SS030BF (A474), FS030BF (A497), OS030EF (D801), OS030BF (E826)
SERVICE MANUAL CONTENTS

PART NO. 550032940 (10/14)

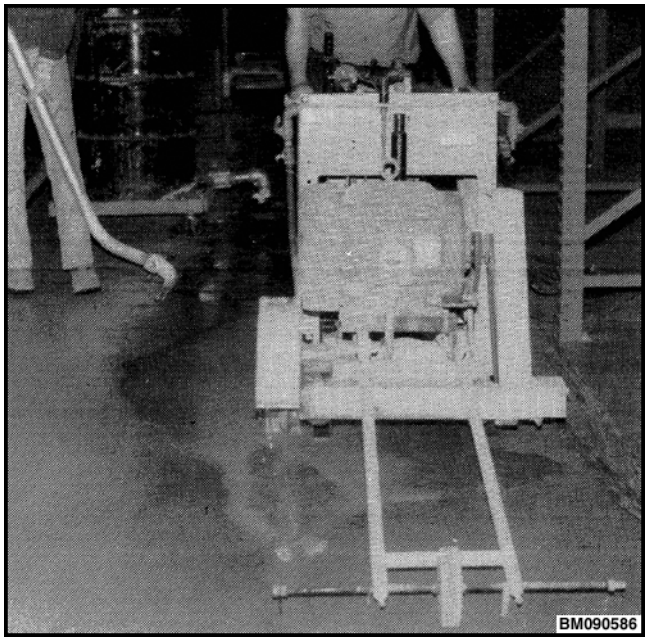


Figure 11. Vacuum Slurry Immediately

16. Saw alignment is critical at all times. If the chalk line is difficult to see, a flashlight can be used. See Figure 10.

⚠ WARNING

If water is used with the electric hand saw, the saw MUST have an insulated case and care must be taken to prevent electrical shock.

17. For short distances, to widen the slot for expansion loops, and to deepen the slot when needed, an electric hand saw can be used. See Figure 12. Although this can be a dry cut, a water supply for cooling and lubrication is better. A water type fire extinguisher filled with water can be used.

18. No special care is given to the slot after cutting. It can be left overnight without covering it. If left for long periods, duct tape can be used to keep the slot free of dirt.

19. Inspect the entire slot (especially guided sections) to locate any metal in the slot path that was not visible at the surface. Rebar, conduit, or pipe are some examples. If the conduit or pipe are still in use, an agreement must be made with the customer on the solution to the problem. Remove any metal within 50.8 mm (2 in.) of the slot. Fill the area with epoxy and grind the epoxy flush with the surface. Cut the slot through the filled area.

20. Just prior to laying the wire, the slot must be cleared using an ice pick or similar instrument. Then vacuum the slot and surrounding area, to make sure there are no granules left in the slot. See Figure 13.

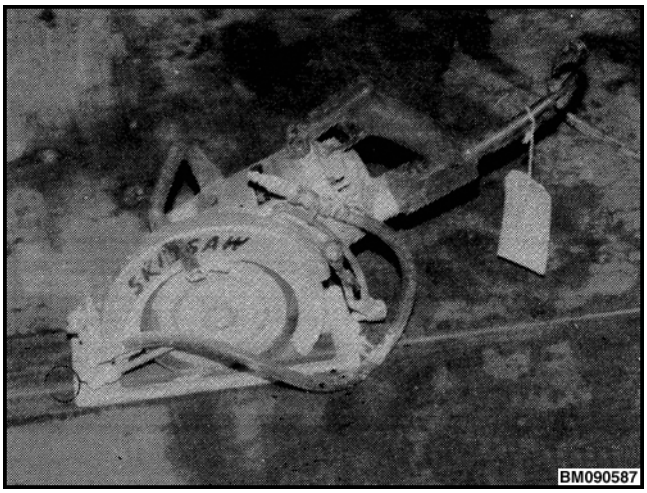


Figure 12. Electric Hand Saw

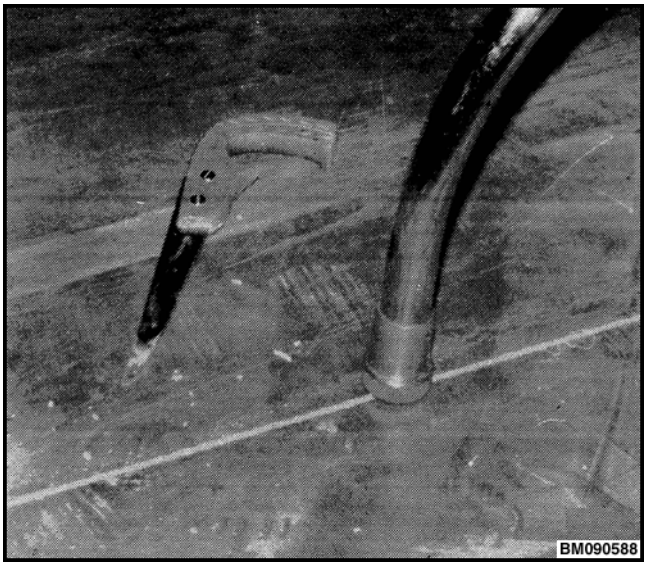
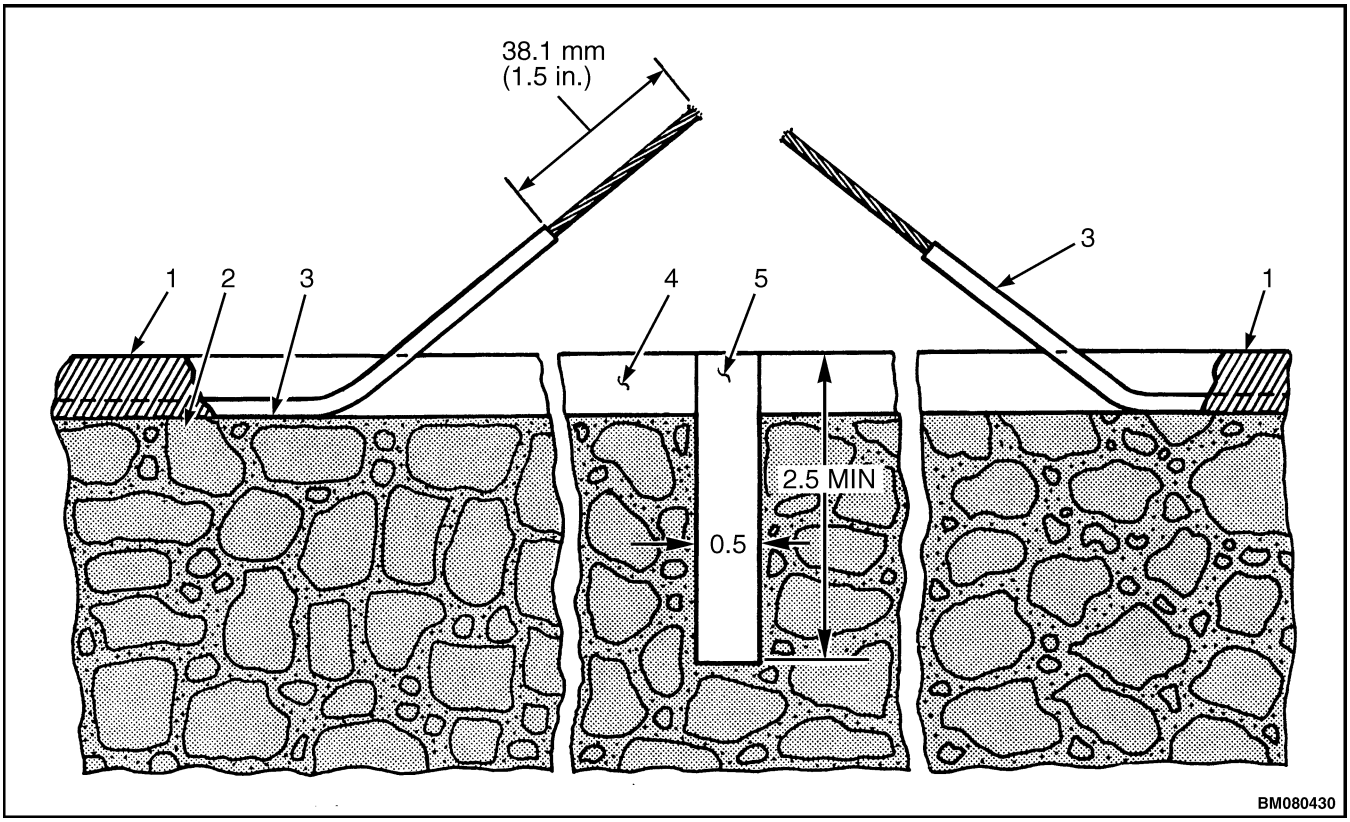


Figure 13. Vacuum Slot

21. The wire is installed in the slot directly from the reel. A blunt instrument is used to press the wire into the bottom of the slot. The instrument shown in Figure 14 is a keyhole saw with the blade ground smooth. If necessary, use pieces of cork or cardboard to keep the wire in the bottom of the saw cut. It is important for correct guidance that the wire is kept at the bottom of the saw cut. The cork or cardboard must be a tight fit in the slot to hold the wire at the bottom of the slot.

Table 3. General Specifications (Continued)

Item or Area		Specification
6.	Floor Flatness Lift Heights to 6096 mm (240 in.)	Floor flatness of Face F65 is recommended. In the direction for truck travel, the elevation between any two points separated by 1828.8 mm (72 in.) will not exceed 4.318 mm (1/6 or 0.17 in.) and will not change at a rate greater than 3.556 mm (1/7 or 0.14 in.) per 0.3048 m (1 ft) of travel across the floor. Areas that do not meet the specification must be corrected (filled or ground) to specification. Perpendicular to the direction of truck travel, the elevation difference between any two points separated by 1371.6 mm (54 in.) will not exceed 3.556 mm (1/7 or 0.14 in.) and will not change at a rate greater than 3.556 mm (1/7 or 0.14 in.) per 0.3048 m (1 ft) of travel across the floor. In any direction, the elevation difference between any two points separated by 304.8 mm (12 in.) will not exceed 1.778 mm (1/14 or 0.07 in.) and will not change at a greater rate than 1.778 mm (1/14 or 0.07 in.) per 0.3048 m (1 ft) of travel across the floor. Areas that do not meet this specification must be corrected (grounded or filled) to specification. Sharp discontinuities in truck aisle must be filled or ground so that there is no jolting of the truck.
7.	Floor Flatness Lift Heights Above 6096 mm (240 in.)	Floor flatness of a Face F95 is recommended. In the direction of truck travel, the elevation difference between any two points separated by 1828.8 mm (72 in.) will not exceed 2.794 mm (1/9 or 0.11 in.) and will not change at a rate greater than 2.032 mm (1/12 or 0.08 in.) per 0.3048 m (1 ft) of travel across the floor. Areas that do not meet this specification must be corrected (grounded or filled) to specification. Perpendicular to the direction of truck travel, the elevation difference between any two points separated by 1371.6 mm (54 in.) will not exceed 2.54 mm (1/10 or 0.10 in.) and will not change at rate greater than 2.032 mm (1/12 or 0.08 in.) per 0.3048 m (1 ft) of travel across the floor. In any direction, the elevation difference between any two points separated by 304.8 mm (12 in.) will not exceed 1.0668 mm (1/24 or 0.042 in.) and will not change at a rate greater than 1.0668 mm (1/24 or 0.042 in.) per 0.3048 m (1 ft) of travel across the floor. Areas that do not meet this specification must be corrected (filled or ground) to specification. Sharp discontinuities in truck aisle must be filled or ground so there is no jolting of the truck.
8.	Floor Magnetic Condition	Guidance sensors respond to a magnetic field from the guide wire. Therefore, all hard topping or any iron or steel must be evenly distributed within 609.6 mm (24 in.) on both sides of the guide wire. Wire mesh and rebar must be at least 101.6 mm (4 in.) below the guide wire. Other magnetic materials, such as pipes, rails, and drains must be at least 152.4 mm (6 in.) below the guide wire. Other guide wires in the floor with the same or different frequencies must be at least 762 mm (30 in.) away from the guide wire in the guide path.



1. ELASTIC CAULKING
2. CONCRETE
3. GUIDE WIRE
4. SLOT
5. HOLE

Figure 5. Guide Wire Preparation

5. Put a 101.6 mm (4.0 in.) length of shrinkable tubing on each wire. See Figure 6.

6. Cut a 355.6 mm (14.0 in.) length of jumper wire and strip 38.1 mm (1.5 in.) of insulation from each end. Twist the wire strands together.

NOTE: The splice **MUST** be soldered to provide the required conductance and corrosion resistance.

7. Connect the jumper wire and each end of the guide wire using the "Western Union" splice. Solder each splice using a 60% tin, 40% lead, non-activated rosin core solder.

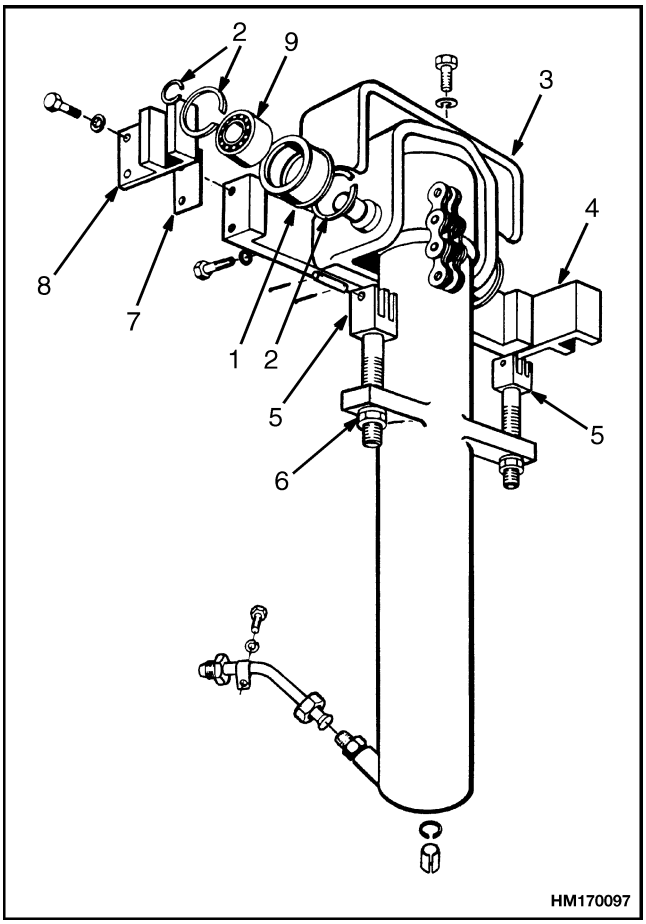
8. Center the shrinkable tubing over each splice and use a heat gun to shrink the tubing in place.

9. Seal each splice using sealant.

10. Make a loop in the jumper wire centered over the hole. See Figure 7.

11. Put the wire in the groove and push the loop in the hole so the wire lays flat in the bottom of the slot.

12. Fill the slot with elastic caulking (silastic silicone).



1. SHEAVE
2. SNAP RING
3. CROSSHEAD
4. CYLINDER GUIDE ASSEMBLY
5. CHAIN ANCHOR
6. WASHER AND NUT
7. SHIM
8. GUIDE SHOE
9. BEARING

Figure 7. Free-Lift Cylinder and Crosshead

Masts That Have Two Cylinders, Main Lift Cylinder and Free-Lift Cylinder

1. Remove the free-lift cylinder as described in the section above for removing a lift cylinder fastened to a crosshead.

2. Remove the main lift cylinder as described in the section above for removing a lift cylinder fastened to an inner mast.

DISASSEMBLE

WARNING

Use slings and a crane to handle and disassemble the lift cylinders of most lift trucks. Make sure that the crane and slings can lift the load.

CAUTION

Carefully disassemble and assemble the lift cylinders so that the rods and sliding surfaces are not damaged.

NOTE: Disassembly of single-stage and two-stage lift cylinders is the same except the two-stage lift cylinder has a second piston rod assembly. The disassembly of the secondary piston rod assembly is similar to the disassembly of the primary piston rod assembly.

1. Loosen the retainer with a spanner. Disconnect the retainer from the shell. See Figure 8 and Figure 9.

2. Remove the cap from the inlet and slide the piston rod assembly from the shell. Use drain pans for the hydraulic oil.

3. Remove the retainer from the piston rod. Remove and discard the O-rings, seals, and bearings.

4. Remove the internal check valve.

5. Remove the lowering control valve.

6. Clean all the parts. Check the sliding surfaces for damage. Repair or replace any damaged parts.

ASSEMBLE

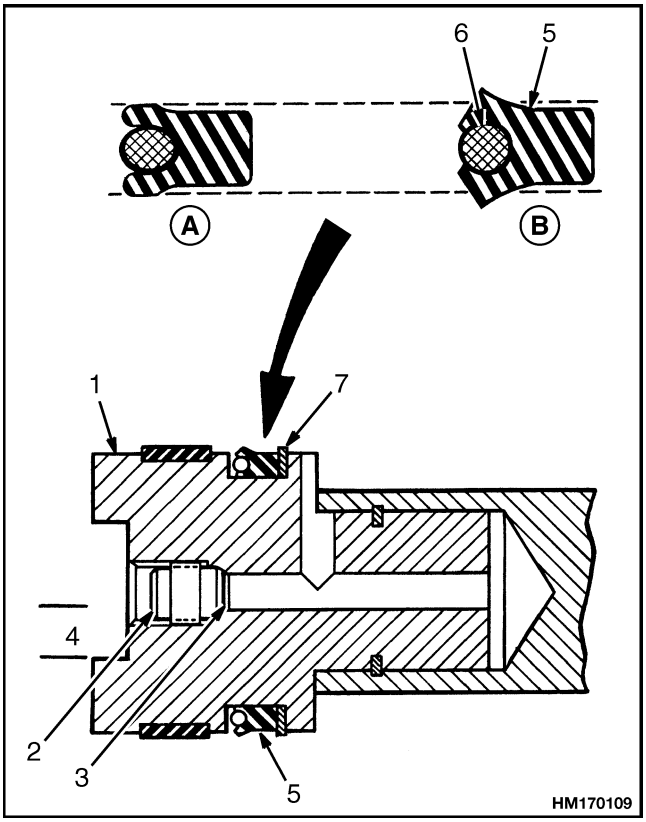
NOTE: Lubricate all internal parts of the lift cylinder with hydraulic oil during assembly.

Use new O-rings, seals, and bearings. Apply lubricant during assembly. Packing lubricant (Part Number 504234269) is available.

Make sure the single-lip seal assemblies are installed with the O-ring toward the base of the lift cylinder.

The spacers control the maximum stroke of the piston rod assembly. If a new spacer is necessary, make sure the same size spacer is installed.

1. Install the internal check valve. Make sure the arrow on the internal check valve is toward the base of the piston.



A. INSTALLED

B. NOT INSTALLED

1. PISTON AND ROD ASSEMBLY
2. CHECK VALVE
3. O-RING
4. INLET AND OUTLET PORT
5. SINGLE-LIP SEAL
6. O-RING
7. BACKUP RING

Figure 13. Internal Check Valve and Single-Lip Seal

DISASSEMBLE

WARNING

Use slings and a crane to handle and disassemble the lift cylinders of most lift trucks. Make sure that the crane and slings can lift the load correctly.

CAUTION

Carefully disassemble and assemble the lift cylinders so that the piston rods and sliding surfaces are not damaged.

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

1. Loosen the retainer with a spanner. Disconnect the retainer from the shell.

2. Remove the protective cap from the inlet and slide the rod and piston assembly from the shell. Drain the hydraulic oil into a container.

NOTE: To remove the retainer, the piston rod and piston assembly must be disassembled if the lift cylinder is the type shown in Figure 12. Use the following procedure:

a. Put a round bar through the 7.9 mm (0.31 in.) hole in the piston. Hold the rod in a vise or clamp so that it does not turn. Use the round bar and turn the threaded piston from the piston rod.

b. If an adhesive was used on the threaded rod and piston, heat the rod to a maximum of 170 to 225°C (300 to 400°F) to loosen the adhesive.

3. Remove the retainer from the piston rod. Remove and discard the O-rings, seals, and bearings.

4. Remove the internal check valve from the base of the lift cylinder.

5. Clean all the parts. Check the sliding surfaces for damage. Repair or replace any damaged parts.

ASSEMBLE

NOTE:
- Lubricate all internal parts of the lift cylinder with hydraulic oil during assembly.
- Use new O-rings, seals, and bearings. Apply lubricant (hydraulic oil) during assembly. Packing lubricant (Part No. 504234269) is also available.
- Make sure the single-lip seal assemblies are installed with the O-ring toward the base of the lift cylinder. (See Figure 13.)

CAUTION

A difficult and important step in assembling lift cylinders is the correct installation of the seals. Most lift cylinder maintenance is caused by seal leaks.

1. Install the internal check valve, if installed. Make sure the arrow on the internal check valve is toward the base of the piston.

2. Install the wear ring, single lip seal, and backup ring onto the piston assembly. If a spacer sleeve is used, install it. Use shim material and a clamp as a guide to move the single-lip seal over the threads of the shell.

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- The Service Manuals are updated on a regular basis, but may not reflect recent design changes to the product. Updated technical service information may be available from your local authorized Yale® dealer. Service Manuals provide general guidelines for maintenance and service and are intended for use by trained and experienced technicians. Failure to properly maintain equipment or to follow instructions contained in the Service Manual could result in damage to the products, personal injury, property damage or death.
- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **YALE APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

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

WARNING

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

CAUTION

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

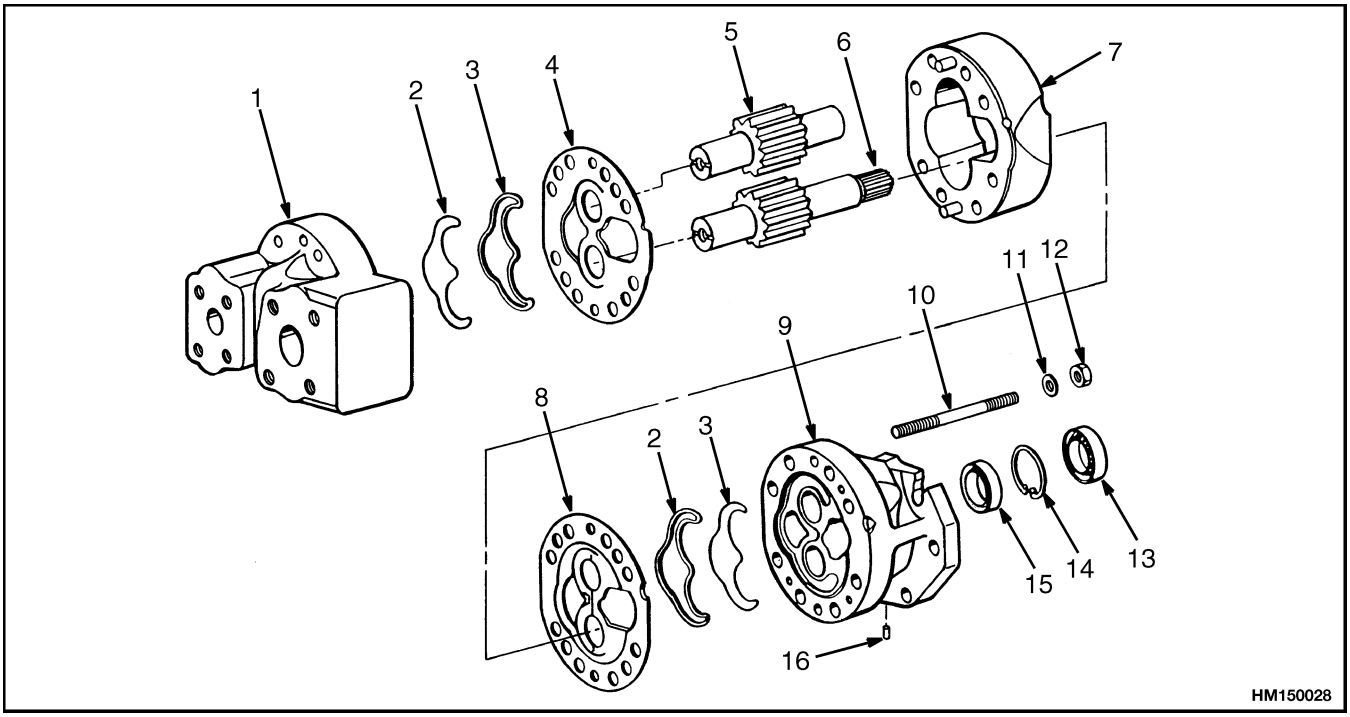
On the lift truck, the WARNING symbol and word are on orange background. The CAUTION symbol and word are on yellow background.

FASTENER TORQUE TABLES

*Table 5. Torque Values for Metric Fasteners**

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

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



NOTE: THERE CAN BE A VARIATION OF INTERNAL PARTS ON DIFFERENT MODELS OF LIFT TRUCKS.

1. REAR COVER
2. SEAL GLAND
3. SEAL RETAINER
4. REAR WEAR PLATE
5. DRIVEN GEAR
6. DRIVE GEAR
7. GEAR HOUSING
8. FRONT WEAR PLATE
9. FRONT COVER
10. STUD
11. WASHER
12. NUT
13. SEAL
14. SNAP RING
15. SEAL
16. PIN

Figure 7. Hydraulic Gear Pump Single-Stage

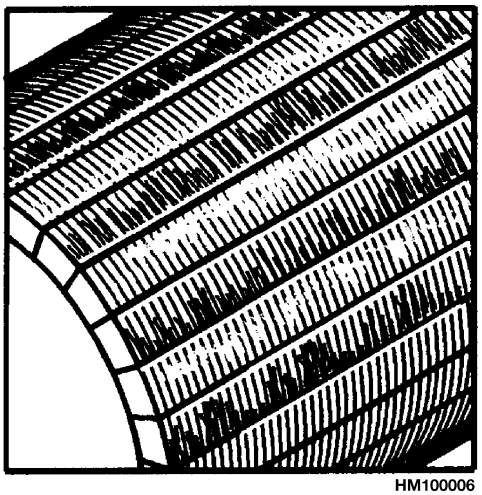
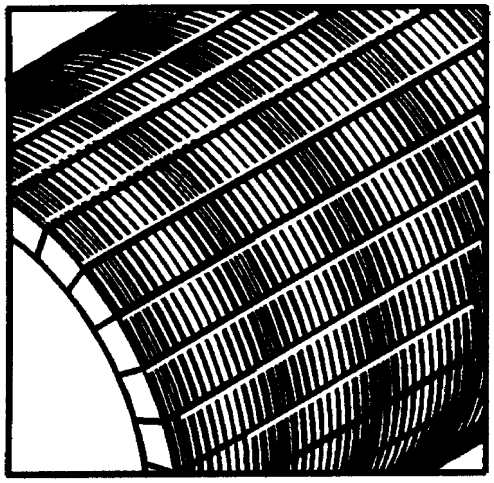
NOTE: Some pump bodies will show gear marks where the gears rotate because of the small clearances between the parts. These gear marks do not indicate a worn or damaged pump unless the pump will not supply the volume and pressure shown in the specifications.

3. Inspect gear housing for wear or grooves. Most wear occurs on the inlet side of the gear chamber. Put a straight edge across the inlet side of the gear chamber. If a 0.13 mm (0.005 in.) thickness gauge fits between the straight edge and the housing, the gear housing must be replaced. If the gear housing is worn, inspect bearings for wear. If the system pressure is too high, the gear housings will wear quickly. Grooves in the gear chamber indicate dirt is in the oil. Small holes in the outlet side of the gear chamber indicate that cavitation has occurred. Make sure inlet hose, fittings, and tank have no restrictions. Cavitation can also occur when the engine speed is too high.

If the surfaces of the gear chamber or gear teeth have blue marks, the pump was too hot. Heat damage in the pump can be caused by hot oil or lack of oil. Check front seal surface to see if air was entering the pump through the front seal. Make sure the oil is the correct viscosity. The wrong viscosity oil can increase leakage within the pump. Leakage inside the pump increases the oil temperature.

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Air in the hydraulic system.	Low oil level in hydraulic tank.	Fill hydraulic oil tank to correct level.
	Leak in inlet hose.	Replace inlet hose.
	Loose inlet fitting.	Tighten inlet fitting.
	Breather on hydraulic tank has a restriction.	Replace hydraulic tank breather.
	Supply hose is twisted or has a restriction.	Remove twist or remove restriction.
	Screen in hydraulic tank has a restriction.	Clean hydraulic tank screen.
	Pump seal is damaged.	Replace pump seal.
	Check valve in pump is damaged.	Replace check valve.
	Pump housing capscrews are loose.	Tighten pump housing screws to correct torque.
	Worn or damaged hydraulic pump.	Repair or replace hydraulic pump.

Table 1. Normal Commutator Surfaces (Continued)

A condition called slot bar marking is also normal if the commutator surface is smooth. The variable color occurs in a pattern according to the number of conductors per slot.  HM100006	A very dark surface is also a normal and an acceptable condition if the commutator surface is smooth.  HM100008

STEERING PUMP MOTOR

NOTE: Some electrical trucks use a steering pump motor. Refer to your truck model's service manual for instructions on removal and installation of steering pump motors.

1. Disconnect battery connector. Remove floor plate from lift truck for access to steering pump motor. Open hood for access to motor. Remove screws that hold two brush cover plates to motor housing.
2. Inspect brushes and commutator as described in previous paragraphs for traction and hydraulic pump motors. The brush replacement procedure is also the same, although there are only two brushes for the steering pump motor. See Table 3.
3. Install brush covers and screws. Install floor plate or close hood and connect battery connector.

NORMAL COMMUTATOR SURFACE

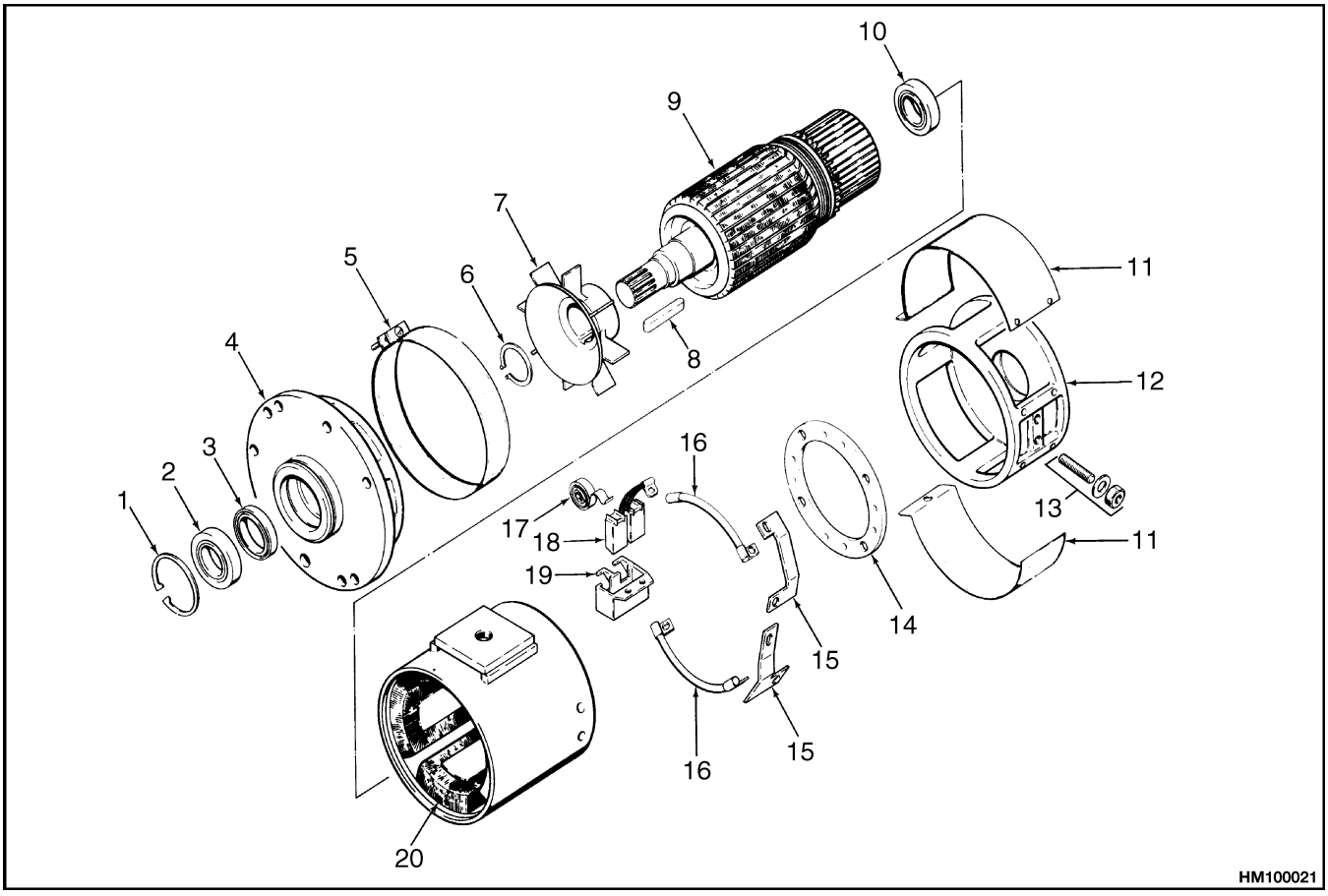
A commutator that has been in service will have a smooth and polished surface with a darker brown color where it rotates under the brushes. See Table 1. A variation of color on the commutator surface between light brown and darker brown is normal. This surface condition is the lubrication between the commutator and the brushes. The brushes will wear rapidly if this surface condition does not develop during the first 6 to 10 hours of operation after a commutator with a new surface is installed.

Steering Pump Motor

NOTE: Some lift trucks could be equipped with a Brushless DC Power Steering motor, which is non-repairable.

NOTE: Some electrical trucks use a steering pump motor. Refer to the service manual for your truck model for instructions on the removal and installation of steering pump motors.

1. See **Power Steering Motor and Pump** for the removal and installation procedures for the steering pump motor. Make index marks on the steering pump and the drive end frame of the motor. Remove two capscrews that hold steering pump to motor. Remove pump and allow oil to drain from drive end frame.
2. Remove brush covers. See Figure 2. Remove two screws that hold brushes and terminal wires to brush holders. Pull brush springs out of the way and pull two brushes from holders.



1. SNAP RING
2. BEARING
3. SEAL
4. DRIVE END FRAME
5. FAN COVER
6. SNAP RING
7. FAN
8. KEY
9. ARMATURE
10. BEARING
11. BRUSH COVER
12. COMMUTATOR END FRAME
13. TERMINAL
14. BRUSH MOUNTING PLATE
15. BUS CONNECTOR
16. WIRE
17. BRUSH SPRING
18. BRUSH
19. BRUSH HOLDER
20. FIELD FRAME

Figure 9. Typical Traction Motor (Example 2)

NOTES

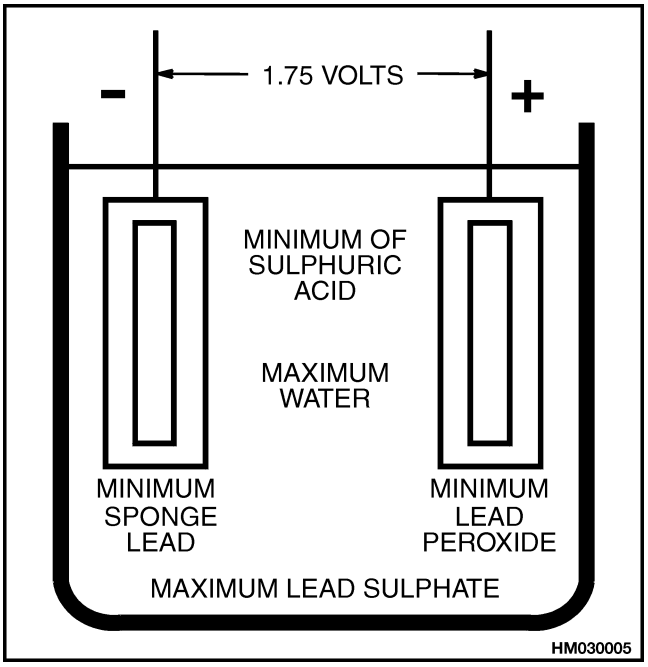


Figure 5. Discharged Cell

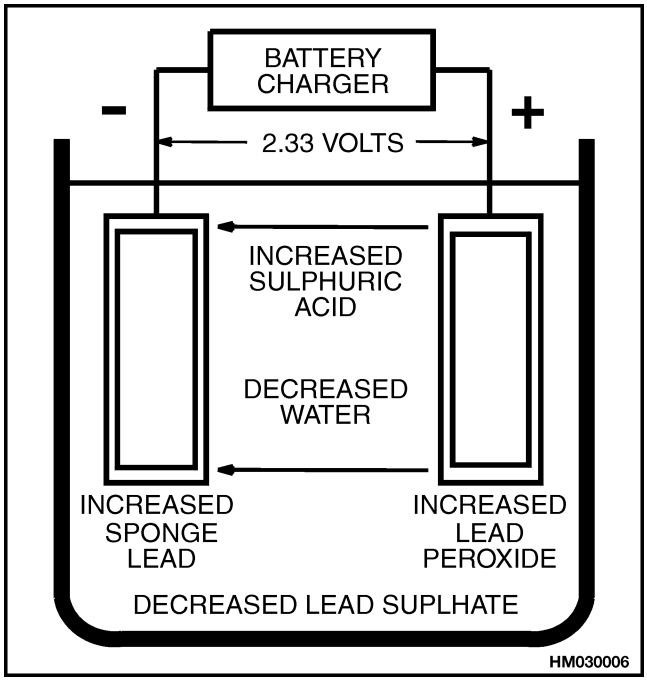


Figure 6. Charging Cell

Electrical Terms

Voltage: Is an electromotive force (EMF) (also called "potential difference") caused by the difference in electric charge between two points. See Figure 7.

Ampere: Is a measurement of electric current.

Watt: Is a measure of electric power. The number of watts is equal to the number of volts multiplied by the number of amperes. A kilowatt-hour is 1000 watts of electric power used in 1 hour.

Ohms: Is the measurement of electrical resistance.

Polarity: In a battery, the electric current is shown to flow from the positive terminal to the negative terminal.

Maintenance-Free Battery: The electrolyte level in the battery does not need to be checked during the life of the battery. Maintenance-free batteries use a calcium alloy of lead instead of an antimony alloy, which reduces the amount of electrolysis. In a maintenance-free battery, the amount of free-standing electrolyte above the plates is much higher, ensuring enough electrolytes to keep the plates covered during extended periods of use. Therefore, there is no need to add water to a maintenance-free battery during the course of its life.

Flooded Cell: This is a lead acid battery that has free flowing electrolyte fluid in each cell of the battery. The electrolyte is a mixture of sulfuric acid and water.

Direct Current (DC): When the voltage between the two terminals is always the same polarity, the current flow and voltage are called Direct Current.

Alternating Current (AC): When the polarity of voltage between two terminals is changing between positive and negative at a quick and constant rate, the voltage is called Alternating Current.

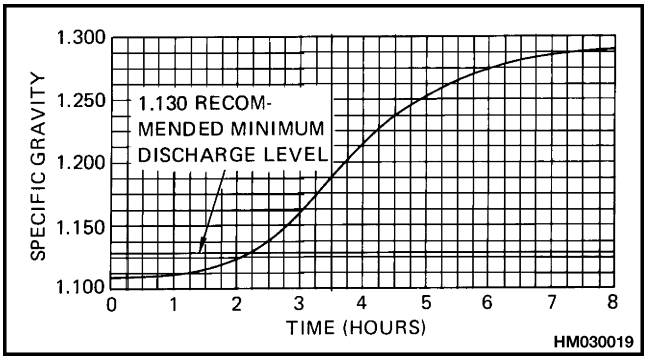


Figure 18. Specific Gravity Compared to Charging Time

Methods of Charging

There are three methods of charging a battery.

1. GRADUAL CHARGE. This method uses a solid-state automatic battery charger. The charging rate begins at 20 to 25 amps/100 amp-hours and decreases to less than 5 amps/100 amp-hours when the battery is 80 percent charged. The charging current decreases when the voltage across the cell increases during the charging cycle shown in Figure 19. The increase in the voltage from the charger is approximately the same as the increase in the specific gravity in the cells.

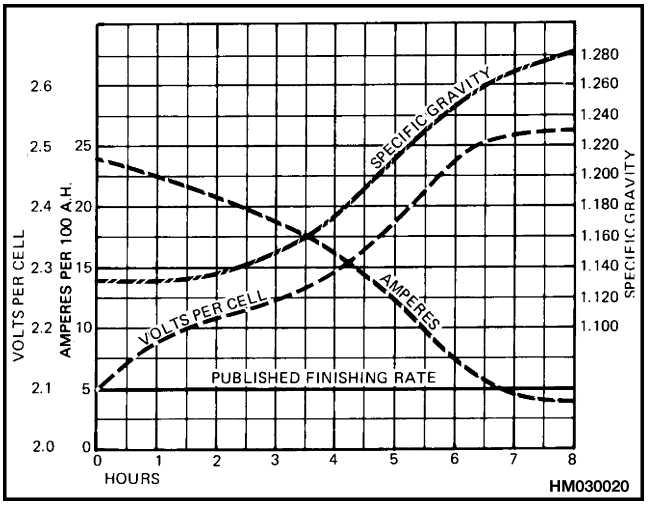


Figure 19. Specific Gravity Compared to Charging Time

2. MODIFIED CONSTANT VOLTAGE. This method uses a generator to generate a constant voltage that is controlled by a resistor. When the charging current decreases, the voltage across the resistor increases. The increasing voltage across the resistor causes an increasing voltage at the battery terminals. The charging is similar to the gradual charge. The resistor must be correctly set, or the charging rate will be wrong. The typical graphs for a modified constant voltage charger are shown in Figure 20.

3. TWO-RATE CHARGE. This method also uses a high charging rate at the beginning followed by a lower rate. Two resistors control the charging rate. One resistor controls the charging rate at the beginning of the cycle and a second resistor reduces the charging rate when the voltage in the cells reaches 2.37 volts. A relay automatically controls the second resistor. The two-rate charging cycle is shown in Figure 21.

NOTE: Many users have battery chargers that can follow a program to automatically charge a battery according to recommendations of the battery manufacturer. Use the recommendations of the battery manufacturer for charging the battery.

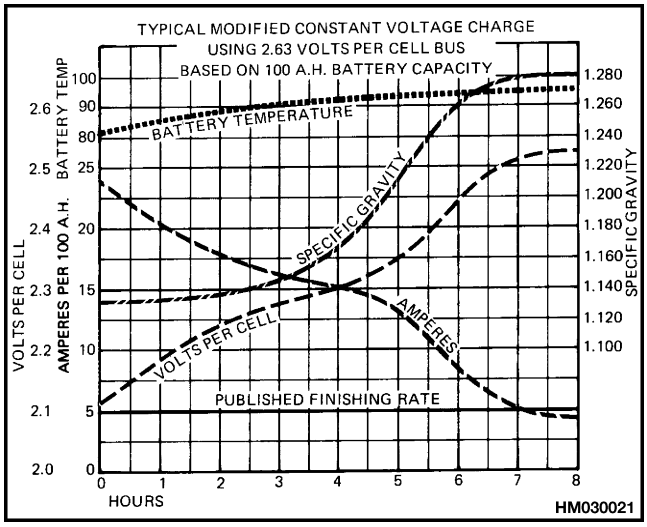


Figure 20. Modified Constant Voltage Charger

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

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

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

WARNING

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

CAUTION

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

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

NOTES

Two-Stage Mast

DESCRIPTION

The two-stage mast assembly has two weldments: the inner mast weldment and the outer mast weldment. See Figure 3. The inner mast weldment has a load roller on each bottom channel section. The load rollers travel along the channels within the outer mast weldment. The outer mast weldment has one load roller located at the top of the inside of each channel. The outside channels of the inner mast weldment travel on the load rollers during channel movement. The load rollers permit control of the forces during movement of the mast. These forces are from the front, back, and sides. Wear strips are used to control forces from front to back. The wear strips are on the inside edge of the channels of the outer mast weldment. Shims and springs are used under the wear strips to keep the correct clearance between the weldments.

The two-stage mast assembly has two single-stage main cylinders that are installed vertically behind each channel of the outer mast weldment. The base of the main cylinders fits into pins that are located in the bottom crossmember of the outer mast weldment. Lock plates are used to position the main cylinders. The lock plates are bolted to the lower end of each outer mast channel. Removable supports for the main cylinders are bolted to the chain anchor weldments. The rods of each main cylinder are fastened to the top crossmember of the inner mast weldment with a snap ring. The inner mast weldment extends from the outer mast weldment as the cylinder rods extend. The weight of the weldment or operator platform causes the cylinder rods to retract. An additional plate is bolted to the mast to prevent cylinder bowing.

Two hoist chains control the movement of the operator platform. The chains fasten to the chain anchor supports that are welded on each channel of the outer mast weldment. The chains go up and over the chain sheaves and then connect to the operator platform. The chain sheaves are installed at the inside of the channels near the top of the inner mast weldment. The chains transfer the force from the main cylinders to the operator platform.

Legend for Figure 3

A. POSITION 1
B. POSITION 2
C. REAR VIEW HOSE ROUTING - LIFT

1. ELEVATING MAST WELDMENT
2. STATIONARY MAST WELDMENT
3. MAIN LIFT CYLINDER
   A. LOCK PLATE
   B. RETAINER
   C. SNAP RING
4. CHAIN ANCHOR
5. CHAIN SHEAVE ASSEMBLY (RH)
   A. CHAIN SHEAVE
   B. BALL BEARING
6. MAIN LIFT CHAIN
7. LOAD ROLLER
8. FLOW REGULATOR HOUSING
9. HYDRAULIC TUBE (MAIN LIFT)
10. HYDRAULIC HOSE (MAIN LIFT)
11. TRUNNION STUB SHAFT
12. TO TRUCK CONTROL VALVE

LIFT CYLINDERS

NOTE: The lift cylinders are removed during disassembly of the mast. To repair the cylinders, see the section **Lift Cylinders** 4000 YRM 135 for the correct service procedures.

ASSEMBLE

NOTE: The shims for the load rollers keep the channels of the mast weldments parallel and give correct clearance. During assembly, the arrangement of the shims will be the same or approximately the same as they were before disassembly. Check the clearance and adjust for wear or changes from the repairs. The strip bearings at the top of the outer mast weldment and the bottom of the inner mast weldment are also adjusted using shims. See the Checks and Adjustments in this section for the instructions to make the necessary adjustments.

1. Assemble the load rollers, sheaves, and strip bearings on the mast weldments and operator platform as necessary. Make sure to keep the same shim arrangement noted during disassembly. Apply a thin layer of multipurpose grease to the strip bearings and the bearing and roller surfaces of the channels.

2. Make sure the cylinders are assembled and install a sling near the center of the cylinder as during removal. Use a crane to move the cylinder into position in the outer mast weldment. Install the snap ring on the bottom of the cylinder. Install the capscrew, washer, and spacer to fasten the cylinder shell to the channel. Repeat the procedure to install the other cylinder.

3. Use the crane to move the inner mast weldment into position over the outer mast weldment. Fasten the slings to the centers of the channels to balance the weldment as during removal. Make sure the inner mast weldment is at approximately a 30-degree angle with the bottom load rollers in the notch near the top load rollers of the outer mast channels. Slowly lower the inner mast weldment and insert it into the outer mast weldment.

4. Check the clearance of the load rollers and the strip bearings. Make the necessary adjustments as described in Mast Adjustments.

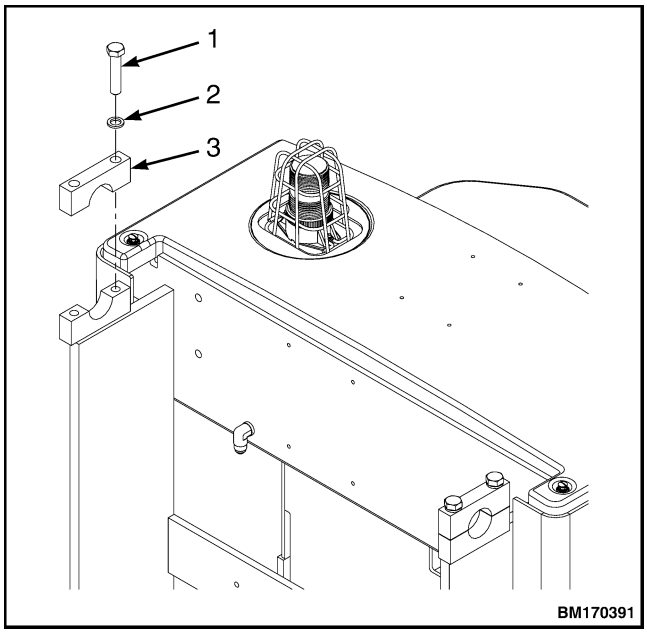
5. With the inner mast weldment approximately 152 to 305 mm (6 to 12 in.) out of the outer mast weldment, install the chain and hose sheaves. Move the inner mast weldment into the outer mast weldment so the tops of the cylinder rods are through the holes in the inner mast channels. Install the washers and snap rings to fasten the cylinder rods to the channels.

INSTALL

NOTE: If two hoists are available, connect one to the mast and the other to the base of the platform for stability. This will allow for easier mounting of the mast. Make sure the hoist and chains or straps have the capacity to lift the mast assembly.

1. Attach a chain or strap to the top of the mast and elevate the mast with the hoist. Ensure the mast cable on the mast is secure during installation of the mast.

2. On the chassis frame, the mast trunnion caps and capscrews allow the mast to attach securely to the frame. Remove the two bolts and caps on both sides of the chassis frame if they were reinstalled after the initial removal of the mast. See Figure 6.



1. CAPCREW
2. WASHER
3. TRUNNION CAP

Figure 6. Mast Trunnion

Troubleshooting

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
No movement of lifting cylinders.	Lift control linkage disconnected.	Connect lift control linkage.
	No oil or not enough oil to supply cylinders.	See the section **Periodic Maintenance** for the correct oil level. Fill hydraulic oil to correct level.
	Hydraulic leaks, bad pump or pump drive, relief valve set too low, bad check valve.	Repair leaks. Replace pump or pump drive. Adjust relief valve or replace check valve.
Slow action of lifting cylinders.	Not enough oil supply to cylinders.	See the section **Periodic Maintenance** for the correct oil level. Fill hydraulic oil to correct level.
	Bad cylinder seals.	Replace cylinder seals.
	Relief valve pressure is adjusted incorrectly.	Adjust relief valve pressure.
Rough movement of the mast assembly.	Air in the hydraulic system.	Purge air from system.
	Bent rods, cylinders with distortion or damage.	Repair or replace cylinders.
	Mast assembly damaged or not in alignment.	Inspect, repair, or align mast assembly.

Pivoted Connection

1. Make sure that the gear rim is clean and pay attention that no foreign substances or cleaning agents get through the threaded boreholes of the connecting structure into the transmission interior. See Figure 3.

2. Align the gear rim and bolt holes with the threaded boreholes of the connecting structure. Install the steering bearing on the correct side and turn it so the bolt holes are aligned with the hole pattern of the gear rim and the housing.

3. Install capscrews to 34 N•m (25 lbf ft) to fasten the steering bearing and the gear rim onto the connecting structure.

NOTE: Use Loctite® adhesive as needed. During disassembly and later reuse of the screws, the adhesive remaining on the thread must be removed and new screws must be used.

The fixing bolts should be checked at fixed intervals or operating hours, especially in case of high breakdown torque load or suspended axial load.

DISASSEMBLE

To disassemble, reverse the assembly process explained in previous section.

INSTALL

⚠ WARNING

The lift truck and components are heavy. Be sure that all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the lift truck or component to avoid personal injury.

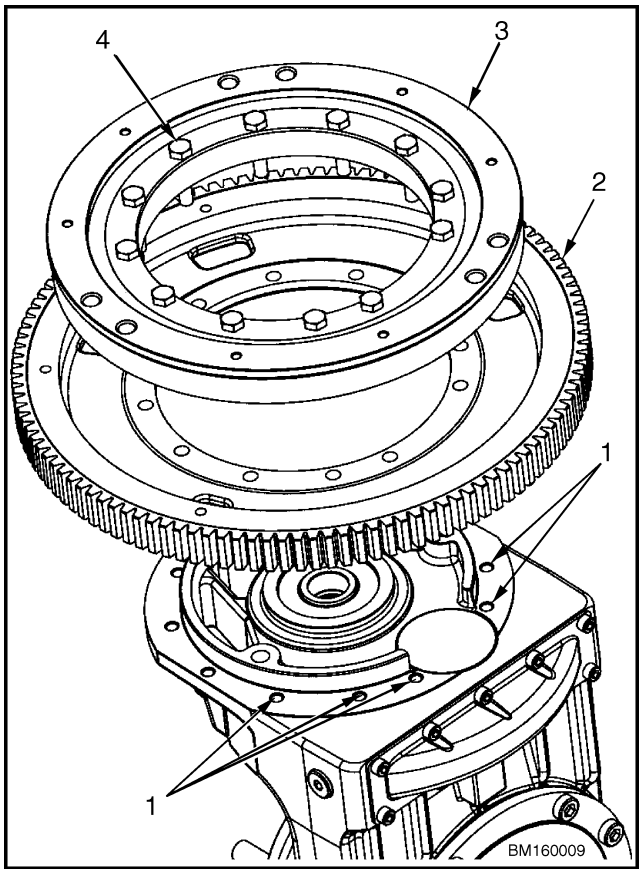
1. Use a crane and chain or sling with appropriate capacity to lift the frame. Lift the frame for enough clearance to slide the MDU under the frame. Temporarily install blocks under the frame to prevent lowering. Lay the MDU under the drive chassis.

2. Move the MDU into approximate alignment under the frame.

3. Align both the MDU with the screw holes and the steer gear with the axle pilot hole. Carefully raise the frame and remove the blocks. Lower the frame and align the capscrew holes in the large ball bearing and the frame.

4. Install the capscrews and lockwashers that fasten the MDU to the frame. Use cross pattern to tighten the capscrews to the appropriate torque. Make sure the steering bearing is in the correct position around the complete circumference.

5. Fill the MDU to the level/fill plug using the proper oil. The proper lubricants are listed in the **Operating Manual** or the section **Periodic Maintenance** 8000 YRM 1472. Add oil slowly. The oil passes through the bearings to the lower part of the MDU.



1. BOREHOLES
2. GEAR RIM
3. STEERING BEARING
4. CAPSCREWS

Figure 3. Steering

Traction Motor Repair

REMOVE

WARNING

The AC traction motor is heavy. To prevent injury, use a lifting device of adequate capacity for lifting the assembly.

It is not necessary to remove the traction motor from the lift truck to make some repairs. Perform only the steps necessary to safely complete the required service.

WARNING

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

1. Turn the key switch to the **OFF** position and disconnect the battery connector. Discharge the capacitors. See Special Precautions in this manual.
2. Disconnect and remove the battery. Use the battery removal procedure described in either the **Operating Manual** or the section **Periodic Maintenance** 8000 YRM 1472.
3. Remove the electrical compartment cover for access to the traction motor controller. Remove the capscrews retaining the cover to the frame.
4. Open the drive unit compartment doors and fasten each door so that they are fully open. Put a pan under the MDU drain and remove the plug. After the oil has completely drained, reinstall the drain plug. Torque to 22 N•m (16 lbf ft).

NOTE: The brake may be removed at this point. However, it is not necessary to remove the brake if the motor will not be disassembled.

5. Remove the brake from the top of the traction motor if necessary. See **Brake System** 1800 YRM 1463.
6. Identify, tag, and disconnect the power cables and wiring connecting the traction motor to the truck electrical system.

WARNING

The motor is heavy. Use appropriate lifting equipment to avoid personal injury.

7. Remove the capscrews and lockwashers that fasten the traction motor to the drive unit bearing.
8. Attach a sling and lifting device to the traction motor. Lift the motor from the drive unit and position it securely at a suitable work station. Remove the sling from the motor.

DISASSEMBLE

WARNING

The bearings and seals on the traction motor are serviceable parts. The AC traction motor weighs 42.2 kg (93 lb). To prevent injury, use a lifting device of adequate capacity for lifting the assembly.

NOTE: When replacing the encoder bearing, also replace the bearing on the drive end of the motor (if applicable).

1. Remove traction motor from the lift truck. See removal information in this section.
2. Screw lifting eye into the threaded hole in the end of the rotor shaft and connect a chain to the lifting eye.
3. Remove temperature sensor wire and encoder wire from holding bracket. See Figure 2.
4. Remove screws from the non drive rear end bell.
5. Place alignment marks on the end bell and motor case. Marks will be used to correctly align the end bell on the motor case during assembly.
6. Lift end bell and rotor assembly from AC motor case. Place horizontally on a flat surface.
7. Remove chain and lifting eye.
8. Remove screws from air guide.
9. Remove end bell from rotor assembly. See Figure 3.

Troubleshooting

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Truck moves slow or in a jerky motion.	Encoder broken.	Replace encoder bearing.
	Encoder wire broken.	Check and repair encoder wire or replace encoder bearing.
Stator shorting.	Loss of insulation in wire.	Disconnect the battery and check resistance between winding and case. Resistance should be at 50,000 ohms or above.
Stator open circuit.	Broken coil windings.	Raise drive wheel off the floor and verify voltage at motor terminals. Disconnect the battery and check resistance of windings.

CAUTION

It is very important that the centering MDU proximity sensor be connected to the EPS AC0 controller and that the sensor air gap is set correctly prior to key-on. If the proximity sensor is not in place and not able to sense the target plate, then the steer system will hit the mechanical stops at key-on. See step 6 under the section "Steering Proximity Switch" to set the air gap between prox sensor and target plate.

CAUTION

If the steer system hits the mechanical stops, then the steer motor and gear reduction assembly must be replaced.

Check Steering System for Correct Operation

The EPS controller checks for the steer input sensor and the centering MDU proximity sensor at key-on.

1. Make sure the battery has a correct specific gravity of at least 1.250. Move the key switch to the **ON** position and press the foot switch. The motor compartment door must be open to check the drive wheel position.
2. Check the system for correct operation: Move the steering handle or steering wheel from a full left turn position to a full right turn position. The master drive unit should move 85 to 95 degrees in each direction from straight travel. There is also a drive wheel position indicator on the Dash Display. The indicator should register plus or minus 90 degrees at the maximum turn angle.
3. If the master drive unit moves less than 90 degrees (±5 degrees) in either direction, the steering is incorrectly adjusted or may have a mechanical problem or require calibration.
4. Check that the master drive unit moves through the full range of rotation in 5 seconds or less. The lift truck must be on smooth concrete with a fully charged battery and no load.
5. If the master drive unit requires greater than 5 seconds to move through the full range of rotation, check for a mechanical problem or defective EPS Unit.
6. Interlock - During startup the Smart Steer input control must all be in the neutral position. This is commonly referred as Static Return to Off (SRO). The Display will note the following message if the input sensor is not in the neutral position.

AUTO-CTR STR

NOT NEUTRAL

NOTE: Calibration of the steer input control sensor may be required to remove this message.

Check High Lift Traction Speed Reduction and Shutoff

1. The traction system should be reduced or should **NOT** operate with the operator platform above a certain height. See Table 1 for the height specifications.

Table 1. Platform Heights

Model	Steer Angle	Speed Reduction Height	Shutoff Height
OS030EF	<10°	Above 1524 mm (60 in.)	Above 3810 mm (150 in.)
	>10°	Above 610 mm (24 in.)	Above 3810 mm (150 in.)
OS030BF	<10°	Above 1524 mm (60 in.)	Above 5380 mm (212 in.)
	>10°	Above 610 mm (24 in.)	Above 3810 mm (150 in.)

Troubleshooting

NOTE: Refer to **Diagrams** 8000 YRM 1473 for diagnosis and troubleshooting of steer related fault codes.

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Truck will not move or steer.	Battery disconnected.	Connect battery.
	Shutoff has occurred.	Set key to **OFF** position, wait 2 seconds, then set key to **START**, then to **ON** position.
No action when steering wheel/handle is turned.	Open circuit in wiring between encoder and EPS.	Check and repair wiring.
	Encoder defective.	Replace encoder.
	No motor speed encoder signal.	Test for voltage change at encoder. If no voltage change, replace encoder. If voltage changes, check wiring. If wiring is good, replace encoder.
	No output from EPS to steer motor.	Replace EPS unit.
	Power leads defective between EPS and steer motor.	Check all power connections.
	Steering proximity switch defective.	Replace proximity switch.
	Steering proximity switch gap too large (Self-Centering Steering only).	Adjust gap to 5 mm (0.2 in.).
	Centering proximity switch defective (Self-Centering Steering only).	Replace proximity switch.
	Steer motor defective.	Replace steer motor.
Truck turns in direction opposite to direction steered.	Steer motor power leads reversed.	Connect steer motor leads correctly.
	Motor speed encoder channel reversed in wiring.	Correct encoder channel wiring.
Drive wheel locks up at a given angle.	Gear reduction unit is defective.	Replace gear reduction unit or complete steer unit assembly.
	Drive wheel blocked.	Remove obstruction from drive wheel.

Repair

AIR GAP

CAUTION

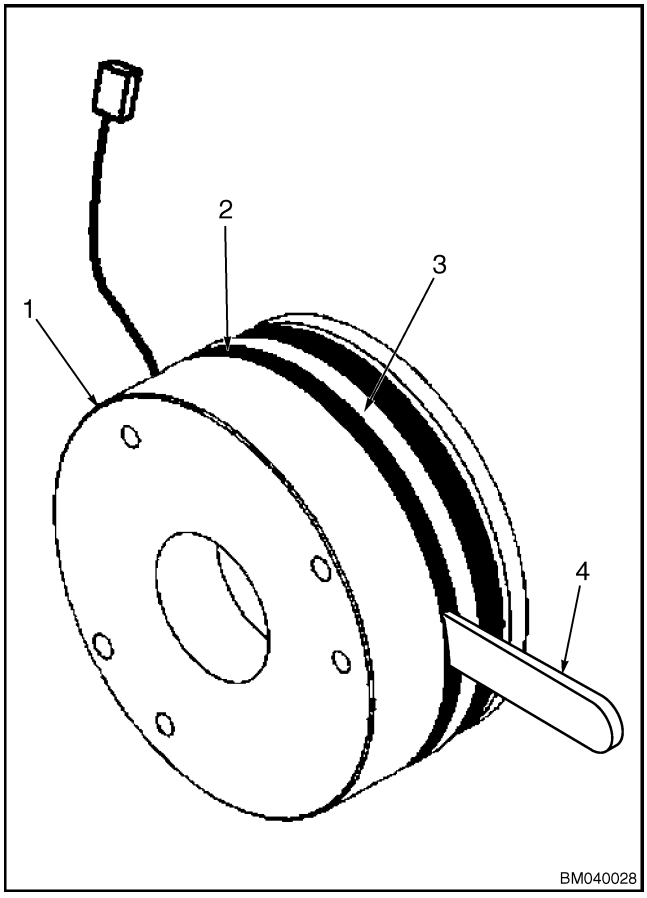
The brake is not adjustable. Check the air gap to determine if replacement is necessary.

NOTE: The air gap is very thin and may not be checked visually. Dimensions are not to scale and are for location references only.

1. Check the three outer socket head screws for appropriate torque to secure the brake to the motor.
2. Check for the correct air gap by measuring the distance between the bottom of the stator and the top of the pressure plate with the brake engaged (disconnected) using feeler gauges. See Figure 5. See Table 1 for brake specifications.
3. The air gap should be checked for minimum and maximum clearance at the six locations shown in Figure 6.
4. If the air gap allows the maximum feeler gauge to enter any of the six locations, replace the entire brake assembly. Refer to the Remove section in this manual.
5. If the air gap is too tight for a minimum feeler gauge to enter any of the six locations, the air gap has been altered by internal damage or tampering. Replace the entire brake assembly. Refer to the Remove section in this manual.

NOTE: During brake operation, the brake should engage and disengage with a solid, single-click noise.

6. Listen to verify the brake engages and disengages in one smooth operation. A double-clicking noise indicates that one side of the brake disc is applying or releasing before the other due to internal damage or tampering. Replace the entire brake assembly. Refer to the Remove section in this manual.



1. STATOR
2. AIR GAP
3. PRESSURE PLATE
4. FEELER GAUGE

Figure 5. Air Gap

Table 1. Specifications

Truck Model	Air Gap		Mounting Capscrews Torque	Minimum Friction Disk Thickness
	Min	Max		
FS/OS/SS030BF/ OS030EF	0.20 mm (0.008 in.)	0.40 mm (0.016 in.)	10.8 N•m (8 lbf ft)	8.50 mm (0.33 in.)

DISASSEMBLE

1. Separate the pump from the motor by removing the two screws and lock washers. See Figure 3.
2. Disassemble the fittings from the pump body.
3. Remove the four capscrews from the pump body and take off the mounting flange and the end cover. Remove the backup rings seals, bushings, and O-rings. See Figure 4.

WARNING

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

4. Remove the snap ring from the housing and remove the shaft seal.
5. Remove the idler gear and drive gear.
6. Inspect the drive gear, idler gear, and the pump body for damage. If any of these parts are damaged, the pump must be replaced with a new pump. All seals, O-rings, backup rings, and snap rings must be replaced if the present pump is to be used.

ASSEMBLE

1. Apply clean hydraulic fluid to all pump components, including O-rings and seals, prior to assembly.
2. Align and install the idler, drive gears, and the two O-rings in the pump body.
3. Install both bushings on the shafts. Install the seals and backup rings in the body of each bushing.
4. Align the end cover, pump body, and mounting flange. Install the four capscrews.

WARNING

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

5. Install a new shaft seal on the drive gear shaft and retain with a new snap ring.
6. Install new O-rings on the fittings and install the fittings to the pump.
7. Lubricate the drive tang with multipurpose lithium complex grease with 2-4% molybdenum disulfide. See the section **Periodic Maintenance** 8000 YRM 1472.
8. Align and insert the splined shaft of the pump in the motor. Secure the pump to the motor by install two capscrews and lock washers through the pump mounting flange.

INSTALL

WARNING

The lift pump and motor assembly is heavy. Be sure that all lifting devices (lifts, cables, chains, or slings) are suitable and of adequate capacity to lift the lift pump and motor. The lift pump and motor assembly can weigh approximately 52 kg (115 lb).

1. Using an appropriate lifting device, carefully lower the pump and motor on to the cradle in the location from which it was removed.
2. Install the four isolator mounts, flat washers, lock washers, and capscrews.
3. Remove the plugs from the suction and pressure hoses and pump ports. Connect the hoses to the lift pump, tighten the connections, and remove the tags. Clean up any oil spills.
4. Connect the two power cables to the motor and remove the tags.
5. Check the hydraulic fluid in the hydraulic tank. Add fluid to the tank, if required. See the section **Periodic Maintenance** 8000 YRM 1472 or the Operating Manual for fluid specifications.
6. Remove the blocks from under the drive wheel and load wheels.
7. Reconnect the battery.
8. Operate all hydraulics functions through their range. Check for oil leaks.
9. Recheck the hydraulic oil level. Add fluid if necessary.
10. Close and secure the drive unit compartment doors and install the electrical compartment cover.

Table 1. Parameter Values (Continued)

Parameter	Function	Range	24V Default (OS030EF)	24V/36V Default (FS/OS/SS030BF)
NOTE: Certain lift truck models are not capable of operating at the Max range allowed by the Dash Display. If a parameter value higher than the truck's ability is entered, the value will revert to the maximum allowed for that lift truck.				
Traction Setup				
TOP SPEED FWD	Sets the top forward speed of the truck.	0.1 to 6.5	6	6.5
TOP SPEED REV	Sets the top reverse speed of the truck.	0.1 to 6.5	6	6.5
ACCEL MODE 1	Percent of maximum acceleration.	0 to 100%	60%	60%
ACCEL MODE 2	Percent of maximum acceleration.	0 to 100%	80%	80%
ACCEL MODE 3	Percent of maximum acceleration.	0 to 100%	80%	80%
ACCEL MODE 4	Percent of maximum acceleration.	0 to 100%	100%	100%
AUTO DECEL	Sets the maximum deceleration rate when the joystick is released.	0.3 to 10	2.8	2.8
PLUGGING REGEN	Determines the maximum deceleration rate when plugging.	0 to 10	1.7	1.7
TRACTION CALIB	Starts traction/throttle calibration routine.	ON/OFF	OFF	OFF
Steering Setup				
MTS GAIN	Sensitivity control for the steering stepper motor. Higher gain settings make the steer control more sensitive, lower settings make it less sensitive.	0 to 9	2	2
AUTO-CTR STR CAL	Activates the Smart Steer calibration program by pressing Right Arrow key on display.	ON/OFF	OFF	OFF

DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
STEER OVERTEMP	**Re-key only**	**Steer**
DESCRIPTION	**BEHAVIOR**	
Steer controller has indicated internal temperature exceeds 78°C (172°F).	**No traction, no steer.**	

Probable Causes and Test Procedures

1. Perform basic checks.
2. Verify steer controller temperature by using another accurate method to measure the temperature of the controller heat sink and compare with the reading from the display diagnostic. If the difference is greater than 4°C (40°F) it may be a faulty controller, contact Service Engineer to confirm failure.
3. Ensure truck is operating within its capacity.
4. Power cables and NEG (battery connector) checks:
   - **a.** Check the cables for proper crimping, seating and torque value.
   - **b.** Ensure the lug contact surfaces are clean.
5. Steer controller studs checks:
   - **a.** Ensure the U, V, W, B+ and B- contact surfaces are clean and secure.
6. Mechanical checks:
   - **a.** Ensure truck has correct tire type on the drive wheel.
   - **b.** Lift drive wheel off the ground and remove ONLY the steer unit assembly from truck. Rotate the MDU with hand to ensure there is no binding in the turn table bearing.
   - **c.** Place back the steer unit assembly and lift drive wheel off the ground, turn steer wheel from one extreme to the other while observing the steer motor current from RUN DIAGNOSTIC. If the current constantly stays above 60 amps there may be possible binding in the turn table bearing.
7. If the following checks do not fix/identify the issue a new steer controller may be needed.

DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
HOIST CONTROL UNDERTEMP	**Re-key only**	**Hoist**
DESCRIPTION	**BEHAVIOR**	
Hoist controller has indicated internal temperature is lower than -40°C (-40°F).	**Limping traction, no lifting.**	

Probable Causes and Test Procedures

1. Remove truck from cold or freezer environment.
2. Verify steer controller temperature by using another accurate method to measure the temperature of the controller heat sink and compare with the reading from the display diagnostic. If the difference is greater than 4°C (40°F) it may be a faulty controller, contact Service Engineer to confirm failure.

DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
TRACT THROT NOT NEUTRAL	**Re-key only**	**CAN I/O**
DESCRIPTION	**BEHAVIOR**	
The system has detected that the Traction hall sensor is not in neutral position.	**No traction.**	

Probable Causes and Test Procedures

1. Return traction control handle to neutral position. Before command for traction, foot pedal switch shall be pressed, and then traction can be commanded.
2. Use the latest version of Field Service Tool to update truck.
3. Check the traction control handle using NO RUN DIAGNOSTIC menu to check status of traction hall sensor. Ensure that when you move the traction control handle in forward and reverse there will be change on the voltage displayed on NO RUN DIAGNOSTIC menu. voltage seen at neutral position should be close to 2.5V ±2V, otherwise traction throttle hall sensor installation.
4. Traction throttle hall sensor installation checks:
   - **a.** Connect CPS270 if it's not connected, remove pin 2 from traction hall sensor connector, turn the key switch on and do the following:
     - Measure the voltage between B- and the removed wire, should be 2.5V ±0.2V when handle is at neutral. If it is not within range, adjust sensor as needed.
     - Use **Electrical System** 2200YRM1467 or **Electrical System** 2200YRM1468 to check for proper installation
     - Recalibrate traction throttle hall sensor through the dash menu.
5. Wire harness checks (turn key switch to the **OFF** position):
   - **a.** Check for correct wires connected to the following components per schematic: CPS50 (CAN I/O) pin 6, 7, 10; CPS270 (traction hall sensor) pin 1, 2,3.
   - **b.** Check CPS50 pin 6, 7, 10 and CPS270 pin 1, 2, 3 for spread socket and socket properly seated.
   - **c.** Disconnect CPS270 (traction sensor), check for shorts on traction sensor side between:
     - Pin 1 and 2
     - Pin 1 and 3
     - Pin 2 and 3
   - **d.** Check continuity between:
     - CPS50 pin 6 and CPS270 pin 3
     - CPS50 pin 7 and CPS270 pin 1
     - CPS50 pin 10 and CPS270 pin 2
6. 5V supply checks (turn key to the **ON** position):
   - **a.** Measure the voltage at CPS270 pin 1 and 3 (approximately 5V ±0.5V) if the voltage is less than 4.5V, do the following:
     - Disconnect CPS270 (traction sensor) and measure the voltage again. If the voltage is within range, traction throttle hall sensor is faulty.

Table 3. Fault Codes (Continued)

AC Motor Controller	
Code	**Description**
25349 Node 2	There is a mismatch condition with the traction motor speed encoder pulses per revolution.
25350 Node 2	There is a mismatch condition between the mast prox switch and the height encoder.
25351 Node 2	No height encoder counts detected when platform is lifting or lowering.
25376 Node 6	Parameter mismatch between CAN I/O and EPS controller.
25408 Node 7 & 8	Stepper motor signals shorted to B-.
25409 Node 7 & 8	Stepper motor Q signal (wire 400) not connected.
25410 Node 7 & 8	Stepper motor D signal (wire 401) not connected.
33024 Node 2	The traction controller has noted no CAN communication with the CAN I/O master microprocessor.
33025 Node 2	The traction controller has noted no CAN communication with the CAN I/O slave microprocessor.
33026 Node 2	The traction controller has noted no CAN communication with the steer controller.
33027 Node 2	The traction controller has noted no CAN communication with the hoist controller.
33028 Node 2	The traction controller has noted no CAN communication with the display.
33056 Node 6	The forward antenna is not present on the CAN.
33057 Node 6	The reverse antenna is not present on the CAN.

STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
8481	8481 Node 6	Set Wire Guidance Switch Off, Re-key	Steer, Wire Guidance
DESCRIPTION		**BEHAVIOR**	
When in wire guidance mode, the truck has moved too far laterally from the wire.		Truck brakes to a stop. Wire guidance is disabled.	

Probable Causes and Test Procedures

NOTE: This alarm occurs in WG mode if the truck is locked on the guide wire and at least one antenna's lateral error overtakes the alarm thresholds. The truck will oscillate laterally left and right of the wire as the truck travels along the wire. In the steered wheel direction, that is forks trailing, only the error in the FWD antenna is used to raise this alarm.

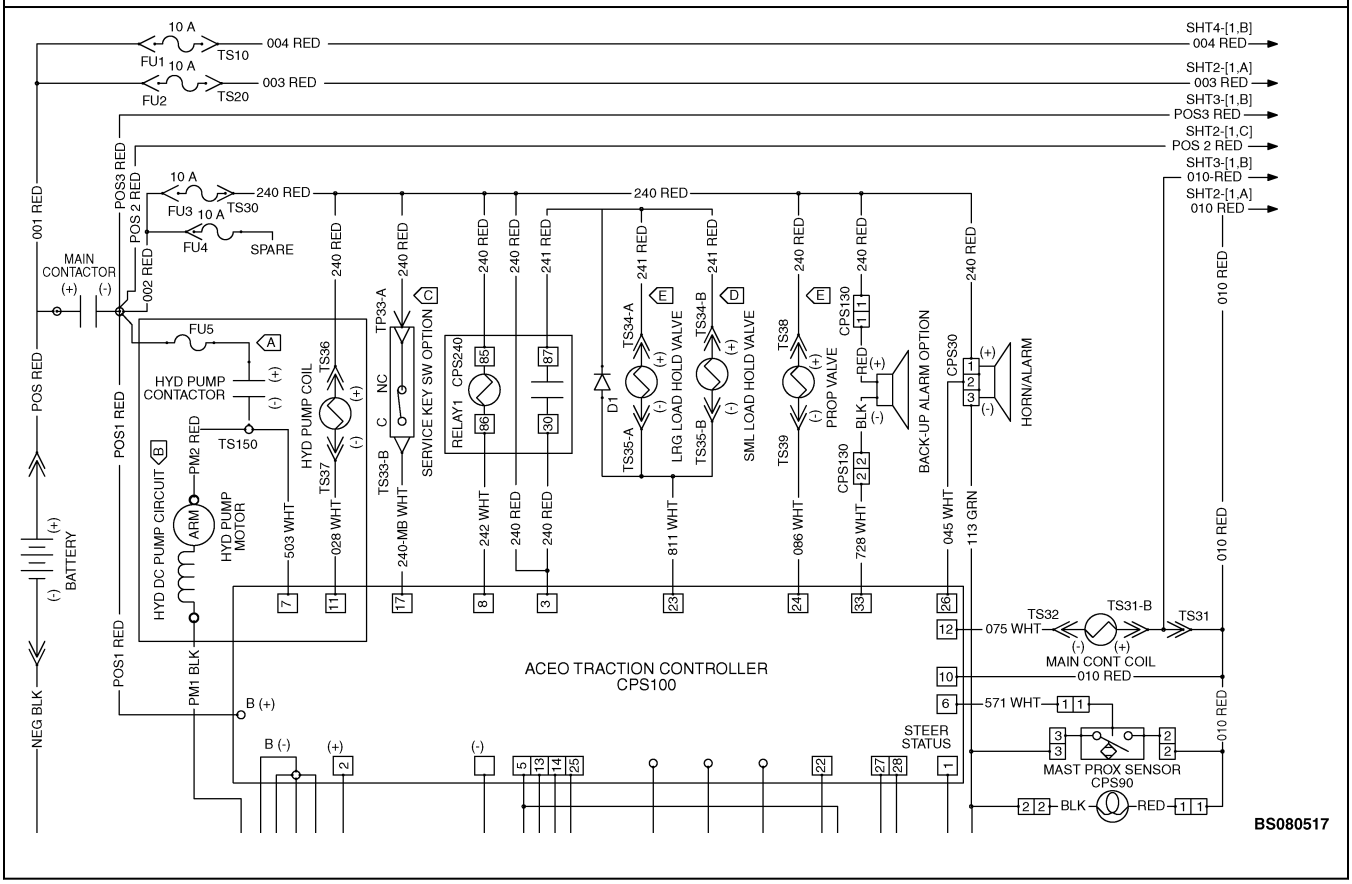
1. The factory settings have been set to minimize oscillation about the guide wire. To get back to the default settings select RESTORE DEFAULTS located in the dash display menu structure.
   - **a.** From the top level menu scroll to SETUP. Press 2 to enter.
   - **b.** Then scroll to TRUCK SETTINGS. Press 2 to enter.
   - **c.** Scroll to RESTORE DEFAULTS.
   - **d.** Select 5 to RESTORE DEFAULTS.
2. Rerun the truck on the guide wire. If the fault code persists, perform the wire guidance setup procedure. It is important to follow wire guidance procedure exactly as stated in **Wire Guidance** 2200YRM1471.
3. Through the dash display, enter the DIAGNOSTICS - WG DIAGNOSTICS menu. Verify that the dash display is receiving information concerning the following menu items. Verify FIELD STR FWD and FIELD STR REV on antennas to have a value of 60% or more. If the difference between the antennas field strength is higher than 10%, probably the antenna with lowest value is faulty.

STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
8963	8963	Re-key only	Traction
	Node 2		
DESCRIPTION		**BEHAVIOR**	
Overcurrent detected from outputs on traction controller connector CPS100 pins 8, 11, and 33.		**Traction in limp mode, disable lift, disable Lower, steer enabled.**	
Probable Causes and Test Procedures			

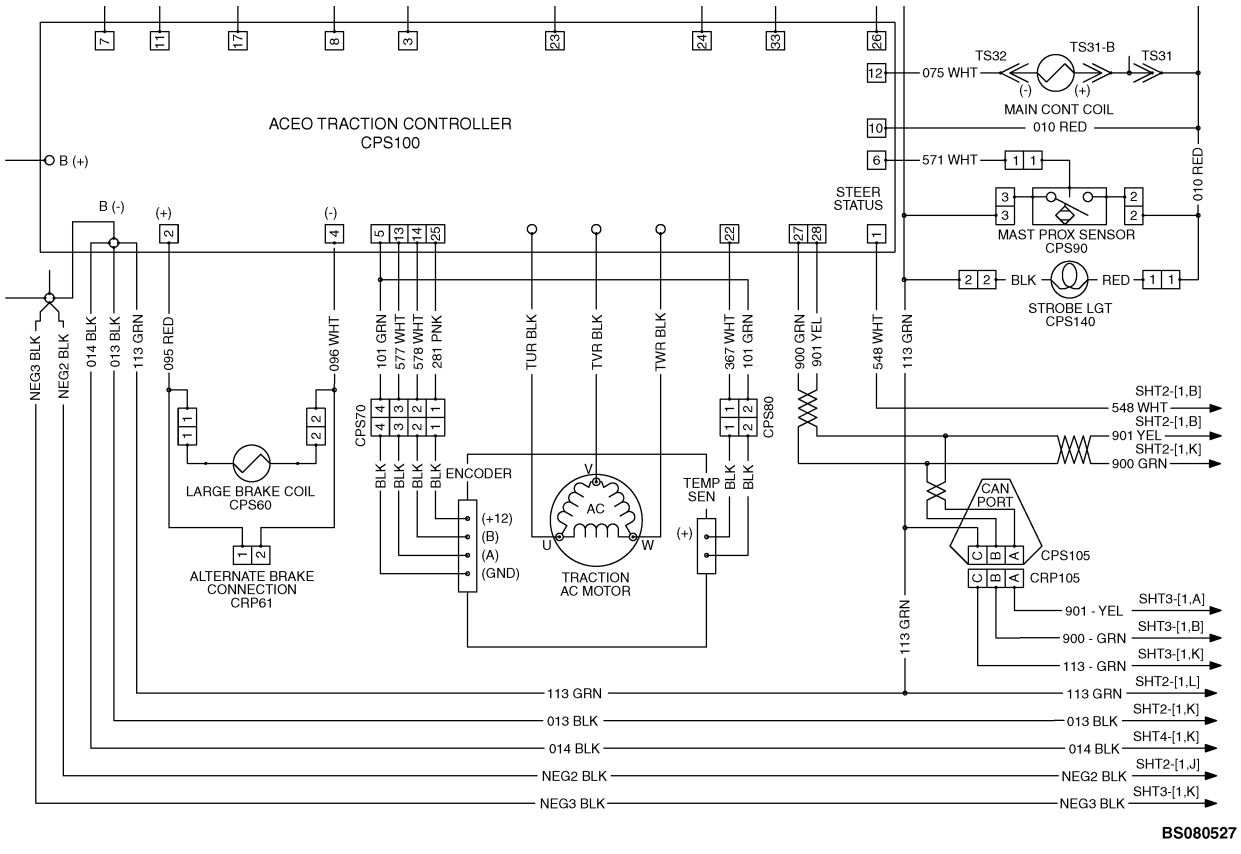
b. Check for shorts between controller pin 11 (controller side) and B- of traction controller.

c. Check for shorts between controller pin 33 (controller side) and B- of traction controller.

4. Use Field Service Tool to perform updates.
5. Circuit connections checks with the key in the OFF position:
   a. Check for correct wires connected to the following components per schematic:
   - CPS100 pin 8, 11, 33
   - FU3
   - Line contactor posts
   - Pump coil
   - RELAY1
   - Backup alarm



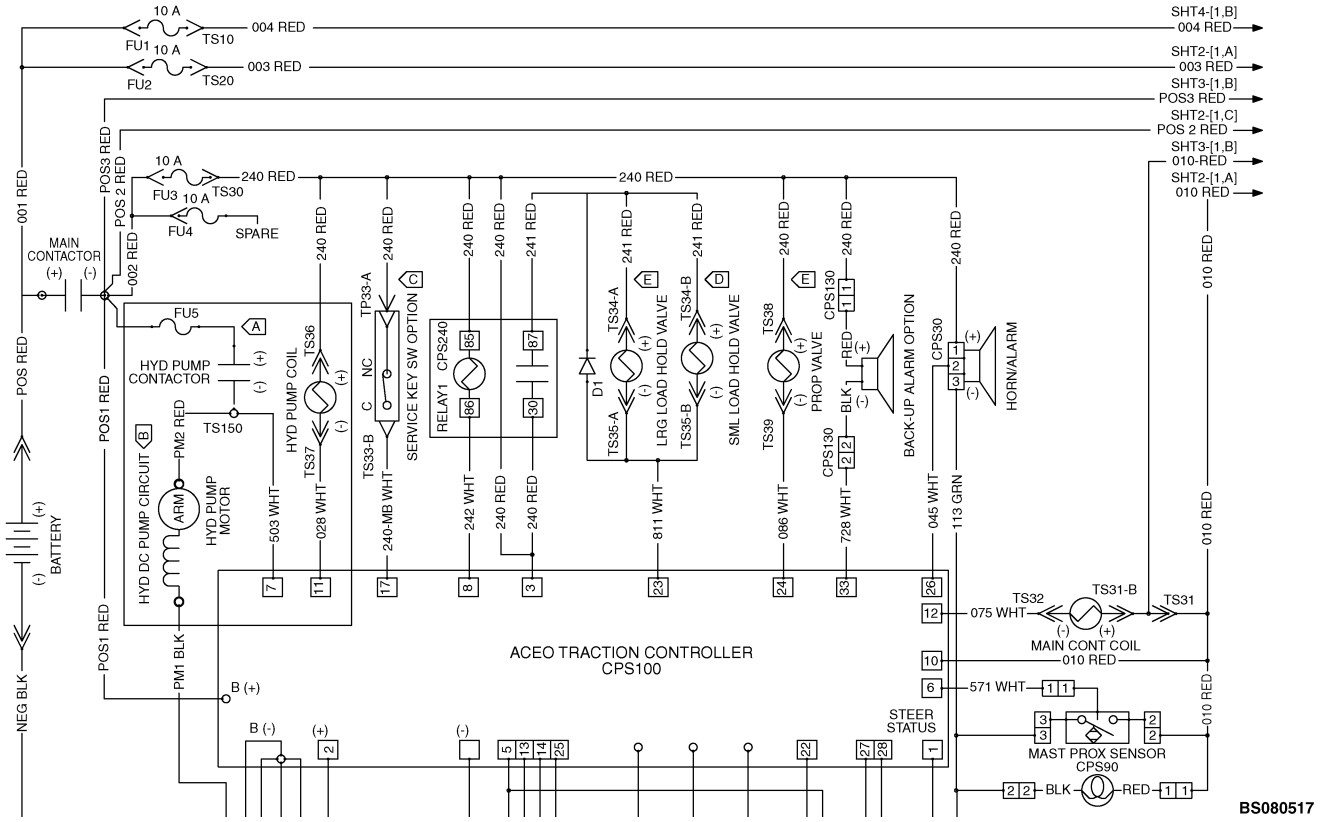
STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
8968	8968	Re-key only	Traction
	Node 2		
DESCRIPTION		**BEHAVIOR**	
No positive supply to electric brake.		Disable traction. Lift, lower and steer enabled.	
Probable Causes and Test Procedures			



STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
8973	8973	Re-key only	Traction
	Node 2		

DESCRIPTION	BEHAVIOR
The lift/lower proportional valve coil circuit is open or shorted.	No lowering, no lifting.

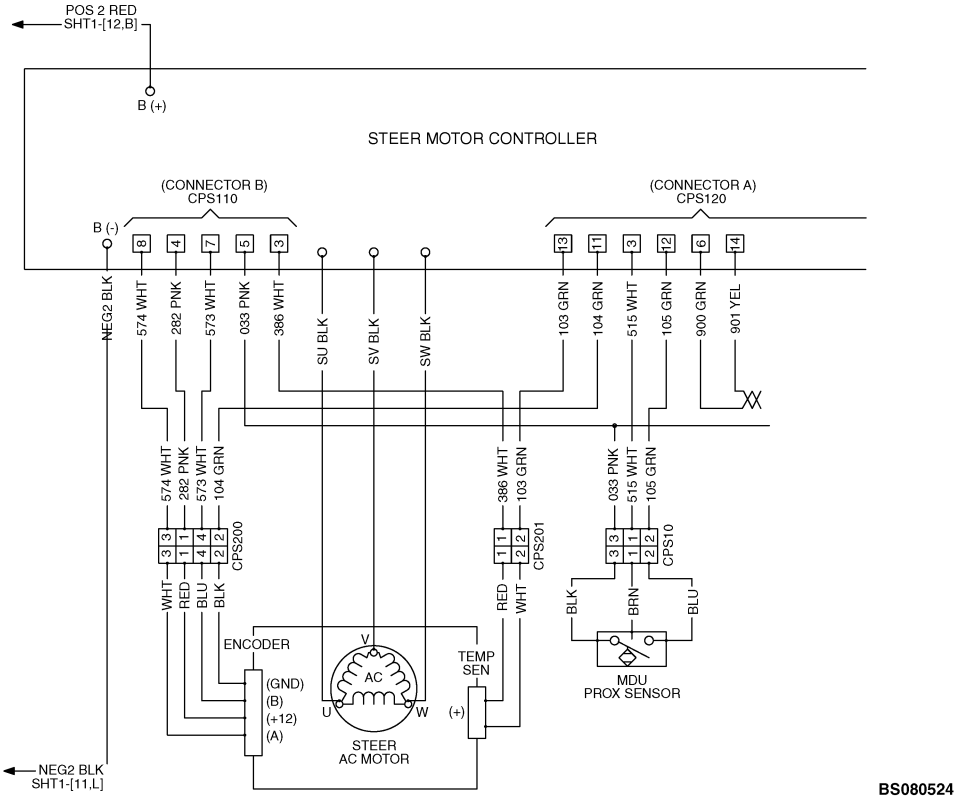
Probable Causes and Test Procedures



STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
8996	8996 Node 6	Re-key only	Steer

DESCRIPTION	BEHAVIOR
Steer (EPS) motor in a locked rotor condition.	No steering, no traction.

Probable Causes and Test Procedures



STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
12293	12293 Node 2	Re-key only	Traction

DESCRIPTION	BEHAVIOR
Lift and lower commands are being requested simultaneously. (Small chassis ONLY)	Disable lift and lower. Traction and steer enabled.

Probable Causes and Test Procedures

1. Perform basic checks.
2. Disconnect CPS93 and if alarm still exists, proceed with below checks, otherwise possible faulty handle.
3. Wire harness checks - disconnect battery connector, turn key to the ON position and disconnect only CPS50 (at CAN I/O):
   - **a.** Check for shorts between:
     - CPS93 pin 9 and 2
     - CPS93 pin 9 and 3
     - TS15 (at key sw) and CPS93 pin 2
     - TS15 and CPS93 pin 3
4. Lift/lower switch checks - turn key to the OFF position and disconnect CPS93:
   - **a.** Without depressing the lift/lower switch, check resistance between pin 9 and 2 (on control handle connector). If resistance is less than 1 Mega ohms, possible faulty lower sw.
   - **b.** Without depressing the lift/lower switch, check resistance between pin 9 and 3 (on control handle connector). If resistance is less than 1 Mega ohms, possible faulty lift switch.
5. CAN I/O checks:
   - **a.** Disconnect CPS50 (CAN I/O) only, turn key to the ON position and view the lift and lower switches status from NO RUN DIAGNOSTIC menu. They should be OFF. If one or both switches show ON, possible faulty CAN I/O.
6. Use the latest version of Field Service Tool to update truck.
7. Circuit connections checks per schematic - turn key to the OFF position:
   - **a.** Check for correct wires connected to the following components:
     - CPS93 (at control handle) pin 2, 3, 9
     - CPS40 (at CAN I/O) pin 9
     - CPS50 pin 8, 13

STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
12325	12325 Node 6	Re-key only	Steer
DESCRIPTION		BEHAVIOR	
Command and encoder feedback direction not matched.		Reduced traction.	
Probable Causes and Test Procedures			

- CPS110 pin 8

4. Power cable checks (key on the OFF position and discharge capacitors):
   a. Measure resistance between truck frame and each of the following points of the Steer controller (they should be greater than 50K ohm):
   - B+
   - B-
   - U, V, W
5. Mechanical checks:
   a. Check for proper installation of encoder.
   b. Check for slippage or binding of encoder.
6. Motor encoder checks (key off and disconnect ONLY CPS200):
   a. Check resistance between the following pair of pins from the encoder connector CPS200 (If resistance of any pair is less than 100ohms, possible faulty encoder. Contact Service Engineer to confirm the failure):
   - CPS200 pin 1 and CPS200 pin 2
   - CPS200 pin 1 and CPS200 pin 3
   - CPS200 pin 1 and CPS200 pin 4
   - CPS200 pin 4 and CPS200 pin 2
   - CPS200 pin 4 and CPS200 pin 3
7. If the previous checks do not fix/identify the issue a new steer encoder may be needed.

STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
12547	12547 Node 2	Re-key only	Traction

DESCRIPTION	BEHAVIOR
A traction controller under voltage or over voltage condition has been detected.	No traction, no steering, no lowering, no lifting.

Probable Causes and Test Procedures

1. Perform basic checks (particularly battery connector checks under Basic Checks).
2. Check battery conditions, such as specific gravity, water level and voltage of each cell.
3. Verify for proper battery voltage and AMP-HOUR rating is connected to the truck.
4. Wire harness checks (key in the OFF position and disconnect traction controller connector):
   - **a.** Ensure socket at CPS100 pin 10 is not spread and is properly seated.
   - **b.** Check for proper connections at battery disconnect switch and key switch.
   - **c.** Check continuity between:
     - Positive stud of line contactor and FU1
     - FU1 and battery disconnect switch
     - Battery disconnect switch and BAT tab of key switchj
     - IGN tab of key switch and CPS100 pin 10
5. Main contactor checks:
   - **a.** Coil has proper connection.
   - **b.** Tips are clean and making proper contacts.
   - **c.** Power cables NEG 1, POS 1, POS and NEG (battery connector) checks:
     - Properly crimped, seated and torqued.
     - Lugs contact surfaces are clean.
6. Traction controller checks:
   - **a.** B+ and B- contact surfaces are clean.
7. Under voltage checks:
   - **a.** With a load on the fork, travel forward and lifting at the same time for at least 3 seconds. If no alarm occurs, repeat this step couple more times. If alarm occurs, truck has under voltage condition. Perform the following checks:
     - Perform the basic checks again (ensure repeat battery connector checks under Basic Checks).
     - Perform the circuit connections checks again.
     - Perform main contactor, traction controller and wire harness checks again.
8. Over voltage checks:
   - **a.** With a load on the fork, operate truck max speed in forward direction for 50ft then plug truck to stop. If no alarm occurs, repeat this step a couple more times. If alarm occurs, truck has over voltage condition. Perform the basic checks again.

STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
12706	12706 Node 5	Re-key only	Hoist

DESCRIPTION	BEHAVIOR
Hoist controller is not receiving CAN messages from ACE0 traction controller.	No functions on the truck due to CAN communication.

Probable Causes and Test Procedures

1. If ACE0 traction controller has been replaced, ensure truck has been updated with latest version of Field Service Tool.
2. Perform basic checks.
3. Circuit connections checks:
   - **a.** Ensure B- and B+ terminal studs on AC hoist controller are clean.
   - **b.** Check for clean and secure connections at traction controller B- stud.
   - **c.** Check for correctness in CAN HI circuit 901 and CAN LO circuit 900 wires connected to the following components per schematic:
     - Traction controller CPS100 pin 27 (CAN LO) and pin 28 (CAN HI)
     - CAN I/O CPS40 pin 16 (CAN HI) and pin 17 (CAN LO)
     - Steer controller CPS120 pin 6 (CAN LO) and pin 14 (CAN HI)
4. Check for continuity on CAN lines and voltage input between each of the following points:
   - **a.** Voltage Input:
     - Key switch and CPS100 pin 10
     - Key switch and CPS40 pin 1
   - **b.** CAN LO:
     - CPS150 pin 20 and CPS100 pin 27
     - CPS150 pin 20 and CPS40 pin 17
     - CPS150 pin 20 and CPS120 pin 6
   - **c.** CAN HI:
     - CPS150 pin 21 and CPS100 pin 28
     - CPS150 pin 21 and CPS40 pin 16
     - CPS150 pin 21 and CPS120 pin 14
5. Check for a short between:
   - **a.** CPS106 (CAN port) pin A and the B (-) negative stud
   - **b.** Pin 28 on CPS100 and the B (-) negative stud
6. General Wire harness checks:
   - **a.** Check the sockets and pins for each one of the following connectors and ensure that they are properly seated and are not spread:
     - CPS/CRP106 - CAN Port
     - CPS/CRP105 - CAN Port
     - CPS20 (connection chassis harness to Mast Sheave Cable)
     - Mast sheave cable

STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
13088	13088 Node 6	Re-key only	Steer
DESCRIPTION		BEHAVIOR	
Wrong voltage on steer security line.		No traction, no steer, no lift, no lower.	
Probable Causes and Test Procedures			

- Voltage between pin 7 and B- stud should be approximately same as battery voltage. If not, possible spread pins inside connectors or open on harness.
- Voltage between pin 4 and B- stud should be approximately same as battery voltage. If not, possible spread pins inside connectors o, open on harness, or possible bad controller.

d. Key in the ON position while main line contactor is open (all connectors connected)

- Voltage between pin 5 and B- stud or/and between pin 7 and B- negative stud should be approximately same as battery voltage. If not, possible spread pins inside connectors or open on harness.
- Voltage between pin 4 and B- stud should be 0 volts.
- If it has been verified that when disconnecting CPS120 there was approximately battery voltage at pin 5 and 7 and that there was 0 volts at pin 4; and that when CPS120 was connected the voltage measured after the contactor dropped (opened) was not approximately 0V, then possible faulty steer EPS controller.

STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
13219	13219 Node 5	Re-key only	Hoist
DESCRIPTION		BEHAVIOR	
AC hoist motor encoder error.		No lift.	

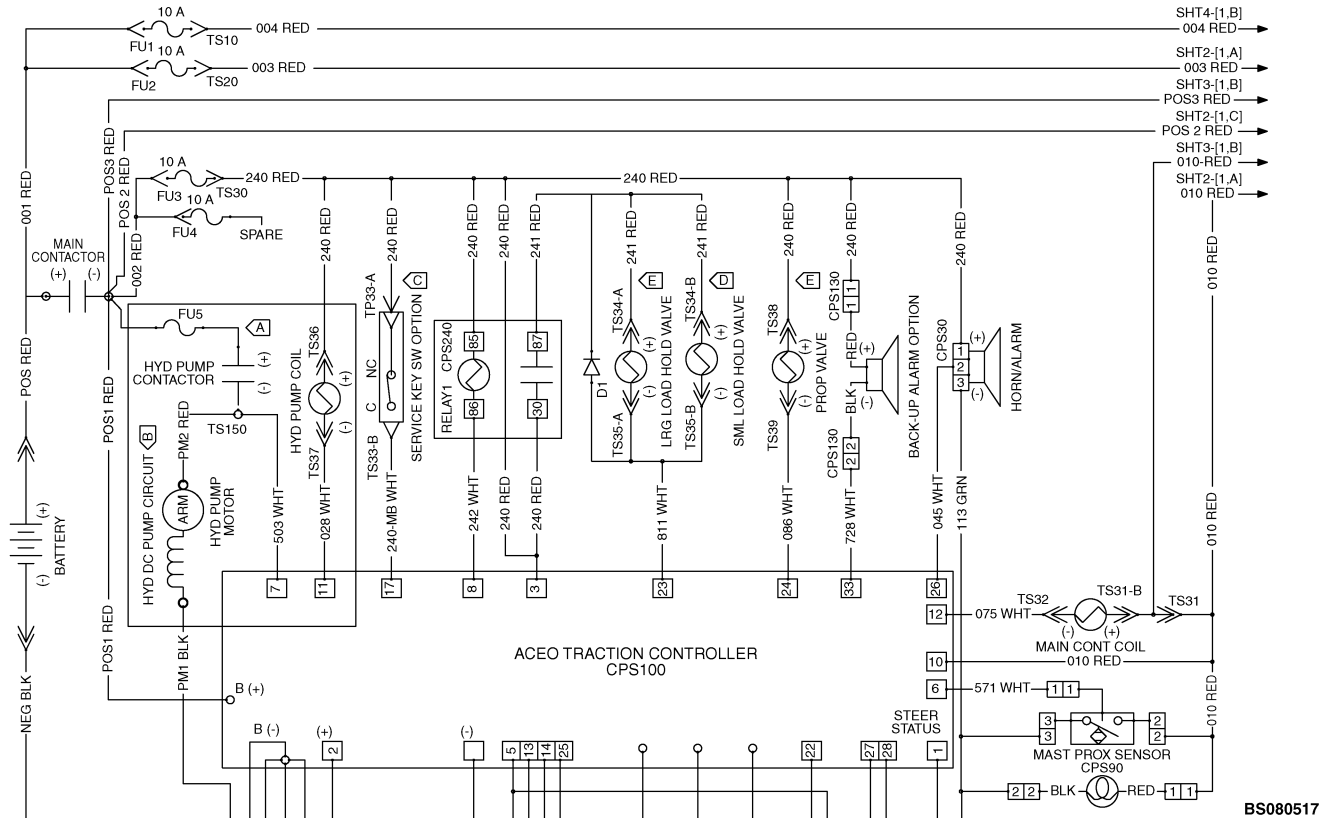
Probable Causes and Test Procedures

1. Perform basic checks.
2. Circuit connections checks:
   - **a.** Check for continuity between hoist motor controller and hoist motor encoder CPS150 pin 8, 7, 14, and 15 with CPS 151 pin 1, 2, 3, and 4 respectively following the schematic
   - **b.** Disconnect CPS151 and measure voltage across pin 1 and pin 4 at the harness side. Voltage should be between 12 and 15 volts.
3. Check for shorted conditions on encoder connector CPS150 (harness side and hoist controller side):
   - **a.** Pin 14 to pin 8
   - **b.** Pin 14 to pin 15
   - **c.** Pin 14 to pin 7
   - **d.** Pin 7 to pin 8
   - **e.** Pin 7 to pin 15
   - **f.** Pin 7 to pin 14
   - **g.** If a short is seen at the harness side, replace harness. If short is seen at the controller side, possible faulty controller. Contact Service Engineering to confirm finding.
4. Check for shorted conditions on the encoder side:
   - **a.** Pin 1 to pin 2
   - **b.** Pin 1 to pin 3
   - **c.** Pin 1 to pin 4
   - **d.** Pin 2 to pin 3
   - **e.** Pin 2 to pin 4
   - **f.** Pin 3 to pin 4

STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
25345	25345	Re-key only	Traction
	Node 2		
DESCRIPTION		**BEHAVIOR**	
The performance mode parameter values have been entered incorrectly.		Traction enabled, lift enabled, lower enabled, steer enabled.	

Probable Causes and Test Procedures

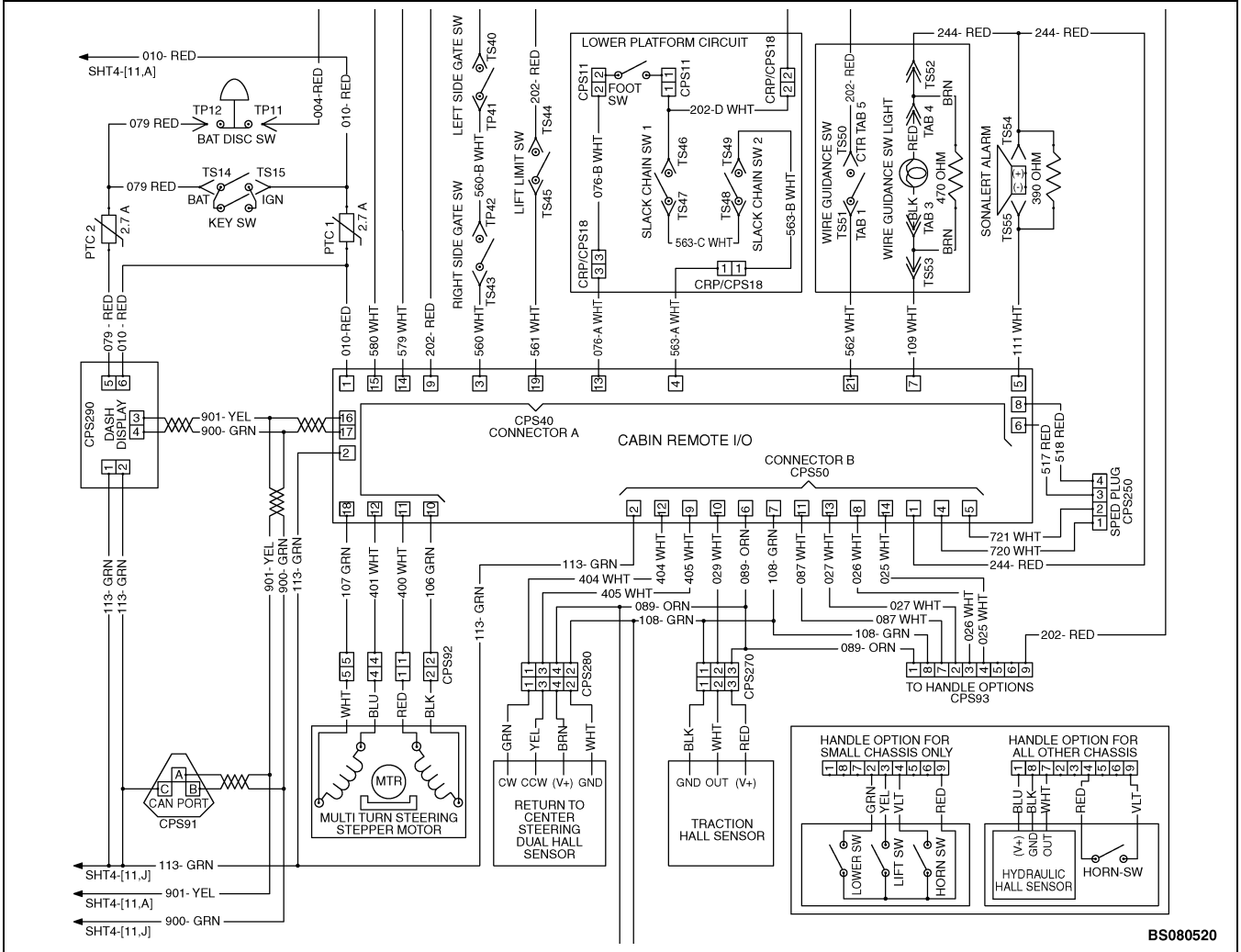
1. Check ACCEL MODE 1 (lowest), 2, 3, 4 (highest) parameters to ensure that higher mode value is greater than lower mode value. If lower mode has higher value than higher mode, use the display to change to appropriate value.
2. If no problem found in step above and alarm persists, then go to Truck Setup through the dash display and perform a "RESTORE DEFAULTS".
   a. Notice that if RESTORE DEFAULTS is performed, all other previous adjustable parameters will also be reset to default.
3. Use Field Service Tool to perform updates.
4. Possible faulty traction controller. Contact Service Engineer to confirm the failure.



STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
25351	25351 Node 2	Lift platform above 30" then lower platform to ground.	Traction

DESCRIPTION	BEHAVIOR
No height encoder counts detected when platform is lifting or lowering.	Reduced traction, lift enabled, lower enabled.

Probable Causes and Test Procedures



STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
33025	33025 Node 2	Re-key only	Traction

DESCRIPTION	BEHAVIOR
The traction controlller has noted no CAN communication with the CAN I/O slave microprocessor.	No traction, no lift, no lower, no steer. Horn allowed.

Probable Causes and Test Procedures

1. Perform basic checks.
2. Wire Harness checks - disconnect the battery connector and check the following:
   - **a.** Check resistance between CANL and CANH wires PC connector, should be approximately 60 ohms.
   - **b.** Check continuity between:
     - CPS40 pin 16 (CAN I/O) and CPS100 pin 28 (traction controller)
     - CPS40 pin 17 and CPS100 pin 27
     - CPS40 pin 2 and B- stud
     - CPS40 pin 1 and TS15 (key switch)
     - Ensure socket at CPS40 pins 1, 2, 16, 17 are not spread and are properly seated.
3. CAN I/O Controller check:
   - **a.** With CPS40 and CPS50 (CAN I/O) connected, measure the voltage across CPS40 pin 1 and CPS40 pin 2. It should be approximately same as battery voltage.
     - If the voltage is shown correctly, CAN I/O MASTER, CAN I/O SLAVE or both in SOFTWARE VERSION menu in the display shows NOT AVAILABLE while other modules **DO NOT** show NOT AVAILABLE, possible faulty CAN I/O.
     - If the voltage measurement in above step is not checked OK, repeat wire harness checks procedure.
     - Perform the Field Service Tool update. If the voltage measurement in above step checked OK and the Field Service Tool fails to update CAN I/O master or slave, possible faulty CAN I/O.
4. If problem is intermittent, perform CANbus test.

STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
33057	WG Not Calib Node 6	When antenna(s) is connected on the CANbus.	Steer
DESCRIPTION		BEHAVIOR	
Reverse antenna is not present on the CAN.		No traction, no steer.	

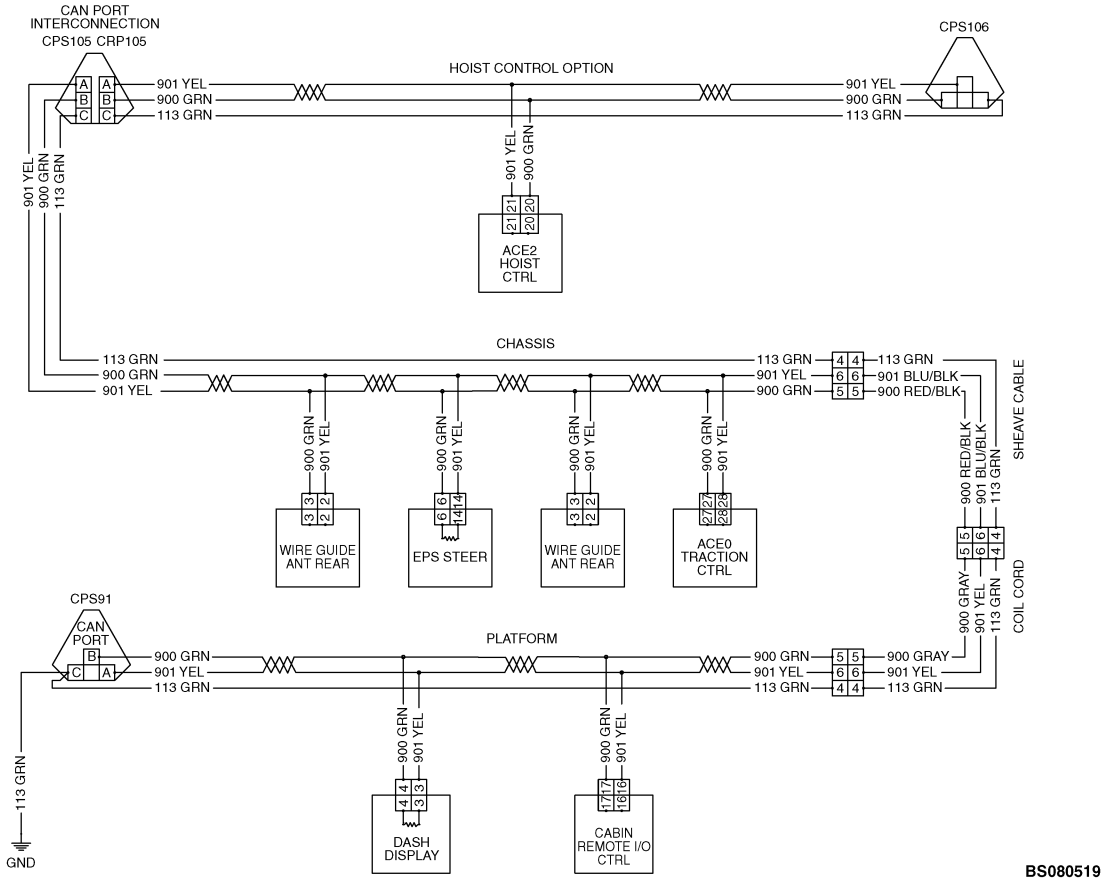
Probable Causes and Test Procedures

1. Perform basic checks.
2. Circuit connections checks:
   - **a.** Check pins and sockets at forward or reverse antenna and ensure that they are properly seated and not deformed:
     - CPS220 pin 2 (Forward antenna)
     - CPS220 pin 3 (Forward antenna)
     - CPS220 pin 4 (Forward antenna)
     - CPS230 pin 2 (Reverse antenna)
     - CPS230 pin 3 (Reverse antenna)
     - CPS230 pin 4 (Reverse antenna)
   - **b.** Check for continuity between the following:
     - CPS220 pin 1 and CPS110 pin 5
     - CPS220 pin 2 and CPS120 pin 14
     - CPS220 pin 3 and CPS120 pin 6
     - CPS220 pin 4 and CPS105 pin p
     - CPS220 pin 5 and CPS110 pin 5
     - CPS230 pin 1 and CPS110 pin 5
     - CPS230 pin 2 and CPS120 pin 14
     - CPS230 pin 3 and CPS120 pin 6
     - CPS230 pin 4 and CPS105 pin p
   - **c.** Check sockets and pins for each one of the following connectors and ensure that they are properly seated and are not spread:
     - CPS/CRP106 - CAN Port
     - CPS/CRP105 - CAN Port
     - CPS20
     - CPS22
     - Mast sheave cable
     - Retractable coil cord
     - CPS40
     - CPS120
     - CPS91 - CAN Port
   - **d.** Check for 12 to 15 volts on CPS 220 pin 4 and pin 1, if voltage is not seen check wiring.

STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
33088	33088	Re-key only	CANbus
	Node 7 or 8		

DESCRIPTION	BEHAVIOR
No communication from CAN I/O slave to CAN I/O master.	No traction, no steer, no lift, no lower.

Probable Causes and Test Procedures



STATUS CODE	DISPLAY MESSAGE	RECOVERY METHOD	CIRCUIT
33217	33217 Node 16	Re-key only	Display

DESCRIPTION	BEHAVIOR
Display has a CANbus communication error with the steer controller.	No traction, no steer, no lift, no lower.

Probable Causes and Test Procedures

1. Perform basic checks.
2. Circuit connections checks:
   - **a.** Check for steer motor controller B- and B+ stud terminals for cleanliness and to be appropriately connected.
   - **b.** If AC hoist system is available ensure that B- of hoist controller is clean and connected appropriately.
   - **c.** Check for correctness in CAN HI circuit 901 and CAN LO circuit 900 wires connected to the following components per schematic:
     - Traction controller CPS100 pin 27 (CAN LO) and CPS100 pin 28 (CAN HI)
     - Steer controller CPS120 pin 6 (CAN LO) and CPS120 pin 14 (CAN HI)
     - Dash display CPS290 pin 3 (CAN HI) and CPS290 pin 4 (CAN LO)
     - CAN I/O CPS40 pin 16 (CAN HI) and CPS40 pin 17 (CAN LO)
     - Hoist controller CPS150 pin 21 (CAN HI) and CPS150 pin 20 (CAN LO)
   - **d.** Measure resistance of CAN circuit on CAN port. This resistance should be approximately 60 ohms.
3. Wire harness checks:
   - **a.** Check the sockets and pins for each one of the following connectors and ensure that they are properly seated and not spread:
     - CPS/CRP106 - CAN Port
     - CPS/CRP105 - CAN Port
     - CPS20 (connection chassis harness to mast sheave cable)
     - Mast sheave cable
     - Retractable coil cord
     - CPS22 (connection between retractable coil cord and platform harness)
     - CPS91 - CAN Port
   - **b.** Check for a short between B- and CPS 100 pin 28
   - **c.** Check for continuity between:
     - CAN LO in CAN port, pin B to CPS120 pin 6
     - CAN LO in CAN port, pin B to CPS290 pin 4
     - CAN HI in CAN port A and CPS290 pin 3 (dash display)
     - CAN HI in CAN port A and CPS120 (steer controller) pin 14
   - **d.** Check for continuity between key switch (ignition side) TS15 and CPS120 pin 7.
     Check for a short between CAN HI on CPS106 pin A and the B- stud or pin 28 on CPS100 and the B- stud.

CANbus Test		
Probable Causes and Test Procedures		
Chassis CAN Port	CPS106, Pin A	CPS106, pin B
FWD Antenna	CPS220, Pin 2	CPS220, Pin 3
REV Antenna	CPS230, Pin 2	CPS230, Pin 3

4. Measure resistance between CANL and truck frame; CANH truck frame - should be greater than 50K ohms.
5. Measure resistance between CANL and B- stud; CANH to B- stud - should be greater than 25K ohms.
6. Check resistance between truck frame to each of B- stud; positive stud of main contactor; negative stud of main contactor; FU1; FU2; TS31 (wire 010) - should be greater than 50K ohms.
7. Check resistance between truck frame and each of U, V, and W of traction controller - should be greater than 50K ohms.
8. If applicable, check resistance between truck frame and each of U, V, and W of hoist controller - should be greater than 50K ohms.
9. Check resistance between truck frame and each of U, V, and W of steer controller - should be greater than 50K ohms.
10. Circuit connections checks (key in the OFF position):
    a. Check for correct wires connected to the following components per schematic:
        - Traction controller: CPS100 pins 10, 27, 28; traction controller B- stud
        - Steer controller: CPS120 pins 6, 14; CPS120 pin 7; steer controller B- stud
        - Hoist controller (if applicable): hoist controller pins 1, 20, 21; hoist controller B- stud
        - FWD antenna (if applicable): CPS220 pins 1, 2, 3, and 4
        - REV antenna (if applicable): CPS230 pins 1, 2, 3, and 4
        - Dash display: CPS290 pins 1, 2, 3, 4, and 6
        - CAN I/O: CPS40 pins 1, 2, 16, 17; CPS50 pin 2
11. Wire harness checks:
    a. Ensure following sockets are not spread and properly seated:
        - Traction controller: CPS100 pin 10, traction controller B- stud
        - Steer controller: CPS120 pin 7; steer controller B- stud
        - Hoist controller (if applicable): hoist controller pin 1, hoist controller B- stud
        - FWD antenna (if applicable): CPS220 pin 1 and 4
        - REV antenna (if applicable): CPS230 pin 1 and 4
        - Dash display: CPS290 pin 1, 2, and 6
        - CAN I/O: CPS40 pins 1, 2, CPS50 pin 2

    b. Check pins of FWD and REV antennas connector - properly seated and not deformed.

    c. Check continuity between:
        - CPS100 pin 28 and each of CPS120 pin 14, CPS220 pin 2
        - CPS230 pin 2, hoist controller pin 21 (if applicable), CPS40 pin 16, CPS290 pin 3
        - Check continuity between CPS100 pin 27 and each of CPS120 pin 6, CPS220 pin 3; CPS230 pin 3, hoist controller pin 20 (if applicable), CPS40 pin 17, CPS290 pin 4.

CAUTION

Correct meter polarity is necessary for some checks. Meter correct positive is indicated as (+). Meter correct negative is indicated as (−).

Use a digital meter with a minimum rating of 20,000 ohms per volt to make accurate measurements.

DISCHARGING THE CAPACITORS

WARNING

DO NOT make repairs or adjustments unless you have been properly trained and authorized to do so. Improper repairs and adjustments can create dangerous operating conditions. DO NOT operate a lift truck that needs repairs. Report the need for repairs to your supervisor immediately. If repair is necessary, attach a DO NOT OPERATE tag on the steering wheel and disconnect the battery.

Disconnect the battery and allow the capacitors to discharge before opening any compartment covers or inspecting or repairing the electrical system. DO NOT place tools on top of the battery. If a tool causes a short circuit, the high current flow from the battery can cause personal injury or property damage.

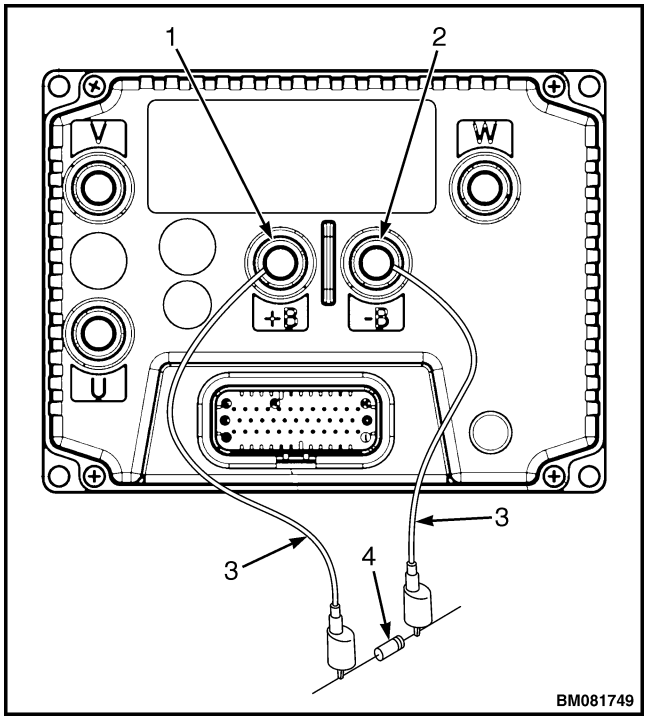
Some checks and adjustments are performed with the battery connected. DO NOT connect the battery until the procedure instructs you to do so. Never wear any metallic items on your fingers, arms, or neck. Metal items can accidentally make an electrical connection and cause injury.

Before performing any tests or adjustments, block the lift truck to prevent unexpected movement.

The capacitor in the transistor controller(s) can hold an electrical charge after the battery is disconnected. To prevent an electrical shock and personal injury, discharge the capacitor(s) before inspecting or repairing any component in the drive unit compartment. Make certain that the battery has been disconnected.

DO NOT short across the motor controller terminals with a screwdriver or jumper wire.

1. To avoid injury and prevent electrical shock, perform the following steps (Step 2 through Step 6 below) to discharge the capacitors before troubleshooting, making adjustments or repairs, or connecting or disconnecting a PC service tool:
2. Turn the key or keyless switch to the **OFF** position and **DISCONNECT THE BATTERY**.
3. Block the lift truck so the drive wheels are off the floor to prevent lift truck from moving.
4. Remove the electrical compartment cover to access the lift controller.
5. Discharge the capacitors in the controllers by connecting a 200-ohm, 2-watt resistor across the lift controller's negative (B−) and positive (B+) terminals. Wait at least 20 seconds to be sure that the capacitors are fully discharged. See Figure 2.
6. Remove the resistor from the controller(s) and reinstall the covers before returning the lift truck to service.



1. B+ TERMINAL
2. B− TERMINAL
3. JUMPER LEADS
4. 200-OHM, 2-WATT RESISTOR

Figure 2. Traction Controller

7. Check ohm value of contactor coil. Disconnect leads from one side of the coil and connect an ohmmeter across coil. Reverse ohmmeter leads and check in the opposite polarity (since spike suppressors on some coils make them polarity sensitive). Compare ohm reading against ohm value for the type contactor. Use the highest rating. See Table 2.

Table 2. Coil Resistance

Device	Location	24v Coil Resistance @ 21°C (70°F)	Notes
Truck main contactor	Contactor panel	44 ohms ±8 ohms	Test coil both ways. Use highest reading.
Lift pump contactor	Contactor panel	17 ohms ±4 ohms	Test coil both ways. Use highest reading.
Lower solenoid valve	On pump assembly	40 ohms ±10 ohms	Test coil both ways. Use highest reading.
Load hold relay	Under chassis cover near the top of the drive motor	320 ohms ±65 ohms	Terminals 85 and 86 are the coil.
Brake coil	On top of drive motor	12 ohms ±4 ohms	

Tips

When replacing tips, make sure the new tips have the same ampere carrying capacity and are direct replacements for the original tips.

A high-voltage drop (2 volts or more) across the tips indicates poor contact or high resistance. Check for burned or worn tips, incorrect size or mismatched tips, and proper gap settings when open.

Disassemble and Assemble

WARNING

Disconnect the battery and separate the connector before opening the drive unit and compartment and inspecting or repairing the electrical system. If a tool causes a short circuit, the high-current flow from the battery can cause a personal injury or property damage.

NOTE: If both the contacts and coil of a contactor will be replaced, replace the complete contactor as described in Replacing the Contactor. Do only the parts of the procedure necessary to replace the defective parts being replaced.

NOTE: All of the contacts for each contactor must be replaced at the same time if any contact requires replacement.

The contactor contacts are made of special silver alloy. The contacts may look black and rough from normal operation. This condition does not cause problems with the operation of the lift truck. Cleaning is not necessary. **DO NOT** USE A FILE ON THE CONTACTS. **DO NOT** LUBRICATE THE CONTACTS. Replace contacts when the silver alloy is worn away to the base support metal. Replace contactor parts as follows:

1. Make an identification of the buss bars for correct installation. Remove nuts that fasten fixed contacts.
2. Remove two screws that fasten covers for each contactor. See Figure 6. Remove cover of each contactor. **DO NOT** lose plunger springs.
3. Replace two fixed contacts in contactor covers.
4. Remove plunger assembly and movable contact and replace fixed contact bar. Replace contact of plungers.
5. If a coil will be replaced, remove cover base. Remove screws that fasten coil frame to mount bracket. Remove coil and frame. Remove bushing part of plunger and armature cap from coil. Install these parts on the replacement coil.

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

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

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

WARNING

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

CAUTION

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

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

Interlocks

After startup, the following controls and switches must be in the noted positions to allow truck operation:

1. Traction throttle, hoist throttle, and the Smart Steer must be all in there neutral positions. This is commonly referred to as Static Return of Off (SRO).
2. The side gate switches and slack chain switches must be closed. When an interlock switch is not set, the display the "Wrench Icon" will blink and the alarm message will be noted on the display.
3. The foot switch must be cycled to allow traction and hoist function. The display "Man Icon" is illuminated when the brake switch is open. The message "Foot SW Open" is noted on the display when traction is selected and the foot switch is open.
4. When installed, the optional service key switch must be closed.

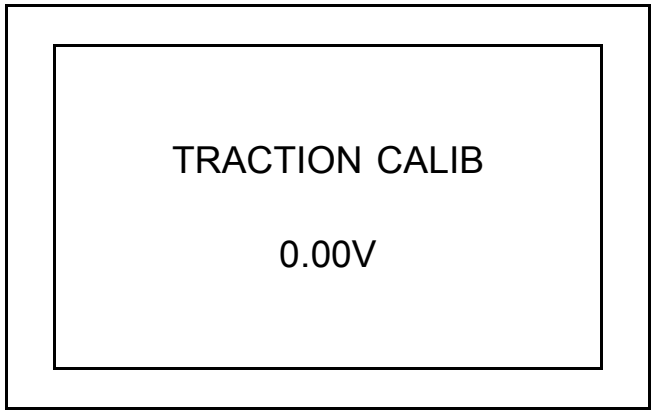
Setup Menu Diagnostics

Enter the Service menu by turning the key to the **ON** position and pressing the display button #5 (Enter) twice. The display screen will indicate "Enter Password." Use the five display buttons to enter the five digit service-level password. (The middle button (Enter) is used to enter the number 5.) If the wrong password is entered, the screen will indicate "Incorrect Password" and then return to the primary graphic mode. Once the service-level password is correctly entered, the first menu item appears. To view the next menu item, press the display button #3 (Down Arrow). Repeat this until the desired menu item has been reached. The Setup and Diagnostic menus are now available. Refer to **User Interface**, **Service-Level FunctionsOn-Board Dash Display** 2200 YRM 1470 for more information on the Setup Menu.

Calibration

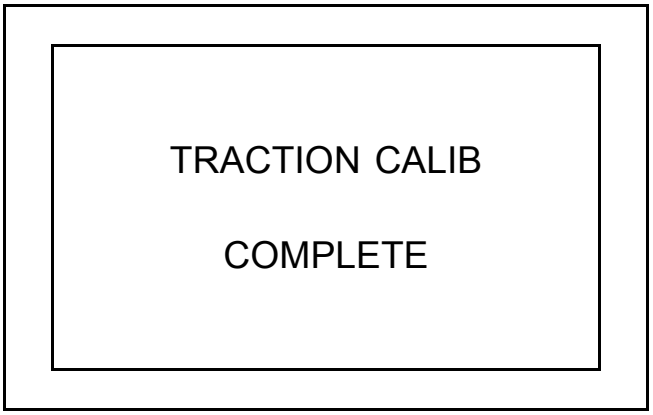
TRACTION THROTTLE

1. Enter the Setup menu.
2. Scroll to TRACT SETTINGS and press 2 to enter.
3. Press button 1 or 3 to scroll to TRACTION CALIBR.
4. The Traction Throttle must now be in the neutral position.
5. Press button 2 to enter and wait for 2 seconds.
6. Display reads:



NOTE: “0.00V” should be 2.50V ± 0.50V when the traction throttle is in neutral position. 2.50V ± 0.50V is the recommended throttle neutral position voltage after the throttle is mechanically in position.

7. Move the Traction Throttle fully forward to the mechanical stop and hold for 2 seconds.
8. Move the Traction Throttle fully reverse to the mechanical stop and hold for 2 seconds. Release the traction throttle back to neutral.
9. Press button 5 to save Neutral, Max and Min value. Display should read the following for 2 seconds.



NOTE: Press button 4 to cancel calibration during Step 6 to Step 8.

10. Press button 4 several times to exit set up.

Instrument Panel Removal and Installation

WARNING

Always disconnect the battery ground cable before making repairs to prevent possible damage and injury. Install a tag on the battery terminal so that no one connects the cable on the terminal.

1. Disconnect battery.
2. Remove four capscrews that fasten console panel cover.
3. Remove four screws that fasten instrument panel to console.
4. Align instrument panel on console and install capscrews.
5. Install instrument panel cover.
6. Connect battery.

Key Switch Removal and Installation

REMOVE

1. Move the lift truck to a safe, level area.
2. Block drive wheel to prevent truck from rolling.
3. Disconnect battery connectors and turn the key switch to the **OFF** position.
4. Remove instrument panel. See Instrument Panel Removal and Installation.
5. Remove cover.
6. Discharge the capacitors inside the controller.
7. Remove nut retaining the key switch to bracket.
8. Remove the key switch.
9. Identify and disconnect electrical wires to switch.

INSTALL

1. Connect wires to proper terminals.
2. Mount the key switch in bracket.
3. Install nut to retain the key switch. Make certain switch is properly aligned before tightening retaining nut.
4. Install instrument panel. See Instrument Panel Removal and Installation.
5. Connect battery connectors.
6. Test the key switch by turning it **ON** and **OFF**.
7. Install cover.

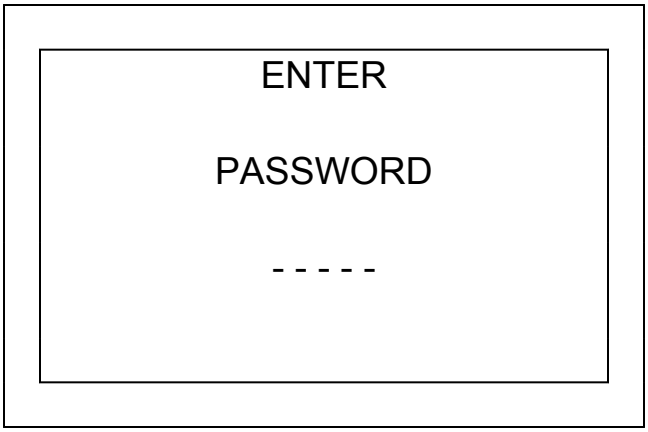
NOTES

DASH DISPLAY MENU ACCESS

To access the dash display menu system:

1. Turn the key or keyless switch to the **ON** position.
2. Depress the center button (#5) on the display two times.
3. The Enter Password screen will now appear on the LCD. Enter your five-digit Service-level password. The factory default Service-level password is 55555.

To enter your password at the ENTER PASSWORD screen, enter the appropriate digit in the highlighted area of the display. Use the appropriate button on the display keypad to enter any digit between 1 and 5. The cursor will automatically move to the next position after a number has been entered. Repeat until all five digits of your password have been entered. Upon successful entry of your Service-level password, the display will enter the Service menu system. If an incorrect password is entered, the display will ask for the password to be entered again. The menu system can be exited at any time by pressing the LEFT (#4) button repeatedly.



Menu Navigation

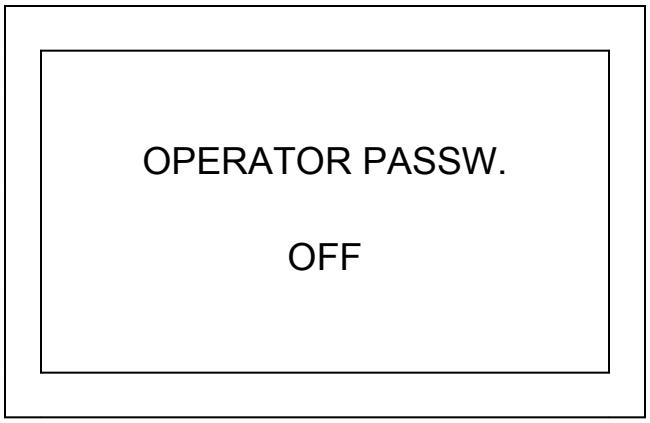
NOTE: The display menus are revolving and will repeat when you scroll beyond the last menu item.

Upon successful entry of your Service-level password, the Service menu screen will appear on the dash display LCD screen. See Figure 2. Menu navigation is accomplished by using the display buttons. From inside the menu, the buttons function as follows:

1. **UP**
   - Scroll up within a menu, or increase the value of a setting when making a parameter adjustment.
2. **RIGHT**
   - Scroll right within a menu. Will move you into the next submenu or activate the highlighted parameter to allow parameter value adjustments.
3. **DOWN**
   - Scroll down within a menu, or decrease the value of a setting when making a parameter adjustment.
4. **LEFT**
   - Scroll left within a menu. Will move you to the previous menu when depressed. Press repeatedly to exit the menu system.
5. **ENTER**
   - Press to accept parameter value adjustments. Press twice to access the Enter Password screen.

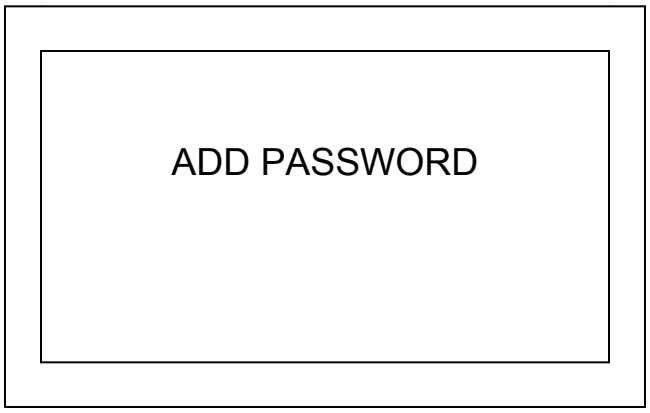
Operator Password

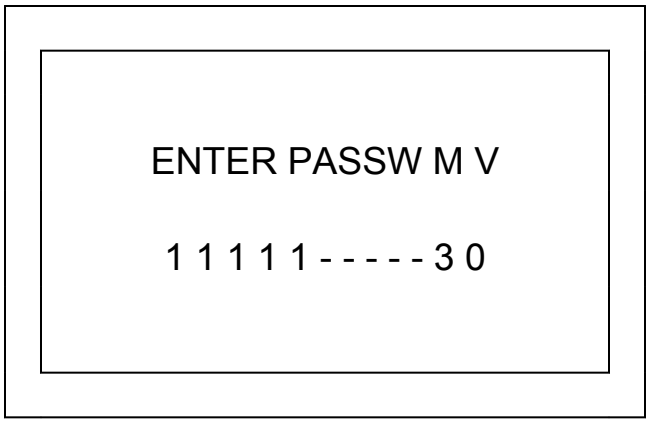
Use this screen to turn the operator password feature ON or OFF.



Add Password

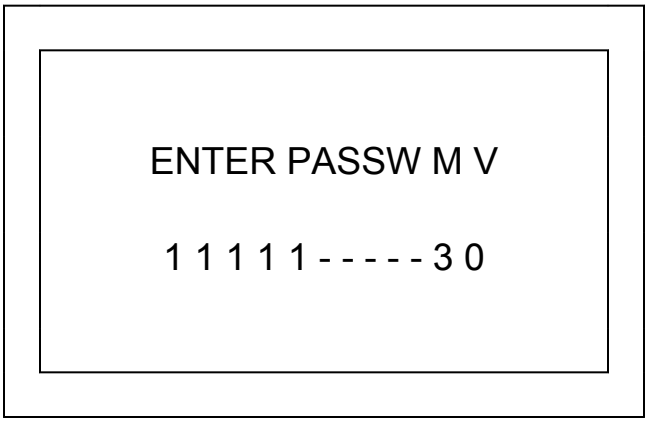
Use this menu to add operator, supervisor, or technician passwords. To enter a new password at the Passwords screen, enter the password to be added and press enter to activate.



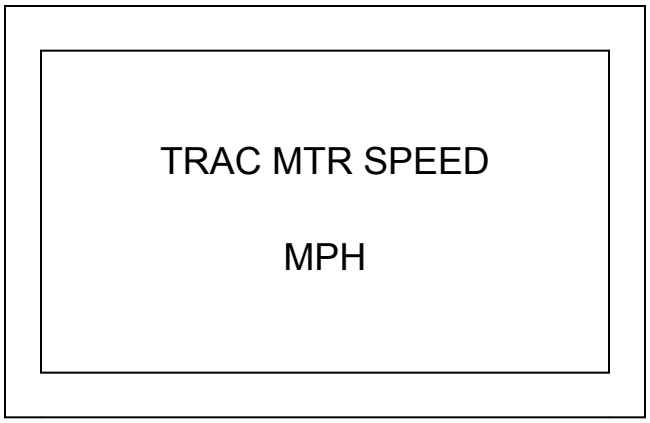


Delete Password

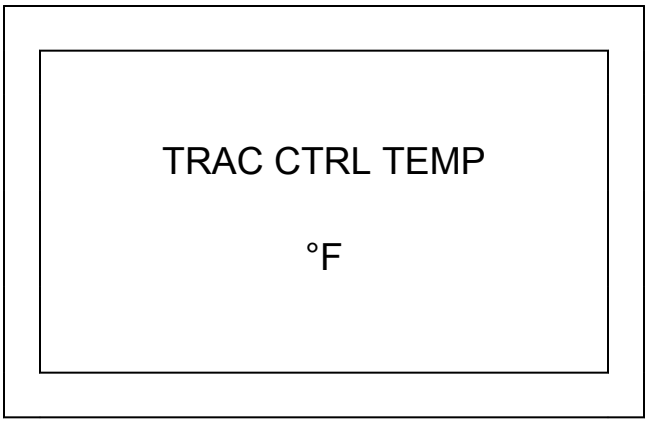
Use this menu to delete operator or supervisor passwords. To delete a password at the Passwords screen, enter the password to be deleted and press enter to finalize.



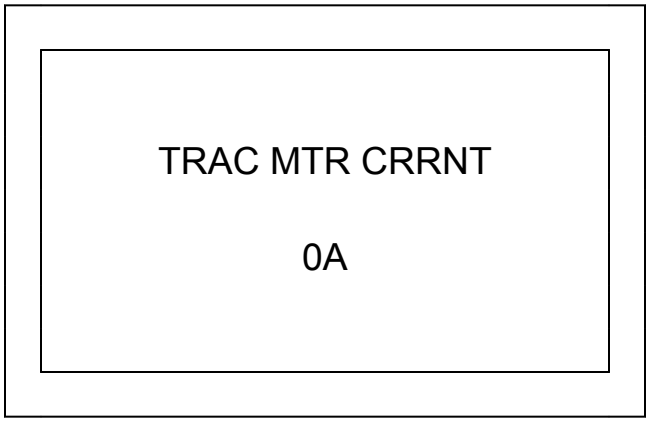
Traction Motor Speed



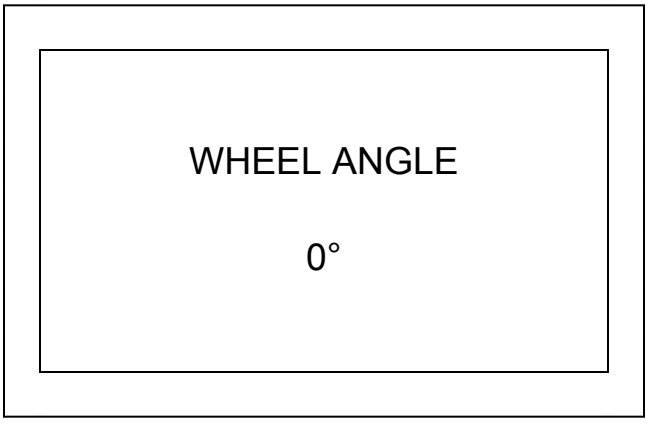
Traction Controller Temperature



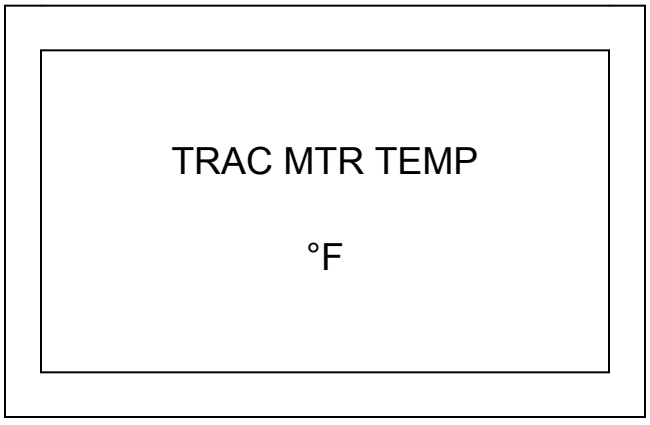
Traction Motor Current



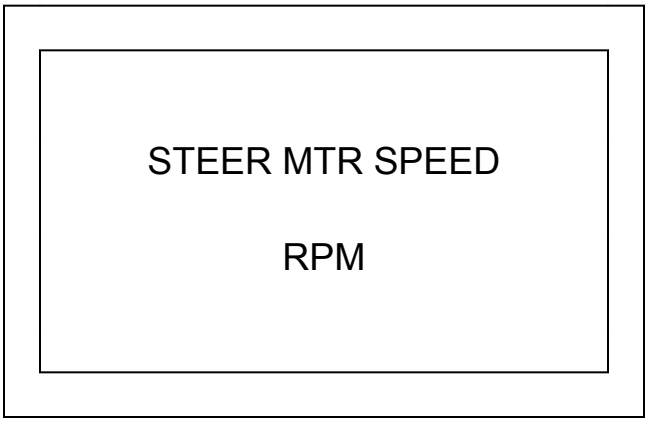
Wheel Angle



Traction Motor Temperature



Steer Motor Speed



Steer Settings

The Steer Settings menu contains parameters which affect the steer motor performance. See Table 11. Scroll through the Steer Settings menu using the UP (#1) and DOWN (#3) buttons and press the RIGHT (#2) button to enter the desired selection. Press the LEFT (#4) button to return to the previous menu.

Table 11. Steer Settings Menu

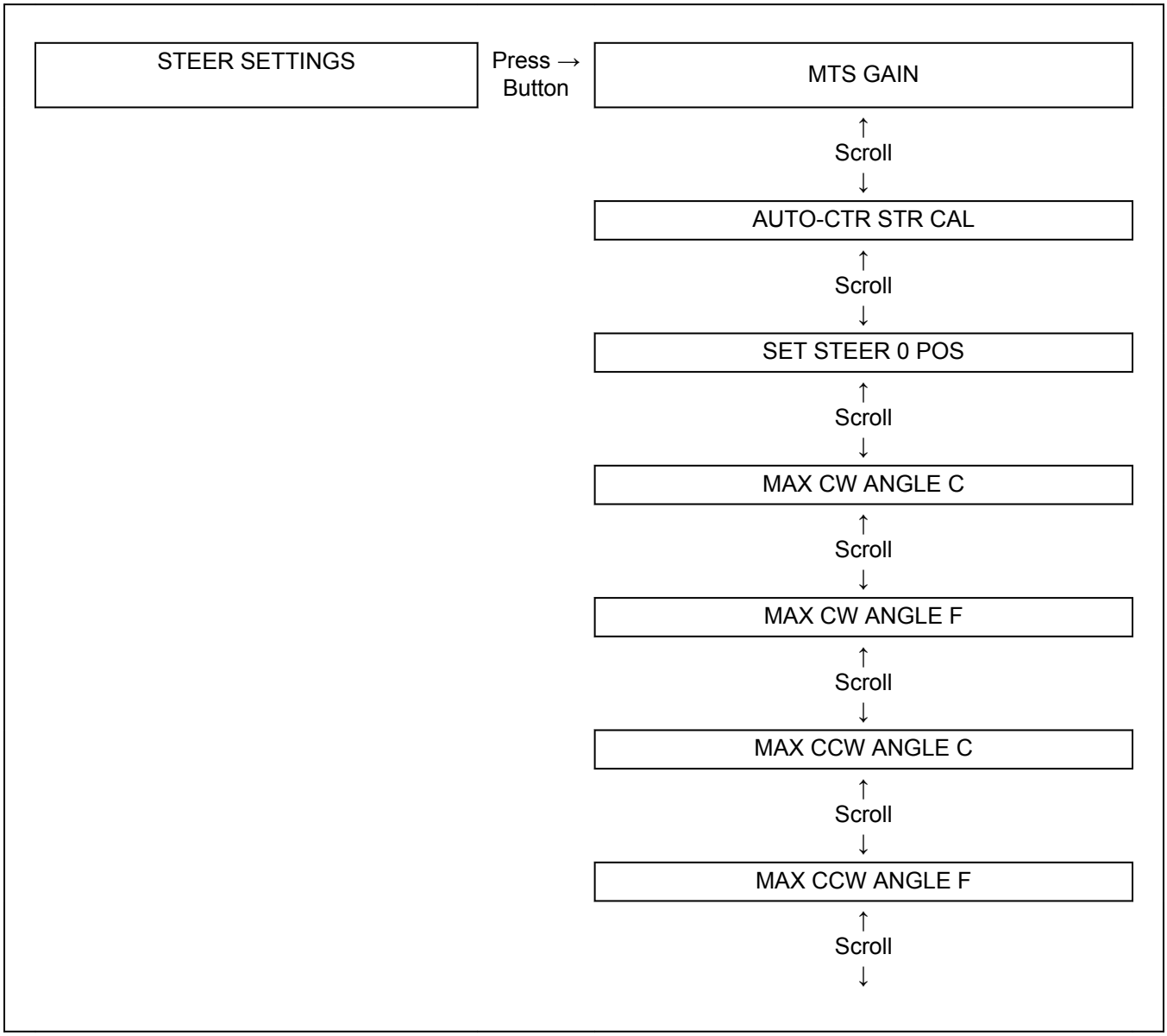
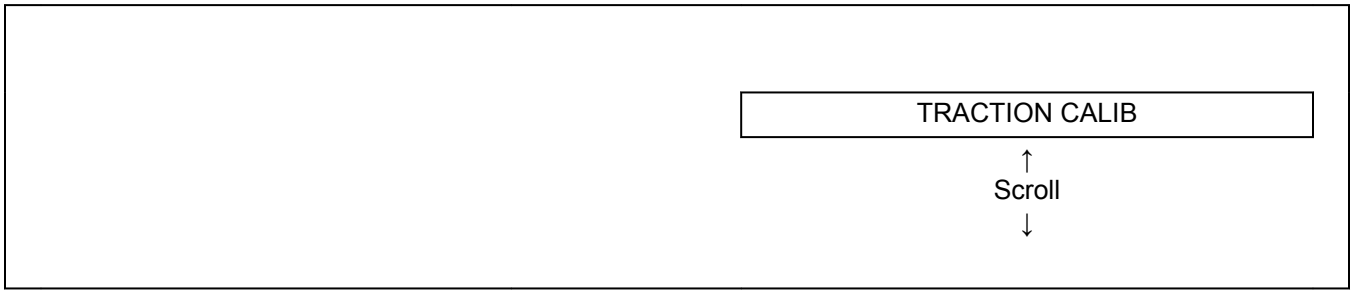
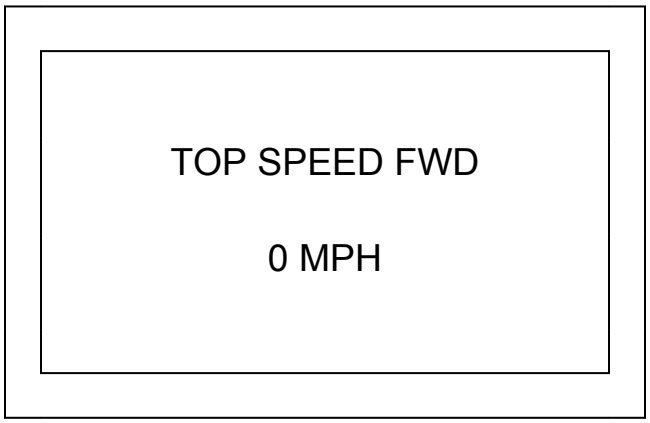


Table 13. Traction Settings Menu (Continued)



Top Speed Forward

This parameter setting determines top speed in the forward direction. Acceleration rates are unaffected by changing the top speed setting.



Top Speed Reverse

This parameter setting determines top speed in the reverse direction. Acceleration rates are unaffected by changing the top speed setting.

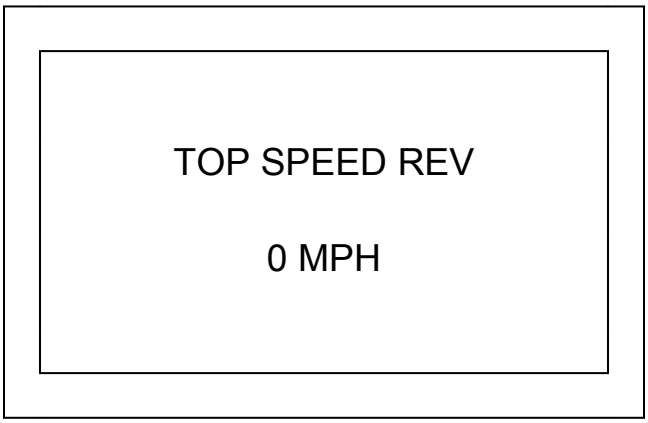
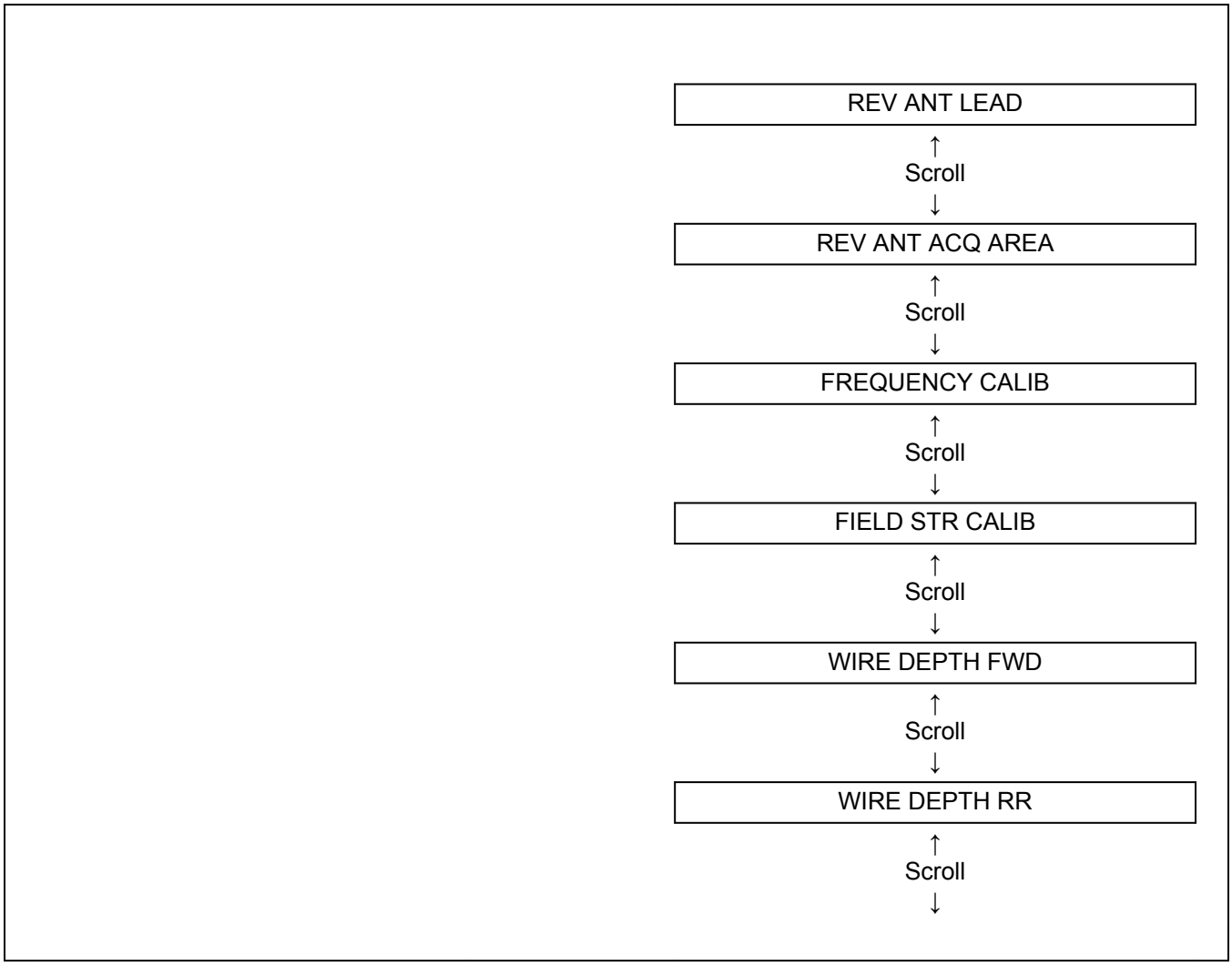


Table 15. W.G. Config Menu (Continued)



SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- The Service Manuals are updated on a regular basis, but may not reflect recent design changes to the product. Updated technical service information may be available from your local authorized Yale® dealer. Service Manuals provide general guidelines for maintenance and service and are intended for use by trained and experienced technicians. Failure to properly maintain equipment or to follow instructions contained in the Service Manual could result in damage to the products, personal injury, property damage or death.
- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **YALE APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

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

WARNING

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

CAUTION

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

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

WG FREQUENCY CALIBRATION

The WG Frequency Calibration procedure allows the antennas to detect the wire frequency automatically. It should be used when either the wire driver is set to a non-standard frequency, or if the truck is having unusual difficulty calibrating field strength.

1. Align the center of the forward and reverse antennas over the center of the wire.

NOTE: Ensure to align the reverse antenna itself, not the bracket.

2. Enter the SETUP menu.
3. Scroll to WG CONFIG and press button 2.
4. Use buttons 1 and 3 to scroll to FREQUENCY CALIB, and press 2.
5. Use button 1 or 2 to change the setting to ON.
6. Press button 5 to save.
7. Press button 4 to exit the setup menu.
8. Recycle the key switch.

NOTE: Performing this procedure may cause the truck's stored Field Strength values to become invalid. WG Antenna Calibration **must** be performed after the WG Frequency Calibration.

SET STEER 0 POSITION

1. Acquire the wire in the forward direction.
2. Enter the WG DIAGNOSTIC menu and scroll to SIDE ERROR FWD. Drive slow (approximately 1mph) in the forward direction while observing the SIDE ERROR FWD (side error forward). SIDE ERROR is the distance in millimeters between the center of the antenna and the wire. When viewing from the fork end, the value is positive if the antenna is on left of the wire and negative if on the right side of the wire.

NOTE: Recommended minimum of traveling distance is 300ft or the longest available distance.

3. If the magnitude of the SIDE ERROR is approximately the same for the positive and negative skip the remaining steps in the Set Steer 0 Position section. This means that the front antenna is tracking about the wire, not on one side of the wire, in forward direction.
4. If the magnitude of the SIDE ERROR is more positive than negative this means that the front antenna is tracking on the left side of the wire. Increase the SET STEER 0 POS (set steer zero position) in the STEER SETTING menu. Save and recycle the key switch after making this change then repeat Step 2 until step Step 3 is met.
5. If the magnitude of the SIDE ERROR is more negative than positive this means that the front antenna is tracking on the right side of the wire. Decrease the SET STEER 0 POS (set steer zero position) in STEER SETTING menu. Save and recycle the key switch after making this change then repeat Step 2 until step Step 3 is met.

REVERSE ANTENNA ADJUSTMENT

1. Acquire the wire in the forward direction.
2. Drive slow (approximately 1 mph) in the forward direction for 50 ft.

⚠ CAUTION

Before adjusting the lateral position of the rear antenna, use blocks and chains on the upright weldments and operator platform so they cannot move. Make sure the moving parts are attached to a nonmoving part. Use blocks and chains to prevent movement of the operator platform. After the Platform has been raised to a level that allows a technician to work under the Platform, the key switch should be in the off position. Also, the battery should be disconnected while a technician is working under the Platform.

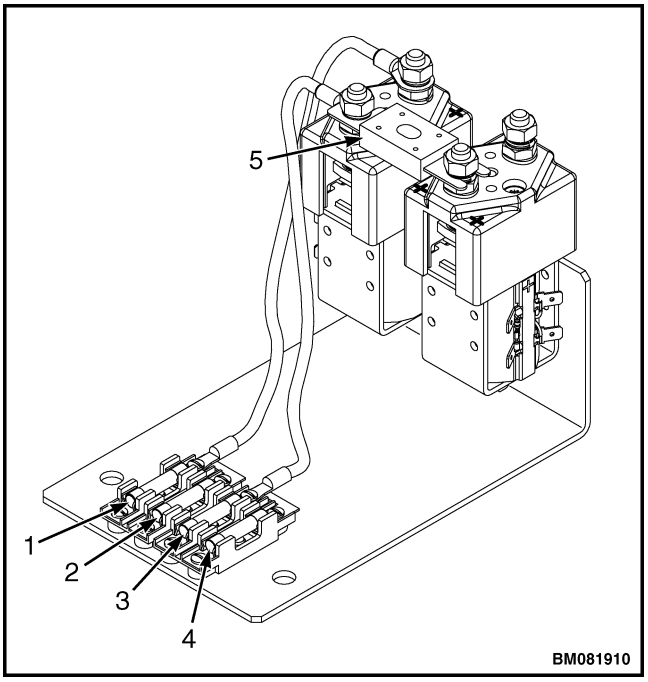
3. Move the reverse antenna (fork side) laterally so that its center is over the center of the wire as needed. In order to move the antenna, bolt 1 and nut 10 in Figure 6 must be loosened (quantity of 4 each). Once the antenna is in the desired position, torque the bolt and nut to 13 N•m (9.6 lbf ft).

Table 1. Maintenance Schedule (Continued)

Item No.	Item	8 hr/ 1 day	350 hr/ 2 mo	2000 hr/ 1 yr	Procedure or Quantity	Specification
6	Battery Restraints	X			Check Condition	Adjusted, Secure, and in Place
7	Battery Disconnect Switch	X			Disconnects Power	
8	Battery Rollers	X, L			Rollers Turn Freely	Silicon Spray Lubricant[2]
	Safety Information					
	Personal Fall Protection System (PFPS)	X		X	Replace if Necessary	See **Parts Manual**
	Safety Labels[10]	X			Replace if Necessary	See **Parts Manual**
9	Operating Manual	X			Replace if Necessary	See **Parts Manual**
	Frame, Covers, and Plates					
10	Frame	X			Visually Inspect Welds and Structure	
11	Plastic Covers	X			Visually Inspect for Damage	See **Parts Manual**
12	Operator Mat	X			Visually Inspect for Damage	See **Parts Manual**
	Electrical System					
	Electrical Circuits[10]	X			Check Operation	
	Static Strap[10]	X			Check for Damage	See **Parts Manual**
13	Fuses	X			Check Operation / Replace if Blown	
	Contactors			X	Check Condition	

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

NOTE: Never use steam to clean electrical parts or chains.



1. FUSE 1
2. FUSE 2
3. FUSE 3
4. FUSE 4
5. FUSE 5

Figure 6. 24-Volt Fuse Locations (OS030EF)

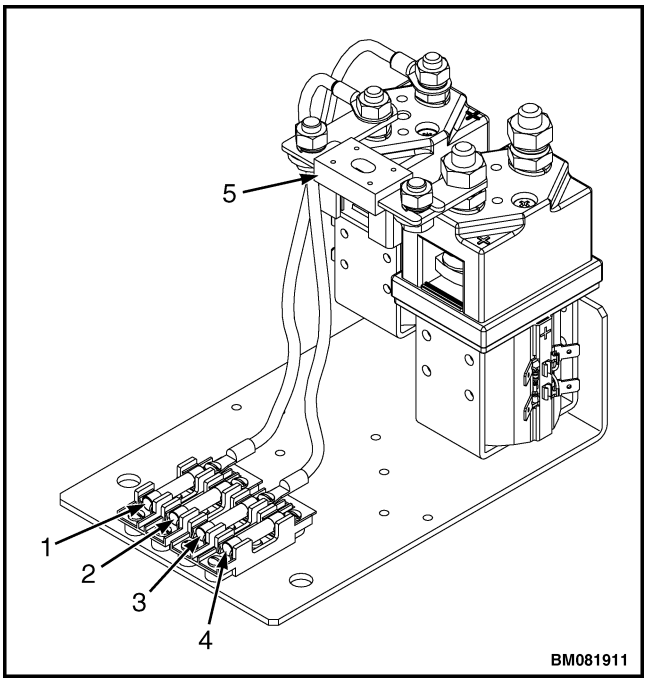
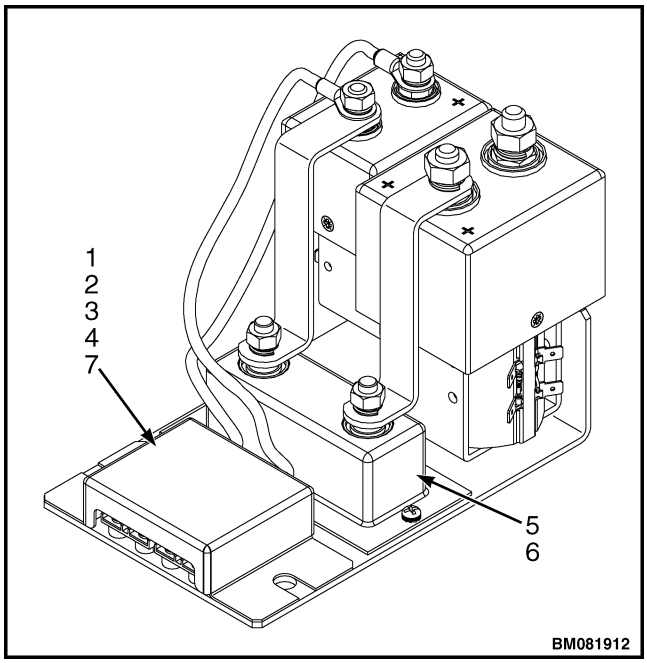


Figure 7. 24/36-Volt Fuse Locations (OS/SS/FS030BF)

Legend for Figure 7

1. FUSE 1
2. FUSE 2
3. FUSE 3
4. FUSE 4
5. FUSE 5



NOTE: FUSES 1 THROUGH 4 ARE POSITIONED THE SAME AS FIGURE 6 AND FIGURE 7.

1. FUSE 1 (NOT SHOWN)
2. FUSE 2 (NOT SHOWN)
3. FUSE 3 (NOT SHOWN)
4. FUSE 4 (NOT SHOWN)
5. FUSE 5 (NOT SHOWN)
6. FUSE BOX
7. FUSE COVER

Figure 8. 24/36-Volt EE Fuse Locations (OS/SS/FS030BF)

Direction/Speed, Lift/Lower, and Horn Control

Check that the direction/speed, lift/lower, and horn control operate as described in Table 1 of the **Operating Manual**. Check that the foot switch and direction/speed control operate as described in the Operating Procedures section of the **Operating Manual**.

HOW TO CHANGE HYDRAULIC OIL AND FILTER

WARNING

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

CAUTION

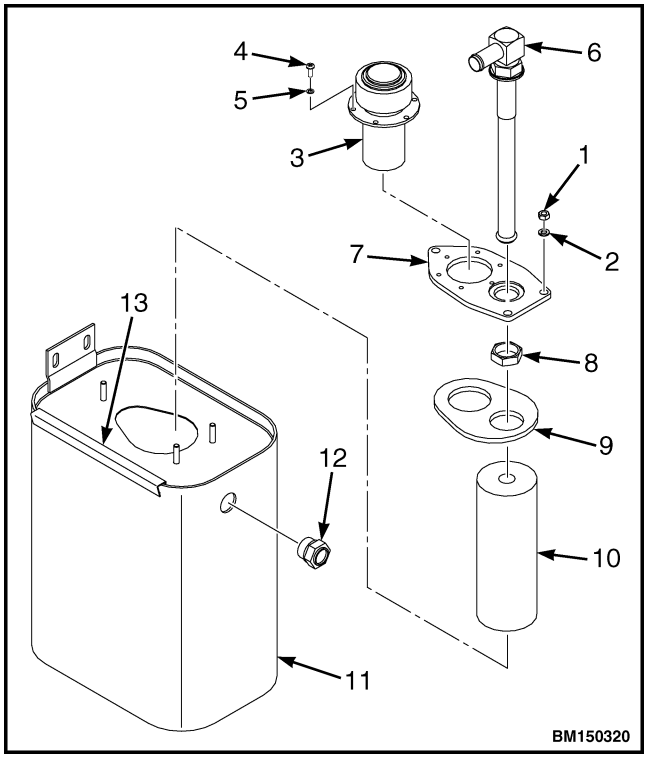
Protect the hydraulic system from dirt and contaminants when servicing the hydraulic system.

Never operate the pump without the proper amount of oil in the hydraulic system. The operation of the hydraulic pump with low oil levels will damage the pump.

Park the lift truck on a level surface. Completely lower the mast and the forks.

To drain the oil, put the lift truck on a level surface. Completely lower the mast and forks. Use a container with a 38 liter (10 gal) capacity near the supply hose of the hydraulic tank. Turn the key switch to the **OFF** position and disconnect the battery.

Replace the element every 2000 hours or yearly with each oil change. To replace the element, remove and plug the hose at the fitting near the breather. Remove the three nuts and washers that fasten the plate to the top of the tank. Carefully lift the plate assembly and filter element while keeping the assembly vertical. The filter element is held on the bottom of the fitting tube by a grommet mounted in the top of the element. Install the replacement element on the fitting tube. Reinstall the plate assembly onto the top of the tank. If your truck is equipped with a ground wire, be sure to reconnect the wire to the plate assembly before use. Reconnect the hose to the fitting near the breather. See Figure 16, Figure 17, or Figure 18.



1. NUT
2. LOCKWASHER
3. FILLER/BREATHER
4. SCREW
5. LOCKWASHER
6. FITTING
7. TANK COVER
8. NUT
9. GASKET
10. FILTER
11. HYDRAULIC TANK
12. SIGHT WINDOW
13. TRIM

Figure 16. Change the Oil Filter (OS030EF)

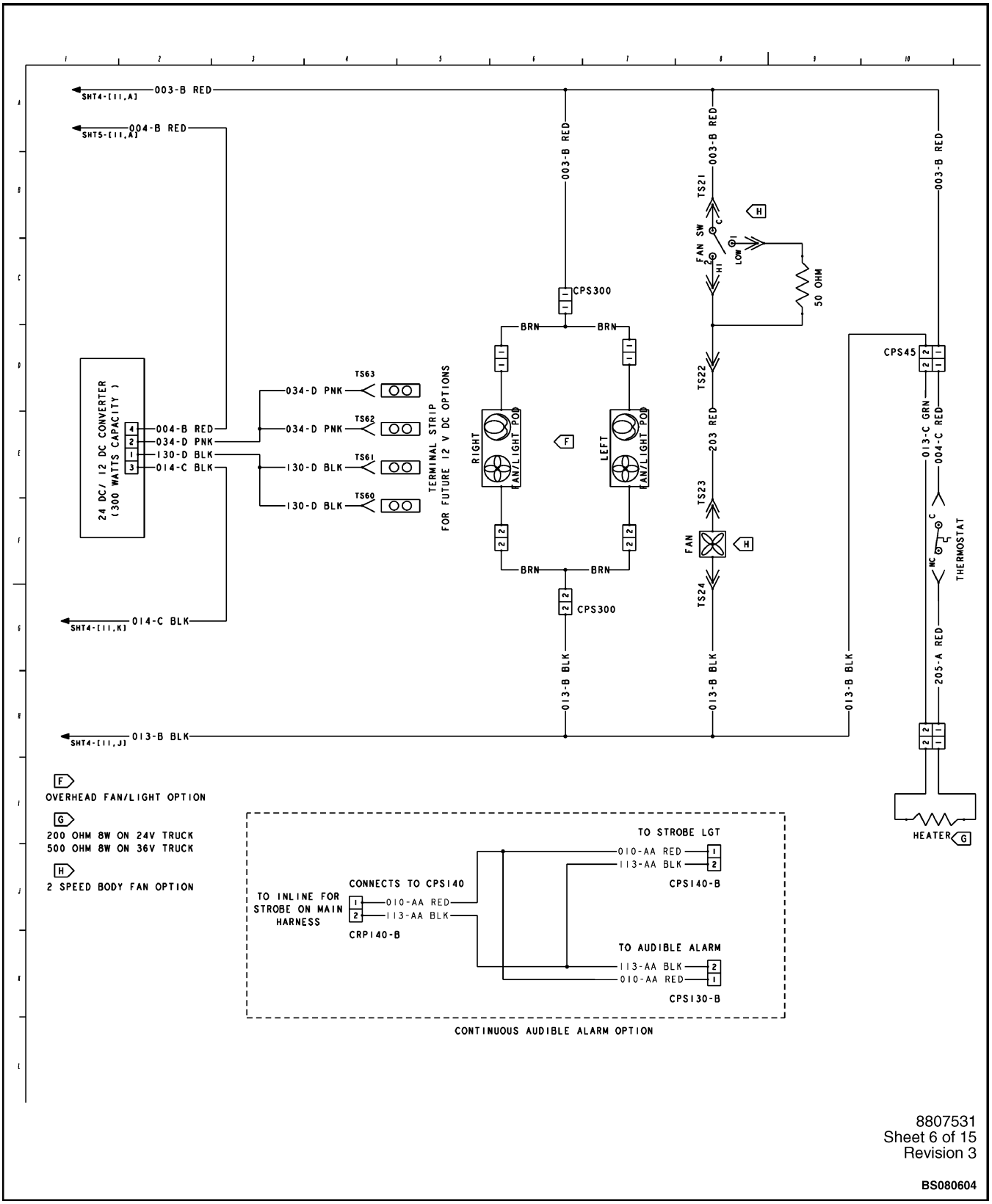
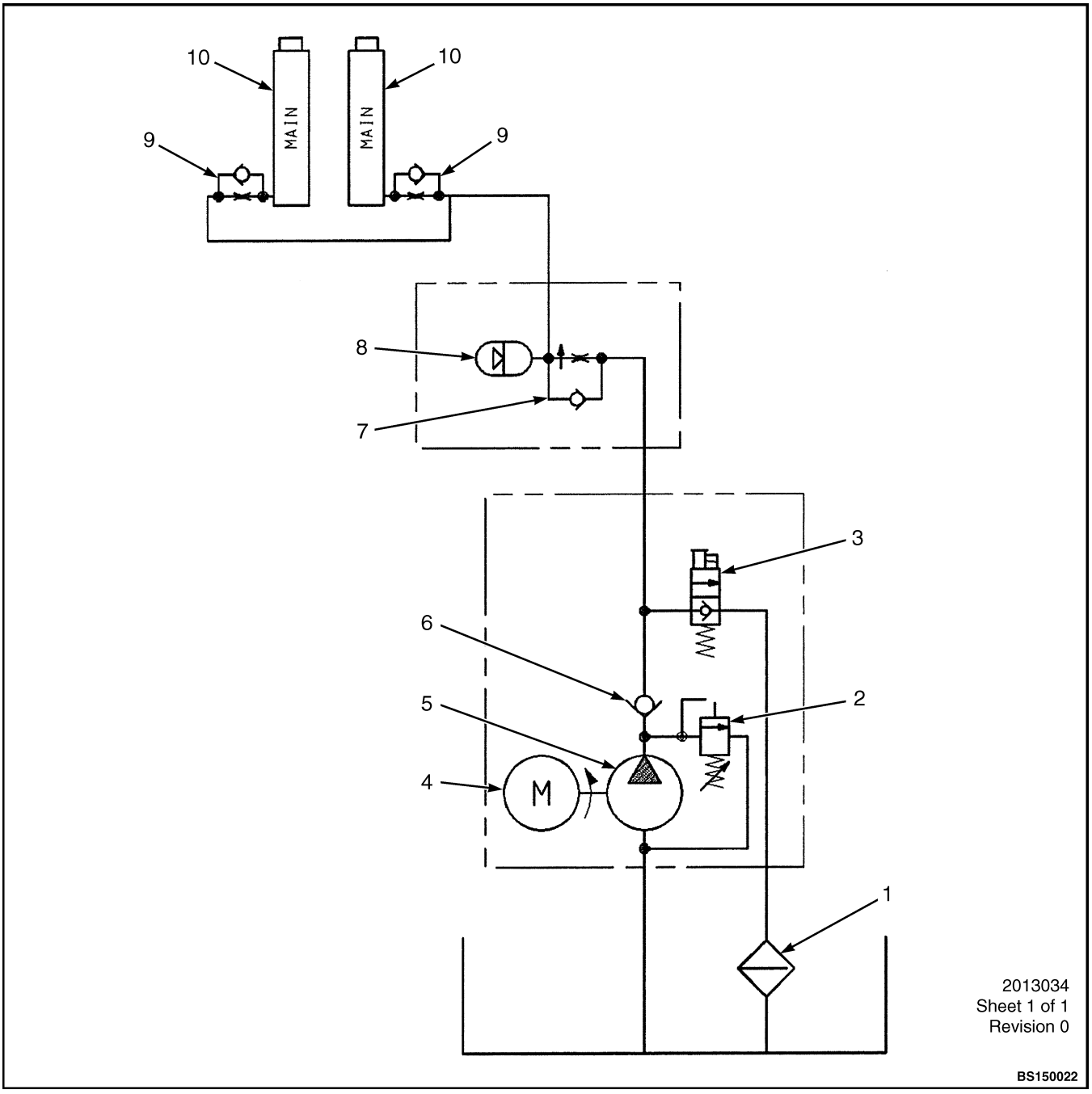


Figure 1. Wiring Schematic (Sheet 6 of 7)



1. FILTER
2. RELIEF VALVE
3. SOLENOID VALVE
4. LIFT PUMP MOTOR
5. LIFT PUMP
6. CHECK VALVE
7. FLOW REGULATOR
8. ACCUMULATOR
9. LOWERING CONTROL VALVE
10. LIFT CYLINDER

Figure 10. Hydraulic Schematic (OS030EF)

Master Drive Unit Specifications

Vehicle	Drive Tire Size Diameter × Width	Fluid Capacity
OS030BF/030EF (Early Production)	304.80 × 140 mm (12.00 × 5.50 in.)	2.5 liter (2.6 qt)
SS/FS030BF (Early Production)	342.90 × 139.70 mm (13.50 × 5.50 in.)	3.7 liter (3.9 qt)
OS030BF/030EF (Late Production)	304.80 × 140 mm (12.00 × 5.50 in.)	2.2 liter (2.3 qt)
SS/FS030BF (Late Production)	342.90 × 139.70 mm (13.50 × 5.50 in.)	3.3 liter (3.5 qt)

System Wire Guidance Specifications

Requirements at Installation	Specifications
Wire Driver Output Requirements	
Standard	
Frequency	6240 to 6260 Hz
Current	76 to 80 mA
Optional	
Frequency	5192 to 5208 Hz
Current	34 to 36 mA
Straightness of Guide Wire Requirements	
Maximum Deviation from Straight	±3.00 mm per 3.05 m (±0.118 in. per 10 ft)
Maximum Deviation Change	1.60 mm per 1.53 m (0.063 in. per 5 ft)
Maximum Deviation Between Any Two Points	0.32 mm per 3.05 mm (0.013 in. per 1 ft)
Maximum Deviations Per 3.05 m (10.00 ft)	one deviation

*Segment specification for **ALL** points within the segment. Segment specifications apply to **ALL** areas of the guide path (path of truck travel during guided operation).

WARNING

The AC traction motor weighs 42.2 kg (93 lb). To prevent injury, use a lifting device of adequate capacity for lifting the assembly.

NOTE: Ensure that the O-ring placed into the groove of the bearing and seal assembly is properly seated in place and lubricated prior to motor being installed into MDU.

2. Using the overhead hoist and sling and the ring eye adapter, lower the drive motor carefully until the pinion gear makes contact with the MDU pinion gear. A slight rotation of the sling and ring eye adapter to allow indexing of the gear teeth may be necessary. Verify a slight backlash in the gear teeth before lowering the motor completely.

3. Slightly tap on the motor housing with the plastic mallet to seat the motor housing ring in the MDU turntable bearing. A slight gap may remain which can be removed by installing the motor cap screws and washers and tightening the bolts equally in a cross pattern until the motor housing is seated in the MDU housing.

4. Install the four capscrews, lockwashers, and washers to secure the motor. Tighten alternately to half torque, then to full torque 23 N•m (17 lbf ft).

5. Connect the drive motor wiring and power cable connections.

6. Install the drive motor brake.

   See **Steering System** 1600YRM1610 for lift truck models NDR035EB, NR045EB (D861), NDR030EB, NR035-040EB (E815) and NDR030DB, NR035-040DB (B295).

   See **Steering System** 1600YRM1462 for lift truck models SS030BF (A474), FS030BF (A497), OS030EF (D801) and OS030BF (E826).

   See **Brakes** 1800YRM1628 for lift truck models MPC060-VG (A372) and MPC080-VG (A283).

   See **Brakes** 1800YRM1638 lift truck model MPE060-VG (B292) and MPE080-VG (B287).

7. Install the steer motor.

   See **Steering System** 1600YRM1610 for lift truck models NDR035EB, NR045EB (D861), NDR030EB, NR035-040EB (E815) and NDR030DB, NR035-040DB (B295).

   See **Steering System** 1600YRM1462 for lift truck models SS030BF (A474), FS030BF (A497), OS030EF (D801) and OS030BF (E826).

   See **Steering Mechanism** 1600YRM1627 for lift truck models MPC060-VG (A372) and MPC080-VG (A283).

   See **Steering Mechanism** 1600YRM1637 lift truck model MPE060-VG (B292) and MPE080-VG (B287).

8. Install the hydraulic tank and hydraulic motor.

   See **Hydraulic System** 1900YRM1616 for lift truck models NDR035EB, NR045EB (D861), NDR030EB, NR035-040EB (E815) and NDR030DB, NR035-040DB (B295).

   See **Hydraulic System** 1900YRM1464 or **Hydraulic System** 1900YRM1465 for lift truck models SS030BF (A474), FS030BF (A497), OS030EF (D801) and OS030BF (E826)

   See **Walkie Hydraulic System** 1900YRM1629 for lift truck models MPC060-VG (A372) and MPC080-VG (A283)

   See **Hydraulic System** 1900YRM1639 lift truck model MPE060-VG (B292) and MPE080-VG (B287).

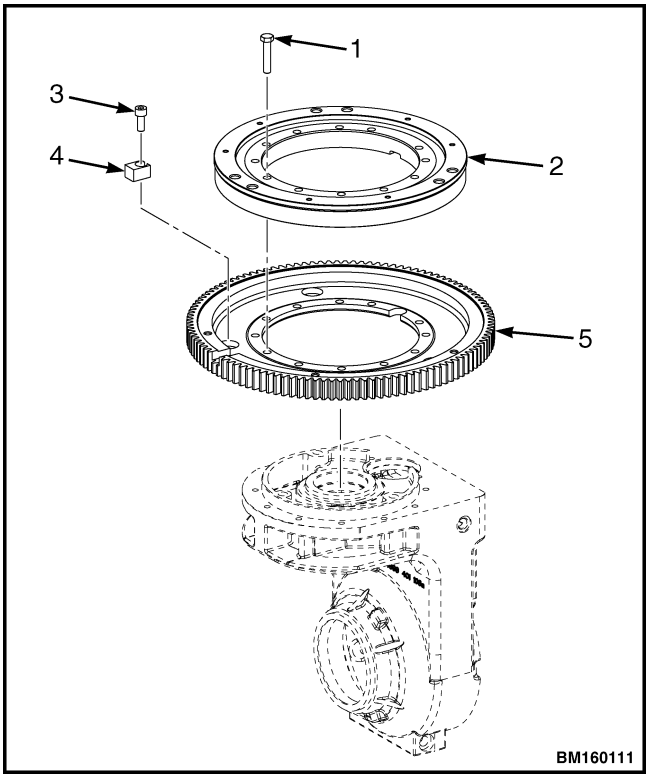
9. Install the operator cover.

   See **Frame** 0100YRM1615, Covers, Panels, and Plates RepairCovers, Panels, and Plates Repair for lift truck modelsNDR035EB, NR045EB (D861), NDR030EB, NR035-040EB (E815) and NDR030DB, NR035-040DB (B295).

   See **Frame** 0100YRM0760, Frame Repair for lift truck models SS030BF (A474), FS030BF (A497), OS030EF (D801) and OS030BF (E826).

NOTE: For STEP 2 and STEP 3, support the MDU in a vertical position.

STEP 2.
Remove twelve hexagon screws, steering bearing, capscrew, lock nut and steering gear from top of MDU.



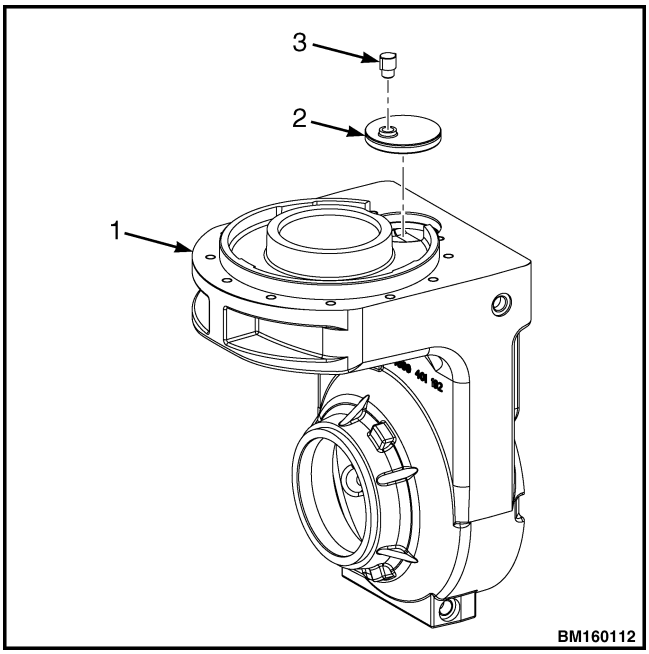
1. HEXAGON SCREWS
2. STEERING BEARING
3. CAPSCREW
4. LOCK NUT
5. STEERING GEAR

CAUTION

DO NOT damage surface area around sealing cap during removal.

NOTE: Remove breather valve from sealing cap and set aside to be installed into new sealing cap.

STEP 3.
Remove and discard sealing cap from top of MDU housing.



1. MDU HOUSING
2. SEALING CAP
3. BREATHER CAP

P1.7 Lower Speed

This parameter allows the user to adjust the mast lower speed from the maximum lower speed to some lower speed within the parameter range. The setting range is from 1 to 9. Setting this parameter to “9” will result in maximum lower speed. Setting this parameter to “1” will result in minimum lower speed.

P1.8 Lift Accel

This parameter allows the user to adjust acceleration during lifting from the maximum acceleration rate to some lower acceleration rate within the parameter range. The setting range is from 1 to 9. Setting this parameter to “9” will result in maximum acceleration during lifting. Setting this parameter to “1” will result in minimum acceleration during lifting.

P1.9 Lift Decel

This parameter allows the user to adjust deceleration during lifting from the maximum deceleration rate to some lower deceleration rate within the parameter range. The setting range is from 1 to 9. Setting this parameter to “9” will result in maximum deceleration during lifting. Setting this parameter to “1” will result in minimum deceleration during lifting.

P1.10 Lower Accel

This parameter allows the user to adjust acceleration during lowering from the maximum acceleration rate to some lower acceleration rate within the parameter range. The setting range is from 1 to 9. Setting this parameter to “9” will result in maximum acceleration during lowering. Setting this parameter to “1” will result in minimum acceleration during lowering.

P1.11 Lower Decel

This parameter allows the user to adjust deceleration during lowering from the maximum deceleration rate to some lower deceleration rate within the parameter range. The setting range is from 1 to 9. Setting this parameter to “9” will result in maximum deceleration during lowering. Setting this parameter to “1” will result in minimum deceleration during lowering.

P1.33 Steer Ratio

This parameter allows the user to adjust the turns lock-to-lock of the steering function. The setting range is from 1 to 9. Setting this parameter to “9” will result in maximum number of turns lock to lock. Setting this parameter to “1” will result in minimum number of turns lock to lock.

TABLE OF CONTENTS (Continued)

H1 Truck Hours

The Truck Hours hourmeter accumulates time when the key switch is in the **ON** position and the operator presence switch is activated.

H2 Traction Hours

The Traction Hours hourmeter accumulates time when the traction motor is activated.

H3 Pump Hours

The Pump Hours hourmeter accumulates time when the lift motor is activated.

H4 Steer Hours

The Steer Hours hourmeter accumulates time when the steer motor is activated.

H5 Odometer Miles

The Odometer Miles shows the total number of miles/ kilometers driven based on the traction hours.

H10 Display Hours

The Display Hours hourmeter shows the total number of hours of operation of the display.

H30 Traction Node Hours

The Traction Hours hourmeter shows the total number of hours of operation of the traction controller.

H40 Steer Node Hours

The Steer Hours hourmeter shows the total number of hours of operation of the steer controller.

H50 Pump Node Hours

The Pump Hours hourmeter shows the total number of hours of operation of the pump controller.

H70 Fwd Ant Node Hours

The Forward Antenna hourmeter shows the total number of hours of operation of the front wire guidance antenna.

H71 Rev Ant Node Hours

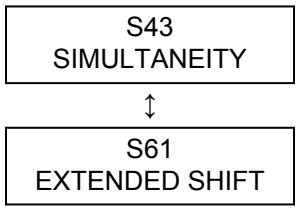
The Reverse Antenna hourmeter shows the total number of hours of operation of the rear wire guidance antenna.

H90 CAN I/O Hours

The CAN I/O Hours hourmeter shows the total number of hours of operation of the CAN I/O module.

Table 8. Settings Menu (Continued)

NOTE: Depending on how an individual lift truck is equipped, some functions shown on the display may not be available for viewing.



S1 Metric

Use this parameter to select the units used to display information on the display. This parameter can be set to either ENABLE or DISABLE. If set to ENABLE, all units such as speed, distance, weight, etc. will be shown in metric units. If set to DISABLE, all units will be shown in English units.

S2 User Performance

NOTE: This parameter is used with the "O4 OPERATOR PW" parameter. Both the Operator PW parameter and this parameter must be set to ENABLE to allow full use of the User Performance settings

Use this parameter to ENABLE or DISABLE the use of Performance Levels. If set to ENABLE, the individual Performance menus P1, P2, P3, and P4 are active. If set to DISABLE, these performance settings will be removed from the visible menu structure.

S3 Timeout

Use this parameter to adjust the amount of time the lift truck can remain inactive before activating automatic power shutdown. Set the parameter to any value between "1" minute and "59" minutes. Setting this parameter to "0" will disable this function. If the system shuts down after timing out, the key must be reset to enable lift truck operation.

S4 Battery Type

Use this parameter to select the battery type used in the lift truck. Select the type of battery in use; FLOODED, MAINTENANCE FREE, or OTHER. Use OTHER if the lift truck has a fuel cell installed. Selecting either FLOODED or MAINTENANCE FREE will pre-select the values used for S6 thru S9. If OTHER is selected, BDI functions will be disabled.

S5 BDI Startup Full

NOTE: * If OTHER is selected as Battery Type, BDI functions will be disabled.

This parameter will be automatically set to the correct value when the "Battery Type" parameter is set. However, this parameter can be used by the user to adjust the number of BDI bars which the display will show immediately after re-key based on battery voltage. A "1" equals the lowest voltage setting for a given number of bars and a "9" equals the highest voltage setting for a given number of bars. This does not affect the discharge rate of the battery, only the initial number of bars displayed after re-key.

S6 BDI Full

NOTE: * If OTHER is selected as Battery Type, BDI functions will be disabled.

This parameter will be automatically set to the correct value when the "Battery Type" parameter is set. However, this parameter allows the user to adjust the battery voltage which the truck software considers to be "10" BDI bars. A "0" equals a lower voltage and a "9" equals a higher voltage.

S7 BDI Empty

NOTE: * If OTHER is selected as Battery Type, BDI functions will be disabled.

D2.10.1 Bus Error

Indicates the current real time error rate on the CAN BUS.

D2.10.2 Bus Max Error

Indicates the maximum error rate on the CAN BUS.

D2.10.30 Traction

Indicates if Traction Controller is On or Off the CAN BUS.

D2.10.40 Steer

Indicates if Steer Controller is On or Off the CAN BUS.

D2.10.50 Pump

Indicates if Pump Controller is On or Off the CAN BUS.

D2.10.70 Forward Antenna

Indicates if the Forward Antenna is On or Off the CAN BUS.

D2.10.71 Reverse Antenna

Indicates if the Reverse Antenna is On or Off the CAN BUS.

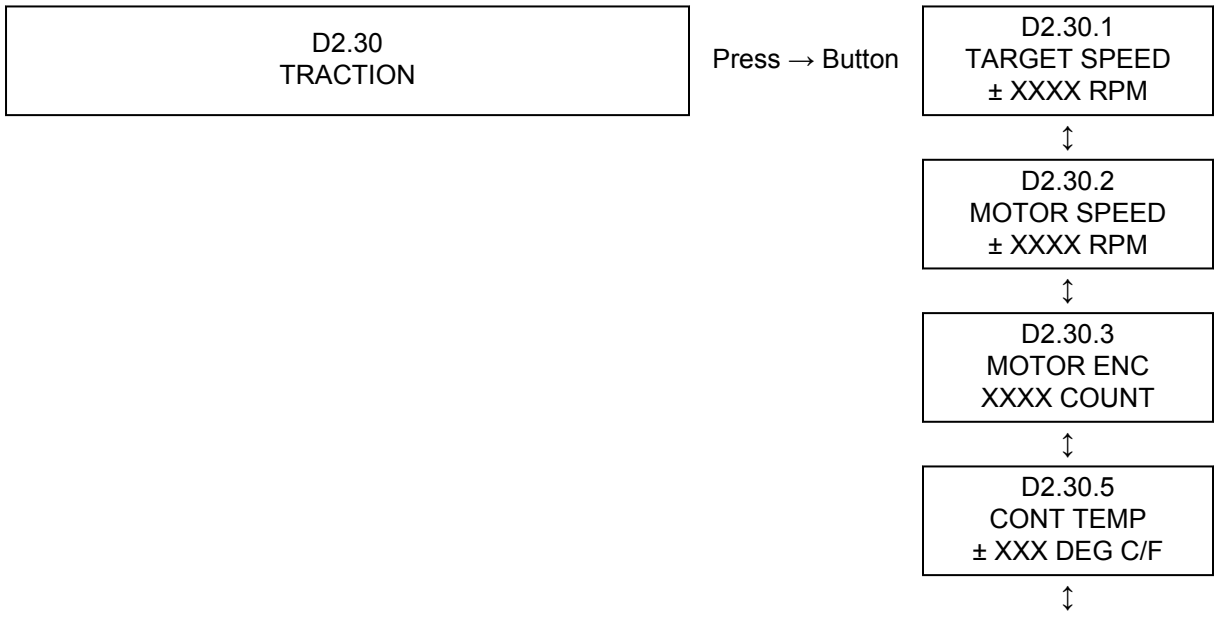
D2.10.90 CAN I/O

Indicates if CAN /IO Controller is On or Off the CAN BUS.

D2.30 Traction

Table 15. D2.30 Traction Menu

NOTE: Depending on how an individual lift truck is equipped, some functions shown on the display may not be available for viewing.



D2.50.10 Cap Min V

This test monitors the minimum cap voltage recorded during the key cycle. Pump controller min cap voltage can be reset when key is recycled (Turn **OFF** and then **ON**).

D2.50.11 Key V

This test allows the technician to monitor the actual lift pump controller key voltage.

D2.50.12 Key Max V

This test monitors the maximum key voltage recorded during the key cycle. Pump controller key max voltage can be reset when key is recycled (Turn **OFF** and then **ON**).

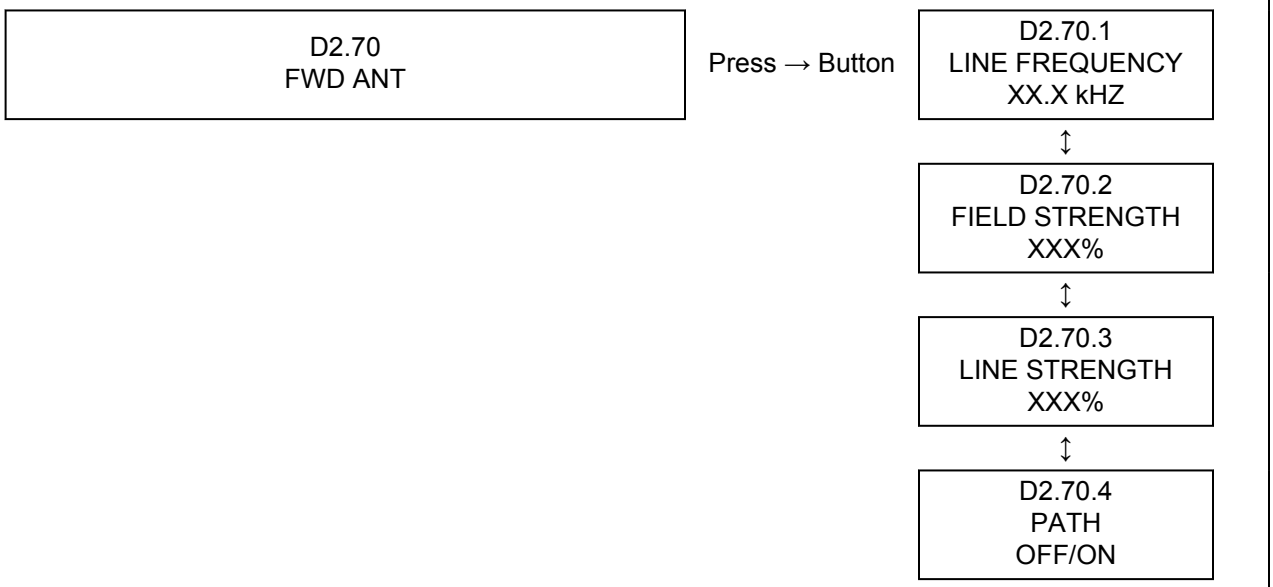
D2.50.13 Key Min V

This test monitors the minimum key voltage recorded during the key cycle. Pump controller key min voltage can be reset when key is recycled (Turn **OFF** and then **ON**).

D2.70 Forward Antenna

Table 18. D2.70 Forward Antenna Menu

NOTE: Depending on how an individual lift truck is equipped, some functions shown on the display may not be available for viewing.



D2.70.1 Line Frequency

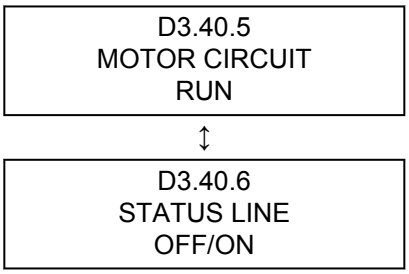
This test allows the technician to determine the line frequency error of a given wire when the truck antennas are over the wire in the forward direction. An acceptable value should be less than 300Hz.

D2.70.2 Field Strength

This test allows the technician to determine the measured field strength of a given wire while the truck antennas are over the wire in the forward direction.

Table 23. D3.40 Steer Menu (Continued)

NOTE: Depending on how an individual lift truck is equipped, some functions shown on the display may not be available for viewing.



D3.40.1 U-V Line DC Curr

When this test is turned **ON**, a DC current is directed to the "U" and "V" post in the AC Motor controller.

D3.40.2 U-W Line DC Curr

When this test is turned **ON**, a DC current is directed to the "U" and "W" post in the AC Motor controller.

D3.40.3 V-W Line DC Curr

When this test is turned **ON**, a DC current is directed to the "V" and "W" post in the AC Motor controller.

D3.40.4 Motor Open

When this test is performed, the steer motor and circuits are checked for an open circuit. If no faults are found, display will read **SUCCESSFUL**.

D3.40.5 Motor Circuit

When this test is performed, the display will read **DISCONNECT MOTOR**. This test will check for motor circuit faults.

D3.40.6 Status Line

This test allows for turning the Status Line On/Off.

SAFETY PRECAUTIONS
TROUBLESHOOTING PROCEDURES

- The Service Manuals are updated on a regular basis, but may not reflect recent design changes to the product. Updated technical service information may be available from your local authorized Yale® dealer. Service Manuals provide general guidelines for maintenance and service and are intended for use by trained and experienced technicians. Failure to properly maintain equipment or to follow instructions contained in the Service Manual could result in damage to the products, personal injury, property damage or death.
- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **YALE APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

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

WARNING

Indicates a condition that can cause immediate death or injury!

CAUTION

Indicates a condition that can cause property damage!

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

Basic Electrical Troubleshooting

ELECTRICAL CHECKS

The following electrical checks are used to diagnose circuit and component faults on trucks. Review the following information so that it may be applied when diagnosing a fault or status code.

Voltage Checks

Voltage is electrical pressure or force that pushes current through a circuit. The force is measured in volts.

Low voltage to a load device will cause the device to be inoperative or operate poorly. This can be caused by a low battery source, high circuit resistance, poor connections, or an open circuit; the resistance of poor connections or poor ground acts as an additional load in the circuit, causing low voltage pushing current, or amperage, through a device.

A voltmeter is used to perform:

- Measurement of force
- Presence of voltage
- Voltage drops

When using a voltmeter to determine if voltage is present and capable of operating a device, connect the positive meter lead to the power circuit of a device's connector and connect the negative meter lead to the negative battery terminal.

Measuring the voltage drop is performed by connecting the positive test lead to the positive side of the device while simultaneously connecting the negative meter lead to the negative side of the device. The test can also be performed across a section of wire that is faulty and suspected of having excessive resistance. A voltage drop must be performed while the device is operating. In a circuit with a single load device, the device will drop the total voltage of the circuit. If the device drops less than battery voltage, it can be assumed that the circuits are using the remaining voltage as a source of excessive resistance or a poor connection exists, assuming the battery state-of-charge is correct.

Amperage Checks

An ammeter is used to measure amperage or current flow through a circuit. An ampere is the measurement of electron flow, which can be used to measure the amount of electrons that are flowing through a circuit. Ohm's Law states that current flow in a circuit is equal to the circuit voltage divided by total circuit resistance, known as the potential difference. Since amperage is the current in the circuit, increasing voltage also increases the current, or amperage levels.

Measuring amperage is always performed by placing the ammeter in series with the device or circuit. This will cause all current to flow through the protected meter. The circuit must be operating in order to measure amperage. Never measure amperage on high amperage circuits or in parallel to a circuit, this can result in the damage of the meter and the electrical system.

Resistance Checks

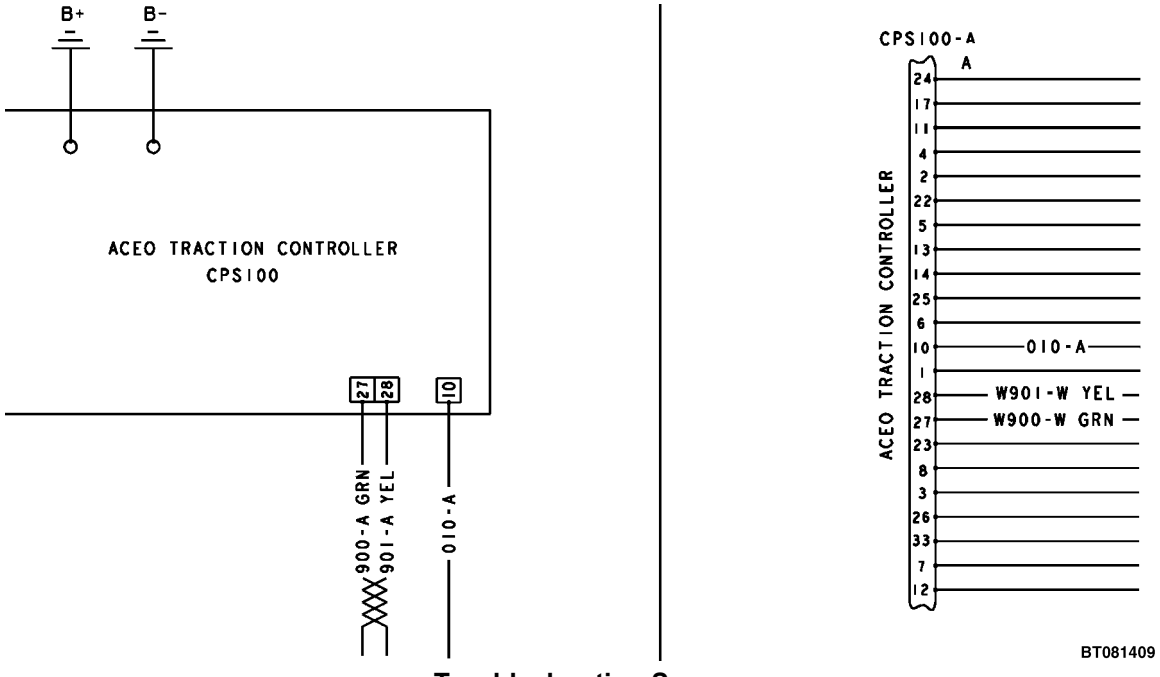
The ohmmeter is used to measure a circuit or device's resistance in ohms. Ohmmeters use low internal voltage and current which flow through an isolated circuit or device being tested. The voltage of the meter battery and the amount of current flow in the circuit are used to calculate the circuit's resistance. It is necessary to disconnect or isolate the circuit being test so not to damage the vehicle's electrical system or the ohmmeter.

An ohmmeter is used to perform:

- Resistance of a load device
- Resistance of conductors
- Value of resistors
- Operation of variable resistors
- CANbus termination resistors
- Continuity

DTC 10101 (Cont)
CANBus Communications - Traction

DTC 10101 CANBUS COMMUNICATIONS - TRACTION DIAGRAMS



Troubleshooting Scene

END FAULT

DTC 10109
CANBus Communications - Display

POSSIBLE CAUSE

A. CANBUS COMMUNICATION FAULT

B. DISPLAY WIRING FAULT

NOTE

Please refer to the end of this procedure for supporting diagrams.

COMPONENT OPERATIONAL CHECK

NOTE: Always check battery condition and state of charge before performing electrical troubleshooting. A faulty or low charged battery will cause electrical features to not operate as designed and give incorrect readings while performing electrical tests.

PROCEDURE OR ACTION:

1. Conduct a visual inspection of all connectors/wiring associated with the fault code.
   Are any faults detected/observed?
   YES: Repair/replace connector or wiring associated with faults found. Refer to the appropriate **Electrical System** YRM.
   NO: Proceed to Step 2.
2. Re-key the vehicle.
   Is the code still present?
   YES: If display diagnostic menu is operational, proceed to Step 3. If display is inoperative, proceed to Cause A.
   NO: Problem may be intermittent.
3. Using input diagnostics (D2.10), determine if other nodes are offline.
   Are other nodes offline?
   YES: Verify CAN HI and CAN LO voltages of offline node(s).
   NO: Proceed to Cause A.

CAUSE A - CANBUS COMMUNICATION FAULT

PROCEDURE OR ACTION:

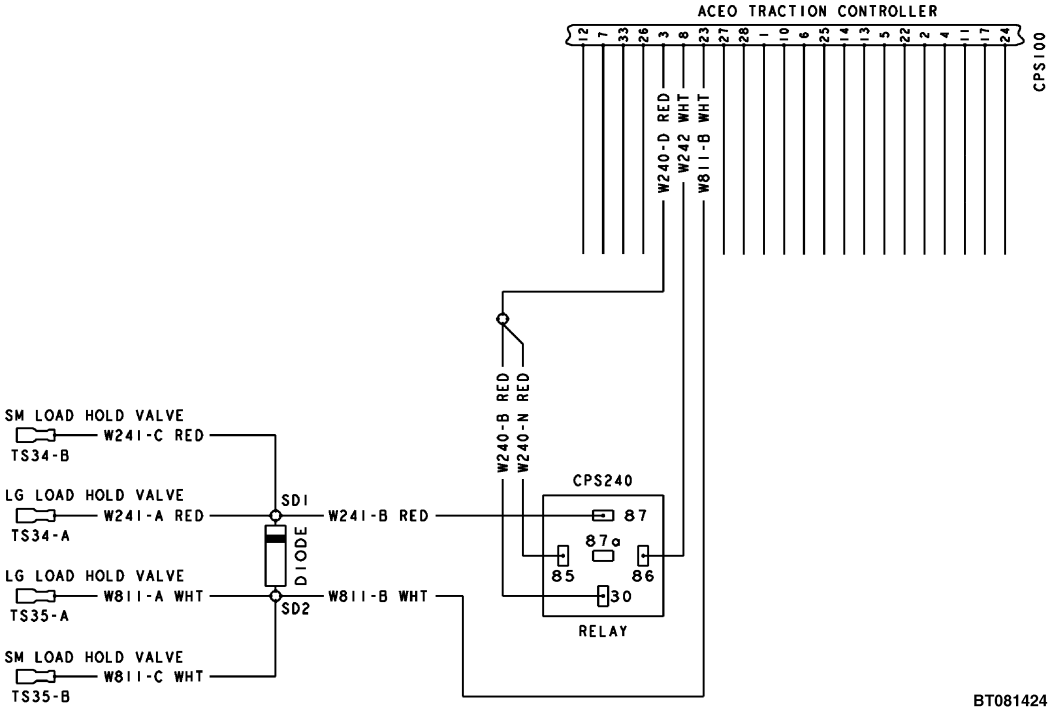
NOTE: Key in ON position

1. Disconnect the display connector CPS20 and measure voltage between socket 3 and B(-).
   Is CAN HI voltage approximately 2.5 Vdc?
   YES: Proceed to Step 2.
   NO: Inspect CAN HI circuit for open or short. If voltage is 0 volts, the CAN HI circuit is shorted to ground or open. If voltage is above 5 volts, the CAN HI circuit is shorted to power.

NOTE: Key in ON position.

2. Measure voltage between the display connector CPS20, socket 4 and B(-).
   Is CAN LO voltage approximately 2.5 Vdc?
   YES: Disconnect battery and proceed to Step 3.
   NO: Inspect CAN LO circuit for open or short. If voltage is 0 volts, the CAN LO circuit is shorted to ground or open. If voltage is above 5 volts, the CAN LO circuit is shorted to power.
3. Measure resistance between the display connector CPS20, socket 3 and socket 4.

Load Hold Coil (Cont)



Troubleshooting Scene

END FAULT

Audible Alarm (Cont)

CAUSE B - AUDIBLE ALARM FAULT

PROCEDURE OR ACTION:

NOTE: Operate the audible alarm while Performing Step 1.

1. Measure voltage between the audible alarm connector CPS130, socket 2 and B(-).
   Is voltage present while alarm is operated?
   YES: Replace faulty alarm.
   NO: Proceed to Cause C.

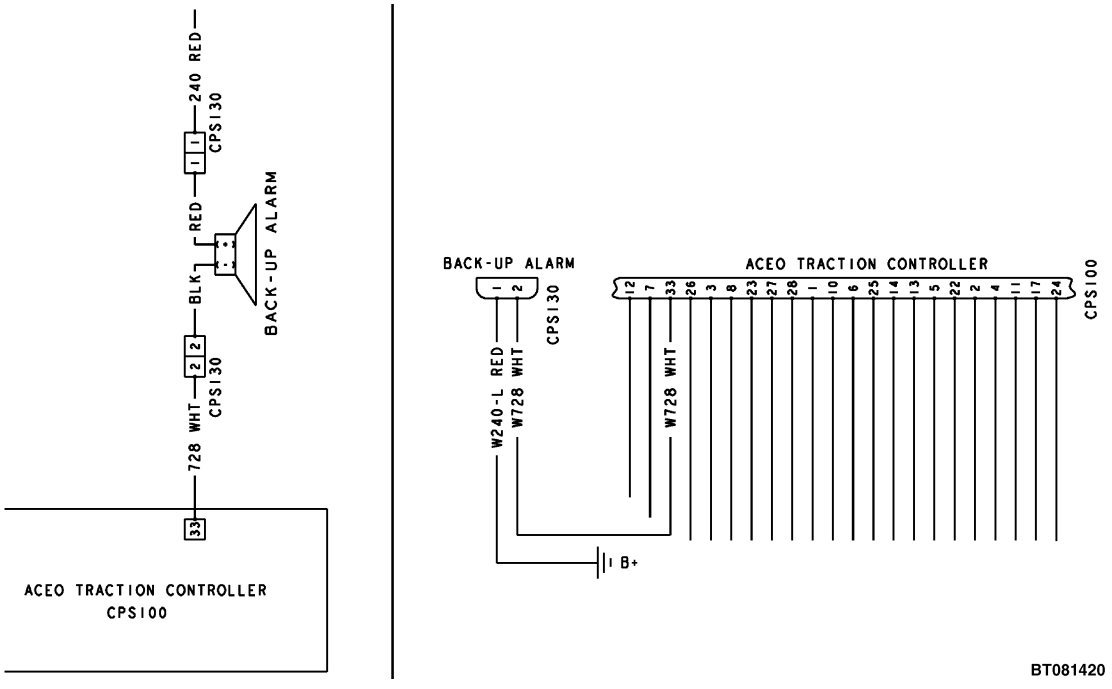
CAUSE C - FAULTY TRACTION CONTROLLER

PROCEDURE OR ACTION:

1. If no faults are found, replace controller. Make sure to indicate the DTC code(s) on the warranty claim to include an accurate problem description leading to controller replacement.

END POSSIBLE CAUSES

DIAGRAMS



Troubleshooting Scenes

END FAULT

Main Contactor

CODES

DTC 30067 - Traction - Main Contactor - Welded Tips
DTC 30068 - Traction - Main Contactor - Not Closed

POSSIBLE CAUSE

A. MAIN CONTACTOR COIL WIRING FAULT
B. MAIN CONTACTOR STUCK CLOSED
C. MAIN CONTACTOR STUCK OPEN
D. FAULTY TRACTION CONTROLLER

NOTE

Please refer to the end of this procedure for supporting diagrams.

COMPONENT OPERATIONAL CHECK

NOTE: Always check battery condition and state of charge before performing electrical troubleshooting. A faulty or low charged battery will cause electrical features to not operate as designed and give incorrect readings while performing electrical tests.

PROCEDURE OR ACTION:

1. Conduct a visual inspection of all connectors/wiring associated with the fault code.
   Are any faults detected/observed?
   YES: Repair/replace connector or wiring associated with faults found. Refer to the appropriate **Electrical System** YRM.
   NO: Proceed to Step 2.
2. Re-key the vehicle.
   Is the code still present?
   YES: Proceed to Step 3.
   NO: Problem may be intermittent.
3. Locate status tests (D1) and view the main contactor (D1.2) to verify main contactor position.
   Does main contactor remain open or closed when coil is energized/de-energized?
   YES: Proceed to Step 4.
   NO: Fault may be intermittent, inspect main contactor tips for damage or debris.
4. Locate output diagnostics (D3.30) and actuate main contactor coil (D3.30.7).
   Does contactor operate correctly when actuated?
   YES: Proceed to Cause C.
   NO: Proceed to Cause A.

CAUSE A - MAIN CONTACTOR COIL WIRING FAULT

PROCEDURE OR ACTION:

NOTE: Key in ON position.

1. Disconnect the main contactor coil's positive terminal TS31-B. Measure voltage between socket TS31-B and B(-).
   Is voltage 24 ± 2.5 Vdc / 36 ± 3.5 Vdc?
   YES: Disconnect battery and proceed to Step 2.
   NO: Inspect circuit 010/010-A for open or short.

(Cont)

Is voltage 24 ± 2.5 Vdc / 36 ± 3.5 Vdc?
YES: Disconnect battery and proceed to Step 3.
NO: Inspect ground circuit W113-D for open or short.

3. Disconnect the traction controller connector CPS100 and measure resistance between socket 6 and the mast proximity sensor connector CPS90, socket 1.
   Is resistance <1 ohm?
   YES: Proceed to Cause B.
   NO: Inspect circuit 571 for open or source of excessive resistance. If no circuit faults are found, replace faulty proximity sensor.

CAUSE B - HOIST ENCODER FAULT

PROCEDURE OR ACTION:

NOTE: Perform Step 1 and Step 2 with key in ON position.

1. Disconnect the hoist motor encoder connector CPS151 and measure voltage between socket 1 and B(-).
   Is voltage 12 ± 1.5 Vdc?
   YES: Proceed to Step 2.
   NO: Inspect circuit 283 for open or short.
2. Measure voltage between the encoder connector CPS151, socket 1 and socket 4.
   Is voltage 12 ± 1.5 Vdc?
   YES: Disconnect battery and proceed to Step 3.
   NO: Inspect ground circuit 114 for open or short.
3. Disconnect the hoist motor controller connector CPS150. Measure resistance between socket 7 of the hoist controller connector and socket 2 of the encoder connector CPS151.
   Is resistance <1 ohm?
   YES: Proceed to Step 4.
   NO: Inspect signal circuit 575 for open or source of excessive resistance.
4. Measure resistance between socket 14 of the hoist motor controller connector CPS150 and socket 3 of the encoder connector CPS151.
   Is resistance <1 ohm?
   YES: Reconnect the encoder connector CPS151 and proceed to Step 5.
   NO: Inspect signal circuit 576 for open or source of excessive resistance.

NOTE: Connect Breakout Kit #580002086 , connect battery, and perform Step 5 with key in ON position.

5. Measure voltage between the hoist motor controller connector CPS150, socket 7/14 and B(-).
   Does voltage signal relate to pump operation?
   YES: Proceed to Cause C.
   NO: Replace faulty encoder.

CAUSE C - FAULTY TRACTION CONTROLLER

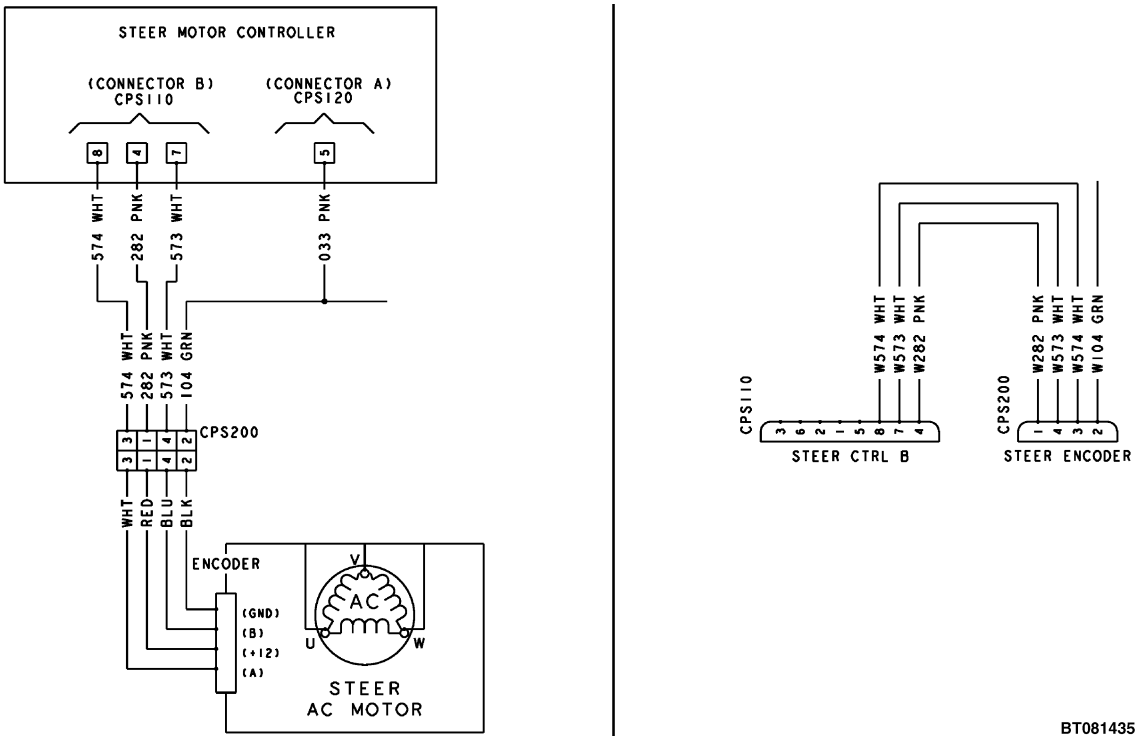
PROCEDURE OR ACTION:

1. If no faults are found, replace controller. Make sure to indicate the DTC code(s) on the warranty claim to include an accurate problem description leading to controller replacement.

END POSSIBLE CAUSES

DTC 40062 (Cont)
Steer - Motor - Encoder

DTC 40062 STEER - MOTOR - ENCODER DIAGRAMS



Troubleshooting Scenes

END FAULT