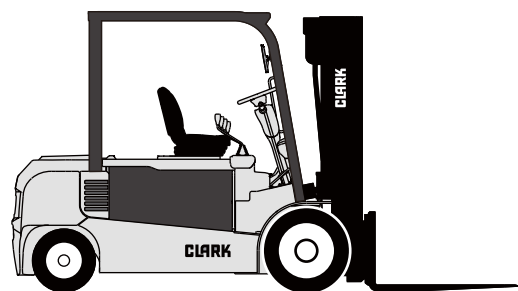


SERVICE MANUAL

GEX 40/45/50

RATED CAPACITY : 4000~4990kg



Part No. 8106230

Book No. SM 889 (Rev 1.4)

Aug. 2018



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Section 2

Lifting, Jacking, and Blocking

Raising Drive Wheels	2
Changing the Upright in Raised Position	3
Raised Rear of Truck	3
Raised Entire Truck	4
Shipping Tie-Down Instructions	5

**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.

“Periodic Service” and “Planned Maintenance”

The term “periodic service” includes all maintenance tasks that should be performed on a regularly scheduled basis.

The term “Planned Maintenance” indicates a formalized program of basic inspections, adjustments, and lubrications that the Clark service organization provides customers at a prescribed interval, usually 500 hours. The recommended basic “Planned Maintenance” procedure is given in Section 2 of this Group.

The current Section, “Maintenance Schedules,” specifies all maintenance tasks, including Planned Maintenance tasks, that should be performed periodically, and suggests intervals at which they should be performed.

Determining Maintenance Intervals

Time intervals on the charts on the next four pages and elsewhere in this manual relate to truck operating hours as recorded on the hourmeter, and are based on experience Clark has found to be convenient and suitable under normal operation. Standard operating condition classifications are:

Normal Operation: Eight-hour material handling, mostly in buildings or in clean, open air on clean, paved surfaces.

Severe Operation: Prolonged operating hours or constant usage.

Extreme Operation:

- In sandy or dusty locations, such as cement plants, lumber mills, and coal dust or stone crushing sites.
- High-temperature locations, such as steel mills and foundries.
- Sudden temperature changes, such as constant trips from buildings into the open air, or in refrigeration plants.

IMPORTANT

MAINTENANCE INTERVALS. If the lift truck is used in severe or extreme operating conditions, the maintenance intervals should be shortened accordingly. Put upright in vertical position and fully lower the forks or attachment.

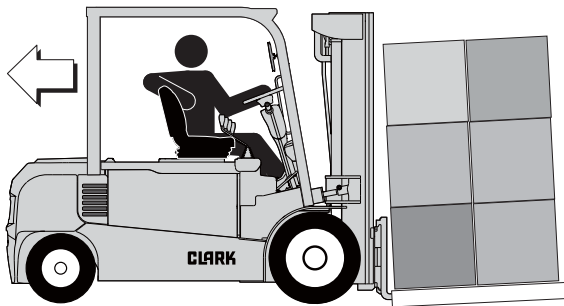
Service Chart/Lubrication Points

This decal is a basic guide to periodic maintenance intervals and tasks. A more detailed chart is supplied on the next page.

WARNING

Check all around to be sure that your intended path of travel is clear of obstructions and pedestrians.

- Drive the truck forward in a straight line at a high rate of speed. Listen for unusual drive train noise. Stop truck.
- Check acceleration from a stop to top travel speed. Acceleration should be smooth without hesitation. Stop the truck. Repeat procedure in reverse.
- Report condition on PM report form.

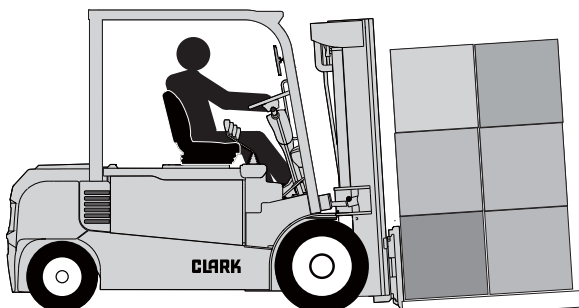


Test Drive Truck with Load

NOTE

Conduct these tests with a rated capacity load, if possible.

Test the truck for proper operation and drive train function by driving the truck in both the forward and reverse directions. Drive first in a straight line and slowly through a series of full right and left turns. Then repeat, driving in opposite direction.



Carry Load Low & Tilt Back

Test for correct function of the transistor control.

Check Controlled Plugging (Braking)

1. Operate the truck with parking brake set. It should not move. Release parking brake.
2. Operate the truck at a slow speed in a forward direction of travel. Reverse direction of travel. The truck should slow down to a smooth controlled stop, and accelerate normally in the opposite direction.

If plugging is as specified, then repeat the procedure at high speed. The truck should come to a smooth controlled stop in approximately 20 feet (6.10 m) with accelerator in maximum travel position.

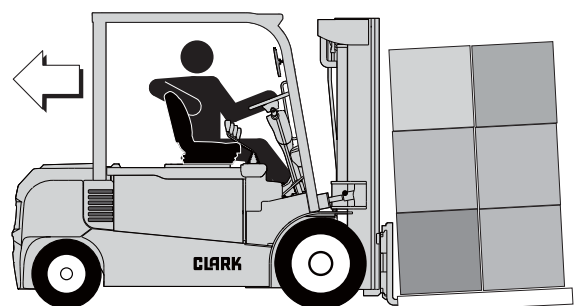
3. Repeat the procedure at high speed with the direction lever moved in reverse direction.

If plugging (braking) is not as specified, refer to the adjustment instructions in Group 19 of this manual. Report condition to designated authority.

Check Accelerator

1. After checking to see that you have a clear path ahead, drive the truck in a straight line at a high rate of speed in a forward direction of travel. Listen for unusual drive train noise. Stop truck
2. Check acceleration from a stand still condition to top travel speed. Acceleration should be smooth without hesitation.
3. After checking to see that you have a clear path behind, drive the truck in reverse. Check acceleration from stand still condition through top travel speed. Acceleration should be smooth.

Check the accelerator pedal while conducting the speed range tests. It must move easily and smoothly throughout the acceleration stroke and return without binding. There should be no restriction to movement on either acceleration or deceleration.



GROUP 12

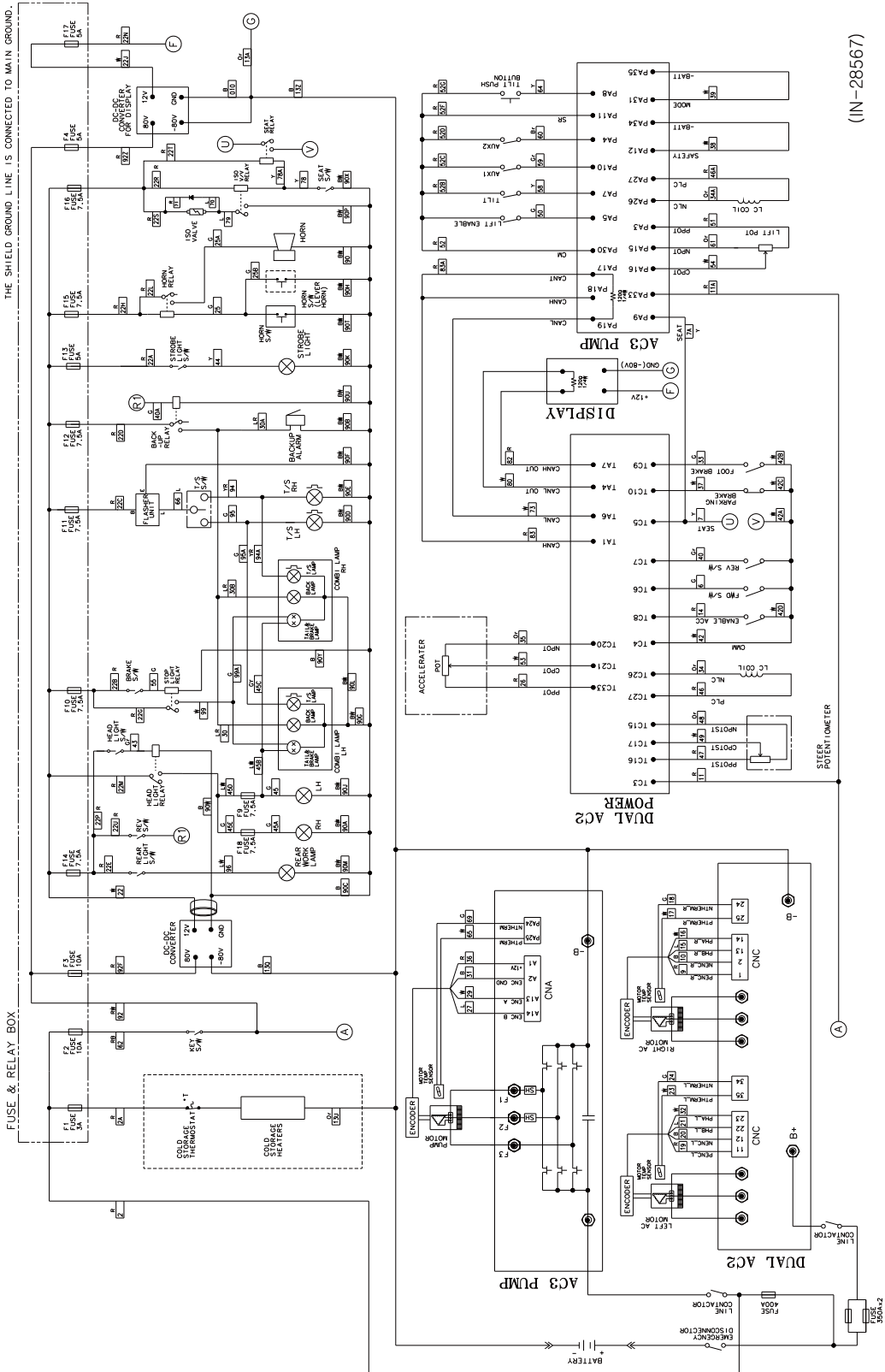
BATTERY

Battery Service Section 1

Standard Truck

WIRING-SCHMATIC

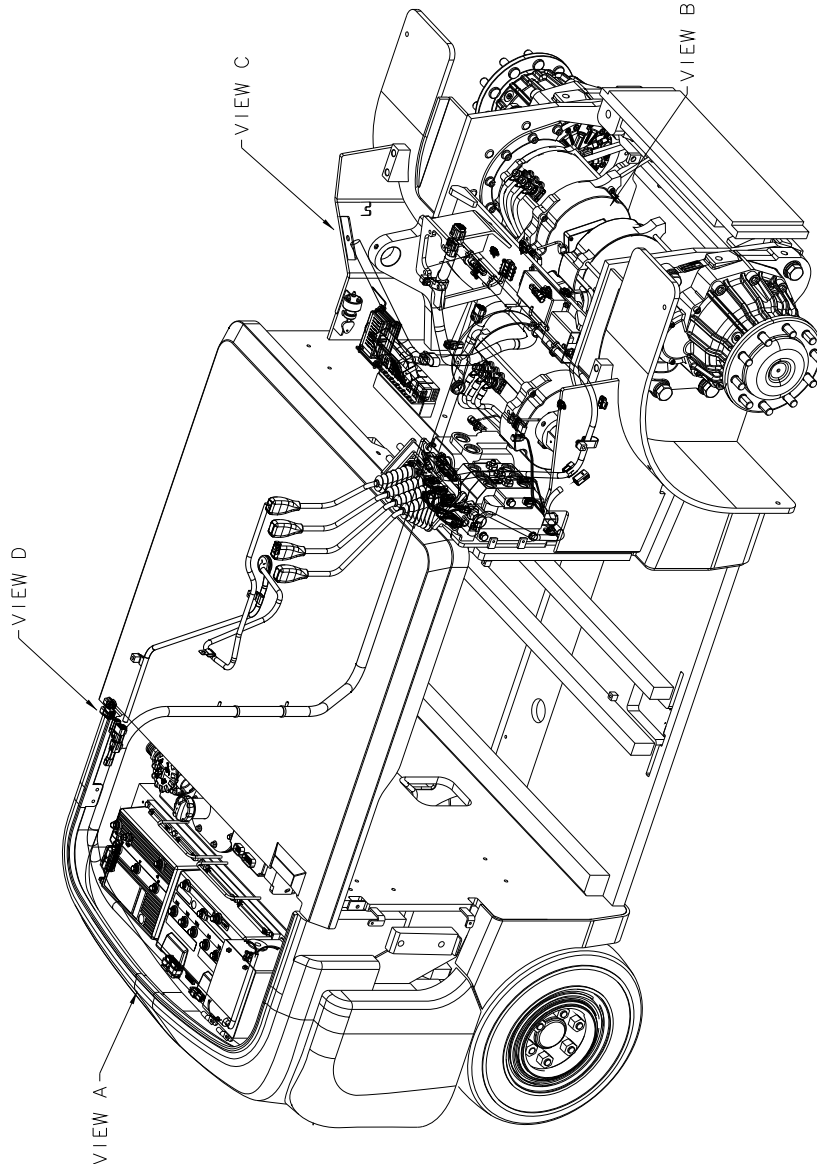
1. MUST BE AN UNDERMETERS LABORATORIES, INC. LISTED OR RECOGNIZED COMPONENT AND BE SO MARKED.
2. DASH LINE IS OPTION.
3. CANBUS LINE IS SHIELD TWISTED WIRE.



(IN-28567)

Main Harness - (1/6)

1. TORQUE TO 2-2.5 kgf-m.
(20-25 N-m)
2. TORQUE TO 0.8-1.1 kgf-m.
(8-10 N-m)
3. BEFORE CONNECTING, APPLY
P/N 2824625 (ELECTRICAL
CONNECTOR GREASE-NYE 760G)

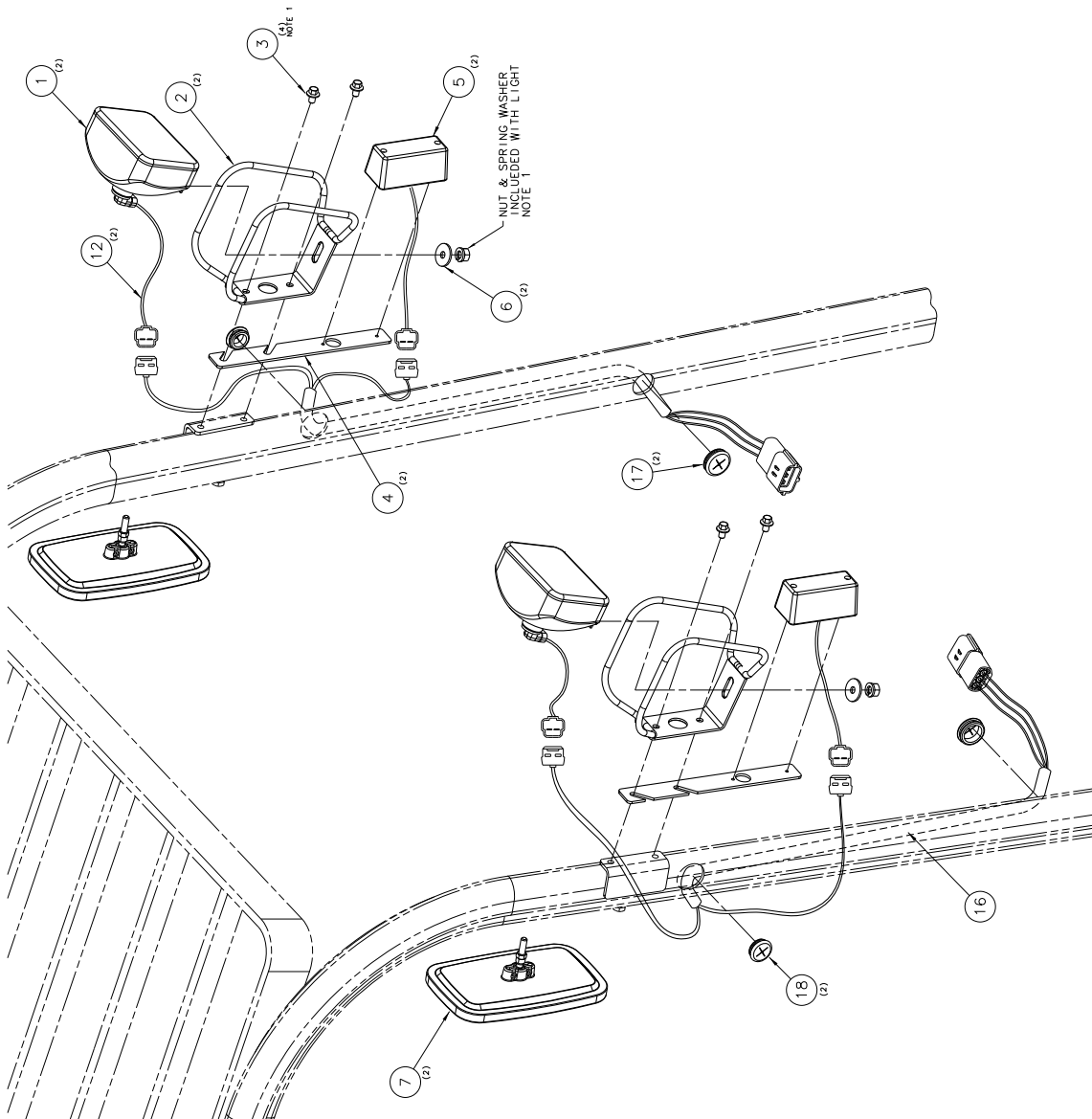


NO	PART NAME	ELH OPTION -	
		STD	
15	W/HARNESS-ELH VALUE	-	1
14	CAPSCREW-HEX	2	2
13	CAP PLUG(925494)	1	-
12	BAR-LIFT SENSOR	1	-
11	CAPSCREW-FLANGE	1	1
10	CLAMP-CABLE (9315-22003)	3	4
9	CLIP-INSULATED WIRE (9317-11200)	2	2
8	BRACKET-FUSE BOX	1	1
7	TUBE CLIP	1	1
6	W/HARNESS-COWL	1	1
5	CAPSCREW-FLANGE	11	11
4	CLAMP-CABLE (9316-02201)	3	3
3	GROMMET	1	2
2	INSULATOR-TER MATE (SH830)	1	1
1	W/HARNESS-MAIN,STD C/S OPT.	1	-
	W/HARNESS-MAIN,ELH	-	1
	W/HARNESS-MAIN,STD	1	-
	Q'TY		REMARK

SI-49686(1/6)

Accessory Harness and Components - (1/2)

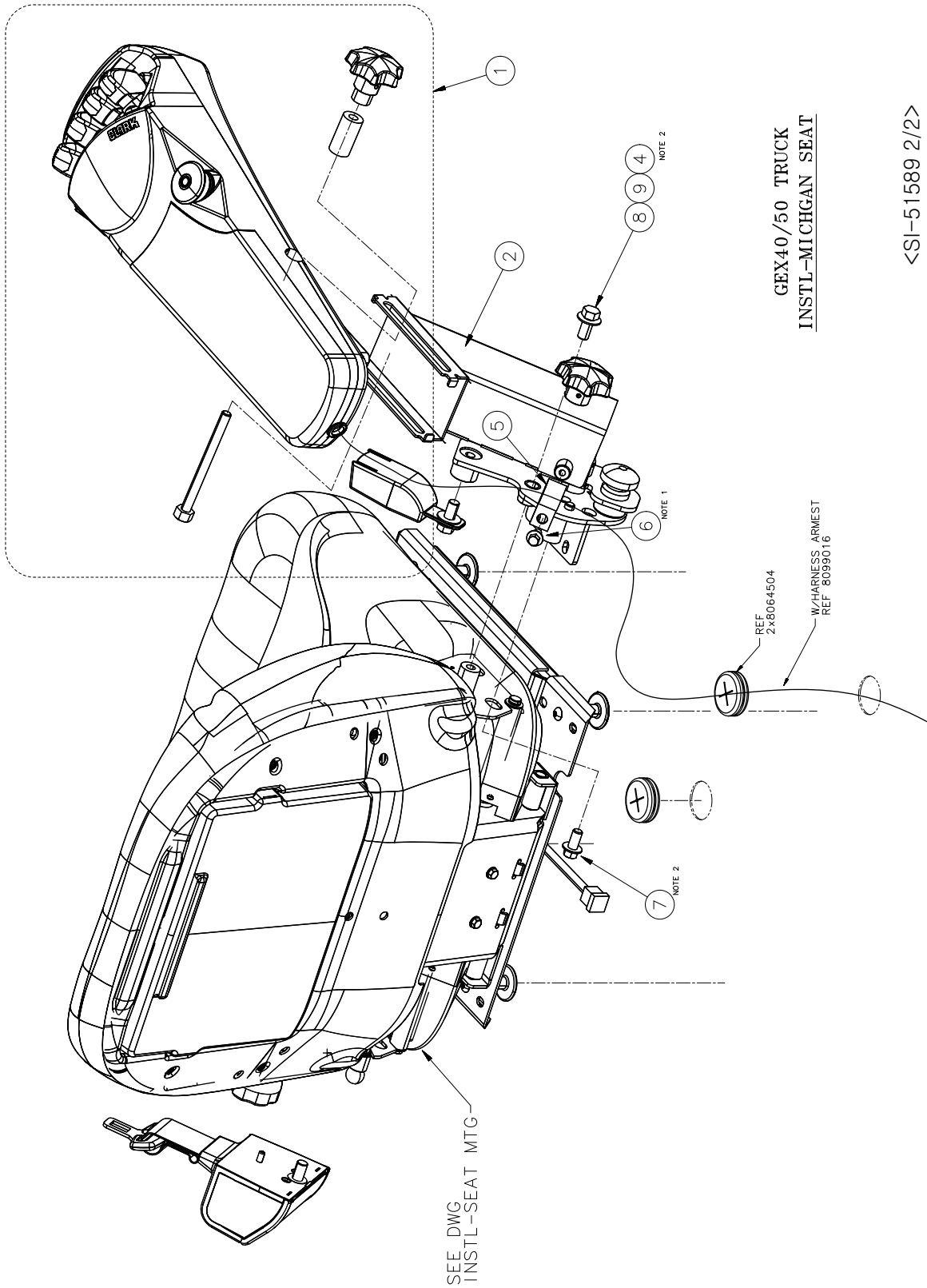
1. TORQUE TO 2.04-2.55 kgf-m.
(20-25 N-m)
2. TORQUE TO 0.82-1.02 kgf-m.
(8-10 N-m)
3. TORQUE TO 0.51-0.61 kgf-m.
(5-6 N-m)











19	GROMMET	1	
18	GROMMET	4	
17	GROMMET	2	
16	W-HARNESS-FRONT	2	
15	FLASHER-UNIT	1	
14	RELAY	2	
13	W-HARNESS-ACCESSORIES	1	
12	W-HARNESS-PLASTIC LIGHT	3	
	STROBE SUB ASSY-AMBER	1	
11	STROBE SUB ASSY-BLUE	1	
	STROBE SUB ASSY-RED	1	
10	CAPSCREW-FLANGED	3	
9	BRKT-REAR LAMP	1	
8	COMBINATION LIGHT-12V	2	
7	BACK-MIRROR-ASSY	2	
6	SPACER	3	
5	T-SIGNAL-LAMP	2	
4	BRACKET-TS	2	
3	CAPSCREW-FLANGED	4	
2	GUARD-HEAD LIGHT	2	
1	PLASTIC HEAD-LIGHT	3	
NO	PART NAME	Q-TY	REMARK

SI-49688(1/2)

Mini Lever (Option) - 2/2



- Display will read "MIN VACC MAX"
- Move the lift lever to full raised position
- Release the lift lever to the neutral position
- Press the "OUT" button
- Display will read "ARE YOU SURE"
"YES=ENTER" "NO=OUT"
- Press "ENTER" button (this stores the value for MIN and MAX lift potentiometer voltage)
- Display will show new settings
- Press the "OUT" button
- Display will read "MAIN MENU" "PROGRAM VACC"
- Press "OUT" button
- Display will show software version
- Turn the key switch Off and remove the tester cord from the control
- Plug the dash display harness into the "B" plug of the control
- Lower truck to the ground and test drive truck

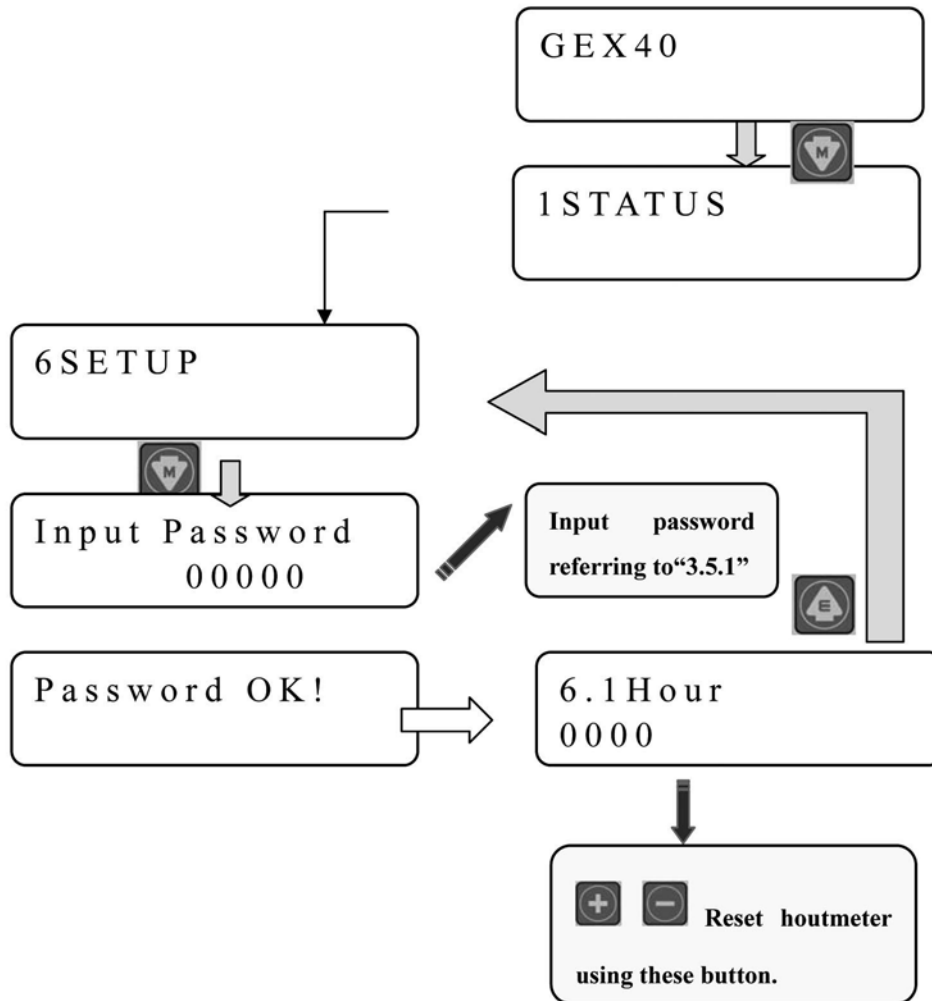
	<p>At the Menu mode, this switch is used for going to right menu.</p> <div style="text-align: center;">      </div> <p>1. At the normal operation mode, it is used for selection of power mode POWER Mode is divided with 3 step. Whenever press 'P' button, it will be changed to Economy→Normal→Power Mode</p> <p style="padding-left: 40px;">Economy : Slow speed up mode, it will minimize the acceleration of the truck and could be save the battery power.</p> <p style="padding-left: 40px;">Normal : Normal operation mode, operator could control the truck smoothly.</p> <p style="padding-left: 40px;">Power : operator could control the truck with powerful acceleration</p>
	<p>1. At the normal mode, it is used for increasing the data.</p>
	<p>1. At the normal mode, it is used for decreasing the data.</p>

3.6 Annex function set

A changeable function on the truck could be accessed and changed only by inputting correct password.

3.6.1 Changing hourmeter

It is for changing the hourmeter on diplay and controller, it should be only used for setting the current hour on display when replacing with a new controller.



GROUP 16

ELECTRICAL MOTORS

Motor Specifications And Descriptions Section 1

Drive Motor Overhaul Section 2

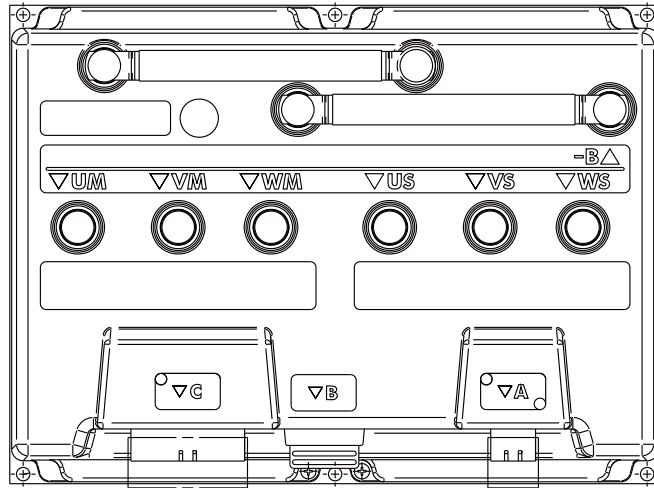
Pump Motor Overhaul Section 3

GROUP 17

ELECTRICAL CONTACTORS

Contactors Specifications and Overhaul Section 1

Description of Power Connections



-B	Negative of the battery
+BT	Positive of the battery; if the power fuse is not present, positive cable coming from the Line contactor must be connected to this power connection
Um: Vm; Wm	Connection bars for the three phases of the right motor; follow this sequence and the indication on the motor.
Us, Vs, Ws	Connection bars for the three phases of the left motor; follow this sequence and the indication on the motor.

PARAMETERS		PROGRAM LEVEL											
	Unit	0	1	2	3	4	5	6	7	8	9		
Dual AC2 PW(8 0V)	Acceleration Delay (*)	Sec.	1	1.5	1.8	2.0	2.5	3	3.5	4	4.5	5	
	Release Braking (**)	Sec.	25	20	18	15	10	8	6	4	3	2	
	Inversion Braking (**)	Sec.	5.5	5	4.5	4	3.5	3	2.5	2	1.5	1	
	Pedal Braking (**)	Sec.	5.5	5	4.5	4	3.5	3	2.5	2	1.5	1	
	Speed Limit Barking (**)	Sec.	8.9	8.3	7.7	7.1	6.6	6	5.5	4.9	4.4	3.8	
	Brake Cutback (**)	Sec.	5.5	5	4.5	4	3.5	3	2.5	2	1.5	1	
	Curve Braking	Sec.	1.5	1.4	1.3	1.2	1.1	1	0.9	0.8	0.7	0.6	
	Max speed Forw	Hz	0 ~ 200										
	Max speed Back	Hz	0 ~ 200										
	Cutback Speed	%	10	20	30	40	50	60	70	80	90	100	
	Cutback Speed 2	%	0 ~ 100										
	Curve Cutback	%	0 ~ 100										
	Curve Cutback #1	%	55	60	65	70	75	80	85	90	95	100	
	Frequency Creep	Hz	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3	
	Maximum Current	% IMAX	47	53	59	65	71	76	82	88	94	100	
	Auxiliary Time	Sec.	0	1.5	3.0	4.5	6.0	7.5	9.0	10.5	12	15	
	Seat Micro Delay	Sec.	2.0	2.1	2.3	2.4	2.6	2.8	2.9	3.1	3.3	3.5	
	Acc. Smooth	Sec.	1.0	1.2	1.5	1.7	2.0	2.2	2.5	2.7	3.0	3.5	
	Inv. Smooth	Sec.	1.0	1.2	1.5	1.7	2.0	2.2	2.5	2.7	3.0	3.5	
Stop Smooth	Hz	5	7	10	12	15	17	20	22	25	27		
Idle time	Min	1	2	3	4	6	8	10	12	15	20 (***)		

*)The acceleration time shown is the time from 0 Hz to 100 Hz. This is the ideal ramp calculated by the software; the real ramp could change as a function of motor control parameter setting and, obviously, a function of the load.

(**)The braking feature is base on deceleration ramps. The value shown in the table is the time to decrease the speed from 100 Hz to 0 Hz. This is the ideal ramp calculated by the software; the real ramp could change as a function of motor control parameter setting and, obviously, a function of the load.

(***)(Always closed).

PARAMETERS	SPEED EMPTY MPH													
	MPH (Km/h)	1.03 (1.66)	1.98 (3.19)	3.01 (4.85)	4.05 (6.51)	4.99 (8.04)	6.03 (9.70)	6.97 (11.22)	8.01 (12.89)	9.04 (14.55)	9.99 (16.07)	11.02 (17.74)	11.97 (19.26)	12.49 (20.09)
MAX SPEED FORWARD	HZ	12	23	35	47	58	70	81	93	105	116	128	139	145
MAX SPEED REVERSE	HZ	12	23	35	47	58	70	81	93	105	116	128	139	145

NOTE

Maximum speed for the GEX40/50 can not exceed 145 Hz.

Maximum speeds are adjustable from 0 Hz to 145 Hz in 1 Hz increments. Forward speed and reverse speeds can be set independently (Forward speed can be set to 8 MPH and Reverse speed can be set at 5MPH if desired)

12) AUX2 SPEED SWITCH:	ON /+BV = input active, switch closed. OFF / GND = input non-active, switch open.
13) AUX3 SPEED SWITCH:	ON /+BV = input active, switch closed. OFF / GND = input non-active, switch open.
14) HRYDRO SPEED REQ.:	ON /+BV = input active, switch closed. OFF / GND = input non-active, switch open.
15) VOLTAGE BOOSTER:	This is the booster voltage supplied to the motor in load condition; It is expressed in a percentage of the full voltage.
16) BATTERY VOLTAGE:	Level of the battery voltage measured at the input of the key switch.
17) COS FI:	This is cosj (real time calculated) of the motor.
18) BATTERY CURRENT:	This is the battery current (not measured but calculated).
19) BATTERY CHARGE:	The percentage charge level of the battery

OTHER HANDSET FUNCTIONS

Save and Restore Function

SAVE Function allows the transfer of controller parameters to the PC memory. With this function, a copy of the controller's set of parameters can be retained in a Pc and downloaded to another controller (see restore).

RESTORE Function allows you to download controller parameters from the PC memory to the controller Eeprom. Thus a copy of the parameters stored in the Pc can be downloaded in a controller avoiding the parameter setting operation.

SETUP for INSTALLING A NEW CONTROL PANEL

Sequence for AC Traction Controller Setting

When the "Key Switch" is turned ON, if no faults are present, the Zapi Handset Display will be showing the standard Opening Display.

If the controller is not configured to your requirements, follow the sequence detailed below. Remember to cycle the key switch if you make any changes to the controller configuration.

- 1) Select the options required.
- 2) Select and set battery voltage.
- 3) Confirm correct installation of all wires. Use Handset's TESTER function to assist.
- 4) Perform the accelerator signal acquisition procedure using the Handset "PROGRAM VACC".(See Group 13, Section 4 for programming procedures).
- 5) Perform the steering potentiometer signal acquisition, using the parameters in "Adjustment" menu.(See Group 13, Section 4 for programming procedures).
Remember: when turning the wheel to the right the voltage will increase.

Fault Code	Fault Name	Fault Description	Control	Troubleshooting	Action Required
86	"PEDAL WIRE KO"	Fault in Accelerator negative (NPOT) Input circuit. This fault indicates that accelerator wiring (NPOT or PPOT) wire is open.	SLAVE	<ul style="list-style-type: none"> • Check accelerator wiring and connections for opens • Check accelerator input voltage using PcConsole handset in tester mode (voltage should range from 2.0 VDC to approx. 0.30 VDC). • Check voltage between NPOT (pin C20) Battery Neg. (pin C12) voltage should be greater than 0.30 VDC. This voltage should remain constant all the way through the pedal stroke. • Check if controller input NPOT (C20) is good. Remove pins (C20, C21, C8) from connector, now connect a 4.7K ohm resistor between PPOT (C8) and NPOT (C20) now plug the connector back in, this will polarize NPOT. Now check voltage between (C12) -Batt and (C20) NPOT the reading should be approx. 0.6 VDC 	<p>Repair wiring as required</p> <p>If accelerator voltage is greater than 2.0 VDC or less than 0.30 VDC replace accelerator</p> <p>If voltage is not greater than 0.3 VDC proceed to the next step</p> <p>If it still read 0 VDC the controller has a failed input</p> <p>If it reads correctly 0.6 VDC the problem is in the accelerator or the harness</p>
87	"WATCH-DOG"	Watchdog circuit has been triggered	SLAVE	<ul style="list-style-type: none"> • It is a self-diagnosing test within the logic between Master and Slave micro controllers. • This fault could also be caused by a Canbus malfunction, which blinds Master - Slave communication. So , before replacing the controller , check the Canbus 	
88	"CHOPPER RUNNING"	FET is running	SLAVE	<ul style="list-style-type: none"> • XXXX 	
96	"LOGIC FAILURE #3"	Failure in overload protection hw circuit	SLAVE	<ul style="list-style-type: none"> • Fault in the hardware section of the controller that manages the hardware current protection. 	Replace controller
97	"LOGIC FAILURE #2"	Failure in U,V,W voltage feedback circuit	SLAVE	<ul style="list-style-type: none"> • Fault in the hardware section of the controller that manages the phase 's voltage feedback. • Line contactor not closing, check parameter setting for main contactor. 	Replace controller
98	"LOGIC FAILURE #1"	An over voltage or under voltage condition has been detected	SLAVE	<ul style="list-style-type: none"> • This fault signals that the under voltage / over voltage protection interrupts been triggered • A real under voltage / over voltage situation happened. • Verify battery setting. • Fault in the hardware section of the controller that manages the over voltage protection. Replace logic Card. • Possible plugging in or unplugging of battery or charger with the key switch on. 	

Fault Code	Fault Name	Fault Description	Control	Troubleshooting	Action Required
249	"THERMIC SENSOR KO"	Warning: Master temperature sensor is out of range	MASTER	<ul style="list-style-type: none"> The range of the temperature sensor is always checked and a warning is signaled if it is out of range. This fault will reduce the maximum current output of the controller to 50%. 	
253	"AUX OUTPUT KO" (Not used)	EB coil driver shorted or open	MASTER	<ul style="list-style-type: none"> The microprocessor checks the driver of the electromechanical brake coil. If the status of the driver output does not correspond to the signal coming from the microprocessor, the fault is signaled. It is suggested to check for an external short or a low impedance pull-down between NAUX (C31) and -Batt. If no external cause is found 	Replace controller
255	"HAND-BRAKE"	Handbrake switch closed	MASTER	<ul style="list-style-type: none"> Indicate that handbrake is activated Check wiring and handbrake switch. 	Repair wiring or replace switch if needed
Blank	"DASH DISPLAY"	Dash Display blank	MASTER	<ul style="list-style-type: none"> Check 5 volt power supply for dash display. If no 5 volts Check wiring and connector at control and display. If not wiring or connections 	Replace 5 V power supply Replace dash display

COB-ID	ID-Name	Byte-Nr.	Function	Data Type	Value	Meaning
DOWNLOAD (WRITE IN CONTROLLER) PUMP						
0x615	DUAL_SDO_rx	0	SDO specifier	U8	0x22	initiate download request expedited
		1	Index OD	U16		Index object
		3	Subindex OD	U8		Subindex object
		4	Data	U32	Value	Data
0x595	DUAL_SDO_tx	0	SDO Specifier	U8	0x60	initiate download response expedited
		1	Index	U16		Index object
		3	Subindex	U8		Subindex object
		4	Data	U32	0	Data
UPLOAD (READ IN CONTROLLER) PUMP						
0x615	DUAL_SDO_rx	0	SDO specifier	U8	0x40	initiate upload request expedited
		1	Index OD	U16		Index object
		3	Subindex OD	U8		Subindex object
		4	Data	U32	0	Data
0x595	DUAL_SDO_tx	0	SDO Specifier	U8	0x43	initiate upload response expedited
		1	Index	U16		Index object
		3	Subindex	U8		Subindex object
		4	Data	U32	Value	Data

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Section 6

Brake installation and maintenance

The brakes chamber shares the reduction gear oil and it is continuously feeded during the working processing.

During the installation of the reduction gear, it is necessary to verify that the handbrake's draught cable is not under tension and that the gap between the brake disks is not reduced: this would compromise the correct working of the brake.

We suggest an installation of a brake pump type: mini-servo with max operative pressure 90 bar.

For the normal use the operative pressure is from 50 to 70 bar.

It is necessary to check every 2000 working hours that the stroke of the brake piston is not over 3.5 mm, otherwise it is necessary to replace the brake disk. In order to estimate the worn of the discs, disconnect the brake rod.

Move the lever closer the brake piston, then pull it strongly and measure the stroke of the lever: it has not to be over 21 mm. In case the stroke exceed this value, it's required to replace the disc pack.

The M10x1 plug is used as connection to the hydraulic service brake circuit.

The bleeder nipple located in the opposite side of the service brake connection is used for bleeding the braking circuit before it is started (see fig 16).

The brake is designed to guarantee that the wheel maximum braking couple exceeds 5600 Nm under a pressure of 90-100 bars or with a pull of approx. 2500N on the brake lever.

For parking brake purpose the relation is 1300N at lever = 3000Nm at wheel.

The lever stroke is 13 to 21 mm depending on brake disks consumption.

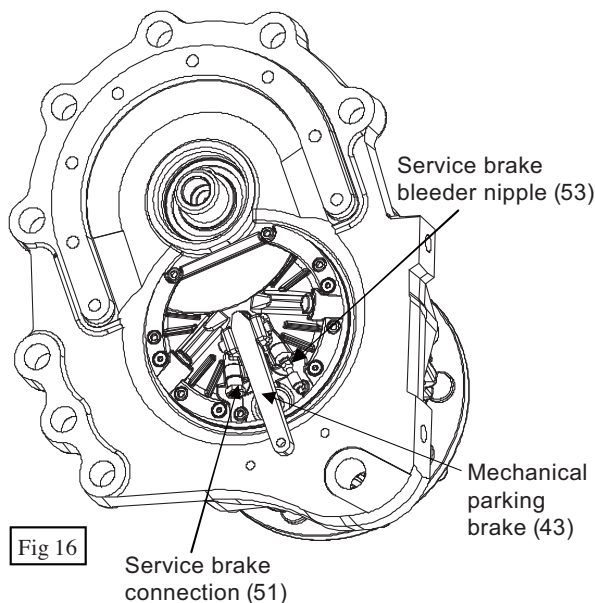
From a mechanical point of view, the brake discs can temporarily bear a pressure exceeding 150 bars in total safety; tightness of gaskets on the brake inner piston is not guaranteed when pressure exceeds 150 bars.

We suggest to not work with pressure higher than 90 bar. Under normal working conditions pressure should be 50 to 70 bar .

Piston gaskets* have been successfully tested with hydraulic fluid—type DOT4 as the: **BRAKE FLUID DOT 4 - AGIP** .

Change the hydraulic fluid—type DOT4 once a year!

* It is possible to assembly special gaskets (for mineral oil) on special request.



GROUP 22
WHEELS AND TIRES

**Wheels and Tires Specifications and
Description Section 1**

Wheels and TiresSection 2

Specifications

Service Brake:

Type: Wet disc brake

Fluid: Hydraulic fluid, DOT3 or DOT4

Pedal Freeplay: None

Parking Brake:

Type: Foot brake linked to service brake at each wheel.

Holding Test: Rated load on 15 % grade.

General Description

Brake pedal linkage - A mechanical system through which the brake pedal operates the master cylinder.

Master cylinder - The pistons are activated by brake pedal movement.

Brake lines - These lines carry the brake flow from the master cylinder to the wheel cylinders.

Service brake assembly - The drums, shoes and wheel cylinders.

Parking brake-Operates the service brake shoes via cables. See "Parking Brake Adjustment", in this Group for details.

Service Brake Operation

The Service brake pedal operates a master cylinder mounted on the front frame. The master cylinder operates a wheel cylinder. The wheel cylinder operates a shoe linings to be contacted on drum.

Parking Brake Operation

Operate the brake by putting your foot on parking pedal on the battery hood. The depressed pedal tensions cables connected to a brake shoe at each brake assembly, thereby applying the brakes.

Put your foot on parking pedal, then the parking brake will be released. This pedal releases the ratchet, and a return spring returns the pedal and cable to the off position. The ratchet also operates the parking brake interlock switch and the parking brake indicator light switch.

Service Requirements

Operational checks and inspection of linkage, brake lining, and brake lines are specified in the Periodic Service Chart in Group PS.

Service brake linkage adjustment and lube are not normally required.

Brakes are self-adjusting and normally require no adjustment.

A leaking master cylinder should be overhauled or replaced.

Components Disassembly

Use Figures 1, 2, and 3 as guide to disassembly and adjustment.

Components Reassembly

Replace the brake pedal components as shown in Figures 1 and 2 using fastener torques where shown. Also use the following notes:

1. Clean the reservoir and master cylinder hoses and fittings. Make sure no contaminants enter the braking system.
2. Adjust pedal free play as described in "Pedal Adjustment" on the page.
3. After re-assembly and adjustment, the brake system must be bled, see Section 2 in this Group. After bleeding, check all fluid connections for leaks and test brakes completely before returning truck to service.

Freeplay Adjustment

When the brake pedal linkage is properly adjusted, braking should begin only after the pedal is depressed a certain distance, This is "Freeplay" is Adjusted as follows :

1. Loosen the jam nut on the rod brake master cylinder (Figure 1).
2. Depress the brake pedal 4~6mm (0.16~0.24 in).
3. Adjust the rod until you feel the push rod make clearance with the cylinder piston.

CAUTION

SAFE PARKING. Before working on truck:

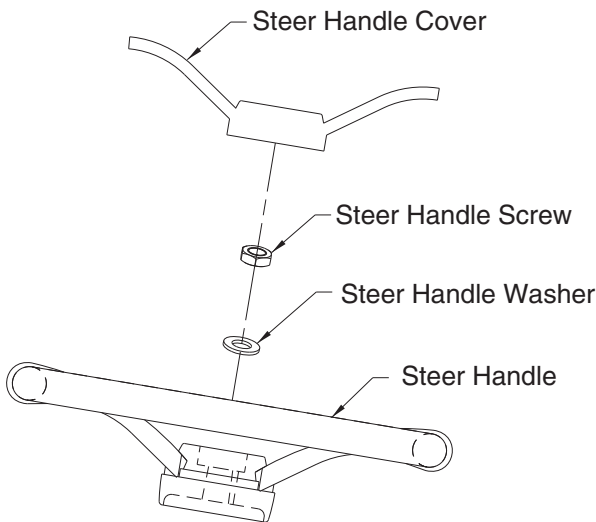
1. Park truck on a hard, level, and solid surface, such as a concrete floor with no gaps or breaks.
2. Put upright in vertical position and fully lower the forks or attachment.
3. Put all controls in neutral. Turn key switch OFF and remove key.
4. Apply the parking brake and block the wheels.

Steering Column and Component Removal

Determine which component requires service and check the procedure for removing that component. Read the procedure completely before beginning disassembly.

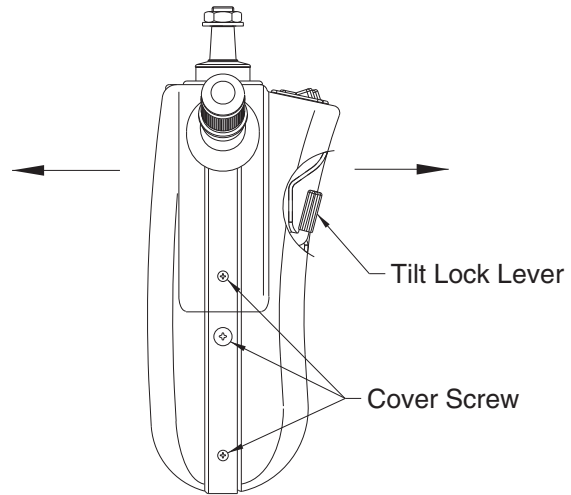
Hand Wheel, Light Switch Lever, and Directional Control Assembly Removal

1. Disconnect the battery.



2. Remove a hand cover and release nut and washer securing handle to steering column.
3. Remove screws securing both column cover using (+) driver. Disconnect connector assembled on

locker switch and pull rear cover smoothly after removing tilt lock lever.



NOTE

Use care when removing the backside cover as the rocker switch wiring is attached.

4. Disconnect wire connector assembled to direction control lever and light switch lever and remove direction control lever and light switch lever from steering column by releasing screw.

Column Tilt Lock Assembly Removal

NOTE

The tilt lock assembly is not serviceable; only the gas springs are serviceable. The tilt lock assembly should be removed only for replacement as a complete assembly.

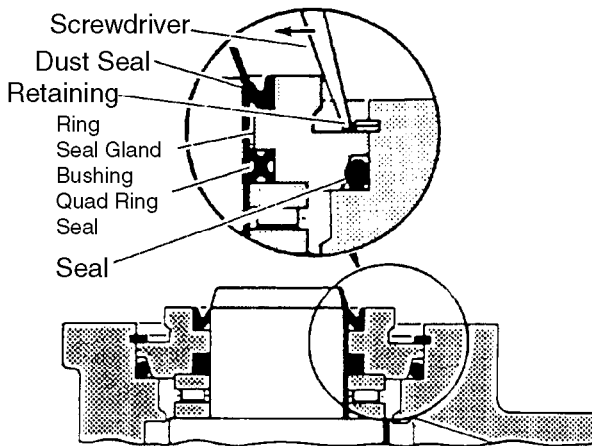
1. Remove the negative cable of battery.
2. Refer to "Handle, light switch lever and direction control assembly removal" to remove upper cover.

16. Install seal gland bushing over the spool end with a twisting motion. Tap the bushing in place with a rubber hammer. Make sure the bushing is flush against the bearing race.

On those units which use the Teflon seal, install the Teflon back-up ring into the recess cut into the seal gland bushing. Install the Teflon seal over the spool end, then carefully install the seal gland bushing over the spool end using a rotary motion.

NOTE

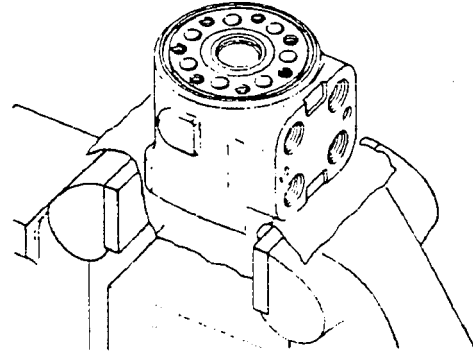
The seal gland bushing which is used with the Teflon seal is not the same as the seal gland bushing used with the standard quad-ring seal. The seal gland bushing with the Teflon seal has an identification groove cut into the outer diameter of the bushing. The grooved bushings can only be used with the Teflon seals and the non-grooved bushings used only with the quad-ring seals.



17. Install retaining ring in housing. After installing ring, tap on ring or pry with screwdriver around entire circumference of ring to properly seat ring in groove.

Meter (Gerotor) End

18. Clamp housing in vise, as shown. Clamp lightly on edges of mounting area. Do not overtighten jaws.



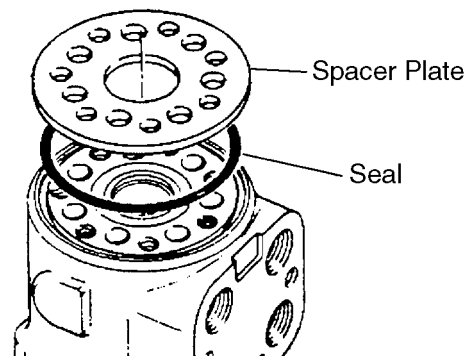
NOTICE

Check to ensure that the spool and sleeve are flush or slightly below the surface of the housing.

IMPORTANT

Clean the upper surface of the housing by wiping with the palm of clean hand. Clean each of the flat surfaces of the meter section parts in a similar way when ready for re-assembly. Do not use cloth or paper to clean surfaces.

19. Install 3-inch diameter seal in housing.



20. Install spacer plate. Align bolt holes in spacer plate with tapped holes in housing.

Section 3

Steering Axle Removal and Replacement

Steer Axle Removal 2
Steer Axle Replacement 3

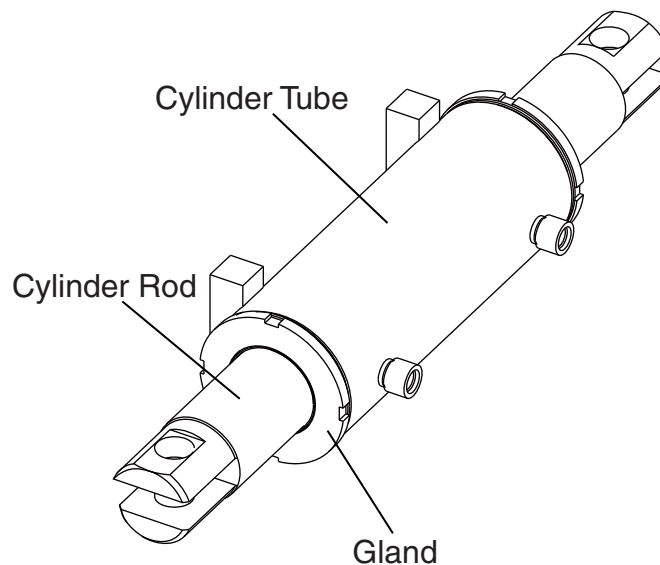
Section 6

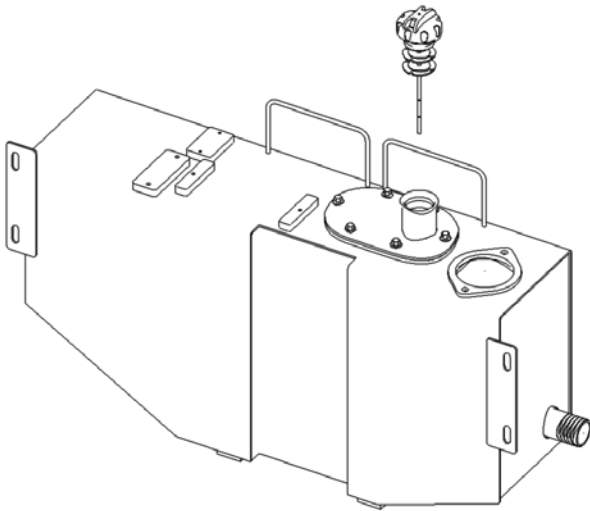
Steer Cylinder Overhaul

Preparation for Steer Cylinder Disassembly and Overhaul	2
Steer Cylinder Disassembly	2
Parts Inspection	2
Steer Cylinder Reassembly	3
Operational Pressure Test	4

IMPORTANT

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





Sump Tank Fill Levels

Pull out the dipstick for the hydraulic oil.

Hydraulic Fluid and Filter Change



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.**

There is drain plug in the hydraulic sump tank. When the sump tank must be drained of all fluid, the procedure is to remove the drain plug and allow the fluid to drain into a suitable drain pan. Unless the sump tank is to be removed for other repair or maintenance, the hydraulic fluid can also be changed by one of the following methods:

Pressure gauge to the diagnostic check port fitting.

NOTE: Use quick-disconnect adapter fitting.

You will need a drain pan of Below MFH 4800mm : 24 L,
Over MFH 5000mm : 31 L minimum capacity. Be sure the outlet end of the drain line is directed into the drain pan and held from moving when pressurized.

Turn key switch ON.

Move tilt control lever to the back tilt position to start the lift pump. Hold tilt lever in this position until sump tank is emptied. A steady stream of used oil should flow from the drain line.

Continue operation until the sump tank is emptied. This point will be reached when the pump starts to cavitate. When cavitation occurs the pump speed will increase and the speed sound will whine. Release the tilt lever immediately when pump cavitation occurs.

IMPORTANT

Be careful when sump is nearly emptied and oil flow becomes erratic as the pump approaches cavitation Do not operate pump after cavitation occurs.

Turn the key switch OFF.

Disconnect drain line from truck.

Description

The following description focuses primarily on hydraulic circuitry controlled by the main hydraulic control valve, that is, the lift/tilt/aux circuit. Various other hydraulic systems come into play, however, and are mentioned. The entire hydraulic system is depicted in the schematics in Section 2 (next page).

Descriptions of the braking and steering circuits are given in Groups 23 and 25.

The main hydraulic pump (described in Group 29) is driven by the pump motor and draws fluid from the sump through a particle-blocking suction screen.

The main hydraulic control valve features an open-center, parallel-circuit type modular design. It has the main (lift/tilt) pressure relief valve (steering pressure relief valve located in the steering control assembly (Orbitrol)), a secondary pressure relief valve for optional auxiliary components, a lift spool, a tilt spool with an integral counterbalance valve, optional auxiliary spools, and adjustable pressure-compensated flow controls. All spools are low-leakage design.

The main hydraulic valve has from two to four valve sections. Each section performs a separate function; standard two spool assemblies have a inlet/lift section (with fluid inlet port), a tilt section, and an outlet section. A third and fourth section may be added to control auxiliary components.

When lift attachments are used, an auxiliary section may be added to the outer (RH) side of the standard (lift/tilt only) main valve. The optional auxiliary sections also have an adjustable relief valve and can be assembled with optional flow control levels.

The valve spools are arranged in standard sequence (from the operator's position) to first provide lift control, then tilt, and finally auxiliary control. The control levers are spring-loaded (by the valve spool centering springs) to return them to neutral when released. Oil flow is controlled by the amount or distance the control handles are moved. Excess oil flow is returned to the sump. A check valve prevents reverse flow.

When all the control valve spools are in neutral, the micro switch turns the pump motor OFF and no fluid flows. When a spool is partially shifted and the associated cylinder or other actuator has not reached its end-of-travel, some of the fluid flows to the cylinder (actuator) and the rest flows to the sump line. In both cases, the pressure in the system should be less than the amount required to open the relief valves.

The main relief valve vents flow to the sump when one of the following conditions is present:

- The operator continues to hold the lift control in the lift position after the lift mechanism reaches its end-of-travel.
- Too heavy a load is being lifted.
- The operator continues to hold the tilt control in the tilt position after the tilt mechanism has reached its end-of-travel (This is called "tilt bypass.")
- Auxiliary relief fails to operate.

The auxiliary relief valve vents flow to the sump when the operator continues to hold the attachment control in the operated position after the attachment reaches its end-of-travel.

Main and auxiliary relief pressure settings can be checked through a gauge port on the main valve.

A tilt-lock valve built into the main control valve assembly locks the upright into its current tilt position when the truck is turned off. A load lowering flow valve mounted on the upright limits the speed at which the operator can lower a load, decreasing the speed for heavier loads. A velocity fuse built into one of the lift cylinder ports prevents the upright from falling rapidly should a hydraulic line rupture or be disconnected.

NOTE

Hydraulic plumbing arrangement is illustrated in Group 29.

Section 5

Hydraulic Control Valve Removal and Replacement

Hydraulic Control Valve Removal	2
Preparation for Valve Removal2
Control Valve Linkage Disassembly	2
Valve Removal.....	2
Hydraulic Control Valve Replacement	3
Valve Replacement	3
Control Valve Linkage Reassembly	3
Operational Checks	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.**

! 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.

Tilt Cylinder Drift Check

To check tilt cylinder drift, a rated capacity load is placed on the forks, lifted up and held to determine if the tilt cylinder rods moves (drifts) in a specified length of time.

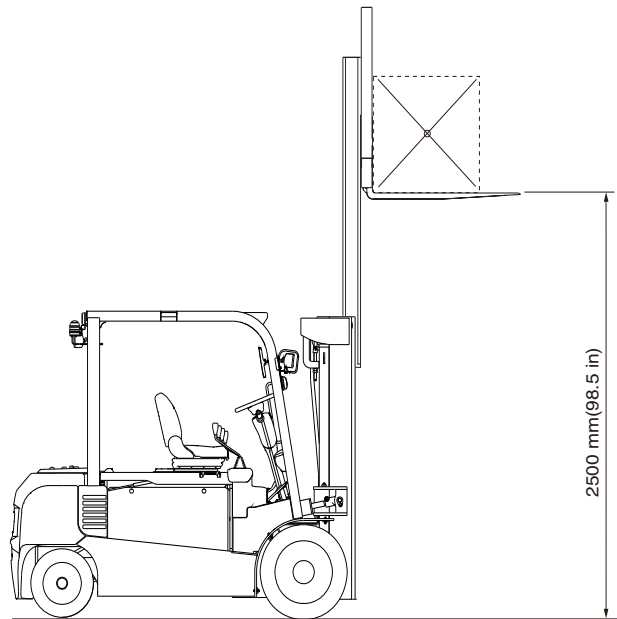
It is recommended that a test load, made up of a full-capacity load equally distributed on a 1220 x 1220 mm (48 x 48 in) pallet, be used. The material used to make up the test load must be stacked to provide load stability and must not extend beyond the pallet. It must be secured on the pallet. Refer to the truck data plate for capacity rating.

1. Adjust fork width as wide as possible to distribute the load. Refer to truck nameplate for capacity rating.

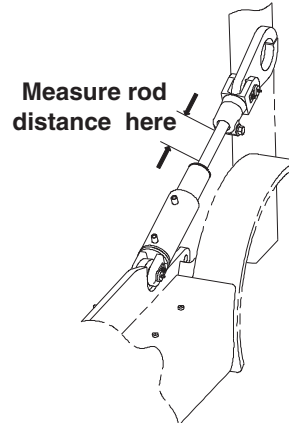
! CAUTION

Test load must be stacked stably, not extend beyond the pallet, and be secured on the pallet. Clamp the load on the load backrest or fork bar to avoid slipping out from fork.

2. Drive the forks into the load pallet until the test load and pallet rest against the load backrest. Apply the parking brake and chock the wheels.
3. Raise the capacity load 2500 mm (98.5 in) off the ground and tilt the upright vertical. Shut off the truck.



4. Measure and write down the distance between the cylinder-spacer face and the rod-end yoke.



5. Wait five minutes and measure and write down distance between rod end and spacer.
6. The measurement must not exceed the following measures:

Temperature	Drift
50°C(122°F)	0.5°, 3.9mm @ 1 min
	5°, 39 mm @ 10 min

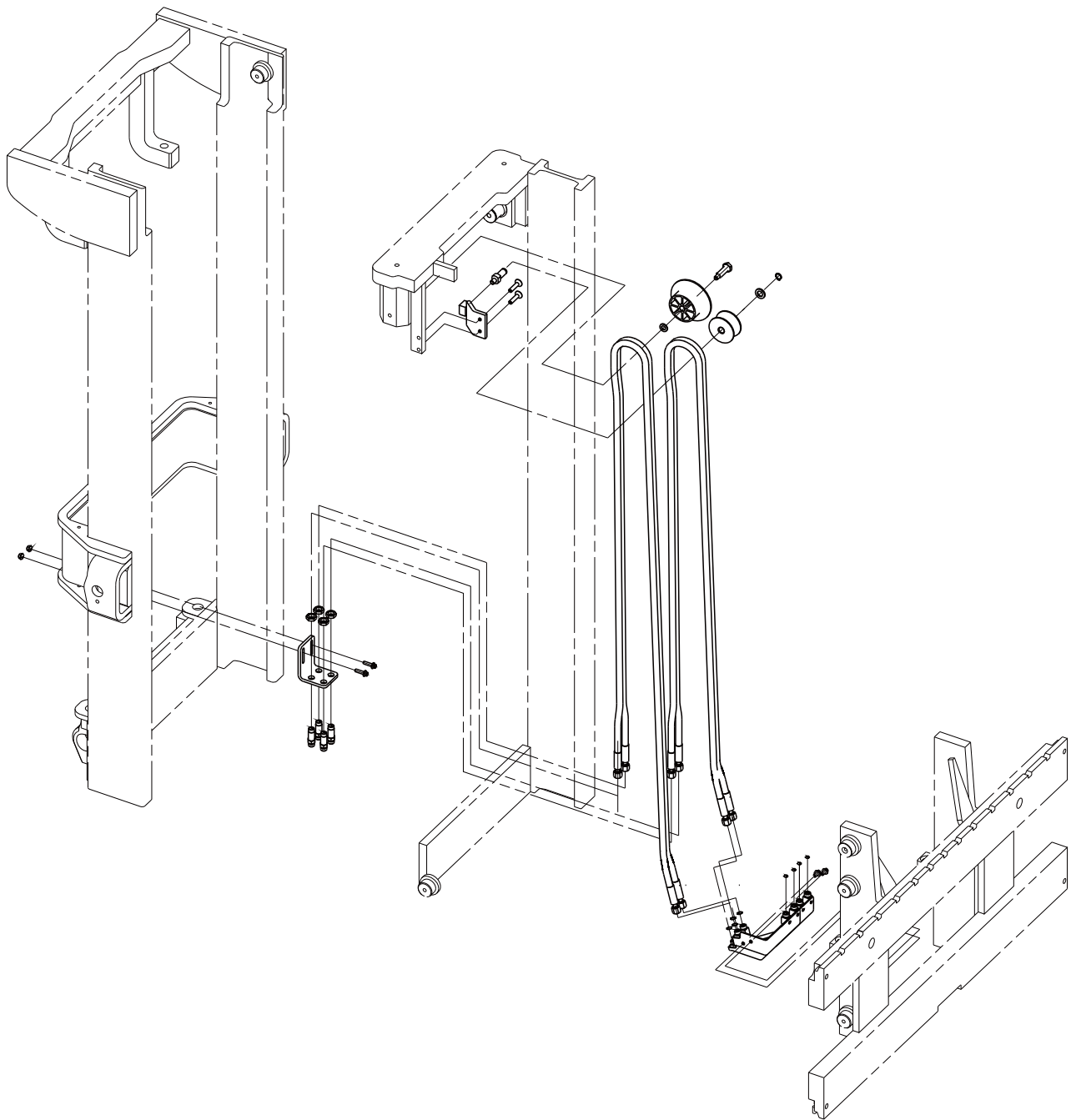
GROUP 34

UPRIGHTS

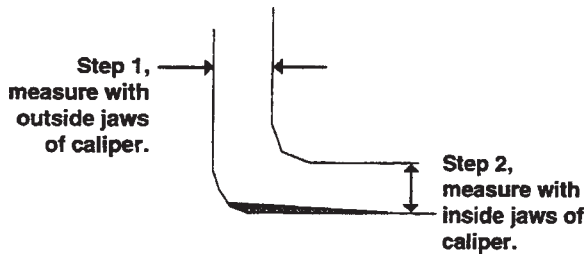
Upright Specifications and Description	Section 1
Troubleshooting	Section 2
Upright Inspection	Section 3
Carriage and Upright Roller Clearance Checks and Shim Adjustments	Section 4
Cylinder Removal, Shimming, Overhaul, and Replacement	Section 5
Upright Chain Inspection, Adjustment, and Replacement	Section 6
Fork and Carriage Removal and Replacement	Section 7
Upright Removal and Replacement	Section 8

IMPORTANT

Related service information is covered in Group 29, “Hydraulic Sump, Filters, and Pump,” Group 30, “Hydraulic Control Valve/Lift Circuit,” and Group 32, “Tilt Cylinder.”



Four-Hose Adaptation for the Standard Upright



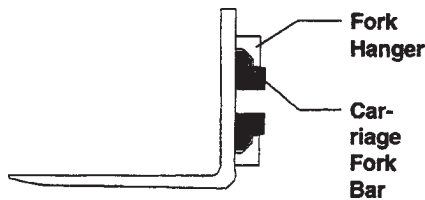
NOTE

Hold the caliper square and use light pressure to squeeze the outer jaw tips against the fork shank. Take care not to accidentally alter the reading of the calipers.

2. Check the fork blade area to the inside jaws of the caliper.
3. If the inside jaws fit over the fork in the blade area, wear exceeds allowable 10% wear and a new set of forks should be installed.

Fork Hanger Wear and Carriage Fork Bar Wear

Inspect the fork hangers and carriage fork bar. Excessive wear can cause the fork to disengage the fork bars or reduce fork hanger life.



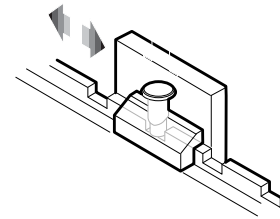
- If fork hangers are excessively worn, replace the forks as a set.
- If carriage fork bar is excessively worn, replace the carriage.

IMPORTANT

Welding is not recommended for repairing forks or carriage. Replace the worn parts with new parts.

Fork Latch and Carriage Fork Stops

1. Check fork latches for proper operation. Latches should operate smoothly. The spring should be in good condition and securely lock the fork into position. Replace the fork latch if it does not operate properly.



NOTE

A small amount of lubricant can be applied to the fork latch. Do not over lubricate and allow lubricant to run down on carriage fork bar.

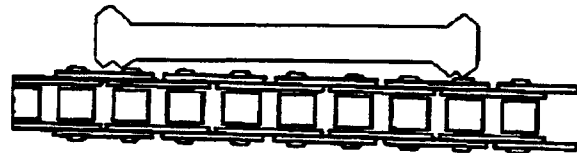
2. Check fork stops for widening of notches or rounding of top edge. Replace the carriage if fork stops are excessively worn.

Lift Chains

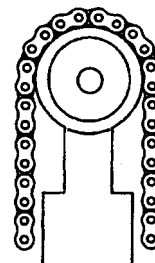
The following checks should be performed every 50-250 hours to ensure correct chain performance See Section 6 for more complete chain inspection and maintenance procedures.

Chain Wear (Stretch) - All Lift Chains

Lift chain stretch due to wear in the joints can be measured using a measuring tape or chain check ruler.



When any section of the chain has worn and increased its original length by 3% or more, the chain must be replaced. When checking chain wear, always measure a segment of the chain that rolls over a sheave.



6. If the clearance at the *widest* rail set span is more than 2.25 mm (0.09 in), the roller set needs shimming.
If the clearance at the *narrowest* rail set span is more than 1.0 mm (0.04 in), the roller set should be shimmed; however, it is OK for the middle carriage roller gap to be up to 1.5 mm (0.06 in).
7. Repeat entire procedure for each roller set, following the instructions in “Directions for Checking Specific Rollers” below.

Directions for Checking Specific Rollers

Use these directions to supplement the general procedures given above.

Carriage Rollers

Bottom Carriage Rollers

Follow the general procedure above.

Middle Carriage Rollers

The middle rollers are difficult to access and require the following special procedures.

1. Raise the carriage until the middle rollers are at the top of the inner rails.
2. Measure roller side clearance at the top of the inner rails. Note measurement here:

_____.

If gap is less than 1.5 mm (0.06 in), shimming is not required.

If gap is more than 1.5 mm (0.06 in), check clearance at narrowest span by comparison with the top of the rail set as follows:

- a. With spanner tool, measure span of inner rail set at top of the front web area. Note measurement here: _____.
- b. With spanner tool, measure span of inner rail set at narrowest span of front web area. Note measurement here: _____.
- c. Subtract measurement in step b from measurement in step a, Write result here:
b-a= _____.

If the calculated gap is less than or equal to the gap measured in step 2, the roller set does not require shimming. Otherwise, the roller set should be shimmed.

Upright Rollers

1. Remove the carriage as described in Section 7 of this Group.
2. Fully extend the upright making sure carriage hoses and chains are secured out of the way to prevent damage.



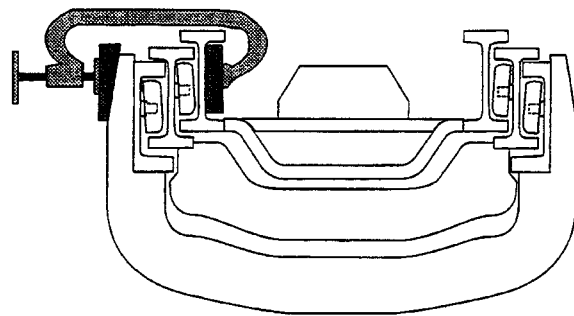
WARNING

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.
- Do not reach through open areas of the upright.
- Never attempt to move or align the rails by hand. Use a prybar.
- Use an approved safety platform to reach the upper areas of the upright. Never use the upright as a ladder.

Failure to follow these warnings can result in serious injury.

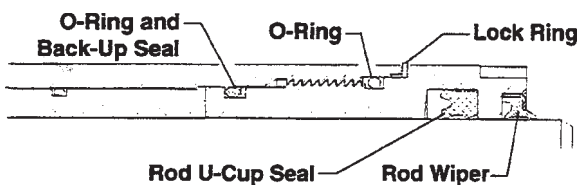
3. Follow the “General Roller Side Clearance Checking Procedure” given earlier in this Section.
The clamping procedure is as illustrated below.



Cylinder Reassembly

Take care when installing these parts to make sure that no parts are damaged.

1. Coat all packing, seals and rings in clean, hydraulic oil (Clark part number 1800236 qt., 1802155 gal.) prior to reassembly. Coat the inside of the gland nut bore with hydraulic oil.
2. Replace the U-cup seal (groove toward bottom of cylinder), rod wiper, and O-ring and back-up seals on the gland.



NOTE

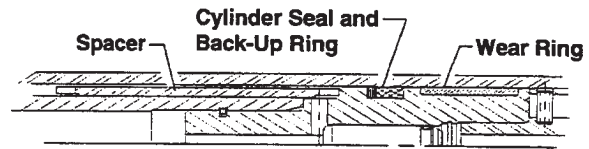
O-rings should be carefully installed to eliminate cuts or twisting.

3. Replace the piston seals:
 - a. Primary cylinder pistons require a piston seal and wear ring. Install the piston seal from the top of the rod. Use a ring compressor to compress the piston seal. This prevents damage to the seal during reassembly.



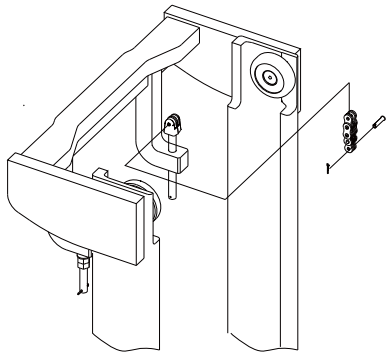
- b. Piston-type lift and secondary cylinder require a cylinder seal, a back-up ring, and a wear ring on

the piston. Install the cylinder seal from the top of the rod.

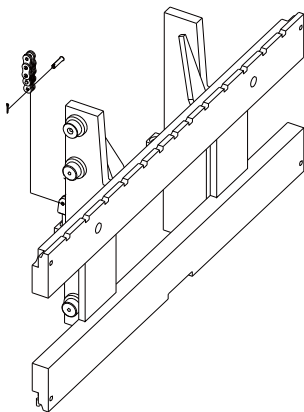


4. For protection against corrosion, lubricate spacers (where used) with petroleum-based hydraulic fluid. Slide the spacer onto the rod.
5. Insert the piston and rod into the cylinder. Be careful not to scratch or damage the cylinder gland nut threads.
6. For primary cylinders, add 3.4 oz (100 ml) of hydraulic oil into the cylinder on the rod side of the piston.
7. Install the lock ring onto the gland. Lubricate cylinder threads and screw gland onto cylinder. Be careful not to damage gland seal. Make sure the gland is fully seated on the cylinder barrel. Deform the lock ring into slots in the tube and the gland.
8. Check the assembly by making sure the piston slides freely in and out of the cylinder.
9. Tighten the gland nut:
 - On primary cylinders, tighten the gland nut to 135 N·m (100 ft·lb).
 - On lift and secondary cylinders, tighten the gland nut to 100 N·m (75 ft·lb).

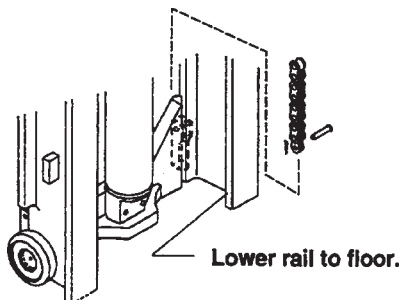
- Lift the carriage or inner rail slightly to create slack in the chains. Block the carriage or inner rail up for safety.
- Remove the chain anchor pins on the outer rail and pull the chains off of the sheaves on the inner or intermediate rails.



- Remove the chain anchor pins from the carriage on the standard upright or the inner rail on the TSU. On the TSU, the inner rails must be lowered to the floor to access the chain anchor pins.



Lift Chain Removal from Carriage (standard upright)



Triple-Stage Upright Lift Chain Removal from Inner Rail

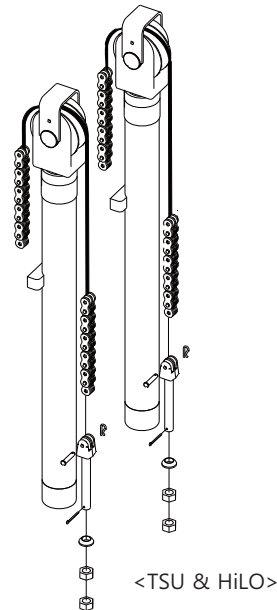
NOTE

If a hose adapter assembly is used, the chain sheaves must be loosened and removed to prevent the hoses from stretching when the inner rails of the TSU are lowered to access the chain anchor pins.

- Use the steps in reverse order to replace the lift chain set.

Primary Cylinder/Carriage Chains (TSU and Hi-Lo)

- Tilt the upright forward, lower it, and completely collapse the primary cylinder to create slack in the chains. The carriage may also be lifted and blocked in position and the primary cylinder completely collapsed to create slack in the chains.
- Remove the chain anchor pins from the back of the primary cylinder. Pull the chains through the chain sheave and lay over the carriage load backrest.

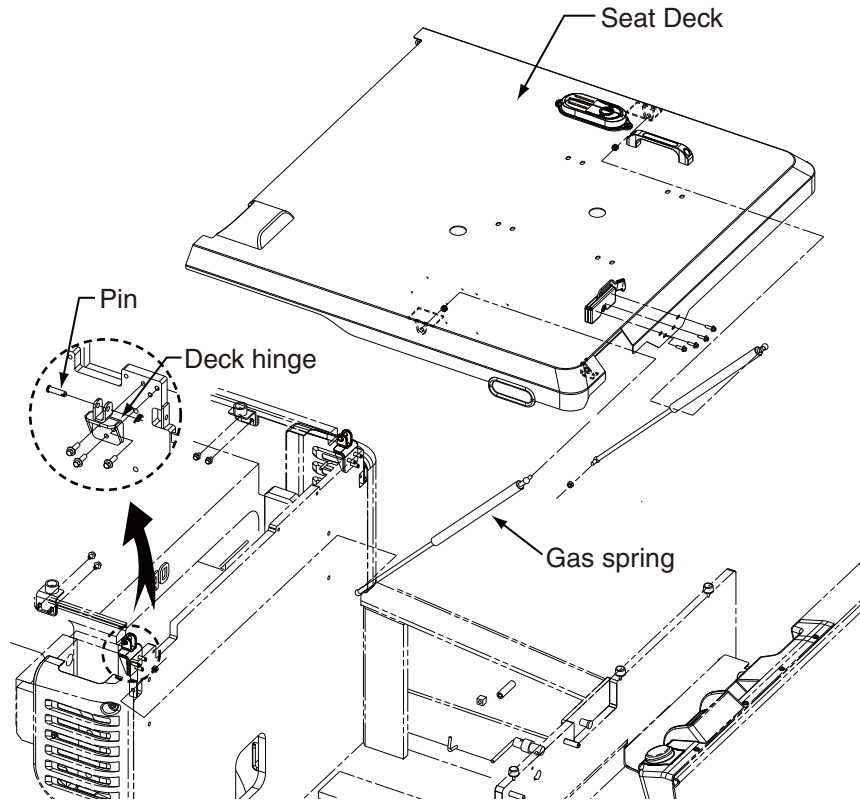


<TSU & HiLO>

GROUP 38

COUNTERWEIGHT AND CHASSIS

Counterweight Specifications and Description ...	Section 1
Counterweight Removal and Installation	Section 2
Overhead Guard Removal and Installation	Section 3
Floor Plate, Seat and Seat Deck Removal and Installation	Section 4



4. Remove various electric devices and gas spring from the driver seat deck.
5. Remove the pins from the hinge of driver seat deck and then remove the deck from the forklift. The deck should be removed by two or more persons.

Reinstallation.

1. Reinstall the hood in reverse order that it was removed.

 WARNING

Failure to follow this reinstallation procedure may result in operator injury. Ensure full latch engagement for battery retention.

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