

SM 646 EC 90/120 Service Manual



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CLARK

Technical
Publications
Lexington, KY
40508

Arrangement and Use of this Manual

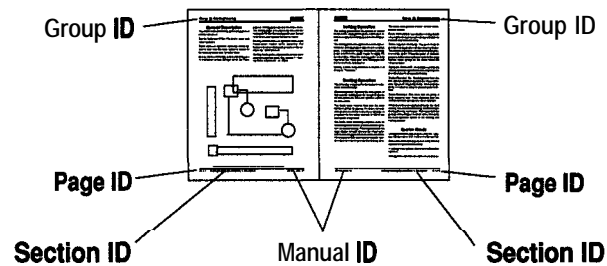
Clark arranges parts and service procedures by standardized **Groups**. In this manual, Groups are similar to “chapters.” Groups are listed in the table of contents on the next page.

Each Group begins with a table of contents that shows the Sections contained within the Group. Lengthy Sections also begin with a table of contents showing the topics contained within the Section.

Each Group and Section has an identifying name and number, or “ID.”

Each page also has a unique ID. The page ID consists of three numbers separated by hyphens. The three numbers represent the Group number, the Section number, and the page number. For example, “00- 1-2” on the lower corner of the page indicates Group 00, Section 1, Page 2.

You can quickly locate a specific point in the manual by using the headers and footers that appear on every Section page. The following illustration points out these areas.



This manual is intended for the use of trained service personnel. Please read Group SA, “Safe Maintenance,” and the *Operator’s Manual* before working on or operating the truck.

Contents by Group and Section

(Alphabetical listing of contents appears on next page.)

Contents are listed here by Group number and name followed by Section number and name:

- | | | | |
|-----------|---|--------------|--|
| SA | SAFE MAINTENANCE <ol style="list-style-type: none">1. Safety2. Lifting, Jacking, and Blocking3. Towing | 23 | BRAKE SYSTEM <ol style="list-style-type: none">1. Specifications and Description2. Service Brake Troubleshooting3. Pedal and Linkage Adjustment4. Brake System Bleeding5. Master Cylinder Service6. Service Brake Overhaul7. Seat Brake Service |
| PS | PERIODIC SERVICE <ol style="list-style-type: none">1. Maintenance Schedule2. Planned Maintenance3. PM Inspection Form | 25/26 | STEER SYSTEM <ol style="list-style-type: none">1. Specifications and Description2. Troubleshooting3. Relief Pressure Check and Adjustment4. Column Removal and Replacement5. Steering Gear Overhaul6. Steer Pump Overhaul7. Steer Axle Service6. Steer Cylinder Overhaul |
| 12 | BATTERY <ol style="list-style-type: none">1. Battery Service | 29/30 | MAIN HYDRAULIC SYSTEM <ol style="list-style-type: none">1. Specifications and Description2. Fluids and Filters3. Troubleshooting4. Pressure Checks and Adjustments5. Main Pumps Overhaul6. Main Control Valve Removal and Overhaul |
| 13 | WIRING, SWITCHES, AND INSTRUMENTS <ol style="list-style-type: none">1. Electrical Diagrams2. General Electrical Service Tips3. Switches and Sensors4. Instrument Panel | 32 | TILT CYLINDERS <ol style="list-style-type: none">1. Specifications and Description2. Checks and Adjustments3. Mounting and Overhaul4. Tilt Lock Valve |
| 16 | ELECTRIC MOTORS <ol style="list-style-type: none">1. Specifications and Description2. Inspection and Troubleshooting3. Drive Motor Overhaul4. Lift Pump Motors Overhaul5. Steer Pump Motor Overhaul | 34 | UPRIGHTS <ol style="list-style-type: none">1. Upright Removal and Replacement2. Lift Chain Inspection and Service Guidelines |
| 19 | MOTOR CONTROLS <ol style="list-style-type: none">1. Specifications and Description2. Maintenance and Checks3. Control Panel Removal and Replacement4. Contactors Overhaul5. EV-200 LX Handset Operation Supplement6. EV-200 LX Status Codes Supplement | 38 | COUNTERWEIGHT AND CHASSIS <ol style="list-style-type: none">1. Counterweight Removal and Installation2. Overhead Guard Removal and Installation3. Seat and Sheet Metal R&R |
| 20 | DRIVE AXLE <ol style="list-style-type: none">1. Specifications and Description2. Troubleshooting3. Removal and Installation4. Overhaul General Practices5. Drive Axle Ends Overhaul6. Differential Adaptor Overhaul7. Differential Overhaul | 40 | SPECIFICATIONS <ol style="list-style-type: none">1. Nameplate and Decals2. General Specifications3. Hydraulic Fitting Tightening Procedure |
| 22 | WHEELS AND TIRES <ol style="list-style-type: none">1. Specifications and Description2. Cushion Wheels & Tires | | |

Alphabetical Listing of Topics

(Contents are listed by order of Group and Section numbers on previous page.)

Contents are listed here by topic followed by the **Group#-Section#** the topic appears in:

Battery Service	12-1	Lift Pump Motor Overhaul	16-4
Brake Fluid Check, Fill, and Bleed	23-2	Maintenance Schedules	PM-1
Brake Master Cylinder Service	23-5	Motors Specifications and Description	16-1
Brake Overhaul	23-6	Motors Troubleshooting	16-2
Brake Pedal and Linkage Adjustment..	23-3	Nameplate and Decals	40-1
Brake System Specifications and Description.....	23-1	Overhead Guard Removal and installation	38-2
Column Removal and Replacement	25/26-4	Parking Brake R & R and Adjustment	23-5
Contactors	19-4	Planned Maintenance	PM-2
Controllers Removal and Replacement	19-3	PM Inspection Form	PM-3
Controllers Specifications and Description	19-1	Safety	SA-1
Counterweight Removal and Installation..	38-1	Seat, Operator's	38-3
Diagnostic Status Codes	19-6	Sheet Metal	38-3
Drive Axle Fluid Check and Change	20-2	Specifications for Entire Truck	40-2
Drive Axle Overhaul	20-4	Steer Axle Overhaul	25/26-7
Drive Axle Removal and Installation	20-3	Steer Cylinder Overhaul	25/26-8
Drive Axle Specifications and Description	20-1	Steer Pump Overhaul	25/26-6
Drive Axle Troubleshooting	20-2	Steer System Troubleshooting	25/26-2
Drive Motor Overhaul	16-3	Steering Gear (Valve) Overhaul	25/26-5
Electrical Diagrams	13-1	Steering Pump Motor Overhaul	16-5
Electrical Service Tips	13-2	Steering Relief Pressure Check and Adjust	25/26-3
Handset Operation	19-5	Steering Specifications and Description	25/26-1
Hydraulic Control Valve Overhaul	29/30-6	Switches and Sensors	13-4
Hydraulic Fitting Tightening Procedure.....	40-3	Tilt Cylinders Checks and Adjustments	32-2
Hydraulic Fluids and Filters	29/30-2	Tilt Cylinders Mounting and Overhaul	32-3
Hydraulic Pressure Checks and Adjustments .	29/30-4	Tilt Cylinders Removal and Installation	32-3
Hydraulic Lift Pump Overhaul	29/30-5	Tilt Cylinders Specifications and Description..	32-1
Hydraulic Specifications and Description	29/30-1	Tilt Lock Valve	32-4
Hydraulic System Troubleshooting..	29/30-3	Towing	SA-3
instrument Panel	13-5	Upright Removal and Replacement	34-1
Jacking and Blocking	SA-2	Wheels & Tires	22-1
Lift Chain inspection and Service Guidelines	34-2	Wiring and Cables	13-3

GROUP SA

SAFE MAINTENANCE

Safety Section 1

Lifting, Jacking, and Blocking the Truck Section 2

Towing Section 3

Section 1. Safety

Safety Signs and Messages

Safety signs and messages in this manual and on the lift truck provide instructions and identify specific areas where potential hazards exist and special precautions should be taken. Be sure you know and understand the meaning of these instructions, signs, and messages. Damage to the truck, death, or serious injury to you or other persons may result if these messages are not followed.

NOTE

This message is used when special information, instructions or identification is required relating to procedures, equipment, tools, pressures, capacities, and other special data.

IMPORTANT

This message is used when special precautions should be taken to ensure a correct action or to avoid damage to, or malfunction of, the truck or a component.

A CAUTION

This message is used as a reminder of safety hazards that can result in personal injury if proper precautions are not taken.

A WARNING

This message is used when a hazard exists that can result in injury or death if proper precautions are not taken.

A DANGER

This message is used when an extreme hazard exists that can result in injury or death or serious injury if proper precautions are not taken.

The above terms have been adopted by Clark Material Handling Company. The same terms may be used in different context in service literature supplied directly or indirectly by vendors of truck components.

Safe Maintenance Practices

The following instructions have been prepared from current industry and government safety standards applicable to industrial truck operation and maintenance. These recommended procedures specify conditions, methods, and accepted practices that aid in the safe maintenance of industrial trucks. They are listed here for the reference and safety of all workers during maintenance operations. Carefully read and understand these instructions and the specific maintenance procedures before attempting to do any repair work.

When in doubt of any maintenance procedure, please contact your local Clark dealer.

1. Powered industrial trucks can become hazardous if maintenance is neglected. Therefore, suitable maintenance facilities, trained personnel, and procedures must be provided.
2. Maintenance and inspection of all powered industrial trucks shall be done in conformance with the manufacturer's recommendations.
3. A scheduled planned maintenance, lubrication, and inspection program shall be followed.
4. Only trained and authorized personnel shall be permitted to maintain, repair, adjust, and inspect industrial trucks. Work should be performed in accordance with the manufacturer's specifications.
5. Properly ventilate work area, vent exhaust fumes, and keep shop clean and floor dry.
6. Avoid fire hazards and have fire protection equipment present in the work area. Do not use an open flame to check for level or leakage of fuel, electrolyte, oil, or coolant. Do not use open pans of fuel or flammable cleaning fluids for cleaning parts.
7. Before starting work on truck:
 - a. Raise drive wheels off of floor and use blocks or other positive truck positioning devices.
 - b. Disconnect battery before working on the electrical system.
8. Before working on engine fuel system of gasoline- or diesel-powered trucks, be sure the fuel shut-off valve is closed.
9. Operation of the truck to check performance must be

conducted in an authorized, safe, clear area.

10. Before starting to drive truck:
 - a. Be in operating position with seat belt fastened.
 - b. Be sure parking brake is engaged.
 - c. Put direction control in neutral.
 - d. Start engine.
 - e. Check functioning of direction and speed controls, steering, brakes, warning devices, and any load handling attachments.
11. Before leaving truck
 - a. Stop truck.
 - b. Put directional control in neutral.
 - c. Apply the parking brake.
 - d. Stop the engine by turning off the key switch.
 - e. Put upright in vertical position and fully lower the forks or attachment.
 - f. Put blocks at the wheels if truck is on an incline.
12. Brakes, steering mechanisms, control mechanisms, warning devices, lights, governors, guards, safety devices, and frame members must be carefully and regularly inspected and maintained in a safe operating condition.
13. Special trucks or devices designed and approved for hazardous area operation must receive special attention to ensure that maintenance preserves the original, approved, safe-operating features.
14. Fuel systems must be checked for leaks and condition of parts. Extra special consideration must be given in the case of a leak in the fuel system. Action must be taken to prevent the use of the truck until the leak has been corrected.
15. The truck manufacturer's capacity, operation, and maintenance instruction plates, tags, or decals must be maintained in legible condition.
16. Batteries, motors, controllers, limit switches, protective devices, electrical conductors, and connections must be inspected and maintained in conformance with good practice. Special attention must be paid to the condition of electrical insulation.
17. To avoid injury to personnel or damage to the equipment, consult the manufacturer's procedures in replacing contacts on any battery connection.
18. Industrial trucks must be kept in a clean condition to minimize fire hazards and help in the detection of loose

or defective parts.

19. Modifications and additions that affect capacity and safe truck operation must not be done without the manufacturer's prior written approval. Capacity, operation and maintenance instruction plates, tags, or decals must be changed accordingly. This is an OSHA requirement.
20. Care must be taken to assure that all replacement parts, including tires, are interchangeable with the original parts and of a quality at least equal to that provided in the original equipment. Parts, including tires, are to be installed per the manufacturer's procedures. Always use genuine CLARK or CLARK-approved parts.
21. Use special care when removing heavy components from the truck, such as counterweight, seat deck, upright, etc. Be sure that lifting and handling equipment is of the correct capacity and in good condition. Also, this removal may upset the stability of the truck. The frame must always be safely blocked for major component removal.

NOTE

You should also be familiar with additional operating and maintenance safety instructions contained in the following publications:

ANSI/ASME B56.1 - 1988: Operator Control-Industrial Tow Tractors (Safety Standard For Powered Industrial Trucks). Published by: American Society of Mechanical Engineers, United Engineering Center, 345 E. 47th Street, New York, NY 10017.

NFPA 505-1982: Fire Safety Standard for Powered Industrial Trucks: Type Designations, Areas of Use, Maintenance and Operation. Available from: National Fire Protection Assoc., Inc., Batterymarch Park, **Quincy**, MA 02269.

General Industrial Standards, OSHA 2206: OSHA Safety and Health Standards (29 CFR 1910), Subpart N-Materials Handling and Storage, Section 1910.178 Powered Industrial Trucks. For sale by: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

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

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

A 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.

A CAUTION

To perform these service procedures, first:

- Park truck on a level surface.
- Put the upright in a vertical position and lower the carriage fully down.
- Return control handle to neutral and turn key switch OFF.

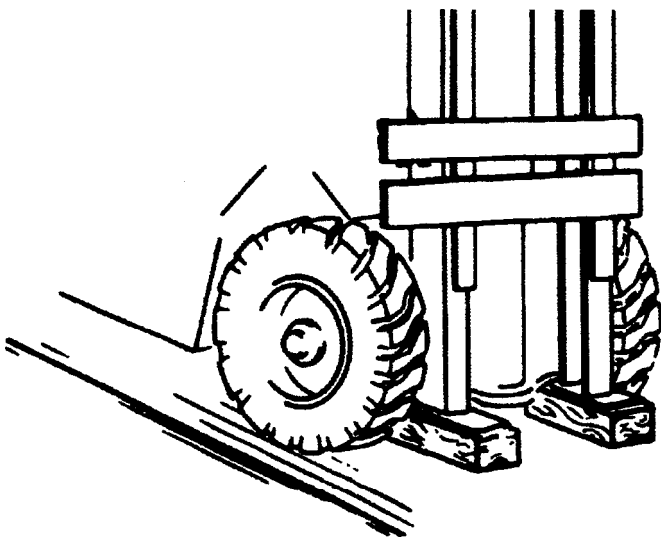
A WARNING

Defective equipment can cause accidents: All tools and lifting equipment must be in good condition, meet the load capacity requirements and have OSHA labels when required. Tools with defects can fail, causing severe injury or death.

Raising Drive Wheels

This procedure uses the upright as a lever to lift the drive wheels off the floor and prevent accidents due to inadvertent powering of the drive wheels.

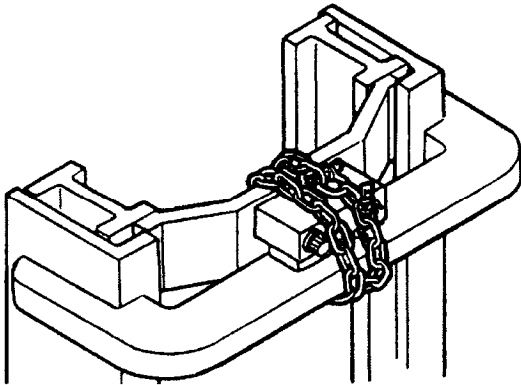
1. Park the truck safely.
2. Turn key switch **ON**. Tilt the upright fully back.
3. Put a solid 100 x 100 mm (4 x 4 inch) hardwood block under the front section of each upright rail. Put a 3-6 mm (0.125-0.250 inch) steel plate on top of each block.
4. Tilt the upright fully forward. This will raise the drive wheels off the floor.
5. Block the truck under the frame behind the drive wheels.
6. Turn key switch **OFF**.
7. Check for safe clearance between drive wheels, block and floor.
8. Check the stability of the truck. Be sure that the blocks are located securely under the frame before operating the drive motor or working on truck.
9. Lower the drive wheels to the floor by reversing this procedure.
 - Turn key switch **ON**.
 - Tilt upright fully back.
 - Turn key switch **OFF**.
10. Remove the blocks from under the frame and upright rails.



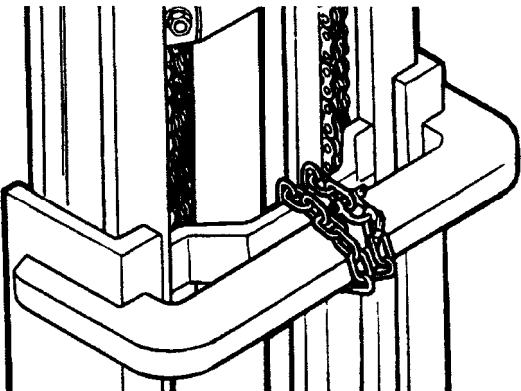
Chaining the Upright in Raised Position

This procedure is used to safely provide clearance for access from the front of truck to components on or near the drive axle.

1. Park truck safely.
2. Put blocks at front of and rear of drive wheels.
3. Raise upright carriage.
4. Chain the center inner rail tie bar to the top outer rail tie bar as shown.



Triple Stage Uprights: Chain the center intermediate rail tie bar and the lower inner rail tie bar to the top outer rail tie bar.



5. Reverse the procedure to remove the chains.

Raising Rear of Truck

The truck may be raised at the rear by jacking and blocking under the center of the frame member at either the front or rear steer axle mounting, or under the center section of the steer axle.

Refer to truck data plate for truck weights.

A WARNING

An incorrectly installed counterweight can move or fall unexpectedly. Never lift or block a truck using the counterweight. Failure to follow procedures outlined in this manual can result in injury or death.

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

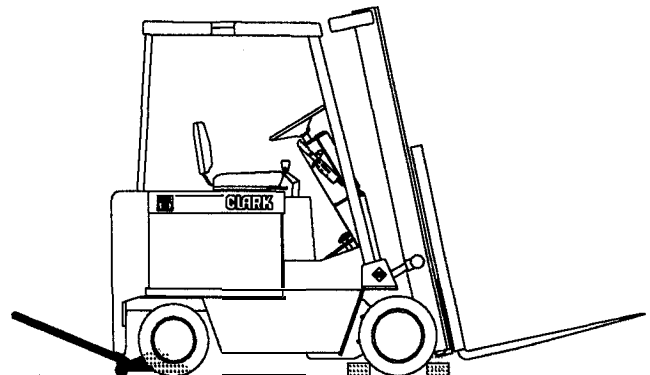
A CAUTION

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

3. Put a floor jack under the steer axle mounting frame member, **centered** between the two wheels.

A WARNING

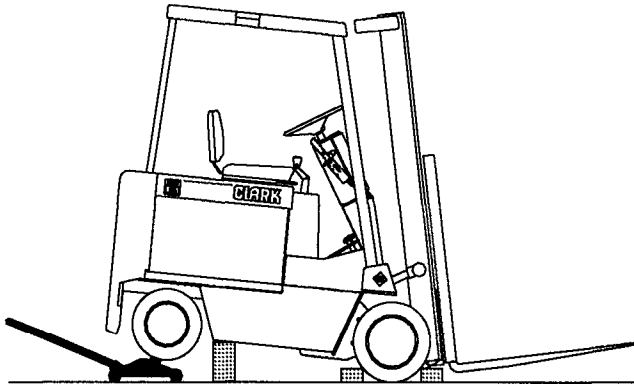
Never lift the truck by the counterweight.



NOTE

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

4. Raise the truck only as high as necessary to perform the maintenance work.
5. Put blocks at both sides of the truck, fully under the frame main side structure. Put the blocks in front of but close to the counterweight and steer wheels for best truck stability.



Put an equal number of blocks under each side of the truck to provide a level working position.

6. Lower the truck onto the blocks and remove the jack.

A CAUTION

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

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

Raising Entire Truck

Refer to truck data plate for truck weights.

1. Park truck safely. Lower upright fully.
2. If necessary, drive truck onto boards to increase underclearance.

A WARNING

SIDE-TO-SIDE TIPOVER. When jacking side of truck, be sure upright is lowered fully. Do not raise one side of the truck more than about 50 mm (2 in) higher than the other, to avoid tipping truck over laterally.

END-TO-END TIPOVER. If the upright and transaxle are removed while the truck is blocked up, the truck will tip backward due to the heavy counterweight. Upright and counterweight must both be removed before attempting to raise the truck for transaxle removal. The back of the truck must be supported by blocking under the steer axle to prevent movement.

If the counterweight is removed while the truck is up on blocks, the weight of the upright and transaxle will cause the truck to fall forward.

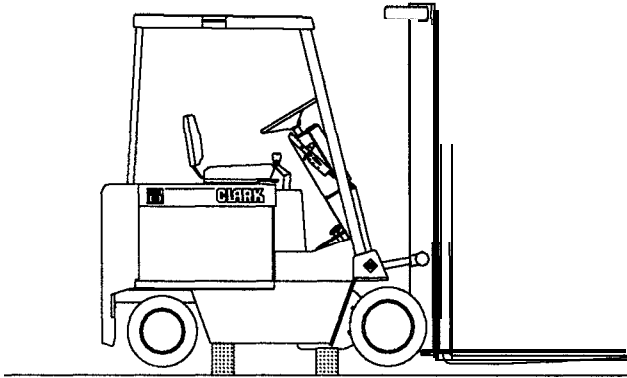
3. Put the jack under side frame, near the center of the truck.

IMPORTANT

Be sure to put the jack squarely and fully under the main side structure of the frame. Do not put the jack under the outer covers which enclose the hydraulic pump and controls.

4. Carefully raise the truck one side at a time, only as high as necessary to do the maintenance work, and not more than 150 mm (6 in) total.

5. Put blocks **under** the side frame, at each side of the jack. Spread the blocks close to the steer and drive wheels for maximum stability.
6. If using one jack, lower the truck onto the blocks and move the jack to the opposite side. Repeat the lifting procedure.
7. Put the same size blocks under each side of the truck so it will be leveled.



A CAUTION

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

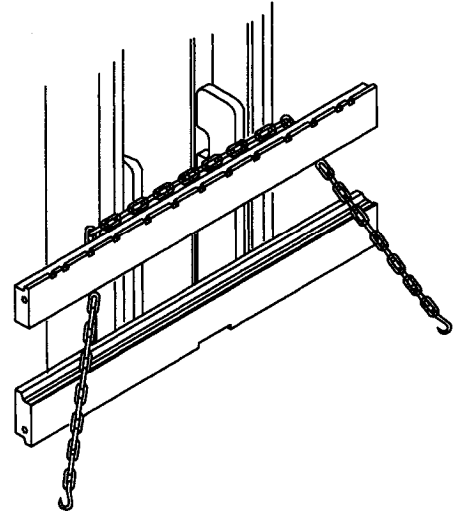
8. When maintenance work is completed, lower the entire truck to the floor by reversing this procedure. Lower the truck one side at a time, while carefully removing the blocks. Be sure no tools or equipment are under the truck or wheels.

NOTE

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

Shipping Tie-Down Instructions

1. Front of Truck
 - a. With Upright and Carriage Installed
 - Lower the carriage fully.
 - Put a tie-down (e.g., chain) between the carriage fork bars.



- b. Without Upright and Carriage Installed
 - Put a chain across the truck floor plate. Protect truck from chain damage by using covered chain or protective material under the chain at contact points.
2. Rear of Truck
 - Attach the tie-down to pocket in bottom of counterweight.

GROUP PS

PERIODIC SERVICE

Maintenance Schedule Section 1

Planned Maintenance Program..... Section 2

The PM Inspection Form Section 3

Section 1. Maintenance Schedule

“Periodic Service” and “Planned Maintenance”	1
Determining Maintenance Intervals	1
Service Chart/Lubrication Points	2
Recommended Periodic Service Schedule	4

“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 50-250 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.

If the lift truck is used in Severe or *extreme* operating conditions, the maintenance intervals should be shortened accordingly.

IMPORTANT

MAINTENANCE INTERVALS. If the lift truck is used in **severe** or **extreme** operating conditions, the maintenance intervals should be shortened accordingly.

Since the operating environments of lift trucks vary widely, the above descriptions are highly generalized and should be applied as actual conditions dictate.

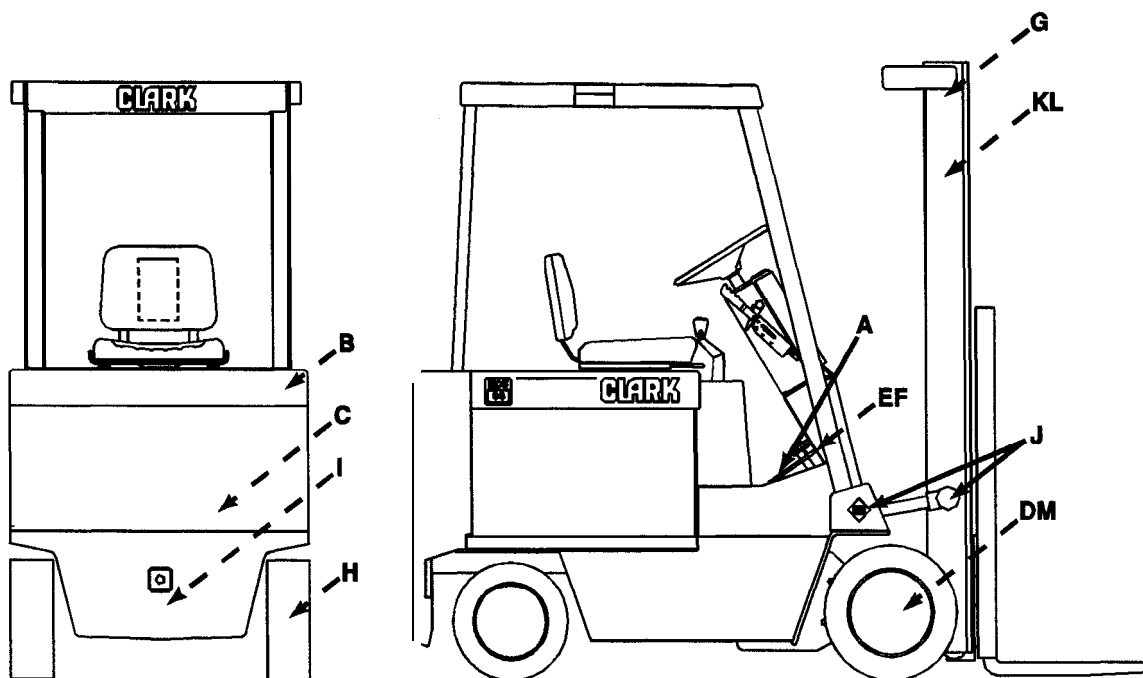
Lubrication Points




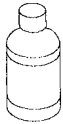

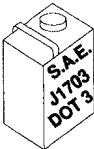
Lubrication Points	No. of Lube Points	Chart Key	Operation Hours			
			250	500	1000	2000
(A) Brake Reservoir	1	L6	X			
(B) Battery Condition and Specific Gravity			X			
(C) Steering Cylinder End *	1	L1	L			
(D) Drive Unit – Oil Level	1	L3		X	X	C
(E) Hydraulic Breather Cap	1	—			C	
(F) Hydraulic Reservoir	1	L5	X			C
(G) Lift Cylinder Head Guide Rollers	2	L1	L			
(H) Steer Wheel Bearings	2	L1	PP			
(I) Steer Trunnion Bearings	2	L1	PP			
(J) Tilt Cylinder Rod Ends	4	L1	L			
(K) Upright Lift Chains	4	L4	X			
(L) Upright Channels	1	L1	X			
(M) Upright Trunnions	2	L1	L			

* Remove battery to access.

C = Change
L = Lubricate

X = Check
PP = Pack every time component is replaced



Lubrication Chart Key			
L1		General Purpose Grease with EP Additive	Use NLGI #1 Grade A multi-purpose grease of refined mineral oil, blended with a lithium soap thickener or equal, containing anti-wear, anti-rust, and anti-oxidants with EP additives.
L2		General Purpose Grease with EP Additive and Moly Additive	Use NLGI #2 Grade A multi-purpose grease of refined mineral oil, blended with a lithium soap thickener or equal, containing anti-wear, anti-rust, and anti-oxidants with EP additives and 3 to 5% moly additives.
L3		80W90	Clark Part No. 2777708 Gear Oil.
L4		Chain Lube	Clark Part No. 886399 Roller and Leaf Chain Lube. One case of 12 one-pint cans.
L5		Hydraulic Fluid	Clark MS-68 Hydraulic Fluid: Part No. 885385 1 case of 24 one-quart cans Part No. 885382 1 case of 6 one-gallon cans Use only high-quality hydraulic fluid with zinc or equivalent anti-wear additive, which meets the requirements of ASTM D-2882 pump wear test, with 50 mg total weight loss maximum, per Clark MS-68.
L6		Brake Fluid "Dot 3"	Clark Part No. 884677 Use only heavy-duty Hydraulic Brake Fluid which meets or exceeds the requirements of SAE 51703 Specification, or alternatively, Type DOT Brake Fluid, Grade DOT 3, as specified by Federal Motor Vehicle Safety Standard No. 116 (FMVSS 116). Non-petroleum type.

Linkage

Any good grade of motor oil in SAE 10, 20 or 30 weight, as the temperature and conditions dictate.

Corrosion Protection

Apply to electrical connections any time they are disconnected. Reapply before making the connection.

Mechanical Lubricant Clark Part No. 280235 1. Use on:

- PL and DP plug connections
- Solenoid coil connections
- Reverse alarm terminals (if applicable)
- Push-on terminals
- Light terminals (headlights, strobe, etc.) (if applicable)
- Thermostat terminals (if applicable)
- Heater connection terminals (if applicable)

Mechanical Paste Lubricant Clark Part No. 2802205 Use on:

- All power cable connections
 - All motor cable connections
 - Brake switch
 - Lift pump ground strap, both ends
 - Steer interlock switch
 - Reverse alarm (if applicable)
- All screw-on type wire terminals
 - Card retainer screws
 - All cable connection points on the control panel

Recommended Periodic Service Schedule

This chart lists maintenance tasks that should be done periodically, the suggested time intervals, and the service manual Group in which the task is covered. Refer to Operator's Manual for **Daily Checks**.

TASKS	1st 50 Hours	Every 50-250 Hours	Every 450-500 Hours (or 3 months)	Every 900-1000 Hours (or 6 months)	Every 2000 Hours (or 1 year)
Group PS -Periodic Maintenance					
Perform Planned Maintenance inspections, lubrications, and adjustments					
Group 12 - Battery					
Battery electrolyte level - check/add					
Battery load voltage test		•			
Battery terminals/cables - clean/tighten					
Group 13 -Wiring and Instruments					
Hourmeter - check					
Lamp check - at start-up					
Wiring harness - inspect					
Instruments/accessories					
Group 16 - Electric Motors					
Drive motor brushes - check/air clean		•			
Lift pump motor brushes - check/air clean		•			
Steer pump motor brushes - check/air clean		•			
Group 17 - Contactors					
Contactor tips - check/air clean					
Group 19 - Motor Controls					
Display - check display for error codes		•			
Controller - air clean		•			
Controller connectors - check and lubricate		•			
Group 20 - Drive Axle					
Air vent - inspect, clean or replace		•			
Axle mounting bolts - inspect/tighten				•	
Pressure checks					•
Fluid change - drain/fill					•
Fluid filter - replace	•				•
Fluid level/condition - check/sample	•	•			
Group 22 - Wheels And Tires					
Wheel mounting bolts - tighten	•	•			
Tire pressure/condition - check	•	•			
Group 23 - Brakes					
Operation - check		•			
Service brake - check wear					•
Brake lines - check	•	•			
Parking brake - check/adjust	•	•			

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

Section 2.**The Planned Maintenance Program**

This Section defines a set of basic service procedures, known as the "Planned Maintenance Program," and describes a systematic approach for performing them.

Introduction to Planned Maintenance	2
PM Intervals	2
The PM Form	2
The Basic PM Procedures	2
Truck Location and Parking	2
External Inspection	3
Decals	3
Fittings and Fasteners	3
Overhead Guard and Chassis	3
Lights and Safety Devices	3
Static Chain	3
Leaks	3
Carriage, Load Backrest, and Upright	3
Forks	4
Wheels and Tires	4
Operational Checks	5
Operator's Environment	5
Service and Parking Brake (Initial Check)	5
Steering (Initial Check)	5
Diagnostic Display and Safety Lock-Outs	6
Hydraulic System	7
Control Levers	7
Carriage, Upright, and Sideshifter	7
Horn, Lights, and Alarms	8
Traction and Braking System	8
Brakes	8
Controlled Reversal	8
Acceleration	8
Turning	9
Internal Inspection	9
General Checks	9
Fluids and Filters	10
Brake Fluid	10
Hydraulic Fluid Level	10
Hydraulic Filter	10
Sump Tank Breather	10
Controller Connectors	10
Battery	10
Air Cleaning the Truck	11
Minor Adjustments Covered by PM	11
Switch Adjustments	11
Parking Brake Adjustment	11
Racking Adjustments	11
Chain Adjustments	11
Missing or Loose Fasteners	11
Access to the Drive Axle	12
Drive Axle Fluid	12
Drive Axle Fluid Change	12
Axle and Chassis Lubrication	12
Truck Chassis Inspection and Lubrication	12
Upright and Tilt Cylinder Lubrication	12
Steer Axle Lubrication	12
Lift Chain Lubrication	12
Critical Fastener Torque Checks	13
Wrapping Up the PM	13
Clean Up	13
Test the Truck	13
Report the PM	13

Group PS, Periodic Service

Introduction to Planned Maintenance

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

The Clark service organization offers customers a formalized program—called **Planned Maintenance**, or PM—for performing these tasks.

PM Intervals

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

The PM Form

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

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

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

The Basic PM Procedures

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

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

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

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

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

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

A CAUTION

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

Truck Location and Parking

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

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

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