OPERATORS MANUAL

LOAD KING

480-126

REV A

SEPTEMBER 09, 2019

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WARNING Operating, servicing and maintaining this equipment can expose you to chemicals including engine exhaust, carbon monoxide, phthalates, and lead, which are known to the State of California to cause cancer and birth defects or other reproductive harm. These chemicals can be emitted from or contained in other various parts and systems, fluids and some component wear by-products. To minimize exposure, avoid breathing exhaust, do not idle the engine except as necessary, service your equipment and vehicle in a well-ventilated area and wear gloves or wash your hands frequently when servicing your equipment or vehicle and after operation. For more information go to www.P65Warnings.ca.gov/passenger-vehicle.

Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information go to www.P65warnings.ca.gov/diesel.

Company

Load King has been producing first-class heavy equipment since 1956. Cutting-edge innovation and engineering excellence make us the market leader. Load King is a key part of the Custom Truck One Source family of brands, offering standard and custom trailers, vocational equipment, and a full line of Boom Trucks and truck cranes. For more information, please visit Load King's website: www.loadkingmfg.com.

About Custom Truck One Source

Custom Truck One Source is the first true single-source provider of specialized truck and heavy equipment solutions. With sales, rentals, aftermarket parts and service, equipment customization, remanufacturing, financing solutions, and asset disposal, our team of experts, vast equipment breadth and integrated network of locations across North America offer superior service and unmatched efficiency for our customers.

Table of Contents

Construction and Industrial Equipment Product Safety

It is the responsibility of the owner of the equipment to be knowledgeable about federal, state and local regulations that effect the total usage of the equipment, and responsibility to working personnel and the public. Since regulations are subject to change, and also differ from one locality to another, this manual makes no attempt to provide such information.

Load King Cranes provides appropriate operation and maintenance manuals for various construction and industrial equipment products that it manufactures and sells. In addition, where applicable, appropriate national consensus standards, industry standards and safety related manuals are included with the Load King manuals in the shipment of each product. It is company policy to provide this information for the owner or user of the equipment. It is expected that the owner or user will utilize these manuals and standards to provide the appropriate information and training to those people who are to operate, maintain and supervise the use of equipment.

Construction and industrial equipment is designed and manufactured to perform heavy-duty work. Under normal usage, the equipment will wear. For this reason it is essential that the owner/user establish and perform a periodic inspection of the equipment. The objective of inspection programs is to prevent accidents, reduce downtime and keep the equipment working efficiently. These inspection programs should be designed to discover worn, cracked, broken or deteriorated parts and loose or missing fasteners before they result in a problem.

Proper training and inspection programs are essential to avoiding injury to persons, damage to property and excessive maintenance costs.

Read and understand the manuals provided with this equipment. Assistance is available from the distributors of your Load King product and from the Load King manufacturing facility.

When operating a hydraulic crane, the operator should realize that hydraulic and structural competence, NOT TIPPING LOAD, is often the determinant of lifting capacity. Therefore, THE OPERATOR MUST BE GUIDED SOLELY BY THE APPROPRIATE MANUFACTURER'S LOAD RATING CHART when considering load weights. The manufacturers rated loads must never be exceeded.

Follow the recommended operating and maintenance procedures and keep your machine" operating at MAXIMUM EFFICIENCY. Use the Suggested Inspection Check List provided." In addition, a MAINTENANCE LOG should be kept in conjunction with all maintenance" performed on the machine.

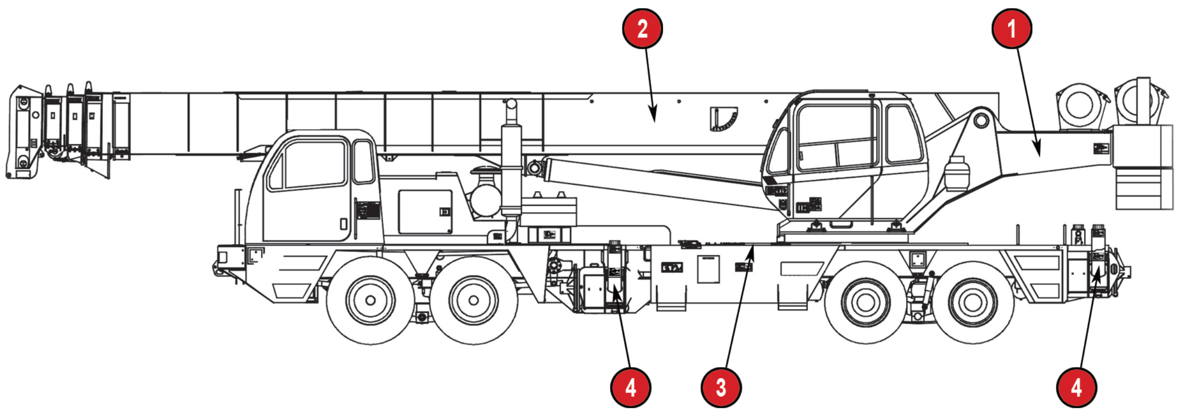
If you desire any special information regarding the care and operation of the machine, we" will gladly furnish it upon request. We ask that you include your machine model and serial" number in all correspondence so that we can provide the correct information.

The information, specifications, and illustrations in this publication are based on the" information in effect at the time of approval for printing. We reserve the right to make" changes at any time without obligation.

Nomenclature

This manual contains instructions and information on the operation, maintenance, lubrication and adjustments of the Truck Crane. The operator should not attempt to operate the machine before gaining a thorough understanding of the material presented in the following pages.

To aid in understanding the contents of this manual, the following terms will always have the meanings given whenever they are used.



1. UPPERSTRUCTURE	The upperstructure weldment, swing mechanism, counterweight, cab.
2. BOOM ATTACHMENT	The telescopic crane boom with hydraulic winch, lift cylinder, hook block assembly, jib arrangement.
3. CARRIER	The chassis complete, power unit, swing bearing, transmission, planetary axles, outrigger assemblies
4. OUTRIGGER	The beams, cylinders, floats, boxes, hydraulic control system.
5. ATB	Anti-Two Block
6. RCI	Rated Capacity Indicator

RIGHT HAND / LEFT HAND	All references to right or left hand will correspond to the operator's right or left hand when he is facing forward in the driver's cab or in the operator's cab with the boom over the front of the crane (in the boom rack).

Intended Use

This mobile crane is designed to lift, lower, move, and position freely suspended loads within its rated capacity while on firm, level ground. The crane is designed exclusively for assembly type, non-duty cycle operations. Use of this product in any other way is prohibited and contrary to its intended use.

Other crane applications outside of the intended use statement above must be approved in writing by **Load King**.

Bulletin Distribution and Compliance

Safety of product users is of paramount importance to Load King. Various bulletins are used by Load King to communicate important safety and product information to dealers and machine owners.

The information contained in bulletins is tied to specific machines using the machine model number and PIN/serial number.

Distribution of bulletins is based on the most current owner of record along with their associated dealer, so it is important to register your machine and keep your contact information up-to-date.

To ensure safety of personnel and the reliable continued operation of your machine, be sure to implement the action indicated in a respective bulletin.

Contacting Manufacturer

At times it may be necessary to contact the manufacturer of this machine. When you do, be ready to supply the model and PIN/serial number of your machine, along with your name and contact information. At minimum, the manufacturer should be contacted for:

- Accident Reporting
- Questions regarding product applications and safety
- Standards and regulations compliance information
- Questions regarding product modifications
- Current owner updates, such as changes in machine ownership or changes in your contact information (see Transfer of Machine Ownership, in this chapter, for more information).

Manufacturer contact information:

Load King
7701 Independence Ave, Kansas City, MO
64125
Parts: (816) 241- 8387
Service: (833) 281-7911
info@loadkingmfg.com

Transfer of Machine Ownership

Complete the New Owner Registration Form on the following page. The Model Name, Product Identification Number (PIN), and serial number is located on a plate inside the operator's cab. The six-digit serial number is shown on a plate on the outside of the operator's cab.

LOAD KING WARRANTY DATA RECORD

Warranty Form Submission		Date	
Date of Delivery			
Model Number			
S/N			
Dealer			
Address			
Customer			
Address			

Record this information at the time that warranty registration form is completed and returned to Load King

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Safety Introduction

Owners, Users, and Operators:

Load King Cranes appreciates your choice of our machine for your application. Our number one priority is user safety, which is best achieved by our joint efforts. We feel that you make a major contribution to safety if you, as the equipment users and operators:

1. **Comply** with OSHA, Federal, State, and Local Regulations.
2. **Read, Understand, and Follow** the instructions in this and other manuals supplied with this machine.
3. **Use Good, Safe Work Practices** in a common sense way.
4. **Only have trained and competent operators**, directed by informed and knowledgeable supervision, running the machine.

OSHA prohibits the alteration or modification of this crane without written manufacturer's approval. Use only factory-approved parts to service or repair this unit.

If there is anything in this manual that is not clear or you believe should be added, please send your comments to Load King Cranes, 7701 Independence Ave, Kansas City, MO 64125; or contact us by telephone at Parts: (816) 241- 8387 Service: (833) 281-7911
Email: info@loadkingmfg.com.

THIS SYMBOL MEANS YOUR SAFETY IS INVOLVED! READ, UNDERSTAND, AND FOLLOW ALL DANGER, WARNING, AND CAUTION DECALS ON YOUR MACHINE.

Many aspects of crane operation and testing are discussed in standards published by the American National Standards Institute. These Standards are updated on an annual basis with addenda, that are sent by ASME to the original purchasers of the standard. **Load King** recommends you purchase and refer to the following standards.

ANSI/ASME B30.5 - Mobile & Locomotive Crane (Latest Version)

These standards can be purchased from:

American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
800-843-2763 (U.S/Canada)
001-800-843-2763 (Mexico)
973-882-1170 (outside North America)

Email:
CustomerCare@asme.org
www.ASME.ORG/SHIP/STANDARDS

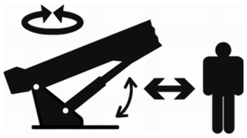
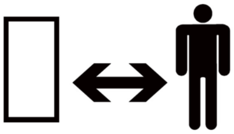
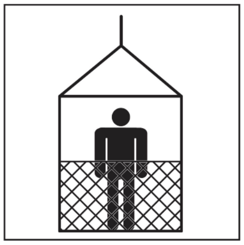
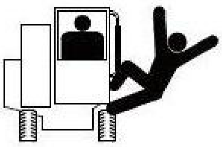
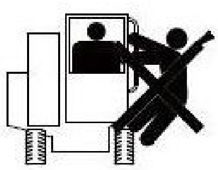
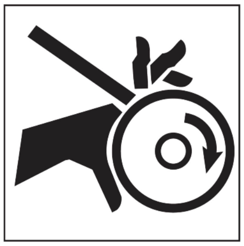
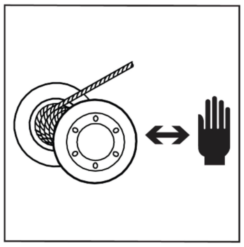
Product Safety Decals

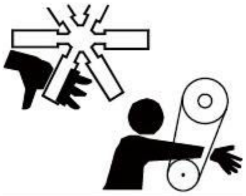
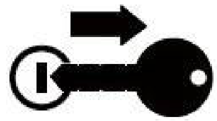
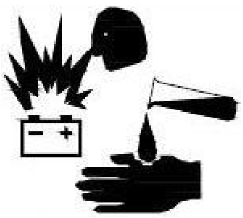
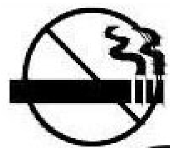
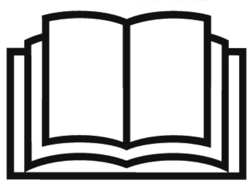
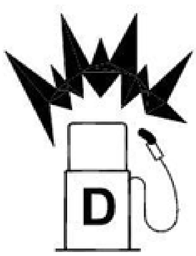
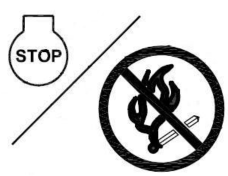
Safety Definitions Used in this Manual

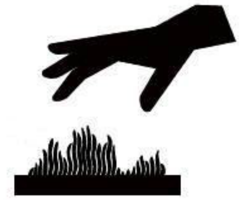
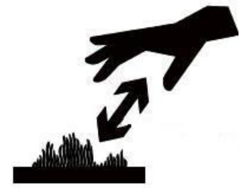
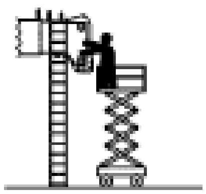
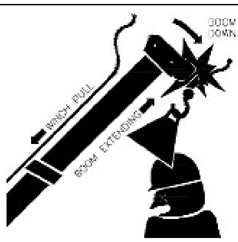
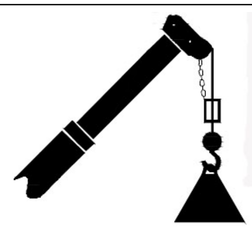
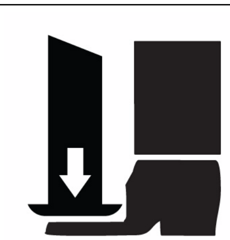
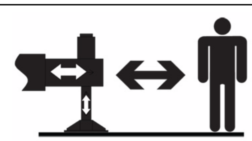
The following table describes text and symbols used to highlight important information.

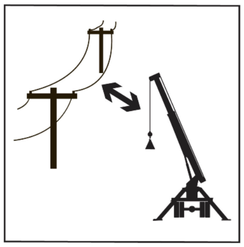
Signal Word	Symbol	Explanation
DANGER		Danger is used to alert readers about an immediate and serious hazard that will likely be fatal.
WARNING		Warning is used to alert readers about the potential for serious injury or death or serious damage to equipment.
CAUTION		Caution is used to alert readers about the potential for anything from moderate injury to serious equipment damage or destruction.
READ		Read is used to alert readers of information to be read on machinery
NOTE		Note is used for a tip or suggestion to help readers carry out a procedure successfully.

SYMBOLS AND PICTORIALS

Hazard		Avoidance	
	CRUSH HAZARD Crushing of fingers or hand - force applied two directions (pinched).		Stay Clear of Moving Turret and Boom.
	CRUSH HAZARD Death or Serious Injury can result from contact with moving machine.		Keep clear of moving machine.
	Safety Alert Symbol		Use personnel lift in compliance with OSHA and ANSI regulatory instructions.
	Skin Injection From High Pressure Fluid.		Use Cardboard or Wood to Check for Leaks.
	Falling From Wheeled Machine.		NO RIDERS
	Hand Entanglement In Pulley / Winch.		Keep Hands Clear of Winch and Load Line.

Hazard		Avoidance	
	Entanglement in Drive Shaft.		Stay Clear of Rotating Shafts.
	ENTANGLEMEN T HAZARD Rotating parts can cause personal injury.		Keep away from fan and belt when engine s running. Stop engine before servicing.
	Explosion / Burn Hazard Will cause death, burns or blindness due to ignition of explosive gases or contact with corrosive acid.	  	Keep all open flames and sparks away. Wear personal protective equipment, including face shield, gloves and long sleeve shirt. READ MANUALS Read all manuals prior to operation. DO NOT OPERATE equipment if you do not understand the information in the manuals.
	BURN HAZARD Fuel and fumes can explode and burn.		No smoking. No flame. Stop engine.

Hazard		Avoidance	
	BURN HAZARD Contact with hot surfaces can cause burns.		Allow surfaces to cool before servicing.
	Falling from height.	 	Use personnel lift or appropriate ladder to reach high places. Maintain 3-Point Contact when using access system.
	Two blocking the crane can cause death, serious injury or property damage. Do not allow the hook block to contact the boom tip by hoisting up, extending or lowering the boom.		Check ATB System.
	CRUSH HAZARD Contact with moving outriggers can result in death or serious injury.		Stay Clear of Outriggers.

Hazard		Avoidance	
	Electrical Shock / Electrocution from Crane to Power Line Contact.		Stay Sufficient Distance From Electrical Power Lines.

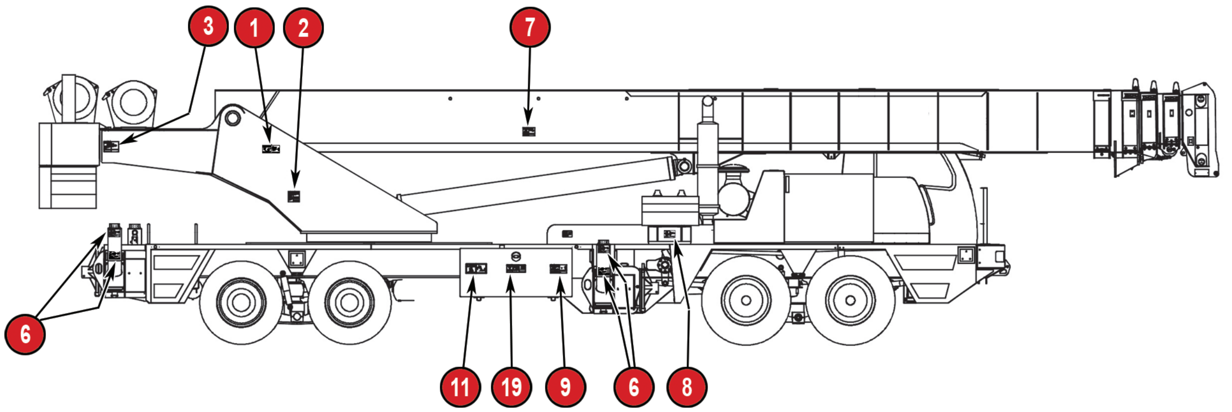
These are general safety rules, that must be followed. You are also required to read and understand the Operators Manual as there are instructions that are more detailed, specific to this machine.

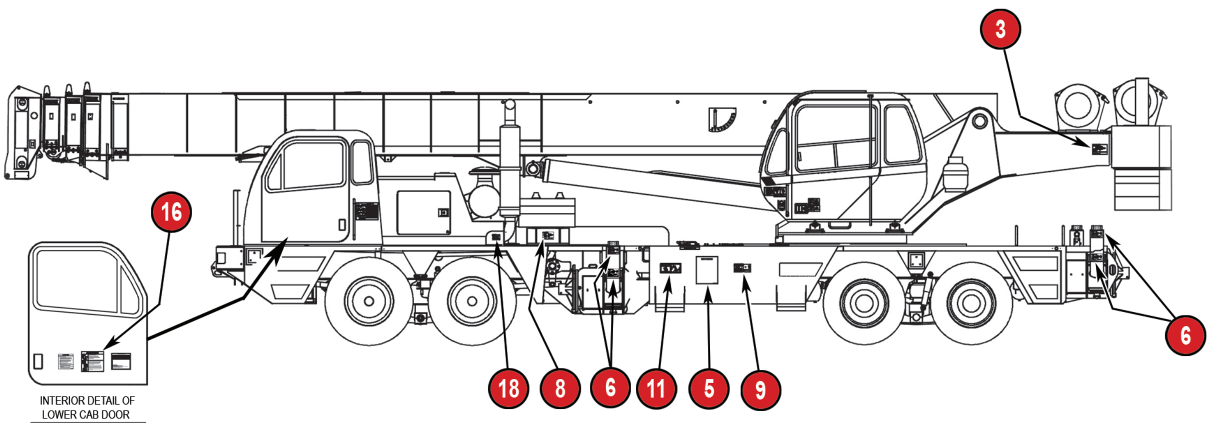
General Safety

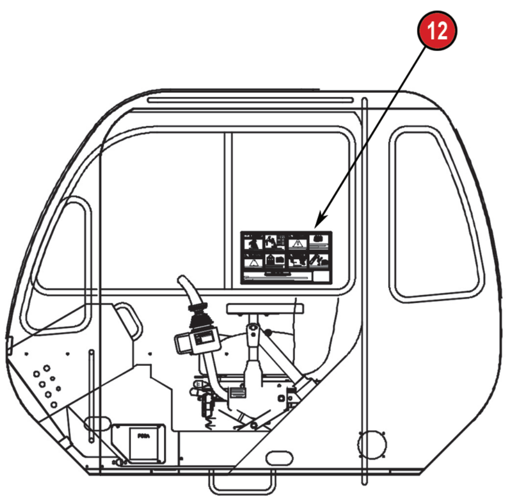
Safety Sign Maintenance

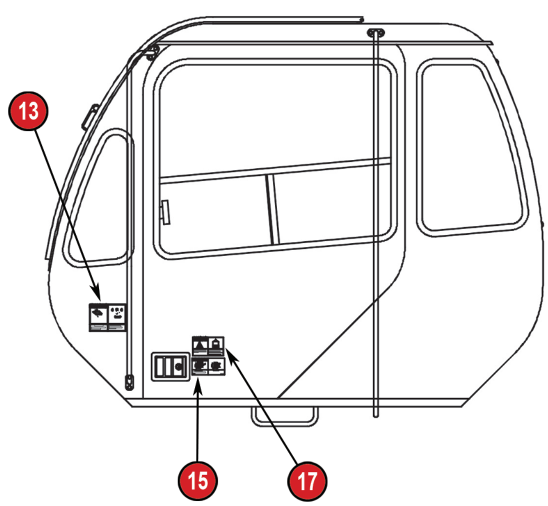
Replace any missing or damaged safety signs. Keep operator safety in mind at all times. Use mild soap and water to clean safety signs. Do not use solvent-based cleaners because they may damage the safety sign material. The graphics on the preceding pages illustrate the location and give you examples of each safety decal located on your machine. During the daily inspection of the equipment, check that the decals are present and in good condition.

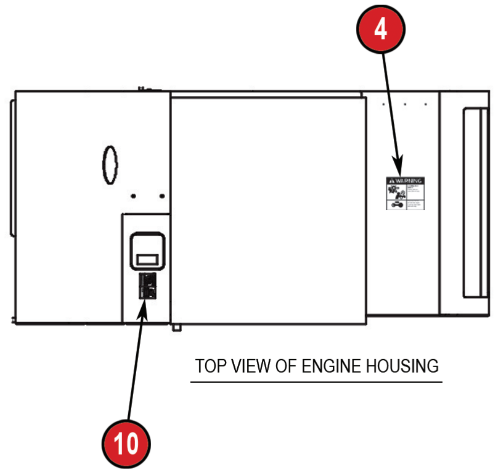
Safety Sign Locations

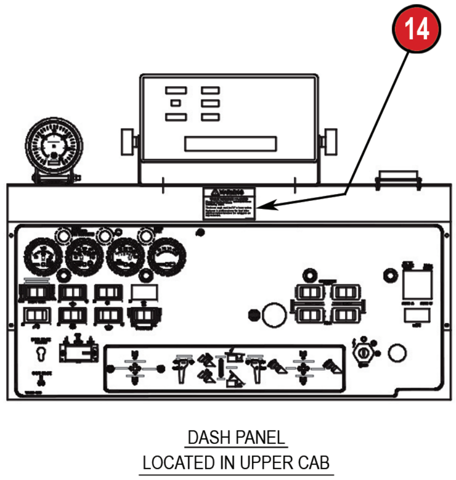


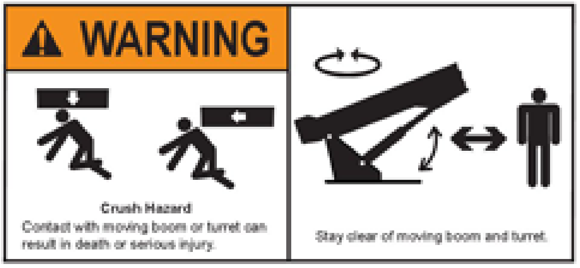






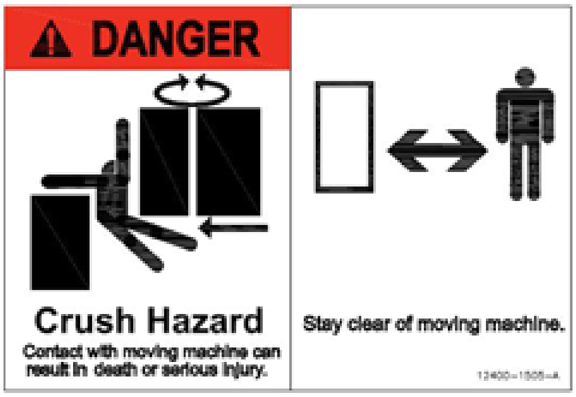

4
10
TOP VIEW OF ENGINE HOUSING


14
DASH PANEL
LOCATED IN UPPER CAB



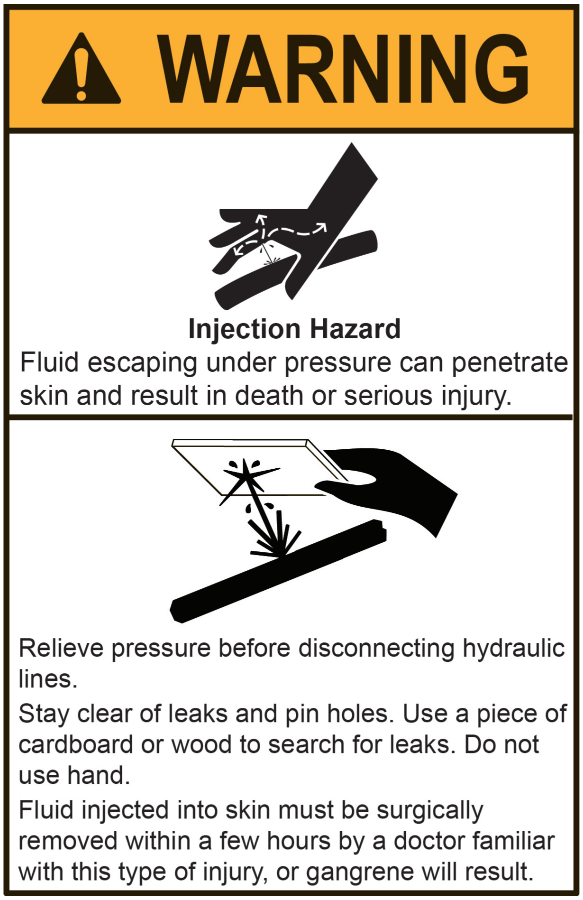
1

Crush Hazard	Stay clear of moving boom or turrent..
Contact with moving boom or turrent can result in death or serious injury.	



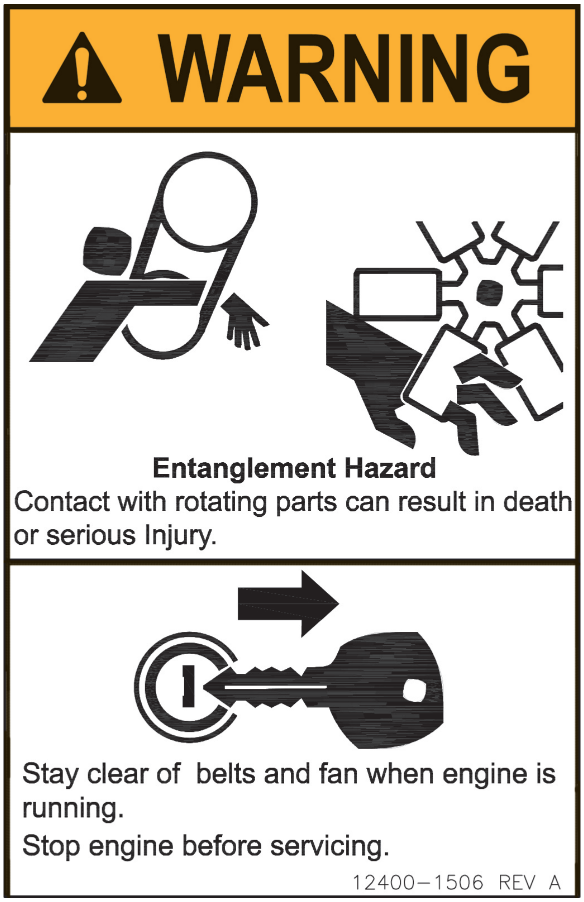
3

Crush Hazard	Stay clear of moving machine.
Contact with moving machine can result in death or serious injury.	



2

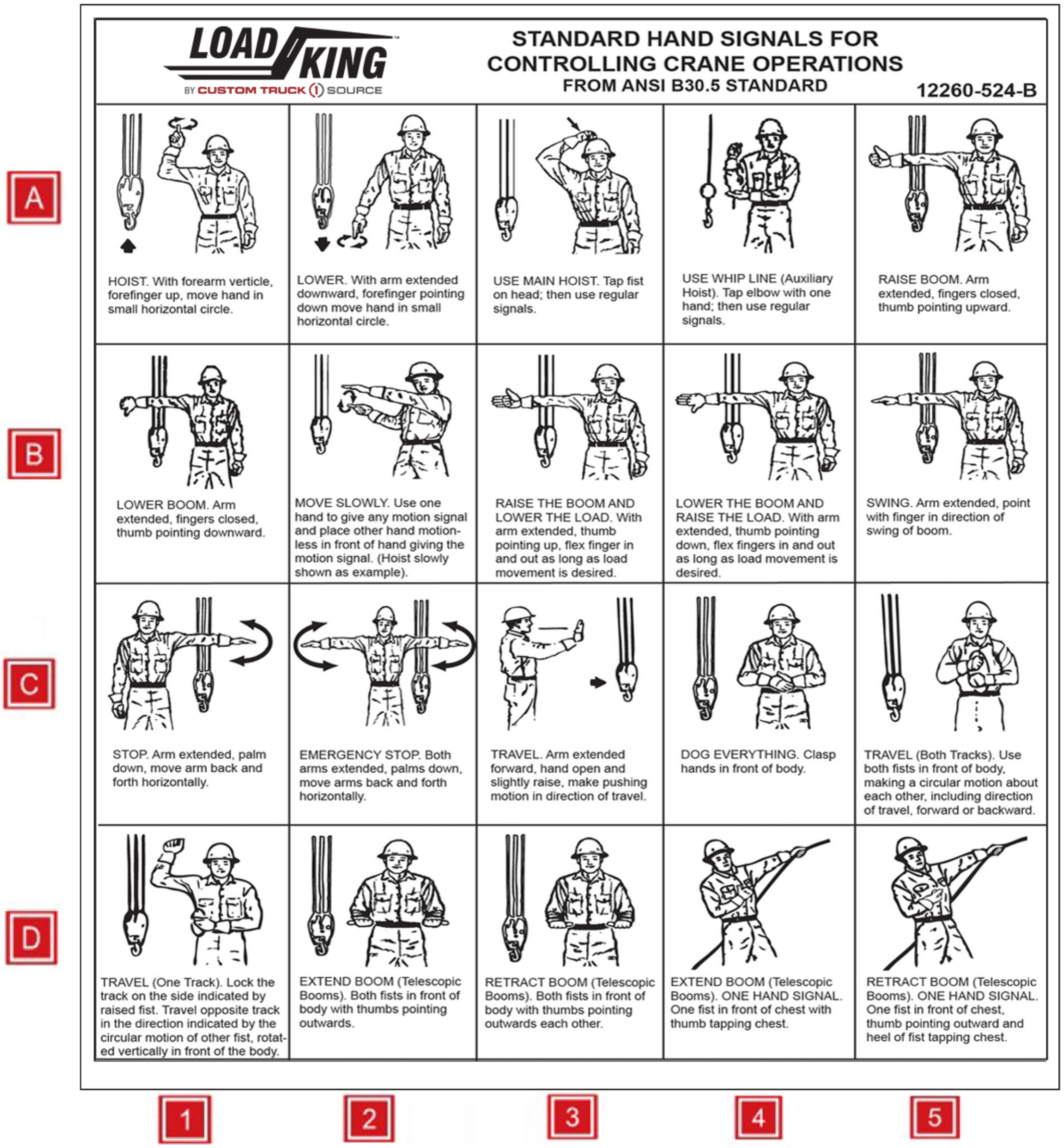
Injection Hazard Fluid escaping under pressure can penetrate skin and result in serious injury.
Relieve pressure before disconnecting hydraulic lines. Stay clear of leaks and pin holes. Use a piece of cardboard or wood to search for leaks. Do not use hand. Fluid injected into skin must be surgically removed within a few hours by a doctor familiar with this type of injury, or gangrene will result.



4

<table>
<tr><td>Entanglement Hazard</td><td rowspan="2">Stay clear of belts and fan when engine is running.

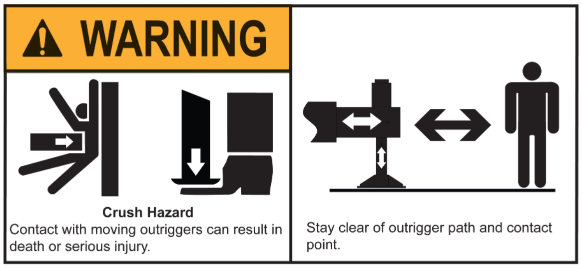
Stop engine before servicing.</td></tr>
<tr><td>Contact with rotating parts can result in death or serious injury.</td></tr>
</table>



5

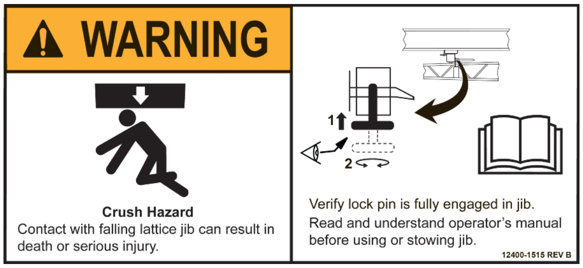
	DESCRIPTION OF MOVEMENT
A1	HOIST. With forearm vertical fore finger pointing up, move hand in small horizontal circle
A2	LOWER. With arm extended downward, forefinger pointing down move hand in small horizontal circle.
A3	USE MAIN HOIST. Tap fist on head; then use regular signals.
A4	USE WHIP LINE. (Auxiliary Hoist) Tap elbow with one hand; then use regular signals.
A5	RAISE BOOM. Arm extended, fingers closed, thumb pointing upward.
B1	LOWER BOOM. Arm extended, fingers closed, thumb pointing downward.

	DESCRIPTION OF MOVEMENT
B2	MOVE SLOWLY. Use one hand to give any motion signal and place other hand motion-less in front of hand giving the motion signal. (Hoist slowly shown as example)
B3	RAISE THE BOOM AND LOWER THE LOAD. With arm extended, thumb pointing up, flex fingers in and out as load movement is desired.
B4	LOWER THE BOOM AND RAISE THE LOAD. With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.
B5	SWING. Arm extended, point with finger in direction of swing of boom.
C1	STOP. Arm extended, palm down, move arm back and forth horizontally.
C2	EMERGENCY STOP. Both arms extended, palms down, move arms back and forth horizontally.
C3	TRAVEL. Arm extended forward, hand open and slightly raise, make pushing motion in direction of travel.
C4	DOG EVERYTHING. Clasp hands in front of body.
C5	TRAVEL (Both Tracks). Use both fists in front of body, making a circular motion about each other, including direction of travel, forward or backward.
D1	TRAVEL (One Track). Lock the track on the side indicated by raised fist. Travel opposite track in the direction indicated by the circular motion of other fist, rotated vertically in front of the body.
D2	EXTEND BOOM. (Telescopic Booms). Both fists in front of body with thumbs pointing outwards.
D3	RETRACT BOOM. (Telescopic Booms). Both fists in front of body with thumbs pointing outwards each other.
D4	EXTEND BOOM (Telescopic Booms). ONE HAND SIGNAL. One fist in front of chest with thumb tapping chest.
D5	RETRACT BOOM (Telescopic Booms). ONE HAND SIGNAL. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.



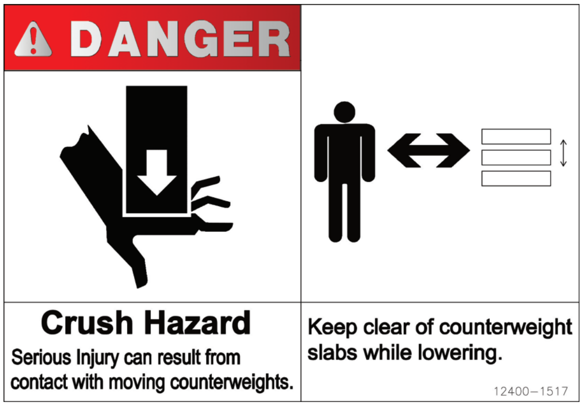
6

Crush Hazard	Stay clear of outrigger path and contact point.
Contact with moving outriggers can result in death or serious injury.	



7

Crush Hazard Contact with falling lattice jib can result in death or serious injury.	Verify lock pin is fully engaged in jib. Read and understand operator's manual before using or stowing jib.



8

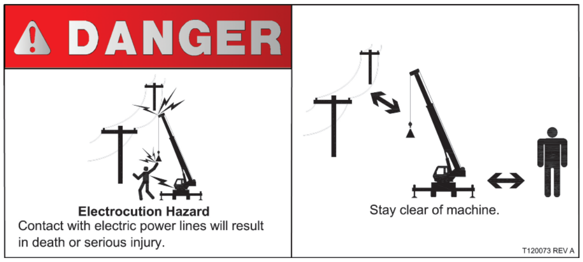
Crush Hazard Serious injury can result from contact with moving counterweights.	Keep clear of counterweight slabs while lowering.

9

Entanglement Hazard Death or serious injury can result from contact with rotating drivelines..	Keep clear of rotating drivelines. Switch off engine before performing service.

10

Burn Hazard	Do not loosen cap until cool.
Release of hot fluid under pressure can result in death or serious injury.	



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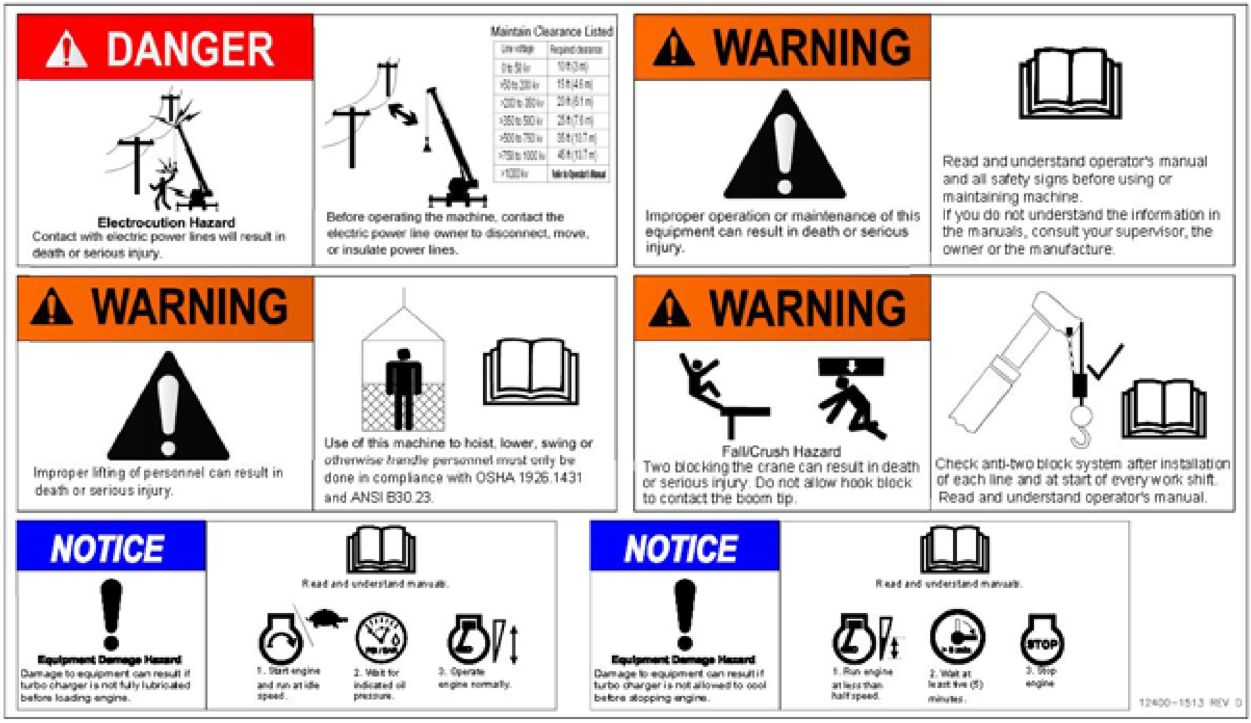
ELECTROCUTION HAZARD	Stay clear of machine
Contact with electric power lines will result in death or serious injury.	



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Electrocution Hazard

Contact with electric power lines will result in death or serious injury.

Before operating the machine, contact the electric power line owner to disconnect, move or insulate power lines.

Improper lifting of personnel can result in death or serious injury

Use of this machine to hoist, lower, swing or otherwise handle personnel must only be done in compliance with OSHA 1926.1431 and ANSI B30.23.

MAINTAIN CLEARANCE LISTED	
Line Voltage	Required Clearance
0 to 50KV	10 ft (3m)
50 to 200KV	15 ft (4.6m)
200 to 350KV	20 ft (6.1m)
350 to 500KV	25 ft (7.6m)
500 to 750KV	35 ft (10.7m)
750 to 1000KV	45 ft 13.7m)
>1000KV	**Refer to Power Line Safety section of manual**
Before operating the machine, contact the electric power line owner to disconnect, move or insulate power lines.	

Equipment Damage Hazard

Damage to equipment can result if turbo charger is not fully lubricated before loading engine.

1. Start engine and run at idle speed.

2. Wait for indicated oil pressure.

3. Operate engine normally.

Improper operation or maintenance of this equipment can result in death or serious injury.

Read and understand operator's manual and all safety signs before using or maintaining machine.

If you do not understand the information in the manuals, consult your supervisor, the owner or the manufacture.

Fall/Crush Hazard

Two blocking the crane can result in death or serious injury. Do not allow hook block to contact the boom tip.

Check ATB system after installation of each line and at start of every work shift. Read and understand operator's manual.

Equipment Damage Hazard

Damage to equipment can result if turbo charger is not allowed to cool before stopping engine.

Read and understand manuals

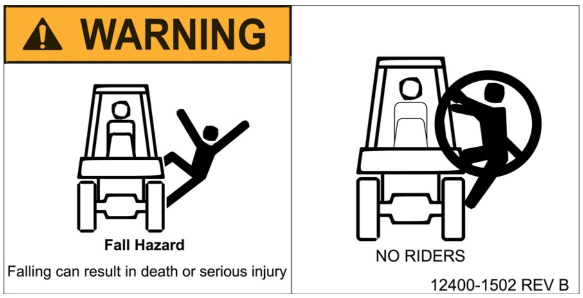
1. Run engine at less than half speed.

2. Wait at least five (5) minutes.

3. Stop engine

13

Fall Hazard Falling can result in death or serious injury.	Use the provided access system.



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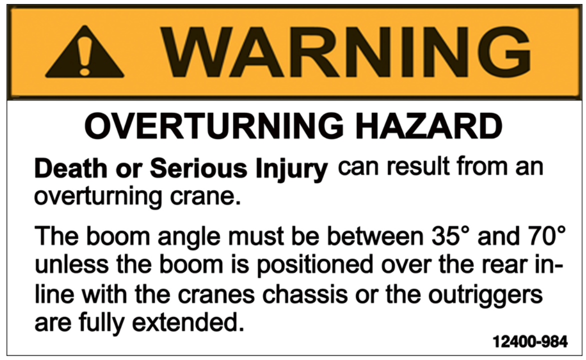
Fall Hazard Falling can result in death or serious injury.
NO RIDERS

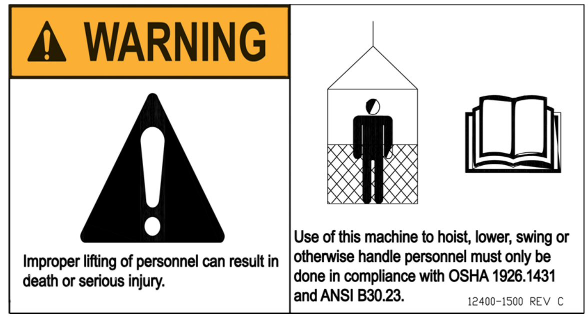


14

Overturning Hazard Death or Serious Injury can result from an overturning crane.
The boom angle must be between 35° and 70° unless the boom is positioned over the rear in-line with the cranes chassis or the outriggers are fully extended.

16

Explosion/Burn Hazard Battery explosion and/or contact with corrosive acid will result in death or serious injury.
Keep all open flames and sparks away. Wear appropriate personal protective equipment, including gloves, face shield and long sleeve shirt. Read manuals. If you do not understand the information in the manuals, consult your supervisor, the owner or the manufacturer.



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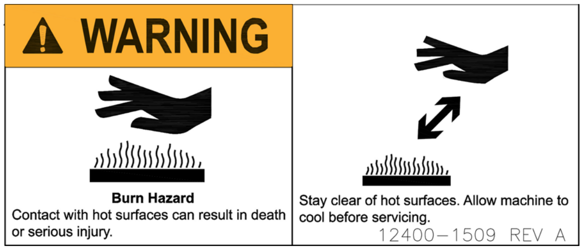
Improper lifting of personnel can result in death or serious injury.
Use of this machine to hoist, lower, swing or otherwise handle personnel must only be done in compliance with OSHA 1926.1431 and ANSI B30.23.



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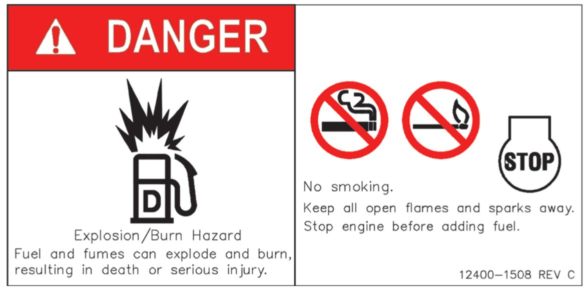
Burn Hazard Contact with hot surfaces can result in death or serious injury.	Stay clear of hot surfaces. Allow machine to cool before servicing.



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Explosion / Burn Hazard Fuel and fumes can explode and burn, resulting in death or serious injury.	No smoking. Keep all open flames and sparks away. Stop engine before adding fuel.

Safety Guidelines

These are general safety rules, which must be followed. You are also required to read and understand the Operators Manual as there are instructions, which are more detailed specific to this machine.

Personal Protection Equipment

Before beginning operation, service or maintenance conduct a hazard assessment to determine appropriate personal protective equipment for the working conditions and the operating environment. For more information refer to the applicable OSHA 1910.132 Standards, ANSI Standards, Federal, State, Local and Jobsite Regulations.

Common Types of PPE

Safety Glasses – Impact resistant lenses offering limited protection for the user's eyes from flying debris.

Ear Plugs – A device that is inserted into the ear canal to protect the user's hearing from loud noises or the intrusiton of foreign bodies and dust.

Hard Hat – A helmet used to protect the user's head from injuries obtained from falling objects and debris.

Leather Gloves – Gloves used to protect the user's hands from minor cuts and other injuries.

Safety Boots – A boot designed to protect the user's feet from various types of injury such as cuts, puncture wounds, crushed toes, etc.

Workplace Safety

	HANDLING PERSONNEL

Cranes can only be used to lift people when it is the least hazardous way to do the job. (See OSHA 1926.1431, 1926.550g, and ASME / ANSI B30.23.)

	TRAINING AND KNOWLEDGE

1. Safe operation must always be the operator's most important concern.
2. Do not operate this crane until you have been trained in its operation. This crane must only be operated by trained personnel, who have demonstrated their ability to do so safely.
3. Comply with the requirements of current Occupational Safety and Health Administration (OSHA) standards, the current ASME B30.5 (latest edition).
4. Read and understand all safety signs and warnings.
5. Read and understand the Load Ratings Charts.
6. By understanding the Load Ratings Charts, the operator can determine what the crane can safely lift before attempting the actual lift.
7. The operator must understand crane signals and take signals only from designated signal people. However, the operator must obey the stop signal from anyone.

	OPERATOR'S RESPONSIBILITIES

1. Read and understand the Operator's Manual.
2. Make sure the machine is in proper order and that all operational aids and warning signals are functional before operating.
3. Keep the machine clean, including all instrumentation, windows, lights and other glazed surfaces.
4. Remove all oil, grease, mud, ice and snow from walking surfaces.
5. Store all tools, rigging and other necessary items in the tool box.
6. Never lift a load without consulting the Rating Chart Manual located in the operator’s cab.
7. Know the load to be lifted.
8. Be alert, physically fit and free from the influences of alcohol, drugs or medications that might affect the operator's eyesight, hearing, or reactions.

(Continued on next page ...)

OPERATOR'S RESPONSIBILITIES

9. Keep people, equipment and material outside of the work area.
10. Signal person(s) must be used when the operator's vision is blocked or when working in hazardous areas such as near power lines or people.
11. Keep a fully charged fire extinguisher and first aid kit in the operator's cab at all times and be familiar with the use of these items.
12. Always know the location of other machinery, vehicles, personnel and other obstacles in the work area.
13. Never permit people on the machine platform while the machine is in operation.
14. Make sure everyone is clear of the work area before moving the hook, boom, load or outriggers.
15. Start and stop movements smoothly and swing at speeds that will keep the load under control.
16. Keep at least two full wraps of wire rope on drum when operating.
17. Use tag lines to keep loads under control when feasible.
18. Keep the load as close to the ground as possible.
19. Use shortest boom length required to complete job.
20. Never leave a running machine unattended or load suspended.
21. Always use outriggers in accordance with requirements of the Load Rating Chart and Operator's Manuals.

SIGNAL PERSON'S RESPONSIBILITIES

1. Standard crane signals must be used, and understood.
2. Assist the operator in safe and efficient operation, without endangering people or property.
3. Have a clear understanding of each lift to be made.
4. Signal people must place themselves where they can be clearly seen and where they can safely observe the entire operation and out of harms way should something unexpected happen.

RESPONSIBILITIES OF ALL CREW MEMBERS

1. Unsafe conditions and/or practices must be corrected.
2. Obey all warning signs.
3. Watch out for your safety and the safety of others.
4. Know and understand proper machine erection and rigging procedures.
5. Alert operator and signal person of hazards, such as power lines, unstable ground, etc.

MANAGEMENT RESPONSIBILITIES

1. Operators must be competent, physically fit and, if required, licensed.
2. Operator, signal people and riggers must be trained in correct crane operation and use.
3. Operator and signal people must know standard crane signals.
4. Have a supervisor at job site responsible for site safety.
5. Crew members must be given specific safety responsibilities and be instructed to report any unsafe conditions to supervisor.
6. Supply the weight and the characteristics of all loads to be lifted to the operator.
7. Verify that all crew members are familiar with OSHA, ANSI B30.5 requirements, state and local jobsite requirements, as well as the instructions in manuals, and all other applicable requirements.

PLANNING THE JOB

1. Have a clear understanding of the work to be done.
2. Consider all hazards at the jobsite.
3. Know what crew members are needed to complete the job.
4. Assign job responsibilities.
5. Appoint a competent signalperson.
6. Establish how the signalperson will communicate with the operator.
7. Know the weight and the characteristics of the loads to be lifted.
8. Utilize rigging and other equipment which will complete the job safely.
9. Establish how equipment can be safely transported to the job site.
10. Determine how the load will be rigged.

(Continued on next page ...)

PLANNING THE JOB

11. Determine the lift radius, boom angle and the rated lifting capacity of the crane.
12. Always pre-plan the course of each lift to determine the best route to reach the load's target destination.
13. Identify the location of gas lines, power lines, or other structures and determine if the crane or structures need to be moved.
14. Ensure that the supporting surface is strong enough to support the machine and load.
15. Establish special safety precautions, if necessary.
16. Consider the weather conditions.
17. Keep unnecessary people and equipment away from the work area.
18. Position the machine to use shortest boom and radius possible.

OPERATOR PRELIFT CHECK

1. Check the machine log book, to see if periodic maintenance and inspections have been performed.
2. Ensure that necessary repairs have been completed.
3. Inspect wire rope for damage (kinks, broken wires etc.)
4. Be sure no unauthorized field modifications have been made.
5. Check for air and hydraulic oil leaks.
6. Check that all controls are in the neutral position before starting engine.
7. After starting the engine, check all gauges and indicators for proper readings.
8. Test all controls in the cab or control station, such as swing, boom extend / retract / up / down, outriggers extend / retract, throttle.
9. Check brakes.
10. Check hoist brakes by lifting a load a few inches off the ground and holding it.

OPERATOR AIDS CHECK

Ensure that the listed items are in place and operational.

1. Boom angle indicator.
2. Backup Alarms.

(Continued on next page ...)

	OPERATOR AIDS CHECK

3. ATB devices.
4. Overload Protection, Load Indicators, Rated Capacity Indicator.

	OPERATION OVERLOAD PROTECTION

1. Know the weight and characteristics of all loads to be lifted.
2. Place the boom lifting point directly above the load when lifting.
3. The load radius will increase when the load is lifted due to boom deflection.To compensate for the boom deflection, maintain the radius by raising the boom.
4. Know the weight of the hook and rigging, the boom and/or jib length, parts of line and the work area.
5. Use next lower rated capacity when working at boom lengths or radius between the figures on the rated lifting capacity chart.
6. Never lift a load without knowing whether it is within the rated capacity.
7. Never operate with anything other than recommended counterweight. Unauthorized reduction or additions of counterweight constitute a safety hazard.
8. Do not lift loads if winds create a hazard. Lower the boom if necessary. Refer to the Rating Chart and Operator's Manual for possible restrictions.
9. Avoid side loading the boom.
10. Never allow the load or any other object strike the boom.
11. Loads shall be freely suspended.
12. Never use the RCI to "weigh" the load.

	OPERATION SETUP

1. Be sure the load bearing surface is strong enough to support the machine with lifted load.
2. Be sure the crane is level. Check frequently and re-level when necessary.
3. Stay away from rotating cranes. Erect barricades to keep people away. Make sure these areas are clear before swinging. WARNING-INJURY CAN OCCUR!

	POWER LINE SAFETY

1. Determine whether there are power lines in the area before starting any job. Only operate around power lines in accordance with Federal, State and Local Regulations as well as ASME B30.5 (latest edition).
2. Never remove materials from under powerlines with a crane if the boom or machine is capable of contacting them.
3. No part of the crane or the load should contact, or violate the minimum allowable clearance required for operation of the crane near electrical lines.

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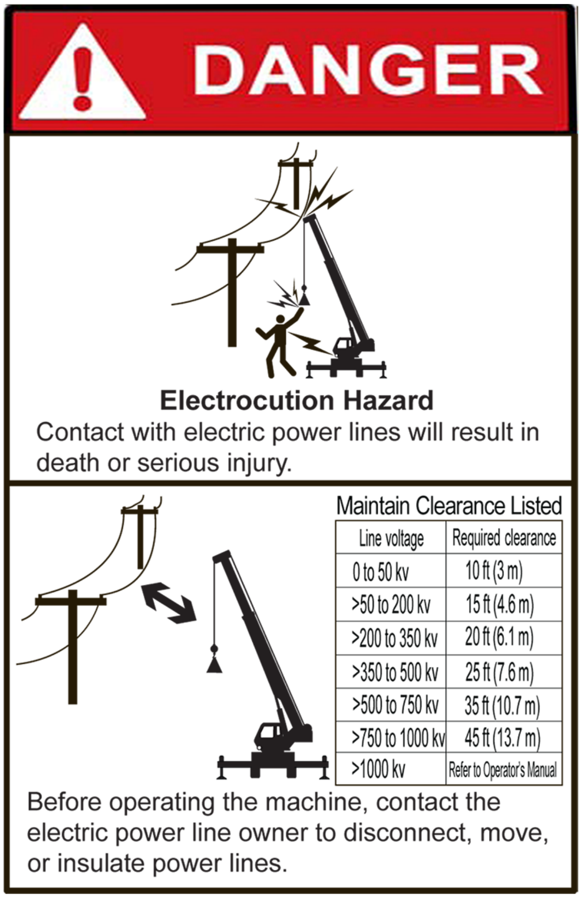
POWER LINE SAFETY



Electrocution Hazard Contact with electric power lines will result in death or serious injury.	
Maintain Required Clearance	
LINE VOLTAGE	REQUIRED CLEARANCE
0 TO 50kV	10 FT (3.0M)
500 TO 200kV	15 FT (4.6m)
2000 TO 350kV	20FT (6.1m)
350 TO 500kV	25FT (7.6m)
500 TO 750kV	35 FT (10.7m)
750 TO 1000kV	45FT (1.37m)
>1000kV	Refer to Item 7
Before operating the machine, contact the electric power line owner to disconnect, move, or insulate power lines.	

(Continued on next page ...)

POWER LINE SAFETY

4. If contact occurs, stay on crane until the boom is cleared or until the electrical current is turned off.
5. If contact occurs, keep all personnel away from the crane. If you must leave the crane, JUMP WITH BOTH FEET TOGETHER COMPLETELY CLEARING THE MACHINE. Continue jumping with both feet together to leave the area.
6. Use a signal person when working around power lines as established by the utility owner / operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution per OSHA regulation 1926.1408 and 1926.1409.

TRAVEL

1. Care must be taken when cranes are driven (traveled) whether on or off the job site.
2. Always pre-plan the path of travel to determine the best route to the destination.
3. A signal person shall be utilized when the operator's vision is blocked or obstructed during traveling operations.
4. Watch for people, power lines, low or narrow clearance, bridge or road load limits, steep hills or uneven terrain.
5. Place the boom in the stowed position.
6. Inflate the tires to the specified pressure.
7. Travel slowly and avoid sudden stops and starts.
8. Use the seat belt during all transit and travel.
9. Make sure travel surfaces can support the weight of machine and any stored load.
10. Always set the parking brake when parking the machine.

OPERATIONAL AIDS - EMERGENCY PROCEDURES

When operational aids are inoperative or malfunctioning, the following requirements shall apply for continued use or shutdown of the crane.

1. Steps shall be taken to schedule repairs immediately. The operational aids shall be put back into service as soon as replacement parts, if required, are available and the repairs and calibration can be carried out. "Can be carried out" does not mean, when convenient. Every effort must be made to expedite the repairs and recalibration.

(Continued on next page ...)

OPERATIONAL AIDS - EMERGENCY PROCEDURES

2. When a load indicator, rated capacity indicator, or rated capacity limiter is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures for determining load weights. Loads with unknown weights shall not be lifted without a properly functioning load indicating device.
3. When a boom angle or radius indicator is inoperative or malfunctioning, radii or boom angle shall be determined by measurement.
4. When an ATB device, two-blocking damage prevention or two-block warning device is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures, such as assigning and additional signal person, to furnish equivalent protection.
5. When a boom length indicator is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish the boom length at which the lift will be made by actual measurement or marking on the boom.
6. When a level indicator is inoperative or malfunctioning, other means shall be used to level the crane.
   ► ANSI / ASME B30.5 Standard calls for the crane to be leveled within 1% or 0.6°.
   ► If there is no mechanical level on the crane, a 4 ft carpenter's level (on a machined surface that would be parallel to the top of the swing bearing) is the generally accepted substitute.
   ► Risk of overturning! Operation of the crane is only permitted when the crane is aligned horizontally!

In certain situations, it may be necessary to override the automatic motion limiter of the RCI / ATB unit in order to safely operate the crane. These include but are not limited to:

The load block may lift the ATB weight before the load line can be tensioned while stowing the boom. This will cause a motion cutout. Overriding the system, in this situation is acceptable in order to continue to winch in slack line, securing the boom. Boom must be in the lowered position.

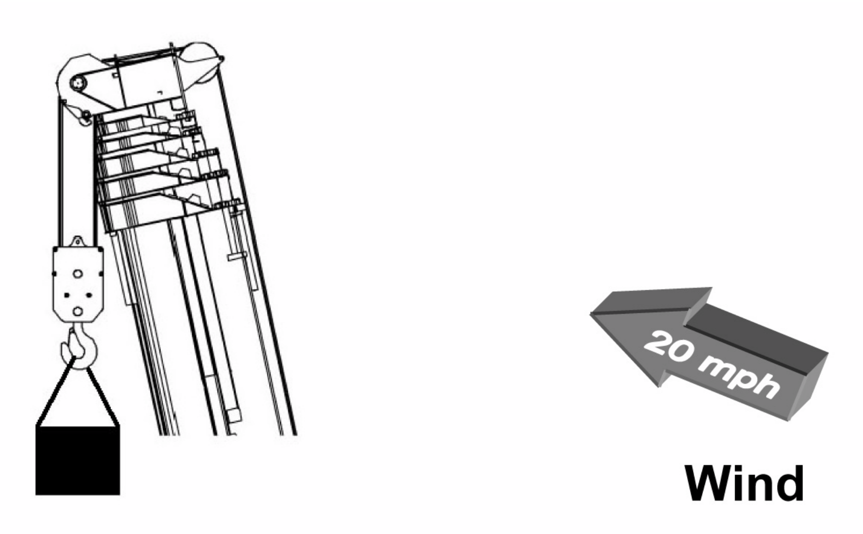
If the Boom Up/Down control joystick is pushed in up position after the boom is fully raised, pressure will be trapped in the base of the main cylinder. This will cause a motion cutout. Overriding the system is acceptable in order to boom down enough to release the trapped pressure.

Effects of Wind Conditions

Lifting Constraints

The crane can be used safely by following the values given in the load capacity tables up to a wind speed of 27.8 ft/s (30 kph - force 5) on a load surface of 11.7 ft^2/ton.

Check the forecast and monitor wind speed conditions near the job site. When wind speed exceeds 20 mph (32 kph - force 5), derating of the cranes lifting capacity is required.



MAXIMUM OPERATIONAL WIND SPEED BEFORE DERATING OF LIFTING CAPACITY IS REQUIRED.

Pay attention to the wind speed values in table below in relation to the information in the WARNING section of the LOAD CHART. Any governmental regulations applicable to the job site must also be observed.

Wind Force		Wind Speed		Consequences
Scale	Terms Described	mph	kph	Inland Territories
0	Calm	0 - 1	1	Calm, Smoke rises vertically
1	Very Light	1- 3	1 - 5	Wind direction indicated by the smoke and not by the banner
2	Light Breeze	4 - 7	6 - 11	The wind can be felt on the face, the leaves rustle , the banner moves
3	Gentle Breeze	8 - 12	12 - 19	Leaves and small branches move, banners lift
4	Mild Breeze	12 - 18	20 - 28	The wind raises dust and leaves. Branches move
5	Fair Breeze	18 - 24	29 - 38	Small bushes sway. Wave crests form on the sea.
6	Strong Breeze	24 - 31	39 -49	Large branches sway.
7	Strong Wind	31 - 38	50 - 61	All the trees sway

Lightning Storm

When lightning is striking in the vicinity of the crane, the operator should never attempt the following procedures:

- Getting into the operator's cab; upper or lower, or attempting to get onto the carrier, superstructure or boom assembly.
- If on the machine, do not try to get off the machine.

If you are in the operator’s cab (upper or lower) during an electrical storm, stay in the cab. If you are on the ground during an electrical storm, stay away from the vicinity of the machine.

Temporary Interruption of Crane Operations

As a general rule, if it is not possible to maintain sufficient control over a rigged crane, the boom and the equipment shall be taken down if the crane's operations are interrupted and may be left unsupervised.

The following instructions are valid for every mobile crane, regardless of the type, the configuration, the rigging mode and the environment:

- The crane shall be left in the smallest, most stable, valid operational configuration that the job site practically allows; this includes parameters such as boom angle, slewing orientation, jib angle.
- The engines shall be switched off.
- All control levers shall be put into the neutral or in a “locked” position.
- The heating system should be switched off.
- The crane shall be secured and the cabins shall be locked to prevent unauthorized use or unintended movement.
- Close all control panels that are fitted with a lock/key when they are not in use.
- Depending on the crane type, mobile control panels connected to the crane with cables shall be removed when they are not in use.
- The radio remote control, if it is available, shall be kept in a safe place to prevent unauthorized use or unintended movement. Make sure that the batteries are recharged.
- The parking brake of the crane chassis shall be applied.
- Transmission gear shall be set to neutral.
- The wheels shall be secured with chocks, the slew brake applied and the main boom secured.

If the crane is in erected mode and the jobsite conditions do not permit the boom and jib of a crane to be fully lowered to the ground, the configuration in which the crane should be left while unmanned shall be determined by a qualified crane operator familiar with the crane, the job site configuration, conditions, and limitations. In addition, following instructions shall be observed:

- A suitable and safe emergency plan shall be worked out to allow bringing the crane into a safe position in case of emergency such as an unforeseen weather change or other possible incidents as listed at the beginning of this document. This plan shall also include sufficient space around the crane to enable dismantling or lowering of boom or equipment, etc.
- The crane shall be left with no load on the hook.
- All slings or fastening ropes shall be removed from the crane hook.
- The hook block shall be at the highest position so that there is no contact possible between the wire ropes and the boom or other obstacles.

- The crane location and configuration does not create hazards to the road traffic, e.g. risk of collision with surrounding obstacles; this may require a specific risk assessment prior to leaving the crane unattended.
- Check for leakage and unintended (slow) movement on all load bearing hydraulic cylinders and winches:
  - Outrigger vertical cylinders
  - Boom lifting cylinder(s)
  - Hoist winch
  - Boom extension cylinder(s)

NOTE: *Slight movement can also be due to changing oil temperature (e.g. slight cylinder movement due to sun warming or hydraulic oil cooling).*

- Weather forecast shall be obtained in advance for the whole period the crane is erected.
  - Changing meteorological conditions, including, but not limited to: wind, ice accumulation, precipitation, flooding, lightning, etc., should be considered when determining the location and configuration of a crane when it is to be left unattended.
  - The crane boom should be lowered before wind speeds exceed the permitted values. This may not be possible depending on job site and crane setup.
  - If, due to unforeseen weather conditions, the wind speeds are in excess of the permitted values with the boom in the up position, the crane should be secured as best it can and everyone cleared from the area.
  - The boom may only be lowered if the expected wind speed during the lowering process is less than the wind speed allowed during assembly and disassembly according to the wind speed charts.

Potential hazards from Unattended Crane - Possible Issue/Risk

The following are examples of possible events that could occur while a crane is left unattended; these possible risks shall be taken into account:

- Ground failure:
  - Ground giving way due to severe rain/ landslides/ washout
  - Melting ice under the supports
- Bad weather:
  - Storm and wind
  - Lightning
  - Rain/Flooding
- Crane hydraulic cylinders movement:

Slow retraction of outrigger support cylinders, lift cylinders and/or telescoping cylinders on unpinned telescoping systems (e.g. due to changes in ambient and oil temperature, leakage).

- Vandalism.

Any or a combination of the above may result in the following events:

- The crane may topple over.
- The crane may move.
- Unsafe operational conditions may be created.
- Unauthorized operation of the crane may occur.

Resuming Crane Operations

Before crane operation is resumed after a period of inactivity/crane being unattended, the operator is required to check the condition of the crane and its location.

Whenever the operator has left the cab, the Rated Capacity Limiter (RCL) settings must be verified and reset.

Ending Crane Operations

Prior to leaving the crane, the operator must be certain the crane is in a condition acceptable to be left unattended.

End of Operations checklist

1. ________	Is the load fully on the ground and unhooked from the crane?
2. ________	Is telescopic boom all the way in?
3. ________	Is work-site crane boom all the way down and disassembled if necessary?
4. ________	Is parking brake on crane chassis set?
5. ________	Is crane engine off and ignition key removed?
6. ________	Is the crane cab locked?
7. ________	Is the crane secured from unauthorized use?
8. ________	Is the vehicle cab unoccupied?
9. ________	Is the vehicle engine off and the key removed?
10.________	Is the vehicle parking brake set?
11.________	All controls in neutral?

Turning/Driving in Reverse

While operating a mobile crane in reverse, the risk of accident or injury is greater and extra caution must be exercised.

> Risk of accidents and personnel injury or death is increased when operating in reverse.

The following cautions must be observed at all times:

- When backing up, the driver must be aware of the needs of other traffic and their safety.
- If the driver does not have visual access to all the areas into which he will be travelling, a guide, who is in communication with the driver at all times, must be used who can see those areas the driver cannot.
- An acoustical back-up warning device does not replace the need for a guide.
- Be certain that no personnel or objects are behind the vehicle before moving.

> Injury or death may occur while driving in reverse.

> Property damage may occur while driving in reverse.

- Rated maneuvering speed is the maximum speed allowed while driving in reverse.
- Follow all other regulations pertaining to driving on construction sites or on local streets.

Parking the Vehicle

NOTE: *Parking Instructions only apply to mobile cranes.*

⚠	Failure to adequately a secure parked vehicle may result in vehicle roll-off and injury or death to personnel and/or damage to property.

⚠	Risk of Death

The following conditions must be strictly adhered to by the crane operator:

- A vehicle should never be parked on a slope greater than 18%.
- The parking brake should always be applied when the crane is parked.
- The ground on which the crane is parked must be even and solid with sufficient load-bearing capacity.

⚠	Mobile cranes can roll away, if not properly prepared, causing injury, death or property damage.

Under the following conditions, the vehicle must employ the use of the (4) four wheel chocks on the rear axle, where (2) wheel chocks are on front side of rear tires and (2) wheel chocks are on rear side of rear tires in addition to the parking brake to prevent it from rolling away:

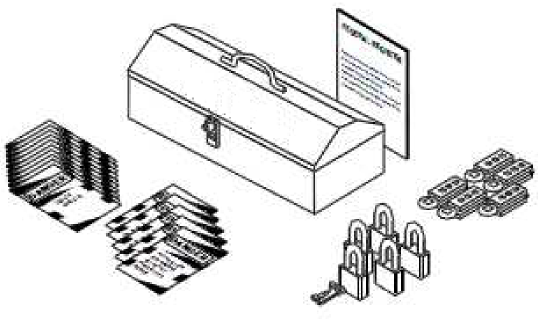
- The vehicle is parked on a slope.
- The vehicle is under repair or in need of repair, especially concerning any deficiencies in the brake system.

Lock Out & Tag Out

Occupational Health & Safety Code of Federal Regulations number 1910.147 requires that employers establish and follow a Lock Out & Tag Out procedure and train their employees in that procedure before any employee can operate, service or maintain any piece of power equipment.

Employers are required to make periodic inspections to see that their Lock Out & Tag Out procedures are being followed, and they must monitor and update their program on an ongoing basis. Employees are responsible for seeing that equipment is locked out and tagged out in accordance with the employer's policy.

A typical Lock Out & Tag Out kit contents are illustrated in the figure below.



Typical Lock Out & Tag Out Kit

What is Lock Out & Tag Out

Lock Out & Tag Out is a procedure that's designed to prevent the unexpected or accidental startup of equipment and to alert all workers whenever it is unsafe to operate any piece of equipment. When used as intended, Lock Out & Tag Out also protects personnel from energy stored in devices such as springs, accumulators, batteries, hydraulic systems, etc.

How to Lock Out & Tag Out

- Install one or more locks to hold the master switch lever in the **OFF** position.
- If the switch is keyed, turn the key to the **OFF** position and remove the key.
- Disconnect the batteries.
- Regardless of which lockout method is used, place one or more tags on machine control panels, access doors and electrical panels.

When is Lock Out & Tag Out required

- Any time anyone is maintaining, repairing, lubricating, or for whatever reason, working on the equipment.
- When the equipment is broken or for whatever reason, unfit or unsafe to operate
- Whenever the equipment is left unattended.

Who must apply a lock & tag

- Any person working on the equipment.
- Foreman or other person responsible for the work being done.
- If several people are working on a machine at the same time, each person must apply his or her own lock and tag.

When can a lock and tag be removed

After performing these six steps:

1. All safety guards are back in place.
2. All work is complete and tools are put away.
3. All workers are notified that a lock is being removed.
4. All workers are positioned safely for startup.
5. Controls are positioned for safe startup.
6. The machine is ready for safe operation.

Who can remove a lock and tag

- Only the person who applied a lock and tag is permitted to remove them.

The Lock Out & Tag Out rules laid out here are generic. To get instructions for your particular workplace, consult your employer's Lock Out & Tag Out procedure.

Access / Egress

⚠	Access/Egress Safety

Access and egress from the crane operator's cab must always be accomplished using a three-point system. Either two-feet and a hand or two hands and a foot should be in contact with the crane while moving from the ground into the operator's cab or moving from the operator's cab to the ground.

To provide safe access and egress to/from the crane, Load King provides a number of steps, ladders and handrails allowing three--point access to all areas of the crane where it is necessary for the operator to be when moving from the ground to the operator's cab or from the operator's cab to the ground.

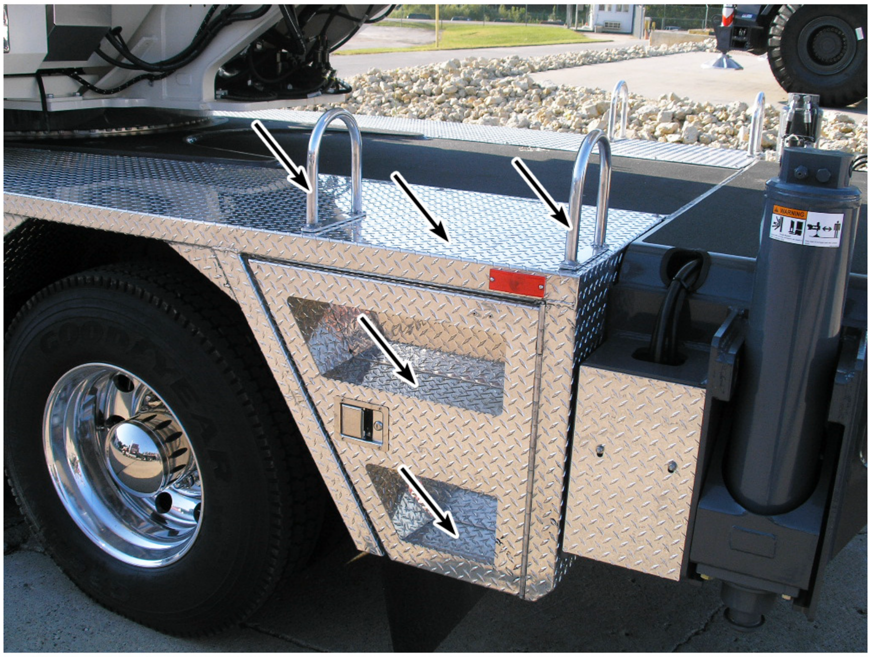
⚠	Access/egress to/from areas of the crane not accessible through the provided three-point access devices should only be attempted using OSHA approved access devices (ladders, lifting platforms, etc) providing three- point access capability.

Crane Cab Access / Egress

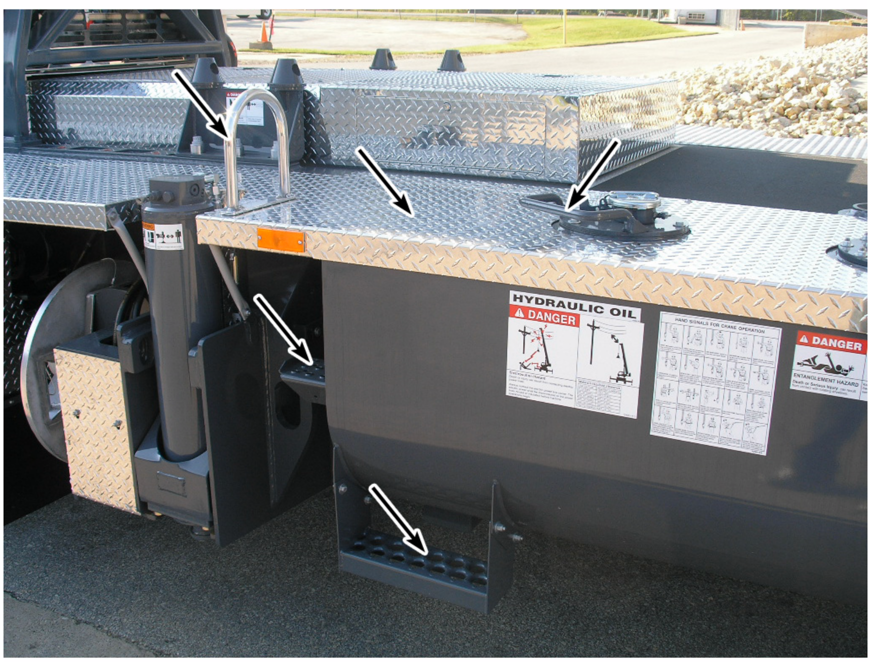
⚠	Do not use item (1) LH Joystick arm lift handle in upper cab or item (1) Steering Wheel in lower cab as a grab handle. Only use grab handles for access or egress of the operator's or driver's cab that are marked in the illustrations.

Carrier Cab Access / Egress

Rear LH Side Access / Egress



Carrier Access / Egress-LH Side



Carrier Access / Egress-RH Side

Personal Safety

SLIP AND FALL PREVENTION

1. Always wait until machine has stopped before getting on and off the equipment.
2. Do not use controls or steering wheel as hand holds.
3. Keep the machine clean and dry. Remove all oil, grease, mud, ice and snow from walking surfaces.
4. Store all tools, rigging and other items in the tool box.
5. Replace all broken ladders or other access system components.
6. Keep non-slip surfaces in good condition.
7. Never jump off the machine. Instead, use the hand holds and step designed for entering and exiting the machine. Face the machine and use three points of contact to ensure your safety.

Seat Belts

SOME SUGGESTED USAGE AND MAINTENANCE INSTRUCTIONS FOR SEAT BELTS

1. Wear your lap belt low and snug.
2. Manually adjustable lap belts and shoulder harnesses are adjusted by pulling the loose end of the webbing through the buckle or adjuster.
3. Seat belts using automatic-locking or emergency-locking retractors are self-adjusting.
4. Hand wash webbing with warm water and mild soap. Rinse thoroughly and dry in the shade.
5. Do not bleach or re-dye, because such processing may severely weaken the assembly.
6. Inspect the seat belt assembly frequently. Anytime it does not operate properly, or if there are any defects in the webbing (e.g. torn or frayed), the seal belt must be replaced.
7. For a non-locking retractor belt, completely extend the lap belt from the retractor(s). After adjusting the belt snugly (see # 2 above), attempt to pull additional webbing from the retractor. If no additional webbing can be pulled from the retractor after adjustment, then the seat belt is adjusted properly.

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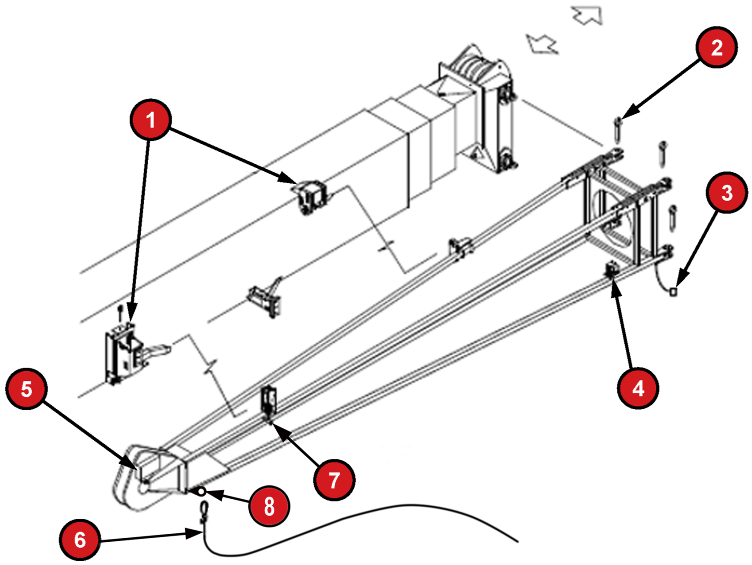
Erecting the Jib



1	Jib Storage Brackets	5	ATB Switch
2	Jib Mounting Pins (4)	6	Guide Rope (yellow rope located in tool box)
3	ATB Pins	7	T-Handle
4	ATB Plug	8	Guide Rope attachment eye

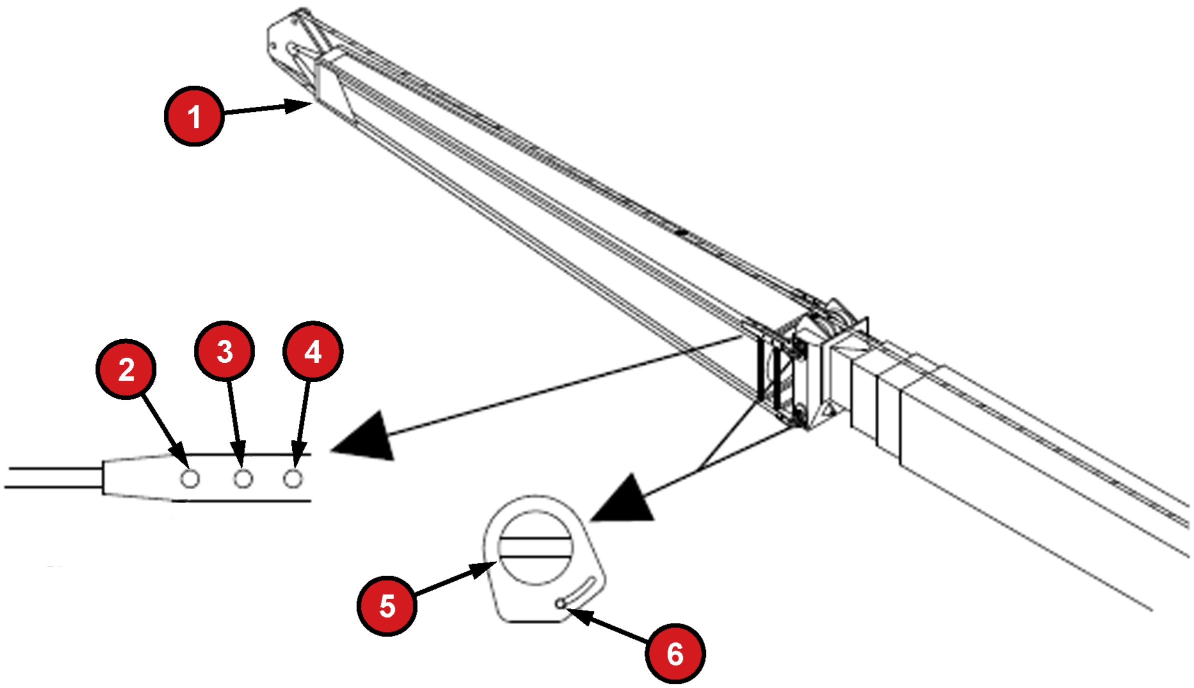
1. Extend and set the outriggers.
2. Rotate the upper structure to the "over rear" position.
3. Retract the boom completely.
4. Boom down to minimum boom angle to allow ease of installation of the jib pins. If necessary raise rear outriggers till boom head can be reached from ground level.
5. Install the upper and lower jib mounting pins in the right side of the boom head.
6. Attach a guide rope to the eye on the bottom tip of the jib.
7. Extend outriggers if retracted, to bring crane back to level. Raise the boom to horizontal.
8. Pull down and rotate the T - handle to unlock the jib from the storage bracket.
9. With the engine at idle, slowly extend the boom 2-3 feet (.6-1 m). As the jib clears the storage brackets, the jib will swing out approximately 45°.

Booming down too quickly can result in damage to jib.

10. With the engine at idle, slowly boom down to minimum boom angle while another operator uses the guide rope to control the speed of the jib rotation. The jib will swing around until the left side mounting holes line up.

11. If cable from main boom is to be used on jib, remove cable from boom head load sheaves and swing over top left jib cord before pinning jib to boom. Install the left upper and lower jib mounting pins.
12. Remove the guide rope.
13. Disconnect the ATB plug from the jib ATB socket and connect it to the socket on the boom head. Move the dummy plug from the boom head socket to the ATB socket on the jib.
14. Reeve the hoist line over the jib sheave.
15. Test the ATB system by lifting the ATB weight. The light and audible alarms should be actuated in the cab and the boom down, boom extend, and winch up controls should disconnect.

Changing the Offset of the Jib



1	Attach hoist line dead end	4	30° Offset Hole
2	0° Offset Hole	5	Sheave Shaft
3	15° Offset Hole	6	Cap Screws

INCREASING OFFSET

1. Retract the boom and set the outriggers.
2. Boom down to minimum boom angle.

3. Loosen the two (2) cap screws on the left side of the upper and lower sheave shafts. This will require a 1/2 inch hex wrench.
4. Reeve the hoist line over the top center sheave on the boom head, around the jib sheave, and attach to the eye on the bottom of the jib tip.
5. Winch up to take the slack out of the hoist line and to take the weight of the jib off of the jib offset pins.

NOTE: *To prevent damaging the jib, do not winch up any more than is necessary to loosen the jib offset pins.*

6. Remove the jib offset pins from the 0° offset hole and place in the 15° hole or if you are using 30° offset then place pins in tool box.
7. With the engine at idle, slowly winch down to pay out hoist cable. This will lower the tip of the jib until the jib comes in contact with the jib offset pins.

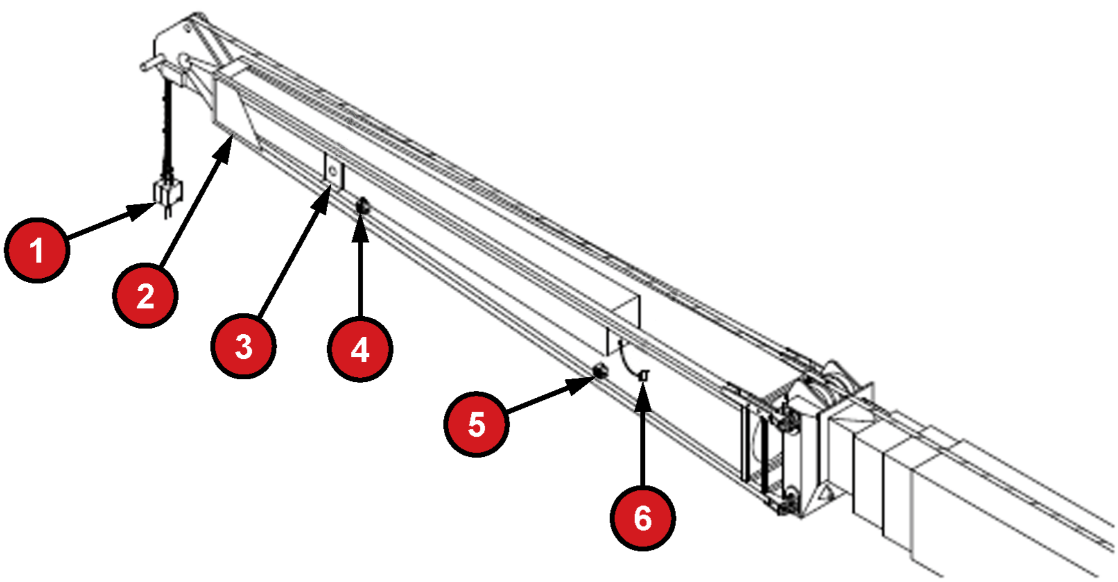
NOTE: *While lowering the tip of the jib, it may be necessary to raise the boom to prevent the tip of the jib from touching the ground.*

8. Remove the hoist line from the tip of the jib and reeve the hoist line as needed.

INCREASING OFFSET

1. Reverse above procedure to return jib to 0° offset position.

Extending and Retracting the Jib Pull-out Section



1	ATB Weight	4	ATB Extended Socket
2	Attach Dead-end Of Rope	5	ATB Retracted Socket
3	Pull Out Retaining Pin Hole	6	Pull out ATB Plug

NOTE: *The jib must be erected before extending the pullout section. Do not attempt to extend the pullout section while the jib is stowed.*

EXTENDING THE PULLOUT SECTION

1. Retract the boom completely and boom down to minimum boom angle.
2. Attach the dead end of the wire rope to the eye on the bottom of the jib tip. This is done to prevent the pullout from extending uncontrollably.
3. Unplug the pull out ATB plug from the ATB Retracted socket. Move the dummy plug from the extended socket to the retracted socket.
4. Remove pullout retaining pin from the retaining pin hole.
5. Pay out cable and extend the pullout until the retaining pin holes line up. Install retaining pin.
6. Plug the ATB plug into the ATB Extended socket.
7. Test the ATB system by lifting the ATB weight. The light and audible alarms should be actuated in the cab and the boom down, boom extend, and winch up controls should disconnect.

RETRACTING THE PULLOUT SECTION

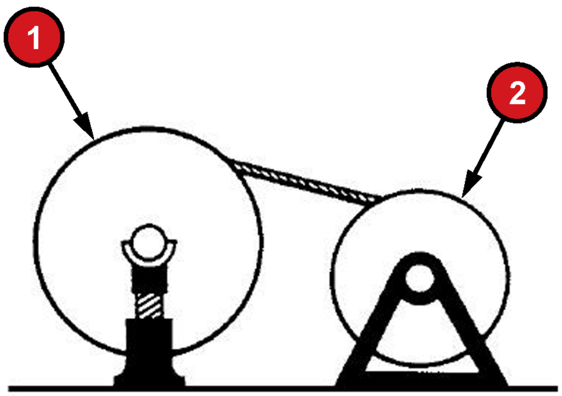
1. Retract the boom completely and boom down to minimum boom angle.
2. Unplug the ATB plug from the ATB Extended socket. Move the dummy plug from the retracted socket to the extended socket.
3. Attach the dead end of the wire rope to the eye on the bottom of the jib tip.
4. Remove pullout retaining pin from the erected retaining pin hole.
5. Winch up slowly to retract the pullout until the retracted retaining pin holes line up and install retaining pin.
6. Plug the ATB plug into the ATB Retracted socket.
7. Test the ATB system by lifting the ATB weight. The light and audible alarms should be actuated in the cab and the boom down, boom extend, and winch up controls should disconnect.

Spooling Wire Rope on Drums

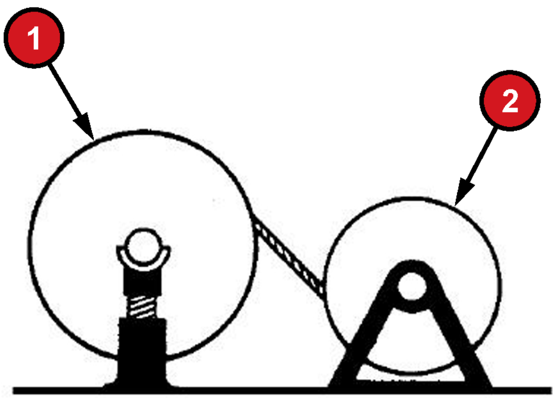
Care must be exercised when installing wire rope on the winch drum. Improper spooling can. result in rope damage through crushing, kinking, dog- legs, abrasion and cutting. Poorly installed wire rope will also adversely affect the operating characteristics of the machine by causing uneven application of force and motion. This, in turn, can cause premature fatiguing and failure of the rope.

Thoroughly inspect and clean the winch before proceeding with the installation. Check the lagging and drum flanges for cracks, breaks and excessive wear. Deformed or outsized drum and excessive undercutting at the base of the flange also indicate that repair or replacement of the drum is necessary.

Check the bearings for excessive wear and play. After correcting any defects revealed by the inspection and determining that the winch is in good operating condition, spool the wire rope as follows:



Correct Spooling



Incorrect Spooling

Mount the cable shipping reel (1) vertically on jacks or a suitable supporting structure, with a pipe or bar through the reel center. The cable should be drawn from the top of the reel, as shown, in order to avoid reverse bending as it is spooled onto the drum (2).

If cable is wound from the storage reel onto the drum, the reel should be rotated in the same direction as the hoist.

Apply braking force to the reel flange in order to prevent overrun as the rope is being drawn off. Loops formed by overrun can cause kinks and doglegs in the rope, resulting in damage and premature rope failure. A timber or block forced against the shipping reel flange can be used to provide the required braking force.

Install cable on the winch drum in accordance with the following procedure:

1. Position the cable over the boom nose sheave and route back to the winch drum.
2. Position the winch drum with the cable anchor slot on top.
3. Insert cable through slot and position around the cable wedge.
4. Position the anchor wedge in the drum slot; pull firmly on the free end of the cable to secure the wedge.
5. Slowly rotate the drum, ensuring the first layer of cable is evenly wound onto the drum.
6. Install the remainder of cable, as applicable. The end of the cable should be even with the bottom of the anchor wedge.

NOTE: *If the wedge does not seat securely in the slot, carefully tap the top of the wedge with a mallet.*

Cable Sockets

MODEL	ROPE SIZE	PART NO. & DESCRIPTION	WHERE USED
T300-1 T500-1	5/8"	5/8 1234-19	5/8 1234-43 USED ON FREE END OF WIRE ROPE (P/N 1234-43)
		5/8 216529	USED IN MAIN & AUX. DRUM WEDGE POCKET
T780	3/4"	3/4 218534	3/4 1234-44 USED ON FREE END OF WIRE ROPE (P/N 1234-44)
		3/4 216529	USED IN MAIN & AUX. DRUM WEDGE POCKET

The wrong cable wedge could permit the wire rope to work loose and detach itself from the drum; possibly causing property damage or personal injury.

Tension the wire rope by braking the shipping reel and slowly operate the winch in the raise mode to wind the cable onto the winch drum. As the spooling proceeds, make sure that adjacent turns are tight against one another. A lead or brass hammer may be used to tap the rope over against preceding turns. Tight winding on the drum is absolutely essential.

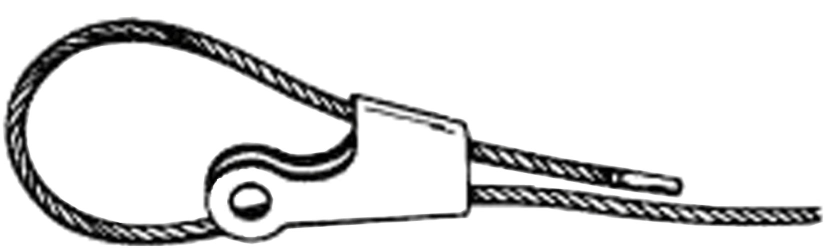
Never use a steel hammer or pry bar to move the rope over on the drum. These tools can easily damage the rope.

After the wire rope is wound onto the winch drum, reeve the cable as desired.

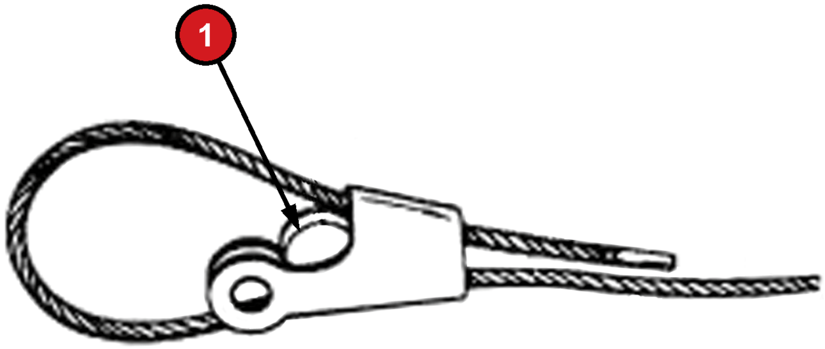
Use only factory supplied sockets, wedges and pins of the proper size; make no substitutions.

Follow the procedure below when installing wedge type sockets on wire rope. Be certain the correct socket and wedge are used.

1. Lead the rope through the socket, form a large loop and draw the rope end back through the socket. A length of rope equal to at least one rope lay should be drawn back through.



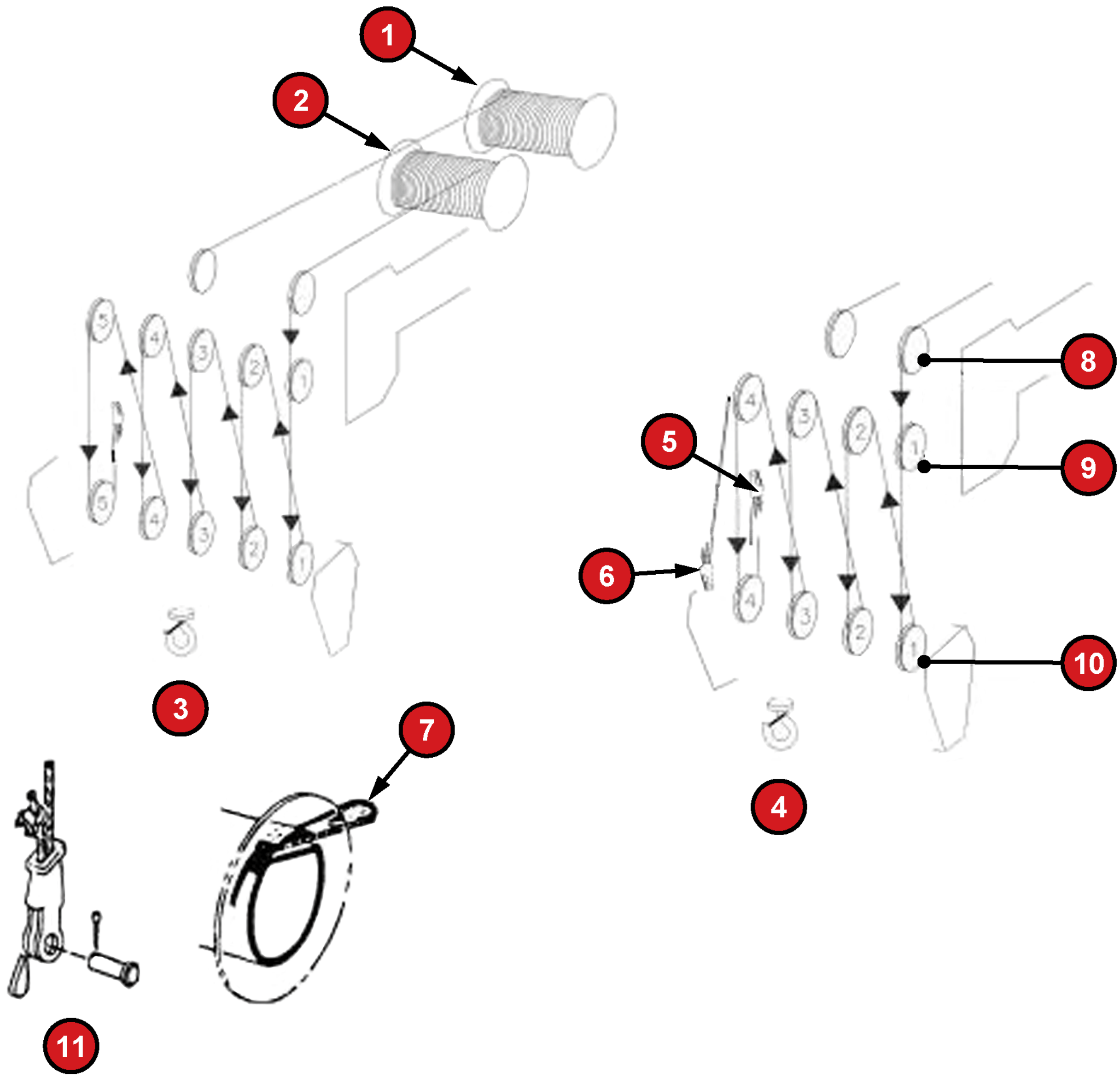
2. Insert the wedge (1) and allow the rope strands to adjust around it.



3. Seat the wedge and loop just tightly enough to allow handling by attaching the socket to a strong support and engaging the winch to take a strain on the rope.
4. Final seating of the wedge is accomplished by making lifts of gradually increasing loads. Avoid imposing shock loading on the rope until the wedge is firmly in place.

5. After the wedge has been firmly seated, a short length (6 inches) of the cable should be secured to the free end of the wire rope to act as a stop as shown. DO NOT clamp the free end to the load supporting end as this will weaken the rope and prevent the wedge from fully seating.

Hoist-Line Reeving



1. AUXILIARY WINCH	2. MAIN WINCH
3. 5 SHEAVE	4. 4 SHEAVE
5. DEAD END FOR EVEN PARTS OF LINE	6. DEAD END FOR ODD PARTS OF LINE
7. WINCH DEAD END	8. IDLER SHEAVE
9. LOAD SHEAVE	10. BLOCK SHEAVE
11. CABLE SOCKET	

NOTE: *SHEAVES IN BOOM HEAD AND HOOK BLOCK ARE NUMBERED FROM LEFT TO RIGHT AS VIEWED FROM THE OPERATOR'S STATION. "D" INDICATES PINNED END OF ROPE.*

PARTS OF LINE	BOOM HEAD (LOAD SHEAVE)	HOOK BLOCK (BLOCK SHEAVE)
1	1	D
2	1 D	3
3	1 5	3 D
4	1 4 D	14
5	1 2 3	2 4 D
6	1 2 4 D	2 3 4
7	1 2 3 4	2 3 4 D
8	1 2 3 4 D	1 2 3 4
9	1 2 3 4 5	1 2 3 4 D
10	1 2 3 4 5 D	1 2 3 4 5

These patterns represent some, though not all, of the options for reeving patterns for hookblocks. Always use a reeving pattern that allows the block to hang level.

When reeving the crane in preparation for any job, it should be kept in mind that hoisting and lowering speeds decrease as the number of parts of line increases. For the most efficient use of the crane, it is therefore desirable to use the minimum required number of parts for lifting the load as determined by referring to the load rating chart.

This crane incorporates a "Quick Reeving" boom head and block which do not require removal of the wedge and socket from the rope in order to change the reeving. Removal of two pins in the boom head and three in the hook block will allow the wedge and socket to pass through.

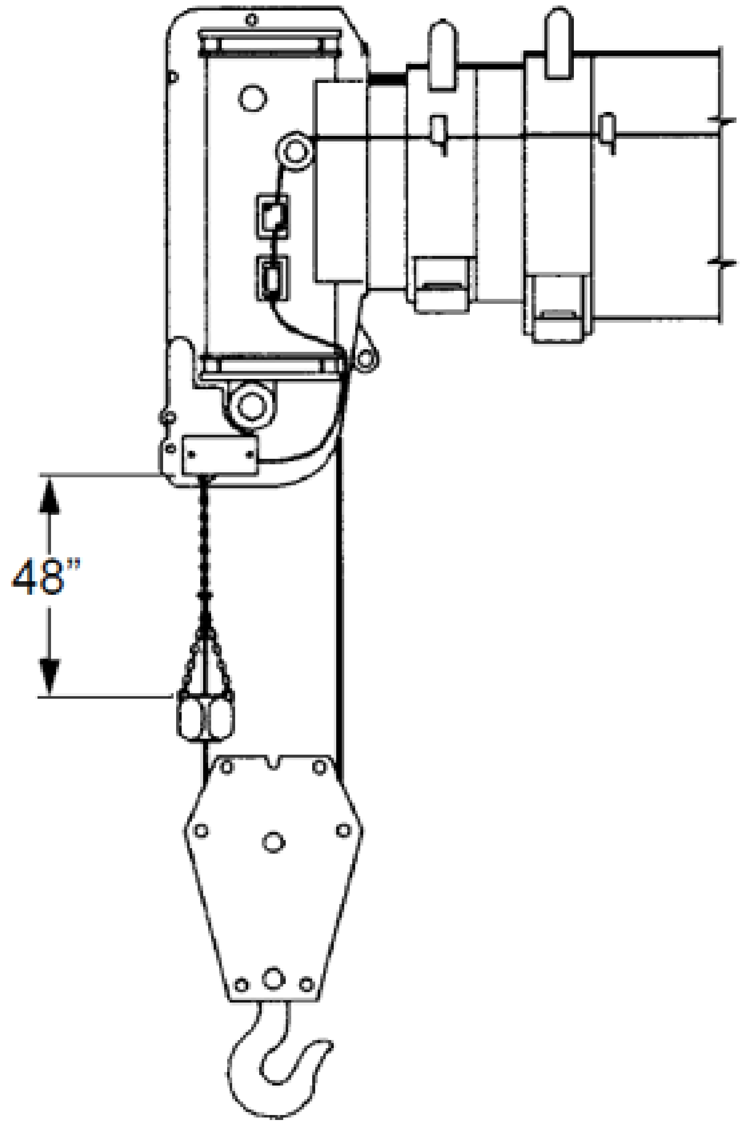
Never use less than the number of parts called for by the load rating chart.

If it is not practical to alter the reeving during the course of the work, the required number of rope parts must be determined on the basis of the heaviest load to be lifted during operations.

When the required number of rope parts has been determined, reeve the rope as shown on the previous page. Attach a wedge type rope socket (refer to Wire Rope User's Manual) to the wire rope dead end and secure it to either the boom peak or hook block as required. Dead end the rope on the hook block for an odd number of line parts, and on the boom peak for an even number of parts.

NOTE: *It may not be possible for the hook block to reach the ground if more than the minimum number of "parts of line" are used.*

Attach the ATB weight to the ATB switch and to the first part of line as shown on the previous page. The ATB chain should be 48 inches long. Verify that the chain is not twisted or knotted after installation.



Test the ATB system by lifting the ATB weight. The light and audible alarms should be actuated in the cab and the boom down, boom extend, and winch up controls should disconnect.

As shipped from the factory, the crane has sufficient wire rope provided to allow the hook to reach ground level with any boom length and elevation when reeved with minimum parts of line required for the load being lifted. Refer to the Crane Capacity Chart for parts of line required.

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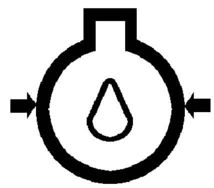
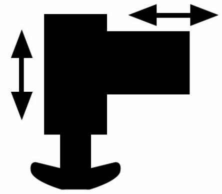
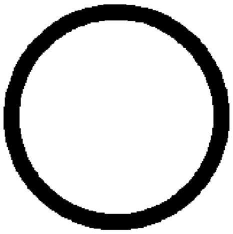
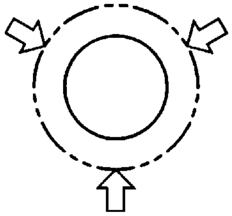
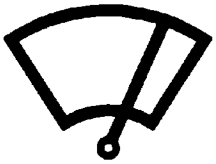
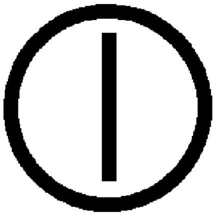
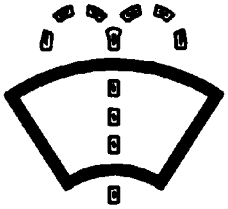
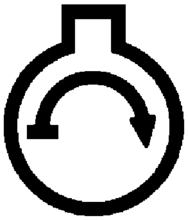
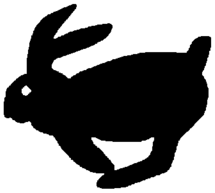
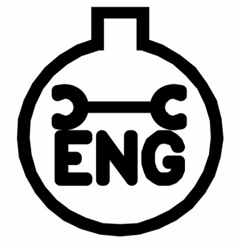
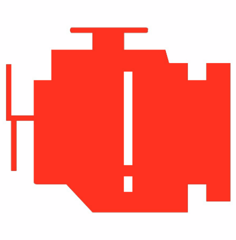
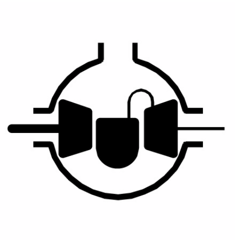
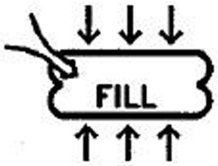
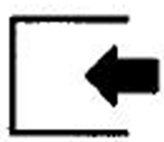
Universal Symbol Identification

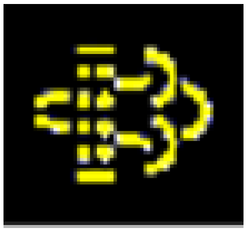
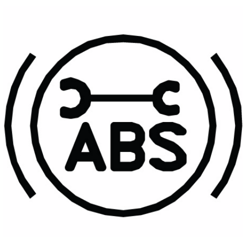
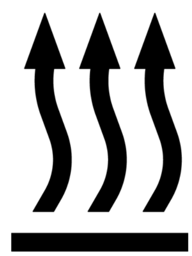
This section is intended to familiarize the operator with the controls and instruments provided for the operation of this machine. It should be emphasized, however, that merely knowing the controls is inadequate preparation for operating hydraulic cranes. Do not attempt to operate the machine until the other sections of this manual have been covered. Sections 1 and 3 are especially important with respect to machine operation.

Diagrams of the various carrier and upper controls are illustrated on the following pages. A list of these controls and instruments are shown opposite each illustration. More detailed explanations of each control or instrument follow in the same order as they appear in the number key.

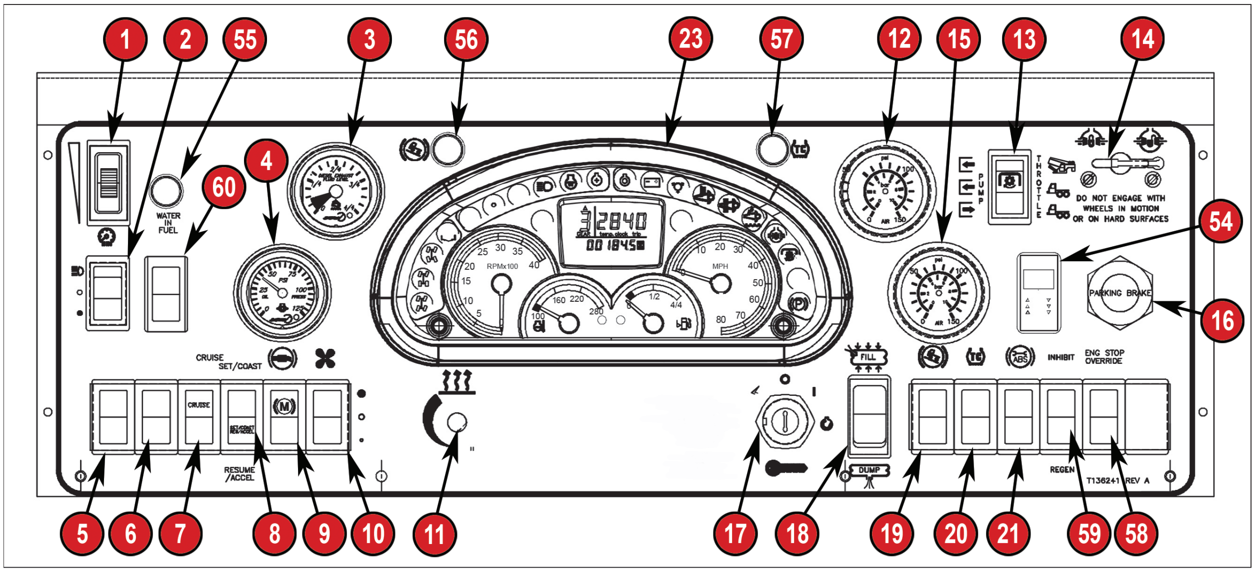
FLOODLIGHTS 	PARKING BRAKE 	ENGINE OIL PRESSURE 
ELECTRICAL ACCESSORIES 	OUTRIGGERS 	COOLANT TEMPERATURE 
ELECTRICAL SYSTEM OFF 	AIR PRESSURE 	WIPER 

ELECTRICAL SYSTEM ON 	HEADLIGHTS 	WASHER 
IGNITION ON 	FAST 	ENGINE DIAGNOSTIC 
IGNITION 	SLOW 	INCR / IDLE ADJ INCREASE 
ENGINE STOP 	AXLE DISENGAGE / RANGE SHIFT 	INCR / IDLE ADJ DECREASE 
AIR SUSPENSION FILL 	KEY - ACC 	ENGINE STOP 

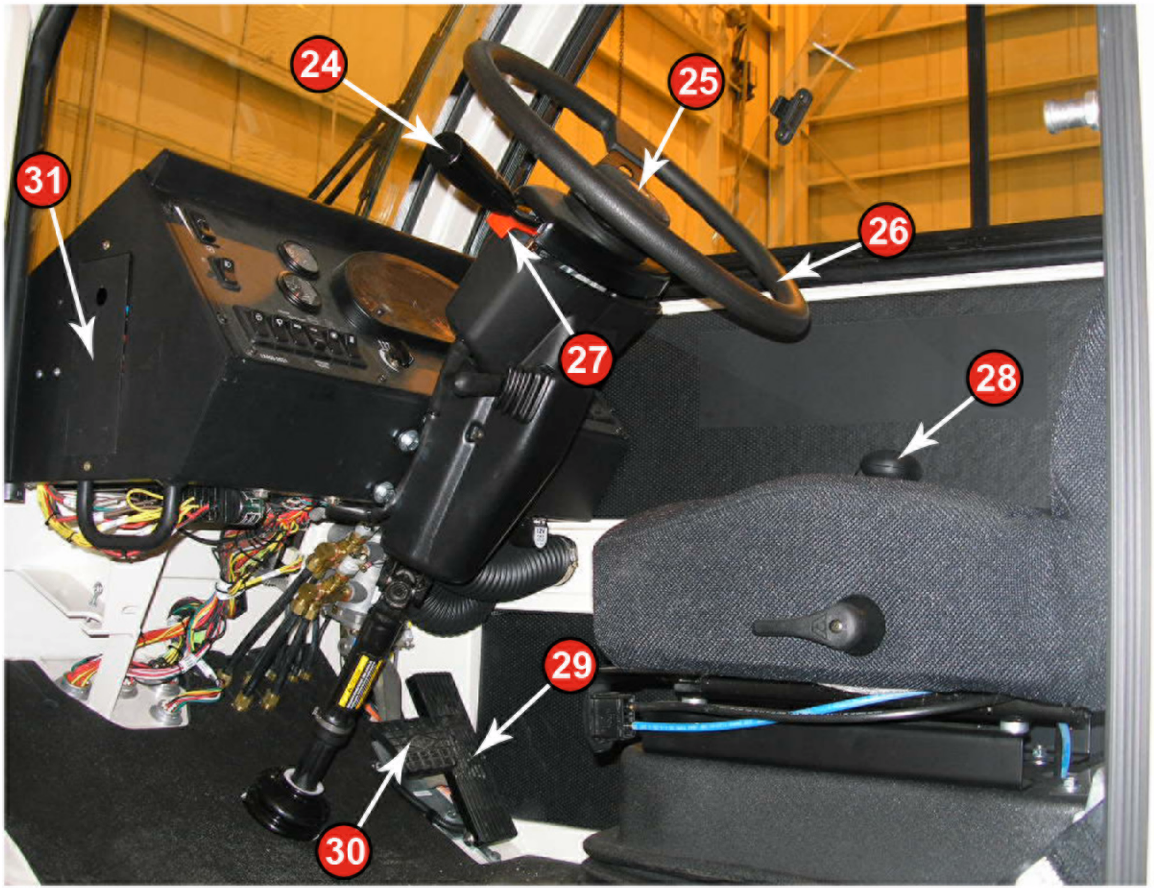
AIR SUSPENSION DUMP 	KEY - OFF 	DIFF LOCK OFF 
HIGH SPEED REAR AXLE 	KEY - ON 	KEYSWITCH 
LOW SPEED REAR AXLE 	KEY - START 	PTO OUT 
DIFF LOCK ON 	PTO IN 	ENGINE WARN 

DPF LAMP 	HEST LAMP 	CHECK ENGINE 
ABS-DIAGNOSTIC 	HILL START AID-HSA 	TRACTION CONTROL INDICATOR 
ENGINE BRAKE 	CRUISE CONTROL 	HEATER "ON" 

Carrier Controls and Instruments



Detroit Diesel DD13-GHG14 Configuration



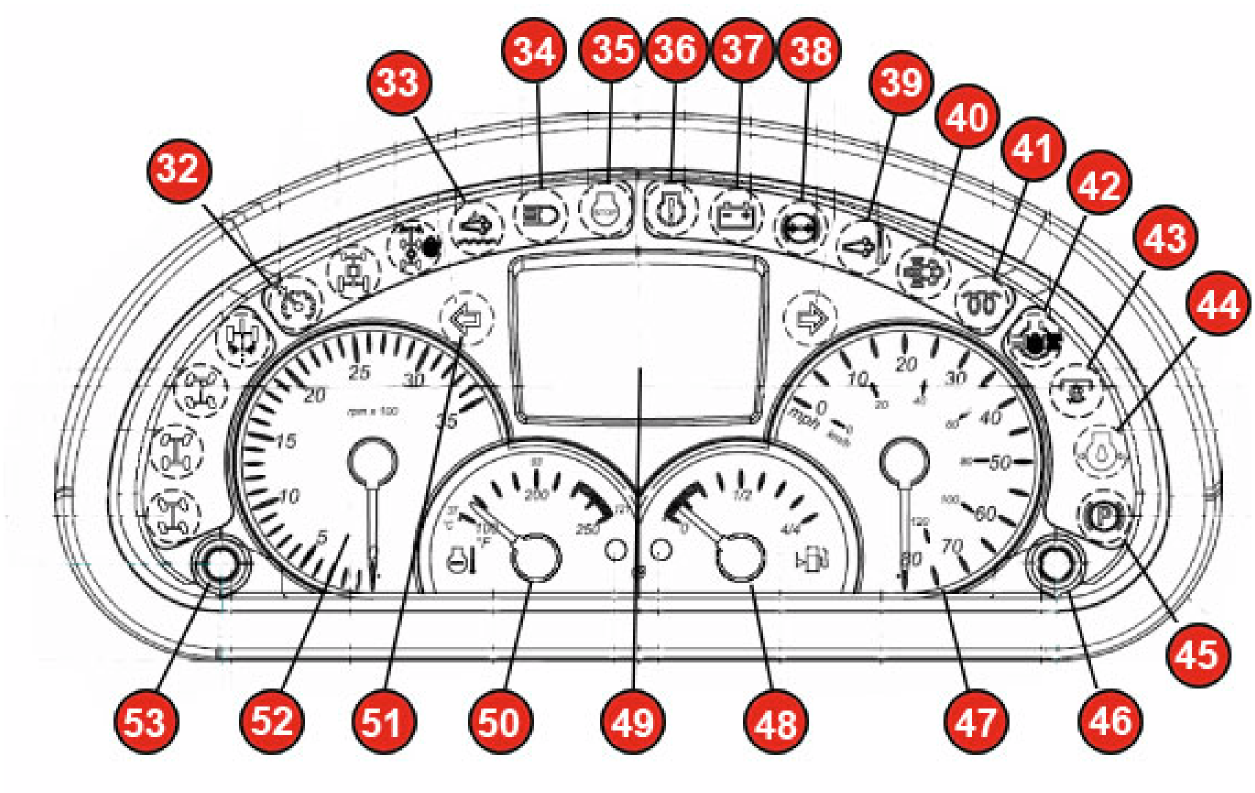
Carrier Controls & Instruments

1. GAUGE LIGHT DIMMER SWITCH -Turn to adjust brighness of gauge lights.	17. IGNITION SWITCH A. Circuits other than ignition "on". B. All circuits "off". C. All circuits including ignition "on". D. Engine "start".
2. HEADLIGHT SWITCH -(3) postion switch-OFF, middle position-marker lamps & dash lights ON, top position-marker lamps, dash lights & head lights ON.	18. AIR SUSPENSION CONTROL -Up to fill suspension, down to release air.
3. DIESEL EXHAUST FLUID LEVEL -Urea tank-red LED light in guage indicates tank is at low level.	19. HILL ASSIST SWITCH (HST) -Hill Assist can be selected as "ON" or "OFF". Amber Indicator Light (56) will be illuminated when Hill Assist is switched to "OFF".
4. ENGINE OIL PRESSURE GUAGE -Measures engine oil pressure. Graduated from 0 to 100 psi and 0 to 700 kPa.	20. TRACTION CONTROL SWITCH -Switch allows for selection of Traction Control "ON" or "OFF". Amber Indicator Light (57) will illuminate when Traction Control is "OFF".
5. WASHER SWITCH -Press for windshield wash.	21. ABS DIAGNOSTIC SWITCH -Down for normal operation, up for ABS diagnostic mode.
6. WIPER SWITCH -Press for windshield wiper.	22. NOT USED
7. CRUISE CONTROL (On/Off)-Press to toggle cruise on and off.	23. WARNING LIGHTS & GUAGE DISPLAY PANEL - Refer to items 32 thru 53 for I.D. and function.
8. CRUISE (Set/Resume) -Press to set or resume cruise speed. Hold "Set" to coast. Hold "Resume" to accelerate. Minimum cruise set speed is 40 MPH.	24. TURN SIGNAL CONTROL & HI/LO BEAM HEADLIGHTS -Lift up to activate right turn signals, press down to activate left turn signals. Pull toward operator for HI or LO beam headlights.
9. ENGINE BRAKE (On/Off) -Press to activate engine brake.	25. HORN -Press to activate horn.
10. AC/FAN (Hi/Lo) -Press down for fan low, up for fan high. Also turns on AC with AC also in "ON" position. AC control switch located on AC unit behind seat.	26. STEERING WHEEL -Turn clockwise to steer the machine right, turn counterclockwise to steer the machine left.
11. TEMPERATURE ADJUST -Adjusts heat temperature.	27. 4 WAY FLASHER -Pull to activate flashers, push to deactivate.

12. AIR GUAGE (Front) -Indicates air pressure in front air tank. Maintain 110 to 115 psi normal system air pressure.	**28. TRANSMISSION SHIFT LEVER** -See Eaton UltraPlus Transmission Operations instructions.
13. PTO AIR VALVE SWITCH -Push up to engage pumps, push down to disengage.	**29. ACCELERATOR PEDAL** -Depress to accelerate.
14. INTER AXLE LOCKOUT VALVE -Lock out inter-axle differential. Should the machine become stuck, a spinning wheel will receive all power transmitted by the drivetrain causing the wheel to spin faster and worsen the condition. Use of the lockout divides the available power between the two axles of the rear tandem. Wheels on both tandems will be locked together. A wheel on each axle may still spin. With the lockout engaged, the stuck wheel may continue to spin but the other side of the tandem will begin "driving".	**30. BRAKE PEDAL** -Depress to actuate.
15. AIR GUAGE (REAR) -indicates air pressure in rear air tank. Maintain 110 to 115 psi normal system air pressure.	**31. CIRCUIT BREAKERS** -Electrical circuit breakers are under this panel.
16. PARKING BRAKE CONTROL VALVE -Controls parking brakes. Pull to apply, push to release.	

Never allow a spinning wheel to spin for an extended period of time.

Never engage the differential locking switch when any axle is revolving. Engage only when all axles are stopped.



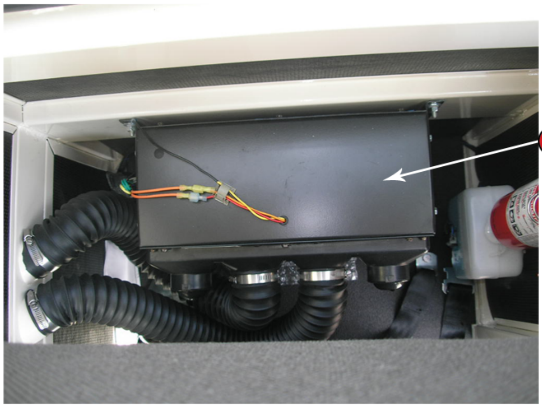
Carrier Instruments & Warning Lights

32. CRUISE -Blue colored Warning Light "ON" when cruise control is set.	**47. SPEEEDOMETER GUAGE** -MPH (0-80) & Kph (0-120).
33. DEF -Red colored Warnling Light "ON" when Diesel Exhaust Fluid (Urea) tank fluid level is low.	**48. FUEL LEVEL GUAGE** -Guage and Amber colored Warning Light "ON" with low fuel level.
34. BRIGHT -Blue colored Warning Light "ON" when HI beam headlamps are "ON".	**49. LCD DISPLAY** -Readouts: Load King Logo, Clock, Total Engine Machine Hours, Engine Oil Pressure, Total Odometer, Partial Odometer, Languages menu, Engine Fault. (See UNIDECK Operation & Instructions).
35. ENGINE STOP -Red colored Warning Light "ON" when Engine should be shutdown.	**50. ENGINE COOLANT TEMPERATURE GUAGE** -Guage and Red colored Warning Light "ON" when engine is at 230° F. (110° C) or above. Engine is overheating.
36. ENGINE CHECK -Amber colored Warning Light "ON".	**51. LEFT TURN SIGNAL** -Green colored flashing Warning Light "ON".
37. BATTERY CHARGING CONDITION -Red colored Warning Light "ON" if less than 12 volts.	**52. TACHOMETER GUAGE** -Engine RPM x 100 Guage (0-3500 RPM).

38. LOW AIR PRESSURE -Red colored Warning Light "ON" if less than 60 PSI.	53. MENU NAVIGATION BUTTON -LCD Display screen menu. (See UNIDECK Operations Instructions).
39. DPF TEMPERATURE -Red colored Warning Light "ON" indicates HIGH exhaust temperature.	54. TRANSMISSION SHIFT GEAR SELECTION -Window will indicates gear transmission is in and requested gear.
40. OPEN	55. ENGINE STOP OVERRIDE SWITCH
41. OPEN	56. HILL ASSIST INDICATOR LIGHT (HSA) - When HSA lamp is controlled by the ABS controller, the lamp will be "OFF" when the system is operating normally. The lamp will turn "ON" if the system is defaulted. The lamp will flash at a reat of 1 Hz when the system has been temporarily disabled by the operator.
42. DIFFERENTIAL LOCK -Amber colored Warning Light "ON". Differential is locked.	57. TRACTION CONTROL INDICATOR LIGHT - Amber light will illuminate if Traction Control is not functional or has been turned "OFF" by switch (20).
43. PTO ON -Amber colored Warning Light "ON", PTO is engaged..	58. WATER IN FUEL INDICATOR LAMP - See Fuel Filter section of Operator's manual for maintenance information.
44. ENGINE OIL PRESSURE -Red colored Warning Light "ON" if less than 80 Kpa (about 12 PSI).	59. DPF REGENERATION SWITCH - Momentary "ON" push top part of switch and hold to start DPF regeration process. Crane must be stopped curbside at idle, transmission in neutral, park brake set to initiate the regeneration process. (See Maintenence Section).
45. PARK LAMP -Red colored Warning Light "ON".	60. MIL-MALFUNCTION INDICATOR LIGHT - The MIL illuminates when the On-Board Diagnostics system detects a malfunction related to the emissions control system. The illuminated MIL indicates that the engine and aftertreatment system should be diagnosed and serviced at your next available opportunity. The MIL can be illuminated along with any of the engine indicator lamps. If the MIL is illuminated with the red Stop Engine Lamp, the vehicle should be stopped as soon as it is safe to do so. It should be taken to an authorized Detroit Diesel location for repair.

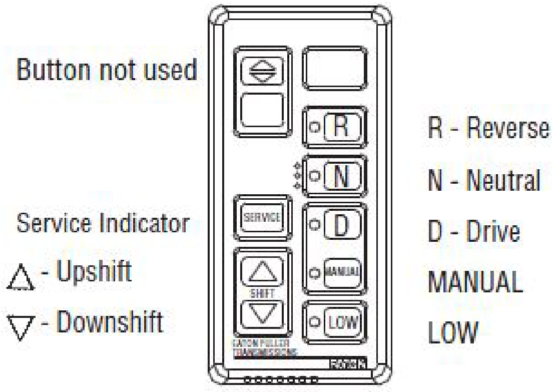
46. SUB MENU NAVIGATION BUTTON - LCD Display screen sub menu select/ deselect button. (See UNIDECK Manual).	

61. FIRE EXTINQUISHER -Fully charged indicator arrow on "Green". Remove latch, pull safety pin, point toward base of flame and depress black handle to discharge fire suppressant.	62. WINDSHIELD WASHER RESERVOIR - Use only over the counter washer fluid made specifically for automotive windshields.



63. HEATER UNIT -Engine hot water supplied to carrier cab heater unit.	

Transmission



TRANSMISSION SHIFTER -Eaton UltraShift PLUS transmission (See Driver Instructions Quick Reference Guide).	

480-126 Pump Engagement Procedure

In the lower carrier cab position, pumps are disengaged and throttle and gauges operate from the lower cab. This is the normal driving position. With the PTO switch (13) in the mid-position, pumps are engaged and the throttle and gauges operate from the lower cab. The PTO light (43) will come on once the engine starts. Use this position if you need to drive the machine while keeping the pumps engaged (for example, pick and carry work). With the PTO switch in the upper position, pumps are engaged and throttle and gauges operate from the upper cab. The PTO light (43) will come on once the engine starts. Use this position for normal craning functions.

1. With engine stopped or at idle move the rocker switch to the lower position (1) as shown in photo below for driving the crane. (Throttle active in lower cab and hydraulics disengaged). Before moving switch from the lower position make sure you have a minimum of 60 psi air pressure on guage. If you do not, keep the switch in the lower position and run the engine until air pressure builds up.
2. Move switch to the center position (2) for work that requires moving the crane while keeping the hydraulics active. (Throttle active in lower cab and hydraulics engaged) PTO light should come "ON" indicating pumps are running only when engine is running.
3. Move switch to upper position (3) for normal craning function. (Throttle active in upper cab and hydraulics engaged) PTO light should come "ON" indicating pumps are running only when engine is running.

UNIDECK Operation & Instructions

INDEX

1. Menu Navigation
2. Visualization
3. Load King Logo
4. Clock
5. Total Engine Machine Hours
6. Total Odometer / partial odometer
7. Engine Fault
8. Select Unit
9. Select Language
10. Internal Buzzer
11. Check

1. Menu Navigation

To access at the Main Menu from Main Screen, press and hold LEFT button (≥2000 ms).

Then the LEFT button will scroll UP while the RIGHT button will scroll DOWN (momentary activation from 200 ms up to 1000 ms).

To enter into the Sub Menu, press and hold RIGHT button (≥2000 ms).

To exit from the Sub Menu or Main Menu, press and hold LEFT button (≥2000 ms).

To enter into the Sub Sub Menu or to select/deselect, press and hold RIGHT button (≥2000 ms).

To clear stored codes press and hold RIGHT & LEFT buttons (≥2000 ms) while viewing.

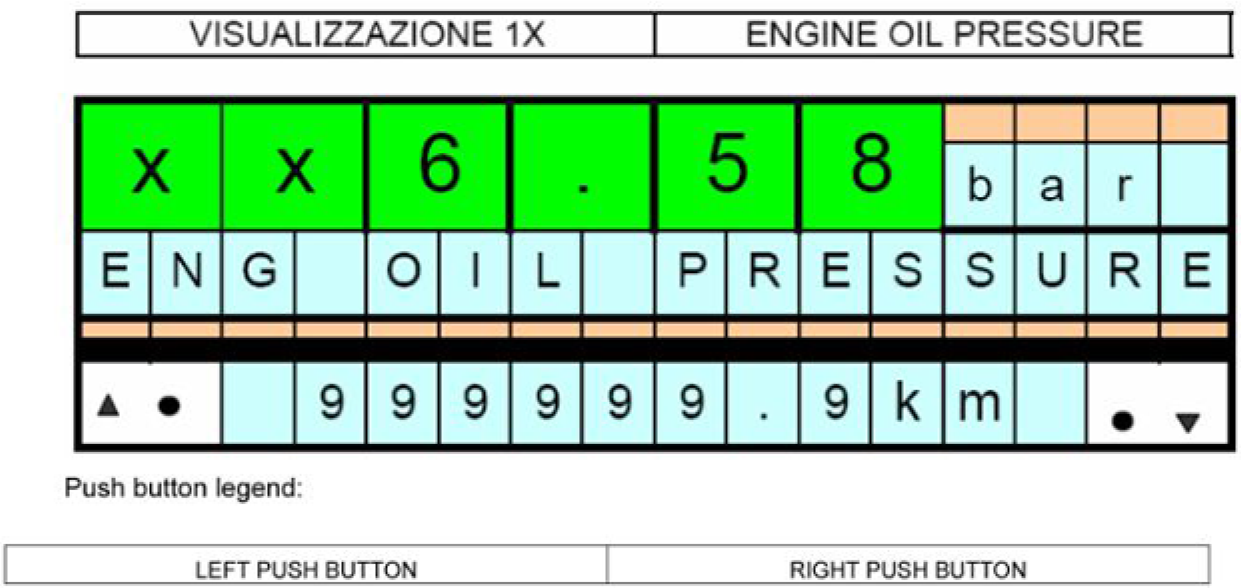
To set day clock press and hold RIGHT & LEFT buttons from idle Main Screen (≥2000 ms).

To change perameter visualizations in the mode 1x push the RIGHT button (momentary activation from 200 ms up to 1000 ms).

To change from the Total odometer visualization to the Partial odometer visualization, push (momentary activation) the LEFT button.

To reset the partial odometer (only from the MAIN SCREEN) press & hold the RIGHT BUTTON (>2000 ms).

In each display visualization are described the available logic of the two push button through their visualization see example:



2. Visualization

SYMBOLS	DESCRIPTION	SYMBOLS	DESCRIPTION
◄	Press Momentary activation (200 mS<T<1000 mS)	►	Press Momentary activation (200 mS<T<1000 mS)
●	Press & Hold (T≥2000 mS)	●	Press & Hold (T≥2000 mS)
▲	Press Momentary activation (200 mS<T<1000 mS)	▼	Press Momentary activation (200 mS<T<1000 mS)

3. Load King Logo

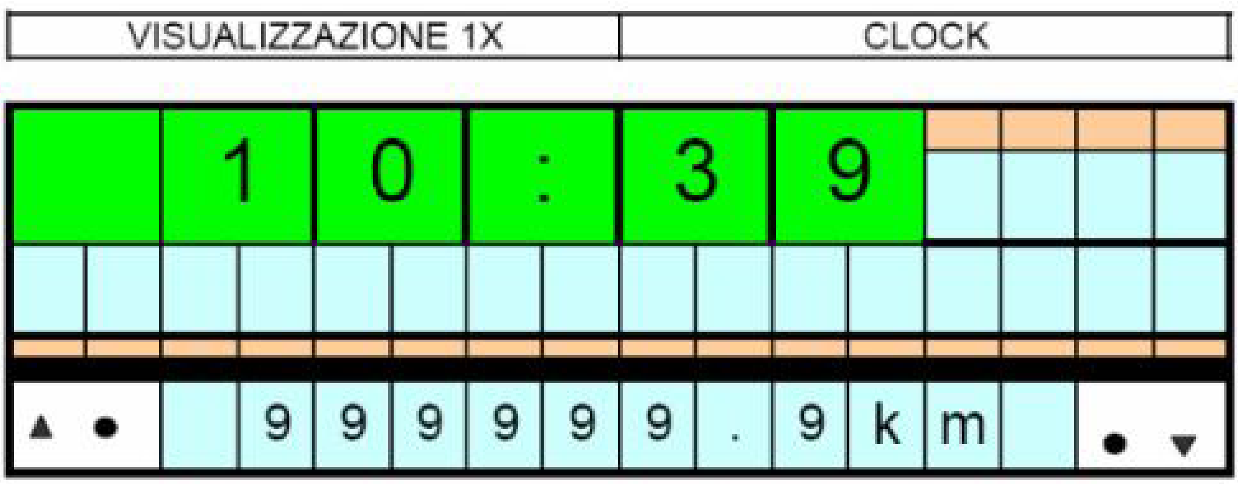
At the key on, on the display will be shown the Load King Logo for 1.5 second, like the following picture:

4. Clock

The clock will be shown on the display only when the function "remove guages" will be activated.

On the PCB must be present an internal battery to quarantee the power supply to the clock when the user cut off the vehicle battery.

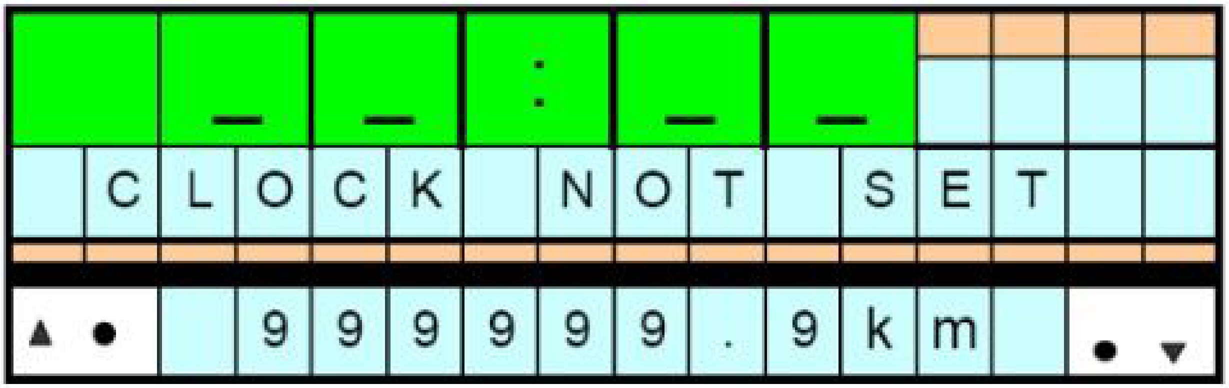
This is the structure:



The two dots of the clock will be blinking (T=2000 ms; Duty cycle=50%) like the "h" of the hourmeter (IF IT IS WORKING).

If the time isn't set yet, at the key on will be shown the following message for 2000 ms (after Load King Logo)

VISUALIZZAZIONE 1X	CLOCK NOT SET



4.1 Clock Setting

While the display is showing the main screen, press and hold LEFT and RIGHT button for ≥2000 ms the hour number start blinking (T=1000 ms; Duty cycle=50%).

With the left button will increment the number, while with the right button will decrement.

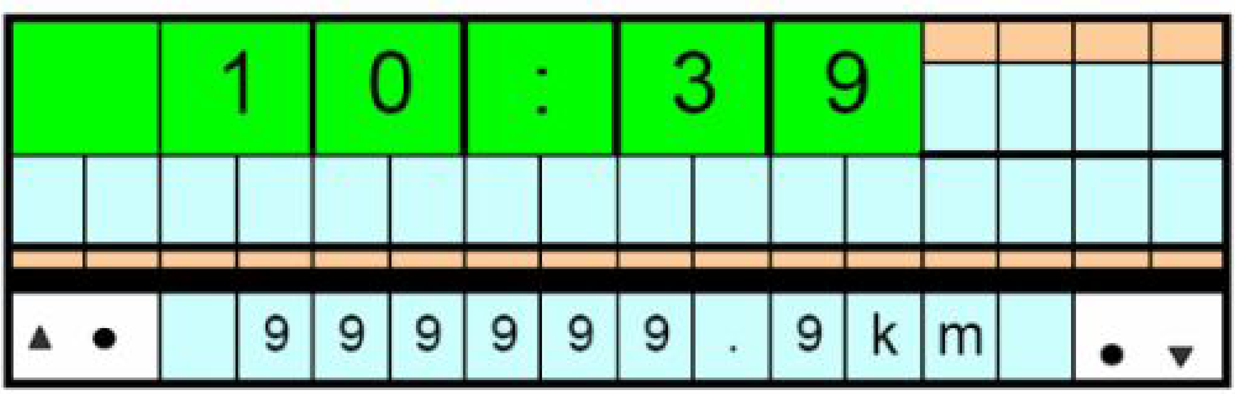
To move to the minute number press and hold the LEFT button.

The minute number start blinking (T=1000 ms; Duty cycle=50%).

With the left button will increment the number, while with the right button will decrement.

To exit from the day time clock setup menu, press and hold the LEFT & RIGHT button (≥ 2000 ms).

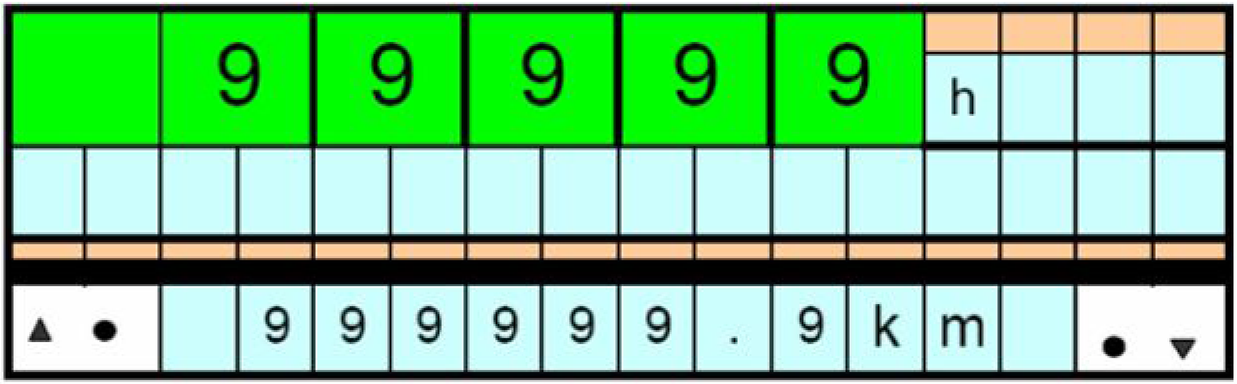
VISUALIZZAZIONE 1X	CLOCK



5. Total Engine Machine Hours

In the up side of the display there will be shown the total engine / machine hours.

VISUALIZZAZIONE 1X	HOURMETER



The "h" of the hourmeter will be blinking (T=2000 ms; Duty cycle=50%) like the "two dots" of the clock only when the Tachometer gauge show at least 200 rpm.

The hourmeter can not be reset; the working hours are saved in the memory every minute and during the key off.

The hourmeter count only when the engine is running.

The hourmeter resolution is of 1 hour.

The maximum hours that can be visualized is 99999 (5 digits).

6. Total Odometer and partial Odometer

In the low area of the display there will be shown the total odometer and partial odometer.

The total odometer resolution is 0.1 miles or 0.1 km.

The default unit is miles (mph).

The maximum miles or km that can be visualized are 999999,9.

The cluster must count all the miles (or km) run from the speedometer guage.

The informations must be saved in memory each 0,1 miles and at each key off.

To change from the Total odometer visualization to the Partial odometer visualization, press (momentary activation) the LEFT button.

It is possible to reset only the partial odometer.

To reset the partial odometer (only from the MAIN SCREEN) press & hold the RIGHT BUTTON (>2000 ms).

7. Engine Fault

The information of the engine fault must be read on the CAN BUS from the following message:

ACTIVE DIAGNOSTIC TROUBLE CODES (DM1)---The information communicated is limited to the current active diagnostic trouble codes preceded by the diagnostic lamp status. Both are used to notify other components on the network of the diagnostic condition of the transmitting electronic component. The data contains the lamp status and a list of diagnostic codes and occurrence counts for currently active diagnostic trouble codes. This is all DTC's including those that are emissions related.

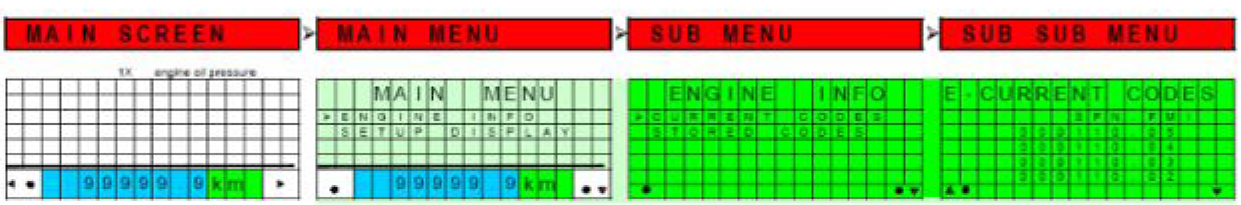
The currently defined lamps (Malfunction Indicator Lamps, Red Stop Lamp, Amber Warning Lamp, and Protect Lamp) are associated with DTC's. If the transmitting electronic component does not have active DTC's, then the lamp status from that component will indicate that the lamps should be off. However, the component controlling the actual lamp illumination must consider the status from all components that use these lamps before changing the state of the lamps.

There may be applications that require additional lamp definitions to accomplish their function (e.g. a lamp that indicates when cruise control is actively controlling would require a separate lamp in another PG.)

Transmission Rate:

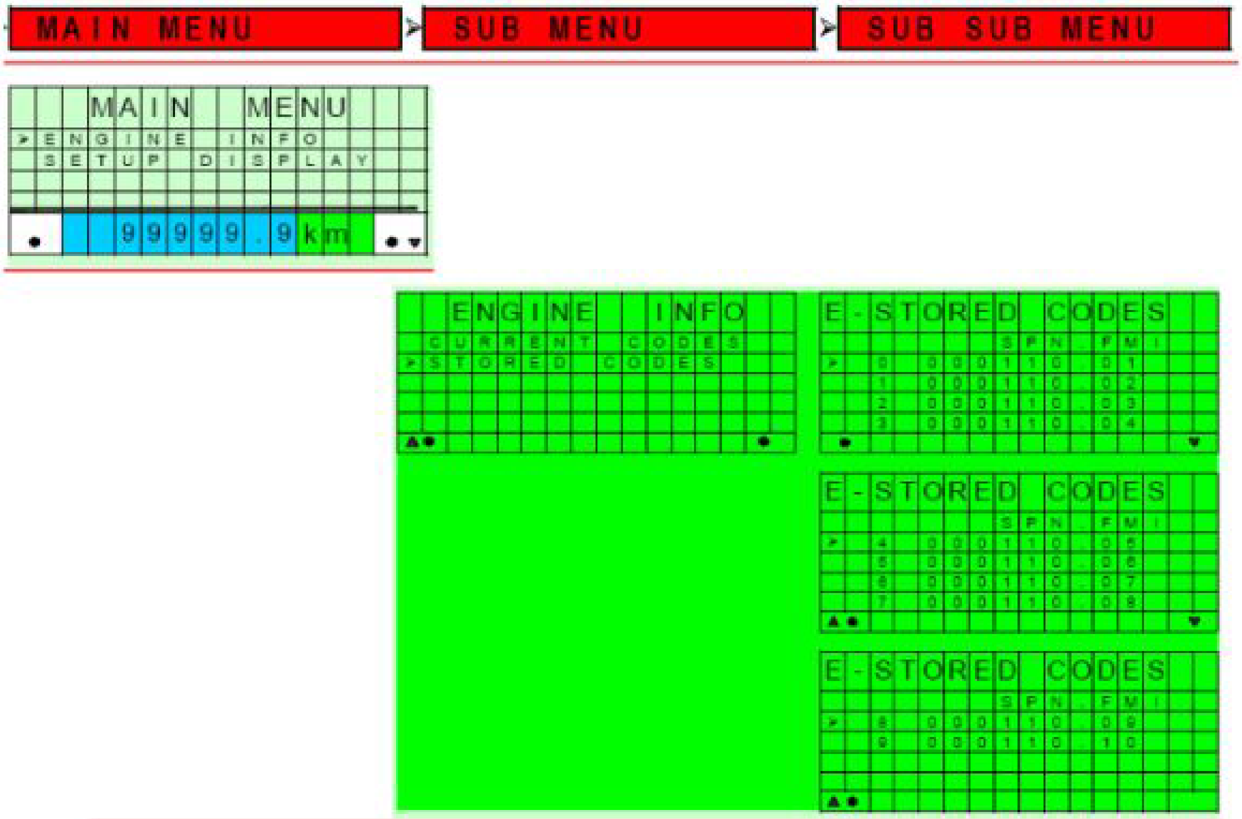
A DM1 message is transmitted whenever a DTC becomes an active fault and at a normal update rate of only once per second thereafter. If a fault has been active for 1 second or longer, and then becomes inactive, a DM1 message shall be transmitted to reflect this state of change. If a different DTC changes state within the 1 second update period, a new DM1 message is transmitted to reflect this new DTC. To prevent a high message rate due to intermittent faults that have a very high frequency, it is recommended tha no more than one state change per DTC per second be transmitted. Thus a DTC that becomes active / inactive twice within a 1 second interval, such as shown in Example Case 1, would have one message indentifying the DTC becoming active, and one at the next periodic transmission identifying it being inactive. This message is sent only when there is an active DTC existing or in response to a request. Note that this Parameter Group will require using the "multipacket Transport" Parameter Group (reference SAE J1939-21) when more than one active DTC exists

The cluster can show the active fault in the Engine Current Codes Menu like the following example:



There is another page of the menu where is possible to have the list of the last 10 faults happen.

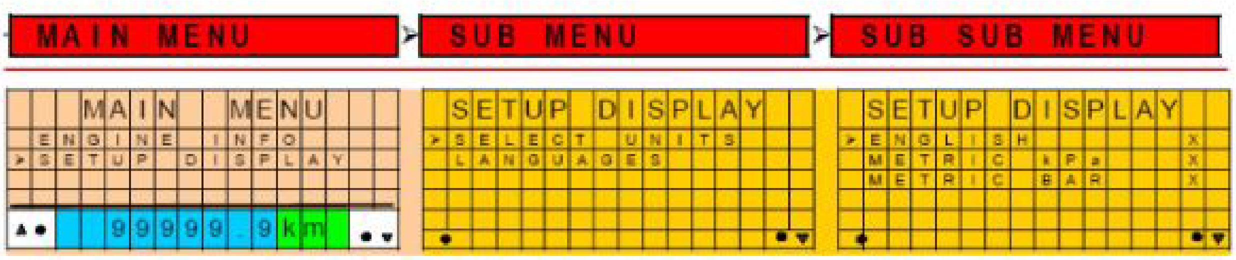
Following the menu structure:



To delete all the faults happen see the paragraph "menu navigation".

8. Select Unit

It is possible to change the units of all the feature like the following structure:



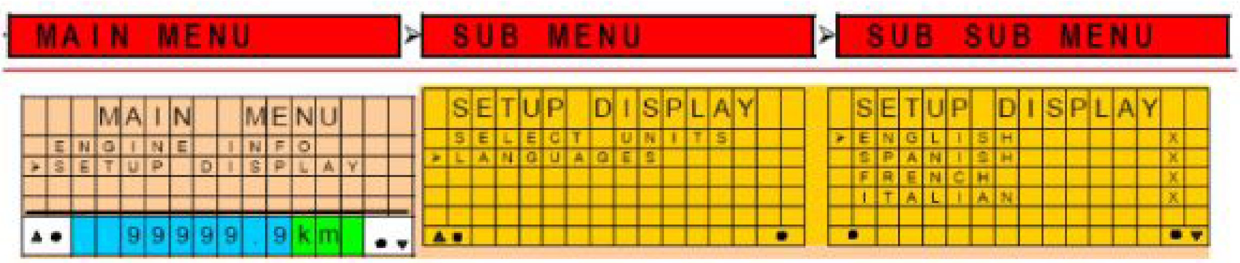
The default unit is English

Following the unit table:

Descrizione parametri	Unita di misura Inglese		Unita di misura Metrica KPa		Unita di misura Metrica bar		Descrizione parametri estesa
OIL PRESSURE	X	psi	X	KPa	X,XX	bar	Oil Pressure
TOT ODO	X,X	Miles	X,X	Miles	X,X	Km	Total Odometer
PART ODO	X,X	Miles	X,X	Miles	X,X	Km	Partila Odometer

9. Select Language

It is possible to change the language of all features like the following structure:



The default language is English.

10. Internal Buzzer

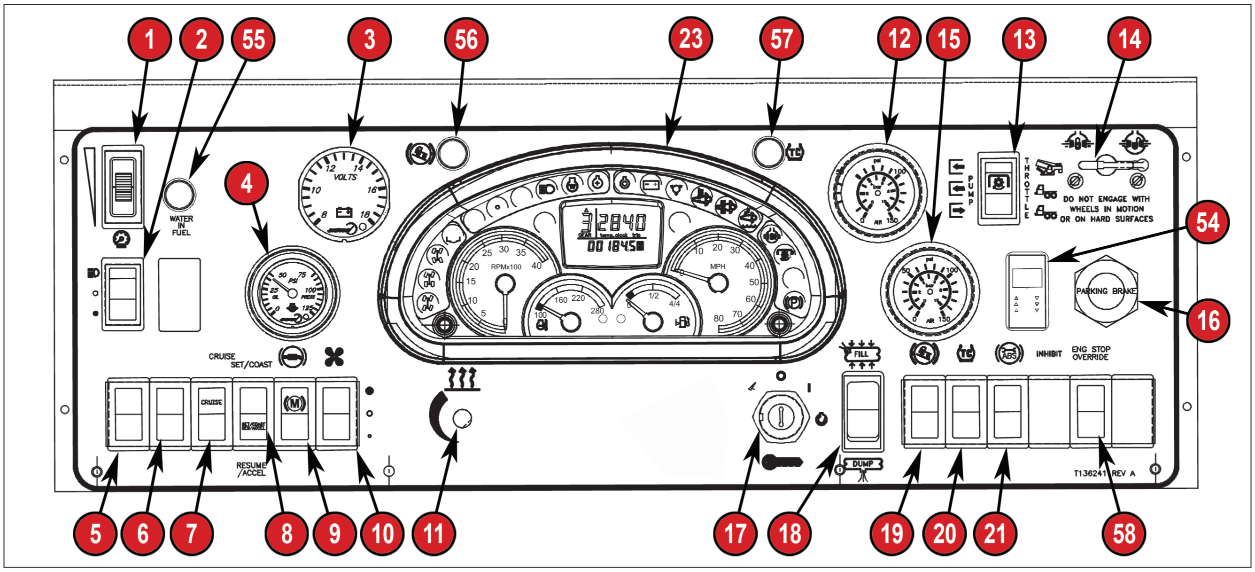
Inside the cluster there is a buzzer.

11. Check

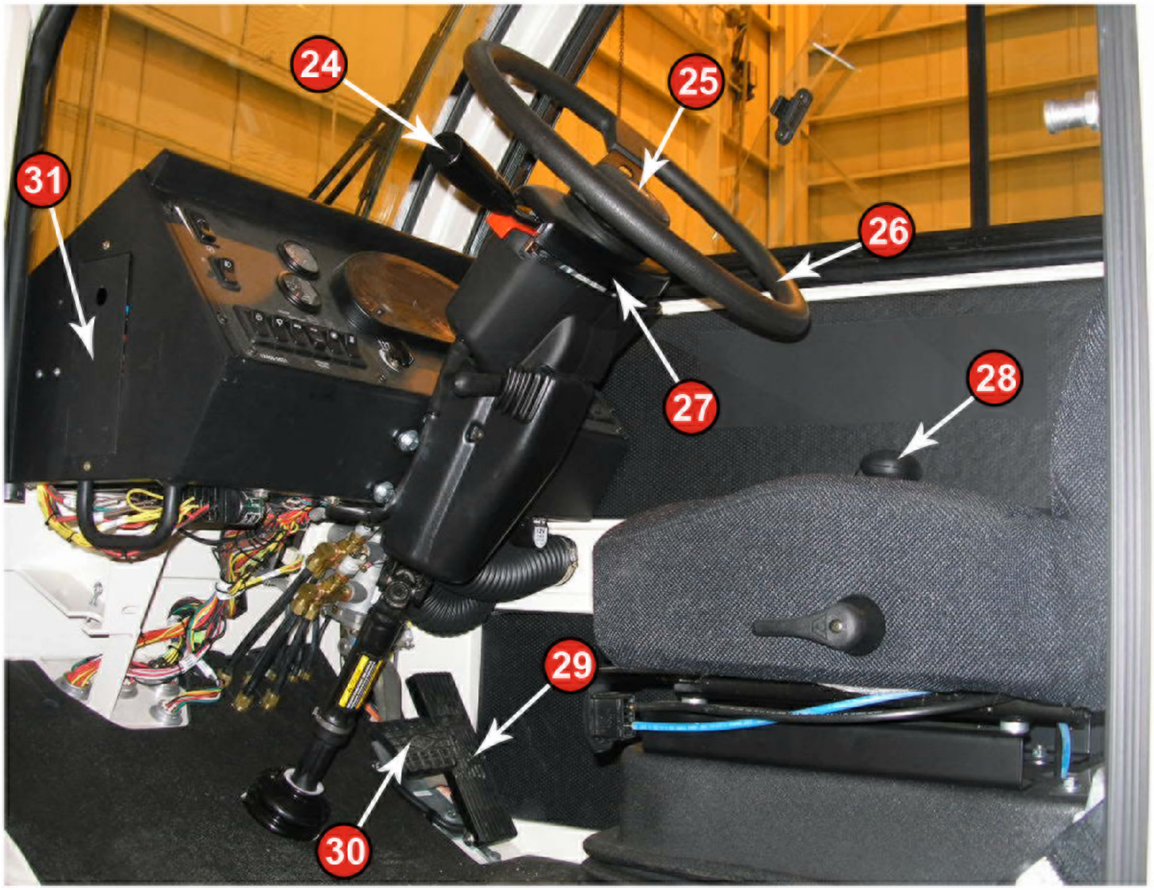
At the key on all the following functions will make a initial check of 2 seconds:

- All warning lights
- Load King Logo on the display
- Sound buzzer but only 1 second.

Carrier Controls and Instruments-EXPORT



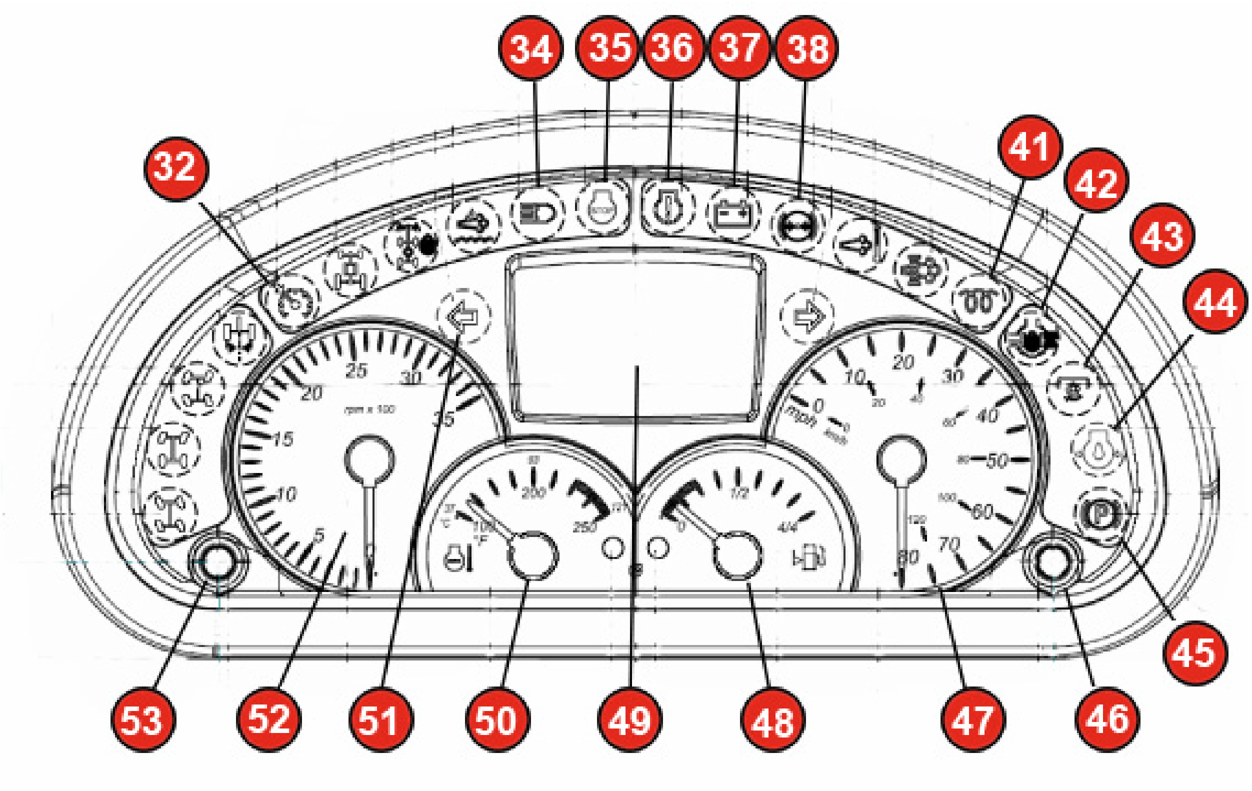
Mercedes-Benz OM460 Configuration



Carrier Controls & Instruments

1. GAUGE LIGHT DIMMER SWITCH-Turn to adjust brighness of gauge lights.	17. IGNITION SWITCH A. Circuits other than ignition "on". B. All circuits "off". C. All circuits including ignition "on". D. Engine "start".
2. HEADLIGHT SWITCH-(3) postion switch-OFF, middle position-marker lamps & dash lights ON, top position-marker lamps, dash lights & head lights ON.	18. AIR SUSPENSION CONTROL -Up to fill suspension, down to release air.
3. VOLTMETER- Indicates battery voltage and state of battery charge.	19. DIFFERENTIAL LOCK -Vehicle must be stopped to engage or disengage. Only for offroad use and increased traction. See Hill Assist Switch (item 19) under Carrier Controls & Instrucment DD13 engine section of manual.
4. ENGINE OIL PRESSURE GUAGE-Measures engine oil pressure. Graduated from 0 to 100 psi and 0 to 700 kPa.	20. ABS DIAGNOSTIC SWITCH-Down for normal operation, up for ABS diagnostic mode.
5. WASHER SWITCH-Press for windshield wash.	21. ENGINE ECM DIAGNOSTICS SWITCH-Momentary "ON" rocker switch. See Troubleshooting section of manual for operation.
6. WIPER SWITCH-Press for windshield wiper.	22. NOT USED
7. CRUISE CONTROL (On/Off)-Press to toggle cruise on and off.	23. WARNING LIGHTS & GUAGE DISPLAY PANEL- Refer to items 32 thru 53 for I.D. and function.
8. CRUISE (Set/Resume)-Press to set or resume cruise speed. Hold "Set" to coast. Hold "Resume" to accelerate. Minimum cruise set speed is 40 MPH.	24. TURN SIGNAL CONTROL-Lift up to activate right turn signals, press down to activate left turn signals.
9. ENGINE BRAKE (On/Off)-Press to activate engine brake.	25. HORN-Press to activate horn.
10. AC/FAN (Hi/Lo)-Press down for fan low, up for fan high. Also turns on AC with AC also in "ON" position. AC control switch located on AC unit behind seat.	26. STEERING WHEEL-Turn clockwise to steer the machine right, turn counterclockwise to steer the machine left.
11. TEMPERATURE ADJUST-Adjusts heat temperature.	27. 4 WAY FLASHER-Pull to activate flashers, push to deactivate.

12. AIR GUAGE (Front)-Indicates air pressure in front air tank. Maintain 110 to 115 psi normal system air pressure.	28. TRANSMISSION SHIFT LEVER -See Dana UltraPlus Transmission Operations instructions.
13. PTO AIR VALVE SWITCH-Push up to engage pumps, push down to disengage.	29. ACCELERATOR PEDAL-Depress to accelerate.
14. INTER AXLE LOCKOUT VALVE-Lock out inter-axle differential. Should the machine become stuck, a spinning wheel will receive all power transmitted by the drivetrain causing the wheel to spin faster and worsen the condition. Use of the lockout divides the available power between the two axles of the rear tandem. Wheels on both tandems will be locked together. A wheel on each axle may still spin. With the lockout engaged, the stuck wheel may continue to spin but the other side of the tandem will begin "driving".	30. BRAKE PEDAL-Depress to actuate.
15. AIR GUAGE (REAR) -indicates air pressure in rear air tank. Maintain 110 to 115 psi normal system air pressure.	31. CIRCUIT BREAKERS-Electrical circuit breakers are under this panel.
16. PARKING BRAKE CONTROL VALVE - Controls parking brakes. Pull to apply, push to release.	



Carrier Instruments & Warning Lights

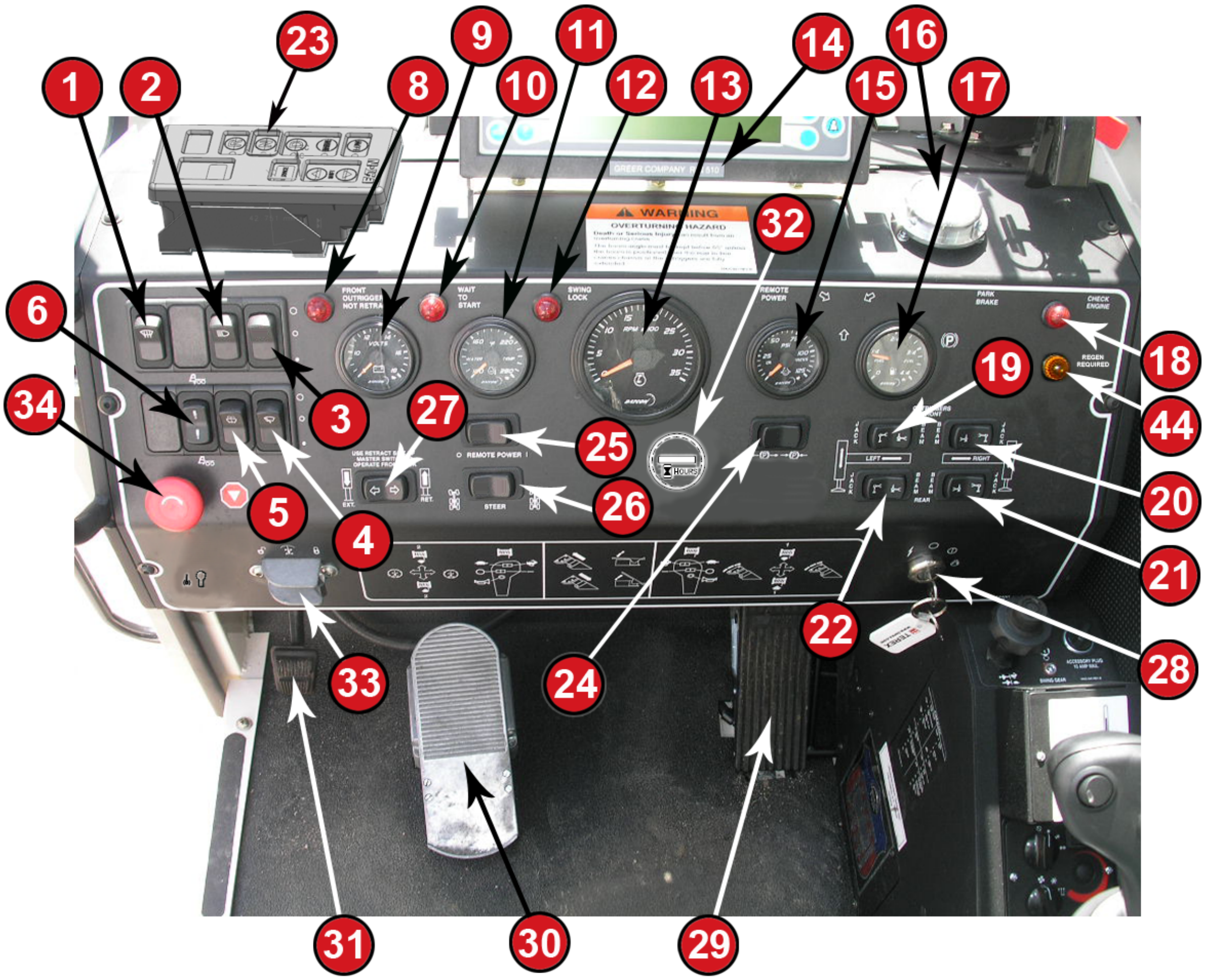
32. CRUISE-Blue colored Warning Light "ON" when cruise control is set.	46. SUB MENU NAVIGATION BUTTON-LCD Display screen sub menu select/ deselect button. (See UNIDECK Manual).
33. NOT USED	47. SPEEEDOMETER GUAGE-MPH (0-80) & Kph (0-120).
34. BRIGHT-Blue colored Warning Light "ON" when HI beam headlamps are "ON".	48. FUEL LEVEL GUAGE-Guage and Amber colored Warning Light "ON" with low fuel level.
35. ENGINE STOP-Red colored Warning Light "ON" when Engine should be shutdown.	49. LCD DISPLAY -Readouts: Load King Logo, Clock, Total Engine Machine Hours, Engine Oil Pressure, Total Odometer, Partial Odometer, Languages menu, Engine Fault. (See UNIDECK Operation & Instructions on 2010 Tier 4 section).
36. ENGINE CHECK-Amber colored Warning Light "ON".	50. ENGINE COOLANT TEMPERATURE GUAGE-Guage and Red colored Warning Light "ON" when engine is at 230 degrees Farenheit (110 C) or above. Engine is overheating.

37. BATTERY CHARGING CONDITION-Red colored Warning Light "ON" if less than 12 volts.	51. LEFT TURN SIGNAL-Green colored flashing Warning Light "ON".
38. LOW AIR PRESSURE-Red colored Warning Light "ON" if less than 60 PSI.	52. TACHOMETER GUAGE-Engine RPM x 100 Guage (0-3500 RPM).
39. NOT USED	53. MENU NAVIGATION BUTTON -LCD Display screen menu. (See UNIDECK Operations Instructions).
40. NOT USED	54. MIL-MALFUNCTION INDICATOR LIGHT - The MIL illuminates when the On-Board Diagnostics system detects a malfunction related to the emissions control system. The illuminated MIL indicates that the engine and aftertreatment system should be diagnosed and serviced at your next available opportunity. The MIL can be illuminated along with any of the engine indicator lamps. If the MIL is illuminated with the red Stop Engine Lamp, the vehicle should be stopped as soon as it is safe to do so. It should be taken to an authorized Detroit Diesel location for repair.
41. NOT USED	55. WATER IN FUEL INDICATOR LIGHT
42. INTERAXLE DIFFERENTIAL LOCK-Amber colored Warning Light "ON". Differential is locked.	56. HILL ASSIST INDICATOR LIGHT (HSA) - When HSA lamp is controlled by the ABS controller, the lamp will be OFF when the system is operating normally. The lamp will turn ON if the system is defaulted. The lamp will flash at a reat of 1 Hz when the system has been temporarily disabled by the operator.
43. PTO ON-Amber colored Warning Light "ON", PTO is engaged..	57. TRACTION CONTROL INDICATOR LAMP
44. ENGINE OIL PRESSURE-Red colored Warning Light "ON" if less than 80 Kpa (about 12 PSI).	58. WATER IN FUEL INDICATOR LAMP
45. PARK LAMP-Red colored Warning Light "ON".	59. NOT USED
	60. NOT USED

61. FIRE EXTINQUISHER -Fully charged indicator arrow on "Green". Remove latch, pull safety pin, point toward base of flame and depress black handle to discharge fire suppressant.	**62. WINDSHIELD WASHER RESERVOIR** - Use only over the counter washer fluid made specifically for automotive windshields.

NOTE: *Refer to Carrier Controls and Instruments-Detroit Diesel DD13-GHG14 for instructions on operation of transmission, PTO Engagement and UNIDECK Instrument Panel.*

Upper Controls and Instruments



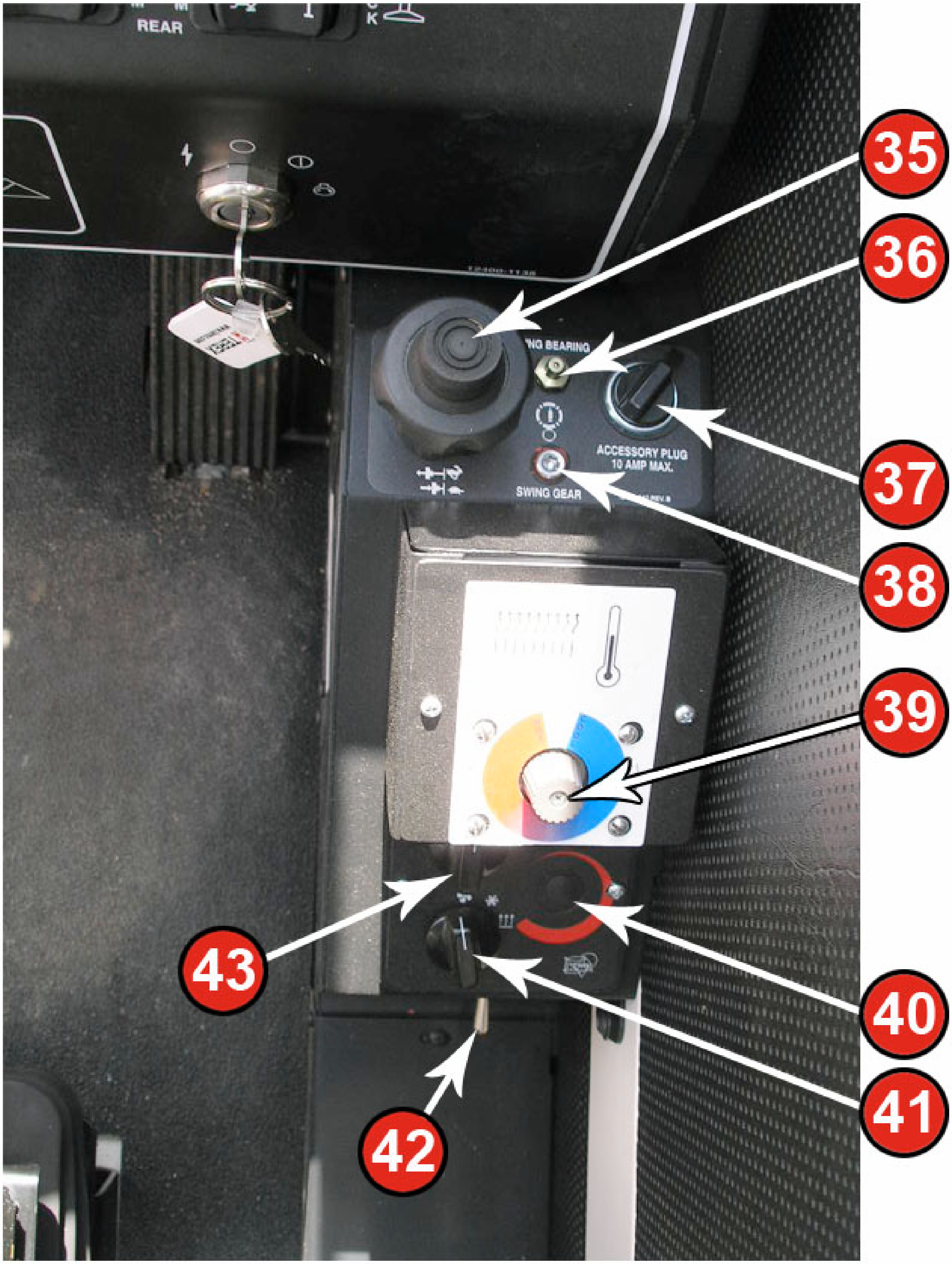
UPPER CONTROLS & INSTRUMENTS

1. DEFROSTER FAN SWITCH	18. CHECK ENGINE-Red light "ON" indicates check Engine condition. 18A STOP ENGINE -Red light "ON" indicates stop engine.

2. DASH LIGHT SWITCH-Press top part of switch to backlight guages and switches.	19. OUTRIGGER SWITCH-LF-Switch controls Left Front Jack cylinder. Push left side of switch to run beam in conjunction with (27) Master Switch. Push right side of switch to run jack in conjuction with (27) Master Swtich. To keep equal pressure on outrigger pads hold (19) and (22) together on left side when raising or lowering, doing incrementally from left side to right side until crane is level.
3. WORK LIGHT SWITCH- Two position switch-OFF or Work Lights ON.	20. OUTRIGGER SWITCH-RF-Switch controls Right Front Jack cylinder. Push right side of switch to run beam in conjunction with (27) Master Switch. Push left side of switch to run jack in conjuction with (27) Master Switch. To keep equal pressure on outrigger pads hold (20) and (21) together on right side when raising or lowering, doing incrementally from right side to left side until crane is level.
4. WIPER SWITCH-Press lower part of switch for "LO" speed, upper for "HI" speed, center for "OFF" windshield wiper.	21. OUTGRIGGER SWITCH-RR-Switch controls Right Rear jack cylinder.. Push right side of switch to run beam in conjunction with (27) Master Switch. Push left side of switch to run jack in conjuction with (27) Master Swtich. To keep equal pressure on outrigger pads hold (20) and (21) together on right side when raising or lowering, doing incrementally from right side to left side until crane is level.
5. WINDSHIELD WASHER SWITCH-Push to dispense washer fluid on windshield.	22. OUTRIGGER SWITCH-LR-Switch controls Left Rear jack cylinder. Push left side of switch to run beam in conjunction with (27) Master Switch. Push right side of switch to run jack in conjuction with (27) Master Swtich. To keep equal pressure on outrigger pads hold (19) and (22) together on left side when raising or lowering, doing incrementally from left side to right side until crane is level.
6. FRONT JACK SWITCH-Setting front jack run engine at IDLE only. Only make contact with pad to ground and sense a slight lifting.	23. HYDRAULIC REMOTE CONTROL SHIFTER (Option)-See Hydraulic Remote Control section for operation.

7. CUP HOLDER	24. HYDRAULIC REMOTE CONTROL TRANSMISSION SWITCH (Option)-See Hydraulic Remote Control section for operation.
8. FRONT JACK INDICATOR-Red light "ON" indicates the front jack is "NOT" retracted.	25. HYDRAULIC REMOTE POWER SWITCH (Option)-See Hydraulic Remote Control section for operation.
9. VOLTMETER-Guage indicates battery or alternator condition.	26. HYRAULIC REMOTE CONTROL STEERING SWITCH (Option)-See Hydraulic Remote Control section for operation.
10. WAIT TO START-Red colored Warning Light "ON". Do not engage Engine starter until light goes "OFF".	27. OUTRIGGER EXTEND/RETRACT MASTER SWTICH-Switch is actuated before the Outrigger Swtiches (19) (20) (21) (22) to Extend or Retract the outrigger beams and jacks. Push switch left to retract and right to extend.
11. ENGINE COOLANT TEMPERATURE GUAGEGuage and Red colored Warning Light "ON" when engine is at 230 degrees Farenheit (110 C) or above. Engine is overheating..	28. IGNITION SWITCH A. All circuits "off". B. Circuits other than ignition "on". C. All circuits including ignition "on". D. Engine "start".
12. SWING LOCKED INDICATOR-Red light "ON" indicates the superstucture is locked and will not rotate.	29. ACCELERATOR-Push to increase engine RPM and release to decrease.
13. TACHOMETER-Guage indicates Engine RPM.	30. BOOM EXTEND/RETRACT PEDAL-Tilt the pedal halfway forward to power-extend the boom. Tilt the pedal all the way forward for high speed (regenerative) extend. The boom extend will stop at the transition between power extend and high speed. In high speed the boom extend has minimal extend force. Tilt pedal backward to retract the boom.
14. GREER LMI DISPLAY-See RCI510 Operators Manual for operation.	31. SWING BRAKE-Apply to prohibit the boom from swinging. This is a dynamic friction brake and can be feathered to slow boom swing during operation, or can be locked into postion via the (32) Swing Brake Release knob above on the dash panel. Always set the Swing Lock (33) when transporting the machine or exiting the cab.

15. ENGINE OIL PRESSURE -Measures engine oil pressure. Graduated from 0 to 100 psi and 0 to 700 kPa.	32. SWING BRAKE RELEASE-Lift up on knob and pull to disengage the swing brake. Knob control can be set in two postions, "OUT" position allowing the swing brake pedal to freely operate. The other postion "IN" locks the swing brake.
16. BUBBLE LEVEL-The crane must be leveled prior to lifting a load.	33. SWING LOCK SWITCH-Push right to engage the swing lock, left to disengage the swing lock. Alway engage the lock when exiting the cab or transporting the machine. *480-126* Swing Lock will not engage when the boom is in the boom rack due to swing bearing teeth alignment.
17. FUEL GUAGE-Guage and Amber colored Warning Light "ON" with low fuel level.	34. EMERGENCY STOP SWITCH-Push to stop engine in case of emergency. "Turn and Pull" switch to reset and allow engine to be started again.


REAR
ACCESSORY PLUG
10 AMP MAX.
SWING GEAR
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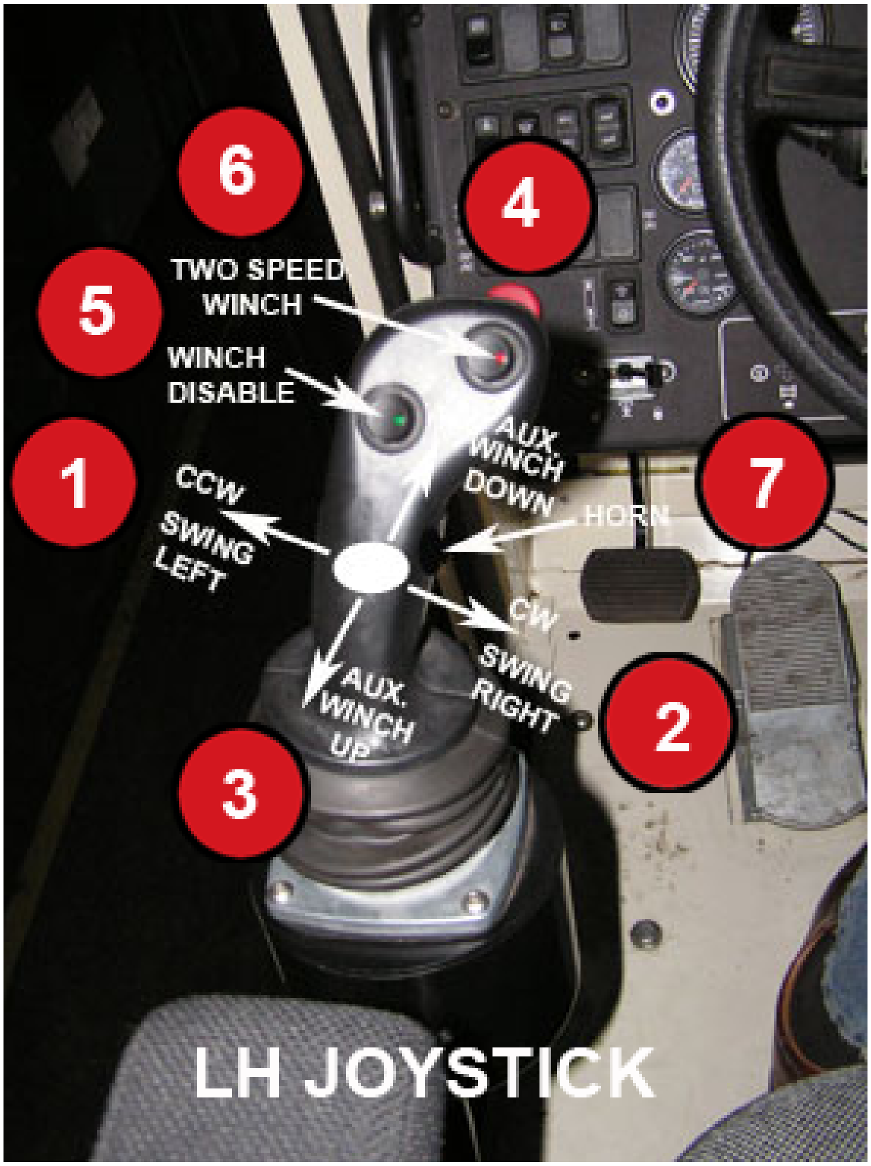
42
43

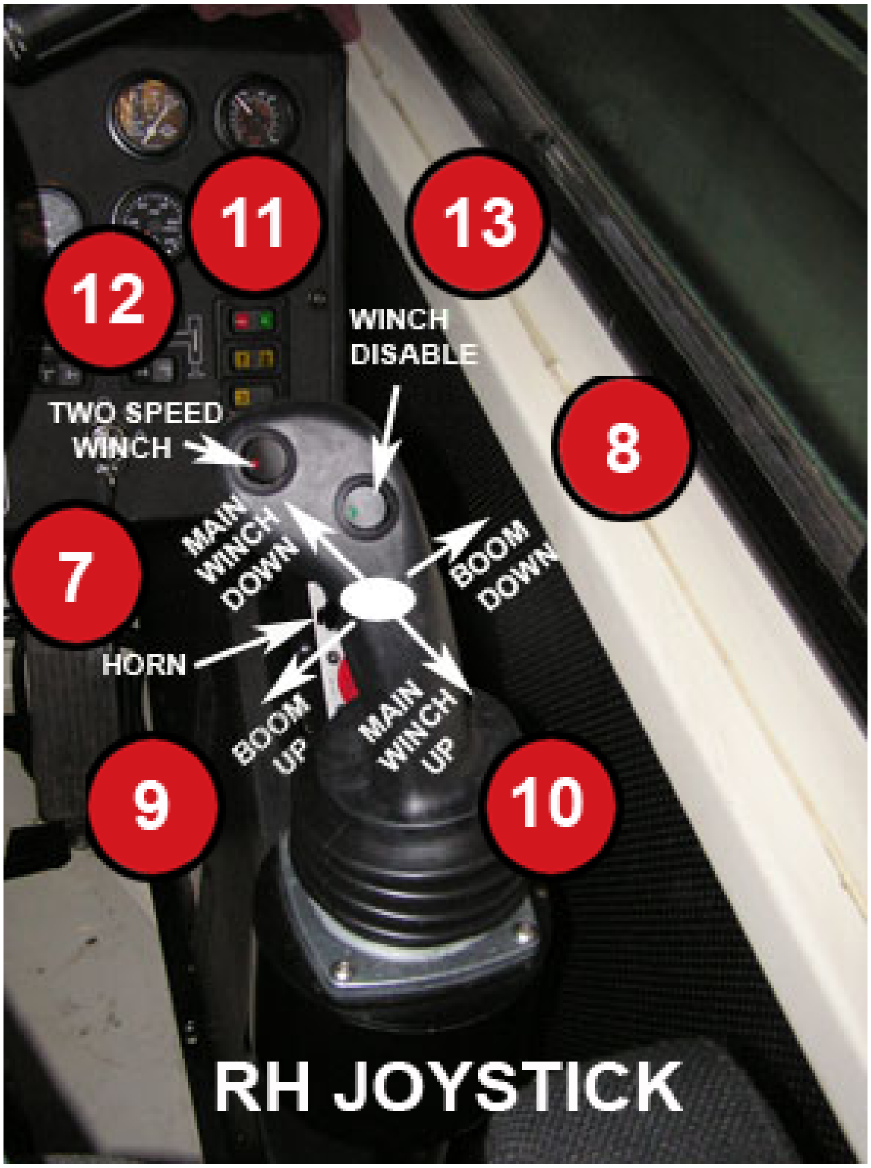
35. HAND THROTTLE - Holds engine throttle at an operator settable position. Place the accelerator (27) at approximate RPM. Push in button on hand throttle. Pull throttle up and release button to lock. Make fine adjustments to engine RPM by rotating the hand throttle clockwise to decrease RPM and counter-clockwise to increase RPM.	40. HEATER RANGE SELECTOR SWITCH-Continuously variable rotary switch. The lowest switch position cuts power to the relief valve and results in a minimal pressure drop of 175-200 psig. Clockwise rotation increases the pressure drop and associated heat output.
36. SWING BEARING GREASE FITTING - Lubricate while swinging upper to distribute grease.	41. MODE SELECTOR SWITCH-Allows the operator to set the unit to fan only, AC or heat mode.
37. ACCESSORY PLUG-12 VDC power.	42. SWING SENSE SWITCH-In "OFF" position shuts off AC compressor to allow Swing function control not to be interupted due to hydraulic oil flow being on the same circuit. In "ON" position AC compressor can cycle on or off as required to maintain temperature control in cab.
38. SWING GEAR GREASE FITTING - Lubricate while swinging upper to distribute grease.	43. MASTER POWER & FAN SPEED SELECTOR SWITCH-Switch powers up the unit and provides operator control of three fan speeds.
39. CAB A/C TEMPERATURE CONTROL-Turn clockwise for cooler temperature.	



LH JOYSTICK CONTROL

1. SWING LEFT-CCW CONTROL-Move joystick to left and upper structure will rotate CCW proportional in speed to throttle setting and movement of joystick.	
2. SWING RIGHT-CW CONTROL-Move joystick to right and upper structure will rotate CW proportional in speed to throttle setting and movement of joystick.	

3. AUXILIARY WINCH-UP CONTROL-Move joystick backward to take in aux winch wire rope. Speed of wire rope is proportional to throttle setting and movement of joystick-raising the load.	**3A. AUXILARY WINCH ROTATION INDICATOR**-Internal to the handle is a thumper indicator that is felt by the operators hand to assist in the speed the winch drum is traveling when the Auxilary winch joystick is moved forward or backward.
4. AUXILIARY WINCH-DOWN CONTROL-Move joystick forward to pay out aux winch wire rope. Speed of wire rope is proportional to throttle setting and movement of joystick-lowering the load.	
5. AUXILIARY WINCH DISABLE SWITCH-Depress switch-LED green light will come "ON", winch function will be disabled. The Auxilary winch function when it is not being utilized prevents damage to the cable when it is on the winch, but not rigged over the boom head. (Tied off to winch drum, etc.)	
6. AUXILIARY WINCH TWO SPEED SWITCH-Depress switch-LED red light will come "ON", Aux. winch wire rope take in and pay out speed will be in "HIGH" speed mode.	
7. HORN-Depress switch on front face of joystick will sound the horn.	

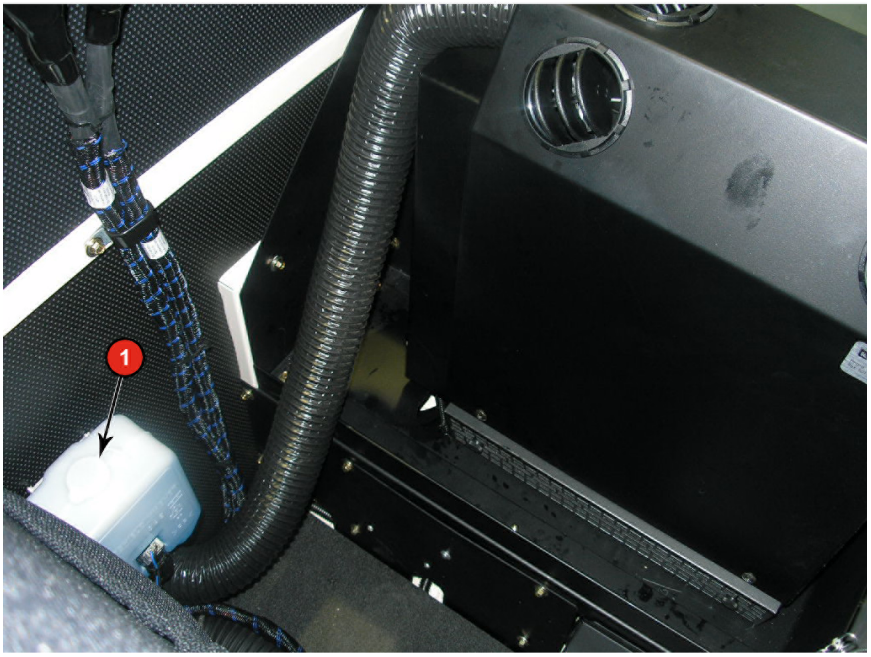


RH JOYSTICK CONTROL

7. HORN-Depress switch on front face of joystick will sound the horn.	
8. BOOM DOWN CONTROL-Move joystick to right will lower the boom proportional in speed to throttle setting and movement of joystick.	
9. BOOM UP CONTROL-Move joystick to left will raise the boom proportional in speed to throttle setting and movement of the joystick.	

10. MAIN WINCH-UP CONTROL-Move joystick backward to take in main winch wire rope-raising the load..	10A. MAIN WINCH ROTATION INDICATOR-Internal to the handle is a thumper indicator that is felt by the operators hand to assist in the speed the winch drum is traveling when the Main winch joystick is moved forward or backward.
11. MAIN WINCH-DOWN CONTROL-Move joystick forward to pay out main winch wire rope-lowering the load.	
12. MAIN WINCH TWO SPEED SWITCH-Depress switch LED red light will come "ON", Main winch wire rope take in and payout speed will be in "HIGH" speed mode.	
13. MAIN WINCH DISABLE SWITCH-Depress switch-LED green light will come "ON", main winch function will be disabled. The Main winch function when it is not being utilized prevents damage to the cable when it is on the winch, but not rigged over the boom head. (Tied off to winch drum, etc.)	

Windshield Washer Reservoir



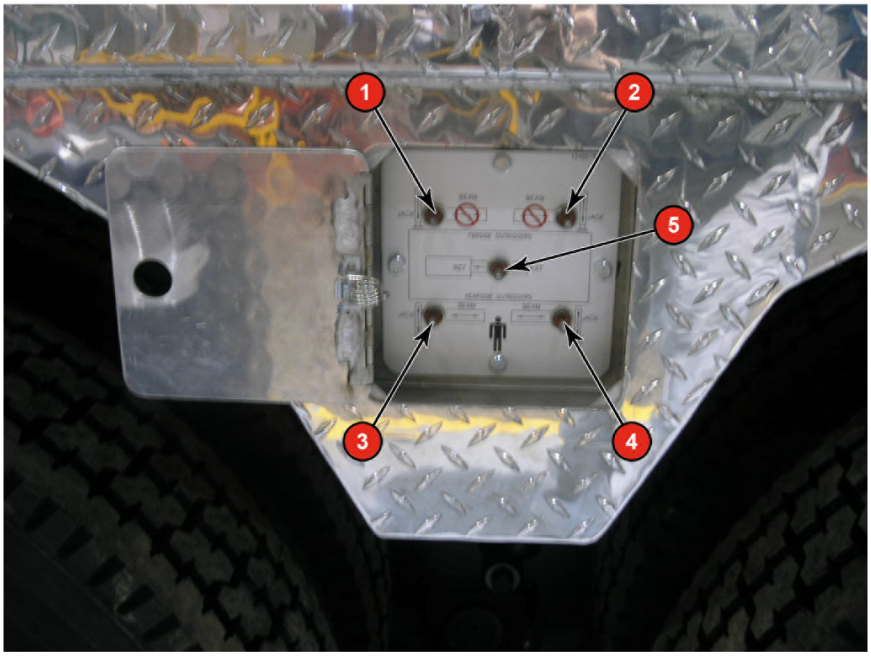
1. WINDSHIELD WASHER RESERVOIR-Fill to "Full" mark with automotive grade washer fluid.

Heater & AC Unit

1. Heater & AC Unit-See Kenway Operations & Maintenence Manual on your Manual Pack Shop Manual CD.

Outrigger Controls-External (Streetside)

Your cranes is available as an Option remote outrigger control boxes. Located on the street side midship (as shown below) is a panel door to access the control switches. There will be a control box with access cover on both sides of crane and one located in the front for control of front jack cylinder.



1. **Right Front Outrigger Jack**-Move toggle switch "UP" or "DN" and hold to enable jack cylinder. Use switch #5 to extend or retract the jack cylinder.	4. **Left Rear Outrigger Jack Cylinder & Beam**- Move toggle switch "Right" for jack cylinder enable and hold. Use switch #5 to extned or retract the jack cylinder. Move toggle switch "Left" for LR beam enable. Use swtich #5 to extend or retract the beam.
2.**Right Rear Outrigger Jack**-Move toggle switch "UP" or "DN" and hold, to enable jack cylinder. Use switch #5 to extend or retract the jack cylinder.	5. **Extend-Retract Master Switch** -Move toggle switch left or right in conjunction with enable switches #1, 2, 3 or 4 to control outrigger jacks and beams.
3. **Left Front Outrigger Jack Cylinder & Beam**-Move toggle switch "Left" for jack cylinder enable and hold. Use switch #5 to extend or retract the jack cylinder. Move toggle switch "Right" for LF beam enable. Use switch #5 to extend or retract the beam.	

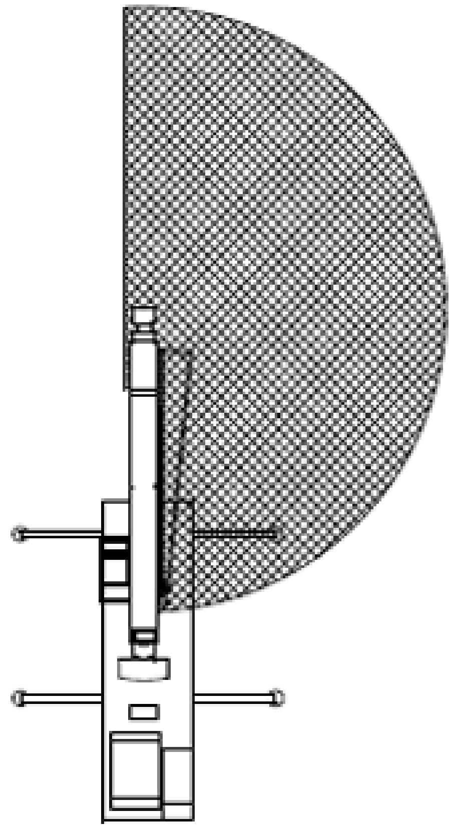
Side-Stow Jib

DESCRIPTION-480-126

Optional jib extension is available to provide additional boom reach, which is a 33-57 ft. (10.05 - 17.37 m) side stow swing-on lattice type jib. The jib is extendible to 57 ft. (17.37 m) by means of a 25ft. (7.62 m) manual pullout tip section.

The 33-57 ft. (10.05-17.37 m) jib weighs 2,070 pounds (939 kg).

Each optional jib extension is pinned directly to the ends of the sheave pins. When not in use, the jib can be unpinned from the boom head and stored on mounting brackets on the right side of the boom base section.



NOTE: *See the Assembly section of this manual for "Erecting the Jib" and the Disassembly section of this manual for "Stowing the Jib".*

Before stowing the jib, ensure that no personnel or obstacles are in the swing path of the jib.

Pre-Start Inspection

The following items should be checked each day before start-up and the start of operations. Also see “Daily Check.” on page 126

ENGINE OIL

The level should be at the full mark.

COOLANT

The level should be near the bottom of fill neck in coolant tank when cold.

DIESEL EXHAUST FLUID

Check diesel exhaust fluid (DEF) or Urea tank level is full. An illuminated Warning on dash or Check Engine light will indicate a low level.

LEAKAGE

Make a ground check below the machine for signs of leaks. See Hydraulic Hose topic in Maintenance section.

FUEL

Fuel for the engine and for upper unit heater should be adequate for sustained operations.

LUBRICATION

Perform the daily lubrication as required in the Lubrication Recommendations. Lubricate cylinder mounting bushings, and pins.

LINES AND BLOCKS

Inspect the hoist lines, hoist block and ball hook, and the crane attachment in general for readiness.

SAFETY EQUIPMENT

Check the safety equipment, including all lights, brakes, and hazard warning devices.

TIRES

The tires should be checked for proper pressure before traveling the machine. The tires should only be checked when cold. Refer to the Tire Pressure Chart in the operator’s cab.

WHEEL NUTS

Torque all lug nuts to 450-500ft. lbs (Dry). Check tightness daily during the first 50 miles of service on new units and any time the wheels have been removed. Ensure proper alignment of tire and rim assemblies by following the torquing procedures in the Service section-Wheel and Rim Mounting topic.

GENERAL CONDITION

Inspect the machine in general for wear, leakage, and damage.

AIR TANKS

Open the air tank drain cock to blow out moisture and sediment.

FUEL FILTER

Water and sediment should be drained from the two fuel filters by opening the drain cock at the bottom of each. See also, “Daily Check.” on page 126

ATB SYSTEM

Inspect all ATB switches found on boom, jib, and auxiliary sheave heads for damage. Check the freedom of counterweight attached to these switches; and also, that counterweight is attached around correct line of hoisting cable in the proper manner. Inspect all electrical connections and wires as well as the entire length of cable attached to the cable reel and it’s connections for evidence of excessive wear, damage, or improper installation. Check spring loaded cable reel for proper tension and to insure that reel is free to rotate. Verify visual and audible warning devices by lifting each of the counter weights.

This crane is equipped with a disconnect system on the control linkages. A check of this system should be made prior to lifting. Hoist the hook block to the boom point so that actual contact between block and ATB counterweight is made. If all functions are operating properly, winch hoisting will cease and the boom cannot be extended or lowered. Should any of these functions continue, disconnect system is functioning improperly and a complete system check must be made. Boom raise, boom retract, and winch down-functions remain active and will be unaffected by ATB system.

> When performing disconnect test, care should be taken as damage may result if disconnect system malfunctions and the hook block is drawn into the boom point.

PUMP DISCONNECT

It is important that you check to ensure that the disconnect light on the carrier cab dash is "ON" after throwing the switch to engage the pumps and before starting the engine.

Failure to follow this procedure will cause damage to the pump disconnect splines.

Suggested Hydraulic Crane Inspection Checklist

This check list is to be used in addition to the information provided in this manual to properly operate and maintain the machine.

ITEMS TO BE INSPECTED & CHECKED	INSPECTION CODE	SATISFACTORY	ADJUST	REPAIR
VISUAL INSPECTION H (Complete Machine)	D			
OVERALL CLEANLINESS	D			
HYDRAULIC SYSTEM (See Hydraulic Hose topic in Maintenance section) (Leaks or Damage)	D, A			
AIR SYSTEM (Leaks or Damage)	D			
HYDRAULIC FLUID	D			
TRANSMISSION FLUID LEVEL	D			
ENGINE CRANKCASE FLUID LEVEL	D			
FUEL TANK FLUID LEVEL	D			
RADIATOR FLUID LEVEL	D			

MACHINE LUBRICATION	D			
ATTACHMENT PIN BOLTS	D			
MUFFLER/ EXHAUST SYSTEM	D			
ALL CONTROL MECHANISMS	D			
INSTRUMENT GAUGES	D			
CLUTCHES & BRAKES	D			
WIRE ROPE, SHEAVES & GUARDS	D			
TWO BLOCK DAMAGE PREVENTION SYSTEM	D			
LOAD SUPPORTING COMPONENTS CONDITION	D			
FIRE EXTINGUISHER	D			
BACKUP ALARM	D			
BOOM ANGLE INDICATOR	D			
HEAD/TAIL/ BRAKE LIGHTS & 4 - WAY FLASHERS	D			
HORN	D			

CABLE SPOOLING PROPERLY	D			
WEDGE SOCKETS	D			
AXLE FLUID LEVEL	W			
SWING REDUCER FLUID LEVEL	W			
DRIVE SHAFTS & U JOINTS	W			
TIRE & WHEEL CONDITION & INFLATION PRESSURE	W			
AIR REGULATORS	W			
AIR CLEANER ELEMENT	W			
CLUTCH & BRAKE LINKAGE & PINS	W			
WHEEL LUG NUT TORQUE	W			
FAN BELT TENSION	W			
STRUCTURAL MEMBERS & WELDS	W			
BOOM INSPECTION	W			

BATTERIES & STARTING SYSTEM	M			
TRANSMISSION FILTER	P			
ENGINE OIL FILTER	P			
ENGINE FUEL FILTER	P			
SWING BEARING BOLT TORQUE	P			
MACHINERY GUARDS	P			
LOAD CHART & SAFETY WARNINGS	P			

H Inspect OVERALL machine (including carrier) for cracks, weld separation, leaks, damage, vandalism.

INSPECTION CODE INTERVALS

D - DAILY

W - WEEKLY

M - MONTHLY

A - ANNUALLY

P - PERIODIC

NOTES:

1. Indicate inspection result by checking in the satisfactory, adjust, or repair boxes provided.
2. When appropriate, enter your diagnosis on back of page for repairs or adjustments made.

REPAIRS - ADJUSTMENTS - REMARKS

ITEM	REQUIREMENT	DATE

Daily Check (8 Hours)

__ Perform Daily Lubrication

__ Check Hydraulic Reservoir Fluid Level

__ Fill Fuel Tank

__ Check Engine Oil Level

__ Check Coolant Level

__DEF Aftertreatment Fluid (Urea) Tank Level

__ Check Hydraulic Cylinder Mounting Bushings And Pins

__ Check Hydraulic Components including hoses. (See the Hydraulic Hose topic in Maintenance section of this manual).

__ Check Transmission Oil Level

__ Drain Fuel Filters or Water Separator

__ Check Boom Front Slider Pads

__ Check Boom Chains And Ends

__ Drain Air Tanks

__ Check Wire Rope And Related Components

__ Check Air Cleaner

__ Check Controls

__ Check Instruments, Gauges, Lights, & Safety Equipment

__ Make Overall Visual Inspection

__ Check ATB System

__ Check Engine Manufacturer's Manual For Additional Maintenance Requirements

__ Ensure Swing Brake Is Able To Hold Against Full Torque Of Swing Motor-depress Swing Brake pedal (5) clicks

Weekly Check (40 Hours)

__ Perform The Daily Check

__ Perform Weekly Lubrication

__ Check Swing Reducer Oil Level

__ Check Axle Oil Level (after initial change)

__ Check Battery Condition

__ Check Tire Pressure And Condition

__ Check Air System Safety Valve

__ Check Torque On Wheel Lug Nuts

__ Check Hydraulic Cylinders And Rods

__ Make Thorough Inspection Of Wire Rope

__ Visually Inspect All Structural Members And Welds For Cracks, Alignment and Wear

__ Check Boom For Wear Cracked Welds, Alignment And Missing Or Illegible Decals

__ Check Engine Manufacturer’s Manual For Additional Maintenance Requirements

__ Clean Machine Weekly If Salt Covered To Prevent Rust And Corrosion

Monthly Check (80 hours)

__ Perform Daily And Weekly Checks

__ Perform Monthly Lubrication

__ Check Engine Belts

__ Check Hydraulic Reservoir For Moisture

__ Check All Slider Pads

__ Have Hydraulic Oil Sample Analyzed

__ Clean Radiator & Oil Cooler Exterior

__ Check Engine Manufacturer’s Manual For Additional Maintenance Requirements

Quarterly Checks (250 Hours)

__ Perform Daily, Weekly And Monthly Checks

__ Perform Quarterly Lubrication

__ Drain Fuel Tank Of Water And Sediment If Necessary

__ Check Brake Shoes for Wear Condition

__ Change Transmission Oil And Shift Air Filter

__ Change Hydraulic Return Line Filters

__ Replenish Cooling System Corrosion Inhibitor (refer to engine manufactures manual)

__ Check Engine Manufacturer's Manual For Additional Maintenance Requirements

Semiannual Checks (1000 Hours)

__ Perform Daily, Weekly, Monthly And Quarterly Checks

__ Perform Semiannual Lubrication

__ Clean Crankcase Breather

__ Check Hydraulic Reservoir Relief Valve

__ Clean Hydraulic Reservoir Intake Suction Filter

__ Check Air Dryer Desiccant For Signs Of Oil Accumulation

__ Check Hydraulic Relief Valve Pressure Settings

__ Torque Swing Bearing Bolts (Refer to Swing Bearing Bolting Procedure in Maintenance section of this manual)

__ Check Engine Manufacturer’s Manual For Additional Maintenance Requirements

__ Check All Adjustments Specified In The “Service And Adjustments” Section Of This Manual And Any Vendor Manuals Supplied

Annual Check (1500 - 2000 Hours)

__ Perform Daily,Weekly,Monthly,Quartly and Semiannual Checks

__ Perform Annual Lubrication

__ Disassemble Winch And Inspect

__ Drain And Clean Hydraulic Reservoir

__ Change Hydraulic Fluid (unless checked by oil analysis).

__ Drain and Refill The Winch Lubricant

__ Change Axle Oil

__ Check the hose lines (see Hydraulic Hose topic in the Maintenance section of this manual).

Crane Boom

MAIN BOOM INSPECTION & MAINTENANCE PROCEDURE

Task	Action
• Broken wire rope or cut strands	Replace
• Corrosion of wire rope	Replace
• Wire rope kinking, crushing, un-stranding, bird caging, main strand displacement or core protrusion	Replace
DAILY	
• Check the sheaves for wear	
• Check pins for cracks	
• Lubricate the wire ropes	
• Clean the wire ropes	
EVERY 50 HOURS	
• Lubricate the hook block	
EVERY 250 HOURS	
• Lubricate the slides	
• Lubricate the main boom head	
• Lubricate sliding surfaces	
EVERY 1000 HOURS	
• Check the sheaves roller bearings or bushings and are properly lubricated.	
EVERY 1500 HOURS	
• Check wear pads, shims & wear pad fasteners.	Replace as req'd
• Check chains for adequate lubrication	
• Check for corrosion of fasteners	
EVERY 4 YEARS	
• Visually inspect extension & retraction ropes.	Disassemble Boom [1]
• Check chains for wear	Disassemble Boom [1]
• Check cable anchors for corrosion or cracking	Disassemble Boom [1]
• Clean boom sections and remove internal grease and re-grease with specified lubricant	Disassemble Boom [1]
• Sheave pins check for corrosion and wear	Disassemble Boom [1]

1. **NOTE:** *The disassembly of boom is a recommendation for proper inspection related to wear, corrosion, cracks or breakage of components. If crane is used in a highly corrosive environment due to salts or chemicals, then inspection and maintenance intervals should be more frequent than shown above.*

WEEKLY:

STRUCTURAL MEMBERS AND WELDS Visually inspect all structural members and welds including (but not limited to) the extended boom for straightness, roller (or pad) adjustment, and cracks. Pay special attention to the longitudinal welds joining the top, side and bottom plates. Check the welds attaching the jib ears to the boom head and the welds attaching the boom head to the tip section. Inspect the cylinder attaching supports and the boom pivot area.

Inspect the superstructure welds, the welds on the hoist cylinder supports and the welds between the bottom mounting plate and the vertical plates. This is especially important if the machine is being used extensively in clamshell, concrete pouring, headache ball, or other high duty cycle applications.

On the carrier, inspect the swing bearing weld band and supporting header welds. Check the welds attaching the outrigger box to the frame, outrigger box ends at the collar, jack cylinder mounting tube, and the beam welds.

Visually inspect all boom sections at least weekly or every fifty (50) hours, whichever occurs first. Preparatory to making the inspection, set the outriggers and rotate the upper to an area where the boom can be fully lowered and extended.

With the boom fully lowered and extended, visually inspect the sides, top and bottom of each section for any unusual deformation, scrubbing, wear, or cracking in either the plates or welds, particularly the fillet welds along the bottom edge of the side plates of the telescoping sections. In addition, note any missing or illegible indicator mark decals on the telescoping sections.

If any cracks in either fillet welds or plates are noted, the particular component must be replaced before any further crane operations are performed. This is necessary to maintain the structural strength of the boom and prevent possible catastrophic failure resulting in injury or property damage.

Field repair of boom sections is NOT recommended because distortion may be introduced and original structural strength not restored.

Boom extension indicator decals are extremely important and must be in place at all times. Boom section failures can occur due to overstressing within rated capacities if the sections are not equally extended within one indicator mark difference between the telescoping sections.

If any indicator decals are missing or illegible (either triangle markers or boom length numbers), order the applicable items through your distributor.

Wire Rope Inspection Record

WIRE ROPE INSPECTION RECORD (Refer to Wire Rope User's Manual for Criteria)					
PLACE OF INSPECTION				DATE	
DESCRIPTION OF CRANE					
Make		Model		Serial No.	
Type and arrangement of attachments					
Date of Last Rope Inspection					
Hours and Time of Service Since Last Inspection					
Results of Inspection					
Rope Inspected	Type and Size	Conditions Noted		Recommendations	
	Inspector				

Mobile Crane Load Test Inspection

General

As a worldwide crane manufacturer, Load King Cranes does not recommend carrying out a regular overload test on mobile cranes.

An overload test after every change of location or crane reconfiguration is not a reliable and safe inspection method and can cause premature material fatigue.

In some countries, national laws require overload tests e.g. in accordance with information from the crane manufacturer.

Every mobile crane is subjected to a load test by the manufacturer within a final acceptance procedure before delivery. These tests are carried out with test loads in different configurations in accordance with the scenarios with the lowest safety reserves in relation to mechanical strength and stability of the crane. This includes an overload test with defined conditions and standards which can be applied accordingly.

Further acceptance tests with overloads during the cranes working life must only be carried out after modifications or repairs of load-bearing components or after an extensive overhaul. In some countries, national regulations may require tests with overload and/or overload tests before carrying out hoist work after any change to the crane configuration.

The calculation of the load-bearing structure of mobile cranes satisfies all applicable international standards (EN, ISO, FEM, etc.) and does not provide for continuous operation. The cranes therefore have a service life which is defined by the permitted number of working cycles. Any overloading of the crane can have a negative effect and leads to a reduction in the cranes service life. This can become a critical problem if the crane is tested with overload before every hoist operation (e.g. when building a wind farm with 80 to 100 wind turbines at one location within a few weeks).

Load King Cranes strictly prohibits operators to overload any crane. Safety equipment such as load limit devices prevent overloads being raised; the corresponding bridging / override switch is only provided for emergency situations or when the load limiter fails (as determined in the operating instructions).

Load and Overload Test

As the manufacturer, Load King Cranes does not recommend using the bridging / override switch regularly for overload tests and generally advises against regular overload tests -even including tests during which the test load is attached via external equipment without activating the bridging / override switch.

Decreased service life due to regular overload tests.
As a manufacturer, Load King Cranes aims to avoid overload tests, as such tests decrease the service life of the cranes.

The following aspects must also be taken into consideration from the viewpoint of the user/ operator:

- Operational planning:
  - Higher floor loading than provided for,
  - difficult handling of the additional test load,
  - ban on carrying out any overload tests on-site in some fields of industry (e.g. petrochemical plants).
- Operational safety:
  - Anyone in the vicinity of the crane must be warned of the test procedure and
  - must leave the area during the test.

Risk of accidents due to damage to load-bearing parts
After an overload test, carry out extensive investigations to ensure the intactness of the load-bearing components.

Damage to load-bearing parts can occur due to cracks caused by overload and/or fatigue; such defects are not exposed by an overload test. For this reason, an overload test can give owners and operators a false sense of security.

To ensure the intactness of load-bearing components, extensive investigations are recommended after an overload test and before carrying out hoist work. Such an investigation consists of a visual inspection combined with function tests (including the safety equipment) and can necessitate non-destructive inspections such as magnetic particle or ultrasonic inspections.

Any malfunction or irregularity discovered during the inspection must be evaluated by an expert. This person must determine whether the movement can be carried out safely or whether immediate repair/modification is required.

Recommendations of Load King Cranes with Regard to Load Tests

Checking Assembly

Checking the correct crane assembly (e.g. after reconfiguration) must include:

- a visual inspection of all assembled parts on the ground before erecting the boom,
- a function check of the crane without or with limited load including:
  - any movements important for the job
  - an inspection of all limit switches (among others, the hoist limit switches),
- an inspection to ensure the assembly has been carried out in accordance with the assembly instructions.

Load Test Factors

If load tests are required by laws mandating checking the assembly of the crane, 100% of the permitted load of the crane in the given configuration must not be exceeded.

This applies to all Load King mobile cranes for the static and dynamic load tests. A period of 5 minutes is sufficient for static tests.

Load tests may be required by law.

- after assembling the crane or
- after changes in location.

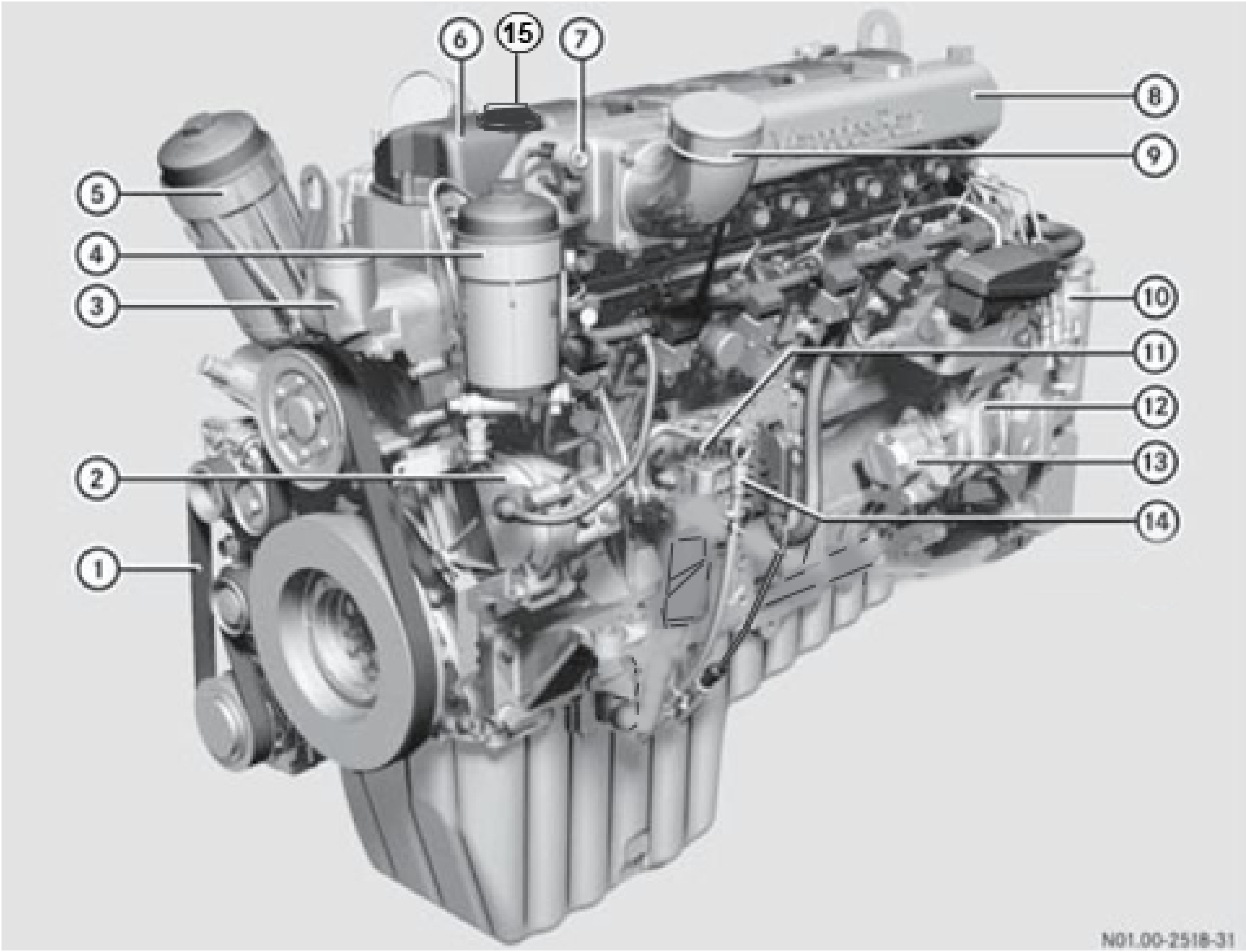
The conditions listed above do not apply after reconfiguration or repairs to load-bearing crane parts. In this case, the load test factor can be higher (in accordance with the safety factors from the product standards). It is recommended to involve the crane manufacturer in such tests.

Load Test Configurations

If a load test is required (by law), the test conditions must correspond with the conditions during the scheduled lift. It is acceptable to Load King to carry out a load test for a given crane configuration with reduced loads (below the max. capacity), but at a greater radius, up to the maximum radius (max. load moment).

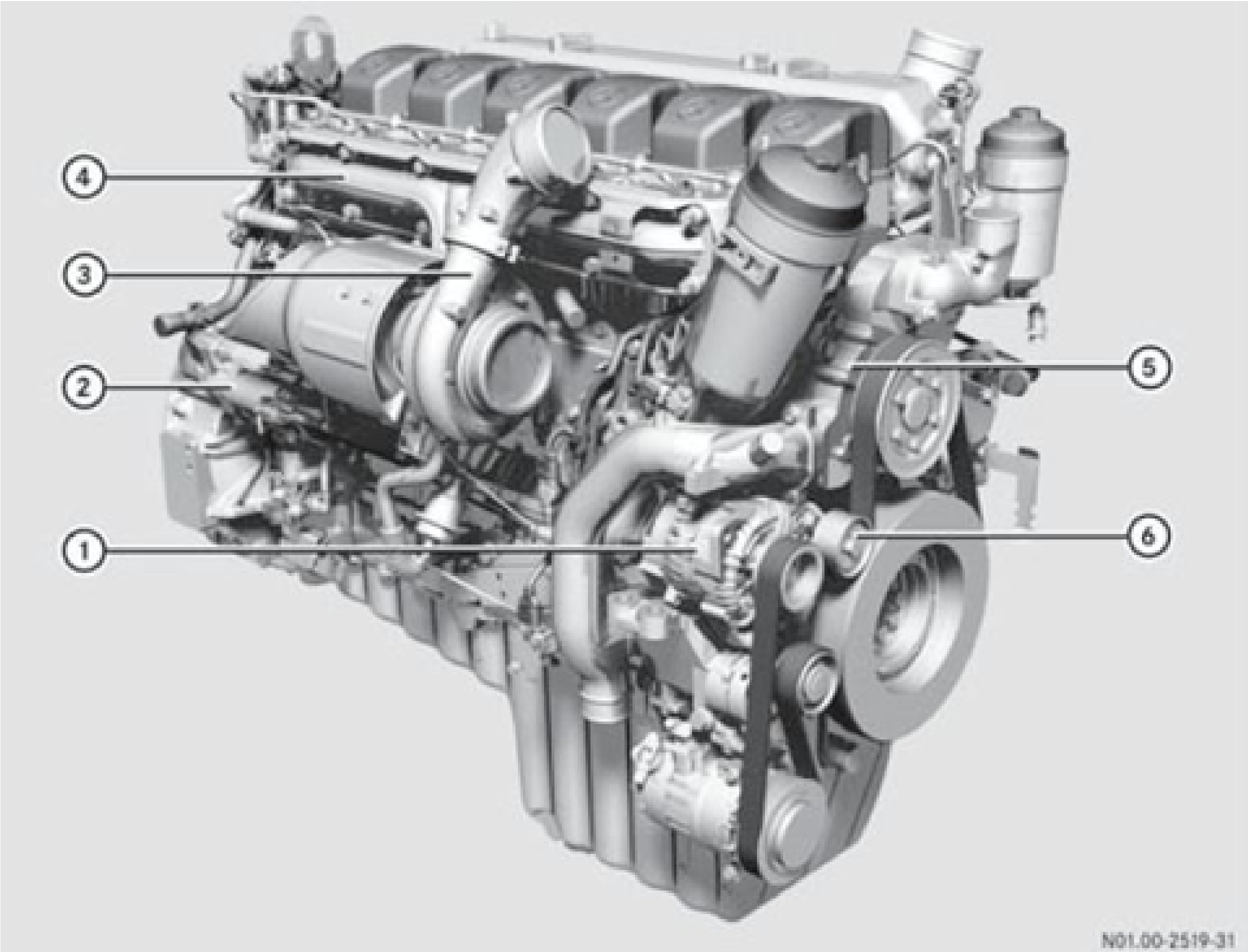
Reason: In lattice mast cranes, erecting the boom from the ground is one of the most critical load cases of a crane configuration with regard to load; erecting must therefore be regarded as a load test for the tension-carrying structures such as the lattice mast sections (with regard to pressure and bending stress), the bracing rods (tensile load), the boom adjustment winch, the Superlift mast, etc.

Diamler Mercedes-Benz OM460 Engine- Overview of Operation

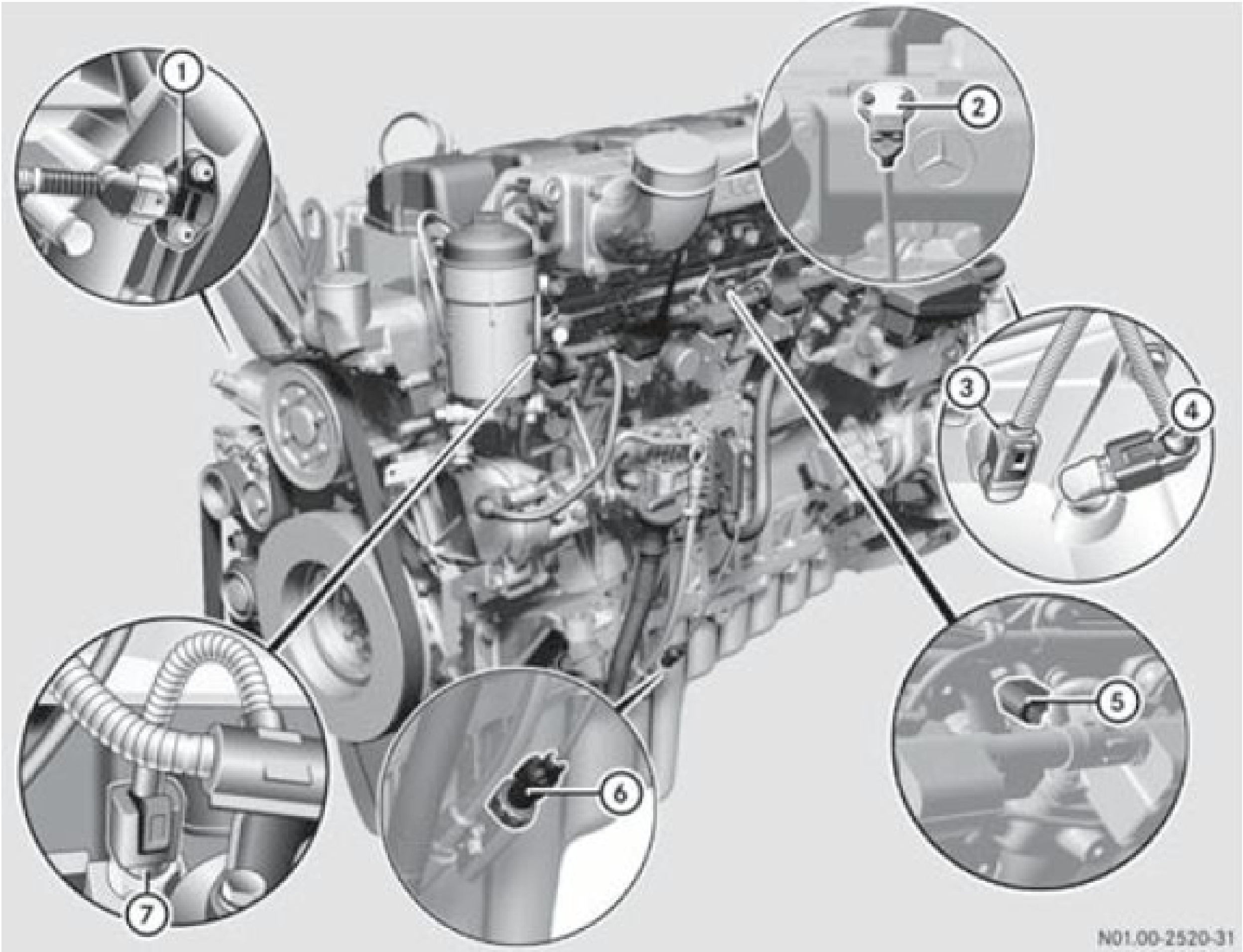


1. Poly-V-belt
2. Fuel Pump
3. Thermostat Housing
4. Fuel Filter
5. Oil Filter
6. Cylinder Head Cover - Oil Fill Location
7. Start / Stop Button
8. Charge-air Distributor
9. Charge pressure pipe from charge-air cooler
10. Crankcase ventilation system
11. Engine Control Unit (MR)
12. Air Compressor
13. Power-steering Pump

14. Dipstick
15. Engine oil filler neck



1. Alternator
2. Starter Motor
3. Exhaust Gas Turbocharger
4. Exhaust Manifold
5. Coolant Pump
6. Poly-V-Belt Tensioning Device



1. Engine Oil Pressure and Temperature Sensor
2. Charge-air Pressure / Temperature Sensor
3. TDC Sensor (on camshaft gear)
4. Crankshaft Position Sensor (on flywheel)
5. Coolant Temperature Sensor
6. Engine Oil Level Sensor
7. Fuel Temperature Sensor

Engine Management Control Unit (MR)

The engine has a fully electronic management system which, along with the engine and its associated sensors, consists of the following components:

- Engine Control Unit (MR)

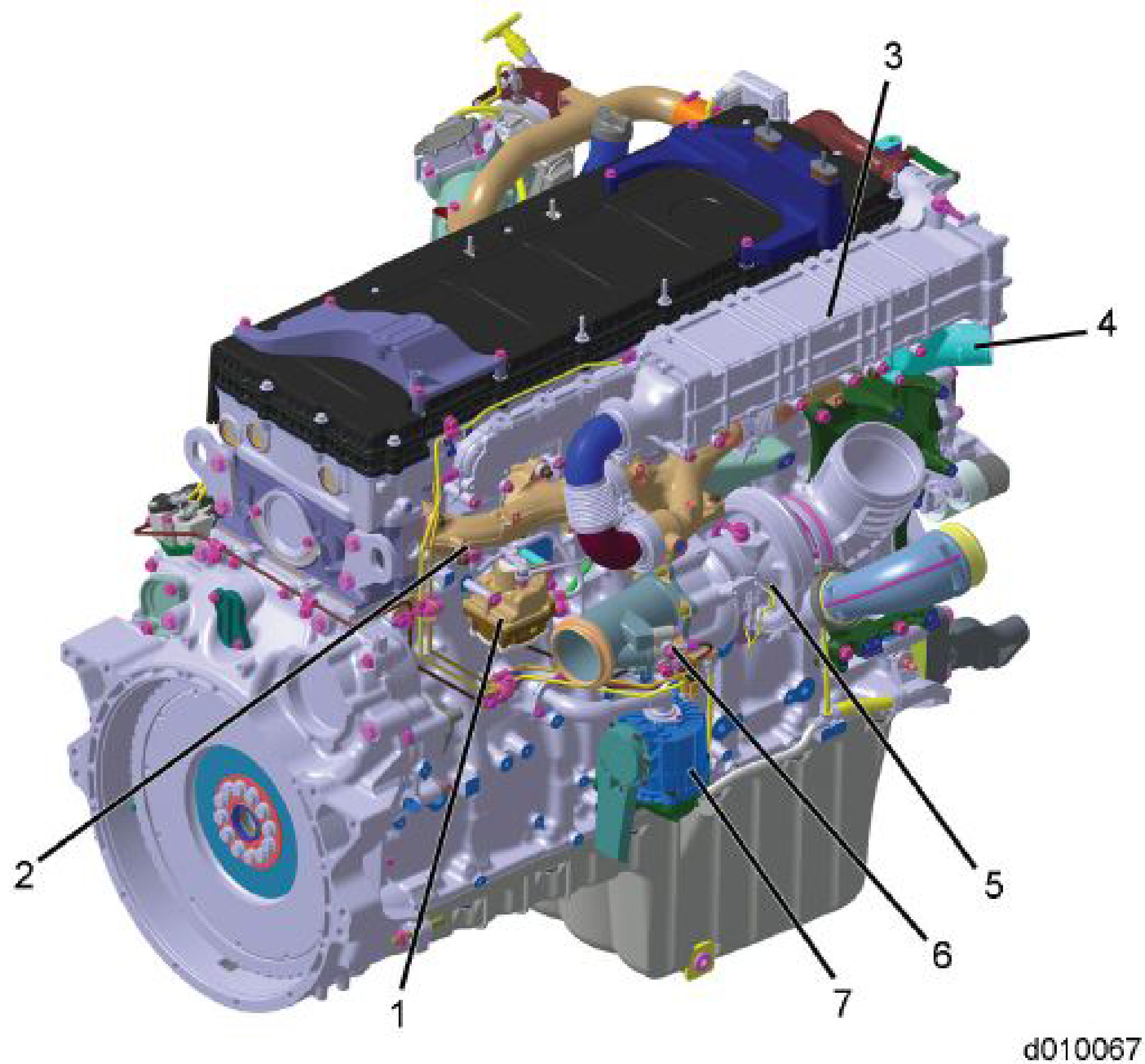
- Drive Control Unit (FR) and/or other vehicle-specific control units, e.g. adaptation module (ADM). The ADM is located under the dash panel in the drivers cab.

The control units are interconnected by a CAN line (Controller Area Network line), which facilitates the exchange of all necessary data.

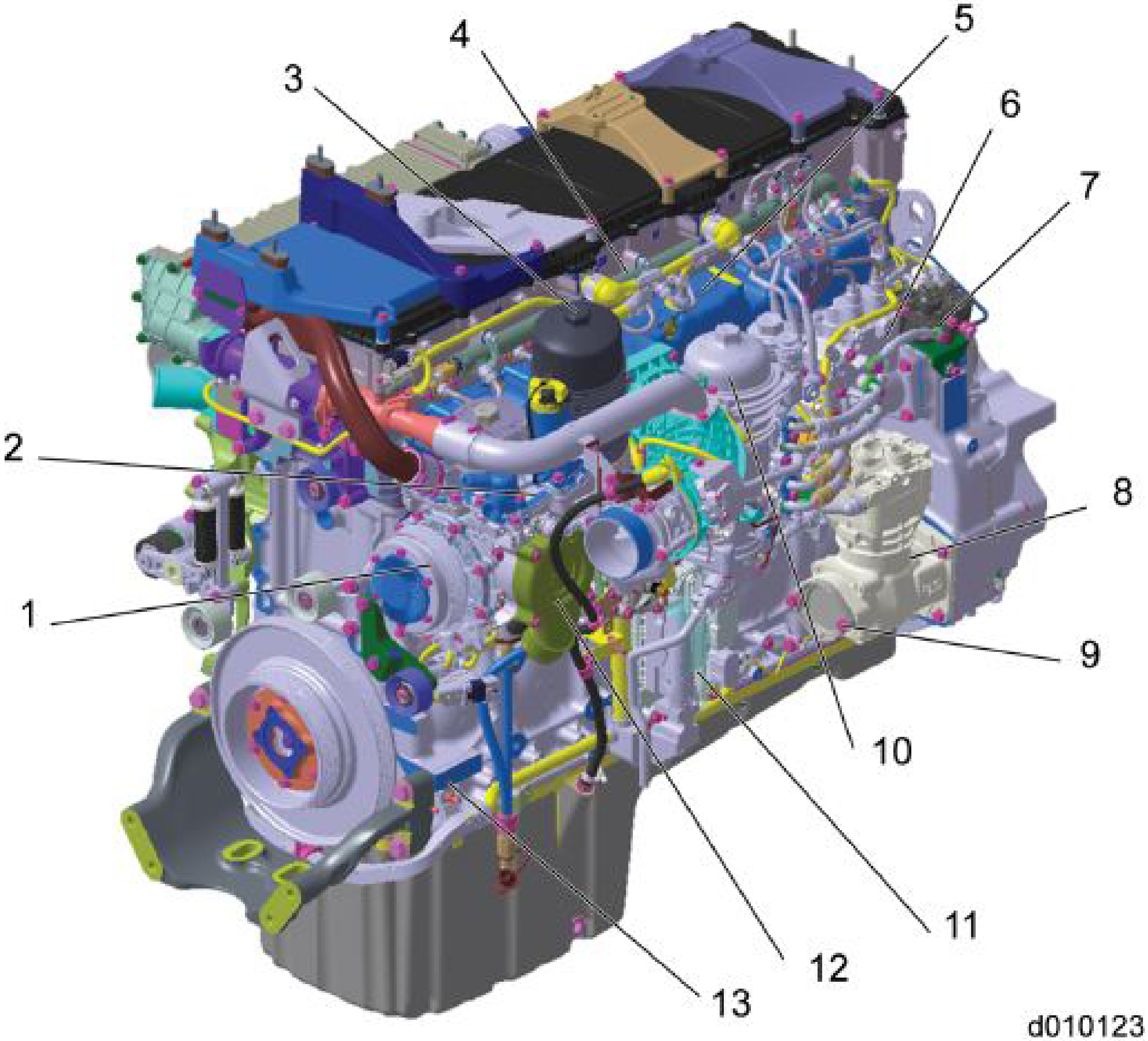
The engine control unit (MR) processes values from the drive control unit (FR) and the adaptation module (ADM). These are, for example, the signal from the position senor (accelerator pedal), the engine brake or engine start / stop, etc.

Detroit Diesel DD13-GHG14 Engine- Overview of Operation

Engine Overview-Detroit Diesel™ DD13-GHG14



1. Exhaust Gas Recirculation (EGR) Actuator
2. Exhaust Manifold
3. Exhaust Gas Recirculation (EGR) Cooler
4. Coolant Outlet Nipple
5. Turbocharger
6. Fuel Doser Valve
7. Crankcase Breather



1. Water Pump
2. Oil/Coolant Module
3. Oil Filter
4. Fuel Rail
5. Air Intake Manifold
6. High Pressure Fuel Pump
7. Hydrocarbon Doser Block
8. Single Stage Air Compressor
9. Power Steering Pump Location
10. Fuel Filter Module

11. MCM
12. Thermostat
13. Engine Serial Number Location

Performing a Parked Regeneration-GHG14 Engine

Perform a Parked Regeneration as follows:

NOTE: Under factory default settings, when the Diesel Particulate Filter (DPF) Regeneration Lamp is not illuminated, the regeneration request switch is disabled.

NOTE: The driver MUST stay with the vehicle throughout the regeneration process.

NOTE: The procedure will take approximately 30 to 40 minutes (depending on engine type and the amount of soot accumulated in the DPF).

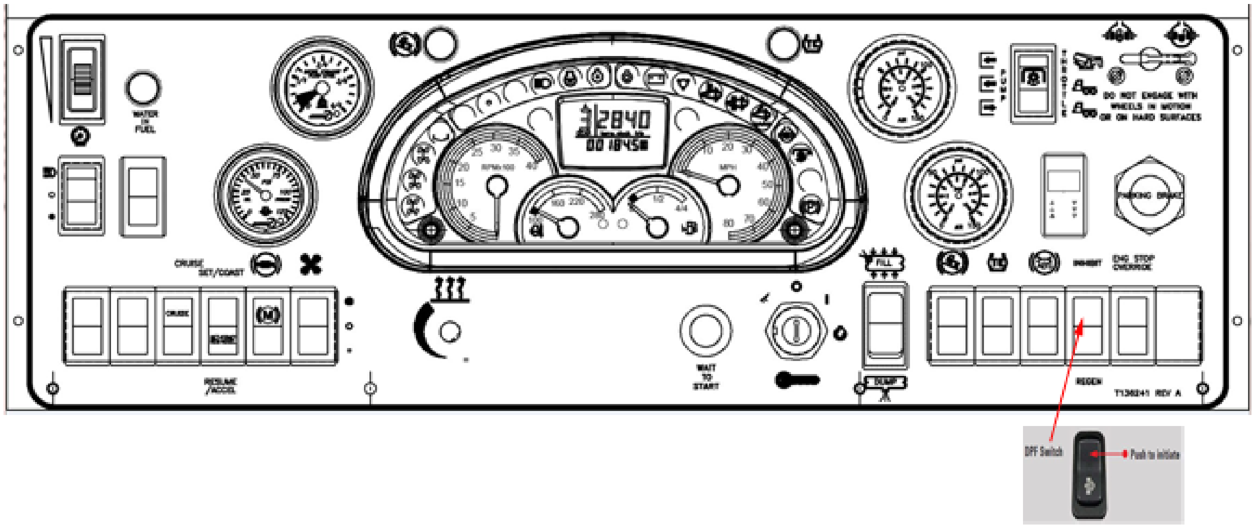
When the parked regeneration request is accepted, the Diesel Particulate Filter (DPF) Regeneration lamp will turn ON one time for one second and then turn off for the remainder of the parked regeneration. The High Exhaust System Temperature (HEST) lamp will flash on one second every ten seconds and eventually become solid when the tailpipe temperature is above 525°C (977°F).

The engine speed will increase to 1100 RPM for all DD Platform engines. The regeneration will take 30-40 minutes. The regeneration is complete when the engine returns to low idle and the DPF lamp remains OFF. The HEST lamp will remain ON, but the vehicle may be driven.

1. HEST (High Exhaust Temperature) LAMP FLASHING: A Regeneration is in process and the system is coming up to temperature.
2. Keep engine at slow idle (cannot be in Fast Idle or PTO Mode). Put transmission in neutral (cycle out of neutral and then back into neutral) (if equipped with an automatic transmission, cycle it into gear and then back to neutral).

NOTICE: Air tank pressure must be high enough for the parking brake switch to hold in the OFF position.

3. Set park brake (cycle the park OFF to ON).
4. Hold DPF Switch to the ON position for five seconds and then release (engine speed will increase and DPF lamp will go out).



Carrier Dash Panel-DPF Switch Location

NOTE: A parked regeneration will STOP and the engine will return to low idle if any of the following happens:

- The key is turned to the OFF position
- The vehicle is put into gear
- The parking brake is released

DD13-GHG14 Diesel Exhaust Fluid Tank

The Diesel Exhaust Fluid (DEF) tank holds the DEF supply. The filler neck has a smaller diameter (19 mm) than the filler neck of the diesel fuel tank and is fitted with a magnetic insert so that diesel fuel cannot be mistakenly added to the DEF tank. The DEF you should use with your Detroit ™ product will be API (American Petroleum Institute) certified and meet the specifications ISO 22241-1 and DIN70700. These are two widely accepted standards in use for qualifying DEF for use in exhaust aftertreatment systems. DEF (Diesel Exhaust Fluid) will be sold at over 2,500 locations throughout North America. The locations include:

- Detroit ™ Distributors
- Freightliner® Truck Dealers
- Western Star® Truck Dealers
- Travel Centers of America® Truck Stops
- Petro® Stopping Centers
- Pilot Travel Centers®
- Additional Diesel Exhaust Fluid (DEF) sales locations can be found at www.afdc.energy.gov/afdc/locator/def/

If diesel fuel is added to the DEF tank or DEF is added to the diesel fuel tank, immediately contact your Certified Detroit ™ Service Center for further instructions.

Aftertreatment Device Operating Requirements

NOTICE: Not following the operating requirements may result in damage to the Aftertreatment Device (ATD) or accelerated ash plugging of the diesel particulate filter.

NOTICE: Do not use kerosene or fuel blended with used lube oil.

The following requirements must be met; otherwise the Aftertreatment Device (ATD) warranty may be compromised:

• Use Ultra-Low Sulfur Fuel (ULSF) with 15 ppm sulfur content or less, based on ASTM D2622 test procedure.

• Lube oil must have a sulfated ash level less than 1.0 wt%; currently referred to as CJ-4 oil. Detroit TM currently recommends CJ-4 oil, and will allow CI-4 Plus oil having sulfated ash levels of 1.4% or less.

GHG14 Diesel Exhaust Fluid (DEF) Information

The Selective Catalytic Reduction (SCR Catalyst) aftertreatment system for this engine requires Diesel Exhaust Fluid (DEF) to maintain exhaust emissions at levels compliant with emission standards. DEF is a simple, non-toxic and inexpensive pre-mixed fluid composed of 2/3 pure water and 1/3 automotive grade urea. The following sections provide information regarding DEF availability, specifications, handling and storage, and certain SCR anti-tampering features.

Diesel Exhaust Fluid Availability

Diesel Exhaust Fluid (DEF) is available in bulk quantities at roadside truck stop service centers. DEF is also available in various container sizes at Detroit ™ Customer Service Center at 1-800-445-1980.

GHG14 Diesel Exhaust Fluid Handling and Storage

When stored at temperatures between 10° and 90° F (minus 12° and 32° C), DEF has a minimum shelf life of 12 months. For best shelf life it is recommended that Diesel Exhaust Fluid (DEF) containers be stored in a controlled environment.

GHG14 Diesel Exhaust Fluid System Anti-Tampering Feature

The diagnostic system monitors for faults in Diesel Exhaust Fluid (DEF) system components and monitors the DEF supply pressure. If the diagnostics detect that components critical to the Selective Catalytic Reduction (SCR Catalyst) or DEF supply system are disconnected (which would indicate tampering), or if the diagnostics detect abnormal system pressures indicative of DEF supply blockage, the warning lamp will illuminate and the control system will initiate time and mileage counters. If the sensors detect that the SCR system has been tampered with, the MIL illuminates to warn the driver, and the engine performance is limited, with a 55 mph (90 km/h) speed limit. If the system fault is not corrected, the STOP engine light illuminates and a 5 mph (8 km/h) speed limit will be applied during non-driving conditions. Similiar warnings and penalties will result when insufficient urea quantity is present.

Aftertreatment Maintenance

The high amount of black smoke emitting from the vehicle or illumination of the Amber Warning Lamp or Red Stop Lamp are indications of a system problem. Should this occur, consult your local Detroit ™ Service Center.

Illumination of the Malfunction Indicator Lamp (MIL) indicates a failure of an emissions control device. The MIL may illuminate along with other ATS warning lamps. Call for service to repair the fault.

Illumination of the Diesel Particulate Filter (DPF) Regeneration Lamp indicates that a parked regeneration is required.

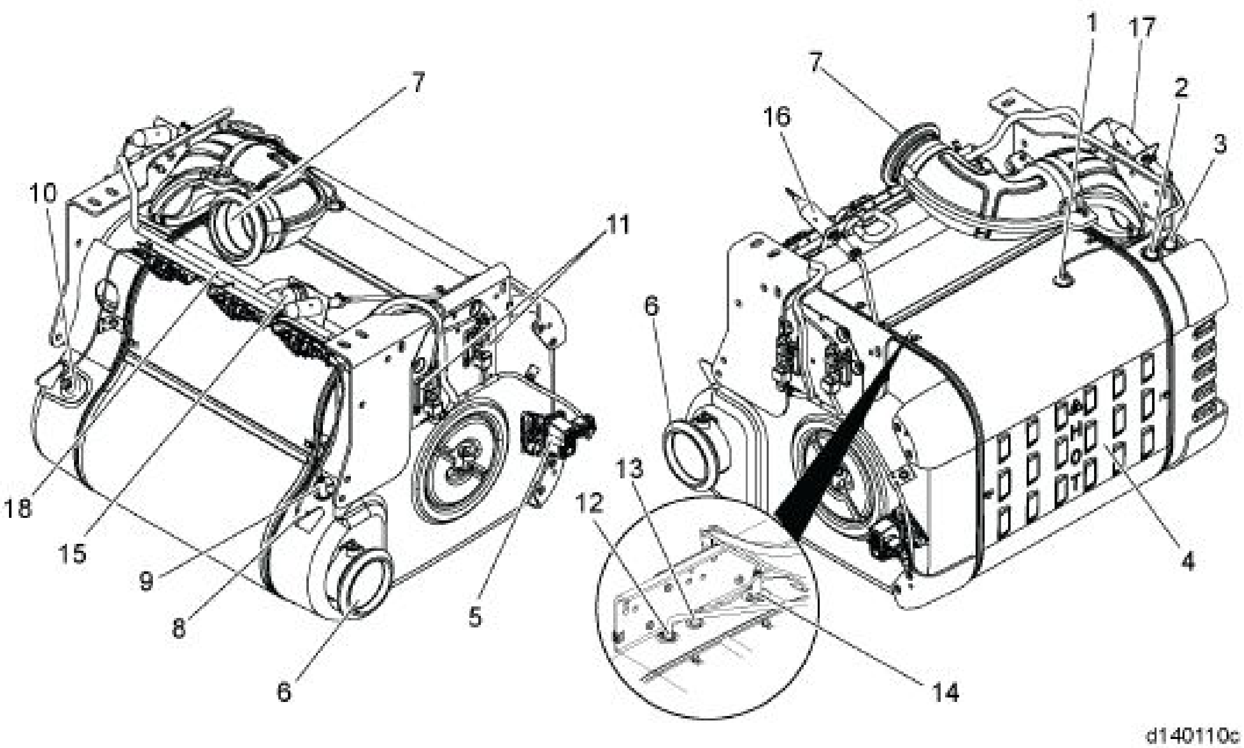
There is a need to periodically remove accumulated ash, derived from engine lube oil, from the filter. This ash does not oxidize in the filter during the regeneration process and must be removed through a cleaning procedure. All Detroit ™ ATD equipped engines will illuminate a dashboard warning lamp indicating the need for ash cleaning.

Fuel Warning

► Do not mix gasoline, alcohol, or gasohol with diesel fuel. This mixture can cause an explosion.

DD13-GHG14 Aftertreatment Devices

The DD13-GHG14 Aftertreatment Device (ATD) has changed to an airless dosing system. The airless dosing unit no longer relies on air pressure to atomize Diesel Exhaust Fluid (DEF) in the Selective Catalyst Reduction (SCR). The SCR system consists of an Aftertreatment Control Module (ACM2.1), a tank for DEF, a DEF pump, and airless DEF dosing unit, and an SCR module. DEF is pumped to the airless dosing unit through a high pressure DEF line at 10 bar (145 psi). The DEF dosing unit injects a fine mist of atomized DEF into the SCR module to producte a chemical reaction. This chemical reaction converts nitrous oxides (NOx) present in the exhaust stream into water vapor and nitrogen.

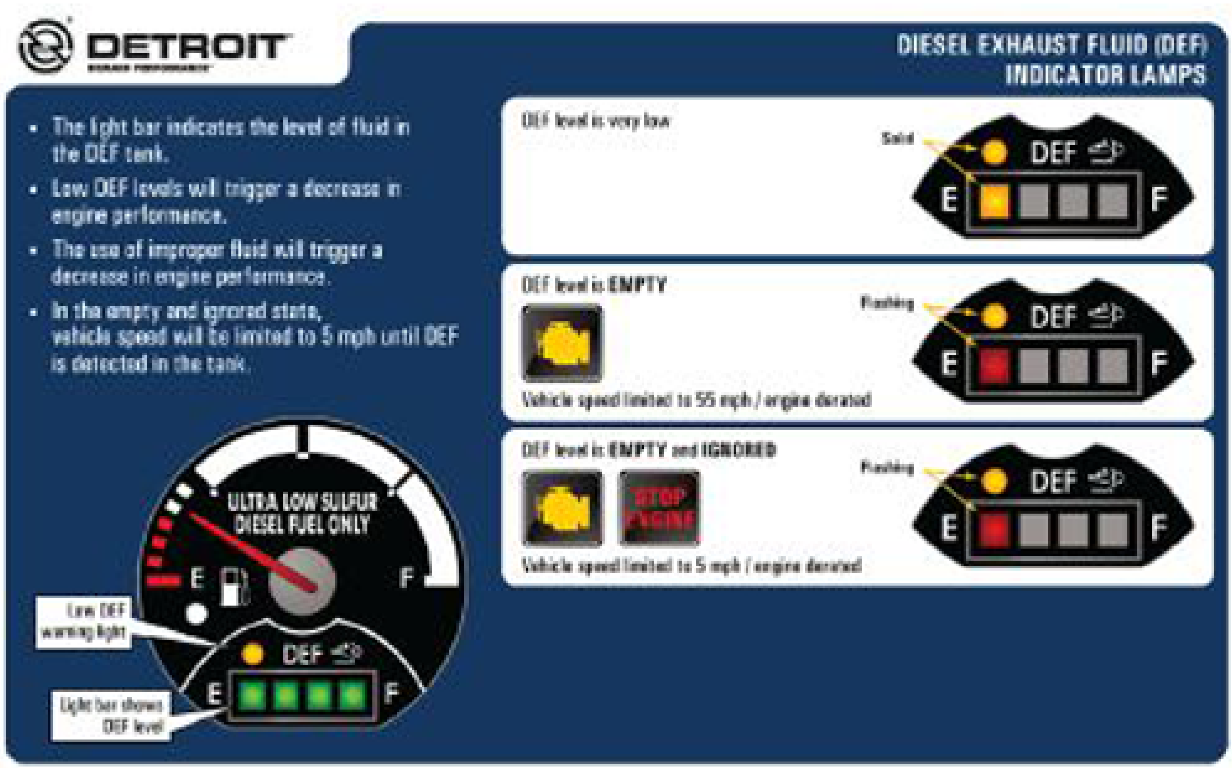


1. Diesel Oxidation Catalyst Outlet Temperature Sensor
2. Diesel Oxidation Catalyst Inlet Pressure Sensor Tube
3. Diesel Oxidation Catalyst Inlet Temperature Sensor
4. Front Heat Shield
5. Diesel Exhaust Fluid Dosing Unit
6. Exhaust Outlet
7. Exhaust Inlet
8. Selective Catalytic Reduction (SCR Catalyst) Outlet Temperature Sensor
9. Selective Catalytic Reduction (SCR Catalyst) Outlet NOx Sensor
10. Selective Catalytic Reduction (SCR Catalyst) Inlet Temperature Sensor
11. Selective Catalytic Reduction (SCR Catalyst) Inlet and Outlet NOx

12. Diesel Particulate Filter Outlet Pressure Sensor Tube
13. Selective Catalytic Reduction (SCR Catalyst) Inlet Temperature Sensor
14. Selective Catalytic Reduction (SCR Catalyst) Inlet NOx Sensors
15. 47-Pin Connector Harness
16. Diesel Particulate Filter Outlet Pressure Sensor
17. Diesel Oxidation Catalyst Inlet Pressure Sensor
18. Sensor Bridge

DD13-GHG14 Diesel Exhaust Fluid Level Warning Lamps

A four light bar segment indicates the Diesel Exhaust Fluid (DEF) level in 25% increments.



- The light bar indicates the level of fluid in the DEF tank.

- Low DEF levels will trigger a decrease in engine performance.

- The use of improper fluid will trigger a decrease in engine performance.

- In the empty or ignored state, vehicle speed will be limited to 5 mph until DEF is detected in the tank.

Instrument Panel Lamps

Instrument panel lamps explained below:

Instrument Panel Lamp	Notifications and Description	Driver Action
	• Diesel Particulate Filter (DPF) regeneration lamp • **SOLID:** Indicates that a regeneration may be needed. • **FLASHING:** Indicates that a parked regeneration is required as soon as possible. • Diesel Particulate Filter (DPF) is reaching system limits.	Perform a parked regeneration OR bring the vehicle to highway speeds to enable an automatic regeneration of the filter. Refer to section "Performing a Parked Regeneration"

Instrument Panel Lamp	Notifications and Description	Driver Action
 	• Diesel Particulate Filter (DPF) regeneration lamp / Check Engine Lamp (CEL) • ENGINE DERATED • Indicates the Diesel Particulate Filter (DPF) has reached system limits.	• A parked regeneration must be performed. Refer to section "Performing a Parked Regeneration" • If the parked regeneration exits and the lamps remain on, repeat the parked regeneration. If the second attempt fails, call for service.

Instrument Panel Lamp	Notifications and Description	Driver Action
 	• Diesel Particulate Filter (DPF) regeneration lamp / Check Engine Lamp (CEL) / Stop Engine Lamp (SEL) • ENGINE SHUTDOWN • Indicates the Diesel Particulate Filter (DPF) has exceeded system limits.	• A parked regeneration must be performed. Refer to section "Performing a Parked Regeneration" • If the parked regeneration exits and the lamps remain on, repeat the parked regeneration. If the second attempt fails, call for service. • **Note:** Engine can be restarted but a parked regeneration must be initiated within 30 seconds or the engine will shutdown.

Aftertreatment Regeneration Lamp Behaviors

High Exhaust System Temperature (HEST) Lamp

- **Solid:** Exhaust is at **high** temperature and vehicle is at low speed or parked.

- **Flashing:** Parked regeneration in process. System is not up to temperature.

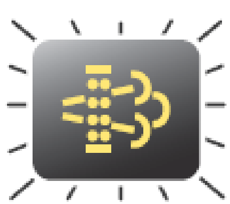
The High Exhaust System Temperature (HEST) Lamp illuminates to indicate that high exhaust temperatures may exist due to aftertreatment regeneration. This is normal and does not signify the need for any kind of vehicle or engine service. When this lamp is illuminated, ensure that the exhaust pipe outlet is not directed at any surface or material that will melt, burn or explode. Refer to your Detroit Diesel Operations Manual on the SHOP-CD.

Malfunction Indicator Lamp (MIL) / Check Engine Lamp

- There is a potential problem with the emission control system or component.

- May illuminate at the same time as the Check Engine Lamp.

- Driving for a prolonged period with the MIL on can cause damage to the engine and / or aftertreatment system as well as degrade mileage and drivablility. If the MIL is illuminated with the red Stop Engine Lamp, the vehicle should be stopped as soon as it is safe to do so. It should then be taken to an authorized Detroit Diesel location for repair.



Aftertreatment Diesel Particulate Filter (DPF) Lamp

- **Solid:** Parked regeneration may be needed.
- **Flashing:** Parked regeneration is required as soon as possible.
- Diesel Particulate Filter reaching system limits.

The Aftertreatment Diesel Particulate Filter Lamp indicates, when illuminated or flashing, that the Aftertreatment Diesel Particulate Filter requires regeneration.

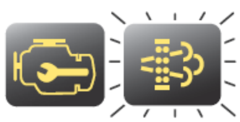
When the DPF Lamp illuminates, the Aftertreatment Diesel Particulate Filter needs to generate within the next 2-6 hours of operation. This is accomplished by:

► Changing to a more challenging duty cycle, such as highway driving for at least 20 minutes.

► Performing a "Parked" regeneration.

When the DPF Lamp flashes, the actions stated above should be performed in the next 1-2 hours. In addition, engine power may be reduced automatically.

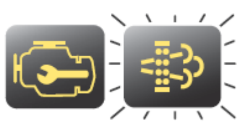
A "Parked" regeneration may be performed using the Manual Regeneration Switch.

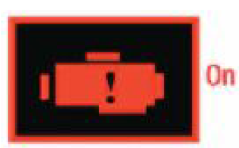


Check Engine Lamp / DPF Regeneration

- ENGINE DERATED
- Diesel Particulate Filter has **reached** system limits.

A flashing DPF Lamp combined with an illuminated Warning or Check Engine Lamp indicates that the Aftertreatment Diesel Particulate Filter needs regeneration immediately. Engine power will be reduced automatically. A "Parked" regeneration is required.

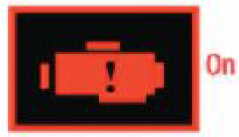




Stop Engine Lamp

ENGINE SHUTDOWN

- Diesel Particulate Filter has **exceeded** system limits.



NOTE: *If a "Parked" regeneration is not performed, the red STOP ENGINE Lamp will illuminate. The vehicle should be stopped as soon as it can safely be done and remain shut down until it can be serviced by a Detroit Diesel authorized repair station.*

Engine Out of Fuel-How to Restart

When an engine has run out of fuel, there is a definite procedure to follow when restarting it.

Use the following procedure to prime the fuel system.

NOTE: *If a vehicle is on uneven ground, more fuel may be required.*

1. Fill the fuel tank with the recommended grade of fuel. If only partial filling is possible, add a minimum of 10% of the total tank volume of fuel to the tank. For example, a 150 gallon tank would require a minimum of 15 gallons of fuel.
2. Connect ESOC 350 (J-47912) or operate the engine mounted hand primer for three minutes or 250 strokes.
3. Turn on the ignition switch.
4. Wait for the engine system indicator lights on the instrument panel to go out.
5. With the accelerator pedal in the idle position, start the engine.
6. Crank engine for 20 seconds.

NOTE: *The starting cycle can be repeated up to three times.*

7. If the engine does not start, allow for a 60 second cool down and repeat previous step.
8. Monitor the oil pressure guage or indicator lamp. Keep the engine running at an idling speed until a stable oil pressure reading of 97 kPa (14 psi) or more is maintained for one minute.
9. Check for leaks.
10. Allow engine to reach operating temperature of 60° C (140° F).
11. Increase engine speed to 1800 RPM for three minutes.
12. Return the engine to idle and allow to idle for approximately one minute.
13. Check for leaks.
14. If engine still fails to start, contact an authorized Detroit™ repair facility.

Operating the Unit

Starting the Engine-Detroit Diesel™ DD13-GHG14 & Mercedes-Benz OM460

First Time Start Preparations

When preparing to start a new engine, which has been in storage, perform all of the operations listed below. Failure to follow these instructions may result in serious engine damage.

Check the following:

Oil Pressure Guage

Low oil pressure warning light.

Coolant temperature guage.

High coolant temperature warning light.

Water-in-Fuel warning light in the side of the fuel filter module.

Air restriction indicator.

Watch for any signs of engine problems when starting or driving. If the engine overheats, uses excessive fuel or lubricating oil, vibrates, misfires, makes unusual noises or shows an unusual loss of power, turn the engine off as soon as possible and determine the cause of the problem. Engine damage may be avoided by a quick response to early indications of problems.

When starting the engine in cold weather, refer to section "Cold Weather Operation".

The engine may require the use of a cold weather starting aid if the ambient temperature is below 40°F (4°C).

Check that the Emergency Stop Button is pulled out. This will allow starting of the engine.

1. To prevent serious starting motor damage, do not press the starter switch again after the engine has started.
2. If the engine fails to start within 15 seconds, release the starter switch and allow the starting motor to cool for 15 seconds before trying again. If the engine fails to start after four attempts, an inspection should be made to determine the cause.

Checking the Cooling System

Check the cooling system as follows:

1. Fill the coolant overflow surge tank with Detroit™ Genuine Coolant until coolant level stays between the low and full coolant marks on the tank.
2. Entrapped air must be purged after filling the cooling system. To do this, allow the engine to warm up with the pressure cap removed. With the transmission in neutral, increase speed to 1000 rpm and add coolant to the surge tank as required.
3. Check to make sure the front of the radiator and charge air cooler are unblocked and free of debris.

Lubrication System Checks

The lubricating oil film on the rotating parts and bearings of a new engine or one that has been in storage for six months or more, may be insufficient when the engine is started for the first time.

Pre-Lubricating the Engine

To ensure an immediate flow of oil to all bearing surfaces at initial engine startup, prepare the engines as follows:

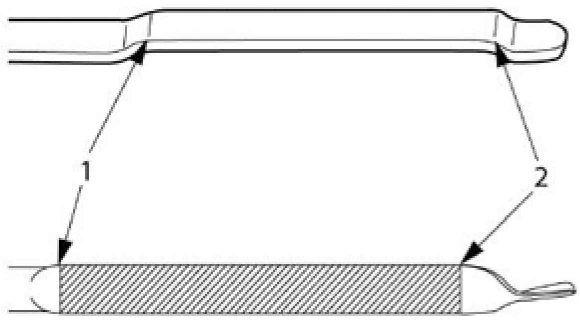
Insufficient lubrication at startup can cause serious damage to engine components. Do not add oil if the oil reading falls on the crosshatch area of the dipstick. There are approximately 5.0L (5.2 qt) from the fill mark to the full mark. Overfilling the oil pan can cause engine damage.

1. Charge the engine lubrication system with lubricating oil using a commercially-available pressure pre-lubricator.
2. After pre-lubricating, check the engine oil level. If necessary, top off by filling engine oil no more than 5.0L (5.2 qt) at a time through the oil fill cap to the satisfactory fill range on the oil dipstick. Do not overfill.

Checking and Monitoring the Oil Level

If the engine operating temperature is below 60°C (140°F), the engine must be on a level surface and then shut down for 60 minutes for an accurate oil level reading. Otherwise, the engine must be brought up to an operating temperature of 60°C (140°F), parked on a level surface and then shut down for five minutes for an accurate oil level reading.

Check the oil level daily with the engine stopped and on a level surface. Add the proper grade of oil to maintain the correct level on the dipstick. Remove the dipstick from the guide tube. Note the dipstick has a positive locking device such as a lever or twist-lock design that must be disengaged before pulling the dipstick out of the guide tube. Use a shop rag to wipe oof the end of the dipstick. Wait 15 seconds to allow any crankcase pressure to dissipate through the guide tube and let the oil level settle in the oil pan. Reinstall the dipstick and make sure it is fully inserted into the guide tube. Remove the dipstick and read the oil level. The figure below shows a conventional dipstick. Note the exact area noted on the bends. For example, the "maximum" oil level with be at the bottom of the bend (1). For the "minimum" oil level, it is noted at the TOP of the bend (2). If the oil level is below the "minimum" fill level on the dipstick, since overfilling may result in high oil consumption and possible severe engine damage.



RUNNING THE ENGINE

Oil Pressure

When the engine has reached its normal operating temperature, the engine oil pressure must not drop below the following values:

• 55 psi (380 kPa) at rated speed

•14 psi (97 kPa) at idling speed

If oil pressure drops below these values, stop the engine and determine the cause.

Warm-up

Run the engine at part throttle for about five minutes to allow it to warm up before applying a load.

During long engine idling periods with the transmission in neutral, the engine coolant temperature may fall below the normal operating range. The incomplete combustion of fuel in a cold engine will cause crankcase dilution, formation of lacquer or gummy deposits on the valves, pistons, and rings, and rapid accumulation of sludge in the engine. When prolonged idling is necessary, maintain at least 850 rpm spring/summer and 1200 rpm fall/winter.

Inspection

Transmission- While the engine is idling, check the transmission for proper oil level and add oil as required. Look for coolant, fuel, or lubricating oil leaks at this time. If any are found, shut down the engine immediately and have leaks repaired after the engine has cooled.

Crankcase- If the engine oil was replaced, stop the engine after normal operating temperature has been reached. Allow the oil to drain back into the crankcase for approximately 20 minutes, and check the oil level. If necessary, add oil to bring the level to the proper mark on the dipstick.

Turbocharger- Make a visual inspection of the turbocharger for oil leaks, exhaust leaks, excessive noise or vibration. Stop the engine immediately if a leak or unusual noise or vibration is noted. Do not restart the engine until the cause of the concern has been investigated and corrected.

STOPPING THE ENGINE

Normal Stopping

1. Decrease engine speed back to normal idle and put all shift levers in the park position.
2. Allow the engine to run between idle and 1000 rpm with no load for four or five minutes. This allows the engine to cool and permits the turbocharger(s) to slow down. After four or five minutes, shut down the engine.

> Stopping a turbocharged engine immediately after high speed operation may cause damage to the turbocharger as it will continue to turn without an oil supply to the bearings.

Emergency Running Mode

The engine is equipped with an electronic motor control system which monitors the engine as it is running.

NOTICE: To prevent possible serious engine damage, have any faults corrected without delay by an authorized service location.

As soon as an engine fault is detected, it is evalutated and one of the following measures is initiated.

• In conjunction with the instrument panel display, the code for the electronic control unit reporting the fault can be read immediately on the display.

• If the fault is serious enough to impair normal operation, the electronic control unit switches over to the "limp home" mode. The limp home speed is dependent on the engine control parameters and could be as low as 1000 rpm. This allows you to safely move the vehicle to a service location or a safe stopping area.

Fuel System Checks

Fill the tank with the recommended fuel. Keeping tanks full reduces water condensation and helps keep fuel cool, which is important in engine performance. Full tanks also reduce the chance for microbe (black slime) growth. For fuel recommendations, refer to section "How to Select Diesel Fuel".

To insure prompt starting and even running, the fuel system must be primed if air has entered the fuel system. Priming is done by operating the manual hand priming pump located on the fuel filter module or connecting an external priming pump to the priming port of the fuel filter module.

Priming is required if the fuel system is serviced.

Drain off any water that has accumulated. Water in fuel can seriously affect engine performance and may cause engine damage.

Adding Fuel

When adding fuel, pay attention to the following:

NOTICE: FOR DD13 ENGINES ONLY - always use Ultra-Low Sulfur Fuel (ULSF) with 15 PPM sulfur content or less, based on ASTM Standard D2622 test procedure. Higher sulfur levels will damage the engine Aftertreatment System (ATS).

Add winter or summer grade fuel according to the season of the year.

Work in the cleanest conditions possible.

Prevent water from entering the fuel tank.

Priming the Fuel System

Prime the fuel system as follows:

1. Operate the hand primer on module for three minutes or 250 strokes, or use an external priming source such as tool J-47912 or ESOC 350.
2. Crank the engine for 20 seconds.
3. Wait 60 seconds for the starter to cool down.
4. If the engine does not start, repeat steps 2 and step 3. The starting cycle can be repeated up to three times.
5. If the engine still fails to start, continue as follows:
   a. Use DDDL to check for fault codes, repair as necessary.

b. Repeat step 2 and step 3.

Jump Starting an Engine- Booster Cable Instructions

Position the vehicle with the booster battery adjacent to the vehicle with the discharged battery so that booster cables can be connected easily to the batteries in both vehicles. Make certain vehicles do not touch each other.

1. On both vehicles, turn off all electrical loads. Set the parking brake. Place transmission in “PARK” or “NEUTRAL”.
2. Determine whether the discharged battery has the negative (-) or positive (+) terminal connected to ground. The ground lead is connected to the engine block, frame, or some other good metallic ground. The battery terminal connected to the starter relay is the one which is not grounded.
3. Be sure that vent caps are tight and level on both batteries. Place a damp cloth over the vent caps of each battery making certain it is clear of fan blades, belts, and other moving parts.

NOTE: *The following steps must be performed in sequence:*

4. On a negative grounded system, connect both ends of one cable to positive(+) terminals of each battery.
5. Connect one end of the other cable to negative (-) terminal of the booster battery.
6. Connect other end of cable, away from battery, to engine block, frame, or some other good metallic ground - except any part of the fuel system with discharged battery.
7. Make certain that all cables are clear of fan blades, belts, and other moving parts of both engines and be sure everyone is standing away from vehicles. Then start the engine with the booster battery. Wait a few minutes, then attempt to start the engine of the vehicle with the discharged battery.
8. After starting, allow the engine to return to idle speed and remove the cable connection at the engine block or good metallic ground. Then remove the other end of the same cable from the booster battery.

WARNING - BATTERIES PRODUCE EXPLOSIVE GASES. These instructions are designed to minimize the explosion hazard. Keep sparks, flames, cigarettes, etc. away from batteries at all times - protect eyes at all times - do not lean over batteries during this operation.

Both batteries must be of the same voltage.

Unusual Operating Conditions

Special problems in maintenance and operation are caused by unusual conditions such as extremes in heat, cold and humidity, high altitude, salt water, and dusty or sandy work sites. When operating under such conditions, special precautions must be taken to prevent damage, minimize wear, and avoid component deterioration.

EXTREME COLD

In periods of extreme cold, the problems of freeze damage, adequate lubrication and battery failure may become particularly troublesome. With the onset of very cold weather, it is advisable to "winterize" the crane by servicing the cooling system and switching to the lubricants recommended for cold weather usage. Follow the recommendations in this manual when the crane must be operated in very cold conditions.

1. To prevent freeze damage to the cooling system and cracking of the engine block or head, drain and flush the cooling system. Clean the radiator exterior, making certain the air passages through the core and the cooling fins are free of foreign matter.

   Refill the cooling system, adding an antifreeze solution recommended by the engine manufacturer in an amount and strength appropriate to the anticipated temperatures. A corrosion inhibitor is recommended. Consult engine manufactures recommendation.

> Never use a chromate base corrosion inhibitor when the coolant contains ethylene glycol. Chromate base inhibitors reacting with ethylene glycol can produce chromium hydroxide, commonly known as "green slime". This substance reduces the heat transfer rate and can cause serious engine overheating.

   Inspect the thermostat, clamps, radiator hoses and radiator core for proper condition. Replace or repair any cooling system component found to be defective.

2. Condensation in the fuel tank contaminates the fuel supply with water, which can freeze in the fuel lines and block the fuel flow to the engine. To minimize this possibility, keep the tank as full as is practical during cold weather. This may entail refilling the tank more frequently than usual, but the inconvenience is small compared to clearing a blocked fuel line.

   If water should be noticed in the fuel supply, drain the tank and refill it with uncontaminated fuel.

3. Lubricate the crane with the lubricants recommended for cold weather operation on the Lubrication Chart. If necessary, change the engine oil and other lubricants in order to conform to the recommendations.

4. The battery is more likely to sustain freeze damage if not kept fully charged because its electrolyte will freeze at a higher temperature than that in a fully charged battery. Be certain the battery is charging when the engine is running and use an external charger to restore full charge when the crane is not being operated.

   The battery can discharge if snow or ice short circuits the terminals. Keep the battery posts and cable connectors clean and dry. Remove any corrosion with a solution of soda and water.

During extremely cold weather, it is advisable to remove and store the battery in a heated area when the crane is to remain idle for any extended period.

Water added to the battery can freeze before it mixes with the electrolyte. During very cold weather, add water to the battery just prior to, or during operation of the crane. If the crane is not to be run, water may be added if an external charger is connected to the battery.

5. Cold, sluggish oil can cause pump cavitation. If the crane is not equipped with a reservoir immersion heater and running the oil over relief will not warm it sufficiently to prevent pump cavitation with the engine running very slowly, cease attempts to load the hydraulic system until an external heat source can be obtained.

   The hydraulic oil may be run over relief to aid in the warm-up process. To do this, actuate a function, allow the cylinders involved to reach the limits of their travel and hold the control in the engaged position for a few seconds.

   When running hydraulic oil over relief to warm it, be sure to restrict the flow to as slow a speed as possible by moderating pressure on the controls being engaged and running the engine at low speed.

   Continue warming the oil and slowly cycle all crane functions, actuating all cylinders in turn, swinging the upper and operating the winches in both directions.

6. At the end of the work period, or whenever the crane is to be left idle for extended periods, prevent it from being frozen to the ground by parking it on a wood, concrete, asphalt or mat surface.

EXTREME HEAT

Like extreme cold, extreme heat requires that precautions be taken with respect to the cooling system, the battery and lubrication. Protect the crane by performing the following recommended procedures:

1. High temperatures necessitate the use of lubricants which are both more viscous and which resist deterioration at higher operating temperatures. Refer to the Lubrication Chart and lubricate the crane using the lubricants recommended for the expected temperatures.

   Crankcase oil is particularly important because it helps dissipate heat. Check the oil level frequently and add oil as necessary to maintain required level. Too little oil will hinder heat dissipation.

2. To ensure proper coolant circulation, drain and flush the cooling system, clean any foreign matter from the radiator cooling fins and through core air passages, replace defective hoses, tighten hose clamps, inspect water pump drive belt properly, eliminate any leaks detected and fill the system with a 50% solution of ethylene glycol. A corrosion inhibitor is recommended by the engine manufacture.

> Allow the engine to cool before draining and flushing the cooling system.

Water containing more than small concentrations of salt or minerals should not be used in the cooling system. Salt facilitates corrosion and minerals deposited on the coolant passage walls. Both processes inhibit proper cooling.

3. Air circulation around the engine and battery must not be restricted. Keep air intake and exhaust openings clear of leaves, paper or other foreign matter which may restrict air flow.

4. Keep the engine clean of dirt, grease and other substances which inhibit heat dissipation.

5. Use sound judgment in operating the engine. Avoid the two extremes of racing and lugging.

Advance the throttle only enough to handle the load, yet be certain that the engine speed is high enough to maintain adequate fan speed for cooling.

SANDY OR DUSTY WORK SITES

The presence of large amounts of sand or dust at the work site can contribute to accelerated component wear. Either substance will act as an abrasive when deposited on moving parts of the crane. The problem is combated by more frequent lubrication and by the servicing of breathers and filters at shorter intervals. Follow the recommendations below when operating in sand or dust on a regular basis.

1. Increase frequency of lubrication and service per lube chart.

The increased frequency of lubrication and service discussed above should be determined by observations made at the work site. Inspection will determine how long it takes for lubricants, breathers and filters to accumulate unacceptable amounts of sand or dust. The frequency of lubrication and service should be adjusted accordingly.

HIGH HUMIDITY OR SALTWATER

In some locations, such as coastal areas, the crane may be exposed to the deteriorating effects of salt, moisture, or both. To protect exposed metallic surfaces, wiring, hoist rope, paint and other items, keep them dry and well lubricated where salt or high humidity are encountered. Follow the recommendations below when operating in these conditions:

1. Always perform frequent inspections for rust and corrosion and remove them as soon as they are detected. Dry and paint exposed surfaces after rust and corrosion have been removed.

2. Where paint may not be applied, such as on polished or machined surfaces, coat the area with grease or lubricant to repel water.

3. Keep bearings and their surrounding surfaces well lubricated to prevent the entry of water.

4. Hoist rope must be kept well lubricated to prevent moisture and salt from penetrating the cable strands.

5. Keep boom sliding surfaces and wear pads extra lubricated with grease.

6. Swing bearing teeth will require extra grease.

HIGH ALTITUDES

Variations in altitude alter the fuel/air mixture burned in the engine and affect the engine's performance. At high altitudes, atmospheric pressures are lower and less oxygen is available for combustion of the fuel. Above 10,000' the engine fuel injectors may have to be changed to ensure proper performance.

Keeping the air cleaner clean and free of obstructions will help alleviate high altitude problems.

At high altitudes, closely monitor the engine temperature for overheating.

Above 10,000 feet the engine will de-rate some causing a noticable reduction in performance. This is a normal condition.

AIR BRAKES

At least once a day, drain the water accumulation from the air tanks.

Making a Typical Lift

LIFT PROCEDURE In making lifts, the operator must successfully coordinate several crane functions. These include the boom raise/lower, boom extend/retract, load hoist/lower and swing functions. Although experienced operators tend to operate two or more of these functions simultaneously, the lift procedure can be broken down into the following sequence of operations.

OUTRIGGERS Set the outriggers as follows before initiating any lifting operations:

1. Remove the outrigger beam retaining pins, extend beams, and reinstall retaining pins.
2. To set the four(4) outriggers evenly, operate switches to raise crane to a level position. When level, retract jacks (together) at one end of crane an inch or so, and then extend them again (together) until crane is level. Then repeat this process for the opposite end of crane. This equalizes pressure in all four jacks. The controls for the out and down outriggers are mounted on the dash. The extend/retract master switch must be actuated before the appropriate function switches can be actuated to operate the outriggers.

FRONT OUTRIGGER JACK This jack is intended to support the front of the crane only and should never be used to level the crane. Set this jack only after the four outriggers are set and the crane is leveled.

The red light on the dash will be on if the front jack is not fully retracted. It will remain on any time the front outrigger jack is extended.

NOTE: When setting front outrigger, run the engine at IDLE only. High RPM will increase jack cylinder hydraulic pressure, causing excessive force on the carrier frame. Extend the front outrigger jack cylinder until the pad is on the ground and you sense a slight lifting motion of the carrier frame. An automatic low pressure relief valve system will prevent excessive loading on the carrier frame during the setting of the front outrigger jack.

The fifth(5th) outrigger must be properly set to operate crane with 360° load rating chart capacities.

360° load rating chart capacities apply only to machines equipped with a front outrigger jack and all five (5) outrigger jacks properly set. If the front (5th) outrigger jack is not properly set, the work area is restricted to the over side and over rear areas as shown on the Crane Working Positions diagram found in the load chart. In this case, use the 360° load ratings in the over side work areas.

The outrigger beams MUST BE PROPERLY POSITIONED FOR THE LOAD RATING CHART BEING USED, and the crane leveled prior to extending the boom or lifting loads. To achieve this condition, the vertical jack cylinders should be extended until the tires are raised free of the supporting surface.

> FULL extension of the vertical jack cylinders should be avoided if not necessary to level the crane and raise wheels clear of the ground because oil expansion under extreme heat conditions can cause cylinder seal failure. Check to ensure that all beams are fully extended, swinging the upper if necessary to visually check that each beam reaches full extension. Level the crane by viewing the IC-1 screen which will show the crane on the X-axis and Y-axis relative to 0.0 degrees. While operating the crane, frequently check and level the outriggers between lifts.

> The operator must exercise sound judgment in positioning the outriggers. The outriggers should not be set near holes, on rocky ground or on extremely soft ground. Setting the outriggers in such locations may result in the crane tipping, causing personal injury or property damage. Where a firm footing or level ground is not otherwise available, it should be provided by substantial timbers, solid blocking, or other structural members sufficient to distribute the load so as not to exceed the safe bearing capacity of the underlying material, and to enable leveling of the crane.

Proper positioning of the outriggers is critically important to both the safety and effectiveness of craning operations.

3. Use the load rating chart attached to the crane to interpret the conditions and limitations that exist when making a lift with the crane. The determining factors are lifted load, radius, boom angle, working position, hoist line reeving, tire pressure, travel data, and use of a jib.

   The examples given in this section are given for your interpretation of the terminology used on the chart section of the manual **Load Rating Chart Interpretation.**

> The load rating chart values used in the examples may not be the same as those on your load rating chart. Use the numbers from the chart attached to your crane whenever making lift calculation.

There is an increased possibility for inadequate wraps remaining on the winch drum occurs when operating with a higher number of parts of line than are required for the load being lifted, particularly at longer boom lengths and high boom angles.

Sufficient wire rope is initially provided to allow the hook block to reach ground level when reeved for the required parts of line indicated on the capacity chart for all given loads. Reeving with more parts of line than required may result in all of the wire rope being payed off the winch drum.

> Always consider, anticipate, and/or determine by trial the maximum amount of wire rope which will be payed off the winch drum to perform each different craning application of this crane. Be sure to provide for no less than two full wraps of wire rope remaining on the winch drum as specified in all applicable crane operating safety standards.

The intent of this caution is to prevent any possibility of either reverse winding of the rope on the winch drum, which could cause breakage of the winch rope, or of unseating the rope wedge in the winch drum, which could result in the uncontrolled fall of the hook block and load. Use of more parts of line than required for the lift increases likelihood of rope damage.

4. Raise the boom to the required angle, consulting the boom angle indicator which indicates boom angle relative to upper structure.

> ⚠ Always consider possible obstructions when varying the boom height or length; not only those to the front of the cab at the time of the adjustment, but those which may be encountered when swinging.

Play the swing through, considering all obstacles, prior to using swing function.

> ⚠ Never hold the controls in an "activated" position once the hoist/lower cylinder or extend/retract cylinders have reached the limits of their travel. This can cause overheating of the hydraulic oil if it is run over relief for prolonged periods.

5. Swing the boom over the load.

Upper structure swing is controlled by the LH joystick. To swing the upper structure to the RIGHT, move the LH joystick to the right or inboard. To swing LEFT, move the joystick to the left or outboard. Swing speed increases as the joystick is moved further side to side on LH joystick. Swing speed also varies with the engine speed.

Before attempting to swing the upper structure, make sure the swing brake is not set and the swing lock is not engaged. Be certain that no obstructions will block the swing.

> ⚠ Stopping the swing too abruptly will cause the load to oscillate and impose side loads on the boom. Because side loading can damage the boom, ALWAYS START AND STOP SWINGS GRADUALLY.

When ready, try for a smooth, controlled, safe swing. The swing should be SLOW. Start the swing SLOWLY and allow the load to build up only enough momentum to carry it through to the point where it is to be lowered.

Begin slowing the swing in advance of the point where the load is to be lowered. Slow the swing GRADUALLY, so that it appears to "coast" to a stop over the desired spot.

GRADUALLY slow the swing by use of the swing lever. First, move the lever to the neutral position and then VERY SLOWLY into the opposite swing direction position as required to slow the swing.

Apply the swing brake, with the foot pedal, when the swing is stopped or when emergency situations dictate that the swing be terminated abruptly.

If properly executed, the load will hang motionless when the swing is terminated. If the load is oscillating, the swing was made too rapidly and/or stopped too abruptly.

Never pull sideways with a crane boom. Crane booms are not designed for excessive side pull and may collapse if subjected to excessive side loading.

6. Extend the boom to the desired length. Do not extend the boom further than necessary to perform the lift. EXTEND the boom by pushing the LH foot pedal FORWARD.

While extending the boom, be sure to pay out sufficient hoist rope to prevent the hook block from being drawn up to the boom peak. The force of the extend cylinders can easily break the hoist line, dropping the hook block and load which may result in personal injury or property damage.

7. Lower the hook block to the load and fasten the hook.

   Before making any crane lift, make sure the hook is properly engaged with the slings, or lifting device employed to make the lift. Be certain the hook latch is not supporting any of the load.

Hook latch is intended to retain loose slings or devices under slack conditions. It is not intended to be an anti-fouling device, so caution should be used to prevent the latch from supporting any of the load. Periodic inspection of the latch must be made to insure its proper operating condition.

   Hoisting or lowering of the load with the winch is controlled by the winch lever. LOWER the load by pushing the lever FORWARD and RAISE the load by pulling the lever BACK. Improved control is obtained by operating the engine at low speed while "metering" the control. Always actuate and release this lever slowly to minimize dynamic effects of the load and to prevent "bird nesting" of the cable on the winch drum.

   To shift the winch into the high-speed, select high speed using the two speed switch. When slowing the winch, slowly return winch lever to neutral position to bring the load to a gradual stop.

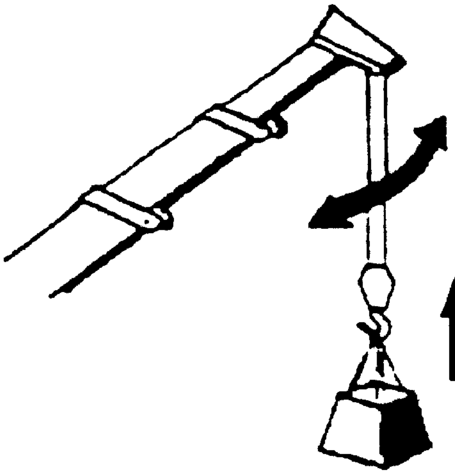
8. Lift the load to the desired height. It is good operating practice to not lift the load any higher than necessary.

   The crane is equipped with an ATB system which includes a warning light, audible alarm, and control disconnects. When the hook block or ball activate a correctly installed and maintained ATB system, the block or ball will not raise, the boom cannot be extended and the boom cannot be lowered. To return to an operating condition, either lower the hook or ball, retract or raise the boom.

   The operator may need to raise the hook block beyond the point at which the ATB system is activated during rigging or travel. The operator may override the system. (shown in control and instrument sections).

Continuing to pull the block up after contact has been made with the boom head may damage the boom head and sheaves or break the cable, causing the load to drop.

9. Swing and spot the load over the location where it is to be deposited.



10. Lower the load and unfasten the hook.

> When spotting the load it may be necessary to alter the boom length or boom angle. In making these adjustments, the operator must guard against exceeding the rated load as determined by the load rating charts.

When operating a hydraulic crane, the operator should realize that hydraulic and structural competence, NOT TIPPING LOAD, is often the determinant of lifting capacity.

Therefore, THE OPERATOR MUST BE GUIDED SOLELY BY THE APPROPRIATE MANUFACTURER'S LOAD RATING CHART when considering load weight. The manufacturer's rated loads must never be exceeded.

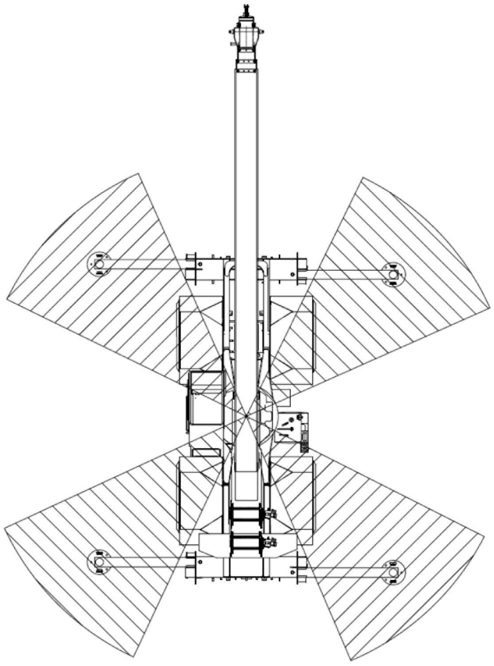
Cranes which are factory equipped with auxiliary winches may require additional counterweight if the auxiliary winch is removed. Refer to the capacity chart (load rating plate) for the required counterweight total.

> When lowering light loads, be sure to maintain sufficient cable tension to prevent the cable from becoming loose on the cable drum. Loose cable can slip and then bind suddenly, causing jerky lowering and shock loading of the boom. Loose wraps may form loops which can be overlain when the cable is wound onto the winch drum. These conditions can result in personal injury or property damage.

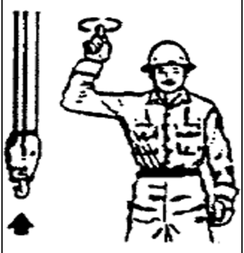
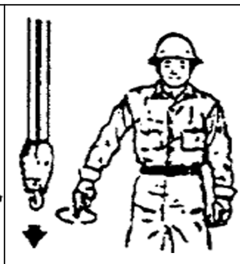
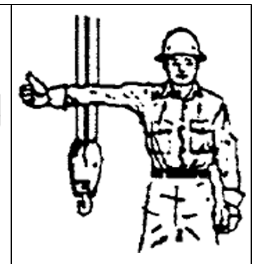
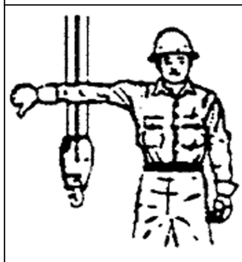
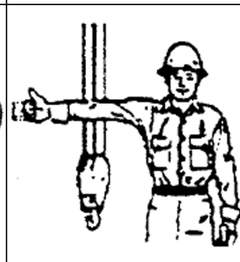
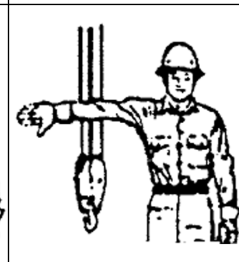
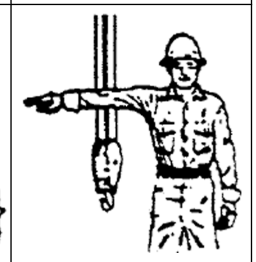
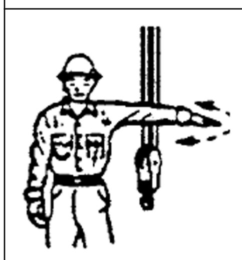
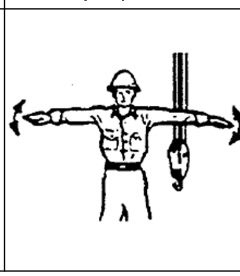
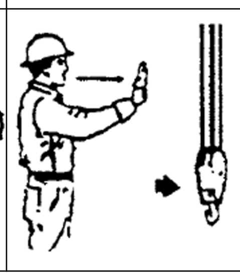
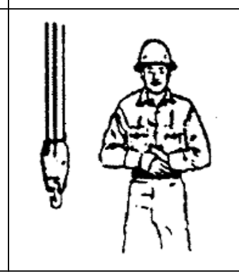
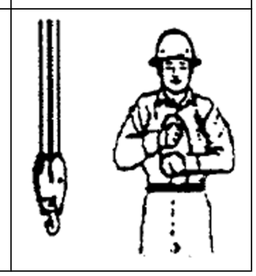
Note: Opposite corner outrigger pad lift.

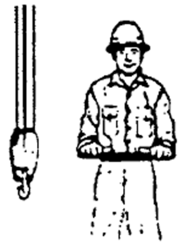
When lifting a rated load over a front or rear corner of the crane it is possible that frame torsion (twist) will cause the opposite corner outrigger pad to lift off the ground a few inches. This is normal and not an indication of a stability problem.

When operating the crane close to the crane's maximum capacity in the shaded zones indicated on the picture below, the outrigger pad on the opposite corner may lift up off the ground. This behavior is normal and does not indicate a stability limit. Be knowledgeable of the load being lifted relative to the load chart and use the RCL as a guide to stay within prescribed load chart limitations.



Arm and Hand Signals

				
HOIST. With forearm vertical fore finger pointing up, move hand in small hori-zontal circle	LOWER. With arm extended downward forefinger pointing down, move hand in small circle	USE MAIN HOIST. Tap fist on head; then use regular signals.	USE WHIPLINE. (Auxiliary Hoist) Tap elbow with one hand, then use regular signals.	RAISE BOOM. Arm extended, fingers closed, thumb pointing upward.
				
LOWER BOOM. Arm extended fingers closed, thumb pointing downward.	MOVE SLOWLY. Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist slowly shown as example)	RAISE THE BOOM AND LOWER THE LOAD. With arm extended, thumb pointing up, flex fingers in and out as load movement is desired.	LOWER THE BOOM AND RAISE, THE LOAD With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.	SWING. Arm extended, point with finger in direction of swing of boom.
				

STOP. Arm extended, palm down, move arm back and forth horizontally.	EMERGENCY STOP. Both arms extended, palms down, move arms back and forth horizontally.	TRAVEL. Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.	DOG EVERYTHING. Clasp hands in front of body.	TRAVEL.(Both Tracks.) Use both fists in front of body, making a circular motion about each other, indicating direction of travel, forward or backward (for land cranes only).
				
TRAVEL. (One Track) Lock the track on one side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist, rotated in front of body (land cranes only).	EXTEND BOOM. (Telescoping Booms.) Both fists in front of body with thumbs pointing outward.	RETRACT BOOM. Telescoping Booms.) Both fists in front of body with thumbs pointing toward each other.	EXTEND BOOM. (Telescoping Boom.) One Hand Signal. One fist in front of chest with thumb tapping chest.	RETRACT BOOM. (Telescoping Boom.) One Hand Signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.

KNOW THE CRANE SIGNALS! Poor communication between the operator and personnel directing lifts can result in property damage or personal injury.

Load Rating Chart Interpretation

In the following pages are examples of a load chart, these example charts may differ from the chart supplied with your crane. Always use the load rating chart supplied with the crane to interpret the conditions and limitations that exist when making a lift with the crane. The determining factors are lifted load, radius, boom angle, working position, hoist line reeving, tire pressure, travel data, use of a jib, and other special conditions that exist, such as wind velocity, soil conditions, etc.

DEFINITIONS OF LOAD CHART TERMS

Lifted Load: The lifted load is the total weight of all the items suspended on the wire rope.

Example:

Hook Block	750 lbs.
Slings	215 lbs.
Object Lifted	19,000 lbs.
Lifted Load	19,965 lbs.

Load Radius: The horizontal distance from the axis of rotation before loading to the center of the vertical hoist line or tackle with a load.

Loaded Boom Angle: It is the angle between the boom base section and the horizontal, after lifting the rated load at the rated radius. The boom angle before loading should be greater to account for deflections. The loaded boom angle combined with the boom length give only an approximation of the operating radius.

Freely Suspended Load: Load hanging free with no direct external force applied except by the hoist rope.

Side Load: Horizontal force applied to the lifted load either on the ground or in the air.

No Load Stability Limit: The stability limit radius shown on the range diagrams is the radius beyond which it is not permitted to position the boom, when the boom angle is less than the minimum shown on the applicable load chart, because the machine can overturn without any load.

Over Rear, over Side and 360°: The “crane working position” diagram is a view looking straight down on the crane with the upper structure and the boom removed. “Over Rear” when the crane is on outriggers is the area inside the arc bounded by lines from the center line of rotation through the rear outrigger vertical jack cylinders.

“Over Side” when the crane is on outriggers is the area inside the arc bounded by lines from the center line of rotation through the rear outrigger vertical jack cylinders and a line passing thru the front vertical jack cylinders.

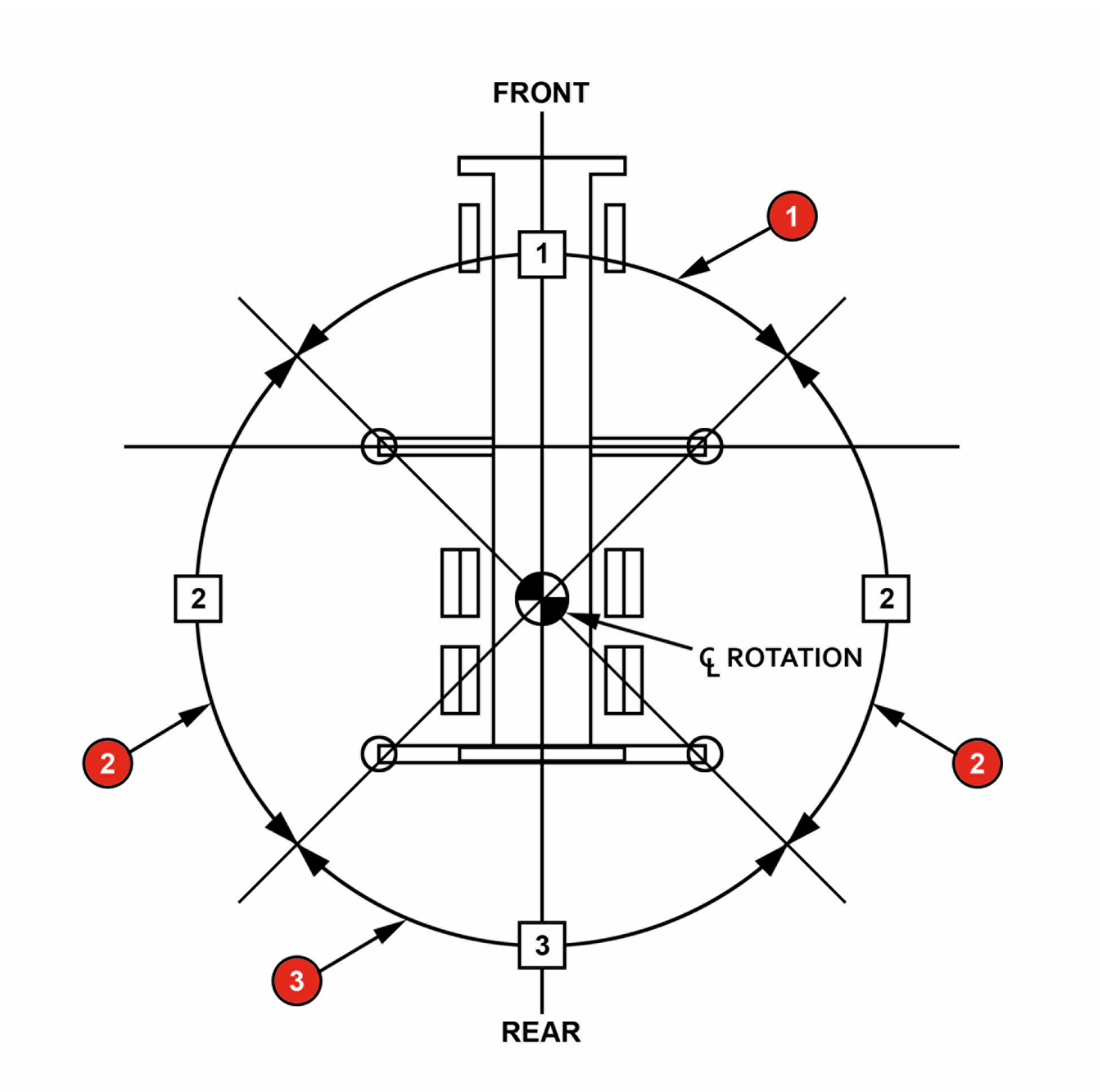
“360°”means the load can be swung to any position around the crane.

360° capacities apply only to machines equipped with a front outrigger jack and all five(5) outrigger jacks properly set. If the front (5th) outrigger jack is not properly set, the work area is restricted to the over side and over rear areas as shown on the Crane Working Positions diagram. Use the 360° load rating in the overside work areas.

Crane Working Positions with Outriggers Extended: Areas measured in a circular arc about the centerline of rotation as shown in the diagram below.

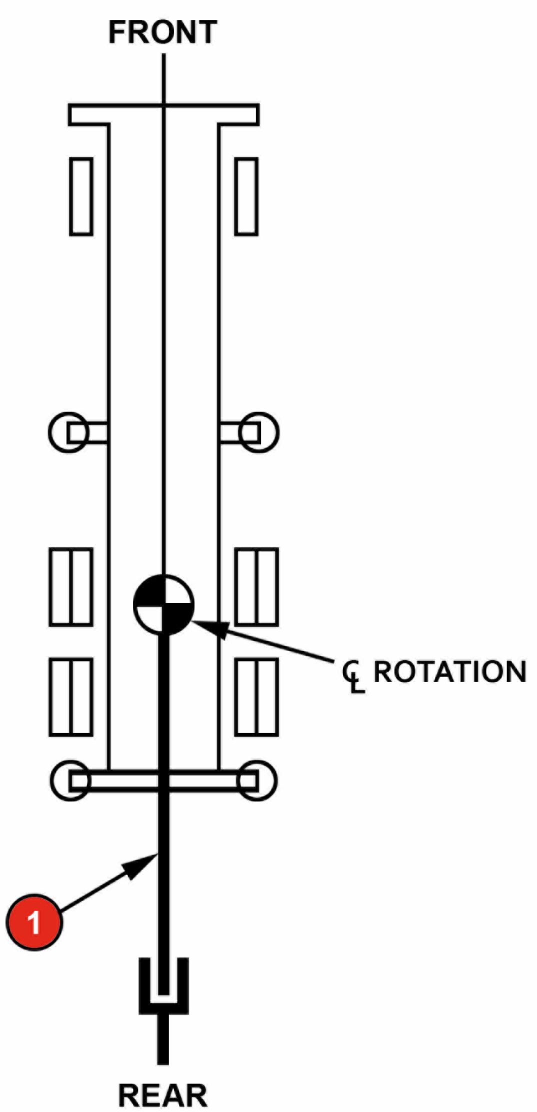
1. Boom over front working area
2. Boom over side working area
3. Boom over rear working area

NOTE: *Ballooned items no. 1, no. 2 & no. 3 determine the limits of WORKING POSITIONS which correspond to those shown on the Crane Capacity Charts.*



Crane Working Position without Outriggers

1. Boom "Straight Over Rear" working lifting position.



Cut - Offs: Rated chart values of less than approximately 1,000 lbs for on outriggers and side-stow jib are not shown. This is done because the effects of wind, pendulum action, jerking, etc., can cause a tip over.

Extending the boom or boom and jib combination into unrated areas of the chart can cause tip over. Do not operate at a longer radius than those listed on the applicable load rating charts as tipping can occur without a load on the hook.

NOTE: *EXAMPLE ONLY LOAD CHART SHOWN Alway use load chart included with the crane.*

Rated Load On Outriggers (Example Only-Not for use)											
Load Radius (FT)	Loaded Boom Angle (DEG)	Over Rear (LB)	360°	Load Radius (FT)	Loaded Boom Angle (DEG)	Over Rear (LB)	360°	Load Radius (FT)	Loaded Boom Angle (DEG)	Over Rear (LB)	360°
Boom Length 30 FT				Boom Length 39 FT				Boom Length 50 FT			
10.0	62.5	40000	40000	10.0	69.1	40000	40000				
12.0	58.1	40000	40000	12.0	65.9	40000	40000	12.0	71.4	40000	40000
15.0	51.0	39100	39100	15.0	60.9	39900	39900	15.0	67.7	37700	37700
20.0	37.0	27500	27500	20.0	51.9	28300	28300	20.0	61.4	28900	28900
25.0	13.2	19800	19800	25.0	41.7	21300	21000	25.0	54.5	21900	21500
25.6	.0	18600	18600	30.0	28.5	16600	14500	30.0	47.0	17200	15100
				34.3	.0	13500	10700	35.0	38.4	13900	11200
								40.0	27.6	11200	8400
								45.0	7.6	8900	6400
								45.3	.0	8700	8200

Example:

Hook Block	660 lbs.
Slings	215 lbs.
Object Lifted	18,700 lbs.
Lifted Load =	19,575 lbs.

On Outriggers Using Main Boom

To determine the lift capacity when lifting off the main boom with the outriggers set, use the following procedure:

1. Determine the weight of the load to be lifted.
2. Determine the weight of slings, rigging hardware and hook block.
3. Calculate weight of lifted load.

4. Determine load radius, boom angle, and boom length.
5. Determine which load chart to use for your lift. Individual load charts exist for the following lift configurations:

   - on outriggers (fully extended, partially extended & retracted), lifting off main boom with jib stowed or not present

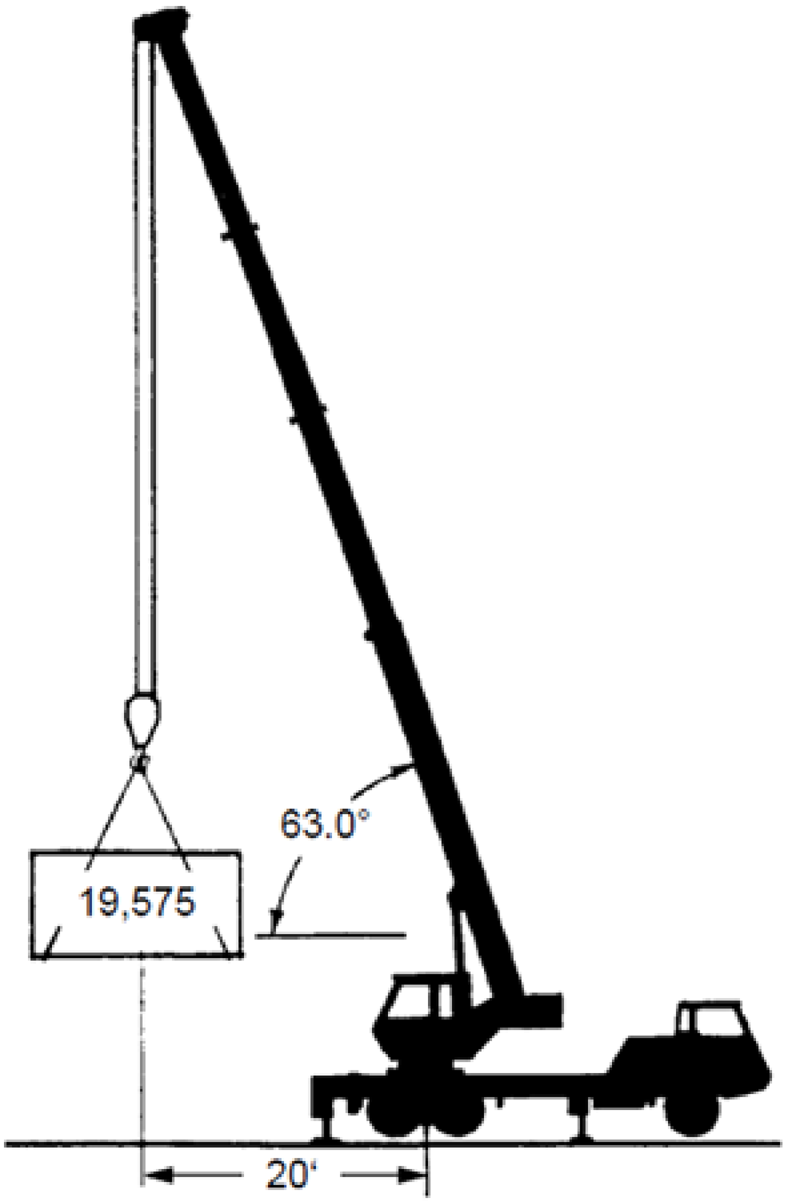
   - on outriggers (fully extended), lifting off main boom with jib erected but unused with jib pullout extension retracted or not present

   - on outriggers (fully extended), lifting off main boom with jib erected but unused with pullout extension extended

   - on outriggers (fully extended & partially extended) with jib erected, jib pullout section retracted or not present, lifting over the jib

   - on outriggers (fully extended & partially extended) with jib erected, jib pullout section extended, lifting over the jib pullout section

   - on tires, lifting over main boom with jib stowed



6. If the auxiliary boom head is not erected, add 100 lbs to the chart rated capacity.
7. Compare load weight with chart rated capacity from the boom length, radius, and boom angle.
8. The lifted load must not exceed the chart rated capacity for the boom length and radius.

In this example, the lifted load of 19,575 lbs is less than the rated load of 28,300 lbs and can be handled.

"On-Tires" Lift

Listed below are special precautions for “On Tires” lifts.

All static crane load ratings are based on nonuse of the travel function while handling loads. However, cranes may be utilized for pick and carry operations. Traveling with suspended loads involves so many variables such as ground conditions, boom length, momentum in starting and stopping, etc., that it is impossible to devise a single standard rating procedure with any assurance of safety. For such operations the user must evaluate prevailing conditions and determine safe practices, exercising precautions, such as the following:

1. The boom shall be carried straight over the rear of the crane.
2. Travel speed reduced to suit conditions.
3. Maintain specified tire pressures.
4. Avoid sudden starts and stops.
5. Provide tag or restraint lines to snub swinging of the load.
6. Keep the load as close to ground as possible.
7. Set the swing brake and swing lock.
8. Travel must be on a smooth level surface that is capable of supporting the weight of the loaded crane. The travel surface must also be free of holes or debris that can cause crane instability.
9. The rear air suspension should be “dumped” before lifting or travelling with a load on tires.

These precautions are necessary to prevent a swinging load, which can cause a machine tip over.

Any variation from the above conditions will require the operator to consider the prevailing conditions and reduce the lift capacities accordingly.

These precautions are necessary to prevent a swinging load, which can cause a machine tip over.

Any variation from the above conditions will require the operator to consider the prevailing conditions and reduce the lift capacities accordingly.

Always carry the load as near the ground as possible with the minimum boom length necessary to carry the load, and straight over the rear with the swing brake locked.

Travel over uneven terrain with excessive boom length can result in instability.

Insufficient tire pressure reduces the “ON TIRES” capacity. Attempts to pick rated capacity without properly inflated tires may cause the crane to tip and/or result in damage to the tires or rims.

Ensure that the tires are inflated as shown in the recommended tire pressure chart. Refer to tire chart in cab of crane or to section on Vehicular Operation.

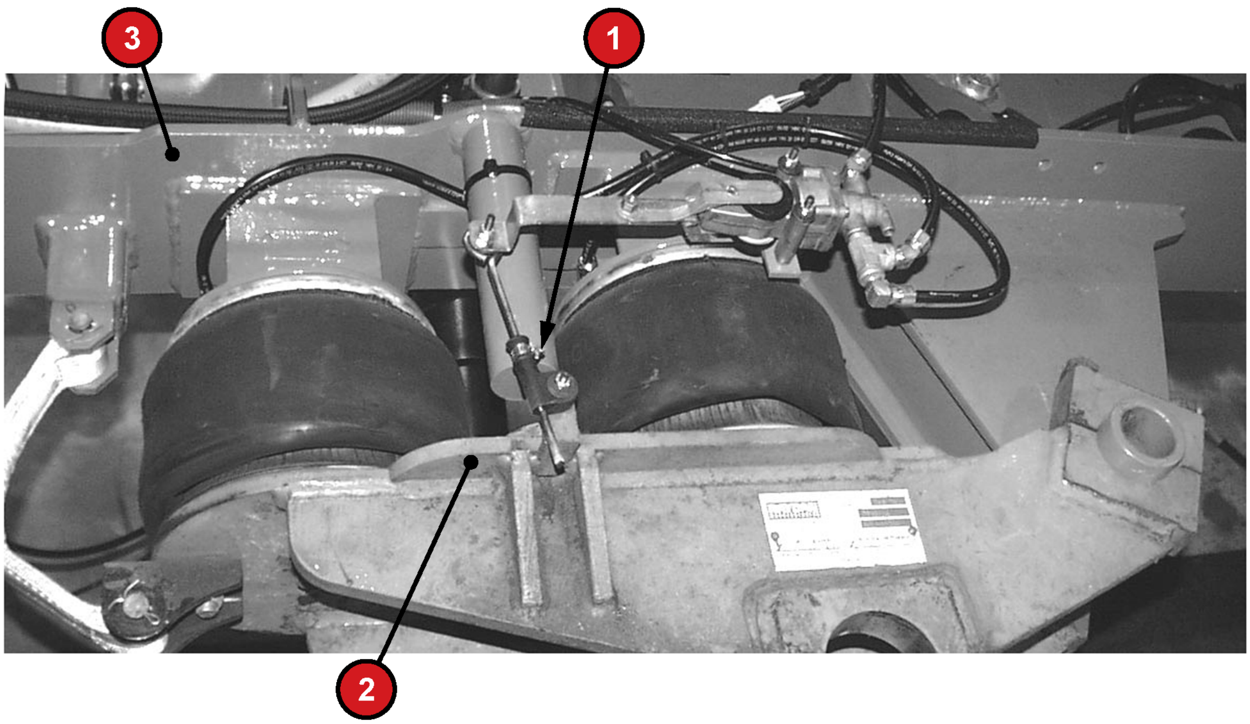
Air-Ride Suspension

This machine is equipped with an air suspension on both the front & rear axles. By using the switch in the drivers cab, the air in the front and rear suspensions can be released before raising the crane up on outriggers or doing pick and carry work. The supension should always be aired up prior to driving the crane on or off road.

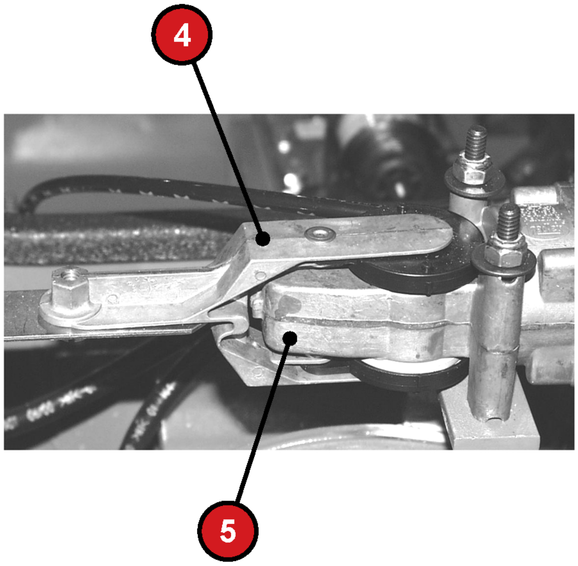
480-126-Dumps air on both front & rear axles.

RIDE HEIGHT ADJUSTMENT

To adjust the ride height, release the air in the suspension with the switch on the dash. Raise the crane up on outriggers until the saddles are parallel to the frame. Loosen the clamp (1) and insert a pin through the ride height valve arm (4) into the mating hole in the body of the valve (5). This puts the valve in the neutral position. Retighten the clamp (1) and remove the pin.



1	Clamp	3	Frame Surface
2	Suspension Member Surface		



4 Right Height Valve Arm	5 Ride Height Valve

Remote Carrier Operation

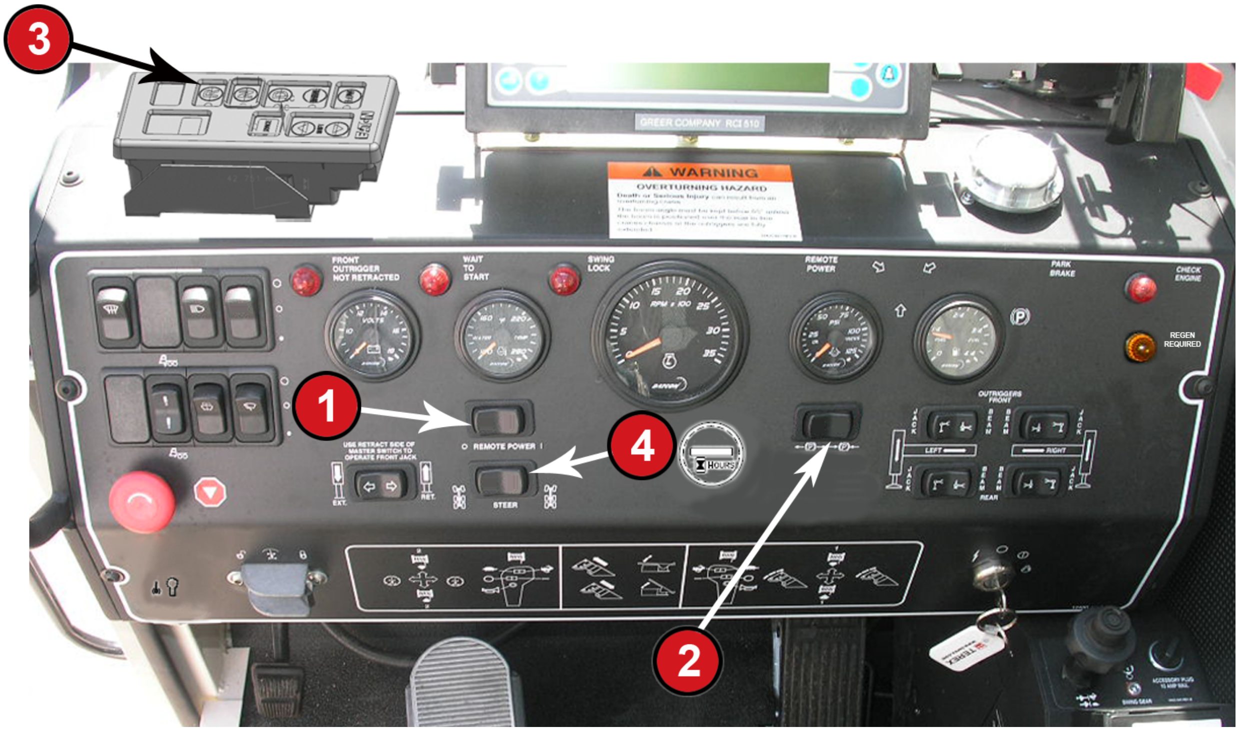
The electric remote option provides a means for the crane operator to maneuver the crane around the job site from the operators cab with (Pick & Carry) or without a load.

To Engage the Remote Control-Carrier Cab

1. Set the parking brakes in the carrier cab.
2. Ensure that the system air pressure is high enough for operation (85 PSI or above). If the air pressure is low, start the engine and build it up before going any further.
3. Shut off the engine.
4. Engage the pumps.
5. Push in the "Air Transfer" button, for "Crane" operation as shown in photo below.

Remote Control-Upper Crane Cab

1. Move to the upper (crane) cab.
2. Start the crane engine. If the red (Low Air) light is "ON", run the crane engine for a few minutes to allow air pressure to build up before moving the carrier.
3. Turn "ON" the "Remote Power" switch item (1) as shown in photo below.
4. Apply the service brakes by pressing foot pedal and release the parking brakes with the parking brake switch item (2) as shown in photo below located on the dash panel.
5. Select the "Transmission" direction by pressing the 3-position upper LH dash mounted switch item (3) as shown in photo below located on the dash panel. "F"=(forward), "N"= (neutral), "R"=(reverse), as applicable.



1	"Remote Power" Switch	3	"Transmission" Direction Switch
2	Parking Brake Switch	4	"Steering" Switch

6. Position the front wheels using the "Steering" switch item (4), "Left" - "Right" on the dash panel and slowly release the brake until you begin to move.

NOTE: *The steering switch is a momentary type. The longer you hold down the switch in either direction, the further the wheels will turn. The wheels will stay in whatever position they are left in, (they will not return to the straight-ahead position automatically) you must actuate the switch in the opposite direction to bring the wheels back to center.*

7. Use the throttle, "Steering Switch", service brakes, and "F"-(foreward), "N"-(neutral), "R"-(reverse) switch as necessary to position the crane as desired.
8. To stop, depress the service brakes, shift the "Transmission" switch to "N"-(neutral), and engage the parking brakes with the parking brake switch.
9. Turn off the "Remote Power" switch. The crane is now ready for operation.

Disengage the Remote Control

1. With the parking brakes set, turn off the "Remote Power" switch, turn off the ignition, move to the carrier cab and reverse the steps under "Engage the Remote Control".

Moving the Unit

Removable Counterweight (480-126)

INSTALLATION

NOTE: *The counterweight slabs are an integral part of this crane. When the crane is driven, the counterweights slabs may need to be moved from the upper to the deck or removed from the crane to meet local weight restrictions and axle weight limits.*

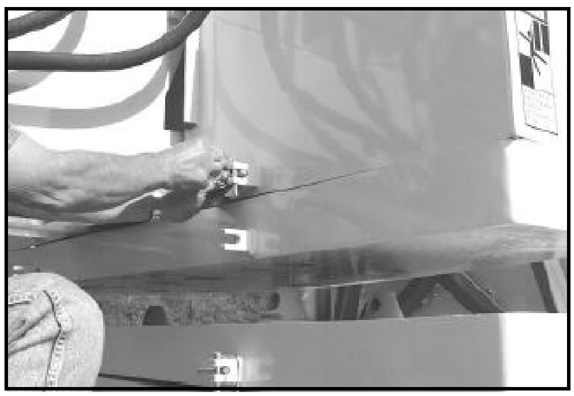
1. Lower the outrigger jacks to support the weight of the crane

2. Rotate the upper to a position straight over the rear of the crane.

3. With the crane still running, move to a position under the superstructure, face the counterweight.

4. Lift both control levers to raise the counterweight slabs up tightly against the shell of the counterweight.

5. Remove the long horizontal pins, and the locking pins that secure them, from the top slabs to free it from the counterweight shell. Both pins should pull freely.



NOTE: *If one or both pins will not release, it may be necessary to slightly lower one side of the slabs and raise the other to get the first pin removed, then slightly lower the side still pinned and pull the other side up tightly to remove the second pin.*

6. With the engine idling slowly and evenly push down on both levers to lower the top counterweight slab onto the second slab.

⚠	Do not continue to extend cylinders after counterweight is resting on the deck. Severe damage may occur to the cylinders or cylinder mounts.

7. Insert the long horizontal pins and the locking pins into the top slab.

8. Remove the locking pins and long horizontal pins from the lower most slab that you wish to attach to the counterweight.

9. Lift both control levers to raise the counterweight slabs up tightly against the shell of the counterweight.

10. Install horizontal pins and locking pins on each side to attach the stack to the counterweight.

Drivers Tips

Use as a guide for engines with Aftertreatment.

NOTIFICATION AND DESCRIPTION	DRIVER ACTION
CHECK ENGINE **Check Engine Lamp or Amber Warning Light (CEL or AWL)** • Engine controls, aftertreatment control system and/or component issues exist.	Vehicle can be driven to end of shift. Call for service.
High Exhaust System Temperature Lamp (HEST) • **Solid**: Exhaust is at **high** temperature and vehicle is at low speed or parked. • **Flashing**: Parked regeneration in process. System is not up to temperature.	No change in driving style is required. When parked, keep vehicle at a safe distance from people and flammable materials or vapors.
CHECK ENGINE **Malfunction Indicator Lamp (MIL) /Check Engine Lamp** • There is a potential problem with the emission control system or component. • May illuminate at the same time as the Check Engine Lamp. • Driving for a prolonged period with the MIL on can cause damage to the engine and/or aftertreatment system as well as degrade mileage and drivability.	Vehicle can be driven to end of the shift. If the MIL remains on after 3 drive cycles, call for service.
DPF Regeneration Lamp • **Solid**: Parked regeneration may be needed. • **Flashing** Parked regeneration is required as soon as possible. • Diesel Particulate Filter reaching system limits.	Perform a parked regeneration **OR** bring vehicle to highway speeds to enable Automatic Regeneration of the filter.
Flashing CHECK ENGINE **DPF Regeneration Lamp / Check Engine Lamp** **ENGINE DERATED** • Diesel Particulate Filter has **reached** system limits.	A parked regeneration **must** be performed. If the parked regeneration exits and the lamps remain on, repeat the parked regeneration. If the second attempt fails, call for service.
Flashing CHECK ENGINE STOP ENGINE **Stop Engine Lamp** **ENGINE SHUTDOWN** • Diesel Particulate Filter has **exceeded** system limits.	A parked regeneration **must** be performed. If the parked regeneration exits and the lamps remain on, repeat the parked regeneration. If the second attempt fails, call for service. **Note**: Engine can be restarted, but a parked regeneration must be initiated within 30 seconds or the engine will shutdown.
Fuel Filter Restriction Sensor Lamp (FFRS) • Fuel Filter is restricted.	Driver has one to three days to seek service or the engine may derate.
Water In Fuel Lamp (WIF) • Water level is too high and must be drained from the fuel system.	Engine water separator must be drained or an engine derate will occur.

Regeneration Inhibit Switch

The purpose of this switch is to prevent or disable aftertreatment DPF regeneration. Reference the vehicle Owners Manual for complete operation and use of this switch. Unnecessary or excessive use of the Regeneration Inhibit Switch will result in a loss of fuel economy, or an increased need for parked regeneration.

How To Perform A Parked (Stationary) Regeneration

If the vehicle has a Manual Regeneration Switch and the DPF Lamp is flashing:

● Park vehicle in an appropriate location, set parking brake, and place transmission in Park or Neutral, and allow up to one hour for regeneration.

● Set up a safe exhaust area. Confirm that nothing is on or near the exhaust system surfaces.

● Ensure that your fast-idle and Power Take-Off switches are off before starting regeneration.

● Push the Manual Regeneration Switch to begin a parked regeneration. Note: Engine speed will increase, and there may be a noticeable change to the sound of the turbocharger during the regeneration process. Once the DPF is regenerated, the engine will automatically return to the normal idle speed.

● Monitor the vehicle and surrounding area during regeneration. If any unsafe condition occurs, shut off the engine immediately. To stop a parked regeneration, depress the clutch, brake or throttle pedal.

● Once the regeneration is complete, exhaust gas and exhaust surface temperatures will remain elevated for 3 to 5 minutes.

Fuel, Oil and DEF

● Use only Ultra-Low Sulfur Diesel (ULSD) Fuel

● CJ-4 (low ash) is the recommended oil.

● Be sure to check the DEF gauge at every refueling. Detroit Diesel recommends topping off the DEF tank when refueling. DEF meeting ISO 22241-1 must be used.

● Put only DEF in the DEF tank, which has a blue cap.

Items Driver Will Notice

● Under certain conditions (cold or very dry), condensation in the form of water vapor can be seen coming from the vehicle tailpipe. This is normal. It will clear within a few minutes of normal vehicle operation.

● If th engine is left at idle for significant periods of time without reaching the minimum exhaust operating temperatures, the engine will automatically increase the engine idle speed for serveral minutes to maintain the condition of the particulate filter. This can be interrupted by pressing either the service brake or the clutch.

● After prolonged idle, you may notice momentary white vapor and an odor. This is normal.

● When the High Exhaust System Temperature Lamp is illuminated, you may notice an odor. This is normal. If the odor is excessive and you also notice white vapor, have the exhaust system inspected for leaks.

Tips for Efficient Driving

1. **Lower drive speeds** - At interstate speeds, each 1.0 mph (1.6 kph) increase equals a 0.1 mpg (0.04 km/L) decrease. For example, driving at 65 mph instead of 70 mph can save 0.5 mpg (0.21 km/L) and create roughly a 7 percent improvement in fuel economy.
2. **Run in top gear more than 90 percent of the time** - Every 10 percent drop in time in top gear equals approximately a 3 percent to 5 percent decrease in fuel economy.
3. **Decrease idle rpm and idling time** - Using the lowest idle speed possible helps reduce fuel use by up to 0.5 gal/hr (1.89 L/hr). Every hour of idle time that you eliminate can increase your vehicle's fuel economy by as much a 1 percent.
4. **Follow proper driving habits** - Sudden braking, rapid acceleration, early downshifting and other poor driving habits can negatively impact fuel economy by as much as 30 percent.

Vehicular Operation

The Hydraulic Crane is capable of both on-road and limited off-road travel. The kind of travel undertaken determines how the carrier is operated.

Before moving the crane, either around the work site or between sites, carefully consider the terrain type, road conditions, and any hazards likely to be encountered en route. Think the move through in advance and carry it out safely.

PRE-MOVE CHECK LIST: Before moving the crane to and from job sites, make sure the following safety checks have been made:

/, Stow the boom in the boom rack.

NOTE: Swing lock will not engage with boom in rack on 480-126.

2, Secure hoist block to the bumper loop. If this is impractical, pull theATB system counterweight up to within approximately 1” of the load sheaves, or until block lightly contacts boom head.

Use the ATB override switch to temporarily bypass the two block system disconnects. Failure to pull the hook block up to the head when traveling, or to secure it to the bumper ring, will result in excessive swinging of the hook block and possible damage to machine.

Continuing to pull the block up after contact has been made may result in damage to the boom head and sheaves.

4. Verify that the hydraulic outrigger beams are fully retracted and secured with retaining pins.
5. Check tires for proper inflation pressure.
6. Adjust the seat and mirrors for clear vision.
7. Disengage the main hydraulic pump drive. Never travel with the main hydraulic pumps engaged.
8. Check the counterweight and removable slabs (if so equipped) to ensure that they are properly secured for roading and that the weight is balanced so as not to over load axles or tires (see the maximums on page 2 of the lift capacity chart).
9. Stow the outrigger pads.

MOVING THE MACHINE: The general procedure for moving a machine is as follows:

1. Be seated in the driver’s seat with the seat belt fastened low and snug.
2. Thoroughly review the shift pattern of the transmission.
3. Start the engine, following the procedure in the topic “Starting the Engine.”
4. Allow air pressure buildup.

5. Make sure the boom is stowed in the boom rack.
6. Apply the Service Brake.
7. Release the Parking Brake.
8. Push in the clutch (if equipped with a manual transmission).
9. Select the desired transmission range.

OFF-THE-ROAD OPERATION: Good judgement in the selection of gear range and route of travel is essential when operating off the road. Holes and soft or spongy ground subject the machine to excessive stresses and should be avoided.

HARD SURFACE OPERATION: When operating on highways, the machine is subjected to the same regulations as which govern the operation of other heavy equipment on public roads. Adequate lighting, flares, flags and safety equipment should be on the machine at all times.

TIRE INFLATION: For maximum tire loading capacities, tire pressures should be maintained as indicated in the following table.

The inflation pressures shown below are for those taken with the tires at the prevailing atmospheric temperatures and do not include any inflation pressure build-up due to vehicle operation.

TIRE DATA - 480-126	DUALS	SINGLES-FRONT
Tire Size	315/80R22.5	445/65R22.5
Ply Rating	L	L
Pressure (PSI)	130	120
Pressure (kPa)	900	830

Before stopping the engine, put the transmission in neutral, engage the parking brake and reduce engine speed.

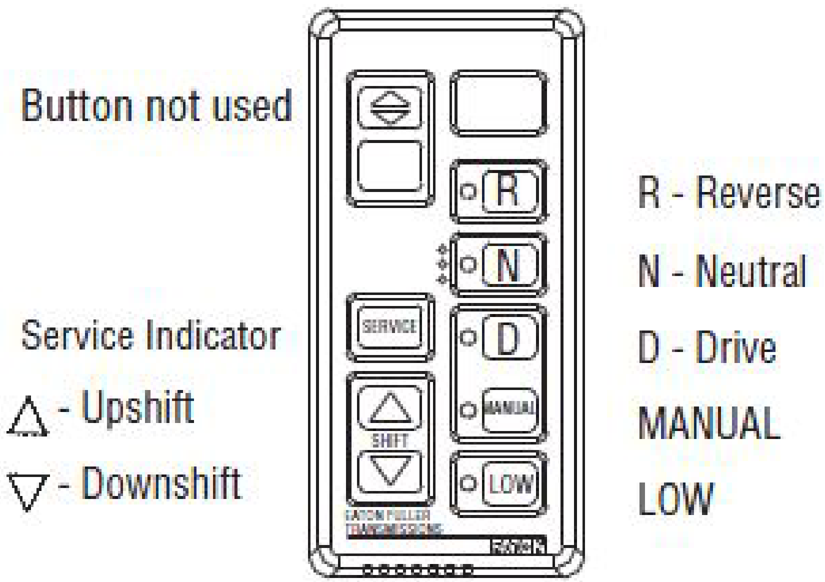
Always idle the engine for at least 5 minutes before stopping it. This give the engine a chance to cool down and prevents overheating which can be caused by localized hot spots in the engine. The idle speed must be high enough to charge the battery but not higher than half speed.

After several minutes at idle, the engine may be shut off by pushing the engine stop button or turn the ignition switch to the OFF position.

Transmission Operation

Eaton UltraShift PLUS Transmission TRDR0941 EN-US

Shift Selector



Gear Engagement

1. Turn the ignition key to "ON" and allow the system to power-up. Note: Engine cranking is delayed until the transmission power-up is complete and the gear display shows a solid "N".
2. Start the engine.
3. Apply the service brake.

NOTE: *If the service brake is not applied while selecting a starting gear, the initial start gear will not engage, requiring the driver to select Neutral and apply the brake while selecting the desired mode.*

4. Select the desired mode and starting gear on the shift console.

NOTE: *The transmission overrides inappropriate start gear selections to avoid driveline damage.*

5. Release vehicle parking brake.
6. Release service brake and apply accelerator.

Power Down

1. Select Neutral on the shift control.
2. Set the vehicle parking brake.

Features

"R" - Reverse Mode:

• Selects Reverse gear.

LR, LLR and R will be made by manually pressing the upshift and downshift buttons while vehicle is moving.

"D" - Drive Mode:

• Automatically selects the default start gear. The selected start gear will vary depending on serveral vehicle inputs like load, grade, and axle/transmisson ration. This start gear can be changed by using the upshift/downshift buttons. The transmission will override inappropriate selections to prevent driveline damage.

• Automatically performs all upshifts and downshifts in all gears except 1st gear on Vocational Multipurpose Series (VMS) models.

• A shift can be advanced by pressing the upshift / downshift buttons when the transmission is near the shift point (condition permitting).

"MANUAL" Mode:

• Use MANUAL mode to manually select shifts instad of allowing the system to automatically make shifts. For example, when driving around the yard, over railroad tracks, or on steep grades.

• Driver manually selects the start gear and uses upshift / downshift buttons to select the shift.

• System holds current gear unless otherwise prompted by using upshift / downshift buttons.

• System automatically shifts or inhibit shifts to prevent engine overspeed or underspeed.

Note: For optimal vehicle performance, it is recommended the vehicle be operated in "D" drive mode.

"LOW" Mode:

• Use LOW mode to maximize engine braking and minimize use of the brake pedal. For example, when driving down long grades or coming to a stop.

• Selects lowest available gear for start gear. The starting gear cannot be changed to LOW mode.

• If LOW is selected while moving, the transmission will not upshift. The transmission system will downshift at the earliest opportunity to provide maximum engine braking.

• System automatically shifts to prevent engine overspeed.

Hill Start Aid (HSA)

• Prevents vehicle from rolling in an unintended direction for up to 3 seconds when launching vehicle on a grade.
• Hill Start Aid defaults to the "ON" position. It can be turned "OFF" for a single launch by pressing and releasing the Hill Start Aid switch.

Vehicle Facing Uphill - Foreward Mode:

• Vehicle must be on incline greater than 1% and in a Forward mode.

• Bring vehicle to a stop and press the service brakes, then release the service brakes.

Note: Vehicle will begin to move after 3 seconds. Driver must either press brake pedal or apply the throttle.

Vehicle Facing Downhill - Reverse Mode:

• Vehicle must be on a decline greater than 1% and in Reverse mode.

• Bring vehicle to a stop and press the service brakes, then release the service brakes.

Note: Vehicle will begin to move after 3 seconds. Driver must either press brake pedal or apply the throttle.

Clutch Abuse Protection:

• This vehicle uses an Electric Clutch Actuator (ECA) for launching the vehicle, however the clutch can still overheat and slip with improper use.

• If the clutch starts to overheat, "CA" appears in the driver display with a warning tone. Full clutch actuation must be completed quickly. If not, the system will either open the clutch if throttle is not applied or close the clutch if throttle is applied. If the abuse continues, the system will open the clutch and remove throttle control briefly to allow the clutch to cool down.

Engine Over-speed Protection:

The transmission system upshifts if necessary to prevent engine overspeed in Drive, MANUAL and LOW modes.

Shuttle Shifting:

Shuttle shifting from Reverse to any forward mode is only allowed if vehicle speed is at or near zero.

Skip Shifting:

When appropriate, the system may skip shift in Drive mode.

Auto Neutral:

• The system will automatically shift into Neutral if the vehicle is left in Drive and the parking brake is set.

• "AN" will appear in the gear display. Driver must select Neutral and then select the desired forward or reverse mode with the service brake applied.

ABS/ATC Interaction:

See Driver Instructions manual Eaton TRDR1110 on the SHOP-CD for detailed information.

Creep Mode Operation:

The transmission system will maintain the current gear and operate at idle.

1. Select MANUAL or LOW mode. (Default setting for DRIVE is disabled.)
2. Apply throttle until you feel the clutch engage, then slowly release throttle pedal.
3. Remove foot from throttle and allow the vehicle to idle in gear.
4. To exit Creep mode, apply the throttle or press the service brake.

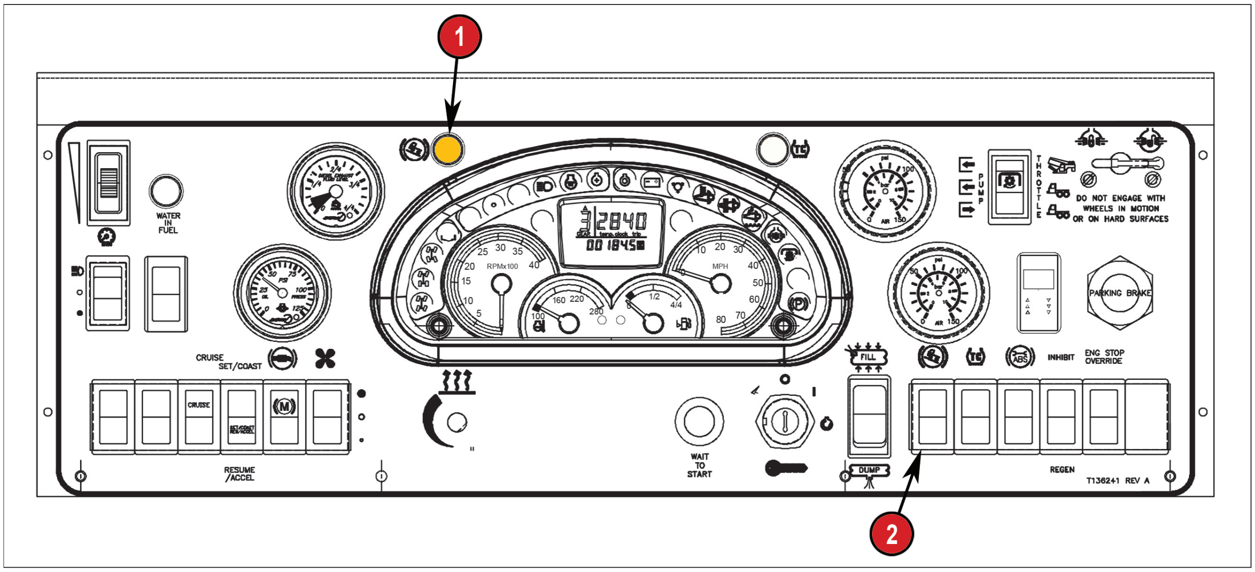
Hill Start Aid

The Hill Start Aid (HSA) feature is a system designed to apply the brakes to resist the vehicle rolling backward (forward if in reverse) when the vehicle is in a stopped postion on a hill. This feature is an enhancement to the Antilock Brake System (ABS) and is designed to be used in conjunction with Eaton's UltraShift transmission. The potential for vehicle roll back is the result of a small lag time between the release of the brake pedal and driveline engagement of the automatic clutch transmission.

The HSA Lamp indicates the status of HSA system. When HSA lamp is controlled by the ABS controller, the lamp will be OFF when the system is operating normally. The lamp will turn ON (indicated as item 1) if the system is faulted. The lamp will flash at a rate of 1 Hz when the system has been temporarily disabled by the operator.

The HSA Disable Switch is a momentary switch (item 2) that can be used by the vehicle operator to temporarily disable HSA. Typically this feature would be used while maneuvering the vehicle at low speed.

The switch is a two position, normally open, momentary ON-OFF.



1. Hill Start Aid (HSA) Indicator Lamp
2. Hill Start Aid (HSA) Disable Switch

Air Brakes

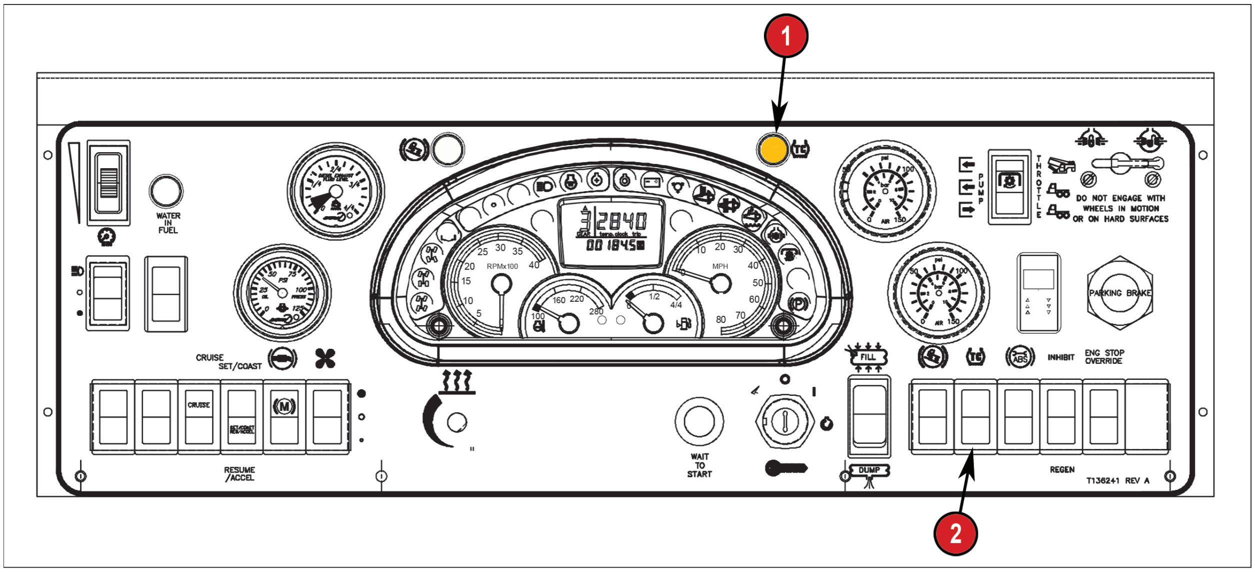
ABS

The ABS system is given "priority" at the wheel ends to manage wheel slip for optimal braking. The Antilock Braking System (ABS) helps to improve braking when excessive wheel slip, or wheel lock-up, is detected. The ECU monitors wheel speeds (on all wheels equipped with speed sensors) and use ABS modulator valves to adjust or pulse the braking force being applied and released, many times per second, during an ABS event. ABS typically improves stability and steerability, and also reduces stopping distances on most surfaces.

Antilock Traction Control

In addtion to the ABS function, the vehicle has Automatic Traction Control (ATC) feature which can help improve vehicle stability and traction during vehicle acceleration (at low speeds), and lateral stability while driving through curves.

The Antilock Traction Control (ATC), is disabled if the amber (TC) indicator light is "ON" on the carrier dash panel or if the Traction Control is switched to deactivate the system.



1. Traction Control (TC) Indicator Lamp
2. Antilock Traction Control (ATC) Switch

Traveling around the Jobsite

When traveling around a job site, it is very important that the crane operator is very aware of what is happening with the crane as well as with other vehicles and personnel on the job site. The crane operator should observe the following rules as well as good common sense while moving a crane around a job site.

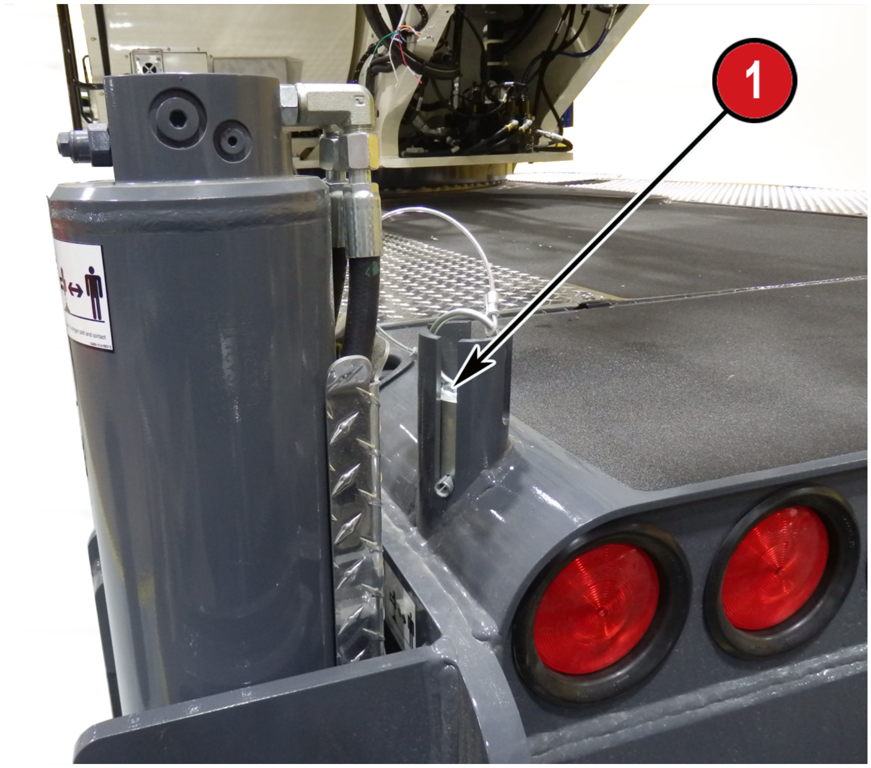
NOTE: *See the "ON TIRES LIFT" instructions found in the Operating Instructions section for Information on moving the crane with a load.*

- Carry the boom over the front only.

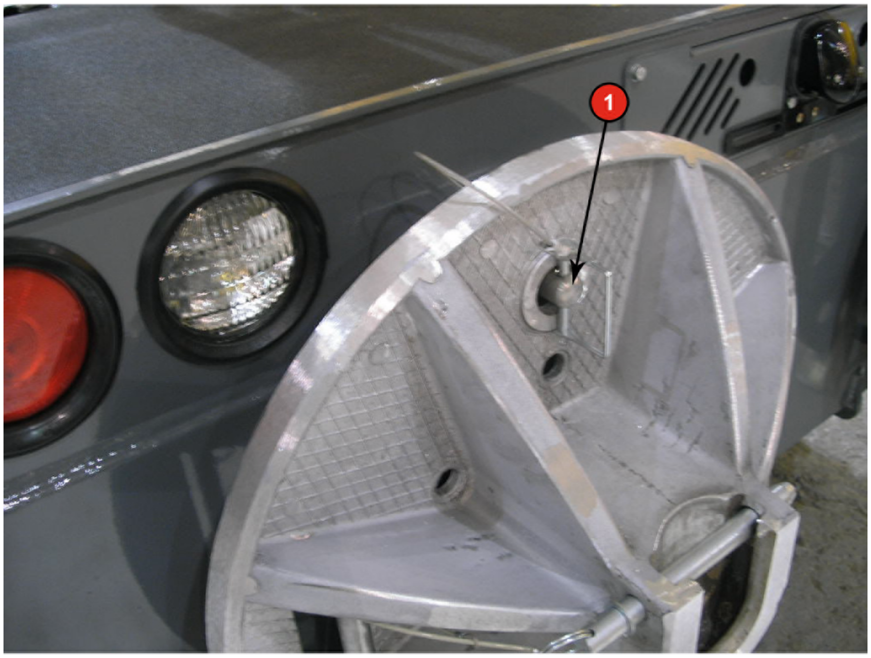
- Lock the swing brake and swing lock.

- Secure the hook block or ball to the bumper loop or raise the hook block or ball close to the boom head sheaves before moving.

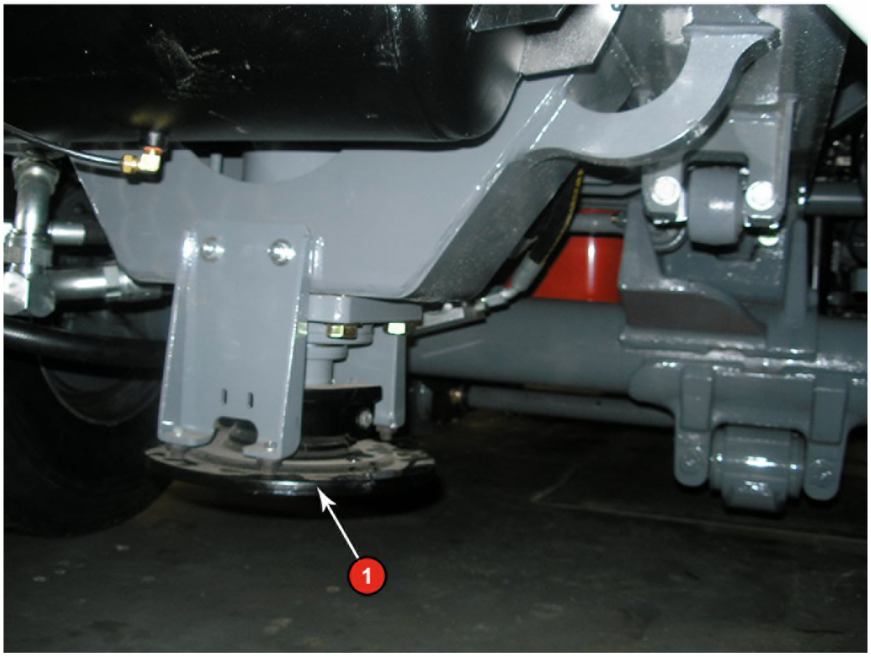
- Make sure all outriggers are completely retracted before moving the crane.



1. Outrigger Beam Lock Pin-Install as shown (4) places.	



1. Outrigger Pad Storage -Insert Lockpin as shown above (4) places



1. Front Outrigger Jack-Fully retract front jack cylinder before traveling.

- Stow the boom in the boom rack.

- Watch for overhead obstructions such as trees, power lines, or bridges.

- If the terrain is rough or uneven it may be necessary to travel at a reduced speed to prevent instability or damage to the crane.

- Operating on steep grades requires caution because the oil in the engine or transmission will move to one side of the engine or transmission. As a result, the engine or transmission may not be fully lubricated which could damage the engine or transmission.

- The operator must be very careful on steep side slopes to avoid tipping the crane.

NOTE: *This machine can travel on 15° side slopes which have a firm level prepared surface. Due to variations in the ground surface, tire pressure, bumps, potholes, etc., we recommend that travel on side slopes be limited to 5° and that the boom be horizontal or below.*

Towing or Pushing Vehicle

The engine cannot be started by pushing or towing.

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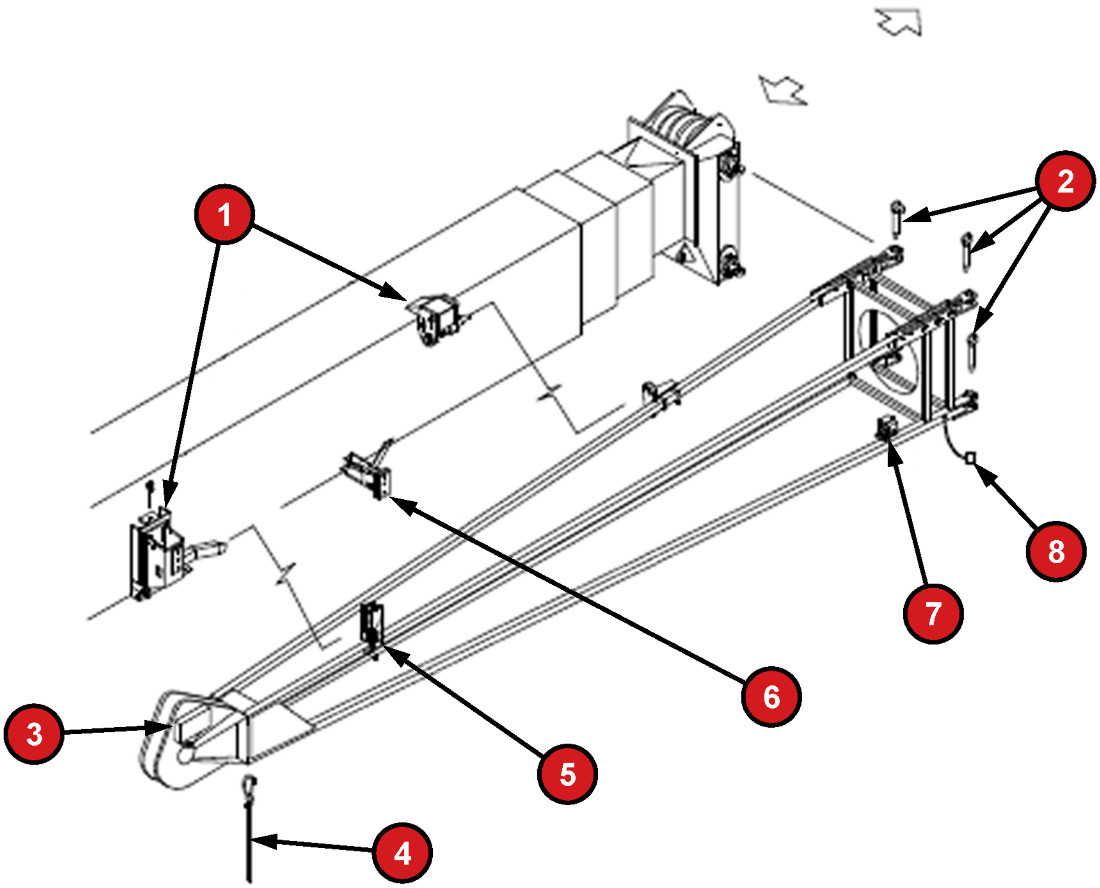
Side Stow Jib Stowage



1	Jib Storage Brackets	5	T - Handle
2	Jib Mounting Pins (4)	6	Wear Pad
3	ATB Switch	7	ATB Socket
4	Guide Rope	8	ATB Plug

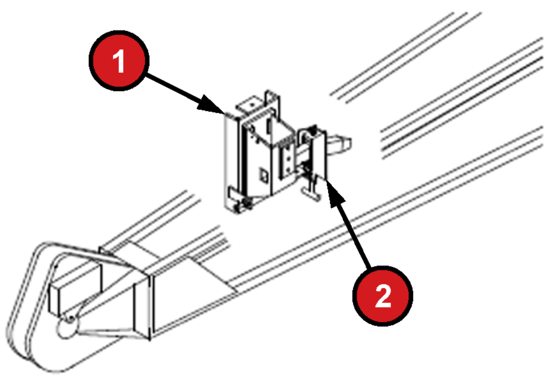
Before stowing the jib, ensure that no personnel or obstacles are in the swing path of the jib.

Prior to stowing the jib and installing the jib stowage brackets on the base boom the following items must be done:

1. The machine needs to be leveled on outriggers.
2. The boom must have been cycled so all the air is out of the system.
3. The boom must be extended 3 ft - 5 ft. (.092 m - 1.52 m).
4. The boom angle must be at 0 +/- 2 degrees.
5. With the engine at maximum RPM, retract the boom by fully engaging the retract pedal.

The boom should not creep out while adjusting the stowage brackets on the base boom. By operating the boom retract function using the same procedure as above (items 3, 4, 5), the jib should always line up with the boom head sheave pin hole so the customer can consistantly install the jib.

6. Extend and set the outriggers and level the machine.
7. Rotate the upper structure to the “over rear” position.
8. Make sure the Load King Stinger is in the stowed position and the jib offset is at 0° offset.
9. The boom angle must be at 0 +/- 2 degrees.
10. Remove the hoist line from jib sheave and lay to left side.
11. Disconnect the ATB plug from the boom head and plug it in to the jib ATB socket. Move the dummy plug from the jib ATB socket to the boom head ATB socket.
12. Extend the boom to 3 ft - 5 ft. (.092 m - 1.52 m).
13. Attach the guide rope to the eye on the bottom tip of the jib.
14. Remove the left upper and lower jib mounting pins. With guide rope, pull left jib ears out of left boom head ears.
15. With the engine at idle, slowly boom up while a second operator holds the guide rope to control the rotating speed of the jib.
16. Boom up to approximately 30°. Allow the jib to swing around until the jib contacts the wear pad on the boom. As the jib gets close to the side of the boom, make sure the jib does not strike the side of the boom.
17. With the engine at idle, slowly retract the boom completely. The jib will engage the jib storage brackets as the boom is retracted.
18. Remove the guide rope from the tip of the jib.



1 Bracket mounted to boom	2 Bracket mounted to jib

19. As the boom is retracted, verify that the stowage bracket mounted to the jib is engaging properly with the stowage bracket mounted to the boom.
20. Rotate and release the T- handle to lock the jib to the storage brackets.

21. Remove the right upper and lower jib mounting pins.
22. Test the ATB system at the boom head by lifting the ATB weight. The light and audible alarms should be actuated in the cab and the boom down, boom extend, and winch up controls should disconnect.

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Transporting the Crane

The boom must be stowed in the boom rack before transporting the crane.

The boom extend sections should be restrained to prevent gradual roll-out when transporting the crane on a semitrailer. The hydraulic system will not hold the sections against the hard breaking jolts while the crane is being transported.

Restrain the boom extend sections by snugging the hook block against the boom head, or secure the boom head back to the base section of the boom with chains or cable. An extended(ing) boom can cause substantial damage.

The outrigger pins need insertion to retain beams in retracted position.

Instructions for Loading and Unloading

LOADING EQUIPMENT

Prior to operation, read and understand the manuals provided with this equipment. Also read and follow all general safety rules.

PREPARE TRAILER

Assure that any ramps are in position or trailer is otherwise prepared for loading and path of travel is clear for loading. All other necessary preparations of trailer must be performed.

PRE-START INSPECTION

Complete Pre-Start Inspection as described in **Inspection** section of manual.

STARTING THE ENGINE

At ambient temperatures over 32° F on Detroit Diesel engines, follow the starting procedure below:

1. Move the transmission shift lever to the neutral position.
2. Put the parking brake switch in the “ON” position.
3. Turn the ignition switch to the “ON” position. Wait to start light goes off.
4. Turn the ignition switch to the “START” position to start the engine.

   Release the ignition switch key as soon as the engine starts.

PRE-MOVE CHECK LIST

Perform Pre-Move Checklist as described in **Vehicular Operation** topic.

SECURE EQUIPMENT

Perform all necessary procedures to assure that machine is blocked and chained in position to trailer to eliminate any possible movement.

PREPARE TRAILER

Assure that any ramps are in position or trailer is otherwise prepared for unloading and path of travel is clear for unloading.

PRE-MOVE CHECK LIST

Perform Pre-Move Checklist as described in **Vehicular Operation** topic.

Engine Data-Mercedes-Benz OM460 (Export) & Detroit Diesel™ DD13-GHG14

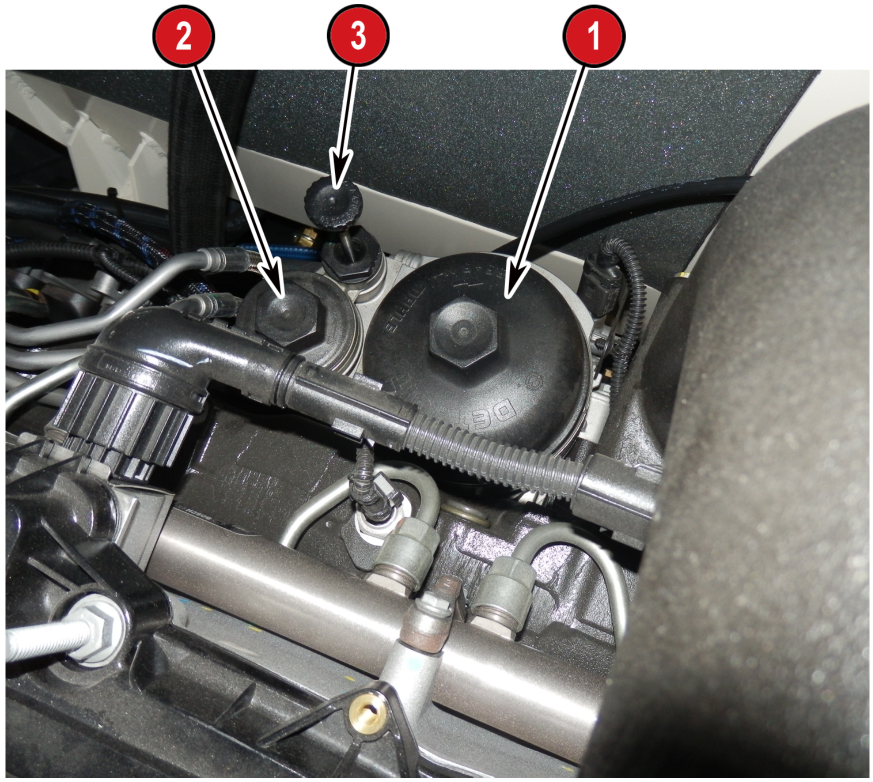
The charts below are a quick reference for all truck crane models with the available engine and transmission data. Select which model pertains to your crane.

480-126 EXPORT Mercedes OM460 LA (Tier 3)	DESCRIPTION
TRANSMISSION	EATON UltraShift PLUS
ENGINE MODEL	Diamler Mercedes
LOAD KING ENGINE NUMBER	T132942
HP & RPM	449@1800
MAX RPM	1800
PEAK TORQUE (Lb-Ft)	1475@1300 RPM
CONTROL MODULE	NA
CYLINDERS	6

480-126 Detroit Diesel GHG14	DESCRIPTION
TRANSMISSION	EATON UltraShift PLUS
ENGINE MODEL	DD13 GHG14
LOAD KING ENGINE NUMBER	T133566

HP & RPM	500@1800
MAX RPM	1800
PEAK TORQUE (Lb-Ft)	1650
CONTROL MODULE	Z53704001
CYLINDERS	6

Fuel Prefilter Operation - DD13 GHG14 Engine Only



1. Fuel / Water Separator
2. Secondary Fuel Filter
3. Fuel Priming Pump

Removal of the Fuel Prefilter - Two-Filter System

Remove the prefilter as follows:

1. Using a 36 mm socket, unscrew the prefilter cap.
2. Pull the cap and prefilter straight up and out of the fuel filter housing.
3. Remove the prefilter (1) from the prefilter cap (2) and placing the filter on a solid surface and apply pressure on prefilter cap (2) at an angle.

4. Disgard the prefilter cap seal ring.

Installation of the Fuel Prefilter - Two-Filter System

Install the fuel prefilter as follows:

NOTE: *If a filter service is being performed, replace all other filters before priming.*

1. Install a new prefilter cap seal ring on to the prefilter cap.
2. Snap new prefilter into the prefilter cap.
3. Apply a thin coat of petroleum-based lithium grease to the prefilter cap seal ring and the prefilter seals (1).
4. Install the prefilter into the fuel filter module.
5. Turn the cap counterclockwise until a click sound is made, then turn clockwise and hand tighten.
6. Torque prefilter cap to 55-60 Nm (41-44 ft lb).
7. Once all required filters have been changed, prime the fuel system.

Removal of the Water Coalescer / Final Filter - 2-Filter System

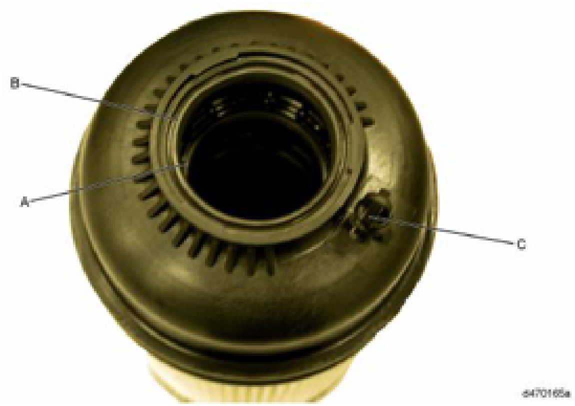
Remove the water coalescer / final filter as follows:

NOTE: *Do not tilt the water coalescer / final filter when removing it from the housing. Possible damage to the water coalescer / final filter or stand pipe may occur.*

1. Using a 36mm socket, unscrew the water coalescer / final filter cap.
2. Pull the cap and water coalescer / final filter straight up and allow the fuel to drain back.
3. Remove the water coalescer / final filter (2) from the water coalescer / final filter cap (1) by placing the filter on a solid surface with the drain back plug location at 12 o'clock (3) and apply pressusre on the water coalescer / final filter cap at an angle.
4. Discard the water coalescer / final filter.
5. Inspect inside the housing for any large debris, clean housing as needed.
6. Discard water coalescer / final filter cap seal ring.

Installation of the Coalescer / Final Filter - Two Filter System

Install the water coalescer / final filter as follows:



The illustration below shows the proper amount of lubricant to use on the upper and lower seals.

NOTE: *If a fuel filter service is being performed, replace all other fuel filters before priming the fuel system.*

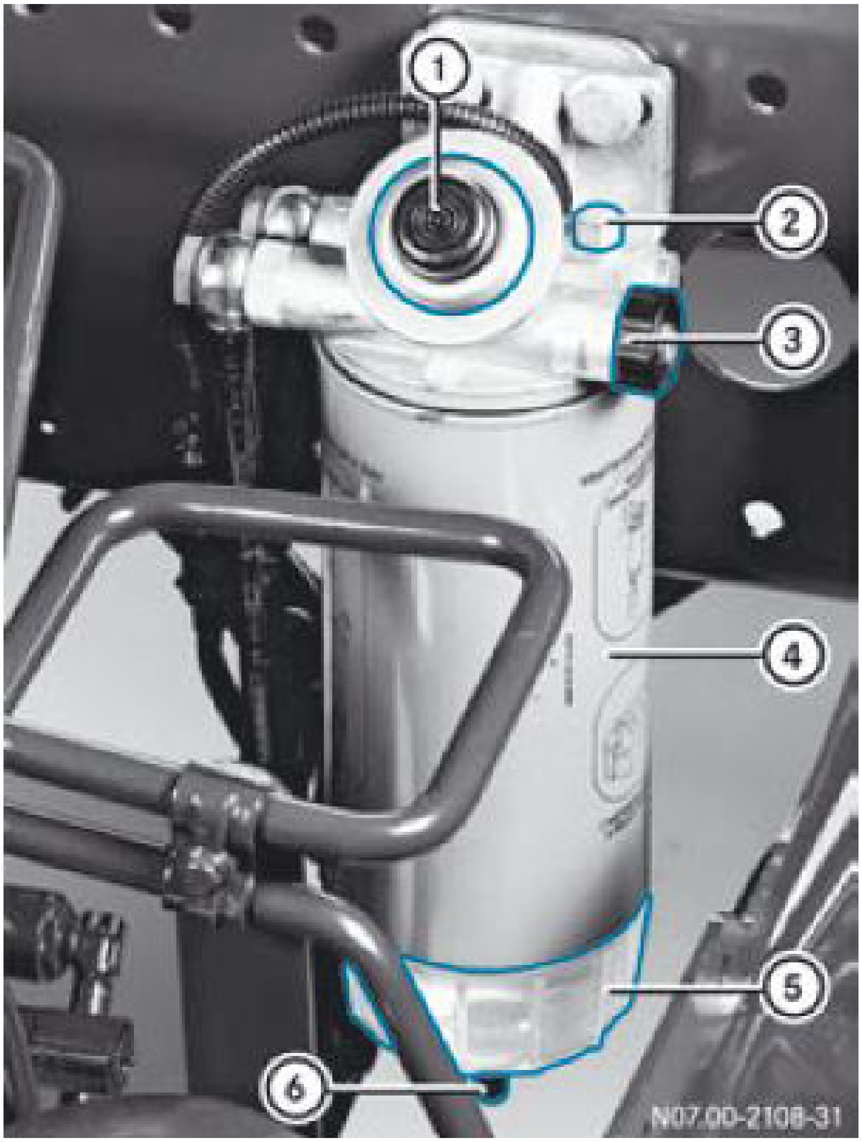
1. Install a new seal ring on to water coalescer / final filter cap.
2. Snap a new water coalescer / final filter into the water coalescer / final filter cap.
3. Apply a light coat of Parker super O-lube or petroleum -based lithium grease to the water coalescer / final filter cap seal ring and drain back plug seal ring (C). Apply a heavy coat of Parker super O-lube or petroleum-based lithium grease to the upper (A) and lower seals (B) on the water coalescer / final filter.
4. Install the water coalescer / final filter into the fuel filter module.

NOTE: *Viewing the fuel filter module from the top, the drain back port is located at 10 o'clock.*

5. **Turn the water coalescer / final filter cap counterclockwise until the drain back plug has located the drain back port.** Apply light pressure to the top of the water coalescer / final filter cap to seat the drain back plug into the drain back port, hand tighten the filter cap by turning the cap clockwise.
6. Torque water coalescer / final filter cap to 55 to 60 Nm (41 to 44 lb ft).
7. Once all required filters have been changed, prime the fuel system.
8. Start the engine with the accelerator pedal in the idle position. Monitor the oil pressure gauge or indicator lamp. Keep the engine running at an idling speed until a stable oil pressure reading of 97 kPa (14 psi) or more is maintained for one minute.
9. Check for leaks.
10. Allow the engine to reach operating temp, rerature of 60°C (140°F).

11. Increase engine speed to 1800 rpm for three minutes.
12. Return the engine to idle and allow to idle for approximately one minute, and then shut down the engine.
13. Check for leaks.

Fuel Prefilter Operation - OM460 Engine Only



1. Fuel Hand Pump
2. Vent Valve
3. Shutoff Valve
4. Filter Housing
5. Water Separator with inspection window
6. Water Release Valve

If water has collected in inspection window (item 5), drain the fuel prefilter before bleeding.

Draining the fuel prefilter

Drain the fuel prefilter regularly.

► Place a collector under water release valve (item 6).

► If fuel filter is at tank level, close shutoff valve (item 3).

► Open water release valve (item 6).

► Briefly press manual fuel pump (item 1) and collect the fuel / water mixture.

► Close water release valve (item 6).

► If fuel prefilter is at tank level: open shutoff valve (item 3).

► Start the engine and allow it to run for about one minute. The fuel system is bled automatically.

► Check the fuel system for leaks.

Bleeding the fuel prefilter using the manual fuel pump

The fuel prefilter may need to be bled when:

● the fuel tank is empty or

● the fuel filter has been replaced.

► Unscrew the fuel tank filler cap.

► Place the collector underneath the fuel prefilter.

► Open shutoff valve (item 3) fully.

► Open bleed nipple (item 2).

► Only press manual fuel pump (item 1) until the fuel escaping from bleed nipple (item 2) is free of bubbles. Do not continue to pump.

► Close bleed nipple (item 2).

► Close the fuel tank filler cap.

► Start the engine. The fuel system is bled automatically.

Maintenance Introduction

A regular program of periodic preventive maintenance is essential to prolong crane operating life, maximize efficient service and minimize downtime. This section details a series of checks and procedures which are to be performed at daily, weekly, monthly and semiannual intervals. These intervals are stated both in terms of calendar periods and hours of operation.

The checks prescribed for longer intervals include all the checks required for the shorter intervals. Thus, the weekly check includes all items in the daily check, the monthly check includes weekly and daily checks, and so on through the semi-annual check, which includes the quarterly, monthly, weekly and daily checks.

A convenient check chart provides a means of recording preventive maintenance performed and serves as a tool detecting problem areas and reanalyzing maintenance requirements. The items in each check interval on the check chart are grouped under their respective headings and covered in detail over the course of Section 6.

This maintenance schedule is a guide which ensures that basic preventive maintenance requirements will be met under average operating conditions. Conditions which impose greater wear, loads or strain on the crane may dictate reduced check intervals. Before altering the maintenance schedule, reevaluate crane operation and review the crane maintenance records. Consider all factors involved and develop a revised schedule adequate to meet routine maintenance requirements.

As a part of each periodic check, refer to the engine manufacturer's manual for engine maintenance requirements. When servicing the engine, the engine manufacturer's recommendations take precedence over those in this manual, should any discrepancy be noted.

Preventive Maintenance Intervals

The following guide establishes preventive maintenance intervals. These recommendations should be followed as closely as possible to obtain long life and optimum performance of your engine. When performed on a regular basis, changing the engine oil, coolant, and filters is the least costly way of obtaining safe and reliable vehicle operation. Added benefits and savings occur when you check that the valves, fuel injectors, oil and cooling circuits are in good working order during oil changes.

The intervals shown apply only to the maintenance functions described. These functions should be coordinated with other regularly scheduled maintenance.

NOTE: Actual fuel filter life will vary based on fuel quality.

NOTE: Diesel Oxidation Catalyst (DOC) and the Selective Catalytic Reduction (SCR Catalyst) do not require maintenance.

NOTE: "R" means REPLACE.

NOTE: "I" means INSPECT.

Severe Service Maintenance Intervals (Detroit Diesel GHG14)						
Miles	25,000	50,000	75,000	100,000	125,000	150,000
Kilometers	40,000	80,000	120,000	160,000	200,000	240,000
Hours*	640	1280	1925	2565	3205	3850
Lubricating Oil	R	R	R	R	R	R
Lubricating Oil Filter	R	R	R	R	R	R
Coolant	Refer to section "How to Select Coolant" for required intervals using recommended coolants.					
Fuel Filters	R	R	R	R	R	R
Valve Lash Adjustment	Adjust at 100,000 miles (160,000 km), at 500,000 miles (800,000 km), and then every 500,000 miles (800,000 km) thereafter.					
Belts	I	I	I	I	R	I
Air System	I	I	I	I	I	I
Air Cleaner	I	I	I	I	I	I
Exhaust System	I	I	I	I	I	I
Aftertreatment Devices	Inspect external hardware and connections every 6 months or at oil change intervals.					
Diesel Particulate Filter	A Check Engine Light will illuminate when ash requires removal. Normal DPF ash clean intervals are 300,000 miles (480,000 km) 9,000 hours to 400,000 miles (640,000 km) 10,250 hours.**					
DEF Pump Filter	Replace filter every 150,000 miles (240,000 km)					

Severe Service Maintenance Intervals (Detroit Diesel GHG14)						
DEF Pump Air Bladder	No maintenance required.					
Air Compressor	I	I	I	I	I	I
• *Whichever comes first. • ** Detroit highly recommends replacing the DPF with a Detroit™ genuine DPF to ensure maximum replacement life.						

Category (B) Service Maintenance Intervals (Mercedes Benz OM460)				
Miles	25,000	15,500	12,500	Note: Category (B) Indicates intermittent use predominantly at medium engine speeds and load ranges.
Kilometers	40,000	25,000	20,000	
Hours*	600	1200	1800	
Oil Grade According to Sheet No.	228.5/51	228.3/31 228.2	228.0/1	
Lubricating Oil	R	R	R	
Lubricating Oil Filter	R	R	R	
Coolant Change	Every 3 years (Sheet 325.0/2, 326.0/2) Every 5 years (Sheet 235.3, 236.3)			
Fuel Filters	R	R	R	
Valve Lash Adjustment	AP05.30-G-0560CH Check V2 valve clearance, adjust (first maintenance service, 3rd, 5th, 7th etc.			
Poly-V-Belts	I	I	I	
Air System	I	I	I	
Air Cleaner	I	I	I	
Exhaust System	I	I	I	
Air Compressor	I	I	I	
*Whichever comes first.				
The oil and filter change has to be done at least every 2 years. If operating using bio-diesel change oil and filter at least once a year				
If the sulfur content of the fuel is higher than 3,000 ppm, the maintenance intervals should be halved.				

Confirmations

Maintenance service/additional maintenance work	
Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance service (OM460)

☐ W ☐ V2 ☐ Z2 ☐ Z3

☐ J1 ☐ J3

Oil Change

Engine

Viscosity	
Sheet No.	

Replaced/Renewed

☐ Fuel prefilter: fuel filter

☐ Fuel filter element

Poly-V-belt

☐ Condition

Engine Cooling system

☐ Fluid level tested and adjusted

☐ Corrosion/antifreeze protection tested and adjusted

Air Filter

☐ Air filter element replaced

Cooling Change

☐ Every 3 years

☐ Every 5 years

Check for leaks and damage

☐ Engine

☐ All lines, holes and sensor cables

☐ Intake pipe between the air filter, charge-air cooler and engine

☐ All reservoirs, covers, bellows and protective caps

☐ Cooling and heating system (radiator, lines and hoses)

Valve Lash Adjustment

☐ Every 100,000 miles

☐ Every 500,000 miles

Aftertreatment Devices (DD13 GHG14)

☐ Every 6 months check external hardware and connections

☐ Diesel particulate filter every 300,000 miles or 9,000 hours

☐ DEF pump filter replace every 150, 000 miles

Engine brake

☐ Condition and setting

Signature/stamp of the Authorized Service Center.

Confirmations

Maintenance service/additional maintenance work	
Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance service (OM460)

☐ W ☐ V2 ☐ Z2 ☐ Z3

☐ J1 ☐ J3

Oil Change

Engine

Viscosity	
Sheet No.	

Replaced/Renewed

☐ Fuel prefilter: fuel filter

☐ Fuel filter element

Poly-V-belt

☐ Condition

Engine Cooling system

☐ Fluid level tested and adjusted

☐ Corrosion/antifreeze protection tested and adjusted

Air Filter

☐ Air filter element replaced

Cooling Change

☐ Every 3 years

☐ Every 5 years

Check for leaks and damage

☐ Engine

☐ All lines, holes and sensor cables

☐ Intake pipe between the air filter, charge-air cooler and engine

☐ All reservoirs, covers, bellows and protective caps

☐ Cooling and heating system (radiator, lines and hoses)

Valve Lash Adjustment

☐ Every 100,000 miles

☐ Every 500,000 miles

Aftertreatment Devices (DD13 GHG14)

☐ Every 6 months check external hardware and connections

☐ Diesel particulate filter every 300,000 miles or 9,000 hours

☐ DEF pump filter replace every 150, 000 miles

Engine brake

☐ Condition and setting

Signature/stamp of the Authorized Service Center.

Confirmations

Maintenance service/additional maintenance work	
Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance service (OM460)

☐ W ☐ V2 ☐ Z2 ☐ Z3

☐ J1 ☐ J3

Oil Change

Engine

Viscosity	
Sheet No.	

Replaced/Renewed

☐ Fuel prefilter: fuel filter

☐ Fuel filter element

Poly-V-belt

☐ Condition

Engine Cooling system

☐ Fluid level tested and adjusted

☐ Corrosion/antifreeze protection tested and adjusted

Air Filter

☐ Air filter element replaced

Cooling Change

☐ Every 3 years

☐ Every 5 years

Check for leaks and damage

☐ Engine

☐ All lines, holes and sensor cables

☐ Intake pipe between the air filter, charge-air cooler and engine

☐ All reservoirs, covers, bellows and protective caps

☐ Cooling and heating system (radiator, lines and hoses)

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☐ Every 100,000 miles

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☐ Every 6 months check external hardware and connections

☐ Diesel particulate filter every 300,000 miles or 9,000 hours

☐ DEF pump filter replace every 150, 000 miles

Engine brake

☐ Condition and setting

Signature/stamp of the Authorized Service Center.

Confirmations

Maintenance service/additional maintenance work	
Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance service (OM460)

☐ W ☐ V2 ☐ Z2 ☐ Z3

☐ J1 ☐ J3

Oil Change

Engine

Viscosity	
Sheet No.	

Replaced/Renewed

☐ Fuel prefilter: fuel filter

☐ Fuel filter element

Poly-V-belt

☐ Condition

Engine Cooling system

☐ Fluid level tested and adjusted

☐ Corrosion/antifreeze protection tested and adjusted

Air Filter

☐ Air filter element replaced

Cooling Change

☐ Every 3 years

☐ Every 5 years

Check for leaks and damage

☐ Engine

☐ All lines, holes and sensor cables

☐ Intake pipe between the air filter, charge-air cooler and engine

☐ All reservoirs, covers, bellows and protective caps

☐ Cooling and heating system (radiator, lines and hoses)

Valve Lash Adjustment

☐ Every 100,000 miles

☐ Every 500,000 miles

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☐ Every 6 months check external hardware and connections

☐ Diesel particulate filter every 300,000 miles or 9,000 hours

☐ DEF pump filter replace every 150, 000 miles

Engine brake

☐ Condition and setting

Signature/stamp of the Authorized Service Center.

Confirmations

Maintenance service/additional maintenance work	
Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance service (OM460)

☐ W ☐ V2 ☐ Z2 ☐ Z3

☐ J1 ☐ J3

Oil Change

Engine

Viscosity	
Sheet No.	

Replaced/Renewed

☐ Fuel prefilter: fuel filter

☐ Fuel filter element

Poly-V-belt

☐ Condition

Engine Cooling system

☐ Fluid level tested and adjusted

☐ Corrosion/antifreeze protection tested and adjusted

Air Filter

☐ Air filter element replaced

Cooling Change

☐ Every 3 years

☐ Every 5 years

Check for leaks and damage

☐ Engine

☐ All lines, holes and sensor cables

☐ Intake pipe between the air filter, charge-air cooler and engine

☐ All reservoirs, covers, bellows and protective caps

☐ Cooling and heating system (radiator, lines and hoses)

Valve Lash Adjustment

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☐ Every 500,000 miles

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☐ Every 6 months check external hardware and connections

☐ Diesel particulate filter every 300,000 miles or 9,000 hours

☐ DEF pump filter replace every 150, 000 miles

Engine brake

☐ Condition and setting

Signature/stamp of the Authorized Service Center.

Confirmations

Maintenance service/additional maintenance work	
Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance service (OM460)

☐ W ☐ V2 ☐ Z2 ☐ Z3

☐ J1 ☐ J3

Oil Change

Engine

Viscosity	
Sheet No.	

Replaced/Renewed

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☐ Fuel filter element

Poly-V-belt

☐ Condition

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☐ Corrosion/antifreeze protection tested and adjusted

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☐ Every 5 years

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☐ Intake pipe between the air filter, charge-air cooler and engine

☐ All reservoirs, covers, bellows and protective caps

☐ Cooling and heating system (radiator, lines and hoses)

Valve Lash Adjustment

☐ Every 100,000 miles

☐ Every 500,000 miles

Aftertreatment Devices (DD13 GHG14)

☐ Every 6 months check external hardware and connections

☐ Diesel particulate filter every 300,000 miles or 9,000 hours

☐ DEF pump filter replace every 150, 000 miles

Engine brake

☐ Condition and setting

Signature/stamp of the Authorized Service Center.

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Odometer reading	
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☐ W ☐ V2 ☐ Z2 ☐ Z3

☐ J1 ☐ J3

Oil Change

Engine

Viscosity	
Sheet No.	

Replaced/Renewed

☐ Fuel prefilter: fuel filter

☐ Fuel filter element

Poly-V-belt

☐ Condition

Engine Cooling system

☐ Fluid level tested and adjusted

☐ Corrosion/antifreeze protection tested and adjusted

Air Filter

☐ Air filter element replaced

Cooling Change

☐ Every 3 years

☐ Every 5 years

Check for leaks and damage

☐ Engine

☐ All lines, holes and sensor cables

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Engine

Viscosity	
Sheet No.	

Replaced/Renewed

☐ Fuel prefilter: fuel filter

☐ Fuel filter element

Poly-V-belt

☐ Condition

Engine Cooling system

☐ Fluid level tested and adjusted

☐ Corrosion/antifreeze protection tested and adjusted

Air Filter

☐ Air filter element replaced

Cooling Change

☐ Every 3 years

☐ Every 5 years

Check for leaks and damage

☐ Engine

☐ All lines, holes and sensor cables

☐ Intake pipe between the air filter, charge-air cooler and engine

☐ All reservoirs, covers, bellows and protective caps

☐ Cooling and heating system (radiator, lines and hoses)

Valve Lash Adjustment

☐ Every 100,000 miles

☐ Every 500,000 miles

Aftertreatment Devices (DD13 GHG14)

☐ Every 6 months check external hardware and connections

☐ Diesel particulate filter every 300,000 miles or 9,000 hours

☐ DEF pump filter replace every 150, 000 miles

Engine brake

☐ Condition and setting

Signature/stamp of the Authorized Service Center.

Confirmations

Maintenance service/additional maintenance work	
Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance service (OM460)

☐ W ☐ V2 ☐ Z2 ☐ Z3

☐ J1 ☐ J3

Oil Change

Engine

Viscosity	
Sheet No.	

Replaced/Renewed

☐ Fuel prefilter: fuel filter

☐ Fuel filter element

Poly-V-belt

☐ Condition

Engine Cooling system

☐ Fluid level tested and adjusted

☐ Corrosion/antifreeze protection tested and adjusted

Air Filter

☐ Air filter element replaced

Cooling Change

☐ Every 3 years

☐ Every 5 years

Check for leaks and damage

☐ Engine

☐ All lines, holes and sensor cables

☐ Intake pipe between the air filter, charge-air cooler and engine

☐ All reservoirs, covers, bellows and protective caps

☐ Cooling and heating system (radiator, lines and hoses)

Valve Lash Adjustment

☐ Every 100,000 miles

☐ Every 500,000 miles

Aftertreatment Devices (DD13 GHG14)

☐ Every 6 months check external hardware and connections

☐ Diesel particulate filter every 300,000 miles or 9,000 hours

☐ DEF pump filter replace every 150, 000 miles

Engine brake

☐ Condition and setting

Signature/stamp of the Authorized Service Center.

Confirmations

Maintenance service/additional maintenance work	
Date	
Odometer reading	
Operating hours (h)	
Job no.	

Maintenance service (OM460)

☐ W ☐ V2 ☐ Z2 ☐ Z3

☐ J1 ☐ J3

Oil Change

Engine

Viscosity	
Sheet No.	

Replaced/Renewed

☐ Fuel prefilter: fuel filter

☐ Fuel filter element

Poly-V-belt

☐ Condition

Engine Cooling system

☐ Fluid level tested and adjusted

☐ Corrosion/antifreeze protection tested and adjusted

Air Filter

☐ Air filter element replaced

Cooling Change

☐ Every 3 years

☐ Every 5 years

Check for leaks and damage

☐ Engine

☐ All lines, holes and sensor cables

☐ Intake pipe between the air filter, charge-air cooler and engine

☐ All reservoirs, covers, bellows and protective caps

☐ Cooling and heating system (radiator, lines and hoses)

Valve Lash Adjustment

☐ Every 100,000 miles

☐ Every 500,000 miles

Aftertreatment Devices (DD13 GHG14)

☐ Every 6 months check external hardware and connections

☐ Diesel particulate filter every 300,000 miles or 9,000 hours

☐ DEF pump filter replace every 150, 000 miles

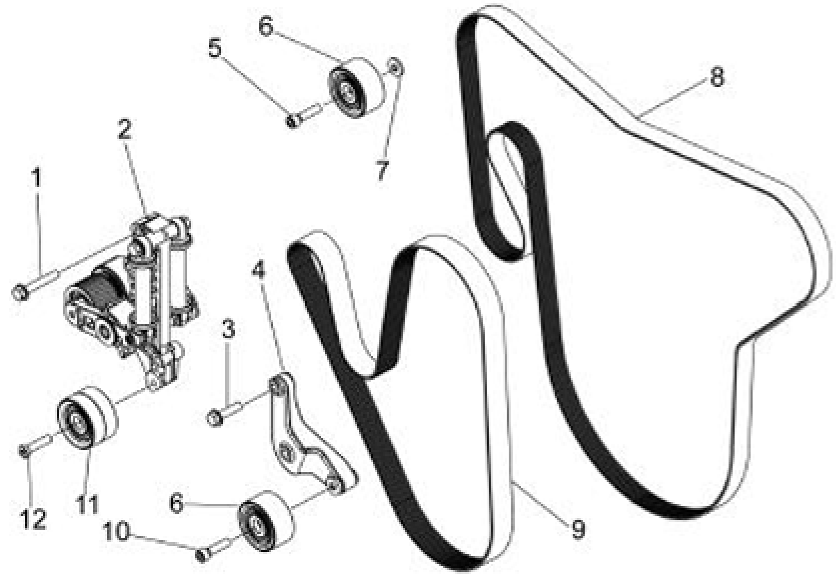
Engine brake

☐ Condition and setting

Signature/stamp of the Authorized Service Center.

Monitoring the Serpentine Belts

The poly-V-belts (8 and 9) are used on the engine for On-Highway Vehicle applications. One belt drives the fan hub and the other belt drives the remaining accessories. To provide proper running tension, the current engine uses an automatic fan hub belt tensioner (6) and an accessory belt tensioner (2). Automatic belt tensioners require no adjustment.



Replacement of Belts

Replace the drive belts every 2,000 hours or 300,000 miles (480,000 km).

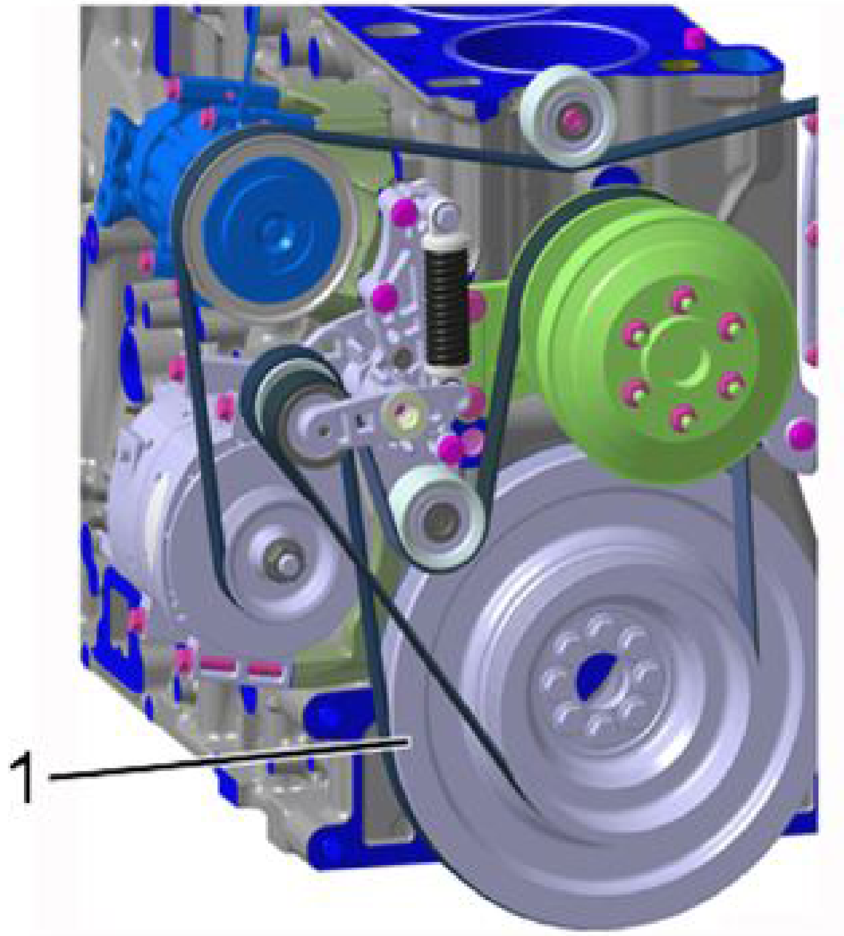
Lubricating the Fan Hub

If the fan bearing hub assembly has a grease fitting, use a hand grease gun to lubricate the bearings with one shot of quality lithium-based, multipurpose grease every 120,000 miles (200,000 km). Care should be taken not to overfill the bearing housing.

Checking the Vibration Damper

Check the vibration damper as follows:

1. Inspect the viscous vibration damper (1) periodically and replace if dented or leaking.



2. Heat from normal engine operation may, over a period of time, cause the fluid within the damper to break down and lose its dampening properties. For this reason, replace the viscous vibration damper at time of normal major engine overhaul, regardless of apparent condition.

Checking the Engine Oil Level - OM460

Check the engine oil level on a regular basis, e.g. every week or each time you refuel.

► Park the vehicle on a horizontal surface.

► Switch off the engine.

► Wait approximately five to ten minutes.

► Check the engine oil level with dipstick (item 1).

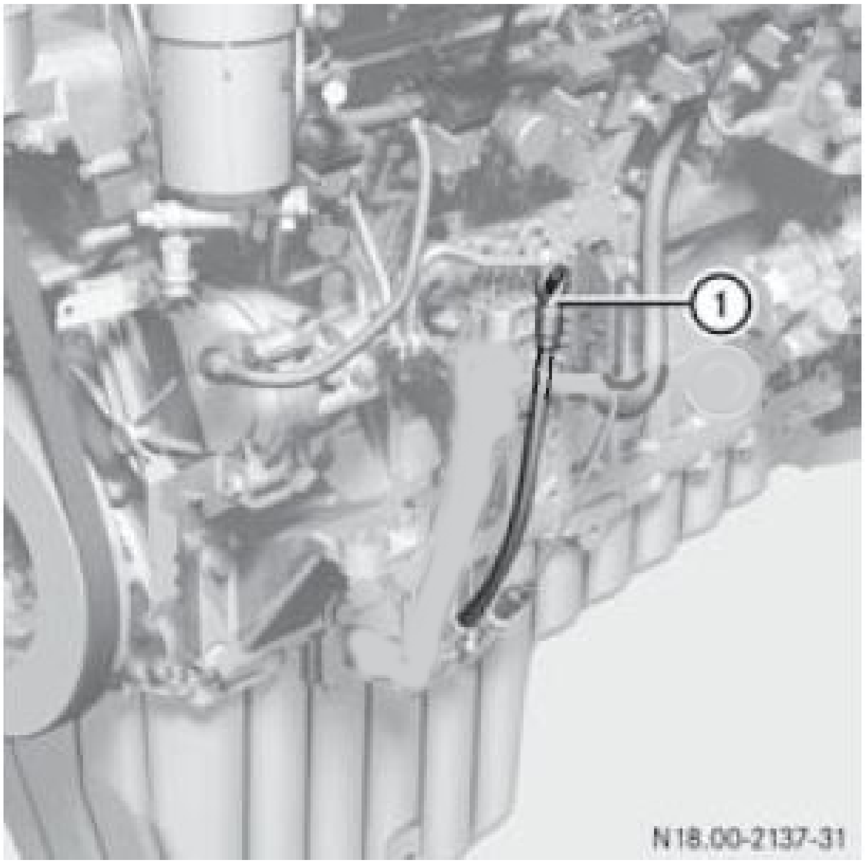
► If necessary, use filler neck (item 15) to add oil, as shown in OM460 Engine Overview.

Only use engine oil that has been approved for the engine and which meets the specified SAE classification. Refer to the following Recommended Engine Oil Specifications that are approved by Mercedes Benz for this engine. See link http://bevo.mercedes-benz.com/

Select language.

Select the specifications PDF document as listed in the chart below for Single Grade or Multigrade Oils:

Spec. No.	Grade of Oil
228.0	Single Grade
228.1	Multigrade
228.2	Single Grade
228.3	Multi Grade
228.31	Multi Grade
228.5	Multi Grade
228.51	Low SPAsh Multi Grade



Mercedes OM460 Oil Fill and Dipstick Location

Changing Engine Oil & Filter - OM460

Only change the engine oil when the engine is at normal operating temperature.

Mercedes OM460 Engine Oil Filter

► Unscrew oil filter cap (item 1) using a socket wrench insert (SW 36). Allow the oil to drain from the filter housing.

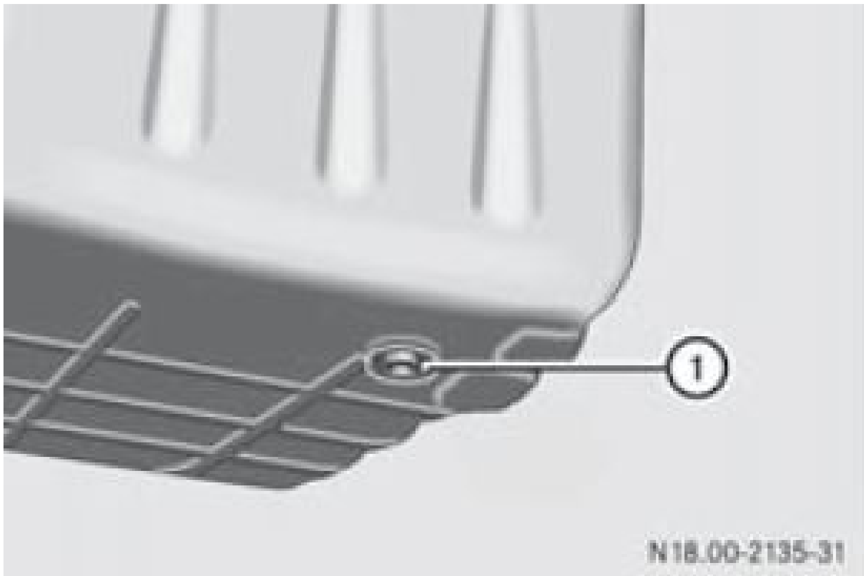
► Remove oil filter cap (item 1) with oil filter element (item 3) and unclip oil filter element (item 3) by pressing in a sideways direction.

► Replace sealing ring (item 2) on cap (item 1).

► Lightly grease sealing ring (item 2).

► Insert new oil filter element (item 3) into oil filter cap (item 1) and press until it clips into place.

► Screw on oil filter cap (item 1) with the oil filter element and tighten. Tightening torque: 40 Nm (29.5 Ft. lbs)

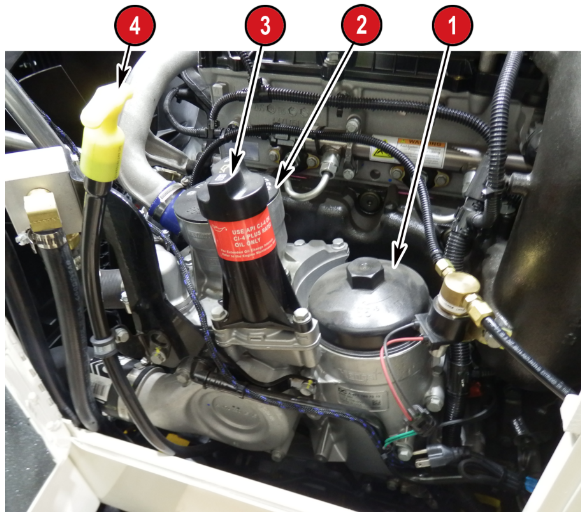


Mercedes OM460 Oil Pan Drain Plug

► To drain off engine oil: place a suitable collecting receptacle under the drain (item 1) on the underside of the oil pan.

► Carefully unscrew drain plug (item 1) and allow the oil to drain out.
► Screw in drain plug (item 1) again with a new sealing ring and tighten it. Tightening torque: M18 x 1.5-50 Nm (37 Ft. lbs), M20 x 1.5-70 Nm (52 Ft. lbs), M22 x 1.5-80 Nm (59 Ft. lbs), M26 x 1.5 -90 Nm (66 Ft. lbs).

Changing the Engine Oil & Filter - DD13 GHG14



1. Engine Coolant Filter
2. Engine Oil Filter
3. Engine Oil Fill
4. Engine Oil Dipstick

The maintenance intervals for the appropriate duty cycle are listed in the tables of Detroit Diesel manual-DDC-SVC-MAN-0075 located in your SHOP-CD.

Change the oil and replace the lubricating oil filter as follows:

NOTE: *If the used oil was contaminated by fuel or coolant, it may be necessary to take the vehicle to a certified Detroit Service Center. The Service Center may drain the oil and then remove the oil pan, oil pump, and oil pump intake manifold to drain the remaining oil held back by the backflow valve. It is important to remove all contaminated oil from the engine.*

NOTE: *Changine the engine oil only when the engine oil temperature is approximately 60° C (140°F). Changing cold oil will result in extended drain times.*

1. Place the transmission in neutral, and set the parking brake.
2. Clean outside of the oil filter housing. Use care to prevent foreign objects from entering the filter housing.
3. Using a 36-mm socket, unscrew the oil filter cap and filter and allow the oil to drain into the housing.
4. Remove the filter element by pressing and twisting the side and detaching it from the cap.
5. Remove the oil filter O-ring and disgard. Lightly coat a new O-ring with clean engine oil and intall it on the filter cap.

6. Check the filter housing for any debris and remove if necessary.
7. Insert a new filter element into the oil filter cap.
8. Insert the filter element and cap assembly into the housing. Torque the cap to 40 to 50 Nm (30 to 37 lb ft).
9. Drain oil from the oil pan as follows:

► Place a suitable receptacle, 55 L (58 qt) or more, beneath the oil drain plug on the underside of the oil pan.

►Carefully unscrew the oil drain plug, and allow the oil to drain out.

►Disgard the plug seal ring.

10. Install the oil pan drain plug with a new O-ring and torque the plug.

►On a plastic oil pan, torque plug to 45 Nm +/- 7 Nm (33 lb ft +/- 5 lb ft).

11. Add new engine oil through the oil fill tube in the following amount; Refer to section "Engine Oil Capacities". Verify the oil level reading is between the full and fill marks on the dipstick.
12. Start the engine with the accelerator pedal in the idle position (600 rpm). Monitor the oil pressure gauge or indicator lamp. Keep the engine running at idling speed (600 rpm) until the oil pressure reading is 11.6 psi (80 kPa).

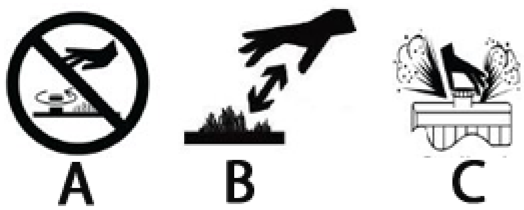
NOTE: *If the engine operating temperature is below 60°C (140°F), the engine must be on a level surface and then shut down for 60 minutes for an accurate oil level reading. Otherwise, the engine must be brought up to an operating temperature of 60°C (140°F), parked on a level surface and then shut down for five minutes for an accurate oil level reading.*

13. Check the filter housing for signs of leakage.
14. Stop the engine. Check the oil level again per the following guidelines. If necessary, add oil no more than 5.0 L (5.2 qt) at a time up to the maximum fill level on the oil dipstick.

Monitoring the Cooling System

The cooling system must be FULL for proper operation of the engine.

WARNING: HOT COOLANT-To avoid scalding, from the expulsion of hot coolant, never remove the cooling system pressure cap until cool. Wear adequate protective clothing (face shield, rubber gloves, apron, and boots). Remove the cap slowly to relieve pressure.



A - Do not loosen cap until cool.

B - BURN HAZARD - Contact with hot surfaces can cause burns.

C - BURN HAZARD - Release of hot fluid under pressure can result in death or serious injury.

1. Check the coolant level daily and maintain it between the full and low marks on the surge tank.
2. Add coolant as required, but do not overfill. Before adding coolant, refer to the recommended coolants. For Detroit Diesel GHG14 engine-see DDC-SVC-MAN-0075 Operator's Manual -How to Select Coolant. For Diamler Mercedes OM460 engine-see Coolant Selection Spec. in your SHOP-CD.

Checking for Coolant Leaks

Perform daily visual checks for cooling system leaks. Look for an accumulation of coolant when the engine is running and when it is stopped.

NOTE: *Coolant leaks may be more apparent on an engine when it is cold.*

WARNING: PERSONAL INJURY-To avoid injury before starting and running the engine, ensure the vehicle is parked on a level surface, parking brake is set, and the wheels are blocked.

Coolant Inhibitors

The inhibitors in antifreeze solutions must be replenished with an approved corrosion inhibitor supplement when indicated by testing the coolant. Refer to section "How to Select Coolant" for the listing of required intervals using the recommended coolants for required test intervals, inhibitor levels, and approved inhibitors.

NOTICE: Coolant must be inhibited with the recommended Supplemental Coolant Additives listed in this manual. Failure to check and maintain Supplemental Coolant

Additive levels at required concentrations will result in severe damage (corrosion) to the engine cooling system and related components.

Coolant Drain Interval

The cooling system properly maintained and protected with supplemental coolant inhibitors can be operated up to the intervals listed. At these intervals the coolant must be drained and disposed of in a environmentally responsible manner according to state and/or federal Environmental Protection Agency (EPA) recommendations.

Inspection of the Radiator

Inspect the radiator as follows:

1. Inspect the exterior of the radiator core every 30,000 miles (50,000 km) or 12 months.

WARNING: EYE INJURY-To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTE: It may be necessary to clean the exterior of the radiator more frequently if the engine is operated in extremely dusty or dirty areas.

2. If necessary, clean the exterior using a quality grease solvent, such as mineral spirits, and dry with compressed air. Do not use fuel oil, kerosene, or gasoline.
3. If the low coolant level sensor is installed in the top tank of the radiator, test for proper operation every 100,000 miles (160,000 km) or 12 months, whichever comes first. Authorized Detroit™ distributors are properly equipped to perform this service.

Cooling System Filter - DD13 GHG14 Engine

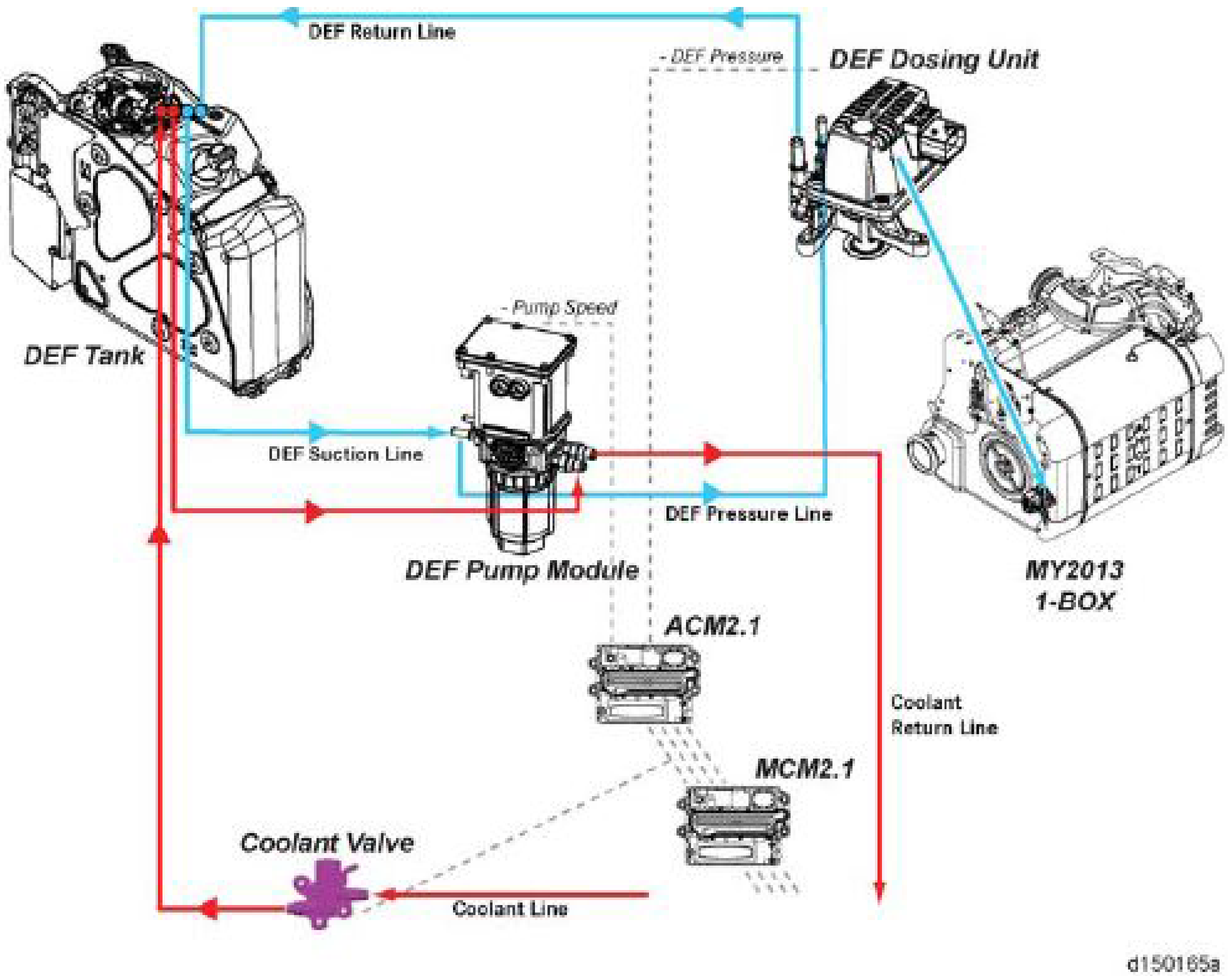
Install a new cooling system filter at the distance intervals indicated by the specific Maintenance Interval chart.

- Refer to section "EPA10/GHG14 DD Series Preventive Maintenance Tables" in the DDC-SVC-MAN-0075 Engine Operator's Manual.

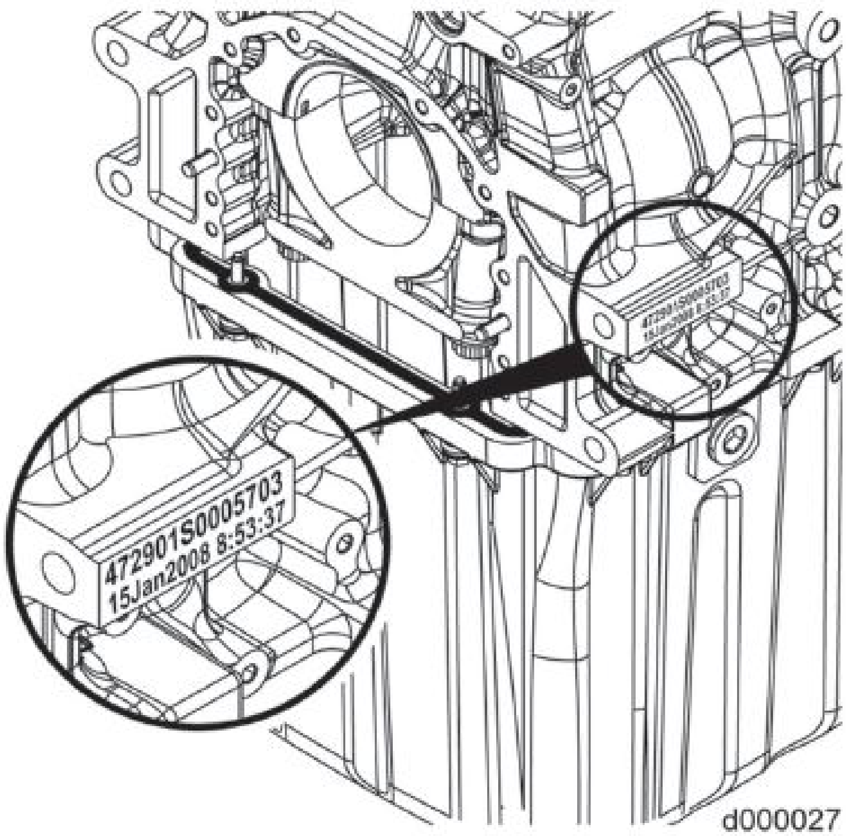
Detroit Diesel™ DD13-GHG14 DEF System Function Schematic

Selective Catalyst Reduction (SCR) System

An SCR system is used within the exhaust aftertreatment system (ATS) to aid in reducing nitrous oxide (NOx) emissons. The SCR system uses Diesel Exhaust Fluid (DEF), a water-based solution containing 32.5% urea, in conjunction with an SCR catalyst to convert nitrous oxides into harmless nitrogen (N^2) and water (H^2O). See schematic below. The SCR system is monitored at all times by multiple diagnostic functions, and fault codes are set should any issues arise.



Engine Indentification

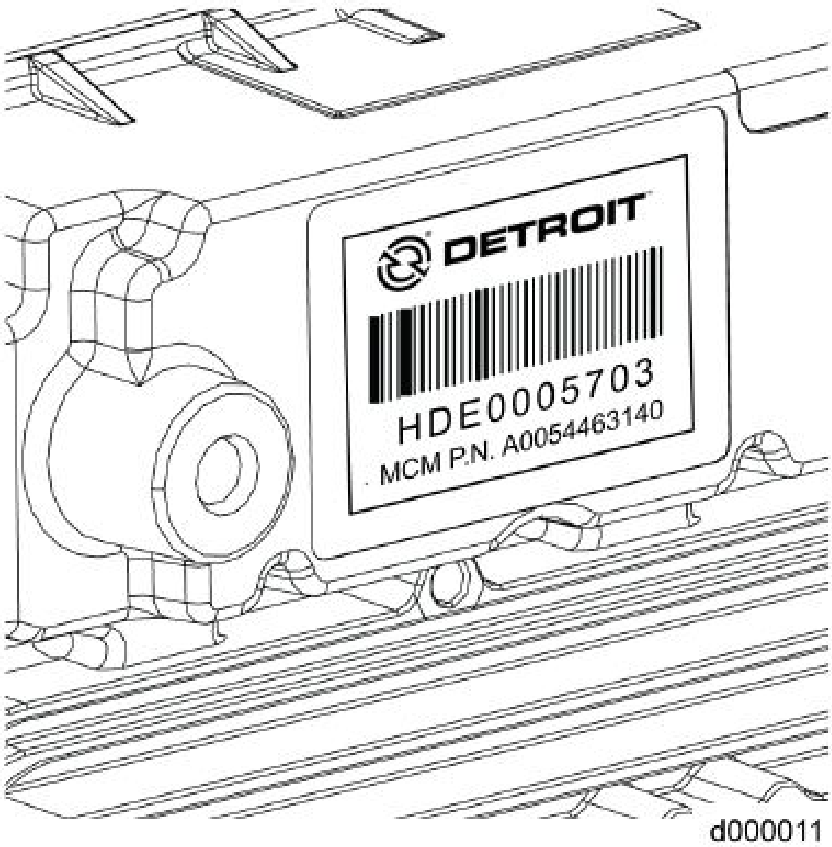


Engine Model and Serial Number Location (Example)

The fourteen-digit engine model and manufacturing serial number is etched on a pad located on the left front of the engine cylinder block, avoe the date and time of manufacture. Using 472901S0005703 as an example:

- 472 = engine model (DD15) (for reference 471 is a DD13 engine).
- 901 = vehicle application (Freightliner)
- S = assembly plant (Detroit™)
- 005703 = serial number

Motor Control Module Label



Engine Certification Exemption Label

An engine certification exemption label is attached to the engine rocker cover. This label certifies the engine conforms to federal and state emissions regulations for its application. It gives the operating conditions under which certification was made.

Engine Emissions Certification Label - EPA07

All Detroit™ engines complies with all United States Environmental Protection Agency (U.S. EPA) and California Air Resources Board (CARB) emission standards. An emission label is attached to the cylinder head cover, as required by law.

NOTE: *The horsepower rating on the emission label is for the highest engine rating and not necessarily the rating of your engine.*

Important Engine Information

This engine conforms to U.S. EPA and California regulations applicable to 2007 model year new heavy duty engines. This engine has a primary intended service application as a heavy duty engine. This engine is not certified for use in an urban bus as defined at 40 CFR 86.093 2. Sale of this engine for use in an urban bus is a violation of federal law under the Clean Air Act.
This engine is certified to operate on ultra low sulfur diesel fuel.

Fuel rate at adv. Hp	mm3/stroke	Adv. Hp	@	rpm	Valve Lash
Initial injection timing	deg. Btc	Disp.			Exhaust
Engine Family		Min. Idle			Intake
Model		Mfg. Date			
Unit:					

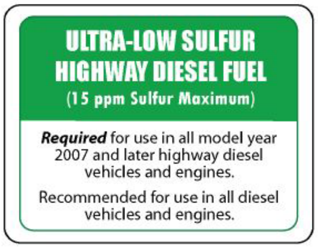
Engine Emission Label - EPA07

How to Select Lubricating Oil

NOTICE: Lubricating oil must have a sulfated ash level less than 1.0 wt %, currently referred to as CJ-4 oil.

API CJ-4 oils are recommended for use in the engine.

Detroit™ currently will allow API CI-4 Plus oil having sulfated ash levels of 1.4% or less.



10W-30 is the preferred oil for optimal fuel economy results in all DD platform engines.

Lubrication Charts

480-126 SERIES LUBRICATION

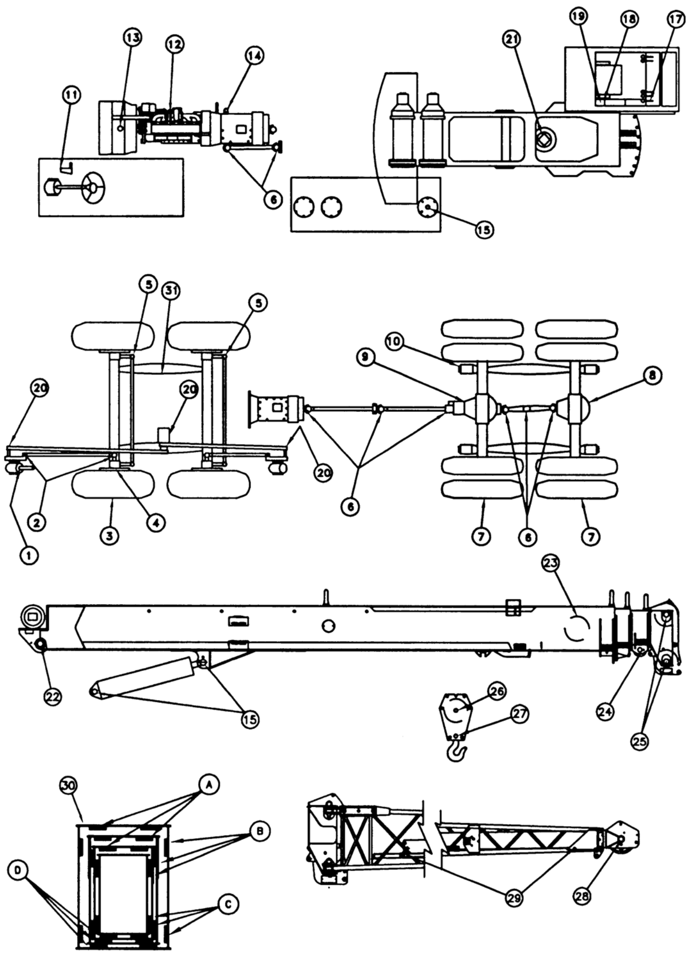


TABLE 1

LEGEND: DIPSTICK
CHK....CHECK
LUB....LUBRICATE
▦ CHANGE FILTER
D/R....DRAIN & REFILL

*REFER TO OPERATORS MANUAL

DAILY (8 HOURS)	WEEKLY (40 HOURS)	TWO WEEKS (80 - 100 HOURS)	THREE MONTHS (250 HOURS)	FOUR MONTHS (500 HOURS)	SIX MONTHS (1000 HOURS)	YEARLY (1500 - 2000 HOURS)	REF	DESCRIPTION	QUANTITY	NO.	LUBRICANT
					CHK		1	STEERING GEAR SEAL	FLUSH CAVITY	1	MPG
	LUB						2	DRAG LINKS	PURGE	2	MPG
					CHK		3	WHEEL BEARINGS, FRONT AXLE	CLEAN, REPACK	4	NLGI GR. 2 BRG. GREASE
	LUB						4	KNUCKLE PINS & BEARINGS	PURGE	4	MPG
	LUB						5	TIE ROD ENDS	PURGE	2	MPG
		LUB					6	DRIVE SHAFTS	PURGE	9/12	MPG
	*CHK				D/R		7	WHEEL BEARINGS, REAR TANDEM	COMMON TO DIFFERENTIAL		GL-5 −15° TO +80°: SAE 80 +10° TO +100°: SAE 90 ABOVE 100°F: SAE 140
	*CHK				D/R		8	REAR AXLE DIFFERENTIAL	36 PT.		
	*CHK				D/R		9	INTERAXLE DIFFERENTIAL	39 PT. (+ 2PT. INTERAXLE)		
	LUB						10	BRAKE SLACK ADJUSTER CAM & PINS	PURGE	4	MPG
	LUB						11	CARRIER ACCELERATOR PEDAL	PURGE	1	MPG
CHK			D/R ▦				12	DETROIT DIESEL	38 QTS W/FILTER	1	CONSULT ENGINE MFR'S OPERATION MANUAL FOR LUBE OIL REQUIREMENTS
CHK			*			D/R ▦	13	COOLING SYSTEM	45 QTS	1	
	CHK		*		D/R		14	AUTOMATIC TRANSMISSION	DIP STICK LEVEL	1	DEXRON-III
CHK	INITIAL ▦		▦			D/R	15	HYDRAULIC RESERVOIR	HO - SEE TABLE 2 - KEEP OIL LEVEL BETWEEN MARKS ON INDICATOR TUBE		
	LUB						16	BOOM CYLINDER BUSHINGS	PURGE	2	MPG
	LUB						17	UPPER ACCELERATOR PEDAL	PURGE	1	MPG
LUB							18	TURNTABLE GEAR, PINION *	20 SHOTS	1	GG (MPG BELOW 32°F)
		LUB					19	TURNTABLE BEARING RACE *	AS REQ'D	1	MPG [BELOW 32°F: EP-1 / ABOVE 32°F: EP-2]
	LUB						20	STEERING LINKS	PURGE	2	MPG
	CHK						21	SWING REDUCTION UNIT	11 1/2 PT.	1	SYNTHETIC GL-5
	LUB						22	BOOM PIVOT PIN	PURGE	2	MPG
	CHK						23	BOOM EXTEND RETRACT CHAIN	AS REQ'D	4*	EO-SAE30 NON-DETERGENT
	LUB						24	CHAIN ROLLER	PURGE	4*	MPG
	LUB						25	BOOM TIP SHEAVES	PURGE	5	MPG
	LUB						26	HOOK BLOCK SHEAVES	PURGE	7	MPG
	LUB						27	HOOK BLOCK TRUNNION	PURGE	1	MPG
	LUB						28	JIB SHEAVE	PURGE	1	MPG
	LUB						29	JIB STINGER ROLLERS	PURGE	4	MPG
	LUB						30	BOOM SLIDE PADS	AS REQ'D	24*	MPG
	LUB						31	BOGIE CENTER (INSIDE)	PURGE	2	MPG

TABLE 2

SPECIFIED LUBRICANTS		
MPG	MULTI-PURPOSE GREASE	EP-2
GG	OPEN GEAR GREASE	Grade 8
GL-1	GEAR LUBRICANT, REGULAR	STRAIGHT MINERAL OIL SAE 80W-90
GL-5	GEAR LUBRICANT, EP	SAE 90 (MII-L-2105B)
SYNTHETIC GL-5	GEAR LUBRICANT, EP	SAE 75W90
HO	HYDRAULIC OIL	*Koehring Spec. 805
EO	ENGINE OIL	A.P.I. Class as Listed
HTF	HYD TRANSMISSION FLUID	DEXRON-III

*REFER TO OPERATOR'S MANUAL FOR COMPLETE LISTING OF RECOMMENDED OILS FOR APPLICABLE TEMPERATURE RANGES AND FOR DRAIN/REFILL PROCEDURES.

PART NUMBER 12400-943

Operator Observation

As the operator, it is your responsibility to observe and report any unusual sounds, odors, or other signs of abnormal performance that could indicate trouble ahead. On a routine basis the following items should be checked before starting or while operating the crane.

Visual Inspection - Check complete machine for any unusual condition.

Check for any leaks or damage to the hydraulic system.

Check in the engine compartment:

- Belts for tension and wear
- Coolant level
- Oil level
- Transmission oil level
- Air cleaner sight gauge
- Air intake
- Muffler and exhaust
- DEF fluid level

Check battery box - For battery condition

Crane boom - Check for:

- Hook block for wear or damage
- Two block system for proper function
- Cable and cable spooling on winch
- Cylinder pin connections for wear

Check tires, axles, and drive lines, for wear or damage.

Check in the cab for:

- Instruments functioning properly
- Control operation
- Glass for good visibility
- Safety equipment is ready for use
- All lights work properly
- Cleanliness - Free from mud and debris.

Special Break-in Requirements for New Cranes

- 8 HOURS - During the first 50 miles of service and any time the wheels have been removed, retorque the wheel nuts to 450-500ft. lbs.
- First 1,000 TO 1,5000 miles inspect oil level of transmission. Check for leaks. Every 2,500 miles inspect lubricant level. Perform transmission inspection. Every 5 years or 500,000 miles, whichever occurs first, change wet clutch, oil and filters.
- 40 HOURS - Retorque the swing bearing bolts to a torque of 980 ft. lbs on 480-126. Recheck every 40 hours until all bolt are found properly torqued. Thereafter checks should be performed quarterly.
- 40 HOURS - Make initial replacement of hydraulic return line filter.
- 40 HOURS - Perform initial axle oil change at approximately 3,000 - 5,000 miles.
- 100 HOURS - After one hundred hours drain and change the winch lubricant.
- 100 HOURS - Retighten winch base mounting cap screws to 225 ft. lbs. of torque after one hundred hours of operation.
- 100 HOURS - Retighten counterweight cap screws to 845 ft. lbs.
- 100 HOURS - Check the driveshaft connections and the driving belts on the engine accessary drives.
- 250 HOURS - Check all engine clamps and hoses for leaks, and tighten as needed.

All handles, steps, walkways and platforms must be kept free of grease, oils, fuel, mud, snow and ice.

Lubrication Introduction

A regular program of periodic preventive maintenance is essential to prolong crane operating life, maximize efficient service and minimize downtime. This section details a series of checks and procedures which are to be performed at daily, weekly, monthly and semiannual intervals. These intervals are stated both in terms of calendar periods and hours of operation.

The checks prescribed for longer intervals include all the checks required for the shorter intervals. Thus, the weekly check includes all items in the daily check, the monthly check includes weekly and daily checks, and so on through the semi-annual check, which includes the quarterly, monthly, weekly and daily checks.

A convenient check chart provides a means of recording preventive maintenance performed and serves as a tool detecting problem areas and reanalyzing maintenance requirements. The items in each check interval on the check chart are grouped under their respective headings and covered in detail over the course of Section 6.

This maintenance schedule is a guide which ensures that basic preventive maintenance requirements will be met under average operating conditions. Conditions which impose greater wear, loads or strain on the crane may dictate reduced check intervals. Before altering the maintenance schedule, reevaluate crane operation and review the crane maintenance records. Consider all factors involved and develop a revised schedule adequate to meet routine maintenance requirements.

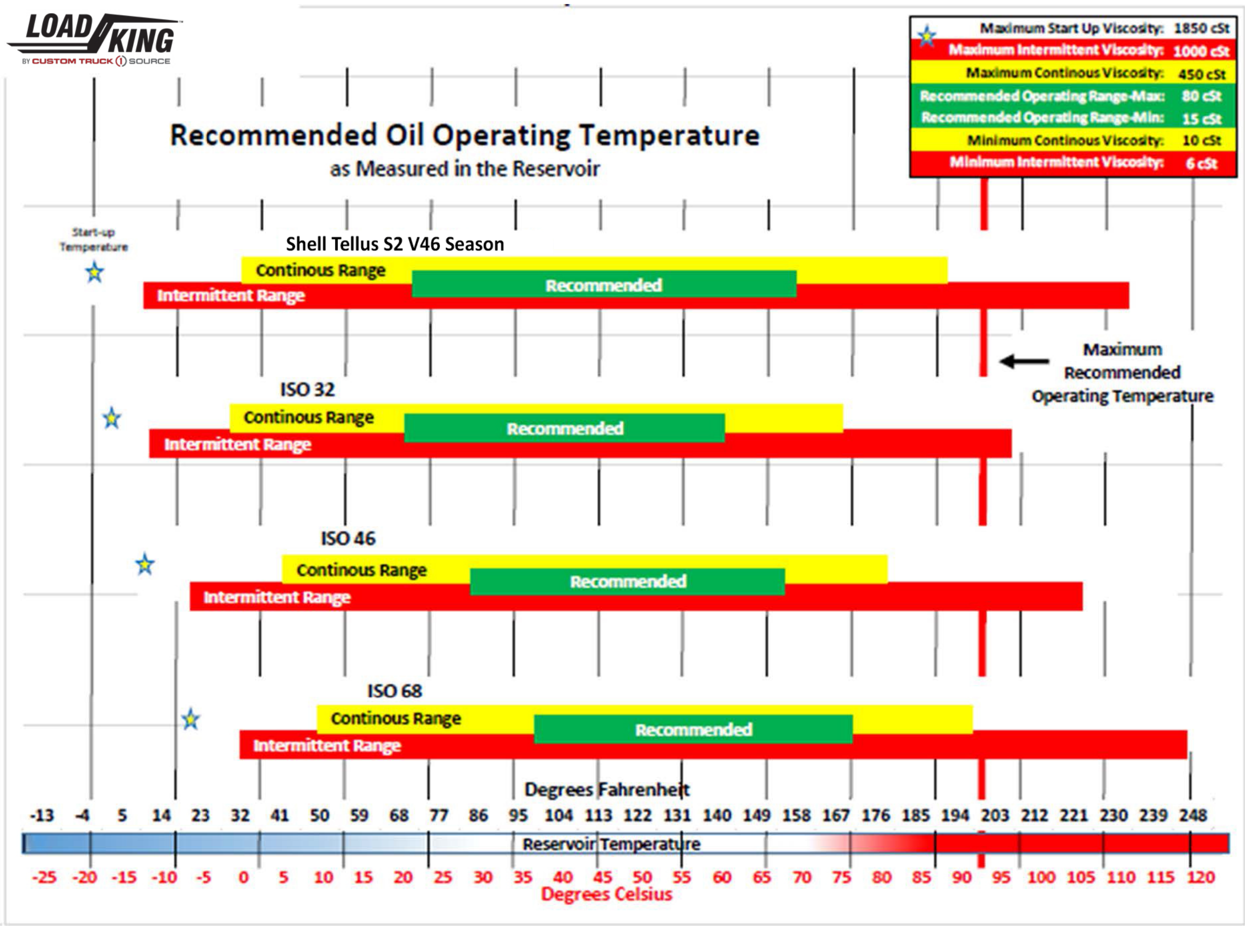
As a part of each periodic check, refer to the engine manufacturer's manual for engine maintenance requirements. When servicing the engine, the engine manufacturer's recommendations take precedence over those in this manual, should any discrepancy be noted.

Hydraulic Oil Requirements

The hydraulic system is filled with a Shell Tellus S2 V 46 premium hydraulic oil. This hydraulic oil is recommended for a broad range of operating temperatures but the end user is ultimately responsible for determining if the oil is appropriate for their specific operating conditions or if another hydraulic oil is required. To ensure the longest life for this piece of equipment, it is critical to maintain the hydraulic oil at the proper level, to keep the hydraulic fluid clean (see Hydraulic Maintenance section), and to avoid overheating the oil.

The oil for the hydraulic system performs multiple functions. While the hydraulic oil must transmit power and provide superior lubrication under high pressure, there are other properties that are critical to the oil and the performance of the equipment. These include, but are not limited to, wear protection, oil oxidation, rust and corrosion protection and foaming. To guide in the selection of the proper oil, refer to the Oil Viscosity Selection Chart on page 281 and the listings of Typical Qualified Hydraulic Oils on page 282 below.

Oil Viscosity Selection Chart



OIl Viscosity Selection Chart Color Legend

GREEN	Recommended - Component manufacturer's optimal Range
YELLOW	Continuous - Component manufacturer's limits for continunous operation
RED	Intermittent - Limited operation range

The factory-filled hydraulic oil is recommended for most operating conditions and for a wide range of oil operating temperatures as measured in the reservoir. Under certain operating temperatures and conditions (duty cycles), it may be advisable to use another fluid in order to maintain the oil viscosity in the recommended range (see Oil Viscosity Selection Chart on page 281). For startup temperatures lower than what is indicated in the chart, follow the warm up procedures in the operating manual to increase the fluid temperature and decrease potential damage. Additionally, these machines should not be operated with hydraulic reservoir temperatures in excess of 200°F (93°C). These high temperatures cause degradation of the hydraulic fluid and rubber components such as hoses and seals.

If overheating occurs, discontinue operation and:

1. Check the hydraulic fluid level.

2. Check the oil cooler for plugs or restricted air flow.
3. Check that the oil viscosity matches that recommended for the operating temperature.
4. Check pressure settings – Is a pump failing or a relief set to low?
5. Reduce the duty cycle of the machine.
6. Consult an Authorized Load King Dealer.

The following hydraulic oils are not recommended:

- Engine Oils
- Transaulic Oils
- Zinc-Free Hydraulic Oils
- Transmission Fluids

Typical Qualified Hydraulic Oils

OIL COMPANY	ISO	BRAND NAME
Conoco		Conoco DN 600 (Arctic)
		Conoco Super Hyd. 5W-20 (Multi-Viscosity)
	32	Conoco Super Hyd. 32
	46	Conoco Super Hyd. 46
	68	Conoco Super Hyd. 68
Exxon Co. (USA)	32	Nuto-H 32
	46	Nuto-H 46
	68	Nuto-H 68
Imperial Oil Limited (Canada)	32	Nuto H 32
	46	Nuto H 46
	68	Nuto H 68
Kendall Refining Co. (USA)	32	Kenoil R&O AW 32
	46	Kenoil R&O AW 46
	68	Kenoil R&O AW 68

OIL COMPANY	ISO	BRAND NAME
Northland Products (USA)	32	Talamar 150
	46	Talamar 215
	68	Talamar 315
	46	Talamar All-Season Premium (Multi-viscosity)
	32	Talamar Extreme 32
	68	Talamar Extreme HTA 68
Pennzoil Products Co. (USA)		AWX Multi-Viscosity
	32	AW 32 Hyd. Fluids
	46	AW 46 Hyd. Fluids
	68	AW 68 Hyd. Fluids
Shell Co. (USA)	23	Tellus 23
	32	Tellus 32
	46	Tellus 46 (XSL 9101)
	68	Tellus 68

OIL COMPANY	ISO	BRAND NAME	OIL COMPANY	ISO	BRAND NAME
Mobil Oil Corp.	32 46 68	DTE 24/DTE-13M DTE 25/DTE-15M DTE 26/DTE-16M	Texaco Inc. (USA)	 32 46 68	Rando Oil HD A2 (5w-20) Rando Oil HD 32 Rando Oil HD 46 Rando Oil HD 68

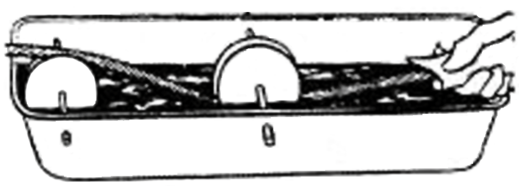
Cable Lubrication Methods

GENERAL

We are covering the more commonly used methods of lubricating cable (wire rope). For special cable lubrication problems consult the cable manufacturer.

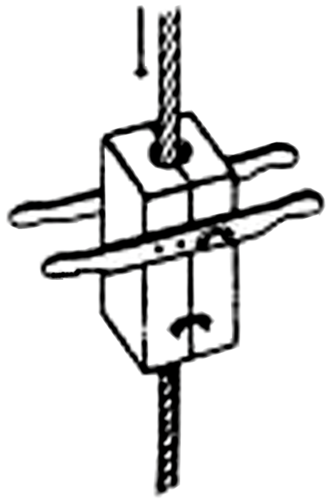
HOT APPLICATION

A heated bath is placed in the path of the wire rope, and the rope is passed through the hot lubrication over sheaves and a center guide wheel. Hot oils or greases have excellent penetrating qualities and upon cooling have high adhesive and film strength around each wire.



CONTINUOUS BATH

Run an operating rope through a specially constructed casing that has been packed with swabbing and loaded with lubricant. This affords continuous lubrication.

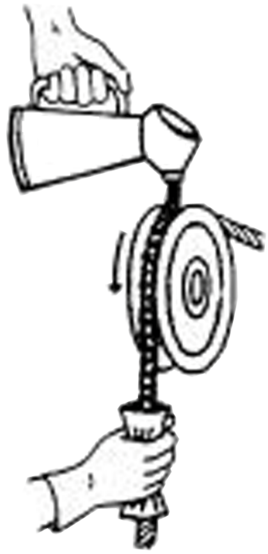


DRIPPING

A container can be placed above the sheave, so that the rope can be lubricated by opening a spigot. Sheaves are the best location for lubricating operating wire ropes, because the wires and strands open somewhat as they bend along the groove.

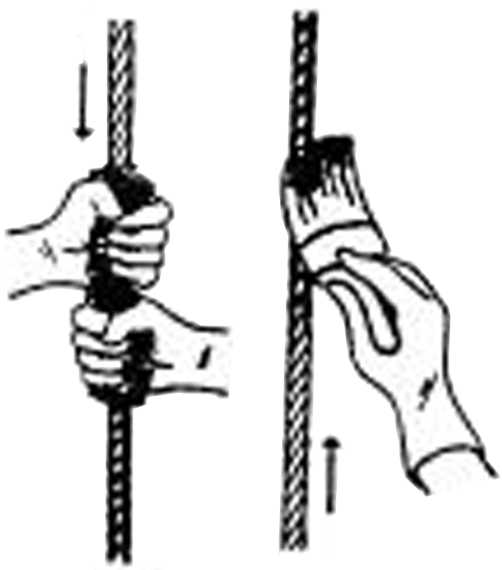
POURING

Lubricant can be poured on. The rope should be lightly loaded and run slowly while being lubricated.



SWABBING AND PAINTING

Lubricant can be swabbed on with rags, or painted on with a brush. Both are quick methods which can be made part of the operating routine.



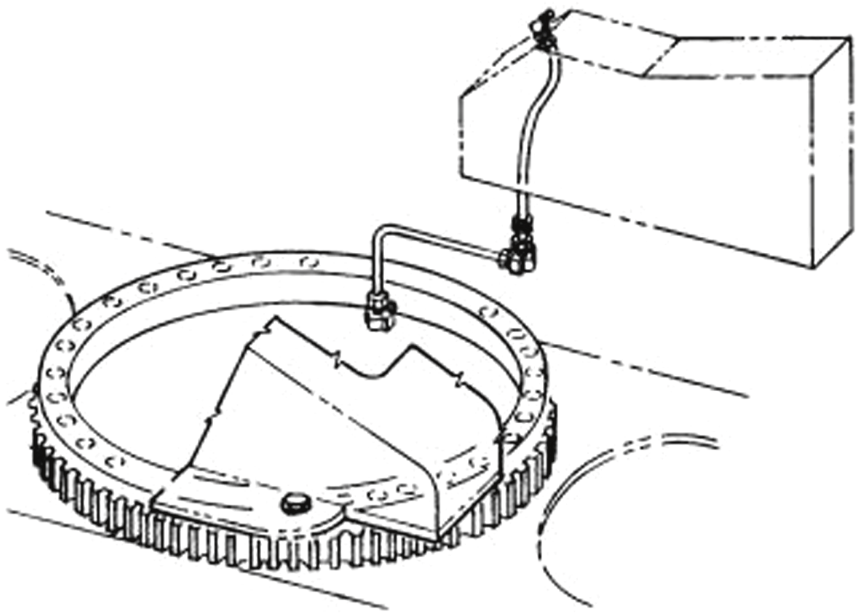
SPRAYING

A light lubricant containing solvents can be applied to a wire rope by a properly directed spray nozzle.

AEROSOL SPRAYING

Installations requiring only small amounts of lubricants, or only occasional applications, may find the new aerosol cans of lubricant useful. They are available from several lubricant manufacturers.

Turntable and Swing Pinion



Standard lubrication frequencies are shown on LUBE CHARTS for each model of crane.

RACE LUBRICATION - Inject grease as recommended through fitting located to rear of console in operator's cab as shown above. Rotate the upper while injecting grease at least two complete revolutions. If complete rotation is impractical, inject grease through fitting and rotate machine back and forth as far as possible.

Under extremely dirty or dusty conditions, sufficient grease should be added to flush out contaminated grease. Under less severe conditions, add grease until it appears at the bottom seal.

GEAR LUBRICATION - While swinging the machine, apply gear grease through the second grease fitting located to the rear of the console to the internal ring gear with sufficient frequency to insure that the teeth remain coated

Some lubricants recommended are:

	MOBIL	TEXACO	SUNOCO	AMOCO	EXON
RACE	Mobilux EP1	Mutifak EP1	Prestige 742EP	Amolith EP1	Beacon EP1
GEAR	Mobiltac 375NC	Crater 2X	407 Compound B	Amovis 8-X	Surett Fluid 4k

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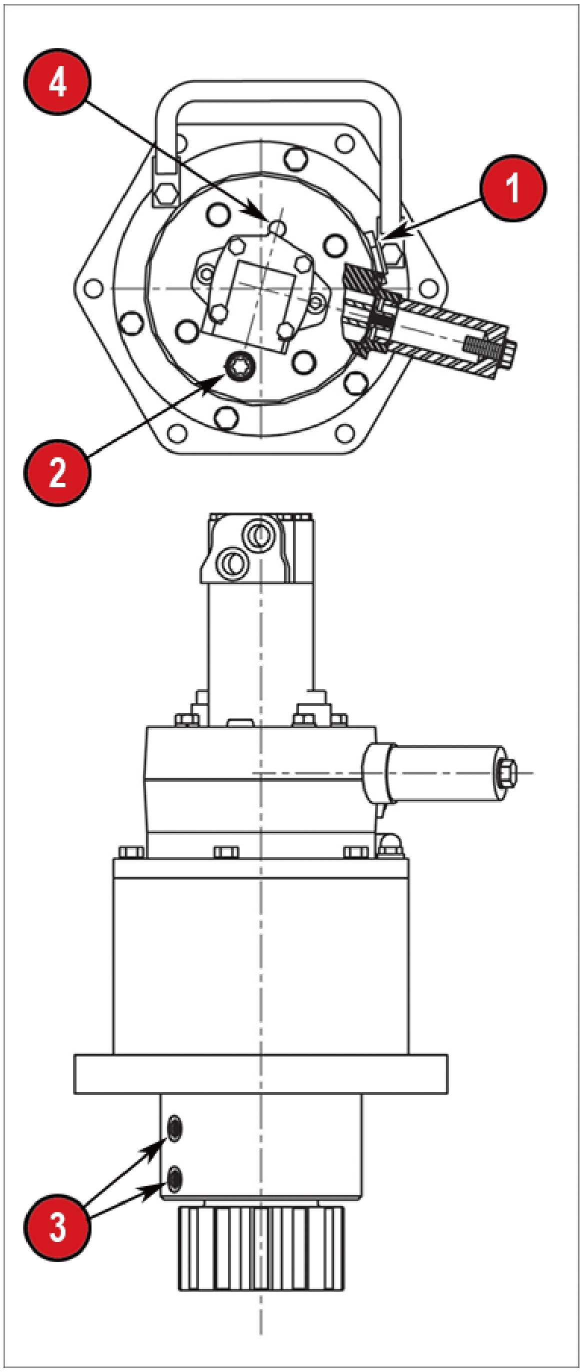
Swing Reducer

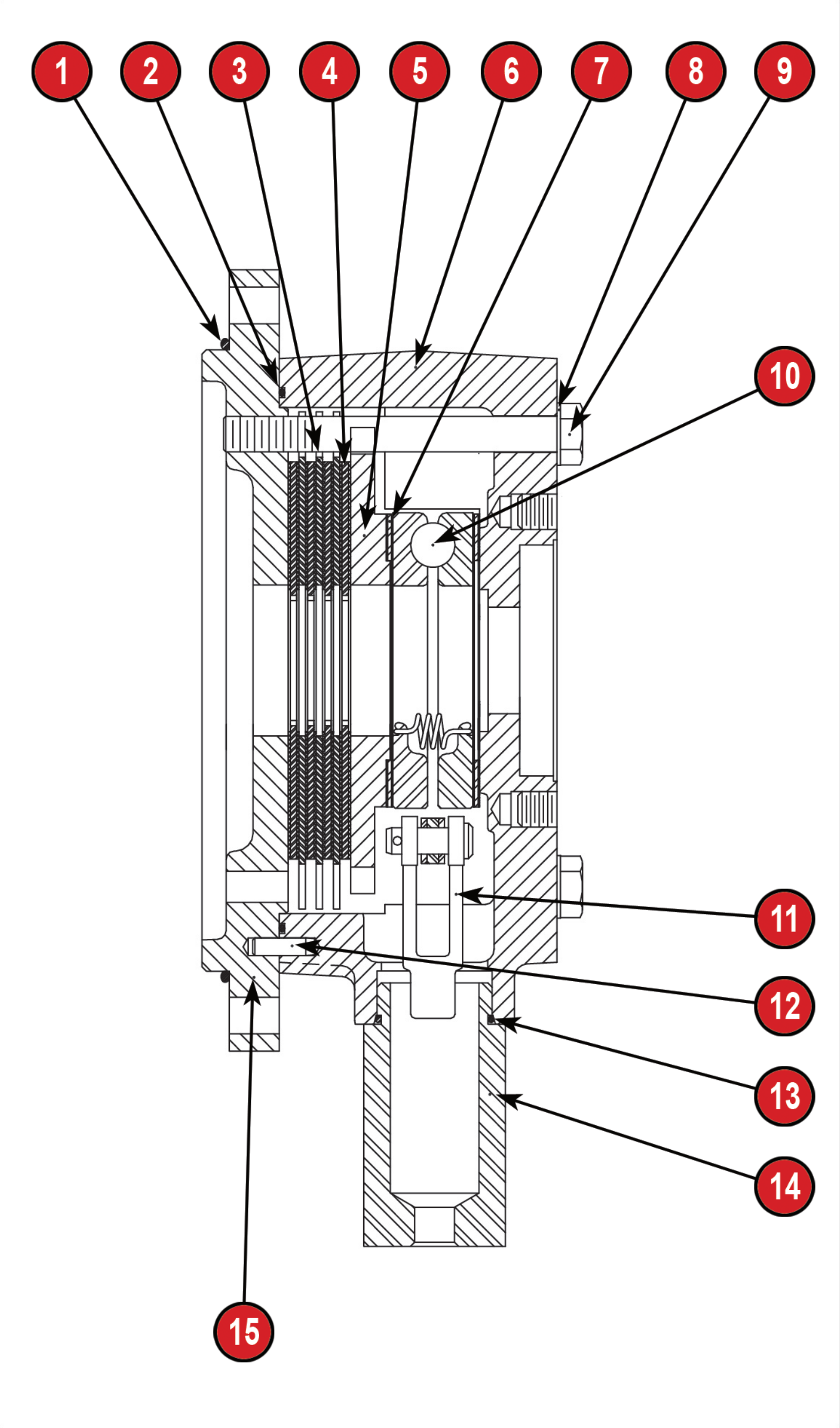
MAINTENANCE CHECK

1. On a WEEKLY basis, check the swing reducer oil level and add oil as needed to maintain the level at the "FULL" showing in the sight glass window as indicated below in the image item 1. Recommended lubricant is AGMA #4EP Gear Oil or equivalent.
2. All swing drive gearboxes from Load King are shipped with an additive to the gear oil of 5 oz (148 ml) of ethylene glycol for cold weather protection. If gear oil in the unit is changed, Load King recommends the same amount of ethylene glycol is added to prevent freeze up of unit due to internal condensation.



480-126 Swing Drive

1. Oil level sight glass
2. Oil fill plug
3. Oil drain port
4. Breather port

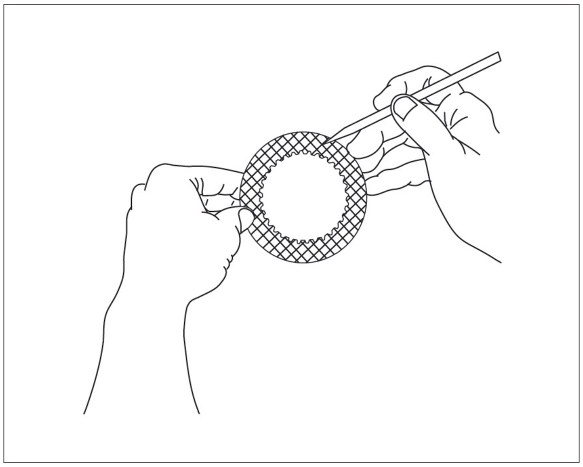


Brake Section Components View

Static Brake Service

Disassembly

1. Remove the four capscrews and sealing washers (items 8 & 9). Turn the assembly over and remove the housing adapter (item 15). Remove and discard the O-Ring (item 2).
2. Remove the friction and steel brake discs (items 3 & 4). Remove the pressure plate (item 5).
3. Remove the brake actuating assembly and clevis (items 10 & 11) and the two thrust bearings (item 7).
4. Thoroughly clean and inspect all parts at this time. Be sure the brake release mechanism operates smoothly and is not damaged. There are no serviceable parts in the actuating mechanism. If it is damaged in any way, the entire assembly must be replaced. Inspect the two teflon impregnated thrust washers for signs of excessive wear and / or mechanical damage. Nominal thickness of these washers is 0.093 in. (2.4 mm) when new. If worn to less than 0.062 in. (1.57 mm) thickness, they should be replaced.
5. Place friction disk on a flat surface and check for distortion with a straight edge. Friction material should appear even across entire surface with groove pattern visible. Replace friction disc if splines are worn to a point, disc is distorted, friction material is worn unevenly, groove pattern is worn away or friction material is burned. Place each steel disc on a flat surface and check for distortion with a straight edge. Check surface for signs of material transfer or heat. Replace steel disc if disc is distorted or heat discolored.



Assembly

1. Place the brake housing on a work bench with motor mounting surface down. Lightly lubricate and install one of the thrust washers into the housing. Install the brake actuating assembly, with the clevis attached to it, into the housing. The clevis must fit into the opening on the side of the housing.
2. Tilt the housing and install two capscrews and sealing washers (item 9 & 8) into two holes in the housing, 180 degrees apart. These capscrews will align the pressure plate and steel discs when they are installed. Apply an oil soluble grease or petroleum jelly to the other thrust washer and install it onto the pilot of the pressure plate (item 5). The grease will hold it in position while the pressure plate is intalled. Install the pressure plate onto the actuating mechanism. Alternately install a friction disc and a steel brake

disc into the housing. NOTE: There are (4) friction and (3) steel discs. Start and end with a friction disk.

3. Install a new O-Ring (item 2) into the groove on the brake housing. Install the housing adapter onto the brake housing. There is a dowel pin between these two parts for correct orientation. Turn the assembly over and install the two remaining capscrews and sealing washers and tighten all four capscrews. NOTE: The brake plates must be free to move in the housing at this point. If they are clamped in place and immovable, the thrust washer between the pressure plate and actuating mechanism may be out of position.

Refer to your parts manual for service part numbers of Swing Drive (Group 22)

ITEM	DESCRIPTION
1	O-RING
2	O-RING
3	BRAKE PLATE
4	FRICTION DISK
5	PISTON
6	HOUSING
7	THRUST BEARING
8	WASHER, SEALING
9	CAPSCREW
10	ACTUATING ASSEMBLY
11	YOKE END
12	DOWEL PIN
13	O-RING
14	CABLE ADAPTER
15	HOUSING ADAPTER

NOTE: *Refer to Braden PB-299 Swing Reducer Service Manual on the 12261-782 (480-126) Shop Manual CD for further maintenance instructions.*

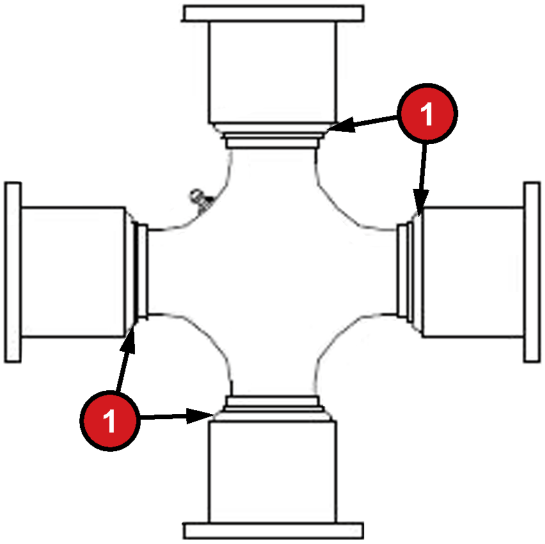
Drive Shaft Maintenance

Rotating shafts can be dangerous. You can snag clothes, skin, hair, hands, etc. This can cause serious injury or death. Do not work on a shaft (with or without a guard) when the engine is running.

UNIVERSAL JOINTS

To insure proper lubrication of the bearing assemblies, it is essential to add lubricant until it appears at all journal cross bearing seals (1). This assures removal of dirt particles and other contaminants that may find their way into the bearings and indicates to the mechanic that the bearings are fully lubricated.

Do not assume that bearing cavities have been filled with new lubricant unless flow is noticed around all four bearing seals! (1).



If all the seals do not "pop" when being lubed, move the drive shaft laterally in all four directions and pull or push on the drive shaft in the direction opposite to the journal cross seal not relieving while lube gun pressure is being applied to the alemite fitting.

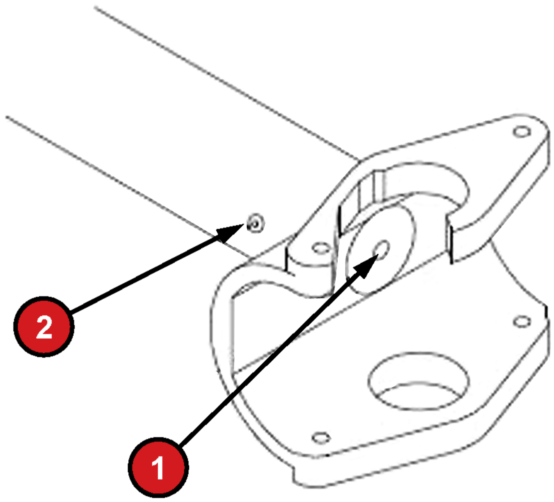
It is recommended that all universal joints be relubed after installation of the drive shaft prior to putting a vehicle in service.

JOURNAL AND BEARING KITS

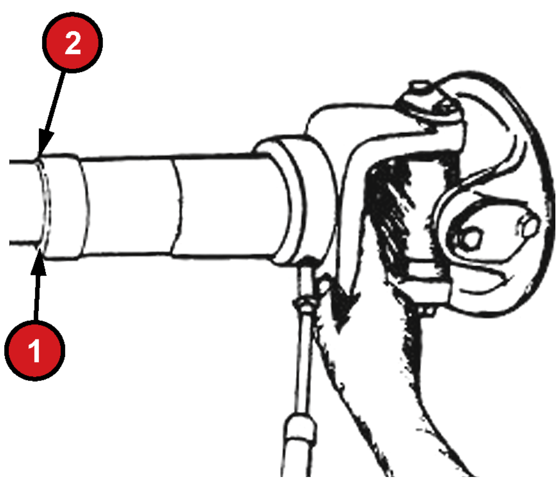
It is necessary to completely lubricate each replacement kit prior to assembly into the drive shaft yokes. Each journal cross lube reservoir should be fully packed with a recommended grease and each bearing assembly should also be wiped with the same grease; filling all the cavities between the rollers and applying a liberal grease coating on the bottom of each race. After the kits are installed into the drive shaft yokes and prior to placing into service, they should be relubed, through the zerks, using the same grease.

SLIDING SPLINE SECTIONS

Steel drive shaft splines should be lubricated with good extreme pressure (EP) grease as recommended by lubricant manufacturers. Extreme pressure grease satisfying NLFI Grade 1 has been adapted by the factory. Relube spline at the intervals prescribed below. Apply grease gun pressure to lubrication zerk (2) until lubricant appears at pressure relief hole (1) in welch plug at the sleeve yoke end of spline.



Cover pressure relief hole with finger and continue to apply pressure until grease (1) appears at sleeve yoke seal (2). This insures complete lubrication of spline.



LUBRICANTS

A high quality extreme pressure (EP) grease recommended by lubrication manufacturers for universal joints should be used. Lithium soap base greases meeting National Lubricating

Grease Institute (NLGI) Grade 1 and Grade 2 specifications are preferred. The use of greases which tend to separate and cake should be avoided.

Lubrication cycles for drive shaft universal joints and slip splines will vary with service requirements and operating conditions.

OPERATING CONDITION	RE-LUBE CYCLE	
	Miles	Hours
NORMAL	6000-8000	150-200
* SEVERE	2000-3000	50-75

* For applications where conditions such as high speeds, high ambient temperatures or high angles are present.

Recommended Lubricants for Axles

Recommendations: Extreme pressure gear lubricant is recommended for use in all drive steer and rigid drive axles except where explicitly specified differently by Spicer Off-Highway Engineering.

Mineral Based: Acceptable lubricants must meet API GL-5 / MT-1 and MIL-PR2105E qualifications. The highest viscosity grade must be used given the prevailing ambient temperatures from the chart below.

Synthetics: Synthetic lubricants are recommended providing they meet API GL-5 / MT-1 qualifications. The highest viscosity grade must be used given the prevailing ambient temperatures from the chart below.

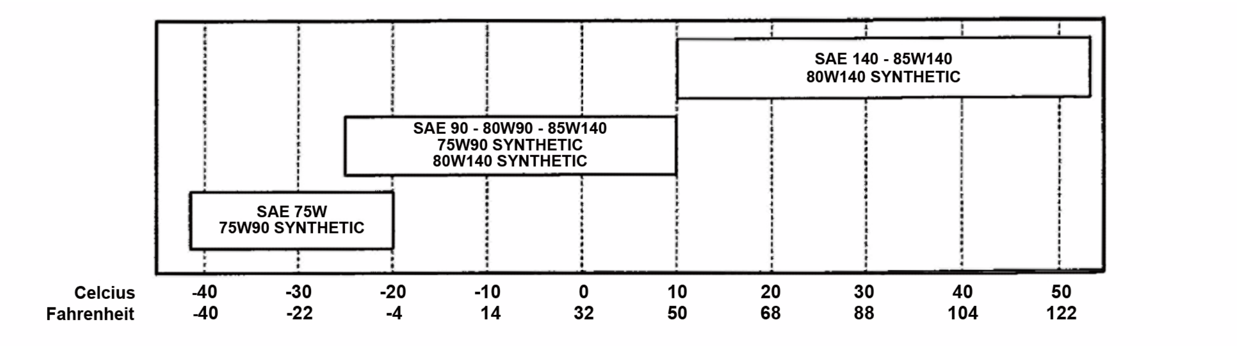
In general, synthetic oils have a lower pressure viscosity response than mineral oil lubricants. As the contact pressure between the gears increases, this produces a thickening of the mineral oil at the contact interface. This increase in viscosity helps to maintain lubricant film thickness reducing the possibility of surface and spalling fatique. Synthetic lubricants do not thicken as much under pressure unless specifically formulated to do so. Before using a synthetic lubricant in heavy applications, the customer must check with the lubricant supplier on this issue of high pressure rheology.

Normal Oil Change Intervals: Oil change intervals for mineral based lubricants in normal environmental and duty cycle conditions is 2500 hours in all off-highway applications and 10,000 miles in on-highway applications. Severe or sustained high operating temperature or very dusty atmospheric conditions will result in accelerated deterioration or contamination. Judgement must be used to determine the required change intervals for extreme conditions.

Extended Oil Change Interval: Extended oil service may result when using synthetic lubricants. Appropriate change intervals must be determined for each application by measuring oxidation and wear metals, over time, to determine a baseline. Wear metal analysis can provide useful information but an axle should not be removed from service based solely on this analysis. Vehicles which are prone to high levels of ingested water in the axle or water as a result of condensation, should not use extended drain intervals.

Friction Modifiers: Friction modifiers may be used with the lubricant to reduce Posi-Torq (limited slip) differential noise or liquid cooled brake noise. If friction modifiers are used, follow instructions on TSB USA 278E.

The use of aftermarket lubricant additives other than those specified is not recommended and may reduce the life of the axle and void warranty.



REAR BRAKES

Using a pressure gun, lubricate the brackets and slack adjusters. An application of lubricant should be applied to the grease fittings each time (weekly) a general lubrication of chassis components is required. Use synthetic grease per specifications in chart below.

Grease should be supplied to the bracket until it begins to squirt out around the camshaft adjacent to the slack adjuster. The slack adjuster should be filled until grease becomes visible around the camshaft.

NOTE: *Camshaft brackets with metal plugs instead of grease fittings are fitted with special seals and packed with extended lubrication interval chassis grease.*

Air System Maintenance

Inadequate delivery pressure or defective component operations can generally be traced to leakage, blocked lines, or the build up of moisture and sediment in the system. A regular program of periodic maintenance is an essential part of air system operation. The materials presented here are listed in accordance with the MAINTENANCE CHECK LIST. Consideration of severe working conditions may dictate a revision in scheduling periodic checks.

DAILY:

AIR TANKS

Open the air tank drain cocks at least once daily to blow out moisture and accumulated sediment. All air drains are located on the front outrigger box and not under each tank.

WEEKLY:

AIR SYSTEM SAFETY VALVE

Manually actuate the air system safety valve by pulling out the system. This will ensure that the valve is not sticking. If the valve cannot be actuated in this manner, it should be repaired or replaced. The valve is located on the wet tank.

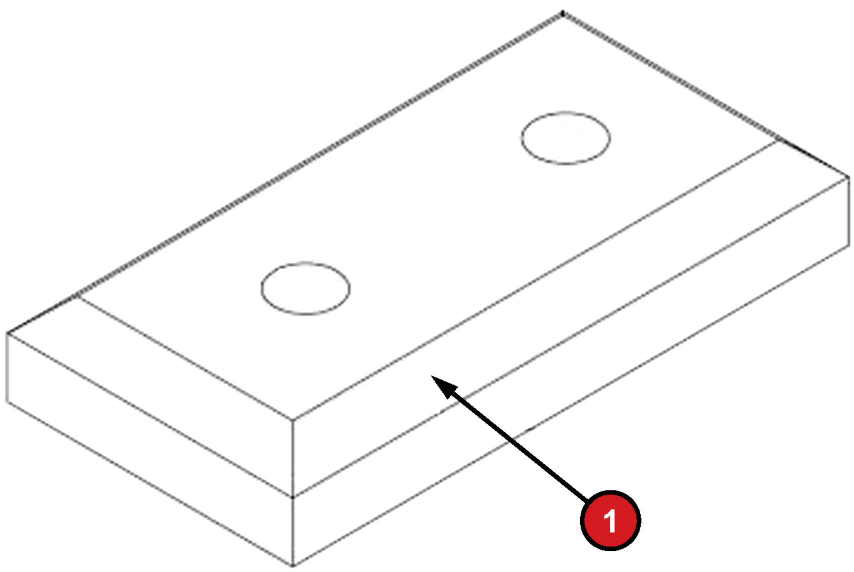
EVERY TWO YEARS:

AIR DRYER

Desiccant cartridge life will vary depending on operating conditions, speeds, loads air usage and compressor condition. It is recommended that the desiccant cartridge be replaced approximately every 2 years. If system performance is reduced, desiccant cartridge replacement is necessary. It isalso recommended that the desiccant cartridge be replaced if the compressor has been rebuilt.

Slider Pads

The front bottom slider pad should be checked daily for wear. The remainder of the slider pads should be checked monthly for wear.



All the slider pads contain a chamfer (1) on the wearing surface. When this chamfer (1) is worn off, the slider pad must be replaced.

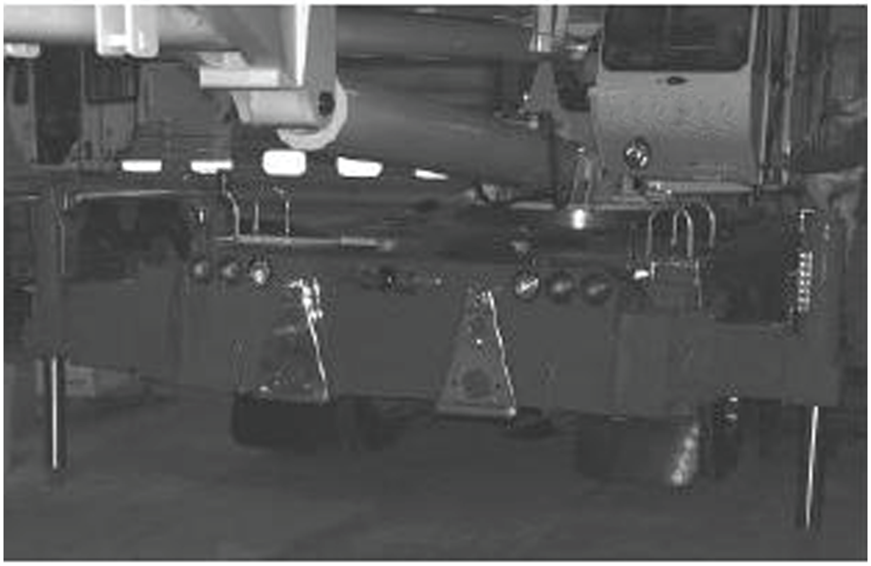
With boom extended brush grease on areas of boom where wear pads contact is evident.The inside of the top plate of all sections except the tip section also require grease. This can be applied through the holes in the side plates and “piled” on top of the next section out just in front of the top rear pads on that section so that extending the boom to the next hole smears the grease onto the inside of the top plate. Remember to do both sides.

Grease intervals vary and should be more frequent if noise or jerking of the boom is evident.

Boom Lubrication

4 SECTION BOOM

1. Fully extend the front & rear outriggers, and level the retracted boom over the front of the machine.



2. This procedure will require (2) people, (1) one operating the boom to align grease zerks to access holes while the other person greasing the boom can signal the operator when the zerks are aligned to holes. A stable working platform is required for this procedure.
3. Use MPG (multi-purpose) grease.
4. To lubricate the upper rear wear pads of the boom that ride on the inside top plate of the base section have the crane operator extended the boom slowly until the first access hole in the base section lines up with the zerk in the second section. Grease the zerk on each side of the base boom (10) shots.

5. Repeat item 4. for each of the access holes going forward on the base boom as the second section is extended approximately (3) FT. each time. The last hole in the base boom will line up with the zerk when the second section is fully extended as shown in photo below.

6. Extend the second section for the 1st zerk hole in the second section of the boom to line up with zerk in 3rd section. Grease the zerk on each side of the second section (10) shots. See photo below.

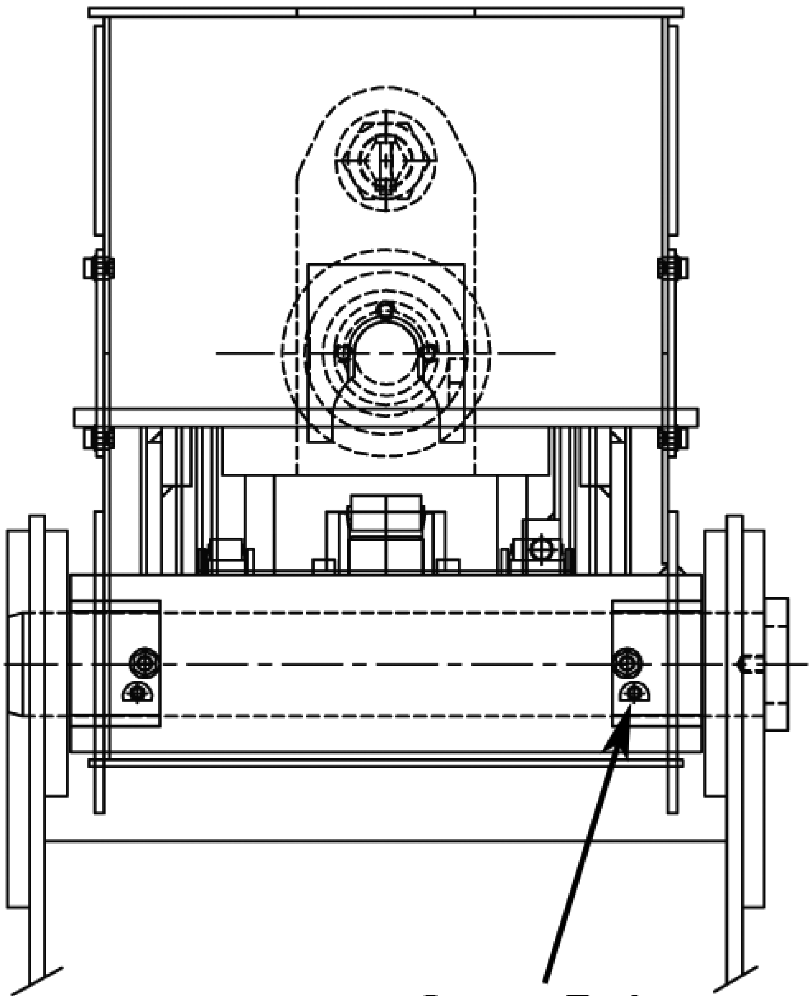
7. Repeat procedure above for each access hole going forward in the second section as the 3rd section is extended. Lining up the zerk and applying the grease.
8. With the 2nd section fully extended use a roller or brush to grease the bottom section of boom on surfaces that you see wear pad contact. See photo below.

9. Fully extend the boom sections 3 & 4 to obtain access to the internal wear pad contact areas thru the large circular openings in the side plates of each section.
10. WARNING-ENGINE MUST BE SHUT DOWN-When performing lubrication internal to the boom sections.

11. Through the holes in the 2nd and 3rd section apply a liberal amount of multi-purpose MPG grease to the top and bottom as shown in photo below.
12. Use a 3" to 4" wide roller to apply the grease to the wear pad contact areas top and bottom. See photo below
13. Apply grease to approximately the center 12" of the floor of the 3rd section as shown in photo below.

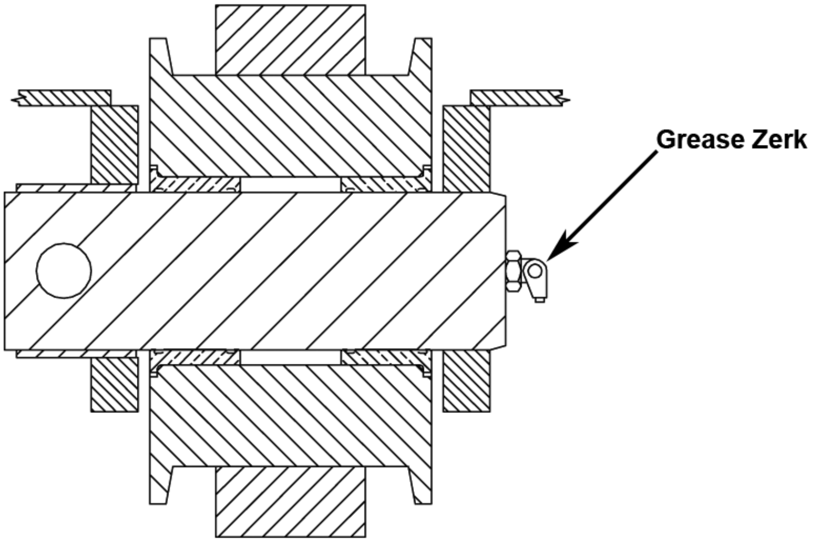
14. Apply multi-purpose grease along the entire length of the section to the outer 5" of both sides of the top plate of Section 3. This area can be accessed through the holes in the #3 section.
15. Apply a fist sized portion of grease in the center of the bottom plate on the inside through each of the holes in the boom on the path where the cylinder slides.
16. No greasing of the 4th section (tip section) is required. Cycle boom in and out a few times to distribute the grease evenly between wear pads before starting normal crane operation.

17. Boom Hoist Cylinder Pin lubrication, lubricate with MPG until grease starts to protrude from bearing sides.
18. Base Boom Pin lubrication, lubricate with MPG until grease starts protruding from side of tube on each side. See image below for zerk locations (2).



19. Hoist Cylinder Rod end pin lubrication-Raise boom up about 20 degrees then SHUTDOWN ENGINE(1) zerk, lubricate until grease starts protruding from sides of rod eye. See below photo.

20. Chain roller pin lubrication zerk on front of base boom head, (3) to (4) shots of grease is required. See image below for location of zerk.



21. Boom Head Sheaves lubrication-With outriggers set , boom retracted, boom lowered, and hook block on the ground then SHUTDOWN ENGINE.
22. All sheaves require lubrication. The top set of sheaves-(1) zerk per sheave, (3) three to (4) four shots of grease per sheave is required. Lower sheaves each have a zerk that can be accessed by aligning web holes to get grease gun to the inboard sheaves.

Swing Bearing Bolting Procedure

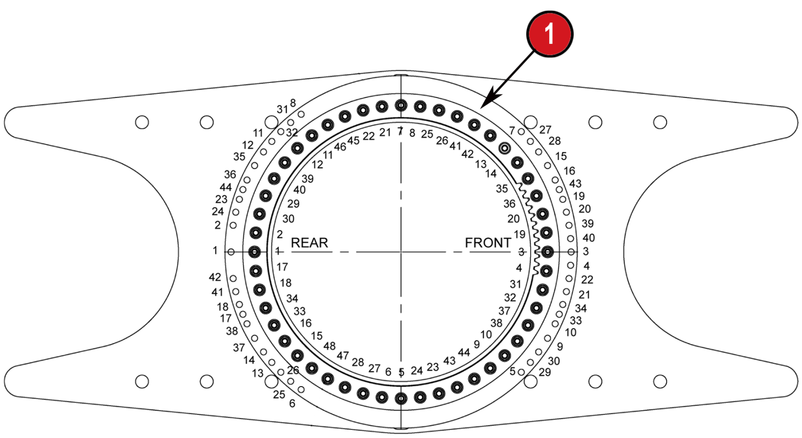
MAINTENANCE CHECK

It is very important to perform periodic swing bearing bolt checks. The bolts MUST BE KEPT TORQUE TIGHTENED to a rating as indicated in chart below. After the first day, and again after the initial 40 hours of machine operation, check and tighten the bolts. If additional torque is required after the first 8 or 40 hours, then recheck each 8 or 40 hours until all bolts are found properly torqued. Thereafter, checks should be performed quarterly.

During each check, if any bolt is found to be broken, replace that bolt and the two adjacent bolts on either side of it (total of 5) before the crane is put back into service.

MODEL	4:1 TORQUE MULTIPIER	NO TORQUE MULTIPLIER
480-126	DRY: 245 FT. LBS. (332 NM)	DRY: 980 FT. LBS (1329 NM)
		Note: Pre-torque in sequence 300 FT. LBS (407 NM) Pre-torque in sequence 700 FT. LBS (950 NM)

Bolt torques are checked by applying the stated torque while observing to determine if the bolt “breaks loose”. If it is tightened (turned) by this procedure then it has loosened and all (26) bolts must be retorqued. Refer to the sequence illustrated below.



RING GEAR BOLTING SEQUENCE- (480-126)

SWING BEARING TORQUE PROCEDURE

A number of causes can reduce tension in the bolts when torquing and after use. These include rust on the threads, damaged or rough threads on bolts or nuts, shanks of bolts which hang up on holes, etc. All of these causes have a tendency to absorb the torque when bolts are being tightened.

All the fasteners inside the upperstructure and the four outside must be checked. This includes a total of sixty four (64) capscrews to be checked. If ANY are found to have loosened, ALL sixty-four (64) must be retorqued.

Remember, it is important to perform periodic checks of the swing bearing bolts. The bolt MUST BE KEPT TORQUE TIGHTENED.

The following equipment is required for checking swing bearing bolt torque:

DESCRIPTION

(1) 3/4 drive ratchet head torque wrench with 200 lb. capacity

(1) 16” extension - 3/4 drive.

(1) 8” extension - 3/4 drive

(1) 7/8” 12 pt. socket - 3/4 drive.

(1) special wrench pn. 706F8697.

(1) 4 to 1 torque multiplier.

(1) 1" 12 pt. socket-3/4 drive.

Transmission Maintenance

Transmission (Eaton UltraShift Plus)

LUBRICATION

Proper lubrication procedures are the key to a good all-around maintenance program. If the oil is not doing its job, or if the oil level is ignored, all the maintenance procedures in the world are not going to keep the transmission running or assure long transmission life. Eaton Fuller Transmissions are designed so that the internal parts operate in an oil bath circulated by the motion of the gears and shafts. Thus, all parts are amply lubricated if these procedures are closely followed:

1. Maintain oil level. Inspect regularly.
2. Change oil and filters regularly.

   Use the correct grade and type of oil. Buy oil from a reputable dealer.

Additives and friction modifiers are not recommended for use in Eaton Fuller Transmissions.

1. Maintain Proper Oil Level-(Eaton Transmission)

First locate the oil level plug holes by facing the rear of the transmission. There are two 1/4 x 18 taper pipe thread oil level holes on the lower left hand side of the transmission case. The ful oil level hole is 1 1/2 inches above the low oil level hole. Initially fill the transmission with oil until it flows out the low oil level plug hole, install the low oil level plug. Start and run the engine at idle speed to prime the converter, oil cooler and lines. Recheck the oil level with the engine running at idle speed and add oil to bring level to the low oil level plug hole. When the oil temperature is stabilized at 180 to 200 degrees F., make final oil level check and bring oil level to the full oil level plug hole and install the oil level plug.

Make sure oil is showing in sight guage. Oil should be checked at idle speed in the neutral position.

2.Draining Oil

Drain transmission while oil is at ambient temperature (65°F + 20). To drain oil, remove the main case drain plug. Clean the drain plug and flush the cooler circuit before reinstalling.

A complete hydraulic circuit flush should be completed when:

- changing oil types and brands

- changing oil viscosity grades from or to Arctic oil.

- a catastrophic failure has occurred.

Parking Brake

Select N (Neutral) and be sure that the parking brake is applied to secure the vehicle when it is not attended. Always make sure the vehicle's parking brake system has been maintained.

> Warning: Whenever it becomes necessary to leave the vehicle, even momentarily, while the engine is running, place the transmission shift lever in N (Neutral), set the parking brake.

Transmission Inspection

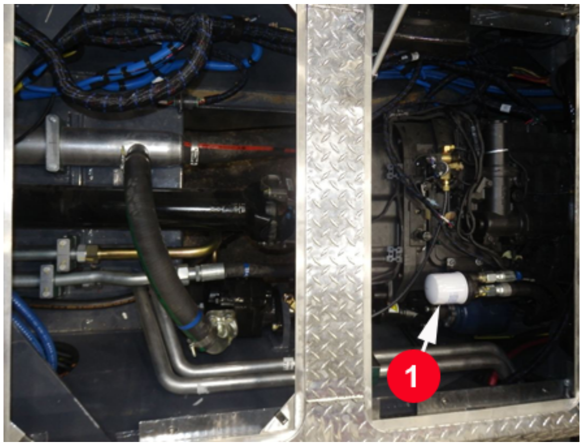
Checks Before Transmission Removal

1. Air System and Connections

   Annually replace the filter/regulator element. If excessive contamination is present, service vehicle air/dryer system.

2. Lubricant and Filter

   Change at specified service intervals. Use only the types and grades as recommended. See LUBRICANTS. Check lubrication lines and cooling circuit for leaks.



   1. Transmission Filter

3. Drain Plug

   Tighten the drain plug securely. Tighten the main case drain plug to 45-50 Lbf.ft of torque. Tighten oil pan plug to 14-20 Lbf.ft of torque.

4. Capscrews and Gaskets

   Check all capscrews, especially those on PTO covers and rear bearing covers for looseness which would cause oil leakage.

   Check PTO opening, oil sump/strainer, hose fittings, and rear bearing covers for oil leakage due to faulty gaskets.

Checks with Drive Line Propped

6. Universal Joint Companion Flange or Yoke Nut

   Check for tightness. Tighten to recommended torque.

7. Output Shaft

Pry upward against output shaft to check radial clearance in mainshaft rear bearing.

Checks with Universal Joint Companion Flange or Yoke Removed.

8. Splines on Output Shaft

   Check for wear from movement and chucking action of the universal joint companion flange or yoke.

9. Mainshaft Rear Bearing Cover

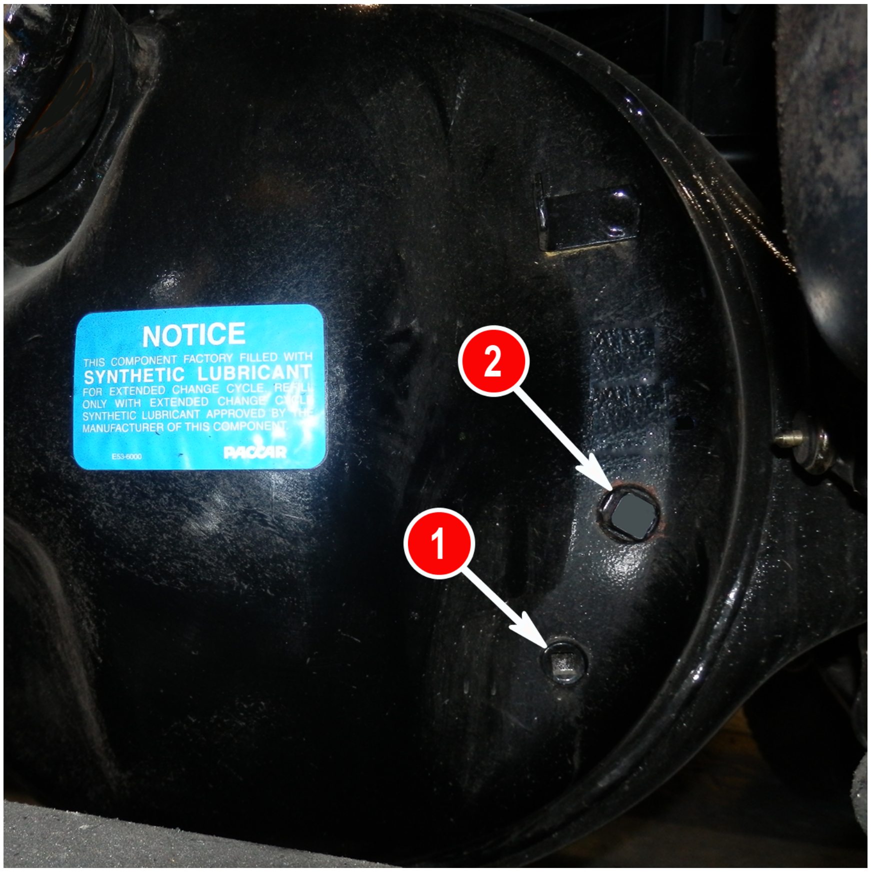
   Check oil seal for wear.

Axle Maintenance

MAINTENANCE CHECK

As a part of the MONTHLY MAINTENANCE CHECK, inspect the axle and differential levels. When checking the AXLE OIL LEVEL, remove plug no. 2 and oil level should be at bottom of threaded plug. Fill as required to get oil to this level. Before checking the forward driving axle, the axle should be run first, because the power divider and forward driving axle have a common lubrication system. Wait for five minutes to allow the oil to settle to the proper levels in the power divider case and axle housing. If the oil level is up to the bottom of the rear filler hole item 2, the power divider is also adequately lubricated. If the oil level is low, add oil as necessary.

If the axles have been drained, fill the forward drive axle until the oil level is level with the bottom of the filler hole in the rear cover. Next, add two (2) more pints through the forward filler hole.



Rear Axle Differential Cover

1. Oil check & fill port
2. Plug

On a ANNUAL basis, drain the oil from the differential by removing the drain plug at the bottom of the differential housing. Replace the plug and refill the differential with the lubricant specified on the lubrication chart. To the level specified above.

See section Recommended Lubricants for Axles

Tire Maintenance

MAINTENANCE CHECK

As a part of the WEEKLY MAINTENANCE, inspect the tires and rims for damage. Cuts and bruises, snags, punctures, and abrasions should be repaired before they can cause tire failure. Bent, cracked or loose rims should be repaired or replaced.

Check tire valve condition and make sure each valve has a cap.

Check the wheel retaining nuts for proper tightness. Wheel retaining nuts should be torqued to 450-500 ft.lbs.

TIRE PRESSURES

Always maintain the recommended tire inflation pressures in all tires.

When driving, some increase in tire pressures can be expected due to heat generated by friction. Overspeeds may also produce increased tire pressures. In such circumstances, NEVER BLEED THE TIRES. Instead slow down or stop until the tires cool.

Inflation pressure should be checked when tires are cool, using an accurate tire pressure gauge. Check pressures at regular intervals.

Bleeding the air from hot tires is dangerous and should not be attempted. While the pressure will be reduced, an increase in temperature of the tire will take place as soon as driving is resumed and tire failure will result.

TIRE DATA - 480-126	DUALS	SINGLES-FRONT
Tire Size	315/80R22.5	445/65R22.5
Ply Rating	L	L
Pressure (PSI)	130	120
Pressure (kPa)	900	830

UNDERINFLATION

Too little air pressure increases deflection, causes the tread to wipe and scuff over the road, results in extra strain on the tire, and increases the chances for bruising.

PROPER INFLATION

Maintaining the proper air pressure provides maximum road contact and results in increased tire life.

OVERINFLATION

Overinflation reduces tire deflection and tire contact area, causing the tire to ride on the crown, and results in rapid wear in the center of the tread.

SAFETY PRECAUTIONS FOR MOUNTING OR DEMOUNTING RIMS AND WHEELS

DO’S AND DON’TS

DO	DON'T
1. Deflate tires completely prior to demounting by removing the valve core.	1. Do not use loads or inflation pressures exceeding the manufacturer’s recommendations.
2. Replace bent, cracked,worn, corroded, or damaged parts.	2. Don’t re-inflate a tire that has been run flat or seriously underinflated without first demounting and inspecting the tire and rim assembly.
3. Inflate tires in a safety cage.	
4. Inspect wheel nuts periodically for excessive wear, corrosion, proper centering and nut torque.	

Tire and rim servicing can be dangerous and must be done only by trained personnel using proper tools and procedures. Failure to read and compy with all procedures may result in serious injury or death to you or others.

Re-inflation of any type of tire and rim assembly that has been operated in a run-flat or under inflated condition (80% or less of recommended operating pressure) can result in serious injury or death. The tire may be damaged on the inside and can explode while you are adding air. The rim parts may be worn, damaged or dislodged and can explosively separate.

The energy stored in a tire and rim assembly under pressure makes changing truck and off-road tires hazardous. Death or personal injury can occur while handling or maintaining these tires. Special procedures must be followed and special tools must be used if tires are to be changed safely. Whenever possible, let your service company handle this job. If you must change a tire, follow the step by step instructions detailed in a tire repair manual. Should low pressures make it necessary to add air, never stand beside the tire tread. Instead use a extension hose long enough to permit you to stand behind the tire tread. Always use a tire cage or equivalent protection when adding air.

Use of starting fluid, ether, or gasoline or any other flammable material to lubricate, seal or seat the beads of a tubeless tire can cause the tire to explode or can cause the explosive separtion of the tire/rim assembly resulting in serious injury or death. The use of any flammable material during tire servicing is absolutely prohibited.

Any inflated tire mounted on a rim contains explosive energy. The use of damaged, mismatched or improperly assembled tire/rim parts can cause the assembly to burst apart with explosive force. If you are struck by an exploding tire, rim part or the air blast, you can be seriously injured or killed.

Re-assembly and inflation of mismatched parts can result in serious injury or death. Just because parts come in together does not mean that they belong together. Check for proper matching of all rim parts before putting any parts together.

Mismatching tire and rim diameters is dangerous. A mismatched tire and rim assembly may explode and can result in serious injury or death. This warning applies to any combination of mismatched components, such as 18" and 18.5" tires. Never assemble a tire and rim unless you have positively identified and correctly matched the parts.

Hydraulic System Maintenance

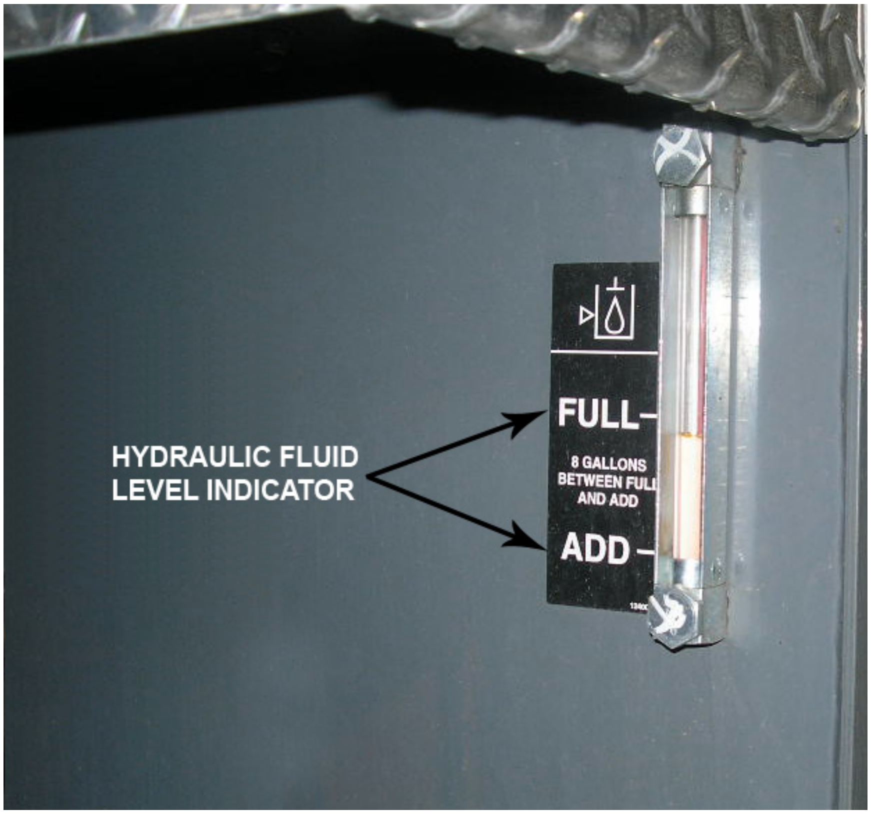
MAINTENANCE CHECKS

A regular program of periodic maintenance is an essential part of continued hydraulic system operation. Allowing accumulations of moisture and sediment to build-up in the system will damage hydraulic valves, pumps and motors. The presence of leaking connections or damaged components effect the efficiency of operation and are dangerous. The materials presented here are listed in accordance with the MAINTENANCE CHECK LIST. Consideration of severe working conditions may dictate a revision in scheduling periodic checks.

DAILY:

HYDRAULIC FLUID LEVEL

The hydraulic reservoir, fluid level indicator, and filler cap are on the right side of the machine.



MODEL	HYDRAULIC TANK CAPACITY
480-126	195 GAL. (738 Liters)

Retract all cylinders to return the maximum amount of oil to the reservoir and note the oil level in the indicator tube. The fluid level should be kept between the indicator marks. The top mark indicates system capacity with all cylinders retracted. Fluid capacity varies with each model as indicated above.

Do not overfill.

Refer to Section 4 for hydraulic oils meeting the manufacturer's specifications. Do not use oils which have detergent additives.

HYDRAULIC CYLINDERS

Check the cylinder mounting brackets, bushings, and pins for wear, alignment, tightness, and damage. If misalignment or excessive play or wear are detected, replace the defective pin or bushing. Check the rod eye welds for cracks and breaks and have damaged welds repaired.

HYDRAULIC COMPONENTS

Check the hydraulic valves, motors, pumps, hoses, tubes and connections for excess dirt, oil and grease. Clean these items if necessary and check for leaks and damage. Tighten leaky connections and repair any damaged components.

WEEKLY:

RETURN LINE FILTER

Change the hydraulic reservoir return line filters after the first 40 hours of the break-in period; thereafter, follow the quarterly check recommendation.

MONTHLY:

HYDRAULIC RESERVOIR

Drain any accumulated moisture from the hydraulic reservoir by parking the machine on a slight incline and loosen the pipe plug in the bottom of the reservoir.

HYDRAULIC OIL

Visually check the condition of the hydraulic oil once each month. Thickening of the oil or a change in its appearance, such as darkening, may serve as a rough indicator of when an oil change is needed. Periodic testing of the oil is the safest, most accurate method of determining the condition of the oil. An oil supplier can be consulted for assistance in testing the oil.

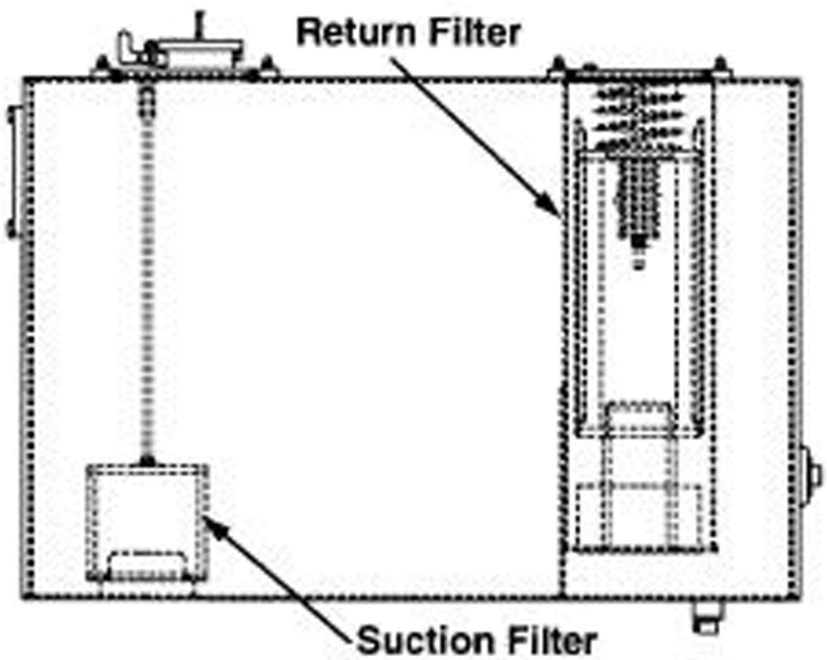
Change the oil whenever testing and/or inspection reveals the oil to be unsuitable for safe and efficient operation or yearly.

QUARTERLY:

HYDRAULIC FILTER

Remove and replace the hydraulic reservoir return line filters. Access is gained by removing the cover plate on the right-hand deck plate.

When replacing the filters, clean the spring and bypass valves. Inspect the “O” ring for damage and replace if necessary.



Before discarding the old filter element, examine the type of material trapped in it. This may indicate which, if any, hydraulic system components are deteriorating.

SEMI ANNUALLY:

SUCTION FILTER

Remove and clean the hydraulic reservoir intake suction filter. This permanent screen type filter is located inside the reservoir on the intake to the pump manifold. Access to the filter is accomplished by removing the cover with filler neck and filter holding device from the top of the reservoir.

Remove the “O” ring from the adapter and check it for damage or deterioration. If the ring is at all damaged, replace it.

Clean the filter by immersing it a non-caustic cleaning solvent. Rub the scree surface with a soft brush to dislodge accumulated foreign matter. Reinstall filter, filter hold-down device, and cover.

1000 HOURS:

HYDRAULIC RESERVOIR

Drain and clean the hydraulic reservoir. Change the hydraulic oil.

A change interval cannot be established which would apply to all oils and all operating conditions of temperature and cleanliness. However, a reputable brand of turbine grade oil can be expected to deliver 1000 hours of service under average operating conditions. Although conditions may necessitate shorter change intervals, do not use hydraulic oil for more than 1000 hours, unless oil analysis is used.

Whenever a visual inspection, chemical test or light test indicates that an oil change is necessary, proceed as follows:

1. Warm the oil prior to draining but avoid draining immediately after prolonged continuous use to reduce the danger of being burned by hot oil.

2. Retract all cylinders to return the maximum amount of oil to the reservoir. Loosen the top covers and remove the drain plug at the bottom of the reservoir. Allow sufficient time for the reservoir to drain thoroughly.

3. Remove the return filters, clean spring, and bypass valves and inspect cover “O” ring for damage and deterioration. Replace “O” ring if necessary.

4. Remove and clean the intake suction filter. This permanent screen-type filter is located inside the reservoir on the intake to the pump manifold. Access to this filter is gained by removing the cover with the filter holding device from the top of the reservoir. Remove the “O” ring from the filter and inspect the “O” ring for damage and deterioration. If it is damaged or deteriorated at all, replace the “O” ring. Clean the filter by immersing it in a non-caustic cleaning solvent. Rub the screen with a soft brush to dislodge accumulated foreign matter.


KEEP THE COVER PLATES ON THE RESERVOIR TO PREVENT ANY CONTAMINANTS FROM ENTERING.

5. Clean the reservoir by either steam cleaning or flushing with diesel fuel.

   If steam is used, steam clean the reservoir thoroughly and allow it to drain and dry completely.

   If diesel fuel is used to clean the reservoir, replace the drain plug and admit about ten gallons of fuel to the reservoir, preferably under pressure. Allow the fuel to remain in the reservoir long enough to thoroughly clean it. The suction filter may be conveniently cleaned at this time. Remove the drain plug, drain out the fuel and dry out the reservoir.

6. Replace the suction screen and reinstall the cover and filter hold down device.

7. Install a new return line filter. Reinstall the spring, bypass filter and cover.

8. Refill the system with new hydraulic oil as recommended in Section 4.

Hydraulic Hoses

The service life of a hose used on a mobile crane may significantly vary from the indicated lifetime of the hose from the manufacturer. The service life is influenced by a number of factors such as environment (temperature, humidity, corrosive air...) and use, duty cycles, bending cycles, abrasion, fluid etc. External unfavorable factors like heat, repeated bending under pressure etc. can reduce the lifetime significantly whereas other circumstances could allow a service life that may exceed a given period.

Inspection of Hydraulic Hoses

A daily visual check of the crane by the operator or a competent service person before starting the operation shall include an inspection of the hydraulic hoses as far as possible; any traces of hydraulic oil on the crane or beneath a parked mobile crane shall lead to further investigation. The daily check might indicate irregularities and / or leakages in the hydraulic system that should be taken care of immediately. In addition to these daily checks Load King recommends annual inspections of all hose assemblies as a minimum maintenance of the crane. Older cranes may require more frequent inspections.

Inspection Criteria:

Hydraulic hoses should be replaced if any of the following criteria are true:

● Damage on outside surface (cover) of the hose (e.g. crack, cuts, any abrasion that exposes the hose braid (reinforcement).

● Embrittlement due to ageing of outer surface (cracking appearing).

● Deformation that does not correspond to the original routing and shape of the hose. This criteria shall be checked in both non-pressurized and pressurized conditions and / or when bending (e.g. check for separation of hose layers, formation of blowholes, crushed points, kinks, torsioning).

● Leakage.

● Damage or deformation of hose fittings (sealing functionality affected).

● Movement between hose bulk and hose assembly (e.g. hose creeping out of fitting).

● Corrosion on fitting that can affect strength or function of the fitting.

Recommended Hydraulic Hose Maintenance & Replacement Schedule:

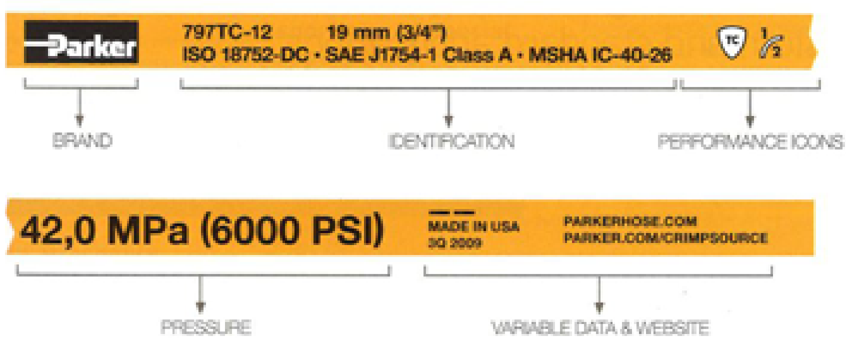
Task	Minimum Maintenance
Checking the hose lines	Annually
Recommended replacement of hose lines	Every 6 years

Recommendations for the replacement of hydraulic hose assemblies:

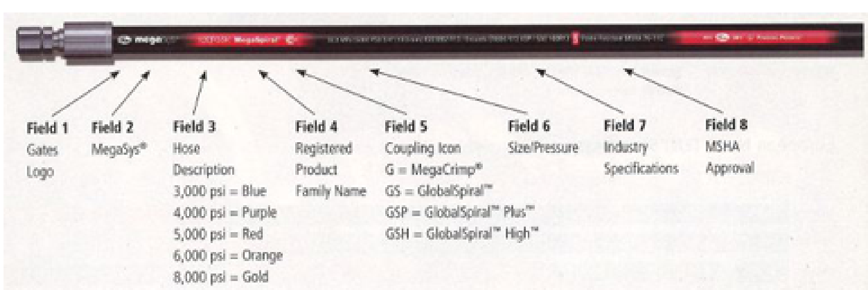
If replacement of hydraulic hose assemblies is required, it is recommended to use original spare parts from the OEM or hose assemblies according to the OEM specification which includes the fittings, bulk hose material and manufacturing process.

Hydraulic Hose Specification & Identification (examples):

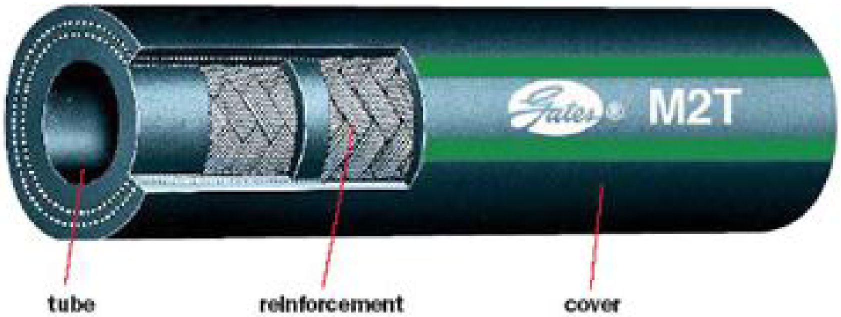
- Parker



- Gates



Typical Hydraulic hose contruction / layout:



WIre Rope and Reeving

MAINTENANCE All wire ropes in active service should be inspected DAILY along with spooling, sheaves, wedge sockets, and any other wire rope fittings for damage. Once WEEKLY a thorough wire rope inspection should be made by a competent inspector. A record should be kept of the inspections on the WIRE ROPE INSPECTION RECORD on page 135 found in Section 5 - Inspection.

Refer to ANSI Standard B30.5 for guidelines covering the inspection, maintenance, repair and replacement of wire rope. Worn, kinked, birdcaged, fatigued or otherwise damaged wire rope must be removed immediately. Wire rope, when properly installed, lubricated and employed, will give many hours of satisfactory use. Whereas, a new piece of wire rope can be immediately ruined if misused.

Replace or repair any items found to be in unsatisfactory condition.

In addition to damage such as kinking, crushing, and broken wires, factors such as corrosion, abrasion, pitting, peening, and scrubbing of outside wires, reduction of rope diameter, the condition of other components and proper lubrication are considered. Refer to CABLE LUBRICATION METHODS on page 284 found elsewhere in this section.

Before installing a new or replacement rope, make certain the rope to be used is the proper type and size. The wrong rope will not function properly and may even be dangerous.

THE USE OF NON-ROTATING 18 x 7 CLASS WIRE ROPE IS NOT RECOMMENDED IN MULTIPLE REEVING APPLICATIONS AND, IF USED FOR APPLICATIONS INVOLVING SINGLE PART LINE, MUST NOT BE USED WITH LOADS EXCEEDING ONE FIFTH (1/5) THE RATED BREAKING STRENGTH. The inner wires are generally the first to fail on this class of rope, making it very difficult to inspect, as broken wires cannot be seen. Refer to ANSI B30.5, Section 5.24 for the necessary inspection procedure and replacement criterion.

If non-rotating or spin resistant rope is used on this crane, the rope must be replaced if two or more wires are found broken in one lay of the rope.

CABLE REEVING When reeving the machine for any job, remember that hoisting and lowering speeds decrease as the number of parts of line increases. For the most efficient use of the machine, it is desirable to use the minimum number of required parts for lifting the anticipated loads.

This machine incorporates a "Quick Reeving" boom head and block which do not require removal of the wedge and socket from the rope in order to change the reeving. Removal of two pins in the boom head and three in the hook block will allow the wedge and socket to pass through.

NEVER USE LESS THAN THE NUMBER OF PARTS CALLED FOR BY THE LOAD RATING CHART. THE MINIMUM REQUIRED NUMBER OF PARTS IS DETERMINED BY REFERRING TO THE LOAD RATING CHART

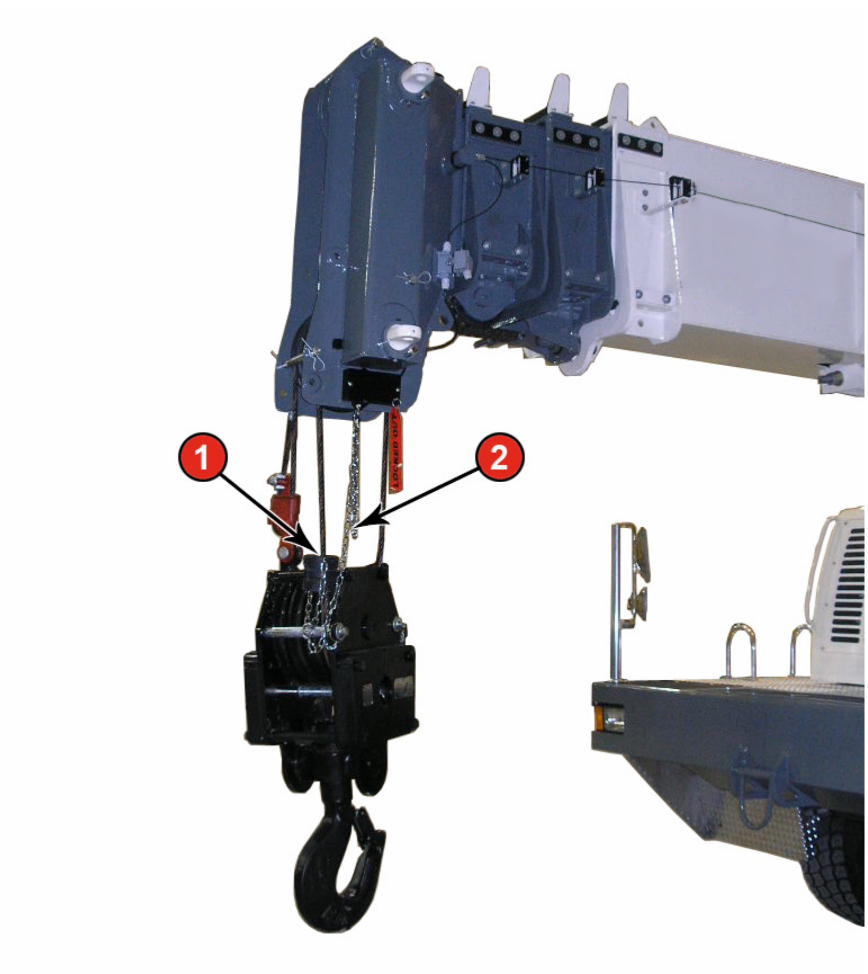
NOTE: IF A SOCKET IS CHANGED OR REPLACED, OR IF YOU ARE CHANGING HOOK BLOCK WEIGHTS; IT IS IMPORTANT TO USE THE CORRECT SOCKET

ATB System

MAINTENANCE

This crane is equipped with an ATB system for both main boom head and jib which sounds a horn (when in the "on" position) and lights a light when a two-blocking condition is imminent. It will also disengage the hydraulic functions. Verify that the two-blocking system is functioning properly by performing the following procedure.

Check ATB switch(es) and freedom of (item 2) chain-hung counterweight (item 1) as shown on main boom head in photo below or in similar application on jib. Check the plug and socket connection at boom head and on lib, if erected and reeved, for connection. The jib connector must be plugged into the boom head receptacle. Check system indication by manually lifting chain hung counterweight(s). A warning light should come on, horn in “on” position should sound, shut-off system should disconnect controls. Check entire length of cable and cable reel for evidence of damage. Check spring loaded cable reel. Ensure it has spring tension and is free to rotate. Check cab control unit.



1. With the engine ignition key in the "off" position, check that free action occurs on the boom lowering pedal, the boom telescope joystick- extended direction, and the winch joystick (S) - raising direction.

2. With the engine ignition key in the "on" position, check to be sure that these controls remain in the neutral position and provide a normal centering action.

NOTE: *This may require lowering the hook block away from the trip mechanism at the boom head to enable the "latching" of controls.*

⚠	INTERAXLE DIFFERENTIAL LOCK

No adjustments are possible. In the event of malfunction, check for air supply.

Steam Cleaning the Engine

The engine and engine compartment should be steam cleaned every 60,000 miles (100,000 km) or 2,000 hours, whichever comes first.

Cold Weather Package Recommendations & Specifications

The standard Load King cranes can operate in temperatures down to -25C (-12F).

Load King Cranes are designed to operate in cold weather conditions to a temperature of -40C (-40F). To operate in these extreme weather conditions, proper start up and recommended operating procedures must be followed.

For the operation and maintenance of your crane in cold weather, the information will cover from 0° C (32° F) to -40° C (-40° F).

Make sure you read and understand the information in the Cold Weather Package Requirements and Specifications for operations to -40°C (-40°F). If your crane does not have this package or components installed, use the information in this document as a guide to properly setup, operate and maintain your crane at these cold temperatures. Use of the fluids recommended and installation of the specific heaters can be ordered from your Load King Parts Department.

Install the correct lubricant in each area of the crane, engine, hydraulic tank, fuel, axles, bearings, bushings, winches, swing drives.

All batteries should be fully charged and electric blanket plugged in to correct voltage source.

Fill the fuel tank at the end of each shift.

Check the air cleaner and air intake daily. Keep any snow clear of the air intake.

When driving, your hydraulic steering gearbox can be slow to react to your steering wheel movement due to the low temperatures, even with the lower viscosity oils.

If the engine is started, run the engine until the engine reaches operating temperature. Achieving operating temperature will help prevent the intake valves and exhaust valves from sticking.

The cooling system and the lubrication system for the engine do not lose heat immediately upon shutdown. The transmission and the hydraulic system lose heat more rapidly because of the exposed areas. Gear cases cool rapidly, since the gear cases do not operate as warm as other components. Thus, the engine can be restarted after shutdown for a couple of hours but the other systems will require exercising (cycling) upon starting.

Fluid Recommendations

Before attempting to start the engine, make sure that the oil in the engine, the oil in the transmission and oil in the hydraulic system are fluid enough to flow. Check the oil by removing the dipstick. If the oil will drip from the dipstick, then the oil is fluid enough to start the engine. Do not use oil that has been diluted with kerosene. Kerosene will evaporate in the engine. This will cause the oil to thicken. Kerosene will cause swelling and softening of the silicone seals. Never mix oils in an attempt to thin them. Alway change the fluid in the complete system to one appropriate for the expected temperature.

If the viscosity of the oil is changed for colder weather, also change the filter element. If the filter is not changed, the filter element and the filter housing can become a solid mass.

Drain all hydraulic cylinders and lines. After you change the oil per recommendations, operate the equipment in order to circulate the thinner oil.

The number of acceptable lubricants is limited in arctic conditions and deviations of these lubricants must be approved by Load King Service Department.

Starting Recommendations

Check the air cleaner daily before starting the machine. If you operate the machine in heavy snow, attach a burlap sack loosely to the pre-cleaner. Keep the burlap sack away from heated parts.

In order to assist in warm-up, block the radiator. Blocking the radiator will restrict air from the fan.

Before entering the operators cab, inspect the condition of the following parts: hydraulic hoses, tires, and fan drive belts. Inspect for cuts, cracks and worn spots and connections. Running the engine at idle will keep the engine compartment warm. The compartment for the transmission will also be kept warm. However, running the engine will not keep the hydraulic system warm.

The outer wrapper on hydraulic hoses can crack when flexing occurs at cold temperatures. This does not mean the hoses have failed. The hoses will still carry oil under pressure.

Check the machine in order to be sure that the voltage of the battery heater blanket, engine coolant heater and engine block heater matches the power source.

To avoid valve damage, always run the engine until the coolant temperature is at least 82°C (180°F).

After the engine is warm, proceed with warming up the other systems. Start with the hydraulics. Run the engine at less than 1/3 throttle, and slowly move the boom hoist joystick control to lift the attachment in sequence of raising, lowering, extending and retracting the boom. Extend the travel of the cylinders during each cycle. Perform this operation for all hydraulic circuits such as winch raise/lower, swing left/right, outrigger raise/lower jack cylinders, beams extend/retract.

Release the brake. Move the crane forward and backward for several meters (feet). Continue this method for several minutes.

Only operate the crane under light loads until the systems reach normal operating temperatures.

Block the radiator to decrease the warm up time of the engine and compartment area . If temperatures are extremely cold, use a canvas over the engine compartment and a space heater. This will aid in starting the engine. Use of a canvas over the hydraulic components will improve initial warming of the components.

Parking Recommendations

Always park the crane in the proper area. Park the machine on wooden planks. The planks will keep the tires from freezing to the ground.

Battery Recommendations

The temperature of the batteries affects the battery's cranking power. When the battery is too cold, the battery will not crank the engine, even though the engine is warm. Batteries may be stored in a warm environment or use of the "Battery Blanket" is recommended. Keeping the battery warm by use of the "Battery Blanket", as specified in the Cold Start Options of the Parts Manual which will maintain the battery's cranking power. Contact Load King Parts & Service Dept. for the Battery Heater (120V or 240V) options: 720 0429 or T114004.

NOTE: *Make sure your battery blanket voltage matches your source voltage.*

Whenever an engine is being stored in cold weather, use a battery charger to keep the batteries charged. A full charge prevents the batteries from freezing.

Be sure to keep your batteries charged to a correct specific gravity of 1.250 or above.

Tire Inflation Recommendations

Make sure your tires that are inflated to the correct pressures for the cold temperatures. If tires are below the recommended pressure they will have a shortened life. A tire that is inflated to the correct pressure in a 18°C to 21° C (64°F to 70°F) shop area will have a lower tire pressure in freezing conditions.

Load King recommends the use of dry nitrogen gas to inflate the tires for cold conditions. When nitrogen gas (N2) is used, there will not be a build up of ice crystals around valve stem which could hold the valve open.

Tire inflation should be done in a heated shop area. The tire bead will seat better when the tire bead is warm. The initial tire pressure should be 15% to 20% higher than the operating pressure in order to seat the bead against the rim. Deflate the tires to operating pressure before operating the crane. The contact surface of the tires will become flat in cold weather when a machine is parked. To return the tire to a normal shape, move the machine gradually.

Inflation Adjustments Needed to Compensate for Lower Outside Temperatures

Desired Cold Inflation Pressure (psi)	Difference Between Shop and Outside Temperature (°F)								
	30	40	50	60	70	80	90	100	110
30	33	34	35	36	37	38	39	41	42
35	38	39	40	41	43	44	45	47	48
40	43	45	46	47	48	50	51	53	55
45	49	50	51	53	54	56	57	59	61
50	54	55	57	58	60	62	63	65	67
55	59	61	62	64	66	68	69	71	73
60	65	66	68	70	72	73	75	78	80
65	70	72	73	75	77	79	82	84	86

Desired Cold Inflation Pressure (psi)	Difference Between Shop and Outside Temperature (°F)								
	30	40	50	60	70	80	90	100	110
70	75	77	79	81	83	85	88	90	92
75	80	82	84	87	89	91	94	96	99
80	86	88	90	92	95	97	100	102	105
85	91	93	96	98	100	103	106	108	111
90	96	99	101	104	106	109	112	115	116
95	102	104	107	109	112	115	118	121	124
100	107	109	112	115	118	121	124	127	130
105	112	115	118	120	123	127	130	133	137
110	118	120	123	126	129	132	136	139	143

DD13 - GHG14 Cold Weather Starting

At ambient temperatures below -10° C (14° F), SAE 5W-30, 5W-40, or 10W-40 oils may be used, provided they are API CJ-4 and have demonstrated field performance in Detroit™ engines. These oils must possess a High Temperature / High Shear Viscosity of 3.7 cP minimum.

The oils must be API CJ-4 and have demonstrated field performance in Detroit™ engines. Detroit™ will allow CI-4 Plus oil having sulfated ash levels of 1.4% or less.

Use of Synthetic Oils

Synthetic oils may be used in Detroit™ engines, provided they are API licensed and meet the performance and chemical requirements of non-synthetic oils as indicated in engine owners manual. Synthetic oils offer improved low-temperature flow properties, high-temperature oxidation resistance, and improved fuel mileage. However, they are generally more costly than non-synthetic oils.

Use of Supplemental Additives

Lubricants meeting the Detroit™ specifications outlined in this publication already contain a balanced additive treatment. Supplemental additives are generally not necessary and can even be harmful. These additives may be marketed as either oil treatments or engine treatments and are discouraged from use in Detroit™ engines.

Engine damage resulting from the use of such materials is not covered by your Detroit™ warranty. Detroit™ will not provide statements beyond this publication relative to their use.

Refer to the DDC-SVC-MAN-0075 Operator's Manual located on your SHOP-CD.

DEF - Low Outside Temperatures

DEF freezes at a temperature of approximately -11° C. Winter operation is also insured for temperatures below -11° C. At low temperatures, DEF crystals may form on the coiled hose between the engine and the muffler. This crystallization does not pose a risk to the correct operation of the exhaust gas aftertreatment. The DEF crystals can be removed with clean water if necessary.

OM460 Mercedes-Benz Cold Weather Recommended Oils

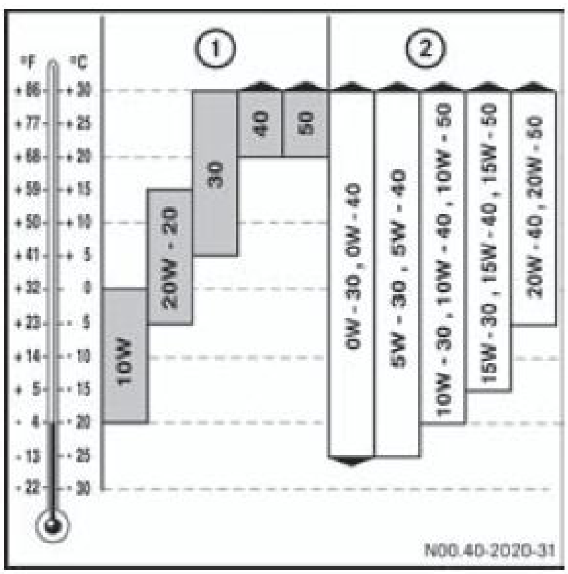
Change Oil

Change the engine oil at the beginning of the cold weather season. Use only an approved engine oil in the specified SAE classification.

If the SAE class (viscosity) of the engine oil used is not suitable for continually low outside temperatures below -20° C, this could cause engine damage.

The specified temperatures of the SAE clas always refer to freshly added oil. Engine oil ages during driving due to soot and fuel residue. The impairs the characteristics of the engine oil, particularly at low outside temperatures.

Mercedes-Benz strongly recommends that, at outside temperature below -20° C, you use engine oils of SAE class 5W-30.



Engine Oil SAE Classes (viscosity) 1 - Single-grade engine oils, 2 - Multi-grade engine oils

► Select the SAE class of engine oil in accordance with the outside temperatures.

DEF - Low Outside Temperatures

DEF freezes at a temperature of approximately -11° C. Winter operation is also insured for temperatures below -11° C. At low temperatures, DEF crystals may form on the coiled hose between the engine and the muffler. This crystallization does not pose a risk to the correct operation of the exhaust gas aftertreatment. The DEF crystals can be removed with clean water if necessary.

Troubleshooting - Engine Problems

Engine Does Not Start

The fuel is not resistant to the cold.

► Replace the fuel prefilter (see page 64 of Mercedes OM460 Operations Manual on your SHOP-CD.)

► Replace the fuel filter (see page 65 of Mercedes OM460 Operations Manual on your SHOP-CD.)

► Use winter fuel (see page 49 of Mercedes OM460 Operations Manual on your SHOP-CD.)

► Engine oil viscosity is incorrect. Alter the engine oil viscosity to the conditions of use (see page 45 of Mercedes OM460 Operations Manual on your SHOP-CD.)

Diesel Fuels at Low Temperatures

At low outside temperatures, paraffin separation may cause the flow properties of the diesel fuel to be insufficient.

To prevent operating problems, diesel fuel with improved flow properties is available in the winter months.

Winter diesel fuels are reliable down to outside temperatures of -22° C. You can normally use winter diesel fuel without problems at the outside temperatures expected in the country where it is on sale.

Fuel Additives

Fuel additives used to improve flow characteristics are flow improvers.

Do not add flow improvers to winter diesel fuel guaranteed to operate down to -22° C. The cold flow properties of the fuel may deteriorate as a consequence of the flow improver.

If summer diesel fuel or winter diesel fuel with less resistance to low temperatures is in use, add a quantity of flow improver, depending on the outside temperatures.

Add the fuel additive to the diesel fuel in good time, before paraffin separation causes the diesel fuel's flow properties to be insufficient. Malfunctions as a result of paraffin separation can only be rectified by heating up the complete fuel system.

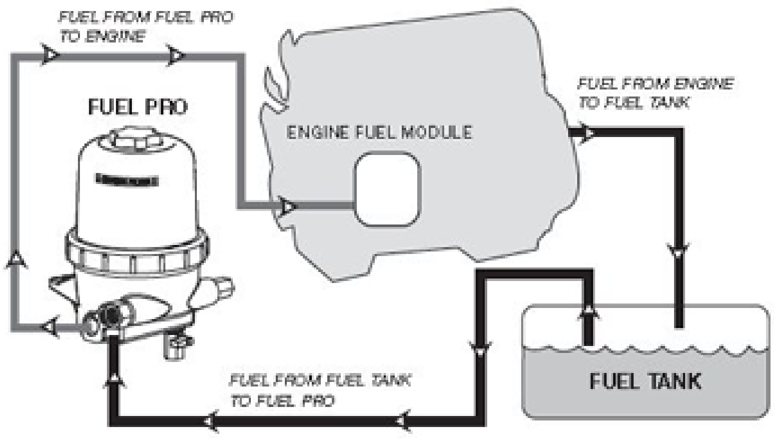
For lower temperatures, the engine can be equipped with a fuel preheating system. This improves the flow characteristics of the diesel fuel according to the output of the installed heater.

Fuel Filtration

DD13 - GHG14 Engine

Detroit Diesel™ recommends an extra fuel filtration in cold weather operation. This will protect the fuel system, especially the injectors. Detroit Diesel™ recommends and approve the Davco Fuel Pro 482. This filter has a 300 mbar bypass valve to protect the engine high pressure pump from damage from fuel starvation. The Davco is available in 12 VDC or 120 VAC.

Fuel System Diagram



Engine Oil Immersion Heater & Block Heater

DD13 - GHG14 Engine

Detroit Diesel™ recommends Oil Immersion Heater Phillips & Temro Part No. 3500049 (450 watt-120V with M27 threads). This installation requires the non-standard oil pan with the M27 port.

Mercedes-Benz OM460 Engine

Load King Cranes has option available to customer for a 240V block heater.

Additionally, the following Cold Weather Package must be installed as listed in chart below:

Fluids and lubricants must be compatible with the expected temperature environment. Refer to chart of recommended fluids for expected temperatures. Hydraulic and transmission systems must be drained and purged of old fluids to allow the maximum exchange for new fluids. Other fluids/lubricants can be exchanged by draining old fluids/refilling with recommended fluids or by applying recommended greases. Use of improper fluids for ambient conditions can damage equipment.

COLD WEATHER PACKAGE COMPONENTS

Description	SPEC NO.	Load King Part No.
Main & Aux. Winch, Swing Drive	Mobil Gear SHC 150 or Shell OMALA HD 150	T117493
Hydraulic Oil-see data sheet	Petro-Canada Hydrex Extreme or Shell Tellus Arctic 32	T117487

Description	SPEC NO.	Load King Part No.
Engine Oil	Consult Detroit Diesel™ or Mercedes-Benz Operator's Manuals located on the SHOP-CD	Consult Detroit Diesel™ or Mercedes-Benz Operator's Manuals located on the SHOP-CD
Gear Oil-Front & Rear Axles	75W90 Full Synthetic	12013-42
Transmission Fluid	CD-50 (gearbox portion)	NA Contact Eaton Corporation Dealer for cold weather options to listed lubricants. See publication TCMT0020.
Coolant Fluid	Northland Pre-mix or equivalent factory installed. Consult Detroit Diesel™ or Mercedes-Benz Operator's Manuals located on the SHOP-CD for other recommendations.	12013-40
Grease	Mobilith SHC 220 or equivalent	T117494
Battery Heater Blankets	120V 240V	720 0429 T114004
Engine Oil Pan Heater	See Parts Manual-Cold Start Options section.	Contact your local Detroit Diesel™ dealer
Engine Coolant Block Heater	See Parts Manual-Cold Start Options section.	See Parts Manual
Hydraulic Tank Heater	120V or 240V	A38556

NOTE: *It is the responsibility of the customer to use the correct mixture and type of diesel fuel for the environment. Failure to do so can result in clogged fuel filter due to waxing and icing formation.*

Axles

In the case of vehicles being started in ambient temperatures below +5°F (-15°C), vehicle warm-up procedures are required or damage can result to transmission, axles or drive line components.

Your Load King Crane with Cold Weather Package is equipped with full synthetic 75W/90 Gear Oil. (See chart below).

Gear Oil Specifications

Gear Oil Type		A.P.I Spec.	SAE Grade	Military/SAE Spec.	Outside Temp.
Non-Extended Drain Lubricants	Petroleum with EP Additives	GL-5	85W/140	MIL-PRF-2105 E and SAE J2360	> +10°F (-12°C)
			80W/140		> -15°F (-26°C)
			80W/90		> -15°F (-26°C)
			75W/90		> -40°F (-40°C)
			75W		> -40°F (-40°C) to +35°F (+2°C)
			75W/140		> -40°F (-40°C)
Extended Drain Lubricants	Petroleum with Extended Drain Additives	GL-5	80W/90	MIL-PRF-2105 E and SAE J2360	> -15°F (-26°C)
	Semi-Synthetic		80W/90		> -15°F (-26°C)
	Full Synthetic		75W/140		> -40°F (-40°C)
	Full Synthetic		75W/90		> -40°F (-40°C)

MicroGuard VGA Display

The MicroGuard VGA Display, containing a built-in heater for electronics and is rated to -40°F (-40°C), is standard equipment. It is recommended that the operator warms up the cab prior to turning “on” the VGA display.

Power -Up Self Test

Immediately following electrical power-up, the system executes a self-test which lasts for three seconds. During this time, the numerical display segments and bar graph segments are all turned on, the audible alarm will sound and alarm indicator lights are illuminated. The home display shows the machine model and rating chart number.

Additional Cold Weather Operation Issues

Contact your Load King Service Representative / authorized Detroit Diesel™ Engine Service Representative / authorized Mercedes-Benz Center or MTU Service Center if you have any questions regarding extreme environment operation or service of your crane.

Storage

Machine Storage

Machines being placed in storage must be adequately protected from deterioration during the period of idleness. This will ensure that they can be restored to active service with a minimum effort.

Before removing this hydraulic crane from service for extended periods, it should be prepared for storage as prescribed in the following paragraphs. In general, three (3) major components must undergo preparation. These are the Machine Proper, the Engine and the Transmission. The specific procedure to be followed depends upon the expected period of storage.

SHORT TERM STORAGE - 30 DAYS OR LESS

Short term storage requires minimal preparation.

The MACHINE should be thoroughly cleaned, lubricated in accordance with Section 4, and painted surfaces retouched where the paint has deteriorated. exposed portions of all hydraulic cylinders should be coated with multipurpose grease. Coat unpainted metal surfaces with multipurpose grease after removing any rust accumulations.

The ENGINE should be prepared as prescribed in the topic “Engine Storage”.

The TRANSMISSION should be prepared as prescribed in the topic “Transmission Storage”.

LONG TERM STORAGE - 30 DAYS OR MORE

Long term storage requires greater preparation than short term storage and must be undertaken with greater care.

The MACHINE should be prepared as follows:

1. Perform the short term machine storage preparation, making certain that All points with grease fittings are liberally lubricated.
2. Drain and refill the swing reducer, winch(es), axle differentials, planetary hubs and the hydraulic reservoir. Refer to page 4-19 when servicing the reservoir.
3. Distribute the new hydraulic fluid to all parts of the system by operating all functions.
4. Clean and tape the battery cables after removing and storing the battery.
5. Coat the external ring gear of the swing bearing with MPG grease.
6. Fill the hydraulic reservoir to the top AFTER THE MACHINE IS PARKED IN ITS STORAGE SPOT.

7. Coat wire rope with lubricant.
8. Coat exposed cylinder rods with"CRC SP-400 Corrosion Inhibitor". This can be removed with "CRC HD Degreaser".

The ENGINE should be prepared as prescribed in the topic “Engine Storage”.

The TRANSMISSION should be prepared as prescribed in the topic “Transmission Storage.”

Engine Storage

PREPARING ENGINE FOR STORAGE

When an engine is to be stored or removed from operation for a period of time, special precautions should be taken to protect the interior and exterior of the engine, transmission, and other parts from rust accumulation and corrosion. The parts requiring attention and the recommended preparations are given below.

It will be necessary to remove all rust or corrosion completely from any exposed part before applying a rust preventive compound. Therefore, it is recommended that the engine be processed for storage as soon as possible after removal from operation.

The crane should be stored in a building which is dry and can be heated during the winter months. Moisture absorbing chemicals are available commercially for use when excessive dampness prevails in the storage area.

TEMPORARY STORAGE (30 DAYS OR LESS)

To protect an engine for a temporary period of time proceed as follows:

1. Drain the engine crankcase.
2. Fill the crankcase to the proper level with the recommended viscosity and grade of oil.
3. Fill the fuel tank with the recommended grade of fuel oil. Operate the engine for two minutes at 1200 rpm and no load.

   NOTE: *Do not drain the fuel system or the crankcase after this run.*
4. Check the air cleaner and service it, if necessary as outlined under Air System.
5. If freezing weather is expected during the storage period, add a high boiling point type antifreeze solution in accordance with the manufacturer's recommendations.
6. Clean the entire exterior of the engine (except the electrical system) with fuel oil and dry it with air.
7. Seal all of the engine openings. The material used for this purpose must be waterproof, vaporproof and possess sufficient physical stength to resist puncture and damage fro m the expansion of entrapped air.

An engine prepared in this manner can be returned to service in a short time by removing the seals at the engine openings, checking the engine coolant, fuel oil, lubricating oil, transmission, and priming the raw water pump, if used.

EXTENDED STORAGE (30 DAYS OR MORE)

When An Engine Is To Be Removed From Operation For An Extended Period Of Time,prepare It as follows:

1. Drain and thoroughly flush the cooling system with clean, soft water
2. Refill the cooling system with clean, soft water.
3. Add a rust inhibitor to the cooling system (refer to Corrsion Inhibitor).
4. Diesel Exhaust Fluid (DEF) or Urea has a limited shelf life. Long term storage in vehicle in excess of 6 months is not recommended. Replace fluid if exceeding this time frame.
5. Remove, check and reconditon the injectors, if necessary, to make sure they will be ready to operate when the engine is restored to service.
6. Reinstall the injectors in the engine, time them, and adjust the valve clearance.
7. Circulate the coolant through the entire system by operating the engine until normal operating temperature is reached (160°F. to 185°F).
8. Stop the engine.
9. Remove the drain plug and completely drain the engine crankcase. Reinstall and tighten the drain plug. Install new lubricating oil filter elements and gaskets.
10. Fill the crankcase to the proper level with a 30-weight preservative lubricating oil MIL-L- 21260, Grade 2 (P10), or equivalent.
11. Drain the engine fuel tank.
12. Refill the fuel tank with enough rust preventive fuel oil such as Americal Oil Diesel Run-In Fuel (LH 4089), Mobil 4Y17, or equivalent, to enable the engine to operate 10 minutes.
13. Drain the fuel filter and strainer. Remove the retaining bolts, shells and elements. Discard the used elements and gaskets. Wash the shells in clean fuel oil and insert new elements. Fill the cavity between the element and shell about two thirds full of the same rust preventive compound as used in the fuel tank and reinstall the shell.
14. Operate the engine for 5 minutes to circulate the rust preventive throughout the engine.
15. Refer to page 4-6 and service the air cleaner.

16. With an all-purpose grease such as Shell Alvania No. 2, or equivalent, lubricate the clutch throwout bearing, clutch pilot bearing, drive shaft main bearing, clutch release shaft, and the outboard bearings (if so equipped).

17. Remove the inspection hole cover on the clutch housing and lubricate the clutch release lever and link pins with a hand oiler. Avoid getting oil on the clutch facing.

18. Apply a non-friction rust preventive compound, to all exposed parts. If it is convenient, apply the rust preventive compound to the engine flywheel. If not, disengage the clutch mechanism to prevent the clutch disc from sticking to the flywheel.

Apply a non-friction rust preventive compound, to all exposed parts. If it is convenient, apply the rust preventive compound to the engine flywheel. If not, disengage the clutch mechanism to prevent the clutch disc from sticking to the flywheel.

19. Drain the engine cooling system (tag cap).

20. The oil may be drained from the engine crankcase if so desired. If the oil is drained, reinstall and tighten the drain plug (tag cap).

21. Remove and clean the battery and battery cables with a baking soda solution and rinse them with fresh water. Store the battery in a cool (never below 32°F.) dry place. Keep the battery fully charged .

22. Insert heavy paper strips between the pulleys and belts to prevent sticking.

23. Seal all of the openings in the engine, including the exhaust outlet, with moisture resistant tape. Use cardboard, plywood or metal covers where practical.

24. Clean and dry the exterior painted surfaces of the engine. Spray the surfaces with a suitable liquid automobile body wax, a synthetic resin varnish or a rust preventive compound.

25. Cover the engine with a good weather-resistant tarpaulin or other cover if it must be stored outdoors. A clear plastic cover is recommended for indoor storage.

The stored engine should be inspected periodically. If there are any indications of rust or corrosion, corrective steps must be taken to prevent damage to the engine parts. Perform a complete inspection at the end of one year and apply additional treatment as required.

Transmission Storage

PRESERVATIVE SELECTION

When transmissions are to be stored or remain inactive for extended periods of time, specific preservative methods are recommended to prevent rust and corrosion damage. The length of storage will usually determine the preservative method to be used. Various methods are described below.

STORAGE, 30 DAYS TO 1 YEAR - WITHOUT OIL

1. Drain Oil.
2. Seal all openings and breathers, except oil drain hole, with moisture-proof cover or tape.
3. Coat all exposed, unpainted surfaces with Nox Rust X-110.
4. Atomize or spray 4 ounces of Nox Rust VCI No. 10 oil, or equivalent, into the transmission through the oil drain hole. Install the drain plug.
5. If additional storage time is required, (3) and (4) above should be repeated at yearly intervals.

*Nox Rust is a preservative additive manufactured by the Daubert Chemical Company, Chicago, Illinois. Motorstor is covered by US Military Specifications MIL-L-46002 (ORD) and MIL-1-23310 (WEP).

Restoration to Service

Refer to “Restoring Engine to Service”, and “Restoring Transmission to Service”, for the procedures required to restore these components to service.

Remove the MACHINE from storage via the following procedure:

1. Remove preservative lubricants from all surfaces.
2. Check all fluid levels, adding or draining as required.
3. Lubricate the machine according to Section 9, making certain that all points with grease fittings are lubricated.
4. Make a thorough visual inspection of the entire machine, placing special emphasis on the condition of all hydraulic hoses.

Restoring Engine to Service

1. Remove the valve rocker cover(s) and pour at least one-half gallon of oil, of the same grade as used in the crankcase, over the rocker arms and push rods.
2. Reinstall the valve rocker cover(s).
3. Remove the covers and tape from all of the openings of the engine, fuel tank, and electrical equipment. Do not overlook the exhaust outlet.
4. Wash the exterior of the engine with fuel oil to remove the rust preventive.
5. Remove the rust preventive from the flywheel.
6. Remove the paper strips from between the pulleys and the belts.
7. Check the crankcase oil level. Fill the crankcase to the proper level with the heavy-duty lubricating oil recommended under Lubricating Oil Specifications.
8. Fill the fuel tank with the fuel specified under Diesel Fuel Oil Specifications.
9. Close all of the drain cocks and fill the engine cooling system with clean soft water and a rust inhibitor. If the engine is to be exposed to freezing temperatures, add a high boiling point type antifreeze solution to the cooling system (the antifreeze contains a rust inhibitor).
10. Install and connect the battery.
11. Service the air cleaner as outlined under Air System.
12. Prepare the generator for starting.
13. Remove the inspection hole cover and inspect the clutch release lever and link pins and the bearing ends of the clutch reliease shaft. Apply engine oil sparingly, if necessary to these areas.
14. After all of the preparations have been completed, start the engine. The small amount of rust preventive compound which remains in the fuel system will cause a smoky exhaust for a few minutes.

NOTE: *Before subjecting the engine to a load or high speed, it is advisable to check the engine tune-up.*

Restoring Transmission to Service

1. If Nox Rust, or equivalent, was used in preparing the transmission for storage, use the following procedures to restore the unit to service.
2. Remove the tape from openings and breather.
3. Wash off all the external grease with solvent.
4. Add hydraulic transmission fluid, per chart below to proper level.
5. If Nox Rust or equivalent, was not used in preparing the transmission for storage, use the following procedures to restore the unit to service.
6. Remove the tape from openings and breathers.
7. Wash off all the external grease with solvent.
8. Drain oil.
9. Install a new oil filter element(s).
10. Refill transmission with hydraulic transmission fluid.

Refer to Transmission Service section of manual.

Chrome Cylinder Rod Storage

Hard chrome plating is primarily applied to steel cylinder rods for its wear resistant properties, although it does provide considerable corrosion resistance as well. Once the chrome-plated rod is assembled into a cylinder and put into service, the hydraulic fluid on the surface of the rod provides all the corrosion resistance required for the rod during its life cycle. As a cylinder cycles, hydraulic fluid is driven into any surface cracks that exist in the chrome plate. When these cracks are filled with hydraulic fluid, moisture or corrosive fluids can not penetrate the cracks. However, some machining and cleaning operations can negatively impact the future corrosion resistance of chrome-plated shafting. For example, additives such as chlorine, sulfur, and sodium found in Extreme Pressure (EP) coolants and some washing solutions are known rust accelerates and can strip chrome plating from the base metal. Cleaning processes, such as phosphate washing are also known to be detrimental to the corrosion resistance of hard chrome plated shafting.

If the rod is not periodically cycled and is subject to a corrosive environment, moisture and oxygen can work its way down through the chrome layer and begin to corrode the base metal. Brand new equipment may be stored outside for a considerable period of time at the equipment dealership before it is sold. During these times, a protective barrier must be applied to the exposed cylinder rod. This protective barrier will preserve the integrity of the chrome plating by preventing the elements of corrosion from getting to the metal substrate.

Cylinders should be stored in the retracted position, if at all possible. The steps outline below cover the procedures to be followed for protecting New Equipment from corrosion if it must be stored in the extended position:

1. Position the equipment as it will be stored and identify all the exposed portions of the chrome plated cylinder rods.
2. Clean any dirt and dust from the exposed portions of the cylinder rods using a dry cloth or a cloth which has been dampened with an appropriate solvent. Do not use caustics or acids.
3. Apply a thin coating of “CRC SP-400 Corrosion Inhibitor” to the exposed surfaces of the chrome plated cylinder rods. This can be removed with "CRC HD Degreaser".
4. Inspect the cylinder rod surfaces and reapply at three to six month intervals.
5. If the equipment is to be moved and then stored again for an extended period of time or if the cylinder is cycled, steps 1 thru 4 should be repeated for all cylinder rods that were exposed.

For the protection of Older Equipment that is to be stored, the procedure outlined above can be used, but greater attention to cleaning the exposed portions of each cylinder rod is required. Solvent applied with plastic or copper wool can be used, but abrasives such as sandpaper should never be used to clean the exposed surfaces of the cylinder rod. If surface damage to the chrome plate is discovered, the frequency of corrosion barrier applications should be increased.

NOTE: *Caution must be used when cleaning equipment in service with high pressure washes. Soaps or chemicals containing chlorines or other corrosive elements should be avoided. Cylinders should be cleaned in a retracted position as not to expose rods to the chemicals. Cylinders should be cycled immediately following the wash. If rods are to be stored in the extended position, refer to steps 1-4 above.*

Wire Rope Specifications-480-126

Main Winch-480-126

STD.-3/4” dia.

MINIMUM BREAKING STRENGTH-25.6 TONS OPT.- 3/4” ROTATION RESISTANT

MINIMUM BREAKING STRENGTH 34.51 TONS

Auxilary Winch-480-126

STD.-3/4” dia.

MINIMUM BREAKING STRENGTH-25.6 TONS

OPT.- 3/4” ROTATION RESISTANT

MINIMUM BREAKING STRENGTH 34.5 TONS

Introduction

A regular program of periodic preventive maintenance is essential to prolong crane operating life, maximize efficient service and minimize downtime. This section details a series of checks and procedures which are to be performed at daily, weekly, monthly and semi annual intervals. These intervals are stated both in terms of calendar periods and hours of operation.

The checks prescribed for longer intervals include all the checks required for the shorter intervals. Thus, the weekly check includes all items in the daily check, the monthly check includes weekly and daily checks, and so on through the semi-annual check, which includes the quarterly, monthly, weekly and daily checks.

A convenient check chart provides a means of recording preventive maintenance performed and serves as a tool detecting problem areas and reanalyzing maintenance requirements. The items in each check interval on the check chart are grouped under their respective headings and covered in detail over the course of Section 6.

This maintenance schedule is a guide which ensures that basic preventive maintenance requirements will be met under average operating conditions. Conditions which impose greater wear, loads or strain on the crane may dictate reduced check intervals. Before altering the maintenance schedule, reevaluate crane operation and review the crane maintenance records. Consider all factors involved and develop a revised schedule adequate to meet routine maintenance requirements.

As a part of each periodic check, refer to the engine manufacturer's manual for engine maintenance requirements. When servicing the engine, the engine manufacturer's recommendations take precedence over those in this manual, should any discrepancy be noted.

OPERATOR OBSERVATION

As the operator, it is your responsibility to observe and report any unusual sounds, odors, or other signs of abnormal performance that could indicate trouble ahead. On a routine basis the following items should be checked before starting or while operating the crane.

Visual Inspection - Check complete machine for any unusual condition.

Check for any leaks or damage to the hydraulic system.

Check in the engine compartment:

- Belts for tension and wear
- Coolant level
- Oil level
- Transmission oil level
- Air cleaner sight gauge
- Air intake

- Muffler and exhaust

Check battery box - For battery condition

Crane boom - Check for:

- Hook block for wear or damage
- Two block system for proper function
- Cable and cable spooling on winch
- Cylinder pin connections for wear

Check tires, axles, and drive lines, for wear or damage.

Check in the cab for:

- Instruments functioning properly
- Control operation
- Glass for good visibility
- Safety equipment is ready for use
- All lights work properly
- Cleanliness - Free from mud and debris.

General Procedure

1. KNOW THE SYSTEM Study this manual and learn what makes the machine "tick", how it should behave, sound and smell.
2. OPERATE THE MACHINE Test operate all machine functions. Note all abnormal sounds, odors and movements. Always proceed in the most logical order to determine the cause.
3. INSPECT THE MACHINE Look for leaks, listen for the source of abnormal sounds, detect the origin of unusual odors. Check the condition of the oil and filters.
4. LIST THE POSSIBLE CAUSES Use your best judgment in listing all possible causes of the failure.
5. REACH A CONCLUSION Review your list of possible causes and decide which are the most likely to cause the failure. Consider the most obvious first.
6. TEST YOUR CONCLUSION Test your conclusions, in order of obviousness, until the source of the failure is found. The machine can then be repaired at minimal cost and downtime. Make the repair. Recheck to ensure that nothing has been overlooked, functionally test the repaired part in the system.
7. REVIEW MAINTENANCE PROCEDURES Prevent recurrences of all premature failures by regularly checking the filters, temperature, adjustments and lubrication. Make daily inspections.

NOTE: *Your safety and that of others is always the number one consideration when working around cranes. Safety is a matter of thoroughly understanding the job to be done and the application of good common sense. It is not just a matter of "do's" and "don'ts". Stay clear of all moving parts.*

Hydraulics - General

Before any troubleshooting is attempted, become fully acquainted with the following two (2) basic fundamental facts of a hydraulic system:

1. SPEED The speed of a hydraulic function is directly related to the system flow. A reduction in speed of a cylinder or motor is caused by an insufficient quantity of oil being delivered to the component.
2. POWER The power or force of a hydraulic function is related to pressure.

If an understanding of the differences between speed and power of a hydraulic system is understood correctly, then accurate troubleshooting can be accomplished in a minimum amount of time.

NEVER resort to increasing the valve relief pressure in an attempt to cure the ills of the system. Fully diagnose the problem.

Hydraulic components are precision units and their continued smooth operation depends on proper care. Therefore, do not neglect hydraulic systems. Keep them clean and change the oil and oil filter at established intervals.

If, in spite of these precautions, improper operation does occur, the cause can generally be traced to one of the following:

1. Use of the wrong viscosity or type of oil.
2. Insufficient fluid in the system.
3. Presence of air in the system.
4. Mechanical damage or structural failure.
5. Internal or external leakage.
6. Dirt, decomposed packing, water, sludge, rust, etc., in the system.
7. Improper adjustments.
8. Oil cooler plugged, dirty or leaking.

Whenever hydraulic, fuel, lubricating oil lines, or air lines are to be disconnected, clean the adjacent area as well as the point of disconnect. As soon disconnected, cap, plug or tape each line or opening to prevent the entry of foreign material. The same recommendations for cleaning and covering apply when access covers or inspection plates are removed.

Clean and inspect all parts. Be sure all passages and holes are open. Cover all parts to keep them clean. Be sure parts are clean when they are installed. Leave new parts in their containers until ready for assembly.

Clean the preservative compound from all machined surfaces of new parts before installing them.

Operator Controls

With the electrically controlled valves on the outriggers, three (3) spools must be checked.

The 480-126 has two reliefs, one for the Swing, A/C and Counterweight removal set at 3500 psi, the other relief is for the outrigger controls set at 2500 psi.

Check the outrigger extend-retract and function valves by pushing the pins in prior to activating the functions. Check to see if the appropriate pin has been pushed back out as the functions are activated. If they have, the spools are shifting.

If the spools do not all shift, check the electrical connections. FREQUENTLY GROUND CONNECTION ARE A PROBLEM.

If no electrical power is present at the valve, check the electrical wiring and correct the fault. Most controls require a minimum of 10 volts.

If power is present, repair or replace the solenoid or valve section which is not shifting.

Power Steering

GENERAL DIAGNOSIS Whenever steering complaints are encountered, it is important that the complete steering system be inspected. Special body or equipment installations should also be considered for their effect on steering performance.

The steering system consists of the Sheppard Integral Power Steering Gear, a hydraulic supply pump with pressure and flow controls and an oil reservoir, the front axle and mechanical components and the steering column or input shaft and connecting linkages. The front tires and wheels must also be considered as part of the total steering system. Refer to the Sheppard manual.

Steering performance can be affected by out of line conditions anywhere in the total steering system. Other factors outside the steering system can also contribute to poor steering performance.

Many times a steering gear is removed and disassembled needlessly, because an organized diagnosis procedure has not been followed. Start your diagnosis by:

DEFINING THE COMPLAINT

a. Talk to and question the driver.

b. Drive the vehicle.

VISUAL INSPECTION

a. Look for poor loading practices.

b. Check tires for mismatch and proper air pressure.

c. Check suspension for sagging or shifting (out of line rear axles will tend to steer the front end of the vehicle).

MECHANICAL COMPONENTS INSPECTION

a. Check all front axle components for wear, looseness or seizure.

b. Inspect front and rear suspension components.

c. Check steering gear mounting to be sure it is tight and not shifting on the chassis or axle.

d. Inspect steering column components.

NOTE: *Keep in mind that the same problems that upset manual steering will also affect power steering.*

HYDRAULIC SUPPLY SYSTEM INSPECTION

Evaluate hydraulic supply system performance. Follow procedures in the “Hydraulic Supply Diagnosis” section of Power Steering Manual. Oil pressure and oil flow must be within the vehicle manufacturer’s specifications.

For specific diagnosis and repair of power steering components refer to the manufacturer’s manual for special procedures to follow.

Front Axles

RAPID OR UNEVEN TIRE WEAR

CAUSE	REMEDY
Incorrect toe-setting	Check and reset toe-in if necessary
Improper tire inflation	Inflate to proper pressure
Unbalanced Tires	Balance

HARD STEERING

CAUSE	REMEDY
Inadequate or improper lubrication of knuckle pins	Consult lubrication chart for proper lubricant, lubrication intervals and procedures.
Improper caster	Adjust caster.

RAPID WEAR OF TIE ROD ENDS

CAUSE	REMEDY
Inadequate or improper lubrication	Consult lubrication chart for proper lubricant, lubrication intervals and procedures.
Severely contaminative environment	Clean and lubricate more often

BENT OR BROKEN TIE ROD, STEERING ARM, TIE ROD ARM, OR BALL STUD

CAUSE	REMEDY
Excessive power steering pressure	Check steering pump relief setting, check steering system relief setting; adjust as required
Misadjusted steering relief plungers	Adjust plungers to unload steering system when wheels are turned to extreme positions
Misadjusted wheel	Check wheel alignment or damage to wheel

HEAVILY WORN STEERING ARM BALL STUD

CAUSE	REMEDY
Inadequate or improper lubrication	Consult lubrication chart for proper lubricant, lubrication intervals and procedures
Torn or missing joint boots	Replace joint boot

EXCESSIVE WEAR OF KNUCKLE PINS AND BUSHINGS

CAUSE	REMEDY
Inadequate or improper lubrication	Consult lubrication chart for proper lubricant, lubrication intervals and procedures. Increase lubrication frequency when operating in extreme conditions.

FRONT AXLE SHIMMY OR VIBRATION

CAUSE	REMEDY
Incorrect caster setting	Adjust caster
Wheels and/or tires not properly balanced	Balance
Worn shock absorbers	Replace

Steering Circuit

OIL LEAKING AT OUTPUT SHAFT OF STEERING GEAR

CAUSE	REMEDY
Pinched or restricted oil return line	Locate and correct. Check back pressure
Damaged quad ring seal	Replace quad ring seal
Damaged bronze bearings	Replace bronze bearings. Polish output shaft or replace to remove bronze deposits
Damaged roller bearings	Replace roller bearings. Polish output shaft or replace to remove pitting & grooving in seal area

OIL LEAKING AT ACTUATING SHAFT OF STEERING GEAR

CAUSE	REMEDY
Worn or damaged oil seal	Replace seals
Damaged actuating seal surface	Replace damaged parts Lube bearing cap more often

OIL LEAKING AT SUPPLY PUMP DRIVE SHAFT

CAUSE	REMEDY
Damaged oil seal	Replace oil seal
Oil seal heat damaged	Check operating temperature
Loose or damaged bushing on pump drive shaft	Repair pump per pump service instructions

OIL LEAKING BETWEEN RESERVOIR AND PUMP BODY

CAUSE	REMEDY
Seal or gasket damaged	Replace damaged parts

LUBRICANT MILKY OR WHITE IN APPEARANCE

CAUSE	REMEDY
Water entry through reservoir venting system	Clean vent system or replace cap assembly

OIL FORCED OUT OF RESERVOIR

CAUSE	REMEDY
Clogged oil filter	Change oil and oil filter. Increase change intervals
Air in system	Bleed air from system. Check for air leak on suction side of supply pump
Faulty supply pump (Cavitation)	Check supply pump following “Hydraulic Supply- Diagnosis”. Repair pump per pump service instruction
Relief plungers of steering gear not adjusted properly	Adjust relief plungers (see final adjustments

LUBRICATING OIL DISCOLORED OR SMELLS BAD

CAUSE	REMEDY
Operating temperatures too high	Check and correct cause of overheating
Change intervals too long	Increase oil change frequency
Incorrect lubricant used	Drain, flush and refill with 10W-40 motor oil

OIL IN RESERVOIR - FOAMING

CAUSE	REMEDY
Air leak in suction side of supply pump	Refer to pump servicing instructions
Pump cavitating	Check for restriction in pump supply
Oil overheating	See high operating temperatures
Incorrect lubricant	Change to 10W-40 motor oil

EXCESSIVE PUMP PRESSURE WITH STEERING GEAR IN NEUTRAL POSITION

CAUSE	REMEDY
Pinched oil return line. High back pressure	Relocate line
Binding steering column	Repair steering column
Damaged actuating shaft bearing	Replace damaged parts as required

WHEEL CUTS RESTRICTED

CAUSE	REMEDY
Relief plungers misadjusted	Adjust relief plungers (see final adjustments)

ERRATIC STEERING OR NO STEERING AT ALL

CAUSE	REMEDY
Insufficient volume of oil being metered by flow divider to steering gear induced by foreign particles on flow divider valve, causing the valve to hang up in the bore	Polish flow divider valve to remove foreign particles and burrs. Refer to pump servicing instructions

HARD STEERING

CAUSE	REMEDY
Faulty supply pump	Refer to pump servicing procedures
Front axle overloaded	Correct loading practices
Faulty steering geometry	Align front end
High operating temperature	Locate and correct cause of overheating

WHEEL STEERING HARD IN ONE OR BOTH DIRECTIONS

CAUSE	REMEDY
Bent or damaged king pins and tie rods	Repair or replace king pins and tie rods. Refer to servicing instructions
Front end load too great for rated axle capacity	Lighten load
Fatigued by-pass valve spring in pump	Replace with flow control valve assembly. Refer to pump servicing instructions
Low oil level in steering system	Fill oil reservoir as required. See “Lubrication”
Air in system	Bleed system and check for cause of air
Caster and camber degree incorrect	Correct to “Specifications”
Metal or foreign material caught in actuating valve	Remove actuating valve. Clean and check parts for damage
Actuating valve worn or chipped by dirt	If damage is excessive replace damaged parts as required

WHEEL STEERING HARD IN ONE DIRECTION

CAUSE	REMEDY
Broken reversing springs in steering gear	Replace reversing springs and damaged parts. Refer to repair procedures to check for additional damage
Metal or foreign material in relief ball seat in piston of steering gear	Remove piston and clean relief valve seats or replace damaged parts
Foreign material in relief valve	Clean relief valve

STEERING EXTREMELY LIGHT IN ONE OR BOTH DIRECTIONS

CAUSE	REMEDY
Bent or damaged reversing springs	Check for impact or accident damage. Replace damaged parts

EXCESSIVE BACKLASH

CAUSE	REMEDY
Worn universal joint	Replace universal joint
Worn pins and keys in universal joint to actuating shaft and universal joint to steering shaft	Replace pins and keys
Low oil volume	Check flow divider and pump drive belts
Worn ball joints on steering arms and drag links	Replace ball joints
Improperly adjusted drag link, pitman arm to drag link and steering arm to drag link	Adjust drag link, drag link to pitman arm and drag link to steering arm
Loose bracket frame to bracket or bracket to gear	Remove bracket. Clean frame and bracket. Check radius of frame making sure bracket is not bearing on radius surface. Check bracket for wear from working. Replace bracket and tighten to recommended torque rating according to size and grade of bolts. If necessary, replace bracket with new one
Rack on piston damaged	Replace parts as required
Damaged pinion gear on output shaft	Replace pinion gear
Damaged output shaft splines	Replace output shaft
Worn output shaft bushings	Replace bushings and polish shaft to remove bronze deposits
Worn pitman arm splines	Replace worn parts
Worn actuating shaft and valve threads	Replace worn parts as required. Follow “Hydraulic Supply Diagnosis” procedures to locate cause of wear
Damaged reversing springs	Check and repair as required
Universal joint yoke loose on actuating shaft	Repair or replace damaged parts, check for spline wear
Worn center pivot bushings	Replace bushings

NO ATTEMPT TO RETURN STRAIGHT AHEAD FROM TURNS

CAUSE	REMEDY
No positive caster	Set to 4° to 6° positive caster
Steering column bind	Check and repair U-joints and support bearings
Steering gear mounting distorted	Shim mounting pads to correct piston to bore interference
Linkage ball sockets seized or binding	Check and repair or replace

Rear Axles

HUMMING NOISE WHILE DRIVING

CAUSE	REMEDY
Improper or inadequate lubrication	Consult lubrication chart for proper lubricant, lubrication interval, and procedure
Bearing rollers worn	Replace bearing. Always replace both cups and cones

EXCESSIVE VIBRATION

CAUSE	REMEDY
Twisted or broken axle shaft	Replace axle shaft
Fractured axle shaft at flange	Replace axle shaft. Examine axle housing for bent condition. Make certain wheel bearings are correctly adjusted. See page 6 - 12

Alternator

OPERATION NOISY

CAUSE	REMEDY
Worn or dry bearings	Replace worn bearings
Alternator mounting loose	Tighten alternator mounting
Belt loose	Replace worn belt or tighten loose belt
Brush holders out of alignment	Replace brush holders
Brushes not seated properly	Reseat or replace brushes
Armature unbalanced	Replace armature
Commutator out-of-round	Dress commutator
Loose windings	Replace defective windings
Armature rubbing	Replace bearings

EXCESSIVELY HIGH ALTERNATOR ELECTRICAL OUTPUT

CAUSE	REMEDY
Alternator regulator out of adjustment	Replace regulator
Field leads shorted	Replace or repair alternator
Alternator regulator shorted	Replace regulator

ALTERNATOR MECHANICALLY INOPERATIVE

CAUSE	REMEDY
Belt loose	Tighten belt
Armature shaft sheared	Replace or repair alternator

LOW OR NO ALTERNATOR ELECTRICAL OUPUT

CAUSE	REMEDY
Field coil open	Replace or repair alternator
Brushes dirty, worn, pitted, or burned	Replace or repair alternator
Alternator regulator defective	Replace regulator
Alternator to regulator field leads open or connections loose	Tighten connections or replace field leads

ALTERNATOR OVERHEATS

CAUSE	REMEDY
Loose or worn belt or pulley	Adjust belt, or replace worn belt or pulleys
Misalignment	Inspect mounting brackets and tension adjusting arm for looseness. Tighten or replace parts as required

Starter

STARTER INOPERATIVE

CAUSE	REMEDY
Commutator dirty	Clean commutator
Brushes worn	Replace brushes
Starter relay malfunctioning	Repair or replace relay
Pinion spring broken or weak	Replace or repair starter
Frame housing defective	Replace or repair starter
Transmission not in neutral	Place transmission in neutral
Insufficient charge in batteries	Charge batteries

Brakes

INSUFFICENT BRAKE ACTION

CAUSE	REMEDY
Improper brake shoe adjustment	Adjust brake shoes
Worn brake linings	Adjust for lining wear or replace brake shoes
Blocked, bent, or broken tubing or hose	Remove obstructions in line or replace faulty tubing
Brake valve delivery pressure below normal	Clean and replace worn parts if brake valve is defective, replace unit
Insufficient parking brake valve delivery pressure	Clean and replace worn parts, or if valve is defective, replace unit

BRAKES RELEASE TOO SLOWLY WITH PEDAL RELEASED

CAUSE	REMEDY
Insufficient brake shoe clearance	Adjust brake shoes
Weak or broken valve diaphragm return spring	Replace brake valve
Relay or quick-release valve exhaust ports obstructed	Clean or replace faulty unit

ONE BRAKE DRAGS WITH PEDAL RELEASED

CAUSE	REMEDY
Insufficient brake shoe clearance	Adjust brake shoe clearance
Brake shoe binding on anchor pin	Remove shoe, clean and lubricate anchor pins.
Weak or broken brake shoe return springs	Replace faulty spring

BRAKES ACT UNEVENLY OR GRAB WHEN PEDAL IS DEPRESSED

CAUSE	REMEDY
Brake shoe clearance is too great	Adjust clearance
Grease or oil on linings	Clean linings or replace linings or shoe assemblies
Drums out of round	Replace drum
Defective brake valve	Replace faulty unit
Brakes need relining	Replace brake shoes
Brake chamber diaphragm leaking	Tighten all fittings; if caused by broken or faulty unit, replace the unit

Parking Brakes

MAXI-BRAKES WON'T APPLY (From Park Brake Button)

CAUSE	REMEDY
Restricted hose or tube	Remove restriction or replace
Defective relay valve	Repair or replace
Defective spring brake valve	Repair or replace
Defective control valve	Repair or replace

MAXI-BRAKES WON'T APPLY (With loss of air pressure in one service reservoir)

CAUSE	REMEDY
Restricted hose or tube	Remove restriction or replace
Defective control valve	Repair or replace control valve

BRAKES WON'T APPLY ON REAR AXLE (With loss of air pressure in one service reservoir)

CAUSE	REMEDY
Restricted hose or tube	Remove restriction or replace
Defective spring brake valve	Repair or replace spring brake valve

MAXI-BRAKES WON'T RELEASE

CAUSE	REMEDY
Control valve not pushed out	Pull in
Insufficient system air pressure	Allow engine to run to increase pressure to above 70 p.s.i.
Restricted hose or tube	Remove restriction or replace
Insufficient hold off pressure	Check for system (or excessive valve) leaks
Leaking brake actuator diaphragm	Replace brake actuator (spring pot)
Defective relay valve	Repair or replace relay valve
Defective spring brake valve	Repair or replace spring brake valve
Defective control valve	Repair or replace control valve

Air Pressure

INADEQUATE AIR PRESSURE

CAUSE	REMEDY
Leaks in system	Repair leaks
Frozen lines	Thaw out lines
Defective compressor	Inspect for sticking unloader valve, replace if necessary
Reservoir leaking	Replace
Tank to compressor supply line damaged	Replace

Swing Circuit

SWING COMPLETELY INOPERATIVE

CAUSE	REMEDY
Mechanical swing lock applied, if equipped	Disengage the swing lock
Swing brake applied	Disengage the swing brake
Spring brake stuck in applied position	Disassemble swing brake and free-up unit
Swing valve main relief valve stuck in open position	See section on “Relief Valves”
Swing motor leaks excessively internally	See section of “Fluid Motor”
Mechanical fault in swing reducer gear box or swing bearing	Repair swing reducer or replace swing bearing
Hose plugged or liner collapsed	Replace hose
Rotary manifold leaking internally	Reseal rotary manifold
Swing pump faulty	See section on “Pumps”
Diverter valve for outriggers stuck closed	Disassemble and check for debris and free-up valve

SWING MOTION SLUGGISH

CAUSE	REMEDY
Main relief valve stuck in open position	Replace
Faulty swing pump	Repair or replace swing pump
Swing motor leaks excessively, internally	Replace or reseal motor
Excessive leakage around swing control valve spool	Replace or replace control valve
AC is "ON" and swing sensor is "OFF"	Check swing sensor activates to shutoff hyd flow to compressor.

SWING MOTION ERRATIC

CAUSE	REMEDY
Brake not releasing completely	Check operation of swing brake and/or swing lock
Low hydraulic oil level	Add oil as required
Swing bearing not lubricated properly	Lubricate swing bearing
Main relief malfunctioning	See section on “Relief Valves”

Boom Hoist Circuit

BOOM DRIFTS DOWN

CAUSE	REMEDY
Hold valve not seating properly	Replace hold valve
Hoist cylinder by-passing	See section on “Cylinder Leakage”

BOOM HOIST ONLY - INOPERATIVE OR ERRATIC

CAUSE	REMEDY
Boom will drift down	Repair or replace hold valve
Boom won’t lower	Repair, replace, or backflush hold valve
Boom hoist cylinder binding	Repair or replace
Load is too great	Consult capacity chart, check RCI.
Piston packings damaged	Replace packings
Low oil level	Add oil as required
Hose plugged or liner collapsed	Replace hose
Air in cylinder	Bleed cylinder

BOOM DROPS SLIGHTLY AS RAISE CONTROL IS RELEASED

CAUSE	REMEDY
Air in cylinder	Bleed cylinder
Boom hoist hold valve free flow check not seating properly	Replace hold valve

BOOM HOIST AND TELESCOPE INOPERATIVE OR ERRATIC

CAUSE	REMEDY
Pump disconnect not engaged	Engage pump disconnect
Main relief valve malfunctioning	See section on “Relief Valves”
Low oil level	Add oil as required.
Rotary manifold leaking internally	Reset rotary manifold
Tandem pump faulty	See section on “Pumps”

Telescope Circuit

TELESCOPE FUNCTION ONLY - WILL NOT OPERATE

CAUSE	REMEDY
Load too great	Move lever to first position, not “high speed”. Reduce load or set boom length before lifting load
Both port relief valves sticking	See section on “Relief Valves”
Hose plugged or liner collapsed	Replace hose

BOOM EXTENSION JERKY OR ERRATIC

CAUSE	REMEDY
Inadequate grease on boom pad surfaces	Lubricate boom where pads contact boom
Wear pads damaged	Replace wear pads
Wear pads shimmed to boom too tight	Reshim wear pads
Faulty counter balance valve	Replace counter balance valve
Loose chain system	Adjust chains as required

TELESCOPE CYLINDER EXTENDS BUT WILL NOT RETRACT

CAUSE	REMEDY
Port relief valve sticking	See section on “Relief Valves”
Hold valve malfunctioning	Repair or replace
Internal leakage in cylinder	See section on “Cylinder Leakage”
Extend valve malfunctioning	Repair or replace

BOOM SECTIONS RETRACT UNDER LOAD

CAUSE	REMEDY
“O” ring around hold valve damaged	Replace “O” rings
Hold valve not seating properly	Repair or replace
Telescope cylinder by-passing	See section on “Cylinder Leakage”

Winch Circuit

WINCH WILL NOT DEVELOP MAXIMUM LINE PULL

CAUSE	REMEDY
Main relief valve is set too low	Readjust the main relief
Main relief valve is sticking	See section on “Relief Valves”
Winch motor worn excessively or damaged	See section on “Fluid Motor”
Tandem pump worn excessively or damaged	See section on “Pumps”
Rotary manifold leaking internally	Reseal rotary manifold
Low oil level	Add oil as required

WINCH WILL LOWER BUT WILL NOT RAISE

CAUSE	REMEDY
The sprag clutch is assembled backwards	Be certain that the winch is assembled properly
Insufficient parts of line for the load being lifted	See the reeving diagram on the capacity chart

WINCH WILL RAISE BUT WILL NOT LOWER

CAUSE	REMEDY
The winch hold valve is mounted on the winch motor incorrectly	Be certain that the winch is assembled properly
The winch hold valve spool is sticking	Repair or replace
The winch brake is not releasing	Be certain that the brake release line is open. If necessary, disassemble and inspect the brake components
Winch brake piston “O” ring damaged	Replace “O” ring

WINCH WILL NOT HOLD LOAD (LOAD DRIFTS DOWN)

CAUSE	REMEDY
System back pressure too high	Warm oil: check for restriction in down stream flow
The over-running sprag on the brake is broken	Inspect and replace, if necessary
The automatic brake is not applying	Be certain that the winch brake release line is not plugged and no foreign objects are in the brake assembly
The winch brake friction plates are worn	Replace friction plates

WINCH CHATTERS WHEN LOWERING

CAUSE	REMEDY
The winch hold valve is set wrong or is malfunctioning	Check the hold valve setting. If the winch continues to chatter, the holding valve is sticking. Inspect it for worn or damaged seals or contamination

Outrigger Circuit

ALL OUTRIGGERS INOPERATIVE

CAUSE	REMEDY
Electrical malfunction	See section on “Electrical Controls”
Outrigger relief valve malfunctioning	See section on “Relief Valves”
Outrigger diverter valve malfunctioning	Repair or replace
Line to or from steer pump plugged or liner collapsed	Clear blockage or replace hose
Low oil level	Add oil as required
Outrigger / Swing Pump	See section on "Pumps"

INDIVIDUAL OUTRIGGER INOPERATIVE

CAUSE	REMEDY
Electrical malfunction	See section on “Electrical Controls”
Cylinder leaking internally	See section on “Cylinders”
Hold valve on jack cylinder not operating	Repair or replace
Line plugged or collapsed between outrigger valve and cylinder	Replace hose.
Beam wedged in extended position	Extend jack far enough to pick up end of beam and retract. Replace slider pad block on top of outrigger box to pick up end of beams

OUTRIGGERS WILL NOT LIFT MACHINE

CAUSE	REMEDY
Outrigger relief valve malfunctioning	See section on “Relief Valves”
Outrigger diverter valve malfunctioning	Repair or replace
Outrigger pump worn or damaged	See section on “Pumps”
Cylinder by-passing	See section on “Cylinders”.

JACK CYLINDER DRIFTS DOWN (OUT & DOWN)

CAUSE	REMEDY
Hold valve on top of cylinder malfunctioning	Replace cartridge
Thermal relief cartridge mounted in wrong end	Check for proper assembly
Cylinder by-passing	See section on “Cylinders”

Swing Pumps Circuit

FAILURE OF PUMP TO DELIVER FLUID

CAUSE	REMEDY
Pumps not engaged	Engage pumps
Low fluid level in reservoir	Add recommended oil and check level
Oil intake suction filter plugged	Clean filter
Air leak in suction line, preventing priming or causing noise and irregular action of control circuit	Repair leaks
Oil viscosity too heavy to pick up prime	Use lighter viscosity oil. Follow recommendation for temperatures encountered
Broken pump shaft or parts broken inside pump	Contact your local distributor; if necessary, refer to the manufacturer’s manual for the correct instructions in pump disassembly and repair

NO PRESSURE IN SYSTEM

CAUSE	REMEDY
Pumps not engaged	Engage pumps
Pump not delivering oil for any of the reasons listed previously	Follow remedies given previously
Relief valve not functioning due to:	
Valve setting not high enough	Increase pressure setting of valves
Valve leaking	Check seat for score marks and reseat
Spring in relief valve broken	Replace spring and readjust valve
Internal leakage in control valves or cylinders	To determine location, progressively block off various parts of circuit. When trouble is located, repair. (Do not block between pump and relief valve)
Relief valve not functioning due to:	
Cold fluid	Warm up system. Work with oil at recommended operating temperature range. (See Operation section)
Air leak or restriction at inlet line	Repair or clean
Internal parts of pump are worn excessively	Replace pump

PUMP MAKING NOISE

CAUSE	REMEDY
Pump disconnect not engaged	Shut engine off and engage pump disconnect
Partially clogged intake line, intake filter or restricted intake pipe	Clean out intake filter screen or eliminate restriction. Be sure suction line is completely open
Air leaks:	
At pump intake pipe joints	Test by pouring oil on joints while listening for change in sound of operation. Tighten as required
Air drawn in through inlet opening	Check and add oil to reservoir if necessary
Air bubbles in oil	Use hydraulic oil containing a foam depressant.
Too high oil viscosity	Work only with oil at recommended operation temperature
Oil intake suction filter plugged	Clean filter
Rag, paper, etc., pulled into suction line or pump	Remove
Worn or broken parts	Replace

EXTERNAL OIL LEAKAGE AROUND PUMP

CAUSE	REMEDY
Shaft seal worn causing oil to leak into gear drive housing	Replace
Loose fitting on pump intake or discharge	Keep all joints tight
Damaged “O” ring seals between pump sections	Replace
Damaged “O” rings at fittings	Replace

EXCESSIVE WEAR

CAUSE	REMEDY
Abrasive matter in the hydraulic oil being circulated through the pump	Clean suction filter and replace return filter. Drain & flush system as necessary
Viscosity of oil too low at working conditions1	Check oil recommendation
Sustained high pressure above maximum pump rating	Check relief valve setting
Air recirculation causing chatter in system	Check for air being drawn into system. Use hydraulic oil with a foam depressant

BREAKAGE OF PARTS INSIDE PUMP HOUSING

CAUSE	REMEDY
Excessive pressure above maximum pump rating	Check relief valve setting
Seizure due to lack of oil	Check reservoir level, oil filter and possibility of restriction in suction line more often
Solid matter being wedged in pump	Check suction line filter, drain and flush system as necessary

Swing Circuit Control Valves

STICKING PLUNGERS

CAUSE	REMEDY
Excessively high oil temperature	See section on “Excessive Heating of Oil in System”
Dirt in oil	Change oil. Clean system.
Fittings too tight	Check torque
Valve warped from mounting	Loosen valve mounting bolts and check
Excessively high flow in valve	Check to see if hoses from pump are not crossed or reversed
Linkage binding	Free up linkage
Plunger damaged	Replace valve
Return spring damaged	Replace faulty parts
Spring or detent cap binding	Loosen cap, re-center and re-tighten
Valve not at thermal equilibrium	Let system warm up

LEAKING SEALS

CAUSE	REMEDY
Paint on or under seal	Remove and clean
Excessive back pressure	Open or enlarge line to reservoir
Dirt under seal	Remove and clean
Scored plunger	Replace valve
Loose seal plates	Clean and tighten
Cut or scored seal	Replace faulty parts

UNABLE TO MOVE PLUNGER IN OR OUT

CAUSE	REMEDY
Water frozen in plunger caps	Remove caps to clean out
Dirt in valve	Clean and flush out
Plunger cap full of oil	Replace seals
Bind in linkage	Free up linkage

LOAD DROPS WHEN PLUNGER MOVED FROM NEUTRAL

CAUSE	REMEDY
Dirt in check valve	Disassemble and clean
Scored check valve poppet or seat	Replace poppet or lap poppet to seat

POOR HYDRAULIC SYSTEM PERFORMANCE OR FAILURE

CAUSE	REMEDY
Dirt in relief valve	Disassemble and clean
Relief valve defective	See section on “Relief Valves”
Load too heavy	Check line pressure
Internal valve crack	Replace valve
Plunger not at full stroke	Check movement and linkage

Swing Circuit Relief Valves

CAN'T GET PRESSURE

CAUSE	REMEDY
Poppet stuck open or dirt under seal	Check for foreign matter between poppets and their mating members. Members must slide freely

ERRATIC PRESSURE

CAUSE	REMEDY
Poppet seal damaged	Replace damaged parts. Clean dirt and remove surface marks for free movement

PRESSURE SETTING NOT CORRECT

CAUSE	REMEDY
Wear due to dirt. Lock nut adj. screw loose	See section on "Valve Adjustments"

LEAK

CAUSE	REMEDY
Damaged seats, worn "O" rings, parts sticking due to dirt	Replace worn or damaged parts. Inspect for free movement of components. Check seats for scratches, nicks, or other marks

Fluid Motor

MOTOR WILL NOT TURN

CAUSE	REMEDY
Pumps not engaged	Engage pumps
No oil	Fill reservoir to proper oil level
Pump broken	Replace pump
Relief valve stuck open or set too low	Clean and free relief valve spool and adjust to proper setting
Work load jammed or stuck	Remove obstruction from work load
Large contaminating foreign bodies in fluid	Flush hydraulic system completely. Use new oil and install new filters

SLOW OPERATION

CAUSE	REMEDY
Wrong oil viscosity	Use proper viscosity oil
Rotary manifold leaking	Reseal rotary manifold
Worn pump	Repair or replace pump
Extremely high fluid temperatures causing pump and motor to slip (temperature increases as pump and motor wear)	Add heat exchangers
Relief setting too low	Set relief valve for proper psi

MOTOR TURNS IN WRONG DIRECTION

CAUSE	REMEDY
Hose connections wrong	Reverse connections
Wrong timing	Re-time motor

ERRATIC MOTOR OPERATION

CAUSE	REMEDY
Relief valve pressure set too low	Adjust relief valve setting
Low oil level in reservoir permitting air to enter system	Fill reservoir to proper level
Air being “sucked in” on inlet side of pump	Tighten fitting(s) on pump inlet side

LEAK AT SHAFT

CAUSE	REMEDY
Worn or cut shaft seal	Replace shaft seal

LEAK BETWEEN HOUSING AND WEAR PLATE OR BETWEEN WEAR PLATE AND GEROLER ASSEMBLY

CAUSE	REMEDY
Motor housing bolts loose	Clean mating surfaces and tighten nuts to appropriate value
Pinched “O” ring seal	Replace

LEAK AT OIL PORTS

CAUSE	REMEDY
Damaged seal or “O” ring	Replace “O” ring or seal
Poor fittings	Replace fittings carefully
Damaged threads	Replace housing

Cylinders

CYLINDER STICKING OR BINDING

CAUSE	REMEDY
Damaged parts	Repair or replace
Dirt or contamination	Check oil condition. Check filters. Clean or replace filter elements. Change oil if condition requires it
Loose parts	Tighten cylinder rod eyes, if loose. Check cylinder heads and tighten, if loose.
Misalignment.	Check mounting pins and bushings. Tighten rod eyes

ERRATIC ACTION OF CYLINDERS

CAUSE	REMEDY
Air in system:	
Oil level is too low	Add or change
Air leak	Locate and correct
Foaming in reservoir	Use hydraulic oil containing a foam depressant
Internal leakage	See “Cylinder Leakage”
Main Relief pressure too low or valve sticking	See section on “Relief Valve”.

Cylinder Leakage

Hydraulic cylinders may retract due to the cooling of the oil in cylinder. Oil shrinks approximately 1% per 100°F of cooling, or as an example, if a cylinder is extended 100" and it cools 100°F, it would shorten approximately 1".

TELESCOPE CYLINDER

If excessive leak-down is encountered, check items in the following sequence:

1. With boom offside and horizontal, extend the boom approximately 6 ft. per section. Mark the first telescoping section at the end of the base section.
2. Elevate the boom to maximum angle and suspend a load on the hook. (7 tons on a 2-part line would approximate manufacturer's inspection procedures.)
3. Return the telescope foot pedal to neutral, start engine, ground the load, and return the boom to horizontal. Re-mark the boom section as in (1). Measure the distance between marks to determine leak-down of the cylinder.

The manufacturer's allowable drift specification for production machines is as follows:

With 14,300 lb. hook load, 2-part hoist line, boom extended about 6 ft. per section at maximum boom angle, and 160 degree F. hydraulic oil temperature, the leak-down per cylinder is not to exceed 3/4 inch in a 15-minute period.

IDENTIFY A DEFECTIVE HOLD VALVE in the cylinder which drifts excessively by interchanging the hold valve cartridge with one removed from a cylinder that is not drifting, or by replacement with a new cartridge. Before installing the cartridge, visually inspect the external "O" rings and backup washers. Retest per the procedure above to determine if hold was defective.

An alternate method to test the hold valve would be to disconnect the two hoses coming from the valve bank and then elevate the boom . If oil continues to flow slowly from the extend line then it is a hold problem. If oil continues to flow from retract, then it is faulty or leaking by piston in cylinder.

NOTE: *With hollow rod telescope cylinders you can drain in excess of 40 gallons of oil from the rod. If the boom comes in while doing this test, then the cylinder is faulty or leaking by the piston in the cylinder.*

IF THE HOLD VALVE IS NOT FOUND DEFECTIVE, the cylinder must be removed from the boom assembly for repacking and checking. Prior to reassembly of the cylinder, conduct an air test on the piston rod by blocking the retract ports on the rod near the piston end. Slip a plastic bag over piston end of rod and retain and seal with rubber band. Apply and hold a slight amount of air pressure at the retract port of the rod. (Port stamped with "R".) Expansion of the plastic bag indicates a defective rod weldment or seals on the port tube in the rod.

WHEN REASSEMBLING THE CYLINDER, care should be taken to keep the piston rod assembly parallel in all planes with the cylinder barrel as the piston enters and is pushed down the barrel prior to gland engagement.

NOTE: *An external leak from telescope cylinders or hydraulic line within the boom assembly does not cause leak-down without also having one or more of the above conditions present.*

BOOM LIFT CYLINDER

The suggested procedure for identifying the specific cause of leak-down should be performed in the following sequence:

ELEVATE THE BOOM TO NEAR MAXIMUM ANGLE, not completely extended, with a boom length sufficient to winch up a convenient payload approximately one (1) foot from ground level. Shut off engine.

DISCONNECT THE EXTEND HOSE, PILOT DRAIN HOSE, AND THE SMALL PILOT LINE HOSE at the holding valve ports and cap the pilot line hose and drain hose ends.

Do not disconnect the RLI pressure hoses as the boom will drop uncontrollably and could result in death or serious injury including damage to equipment.

IF HYDRAULIC OIL CONTINUES TO RUN after the initial draining from either port of the hold valve as the hoist cylinder continues to leak-down, the cause is within the hold valve.

IF CYLINDER LEAK-DOWN OCCURS with no oil leak from the hold valve ports, the cause is within the cylinder.

OUTRIGGER JACK CYLINDER

The suggested procedure for identifying the specific cause of leak-down is similar to the boom lift cylinder procedure:

SET THE OUTRIGGERS.

ELEVATE THE BOOM TO NEAR MAXIMUM ANGLE, not completely extended, with a boom length sufficient to winch up a convenient payload approximately one (1) foot from ground level. Shut off engine and remove pressure from the hydraulic reservoir by loosening the filler cap.

DISCONNECT THE EXTEND HOSE FROM THE HOLD VALVE. This is a hose farthest away from the port tube and should have an “E” stamped next to it.

IF HYDRAULIC OIL CONTINUES TO RUN after the initial draining from the port of the hold valve as the jack cylinder continues to leak-down, the cause is within the hold valve.

IF CYLINDER LEAK-DOWN OCCURS with no oil leak from the hold valve port, the cause is within the cylinder.

DO NOT START THE ENGINE UNTIL THE HOSES HAVE BEEN RECONNECTED. The control valve spool is open-center to reservoir in the neutral position and return line oil would be pumped out.

Excessive Heating of Oil In System

HEATING CAUSED BY POWER UNIT (RESERVOIR, PUMP, RELIEF VALVE, AND COOLERS)

CAUSE	REMEDY
Relief valve set at a higher or lower pressure than specified. Excess oil dissipated through increased slippage in various parts, or through relief valve	Reset relief valve to recommended pressure
Internal oil leakage due to wear	Repair or replace faulty component
Viscosity of oil too high or too low	Follow recommendations for correct viscosity grade to be used.
Pumps assembled after overhaul may be assembled too tightly. This reduces clearances and increases rubbing friction	Follow instructions when reassembling
Leaking relief valves	Repair.
Improper functioning of oil cooler	Inspect cooler and see that it is working properly.
Improper machine operation	Return control to neutral when stalled, cylinder at end of stroke, etc.

HEATING BECAUSE OF CONDITIONS IN SYSTEM

CAUSE	REMEDY
Restricted lines	If lines are crimped, replace; if partially plugged for any reason, remove obstruction.
Internal leaks	Locate leaks and correct
Low oil level	Check oil level and fill if necessary.

Electrical Controls

ELECTRICAL FAILURE

CAUSE	REMEDY
Rocker switch sticking	Remove switch, check if hole is too tight. Cut out decal or file hole larger.
Tripped circuit breakers	Reset breaker
Disconnected or broken wires	Replace or repair
Open circuit	Check with test light. Repair or replace
Low voltage	Check wires and grounds
Poor engine solenoid connection	Clean and tighten
Defective solenoid	Replace
Solenoid failure	Replace
Poor ground connections	Clean and tighten connections

Propane Heater

HEATER FAILS TO START (MOTOR DOES NOT RUN)

CAUSE	REMEDY
Fuse defective or burnt out	Check fuse; replace if necessary
Electrical connection(s) defective	Check all electrical connections, including ground; repair any defects
Full voltage not available at heater	Check for power at the heater: at least 11 VDC with heater turned on. Trace system to find any fault(s).
Motor defective	Check motor. Replace if necessary

MOTOR RUNS, BUT NO COMBUSTION

CAUSE	REMEDY
Fuel supply blocked	Check fuel supply by loosening the fitting on the outside of the heater and checking for propane odor. If propane odor is present, pull off the igniter wire completely and remove the igniter. Try to start the heater and listen for the solenoid click. Check for the odor of propane in the burner. If propane odor is present at bulkhead fitting, but not the burner head, the solenoid valve is defective or contaminated with some foreign object. The solenoid valve can become contaminated when a liquid takeoff bottle is used instead of the required vapor take-off bottle. If the fuel system is contaminated, the lines and solenoid must be cleaned with a degreasing solvent.
Temperature control &/or microswitch defective or out of adjustment	Check temperature control switch and microswitch and microswitch for adjustment. Adjust, repair, or replace as necessary. See Section 6, “Repairs and Adjustments”.

Ignition pack defective or inoperative	Check for spark by holding an insulated-handle screwdriver with the shaft grounded and the tip approximately 1/8" away from the high tension lug of the ignition coil. There should be a continuous strong spark. If no spark is produced, check that there is voltage applied to the ignition pack. If input voltage is present and no spark or a weak spark is produced, replace or repair the ignition pack.
Tilt switch defective, improperly mounted or not getting power	Check tilt switch. The switch must be secure in its bracket and be in the vertical position with the electrical leads pointing down. Check leads on both sides of switch for power. Replace if defective.
Igniter defective or inoperative	Check the igniter. To check, shut off the fuel tank and depress the start switch until the lines are purged of fuel. Remove the burner head and check the gap between the igniter and the burner tube. It should be 1/16" to 1/8". With the burner head grounded, move the STARTRUN- OFF switch to the START position and check the gap for spark. If no spark is produced, the igniter may be dirty or defective. Before removing the igniter from burner head, check inside the burner head to determine if any carbon threads or chips are present which could short the plug.
Fuel not suitable for temperatures encountered	Check with your propane supplier to be sure your fuel is suitable for the temperatures encountered. Around -10°F, propane may not produce enough pressure to pass through the regulator.

HEATER REMAINS ON BURNER CYCLE AFTER HEAT DEMANDS ARE MET

CAUSE	REMEDY
Temperature control &/or microswitch defective or out of adjustment	Check temperature control switch and microswitch and microswitch for adjustment. Adjust, repair, or replace as necessary.
Bi-metal blade broken or linkage out of adjustment	Check bi-metal blade and linkage and adjust, repair or replace as necessary.
Dirt on fuel solenoid valve lip	Clean solenoid valve lip

EXCESSIVE POPPING OR BACKFIRING

CAUSE	REMEDY
Ignition pack defective or inoperative	Check for spark by holding an insulated-handle screw driver with the shaft grounded and the tip approximately 1/8” away from the high tension lug of the ignition coil. There should be a continuous strong spark. If no spark is produced, check that here is voltage applied to the ignition pack. If input voltage is present and no spark or a weak spark is produced, replace or repair the ignition pack.
Full voltage not available at heater	Using voltmeter, check to be sure full voltage is available for heater operation, at least 11 VDC with heater turned on. Trace system to find fault.
Solenoid defective	Check solenoid. When the START-RUN-OFF switch is in the RUN position, the solenoid should produce an audible click and remain open until heater cycles off.
In extremely cold weather, the regulator may become frosted. As it thaws and freezes, the heater will burn intermittently	No action recommended
Clogged or restricted exhaust	Check exhaust for blockage or restrictions. Clean and clear as necessary.

EXCESSIVE SMOKING AT EXHAUST PORT AND BUILDUP OF CARBON IN HEAT EXCHANGER

CAUSE	REMEDY
Air inlet tube blocked	Check for plugged or blocked air inlet tube and clear if necessary.
Low voltage	Check for low voltage, at least 11 VDC.
Defective pressure regulator	Check for defective pressure regulator. There should be 11 inches water pressure in the propane supply line at the connector.

HEATER DOESN’T SWITCH OFF AFTER PURGE (COOL DOWN) CYCLE

CAUSE	REMEDY
Flame switch will not open	Replace

Maintenance -Free Battery Testing

VISUAL INSPECTION

CAUSE	REMEDY
Visible damage, terminal leakage, etc	Cannot be used. Replace.

ELECTROLYTE LEVELS & STATE OF CHARGE NOTE: PROCEED DIRECTLY TO CAUSE THAT APPLIES

CAUSE	REMEDY
Level at top of plates. Water cannot be added	Replace
If there is an indicator and it shows low level	Replace
Level OK, unknown, or water can be added. Stabilized voltage below 12.4 volts*	Add water if needed (if possible). Charge, then turn on high-beam head lamps (or 15 amp load for 15 seconds). Proceed to load test.
If there is an indicator and it shows low charge	Charge, then turn on high-beam head lamps (or 15 amp load for 15 seconds). Proceed to load test.
Stabilized voltage above 12.4 volts* or indicator indicates charged	Perform load test

LOAD TEST

Perform load test using the following procedure:

1. Connect voltmeter and ampere load equal to 1/2 cold cranking amperes @ 0°F (-18°C) rating of battery for 15 seconds.
2. Observe voltage at 15 seconds with load on.
3. Refer to voltage chart

If the voltage remains below the voltage chart levels, replace battery. If the voltage is equal to or above chart values, return to service.

VOLTAGE CHART		
ESTIMATED ELECTROLYTE TEMPERATURE		MINIMUM REQUIRED VOLTAGE UNDER 15 SECOND LOAD
70°	(21° C) & ABOVE	9.6
60°	(16° C)	9.5
50°	(10° C)	9.4
40°	(4° C)	9.3
30°	(-1° C)	9.1

20°	(-7° C)	8.9
10°	(-12° C)	8.7
0°	(-18° C)	8.5

NOTE: *IF WATER CAN BE ADDED TO A BATTERY, A HYDROMETER READING OF 1.225 @ 80° F (27° C) CAN BE USED INSTEAD OF THE 12.4 VOLTAGE READING.*

Two-Block System

PANEL LIGHT & HORN WILL NOT COME ON WITH BOOM SWITCH WEIGHT LIFTED (IF EQUIPPED WITH DISCONNECTS, CONTROLS WILL NOT ENGAGE)

CAUSE	REMEDY
Burned out fuse	Check and replace fuse (8 amp only).
Broken wire	Check voltage in control panel between terminals #0 and #37. If 0 volts, check between ignition post of ignition switch and ground. If 12 volts available, wire to control panel is bad. Correct.

HORN WORKS, BUT NO LIGHT WITH SWITCH WEIGHT LIFTED (AND IF EQUIPPED W/ DISCONNECTS, CONTROLS WILL ENGAGE)

CAUSE	REMEDY
Light bulb burned out	Replace bulb

LIGHT AND HORN ARE ON WITH HOOK BLOCK NOT CONTACTING SWITCH WEIGHT (IF EQUIPPED W/ DISCONNECTS, CONTROLS WILL NOT ENGAGE)

CAUSE	REMEDY
Jumper wire or jib/rooster sheave not plugged in boom head	Plug in.
Boom head weight wire rope broken or hung up	Check that weight is attached to wire and hanging freely. If rope is caught up on something, correct
Jib or auxiliary boom head switch plugged in, but no weight	Attach weight
Broken electrical cable or bad connection	Check all cable for visible damage, then remove wire from terminals #3 and #6 in control panel and check for continuity. If circuit is open, check the wires inside cable reel, and wires from the reel to the boom head switch. If the wires are OK, check the ATB switch. If there is continuity between #3 and #6 check the relay in the panel.
Defective two block switch	Check for correct mechanical operation. If OK, remove cover and wires from terminals #1 and #2. With arm pulled down, there should be a closed circuit between them. With the arm up, the circuit should be open. If all conditions are not met, replace switch.

Defective relay in panel	Check for 12 volts between relay pins #30 (hot) and #86 (ground). If voltage is 0, check for voltage between pin #87a and ground. If 12 volt, replace relay (With no electrical power to the relay, pins #30 and #87a should show continuity. With 12 volts to either #85 or #86 and the other grounded, there should be continuity between pins #87 and #30.)

ATB SYSTEM FOR CRANES EQUIPPED WITH FUNCTION DISCONNECTS ONLY. LIGHT AND HORN ARE ON, BUT CONTROLS WILL NOT DISENGAGE

CAUSE	REMEDY
Defective function disconnect	Check voltage across disconnect terminals. If 12 volts, check override key switch in control panel. If 0 volts, repair or replace disconnect. (Check other disconnects for condition.) To operate the crane the solenoid must have 12 volts supplied to one side and have a good ground on the other side. Under this condition, the disconnect should act as a solid link. With the 12 volts removed, the disconnect should allow free motion of the control lever in one direction and operate the valve spool in the other direction.
Defective override key switch	Check to insure that the switch is in the off position and the key removed. Check for 12 volts in the control panel. If so, replace the switch or control panel.

NO LIGHT AND HORN, BUT CONTROL WILL NOT ENGAGE

CAUSE	REMEDY
Broken wire or bad connection	Check voltage across disconnect terminals. If 0 volts, check voltage across terminals in the control panel. If 12 volts, replace wire. If 12 volts across disconnect, then disconnect is defective.
Defective function disconnect	Check solenoid for function. Applying 12 volts to disconnect, solenoid should engage with a distinct snap. If not, the solenoid must be replaced. If the solenoid engages, but the disconnect “breaks” under load, the spool, ball, and case should be replaced.
Contaminated function disconnect	1. Ensure that a drain hole is present in the end of the rubber tube covering the solenoid. 2. Lubricate solenoid with SAE 30 oil. 3. Remove solenoid from disconnect and check for proper operation. DO NOT lose the stainless steel ball under the solenoid. If the solenoid does not operate replace the disconnect. If disassembly and cleaning corrects the problem reassemble and replace the silicon sealant.

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General Service Information

Machine productivity, longevity and low cost performance depend on periodic maintenance, troubleshooting and proper service and adjustment procedures.

As the operator, it is your responsibility to detect any unusual sounds, odors or other signs of abnormal performance that could indicate trouble ahead.

By detecting any malfunctions in their early stages, you can save yourself unnecessary downtime and your employer a lot of money! Therefore, it is also your responsibility to use good judgement in detecting potential problems in the early stages and repairing them quickly. If you don't, one problem may lead to another.

Before attempting to make a repair, ask yourself IF you have the RIGHT TOOLS, IF you have the PROPER TEST EQUIPMENT and IF you can accurately DIAGNOSE the cause of the malfunction.

If you can't answer YES to all three questions, rely on your distributor serviceman. He has the tools, testing equipment and service knowledge to pinpoint the problem in minutes instead of the hours consumed in hit - or - miss methods. TIME IS MONEY! He will save it for you.

If you decide to attempt a repair yourself, follow a logical TROUBLE-SHOOTING PROCEDURE. Don't simply replace parts until the trouble is found.

Once the cause of a problem or malfunction has been diagnosed, take the corrective action specified in this manual. Follow the procedures given for the specific problem. If the difficulty is not covered, consult your Distributor Serviceman.

NOTE: *A time table styled check list for periodic maintenance requirements is given in Section 4. Maintenance check procedures are found under each of the respective subject headings.*

When performing maintenance on a vehicle ALWAYS PLACE THE SHIFT LEVER IN THE NEUTRAL POSITION, set the parking brakes, block the vehicle's wheels, and NEVER work under, in front of, or in back of a vehicle when the engine is running.

The methods used to remove assemblies, guards, cab panels, etc. is left to the discretion of the customer dependent on the type of overhaul equipment and maintenance personnel at hand.

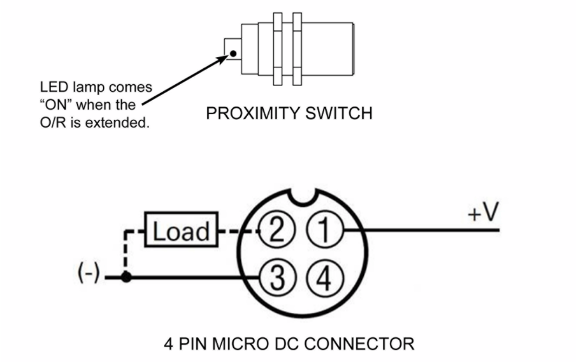
Keep parts in order when large components are disassembled, particularly so when it has a great number of similar parts. Loosely reassemble assemblies whenever possible to prevent small parts from being lost. Keep subassembly parts together, but be careful not to get right and left hand parts mixed up.

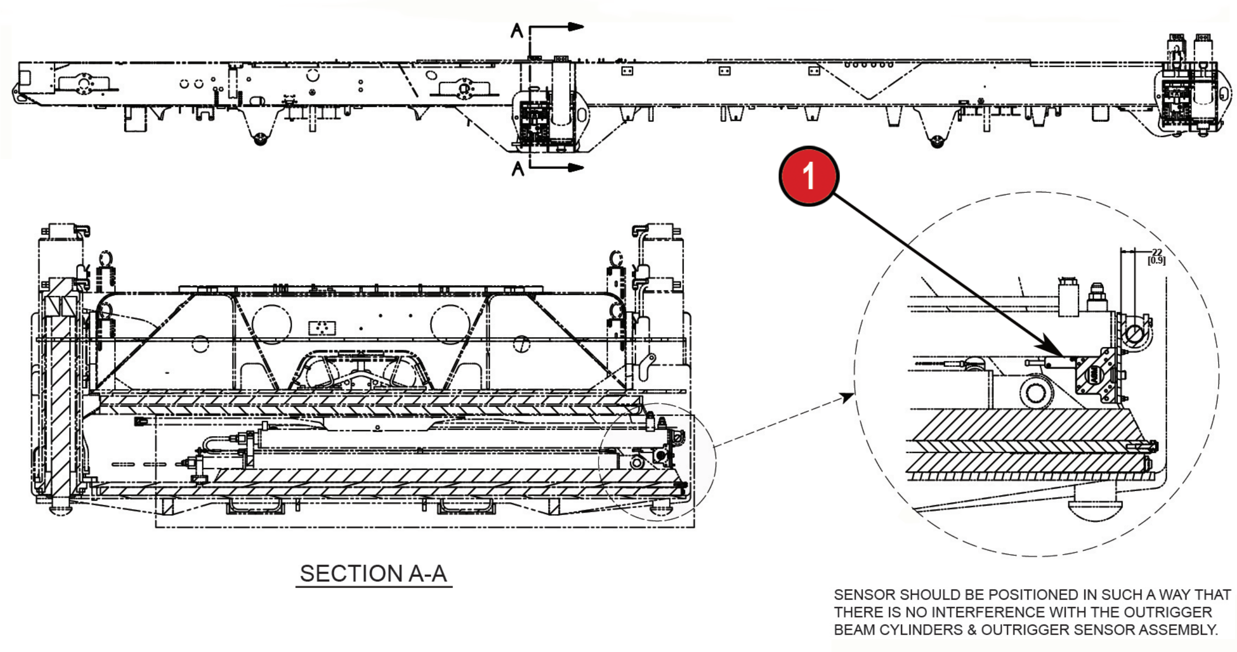
When an assembly is removed to correct only one difficulty, it is good practice to recondition the whole assembly at the time thus avoiding repetition of work at a later date.

Bolts and nuts should be placed into their respective holes when removing guards, cases, etc. so that proper bolt will be on hand when reassembling these parts.

Outrigger Position Sensors

If your crane is equipped with Outrigger Position Sensors-each outrigger box will contain (4) four proximity sensors for determining the location of outrigger beams at mid extend position and full extension. Each sensor has an air gap to maintain to operate properly and send signals to the Rated Capacity Indicator (RCI) or Rated Capacity Limiter (RCL). Visually inspect sensors for damage, the condition of related wiring harness connections and dirt / debris that could inhibit the sensor signal or proper air gap.





1. 480-126 Outrigger Position Sensor

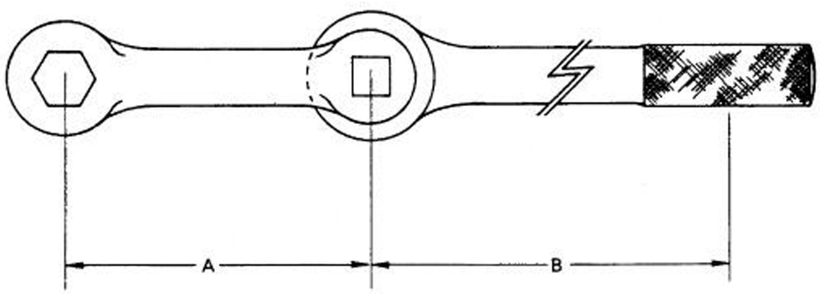
NOTE: *Sensor should be positioned in such a way that there is no interference with the outrigger beam cylinders & outrigger sensor assembly.*

Torque Wrench Extensions

In some applications, a standard torque wrench and socket cannot be fitted to the bolt(s) to be tightened because of restricted access. In other instances, the torque value specified cannot be obtained because sufficient force cannot be applied to the standard length wrench. Both of these problems may be solved by the use of appropriate torque wrench extensions - either commercially made or fabricated by the user.

When using an extension, it must be remembered that the wrench torque (the actual torque reading or setting of the wrench) and the wrench force (the force applied to the wrench) must be adjusted to compensate for the added length and produce the desired bolt torque.

Refer to the illustration and formula below when calculating the proper adjusted values for wrench torque, wrench force, and bolt torque.



NOTE: *Torque wrench setting at length "B" would be same as torque specified for capscrews not requiring use of adapter.*

FORMULA

$$\text{Torque wrench setting (TWS)} = \frac{\text{(600 ft. lb.) times ("B")}}{\text{("B") plus ("A")}}$$

EXAMPLE
(Assuming "B" = 43")
(Assuming "A" = 10.25")

$$\text{TWS} = \frac{\text{(600 ft.lb.)} \times 43"}{43" + 10.25"} =$$

$$\frac{25.800}{53.25} =$$

485 ft. lb.

Welding Instructions

⚠	When doing repair welding on your unit take precaution attaching your ground to the component being repaired. This will reduce the chance of arcing through a bearing, cylinder, etc., damaging the component. Paint should be removed from the surface to be used as the "ground" (earth).

⚠	Use necessary precaution when welding around fuel tanks, oil reservoir, batteries, tubing and pressure systems.

⚠	When welding close to glass, cylinder rods, or any polished surface, provide adequate protection from splatter.

⚠	Never weld when the engine is running. Always disconnect the battery cables and applicable grounds before welding.

⚠	Do not weld on wet surfaces since this will cause hydrogen embrittlement of the weld.

⚠	Always have a fire extinguisher on hand in case of fire. Adequate ventilation and dry area are necessary. Protective clothing should be used and all persons in the welding area should have protection for their eyes. Follow instructions for welding and cutting on paint.

AWS CLASS E7018

Low hydrogenrod for normal repairs on low alloy to medium carbon steel. All position welding, good penetration, and crack resisting up to 80,000 yield. Also suitable for repair of previous intershield welds.

AWS CLASS E11018G

Low hydrogen rod for repair on high strength alloy steel such as T-1, 80,000 to 100,000 yield. All position welding, good penetration, and high tensile stength up to 110,000.

NOTE: *Low hydrogen rod E7018 must be used within four (4) hours upon removal from a freshly opened container or from a storage oven.*

Low hydrogen rod E11018G must be used within 1/ 2 hour upon removal from its container or from a storage oven.

⚠	All welding procedures and welding operator qualifications shall be in accordance with ISO5817-C when welding on load sustaining members. Refer to ISO2553 for interpretation of welded joints symbols on drawings.

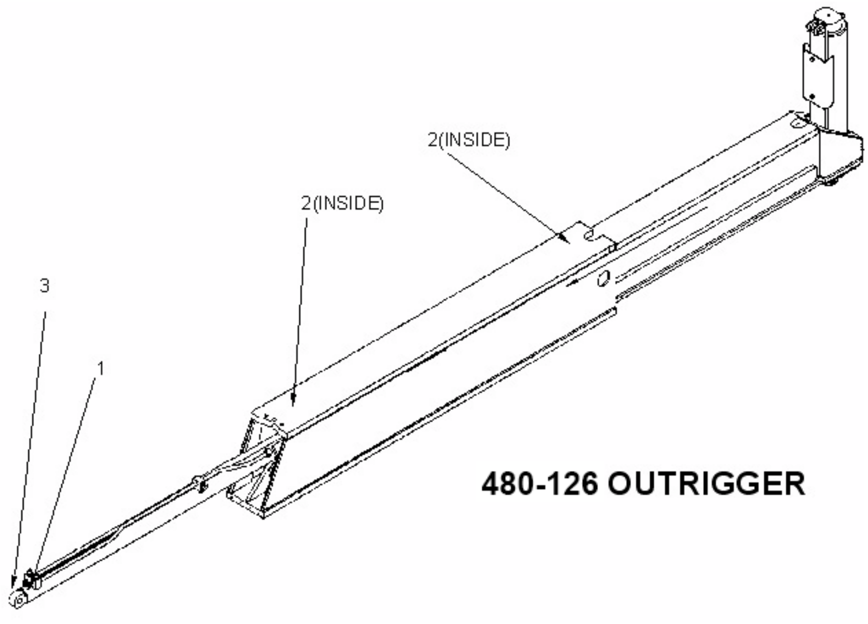
⚠	Special Considerations for Welding Painted Surfaces

When welding or cutting steel coated with a certain paint systems, the worker is exposed to decomposition products (metal fumes, gases or vapors, particulate) which vary depending on the type of process being used to weld or cut, the nature of the base metal, and the type of coating system. The following control procedures should be utilized when one is welding or cutting coated steel:

- Use a power brush or grinding wheel to strip the coating from the steel in the vicinity where the cut or weld is to be made. Remove the paint far enough from the weld to prevent any remaining paint from becoming heated and bubbling. If this happens, continue to brush or grind the paint away.
- A toxic dust respirator and eye protection should be used while stripping the paint.
- Welder should be outfitted with a fresh air supplied respirator and other personal protective equipment required for welding.
- Other employees should be removed from the area or told to stand back a minimum of 10 feet from the welder. Do not be in direct line with the weld fumes.
- Use a local exhaust hood to remove fumes during the welding or cutting operation if one is available.

Outriggers

480-126-Use a double beam outrigger as shown below.



1. Hose Disconnects
2. Wear Pad
3. Outrigger Extend Cylinder Deadend

NOTE: *The outriggers section coincides with section 3 in the parts manual.*

WEAR PAD (2)

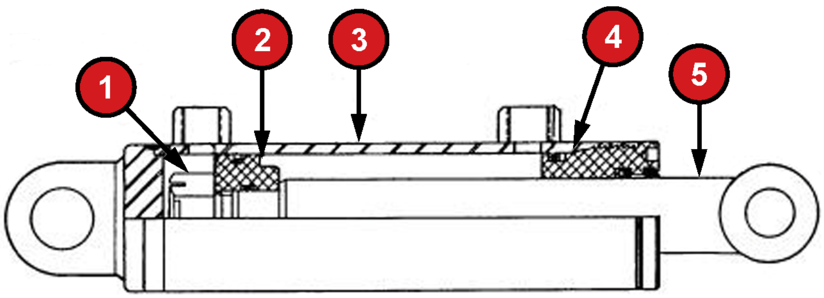
A wear pad (2) is mounted on the back end of each outrigger beam to prevent the beam from gouging the outrigger box when extending or retracting the outrigger beams. The wear pad (2) can be reached when the outrigger beam is fully retracted. The wear pad (2) can be replaced by removing one bolt.

BEAM REMOVAL AND REPLACEMENT

The outrigger beams must be removed to service the outrigger extend cylinder. The beams are removed by the following procedure:

1. Disconnect the hydraulic hoses (1) from the extend/ retract cylinder dead end (3).
2. Remove the extend/retract cylinder dead end pin.
3. Support the beam with a hoist and pull the beam out of the outrigger box. The extend/ retract cylinder will come out with the beam.

Install the outrigger beam by reversing the removal procedure.



1. Retaining Nut
2. Piston
3. Cylinder Barrel
4. Head Gland
5. Rod

BEAM EXTEND CYLINDER

The outrigger beam must be removed from the crane and the extend cylinder removed from the outrigger beam before servicing. With the beam removed, disconnect the hydraulic hoses form the jack cylinder and remove the extend cylinder live end pin. Remove the cylinder from the back end of the beam.

DISASSEMBLY

Disassemble the extend cylinder by means of the following procedure:

1. Extend the rod (5) far enough to allow the head gland (4) to be completely screwed out of the cylinder barrel (3).
2. Screw the head gland (4) out of the cylinder barrel (3).
3. Remove the head gland (4), rod (5) and piston (2) as a unit.

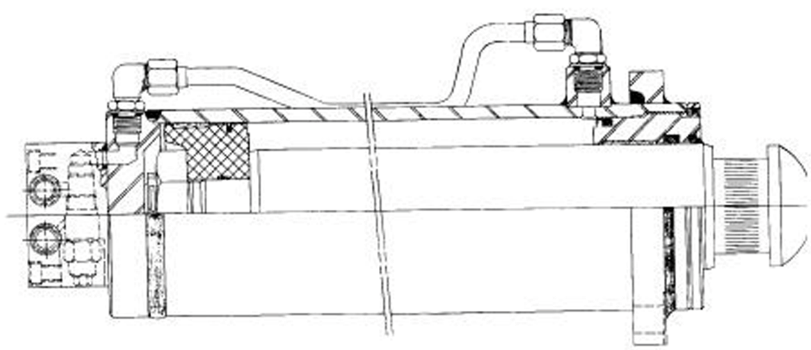
4. Remove the piston retaining nut (1) and slide the piston (2) and head gland (4) off the rod (5).

O-rings, back-up rings and seals may now be replaced.

ASSEMBLY

Reassemble the extend cylinder by reversing the disassembly procedure. Torque the piston retaining nut to 100-150 ft. lbs.

As the cylinder components are reassembled, be certain all rings, seals, spacers and setscrews required in one step are in place before proceeding to the next step. See Group 3 of the parts book for a complete listing of cylinder parts.



JACK CYLINDERS

The jack cylinders on this crane can be removed without removing the outrigger beams. To remove the jack cylinders, extend the outrigger beam a few feet, disconnect the hydraulic hoses and remove the four bolts retaining the jack cylinder to the outrigger beam.

DISASSEMBLY

Disassemble the jack cylinders by means of the following procedure:

1. Remove the jack cylinder from the outrigger beam.

2. Extend the cylinder rod far enough to allow the head gland to be screwed out of the cylinder barrel.
3. Remove the head gland, piston rod and piston as a unit. Remove the lower port tube fitting before removing the piston from the barrel.
4. Remove the piston retaining nut.
5. Slide the piston and head gland off the piston rod.
6. If the hold valve is to be serviced, disassemble as required.

NOTE: *The hold valve cartridge does not contain any serviceable parts. If the hold valve cartridge is broken, replace the entire hold valve cartridge.*

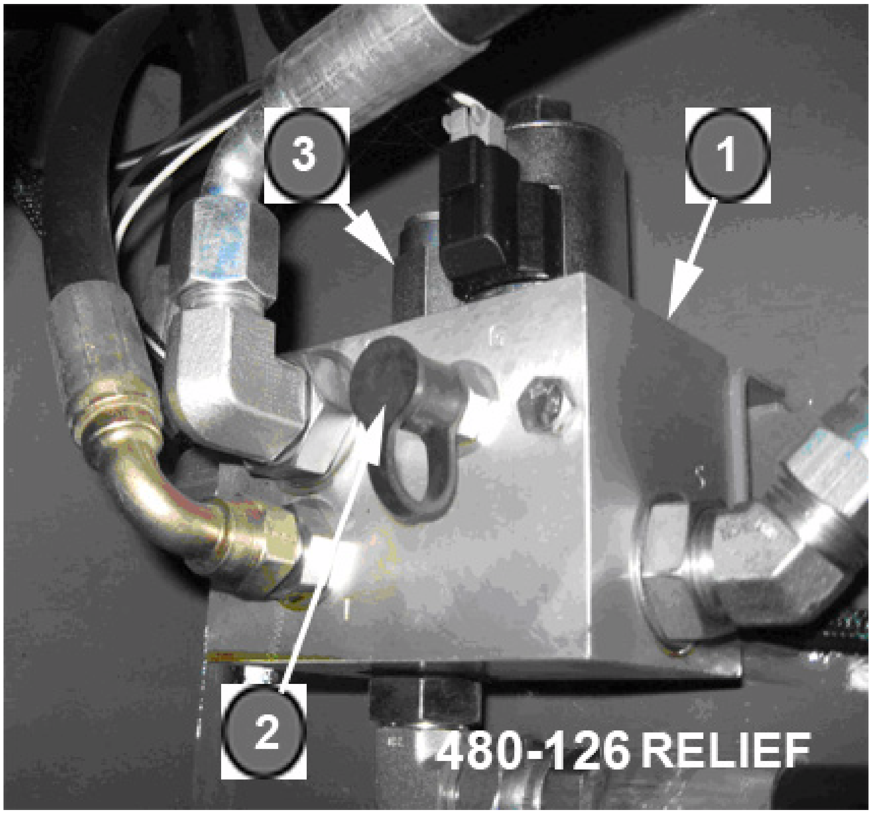
Replace O-rings, wear rings, seals or other components as required.

ASSEMBLY

Assemble the jack cylinder by reversing the disassembly procedure.

Apply Loctite to the threads of the piston retaining nut before assembly. Torque piston retaining nut to 900 ft lbs.

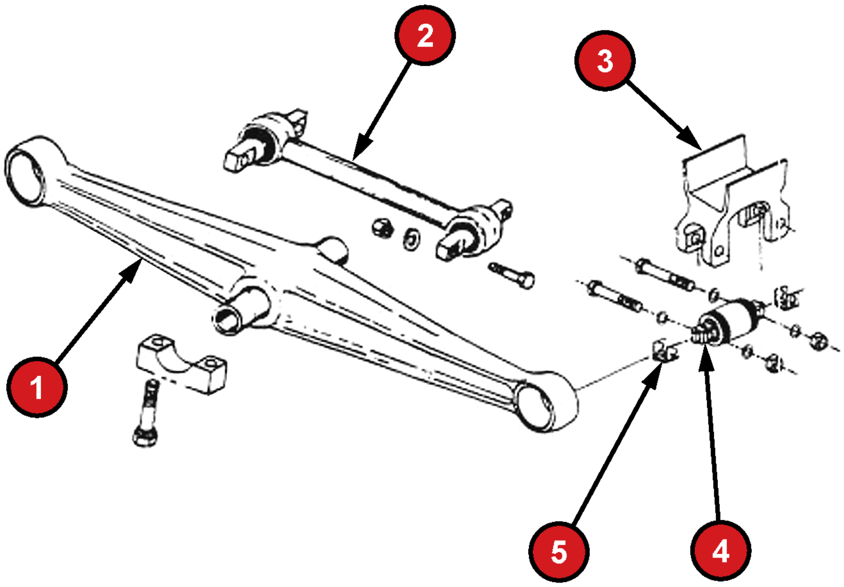
As the cylinder components are reassembled, be certain all rings, seals, spacers and setscrews required in one step are in place before proceeding to the next step. See Group 3 of the parts book for a complete listing of cylinder parts.



1. 480-126 Relief Valve
2. Test Port
3. Relief Pressure Adjustment

NOTE: *Relief is pre-set at 600 PSI.*

Rear Suspension



1. Equalizer Beam
2. Torque Rod
3. Part of Axle
4. Bushing
5. Shims

The rear suspension incorporates equalizer beams (1), which link front and rear driving axles, and torque rods (2) which locate the axles. Servicing these components consists of replacing worn bushings (4).

EQUALIZER BEAM BUSHINGS

Both center and end bushings (4) are replaceable. The beams (1) must be removed prior to servicing the bushings (4). Remove the beams (1) by the following procedure:

1. Remove the capscrews and saddle caps from the beam center pin.
2. Support the beam at one end (1). Remove the through bolt and shims (5) from the same end. Remove the support and lower the beam end to the ground.
3. Support the other beam end and repeat step #2.

BEAM INSTALLATION

Reverse the beam removal procedure to reinstall the beam.

Torque the center pin saddle clamp capscrews to 225- 275 ft. lbs and beam end through bolt nuts to 210-240 ft. lbs.

Front Axle

WHEEL BEARING AND ADJUSTMENT

Before adjusting the wheel bearings, be certain there is sufficient clearance between the brake shoe and drum so that shoe drag will not interfere with bearing adjustment. Use a torque wrench to make the adjustment.

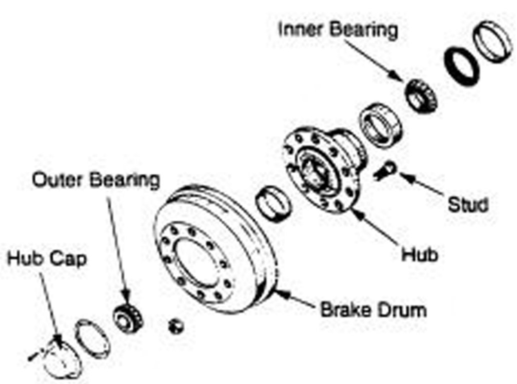
Torque the adjusting nut to 50 ft. lbs. while rotating the wheel in both directions to ensure that all bearing surfaces are in contact. Then, back off the adjusting nut 1/ 8 to 1/6 turn and cotter pin the nut.

End play must be within the limits of .001” to .010” loose.

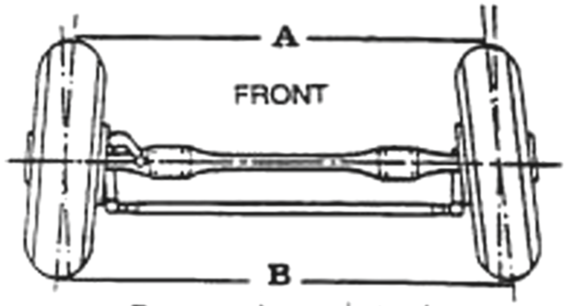
TOE-IN ADJUSTMENT

When checking or adjusting toe-in, the weight of the vehicle must be on the axle. The axle is initially jacked up for the purpose of chalking and scribing the center area of each front tire and then lowered for checking. Outriggers can be used when jacks of a capacity to raise the vehicle are unavailable. If an adjustment is found necessary, we recommend consulting your local distributor. Check the toe-in using the following procedure:

1. Jack up the front axle. Use a piece of chalk to whiten the center area of both tires around the entire circumference.
2. Position a scribe or pointed instrument against the whitened part of each tire and rotate tires. The scribe must be held firmly in place so a single straight line is scribed around the tire.
3. Position a full-floating turning-radius gauge plate under each wheel. Lower vehicle and remove lock pins from gauge plates. (If full-floating turning radius gauge plates are not available, lower vehicle and move backward and forward approximately six feet).
4. Set the sliding scale end of the trammel bar on “0” (zero) and lock in place.



HUB & DRUM ARRANGEMENT



B minus A equals toe-in.

5. Position trammel bar at rear of tires and adjust pointers to line up with scribe lines and lock in place. (Repeat for front of tires.)
6. Read toe-in (or toe-out) from scale. The recommended loaded toe-in is 1/32” - 1/16”.

NOTE: *Set radial tires from 0 to 1/32”.*

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Propellor Shaft & Universal Joints

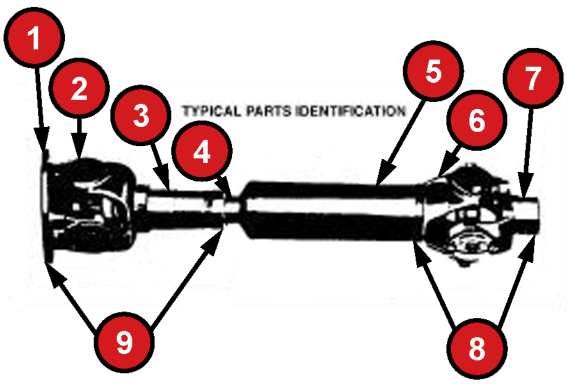
The drive train on this machine incorporates three drive shafts and five universal joints:

The front shaft extends from the transmission to a point just above and aft of the forward outrigger box. The shaft runs in a “Hanger” bearing at this point.

The second shaft couples with the front shaft and extends rearward to the intermediate axle.

The third shaft couples the two axles of the rear bogie, transmitting drive from the forward driving axle to the rear axle.

End yokes are used at all shaft ends and all couplings use bearing-cap type cross journal retainers.



1. Flange Yoke	6. Stub Yoke
2. Journal and Bearing Kit	7. End Yoke
3. Sleeve Yoke Assembly	8. Permanent Joint
4. Slip Stub Shaft	9. Slip Joint
5. Tubing	

DRIVE SHAFT REMOVAL

Remove the drive shafts by the following procedures:

THIRD SHAFT (Inter-axle Shaft)

Remove the capscrews, lock plates, and bearing caps from the intermediate and rear axle end yokes. Remove the shaft with journal crosses and remaining bearings as a unit. Axle end yokes remain on the vehicle

SECOND SHAFT

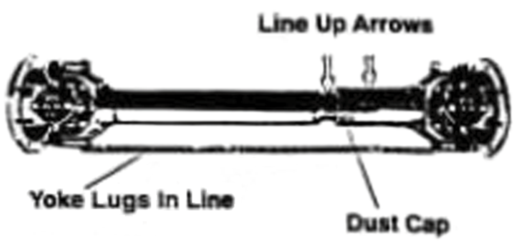
Remove the capscrews and bearing caps from the intermediate axle end yoke. Remove capscrews, lock plates, and bearing caps from rear end yoke of front shaft. Remove the second shaft with journal crosses and remaining bearings as a unit. Intermediate axle end yoke remains on machine.

FRONT

Prop up the rear of the shaft and remove the capscrew from "hanger" bearing; do not allow the shaft to fall onto or rest on the hydraulic connections on the outrigger solenoid valve. If the second shaft has been removed, remove the capscrews, lock plates, and bearing caps from the transmission end yoke. If the second shaft is in place, remove these same components from the front end yoke of the second shaft also. Remove the front shaft with journal cross(es) and remaining bearings as a unit.

SLIP JOINT REMOVAL

Before removing the slip joint, be certain there are arrow marks stamped on the shaft and sleeve yoke. If the arrow marks are not readily seen, mark both members so that, when reassembling, these marks can be placed in the same relative position. This is extremely important because the sleeve yoke lugs must be in the same place as the stub ball yokes to prevent excessive vibration in operation.



Remove the slip joint by unscrewing the dust cap from the sleeve yoke and sliding the joint off the drive shaft.

UNIVERSAL JOINT DISASSEMBLY

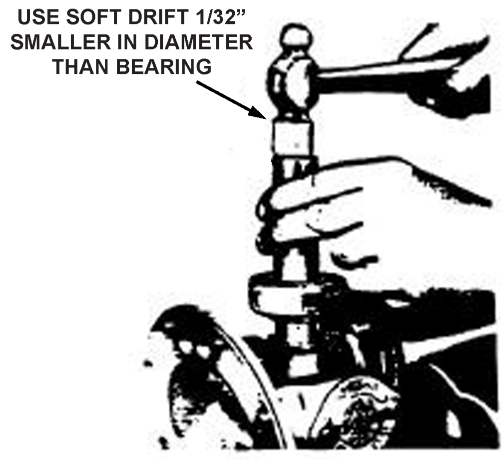
Disassemble the universal joints by the following procedure:

1. Bend the lock plates down with a screwdriver and remove the capscrews.

2. Using a large pair of channel lock pliers to grip retaining cap edges, turn retaining cap and bearing assembly while at the same time lifting the assembly from the journal trunnion and out of the yoke hole.

3. Turn the yoke over and tap the exposed end of the journal cross until the opposite needle bearing is free.

> ⚠ TO PREVENT DAMAGE TO THE BEARING, USE A SOFT ROUND DRIFT WITH FLAT FACE AND DIAMETER ABOUT 1/32" SMALLER THAN YOKE HOLE.



4. Remove the journal cross by sliding it to one side of the yoke and tilting it over the top of the yoke lug.

UNIVERSAL JOINT ASSEMBLY

Before reassembly, be sure to clean and inspect all parts. If necessary, replace the four journal retainer seals. Assemble the universal joint by means of the following procedures:

JOURNAL CROSS

With the relief valve facing the flange yoke, insert one trunnion of the journal cross into the bearing hole in the yoke lug from the inside (between the lugs) and tilt until the trunnion of the journal cross will clear hole in opposite yoke lug.

NEEDLE BEARING AND RETAINING CAP ASSEMBLY

Insert from outside of yoke. Press into place with an arbor press or tap with a soft round drift. Be careful not to mar or dent any surfaces.

LOCK STRAP AND CAPSCREWS

Assemble and bend lugs of lockstrap up against the flat of capscrews. If joint appears to bind, tap lugs lightly to relieve any pressure on journal end bearings.

DRIVE SHAFT INSTALLATION

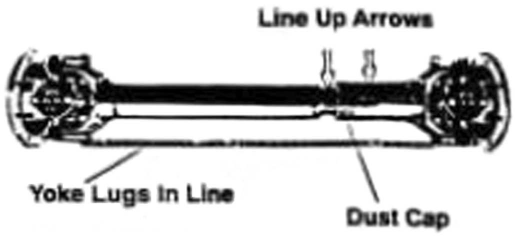
The installation of the drive shaft into the carrier does not present any unusual mechanical difficulties. Before actual installation, the drive shaft should be checked for the following items:

1. No damage or dents on drive shaft tubing which could cause unbalance. If the dents are severe enough, they can weaken the tube and a failure might occur under torque load.
2. Splines should slide freely with slight drag from spline seal.
3. Bearings should flex and be free from excessive bind. A slight drag is the most desirable condition on a new universal joint. This drag is from the earing seals. When rotating, yoke lug deflections cause some addititonal clearance. Excessive looseness is not desirable due to the resulting unbalance.
4. Mounting flanges and pilots should be free from burrs, paint, and foreign substances which would not allow proper seating at assembly.

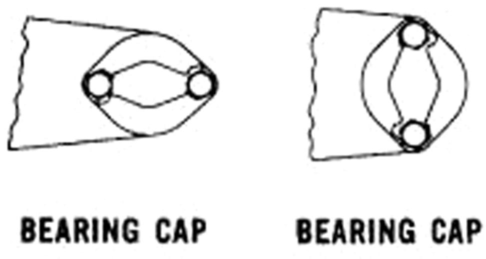
SLIP JOINT ASSEMBLY

Lubricate the splines thoroughly and assemble on the shaft. BE SURE that the arrows on the shaft and slip joint are in line. The sleeve yoke must be in the same plane as the stub ball yoke lugs to prevent excessive vibration.

The cork washer should be replaced if necessary before assembling with the dust cap and steel washer on the sleeve yoke.



NOTE: *In bearing cap construction joints, be sure to torque the capscrews to 100 ft. lbs.*



UNIVERSAL JOINT PHASING

When yokes are assembled to their shafts in the same plane, they are in phase. To obtain vibration-free operation, check the following:

1. The forward and second shafts, between the transmission and the intermediate axle, must be assembled “In Phase”.
2. The inter-axle drive shaft yokes, at the third shaft, must be assembled “In Phase”.
3. When drive shafts are running at parallel angles throughout the drive line system yokes and flanges must be held parallel to within 1° of each other.

Wheel and Rim Mounting

MAINTENANCE CHECK

As a part of your WEEKLY MAINTENANCE, check the wheel retaining nuts to insure proper tightness. Torque values and correct torquing procedures are offered in this section.

HEAVY TRUCK ALUMINUM DISC WHEEL INSTALLATION PROCEDURE

1. HUB-PILOTED MOUNTING

   Wheels with the hub-piloted mounting system are called hub piloted wheels. Hub Piloted Disc Wheels are designed to center on the hub at the center hole or bore of the wheel. The wheel center hole locates the wheel on pilots built into the hub. Hub piloted wheels are used in two-piece flange nuts which contact the disc face around the bolt hole. Only one nut on each stud is used to fasten single or dual wheels to a vehicle. All stud and nut threads are right hand. Hub piloted wheels are straight through bolt holes with no ball seat, which provides a visual way of identifying them. See figure below.

A. 10 Hole, 11.25” Bolt Circle DCN Mounting.

1. Inflate tire prior to installing on vehicle.
2. Inspect parts before installing.

Check all parts for damage, including rims/ wheels . Ensure that studs, nuts, and mounting faces of hub drum and wheels are flat, clean, and free from grease. Clean hub surface with wire brush if scale is present.

Replace any damaged parts. Do not bend, weld, heat, or braze components. Do not use tubes to stop rim air leakage.

> Not all nuts and studs can be used with all types of wheels. The use of improper nuts and studs can cause nut loosening, stud failure, or premature wheel failure, which could cause an accident or injury.

Use correct nuts. Inspect nuts to ensure they are not worn and function properly.

a. **Front Wheels**

Slide front wheel over studs, being careful not to damage the stud threads. Snug up nuts in the sequence shown in Figure 4. Do nut tighten them fully until all have been seated. This procedure will permit the uniform seating of nuts and ensure the even, face-to-face contact of wheels, hub, and drum. Tighten nuts to 450- 500 ft.-lbs. (item 1 dry) using the same criss-cross sequence.

1. Torque each nut to 450-500 ft.-lbs (dry).
2. Install 1222-356 Cover, Lug Nut (10).

b. **Dual Rear Wheels**

Slide the inner dual wheel over studs, being careful not to damage the stud threads (1). Do not tighten them fully until all have been seated. This procedure will permit the uniform seating of nuts and ensure the even face-to-face contact of wheels, hub, and drum.

1. Torque each nut to 450-500 ft.- lbs (dry).
2. Install 1222-356 Cover, Lug Nut (10)

Align the hand holes to allow access to the air valves.

Slide the outer dual wheel over the inner cap nuts and repeat the entire procedure except using the nut tightening sequence in Figure 5.

4. Torque Nuts Properly

Be sure to tighten wheel nuts to the recommended nut torque. Do not overtighten. Do not lubricate the nuts or studs.

After the first 50 & 250 miles of operation, recheck the torque level and retighten nuts to the proper torque level. When inner cap nuts are retightened, be sure to loosen the outer cap nuts first, tighten inner cap nuts and retighten outer cap nuts to proper torque level. - Maintain nut torque at the recommended level through planned, periodic checks.

If air wrenches are used, they must be periodically calibrated for proper torque output. Use a torque wrench to check the air wrench output and adjust the line pressure to give correct torque.

Nuts must be kept tight by retorquing nuts on a routine basis and using the proper nut torque and tightening sequence. Loose nuts could result in loose wheels or premature wheel failure. This can result in an accident or injury.

The procedure used to install aluminum wheels on a vehicle are identical to those used for heavy truck steel wheels except for the nuts used. Aluminum wheels have a thicker disc than conventional steel wheels: therefore, special nuts and longer studs may be required.

Not all nuts and studs can be used with all types of wheels. The use of improper nuts and studs can cause nut loosening, stud failure, or premature wheel failure, which could cause an accident or injury.

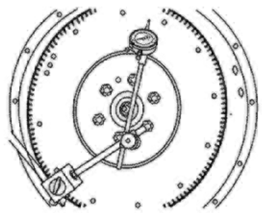
Engine Clutch Adjustment & Repair

Measure Engine Flywheel Housing And Flywheel

Engine flywheel housing and flywheel must meet these specifications or there will be premature clutch wear. Remove old Pilot Bearing. All gauge contact surfaces must be clean and dry. Use a dial indicator and check the following:

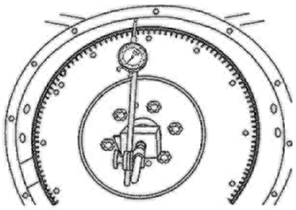
Flywheel Face Runout

Secure dial indicator base to flywheel housing face. Put gauge finger in contact with flywheel face near the outer edge. Rotate flywheel one revolution. Maximum runout is .008" (.20 mm).



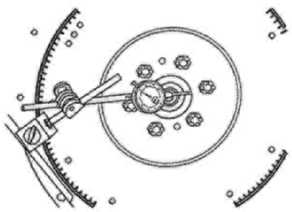
Flywheel Housing I.D. Runout

Secure dial indicator base to crankshaft. Put gauge finger against flywheel housing pilot I.D. Rotate flywheel one revolution. Maximum runout is .008" (.20 mm).



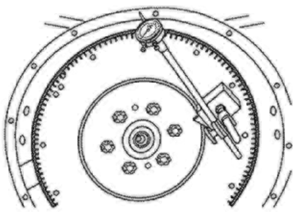
Pilot Bearing Bore Runout

Secure dial indicator base to flywheel housing face. Position gauge finger so that it contacts pilot bearing bore. Rotate flywheel one revolution. Maximum runout is .005" (.13 mm).



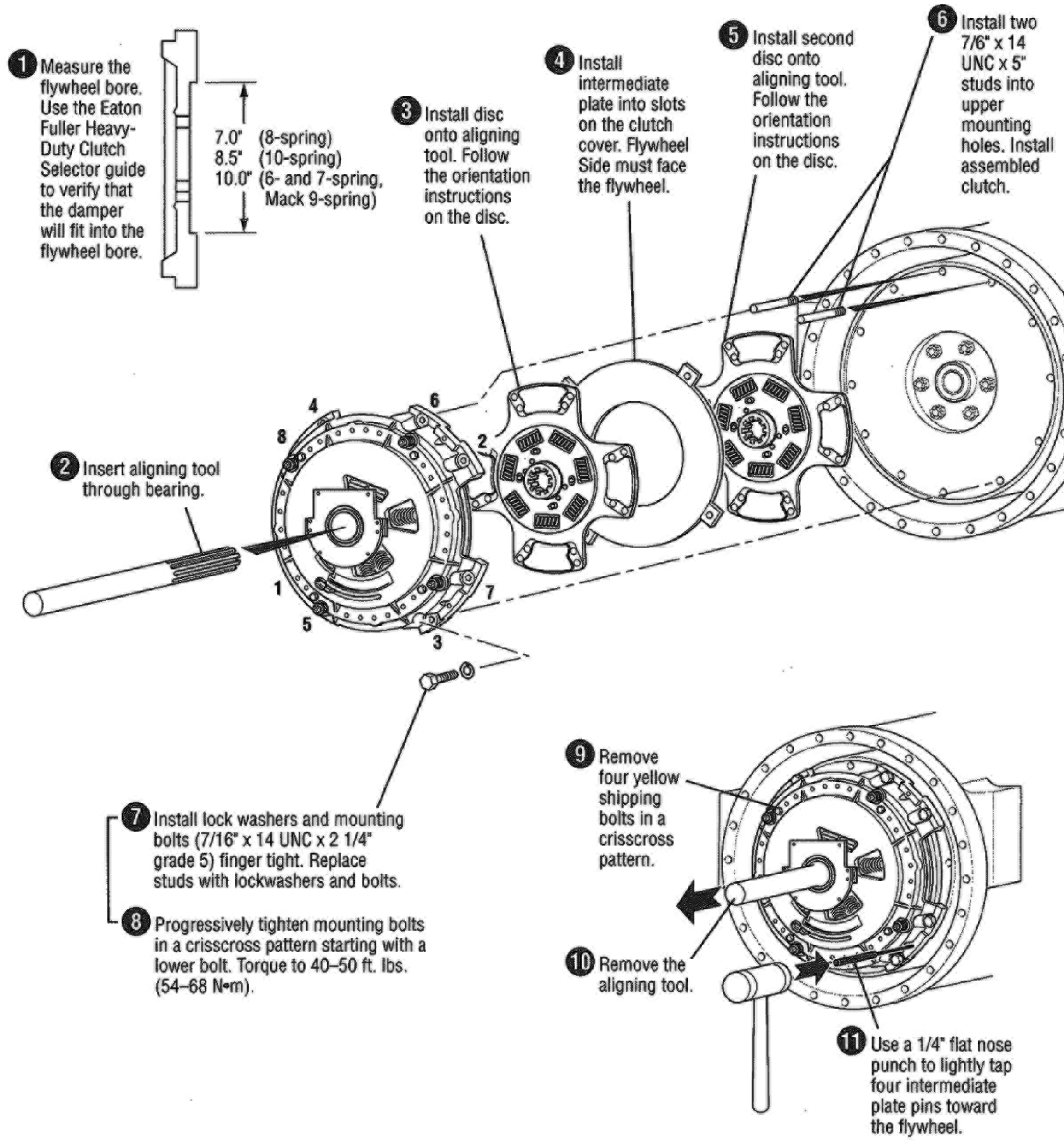
Flywheel Housing Face Runout

Secure dial indicator base to flywheel near the outer edge. Put gauge finger in contact with face of flywheel housing. Rotate flywheel one revolution. Maximum runout is .008" (.20 mm).



IMPORTANT: Use the Eaton Fuller Heavy-Duty Clutch Selector guide (CLSL-1299) to make sure you have the right clutch!

CAUTION: An assembled clutch weighs about 150 lbs. (68 kg). Avoid the risk of injury. Use proper equipment when lifting a clutch.

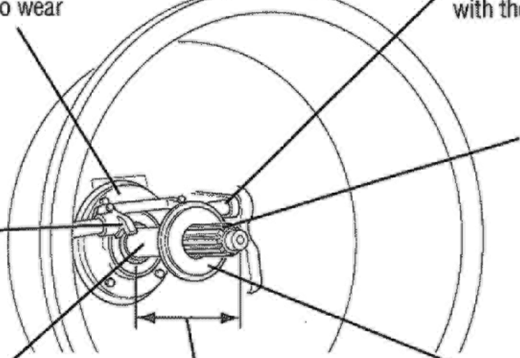


Check Transmission For Wear

Replace any worn components.

Transmission Bearing Retainer Cap
A worn/rough bearing retainer cap may cause the clutch brake to wear prematurely.

Cross Shaft And Bushings
Excessive wear at these points can cause side loading on the sleeve bushing, bushing failures and yoke bridge contact with the clutch when the pedal is down.



Release Yoke
Worn fingers can cause bushing wear and yoke interference when the pedal is down.

Input Shaft Splines
Any wear on the splines will prevent the driven discs from sliding freely, causing poor clutch release (clutch drag). Slide discs full length of shaft to check for twisted shaft splines.

Clutch Brake
Replace if worn.

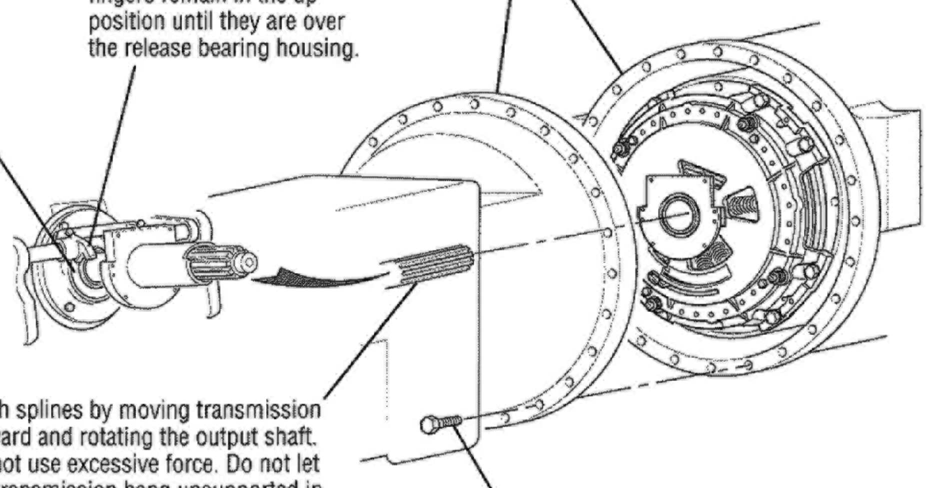
Input Shaft
Wear (roughness) can reduce sleeve bushing life and cause it to come out.

Measure Input Shaft
Length should be 8.657" (219.89 mm) nominal, and not greater than 8.71" (221.23 mm). Ref. 1990 SAE handbook 4:36.106. Replace transmission bearing retainer cap if length is greater than 8.71" (219.89 mm).

Fasten Transmission To Flywheel Housing

Transmission installation and clutch set-up procedures are the same for the Solo and Solo XL.

1. Put transmission in gear. Be sure new clutch brake has been installed.
2. Make sure that the yoke fingers remain in the up position until they are over the release bearing housing.
3. Position transmission so it is square to and aligned with engine.



4. Mesh splines by moving transmission forward and rotating the output shaft. Do not use excessive force. Do not let the transmission hang unsupported in the discs.
5. Install mounting bolts and torque to OEM specs.

CAUTION: Do not pull on release arm to install transmission. This will cause the clutch to over adjust.

Never wait for a clutch to slip before making adjustment. It is too late then to make adjustment. Facings quickly disintegrate once they become burned through slippage, and have short life thereafter.

Steering and Power Steering

STEERING STOP ADJUSTMENT

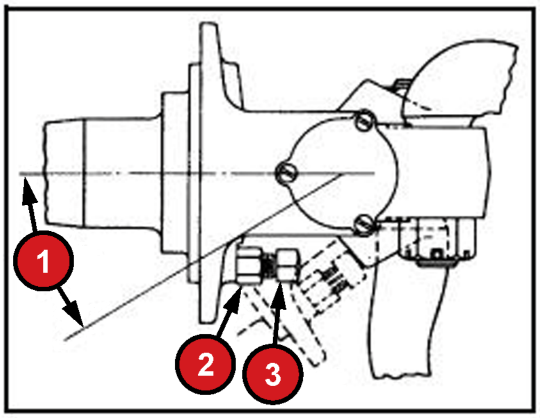
An initial stopscrew (3) adjustment is made on all steering axles to obtain maximum turning angle (1). However, because a power steering unit has been added, the stop screw (3) should be reexamined to assure that the adjustment is such that the power steering unit will not override the axle stop.

To prevent overriding, adjust power steering systems and stopscrews so that the power is cut-off ahead of the axle stop.

a. Adjust the axle steering stops (3) to contact when the maximum turning angle (1) of the specific axle is reached, and lock with jam nut (2).

b. Adjust the power steering unit to stop approximately 1/16” to 1/8” before axle steering stops (3) contact. (maximum turning angle 1).

The adjustment of both axle steering stops and power steering unit should be periodically checked and corrected if necessary.



1. Maximum Turning Angle	2. Jam Nut
3. Stop Screw	

Pumps

GENERAL INSTRUCTIONS

In the event of pump failure, we strongly recommend that you contact your local distributor. However, should you decide to facilitate the repair of these units - CONSULT THE MANUFACTURER'S REPAIR MANUAL - read all of the steps used in disassembly and all of the steps used in building up the unit. It is important to airblast all parts and wipe them with a clean, lintless cloth before assembly.

Dirt is the enemy of any hydraulic system. The first requirement of good maintenance of hydraulic equipment is cleanliness. MAKE SURE YOU DISASSEMBLE AND ASSEMBLE YOUR HYDRAULIC EQUIPMENT IN A CLEAN AREA.

USE CAUTION IN GRIPPING ALL PARTS IN THE VISE TO AVOID DAMAGING MACHINED SURFACES.

A pump must be driven in the direction of rotation for which it was built; otherwise, pressure will blow the shaft seal.

START-UP PROCEDURE

Before installing a new or rebuilt pump or motor, back off the main relief valve until the spring tension on the adjusting screw is relieved. This will avoid the possibility of immediate damage to the replacement unit in the event that the relief valve setting had been increased beyond the recommended operating pressure prior to removing the old unit.

Before connecting any lines to the pump or motor, fill all ports with clean oil to provide internal lubrication. This is particularly important where the unit is located above the oil reservoir.

After connecting the lines and mounting the replacement unit, operate the pump or motor at least two minutes at zero pressure at lowest R.P.M. During this break-in period, the unit should run free and not develop an excessive amount of heat. If the unit operates properly, speed and pressure can then be increased to normal operating settings.

Reset the main relief valve to its proper setting while the pump is running at maximum operating engine (motor) speed for the vehicle.

TEST PROCEDURE

Be sure there is an adequate supply of oil for the pump, at least one gallon of oil for each GPM of pump capacity.

If one section of a tandem pump is being tested, make sure that all other sections not being tested are adequately supplied with oil. If any of the other sections run dry, or if plugs are left in ports, serious and permanent damage will result.

The oil should be a good quality hydraulic oil rated at 150 SSU at 100°F, with the oil temperature held at 120°F plus or minus 5°F.

The feed line must be of adequate size with no more than 5” mercury vacuum adjacent to the pump inlet. As a rule, the feed line must provide a feed flow velocity not in excess of 8 feet per second.

Hot oil must not be fed into a cold pump. It may seize. Jogging may prevent seizure.

Operate the pump at least two minutes at zero pressure and at moderate speed (not over 1500 rpm).

If pump becomes hot to touch, it is binding and may seize. This doesn’t happen very often, but if it does, pump will have to be disassembled and rebuilt, with extra care taken to remove burrs and to assure freedom from binding.

Gradually increase pressure on pump, intermittently, until the desired test pressure has been reached. This should take about five minutes.

Delivery should run close to rated catalog performance figures which are averaged from testing several pumps. Something like a 5% lower reading may be used as a rated minimum if new or relatively new parts have been used. When rebuilding the pump with parts from the original pump, which, while worn, appear satisfactory for re-use, a 10% or 15% lower reading may be permitted, depending on the performance expected from the equipment. One’s own experience will prove the best guide here.

Many repairmen measure the output at normal operating speed and at zero pressure, then again at 1000 psi (or the operating pressure of the equipment) and allow a volume decrease approximating the listing below. It is a suggested reference only which makes allowance for re-used parts.

Be sure to run the pump in the direction for which it was designed and built. Driving pump in the wrong direction will build up pressure behind shaft seal, damaging it and necessitating replacement.

Since it is rarely feasible to test motors on dynamometers, the practical procedure is to test them as pumps, running complete testing procedures in each direction.

After completing testing procedures, pump is ready for installation and immediate duty operation on equipment. Again, it must be remembered that to prevent seizure, hot oil must not be fed into a cold pump.

USE OF IMPROPER TOOLS IN SERVICING THESE PUMPS MAY RESULT IN DAMAGE TO PUMP COMPONENTS.

Valve Adjustments

Setting hydraulic pressure is an extremely complex and intricate operation and should be performed only after satisfying the following conditions:

1. Warm the hydraulic oil to 130° F in normal conditons. NOTE: If the normal hydraulic reservoir operating temperature is substantially above or below 130° F, use that value instead.
2. Pressure should be set at maximum pump RPM (engine needs to be set for correct "max" RPM). The relief valve setting will vary with the flow rate.
3. Be certain to calibrate the pressure gauge used. Gauge calibration can be lost if the gauge is subjected to rapidly pulsating pressure for a few seconds. The gauge must have a proper snubber to read center of pump pressure ripple or erroneous readings will result.

MAINTENANCE CHECKS

All relief valve maintenance checks are conducted on a SEMIANNUAL BASIS. Check the relief valves and make the necessary adjustments by the following procedures.

The relief valves used on this hydraulic crane have screw-type adjustment. If it is determined that a valve is out of adjustment, follow this general adjustment procedure. Install a good quality 5000 psi gauge in the designated test port locations and proceed with pressure check and adjustment as follows.

THIS MACHINE USES A PRESSURIZED HYDRAULIC RESERVOIR. THE PRESSURE MUST BE RELEASED BEFORE ANY HYDRAULIC LINE OR CONNECTION IS OPENED. Failure to do so will result in substantial loss of oil and may cause personal injury. The pressure is relieved by turning the reservoir cap counterclockwise to the first stop. DO NOT turn the cap beyond the first stop until pressure has been released. This will cause the cap to be blown off the reservoir with sufficient force to cause personal injury. DO NOT place any portion of your body above the reservoir cap while relieving pressure or removing cap.

BOOM HOIST & MAIN RELIEFS

Check the boom relief settings as follows:

1. Operate the boom over relief to warm the oil if necessary.
2. Attach a calibrated pressure gauge to test port on the inlet pressure port at the valve bank.
3. Lower the boom completely and continue to boom down with the engine running at full governed rpm. The relief setting per chart below:

480-126	BOOM HOIST	**SET TO:** 4500 psi

BOOM RELIEF ADJUSTMENTS

Adjust the boom hoist, retract, and telescope reliefs using the following procedures.

Adjust the boom hoist relief by loosening jam lock nut on relief valve. Adjust valve with adjusting screw while booming up or down over relief withe engine at maximum governed rpm. Screw in to increase pressure setting; out to decrease it. Retighten lock nut when proper setting is obtained.

EXTEND/RETRACT RELIEFS

The initial range has been preset. Adjustment is accomplished by loosening the jam nut and either turning the adjusting screw in to increase pressure or backing it off to lower pressure. Retighten the jam nut when the desired pressure is obtained.

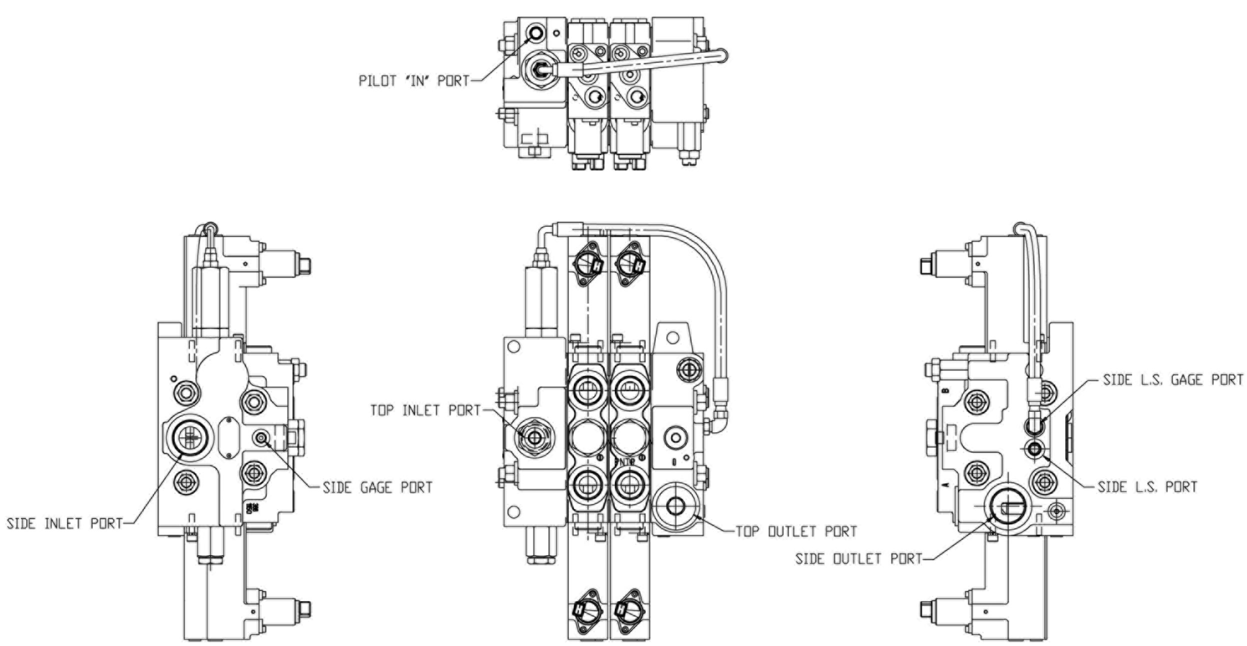
Set extend/retract by the following procedure:

First, retract the boom completely and continue to retract over relief with the engine running at full governed rpm. Initially, set the retract port relief valve (located on spring cap end of telescope section) to obtain a reading according to above chart. Then turn it an additional 1/2 turn clockwise.

MAIN WINCH RELIEF

Check the winch relief setting using the following procedure:

1. Attach a pressure gauge to the test port on the mid-section inlet port.
2. Disconnect and plug the brake line at the piston housing on the winch.
3. Restart the engine and run at high idle speed.
4. Winch and hold the lever in the “lower” position while obtaining a reading. See chart below for proper settings. The main & auxilary winch relief are combined into one valve bank assembly as shown below. It is adjusted in the same manner as the boom relief.



AUXILIARY WINCH RELIEF

Check the pressure using the following procedure.

1. Attach a pressure gauge to the main & auxilary winch test port.
2. Disconnect and plug the brake line at the piston housing of the auxiliary winch.
3. Restart the engine and run at high idle speed.
4. Winch down and hold the lever in the “lower” position while obtaining a pressure reading. See chart below for proper settings. If required, adjust the relief at the auxiliary winch valve. This relief is adjusted in the same manner at the boom relief.

480-126	MAIN & AUX WINCH	SET TO: 4500 psi

SWING RELIEF

Check the swing relief setting by means of the following procedure:

1. Attach a gauge to swing test port.
2. Set the swing brake and attempt to swing against the brake with the engine running at maximum governed rpm. Adjust the swing relief valve, if necessary, per the chart below.
3. The 480-126 has two (2) reliefs on the diverter valve, one is for Swing/AC/Counterweight Removal with setting of 3500 psi. The other relief is for outriggers.

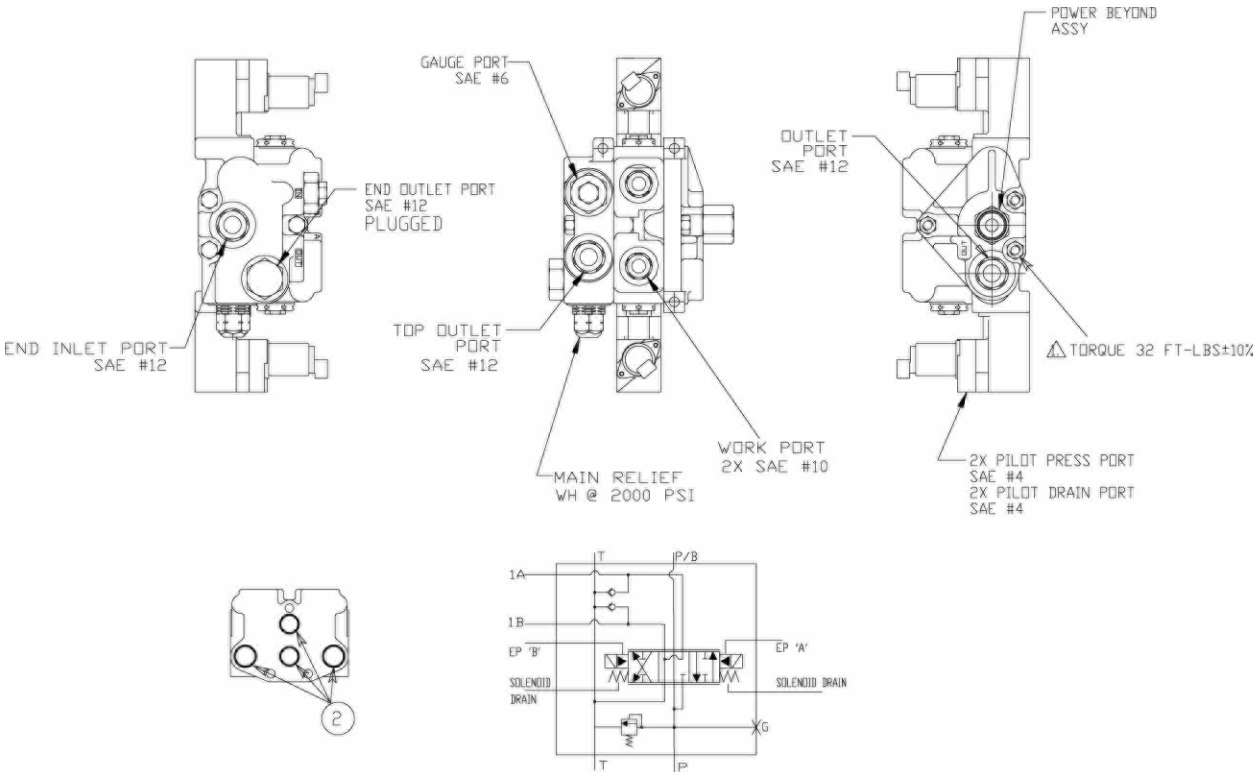
480-126	SWING/AC/C'WT	SET TO: 3500 psi
480-126	OUTRIGGERS	SET TO: 2500 psi

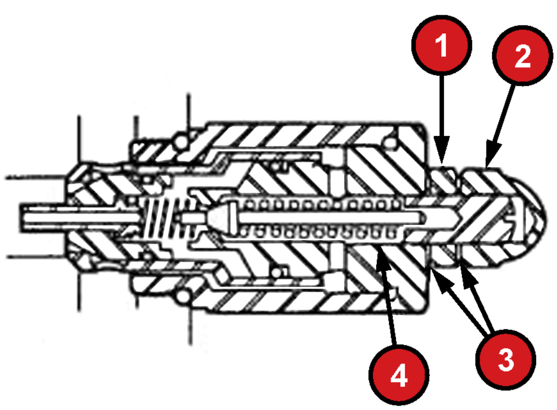
SWING RELIEF ADJUSTMENT

Remove acorn nut from relief valve and loosen lock nut. (See graphic image below for location)

While stalling out the swing motor with swing brake applied at maximum rpm, adjust valve with screwdriver until proper pressure is obtained; screwing in adjustment screw to increase pressure setting and out to decrease it.

Re-tighten lock nut and replace acorn nut.





1. JAM NUT	2. ACORN NUT
3. WASHER	4. ADJUST SCREW

SETTING RELIEF VALVE PRESSURES ON SWING VALVE

Attach the pressure gauge on the swing valve test port, and follow these steps:

Remove acorn nut and loosen jam nut, make sure several threads on adjusting screw are engaged in pilot section.

Use a screw driver and set adjusting screw as follows:

a. Run the pump at low operating speed (approximately 1/4 of full engine rpm) but fast enough so that the pump is developing the required pressure.

b. Operate the control valve at its extreme position long enough to get a pressure reading on the gauge.

c. Turn the adjusting screw clockwise to increase pressure or counterclockwise to decrease pressure until desired setting is obtained.

d. Hold the adjusting screw, tighten jam nut and install and tighten acorn nut.

e. Retest to check pressure setting.

NOTE: *Results of the above settings will indicate a relatively constant relief valve setting across full engine rpm.*

RELIEF VALVE REPAIR RECOMMENDATIONS

The cartridge type service port reliefs used in the swing valve are of the pilot poppet type with external adjustment. Any malfunctioning is usually the result of foreign matter lodging between the piston, relief valve poppet, and check valve.

To perform service, clean the surrounding area and remove the complete relief valve cartridge. Examine the seat in the main valve housing for grooves or ridges. If damaged, either replace the valve or have it re-machined.

The design of the pilot poppet and its seat provides positive seating and very seldom requires any maintenance. The pilot section can be removed from the cartridge housing without disturbing the setting.

With it will come the check valve poppet and other internal parts. These are easily disassembled and should be examined for foreign matter. All seats and seating surfaces should be free of nicks, scratches, or grooves. Examine "O" rings and back-up washers for any damage. If any parts are found to be faulty, replace the relief cartridge. All moving parts should slide freely, with only seal friction being present. After inspecting and cleaning, immerse all parts in hydraulic oil and reassemble. If pressure setting was not disturbed, unit can be tested for proper functioning under normal working conditions. If operating difficulties indicate that the pilot poppet is still leaking or sticking, replace the relief.

OUTRIGGER RELIEF

Use the 4000 psi test gauge and check as follows:

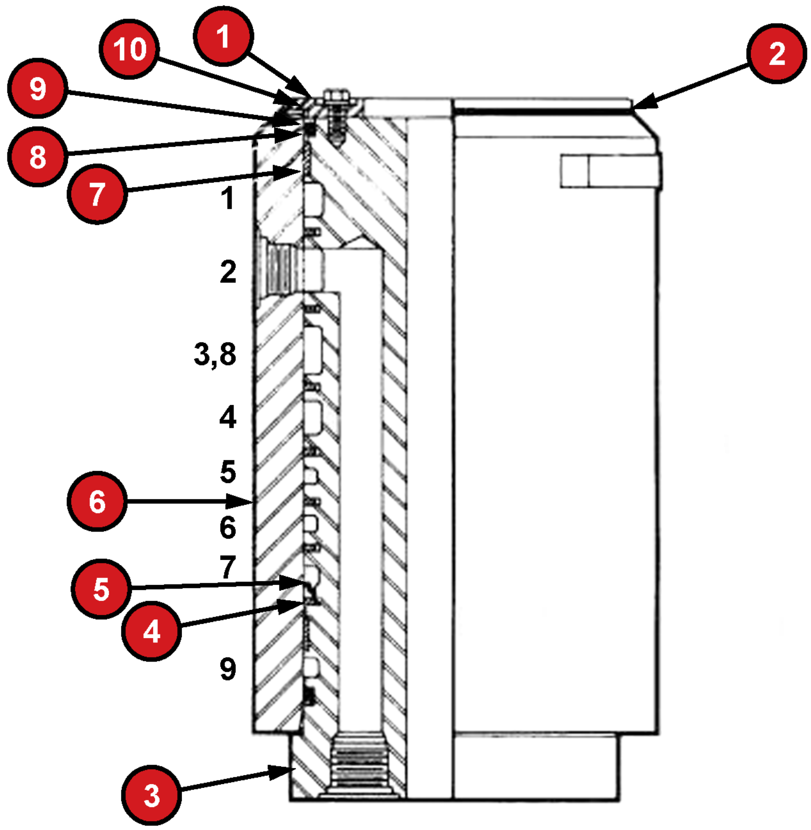
1. Attach the gauge at the quick disconnect on the diverter valve (B), located on the L.H. side of the front outrigger box.
2. Start engine and run at full throttle.
3. Set the outrigger extend/retract switch to the retract position and read the gauge. The relief is located above the outrigger diverter valve. Adjust to proper setting as listed in chart below:

480-126	OUTRIGGERS	**SET TO:** 2500 psi

OUTRIGGER RELIEF ADJUSTMENT

With the test gauge still attached to the test port, remove the hex cap, insert an allen wrench. adjust to the proper setting while holding the outrigger in the retract position. Turn in to increase pressure, out to decrease. After completing adjustment, replace cap on the relief valve.

Rotary Manifold



1. END PLATE	2. "O" RING
3. SPOOL	4. SEAL
5. RECTANGULAR RING	6. CASE
7. WEAR RING	8. "O" RING
9. BACK-UP RING	10. THRUST WASHER

Use the following procedures when disassembling, inspecting, repairing, and reassembling the rotary manifold

AS SOON AS THE ROTARY MANIFOLD IS READY TO BE PLACED INTO OPERATION, IT SHOULD BE SLOWLY ROTATED SEVERAL MINUTES TO ALLOW ANY ENTRAPPED AIR TO ESCAPE AND TO FACILITATE REFORMING OF SEALS THAT MAY HAVE TEMPORARILY DEFORMED DURING STORAGE.

All overhaul should be done in a clean, enclosed facility with personnel familiar with hydraulic systems and cleanliness procedures.

DISASSEMBLY

The rotary manifold may be disassembled by removing the four capscrews and the top plate.

NOTE: *Be sure to mark an index point on the case and spool to insure proper reassembly.*

INSPECTION AND SEAL REPLACEMENT

1. The “case” bore should be thoroughly washed with solvent or diesel fuel and inspected for signs of “scoring” or deep scratches. This type of damage is generally caused by the presence of foreign material in the hydraulic system. No satisfactory method of repairing this type of damage can be conducted in the field.
2. The “spool” should be carefully washed in solvent or diesel fuel. The seals and “O” rings should not be removed from the spool unless they show signs of wear or damage. NOTE: If the seal is removed for any reason, it should be replaced since removal will almost always damage it beyond use.

When installing a new seal and ring, it must be “walked” into place past other seals and oil grooves and then into its own groove in the same manner that the bead of a tire is “walked” into the wheel rim. The spool should be well oiled to aid in this assembly. Best results can be achieved if the spool, with the seals mounted on the end, is allowed to sit overnight. This gives the seals a chance to adjust to normal size.

REASSEMBLY

1. The top and bottom “O” rings and back-up washers can be replaced without removing the spool. Removing the top cover exposes the top “O” ring. The spool will drop out of the case, exposing the bottom “O” ring.

UPON REASSEMBLY, INSTALL THE UPPER “O” RING AND BACK-UP RING AFTER THE SPOOL IS IN THE CASE. THIS WILL PREVENT ANY DAMAGE WHICH MIGHT RESULT FROM SLIDING PAST PORT OPENINGS.

2. The rotary manifold should be reassembled using a generous coat of oil on the case ID and spool OD. Generally, reassembly is most successful by placing the case in a vertical position and inserting the spool into the case. Each seal and wear ring should be compressed by hand to initially enter the case bore. With the spool fully inserted into the case, the assembly may be “up-ended” to replace the end plate.
3. Ports should be properly protected, capped, and, preferably, oil filled without pressure.

NOTE: *If the rotary manifold is oil filled and plugged, ample air space should be allowed for the expansion of oil due to temperature changes.*

IT IS IMPORTANT THAT THE SPOOL FLOATS FREELY WITH THE CASE TO PREVENT WEAR AND LEAKAGE. THE SPOOL IS HELD STATIONARY WITH RESPECT TO THE LOWER BY A RESTRAINING BRACKET DESIGNED TO ALLOW FOR SOME ECCENTRICITY. THE ROTARY MANIFOLD SHOULD BE SHIMMED AT THE MOUNTING EARS AS NECESSARY TO INSURE CONCENTRIC ROTATION. ROTATE THE MACHINE WHILE VISUALLY CHECKING THE ALIGNMENT. THE BRACKET MUST NOT BIND DURING ROTATION.

Control Linkage Adjustment

SWING LOCK

The swing lock cable linkage is adjusted at the control handle. Cable tension is increased or decreased by turning the control handle in or out. Avoid excessive tension to prevent cable damage. Adjustment of the rod length or the clevis ends of the cable should not be necessary unless new parts are installed.

SWING BRAKE PEDAL

Adjust swing brake pedal by loosening cable lock nuts at pedal anchor. Increase tension by shifting cable out of the "U" shaped bracket with adjustment of the locking nuts.

SHIFT CONTROL

No adjustments are possible. In the event of malfunction, check for electrical continuity.

THROTTLE CONTROL

The throttle control is electronic, see Detroit Diesel™ Engine Maintenence Manual for output signals & voltage range.

REAR AXLE DISENGAGE

No adjustments are possible. In the event of malfunction, check for electrical continuity and air supply.

Heaters & AC Systems

Refer to the Shop Manual CD in your Manual Packet for the following Service & Operations Manuals.

PART NO.	MANUFACTURER
OM-TXCR406	Kenway AC/HYD. Heater Manual-2010 Models
NT-20S-TC	Suburban Users Manual

Electrical System Battery Check

MAINTENANCE CHECK

Observe all instruments and gauges while operating machine and carrying out your DAILY MAINTENANCE CHECKS. Replace or repair any malfunctioning instruments or gauges.

BATTERY

The maintenance-free batteries are located under the battery cover on the right-hand side for the 480-126. Use maintenance-free battery charging information.

A maintenance-free battery does not require the addition of water during its life in normal service. This is due to the fact that maintenance-free batteries produce little gas at normal charging voltages.

TESTING MAINTENANCE-FREE BATTERIES

> WHENEVER THE BATTERY IS PLACED ON CHARGE, WEAR SAFETY GLASSES. DO NOT BREAK "LIVE" CIRCUITS AT THE BATTERY TERMINALS. Maintenance-free batteries of the latest design incorporate flame arrester vents to reduce the possibility of explosions caused by external sparks. Therefore, during charging, the vents, if removable, should remain in place. A wet cloth should be placed over the vent openings as an additional precaution.

Step 1 - Visual Inspection

Visually inspect the outside of the battery for obvious damage such as a cracked or broken case or cover which would allow electrolyte loss. Check for terminal damage. If obvious physical damage is found, replace the battery. If possible, determine the cause of damage and correct.

Check the condition and size of the cables. Are the cable clamps tight? Check for corrosion on the terminal or clamps. Clean corroded parts and/or tighten clamps if necessary. Replace badly corroded cables or cables with defective terminals. Make certain the negative cable is making a good connection where it is grounded to the engine and the positive cable to the starter relay. If the "Visual Inspection" is satisfactory, proceed to Step 2.

Step 2 - Electrolyte Levels And State Of Charge

Check the electrolyte level in the cells if possible. The level can be seen through translucent plastic cases. It can also be checked in batteries which are not sealed. If the electrolyte level is below the tops of the plates in any cell, add water if the vents are removable. If the battery is sealed, and water cannot be added to it, replace the battery and check the charging system for a malfunction such as a high voltage regulator setting. Follow instructions of manufacturer if the battery has a special indicating device.

If the level is O.K., unknown, or water can be added to the battery, and the stabilized open circuit voltage is below 12.4 volts, charge the battery as described under "Charging". The voltage is stabilized if the battery has stood overnight without being charged or discharged. If the battery has been on charge, the voltage can be stabilized by placing a 15 ampere load across the terminals for 15 seconds. Another method of stabilization is to turn on the headlamps for 15 seconds. Read the voltage at least three minutes after the discharge load is removed. When a hydrometer reading can be taken, a value of 1.225 @ 80°F (26.7°C) can be used instead of the 12.4 voltage reading. If the battery has a test indicator, follow the instructions of the manufacturer. After the battery is recharged, stabilize the voltage as described above, then proceed to Step 3.

If the stabilized voltage of the battery was above 12.4 volts when it was first examined, or the test indicator indicated the battery is charged, proceed to Step 3 without charging the battery.

Step 3 - Load Test Procedure

The load test procedure is conducted to determine if the battery requires recharging or replacement.

A. Disconnect the battery cables (ground connection first) and connect the voltmeter and load test leads to the battery terminals, making sure the load switch on the tester is in the “OFF” position.

B. Apply a test load equal to 1/2 the Cold Cranking Amperes @ 0°F (-18°C) Rating of the battery, for 15 seconds. (Example: a battery has a Cold Cranking Rating @ 0°F (118°C) of 350 amperes. Use a test load of 175 amperes.)

C. Read the voltage at 15 seconds and remove the load. If the voltage is less than the minimum specified in the “Voltage Chart” (see “Maintenance-Free Battery Testing Chart”, in Troubleshooting section) replace the battery. If the voltage meets or exceeds the specified minimum, clean and return battery to service.

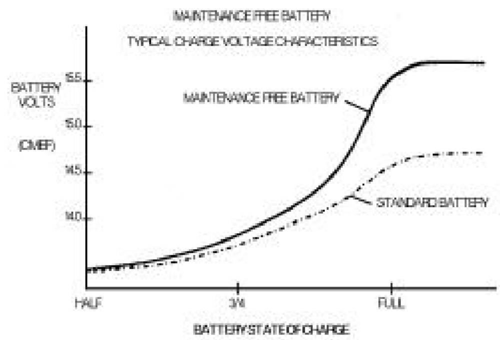
If the state of charge of a battery cannot be determined and the battery fails the load test, it must be recharged and retested. If it meets the specified voltage on the second test, return it to service. If it does not meet the specified voltage on the second test, replace the battery.

The above is a standard test procedure to determine the ability of a battery to function properly. If a commercially available tester is being used to analyze the battery, follow the instructions of the equipment manufacturer.

CHARGING MAINTENANCE-FREE BATTERIES

Maintenance-free batteries contain sulfuric acid and generate explosive hydrogen and oxygen gases; the same as all lead acid batteries. No one should charge a battery unless they have been thoroughly instructed concerning the step by step procedures to use and the safety precautions to take.

Battery chargers for maintenance-free batteries should include a charge duration control of some sort. The simplest control is a timer which the operator sets. Voltage controls can limit the charge more consistently and accurately. Such controls also may have a safety feature that prevents sparks and reverse charging when the clamps are connected in reverse, by mistake.



Place a wet cloth over the vent opening or openings. If, when charging the battery, violent gassing or spewing of electrolyte occurs, or the battery case feels hot (125°F, 52°C), reduce or temporarily halt charging to avoid damaging the battery.

Follow the manufacturers instructions on the charger. If they can no longer be read and a copy of them is not available, write to the manufacturer for a copy and paste it on the charger. Never use a charger without these instructions.

Electrical System Collector Ring

ELECTRICAL COLLECTOR RING

When troubleshooting the electrical system, always check the collector ring first to see that spring loaded brushes are centered in the bands. Keep free of any foreign material.

Keep the setscrews on the collector ring frame tight. Otherwise, the wire harness may wrap up as the machine is swung.

The cover should allow for free operation of the collector ring and the brake. If linkages bind, erratic operation may result. Check for unrestricted operation.

COLLECTOR RING MAINTENANCE AND SERVICE

If not revolved for some time, under some conditions, the ring will have a tendency to collect fine silt, or a salt atmosphere will cause corrosion. If this happens, the crane should be rotated through several revolutions, if possible. The cleaning action of the brushes should clean ring surfaces. If it does not, or it is not practical to revolve the machine, it may be necessary to use a standard non-residue solvent to clean the ring. Then lightly sand the brushes and rings with a fine grade of sandpaper and dust off with compressed air.

To replace a brush and arm assembly, remove the hex nuts and washers at the top of the brush stud along with the outboard bearing. This will allow the brush assemblies to be removed. Carefully remove the brushes without “over” stretching the brush springs and arrange in order of removal with spacers. Replace the damaged brush assembly and then reassemble the brushes and spacers in reverse the removal order. This will insure the correct spacing between electrically live parts. Be sure that all brushes are snapped in tight and making full contact with their corresponding brass ring. Also check that all springs are hooked correctly through the brush arm.

NOTE: *Special care should be exercised when handling or replacing the 7 1/2 Amp brush and arm assemblies. Because of their small size, they can be broken if forced up or down. In the correctly installed position, the possibility of breakage is minimal.*

The collector ring has a nylon bearing in the base of the assembly, eliminating the need for lubrication.

If it should become necessary to remove the collector ring from the machine, do so by loosening the socket screws at the base of the ring. This will allow the ring to be lifted off the mounting tube. When replacing it, make sure these set screw, are again tightened. (Recommended torque 45-55 in.-lbs.) If the set screws are not tight, the core can turn or be held by the brushes, and twist off the core leads or center harness.

NOTE: *The collector ring circuits are self-cleaning and if crane has been out of service for an long time period, by rotating the upper structure 360 degrees 10-20 times should clean off the copper brush circuits. The collector ring is not servicable internally, thus if defective, broken terminals, brush circuits not functional, contact your Load King Parts Department for a complete replacement collector ring.*

Electrical System Voltmeter Diagnosis

This electrical system has a voltmeter installed in it. It is used as an aid to diagnose the condition of the battery and electrical system. The following illustrations show how the voltmeter indicates the condition of the battery, alternator, and voltage regulator and what to so to correct the condition.

ENGINE NOT RUNNING OR RUNNING AT SLOW IDLE

Dead or disconnected battery. Disconnected or badly connected voltmeter.

Very low battery charge. Engine might not start.

Low battery charge. Constant reading in this area would indicate need for check on alternator and voltage regulator.

Well-charged battery. This indicates a good battery and also that alternator and voltage regulator are operating properly

The pointer might remain in this position temporarily when the engine has been stopped after considerable use, due to a "surface charge" in the battery. To get a correct reading, turn on lights for a few minutes or let machine stand for an hour or so.

Under normal conditions, a 12V battery is fully charged at 12.8V. A slightly higher reading may occur under the conditions outlined in the last step, but, generally speaking, any reading above 12.8 when the engine is stopped is not a true reading.

ENGINE RUNNING FAST ENOUGH TO MAKE ALTERNATOR PRODUCE CHARGE

Disconnected voltmeter. Engine could not run with dead or disconnected battery unless circuit was completed around battery.

When voltmeter pointer stays below 13.3 with the engine running fast enough to operate the alternator, it shows that the alternator is not operating or voltage regulator is out of adjustment, or that current being drawn from battery by lights, heater fan, or accessories exceeds alternator output.

When engine is started, pointer may stay in this area temporarily but should gradually rise above 13.3 as alternator reaches normal output.

This is the area in which the pointer should be when alternator, voltage regulator, and battery are all in good condition and working properly.

When the pointer goes above 15.2, the voltage regulator is set too high or is jammed and continued operation of the engine will burn out the battery.

Hydraulic Cylinder Maintenance

HYDRAULIC CYLINDER DISASSEMBLY

GENERAL

Do not disassemble a cylinder unless no other maintenance procedure can correct the problem. All overhaul or new cylinder installations should be done in a clean, dust-free atmosphere with all ports plugged until hose connections are made.

BOOM EXTEND CYLINDERS

The outer case is the "moving" member of the cylinder. The hollow shaft is "stationary". The hollow shaft ports the piston and case end to retract the cylinder while a tube within the "shaft" ports the piston and head gland to extend the cylinder.

Disassemble the boom extend cylinders by the following procedure:

1. Using an adjustable spanner wrench, remove head gland of cylinder. As head gland is loosened, it may be necessary to begin to move rod out of cylinder tube.
2. With head gland fully disengaged, remove as an assembly, piston rod, head gland, and piston assembly.
3. To remove piston, remove the setscrews which secure the piston retaining ring to piston rod.
4. Remove piston and gland which allows access to all seal units of cylinder.

BOOM LIFT CYLINDER

Disassemble the boom lift cylinder by the following procedure:

1. Remove the locking socket head capscrew from the draw ring. CAUTION: Failure to remove the locking capscrew may result in thread damage. With an adjustable spanner wrench, remove the draw ring and head gland. N0TE: One turn off, back 1/3 turn, alternately.
2. Remove the head gland, shaft, and piston from the case.
3. Remove piston and gland by removing setscrews in retaining collar and removing retaining nut. Remove piston and gland from rod. Access to all seal units is now possible.

HYDRAULIC CYLINDER INSPECTION

Wash the cylinder bore and all the components with solvent and make the following inspections:

CYLINDER BORE

For signs of scoring and deep scratches. In the event of any defects, reassemble the entire cylinder and contact your distributor.

CYLINDER SHAFT

For dents, deep scratches, or damaged chrome plating. File any sharp edges on ends of shaft to protect the seals upon reassembly. Always protect the shaft finish when clamping in a vice or when welding against weld splatter.

PISTON RINGS

For cracks or other damage. Particularly check the interlocking ends that they are not missing or broken.

PISTON SEALS

For signs of severe damage. Do not remove unless replacement is necessary.

PISTON & HEAD GLAND

It is not normally necessary to replace the piston, piston rings, or head gland.

HYDRAULIC CYLINDER REASSEMBLY

GENERAL

As cylinder components are reassembled, be certain all rings, seals, spacers and setscrews required in one step are in place before proceeding to the next step. See related section of the Parts Book for a complete listing of cylinder parts.

A teflon ring must be installed before the piston ring or wear ring is installed since the teflon ring must first be "walked" into the piston ring groove and then onto its own groove. Warm the teflon ring until reasonably flexible and oil the piston ring or wear ring to aid in the installation.

> MOST PISTON RING BREAKAGE IS DUE TO CARELESS OR HASTY ASSEMBLY AT THIS POINT.

BOOM LIFT CYLINDERS

With the piston, piston rod, head gland, retaining ring and rod eye reassemble as a unit, slide the piston into the cylinder bore. Next, insert and seat the head gland. It may be necessary to drive the gland into place using a wood block and hammer. In this event, cover the rod with rags or a rubber tube to prevent damage from a glancing hammer blow. The retaining ring is then spun in and tightened to secure the head gland. Install socket capscrews. the retaining ring should be secured with Loctite Grade 242. Coat both grooves around the thread ring as well as the bolt heads with a "silastic" type silicon sealant to keep moisture out.

NOTE: *Contact Load King Service Dept. for correct torque value when reinstalling piston ring nut on the piston rod. Use Loctite Grade 242 on ring nut and setscrews.*

BOOM EXTEND CYLINDERS

With the piston, piston rod, head gland, and retaining ring assembled as a unit, slide the piston into the cylinder bore. Next, insert the head gland. It may be necessary to tap the gland into place using a wood block and hammer. In this event, cover the rod with rags or a rubber tube to prevent damage from a glancing hammer blow. The head gland is then spun in and tightened.

NOTE: *Apply Loctite Gr. 242 to piston retaining rings at assembly. Also apply to locking setscrews.*

HYDRAULIC CYLINDER OPERATION

As soon as the cylinder is ready to be placed in operation, it should be slowly cycled under no load conditions for several minutes in order to allow the entrapped air within the cylinder to escape to the reservoir and, also to facilitate the reforming of the seals which may have temporarily deformed during shipping, storage or reassembly.

New cylinders may show a slight "drifting" tendency when first used. This is natural, due to one or both of the following causes.

1. Air entrapped in the oil.
2. Seals not yet fully reformed or seated.

"Drifting" should decrease with operation as piston rings and seals "break in" to provide better sealing and the eventual escaping of the trapped air in the oil.

Chain Adjustment - 4-Section Boom

For proper operation and boom life the extend and retract chains must be adjusted properly. To adjust these chains use the following procedure.

THIRD SECTION EXTEND AND RETRACT CHAINS (4 SECTION BOOMS):

1. Fully retract boom. (Both cylinders)
2. Measure the gap between the front of second section and the back of the third section. This gap should be .25 inch (6 mm) to .38 inch (10 mm).
3. If adjustment is required, extend the boom approximately 1/2 way.

NOTE: *Before attempting to turn one of the adjusting nuts, extend or retract the boom slightly to relieve the tension on that nut. After extending the boom, adjustment A will be under tension and B will be free.*

4. If the gap is less than .25 inch (6 mm), loosen adjustment B and tighten adjustment A until the gap is within specifications.
5. If the gap is more than .38 inch (10 mm), loosen adjustment A and tighten adjustment B until the gap is within specifications.
6. Fully retract the boom and recheck the gap. Repeat step 3 through 5 if necessary.
7. Fully extend the boom horizontal.
8. Through the first hole in the side plate of the second boom section (the hole closer to the base section), measure the sag of the retract chain. This measurement must be taken from the bottom of the second section to the bottom of the chain. This dimension should be 2.25 inches (57 mm)to 2.50 inches (64 mm).
9. If the dimension is greater than 2.50 inches (64 mm), loosen adjustments A and B equal amounts until the measurement is within specifications.
10. If the dimension is less than 2.25 inches (57 mm), tighten adjustments A and B equal amounts until the measurement is within specifications.
11. The gap between the #1 and #2 sections are not adjustable. They are set by the extend cylinder. See figure below.

FOURTH SECTION EXTEND AND RETRACT CHAINS (4 SECTION BOOMS)

1. Fully retract the boom.
2. Measure the gap between the front of the third section and the back of the tip section. This gap should be .25 inch (6 mm) to .38 inch (10 mm).
3. If adjustment is required, extend the boom approximately 1/2 way.

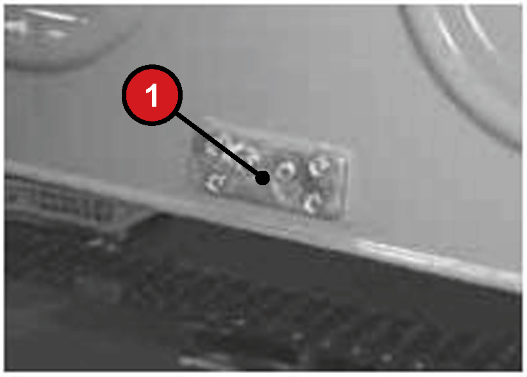
Before attempting to turn one of the adjustment nuts, extend or retract the boom slightly to relieve the tension on that nut. After extending the boom, adjustment C will be under tension and D will be free. After retracting the boom, adjustment D will be under tension and C will be free.

4. If the gap is less than .25 inch (6 mm), loosen adjustment D and tighten adjustment C until the gap is within specifications.
5. If the gap is more than .38 inch (10 mm), loosen adjustment C and tighten adjustment D until the gap is within specifications.
6. Fully retract the boom and recheck the gap. Repeat step 3 through 5 if necessary.
7. Fully extend the boom horizontal.
8. Through the first hole in the side plate of the third boom section (the hole closer to the second section), measure the sag of the retract chain. This measurement must be taken from the bottom of the third section to the bottom of the chain. This dimension should be 2.75 inches (70 mm) to 3 inches (76 mm).
9. If the dimension is greater than 3.00 inches (76 mm), loosen adjustments C and D equal amounts until the measurement is within specifications.
10. If the dimension is less than 2.75 inches (70 mm), tighten adjustments C and D equal amounts until the measurement is within specifications.
11. Under the same condition, the maximum sag in the extend chain should be 7.00 inches (178 mm) to 7.50 inches (190 mm). This measurement is from the bottom of the third boom section to the top of the extend chain.

Boom Centering

4 SECTION BOOM (126')

On both sides of every boom section (except 4) there are wear pads (1) located near the bottom of the no. 4 section, approximately 10' from the tip end. These pads are used to adjust each inner boom section left and right within its respective outer boom section.



1. WEAR PAD

1. Remove the pad plate on both sides. Add shims (1) until the pad plate will not touch the boom section. Then remove one shim and tighten the inner two bolts. Install the pad plate and tighten the outer four bolts. To move the boom add and remove shims from the plates. For every shim added to one side, remove a shim from the other side.

1. WEAR PAD SHIM

2. After the pad plates are set, adjust the lower tip pads of each section until they are within 1/16” of the inner section.

3. Repeat this process on Sections 2, and 3.

Repairs-Adjustments-Remarks Log

ITEM	REQUIREMENT	DATE

Conversion Tables

DECIMAL AND METRIC EQUIVALENTS OF FRACTIONS OF AN INCH

Fractions of an Inch	Decimals of an inch	Millimeters
1/64	0.0156	0.397
1/32	0.0313	0.794
3/64	0.0469	1.191
1/16	0.0625	1.588
5/64	0.0781	1.985
3/32	0.0938	2.381
7/64	0.1094	2.778
1/8	0.1250	3.175
9/64	0.0406	3.572
5/32	0.1563	3.969
11/64	0.1719	4.366
3/16	0.1875	4.762
13/64	0.2031	5.159
7/32	0.2188	5.556
15/64	0.2344	5.953
1/4	0.2500	6.350
17/64	0.2656	6.747
9/32	0.2813	7.144
19/64	0.2969	7.541
5/16	0.3135	7.937
21/64	0.3281	8.334
11/32	0.3438	8.731
23/64	0.3594	9.128
3/8	0.3750	9.525
25/64	0.3906	9.922
13/32	0.4063	10.319
27/64	0.4219	10.716
7/16	0.4375	11.12
29/64	0.4531	11.509
15/32	0.4688	11.906
31/64	0.4844	12.303

Fractions of an Inch	Decimals of an inch	Millimeters
1/2	0.5000	12.700
33/64	0.5156	13.097
17/32	0.5313	13.494
35/64	0.5469	13.891
9/16	0.5625	14.287
37/64	0.5781	14.684
19/32	0.5938	15.081
39/64	0.6094	15.478
5/8	0.6250	15.875
41/64	0.6406	16.272
21/32	0.6563	16.688
43/64	0.6719	17.085
11/16	0.6875	17.462
45/64	0.7031	17.859
23/32	0.7188	18.256
47/64	0.7344	18.653
3/4	0.7500	19.050
49/64	0.7656	19.447
25/32	0.7813	19.843
51/64	0.7969	20.240
13/16	0.8125	20.637
53/64	0.8281	21.034
27/32	0.8438	21.430
55/64	0.8594	21.827
7/8	0.8750	22.224
57/64	0.8906	22.621
29/32	0.9063	23.018
59/64	0.9219	23.415
15/16	0.9375	23.812
61/64	0.9531	24.209
31/32	0.9688	24.606
63/64	0.9844	25.003
1	1.0000	25.400

WEIGHTS AND MEASURES

LIQUID MEASURE (U.S.)

4 gills	=	1 pint
2 pints	=	1 quart
4 quarts	=	1 gallon
7.48 gallons	=	1 cu. ft.
240 gallons of water	=	1 Ton
340 gallons of gasoline	=	1 Ton

LIQUID MEASURE (METRIC)

1 litre	=	0.0353 cu. ft.
1 litre	=	0.2642 gallon
1 litre	=	61.023 cu. in.
1 litre	=	2.202 lbs. of water(62ºF.)
1 cu. foot	=	28.32 litres
1 gallon	=	3.785 litres
1 cu. inch	=	0.0164 litre

MEASURES OF WEIGHTS (U.S.)

16 ounces	=	1 pound
2000 pounds	=	1 short ton
2240 pounds	=	1 long ton
100 cu. feet	=	1 register ton
40 cu. feet	=	1 U.S. shipping ton

MEASURES OF WEIGHTS (METRIC)

1 gram	=	0.0353 ounce
1 kilogram	=	2.205 lbs.
1 ounce	=	28.35 grams
1 pound	=	0.454 kilogram
1 ton	=	0.907 metric ton

CIRCULAR MEASURE

60 seconds	=	1 minute
60 minutes	=	1 degree
90 degrees	=	1 quadrant
360 degrees	=	1 circumference

ELECTRICAL UNITS

1 kilowatt	=	1.34 H.P.
1 horsepower	=	746 watts

SURVEYOR'S MEASURE

7.92 inches	=	1 link
100 links	=	66 feet or 4 rods or 1 chain
80 chains	=	1 mile

Average Weight of Materials

MATERIAL	KG/CU. METER	KG/CU. FOOT	1 CU. YARD
Ashes - Piled Dry	560.70	35	945
Brick Bats	881.10	55	1485
Cement - Portland	1505.88	94	2538
Charcoal	400.50	25	695
Cinders	881.10	55	1485
Clinker - Portland Cement	1361.70	85	2295
Clay - Dry, in Lumps	1009.26	63	1701
Clay - Compact, Natural Bed	1746.18	109	2943
Coal - Anthracite	897.12	56	1512
Coal - Bituminous R of M Piled	881.10	55	1485
Coal - Bituminous Slack, Piled	801.00	50	1350
Coke - Blast Furnace Size	432.54	27	729
Coke - Foundry Size	448.56	28	756
Concrete - Ready to Pour	2370.96	148	3996
Dolomite - Crushed Fine	1521.90	95	2565
Dolomite - Broken Lump	1521.90	95	2565
Earth - Loamy, Dry Loose	1201.50	75	2025
Earth - Dry, Packed	1521.90	95	2565
Earth - Wet (Mud)	1762.20	110	2970
Flue Dust - Blast Furnace	1842.30	115	3105
Flue Dust - Blast Furnace, Wet	2403.00	150	4050
Gypsum - Crushed to 3"	1521.90	95	2565
Gypsum - Calcined	961.20	60	1620
Gravel - Dry, Loose	1762.20	110	2970
Gravel - Dry, Packed	1810.26	113	3051
Gravel - Wet, Packed	1922.40	120	3240
Iron Ore - 60% Iron	4806.00	300	8100
Iron Ore - 50% Iron	4005.00	250	6750
Iron Ore - 40% Iron	3204.00	200	5400
Iron Punchings - Scrap	4325.40	270	7290
Iron Turnings - Scrap	2803.50	175	4725
Limestone - Run of Crushed	1521.90	95	2565
Limestone - Fines Out	1602.00	100	2700

MATERIAL	KG/CU. METER	KG/CU. FOOT	1 CU. YARD
Limestone - 1 1/2 or 2 Graded	1361.70	85	2295
Limestone - Above 2 Graded	1281.60	80	2160
Phosphate, Acid (Fertilizer)	1361.70	85	2295
Phosphate, Rock	1281.60	80	2160
Pyrites	2167.70	135	3645
Salt	929.16	58	1566
Sand - Dry, Loose	1521.90	95	2565
Sand - Wet, Packed	1922.40	120	3240
Scale - Rolling Mill, Wet	2114.64	132	3564
Shale - Broken	1361.70	85	2295
Slag - Blast Furnace, Broken	2210.76	138	3726
Slag - Open Hearth, Crushed	1682.10	105	2835
Slag - Granulated, Dry	606.76	38	1026
Slag - Granulated, Wet	929.16	58	1566
Snow	528.66	33	891
Sulphur - Broken	528.66	60	1620
Timber - Green Cedar	592.74	37	999
Douglas Fir	606.76	38	1026
Hemlock	656.82	41	1107
Southern Pine	881.10	55	1485
Spruce	576.72	36	972
Redwood	801.00	50	1350
Zinc Ore - Broken	2403.00	150	4050

Torque Specs -SAE & Metric

SIZE	THREAD	BOLT DIA. (IN.) d	TENSILE STRESS AREA (SQ. IN.) A_t	PLAIN & ZINC PLATED FASTENERS — SAE GRADE 2 or GRADE 5 with a GRADE A nut: PROOF STRENGTH (psi) S_p	MAX CLAMP LOAD (LB.) F_i	TORQUE* DRY K=.20 IN-LB	TORQUE* OIL LUBED** K=.15 IN-LB	SAE GRADE 5 with a GRADE 5 or higher nut: PROOF STRENGTH (psi) S_p	MAX CLAMP LOAD (LB.) F_i	TORQUE* DRY K=.20 IN-LB	TORQUE* OIL LUBED** K=.15 IN-LB	SAE GRADE 8: PROOF STRENGTH (psi) S_p	MAX CLAMP LOAD (LB.) F_i	TORQUE* DRY K=.20 IN-LB	TORQUE* OIL LUBED** K=.15 IN-LB	HIGH STRENGTH BLACK OXIDE BOLTS, SHC — ASTM A574 - ANSI B18.3: PROOF STRENGTH (psi) S_p	MAX CLAMP LOAD (LB.) F_i	TORQUE* DRY K=.30 IN-LB	TORQUE* LUBED K=.15 IN-LB
4	40	0.112	0.00604	55000	250	6	4		----	----	----		----	----	----	140000	630	Not Recommended	11
	48		0.00661		270	6	5		----	----	----		----	----	----		690		12
6	32	0.138	0.00909		370	10	8		----	----	----		----	----	----		950		20
	40		0.01015		420	12	9		----	----	----		----	----	----		1070		22
8	32	0.164	0.014		580	19	14		----	----	----		----	----	----		1470		36
	36		0.01474		610	20	15		----	----	----		----	----	----		1550		38
10	24	0.19	0.0175		720	27	21		----	----	----		----	----	----		1840		52
	32		0.02		830	32	24		----	----	----		----	----	----		2100		60
1/4	20	0.25	0.0318		1310	66	49	85000	2030	100	80	120000	2860	140	110		3340		130
	28		0.0364		1500	75	56		2320	120	120		3280	160	160		3820		140
						FT-LB	FT-LB			FT-LB	FT-LB			FT-LB	FT-LB				FT-LB
5/16	18	0.3125	0.0524		2160	11	8		3340	17	13		4720	25	18		5500		21
	24		0.058		2390	12	9		3700	19	14		5220	27	20		6090		24
3/8	16	0.375	0.0775		3200	20	15		4940	31	23		6980	44	33		8140		38
	24		0.0878		3620	23	17		5600	35	26		7900	49	37		9220		43
7/16	14	0.4375	0.1063		4380	32	24		6780	49	37		9570	70	50		11160		61
	20		0.1187		4900	36	27		7570	55	41		10680	80	60		12460		68
1/2	13	0.5	0.1419		5850	49	37		9050	75	57		12770	110	80		14900		93
	20		0.1599		6600	55	41		10200	85	64		14390	120	90		16790		105
9/16	20	0.5625	0.182		7510	70	53		11600	110	80		16380	150	120	135000	18430		130
	18		0.203		8370	78	59		12900	120	90		18270	170	130		20550		140
5/8	11	0.625	0.226		9320	100	73		14400	150	110		20340	210	160		22880		180
	18		0.256		10600	110	83		16300	170	130		23040	240	180		25920		200
3/4	10	0.75	0.334		13800	170	130		21300	270	200		30060	380	280		33820		320
	16		0.373		15400	190	140		23800	300	220		33570	420	310		37770		350
7/8	9	0.875	0.462		19100	280	210		29500	430	320		41580	610	450		46780		510
	14		0.509		21000	310	230		32400	470	350		45810	670	500		51540		560
1	8	1	0.606		25000	420	310		38600	640	480		54540	910	680		61360		770
	12		0.663		27300	460	340		42300	710	530		59670	990	750		67130		840
1 1/8	7	1.125	0.763		31500	590	440	74000	42300	790	590		68670	1290	970		77250		1090
	12		0.856		35300	660	500		47500	890	670		77040	1440	1080		86670		1220
1 1/4	7	1.25	0.969		40000	830	630		53800	1120	840		87210	1820	1360		98110		1530
	12		1.073		44300	920	690		59600	1240	930		96570	2010	1510		108600		1700
1 1/2	6	1.5	1.405		58000	1450	1090		78000	1950	1460		126450	3160	2370		142300		2670
	12		1.58		65200	1630	1220		87700	2190	1640		142200	3560	2670		160000		3000

*Acceptable manufacturing torque value range is +0% / -10% of listed torque.
**For other lubricants consult supplier.

Table 2. Metric Size Bolt Torque

			PLAIN & ZINC PLATED FASTENERS															
			CLASS 4.6 per ISO 898/I				CLASS 8.8 per ISO 898/I				CLASS 10.9 per ISO 898/I				CLASS 12.9 per ISO 898/I			
					TORQUE*				TORQUE*				TORQUE*				TORQUE*	
SIZE	BOLT DIA. (mm) d	TENSILE STRESS AREA (SQ. mm) A_t	PROOF STRENGTH (Mpa) S_p	MAX CLAMP LOAD (N) F_i	DRY K=.20 N-m	OIL LUBED** K=.15 N-m	PROOF STRENGTH (MPa) S_p	MAX CLAMP LOAD (N) F_i	DRY K=.20 N-m	OIL LUBED** K=.15 N-m	PROOF STRENGTH (MPa) S_p	MAX CLAMP LOAD (N) F_i	DRY K=.20 N-m	OIL LUBED** K=.15 N-m	PROOF STRENGTH (MPa) S_p	MAX CLAMP LOAD (N) F_i	DRY K=.20 N-m	LUBED K=.15 N-m
M3-0.5	3	5.03														3660	2.2	1.65
M3.5-0.6	3.5	6.78														4932	3.45	2.59
M4-0.7	4	8.78														6387	5.11	3.83
M5-0.8	5	14.2		2396	2.4	1.8		6177	6.18	4.63		8840	8.84	6.63		10330	10.3	7.75
M6-1	6	20.1		3392	4.07	3.05		8743	10.5	7.87		12512	15	11.3		14623	17.6	13.2
M7-1	7	28.9		4877	6.83	5.12		12570	17.6	13.2		17990	25.2	18.9		21025	29.4	22.1
M8-1.25	8	36.6		6176	9.88	7.41	580	15921	25.5	19.1		22784	36.5	27.3		26626	42.6	32
M10-1.5	10	58		9787	19.6	14.7		25230	50.5	37.8		36105	72.2	54.1		42195	84.4	63.3
M12-1.75	12	84.3		14225	34.1	25.6		36670	88	66		52475	125	94.5		61328	147	110
M14-2	14	115		19406	54.3	40.8		50025	140	105		71587	200	150	970	83663	234	175
M16-2	16	157		26495	84.8	63.6		70650	226	170		97732	313	235		114218	365	274
M18-2.5	18	192	225	32400	117	87.5		86400	311	233	830	119520	430	323		139680	503	377
M20-2.5	20	245		41345	165	124		110250	441	330		152513	610	458		178238	713	535
M22-2.5	22	303		51130	225	169		136350	600	450		188618	830	622		220433	970	727
M24-3	24	353		59570	285	214		158850	762	570		219743	1055	791		256808	1233	925
M27-3	27	459		77456	418	314	600	206550	1115	837		285728	1543	1157		333923	1803	1352
M30-3.5	30	561		94669	568	426		252450	1515	1136		349223	2095	1572		408128	2450	1837
M33-3.5	33	694		117113	773	580		312300	2061	1546		432015	2851	2138		504885	3332	2500
M36-4	36	817		137870	993	745		367650	2647	1985		508582	3662	2746		594368	4279	3210

*Acceptable manufacturing torque value range is +0% / -10% of listed torque.
**For other lubricants consult supplier.

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.

WARNING: Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.

Greer Element VGA Operator's Manual

Your crane will be set up with an Element VGA system. Completely read the attached manual in the Appendix section before attempting to operate the crane.

For troubleshooting or calibrations refer to your SHOP MANUAL-CD where you will find a Greer Troubleshooting & Calibration manual for the ELEMENT VGA system.

Notes

LOAD KING WARRANTY

Load King (herein after referred to as the COMPANY) warrants all products manufactured by it and purchased by you to be free from defects in material and manufacture at the time of shipment, for one

(1) year from date of delivery. The COMPANY will furnish replacements for such parts as the COMPANY finds to have been defective at the time of delivery or, at the COMPANY's option, will make or authorize repairs to such parts, provided that, upon request, such parts are returned, transportation is prepaid to the factory from which they were shipped.

This warranty shall not apply to any Product which has been subjected to misuse, misapplication, overloading, neglect (including but not limited to use of unauthorized parts or attachments), adjustments or repair. Engines, motor, tires, wheels, suspensions, axles, etc. and any accessories furnished with or used in the COMPANY's products, but which are not manufactured by the COMPANY, are not warranted by the COMPANY but are sold only with the express warranty, if any, or the manufacturers thereof. This warranted is limited to the first purchaser/user and is not transferable.

THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESSED OR IMPLIED (INCLUDING, WITHOUT LIMITATIONS, OF MERCHANTABILITY AND FITNESS OF ANY PRODUCT FOR A PARTICULAR PURPOSE), AND OF ANY OTHER OBLIGATION OR LIABILITY ON THE PART OF THE COMPANY. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION OF THE FACE THEREOF.

LIMITATION OF LIABILITY

It is expressly understood and agreed by you that the COMPANY's liability for its products, whether due to breach of warranty, or otherwise is limited to the furnishing of such replacement parts, F.O.B.

factory, and the COMPANY will not be liable for any other injury, loss, damage, or expense, whether direct or consequential, including but not limited to loss of use, income, profit, or production, injury to person or increase in cost of operation, spoilage of or damage to material, arising out of or in connection with the sale, installation, use or inability to use, or the repair or replacement of the COMPANY's products.

All used vehicles and/or bodies are sold in the "AS IS" condition and no expressed or implied warranty is made.

All of COMPANY'S Products are of high quality and are manufactured in conformity with the best commercial practices in the various lines. The COMPANY guarantees all Products manufactured by it to be free from defects in material and manufactured at the time of shipment, for one (1) year from date of delivery. In addition, the COMPANY guarantees the portion of the product to be considered structural for one (1) year from date of manufacture.

While Load King, LLC. designs and manufactures its specific equipment configurations to industry standards, it is ultimate responsibility of the buyer/operator to assure that all loads are properly loaded and distributed. All loads must comply with the applicable state and federal load limits.

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