SERVICE REPAIR

MANUAL

Hyster B234 (W60Z, W65Z, W80Z) Forklift

HYSTER

ELECTRICAL SYSTEM

B60Z [A230];
W60Z [A231, B231];
W65Z [A229, B229];
W80Z [A234, B234];
B80Z [A233]

HYSTER

PART NO. 1492462 **2200 SRM 0929**

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 Hyster® 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 HYSTER 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.

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This section is for the following models:

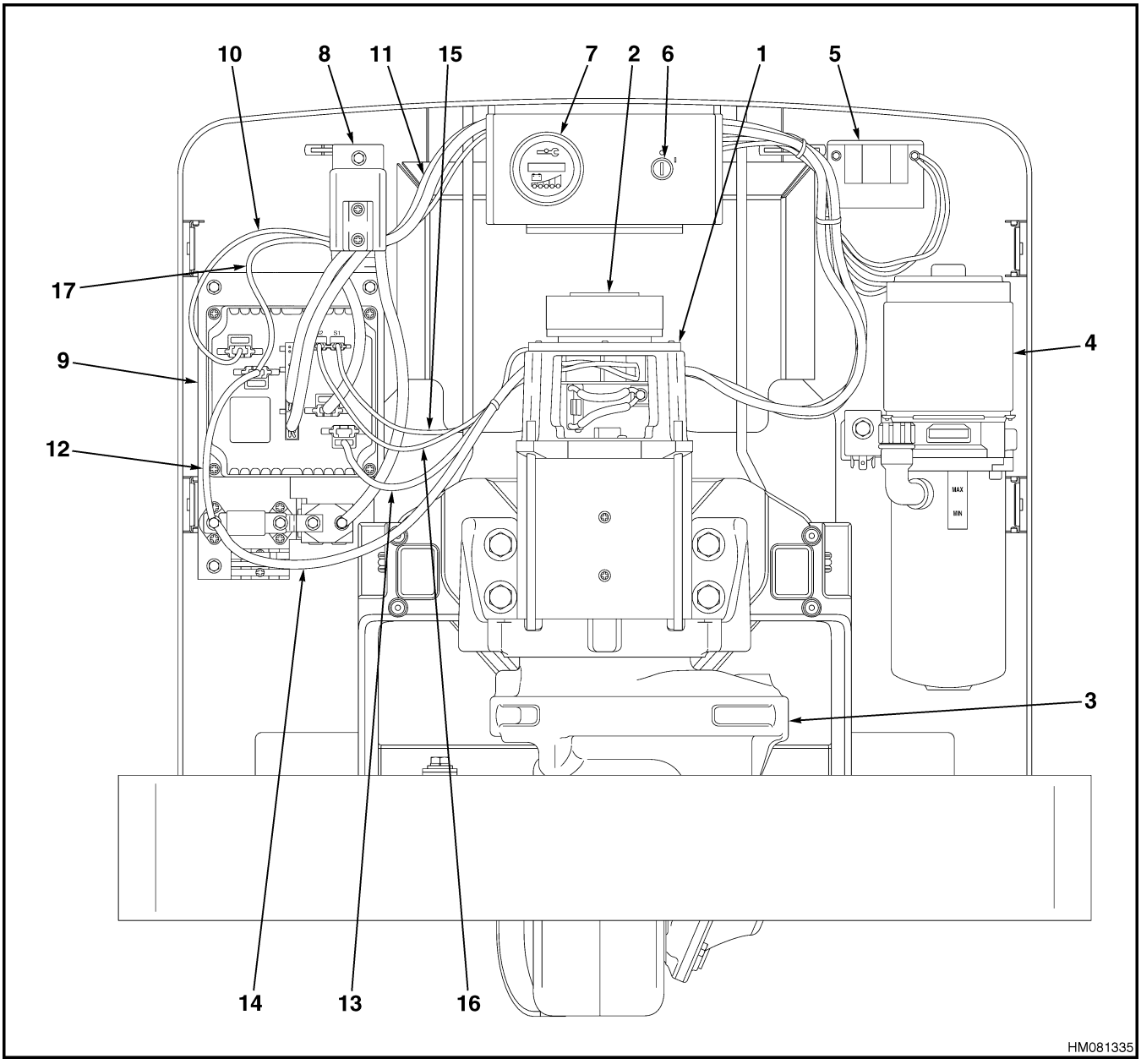
(B60Z) [A230];
(W60Z) [A231, B231];
(W65Z) [A229, B229];
(W80Z) [A234, B234];
(B80Z) [A233]

General

WARNING

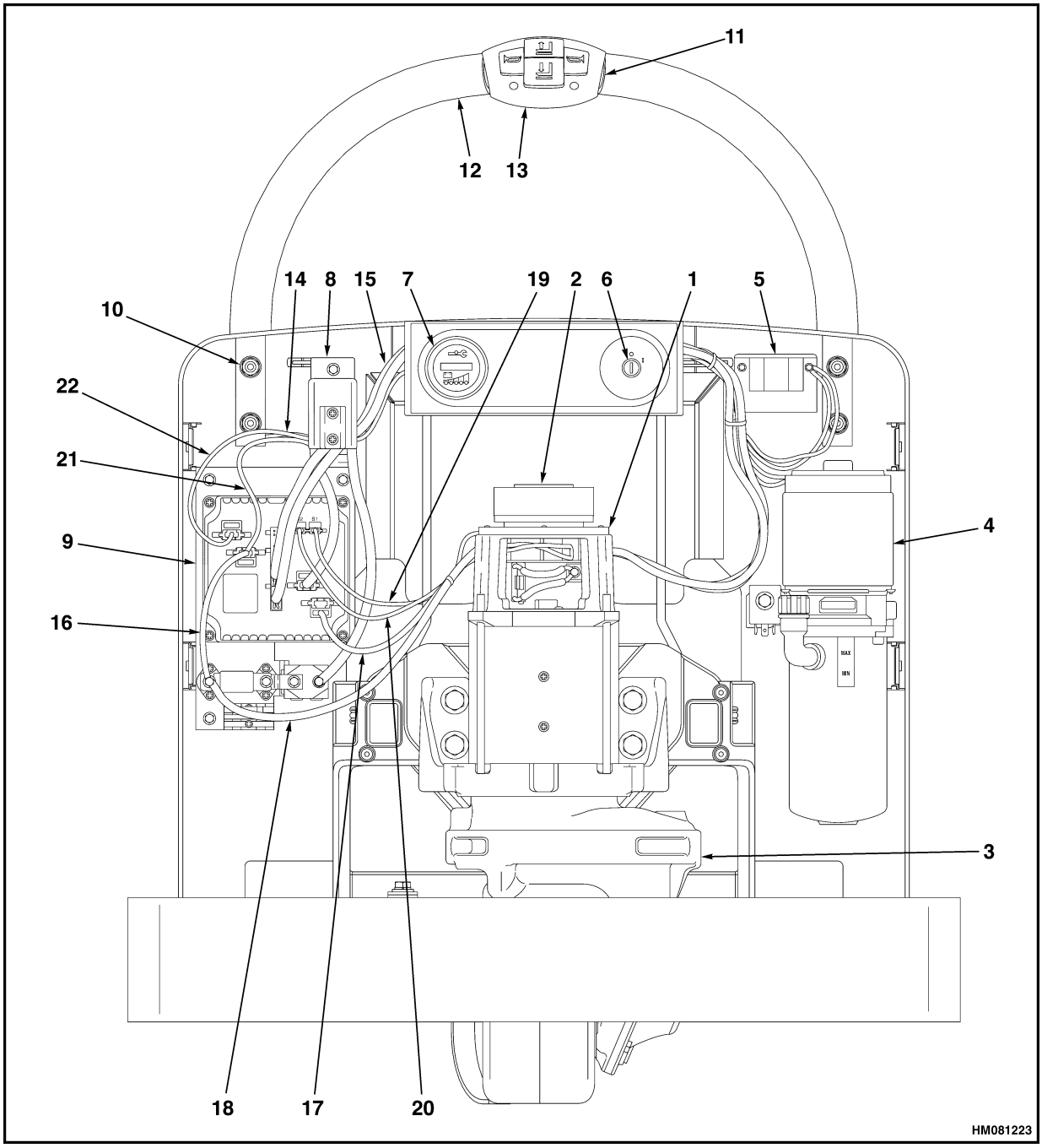
DO NOT make repairs or adjustments unless you have both authorization and training. Repairs and adjustments that are not correct can create a dangerous operating condition. DO NOT operate a lift truck that needs repairs. Report the need for repairs to your supervisor immediately. If repair is necessary, put a DO NOT OPERATE tag on the control handle. Remove the key from the key switch.

This manual describes the electrical systems used on the motorized hand lift trucks. Procedures are outlined for the maintenance, adjustment, and repair that may be required when servicing these lift trucks. The drive control for the Motorized Hand Trucks is a Curtis Transistor Motor Controller 1297 Model, also known as a MOSFET or PMC system. See Figure 1, Figure 2, and Figure 3.



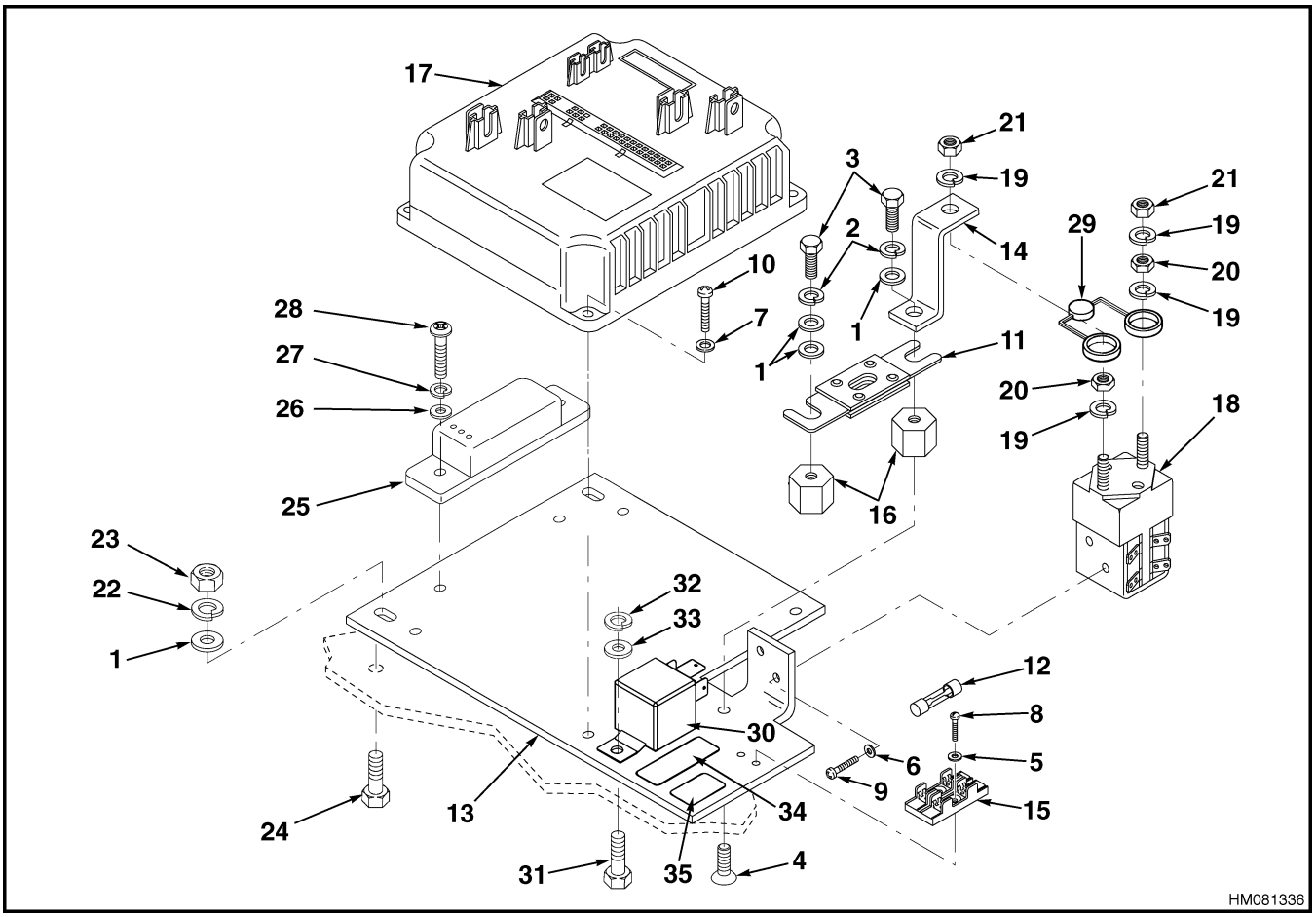
1. TRACTION MOTOR
2. ELECTRIC BRAKE
3. DRIVE UNIT
4. HYDRAULIC UNIT
5. HORN
6. IGNITION SWITCH
7. BATTERY GAGE/SPYGLASS
8. BATTERY CONNECTOR
9. CONTROLLER PANEL
10. PUMP CABLE (NEG.)
11. WIRE HARNESS-MAIN
12. CABLE (POS.)
13. CABLE (A1)
14. CABLE (A2)
15. CABLE (F1)
16. CABLE (F2)
17. PUMP CABLE (POS.)

Figure 1. Drive Unit Compartment (W60Z, W65Z, and W80Z)



1. TRACTION MOTOR
2. ELECTRIC BRAKE
3. DRIVE UNIT
4. HYDRAULIC UNIT
5. HORN
6. IGNITION SWITCH
7. BATTERY GAGE/SPYGLASS
8. BATTERY DISCONNECT
9. CONTROL PANEL
10. CAPSCREW
11. CAPSCREW
12. GRAB RAIL
13. CONTROL BOX
14. WIRE HARNESS-HANDRAIL
15. WIRE HARNESS-MAIN
16. CABLE (POS)
17. CABLE (A1)
18. CABLE (A2)
19. CABLE (F1)
20. CABLE (F2)
21. PUMP CABLE (POS.)
22. PUMP CABLE (NEG.)

Figure 2. Drive Unit Compartment (B60Z and B80Z)



1. WASHER
2. LOCKWASHER
3. CAPSCREW
4. CAPSCREW
5. WASHER
6. LOCKWASHER
7. WASHER
8. SCREW
9. SCREW
10. SCREW
11. FUSE-MOTORS
12. FUSE-CONTROLLER
13. MOUNTING PLATE
14. BUSS BAR
15. FUSE HOLDER
16. STAND-OFF
17. CONTROLLER
18. CONTACTOR
19. LOCKWASHER
20. NUT
21. NUT
22. LOCKWASHER
23. NUT
24. SCREW
25. CONVERTER - 12 V ONLY
26. WASHER
27. LOCKWASHER
28. CAPSCREW
29. RESISTOR
30. RELAY
31. SCREW
32. WASHER
33. LOCKWASHER
34. LABEL
35. LABEL

Figure 3. Controller Panel Assembly

Electrical System Checks

WARNING

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

The capacitor in the transistor controller can hold an electrical charge after the battery is disconnected. To prevent electrical shock and personal 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.

All checks, adjustments, and repairs in the drive unit compartment are done with the compartment cover removed. Remove the drive unit compartment cover for access to the electrical components.

SAFETY PRECAUTIONS

WARNING

Some checks require the battery to be reconnected. DO NOT connect the battery until the procedure tells you to do so. Make sure the drive wheel is raised to prevent truck movement and possible injury. Raise the drive wheel. The blocks must prevent the lift truck from falling and causing personal injury or property damage.

CAUTION

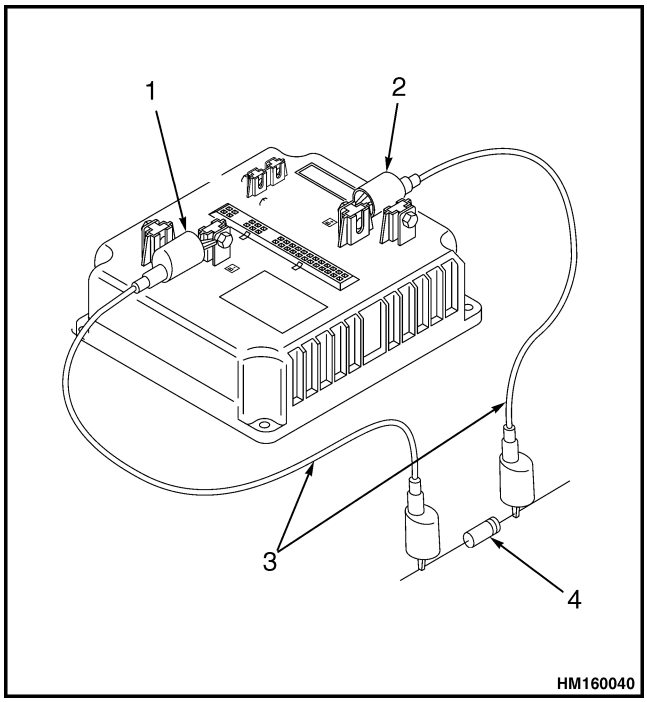
To avoid controller damage, always disconnect the battery before disconnecting any cables from the controller. Discharge the capacitor, and never put power to the controller with any power wire disconnected. Never short any controller terminal or motor terminal to the battery. Make sure to use proper procedure when servicing the controller.

1. Block lift truck so the drive tire is raised slightly off the floor to prevent unexpected movement when making checks.
2. Turn the key switch to the OFF position and disconnect the battery.
3. Discharge capacitors in controllers by connecting a 200-ohm, 2-watt resistor across the controller's B+ and B- terminals. See Figure 4. DO NOT short across the motor controller terminals with a screwdriver or jumper wire. Remove the 200-ohm, 2-watt resistor before reconnecting the battery.

NOTE: These checks require a volt-ohmmeter with a meter movement. Most digital meters will not operate correctly for some of these checks. Specific checks require additional equipment.

NOTE: The correct meter polarity is necessary for the checks. The voltage checks are made between the point indicated in Table 1 and battery negative. Connect the meter negative to battery negative.

NOTE: The battery does not have to be removed to check the specific gravity.



1. POSITIVE CONNECTION
2. NEGATIVE CONNECTION
3. INSULATED JUMPER WIRES
4. 200-OHM, 2-WATT RESISTOR

Figure 4. Discharging the Capacitors

4. Using a hydrometer, check the specific gravity of the battery. If the specific gravity is less than 1.260, the battery is not fully charged or is damaged. A fully-charged battery has a specific gravity of 1.270 to 1.290. A discharged battery has a specific gravity of approximately 1.165.

5. The electric lift truck has a two-wire system. The frame must not be a common electrical path. Check for 50,000 ohms or more between each battery terminal and a clean connection on the frame. Remove any circuit paths between the controller and the frame of the lift truck, such as a dirty battery case. Carbon dust in a motor or other parts can cause a circuit path. Check for additional equipment that may cause a circuit path to the frame.

6. Check for voltage between each terminal of the connector that fastens to the battery and a clean connection on the frame. Normally, there is small voltage (less than 30 percent of the battery voltage) between the battery and the frame, even though the resistance is very high. A higher voltage can indicate a dirty battery or a damaged battery. Clean the battery and battery compartment as necessary.

7. Visually check for parts or wires that are loose or damaged.

NOTE: Make an identification of any wires before you disconnect them. The wires must be reconnected correctly after checks or repairs.

Table 1. Voltage Checks

LIFT TRUCK WILL NOT MOVE IN EITHER DIRECTION.
NO FAULT IS DISPLAYED ON THE CONTROLLER.

Possible Causes:

1. Battery not connected.
2. Control fuse is damaged.
3. Key switch or brake switch is damaged.
4. Transistor controller connector unplugged.
5. Transistor controller is damaged.

1.0 Check for battery voltage on the battery side of control fuse.	→→ --	1.01 Battery voltage at control fuse. Check for open control fuse.
	-→	1.02 No battery voltage at control fuse. Connect battery or check wiring between battery and fuse.
1.1 Check for battery voltage at control fuse terminal of key switch.	→→ --	1.1.1 Battery voltage at key switch. Check for damaged key switch. Check connector.
	-→	1.1.2 No voltage at key switch. Wire to key switch or connections is damaged.
1.3 Key switch closed. Brake switch closed. Check for battery voltage at B+ terminal of transistor controller.	→→ --	1.3.1 Battery voltage at B+ terminal. Check fault code. If no fault code, possible damaged control handle card.
	-→	1.3.2 No voltage at B+ terminal. Check B- terminal. Check fault code.

Repairs

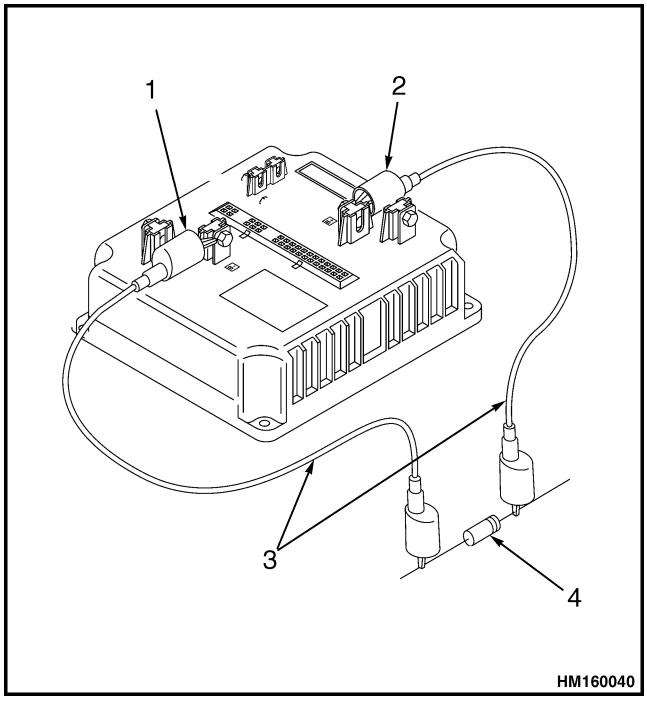
WARNING

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 to the control handle and disconnect the battery.

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

The capacitor in the transistor controller can hold an electrical charge after the battery is disconnected. To prevent electrical shock and personal injury, discharge the capacitor before inspecting or repairing any component in the drive unit compartment. Connect a 200-ohm, 2-watt resistor across the B+ (positive) and B- (negative) connectors of the controller. See Figure 5.

All checks, adjustments, and repairs in the drive unit compartment are done with the compartment cover removed. Remove the drive unit compartment cover for access to the electrical components and discharge the capacitor.



1. POSITIVE CONNECTION
2. NEGATIVE CONNECTION
3. INSULATED JUMPER WIRES
4. 200-OHM, 2-WATT RESISTOR

Figure 5. Discharging Controller

CONTROLLER, REPLACE

WARNING

Some checks require the battery to be connected. DO NOT connect the battery until the procedure tells you to do so. Make sure the drive wheel is raised to prevent movement and possible injury. Raise the drive wheel. See the section Periodic Maintenance 8000SRM0919 - How to Put a Lift Truck on Blocks. The blocks must prevent the lift truck from falling and causing personal injury or property damage.

NOTE: Although the controller is factory programmed, any custom parameters must be uploaded or re-entered into the controller when replacing. See the section Curtis 1297 Transistor Motor Controller 2200SRM0928.

DO NOT replace the controller until you have thoroughly checked all other electrical components and are sure the controller is malfunctioning. For the following procedures, refer to Figure 6.

Remove

1. Move the truck to a safe, level location. Turn the key switch to the OFF position, disconnect the battery, and block the drive tire to prevent unexpected movement.
2. Remove the drive unit compartment covers.
3. Discharge the capacitor. See Figure 5 in this section.
4. Tag and disconnect wires from the controller.
5. Remove mounting screws and remove controller.

Install

1. Install replacement controller on lift truck using mounting hardware.
2. Connect wires and cables to the proper terminals as identified during the removal procedure.
3. Connect battery, turn the key switch to the ON position, and turn parking brake to the OFF position.
4. Test for proper operation.
5. Install the drive unit compartment covers.

CONTACTOR COIL, CHECK

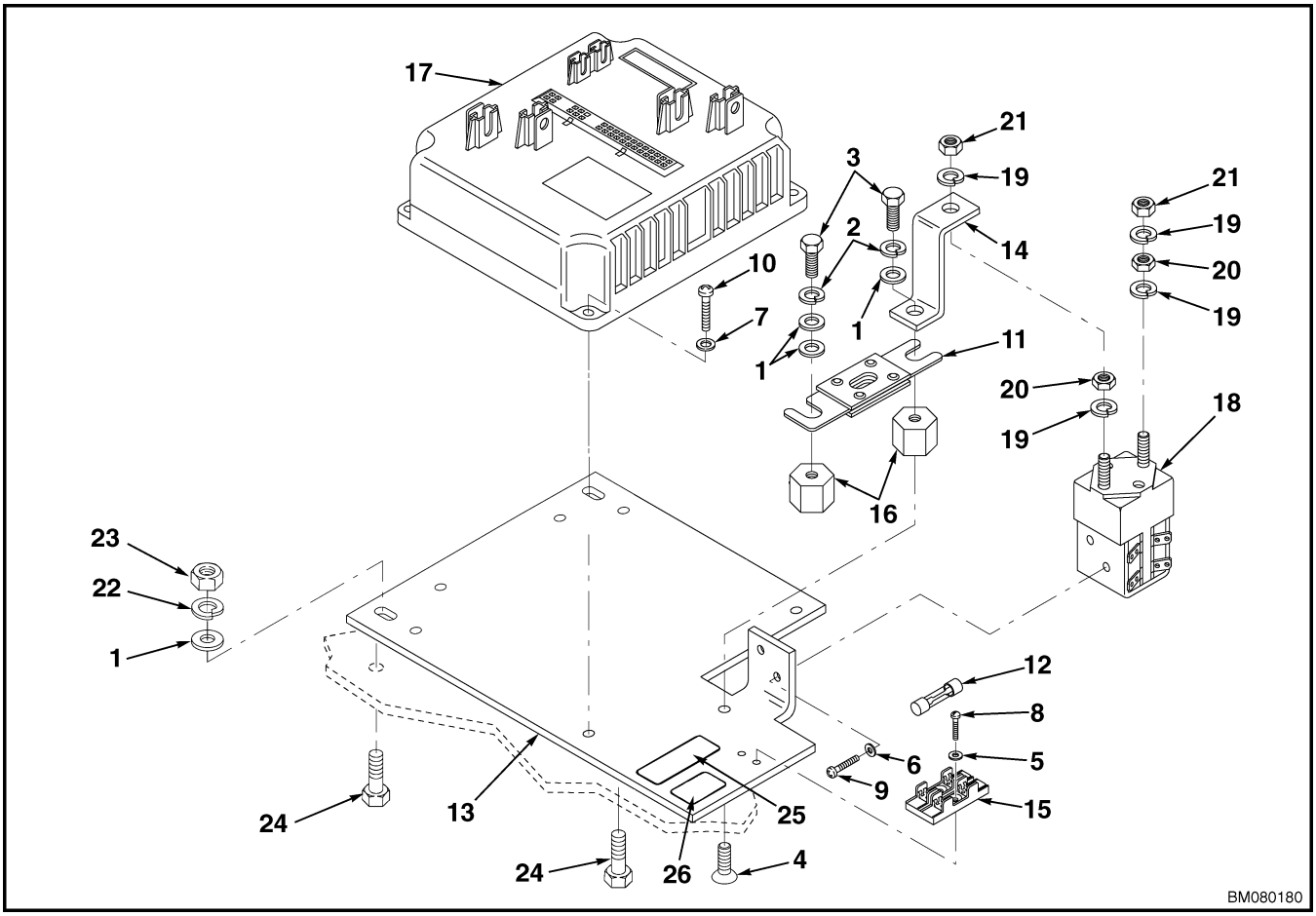
Disconnect coil wires. Test contactor coil using an ohmmeter to measure the resistance. Use the highest resistance indication. The coil should read 23 ohms ±10% (14 ohms ±10% on models W65Z). Remove and replace contactor if resistance readings indicate a short circuit in both directions or if there is an open circuit in both directions. Make sure coil wires are connected to the proper terminals.

NOTE: The contactor contains no serviceable parts and must be replaced as a complete assembly.

CONTACTOR, REPLACE

NOTE: Make an identification of any wires before disconnecting them. The wires must be connected correctly after checks or repairs.

Make sure battery is disconnected and capacitor in controller is discharged. For the correct procedure to discharge the controller, refer to Figure 5. If the lift truck has an EE rating, remove cover of the contactor box for access to the contactor terminals. Make an identification of the wires and cables, and disconnect them from the contactor assembly. Remove mounting screws and replace contactor assembly. Install wires and cables as removed. Install cover of contactor box on EE units.



1. WASHER
2. LOCKWASHER
3. CAPSCREW
4. CAPSCREW
5. WASHER
6. LOCKWASHER
7. WASHER
8. SCREW
9. SCREW
10. SCREW
11. FUSE-MOTORS
12. FUSE-CONTROLLER
13. MOUNTING PLATE
14. BUSS BAR
15. FUSE HOLDER
16. STAND-OFF
17. CONTROLLER
18. CONTACTOR
19. LOCKWASHER
20. NUT
21. NUT
22. LOCKWASHER
23. NUT
24. SCREW
25. LABEL
26. LABEL

Figure 6. Controller Panel Assembly

CONTACTOR TIPS, REPLACE

CAUTION

All contactor tips must be replaced at the same time if any need replacing.

NOTE: If both the contactor tips and the coil will be replaced, replace complete contactor as described in Contactor, Replace. Perform only the procedures necessary to complete the repairs.

The contactor tips are made of special silver alloy. The contacts will 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.

Remove

Refer to Figure 7 for the following procedures.

1. Remove contactor as described in Contactor, Replace.
2. Remove screws (4) that fasten the top cover to the coil and frame.
3. Remove cover, moving contact (2), and return spring.
4. Remove capscrews, washers, and nuts that make up the fixed contactor tips (1) from the top cover.
5. If a coil will be replaced, remove coil frame and remove end cap from frame.
6. Remove coil from frame.

Install

1. Install new coil on frame and install end cap.
2. Install moving contact (2) and return spring.
3. Install capscrews, washers, and nuts that make up the fixed contactor tips (1) to the top cover.

NOTE: Check that the moving contactor and springs move freely without binding.

4. Install cover to coil and frame using screws (4).
5. Install contactor assemblies on the lift truck as described in Contactor, Replace.

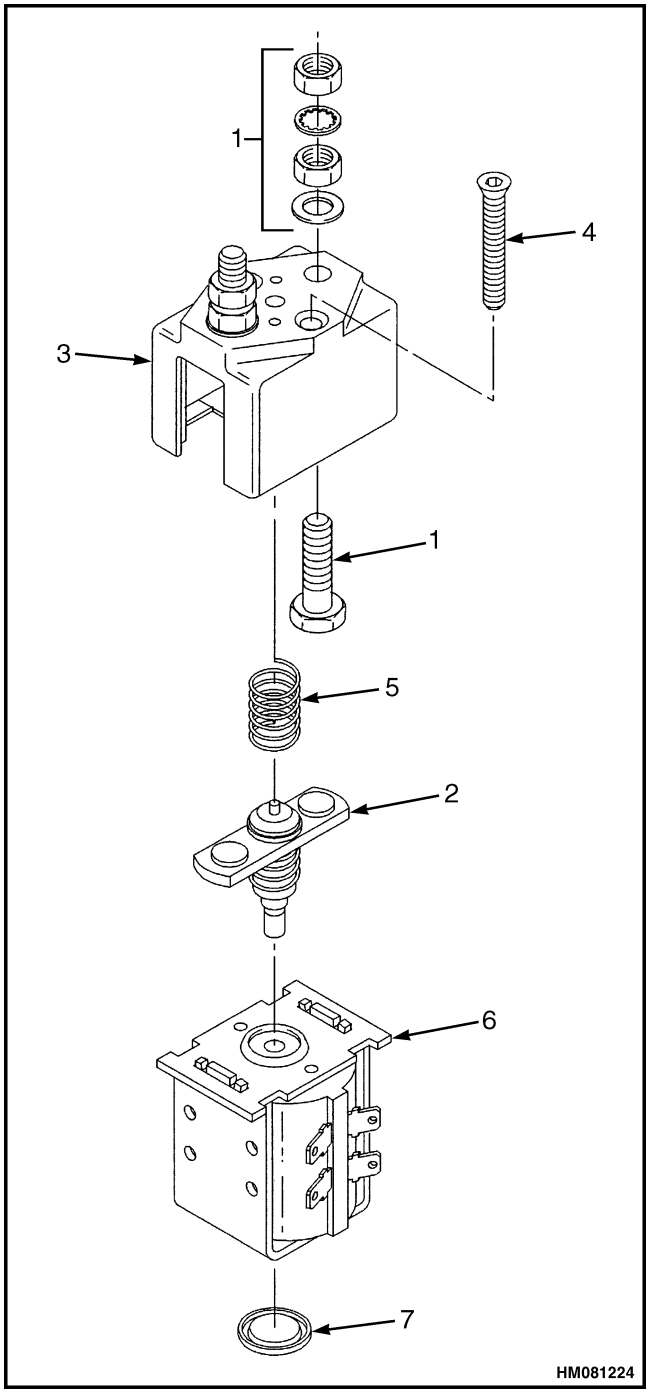


Figure 7. Contactor

Legend for Figure 7

1. FIXED CONTACTS
2. MOVING CONTACTS
3. TOP COVER
4. SCREW
5. RETURN SPRING
6. COIL AND FRAME
7. END CAP

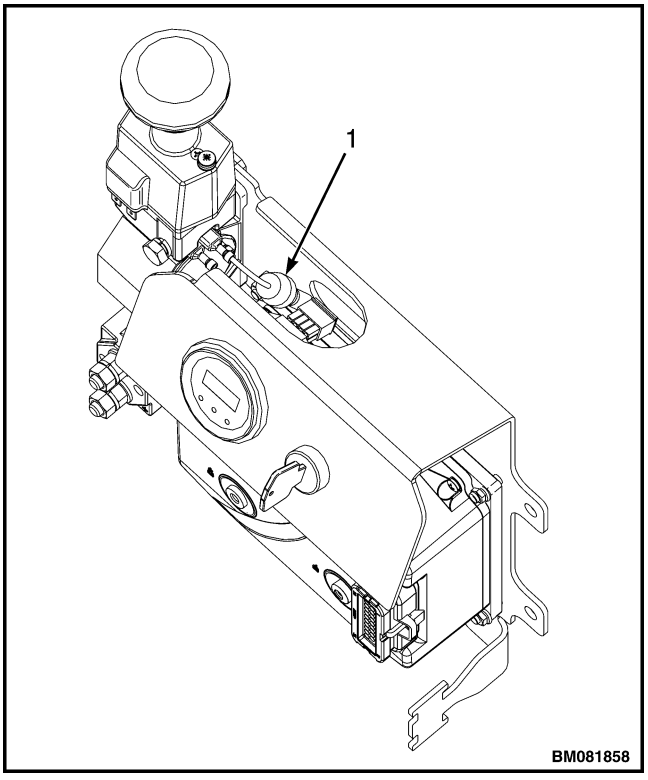
Fuses

WARNING

The capacitor in the transistor controller can hold an electrical charge after the battery is disconnected. To prevent electrical shock and personal 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.

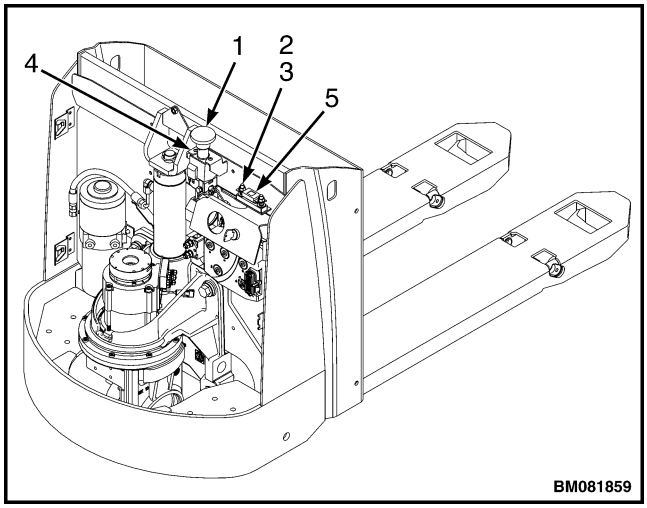
The motorized hand trucks use a single 5-amp (FU 2) fuse for the control circuit, and 400-amp (FU 1) fuses for both the drive motor and the hydraulic pump motor. The fuses are located on the contactor panel. Remove and replace as required. See Figure 8 and Figure 9.

If it cannot be determined visually that a fuse has failed, check for continuity using an ohmmeter. To replace FU1, loosen nuts retaining it. Install a new fuse and tighten nuts. FU2 is retained by a fuse holder. Make certain that any replacement fuse is of the right amperage before installation.



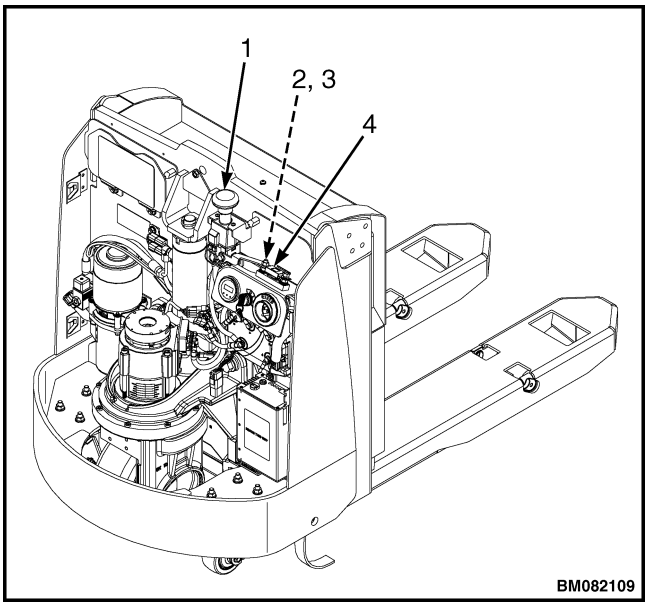
1. FUSE

Figure 8. Control Circuit Fuse



1. BATTERY DISCONNECT SWITCH
2. NUT
3. WASHER
4. SCREW
5. FUSE

Figure 9. Electrical Components



1. BATTERY DISCONNECT SWITCH
2. NUT
3. WASHER
4. FUSE

Figure 10. Electrical Components (A230, A233)

Brake Switch - W60Z, W65Z, W80Z, B60Z (→Aug. 2003) and B80Z (→Aug. 2003)

REMOVE AND INSTALL

WARNING

The capacitor in the transistor controller can hold an electrical charge after the battery is disconnected. To prevent electrical shock and personal 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.

Check the brake switch for continuity. Remove the nut that retains the switch to the bracket. Remove the switch.

Attach the brake switch to the bracket using the nut. Install wires to the switch.

Connect the battery. Move the brake handle to check that brake switch closes when the brake is released and opens when the brake is engaged. See Figure 11.

The brake switch is normally open until the control handle is moved to the operating position. Refer to Brakes 1800SRM0963.

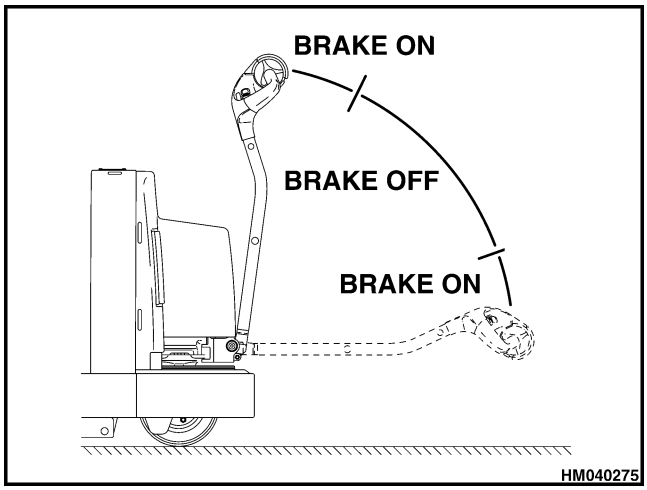


Figure 11. Brake Operation

Brake and Interlock Switches - B60Z (Aug. 2003→) and B80Z (Aug. 2003→)

DISASSEMBLE

1. Position the lift truck on a level surface. Turn the key switch to the OFF position and disconnect the battery.

NOTE: The screws have been installed using Loctite® 290.

2. Remove the two screws and the nut plate retaining the switches to the control handle hub. See Figure 12.

3. Remove switches from the hub and tag all wiring connections to the switches for later use when assembling the switches to the hub.

4. Remove the switch.

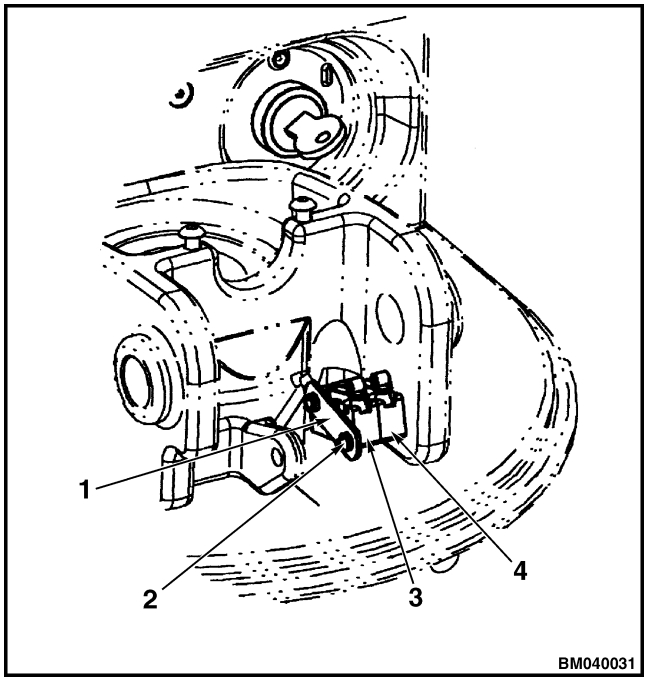
ASSEMBLE

1. Attach wiring to correct switch terminals.

2. Install switches into hub with two screws and nutplate. Apply Loctite® 290 to the screws, install, and tighten.

3. Connect battery and turn the key switch to the ON position.

4. Test for proper operation before returning the truck to service.



1. NUTPLATE
2. SCREW
3. REGEN SWITCH
4. BRAKE SWITCH

Figure 12. Brake and Interlock Switches

Height Limit

Height limiting is controlled by the height limit switch in the 1297 Curtis controller. When the controller senses a high current draw from the hydraulic pump, it will shut down the pump. There are two separate incidents that will cause this current draw: The first is when the lift cylinder reaches maximum height, and the second is when the load exceeds the rated capacity. In either case, the controller will shut down the pump.

Control Handle

DISASSEMBLE

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 to the control handle and disconnect the battery.

NOTE: It is not always necessary to remove and disassemble all the components that make up the control section of the steering handle to replace a damaged part. Perform only the steps necessary to replace the damaged parts. See Figure 17.

1. Move the lift truck to a safe, level area and block the drive wheel to prevent movement of the lift truck.
2. Turn the key switch to the OFF position and disconnect the battery.
3. The handle is comprised of two molded-plastic halves and is held together by capscrews. (W60/65/80Z has three and the B60/80Z has five.) Remove the screws.
4. Disengage the hooks under the auto-reverse switch. Slide the upper half off of the lower half using a gentle rocking motion while lifting and pulling the upper half away from lower half.
5. Unplug the handle wiring harness from the control handle card.
6. Place upper half of the handle upside down on a secure, level work surface so the internal parts are facing up.

NOTE: Make note of the position of the butterfly knobs relative to the handle BEFORE removal.

7. Remove one of the butterfly knobs by removing the screw that holds it to handle (4).
8. Using the remaining butterfly knob, slide the shaft out of the handle. Be careful not to rotate the shaft within the control handle card.
9. Refer to the wiring diagram, or draw a sketch of where each of the push button switches are plugged into the control handle card. Unplug switches from the control handle card and remove the card.

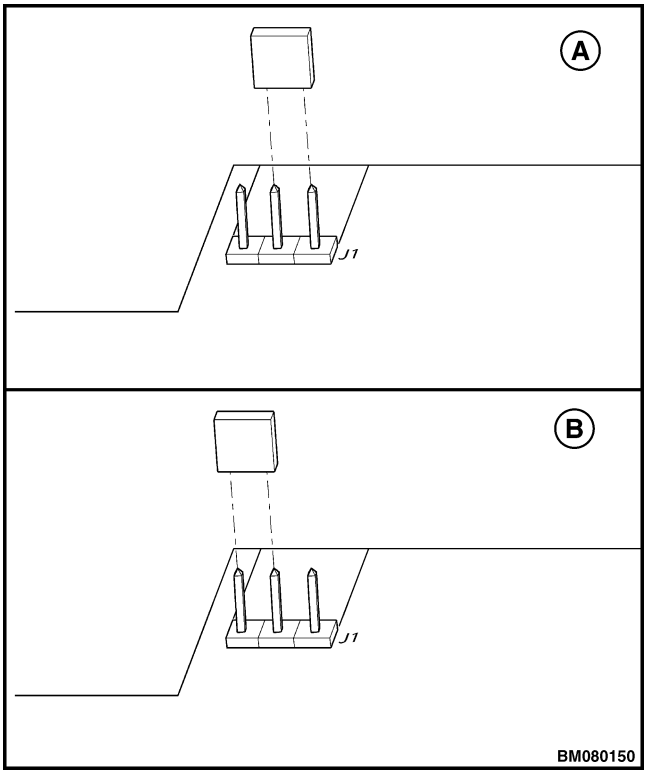
CONTROL HANDLE CARD (OLD STYLE)

After servicing the control handle head, it is necessary to calibrate the control handle card. If replacing with a new style card (usually blue in color), refer to Control Handle Card (New Style).

1. Install the control handle card in the upper half of the control handle.

NOTE: When inserting knobs make sure that flange on one of the butterfly knobs inserts between the spring on the control handle.

2. Slide shaft and butterfly knob into the control handle card. Be careful not to rotate the shaft inside the control handle card.
3. Connect the switches and wire harness connectors.
4. Install the remaining butterfly knob. Apply Loctite® 242 to the screw attaching the butterfly knob onto the upper half of the handle and tighten the screw to 1 N•m (9 lbf in).
5. Lubricate friction points on the butterfly knobs with silicone spray lubricant.
6. Connect the battery.
7. Move the jumper on the J1 terminal to the calibrate mode. See Figure 13, view B.
8. With the handle in the full upright position, turn the key switch to the ON position.
9. Slowly rotate the butterfly knobs in the forward direction and hold at maximum rotation for 5 seconds.
10. Slowly rotate the butterfly knobs back to the neutral position and leave for 5 seconds.
11. Slowly rotate the butterfly knobs in the reverse direction and hold at maximum rotation for 5 seconds.



A. RUN MODE
B. CALIBRATE MODE

Figure 13. Control Handle Card Calibration

12. Slowly rotate the butterfly knobs back to the neutral position and leave for 5 seconds.

NOTE: If control handle includes the optional proportional switches, it will be necessary to perform Step 13 through Step 16. If control handle includes only the full speed and half speed ON/OFF lift and lower switches, then go to Step 17.

13. Slowly press the proportional LIFT button and hold down five seconds.

14. Slowly release the proportional LIFT button and wait for five seconds.

15. Slowly press the proportional LOWER button and hold down for five seconds.

16. Slowly release the proportional LOWER button and wait for five seconds.

17. Move the jumper on the J1 terminal to the RUN mode. See Figure 13, view A.

18. Turn the key switch to the OFF position.

19. Install the upper half on the lower half. Refer to Assemble for instructions on how to install the upper half on the lower half.

20. Test the lift truck to verify correct travel, lift, and lower speeds.

CONTROL HANDLE CARD (NEW STYLE)

NOTE: New style control handle cards will be blue in color and should be used as replacement cards regardless of color of the card removed. If simply calibrating an existing old style card (green in color), refer to Control Handle Card (Old Style).

NOTE: Verify that the magnetic holder of the thumbwheel switch has been installed in the proper position. See Figure 14.

After servicing the control handle head, it may be necessary to configure and/or calibrate the control handle card.

Configure

Refer to Figure 14 for the following instructions.

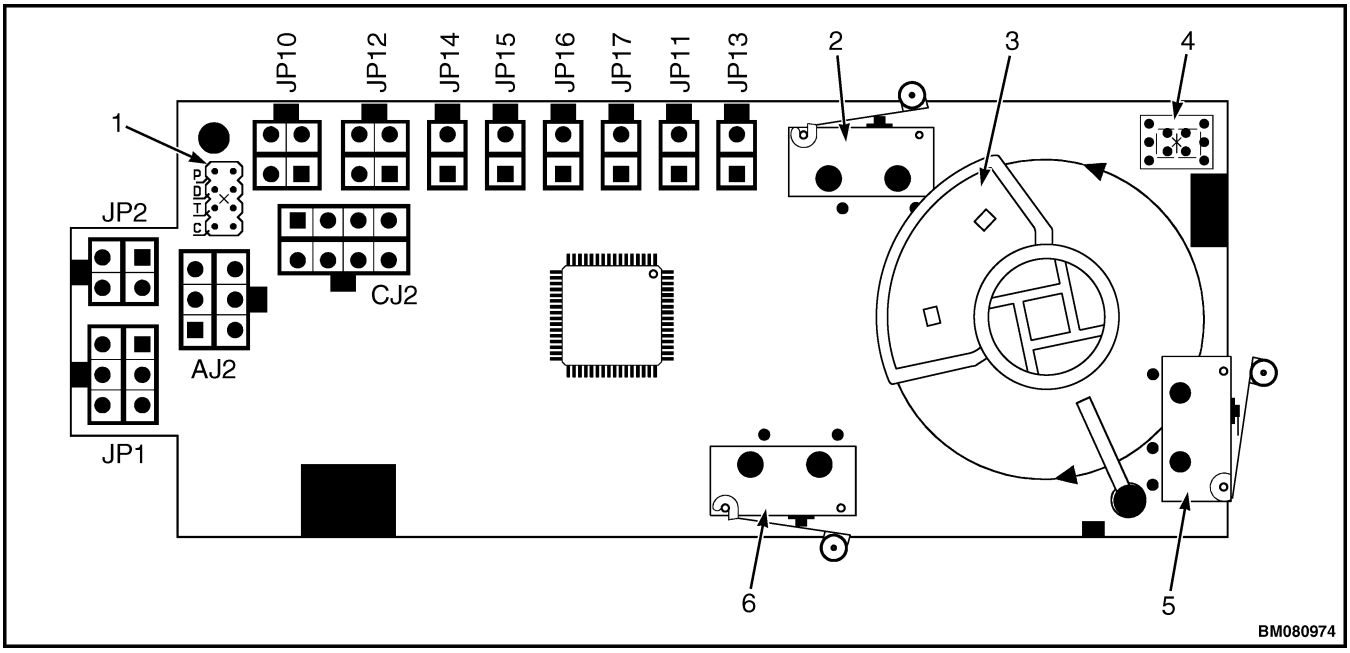
1. Partially assembly the control handle head. Refer to Assemble.

2. Connect the control handle card wiring, verify that the battery is connected, and turn the key switch to the ON position.

3. The LED will display the program setting for approximately five seconds. See Figure 14. The proper control handle card setting for this model is number 7. If the correct number is displayed on the LED, the control handle card is configured correctly.

4. To begin configuring the card, turn the key switch to the OFF position.

5. Move the jumper from P (park) to C (configure). See Figure 15.



1. JUMPER TERMINALS (SV2)
2. HORN SWITCH (S1)
3. THUMBWHEEL SWITCH (MAGNETIC HOLDER)
4. LED DISPLAY SCREEN
5. BELLY SWITCH (S)
6. TURTLE SWITCH (S2)

Figure 14. Control Handle Card (New Style)

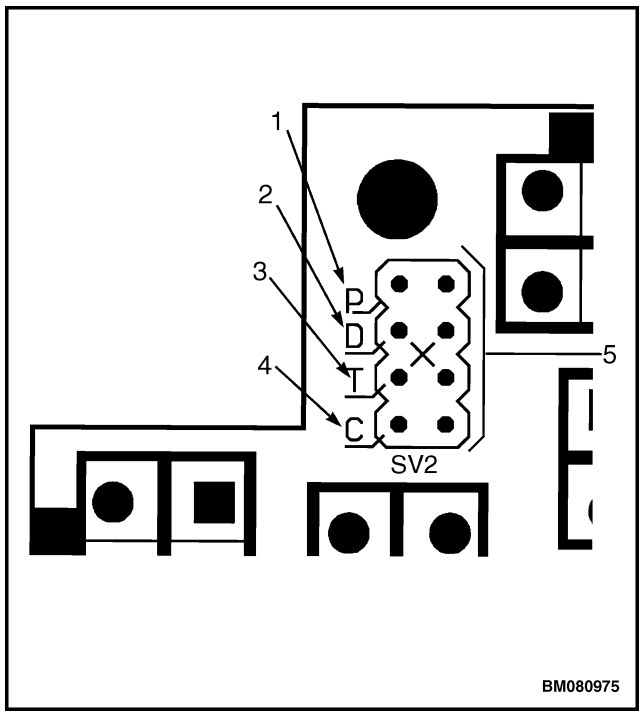


Figure 15. Jumper Terminal (SV2)

Legend for Figure 15

1. P (PARK/ HOME POSITION)
2. D (NOT USED)
3. T (TEACH/CALIBRATE)
4. C (CONFIGURE)
5. JUMPER TERMINAL (SV2)

6. Turn the key switch to the ON position and view the LED display.

7. Press and release the S2 (turtle) switch or S3 (horn) switch to change the number displayed on the LED to the correct value.

8. Press and release the S (belly) switch to save the value. A decimal will appear on the LED display beside the number showing it has been saved.

9. Turn the key switch to the OFF position and move the jumper to the park (P) position.

10. Turn the key to the ON position and view the LED to verify the correct number has been saved. The LED will display the program setting for approximately five seconds.

Calibrate

Refer to Figure 14 for the following instructions.

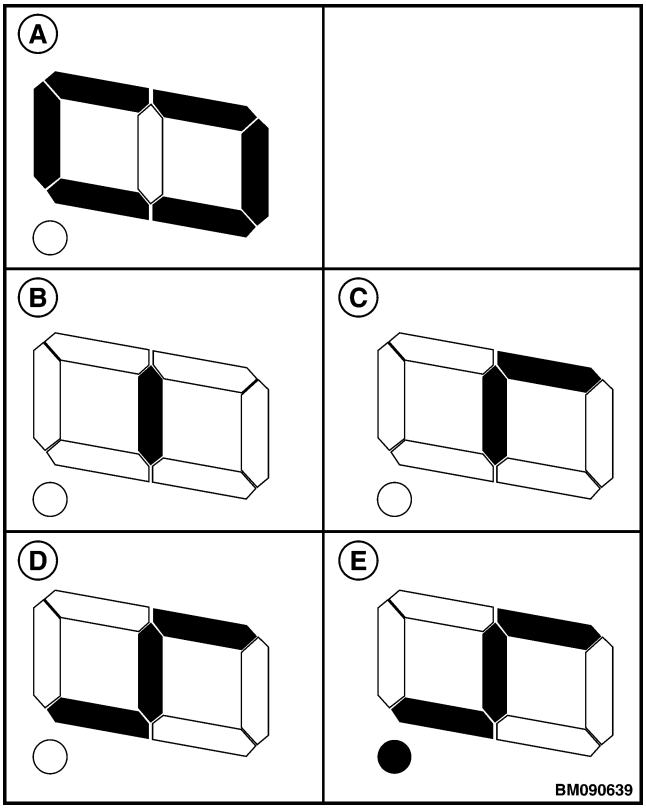
1. Verify that the key switch is in the OFF position.
2. Move the jumper from P (park) to T (teach). See Figure 15.
   a. Ensure the leads from the Right Lift switch connects to the JP10 socket and the leads from the Right Lower switch connects to the JP12 socket. See Figure 14.
   b. Ensure the leads from the Left Lift switch connects to the JP14 socket and the leads from the Left Lower switch connects to the JP15 socket. See Figure 14.
   c. Ensure the tiller harness connects to AJ2 socket. See Figure 14.
3. Verify that the battery is connected and turn the key switch to the ON position. The LED will display a symbol (see Figure 16 view A or B) to signal that the card is in calibration mode.
   a. If LED displays as shown in Figure 16 view A, return butterfly to neutral then press left lift button. The LED will display as shown in Figure 16 view B.

NOTE: "Rotation Right" and "Rotation Left" directions are specified by labels printed on face of card.

4. Rotate the thumbwheel in the "Rotation Right" direction (toward the forks) and hold to the mechanical stop. Press the left side lift button.
5. The LED screen will change to show this segment complete. See Figure 16, view C. Release the thumbwheel so it returns to the neutral position.

NOTE: "Rotation Right" and "Rotation Left" directions are specified by labels printed on face of card.

6. Rotate the thumbwheel in the "Rotation Left" direction (toward the operator) and hold to the mechanical stop. Press the left side lower button.
7. The LED screen will change to show this segment complete. See Figure 16, view D. Release the thumbwheel so it returns to the neutral position.
8. Move the jumper from T (teach) to P (park). See Figure 15.
9. The LED screen will change to show a decimal beside the completed segments indicating they have been saved. See Figure 16, view E.
10. Use diagnostic from handset to verify the “Throttle” output 95% and above for both directions.
11. Recycle the key switch OFF and ON and test all truck functions for proper operation.



A. CALIBRATION MODE
B. CALIBRATION MODE
C. ROTATION RIGHT SEGMENT COMPLETE
D. ROTATION LEFT SEGMENT COMPLETE
E. ALL SEGMENTS COMPLETE AND SAVED

Figure 16. LED Views

ASSEMBLE

1. Install control handle card in the upper half of control handle. See Figure 17.

NOTE: When inserting knobs, make sure that flange on one of the butterfly knobs inserts between spring on handle (9).

2. Slide shaft and butterfly knob into control handle card. Be careful not to rotate the shaft inside the control handle card.

3. Connect the switches and wire harness connectors.

4. Plug handle wiring harness into control handle card.

CAUTION

DO NOT force the upper half onto the lower half as this will cause damage to the retaining hooks of the upper half.

5. To install upper half of handle onto the lower half:

   a. Tip the upper half up and align the hooks under the auto-reverse switch.

   b. Lower the upper half onto the lower half.

6. Install capscrews to retain upper half of control handle to lower half.

7. Connect battery cable and test control handle operation.

Remote Control Box Switches (B60Z and B80Z)

REMOVE

1. Turn key to OFF position. Disconnect battery.

2. Remove drive unit compartment cover.

3. Unplug remote control box wiring harness and gently push some of the wiring up inside the tube of the grab bar.

4. Remove four corner Allen head screws and washers retaining control box covers to handrail. Remove covers and switch assemblies from grab bar.

5. Gently pull wiring harness out of grab bar a couple of inches or just enough to allow switch wiring to be unplugged.

6. Make certain wires to switches are identified. Pay special attention to the order in which the switches are plugged into the wire harness. Unplug switches from wiring harness. Remove remote control box and switches and place them on a clean, level work area.

7. Test switches for continuity. Replace any switches found to be damaged or inoperative. Remove switches from control box by gently prying them out with a small, flat head screwdriver.

8. Inspect actuator springs for damage. Replace any damaged springs.

INSTALL

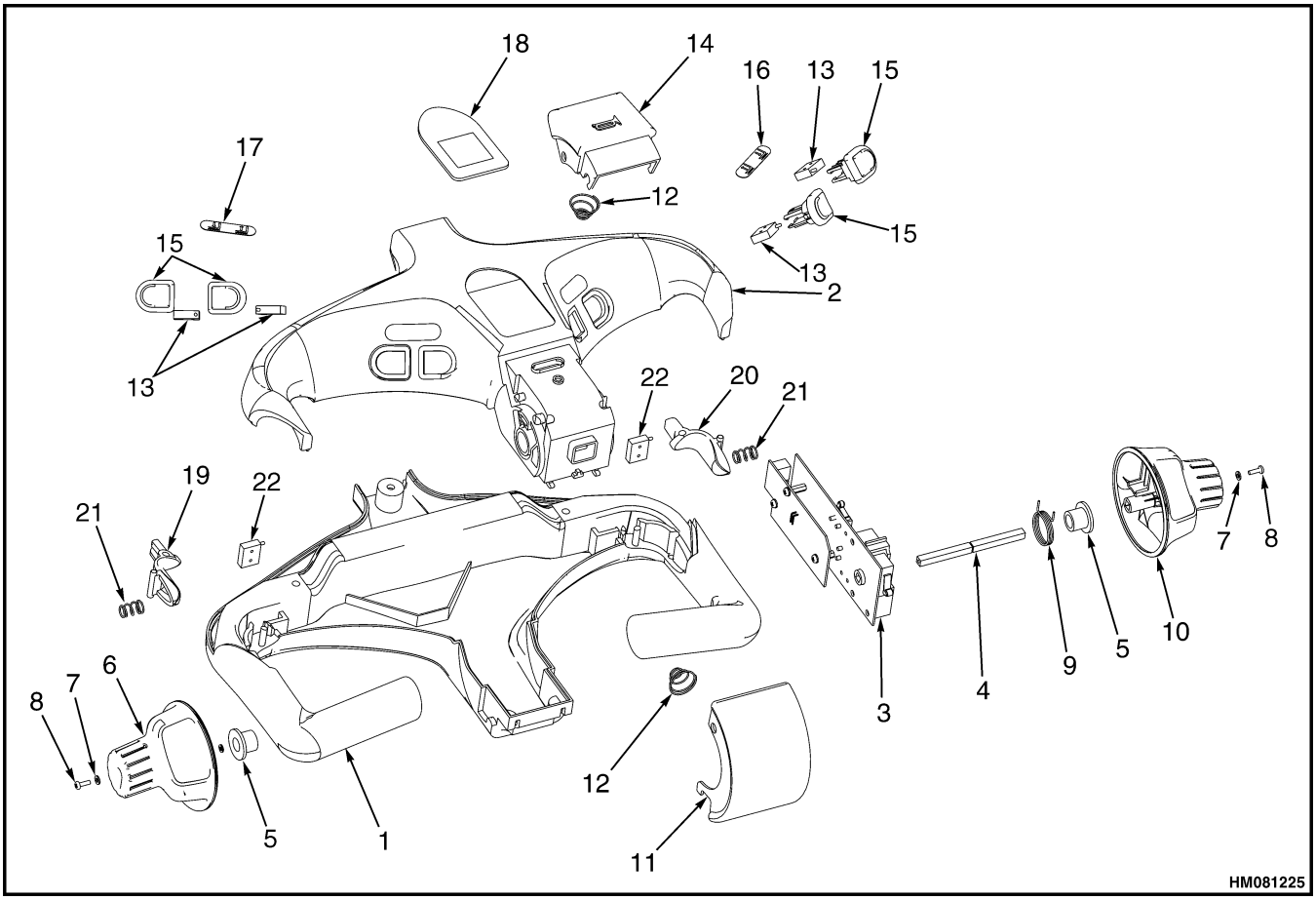
1. Position each switch in the correct mounting bracket with the switch plunger aligned correctly and push it in gently until it locks into place.

2. Plug switches into remote control box wiring harness. Pay special attention to the order the switches are plugged into the harness.

3. Pull remote control box wiring harness downward through the grab rail until it is flush with the upper opening of the tube.

4. Install four Allen head screws to retain cover and switches to handrail.

5. Reconnect battery and test operation of lift truck before returning truck to service.



1. LOWER HALF
2. UPPER HALF
3. CONTROL HANDLE CARD ASSEMBLY
4. SHAFT
5. BUSHING
6. LH BUTTERFLY KNOB
7. WASHER
8. SCREW
9. SPRING
10. RH BUTTERFLY KNOB
11. SWITCH COVER
12. SPRING
13. SWITCH
14. HORN SWITCH COVER
15. SWITCH ASSEMBLY
16. LABEL
17. LABEL
18. LABEL
19. ACTUATOR (B60Z AND B80Z)
20. ACTUATOR (B60Z AND B80Z)
21. SPRING
22. MICROSWITCH (B60Z AND B80Z)

Figure 17. Control Handle

Motor Maintenance - General

This portion of the electrical section describes disassembly and assembly, brush replacement, inspection, and checks for malfunction of DC motors. Inspect commutator and brushes every 200 hours of operation. The commutator is the rotating electric connection between the armature and the electric power supplied by the battery. Brushes made of carbon compounds slide on the rotating commutator and are the path for electricity from the battery to the commutator and the armature. The maintenance of the commutator and the brushes is important to the good operation of a DC motor.

Drive motors and hydraulic pump motors are similar in design. The hydraulic pump motors are smaller than the drive motors, but the disassembly and maintenance of the motors are similar.

Brush and Commutator Inspection

WARNING

Put blocks under each side of the truck under the drive unit frame. Position blocks on both sides of the load wheels. The blocks must prevent the lift truck from falling and causing personal injury or property damage.

1. Raise drive wheel off the floor. Block lift truck. Disconnect battery.
2. Remove drive unit compartment covers.

WARNING

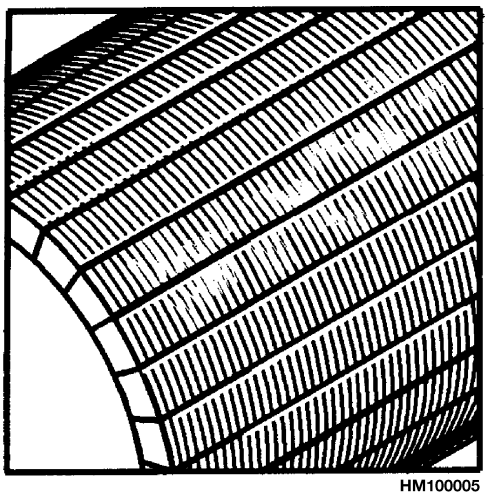
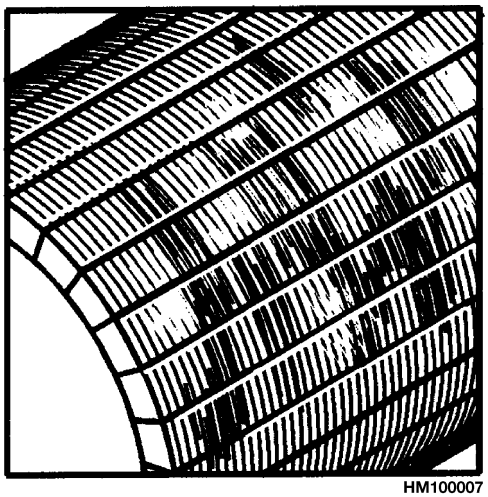
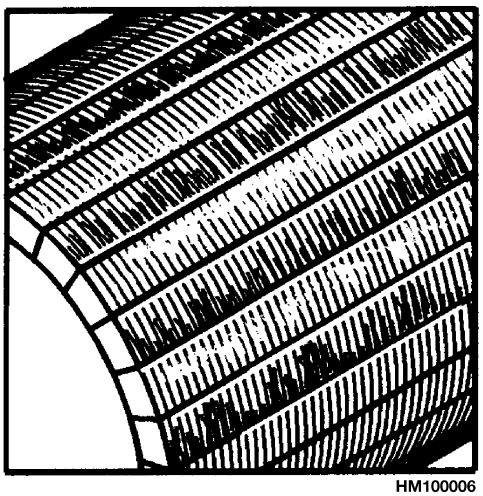
The capacitor in the transistor controller can hold an electrical charge after the battery is disconnected. To prevent electrical shock and personal injury, discharge the capacitor before inspecting or repairing any component in the drive unit compartment. Wear safety glasses. Make certain the battery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

3. Discharge capacitor in transistor controller.
4. If used, remove brush covers to motor. Wear eye protection. Use a vacuum cleaner or compressed air to remove dirt and brush dust from commutator area.

NOTE: Vacuum cleaning, when possible, is the recommendation of manufacturers of electric motors. The use of compressed air can send dirt particles into the bearings and other areas of the motor that can cause possible damage.

5. Inspect commutator surface. Refer to Table 2, Table 3, Table 4, Table 5, Table 6, Table 7, Table 8, Table 9, Table 10, Figure 18, Figure 19, Figure 20, and Figure 23. The commutator wears slowly in normal service. The mica must be cut below the surface of the commutator bars after a long service period or after a commutator has been turned in a lathe. Carefully rotate armature. DO NOT damage commutator if you use a tool to rotate the armature.
6. Inspect white or gray insulation (mica) between commutator bars. The mica must not touch the brushes or the brushes will wear very rapidly.
7. Install brush covers, when used, and drive unit compartment cover.
8. Connect battery. Lower truck to floor. Test operation of motorized hand truck before returning truck to service.

Table 2. Normal Commutator Surfaces

 HM100005	A light brown surface of the commutator, where it rotates on the brushes, is a normal condition. The surface of the commutator must be smooth.
 HM100007	Variations between light brown and dark brown colors are normal. The surface of the commutator must be smooth.
 HM100006	A condition called slot bar marking is normal if the commutator surface is smooth. The variable color occurs in a pattern according to the number of conductors per slot.