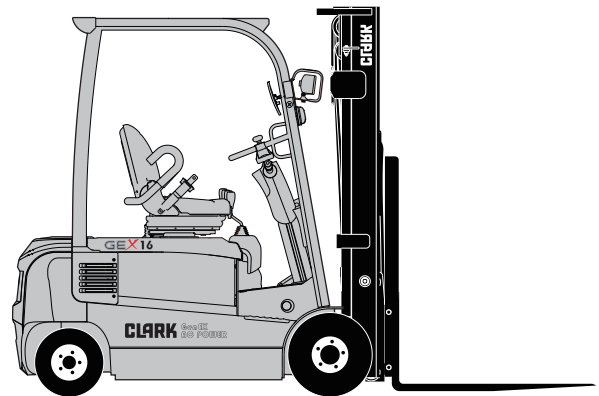


SERVICE MANUAL

GEX 16/18/20s (4 Wheel)

GTX 16/18/20s (3 Wheel)

RATED CAPACITY : 1600 - 2000Kg



**SM-795
Jun. 2008**



(Head office) 202-1 Ojung-Dong, Ojung-Gu,
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(Factory) 40-1 Ungnam-dong, Changwon-city,
Kyungnam, Korea

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Section 2**Lifting, Jacking, and Blocking**

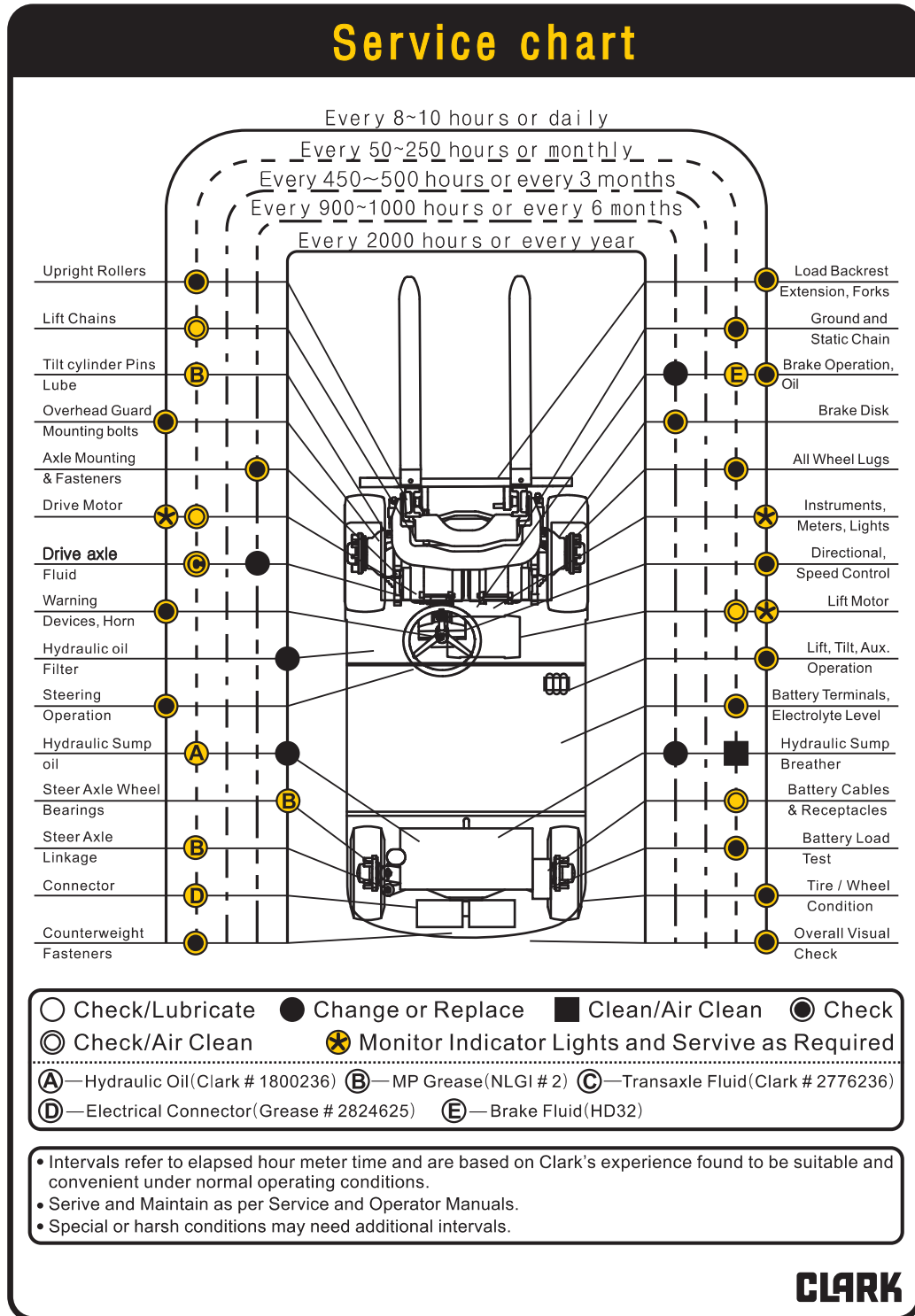
Raising Drive Wheels	2
Chaining the Upright in Raised Position	2
Raising Rear of Truck.....	3
Raising Entire Truck	4
Shipping Tie-Down Instructions.....	4

**WARNING**

Lifting or jacking any large piece of equipment such as a fork truck presents obvious hazards. It must be done with great care and forethought. Consult the truck weight information in Group 40, Specifications, to ensure that your lifting equipment is of adequate capacity.

GEX16-20s Service Chart/Lubrication Points

A decal, similar to the illustration below, is located on the underside of the seat deck. This decal is a basic guide to periodic maintenance intervals and tasks. A more detailed chart is supplied on the next page.





CAUTION

If the service brake, parking brake, or interlock is not operating properly, take the truck out of service until it is repaired.

Traction and Braking System

Next, drive the truck to test the braking, accelerating, turning and reversing.



WARNING

Fasten your seat belt before driving the truck.

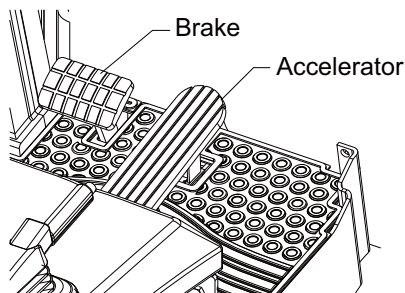
NOTE

After you move the truck, you can check where the truck was parked to see if there are any leaks.

Brakes

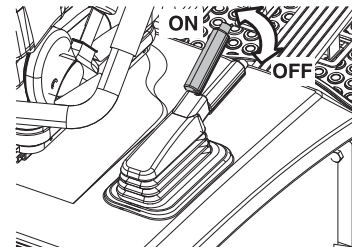
Make sure that the truck is on a level surface, the travel area is clear in front of and behind the truck, the parking brake is released, the direction control is in neutral, and the key switch is on. The numerical display should show battery condition with the parking brake off.

1. Move the direction control lever from neutral to forward.
2. Check brakes at creep speed: Release the brake pedal and depress the accelerator pedal to obtain slow forward speed. Apply the brake pedal to ensure that the brakes are sufficient to stop the truck. Pedal should feel firm and drive motor should cut off before brakes apply.



3. Check brake pedal freeplay: Travel again and gently depress the brake the brake pedal. The pedal should drop a very slight distance before the brakes begin to apply.
4. Check brakes at full travel speed: Depress and release the brake pedal several times while driving the truck. The brakes should bring the truck to a smooth stop without pulling, squealing, or shuddering. Drive motor should cut off before brakes apply.

5. Check brake holding capability and adjustment: Park the truck on a grade and depress brake pedal. The brake should hold a lift truck with rated load on a 15% grade.
6. Check the function of the parking brake: Park the truck on a grade and apply the parking brake. The parking brake should hold a lift truck with rated load on a 15% grade. Also, when travelling at full speed, application of the parking or service brake should stop the truck in one truck-length.



Release Braking

Release Braking is the automatic slowing of the truck, using the drive motor as a generator, when you lift your foot from the accelerator.

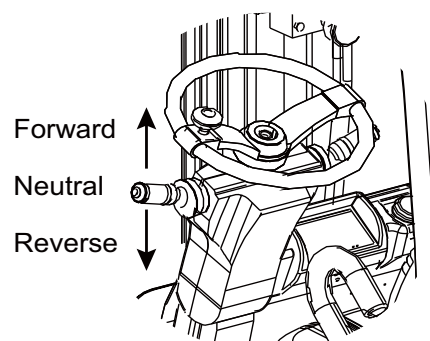
Accelerate to a Medium speed. Take your foot off the accelerator, truck should smoothly brake to a stop (distance depends on the RELEASE BRAKING setting).

When the truck is on a ramp and the accelerator pedal is released, the truck should brake to a stop and then continue the creep down the ramp at approx. 1 MPH.

See Section 19 for adjustment procedures for the Release Braking function.

Controlled Reversal

Accelerate to a slow speed and reverse the direction control without applying the foot brake. Truck should slow to a smooth stop then accelerate normally in the opposite direction.



Repeat in both directions at various speeds.

Section 1

Battery Service

Battery Handling	2
Battery Removal	3
Battery Maintenance	4
Battery Installation	5
Keeping Battery Records	6
Battery Tests	6
Connector Installation	7

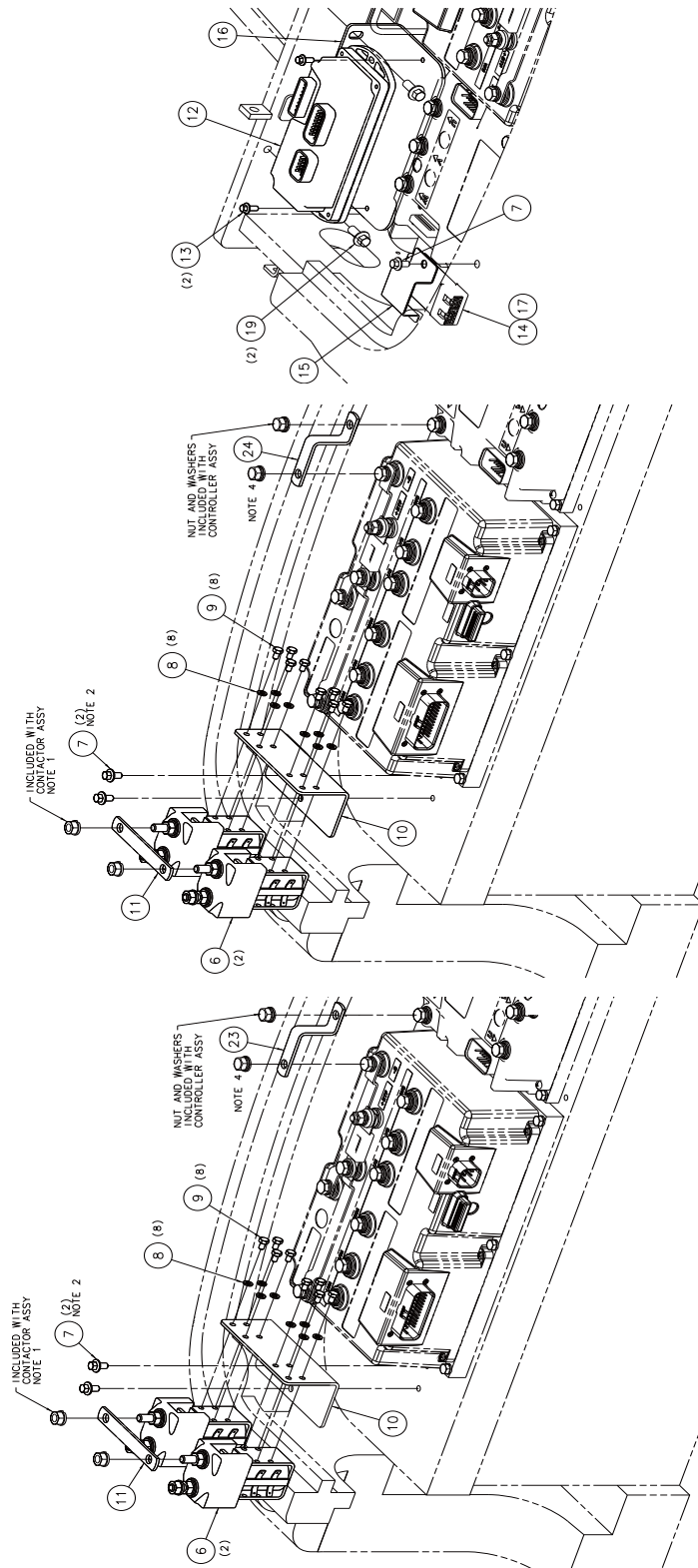
Section 1

Schematic Electric Circuit Diagrams

Standard Truck 2

Optional Truck 3

Electrical Components (GEX)

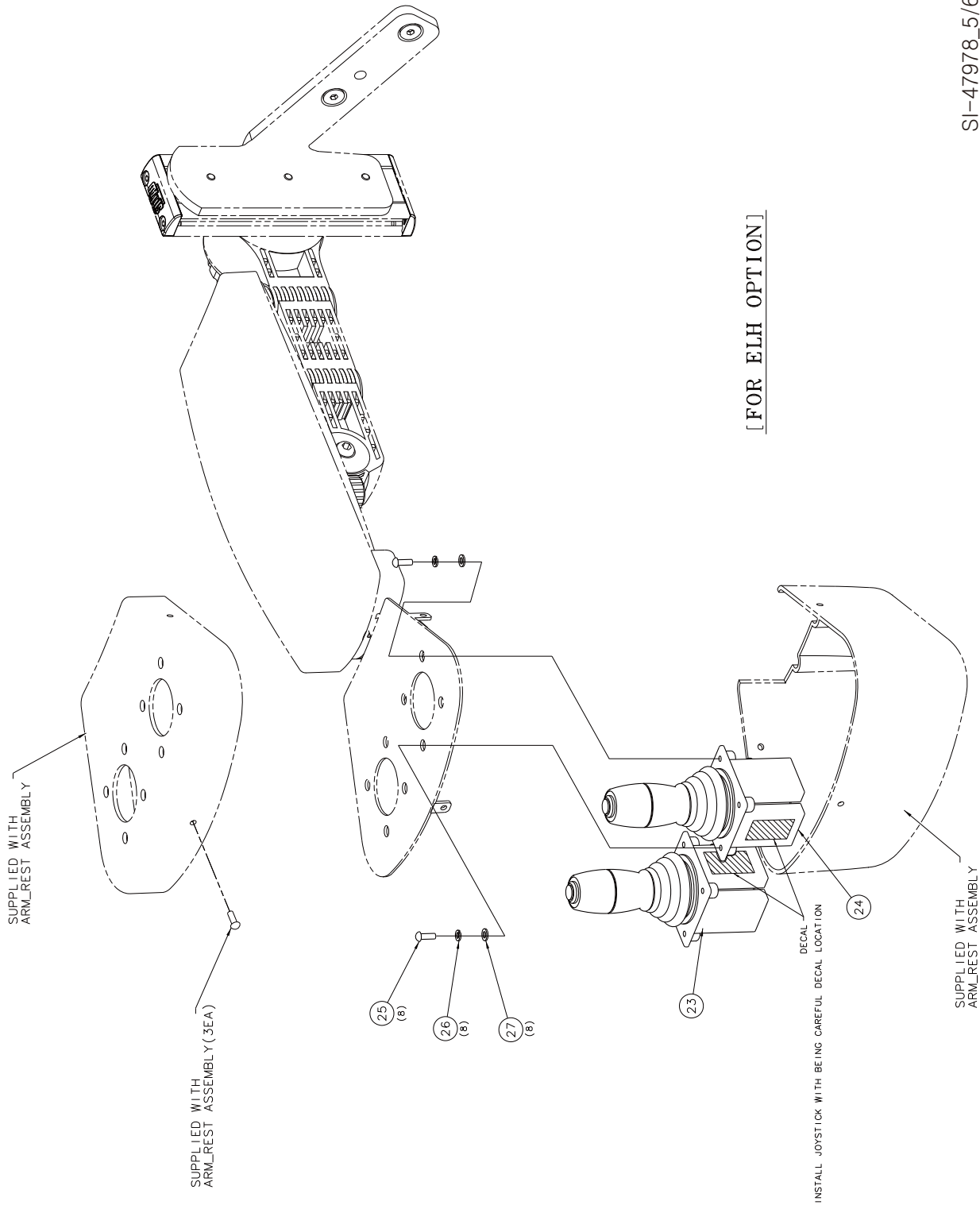


ELH OPTION

STD

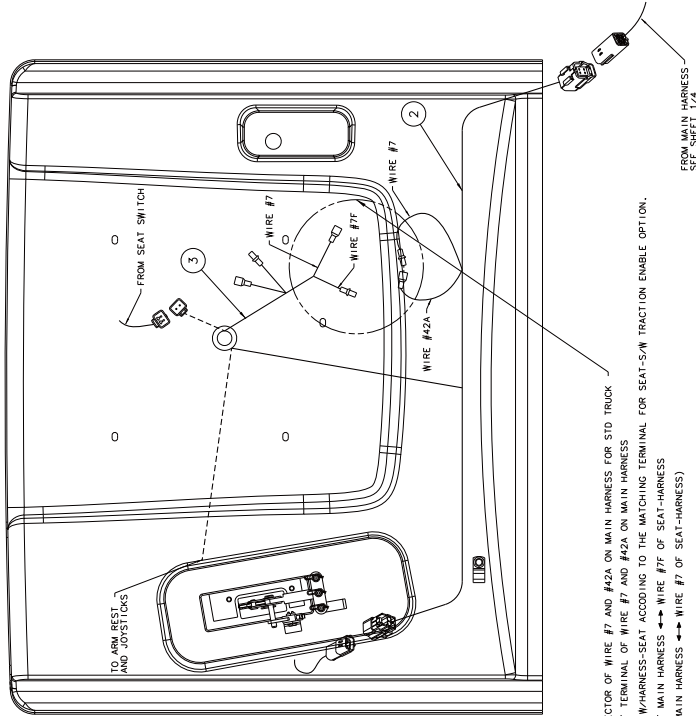
SI-48300(2/7)

Electrical Components (GTX)

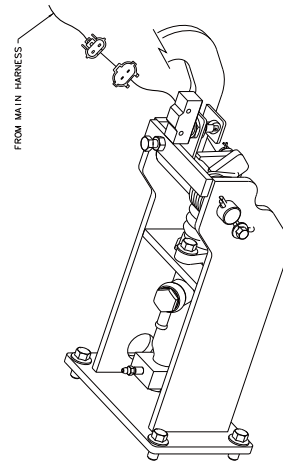
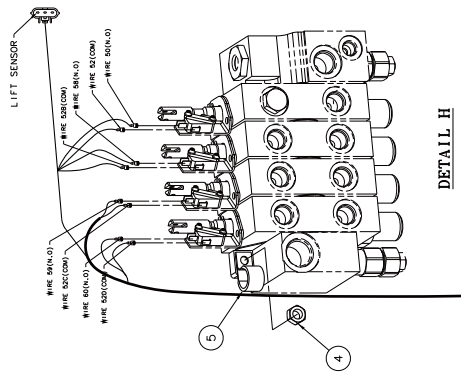
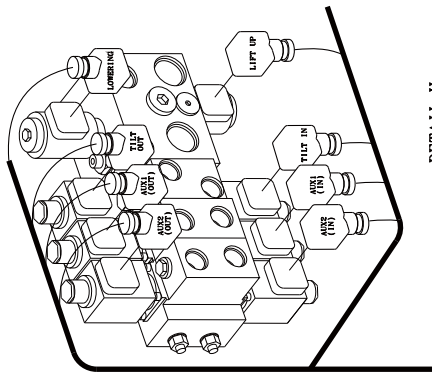


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Main Harness (GTX)

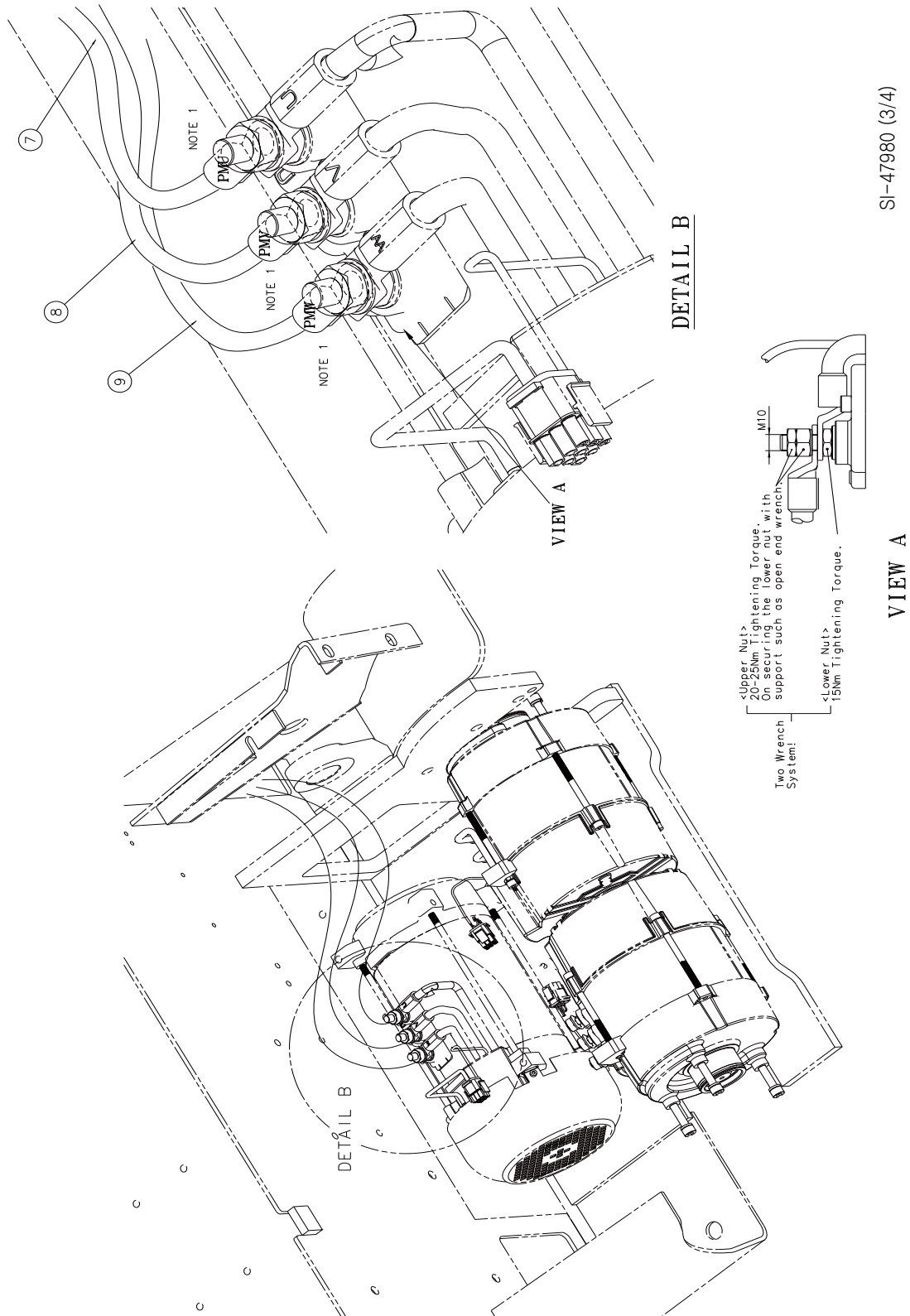


1. JOIN CONNECTOR OF WIRE #7 AND #42A ON MAIN HARNESS FOR STD TRUCK
2. DISCONNECT TERMINAL OF WIRE #7 AND #42A ON MAIN HARNESS AND ASSEMBLE W/HARNESS-SEAT ACCORDING TO THE MATCHING TERMINAL FOR SEAT-S/M TRACTION ENABLE OPTION.
(WIRE #42A OF MAIN HARNESS ↔ WIRE #77 OF SEAT-HARNESS)
WIRE #7 OF MAIN HARNESS ↔ WIRE #7 OF SEAT-HARNESS)



SI-47979_4/5

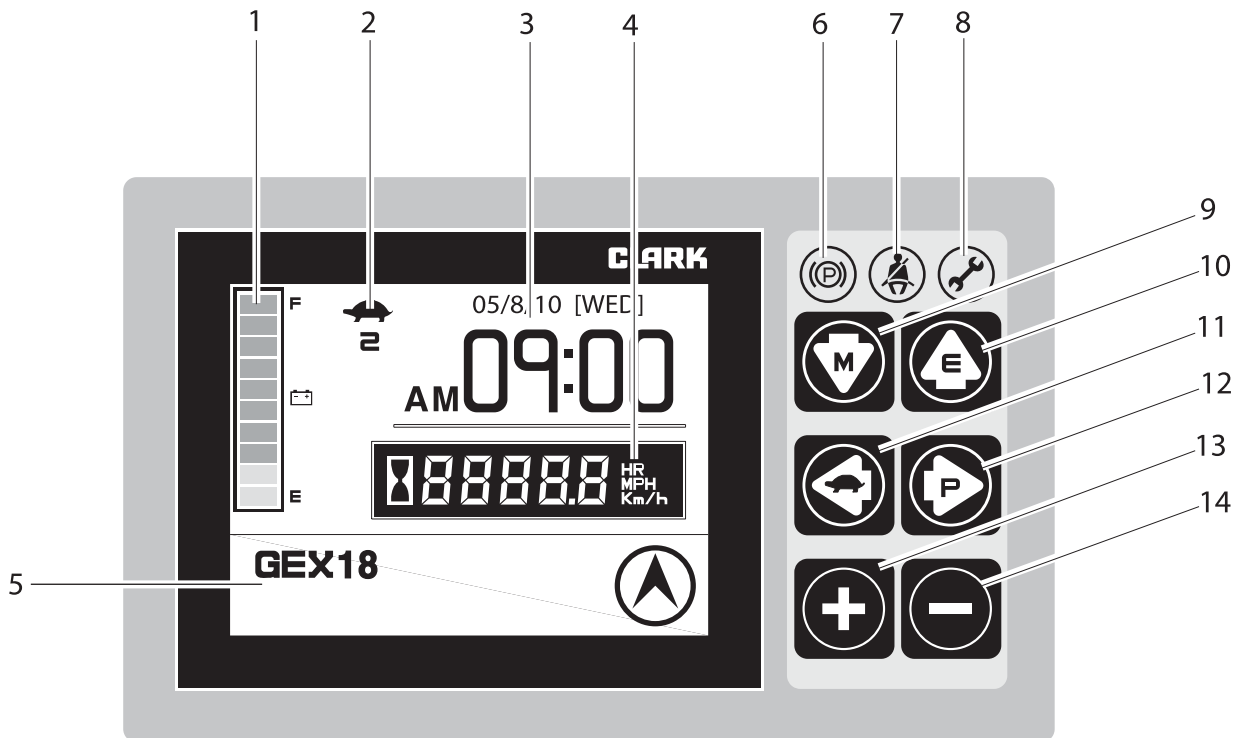
Cable (GTX)



SI-47980 (3/4)

1.2 Name of section

The Dash Display provides the operator with an easily understandable, visual feedback of the status of the truck and its system components..

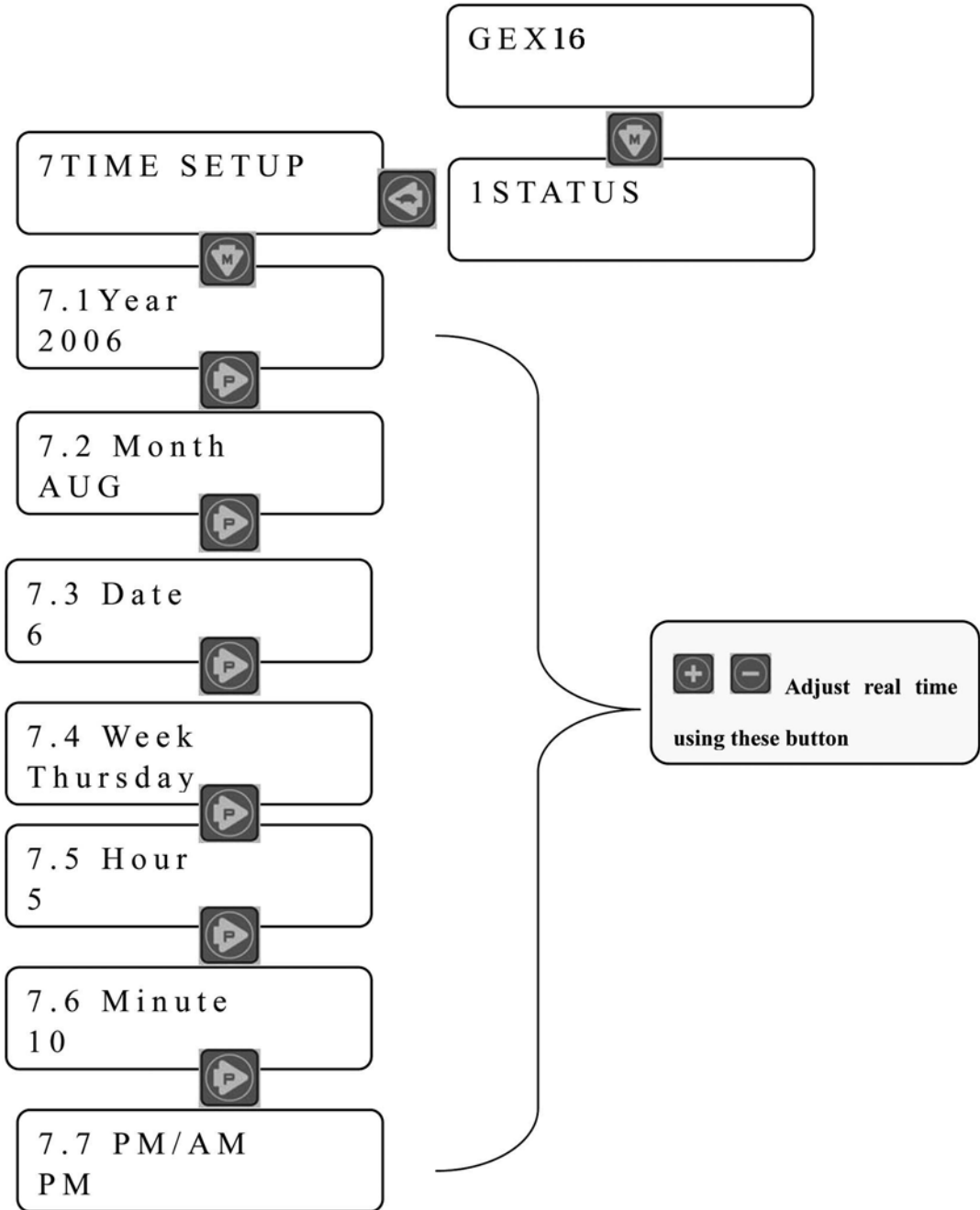


- | | |
|--|---|
| 1. Fuel level Indication | 8. Error LED |
| 2. Slow-speed icon (Turtle shaped) | 9. Down arrow button (Mode button) |
| 3. Date & Time | 10. Up arrow button (Enter button) |
| 4. Hourmeter & Speed | 11. Left arrow button (Slow speed button) |
| 5. Message display & Travel direction icon | 12. Right arrow button (Power button) |
| 6. Parking brake LED | 13. Plus button |
| 7. Seat belt LED | 14. Minus button |

	PASSWORD	TRACTION PARAMETER Change	ON	OFF	ON
5	PASSWORD	Password management			
5.2	SETUP MODE	SETTING change		99999	ON
5.3	PASSWORD CHANGE	Password change	00000		10000
6	SETUP				
6.1	T-PARAMETER				
6.1.1	ACCEL DELAY	ACCEL DELAY	0	9	3 +/- (Note #1)
6.1.2	RELEASE BRAKING	RELEASE BRAKING	0	9	3 +/- (Note #1)
6.1.3	INVERS BRAKING	INVERS BRAKING	0	9	6 +/- (Note #1)
6.1.4	PEDAL BRAKING	PEDAL BRAKING	0	9	7 +/- (Note #1)
6.1.5	SPEED LIMIT BRK	SPEED LIMIT BRK	0	9	0 +/- (Note #1)
6.1.6	BRAKE CUTBACK	BRAKE CUTBACK	0	9	5 +/- (Note #1)
6.1.7	CURVE BRAKING	CURVE BRAKING	0	9	5 +/- (Note #1)
6.1.8	MAX SPEED FORW	MAX SPEED FORW	0	200hz	140hz +/- (Note #1)
6.1.9	MAX SPEED BACK	MAX SPEED BACK	0	200hz	140hz +/- (Note #1)
6.1.10	CUTBACK SPEED I	CUTBACK SPEED I	0	9	9 +/- (Note #1)
6.1.11	CURVE CUTBACK	CURVE CUTBACK	0	100%	20% +/- (Note #1)
6.1.12	CURVE CUTBACK #1	CURVE CUTBACK #1	0	9	5 +/- (Note #1)
6.1.13	FREQUENCY CREEP	FREQUENCY CREEP	0	9	0 +/- (Note #1)
6.1.14	MAX CURRENT	MAX CURRENT	0	9	9 +/- (Note #1)
6.1.15	AUXILIARY TIME	AUXILIARY TIME	0	9	3 +/- (Note #1)
6.1.16	SEAT MICRO DELAY	SEAT MICRO DELAY	0	9	5 +/- (Note #1)
6.1.17	ACC. SMOOTH	ACC. SMOOTH	0	9	6 +/- (Note #1)
6.1.18	INV. SMOOTH	INV. SMOOTH	0	9	0 +/- (Note #1)
6.1.19	STOPSMOOTH	STOPSMOOTH	0	9	6 +/- (Note #1)
6.2	T-OPTION	T-OPTION			
6.2.1	STOP ON RAMP	STOP ON RAMP	0	1	0: OFF +/- (Note #1)
6.2.2	STEER TABLE	STEER TABLE	0	1	0: OPT #1 +/- (Note #1)
6.3	T-ADJUSTMENT	T-ADJUSTMENT			
6.3.1	SET BATTERY TYPE	SET BATTERY TYPE	0	5	1: 36V +/- (Note #1)
6.3.2	MAX STEER RIGHT	MAX STEER RIGHT	0x (5V/255)	255x (5V/255)	210x (5V/255) +/- (Note #2)
6.3.3	MAX STEER LEFT	MAX STEER LEFT	0x (5V/255)	255x (5V/255)	46x (5V/255) +/- (Note #2)
6.3.4	SET STEER O-POS	SET STEER O-POS	0x	255x	127x +/- (Note #2)

3.7 DATE(Time) set

Display could be reset time and date



Replacing Speed sensor

- Turn key OFF.
- Set park brake.
- Disconnect battery.
- Remove the socket bolt on the speed sensor.
- Remove the speed sensor form the motor.

Speed Sensor Reassembly

- Reinstall in reverse order.

Protection against accidental startup:

A precise sequence of operations is necessary before the control will start (SRO). Startup cannot occur if the sequence is not followed completely. (Request for drive, must be made after closing the key switch).

Capacitor Charge:

The controllers can hold an electrical charge for several seconds, due to the power capacitor bank. A discharge resistance is built in the controller, which ensures capacitor discharge to a safe voltage in about one minute, after the key is switched off. If it is necessary to work on the controller before that time, discharge the capacitors as described below.

Discharging Controller Capacitors

It is necessary to discharge the capacitors before you work on the controller. To discharge the capacitors, disconnect the battery at the battery receptacle, connect a 200 ohm 10 watt resistor between the positive and negative input post of the controller for 10 seconds.

Communications with CLARK Dash:

The traction controller communicates by CANBUS to CLARK dash. The dash shows Battery State of charge, Hourmeter and fault code if a fault occurs.

Microswitches:

The micro switches must have a contact resistance lower than 0.1ohm and a leakage current lower than 100 micro amps.

When full load is connected, the voltage between the key switch contacts must be lower than 0.1 volt.

The micro switches send a voltage signal to the microprocessor when a function is requested (for example: running request) is made.

Accelerator Unit:

The accelerator unit consists of a potentiometer in 3 wire configuration.

CPOT (C21) signal.

EN ACC (C8) is the accelerator enable. It is fed with +Batt from the key switch.

NPOT (C20) is the accelerator negative supply. This output is feed back to the microprocessor A/D converter to test the continuity of the accelerator unit circuit (test of pot wire disconnection). The procedure for automatic potentiometer signal acquisition is carried out using the handset. This enables adjustment of the minimum and maximum useful signal level (PROGRAM VACC function), in either direction. This function is unique when it is necessary to compensate for asymmetry with the mechanical elements associated with the Potentiometer. Especially relating to minimum level. The sequence of procedure is described later in this manual.

Analog control unit

Connection C35 (PTHERMR) and C34 (NTHERMR) are used for the right motor thermal sensor. Connection C35 (PTHERML) and C34 (NTHERML) are used for the Left motor thermal sensor. Sensors are analog.

Speed Feedback

The traction motors control is based upon the motor speed feed back. The speed transducer is an incremental encoder, with two phases shifted at 90°. The encoder is supplied with +12V from the control panel.

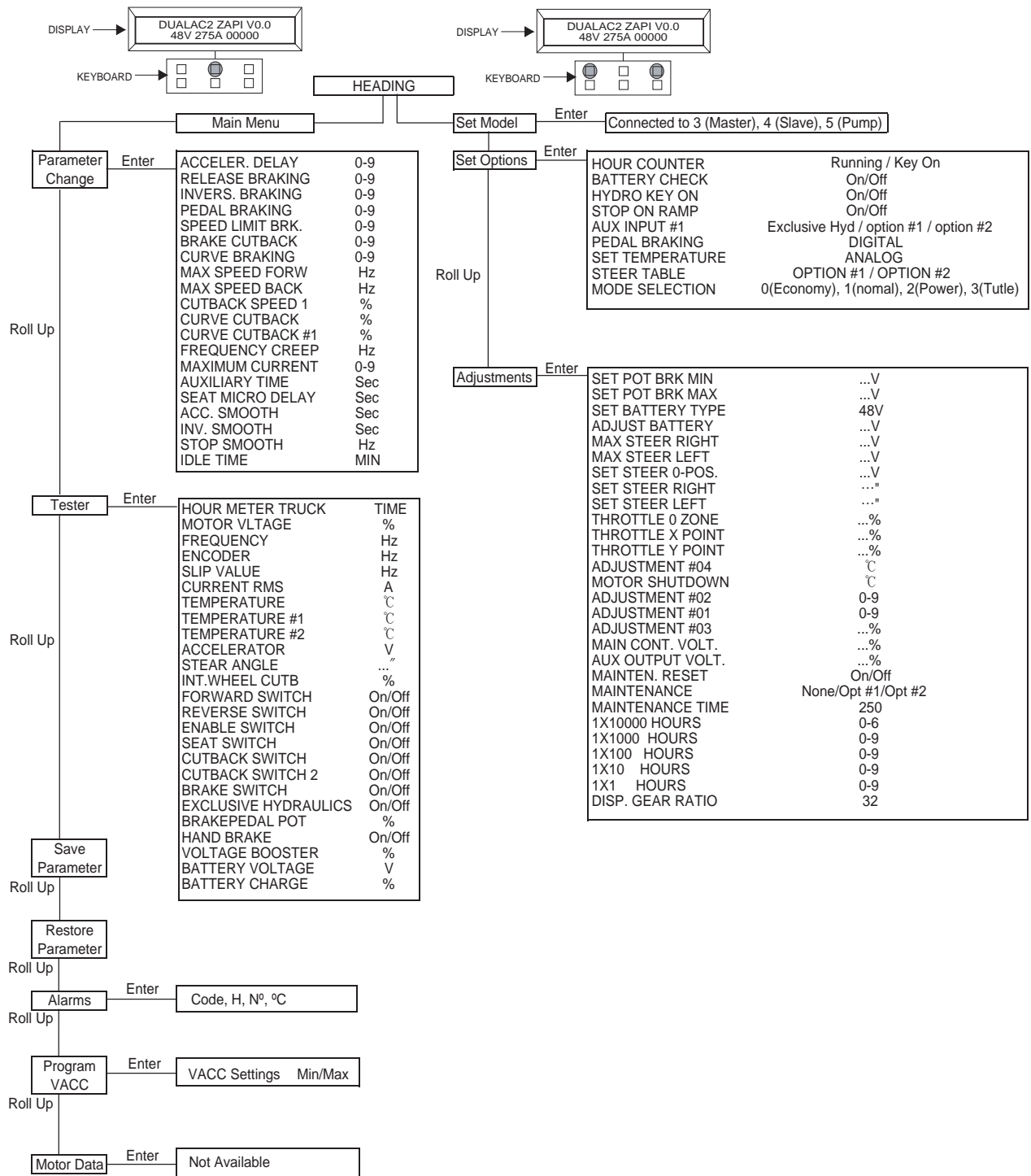
Steer Angle Transducer

Angular position of steered wheels is transduced to an electric information (voltage) by means of a potentiometer, with following characteristics:

- Positive supply: 12V \pm 2V
- Voltage potentiometer : 1V~9V
- Neutral : 5V
- Potentiometer is installed in a way that in the zero position (straight wheels), pot output voltage is in the middle of the electric range corresponding to a full left-to-right transition of steer wheels;
- The potentiometer is installed in a way that, when the truck turns right, pot voltage increases;
- Use "SET STEER MIN" and "SET STEER MAX" functions of the handset to record the extremes (minimum and maximum) of the potentiometer range;
- Use "SET STEER 0-POS" function of the handset to record the pot output when the steer wheels are straight.

See Group 19, Section 4 for GEX/GTX Factory Control Settings

GEX/GTX Handset Master Control Configuration



See Group 19, Section 4 for GEX/GTX Factory Control Settings

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:

SLAVE CONTROL

Motor voltage (%)	Current RMS (A)	Back switch (ON/OFF)
Frequency (Hz)	Temperature (°C)	Enable switch (ON/OFF)
Encoder (Hz)	Seat switch (ON/OFF)	Voltage booster (%)
Slip Value (Hz)	Forw switch (ON/OFF)	Battery voltage (V)

Slave Control - "Dual AC2 48V"

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) SEAT SWITCH:	The level of seat microswitch digital input. ON /+BV = input active, switch closed. OFF / GND = input non-active, switch open.
8) FORWARD SWITCH:	The level of the Forward direction digital input FW. ON /+BV = input active, switch closed. OFF / GND = input non-active, switch open.
9) BACKWARD SWITCH:	The level of the Reverse direction digital input BW. ON /+BV = input active, switch closed. OFF / GND = input non-active, switch open.
10) ENABLE SWITCH:	The level of the Enable digital input. ON /+BV = input active, switch closed. OFF / GND = input non-active, switch open.
11) VOLTAGE BOOSTER:	This is the booster voltage supplied to the motor in load condition; It is expressed in a percentage of the full voltage.
12) BATTERY VOLTAGE:	Level of the battery voltage measured at the input of the key switch.

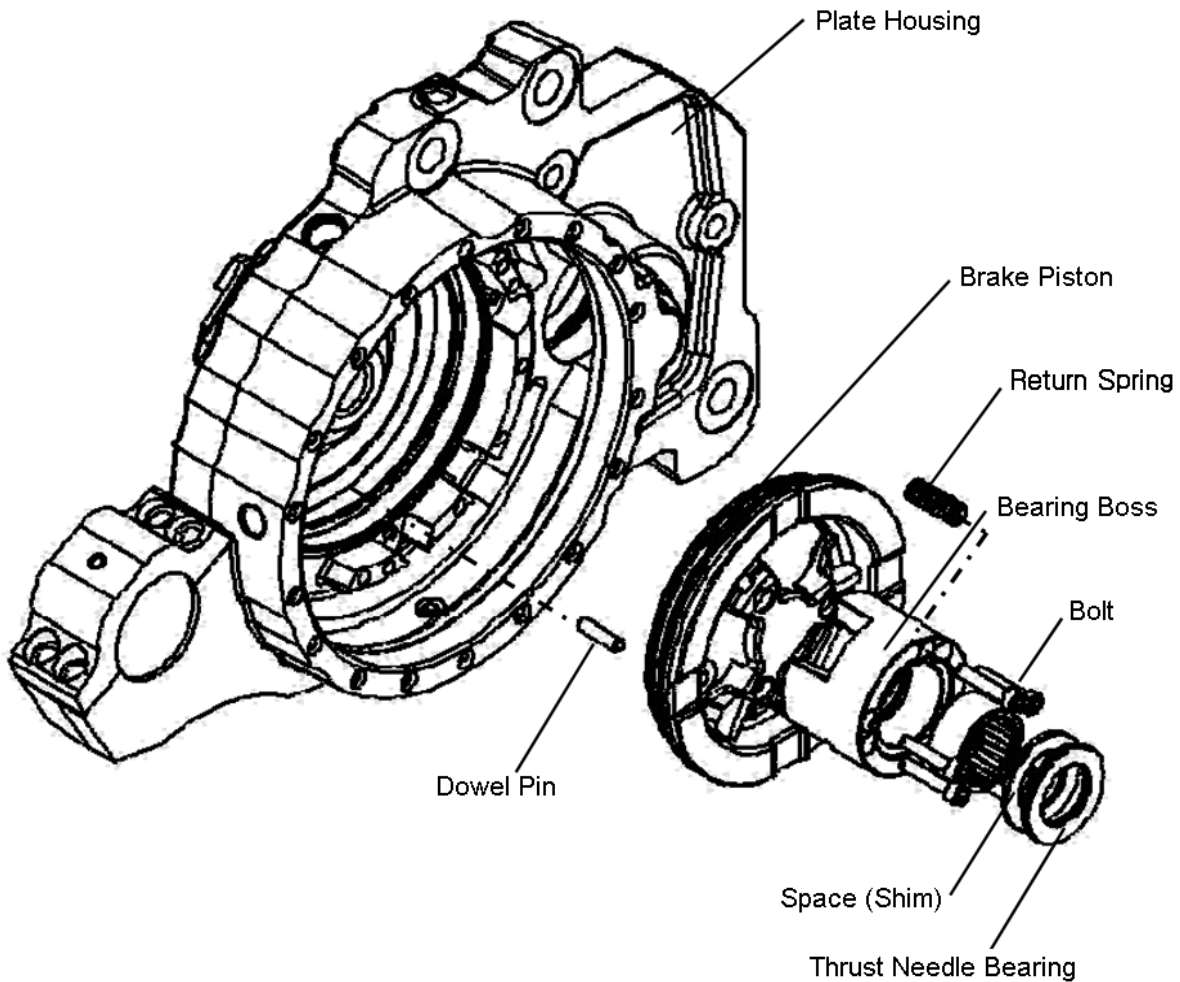
Fault Code	Fault Name	Fault Description	Control	Troubleshooting	Action Required
18	"LOGIC FAILURE #2	Failure in U,V,W voltage feedback circuit	MASTER	<ul style="list-style-type: none"> Fault in the hardware section of the logic board that manages the phase 's voltage feedback. 	Replace controller
19	"LOGIC FAILURE #1	An over voltage or under voltage condition has been detected	MASTER	<ul style="list-style-type: none"> This fault signals that the under voltage / over voltage protection interrupt has been triggered A real under voltage / over voltage key input (C3) happened. Voltage has been below 30V A real over voltage on the power capacitors happened, voltage has been 115V. Fault in the hardware section of the logic board that manages the over voltage protection. Possible plugging in or unplugging of battery or charger with the key switch on. 	Replace controller
30	"VMN LOW"	Wrong voltage on motor power outputs; failure in the power section or in the mosfet driver circuit or in the motor	MASTER	<ul style="list-style-type: none"> 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. A problem with motor connection or power circuit. <ul style="list-style-type: none"> Check if all 3 phases are correctly connected. Check for short between motor terminal and chassis Perform diode test unhook battery at controller and do a diode check between Batt + and Batt - (should read .3 to .5 volts) Diode test <ul style="list-style-type: none"> Disconnect all power and motor leads from control. Select diode test on your multi meter. Place positive meter lead on control - Battery terminal place negative meter lead on terminals U,V,W meter should read .3V to .5V if not replace control. Place negative meter lead on control + Battery terminal place positive meter lead on terminals U,V,W meter should read .3V to .5V if not replace control. If code persist replace control Fault in the inverter power section. 	Replace controller

Fault Code	Fault Name	Fault Description	Control	Troubleshooting	Action Required
171	"MOTOR SHUT-DOWN"	Warning: Pump motor temp. are very high (over MOTOR SHUT-DOWN param.)	PUMP	<ul style="list-style-type: none"> • This fault occurs when the pump 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 sub-menu. • If this fault occurs, maximum current is reduced to 130 amps needed for steering. • If the shutdown occurs when the motor is cold check the wiring. If wiring is ok replace logic board. 	
172	"VMN LOW"	Wrong voltage on motor power outputs; failure in the power section or in the mosfet driver circuit or in the motorPUMP		<ul style="list-style-type: none"> • This fault signals that the under voltage / over voltage protection interrupt has been triggered Two possible reasons: • A real under voltage / over voltage situation happened. • Fault in the hardware section of the controller that manages the over voltage protection. • A problem with motor connection or power circuit. • Check if all 3 phases are correctly connected. • Check for short between motor terminal and chassis • Perform diode test • Diode test <ul style="list-style-type: none"> -Disconnect all power and motor leads from control. -Select diode test on your multi meter. -Place positive meter lead on control - Battery terminal place negative meter lead on terminals U,V,W meter should read .3V to .5V if not replace control. -Place negative meter lead on control + Battery terminal place positive meter lead on terminals U,V,W meter should read .3V to .5V if not replace control. -If code persist replace control 	Replace controller

GEX/GTX MHYRIO CB (48V)

PARAMETER CHANGE			
243	MIN EVP	25.10%	
244	MAX EVP	85.10%	
241	MIN EVP1	25.10%	LOWER -C1
242	MAX EVP1	85.10%	
243	MIN EVP2	25.10%	LIFT-C3
244	MAX EVP2	85.10%	
245	MIN EVP3	25.10%	AUX BACK - C4
246	MAX EVP3	85.10%	
247	MIN EVP4	25.10%	AUX FORWARD-C6
248	MAX EVP4	85.10%	
249	MIN EVP5	25.10%	TILT BACK - C7
250	MAX EVP5	85.10%	
251	MIN EVP6	25.10%	TILT FORWARD - C15
252	MAX EVP6	85.10%	
253	MIN EVP7	25.10%	SIDE SHIFT RIGHT - C12
254	MAX EVP7	85.10%	
241	MIN EVP8	25.10%	SIDE SHIFT LEFT - C14
242	MAX EVP8	85.10%	
247	EVP OPEN DELAY	0.2	
248	EVP CLOSE DELAY	0.4	
245	EVP1 OPEN DELAY	0.2	LOWERING
246	EVP1 CLOSE DELAY	0.1	
247	EVP2 OPEN DELAY	0.2	LIFT
248	EVP2 CLOSE DELAY	0.1	
249	EVP3 OPEN DELAY	0.2	AUX1 BACK
250	EVP3 CLOSE DELAY	0.4	
251	EVP4 OPEN DELAY	0.2	AUX1 FORWARD
252	EVP4 CLOSE DELAY	0.4	
253	EVP5 OPEN DELAY	0.8	TILT BACK - C7
254	EVP5 CLOSE DELAY	0.4	
241	EVP6 OPEN DELAY	0.8	TILT FORWARD - C15
242	EVP6 CLOSE DELAY	0.4	
243	EVP7 OPEN DELAY	0.2	SIDE SHIFT RIGHT - C12
244	EVP7 CLOSE DELAY	0.4	
245	EVP8 OPEN DELAY	0.2	SIDE SHIFT LEFT - C14
246	EVP8 CLOSE DELAY	0.4	

Disassembly the Bearing Boss



Disassembling The Bearing Boss

- Remove the thrust needle bearing and spacer from bearing boss.
- Use a spanner or wrench to remove the bearing boss socket bolt from the bearing boss.
- Be careful not to cause escape or damage of the brake piston return springs.

GROUP 22

WHEELS AND TIRES

Wheels and Tires Specifications and Description Section 1

Wheels and Tires Mounting and Maintenance Section 2

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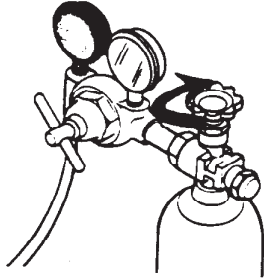
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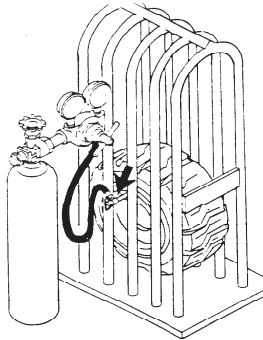
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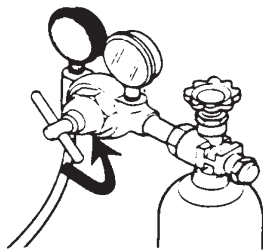
- Turn the tank valve clockwise (CW) and close the valve.



- Disconnect the air chuck from the valve stem.



- Turn the regulator valve counterclockwise (CCW) to the off position.



- Use a tire pressure gauge to check the tire pressure. If necessary, put more air into the tire. Do this as many times as necessary to reach the correct tire pressure.

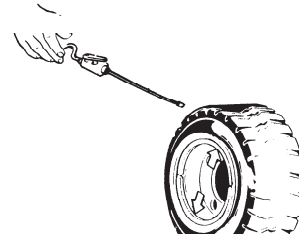
CAUTION

Use a long-handled gauge so that your hand does not go inside the cage, or in front of any component of a multi-piece wheel.

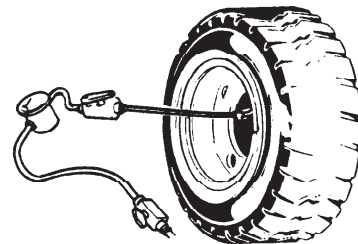
Checking and Adjusting Tire Pressure

WARNING

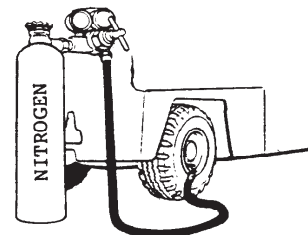
Before you add air pressure to the tire, make sure the lock ring is correctly positioned in the rim and wheel wedge. The lock ring can separate from the rim with enough force to cause injury or death.



- Attach a clip-on air chuck to valve stem. Stand by the side of the wheel and put the correct air pressure in the tire.



- If your air supply does not have enough pressure to fill the tire, you can use a nitrogen cylinder to get the correct pressure.



- Put a clip-on type air chuck on the nitrogen cylinder hose and attach it to the valve stem. Follow the procedures described previously for adjustment of the nitrogen cylinder valves.

WARNING

Use nitrogen only. Do not use oxygen or any other gas to fill tires.

Section 4

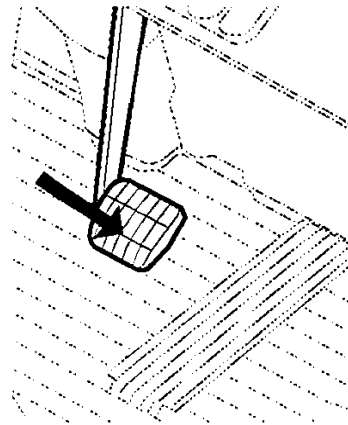
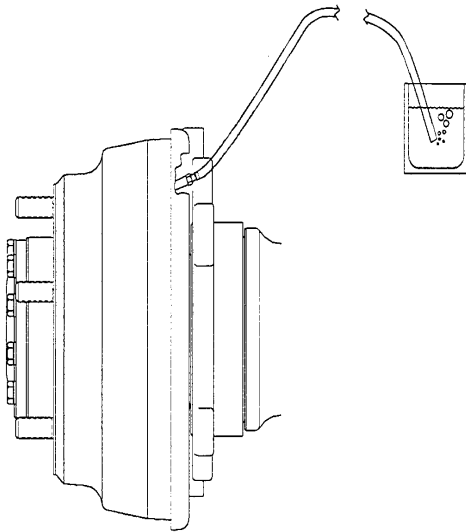
Brake Bleeding

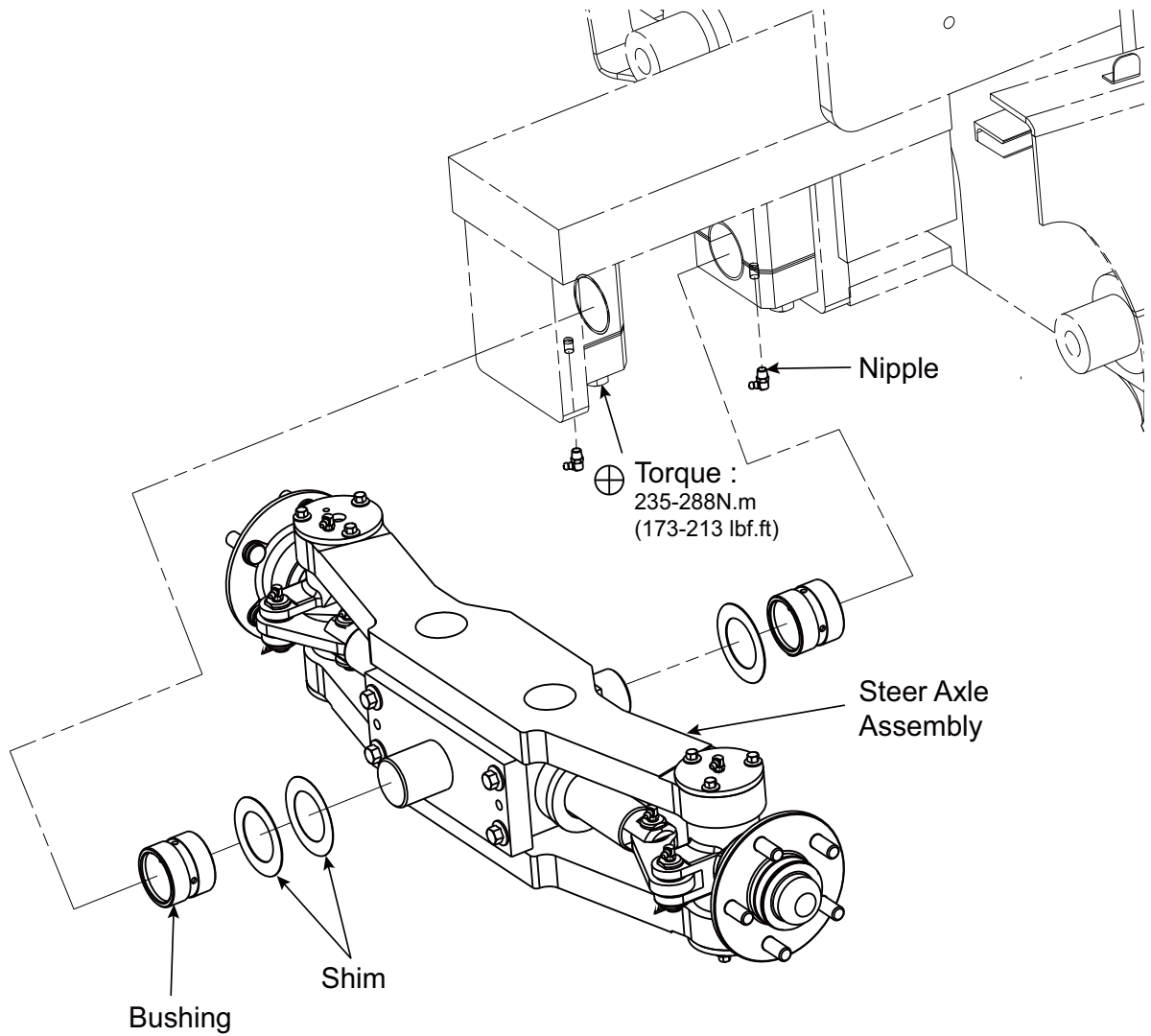
Bleed brakes when:

- The brake pedal feels spongy.
- The brake master cylinder or wheel cylinders-or lines between-have been leaking and/or have been repaired or replaced.
- Troubleshooting otherwise indicates that air has been introduced into the system.

Bleed the brakes as follows:

1. Park truck on level floor. Put direction control in neutral. Lower forks to floor, tilt forward, and apply parking brake.
2. Remove cap from the brake reservoir to be sure it is full of fluid.
3. Attach a clear hose to a bleed screw on one of the brake cylinders. Place the other end of the hose in a jar containing Hydraulic fluid, RANDO HD32 or NUTO H32 in accordance with CLARK specification MS-68 (CLARK #2776239).
4. Open the bleed screw.
5. Depress the brake pedal and watch fluid flow into the jar. When the fluid appears to be free of bubbles, tighten the bleed screw, then release the pedal.
6. Check the fluid in the brake reservoir. Refill as required.
7. Release the parking brake and operate the brake pedal. If the brake pedal does not come up or still feels spongy, bleed the system again.





Steer Axle assembly

Section 4

Steering System Relief Pressure Check and Adjustment



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.

Description and Operation

Steering system relief pressure settings above the specified values can cause failure of the steer lines, damage to seals in the steering gear, and steering linkage breakage on the steer axle. The steering system's pressure relief valve is part of the steering gear assembly. Steering system relief pressure is adjustable and should be checked if indicated by troubleshooting. A pressure gauge will need to be plumbed into the pressure line from the priority valve on the hydraulic pump to the steering gear assembly to check steering relief pressure.

Steering system relief pressure setting should be 8340-8830kPa (1210~1280psi).

NOTE

If relief pressure is not correct, the problem may be caused by dirt in the valve or relief valve on the steer pump or worn parts in the steering control valve or steer pump.



WARNING

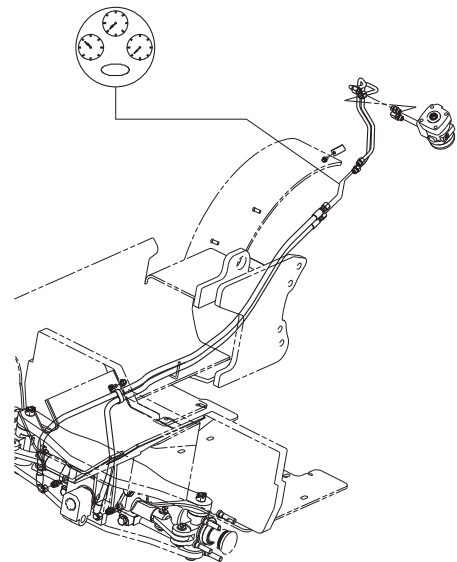
Do not use your hands to check for hydraulic leakage. Use a piece of cardboard or paper to search for leaks. Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. If any fluid is injected into the skin, it must be sur-

gically removed within a few hours by a doctor familiar with this type of injury or gangrene may result.

Steering System Relief Pressure Setting Check and Adjustment

This procedure requires installation of a pressure gauge in the pressure line from the priority valve on the hydraulic pump to the steering gear assembly. The pressure is measured while the steering handwheel is turned fully in one direction to put the steering system in bypass. Steering system relief pressure setting may be checked using a Mica Quadrigage (Clark Part No. 1800106) or with a conventional pressure gauge, 0-20,700 kPa (0-3000 psi).

1. Tilt the steering column fully forward and raise the seat deck.
2. Remove floor plate to access steering gear.
3. Install Quadrigage in the pressure line to the steering gear.



4. Put the key in the key switch and turn it On.
5. Turn the steering handwheel in one direction until steering cylinder reaches its stop (relief bypass). Hold steering handwheel in relief position until pressure reading is taken, and then release. Turn key

Section 8

Steering Gear Overhaul

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.

2. Install new gland packing (O-ring) seal and dry bearing on inner end of gland.
3. Install new dust wiper and rod (U-cup) seal in outer end of gland and install retainer ring.

IMPORTANT

Be sure the rod wiper and dust (U-cup) seal are installed in the correct directions.

4. Lightly lubricate the cylinder and gland mating surfaces with hydraulic oil before assembly.
5. Install the gland onto the cylinder bore rim, making sure gland is fully seated on cylinder.
6. Install piston and rod assembly into the cylinder.

NOTE

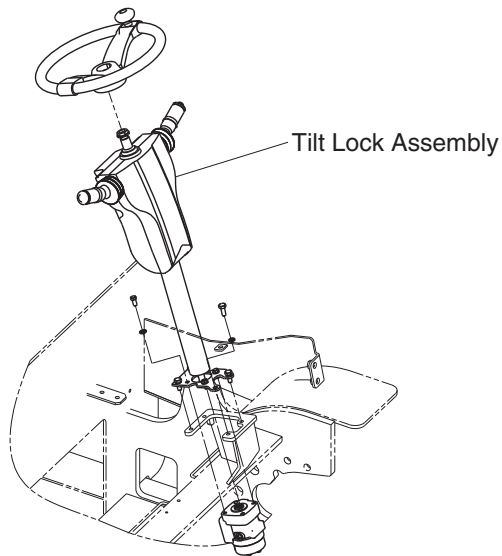
A special part is included in the parts kit to allow you to slip the gland over the rod end without damaging the gland seals.

7. Repeat above procedure for installation of opposite gland.
8. Install the tie rods and nuts.

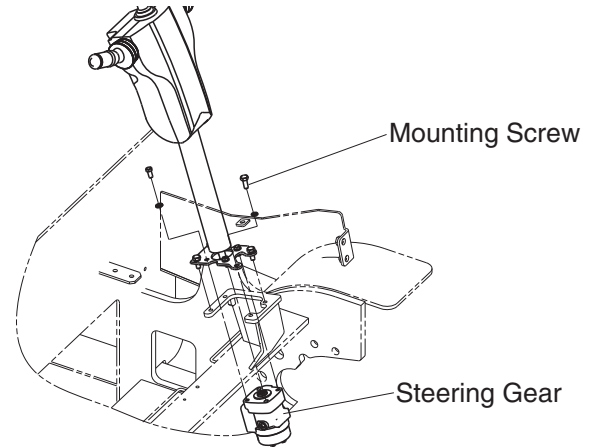
Operational Pressure Test

Once cylinder is remounted on axle (see Section 4), connect pressure source in turn at each port. Extend piston rod at each side and test with internal pressure of 13790 kPa (2000 psi). At this pressure no leakage must occur. Typical operating pressure is 8620kPa (1250psi).

4. Remove 4 bolts securing tilt assembly to frame. .



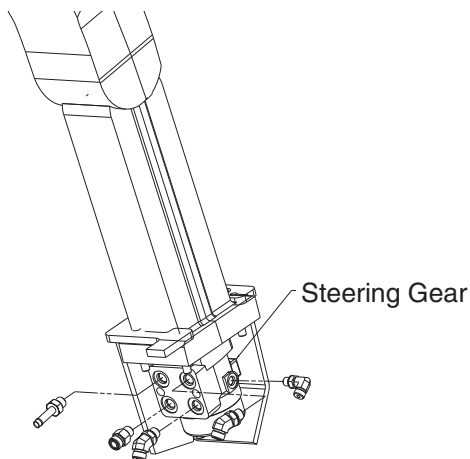
2. Remove the four bolts securing the lower column shaft and steering gear to the bracket on the frame.



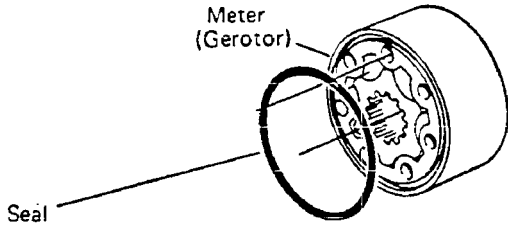
3. Remove the lower shaft and steering gear assembly from the truck.

Steering Gear Removal

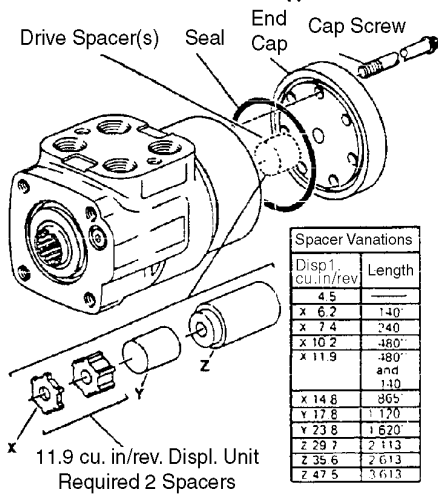
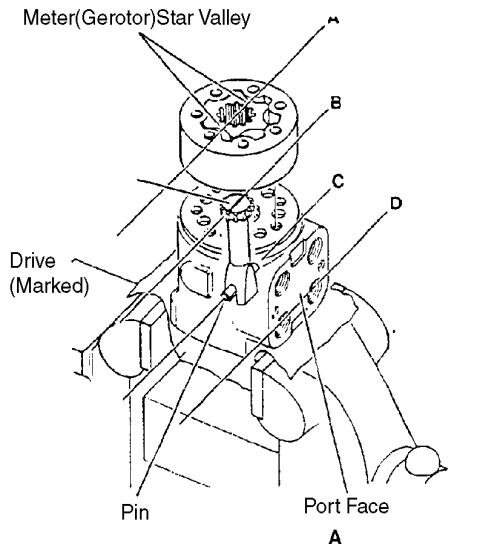
1. Put a pan under the truck to catch hydraulic fluid which will drip when fittings are loosened. Label the four hose fittings of the steering gear to make sure they are reassembled correctly. Loosen and remove the hydraulic fittings at the steering gear. Cap the ends to prevent fluid leaks. Cap the steering gear ports to prevent dust and debris from getting into the steering gear. Keep hydraulic ports and hoses clean.



22. Install 173.5 mm (2.89 in.) seal in meter (gerotor).



23. With seal side of meter toward spacer plate, align star valleys on drive. Note the parallel relationship of reference lines A, B, C, and D in figure. Align bolt holes without disengaging meter from drive. Be sure star has engaged drive spline in position shown.

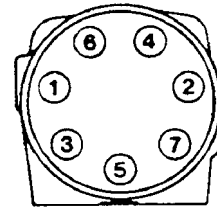


24. Install drive spacer(s) when used, in meter.

25. Install 73.5 mm (2.89 in.) seal in end cap.

26. Install end cap on gerotor, and align holes.

27. Install 7 dry cap screws in end cap. Pretighten screws to initial torque of 17 N-m (150 in-lb), then torque screws to final torque of 39 N-m (28.7 lbf-ft) in the sequence shown.



28. Inspect the assembly to be sure all parts have been installed and fasteners correctly installed and tightened.

Section 7

Steering Gear Overhaul (ELH Optional)

Disassembly	2
Parts Inspection	4
Reassembly	4
Steering unit	8

IMPORTANT

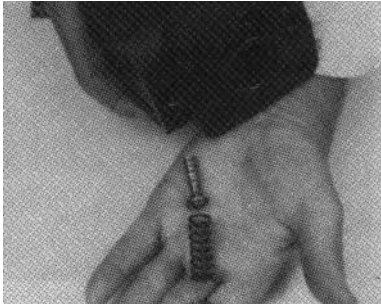
Before removing any component for overhaul, make sure the correct repair parts, seals, and gasket sets are available.



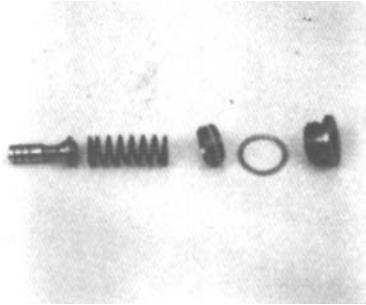
CAUTION

Because of unsatisfactory results of field rebuilding of the Gerotor Unit, the manufacturer recommends that only bearing and seal replacement be attempted in the field and that unit rebuilding be done only by qualified rebuilders. Clark Material Handling Company agrees with this. If field rebuilding is absolutely necessary, the rebuilt unit should be thoroughly tested after reinstallation in the truck. Extreme cleanliness is critical to successful rebuilding of these units.

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



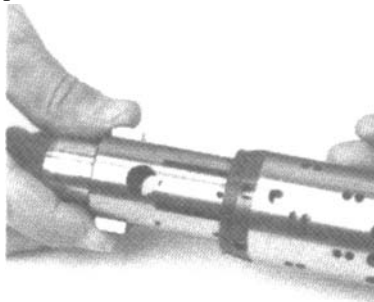
The pressure relief valve is now disassembled.



Line up the spring set.



Guide the spool into the sleeve.



Assembly

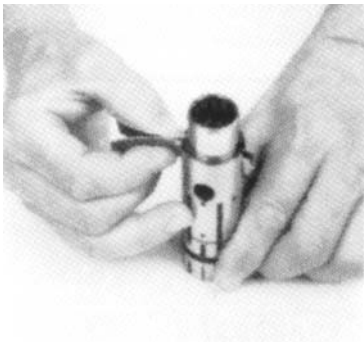
Before assembly clean all parts very carefully, replace all seals and O-rings, and lubricate all parts with hydraulic oil.

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 at 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.

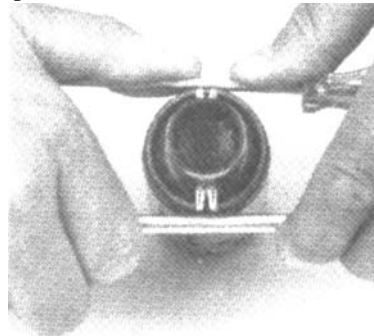
Place the curved springs between the flat ones and press them into place.



Make sure that spool and sleeve are placed correctly in relation to each other.



Press the spring together and push the neutral position springs into place in the sleeve.



Line up the springs and center them.

Section 1**Main Hydraulic Sump, Filters, and Pump
Specifications and Description**

Specifications	2
Service Intervals	2
System Description	2
Sump Tank Fill Levels	4
Hydraulic Fluid and Filter Change	5
Remove, clean and replace the strainer	5

Section 3

Main Hydraulic Pump Removal and Installation

Main hydraulic Pump Removal 2

Main Hydraulic Pump Installation 3

Section 3

Hydraulic System Troubleshooting

The following is a list of problems and solutions relating to the main hydraulic control valve and associated components. For other hydraulic system troubleshooting, refer to Groups 29 and 34.

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 and suction screen or repair kinked hose.
- Hydraulic pump cavitating (pumping air with fluid); check hydraulic plumbing for airtight hoses and connections.

Overheated hydraulic fluid

- Thin fluid; drain and fill with correct fluid.
- Fluid contaminated; drain sump, clean suction screen, 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.

See Group 34, "Cylinder Removal, Overhaul, and Replacement."

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.

GROUP 32

TILT CYLINDERS

Tilt Cylinder Specifications and Description	Section 1
Tilt Cylinder Checks and Adjustments	Section 2
Tilt Cylinder Removal and Installation	Section 3
Tilt Cylinder Overhaul	Section 4

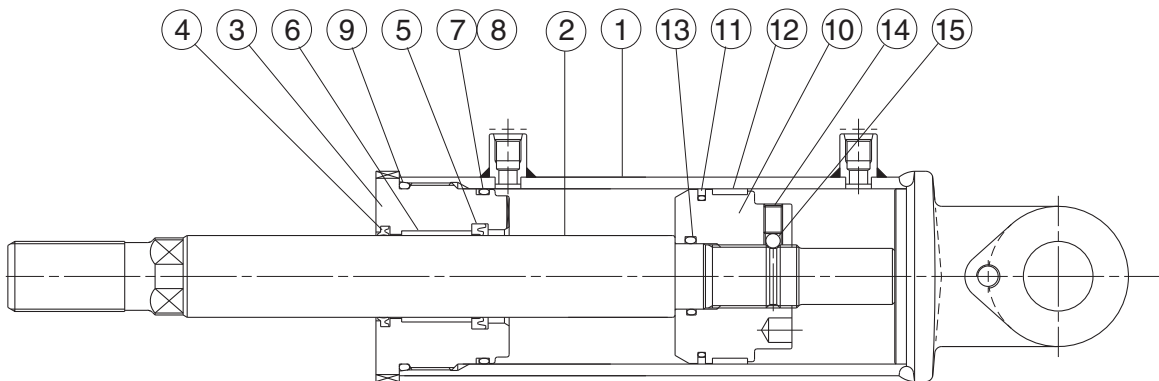
IMPORTANT

Other hydraulic-related components and circuits are described and illustrated in Group 25, "Steering Column and Gear", Group 26 "Steer Axle", Group 29, "Hydraulic Sump, Filters, and Pump", Group 30, Hydraulic Control Valve/Lift Circuit." and Group 31, "Uprights." Refer to these other groups for hydraulic components not covered in this group.

Section 4
Tilt Cylinder Overhaul

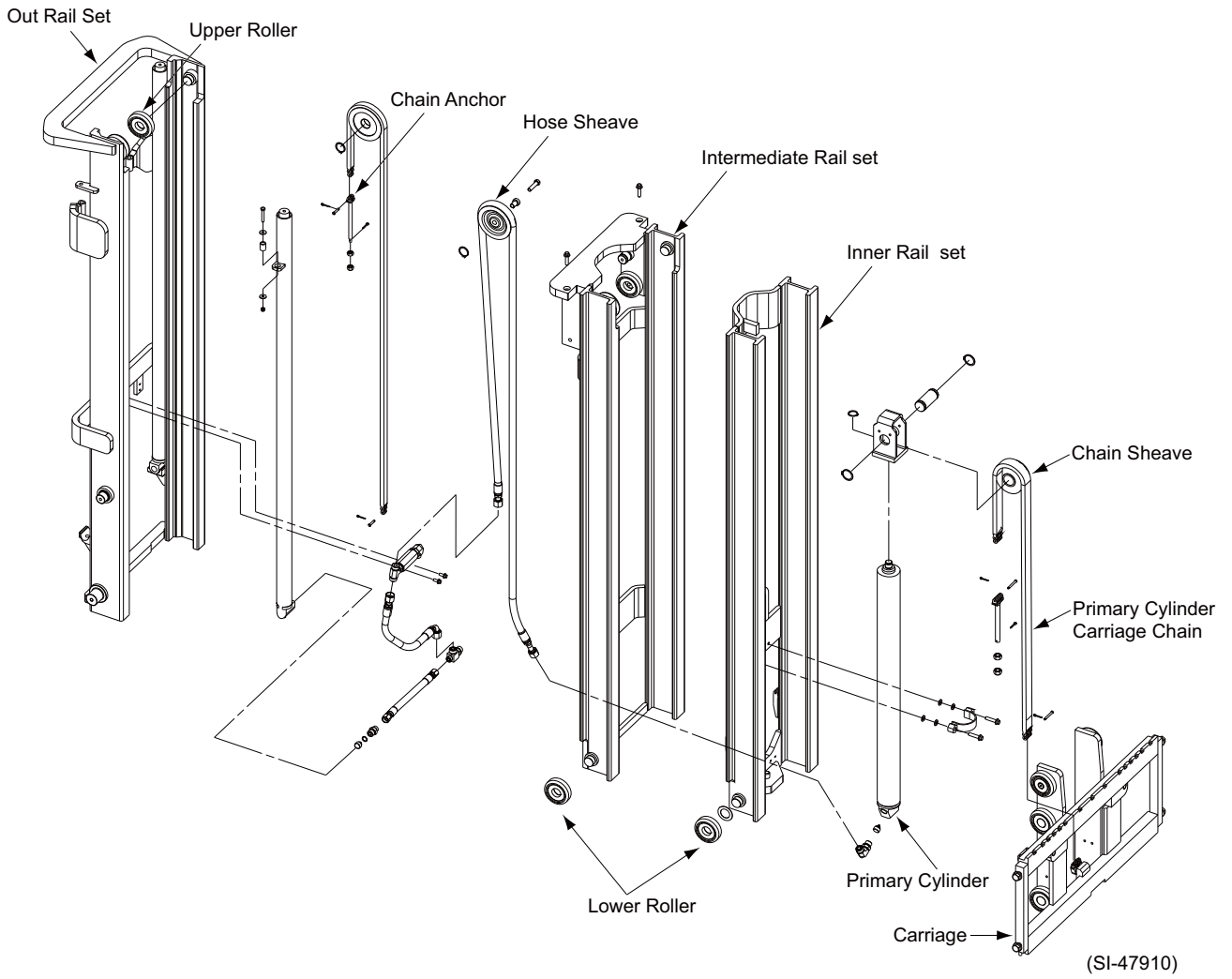
IMPORTANT

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



Typical Tilt Cylinder Cross section

1	Tube Assy	9	O-ring(1B G75)
2	Rod	10	Piston
3	Gland	11	Piston Seal
4	Dust Wiper	12	Wear Ring
5	Rod Seal	13	O-ring
6	Du Bush	14	Set Screw
7	O-Ring	15	Steel Ball
8	Back up ring		



Typical Triple-Stage Upright Assembly

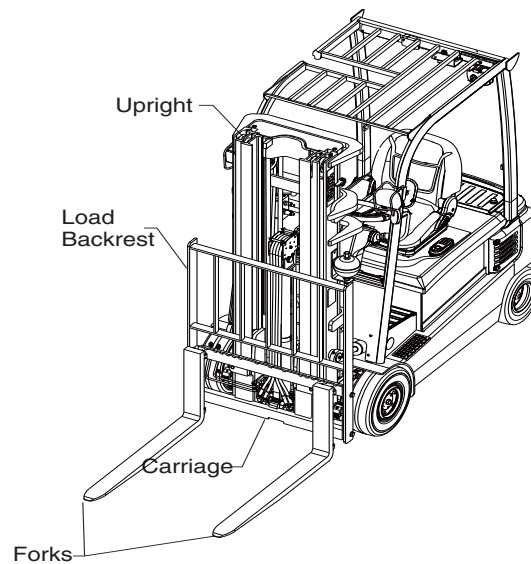
Section 3

Upright Inspection

 **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 4

Carriage and Upright Roller Clearance Checks and Shim Adjustment

IMPORTANT

Before removing any component for overhaul, make sure the correct repair parts and/or kits are available.



WARNING

An upright or carriage can move unexpectedly:

- Do not walk or stand under raised forks
- Kee 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.



WARNING

Use an approved safety platform to reach the upper areas of the upright. Never use the upright as a ladder.

Introduction

Standard and Hi-Lo upright assemblies have two lift roller sets mounted on the rails, three lift roller sets mounted on the carriage, and on external thrust roller set mounted on the carriage.

The triple-stage upright assemblies have four lift roller sets mounted on the rails, three lift roller sets mounted on the carriage, and one thrust roller sets (“external”) mounted on the carriage. (see the “Roller Side Clearance Chart” on next page.)

Each carriage and upright lift roller is nested within its adjacent rail set. The front “face” of the lift roller handles front-to-back friction and play between the nesting segments of the upright assembly, the side “face” of the roller radius handles side-to-side friction and play. The rollers are canted (tilted) to allow the side face to bear properly on the web.

Section 5

**Cylinder Removal, Shimming, Overhaul,
and Replacement**

Cylinder Types

Standard uprights use two lift cylinders. Hi-Lo and Triple stage uprights use three cylinders, a primary (center-mounted) cylinder, and two secondary cylinders. All primary cylinders used on Hi-Lo and triple-stage uprights (TSUs) are piston cylinders. The secondary cylinder used on Hi-Lo uprights are ram cylinders.

IMPORTANT

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

Upright Type		Upright Number	Cylinder Type
GEX/ GTX	STD	S1202	Piston-Type Lift Cylinder
	TSU	T1202	Piston-Type Secondary Cylinder
	HiLO	F1202	Ram-Type Secondary Cylinder

 **CAUTION**

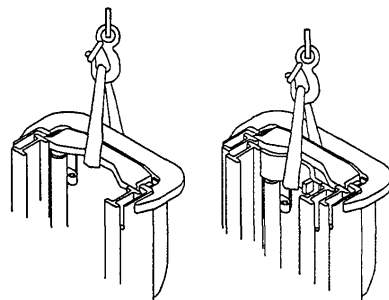
To remove, or partially remove, the cylinders from the upright for shimming or overhaul, start with the truck in a safe position:

- Turn key switch to OFF and remove key
- Parking brake applied
- Directional lever in neutral
- Forks lowered completely
- Wheels blocked.

Lift Cylinder Shimming Procedure

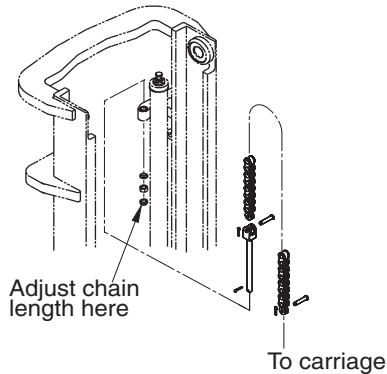
To shim the lift cylinders to correct unequal cylinder stroke:

1. Fully lower upright until both lift cylinders are collapsed.
2. Attach a hoisting strap to the tie bar of the inner rail or intermediate rail tie bar of TSUs.

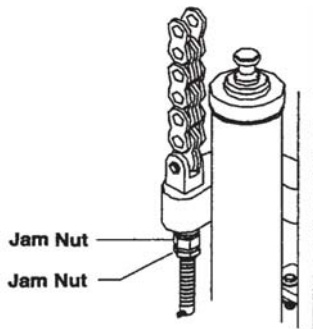


Standard Upright Chain Length Adjustment

To adjust chain length on the standard upright use the following illustration and procedures:



1. Fork-to-ground clearance:
 - a. Set the upright to vertical position.



- b. Break the jam nuts loose on the chain anchors.
 - c. Turn the chain adjustment nuts until clearance between forks and ground is 10-20 mm (0.40-0.80 in).

IMPORTANT

For all chain anchor adjustments:

- Threaded chain anchors must be left free to pivot in mounting hole.
- Anchor cotter pin heads must be to the inside of the upright.
- Torque jam nuts to adjustment nuts to 80-150 N.m (59-110 ft-lb)
- Make sure chain anchors are secured so that no twist is evident in the chains.

2. Carriage roller position:
 - a. Raise carriage about 1 m (3.2 ft) and smear a bead of grease on the bottom 75 mm (3 in) inner rail in the area of the roller pattern.
 - b. Tilt upright fully back and completely lower.

- c. Raise carriage about 1 m (3.2 ft) and measure the distance from where the center of the bottom carriage roller stopped to the bottom edge of the inner rail. Distance should not be less than 20 mm (0.80 in) or chain length adjustment is required.

3. Carriage stop-to-upright:

- a. Lift upright to its full height and check for clearance on the carriage safety stop.
 - b. If the carriage stop hits the upright stop, adjust the chain anchor adjustment nuts out until there is at least 3 mm (0.12 in) clearance between the stops.

IMPORTANT

The carriage stop must not be allowed to contact the upright stop under any circumstance during normal operations.

If all three chain length requirements listed above cannot be met, the tire diameter may be out of the design range allowance. Also, excessive tire wear will decrease carriage stop clearance.

Oversized tires will reduce the bottom carriage roller engagement on the inner rail when the carriage is in the lowered position. The fork-to-ground clearance can deviate from the 10-20 mm (0.40-0.80 in) allowance by a small amount if necessary to maintain the safe 20 mm (0.80 in) clearance of the bottom carriage roller to the lower edge of the inner rail.

Triple-Stage Upright (TSU) and Hi-Lo Chain Length Adjustments

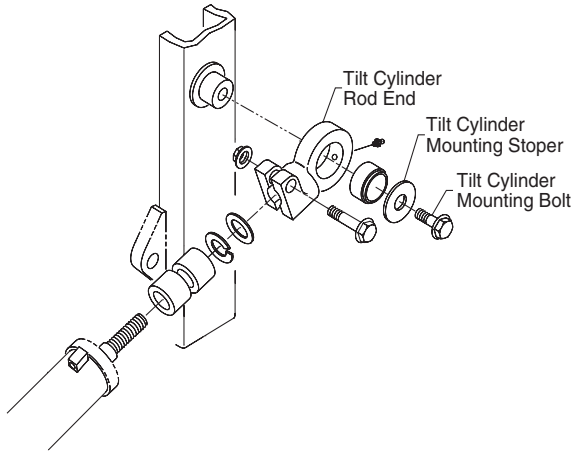
Triple-stage uprights use two chain sets; one set for carriage lift and one set for rail lift. Adjustment anchors for the lift cylinder stage are located at the back of the outer rail. Adjustment anchors for the primary lift stage are behind the primary cylinder. Carriage chain anchors are not intended for adjustment.

For TSU inner rail lift chains, chain length must be adjusted if the difference between the bottom of the inner rail and the outer rail is greater than 10 mm (0.40 in).

For the TSU and Hi-Lo primary cylinder lift chain, the chain length must be adjusted if:

- The fork-to-ground clearance is less than 5 mm (0.20 in) or more than 25 mm (1.0 in) when the upright is vertical.
- The center of the bottom carriage roller comes within 20 mm (.80 in) of the bottom edge of the inner rail.

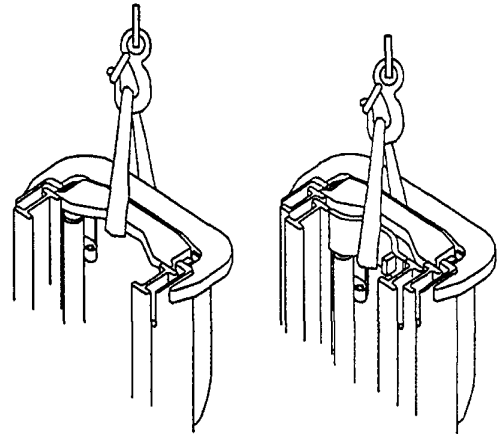
- Remove tilt cylinder rod-end, rod-end mounting bolt and stopper from upright.



- Remove upright mounting pin bolt and lift upright off frame. See illustration on page 1.
- Slowly set upright down on the floor, 100 x 100 mm (4 x 4 in) blocking, or sturdy pallets set end-to-end.

Upright Replacement

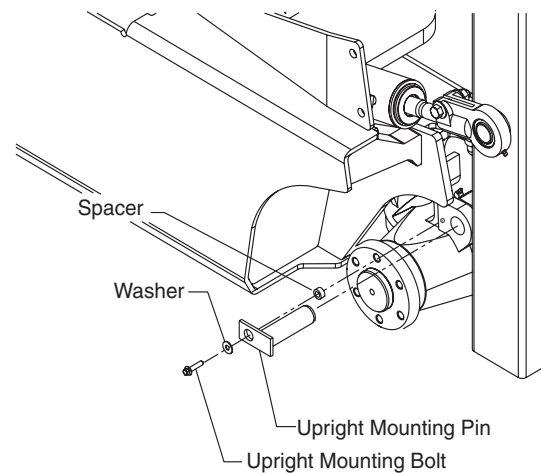
- Use an overhead chain hoist of adequate capacity and an approved lift chain to lift upright into position.



WARNING

Use prybars to move the assembly into position for reattachment.

- Install upright mounting pin and bolt. Torque to 20-30 N.m (15 ~ 22 lb-ft)



Section 3**Overhead Guard Removal and Installation**

Overhead Guard Removal 2

Overhead Guard Installation 2

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