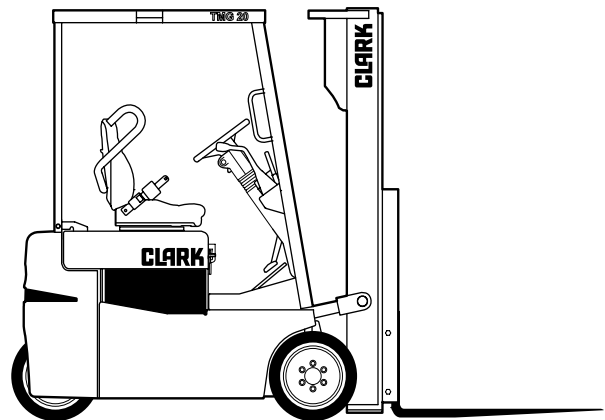

Service Manual

SM 616



TMG 12-25



CLARK Technical
Publications
Lexington, KY
40508

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Raising Rear of Truck

The truck may be raised at the rear by jacking and blocking under the frame just beyond the counterweight..

Refer to truck data plate for truck weights.

! WARNING

An incorrectly installed counterweight can move or fall unexpectedly. NEVER LIFT OR BLOCK A TRUCK USING THE COUNTERWEIGHT. Failure to follow procedures outlined in this manual can result in injury or death.

1. Park truck safely.
2. Put blocks at front and rear of drive wheels.

! CAUTION

If possible, remove the battery from truck to reduce weight for added safety and ease of jacking.

3. Put a floor jack under the frame just beyond the counterweight.

! WARNING

Never lift the truck by the counterweight.

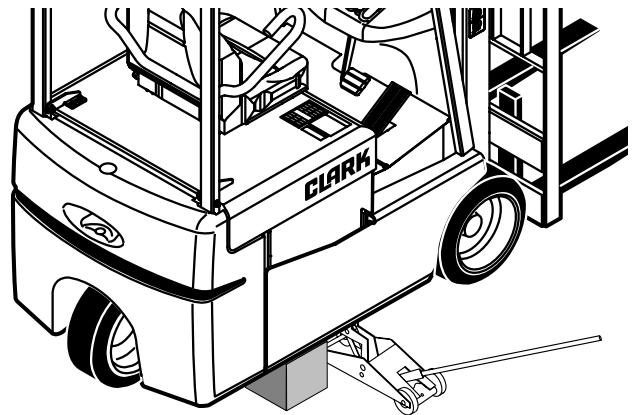


NOTE

If there is insufficient clearance under frame for your jack, the truck may first be driven onto shims, such as 25 x 150 x 300 mm (1 x 6 x 12 in) pieces of board, to increase the truck frame under-clearance.

4. Jack up one side of the truck about 50 mm (2 in) and put a block under the frame to hold that elevation. Then move the jack to the other side and jack and block it. Continue to alternate the procedure from side to side, increasing elevation not more than 50 mm (2 in) each time. Raise the truck no higher than necessary to perform the maintenance work.

Make sure the left and right sides of the truck are finally blocked in a level working position.



! CAUTION

Before performing any maintenance work, check the truck for stable condition on the blocking by determining that it will not rock on blocks.

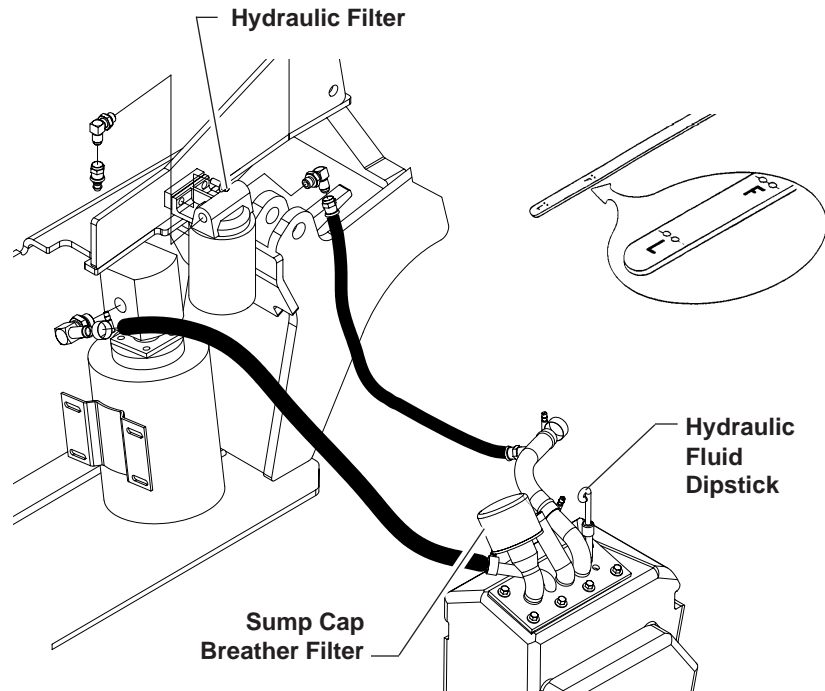
5. When maintenance work is completed, lower the rear of truck to the floor by reversing the above procedure and lowering each side of the truck 50 mm (2 in) at a time:
 - Put jack under frame and raise truck.
 - Carefully remove blocks and lower truck.
 - Remove jack and blocks from drive wheels.

TASKS	1st 50 Hours	Every 50-250 Hours	Every 450-500 Hours (or 3 months)	Every 900-1000 Hours (or 6 months)	Every 2000 Hours (or 1 year)
<i>Group 25/26 - Steer Axle and Lines</i>					
Operation - check		•			
Power steering relief pressure - check					•
Steer axle mounting - inspect		•			
Steer wheel and trunnion bearings - check		•			
Steer wheel and trunnion bearings - lubricate/adjust					•
Steering cylinder seals - check leakage		•			
Steering linkage - lubricate		•			
<i>Group 29/30 - Hydraulic Lift System</i>					
Hydraulic fluid level/condition - check/sample		•			
Hydraulic fluid change - drain/fill					•
Hydraulic filler screen - clean					•
Hydraulic fluid filter - replace	•				•
Hydraulic tank breather - clean/replace	•	•			•
Control valve linkage - check/clean					
Hydraulic system relief pressure - test/adjust					•
<i>Group 32 - Tilt Cylinders</i>					
Tilt cylinder adjustment - check/adjust		•			
Tilt cylinder drift - test		•			
Tilt cylinder mounting - check/tighten		•			
Tilt cylinder rod ends - check/tighten/lubricate		•			
Tilt cylinder rod/seals - check for leaks		•			
<i>Group 34 - Upright, Lift Cylinders, Carriage, Forks</i>					
Operation - check		•			
Carriage and lift chain - lubricate		•			
Carriage chain condition - inspect/adjust		•			
Forks, latches, stop pin - inspect/check wear		•			
Lift chain condition - inspect/adjust		•			
Load backrest		•			
Upright cylinder/mounting - inspect/tighten		•			
Upright lift cylinder downdrift - test		•			
Upright rollers - check		•			
Upright trunnion bolts - tighten		•			

Hydraulic Fluid and Filters

Remove dipstick and check **hydraulic fluid level**. Top off if below full mark as described in Group 29.

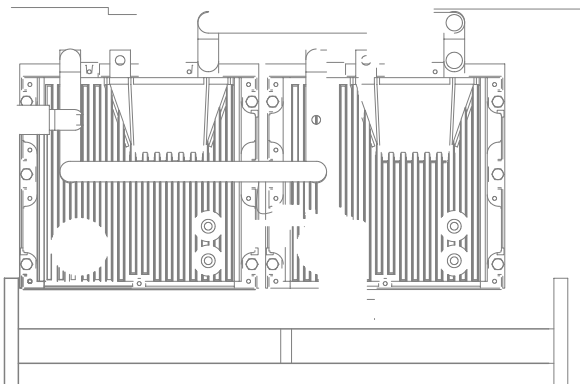
Consult the periodic service chart (or service decal) to determine if it is time to replace the **sump cap filter** and/or spin-on **hydraulic filter**. If they are due, their replacement is considered part of the PM.



Controller Connectors

Pull connectors PL-3 and PL-5 and lubricate terminals with Clark Electrical Connector Grease, part # 2819910.

Make sure all connections are tight.



Battery

Inspect the battery for any damage, cracks, leaking condition, etc. If the terminals are corroded, clean and protect them with CLARK Battery Saver (available from your Clark dealer).

Check six cells with your hydrometer as described in Group 12. A consistent reading among the six cells indicates the battery is probably in good condition.

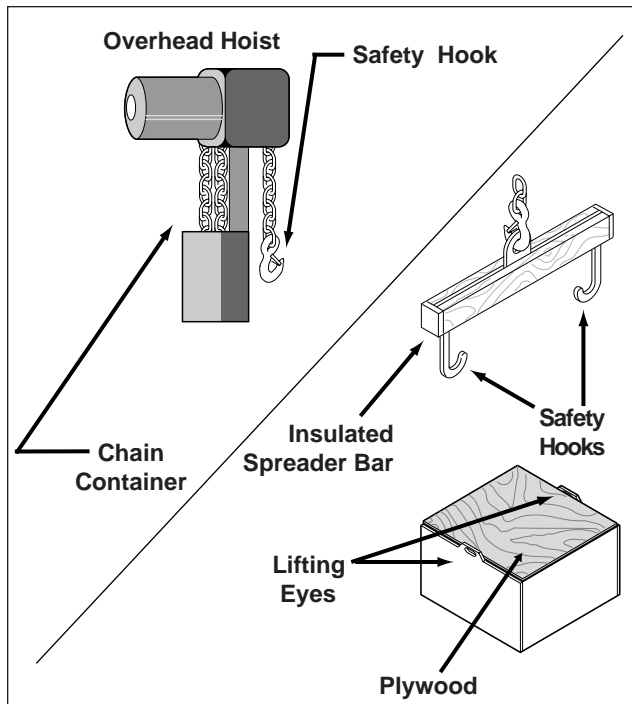
Perform the battery load test described in Group 12.

Be sure the battery service area is equipped with material handling equipment designed for the purpose of removing and replacing batteries, such as a conveyer or overhead hoist equipped with safety hooks.

IMPORTANT

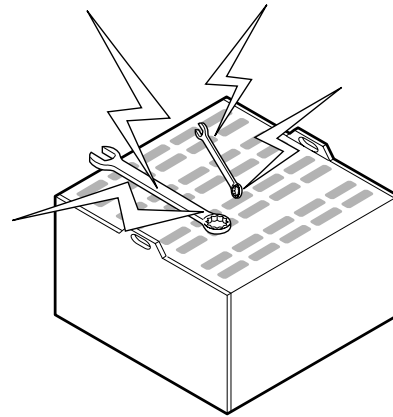
To prevent side forces from damaging the battery, the distance between the lifting hooks (of the spreader bar) must be adjusted to the same dimension as measured between the battery lifting eyes. Make sure the lifting hooks are the correct size to fit the lifting eyes of the battery.

- When using an overhead hoist, be sure to use an insulated spreader bar or similar lifting device.
- Be sure the hoist is equipped with a chain container to accumulate excess lifting chain. When this is not possible, be sure the battery is covered with a non-conductive material, such as plywood, as shown below.
- If the battery does not have a cover of its own, cover it with a non-conductive material such as plywood.



⚠ DANGER

Never lay tools or other metal objects on a battery. Metal objects contacting battery terminals will cause short circuits. The shorted circuits could ignite battery fumes and cause the battery to explode.



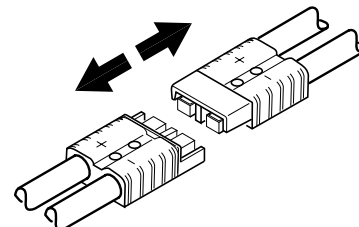
Battery Removal

1. Move truck to the designated battery service area.

⚠ CAUTION

SAFE PARKING. Before working on truck:

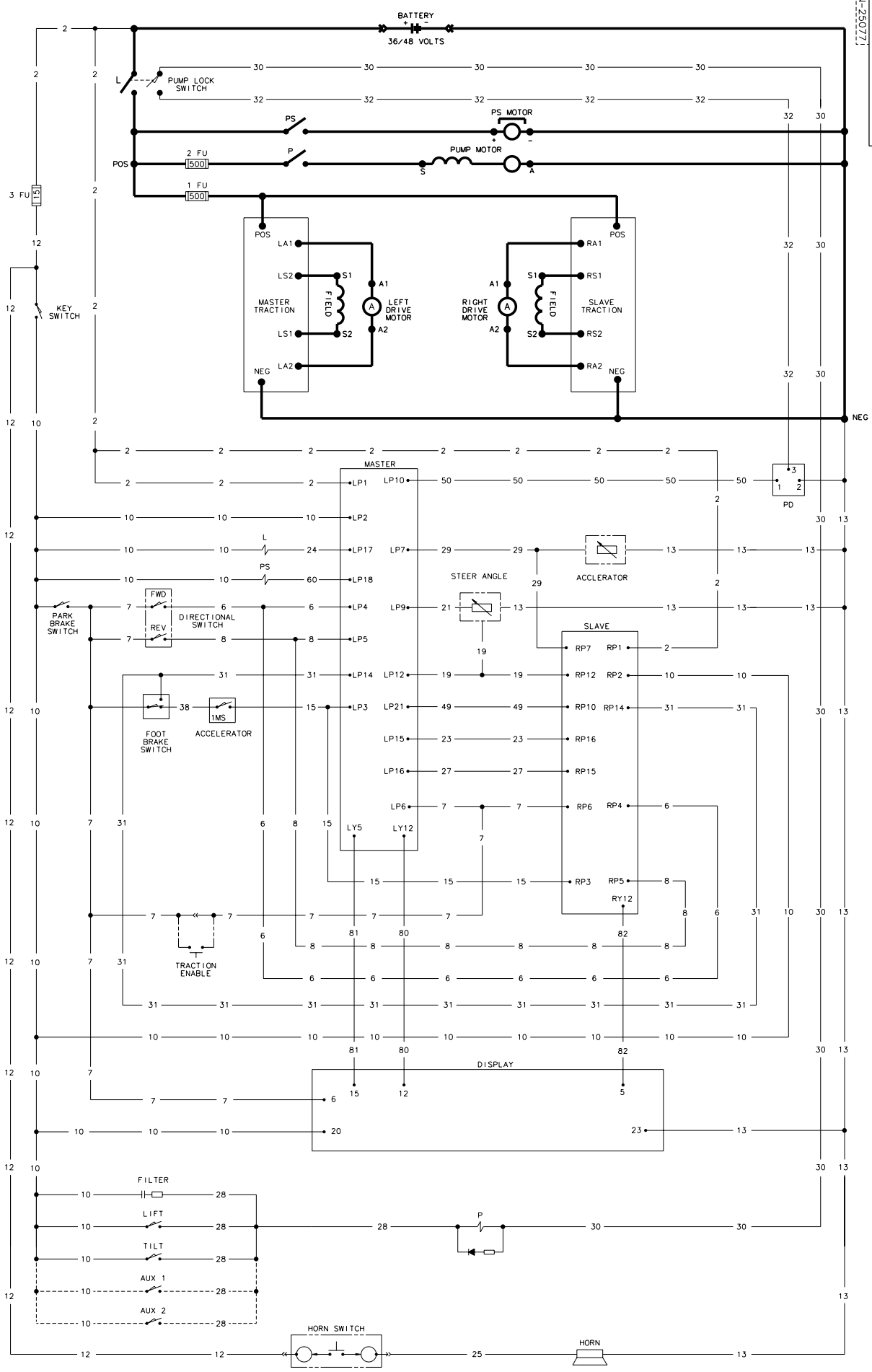
- Park truck on a hard, level and solid surface, such as a concrete floor with no gaps or breaks.
 - Put upright in vertical position and fully lower the forks or attachment.
 - Put all controls in neutral. Turn key switch OFF and remove key.
 - Apply the park brake and block the wheels.
2. Turn key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



Battery Disconnected

THE PARTY RESPONSIBLE FOR THIS EQUIPMENT
 LEADS AND HALLS THE DATA DISCLOSED
 AND WILL BE MAINTAINED IN CONFIDENCE
 AND NOT BE DISCLOSED TO ANY OTHER
 PERSONS WITHOUT THE EXPRESS WRITTEN
 PERMISSION OF THE COMMAND.

IN-25077



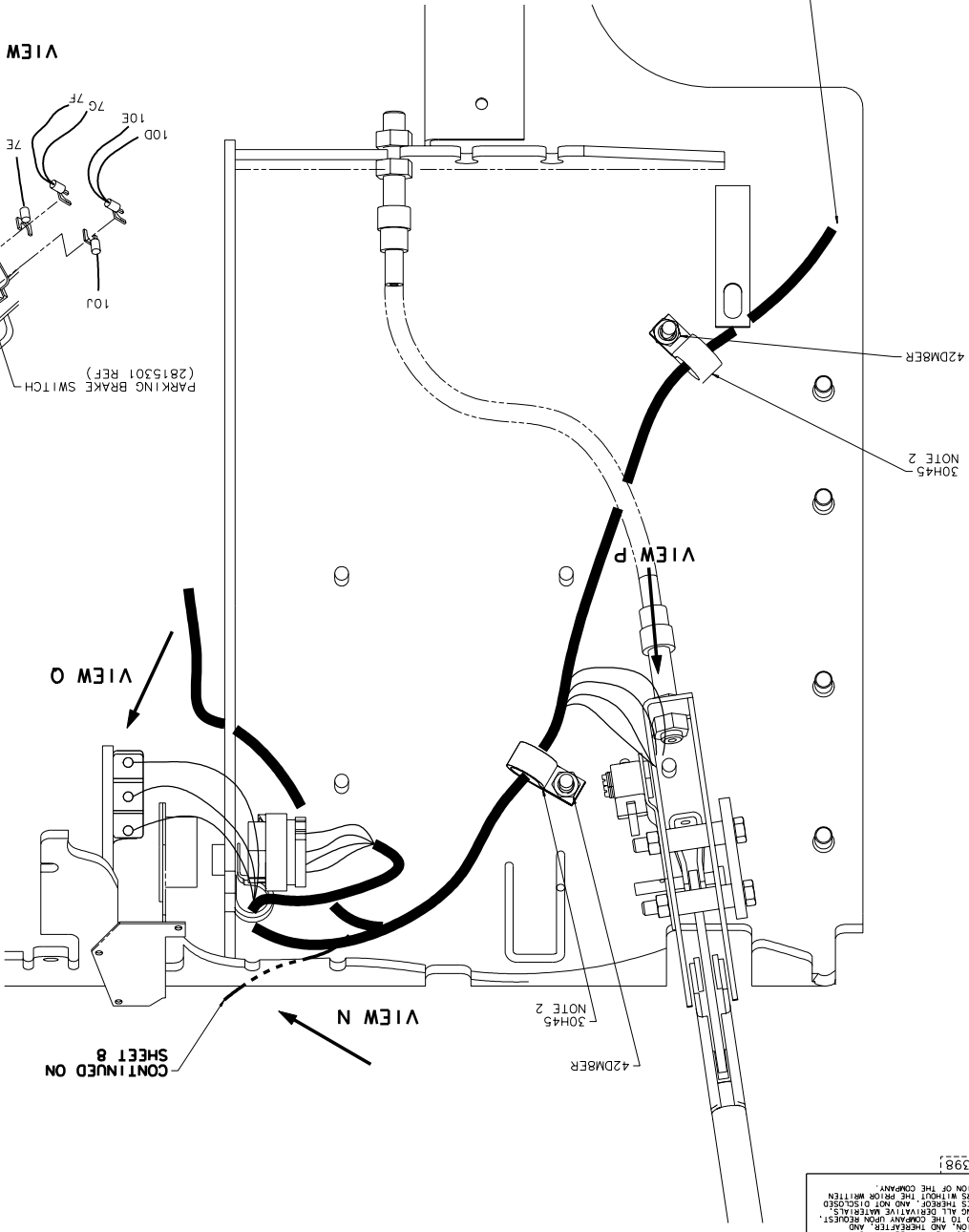
DESIGN CONTROL		METS	
NO.	REV.	DATE	BY
1		11/14/97	...
2		12/14/97	...
3		12/14/97	...
4		12/14/97	...
5		12/14/97	...
6		12/14/97	...
7		12/14/97	...
8		12/14/97	...
9		12/14/97	...
10		12/14/97	...
11		12/14/97	...
12		12/14/97	...

UNAPPROVED WORK	ALL RIGHTS RESERVED
1970016 22	12/14/97
1970002 23	12/14/97
1970003 24	12/14/97
1970004 25	12/14/97
1970005 26	12/14/97
1970006 27	12/14/97
1970007 28	12/14/97
1970008 29	12/14/97
1970009 30	12/14/97
1970010 31	12/14/97
1970011 32	12/14/97
1970012 33	12/14/97
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1970070 91	12/14/97
1970071 92	12/14/97
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1970076 97	12/14/97
1970077 98	12/14/97
1970078 99	12/14/97
1970079 100	12/14/97

WIRING DIAGRAM
 (STANDARD)
 IN-25077
 SHEET 1 OF 2

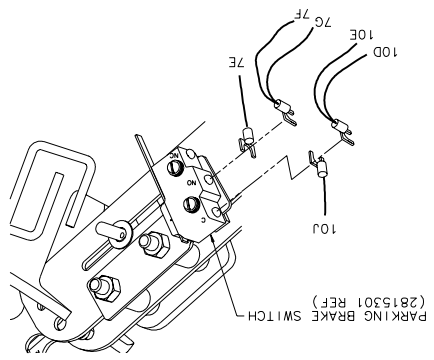
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S1-13398

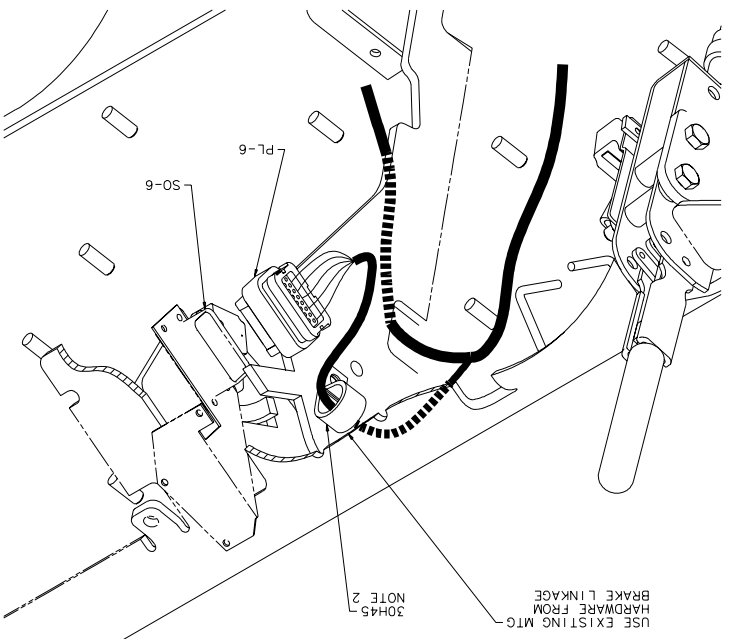


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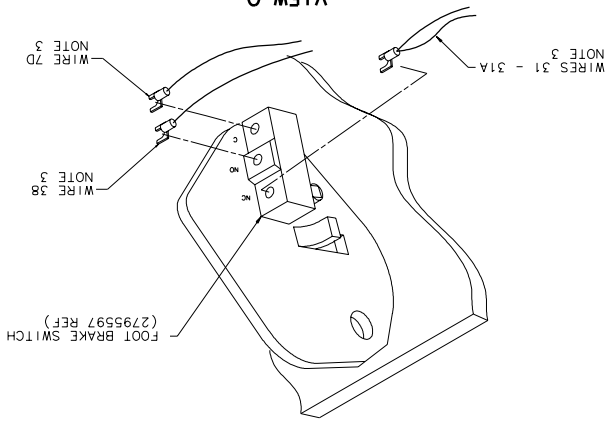
VIEW P



VIEW N



VIEW O



DESIGN CONTROL		MSTRIE	
DIM. ARE IN MM UNLESS NOTED		UNITS ARE IN INCHES UNLESS NOTED	
F		E	
LUMBER, SHED WORK		RODERS	
COL. NO.	Q8A0597	COL. NO.	Q8A0597
ALL RIGHTS RESERVED		© 1970/02	
INSTL-MAIN HARNESS		S1-13398	
SHEET 6 OF 10		1-DEAS	

Accelerator Control Switch

Description

The accelerator control is operated by the accelerator foot pedal to send a signal for power demand to the control.

At the start, the accelerator control is stroked (by the action of the accelerator pedal), and in turn sends a signal to the motor control, requesting it to produce longer electrical pulses to the motor, which in turn will supply more power to the drive train.

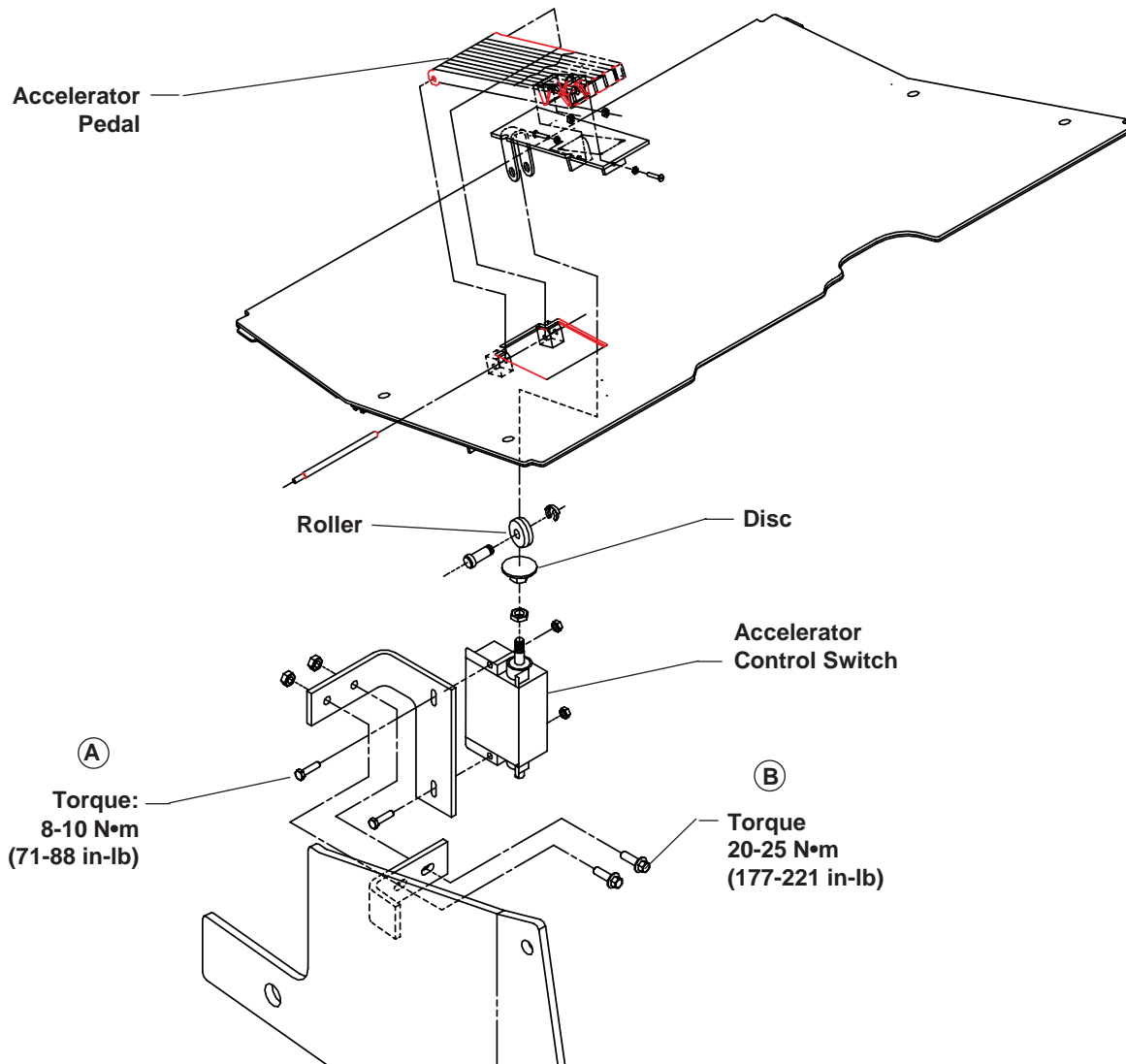
An internal spring returns the control to start position.

The accelerator is an integral unit and is not serviceable. Opening of the unit will void the warranty.

Adjustment

1. Loosen four fasteners at **A** and **B** on illustration.
2. Depress pedal to floor mat and hold.
3. Position switch so that push rod is fully pushed in and that roller is centered on top of disc.
4. Tighten fasteners as indicated on illustration.

Trouble with the accelerator control is normally investigated in conjunction with the motor control. Refer to Group 19 for proper procedure.



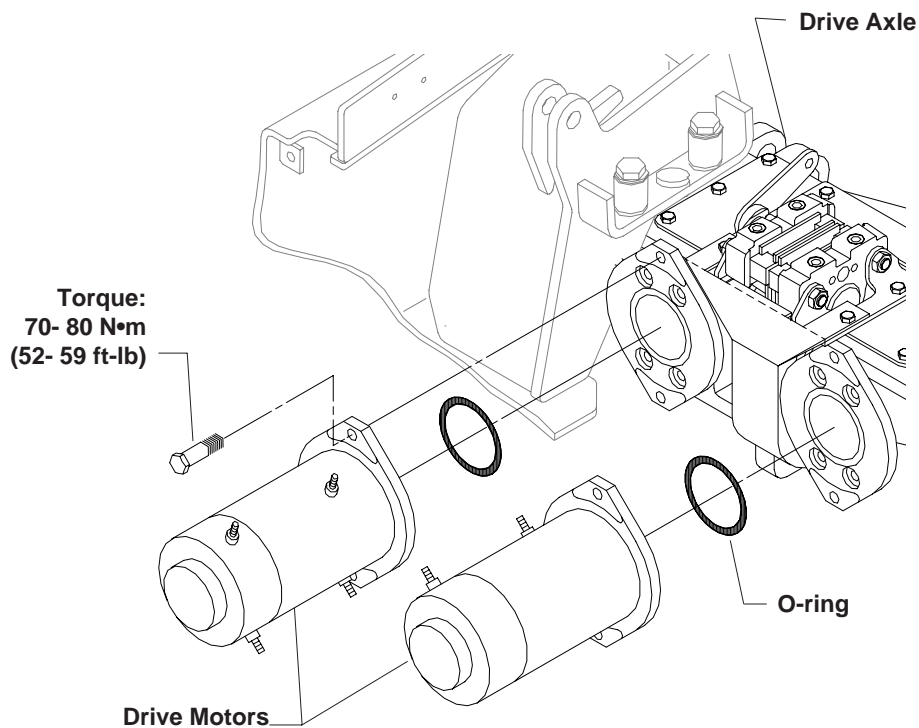
NOTES:

Drive Motor Removal and Installation

1. Tilt the steering column fully forward and remove the floor plate.
2. Disconnect battery and remove all electrical cables from the motor. Tag cable terminals to aid in reinstallation. Position cables out of the way of motor removal.
3. Remove the battery.
4. Remove bolts holding motor to axle. Have drain pan in place to catch axle oil.
5. Lower motor onto floor.
6. Jack up and block the rear of the truck high enough to slide motor from under truck.
7. Reinstall in reverse order. Use new O-ring, coated with drive axle fluid. New motors may have a plastic packing around the input shaft. Remove and discard this packing prior to motor installation.
8. Check and fill drive axle oil as described in Group 20.

NOTE

When removing or installing cables to motor, hold the terminal's lower nut with a wrench while turning the upper fastening nut with another wrench.



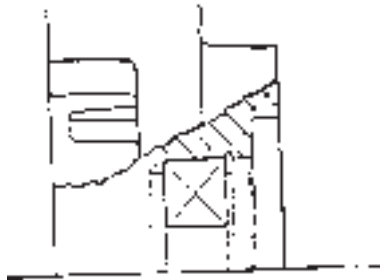
2. BEARING REPLACEMENT. Remove bearing from drive end frame.

The bearing is retained with a snap ring. Remove internal snap ring from groove in frame at end of bearing, then press bearing out of frame.



Install new bearing by pressing on outer race of bearing to force it into bore until it is firmly seated against shoulder.

Install snap ring to retain it.



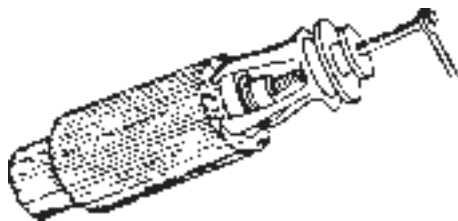
NOTE

Do not reuse bearings but replace with new.

3. If necessary, remove bearing from commutator end of armature shaft by using a bearing puller.

Protect end of armature shaft with a nut or thick flat washer.

Be careful not to damage commutator bars.



4. Install new bearing on armature shaft by pressing inner race of bearing firmly against shoulder on shaft.

5. BEARING LUBRICATION. Replacement bearings are packed with lubricant and need no further lubrication.

Assembly

1. Press drive end frame assembly onto armature shaft until bearing inner race is firmly seated against shoulder on shaft.



Section showing shaft in place against bearing.

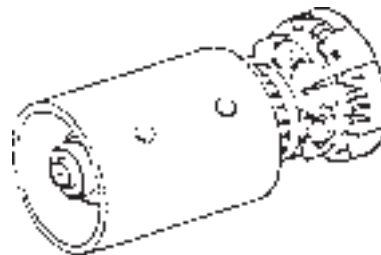
NOTE

Install bearing on shaft by pressing on bearing inner race.

DO NOT PRESS OR USE FORCE AGAINST DRIVE END FRAME.

2. Install armature and drive end frame assembly into motor body.

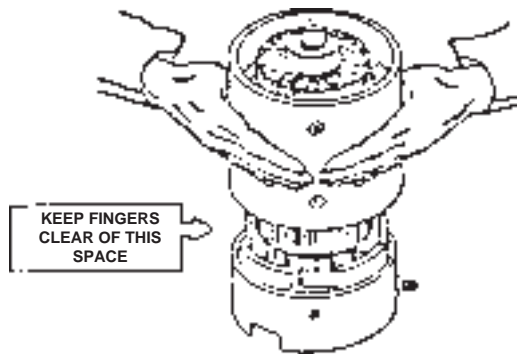
Align match marks on end frame and motor body.



3. Install drive end frame mounting screws and tighten lightly to temporarily hold assembly. Tighten alternately to assure good mechanical alignment.

4. Install bearing spring (end thrust) washer into bearing bore in commutator end frame. Use thin film of grease to hold in place.

- Put complete stator assembly over vertical armature, and into position on commutator cover.



⚠ CAUTION

Care must be exercised at this point. There is a strong magnetic attraction between stator assembly and armature, which tends to pull stator assembly rapidly downward. It is important to have a firm grasp on stator assembly and be sure fingers are free from space between stator assembly and commutator cover.

- The stator assembly must be placed in a definite relationship with commutator cover in order to obtain a neutral brush setting.



There should be match-marks on both items.

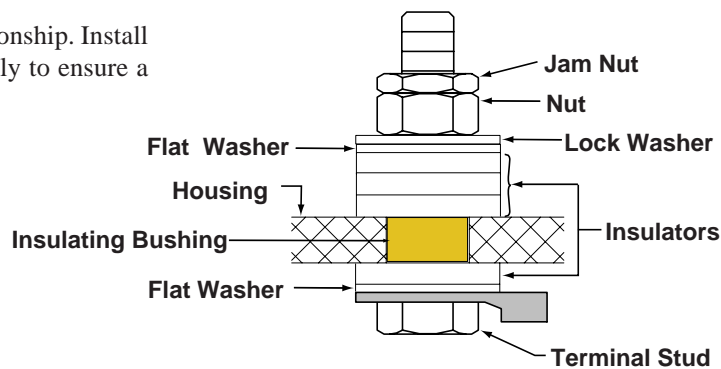
- Assemble drive end cover in correct relationship. Install mounting thru bolts and tighten alternately to ensure a good mechanical alignment.

Do not use hammer or excessive force.

- If brushes were not removed (replaced), set brushes to final (lowered) position, by moving brush springs to top of each brush. If brushes were removed, refer to step 8, below.



- Install new brushes by reversing removal procedure:
 - Install brush with lead wires positioned as when removed.
 - Install brush assembly into brush holder. Be sure all brushes are free in holder.
 - Connect brush lead assembly.
 - Install brush spring clip on top of brush.
 - Install brush cover.
 - Install pump drive coupling segment.
 - Spin shaft by hand to check if it is free.
- Be sure motor leads (if attached) are not touching together.
- If leads are touching, a generator action will give effect of friction in motor.
- Perform the “no load test” described earlier in this Section under “Troubleshooting Prior to Disassembly.”



Terminals Connection Torque: 8-10 N•m (71-88 in-lb). Hold lower nut with a wrench when tightening jam nut.

Specifications

Drive Motor Control

Type: GE CTS450 transistorized control providing separate excitation of motor fields and armature. One for each drive motor.

Voltage: 36 or 48 volts

Lift Pump Motor Control

Standard type: Contactor only

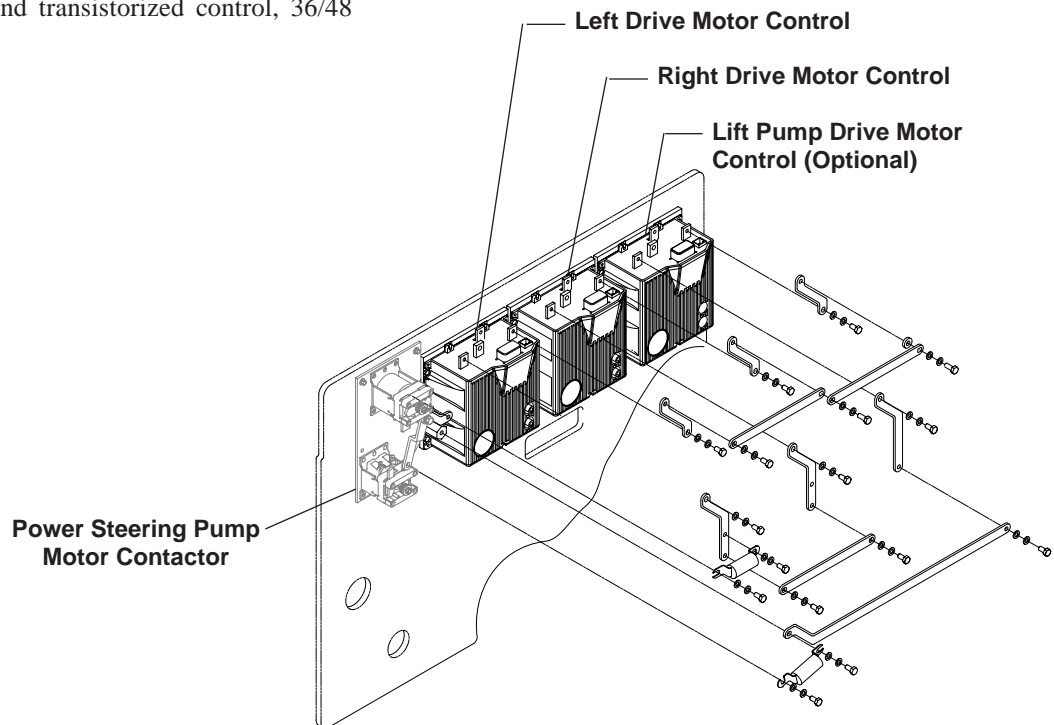
Optional type: Transistorized.

Voltage: 36/48 volts

Power Steering Pump Motor Control

Standard Type: Contactor only (See Group 17.)

Optional Type: On-demand transistorized control, 36/48 volt.



Sequence #2: Connecting the Battery

A. Battery positive is applied:

- to the Line Contactor.
- thru wire #2
 - to LP1 and RP1 of the Traction Controls.
 - thru the Fuse (FU3) to the Key Switch and to the Horn Button.

B. Battery negative is applied:

- to the “NEG” connections of each traction controls.
- thru wire #13
 - to terminal #3 of the Pump Driver (PD).
 - to the Accelerator Control.
 - to the Steer Angle Potentiometer.
 - to wire #23 of the Dash Display.
 - to the negative terminal of the Horn.

The internal capacitors of each Traction Control are charged in about 2 seconds.

NOTE

A Status Code “51” displays if the internal capacitors of each Traction Control do not charge to above 85% battery volts. It is normal for a Status Code “51” to be intermittently be displayed for about 2 seconds during the charging time, when the battery is initially plugged in.

C. The Horn is operated by pushing on the Horn Button which supplies battery voltage from wire #12 through the Horn Button contacts, through wire #25 to the positive terminal of the horn.

Voltages Present:

- A. Battery Positive Volts
- B. Battery Negative Volts
- C. Battery Positive Volts on wire #25 and the Horn positive terminal

Sequence #6: Turning on the Traction Controls

- A. Depressing the accelerator pedal slightly closes the IMS switch and supplies battery positive voltage through the #15 wires to terminals LP3 and RP3
- B. When the traction controls senses battery positive at terminals LP3, RP3, and LP4, RP4, and 0 volts at terminals LP5, RP5 the control starts pulsing the forward field transistors and the armature transistors.

NOTE

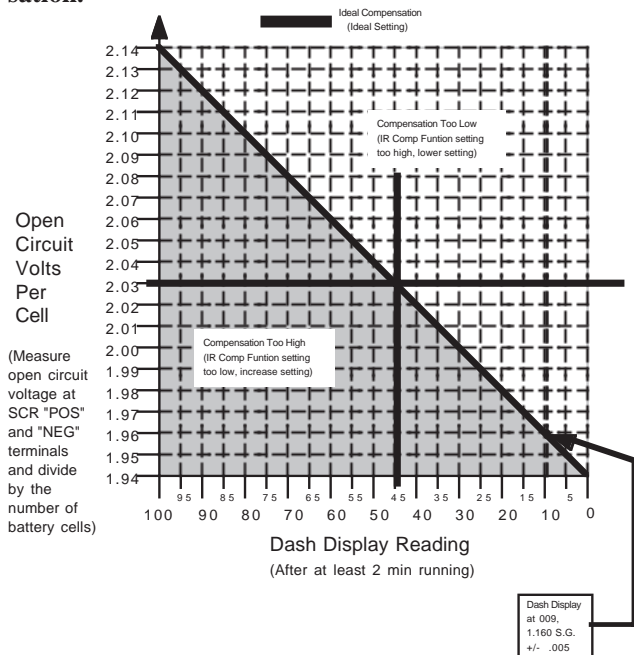
The field transistors of this control do the job of directional contactors as well as supplying power to the drive motor fields. A separate set of transistors supplies power to the armature.

- C. By pressing the pedal further a signal from the accelerator is sent through the #29 wires to terminals LP7 & RP7 of the traction controls and starts an internal time delay which controls the oscillator.
- D. The traction controls pulse the field and armature transistors. Current now flows from the battery, through the line contactor, 1FU fuse, Master & Slave POS terminals, through the armature and field transistors of each control, out through the controls NEG terminals to battery negative.
 - The interaction of magnetic energy between the motor fields and armature causes the armature to rotate.
 - As the accelerator is pressed further down the signal voltage supplied to the controls changes from approximately 3.5 volts at creep to 0.2 volts at full speed.
 - The control pulses the transistors at a constant 2200 pulses per second but increases the ON time of each pulse to increase motor speed.
 - The CTS-450 Traction Controls regulates the armature current to field current separately to maintain the desired speed at all times regardless of the load weight or floor grade.

Voltages Present:

- A. Battery positive volts
- B. See explanation above
- C. Less than 3.5 volts at terminals LP7 & RP7
- D. See explanation above

Below is an example test where the Dash Display Reading was '45' and the voltage reading was 36.54 volts. The battery has 18 cells, so the Open Circuit Volts Per Cell is 2.03 volts. The example graph below shows that this truck has the proper level of compensation.



NOTE

THE FOLLOWING FUNCTIONS HAVE FUNCTION NUMBERS LARGER THAN THE NUMBERS ON THE HANDSET KEYBOARD. To access these functions, the parking brake must be applied (parking brake switch open), and push the CONT key and the number shown in the following instructions at the same time.

FUNCTION 16 ACCELERATOR PEDAL POSITION REGEN (Push CONT 1)

Allows the adjustment of the accelerator pedal position regen range. The pedal position will reduce the regen current to the value set by this function as the accelerator is returned to the creep speed position. Maximum regen current is obtained with the accelerator in the top speed position.

- Range: 55 to 455 amps
- Setting: 0 to 255
- Resolution: 1.56 amps
- Example: A setting of 20 = 86.2 amps

FUNCTION 17 CONTROL TYPE SELECTION (Push CONT 2)

Allows for selecting the type of control being used.

Control Type	Set Units
Master	057
Slave	121

NOTE

This function is used to optimize the motor and control performance and this setting has been determined by Clark Engineering. This setting must not be changed from the published factory settings.

FUNCTION 15 BATTERY VOLTS (Push 15)

Allows the adjustment of voltage range. In order for the BDI to function properly, the settings in the following table must be entered.

Battery Volts	Set Units
36 Volts	Between 32 and 44
48 Volts	Between 45 and 69

NOTE

The TMG is not a dual voltage truck. The controls need to be adjusted for the voltage setting as the truck was built.

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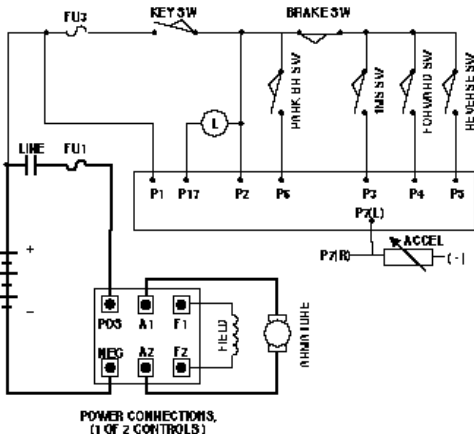


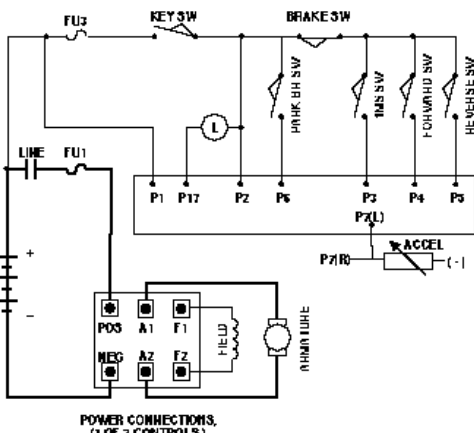
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STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
<p>11</p> <p>Memory Recall: NO Applies to: Traction Controller</p>	<p>IMS switch closed on power up after initial key switch closure.</p>	<p>Code displays when P3 is greater than 60% of battery voltage when the key switch is closed.</p>
<p>SYMPTOM</p> <p>Controller will not operate.</p>	<p>DIAGNOSIS/CORRECTION</p> <p>IMS switch input mis-adjusted or defective.</p> <ul style="list-style-type: none"> • Input voltage at P3 should be less than 60% battery volts at key switch closing. Adjust or replace accelerator unit to insure that the voltage at P3 is less than 60% battery volts before closing the IMS switch pedal. <p>Short circuit between battery positive and P3 in IMS switch input circuit.</p> <ul style="list-style-type: none"> • Disconnect wire from P3. Check for short circuit from wire to battery positive. Resistance should be greater than 4.7K ohms. <p>Defective Controller.</p> <ul style="list-style-type: none"> • Disconnect wire from P3. Measure voltage from P3 to negative. Voltage should be zero; if not, replace controller. 	<p>TROUBLESHOOTING DIAGRAM</p>

STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
<p>12</p> <p>Memory Recall: YES Applies to: Traction Controller</p>	<p>Steer angle potentiometer voltage is too low.</p>	<p>Code displays when P12 is less than .39 volts.</p>
<p>SYMPTOM</p> <p>Controller will not operate</p>	<p>DIAGNOSIS/CORRECTION</p> <p>Steer angle potentiometer input mis-adjusted or defective. Loose or missing connections at P19, P12 or P20.</p> <ul style="list-style-type: none"> • Input voltage at P12 should be greater than .39 volts at all times. Insure that the adjustment of the steer potentiometer is in accordance with Group 13. <p>Defective Controller.</p> <ul style="list-style-type: none"> • Replace controller unit. 	<p>TROUBLESHOOTING DIAGRAM</p>

STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
<p>76</p> <p>Memory Recall: YES Applies to: Traction Controller</p>	<p>Capacitor (1C) voltage too high.</p>	<p>Code displays when the voltage on the capacitor goes above 96 volts during the regenerative braking cycle.</p>
<p>SYMPTOM</p> <p>Line contactor closes then opens and then can only be closed by opening and closing the key switch.</p>	<p>DIAGNOSIS/CORRECTION</p> <ul style="list-style-type: none"> • Unplugging the battery connector during regenerative braking. • Line contactor bouncing open during regen. • Main power fuse opening during regen. • Intermittent battery plug connection. 	<p>TROUBLESHOOTING DIAGRAM</p>  <p>POWER CONNECTIONS. (1 OF 2 CONTROLS)</p>

STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
<p>77</p> <p>Memory Recall: YES Applies to: Traction Controller</p>	<p>Motoring current is detected during regenerative braking.</p>	<p>Code displays when motoring current is detected during the regenerative braking cycle.</p>
<p>SYMPTOM</p> <p>Line contactor closes then opens and then can only be closed by opening and closing the key switch.</p>	<p>DIAGNOSIS/CORRECTION</p> <p>Defective controller.</p> <ul style="list-style-type: none"> • Replace controller unit.. 	<p>TROUBLESHOOTING DIAGRAM</p>  <p>POWER CONNECTIONS. (1 OF 2 CONTROLS)</p>

NOTES:

Introduction

Refer to Figures 1A and 1B.

Drive unit disassembly and overhaul procedures are grouped according to the following major sub-assemblies:

- 1 **Ring gear shaft assembly**, including bearing housing, shaft, ring gear, straight and tapered roller bearings, bearing cap, and oil seal.
- 2 **Pinion assembly**, including pinion gear, bearing carrier, bearings, and bearing retainer.
- 3 **Drive axle shaft assembly**, including shaft, gear, gear retainer, bearings, and oil seal.

Drive Unit Disassembly

1. Remove the brake caliper as shown in Group 23.
2. Remove the drive motors as shown in Group 16.
3. Remove the flange bolts and separate the two drive axle housings, as shown in the Section, "Drive Axle Removal and Replacement."
4. Be sure all fluid is drained from each drive unit before starting disassembly.
5. Remove the inspection (A) cover and gasket (B) from top of unit. (Figure 1A.)
6. Remove the brake disc (C) by sliding it off the ring gear shaft spline. (Figure 1B.)

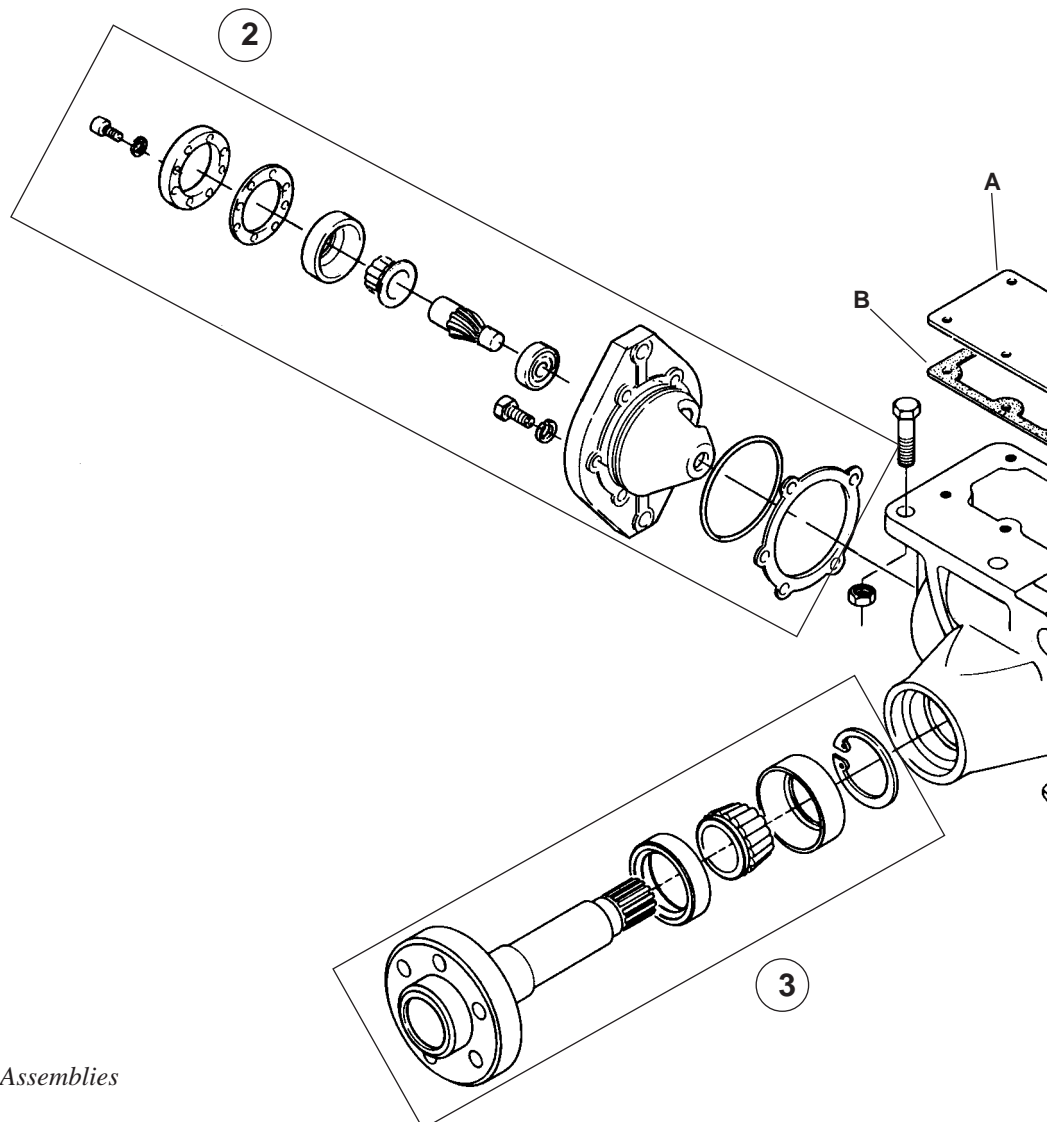


Figure 1A. Drive Unit Sub-Assemblies

Input Pinion Gear Carrier Reassembly

Refer to Figure 6.

1. Arrange the parts of the pinion gear bearing carrier for assembly.
2. Install the tapered roller bearing cones (F, G) on the pinion gear by pressing the inner races until firmly seated square and tight against shoulders on gear. Be sure to use a pressing tool or tubing of the correct diameter and press on inner race only to prevent damage to the roller cages.
3. Install the input pinion inner bearing cup (H) by pressing the cup into carrier bore tight and square against the shoulder.
4. Put the pinion gear and bearing assembly (F-H) into the carrier. Be sure it is seated correctly into inner bearing cup.
5. Then, using a pressing tool or a piece of tubing of correct diameter for cup, install outer bearing cup (E) by pressing or driving on cup until seated lightly against outer bearing rollers.
6. Install the input pinion bearing retainer (bearing preload adjustment) shims (D). For initial assembly, use same number of shims as were removed at disassembly. Be sure holes in shims are aligned with bolt holes in carrier.
7. Install the outer pinion bearing retainer plate (C).
8. Install and tighten the eight bearing retainer plate bolts (A).
Bolt Tightening Torque: 7-10 N•m (5-7 ft-lb)
9. After assembly, turn (rotate) the input pinion gear in the bearings to check for correct bearing preload setting.
As an aid for rotating the pinion gear, a temporary tool may be made using a discarded drive motor shaft spline end with a nut welded to it.
10. Put the tool into gear spline and turn the pinion gear slowly with a torque wrench to measure torque required to rotate the pinion.
Add or remove shims at end of outer bearing cup under retainer plate to obtain bearing preload value of:
0.11-0.56 N•m (1-5 in-lb) torque required to rotate pinion gear.
Available shim thicknesses: 0.003, 0.004, 0.007, 0.010, and 0.020 inch.
12. When correct pinion bearing preload has been set, be sure retainer bolts are tightened to the correct torque.
12. Install new O-ring seal (U) in groove of carrier (I) pilot flange.
13. Put pinion bearing carrier (pinion gear position) shims (K) on the carrier mounting surface. For initial assembly, use same number of shims and washers (N) as were removed at disassembly. Install several bolts to align and hold shims in place.
14. Put the pinion gear and carrier assembly on drive unit main housing.
Be careful not to damage O-ring seal surface when installing carrier pilot flange into housing.
15. Install mounting bolts and washers and tighten.
Bolt Tightening Torque: 77-88 N•m (57-65 ft-lb)

NOTE

After reassembly of the ring gear and shaft assembly (see following section), check the ring and pinion gears for tooth bearing pattern (correct position) and backlash. Add or remove carrier mounting shims (noted above) as needed to adjust pinion gear position. Be sure carrier mounting bolts are tightened to correct torque after shim adjustment.

Section 4.

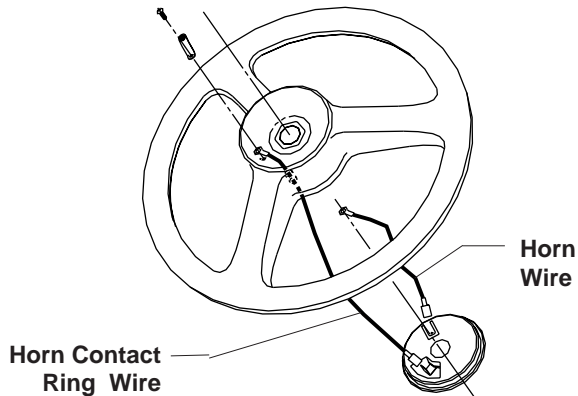
Brake Caliper Removal and Replacement

GROUP 25/26

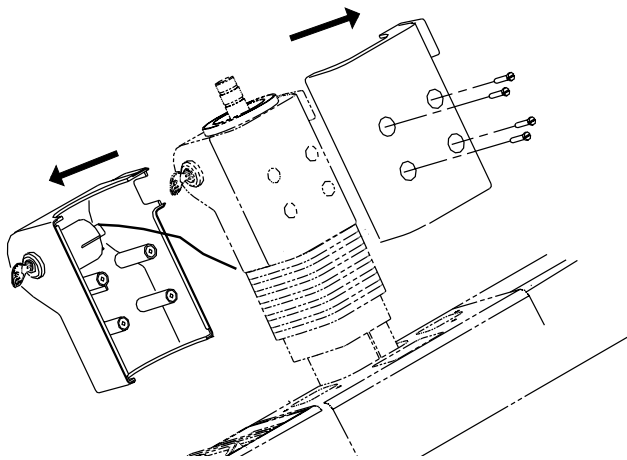
STEERING

Steering System Specifications and Description	Section 1
Steering System Troubleshooting	Section 2
Steering Column and Component Removal and Replacement	Section 3
Steering System Relief Pressure Check and Adjustment	Section 4
Steering Gear Overhaul	Section 5
Steer Axle Service	Section 6
Steer Cylinder Overhaul	Section 7
Steer Pump Overhaul	Section 8

- Unplug the horn contact ring wire from the terminal on the bottom of the handwheel.



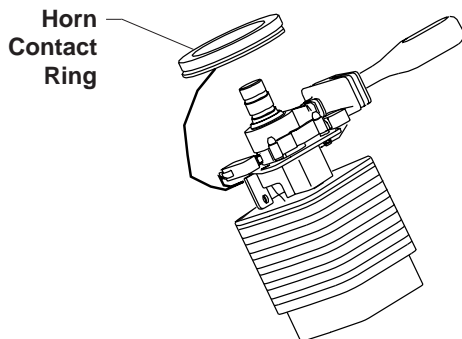
- Using a 2.5 mm hex key, remove the four socket head bolts holding the two halves of the column cover together. Remove the top cover. Gently pull the bottom cover away.



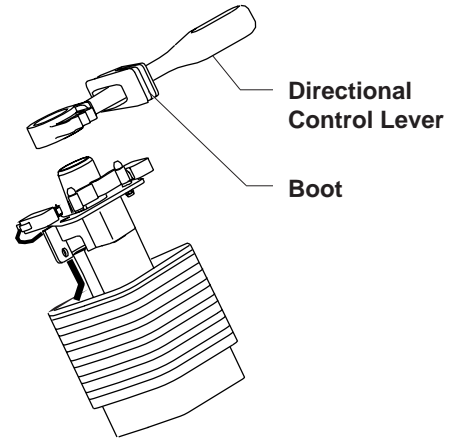
NOTE

Use care when removing the bottom cover as the key switch wiring is attached.

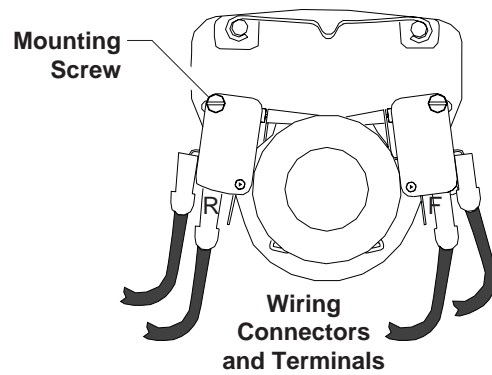
- Remove the horn contact ring. Unplug the wire from the terminal on the bottom of the ring.



- Lift the directional control lever and boot off the die-cast base.

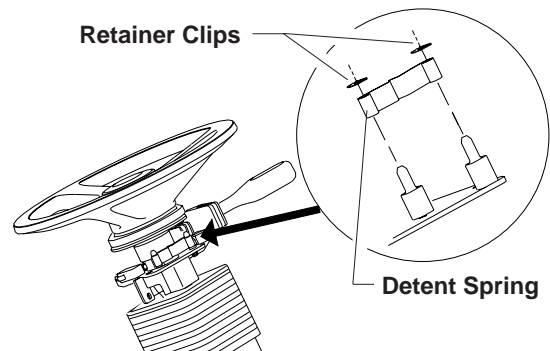


- Unplug wires from directional switches. Label all wires and terminals for correct connection when reassembling. Remove the direction control switches by removing the mounting screws on the base.



Detent Spring Removal

- If not already disassembled, remove the four socket bolts holding the two sides of the column cover together. Remove the top cover.
- Pry the two retainer clips from the posts on the directional control base securing the detent spring. Lift spring off posts.



Section 5.

Steering Gear Overhaul

Disassembly	2
Meter (Gerotor) End	2
Control End	2
Parts Inspection	4
Reassembly	4
Control End	4
Meter (Gerotor) End	6

IMPORTANT

Before removing any component for overhaul, make sure the correct repair parts, seals, and gasket sets are available.

NOTE

The following material does not show the load sensing port on the steering gear (steering control unit). The port is located in the center of the other four ports. The load sensing port requires no special overhaul procedures.

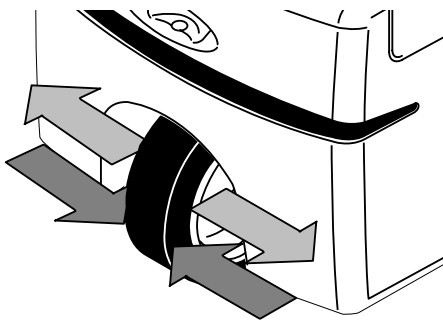
Steer Wheel Bearing Maintenance

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

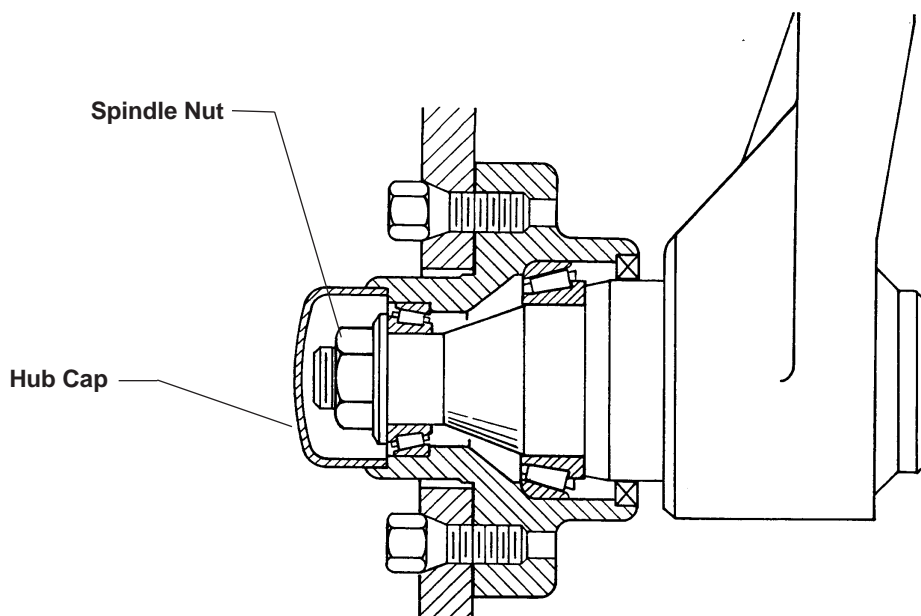
SPINDLE NUT SHOULD BE REPLACED WITH A NEW ONE each time it is removed because holding torque capability is partially destroyed with each removal.

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.



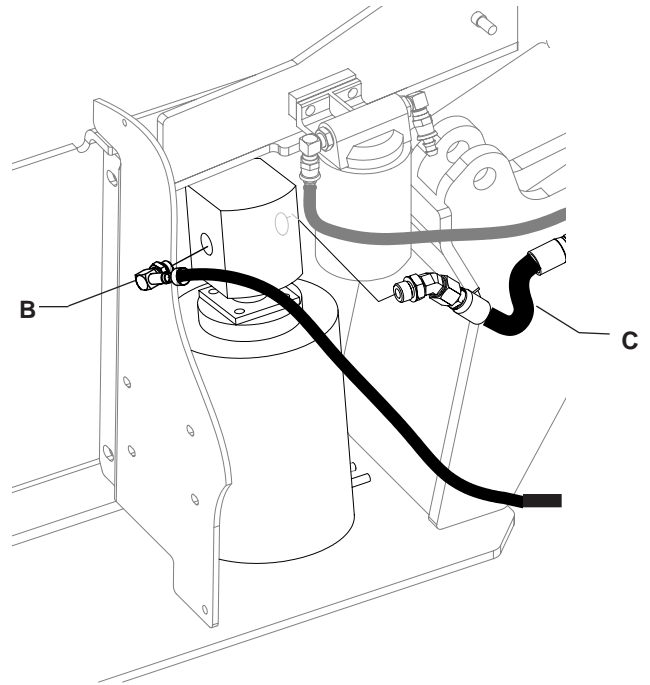
Section 8. Steer Pump Overhaul

Removal and Replacement

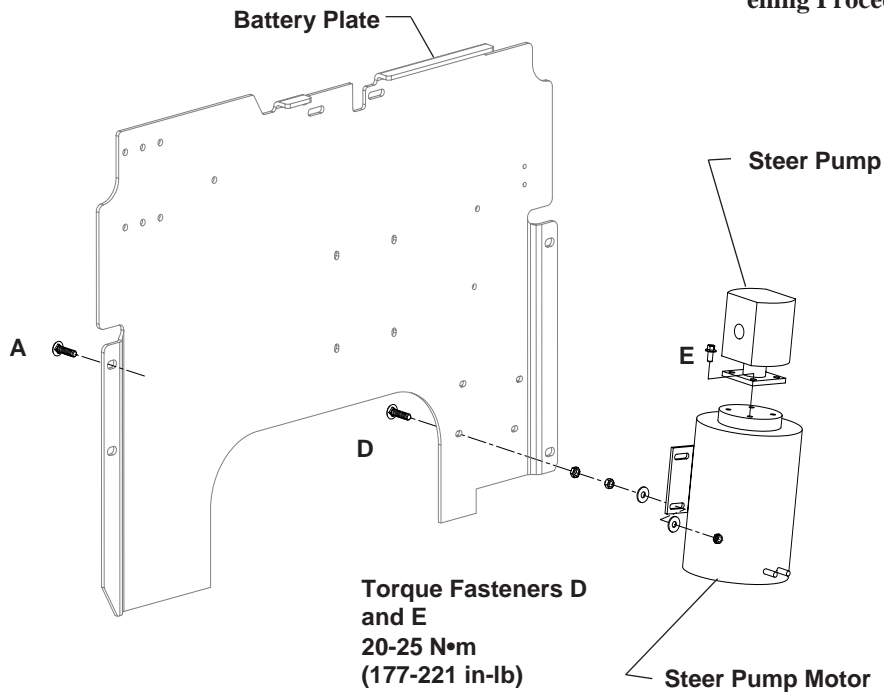
The pump can be removed by itself, or the motor/pump assembly can be removed as a unit as show below. Set up a shallow pan to catch oil from hoses and pump.

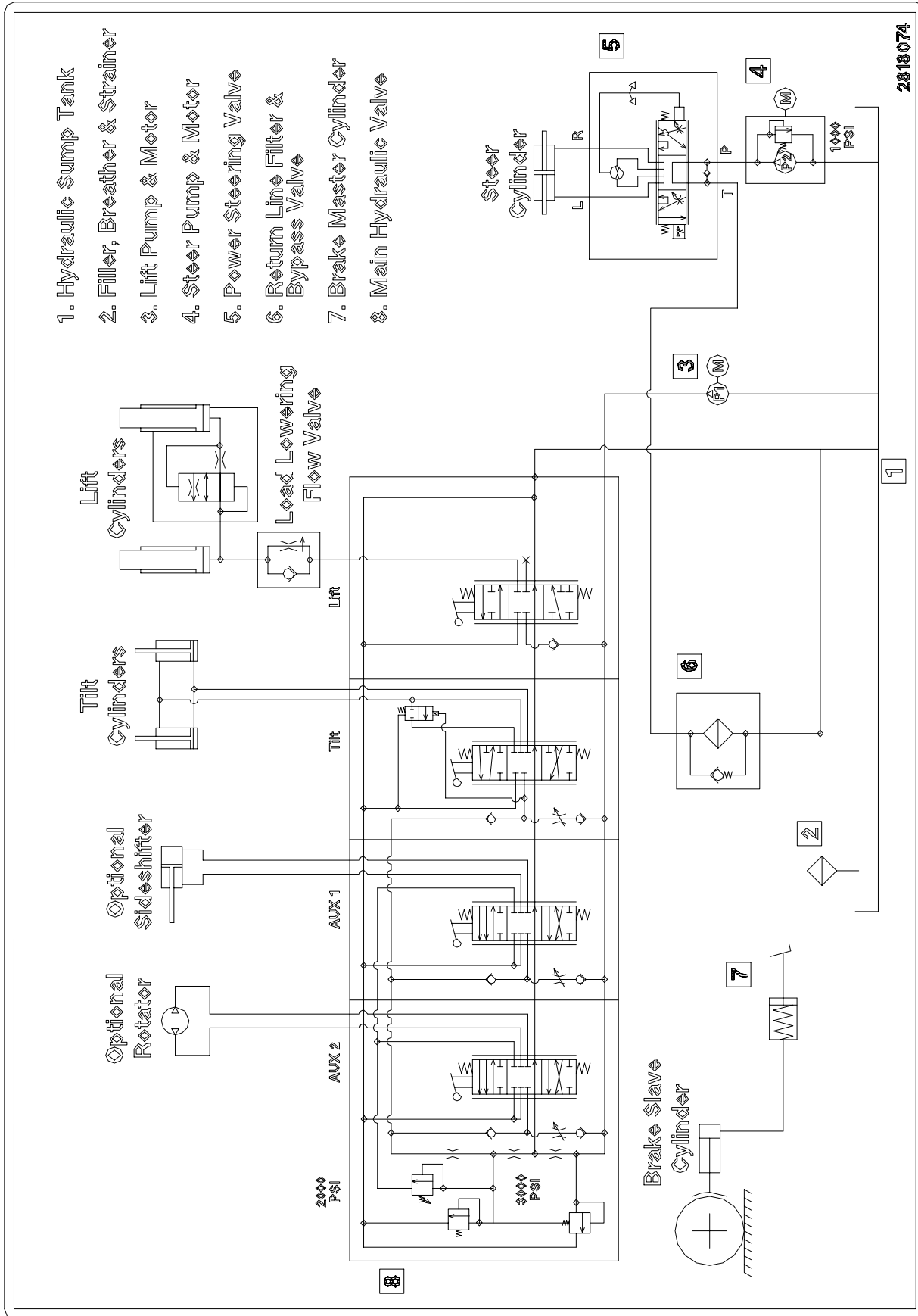
Removal and Replacement (reverse order):

- A. Battery plate mounting screws. Loosen fasteners and tilt back plate for access. To install fasteners, tap in with hammer.
- B. Suction line from sump.
- Note: Keep disconnected lines elevated to prevent leakage.
- C. Supply line to steering circuit.
- D. Motor/pump assembly mounting screws.
- E. Pump mounting screws.



NOTE
Tighten fittings per “Hydraulic Fitting Tightening Procedure” in Group 40.





- 1. Hydraulic Sump Tank
- 2. Filler, Breather & Strainer
- 3. Lift Pump & Motor
- 4. Steer Pump & Motor
- 5. Power Steering Valve
- 6. Return Line Filter & Bypass Valve
- 7. Brake Master Cylinder
- 8. Main Hydraulic Valve

2818074

Hydraulic Schematic

Section 4.

Hydraulic System Pressure Checks and Adjustments

Relief Pressure Checks	2
Main Pressure Relief Adjustment	3
Auxiliary Pressure Relief Adjustment	3
Flow Control Adjustments	4

**CAUTION**

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. Apply the parking brake and block the wheels.

Section 6.

Hydraulic Control Valve Removal and Overhaul

Hydraulic Control Valve Removal	2
Preparation for Valve Removal	2
Control Valve Linkage Disassembly	2
Valve Removal	2
Hydraulic Control Valve Replacement	3
Valve Replacement	3
Control Valve Linkage Reassembly	3
Lift and Tilt Pump Switches Adjustment	4
Operational Checks	4
Hydraulic Control Valve Overhaul	5
Preparation for Disassembly	5
Disassembly	6
Cleaning, Inspection, and Repair	7
Reassembly	8
Relief Valve Settings	8

CAUTION

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. Apply the parking brake and block the wheels.**
- 5. Disconnect the battery.**

Section 1.

Tilt Cylinder Specifications and Description

Specifications

See Group 29 for hydraulic system specifications.

Tilt Cylinder Type: Double-acting

Maximum Operating Pressure: 21,000 kPa (3,000 psi)

Tilt Ranges: (188 Cascade Triple Stage Upright): 3° back tilt and 5° forward tilt

Fastener Torques

Rod-End Yoke Bolts: 170-190 N•m (125-140 ft-lb)

Service Intervals

Tilt Cylinder Drift Test: Every 50-250 hours or each PM.

Tilt Cylinder Check and Adjustment: Every 50-250 hours or each PM.

Tilt Cylinder Rod Seal Condition Check: Every 50-250 hours or each PM.

Tilt Cylinder Mounting Check and Tightening: Every 50-250 hours or each PM.

Tilt Cylinder Rod-End Check and Tightening: Every 50-250 hours or each PM.

Tilt Cylinder Rod-End Lubrication: Every 50-250 hours or each PM.

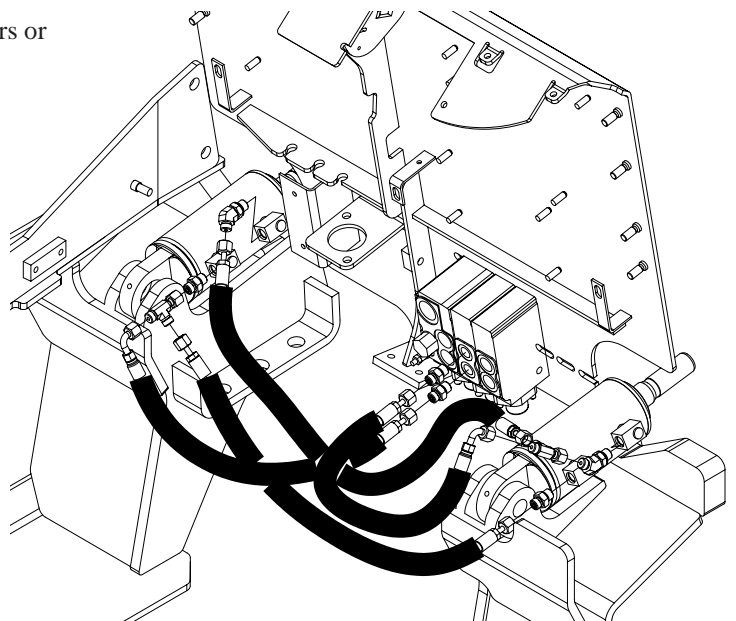
Description

The tilt cylinders provide backward and forward tilt of the upright. The forward and back tilt angles are governed by the cylinder stroke and by use of spacers and different length rod ends. The tilt cylinders are pin-mounted to the truck frame and upright using yokes, clevises, and pins. Pins are held in place by a lock plate and fastener to prevent the pins from working their way out.

The tilt cylinders are serviced by removing them from the truck and disassembling them for complete overhaul, including installation of new seals and or other cylinder components.

The tilt lock valve is integrated into the tilt section of the main hydraulic control valve. The tilt lock valve prevents the upright from tilting forward when the truck is not running. The tilt lock valve is not serviceable and must be replaced as a valve section if defective.

Tilt Cylinders



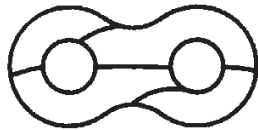
Section 4.

Tilt Cylinder Overhaul

IMPORTANT

Before removing any component for overhaul, make sure the correct repair parts, seals, and gasket sets are available.

- **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

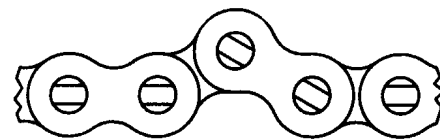
This type of failure is caused by overloads far in excess of the design load.



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.**

Section 3.

Overhead Guard Removal and Installation

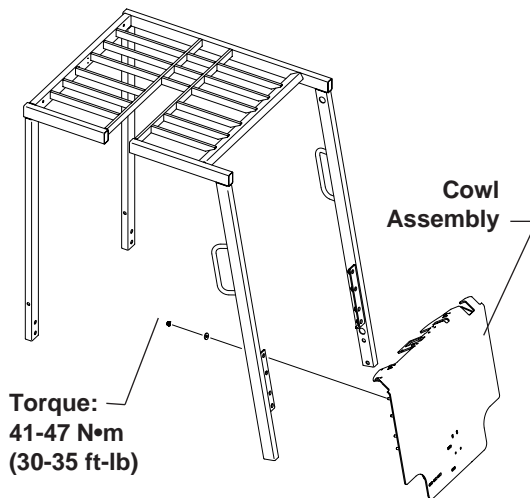
CAUTION

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. Apply the park brake and block the wheels.

It is not necessary to remove the overhead guard for normal service or repair of the truck. If the overhead guard must be replaced or repaired, remove it as follows:

1. Remove the seat deck from the truck
2. Support the cowl assembly with an overhead lifting device and remove fasteners holding the front cowl assembly to the overhead guard.

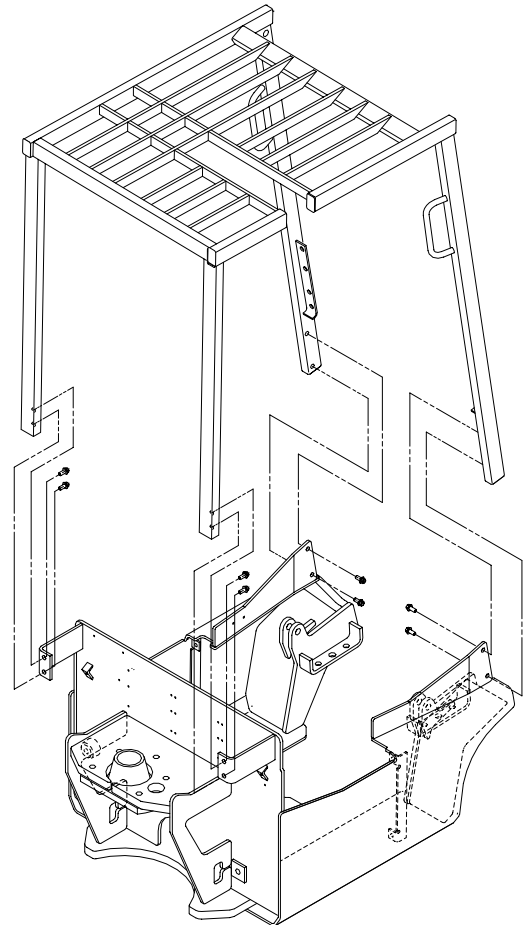


3. Remove the overhead guard mounting bolts.
4. Lift the overhead guard from the truck.
5. Reverse procedure for installation.

If it is necessary to replace the rivet nuts in the overhead guard, use AVK Rivet Nut Gun #AKPT3P12175, available from AVK Industrial Products in Valencia, CA.

WARNING

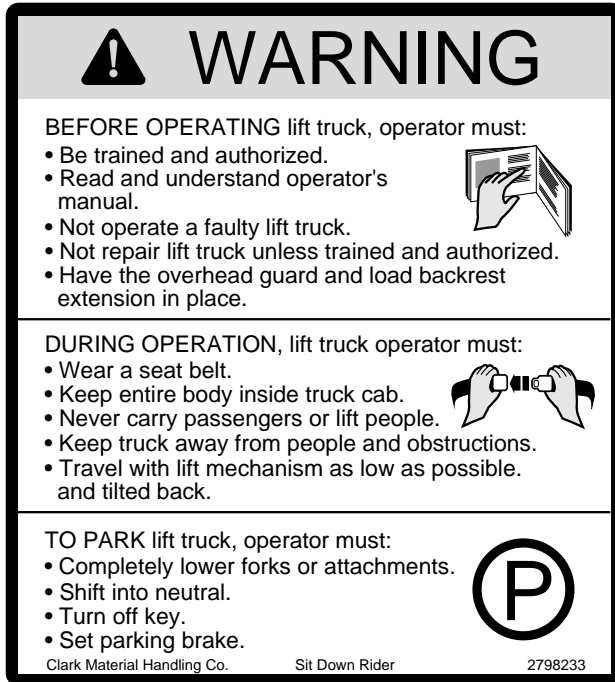
Overhead guard must be in place to protect operator from falling objects.



Torque overhead guard mounting bolts:
88-95 N•m (65-70 lb-ft)

Warning Decal

The Operator Safety Warning Decal describes basic safe operating procedures that should be used when operating the truck. This decal depicts important points about truck operation and warns operators about truck safety hazards. This decal is meant as a reminder for operators. It is placed where operators can review the points daily as they conduct a visual inspection and prepare the truck for work.



IMPORTANT

Safety and warning decals are placed in conspicuous locations on the truck to remind operators of essential procedures or to prevent them from making an error that could damage the truck or cause personal injury. Safety and warning decals should be replaced immediately if missing, damaged or illegible. This is required by OSHA.

Lift trucks can be tipped over if operated improperly. Experience with lift truck accidents has shown that the driver cannot react quickly enough to jump clear of the truck and overhead guard as the truck tips. To protect operators from severe injury or death in the event of a tip-over, make sure this decal is in place to remind them to always use their seat belts.

Operator Safety Decal

The Operator Safety Decal depicts important points about truck operation and warns operators about truck safety hazards. The Operator Safety Decal is meant as a reminder for operators and is placed where operators can review the points daily as they conduct a visual inspection and prepare the truck for work.



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