apply thread sealant to the last two threads on any fitting, as doing so may allow the thread sealant to enter the hydraulic system.

2. Remove the fittings one at a time from the old electro-hydraulic control valve, clean the fitting threads, apply a liberal amount of thread sealant, and install the fittings into the new electro-hydraulic control valve.

3. Cap and plug all holes on the old electro-hydraulic control valve.

4. Inspect electro-hydraulic control valve to be sure that all unused ports are plugged.
Electro-hydraulic Control Valve - Installation

1. Align the electro-hydraulic control valve with the lift truck frame and secure with four capscrews. Torque four capscrews to 35 ft-lb (47 N•m).

2. Install the hydraulic hoses to the fittings on the electro-hydraulic control valve as marked during removal.

3. Connect the electro-hydraulic control valve’s wire connector to the wiring harness.

4. Secure any loose wiring with wire ties.

5. Install the battery. See the BATTERY-INSTALLATION procedure in this manual.

6. Check the level of the hydraulic fluid in the hydraulic oil tank and fill as needed.

7. Remove the tag from the battery connector and connect the battery.

8. Operate the lift truck to check the operation of the hydraulic system and check for leaks.

9. Recheck the level of the hydraulic fluid in the hydraulic oil tank and fill as needed.

10. Install the left-hand side cover on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator’s Manual.

Figure 11: ELECTRO-HYDRAULIC CONTROL VALVE - REMOVE/INSTALL
### Table 1: Hydraulic System Troubleshooting

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic pressure is low.</td>
<td>Hydraulic gear pump is worn or damaged.</td>
<td>Replace hydraulic gear pump.</td>
</tr>
<tr>
<td></td>
<td>Leak in hydraulic system.</td>
<td>Find and repair leak.</td>
</tr>
<tr>
<td></td>
<td>Restriction in hydraulic system.</td>
<td>Find restriction and repair.</td>
</tr>
<tr>
<td></td>
<td>Battery voltage low.</td>
<td>Change or charge battery.</td>
</tr>
<tr>
<td>Hydraulic pump noise is not normal.</td>
<td>Hydraulic tank fluid level is low.</td>
<td>Fill hydraulic oil tank to proper level.</td>
</tr>
<tr>
<td></td>
<td>Suction hose is restricted.</td>
<td>Disconnect hose and remove restriction.</td>
</tr>
<tr>
<td></td>
<td>Loose suction fitting.</td>
<td>Tighten suction fitting.</td>
</tr>
<tr>
<td></td>
<td>Damaged bearings or gears.</td>
<td>Replace hydraulic gear pump.</td>
</tr>
<tr>
<td></td>
<td>Loose mount bolts for hydraulic gear pump or hydraulic motor.</td>
<td>Tighten all bolts to correct torque.</td>
</tr>
<tr>
<td>Hydraulic motor noise is not normal.</td>
<td>Hydraulic motor is worn or damaged.</td>
<td>Replace hydraulic motor.</td>
</tr>
</tbody>
</table>

### Table 2: Hydraulic System Specifications

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYDRAULIC SYSTEM CAPACITY:</td>
<td>6 gal (22.7 liters)</td>
</tr>
<tr>
<td>• Hydraulic Oil Tank</td>
<td></td>
</tr>
</tbody>
</table>
TILT CYLINDERS

RETURN FILTER
10 MICRON

T1

HYD. RESERVOIR

A1 A2 B1 B2 TL1 TL2

SYMBOL
GENERAL

This manual provides the installation instruction, periodic maintenance, troubleshooting, and service procedures for the mast furnished with the Airtrax™ lift truck.

There are two types of masts that are used on the SIDEWINDER™ ATX-3000 lift truck. The two-stage mast or model 30D MS and the three-stage mast or model 30D MT. While using this manual, keep in mind that some procedures will combine both types of masts in the procedure. However, the differences will be clearly defined in these procedures.

In any communication about the mast, refer to the mast serial number stamped in the nameplate. If the nameplate is missing, these numbers are also stamped on the left-hand upper cheekplate.

Modifications and additions which affect capacity or safe operation shall not be performed without prior written approval from either Airtrax™ or the manufacturer of the mast, per ANSI B56.1.

System Requirements

To achieve maximum lifting capacity of the mast, the lift truck relief valve should be set to relieve at the pressure indicated in the table below. This table also indicates the hose fitting size to use on the lift truck relief valves.

<table>
<thead>
<tr>
<th>Table 1: Relief Valve Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mast Model</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>30D MS</td>
</tr>
<tr>
<td>30D MS</td>
</tr>
<tr>
<td>30D MT</td>
</tr>
<tr>
<td>30D MT</td>
</tr>
</tbody>
</table>

* Valve inlet port is 3/4-inch with a SAE O-ring.

WARNING

For proper lift truck stability or to prevent interference, tilt restriction may be required. Contact the lift truck manufacturer.

CAUTION

These masts are compatible with SAE 10W petroleum base oil only. Use of synthetic or aqueous base hydraulic oil is not recommended. The use of improper lubricants on these masts may cause premature wear. See the MAINTENANCE SCHEDULE for proper lubrication specifications.

DESCRIPTION

Mast Uprights

Outer Upright Assembly:

- The outer upright assembly is mounted to the lift truck.
- A pair of shim adjustable rollers are attached to stub shafts located near the top of the upright.
- A pair of adjustable hoist chain anchors are located in the top crossmember.

Intermediate Upright Assembly (three-stage mast only):

- The intermediate upright assembly telescopes within the outer upright assembly.
- A pair of shim adjustable load rollers are attached to stub shafts located at the top and bottom of the upright.
- A pair of chain sheaves are located near the top of the upright to provide a rolling surface for the main lift chains.

Inner Upright Assembly:

- The inner upright assembly telescopes within the outer upright (intermediate upright assembly on the three-stage mast) assembly.
- A pair of shim adjustable load rollers are attached to stub shafts located at the bottom of the upright.
- The free chain anchors are attached to the center crossmember (three-stage mast only).
- The free lift cylinder rests on a cradle that is integral with the lower crossmember (three-stage mast only).
Upright Operations (Two-Stage Mast Only)

Fully Lowered

- The hoist chains are anchored to the outer upright top crossmember. The chains travel over the inner upright chain sheaves and attach to the carriage anchors.

Extension

- Activating the truck hoist valve causes the hoist cylinders to extend the inner upright. The extension of the upright causes the chains to raise the carriage.
- Lowering of the mast is a reversal of extension.

Lowering

- The cylinders lower at the same time, resulting in a smooth lowering of the carriage.

Tilt Cylinders

The tilt cylinder moves the mast forward and backward. When the cylinder rod moves the mast for the tilt backward function, hydraulic oil enters the tilt cylinder through the port at the rod end of the cylinder. The oil pressure pushes the piston and causes the rod to retract in the cylinder. Hydraulic oil in the piston end of the cylinder returns to the hydraulic oil tank.

When the cylinder rod moves the mast for the tilt forward function, the hydraulic oil enters the port at the piston end of the tilt cylinder. The oil pressure pushes the cylinder and causes the rod to extend. The hydraulic oil in the rod end of the tilt cylinder returns to the hydraulic oil tank.

Carriage

The carriage attached to the mast is a structure that hook-type forks or attachments can be attached onto. The carriage travels within the rails of the mast inner upright on four (or six optional) shim adjustable rollers*. The rollers are held in the uprights*. All load rollers are interchangeable (except the six roller carriages middle rollers). There are four side thrust rollers to transfer carriage side loading to the inner rails. These rollers are eccentrically adjustable. A pair of chain anchors are used to connect the carriage chains to the carriage.

* Except on six roller carriages, where the top roller extends past the top of the mast inner upright at full extension and is held in place by a retainer plate.

Figure 1: TWO-STAGE MAST FUNCTION
Upright Operations (Three-Stage Mast Only)

Fully Lowered

- The main lift chains are anchored to the outer upright top crossmember, then travel over the intermediate upright chain sheaves and attach to the inner upright anchors.
- The free lift chains are anchored to the inner upright center crossmember, then travel over the free lift cylinder chain sheaves and attach to the carriage chain anchors.

Free Lift

- Activating the lift truck hoist valve causes the free lift cylinder to raise, which draws the carriage to the top of the inner upright.

Full Extension

- When the free lift cylinder reaches the end of its stroke, the main lift cylinders begin to rise. The extension of the cylinders causes the intermediate and inner uprights to raise.

Lowering

- The cylinders lower at the same time, resulting in a smooth lowering of the carriage.

Main Lift Cylinders

The main lift cylinders are single stage piston type cylinders. They consist of a shell and a telescoping plunger/piston assembly. During extension, oil pressure is acting against the full piston area. The lift truck hoist control valve holds the cylinder in place once the extension has stopped.

The shell is internally threaded at the top end to hold the retainer. The retainer seals provide a high-pressure hydraulic seal against the plunger. The retainer also limits the upward stroke of the plunger.

A piston is attached to the bottom end of the plunger. The piston seal provides a high-pressure seal against the shell. A check valve is located in the bottom of the piston. The check valve allows residual oil between the shell and plunger to escape when the cylinder is extending.

A hydraulic fuse/cushion valve is located in the cylinder port. In case of a hose failure between the lowering control valve and cylinders, the fuse limits the lowering speed of the cylinder. The valve also cushions the piston when the cylinder nears the fully lowered position.
**Free Lift Cylinder (Three-Stage Mast Only)**

The free lift cylinders are single stage piston type cylinders. They consist of a shell and a plunger/piston assembly. During extension, the oil pressure is acting against the full piston area. The lift truck hoist control valve holds the cylinder in place once the extension has stopped.

The shell is internally threaded at the top end to hold the retainer. The retainer seals provide a high-pressure hydraulic seal against the plunger. The retainer also limits the upward stroke of the plunger. A piston is attached to the bottom end of the plunger. The piston seal provides a high-pressure hydraulic seal against the shell. A check valve is located in the bottom of the piston. The check valve allows residual oil between the shell and the plunger to escape when the cylinder is extending.

**Cylinder Operation**

**Raising**

1. When the lift truck hoist control valve is actuated, oil enters the lowering control valve through the lowering control valve cartridge.

2. Hydraulic oil flows to the cylinder inlet ports. Due to the larger bore diameter of the free lift cylinder compared to both main lift cylinders, the free lift cylinder will raise completely before the main lift cylinders raise.

3. Hydraulic oil flows through the free lift cylinder hydraulic fuse/cushion valve to the bottom of the piston. Lifting force is created against the bottom of the piston, causing the plunger to raise. Oil in the area between the plunger and shell is allowed to escape through the check valve in the piston as the plunger rises to the end of its stroke.

4. Oil flows through the hydraulic fuse/cushion valve to the bottom of the piston. Lifting force is created against the bottom of the piston, causing the plunger to raise. Oil in the area between the plunger and shell is allowed to escape through the check valve in the piston as the plunger raises.

5. When oil flow from the lift truck hoist control valve is discontinued, the cylinders are held in position by the closed center spool of the lift truck valve.

**Lowering**

1. When the lift truck hoist control valve is actuated, the main lift, then free lift cylinder plungers lower, forcing the hydraulic oil out through the hydraulic fuse/cushion valves.

**NOTE:** The restriction setting of each hydraulic fuse is lower (allows more hydraulic oil flow) than the setting of the control valve. The hydraulic fuses restrict the flow only in the instance of a lowering control valve or hose failure.

2. Hydraulic oil flows to the lowering control valve where it is restricted at a controlled speed determined by the load being handled.

3. As the main lift cylinder pistons lower over the spears in the bottom of the shell, a high pressure area is developed between the piston and shell which engages the cushion valve to restrict flow. This slows the piston/plunger just prior to bottoming, providing a smooth transition to lower the free lift cylinder.

**Figure 3: HYDRAULIC SCHEMATIC TWO-STAGE MAST**
Figure 4: HYDRAULIC SCHEMATIC THREE-STAGE MAST
SAFETY PROCEDURES WHEN WORKING NEAR THE MAST

This lift truck meets all applicable mandatory requirements and safety standards for powered industrial lift trucks at the time of manufacture.

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.

The following procedures must be used when inspecting or working near the mast. Additional precautions and procedures can be required when repairing or removing the mast.

⚠️ WARNING
Never work on the mast with a load on the forks or attachment, in the raised position without supports, or while anyone is near the lift truck joystick controls.

⚠️ WARNING
Mast parts are heavy and can move. Distances between parts are small. Serious injury or death can result if part of the body is hit by parts of the mast or the carriage.

⚠️ WARNING
Mounting bracket and crossmember welding must be performed by a certified welder that is familiar with this type of fabrication.

⚠️ WARNING
Never put any part of the body into or under the mast or carriage unless all parts are completely lowered or a safety chain is installed. Also, make sure that the power is off and the key is removed.

⚠️ WARNING
Put a DO NOT OPERATE tag in the operator’s compartment. Disconnect the battery on electric lift trucks and put a tag or lock on the battery connector.

⚠️ WARNING
Be careful of the forks. When the mast is raised, the forks can be at a height to cause an injury.

⚠️ WARNING
DO NOT climb on the mast or lift truck at any time. Use a ladder or personnel lift to work on the mast.

⚠️ WARNING
DO NOT use blocks to support the mast weldments nor to restrain their movement.

⚠️ WARNING
Mast repairs require disassembly and removal of parts and can require removal of the mast or carriage. Follow the repair procedures in this section of this manual.
When Working Near the Mast

1. Lower the mast and carriage completely. Operate the hydraulic control joystick to make sure there is no movement in the mast. Make sure that all parts of the mast that move are fully lowered.

2. If parts of the mast must be in a raised position, install a safety chain to restrain the moving parts of the mast. Connect moving parts to a part that does not move. Follow these procedures:
   a. Put the mast in a vertical position.
   b. Raise the mast to align the bottom crossmember of the weldment that moves in the outer weldment with a crossmember on the outer weldment. On the two-stage mast, the moving part is the inner weldment. On the three-stage mast it is the intermediate weldment.
   c. Use a 3/8-inch minimum safety chain with a hook to fasten the crossmembers together so that the movable crossmember cannot lower. Put the hook on the backside of the mast. Make sure the hook is completely engaged with a link in the chain. Make sure the safety chain does not touch lift chains or chain sheaves, tubes, hoses, fittings, or other parts on the mast.
   d. Lower the mast until there is tension in the safety chain and the free-lift cylinder (three-stage masts only) is completely retracted. Install a DO NOT REMOVE tag on the safety chain(s).
   e. Install another safety chain (3/8 in. minimum) between the top or bottom crossmember of the carriage and a crossmember on the outer weldment.

3. After lowering or restraining the mast, shut off the power and remove the key.

4. Put a DO NOT OPERATE tag in the operator's compartment.

5. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect the battery.

Figure 5: SAFETY CHAIN - INSTALLATION
MAST MAINTENANCE

Mast - Removal (Two-Stage and Three-Stage Masts)

⚠️ WARNING
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

⚠️ WARNING
Exercise extreme care when removing and installing the mast or components of the mast. The mast and certain components of the mast are very heavy and the weight is not well distributed due to the shape of the components. Failure to comply may result in serious injury or death to personnel.

⚠️ WARNING
Hydraulic oil can become very hot. Ensure that hydraulic oil has cooled prior to performing this procedure.

⚠️ CAUTION
After removing any hydraulic hoses, allow the hydraulic oil to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminates into the system and damage equipment.

1. Raise and block the front end of the lift truck 1 ft (30 cm) or drive the truck over a service pit.
2. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

⚠️ WARNING
Make sure the mast is fully lowered before continuing. If a hydraulic hose is opened while the mast is raised, the mast can suddenly lower and cause personal injury or death.

3. Remove the pressure in the hydraulic system.

NOTE: Have a container available to catch any hydraulic fluid that is in the hydraulic hoses that will be removed.

4. Attach an overhead hoist with lifting strap routed under all upper crossmembers. Take up slack in the lifting strap.
5. Disconnect the hydraulic supply hose from the mast valve. Plug the hose end and cap the valve fitting.
6. Remove two capscrews, lock washers, and anchor pins from the tilt cylinders and the mast anchor brackets.
7. Remove four capscrews, lock washers, and two mount brackets from the lower mast mount brackets.
8. Remove the lower mount bearings from the lower mast mounts.

⚠️ WARNING
Do not stand under the mast upright unless it is chained to a support. Failure to comply may result in injury or death to personnel.

9. Lift the mast away from the lift truck.
**MAST**

Upright - Removal (Two-Stage Mast Only)

⚠️ **WARNING**
Exercise extreme care when removing and installing the mast or components of the mast. The mast and certain components of the mast are very heavy and the weight is not well distributed due to the shape of the components. Failure to comply may result in serious injury or death to personnel.

⚠️ **WARNING**
Hydraulic oil can become very hot. Ensure that hydraulic oil has cooled prior to performing this procedure.

⚠️ **CAUTION**
After removing any hydraulic hoses, allow the hydraulic oil to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminates into the system and damage equipment.

1. Remove the mast assembly from the lift truck. See MAST - REMOVAL procedure in this manual.

⚠️ **CAUTION**
Position the mast assembly on wooden blocks to prevent damage to equipment.

2. Remove the main lift cylinders from the mast. See MAIN LIFT CYLINDERS - REMOVAL procedure in this manual.

3. Turn the mast over and position on blocks.

4. Remove the carriage from the mast as described in CARRIAGE - REMOVAL (Mast on Floor) procedure in this manual.

5. Remove the internal hose reeving sheave and hoses (if equipped).

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Figure 7: UPRIGHT - REMOVE/INSTALL (TWO-STAGE MAST)
A WARNING
The chain anchor nuts should be replaced each time they are removed from the mast assembly. Failure to comply may result in damage to equipment and injury or death to personnel.

6. Remove the carriage chain anchors from the hoist chains. Pull the hoist chains back through the chain sheaves.

7. Attach an overhead hoist to the inner upright cross-member.

NOTE: Record the number of shims behind each load roller for proper installation during assembly.

8. Roll the inner upright downward to expose the load rollers. Remove the load rollers.

9. Remove the inner upright through the top of the outer upright.
Upright - Removal (Three-Stage Mast Only)

⚠️ WARNING
Exercise extreme care when removing and installing the mast or components of the mast. The mast and certain components of the mast are very heavy and the weight is not well distributed due to the shape of the components. Failure to comply may result in serious injury or death to personnel.

⚠️ WARNING
Hydraulic oil can become very hot. Ensure that hydraulic oil has cooled prior to performing this procedure.

⚠️ CAUTION
After removing any hydraulic hoses, allow the hydraulic oil to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminates into the system and damage equipment.

1. Remove the mast assembly from the lift truck. See MAST - REMOVAL procedure in this manual.

2. Remove the main lift cylinders from the mast. See MAIN LIFT CYLINDERS - REMOVAL procedure in this manual.

3. Turn the mast over and position on blocks.

4. Remove the free lift cylinder as described in FREE LIFT CYLINDER - REMOVAL (Mast on Floor) procedure in this manual.

5. Remove the carriage from the mast as described in CARRIAGE - REMOVAL (Mast on Floor) procedure in this manual.

6. Remove the internal hose reeving sheave and hoses (if equipped).

7. Remove the pins retaining the main lift chains to the inner upright chain anchors. Pull the main lift chains back through the chain sheaves.

Figure 8: INNER UPRIGHT - REMOVE (THREE-STAGE MAST)
**WARNING**
The chain anchor nuts should be replaced each time they are removed from the mast assembly. Failure to comply may result in damage to equipment and injury or death to personnel.

8. Remove the main lift chain anchors (long anchors) from the inner upright. Tag the anchors for proper installation during assembly.

9. Remove the pins securing the free lift chains to the inner upright chain anchors.

10. Remove the free lift cylinder supply hose and sheave. Remove the free lift chain sheaves.

**NOTE:** Record the number of shims behind each load roller for proper installation during assembly.

11. Roll the inner upright downward to expose the inner and intermediate upright load rollers. Remove the load rollers.

12. Attach an overhead hoist to the inner upright. Remove the inner upright through the top of the intermediate upright.

**WARNING**
The chain anchor nuts should be replaced each time they are removed from the mast assembly. Failure to comply may result in damage to equipment and injury or death to personnel.

13. Remove the main lift chain anchors (long anchors) and chains from the outer upright crossmember. Tag the anchors for proper installation during assembly.

**NOTE:** Record the number of shims behind each load roller for proper installation during assembly.

14. Roll the intermediate upright downward to expose the outer load rollers. Remove the load rollers.

15. Attach an overhead hoist to the intermediate upright. Remove the intermediate upright through the top of the outer upright.

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**Figure 9:** INTERMEDIATE UPRIGHT - REMOVE (THREE-STAGE MAST)
Upright - Inspection

1. Inspect load rollers for excessive wear or damage. Rollers with visible flat spots or cracks should be replaced.

2. Inspect the load roller bearings by turning the rollers on their stub shafts. Rollers with roughness or noticeable restrictions to turning should be replaced.

3. Check lubrication on the uprights and rollers.

4. Inspect the load roller stub shafts. If they are damaged or have cracks at the base, the upright must be repaired or replaced.

5. Inspect the outer upright thrust plugs. If the wear surface is worn to less than 1/16 in. (1.6 mm), they should be replaced.

Figure 10: THRUST ROLLERS

Figure 11: UPRIGHT LUBRICATION

Figure 12: THRUST PLUG
Upright - Installation (Two-Stage Mast Only)

**WARNING**
Exercise extreme care when removing and installing the mast or components of the mast. The mast and certain components of the mast are very heavy and the weight is not well distributed due to the shape of the components. Failure to comply may result in serious injury or death to personnel.

1. Lubricate the outer upright rails with chassis lube or Kendall SR-12X.

2. Attach an overhead hoist to the inner upright cross-member. Install the inner upright through the top of the outer upright.

**NOTE:** Roll the inner upright past the thrust plugs before checking for roller clearances.

3. Assemble the load rollers on the stub shafts using the appropriate number of shims. The shims should be installed to provide a total side-to-side clearance of no looser than 1/16 in. (1.6 mm) at the tightest point throughout the travel of the inner upright. Use an equal number of shims side-to-side.

4. Pull the hoist chains through the chain sheaves. Install the carriage chain anchors to the chains.

5. Install the hose reeving sheaves and hoses (if equipped). Tighten the sheave capscrew to a torque of 65 ft-lb (88 N\(\cdot\)m).

6. Install the carriage on the mast. See CARRIAGE - INSTALLATION procedure in this manual.

7. Install the main lift cylinders. See MAIN LIFT CYLINDER - INSTALLATION procedure in this manual.

8. Adjust the main lift chains. See MAIN LIFT CHAIN - ADJUSTMENT procedure in this manual.

9. Install the mast on the lift truck. See MAST - INSTALLATION procedure in this manual.

10. Adjust the main lift chains. See MAIN LIFT CHAIN - ADJUSTMENT procedure in this manual.

11. Remove the tag from the battery connector and connect the battery.


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![Diagram of Upright - Remove/Install (Two-Stage Mast)](image)

Figure 13: UPRIGHT - REMOVE/INSTALL (TWO-STAGE MAST)
Upright - Installation (Three-Stage Mast Only)

WARNING

Exercise extreme care when removing and installing the mast or components of the mast. The mast and certain components of the mast are very heavy and the weight is not well distributed due to the shape of the components. Failure to comply may result in serious injury or death to personnel.

1. Lubricate the outer upright rails with chassis lube or Kendall SR-12X.

2. Attach an overhead hoist to the intermediate upright. Install the intermediate upright through the top of the outer upright.

3. Install the thrust plugs to the uprights.

NOTE: Roll the upright past the thrust plugs before checking the roller clearances.

4. Assemble shims and load rollers to the outer upright and lower intermediate upright stub shafts. The shims should be installed to provide a total side-to-side clearance no looser than 1/16 in. (1.6 mm) at the tightest point throughout the travel in the upright. Use an equal amount of shims side-to-side.

Figure 14: THRUST PLUG

Figure 15: INTERMEDIATE UPRIGHT - INSTALL (THREE-STAGE MAST)
5. Lubricate the intermediate upright rails in the same manner as the outer uprights in step number 1.

6. Attach an overhead hoist to the inner upright. Install the inner upright through the top of the intermediate upright.

**NOTE:** Roll the upright past the thrust plugs before checking roller clearances.

7. Assemble shims and load rollers to the intermediate upright top and inner upright lower stub shafts. The shims should be installed to provide a total side-to-side clearance no loosen than 1/16 in. (1.6 mm) at the tightest point throughout the travel in the upright. Use an equal amount of shims side-to-side.

8. Install the chain sheave and free lift hose sheave to the intermediate upright. Tighten the capscrew to a torque of 26 to 30 ft-lb (35 to 41 N•m).

**WARNING**
The chain anchor nuts should be replaced each time they are removed from the mast assembly. Failure to comply may result in damage to equipment and injury or death to personnel.

9. Install the main lift chain anchors (long anchors) and chains to the outer upright crossmember.

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**Figure 16:** INNER UPRIGHT - INSTALL (THREE-STAGE MAST)
10. Install the chain anchors (long anchors) to the back side of the inner upright lower crossmember.

11. Pull the main lift chains over the chain sheaves and attach to the lower inner upright chain anchors.

12. Install the free lift chain anchors (short anchors) and chains to the inner upright center crossmember.

13. Install the free lift cylinder supply hose through the hole in the outer upright top crossmember and over the sheave on the intermediate top upright.


15. Install the free lift cylinder on the mast. See FREE LIFT CYLINDER - INSTALLATION procedure in this manual.

16. Install the internal reeving sheave and hoses (if equipped).

17. Turn the mast over and position on blocks.

18. Install the main lift cylinders. See MAIN LIFT CYLINDER - INSTALLATION procedure in this manual.

19. Install the mast on the lift truck. See MAST - INSTALLATION procedure in this manual.

20. Adjust the main lift and free lift chains. See MAIN LIFT CHAIN - ADJUSTMENT and FREE LIFT CHAIN - ADJUSTMENT procedures in this manual.

21. Remove the tag from the battery connector and connect the battery.

22. Check for mast skewing. See MAST SKEWING - ADJUSTMENT procedure in this manual.

Figure 17: UPRIGHT - INSTALL (THREE-STAGE MAST)
MAST - Installation (Two-Stage and Three-Stage Masts)

A WARNING

Exercise extreme care when removing and installing the mast or components of the mast. The mast and certain components of the mast are very heavy and the weight is not well distributed due to the shape of the components. Failure to comply may result in serious injury or death to personnel.

1. Raise and block the front end of the lift truck 1ft (30 cm) or drive the truck over a service pit.
2. Install the bearings to the lower mast mounts.
3. Lubricate the bearing surfaces of the lower mast mounts with chassis grease.
4. Lift the mast using an overhead hoist with lifting strap routed under all upper crossmembers. Position the mast by lowering the mast mounts on the lift truck.
5. Install the lower mast mount caps and capscrews. Torque the capscrews to 88 ft-lb (119 N•m).

A WARNING

Use as few fittings as possible and always use 45° fittings instead of 90° fittings. Keep the hose lengths to a minimum. Avoid sharp bends or pinch points when routing the hydraulic hoses.

6. Connect the hydraulic supply hose to the mast valve.
7. Align the tilt cylinders to the mast anchor brackets and secure with two anchor pins.
8. Secure the anchor pins to the mast anchor brackets with two capscrews. Torque the capscrews to 36 ft-lb (49 N•m).

Figure 18: MAST - INSTALLATION
Internal Reeving - Installation (Two-Stage Mast Only)

1. Install fittings and hose ends to the carriage hose bracket. For single function (two hoses), install the fittings and hoses to the lower two holes in the bracket.

2. Install the carriage hose bracket and spacer to the left-hand carriage chain anchor plate. Tighten the capscrews to a torque of 20 ft-lb (27 N•m).

3. Install the brackets, hose clamps, and sheaves to the uprights. Tighten the bracket capscrews to a torque of 30 ft-lb (41 N•m).
4. Completely lower the carriage.

5. Route the hoses up and over the upper hose sheaves and then down to the upper hose bracket. Orient the hoses with the natural curve over the sheaves.

6. Assemble the clamp and hoses to the upper bracket, leaving the capscrews finger tight. Pull down on the hoses with 80 lbs force to remove slack, then tighten the clamp capscrews to a torque of 11 ft-lb (15 N·m).

7. Attach the hose ends to the center hose bracket aligning the hoses with their natural curve. Tighten the clamp capscrews to a torque of 11 ft-lb (15 N·m).

8. Raise and lower the mast slowly through several cycles checking for proper hose alignment, clearances, and hose tracking.

Figure 21: HOSE ROUTING (TWO-STAGE MAST)
Internal Reieving - Installation (Three-Stage Mast Only)

1. Install the shafts, sheaves, and hose guards to the crosshead center plate. Leave the capscrew and nut finger tight to allow hose installation.

2. Install the carriage bracket to the tabs between the carriage side plates. Leave the capscrews finger tight.

3. Install fittings to bracket as follows:
   a. Single Function - Install the fittings to the left-side or right-side location. Tighten the fittings finger tight.
   b. Double Function - Install the fittings to the left-side and right-side location. Tighten the fittings finger tight.

Figure 22: CROSSHEAD ASSEMBLY - INSTALL (THREE-STAGE MAST)

Figure 23: CARRIAGE BRACKET FITTINGS - INSTALL (THREE-STAGE MAST)

Figure 24: CARRIAGE BRACKET - INSTALL (THREE-STAGE MAST)
4. Install the brackets, hose clamps, and sheaves to the uprights. Tighten the bracket capscrews to a torque of 38 ft-lb (52 N•m).

5. Completely lower the carriage. Route the hoses down behind the top carriage bar to the carriage bracket fittings. Connect the hoses fittings to the carriage fittings and tighten.

6. Loosen the crosshead cover plate capscrew. Route the hoses up over the crosshead sheaves. Orient the hoses with the natural curve over the sheaves.

7. Route the hoses down between the free lift cylinder and middle inner crossmember to the bracket behind the free lift cylinder. The hoses route through the wire loop then underneath the lower inner crossmember.

8. Assemble the clamp and hoses, then pull down on the hoses with 80 lbs. force to remove slack. Tighten the clamp capscrews to a torque of 8 ft-lb (11 N•m).

Figure 25: BRACKET - INSTALL (THREE-STAGE MAST)
9. Route the hoses under the lower inner crossmember to loop up to the lower hose bracket. Install the hose clamps leaving the capscrews finger tight. Align the hoses under the crossmember and into the clamp. Tighten the clamp capscrews to a torque of 8 ft-lb (11 N•m).

10. Route the hoses up to and over the upper hose sheaves and then down to the upper hose bracket.

11. Assemble the clamp and hoses to the upper bracket leaving the capscrews finger tight. Starting with the outer hose, pull down on the hoses with 80 lbs of force to remove slack, then tighten the clamp capscrews to a torque of 8 ft-lb (11 N•m).

12. Attach the hose ends to the center hose bracket aligning the hoses with their natural curve. Tighten the clamp capscrews to a torque of 8 ft-lb (11 N•m).

13. Attach the left hand cylinder supply hose and clamp to the outer upright center crossmember. Tighten the clamp capscrew to a torque of 8 ft-lb (11 N•m).

**Internal Reieving - Removal (Two-Stage and Three-Stage Masts)**

For removal procedures reverse the installation procedures for the appropriate mast. See the INTERNAL REEVING - INSTALLATION (TWO-STAGE MAST) or INTERNAL REEVING - INSTALLATION (THREE-STAGE MAST) procedure in this manual.
Mast Skewing - Repair (Two-Stage Mast Only)

1. Extend the mast to full extension.
   - If the mast bends to the right at full extension, a shim(s) (Part No. 683797) needs to be installed to the right-hand cylinder rod.
   - If the mast bends to the left at full extension, a shim(s) (Part No. 683797) needs to be installed to the left-hand cylinder rod.

⚠️ WARNING
The inner upright must be supported by angle iron to avoid possible injury.

2. Place a 6 in. (15 cm) long, 2 X 2 in. (5 X 5 cm) angle iron between the top of the main lift cylinder and the crossmember. Lower the crossmember onto the angle iron. Avoid contacting the cylinder rod seal.

3. Remove the snap ring from the cylinder to be adjusted. Open the lift truck valve to allow the center (free lift) cylinder to fully retract. Tap the main lift cylinder rod down past the crossmember to install the shim.

4. Install the shim(s) to the cylinder rod below the inner crossmember.

5. Slowly hydraulically power the main lift cylinder back into the crossmember and reinstall the snap ring.

6. Repeat steps 1 through 5 until the skewing has been removed.

Mast Skewing - Repair (Three-Stage Mast Only)

1. Extend the mast to the full lift height.
   - If the mast kicks to the right at the full lift height, a shim(s) (Part No. 200524) needs to be installed to the right-hand main lift cylinder rod.
   - If the mast kicks to the left at the full lift height, a shim(s) (Part No. 200524) needs to be installed to the left-hand main lift cylinder rod.

⚠️ WARNING
The inner upright must be supported by angle iron to avoid possible injury.

2. Place a 6 in. (15 cm) long, 2 X 2 in. (5 X 5 cm) angle iron between the top of the main lift cylinder and the crossmember. Lower the crossmember onto the angle iron. Avoid contacting the cylinder rod seal.

3. Remove the snap ring from the cylinder to be adjusted. Open the lift truck valve to allow the center (free lift) cylinder to fully retract. Tap the main lift cylinder rod down past the crossmember to install the shim.

4. Install the shim(s) to the cylinder rod below the inner crossmember.

5. Slowly hydraulically power the main lift cylinder back into the crossmember and reinstall the snap ring.

6. Repeat steps 1 through 5 until the skewing has been removed.
CHAIN MAINTENANCE

Chains - Inspection and Tension

Each pair of chains has been factory-lubricated using heat and pressure to force the lubricant thoroughly into the chain links. Avoid removal or contamination of this factory applied lubricant. Do not wash, sand blast, etch, steam clean, or paint the chains on initial mast installation.

The chains must be adjusted with equal tension to ensure proper load distribution and mast operation. To determine equal tension, extend the unloaded mast to put the chains under tension. Press the center of a strand of chain with your thumb, then press at the same place on the other chain of the pair. Each chain in a pair should have equal "give". If tension is not equal, adjust the chains as described in MAIN LIFT CHAIN - ADJUSTMENT and FREE LIFT CHAIN - ADJUSTMENT procedures in this manual.

Inspect the chains. If inspection reveals that one strand of a pair of chains requires replacement, both strands of the pair should be replaced.

- Check for rust and corrosion.
- Check for cracked side plates. If you find cracked side plates, replace both strands of chain.
- Check for tight pin joints. If tight pin joints are caused by rust or corrosion, loosen them with SAE 40W oil or penetrating oil. If they cannot be loosened, or if the tight pin joints are caused by bent pins or plates, or by peened plate edge, replace both strands of the chain.
- Check for protruding or turned pins. Replace both strands of the chain if bad pins are found.
- Check for chain side wear. If pins and outside plates show signs of wear, check for misalignment of sheaves, anchors, or other components. Correct the misalignment. If wear is excessive, replace both strands of chain.
- Check for worn, broken, or misaligned chain anchors. Replace or adjust as required.
- Lubricate the full length of the chains with SAE 40W oil or Bowman Heavy Load Red Grease.

Figure 30: CHAIN - INSPECTION
Main Lift Chain - Service

⚠️ WARNING

The intermediate upright must be supported by a block to avoid possible injury or death to personnel (three-stage mast only).

1. Raise the inner upright 3 ft (91 cm). Place a 3 ft (91 cm) block under the carriage on two-stage masts and under the free lift cylinder support casting on three-stage masts.

2. Lower the cylinder support onto the block. The main lift chains should be slack.

3. Remove the cotter pins and pins from the chain anchors. Remove the chains.

4. Inspect the chain anchors for cracks. Replace as required.

5. For reassembly, reverse the above procedures. Adjust the chains as described in MAIN LIFT CHAIN - ADJUSTMENT procedure in this manual.

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Free Lift Chain - Service

⚠️ WARNING

The carriage must be supported by a block to avoid possible injury or death to personnel.

1. Raise the carriage 1 ft (30 cm). Place a 1 ft (30 cm) block under the carriage, then lower the carriage onto the block. The free lift chains should be slack.

2. Remove the cotter pins and pins from the chain anchors. Remove the chains.

3. Inspect the chain anchors for cracks. Replace as required.

4. For reassembly, reverse the above procedures. Adjust the chains as described in FREE LIFT CHAIN - ADJUSTMENT procedure in this manual.
Measuring Chain Stretch

Regular inspection and lubrication of the chains will increase their service life and reduce downtime.

If the chains stretch beyond the recommended amount, they should be replaced in pairs. Chain stretch can be measured with a chain wear scale. Measure the chains according to the instructions printed on the chain wear scale, without a load on the carriage.

- To check the main lift chains, raise the mast until the inner upright starts to extend, putting tension on the chains.
- To check the free lift chains, raise the carriage 1 ft (30 cm) off the ground to put tension on the chains (three-stage mast only).

Figure 33: MEASURING CHAIN STRETCH
Main Lift Chain - Adjustment

The main lift chains should be adjusted so that when the unloaded mast is fully lowered, the uprights and forks are positioned as shown.

1. TILT MAST FULLY BACKWARD
2. CARRIAGE ROLLER
3. FORK
4. CARRIAGE ROLLER MUST NOT EXTEND MORE THAN 1.3 in (33 mm) BELOW THE MAST CHANNEL

Figure 34: FORK HEIGHT

- The tension will be the same on each chain of the chain set. Check tension by pushing on both chains at the same time.
- The chain length will be correct.
- The chains must travel freely through the complete cycle.

1. Put a load equal to 80 to 90% of the capacity load on the forks. Lower the forks as much as possible. Tilt the mast fully backward.

2. Check the amount that the bottom carriage roller extends below the inner channel of the mast. The carriage roller must not extend more than 1.3 in. (33 mm) below the mast channel. If the adjustment is not correct, adjust the chain anchors. Make sure each chain anchor is adjusted the same amount.

3. Remove the load from the forks. Check the clearance of the carriage when the mast is fully extended. The carriage stops must not touch the stop on the top crossmember of the inner weldment. The chains are too tight if the carriage touches the crossmember.

4. Put the mast in a vertical position and lower the carriage completely. If the forks do not just touch the surface, the chains are too tight. If the chains are too tight, adjust the chain anchors. Make sure each anchor is adjusted the same amount.

5. Three-stage mast chain adjustment: Adjust the main lift chains so that the top of the inner weldment is even with the top of the intermediate weldment within +/- 0.06 in. (1.5 mm).

6. Adjust the other chain to achieve equal chain tension. Tighten the nuts together to a torque of 50 to 70 ft-lb (68 to 95 N·m).

7. Raise and lower the mast several times to confirm the adjustments.
Free Lift Chain - Adjustment (Three-Stage mast only)

The main lift chains should be adjusted so that when the unloaded mast is fully lowered, the uprights and forks are positioned as shown.

1. TILT MAST FULLY BACKWARD
2. CARRIAGE ROLLER
3. FORK
4. CARRIAGE ROLLER MUST NOT EXTEND MORE THAN 1.3 in (33 mm) BELOW THE MAST CHANNEL

Figure 36: FORK HEIGHT

- The tension will be the same on each chain of the chain set. Check tension by pushing on both chains at the same time.
- The chain length will be correct.
- The chains must travel freely through the complete cycle.

1. Locate the threaded chain anchors on the front side of the inner upright crossmember on each side of the cylinder. Adjust one chain to achieve the correct upright position when fully lowered.

2. Adjust the other chain to achieve equal chain tension. Tighten the nuts together to a torque of 50 to 70 ft-lb (68 to 95 N·m).

3. Raise and lower the mast several times to confirm the adjustments.

Figure 37: FREE LIFT CHAIN - ADJUSTMENT
CYLINDER MAINTENANCE

Main Lift Cylinder (Mast on Floor) - Removal (Two-Stage and Three-Stage Masts)

⚠️ WARNING
Hydraulic oil can become very hot. Ensure that hydraulic oil has cooled prior to performing this procedure.

⚠️ CAUTION
After removing any hydraulic hoses, allow the hydraulic oil to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminates into the system and damage equipment.

1. Remove the mast assembly from the lift truck. See MAST - REMOVAL procedure in this manual.

2. Lay the mast down on wooden blocks. Position the wooden blocks under the mast upright so the inner upright will be free to move. The carriage must also be positioned between the blocks and free to move.

⚠️ CAUTION
Care must be taken when removing fittings from the main lift cylinders as each fitting holds a compressed spring in place.

3. Disconnect the main lift cylinder supply hoses from the main lift cylinder inlet ports and remove the special long fittings from the main lift cylinder ports. Cap the fittings and plug the supply hoses.

4. Remove the snap rings fastening the main lift cylinder rods to the inner upright (intermediate upright on three-stage masts).

5. Pull the inner upright (intermediate upright on three-stage masts) outward 2 ft (61 cm) from the top of the outer upright to remove the main lift cylinders.

6. Lift the cylinders from the base mount and angle inward to remove through the gap at the top of the uprights.

7. Note the number of shims (if equipped) on each cylinder rod to ensure proper installation.

Figure 38: MAIN LIFT CYLINDER - REMOVE

TWO-STAGE MAST SHOWN
**Main Lift Cylinder (Mast on Floor) - Installation (Two-Stage and Three-Stage Masts)**

**NOTE:** The inner upright (intermediate upright on three-stage masts) must be pulled outward 2 ft (61 cm) from the top of the outer upright to install the main lift cylinders.

1. Install the lift cylinders through the gap at the top of the uprights and onto the base mount.
2. Install shims (if equipped) as recorded during removal procedures.
3. Push the inner upright (intermediate upright on three-stage masts) back onto the outer upright until the main lift cylinders are positioned through the crossmember of the inner upright (intermediate upright on three-stage masts).
4. Install the snap rings that fasten the main lift cylinder rods to the inner upright (intermediate upright on three-stage masts).
5. Remove the caps from the fittings and the plugs from the supply hoses.

**CAUTION**
Care must be taken when installing fittings to the main lift cylinders as each fitting holds a compressed spring in place.

6. Screw the special long fittings into the main lift cylinder ports and connect the main lift cylinder supply hoses to the main lift cylinder inlet ports.

7. Install the mast on the lift truck. See MAST - INSTALLATION procedure in this manual.

**WARNING**
The main lift cylinders must be bled to remove air. Air in the cylinders will compress on the first extension which could rupture the cylinders causing serious bodily injury and property damage.

Free Lift Cylinder (Mast on Floor) - Removal (Three-Stage Mast Only)

⚠️ WARNING
Hydraulic oil can become very hot. Ensure that hydraulic oil has cooled prior to performing this procedure.

⚠️ CAUTION
After removing any hydraulic hoses, allow the hydraulic oil to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminants into the system and damage equipment.

1. Remove the mast assembly from the lift truck. See MAST - REMOVAL procedure in this manual.

2. Place the mast on the floor with wooden blocks positioned under the mast.

3. Move the carriage toward the center of the free lift cylinder to place slack in the chains and the internal reeving hoses (if equipped).

4. Disconnect the supply hose from the free lift cylinder's 45° fitting. Cap the fitting and plug the hose.

5. Remove the chain guards from the crosshead.

6. Remove the snap ring retaining the free lift cylinder rod to the crosshead.

7. Pull the crosshead with the chains and hoses (if equipped) away from the free lift cylinder rod.

8. Remove the free lift cylinder's mount strap.

9. Remove the free lift cylinder from the mast.

Figure 40: FREE LIFT CYLINDER (MAST ON FLOOR) - REMOVE/INSTALL
Free Lift Cylinder (Mast on Floor) - Installation (Three-Stage Mast Only)

1. Position the free lift cylinder on the mast.
2. Secure the mount strap to the free lift cylinder.
3. Install the crosshead with the chains and hoses (if equipped) to the free lift cylinder rod.
4. Install the snap ring that secures the free lift cylinder rod to the crosshead.
5. Install the chain guards to the crosshead.
6. Remove the cap from the free lift cylinder’s 45° fitting and the plug from the supply hose.
7. Connect the supply hose to the free lift cylinder’s 45° fitting.
8. Install the mast on the lift truck. See MAST-INSTALLATION procedure in this manual.

⚠️ WARNING
The free lift cylinders must be bled to remove air. Air in the cylinders will compress on the first extension which could rupture the cylinders causing serious bodily injury and property damage.


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Figure 41: FREE LIFT CYLINDER (MAST ON FLOOR) - REMOVE/INSTALL
Free Lift Cylinder (Mast on Lift Truck) - Removal (Three-Stage Mast Only)

Be careful not to short out battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

⚠️ WARNING
Hydraulic oil can become very hot. Ensure that hydraulic oil has cooled prior to performing this procedure.

⚠️ WARNING
The carriage must be supported by a wooden block while removing the free lift cylinder to avoid possible injury.

⚠️ CAUTION
After removing any hydraulic hoses, allow the hydraulic oil to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminates into the system and damage equipment.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Completely lower the carriage. Remove the forks and attachment (if equipped). Make sure the free lift cylinder is completely retracted. Attach an overhead hoist to the top of the carriage bar.
3. Raise the carriage toward the center of the free lift cylinder to place slack in the chains and the internal reeling hoses (if equipped). Block the carriage in place using a 4 X 4 X 24 in. (10 X 10 X 61 cm) wooden block between the lower carriage bar and the floor.
4. Remove the free lift cylinder mount strap.
5. Remove the chain guards from the crosshead.
6. Remove the snap ring retaining the free lift cylinder rod to the crosshead.
7. Pull the crosshead with the chains and hoses (if equipped) away from the free lift cylinder rod. Lay the chains and hoses (if equipped) over the upper carriage bar.
8. Pry the free lift cylinder up and out of the support casting to gain access to the free lift cylinder hose fitting. Remove the supply hose from the 45° fitting. Cap the fitting and plug the hose.
9. Remove the free lift cylinder from the mast.

Figure 42: FREE LIFT CYLINDER (MAST ON LIFT TRUCK) - REMOVE/INSTALL
Free Lift Cylinder (Mast on Lift Truck) - Installation (Three-Stage Mast Only)

1. Position the free lift cylinder on the mast.

2. Remove the cap from the free lift cylinder's 45° fitting and the plug from the supply hose.

3. Connect the supply hose to the 45° fitting. Seat the free lift cylinder all the way into the support casting.

4. Position the crosshead with the chains and hoses (if equipped) on the free lift cylinder rod.

5. Install the snap ring that secures the free lift cylinder rod to the crosshead.

6. Install the chain guards to the crosshead.

7. Secure the free lift cylinder with the cylinder mount-strap.

8. Remove the wooden block from the carriage.

9. Remove the tag from the battery connector and connect the battery.

**WARNING**
The free lift cylinders must be bled to remove air. Air in the cylinders will compress on the first extension which could rupture the cylinders causing serious bodily injury and property damage.


Figure 43: FREE LIFT CYLINDER (MAST ON LIFT TRUCK) - REMOVE/INSTALL
Tilt Cylinder - Removal

**WARNING**
Be careful not to short out battery terminals. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**
Hydraulic oil can become very hot. Ensure that hydraulic oil has cooled prior to performing this procedure.

**WARNING**
After removing any hydraulic hoses, allow the hydraulic oil to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminates into the system and damage equipment.

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1. Attach a tag on the battery connector stating **DO NOT CONNECT BATTERY**. Disconnect battery.

2. Remove the floor plates. Refer to the COVERS/FLOOR PLATES procedure in the Operator’s Manual.

3. Completely lower the carriage. Remove the forks and attachment (if equipped). Make sure the free lift cylinder is completely retracted (three-stage mast only).

**WARNING**
Make sure the mast is fully lowered before continuing. If a hydraulic hose is opened while the mast is raised, the mast can suddenly lower and cause personal injury or death.

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4. Remove the pressure in the hydraulic system.

5. Have a container available to catch any hydraulic fluid that is in the hydraulic hoses that will be removed.

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6. Remove the hydraulic hoses at the elbow fittings on the tilt cylinder. Cap the fittings and plug the tilt cylinder.

**WARNING**
Before disconnecting the tilt cylinder, tilt the mast forward. Use a chain to hold the mast to the frame, or an overhead hoist secured to the top crossmember, to prevent the bottom of the mast from rolling forward.

7. Remove the capscrews from the upper and lower anchor pins.

**WARNING**
Do not use your fingers to push the pin from the rod end of the tilt cylinder. Unexpected movement of the mast or tilt cylinder may cause injury. Use a punch.

8. Remove the upper and lower anchor pins from the tilt cylinder.

9. Remove the tilt cylinder from the lift truck. Remove the bearings from the mast anchor bracket and the frame mount bracket.

10. Remove the elbow fittings from the tilt cylinder. Note the position of the fittings to ensure proper installation.
Tilt Cylinder - Installation

1. Install elbow fittings into the tilt cylinder as noted during removal procedure.

2. Inspect the anchor pin bearings for damage. If damaged refer to the PARTS MANUAL for replacement parts. Install the bearings into the frame mount bracket and the mast anchor bracket.

3. Attach the base of the tilt cylinder to the frame mount bracket of the lift truck. Carefully install the pin through the bearing in the frame mount bracket. This bearing must be aligned so that the pin can be installed without damaging the bearing.

4. Align the anchor pin with the threaded hole for the cap screw. Install the cap screw and torque to 45 ft-lb (61 N•m).

5. Install the clevis of the tilt cylinder rod to the mast anchor bracket. Carefully install the pin through the clevis and the bearing in the mast anchor bracket. This bearing must be aligned so that the pin can be installed without damaging the bearing.

6. Align the anchor pin with the threaded hole for the cap screw. Install the cap screw and torque to 45 ft-lb (61 N•m).

7. Remove the caps from the elbow fittings and the plugs from the tilt cylinder.

8. Connect the hydraulic hoses to the elbow fittings on the tilt cylinder.

9. Check the level of the hydraulic oil in the hydraulic oil tank and fill as needed.

**WARNING**

The tilt cylinders must be bled to remove air. Air in the cylinders will compress on the first extension which could rupture the cylinders causing serious bodily injury and property damage.


11. Remove the tag from the battery connector and connect the battery.


13. Operate the tilt cylinders. Check for correct operation and possible leaks.
Main Lift Cylinder - Service

1. Remove the main lift cylinder from the mast. See MAIN LIFT CYLINDER - REMOVAL procedure in this manual.

2. Use a claw type spanner wrench to remove the retainer.

NOTE: To service the plunger/piston assembly, refer to CYLINDER PISTON - SERVICE procedure in this manual.

3. Remove the plunger/piston assembly from the shell.

4. Remove the Hydraulic Fuse/Lowering Cushion components.

NOTE: Minor nicks are those that will not bypass oil when under pressure. If they cannot be removed with emery cloth, replace the part.

5. Inspect all components for nicks or burrs. Minor nicks or burrs can be removed with 400 grit emery cloth. If the piston requires replacing, refer to the PARTS MANUAL.
6. Replace the retainer and piston seals, back-up rings, O-rings, and bearing. Lubricate the new seals with petroleum jelly prior to installation. The cylinder will not operate correctly if the seals are installed backwards.

7. 2000 PSI CYLINDERS ONLY - When replacing the piston check valve O-ring, make sure the check valve is reinstalled with the arrow pointed in the correct direction.

8. Install the plunger/piston assembly into the cylinder shell.

9. Install the retainer on the cylinder. Torque the retainer to 95 to 125 ft-lb (129 to 169 N•m).
Free Lift Cylinder - Service (Three-Stage Mast Only)

1. Remove the free lift cylinder from the mast. See FREE LIFT CYLINDER - REMOVAL procedure in this manual.

2. Use a claw type spanner wrench to remove the retainer.

NOTE: To service the plunger/piston assembly, refer to CYLINDER PISTON - SERVICE procedure in this manual.

3. Remove the plunger/piston assembly from the shell.

4. Remove the Hydraulic Fuse/Lowering Cushion components.

NOTE: Minor nicks are those that will not bypass oil when under pressure. If they cannot be removed with emery cloth, replace the part.

5. Inspect all components for nicks or burrs. Minor nicks or burrs can be removed with 400 grit emery cloth. If the piston requires replacing, refer to the PARTS MANUAL.

NOTE: Record the correct seal directions prior to removal to ensure proper installation.

6. Replace the retainer and piston seals, back-up rings, O-rings, and bearing. Lubricate the new seals with petroleum jelly prior to installation. The cylinder will not operate correctly if the seals are installed backwards.

7. When replacing the piston check valve O-ring, make sure the check valve is reinstalled with the arrow pointed in the correct direction.

8. Install the plunger/piston assembly into the cylinder shell.

9. Install the retainer on the cylinder. Torque the retainer to 95 to 125 ft-lb (129 to 169 N•m).

Figure 50: FREE LIFT CYLINDER - SERVICE
Cylinder Piston - Service

NOTE: If replacement parts are needed, refer to the PARTS MANUAL.

1. Remove the plunger/piston assembly from the cylinder shell as described in the FREE LIFT CYLINDER - SERVICE or MAIN LIFT CYLINDER- SERVICE procedures in this manual.

2. Use a strap wrench and 400 grit emery cloth to secure the plunger while turning the piston with a pin type spanner wrench.

3. Turn the piston until the snap wire end is visible through the hole. Use a screwdriver to start the wire end out the hole. Turn the piston to feed the wire out.

4. Pull the piston from the plunger.

NOTE: For reassembly, reverse the removal procedures except as follows:

- Install a new snap wire when installing the piston.

Cylinder Bleeding - Operations

WARNING
The cylinders must be bled to remove air. Air in the cylinders will compress on the first extension which could rupture the cylinders causing serious bodily injury and property damage.

1. Without a load, extend the free lift cylinder and continue to extend the main lift cylinders to 90% of full stroke. Retract all cylinders completely. Repeat three times.

2. Extend the cylinders without a load at 50% full engine speed, then build to full system pressure at the end of the main lift cylinder stroke. Electric trucks - limit the control valve movement to achieve 50% speed. Retract all cylinders. Repeat four times.

3. Cycle the mast with a half load (50% mast rated capacity) through full cylinder extension several times. The cylinders should extend smoothly. Repeat the steps if cylinder extension is not smooth.

Mast Valve Cartridge - Service

1. Completely lower the mast.

2. Remove the supply hose from the valve cartridge. Plug the hose and cap the fitting.

3. Remove the valve cartridge from the mast valve. Note the stamped Part No. on the cartridge for ordering a replacement.

WARNING
Replacing the valve cartridge with a different Part No. cartridge may cause the mast to malfunction.

4. For reassembly, reverse the removal procedures.

Cylinder Hose Tracking - Adjustment

Make sure the cylinder supply hose is not twisted and travels evenly in the hose guide. Check the hose to be sure it is not scuffing. Adjust the hose by loosening the hose connection at the valve and twisting the hose. Tighten the hose end while holding the hose in place. Tension on the hose can be adjusted by using a different set of bracket holes. Use the holes that place a small amount of tension on the hose.
**CARRIAGE MAINTENANCE**

Carriage (Mast on Lift Truck) - Removal (Two-Stage Mast Only)

**WARNING**
Be careful not to short out battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**
Hydraulic oil can become very hot. Ensure that hydraulic oil has cooled prior to performing this procedure.

**CAUTION**
After removing any hydraulic hoses, allow the hydraulic oil to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminates into the system and damage equipment.

1. Attach a tag on the battery connector stating **DO NOT CONNECT BATTERY**. Disconnect battery.

**WARNING**
The inner upright must be supported by a piece of angle iron and the carriage must be supported by a wooden block to avoid possible injury. When installing the angle iron on mast, extra care must be taken to avoid contacting the cylinder rod seal.

2. Raise the mast high enough to install a 6 in. (15 cm) long 2 X 2 in. (5 X 5 cm) piece of angle iron between the top of the main lift cylinder and the crossmember. Avoid contacting the cylinder rod seal. Lower the crossmember onto the angle iron.

3. Attach an overhead hoist to the carriage.

**NOTE:** Record the location of the double nuts on the chain anchors to ensure proper installation.

4. Remove the chain anchor nuts.

5. Disconnect the internal reeving hoses from the carriage fittings (if equipped). Plug the hose ends and cap the fittings.

6. Remove the top carriage side thrust rollers from the carriage.

7. Using the overhead hoist, lower the carriage to the bottom of the mast and remove the carriage.

8. If any load rollers are removed at this time, be sure to record the number of shims behind each load roller to ensure proper installation during assembly.

![Diagram showing the carriage and its components](image-url)

**Figure 53:** CYLINDER SHIM - INSTALL

**Figure 54:** CARRIAGE (MAST ON LIFT TRUCK) - REMOVE/INSTALL (TWO-STAGE MAST)
Carriage (Mast on Lift Truck) - Installation (Two-Stage Mast Only)

1. Perform a thorough inspection of the carriage before reinstalling. See CARRIAGE - INSPECTION procedure in this manual.

2. Lubricate the inner upright rails with chassis lube or Kendall SR-12X.

3. Assemble shims and load rollers on the stub shafts. The shims should be installed to provide a total side-to-side clearance no looser than 1/16 in. (1.6 mm) at the tightest point throughout the travel of the carriage. Use an equal amount of shims side-to-side.

4. Attach a lifting device to the top bar of the carriage.

5. Install the carriage through the bottom of the inner upright. Install lower load rollers.

6. Roll the carriage the full travel of the inner upright channel, checking side play and freedom of movement. If the load roller clearance is still in need of adjustment, refer to Step 3 in this procedure.

7. Install the top carriage side thrust rollers and lubricate all rollers.

8. Adjust the carriage side thrust rollers for unrestricted clearance along the travel of the carriage. The rollers have eccentric mount bases. Tighten the cap screws to a torque of 70 to 80 ft-lb (95 to 108 N•m).

Figure 55: THRUST ROLLERS

NOTE: A cotter pin removal tool can be used to adjust the side thrust rollers. Turn the side thrust rollers toward the upright to decrease clearance.

Figure 56: CARRIAGE (MAST ON LIFT TRUCK) - REMOVE/INSTALL (TWO-STAGE MAST)

⚠️ CAUTION

The chain anchor nuts should be replaced each time they are removed from the mast assembly. Failure to comply may result in damage to equipment.

9. Install carriage chain anchors and hoist chains to the carriage.

10. Remove the cap from the fitting and the plug from the hose (if needed).

11. Connect the internal reeving hoses from the carriage fittings (if equipped).

12. Check and adjust the main lift chains as needed. See MAIN LIFT CHAIN - ADJUSTMENT procedure in this manual.

13. Remove the tag from the battery connector and connect the battery.
Carriage (Mast on Lift Truck) - Removal (Three-Stage Mast Only)

**WARNING**
Be careful not to short out battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**
Hydraulic oil can become very hot. Ensure that hydraulic oil has cooled prior to performing this procedure.

**CAUTION**
After removing any hydraulic hoses, allow the hydraulic oil to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminants into the system and damage equipment.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Raise the mast high enough to place a 20 in. (50 cm) long, 4 X 4 in. (10 X 10 cm) wooden block between the intermediate upright's lower crossmember and the ground. Lower the carriage to be even with the bottom of the inner upright.
3. Attach an overhead hoist to the carriage. Raise the carriage to loosen the carriage chains.

**NOTE:** Record the location of the double nuts on the chain anchors to ensure proper installation.

4. Remove the chain anchor nuts.
5. Disconnect the internal reeving hoses from the carriage fittings (if equipped). Plug the hose ends and cap the fittings.
6. Using the overhead hoist, lower the carriage to the bottom of the mast and remove the carriage.
7. If any load rollers are removed at this time, be sure to record the number of shims behind each load roller to ensure proper installation during assembly.

Figure 57: CARRIAGE (MAST ON LIFT TRUCK) - REMOVE/INSTALL (THREE-STAGE MAST)
Carriage (Mast on Lift Truck) - Installation (Three-Stage Mast Only)

1. Perform a thorough inspection of the carriage before reinstalling. See CARRIAGE - INSPECTION procedure in this manual.

2. Lubricate the inner upright rails with chassis lube or Kendall SR-12X.

3. Assemble shims and load rollers on the stub shafts. The shims should be installed to provide a total side-to-side clearance no looser than 1/16 in. (1.6 mm) at the tightest point throughout the travel of the carriage. Use an equal amount of shims side-to-side.

4. Attach a lifting device to the top bar of the carriage.

5. Install the carriage through the bottom of the inner upright. Install lower load rollers.

6. Roll the carriage the full travel of the inner upright channel, checking side play and freedom of movement. If the load roller clearance is still in need of adjustment, refer to Step 3 in this procedure.

7. Install the top carriage side thrust rollers and lubricate all rollers.

8. Adjust the carriage side thrust rollers for unrestricted clearance along the travel of the carriage. The rollers have eccentric mount bases. Tighten the capscrews to a torque of 70 to 80 ft-lb (95 to 108 N·m).

9. Install carriage chain anchors and hoist chains to the carriage.

10. Remove the cap from the fitting and the plug from the hose (if needed).

11. Connect the internal reeving hoses from the carriage fittings (if equipped).

12. Check and adjust the main lift chains and free lift chains as needed. See MAIN LIFT CHAIN - ADJUSTMENT and FREE LIFT CHAIN - ADJUSTMENT procedures in this manual.

13. Remove the tag from the battery connector and connect the battery.

NOTE: A cotter pin removal tool can be used to adjust the side thrust rollers. Turn the side thrust rollers toward the upright to decrease clearance.

CAUTION
The chain anchor nuts should be replaced each time they are removed from the mast assembly. Failure to comply may result in damage to equipment.
Carriage (Mast on Floor) - Removal (Two-Stage Mast Only)

**WARNING**
Hydraulic oil can become very hot. Ensure that hydraulic oil has cooled prior to performing this procedure.

**CAUTION**
After removing any hydraulic hoses, allow the hydraulic oil to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminates into the system and damage equipment.

1. Remove the mast assembly from the lift truck. See MAST - REMOVAL procedure in this manual.
2. Position carriage midway on mast.

**NOTE:** Record the location of the double nuts on the chain anchors to ensure proper installation.

3. Remove the snap rings fastening the chain anchors to the carriage. Remove the chain anchors.
4. Disconnect the internal reeving bulkhead fittings from the carriage (if equipped). Cap the fitting ends.
5. Remove the top side thrust rollers from the carriage.
6. Roll the carriage to the bottom of the mast.

**NOTE:** Record the number of shims behind each load roller for proper installation during assembly.

7. Attach an overhead hoist to the carriage fork bars. Remove the lower load rollers from the carriage.
8. Remove the carriage by pulling upward to clear the crossmember, then pull out.

![Figure 60: LIFTING DEVICE CONNECTION](image-url)

![Figure 61: CARRIAGE (MAST ON FLOOR) - REMOVE/INSTALL (TWO-STAGE MAST)](image-url)
Carriage (Mast on Floor) - Installation (Two-Stage Mast Only)

1. Perform a thorough inspection of the carriage before reinstalling. See CARRIAGE - INSPECTION procedure in this manual.

2. Lubricate the inner upright rails with chassis lube or Kendall SR-12X.

3. Assemble shims and load rollers on the stub shafts. The shims should be installed to provide a total side-to-side clearance no looser than 1/16 in. (1.6 mm) at the tightest point throughout the travel of the carriage. Use an equal amount of shims side-to-side.

4. With an overhead hoist, install the carriage through the bottom of the inner upright. Install the lower load rollers.

5. Roll the carriage the full travel of the inner upright channel checking side play and freedom of movement. Adjust the load roller clearance as specified in Step 3.

6. Install the top carriage side thrust rollers and lubricate all rollers.

NOTE: A cotter pin removal tool can be used to adjust the side thrust rollers. Turn the side thrust rollers toward the upright to decrease clearance.

7. Adjust the carriage side thrust rollers for unrestricted clearance along the travel of the carriage. The rollers have eccentric mount bases. Turn the base of the roller toward the upright rail to decrease clearance. Tighten the cap screws to a torque of 70 to 80 ft-lb (95 to 108 N•m).

8. Install carriage chain anchors and main lift chains to the carriage.

9. Remove the cap from the fitting and the plug from the hose (if needed).

10. Install internal reeving bulkhead fittings and hoses (if equipped) to carriage.

11. Check and adjust the main lift chains as needed. See MAIN LIFT CHAIN - ADJUSTMENT procedure in this manual.
Carriage (Mast on Floor) - Removal (Three-Stage Mast Only)

⚠️ WARNING
Hydraulic oil can become very hot. Ensure that hydraulic oil has cooled prior to performing this procedure.

⚠️ CAUTION
After removing any hydraulic hoses, allow the hydraulic oil to drain into a container and then cap and plug the hose and component that the hose was removed from. Failure to properly cap and plug the openings may allow contaminants into the system and damage equipment.

1. Remove the mast assembly from the lift truck. See MAST - REMOVAL procedure in this manual.

NOTE: Record the location of the double nuts on the chain anchors to ensure proper installation.

2. Remove the chain anchor nuts.
3. Disconnect the internal reeving bulkhead fittings from the carriage (if equipped). Cap the fitting ends.
4. Roll the carriage to the bottom of the mast.

NOTE: Record the number of shims behind each load roller for proper installation during assembly.

5. Attach an overhead hoist to the carriage fork bars. Remove the lower load rollers from the carriage.
6. Remove the carriage by pulling upward to clear the crossmember, then pull out

Figure 64: CARRIAGE (MAST ON FLOOR) - REMOVE/INSTALL (THREE-STAGE MAST)
Carriage (Mast on Floor) - Installation (Three-Stage Mast Only)

1. Perform a thorough inspection of the carriage before reinstalling. See CARRIAGE - INSPECTION procedure in this manual.

2. Lubricate the inner upright rails with chassis lube or Kendall SR-12X.

3. Assemble shims and load rollers on the stub shafts. The shims should be installed to provide a total side-to-side clearance no looser than 1/16 in. (1.6 mm) at the tightest point throughout the travel of the carriage. Use an equal amount of shims side-to-side.

4. With an overhead hoist, install the carriage through the bottom of the inner upright. Install the lower load rollers.

5. Roll the carriage the full travel of the inner upright channel checking side play and freedom of movement. Adjust the load roller clearance as specified in Step 3.

6. Install the top carriage side thrust rollers and lubricate all rollers.

NOTE: A cotter pin removal tool can be used to adjust the side thrust rollers. Turn the side thrust rollers toward the upright to decrease clearance.

7. Adjust the carriage side thrust rollers for unrestricted clearance along the travel of the carriage. The rollers have eccentric mount bases. Turn the base of the roller toward the upright rail to decrease clearance. Tighten the cap-screws to a torque of 70 to 80 ft-lb (95 to 110 N\(\cdot\)m).

CAUTION
The chain anchor nuts should be replaced each time they are removed from the mast assembly. Failure to comply may result in damage to equipment.

8. Install carriage chain anchors and hoist chains to the carriage.

9. Install internal reeving bulkhead fittings and hoses (if equipped) to carriage.

10. Check and adjust the main lift chains as needed. See MAIN LIFT CHAIN - ADJUSTMENT and FREE LIFT CHAIN - ADJUSTMENT procedures in this manual.
Carriage - Inspection
1. Inspect the rollers for excessive wear or damage. Rollers with visible flat spots or cracks should be replaced.
2. Inspect the roller bearings by turning the rollers on their shafts. Rollers with roughness or noticeable restrictions to turning should be replaced.
3. Inspect all welds between the carriage side plates and the carriage fork bars. If any welds are cracked, replace the carriage.
4. Inspect the roller stub shafts. If they are damaged or if there are cracks at the base of the stub shafts, the carriage must be replaced or repaired.

Figure 67: CARRIAGE - INSPECTION (TWO-STAGE MAST)
Figure 68: CARRIAGE - INSPECTION (THREE-STAGE MAST)
MAST TROUBLESHOOTING

The following table lists problems that may be encountered with the mast, the probable causes, and recommended corrective action that should be taken to restore the mast to normal operating condition.

⚠️ WARNING
Extreme care should be used when working on a unit when the carriage (with or without a load) is in the raised position.

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>PROBABLE CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYLINDERS DO NOT LIFT LOAD OR WILL NOT MOVE: EMPTY</td>
<td>a) Plugged inlet hose.</td>
<td>a) Unplug hose or replace.</td>
</tr>
<tr>
<td></td>
<td>b) Insufficient oil.</td>
<td>b) Check the truck hydraulic system for correct oil level in tank, defective pump or pump drive, leaks in the lines, or disconnect control valve linkage. Repair or replace as necessary.</td>
</tr>
<tr>
<td></td>
<td>c) Bent or jammed plunger.</td>
<td>c) Repair or replace as necessary.</td>
</tr>
<tr>
<td>CYLINDERS DO NOT LIFT LOAD OR WILL NOT MOVE: LOADED</td>
<td>a) Plugged piston check valve.</td>
<td>a) Unplug check valve or replace.</td>
</tr>
<tr>
<td></td>
<td>b) Truck relief valve setting low.</td>
<td>b) Raise truck relief setting to specified level.</td>
</tr>
<tr>
<td></td>
<td>c) Over capacity.</td>
<td>c) Reduce load to specified capacity.</td>
</tr>
<tr>
<td></td>
<td>d) Mechanical bind due to bent plunger or bad rollers.</td>
<td>d) Remove mechanical bind by replacing/freeing plunger and rollers.</td>
</tr>
<tr>
<td>CYLINDERS DRIFT</td>
<td>a) External leak in pressure line.</td>
<td>a) Tighten or replace as necessary.</td>
</tr>
<tr>
<td></td>
<td>b) Truck valve defective-cycle to full lift height to verify.</td>
<td>b) Repair or replace truck valve.</td>
</tr>
<tr>
<td></td>
<td>c) External leaks at retainer.</td>
<td>c) Replace all cylinder seals.</td>
</tr>
<tr>
<td></td>
<td>d) Piston check valve leaking.</td>
<td>d) Replace check valve.</td>
</tr>
<tr>
<td>SPONGY OR JERKY ACTION</td>
<td>a) Sticky or defective truck relief valve.</td>
<td>a) Remove and check the truck relief valve. If contaminated oil caused the malfunction, drain and flush the system, change the filter, and refill with fresh oil.</td>
</tr>
<tr>
<td></td>
<td>b) Bent or damaged cylinder plunger.</td>
<td>b) Disassemble, check, and repair cylinder assembly.</td>
</tr>
<tr>
<td></td>
<td>c) Load rollers not properly adjusted or defective.</td>
<td>c) Adjust or repair as necessary.</td>
</tr>
<tr>
<td></td>
<td>d) Mast channels improperly lubricated.</td>
<td>d) Lubricate mast.</td>
</tr>
<tr>
<td></td>
<td>e) Low battery charge.</td>
<td>e) Charge battery.</td>
</tr>
<tr>
<td></td>
<td>f) Low pump volume.</td>
<td>f) Install accumulator.</td>
</tr>
<tr>
<td></td>
<td>g) Low oil level.</td>
<td>g) Fill oil reservoir.</td>
</tr>
<tr>
<td></td>
<td>h) Insufficient hydraulic tank capacity or baffles.</td>
<td>h) Install larger tank baffles.</td>
</tr>
</tbody>
</table>
This section has a description and the service procedures for the parts of the frame. These parts include the overhead guard, counterweight assembly, ring bearing, bumper, battery cover assembly, carrier arm assemblies, seat assembly, cowl, grounding straps, and positions for safety labels.

There are two separate sections that make up the frame: the main frame weldment and rear frame weldment, which are fastened together with a single ring bearing.

The main section of the frame is a single weldment with mounts for the overhead guard, mast, bumper, cowl, floor plates, battery, battery cover, hydraulic components, front grounding strap, and the front Omni-Directional™ Drive components.

The rear section of the frame is a box-shaped single weldment with mounts for the rear ground strap, counterweight assembly, and rear Omni-Directional™ Drive components.

Holes have been established in the frame weldment for mounting all the necessary components. There are several existing holes in the frame that are pre-tapped to make certain maintenance procedures easier to perform.

Figure 1: FRAME WELDMENTS
DESCRIPTION

Overhead Guard

The overhead guard is a safety device that helps protect the driver from serious injury in the event of a tip-over and from falling debris. The lift truck should never be utilized for service without the overhead guard installed. The overhead guard does not have to be removed for any normal maintenance, but will have to be removed to remove the front traction components and in some special cases. A slot in the overhead guard permits removal of the battery without removing the overhead guard.

Counterweight System

The weight of the battery is the main part of the counterweight system on the lift truck. The lift truck also has a cast-iron counterweight assembly which fastens to the back of the rear frame weldment and has the weight necessary for the indicated capacity located on the dash nameplate.

Hydraulic Components

All hydraulic components are mounted to the left side of the frame which simplifies maintenance procedures. The hydraulic components can be accessed by removing the rear and left-side covers.

Battery Cover

The battery cover is an assembly that contains the seat assembly and the carrier arm assemblies for both traction and hydraulic operations of the lift truck. The battery cover is mounted to a large plate that acts as a battery restraint in the event of a tip-over. The battery cover can be opened for access with a latch and is held in the open position with gas shocks.

Omni-Directional™ Drive Components

The Omni-Directional™ Drive components are secured directly to the frame weldment and can be accessed through the rear cover and the floor plates.

Mast

There are four mounts welded to the main section of the frame for securing the mast assembly. The bottom mounts are used for securing the main mast assembly and the top mounts secure the tilt cylinders.
MAINTENANCE PROCEDURES

Overhead Guard - Removal

⚠️ WARNING Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

⚠️ WARNING The overhead guard is a safety device. The lift truck should never be utilized for service without the overhead guard installed. Failure to comply may result in injury or death to personnel.

NOTE: The overhead guard does not have to be removed for any normal maintenance, but will have to be removed to access the front drive motors, front transaxles, and in some other cases.

NOTE: If any optional lights are attached, tag and mark all wire connections prior to removal.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Disconnect the wiring connections (if equipped) to the overhead guard.
4. Remove two capscrews, washers, lock washers, and nuts that fasten the overhead guard to both sides of the cowl.

⚠️ WARNING Make sure that the battery cover is in the closed position before proceeding. Failure to comply may result in damage to equipment or injury to personnel.

5. Remove two capscrews and spacers from the overhead guard and hinge sideplates.
6. Attach a suitable lifting device to the overhead guard.
7. Remove two capscrews and lock washers from the front supports, lower cowl, and the lift truck frame.
8. Remove two capscrews and lock washers that secure the rear supports of the overhead guard to the lift truck frame.
9. Using the lifting device, remove the overhead guard from the lift truck frame.

Figure 3: OVERHEAD GUARD - REMOVE/INSTALL

Overhead Guard - Installation

⚠️ WARNING The overhead guard is a safety device. The lift truck should never be utilized for service without the overhead guard installed. Failure to comply may result in injury or death to personnel.

1. Attach a suitable lifting device to the overhead guard.
2. Using the lifting device, install the overhead guard. Align the front and rear supports of the overhead guard to the lift truck frame.
3. Apply Loctite 242 to all six mounting capscrews for the overhead guard.
4. Install two capscrews and lock washers to the rear supports of the overhead guard and the lift truck frame. Torque two capscrews to 88 ft-lb (119 N•m).
5. Install two capscrews and lock washers to the front supports of the overhead guard, the cowl, and the lift truck frame. Torque two capscrews to 88 ft-lb (119 N•m).
6. Remove the lifting device from the overhead guard.
7. Secure the hinge sideplates to the overhead guard with two capscrews and spacers. Be sure to install the spacers through the holes in the hinge sideplates and hand-tighten the capscrews at this time.
Extreme care should be taken when accessing the battery as the cover has several pinch points. Failure to comply may result in injury to personnel.

8. Check the operation of the battery cover at this time to confirm that it opens and closes properly. Torque two capscrews to 88 ft-lb (119 N•m).

9. Secure the overhead guard to both sides of the cowl with two capscrews, washers, lock washers, and nuts. Torque two capscrews to 35 ft-lb (47 N•m).

10. Install the floor plates on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator’s Manual.

11. Connect wiring connections (if equipped) to overhead guard as marked during removal procedure.

12. Remove the tag from the battery connector and connect the battery.

Counterweight - Removal

WARNING
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

WARNING
Exercise extreme care when removing and installing the counterweight. The counterweight is very heavy and the weight is not well-distributed due to the shape of the counterweight. Failure to comply may result in serious injury or death to personnel.

WARNING
Do not operate the lift truck if the capscrews for the counterweight are not installed. When the capscrews are removed, the counterweight can fall from the lift truck.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

2. Place the lift truck on blocks. See HOW TO PUT A LIFT TRUCK ON BLOCKS procedure in this manual.

3. Remove the rear cover from the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator’s Manual.

NOTE: The right rear transaxle assembly must be removed to gain access to the right counterweight mount capscrew.

4. Remove the right rear transaxle assembly before proceeding. See TRANSAXLE ASSEMBLY - REMOVAL procedure in this manual.

5. Install a lifting strap around the counterweight and attach a suitable lifting device to the lifting strap.

6. Remove three capscrews and lock washers from the lift truck frame and the counterweight.

NOTE: Some assistance will be required to pry the counterweight from the attachment points on the lift truck frame.

7. Carefully remove the counterweight by sliding the counterweight out of the lift truck frame and lifting away from the lift truck.

Figure 4: COUNTERWEIGHT - REMOVE/INSTALL
Counterweight - Installation

⚠️ WARNING
Exercise extreme care when removing and installing the counterweight. The counterweight is very heavy and the weight is not well-distributed due to the shape of the counterweight. Failure to comply may result in serious injury or death to personnel.

⚠️ WARNING
Do not operate the lift truck if the capscrews for the counterweight are not installed. When the capscrews are removed, the counterweight can fall from the lift truck.

1. Install a lifting strap around the counterweight and attach a suitable lifting device to the lifting strap.

NOTE: Some assistance will be required to engage the attachment points on the lift truck frame.

2. Carefully install the counterweight into the lift truck frame by aligning the counterweight with the opening in the lift truck frame and sliding the counterweight into the lift truck frame until the mounting holes are lined up.

3. Install three capscrews and lock washers into the lift truck frame and counterweight. Torque three capscrews to 320 ft-lb (434 N·m).

4. Remove the lifting device and strap from the counterweight.

5. Install the right rear transaxle assembly before proceeding. See TRANSAXLE ASSEMBLY - INSTALL procedure in this manual.

6. Install the rear cover on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator’s Manual.

7. Remove the blocks from under the lift truck.

8. Remove the tag from the battery connector and connect the battery.

Figure 5: COUNTERWEIGHT - REMOVE/INSTALL
Bumper - Removal

⚠️ WARNING

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Install a lifting strap around the bumper and attach a suitable lifting device to the lifting strap.
3. Remove two capscrews and lock washers from the lift truck frame and the bumper.
4. With the aid of the lifting device, remove the bumper from the lift truck frame.

Bumper - Installation

1. Install a lifting strap around the bumper and attach a suitable lifting device to the lifting strap.
2. With the aid of an assistant, position the bumper on the lift truck frame, and align the mounting holes.
3. Install two capscrews and lock washers through the lift truck frame and into the bumper. Torque two capscrews to 320 ft-lb (434 N•m).
4. Remove the tag from the battery connector and connect the battery.

Figure 6: BUMPER - REMOVE/INSTALL
Dash Cover - Removal

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating **DO NOT CONNECT BATTERY.** Disconnect battery.
2. Tag and mark all wiring prior to removal to ensure proper installation.
3. Remove the key switch from the dash cover. See **KEY SWITCH - REMOVAL** procedure in this manual.
4. Remove the dash display from the dash cover. See **DASH DISPLAY - REMOVAL** procedure in this manual.
5. Disconnect the wire connectors from both light switches (if equipped).
6. Remove two screws, washers, lock washers, and nuts from the dash cover and the cowl.
7. Lift the dash cover off the cowl and remove the dash cover from the lift truck.

**NOTE:** If no optional light switches are mounted on the dash, then two plugs will be mounted in the dash cover.

8. Remove two light switches or two plugs from the dash cover.

**Dash Cover - Installation**

**NOTE:** If a new dash cover is being installed, ensure the nameplate is removed from the old dash cover and installed on the new dash cover prior to installing the dash cover.

1. Install two light switches or two plugs to the dash cover.
2. Position the dash cover onto the cowl and align the mounting holes.
3. Install and secure two screws, washers, lock washers, and nuts to the dash cover and the cowl.
4. Connect the wire connectors to both light switches (if equipped) as marked during removal.
5. Install the dash display on the dash cover. See **DASH DISPLAY - INSTALLATION** procedure in this manual.
6. Install the key switch on the dash cover. See **KEY SWITCH - INSTALLATION** procedure in this manual.
7. Remove the tag from the battery connector and connect the battery.

---

**Figure 7: DASH COVER - REMOVE/INSTALL**
Cowl - Removal

A WARNING

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Remove the floor plates from the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator’s Manual.
3. Remove the horn from the cowl. See HORN REMOVAL procedure in this manual.
4. Remove the dash cover from the cowl. See DASH COVER - REMOVAL procedure in this manual.
5. Remove two capscrews, washers, lock washers, and nuts from the overhead guard and the cowl.
6. Remove two screws and lock washers from the cowl, the lift truck frame, and the overhead guard.
7. With the aid of an assistant, carefully slide the cowl straight up and off the lift truck.

Cowl - Installation

NOTE: There are two retainer nuts on the bottom of the cowl that are used for securing the floor plate. If a new cowl is being installed, the two retainer nuts need to be removed from the old cowl and installed on the new cowl.

1. With the aid of an assistant, lower the cowl into place on the lift truck and align the mounting holes.
2. Apply Loctite 242 to the threads of two screws and two capscrews.
3. Install two screws and lock washers to the cowl, the lift truck frame, and the overhead guard.
4. Install two capscrews, washers, lock washers, and nuts to the overhead guard and the cowl.
5. Install the dash cover on the cowl. See DASH COVER - INSTALLATION procedure in this manual.
6. Install the horn on the cowl. See HORN - INSTALLATION procedure in this manual.
7. Install the floor plates on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator’s Manual.
8. Remove the tag from the battery connector and connect the battery.

Figure 8: COWL - REMOVE/INSTALL
Seat Assembly - Removal

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**

If the battery is mounted in the lift truck, place a piece of cardboard or rubber over the battery to shield the battery from falling objects while working with the battery cover in the open position.

**WARNING**

When working around battery cover, keep fingers clear of pinch points. Failure to comply may result in injury to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Secure the battery cover in the open position.
3. Remove four nuts, lock washers, and washers retaining the seat assembly to the battery cover frame weldment.
4. Pull the seat assembly from the battery cover and lay the seat straight down on the rear cover of the lift truck.
5. Disconnect the wire connector to the seat pressure switch.
6. Remove the seat assembly from the lift truck.

Seat Assembly - Installation

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**

If the battery is mounted in the lift truck, place a piece of cardboard or rubber over the battery to shield the battery from falling objects while working with the battery cover in the open position.

**WARNING**

When working around battery cover, keep fingers clear of pinch points. Failure to comply may result in injury to personnel.

1. Secure the battery cover in the open position.
2. Position the seat assembly so the seat back is resting on the rear cover of the lift truck and the bottom is facing the battery cover.
3. Connect the seat pressure switch wire connector.
4. Align the seat assembly with the mount holes in the battery cover.
5. Install four nuts, lock washers, and washers to the seat assembly and battery cover frame weldment. Torque four nuts to 20 ft-lb (27 N·m).
6. Remove the tag from the battery connector and connect the battery.
Latch Assembly - Removal

**WARNING**
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**
If the battery is mounted in the lift truck, place a piece of cardboard or rubber over the battery to shield the battery from falling objects while working with the battery cover in the open position.

**WARNING**
When working around battery cover, keep fingers clear of pinch points. Failure to comply may result in injury to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Secure the battery cover in the open position.
3. Unscrew and remove the knob from the latch assembly.
4. Remove two nuts, washers, lock washers, and cap screws from the battery cover frame weldment and latch assembly. Remove the latch assembly.

Latch Assembly - Installation

**WARNING**
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**
If the battery is mounted in the lift truck, place a piece of cardboard or rubber over the battery to shield the battery from falling objects while working with the battery cover in the open position.

**WARNING**
When working around battery cover, keep fingers clear of pinch points. Failure to comply may result in injury to personnel.

1. Secure the battery cover in the open position.
2. Align the latch assembly on the battery cover frame weldment.
3. Secure the latch assembly with two capscrews, washers, lock washers, and nuts.
4. Place the battery cover in the closed position.
5. Screw the knob on the latch assembly and confirm that the latch assembly is functioning properly.
6. Remove the tag from the battery connector and connect the battery.

Figure 10: LATCH ASSEMBLY - REMOVE/INSTALL
Gas Shocks - Removal

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**

If the battery is mounted in the lift truck, place a piece of cardboard or rubber over the battery to shield the battery from falling objects while working with the battery cover in the open position.

**WARNING**

When working around battery cover, keep fingers clear of pinch points. Failure to comply may result in injury to personnel.

Gas Shocks - Installation

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**

If the battery is mounted in the lift truck, place a piece of cardboard or rubber over the battery to shield the battery from falling objects while working with the battery cover in the open position.

**WARNING**

When working around battery cover, keep fingers clear of pinch points. Failure to comply may result in injury to personnel.

1. Secure the battery cover in the open position.
2. Align the gas shock on the mount holes and snap the ends into place on the battery cover frame weldment and the lift truck frame.
3. Ensure that the gas shocks hold the battery cover in the opened position.
4. Secure the battery cover in the closed position.
5. Remove the tag from the battery connector and connect the battery.

---

**Figure 11: GAS SHOCKS - REMOVE/INSTALL**

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. The gas shocks hold the battery cover in the upright position. Secure the battery cover in the open position with some other means prior to removing either of the gas shocks.
3. Use a screwdriver and a pair of pliers to remove the retainer rings that mount the two ends of the gas shock to the battery cover frame weldment and the lift truck frame.
4. Remove the gas shock from the lift truck.
Battery Cover - Removal

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**

If the battery is mounted in the lift truck, place a piece of cardboard or rubber over the battery to shield the battery from falling objects while working with the battery cover open.

**WARNING**

When working around battery cover keep fingers clear of pinch points. Failure to comply may result in injury to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Secure the battery cover in the open position.

3. Tag and mark all wiring prior to removal to ensure proper installation.
4. Disconnect the wire connectors from the right-side carrier arm assembly.
5. Remove two capscrews and lock washers from the battery cover frame weldment and the right-side carrier arm assembly.
6. Carefully remove the right-side carrier arm assembly by lifting it from the battery cover and guiding the wiring through the hole in the battery cover.
7. Disconnect the wire connectors from the left-side carrier arm assembly.
8. Remove two capscrews and lock washers from the battery cover frame weldment and the left-side carrier arm assembly.
9. Carefully remove the left-side carrier arm assembly by lifting it from the battery cover and guiding the wiring through the hole in the battery cover.

10. Remove four nuts, lock washers, and washers retaining the seat assembly to the battery cover frame weldment.
11. Pull the seat assembly from the battery cover and lay the seat straight down on the rear cover of the lift truck.
12. Disconnect the wire connector to the seat pressure switch.
13. Remove the seat assembly from the lift truck.
14. Unscrew and remove the knob from the battery cover latch assembly.

15. Remove three capscrews, washers, lock washers, and nuts from the battery cover and battery cover frame weldment.

16. Remove the battery cover from the lift truck.

**Battery Cover - Installation**

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**

If the battery is mounted in the lift truck, place a piece of cardboard or rubber over the battery to shield the battery from falling objects while working with the battery cover in the open position.

1. Position the battery cover on the lift truck.

2. Secure the battery cover to the battery cover weldment with three capscrews, washers, lock washers, and nuts.

3. Install the knob on the battery cover latch assembly.

**WARNING**

When working around battery cover, keep fingers clear of pinch points. Failure to comply may result in injury to personnel.

**NOTE:** There are safety labels that are required to be attached to the battery cover. If a new battery cover is being installed, refer to the PARTS MANUAL for location and part numbers.

4. Position the seat assembly so the seat back is resting on the rear cover of the lift truck and the bottom is facing the battery cover.

5. Connect the seat pressure switch wire connector.

6. Align the seat assembly with the mount holes in the battery cover.

7. Install four nuts, lock washers, and washers to the seat assembly and battery cover frame weldment. Torque four nuts to 20 ft-lb (27 N·m).
8. Position the left-side carrier arm assembly on the battery cover and guide the wiring through the hole in the battery cover and battery cover frame weldment.

9. Secure the left-side carrier arm assembly to the battery cover frame weldment with two capscrews and lock washers.

10. Connect the wire connectors for the left-side carrier arm assembly as marked during the removal procedure.

11. Position the right-side carrier arm assembly on the battery cover and guide the wiring through the hole in the battery cover and battery cover frame weldment.

12. Secure the right-side carrier arm assembly to the battery cover frame weldment with two capscrews and lock washers.

13. Connect the wire connectors for the right-side carrier arm assembly as marked during the removal procedure.

14. Place the battery cover in the closed position.

15. Remove the tag from the battery connector and connect the battery.

16. Test drive the lift truck and check the operation of the controls.

---

**Battery Cover Frame Weldment - Removal**

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**

If the battery is mounted in the lift truck, place a piece of cardboard or rubber over the battery to shield the battery from falling objects while working with the battery cover in the open position.

**WARNING**

When working around battery cover keep fingers clear of pinch points. Failure to comply may result in injury to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

2. Remove the battery cover. See BATTERY COVER - REMOVAL procedure in this manual.

3. Remove two gas shocks from the battery cover frame weldment. See GAS SHOCK - REMOVAL procedure in this manual.

4. Position the battery cover frame weldment in the closed position.

5. Remove two screws and spacers from the hinge side plates and overhead guard.

6. Lift the battery cover frame weldment from the lift truck.
Battery Cover Frame Weldment - Installation

**WARNING**
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

**WARNING**
If the battery is mounted in the lift truck, place a piece of cardboard or rubber over the battery to shield the battery from falling objects while working with the battery cover in the open position.

**WARNING**
When working around battery cover, keep fingers clear of pinch points. Failure to comply may result in injury to personnel.

**NOTE:** If a new battery cover frame weldment is being installed, be sure to remove the latch assembly and hinge sideplates from the old battery cover frame weldment and install them on the new battery cover frame weldment.

1. Position the battery cover frame weldment on the lift truck in the closed position.

**NOTE:** When installing the spacers on the hinge sideplates, be sure to position the spacers in the holes of the hinge side plates.

2. Align the hinge side plates to the overhead guard and secure the hinge side plates with two screws and spacers.

3. Install two gas shocks to the battery cover frame weldment. See GAS SHOCK - INSTALLATION procedure in this manual.

4. Operate the battery cover frame weldment several times to confirm that the battery cover frame weldment lines up properly and the latch assembly is functioning correctly.

5. If adjustment of the battery cover frame weldment is needed, loosen the four hinge side plate mounting cap screws, align the battery cover frame weldment, and retighten the four cap screws.

6. Install the battery cover. See BATTERY COVER - INSTALLATION procedure in this manual.

7. Remove the tag from the battery connector and connect the battery.

8. Test drive the lift truck and check the operation of the controls.

---

**Figure 17: BATTERY COVER FRAME WELDMENT - REMOVE/INSTALL**
Carrier Arm Assembly - Removal

⚠️ WARNING
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

⚠️ WARNING
If the battery is mounted in the lift truck, place a piece of cardboard or rubber over the battery to shield the battery from falling objects while working with the battery cover in the open position.

⚠️ WARNING
When working around battery cover, keep fingers clear of pinch points. Failure to comply may result in injury to personnel.

NOTE: The left-side carrier arm assembly is referenced in this procedure.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.

2. Remove the hydraulic joystick from the left-side carrier arm assembly. See HYDRAULIC JOYSTICK - REMOVAL procedure in this manual. To remove the right-side carrier arm assembly, remove the traction joystick in Step 2 instead of the hydraulic joystick. See TRACTION JOYSTICK - REMOVAL procedure in this manual.

3. Secure the battery cover in the open position.

4. Remove two capscrews and lock washers from the battery cover frame weldment and the left-side carrier arm assembly.

5. Carefully remove the left-side carrier arm assembly by lifting the left-side carrier arm assembly from the battery cover and guiding the wiring harness out of the carrier arm assembly.

NOTE: If removing the right-side carrier arm assembly, the emergency cut-out switch must be removed at this time. See EMERGENCY CUT-OUT SWITCH - REMOVAL procedure in this manual.

Figure 18: CARRIER ARM ASSEMBLY - REMOVE/INSTALL
Left-Side Carrier Arm - Disassemble

NOTE: For micro switch removal, see the MICRO SWITCH - REMOVAL procedure in this manual.

1. Remove the left-side carrier arm assembly from the battery cover. See CARRIER ARM ASSEMBLY - REMOVAL procedure in this manual.

2. Place the left-side carrier arm assembly on a clean and dry work surface.

3. Remove the arm rest adjustment knob and slide the arm rest from the carrier arm weldment.

4. Remove two screws, lock washers, the boot retainer, and the boot from the carrier post.

5. Remove two capscrews, spacer washers, and the spacer tube from the carrier arm weldment and carrier post.

6. Slide the two bushings from the carrier arm weldment and remove the carrier post with two washers.

7. Position the carrier arm assembly upside down.

8. Remove six screws from the bottom cover and the carrier arm weldment. Slide the bottom cover off the carrier arm weldment.

9. To remove the rubber bumper, remove the screw, rubber bumper, and three washers from the bottom cover.

10. Remove two cotter pins and washers from the pull rod. Slide the pull rod from the release handle and the latch assembly to remove.

11. Unscrew and remove the knob from the release handle.

12. Remove the screw, bushings, and release handle from the carrier arm weldment.

13. Remove the latch assembly and spacer plate from the carrier arm weldment by removing two screws, washers, lock washers, and nuts from the carrier arm weldment.

Figure 19: LEFT-SIDE CARRIER ARM - DISASSEMBLE/ASSEMBLE

Figure 20: LEFT-SIDE CARRIER ARM LINKAGE - REMOVE/INSTALL
Left-Side Carrier Arm Assembly - Assemble

NOTE: For micro switch installation and adjustment, see the MICRO-SWITCH - INSTALLATION and MICRO-SWITCH - ADJUSTMENT procedures in this manual.

NOTE: Prior to assembly, inspect all parts for damage and worn components. Refer to the PARTS MANUAL for replacement parts.

1. Align the spacer plate and latch assembly on the carrier arm weldment mount holes. Secure the latch assembly and spacer plate with two screws, washers, lock washers, and nuts.
2. Install the release handle, bushings, and secure with the screw.
3. Screw the knob onto the release handle.
4. Install the pull rod on the release handle and the latch assembly. Install a washer and cotter pin on each end of the pull rod to secure.
5. Insert the screw through the bottom cover and place three washers and the rubber bumper on the screw. Tighten the screw while holding the rubber bumper.
6. Align the bottom cover on the carrier arm weldment and secure with six screws.
7. Position the carrier post onto the carrier arm weldment and slide the two washers between the carrier arm weldment and carrier post. Install the bushings and spacer tube into the carrier arm weldment and secure with two spacer washers, and capscrews.

Figure 21: LEFT-SIDE CARRIER ARM LINKAGE - REMOVE/INSTALL

Figure 22: LEFT-SIDE CARRIER ARM - DISASSEMBLE/ASSEMBLE

8. Install the boot onto the carrier post and align the boot retainer with the mount holes. Secure with two lock washers and screws.
9. Install the arm rest and the arm rest adjustment knob on the carrier arm weldment.
10. Install the left-side carrier arm assembly on the battery cover. See CARRIER ARM ASSEMBLY - INSTALLATION procedure in this manual.
Right-Side Carrier Arm Assembly - Disassemble

1. Remove the right-side carrier arm assembly from the battery cover. See CARRIER ARM ASSEMBLY - REMOVAL procedure in this manual.

2. Place the right-side carrier arm assembly on a clean and dry work surface.

3. Remove the arm rest adjustment knob and slide the arm rest from the carrier arm weldment.

4. Remove two screws, lock washers, the boot retainer, and the boot from the carrier post.

5. Remove four screws and lock washers from the carrier arm weldment and the carrier post. Remove the carrier post from the carrier arm weldment.

Right-Side Carrier Arm Assembly - Assemble

NOTE: Prior to assembly, inspect all parts for damage and worn components. Refer to the PARTS MANUAL for replacement parts.

1. Align the carrier post with the carrier arm weldment and secure with four screws and lock washers.

2. Install the boot onto the carrier post and align the boot retainer with the mount holes. Secure with two lock washers and screws.

3. Install the arm rest and adjustment knob on the carrier arm weldment.

4. Install the right-side carrier arm assembly on the battery cover. See CARRIER ARM ASSEMBLY - INSTALLATION procedure in this manual.

Carrier Arm Assembly - Installation

NOTE: The left-side carrier arm assembly is referenced in this procedure. However, any variations to the right-side carrier arm assembly are noted.
Ring Bearing - Removal

![Warning Icon]

**WARNING**

Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Remove the battery from the lift truck. See the BATTERY - REMOVAL procedure in this manual.
3. Remove the rear cover from the lift truck. See the COVERS/FLOOR PLATES procedure in the Operator's Manual.
4. Place the lift truck on blocks. See HOW TO PUT A LIFT TRUCK ON BLOCKS procedure in this manual.
5. Remove the bumper from the lift truck. See the BUMPER - REMOVAL procedure in this manual.
6. Remove the counterweight from the lift truck. See the COUNTERWEIGHT - REMOVAL procedure in this manual.
7. Both rear Omni-Directional™ Wheel assemblies and transaxles must be removed before proceeding. See TRANSAXLE ASSEMBLY - REMOVAL procedure in this manual.
8. Attach a suitable lifting device to the rear frame weldment.
9. Remove the capscrews from the rear frame weldment and the ring bearing.
10. Carefully remove the rear frame weldment from the lift truck.
11. Remove all capscrews (except one on each side) from main frame weldment and ring bearing.
12. Remove the capscrews from the rear frame weldment and the ring bearing.

---

**Diagram:**

Figure 25: RING BEARING - REMOVE/INSTALL
13. Carefully remove the rear frame weldment from the lift truck.

14. Remove all capscrews; except one on each side, from main frame weldment and ring bearing.

⚠️ CAUTION
The ring bearing has four grease fittings around the interior. Be careful not to damage these grease fittings when connecting a lifting device.

15. Attach a suitable lifting device to the ring bearing.

16. Remove the last two capscrews from the sides of the main frame weldment and the ring bearing.

17. Remove the ring bearing from the lift truck.

Ring Bearing - Installation

⚠️ CAUTION
The ring bearing has four grease fittings around the interior. Be careful not to damage these grease fittings when connecting a lifting device.

1. With the aid of a lifting device, position the ring bearing on the lift truck's main frame weldment and align the mounting holes.

⚠️ CAUTION
The ring bearing has pre-tapped holes for easy installation. Avoid damaging these threaded holes by starting all capscrews into the ring bearing by hand.

2. Install the capscrews to the main frame weldment and into the ring bearing.

3. Remove the lifting device from the ring bearing and torque the capscrews to 170 ft-lb (230 N•m).

4. Attach a suitable lifting device to the rear frame weldment and align the rear frame weldment with the ring bearing.

5. Install the capscrews to the rear frame weldment and into the ring bearing. Torque the capscrews to 170 ft-lb (230 N•m).

6. Remove the lifting device from the rear frame weldment.

Figure 26: RING BEARING - REMOVE/INSTALL
7. Apply lubricant to four grease fittings as outlined in the GENERAL LIFT TRUCK AND LUBRICATION SCHEDULE section.

8. Install both rear Omni-Directional™ Wheel assemblies and transaxles. See the TRANSAXLE ASSEMBLY - INSTALLATION procedure in this manual.

9. Install the counterweight assembly on the lift truck. See the COUNTERWEIGHT - INSTALLATION procedure in this manual.

10. Install the bumper on the lift truck. See the BUMPER - INSTALLATION procedure in this manual.

11. Remove the blocks from the lift truck.

12. Install the rear cover on the lift truck. Refer to the COVERS/FLOOR PLATES procedure in the Operator's Manual.

13. Install the battery. See BATTERY - INSTALLATION procedure in this manual.

14. Remove the tag from the battery connector and connect the battery.

Grounding straps - Removal

⚠️ WARNING
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

⚠️ CAUTION
The grounding straps are a safety device. The lift truck should never be utilized for service without the grounding straps installed. Failure to comply may result in damage to equipment.

NOTE: There are two grounding straps on the lift truck and both must be serviceable at all times.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Place the lift truck on blocks. See HOW TO PUT A LIFT TRUCK ON BLOCKS procedure in this manual.
3. Remove the capscrew, lock washer, and washer from the grounding strap.
4. Remove the grounding strap from the lift truck frame.

Grounding Straps - Installation

⚠️ CAUTION
The frame weldment has pre-tapped holes for easy installation. Avoid damaging these threaded holes by starting all capscrews into the frame weldment by hand.

NOTE: The grounding straps must ride on the ground. Be certain that they are bent properly so that contact with the ground will occur.

1. Position grounding strap on the lift truck frame and secure with the capscrew, lock washer, and washer.
2. Torque capscrew to 20 ft-lb (27 N•m).
3. Remove the blocks from the lift truck.
4. Remove the tag from the battery connector and connect the battery.
Step Box Cover - Removal

⚠️ WARNING
Be careful not to short out a battery terminal. Do not smoke or use open flame near batteries. Batteries may explode from spark. Remove all jewelry and exercise care with tools. If jewelry or tools contact battery terminals or a positive electrical circuit, a direct short may result in instant heating of tools, damage to equipment, and injury or death to personnel.

1. Attach a tag on the battery connector stating DO NOT CONNECT BATTERY. Disconnect battery.
2. Remove the electro-hydraulic control valve from the lift truck to gain access to the step box cover. See the ELECTRO-HYDRAULIC CONTROL VALVE - REMOVAL procedure in this manual.

NOTE: Access the mount screws for the step box cover through the step hole.

3. Remove two screws from the lift truck frame and the step box cover.
4. Remove the step box cover through the inside of the frame to the front of the hydraulic oil tank.

Step Box Cover - Installation

NOTE: There are two retainer nuts that are slid onto the step box cover for securing the mount screws. If a new step box cover is being installed, remove the retainer nuts from the old step box cover and install them on the new step box cover.

1. Position the step box cover on the top of the step box.
2. Secure the step box cover with two screws.
3. Install the electro-hydraulic control valve on the lift truck. See the ELECTRO-HYDRAULIC CONTROL VALVE - INSTALLATION procedure in this manual.
4. Remove the tag from the battery connector and connect the battery.
SAFETY LABELS

⚠️ WARNING
Safety labels are installed on the lift truck to give information about operation and possible hazards. It is important that all safety labels are installed on the lift truck and can be read.

⚠️ WARNING
DO NOT add to or modify the lift truck. Any change to the lift truck or its equipment can change the lifting capacity. The lift truck must be rated as equipped and the nameplate must show the correct capacity rating. Contact your Airtrax™ lift trucks dealer for a replacement nameplate.

Safety and informational labels are located in conspicuous locations on the lift truck and should be strictly followed. Check the nameplate on each lift truck before operation. These safety and informational labels must be replaced immediately if missing or defaced. Make certain all capacity, safety, and informational plates or labels are attached.

Safety Labels - Replacement

⚠️ WARNING
Cleaning solvents can be flammable and toxic, and can cause skin irritation. When using cleaning solvents, always follow the recommendations of the manufacturer.

⚠️ CAUTION
Do not use solvent on new paint as the solvent will damage the paint. Failure to comply may result in damage to equipment.

1. Ensure that all portions of the old safety label are removed.
2. Make sure the surface is clean, dry, and has no oil or grease. Clean any old paint from the surface with a cleaning solvent.
3. Remove the paper from the back of the label. Do not touch the adhesive surface.

NOTE: The label cannot be moved after it touches the surface due to the strong adhesive used on the labels.

4. Carefully hold the label in the correct position above the surface. After the label is attached, make sure that all air is removed from under the label and the corners and edges are secured.
NOTE: This figure shows the safety labels and nameplate for the **SIDEWINDER™ ATX-3000** lift truck.

**NOTE:** For locators and part numbers of all safety labels, nameplate, manufacturer decals, model decals, and striping decals, refer to the **PARTS MANUAL**.

---

**Figure 29: SAFETY LABELS**

1. OPERATION WARNING LABEL
2. PINCH POINTS
3. VEHICLE MOVES IN ALL DIRECTIONS
4. NO RIDERS
5. NAMEPLATE
6. EMERGENCY STOP SWITCH
7. TIP-OVER and BUCKLE-UP
8. GENERAL DRIVING SAFETY
9. HYDRAULIC FILL LOCATION
10. BATTERY MOVEMENT
## Technical Data

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<thead>
<tr>
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<th>General Information</th>
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<td>Model</td>
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<td>Load Center</td>
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<td>Power</td>
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<td>Tire Type</td>
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### Dimensions

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<td>Upright Maximum Fork Height, Full Capacity - in. (mm)</td>
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<td>Lift Height (Standard) - in. (mm)</td>
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<td>11</td>
<td>Free Lift (Standard) - in. (mm)</td>
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<td>Fork Carriage Standard - in. (mm)</td>
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<td>Forks Standard Fork Length/Width/Thickness - in. (mm)</td>
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<td>Right Angle Stacking With 42 Wide x 48 Long Pallet - in. (mm)</td>
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### Performance

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<td>Stability Comply with ANSI</td>
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<td>24</td>
<td>Speeds Travel - Empty/Loaded - mph (km/h)</td>
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<td>Lift - Empty/Loaded - ft/min (m/s)</td>
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<td>Lowering - Empty/Loaded - ft/min (m/s)</td>
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### Technical Data (Continued)

#### Weight

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#### Chassis

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#### Battery

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#### Control

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<th>Left Hand Standard</th>
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<td>Operator Control</td>
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<td>Electric Control</td>
<td>Traction Motor Super Drives - vdc/vac</td>
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<td>Joystick - Hydraulic Functions</td>
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<td>Hydraulic Pump Motor Super Drive - vdc/vac</td>
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#### Hydraulic System

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**CAUTION**
When replacing capscrews, always use a capscrew of the same measurement and strength as the capscrew being replaced.

Metric capscrews are identified by the grade number stamped on the head of the capscrew or on the surface of the nuts. U.S. Customary capscrews are identified by radial lines stamped on the head of the capscrew.

**ALWAYS** use the torque values listed in the following tables when specific torque values are not available.

**DO NOT** use these torque values in place of torque values listed in the TORQUE SPECIFICATIONS table or located within the procedures of this manual.

**NOTE:** When the ft-lb torque value is less than 10, convert the ft-lb value to in-lb to obtain a better torque with an in-lb torque wrench. Example: 6 ft-lb equals 72 in-lb.

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Figure 1: METRIC CAPSCREW MARKINGS AND TORQUE VALUES
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Figure 2: U.S. CUSTOMARY CAPSCREW MARKINGS AND TORQUE VALUES