

GRADALL®

OPERATOR'S MANUAL

XL4100 CARRIER

24604133

July 2002
Starting S/N
Undercarriage - G04391

Form #29612

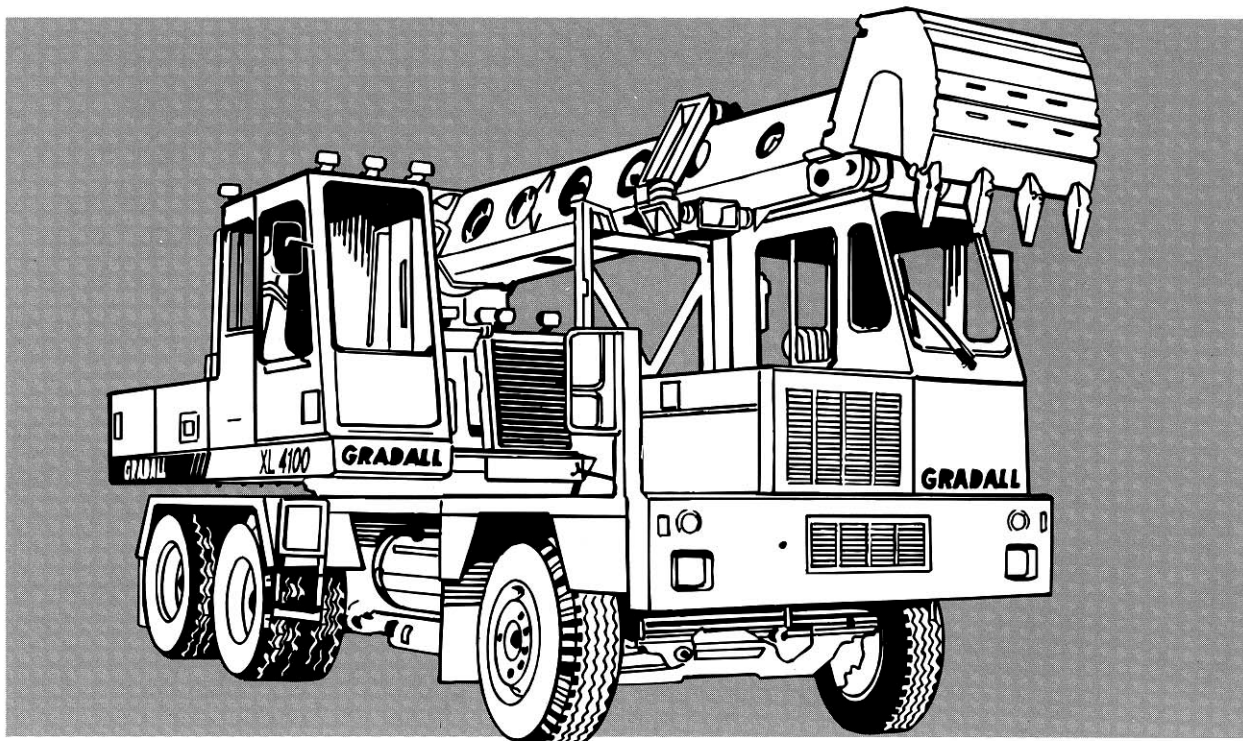
Original Issue 8/96

GRADALL
406 Mill Avenue S.W.
New Philadelphia, OH, 44663, USA
Telephone: (330) 339-2211
Fax: (330) 339-3579

GRADALL®

HYDRAULIC EXCAVATORS

XL 4100 6x4 & 6x6 Carrier Operation & Lubrication Manual



IMPORTANT!

Read and understand this Manual, the XL 4100 & XL 4200 Upperstructure Operation & Lubrication Manual as well as the GRADALL & EMI Hydraulic Excavator Safety Manuals before starting, operating or performing maintenance procedures on this equipment.

KEEP ALL OPERATOR AND SAFETY MANUALS IN CAB

AVERTISSEMENT! Si vous ne lisez pas l'Anglais, demandez a votre surveillant de vous donner les instructions de securite!

ATENCION! Si no lee Ingles, preguntele a su supervisor para las instricciones de seguridad!

VORSICHT! Wen Sie kein Enlisch lesen, bitten Sie ihren Vorgesetzten um die Sicherheitsvorschriften!

IMPORTANT SAFETY NOTICE

Safe operation depends upon reliable equipment and proper operating procedures. Performing the checks and services described in this manual will help to keep your Gradall® Excavator Carrier in reliable condition and use of the recommended operating procedures can help you avoid accidents. Because some procedures may be new to even the experienced operator we recommend that this manual be read, understood and followed by all who operate the unit.

Strict attention to, and compliance with, instructions provided in this manual, the XL4100 & XL4200 Upperstructure Operation & Lubrication Manual, as well as the EMI & Gradall Hydraulic Excavator Safety Manuals and all instructional decals and plates affixed to the machine, will help avoid personal injury and damage to the equipment. The information provided is not intended to cover all situations; it would be impossible to anticipate and evaluate all possible applications and methods of operation for this unit.

Any procedure not specifically recommended by The Gradall Company must be thoroughly evaluated from the standpoint of safety before it is placed in practice. If you aren't sure, contact your Gradall Excavator Distributor before operating.

Do not modify this machine without written permission from The Gradall Company. Use only genuine Gradall replacement parts.

OTHER NOTICES

The Gradall Company retains all proprietary rights to the information contained in this manual.

The Company also reserves the right to change specifications without notice.

Gradall is a registered trademark for hydraulic excavators, hydraulic material handlers and attachments manufactured by The Gradall Company.

The Gradall Company

406 Mill Avenue, S.W., New Philadelphia, Ohio 44663

TABLE OF CONTENTS

IMPORTANT SAFETY NOTICE	inside front cover
TABLE OF CONTENTS	1
INTRODUCTION	2
General	2
Related Manuals	2
Operator Qualifications	2
Orientation	2
Serial Number Location	2
SAFETY HIGHLIGHTS	3
INSTRUMENTS AND INDICATORS	11
CONTROLS	12
CHECKS AND SERVICES BEFORE STARTING ENGINE	13
ENGINE OPERATION	15
Starting Diesel Engine	15
Cold Weather Starting Aids	15
Normal Engine Operation	16
Stopping the Engine	16
CHECKS AFTER STARTING ENGINE	17
CHECKS BEFORE DRIVING	17
PLAN YOUR TRIP	17
BRAKE SYSTEM	18
Service Brake	18
Emergency Brake	18
Parking Brake	19
Digging Brake	19
Remote Control Braking	20
STEERING SYSTEM	21
Conventional Steering	21
Remote Control Steering	21
POWER TRAIN	22
Shifting Gears	23
Inter-Axle Differential	28
REMOTE CONTROL	29
Preparing Carrier for Remote Control Operation	29
Preparing Upperstructure for Remote Control Operation	29
Precautions for Remote Control Operation	30
Driving Carrier from Upperstructure Cab	30
Preparing Upperstructure for Conventional Carrier Operation	30
Preparing Carrier for Conventional Operation	30
PARKING THE GRADALL	31
Precautions	31
Parking Procedure	31
IN CASE OF TROUBLE	31
Towing	31
IF YOU GET STUCK	31
LUBRICATION	32
6 x 4 Carrier Lubrication and Maintenance Diagram	32
6 x 6 Carrier Lubrication and Maintenance Diagram	34
Recommended Lubricants & Capacities	36
Torque Chart	36
CHECKING AUTOMATIC SLACK ADJUSTERS	inside back cover

INTRODUCTION

General

This manual provides important information to familiarize you with required operator maintenance and with safe operating procedures for the Gradall wheeled excavator undercarriage.

Because two operators are sometimes assigned to the unit, operator information for the upperstructure and for the undercarriage is provided in separate manuals.

The undercarriage includes a separate operator's station for control of undercarriage functions and is equipped with a separate engine to propel the unit.

Throughout this manual, the term "carrier" will be used to designate the excavator under carriage.

Related Manuals

Separate publications are furnished with the Gradall to provide information concerning safety, replacement parts, detailed maintenance procedures, vendor components and operation of the upperstructure.

You must read and understand the Gradall Upperstructure Operation & Lubrication Manual, the Gradall Hydraulic Excavators Safety Manual and the EMI Hydraulic Excavator Safety Manual before operating the upperstructure.

If you have any questions regarding the Gradall Carrier or the Upperstructure, contact your Gradall Distributor; he is thoroughly familiar with the unit and will be happy to help you.

Operator Qualifications

The operator must hold a valid, applicable driver's license which requires acceptable age, vision, hearing, manual dexterity and response. He must also be in acceptable physical and mental condition (not undergoing medical treatment or using drugs or alcohol which would violate traffic laws.)

Before driving the unit on the highway or operating the excavator at a worksite, the operator must familiarize himself with the machine by practicing in a safe, open area not hazardous to people or property.

The operator must read, understand and comply with instructions contained in the following material furnished with the excavator.

This Operation & Lubrication Manual

EMI Hydraulic Excavator Safety Manual

All Instructional decals and plates

If driver will also operate upperstructure:

XL4100 & XL4200 Upperstructure Operation & Lubrication Manual

Gradall Hydraulic Excavators Safety Manual

Models Covered

Wheeled carriers for the XL4100 Gradall Hydraulic Excavators are furnished with the following basic carrier variations to suit job application and contractor preference:

Driving axles at rear only (6x4) or driving axles at both front and rear (6x6).

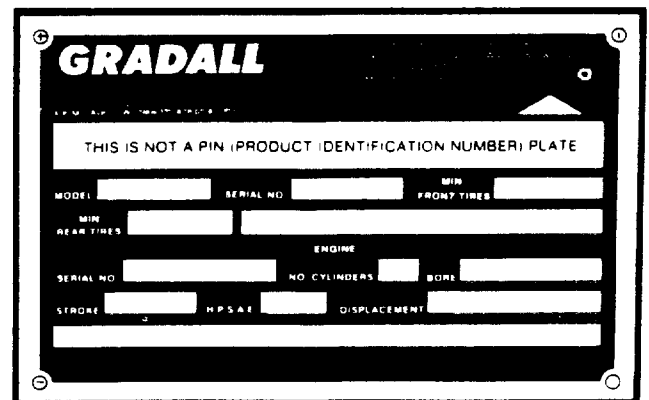
Where information in this manual applies only to certain units, it will be so noted.

Orientation

When used to indicate direction or location, the terms front, rear, left and right relate to the orientation of a person sitting in the driver's seat.

Serial Number Location

The carrier nameplate is located on the right side of the carrier frame. Be sure to specify the serial number (on nameplate) when ordering parts and when discussing procedures and applications with your distributor.



SAFETY HIGHLIGHTS

Read and understand this manual and “EMI Safety Manual” before starting, operating or performing maintenance procedures on this carrier. Do not permit this carrier to be driven by an operator who cannot read English unless these manuals have been read and explained to him and his full understanding is determined. Keep these manuals in cab.

If driver will operate upperstructure, he must also read and understand Gradall Upperstructure Operation & Lubrication Manual and Gradall Hydraulic Excavators Safety Manual.

Watch for these symbols; they are used
to call your attention to safety notices.



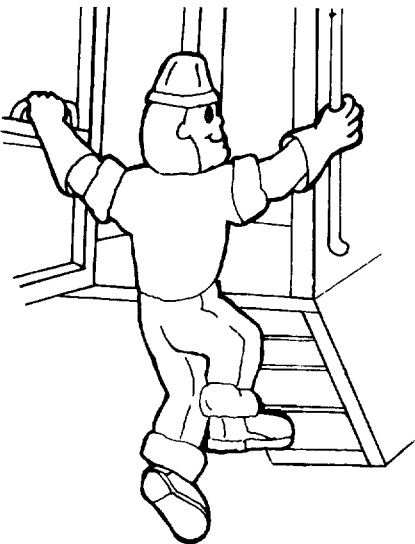
This symbol indicates an extreme hazard which would result in high probability of death or serious injury if proper precautions are not taken.



This symbol indicates a hazard which could result in death or serious injury if proper precautions are not taken.

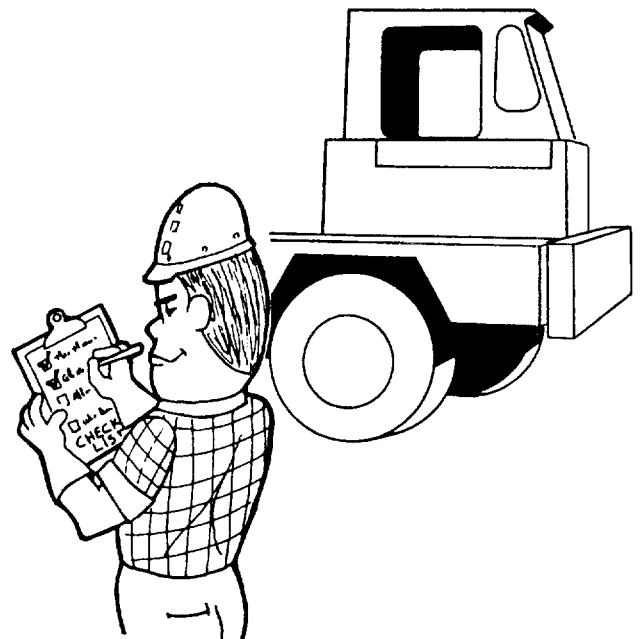


This symbol indicates a hazard which could result in injury or damage to equipment or property if proper precautions are not taken.



Maintain three point contact with grab handles and steps when climbing on and off the machine.
Never jump from the machine.

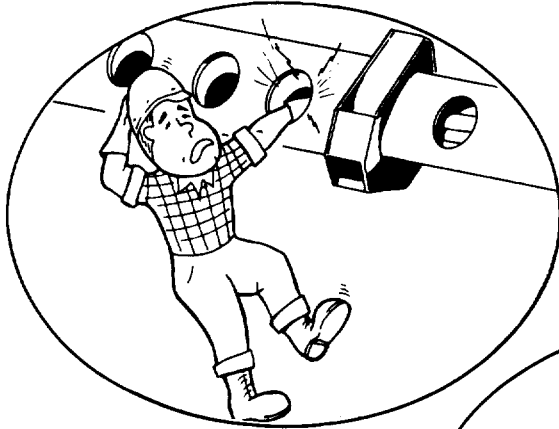
Repair or replace damage steps and grab handles.



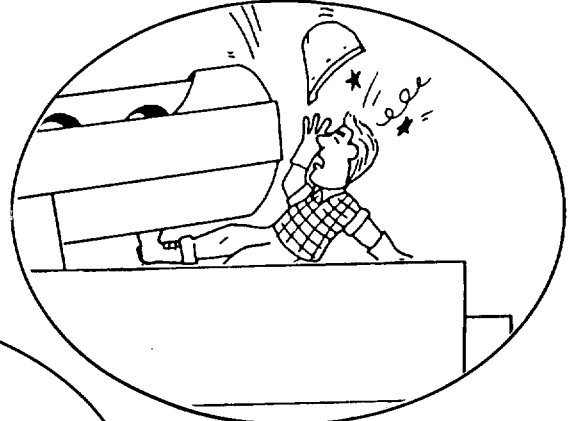
Perform all “CHECKS & SERVICES BEFORE STARTING ENGINE” (pages 13 & 14), “CHECKS AFTER STARTING THE ENGINE” (page 17) and “CHECKS BEFORE DRIVING” (page 17) before driving the carrier. **Complete all required maintenance before driving the carrier.**

SAFETY HIGHLIGHTS

Learn to recognize 'PINCH POINTS'

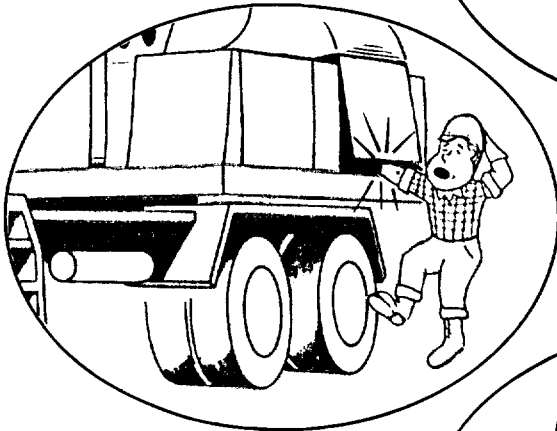


Boom Holes

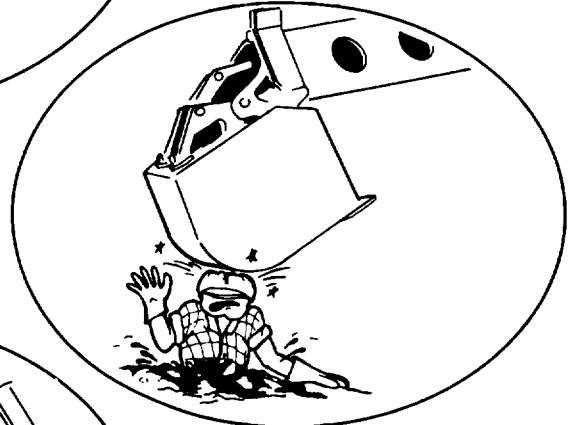


Boom Cradle

Stay clear of PINCH POINTS. Getting caught in a pinch point can cause serious injury or death.



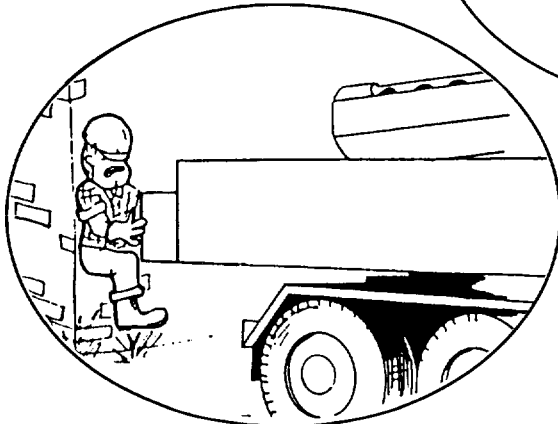
Access Covers



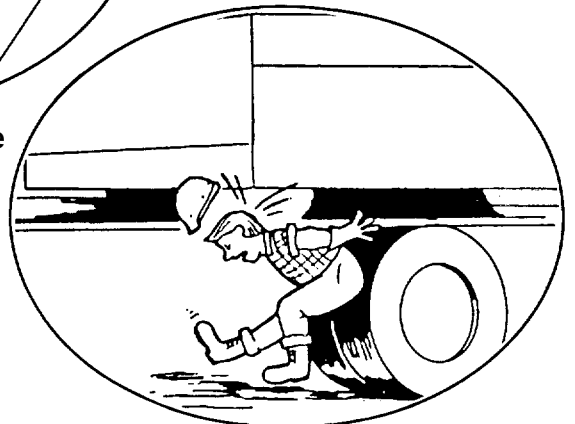
Boom



Bucket & Linkage

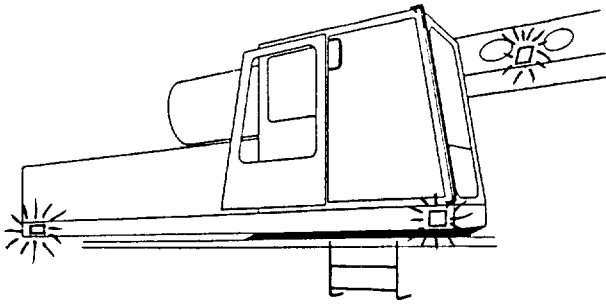


Countweight & Another Object



Upperstructure & Carrier

SAFETY HIGHLIGHTS



Check to be sure all **DANGER, WARNING, CAUTION and INSTRUCTION DECALS** are in place and can be read. Clean or replace decals as required.



Some owners alter their machines. Check to be sure your machine fits the pictures and description in this manual. If it differs, or if you aren't sure, contact your Gradall distributor before you run your unit.

Sound Horn

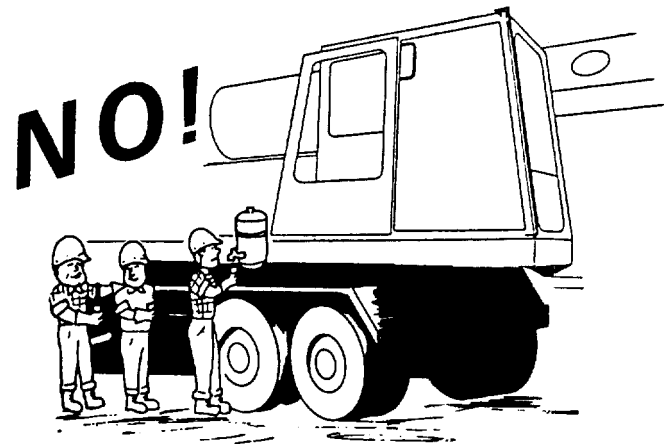
Always **sound horn** to warn others of unexpected machine movements (horn button is located at top of left joystick).

The unit is also equipped with an automatic **back-up alarm** to warn others of reverse travel.

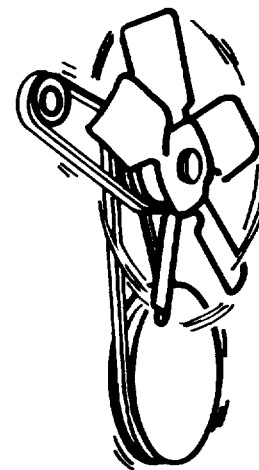
An **automatic travel** alarm is also provided to warn of remote control travel in either direction.



Keep steps and deck areas free of mud, oil, grease and other foreign material. Replace non-skid surface material as required.

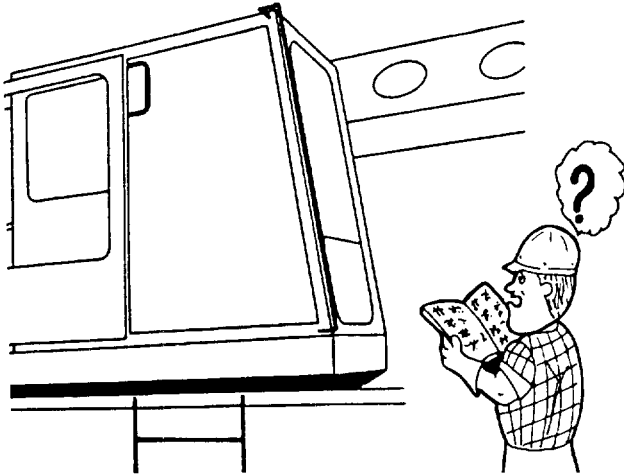


Never carry a water can, equipment, or other worker's tools or personal items on the machine. Such items can cause other workers to approach the machine without your knowledge and result in serious injury or death.



Stay clear of moving fan, belts, pulleys, meshing gears, drive shafts and other moving parts. Do not operate without covers and guards in place.

SAFETY HIGHLIGHTS



Be particularly careful if this is not the machine you usually operate. **Read the manuals** listed on page 2 and then **operate the unit in a safe, open area** to become familiar with the controls.



Learn and **follow your employer's safety rules.**



WARNING

Travel on off-highway grades is recommended only under the following conditions:

Boom secured in rest

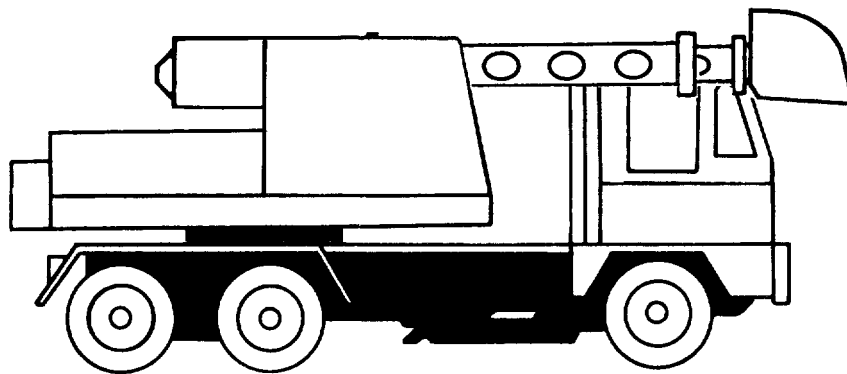
Tires properly inflated

Surface is firm enough to support unit

Surface provides adequate traction to prevent slipping

Surface is not rough enough or steep enough to cause tipping

Transmission is in Lo Lo or Lo gear range.



TRAVEL TO AND FROM JOBSITE ONLY UNDER FOLLOWING CONDITIONS:

Boom secured in rest

Mirrors clean and properly adjusted

Seat belt buckled snugly across lap

Door secured in closed position

Plan your route

Bucket secured to boom

No load attached to any part of machine

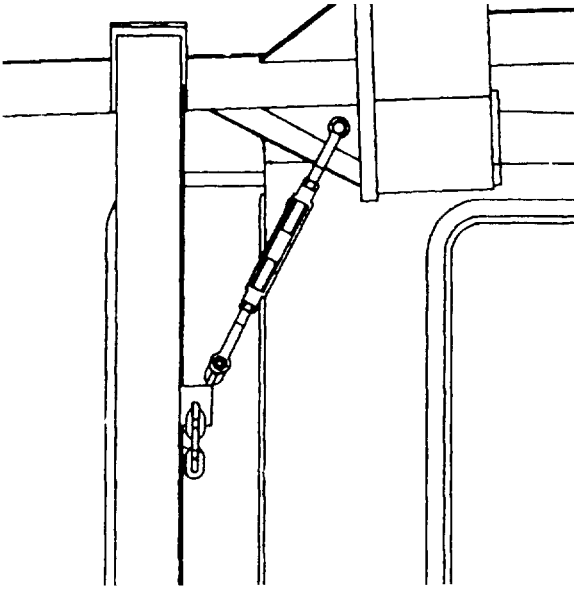
Joystick switch in off position

Travel in accordance with local requirements

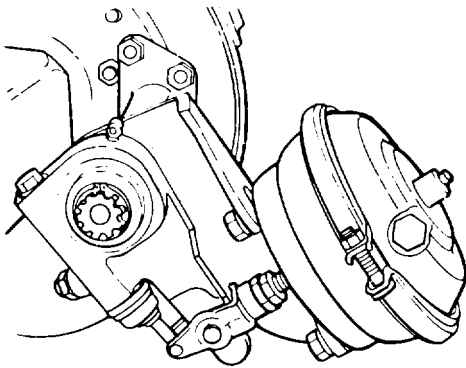
Tires inflated to proper pressure

Upperstructure engine stopped

SAFETY HIGHLIGHTS



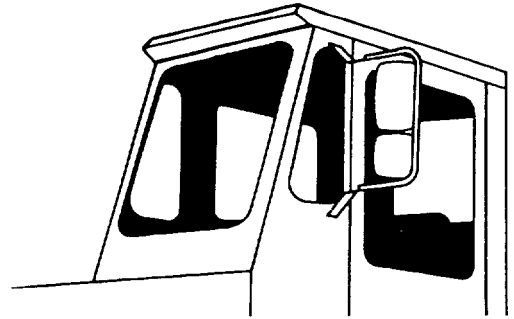
Use boom tie-down device to secure boom in rack when traveling between jobsites.



Inspect brakes before driving carrier after digging.

NOTE: This illustration shows a typical automatic slack adjuster. Refer to instructions provided on inside back cover of this manual

1. Apply digging brake and stop engines.
2. Check the following for apparent damage:
 - Brake actuator chambers and rods
 - Brake actuator brackets
 - Slack adjusters
3. With brake applied, actuator rod should form an approximate right angle with slack adjuster.
4. **Do not drive unit** until any damage or malfunction has been repaired.



Check to be sure **windows and mirrors** are clean and that mirrors are properly adjusted for your driving position and machine configuration. Ensure adequate visibility for safe travel.

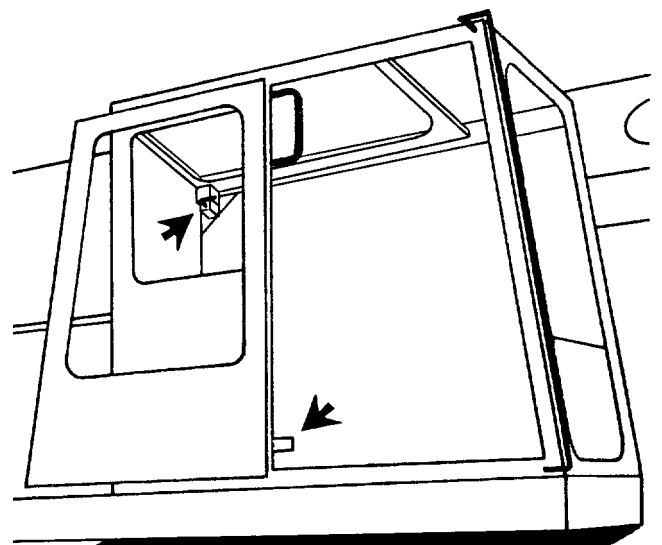


DANGER

Whenever rotating equipment (such as a mower or mixer) is installed on machine, adequate shielding must be installed to prevent flying debris.

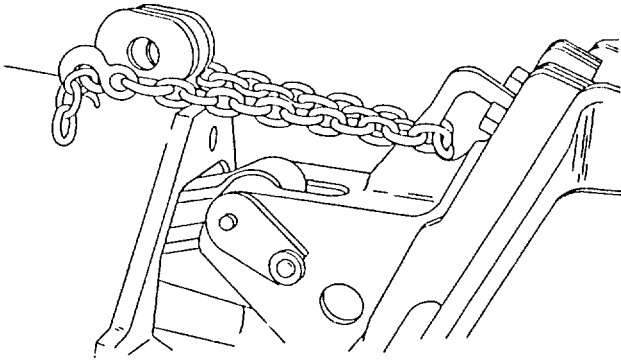
Never operate such equipment with other persons within range of possible flying debris. Be certain that mower discharge is never aimed at persons, equipment or structures.

As an additional precaution, safety glass and appropriate window guards must be installed on machine.

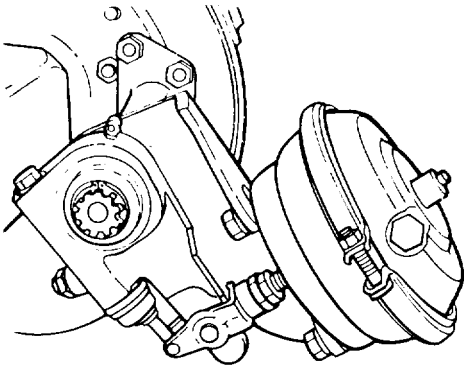


Be sure windows and doors are **securely latched** in open or closed position when operating. Replace **defective latches** and **weak** access cover support struts **immediately**.

SAFETY HIGHLIGHTS

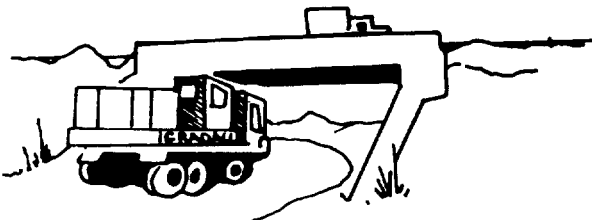


If required, **secure attachment** as shown to prevent drift while traveling.



Check for proper slack adjuster operation in accordance with Lubrication & Maintenance Schedule (page 33).

SLOW!



Know overall height of your unit before traveling. Approach unknown clearances slowly.



Remember, **getting too close to unstable ground or the edge of an excavation can cause the machine to tip.**



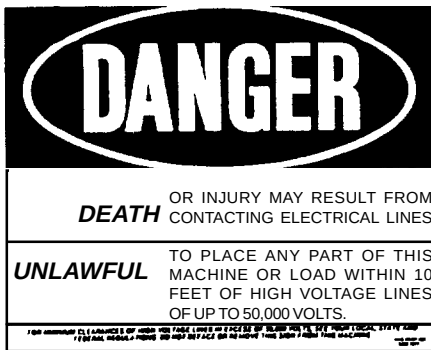
Always **apply digging brake** to prevent carrier movement **while operating upperstructure.**

NO!

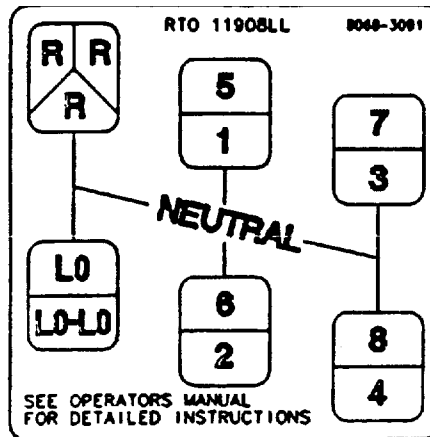


Do not carry passengers or move the unit until all other persons have gotten off and are clear of the machine. Do not carry passengers in upperstructure cab.

Decals Inside Cab



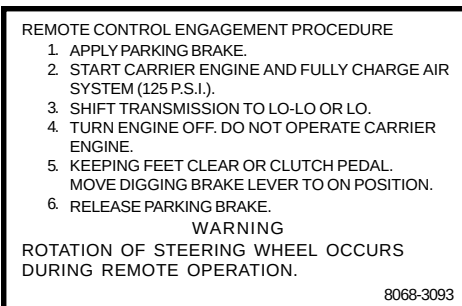
Located inside cab door
Part No. 8360-1011



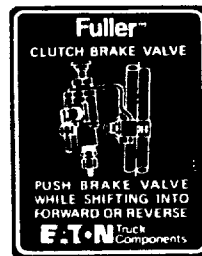
Located on dashboard
Part No. 8068-3091



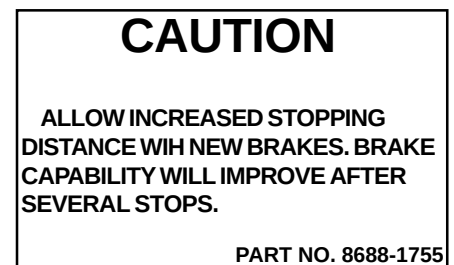
Located inside cab door &
above engine compartment
Part No. 7702-3004



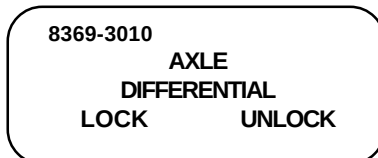
Located inside cab door
Part No. 8068-3093



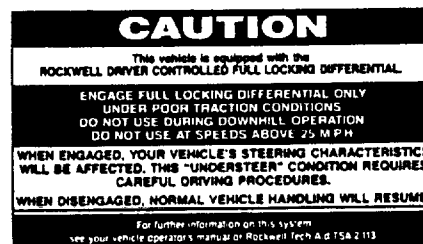
Located on right cab window
Part No. 8395-3002



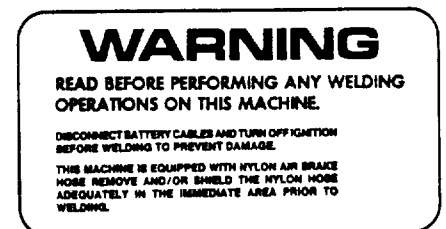
Located on right cab window
Part No. 8688-1755



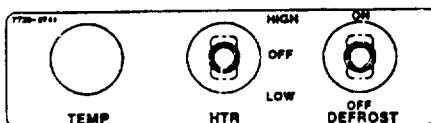
Located on dashboard
Part No. 8068-3093



Located on cab wall
Part No. 7738-3675



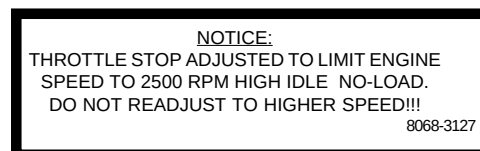
Located on right cab window
Part No. 8688-1305



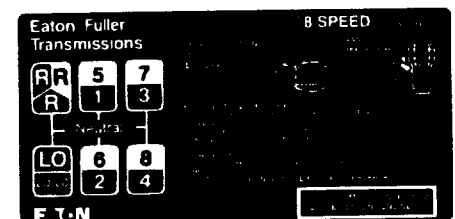
Located on dashboard
Part No. 8369-3010



For 6BTA5.9 Engine only
Located on dashboard
Part No. 8068-3122



For 6BTA5.9 Engine Only
Located on right cab wall
Part No. 8068-3127

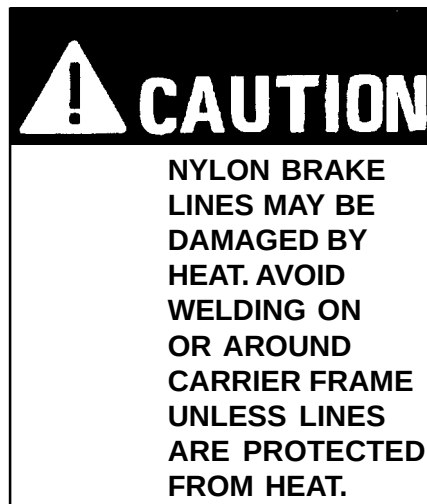


Located on right cab window
Part No. 8068-3092

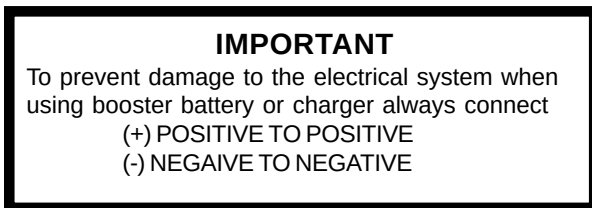
Decals Outside Cab



Located at right of cab door
Part No. 7702-3003



Located on air reservoir
Part No. 7702-3002



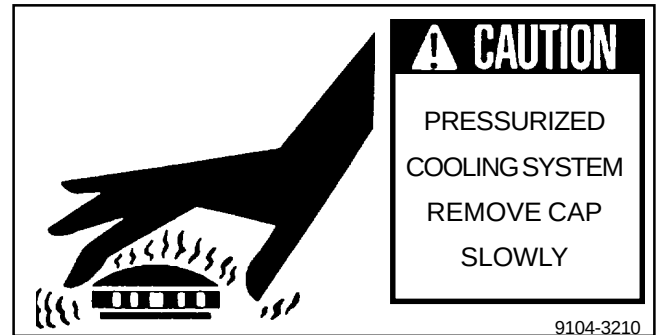
Located inside battery box cover
Part No. 7702-3007



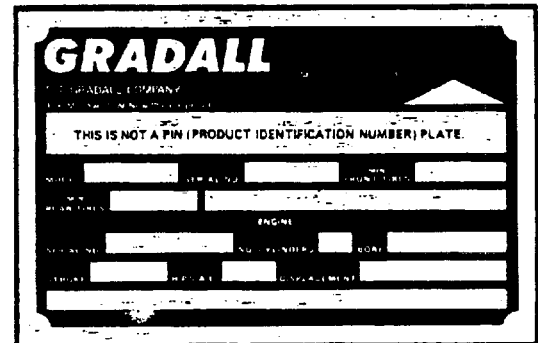
For 6BTA5.9 Engine Only
Located on air cleaner
Part No. 8068-3123



Located on back of cab
Part No. 8360-1018



Located near coolant filler cover
Part No. 9104-3310

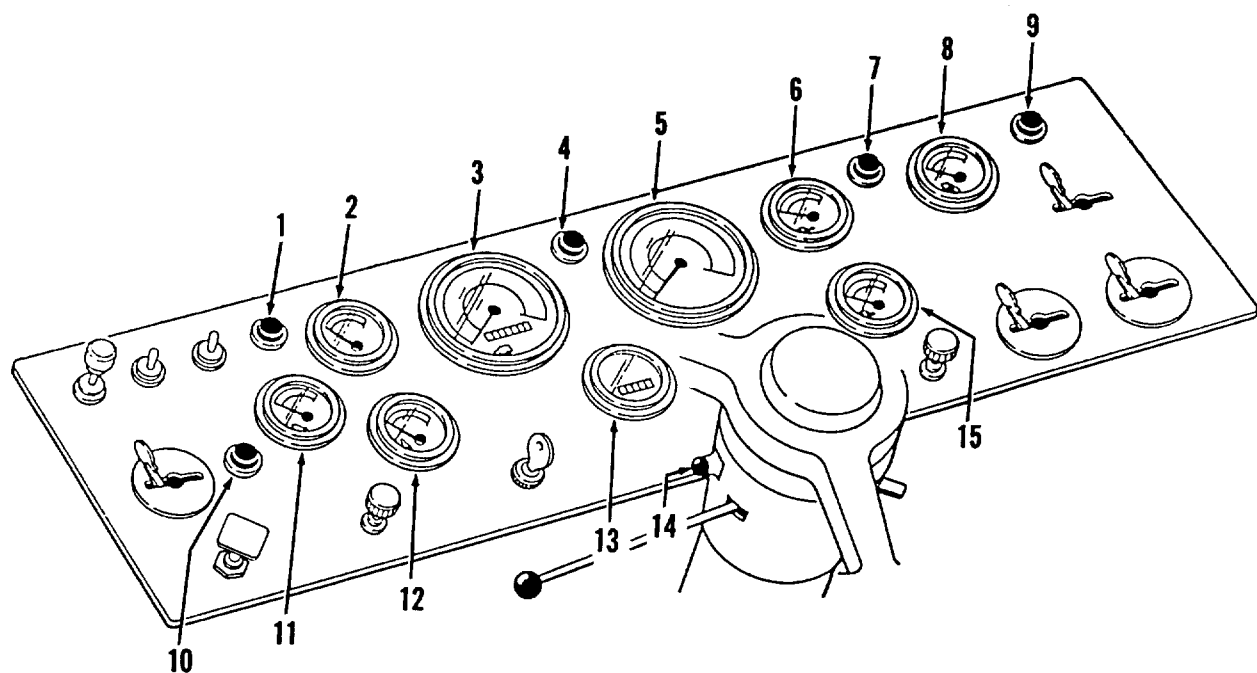


Located on right frame rail
Part No. 7702-3029



Located near fuel filler cover
Part No. 7702-3008

INSTRUMENTS AND INDICATORS



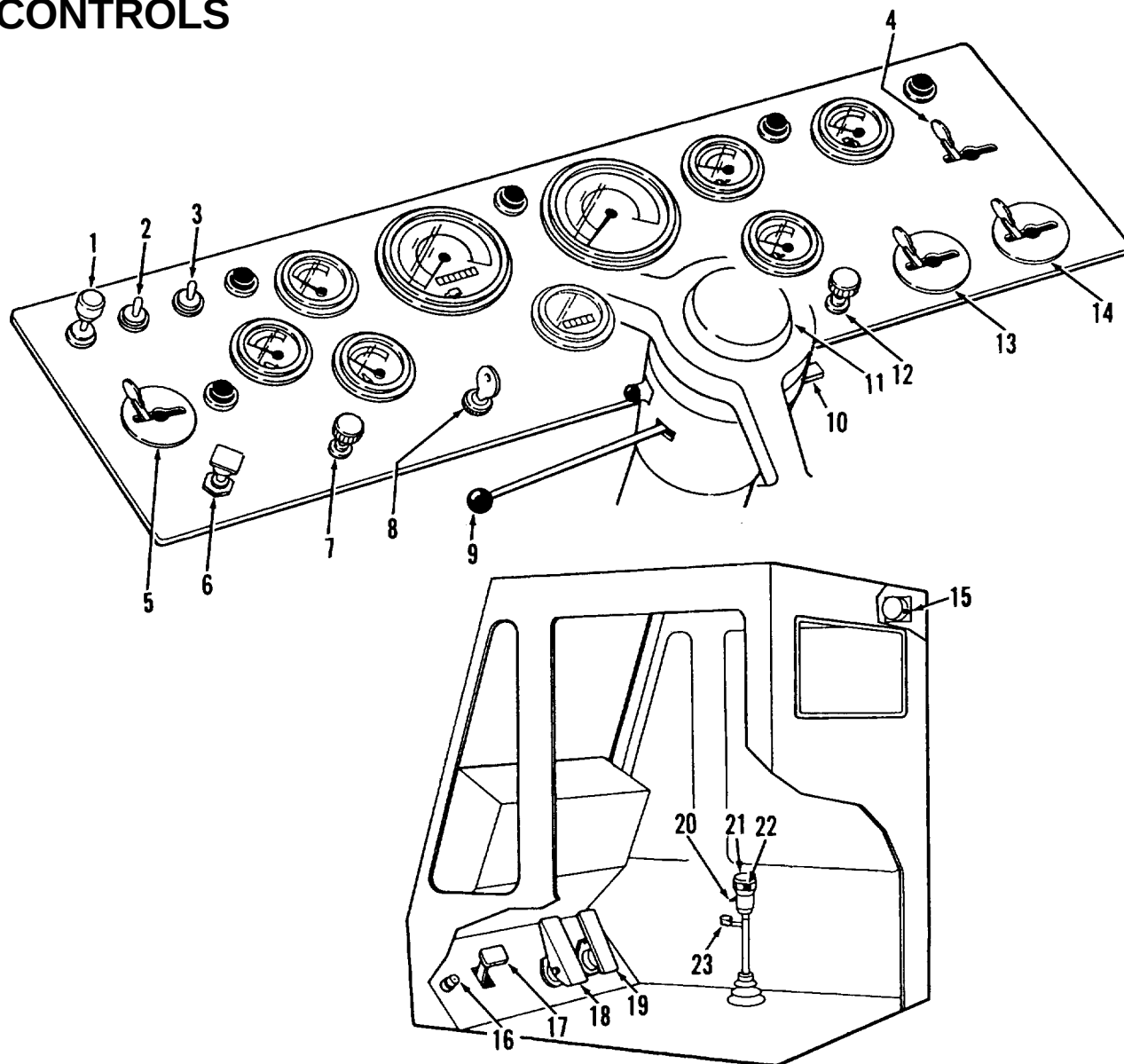
1. Alternator Indicator Light
2. Voltmeter
3. Speedometer/Odometer
4. Hi/Lo Beam Indicator Light
5. Tachometer (optional)
6. Air Pressure Gage (front)
7. Low Air Indicator Light
8. Fuel Gage
9. Differential Lock Indicator Light
10. Digging Brake Indicator Light
11. Oil Pressure Gage
12. Coolant Temperature Gage
13. Hourmeter
14. Turn Signal/Hazard Indicator Light
15. Air Pressure Gage (rear)



WARNING

Do not move carrier while low air light is glowing or while any auxiliary device is signaling a dangerous condition.

CONTROLS



- | | |
|------------------------------------|---|
| 1. Heat Control Knob | 13. Front Wheel Drive Toggle (6x6 only) |
| 2. Heater Fan Switch | 14. Interaxle Differential Toggle |
| 3. Defroster Fan Switch | 15. Dome Light Switch |
| 4. Differential Lock Toggle | 16. High/Low Beam Switch |
| 5. Digging Brake Toggle | 17. Clutch Pedal |
| 6. Parking Brake Knob | 18. Brake Valve Pedal |
| 7. Light Switch | 19. Accelerator Pedal |
| 8. Ignition Switch | 20. Range Preselection Lever |
| 9. Turn Signal Lever | 21. Gear Shift Lever |
| 10. Hazard Flasher Switch | 22. Deep Reduction Button |
| 11. Horn Button | 23. Countershaft Brake Button |
| 12. Windshield Wiper/Washer Switch | |

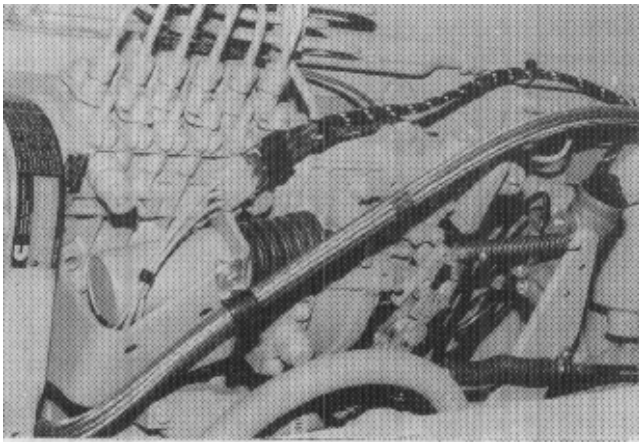
CHECKS AND SERVICES BEFORE STARTING ENGINE

Complete all required maintenance before driving the carrier

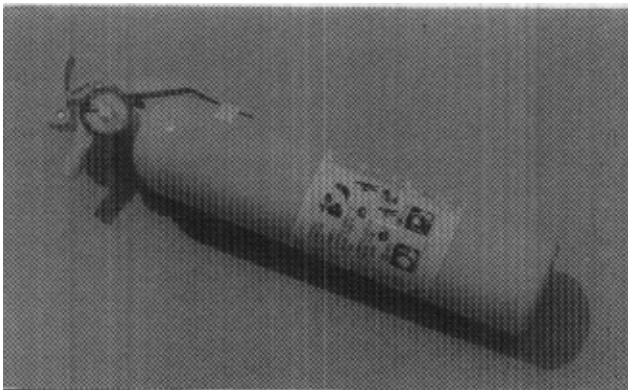


WARNING

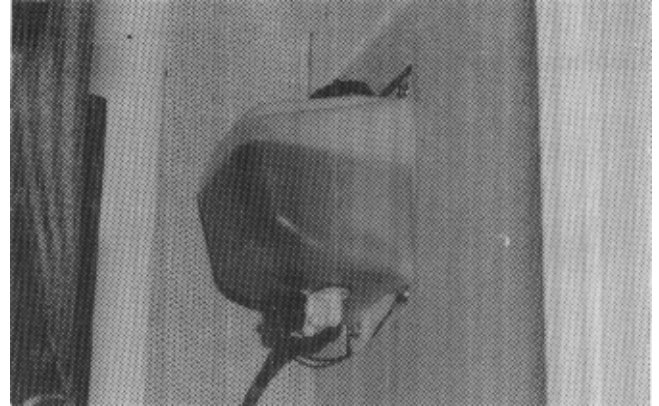
Use extreme caution when checking items beyond your normal reach. Use an approved safety ladder.



Inspect carrier for obvious damage, vandalism and needed maintenance. Check for signs of fuel, lubricant, coolant and hydraulic leaks. Open access doors and look for loose fittings, clamps, components and attaching hardware. **Check brake and steering systems** for obvious damage. **Check operation** of all lights and repair as necessary before operating. Broken windows must be replaced before operating. If spark arrestors are used, be sure they are in place and in good working order.



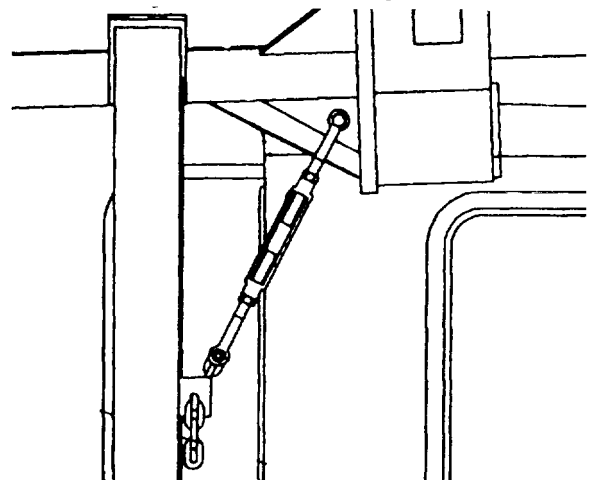
Check for fully charged **fire extinguisher** on rear wall in carrier cab. Be sure to read and understand instructions on extinguisher. Replace extinguisher as necessary.



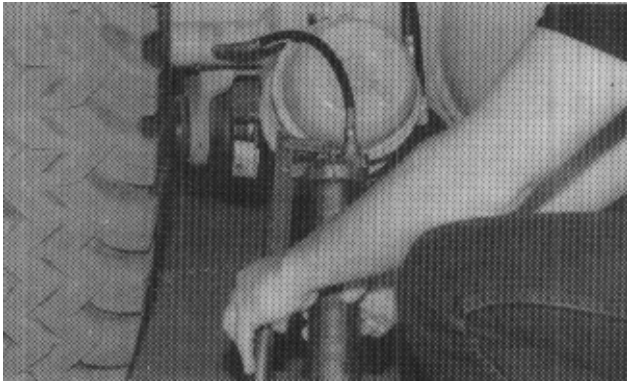
Check fluid level in **windshield washer** reservoir on rear wall in carrier cab. Add windshield washer solvent as necessary.



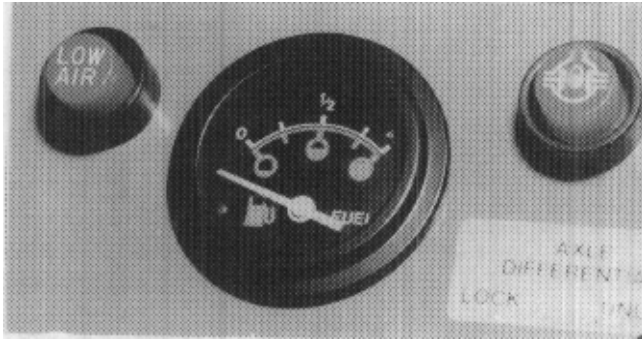
Check position of **DIGGING BRAKE** toggle. Toggle should be in OFF position for operation from carrier cab. Be sure parking brake is applied before moving toggle to OFF position.



Check for **secure stowage** of boom and any auxiliary equipment or material.



Lubricate unit as indicated on lubrication chart.

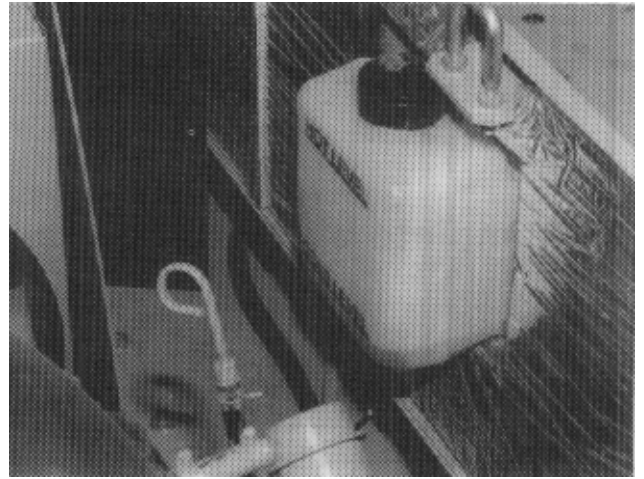


Check fuel level and replenish as necessary. Refuel at the end of the work shift to minimize condensation.



WARNING

Engine should be turned off while refueling. Be sure area is free of open flame, sparks or any condition which could cause fuel to ignite.



Check oil level in engine crankcase and replenish as necessary. DO NOT OVERFILL.

Check engine coolant level and replenish as necessary. Be sure anti-freeze solution is adequate for expected temperatures. Be sure radiator fins are clean.



WARNING

Always check engine coolant level by observing level in coolant expansion container. Do not attempt to remove radiator cap from a hot radiator. Hot coolant, under pressure, can be expelled and cause serious burns.

ENGINE OPERATION

NOTE: If engine is being started at beginning of work shift be sure to perform all “CHECKS AND SERVICES BEFORE STARTING ENGINE”

Starting Diesel Engine (Cummins)

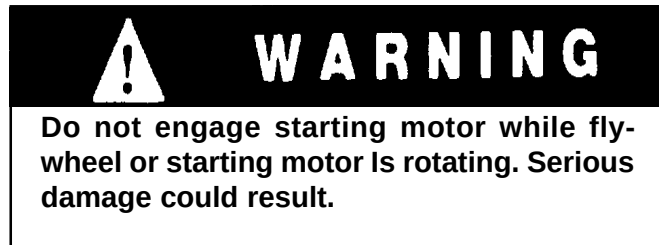
NOTES: Your unit may be equipped with **standard 6BTA5.9, 200 HP engine** or **optional 6CTA8.3, 245 HP engine**. Refer to engine Model/SN/Data plate to determine which engine you have.

Standard 6BTA5.9 engines are equipped with an ether injection system which is **engaged automatically below 32° F. (10° C.)**.

Optional 6CTA8.3 engines are not equipped with an ether starting aid unless it is ordered as an option.

1. Be sure transmission is in neutral (neutral start switch) and parking brake is applied.
2. Turn ignition switch to ON position.

3. Position throttle at low idle.
4. Turn ignition switch fully clockwise to engage starting motor. Release key immediately when engine starts. If engine fails to start within 20 seconds, release key and allow starting motor to cool for a few minutes before trying again.
5. After engine starts, observe oil pressure gage. If gage remains on zero for more than 15 seconds, stop engine and determine cause. Correct cause of malfunction before attempting to restart engine.
6. Warm up engine at approximately 1000 RPM until coolant temperature reaches operating range, (approximately 140° F. [60° C.]).



Cold weather starting aids

Diesel engine ignition is accomplished by heat generated when fuel/air mixture is compressed within the cylinders. Because this heat may be insufficient to start a cold engine in cold weather, the use of starting aids has become common practice.

Because of the wide variety of starting aids available

it would be impractical to attempt to provide specific instructions for their use in this manual. Carefully follow instructions furnished with your starting aid.

If you use a starting aid employing ether or a similar substance pay particular attention to manufacturer's warnings.

WARNING
DO NOT use ether starting aid if air system is equipped with an alcohol moisture evaporator.

Normal engine operation (Cummins)

Observe volt meter water temperature and oil pressure **gages frequently to be sure all engine systems are functioning properly.**

Be alert for unusual noises or vibration. When an unusual condition is noticed stop in a safe area and shut off engine. Determine cause and correct before continuing.

Early recognition and correction of unusual conditions can often prevent a major breakdown.

Apply load to engine gradually; shock loads are hard on all drive line components.

When using engine braking power (downshifting or releasing accelerator and permitting carrier to “push” engine) to slow travel take care to **avoid overspeeding the engine** (exceeding governed

RPM - 22 00 RPM). The governor has no control over engine speed when engine is being “pushed” by carrier load.

Select an appropriate gear ratio and use service brake to assist in slowing travel down steep grades.

Permitting the engine to labor under too great a load for the gear ratio being used (lugging the engine) will shorten engine life. **Shift to the proper gear ratio for conditions.**

Avoid prolonged idling. Idling causes engine temperature to drop and this permits formation of heavy carbon deposits and dilution of lubricating oil by incompletely burned fuel. If the engine is not being used turn it off.



Stopping the engine (Cummins)

Operate engine at idle speed for a few minutes before turning it off. This allows engine coolant and lubricating oil to carry excessive heat away from critical engine areas. **This is especially important for turbocharged engines.**

Do not “gun” engine before shut down; this practice causes raw fuel to remove oil film from cylinder walls and dilute lubricant in crankcase.

Stop engine by turning ignition switch to “OFF” position.

CHECKS AFTER STARTING ENGINE

(To be performed at beginning of each work shift)

Complete all required maintenance before driving

1. Check operation of **windshield washer and wiper**.
2. Check all **lights and turn signals** for proper operation.
3. Check operation of heater and defroster.
4. Observe **oil pressure gage** with engine running at operating temperature and speed. Minimum oil pressure is 10 to 30 psi (69 to 207 kPa).
5. Observe **voltmeter** indication of alternator output. Proper output is approximately 14 V. with engine running at 2000 RPM.
6. Observe **water temperature gage**. Proper operating temperature is approximately 140/200°F. (60/93°C.).
7. Observe **tachometer** response to changes in engine speed.
8. Observe low air warning light. Light should continue to glow until brake system pressure reaches approximately 60 psi (414 kPa). **Do not release parking brake or move carrier** while low air warning light is still glowing.
9. Observe **air pressure gages**. Proper brake system pressure is 125 psi (862 kPa).

CHECKS BEFORE DRIVING

(To be performed at beginning of each work shift)

Complete all required maintenance before driving.

1. Check operation of brakes by performing the following procedure:
 - a. Position unit on level surface and apply digging brake. Unlock differential lock and inter-axle differential.
 - b. Position boom over rear of chassis and imbed bucket in ground or against a solid object.
 - c. Apply down pressure with boom and pull and push with boom while helper watches for rotation of each wheel.
 - d. Rotation of any wheel during step c. indicates brake failure on that wheel. Have any failure corrected before driving the unit.
2. Check operation of steering while moving slowly in first gear. Be alert for any increase in effort needed to turn wheels and any unusual steering response to normal steering effort.
3. Check operation of horn and travel and back-up alarm and any other signal devices.
4. Check condition of seat belt and **be certain to fasten seat belt when traveling**.

PLAN YOUR TRIP

1. Plan a safe route to your destination.
2. Ask your supervisor about permit requirements.
3. Check on load & clearance limits along your route.

Dimensions for your unit are shown below:

Height – varies depending on attachment – measure unit to be sure.

Width 8'(2.44m)

Ground Clearance 10" (254 mm)

Weight – varies depending on options – weigh unit to be sure.

BRAKE SYSTEM

The air brake system includes a service brake, an emergency brake, a parking brake and a digging brake.

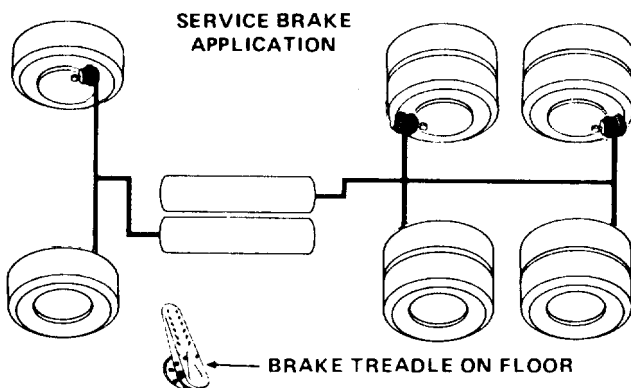


WARNING

Wear safety belt to avoid being thrown from driver's seat during braking emergency.

NOTE: Lines in following simplified brake system diagrams show pressure and exhaust air flow under various system conditions.

Service brake



The basic system includes two reservoirs to store and furnish air pressure for service brake operation. One reservoir supplies pressure to apply brakes to the wheels of the front axle and the other supplies pressure to apply brakes to the wheels of the forward and rear tandem axles. Depressing the brake treadle causes air pressure to be applied to brake actuators of all wheels simultaneously.



WARNING

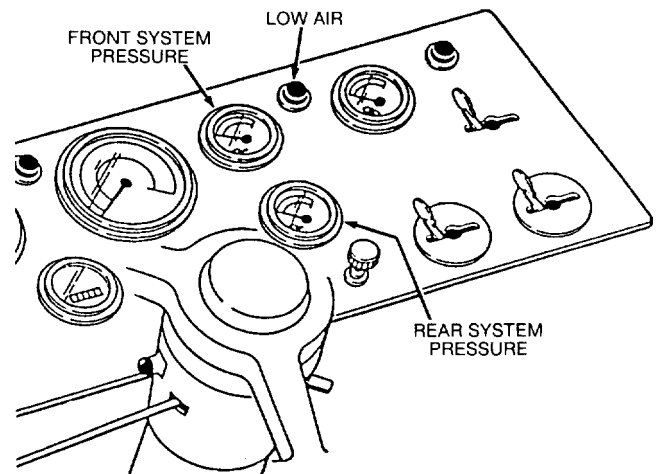
Do not "fan" the brake valve treadle. A long series of rapid brake applications can reduce system pressure to a point where effective service braking will be lost until air compressor can restore pressure.

The operating pressure range for service brakes is 60 to 125 psi (414/862 kPa). Two pressure gages are furnished to indicate pressure in front and rear portions of the system. The gage on top indicates pressure available for front axle brakes and the gage on the bottom indicates pressure available for tandem axle brakes. If pressure in either portion of the system falls below safe operating range, the low air indicator light will flash.



WARNING

Do not drive while low air indicator is flashing. If light comes on while carrier is moving, stop carrier in a safe area as soon as possible. If carrier will not maintain proper brake pressure notify maintenance personnel immediately for repair of condition.



Emergency brake

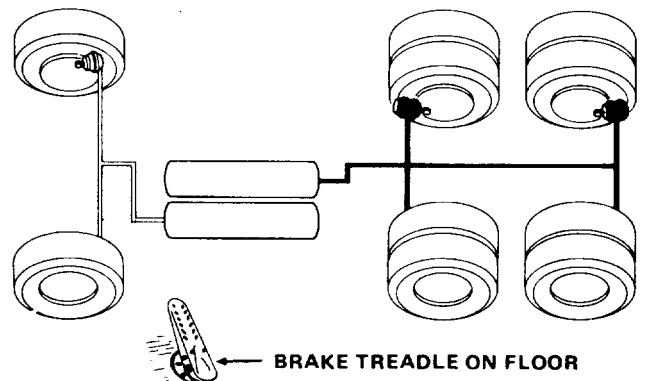
The emergency brake functions only when air pressure has been lost from some portion of the dual brake system. Emergency brakes are applied by normal foot pressure on the brake treadle.



WARNING

Emergency brakes will not stop carrier in as short a distance as the service brakes.

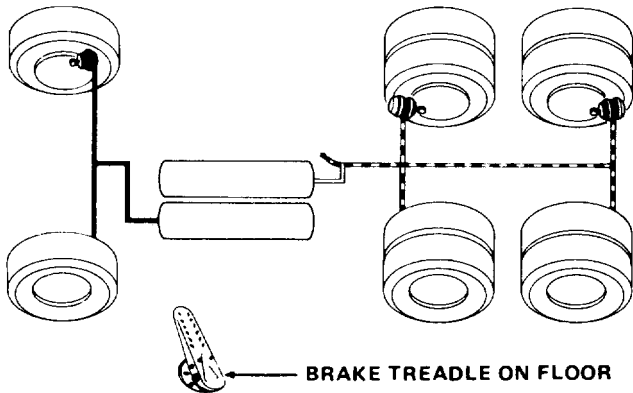
**EMERGENCY BRAKE APPLICATION
(pressure lost in front)**



If air pressure is lost from the front portion of the dual brake system, normal actuation of the brake

treadle valve will apply service brakes to the wheels of the forward and rear tandem axles. There will be no braking on the wheels of the front axle.

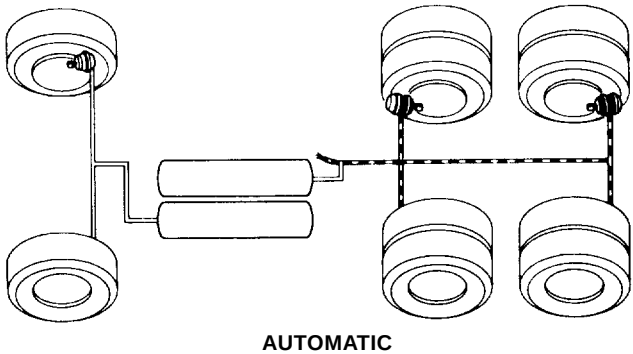
**Emergency Brake
Application**
(pressure lost in rear)



If air pressure is lost from the rear portion of the dual brake system, normal actuation of the brake treadle will apply service brakes to the wheels of the front axle and cause a controlled application of spring brakes to the wheels of the forward and rear tandem axles.

After pressure is lost from one portion of the dual brake system, there may only be enough pressure in the other portion for one or two emergency brake applications. When the available pressure has been used the spring brakes will apply automatically.

**Emergency Brake
Application**
(pressure lost in rear)



In the event air pressure is lost from both front and rear portions of the system there will be an automatic application of the spring brakes. They will begin to apply as pressure drops to 60 p.s.i. (414 kPa) and there will be a complete application when pressure decreases to 40 p.s.i. (276 kPa).

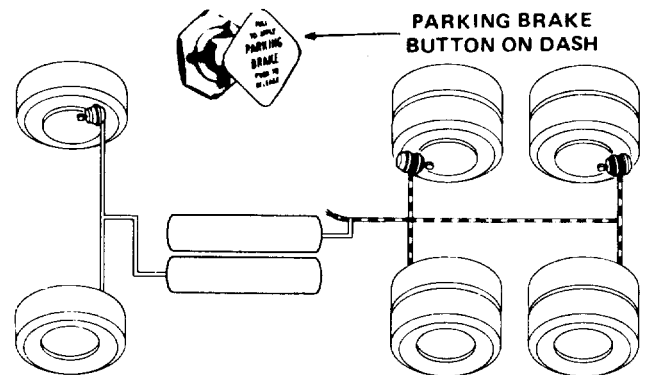
Because air pressure is required to release spring brakes, an automatic application will remain ON until air pressure can be restored.

If the air pressure gages indicate some system pressure remaining, it may be possible to drive the unit a short distance to remove it from a hazardous position (hold parking brake knob in depressed position and use Lo Lo gear range).

If carrier cannot be moved, direct traffic around carrier until warning flags, flares or lights can be displayed. Notify proper authorities and maintenance personnel as soon as possible.

Parking brake

Apply parking brake by raising parking brake control knob. This causes air pressure to be vented from spring chambers allowing springs to apply brakes to wheels of forward and rear tandem axles. Knob will raise automatically if air pressure is lost from front and rear portions of system.

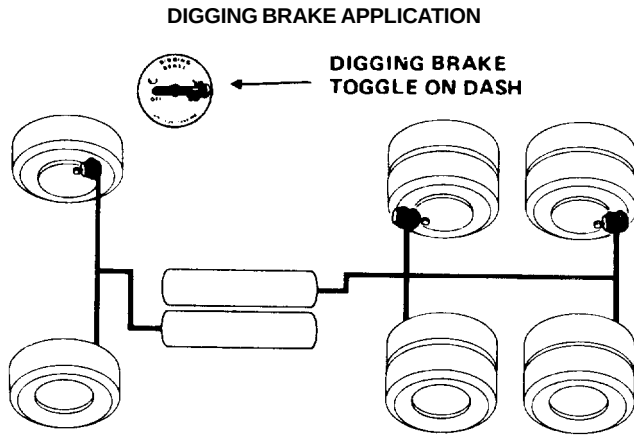


Release parking brake by depressing parking brake control knob (system must be pressurized to release parking brake).

Digging brake

Digging brakes are furnished on units equipped only for conventional control as well as on units equipped for both conventional and remote control. When activated, the digging brake is applied to all wheels to hold the carrier stationary while the excavator is digging.

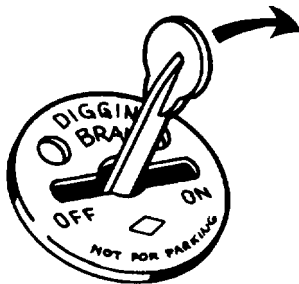
Air pressure requirements for digging brake application are not the same as those for the service brake (60 to 85 p.s.i.- 414 to 586 kPa). If pressure is lost after the digging brake has been applied, emergency brakes will be applied automatically.



! WARNING

Move digging brake control toggle to ON position only when carrier is stopped. Maximum braking is applied to wheels when toggle is moved to ON.

Moving toggle to ON while traveling would also cause disengagement of clutch and engagement of remote drive power take-off.



Apply digging brake by moving control toggle to ON position and release by moving toggle to OFF position.



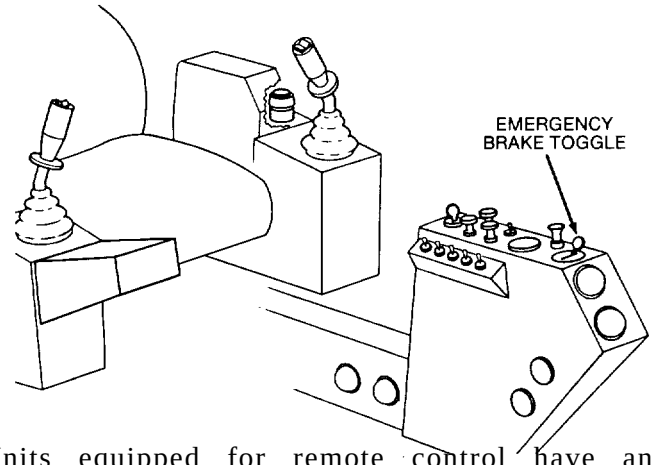
The DIGGING BRAKE indicator light will flash on and off when digging brake is applied and ignition switch is turned on.

Remote control braking

The digging brake is applied by the control toggle in the carrier cab. After moving digging brake control toggle to ON, the digging brake will be released and reapplied automatically as travel pedal in upperstructure is actuated and released.

! WARNING

Allow sufficient time for full brake system pressure (125 p.s.i. – 862 kPa) to be developed in upperstructure before operating unit in remote control.



Units equipped for remote control have an emergency brake control **located in the upperstructure cab**. This control is to be used in case of failure of the automatic digging brake.

If digging brake fails to apply when travel pedal is released, move emergency brake toggle to apply emergency brake. Notify maintenance personnel immediately for repair of digging brakes.

Apply upperstructure emergency brake when leaving upperstructure cab.

See pages 29 and 30 for detailed instructions on remote control operation.

Air Drier

An air drier is furnished to remove moisture and contaminants from air as it is delivered from compressor to first air reservoir. The drier includes a heating element to prevent freezing.

During compressor unloading, moisture and contaminants are purged from drier to atmosphere.

Under certain temperature conditions, condensation may cause a small amount of water to accumulate in system. Check air reservoirs weekly for moisture accumulation.

The air drier desiccant cartridge should be serviced or replaced annually unless experience indicates a shorter or longer interval. Refer to brake section of service manual for air drier maintenance instructions.

STEERING SYSTEM

Conventional steering

The power steering system provides low effort steering under normal conditions and greater control in the event of a blowout or soft ground. “Road feel” is similar to that of a conventional manual steering system.



CAUTION

Use of power steering while carrier is stopped causes unnecessary stress on system components and can cause serious damage to system.

Holding steering wheel in full left turn or full right turn position will cause system to overheat. This can cause steering pump to fail.

Remote control steering

Your unit is equipped with a steering pedal in the upperstructure cab. Upperstructure engine must be running to provide power for remote control steering.

Regardless of upperstructure position on carrier, depressing left side of pedal turns wheels to left; depressing right side of pedal turns wheels to right.

When not held in a left or right steering position, the steering pedal will return automatically to its neutral (non-steering) position. Be sure upperstructure cab is kept free of equipment and foreign material which could jam steering pedal in a steering position.

Rotation of steering wheel will occur during remote operation. KEEP CLEAR!



WARNING

Be alert for any increase in effort needed to steer. If any difference is noted, notify maintenance personnel immediately for correction. If power assist feature should fail for any reason IT WOULD BECOME VERY DIFFICULT TO STEER. For this reason it is extremely important that you NEVER TURN ENGINE OFF WHILE TRAVELING.

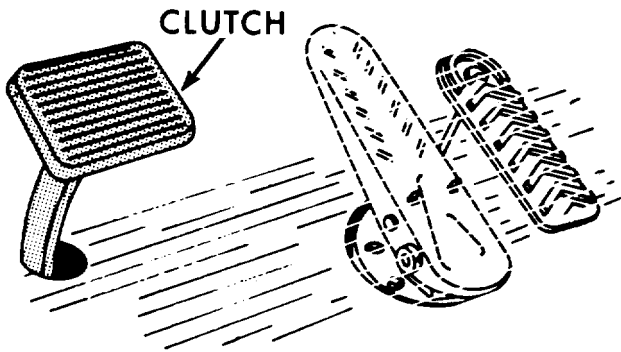
In the event power steering fails, stop as soon as possible. Do not drive unit until problem has been corrected.

POWER TRAIN

The power train furnished on 6x4 carriers (units having two driving axles at rear) includes the engine, clutch, transmission, rear tandem axles and the necessary propeller shafts to transfer torque (power) between these units.

The major variations found on 6x6 carriers (units having two driving axles at rear and a third driving axle in front) are the substitution of a front driving axle in place of a non-driving front axle and the addition of a transfer case to drive front axle.

Clutch



The clutch is located within a housing between the engine and transmission and functions to control the transfer of torque from engine to transmission.

Depressing the clutch pedal disengages the clutch and prevents a transfer of torque from the engine to the transmission. Releasing the clutch pedal engages the clutch and causes a transfer of torque from the engine to the transmission.

Countershaft Brake

The countershaft brake slows rotation of transmission gearing. Its **only** purpose is to ease the shift from neutral to LO LO, LO, 1st or reverse gear **while the carrier is stopped**.

The countershaft brake is controlled by the countershaft brake button (mounted on front side of shift lever). Depress button to apply brake and release button to release brake.

Do not use countershaft brake when downshifting.

Transfer Case (for 6x6 units only)

The transfer case is a gearbox located between the transmission and rear tandem axles. It functions with the transmission to transmit torque to the front and rear driving axles.

Front axle drive is controlled by the front wheel drive toggle located on the dashboard.

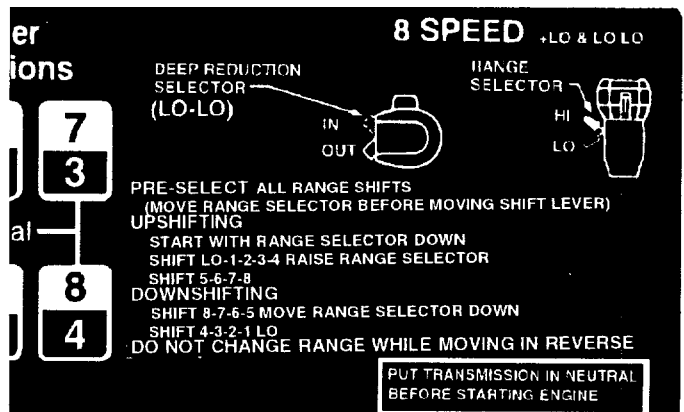


Transmission

The transmission is a gearbox which transmits torque from the engine as it is delivered to move the carrier. The transmission in your carrier provides 8 forward speeds plus Lo Lo and Lo. It also provides 3 corresponding reverse gear ranges.

The lowest transmission gear (LO LO) provides the greatest carrier torque and the lowest carrier speed. The highest transmission gear (8th gear) provides the greatest carrier speed with the least carrier torque. Gear selections between these gear ranges provide torque/speed combinations between these extremes. Reverse gears provide approximately the same torque/speed ratios as LO LO, LO and 1st gears.

Although your transmission is classified as having eight forward speeds, LO LO and LO can be included in the sequence of upshifting and downshifting. This, in effect, provides ten torque/speed ranges if required by conditions. However, it should seldom be necessary to use LO LO except under severe conditions. In most on-highway conditions the Lo plus the numbered gears will provide adequate torque for travel.



SHIFTING GEARS

Smooth, efficient gear shifting depends on coordinated use of accelerator pedal, clutch pedal, range preselection lever, deep reduction button and shift lever. It is also important that shifting occur at the proper time with respect to carrier power requirements.

For those unfamiliar with a manual transmission it may seem that gear shifting is a complicated procedure. A practice period with the carrier parked and the engine turned off will help develop the necessary coordination and confidence. There should be little difficulty if shifting procedures are followed step by step.

When practicing with the engine turned off there will be areas in the shift pattern where you will be unable to make a complete engagement. Don't use excessive force, just learn the pattern.

When to shift gears

Smooth, timely shifting not only increases carrier service life, it provides greater driving safety.

In lower gears use only enough engine speed to get the carrier rolling easily. High engine speeds under light load conditions waste fuel and cause excessive and unnecessary noise. Use a little more engine speed for each successive upshift until reaching desired cruising speed.

Unless starting from a standstill on an uphill grade, or in off-road use, it is unnecessary to use LO-LO range. When load conditions cause a continuing loss of engine speed, downshift to the next lower gear.

In general, operate in a gear that will permit acceleration.

Though it is permissible to use the braking power of the engine when traveling downhill, take care to avoid overspeeding the engine (exceeding governed RPM). The governor has no control over engine speed when the engine is being pushed by the carrier load. Select an appropriate gear ratio and use your brakes to assist in slowing the carrier.

Use Lo Lo, or Lo gear ranges for off-road conditions and for remote control operation. First gear may be used only if surface is hard and level.



WARNING

Stop carrier and select appropriate gear range before traveling a steep grade under off-highway conditions. Attempting up or downshifts under these conditions can be dangerous.

Double-Clutching

Gears in the main transmission are not synchronized and double clutching procedure must be used when shifting.

Double-clutching is a procedure for adjusting the speed of one transmission gear shaft (driven by the engine) to a second transmission gear shaft (connected to carrier drive wheels) to prevent clashing when gears on these shafts mesh.

This is accomplished by using the engine to increase or decrease the speed of the engine-driven gear shaft. Two double-clutching procedures are given, one for upshifting and one for downshifting. Be sure to use each at the proper time. Using the wrong procedure will cause gears to clash.

NOTES: The following double-clutching procedures apply to shifts within a **gear range** (Lo thru 4th gears and 5th thru 8th gears). **Additional steps** are required when shifting from one range to another. These steps will be described under Upshifting and Downshifting headings (starting on page 24).

Although double-clutching procedures are broken down into separate steps, the actual performance of these steps should be rapid and smooth.

Double-Clutching for Upshift

1. Release accelerator pedal and depress clutch pedal.
2. Move gear shift lever to neutral and release clutch pedal.
3. When engine speed nears low idle, depress clutch and shift to next higher gear. If shift timing has been correct, gears will mesh smoothly with no clash.
4. Release clutch evenly while depressing accelerator to apply power smoothly.

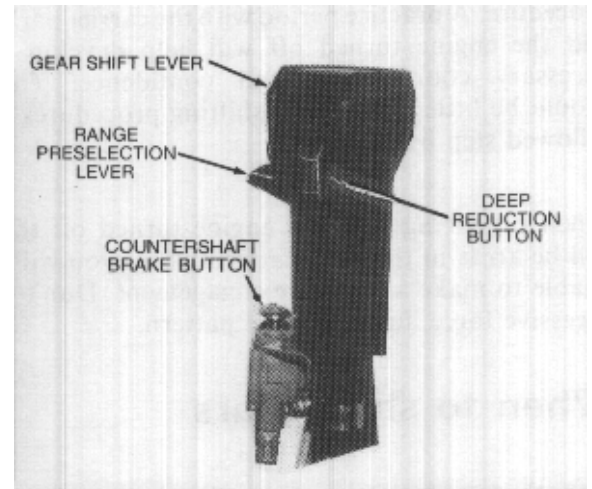
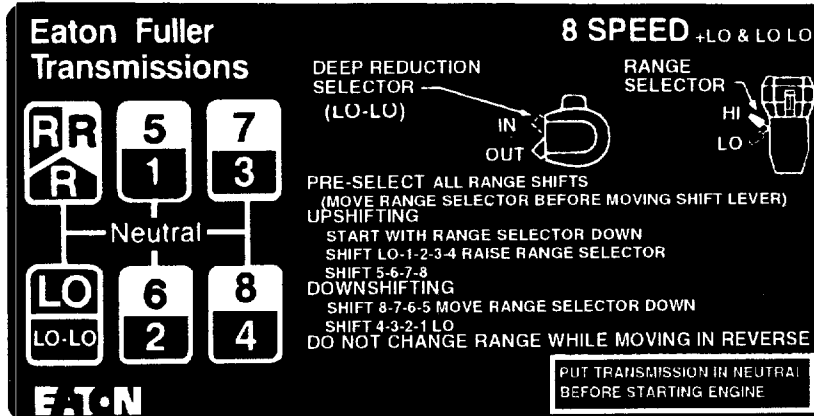
Double-Clutching for Downshift

NOTE: Downshifting is used to aid in reducing carrier speed or to increase carrier power.

1. Release accelerator pedal and depress clutch pedal.
2. Move gear shift lever to neutral and release clutch pedal.

3. Depress accelerator pedal to increase engine speed to high idle depress clutch and shift to next lower gear. If shift timing has been correct, gears will mesh smoothly with no clash.
4. Release clutch evenly and depress accelerator as appropriate for conditions.

Upshifting



Precautions

- For a smooth start, select a starting gear that will provide sufficient reduction for the load and terrain.
- Always use normal double-clutching procedures when making lever shifts.
- Never slam or jerk the shift lever to complete gear engagement.
- Never coast with the gear shift lever in neutral.
- Never make a range shift when in reverse.
- Never downshift at too high of a road speed.
- Never move the Deep Reduction Button or the Range Preselection Lever with the gear shift lever in neutral while vehicle is moving.

1. With parking brake applied, depress clutch and move gear shift lever to neutral.
2. Start engine and wait till carrier air system reaches 125 psi (862 kPa).
3. Release parking brake and hold carrier in position using service brake.



CAUTION

NEVER move range preselection lever or deep reduction button while carrier is moving and transmission is in neutral. When carrier is moving, these controls **MUST** be moved to desired position while carrier is in gear, **BEFORE** disengaging clutch and shifting to neutral for next shift.

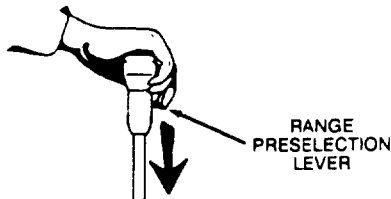
IMPORTANT NOTES: The following procedure/s make assumptions which you must understand and observe:

- The first part of the procedure applies to all conditions: these steps **(steps 1 thru 3)** must be performed.
- **Conditions may require travel in Lo Lo.** In this situation, continue with steps 4 thru 10.
- **Conditions may permit travel in Lo.** In this situation, continue with steps 11 thru 18.
- **Conditions may require starting travel in reverse.** In this situation, choose either Lo Lo procedure or Lo procedure as appropriate and select reverse gear instead of a forward gear. **Do not** attempt to change ranges while in reverse. **Stop carrier** before proceeding with forward travel.

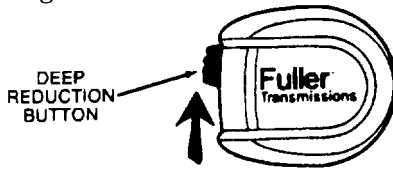
For all conditions:

1. With parking brake applied, depress clutch and move gear shift lever to neutral.
2. Start engine and wait until carrier air system reaches 125 psi.
3. Release parking brake and hold carrier in position using service brake.

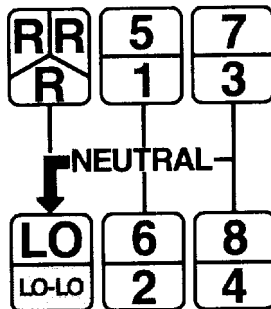
If conditions require travel in Lo Lo, proceed with step 4.



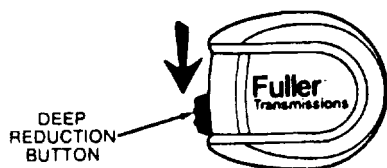
4. Move range preselection lever down to select Lo gear range.



5. Move deep reduction button forward to select Lo Lo gear range:



6. Depress clutch pedal, depress countershaft brake button and then move shift lever to Lo Lo gear position. Release countershaft brake button.
7. Release clutch pedal evenly while depressing accelerator pedal smoothly. Carrier will move forward in Lo Lo gear range.



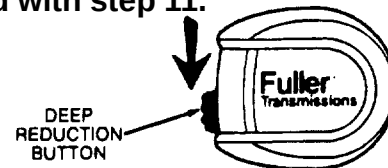
8. When ready to shift to next higher gear (Lo), move deep reduction button to rear to select Lo range position.

9. Release accelerator pedal immediately and fully depress clutch pedal. Release clutch pedal. Transmission will shift from Lo Lo to Lo when gears are synchronized. Accelerate to appropriate travel speed/engine RPM.

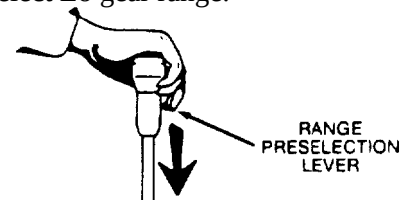
10. Continue with step 15.

OR

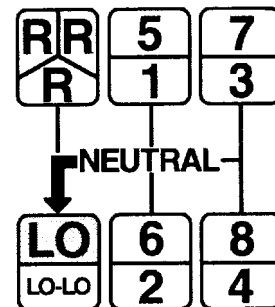
If conditions permit travel in Lo, proceed with step 11.



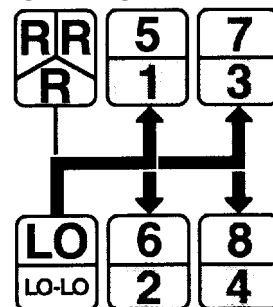
11. Check to be sure deep reduction button is in rear position to select Lo gear range.



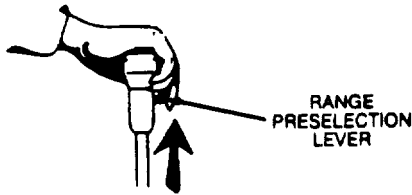
12. Move range preselection lever down to select Lo gear range.



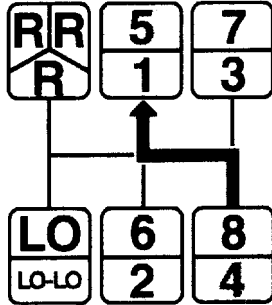
13. Depress clutch pedal, depress countershaft brake button and then move shift lever to Lo gear position. Release countershaft brake button.
14. Release clutch pedal evenly while depressing accelerator pedal smoothly. Carrier will move forward in Lo gear range.



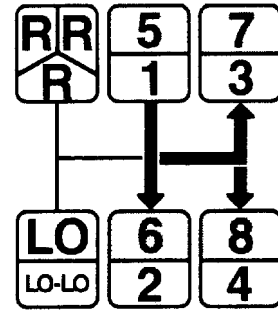
15. When ready to shift to next higher gear (1st gear), using upshift, double-clutching method, shift from to Lo gear to 1st gear. When appropriate, continue upshifting to 2nd 3rd and 4th gears.



16. When ready, move range preselection lever up to high range position.



17. Using upshift, double-clutching method, immediately shift from 4th to 5th gear position.



18. As conditions permit, still using upshift, double-clutching method, shift from 5th gear to 6th, 7th and 8th gear.

Downshifting

During normal driving there are times when it is necessary to downshift (shift from one gear or range to the next lower gear or range) to decrease carrier speed or increase carrier power. Double-clutching is required.

NOTE: The following procedure assumes that carrier is traveling in 8th gear. However, this procedure can be applied to downshifts from other gears. Follow procedure from appropriate gear. This procedure covers downshifting from 8th gear to Lo Lo. Unless traveling a very steep upgrade it shouldn't be necessary to downshift thru the entire range of gears; use that portion of procedure which applies to your situation.

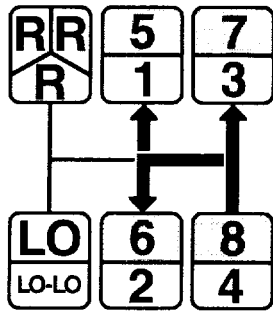


CAUTION

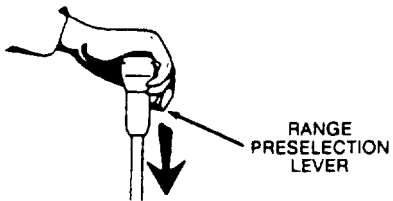
Never downshift when carrier speed will cause engine to overspeed in next lower gear or serious damage to engine may result. Use service brake to slow carrier to speed for downshift if necessary.

MAXIMUM CARRIER SPEED IN EACH GEAR

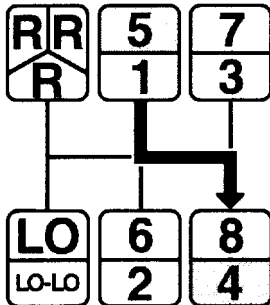
		200 HP 6BTA5.9 Engine		245 HP 6CTA8.3 Engine	
RANGE	GEAR	MI/HR	KM/HR	MI/HR	KM/HR
LO LO	-	3	4	3	5
LO	-	4	7	4	7
LO	1	6	10	7	11
LO	2	8	13	9	15
LO	3	11	18	12	20
LO	4	15	24	17	27
HI	5	21	34	23	37
HI	6	28	45	31	50
HI	7	38	61	42	68
HI	8	52	83	57	92



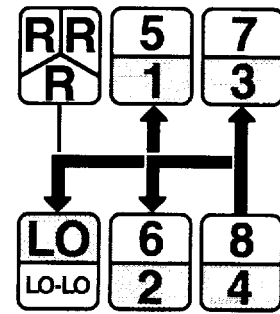
1. Using downshift, double-clutching method, shift from 8th gear to 7th, 6th and 5th gears as appropriate.



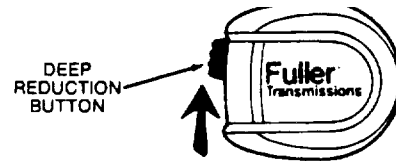
2. While still in 5th gear, push range preselection lever down to Lo range position.



3. Using downshift, double-clutching method, immediately shift to 4th gear. Transmission will shift to Lo range as shift lever passes thru neutral.



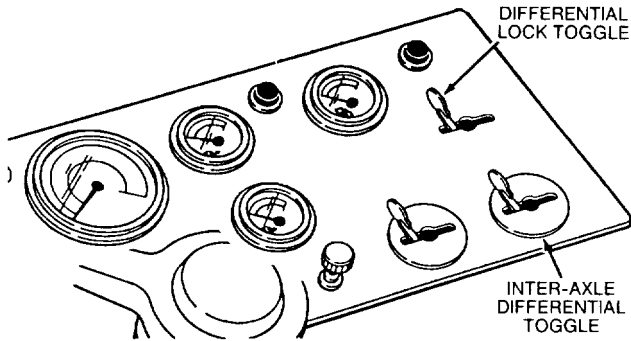
4. Continue to downshift using double-clutching method from 4th to 3rd, 2nd, 1st and Lo gears as appropriate.
5. If it is absolutely necessary to downshift to Lo Lo range while moving, perform steps 6 and 7.



6. While still traveling in Lo gear, move deep reduction button forward to Lo Lo position.
7. Immediately release accelerator pedal and depress clutch pedal fully to break torque. Then release clutch and accelerate. Transmission will shift to Lo Lo range when gears are synchronized.

INTER-AXLE DIFFERENTIAL

An inter- axle differential is provided at the rear of the front tandem axle. This unit divides input torque equally between the front and rear tandem axles.



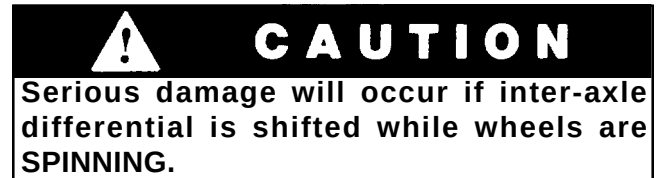
The inter-axle differential is controlled by a toggle lever mounted at the lower right portion of the dashboard. With toggle in **UNLOCK** position, the front and rear tandem axles are permitted to rotate at different speeds to compensate for worn tires on one of the axles. Keep toggle in **UNLOCK** position when driving on good tractive conditions.

Differential Lock

- The differential can be locked or unlocked when the vehicle is standing still or at a constant low speed **when wheels are not slipping**.
 - When necessary, lock the differential and operate the vehicle only at low speeds (**1st gear in Lo range maximum**).
 - **will increase**. This condition is called “understeer”. when operating vehicle with a locked differential.
 - Lock differential only when **maximum traction is needed** on poor road or highway surfaces **or when digging over the side**.
 - **Always unlock the differential** when need for maximum traction has passed or when traveling on good surface.
 - **Do not lock differential when wheels are slipping**. Damage to the differential can result.
 - **Do not lock differential** when the vehicle is traveling **down steep grades** and **traction is minimal**. Potential loss of vehicle stability can result.
 - **Locking The Differential:** When encountering poor traction conditions, do the following:
NOTES: The differential lock **can be engaged (locked) ONLY** when the inter-axle differential has been engaged.
The differential lock is intended for use **ONLY** in gear ranges LoLo 1, 2 and 3 and Lo 1.
1. Check to be sure inter-axle differential toggle is in

With toggle in **LOCK** position, there is positive drive to the front and rear tandem axles and either axle will drive up to its maximum tractive ability without regard to the other axle. Keep toggle in **LOCK** position when driving over poor tractive conditions (mud, ice, snow or off-road travel). Also use lock position for remote control travel.

The inter-axle differential may be locked when traveling **BUT NEVER** when wheels have lost traction and are **SPINNING**.



If shifting inter-axle differential while traveling, release accelerator first to provide an interruption in torque to the axles.

1. **LOCK** position. Refer to previous heading for procedure.
2. With vehicle **stopped** or traveling straight at a **constant speed** in proper gear range, **and no wheels slipping**, move differential lock toggle to **LOCK** position.
3. Let up momentarily on accelerator to relieve torque on gearing, allowing differential to fully lock.
4. When differential lock is **fully engaged**, the **indicator light will glow**.
5. When the differential is fully locked the vehicle will have an “**understeer**” condition when making turns. **Proceed cautiously** over poor surface conditions.

NOTE: Normally, differential lock will engage and disengage immediately in response to **LOCK/UNLOCK** toggle. However differential “wind-up”, or misalignment can delay engagement/disengagement. In this event, reversing direction of travel and/or operation of steering while traveling may relieve differential “wind-up”. **Indicator light shows actual state of lock engagement/disengagement.**

Unlocking The Differential: After poor surface conditions have passed, do the following:

1. Move control toggle to **UNLOCK** position.
2. Let up momentarily on accelerator to relieve torque on gearing, allowing differential to fully unlock.
3. When the differential lock is fully disengaged, the indicator light will stop glowing.

REMOTE CONTROL

NOTE: Remote control is to be used for positioning unit at job site, not for over-the-road travel.

Preparing Carrier for Remote Control Operation

1. With carrier on level surface, apply parking brake.
2. Start carrier engine and develop full brake system pressure in front and rear portions of system (125 psi/862 kPa.).
3. With engine running, depress clutch and shift transmission to Lo Lo or Lo gear range. Use Lo Lo if operating on a grade. First gear may be used if operating on hard, level surface. Move inter-axle differential and differential lock toggles to LOCK position for off-road conditions and for digging over side. When sure of complete engagement, stop engine and release clutch.

**WARNING**

Be sure to keep feet clear of clutch pedal when moving **DIGGING BRAKE** toggle to **ON** position (step 4).

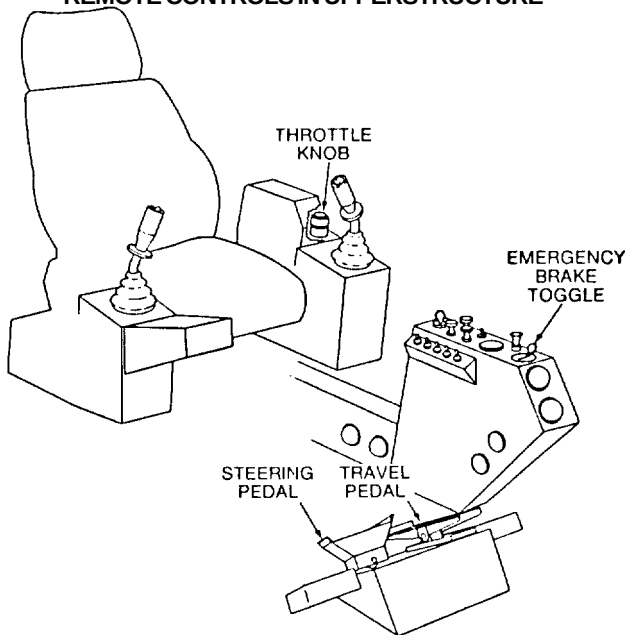
4. Move **DIGGING BRAKE** toggle to **ON** position. This applies digging brake, disengages carrier engine clutch and engages remote drive power take-off.
5. Release parking brake.

**CAUTION**

Serious damage can occur to engine and clutch if carrier engine is permitted to run with digging brake engaged.

Preparing Upperstructure for Remote Control Operation

REMOTE CONTROLS IN UPPERSTRUCTURE



1. Be sure controls in carrier cab have been properly set for remote control operation (above).

2. Be sure joystick and foot pedal controls are in neutral position.
3. Start upperstructure engine and develop full brake system pressure (125 psi/862 kPa).
4. With emergency brake applied, perform following procedure to be sure power take-off is fully engaged.
 - a. Adjust upperstructure engine speed to low idle.
 - b. Very gently engage travel pedal to cause a slight rotation of power take-off gear.
 - c. If step b caused gears to clash, power take-off was not engaged. Repeat step b.

If step b caused engine to reduce speed, power take-off is fully engaged. **Increase engine speed to full throttle for upperstructure operation.**

5. Move **EMERGENCY BRAKE** control to **NORMAL** position.

Precautions for Remote Control Operation

Be sure of clear visibility in direction of travel; use a signalman to compensate for blind spots.

Be sure all Warm-Up and Operational Checks have been performed.

Be sure of clear path for carrier, boom and counterweight before starting to move. Be especially watchful for people, overhead wires and traffic.

Never tow load using remote control drive.

Always give audible signal before moving unit.

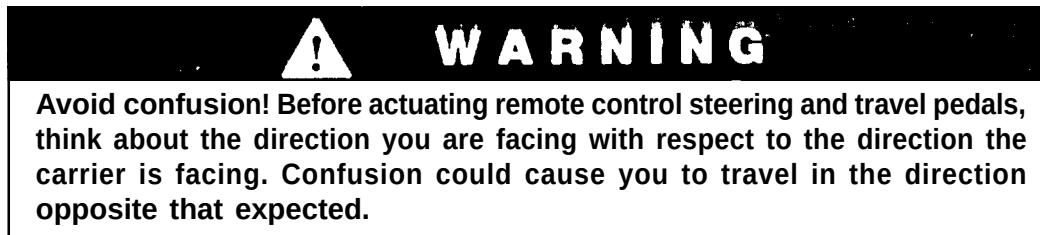
Never permit bucket to drag while moving unit.

Rotation of steering wheel will occur during remote operation. **KEEP CLEAR!**

Be sure travel alarm functions properly.

Over the side stability is reduced during remote travel because front axle lock cylinders automatically unlock when traveling.

Driving carrier from upperstructure cab



1. Be sure controls in carrier and upperstructure cabs have been properly set for remote control operation (see previous page).
2. Carrier speed is controlled by gear selection and amount of pedal actuation.
3. Travel pedal controls forward and reverse travel. Depressing front of pedal releases digging brake and causes forward travel. Depressing rear of pedal releases digging brake and causes reverse travel. Gear range selection engine speed and extent of pedal depression determine travel speed. Digging brake is applied automatically when travel pedal is released.
4. Steering pedal controls left and right turns. Depressing right side of pedal causes right turn and depressing left side of pedal causes left turn.
5. Use **EMERGENCY BRAKE** to stop carrier if automatic digging brake fails. Move emergency brake toggle to ON position.

EMERGENCY BRAKE IN UPPER CAB MUST BE RELEASED TO MOVE CARRIER.

Preparing Upperstructure for Conventional Carrier Operation

1. Inspect brakes before driving carrier after digging (refer to page 7)
2. With bucket opened fully retract boom (watch bucket clearance) and position in boom rest as shown on page 7. Secure boom, and bucket using hold-down devices as necessary.
3. Allow engine to cool by running at idle speed for a few minutes. **Stop engine.**
4. Be sure travel and steering pedals are in neutral position and emergency brake is released.

Preparing Carrier for Conventional Operation

1. Apply parking brake.
2. Shift transmission to neutral.
3. Move **DIGGING BRAKE** toggle to OFF position
4. If conditions permit move inter-axle differential and differential lock toggles to **UNLOCK** position.
5. Shift transfer case to engage or disengage front drive axle as appropriate for driving conditions (if so equipped).

PARKING THE GRADALL

Precautions:

Avoid parking on banks or near an excavation. Avoid parking on roads or highways. If it cannot be avoided, be sure to display warning flags during day and flares or flashing lights at night

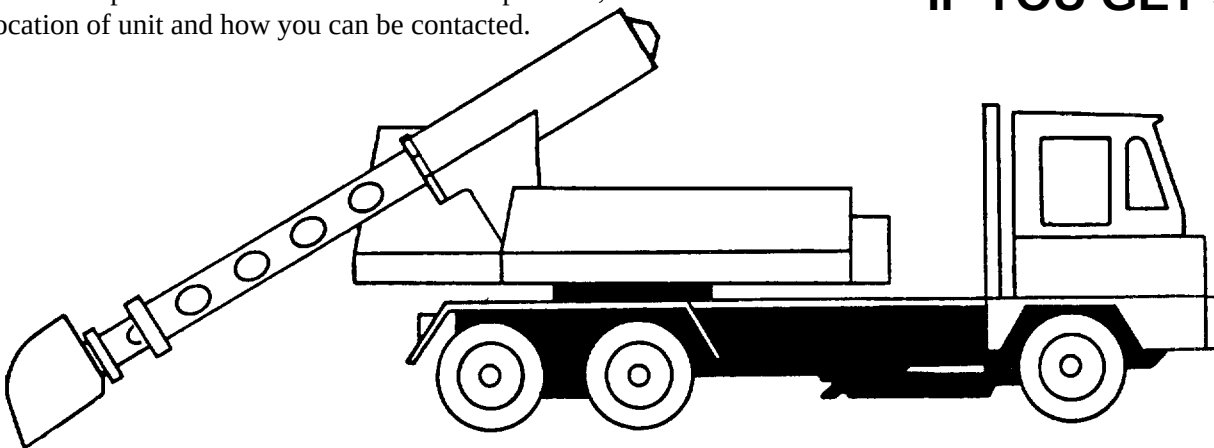
Position boom in boom rest or on ground.

Parking procedure

1. Using service brake, stop unit in appropriate parking area and **apply parking brake.**
2. Allow engine to cool at idle speed for a few minutes and then stop engine.
3. Shift transmission to first gear.
4. Block carrier wheels as an extra precaution against rolling.

IN CASE OF TROUBLE

1. Park unit in a safe area, apply parking brake and block wheels.
2. Display warning flags, flares or flashing lights as necessary.
3. Contact supervisor and advise of nature of problem, location of unit and how you can be contacted.



If unit becomes stuck in soft ground you can use boom to help free it.

Position carrier and upperstructure controls for remote control operation.

Position boom over rear of carrier (centered over

Never leave machine with boom in air.

Park on level ground, apply parking brake and chock wheels.

If parking on a slope cannot be avoided, be certain that parking brake is applied and wheels are securely chocked.

5. Fill fuel tank/s to minimize condensation.

6. Lock carrier and upperstructure cabs and install protective window covers if available.

7. Disconnect batteries if unit is in an area where tampering seems possible.

Towing

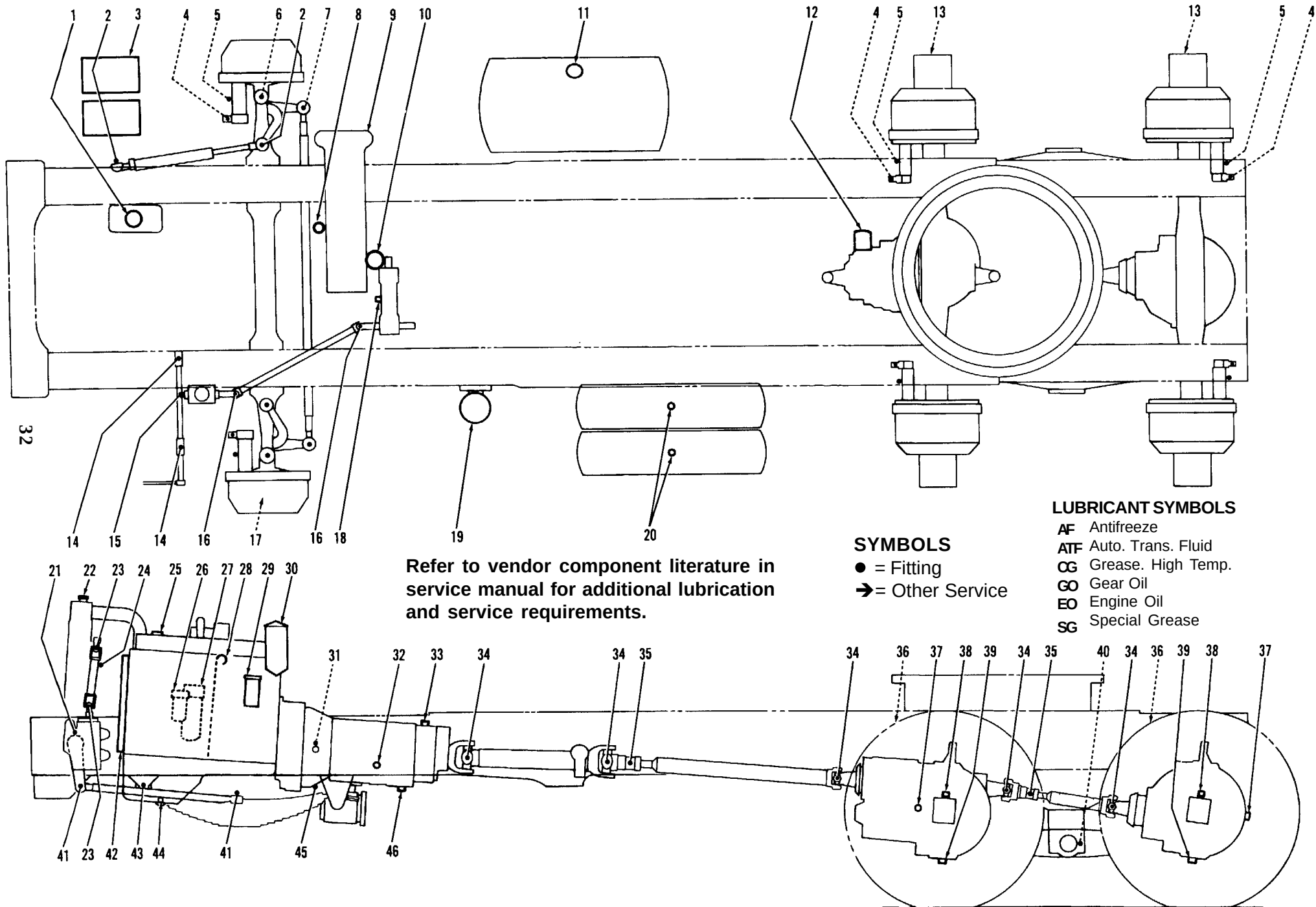
Should it become necessary to tow the unit, have maintenance personnel remove forward-rear axle shafts (refer to Rockwell Technical Service Aid in service manual), propeller shafts between drive axles and transmission and transfer case (if so equipped), Store propeller shafts and axle shafts in a safe location.

IF YOU GET STUCK

rear to prevent tipping) and imbed bucket in ground.

While actuating travel pedal in appropriate direction, extend or retract boom as required to help push or pull unit to solid ground. Raise or lower boom as necessary to keep rear wheels in proper contact with ground.

6X4 CARRIER LUBRICATION & MAINTENANCE DIAGRAM



CAUTION

Service intervals are based on carrier usage of 250 hours annually. Use of your unit may vary significantly and you must adjust service frequency for your usage to obtain maximum service life. Frequency headings in the following schedule indicate a calendar limit and an operating hour limit. Perform service at whichever interval occurs first.

Item		No. of Points	Lube Symbol	Item	Lube Symbol	No. of Points
Daily or Shift (10 Hour Maximum) Lubrication & Maintenance						
1.	Coolant Expansion Tank (check level & refill as req'd)	1	-	23.	Steering Universal Joints	2
8.	Air Cleaner Condition Indicator (observe with engine running at full throttle - clean or replace as required - item 9 is air cleaner)	1	-	30.	Power Steering Reservoir (check level & refill as req'd)	1
11.	Fuel Tank (fill at end of 1 work shift to minimize condensation)	1	-	31.	Clutch Throwout Shaft Bearing	2
28.	Engine Crankcase Dipstick (check level & refill as req'd - item 25 is filler cap)	1	EO	32.	Transmission Fill & Level Plug (check level & refill as req'd)	1
36.	Tires (check for damage & proper pressure)	1	-	34.	Universal Joints	5
Front std. - 11:00 x 20, 12 ply - 85 psi				35.	Drive Shaft Splines	2
Rear std. - 11:00 x 20, 12 ply - 75 psi				37.	Differential Fill & Level Plug (check level & refill as req'd)	2
Front option - 15:00 x 22.5, 16 ply - 85 psi				40.	Walking Beam Pivots	2
				41.	Drag Link Ball Joints	2
				43.	Spring Anchor Pins	2
				45.	Clutch Throwout Bearing (lubricate sparingly)	1

Quarterly (250 Hours Maximum Lubrication & Maintenance)
(includes all previous periodic services)

- 27. Engine Oil Filter (replace element at each oil change - 250 hours maximum)
- 44. Crankcase Drain Plug (drain & refill to level on dipstick - item 25 is till cap-250 hour maximum)

At End of First 30 Hours

- 46. Transmission Drain Plug (drain & refill to level - item 32 is level plug)

Weekly (50 Hour Maximum) Lubrication & Maintenance
(include all previous periodic services)

- 10. Fuel/Water Separator (drain water & sediment - behind engine compartment)
- 20. Air Reservoir Drain (et end of work shift drain reservoirs & inspect for excessive moisture - a slight accumulation is normal - service air drier as req'd)

At End of First 30 Days

- Check torque of all names listed in Torque Chart - page 36

Monthly (125 Hours Maximum) Lubrication & Maintenance
(includes all previous periodic services)

- 2. Steering Cylinder Pivots
- 3. Batteries (check electrolyte level & refill as req'd)
- 4. Slack Adjusters
- 6. King Pin Bearings
- 7. Tie Rod Ends
- 14 Clutch Pedal Pivot Shaft
- 15. Slack Tower Shaft
- 16. Shift Linkage Universal Joints
- 19. Air Drier (refer to page 20 of this manual)

LUBRICATION NOTES

Clean lubrication fittings before lubricating

Intervals shown are for normal (8 hour day)usage and conditions. Adjust intervals for abnormal usage and conditions.

See recommended lubricants. Page 36.

Lubricate points indicated by dotted leaders both sides of unit.

Drain engine and gear cases only after operation when lubricant is hot.

Check lubricant levels when lubricant is cool.

Item

Monthly Lubrication & Maintenance (cont.)

- 23. Steering Universal Joints
- 30. Power Steering Reservoir (check level & refill as req'd)
- 31. Clutch Throwout Shaft Bearing
- 32. Transmission Fill & Level Plug (check level & refill as req'd)
- 34. Universal Joints
- 35. Drive Shaft Splines
- 37. Differential Fill & Level Plug (check level & refill as req'd)
- 40. Walking Beam Pivots
- 41. Drag Link Ball Joints
- 43. Spring Anchor Pins
- 45. Clutch Throwout Bearing (lubricate sparingly)

Quarterly (250 Hours Maximum Lubrication & Maintenance)
(includes all previous periodic services)

- 27. Engine Oil Filter (replace element at each oil change - 250 hours maximum)
- 44. Crankcase Drain Plug (drain & refill to level on dipstick - item 25 is till cap-250 hour maximum)

Semi-Annual (750 Hours Maximum Lubrication & Maintenance)
(includes all previous periodic services)

- 4. Slack Adjusters (inspect or adjust by performing services described inside back cover of this manual)
- 5. Brake Camshaft (lubricate sparingly)
- 17. Wheel Bearings (front axle) (remove, clean, pack & install)
- 18. Shift Tower Breather (remove clean & install)
- 21. Steering Gear Dirt Seal (purge old grease slowly using manual grease gun)
- 24. Steering Shaft Splines
- 33. Transmission Breather (remove, clean & install)
- 38. Differential Breather (remove, clean & install)
- 42. Engine Drive Belt (check condition - replace as req'd)
- Check torque of all items listed in torque chart- page 36

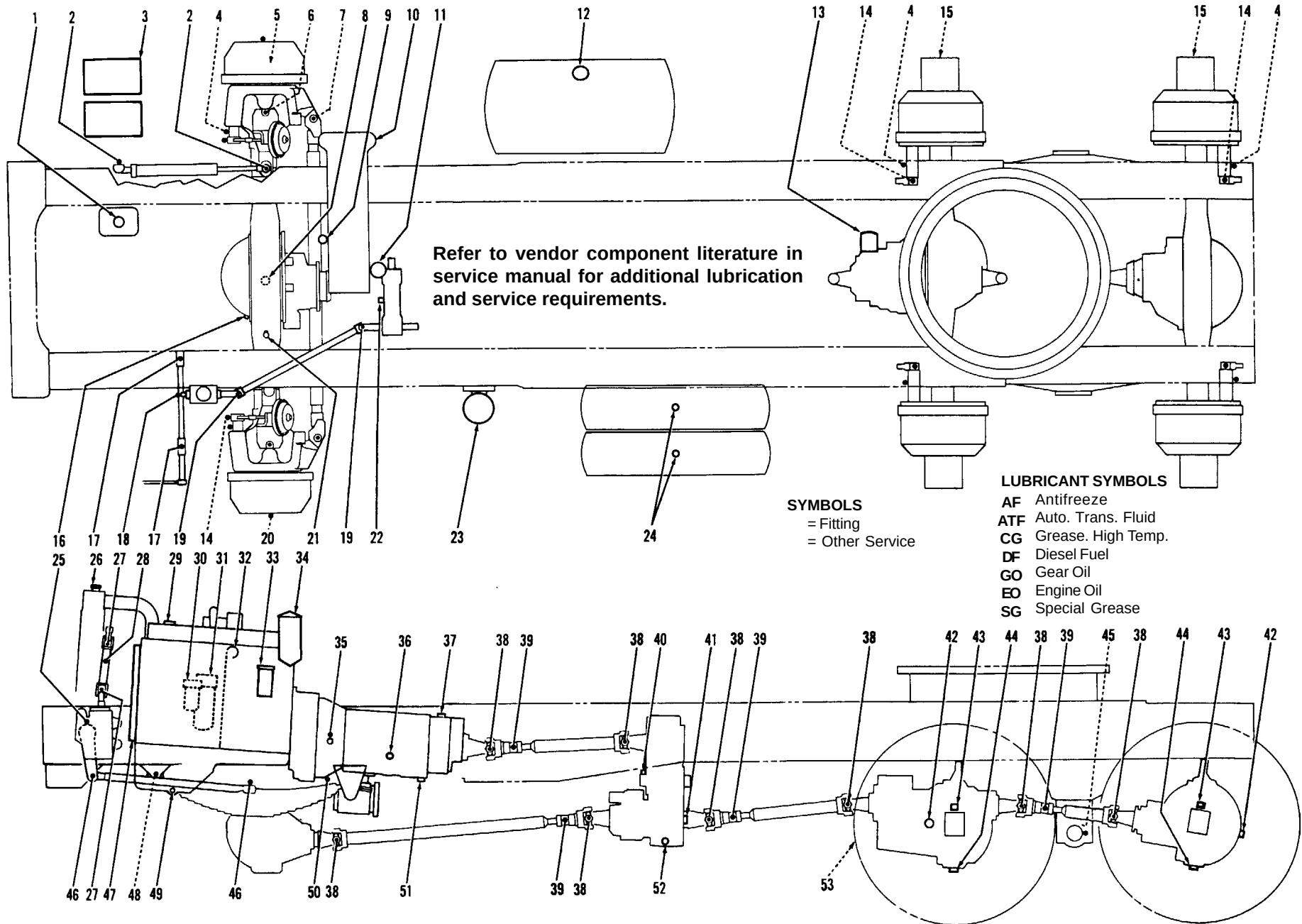
Annual (1500 Hours Maximum) Lubrication & Maintenance
(includes all previous periodic services)

- 10 & 29 Fuel Filters (replace elements)
- 12. Differential Filter (replace element)
- 13. Wheel Ends (Fill to level with level plug at 3 or 9 o'clock position)
- 19. Air Drier (refer to page 20 of this manual)
- 22. Cooling System (replace coolant per manufacturer's suggestion)
- 26. Coolant Filter (replace element)
- 30. Steering System (drain & refill to level)
- 39. Differential Drain Plug (drain & refill)
- 46. Transmission Drain Plug (drain & refill)

Clean filter and air cleaner housings and reusable elements using cleaing solvent or diesel fuel. Dry components thoroughly using a lint free cloth.

Apply a light coating of engine oil to all linkage pivot points

6 X G CARRIER LUBRICATION & MAINTENANCE DIAGRAM



CAUTION

Service intervals are based on carrier usage of 250 hours annually. Use of your unit may vary significantly and you must adjust service frequency for your usage to obtain maximum service life. Frequency headings in the following schedule indicate a calendar limit and an operating hour limit. Perform service at whichever interval occurs first.

Daily or Shift (10 Hour Maximum) Lubrication & Maintenance

Item	Lube Symbol	No. of Points
9. Air Cleaner Condition indicator (observe with engine running at full throttle clean or replace as required - item 10 is air cleaner)	-	1
12. Fuel Tank (fill at end of work shift to minimize condensation)	DF	1
32. Engine Crankcase Dipstick (check level & refill as req'd - item 29 is filler cap)	EO	1
54. Tires (check for damage & proper pressure)	-	2
Front std. - 15:00 x 22.5, 16 ply - 85 psi	-	8
Rear std. - 10:00 x 20, 14 ply - 75 psi	-	8
Front option - 10:00 x 20, 14 ply - 85 psi	-	2

At End of First 40 Hours

51. Transmission Drain Plug (drain & refill to level - item 36 is level plug)	EO	1
52. Transfer Case Drain Plug (drain & refill to level - item 41 is level plug)	EO	1

Weekly (50 Hour Maximum) Lubrication & Maintenance

(include all previous periodic services)		
1. Coolant Expansion Tank (check level & refill as req'd)	AF	1
11. Fuel/Water Separator (drain water & sediment - behind engine compartment)	-	1
24. Air Reservoir Drain (at end of work shift drain reservoirs & inspect for excessive moisture - a slight accumulation is normal - service air drier as req'd)	-	2

At End of First 30 Days

- Check torque of all items listed in Torque Chart - page 36

Monthly (125 Hours Maximum) Lubrication & Maintenance

(includes all previous periodic services)		
2. Steering Cylinder Pivots	CG	2
3. Batteries (check electrolyte level & refill as req'd)	-	2
6. Wheel Pivot Trunnions	CG	4
7. Tie Rod Ends	CG	2
14. Slack Adjusters	CG	6
16. Front Differential Level Plug (check level & refill as req'd)	GO	1
17. Clutch Pedal Pivot Shaft	CG	2
18. Shift Tower Shaft	CG	1
19. Shift Linkage Universal Joints	CG	2
20. Front Axle Drive Splines	CG	2
23. Air Drier (refer to page 20 of this manual)	-	1
27. Steering Column Universal Joints	CG	2
34. Power Steering Reservoir (check level & refill as req'd)	ATF	1

LUBRICATION NOTES:

- See recommended lubricants (page 36).
- Clean lubrication fittings before lubricating.
- Lubricate points indicated by dotted leaders on both sides of machine.
- Check lubricant levels when lubricant is cool.

Monthly Lubrication & Maintenance (cont.)

Item	Lube Symbol	No. of Points
35. Clutch Throwout Shaft Bearings	CG	2
36. Transmission Fill & Level Plug (check level & refill as req'd)	EO	1
38. Universal Joints	CG	8
39. Drive Shaft Splines	CG	4
41. Transfer Case Fill & Level Plug (check level & refill as req'd)	EO	1
42. Rear Differential Fill & Level Plugs (check level & refill as req'd)	GO	2
45. Walking Beam Pivots	CG	2
46. Drag Link Ball Joints	CG	2
48. Spring Anchor Pins	CG	2
50. Clutch Throwout Bearing (lubricate sparingly)	CG	1

Quarterly (250 Hours Maximum Lubrication & Maintenance)

(includes all previous periodic services)		
31. Engine Oil Filter (replace element at each oil change - 250 hours maximum)	-	1
49. Crankcase Drain Plug (drain & refill to level on dipstick - item 25 is fill cap-250 hour maximum)	EO	1

Semi-Annual (750 Hours Maximum Lubrication & Maintenance)

(include all previous periodic services)		
4. Brake Camshaft (lubricate sparingly)	CG	4
5. Wheel Bearings (front axle) (remove, clean, pack & install)	CG	2
14. Slack Adjusters (inspect by performing services described inside back cover of this manual)	-	6
21. Front Differential Breather (remove, clean & install)	-	1
22. Shift Tower Breather (remove, clean & install)	-	1
25. Steering Gear Dirt Seal (purge old grease slowly using manual grease gun)	CG	1
28. Steering Shaft Splines	CG	1
37. Transmission Breather (remove, clean & install)	-	1
43. Rear Differential Breathers (remove, clean & install)	-	2
47. Engine Drive Belt (check condition - replace as req'd)	-	1
● Check torque of all items listed in torque chart-page 36	-	-

Annual (1500 Hours Maximum) Lubrication & Maintenance

(includes all previous periodic services)		
8. Front Differential Drain Plug (drain & refill)	GO	1
11 & 33. Fuel Filters (replace elements)	-	2
13. Differential Filter (replace element)	-	1
15. Wheel Ends (fill to level with level plug at 3 or 9 o'clock position)	GO	4
23. Air Drier (refer to page 20 of this manual)	-	1
26. Cooling System (replace coolant per manufacturer's suggestion)	AF	1
30. Coolant Filter (replace element)	-	1
34. Steering System (drain & refill)	ATF	1
44. Rear Differential Drain Plugs (drain & refill)	GO	2
51. Transmission Drain Plug (drain & refill)	EO	1
52. Transfer Case Drain Plug (drain & refill)	EO	1

- Drain lubricants after operation when lubricant is hot.
- Clean filter and air cleaner housing cleaning solvent or diesel fuel. Dry using lint free cloth or compressed air.
- Clean reusable filter elements in accordance with manufacturer's recommended method (ref. service manual).
- Apply a light coating of engine oil to all linkage pivot points.

Recommended Lubricants & Capacities

APPLICATION	SYMBOL	WHEN USED	GRADE	SPECIFICATION	CAPACITY *	
					ENGLISH	LITERS
Engine Crankcase (Cummins)	EO (engine oil)	All Year	15W40	MIL-L-2104E	23.7 quarts	22.4
Engine Cooling System	AF (anti-freeze)	All Year	Permanent	50/50 sol.	30.4 quarts	28.8
Front Drive Axle (6x6 only)	GO (gear lubricant)	All Year	80W/90	MIL-L-2105D	36.4 pints	17.1
Fuel Tank	DF (diesel fuel)	All Year	#2	-	38 gal.	144
Grease Fittings	CG (extreme pressure lube)	All Year	NLGI #2	H-152	-	-
PTO/Trans. Combination	EO (engine oil)	All Year	50 WT	MIL-L-2104E	19 qts initial 14 qts refill	18 13.2
Slack Adjusters	SG (special grease)	All Year	NLGI	**	-	-
Steering Reservoir	ATF (auto. trans. fluid)	All Year	Dexron II	**	**	**
Tandem Axle (forward)	GO (gear lubricant)	All Year	80W/90	MIL-L-2105D	34 pints	16
Tandem Axle (rear)	GO (gear lubricant)	All Year	80W/90	Mil-L-2105D	31 pints	14.7
Transfer Case (6x6 only)	EO (engine oil)	All Year	50 Wt	MIL-L-2104E	6.5 quarts	6.2

*Capacities are approximate; check level to be sure.

**Refer to manufacture's literature for this information.

NOTE: Lubricants described in this table are used in standard machines when they are shipped from Gradall. Acceptable alternative lubricants (for varying conditions) are listed in component manufacture's literature included in your service manual.

Torque Chart

Check torque using an accurate torque wrench to apply maximum torque value shown.
DO NOT EXCEED MAXIMUM TORQUE. Exceeding maximum torque may cause fastener to fail.

ITEM	Qty.	THREAD SIZE (GRADE)	TORQUE (lubricated)			
			POUND / FEET		NEWTON / METERS	
			MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
SPRING U-BOLT NUTS	8	3/4-16 (-)	335	365	456	496
STEERING GEAR BOX	4	7/8-14 (8)	490	510	666	694
WHEEL LUG NUTS (DISC WHEEL)	ALL	-	450	500	612	680
WHEEL LUG NUTS (SPOKE WHEEL)	ALL	-	200	260	272	354

CHECKING AUTOMATIC SLACK ADJUSTERS

IMPORTANT NOTES

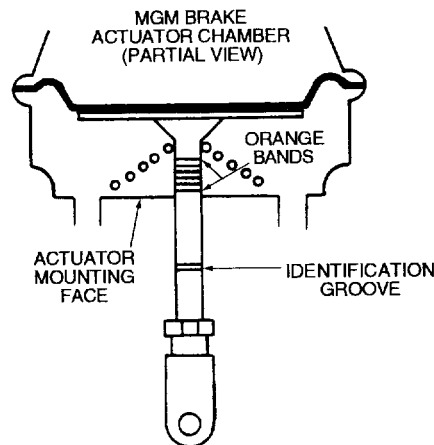
Brake actuator chambers on your unit provide visual indication that automatic slack adjusters are, or are not, working properly. These indications must be observed with brake system **fully charged (125 psi)** and **digging brake applied**.

Rockwell Driving Axles and Eaton Non-Driving Axles equipped with MGM Brake Actuator Chambers: Rockwell axles are equipped with Rockwell slack adjusters and Eaton axles are equipped with Haldex slack adjusters.

MGM brake actuator chamber push rods have a series of orange bands which will appear at mounting face of actuator (**not bracket**) if automatic adjustment fails to occur at proper time. These push rods also have a groove machined in push rod (near clevis) to provide identification.

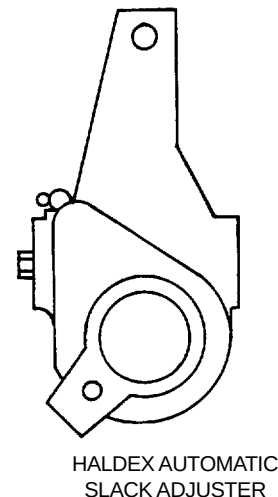
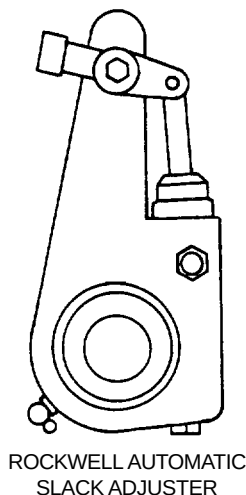
Procedure

1. Position unit in a safe, level area.
2. With brake system fully charged (125 psi), apply digging brake and stop engine.
3. Install wheel chocks as additional caution to prevent carrier movement.
4. Inspect all actuator push rods to determine position with digging brake applied. If one or more orange bands, are visible at mounting face of any actuator, immediately notify your supervisor and/or maintenance personnel for inspection and /or repair.
5. In event of slack adjuster replacement, installation of new brake shoes or drum turning, refer to your service manual for instructions to install/adjust automatic slack adjusters.



NOTE

BRAKE ACTUATOR CHAMBER IS SHOWN WITH DIGGING BRAKE APPLIED AND WITH BRAKE WORN TO A POINT JUST BEFORE AUTOMATIC ADJUSTMENT. IF ORANGE BAND IS VISIBLE, NOTIFY MAINTENANCE PERSONNEL FOR ADJUSTMENT/REPAIR.



CALIFORNIA

Proposition 65 Warning

**Battery posts, terminals and related accessories
contain lead and lead compounds, chemicals
known to the State of California to cause cancer
and birth defects or other reproductive harm.**

Wash hands after handling.

CALIFORNIA

Proposition 65 Warning

**Diesel engine exhaust and some of its
constituents are known to the State
of California to cause cancer, birth
defects, and other reproductive
harm.**

GRADALL®

406 Mill Ave. SW, New Philadelphia, Ohio 44663

Phone (330) 339-2211 FAX (330) 339-8468

<http://www.gradall.com>