



Bendi B3/30 AC Maintenance Manual



LANDOLL CORPORATION

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Chapter 1

Introduction, Safety & Planned Maintenance

Before You Begin (Please Read)

Introduction

This manual is intended for the service technician who is seeking information on product maintenance and service replacement parts. It contains troubleshooting tips and information on repair which will help the technician solve problems that may occur.

Operating Instructions

This manual does not contain operating instructions. Operating instructions are sent with each truck. If the operators manual is missing on your Bendi B3/30 AC truck, call Landoll Corporation to order a replacement.

Service Training

Service Training is available for the forklift technician from Landoll Corporation. This includes operation, repair, maintenance, hydraulic system and electrical system. Contact your regional Landoll service technician for more information.

Tools Needed

The tools needed will be the same tools that are often found in well-equipped service centers, in both SAE and metric sizes. For example, an assortment of open-end and box-end wrenches, sockets, as well as Allen and adjustable wrenches, assorted screwdrivers and non-marring mallets should be available.

Replacement Parts

When ordering parts that will be used for the repair an maintenance of your Landoll AC truck, the model and serial number of the truck being repaired will be required. This information is located on the serial number and capacity plate located in front of the battery compartment. See Figure 1-1.

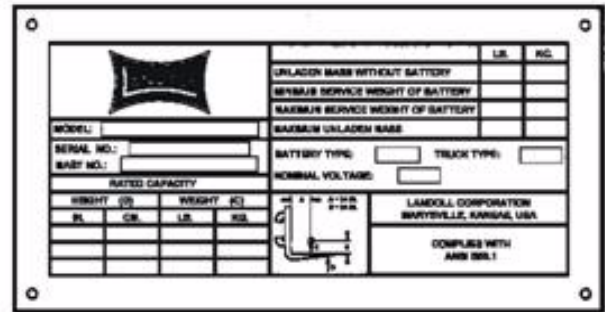


Figure 1-1: Serial Number and Capacity Plate

Below are the Notice, Caution, Warning and Danger safety notices and their descriptions that may be used in this book.

NOTICE

Special notice that may include a helpful maintenance hint-read and thoroughly understand.



CAUTION

Proceed with caution. Failure to heed may cause injury to person or damage product.



WARNING

Proceed with caution. Failure to heed warning will cause injury to person or damage product.



DANGER

Proceed with caution. Failure to heed warning will cause injury to person or damage product.

General Maintenance Instructions



CAUTION

Steel toe shoes and eye protection are required when maintaining or repairing a lift truck. Ear protection may also be required if the repair facilities are excessively noisy, per OSHA standards. Keep feet and hands and all other body parts away from all mast areas and pinch points. Power industrial trucks may become hazardous if scheduled maintenance is neglected. Therefore, adequate maintenance facilities, trained personnel and procedures should be provided.

IMPORTANT

Maintenance and inspection shall be performed in conformance with the following practices:

1. A scheduled planned maintenance, lubrication, and inspection system should be followed. A daily check before each shift is an OSHA requirement.
2. Only qualified and authorized personnel shall be permitted to inspect, maintain and service the truck.
3. Before leaving the truck:
 - Stop the truck.
 - Completely lower the mast. Place directional controls in neutral.
 - Apply the parking brake. Turn off the power and disconnect the battery.
 - Block the wheels, making sure the truck is NOT on an incline.
4. Before working on the truck:
 - Perform a Lock Out/Tag Out operation on the truck.
 - Raise drive wheel free of floor or disconnect the power sources.
 - Use chocks or other positive positioning devices.
 - Block load engaging means, inner masts, or chassis before working under them.
 - Operation to check performance of truck or attachments shall be conducted in an authorized safe clearance area.
5. Before starting to operate the truck:
 - Be in operating position.
 - Apply brake.
 - Place directional control in neutral.
 - Check functions of lift systems, directional control, speed control, steering, warning devices, brakes and any attachments if any are used.
6. To avoid fire hazards, have fire protection equipment present. Do not use an open flame to check fluid levels, or for leakage of electrolyte and fluids or oil. Do not use open pans of fuel or flammable cleaning fluids for cleaning parts.
7. Keep shop well ventilated, clean and dry.
8. Brakes, steering mechanisms, control mechanisms, lift overload devices, guards, and safety devices shall be inspected regularly and maintained in a safe operating condition.
9. Capacity, operation and maintenance instruction plates or decals shall be maintained in legible condition.
10. All parts of lift mechanisms shall be inspected to maintain them in safe operating condition.
11. All hydraulic systems shall be regularly inspected and maintained in conformance with good practice. Cylinders, valves, and other similar parts shall be checked to assure that "drift" has not developed to an extent that it would create a hazard.
12. Batteries, motors, controllers, limit switches, protective devices, electrical conductors, and connections shall be maintained in conformance with good practice. Special attention shall be paid to the condition of electrical insulation.
13. Trucks shall be kept in a clean condition to minimize fire hazards and facilitate detection of loose or defective parts.
14. Modifications and additions that affect capacity and safe truck operation shall not be performed by the customer or user without manufacturers prior written approval. Capacity, operation and maintenance plates or decals shall not be changed accordingly.
15. Care must be taken to assure that all replacement parts are interchangeable with the original parts and are of equal quality of parts that were originally installed on the truck at the factory.
16. Be sure that any optional equipment added to the truck is positioned so that it does not block the vision of the operator or interfere with safe and efficient operation of the truck.

For your Safety

NOTICE

In the interest of operator safety and in compliance with OSHA regulations, guidelines have been developed for performing service and maintenance on the truck. Before performing service and maintenance on the truck, review the following sections in this manual for additional procedures to be followed.

Lock Out/Tag Out

IMPORTANT

When doing maintenance or repair on the Bendi AC truck, unless the truck must be on for testing, remove the key from the key switch. In addition, because it's possible to have a duplicate key, remove the main power fuse and install a commercially available Lock Out/Tag Out device on the battery connectors. Also, install a lockout warning reminder on the steering wheel warning that the truck is not available for use.



CAUTION

Battery Safety Rules:

- Wear protective clothing, rubber apron, boots, gloves, and full-face shield when performing any maintenance on batteries. **DO NOT** allow electrolyte to come in contact with eyes, skin, clothing or floor.
- If electrolyte contacts eyes, flush immediately with clean water. **OBTAIN MEDICAL ATTENTION IMMEDIATELY!!**. Should electrolyte be spilled on skin, rinse promptly with clean water and soap. A baking soda solution (one pound to one gallon of water) will neutralize acid spilled on clothing, floor or other surfaces. Apply solution until bubbling stops and rinse with clean water.
- Keep battery vent plugs firmly in place at all times, except when adding water or taking hydrometer readings.
- **DO NOT** bring any type of flame or spark near the battery.
- **DO NOT** place any electrically conductive tool on the battery that could cause a spark. Gas formed while the battery is charging is highly explosive. This gas remains in the cells long after charging is complete.
- Keep the battery clean. Foreign matter in the electrolyte will result in poor battery performance.
- Follow the battery manufacturer's instructions concerning maintenance and repair.

Battery Care and Charging



CAUTION

- Only qualified and experienced personnel should perform maintenance and repair on batteries.
- Make certain the charger being used matches the voltage and amperage of the truck battery. This voltage is listed on the truck serial plate. See Figure 1-1.
- Before connecting or disconnecting batteries to the charger, make sure the charger is OFF. Attempts made to do this while the charger is ON, could result in serious injury to the operator and damage could occur to the charger with sparks or electrical spikes.
- Keep sparks or open flame away the battery or the charging area. **BATTERY FUMES ARE EXPLOSIVE!!**
- NEVER smoke or have an open flame near the battery. Gas formed during charging is explosive and can cause injury. Consult the charger manufacturer's manual covering your charger for operation and maintenance.
- The battery must meet size, weight and voltage requirements of the truck.



CAUTION

- **BATTERY INSTALLATION:** When installing the battery, move truck to an area intended for battery care. The load forks must be all the way down to the floor. Turn key or toggle switch to OFF position and put the key in a secure place.

Good Battery Care Recommendations:

- Add approved water only - never add acid.
- Keep electrolyte levels proper.
- Keep Battery top clean and dry.
- Keep flame and metal away from battery top.
- Keep vent caps tightened.
- The temperature of the battery should be below 115°F when charging or operating.
- Use only approved correct voltage/current charger.
- Keep battery cover open while charging.
- If in doubt, call your local Landoll service technician.

Battery Removal and Installation



CAUTION

- **BATTERY REMOVAL:** When removing the battery, move the truck to an area intended for battery care, on a level floor. Turn the key switch to OFF position and remove the key. Disconnect battery and lock out the truck as described in the Lock Out/Tag Out section described above. Never remove the battery partially from truck without a roller stand in place. Lower load engagement completely. If battery is removed with load raised, use hoist attached to mast to protect against tip over. DO NOT allow any metallic object to come in contact with the top of the battery. This may cause a short circuit when removing or transporting the battery. Use an insulator (such as plywood) to cover the top of the battery during removal.

Hydraulic System



WARNING

- **HIGH PRESSURE FLUIDS ARE DANGEROUS!**
- High pressure hydraulic oil can puncture the skin and cause severe injury!
- Relieve all pressure from the hydraulic system before attempting to work on it.
- Make sure all hydraulic lines are tight before starting the system. Leaks in the hydraulic system can pierce the skin and cause severe injury. Any fluid injected into the skin under high pressure should be considered a medical emergency despite a normal appearance of the skin. Medical attention should be administered immediately.

IMPORTANT

When maintenance is to be performed on the hydraulic system, make sure the system hydraulic pressure is relieved by:

- Moving the truck to a level area.
- Have no load on the forks.
- Completely lower the mast, or if the mast is the object of repair, have blocks under the mast.
- Relieve all system pressure by moving the hydraulic levers in each direction several times.

Towing the Truck

General Safety Tips:



WARNING

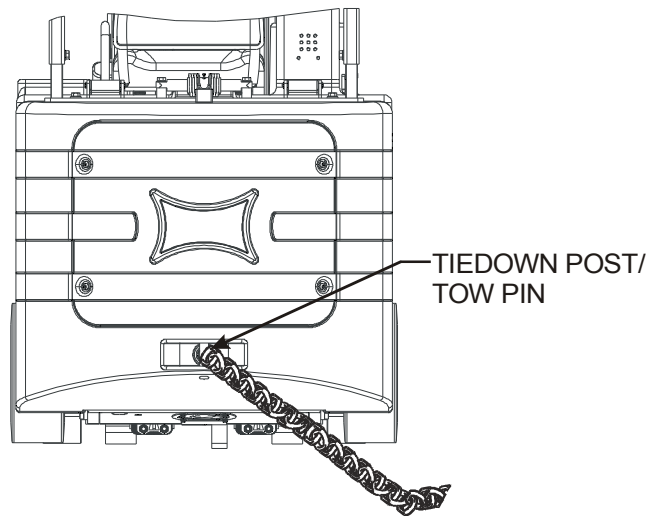
- Have the emergency brake applied when hooking up the tow chain.
- Release the emergency brake only when ready to tow the truck.
- Tow the truck using a speed of 2 mph or less.
- **DO NOT** make sharp turns when towing the truck. The towed truck will be difficult to steer. **USE EXTREME CAUTION** and keep the towed vehicle at a slow, manageable speed.
- Forks must be empty and preferably not more than 12" off the floor.
- The truck can roll easily - **USE EXTREME CARE!!**

Towing Vehicle Requirements

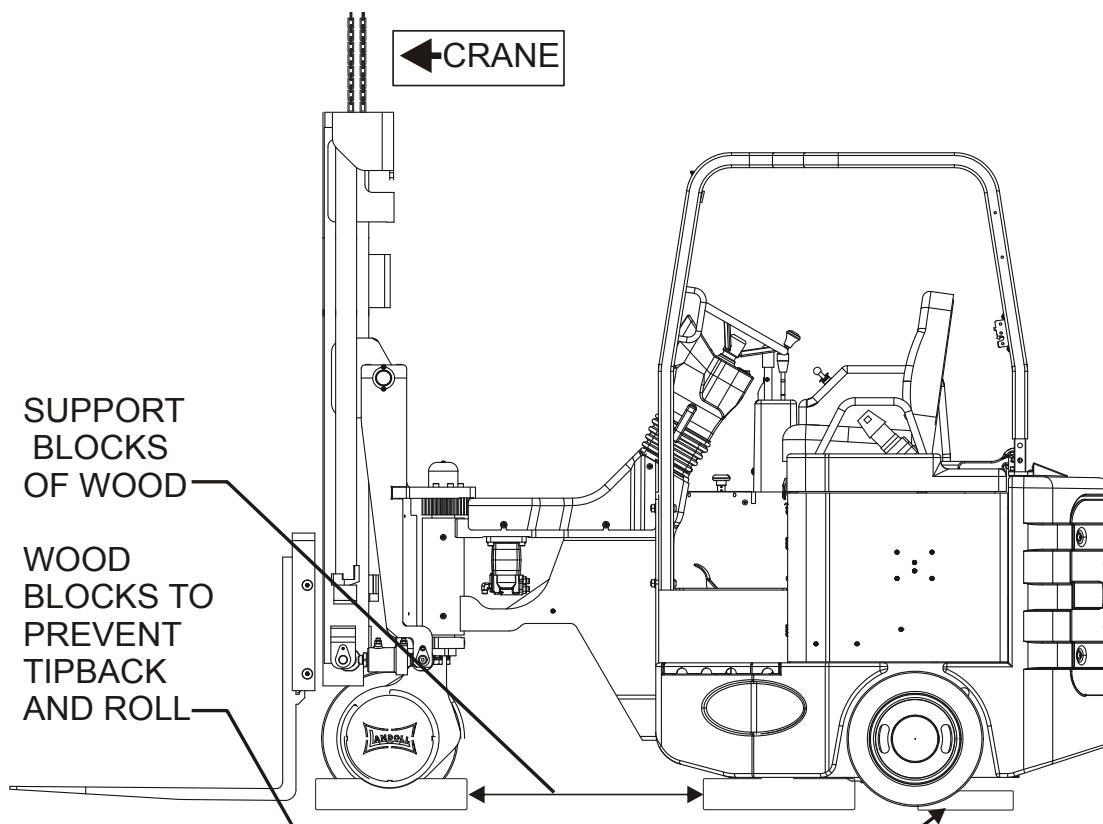
- Towing vehicle must have a pull and braking capacity greater than 8000 lbs.
- Brakes on towed truck will operate, but could operate differently versus an operational truck.
- Maximum towing speed should not exceed 2mph.
- Always tow the truck in the reverse direction.

Towing a Truck in the Reverse Direction

- Key must be in the OFF position.
- When attaching towing vehicle to lift truck to be towed, a removable pin has been provided on the rear bottom side of the counter weight. (See illustration below) Firmly attach tow device to this pin.
- Towing device must have a pulling capacity of 8000 lbs.
- Towed vehicle's forks should be empty and no higher than 12 in. off the ground.
- Be careful. With brakes released, vehicle will roll and steering will be difficult.
- Keep towing speed below 2 mph. Remember that the person on the towed lift has to turn his head to observe operations.



Lifting and Blocking the Truck



- Move truck to a level area designated for repair.
- Keep forks empty and low to the ground.
- Remove the key and place in a secure place.
- Unhook the battery.
- Attach Lock Out/Tag Out device to the truck.
- Use a jack or hoist with a 8000 lb. minimum lift.
- Set the lift on designated hardwood blocks. See Figure above for block(s) placement.
- Keep the height of the lifted truck to a minimum.
- Remove forks before starting mast repairs.
- NEVER reach through the upright open areas of the mast.
- NEVER maintain or repair the mast without supports or while anyone is near the truck. (ASME B56.1-2000)
- Raise mast and position blocks under the second stage mast.
- Using an appropriate set of C-clamps, secure wooden blocks to mast channel.
- Lower mast until it sits firmly on wooden blocks.
- Disable the truck as described in the Lock Out/Tag Out section.
- For mast inspection, use only an approved safety platform or step ladder.
- NEVER repair chains, they are to be replaced.
- NEVER replace chain sets with only one chain. All chains are to be replaced in pairs.

Mast Service Precautions



WARNING

When servicing the mast or sections of the mast, hardwood blocks (4"X4", 100 X 100mm minimum) should be used to keep individual sections of the mast from falling. In addition to the wood blocks, chains should be used to hold the mast sections from moving, in both the vertical and horizontal directions.

- Mast work to be done in a flat, designated area.
- NEVER walk under or stand upon forklift forks.

Disconnecting the Tilt Cylinder



WARNING

Steel toed shoes and eye protection are required when doing maintenance or repair work on a lift truck. Do not place feet or hands in any areas through the mast or in truck pinch points. Servicing the tilt cylinders requires the use of an overhead hoist, hoist slings and wheel blocks. The overhead hoist and slings must have a rating of 8,000 lb. or greater. Do not work under or around a truck that is not properly secured. The battery must be disconnected and removed from the truck.

- Truck repair must be in a level, designated area.
- Turn the lift off, pull the key and put it in a secure place.
- Lower the mast completely to the floor.
- Chock wheels so that the truck cannot move.
- Attach a sling and hoist to all the top cross braces so the mast sections cannot move.

Mast Removal

1. Move the truck to a level, designated area.
2. Remove the key and place it in a secure place.
3. Perform the Lock Out/Tag Out procedure.
4. Remove the battery.
5. Remove the forks.
6. Move all levers back and forth several times to relieve internal hydraulic pressure.
7. Slowly and carefully remove the lift cylinder lines. Use a container to catch oil and an oil absorbent product to absorb any spilled oil.
8. Disconnect all wiring (if used) between the mast and the truck body.
9. Support the mast using the sling and the overhead hoist.
10. Chain the individual sections of mast together at the upper cross braces. Chain the lower mast carriage to the lower section of the mast, keeping the sections from moving when the mast is laid down on the floor.
11. Remove all pins holding the tilt cylinders to the mast.
12. Remove mast and CAREFULLY place the mast in a horizontal position.

Cleaning the Truck

Landoll Corporation recommends that their fork trucks NOT be cleaned with a power washer. Electrical boards, circuitry and wiring can be damaged by high pressure water and soap. Moisture and soap left on components can rust, corrode or leave a residue that can damage everything that it comes in contact with. The preferred method of removing dust is compressed air. For localized cleaning, use a non-flammable solvent parts washer and dry parts with compressed air after the part or area is cleaned.

Maintenance Introduction

Preventative maintenance is an important part of all industrial equipment.

A well planned preventative maintenance program is essential to keeping the working environment safe for the operator and the longevity of the affected equipment. Regular and planned maintenance is the responsibility of both the daily operator and the forklift technician.

Inspection Sheets

The following pages are OSHA (Occupational Safety and Health Administration) required check sheets. These sheets should be copied and the copies used for maintenance checks on your Bendi AC lift. The pre-shift inspection on your AC lift is an OSHA requirement. It is the operator's duty to inspect the lift at each pre-shift and report all problems to the person in charge of forklift maintenance. Have a qualified mechanic correct all noted problems.

The following pages show daily, 50 hour, 200 hour, 600 hour, 1000 hour and 2000 hour suggestive maintenance checks. These should be copied and the maintenance should be followed by daily operator and the forklift technicians.

INTRODUCTION, SAFETY & PLANNED MAINTENANCE

Daily pre-shift inspection is an OSHA requirement.

It's important that these inspections are documented.

Operators Daily Checklist	Status	Landoll / Bendi AC
SAFETY & OPERATIONAL CHECKS Have a qualified technician correct all problems.	OK - Yes,No	Maintenance Note if Applicable
Load Backrest Extension-Attached.		
Tilt Control-Forward/Reverse Functioning smoothly.		
Side Shift Control Functioning smoothly.		
Hang-on Attachment Functioning smoothly, securely attached, fittings attached.		
Steering Operation Functioning smoothly.		
Accelerator & Brake Pedal Functioning smoothly.		
Controls (Turn Power On) Investigate Unusual noises.		
Display (Hour Meter, Oil Temp, Voltmeter, etc) Functioning Properly.		
Horn, Lights, Seat Switch Functioning Properly.		
Service and Parking Brake Functioning Properly.		
Drive Control-Forward/Reverse Functioning Smoothly.		
Battery-Check electrolyte level after a full charge.		
Battery Discharge Indicator Functioning.		
Battery Restraint System - Adjust or Fasten.		
Hood and seat latch Functioning properly.		
Operator's Compartment Capacity Plate Attached - Info matches Model, Serial No. and attachments - Operator's Manual in Case.		
Seat Belt, Buckle, and Retractors Functioning Properly.		
Overhead Guard Properly mounted & attached.		
Hydraulic Oil, Battery, Brake Fluid - Check levels & look for leaks.		
Tires-Check for debris, Torque lug nuts - 225ft-lb.		
Finger Guards attached.		
Major Structural Points (Front Rotation, Mast Braces, Overhead Guard) - Check for cracks.		
Hydraulic Cylinders, Pump, Valve-Check for leaks, noise.		
Safety Warnings Attached (See Manual for location).		

Date	Inspector:	Truck No.	Model No.	Location	Serial No.	Shift	Hr Meter	Battery Fluid	Hydraulic Oil

To be performed after 1st 50 hours of truck operation
in addition to the required pre-shift daily inspection

Forklift 1st 50 Hour Inspection	Status	Landoll / Bendi AC
SAFETY & OPERATIONAL CHECKS Have a qualified technician correct all problems.	OK - Yes, No	Maintenance Note if Applicable
Mast chains-Inspect, clean and lubricate.		
Power Steering System-Inspect and Fill.		
Drive wheels, Re-Torque lug nuts (225 Ft.-lbs.).		
Gear Box-Drain, flush and refill.		

Date	Inspector:	Truck No.	Model No.	Location	Serial No.	Shift	Hr Meter	Battery Fluid	Hydraulic Oil

INTRODUCTION, SAFETY & PLANNED MAINTENANCE

To be performed after 1st 200 hrs of truck operation
in addition to the required pre-shift daily inspection

Forklift 1st 200 Hour Inspection	Status	Landoll / Bendi AC
SAFETY & OPERATIONAL CHECKS Have a qualified technician correct all problems.	OK - Yes,No	Maintenance Note if Applicable
Mast - Inspect all friction surfaces and check lift chain tension		
Lift and Tilt cylinder - Check to be sure they work together and in unison		
Power Steering Pump - Check Operation		
Brake Pedal - Check for free play		
Parking & Service Brakes - Check for effectivity		
Check Contactor Points & Micro Switches Operation		
Control Panel - Clean surface		
Hydraulic Oil Pump - Check Operation		
Switches (interlock, direction, parking/seat, key, pressure/temperature) - Check operation		
Wires, Connections, Bolts and Nuts - Check		

Date	Inspector:	Truck No.	Model No.	Location	Serial No.	Shift	Hr Meter	Battery Fluid	Hydraulic Oil

To be performed each 200 hrs of truck operation in addition to the required pre-shift daily inspection

Forklift 200 Hour Inspection	Status	Landoll / Bendi AC
SAFETY & OPERATIONAL CHECKS Have a qualified technician correct all problems.	OK - Yes, No	Maintenance Note if Applicable
Mast, carriage, or attachment friction surfaces - Clean, inspect for wear or damage, and lubricate.		
Lift chains - Clean and lubricate.		
Extend mast - Check for excessive wear.		
Attachment control - Operational.		
Accelerator - Functioning smoothly		
Controls (turn power on); Investigate unusual noises immediately.		
Instrument monitors - Functioning.		
Parking and service brakes - Functioning smoothly, check pads for excessive wear.		
Hydraulic fluid level - Check and fill.		
Exterior of hydraulic Tank and Oil Tank Breather - Clean.		
Hydraulic oil and power steering pumps - Clean dust from motors.		
Hydraulic oil and power steering pumps - Check commutator surface for roughness.		
Battery - Thoroughly clean.		
Battery box and connectors - Neutralize and clean.		
Battery - Check water/electrolyte level.		
Battery - Check structure and electrical conditions.		
Traction motors - Clean dust.		
Seat belt, buckle, and retractors - Functioning smoothly.		
Tires-Check for debris, torque lug nuts to 225 ft. lbs.		
Load wheel bearings - Clean and fill with grease.		
Leaks - Hydraulic oil, battery, brake fluid, transmission.		
Hydraulic hoses and connections - Check for wear.		
Switches (interlock, direction, parking/seat, key, pressure, and temperature) - Check.		
Wire connections and sending units - Check.		
Grease fittings - Service.		
Check and torque all 5/8" overhead guard bolts - 170 ft.-lbs (230 Nm.).		

Date	Inspector:	Truck No.	Model No.	Location	Serial No.	Shift	Hr Meter	Battery Fluid	Hydraulic Oil

INTRODUCTION, SAFETY & PLANNED MAINTENANCE

To be performed each 600 hours of truck operation in addition to the required pre-shift daily inspection

Forklift 600 Hour Inspection	Status	Landoll / Bendi AC
SAFETY & OPERATIONAL CHECKS Have a qualified technician correct all problems.	OK - Yes, No	Maintenance Note if Applicable
Tires - Check for debris; drive tire lug nuts - Torque to 225 ft. lbs. (300 Nm)		
Wheel bearings - Clean and pack with grease		
Leaks - Hydraulic oil, battery, brake fluid, Complete gear box		
Hydraulic hoses and connections - Check for wear		
Switches (interlock, direction, parking/seat, key, pressure, and temperature) - Check		
Wire connections and sending units - Check		
Grease fittings - Service		
Forks, top clip retaining pin and heel - Condition		
Load rollers - No greater clearance than 1/16"		
Mast chains - Lube with SAE 40W oil or Bowman Heavy Load Red grease - Check for wear and stretch		
Steering operation - Functioning smoothly; Lubricate steering knob		
Steering Operation - Functioning smoothly; Lube steer knob		
Brake fluid - Check level		
Hydraulic oil filter - Change element and check for proper level - Check pressures		
Battery - Check resistance between truck body and negative/positive terminal		
Battery rollers-Remove, clean, and repack		
Contact points and Micro Switches - Check operation		
Control panel - Clean surface		
Operator's compartment capacity Plate Attached - Information matches model, serial no., and attachments		
Check all connections for proper torque		

Date	Inspector:	Truck No.	Model No.	Location	Serial No.	Shift	Hr Meter	Battery Fluid	Hydraulic Oil

To be performed each 1000 hrs of truck operation in addition to the required pre-shift daily inspection.

Continued onto the next page for clarity.

Forklift 1000 Hour Inspection	Status	Landoll / Bendi AC
SAFETY & OPERATIONAL CHECKS Have a qualified technician correct all problems.	OK - Yes, No	Maintenance Note if Applicable
Mast, carriage, or attachment friction surfaces - Clean, inspect for wear or damage, and lubricate		
Lift chains - Clean and lubricate		
Extend mast - Check for excessive wear		
Attachment control - Operational		
Accelerator - Functioning smoothly		
Controls (turn power on); Investigate unusual noises immediately		
Instrument monitors - Functioning		
Parking and service brakes - Functioning smoothly, check pads for excessive wear		
Hydraulic fluid level - Check and fill		
Exterior of hydraulic tank and oil tank breather - Clean		
Hydraulic oil and power steering pumps - Clean dust from motors		
Battery - Thoroughly clean		
Battery box and connectors - Neutralize and clean		
Battery - Check water/electrolyte level		
Battery - Check structure and electrical conditions		
Traction motors - Clean dust		
Seat belt, buckle, and retractors - Functioning smoothly		
Tires-Check for debris, torque lug nuts to 225 ft. lbs.		
Wheel bearings - Clean and fill with grease		
Leaks - Hydraulic oil, battery, brake fluid, complete transmission		
Hydraulic hoses and connections - Check for wear		
Switches (interlock, direction, parking/seat, key, pressure, and temperature) - Check		
Wire connections and sending units - Check		
Grease fittings - Service		
Forks, top clip retaining pin and heel - Condition		
Load rollers - No greater than 1/16"		
Mast chains - Lube with SAE 40W oil or Bowman Heavy Load Red grease - Check for wear and stretch		
Steering operation - Functioning smoothly; Lube knob		
Brake fluid - Check level		
Hydraulic oil filter - Change element and check for proper level - Check pressures		
Battery - Check resistance between truck body and negative/positive terminal		
Battery rollers - Remove, clean, and repack		
Contact points and Micro Switches - Check operation		
Control panel - Clean surface		

INTRODUCTION, SAFETY & PLANNED MAINTENANCE

Forklift 1000 Hour Inspection	Status	Landoll / Bendi AC
Traction motor - Clean housing with compressed air		
Operator's compartment capacity plate attached - Information matches model, serial no., and attachments		
Check all connections for proper torque		
Power steering system - Fill and air bleed		
Motor - Check that terminal studs and mounting bolts are clean and tight		
Motor - Clear cooling holes of debris or restrictions		

Date	Inspector:	Truck No.	Model No.	Location	Serial No.	Shift	Hr Meter	Battery Fluid	Hydraulic Oil

To be performed each 2000 hrs of truck operation in addition to the required pre-shift daily inspection.
Continued onto the next page for clarity.

Forklift 2000 Hour Inspection	Status	Landoll / Bendi AC
SAFETY & OPERATIONAL CHECKS Have a qualified technician correct all problems.	OK - Yes, No	Maintenance Note if Applicable
Mast, carriage, or attachment friction surfaces - Clean, inspect for wear or damage, and lubricate		
Lift chains - Clean and lubricate		
Extend mast - Check for excessive wear		
Attachment control - Operational		
Accelerator - Functioning smoothly		
Controls (turn power on); Investigate unusual noises immediately		
Instrument monitors - Functioning		
Parking and service brakes - Functioning smoothly, check pads for excessive wear		
Hydraulic fluid level - Check and fill		
Exterior of hydraulic tank and oil tank breather - Clean		
Hydraulic oil and power steering pumps - Clean dust from motors		
Hydraulic oil and power steering pumps - Check commutator surface for roughness		
Hydraulic oil and power steering pumps - Check commutator surface for roughness		
Battery - Thoroughly clean		
Battery box and connectors - Neutralize and clean		
Battery - Check water/electrolyte level		
Battery - Check structure and electrical conditions		
Traction motors - Clean dust		
Seat belt, buckle, and retractors - Functioning smoothly		
Tires-Check for debris, torque lug nuts to 225 ft. lbs.		
Wheel bearings - Clean and fill with grease		
Leaks - Hydraulic oil, battery, brake fluid, complete transmission		
Hydraulic hoses and connections - Check for wear		
Switches (interlock, direction, parking/seat, key, pressure, and temperature) - Check		
Wire connections and sending units - Check		
Grease fittings - Service		
Forks, top clip retaining pin and heel - Condition		
Load rollers - No greater than 1/16" clearance		
Mast chains - Lube with SAE 40W oil or Bowman Heavy Load Red grease - Check for wear and stretch		
Steering operation - Functioning smoothly; Lube knob		
Brake fluid - Check level		
Hydraulic oil filter - Change element and check for proper level - Check pressures		
Battery - Check resistance between truck body and negative/positive terminal		
Battery rollers (optional) - Remove, clean, and repack		
Contact points and Micro Switches - Check operation		
Control panel - Clean surface		

INTRODUCTION, SAFETY & PLANNED MAINTENANCE

Forklift 2000 Hour Inspection	Status	Landoll / Bendi AC
Operator's compartment capacity plate attached - Information matches model, serial no., and attachments		
Check all connections for proper torque		
Power steering system - Fill and air bleed		
Motor - Check that terminal studs and mounting bolts are clean and tight		
Motor - Clean cooling holes of debris or restrictions		
Gear box - Drain, flush, and refill		
Hydraulic oil - Change		
Hydraulic reservoir suction screens - Clean with solvent		

Date	Inspector:	Truck No.	Model No.	Location	Serial No.	Shift	Hr. Meter	Battery Fluid	Hydraulic Oil

Lubrication Specifications

Refer to Chapter 6 for Lubrication instructions, also See Figures 1-2 and 1-3 for reference.

Name	Lubrication	Notes
Mast Chain	SAE W. oil or Bowman Heavy Load Red Grease	Clean and re-oil
Mast Rail	Chassis Lube or Kendall Sr-12X.	Lube inner side of upright rail
Rotation Bearings	Texaco Ref. C&C #880	Use standard lubrication gun
Steering Knob	Light weight oil	Lightly oil
Battery Rollers (opt.)	SAE 30W oil	Drain, flush, and refill
Reservoir Cap	SAE 30W oil	Clean in solvent and re-oil
Hydraulic Reservoir	Mobil DTE13 (ISO Grade 32)	Drain, flush, and refill
Gear Case	Mobilube SHC-630 (ISO Grade 220 Synthetic)	Drain, flush, and refill
Master Cylinder	Heavy duty brake fluid DOT 3	Check level. Add if necessary
Gear Racks	Exposed Gear Lube, Mobil 375 NC	Aerosol Spray
Carriage Rollers	Texaco Ref. C & C #880	Use standard lubrication gun
Hubs, King Pin, and Tie Rod (Steer Axle)	Texaco Ref. C & C #880	Brush or spray on lubricant



Figure 1-2: Lubrication Locations

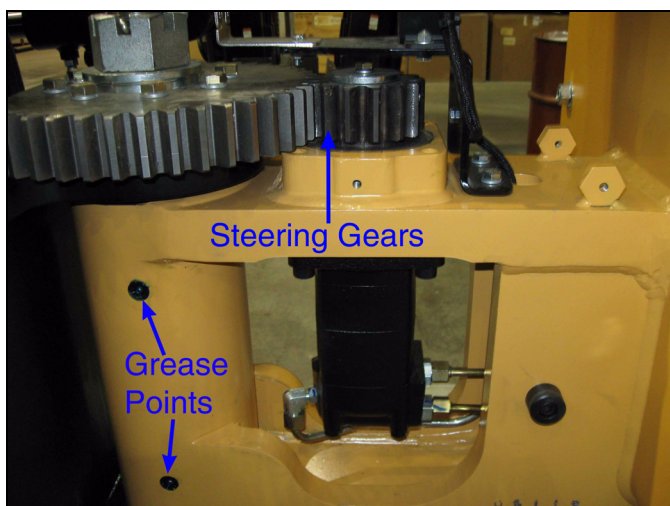


Figure 1-3 Rotation Bearing Grease Points

Torque Specifications

Component	Torque
Wheel	225 ft. lbs. (305 Nm.)
Fluid draining and filling plug	16 ft. lbs. (22 Nm.)
Hydraulic braking unit and brake cable	37 ft. lbs. (50 Nm.)
Drive motor with vehicle frame	130 ft. lbs. (176 Nm.)
Hydrostatic Steering Control Unit	
Plug and o-ring assy #8 SAE fitting	Refer to Torque Chart - Page 1-19
Steer control unit assy bolt (M8 X1.0)	18-23 ft. lbs. (24-31 Nm.)
Mounting bolts	23-25 ft. lbs. (31-34 Nm.)
Mast and Side Shift Mechanism	
Chain guard capscrews	48-52 ft. lbs. (65-71 Nm.)
Main lift cyl. plunger retainer	95-125 ft. lbs. (129-169 Nm.)
Free lift cyl. plunger retainer	275-300 ft. lbs. (373-407 Nm.)
Carriage roller capscrews	70-80 ft. lbs. (95-108 Nm.)
Chain and hose sheave screws	26-30 ft. lb. (35-41 Nm.)
Lift chain adjusting nuts	50-70 ft. lbs. (68-90 Nm.)
Backrest screws	145 ft. lbs. (197 Nm.)
Side shift mounting hooks	115-125 ft. lbs. (156-170 Nm.)

Fluid Capacities

Item	Capacity -Quarts (Liters)
Hydraulic Tank	11.6 gallons (44 liters)
Brake Fluid	0.21 quarts (0.20 liters)
Gear Box	16 oz.

General Torque Specifications (R 4/97)

This chart provides tightening torques for general purpose applications when special torques are not specified on process or drawing. Assembly torques apply to plated nuts and capscrews assembled without supplemental lubrication (as received condition). They do not apply if special graphite moly-disulfide or other extreme pressure lubricants are used. When fasteners are dry (solvent cleaned) add 33% to as received condition torque. Bolt head identification marks indicate grade and may vary from manufacturer to manufacturer. Thick nuts must be used on grade 8 capscrews. Use value in [] if using prevailing torque nuts.

Torque Specified in Foot Pounds

UNC SIZE	SAE Grade 2	SAE Grade 5	SAE Grade 8	UNF SIZE	SAE Grade 2	SAE Grade 5	SAE Grade 8
1/4-20	4 [5]	6 [7]	9 [11]	1/4-28	5 [6]	7 [9]	10 [12]
5/16-18	8 [10]	13 [13]	18 [22]	5/16-24	9 [11]	14 [17]	20 [25]
3/8-16	15 [19]	23 [29]	35 [42]	3/8-24	17 [21]	25 [31]	35 [44]
7/16-14	24 [30]	35 [43]	55 [62]	7/16-20	27 [34]	40 [50]	60 [75]
1/2-13	35 [43]	55 [62]	80 [100]	1/2-20	40 [50]	65 [81]	90 [112]
9/16-12	55 [62]	80 [100]	110 [137]	9/16-18	60 [75]	90 [112]	130 [162]
5/8-11	75 [94]	110 [137]	170 [212]	5/8-18	85 [106]	130 [162]	180 [225]
3/4-10	130 [162]	200 [250]	280 [350]	3/4-16	150 [188]	220 [275]	320 [400]
7/8-9	125 [156]	320 [400]	460 [575]	7/8-14	140 [175]	360 [450]	500 [625]
1-8	190 [237]	408 [506]	680 [850]	1-14	210 [263]	540 [675]	760 [950]
1-1/8-7	270 [337]	600 [750]	960 [1200]	1-1/8-12	300 [375]	660 [825]	1080 [1350]
1-1/4-7	380 [475]	840 [1050]	1426 [1782]	1-1/4-12	420 [525]	920 [1150]	1500 [1875]
1-3/8-6	490 [612]	1010 [1375]	1780 [2225]	1-3/8-12	560 [700]	1260 [1575]	2010 [2512]
1-1/2-6	650 [812]	1460 [1825]	2360 [2950]	1-1/2-12	730 [912]	1640 [2050]	2660 [3325]

METRIC:

Coarse thread metric class 10.9 fasteners and class 10.0 nuts and through hardened flat washers, phosphate coated, Rockwell "C" 38-45. Use value in [] if using prevailing torque nuts.

Nominal thread diameter (mm)	Newton-Meters (Standard Torque)	Foot-Pounds (Standard Torque)	Nominal Thread Diameter (mm)	Newton-Meters (Standard Torque)	Foot-Pounds (Standard Torque)
6	10 [14]	7 [10]	20	385 [450]	290 [335]
7	16 [22]	12 [16]	24	670 [775]	500 [625]
8	23 [32]	17 [24]	27	980 [1105]	730 [825]
10	46 [60]	34 [47]	30	1330 [1470]	990 [1090]
12	80 [125]	60 [75]	33	1790 [1950]	1340 [1450]
14	125 [155]	90 [115]	36	2325 [2515]	1730 [1870]
16	200 [240]	150 [180]	39	3010 [3210]	2240 [2380]
18	275 [330]	205 [245]			

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Hydraulic Fitting Torque Specifications

37 degree JIC, ORS, & ORB (REV. 10/97)

This chart provides tightening torques for general purpose applications when special torques are not specified on process or drawing. Assembly torques apply to plated nuts and capscrews assembled without supplemental lubrication (as received condition). They do not apply if special graphite moly-disulfide or other extreme pressure lubricants are used. When fasteners are dry (solvent cleaned) add 33% to as received condition torque. Bolt head identification marks indicate grade and may vary from manufacturer to manufacturer. Thick nuts must be used on grade 8 capscrews. Use value in [] if using prevailing torque nuts.

Hydraulic Fittings Torque Specified

(IN FOOT POUNDS)

Parker® Brand Fittings

Dash Size	37 Deg. JIC	O-ring (ORS)	O-ring boss
-4	11-13	15-17	13-15
-5	14-16	-----	21-23
-6	20-22	34-36	25-29
-8	43-47	58-62	40-44
-10	55-65	100-110	58-62
-12	80-90	134-146	75-85
-16	115-125	202-218	109-121
-20	160-180	248-272	213-237
-24	185-215	303-327	238-262
-32	250-290	-----	310-340

Aeroquip® Brand Fittings

Dash Size	37 Deg. JIC	O-ring (ORS)	O-ring boss
-4	11-12	10-12	14-16
-5	15-16	-----	16-20
-6	18-20	18-20	24-26
-8	38-42	32-35	50-60
-10	57-62	46-50	75-80
-12	79-87	65-70	125-135
-14	-----	-----	160-180
-16	108-113	92-100	200-220
-20	127-133	125-140	210-280
-24	158-167	150-165	270-360

General Bendi AC Troubleshooting Chart

Shown on the following page is a general Bendi AC troubleshooting chart that will allow the service technician to diagnose areas of failure, by way of audible, performance and pump conditions and then proceed to the proper chapter in this Maintenance Manual for detailed service.

Condition	Cause	Suggested Repair
AUDIBLE PROBLEMS		
Back up alarm does not sound.	Faulty alarm module. Electrical problem-frayed or broken wires, faulty direction control switch or electronics.	- Continuity check alarm module-replace as needed. - Check related wire harnesses and connectors for contact problems, broken wires, etc. - Examine cable assemblies - tight connections. - Wire terminal crimps should be secure and wire stranding must not be frayed or corroded.
Unusual noise when truck is in motion.	Rubbing or binding brake pads in rear wheels (possible frozen caliper). Faulty gear box assembly.	- Attempt to isolate cause of noise. - Drive truck slowly having another operator check for the unusual noise. - Step on brakes lightly to see if brakes are binding or rubbing excessively - repair or replace. - Replace if defective.
Singing noise.	Insufficient fluid level in gearbox. Faulty motor bearing.	- Check fluid level. Check and add lubricating oil as needed. - Repair or replace bearing or motor.
Muffled grinding noise.	Faulty wheel bearings - could be insufficient fluid or high pre-stress or excessive play on bearings. Damaged planetary step gearing - could be insufficient fluid, excessive play in bearing.	- Determine if noise is in the front or rear. - Dismount gear box and examine for damage.
Clicking noise during a turn.	Loose or shifting component.	- Try to isolate the area of the noise, then check for loose parts, misalignment, load shifting, etc. - Check that components are in place and properly torqued.
Horn does not work.	Faulty horn assembly or push button. Blown fuse.	- Disconnect horn wires and push button - continuity test horn with leads connected to battery power. - Check related wire harnesses and connectors for contact problems, broken wires, etc. - Examine cable assemblies for tight connections. - Wire terminal crimps should be secure and wire stranding must not be frayed, pinched or corroded. - Check fuse. - Check for electrical shorts in wiring or components.

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Condition	Cause	Suggested Repair
Rubbing noise from the front wheel.	Faulty wheel bearing or damaged wheel shaft.	- Dismount suspected wheel and examine bearings and shaft. - Check for foreign material lodged inside wheel hub - remove and repair and/or replace as needed.
Scraping noise when the mast is operated	Out of alignment. Faulty hydraulic cylinder - lift, tilt and/or shift.	- Realign and shim mast rails accordingly. - Determine which cylinder is bad-rebuild or replace. (Seal kits are available for repair and can be ordered from the parts book)
PERFORMANCE PROBLEMS		
NO operation!	Battery disconnected or insufficient charge. Emergency STOP (disconnect) push button is pressed. Improper start-up sequence. Blown fuse.	- Make sure battery installed is a 48 VDC battery. - Check battery for connection. - Check battery for full charge. - Check push button and if necessary, release push button. - Place the direction switch in NEUTRAL before power on. - Remember to wait about ten (10) seconds after power on to allow diagnostic testing. - Check main power fuses (425 Amp). - Check for electrical short, or electrical connections.
Poor truck performance.	Battery undersized. Undercharged battery. Excessive electrolyte loss. Defective battery.	- Refer to capacity plate for battery rating and install battery with proper ratings. - Check/test battery characteristics. - Adjust specific gravity at state of full charge. - Replace battery.
Service brakes do not stop the truck.	Low fluid level in master cylinder reservoir. Worn brake shoes. Brake pedal linkage adjustment. Brake shoe contamination.	- If low, check for leaking fittings or lines - tighten and/or replace. Add brake fluid and bleed brakes if needed. - Also check wheel cylinders for leaks -replace if needed. - Check brake shoes for wear or defects -always replace both sides. - Check linkage for loose nuts, broken or stressed linkage, improper adjustment - repair and re-adjust. - If the shoes are saturated, they must be replaced.

Condition	Cause	Suggested Repair
Spongy or soft service brake pedal.	Possible air in brake lines. Faulty master cylinder. Faulty wheel cylinders.	• Bleed air from brake lines - indicated by bubbles in fluid during fluid bleed, or when checking the master fluid reservoir. • Check brake system for loose fittings, cross threaded fittings and brake cylinders for leaks. • Also check master cylinder reservoir fluid level - low level can allow air into lines. • Examine the brake lines, wheel calipers and master cylinder for leaks - repair immediately, then bleed the brakes. • Also check master cylinder piston for worn seals. • Remove the master cylinder filler cap and "slowly" press the brake pedal. A pulse of fluid should be seen in the cylinder reservoir. If not, replace the cylinder. • Check wheel cylinders for leaks - rebuild or replace.
Parking brake does not hold the truck.	Brake cable system malfunction or out of adjustment.	• Check parking brake linkage for loose nuts, broken or stressed linkage, improper adjustment - repair and readjust.
Steering drifts/wanders or is erratic.	Low fluid or leaks in power steering system. Worn or out-of-adjustment steer assembly. Insufficient hydraulic pressure. Steering potentiometer misaligned. Worn, loose wheel bearings. Air in the hydraulic system.	• Check hydraulic fluid level -replenish as necessary. • Check all related components for seal or fitting leaks - repair or replace. • Check motion control valve cartridges for foreign material (these are replaceable cartridges and will wear out over time). • Failed or weak orbitrol centering spring will cause the steering to drift - replace accordingly. • Check if steer pinion gear is seated properly on steer motor. • Make sure the shaft woodruff key, between steer pinion gear and steer motor is installed correctly. • Bad steer motor - repair or replace accordingly. • Check hydraulic pressure of steering relief valve (2,600 psi). • Check steering motor for seal leaks, sticking or improper adjustment - repair or replace. • Perform dash calibration. • Check wheel bearings - replace as needed. • Check the inlet connections to determine where air is being drawn into the system. • Tighten loose connections. • Check the minimum drive speed which may be too slow to prime the pump. • Bleed hydraulic system.

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Condition	Cause	Suggested Repair
Hard steering effort in one or both directions.	Vehicle overloaded. Low hydraulic fluid. Low flow rate or fluid pressure. Components in steering linkage binding or making noise.	• Vehicle overloaded. NEVER exceed capacity of the truck. • Check capacity nameplate for tire specs. • Never exceed vehicle capacity. • Add hydraulic fluid until dipstick shows full. • Check/fill hydraulic oil level, low flow rate or fluid pressure. • Restriction in fluid return line or line is too small. Remove line, clean and/or replace line. • Check pump. • Check hydraulic pressure - 2,600 psi. • Check for steering column, orbital, front rotation bearing noise. • Check steer priority valve. Replace if needed.
Lost motion at the steering wheel.	Steering wheel loose on column or stripped. Air in the hydraulic system.	• Check and retorque the steering wheel locking nut. • Check the inlet connections to determine where air is being drawn into the system. • Tighten loose connections. • Check the minimum drive speed which may be too slow to prime the pump. • Bleed hydraulic system
Truck does not turn.	Hydraulic pump not activated.	• Check that the hydraulic pump/motor is activated when the operator is on the seat and the direction is selected.
Truck moves slowly.	Battery may be too low. Traction motor encoder error. Faulty accelerator switch module. Overheated motor or motor controller (thermal cutback). Truck has gone into LOS Mode ("Loss of Sensor" also known as "Limp Home Mode")	• Check battery charge state and recharge battery, if necessary. A discharged battery reduces effective voltage across the traction motors and control circuits. Slow travel speeds and erratic contactor operation may result. • Verify encoder is operational. • Replace accelerator switch module. • If overheating is suspected, turn OFF the truck, and allow time for the system to cool. While the truck is cooling, check the following: • Check motor compartment cooling fans to ensure they are operating and clean. • Look at dash display to check for errors. Record fault code to determine problem - Refer to chapter 5 for calibration and programming fault code definitions.
Truck does not move.	Battery charge state too low. System fault is present. Faulty direction control lever. Faulty accelerator switch assy. Open armature on traction motor.	• Check battery charge state and recharge battery if necessary. • Check dash display for fault condition. Refer to controller troubleshooting if fault is present. • Check that the direction control forward-neutral-reverse control is functioning properly. • Repair accelerator switch. • Repair or replace.

Condition	Cause	Suggested Repair
Creep speed or acceleration sluggish.	Control panel system is improperly adjusted.	Re-adjust the control panel.
Mast does not lift load.	Attempting to lift a load in excess of the truck's capacity. Faulty lift pot. Battery charge state may be too low. Low hydraulic oil. Faulty hydraulic control valve. Insufficient system pressure. Faulty pump. Note: If the pump were faulty, other mast functions would also be affected. Blown fuse. Mechanical damage to mast.	- NEVER attempt to lift a load heavier than the specified rating of the truck. - Replace lift pot. - Check battery charge state and recharge battery if necessary. - Low levels can cause the cylinder to "cavitate" and not permit full lift of the mast. Add hydraulic oil. - Bent or damage plunger, worn internal seals - repair or replace as needed. - Check hydraulic pressure of system relief valves. Try re-adjusting the pressure relief valves. Maximum system pressure must not exceed 2,800 psi. - Check valves for seal leaks, sticking or misadjustment. - Repair or replace and/or readjust accordingly. - If problem persists, replace the relief valve cartridge. - Check settings. - Replace the pump. - Determine which cylinder is leaking or binding - rebuild or replace. Seal kits are available. - Check lift pump control fuse. - Check mast for damage and signs of improper adjustment.
Mast lifts slowly - loss of lift speed.	Attempting to lift a load in excess of the truck's capacity. Faulty lift pot. Battery charge state may be too low. Controller output incorrect. Insufficient pump or relief valve pressure setting. Mechanical damage of the mast. Hydraulic cylinders leaking.	- NEVER attempt to lift a load heavier than the specified rating of the truck. - Adjust or replace. - Check battery charge state and recharge if necessary. - Check settings. - Check settings. - Repair or replace. - Repair or replace.

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Condition	Cause	Suggested Repair
Mast drifts downward.	Excessive load - attempting to lift loads beyond the capacity of the truck. Pressure relief valve malfunction. Lift hydraulic cylinders leaking or binding. Faulty lift control valve.	• Never exceed truck lift ratings. • Adjust system pressure. • Oil may be bypassing between the spool and body - repair or replace directional control valve. • The spool is not centering properly or is broken - repair or replace directional control valve. • Check the Appendix for vendor service information, where applicable.
Mast does not tilt.	Inoperative tilt directional control valve. Faulty switch. Insufficient pump or relief valve pressure. Inadequate lubrication or worn bearings. Lower mounting hooks installed incorrectly. Restricted or leaking supply hoses. Hydraulic cylinder leaking or binding. Controller output incorrect.	• Repair or replace. • Continuity test switch. Replace if defective. • Check settings and adjust pressure. • Follow recommended maintenance schedule. • Check the Appendix for vendor service information, where applicable. • Locate restriction or replace hose. Tighten fittings to seal any leaks. • Shift cylinder is leaking or binding-rebuild or replace. Seal kits are available for most cylinders. • Check settings via the 1314 software program.

Condition	Cause	Suggested Repair
Intentionally empty		
PUMP PROBLEMS		
No hydraulic pressure.	Pump driven in the wrong direction of rotation <i>after</i> servicing. Coupling or shaft sheared or disengaged. Oil intake line is restricted. Fluid viscosity too heavy to pick up prime.	• Change the drive direction immediately to prevent seizure. • Correct the pump cartridge ring position for each direction of rotation. • Check the Appendix for vendor service information, where applicable. • Disassemble the pump and check the shaft and cartridge for damage. • Check all strainers and filters for dirt and sludge - clean or replace. • Completely drain the system. • Add new filtered oil of the proper viscosity.
Leaking fluid.	Cracked or cut hoses, where applicable. Loose or faulty hose clamps, where applicable. Loose or faulty hydraulic fittings. Oil seals deteriorated.	• Replace. NEVER attempt to patch a hose. • Tighten and/or replace. • Tighten and/or replace. Be careful not to strip the threads, rendering the fitting defective. • Disassemble the unit and replace the oil seals.
Pump making noise.	Pump intake partially blocked. Air leaks at the intake or shaft seal. (Oil in reservoir would possibly be foamy.) Damaged pump/motor mounting.	• Service the hydraulic tank intake strainer. • Check the fluid condition and, if necessary drain and flush the hydraulic system. Refill with clean oil. • Check intake lines (hoses and fittings) and seals for leaks. Repair all leaks. • Repair and/or replace.
Significant loss of speed under load.	Lack of sufficient oil supply. Excessive heat source. High internal pump leakage. Severely worn or damaged internal splines.	• Check for faulty relief valve and adjust or replace as required. • Check for and repair worn pump. • Check for correct oil. • Locate excessive heat source (usually a restriction) in the system and correct the condition. • Disassemble unit and replace worn rotor set. • Disassemble unit and replace worn rotor set, drive link and coupling shaft.

Table provided for general use with this manual.

[illegible]

Chapter 2

Tires, Brakes and Drivetrain

Floor Plate

NOTE

While not absolutely necessary for many of the repairs described in this section, sometimes the removal of the floor plate can decrease the required downtime needed for maintenance work. The floor plate removal and reassembly takes only a few minutes, and for this reason, it is described early in this chapter.

When instructions are given for repairs in this chapter, it will automatically be assumed that the floor plate has been removed.

Floor Plate Removal and Assembly

This panel provides access to the accelerator assembly which is mounted to the underside of the floor plate. The master cylinder and service brake pedal and linkage are mounted within the frame well, easily accessible when the floor plate has been removed.

1. Thoroughly clean the floor area using a vacuum.
2. Lift up the rubber floor mat, carefully separating it from the accelerator and brake pedal. (See Figure 2-1)
3. Remove the 5/16"-18 floor plate fasteners.
4. Remove the left floor plate from the truck frame.
5. Carefully lift up the right floor plate a few inches. The accelerator pedal assembly will still be attached to the floor plate by the accelerator wiring harness. Unhook the accelerator harness and lift away the floor plate.
6. Assemble in reverse procedure.

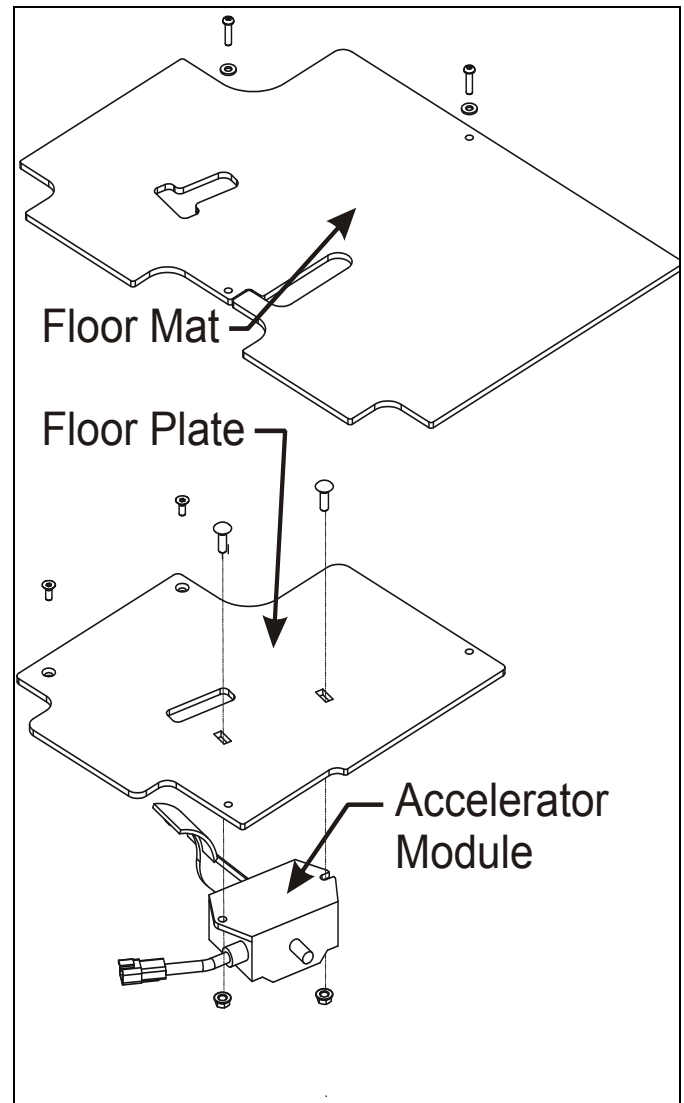


Figure 2-1 Floor Plate Assembly

Tire Inspection



WARNING

The truck is equipped with tires of a size and hardness that provide the necessary traction and still maintain a proper shape to minimize tipping. To maintain stability and maximum reliability, you must always replace tires with the type originally supplied and torqued to specification as listed on the specification sheet on page 1-17.

IMPORTANT

It is recommended to replace worn follower tires in pairs. A treaded drive tire must be replaced when the tread depth is less than 0.0625" (1.6mm) at the deepest point. Careful driving habits add additional miles to tire life.

NOTE

- Check all drive wheel lug nuts after 2 to 5 hours of operation when new lift trucks begin operation and on all lift trucks when the drive wheel has been removed and installed.
- Tighten the nuts in a cross pattern to the correct torque value of 225 ft. lbs. (305 Nm). When the nuts stay tight for eight hours, the interval for checking the torque can be extended to 200 hours.

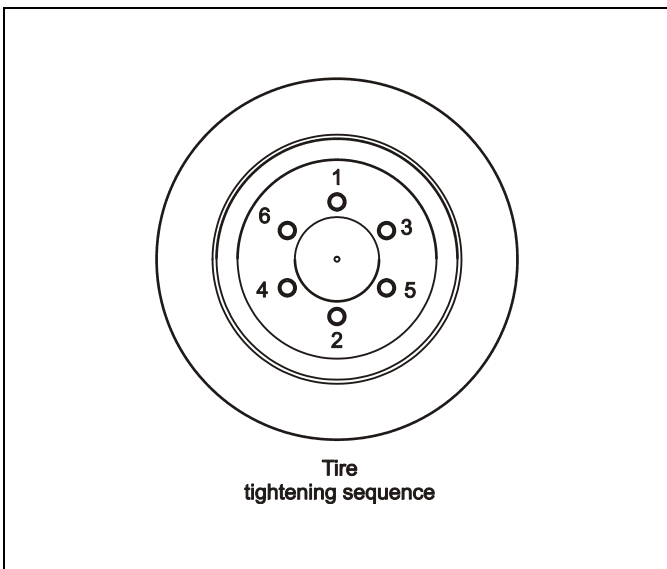


Figure 2-2 Tire Tightening Sequence

Visual Inspection

1. Inspect the tires for chunking (or chipping), embedded foreign material (wire, rocks, glass, metal, etc.), cuts, gouges, undercutting or uneven wear. Remove any object that will cause damage.
2. Check for loose or missing hardware.
3. Remove any wire strapping or other material that is wrapped around the inside of wheel.
4. Make sure drive wheel nuts are tight. Tighten the wheel nuts in a criss-cross pattern to a correct torque value (225 ft. lbs (300 Nm)). (See Fig. 2-2)

Chunked Tires or Embedded Objects

IMPORTANT

- **Chunking, or chipping is caused by repeatedly running over objects on a littered floor which can chip away or produce deep cuts to the rubber surface of the tire. Embedded objects, such as glass, metal chips, or nails left in a tire, and truck overloading cause the same effect.**
 - **Sharp, rapid turns at quick speeds, jack-rabbit starts and stops and other such bad driving habits can cause the same kind of damage.**
1. Remove any embedded foreign material from the tire as soon as it is noticed. Also remove torn pieces of tread.
 2. To avoid overloading, always center the payload on the truck to equalize the load on all tires. Do not dangle the load on the ends of the forks. Also avoid fast cornering, which can cause an overload affect.
 3. If the tires are chunked bad enough to produce a bouncy ride, replace them.

Undercutting and Uneven Wear

IMPORTANT

- **Undercutting is caused by continuous overloads, rapid, sharp turns, operating on slopes, a faulty drive axle, transporting loads with a high center of gravity, or transporting off-center loads.**
 - **Uneven tire wear is usually the result of mechanical defects, such as badly adjusted brakes, misaligned wheels (misaligned steer axle), or a faulty drive train.**
1. Undercutting causes the rubber to bulge out over the edge of the steel band, cutting the rubber just above the base band.
 2. Check that the tires remain centered on the wheels to prevent splitting of the base band and tread separation.
 3. Correct such defects as soon as possible.

Flat-spotting

IMPORTANT

Flat-spotting occurs when:

- **The truck has been sitting idle for some time after heavy use and is usually caused by the tires overheating.**
 - **The truck has standing loads (loads left on the forks overnight).**
 - **Locking the brakes while traveling in either direction on grades (slopes), with or without a load, causing excessive skidding. Polyurethane tires are extremely susceptible to this type of abuse.**
1. Avoid excessive heat. Where possible, avoid contact with hot metal or operation for long periods in hot oven rooms. Excessive heating will break-down the tire structure. Shields which prevent heat from striking tires directly will often prolong life.
 2. Avoid standing loads. In addition to being unsafe, solid tires will flat-spot when loads are left standing on the truck overnight. In extreme cases, a flat spot develops and the tire bounces with every revolution.
 3. If the tires are flat-spotted bad enough to produce a bouncy ride, replace them.
 4. Do not indulge in stunt driving or horseplay where excessive hard braking is needed, especially on grades (slopes).

Extending Tire Life

A few simple measures can help increase tire life and reduce maintenance (downtime) and cost of operation.

1. Inspect tires regularly and remove embedded objects when they are found.
2. Check that the tires remain centered on the wheels.
3. Use a replacement tire that meets Landoll's B3/30 new tire specifications.
4. Keep runways clean and maintain floors in good repair, free from breaks, ruts, cracks and debris.
5. Avoid excessive heat, overloading and standing loads.
6. Regularly check axle alignment and steering.
7. Avoid sharp turns and quick starts and stops.
8. Avoid oil, grease, gasoline and acid. Wipe these compounds off as soon as possible.
9. Do not allow hydraulic oil to drip onto the tires.

Replacing the Drive Tire



WARNING

Make sure that replacement drive tires are of the same size and composition as what was originally supplied by Landoll Corporation. Tire composition can affect braking, capacity, turning and operator safety. Landoll Bendi B3/30 tires are an interference type, meaning the tires are pressed on and pressed off. The front drive tire can be replaced individually, but the two follower tires should be replaced in pairs to maintain performance and stability.



CAUTION

Replacing pressed-on tires should be done only by technicians who have been specifically trained for this procedure and have the specific tools to perform this job.

1. Park the truck at a level, designated work area. Lower the forks and chock the wheels.
2. Remove the ignition key and place in a secure area.
3. Perform a Lock Out/Tag Out procedure.
4. Lift the truck so that the tire being replaced is just off the floor.
5. Remove the lug nuts to replace the front drive tire.
6. Replace tire only with Landoll approved replacement part.

TIRES, BRAKES AND DRIVETRAIN

7. Press the replacement tire onto hub. The replaced tire gets pressed off during this procedure. Make sure the outside of the new tire is flush with the hub.
8. Install tire/hub assembly onto the truck and torque lug nuts to 225 ft. lbs. (305 Nm.) in a cross-cross pattern. (See Figure 2-2).

Disassembling and Inspecting Rear Wheel Bearings

1. First, review Before You Begin on page 1-1.
2. Lift axle and support wheel so it is free to rotate.
3. If the diameter of the tire is less than 13", Landoll recommends that the tire be replaced.
4. Remove hub cap, 1-14" hex slot nut, lock washer, and outer bearing. (See Figure 2-3)
5. Slide hub/wheel assembly from spindle. Remove inner bearing cone and seal from hub.
6. Clean bearing cones and seal. Clean bearing cups inside hub.
7. Examine for damage and replace bearing if needed.
8. Replace bearing cones if cones are cracked or pitted.
9. Replace seal if worn or damaged.

NOTE

You should pre-pack the bearings with grease before replacing. Bearing components get replaced as a set.

Replacing the Braking Tires

NOTE

Rear braking tires must be replaced in pairs, but do this procedure one tire at a time. Replacement braking tires must have same size and composition as factory tires.



CAUTION

Replacing pressed-on tires should be done only by technicians who have been specifically trained for this procedure and have the specific tools to perform this job.

1. Follow steps 1-3 on "Replacing the Drive Tire" on page 2-3.
2. Continue with steps 2-9 on "Disassembling and Inspecting Rear Wheel Bearings" on page 2-4.
3. Press the replacement tire onto the hub. The replaced braking tires gets pressed off as the new tire gets pressed on. Make sure the outside of the new tire is flush with the hub.

4. Continue with all steps of "Assembling Rear Wheel Bearings" on page 2-4.

Assembling Rear Wheel Bearings

1. If bearing cups are replaced, clean hub and press new bearing cups into hub. (See Figure 2-3).
2. Pack wheel bearings with grease.
3. Place outside face of wheel down on bench. Insert inner bearing and carefully drive seal in until flush with hub.
4. Carefully slide hub, bearing, and seal assembly onto spindle.

IMPORTANT

Avoid damaging the grease seal. A damaged seal must be replaced.

5. Put a moderate amount of wheel bearing grease in the hub cavity area between the inner and outer bearing space.
6. Insert the outer bearing cone and washer. Tighten hex slot nut against spindle washer by hand.
7. Adjust bearing preload by slowly rotating hub while tightening hex slot nut until resistance is felt. (Approximately 75 ft./lbs) Back nut off 1/16 of a turn or until a notch aligns with the lock nut tab.
8. Readjust if the wheel does not rotate smoothly.
9. Using a small hammer, lock the hex slot nut in place by tapping a tab from the lock washer down into the slot on the hex slot nut.
10. Apply a thin layer of grease to the hub cap o-ring and press hub cap into hub.

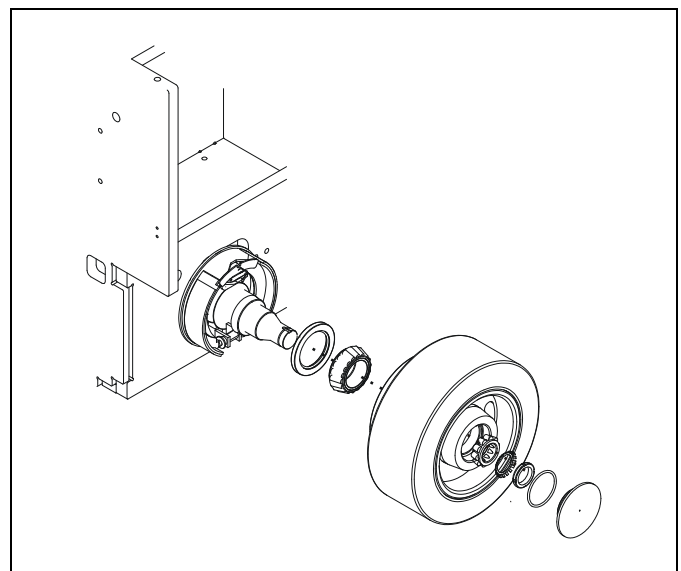


Figure 2-3 Rear Wheel Bearing Assembly

Brake System

The drum brakes are self-adjusting and should require no maintenance after the initial technician setup. Typical brake assembly illustration shown on top of page 2-7 for reference.

IMPORTANT

- Safety must always be paramount when working on brake system components.
- Parts that are not in perfect working condition should not be used. It is recommended to only use genuine Landoll parts.
- Whenever servicing a brake component, it is recommended to service both sides of the truck to ensure that both sides have equal braking and to prevent premature wear and uneven braking action.
- If you are unsure about a procedure, seek professional help.
- Wear eye protection. If brake fluid comes in contact with eyes, immediately rinse with water and seek medical attention.
- Use only DOT #3 brake fluid. Brake fluid will damage paint. Cover all body parts and be careful not to spill brake fluid during brake maintenance.
- Do not use petroleum based solvents to clean brake parts. Use only brake cleaner or denatured alcohol.
- Do not use compressed air to blow particles from the brake assembly.
- Make sure you strictly adhere to all clearances and torque specifications.
- When you are finished working on the brakes, test them carefully under controlled areas before releasing truck for operation.
- If the contact surfaces of the drums show cracks, score marks, deep grooves, a raised lip on the outer edge, or signs of overheating or warping, the drum must be replaced.
- If a problem is suspected, do not release or drive the truck until the problem is corrected.

Brake System Service

NOTE

Braking of the Bendi B3/30 AC truck is accomplished by using the drive motor for restraining the truck, or by putting pressure on the brake pedal. When the accelerator pedal is released, the moving motion of the truck is restrained by the drive motor in both the forward and reverse direction. Stopping the truck can also be done by the normal pressing of the brake pedal.

Check Service Drum Brakes

- The service brakes are hydraulically-actuated drum brakes, similar to an automotive drum brake system. The brake drums are installed on the two rear wheels only.
- The brakes should be checked every 200 hours of operation. Normal brake shoes can last 3,000 hours of operation, but that figure can vary widely as determined by the operator and driving conditions. If you are near or beyond this time frame, you must thoroughly inspect the brakes.
- New brake shoes are approximately 0.265" (6.7 mm) thick. Replace them when the shoe thickness is 0.0625" (1.588 mm) or less.

NOTE

A few indications of possible brake shoe replacement are:

- Excess travel of the service brake pedal.
- The truck pulling to one side when the brakes are applied.
- Squealing or grinding is heard when brakes are applied.
- Drive the truck at creep speed and apply brakes lightly, to determine if brakes pads are contacting the drum. You should feel pedal resistance as the shoes contact the drum.
- If any of the above occurs during brake inspection, see "Checking/Changing Brake Shoes," beginning on page 2-6.

The service brake pedal must also have about 1/2" (12.7 mm) of the travel remaining when the brakes are fully applied. If less than 1/2" (12.7 mm) is available, adjust or check the shoes for wear and replace as needed.

TIRES, BRAKES AND DRIVETRAIN

Checking/Changing Brake Shoes

The brakes are located in the rear drum/wheel assembly and are attached to a backing plate. Typical brake assembly illustration shown on top of page 2-7 for reference.

1. First, review Before You Begin on page 1-1.
2. Set the key switch to OFF, remove the key from the key switch and secure key in a safe place.
3. Perform a Lock Out/Tag Out procedure.
4. Place blocks in front of and behind all other wheels not being serviced.
5. Raise and block the side of the truck being serviced.
6. Remove the hub cap and o-ring.
7. Lift lock washer tang, and remove the lock nut.
8. Remove the integrated brake drum/wheel assembly.

NOTE

If the wheel will not come off, make sure the parking brake is completely released. In extreme cases of wear, the brake shoes must be fully returned (retracted) before the wheel can be removed. Brake fluid will damage paint. Have a container and shop rags handy to soak up any spilled brake fluid. Cover all body parts and be careful not to spill fluid during this procedure.



WARNING

Do not use forced air to clean brake parts.

9. Check the inside contact surfaces of the drums for cracks, score marks, deep grooves, a raised lip on the outer edge, and signs of overheating. If the drums show blue spots, indicating overheated areas, the drum must be replaced. Also, look for surface glazing, grease or brake fluid on the shoe contact surfaces. Grease and brake fluid can be removed from metal surfaces, but if the shoes are contaminated, they must be replaced. Surface glazing, which is a glossy, highly polished finish, can be removed with medium grit emery cloth. (100-120 grit)
10. Before removing the internal brake components, wash (spray) them with brake cleaner and allow to dry. Position a container under the brake assembly to catch the excess residue.
11. Pull or press to release the star wheel adjuster latches and turn the star wheel to retract both the front and rear brake shoes.
12. Loosen one clamp hold-down screw and remove the other screw to allow the clamp to drop down making it easier to remove the front and rear return springs.

13. Unhook and remove both return springs.
14. Press in on the hold-down spring and pop it to one side (opposite of where hook is attached) to free the spring hook from the rear of the brake backing plate. This will require some force to compress the spring to pop it free.
15. Remove both hold down screws and the hold down clamp. Carefully separate the front and rear shoes from the wheel cylinder and parking brake lever assembly.
16. Clean the area and check the wheel cylinder for leaks. Pull back on the bottom portion of the rubber boot on both sides of the cylinder. If it is not dry, see "Repairing Brake Wheel Cylinders," page 2-7.

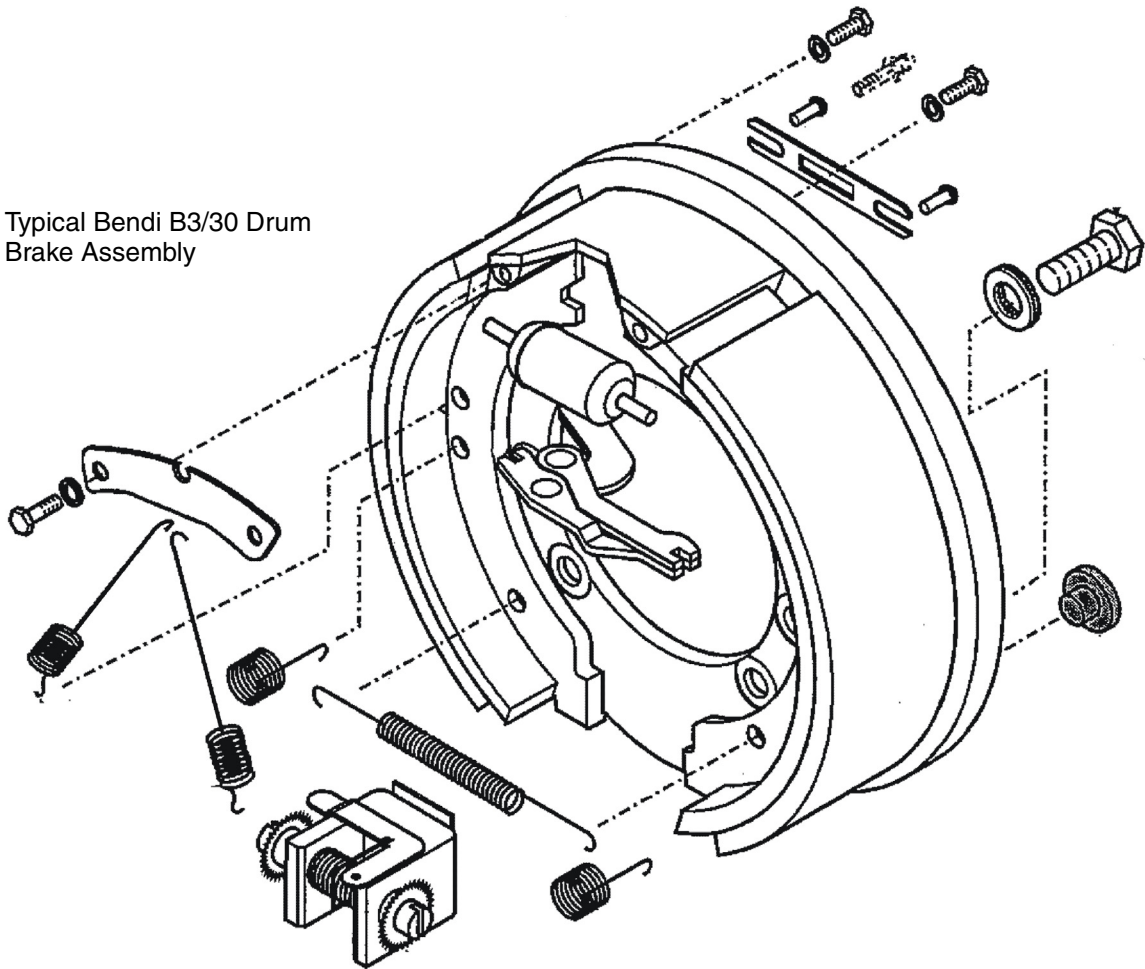
NOTE

Check the brake lines for cracking, splits, or any apparent weakness - replace as needed.

17. SPARINGLY lubricate the brake shoe contact areas of the backing plate with high temperature grease. Install the new brake shoes and install the brake drum (two outer hex head screws and hardware). Do not allow any grease to come in contact with braking area of the shoe. Torque the screws to specifications shown on page 1-18 on the "General Torque Specification" chart.
18. Install the new brake shoes by following the above instruction in reverse order. Be sure that all springs are properly hooked at both ends and that they hold-down clamp screws are tight.
19. Wiggle the brake assembly to ensure that the shoes are centered on the backing plate.
20. Reinstall components in reverse order. (See "Assembling Rear Wheel Bearings" on page 2-4)
21. Bleed the brakes. (See page 2-14)
22. Pump the brakes several times to seat the new brake shoes.

Make a few normal stops in forward and reverse to allow the brakes to further seat themselves. DO NOT lock the brakes which could cause flat spots.

Typical Bendi B3/30 Drum
Brake Assembly



Repairing Brake Wheel Cylinders

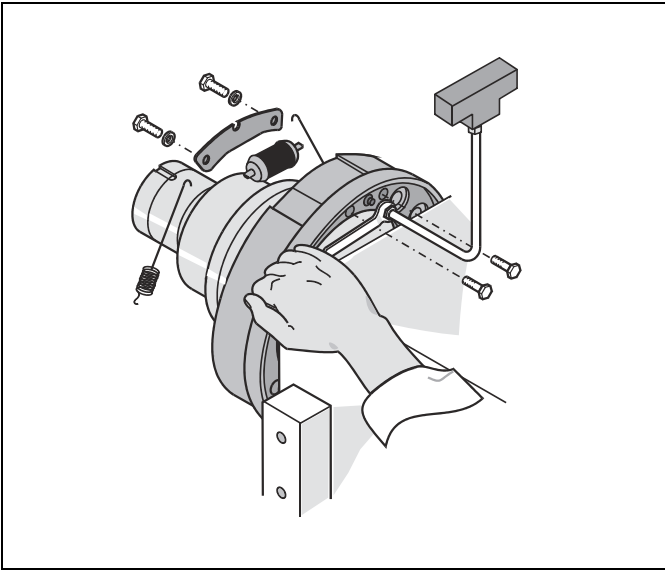
NOTE

The wheel cylinder, if it freezes-up or shows signs of leakage, must be replaced before returning the truck to operation.

1. Set the key switch of OFF and place the key in a secure place.
2. Initiate a Lock Out/Tag Out procedure.
3. Raise the side of the truck being serviced.
4. Remove the wheel. (See "Replacing Brake Drum Assemblies", page 2-8)
5. Remove the brake shoes. (See "Changing Brake Shoes", on page 2-6)
6. Using a flare-nut wrench, disconnect the brake fluid inlet line from the wheel cylinder. Have shop rags handy to soak up any spilled fluid. (See Figure 2-4)
7. Do not pull the brake line away from the cylinder. Plug the end to reduce fluid loss and contamination.
8. Remove the two bolts holding the cylinder to the backing plate.
9. Install the new cylinder and tighten fasteners to the specified torque as shown in "General Torque Specifications" on page 1-18.
10. Connect the brake inlet line and install the brake shoe assembly and drum. To avoid stripping the brass threads, do not overtighten the brake line fittings. (See "Changing Brake Shoes," on page 2-6)
11. Reinstall the components in reverse order.
12. Bleed the brakes. (See "Bleeding Brakes" on page 2-14)

NOTE

When replacing a brake assembly, a wheel cylinder or a master cylinder, it is advisable to purge the entire brake system of old, possibly contaminated fluid.

**Figure 2-4 Wheel Cylinder Repair**

Hydraulic Brake Drums

NOTE

Whenever servicing and/or replacing a brake drum assembly, you must service both sides of the truck to prevent premature wear and uneven braking action. The drum and the wheel is an integrated assembly.

Measure Brake Drum Diameter

Repeat steps 1 through 8 of preceding section "Checking/Changing Brake Shoes", beginning on page 2-6.

Check the drums for scoring, cracks, deep grooves, a raised lip on the outer edge, signs of overheating, out of round or other damage.

Drum diameter measurements may be checked with the drum removed from the truck. Using a brake drum gauge, measure the diameter at four or more points on the drum and make sure all measurements are taken at the same distance in from the outer edge of the drum.

Thickness variations of more than 0.005" (0.13 mm) can cause pedal pulsation and/or vibration when applying the brakes. A drum that does not meet these specifications must be turned or replaced.

Replacing Brake Drum Assemblies

1. Repeat Steps 1 through 9 of preceding section "Checking/Changing Brake Shoes", beginning on page 2-6.
2. Check the brake lines for cracks, splits or any apparent weaknesses. Replace as needed.
3. Loosen the locknut and hardware from the spindle. DO NOT remove the nut from the assembly at this time.
4. Rock the drum back and forth while gently pulling on the drum.
5. If needed, using the rubber mallet (dead-blow hammer), hit the drum on the opposite side, driving it towards the loosened nut.
6. Repeatedly hit the drum evenly in a circular motion until it pops free, then remove the nut.
7. Remove the drum and tire assembly.

NOTE

When handling the new drum, protect the finish surfaces from damage, such as nicks, deep scratches, dents from dropping, corrosion, etc. Damage to the braking surfaces renders the brake drum defective. The tire must be pressed on the new drum before assembly.

8. Install the new drum and tire assembly to the spindle, being careful not to damage the grease seal during assembly. Make sure the spindle is clean and free of dirt and grease and then install.
9. Adjust bearing preload by slowly rotating hub while tightening hex slot nut until resistance is felt. (Approximately 75 ft./lbs) Back nut off 1/16 of a turn or until a notch aligns with the lock nut tab.
10. Reassemble in reverse order.
11. Repeat Steps 20 through 23 of preceding section "Checking/Changing Brake Shoes," beginning on page 2-6

Parking Brake Assembly

- The parking brake assembly includes:
- Parking Brake Lever
- Parking Brake Switch
- Parking Brake Cable
- Parking Brake Assembly

Parking Brake Lever

NOTE

The amount of travel of the parking brake lever should allow the lever to move from the released position to the brake position, having the brake fully applied before handle travel is at its maximum.

Checking Parking Brake Adjustment



CAUTION

Make sure you are wearing work gloves. Before reaching in to turn the wheel, make sure the truck has sat idle long enough to cool. Various parts can get extremely hot during operation.

Adjusting the parking brake lever too tight will overheat the brake shoes and cause premature wear or overheat the brake drums, causing premature failure.

1. Set the key switch to OFF, remove the key from the key switch and disconnect the battery.
2. Block the front wheel and the left wheel.
3. Raise and block the right side of the truck until the right braking tire clears the floor by no more than 1" (25.4 mm).
4. While sitting on the seat, pull on the parking brake lever as far as possible using moderate force. The lever should apply pressure on the right drum before the handle moves to the rear most position. When the parking brake is applied, the right wheel should not turn when attempting to turn by hand.
5. Release the parking brake by pushing the button as the lever is pulled toward you. Then allow the handle to move toward the front of the truck.

6. To adjust, loosen the Allen head adjustment setscrew located on the park brake lever. Turning the lever clockwise tightens the setting; counterclockwise loosens the setting. After adjustment, tighten Allen head adjustment setscrew.

IMPORTANT

DO NOT OVERTIGHTEN. You will separate the cable from the clevis ends.

7. Apply and release the parking brake five or six times to stretch (seat) the cable, then double check your adjustment.
8. If this fails to properly adjust the park brake, see "Adjusting Parking Brake Cable", page 2-10.

Replacing Parking Brake Lever Assembly

1. First, review "General Maintenance Instructions," on page 1-1.
2. Set the key switch to OFF, then remove the key from the key switch and place in a secure area.
3. Perform a Lock Out/Tag Out and disconnect the battery.
4. Make sure all the other wheels are securely blocked so that the truck cannot move.
5. Remove the battery.
6. Remove floor plates.

NOTE

The parking brake lever assembly is located to the left of the hydraulic control valves & to the right of the operator.

7. Disconnect the clevis end brake cable.
8. Replace with new parking brake lever assembly.
9. Remove brake linkage and brake switch cam from old lever assembly and install on the new lever.
10. Reassemble in reverse order.
11. Adjust park brake. (See "Checking Parking Brake Adjustment" on page 2-9)

Parking Brake Switch

The parking brake switch electrically disables the truck from driving when applied and is located on the park brake handle assembly.

Checking Parking Brake Switch

1. Set the key switch to OFF, remove the key from the key switch and store the key in a secure area.
2. Disconnect the battery.
3. Make sure all the wheels are securely blocked so that the truck cannot move.
4. Remove the hydraulic control valve cover.
5. Remove the floor plates.
6. Disconnect e-brake cutout switch connector.
7. Connect the ohm meter leads to the switch wires.

NOTE

The meter should show less than 1 ohm.

8. Slowly pull back on the brake lever. The meter should not indicate continuity, indicating the switch is released before the lever reaches its full locking position.

IMPORTANT

If the meter indicates continuity when the switch in not activated, it is defective and requires replacement. (See "Replacing Parking Brake Switch" on page 2-10).

9. Disconnect the ohm meter.
10. Reassemble in reverse order.

Replacing Parking Brake Switch

1. Review "Before You Begin," on page 1-1.
2. Set key to OFF, remove the key from the key switch and store in a secure area.
3. Apply the parking brake and disconnect the battery.
4. Perform a Lock Out/Tag Out procedure.
5. Make sure wheels are blocked.
6. Remove the floor plates and control valve cover to expose the parking brake components.
7. Disconnect the switch at the Deutsch connector and remove the two screws holding the switch to the frame.
8. Install the new switch in reverse order.
9. Connect the switch at the connector.

NOTE

A plunger within the handle activates the switch and has no adjustment. It is always activated in the resting position.

To check the operation of this switch:

1. Start the truck and release the parking brake.
2. Set the control lever to FORWARD and very slowly increase motor speed.
3. As the truck is moving forward at slow speed, slowly pull up on the brake lever.
4. The truck must immediately slow to a STOP.
5. If the truck continues moving forward, recheck the setting and operation of the switch.

Replacing the Parking Brake Cable

1. First, review "General Maintenance Instruction," on page 1-2.
2. Set the key switch to OFF, remove the key from the key switch and place in a secure area.
3. Disconnect the battery.
4. Perform a Lock Out/Tag Out procedure.
5. Make sure all the other wheels are securely blocked so that the truck cannot move.
6. Remove the hydraulic valve cover to expose the parking brake mechanism.
7. Remove the floor plates.
8. At the park lever, pull the pin that connects the cable to the park brake linkage and remove old cable.
9. Remove the cable from the truck noting how the cable is positioned.
10. Route the new cable from the parking brake lever to the rear drum brake assembly in the same manner as the original cable, then connect both ends.
11. Adjust the parking brake cable - see "Adjusting Parking Brake Cable," page 2-10.
12. Reassemble in reverse order.

NOTICE

DO NOT release or operate the truck if you are in doubt about the effectiveness of the parking brake system. Contact your Landoll service representative for assistance.

Parking Brake Assembly

The parking brake assembly is used for holding the forklift in place while unattended; it is activated by pulling the park brake lever.

Adjusting Parking Brake Cable

1. First, review "Before You Begin," page 1-2.
2. Set the key switch to OFF, remove the key from the key switch and disconnect the battery.
3. Make sure all the other wheels are securely blocked so that the truck cannot move.
4. Remove the floor plates.
5. Loosen adjustment bolt jam nut.
6. Remove emergency brake yoke pin.
7. Turn emergency brake yoke to adjust desired brake cable tension.
8. Replace yoke pin nut and tighten.

IMPORTANT

The adjustment should be set that so when the park brake lever is screwed all the way out (completely counterclockwise) and the lever is pulled to its full vertical position, the parking brake holds the wheel as stated in the section "Checking Parking Brake Adjustment", on page 2-9.

9. Tighten adjustment bolt jam nut.
10. Reassemble in reverse order.

IMPORTANT

The parking brake cable assembly and bracket will be loose when hardware is removed. Remove the parking brake assembly carefully so that the actuator pins, yoke, and parking brake springs do not fall out.



Figure 2-5 Brake Pot and Switch

Brake Pedal Assembly

NOTE

The two piece floor plate gets removed to provide access to the brake pedal and accelerator pedal which is mounted to the underside of the floor plate. The master cylinder and service brake pedal and linkage are mounted within the frame well.

Brake Pedal

The service brake pedal has about 1" maximum free-play before any pressure is applied to the brakes, (or before the pedal moves the master cylinder plunger).

The pedal also has a maximum range of travel of up to only 0.500" (12.7 mm) before it contacts the positive stop hex screw, and includes a brake light switch that energizes the brake STOP lights, where applicable, and has a switch for disengaging traction drive. The brake light/accelerator switch is factory set to trip just as the brake pedal begins its downward stroke.

TIRES, BRAKES AND DRIVETRAIN

Service Brake Linkage

NOTE

The linkage between the brake pedal and the master cylinder is non-adjustable.

Some other areas that can affect the braking system include:

- Low fluid level in the master cylinder reservoir.
- Air or leaks in the system.
- Worn brake shoes (See "Checking/Changing Brake Shoes," on page 2-6).

Any of these conditions can affect pedal free-play.

Proceed to the appropriate heading for repairs.

Service Brake Switch

Brake Light/Accelerator Switch Adjustment

1. First, review "Before You Begin," page 1-1.
2. Set the key switch to OFF, remove the key from the key switch and put it in a secure place.
3. Disconnect the battery and perform a Lockout/Tagout.
4. Slightly loosen both brake switch hex head screws (See Figure 2 -5).
5. Disconnect the wiring harness and connect an Ohm meter to the connectors of the switch that is being tested.
6. Slowly push down on the brake pedal. Before you feel pedal resistance, the meter must read one of the following:
 - The meter must not indicate continuity with the pedal fully released for brake lights (2 black wires).
 - The meter must indicate continuity <1 Ohm with pedal fully released for brake switch (2 green wires).
7. The switch can be adjusted forward or rearward to achieve proper actuation of the switches as the brake pedal is depressed.
8. Carefully torque the screws (8 to 10 ft. lbs.; 11-14 Nm) to secure the switch without moving the setting, then release the brake pedal to verify the setting.
9. Disconnect the ohm meter and reconnect the wiring harness.
10. Connect the battery and start the truck.
11. Depress the brake pedal and verify that the brake lights (if equipped) operate and travel of the truck is interrupted when the brake pedal is depressed =>.5 inches.

Replacing the linear pot

To replace the linear pot, disconnect the wiring harness to the assembly and remove the 2 bolts holding the assembly into position and replace the assembly. Calibration is required through the dashboard calibration procedure. See calibration procedures starting on page 5-2.

Service Brake Switch Replacement

1. First, review "Before You Begin," page 1-1.
2. Set the key switch to OFF, remove the key from the key switch and place in a secure area.
3. Perform Lock Out/Tag Out procedure.
4. Disconnect the battery, block the wheels and engage the parking brake.
5. Remove floor plates (See "Floor Plate Removal," page 2-1).
6. Unscrew and remove the switch assembly from the brake pedal frame and install the new switch. (See Figure 2-5)
7. To set the switch, see "Brake Light/Accelerator Switch Adjustment," on page 2-11.

Master Cylinder

Replacing Master Cylinder

1. First, review "Before You Begin," page 1-1.
2. Set the key switch to OFF, remove the key from the key switch and put in a secure place.
3. Apply the parking brake, disconnect the battery and block the wheels.
4. Remove the master cylinder fill cap and rubber diaphragm by loosening the two round head screws.

NOTE

Note: Siphon out as much fluid as possible. Install and tighten the fill cap and diaphragm before removing the cylinder.

5. Place rags under the brake line connections. Have a plastic cap or bag handy to cover the end of the line to limit fluid spillage.

IMPORTANT

Brake fluid will damage paint. Cover truck body parts and be careful not to spill fluid during this procedure.

6. Using a flare-nut wrench, disconnect the brake fluid line at the rear of the cylinder.

NOTE

Flare-nut wrenches should be used to prevent rounding off the corners of the brake line fitting.

7. Carefully pull the brake line away from the cylinder. Seal or plug the brake line and master cylinder port to prevent fluid loss and/or contamination.
8. Disassemble the yoke from the master cylinder crank plate (one 5/16-18 screw and hardware).
9. Remove the two master cylinder mounting bolts and remove the cylinder from the truck.
10. Remove the reservoir cap and discard any fluid remaining in the reservoir.
11. Mark the push rod lock nut setting, then remove the yoke and lock nut from the old cylinder and install it to the new cylinder, maintaining the same lock nut setting.

NOTE

The push rod lock nut should be installed so that when the pedal is completely retracted, the yoke to the master cylinder crank plate hardware is loose, when it is completely assembled.

NOTE

Whenever the master cylinder is removed and/or replaced, the hydraulic brake system must be bled. (See "Bench Bleed the Master Cylinder," on page 2-13).

12. Install the new master cylinder in reverse order.

IMPORTANT

Brake fluid will damage paint. Wipe up any spilled fluid immediately, then flush the area with clean water.

NOTE

Since high pressure is not involved in the bench bleed procedure, your finger can be used to plug the cylinder hole and prevent the intake of air. Wash hands after this procedure or wear protective latex glove. Kits to aid in the bench-bleeding of master cylinders are also available at your local auto parts store.

Bench Bleed the Master Cylinder

1. Support the cylinder in a vise while allowing you to push the internal piston with the push rod (See Figure 2-6).
2. Fill the cylinder with DOT 3 brake fluid.
3. Slowly push in on the rubber boot and cylinder plunger (push rod) assembly to force air from the cylinder, then hold the push rod in (See Figure 2-6).

4. Press your finger tightly over the outlet port to prevent air from being drawn back into the cylinder when you release the push rod. Wait several seconds to allow fluid to be drawn from the reservoir to the cylinder bore, then repeat this step. When you push the rod in again, it will force your finger from the master cylinder outlet port to expel any trapped air. Place rags underneath to soak up any fluid loss.
5. When only brake fluid is expelled, hold the push rod in and seal the master cylinder outlet port with an appropriate threaded plug or plastic cap, then release pressure on the push rod.
6. Fill the master cylinder reservoir and install the filler cap and gasket.

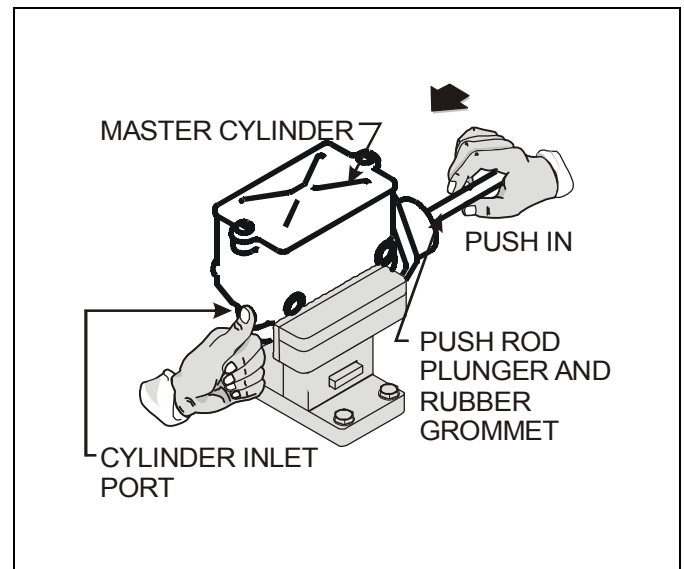


Figure 2-6 Bench Bleeding the Master Cylinder

Check Master Cylinder Fluid Level

The master cylinder is located below the driver's compartment floor plate.

1. Remove the left floor plate (See page 2-1).
2. First clean the reservoir cap to avoid fluid contamination, then remove the fill cap and rubber gasket (See Figure 2-6).
3. Additional fluid is needed when the fluid level is below the FULL line stamped in the master cylinder housing body.
4. Add fluid as needed. **DO NOT OVER FILL.** Use only DOT3 brake fluid from a clean, sealed source.
5. Reinstall the reservoir fill cap and rubber gasket. Tighten only enough to provide a leak-proof seal.
6. Note: Do not overtighten. This could crimp, split, or damage the seal.

TIRES, BRAKES AND DRIVETRAIN

Bleeding Brakes

NOTE

Bleeding the brake system is necessary to remove any air that is trapped when replacing brake lines, brake calipers or the master cylinder. To avoid extensive damage to the system, use only DOT 3 brake fluid.



CAUTION

Wear eye protection. If brake fluid comes in contact with your eyes, immediately rinse them with water and seek medical attention.

NOTE

Check the fluid level often during the bleeding operation and add fluid as needed to prevent the level from falling low enough to allow air bubbles into the master cylinder. Use only new DOT 3 brake fluid from a sealed container. NEVER use old or used brake fluid. It contains moisture which will deteriorate the brake system components.

IMPORTANT

It is necessary to bleed both wheels if air has entered the system. Air in the brake system can be caused by low fluid level or if a brake line has been leaking or disconnected. If the brake pedal feels spongy when pressed and travels almost to the mechanical stop but regains height when pumped, air has entered the system. The system must be bled. If no fittings were recently opened for service, check for leaks that would have allowed air into the system and repair leaks before attempting to bleed the system. DO NOT allow fluid to go inside of the brake drum and onto the brake pad. It will contaminate the brake shoes and cause failure.

NOTE

Have an assistant available, as well as a supply of brake fluid, an empty container, a length of 3/16" (4.763 mm) clear plastic or vinyl tubing to fit over the cylinder bleeder fitting and a six point wrench to open and close the fitting.

1. First, review "Before You Begin," page 1-1.
2. Set the key switch to OFF, remove the key from the key switch and put in a secure place.
3. Apply the parking brake, perform a Lock Out/Tag Out procedure and disconnect the battery.
4. Block the wheels so that the truck can't move.
5. Start with the right wheel (the wheel farthest from the master cylinder).

6. Loosen the bleeder fitting slightly, then tighten it where it is snug but can be loosened quickly and easily.
7. Fit a length of tubing over the bleed screw and immerse the other end in the container of new brake fluid. Check that the tubing fits tightly over the bleeder fitting. (See Figure 2-7)
8. Check fluid level in the master cylinder. Fill before you begin.
9. Have someone slowly press on the brake pedal several times to build pressure in the system, then hold the pedal down.

IMPORTANT

Be careful when handling bleeder screws. Rust may cause the fitting to break. Spray the fitting with penetrating oil before attempting to loosen. Use a 6-sided wrench or socket instead of a 12-sided.

10. Loosen the cylinder bleed screw until fluid starts to flow. Watch for air bubbles at the immersed end of the tube.
11. When the brake pedal bottoms, tighten the bleed screw, then release the pedal. **DO NOT** release pressure on the pedal until the bleed screw is tightened.
12. Repeat Steps 8 through 11 as many times as needed until the fluid draining in the container is free of air bubbles.
13. Fill the master cylinder fluid level and add as needed before bleeding the other side.
14. Check the operation of the brakes. The pedal should feel solid when depressed, with no softness. If necessary, repeat this procedure.

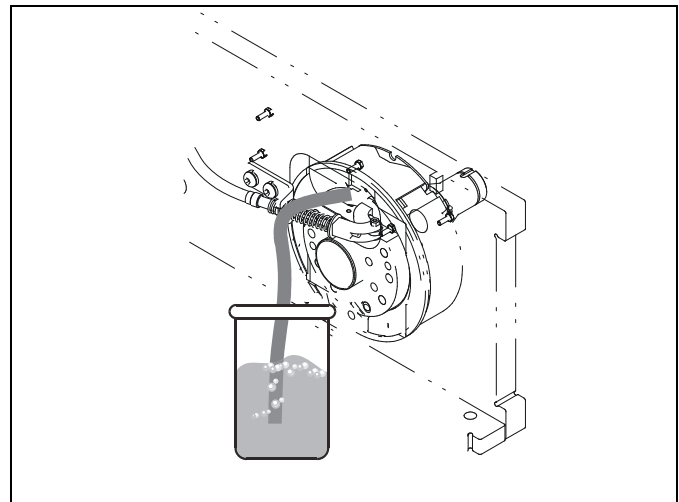


Figure 2-7 Bleeding Brakes

Service Brake Pedal Assembly

NOTE

The service brake assembly (brake pedal) includes the mechanical brake pedal assembly, containing a pivot bushing. The only normal repair items are the switch, the pivot bushing, linear brake potentiometer, or the brake return spring.

Replacing Any Other Hydraulic Brake Component

1. First, review "Before You Begin," on page 1-1.
2. Set the key switch to OFF, remove the key from the key switch and place in a secure area.
3. Perform Lock Out/Tag Out procedure and disconnect the battery.
4. Apply the parking brake.
5. Make sure all the other wheels are securely blocked so that the truck cannot move.
6. Remove covers as needed.
7. Replace the damaged component.

Traction Motor, and Gear Box

NOTE

This section explains front tire/gearbox maintenance.

Removing the Drive Wheel

1. Review "Before You Begin" on page 1-1.
2. Set the key to OFF, remove the key and place in a secure area.
3. Apply the parking brake.
4. Disconnect the battery.
5. Perform a Lock Out/Tag Out as required.
6. Block both rear wheels so the truck cannot move.
7. Lift and support the truck so that the drive wheel is clear of the floor by about an inch.
8. Remove the lug nuts.
9. Using adequate support, remove the drive wheel.

NOTES

Wheel and tire combination weigh over 200 lbs. (90.7 kg)

10. When installing the new wheel, tighten the lug nuts to 225 ft. lbs. (305 Nm) in a staggered order. (See Figure 2-2)

Checking Drive Wheel Gearbox

1. First, review Before You Begin on page 1-1.
2. With the front tire raised and supported, spin the drive wheel and check for noise, rolling resistance and free play.
3. Rock the wheel in and out on the gearbox. If there is any noticeable movement, the gearbox must be checked or replaced.

NOTE

There are no user serviceable parts for the gearbox assembly. The unit must be replaced as a whole.

Servicing the Drive Train Assembly



WARNING

Perform service only in a well-ventilated area. Do not breathe vapors. Wear protective goggles, aprons and gloves. Avoid contact with skin, eyes and clothes. Keep away from heat and flame. Failure to observe these precautions may result in death or injury. If you become dizzy, get fresh air and medical help immediately. If solvent contacts your eyes, immediately treat in accordance with the manufacturer's recommendations on the container.

Do not mix different types of lubricants. Always read the label affixed to the fluid container for all safety information before use.

1. Position the truck on a flat surface, set the parking brake and block the wheels to prevent movement.
2. Set the key switch to OFF, remove the key from the key switch and place in a secure area.
3. Disconnect the battery.
4. Raise the front wheel of the vehicle. Use jack stands, or a suitable supporting device, to support vehicle to allow the drive tire to rotate.
5. Remove wheel from unit being serviced.
6. Thoroughly clean the area around the fill and drain/level plugs.

IMPORTANT

Always place an appropriate support stand under the truck if it is being lifted. Lower the truck to the stand, having both the lifting device and stand supporting the weight of the truck.

TIRES, BRAKES AND DRIVETRAIN



DANGER

Getting under a truck when it is lifted or jacked is dangerous and could cause serious injury or death. NEVER go under a truck that is supported only by a jack.

7. To drain, turn the gear box so that one of the drain plugs is at the lowest point. If rotating the gear box proves difficult, brace a 2" x 4" (5cm x 10cm) between the wheel studs and rotate. See Figure 2-8.
8. Place a drain pan capable of storing up to 32 ounces (1.0 liter) of fluid under the drain plug.
9. Using a 4 mm Allen key, unscrew the drain/level (position A) and fill (position B) plugs.
10. Drain the fluid completely into the drain pan.



CAUTION

If truck has just been in operation for a period of time the oil could be very hot. Use special gloves and/or allow the truck to cool before changing the oil. It is best to drain fluid while the unit is warm, but not HOT! Never drain oil into sewer lines.

11. Once the fluid has been drained, replace the drain/level plug in position A.
12. Wash the interior of the gear box with a suitable cleaning liquid as recommended by the lubricant manufacturer.
 - Put liquid into the gear box through the fill plug and replace the fill plug.
 - Run the gear box for a few minutes at a high speed.
 - Drain the cleaning liquid from the gear box in the same way as described for draining the oil.
 - Clean any contaminants from the magnetic trap and O-ring seal on the plugs.
13. To fill the gear box, turn until the drain/level hole in position A is about 15° below the horizontal center line of the gear box. (See Figure 2-9)
14. Fill the gear box with synthetic gear lube through position B until fluid flows out from position A. Fluid capacity is approximately 1 pint (16 oz.). (See "Lubrication Specifications" on page 1-17)
 - **DO NOT OVERFILL.**
15. Install both plugs. Tighten to 25 ft. lbs. (34 Nm).
16. Wipe off any oil spillage on outside of the gear box.

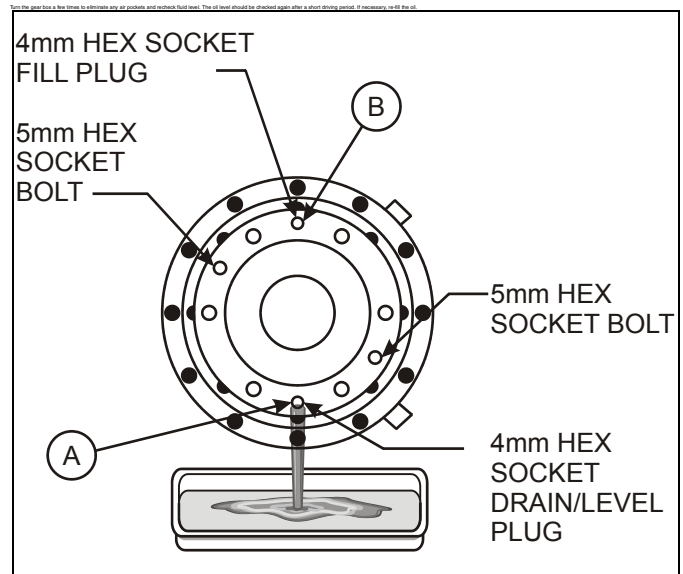


Figure 2-8 Servicing the Gear Box

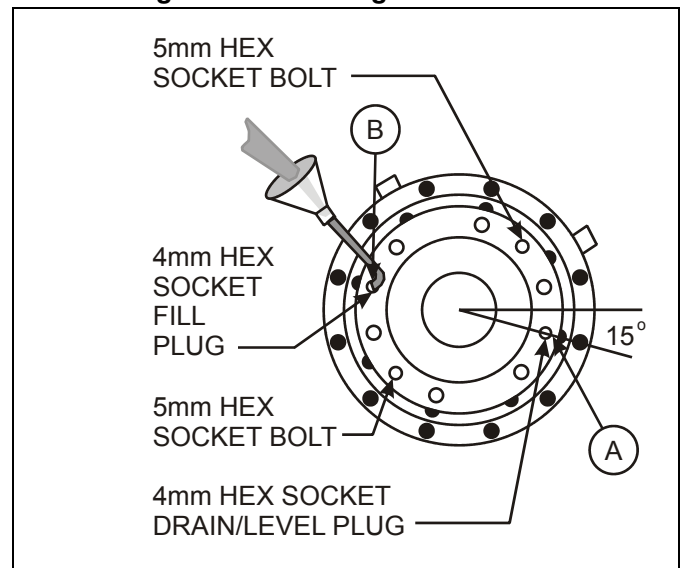


Figure 2-9 Refilling the Gear Box

Gearbox Replacement

To repair and/or replace the traction motors:

1. Review "Before You Begin" on page 1-1.
2. Set the key switch to OFF and remove the key from the key switch and place in a secure area.
3. Disconnect the battery.
4. Perform a LockOut/TagOut procedure.
5. Support the unit as the mounting screws are removed.
6. Remove the eight M16-2 X 30 hex socket screws and hardware holding the gear box to the truck frame.
7. Evenly support the gear box and allow the shaft to slide free from the motor.
8. Place the gear box on a sturdy work bench. Use wood blocks balance and support the assembly while on the work bench.
9. Reassemble the gear box to the truck by following the preceding steps in reverse order.
10. Fill the gear box with synthetic gear lube through position B until fluid flows out from position A. Fluid capacity is approximately 1 pint(16 oz.). (See "Lubrication Specifications" on page 1-17) **DO NOT OVERFILL!**
11. Tighten and torque the M16-2 X 30 screws. (See General Torque Tables on page 1-18)

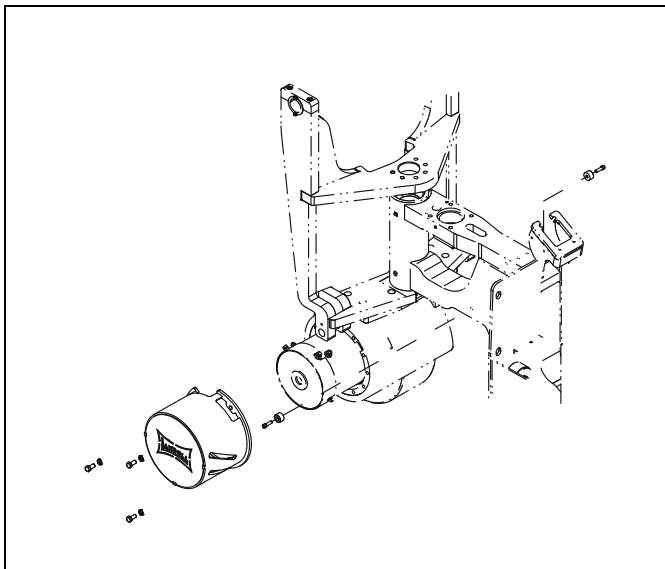


Figure 2-10 Gear Box Cover Removal

Traction Drive Motor Service

1. Repeat steps 1-8 in "Gearbox Replacement" on page 2-17.
2. Support the unit as the mounting bolts are removed.
3. Remove the twelve 1/2-20 X 2 hex socket screws and hardware holding the motor to the motor mount weldment.
4. With the motor supported, rotate the motor to align the electrical connecting terminals to the slots machined in the motor mount weldment.
5. Slide the motor out far enough to install a second strap around the motor. This strap is to support the motor from outside the truck frame.
6. Place the assembly on a sturdy work bench. Use wood planks to balance and support the assembly while on the workbench.
7. Assemble the new motor by following the preceding steps in reverse.
8. Tighten and torque the screws. (See torque specifications on page 1-18)

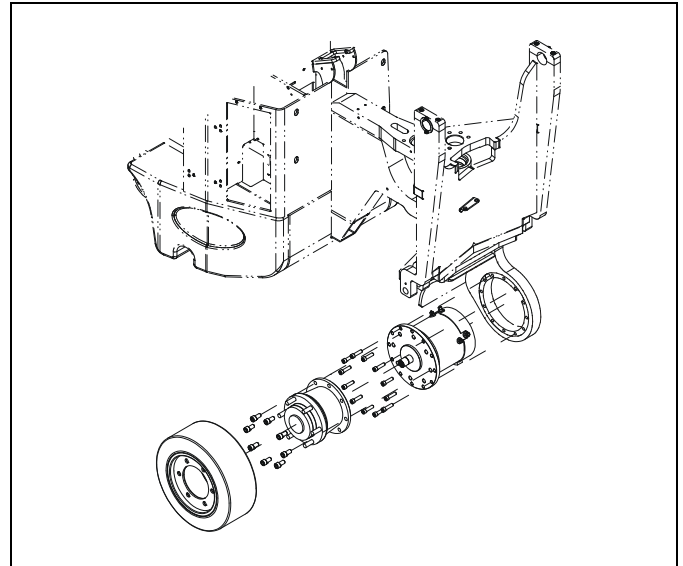


Figure 2-11 Tire, Gear Box and Motor Exploded View

Accelerator Pedal

NOTE

The accelerator assembly consists of the linear potentiometer, harness, and accelerator pedal.

Adjusting Accelerator Pedal

1. Set the key switch to OFF and remove the key from the key switch.
2. Block wheels.
3. Remove the floor plates.

NOTE

It is recommended to hold the right hand floor plate in a vice while doing this procedure.

4. Loosen the allen head fastener on the pedal arm so that it can rotate freely. Rotate the pedal until the pedal touches the rear of the slot. Tighten the fastener.
5. Install floor plate assembly back on the forklift.
6. Install left hand floor plate.
7. Refer to Landoll Setup Procedure, located in "Calibration of Steering and Throttle Pot" on page 5-1 to re-calibrate the accelerator module.

Replacing Accelerator Module

1. First, review "Before You Begin," page 1-1.
2. Set the key switch to OFF, remove the key from the key switch and put it in a secure area.
3. Apply the parking brake, perform a Lock Out/Tag Out procedure, disconnect the battery and block all wheels.
4. Remove the floor plates (See "Floor Plate Removal", on page 2-1).
5. Remove the two round head screws (5/16-18 x 1) and hardware securing the accelerator to the floor panel (See Figure 2-1).
6. Disassemble the accelerator from the floor plate and install the replacement accelerator in its place.
7. Loosen the allen headed fastener on the pedal arm and orient the pedal 90° up. Insert the flat part of the arm through the slot, rotate and mate the accelerator mounting surface to the underside of the floor plate. Align with the 5/16" bolts and tighten to secure the accelerator.
8. Adjust the pedal (See "Adjusting Accelerator Pedal" on page 2-17).
9. Refer to Landoll Setup Procedure, located in "Calibration of Steering and Throttle Pot" on page 5-1 to re-calibrate the accelerator module.

Chapter 3

Hydraulic Oil, Motors, Pumps, and Cylinders

Hydraulic Components

NOTE

This section explains the following:

- Hydraulic System Maintenance
 - Changing Hydraulic Oil
 - Changing the Hydraulic Filter
 - Checking Hydraulic Pressure
 - Servicing the Lift Motor and Pump
1. First, review “Before You Begin,” page 1-1.
 2. Set the key switch to OFF, remove the key from the key switch and place in a secure area.
 3. Apply the parking brake, perform a Lock Out/Tag Out procedure and disconnect the battery.
 4. Make sure all the other wheels are securely blocked so that the truck cannot move.
 5. Remove the floor plate, if necessary.

Hydraulic System Maintenance

Maintain the hydraulic system, and associated components, as required by the various checklists beginning on page 1-8.



CAUTION

Do not allow:

- Hydraulic fluid level to drop significantly or allow the reservoir to run dry. This will induce air into the system and cause damage to hydraulic system components.
- Prevent dirt or other foreign matter from entering the hydraulic system; clean filler caps before checking oil level.

Cylinders and Valves: Check these components for drift and leakage. Refer to Landoll Corporation and other vendor service information for specifications.

Hoses and Tube lines: Check for cracks, hardening, or other signs of wear. Reroute any usable hoses that are kinked, severely bent, or rest against hot parts. Look for leaks, especially at couplings and fittings. Replace any hoses or tube lines that do not meet system flow and pressure ratings.

Hydraulic Fluid: Check fluid level and look for air bubbles. Check the filter. See “Change the Hydraulic Oil Filter” on page 3-2.

Other Hydraulic System Components: Visually check other components to see if they are loosely mounted, show signs of leaks, or other damage or wear to the Hydraulics.

NOTE

The hydraulic pump in your Bendi truck is powered by an AC non-serviceable motor. The pump supplies hydraulic pressure for steering and mast lift.



CAUTION

After prolonged truck use, hydraulic oil will be hot and can burn human skin. Allow hydraulic oil to cool to a temperature that does not burn skin before performing this procedure.

Check Hydraulic Oil Level

IMPORTANT

- It is important that the proper level of properly specified oil be maintained at all times. Failure to check the oil level as recommended could cause serious mast function operating problems.
- The oil level indicated on the dipstick is most accurate when the oil is at operating temperature (130°F to 200°F (53°C to 93°C)).
- Do not overfill. Having the level above the FULL line does not allow enough area for expansion when the oil heats during normal operation.

HYDRAULIC OIL, MOTORS, PUMPS, AND CYLINDERS

1. Lower the mast to within a few inches of the ground, then tilt it forward completely.
2. With the key switch OFF, turn the steering wheel left and right until it becomes difficult to turn.
3. The fill/dipstick cap is located under the floor plate. Disconnect the battery and remove the floor plate to access the dipstick and the filter.
4. First clean the area around the dipstick, then pull dipstick out and wipe clean. Reinsert dipstick.
5. Remove the dipstick again, holding the dipstick tip level and check the oil level. If the oil level is at the FULL line or between the FULL and ADD lines, the level is correct and no oil is needed. If the oil is at or below the ADD line, you will need to add oil to bring it up to the FULL line (maximum).
6. Add hydraulic oil as needed. (See page 1-17 for recommended hydraulic oil specifications)
7. If the fluid appears very dirty or dark in color, check the truck's maintenance log for the last fluid and filter change and change accordingly.
8. Install dipstick, making sure it is seated. Attach the accelerator wiring harness and install the floor plate.

13. Add hydraulic oil. See page 1-17 for recommended lubricants. DO NOT overfill.
14. Replace the fill/dipstick cap, turn clockwise, and make sure it is tightened securely.
15. Make sure the drain plug is tight enough to prevent oil leaks, but do not over tighten.
16. Run lift to check for leaks.
17. With the lift OFF and the forks down, check the oil level on the dipstick and add oil accordingly.

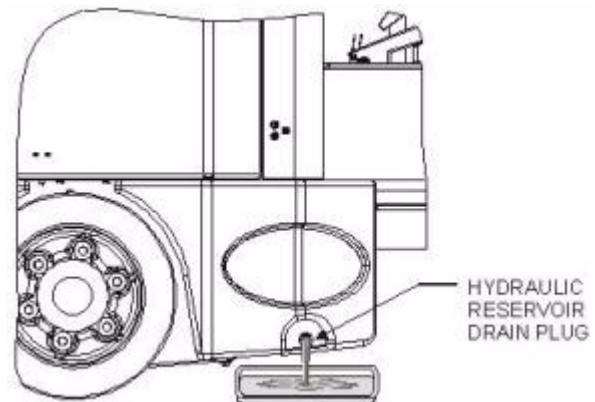
Change the Hydraulic Oil Filter



CAUTION

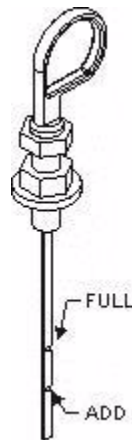
After prolonged truck use, hydraulic oil will be hot and can burn human skin. Allow hydraulic oil to cool to a temperature that does not burn skin before performing this procedure.

1. Park the truck on a level, designated service area, set the parking brake and block the wheels.
2. Set the key to OFF, remove the key from the key switch and place in a secure area.
3. Perform Lock Out/Tag Out procedure.
4. Disconnect the battery.

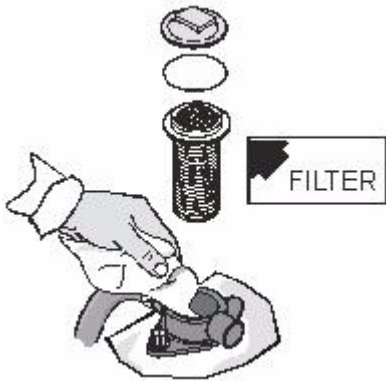


Changing Hydraulic Oil

1. Review "Before You Begin" on page 1-1.
2. Park the truck on a level, designated service area.
3. Set the parking brake and block the rear wheels.
4. Perform Lock Out/Tag Out procedure.
5. Set the key to OFF, remove the key from the key switch and place in a secure area.
6. Disconnect the battery.
7. Remove the floor cover.
8. Open the fill/dipstick cap.
9. The hydraulic reservoir drain plug is located in the bottom of the truck, underneath the reservoir.
10. Slide a flat collection pan, (minimum 10 gallons (40 liters)) under the drain plug, then remove the plug.
11. Change the hydraulic filter. (See "Change the Hydraulic Oil Filter" on page 3-3)
12. Clean the magnetic trap on the drain plug of any contaminants. When the tank is empty, clean and reinstall the drain plug.



5. Remove the floor plate.
6. Using a clean, lint-free cloth, clean the area around the filter element housing.
7. Unscrew and remove the old filter housing.
8. Coat the O-ring seal on the new filter element with a thin film of hydraulic oil, then screw the new element onto the housing.
9. Operate the hydraulic system by running the mast functions and observe the filter for oil leaks.
10. Reinstall the driver's floor plate.



Checking and Adjusting Hydraulic Pressure



WARNING

HIGH PRESSURE FLUIDS CAN BE DANGEROUS!
Before continuing with this section, read about the warnings of pressurized hydraulic oil under “Hydraulic System” Warning page 1-5.

NOTE

For ease of checking hydraulic pressure, Landoll offers a Pressure Check Kit (P.N. 0018152) which includes a 5000 p.s.i. (344.7 bar) gauge, hose and a quick-coupler assembly. If you are using your own system, have shop rags, oil absorbent and a small container ready to collect any oil spills.

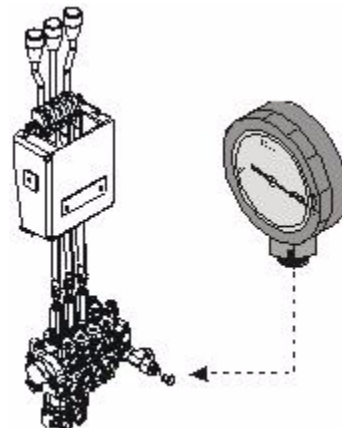
1. For this test, make sure that the hydraulic tank has plenty of oil.
2. Set the key to OFF, remove the key from the key switch and disconnect the battery.
3. Remove the control valve cover, located to the right of the driver's seat.
4. Operate the function joystick briefly to relieve any system pressure.
5. Connect the pressure check kit quick-coupler (female end) to the coupler (male end) on the control valve.
 - If you are not using the pressure check kit, remove the quick-coupler and install an appropriate fitting to accept your pressure gauge arrangement
 - Have rags handy to collect any oil leakage.
 - Install your 5000 psi (344.7 bar) gauge arrangement to the tee fitting.
 - All parts connected to the gauge port must be capable of handling up to 5000 p.s.i. (344.7 bar).

- To adjust pressure, the truck (pump) must be running to create hydraulic pressure. Always pay careful attention when servicing while the truck is running. To check or set the pressure, you must pull the tilt lever to dead head the cylinder to build pressure, then set the relief valve.
6. Loosen the relief valve jam nut.
 7. Start the truck.
 8. Adjust the valve stem by turning clockwise to increase pressure, counterclockwise to decrease pressure. This procedure adjusts the pressure relief valve setting.
 9. Release the joystick immediately once the pressure is set at 2600 psi. (179 bar)

IMPORTANT

Do not hold a hydraulic joystick (bottomed out) for excessive periods of time. Extreme pressure is applied to the system which can, over periods of time, generate heat and damage oil and internal components.

10. If the pressure is low and cannot be adjusted to the proper value, check the pump and make sure there are no leaks in the hydraulic system. If the pressure is too high and cannot be adjusted to the proper pressure, replace the relief valve.
11. Tighten the relief valve lock nut.
12. Set the key to OFF, remove the key from the key switch, and disconnect the battery.
13. Operate the function joysticks momentarily to relieve system pressure.
14. Remove the pressure gauge quick-coupler or remove your gauge arrangement.
15. Start the truck.
16. Left and lower the mast a few times to check the hydraulic system for leaks.
17. Set the key to OFF and disconnect the battery.
18. Reassemble all covers and panels that were previously removed.



Steering Motor Service

NOTE

When performing any steering motor service, it is important to have the proper tools and clean facilities to complete a successful repair. Also make sure that when doing a motor repair that all related components are correctly working and that clean oil and filters are to be used. Dirt, grease and old oil will not only hurt motor performance, but shorten the motor's life as well.

Load Sense Steering System

The Bendi AC B3/30 lift truck uses a load sense priority flow control (See Figure 3-1) to meter hydraulic oil flow to the steering system. As the operator turns the wheel, a fluid signal from the steering control unit (orbital), shifts a load sense valve in the main control valve that meters fluid from the control valve to the steering orbital. This system provides fluid to the steering system as needed and allows the fluid to flow back to the tank at a low pressure when steering is not needed, thereby reducing power consumption.

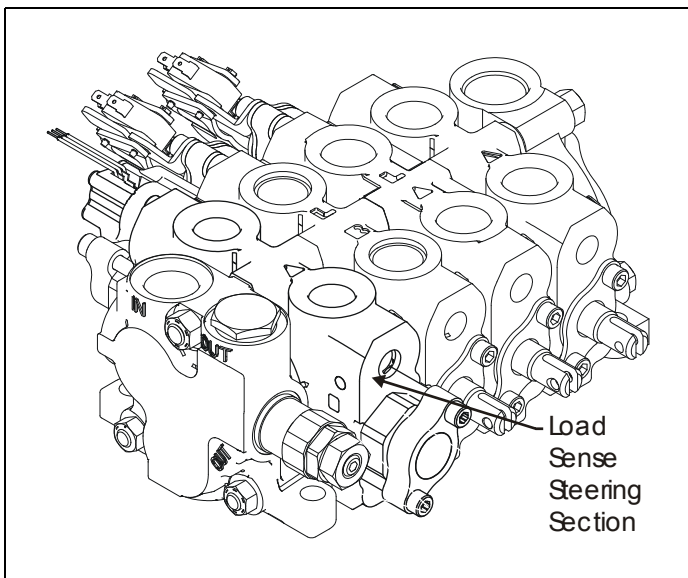


Figure 3-1 Load Sense Section of Hydraulic Spool

Power Steering System Maintenance

Guidelines to perform maintenance on the power steering system is provided in the following paragraphs.

- Fluid for the hydraulic power steering system comes from the central hydraulic reservoir.
- Some hydraulic repair will need the steering wheel pulled. Always use a puller to remove the steering wheel. Do not use a hammer, torch, or crow bar.

- Investigate and immediately correct any play, rattle, shimmy, misalignment, or other unusual occurrence in the steering system.
- Report any malfunction or accident that may have damaged a steering system part.

Check Power Steering

1. Sit in the driver's seat and turn the key switch to ON.
2. While applying the service brake, release the parking brake and set the direction control lever to FORWARD or REVERSE. The power steering pump motor should start running.
3. If the motor does not start, first check that the parking brake is released.
4. While moving forward or backward slowly, verify that the truck turns left or right with a smooth motion.
5. While moving forward or backward slowly, turn the steering wheel completely to the right (a full right-hand turn).
6. While moving slowly in either direction, turn the steering wheel completely to the left (counterclockwise) while counting the number of full revolutions. The steering wheel must complete approximately seven to nine revolutions, $\pm 1/2$ revolution, lock-to-lock.
7. Next, turn the steering wheel completely to the right (clockwise) while counting the number of revolutions. The steering wheel must complete approximately seven to nine revolutions, $\pm 1/2$ revolution, lock-to-lock.
8. Sit in the truck without touching the steering, set the direction switch to neutral, and check that the pump turns off.

Filling and Air Bleeding the Power Steering System

Fill and air bleed the power steering system per the schedule shown on the Routine Maintenance Schedule of the Bendi AC B3/30 Operator's Manual (F-522-__)

1. Fill the reservoir until it is between the F and E marks on the dipstick. **DO NOT OVERFILL.**
2. Run the steering through three complete cycles by turning the steering wheel all the way in one direction, then all the way the other direction.
3. Check and refill the reservoir after each cycle.
4. Add fluid until it is between the F and E marks on the dipstick.

Steer Motor Maintenance

NOTE

When performing a hydraulic motor repair, it is important to have the proper tools and facilities to complete a successful rebuild. Make sure the area around the motor has been thoroughly cleaned and that the correct replacement parts will be used. Dirt, grease and old oil will shorten the pump and steering motor life. For replacement, See "Hydraulic Steer Motor Replacement" on page 3-6.

Parts Disassembly and Inspection

If the hydraulic steering motor is leaking oil from between the sections, but works okay, a simple rebuild kit with replacement o-rings may give an adequate repair. A motor with more serious problems will need to be replaced. See the F-549-____ Bendi B3 AC parts book for individual part numbers and exploded views or contact your nearest Landoll approved service location for further information.

Hydraulic Steering Motor Reassembly

1. All parts should be clean and have a light coating of hydraulic oil.
2. Pay close attention when assembling o-rings, as they can be pinched.
3. Insert the hold-down bolts into the pump body and hand tighten into the tapped holes in the mounting flange of the motor.
 - Investigate and correct any external leak in the steering system, no matter how minor the leak.
 - Do not attempt to weld a broken steering component. Replace the component with original equipment only. Do not cold straighten, hot straighten, or bend any steering part.



CAUTION

Prevent dirt or other foreign matter from entering the hydraulic system; clean filler caps before checking oil level.

Hydraulic Pump Service

NOTE

The hydraulic lift pump used on the Bendi AC has no serviceable parts and is repaired by replacement only.

When replacing the lift pump, make sure that the hydraulic oil is clean and that the hydraulic system has a new clean filter. (See "Changing Hydraulic Oil" and "Changing Hydraulic Filter" on page 3-2)

Replacing the Hydraulic Pump and Motor

NOTE

The AC motor and pump are located in the rear of the truck, surrounded by the counterweight and are accessible by removing the rear cover.

1. Remove the key and place in a secure area.
2. Perform the Lock Out/Tag Out procedure.
3. Disconnect the battery.
4. Remove the rear enclosure cover. (See Figure 3-2)
5. Move the hydraulic levers back and forth to relieve pressure from the lines.
6. Disconnect the suction and pressure hoses from the hydraulic pump, item #1. Place shop rags under the connections to catch hydraulic oil.
7. Mark and disconnect the 2 snap electrical connectors, item #2.
8. Mark and disconnect the 3 heavy gauge electrical cables, item #3.
9. Remove three 3/8" fasteners, to allow the pump and motor assembly to be moved out of the frame.
10. Using an overhead hoist, remove the pump and motor assembly from the truck and place it the repair area. NOTE: Assembly is very heavy.
11. Assemble in reverse procedure.

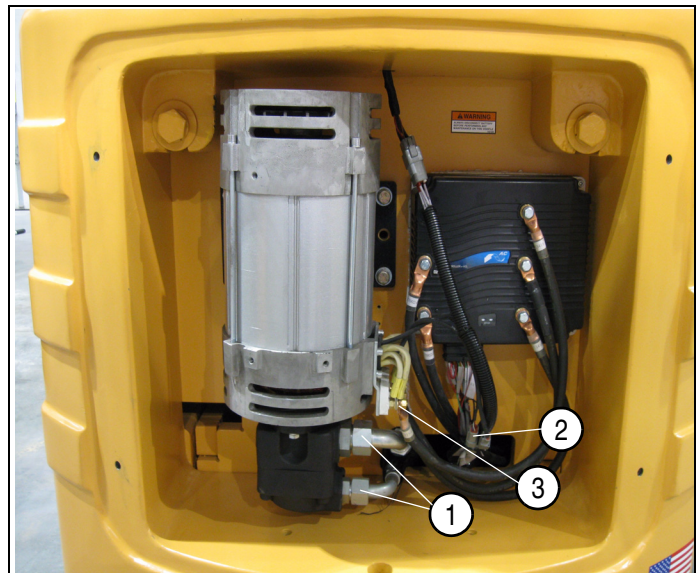


Figure 3-2 Hydraulic Motor and Pump Assembly

Hydraulic Steer Motor Replacement

1. Refer to Figure 3-3, with instructions.
2. Remove the key and place in a secure area.
3. Perform the Lock Out/Tag Out procedure.
4. Disconnect the battery.
5. Release hydraulic pressure in the system by moving all control levers back and forth and turning the steering wheel left and right.
6. Remove the six 1/4" - 20 x 3/4" bolts that hold the front rotation cover and remove the cover.
7. Remove the hydraulic gear nut - item 1.
8. Remove the allen head set screw - item #2.
9. If needed, remove idler gear assembly - item 3.
10. Using even pressure from 2 sides, pry up on the steering pinion gear to remove.
11. Mark and remove all 3 hydraulic lines from the steering motor. Keep shop rags near for spills.
12. Remove the four 1/2" - 20 x 2" bolts that hold the motor to the frame - item #4. Remove the motor.
13. Reassemble the steering motor in reverse order. Item #3 bolts are to be torqued to 90 ft.-lbs(122 Nm).
14. Item #2 bolt is to be torqued to 40 ft.-lbs(55 Nm).
15. Recalibrate the Landoll Bendi AC truck directions beginning on page 5-1.

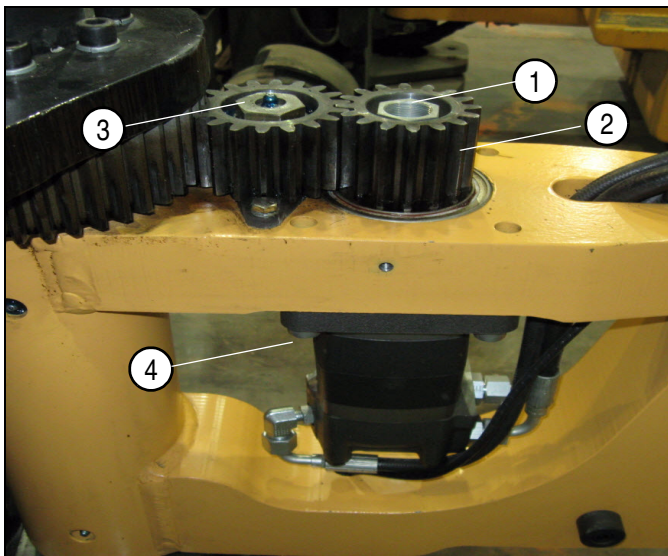


Figure 3-3 Steering Motor and Gears (Cover off)

NOTE

- Power steering pressure is set at 2600 psi $\pm$ 100 psi (131 bar, $\pm$ 7 bar). A pressure gauge port is provided, with a "quick-coupler," (pressure service kit, Landoll p/n: 0018152) for reading the steer pump pressure when hooked to the pressure relief valve.

Before you service this valve for possible pressure problems, make sure there are no leaks in the hydraulic system and that there is sufficient oil in the tank. Both conditions can contribute to low pressure problems. (For additional information, also see "Pump Problems" on page 1-25)

Checking Steer Pump Pressure

1. First, review Before You Begin on page 1-1.
2. Set the key switch to OFF, remove the key from the key switch.
3. Remove the floor plates. (See "Floor Plate Removal," page 2-1)
4. For ease in checking pressure Landoll Service offers a Pressure Check Kit (p/n: 0018152) which includes a 5,000 psi (344.7 bar) pressure gauge, hose and quick-coupler). Have shop rags and a small container available to collect any oil spills.
5. Turn the steering wheel briefly from one side to the other to relieve system pressure - allow oil to drain.
6. Connect the pressure check kit quick-coupler (female end) to the coupler (male end) on the pressure relief valve. (See Figure 3-4)
 - If you are not using the pressure check kit, remove the quick-coupler and install an appropriate fitting to accept your pressure gauge arrangement.
 - Be prepared to collect the oil leakage.
 - Install your 3,000 psi (207 bar) pressure gauge arrangement to the fitting. Landoll recommends a 5000PSI gauge for accuracy, 3000PSI minimum.
7. Start the truck.

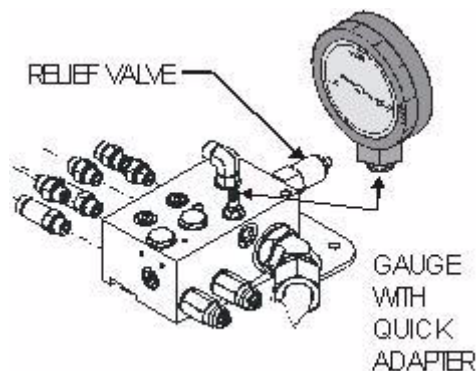


Figure 3-4 Setting Steering Pressure



CAUTION

To check pressure, the truck & therefore the pump, must be running to create hydraulic pressure. Always use extreme caution when servicing the truck while it is running.

8. Turn the steering wheel fully to the right and hold the wheel to allow pressure buildup. The pressure reading must be 2600 psi, ± 100 psi (179 bar, ± 7 bar) maximum. If needed, the pressure can be changed by adjusting the relief valve located on the steer control valve.
9. Release the steering wheel.



CAUTION

Do not turn and hold the steering wheel against the rotation limit for long periods of time. Excessive pressure is applied to the circuit which can, over long periods of time, generate heat and damage internal components. If the pressure is low, check the pump and make sure there are no leaks in the hydraulic system. If the pressure is too high or too low, replace the relief valve.

10. Turn the steering wheel from one side to check the hydraulic connections for leaks.
11. Check for a pressure reading of 2600 psi ± 100 psi (179 bar, ± 7 bar) maximum, set the key switch to OFF.
12. Turn steering wheel to release pressure.
13. Remove pressure gauge.
14. Replace relief valve if pressure cannot be adjusted to specifications.
15. With the key "OFF", check the hydraulic oil level.
16. Reassemble in reverse order.

Hydraulic Control Valve Assembly

General

While a leaky control valve may be fixed by installing a service kit, if there are more serious problems to the hydraulic spool, Landoll recommends a complete hydraulic valve replacement.

The following procedure explains how to replace a specific valve should a sluggish or sticking valve spool be suspect.



If you remove the valve from the truck for servicing (hex head screws and hardware), when reinstalling the valve be certain to tighten the mounting screws in a staggering fashion while applying equal pressure to all screws. If the screws are not tightened and torqued evenly, you could create a stress crack, thus internal oil leaks, rendering the valve defective.

NOTE

- The main hydraulic pump for lift, tilt, pivot, and shift (mast functions) is a fixed displacement gear pump (2.008 cu. inch/rev). System pressure must not exceed 3,000 psi, ± 65 psi (205 bar, ± 4 bar) maximum.
- The main pump pressure relief valve is part of the hydraulic control valve.
- A pressure gauge port is provided, with a "quick-coupler," (pressure service kit, Landoll p.n. 0018152) for reading the pump pressure on the hydraulic control valve. The pressure check port on the forklift is attached to the inlet port on the hydraulic control valve.

IMPORTANT

- Before you service this valve for possible pressure problems, make sure there are no leaks in the hydraulic system and that there is sufficient oil in the tank. Both conditions can contribute to low pressure problems.

Hydraulic Control Valve and Switches Removal

1. First, review Before You Begin on page 1-1.
2. Set the key switch to OFF, remove the key from the key switch, perform a Lock Out/Tag Out procedure and disconnect the battery.
3. Apply the hand brake and block the wheels.
4. Relieve pressure in the system by moving the hydraulic levers back and forth a few times.
5. Remove the floor plate.
6. Remove valve cover.
7. Inspect the spool actuator end (upper) and the switch actuator end (lower) for leakage. Also inspect valve for leakage between valve sections.
8. If leakage is found, the spool seals can be replaced. If there is leakage within the spools, as determined by drift in the hydraulic actuator, the valve may need to be replaced. If leakage is found between sections, replace o-ring between the section.
9. Remove the valve from the truck by first identifying and marking all hoses, disconnecting and plugging all hydraulic tubes. Be prepared to manage spills.
10. Disconnect the lift pot from the truck wiring harness and switches from the truck wiring harness at the Deutsche connector.
11. Remove the push/pull linkage from the spools by removing the linkage pins and pulling the pins from the spools.
12. Remove the bolts holding the valve to the valve mounting bracket.
13. Place valve on a bench or in a vice.
14. Seals can only be removed by removing the spools.
15. Remove the lift pot/switch mounts by removing the mounting screws.
16. Remove the fasteners on the spool actuation end and remove the cover plate(s).

NOTE

During this time close inspection should be given looking for leaks between the sections. If there have been sectional leaks, simply unbolt the three bolts that hold the sections together, replace the leaking o-ring and tighten up the bolts holding the sections together. (See "Hydraulic Control Valve" in F-523 Bendi AC parts book)

17. Remove the spool and end mechanism from the bore.
18. Remove the seal, wiper and seal plate from the tang/clevis end of the spool. A dental pick can be used to remove the wiper and o-ring. Use caution to avoid nicking the bore.

19. Remove the end mechanism from the cap end of the spool.
20. Remove all foreign material from the spool and seal counter bores.
21. Lubricate the seal groove bores on the cap and tang/clevis ends of the housing.
22. Re-assemble the cap end of the spool with the new seals per the applicable end mechanism repair instruction.
23. Carefully reinsert the spool.
24. Install the new seal and wiper on the tang/clevis end of the spool using the seal plate to push them in prior to completing the seal plate cap screw installation and torque.
25. Assemble the switch pot brackets to the other end of the valve.
26. Apply grease (NLSI #2 Texaco #880) to actuator end prior to assembly of the spool actuator.
27. Reassemble valve to truck.
28. Attach and tighten all hoses.
29. Operate valve functions and check for leaks.

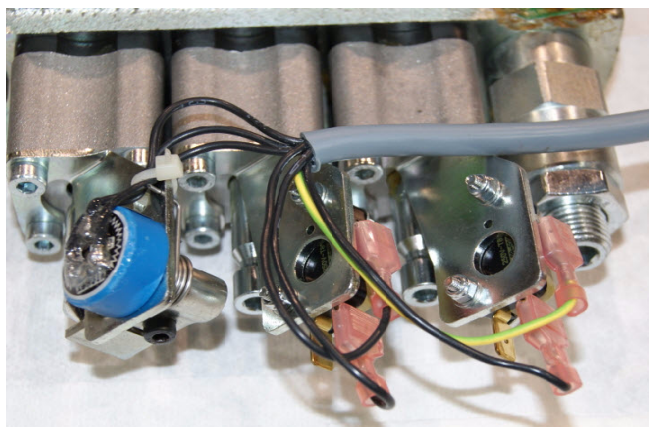


Figure 3-5 Hydraulic Valve Switches

Spool Section Rebuild

NOTE

The inlet assembly will include an o-ring, and the spool sections will include an o-ring, load check poppet and load check spring.

1. For proper reassembly alignment, lay valve components on a clean, hard, flat surface.
2. Thread tie rod nuts onto the short threaded end of each of the individual tie rods with the nuts threaded up the entire length of the threads.

3. Insert tie rods through tie rod holes of inlet housing, lay inlet on end with tie rods pointing up and install o-ring into groove. Special care must be taken to ensure o-ring has been completely installed in groove.
4. Place first spool section over inlet section with o-ring groove facing upward and install o-ring into groove.
5. Install load check poppet into load check cavity, nose first.
6. Once load check poppet has been properly installed, place load check spring in hollow cavity inside check poppet.
9. Install new sensor and reassemble the pot to the bracket.
10. Reassemble pot mount bracket to valve.
11. Reinstall valve on truck.
12. Attach and tighten hydraulic hoses.
13. Start truck, operate hydraulic system, and check for leaks.
14. Calibrate lift sensor input to controller. (Refer page 5-1 for controller calibration) This adjustment is actually completed through the controller electronically.
15. Reinstall brake assembly.
16. Install floor plates and valve cover.



Figure 3-6 Hydraulic Valve Disassembly

Hydraulic Lift Sensor

NOTE

The hydraulic lift sensor is replaced as a complete unit with the wiring harness. See Figure 3-5.

Replacing Lift Sensor

1. First, review Before You Begin on page 1-1.
2. Set the key switch to OFF, remove the key from the key switch and put in a secure area.
3. Apply the parking brake, perform a Lock Out/Tag Out procedure, disconnect the battery and block the wheels.
4. Relieve pressure in the system by turning the steering wheel two times to the left, then two times to the right and move the joysticks in both directions.
5. Remove the floor plate to allow removal of the valve cover.
6. Disconnect the lift sensor from the main truck harness at the Deutsche connector.
7. Remove the lift sensor bracket from the end of valve.
8. Remove the two screws holding the lift sensor from the bracket.
5. Remove the hose coupling from the defective fitting. Use two wrenches; one wrench to loosen the hose coupling, and one to prevent the fitting from turning. Be prepared to clean up any oil spillage.
6. Always tag the hoses and fittings for identification. If necessary, keep notes and put markings on parts using a non-destructive marker.

Hydraulic Fittings and Hoses

1. First, review Before You Begin on page 1-1.
2. Set the key switch to OFF and remove the key from the key switch.
3. Perform a Lock Out/Tag Out procedure, disconnect the battery and block the wheels.
4. Before disconnecting any hydraulic fittings or hose assemblies, relieve the system pressure, down to zero psi. This is accomplished by turning the steering wheel a few times in both directions, and moving the control levers in both directions after the key switch is turned OFF.



WARNING

High pressure hydraulic oil leaks can pierce the body and cause SEVERE injury to personnel. Always reduce pressure before opening any hydraulic pressure line.



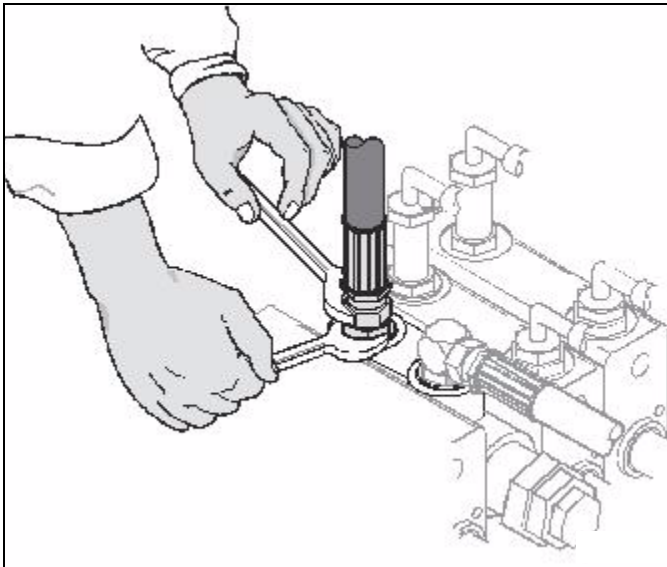
CAUTION

Oil spills can cause falls. To avoid injury, make sure all spills are cleaned well with oil dry/wipes.

7. Remove the defective fitting and replace with a new fitting. Use two wrenches; one wrench to tighten the hose coupling, and one to prevent the fitting from turning.

NOTE

SAE fittings do not need a thread sealant. They are straight thread and include an O-ring seal.



Check Hydraulic Functions

1. Position the truck on a level, flat surface. Clear area around the truck.
2. Check hydraulic fluid level.
3. Turn the key switch to the ON (RUN) position.
4. Make sure your right foot is on the floor of the operator's compartment and prepared to brake.
5. Pull either joystick to see if hydraulics are working.
6. Visually check cylinders, valves, and hoses for leaks or other signs of wear.
7. Pump troubleshooting tips can be found in "Pump Problems" on page 1-25.

Chapter 4

Electrical System

Steering Column/Dash Assembly

This procedure replaces the steering wheel, steering column, and components.

The console assembly includes the following and are accessible by removing the right side steering assembly cover (black) - ten (10) screws and hardware:

- Auxiliary power rocker switch (fan, scanner, etc.)
- Headlights (rocker switch, where fitted)
- Standard/Ramp mode (Allows current to increase in the ramp mode)
- Tilt steering lever
- Key switch

Remove the Display Panel

1. First, review Before You Begin page 1-1.
2. Set the key switch to OFF, remove the key from the key switch and place in a secure area.
3. Apply the parking brake, perform a Lock Out/Tag Out procedure and disconnect the battery. Make sure all the wheels are securely blocked so that the truck cannot move.
4. Remove the right side cover of the steering column to expose the internal components of the steering column by removing the 2 cover screws and hardware marked (B). (See Figure 4-1)
5. Remove the four large screws and hardware marked (A). (See Figure 4-1)
6. Remove the bellows (rubber boot) free of the steering column cover.
7. Reach inside the steering column and disconnect the appropriate display wire connectors from the main wire harness.
8. Install the new display by reversing the above steps.
9. Connect the wire connector to the display and close the steering column by reversing the steps outlined in 4 through 8.

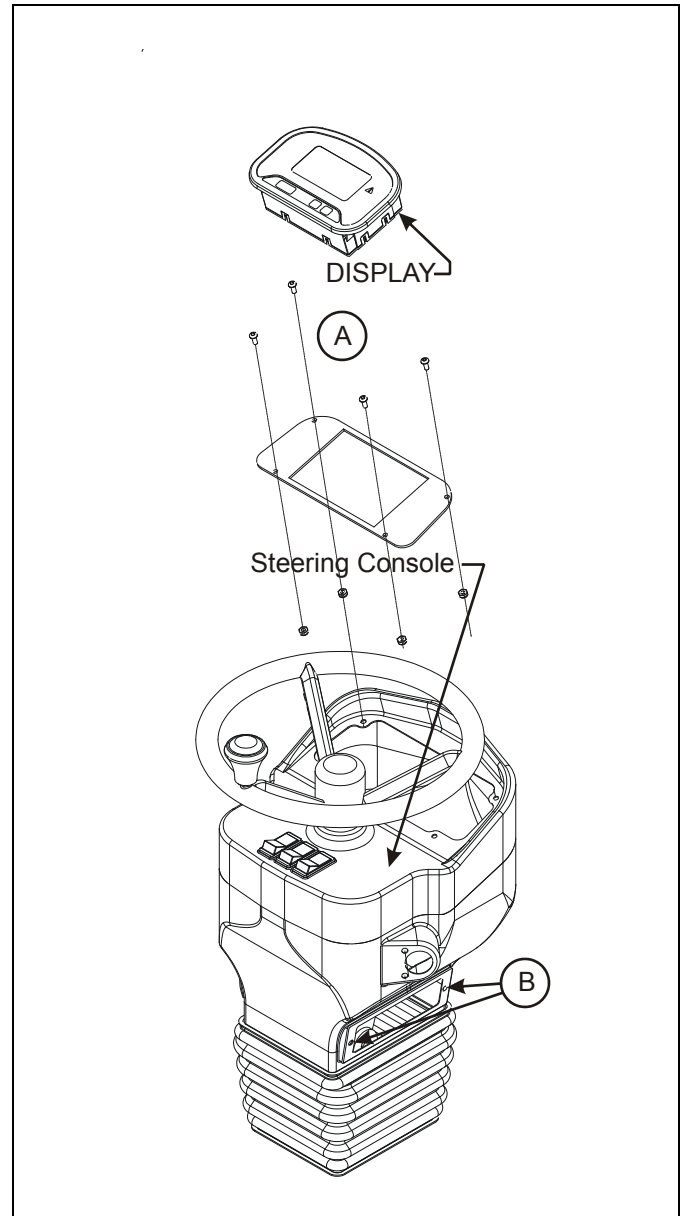


Figure 4-1 Dash and Steering Console Assembly

Key Switch

1. First, review Before You Begin page 1-1.
2. Set the key switch to OFF and remove the key from the key switch.
3. Apply the parking brake, perform a Lock Out/Tag Out procedure and disconnect the battery. Make sure all the wheels are securely blocked so that the truck cannot move.
4. Remove the right side cover to expose the internal components of the steering column as described on page 4-1.
5. Reach inside the steering column and disconnect the appropriate switch connector from the main wire harness.
6. Unscrew the knurled switch collar ring to separate the switch from the base plate. (See Figure 4-2)
7. Disconnect the wires from the switch terminals noting how they are connected to ensure proper orientation when connecting the new switch.
8. Install the key switch by reversing the preceding steps.

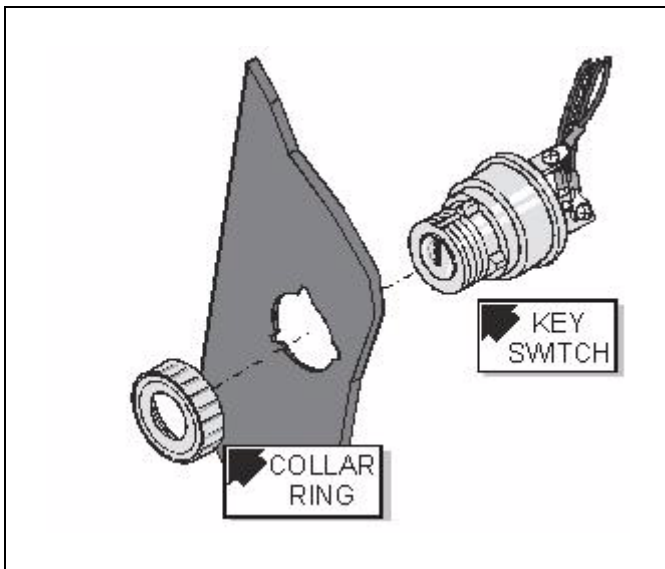


Figure 4-2 Key Switch Assembly

Rocker (On/Off) Switches

NOTE

Rocker switches are dash mounted and are used to control various light packages and accessories.

1. Repeat preceding sections 1-4 in "Key Switch Removal" on page 4-2.
2. Reach inside the steering column and disconnect the appropriate accessory switch connector from the main wire harness.
3. The accessory on/off rocker switches are held by locking tabs. Compress the tabs on one side at a time to release the switch body, then push up and lift out of the slot. (See Figure 4-3)

NOTE

Be careful when compressing and pushing the switch in or out. The tabs could break off if the procedure is not done carefully and evenly on all sides.

4. Detach the wires from the defective switch, noting the connection arrangement for when installing the new rocker switch.
5. Insert the replacement switch in the slot and compress the tabs as needed to allow it to insert.
6. Connect the cable connector to the wire harness and close the steering column by reversing the steps outlined in the above section.
7. Close the steering column by installing the right side cover.

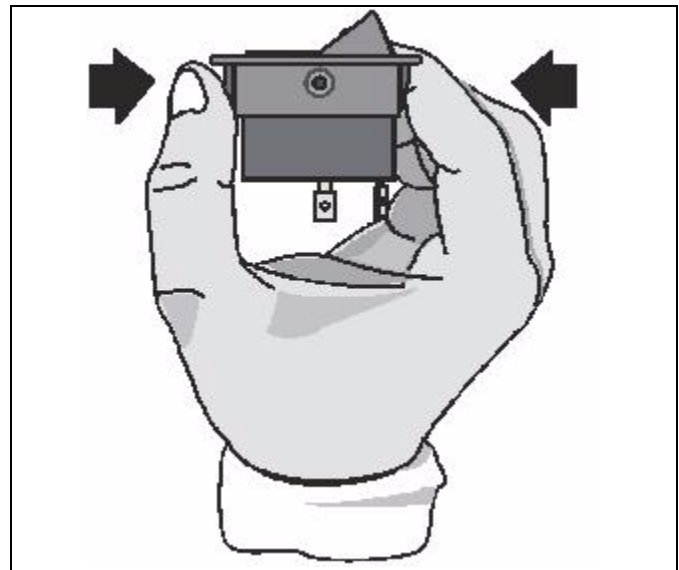


Figure 4-3 Rocker Switch Removal

Steering Wheel Removal

1. Pry the plastic cover from the steering wheel using your finger tips. If you cannot grab the cover, you can start it by carefully using a medium sized flat blade screw driver and gently prying upwards. **DO NOT** force it or the cover may crack.
2. Loosen the steering wheel nut.
3. Remove the steering wheel.

NOTE

If the steering wheel is difficult to remove, use a commercial puller. With this tool, it should remove easily.

4. Install the steering wheel by placing it over the shaft, aligning the wheel and shaft splines and pushing downward evenly until the nut can be installed.
5. Tighten the nut.

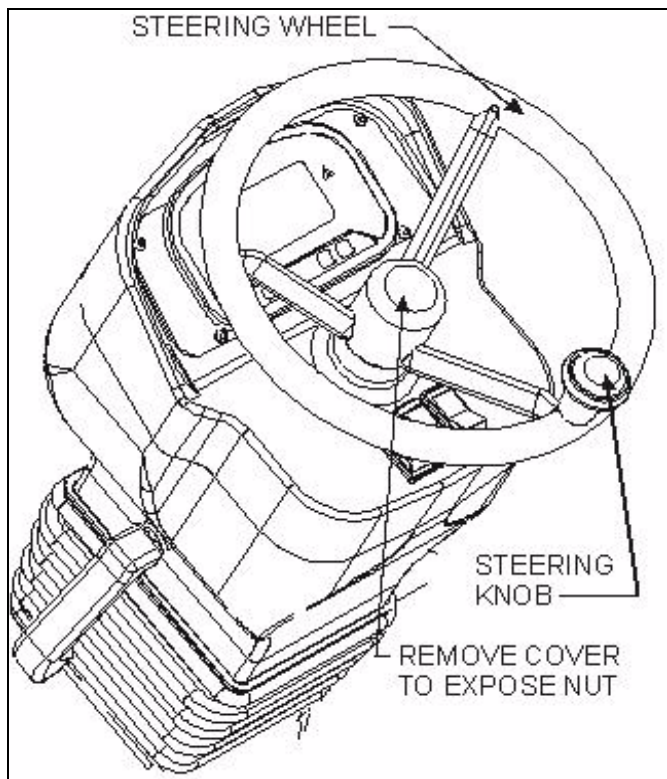


Figure 4-4 Steering Wheel and Knob

Steering Column (Console) Removal

NOTE

This is a two man operation, due to weight of steering column (approximately 30 pounds/14 kgs.). If an overhead crane is available, the crane could be strapped to the steering wheel for support.

1. Remove floor plates. (See "Floor Plate Removal," page 2-1)
2. Remove the lower dash cover weldment.
3. Disconnect the plugs that connect the dash harness to the main harness and any optional lighting harnesses.
4. Relieve hydraulic pressure in the system by turning the steering wheel a few times to the left and right.
5. Also pry (up) the bellows (rubber boot) free of the bellows retainer plate. This exposes the mounting plate for the steering column and the orbital control unit.

IMPORTANT

Four screws secure the assembly to the orbital steering mount bracket for stability. Once removed the unit is supported by the hydraulic hoses only.

6. Remove the four bolts and hardware securing the orbital control unit to the steering column.
7. Remove the four bolts and hardware securing the steering column console to the bellows retainer plate. (See Figure 4-5)
8. With help, lift the steering column upwards to disengage the shaft from the orbital unit, then remove the steer column from the truck.
9. When installing the new steer column, you must turn the steering shaft until it aligns with the orbital unit and drops into place.
10. Continue by reversing the preceding steps making sure to tighten and torque all mounting screws (See General Torque, Hydraulic Fitting Torque, and Bendi AC Special Torque Tables in on page 1-18)

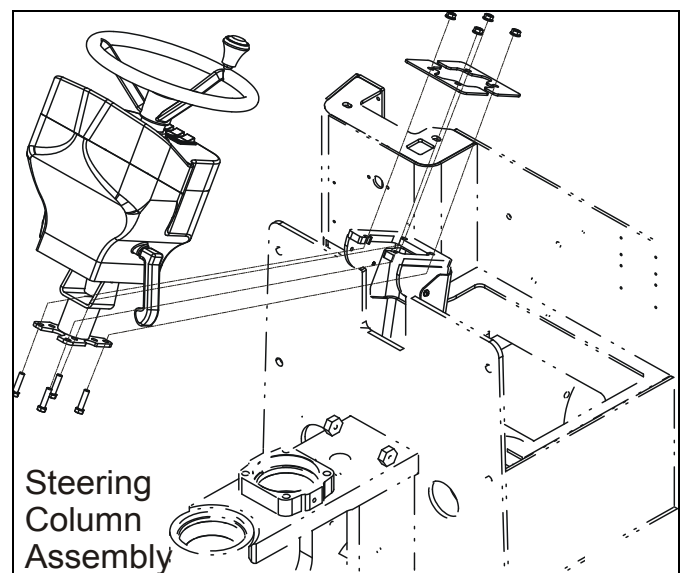


Figure 4-5 Steering Column Removal

ELECTRICAL SYSTEM

Steering Orbital Control Unit

1. Remove floor plates (See "Floor Plate Removal," page 2-1).
2. Remove the lower dash cover weldment.
3. Relieve hydraulic pressure in the system by turning the steering wheel a few times to the left and right.
4. Tag the port locations of each hydraulic line and fitting, then disconnect the four lines from the unit.
5. Review section "Hydraulic Fittings and Hoses," on page 3-9.

NOTE

Immediately plug and cap all hose ends and tag each for identification. Be prepared to clean up any oil spills.

6. If the unit is being replaced, or the fittings are defective, notice the placement angle of the hose fittings before removing them.
7. Install the new steering orbital control unit to the steering column by following the preceding steps in reverse order.
8. Check oil level in the hydraulic tank and fill as needed.

Electrical Contactors



CAUTION

Before any maintenance or work is performed on the electrical system of the truck, perform a Lock Out/Tag Out procedure, disconnect the battery, raise the lift and put blocks on the underside of the truck.

Inspecting the Contacts

NOTE

Contactors are set at the factory and should not require any adjustment. During the life of the contactor, they may become discolored, blacken or corroded. Cleaning or maintenance should be avoided. Replacement is recommended instead of maintenance. If one contactor is due for replacement, it is recommended that they are all replaced as a set.

Batteries - Care and Replacement

Battery Safety - Duplicate of Chapter 1.



WARNING

Forklift batteries give off explosive gasses during use. Do not smoke, strike a welding arc, or create any flame while using, working in the area or maintaining a forklift. Charge the forklift battery in a designated area with adequate ventilation. Batteries also contain sulfuric acid which can severe skin and eye burns. Avoid sulfuric acid contact to all parts of the body, including the eyes. In case of contact, flush immediately and thoroughly with clean water. If the eyes have been affected, get medical attention.

IMPORTANT

Keep all areas of the battery and the battery cables clean. Dirt or corrosion in these areas can drain the battery or cause erratic performance. Battery corrosion can also cause a voltage drop to the electrical components of the lift.

Battery Safety



CAUTION

Wear protective clothing when working around batteries, including rubber aprons, gloves, boots, eye goggles and face shields. Do not allow body to become in contact with battery electrolyte. If contact with electrolyte is made, wash affected areas immediately. In case of contact with eyes, flush immediately with clean water and get medical attention. A baking soda solution (one pound baking soda to one gallon of water) will neutralize electrolyte acid spilled on clothing, the floor or most other surfaces. Apply the solution until the bubbling stops and rinse with clean water.

IMPORTANT

- If any repairs to the battery are needed, follow the instructions given by the battery manufacturer.
- Do not lay metallic items or tools on the battery. Arcing or an explosion may result.
- Battery gas is explosive. Keep all flame and arcing away from the battery.
- Keep the battery clean. Impurities can weaken and eventually discharge the battery.
- Keep battery vent plugs firmly in place, except when checking or charging the battery.

Checking Batteries

NOTE

The electrolyte fluid level of the battery should be checked after each charge of the battery. The optimum level of the electrolyte should be about 1/2" (13 mm) over the top of the plates or just below the bottom the lowest part of the lip of the battery filler vent hole. If low, add distilled water OR the solution recommended by the battery manufacturer. Do not overfill.

For increased battery life reference "Battery Care" on page 1-4 and check daily the specific gravity readings. Since the water must be mixed with the electrolyte for an accurate reading, do not check the gravity readings right after adding water. Unless the electrolyte is below the top level of the plates, do not add water right before the battery is scheduled to be charged. Normal full charged specific gravity should be between 1.265 and 1.285.

- Always assume the battery is emitting hydrogen and follow proper safety precautions.
- Do not smoke, use an open flame, or create arcs or sparks near the battery.
- Packaged with every battery are specific instructions for battery safety, care and use, plus a Material Safety Data Sheet (MSDS). Read these documents thoroughly before servicing the battery.
- Always disconnect the battery before performing any service.
- Do not lay objects on the battery as they may cause a short circuit. Shorting battery terminals can release enormous amounts of energy, causing electrical shock, sparks or flame, or heating nearby components to dangerous temperatures.
- Truck batteries contain concentrated sulfuric acid which can cause severe chemical burns. When adding water to the battery, wear rubber gloves, protective clothing and safety glasses or a full-face shield. Use a plastic container or an automatic cell filler to prevent container breakage.
- Neutralize acid spills immediately with Bicarbonate of Soda. If acid contacts the skin or eyes, wash with water immediately and seek medical help at once.
- Use caution when changing battery connectors to ensure that correct polarity is maintained.
- Keep vent plugs in place, fully tightened and clean at all times.
- Be sure to replace and retighten any battery restraints which have been installed on the truck.

Battery Care

- Only charge the battery in the designated area.
- Make sure that the charger being used matches the voltage and amperage of the truck battery.
- Before connecting and disconnecting the battery charger to the battery, make sure the charger is OFF. Connecting or disconnecting the charger when it is ON, could damage the charger or cause an arc.
- Before charging, make sure the electrolyte covers the top of the battery plates.
- Before connecting the battery cable to the truck's receptacle, make sure the key to the truck is off and that the controls are in the off position.
- Make sure the batter terminals and cables are cleaned of corrosion regularly. Clean battery terminals are important not only to the operation of the lift, but for proper battery charging.
- Make certain that the battery used meets weight and size requirements of the truck. NEVER operate the truck with an undersized battery. Reference data plate information for this information.

Charging the Battery

NOTE

Charging time and requirements will vary with the battery size and condition. Whenever the truck needs to be troubleshot, the battery must be fully charged.



CAUTION

- Never smoke or bring open flame to a charging or idle battery. Gas from a battery is highly explosive and can cause serious injury.
- Avoid over filling as it will cause overflow (flooding) of the electrolyte, resulting in loss of electrolyte, battery tray corrosion, ground paths and loss of capacity or working ability.
- Connecting the charger cable to the truck cable can cause damage to the forklift

IMPORTANT

1. Park the truck at the designated charge area with forks down and key OFF.
2. Make sure charger is in the OFF position.
3. Connect battery to the charger and make certain cables are firmly connected.
4. Turn the charger on and set the timer, if equipped. For an overnight fill, set charger to NORMAL.
5. View the charger gauge to be positive of charge.

ELECTRICAL SYSTEM

Removing the Battery From the Charger

1. Make sure the charger is off and disconnect the charger cables from the battery with a straight pulling motion. Store the charging cables appropriately.
2. Check the battery for the appropriate electrolyte level and measure specific gravity, if needed.

Cleaning the Battery

When properly maintained, the battery will remain relatively clean and dry. It may be necessary to clean the top of the battery. Occasionally it may be necessary to remove excessive electrolyte. If this happens, remove the battery from the truck and clean with a solution of baking soda and water. (one pound baking soda to 1 gallon of water) Rinse the battery off with water and allow to air dry.

Battery Removal



CAUTION

Don't allow metallic objects to be on top or near the battery. A short could cause an electrical arc and personal injury may result. When moving the battery, keep the top of the battery covered with an insulator, such as a piece of plywood or tarp.

Rollout Battery Removal - optional

1. Remove the safety retainer bar, deactivating the safety switch.
2. Position battery roll out stand next to the truck and align the stand with the path of the battery.
3. Roll and secure the battery onto the stand.

Battery Installation

1. Change and charge batteries in accordance with ANSI/NFPA 505.
2. Check to be sure the key is off.
3. Open the right hand door.
4. If using a rollout stand, position the battery stand next to the truck. Align stand with battery compartment. Battery roller stand should be the same height as the truck.
5. Push battery into the truck's battery compartment or lower if using a hoist.
6. Install battery retainer safety bar or the truck will not operate.
7. Connect the battery.

Electrical Static Discharge

IMPORTANT

- Normal precautions concerning the handling of electronic components are applicable in order to minimize the risk of damage to these devices by ELECTRICAL STATIC DISCHARGE. Avoid contact with the pins of these devices and ensuring that when they are removed from a printed circuit board (PCB), the pins are strapped together with conductive tape. Immediately place the PCB in static-free bubble wrap or ESD bag.
- ESD smocks over normal clothing must be worn to discharge high voltage potentials caused by friction during normal wear.
- Use a grounding wrist band to protect microprocessors and all electronic components from static electricity and always touch a metal surface (other than the truck) before touching a PCB. These precautions are especially necessary with respect to microprocessor devices, found on the hydraulic control PCB's of this truck.

Electrical Controls and Levers

Direction Control Lever

NOTE

The directional control lever (forward-neutral-reverse) is located on the battery cover. Each assembly is available as a complete unit only.

Replacing Direction Control Lever

1. First, review "Before You Begin," page 1-1.
2. Set the key switch to OFF, remove the key from the key switch and place in a secure area.
3. Apply the parking brake, perform a Lock Out/Tag Out procedure and disconnect the battery.
4. Make sure all the other wheels are securely blocked so that the truck cannot move.
5. Raise the battery cover.
6. Remove the directional control lever wires from the contact blocks on the main harness.
7. Replace in reverse order.
8. Test for proper operation.

Check the Return-to-Neutral

1. Sit in the driver's seat, and turn the key switch ON.
2. Set the direction control lever to FORWARD.
3. Slowly move the truck forward, then stop by using the service brake.
4. Turn the key switch OFF, then back on again.
5. Press on the accelerator pedal.
6. The truck must not move.
7. If the truck does not move, take your foot off the accelerator pedal. Place the directional control lever in NEUTRAL then back to FORWARD again.
8. Slowly push on the accelerator pedal. The truck should move forward. If it does not move, Refer to Programming Troubleshooting Chart and 1314 Monitoring Function both in chapter 5.
9. Repeat preceding Steps through, but instead of turning the key switch OFF in Step, lift yourself from the driver's seat to allow the switch interlock to release. The truck must react as stated in Steps 4 through 8.

5. Remove the control compartment cover.
6. Mark and remove all cables connected to high current terminals of the panel and disconnect the main harness.
7. Remove mounting hardware that secures the assembly to the truck and remove the panel or single component from the truck. (See Figure 4-7)
8. Reassemble in reverse order. All cables installed on the motor controllers must use all the required Landoll approved fasteners and be in the correct assembled order. (See Figure 4-6) Refer to the Bendi AC Parts Manual for replacement parts.
9. Tighten cables connected to the high current terminals, identified on the controller housing as B+, B-, U, V and W to 90 +/- 1- in-lbs(10.2 +/- 1.1 Nm). Refer to view shown below for high current cables.

NOTE

After replacing the controller it must be reprogrammed. See Chapter 5 "Calibration and Programming"

HIGH CURRENT CONNECTIONS DEFINITION:

B+ = Positive Battery to Controller.

B- = Negative Battery to Controller.

U = Motor phase U.

V = Motor phase V.

W = Motor phase W.

Replacing a Complete Control Panel

1. First, review "Before You Begin," page 1-1.
2. Set the key switch to OFF, remove the key from the key switch and place in a secure area.
3. Apply the parking brake, perform a Lock Out/Tag Out procedure and disconnect the battery.
4. **Make sure all the other wheels are securely blocked so that the truck cannot move.**

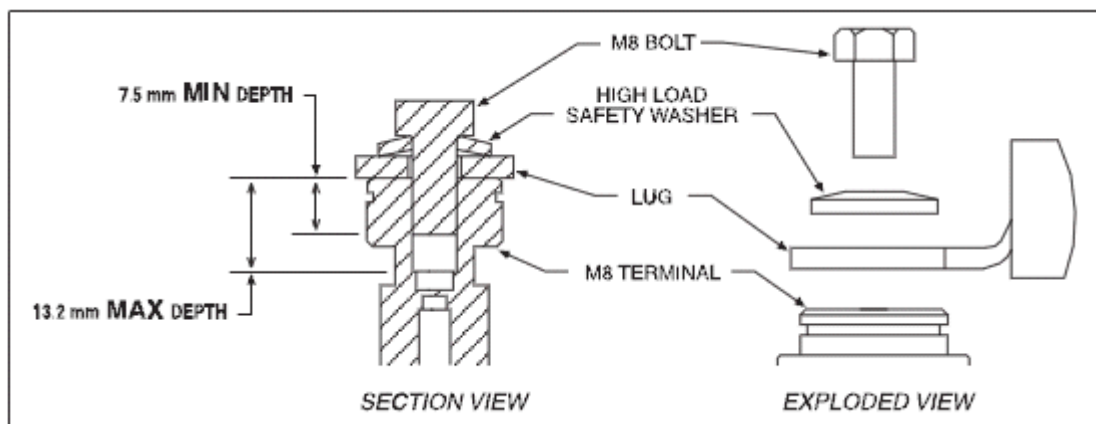


Figure 4-6 Heavy Cable Hardware and Assembly

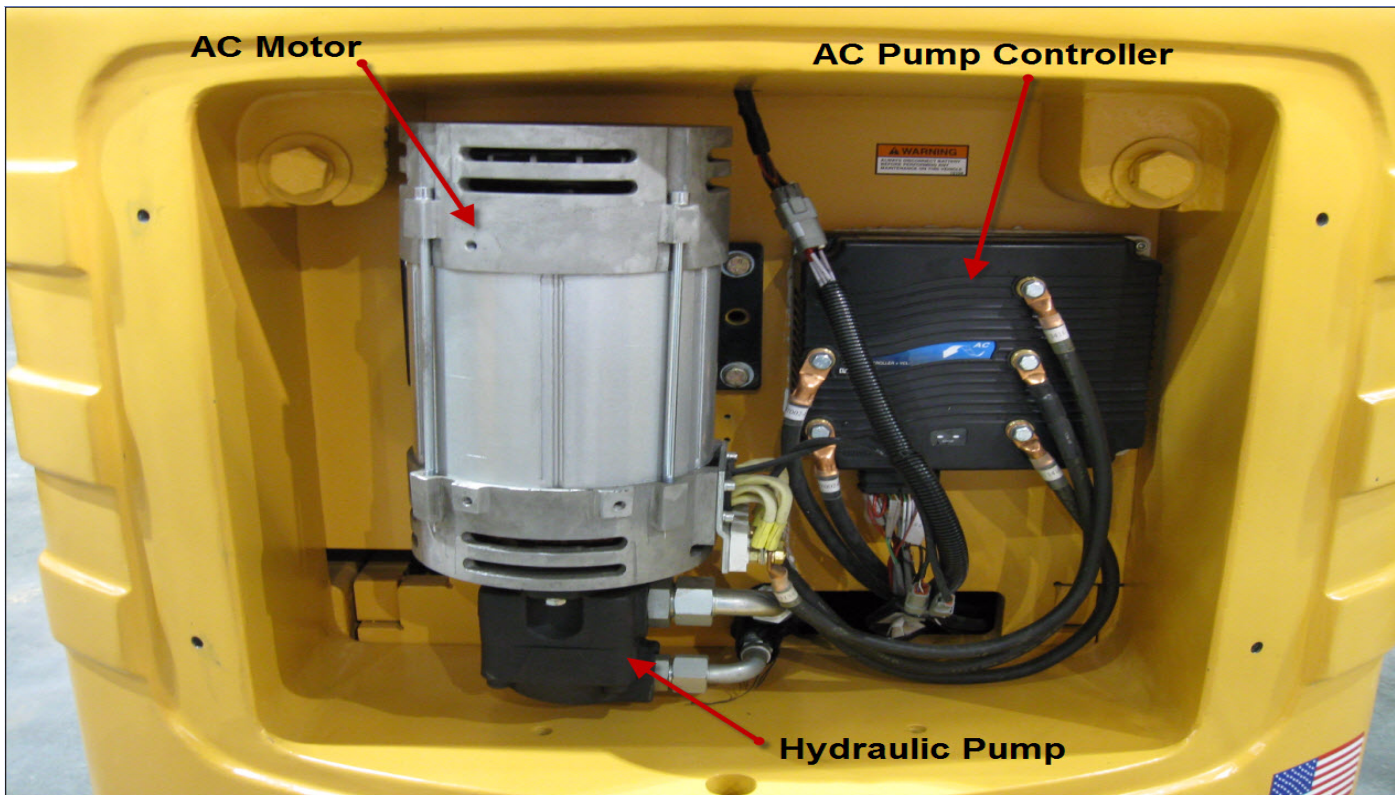


Figure 4-7 AC Motor, Pump and Controller

Seat Assembly

Horn Service

NOTE

The horn button is located to the right of the direction control lever.

Removing the horn

1. Turn the key switch is OFF, remove the key, perform Lock Out/Tag Out procedure and disconnect battery.
2. Remove front rotation cover plate.
3. Disconnect the electrical wires.
4. Remove the hex screws and hardware to separate the horn from the frame.
5. Install the new horn by reversing the preceding steps.
6. Connect the battery and test the horn.

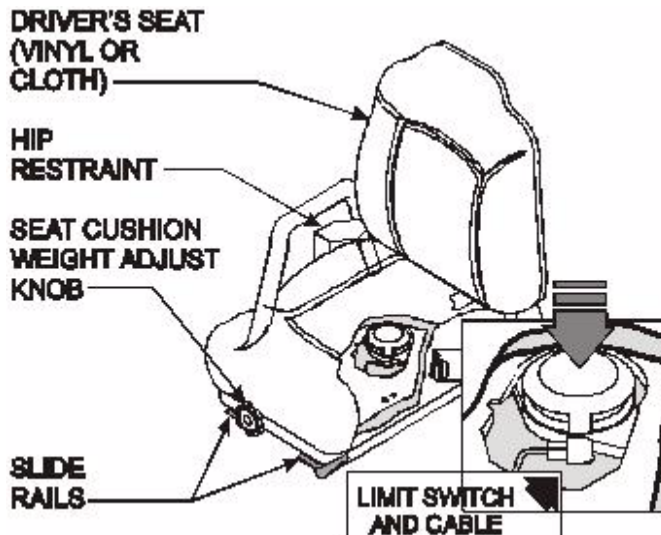
Seat Switch

The driver's seat micro switch and cable assembly are mounted to the bottom of the seat cushion.

Check Driver's Seat Switch

This procedure checks the physical mechanics (actuation) of the driver's seat switch only. The switch is part of the seat.

1. Start the truck and release the parking brake.
2. The seat switch and actuator are internal to the seat cushion, located on the under side of the seat cushion between the cushion and the bottom plate.
3. Set the direction control lever in either FORWARD or REVERSE and slowly apply acceleration. As the truck begins to slowly move in either direction, lift yourself from the driver's seat just enough to release the switch in the seat cushion.
4. The truck will not come to an immediate stop. You should lose forward direction (or reverse). The truck will coast unless you use you brakes.
5. If the truck continues, see "Seat Switch," on page 4-9 or refer to Troubleshooting the controller - Chapter 5.



Replacing the Switch and Cable

1. First, review Before You Begin page 1-1.
2. Set the key switch to OFF, remove the key from the key switch and place in a secure area.
3. Apply the parking brake, perform a Lock Out/Tag Out procedure, disconnect the battery and block all wheels.
4. Remove the hardware securing the front portion of the seat slide rails to the cover. Then loosen the back two sets of hardware.
5. Raise the front of the seat up to expose the switch and cable mounting.
6. Have a helper disconnect the switch cable from the main harness, then unscrew the switch assembly.
7. Install the new switch and cable by performing the preceding steps in reverse order.
8. Before placing the truck back into operation, test it to be sure the switch functions properly. (See "Check Driver's Seat Switch" on page 4-8)

Truck Lighting

Trucks equipped with optional lighting, flashing or spot lights may contain replaceable bulbs or the housing may be replaced as a whole. Lighting replacement varies according to the manufacturer.

Headlights

These lights have non-replaceable LED elements and are replaced as an entire unit.

Brake and Tail Lights

1. Set the key switch to OFF and remove the key.
2. Apply the parking brake and disconnect the battery.

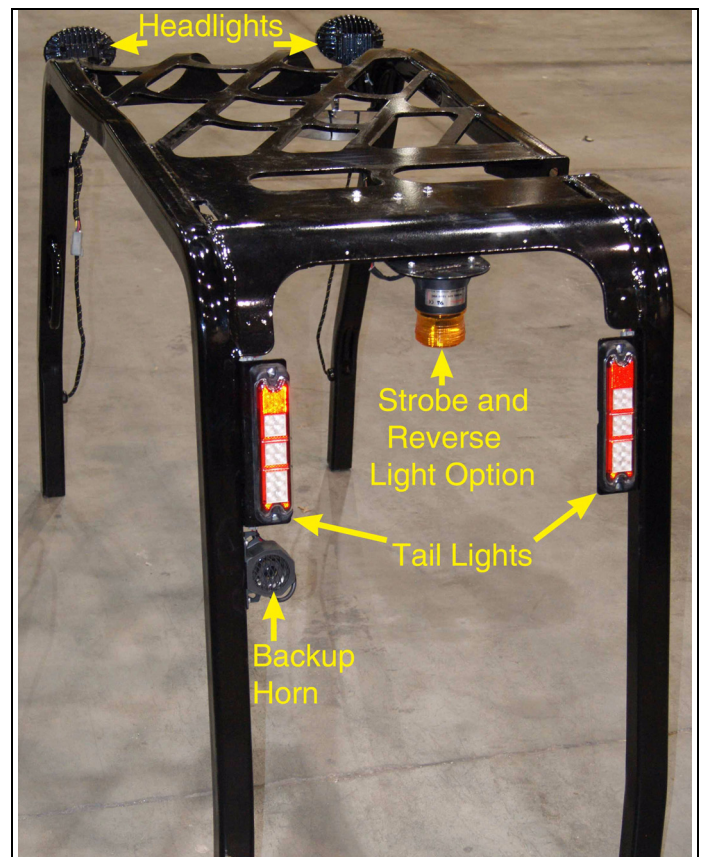
3. The complete LED light assembly must be replaced to repair a faulty light assembly.
4. Pull off the complete LED light assembly. Exercise care to avoid breaking the LED assembly.
5. Disconnect the wire connector and remove the bracket that is attached to the overhead guard.
6. If shielding or guard covers are involved, make certain that the guard is replaced after the repair. Reassemble in reverse order.

Back Up Alarms

1. First, review Before You Begin on page 1-1.
2. Set the key switch to OFF and remove the key.
3. Apply the parking brake and disconnect the battery.
4. To access the alarm assembly, raise the seat base as it is located under the arm rest.
5. To replace the alarm assembly, disconnect the wire connector and remove the mounting hardware holding the alarm to the mounting bracket.

Overhead Guard, Lighting and Alarms

Trucks equipped with optional LED flood / headlights, tail and stop lights, flashing or spot lights (strobe lights), etc. do not contain replaceable bulbs. Bulb replacement must be done as a complete assembly.



ELECTRICAL SYSTEM

Side Shift Circuit Maintenance

The following information is provided for authorized service facilities ONLY.

Perform maintenance on the side shift circuit as required by the Hourly Checklists.



CAUTION

- Before you remove any hoses or tubes, relieve hydraulic system pressure. With the truck off, open the truck auxiliary control valve(s) several times in both directions.
- Check for hydraulic fluid leaks using a piece of cardboard or wood.
- Do not use your bare hands.
- Remember to wear safety glasses.



DANGER

Hydraulic oil can be under very high pressure. A pinhole leak is not easily seen and if it pierces your skin, can cause injury and possible death.

Check the hydraulic system pressure at the control valve fitting. Refer to the truck service manual for details on measuring hydraulic system pressure. System pressure must not exceed 3000 psi (206 bar).

Check Side Shift Circuit Performance

1. Side shift completely to the left and hold the control handle in this position for 5 seconds. Check for external leaks at the cylinder, fittings, and hoses.
2. Side shift completely to the right and hold the control handle in this position for 5 seconds. Check for external leaks at the cylinder, fittings, and hoses.

Steering Potentiometer Replacement

NOTE

The steering wheel pot is located on the bottom side of the frame behind the mast pivot.

1. First, review "Before You Begin" on page 1-1.
2. Set the key switch to OFF, remove the key and place in a secure area.
3. Unhook the battery and perform a Lockout/Tagout procedure.
4. Unhook the wiring connector from the harness. (See Figure 4-8)
5. Remove both connectors that hold the steering pot in position.
6. Reassemble in reverse order.
7. Calibrate the system as described in Chapter 5.

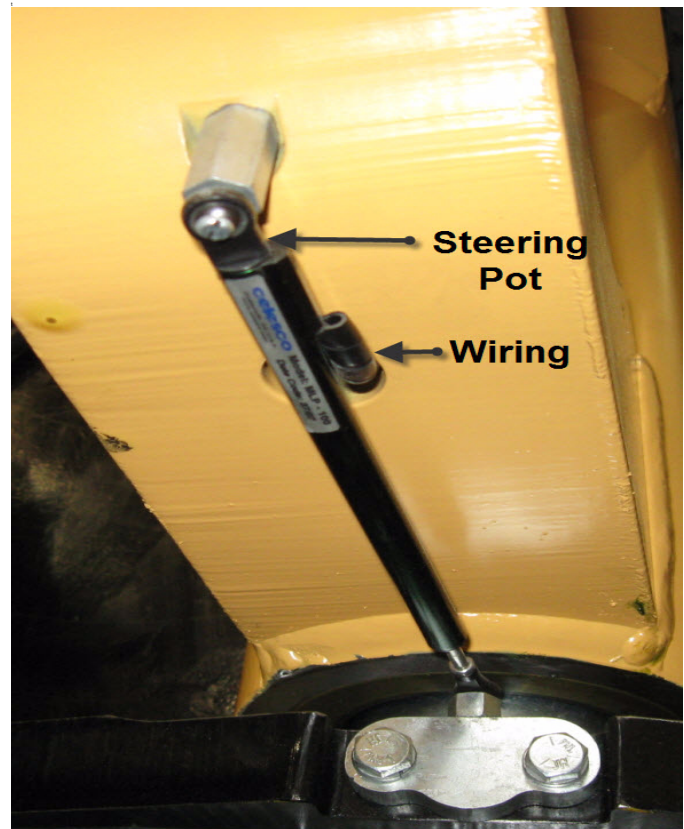


Figure 4-8 Steering Potentiometer

Fuses

Shown on page 4-11 is the location of the Bendi AC System and Controller fuses. Exact size and amperage rating must be retained when replacing.

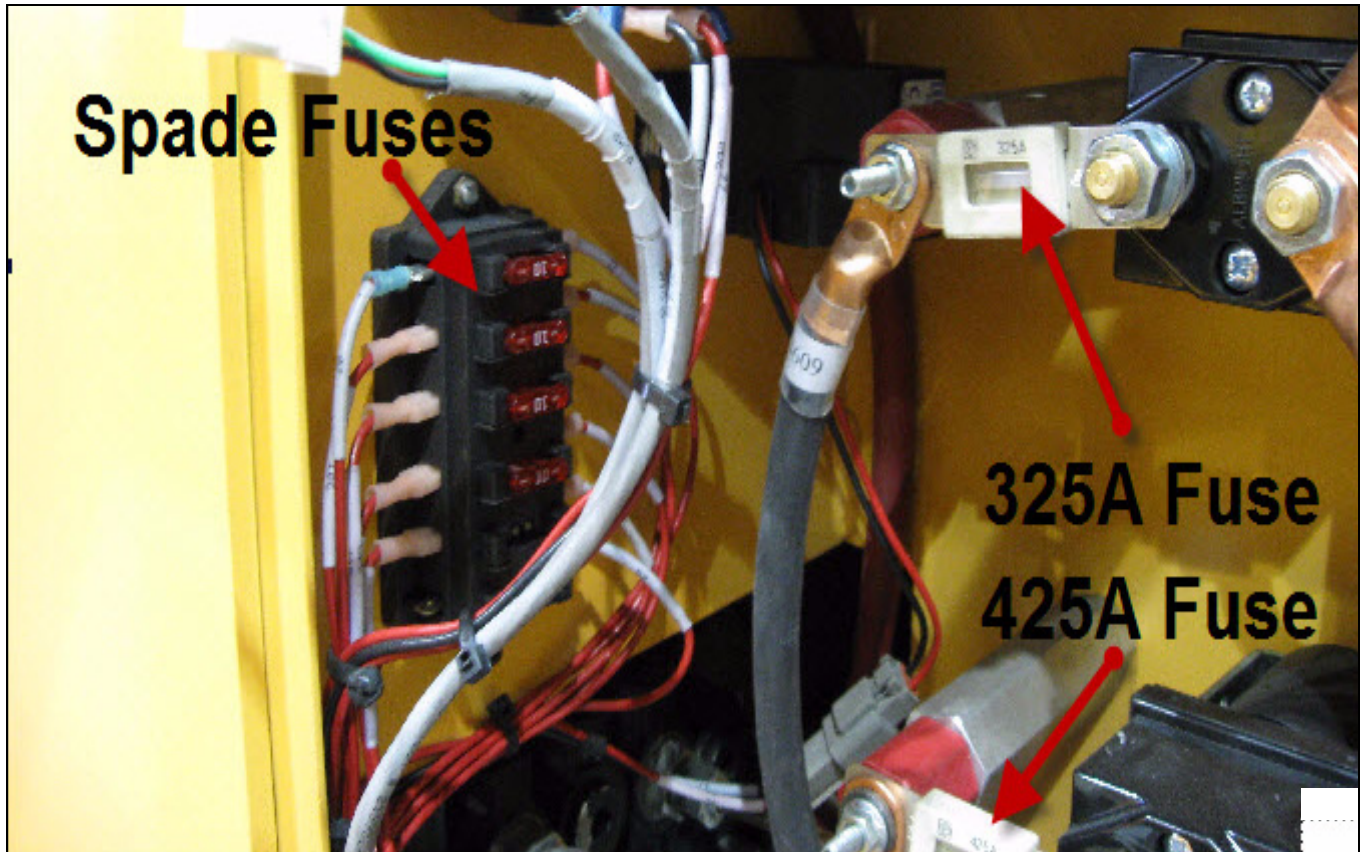


Figure 4-9 Fuse Location

ESD Strap

Shown to the right is the ESD Strap which will be installed just behind the front steering assembly. This device will drain all static electricity build up that may occur on the Bendi AC forklift.



Table provided for your general use with this manual

[illegible]

Chapter 5

Bendi B3/30 AC Calibration and Programming

Controller Theory of Operation

The Bendi AC truck uses Curtis controllers that convert DC battery power to 3-phase AC power by precisely controlling the induction drive for high bandwidth, efficiency and low ripple torque generation. The Dual Drive feature of Curtis controllers allows two controllers to work together in vehicles with dual fixed axle drive motors, a steered wheel or axle, and an analog steer-angle sensor. The two controllers should be the same size and model. Different models of controllers cannot be mixed. The pair of controllers control motor speed on the inner and outer wheels during turns, as well as vehicle speed and acceleration while turning. Current is automatically balanced between the two traction motors when driving straight, and a limited operating strategy (LOS) allows limp-home in case of a steer angle sensor or single motor or controller failure.

Below is shown the Dash Display for reference:

Button #1 “Enter Key” - Used to Enter the Calibration Mode and to make selections after they are located.

Display directions:

Hold the enter button down until the change is accepted.

Button #2 “Up Key” - Moves “Up” through the selections.

Button #3 “Down Key” - Move “Down” through the selections.



The following parameters can be adjusted through the dash display:

- **Maintenance Monitor** - Used to set the hour meter value at which the operator will be alerted that service is required, NXT SVC DUE. When the truck meets or exceeds the value entered in this section, “SERVICE DUE” will be shown on the display. If this feature is not desired, set the value to the factory default of 99900 hrs. Use the Up/Down arrows to manipulate the values by the hundreds.
- **Steer Potentiometer(POT) Setup** - Used to calibrate the steering position potentiometer.
- **Accelerator Potentiometer(POT) Setup** - Used to calibrate the accelerator potentiometer.
- **Lift Potentiometer(POT) Setup** - Used to calibrate the lift potentiometer.
- **Brake Potentiometer(POT) Setup** - Used to calibrate the brake potentiometer.
- **Lift Lockout Setup** - This parameter allows for adjustment of the battery capacity percentage where lift lockout is initiated.

IMPORTANT

When replacing the steering, brake, acceleration or lift potentiometer maintenance has been performed, re-calibration of the Bendi AC is required.

BENDI B3/30 AC CALIBRATION AND PROGRAMMING

Truck calibration is performed by activating the key switch and performing the following procedure:
Follow flow chart in Figure 5-1.

1. At the Main Screen, press and hold the ENTER button for approximately 5 seconds. This will open the main menu. "TRUCK SETUP".
2. An "Asterisk" will show your selection - Use the Up/Down arrows to move to the next selection. Hold down ENTER to select.
3. Truck Setup now will display the password screen.
4. To enter the password, use the Up/Down arrows to manipulate the value to the desired digit and press ENTER. Repeat this process for each digit. After entering the correct password, the truck setup menu will be displayed.

Note: The default password is: 4 2 3 1.

5. If use of Maintenance Monitor is desired, navigate to "MAINT MONITOR" selection and adjust the Service Due Hour Meter value as you require.
6. **ACCEL POT SETUP:** Navigate to Steer POT SETUP on the main menu and press enter. Press ENTER again to begin calibration

- The astericks moves to the right indicating your selection. (The location of (*) defines current stage of calibration)
- Steer truck fully left and press ENTER. Turn Steer to straight selection and hit ENTER. Steer the truck to the right position & press ENTER.
- This completes the STEER POT SETUP.

7. **ACCEL POT SETUP:** Navigate to ACCEL POT SETUP on the main menu and press enter. Press ENTER again to begin calibration.

- ACCEL ZERO calibration - Ensure the foot pedal is in the up position and press ENTER.
- ACCEL FULL - Press the pedal to the floor and press ENTER. Monitor the accelerator pot voltage on the screen; ensure this value is changing with movement of the pedal between .1VDC and 5.2VDC. This completes the ACCELERATOR POT SETUP.

8. **LIFT POT SETUP:** Select LIFT POT SETUP from the truck setup menu and press ENTER. Press ENTER again to begin calibration.

- LIFT LEVER ZERO - Ensure the lift lever is in the neutral position and press ENTER.
- LIFT LEVER FULL - Pull the lift lever back completely and press ENTER. Monitor the lift pot voltage on the screen; ensure this value is changing with movement of the lever between .1VDC & 5.2V.

9. **BRAKE POT SETUP:** Select BRAKE POT SETUP from the truck setup menu and press ENTER. Press ENTER again to begin calibration.

- BRAKE PEDAL ZERO - Ensure the brake pedal is in the up position and press ENTER.
 - BRAKE PEDAL FULL - Press the brake pedal to the floor and press ENTER. Monitor the brake pot voltage on the screen; ensure this value is changing with movement of the pedal between .1VDC and 5.1VDC. This completes the BRAKE POT SETUP.
10. **LIFT/LOCKOUT SETUP:** Select LIFT LOCKOUT from the truck setup menu and press enter. Press ENTER again to begin editing.
 11. Use the Up/Down arrows to manipulate the value to the desired percentage and press enter to store the new value. This completes the LIFT/LOCKOUT.

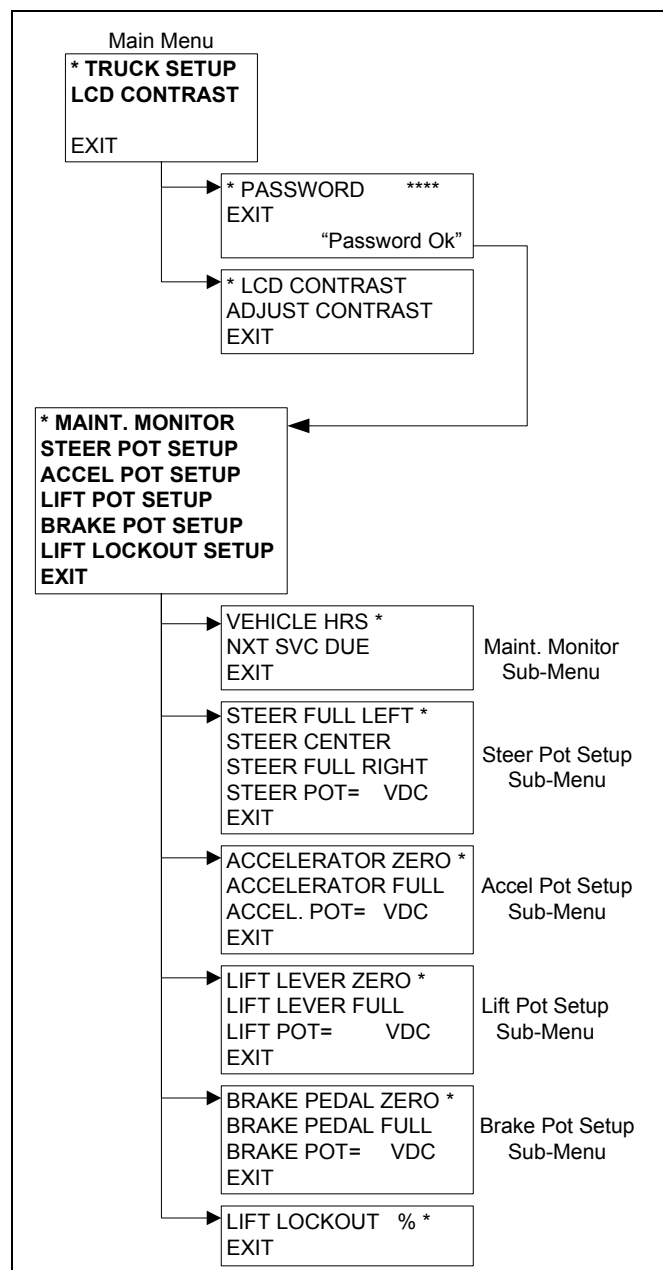


Figure 5-1

1314 Bendi AC Controller Software Program Installation and Operation

The 1314 Controller Software is used to manipulate, monitor and diagnose the Bendi AC Forklift performance and functions.

The following sections will guide you through the installation of the 1314 Controller Programming Station and explain the software program functionality.

USB to Serial Port Adaptor Cable

Depending on the configuration of your laptop, an interface cable may be needed for the software transfer between the laptop and the Bendi controllers. A 9-pin Serial to USB port adapter is needed.

Note: The Belkin F5U509 is a recommended model, although other suppliers of this type of adapter are available at many computer cable suppliers. Refer to picture shown in the previous column.

If your laptop is equipped with a serial port you may connect the Bendi controller directly to your laptop with the supplied 1309 Curtis interface cable shown below.



Shown below is a Serial to USB adaptor cable connected to the Curtis 1309 interface cable to be connected between the forklift controller and your laptop computer. Reference page 5-48 for truck cable connector locations.



1314 Installation Procedure

1. Insert CD into your CDROM Drive, the following screen should appear
2. Click the Next button



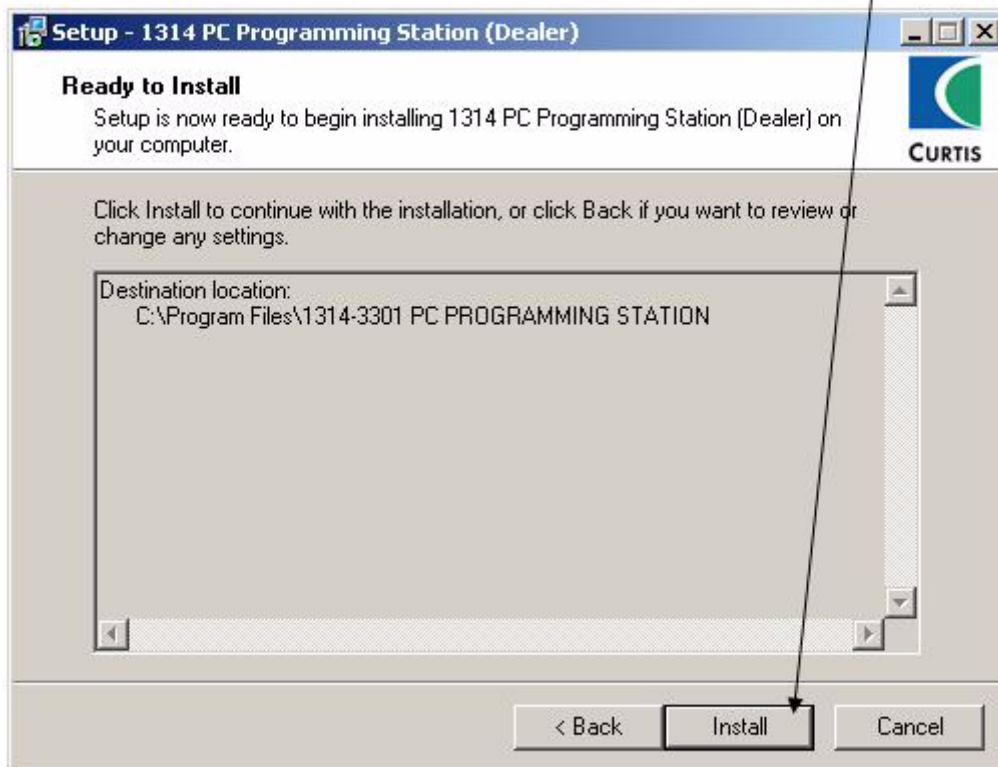
Follow the
below
installation
instructions:

3. Read and accept the software license agreement.



4. Click NEXT

5. Select the **INSTALL** button to proceed with the installation.



With installation complete, the software program is ready to use.

Proceed to next step & update the program to the latest revision.

1. Open the 1314 Software program and select "Help"

2. Select the **CHECK FOR UPDATES** menu.

This will use internet access to ensure that you are at the latest revision levels.

1314 Update Procedure



NOTE

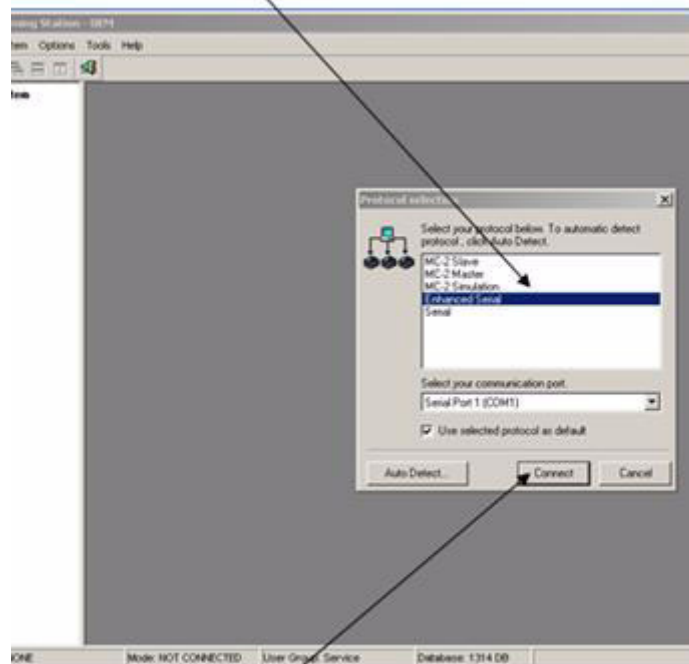
This must be completed before using the software, on every installation of the software.

BENDI B3/30 AC CALIBRATION AND PROGRAMMING

1. Access OPTIONS and then CHANGE PROTOCOL/PORT menu.



2. Select ENHANCED SERIAL protocol

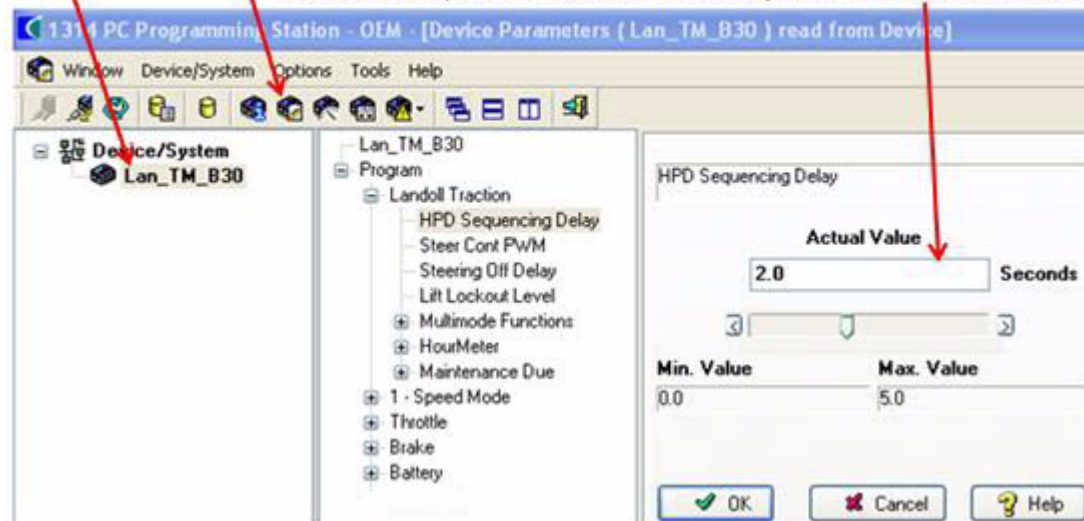


3. Click the CONNECT button

4. Highlight connected controller.

5. Click on Device Parameters button.

6. Controller parameters can now be adjusted in the active window.

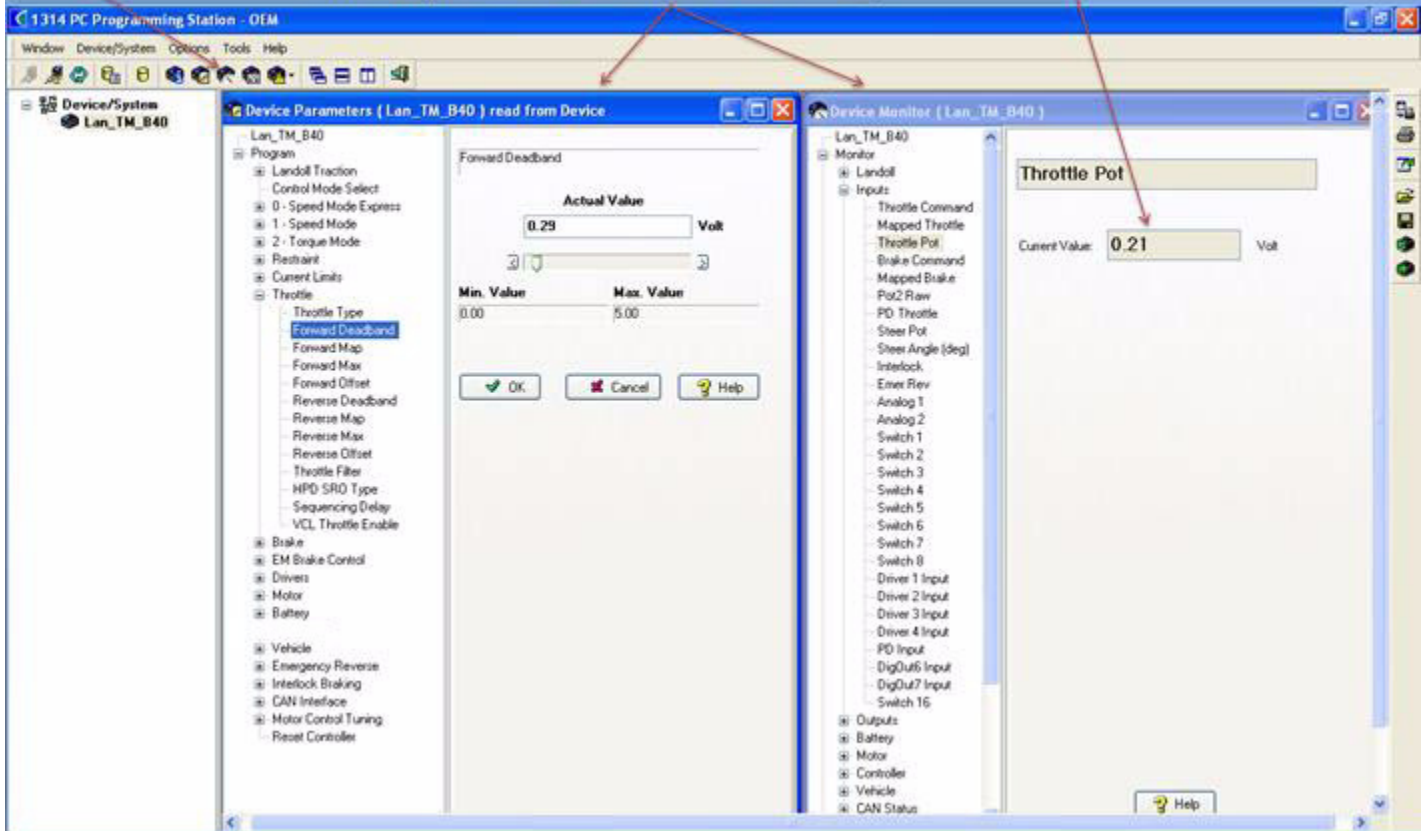


Communicating with Bendi AC Controllers

7. Device may be monitored by clicking on the MONITOR button.

Note: Multiple screens can be viewed simultaneously.

8. The Monitor function is useful to see actual controller values during operation of the truck.

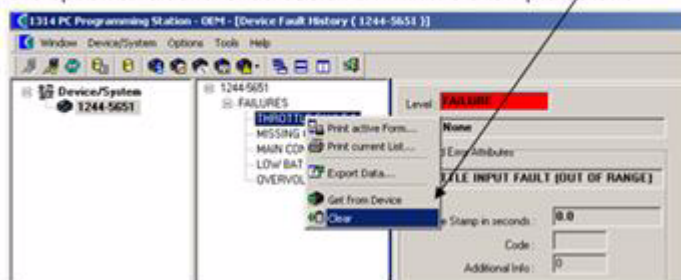


1314 Software has many built in features to help in troubleshooting individual controllers. The example below shows the opened fault monitor. This can be accessed by clicking on the DIAGNOSE button



Additional 1314 Controller Features

Individual faults in FAULT HISTORY are cleared by highlighting the fault and RIGHT clicking it. A drop down menu will give you the option to clear the fault as shown in the example below.



You may now begin to manipulate, monitor and diagnose the forklift performance and functionality.

Follow the below instructions to “Connect”, check software “Revision Levels”, change required forklift “Settings” and “Monitor” functionality.

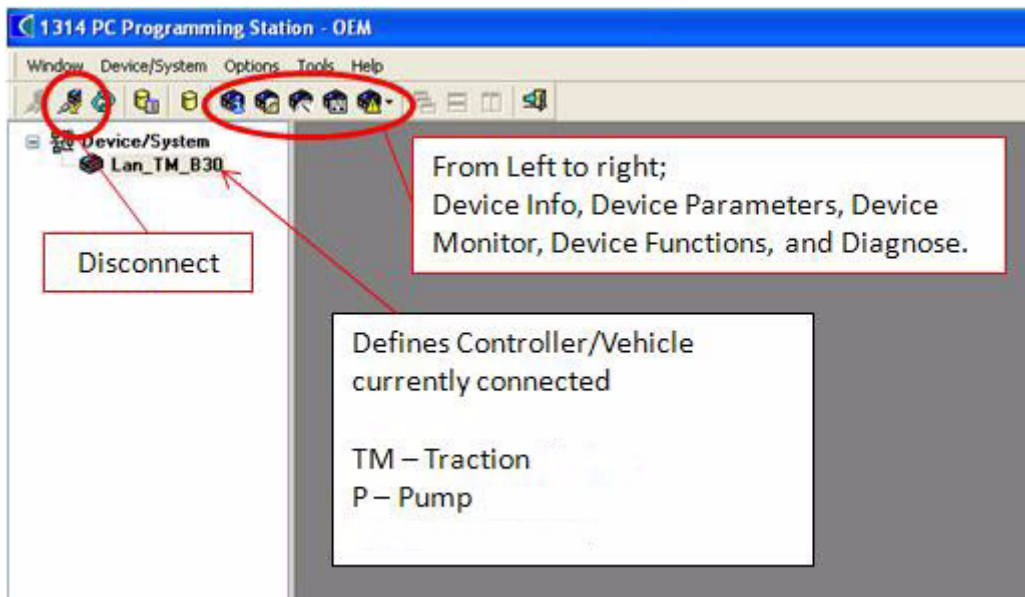
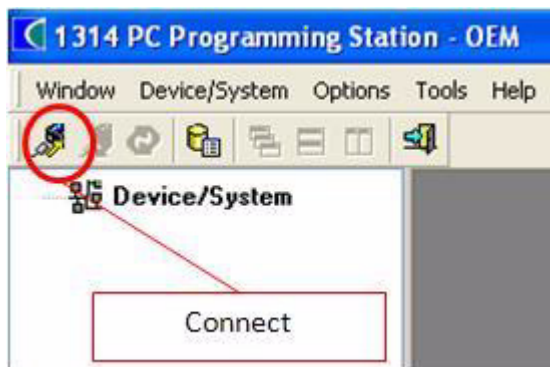
IMPORTANT

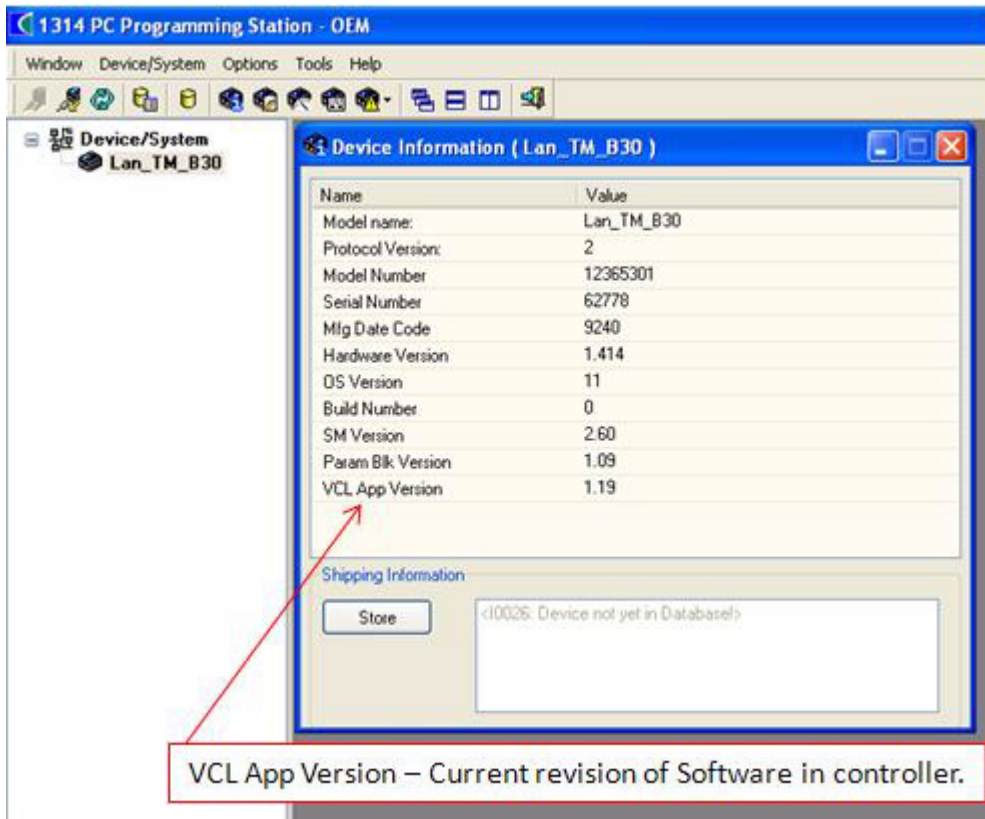
After successfully reflashing a controller, make sure to clear the fault history of all comments.

Controller Fault History

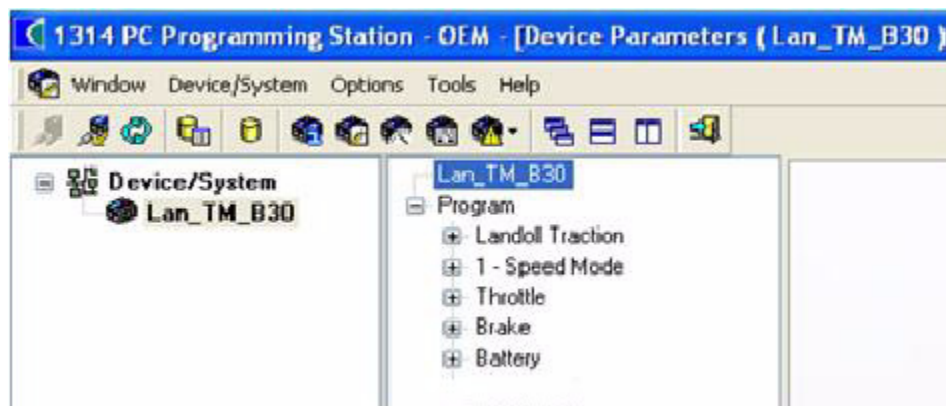
The 1314 programmer can be used to access the controller’s fault history file. The programmer will read out all the faults the controller has experienced since the last time the fault history file was cleared. Faults such as contactor faults may be the result of loose wires; contactor wiring should be carefully checked. Faults such as over temperature may be caused by operator habits or by overloading. After a problem has been diagnosed and corrected, it is a good idea to clear the fault history file.

This allows the controller to accumulate a new file of faults. By checking the new fault history file at a later date you can readily determine whether the problem was indeed fixed.





After successfully connecting to the controller proceed through the below instructed menu's and sub-menu's to review all parameters.



BENDI B3/30 AC CALIBRATION AND PROGRAMMING

The screenshot shows the 1314 PC Programming Station interface. The left pane displays the device tree with 'Lan_TM_B30' selected. The right pane shows the 'HPD Sequencing Delay' parameter configuration. The 'Actual Value' is set to 2.0 seconds. The 'Min. Value' is 0.0 and the 'Max. Value' is 5.0. A text box explains: 'Defines how long the Seat switch can be false before SRO (return to neutral) occurs.' Another text box points to the 'OK' button: 'Input desired Actual Value then click "ok" to write value to controller.'

Important Note: This same procedure will be used for all parameters.

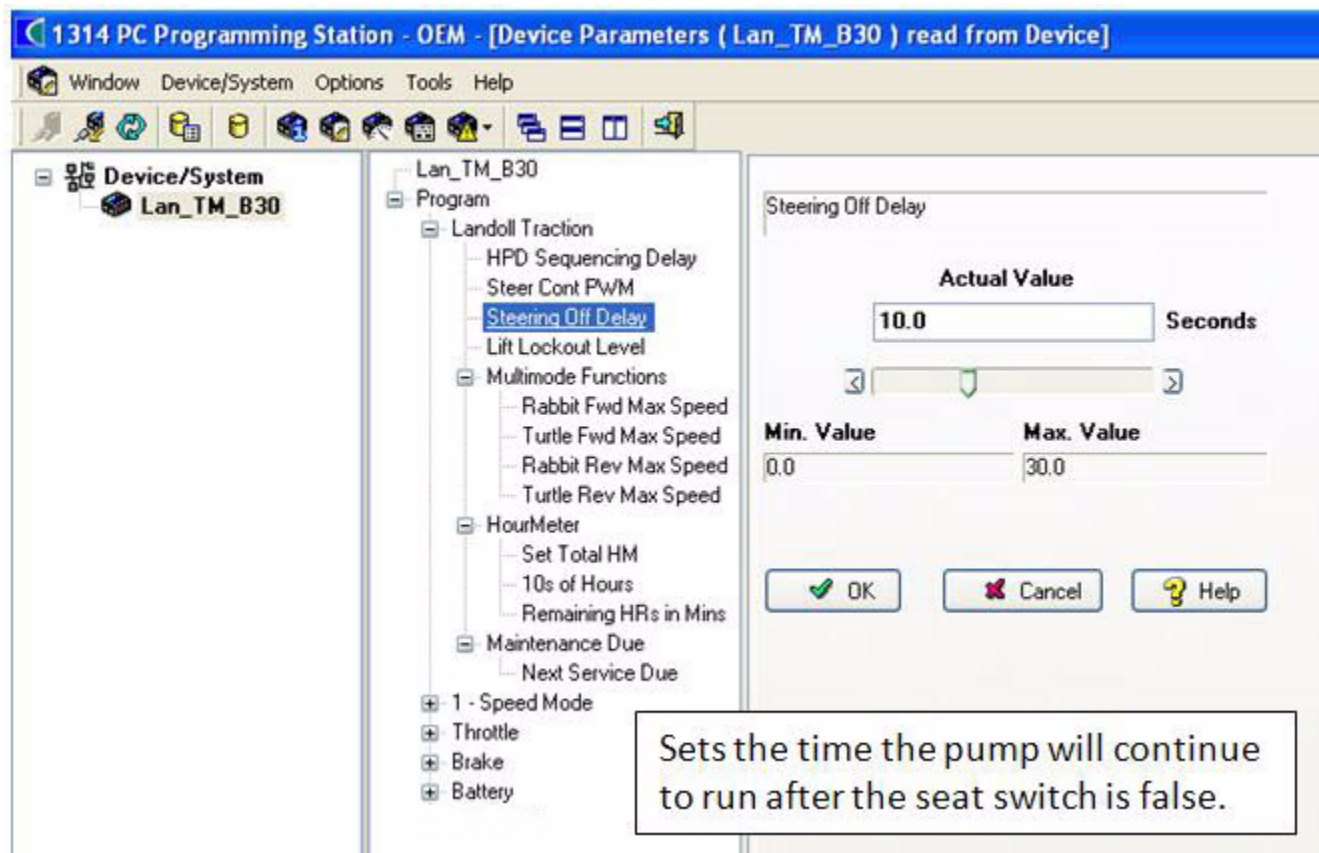
This screenshot shows the same parameter configuration as the previous one, but with an 'Information' dialog box open. The dialog box contains the message 'Parameter value successfully changed' and an 'OK' button. A text box points to the 'OK' button in the dialog: 'Click "ok" to acknowledge changed parameter.'

Important Note: This same procedure will be used for all parameters.

IMPORTANT

Contact Landoll for Current Revision.

Intentionally left blank for service technician notes.



BENDI B3/30 AC CALIBRATION AND PROGRAMMING

1314 PC Programming Station - OEM - [Device Parameters (Lan_TM_B30) read from Device]

Window Device/System Options Tools Help

Device/System
Lan_TM_B30

Lan_TM_B30
Program
Landoll Traction
HPD Sequencing Delay
Steer Cont PWM
Steering Off Delay
Lift Lockout Level
Multimode Functions
Rabbit Fwd Max Speed
Turtle Fwd Max Speed
Rabbit Rev Max Speed
Turtle Rev Max Speed
HourMeter
Set Total HM
10s of Hours
Remaining HRs in Mins
Maintenance Due
Next Service Due
1 - Speed Mode
Throttle
Brake
Battery

Lift Lockout Level

Actual Value
0 %

Min. Value Max. Value
0 99

OK Cancel Help

Sets the percentage of Battery discharge before lift lockout occurs.
Protects operator from taking Battery below safe level.

1314 PC Programming Station - OEM - [Device Parameters (Lan_TM_B30) read from Device]

Window Device/System Options Tools Help

Device/System
Lan_TM_B30

Lan_TM_B30
Program
Landoll Traction
HPD Sequencing Delay
Steer Cont PWM
Steering Off Delay
Lift Lockout Level
Multimode Functions
Rabbit Fwd Max Speed
Turtle Fwd Max Speed
Rabbit Rev Max Speed
Turtle Rev Max Speed
HourMeter
Set Total HM
10s of Hours
Remaining HRs in Mins
Maintenance Due
Next Service Due
1 - Speed Mode
Throttle

Rabbit Fwd Max Speed

Actual Value
100 %

Min. Value Max. Value
0 100

OK Cancel Help

NOTE: The "Rabbit and Turtle" function is determined and activated by the position of the switch on the dash.

Sets the "Forward" vehicle max speed in Rabbit Mode.

1314 PC Programming Station - OEM - [Device Parameters (Lan_TM_B30) read from Device]

Window Device/System Options Tools Help

Device/System
Lan_TM_B30

Program
Landoll Traction
HPD Sequencing Delay
Steer Cont PWM
Steering Off Delay
Lift Lockout Level
Multimode Functions
Rabbit Fwd Max Speed
Turtle Fwd Max Speed
Rabbit Rev Max Speed
Turtle Rev Max Speed
HourMeter
Set Total HM
10s of Hours
Remaining HRs in Mins
Maintenance Due
Next Service Due
1 - Speed Mode
Throttle
Brake
Battery

Turtle Fwd Max Speed

Actual Value
15 %

Min. Value Max. Value
0 100

OK Cancel Help

Sets the "Forward" vehicle max speed in turtle mode.

1314 PC Programming Station - OEM - [Device Parameters (Lan_TM_B30) read from Device]

Window Device/System Options Tools Help

Device/System
Lan_TM_B30

Program
Landoll Traction
HPD Sequencing Delay
Steer Cont PWM
Steering Off Delay
Lift Lockout Level
Multimode Functions
Rabbit Fwd Max Speed
Turtle Fwd Max Speed
Rabbit Rev Max Speed
Turtle Rev Max Speed
HourMeter
Set Total HM
10s of Hours
Remaining HRs in Mins
Maintenance Due
Next Service Due
1 - Speed Mode
Throttle
Brake
Battery

Rabbit Rev Max Speed

Actual Value
90 %

Min. Value Max. Value
0 100

OK Cancel Help

Sets the "Reverse" vehicle max speed in rabbit mode.

BENDI B3/30 AC CALIBRATION AND PROGRAMMING

1314 PC Programming Station - OEM - [Device Parameters (Lan_TM_B30) read from Device]

Window Device/System Options Tools Help

Device/System
Lan_TM_B30

Program
Landoll Traction
HPD Sequencing Delay
Steer Cont PWM
Steering Off Delay
Lift Lockout Level
Multimode Functions
Rabbit Fwd Max Speed
Turtle Fwd Max Speed
Rabbit Rev Max Speed
Turtle Rev Max Speed
HourMeter
Set Total HM
10s of Hours
Remaining HRs in Mins
Maintenance Due
Next Service Due
1 - Speed Mode
Throttle
Brake
Battery

Turtle Rev Max Speed

Actual Value
15 %

Min. Value Max. Value
0 100

OK Cancel Help

Sets the "Reverse" vehicle max speed in turtle mode.

1314 PC Programming Station - OEM - [Device Parameters (Lan_TM_B30) read from Device]

Window Device/System Options Tools Help

Device/System
Lan_TM_B30

Program
Landoll Traction
HPD Sequencing Delay
Steer Cont PWM
Steering Off Delay
Lift Lockout Level
Multimode Functions
Rabbit Fwd Max Speed
Turtle Fwd Max Speed
Rabbit Rev Max Speed
Turtle Rev Max Speed
HourMeter
Set Total HM
10s of Hours
Remaining HRs in Mins
Maintenance Due
Next Service Due
1 - Speed Mode
Throttle
Brake
Battery

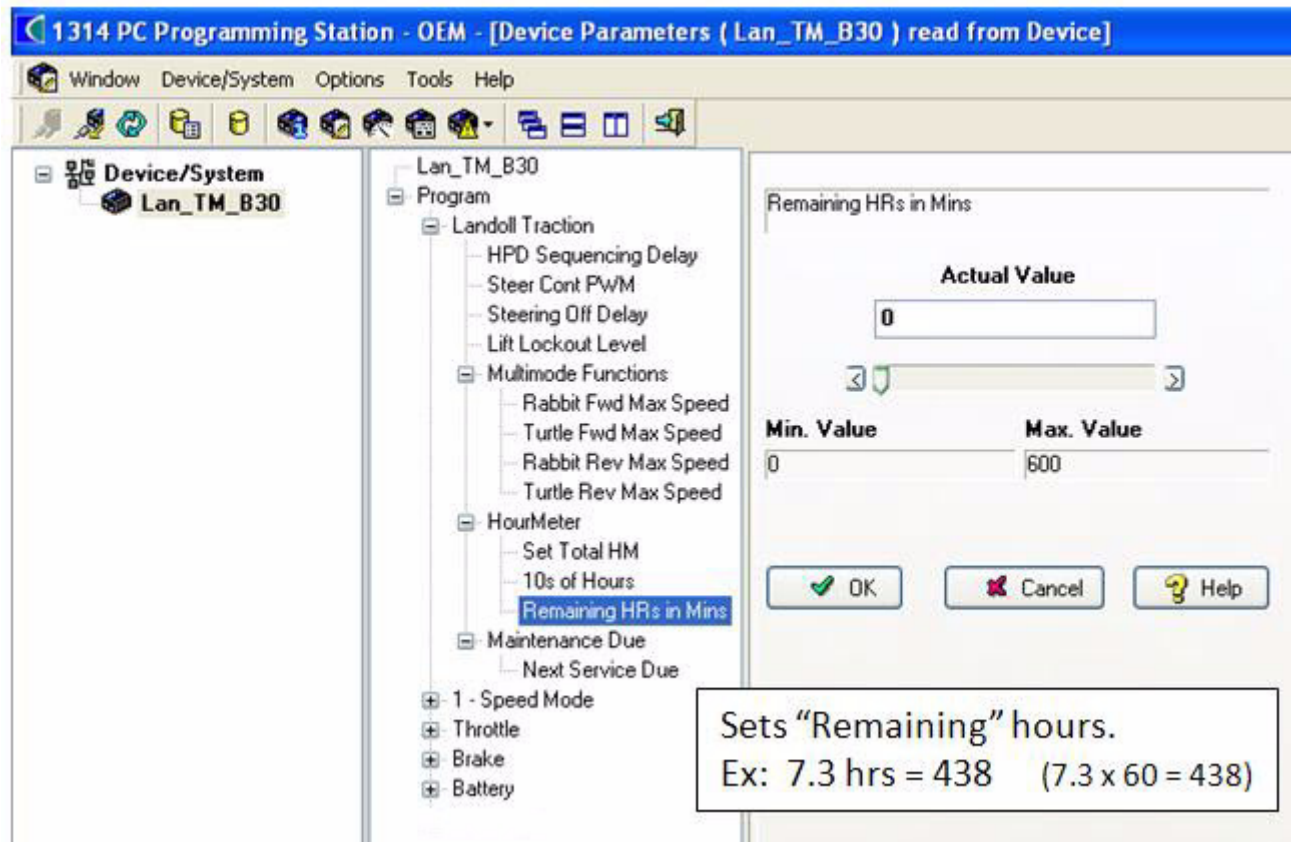
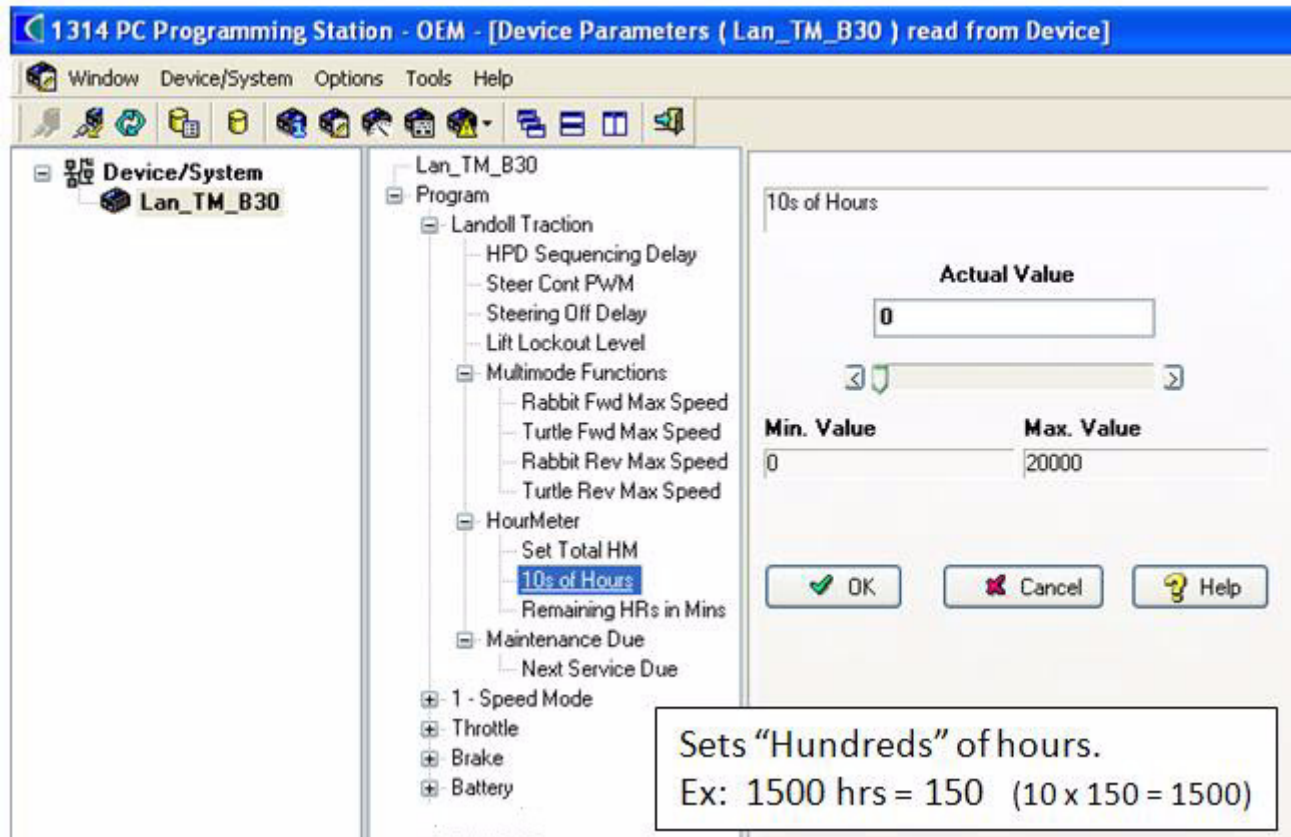
Set Total HM

Actual Value
Off

Min. Value Max. Value
Off On

OK Cancel Help

When set to "on" values entered in 10's of Hours, Remaining Hr's in Min's are sent to the controller.



BENDI B3/30 AC CALIBRATION AND PROGRAMMING

1314 PC Programming Station - OEM - [Device Parameters (Lan_TM_B30) read from Device]

Window Device/System Options Tools Help

Device/System
Lan_TM_B30

Lan_TM_B30
Program
Landoll Traction
HPD Sequencing Delay
Steer Cont PWM
Steering Off Delay
Lift Lockout Level
Multimode Functions
Rabbit Fwd Max Speed
Turtle Fwd Max Speed
Rabbit Rev Max Speed
Turtle Rev Max Speed
HourMeter
Set Total HM
10s of Hours
Remaining HRs in Mins
Maintenance Due
Next Service Due

Next Service Due

Actual Value
99900 Hours

Min. Value 0 Max. Value 99900

OK Cancel Help

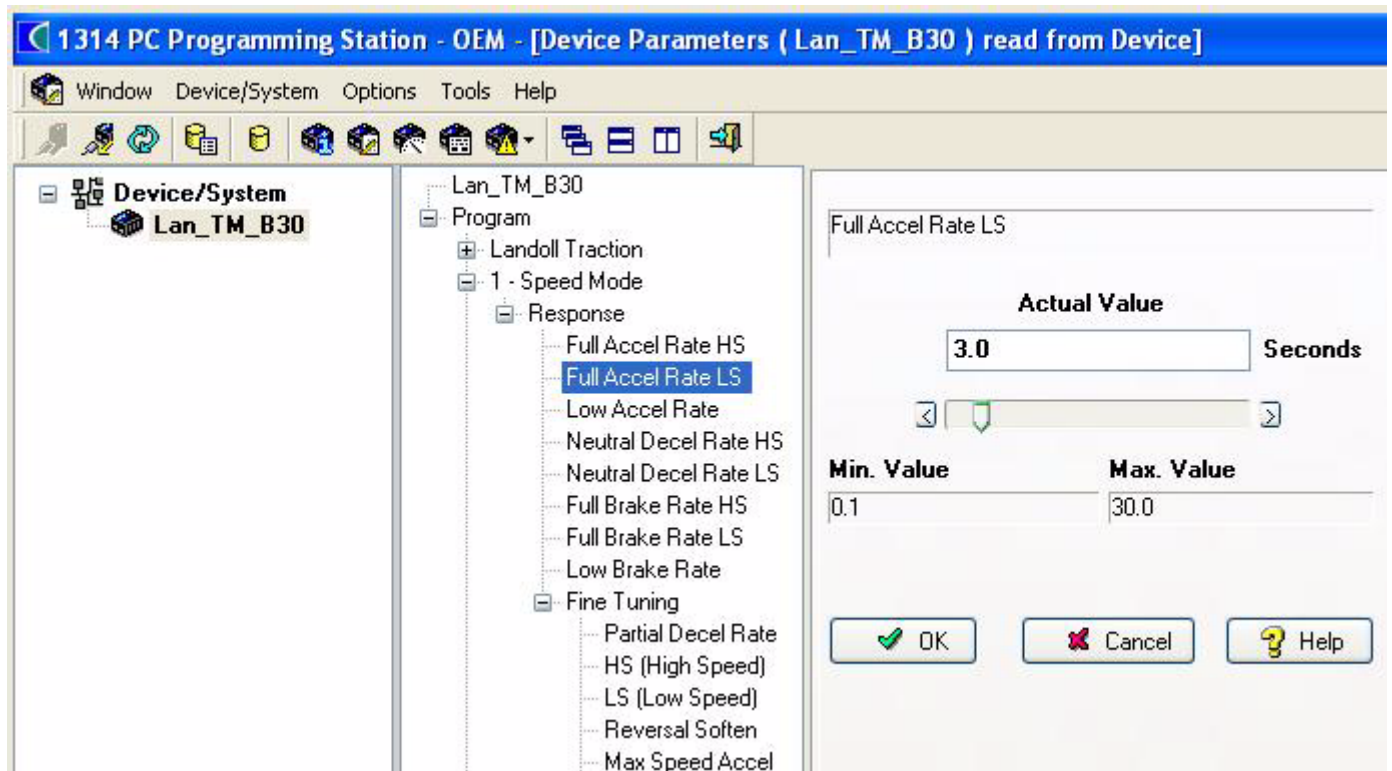
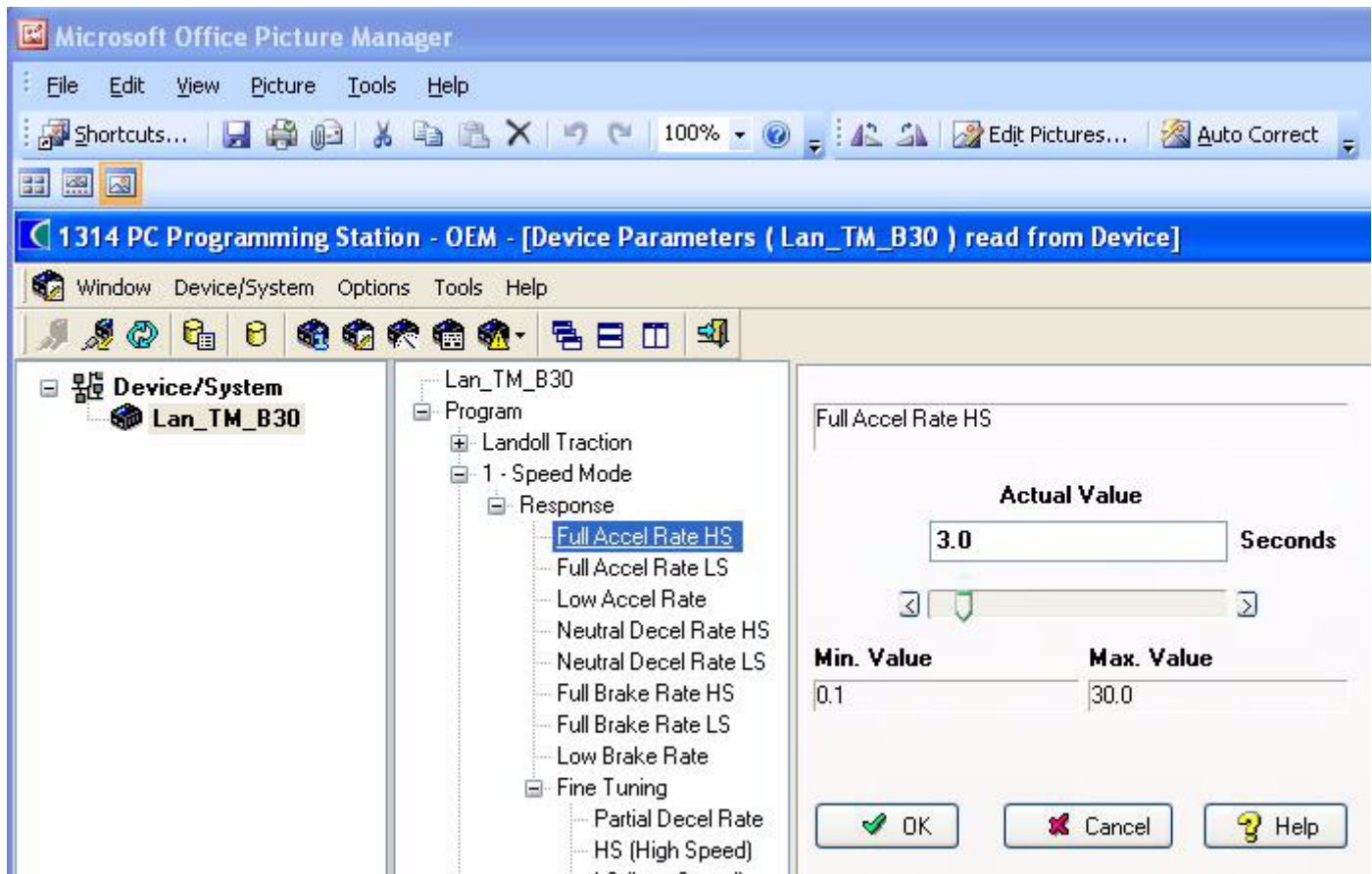
Sets "Next Service Due",
When Hr meter => Next service due,
Service Due will be displayed on the dash display.
Optional Set, factory default is set to max "99900"

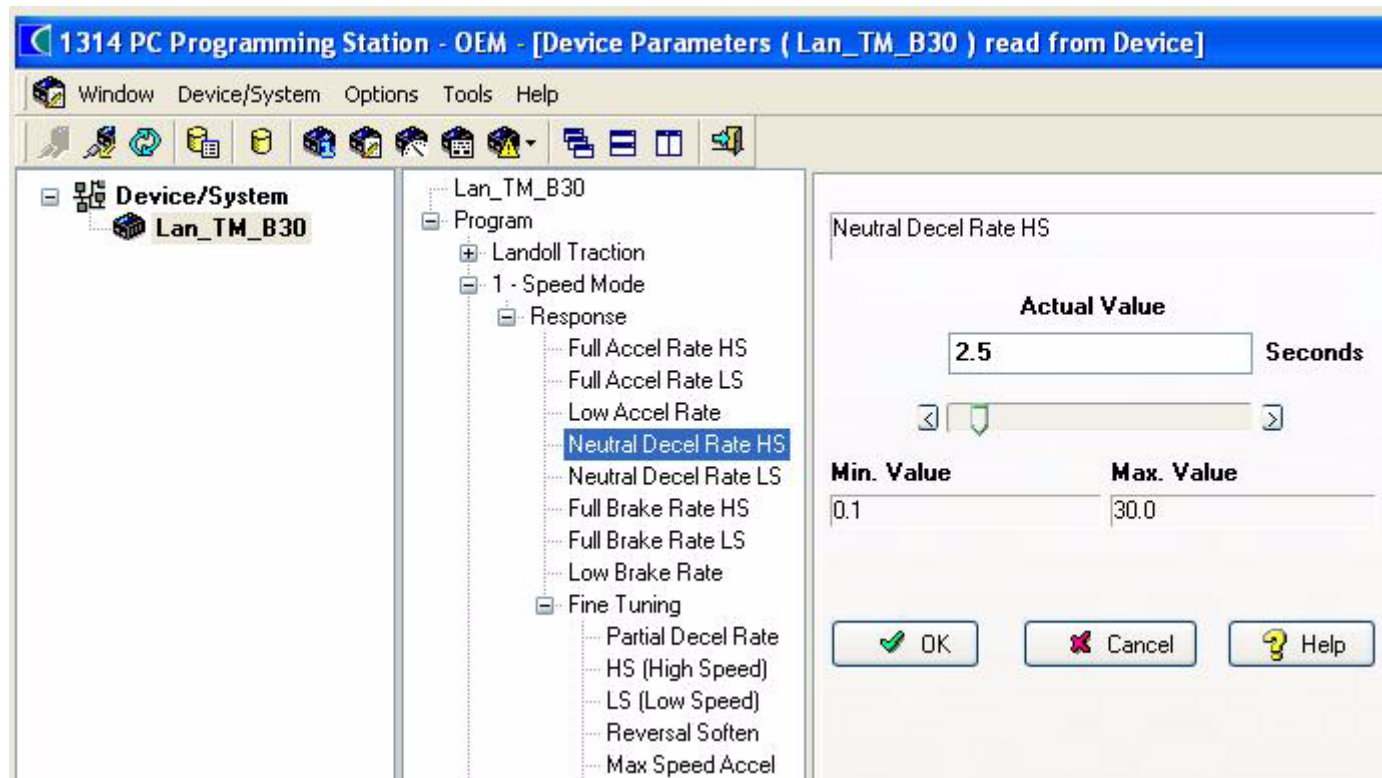
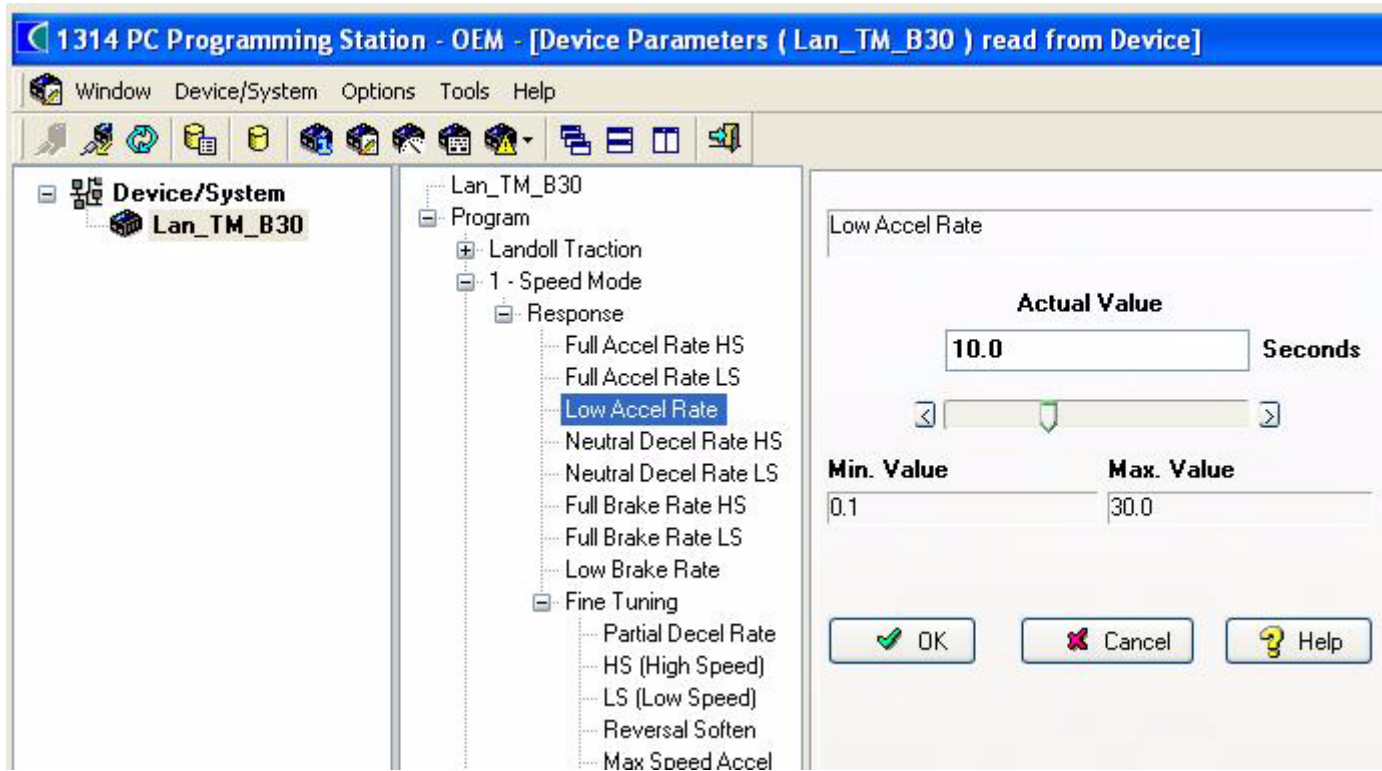
1314 PC Programming Station - OEM - [Device Parameters (L

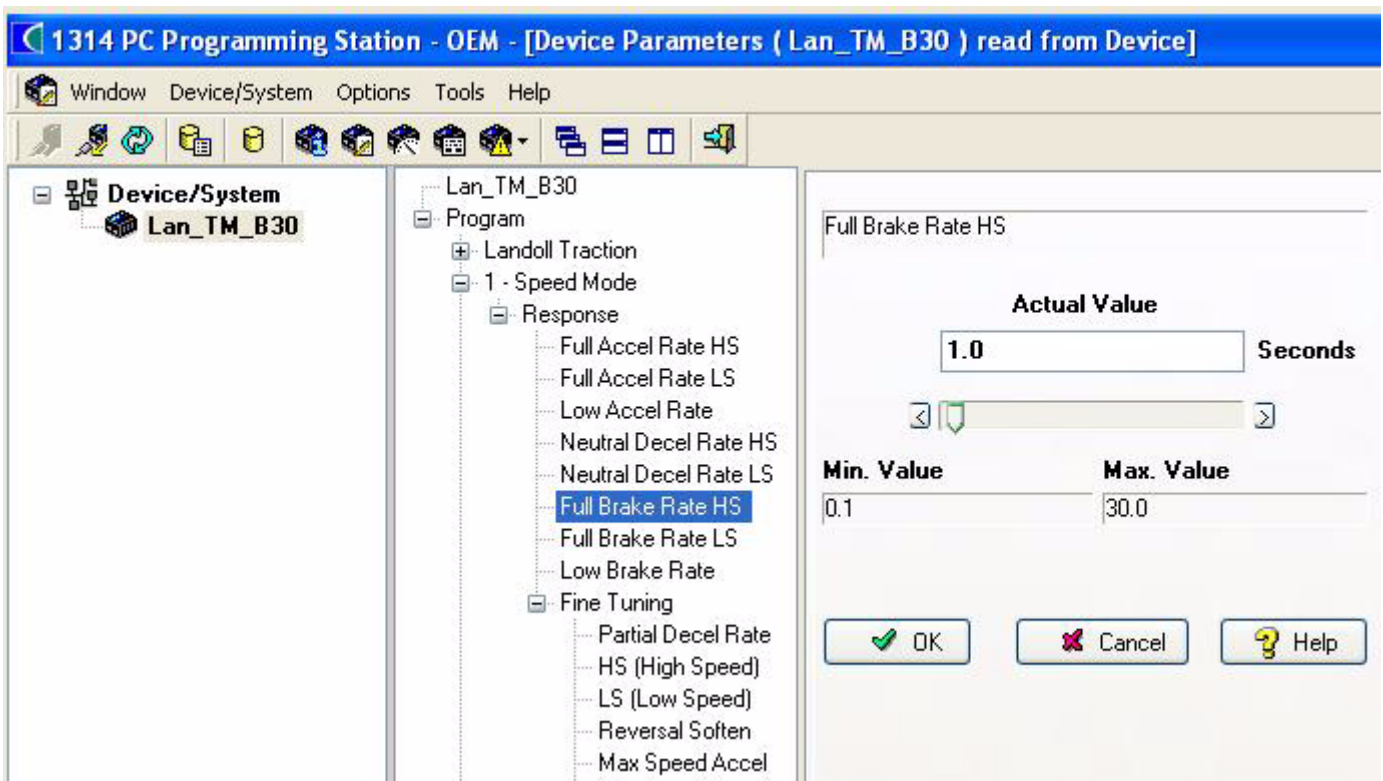
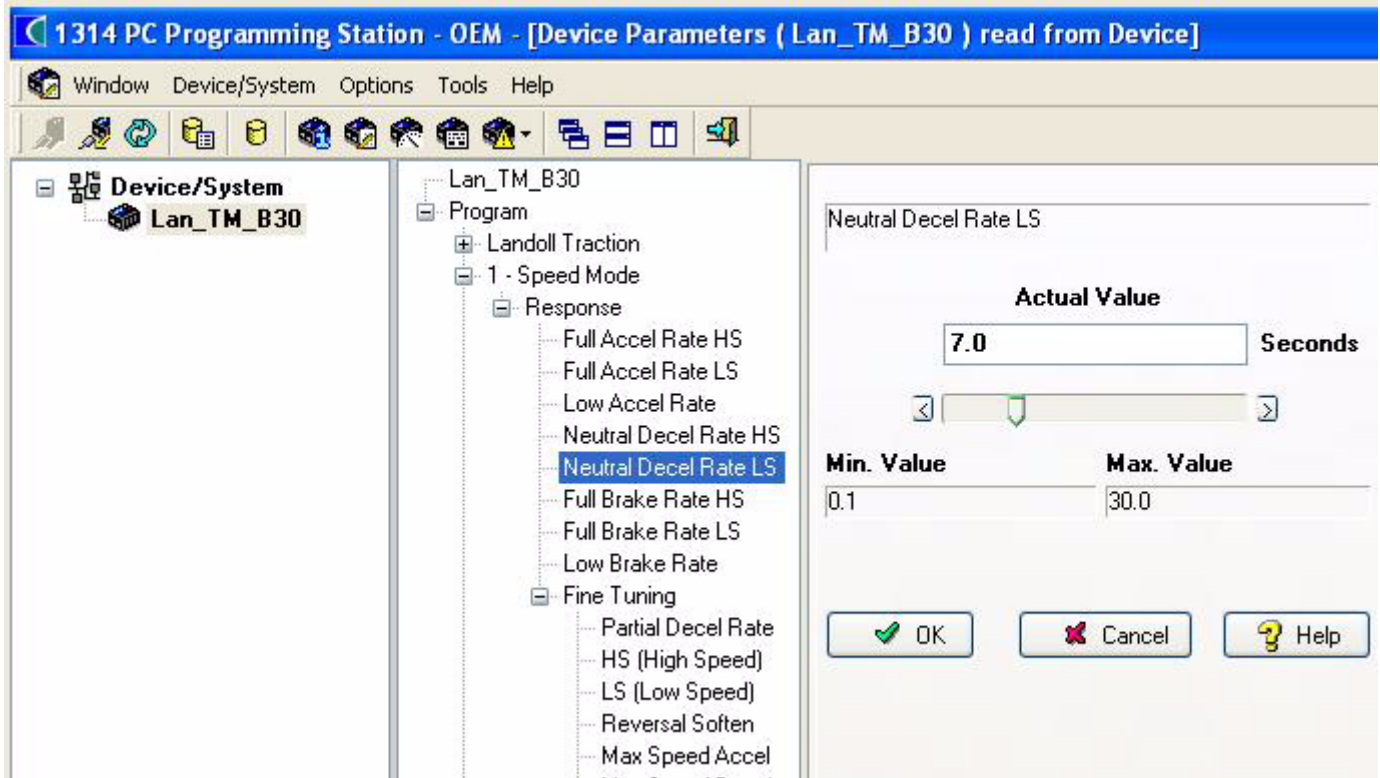
Window Device/System Options Tools Help

Device/System
Lan_TM_B30

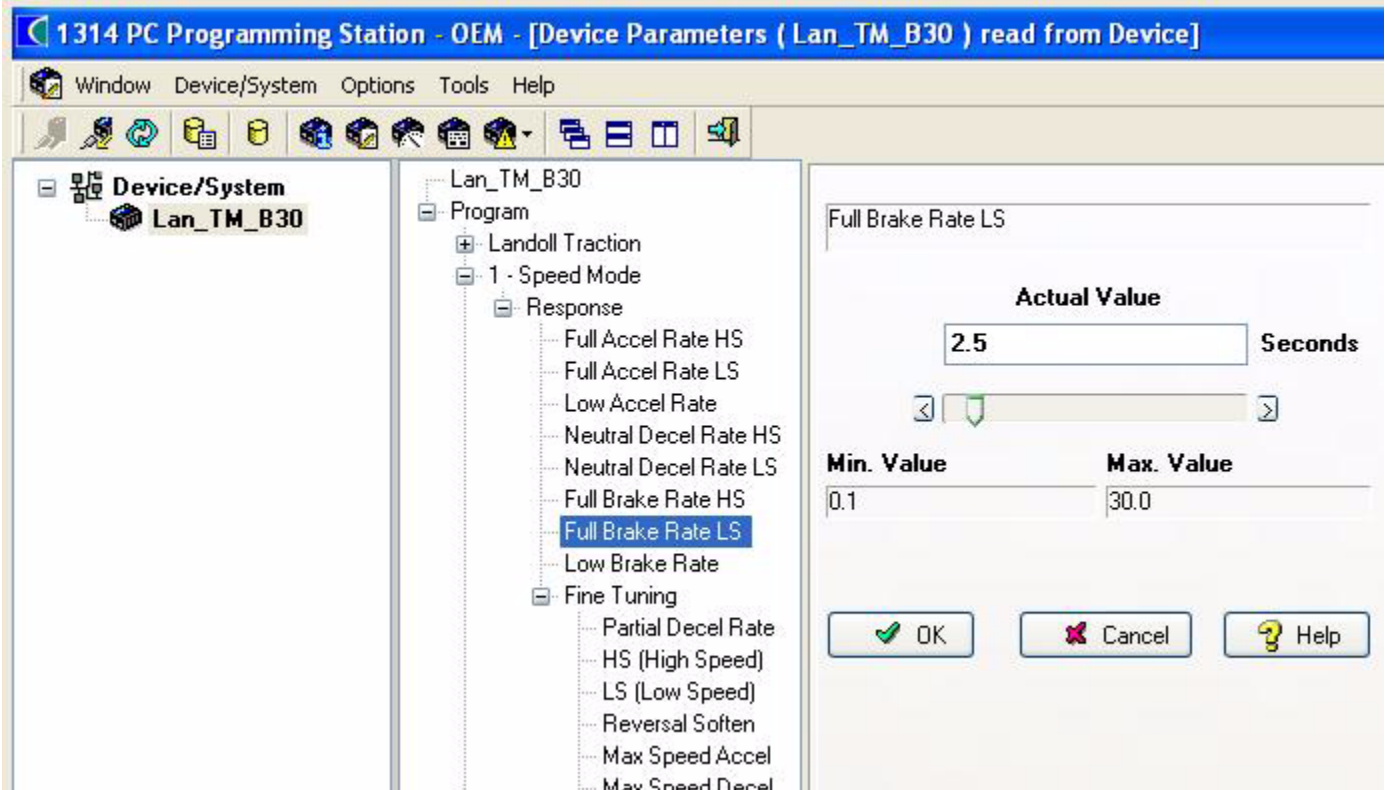
Lan_TM_B30
Program
Landoll Traction
1 - Speed Mode
Response
Full Accel Rate HS
Full Accel Rate LS
Low Accel Rate
Neutral Decel Rate HS
Neutral Decel Rate LS
Full Brake Rate HS
Full Brake Rate LS
Low Brake Rate
Fine Tuning
Partial Decel Rate
HS (High Speed)
LS (Low Speed)
Reversal Soften
Max Speed Accel
Max Speed Decel



BENDI B3/30 AC CALIBRATION AND PROGRAMMING

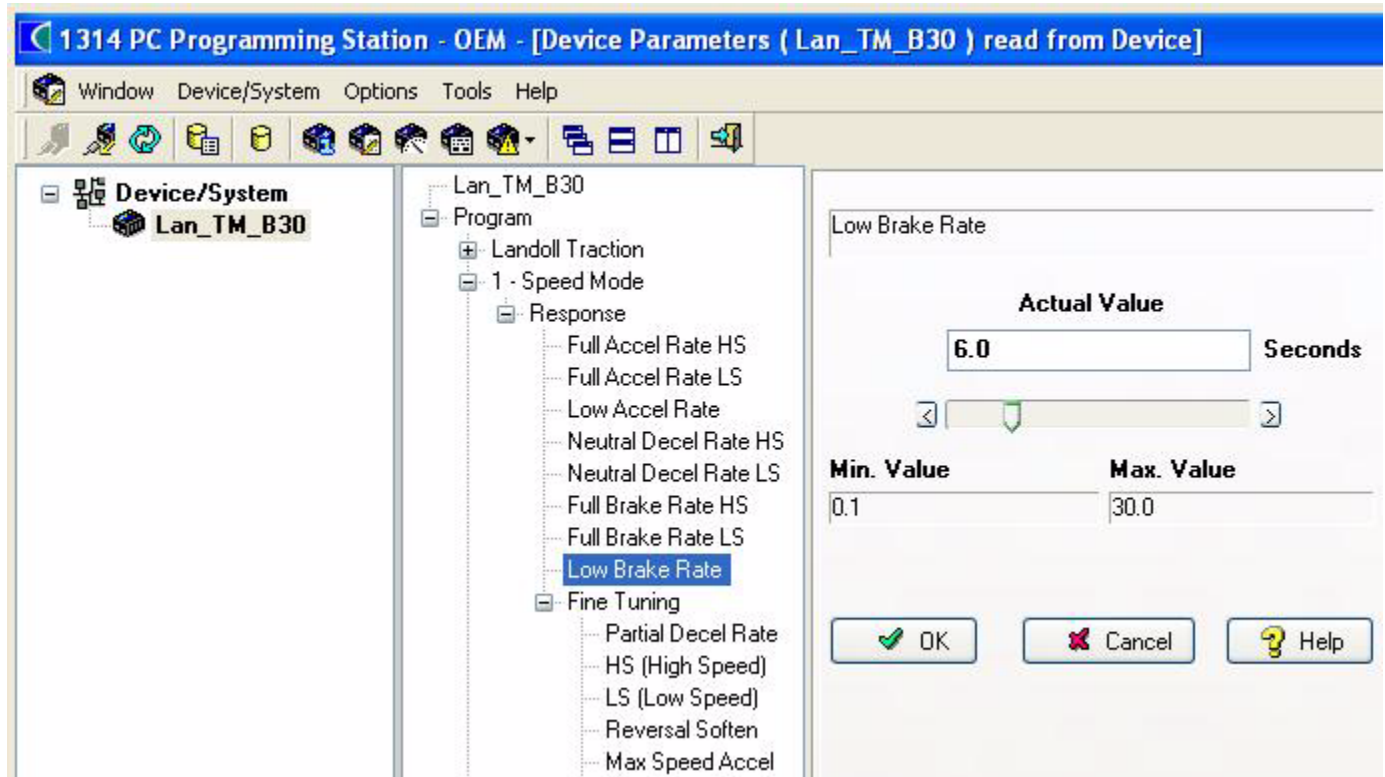


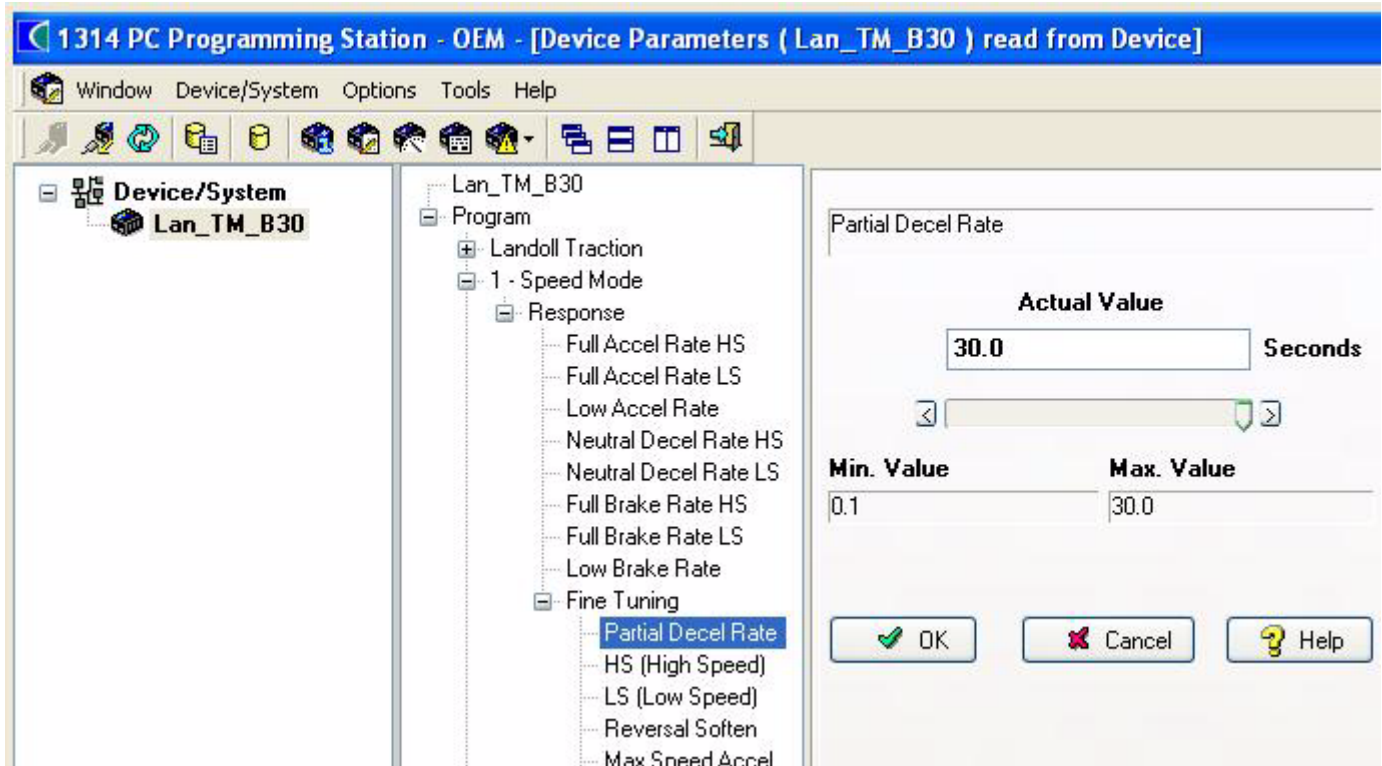
BENDI B3/30 AC CALIBRATION AND PROGRAMMING



Full Accel Rate HS: Above - The rate of which speed command increases when full throttle is applied at high speeds.

Full Accel Rate LS: Below - The rate of speed command increases when full throttle is applied at low speeds.

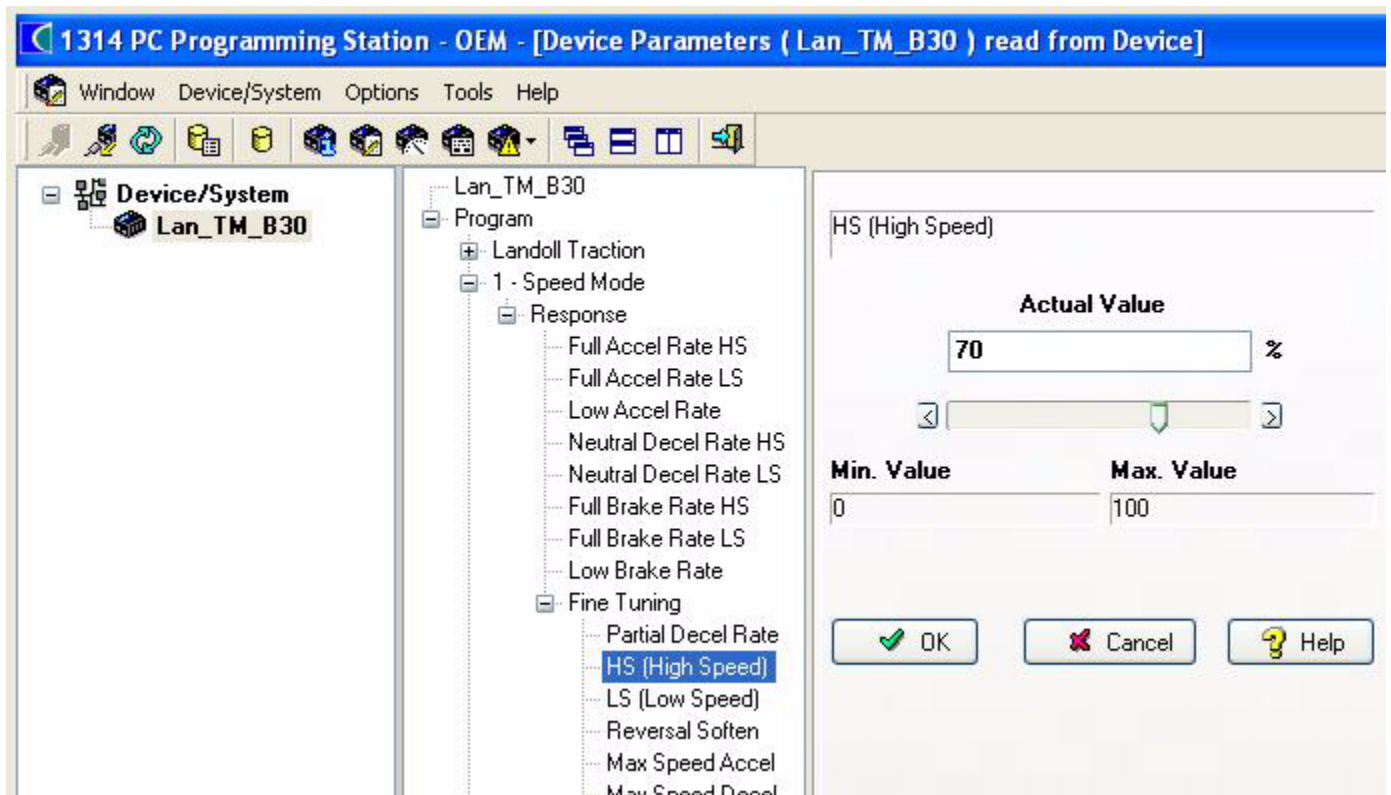




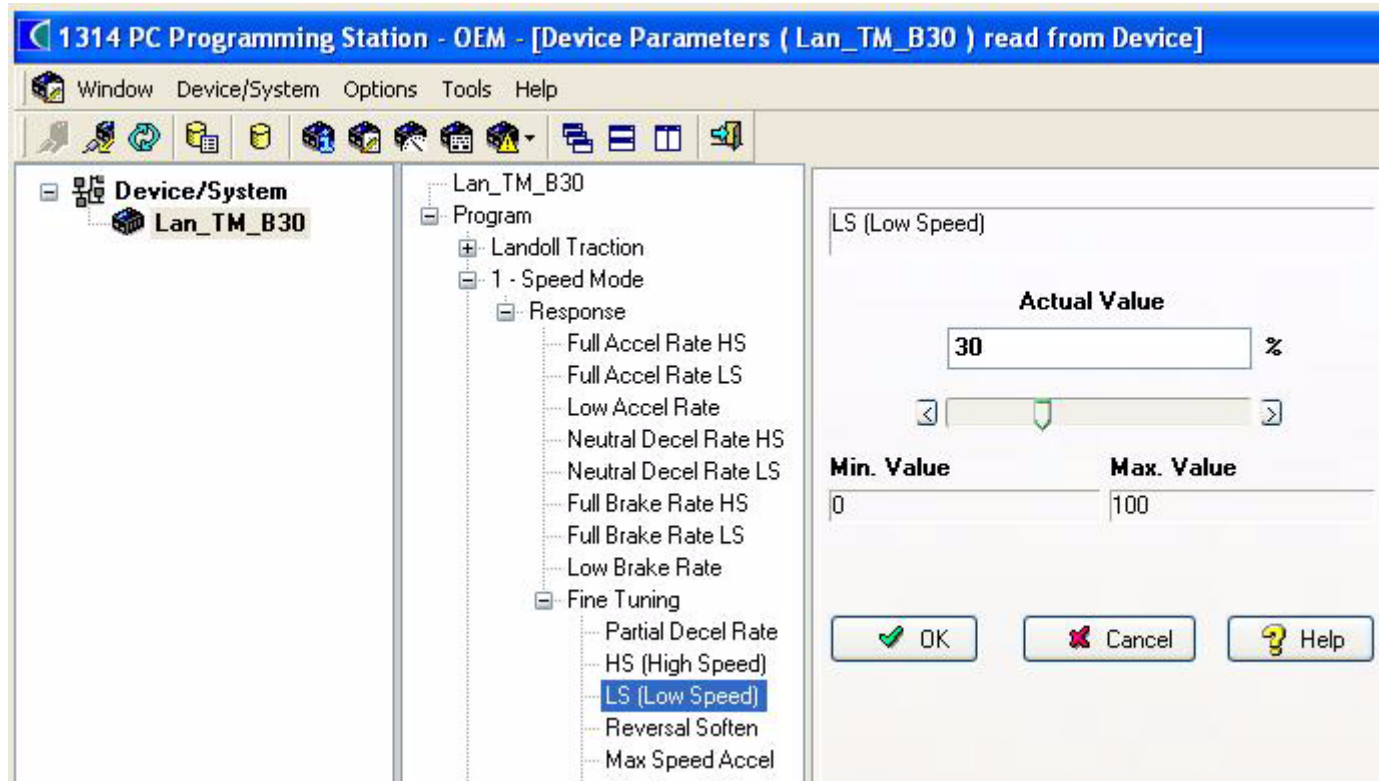
Low Accel Rate: Above - Sets the rate at which the speed command increases when a small amount of throttle is applied. Typically adjusts low speed control.

Neutral Decel Rate HS: Below - Sets the rate that slows down the vehicle when the throttle is released to neutral at high vehicle speeds.

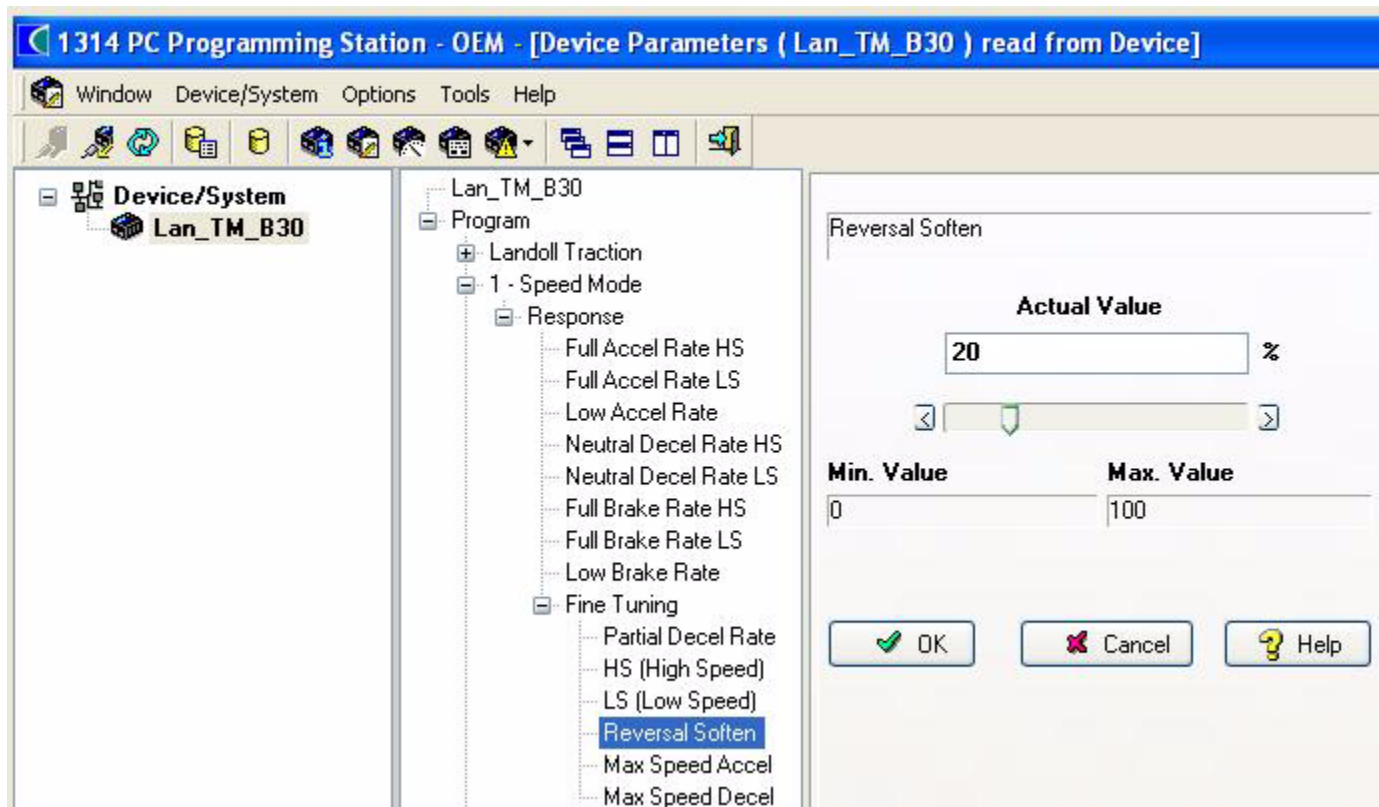
Neutral Decel Rate LS: Above - Sets the rate that slows down the vehicle when the throttle is released to neutral at slow vehicle speeds.

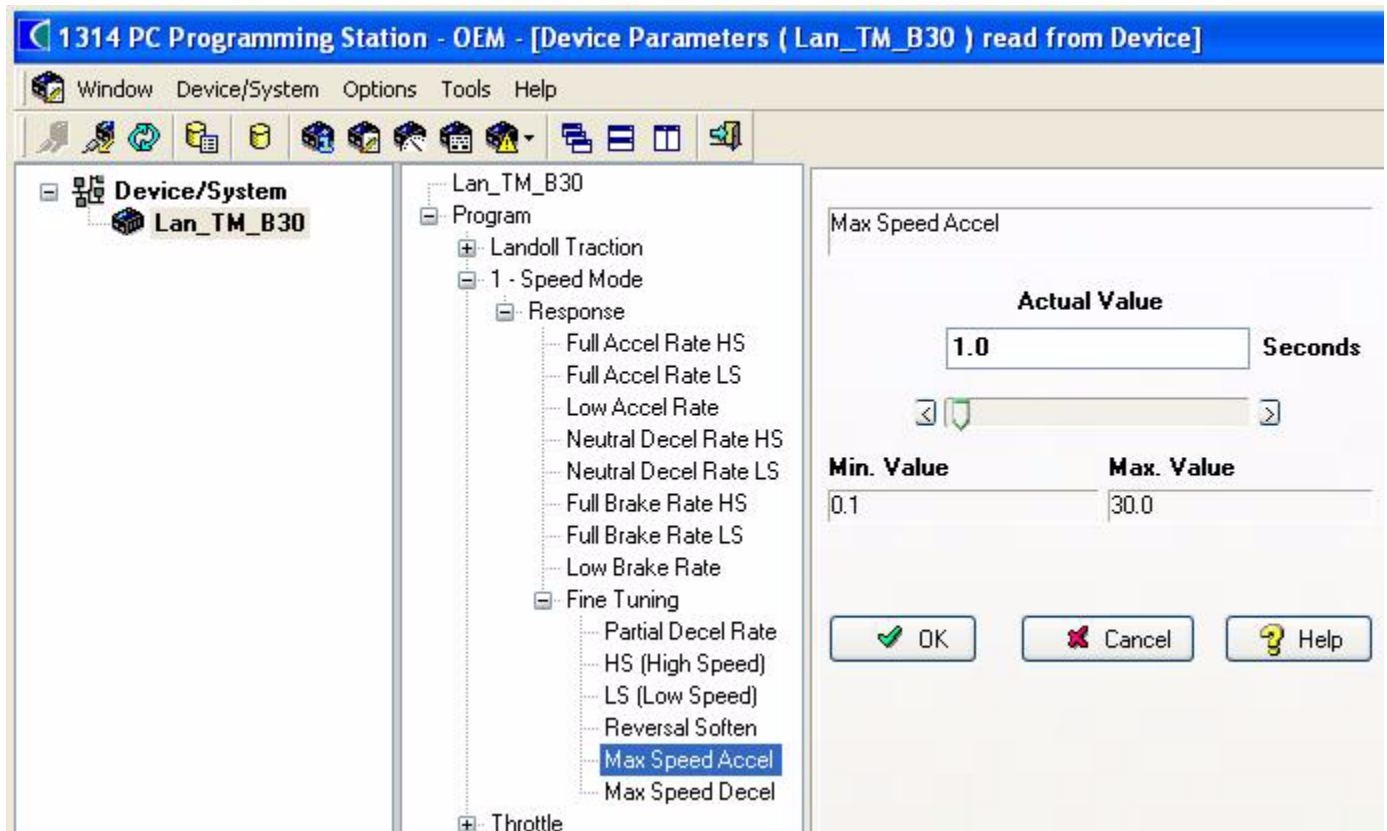


BENDI B3/30 AC CALIBRATION AND PROGRAMMING

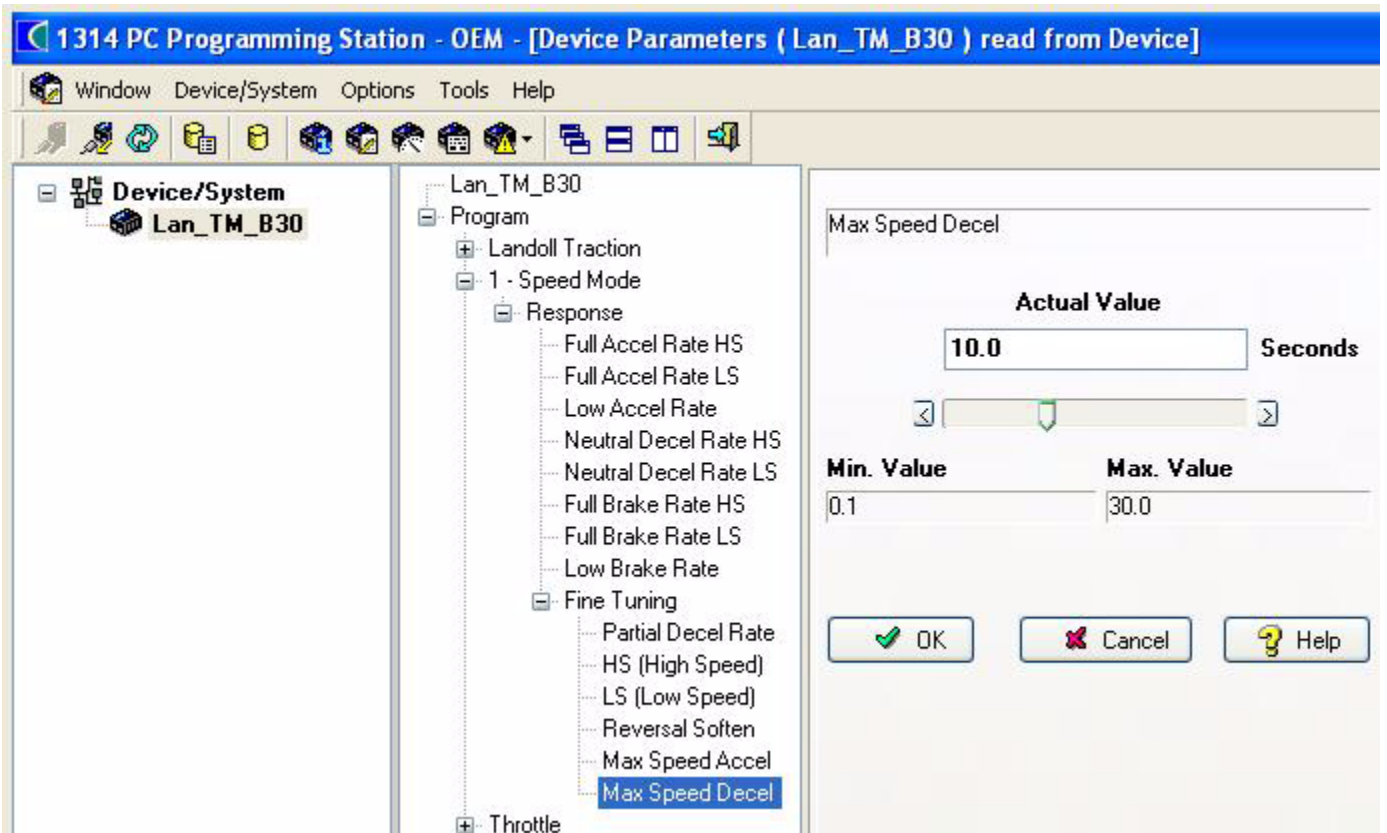


Full Brake Rate HS: Below - Sets the rate at which the vehicle slows down from high speeds when full brake is applied or when full throttle is applied in the opposite direction.





Full Brake Rate LS: Above - Sets the rate at which the vehicle slows down from slow speeds when full brake is applied or when full throttle is applied in the opposite direction.



BENDI B3/30 AC CALIBRATION AND PROGRAMMING

Low Brake Rate: Below - Sets the rate at which the vehicle slows down at all speeds when a small amount of brake is applied or a small amount of throttle is applied in the opposite direction.

Partial Decel Rate: Above - Sets the rate that is used to slow down the vehicle when the throttle is reduced without being released to neutral.

HS (High Speed): Below - Sets the percentage of the Typical Max Speed above which parameters will be used.

LS (Low Speed): Above - Sets the percentage of the Typical Max Speed below which the "LS" parameters will be used.

Reversal Soften: Below - Larger values create a softer reversal from regen braking to drive when near zero speed.

Max Speed Accel: Above - This parameter controls the rate at which the maximum speed setpoint is allowed to change when the value of Max Speed is raised.

Max Speed Decel: Below - This parameter controls the rate at which the maximum speed set point is allowed to change when the value of Max Speed is lowered.

1314 PC Programming Station - OEM - [Device Parameters (Lan_TM_B30) read from Device]

Window Device/System Options Tools Help

Device/System
Lan_TM_B30

Lan_TM_B30
Program
Landoll Traction
1 - Speed Mode
Throttle
Forward Deadband
Forward Max
Reverse Deadband
Reverse Max
Brake
Battery

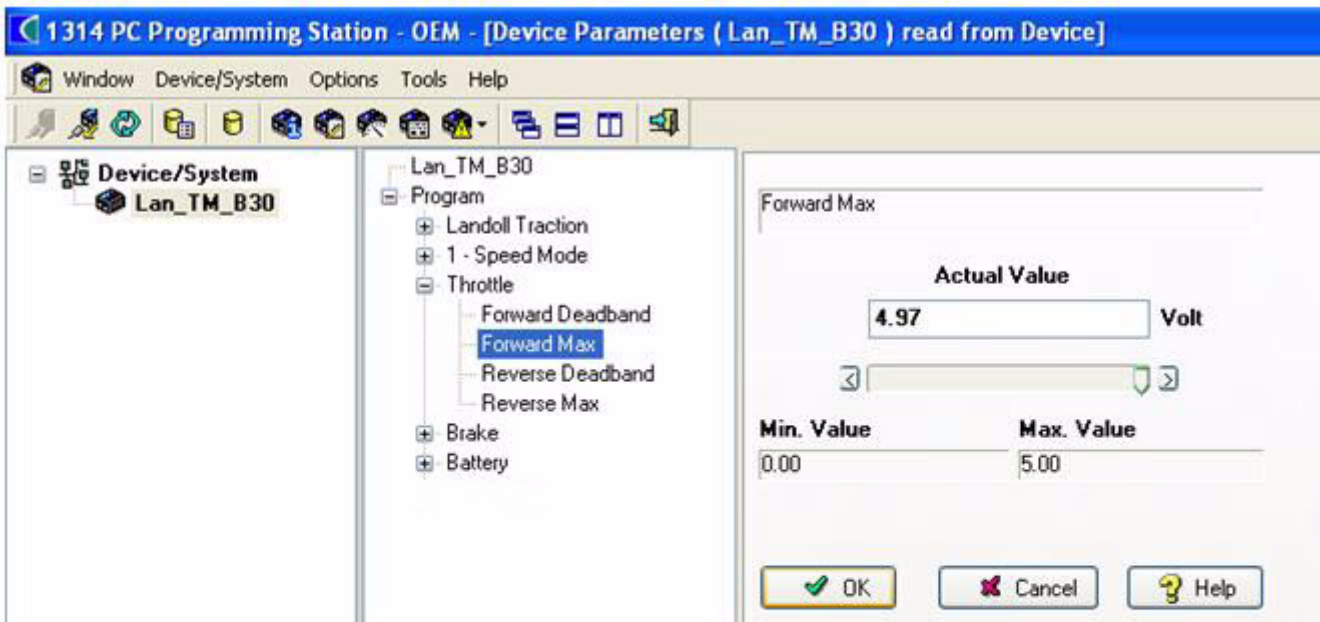
Forward Deadband

Actual Value
0.31 Volt

Min. Value 0.00 Max. Value 5.00

OK Cancel Help

Forward Deadband = Value when the accelerator is in the “not depressed” position. Using the monitor menu, view the Inputs/Throttle Pot, add .10 to this value then enter it into the Actual Value for Forward and Reverse Deadbands.
Note: Calibration should be completed through the Display.
When calibrating through the display the offsets will be automatically set

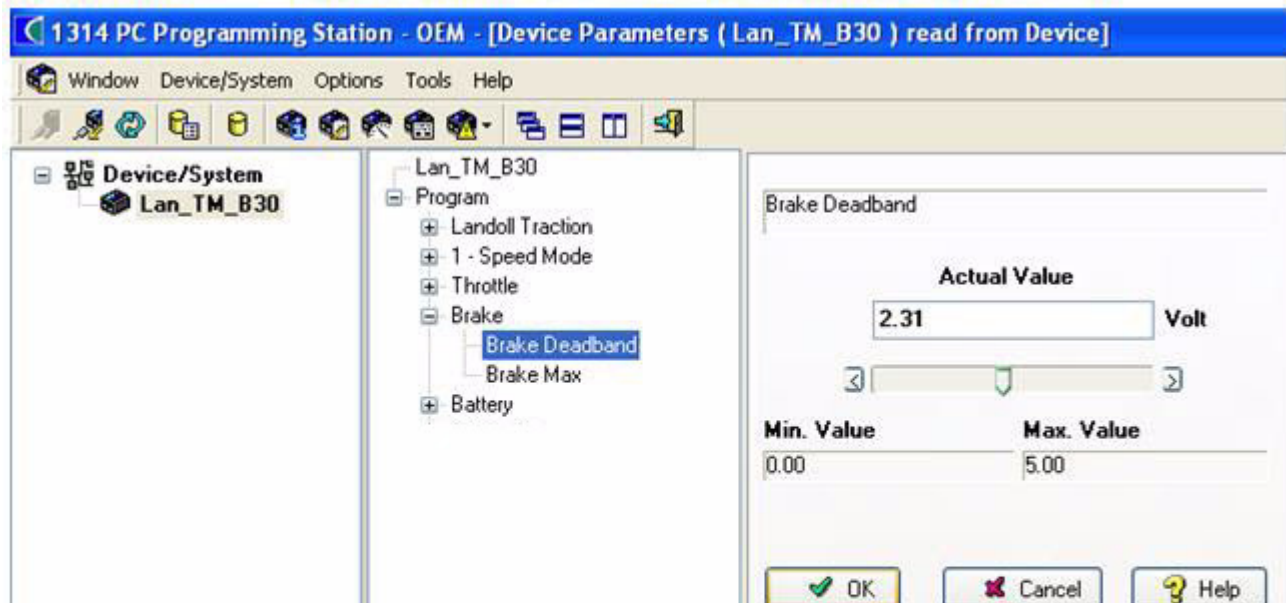


Forward Max = Value with the accelerator fully depressed.

Using the monitor menu, view the Inputs/Throttle Pot, subtract .10 from this value then enter it into the Actual Value for Forward and Reverse Max.

Note: When calibrating through the display the offsets will be automatically set.

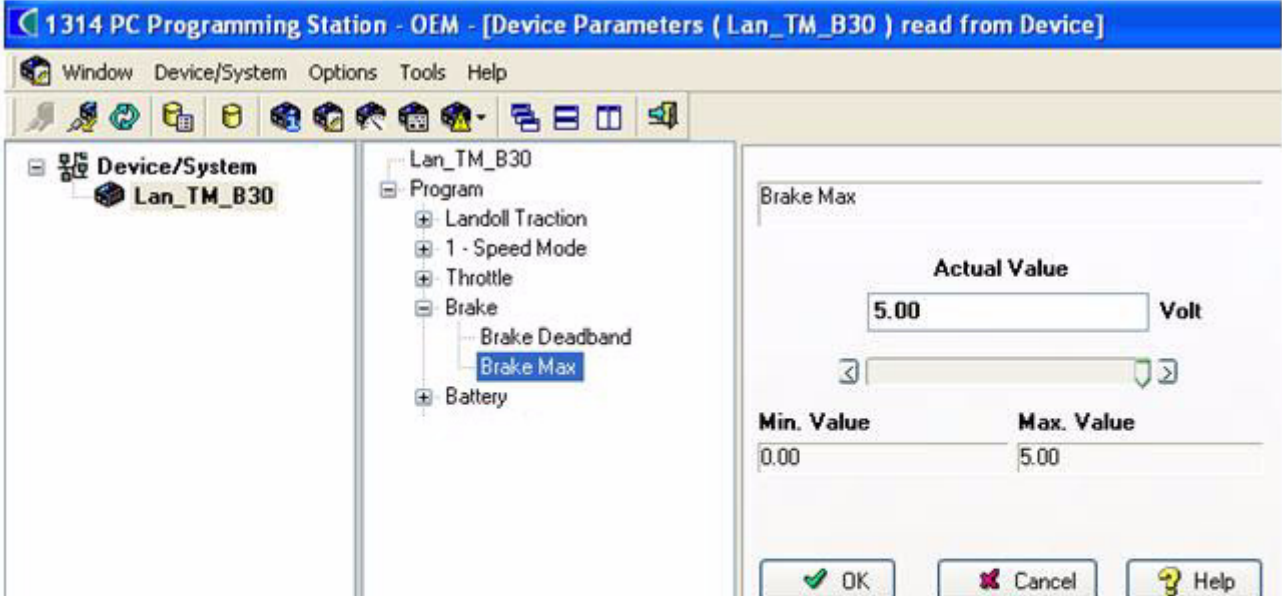
Note: Reverse Deadband & Max should be mirrored from the forward parameters.



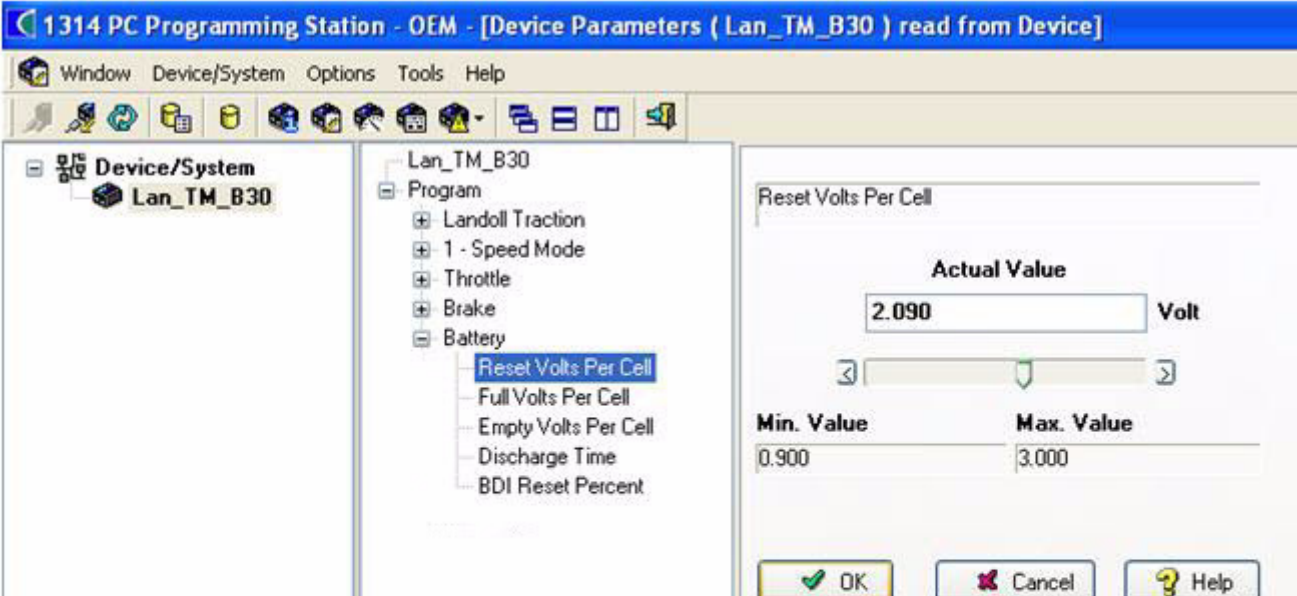
Brake Deadband = Value when the Brake is in the up "not depressed" position. Using the monitor menu, view the Inputs/Brake Pot add 2.0 to this value then enter it into the Actual Value in the Brake Deadband menu.

Note: When calibrating through the display the offsets will be automatically set

BENDI B3/30 AC CALIBRATION AND PROGRAMMING

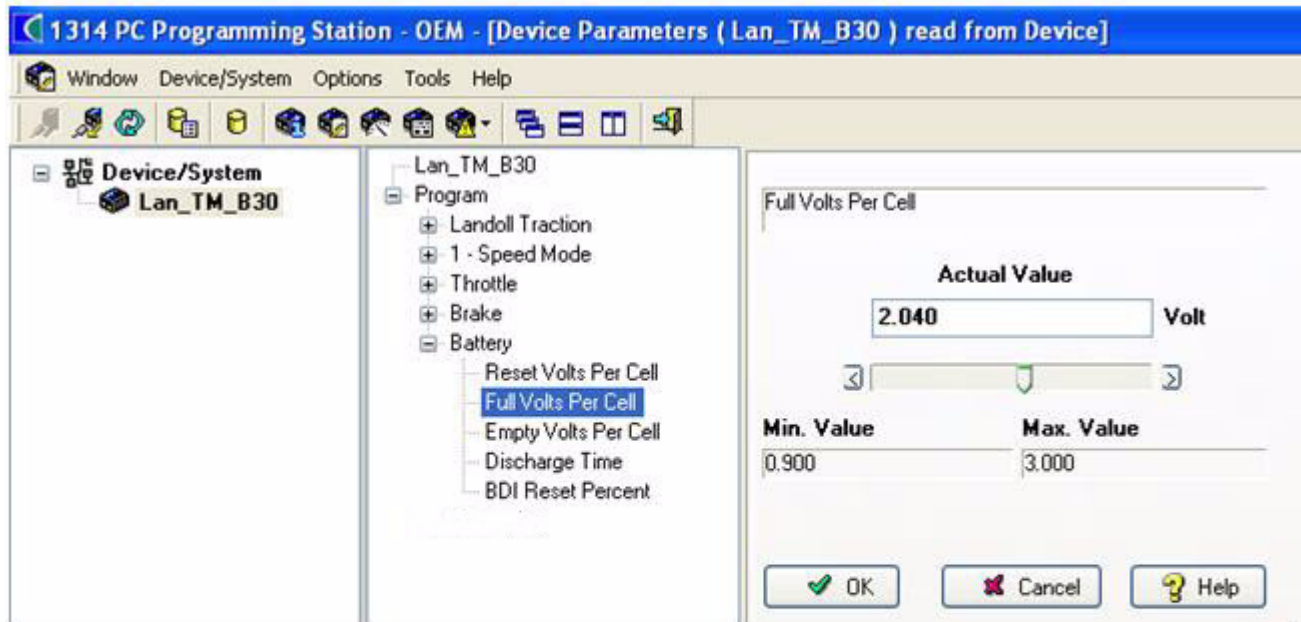


Brake Max = Value when the Brake is fully depressed.
Using the monitor menu, view the Inputs/Brake Pot subtract .10 from this value then enter it into the Actual Value in the Brake Max menu.
Note: When calibrating through the display the offsets will be automatically set



The Reset Voltage Per Cell level is checked only once, when KSI is 1st keyed.
*Note: BDI Reset Percent setting interacts with BDI Reset Voltage to equal 100%.
Reset Volts Per Cell should always be set higher than Full Volts Per Cell.
Reset Voltage Level = Reset Volts Per Cell × number of cells in the battery pack.*

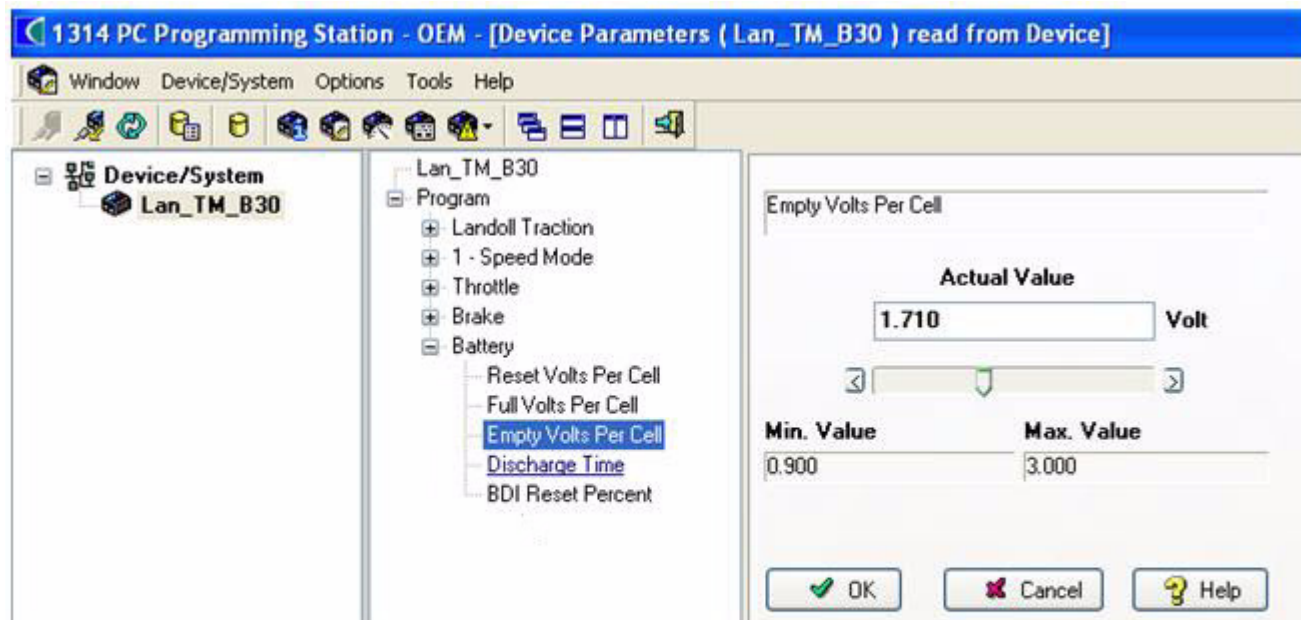
Parameter Changes not Recommended - Landoll Default Settings.



The Full Volt Per Cell level sets the Voltage considered to be 100% charged. When a loaded battery drops below this voltage, it begins to lose charge. Keyswitch Voltage is viewable in the 1314 menu Monitor/Battery.

Note: Full Voltage Level = Full Volts Per Cell × number of cells in the battery pack.

Parameter Changes not Recommended - Landoll Default Settings.



The Empty Volt Per Cell level sets the Voltage considered to be 0% charged.

Note: Empty Voltage Level = Empty Volts Per Cell × number of cells in the battery pack.

Parameter Changes not Recommended - Landoll Default Settings.

BENDI B3/30 AC CALIBRATION AND PROGRAMMING

1314 PC Programming Station - OEM - [Device Parameters (Lan_TM_B30) read from Device]

Window Device/System Options Tools Help

Device/System
Lan_TM_B30

Program
 + Landoll Traction
 + 1 - Speed Mode
 + Throttle
 + Brake
 - Battery
 Reset Volts Per Cell
 Full Volts Per Cell
 Empty Volts Per Cell
 Discharge Time
 BDI Reset Percent

Discharge Time

Actual Value
60 Minutes

Min. Value 0 Max. Value 600

OK Cancel Help

Discharge Time sets the minimum time for the BDI Percentage to decrement from 100% to 0%.

Note: State of Charge Level = ((Full Voltage Level - Empty Voltage Level) × BDI Percentage / 100) + Empty Voltage Level.

1314 PC Programming Station - OEM - [Device Parameters (Lan_TM_B30) read from Device]

Window Device/System Options Tools Help

Device/System
Lan_TM_B30

Program
 + Landoll Traction
 + 1 - Speed Mode
 + Throttle
 + Brake
 - Battery
 Reset Volts Per Cell
 Full Volts Per Cell
 Empty Volts Per Cell
 Discharge Time
 BDI Reset Percent

BDI Reset Percent

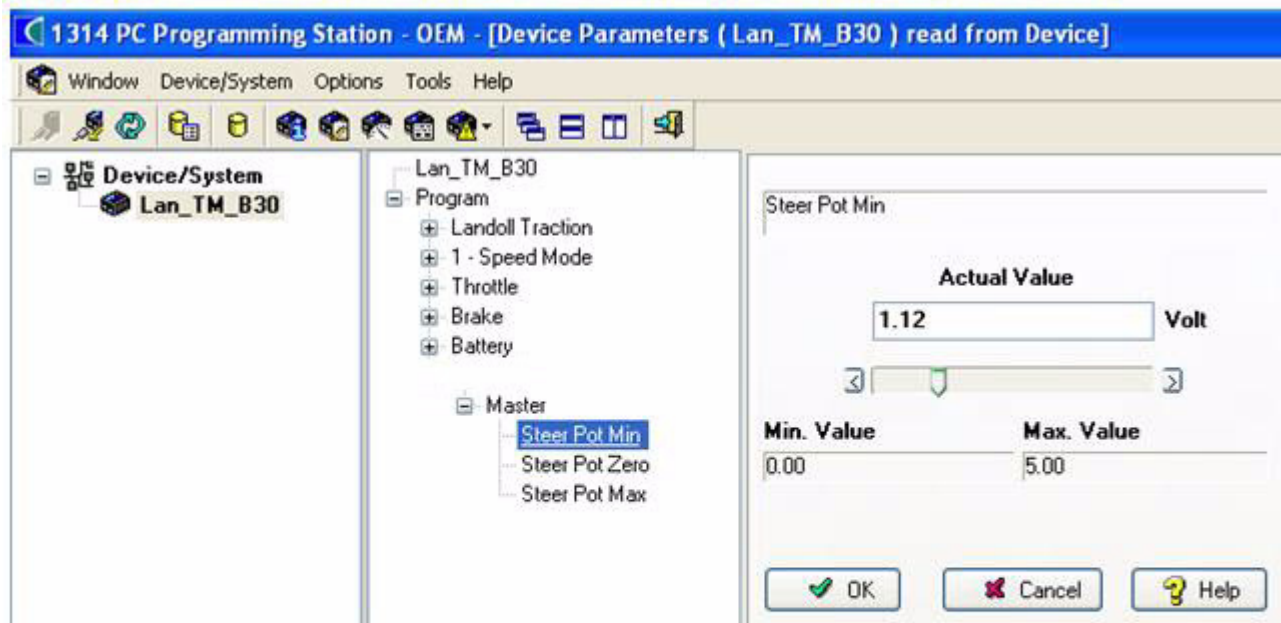
Actual Value
75 %

Min. Value 0 Max. Value 100

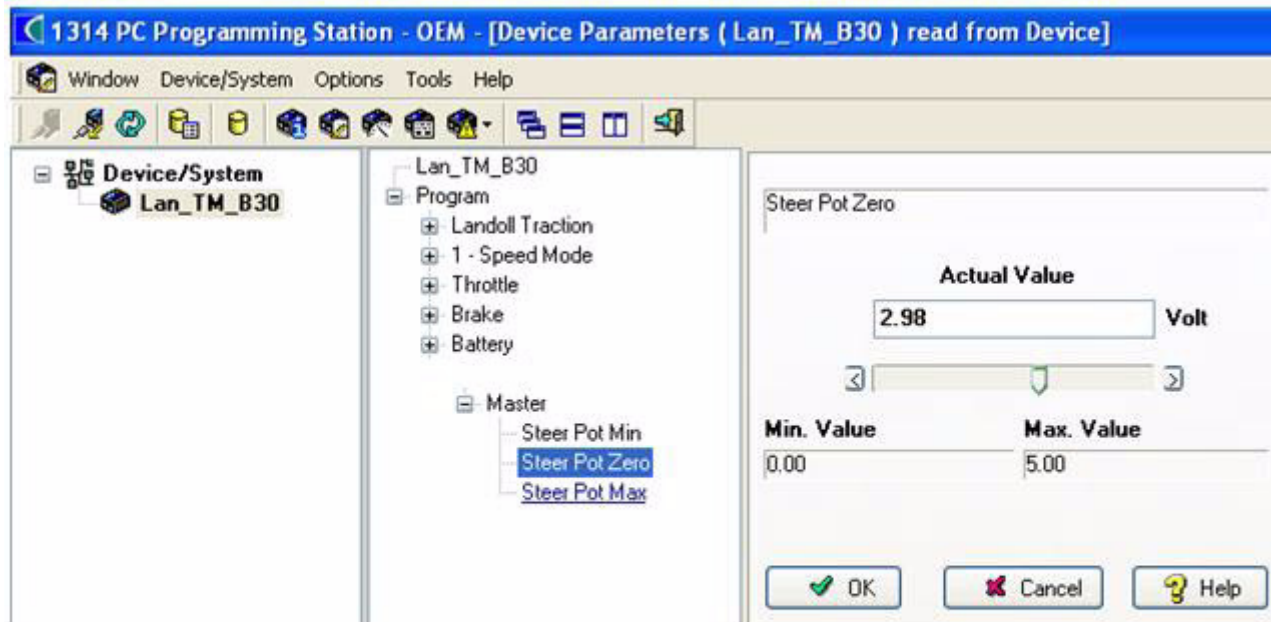
OK Cancel Help

When a battery has a high BDI percentage, its float voltage at KSI On can cause false resets. The BDI Reset Percent parameter addresses this problem by allowing the user to define a BDI Percentage value above which the BDI Percentage variable will not reset.

Note: When KSI is first powered on, the BDI Percentage variable will reset to 100% only if ((Kevswitch Voltage > Reset Voltage Level) and (BDIPercentage < BDI Reset Percent)).

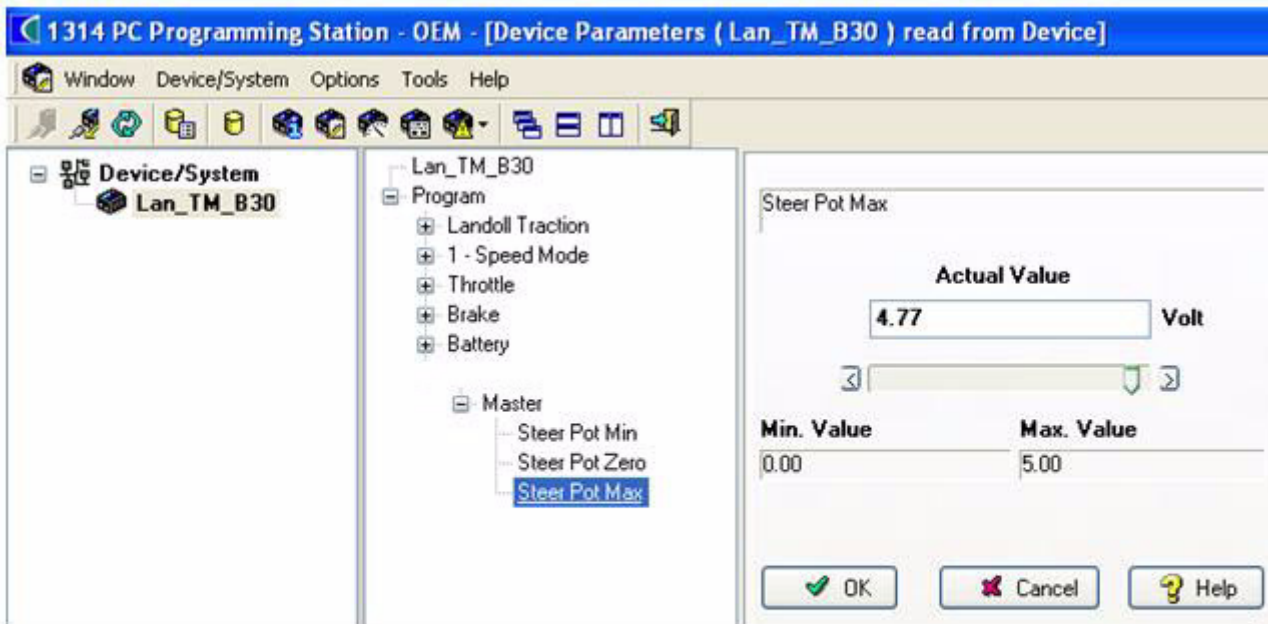


Set Steer Pot Min to the voltage on the steering pot with steering full counter clockwise (Left). Determine the value by reading the monitor menu Inputs/Steer pot when steering CCW to the maximum position.
Note: Calibration should be completed through the Display.

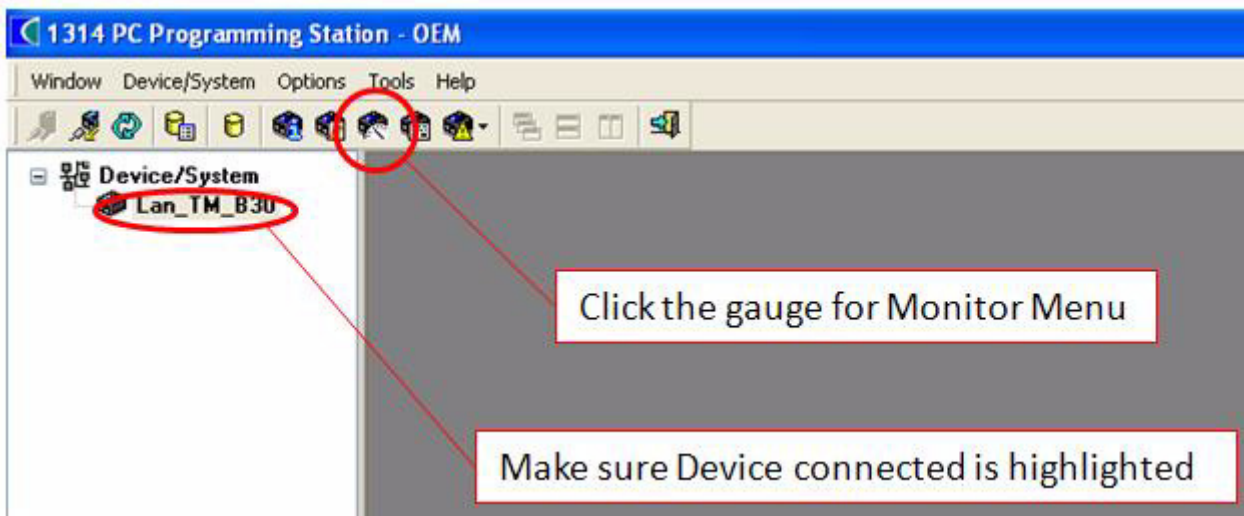


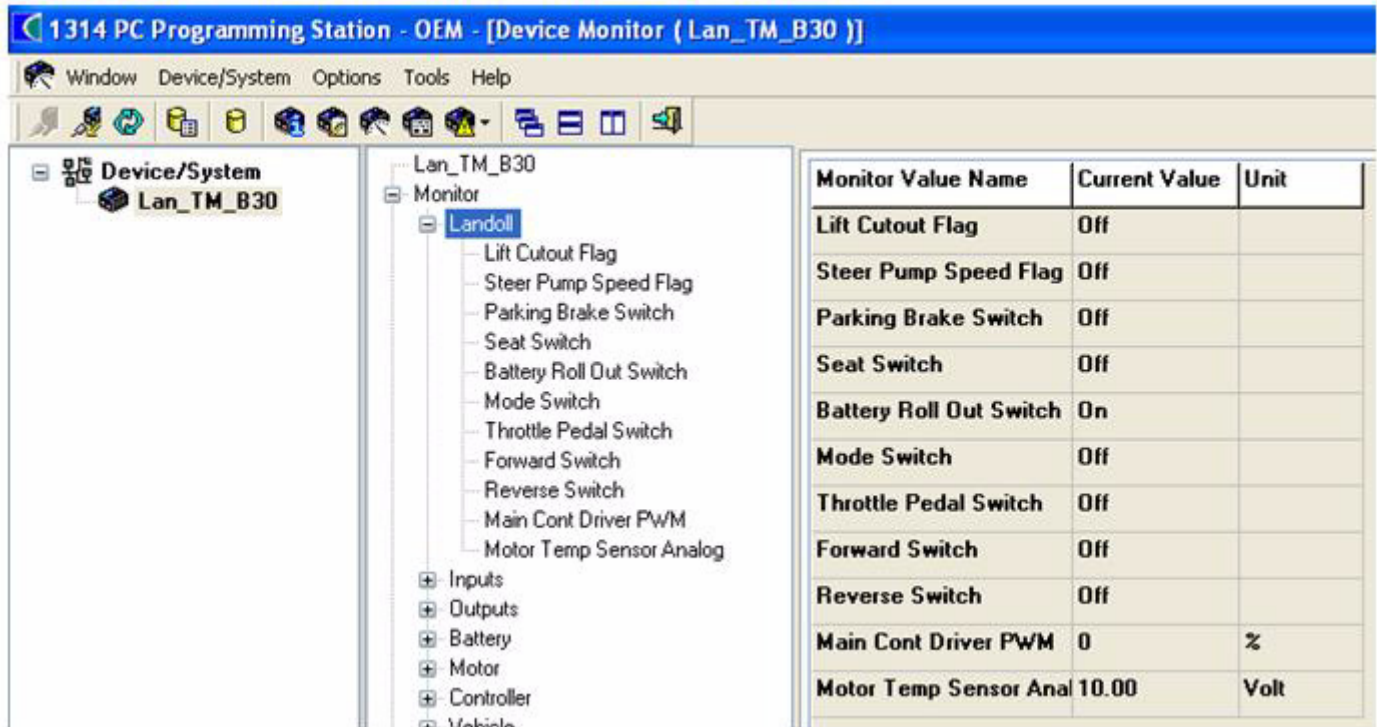
Set Steer Pot Zero to the voltage on the steering pot when steering straight *ahead*. Determine the value by reading the monitor menu Inputs/Steer pot when steered to the straight position.

BENDI B3/30 AC CALIBRATION AND PROGRAMMING



Set Steer Pot Max to the voltage on the steering pot with steering full clockwise (Right). Determine the value by reading the monitor menu Inputs/Steer pot when steering CW to the maximum position.



**“Landoll” Parameter Details:**

“Lift Cutout Flag” “on” when in Lift Lock Out.

“Steer PumpSpeed Flag” “on” when in forward or reverse AND driver is on the seat.

“Seat Swith” “on” when operator is on seat.

“Battery Roll Out Switch” - Optional Feature - check to see if jumper is in place on battery roll out connector.

“Mode Switch” in Turtle mode is “off” and in Rabbit mode is “on”

“Throttle Pedal Switch” - safety switch on accelerator that disables/enables throttle command.

“Forward Switch” is “on” when in Forward.

“Reverse Switch” is “on” when in Reverse.

“Main Cont Driver PWM” - 100% setting to pull in contactor and 80% to hold contactor.

“Motor Temp Sensor Analog” - Linear Thermocouple reading.

BENDI B3/30 AC CALIBRATION AND PROGRAMMING

1314 PC Programming Station - OEM - [Device Monitor (Lan_TM_B30)]

Window Device/System Options Tools Help

Device/System

- Lan_TM_B30
 - Monitor
 - Landoll
 - Inputs
 - Throttle Command
 - Mapped Throttle
 - Throttle Pot
 - Brake Command
 - Mapped Brake
 - Brake Pot
 - Steer Pot
 - Steer Angle (deg)
 - Interlock
 - Outputs
 - Battery
 - Motor
 - Controller

Monitor Value Name	Current Value	Unit
Throttle Command	0.0	%
Mapped Throttle	0.0	%
Throttle Pot	6.24	Volt
Brake Command	99.6	%
Mapped Brake	100.0	%
Brake Pot	6.24	Volt
Steer Pot	6.24	Volt
Steer Angle (deg)	0	
Interlock	On	

1314 PC Programming Station - OEM - [Device Monitor (Lan_TM_B30)]

Window Device/System Options Tools Help

Device/System

- Lan_TM_B30
 - Monitor
 - Landoll
 - Inputs
 - Outputs
 - 5 Volts
 - Ext Supply Current
 - Battery
 - Motor
 - Controller
 - Vehicle
 - CAN Status
 - Model Number

Monitor Value Name	Current Value	Unit
5 Volts	5.25	Volt
Ext Supply Current	31	mAmpere

Supply for Left motor Encoder, TM = Left motor, TS = Right motor

1314 PC Programming Station - OEM - [Device Monitor (Lan_TM_B30)]

Window Device/System Options Tools Help

Device/System

- Lan_TM_B30
 - Monitor
 - Landoll
 - Inputs
 - Outputs
 - Battery
 - BDI
 - Capacitor Voltage
 - Keyswitch Voltage
 - Motor

Monitor Value Name	Current Value	Unit
BDI	84	%
Capacitor Voltage	1.0	Volt
Keyswitch Voltage	47.7	Volt

1314 PC Programming Station - OEM - [Device Monitor (Lan_TM_B30)]

Window Device/System Options Tools Help

Device/System Lan_TM_B30

Lan_TM_B30

- Monitor
 - Landoll
 - Inputs
 - Outputs
 - Battery
 - Motor
 - Motor RPM
 - Temperature
 - MotorSpeed A
 - MotorSpeed B

Monitor Value Name	Current Value	Unit
Motor RPM	0	rpm
Temperature	200	deg C
MotorSpeed A	0	rpm
MotorSpeed B	0	rpm

1314 PC Programming Station - OEM - [Device Monitor (Lan_TM_B30)]

Window Device/System Options Tools Help

Device/System Lan_TM_B30

Lan_TM_B30

- Monitor
 - Landoll
 - Inputs
 - Outputs
 - Battery
 - Motor
 - Controller
 - Current (RMS)
 - Temperature
 - Main State
 - Regen
 - VCL Error Module
 - VCL Error
 - Cutbacks

Monitor Value Name	Current Value	Unit
Current (RMS)	0.0	Ampere
Temperature	25	deg C
Main State	9	
Regen	0n	
VCL Error Module	0	
VCL Error	0	

1314 PC Programming Station - OEM - [Device Monitor (Lan_TM_B30)]

Window Device/System Options Tools Help

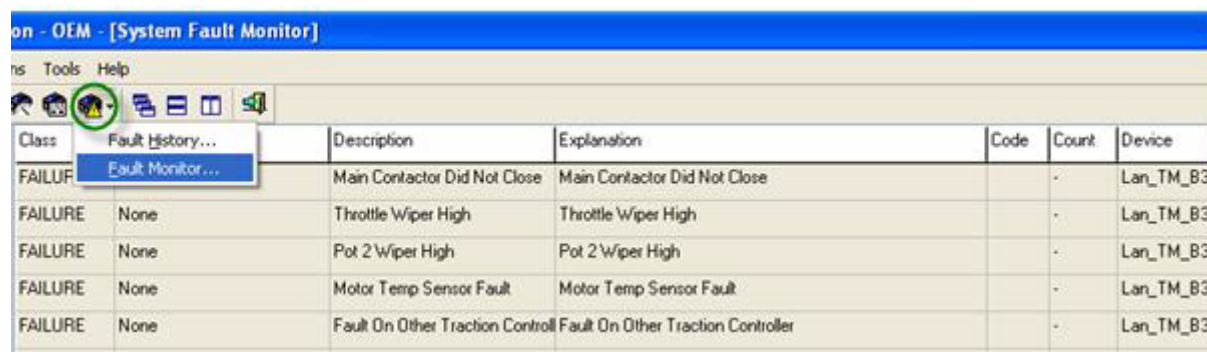
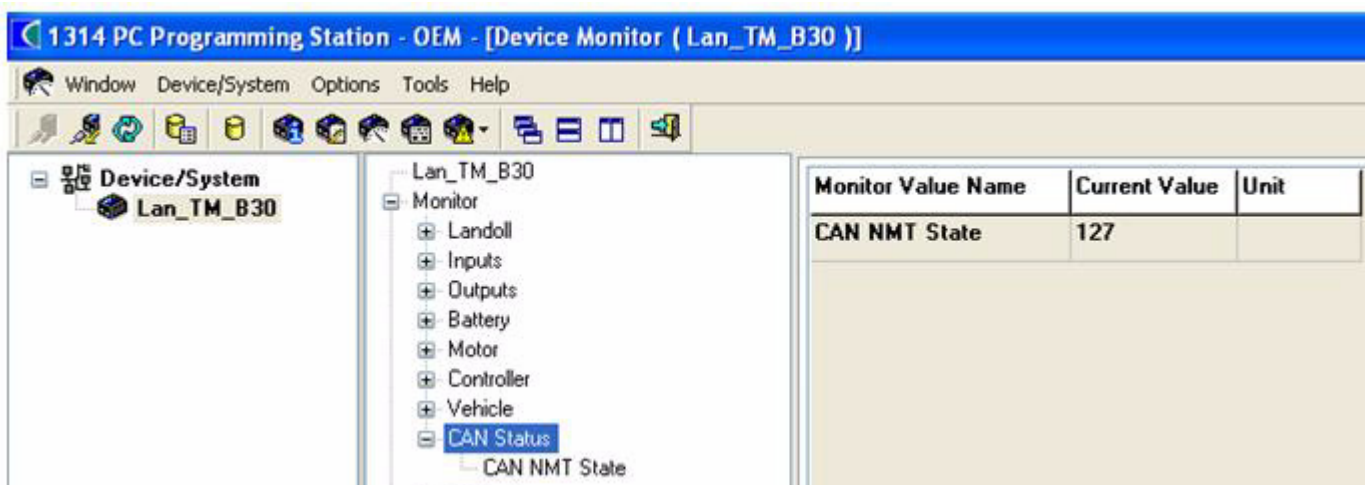
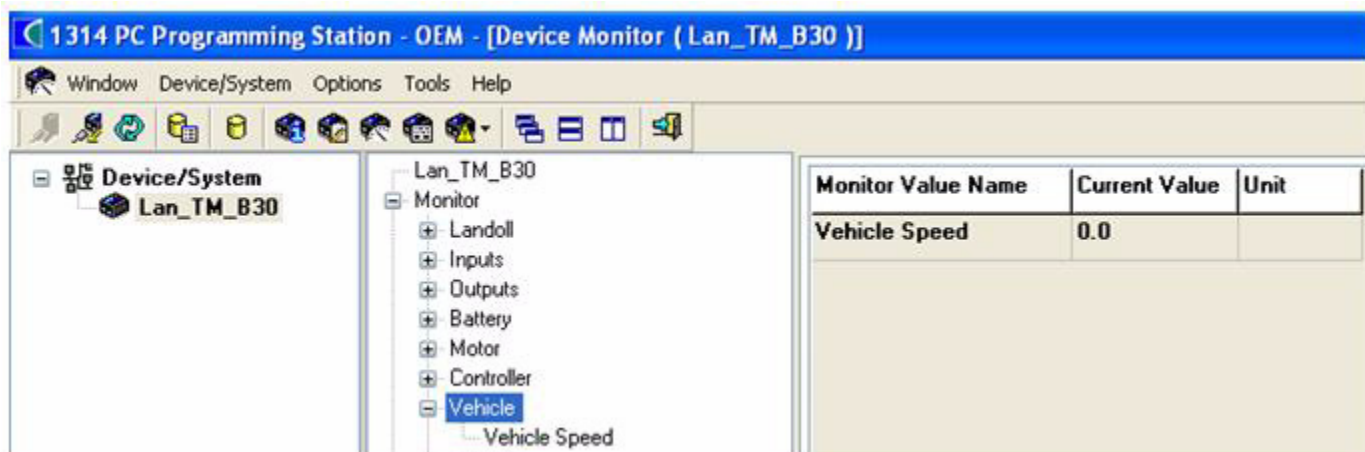
Device/System Lan_TM_B30

Lan_TM_B30

- Monitor
 - Landoll
 - Inputs
 - Outputs
 - Battery
 - Motor
 - Controller
 - Current (RMS)
 - Temperature
 - Main State
 - Regen
 - VCL Error Module
 - VCL Error
 - Cutbacks
 - Motor Temp Cutback
 - Controller Temp Cutback
 - Undervoltage Cutback
 - Overvoltage Cutback

Monitor Value Name	Current Value	Unit
Motor Temp Cutback	100	%
Controller Temp Cutback	100	%
Undervoltage Cutback	0	%
Overvoltage Cutback	100	%

BENDI B3/30 AC CALIBRATION AND PROGRAMMING



IMPORTANT

After successfully reflashing a controller, make sure to clear the fault history of all comments.

Detailed explanation of all controller parameters are shown below in the following tables.

Landoll_TM_S Parameters

DESCRIPTION	Unit	Value	Min	Max	Text Description
Landoll Traction					
HPD Sequencing Delay	Sec	2	0	5	Sets amount of time an operator can be off seat before SRO enables.
Steer Cont PWM	%	100	0	100	Sets the voltage to the steer contactor.
Steering Off Delay	Sec	10	0	30	Time that the pump continues to run after operator leaves seat.
Lift Lockout Level	%	0	0	99	Determines battery percentage before LOS engages.
Multimode Functions					
Rabbit Fwd Max Speed	%	100	0	100	Sets maximum speed of vehicle in rabbit mode.
Turtle Fwd Max Speed	%	15	0	100	Sets maximum speed of vehicle in turtle mode.
Rabbit Rev Max Speed	%	90	0	100	Sets maximum speed of vehicle in rabbit mode.
Turtle Rev Max Speed	%	15	0	100	Sets maximum speed of vehicle in turtle mode.
HourMeter					
Set Total HM		0	0	1	Set to 1 to write 10s of hours and remaining hours in minutes to controllers.
10s of Hours		0	0	20000	Sets 10s of hours. (I.E. 90=900 hours)
Remaining HRs in min.		0	0	600	Sets remaining hours in minutes. (I.E. 60=1hour)
Maintenance Due					
Next Service Due					When hour meter = next service due, maintenance due will be displayed on dash.
Speed Mode					
Response					
Full Accel Rate HS	Sec	0.1	3.0	30.0	Sets the rate at which the speed command increases when full throttle is applied at high vehicle speeds. Larger values represent slower response.
Full Accel Rate LS	Sec	0.1	3.0	30.0	Sets the rate at which the speed command increases when full throttle is applied at low vehicle speeds. Larger values represent slower response.
Low Accel Rate	Sec	0.1	10.0	30.0	Sets the rate at which the speed command increases when a small amount of throttle is applied. Typically adjusted to affect low speed control.
Neutral Decel LS	Sec	0.1	7.0	30.0	Sets the rate slows down the vehicle when the throttle is released to neutral at high vehicle speeds. Larger values represent slower response.

BENDI B3/30 AC CALIBRATION AND PROGRAMMING

DESCRIPTION	Unit	Value	Min	Max	Text Description
Neutral Decel Rate HS	Sec	0.1	2.5	30.0	Sets the rate that slows down the vehicle when the throttle is released to neutral at slow vehicle speeds. Larger values represent slower response.
Full Brake Rate HS	Sec	0.1	1.0	30.0	Sets the rate at which the vehicle slows down from high speeds when full brake is applied or when full throttle is applied in the opposite direction. Larger values represent slower response.
Full Brake Rate LS	Sec	0.1	2.5	30.0	Sets the rate at which the vehicle slows down from low speeds when full brake is applied or when full throttle is applied in the opposite direction. Larger values represent slower response.
Low break Rate	Sec	0.1	6.0	30.0	Sets the rate at which the vehicle slows down at all speeds when a small amount of brake is applied or a small amount of throttle is applied in the opposite direction. Larger values gives a slower response
Fine Tuning					
Partial Decel Rate	Sec	0.1	30.0	30.0	Sets the rate that is used to slow down the vehicle when the throttle is reduced without being released to neutral. Larger values represent slower response.
HS (High Speed)	Sec	0	70	100	Sets the percentage of the Typical Max Speed above which parameters will be used.
LS (Low Speed)	Sec	0	30	100	Sets the percentage of the Typical Max Speed below which the "LS" parameters will be used.
Reversal Soften	Sec	0	20	100	Larger values create a softer reversal from regen braking to drive when near zero speed. This helps soften the transition when the regen and drive current limits are set to different values.
Max Speed Accel	Sec	.1	1.0	30.0	In some applications, the Max Speed value is changed frequently through VCL or over the CAN bus. The Max Speed Accel parameter controls the rate at which the maximum speed setpoint is allowed to change when the value of Max Speed is raised. The rate set by this parameter is the time to ramp from 0 rpm to Typical Max Speed rpm. For example, suppose Max Speed is raised from 1000 rpm to 4000 rpm. If Typical Max Speed is 5000 rpm, and the rate is 10.0 seconds, it will take $10.0 * (4000 - 1000) / 5000 = 6.0$ seconds to ramp from 1000 rpm to 4000 rpm.
Max Speed Decel	Sec	0.1	10	30	This parameter works like the Max Speed Accel parameter, except that it controls the rate at which the maximum speed setpoint is allowed to change when the value of Max Speed is lowered. For example, suppose you change Max Speed from 4500 rpm to 2500 rpm. If Typical Max Speed is 5000 rpm, and the rate is 5.0 seconds, it will take $5.0 * (4500 - 2500) / 5000 = 2.0$ seconds to ramp from 4500 rpm to 2500 rpm.
Throttle					
Forward Deadband	Volt	Auto set during calibration.	0	5	Defines the wiper voltage at the throttle deadband threshold. Increasing the throttle deadband setting will increase the neutral range. This parameter is especially useful with throttle assemblies that do not reliably return to a well-defined neutral point, because it allows the deadband to be defined wide enough to ensure that the controller goes into neutral when the throttle mechanism is released.

DESCRIPTION	Unit	Value	Min	Max	Text Description
Forward Max	Volt	Auto set during calibration.	0	5	Defines the wiper voltage required to produce 100% controller output. Decreasing the throttle max setting reduces the wiper voltage and therefore the full stroke necessary to produce full controller output. This parameter allows reduced-range throttle assemblies to be accommodated.
Reverse Deadband	Volt	10	2	125	The four Throttle Reverse parameters are the same as their Throttle Forward counterparts, and apply when the throttle direction is reversed.
Reverse Max	Volt	3	0	5	Same as above.
Brake					
Brake Deadband	ms	48	40	2000	The four Brake throttle adjustment parameters are the same as their Drive throttle counterparts
Brake Max	ms	200	0	800	Same as above.
Battery					
Reset Volts Per Cell	Volt	2.09	0.9	3	The value of this parameter is a percentage of the Nominal Voltage setting. The User Undervoltage parameter can be used to adjust the undervoltage threshold, which is the voltage at which the controller will cut back drive current to prevent damage to the electrical system. Typically this parameter is changed only when the controller is being used in an application at the high end of the controller's range: such as a 24–36V controller being used in a system with a 36V battery pack. In this case, the undervoltage threshold can be lowered by setting the User Undervoltage to a lower value. The undervoltage threshold can never be lowered below the controller's power base minimum voltage rating.
Full Volts Per Cell	Volt	2.04	0.9	3	The reset voltage level is checked only once, when KSI is first turned on. Note that the BDI Reset Percent parameter also influences the algorithm that determines whether BDI Percentage is reset to 100%. Reset Volts Per Cell should always be set higher than Full Volts Per Cell. Reset Voltage Level = Reset Volts Per Cell × number of cells in the battery pack
Empty Volts Per Cell	Volt	1.71	0.9	3	The full voltage level sets the Keyswitch Voltage that is considered to be 100% state-of-charge; when a loaded battery drops below this voltage, it begins to lose charge. Keyswitch Voltage is viewable in the 1311 menu Monitor » Battery. Full Voltage Level = Full Volts Per Cell × number of cells in the battery pack.
Discharge Time	Min	60	0	600	Sets the minimum time for the BDI algorithm to count down the BDI Percentage from 100% to 0%. The BDI algorithm integrates the time the filtered keyswitch voltage is below the state of charge voltage level. When that cumulative time exceeds the Discharge Time / 100, the BDI Percentage is decremented by one percentage point and a new state of charge voltage level is calculated. State of Charge Level = ((Full Voltage Level - Empty Voltage Level) × BDI Percentage / 100) + Empty Voltage Level.

BENDI B3/30 AC CALIBRATION AND PROGRAMMING

DESCRIPTION	Unit	Value	Min	Max	Text Description
BDI Reset Percent	%	75	0	100	When a battery has a high BDI percentage, its float voltage at KSI On can sometimes cause false resets. The BDI Reset Percent parameter addresses this problem by allowing the user to define a BDI Percentage value above which the BDI Percentage variable will not reset. When KSI is first powered on, the BDI Percentage variable will reset to 100% only if ((Keyswitch Voltage > Reset Voltage Level) and (BDI Percentage < BDI Reset Percent)).
Dual Drive					
Master					
Steer Pot Min	Volt	1.12	0	5	Set Steer Pot Min to the voltage on the steering pot when steering as far as possible clockwise. Determine the value by reading the voltage on the pot when steering CW to the maximum position.
Steer Pot Zero	Volt				Set Steer Pot Zero to the voltage on the steering pot when steering straight ahead. Determine the value by reading the voltage on the pot when steering straight.
Steer Pot Max	Volt	4.77	0	5	Set Steer Pot Max to the voltage on the steering pot when steering as far as possible counterclockwise. Determine the value by reading the voltage on the pot when steering CCW to the maximum position.

Landoll_P_S Parameters

DESCRIPTION	Unit	Value	Min	Max	Text Description
Landoll Pump					
Pump Speeds					
Max Total Speed	rpm	2600	1000	5000	Max Pump motor RPM
Sideshift Speed	rpm	900	0	5000	Sideshift maximum motor RPM
Tilt Speed	rpm	900	0	5000	Tilt maximum motor RPM
Lift Speed	rpm	See p. 5-38.	0	5000	Lift maximum motor RPM
Steer Speed	rpm	850	0	5000	Steer maximum motor RPM
Seat Hydraulics Enable		0	0	1	When off, hydraulics can be operated without operator on seat. On: Can be operated regardless of seat switch.
Throttle					
Lift Deadband	Volt	2.72	0	5	Defines the wiper voltage at the throttle deadband threshold. Increasing the throttle deadband setting will increase the neutral range. This parameter is especially useful with throttle assemblies that do not reliably return to a well-defined neutral point, because it allows the deadband to be defined wide enough to ensure that the controller goes into neutral when the throttle mechanism is released.
Lift Max	Volt	3.8	0	5	Defines the wiper voltage required to produce 100% controller output. Decreasing the throttle max setting reduces the wiper voltage and therefore the full stroke necessary to produce full controller output. This parameter allows reduced-range throttle assemblies to be accommodated.

CURTIS CONTROLLER TROUBLESHOOTING

IMPORTANT

The following troubleshooting chart provides information on the Curtis controller faults:

- • Fault code
- • Fault name displayed on the dash display.
- • The effect of the fault
- • Possible causes of the fault
- • Fault *set* conditions
- • Fault *clear* conditions

NOTE

Whenever a fault is encountered and no wiring or vehicle fault can be found, shut off KSI and turn it back on to see if the fault clears. If it does not, shut off Key Switch Interrupt (KSI) and remove the 35-pin connector. Check the connector for corrosion, damage, or unseated terminals. Clean, and if necessary, re-insert it.

TYPES OF LED DISPLAY

DISPLAY	STATUS
Neither LED illuminated	Controller is not powered on; or vehicle has dead battery; or severe damage.
Yellow LED flashing	Controller is operating normally.
Yellow and red LED's both on solid	Controller is in Flash program mode.
Red LED on solid	Watchdog failure or no software loaded. Cycle KSI to restart, and if necessary load software.
Red LED and yellow LED flashing alternately	Controller has detected a fault. 2-digit code flashed by yellow LED identifies the specific fault; one or two flashes by red LED indicate whether first or second code digit will follow.

BENDI B3/30 AC CALIBRATION AND PROGRAMMING

PROGRAM TROUBLESHOOTING CHART

C O D E	PROGRAMMER LCD DISPLAY	T	P	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
12	Controller Overcurrent <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake;</i> <i>ShutdownPump.</i>	X	X	1. External short of phase U,V, or W motor connections. 2. Motor parameters are mis-tuned. 3. Controller defective.	<i>Set:</i> Phase current exceeded the current measurement limit. <i>Clear:</i> Cycle KSI.
13	Current Sensor Fault <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake;</i> <i>ShutdownPump.</i>	X	X	1. Leakage to vehicle frame from phase U, V, or W (short in motor stator). 2. Controller defective.	<i>Set:</i> Controller current sensors have invalid offset reading. <i>Clear:</i> Cycle KSI.
14	Precharge Failed <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>Full Brake;</i> <i>ShutdownPump.</i>	X	X	1. See Monitor menu » Battery: Capacitor Voltage. 2. External load on capacitor bank (B+ connection terminal) that prevents the capacitor bank from charging.	<i>Set:</i> Precharge failed to charge the capacitor bank to the KSI voltage. <i>Clear:</i> Cycle Interlock input or use VCL function Precharge().
15	Controller Severe Undertemp <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake;</i> <i>ShutdownPump.</i>	X	X	1. See Monitor menu » Controller: Temperature. 2. Controller is operating in an extreme environment.	<i>Set:</i> Heatsink temperature below -40°C. <i>Clear:</i> Bring heatsink temperature above -40°C, and cycle interlock or KSI.
16	Controller Severe Overtemp <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake;</i> <i>ShutdownPump.</i>	X	X	1. See Monitor menu » Controller: Temperature. 2. Controller is operating in an extreme environment. 3. Excessive load on vehicle. 4. Improper mounting of controller.	<i>Set:</i> Heatsink temperature above +95°C. <i>Clear:</i> Bring heatsink temperature below +95°C, and cycle interlock or KSI.
17	Severe Undervoltage Reduced drive torque.	X	X	1. Battery Menu parameters are misadjusted. 2. Non-controller system drain on battery. 3. Battery resistance too high. 4. Battery disconnected while driving. 5. See Monitor menu » Battery: Capacitor Voltage. 6. Blown B+ fuse or main contactor did not close.	<i>Set:</i> Capacitor bank voltage dropped below the Severe Undervoltage limit (see page 55) with FET bridge enabled. <i>Clear:</i> Bring capacitor voltage above Severe Undervoltage limit.
18	Severe Overvoltage <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake;</i> <i>ShutdownPump.</i>	X	X	1. See Monitor menu » Battery: Capacitor Voltage. 2. Battery menu parameters are misadjusted. 3. Battery resistance too high for given regen current. 4. Battery disconnected while regen braking.	<i>Set:</i> Capacitor bank voltage exceeded the Severe Overvoltage limit (see page 55) with FET bridge enabled. <i>Clear:</i> Bring capacitor voltage below Severe Overvoltage limit, and then cycle KSI.

C O D E	PROGRAMMER LCD DISPLAY	T	P	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
22	Controller Overtemp Cutback <i>Reduced drive and brake torque.</i>	X	X	1. See Monitor menu » Controller: Temperature. 2. Controller is performance-limited at this temperature. 3. Controller is operating in an extreme setting. 4. Excessive load on vehicle. 5. Improper mounting of controller	<i>Set:</i> Heat sink temperature exceeded 85°C. <i>Clear:</i> Bring heat sink temperature below 85°C.
23	Undervoltage Cutback <i>Reduced drive torque.</i>	X	X	1. Normal operation. Fault shows that the batteries need recharging. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Non-controller system drain on battery. 4. Battery resistance too high. 5. Battery disconnected while driving. 6. See Monitor menu » Battery: Capacitor Voltage. 7. Blown B+ fuse or main contactor did not close.	<i>Set:</i> Capacitor bank voltage dropped below the Undervoltage limit (see page 55) with the FET bridge enabled. <i>Clear:</i> Bring capacitor voltage above the undervoltage limit.
24	Overvoltage Cutback <i>Reduced brake torque.</i>	X	X	1. Normal operation. Fault shows that regen braking currents elevated the battery voltage during regen braking. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Battery resistance too high for given regen current. 4. Battery disconnected while regen braking. 5. See Monitor menu » Battery: Capacitor Voltage.	<i>Set:</i> Capacitor bank voltage exceeded the Overvoltage limit (see page 55) with the FET bridge enabled. <i>Clear:</i> Bring capacitor voltage below the Overvoltage limit.
25	+5V Supply Failure <i>None, unless a fault action is programmed in VCL.</i>	X	X	1. External load impedance on the +5V supply (pin 26) is too low. 2. See Monitor menu » outputs: 5 Volts and Ext Supply Current.	<i>Set:</i> +5V supply (pin 26) outside the +5V±10% range. <i>Clear:</i> Bring voltage within range.
28	Motor Temp Hot Cutback <i>Reduced drive torque.</i>	X	X	1. Motor temperature is at or above the programmed Temperature Hot setting, and the requested current is being cut back. 2. Motor Temp Control Menu parameters are mis-tuned. 3. See Monitor menu » Motor: Temperature and » Inputs: Analog2. 4. If the application doesn't use a motor thermistor, Temp Compensation and Temp Cutback should be programmed Off.	<i>Set:</i> Motor temperature is at or above the Temperature Hot parameter setting. <i>Clear:</i> Bring the motor temperature within range.
29	Motor Temp Sensor Fault <i>MaxSpeed reduced (LOS, Limited Operating Strategy), and motor temperature cutback disabled.</i>	X	X	1. Motor thermistor is not connected properly. 2. If the application doesn't use a motor and motor thermistor, Motor Temp Sensor Enable should be programmed Off. 3. See Monitor menu » Motor: Temperature and » Inputs: Analog2.	<i>Set:</i> Motor thermistor input (pin 8) is at the voltage rail (0 or 10V). <i>Clear:</i> Bring the motor thermistor input voltage within range.
31	Coil1 Driver Open/Short ShutdownDriver1.	X	X	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	<i>Set:</i> Main contactor driver (pin 6) is either open or shorted. This fault can be set only when Main Enable = Off. <i>Clear:</i> Correct open or short, and cycle driver.

BENDI B3/30 AC CALIBRATION AND PROGRAMMING

C O D E	PROGRAMMER LCD DISPLAY	T	P	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
36	Encoder Fault <i>ShutdownEMBrake.</i>	X	X	1. MotorCoil3 Driver Open/Short ShutdownDriver3. encoder failure. 2. Bad crimps or faulty wiring. 3. See Monitor menu » Motor: Motor RPM.	<i>Set:</i> Motor encoder phase failure detected. <i>Clear:</i> Cycle KSI.
37	Motor Open <i>ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.</i>	X	X	1. Motor phase is open. 2. Bad crimps or faulty wiring.	<i>Set:</i> Motor phase U, V, or W detected open. <i>Clear:</i> Cycle KSI.
38	Main Contactor Welded <i>ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.</i>	X	X	1. Main contactor tips are welded closed. 2. Motor phase U or V is disconnected or open. 3. An alternate voltage path (such as an external precharge resistor) is providing a current to the capacitor bank (B+ connection terminal).	<i>Set:</i> Just prior to the main contactor closing, the capacitor bank voltage (B+ connection terminal) was loaded for a short time and the voltage did not discharge. <i>Clear:</i> Cycle KSI
39	Main Contactor Didn't close <i>ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump</i>	X	X	1. Maincontactor did not close. 2. Main contactor tips are oxidized, burned, or not making good contact. 3. External load on capacitor bank (B+ connection terminal) that prevents capacitor bank from charging. 4. Blown B+ fuse.	<i>Set:</i> With the main contactor commanded closed, the capacitor bank voltage (B+ connection terminal) did not charge to B+. <i>Clear:</i> Cycle KSI.
41	Throttle Wiper High <i>ShutdownThrottle.</i>	X	X	1. See Monitor menu >> Inputs: Throttle Pot. 2. Throttle pot wiper voltage too high.	<i>Set:</i> Throttle pot wiper (pin 16) voltage is higher than the high fault threshold (can be changed with the VCL function SETUP POT FAULTS) <i>Clear:</i> Bring throttle pot wiper voltage above the fault threshold.
42	Throttle Wiper Low <i>ShutdownThrottle;</i>	X	X	1. See Monitor menu >> Inputs: ThrottlePot. 2. Throttle pot wiper voltage too high.	<i>Set:</i> Throttle pot wiper (pin 16) voltage is higher than the high fault threshold (can be changed with the VCL function Setup_Pot_Faults). <i>Clear:</i> Bring throttle pot wiper voltage below the fault threshold.
43	Pot2 Wiper High <i>FullBrake.</i>	X		Refer to Curtis	Return Controller to Landoll Corporation for evaluation.
44	Pot2 Wiper Low <i>FullBrake.</i>	X		Refer to Curtis	Return Controller to Landoll Corporation for evaluation.
45	Pot Low Overcurrent <i>ShutdownThrottle. FullBrake ShutdownSteer</i>	X	X	1. See Monitor menu >> Outputs: Pot Low. 2. Combined pot resistance connected to pot low is too low.	<i>Set:</i> Pot low (pin 18) current exceeds 10mA. <i>Clear:</i> Clear pot low overcurrent condition and cycle KSI.

C O D E	PROGRAMMER LCD DISPLAY	T	P	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
46	EEPROM Failure <i>ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock;Shutdown Driver1 ShutdownDriver2;ShutdownDr iver3; ShutdownDriver4;ShutdownP D; Fullbrake; ShutdownPump; TrimDisable;SevereDual; ShutdownSteer; LOSDual</i>	X	X	1. Failure to write to EEPROM memory. This can be caused by EEPROM memory writes initiated by VCL, by the CAN bus, by adjusting parameters with the programmer, or by loading new software into the controller.	<i>Set:</i> Controller operating system tried to write to EEPROM memory and failed. <i>Clear:</i> Download the correct software (OS) and matching parameter default settings into the controller and cycle KSI.
47	HPD/Sequencing Fault. <i>Shutdown Throttle</i>			1. KSI, interlock, direction, and throttle inputs applied in incorrect sequence. 2. Bad crimp, faulty wiring or KSI switch. See Monitor menu>>Inputs.	<i>Set:</i> HPD (High Pedal Disable) or sequencing fault caused by incorrect sequence if KSI, interlock, direction and throttle inputs. <i>Clear:</i> Reapply correct input sequence.
49	Parameter Change Fault <i>ShutdownMotor; ShutdownEMBrake; ShutdownThrottle; Fullbrake; ShutdownPump</i>	X	X	1. This is a safety fault caused by a change in certain parameter settings so that the vehicle will not operate until KSI is cycled. For example, if a user changes the Throttle Type, this fault will appear and require cycling KSI before the vehicle can operate.	<i>Set:</i> Adjustment of a parameter setting that requires cycling of KSI. <i>Clear:</i> Cycle KSI.
52	Battery Rollout Switch <i>Fault in Left traction controller.</i>				Return Controller to Landoll Corporation for evaluation.
68	VCL Run Time Error <i>ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake; ShutdownPump. ShutdownPump: TrimDisable; SevereDual; ShutdownSteer; LOSDual.</i>	X	X	1. VCL code encountered a runtime VCL error. 2. See Monitor menu>>Controller:VCL Error Module and VCL Error. This error can then be compared to the runtime VCL module ID and error code definitions found in the specific OS system information file.	<i>Set:</i> Runtime VCL code error condition. <i>Clear:</i> Edit VCL application software to fix this error condition; flash the new compiled software and matching parameter defaults; cycle KSI.
69	External Supply Out of Range <i>None, unless a fault action is programmed in VCL;</i>	X	X	1. External load on the 5V and 12V supplies draws either too much or too little current. 2. Fault Checking Menu parameters Ext Supply Max and Ext Supply Min are mistuned. 3. See Monitor menu>>Outputs: Ext Supply Current.	<i>Set:</i> The external supply current (combined current used by the 5V supply [pin 26] and 12V supply [pin 25]) is either greater than the upper current threshold or lower than the low current threshold. The two thresholds are defined by the External Supply Max and External Supply Min parameter settings. <i>Clear:</i> Bring the external supply current within range.

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C O D E	PROGRAMMER LCD DISPLAY	T	P	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
71	OS General <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>ShutdownInterlock;</i> <i>ShutdownDriver1;ShutdownD</i> <i>river2;</i> <i>ShutdownDriver3;ShutdownD</i> <i>river4; ShutdownPD;</i> <i>FullBrake:Shutdown Pump;</i> <i>TrimDisable;</i> <i>SevereDual;Shutdown Steer;</i> <i>LOSDual</i>	X	X	1.Internal Controller fault.	<i>Set:</i> Internal controller fault detected. <i>Clear:</i> Cycle KSI.
72	PDO Timeout <i>Shutdown Interlock;</i> <i>CAN NMT State set to</i> <i>Pre-operational</i>	X	X	Time between CAN PDO messages received exceeded the PDO Timeout Period.	<i>Set:</i> Time between CAN PDO messages received exceeded the PDO Timeout Period. <i>Clear:</i> Cycle KSI or receive CAN NMT message
73	Stall Detected <i>ShutdownMotor;</i> <i>SevereDual;</i> <i>ShutdownEMBrake;</i> <i>Control Mode changed to</i> <i>LOS (Limited Operating</i> <i>Strategy)</i>	X	X	1. Stalled motor. 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Problems with power supply for the motor encoder. 5. See Monitor menu>>Motor: Motor RPM.	<i>Set:</i> No motor encoder movement detected. <i>Clear:</i> Either cycle KSI, or detect valid motor encoder signals while operating in LOS mode and return Throttle Command=) and Motor RPM=0.

C O D E	PROGRAMMER LCD DISPLAY	T P		POSSIBLE CAUSE	SET/CLEAR CONDITIONS
		T	P		
74	Fault On other Traction Controller <i>For information on this fault, plug the programmer into the other controller.</i>	X	X	1. A fault is active on the other traction controller.	<i>Set:</i> In a Dual Drive traction system, any fault in the other traction controller will cause this fault to be set. <i>Clear:</i> Clear all the active faults in the other traction controller.
75	Dual Severe Fault <i>ShutdownMotor; ShutdownMainContactor ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump Other controller: Same effects as this controller.</i>	X	X	1. Both traction controllers have active severe faults and therefore both will be disabled.	<i>Set:</i> A severe fault in each traction controller will cause this fault to be set. <i>Clear:</i> Correct the severe fault(s) in either controller to clear the Dual Severe Fault; of course, you will want to clear all faults on both controllers.
91	VCL/OS Mismatch <i>ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake; ShutdownPump</i>			1. The VCL software in the controller does not match the OS software in the controller.	<i>Set:</i> VCL and OS software do not match when KSI cycles, a check is made to verify that they match and a fault is issued when they don't. <i>Clear:</i> Download the correct VCL and OS software into the computer.
91	VCL/OS Mismatch <i>ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake; ShutdownPump</i>			1. The VCL software in the controller does not match the OS software in the controller.	<i>Set:</i> VCL and OS software do not match when KSI cycles, a check is made to verify that they match and a fault is issued when they don't. <i>Clear:</i> Download the correct VCL and OS software into the computer.
93	Encoder LOS <i>(LimitedOperatingStrategy). Enter LOS control mode.</i>			1. Limited Operating Strategy (LOS) control mode has been activated, as a result of either an Encoder Fault (Code 36) or a Stall Detect Fault (Code 73). 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Vehicle is stalled.	<i>Set:</i> Encoder Fault (Code 36) or Stall Detect Fault (Code 73) was activated, and Brake or Interlock has been applied to activate LOS control mode, allowing limited motor control. <i>Clear:</i> Cycle KSI or, if LOS mode was activated by the Stall Fault, clear by ensuring encoder senses proper operation, Motor RPM=0, and Throttle Command=0.
98	Illegal Model Number <i>ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake; ShutdownPump.</i>	X	X	1. Model_Number variable contains illegal value (not 1234, 1236, 1238, or 1298). 2. Software and hardware do not match. 3. Controller defective.	<i>Set:</i> Illegal Model_Number variable; when KSI cycles, a check is made to confirm a legal Model_Number, and a fault is issued if one is not found. <i>Clear:</i> Download appropriate software for your controller model.

Controller Maintenance

There are no user serviceable parts in the Curtis 1234/36/38 controllers. No attempt should be made to open, repair, or modify the controller. Modifying the controller will void the warranty. It is recommended that the controller and connection be kept clean and dry and that the controller's fault history file be checked and cleared during service.

Controller Cleaning

Periodically cleaning the controller exterior will help protect it against corrosion and possible electrical problems created by dirt that is part of the operating environment and that normally exists in battery powered systems. When working around any battery powered system, proper safety precautions should be taken. These include, but are not limited to: proper training, wearing eye protection, and avoiding loose clothing and jewelry.

IMPORTANT

Never use a pressure washer to clean the controller.

Use the following cleaning procedure for routine maintenance:

1. Remove power by disconnecting the battery.
2. Discharge the capacitors in the controller by connecting a load across the controller's **B+** and **B** terminals.
3. Remove any dirt or corrosion from the power and signal connector areas. The controller should be wiped clean with a moist rag. Dry it before reconnecting the battery.
4. Make sure the connections are tight.

PROGRAMMER MENUS

The programmers have six menus, which in turn lead to nested submenus.

- **Program** — provides access to the programmable parameters.
- **Monitor** — presents real-time values during vehicle operation; these include all inputs and outputs, as well as the mapped throttle values and conditioned throttle requests.
- **Faults** — presents diagnostic information and also a means to clear the fault history file.
- **Functions** — provides access to the controller-cloning commands and to the "reset" command.
- **Information** — displays data about the host controller, model and serial numbers, date of manufacture, hardware and software revisions, and itemization of other devices that may be associated with the controller's operation.
- **Programmer Setup** — displays data about the programmer: model and serial numbers, and date of manufacture.

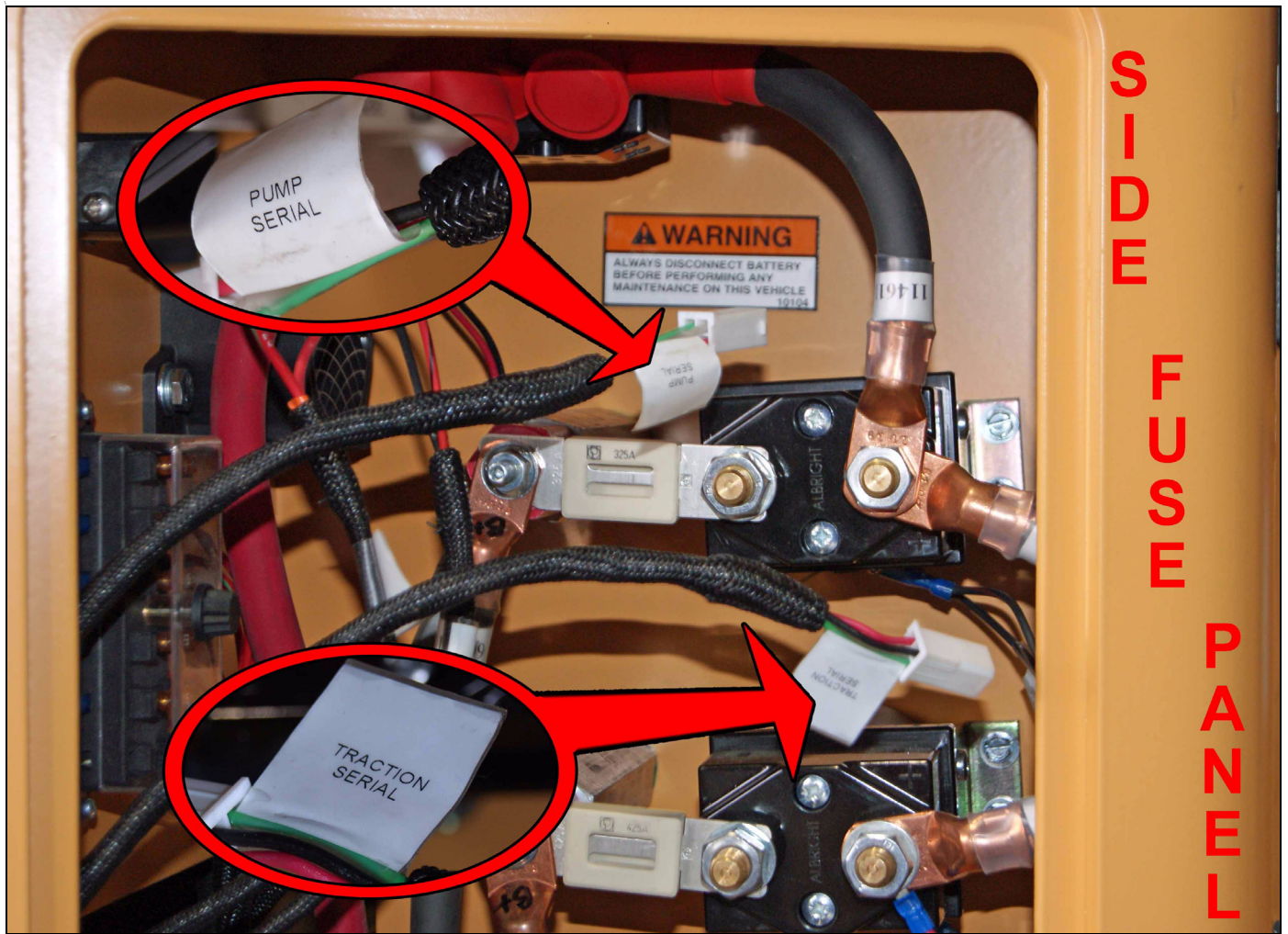


Figure 5-2: Cable Connections

BENDI B3/30 AC CALIBRATION AND PROGRAMMING

Chapter 6

Truck Lubrication and Chain Maintenance

Lubricating the Truck

1. Before lubricating the truck, lower the forks, set the key switch to the OFF position, and set the parking brake.
2. Certain grease fittings may include protective plastic caps. Remove them before applying grease. Remember to replace the caps when you are finished.
3. In the following procedures, the location of grease fittings or surfaces to be greased are by either a grease-gun or brush respectively.
4. Make sure all grease fittings are wiped clean before lubricating. If any of the fittings are corroded or blocked, replace them. Before brush-applying grease to bearing pad surfaces, wipe out the channel to remove any foreign matter that may have accumulated since your last lubrication.
5. After a truck cleaning, lubricate all unprotected grease fittings and metal-to-metal surfaces, located outside the truck.
6. Interval frequency can be recorded from the running hours read on the hour meter in the driver's compartment.
7. See "Lubrication Specifications" on page 1-17 for recommended lubricants.



WARNING

Do not service the truck and/or mast area while the key switch is ON. If a joystick, steering wheel or accelerator pedal is accidentally moved, serious injury could occur.

Tilt Cylinder Clevis

1. Start the truck and pivot the mast straight forward to the normal carry position.
2. Set the key switch to OFF, remove the key from the key switch and place in a secure area.
3. Grease clevis fitting on end of tilt cylinder until fresh grease is squeezed from the clevis. (See Figure 6-1).
4. Wipe off excess grease.

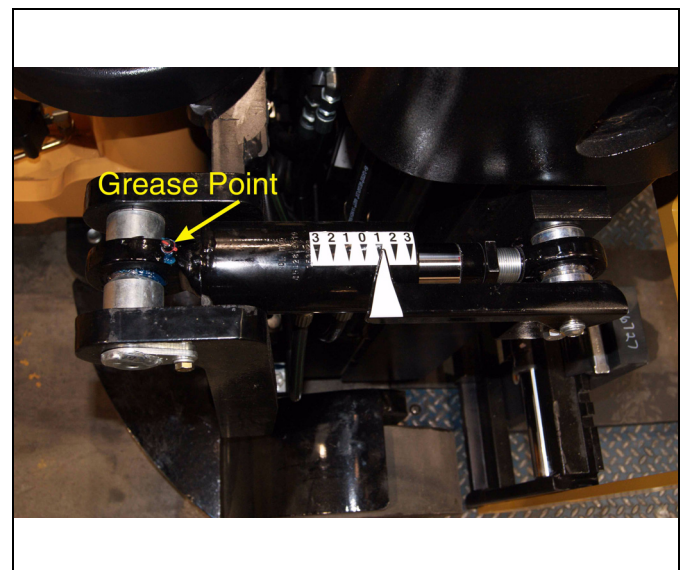


Figure 6-1

Main Rotation Bearings

1. Start the truck and pivot the mast straight forward to the normal carry position.
2. Set the key switch to OFF, remove the key from the key switch and place in a secure area.
3. Perform a Lock Out/Tag Out procedure.
4. Grease the upper and lower front rotation bearing fittings until fresh grease is squeezed from the lower bearing. (See Figure 6-2).
5. Wipe off excess grease at the lower bearing.

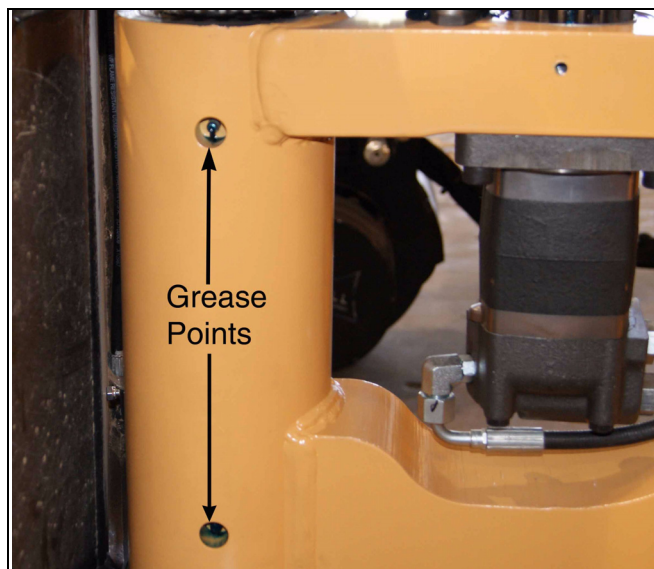


Figure 6-2

Fork Positioner Lubrication, Non-Side Shifting (Option)

1. Start the truck and position the mast straight ahead.
2. Set the key switch to OFF, remove the key from the key switch and place in a secure area.
3. Before lubricating the positioner rails, wipe off excess lubricant and dirt buildup from within the rail channels and dirt from the top and bottom of the rail grooves.
4. Using a brush, lubricate the top areas on the fork rails, including a thin film on the front face of both rails. (See Figure 6-3).
5. Wipe off excess grease.

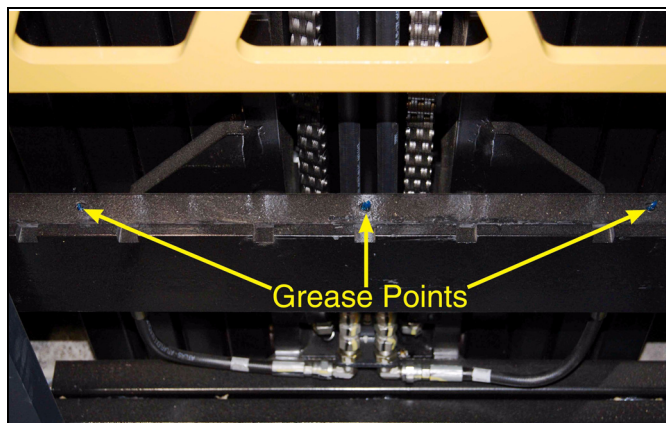


Figure 6-3

Chain Lubrication



CAUTION

The chains must be coated with a film of lubricant at all times.

- Lubricate the chains as required by the Checklists beginning on page 1-8.
- Use lubricant listed on the Lubrication Chart located on page 1-17. Brush lube along all chain surfaces.
- 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.

Chain Adjustment

The chain must be adjusted so each strand is under equal tension for proper load distribution and mast operation.

To determine whether the chains are properly adjusted:

1. Remove load from forks.
2. Extend the mast to put the chains under tension.
3. Press the center of a strand of chain with your thumb, then press at the same place on the other chain of the pair.
4. Each chain in a pair should have equal "give". If tension is not equal, adjust them as described in the manufacturer's mast service manual.

Measuring Chain Stretch

If the chains stretch beyond the recommended amount, they should be replaced in pairs. Chain stretch can be measured with a chain wear scale. (See Figure 6-4) The scale indicates whether the distance between two chain links is within tolerance. The shaded area in the illustration, compares a stretched chain, to a new chain. Measure the chains according to the instructions printed on the chain wear scale, without load on the carriage.

- To check the free lift chains, raise the carriage 1 ft. (30 cm) off the ground to put tension on the chains.
- To check the main lift chains, raise the mast until the inner upright starts to extend putting tension on the chains.

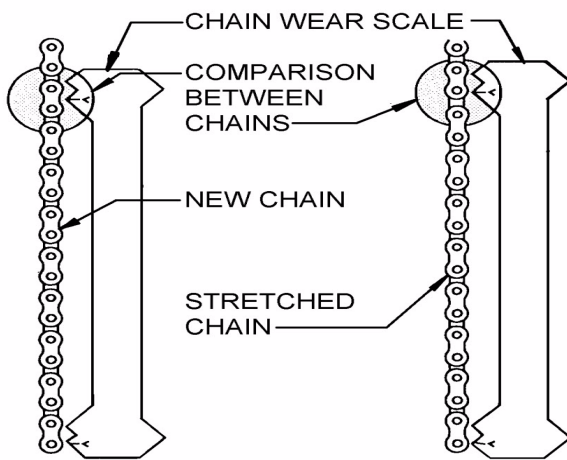


Figure 6-4 Measuring Chain Stretch

Check Primary Lift Chain

1. Park the truck on a flat, level surface, with the parking brake fully engaged.
2. Set the mast in the center of the truck, facing straight ahead, level to the floor and empty. (unloaded)
3. Set the key switch to OFF, remove the key and place in a secure area.
4. Measure the distance from the floor to the bottom heel of each fork tine. Measurement must be 1/8" (3.175 mm) minimum to 1/4" (6.35 mm) maximum.

If it is not within 1/8" to 1/4" (3.175 mm to 6.35 mm), adjust the primary lift chain accordingly.

Check Lift Operation

1. Check the lift cylinders to ensure proper sequencing. If adjustment is needed, see "Chain Adjustment" on page 6-2 or supplier information in Chapter 7.

2. Check to see that an unloaded mast will completely lift to full lift height. (the relief valve opens) If it will not, check the hydraulic oil level in the reservoir; add oil if necessary.
3. Load the mast and raise it approximately to 5'. (1.524 m) quickly lower the mast until it is about 6". (152.4 mm) above the floor and stop the mast abruptly.
4. Make sure the elevating channel rollers maintain proper contact with the mast channel.
5. Look for signs of galling where the rollers contact the rail. Galling is indicated by track marks in the rails that are 1/4" to 1/2" (6.35 mm to 12.7 mm) wide running up the rail. Normal track marks are no more than 1/4" (6.35 mm) wide.
6. If galling is detected, adjust the rollers for the proper clearance over the full length of the mast rails. (See "Inspection Check List" beginning on page 1-8)

Checking and Adjusting Degree of Tilt

1. To check degree of tilt, be certain the truck is on a smooth, level surface.
2. Tilt the mast completely back. Place the tilt gauge against the rear outer mast rail on the right side of the truck.
3. If equipped with a mast that has a fork height greater than 240", available tilt is limited to 1 degree forward and 2.1 degrees back. The standard tilt is 3 degrees forward and 3.1 degrees back for masts of 239" or lower. When testing a standard truck equipped with a mast gauge, the gauge must read between 3.0 and 3.1, while the taller mast must read between 2.0 and 2.1 degrees of rear tilt.
4. To adjust the degree of tilt, tilt the mast fully backward.
5. Set the key switch to OFF and remove the key from the key switch.



CAUTION

Do not service the tilt cylinder while the key switch is ON. If a joystick, steering wheel or accelerator pedal is accidentally moved, you could be caught between the mast and the truck, causing serious injury.

6. Loosen the tilt cylinder adjuster bolt.
7. Continue to loosen the tilt cylinder adjuster bolt until there is no bolt pressure on the tilt cylinder clevis.
8. Place the tilt gauge against the rear outer mast rail on the right side of the truck, about 6" (152 mm) above the mast cross member.

TRUCK LUBRICATION AND CHAIN MAINTENANCE



CAUTION

NEVER exceed 3.0° to 3.1° rear tilt for 239" or shorter masts. Never exceed 2.0° to 2.1° rear tilt for 240" or taller masts. Actual rear tilt in excess of recommended tilt can cause the truck to become unstable under certain conditions.

9. Relieve the hydraulic pressure on the tilt cylinder. Rotate the tilt cylinder rod, using a 1-3/4 open end wrench on the tilt cylinder rod. Looking at the rod end of the cylinder turn clockwise to shorten the rear tilt or counterclockwise to increase the rear tilt. It is best to turn the rod only a 1/2 turn at a time.
10. You may have to tilt the mast a number of times, repeating steps 4 thru 9, until the adjustment is correct.

NOTE

At this time, make sure all hydraulic hoses, electrical wiring and all parts of the mast move smoothly and clear the frame when the mast is going through the complete tilt movement. Also check and correct mast flex, a misadjustment of the tilt cylinders that causes one tilt cylinder to bottom out before the other one has completed travel.

11. When the adjustment is complete, reinsert the key and turn to the ON position. Using the tilt cylinder lever, tilt the mast back to its full stroke.
12. Tighten and torque the tilt cylinder adjuster bolt against the cylinder clevis. (See General Torque, Hydraulic Fitting Torque, and Bendi AC Special Torque Tables on page 1-18)

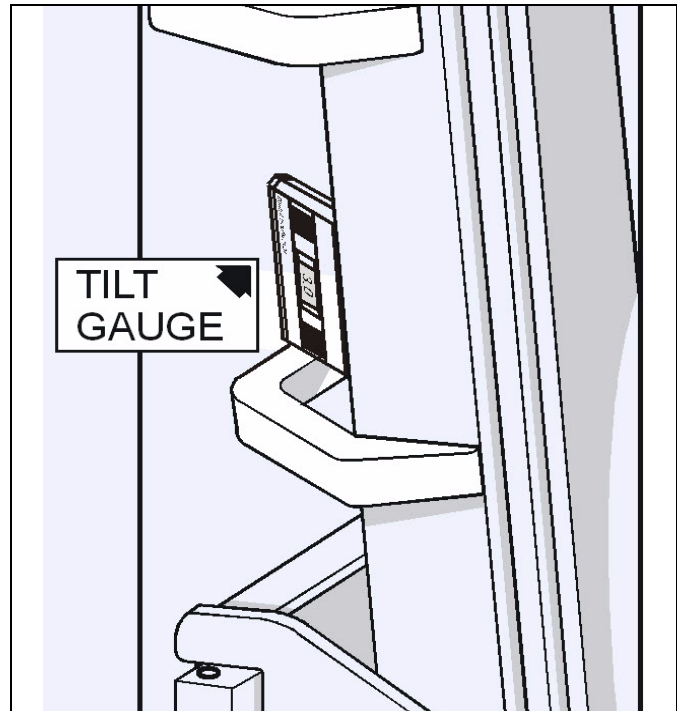


Figure 6-5 Mast Tilt Gauge

Removing the Tilt Cylinders



WARNING

Steel toed shoes and eye protection are required when doing maintenance or repair work on a lift truck. Do not place feet or hands in any areas through the mast or in truck pinch points. Servicing the tilt cylinders requires the use of an overhead hoist, hoist slings and wheel blocks. The overhead hoist and slings must have a rating of 8,000 lb. or greater. Do not work under or around a truck that is not properly secured. The battery must be disconnected and removed from the truck.

- Truck repair must be in a level, designated area.
- Turn the lift off, pull the key and put it in a secure place.
- Lower the mast completely to the floor.
- Chock the wheels so that the truck cannot move.
- Relieve any hydraulic pressure by moving all levers back and forth and turning the steering wheel both ways.
- Slowly loosen the hydraulic fittings and catch all oil with a pan or shop rag.
- Attach a sling and hoist to all the top cross braces so the mast sections cannot move.

1. Review "Before You Begin" on page 1-1.
2. If the cylinder is being removed, disconnect the two hydraulic hoses from the tilt cylinder. Mark, cap and plug all hoses and cylinder ports.
3. If replacing the cylinder, mark the cylinder jam nut for reassembly on new cylinder.
6. Attach an overhead crane (rated at 6,000 or higher) to the mast and lift slightly.
7. Disconnect the two tilt cylinders. (See "Removing the Tilt Cylinders") on page 6-4.
8. With the tilt cylinders disconnected from the mast, move the overhead crane forward slightly to provide a gap between the mast and the front mounting plate.

**WARNING**

The mast will fall forward if not being held up. Make sure mast is held up by a hoist and sling.

4. On the mast end of the cylinder, remove the bolt and the hardware from the tilt cylinder pin weldment and remove the pin from the tilt cylinder clevis.
5. Remove bolts (4) from tilt cylinder mounts and remove cylinder.

**WARNING**

The mast will fall forward if not being held up. Make sure mast is held up by a hoist and sling. Be careful if the top of the mast is lower than the bottom of the mast when laying flat. The carriage may slide and cause damage or injury. Always secure the carriage to the mast.

9. Lay down the mast horizontally on some planks of wood.

Removing the Mast From Truck

**WARNING**

Only trained and experienced technicians or your Landoll service representative must be allowed to service the mast assembly. Never place any part of one's body into the working area of the mast. Never work on the mast while it is loaded; remove the load first.

Observe all safety precautions while operating the overhead crane and lifting apparatus.

Steel toed shoes and eye protection are required when doing maintenance or repair work on a lift truck. Do not place feet or hands in any areas through the mast or in truck pinch points.

Servicing the tilt cylinders requires the use of an overhead hoist, hoist slings and wheel blocks. The overhead hoist and slings must have a rating of 8,000 lb. or greater. Do not work under or around a truck that is not properly secured. The battery must be disconnected and removed from the truck.

**WARNING**

The mast will fall forward if not being held up. Make sure mast is held up by a hoist and sling.

10. Dismantle, clean and inspect the mast assemblies and subassemblies.
11. Reassemble the mast in reverse order.

IMPORTANT

Before returning the mast into service, perform all adjustment procedures listed in Supplier Provided Documentation in Chapter 7.

1. Review "Before You Begin" on page 1-1.
2. Remove the forks.
3. Remove the four bolts and hardware holding the backrest to the mast. Carefully remove the backrest. The backrest is heavy; use an appropriate lifting device or a helper.
4. At the mast, disconnect the lift cylinder hose.
5. Oil will drain from these hoses. Plug, mark and cap all oil lines and cylinder ports.

Table provided for your general use with this manual

[illegible]

Chapter 7

Supplier Provided Documentation

Disclaimer:

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Lift Technologies Mast Service Manual

Models 30D/35D/40D/50D/55D/60D

Table of Contents - page 5

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SUPPLIER PROVIDED DOCUMENTATION

Service Manual

30D/35D/40D/50D/55D/60D Full Free Lift 3-Stage Mast - MT

Manual Part Number 687250 R3

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Section 1 Introduction

1.1 Introduction

This manual provides the installation instruction, periodic maintenance, troubleshooting and service procedures for the Lift Tek Series masts.

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. See Figure 1.



WARNING: Do not install a Lift Tek Mast on a truck with a capacity greater than the truck rated capacities shown below

TRUCK CAPACITY AT 24IN. (610 mm) LOAD CENTER

30D	35D	40D	50D	55D	60D
3000 lbs.	3500 lbs.	4000 lbs.	5000 lbs.	5500 lbs.	6000 lbs.
(1361 kg)	(1585 kg)	(1812 kg)	(2268 kg)	(2491kg)	(2718 kg)

Modifications and additions which affect capacity or safe operation shall not be performed without prior written approval from Lift Technologies per ANSI B56. 1.

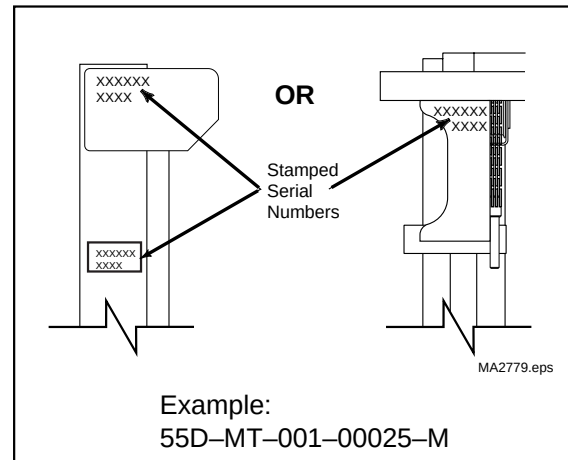


Figure 1. Serial Mast Number Location

1.2 Special Definitions



A statement preceded by **WARNING** is information that should be acted upon to prevent **bodily injury**. A **WARNING** is always inside a ruled box.

CAUTION

A statement preceded by **CAUTION** is information that should be acted upon to prevent **machine damage**.

IMPORTANT

A statement preceded by **IMPORTANT** that possesses special significance.

NOTE

A statement preceded by **NOTE** is information that is handy to know and may make your job easier.

Section

2 Installation Instructions

2.1

Truck System Requirements

To achieve maximum lifting capacity of the mast, the truck relief valve should be set to relieve at the pressure indicated in the chart below. This chart also indicates the hose fitting size to use between the truck control valve and masts valve.

Lift Tek Mast	Relief Pressure	Hose Size	Fitting* Size
30D/35D/40D	2000 psi	No. 8 min.	No. 8 min.
30D/35D/40D	2600 psi	No. 6 min.	No. 6 min.
50D/55D/60D	2600 psi	No. 8 min.	13/32 in. Orifice

* Valve inlet port is 3/4 in. SAE O-ring. See Figure 2.



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

IMPORTANT: Lift Tek Masts are compatible with SAE 10W petroleum base oil per Mil. Spec. MIL-O-5606 or MIL-O-2104 B only. Use of synthetic or aqueous base hydraulic oil is not recommended. If fire resistant hydraulic oil must be used, contact Lift Tek.

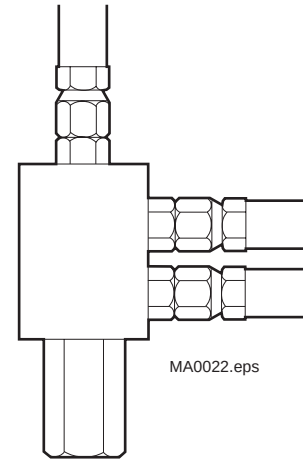


Figure 2. Valve inlet Port.

2.2

Mounting Bracket Installation

If it is necessary to install mounting brackets and cross-members to fit your lift truck, consult with the nearest Lift Tek Service Department listed on the back cover. You must supply dimensions **A** through **F** shown in Figure 3. Failure to install the correct brackets and cross-members can result in mast structural failure, bodily injury and loss of warranty.



WARNING: Failure to install the correct brackets and crossmembers can result in mast structural failure, bodily injury and loss of warranty.

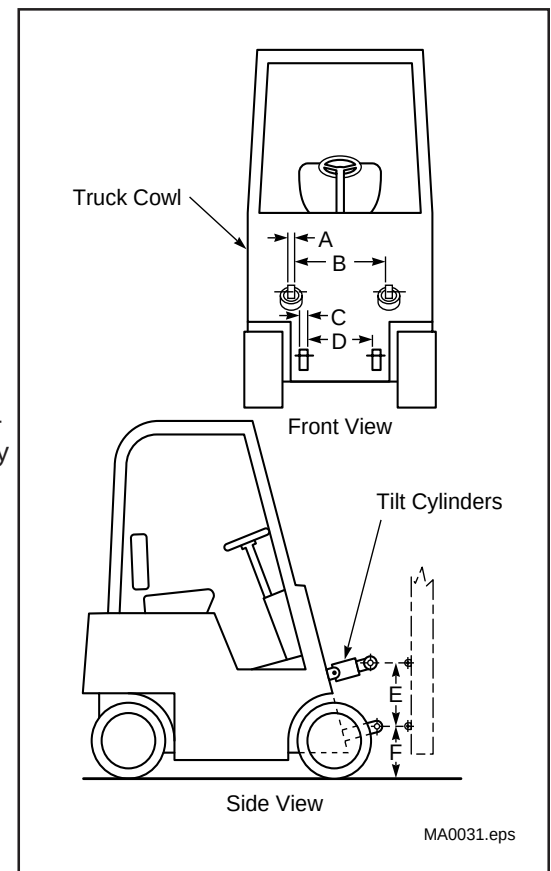


Figure 3. Determining Mounting Bracket Location.

2 Installation Instructions

2.3

Mast Installation

1. **Raise** and block the front end of the truck 1ft. (30 cm) per ANSI B56.1 or drive the truck over a service pit.
2. Install the bearings to lower the axle mounts.
3. Lubricate the bearing surfaces of the lower axle and tilt cylinder mounting brackets with chassis grease.
4. Lift the mast using an overhead hoist with chain hooks attached to the cheekplate lifting holes. Position the mast by lowering the axle mounts on the truck axle. Install the mount caps and capscrews. Tighten the capscrews to the truck manufacturer's torque specifications.

IMPORTANT: Prior to connecting the tilt cylinders to the mast, make sure the cylinders "bottom" evenly. Adjust the tilt cylinders to prevent the mast from "racking" during tilting. Refer to your truck service manual for procedures.

5. Connect the lift truck hose to the mast valve.
6. Connect the tilt cylinders to the mast anchor brackets. Tighten the pin capscrews to the truck manufacturer's torque specifications.

NOTE: 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 hose.

Contact Lift Tek if additional fittings are required. See back cover.

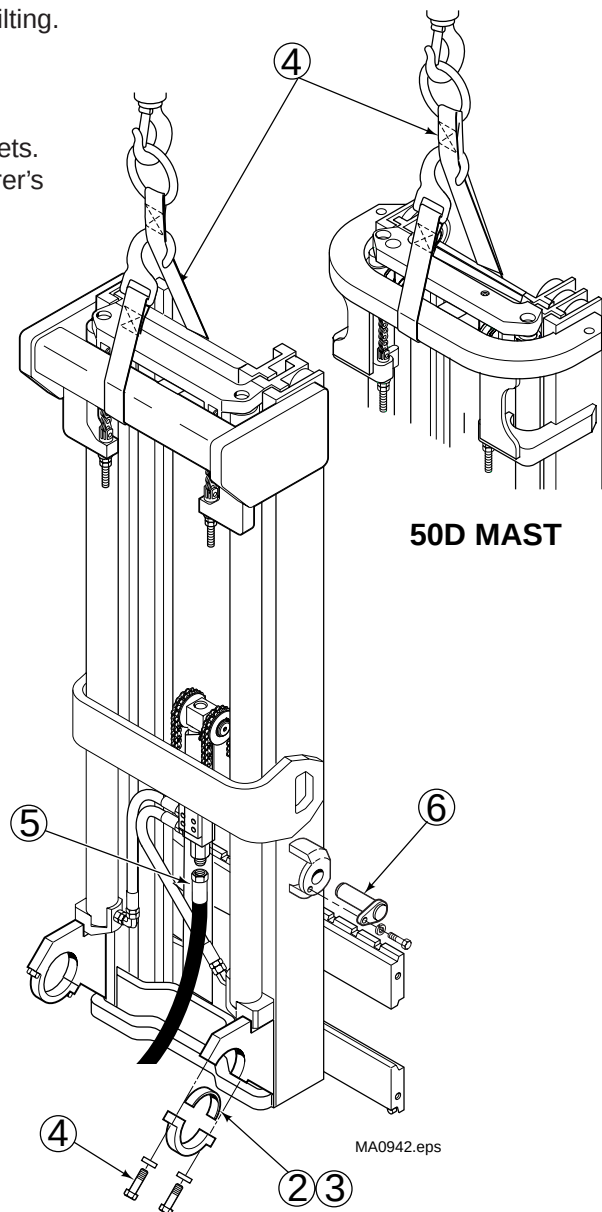


Figure 4. Mast Installation.

2 Installation Instructions

2.4 Inspection and Adjustments

2.4-1 Chain Inspection and Tension

The hoist Chains have 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 for internal mast installation.**

The chains must be adjusted with equal tension to ensure proper load distribution and mast operation. To determine equal tension, extend the unload 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 they do not have equal tension, perform the hoist chain adjustments described in Section 5.6-3 and 5.6-4.

2.4-2 Main Lift Chain Adjustment

SEE SECTION 5.6-4.

2.4-3 Free Lift Chain adjustment

SEE SECTION 5.6-6.

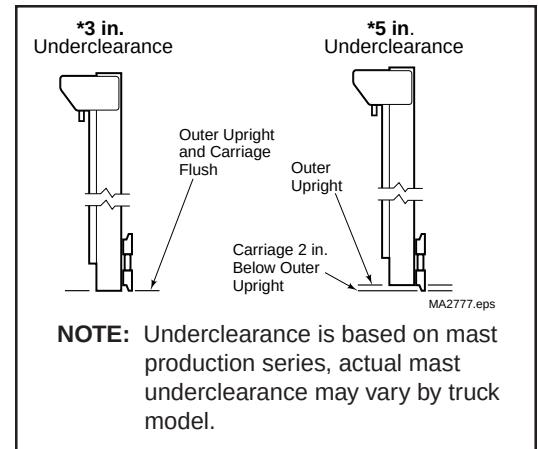


Figure 5. Upright and Carriage Position.

2 Installation Instructions

2.4-4 Free lift Cylinder Supply 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 end connection at the valve and twist the hose. Tighten the hose end while holding the hose in place. See Figure 10. 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.

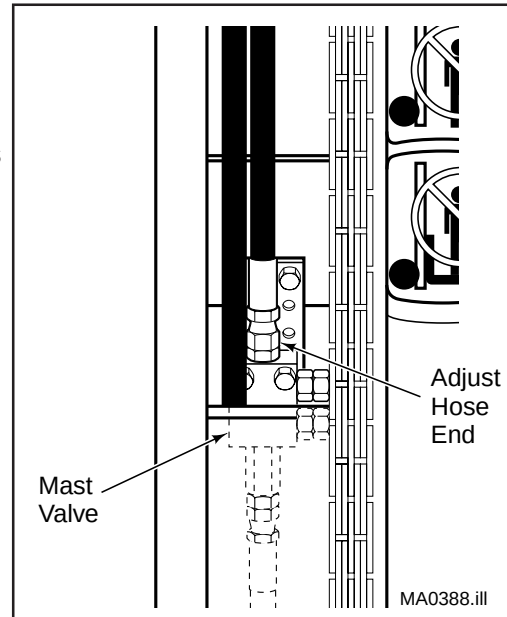


Figure 6. Free Lift Cylinder Supply Hose Adjustment.

2.4-5 Upright Rail Lubrication

Lubricate the full length of each upright rail with chassis lube or Kendall SR-12X as shown in Figure 6.

2.4-6 Cylinder Bleeding

SEE SECTION 5.2-11.

2.4-7 Mast Skewing

Check for mast skewing as described in Section 5.5-6.

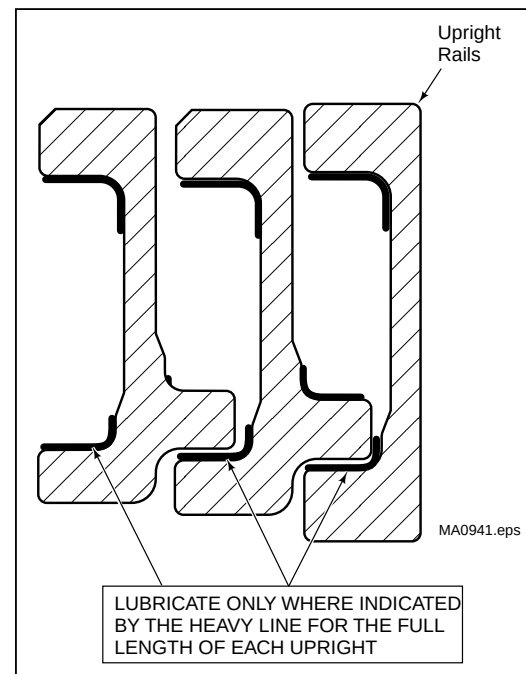


Figure 7. Channel lubrication.

2 Installation Instructions

Internal Reeving - Hi-Vis Installation 30D/35D/40D and 50D

1. Install the shafts, sheaves and hose guards to the crosshead center plate. Leave the capscrew and nut finger tight to allow hose installation.

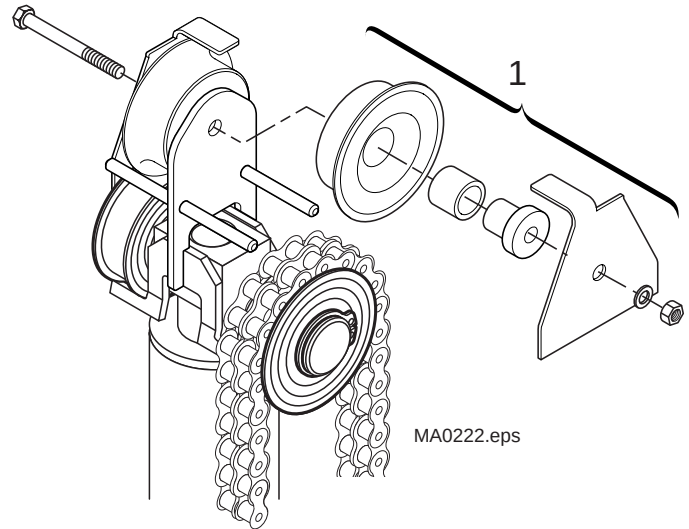


Figure 8 . Crosshead Assembly.

2. Install the carriage bracket to the tabs between the carriage sideplates. Leave the capscrews finger tight.

3. Install fittings to bracket.

- * Single Function - Install the fittings to the left or right side location. Tighten the fittings finger tight.
- * Double Function - Install the fittings to the left and right side location. Tighten the fittings finger tight.

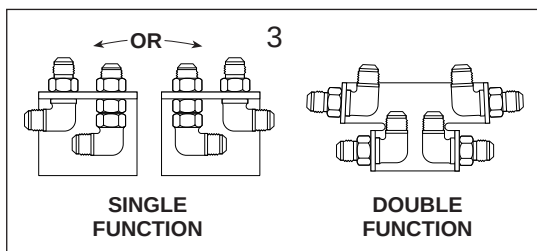


Figure 8. Carriage Bracket Assembly.

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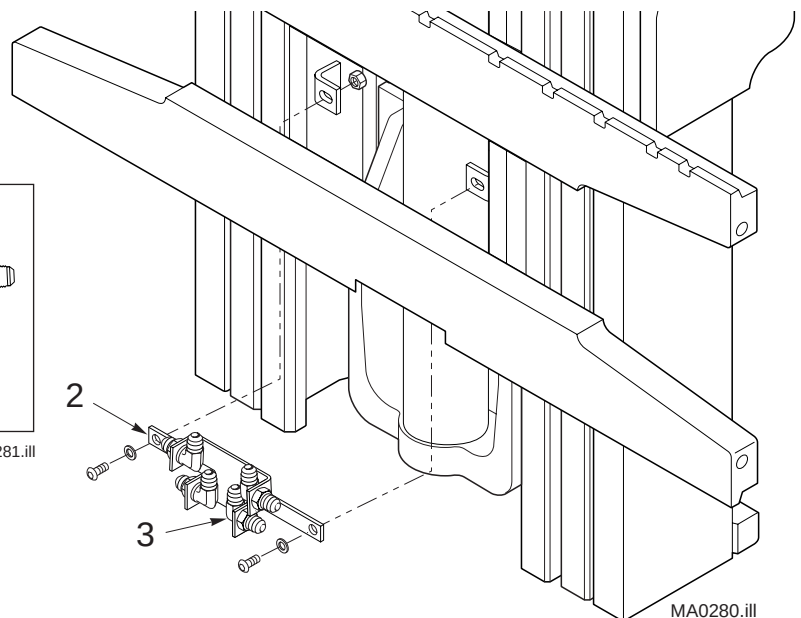


Figure 9. Carriage bracket Installation.

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2 Installation Instructions

Internal Reeving - Hi-Vis

Installation 30D/35D/40D and 50D

4. Install the brackets, hose clamps and sheaves to the uprights. Tighten the bracket capscrews to a torque of 38 ft.- lbs. (51 Nm).
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 coverplate 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. 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.-lbs (11Nm).

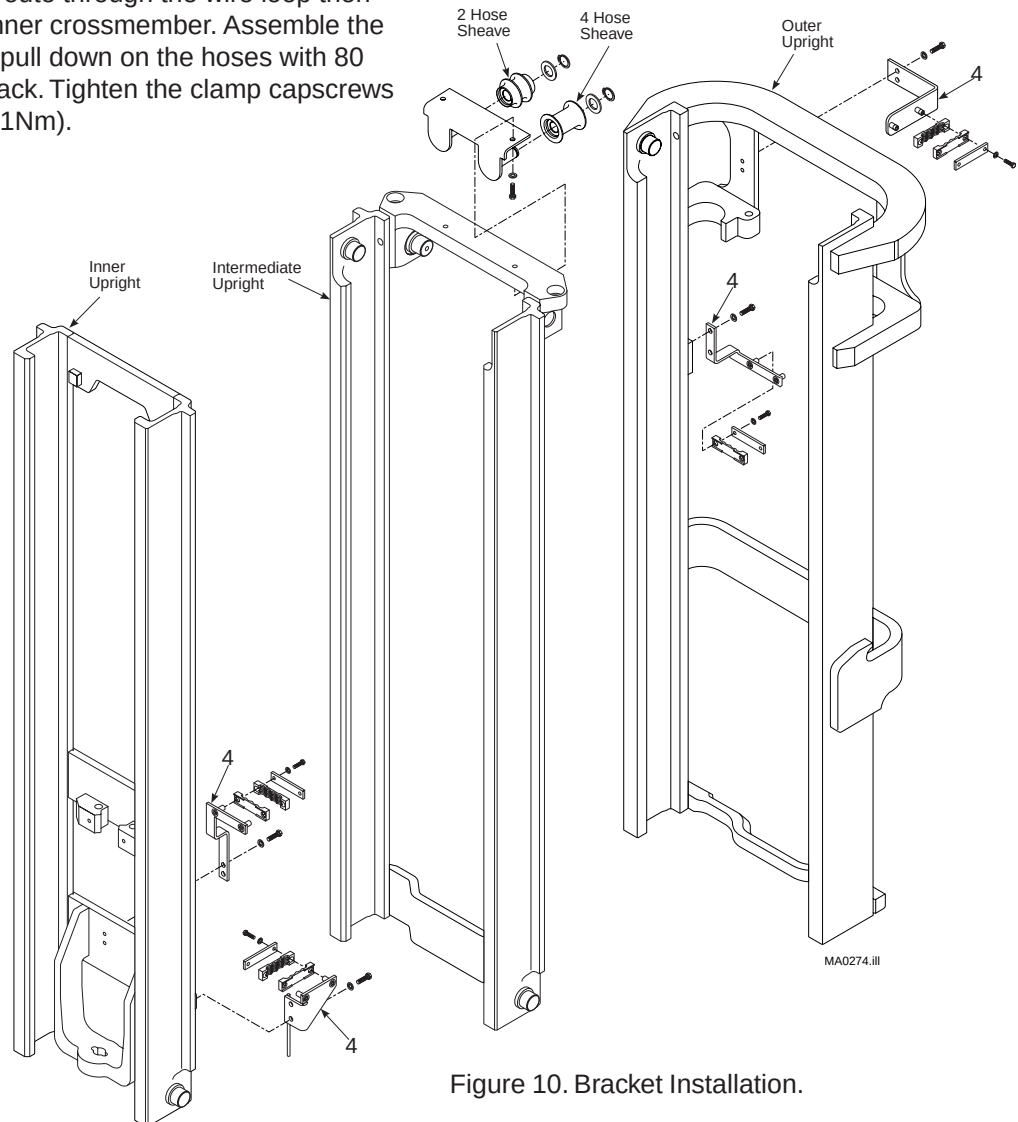


Figure 10. Bracket Installation.

2 Installation Instructions

Internal Reeving - Hi-Vis Installation 30D/35D/40D and 50D

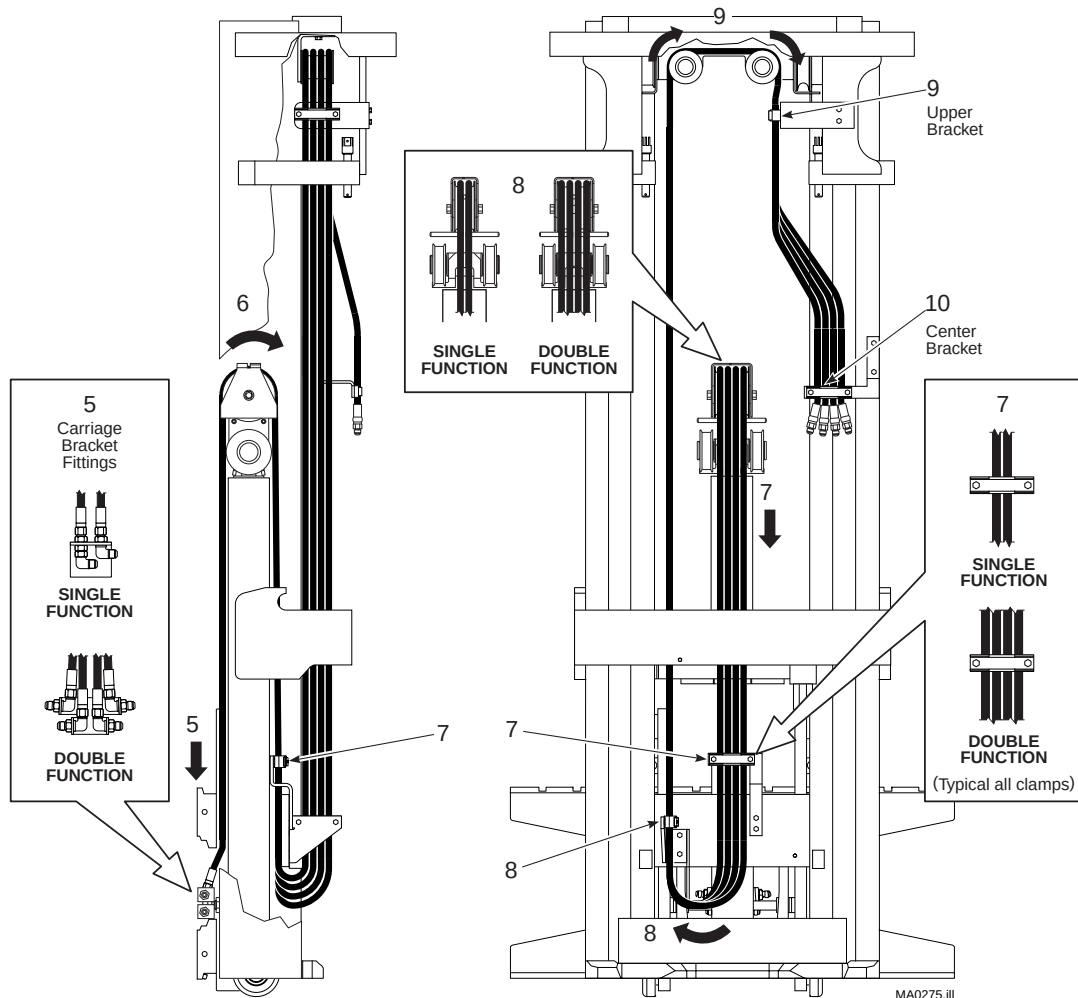


Figure 11. Hose Routing.

8. 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.-lbs. (11Nm).
9. Route the hoses up to and over the upper hose sheaves and then down to the upper hose bracket. 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.-lbs. (11Nm).
10. 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.-lbs. (11Nm.)
11. 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.-lbs. (11Nm.)

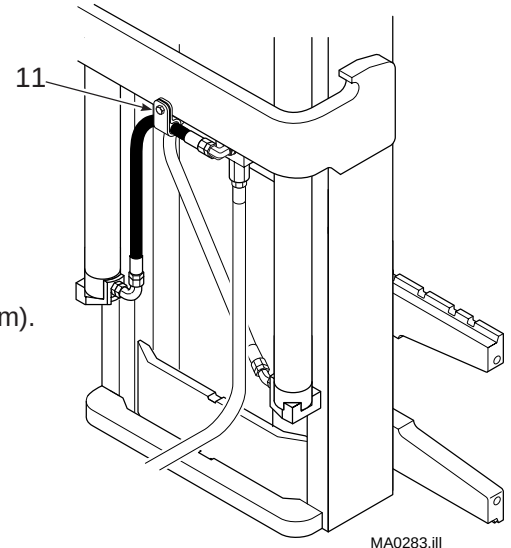


Figure 12. Main Lift Hose.

2 Installation Instructions

Internal Reeving - Hi-Vis

Installation 30D/35D/40D and 50D

12. Tighten the crosshead coverplate capscrew to a torque of 51 ft.-lbs. (70Nm.).
13. Tighten the carriage bracket capscrews to a torque of 46 ft.-lbs. (63 Nm.)
14. Raise and lower the mast slowly through several cycles checking for proper hose alignment, clearances and hose tracking.

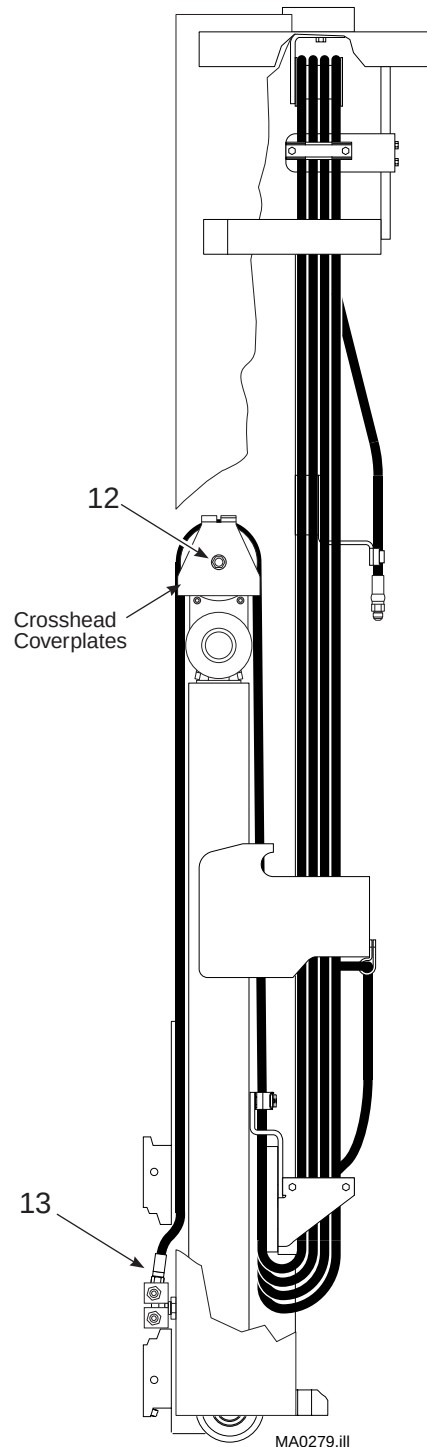


Figure 13. Crosshead Assembly.

2 Installation Instructions

Internal Reeving - Std-Vis Installation 55D/60D

1. Install the reeving brackets to the crosshead. Tighten the capscrews to a torques of 12 ft.-lbs. (17Nm.).
2. Install the rollers and hose guards to the crosshead reeving bracket. Leave the nut finger tight to allow hose installation.

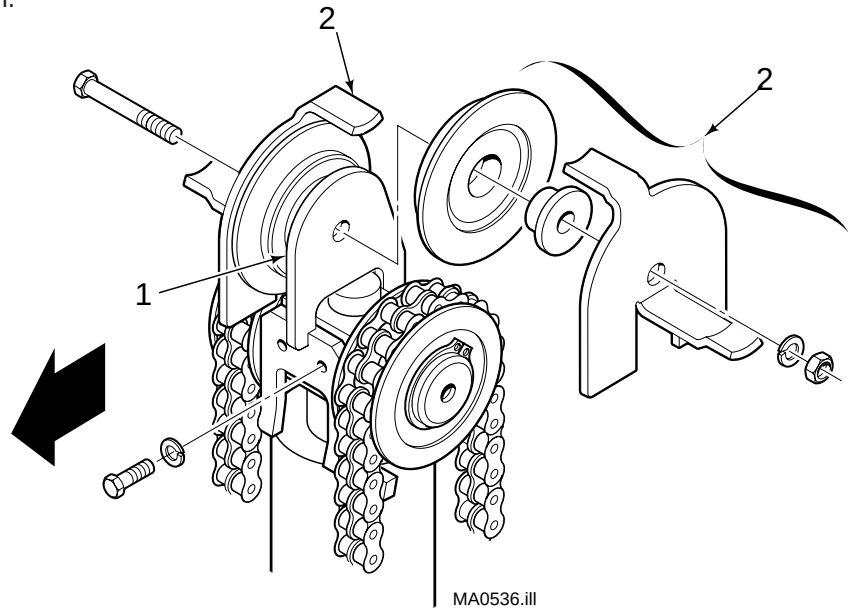


Figure 14. Center Crosshead Sheaves.

3. **Double Function Internal Reeving** - Install the sheaves to the crosshead chain shafts. Leave the capscrews finger tight to allow for hose installation.

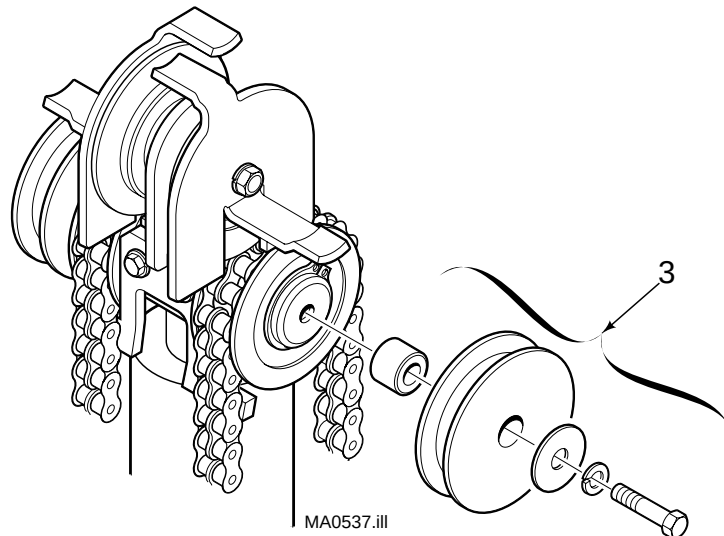


Figure 15. Outer Crosshead Sheaves.

Section

2 Installation Instructions

Internal Reeving - Std-Vis

Installation 55D/60D Single Function

1. Install the carriage bracket to the tabs on the carriage side plates. Tighten the nuts to a torque of 38 ft.-lbs. (51Nm.)
2. Install the bulkhead and 90° fitting to the middle two holes in the carriage bracket.
3. Install the hoses to the carriage bracket fittings. Leave the fittings loose.
4. Route the hoses up and over the rollers on the center of the crosshead. Tighten the hose guard capscrew to a torque of 38 ft.-lbs. (51Nm.).



WARNING: Chain and block the uprights and carriage to secure for step 5.

5. Install spacers to the inner crossmember backside tabs.
6. Raise the carriage approximately 8 ft. (240cm). route the hoses downward on the front side of all the crossmembers, then under the tab on the front side of the cylinder support. Feed the hoses backward under the crossmember, around the casting guide upward under the back side.
7. Pull the hose ends to remove hose slack.
8. Remove the existing capscrews from the main lift chain shafts. Install the hose, sheaves, shafts and spacers to the main lift chain shafts. Tighten the capscrews to a torque of 58 ft.-lbs. (79Nm.). Make sure the sheaves rotate freely.
9. Attach the hoses to the brackets and fittings. Leave the fittings loose on the bracket.

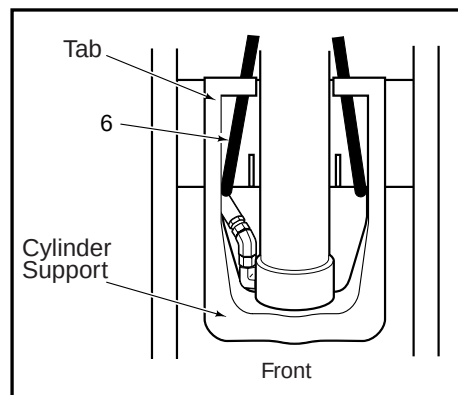
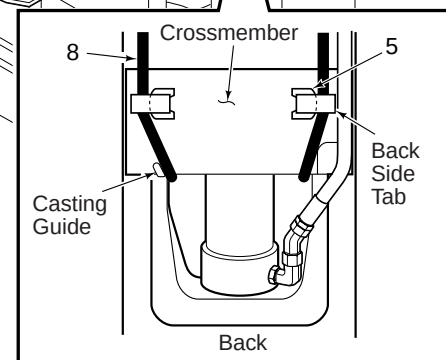
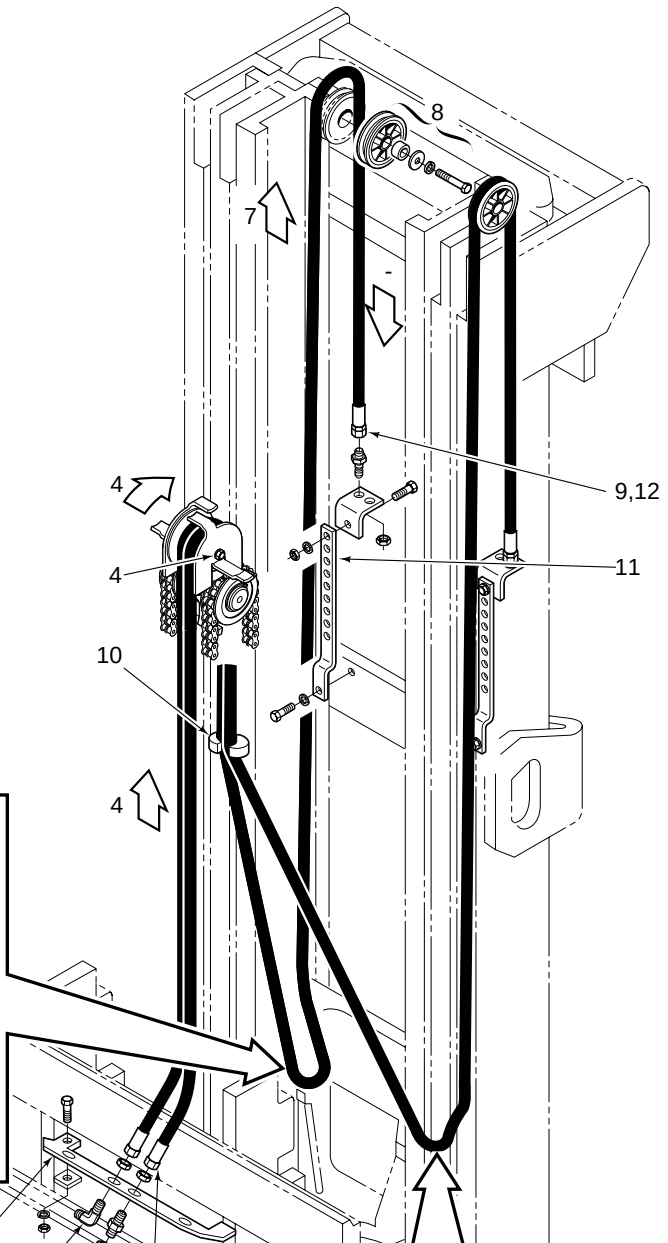


Figure 16. Hose Routing.

10. Install the hose clamps to the hoses half way between the crosshead and lower crossmember.
11. Pull down on the hoses to remove slack and stretch hoses one inch. Install the brackets on the front side of the crossmember using the next hole down. Tighten the capscrew to a torque of 38 ft.-lbs. (51 Nm.).
12. Raise and lower the mast several times to make sure the hoses are tracking correctly. Use the white line on the hose to detect twisting. Adjust the hose ends if required. Tighten fittings making sure they do not twist.



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2 Installation Instructions

Internal Reeving - Std-Vis

Installation 55D/60D Double Function

1. Install the carriage bracket to the tabs on the carriage side plates. Tighten the nuts to a torque of 38 ft.-lbs. (51Nm.).
2. Install the bulkhead and 90° fitting to the holes in the carriage bracket.
3. Install the hoses to the carriage bracket fittings. Leave the fittings loose.
4. Route the hoses up and over the rollers on the cross-head. Tighten the sheave capscrews to a torque of 38 ft.-lbs. (51Nm.).

WARNING: Chain and block the uprights and carriage to secure for step 5.

5. Raise the carriage approximately 8 ft. (240 cm). Route the hoses downward on the front side of all crossmembers, then under the tab on the front side of the cylinder support. Feed the hoses backward under the crossmember, around the casting guide upward under the back side tabs.
6. Pull the hose ends to remove slack.
7. Remove the existing capscrew from the main lift chain shafts. Install the hoses, sheaves, shaft and spacers to the main lift chain shafts. Tighten the capscrew to a torque of 58 ft.-lbs. (79Nm.). Make sure the sheaves rotate freely.
8. Attach the hoses to the brackets and fittings. Leave the fittings loose on the bracket

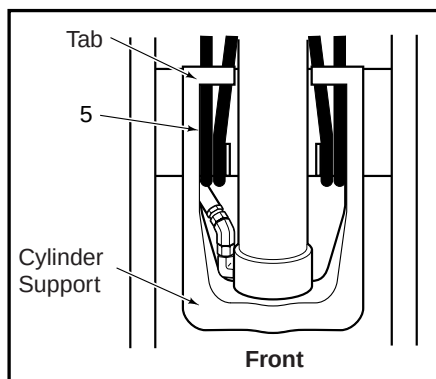
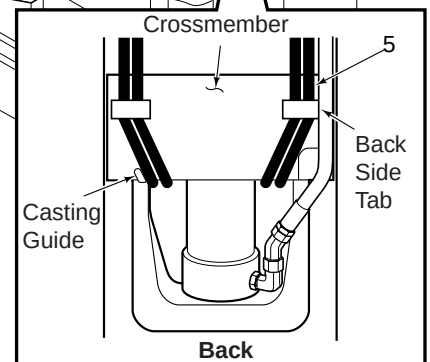
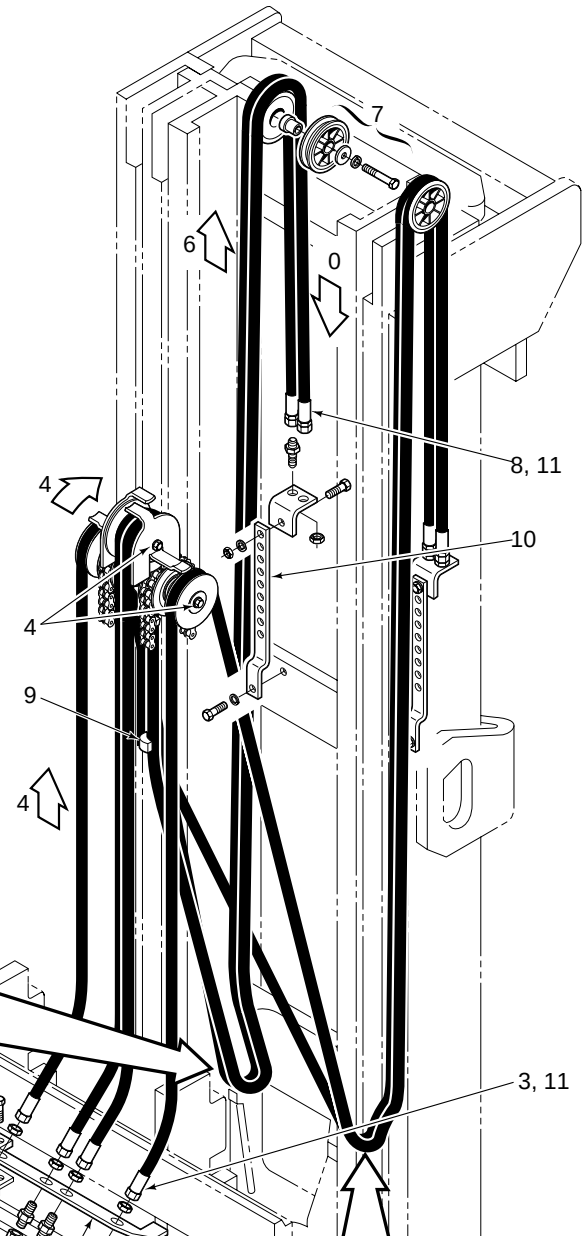


Figure 17. Hose Routing.

9. Install the hose clamp to the two center hoses half way between the crosshead and lower crossmember.
10. Pull down on the hoses to remove slack and stretch the hoses one inch. Install the brackets on the front side of the crossmember using the next hole down. Tighten the capscrew to a torque of 38 ft.-lbs. (51Nm.).
11. Raise and lower the mast several times to make sure the hoses are tracking correctly. Use the white line on the hose to detect twisting. Adjust the hose ends if required. Tighten the fittings making sure they do not twist.



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3 Periodic Maintenance

3.1 Periodic Maintenance

For proper operation and an extended service life, your Lift Tek Mast should be inspected and serviced regularly as part of your normal lift truck maintenance schedule according to the following outlines and ANSI B56.1 procedures.

The recommended intervals are for masts operating under normal conditions. If the mast is operating in severe conditions or corrosive atmospheres, the inspections should be performed more frequently.



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 control handles per ANSI B56.1

3.1-1 Daily Inspection

Perform the following at the beginning of each work shift:

1. Extend the carriage a few inches off the ground and make sure the chains are under equal tension. Refer to Section 5.6-3 and 5.6-6 for chain adjustment.
2. Extend the mast to its fullest height to make sure the mast rails and carriage extend freely without binding.
3. While the mast is extended, inspect the upright rails for proper lubrication. Refer to Section 2.4-5 Step for rail lubrication.
4. Make sure the internal reeving hoses (if equipped) travel evenly in the hose guides. Adjust the hose ends if required. Tighten the fittings making sure they do not twist.

100 Hour Inspection

After each 100 hours of lift truck operation, and in addition to the daily inspection:

1. Inspect and lubricate the full length of the chains with SAE 40 wt. oil or Bowman Heavy Load Red Grease.

CAUTION: The chains must be coated with a film of lubricant at all times.

500 Hour Inspection

After each 500 hours of lift truck operation, and in addition to the Daily and 100 Hour Inspection:

1. Each pair of load rollers on the uprights and carriage should be shimmed so that a total side to side clearance no greater than 1/16 in. (1.5 mm) occurs at the tightest point throughout the travel of the member. Pry between the upright and load roller so that the opposite load roller is tight against the upright. Measure the clearance for the pair of rollers at XXX shown. See Figure 18.

2. Check the chains for wear and stretch. Refer to Section 5.6-1 for complete chain inspection.

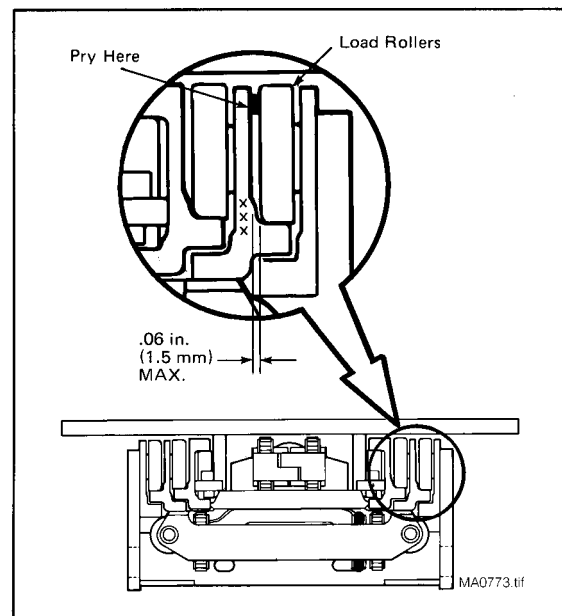


Figure 18. Load Roller Clearances.

Section

4 Troubleshooting

The following table lists problems that may be encountered on your Lift Tek Mast, the probable causes and recommended corrective action that should be taken to restore the mast to normal operating condition.

PROBLEM	PROBABLE CAUSE	SOLUTION
Cylinders don't lift load or won't move		
Empty	a) Plugged inlet hose b) Insufficient oil.	a) Unplug hose or replace. 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.
	c) Bent or jammed plunger.	c) Repair or replace as necessary.
	⚠ WARNING: Extreme care should be used when working on a unit when the carriage (with or without a load) is in the raised position.	
Loaded	a) Plugged piston check valve. b) Truck relief valve setting low. c) Over capacity. d) Mechanical bind due to bent plunger or bad rollers.	a) Unplug check valve or replace. b) Raise truck relief setting to specified level. c) Reduce load to specified capacity. d) Remove mechanical bind by replacing/freeing plunger and rollers.
	⚠ WARNING: Extreme care should be used when working on a unit when the carriage (with or without a load) is in the raised position.	
Cylinders drift-	a) External leak in pressure line. b) Truck valve defective-cycle to full lift height to verify. c) External leaks at retainer. d) Piston check valve leaking.	a) Tighten or replace as necessary. b) Repair or replace truck valve. c) Replace all cylinder seals. d) Replace check valve.
Spongy or jerky action-	a) Sticky or defective truck relief valve.	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.
	⚠ WARNING: Extreme care should be used when working on a unit when the carriage (with or without a load) is in the raised position.	
	b) Bent or damaged cylinder plunger.	b) Disassemble, check and repair cylinder assembly.
	⚠ WARNING: Extreme care should be used when working on a unit when the carriage (with or without a load) is in the raised position.	
	c) Load rollers not properly adjusted or defective.	c) Adjust or repair as necessary.
	⚠ WARNING: Extreme care should be used when working on a unit when the carriage (with or without a load) is in the raised position.	
	d) Mast channels improperly lubricated.	d) Lubricate mast.
	⚠ WARNING: Extreme care should be used when working on a unit when the carriage (with or without a load) is in the raised position.	
	e) Low Battery charge.	e) Charge battery.
	f) Low pump volume.	f) Install accumulator.
	g) Low oil level.	g) Fill oil reservoir.
	h) Insufficient hydraulic tank capacity or baffles.	h) Install larger tank baffles
Other.	Contact Lift Technologies	

Section 5 Service

5.1 Mast Removal

1. Raise and block the front end of the truck 1ft. (30cm) or drive the truck over a service pit.

2. Disconnect the lift truck supply hose from the mast valve. Plug the hose end and cap the valve fitting.



WARNING: Do not stand on or near the mast while suspended by the hoist.

3. Attach overhead hoist with lifting strap routed under all upper crossmembers. Take up slack in the strap.

4. Disconnect the tilt cylinders from the mast anchor brackets. For reassembly, tighten the pin capscrews to the truck manufacturer's torque specifications.

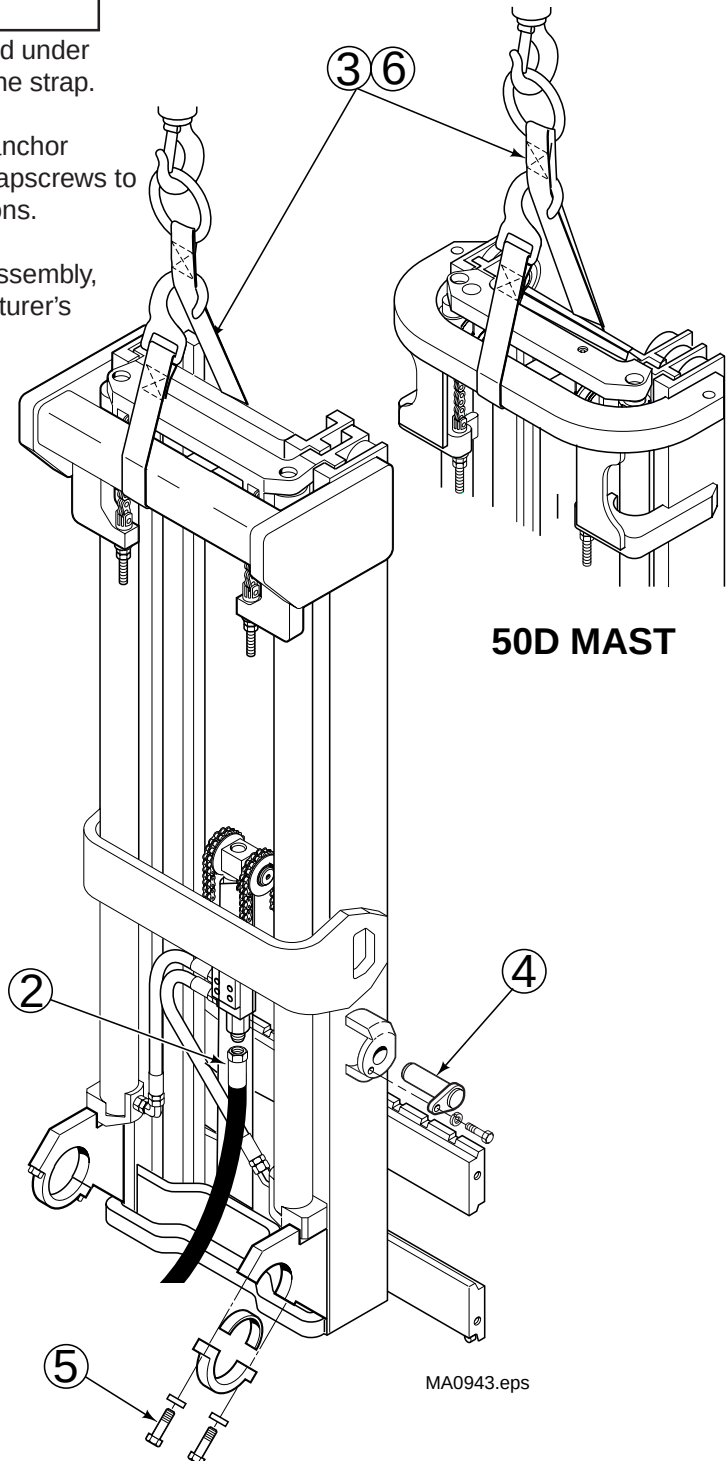
5. Disconnect the mast lower mounts. For reassembly, tighten the capscrews to the truck manufacturer's torque specifications.

6. Lift away the mast.

7. For mast installation, refer to Section 2.1.



WARNING: Do not stand the mast upright unless it is chained to a support.



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Figure 19. Mast Removal

Section 5 Service

5.2

Cylinders

5.2-1

2000 PSI Main Lift Cylinder Description

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 truck hoist control valve holds the cylinder in place once 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 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.

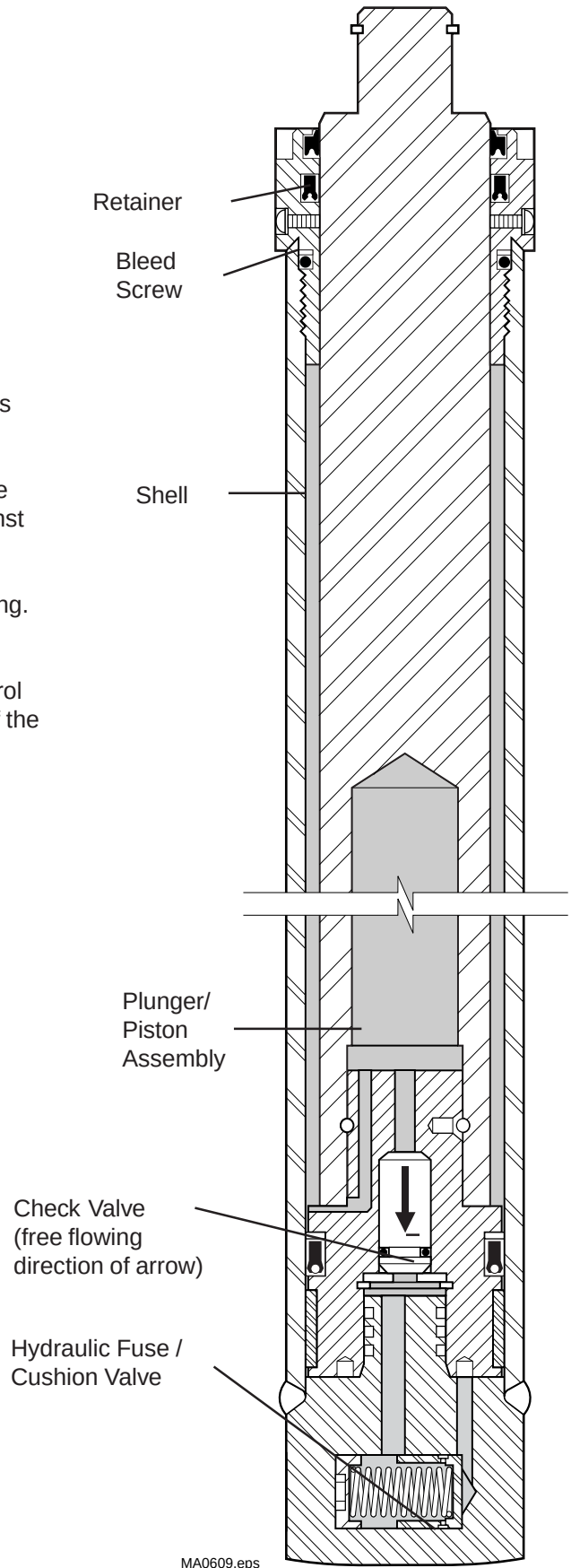


Figure 20. 2000 PSI Cylinder
687250 R3

2600 PSI Main Lift Cylinder Description

The main lift cylinders are a single stage displacement type cylinders. They consist of a shell and a telescoping plunger/piston assembly. During extension the oil pressure is acting against the plunger outer diameter due to the internal porting through the piston. The piston seals do not affect cylinder extension. The truck hoist control valve holds the cylinders in place once 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 that engages the cushion valve when the cylinder is fully lowered.

A hydraulic fuse/cushion 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.

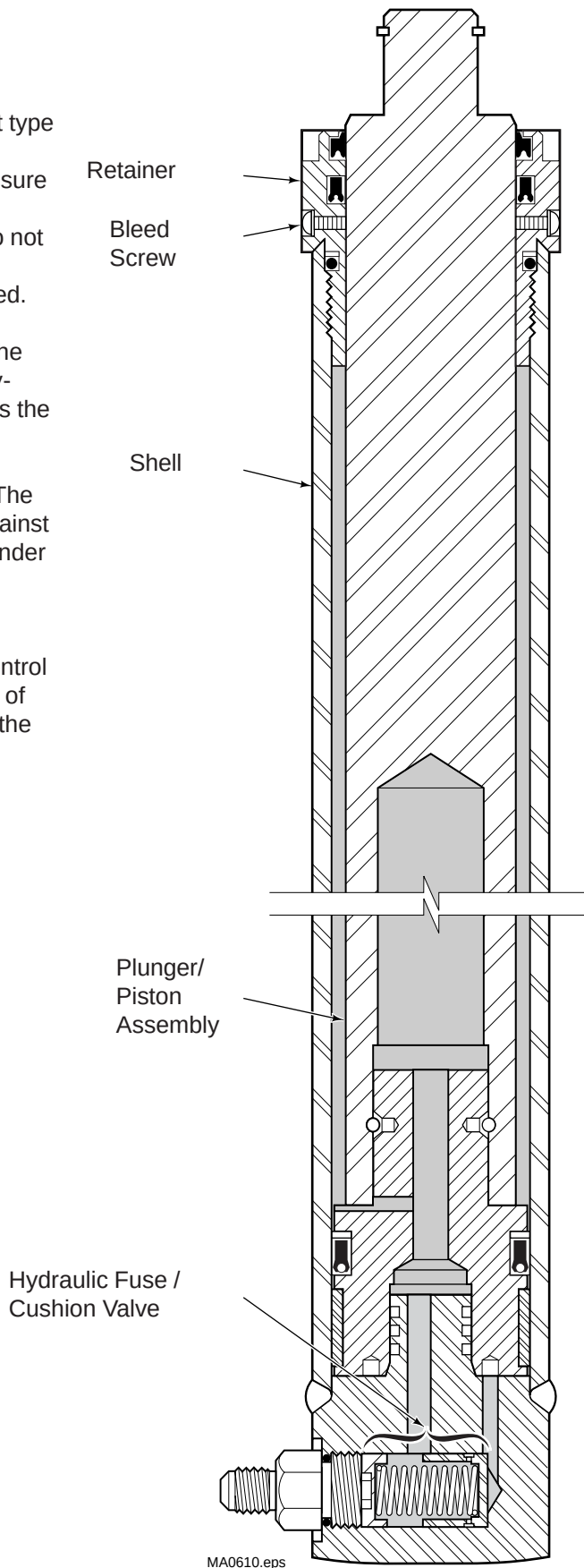


Figure 21. 2600 PSI Cylinder

Section 5 Service

5.2-3 Free Lift Cylinder Description

The 2000 and 2600 psi 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 truck hoist control valve holds the cylinder in place once extension has stopped.

The shell is internally threaded at the top end to hold the retainer. The retainer seal 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 on 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 cylinder, the fuse limits the lowering speed of the cylinder.

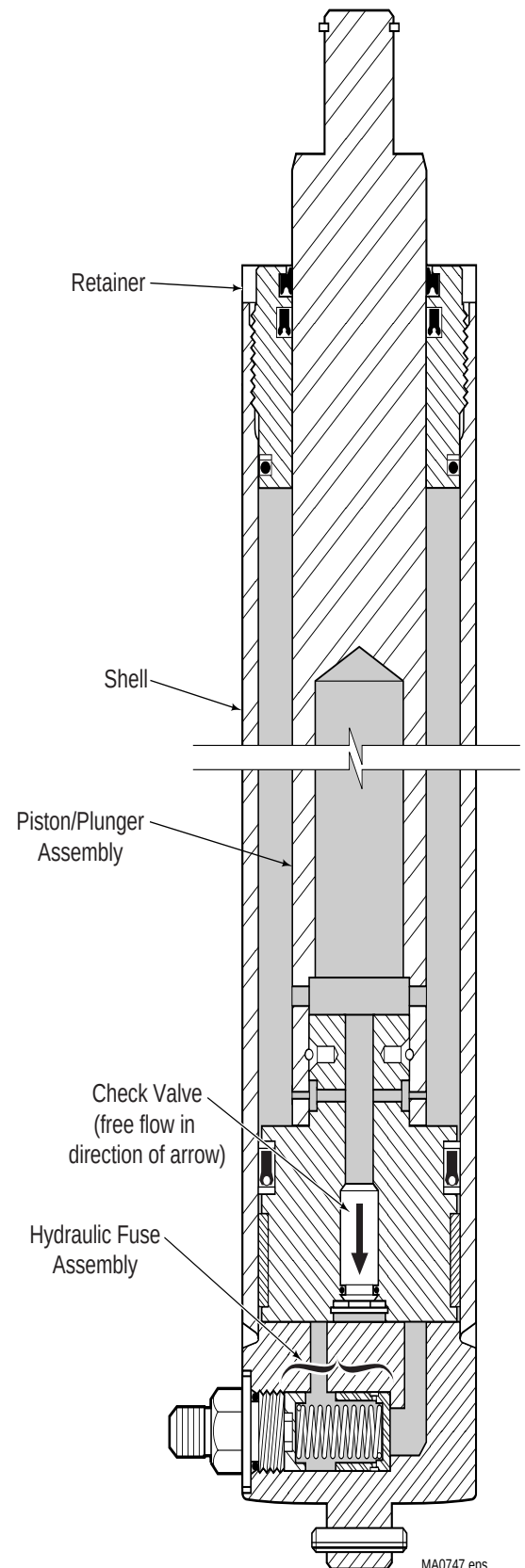


Figure 22. Free Lift Cylinder

Section 5 Service

5.2-4 Cylinder Operation

Cylinders Raising

1. When the truck hoist control valve is actuated, oil enters the lowering control valve through the inlet port and flows unrestricted through the lowering control cartridge.
2. 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. 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 raises to the end of its stroke.
4. **2000 PSI Piston Type Main Lift-Cylinders-** 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.
- 2600 PSI Displacement Type Main Lift Cylinders-** Oil flows through the hydraulic fuse/cushion valve to the piston. The piston is internally ported to allow oil flow to the area between the plunger and shell. Lifting force is created that acts on the diameter of the plunger causing the plunger to raise.
5. When oil flow from the truck hoist control valve is discontinued, the cylinders are held in position by the closed center spool of the truck valve.

Cylinders Lowering

1. When the truck hoist control valve is actuated, the main lift then free lift cylinder plungers lower, forcing oil out through the hydraulic fuse/cushion valves.
NOTE: The restriction setting of each hydraulic fuse is lower (allows more oil flow) than the setting of the lowering control valve. The hydraulic fuses restrict flow only in the instance of a lowering control valve or hose failure.
2. 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 spear 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 the free lift cylinder lowering.

Section 5 Service

Triple Mast (MT) Hydraulic Schematic

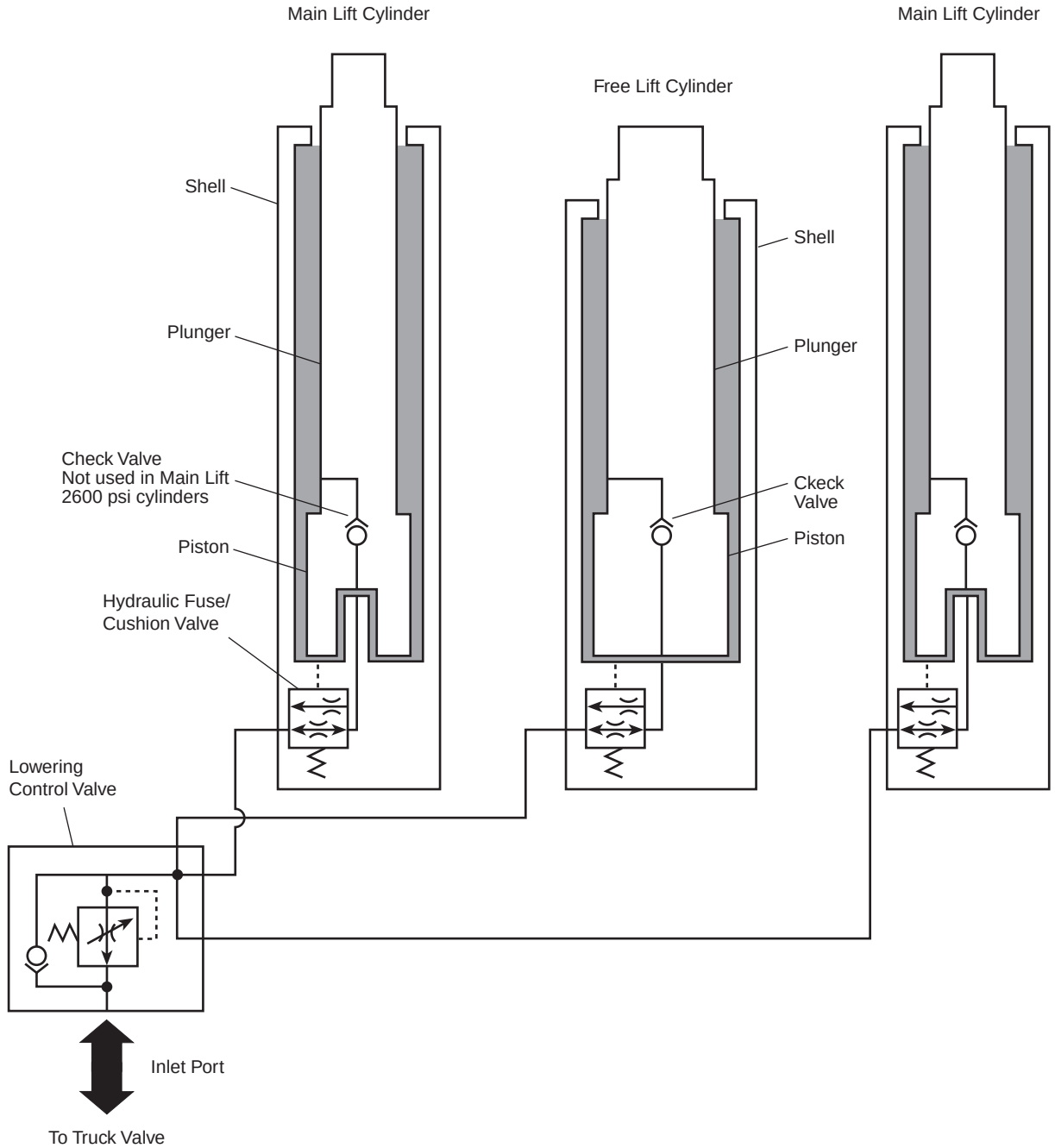


Figure 23. Cylinder Operation

Section 5 Service

5.2-5 Main Lift Cylinder Removal- Mast on Floor

1. **Remove** the mast from the truck as described in Section 5.1
2. Lay the mast down on wooden blocks as shown. Block under the outer upright so the inner upright will be free to move. The carriage must be positioned between the blocks and free to move.
3. Disconnect the cylinder supply hoses from the cylinder inlet ports. Remove the special long fittings from the cylinder ports and install plug fittings. **NOTE:** Each fitting holds a compressed spring in place.
4. Remove the snap rings fastening the cylinder rods to the intermediate upright.
5. Pull the inner and intermediate upright outward 2 ft. (60 cm).
6. Lift the cylinder 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.
8. For reassembly, reverse the above procedures except as follows:



WARNING: Main lift cylinders must be bled to remove trapped air prior to returning the mast to operation. Refer to Section 5.2-11.

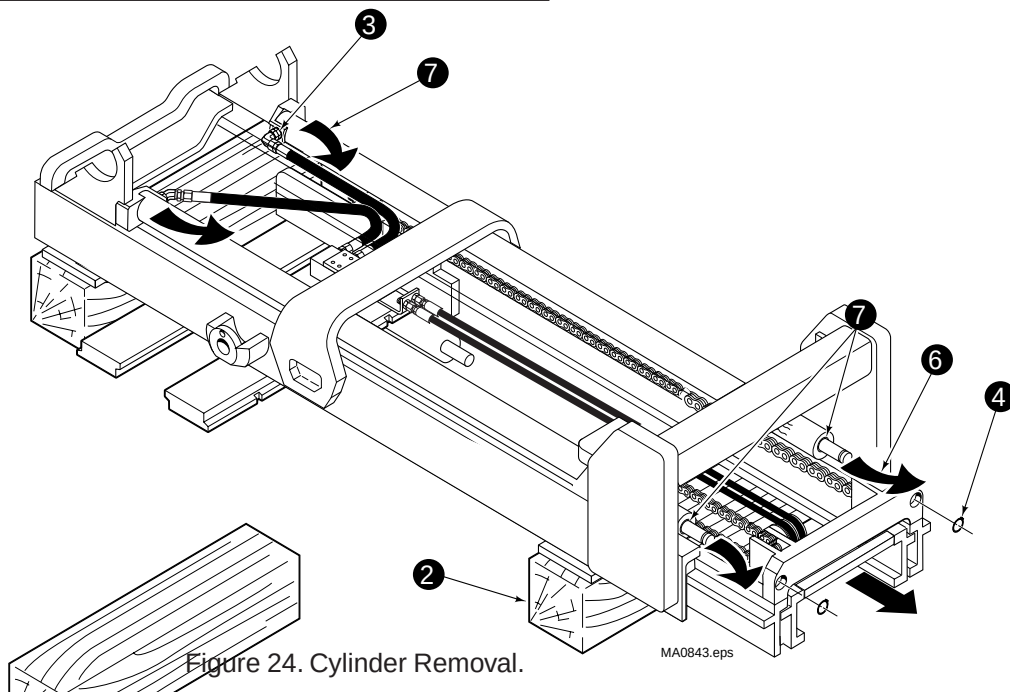


Figure 24. Cylinder Removal.

Section 5 Service

5.2-6

Free Lift Cylinder Removal-Mast on Floor

1. Remove the mast from the truck as described in Section 5.1.
2. Lay the mast down as shown.
3. Roll the carriage toward the center of the cylinder to slacken the chains and internal reeving hoses (if equipped).
4. Disconnect the hose from the cylinder 45° fitting. Cap the fitting and plug the hose.
5. Remove the chain guards from the crosshead. For reassembly, tighten the capscrews to a torque of 48-52 ft.-lbs. (65-70 Nm).
6. Remove the snap ring fastening the crosshead to the cylinder rod.
7. Pull the crosshead with chains and hoses (if equipped) off the cylinder rod.
8. Remove the cylinder strap.
9. Remove the cylinder from the mast.
10. For reassembly, reverse the above procedures.

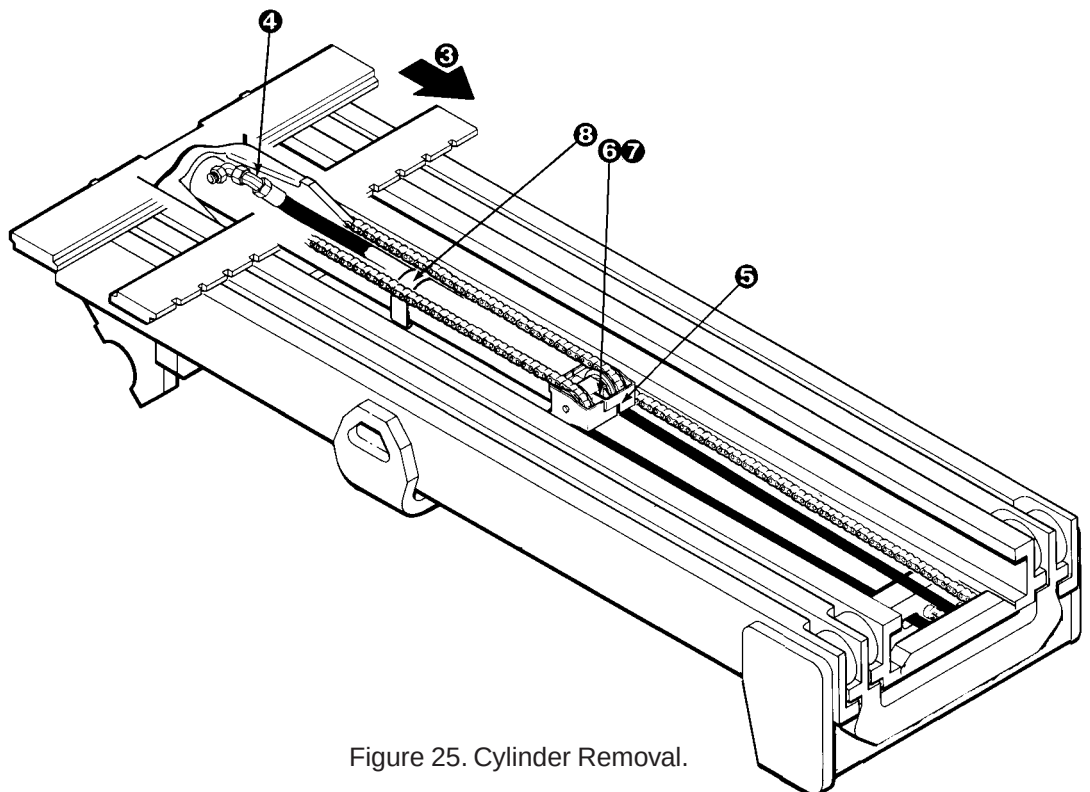


Figure 25. Cylinder Removal.

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Section 5 Service

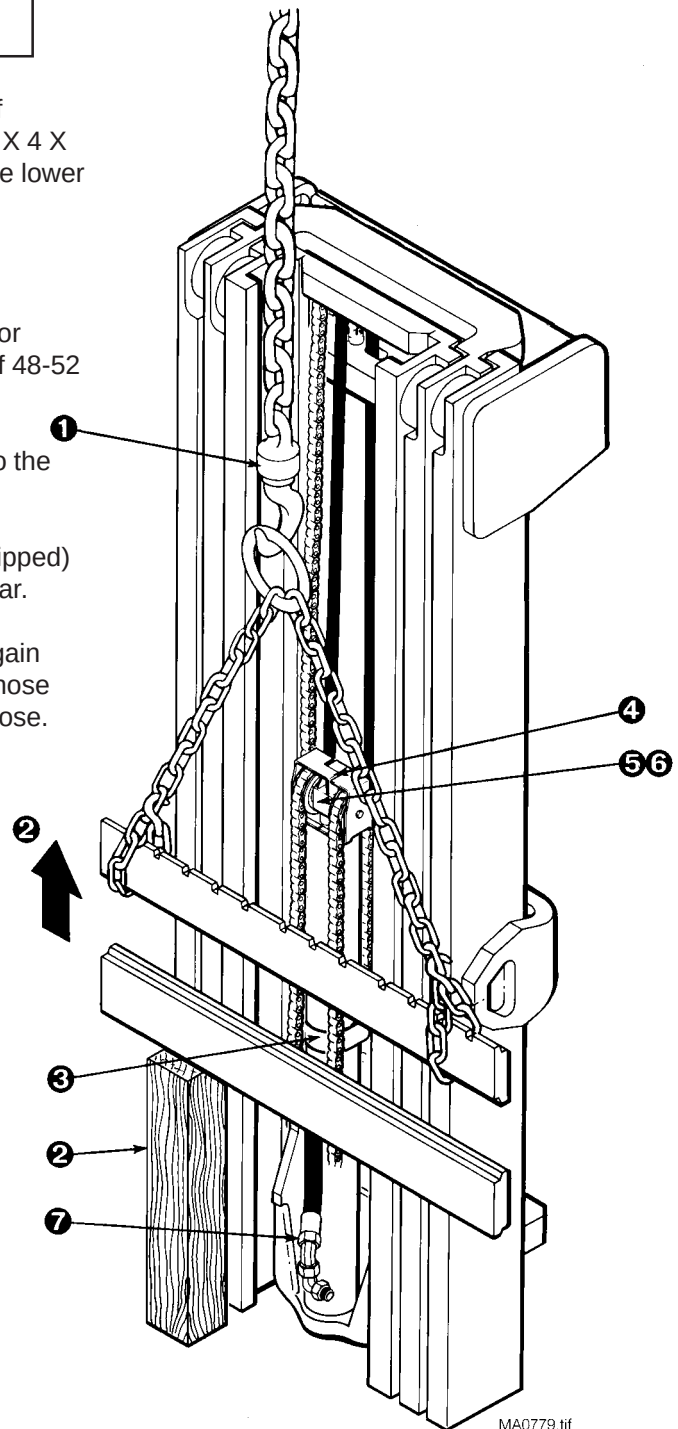
5.2-7 Free Lift Cylinder Removal-Mast on Truck

1. Completely lower the carriage. Remove forks or attachment if equipped. Make sure the free lift cylinder is completely retracted. Attach an overhead hoist to the top carriage bar.



WARNING: The carriage must be supported by a block while removing the cylinder to avoid possible injury.

2. Raise the carriage to the center of the cylinder to slacken the chains and internal reeving hoses (if equipped). Block the carriage in place using a 4 X 4 X 24 in. (10 X 10 X 60 cm) wood block between the lower carriage bar and the floor.
3. Remove the cylinder strap.
4. Remove the chain guards from the crosshead. For reassembly, tighten the capscrews to a torque of 48-52 ft.-lbs. (65-70 Nm).
5. Remove the snap ring fastening the crosshead to the cylinder rod.
6. Pull the crosshead with chains and hoses (if equipped) off the cylinder rod and lay over upper carriage bar.
7. Pry the cylinder up out of the support casting to gain access to the cylinder hose fitting. Remove the hose from the 45° fitting. Cap the fitting and plug the hose.
8. Remove the cylinder from the mast from the top.
9. For reassembly, reverse the above procedures.



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Figure 26. Cylinder Removal.

Section 5 Service

5.2-8 Main Lift Cylinder Service

1. Remove the cylinder from the mast as described in Section 5.2-5.
2. Use a claw type spanner wrench to remove the retainer. See Figure 27.
3. **Remove** the plunger/piston assembly from the shell.
4. Remove the Hydraulic Fuse/Lowering Cushion components.
5. Inspect all components for nicks or burrs. Minor nicks or burrs can be removed with 400 grit emery cloth.
NOTE: Minor nicks are those that will not bypass oil when under pressure. If they cannot be removed with emery cloth, replace the part. If the piston requires replacing, refer to Section 5.2-10.
6. Replace the retainer and piston seals, back-up rings O-rings and bearing. Lubricate the new seals with petroleum jelly prior to installation. **Note the correct seal directions.** The cylinder will not operate correctly if the seals are installed backwards.
7. **2000 PSI CYLINDERS-** 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 retainer on the plunger. Install the plunger/piston assembly into the cylinder shell. Tighten the retainer to the torque value listed below using the claw spanner wrench and a strap wrench.

30D/35D/40D- 95-125 ft.-lbs. (129-169 Nm)
50D/55D/60D- 225-250 ft.-lbs. (305-340 Nm)

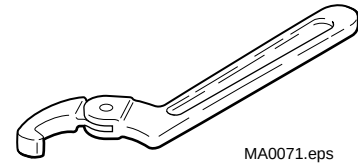


Figure 27. Claw Type Spanner Wrench..

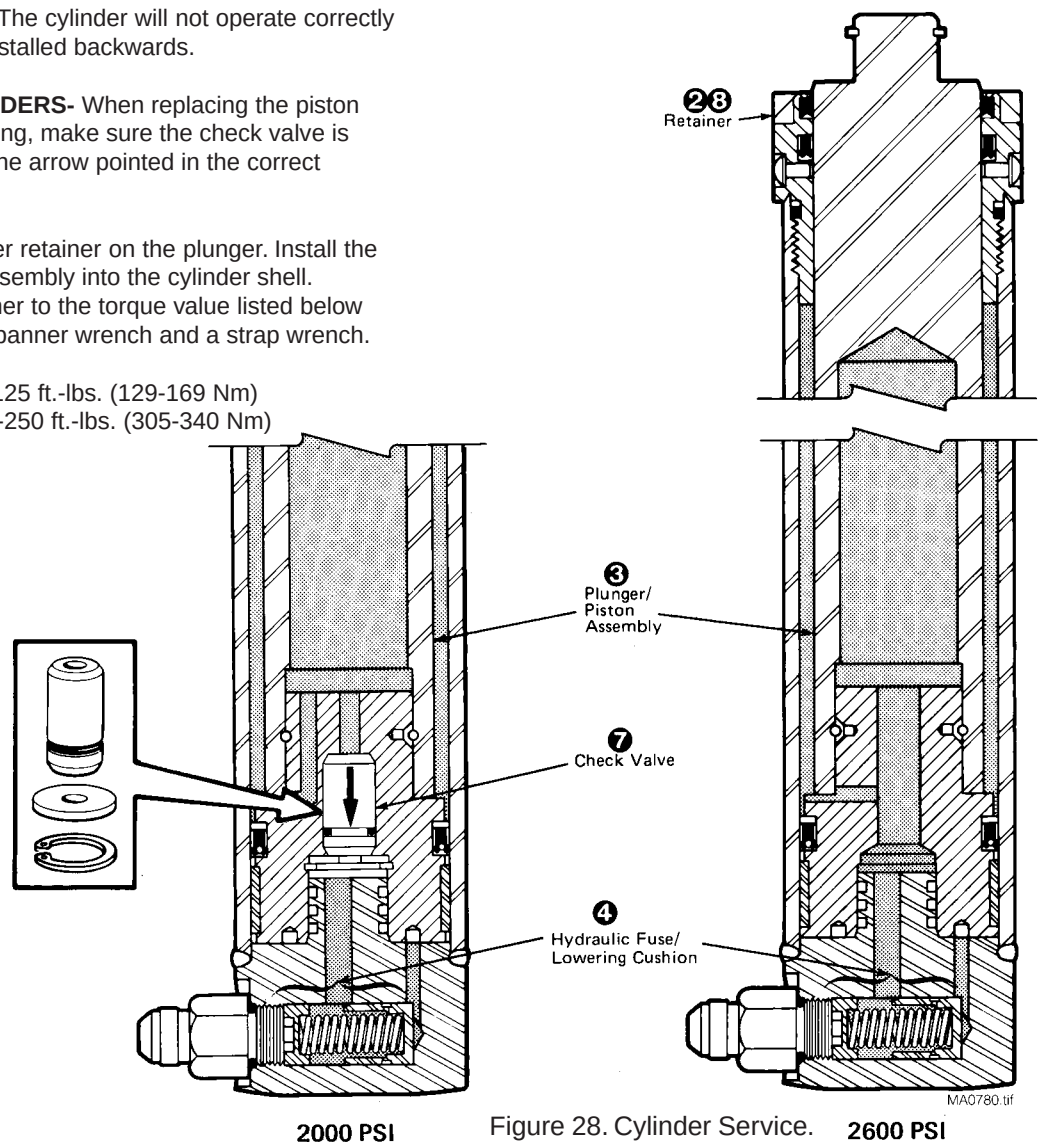


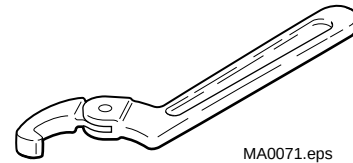
Figure 28. Cylinder Service. 2600 PSI

2000 PSI

Section 5 Service

5.2-9 Free Lift Cylinder Service

1. Remove the cylinder from the mast as described in Section 5.2-6 or 5.2-7.
2. Use a claw type spanner wrench to remove the retainer. See Figure 29.
3. Remove the plunger/piston assembly from the shell.
4. Remove the Hydraulic Fuse/Lowering Cushion components.
5. Inspect all components for nicks or burrs. Minor nicks or burrs can be removed with 400 grit emery cloth.
NOTE: Minor nicks are those that will not bypass oil when under pressure. If they cannot be removed with emery cloth, replace the part. If the piston requires replacing, refer to Section 5.2-10.
6. Replace the retainer and piston seals, back-up rings, O-rings and bearing. Lubricate the new seals with petroleum jelly prior to installation. **Note the correct seal directions.** 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 retainer on the plunger. Install the plunger/piston assembly into the cylinder shell. Pour 1/2 cup (120 ml) hydraulic oil into the cylinder cavity between the shell and rod. Tighten the retainer to a torque of 275-300 ft.-lbs. (375-405 Nm) using the claw spanner wrench and a strap wrench.



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Figure 29. Claw Type Spanner Wrench..

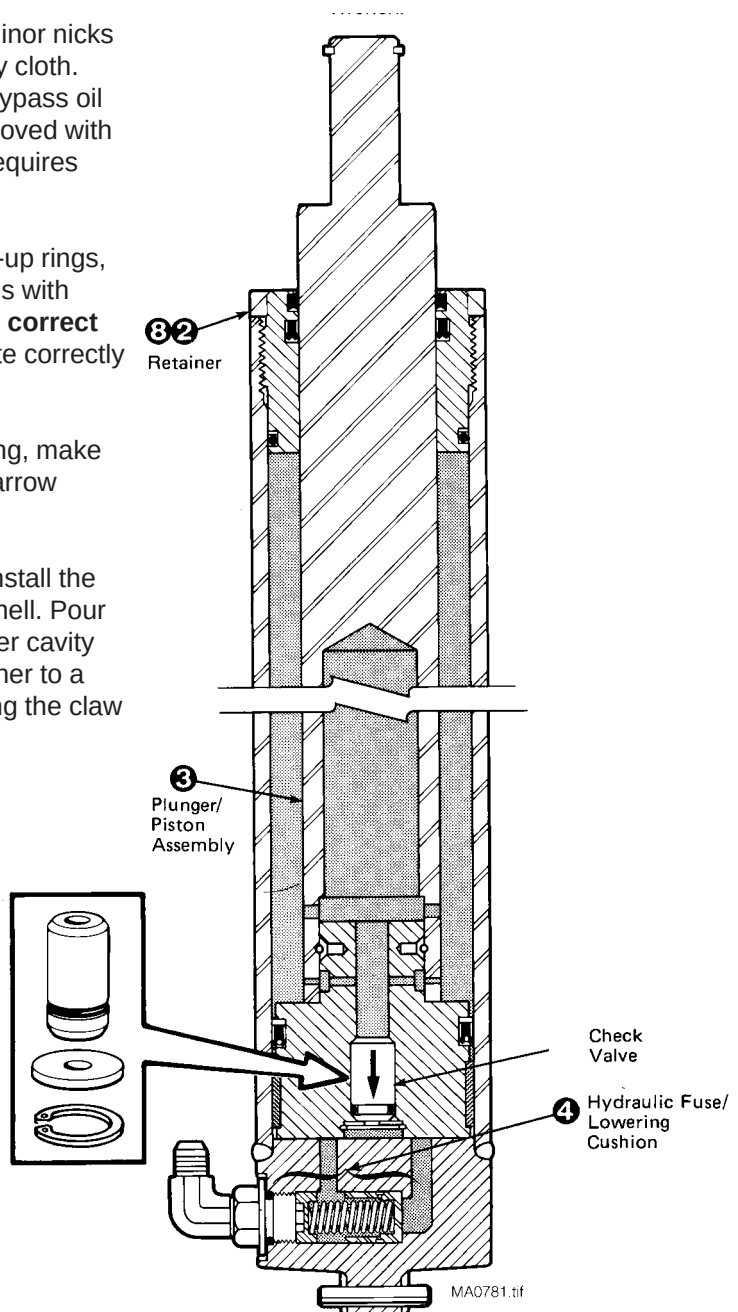


Figure 30. Cylinder Service.

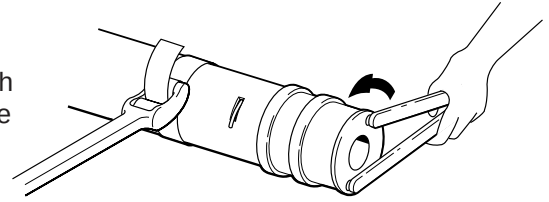
Section

5 Service

5.2-10

Piston Removal

1. Remove the plunger/piston assembly from the cylinder shell as described in Section 5.2-8 or 5.2-9.
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.
5. For reassembly, reverse the above procedures except as follows:
*Install a new snap wire when installing the piston.



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Figure 31. Piston Removal.

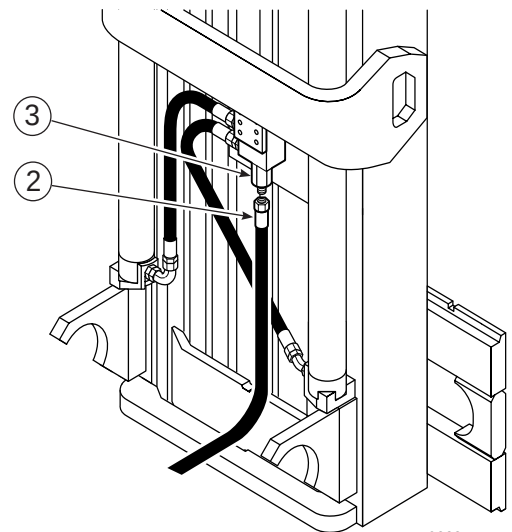
5.2-11 Cylinder Bleeding



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.

After repair, the cylinders may have air trapped in them that must be removed. To bleed air do the following:

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.



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Figure 32. Valve Cartridge Service.

5.3

Valve

5.3-1

Valve Cartridge Service

1. Completely lower the mast.
2. Remove the truck supply hose from the valve cartridge. See Figure 32. Plug the hose.
3. Remove the valve cartridge from the 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 above procedures.

Section 5 Service

5.4 Carriage

5.4-1 Description

The carriage shown below is the structure that hook-type forks or attachments are attached. 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. 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 6 roller carriages where the top roller extends past the top of the mast inner upright at full extension and are held in place by a retainer plate.*

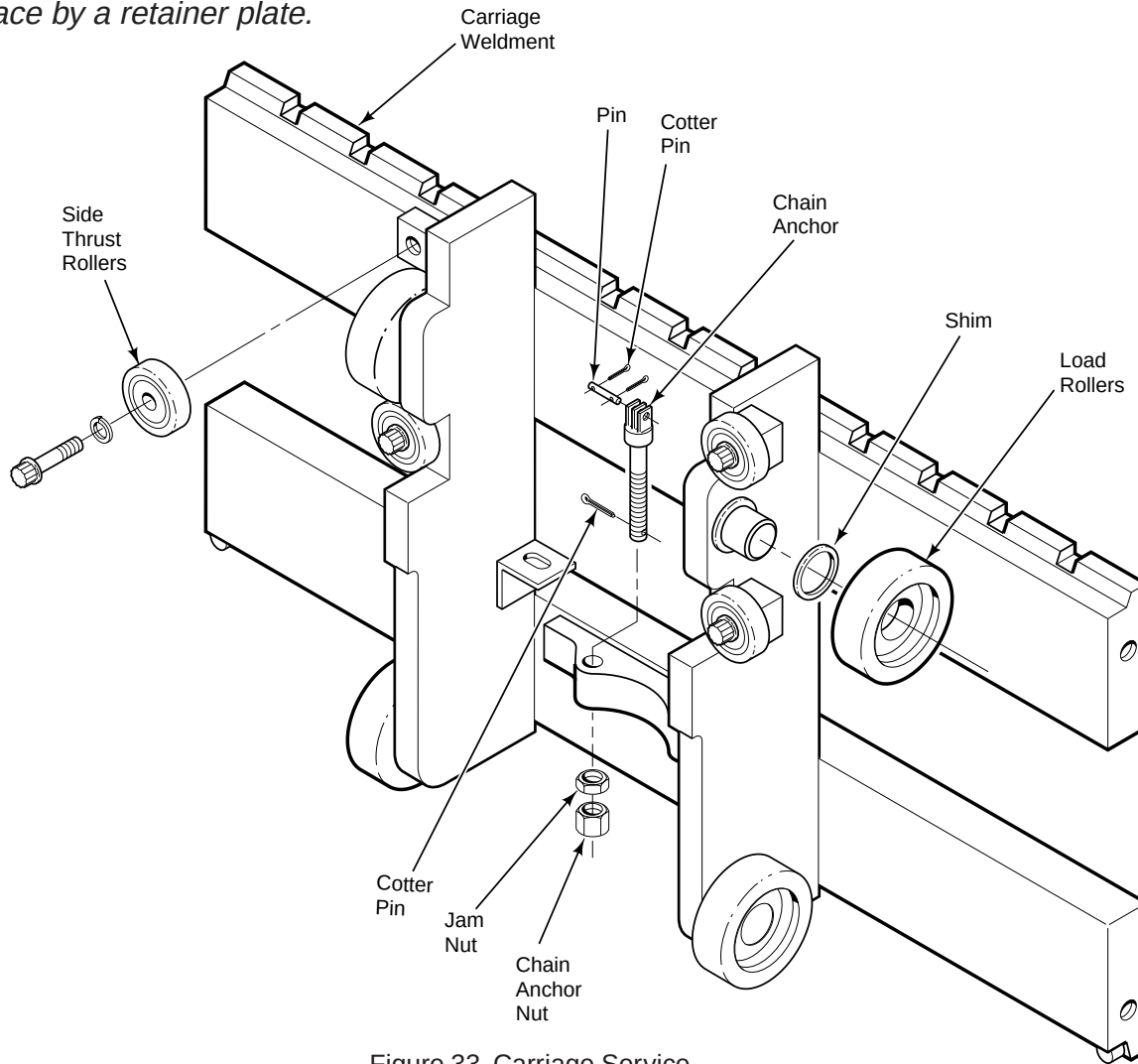


Figure 33. Carriage Service.

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IMPORTANT: The chain anchor nuts must be installed as shown for correct operation.

Section

5 Service

5.4-2

Carriage Removal-Mast on Truck

1. Raise the mast high enough to place a 20 in. (50 cm) long, 4X4 in. (10 X 10cm) wood block between the intermediate lower crossmember and the ground. Lower the carriage to be even with the bottom of the inner upright
2. Attach an overhead hoist to the carriage. Raise the carriage to slacken the carriage chains.
3. Remove the chain anchor nuts. Note the location of the double nuts for reassembly.
4. Disconnect the internal reeving hoses from the carriage fittings (if equipped). Plug the hose ends.
5. Using the overhead hoist, lower the carriage to the bottom of the mast to remove.
6. Note the number of shims behind each load roller for reassembly.
7. For reassembly, reverse the above procedures except as follows:

*inspect the carriage as described in Section 5.4-4.

*Lubricate the inner upright rails with chassis lube or Kendall SR-12X.
See Figure 34.

*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. (1.5 cm) at the tightest point throughout the travel of the carriage. Use an equal amount of shims side to side.

*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. See Figure 28. Tighten the capscrews to a torque of 70-80 ft.-lbs. (95-110 Nm).

*Check and adjust the free lift chains as described in Section 5.6-4 and 5.6-6.

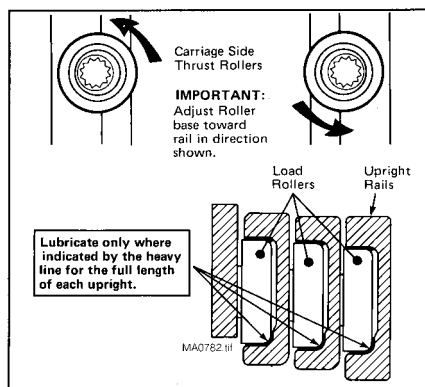


Figure 34. Rail Lubrication and Carriage Side Thrust Rollers.

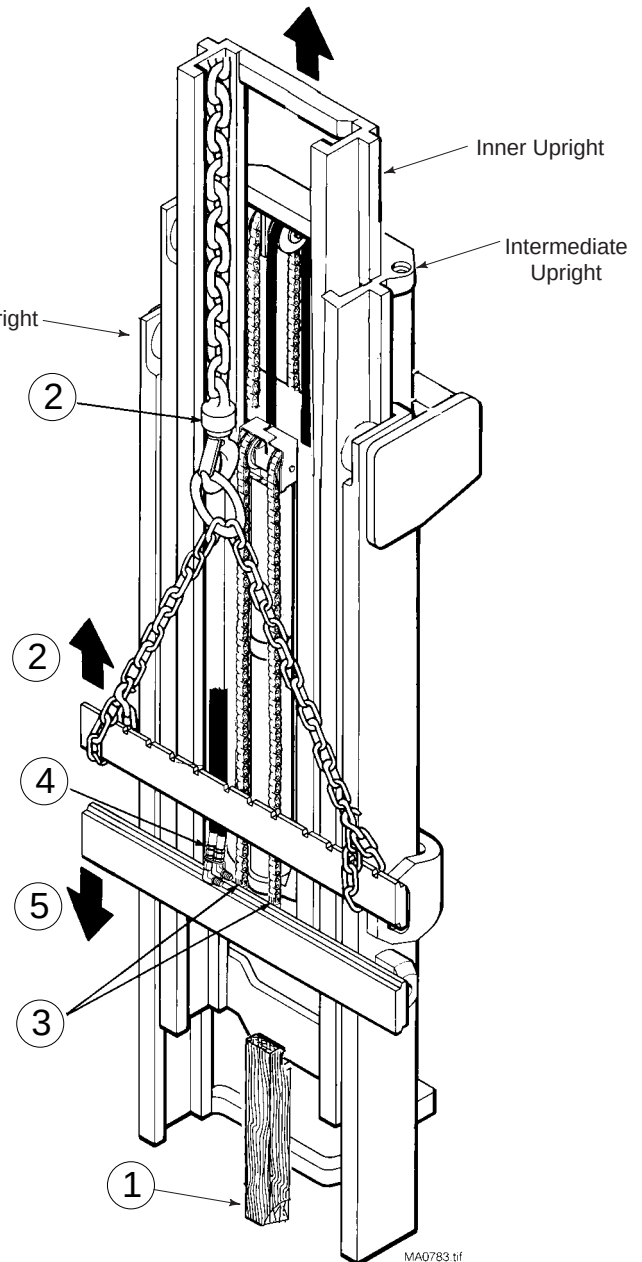


Figure 35. Carriage Removal.

Carriage Removal-Mast on Floor

1. Remove mast from truck as described in Section 5.1.
2. Remove chain anchor nuts. Note location of double nuts for reassembly. Remove the chain anchors.
3. Disconnect the internal reeving hoses for the carriage fittings (if equipped). Plug the hose ends.
4. Roll the carriage to the bottom of the mast.
5. Attach an overhead hoist to the carriage for bars. Remove the carriage through the bottom of the mast.
6. Note the number of shims located behind each load roller for reassembly.

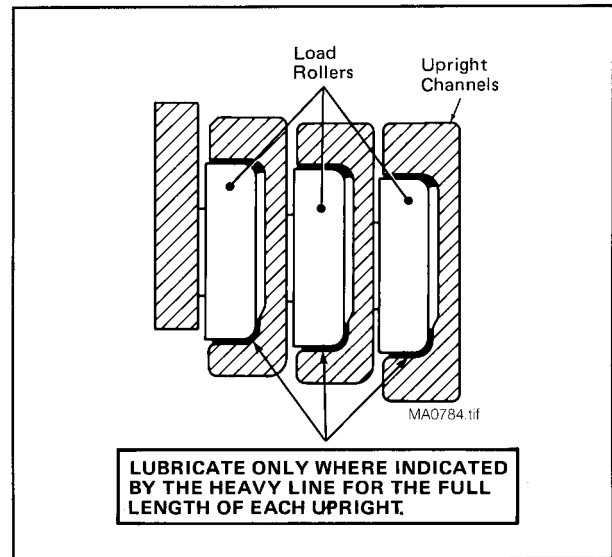


Figure 36. Rail Lubrication.

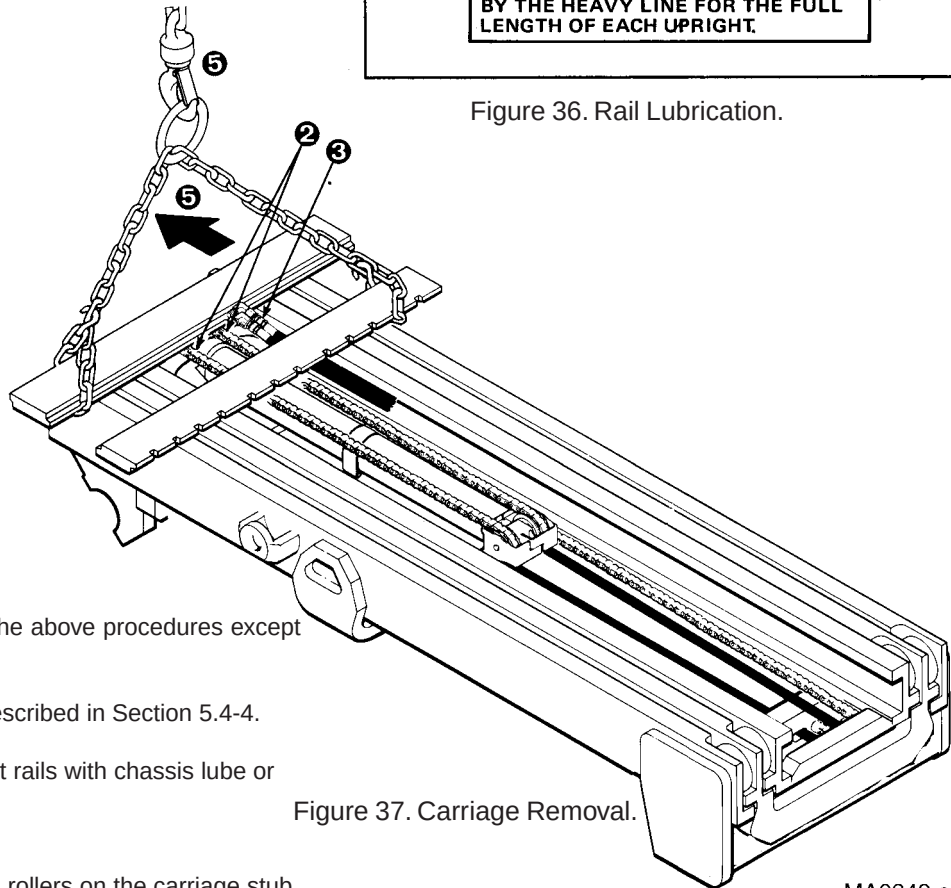


Figure 37. Carriage Removal.

7. For Reassembly, reverse the above procedures except as follows:

*inspect the carriage as described in Section 5.4-4.

*Lubricate the inner upright rails with chassis lube or Kendall SR-12X . See Figure 38.

*Assemble shims and load rollers on the carriage stub shafts. The shims should be installed to provide a total side to side clearance no looser than 1/16 in. (1.5 mm) at the tightest point throughout the travel of the carriage. Use an equal amount of shims side to side.

*Adjust the carriage side thrust rollers for unrestricted clearance along the travel of the carriage. The rollers have eccentric mount bases. Turn base of rollers toward the upright rail to decrease clearance. Tighten to a torque of 70-80 ft.-lbs. (96-110 Nm).

*Check and adjust the free lift chains as described in Section 5.6-4 and 5.6-6.

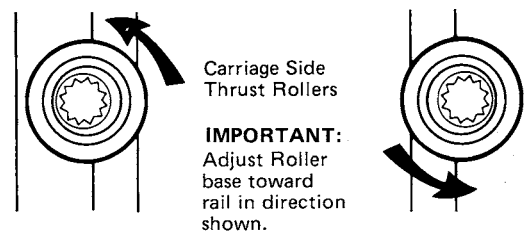


Figure 38. Carriage Side Thrust Rollers.

Section 5 Service

5.4-4 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. Contact Lift Tek for repair procedures.

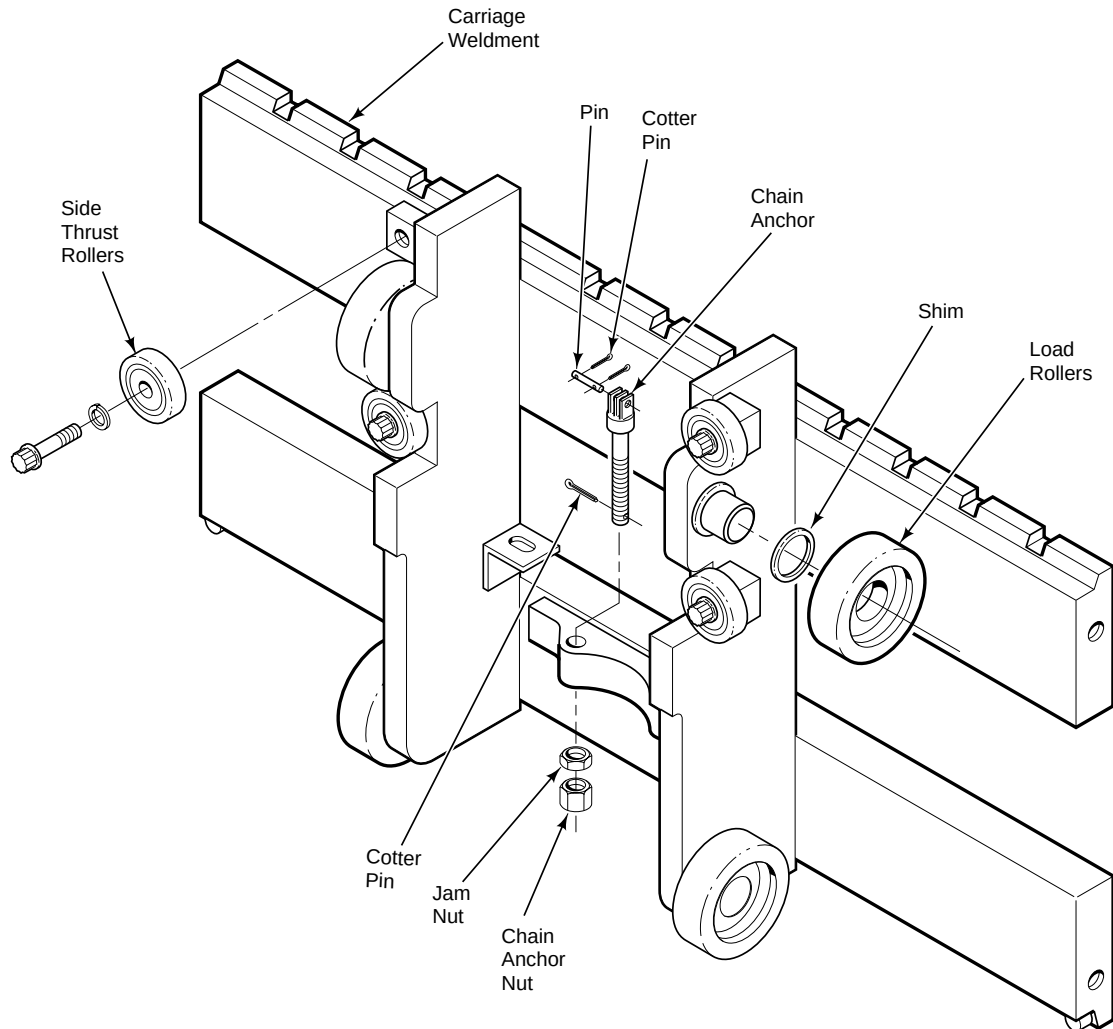


Figure 39. Carriage .

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IMPORTANT: The chain anchor nuts must be installed as shown for correct operation.

Section 5 Service

5.5 Mast Uprights

5.5-1 Upright Description

Outer Upright Assembly

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

Intermediate Upright Assembly

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 intermediate upright assembly. A pair of shim adjustable load rollers are attached to stub shafts located at the bottom of the upright. The free lift chain anchors are attached to the center crossmember. The free lift cylinder rests on a cradle which is integral with the lower crossmember.

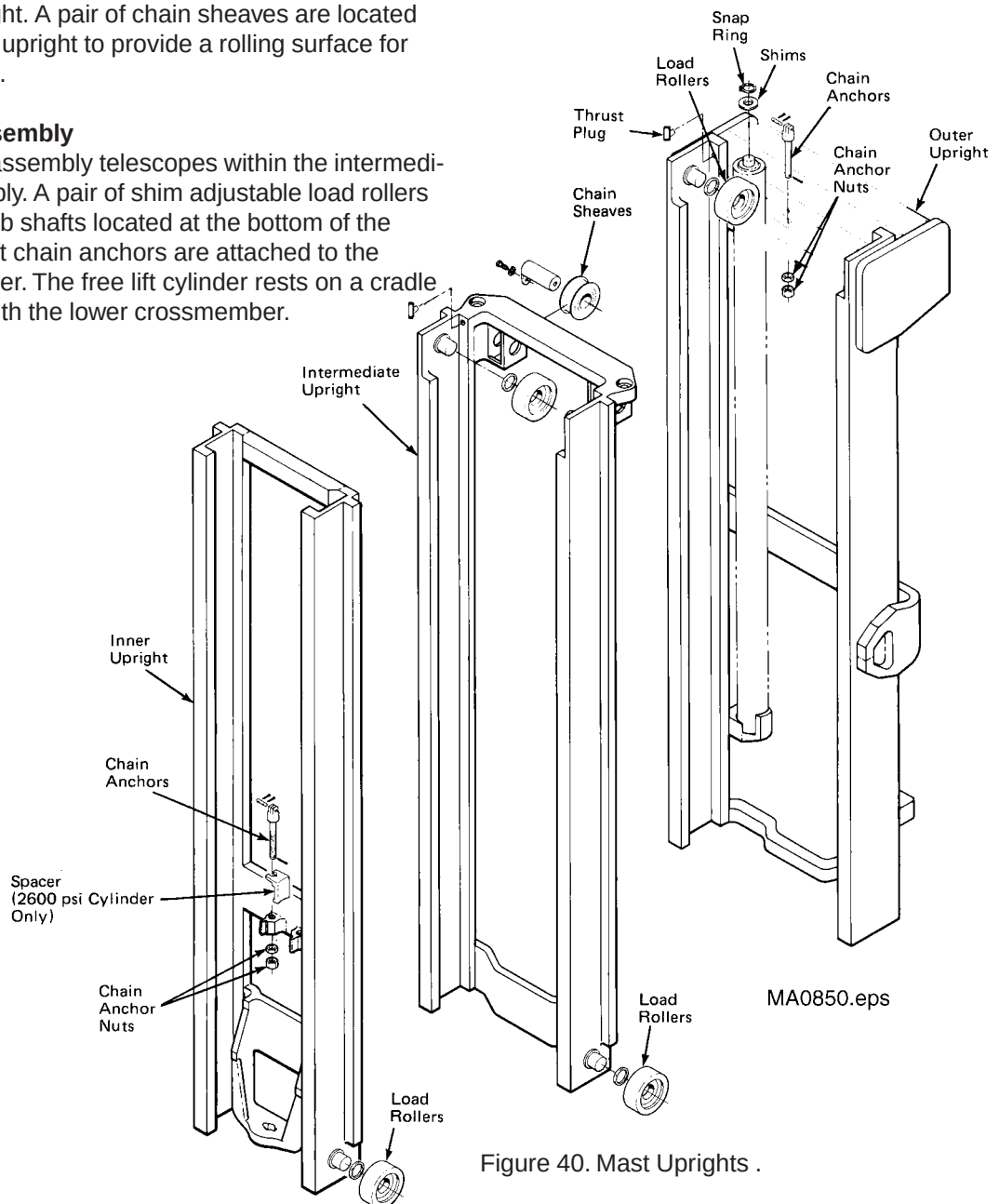


Figure 40. Mast Uprights .

Section 5 Service

5.5-2 Upright Operation

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

Actuating the 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 main lift cylinders lower at the same time. Once the main lift cylinder have nottomed out, the free lift cylinder begins to lower resulting in a smooth lowering of the carriage.

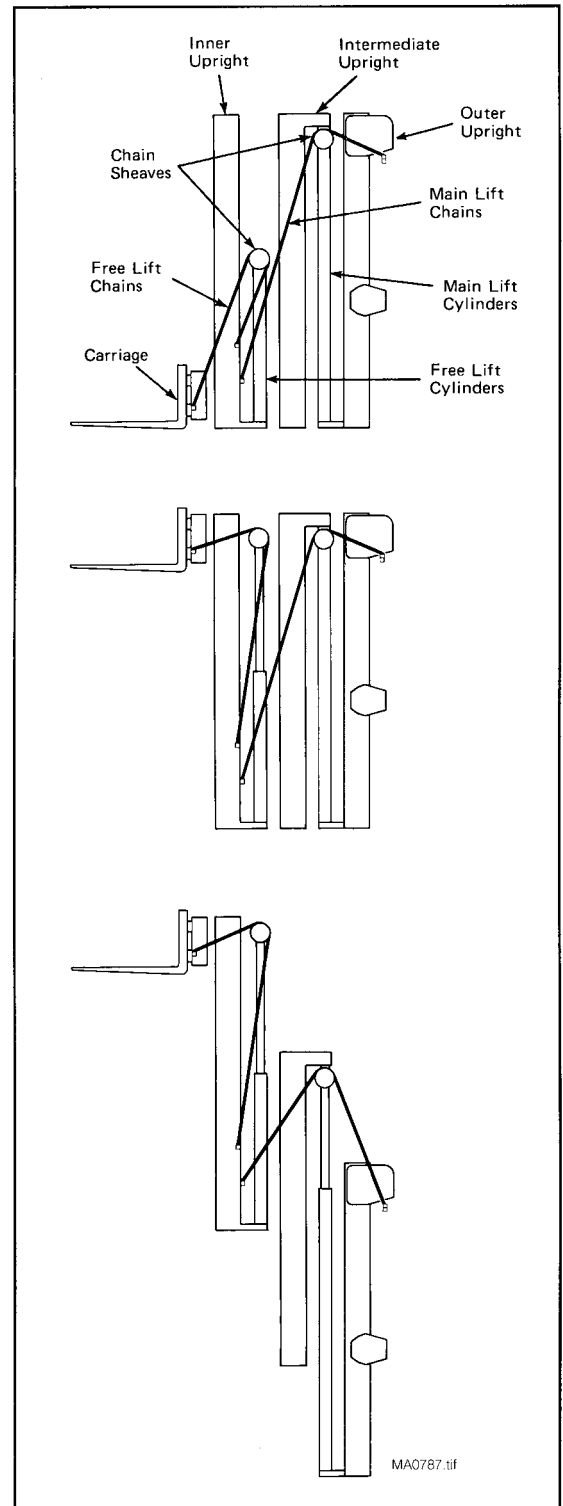
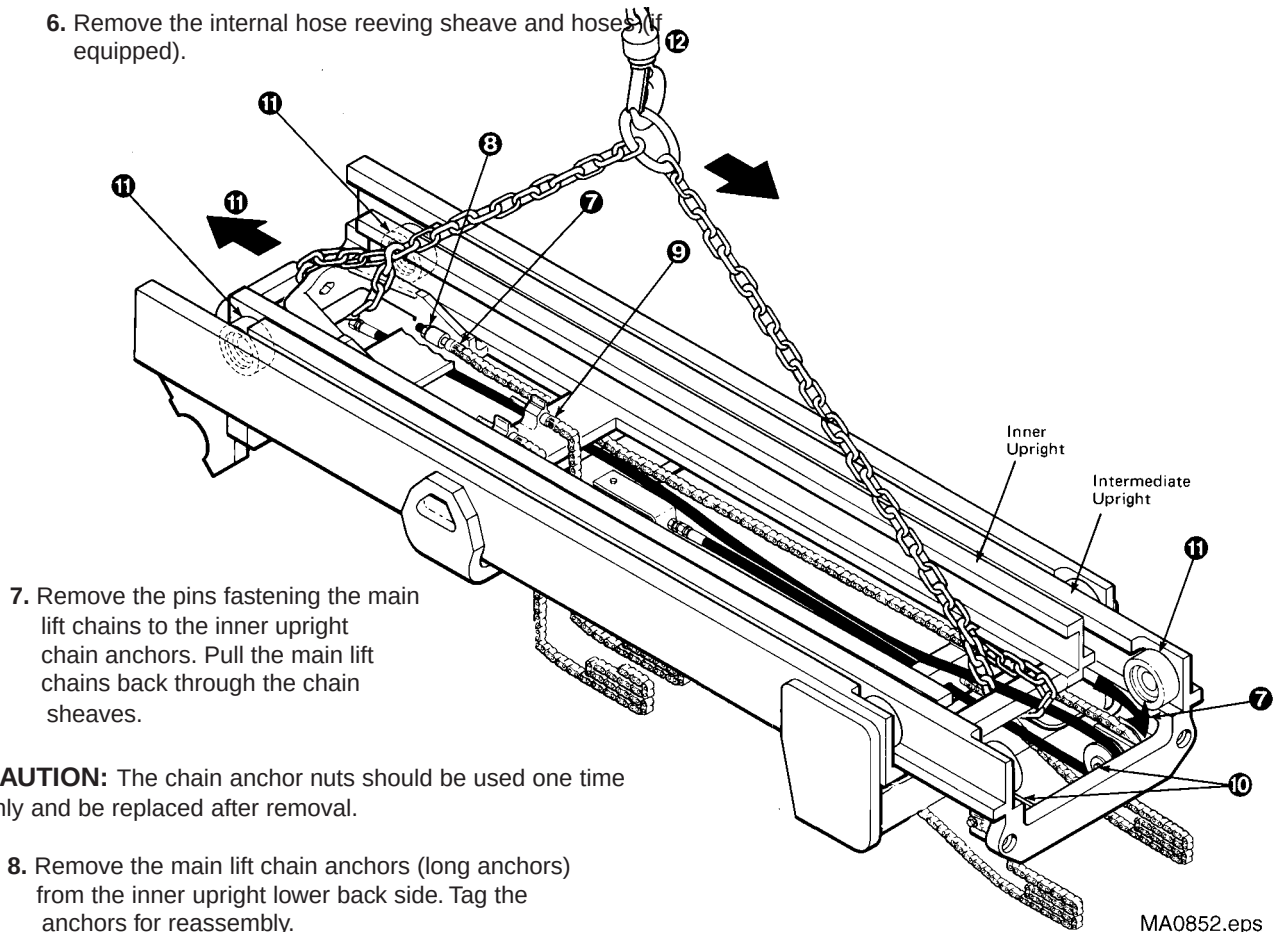


Figure 41. Upright Operation .

Section 5 Service

5.5-3 Upright Disassembly

1. Remove the mast assembly from the truck as described in Section 5.1.
2. Remove the main lift cylinders from the mast as described in Section 5.2-5.
3. Turn the mast over.
4. Remove the free lift cylinder from the mast as described in Section 5.2-6.
5. Remove the carriage from the mast as described in Section 5.4-3.
6. Remove the internal hose reeving sheave and hoses (if equipped).



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Figure 42. Upright Disassembly .

7. Remove the pins fastening the main lift chains to the inner upright chain anchors. Pull the main lift chains back through the chain sheaves.
- CAUTION:** The chain anchor nuts should be used one time only and be replaced after removal.
8. Remove the main lift chain anchors (long anchors) from the inner upright lower back side. Tag the anchors for reassembly.
9. Remove the pins fastening the free lift chains to the inner upright chain anchors.
10. Remove the free lift cylinder supply hose and sheave. Remove the main lift chain sheaves.
11. Roll the inner upright downward to expose the inner and intermediate upright load rollers. Remove the load rollers. Note the number of shims behind each load roller.
12. Attach an overhead hoist to the inner upright. Remove the inner upright through the top of the intermediate upright.

Section 5 Service

5.5-3 Upright Disassembly

(Continued)

CAUTION: The chain anchor nuts should be used one time only and be replaced after removal.

13. Remove the main lift chain anchors (long anchors) and chains from the outer upright crossmember. Tag the anchors for reassembly.
14. Roll the inner upright downward to expose the intermediate and outer upright load rollers. Remove the load rollers. Note the number of shims behind each load roller.
15. Attach an overhead hoist to the intermediate upright. Remove the intermediate upright through the top of the outer upright.

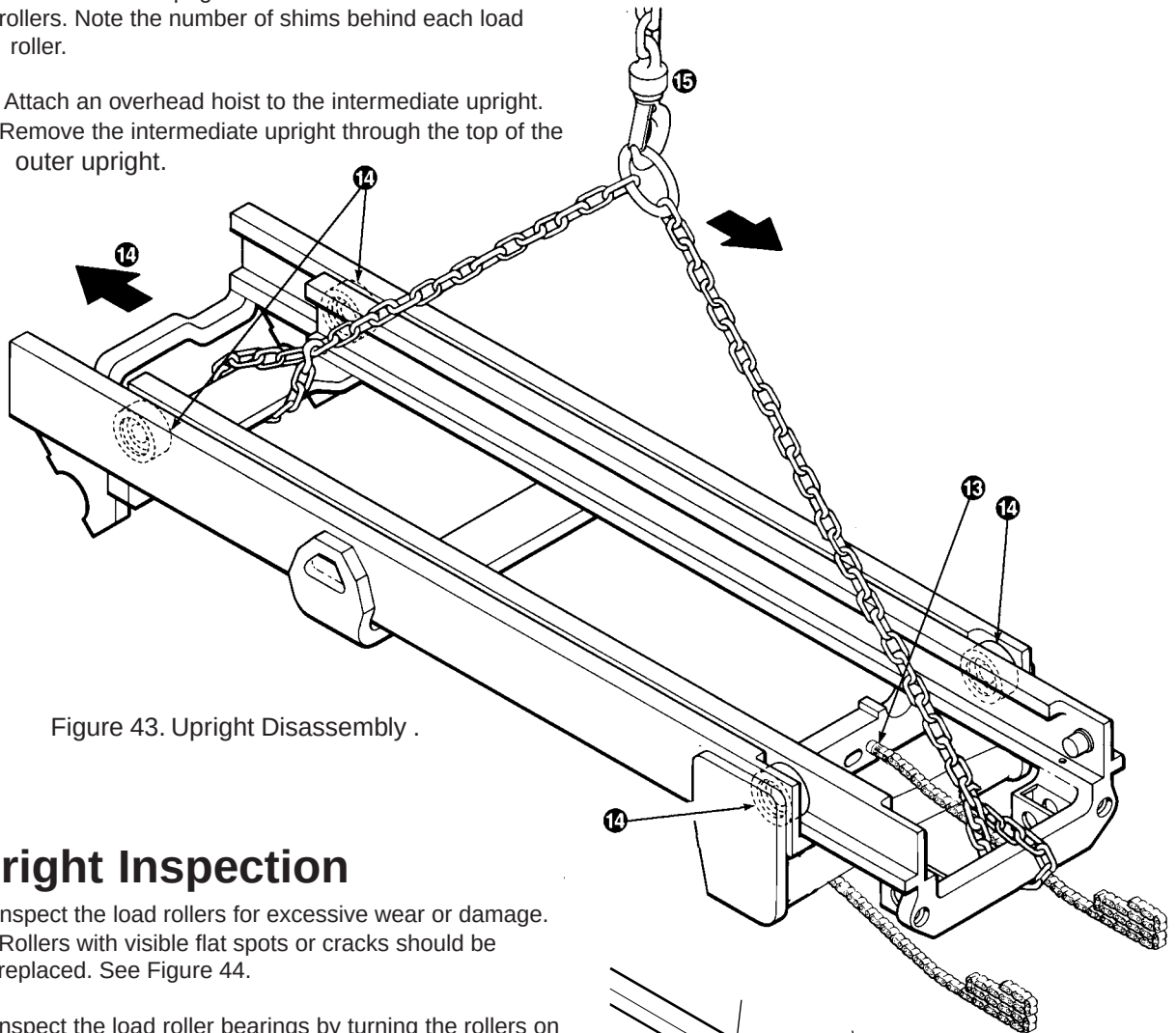
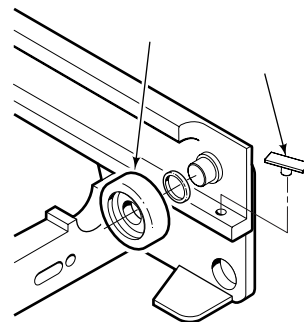


Figure 43. Upright Disassembly .

5.5-4 Upright Inspection

1. Inspect the load rollers for excessive wear or damage. Rollers with visible flat spots or cracks should be replaced. See Figure 44.
2. Inspect the load roller bearings by turning the rollers on their 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 mast must be replaced or repaired.
4. Inspect the outer and intermediate upright thrust plugs. If the wear surface is worn to less than 1/16 in. (1.5 mm), they should be replaced.
5. Inspect the hoist chains as described in Section 5.6-1.



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Figure 44. Upright Inspection .

Section 5 Service

5.5-5 Upright Reassembly

1. Lubricate the outer upright rails with chassis lube or Kendall SR-12X. See Figure 45.
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.
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. (1.5 mm) at the tightest point throughout the travel in the upright. Use an equal amount of shims side to side. **NOTE:** Roll the upright past the thrust plugs before checking roller clearances.
5. Lubricate the intermediate upright rails with chassis lube or Kendall SR-12X. See Figure 40.

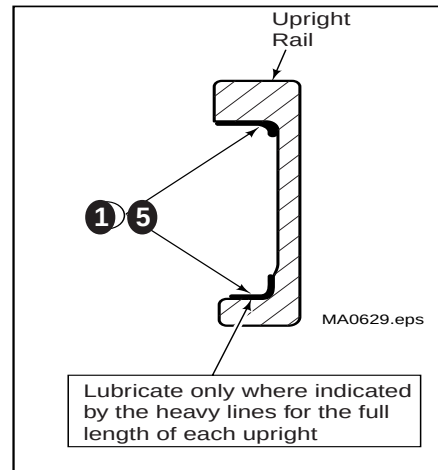


Figure 45. Rail Lubrication

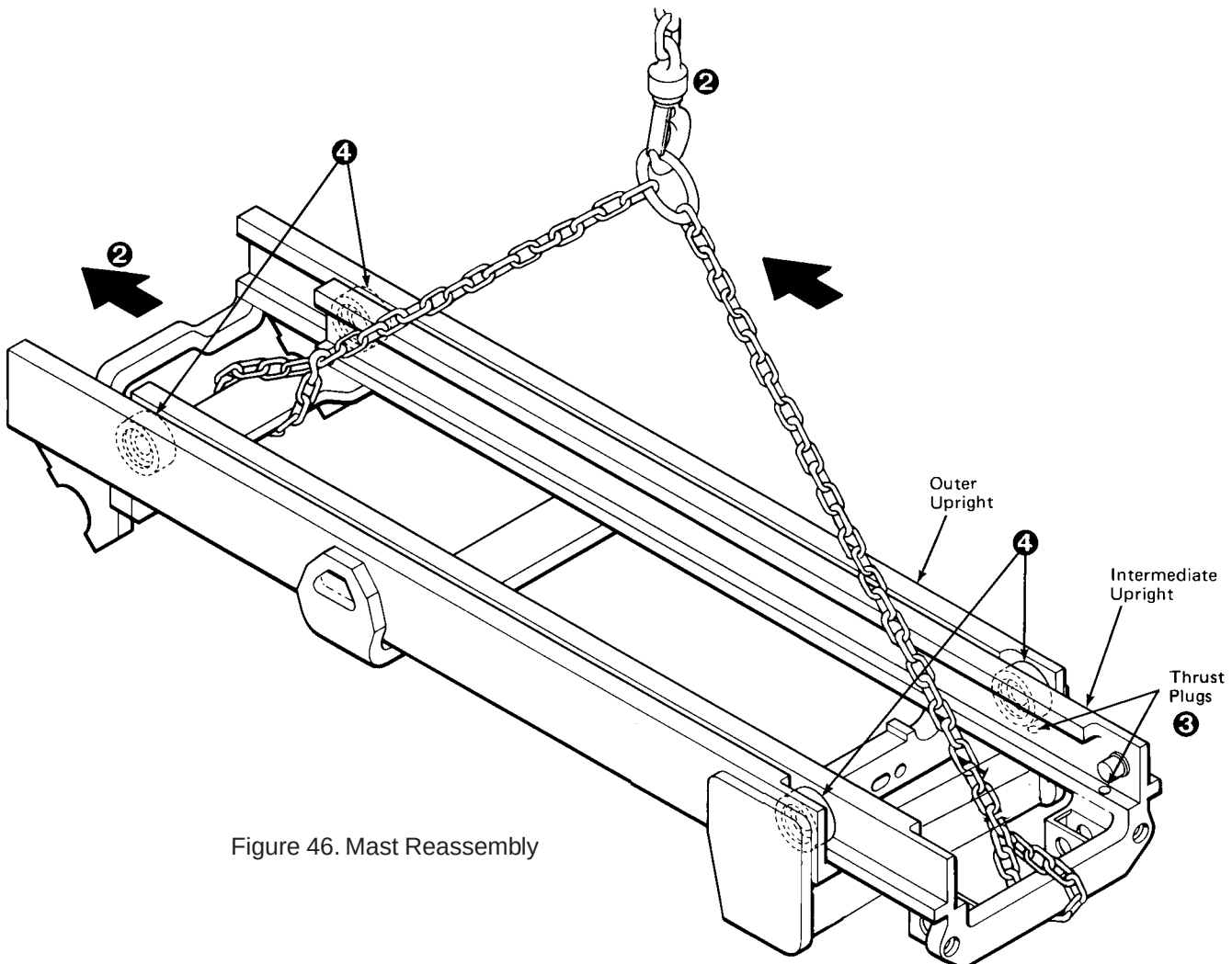


Figure 46. Mast Reassembly

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Section 5 Service

5.5-5 Upright Reassembly (Continued)

5. Attach an overhead hoist to the inner upright. Install the inner upright through the top of the intermediate upright.
6. 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 clearance no looser than 1/16 in. (1.5 mm) at the tightest point throughout the travel in the upright. Use an equal amount of shims side to side. **NOTE:** Roll the upright past the thrust plugs before checking roller clearances.
7. Install the chain sheave and free lift hose sheave to the intermediate upright. Tighten the capscrew to a torque of 26-30 ft.-lbs. (35-40 Nm).
8. Install the main lift chain anchors (long anchors) and chains to the outer upright crossmember.

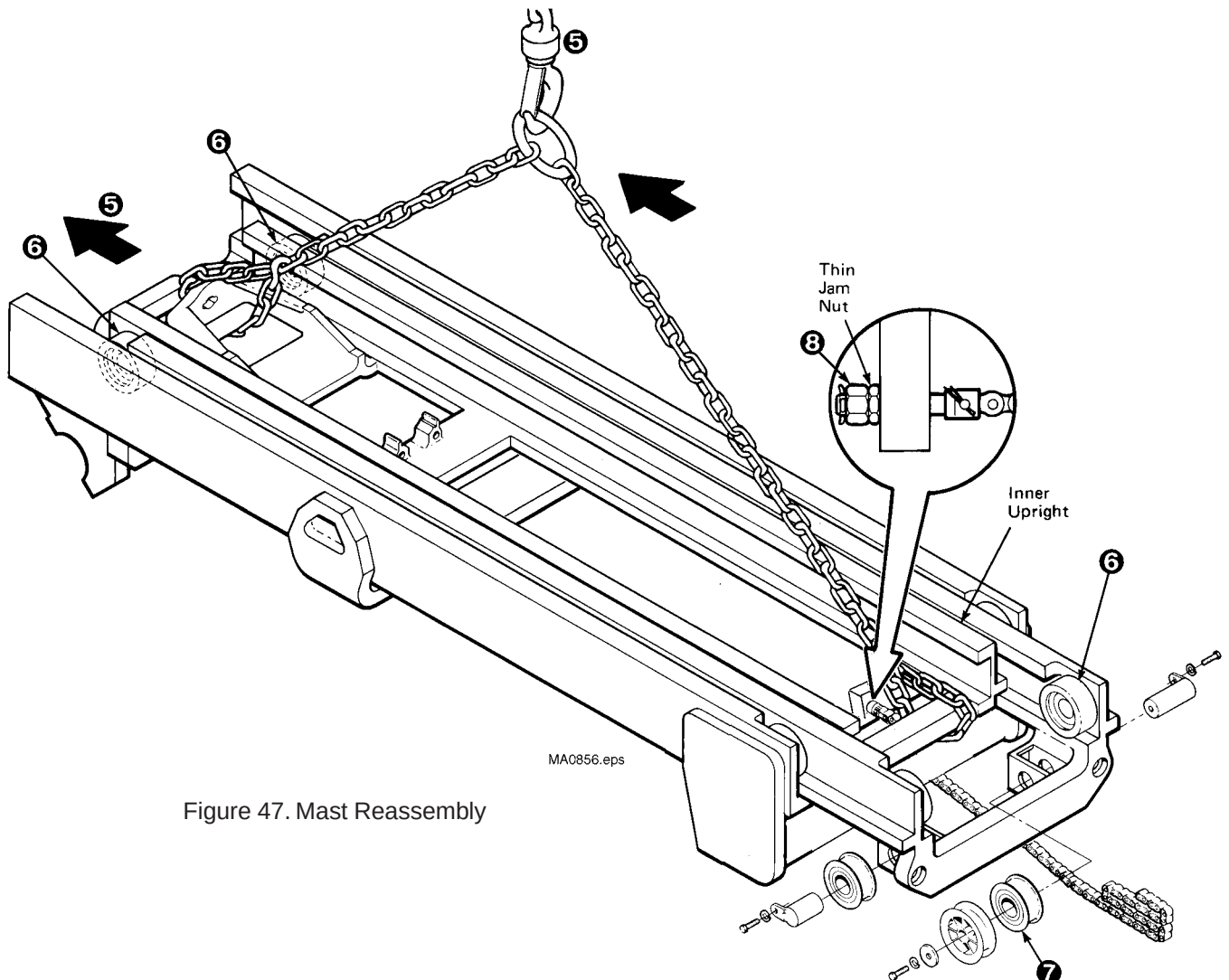


Figure 47. Mast Reassembly

Section 5 Service

5.5-5 Upright Reassembly

(Continued)

9. Install the chain anchors (long anchors) to the back side of the inner upright lower crossmember.
10. Pull the main lift chains over the chain sheaves and attach to the lower inner upright chain anchors.
11. Install the free lift chain anchors (short anchors) and chains to the inner upright center crossmember.
12. 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.
13. Install the carriage as described in Section 4.5-3.
14. Install the free lift cylinder as described in Section 5.2-6.
15. Install the internal reeving sheave and hoses (if equipped) as described in Section 2.4.
16. Turn the mast over.
17. Install the main lift cylinders as described in Section 5.2-5.
18. Install the mast to the truck as described in Section 5.1.
19. Adjust the main lift and free lift chains as described in Sections 5.6-3 and 5.6-4. Check for mast skewing as described in Section 5.5-6.

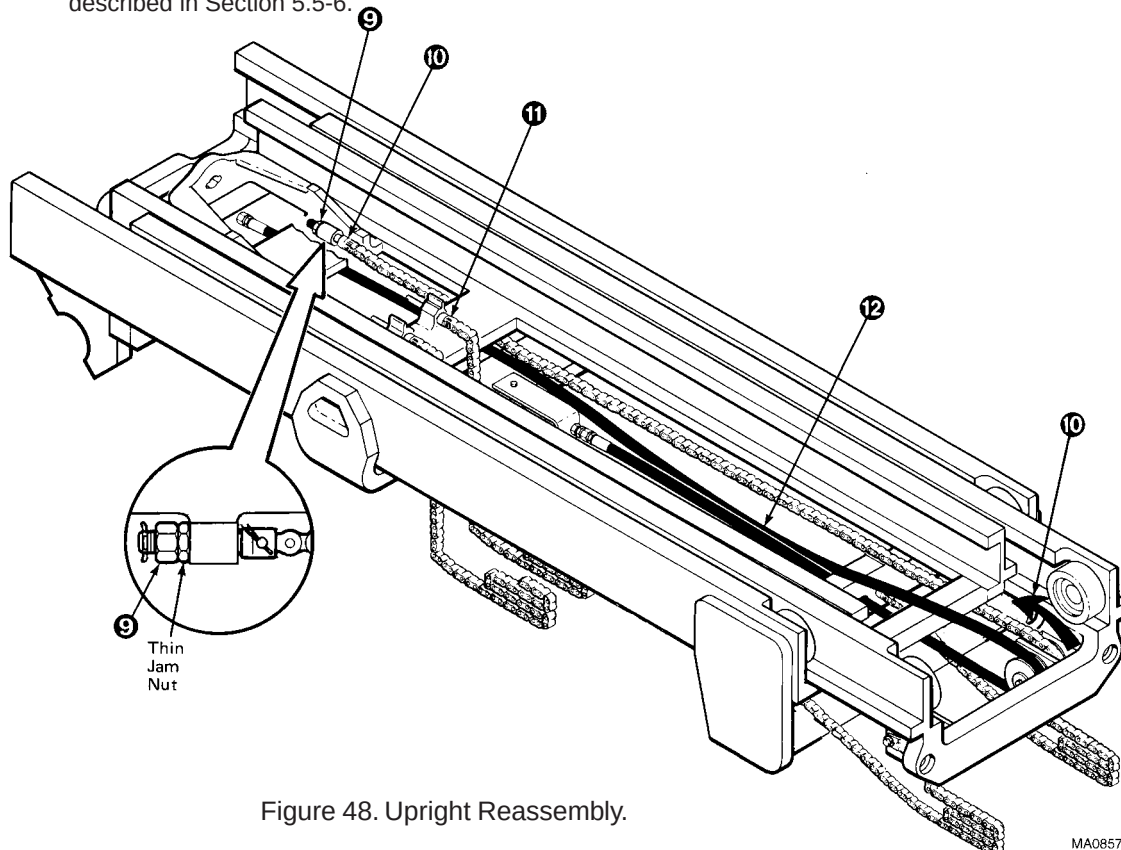


Figure 48. Upright Reassembly.

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Section

5 Service

5.5-6 Mast Skewing

1. Extend the mast to the full lift height.

*If the mast kicks to the right at full extension, a shim (part no. 200524) needs to be installed to the right hand main lift cylinder rod.

*If the mast kicks to the left at full extension, a shim (part no. 200524) needs to be installed to the left hand main lift cylinder rod.

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. See Figure 45. Lower the crossmember onto the angle iron.
3. Remove the snap ring from the cylinder to be adjusted. Open the 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. Slowly hydraulically power the main lift cylinder back into the crossmember and reinstall the snap ring.
5. Repeat steps through until skewing is removed.



WARNING: The intermediate upright must be supported by angle iron to avoid possible injury.

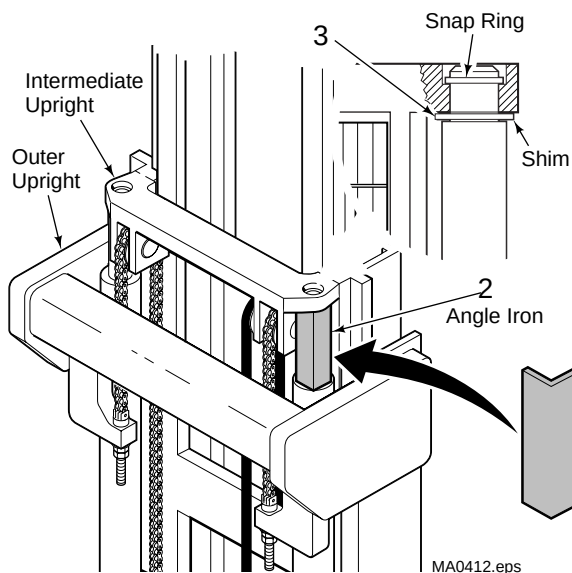


Figure 49. Shim Installation.

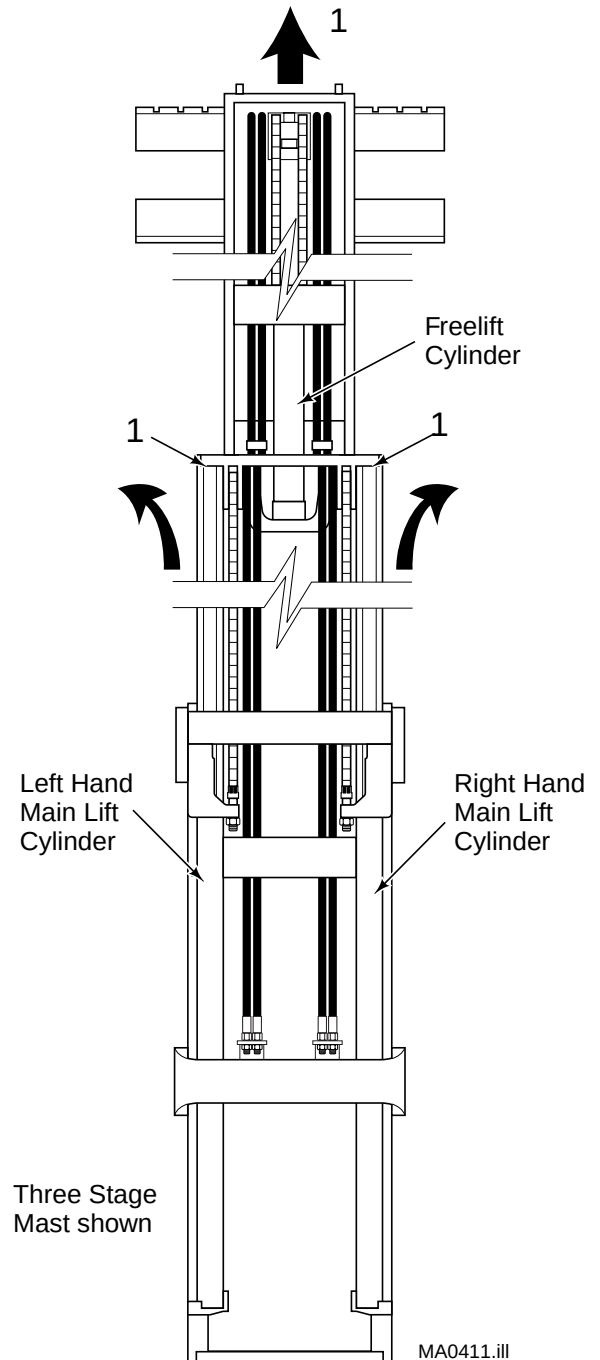


Figure 50. Extended Upright.

Chains

5.6-1 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 **Chain Adjustment**.

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 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 peened plate edge, replace **both** strands of the chain.

*Check for protruding or turned pins. Replace **both** strands of the chain.

*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 40 wt. oil or Bowman Heavy Load Red Grease.

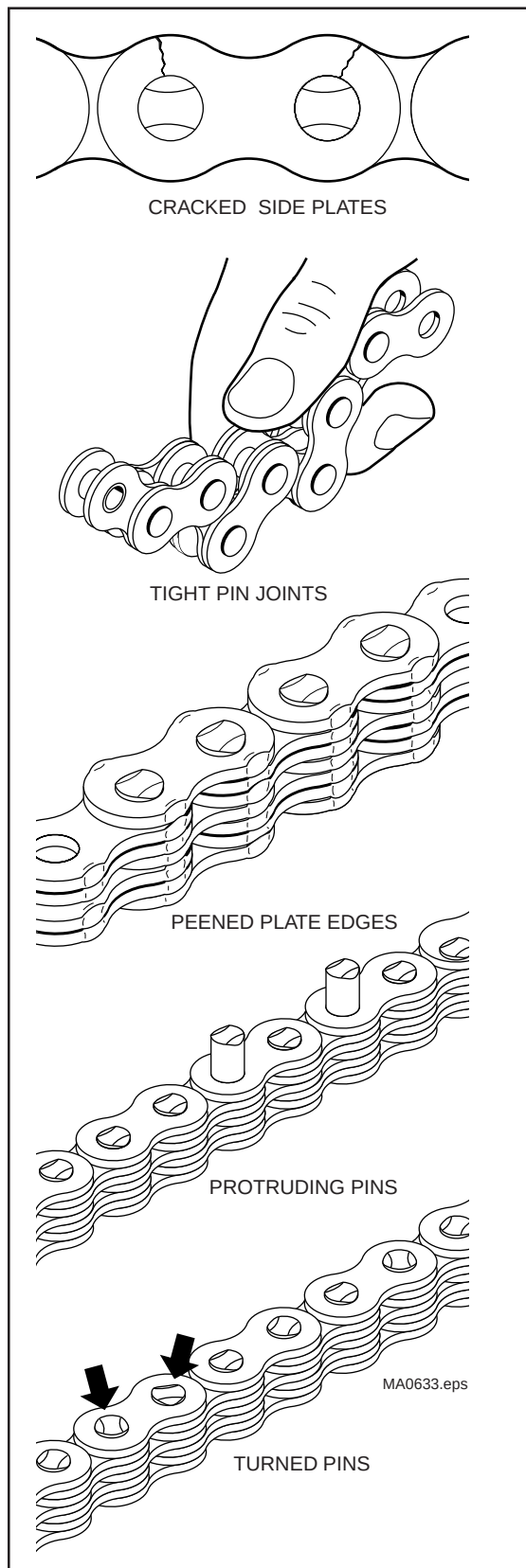


Figure 51.Chain Inspection.

Section 5 Service

5.6-2 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 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 free lift chains, raise the carriage 1 ft. (30 cm) off the ground to put tension on the chains.

*To check the main lift chains, raise the mast until the inner upright starts to extend ensuring tension on the chains.

Main Lift Chain Adjustment

5.6-3 The main lift chains should be adjusted so that when the unloaded mast is fully lowered, the uprights are positioned as shown in figure 53.

1. Adjust one chain to achieve the correct upright position when fully lowered. See Figure 55.
2. Adjust the other chain to achieve equal chain tension. Tighten the nuts together to a torque of 50-70 ft.-lbs. (98-96 Nm).
3. Raise and lower the mast several times to confirm the adjustments.

Free Lift Chain Adjustment

5.6-4 The free lift chains should be adjusted so that when the unloaded mast is fully lowered, the upright channels and carriage are positioned as shown in Figure 53.

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. See Figure 54.
2. Adjust the other chain to achieve equal chain tension. Tighten the nuts together to a torque of 50-70 ft.-lbs. (68095 Nm).
3. Raise and lower the mast several times to confirm the adjustments.

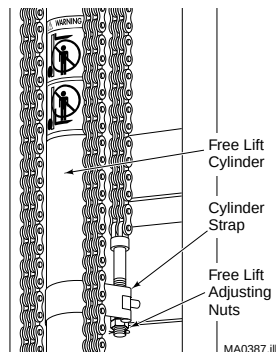


Figure 54.Free Lift Chains.

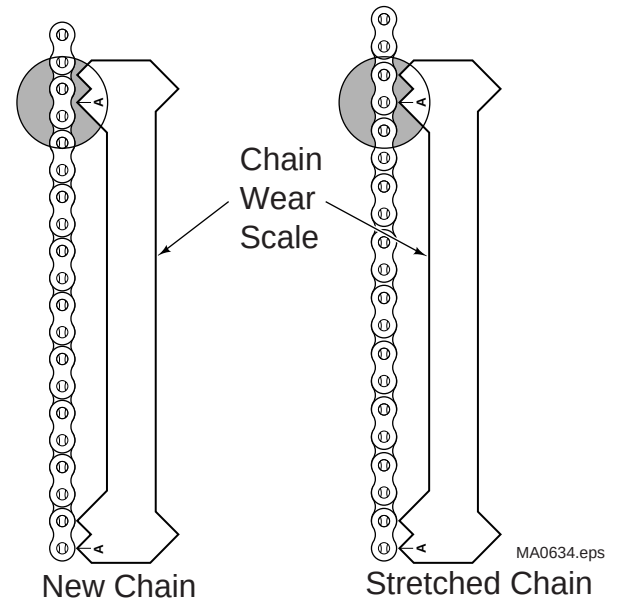
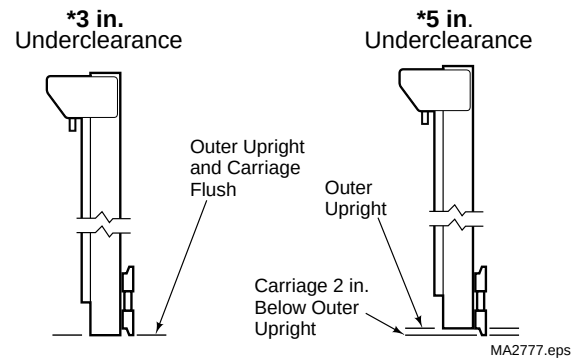


Figure 52.Measuring Chain Stretch.



NOTE: Underclearance is based on mast production series, actual mast underclearance may vary by truck model.

Figure 53.Upright and Carriage Position.

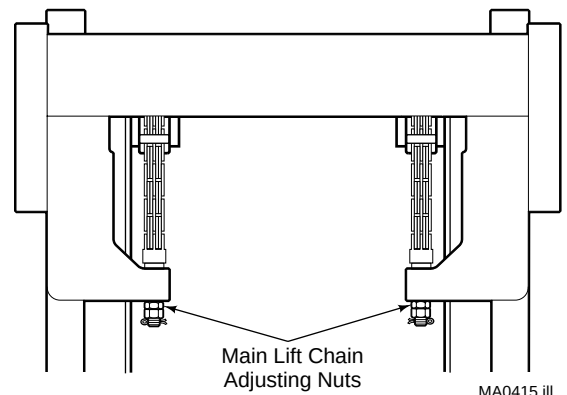


Figure 55.Main Lift Chains.

Section 5 Service

5.6-5 Main Lift Chain Service

WARNING: The intermediate upright must be supported by a block to avoid possible injury.

1. Raise the inner upright 3 ft. (90 cm). Place a 3 ft. (90 cm) block under the free lift cylinder support casting, then lower the cylinder support onto the block. The main lift chains should be slack. See Figure 51.
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 Section 5.6-3.

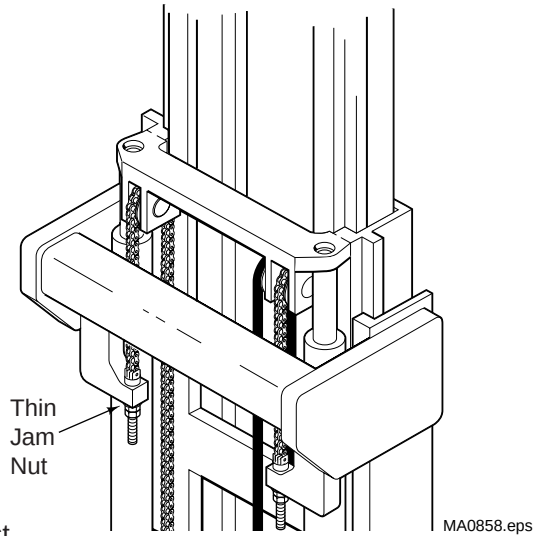


Figure 56.Main Chains.

5.6-6 Free Lift Chain Service

WARNING: The carriage must be supported by a block to avoid possible injury.

1. Raise the carriage 12 in. (30 cm). Place a 12 in. (30 cm) block under the carriage, then lower the carriage onto the block. The free lift chains should be slack. See Figure 52.
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 Section 5.6-4.

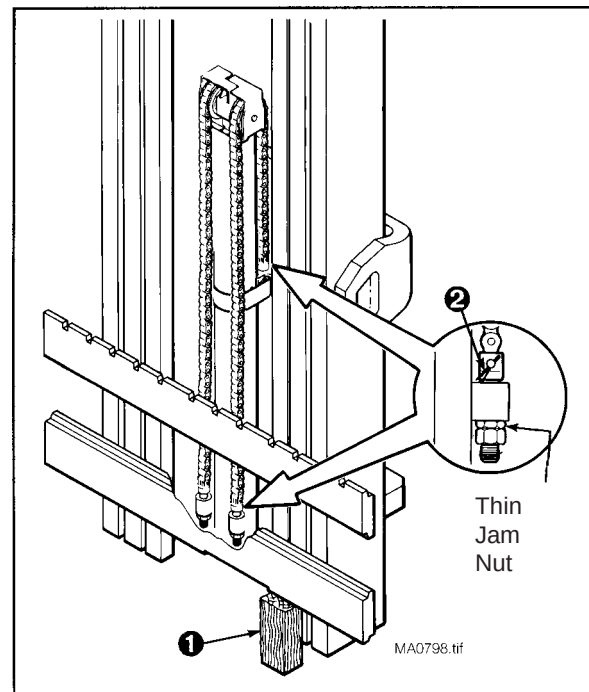


Figure 57.Free Lift Chains.

Manual Change Summary

R3 - 07/20/05

Remove description "cushion" and "pneumatic" from figures 5 and 53.

Add note to page 30.

Add nameplate to figure 1.

Do you have any questions that need to be answered right now?

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