OPERATING INSTRUCTIONS

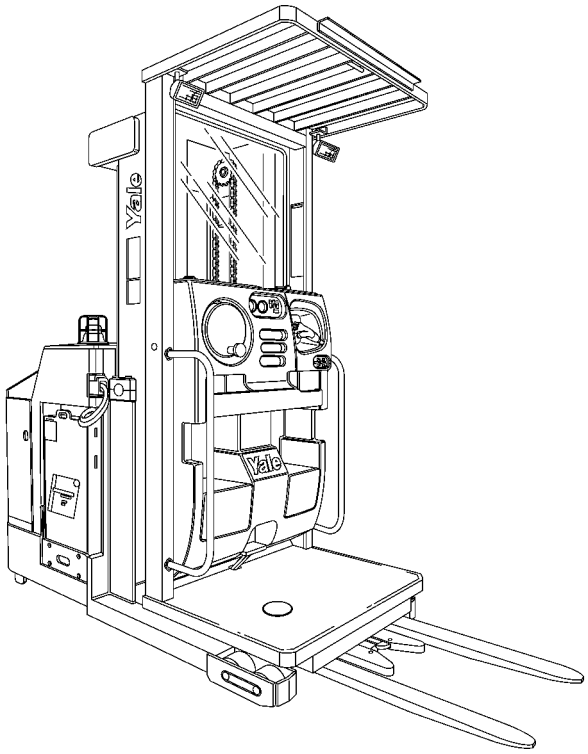


Figure 1-1 -OS030EB Truck

MODEL DESCRIPTION

The Yale OS 030 EB electric lift truck has a 3,000 lb. lifting capacity and is specially designed for order picking. The power source is a 24 volt battery. The operator's platform is elevated with the load. This allows accurate fork positioning and order picking operations. The lift truck can be operated from the standing position with the operator facing either direction.

NOTE: Throughout this manual the terms left, right, front and rear relate to the viewpoint of an operator standing in the truck facing the steer/drive tire.

The control handle allows the use of one hand to control forward and reverse travel as well as lift and lower. The variable lift/lower control allows the operator the option of varying the lift and lower speeds. The drive motor is stationary to prevent flexing and wear of the power cables. An electrically released, spring applied brake is also provided. Yale Hi-Vis Triplex masts provide excellent visibility for these models.

Before attempting to operate this lift truck, carefully read and understand these operating procedures. Make sure the lift truck is in proper operating condition. Be sure all safety devices such as the overhead guard and the tether line and belt are in place and properly secured. The operator should always wear the tether line and belt when operating this unit.

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

combined. Lift truck weight information is located on the nameplate.

4. Travel with the load lowered. Do not elevate the load except during stacking.

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

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

7. If visibility is impaired and you must operate the lift truck in reverse, look in the direction of travel.

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

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

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

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

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

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

14. These lift trucks are designed for use on smooth, hard floors with minimal grades.

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

16. Do not push loads with the lift truck.

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

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

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

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

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

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

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

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

LEGEND

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

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

NA-794

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

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

The metric system used by Yale Materials Handling Corporation is described as SI (Le Systeme d'Unites orthe International System of Units, also called SI in all languages). The SI system of measurement is described in ISO Standard 1000, 1973. A conversion table of common measurements is shown in Table 2-12.

THREADS, NOMENCLATURE

The thread design is specified by a series of numbers and letters for inch and metric fasteners. See Figure 2-9. The diameter of the shank of the fastener is shown first in the series [M12 = 12 mm, M20 = 20 mm (1/2 = 1/2 inch, 3/4 = 3/4 inch)].

The length of the shank is often indicated as part of the description of a fastener. This length is shown in inches for inch fasteners and in millimeters for metric fasteners.

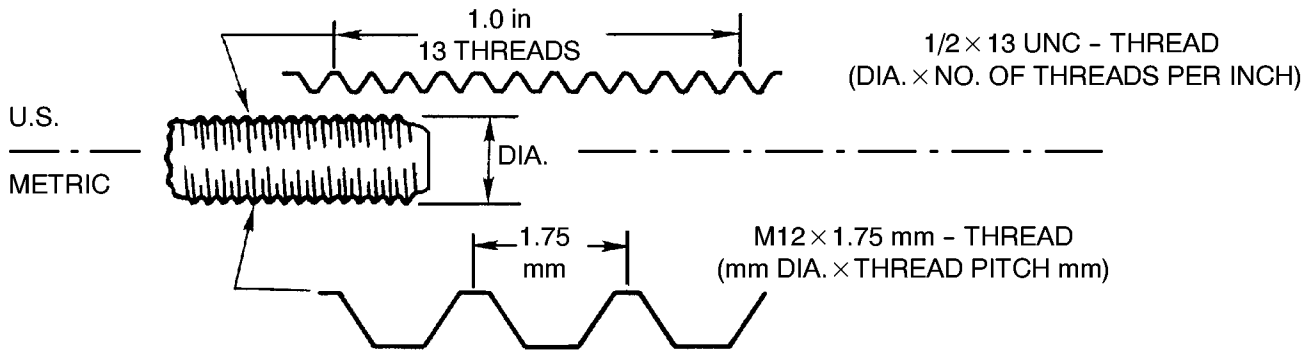
The number of threads per inch for inch fasteners may either be shown as UNC (Unified National Coarse) or UNF (Unified National Fine). Metric fasteners show the thread pitch.

A capscrew will have the following description:

Table 2-4 -Capscrew Description

INCH	METRIC
1/2×13 UNC×1-1/2	M12×1.75×50
A × B C × D	A × B × C
A = Shank Diameter B = Number of Threads Per Unit of Length C = Type of Thread D = Shank Length	A = Thread Size B = Pitch C = Length

Figure 2-9 -Thread Design



STRENGTH IDENTIFICATION

The most common property classes for metric fasteners are 8.8 and 10.9. The property class is marked with a number on the head of the capscrew or on a nut. Property classes less than 8.8 are often not marked. Grades for inch bolts go from 2 to 8. Grade 2 fasteners normally do not have any marks. The following tables show the marks that identify the grades and property classes for different fasteners.

CAUTION: When fasteners must be replaced, the new fasteners must be of the same strength or greater than the original fasteners. The new fasteners must also be the correct size.

NOTE: Identification marks are according to bolt strength. The higher the number or the increase in the number of marks indicates increased bolt strength.

Table 2-5 - Bolts and Screws

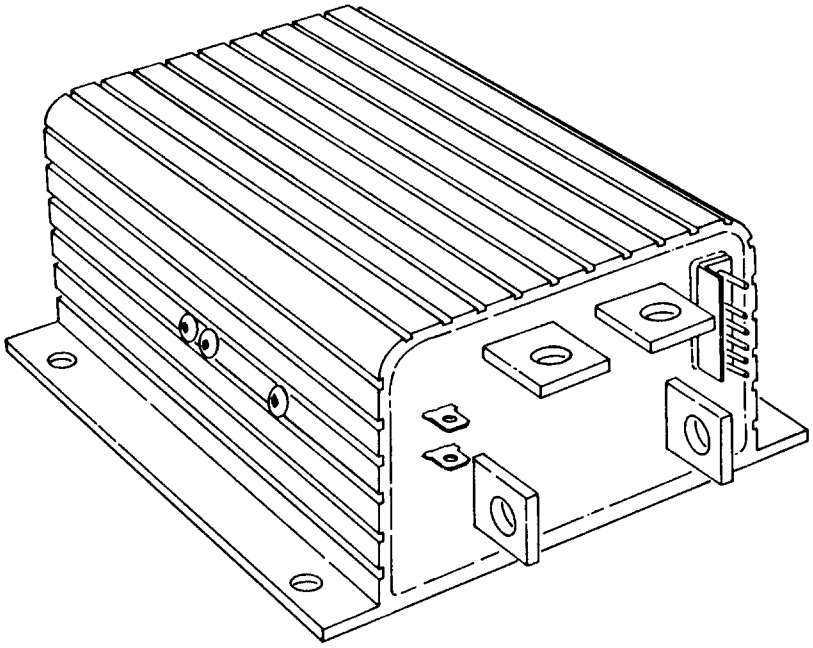


Figure 3-2 - Transistor Motor Controller

The description of the current flow in the electrical circuits in this section uses the "Conventional Theory of Current Flow". This theory describes the current as flowing from positive to negative. An electric lift truck uses a two-wire electrical system. There is no common ground through the frame. Both the positive supply and the negative return currents flow through wires and cables. There must be a minimum resistance of 50,000 ohms between the electrical circuits and the frame of the lift truck.

The controller for the traction system uses digital logic. Digital logic uses transistor to operate like very fast switches. The transistors are controlled by electrical gate pulse. Electrical noise is high voltage pulses caused by momentarily operating other electrical devices. Digital logic can not understand the difference between control pulses and electrical noise. Filter
capacitors are connected between the B+ and B-terminals in the controller to prevent electrical noise from entering the logic and causing errors.

The logic of the controller also checks the following functions:

a. Checks the temperature and gives both low and high temperature thermal protection to the controller.

b. Electrically checks that an operator follows the correct starting sequence to help prevent unexpected operation. This function is called "Static-Return-To-Off" (SRO).

c. Electrically checks the traction circuit for malfunctions, This function prevents lift truck operation if a failure is sensed.

d. Checks the current in the motor circuit and automatically decreases the motor voltage to reduce the current and prevent damage. The plugging circuit is also controlled for smoother operation.

Additional information showing how the motor controller is electrically connected in the lift truck is shown on the Wiring Diagrams and Schematics located at the rear of this section.

OPERATION

A motor controller for an electric lift truck must give a fine speed control to the traction motor by making a variation in the applied voltage. This controller uses solid-state electronic devices to permit efficient control of the applied voltage.

A motor controller must also generate a high current flow in the traction motor while keeping a low current draw from the battery. A battery is less efficient at a high current draw. A battery will not give all its electrical power at a high current draw. The traction motor is a series wound motor that generates torque. This torque is proportional to the current moving through the motor. The speed of the motor is controlled only by the mechanical load connected to the motor. The motor will accelerate until the mechanical load compares equally to the torque. If the current through the motor is increased, the torque will increase. The increased torque will give a higher speed with the same mechanical load.

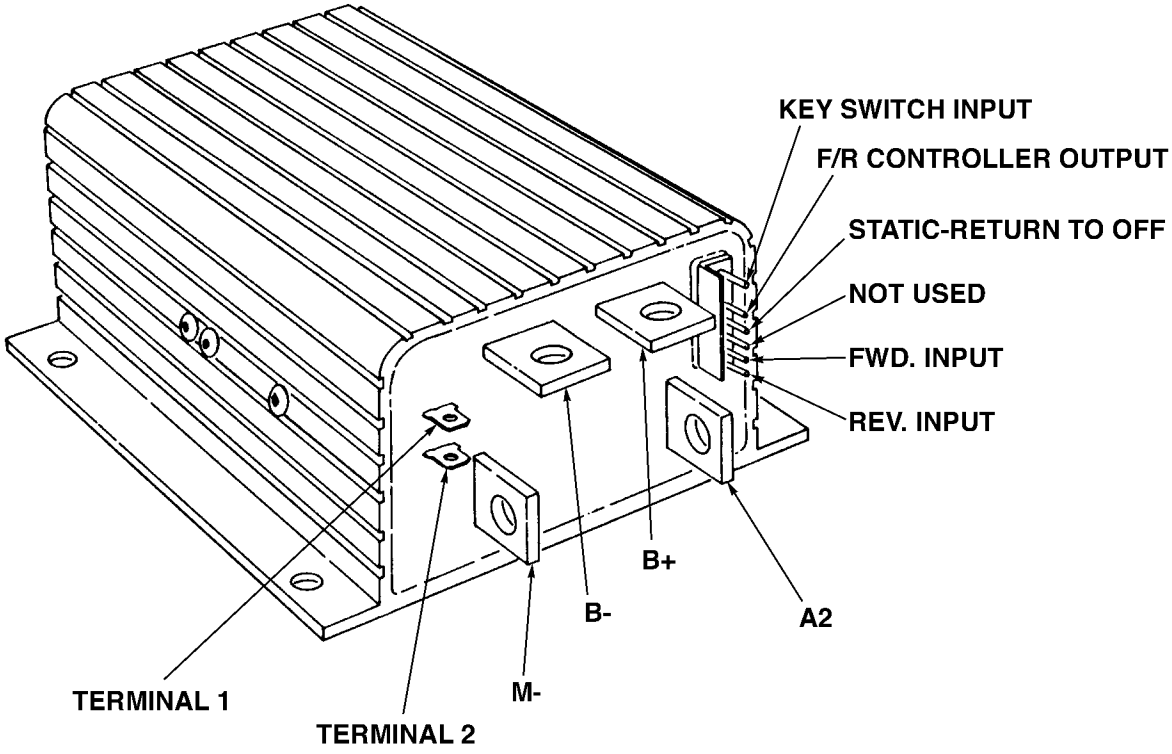


Figure 3-11 -Battery Indicator Voltage Selection

SEQUENCE OF OPERATION

The sequence of operation chart describes a complete cycle of the transistor traction chart

on some coils make them polarity sensitive). Compare the ohm reading against the ohm value for the type contactor being tested. Ohm values for G.E. contactors readings that vary from these values may be caused by:

Reading	Cause
High Resistance:	Corrosion or a burnt coil
Infinite Resistance:	Open coil
Low Resistance:	Shorted or burnt coil
No Resistance:	Shorted coil

9. If the contactor closes but the truck does not work properly, check the electrical function of the high current section of the contactor (the tips and bus bars). With the truck battery connected and all switches closed, connect a voltmeter across the high current terminals of the contactor.

Set the voltage scale of the meter to the lowest range higher than battery voltage (50 volt range for 24 volt battery, etc.). On forward and reverse contactors, a reading of zero volts with the contactor open should be obtained, then the meter should jump as the contactor closes and immediately drop to zero or close to zero. This is the voltage drop across the contactor. On pump contactors, you should read battery voltage across the contactor with the tips open, and it should drop to zero or near zero volts as the lips close.

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 mis-matched tips, and for incorrect gap settings on those contactors with adjustable point gaps.

CONTACTORS

The "FORWARD" and "REVERSE" contactor assembly controls the direction of current flow through the traction motor. The contactor is a heavy-duty switch that opens and closes the power circuit. The traction circuit has a "FORWARD" and "REVERSE" contactor assembly. Each contactor assembly has the following parts: two sets of normally open (NO) contacts, two sets of normally closed (NO contacts and a coil. The coil is an electromagnet that moves the NO contacts to the closed position against spring pressure. The coil is in the control circuit. The contactor tips are in the traction circuit. A suppressor is connected to each coil.

When a contactor coil is energized, the normally open (NO) contacts close and the normally closed (NC) contacts open. Current flows through the traction motor field in one direction when the "FORWARD" contactor is energized and in the other direction when the "REVERSE" contactor is energized. This action gives direction control to the traction motor. The contacts normally have a long service life because the current flow through the contacts is stopped before the contacts open. The FETs are "OFF" before the contactor coil de-energized.

CONTACTOR-REMOVE AND INSTALL

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

The capacitor in the transistor controller can hold an electrical charge after the battery is disconnected. To prevent electrical shock and injury, discharge the capacitor before inspecting or repairing components in the drive unit compartment. Wear safety glasses. To discharge the capacitor, first disconnect the battery. Then connect an insulated jumper wire between the B+ and B -terminals (Figure 3-11) of the transistor controller.

Some checks require the battery to be connected. Do not connect the battery until the procedure tells you to connect the battery. Make sure the drive wheel is raised to prevent truck movement and possible injury. Raise the drive wheel as described in the Operating Manual or in Section 6 of this Manual.

Make sure the battery is disconnected and the capacitor in the controller is discharged. The correct procedure to discharge the capacitor is described in the WARNING, Make an identification of the wires and cables and disconnect them from the contactor assembly. Remove the mounting screws and replace the contactor assembly. Install the mounting screws and reconnect wires and cables as removed.

CONTACTOR DISASSEMBLY AND ASSEMBLY

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.

9. **SHAFT**
10. **SCREW**
11. **POTENTIOMETER**
12. **BRACKET**
13. **SCREW**
14. **GEAR-SPUR**
15. **GEAR-SPUR**
16. **PIN-SPRING**
17. **WASHER**
18. **SPRING RETURN**
19. **CAM**
20. **PIN SPRING**
21. **BUSHING**
22. **STANDOFF**
23. **NUT PLATE**
24. **INSULATOR**
25. **SWITCH**
26. **PLATE SPACER**

HORN SWITCH-REMOVAL AND INSTALLATION

1. Disconnect the battery.
2. Remove the four capscrews that fasten the instrument panel cover to the cowl.
3. Disconnect the electrical plug X-1 .
4. Remove the four capscrews that fastens the horn switch cover.
5. Disassemble the switch from the mounting bracket. Identify and remove the electrical wires.
6. Install the switch on the mounting bracket and install the wires to the proper terminal.
7. Install horn switch cover.
8. Reconnect electrical plug X-1
9. Install instrument panel cover on the cowl.
10. Reconnect battery. Turn on key and test the horn switch for proper operation.

INSTRUMENT PANEL-REMOVAL AND INSTALLATION

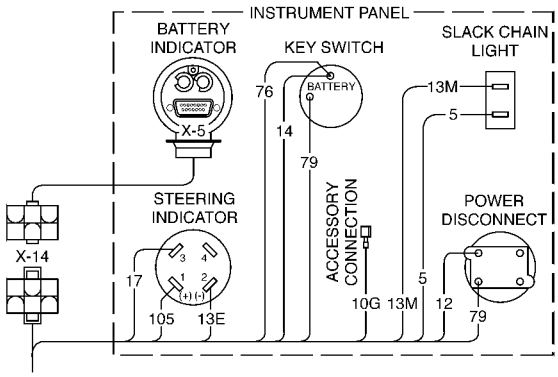


Figure 3-22 -Instrument Panel Schematic

1. Disconnect the battery.
2. Remove the four capscrews that fasten the instrument panel cover to the cowl.
3. Remove the four screws that fasten the instrument panel to the cowl.

commutator damage.

3. Before installing brushes, inspect the brush holders inside and out for burned spots. Make sure that the brush pigtails are properly secured in the brushes, and that the brushes move freely in the brush holders.

4. Fit the new brushes to the commutator surface by using a strip of fine sandpaper placed between the face of the brush and the commutator (sand surface against brush). Use several one direction strokes of the sandpaper, pulled in the direction of the commutator rotates with the forward direction of the truck (drive motor), and in the direction in which the commutator rotates while hoisting (hoist pump motor). Only the pressure of the brush should be on the sandpaper when it is fitted in this matter. Make sure that the complete surface of the brush rides on the cleaned-up surface of the commutator.

5. Following the installation of new brushes, the motor should be blown out with clean, dry compressed air.

DRIVE MOTOR BRUSH-REMOVAL AND INSTALLATION (MOTOR INSTALLED)

1. Disconnect battery, and open drive unit compartment door.

2. Remove screws securing motor cover plates, if equipped.

3. Note position of brush and wire assemblies before removing. When installing brush set, be certain to place brush set and wires in same position as removed.

4. Loosen screw and washer securing brush wire to terminal. Remove brush springs and brush set.

5. Reverse above to install. Refer to Fitting Brushes paragraph in this section.

DRIVE MOTOR BRUSH HOLDER-REMOVAL AND INSTALLATION (MOTOR INSTALLED)

1. Disconnect battery, and open drive unit compartment door.

2. Remove Brush assemblies (Refer to brush removal section).

3. Scribe motor field ring housing and commutator end head to make certain end head is installed in same position as removed.

4. Tag and disconnect drive motor wires from terminals on end head.

5. Remove hex head screws securing end head to field ring.

6. Remove end head assembly.

   NOTE: It may be necessary to use a puller to start the end head off the bearing when removing. Do not force, or damage to the end head may result.

7. Remove screws securing brush holder assembly to end head. Inspect all parts for wear or damage, and replace when necessary.

8. Reverse above to install. Be sure the new brush holders are rigid, not sloppy, and there are no loose rivets.

   NOTE: Do not drive on end head when installing. Lightly tap using a plastic hammer.

DRIVE MOTOR-REMOVAL AND INSTALLATION

1. Disconnect the battery.

2. Open drive unit compartment.

3. Tag and disconnect power cables to the motor and the wires to the electric brake.

4. Remove bolts mounting the motor to the drive unit.

5. Remove the drive motor with the brake assembly in place using a sling and proper lifting equipment. Refer to Section 5 of this manual for brake disassembly.

   CAUTION: Be sure to cover the drive unit opening so that debris does not enter it.

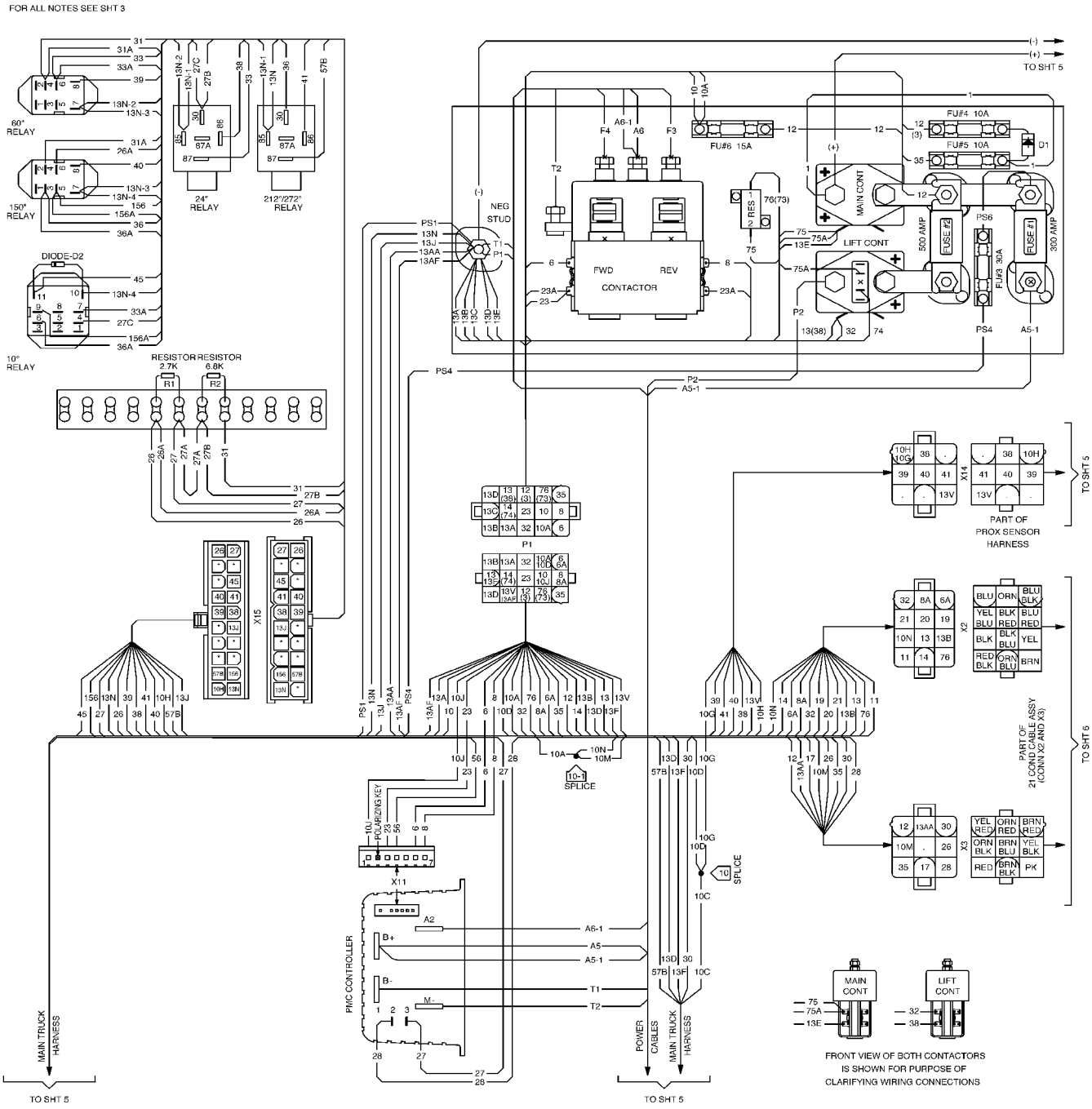


Figure 3-36 -Wiring Diagram

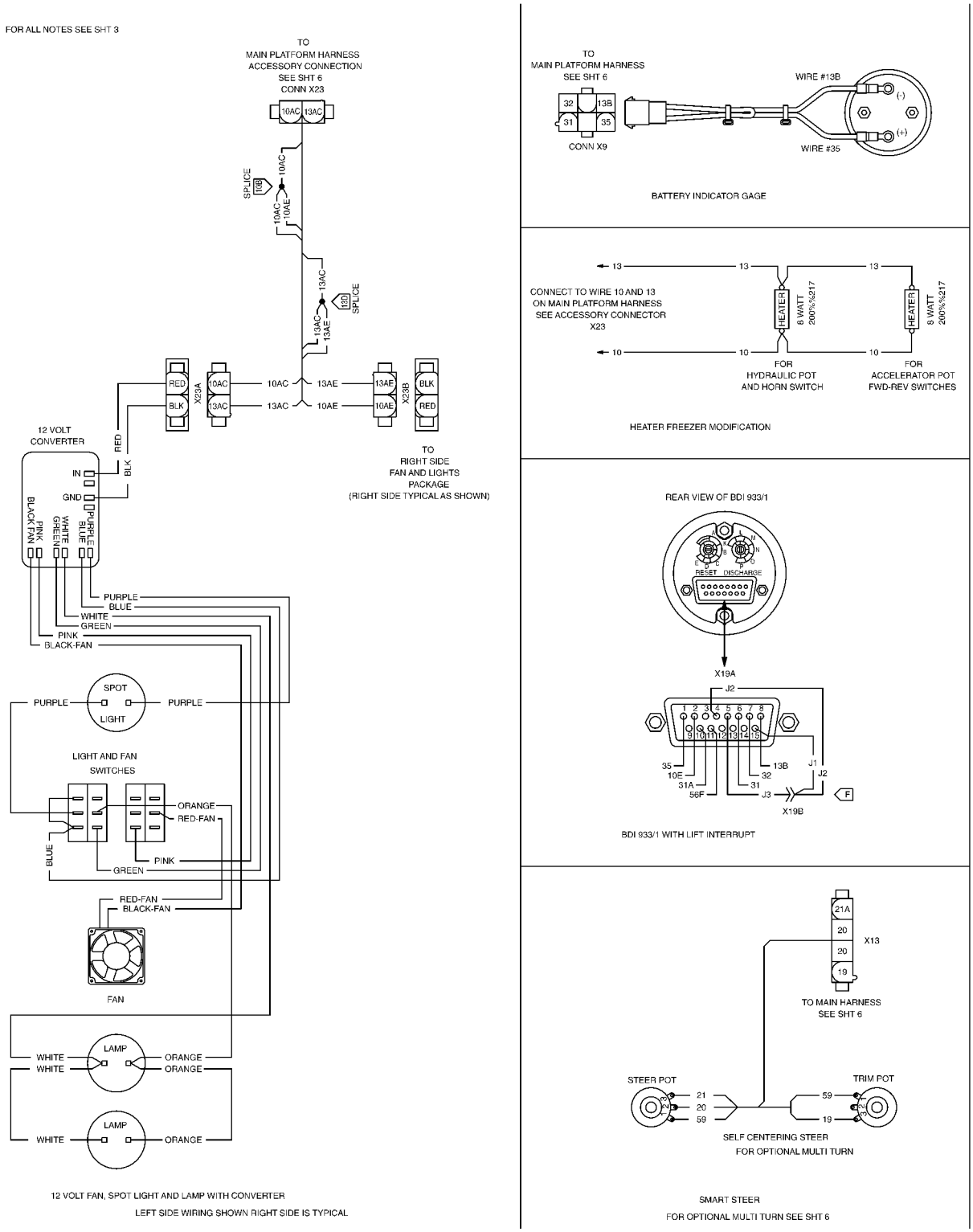


Figure 3-44 -Options Diagram -Wire Guidance

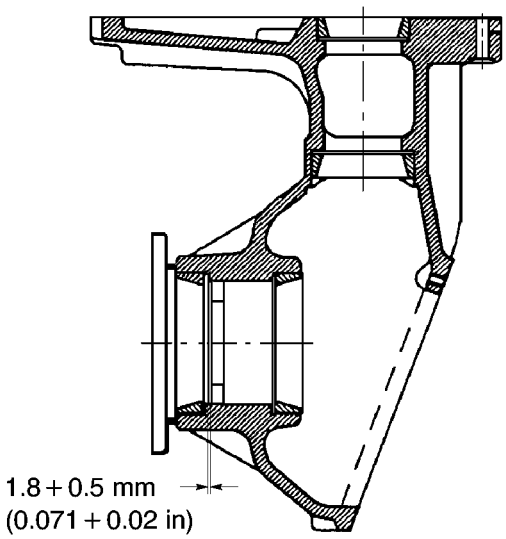


Figure 4-6 -Inner Seal Installation

10. Install the shims, outer bearing cup and the axle shaft. Apply Loctite® 270 to the internal splines of the bevel gear. Install the bevel pinion on the axle shaft. Remove any excess Loctite from the bevel gear using a clean cloth. Install the M16 capscrew and special washer. Tighten the M16 capscrew to 245 Nm (332 lbf ft) torque.

NOTE: If the tapped holes in the bottom of the lower housing extend through the housing, it is recommended that the capscrews are completely sealed with Loctite®to prevent oil from leaking from around the threads.

11. Use Loctite® 574 on the cover. Apply one drop of Loctite 243 on each of the cover capscrew threads. Install the cover. Tighten the cover capscrews to 9.5 Nm (7 lbf ft) torque.

12. Use Loctite® 574 to install the upper housing on the lower housing. Make sure the upper housing is aligned correctly and use a punch to install the two dowels, if removed. See Step 3 of the DISASSEMBLY procedure. Install the capscrews to retain the upper housing to the housing. Tighten the 8 mm capscrews to 23 Nm (17 lbf ft) torque. Tighten the 10 mm capscrews to 46 Nm (34 lbf ft) torque. Install the alien head capscrews and the washers and nuts. Tighten the nuts to 23 Nm (17 lbf ft) torque.

NOTE: To replace the drive tire on the wheel, the wheel must be pressed out of the tire rim. See Section 2 -HOW TO CHANGE THE DRIVE/STEER TIRE.

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

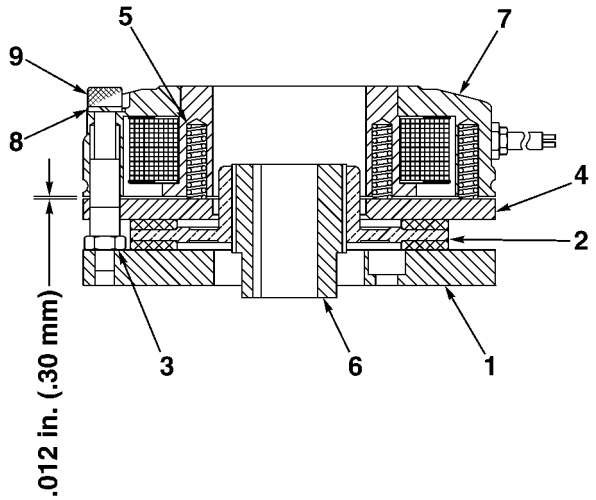


Figure 5-2 -Electric Brake

1. **MOUNTING FLANGE**
2. **ROTOR**
3. **HOLLOW SPACER**
4. **ARMATURE**
5. **SPRING**
6. **HUB**
7. **COIL**
8. **WASHER**
9. **CAPSCREW**

ELECTRIC BRAKE-ADJUSTMENT

New brakes are pre-adjusted at the factory to the correct .012 in. (.3mm) air-gap (distance between coil and armature). See Figure 5-2. As the brakes wear, the air-gap will increase. When the air-gap reaches two or three times the specified value, it should be adjusted. The air-gap should also be adjusted whenever the rotor replaced or a replacement brake assembly has been installed.

1. Loosen the three capscrews that secure the brake assembly to the mounting flange.

2. Turn the hollow spacers counterclockwise two or three revolutions.

3. Using a measuring device between the coil and armature, set the air-gap slightly smaller than the desired air-gap, .010 in. (.25 mm) by turning the capscrews clockwise.

NOTE: The air-gap is to be checked between the bolts (in the middle), not at the bolts. The air-gap adjustment is made when turning the capscrews, not the hollow spacers.

4. Turn the hollow spacers clockwise until they are snug against the mounting flange. The air-gap should now be at the desired .012 in. (.3 mm).

5. Check that the final setting is correct.

6. Use adhesive sealant on the capscrews.

NOTE: Acceptable adhesive sealants include those below:

Loctite Corporation No.	290
Felt-pro Inc.	Pro-Lock
Saf-T-Lok Chemical Corp	Saf-T-Lok S90

7. Tighten the three capscrews. Torque to 33 Ib \ ft (45 Nm).

8. Connect the wiring harness connector to the coil connector.

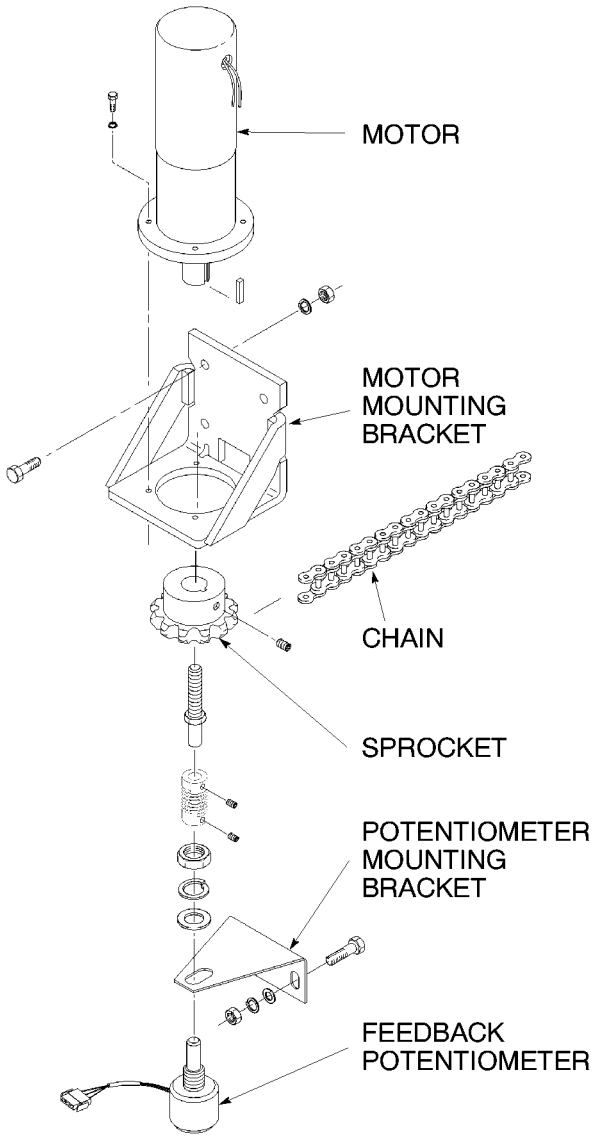


Figure 6-5 -Motor Mounting Assembly

STEERING CHAIN ADJUST

1. Disconnect the battery connector. Open the motor compartment doors.

2. Position a straight edge (e.g. a thin piece of rigid material) against the steering chain between the sprockets. Make sure the chain is tight on the opposite side of the sprockets.

3. Push on the chain at a point approximately halfway between the sprockets with a force of 9 to 12 kg (20-25 lbs). Measure the clearance between the straight edge and the chain. The clearance should not exceed 3.3 mm (0.13 in). See Figure 6-6.

4. Tighten the adjustment nut at the master drive unit sprock-et to obtain a maximum clearance of 3.3 mm (0.13 in) between the chain and straight edge. Do NOT tighten the chain to a clearance of less than 1.3 mm (0.05 in).

5. Close and fasten the motor compartment doors.

12. **SWITCHES 1 AND 2**
13. **MEDIUM SPEED ADJUST RT 6**
14. **SLOW SPEED ADJUST RT 7**
15. **TEST POINTS TP1 -TP15**

Table 7-1 -Guidance ECM Component Functions

COMPONENT OR TEST POINT	FUNCTION	RANGE*
RT1	Steer Balance Pot	N/A
RT2	MDU Centering Pot	N/A
RT4	Steer Sensor Balance Pot	N/A
RT5	Load Sensor Balance Pot	N/A
RT6	"Medium Speed" Pot	N/A
RT7	"Slow Speed" Pot	N/A
S1	Test Switch	N/A
S2	Not Used	N/A
TP1	5 Volt Supply	4.8 to 5.2 Volts
TP2	14 Volt Supply	13 to 15 Volts
TP3	Auto/Manual Input	Auto: 2.7 to 4.0 Volts Manual 0.0 to 2.2 Volts
TP4	Steering Input Signal During CW Rotation of Steering wheel	Less Than 2.5 to Greater Than 0.1 Volts
TP4	Steering Input Signal Steering Wheel Stationary	Approximately 2.5 Volts See Steering Input Signal Balance Adjustment for adjustment procedure and specific voltages.
TP4	Steering Input Signal During CCW Rotation of Steering Wheel	Greater Than 2.5 to Less Than 4.9 Volts
TP5	MDU Course	Full Left 4.7 to 4.9 Volts Center 2.4 to 2.6 Volts Full Right 0.1 to 0.3 Volts
TP6	MDU Medium	22° Left 4.9 to 5.6 Volts Center 2.4 to 2.6 Volts 22° Right 0.0 to 0.2 Volts
TP7	MDU Fine	5.6° Left 4.9 to 5.6 Volts Center 2.40 to 2.55 Volts 5.6° Right 0.0 to 0.2 Volts
TP8	Right Rear Sensor Signal (Load Wheel) See Figure 7-9	1.5 to 2.5 Volts Truck Centered on Guide Wire 1.0 Volts or Less Truck Away Guide Wire
TP9	Left Rear Sensor Signal (Load Wheel) See Figure 7-2	1.5 to 2.5 Volts Truck Centered on Guide Wire 1.0 Volts or Less Truck Away Guide Wire
TP10	Right Front Sensor Signal (Steer Tire) See Figure 7-2	1.5 to 2.5 Volts Truck Centered on Guide Wire 1.0 Volts or Less Truck Away Guide Wire
TP11	Left Front Sensor Signal (Steer Tire) See Figure 7-2	1.5 to 2.5 Volts Truck Centered on Guide Wire 1.0 Volts or Less Truck Away Guide Wire
TP12	Motor Current	Variable
TP13	Not Used	N/A
TP14	Not Used	N/A
TP15	Battery Negative (Common)	Signal Common for all Test Points Measurements

NOTE: * FLOOR TO TIRE FRICTION CAN MAKE A DIFFERENCE IN THE READINGS WHEN A CHECK IS REPEATED.

Table 7-2 -Guidance ECM Terminals

TERMINAL OR PLUG TYPE	TERMINAL OR PLUG NUMBER	FUNCTION OR CONDITION	*VOLTAGE (Use Battery Negative as Common Test Point for All Measurements)
POWER TERMINALS	1	Battery Positive	Battery Voltage
	2	Output to Steering Gearmotor	0.0 to Battery Volts – 2 Volts (Variable L/R & Rate)
	3	Output to Steering Gearmotor	0.0 to Battery Volts – 2 Volts (Variable L/R & Rate)
	4	Battery Negative	0.0 Volts
ECM PLUG A	A1	Battery Negative	0.0 Volts
	A2	Battery Voltage to Traction and Brake Circuits	Battery Voltage PSC & Brake Sw. Closed
	A3	Battery Voltage from PSC Contactor and Brake Switches	Battery Voltage PSC & Brake Sw. Closed
	A4	MDU Pot Wiper (Wiper Centered)	2.5 Volts
	A5	Signal from Tach Steer Module (Steering Wheel Stationary)	Approximately 2.5 Volts NOTE: See Steering Input Signal Balance Adjustment for adjustment procedure and specific voltages.
	A6 and A7	Speed Input (Accelerator Pot Wiper)	0.0 to 5.0 volts
	A8	MDU Pot Supply Voltage	5 Volts
	A9	Steer Pot/Tach Steer Module Supply Voltage	5 Volts
	A10	Not Used (5 Volt Supply)	N/A
	A11	Reference Voltage to MDU Pot	0.0 Volts
	A12	Reference Voltage to Tach Steer Module and Guidance Switch	0.0 Volts
ECM PLUG B	B1	Reverse Contactor Positive Connection	80% Battery Voltage (Dir. Selected)
	B2	Forward Contactor Positive Connection	80% Battery Voltage (Dir. Selected)
	B3	Plug Detection Signal (Momentary Signal)	12 to 0 Volts (Start of Plug) 0 Volts (At End of Plug)
	B4	Input from Guidance Switch (Off-Manual) (On–Auto)	.5 to 2.5 Volts Off 0 Volts On
	B5	Input from Guidance Switch (Off-Manual) (On-Auto)	0 Volts Off 12 to 14 Volts On
	B6	Guidance Light Signal	Approx. 12 Volts Off-10 Volts On
	B7	Supply Voltage to Guidance Light and Alarm	13 to 14 Volts
	B8	NOT USED	N/A
	B9	Speed Input (Accelerator Pot Wiper)	Below 24° Same as A5/A7 Above 24° Same as A5/A7
	B10	Guidance Alarm Signal	13 to 14 Volts Off-0 Volts On
	B11	NOT USED	N/A
	B12	Input from Traction Control	Below 24° Same as A5/A7 Above 24° Same as A5/A7
ECM PLUG C LOAD WHEEL SENSOR	C1	Supply Voltage	14 Volts
	C2	Right Rear Output Signal on Wire	Over 1 Volt and Near Equal to C5 [1]
	C3	Left Rear Output Signal on Wire	Over 1 Volt and Near Equal to C5 [1]
	C4	Reference Voltage	0 Volts
ECM PLUG D STEER TIRE SENSOR	D1	Supply Voltage	14 Volts
	D2	Right Front Output Signal on Wire	Over 1 Volt and Near Equal to D5 [1]
	D3	Left Front Output Signal on Wire	Over 1 Volt and Near Equal to D5 [1]
	D4	Reference Voltage	0 Volts

[1] With lift truck centered on guide wire.

NOTE: * All voltage readings listed subject to ±10% variation unless otherwise noted.

CHECKS

GENERAL

CAUTION: The steering chain MUST be correctly adjusted for the guidance system to operate correctly AND to make the checks and adjustments correctly. Check and if necessary, adjust the steering chain. Refer to ADJUSTMENTS, ADJUSTING THE STEERING CHAIN CLEARANCE.

Checking for Short-Circuits to the Frame

It is important for the correct operation of the guidance system that all system components have electrical insulation. There must be electrical insulation between the frame of the lift truck and each component. If a connector, cable, wire or component is making a connection to the frame, a malfunction can occur. The position of a motor cable can make a magnetic field that can change the sensor signal. Electrical static can also cause a malfunction. Make sure all cables are installed in the same position if they were moved for checking or replacement. Make sure all shields are correctly installed and connected. Make sure all insulation and isolators are correctly installed. Repair all short-circuits as soon as they are found. Keep the battery and battery compartment clean and painted. Keep all carbon dust and dirt removed from the inside of all the motors. Use dry compressed air.

CHECKS TO THE LIFT TRUCK

4. Verify that the steer chain is properly adjusted. Refer to ADJUSTING THE STEERING CHAIN CLEARANCE.

5. Do not move the steering wheel. Do not use the steering wheel to position the steer tire for straight travel. Use a large screwdriver at the armature shaft of the steering gearmotor to move the steer tire to the straight travel position.

The steer tire is set for straight travel when the distance from the front edge of the steer tire wheel to the frame plate is equal to the distance from the rear edge of the steer tire wheel to the frame plate.

6. The MDU potentiometer must now be centered. Do not reconnect the battery at this time. Refer to CENTERING THE MDU POTENTIOMETER to complete this procedure.

CENTERING THE MDU POTENTIOMETER

This procedure adjusts the ECM to the MDU pot signal. See Figure 7-11 for the location of MDU potentiometer.

NOTE: This procedure is **ONLY NECESSARY** after the MDU potentiometer has been replaced, or if the MDU potentiometer adjustment has been disturbed. The potentiometer must be positioned at mid-range with the steer tire positioned for straight travel.

Adjustment can be checked and the mid-range position of the potentiometer can be verified by checking for 2.3 to 2.7 volts at the pot wiper (wire 17) with the steer tire positioned for straight travel and the system energized. Use TP15 for the negative test point. Refer to ADJUSTMENTS, CENTERING THE STEER TIRE for the procedure to center the steer tire.

Proceed to ADJUSTING RT2 FOR STRAIGHT TRAVEL if the potentiometer **DOES NOT** need adjustment.

Perform the following Steps (1.) to (10.) if the potentiometer **DOES** require adjustment.

1. Verify that the steer chain is properly adjusted. Refer to ADJUSTING THE STEERING CHAIN CLEARANCE.

2. Position the steer tire for straight travel. Refer to ADJUSTMENTS, CENTERING THE STEER TIRE.

3. Disconnect the electrical plug for the MDU potentiometer. Loosen the nut (5) that fastens the potentiometer to the bracket (4).

4. Adjust the MDU potentiometer for mid-range. Compare the resistance measured between wires 16 and 17 with the resistance measured between wires 17 and 18. The potentiometer is at the mid-range position when the resistance readings are equal within 50 ohms. Rotate the potentiometer body for the correct resistance readings.

5. Tighten the nut that fastens the potentiometer to the bracket without moving the potentiometer body. Maintain the clearance between the bottom of the coupling and the gearmotor housing. See Figure 7-11. Reconnect the electrical plug for the MDU potentiometer.

6. Reconnect the battery and energize the electrical system of the lift truck.

7. Set switch S1 on the ECM circuit board to the "open" (down) position. With the key switch ON, the displays will show "dd dd".

8. Push the Mode button on the ECM for a left display of "03".

9. Use RT2 to adjust the right-hand display to "25" with the steer tire set for straight travel. This will set RT2 to approximately the mid-range position. Return switch S1 to the "closed" (up) position for normal operation.

10. Adjust RT2 for straight travel. Refer to ADJUSTING RT2 FOR STRAIGHT TRAVEI.

The board will be used Hyster or Yale, small or large chassis, Guidance or non-W/G, 24V or 36V, and Traction performance or standard. The board receives the prox switch inputs, as well as a steering input, and outputs signals necessary to invoke speed limits or inhibit traction.

Steering input:

Steering input for wire guided trucks is the feedback pot wiper, into a high-impedance comparator input into the TRAM. This can be adjusted for +/-10°, using two pots on the TRAM.

Proximity inputs:

The proximity switches on a standard truck are at 24", 60",150", and 212"/272" heights, and the Traction

NOTE: The numbers in the"( )" of the following procedure are the item numbers in Figure 7-14.

1. Disconnect the battery so that the connector is completely free.

2. Remove the screw that fasten steering wheel to the shaft of the steering mechanism. Remove the steering handle.

3. Remove the screws at the top of the instrument panel. Tilt the instrument panel to the open position for access to the parts.

4. To replace the switch or indicator, put tags on the wires for correct connection during installation. Pull the wire terminals off the switch or indicator terminals.

5. Push the switch assembly or indicator assembly out of the instrument panel. Push the replacement switch or indicator assembly into the instrument panel. Make sure the words on the switch are not upside down.

6. To replace the alarm, put tags on the alarm wires for correct connection during installation. Remove the bezel nut that fastens the alarm and remove the alarm. Install the replacement alarm and connect the wires as tagged during removal.

7. Close the instrument panel and tighten the screws. Install the steering handle on the shaft of the steering mechanism. Tighten the screw.

REPLACE THE MDU POTENTIOMETER

1. Set the steering for straight travel. Refer to ADJUSTMENTS, CENTERING THE STEER TIRE.

2. Disconnect the battery so that the connector is completely free.

3. Open the motor compartment door. Disconnect the electrical plug for the MDU potentiometer.

4. Loosen the setscrew that fastens the shaft of the potentiometer. See Figure 7-11. Loosen the upper coupling setscrew (11). Remove the nut that fastens the potentiometer to the bracket (4). Remove the potentiometer (3).

5. Center the MDU potentiometer. Refer to ADJUSTMENTS, CENTERING THE MDU POTENTIOMETER.

6. Adjust RT2 for straight travel. Refer to ADJUSTMENTS, ADJUSTING RT2 FOR STRAIGHT TRAVEL.

7. Close the motor compartment doors and connect the battery.

REPLACE THE ECM

Replace the Complete Module

NOTE: Complete disassembly is usually not necessary. Remove only the parts necessary to replace the defective part.

See Figure 7-15 and Figure 7-16.

1. Disconnect the battery so that the connector is completely free.

2. To replace the complete module, install tags on the wires at the terminal strip for correct connections during installation. Disconnect the wires from the terminal strip. Disconnect the plugs of the wiring cables.

3. Hold the module and remove the capscrews and washers that fasten the module to the frame plate. Access to the capscrews is from the traction motor compartment.

NOTE: Keep the frame area clean to prevent voids between the power base and the frame panel. Use a piece of plastic to cover the silicon grease on the power base or remove the grease.

4. Install silicon grease on the power base of the replacement module and the frame. Install the module on the frame panel using the four capscrews and the washers.

5. Install the wires on the terminal strip as marked during removal. Connect the wiring cable plugs.

6. Adjust the ECM. Refer to CHECKS AND ADJUSTMENTS, ADJUSTMENTS.

velocity fuse would act as a flow regulator to allow the mast to lower at a controlled rate.

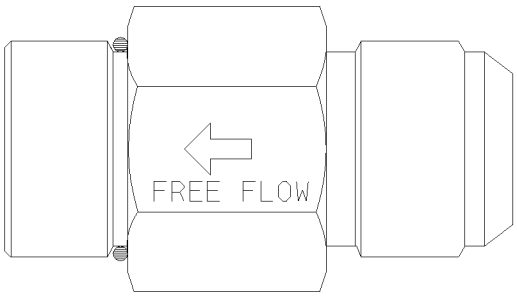


Figure 8-5 -Velocity Fuse

WARNING: Never operate a mast with the velocity fuse disassembled or removed.

Velocity fuses are supplied in different flow ratings depending on the mast. If replacement is necessary, be sure to install the correct part number.

SPECIFICATIONS

LIFT PUMP AND MOTOR

Rated Flow (24V)	32 litre/min (8.5 gpm)@ 2000 RPM
Rated Flow (36V)	28 litre/min (7.4 gpm)@ 2000 RPM
Rated Maximum Pressure	21 MPa (3046 psi)
Operating Speed	50 to 3500 RPM

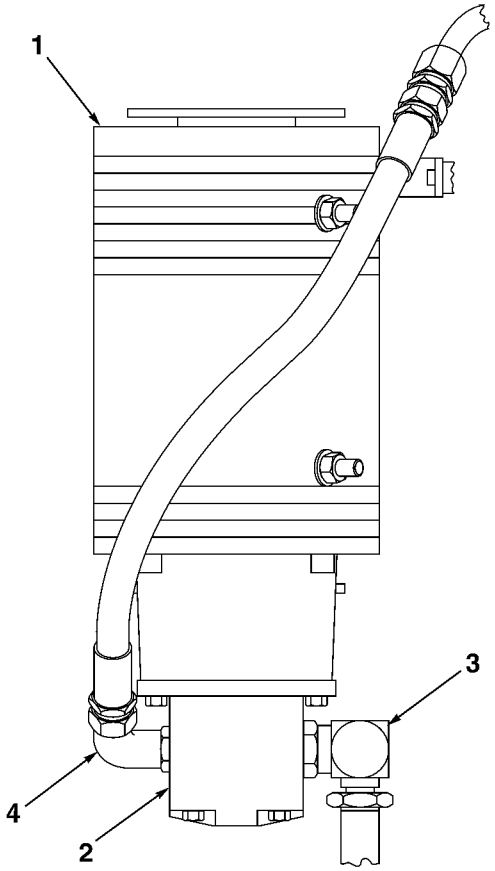
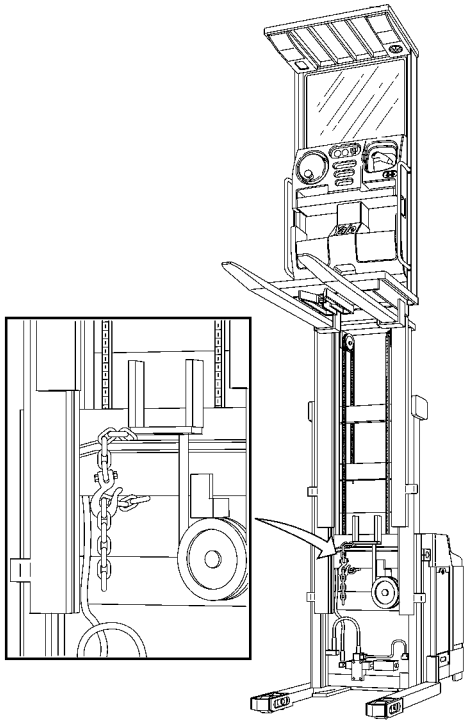


Figure 8-6 -Lift Pump and Motor



CHECKS

Check Mast Operation

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

1. Check for leaks in the hydraulic system (see below). Check the condition of the hydraulic hoses and tubes.

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

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

3. The weldments and the operator's compartment assembly must lower completely.

4. Check that the controls for the operator's compartment operate the functions installed on the lift truck. Seethe symbols by each of the controls and refer to the OPERATING MANUAL for your lift truck. Make sure all of the hydraulic lines are connected correctly and do not leak.

Check for Leaks in Hydraulic System

WARNING: Pressurized hydraulic oil can be injected into the body by pressure. Do not try to locate hydraulic leaks by putting hands on pressurized hydraulic components. Check for the location of high-pressure leaks by holding a piece of cardboard in front of the suspected area.

1. Slowly raise and lower the mast several times without a load. Put a capacity (see the Nameplate) load on the forks and raise and lower the load several times. Lower the load. Check for any external hydraulic oil leaks. Repair as necessary.

2. On all models, raise the operator's compartment and the capacity load one metre (3 ft). Verify that there are no external hydraulic oil leaks. If the operator's compartment lowers slowly with the lift control in a NEUTRAL position there are leaks inside the hydraulic system. The maximum speed that the operator's compartment is allowed to lower is 50 mm (2 in) in ten minutes when the hydraulic oil is 30°C (90° F). If the oil temperature is 70°C (160°F), the maximum speed that the operator's compartment can lower is 150 mm (6 in) per ten minutes.

3. Check the lift cylinders for internal leaks. Remove the load from the forks. Install agate valve in the supply line between the control valve and the mast. Put a capacity load on the forks again. Raise the operator's compartment one metre (3 ft). Close the gate valve. If the operator's compartment or inner mast lowers slowly,

17. Disconnect the battery and separate the connectors.

18. Remove the dash cover in the operator's compartment.

19. Disconnect the two connectors of the wire take-up harness in the operator's compartment.

20. Remove the two screws securing the wire take-up strain relief fitting to the operator's compartment.

    WARNING: Care must be taken to adequately support the operator's compartment at all times to prevent tipping.

Installation

The operator's compartment is installed similar to the way it was removed. The mast on the lift truck must be secured in the raised position with chains high enough to allow the lift truck to be maneuvered into position above the load rollers of the operator's compartment. Follow the procedure below:

1. Align the operator's compartment and the lift truck into the proper position for installation. The mast inner weldment should be positioned above the load rollers of the operator's compartment.

2. Disconnect the battery and separate the connectors.

3. Insert the wire take-up harness and strain relief through the opening in the center of the mast side of the operator's compartment. Secure the strain relief with the two screws. Connect the wire harness in the operator's compartment by plugging in the two connectors.

4. Open the drive unit compartment.

   WARNING: The capacitor in the SCR controller can hold an electrical charge after the battery is disconnected. To prevent electrical shock and injury, discharge the capacitor before inspecting or repairing any component in the drive unit compartment. Wear safety glasses. **Make certain the battery has been disconnected.**

Use a jumper wire between the two terminals to discharge capacitor C1. Block the drive wheels.

5. Discharge the capacitor.

6. Slowly lower the mast inner weldment onto the load rollers of the operator's compartment using the manual lowering valve on the hydraulic pump. Gradually turn the valve clockwise and wait until the mast is completely lowered. Use caution to avoid pinching any hoses or cables. Close the manual lowering valve by rotating the valve counterclockwise to the stop.

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

7. Check the adjustment of the tapered load rollers of the operator's compartment. Check for zero clearance at the tightest point of travel within the mast channel. Adjustment to the tapered load rollers is made using shims behind each load roller as required. Use caution when removing the snap ring retaining the load roller to the bracket. The operator's compartment must be centered and parallel with the mast inner weldment within 1.5 mm (0.060 in.).

   WARNING: Mast parts are heavy and can move. Distances between parts are small. Serious injury or death can result if part of the body is hit by parts of the mast or the operator's compartment. Never put any part of the body into or under the mast or operator's compartment unless all parts are completely lowered or a safety chain is installed. Also make sure that the power is OFF and the key is removed. Refer to SAFETY PROCEDURES WHEN WORKING NEAR THE MAST.

8. Remove the safety chains preventing the mast and operator's compartment from moving.

9. Close the drive unit compartment and connect the battery.

10. Raise the operator's compartment using the lift/lower control until the floor of the operator's compartment is even with the top of the drive unit compartment.

    WARNING: Mast parts are heavy and can move. Distances between parts are small. Serious injury or death can result if part of the body is hit by parts of the mast or the operator's compartment. Never put any part of the body into or under the mast or operator's compartment unless all parts are completely lowered or a safety chain is