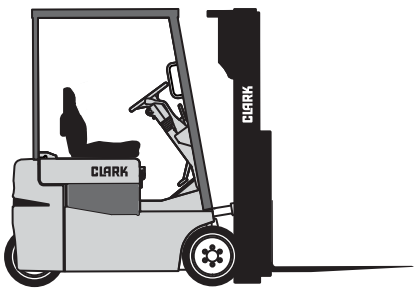
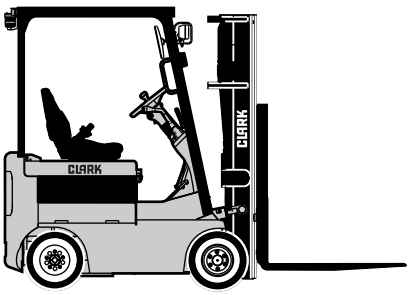
SERVICE MANUAL

TMX 12-25
EPX 16-20s

(TMX)



(EPX)



Rated Capacity : 1250~2270kg

Part No. 8037870
Book No. SM 715 (Rev 3.1)
Nov. 2019

CLARK THE FORKLIFT
CLARK
100 Years
EST. 1917

CLARK
THE FORKLIFT

CLARK MATERIAL HANDLING INTERNATIONAL
215, Ojeong-ro, Bucheon-Si, Gyeonggi-do, Korea
Tel: 82-32-680-6300 [www.clarkmhc.co.kr]

Raising Entire Truck

Refer to truck data plate for truck weights.

1. Park truck safely. Lower upright fully. If necessary, drive truck onto boards to increase under-clearance.

WARNING

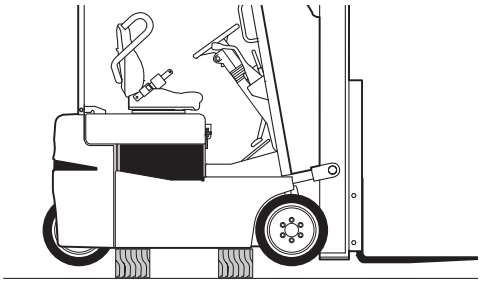
SIDE-TO-SIDE TIPOVER. When jacking side of truck, be sure upright is lowered fully. Do not raise one side of the truck more than about 50 mm (2 in) higher than the other, to avoid tipping truck over laterally.
END-TO-END TIPOVER. If the upright and drive axle are removed while the truck is blocked up, the truck will tip backward due to the heavy counterweight. Upright and counterweight must both be removed before attempting to raise the truck for drive axle removal. The back of the truck must be supported by blocking under the steer axle to prevent movement.
If the counterweight is removed while the truck is up on blocks, the weight of the upright and drive axle will cause the truck to fall forward.

2. Put the jack under side frame, near the center of the truck.

IMPORTANT

Be sure to put the jack squarely and fully under the main side structure of the frame.

3. Carefully raise the truck one side at a time, only as high as necessary to do the maintenance work, and not more than 150 mm (6 in) total.
4. Put blocks under the side frame, at each side of the jack. Spread the blocks close to the steer and drive wheels for maximum stability.
5. If using one jack, lower the truck onto the blocks and move the jack to the opposite side. Repeat the lifting procedure.
6. Put the same size blocks under each side of the truck so it will be leveled.



CAUTION

Before performing any maintenance work, check the truck for stable condition on the blocking.

7. When maintenance work is completed, lower the entire truck to the floor by reversing this procedure. Lower the truck one side at a time, while carefully removing the blocks. Be sure no tools or equipment are under the truck or wheels.

NOTE

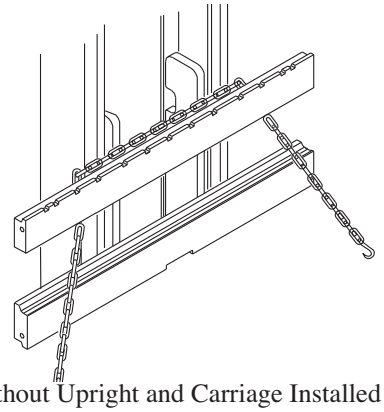
Depending on jack height, shims under the tires may be needed for clearance to allow removal of jack.

Shipping Tie-Down Instructions

1. Front of Truck

   a. With Upright and Carriage Installed

   - Lower the carriage fully.
   - Put a tie-down (e.g., chain) between the carriage fork bars.



   b. Without Upright and Carriage Installed

   - Put a chain across the truck floor plate. Protect truck from chain damage by using covered chain or protective material under the chain at contact points.

2. Rear of Truck

   - Attach the tie-down to the toe-pin in top of counterweight.

Introduction to Planned Maintenance

A program of regular, routine inspections, lubrication, and other service tasks is important for the long life and troublefree operation of the lift truck.

The Clark service organization offers customers a formalized program.called Planned Maintenance, or PM.for

performing these tasks.

PM Intervals

The PM inspections, adjustments, and lubrications are typically performed on each covered truck at 50-250 hour intervals. (See Section 1, in this Group about defining service intervals.)

The PM Form

As an aid to service technicians performing and documenting PM inspections, Clark has prepared a "Planned Maintenance Report" form. A copy of this form is inserted in Section 3 of this Group.

We recommend that you use this form as a checklist and to make a record of your inspection and truck condition. This record can be used to inform the owner of needed repairs and help establish the optimal PM intervals.

When you have finished the PM inspections, be sure to give a copy of the report to the person responsible for lift truck maintenance.

The Basic PM Procedures

The basic PM procedure is to perform checks first, repairs and adjustments last. As you go through each step of the PM, you should note all your findings on the PM report form.

The PM report form serves as a record of what you did in the PM and what further service needs to be performed. "Further service" consists of any repair, adjustment, inspection, or lubrication that you discovered during the PM or any periodic service procedure that is due but not covered by the PM agreement).

You should consult the previous PM report forms, periodic service chart, and truck hour meter to determine what periodic service is due. List the service due on the new PM form.

The PM procedure, in outline form, is as follows:

1. **External visual checks.** Perform these as you walk around the truck with it turned off.
2. **Operational checks.** Perform these while operating the truck.
3. **Internal visual checks.** Perform these after removing the floor board and cowl cover.
4. **Air cleaning internal components.** Do this while performing the previous step.
5. **Critical fastener torque checks.**
6. **Minor adjustments and repairs** you found in your inspection.
7. **Fluid level checks and fill.**
8. **Chassis lubrication.**
9. **Final clean up.**
10. **Minor adjustments** to the responsible party.

Each of these steps is explained in detail beginning on the next page.

CAUTION

- **Do not make repairs or adjustments unless authorized to do so.**
- **Disconnect the battery before you work on electrical components.**
- **Always wear safety glasses.**
- **Wear a safety (hard) hat in industrial plants and in special areas where protection is necessary or required.**
- **Remove all jewelry (watch, rings, bracelets, etc.) before working on the truck.**

Truck Location and Parking

Before starting the external inspection, make sure the truck is parked on a clean, level surface. Fully lower upright, turn truck off, and engage the parking brake.

If it is necessary to drive the truck to a suitable inspection location, perform the initial braking and steering checks, given later in this Section, as you begin to move the truck.

To perform the operational checks, the truck must be where there is sufficient clearance to raise the upright and room to maneuver the truck at full speed without endangering personnel, equipment, or materials.

Critical Fastener Torque Checks

For safety, maintain correct torque on all fasteners of components that directly support, handle, or control the load and protect the operator.

Check torque of critical items, including:

- Drive axle mounting
- Drive and steer wheel mounting
- Counterweight mounting
- Overhead guard mounting
- Tilt cylinder mounting and yokes
- Upright mounting and components.

Critical fastener torque specifications are given in the general specifications Section of Group 40.

Wrapping Up the PM

Clean Up

Before closing up the truck, wipe up any spilled fluids and hand prints you may have left.

After closing up the truck, wipe off any handprints, drips, spills, or other blemishes caused by the PM. It's a good practice to leave the truck looking noticeably better than when you started.

Clean up any spills or debris you left on the floor or other surfaces.

Test the Truck

Operate the truck one last time to ensure that you identified all problems and that your repairs/adjustments were successful.

Report the PM

Finish filling out your PM form, making sure you noted everything you checked, all the problems you found, and all the items you adjusted or repaired.

Take the PM form to the person responsible for lift truck maintenance, present your results, discuss any problems, and point out where further service is needed.

Battery Tests

NOTE

Use both tests described here.

Specific Gravity Test

Test at least six cells across battery with a temperaturecorrected hydrometer (see chart). Battery is fully charged when the reading falls in the 1.280 to 1.300 range. If the difference between cells is more than .015, battery needs maintenance.

SPECIFIC GRAVITY TEST	
SPECIFIC GRAVITY	STATE OF CHANGE
1.260~1.300	100% CHARGED
1.230~1.250	75% CHARGED
1.200~1.220	50% CHARGED
1.170~1.190	25% CHARGED
1.140~1.160	VERY WEAK
1.110~1.130	DISCHARGED

The battery specific gravity is an indication of the battery's state of charge. You can determine the specific gravity of the electrolyte solution in a battery with an hydrometer. If the state of charge is low, the hydrometer will read low. If the state of charge is high, the hydrometer will read high.

For, example a reading from:

- 1.260 to 1.300 indicates a fully-charged battery.
- 1.200 to 1.220 indicates a battery is in a discharged condition and cannot give satisfactory service.

Load Test

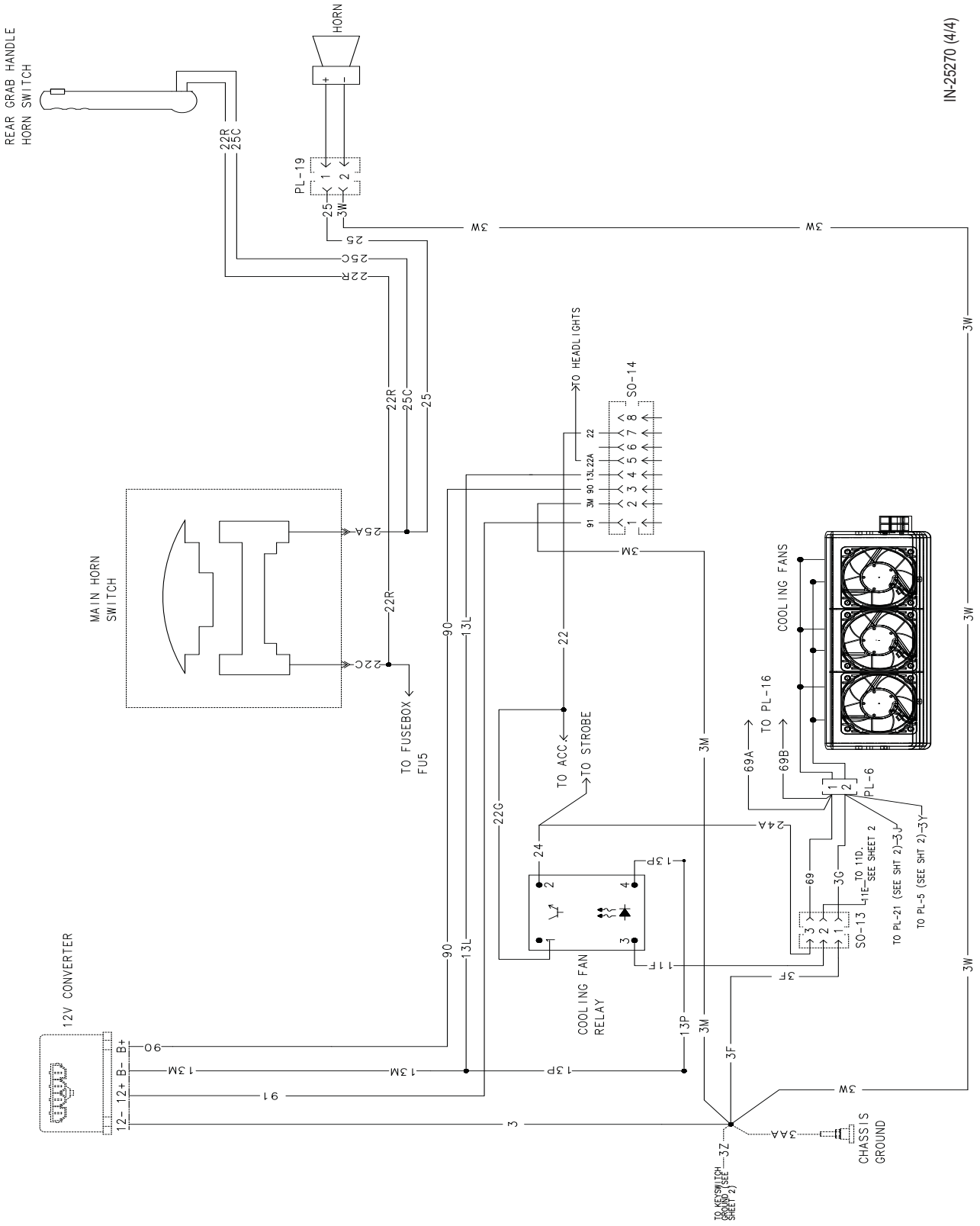
Put the main hydraulic system into tilt by-pass while reading battery volts with a voltmeter.

Battery needs recharge or repair if voltage drops below 80% of the rated voltage of the battery.

Minimum acceptable readings:

- 36 volt battery: 28.8 volts
- 48 volt battery: 38.4 volts

Standard Truck (TMX - with telematics) - 4/4

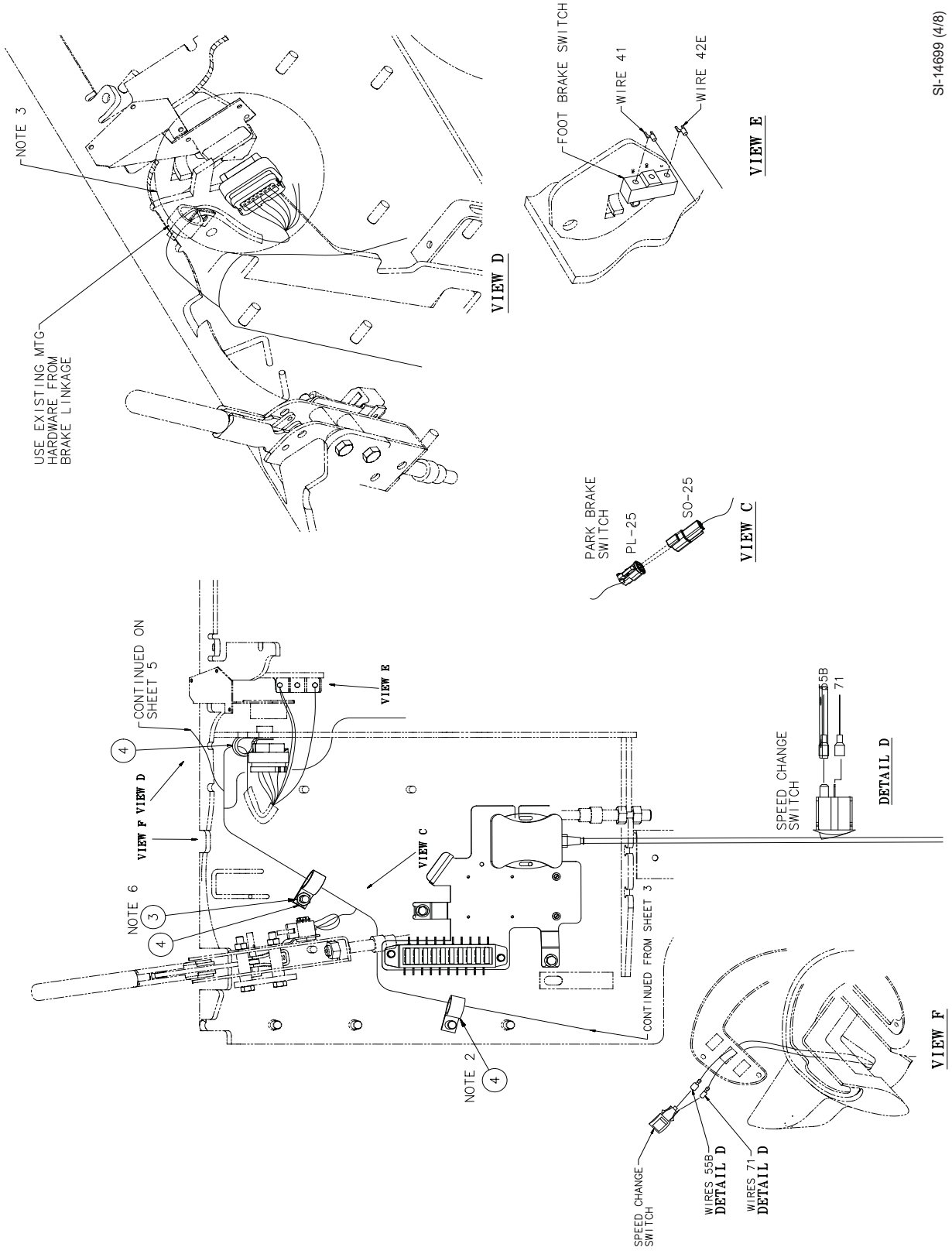


Section 3

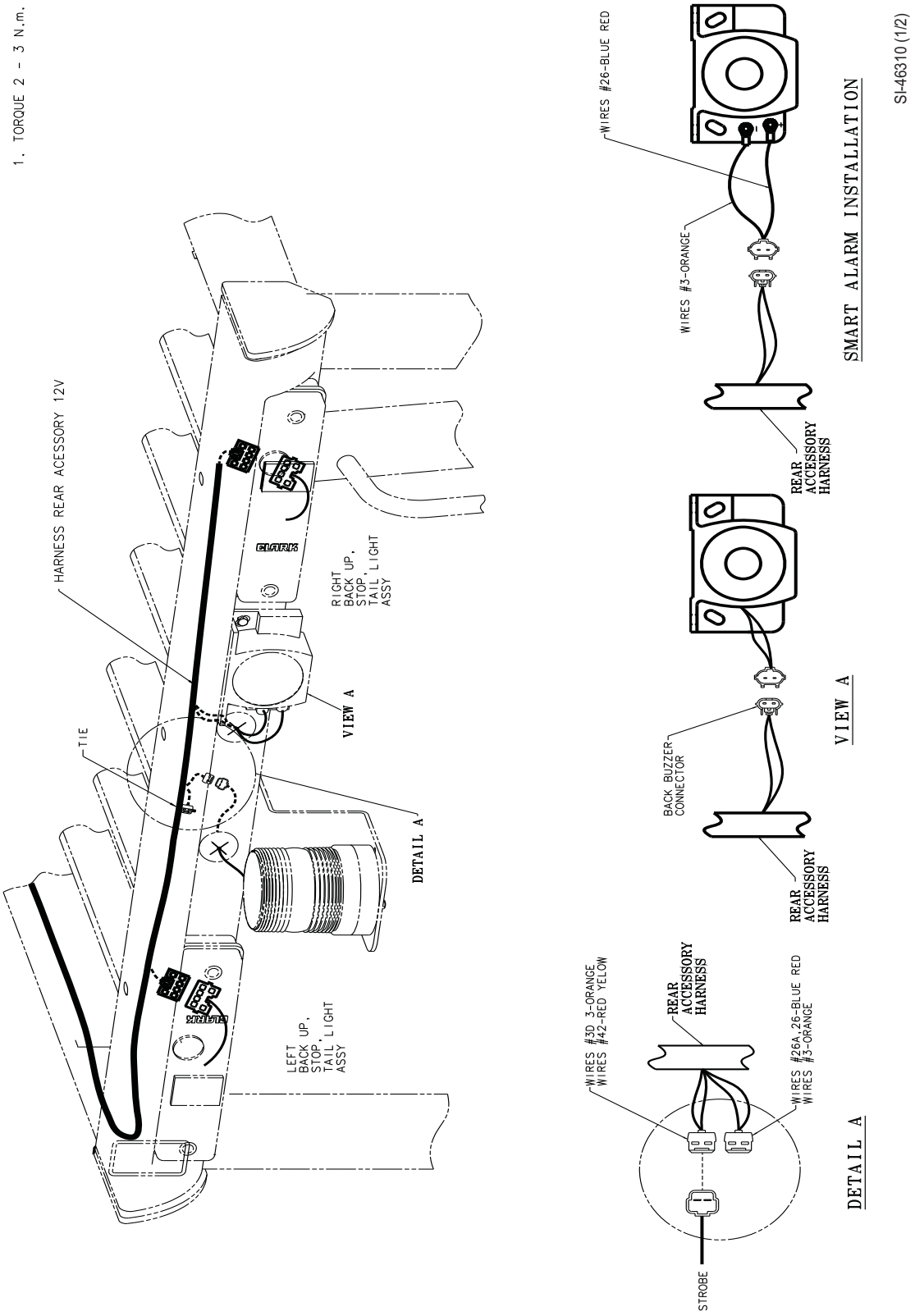
Wiring and Cables

The following illustrations depict wiring and cable routing and connections for standard trucks and main accessory harness.

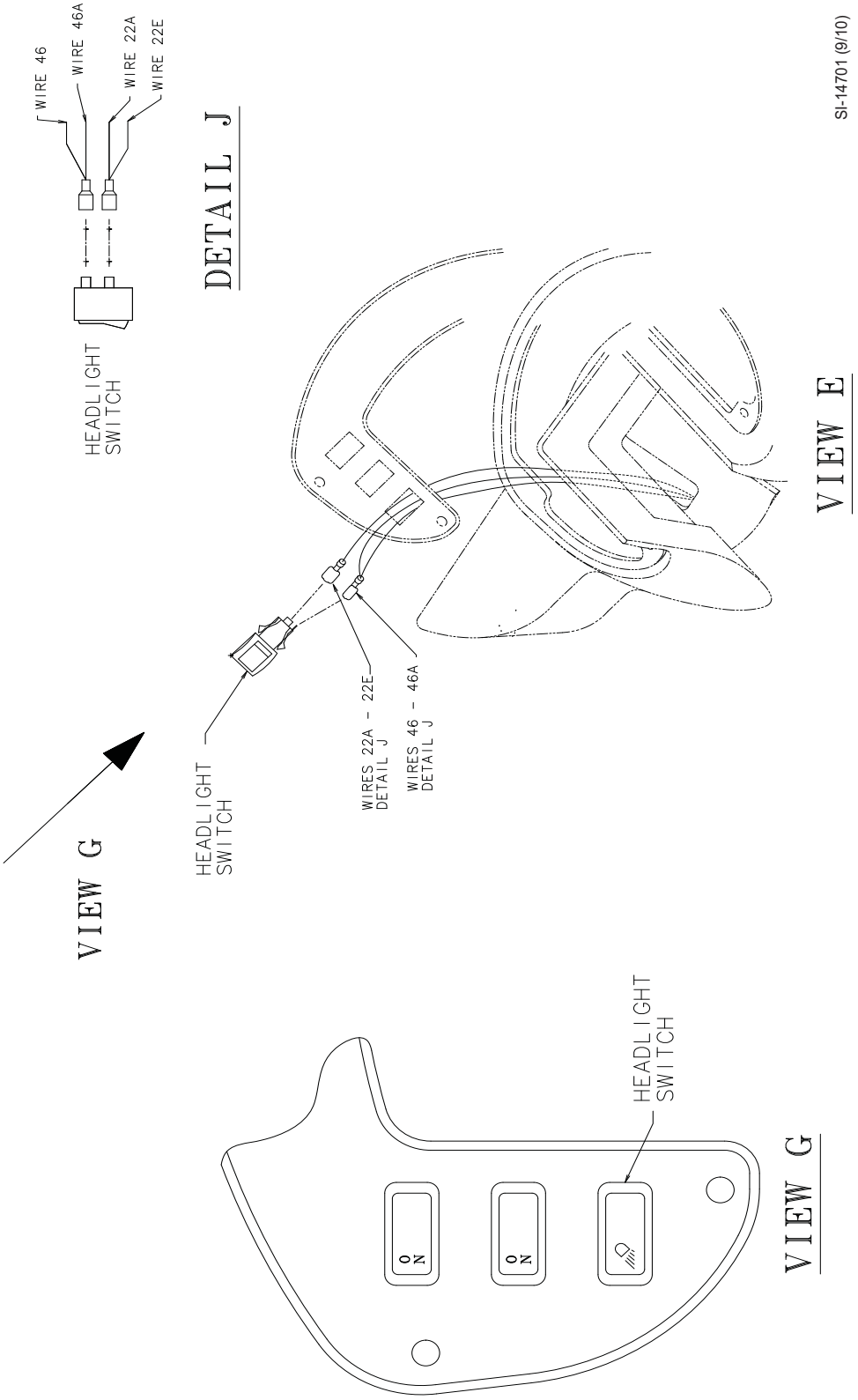
Main Harness(TMX) - 4/8



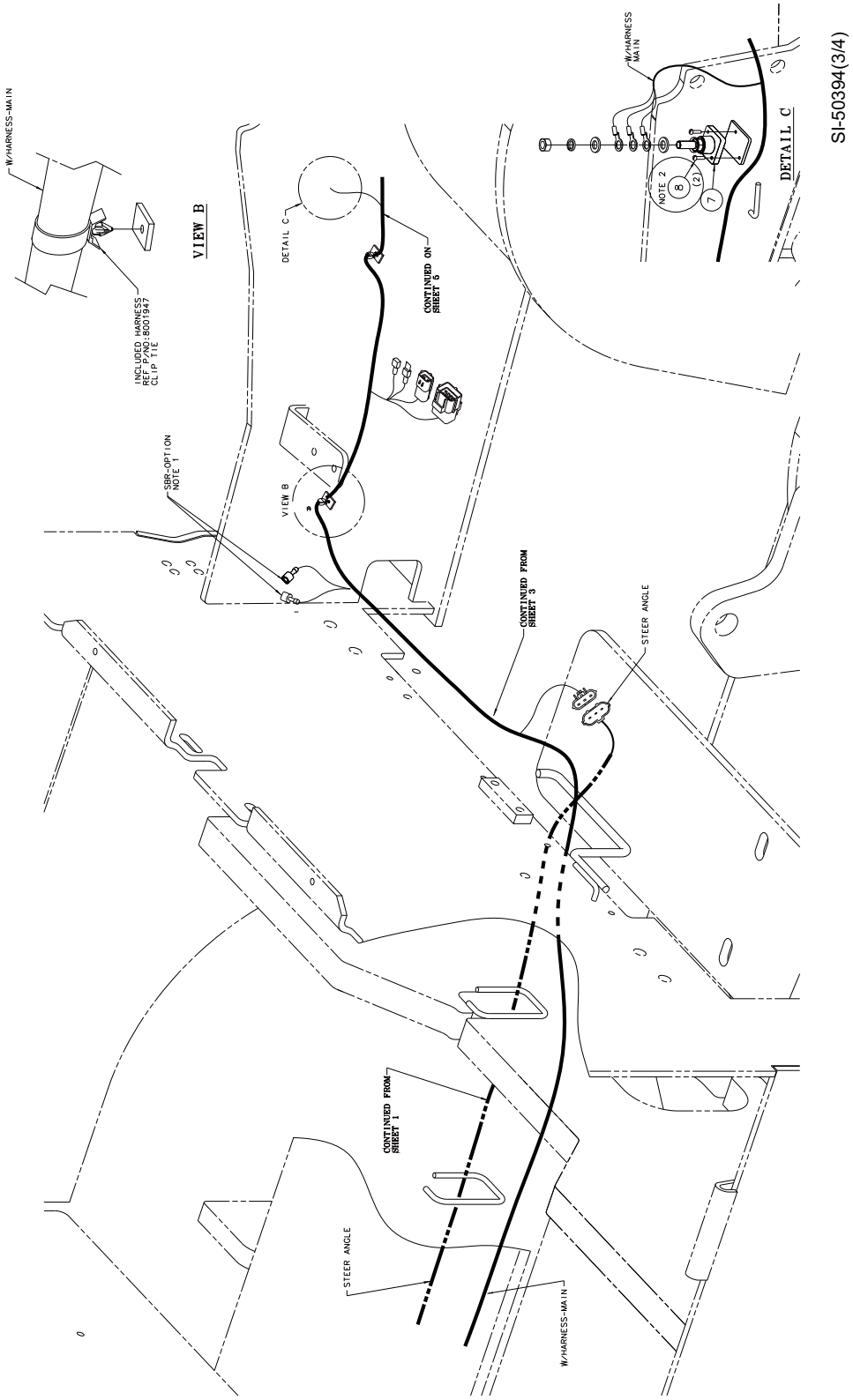
Rear Accessory Harness(TMX) - 1/2



Main Accessory Harness(TMX) - 9/10



Main Harness(EPX) - 3/4

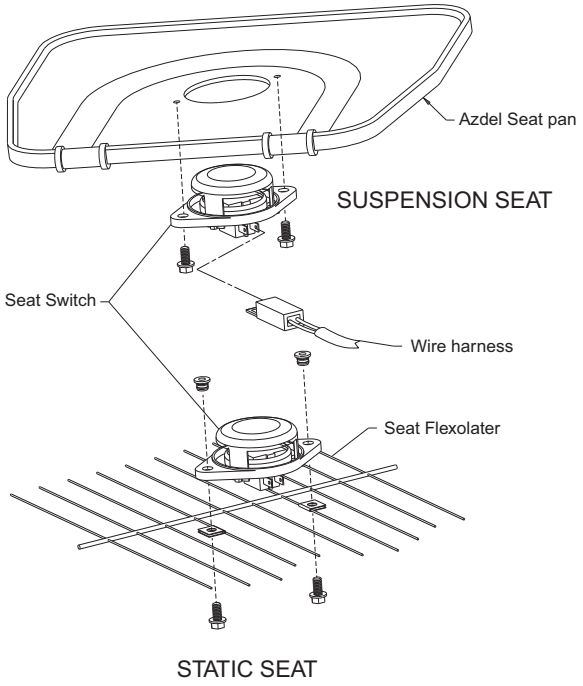


Seat Switch

The TMX trucks are equipped with a seat switch that signals the control to cut the power to the drive motors when it is opened.

When the seat switch is open, a -01 fault code will be displayed on the dash display.

There is a 1.5 second time delay built into the control to allow for momentary opening of the seat switch. If the truck is operated over rough surfaces and the operator is bounced, causing a momentary opening of the seat switch, the truck will not shut down.



Direction Control Switches

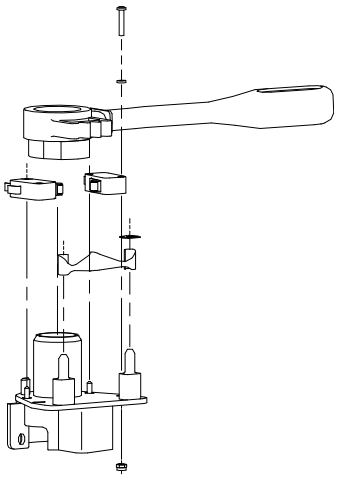
Description

These switches are normally open. When the directional control lever is placed in the FWD or REV detent, the proper switch is actuated (closed), its contacts close, and a signal current passes to the drive motor controller, which controls the rotational direction of the drive motor.

The FWD and REV switches are located at the base of the directional control lever. They are actuated by a cam on the directional control lever.

Adjustment

1. Turn key switch OFF.
2. Loosen FWD and REV switch mounting screws.
3. Adjust position of FWD switch so it actuates when directional control lever is in forward detent. Adjust REV switch so it actuates when directional control lever is in reverse detent.
4. Tighten mounting screws.
5. Check operation of switches before truck is returned to service.



GROUP 16

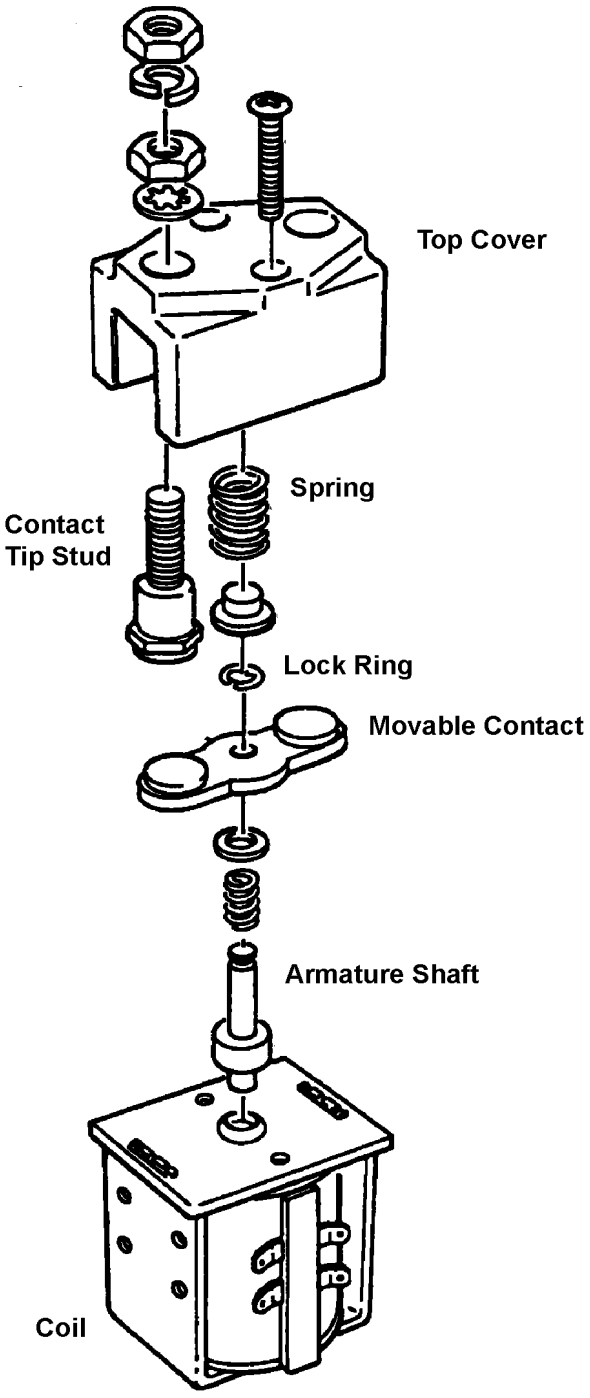
ELECTRICAL MOTORS

CONTACTOR INSPECTION AND TIP REPLACEMENT

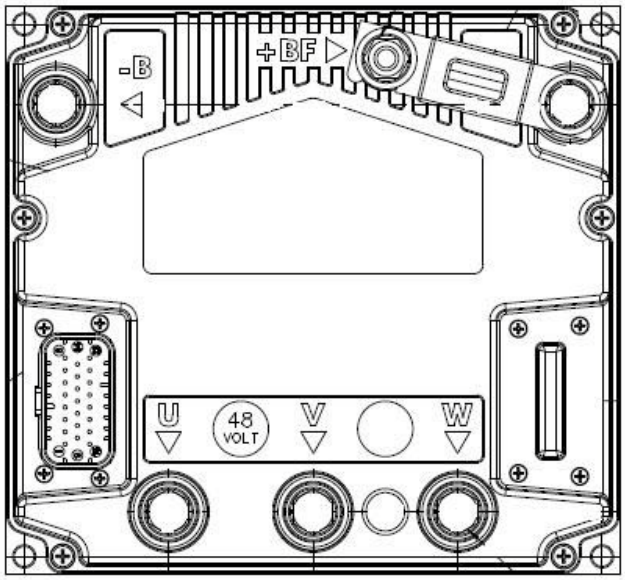
1. Check armature and movable contacts for freedom of movement by depressing movable arm with a screwdriver or small rod. Check for any restrictions to movement and for return of parts by action of spring.
2. Inspect contact tips. Look for any worn or eroded surfaces. Look for evidence of tip welding.
   Inspect for evidence of any contaminants on tips (paint, dirt, paper or cloth material, etc.) which would impair operation.
   Do not use sandpaper or file tips. Any damage must be corrected by tip replacement.
   Tips must be replaced before they wear through and damage copper base.
   To remove and replace contact tips, use following
3. To replace tips on the contactors, loosen and remove two cover mounting screws attaching it to coil frame. (Observe position of positive (+) marking on cover). Be careful not to lose return spring fitted under cover. Remove locknut and lockwasher from contact studs and remove contact studs from top cover. Inspect the top cover to make sure it has not been overheated and that the contact studs have not melted into the plastic. Replace the studs with new.
   Lift movable contact assembly off base. Remove lock ring from armature shaft and remove moving contact tips. Be careful not to disassemble or lose other parts under contact tips on armature assembly.
   Replace movable contacts with new and assemble onto armature shaft. Make sure lock ring is fully seated.
   Assemble contactor by putting moving contact assembly armature shaft into coil plunger with return spring on top of armature shaft. Put top cover over spring and install cover mounting screws. Be sure return spring is in recess in top cover.

NOTE

When assembling top cover to base, make sure it is installed with positive sign (+) markings located correctly. Use a bar or rod to move contacts. Be sure movement is free of binding and that tips are in correct orientation and tips contact correct mating parts.



Description of Connections - Hydraulic ACE2



A1	KEY	Connected to the power supply through a microswitch (CH) with a 10 A fuse in series.
A2	PPOT	Potentiometer positive: 12 V / 5 V output; keep load > 1 kohm / 0.5 kohm.
A3	CPOT	Lifting potentiometer wiper.
A4	LIFT ENABLE	Input for potentiometer lifting enable input; it is active HIGH.
A5	SPEED1	Input for first speed request; it is active HIGH. It can also be used as NPOT (potentiometer negative reference) with the PEDAL WIRE KO diagnosis implemented.
A6	SPEED2	Input for second speed request; it is active HIGH.
A7	ENCA	Incremental encoder phase A input.
A8	PENC	Incremental encoder positive supply 12 V / 5 V
A9	-BATT	Negative power supply. It is used as NPOT, without PEDAL WIRE KO diagnosis, for lifting potentiometer
A10	SEAT	SEATinput; it must be connected to the SEAT microswitch; it is active when connected to -BATT.
A11	SAFETY IN	If not connected to -Batt the AUX1 and AUX2 coil power output will be disabled. It can also be used as a general purpose digital input.
A12	CAN-T	If it is connected with A21 (CAN H) it introduces the 120 Ohm termination resistance between CAN-L and CAN-H.
A13	SPEED3	Input for third speed request; it is active when connected to -Batt.
A14	ENCB	Incremental encoder phase B input.
A15	ENC GND	Encoder negative power supply.
A16	NLC	Main contactor coil output. The coil is driven to negative reference.
A17	PLC/PAUX	Positive of the LC and Auxiliary coil.
A18	NAUX	Auxiliary coil output. The coil is driven to negative reference.

TESTER MENU

The most important input or output signals can be measured in real time using the TESTER function of the handset. The handset acts as a multimeter able to read voltage, current and temperature. The following is a list of measurements for different configurations.

Handset Tester: user can verify the state of the following parameters:

MASTER CONTROL

Truck Hour Meter(HRs)	Accelerator (V)	Brake switch (ON/OFF)
Motor voltage (%)	Steer Angle (°)	Exclusive hydro (ON/OFF)
Frequency (Hz)	Int wheel cutback (%)	Brake pedal poti (%)
Encoder (Hz)	Forw switch (ON/OFF)	Hand brake (ON/OFF)
Slip Value (Hz)	Back switch (ON/OFF)	Voltage booster (%)
Current RMS (A)	Enable switch (ON/OFF)	Battery voltage (V)
Temperature (°C)	Seat switch (ON/OFF)	Battery charge (%)
Temperature #1 (°C)	Cutback switch (ON/OFF)	
Temperature #2 (°C)	Cutback switch2 (ON/OFF)	

Master Control - "Dualac2"

1) TRUCK HOUR METER:	Shows truck hour meter
2) MOTOR VOLTAGE:	This is the voltage supplied to the motor by the controller; it is expressed as a percentage of full battery voltage.
3) FREQUENCY:	This is the frequency of the voltage and current supplied to the motor.
4) ENCODER:	This is the speed of the motor, expressed in the same unit of the frequency; this information comes from the speed sensor.
5) SLIP VALUE:	This is the difference of speed between the rotating field and the shaft of the motor, expressed in the same unit of the frequency.
6) CURRENT RMS:	Root Mean Square value of the motor current.
7) TEMPERATURE:	The temperature measured on the aluminum heat sink holding the MOSFET devices.
8) TEMPERATURE #1:	This is the temperature of the right motor; if this option is programmed "None" it shows 0°.
9) TEMPERATURE #2:	This is the temperature of the left motor; if this option is programmed "None" it shows 0°.
10) ACCELERATOR:	The voltage of the accelerator potentiometer's wiper (CPOT). The voltage level is shown on the left-hand side of the Handset display and the value in percentage is shown on the right-hand side.
11) STEER ANGLE:	This is the indication off the angular position of the steer wheel.
12) INTERNAL WHEEL CUTBACK:	This is an indication of the speed reduction applied to the inside wheel; in other words, it shows the ratio of the two speeds.
13) FORWARD SWITCH:	The level of the Forward direction digital input FW. ON /+BV = input active, switch closed. OFF / GND = input non-active, switch open.
14) BACKWARD SWITCH:	The level of the Reverse direction digital input BW. ON /+BV = input active, switch closed. OFF / GND = input non-active, switch open.

TESTER MENU

The most important input or output signals can be measured in real time using the TESTER function of the handset. The handset acts as a multimeter able to read voltage, current and temperature. The following is a list of measurements for different configurations.

Handset Tester: user can verify the state of the following parameters:

PUMP CONTROL

Motor voltage (%)	Accelerator (V)	Hydro speed req. (ON/OFF)
Frequency (Hz)	Lifting switch (ON/OFF)	Voltage booster (%)
Encoder (Hz)	1st speed switch (ON/OFF)	Battery voltage (V)
Slip Value (Hz)	2nd speed switch (ON/OFF)	Cos fi
Current RMS (A)	3rd speed switch (ON/OFF)	Battery Current (A)
Temperature (°C)	4th speed switch (ON/OFF)	Battery charge (%)
Motor Temperature (°C)		

1) MOTOR VOLTAGE:	This is the voltage supplied to the motor by the controller; it is expressed as a percentage of full battery voltage.
2) FREQUENCY:	This is the frequency of the voltage and current supplied to the motor.
3) ENCODER:	This is the speed of the motor, expressed in the same unit of the frequency; this information comes from the speed sensor.
4) SLIP VALUE:	This is the difference of speed between the rotating field and the shaft of the motor, expressed in the same unit of the frequency.
5) CURRENT RMS:	Root Mean Square value of the motor current.
6) TEMPERATURE:	The temperature measured on the aluminum heat sink holding the MOSFET devices.
7) MOTOR TEMPERATURE:	This is the temperature of the right motor; if this option is programmed "None" it shows 0°.
8) ACCELERATOR:	The voltage of the accelerator potentiometer's wiper (CPOT). The voltage level is shown on the left-hand side of the console display and the value is in percentage is shown on the right-hand side
9) LIFTING SWITCH:	Status of lifting switch. ON /+BV = input active, switch closed. OFF / GND = input non-active, switch open.
10) 1st SPEED SWITCH:	ON /+BV = input active, switch closed. OFF / GND = input non-active, switch open.
11) 2nd SPEED SWITCH:	ON /+BV = input active, switch closed. OFF / GND = input non-active, switch open.

Fault Code	Fault Name	Fault Description	Control	Troubleshooting	Action Required
65	"MOTOR TC START"	Warning: Right or left or both motors temperature high (over Adj #4)	MASTER or SLAVE	• Right or left or both drive motors analog temperature sensor is greater than the temperature set in ADJUSTMENT #4 (130°C) in the ADJUSTMET submenu. • When this fault occurs. Maximum current is reduced to half and maximum speed is reduced to 60Hz. • If it happens when the motor is cold, check the wring. If all is ok,	Check temperature shown on handset in tester mode Replace controller
66	"BATTERY LOW"	Warning: Battery charge level below 20%	MASTER	• When battery level reaches 20% or less or (10% on the dash display), the current level for the drive motors is reduced to 50% of the programmed level and the lift function is locked out.	
71	"MOTOR SHUT-DOWN"	Warning: Right or left or both motors temp. are very high (over MOTOR SHUT-DOWN param.)	MASTER	This fault occurs when the right or left or both motor temperature switches are open (digital sensor), or if the analog sensor temperature overtakes the cut off level. The cut off level is adjusted with the MOTOR SHUTDOWN parameter (145°C) in the ADJUSTMENT submenu. If this fault occurs, maximum current is reduced to zero and the motor is stopped. If the shutdown occurs when the motor is cold check the wiring. If wiring is ok	Replace controller
72	"MOTOR LOCKED"	Drive motor locked up	MASTER	• After 15 seconds the motor stalled with maximum current, controller reduces maximum current to 50%. • Check if Line Contactor is pulled in.	
74	"DRIVER SHORTED"	Line contactor coil driver is shorted	MASTER	• When the key is turned ON, the microprocessor checks that the line contactor coil driver is not shorted • If it is, this fault is signaled. • Check if there is an external short or low impedance pull-down between NLC (C26) and -Batt. • If no external causes can be found.	Replace controller
75	"CONTACTOR DRIVER"	Line contactor coil driver is open (not able to drive the coil to the correct voltage)	MASTER	• When the initial diagnosis is finished, the traction logic closes the line contactor and checks the voltage drain of the driver. • If this is not low, the driver is unable to close and the fault is signaled.	Replace controller

Fault Code	Fault Name	Fault Description	Control	Troubleshooting	Action Required
173	"VMN HIGH"	Wrong voltage on motor power outputs; failure in the power section or in the mosfet driver circuit or in the motor	PUMP	• This test is carried out during initial diagnosis and in standby. Possible causes: • Problem with motor connections or the motor power circuit; check if the 3 phases are correctly connected; check if there's chassis ground of the motor to truck frame. • unhook battery at controller and do a diode check between Batt + and Batt - (should read .3 to .5 volts) • Fault in the inverter power section. • Possible bad battery, Excessive voltage to case of battery.	Replace controller
174	"TH MOTOR SENSOR KO"	Warning:Motor Pump temperature sensor is out of range	PUMP	• The range of the motor temperature analog sensor is always checked and a fault is signaled if it's out of range • When this fault occurs. The maximum current is reduced to half and maximum speed is reduced to 60 Hz.	
182	"MOTOR LOCKED"	Pump motor locked up	PUMP	• After 15 seconds of the motor being stalled with maximum current, controller reduces maximum current to 50%. • Check to see that the pump contactor is pulled in • Possible bad encoder(Sensor, Bearing)	
183	"ACQ JOY2"	Acquired JOY2 function value is not valid	PUMP	• Check the output of the JOY2. • Teach the JOY2 Value	
184	"SHT RANG"	Potentiometer value of Shift is out of range	PUMP	• check the potentiometer output value • teach the shift value	
185	"AUX RANG"	Potentiometer value of Aux is out of range	PUMP	• check the potentiometer output value • teach the Aux value	
186	"MHY ALM"	there's an alarm in Mhyrio CB	PUMP	• Check an Alarm of MHYRIO CB	
187	"TLT RANG"	Potentiometer value of Tilt is out of range	PUMP	• check the potentiometer output value • teach the Tilt value	
188	"LFT RANG"	Potentiometer value of Lift is out of range	PUMP	• check the potentiometer output value • teach the Lift valu	
189	"ACQ JOY"	Acquired JOYSTICK function value is not valid	PUMP	• Check the output of the JOYSTICK • Teach the JOYSTICK Value	
190	"MHY ALM"	there's an alarm in Mhyrio CB	PUMP	• Check an Alarm of MHYRIO CB	

ADJUST BATTERY	-	TEACHED VALUE
THROTTLE 0 ZONE	5%	
THROTTLE X POINT	63%	
THROTTLE Y POINT	57%	
MAIN CONT. VOLT	100%	
MAIN CONT. V RID	60%	
ADJUSTMENT #4	130°C	
MOTOR SHUTDOWN	145°C	
IMAX PROTECTION	100%	

ELH CONTROL (MHYRIO-CB)		
PARAMETER CHANGE		
MIN EVP	25.10%	
MAX EVP	85.10%	
MIN EVP 1	25.10%	LOWER-C1
MAX EVP 1	85.10%	
MIN EVP 2	25.10%	LIFT-C3
MAX EVP 2	85.10%	
MIN EVP 3	25.10%	AUX BACK-C4
MAX EVP 3	85.10%	
MIN EVP 4	25.10%	AUX FORWARD-C6
MAX EVP 4	85.10%	
MIN EVP 5	25.10%	TILT BACK-C7
MAX EVP 5	85.10%	
MIN EVP 6	25.10%	TILT FORWARD-C15
MAX EVP 6	85.10%	
MIN EVP 7	25.10%	SIDE SHIFT RIGHT-C12
MAX EVP 7	85.10%	
MIN EVP 8	25.10%	SIDE SHIFT LEFT-C14
MAX EVP 8	85.10%	
EVP OPEN DELAY	0.2	
EVP CLOSE DELAY	0.4	
EVP1 OPEN DELAY	0.2	LOWERING
EVP1 CLOSE DELAY	0.1	
EVP2 OPEN DELAY	0.2	LIFT
EVP2 CLOSE DELAY	0.1	
EVP3 OPEN DELAY	0.2	AUX1 IN
EVP3 CLOSE DELAY	0.4	
EVP4 OPEN DELAY	0.2	AUX2 OUT
EVP4 CLOSE DELAY	0.4	
EVP5 OPEN DELAY	0.8	TILT IN
EVP5 CLOSE DELAY	0.4	
EVP6 OPEN DELAY	0.8	TILT OUT
EVP6 CLOSE DELAY	0.4	
EVP7 OPEN DELAY	0.2	AUX2 IN
EVP7 CLOSE DELAY	0.4	
EVP8 OPEN DELAY	0.2	AUX2 OUT
EVP8 CLOSE DELAY	0.4	

SET OPTION		
DESCRIPTION	TMX 48V	TMX 36V
SET BATTERY TYPE	48V	36V
V VALVES COIL	24V	24V
VALVES SUPPLY	48V	36V
EVP TYPE	ANALOG	
EVP1 TYPE	ANALOG	
EVP2 TYPE	ANALOG	
EVP3 TYPE	ANALOG	
EVP4 TYPE	ANALOG	
EVP5 TYPE	ANALOG	
EVP6 TYPE	ANALOG	
EVP7 TYPE	ANALOG	
EVP8 TYPE	ANALOG	
SET MODEL		
CONNECTED	9	

NOTE

All motors must be stopped before saving parameters. parameter may not be stored to EEPROM if motor is running.

Removal

After battery and upright have been removed:

1. Drain the oil from drive units when truck is in a level position as described Section 2 of Group 20.
2. Attach a hoist with chains of correct capacity and remove the drive wheels as described in Group 22. Leave chains and hoist attached.

CAUTION

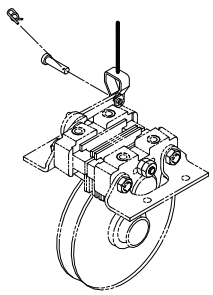
Watch truck for signs of lateral instability. It may tip sideways. You may have to support or guide the sides of the truck or overhead guard to prevent tipping.

3. Support truck with blocks under the frame as shown in Group SA. Place blocks of wood under drive motors to support them, if motors were not previously removed.
4. Disconnect power cables from drive motors. Attach tags to the motor cables for easy and correct identification at assembly. Replace the nuts on motor terminals to avoid losing them.

NOTE

Alternative Procedure: It is optional to remove drive motors before removing drive axle from truck. Refer to GROUP 16.

5. Release the parking brake hand lever to provide free-play in the brake cable for removal of the parking brake cable yoke. If necessary, adjust the cable to release tension as described in Group 23,

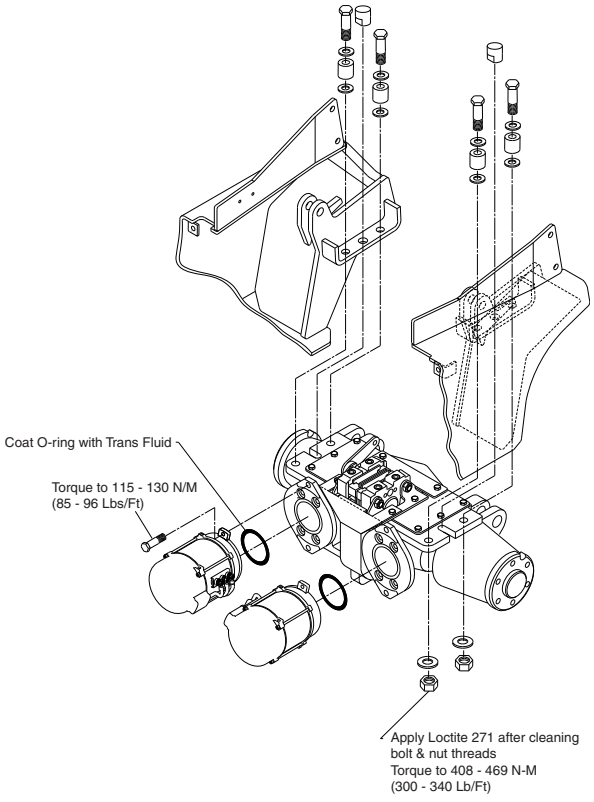


6. Remove the yoke of parking brake cable from the levers on brake caliper assembly. (Group 23.)
7. Disconnect hydraulic brake line from master cylinder. Put caps on fittings to keep clean. (Group 23.)
8. Inspect your truck for any other wiring leads or optional equipment that may have to be disconnected before axle is removed.
9. Loosen and remove axle mounting bolts (nuts underneath) from axle on both sides of frame.
10. Raise truck frame slightly off of drive axle and move the truck backwards away from axle assembly.

CAUTION

Truck may tip sideways. You may have to support or guide the side of the truck or overhead guard to prevent tipping.

11. Lower front of truck frame to the floor. Truck frame may also be blocked up under axle mounting surfaces. Block the steer wheel and be sure blocking is put safely under the frame.
12. Attach hoist and move drive axle assembly to the overhaul disassembly area. Installation Reverse the above procedure to replace the drive axle.
    - Be sure to follow safe lifting and jacking procedures given Group SA, “Safe Maintenance.”
    - Apply Loctite 271 to axle mounting bolts threads and properly torque axle mounting bolts.
    - Retighten hydraulic fittings per procedure in Group 40.



Drive Unit Reassembly

- Apply very light coating of Permatex No. 2 to OD of all oil seals and hole plugs before assembly.
- Apply light coating of Crane Sealer to all pipe plugs.
- Use Crane Sealer on all capscrews and studs with thru holes (housing end only).
- After assembly of parts using Permatex or Crane Sealer, clean all surfaces. There must not be any free or excess material that could enter the oil system.
- All lead-in chamfers for oil seals and O-rings must be smooth and free from burrs. Inspect at assembly.
- Lubricate all O-rings with oil before assembly.
- Apply a thin coating of grease between seal lips on lip-type seals prior to assembly.
- Brush specified transmission fluid on all tapered and straight roller bearing cups and cones.

Drive Axle Shaft Reassembly

Refer to Figure 5.

1. Press new axle shaft outboard bearing cup (D) (outer race) into housing bore tight. Install bearing cone(C).
2. Install new oil seal (B). Press seal into bore until outer surface is flush with end of housing.
3. Install new axle shaft inboard bearing cup (H). Press bearing cup into housing bore until tight and square against snap ring (G). NOTE - The use of a 73 mm OD piece of tubing or spacer ring as a driver is suggested.
4. Install the ring gear shaft inboard roller bearing (S on Fig. 2).
5. Then, put the axle shaft into the drive unit housing (F) end.

IMPORTANT

Be very careful not to damage seal lips when inserting shaft spline and bearing through the seal.

6. Assemble the drive axle shaft inboard bearing cone (I) on the end of axle shaft (A).

NOTE

Be sure to hold the axle shaft firmly in place in the outboard bearing. Support (back up) the outer end of axle shaft to prevent shaft from slipping out of outboard bearing while tapping the inboard bearing into place. Suggestion: Turn (rotate) housing up and support it temporarily on axle shaft outer end.

7. Install axle shaft inboard bearing (I) into correct position.
8. A special tool for pressing or driving the axle shaft inboard bearing cone into place may be fabricated as shown by Diagram A on the last page of this Section. Install axle shaft gear on spline of axle shaft (A).
9. Install shims (K) against end of shaft, then gear retainer plate (L), lock plate (M), and the three retainer bolts (N). Do not bend tabs of lock plate until bearing preload has been checked.
10. Torque gear retainer bolts (N) to:
    44-49 N·m (32-36 lbf·ft)
11. Rotate the axle shaft to check for correct axle shaft bearing preload setting. Add or remove shims (K) at end of shaft under the axle shaft gear retainer plate to obtain a bearing preload value of 0.68-1.13 N·m (6-10 lbf·in). This is the torque required to rotate the shaft.
    For rotating the axle shaft when checking axle shaft bearing preload, it is recommended that a special adapter tool be constructed. This construction is shown in Diagram B on the last page of this Section. This tool is designed to fit into the wheel mounting flange bolt holes of the axle shaft. Attach a torque wrench in the 3/8-inch square drive hole at the center. Turn shaft slowly to measure torque required to rotate the shaft.
12. When the correct axle shaft bearing preload has been set, be sure the bolts are tightened to the correct torque.
    Then, bend the tabs of the lock plate against the bolt heads.

Section 1

Wheels and Tires
Specifications and Description

Specifications

Cushion

Material: Rubber except as noted.

Size:

	Drive	Steer
TMX 12/13/15s/15	18x7x12. 12	18x7x12 .12
TMX 17/18/20	18x8x12 .12	18x7x12 .12
TMX 20x/23/25	18x9x12 .12	18x6x12.12 (Urethane)

Mounting Nut Torques: Refter to mounting procedure in Section 2.

Pneumatic

Material: Rubber

Size:

	Drive	Steer
TMX 12/13/15s/15	18x7x8-16PR	18x7x8-16PR
TMX 17/18/20/20x/23	18x9x8-16PR	-
TMX 25	-	-
EPX16/18/ 20s	21x8x9-14PR	5.00x8-10PR

Tire Inflation Pressure:

	Drive	Steer
TMX 12-25	1000 kPa (145 psi)	1000 kPa (145 psi)
EPX16/18/ 20s	1000 kPa (145 psi)	883 kPa (128 psi)

Mounting Nut Torques: Refter to mounting procedure in Section 3.

Service Intervals

Wheel Mounting Bolts Check and Tightening: Every 50-250 hours of operation and each PM.

Tire Condition: Daily inspection.

Tire Pressure Check: Daily inspection.

Description

Cushion tires are mounted on one-piece rims. A general description of cushion tire removal and replacement appears in the section for cushion tires. However only trained and experienced personnel with the proper equipment should attempt to change out cushion tires on the rims. Pneumatic tires are mounted on multi-piece rims with locking rings.

WARNING

For your safety and the safety of others, before you do tire or rim maintenance or service, read the OSHA rules regarding owner responsibility. Do not work on tires or rims unless you have been trained in the correct procedures. Read and understand all maintenance and repair procedures on tires and rims. Serious injury or death can result if safety messages are ignored.

The Occupational Safety and Health Act (OSHA) specifies required procedures for servicing multi-piece rim wheels in 29 CFR Section 1910.177. It is the owner's responsibility to comply with OSHA.

In accordance with OSHA, the owner must provide a training program to train and instruct all employees who service multi-piece rim wheels in the hazards involved and the safety procedures to be followed. Do not let anyone mount, demount, or service multi-piece rim wheels without correct training.

The owner should obtain and maintain in the service area current copies of the United States Department of Transportation, National Highway Traffic Safety Administration publications entitled "Safety Precautions for Mounting and Demounting Tube-Type Truck/Bus Tires,"and Multi-Piece Rim/Wheel Matching Chart" or other similar publications applicable to the types of multi-piece rim wheels being serviced.

GROUP 23

BRAKES

Section 5

Parking Brake Removal, Replacement, and Adjustment

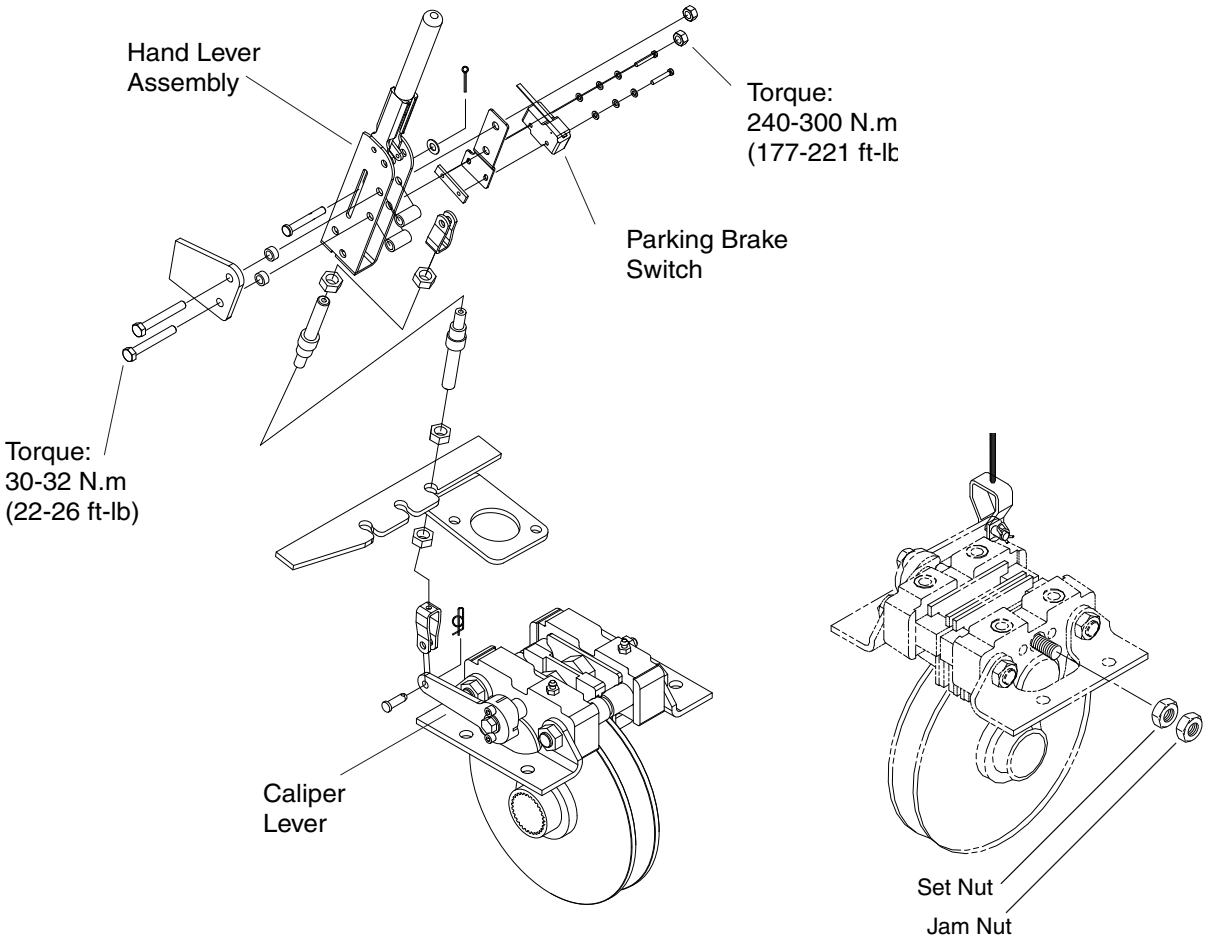
Removal and Replacement(TMX)

Remove and replace parking brake components as shown in the illustration.

Adjustment(TMX)

Parking brake must be adjusted after removal and replacement and at every PM.

1. Install parking brake assembly and adjust cable so that caliper lever is horizontal.
2. Set brake handle to Off (down) position.
3. Tighten adjustment set nut until all clearance between pads and disks is removed.
4. Loosen set nut 1/2 turn. This allows approximately 1 mm (0.03 in) gap between brake and pad.
5. Tighten jam nut.
6. Adjust parking brake by tightening or loosening the operator's adjustor in the brake handle so that the truck holds on 15% grade.
7. See Group 13 for parking brake switch check and adjustment.



Steer Angle Sensor Removal and Replacement

Removal of entire assembly. Replacement is reverse order:

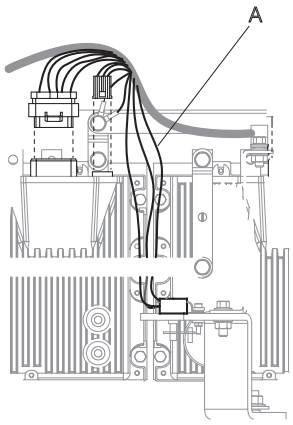
A. Potentiometer wires.
B. Fastener and washer
C. Bracket/Assembly

NOTE

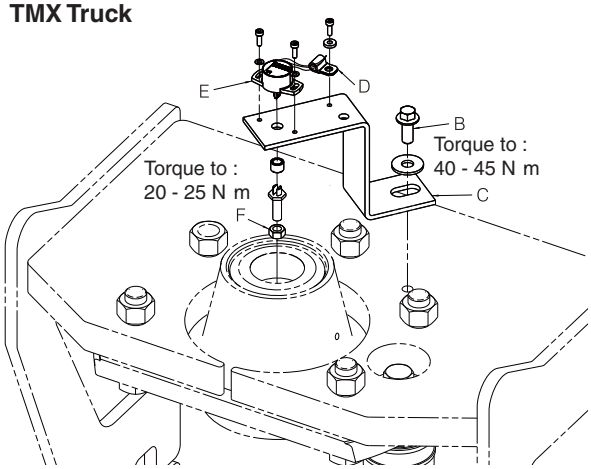
Potentiometer shaft holder (G) and fastener may remain on steer axle. NOTE Potentiometer (E) wire leads should point toward front of truck,.

Removal and replacement (reverse order) of potentiometer only. Replacement is reverse order:

A. Potentiometer wires.
D. Cable clamp
F. Locknut
E. Potentiometer

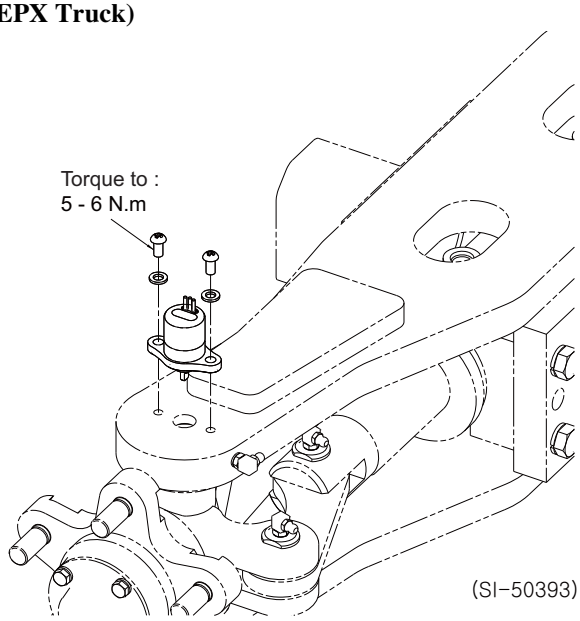


TMX Truck



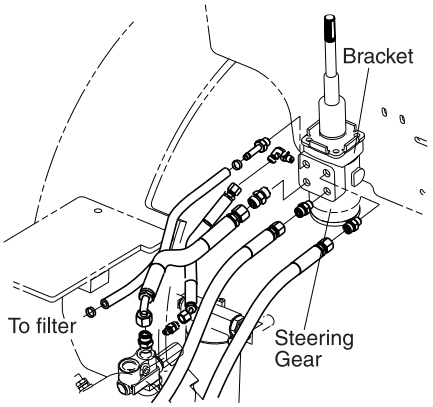
(SI–46400)

(EPX Truck)



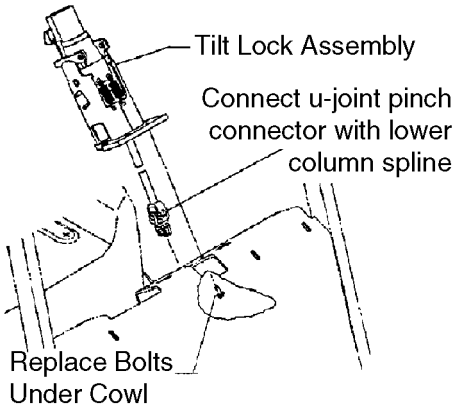
(SI–50393)

3. Coat the splines of the lower assembly with alight coat of anti-seize lubricant and insert into the universal joint pinch connector of the upper assembly. Match the skip tooth on the spline with spline on universal joint. Torque the pinch bolt to 25-30 N·m (18.5-22.25 ft-lb).
4. Reconnect the clean hydraulic fluid lines to the clean steering gear. Make sure the hoses are reconnected to the correct ports. Torque the fittings per Group 40, “Hydraulic Fitting Tightening Procedure.



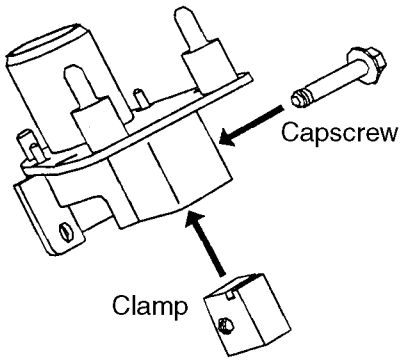
Column Tilt Lock Assembly Replacement EPX)

1. Set the tilt lock assembly onto the cowl. Replace the four bolts and torque to 20-25 N·m (14.8-18.5 ft-lb).

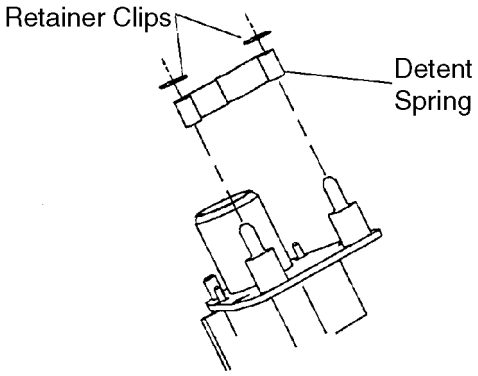


Directional Control Assembly Reassembly

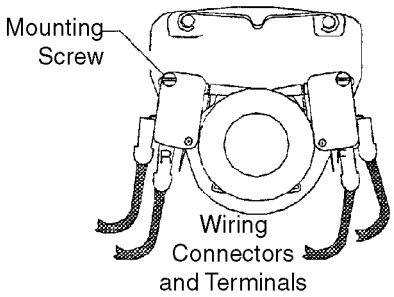
1. Slip the lever boot onto the lever if it has been removed.



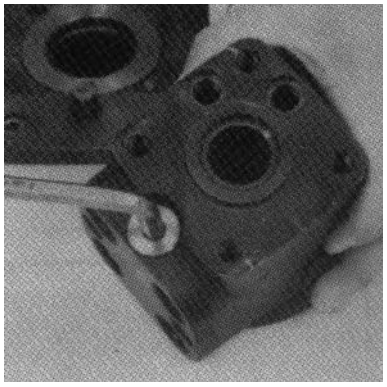
2. Make sure the flange capscrew and clamp are on the directional control base.
3. Install the detent spring on the posts of the base and secure with the retainer clips.



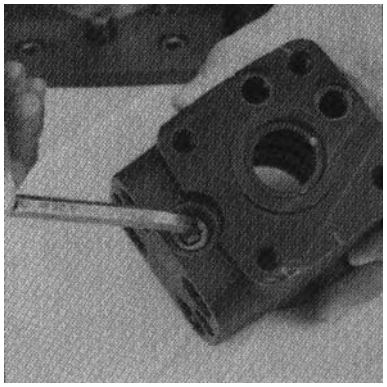
4. Reset the forward or reverse switch onto the base and secure with screws.



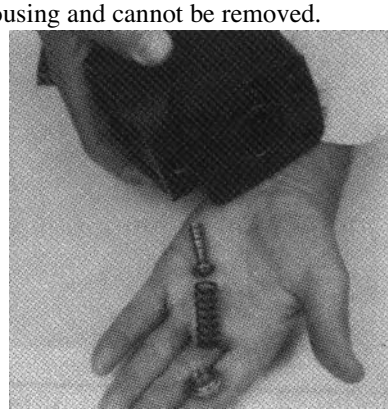
Screw out the plug using and 6 mm hexagon L wrench. Remove seal washers.



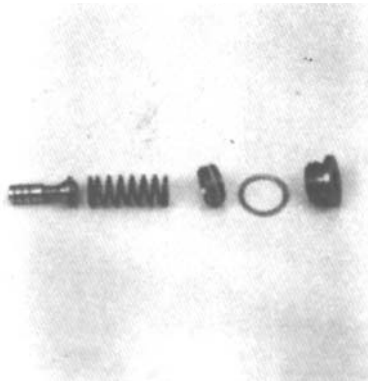
Unscrew the relief set screw using and 6 mm hexagon L wrench.



Shake out the spring and piston. The valve seat is boned into the housing and cannot be removed.



The pressure relief valve is now disassembled.



Assembly

Before assembly clean all parts very carefully, replace all seals and O-rings, and lubricate all parts with hydraulic oil.

Assemble Spool And Sleeve

When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool/sleeve opposite to the end with spring slots. Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.

Place the two flat neutral position springs in the slot.

Place the curved springs between the flat ones and press them into place.

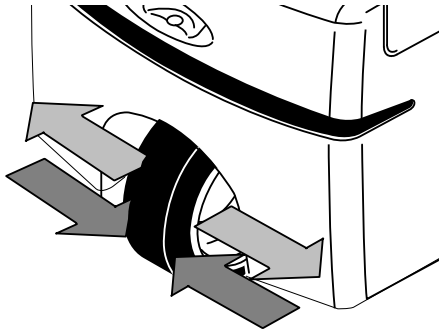
Steer Wheel Bearing Maintenance

1. Be sure that truck is parked and blocked up correctly to raise the steer wheel off the floor.

   NOTE

   It is optional to raise and block up entire truck.

2. To check the steer wheel bearings for excessive free play or looseness, hold the wheel with both hands and try to rock it from side to side. Also, try to pull it in and out along the wheel spindle. There should be a small amount of free movement. (The maximum allowable bearing end play is 0.08 mm [0.003 in]). If the wheel has excessive end play, the bearings require additional service and/or adjustment.



Steer Wheel Bearing Adjustment

The steer wheel bearings are retained and adjusted by a self-locking bearing nut. With truck properly blocked:

1. Remove hubcap by tapping lightly on the outer edge of hubcap.
2. Loosen spindle (bearing adjusting) nut and bearings: After spindle nut is loosened, hit the top of wheel to loosen the bearings.

   IMPORTANT

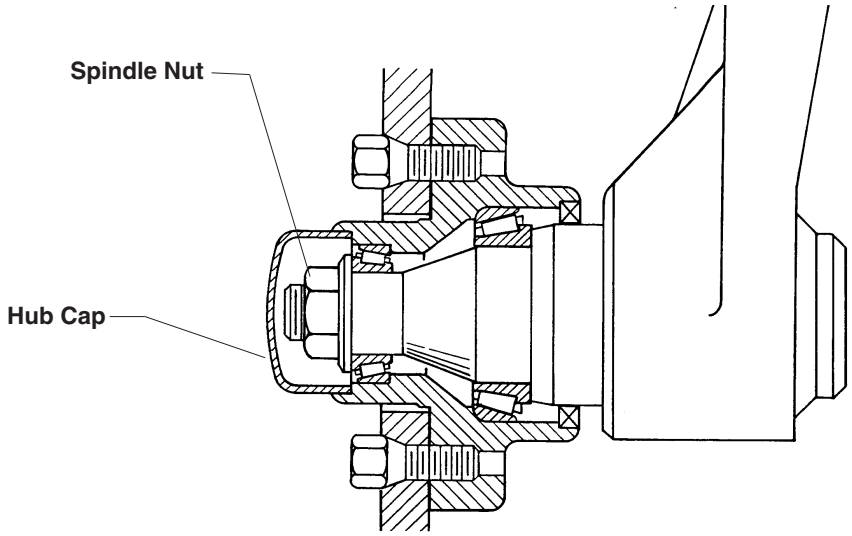
   SPINDLE NUT SHOULD BE REPLACED WITH A NEW ONE each time it is removed because holding torque capability is partially destroyed with each removal.

3. Tighten spindle nut to the correct tightening torque while rotating the wheel by hand: 230-244 N.m (170-180 ft-lb).

   NOTE

   Set the steer wheel bearing adjustment by torquing the self-locking spindle nut to the specified value. Overtightening causes drag and results in lower travel speed and higher power use. Some additional adjustment may be required however. See next step.

4. Check for correct bearing adjustment by rotating the wheel by hand. Wheel should rotate freely or with only slight “drag.” Readjust bearings as necessary.
5. Install the hub cap by tapping it into place with a rubber or plastic-faced hammer.



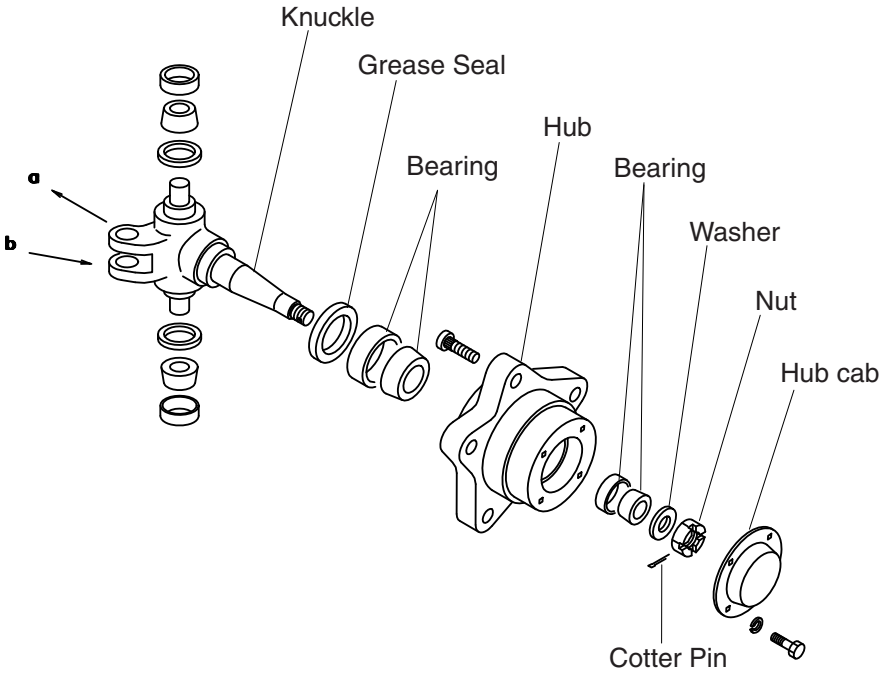
Bearing Disassembly

1. Be sure truck is parked and blocked up correctly and safely to raise steer wheels off the floor. Refer to "Lifting, Jacking, and Blocking," in the Group "SA."

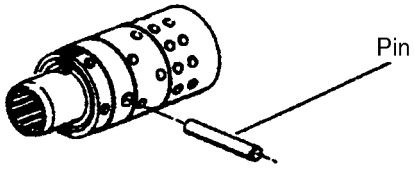
NOTE

Because of the heavy weight of the wheel and tire, it is suggested to first remove the wheel and tire assembly from spindle when servicing the bearings to avoid damage to the grease seal when the wheel hub is moved off or on the spindle. It also makes the work simpler and easier.

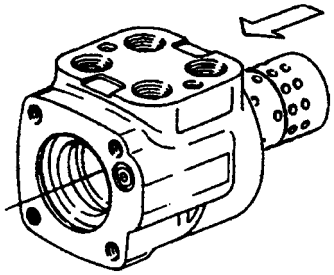
2. Refer to the exploded view illustration of the wheel bearing assembly. Loosen and remove the hubcap from hub.
3. Clean the excess grease from around the wheel nut.
4. Remove cotter pin, loosen and remove wheel nut.
5. Remove outer bearing by pulling out on the hub slightly to loosen bearings.



8. Compress extended end of centering spring set and push into spool sleeve assembly withdrawing installation tool at the same time.
9. Center the spring set in the parts so that they push down evenly and flush with the upper surface of the spool and sleeve.
10. Install pin through spool and sleeve assembly until pin becomes flush at both sides of sleeve.



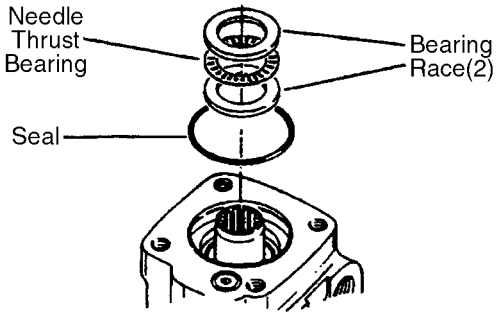
11. Position the spool and sleeve assembly so that the splined end of the spool enters the 14-hole end of housing first.



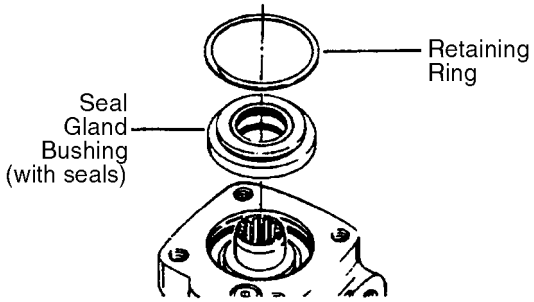
IMPORTANT

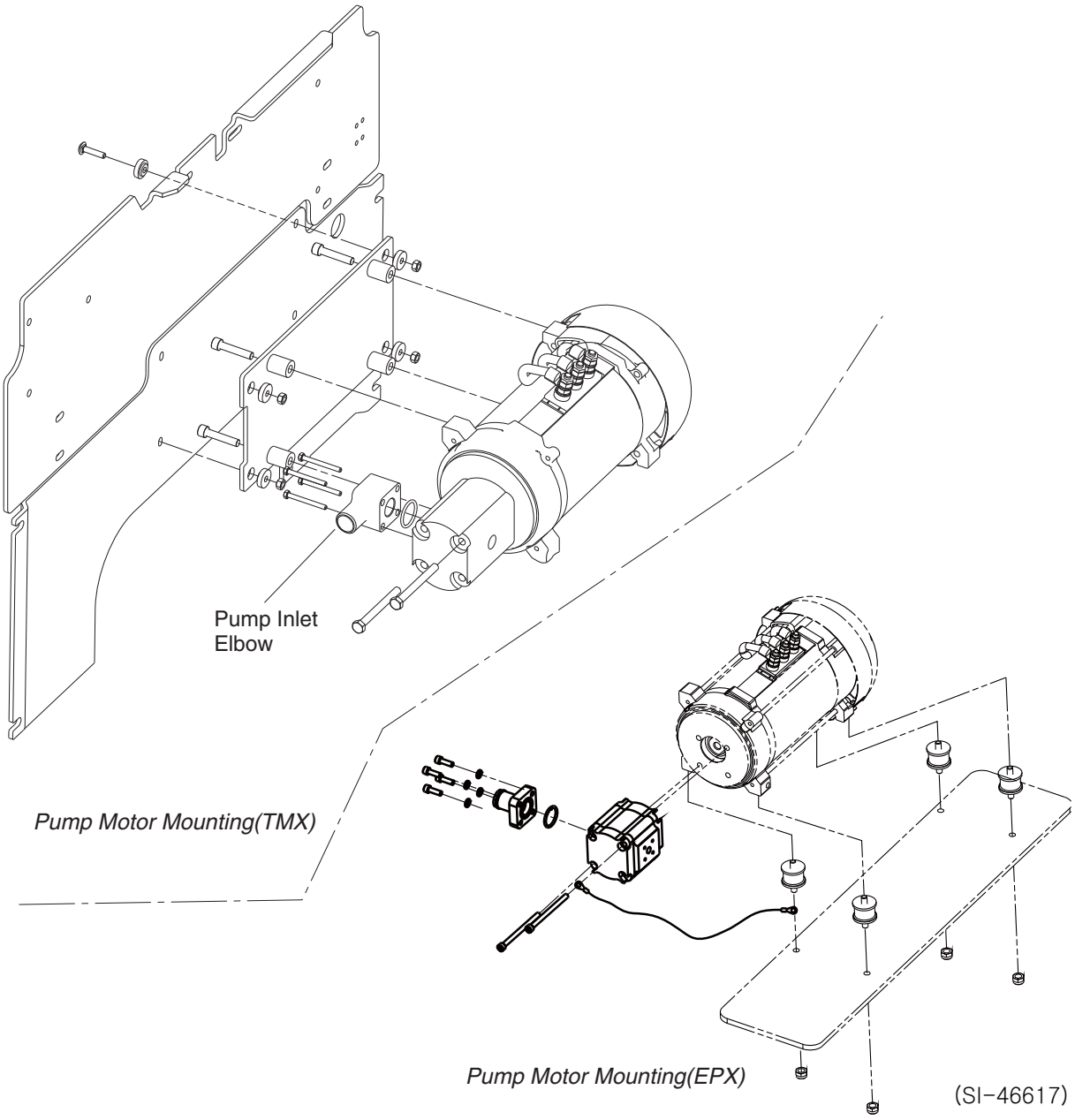
Be extremely careful that the parts do not tilt out of position while being installed. Push parts gently into place with slight rotating action; keep pin nearly horizontal. Push the spool assembly entirely within the housing bore until the parts are flush at the meter end or 14-hole end of housing. Do not push the spool assembly beyond this point to prevent the cross pin from dropping into the discharge groove of the housing. With the spool assembly in this flush position, check for free rotation within the housing by turning with light finger tip force at the splined end.

12. Place housing on clean, lint free cloth. Install 2-1/8-inch diameter seal in housing.
13. Install two bearing races and the needle thrust bearing in the order shown.



14. Install 1-1/4-inch diameter dust seal in seal gland bushing; flat or smooth side of dust seal must face down towards bushing.
15. Install dry quad ring seal in seal gland bushing. Smooth seal in place with your finger. Do not use any seal that falls freely into pocket of bushing. Seal should not “fall” into place but should require light force to seat.





- Shaft seal housing bore scratched; replace front cover assembly.
- Improper fit of shaft; replace front cover assembly.
- Contamination; inspect and service pump.
- Pump operated in wrong rotation; replace shaft and pressure loading seals.
- Seal installed backwards; inspect and service seal.

No lift, tilt, or auxiliary function

- Hydraulic fluid very low; check and fill to correct level.
- Hose or fittings broken; replace component.
- Defective main lift valve; check other Troubleshooting items for possible cause, then consider rebuilding or replacing main lift valve.
- Hydraulic pump defective; check other Troubleshooting items for possible cause, then consider rebuilding or replacing pump.

No motion, slow or jerky action of hydraulic system

- Spool not moved to full stroke; check travel and linkage adjustment.
- Relief valve not properly set, stuck in place, and/or worn; check and clean valve, replace if necessary.
- Dirt or foreign particles lodged between relief valve control poppet and seat; check valve and clean.
- Valve body cracked inside; check and replace entire valve.

Foaming hydraulic fluid

- Low oil level; check and fill to correct level.
- Wrong fluid; drain and refill with correct oil.
- Oil too heavy; change to correct viscosity.
- Pump inlet line restriction or line kinked; clean line or repair kinked hose.
- Hydraulic pump cavitating (pumping air with fluid); check hydraulic plumbing for airtight hoses and connections on inlet side of pump.

Overheated hydraulic fluid

- Thin fluid; drain and fill with correct fluid.
- Fluid contaminated; drain sump, replace filter, and refill.
- Cavitating pump; check hydraulic plumbing for airtight hoses and connections.
- Pump driveshaft misaligned; check mounting and alignment.
- Axial loading on drive shaft; check shaft end clearance and shaft alignment; check for worn key/spline.
- Relief valve in bypass; check relief setting.

Load cannot be lifted to maximum height

- Hydraulic fluid low; check and fill to correct level.
- Hydraulic pump defective; check other Troubleshooting items for possible cause, then consider rebuilding or replacing pump.

Oil leaks at top of lift (secondary) cylinder(s)

- Plugged vent line; check and clear line.
- Worn or damaged piston seal; rebuild cylinder.
- Scored cylinder wall; replace cylinder.

Oil leak at tilt or auxiliary function cylinder

- Worn or damaged seal; rebuild cylinder.
- Scored piston rod; repair or replace rod.

See Group 34, “Cylinder Removal, Overhaul, and Replacement.”

Load will not hold

- Oil bypassing between lift spool and valve body; overhaul valve and spool.
- Spool not centered; see spool remedies for correcting problems when spools do not return to neutral.
- Oil bypassing piston in cylinder; repair or replace cylinder.

Oil leaks at either end of main hydraulic valve spool

- Defective O-ring seals; rebuild valve.

Removal and Installation

WARNING

SAFE PARKING. Before working on truck:

1. **Park truck on a hard, level and solid surface, such as a concrete floor with no gaps or breaks.**
2. **Put upright in vertical position and fully lower the forks or attachment.**
3. **Put all controls in neutral. Turn key switch OFF and remove key.**
4. **Disconnect the battery.**
5. **Apply the park brake and block the wheels.**

NOTE

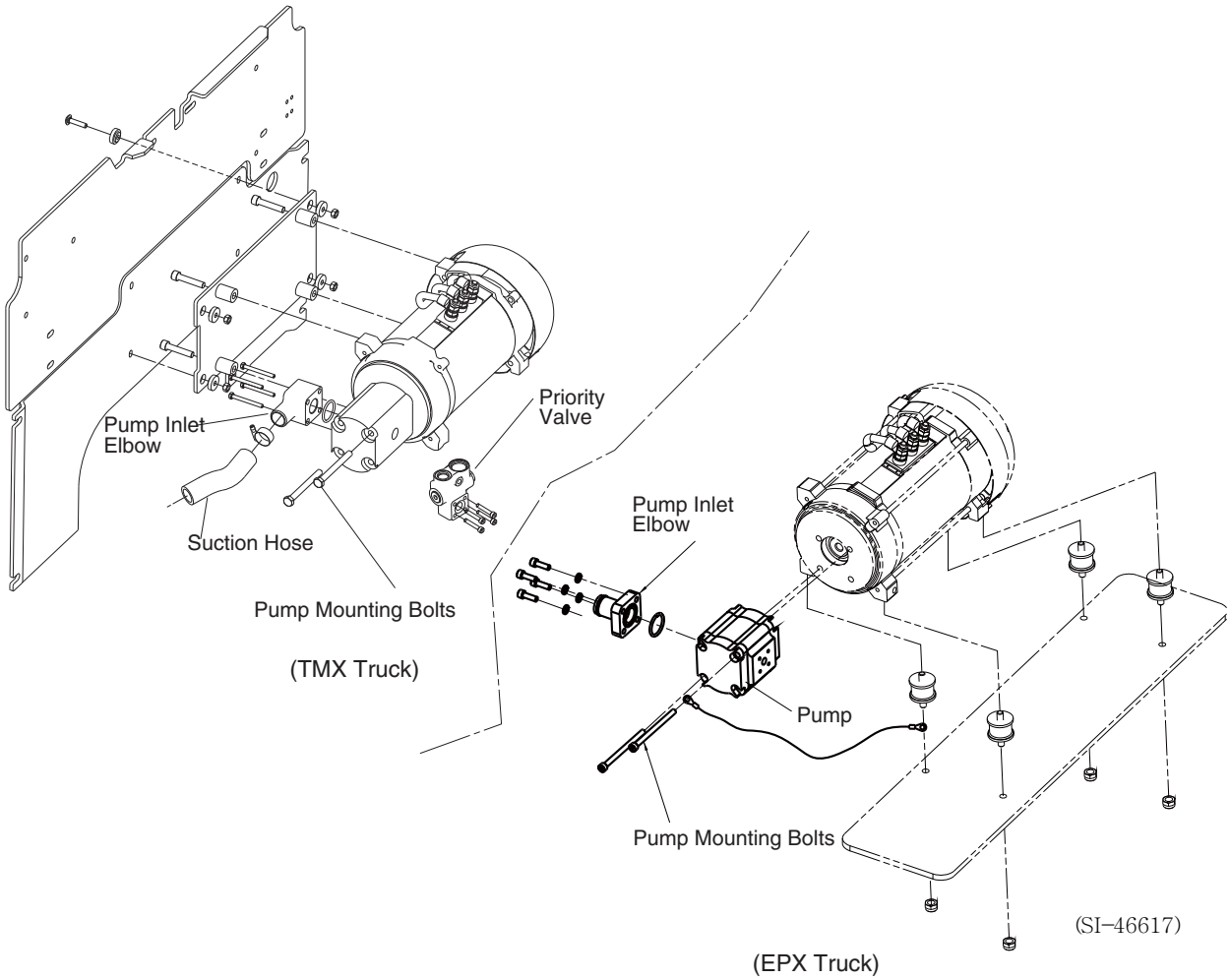
To remove motor and pump as an assembly, refer to motor removal procedure in Group 16.

Te remove or replace pump and leave motor installed, proceed as follows (replacement is reverse order):

A. Loosen/tighten bracket clamp screw (A) and shift motor/pump assembly as ncessary for punp access or mounting.
B. Hydraulic fittings.
   Keep lines elevated to prevent dripping of fluid.
   Tighten per hydraulic fitting tightening procedure in Group 40.
C. Mounting bolts.
D. Ground lead.
E. Main pump.

After installation:

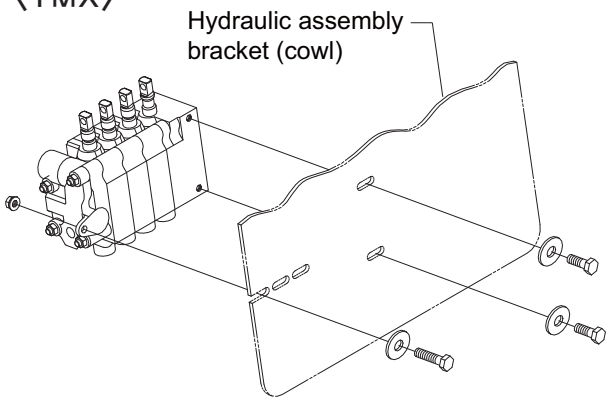
Check operation of hydraulic system and fluid level of sump. Add MS-68 hydraulic fluid as necessary.



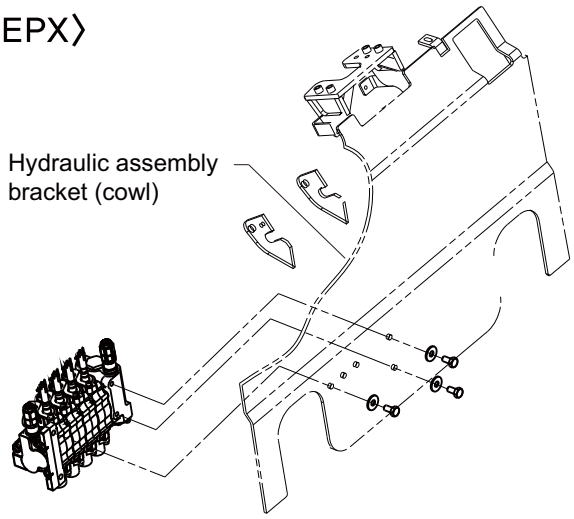
Valve Removal

1. Remove the three hex capscrews mounting the hydraulic valve to the hydraulic assembly bracket. Two of the capscrews thread into the valve itself; the third is secured with a flange nut.

〈TMX〉



〈EPX〉



2. Remove valve assembly from truck. See Section 6 for valve overhaul instructions.

NOTE

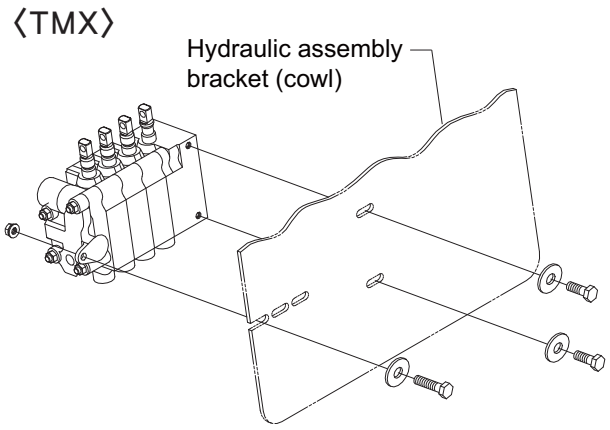
Be sure to clean up any oil spills and dry the floor to prevent accidents.

Hydraulic Control Valve Replacement

Valve Replacement

Position the main valve on the hydraulic assembly bracket (lower cowl). Install valve mounting fasteners and tighten hand tight so that valve mounting can be adjusted for alignment with the lever connecting rods.

〈TMX〉



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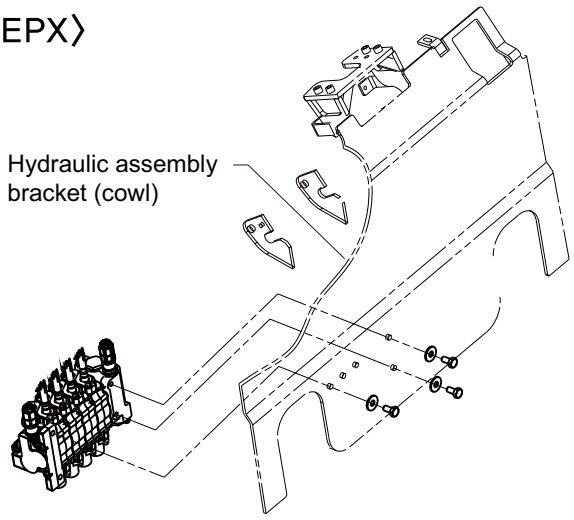


1. Install the hydraulic lines on the proper ports. Make sure all lines are clean, are routed correctly in the truck, and are not kinked. Torque fittings according to “Hydraulic Fitting Tightening Procedure” in Group 40.

Temperature Drift

50° C (122° F)	0.5°, 3.1mm @ 1 min
	5°, 31.1mm @ 10 min

Drift Causes and Remedies

Tilt cylinder drift indicates the following possible problems:

- Tilt cylinder hydraulic circuit hoses or fittings are leaking. Check the circuit components and repair as necessary.
- Cylinder piston seals are worn, damaged, or defective allowing fluid past the piston and causing the rod to drift. Consider rebuilding the cylinders if the other remedies in this list are not successful. See Section 3 for cylinder removal and replacement and Section 4 for cylinder repair, if necessary.
- The main hydraulic tilt valve is misadjusted, worn, or defective. Fluid is leaking past the valve and causing the tilt cylinders to drift. See Group 30 for hydraulic valve troubleshooting.

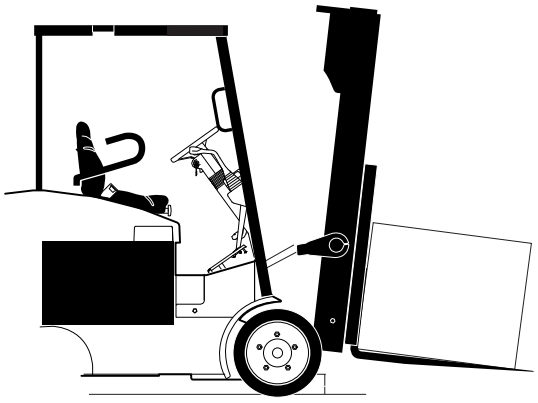
Tilt Cylinder Racking Check

Upright racking occurs when tilt cylinder strokes are unequal. Cylinders should be checked regularly during operation to determine if cylinder strokes are the same. To check for racking:

- Make sure truck is parked on level surface with parking brake applied and wheels chocked.
- Check condition of the tilt cylinder, rod-end yoke, mounting pins, piston rod, rod wiper, cylinder gland, etc., for excessive wear or damage. Make repairs before making twisting adjustment.
- Use a capacity load (see truck nameplate) centered on the forks.

CAUTION

Be sure to secure the load to the fork carriage to keep it from falling off when tilted forward.
Raise the upright only to the height that will allow the fork tips to clear the floor when tilted fully forward.



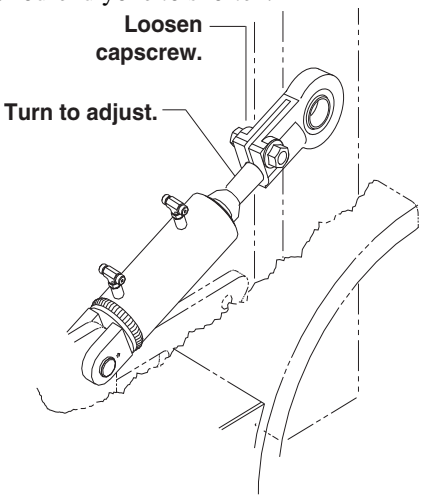
Forward Adjustment

1. Slowly tilt upright fully forward to the end of the tilt cylinder stroke.
2. As the cylinders approach the end of the stroke, watch both piston rods for equal movement and upright for twisting. Note if upright “racks” (is twisted at the end of its movement by unequal stroke of tilt cylinders).

NOTE

Correct the twisting effect by shortening the cylinder that is the longest length. Forward twisting must be adjusted before backward twisting. If forward adjustment is not needed, continue with backward adjustment.

3. To adjust, loosen rod-end yoke capscrew on the tilt cylinder that extends the farthest, and turn piston rod into rod-end yoke to shorten.



Forward Adjustment: Pneumatic-tire truck rod-end yoke orientation shown.

Service Intervals

- All upright components should be visually checked every day during the Operator's Daily Inspection.
- A thorough visual inspection should be performed by a trained service professional every 50-250 hours.
- Lift chains should be inspected and lubricated every 50-250 hours or monthly.
- Lift chain tension should be checked every 50-250 hours or monthly.
- Upright and carriage roller checks should be performed every 50-250 hours or monthly.
- Roller patterns should be checked every 6 months or after 1000 hours of service.
- Racking and drift tests should be performed every 6 months or after 1000 hours of service.
- The complete extended inspection should be performed at least every year or 2000 hours of operation.

Description

The upright assembly includes the lift chains, lift cylinders, carriage, forks, and mast or rail sets. Each of the components can be serviced using the tests, checks, adjustments, and removal and replacement procedures in the following Sections.

The upright uses the hydraulic cylinders and chain sets to lift the carriage and rail sets. On standard, two-stage uprights, the lift cylinders lift the carriage with chains and directly lift the inner rail set. On triple-stage uprights, the primary (free-lift) cylinder lifts the carriage by chains. When the primary cylinder reaches its maximum extension, fluid is diverted to the secondary lift cylinders, which lift the inner rails using a second set of chains and lift the intermediate rails by direct lift.

On Hi-Lo uprights, the primary (free-lift) cylinder lifts the carriage by chains. The secondary cylinders directly lift the inner rail set by rod.

Hi-Lo uprights not used second set of chain for secondary cylinder.

Friction and play between the nesting rails is controlled by roller sets mounted on the rails and carriage. When rails or rollers become worn, the gap between the rollers and rails becomes larger, creating more play in lifting and lowering operations. The rail web to roller side clearances can be reduced by shimming the rollers to close the gap between the roller and rails. The gap between the rail flange and roller bearing surface can be reduced by the use of oversize rollers on a one-time basis.

Forks use a hanger design for mounting on the carriage. Auxiliary attachments may be added to the upright for specialized handling operations. The hydraulic circuit is modified with a hose adapter kit and an auxiliary section is added to the main hydraulic valve to operate the attachment.

The lift and secondary cylinders on standard uprights, Hi-Lo uprights and triple-stage uprights (TSUs) may be either piston-or ram-type cylinders. The primary cylinder on TSUs and Hi-Lo uprights are piston-type cylinder. See the chart under "Specifications" to determine the type of cylinder used on the upright you are servicing.

Piston-type cylinders contain a by-pass check valve in the piston that allows air and fluid that have accumulated in the rod end of the cylinder to return to the system. The check valve can be removed and cleaned if indicated by troubleshooting. A non-serviceable check-ball-type cushioning function is built into ram and piston cylinders for smooth staging during the lowering cycle. The primary cylinder on TSUs incorporates cushioning on the lift cycle. A flow control valve in the hydraulic port of the lift cylinders (secondary cylinders on TSUs) prevents the mast from falling rapidly in case of sudden fluid pressure loss due to line breaks or other malfunction of the hydraulic circuit.

As explained in more detail in Group 30, the main pump sends fluid to the main hydraulic control valve, which contains spools that route fluid to the lift cylinders and tilt cylinders. The valve assembly also contains a counterbalance valve that prevents upright tilt when the truck is not operating.

Fluid flow rates for lift functions are factory set and not adjustable. Flow rates for tilt and auxiliary functions are controlled by adjustments on the main hydraulic valve. A non-adjustable "load-lowering" flow valve mounted on the upright limits upright lowering speed.

Groups 29 and 30 contain general hydraulic information including upright hydraulic functions. Other hydraulic checks for the upright appear in "Troubleshooting," Section 2.

- Internal leakage in primary lift cylinder; perform cylinder checks listed under "Load cannot be lifted to maximum height."
- Damaged primary lift cylinder causing binding in the cylinder; inspect and repair or replace cylinder.
- Defective velocity fuse; remove fuse from cylinder hydraulic port, clean and recheck for proper operation.

Upright mis-staging (TSU lowering)

- Debris in upright roller area or tie bar area; check and clean.
- Bent or broken carriage or inner rail; replace part - do not try to repair by welding.
- Damaged or binding roller on upright; check condition of roller and replace if necessary.
- Carriage and upright roller shimming or thrust roller out of adjustment; perform roller checks on upright and/or carriage and make adjustments as necessary.
- Damaged or kinked lift cylinder hose; check condition of hose, repair or replace as necessary.
- Lift cylinder chain or chain sheave binding or damaged; inspect and repair.
- Bent cylinder rod; inspect and replace rod and/or cylinder as necessary.
- Internal leakage in piston-type cylinders; perform cylinder checks listed under "Load cannot be lifted to maximum height."
- Damaged lift cylinder causing binding in the cylinder; inspect and repair or replace cylinder.
- Defective velocity fuse; remove fuse from cylinder hydraulic port, clean and recheck for proper operation.

Upright mis-staging (Standard and Hi-Lo upright lowering)

- Damaged or binding roller on upright; check condition of roller and replace if necessary.
- Top carriage roller retaining cap screw loose; check and replace cap screw.
- Lift cylinder chain or chain sheave binding or damaged; inspect and repair.
- Debris in upright roller area or tie bar area; check and clean.
- Bent or broken carriage or inner rail; replace part - do not try to repair by welding.
- Carriage and upright roller shimming or thrust roller out of adjustment; perform roller checks on upright and/or carriage and make adjustments as necessary.
- Defective velocity fuse; remove fuse from cylinder hydraulic port, clean and recheck for proper operation.

External leakage on primary cylinder

- Gland loose; check and tighten primary cylinder gland to 135 N·m (100 lbf·ft) and glands on lift (secondary) cylinders to 100 N·m (73 lbf·ft).
- Cracked cylinder tube; replace tube.
- Rod seal damage; replace seals and check for:
  - Damaged rod seal groove in gland; check for damage to groove and replace seal or gland if necessary
  - Scored cylinder wall; repair or replace cylinder tube if necessary
  - Leaking check valve; clean and replace if necessary
  - Leaking O-ring seal on check valve; replace check valve.
- Gland static seals (O-rings and back-up ring) damaged; replace back-up ring.
- Gland static seals sealing surface damaged; check groove and bore and repair or replace as necessary.

External leakage on lift (Standard) and secondary cylinder (TSU & Hi-Lo)

- Gland loose; check and tighten gland on cylinders to 100 N·m (73 lbf·ft).
- Cracked cylinder tube; inspect and replace tube.
- Seal damage in piston-type cylinders; replace piston seals and rod seals.
- Damaged seal groove, piston-type cylinders; check for scratches, nicks, or burrs and repair or replace rod and piston.
- Scored cylinder wall, TSU piston-type cylinders; replace tube and all seals.
- Scored or damaged rod; replace rod and all seals.
- Damaged gland back-up seal; inspect and replace seal.
- Gland static seals sealing surface damaged; check grooves and bore.

CAUTION

Make sure truck is parked on level surface with parking brake applied and wheels chocked; make sure overhead clearance is adequate to extend upright to its full height.

1. Center the forks or attachments on the upright.
2. Check for equal chain tension.
3. Raise the upright from the retracted position to full lift height. Note the point when the lift cylinders reach the end of their stroke.
   - If the upright shifts right or left noticeably, shimming is required.
   - Repeat the check three times before adding shims.

NOTE

Offset or unbalanced loads and off-center attachments can cause the upright to shift even with proper lift cylinder shimming.

See Section 5 for lift cylinder shimming procedure. Racking adjustments for tilt cylinders appear in Group 32, Section 2, "Tilt Cylinder Checks and Adjustments."

Hydraulic Plumbing

Use the Lift Cylinder Shimming Check, the Load Test, and the following Drift Test to check the performance of the hydraulic system.

1. Check all fittings for leakage. Disassemble fittings and inspect the seals. Replace seals as required. See Group 40 for hydraulic fitting tightening procedures.
2. Check all hoses and tubes for wear and damage.
   a. Hoses or tubes with scrapes or kinks should be replaced.
   b. Hoses with outer cover wear exposing the reinforcement braiding should be replaced.

Upright Drift

Drift tests check cylinder, main valve, and hydraulic circuit integrity under load pressures. A load is held elevated for an extended period to determine how much the upright "drifts" (moves) over a specified time period. A tilt cylinder drift test appears in Group 32, Section 2, "Tilt Cylinder Checks and Adjustments."

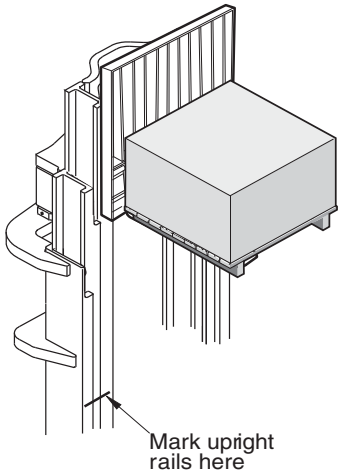
WARNING

An upright or carriage can move unexpectedly during service procedures causing severe injury:
Do not walk or stand under raised forks.
Keep clear of load and carriage when making any check or adjustment.
Keep your arms and fingers away from moving parts of the upright.
Do not reach through open areas of the upright.
Failure to follow these warnings can result in serious injury.

1. Raise the empty upright and carriage to its full extension and lower to a point halfway down from full extension.
2. Shut off the truck. Apply the parking brake and chock the wheels.
3. With a pencil or chalk, make a mark across the rails on one side of the upright.

WARNING

Keep clear of load and carriage when making any checks or adjustments. Do not use the upright to climb; use an approved platform.



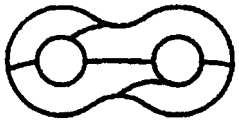
9. Test the upright lift and tilt functions; make sure all upright components work correctly and smoothly. Check for overshimming as described in the next subsection. Repeat the load test to make sure the upright works correctly under load. When you are sure all components are operating correctly, perform the chain adjustment checks in Section 3 before returning the truck to service.

Overshimming

Use these steps to check for overshimming:

1. With the forks removed, lift the upright to maximum fork height.
2. Slowly lower the upright.
   - The carriage should not bind or hang up at any point along the rails.
   - If the carriage binds or hangs up, and the rails are not clogged with grease or debris, the carriage requires reshimming. See “Troubleshooting” for other mis-staging problems.

- Stress - Corrosion Cracking - The outside link plates, which are heavily press fitted to the pins, are particularly susceptible to stress corrosion cracking. Like fatigue cracks, these initiate at the point of highest stress (pin hole) but tend to extend in an arc-like path between the holes in the pin plate.



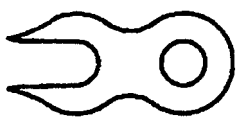
Arc-like cracks in plates are a sign of stress corrosion.

More than one crack can often appear on a link plate. In addition to rusting, this condition can be caused by exposure to an acidic or caustic medium or atmosphere.
Stress corrosion is an environmentally assisted failure. Two conditions must be present: a corrosive agent and static stress. In the chain, static stress is present at the pin hole due to the press fit pin. No cyclic motion is required, and the plates can crack during idle periods. The reactions of many chemical agents (such as battery acid fumes) with hardened steel can liberate hydrogen which attacks and weakens the steel grain structure.
For this same reason, never attempt to electroplate a leaf chain or its components. The plating process liberates hydrogen, and hydrogen embrittlement cracks will appear. These are similar in appearance to stress corrosion cracks.
If a plated chain is required, consult Clark. Plated chains are assembled from modified, individually plated components which may reduce the chain rating.

- Corrosion Fatigue - Corrosion fatigue cracks are very similar (in many cases identical) to normal fatigue cracks in appearance. They generally begin at the pin hole and move perpendicular (90°) to the chain pitch line.
Corrosion fatigue is not the same as stress corrosion. Corrosion fatigue is the combined action of an aggressive environment and a cyclic stress (not a static stress alone, as in stress corrosion).

Ultimate Strength Failure

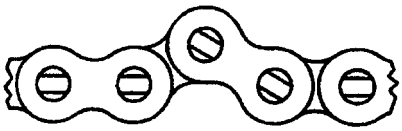
This type of failure is caused by overloads far in excess of the design load.



Broken plate caused by overload.

Tight Joints

All joints in leaf chain should flex freely. Tight joints resist flexure and increase internal friction, thus increasing chain tension required to lift a given load. Increased tension accelerates wear and fatigue problems.



If lubrication does not loosen a tight joint, the chain may have corrosion and rust problems or bent pins and must be replaced.

See Section 3 for detailed chain stretch, length, and tensions checks.

Chain Length Adjustments

WARNING

An upright or carriage can move unexpectedly:

- **Do not walk or stand under raised forks**
- **Keep clear of load and carriage when making any check or adjustment**
- **Keep your arms and fingers away from moving parts of the upright.**
- **Block the carriage or upright when working with the components in a raised position.**
- **Do not reach through open areas of the upright.**
- **Never attempt to move or align the rails by hand. Use a prybar.**

Failure to follow these warnings can result in serious injury.

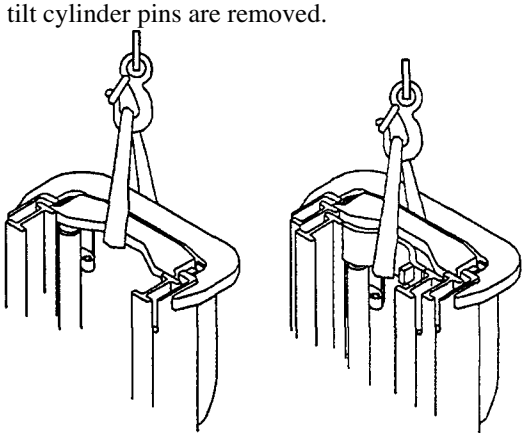
Upright Removal

The following procedures are for uprights with carriage and forks, or auxiliary components removed. See Section 7, “Fork and Carriage Removal and Replacement,”for instructions on removing the forks and carriage.

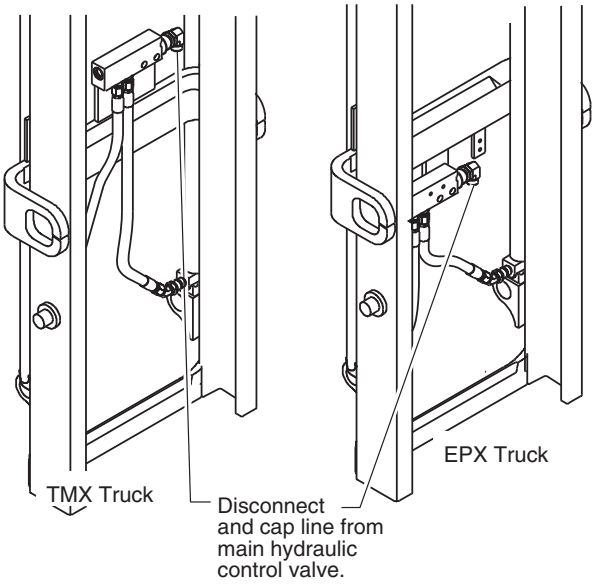
WARNING

The upright assembly is heavy. Use only hoists with enough capacity to lift the entire assembly. Keep clear of the assembly as it is being hoisted and set down. Keep hands and feet away from the assembly. Use prybars to move the assembly into position for reattachment.

1. Attach a hoist and strap of adequate capacity to the upright as shown below. Tension the hoist so that the upright cannot fall when upright mounting pins and tilt cylinder pins are removed.

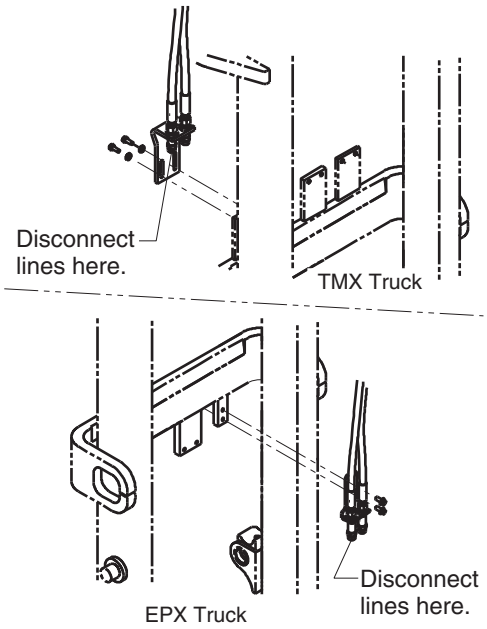


2. Disconnect and cap hydraulic line at the load-lowering flow valve. Secure the hose out of the way of the upright.



NOTE

For two-hose adapter assemblies, the hydraulic lines to the upright must also be disconnected and capped.



GROUP 40

SPECIFICATIONS

Parking Brake Test

The brake must be capable of holding the truck with a full rated-capacity load on a 15 % grade.

Travel Speeds

Maximum speeds with triple stage upright.

(For U.S markets)												
	TMX 12 MPH(kph)		TMX 15s MPH(kph)		TMX 15 MPH(kph)		TMX 17 MPH(kph)		TMX 20 MPH(kph)		TMX 25 MPH(kph)	
	36 Volt	48 Volt	36 Volt	48 Volt	36 Volt	48 Volt	36 Volt	48 Volt	36 Volt	48 Volt	36 Volt	48 Volt
Empty	9.3(15)	9.3(15)	9.3(15)	9.3(15)	9.3(15)	9.3(15)	9.3(15)	9.3(15)	9.3(15)	9.3(15)	7.5(12)	7.5(12)
Loaded	9.3(15)	9.3(15)	9.3(15)	9.3(15)	9.3(15)	9.3(15)	9.3(15)	9.3(15)	9.3(15)	9.3(15)	7.5(12)	7.5(12)

(For Other markets)						
	TMX 13 MPH(kph)	TMX 15s MPH(kph)	TMX 15 MPH(kph)	TMX 18 MPH(kph)	TMX 20x MPH(kph)	TMX 23 MPH(kph)
	48 Volt	48 Volt	48 Volt	48 Volt	48 Volt	48 Volt
Empty	9.3(15)	9.3(15)	9.3(15)	9.3(15)	7.5(12)	9.3(15)
Loaded	9.3(15)	9.3(15)	9.3(15)	9.3(15)	7.5(12)	9.3(15)

Maximum speeds with two stage upright

(For Other markets)			
	EPX 16 MPH(kph)	EPX 18 MPH(kph)	EPX 20s MPH(kph)
	48 Volt	48 Volt	48 Volt
Empty	10.6(17)	10.6(17)	10.6(17)
Loaded	10.6(17)	10.6(17)	10.6(17)

Turning Radius (outside)

Model	mm	in	Model	mm	in
TMX 12	1356	53.4	EPX 16	1805	71.0
TMX 13	1356	53.4	EPX 18	1835	72.2
TMX 15S	1356	53.4	EPX 20s	1880	74.0
TMX 15	1519	59.8			
TMX 17	1519	59.8			
TMX 18	1519	59.8			
TMX 20	1519	59.8			
TMX 20x	1628	64.1			
TMX 23	1519	59.8			
TMX 25	1565	61.6			

Drift, Lift and Tilt Cylinders

Upright Fork Downdrift: Should not exceed 100 mm (4 in) in a 10-minute period.

Tilt Cylinder Drift: Should not exceed 5° in a 10-minute period.

Determined by marking and measuring carriage descent and upright forward tilt from raised, non-tilted position with hydraulic fluid at operating temperature; and a capacity load held evenly distributed on lift forks. (If a pallet is used, load should not extend beyond pallet; load should be stacked to provide maximum stability.) Fork completely engaging load