ORIGINAL INSTRUCTIONS

TEREX®

2013 ON-HIGHWAY & EXPORT TIER 3

T300-1/T500-1/T780

Operator's Manual

Revised: January 2015 12261-683

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Introduction

Construction and Industrial Equipment Product Safety

SAFETY ALERT SYMBOL

The safety alert symbol is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death

SAFETY ALERT SYMBOL

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

Terex 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 Terex 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 in a proper and safe manner.

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 Terex product and from the Terex 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 Hydraulic Crane Inspection Check List provided. In addition, we STRONGLY URGE that a MAINTENANCE LOG 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. Because we build various types of equipment, 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.

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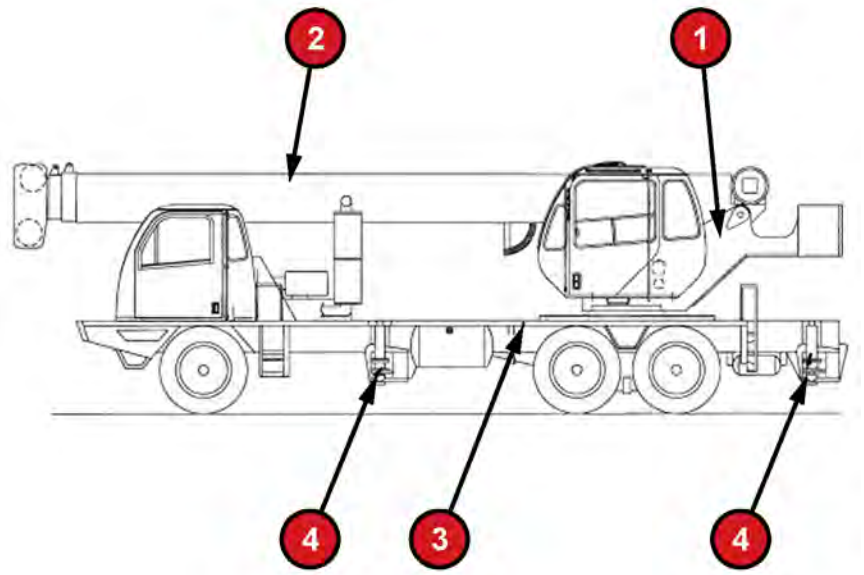
T Nomenclature

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 he has gained 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.
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 from the operator's seat, with the front mounted engine to his back.

Intended Use

This machine and its approved attachments are designed to lift, lower and move freely suspended loads within the rated capacity of the crane. Use of this product in any other way is prohibited and contrary to its intended use.

Bulletin Distribution and Compliance

Safety of product users is of paramount importance to Terex. Various bulletins are used by Terex 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 comply with 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:

Terex Cranes
106 12th Street
Waverly, IA 50677

1 (877) MY-TEREX
1 (877) 698-3739

Transfer of Machine Ownership

If you are not the original owner of this machine, please fill out the form below and submit via Fax / scan and e-mail / or mail as indicated at bottom of form. This will ensure that you are the owner on record for this machine, allowing you to receive any applicable notices and advisories in a timely manner.

TEREX Please send this form to: customersupport.wil@terex.com

New Owner Registration Form

Terex requires that the seller or owner of a Terex machine register to Terex, the model and serial number of each machine sold as well as the name and telephone number of the new owner, within 60 days of the sale.
*Taking a few minutes to update owner information will ensure that you receive important safety, maintenance, and operating information that applies to your machine. Please note that the fields marked with a * are required fields.*

Product Information		**Machine**
Model Name:	*	
Serial Number:	*	
Purchase Date (mm/dd/yy):		
New Owner Information		
Company Name:	*	
Contact Name:		
Terex Acct # (if applicable):		
Mailing Address 1	*	
Mailing Address 2		
City:	*	
State / Province:	*	
Zip / Postal Code:	*	
Country:	*	
Telephone No:	*	
E-mail:		
Previous Owner Information		
Company Name:		
Address 1:		
City:		
State / Providence:		
Zip / Postal Code:		

This registration will not be accepted if incomplete or falsified in any way.

Fax to: United States: 1 910 395 8556 **Email to:** customersupport.wil@terex.com
Mail to: Warranty Department, Terex Cranes, Product Support, 3147 South 17th Street, Wilmington, NC 28412
After hours: 1-877-MyTerex

Safety Introduction

Owners, Users, and Operators:

Terex 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 operators** - directed by informed and knowledgeable supervision - running the machine.

NOTE: *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 which you believe should be added, please send your comments to Technical Publications Coordinator, Terex Cranes, 106 12th Street SE, Waverly, Iowa 50677; or contact us by telephone at (319) 352-3920.

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 addendas, which are sent by ASME to the original purchasers of the standard. Terex recommends that 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
Information Central Orders/Inquiries
P.O. Box 2300

Fairfield, NJ 07007-2300

800-843-2763

Email: infocentral@asme.org

Alert System

SAFETY ALERT SYMBOL

The safety alert symbol is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death

SAFETY ALERT SYMBOL

MACHINE DECAL HAZARD CLASSIFICATION SYMBOLS

A multi-tier hazard classification system is used on machine decals to communicate potential personal injury hazards. The following signal words used with the safety alert symbol indicate a specific level of severity of the potential hazard. Signal words used without the safety alert symbol relate to property damage and protection only. All are used as attention-getting devices on decals and labels fixed to the machinery to assist in potential hazard recognition and prevention.

1. DANGER - Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

2. WARNING - Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

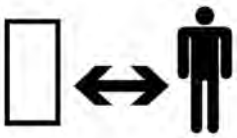
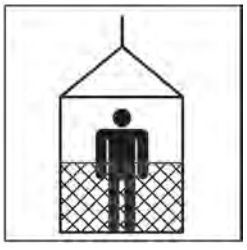
3. CAUTION - Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION

4. NOTICE - Notice used without a safety alert symbol indicates a hazardous situation, which, if not avoided, could result in property damage.

NOTICE

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.

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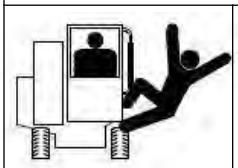
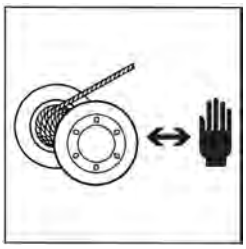
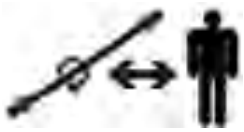
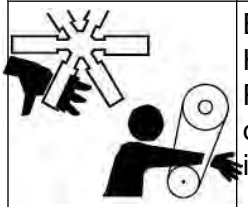
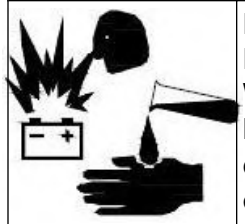
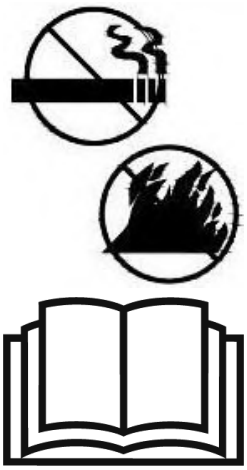
Hazard		Avoidance	
	Falling From Wheeled Machine.		NO RIDERS
	Hand Entanglement In Pulley / Winch.		Keep Hands Clear of Winch and Load Line.
	Entanglement in Drive Shaft.		Stay Clear of Rotating Shafts.
	ENTANGLEMENT HAZARD Rotating parts can cause personal injury.		Keep away from fan and belt when engineis 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.

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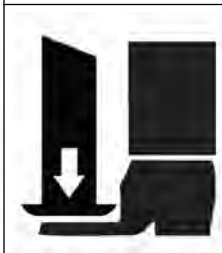
Hazard		Avoidance	
	BURN HAZARD Fuel and fumes can explode and burn.		No smoking. No flame. Stop engine.
	BURN HAZARD Contact with hot surfaces can cause burns.		Allow surfaces to cool before servicing.
	Falling from height.	 	Use personnel lift or appropriate ladder to reach high places. Maintain 3-Point 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 Anti-two Block System.
	**CRUSH HAZARD** Contact with moving outriggers can result in death or serious injury.		Stay Clear of Outriggers.

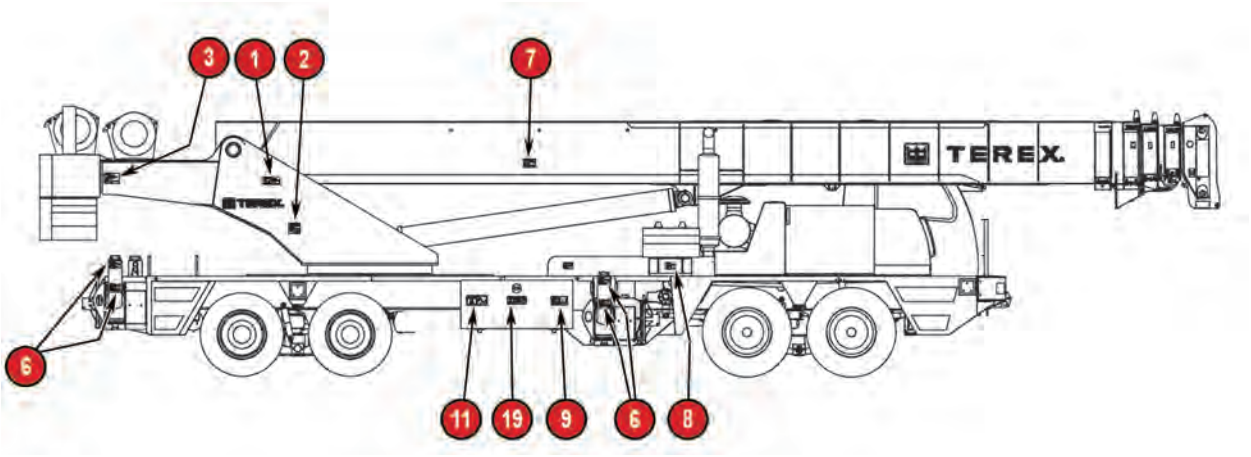
Hazard		Avoidance	
	Electrical Shock / Electrocution from Crane to Power Line Contact.		Stay Sufficient Distance From Electrical Power Lines.

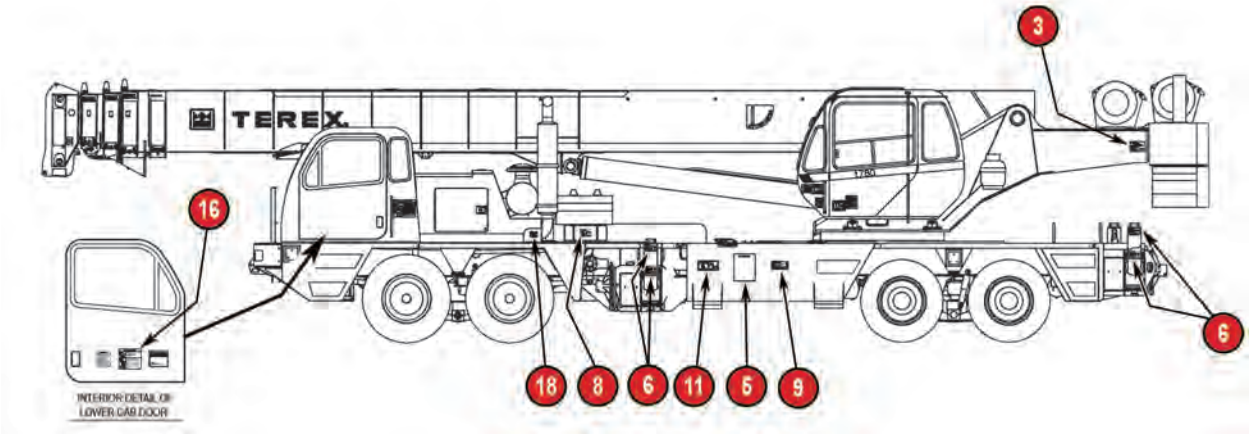
These are general safety rules, which must be followed. You are also required to read and understand the Operators Manual as there are instructions, which are more detailed specific to this machine.

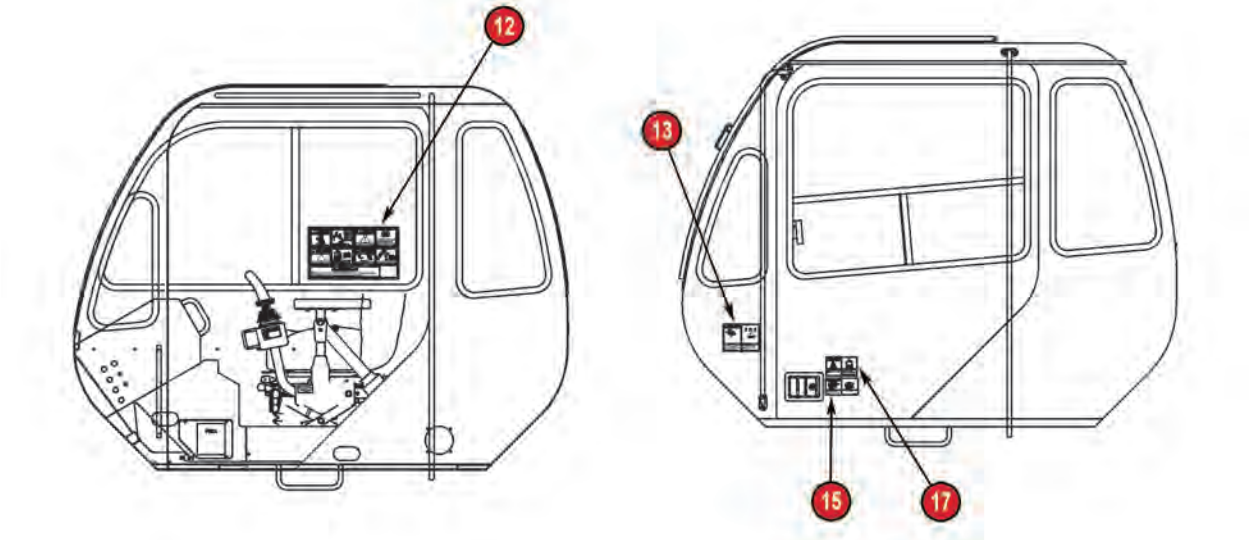
TEREX®

General Safety

Safety Sign Locations







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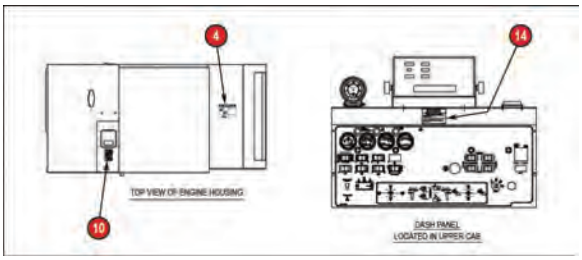

1

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.

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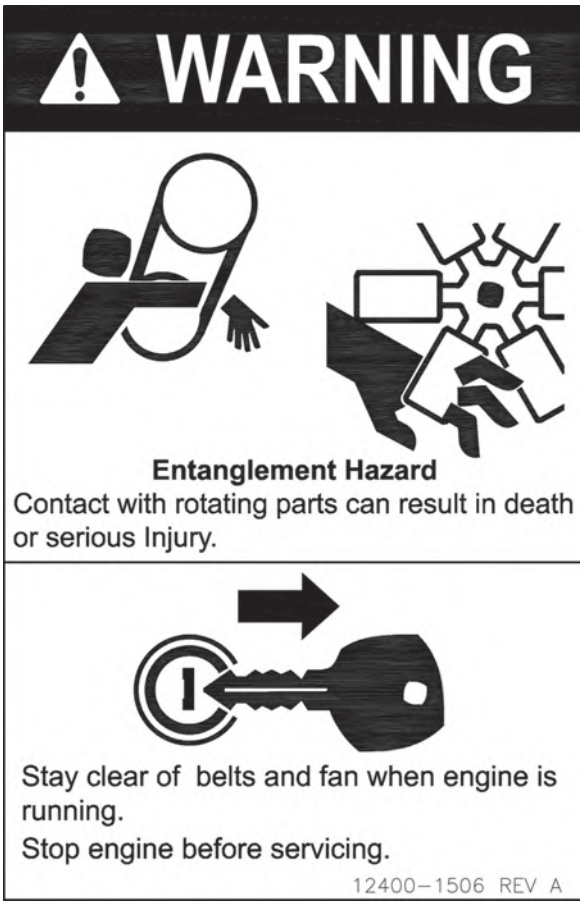

4

Entanglement Hazard	Stay clear of belts and fan when engine is running. Stop engine before servicing.
Contact with rotating parts can result in death or serious injury.	

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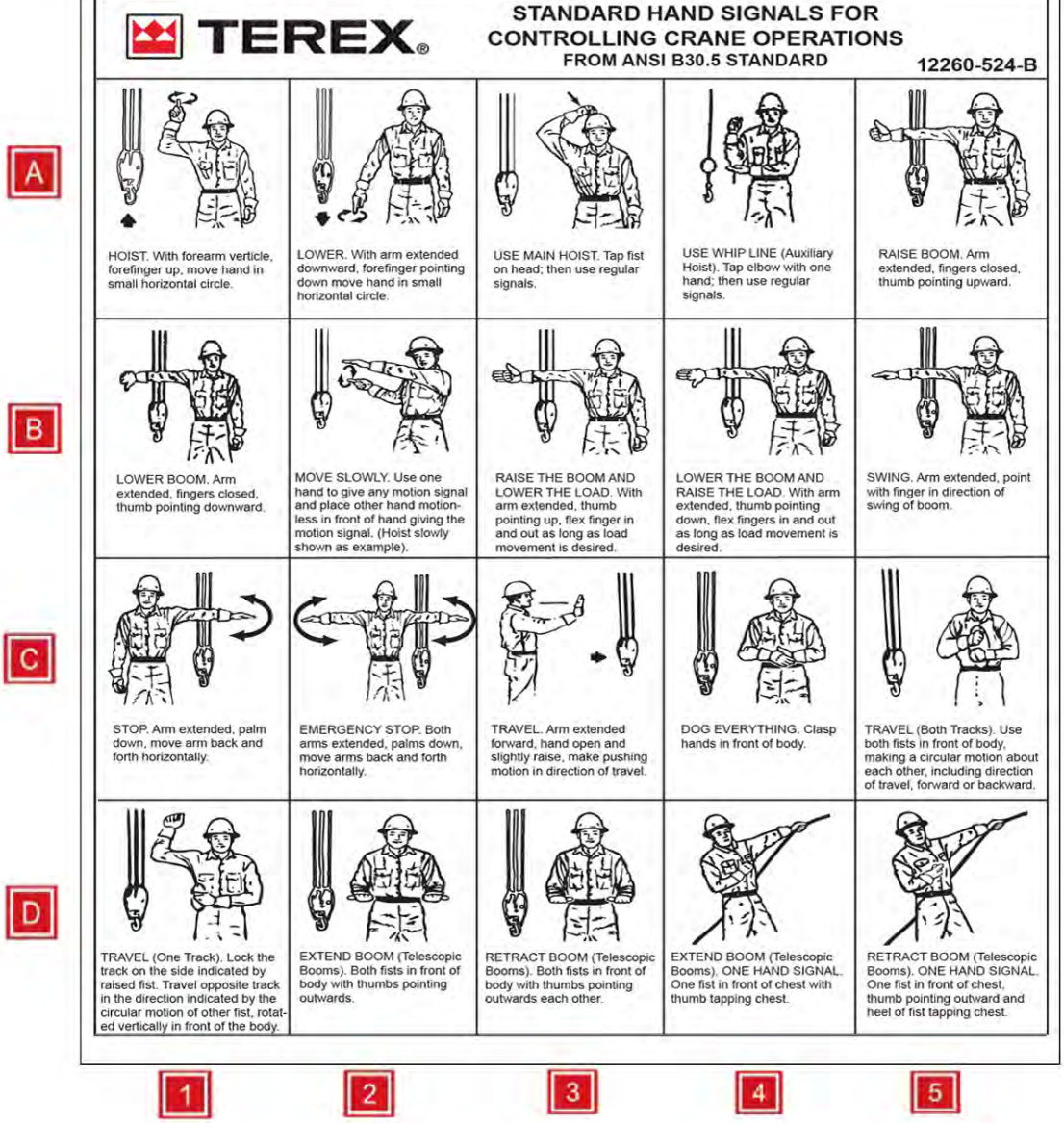

5

	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.

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	DESCRIPTION OF MOVEMENT
B2	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)
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 Contact with moving outriggers can result in death or serious injury.	Stay clear of outrigger path and contact point.

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

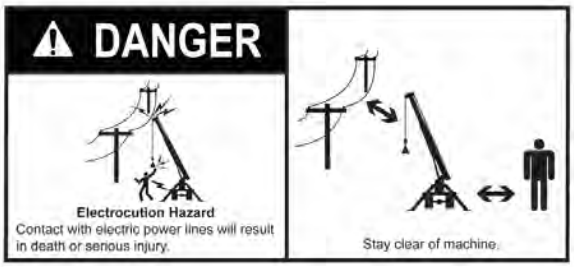
Crush Hazard Serious injury can result from contact with moving counterweights.	Keep clear of counterweight slabs while lowering.

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.

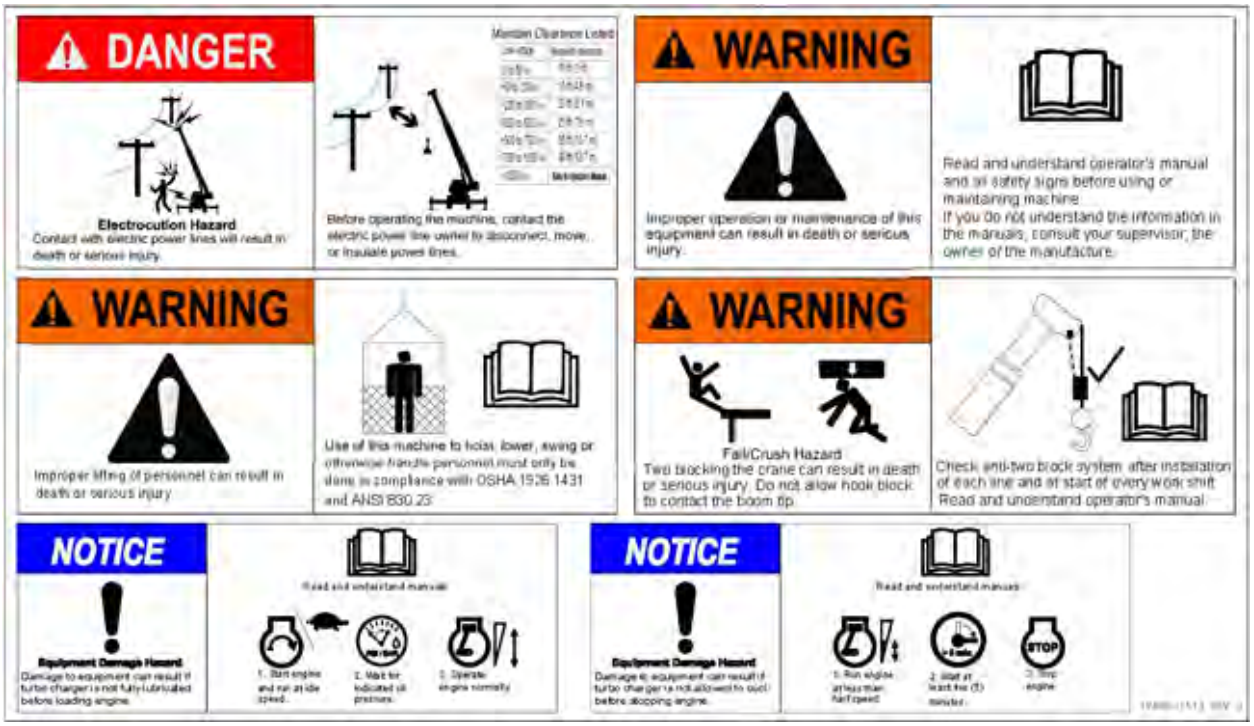
10

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



11

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 Operator's 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 anti-two block 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

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Safety

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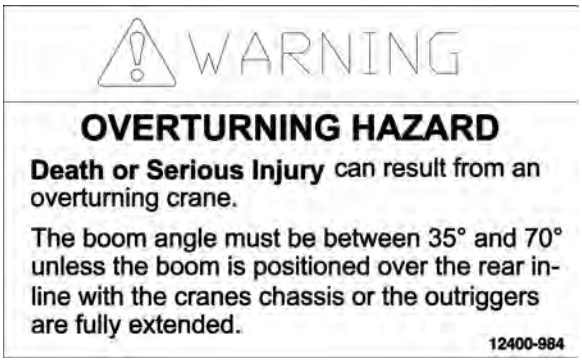
Fall Hazard Falling can result in death or serious injury.	Use the provided access system.

15

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

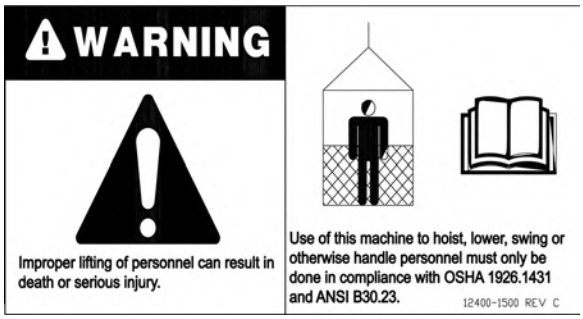


14

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.



17

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.

18

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

19

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 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 following 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.

Workplace Safety

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

1. Safety 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 American National Standards Institute (ANSI) B30.5 latest edition.
4. Read and understand all decals and warnings.
5. Read and understand the Rating Chart.
6. Know that the crane can safely lift each load before attempting to 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.

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 dangers, 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.

PLANNING THE JOB

1. Have a clear understanding of the work to be done.
2. Consider all dangers at jobsite.
3. Know what crew members are needed to complete the job.
4. Assign job responsibilities.
5. Establish how signal people will communicate with the operator.
6. Appoint a competent signal person.
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.
11. Determine the lift radius, boom angle and the rated lifting capacity of the crane.

(Continued on next page ...)

PLANNING THE JOB

12. Always pre-plan the course of each lift to determine the safest method 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 machine to use shortest boom and radius possible.

OPERATOR SAFETY CHECK

1. Safety related items must be in place.
2. Check machine log book, to see if periodic maintenance and inspections have been performed.
3. Ensure that necessary repairs have been completed.
4. Inspect wire rope for damage (kinks, broken wires etc.)
5. Be sure no unauthorized field modifications have been made.
6. Check for air and hydraulic oil leaks.
7. Check that all controls are in the neutral position before starting engine.
8. After starting engine, check all gauges and indicators for proper readings.
9. Test all controls.
10. Check brakes and clutches.
11. 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.
3. Anti-Two Block devices.

(Continued on next page ...)

OPERATOR AIDS CHECK

4. Overload Protection, Load Indicators, Rated Capacity Limiters.

OPERATION OVERLOAD PROTECTION

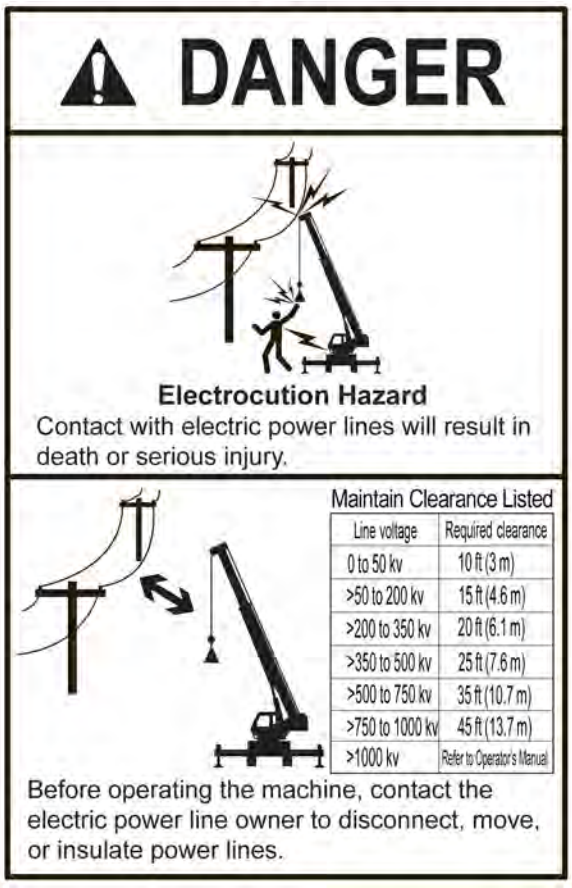
1. Know the weight and characteristics of all loads to be lifted.
2. Place the boom lifting point directly above the load when lifting.
3. The load radius will increase when the load is lifted due to boom deflection.To compensate for the boom deflection, maintain the radius by raising the boom.
4. Know 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 RLI to "weigh" the load.

OPERATION SETUP

1. Be sure the load bearing surface is strong enough to support the machine and 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.

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 ANSI 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 crane or load must come in contact with, or violate the minimum allowable clearance required for operation of crane near, electrical lines.



Electrocution Hazard Contact with electric power lines will result in death or serious injury.	Maintain Clearance Listed

(Continued on next page ...)

POWER LINE SAFETY

Before operating machine, contact the electric power line owner to disconnect, move, or insulate power lines.	LINE VOLTAGE	REQUIRED CLEARANCE
	>0 TO 50kV	10 FT (3.0M)
	>500 TO 200kV	15 FT (4.6m)
	>200 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.

4. Should contact occur, 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.
7. 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.

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 safest 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 tires to specified pressure.
7. Travel slowly and avoid sudden stops and starts.
8. It is recommended that the seat belt be used during transit and travel.
9. Make sure travel surfaces can support weight of machine and any stored load.
10. Always set parking brakes 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.
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 anti-two-block 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 LMI / 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

Wind Speed Detection

It is essential that you observe the permitted maximum wind speeds. To check the wind speed, the crane can be equipped with an air speed indicator (anemometer).
This consists of two elements:

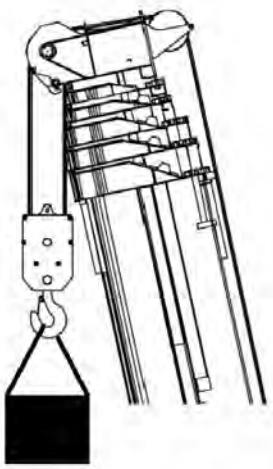
1. Rotor - fitted to the head of the main boom or main boom extension.
2. Display - on the screen. The rotational movement of the rotor caused by the wind is converted into an electrical signal which is displayed on screen in the crane operator's cab. The crane operator can read off the wind speed here in m/s.

Before commencing work or erecting the equipment it must be ensured that the anemometer is fully functional. If the values on the display change when the rotor is rotated, the unit is functioning.
To verify functionality during conditions of no wind, the rotor should be manually rotated.

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 13 ft^2/tonne.

Check the forecast and monitor wind speed conditions near the job site. When wind speed exceeds 27.8 ft/s (30 kph - force 5), derating of the cranes lifting capacity is required.



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

TEREX®

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 luffing cylinder(s)
  - Jib luffing cylinder, as applicable
  - Hoist winch
  - Luffing winch, as applicable

  NOTE: *Slight movement can also be due to a 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, luffing 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, its location and safety devices.

Danger of Accident

Whenever the operator has left the cab, the operating mode 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 master control level to the centered (0) position?
5. _____ Is parking brake on crane chassis set?
6. _____ Is crane engine off and ignition key removed?
7. _____ Is the crane cab locked?
8. _____ Is the crane secured from unauthorized use?
9. _____ Is the vehicle cab unoccupied?
10. _____ Is the vehicle engine off and the key removed?
11. _____ Is the vehicle parking brake set?

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.

Danger of accidents and personnel injury are increased when operating in reverse.

To minimize the risk of personnel injury or property damage, the following cautions must be observed.

- 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.

Be certain no injury or death may occur during backing operations.

Be certain no property damage will occur during backing operations.

- Rated maneuvering speed is the maximum speed allowed while backing up.
- 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 secure parked vehicle may result in vehicle roll-off and damage to personnel and/or property.

Risk of Death

The following conditions must be strictly adhered to by crane drivers-

- 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 on even, solid ground with sufficient load-bearing capacity.

Mobile cranes can roll away, if not properly prepared, causing injury 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-

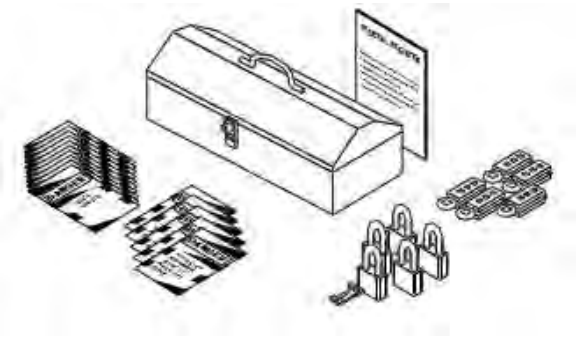
- The vehicle is parked on a slope.
- The vehicle is defective, especially concerning any deficiencies in the brake system.

Lock Out & Tag Out

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 absolutely 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, Terex 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 approved access devices (ladders, lifting platforms, etc) providing three- point access capability.

Crane Cab Access / Egress

Do not use item 1 as a grab handle. Only use grab handles for access or egress of the operator's cab that are marked in the illustrations.

Carrier Cab Access / Egress

Rear LH Side Access / Egress

Carrier Access / Egress-LH Side

Personal Safety

LOCK OUT/TAG OUT

The purpose of a Lock Out / Tag Out procedure is to ensure that the machine is isolated from potentially hazardous energy, locked and tagged out before performing any service or maintenance where energization, start-up or release of stored energy could cause injury.

Locate and identify all energy isolating devices and be certain which switch(es), valve(s), or other energy isolating devices apply to the machine to be locked out. More than one energy source (electrical, mechanical, hydraulic, etc.…) may be involved.

The Lock Out Procedure

1. Notify all affected personnel that a lockout system is going to be used and the reason.
2. If the machine is operating, shut it down following the normal shut down procedure.
3. Isolate and disconnect all machine energy sources. Stored energy (such as that in springs, machine members, hydraulic systems, etc.) must be dissipated or restrained.
4. Lockout the machine with assigned individual lock(s). Affix a tag to the lockout device and sign and date the tag with the name of the individual doing the work.
5. After ensuring that no personnel are exposed, and to ensure that energy sources are disconnected, try to start the machine and engage operating controls to ensure that the machine will not operate. Return the operating controls to the "neutral" position.
6. The equipment is now locked out.

Returning to Normal Operations

1. After service and/or maintenance has been completed and the machine is ready to operate, check the area around the machine to ensure that no one is exposed.
2. After all tools have been removed from the machine, guards have been reinstalled, and personnel are clear, remove the lockout device. Reconnect energy sources to restore energy to the machine.
3. Notify all affected personnel that the machine has returned to normal operations.

For more information regarding Lock-Out/Tag-Out procedures refer to the applicable OSHA 1910.147 Standards, ANSI Standards, Federal, State, Local and Jobsite Regulations.

SLIP AND FALL PREVENTION

1. Always wait until machine has stopped before getting on and off equipment. Do not jump on or off.
2. Do not use controls and steering wheel as hand holds.

(Continued on next page ...)

SLIP AND FALL PREVENTION

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 seat belt assemble frequently. Anytime it does not operate properly, or if there are any defects in the webbing (i.e. 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.

Temperature Effects on Telescope and Boom Hoist Cylinders

Background

Liquids exhibit changes in volume with changes in temperature. The degree of volume expansion divided by the change in temperature is called the material's coefficient of thermal expansion and generally varies with temperature. The thermal expansion coefficient of Petroleum oils varies slightly depending on several factors including API Specific Gravity. Generally, lower API oils expand at a higher rate than those with a higher API classification. The differences however are minimal and may be neglected for the purpose of this discussion. This thermal expansion characteristic leads to cylinder retraction as the hydraulic oil within the cylinder cools. This causes what is commonly referred to as “Load Drift” in hydraulic telescoping boom cranes. It is exhibited by all hydraulic telescoping boom cranes to varying degrees.

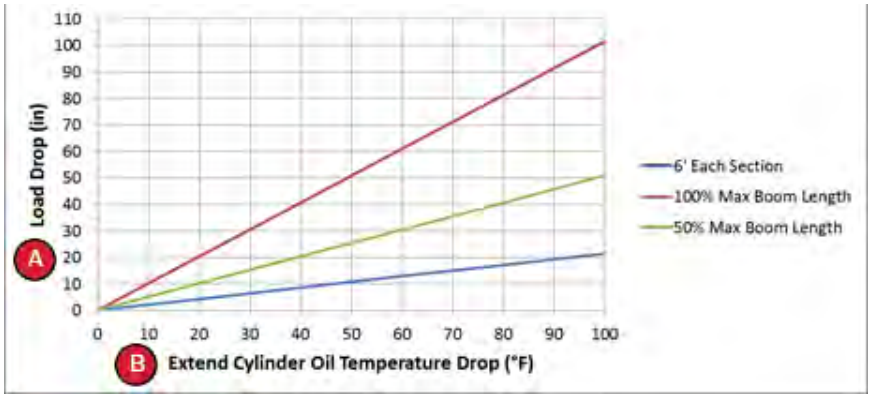
Load drift occurs when the hydraulic cylinder holding the load changes length over time. The change in length of the cylinder is proportional to its extended length and the oil temperature change within the cylinder. The rate at which the oil in a cylinder cools is dependent upon several factors. These factors include the differential temperature between the oil and ambient, thermal mass of the cylinder body and rod, and volume of oil to name a few. Assuming no internal leakage, load drift progresses until such time (given sufficient time) that the oil temperature in the cylinder reaches ambient temperature.

Safe crane operation involves careful monitoring of numerous environmental, jobsite, and equipment conditions, including an awareness of the load drift phenomenon. As the telescope and boom hoist cylinders retract, the load may radius increase and the load height decreases. This can increase the risk of tipping when handling loads close to the stability limits of the crane. The opposite situation occurs when cold oil is heated by ambient temperatures. In this case the cylinders will extend, increasing boom length and boom angle, possibly increasing radius.

Load Drift Graphs

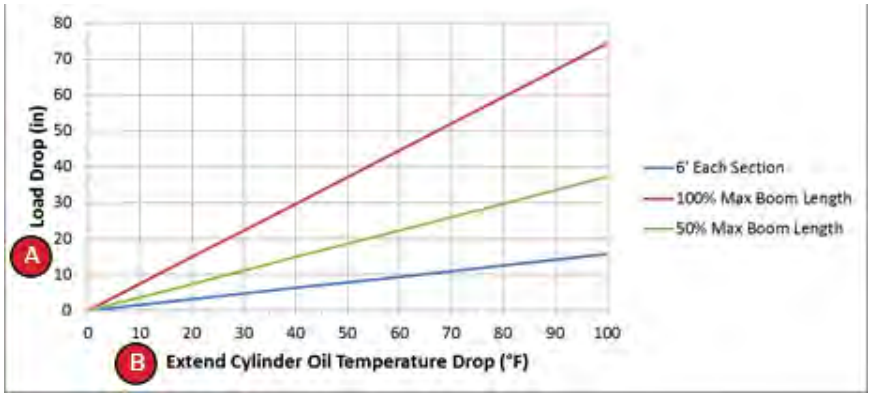
The graphs below provide guidance to understand the expected load drift behavior of the RT130 crane based on hydraulic oil temperature changes for various boom lengths and parts of line.

RT130 Load Drop Due to Temperature
1 Part of Line, 3 Different Boom Extensions, 60° Boom angle



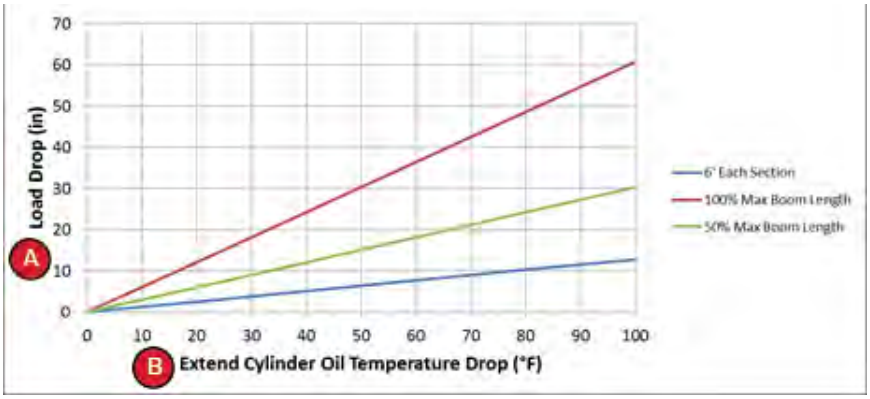
A Load Drop (inches)	100% Max Boom Length
B Extend Cylinder Oil Temperature Drop (F°)	50% Max Boom Length
	6' Each Section

RT130 Load Drop Due to Temperature
2 Part of Line, 3 Different Boom Extensions, 60° Boom angle



A Load Drop (inches)	100% Max Boom Length
B Extend Cylinder Oil Temperature Drop (F°)	50% Max Boom Length
	6' each section

RT130 Load Drop Due to Temperature
4 Part of Line, 3 Different Boom Extensions, 60° Boom angle

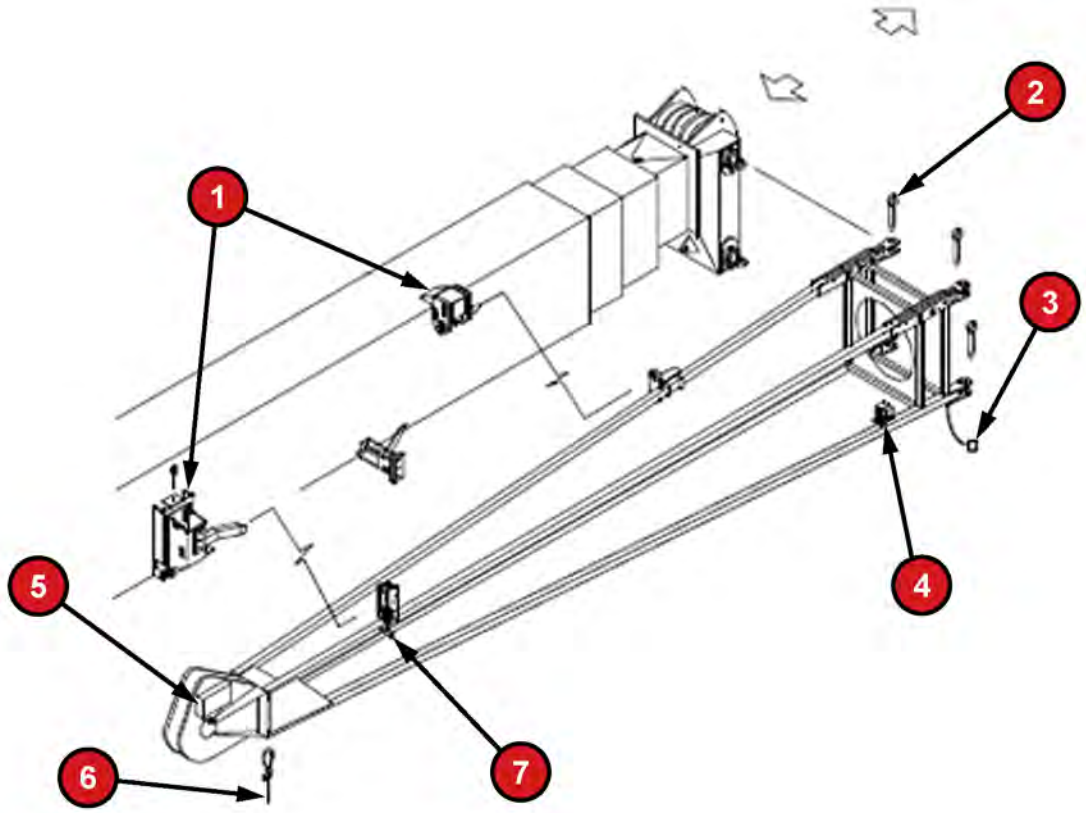


A Load Drop (inches)	100% Max Boom Length
B Extend Cylinder Oil Temperature Drop (F°)	50% Max Boom Length
	6' each section

Notes:

1. Projected load drift will be lower for boom angles less than 60°, and slightly more for boom angles greater than 60° in comparison to the values in the graphs provided herein.
2. Load drift due to thermal contraction of the hydraulic oil can be mistaken for leaking cylinder seals or faulty holding valves. If leaking seals or faulty holding valves are suspected, follow the recommended inspection and diagnostic procedures for correcting the problem.

Erecting the Jib



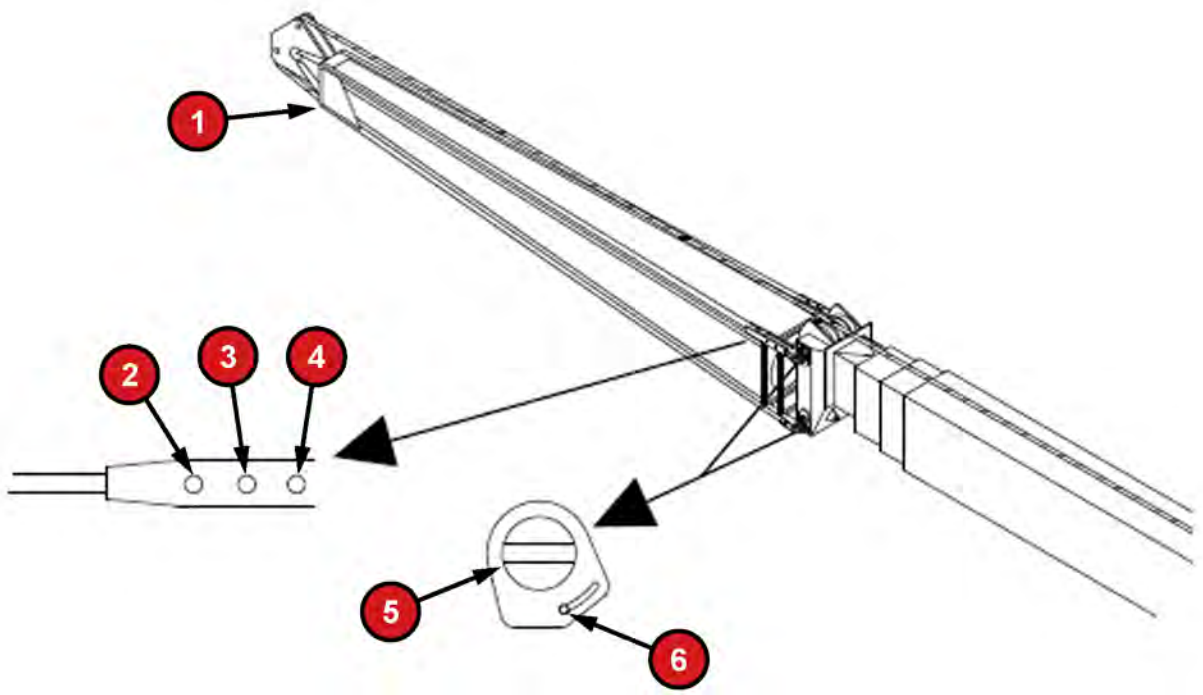
1	Jib Storage Brackets	5	Anti Two-Block Switch
2	Jib Mounting Pins (4)	6	Guide Rope
3	Anti Two-Block Pins	7	T-Handle
4	Anti Two-Block Plug		

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 anti two-block plug from the jib anti two-block socket and connect it to the socket on the boom head. Move the dummy plug from the boom head socket to the anti two-block socket on the jib.
14. Reeve the hoist line over the jib sheave.
15. Test the anti two-block system by lifting the anti two-block 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 3/ 4 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.

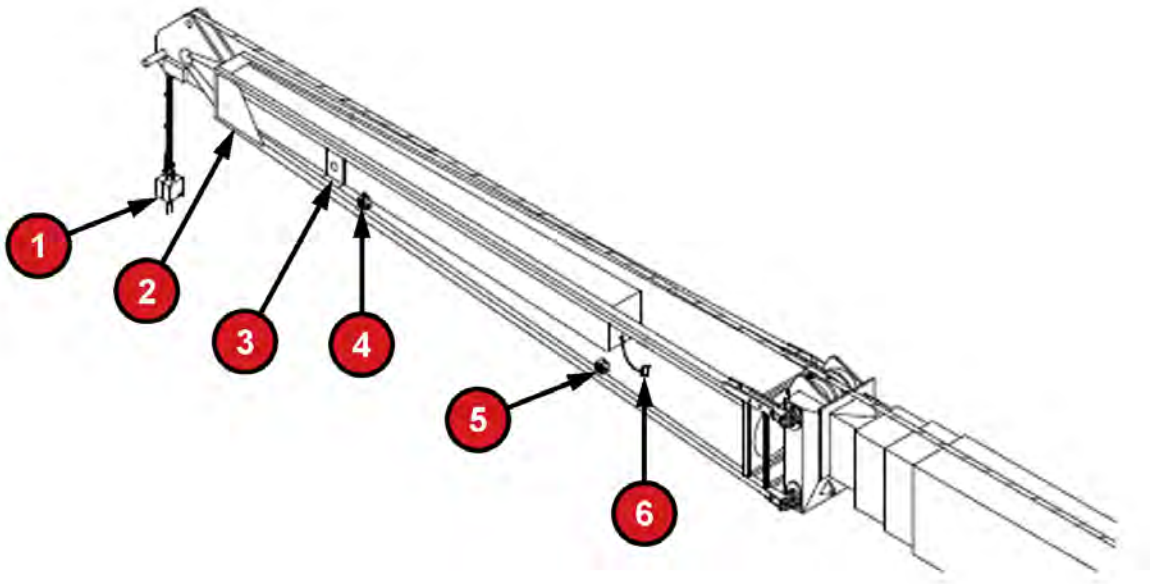
   NOTE: *To prevent damaging the jib, do not winch up any more than is necessary to loosen the jib offset pins.*
6. Remove the jib offset pins from the 0° offset hole and place in the 15° hole or if you are using 30° offset then place pins in tool box.
7. With the engine at idle, slowly winch down to pay 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	Anti Two-block Weight	4	Anti Two-block Extended Socket
2	Attach Dead-end Of Rope	5	Anti Two-block Retracted Socket
3	Pull Out Retaining Pin Hole	6	Pull out Anti Two-block 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 anti two-block plug from the anti two-block 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 anti two-block plug into the anti two-block **Extended** socket.
7. Test the anti two-block system by lifting the anti twoblock 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

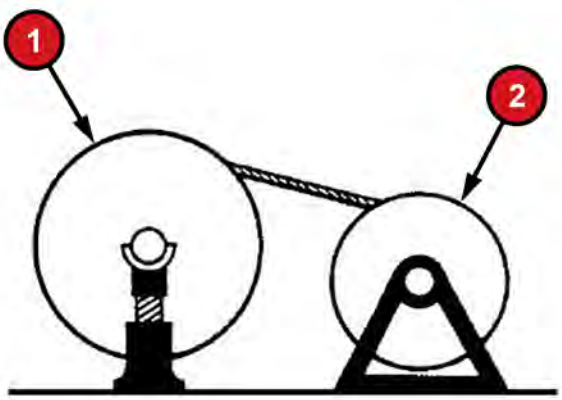
1. Retract the boom completely and boom down to minimum boom angle.
2. Unplug the anti two-block plug from the anti twoblock **Extended** socket. Move the dummy plug from the retracted socket to the extended socket.
3. Attach the dead end of the wire rope to the eye on the bottom of the jib tip.
4. Remove 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 anti two-block plug into the anti two-block **Retracted** socket.
7. Test the anti two-block system by lifting the anti twoblock 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

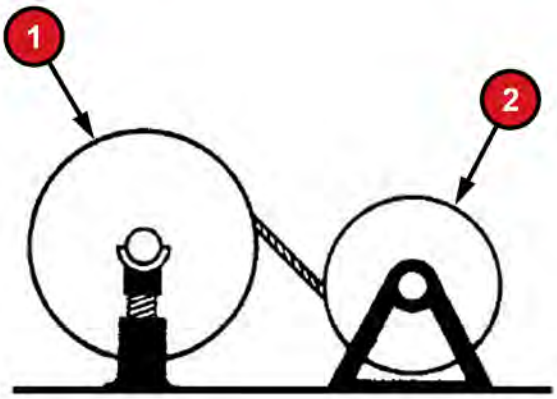
Care must be exercised when installing wire rope on the winch drum. Improper spooling can. result in rope damage through crushing, kinking, dog- legs, abrasion and cutting. Poorly installed wire rope will also adversely affect the operating characteristics of the machine by causing uneven application 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 1234-18)
		5/8 216529	USED IN WINCH 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.

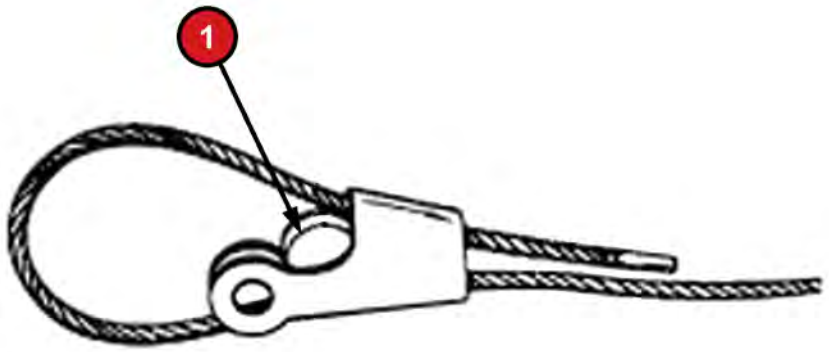
After the wire rope is wound onto the winch drum, reeve the cable as desired.

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.

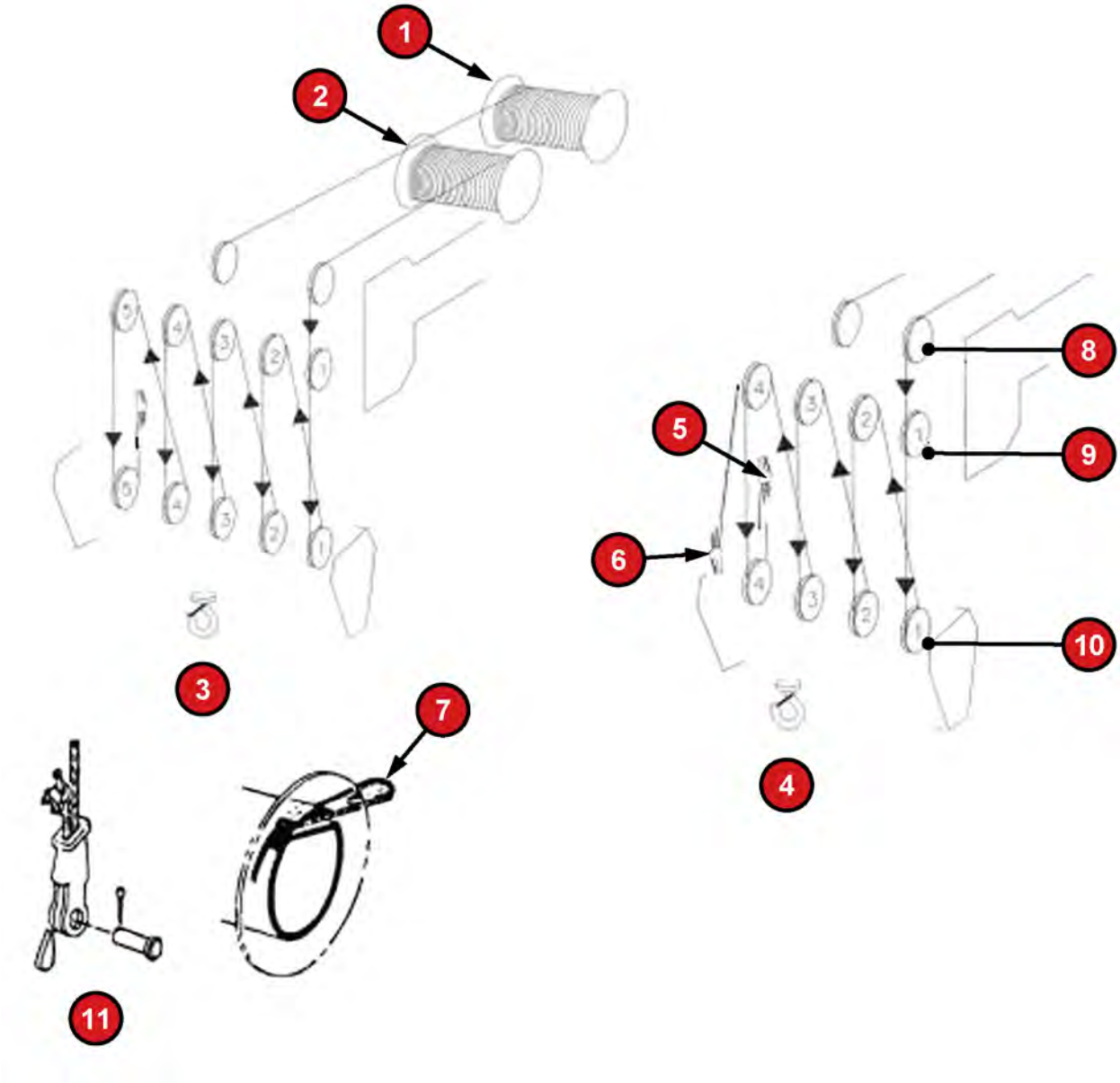
2. Insert the wedge (1) and allow the rope strands to adjust around it.



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.

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.

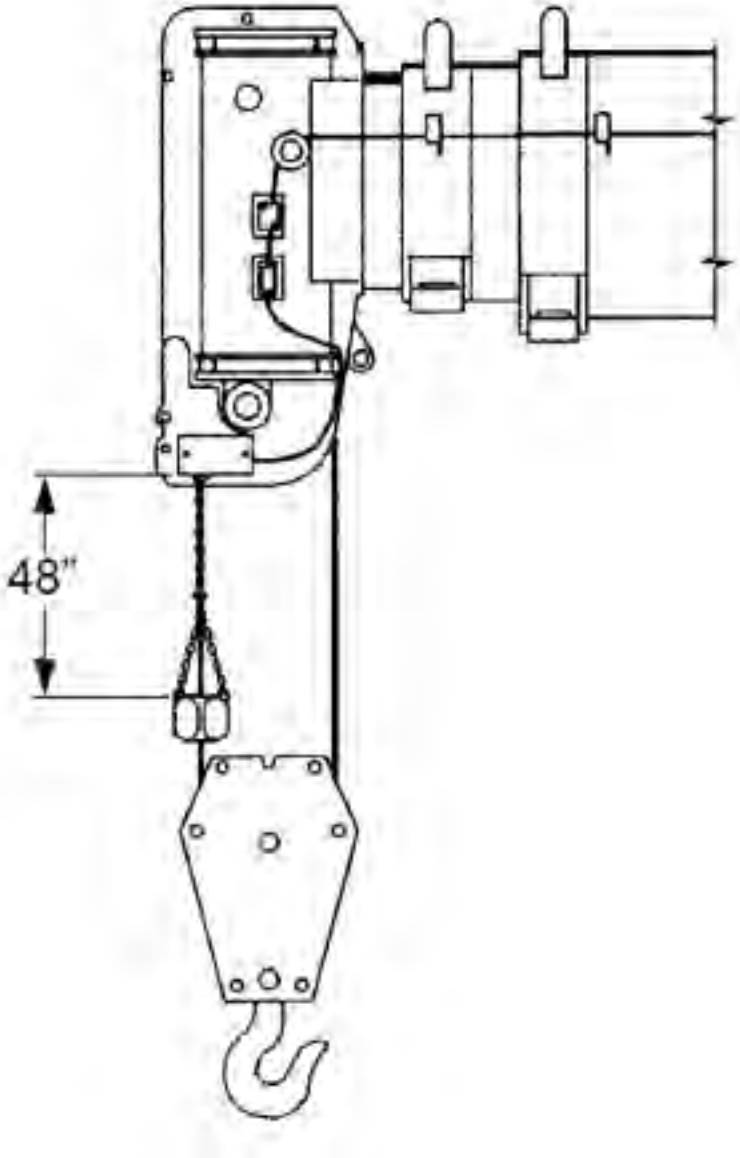
This crane incorporates a "Quick Reeving" boom head and block which do not require removal of the wedge and socket from the rope in order to change the reeving. Removal of two pins in the boom head and three in the hook block will allow the wedge and socket to pass through.

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.

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



Test the anti two-block system by lifting the anti two block 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.

Counterweight Change - (T300-1 Only)

In some cases it may be desirable to change the counterweight on the T300 for use in locales where it can be advantageous to have a heavier or lighter crane, with the corresponding change in rated lift capacity.

When the configuration of the crane is changed, the RLI must be programmed to match the physical configuration of the crane.

Procedure for Counterweight & Greer Computer HEX File Change

1. Determine the desired counterweight of the crane and matching load chart. See the Parts book (Group 13) for the required configuration of the desired weight.
2. Remove or add the counterweight to the front bumper and install the appropriate bumper cover. If adding counterweight, bolt it to the frame with the specified fasteners.
3. If equipped with Aux Winch:
   3A. Wrap all of the cable onto the winch and secure the end of the cable so it will not be damaged or work free.
   3B. Disconnect all electrical connections to the winch and secure the wires to insure they will not be damaged.
   3C. Disconnect and cap all hydraulic connections. Make note of where each hose goes for reassembly.
   3D. Remove the bolts securing the winch to the counterweight.
   3E. Using a suitable lifting device, lift the Aux winch off of the crane and place it aside.
4. Attach a suitable lifting device to the counterweight and support the weight of the counterweight with the hoist or crane that will be used for the counterweight removal.
5. Remove the bolts holding the counterweight to the rear of the superstructure.
6. Lift the counterweight off of the crane and place it aside.
7. Remove the paper copy of the load chart from the crane.
8. Lift the new counterweight onto the crane.
9. While still supporting the counterweight, install the hardware securing the counterweight to the crane and torque fasteners as specified in the chart below.
10. If not using Aux Winch, install additional counterweight as specified.
11. If using Aux Winch:
    11A. Lift the Aux winch into position on the counterweight.
    11B. Install and torque the fasteners holding the winch to the counterweight as specified in chart below.
    11C. Re-attach the hydraulic hoses to the winch, each in their original locations.
    11D. Reconnect all of the electrical connections to the winch.
    11E. Re-install the cable per operating instructions.
12. Program the RLI with matching load chart file.
    12A. Remove power from the RLI computer and follow instructions 1. thru 15.

Downloading Application .Hex files to the Greer Computer.....

1. Remove power from the Greer MicroGuard® computer.
2. Ensure the USB end of the Greer programming cable is connected to the PC.
3. Remove the cover of Greer computer and push the small black connector onto the JU2 header.

4. Connect the large white connector of the programming cable to the J7 header on the Greer PCBA.
5. Start the Greer MicroGuard® Application MiniLoader (Miniloader.exe) and apply power to the Greer computer.

NOTE: *The Miniloader.exe program will locate the correct COM port and will provide a connection between the user PC and the Greer computer.*

TWG

Infrastructure Energy Recovery

Downloading Application .Hex files to the Greer Computer.....

6. The main dialog box will look similar to this:

7. If the "USB Connected" or "Greer Computer Connected" do not have a green checkmark next to them, ensure the programming cable is securely connected on both ends.
8. If the "Communication OK" checkbox is still unchecked, it may be necessary to remove power to the Greer computer and re-power, until the checkbox is checked.
9. Click "Browse" and an explorer style dialog box will open.
10. Select the hex file to load and press "Open".

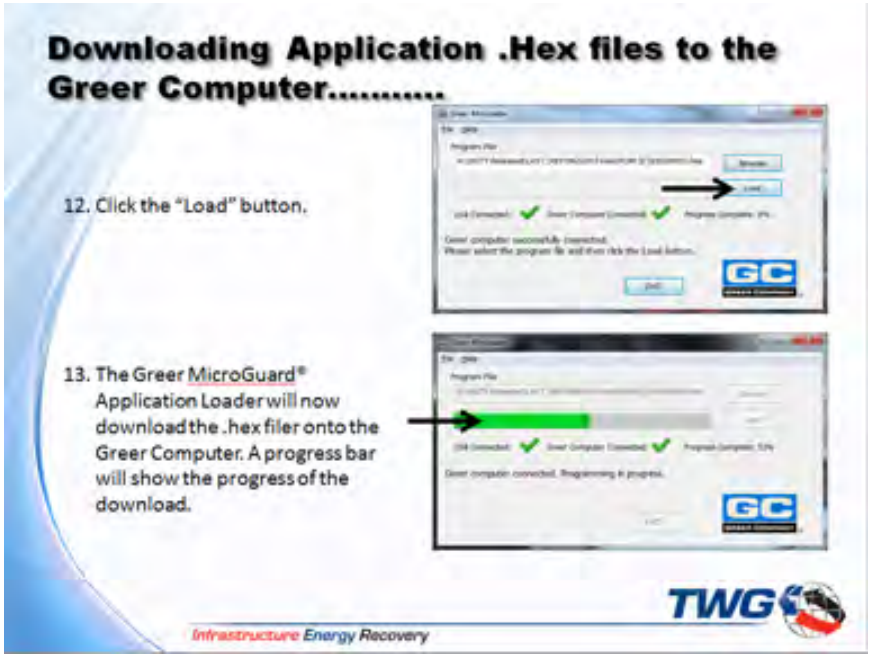
NOTE: *When selecting the .hex program to download, the USB connected and Greer Computer Connected must have green check marks.*

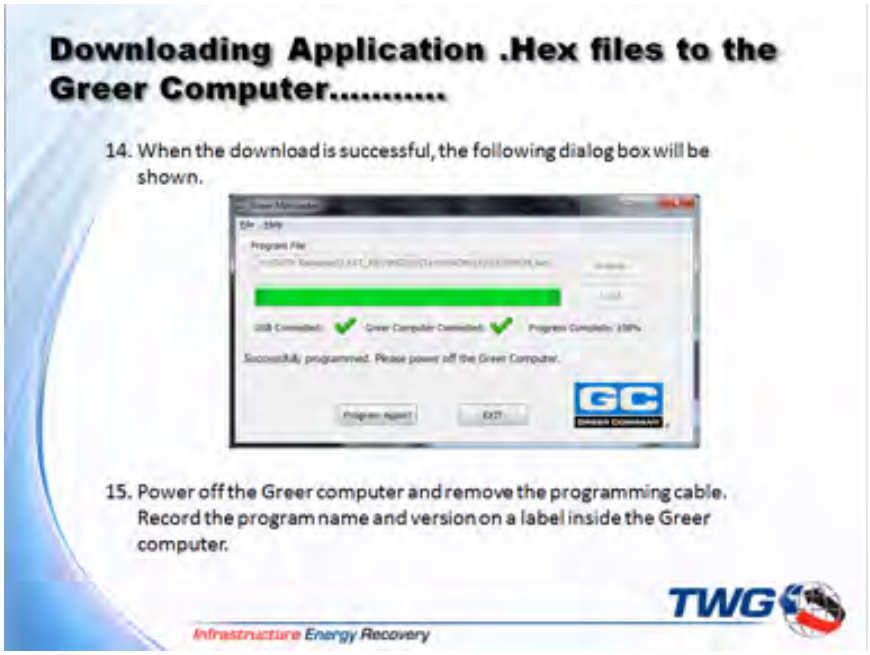
11. The main dialog box should now look like the dialog below:

If they are not checked, it may be necessary to cycle power to the Greer computer and try again. This may also happen if the Greer computer has been powered up for a long period of time.

TWG

Infrastructure Energy Recovery





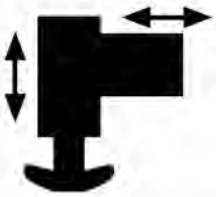
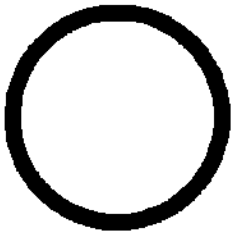
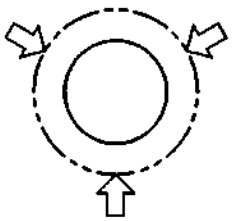
13. Place new paper copy of the load chart that matches the cranes configuration in the operator's cab.
14. Verify that all functions of the crane and RLI are working properly and that the programmed load chart matches the configuration of the crane.

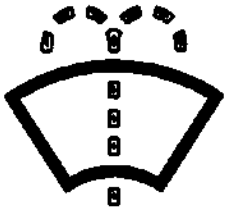
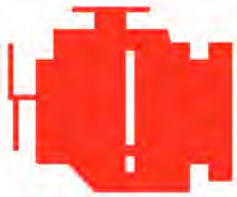
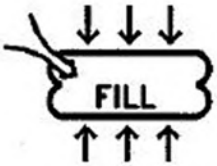
COUNTERWEIGHT FASTENER TORQUE TABLE		
LOCATION ON CRANE	FASTENER SIZE	TORQUE VALUE (FT. LBS)
AUX WINCH to C'WT	1-8 NC X 8" GRD 5	640 (DRY)
C'WT to SUPERSTRUCTURE	1.25 NC X 19.50' GRD 5	1120 (DRY)
C'WT to C'WT- add on weight	.75 NC X 4.50" GRD 5	270 (DRY)

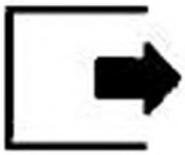
Universal Symbol Identification

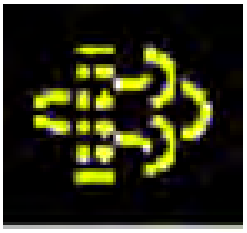
This section is intended to familiarize the operator with the controls and instruments provided for the operation of this machine. It should be emphasized, however, that merely knowing the controls is inadequate preparation for operating hydraulic cranes. Do not attempt to operate the machine until the 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 

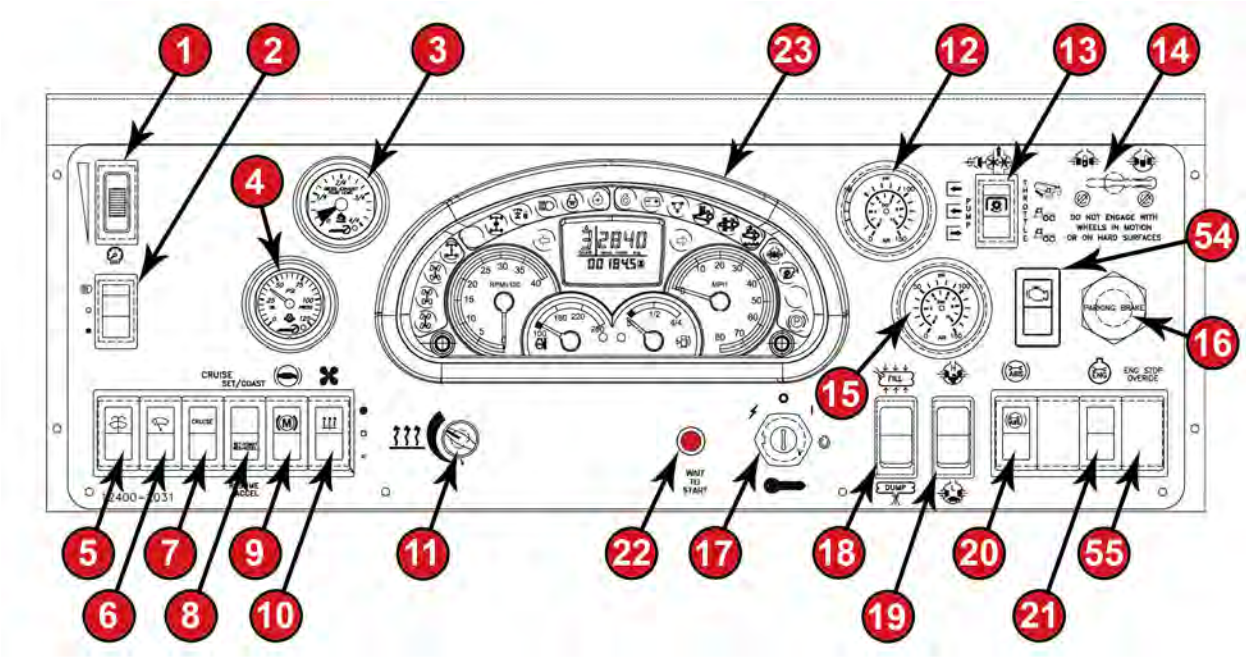
ELECTRICAL SYSTEM ON 	HEADLIGHTS 	WASHER 
IGNITION ON 	FAST 	ENGINE DIAGNOSTIC 
IGNITION 	SLOW 	INCR / IDLE ADJ INCREASE 
ENGINE STOP 	AXLE DISENGAGE / RANGE SHIFT 	INCR / IDLE ADJ DECREASE 
AIR SUSPENSION FILL 	KEY - ACC 	ENGINE STOP 

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 		

TEREX

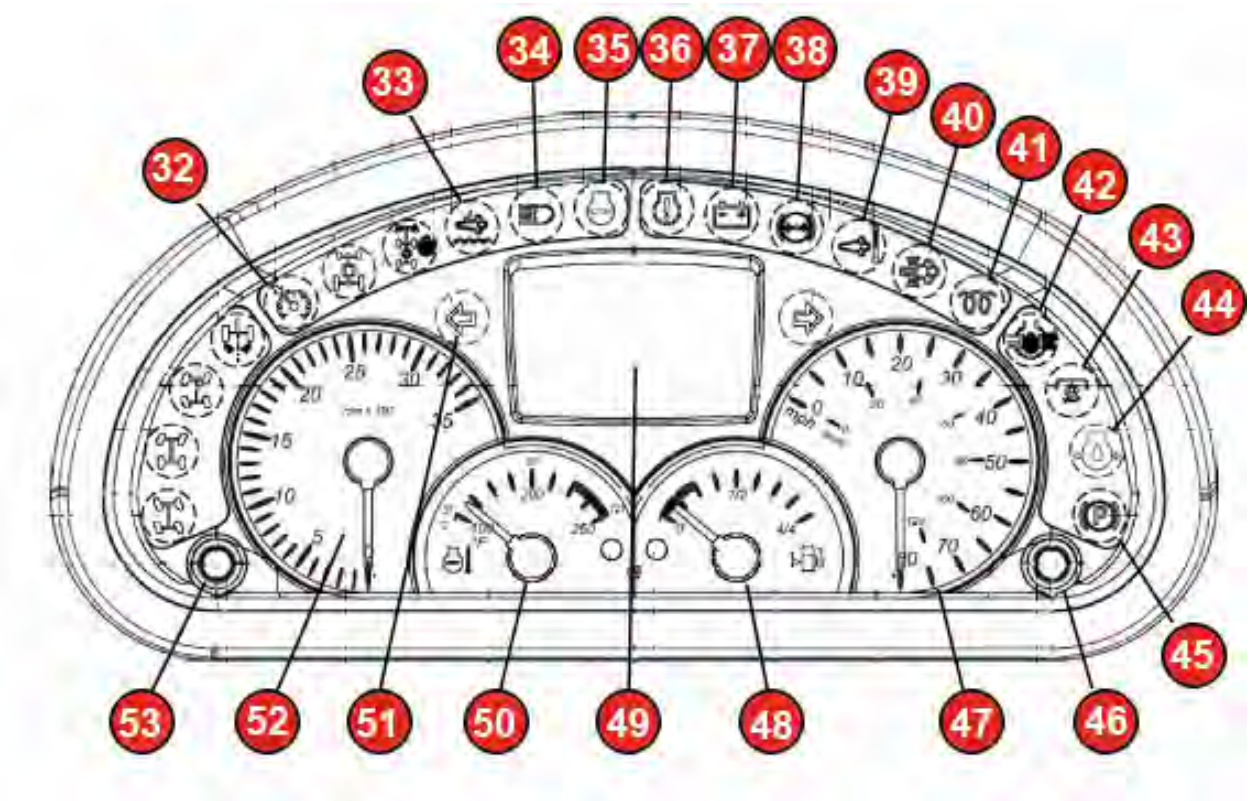
Carrier Controls and Instruments-EPA 2013 Engines



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. DIFFERENTIAL LOCK** -Vehicle must be stopped to engage or disengage. Only for offroad use and increased traction.
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. 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).
6. WIPER SWITCH-Press for windshield wiper.	**22. WAIT TO START** - Red colored Warning Light "ON". Do not engage starter until light goes "OFF". (EPA 2013 Engine Only)
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.

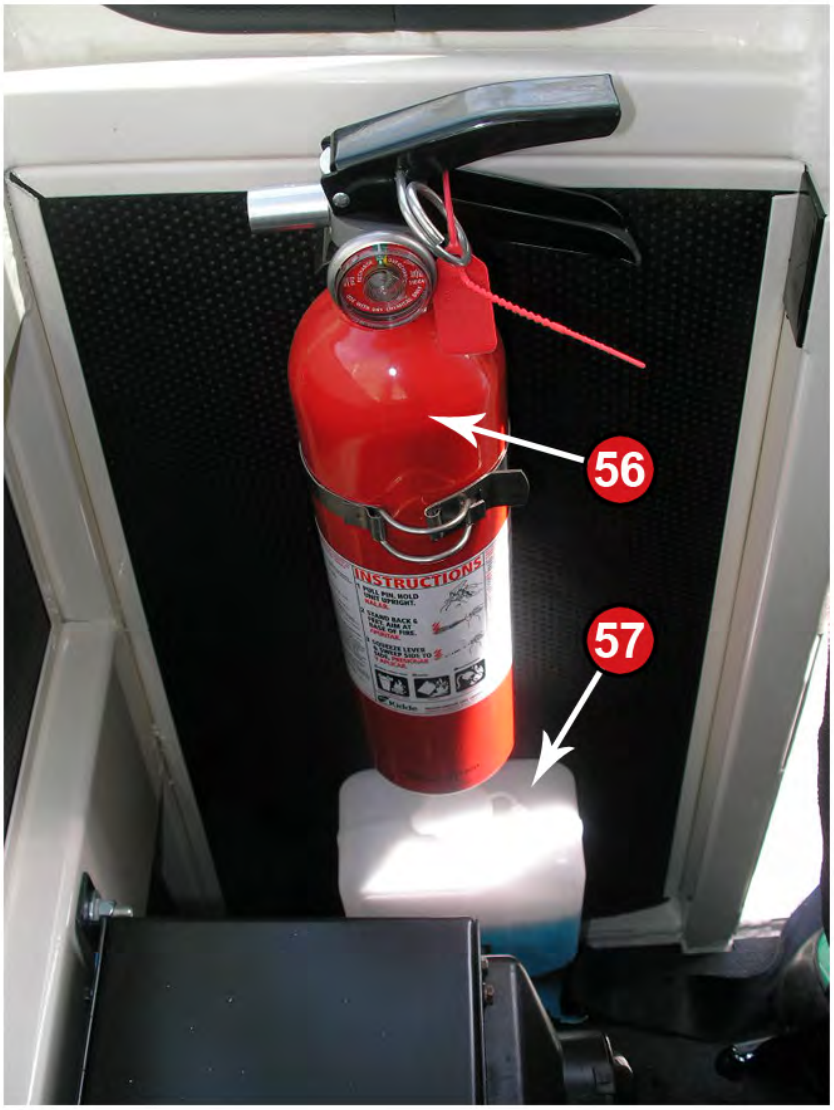
11. TEMPERATURE ADJUST-Adjusts heat temperature.	**27. 4 WAY FLASHER**-Pull to activate flashers, push to deactivate.
12. AIR GUAGE (Front)-Indicates air pressure in front air tank. Maintain 110 to 115 psi normal system air pressure.	**28. TRANSMISSION SHIFT LEVER** -See Fuller Manual or Allison Transmission 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. With the lockout engaged, the stuck wheel may continue to spin but the other side of the tandem will begin "driving", thus	**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.	**44. ENGINE OIL PRESSURE**-Red colored Warning Light "ON" if less than 80 Kpa (about 12 PSI).
33. DEF-Red colored Warnling Light "ON" when Diesel Exhaust Fluid (Urea) tank fluid level is low.	**45. PARK LAMP**-Red colored Warning Light "ON".
34. BRIGHT-Blue colored Warning Light "ON" when HI beam headlamps are "ON".	**46. SUB MENU NAVIGATION BUTTON**-LCD Display screen sub menu select/ deselect button. (See UNIDECK Manual).
35. ENGINE STOP-Red colored Warning Light "ON" when Engine should be shutdown.	**47. SPEEEDOMETER GUAGE**-MPH (0-80) & Kph (0-120).
36. ENGINE CHECK-Amber colored Warning Light "ON".	**48. FUEL LEVEL GUAGE**-Guage and Amber colored Warning Light "ON" with low fuel level.
37. BATTERY CHARGING CONDITION-Red colored Warning Light "ON" if less than 12 volts.	**49. LCD DISPLAY** -Readouts: Terex Logo, Clock, Total Engine Machine Hours, Engine Oil Pressure, Total Odometer, Partial Odometer, Languages menu, Engine Fault. (See UNIDECK Operation & Instructions).

38. LOW AIR PRESSURE-Red colored Warning Light "ON" if less than 60 PSI.	**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.
39. DPF TEMPERATURE-Red colored Warning Light "ON" indicates HIGH exhaust temperature.	**51. LEFT TURN SIGNAL**-Green colored flashing Warning Light "ON".
40. DPF FILTER-Red colored Warning Light "ON" indicating filter is clogged.	**52. TACHOMETER GUAGE**-Engine RPM x 100 Guage (0-3500 RPM).
41. WAIT TO START-Red colored Warning Light "ON". Do not engage starter until light goes "OFF". (EPA 2010 & Export Engine Only)	**53. MENU NAVIGATION BUTTON** -LCD Display screen menu. (See UNIDECK Operations Instructions).
42. DIFFERENTIAL LOCK-Amber colored Warning Light "ON". Differential is locked.	**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 Cummins location for repair.
43. PTO ON-Amber colored Warning Light "ON", PTO is engaged..	**55. OPEN**



56. 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.	**57. WINDSHIELD WASHER RESERVOIR** - Use only over the counter washer fluid made specifically for automotive windshields.

58. HEATER UNIT-Engine hot water supplied to carrier cab heater unit.	**59. TRANSMISSION SHIFTER**-Eaton Fuller transmission (See Trans Operations Instructions).

T300-1_T500-1_T780
Description Of Machine and Controls

Manual & Automatic Transmission

P/N 12261-683 REVISED: January 2015

60. TRANSMISSION SHIFTER-Allison Auto transmission (See Trans Operations Instructions).	**61. TRANSMISSION OIL TEMPERATURE GUAGE**-When oil temperature is in the Yellow or Red zone, consult an Allison Service Representative. PTO will not engage when pressure in transmission is low.

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.

T300-1 Pump Engagement Procedure

With this system, only change the PTO switch position with the engine at low idle or with the engine off. The pumps will not engage, however, until the engine is started.

Note that with either system the LMI in the upper cab will not come on until the pumps are engaged.

To Disengage Pumps: Shut off the engine, turn the ignition switch (17) back on without starting the engine (Position 'C'). Push the PTO Switch (29) all the way down and let it spring back to the center position. The PTO light (24) will go out. This is the normal driving position.

Only engage pumps while the engine is OFF. Attempting to engage the pumps with the engine running will result in damage to the pump disconnect splines.

To Engage Pumps: Turn the ignition switch (36) on (Positon C), DO NOT start the engine. Push PTO switch (13) all the way up. PTO light (43) should come on. If it does not, make sure you have a minimum of 60 psi of air. If you do not, return the PTO switch to the lower position and start the engine and run until air pressure builds. You may also need to bump the starter to jog the engine in order to align the pump slines and turn the PTO light (43) on. This will also transfer the gauges and throttle to the upper cab. This is the normal craning position.

If you return the PTO switch (13) to the center position, the throttle will be returned to the lower cab while keeping the pumps engaged. The PTO light (43) will stay on. Use this position if you need to drive the machine while keeping the pumps engaged. An example of this would be pick and carry work. While damage to the pump disconnect splines will not result from making this change with the engine running, it is recommended stopping the engine before making any change to the PTO switch (13).

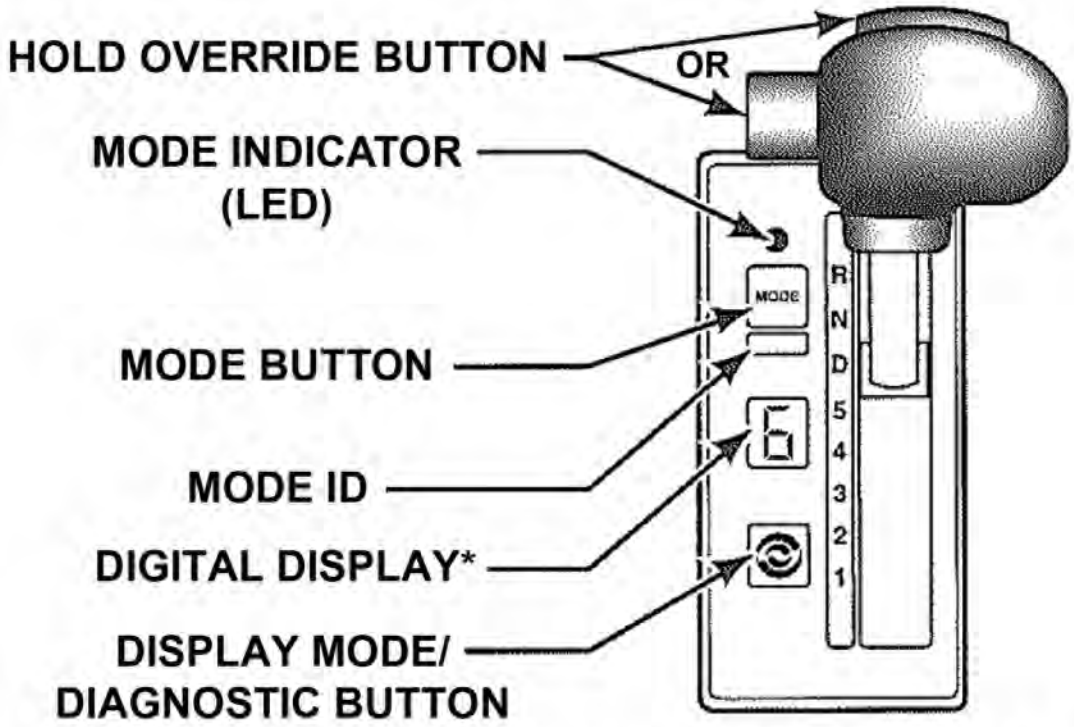
T500-1 & T780 Pump Engagement Procedure (Auto & Manual Trans)

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.

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.

TRANSMISSION OPERATIONS INSTRUCTIONS



SIX-SPEED, RIGHT-HAND LEVER SELECTOR

Abbreviations

ABS	Anti-lock brake system
DMD	Display Mode/Diagnostic
DOC	Diagnostic Optimized Connection
DTC	Diagnostic Trouble Code
ECU	Electronic Control Unit
EMI	Electromagnetic interference
FCC	Federal Communications Commission
FM	Filter Life Monitor
I/O	Input/Output
KOH	Potassium Hydroxide
MIL	Military specifications
MY09	Model Year 2009
OEM	Original equipment manufacturer
OLS	Oil level sensor
OM	Oil Life Monitor
PTO	Power Takeoff
PWM	Pulse Width Modulated
RFI	Radio frequency interference
RMR	Retarder Modulation Request
SP	Specialty Series
TAN	Total acid number
TM	Transmission Health Monitor
TPS	Throttle position sensor
VIM	Vehicle interface module
WTEC	World Transmission Electronic Control

LEVER SHIFT SELECTOR.

General Description. The Allison 4th Generation lever shift selector is an electromechanical control. Typical lever positions are:

- **R** (Reverse)
- **N** (Neutral)
- **D** (Drive)
- Some number of lower forward range positions

Allison transmissions can be programmed to have up to six (seven for 4700/4800 SP) forward ranges. Shift selector positions should agree with the programming of the TCM.

The lever shift selector includes the following:

- **HOLD OVERRIDE** button
- **MODE** button

- Digital display
- **DISPLAY MODE/DIAGNOSTIC** button

Hold Override Button. The lever shift selector has three locked positions to prevent accidentally selecting **R** (Reverse), **N** (Neutral), or **D** (Drive). Select **R** (Reverse), **N** (Neutral), or **D** (Drive) by pressing the **HOLD OVERRIDE** button and moving the lever to the desired position. Once **D** (Drive) is selected, lower forward range positions may be selected without pressing the **HOLD OVERRIDE** button.

MODE Button. The **MODE** button can allow the driver to enable a secondary shift schedule, PTO enable, or other special functions that have been programmed into the TCM unit at the request of the OEM. For example, a vehicle OEM may have provided a secondary shift schedule for improved fuel economy. The name of the special function (ECONOMY) appears on the MODE ID label adjacent to the **MODE** button. Pressing the **MODE** button activates the ECONOMY shift schedule and illuminates the MODE INDICATOR LED.

When the Diagnostic Display Mode has been entered, the **MODE** button is used to view and toggle through diagnostic code information. The code displayed is active if the MODE INDICATOR LED is illuminated.

NOTE: Visually observe the digital display whenever the lever is moved. **N** should appear in the digital display if **N** is selected.

Digital Display. Allison 4th Generation Controls contain two digital displays, SELECT and MONITOR. During normal operation, if **D** (Drive) is selected, the SELECT digital display shows the highest forward range attainable for the shift schedule in use. The MONITOR digital display shows the lowest available forward range.

Limited operation is indicated by the digital display as follows:

- All digital display segments are illuminated during initialization. If after 10 seconds communication is not established with the TCM, both digital displays show \/\ (cateyes).
- When both digital displays show \/\ (cateyes), a selector-related fault code has been logged.
- When the SELECT display shows **R** or **D** has been requested and the display is flashing the selected range, then the selected range has not been attained due to an inhibit function.
- Inhibited range, shown by a flashing SELECT digital display, is not an indication that there is a transmission control component fault. It indicates that a DTC has not. An inhibit means there is a vehicle or engine

— Too high idle speed in **N** to allow **R** or **D**

— Too high a throttle signal in **N** to allow **R** or **D**

— Too high of an output speed in **N** to allow **R** or **D**

— An active vehicle function or I/O function is operating which inhibits range.

CAUTION: The transmission will not shift into range from **N** if a **CHECK TRANS** code is active. If a **CHECK TRANS** code is active, move vehicle to a safe location before turning off the engine.

Conditions which illuminate the **CHECK TRANS** light disable the shift selector. The SELECT display is blank and the MONITOR display shows the range actually attained.

Once **D** (Drive) is attained, the transmission will shift into the lowest forward range programmed for the **D** (Drive) position, usually first-range.

Display Mode/Diagnostic Button. The **DISPLAY MODE/DIAGNOSTIC** button allows access to fluid level information and diagnostic code information.

- Move the shift lever to **N** and apply the parking brakes.
- Press the **DISPLAY MODE/DIAGNOSTIC (DMD)** button once to access oil level information (if an OLS is installed).
- Press the **DMD** again to access the diagnostic code information.
- Press the **MODE** button to view subsequent code positions d2 through d5.
- To exit the diagnostic code mode, move the shift lever to another position.

RANGE SELECTION

PUSHBUTTON AND LEVER SHIFT SELECTORS WITH DIGITAL DISPLAY

Description of Available Ranges		
REVERSE		**WARNING:** If you leave the vehicle and the engine is running, the vehicle can move unexpectedly and you or others could be injured. If you must leave the engine running, do not leave the vehicle until you have completed all of the following procedures: 1. Put the transmission in **N** (Neutral). 2. Be sure the engine is at low idle (500–800 rpm). 3. Apply the parking brakes and emergency brake and make sure they are properly engaged. 4. Chock the wheels and take any other steps necessary to keep the vehicle from moving.
		**WARNING: R** (Reverse) may not be attained due to an active inhibitor. Always apply the service brakes when selecting **R** (Reverse) to prevent unexpected vehicle movement and because a service brake inhibit may be present. When **"R"** is flashing, it indicates the shift to **R** (Reverse) is inhibited. Determine if diagnostic codes are active if **R** (Reverse) is not attained.
		**CAUTION:** Do not idle in **R** (Reverse) for more than five minutes. Extended idling in **R** (Reverse) can cause transmission overheating and damage. Always select **N** (Neutral) whenever time at idle exceeds five minutes.

PUSHBUTTON AND LEVER SHIFT SELECTORS WITH DIGITAL DISPLAY *(cont'd)*

Description of Available Ranges		
REVERSE		**NOTE:** Visually observe the digital display window whenever a button is pushed or the lever is moved to be sure the range selected is shown (i.e., if the **N** (Neutral) button is pressed, **"N"** should appear in the digital display). A flashing display indicates the range selected was not attained due to an active inhibit.
	R	Completely stop the vehicle and let the engine return to idle before shifting from a forward range to **R** (Reverse) or from **R** (Reverse) to a forward range. The digital display will display **"R"** when **R** (Reverse) is selected.
NEUTRAL		**WARNING:** When starting the engine, make sure the service brakes are applied. Failure to apply the service brakes can result in unexpected vehicle movement.
		**WARNING:** Vehicle service brakes, parking brake, or emergency brake must be applied whenever **N** (Neutral) is selected to prevent unexpected vehicle movement. Selecting **N** (Neutral) does not apply vehicle brakes, unless an auxiliary system to apply the parking brake is installed (refer to the Operator's Manual for the vehicle).
		**WARNING:** If you let the vehicle coast in **N** (Neutral), there is no engine braking and you could lose control. Coasting can also cause severe transmission damage. To help avoid injury and property damage, do not allow the vehicle to coast in **N** (Neutral).

PUSHBUTTON AND LEVER SHIFT SELECTORS WITH DIGITAL DISPLAY *(cont'd)*

Description of Available Ranges		
NEUTRAL	**N**	Use **N** (Neutral) when starting the engine, to check vehicle accessories, and for extended periods of engine idle operation (longer than five minutes). For vehicles equipped with the pushbutton selector, **N** (Neutral) is selected by the TCM/ECU during start-up. For vehicles equipped with the lever selector, the vehicle will not start unless **N** (Neutral) has been selected. If the vehicle starts in any range other than **N** (Neutral), seek service immediately. **N** (Neutral) is also used during stationary operation of the power takeoff (if the vehicle is equipped with a PTO). The digital display will show **"N"** when **N** (Neutral) is selected. Always select **N** (Neutral) before turning off the vehicle engine.
DRIVE		**WARNING: D** (Drive) may not be attained due to an active inhibitor. Always apply the service brakes when selecting **D** (Drive) to prevent unexpected vehicle movement and because a service inhibit may be present. When **"D"** is flashing, it indicates the shift to **D** (Drive) is inhibited. Determine if diagnostic codes are active if **D** (Drive) is not attained.
		**CAUTION:** Do not idle in **D** (Drive) for more than five minutes. Extended idling in **D** (Drive) may cause transmission overheating and damage. Always select **N** (Neutral) if time at idle exceeds five minutes.
		**NOTE:** Turn off the vehicle HIGH IDLE switch, if present, before shifting from **N** (Neutral) to **D** (Drive) or **R** (Reverse). **D** (Drive) or **R** (Reverse) will not be attained unless the shift is made with the engine at idle. Also, be aware of other interlocks that would prevent attaining **D** (Drive) or **R** (Reverse). Example: "service brakes not applied" (service brake interlock present).

PUSHBUTTON AND LEVER SHIFT SELECTORS WITH DIGITAL DISPLAY *(cont'd)*

Description of Available Ranges		
D R I V E	**D**	The transmission will initially attain first range when **D** (Drive) is selected (except for those units programmed to start in second-range). As vehicle speed increases, the transmission will upshift automatically through each range. As the vehicle or equipment slows down, the transmission will automatically downshift to the correct range. The digital display will show the highest range available in **D** (Drive).

PUSHBUTTON AND LEVER SHIFT SELECTORS WITH DIGITAL DISPLAY *(cont'd)*

Description of Available Ranges		
MANUAL SELECT		**WARNING:** The transmission incorporates a hold feature to prohibit upshifting above the range selected during normal driving. For downhill operation, select a lower transmission range. If the engine governed speed is exceeded in the held range, however, the transmission will upshift to the next higher range to prevent engine damage. To avoid injury and/or property damage due to loss of vehicle control, use the vehicle brakes to prevent exceeding engine governed speed in the held range.
	7+ **6*** **5*** **4*** **3** **2**	Lower ranges provide greater engine braking for going down grades (the lower the range, the greater the braking effect). Occasionally, it may be desirable to restrict automatic shifting to a lower range because of: • Road conditions. • Load. • Traffic conditions. • Etc. The pushbutton shift selector arrow buttons access individual forward ranges. Push the ↑ (Up) or ↓ (Down) arrow for the desired range. The digital display shows the range chosen. Even though a lower range is selected, the **transmission may not downshift** until vehicle speed is reduced (this prevents excessive engine speed in the lower range).
	1	First-range provides the vehicle with its maximum driving torque and engine braking effect. Use first-range when: • Pulling through mud and deep snow. • Maneuvering in tight spaces. • Driving up or down steep grades. For vehicles equipped with the pushbutton selector, push the ↓ (Down) arrow until first-range appears in the select window.

RANGE PRESELECTION

NOTE: Preselecting during normal operation may result in reduced fuel economy.

Range preselection means selecting a lower range to match driving conditions encountered or expect to be encountered. Learning to take advantage of preselected shifts will give you better control on slick or icy roads and on downgrades.

Downshifting to a lower range increases engine braking. The selection of a lower range often prevents cycling between that range and the next higher range on a series of short up-and-down hills.

COLD WEATHER STARTS

All transmissions are programmed to restrict full operation until specific fluid temperatures are reached. Refer to the following table for temperature restrictions.

Minimum Fluid Operating Temperatures

Sump Fluid Temperature	CHECK TRANS Light	Operation
–32°C (–25°F) to –7°C (19°F)	OFF	Neutral, Reverse, Second
–7°C (19°F)	OFF	Full operation in all ranges

Transmission operation at cold ambient temperatures may require preheating or the use of a lower viscosity transmission fluid. Refer to MANUAL FLUID CHECK PROCEDURE in the CARE AND MAINTENANCE section, of Allison manual.

PARKING BRAKE

WARNING: If you leave the vehicle and the engine is running, the vehicle can move unexpectedly and you or others could be injured. If you must leave the engine running, **DO NOT LEAVE** the vehicle until you have completed all of the following procedures:

- Put the transmission in **N** (Neutral).
- Be sure the engine is at low idle (500–800 rpm).
- Apply the parking brake and emergency brake and make sure they are properly engaged.
- Chock the wheels and take other steps necessary to keep the vehicle from moving.

The parking brake is only intended to secure an unattended vehicle with the engine ignition **OFF**. Always maintain the vehicle parking brake system according to the manufacturer's specifications. The parking brake may not have sufficient capacity to restrain a vehicle with the engine running and the transmission in a forward or reverse range. When the vehicle is unattended and the engine is in operation, the transmission **must be in N** (Neutral) with the **brakes fully applied** and the **wheels chocked**.

TOWING OR PUSHING

CAUTION: Failure to lift the driving wheels off the road, disconnect the driveline, or remove the axle shafts before pushing or towing can cause serious transmission damage.

The engine cannot be started by pushing or towing. Before pushing or towing a vehicle do one of the following:

- Disconnect the driveline.
- Lift the drive wheels off the road.
- Remove the axle shafts from the drive wheels.

An auxiliary air supply will usually be required to actuate the vehicle brake system.

When the axle shafts are removed, be sure to cover the wheel openings to prevent loss of lubricant and entry of dust and dirt.

TURNING OFF THE VEHICLE

PRIMARY/SECONDARY SHIFT SCHEDULES

The points at which shifts occur depend upon predetermined speeds and other operating conditions. A transmission "shift calibration" includes several sets of shift points which may be used according to current or anticipated operating conditions. Some shift schedules may be inhibited as a result of operating conditions, such as engine or transmission fluid temperature. Shift schedules may be changed using the **MODE** button (some applications may use a dash-mounted switch)—which is typically associated with a change in anticipated vehicle operation.

The TCM/ECU includes the capacity for two separate and distinct shift calibrations (customer-selectable), one for use in "Primary Mode" of operation and one in "Secondary Mode."

- **Primary**—This shift schedule is typically used for all normal vehicle operations.
- **Secondary**—This is an alternate shift schedule that the TCM/ECU uses upon request. Not all vehicles will be equipped with a secondary shift schedule. The request can be interlocked with a vehicle component, or be operator-controlled using the **MODE** button.

Your vehicle may have a dash-mounted light that illuminates when the secondary mode is active.

CRUISE CONTROL OPERATION

Operating an Allison transmission-equipped vehicle on cruise control may cause the transmission to shift cycle if the cruise control speed setting is set too close to a scheduled shift point. One of the following actions may eliminate shift cycling:

- Select the secondary shift schedule by pushing the **MODE** button on the shift selector.
- Select a lower range by pushing the ↓ **(Down) Arrow** or moving the lever on the shift selector.
- Change the cruise control setting away from the shift point.

Some vehicles equipped with an engine brake will have the engine brake controlled by the TCM/ECU. This is done so the transmission will automatically select a lower range when the engine brake is turned on and the throttle is near idle position.

Operating a vehicle on cruise control with the engine brake turned on and controlled by the transmission TCM/ECU, may cause an unwanted application of the engine brake when the cruise control decelerates for downhill grades. Eliminate this condition by turning off the engine brake while operating the vehicle on cruise control.

UNIDECK Operation & Instructions

UNIDECK **OPERATION & INSTRUCTION MANUAL**

2. Menu navigation

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

Than 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).

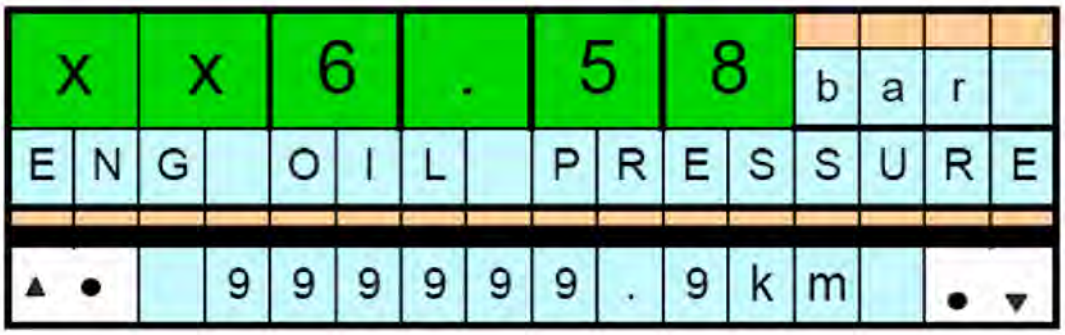
To change parameter visualisation in the mode 1x push the RIGHT button (momentary activation from 200 ms up to 1000 ms).

To change from the Total odometer visualisation to the Partial odometer visualisation, 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 visualisation are describe the available logic of the two push button through their visualisation see example:

VISUALIZZAZIONE 1X	ENGINE OIL PRESSURE



Push button legend:

LEFT PUSH BUTTON	RIGHT PUSH BUTTON

UNiDECK OPERATION & INSTRUCTION MANUAL

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)

4. Terex logo

At the key on, on the display will be shown the Terex Logo for 1,5 second, like the following picture:

LOGO TEREX

UNiDECK OPERATION & INSTRUCTION MANUAL

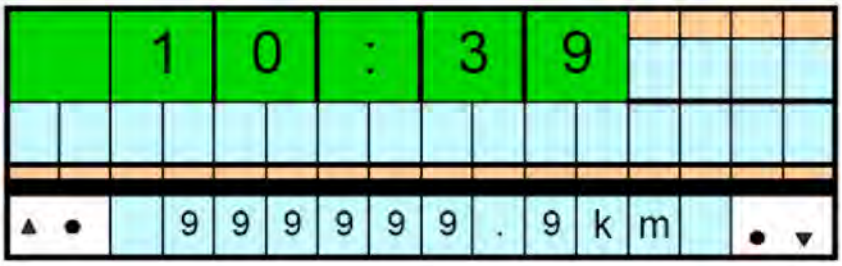
5. Clock

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

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

This is the structure:

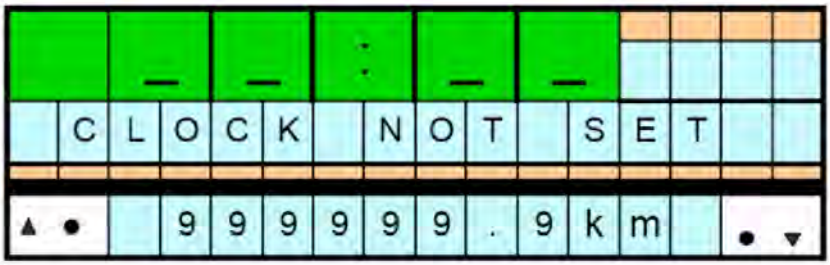
VISUALIZZAZIONE 1X	CLOCK



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 Genie Logo)

VISUALIZZAZIONE 1X	CLOCK NOT SET



5.1 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%).

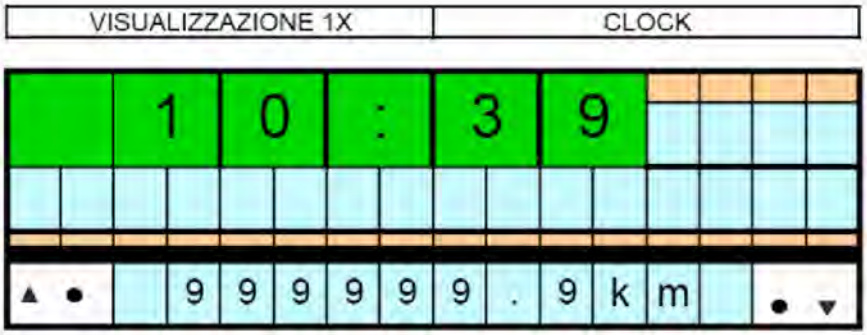
With the left button will increment the number, while with the right button will decrement.

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).

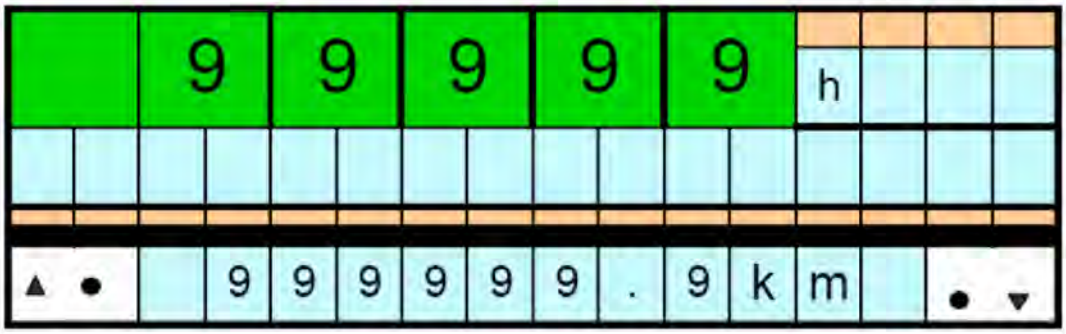


UNiDECK OPERATION & INSTRUCTION MANUAL

6. 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 never 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).

7. 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 gauge.

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

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

It's possible reset only the partial odometer.

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

UNiDECK OPERATION & INSTRUCTION MANUAL

8. Engine fault

The information of the engine fault must be read on the Can bus from the following message:

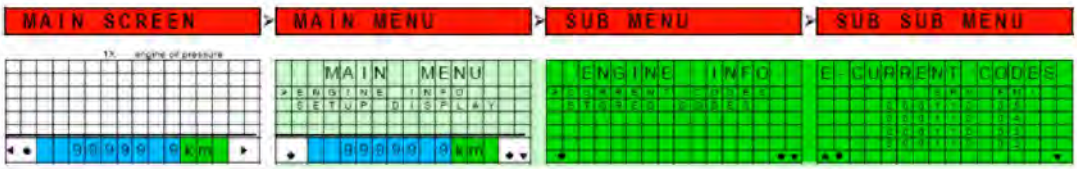
ACTIVE DIAGNOSTIC TROUBLE CODES (DM1)—The information communicated is limited to the currently active diagnostic trouble codes preceded by the diagnostic lamp status. Both are used to notify other components on the network of the diagnostic condition of the transmitting electronic component. The data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

The currently defined lamps (Malfunction Indicator Lamp, Red Stop Lamp, Amber Warning Lamp, and Protect Lamp) are associated with DTCs. If the transmitting electronic component does not have active DTCs, 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 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 that 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 identifying 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.

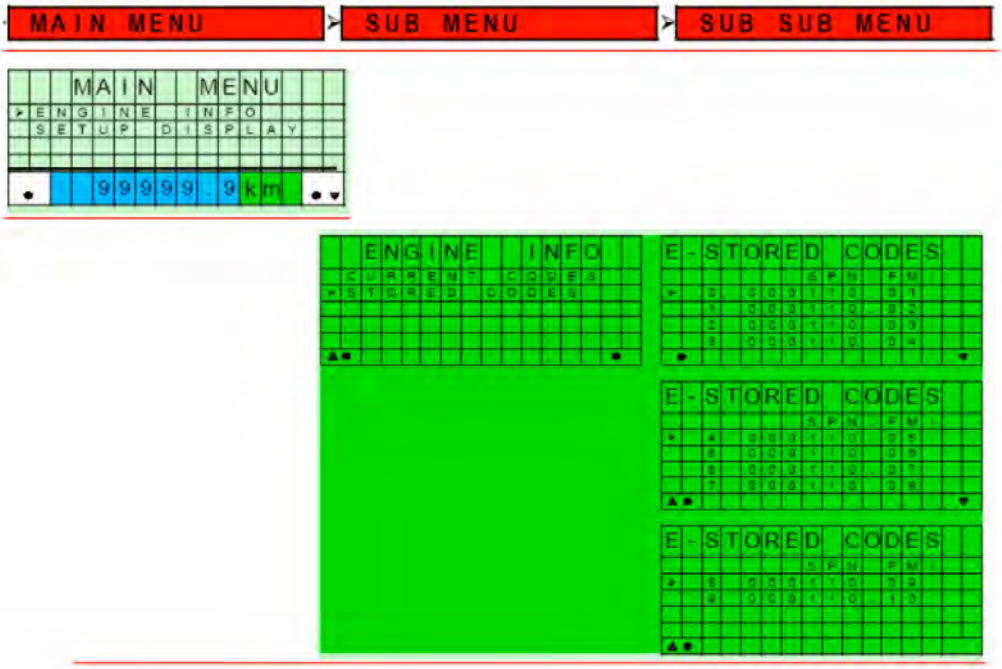
The cluster can show the active fault in the Engine Current Codes Menu like the following example:



Only the active faults.

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

Following the menu structure:

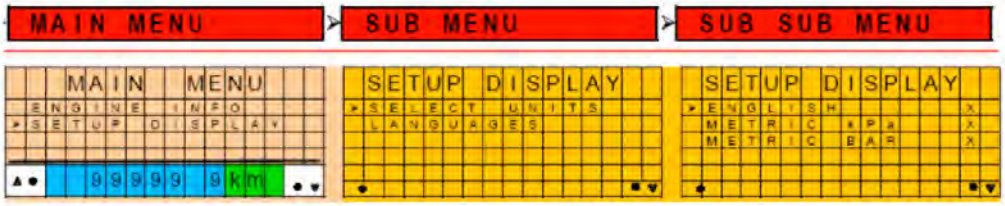


To delete all the faults happen see the paragraph "menu navigation".

UNIDECK OPERATION & INSTRUCTION MANUAL

9. Select unit

It's possible change the units of all the feature like the following structure:



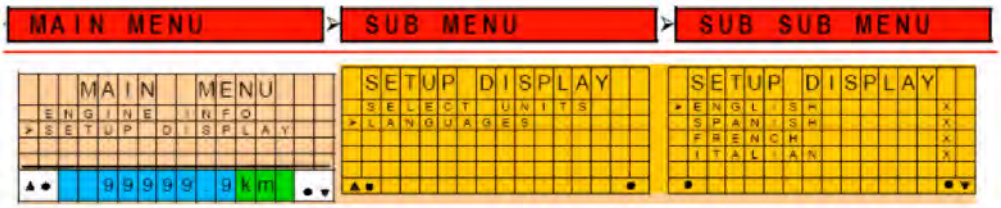
The default unit is English.

Following the unit table:

Descrizione parametri	Unità di misura Inglese		Unità di misura Metrica KPa		Unità di misura Metrica bar		Descrizione parametri estesa
OIL PRESS	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

10. Select language

It's possible change the language of the all feature like the following structure:



The default language is English.

11. Internal Buzzer

Inside the cluster there is a buzzer.

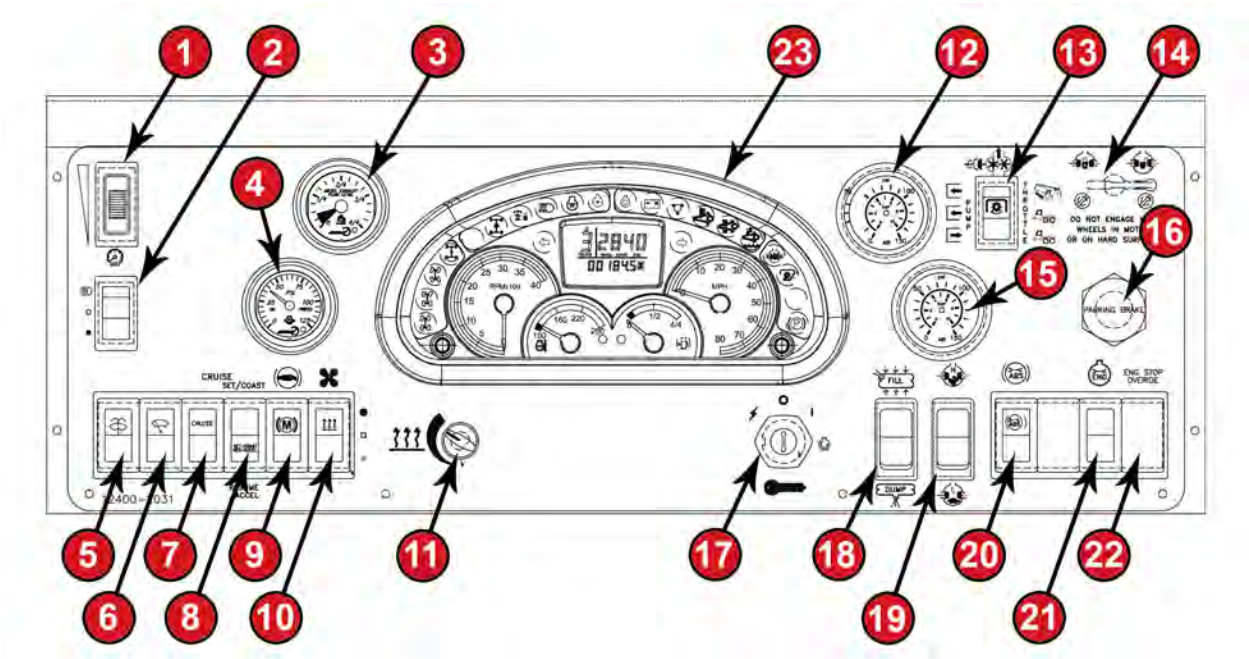
12. Check

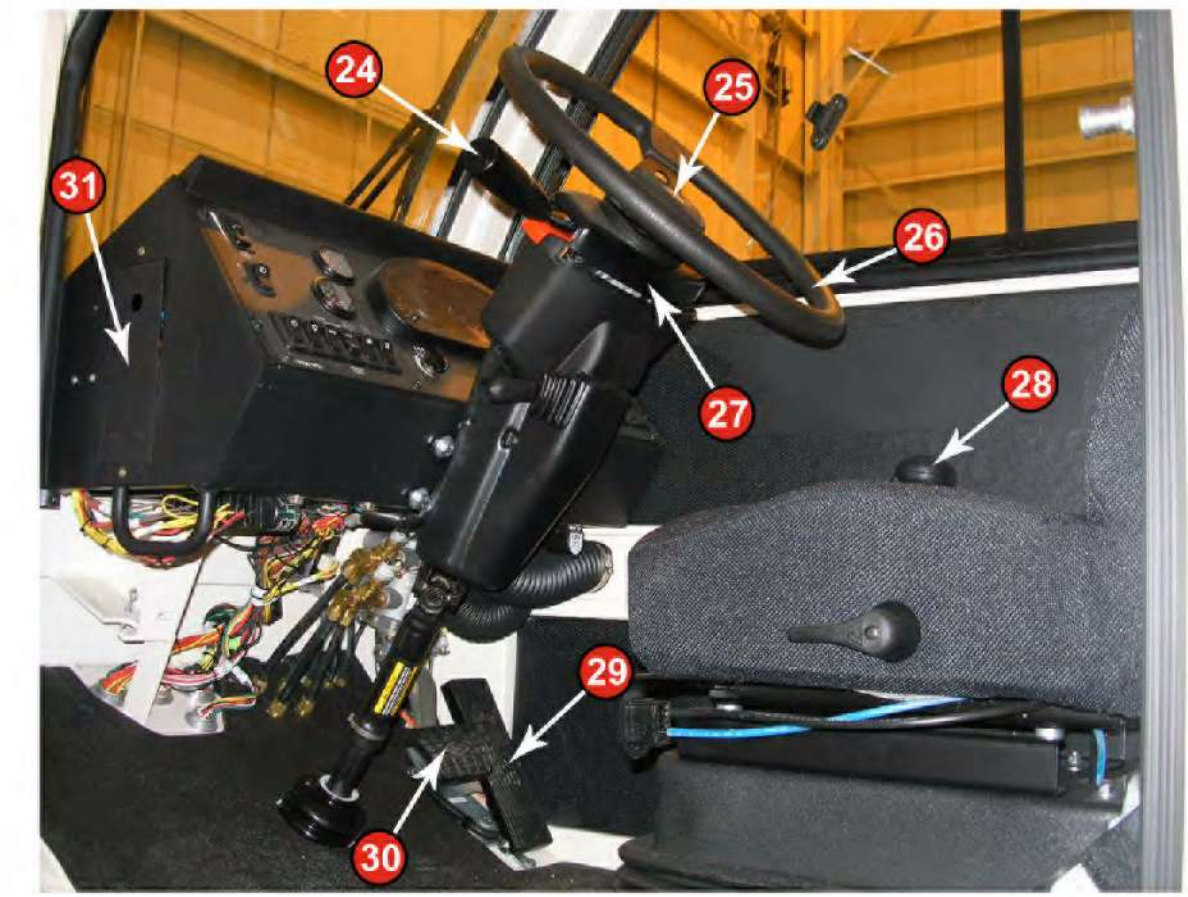
At the key on all the following functions will make a initail check of 2 second:

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

TEREX

Carrier Controls and Instruments-EXPORT





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. DIFFERENTIAL LOCK** -Vehicle must be stopped to engage or disengage. Only for offroad use and increased traction.
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. OPEN**
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 Fuller Manual or Allison Transmission Operations instructions.

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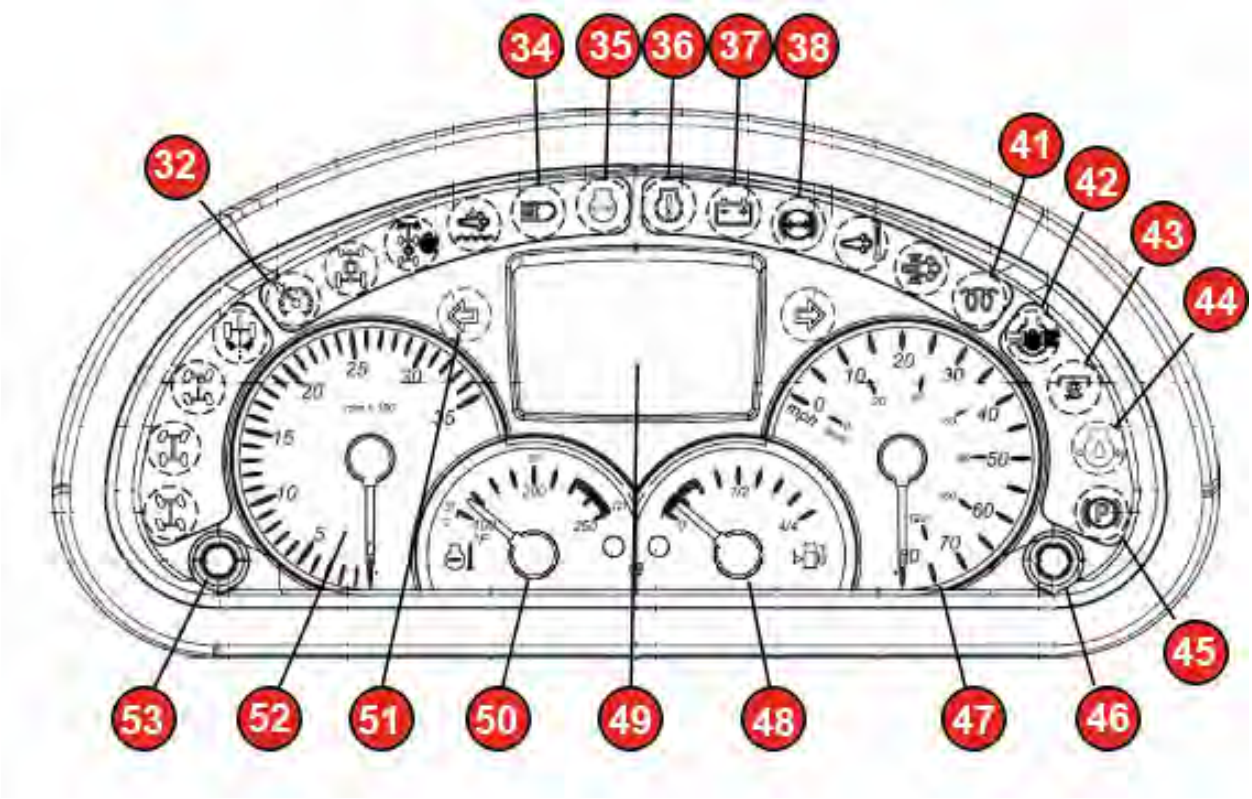
13. PTO AIR VALVE SWITCH-Push up to engage pumps, push down to disengage.	**29. ACCELERATOR PEDAL**-Depress to accelerate.
14. INTER AXLE LOCKOUT VALVE-Lock out inter-axle differential. Should the machine become stuck, a spinning whell will receive all power transmitted by the drivetrain causing tha wheel to spin faster and worsen the condition. Use of the lockout divides the available power between the two axles of the rear tandem. With the lockout engaged, the stuck wheel may continue to spin but the other side of the tandem will begin "driving", thus	**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.	**43. PTO ON**-Amber colored Warning Light "ON", PTO is engaged..
33. NOT USED	**44. ENGINE OIL PRESSURE**-Red colored Warning Light "ON" if less than 80 Kpa (about 12 PSI).
34. BRIGHT-Blue colored Warning Light "ON" when HI beam headlamps are "ON".	**45. PARK LAMP**-Red colored Warning Light "ON".
35. ENGINE STOP-Red colored Warning Light "ON" when Engine should be shutdown.	**46. SUB MENU NAVIGATION BUTTON**-LCD Display screen sub menu select/ deselect button. (See UNIDECK Manual).
36. ENGINE CHECK-Amber colored Warning Light "ON".	**47. SPEEEDOMETER GUAGE**-MPH (0-80) & Kph (0-120).
37. BATTERY CHARGING CONDITION-Red colored Warning Light "ON" if less than 12 volts.	**48. FUEL LEVEL GUAGE**-Guage and Amber colored Warning Light "ON" with low fuel level.
38. LOW AIR PRESSURE-Red colored Warning Light "ON" if less than 60 PSI.	**49. LCD DISPLAY** -Readouts: Terex 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).
39. NOT USED	**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.
40. NOT USED	**51. LEFT TURN SIGNAL**-Green colored flashing Warning Light "ON".
41. WAIT TO START-Red colored Warning Light "ON". Do not engage starter until light goes "OFF".	**52. TACHOMETER GUAGE**-Engine RPM x 100 Guage (0-3500 RPM).
42. DIFFERENTIAL LOCK-Amber colored Warning Light "ON". Differential is locked.	**53. MENU NAVIGATION BUTTON** -LCD Display screen menu. (See UNIDECK Operations Instructions).

NOTE: *Refer to**Carrier Controls and Instruments-2010 Tier 4**section of manual for Manual or Auto Transmission instructions of operation, Unideck Display operation, Fire Extinquisher location /operation and Windshield Washer Reservoir location.*

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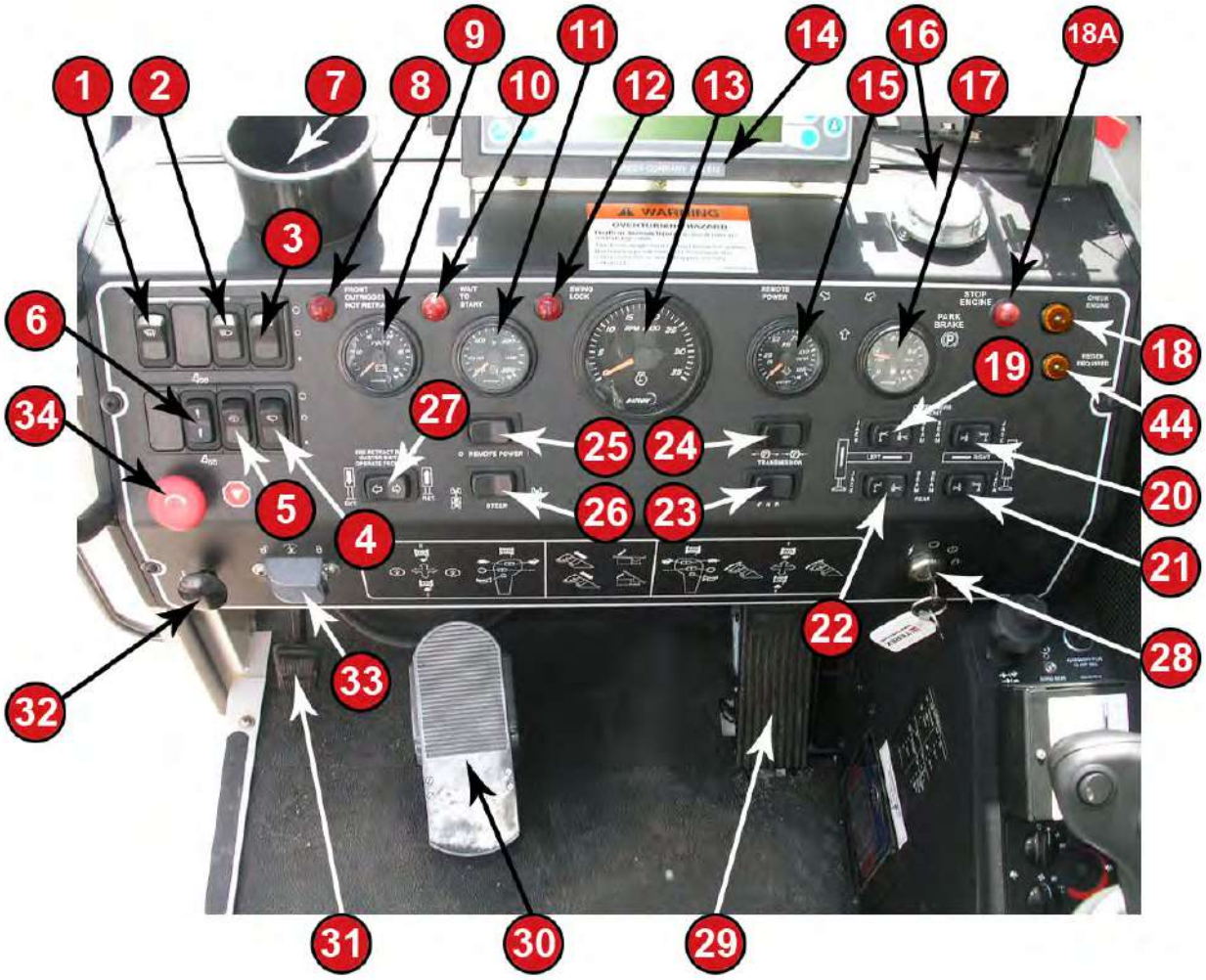
Upper Controls and Instruments



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. F-N-R HYDRAULIC REMOTE CONTROL SWITCH (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 GUAGE Guage 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. **T780 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. Pull to allow engine to be started again.

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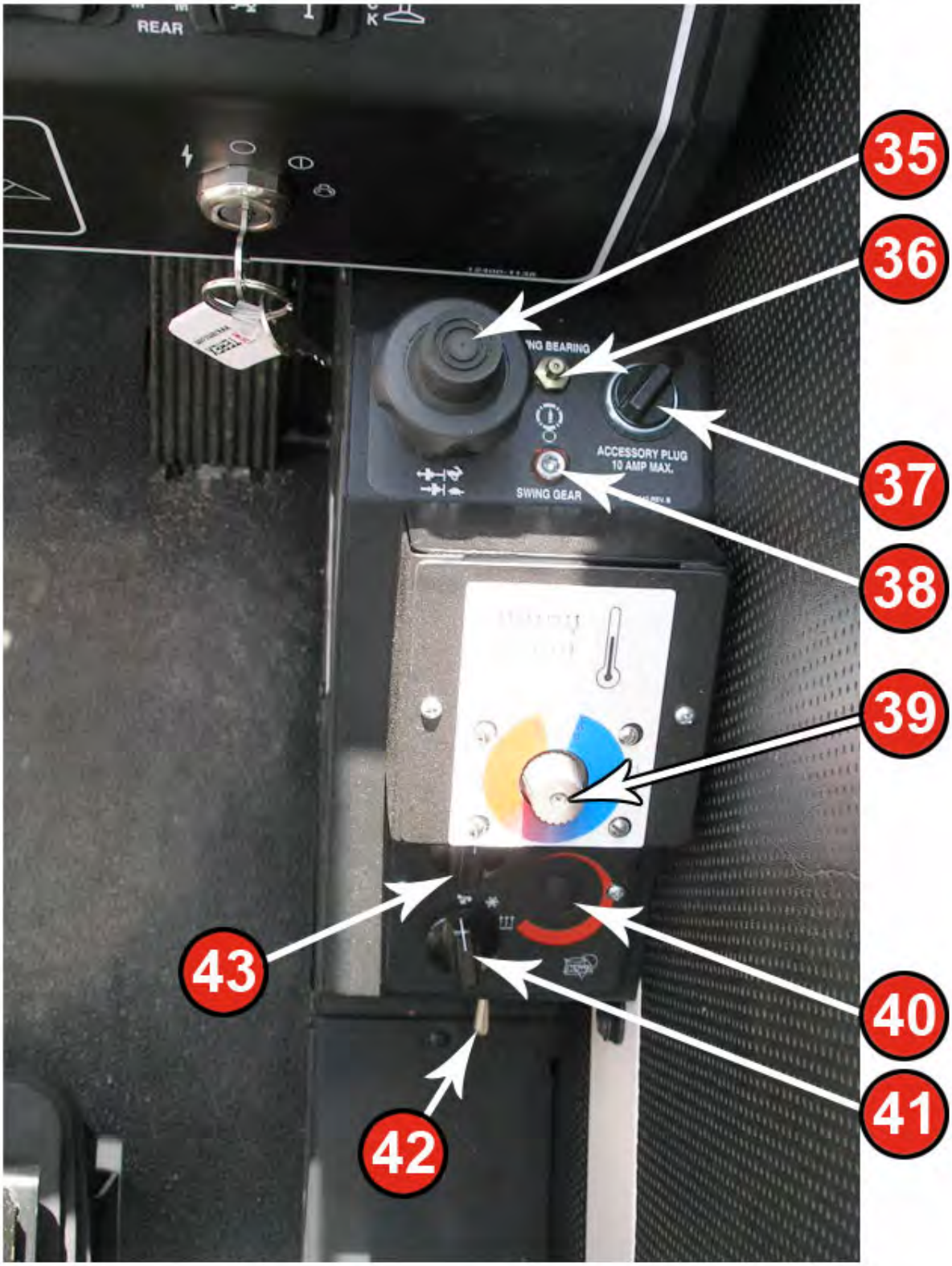


35. HAND THROTTLE - Holds engine throttle at an operator settable position. Place the accelerator (27) at approximate RPM. Push in button on hand throttle. Pull throttle up and release button to lock. Make fine adjustments to engine RPM by rotating the hand throttle clockwise to decrease RPM and counter-clockwise 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.	**44. REGENERATION REQUIRED**-When red light is "ON" regeneration process is required.

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.	

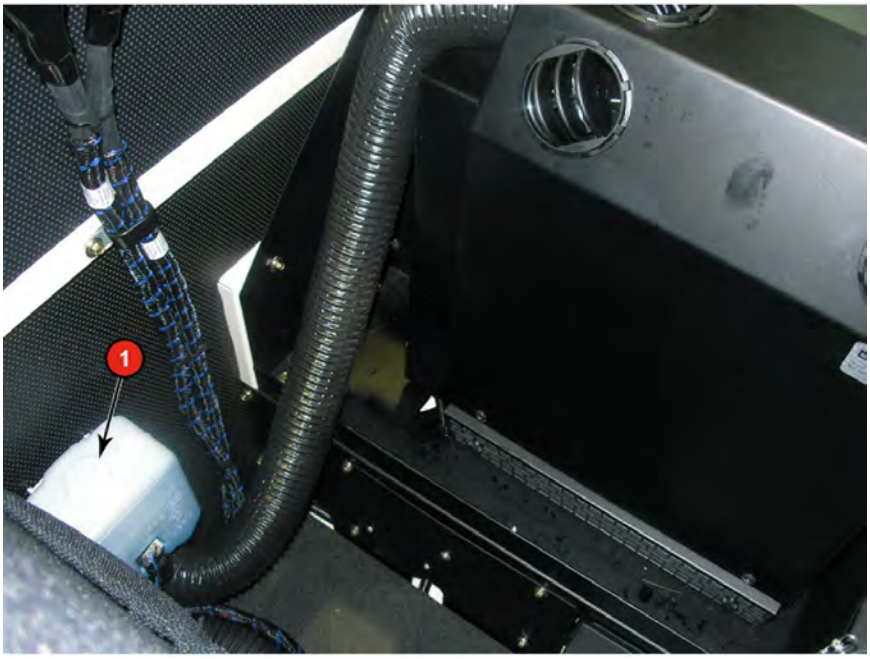
3. AUXILIARY WINCH-UP CONTROL-Move joystick backward to take in aux winch wire rope. Speed of wire rope is proportional to throttle setting and movement of joystick-raising the load.	3A. AUXILARY WINCH ROTATION INDICATOR-Internal to the handle is a thumper indicator that is felt by the operators hand 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



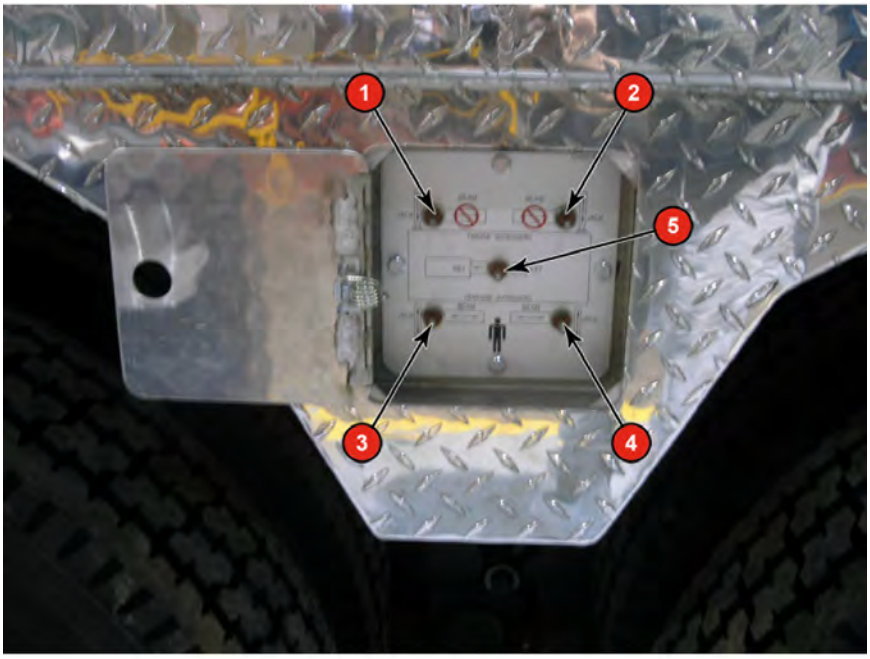
1. WINDSHIELD WASHER RESERVOIR-Fill to "Full" mark with automotive grade washer fluid.

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 side 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-T300-1

Optional jib extension is available to provide additional boom reach, which is a 32-49 ft. (9.75-14.9 m) side stow swing-on one-piece lattice type jib that is offsettable at 0°, 15°, or 30°. The jib is extendible to 49 ft. (14.9 m) by means of a 18 ft. (5.5 m) pull out tip section.

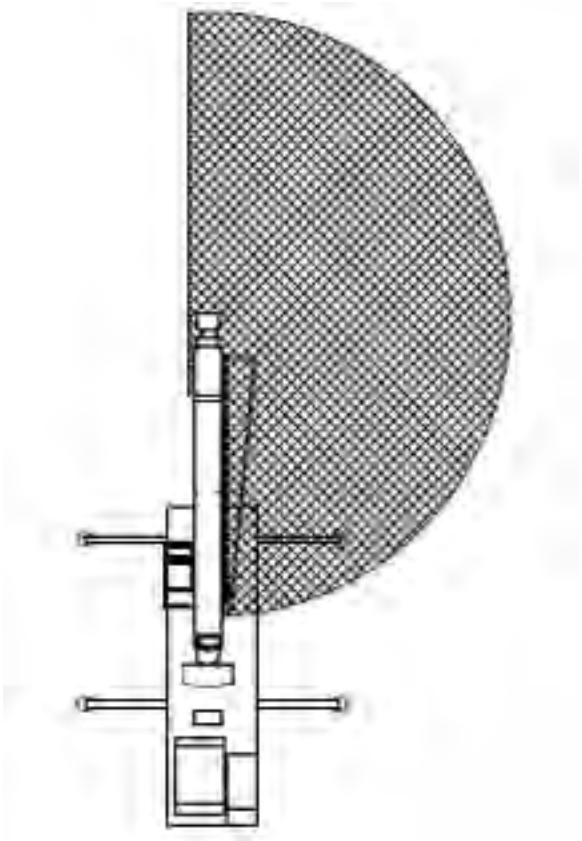
The 32 ft. (9.75 m) jib weighs 1,280 pounds (581 kg).

DESCRIPTION-T500-1 & T780

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.



Before erecting or 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 146

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 Wheel and Rim Mounting on page 460.

GENERAL CONDITION

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

AIR TANKS

Open the air tank drain cocks 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 146

ANTI TWO-BLOCK SYSTEM

Inspect all anti-two block 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 anti-two block 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 anti-two block 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. If the light is not on, bump the starter to jog the engine on T300-1 only, and align the pump splines, until the light comes on 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 Anti-Two Block 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

__ Lubricate Valve Disconnects

__ Clean And Wax All Exterior Painted Surfaces

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

__ Change Power Steering Filter Element

__ Check Hydraulic Relief Valve Pressure Settings

__ Torque Swing Bearing Bolts (725 ft. lbs. according to tightening sequence)

__ 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).

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		Recommmendations	
	Inspector				

Mobile Crane Load Test Inspection

General

As a worldwide crane manufacturer, Terex 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 within 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...).

Terex Cranes strictly prohibits operator to raise an overload with 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, Terex 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, Terex 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 Terex 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 due to national laws for checking the assembly of the crane, 100% of the permitted load of the crane in the given configuration must not be exceeded.

Load tests due to national laws can be e. g. required

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

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

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 e.g. the safety factors from the product standards). It is recommended to involve the crane manufacturer in such tests.

Load Test Configurations

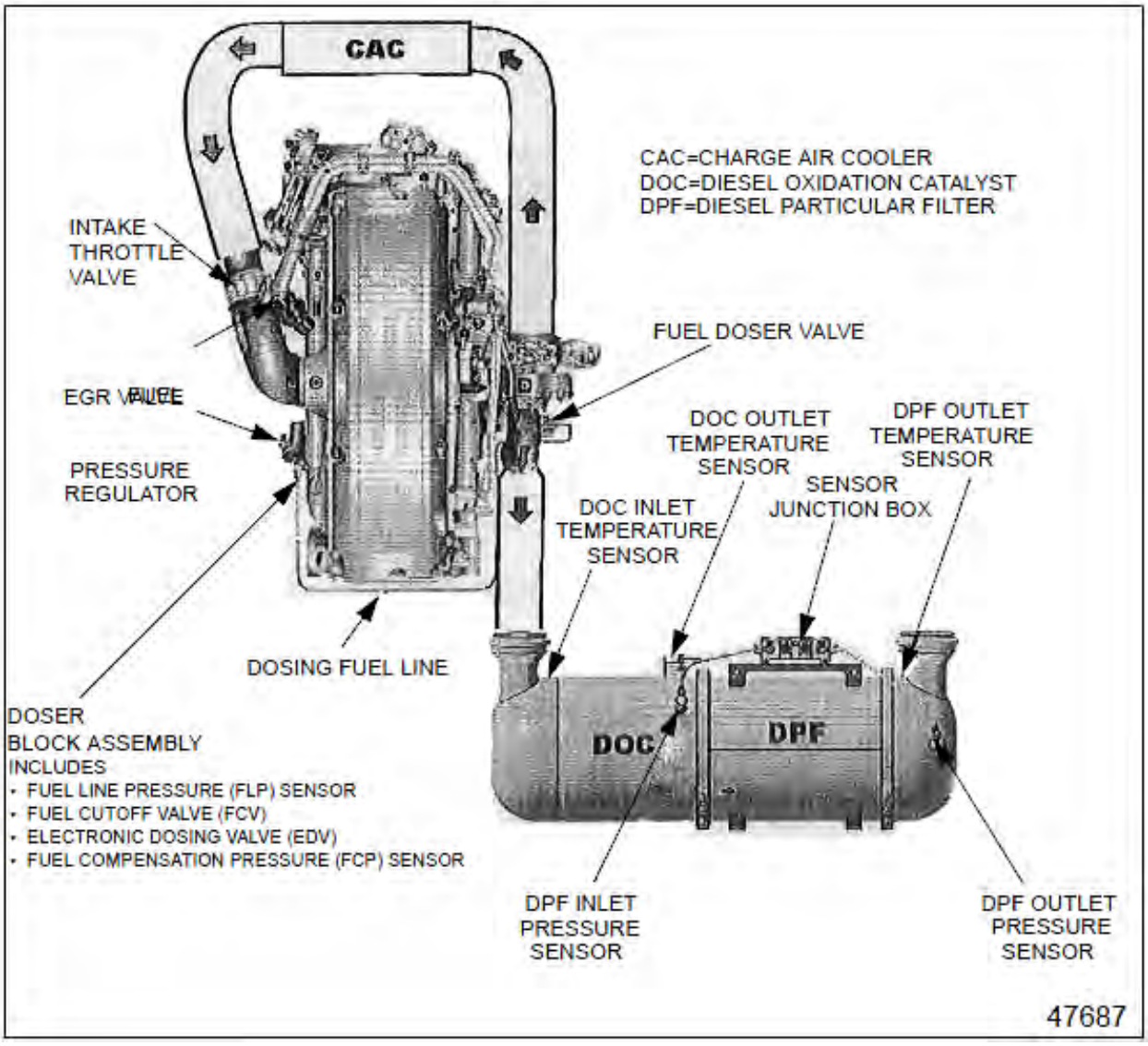
If a load test is required (due to national laws), the test conditions must correspond with the conditions during the scheduled lift. It is acceptable for Terex to carry out a load test for a given crane configuration with reduced loads (below the max. capacity), but at a greater radius up to the maximum radius e.g. 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.

Regeneration Process for DD Series 60 - (T500-1 & T780 Only)

After-treatment System

In order to meet current emissions regulations, the traditional muffler has been replaced by a new After-treatment Device (ATD). This device consists of a Diesel Oxidation Catalyst (DOC) and a Diesel Particulate Filter (DPF). Together these two components burn off collected particulate matter in a process called "regeneration". The key to successful regeneration is high exhaust temperatures for an extended period of time. Without adequate temperatures for regeneration, the filter will continue to trap particulates and eventually plug. In order to avoid plugging, the engine manufacturers have designed an actively regenerated After-treatment System (ATS). See below.



Operating Requirements

Oxidation of the particulate matter is the key to filter performance. This requires that the catalyzing agent (platinum coated passages) are providing optimum enhancement to the oxidation process. The following requirements must be met; otherwise the warranty may be comprimised:

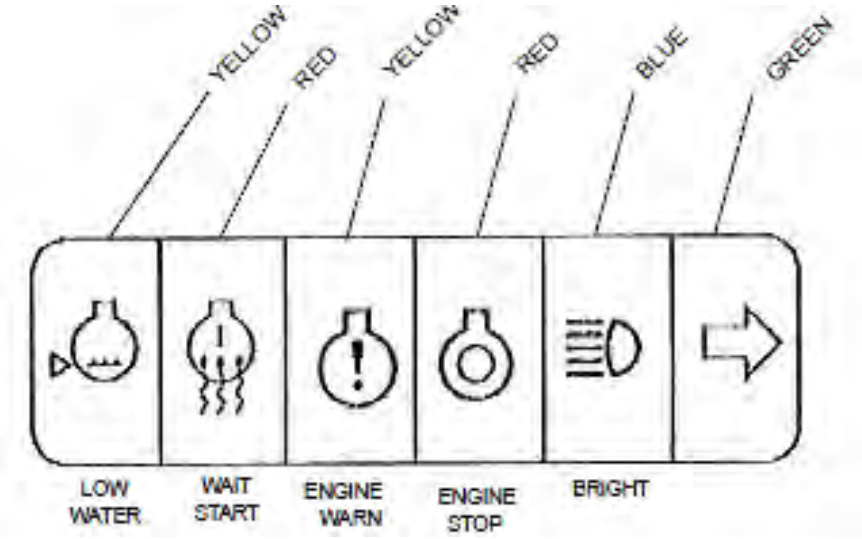
NOTE: *Do not use kerosene or fuel blended with used lube oil.*

1. Use Ultra - Low Sulfur Fuel (ULSF) with 15 PPM sulfur content or less, based on ASTM D2622 test procedure.
2. Lube oil must have a sulfated ash level less than 1.0wt%; currently referred to as CJ-4 oil.

   NOTE: *Not following the operating requirements may result in damage to the ATD or accelerated ash plugging of the diesel particulate filter.*

Maintenance

A high amount of black smoke emitting from the vehicle or illumination of the Amber (Yellow Engine Warning) Warning Light or Red Stop Light are indications of a system problem.



Illumination of the yellow light 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 Terex Truck Cranes equipped with diesel Tier lll engines will illuminate a dashboard warning: light indicating the need for ash cleaning.

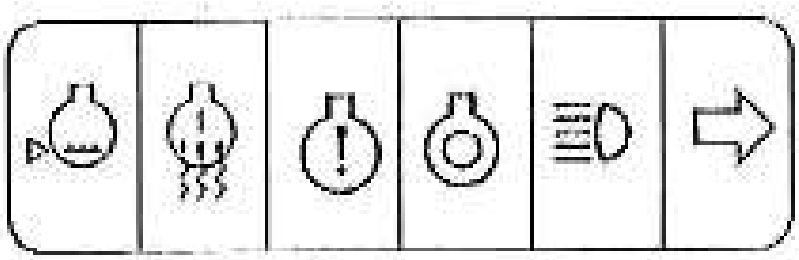
Parked Regeneration

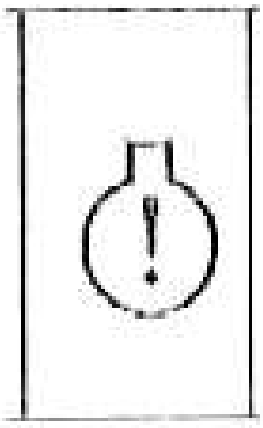
Regeneration of the ATD is fundamental for the oxidation of soot. This process happens during the normal operation cycle of the truck crane; it can occur both passively or actively. Regardless of this, the operator will see no difference in performance or control. If the ATD is not capable of completing regeneration due to duty cycle constraints or other restrictions, a parked regeneration may need to occur.

The operator will be notified of the need for a parked regeneration due to the illumination of the yellow DPF Regeneration Light.

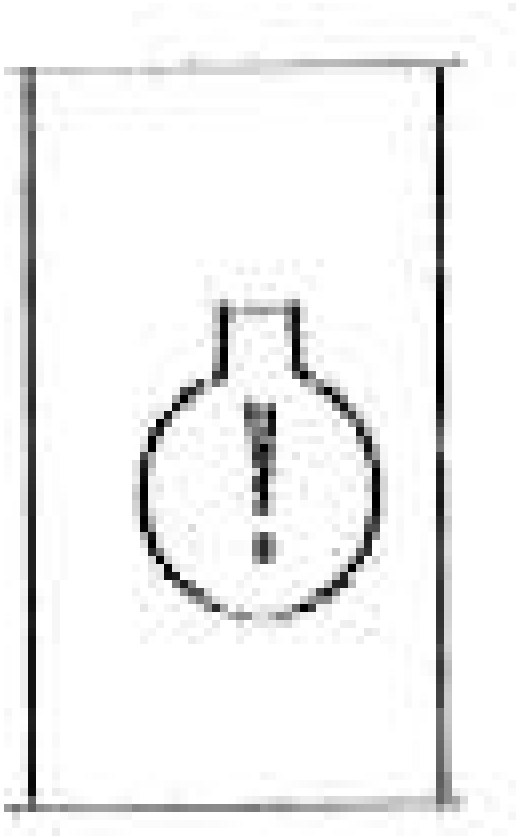
The sequence of lights is as follows:

1. The DPF Regeneration Light will be illuminated prior to any engine protection measures being taken. Once the light is lit, the parked regeneration process should be initiated.



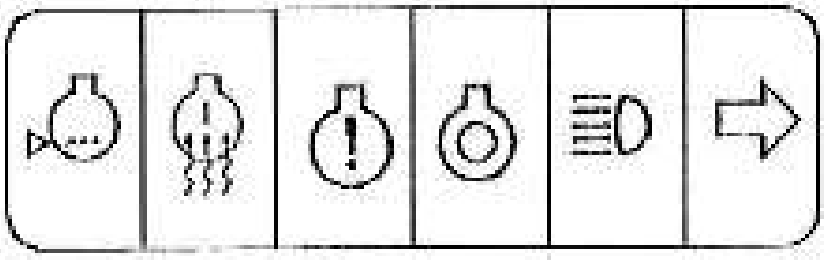


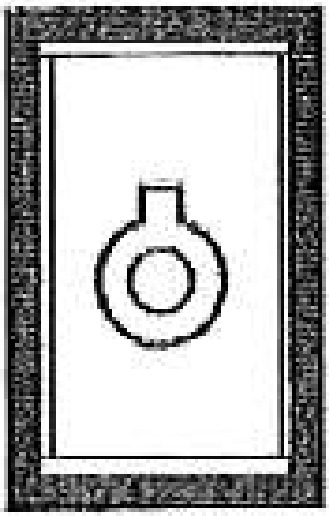
2. If no regeneration occurs after the intial DPF Regeneration Light illumination, the light will begin blinking and a parked regeneration should be initiated as soon as possible.



NOTE: *The check engine light in the upper cab of the truck crane will come on if the DPF Regeneration Light starts flashing in the lower cab.*

3. If the flashing DPF is still ignored, the AWL (Check Engine - Red Light) light will illuminate. This will be accompanied by the 25% engine torque reduction.





4. If parked regeneration is still not initiated, a standard 60 second engine shutdown sequence will occur. The dash lights will have a yellow blinking light and a solid red light. Once the engine shutdown sequence is completed, a parked regeneration MUST occur to continue crane operations. If the engine is operated without regeneration, additional measures will be taken to protect the engine and ATD from damage, up to and including engine shutdown which will require the engine dealer to reset the regeneration sequence.

NOTE: *If the DDEC VI electronics have not requested the initiation of a parked regeneration (The yellow light is not illuminated), the regeneration request switch will be disabled. Regeneration is only possible with the yellow light lit.*

NOTE: *Times between illuminations of lights will vary with engine brand. Typically the time from solid yellow - to blinking. 2 - 6 hrs; yellow - to solid red, 1 - 2 hrs of operating time.*

HOT EXHAUST

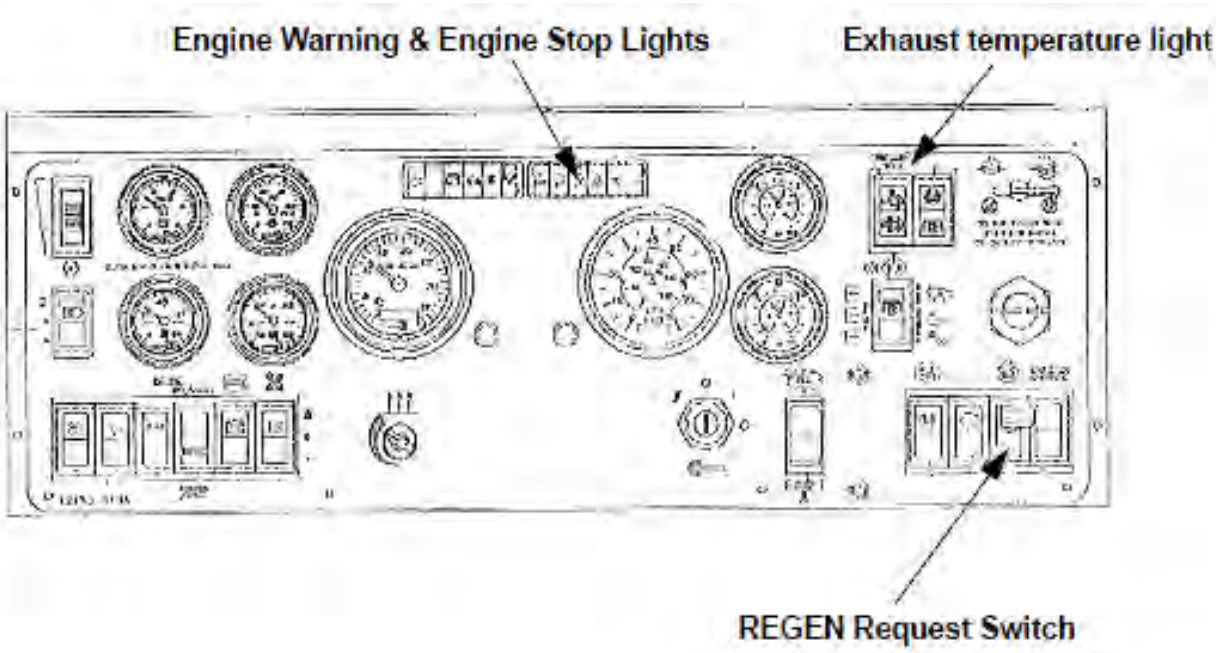
During parked regeneration the exhaust gases will be extremely HOT and could cause a fire if directed at combustible materials. The crane MUST be parked outside.

NOTE: *The operator MUST stay with the crane throughout the regeneration process.*

NOTE: *The procedure will take up to 1 hr. Times could be less or more dependent on engine type and the amount of soot accumulated in the filter.*

To initiate a parked regeneration, the following must occur:

1. Locate the REGEN request switch on the dash board. This is a momentary style switch.



2. Cycle the park brake OFF to ON.

3. Cycle the clutch pedal (if configured).
4. If automatic transmission, cycle into gear and back to neutral.
5. Park Brake must be ON and the clutch must be released. Transmission, either manual or automatic must be in neutral.
6. Engine speed must be set at idle.
7. PTO must be disengaged.
8. The engine needs to be warmed to at least 185 degrees F.
9. Vehicle speed must be 0 mph.
10. Hold the REGEN switch to the ON position for 5 seconds and release.

When the request is accepted, the DPF Regeneration Light will turn on for one second and then go off for the rest of the parked regeneration. The engine speed will increase up to 1600 rpm depending on engine model.

With completion of the regeneration, the following will occur:

1. The high temperature exhaust light will remain illuminated until the exhaust outlet temperature is below 977 degrees F.
2. The DPF Regeneration Light will turn off along with all other associated warning lights.

If any of the above requirements are not met, the engine will return to idle.

To cancel the parked regeneration the operator can toggle the REGEN switch to ON for five seconds. The DPF Regeneration Light will turn ON for one second to show acceptance of the cancellation request and then return to the appropriate state as defined by the current soot level in the DPF.

Duty Cycle Regeneration

Duty cycle regeneration can be performed by either going to a more challenging duty cycle application, or by operating the crane at highway speeds for a minimum of 20 minutes. If the regeneration light still is illuminated, a parked regeneration will be required.

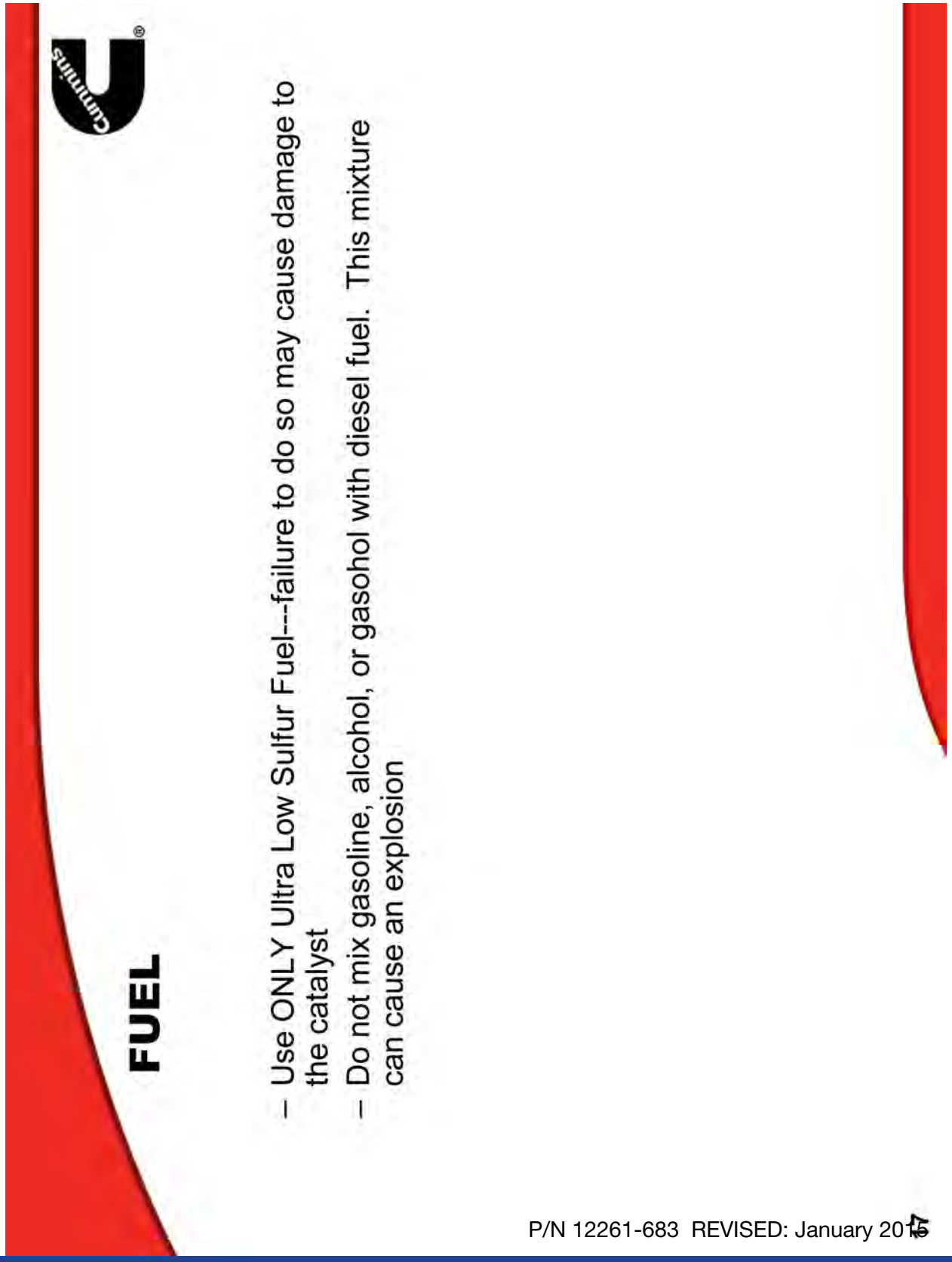
Service Records

It is mandatory that customers or distributors maintain a proper record of the particulate filter servicing and cleaning. The record is an agent to warranty considerations. The record must include information such as:

1. Date of cleaning or replacement.
2. Vehicle mileage and hours at the time of cleaning or replacement.
3. Particulate filter par number and serial number.

Cummins 2013 Engine- Overview of Operation

Fuel Warning



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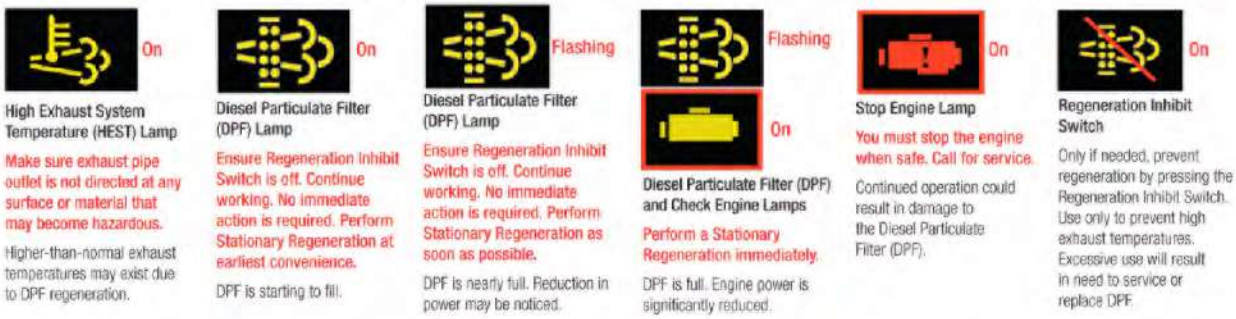
Aftertreatment Regeneration Lamp Behaviors



High Exhaust System Temperature (HEST) Lamp

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. Reference your Cummins Owners Manual for complete instructions.

Aftertreatment Diesel Particulate Filter (DPF) Lamp

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 regenerate within the next 2-6 hours of operation. This is accomplished by:

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

Or

2) 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. Note: Engine derate does not apply to emergency vehicle applications.

A 'Parked' regeneration may be performed using the Manual Regeneration Switch if provided by the truck manufacturer. Reference the OEM's Owners Manual for complete instructions.

Some vehicles may be equipped with an 'Inhibit Switch.' The purpose of this switch is to prevent or disable Aftertreatment Diesel Particulate Filter regeneration. Again, reference the OEM's Owners Manual for complete operation and use of this switch. Unnecessary or excessive use of the 'Inhibit Switch' **will** result in a loss of fuel economy, or an increased need for 'Parked' regeneration.

Warning or Check Engine Lamp

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.

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 Cummins authorized repair location.

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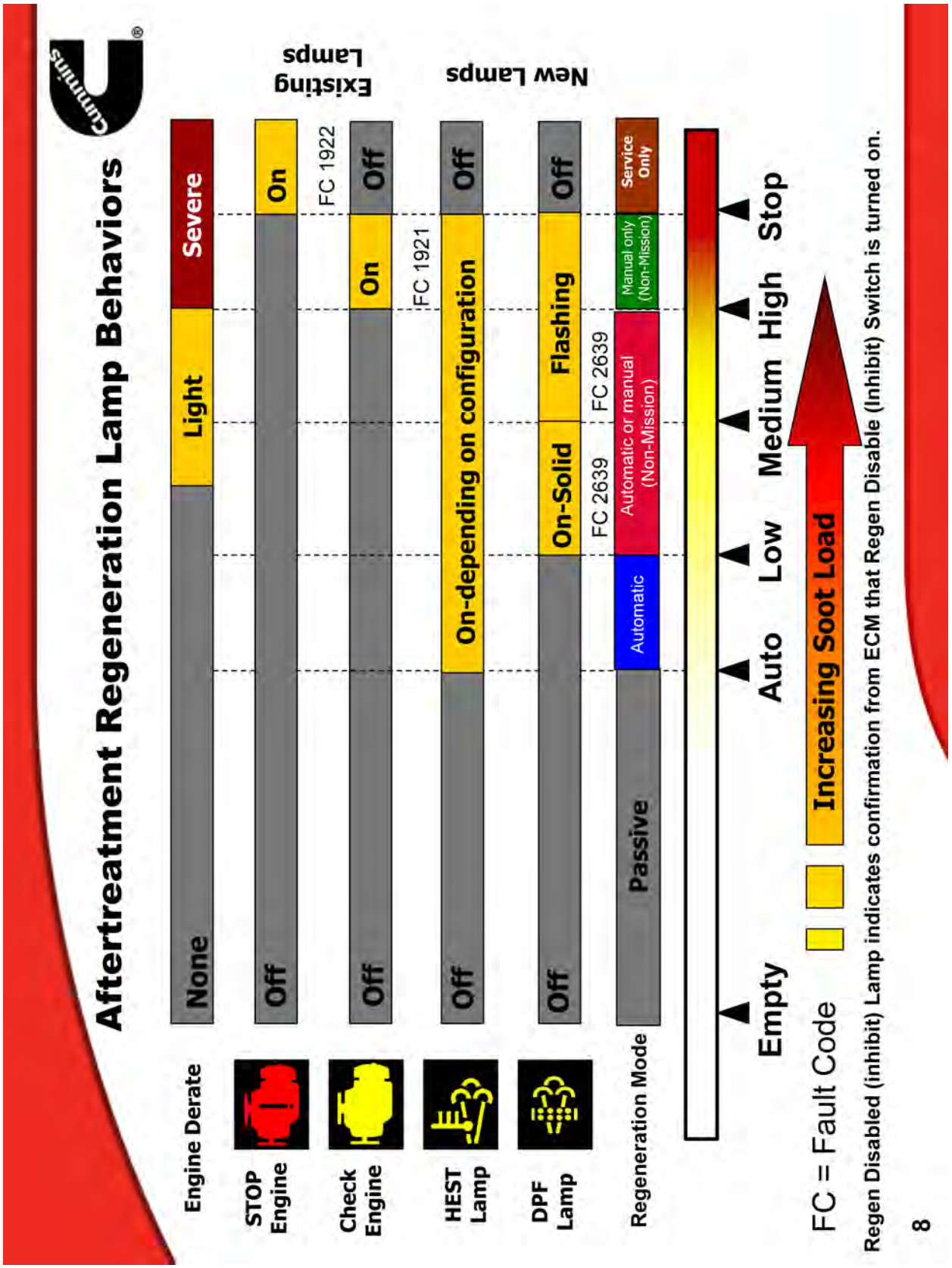


Regeneration Modes

Regeneration Modes

- **Passive Regeneration** – Once soot accumulates to a certain level, the soot accumulation rate is balanced by a natural oxidation of collected soot.
- **Active Regeneration** – There are three different types of active regeneration.
  - **Automatic Regeneration** – This occurs during "in mission" machine operation. Based on the inputs to the DPF, the control system will initiate automatic regeneration when necessary.
  - **Manual (Non-Mission) Regeneration** – This is initiated by the operator via a switched input when the system has not been able to perform automatic regeneration during "in mission" operation. This mode of regeneration is only possible when the machine is "out of mission" and meet the configured entry conditions.
  - **Service Regeneration** – This is done by a trained service technician.

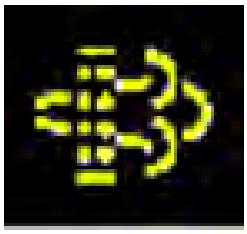
2

Manual Regeneration Procedure

For the majority of the crane operating time, the Cummins Engine Particulate Filter is self-cleaning with no operator action required. On some occasions, the operator may need to perform a Stationary Regeneration.

Under some operating conditions, such as low speed, low load, or stop and go duty cycles, the engine may not have enough opportunity to regenerate the aftertreatment diesel particulate filter during normal operation.

When this occurs, the engine will illuminate the aftertreatment diesel particulate filter lamp to inform the operator that assistance is required, typically in the form of a Manual (non mission) regeneration.



Manual regeneration is a form of active regeneration that is initiated by the equipment operator when not in operation.

Manual regeneration requires an elevated engine speed of approximately 1000 to 1400 RPM. The length of a manual regeneration will vary depending on how full the aftertreatment diesel particulate filter is, but will typically take anywhere from 45 minutes to 1.5 hours to complete.

A manual regeneration can be initiated with the Regeneration Switch. The manual regeneration switch will only initiate a regeneration when the Aftertreatment Diesel Particulate Filter Lamp is illuminated.

To perform a manual (non-mission) regeneration, follow the steps listed:

_Select an appropriate location to park the equipment. (See Note 3.)
_Park the vehicle securely. Place the transmission in neutral. (See Note 4.)
_With a manual transmission the clutch pedal is released.
_The brake pedal is released.
_PTO is OFF (not engaged).
_The vehicle speed is 0 MPH.
_The throttle pedal is released.
_Initiate the manual regeneration by toggling the crane carrier cab manual Regeneration Switch located in the lower RH corner of the Carrier Cab dash panel. The switch has two (2) functions:
If the engine RPM is 0, the switch becomes a Diagnostic Switch.
If the engine RPM is greater than 0, the switch becomes a Manual Regeneration Initiate Switch.
_Once the manual regeneration is initiated, the engine speed may increase, the turbocharger noise will increase, and the High Exhaust System Temperature lamp will illuminate.

_When the engine ECM detects that the aftertreatment diesel particulate filter has been regenerated, the engine will automatically return to normal idle speed, if increased. (See note 5.)

NOTE 1: If a manual (non-mission) regeneration is attempted, and the High Exhaust System Temperature lamp doesn't illuminate, contact a Cummins authorized repair facility for assistance.

NOTE 2: If the low idle engine speed is 1000 RPM or greater, the engine speed will not increase when a manual (non-mission) regeneration is initiated.

NOTE 3: Preferably on a surface that will not burn or melt under high exhaust temperatures (such as clean concrete or gravel, not grass or asphalt).

_Ensure there are no items within 2 feet of the exhaust outlet.
_Items that can burn, melt or explode must be kept at least 5 feet from the exhaust outlet (such as gasoline, paper, plastics, fabrics, compressed gas containers, hydraulic lines). Ensure that there are no gases or vapors nearby that could burn, explode or contribute to a fire (such as LP gas, gasoline vapors, oxygen, nitrous oxide).

NOTE 4: Set wheel chocks at front and rear of at least one tire.

During regeneration, exhaust gas temperature could reach 1500 degrees F., and exhaust system surface temperature could exceed 1300 degrees F., which is hot enough to ignite or melt common materials, and burn people. Engine speed will increase and could possibly reach between 1000 to 1500 RPM. Follow these instructions to avoid the risk of fire, property damage, burns, or other serious personal injury. Keep people at least 5 ft. from the exhaust outlet during the manual (non-mission) regeneration. When indoors, attach an exhaust discharge pipe rated for at least 1500 degrees F.
-Keep a fire extinguisher nearby.
-Check the exhaust system surfaces. Confirm that nothing is on or near the exhaust system surfaces (such as tools, rags, grease, or debris).

NOTE 5. Monitor the vehicle and surrounding area during the stationary (parked) regeneration. If any unsafe condition occurs, shut off the engine immediately. To stop a manual (non-mission) regeneration before it has completed, depress the clutch, brake or throttle pedal, set the regeneration permit switch to the inhibit position, or turn off the engine.

Once the manual (non-mission) regeneration is complete, exhaust gas and surface temperatures will remain elevated for 3 to 5 minutes.

Operating the Unit

Operating the Engine

101-999 Operating Instructions - Overview

General Information

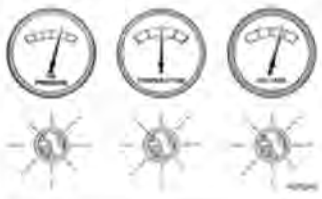
Correct care of your engine will result in longer life, better performance, and more economical operation.

Follow the daily maintenance checks listed in Maintenance Guidelines (Section 2).

The **new** Cummins® engine associated with this manual does **not** require a "break-in" procedure. This section of the manual provides all of the necessary information required for proper engine operation.

U.S. legislation requires that stationary compression ignition internal combustion engines designated for emergency use are limited to emergency operations and required maintenance and testing.

Check the oil pressure indicators, temperature indicators, warning lights, and other gauges daily to make sure they are operational.

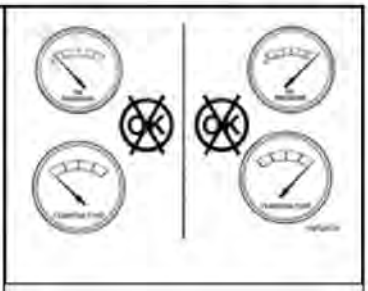


101-015 Operating the Engine

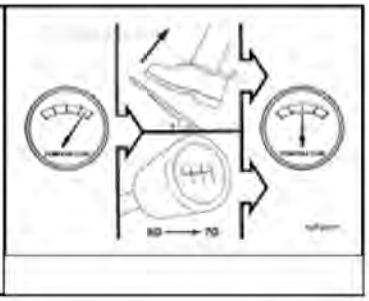
Normal

If equipped, monitor the oil pressure and coolant temperature gauges frequently. Refer to Lubricating Oil System specifications and Cooling System specifications, in Maintenance Specifications (Section V) for recommended operating pressures and temperatures. Shut off the engine if any pressure or temperature does **not** meet the specifications.

Continuous operation with engine coolant temperature above or below the engine coolant temperature specifications listed in Maintenance Specifications (Section V) can damage the engine.

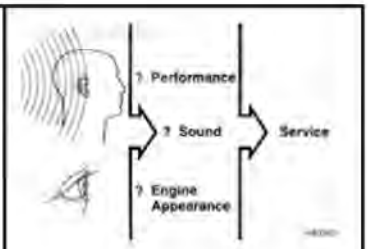


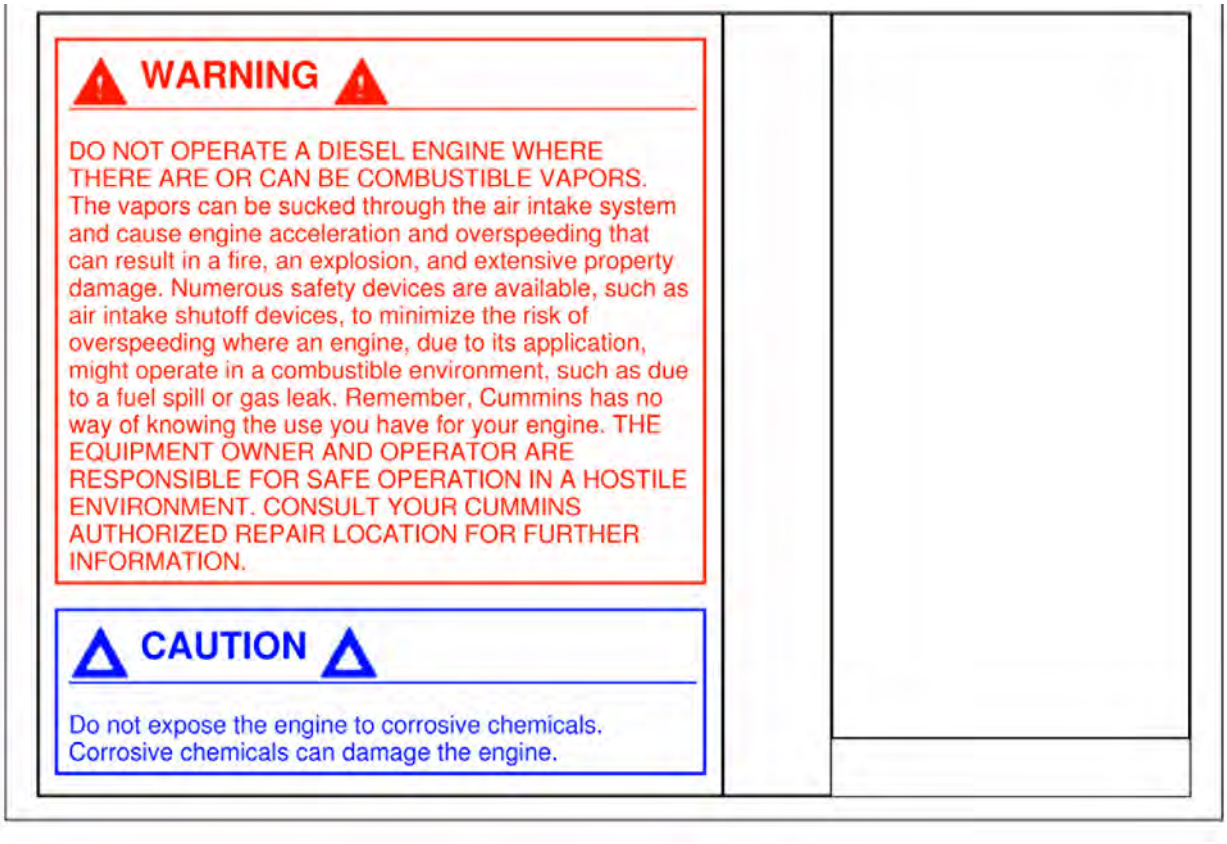
If an overheating condition starts to occur, reduce the power output of the engine by releasing the accelerator pedal or lever or shifting the transmission to a lower gear, or both, until the temperature returns to the normal operating range. If the engine temperature does **not** return to normal, shut off the engine, and refer to Troubleshooting Symptoms (Section TS), or contact a Cummins® Authorized Repair Location.



Most failures give an early warning. Look and listen for changes in performance, sound, or engine appearance that can indicate service or engine repair is needed. Some changes to look for are:

- Engine misfires
- Vibration
- Unusual engine noises
- Sudden changes in engine operating temperatures or pressures
- Excessive smoke
- Loss of power
- An increase in oil consumption
- An increase in fuel consumption
- Fuel, oil, or coolant leaks.





Starting the Engine-EPA 2010

STARTING THE ENGINE-2010 Tier 4

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

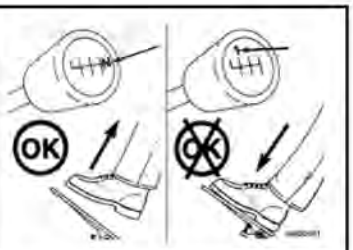
The engine may require the use of a cold weather starting aid if the ambient temperature is below 40°F (4°C).

101-014 Normal Starting Procedure

Starting

Disengage the driven unit, or if equipped, put the transmission in neutral.

With the accelerator pedal or lever in the idle position, turn the keyswitch to the ON position.

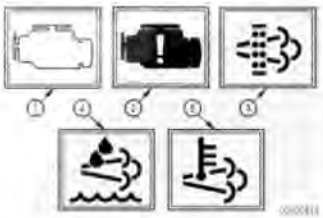


With the key in the ON position, the engine indicator lamps will come on momentarily and then go out. The engine indicator lamps include:

1. WARNING (or CHECK ENGINE) lamp, amber in color
2. STOP (or STOP ENGINE) lamp, red in color
3. AFTERTREATMENT DIESEL PARTICULATE FILTER lamp, amber in color.
4. AFTERTREATMENT DIESEL EXHAUST FLUID lamp, amber in color

Additionally, some engines have an additional lamp, (5) HIGH EXHAUST SYSTEM TEMPERATURE, which is amber in color.

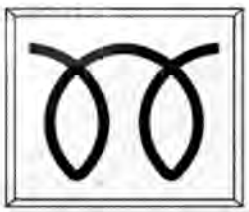
If any of the lamps remain on or begin to flash, reference the following procedure. Refer to Procedure 101-048 in Section 1.



CAUTION

Do not engage the starting motor for more than 30 seconds or damage to the starting motor can result. Wait 2 minutes between each attempt to start (electrical starting motors only).

Under cold conditions, the Wait-to-Start lamp (generally a



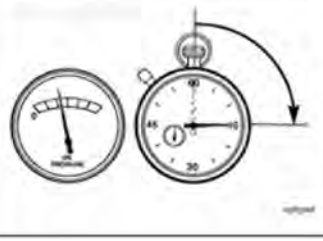
yellow lamp using a symbol similar to the graphic, or the words WAIT TO START) will illuminate at key ON, and will stay on for a period of up to 30 seconds (T300-1 only).

NOTE: The length of time the Wait-to-Start lamp remains illuminated depends on the ambient temperature. The lower the ambient temperature, the longer the lamp will be illuminated.

Once the Wait-to-Start lamp turns off, turn the key to the starting position to start the engine.

⚠ CAUTION ⚠

The engine must have adequate oil pressure within 15 seconds after starting. If the WARNING lamp indicating low oil pressure has not gone out or there is no oil pressure indicated on a gauge within 15 seconds, shut OFF the engine immediately to avoid engine damage.



Idle the engine 3 to 5 minutes before operating with a load.

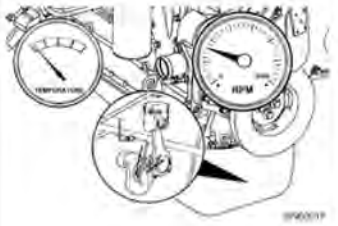
After starting a cold engine, increase the engine speed (rpm) slowly to provide adequate lubrication to the

bearings and to allow the oil pressure to stabilize.

Some engines are equipped with a Fast Idle Warm Up feature. When enabled, this feature elevates the idle speed of the engine in cold ambient conditions, in order to shorten the time necessary to warm up the engine. When the idle speed is elevated, the engine noise may change. This is normal. To bring the engine back to low idle speed:

- For vehicles equipped with a manual transmission and clutch switch: Depress the clutch pedal.
- For vehicles equipped with a brake switch: Depress the service brake pedal.
- Depress the accelerator pedal.

For more information on the Fast Idle Warm Up feature, contact a Cummins® Authorized Repair Location.

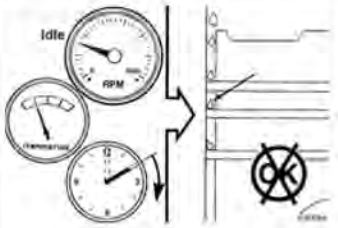


⚠ CAUTION ⚠

Do not operate the engine at low idle for long periods with engine coolant temperature below the minimum specification in Maintenance Specifications (Section V).

This can result in the following:

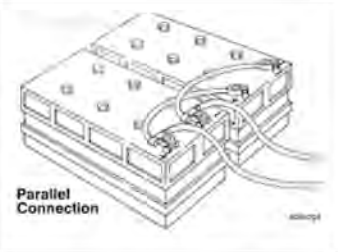
- Fuel dilution of the lubricating oil
- Carbon buildup in the cylinder
- Cylinder head valve sticking
- Reduced performance.



Jump Starting

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery



cable first and attach the negative (-) battery cable last.

CAUTION

When using jumper cables to start the engine, make sure to connect the cables in parallel: Positive (+) to positive (+) and negative (-) to negative (-).
Remove the key before attaching the jumper cables.

CAUTION

To reduce the possibility of damage to engine parts, do not connect jumper starting or battery charging cable to any fuel system or electronic component.

This illustration shows a typical parallel battery connection. This arrangement doubles the cranking amperage.

NOTE: Always reference the relevant OEM literature for jump starting procedures. Failure to follow correct procedures can result in damage to the ECM and other electrical equipment.

Last Modified: 06-Jul-2010

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.

RUNNING THE ENGINE

Oil Pressure

Observe the oil pressure gauge immediately after starting the engine. A good indicator that all of the moving parts are getting lubrication is when the oil pressure gauge registers pressure (5 psi - 34.5 kPa at idle speed). If there is no oil pressure indicated within 10 to 15 seconds, stop the engine and check the lubricating system. The pressure should not fall below 28 psi (193 kPa) at 1800 rpm, and normal operating pressure should be higher. If pressure does not fall within these guidelines, it should be checked with a manual gauge.

Warm-up

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

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.

Avoid unnecessary Idling

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.

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.

Engine Cold Weather Operation

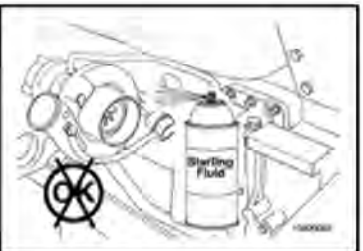
101-004 Cold Weather Starting

General Information

Follow the Normal Starting Procedure in this section. In cold weather, the engine can run longer at idle but **only** until the minimum specified oil pressure is detected by the electronic control module (ECM).

Using Starting Aids

Cold weather starting aids are available for the engine. Contact a Cummins® Authorized Repair Location for more information.



Cold Weather

It is possible to operate engines in extremely cold environments if they are properly prepared and maintained. Satisfactory performance of an engine in low ambient temperature conditions requires modification of the engine, surrounding equipment, operating practices and maintenance procedures.

The correct engine coolant lubricating oil and fuels **must** be used for the cold weather range in which the engine is being operated. Below are the recommendations for these critical engine fluids:

Ambient Temperature

0 to -32°C [32 to -25°F]

Use 50-percent ethylene glycol antifreeze and 50-percent water for the engine coolant mixture.

Refer to Maintenance Specifications (Section V) Lubricating Oil recommendations for the correct specifications.

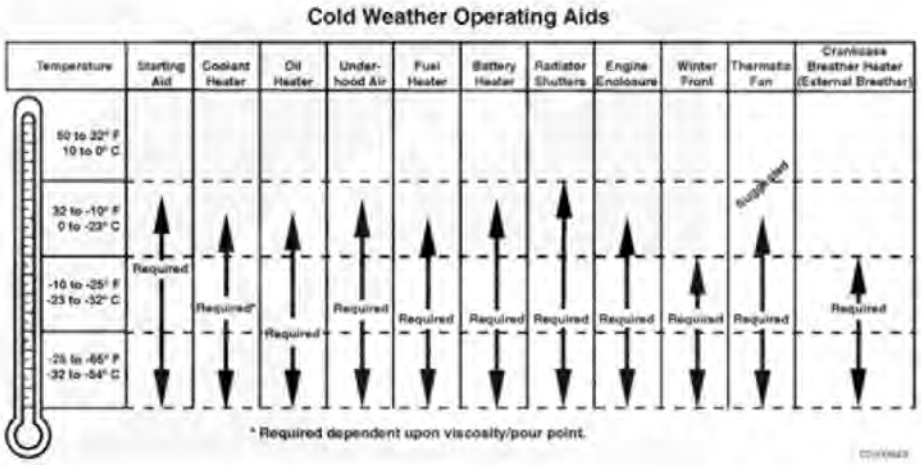
The Diesel fuel **must** have maximum cloud and pour points 6°C [10°F] lower than the ambient temperature in which the engine operates.

-32 to -54°C [-25 to -65°F]

Use 60-percent ethylene glycol antifreeze and 40-percent water for the engine coolant mixture.

Refer to Maintenance Specifications (Section V) Lubricating Oil recommendations for the correct specifications.

The Diesel fuel **must** have maximum cloud and pour points 6°C [10°F] lower than the ambient temperature in which the engine operates.



The cold weather operating aid is required for cold weather situations.

Winterfronts and Shutters

Winterfronts and shutters can be used on a vehicle or equipment to reduce air flow through the radiator core into the engine compartment. This can reduce the time required to warm the engine and help maintain the engine coolant temperature. The engine coolant temperature specifications are in the Maintenance Specification (Section V).

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 carburetor or tubing on vehicle 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 should 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. Use only non-chromate base inhibitors. 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 con- form 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.

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. Consult engine manufacturer should this problem arise.

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.

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 crane and raise wheels clear of 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 using the bubble indicator to determine when a level condition is achieved. 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 (see LOAD RATING CHART INTERPRETATION on page 196).

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.

The 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.

   The boom elevation is controlled by foot pedals or hand lever. To RAISE the boom, slowly depress the LEFT boom control foot pedal forward or pull the joystick lever back. To LOWER the boom, slowly depress the LEFT boom control foot pedal backward or push the joystick lever forward. Improved control is obtained by operating the engine at low speed while “metering” the controls. Always operate and release the controls slowly to minimize dynamic effects of the load. During a lift where precise control of the load is required, do not attempt to use more than one function at a time.

Always consider possible obstructions when varying 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 during swings.

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 swing lever. To swing the upper structure to the RIGHT, PUSH the lever forward. To swing LEFT, PULL the lever backwards. Swing speed increases as the lever 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 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 or by pushing the LH joystick lever FORWARD and RETRACT it by pulling the joystick lever BACK.

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.

The boom extend function on this crane has two positions and two speeds. When the lever is all the way forward, the regenerative mode provides increased speed. With the lever approximately one half of the way forward, increased “PUSH” is available at reduced speed.

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.

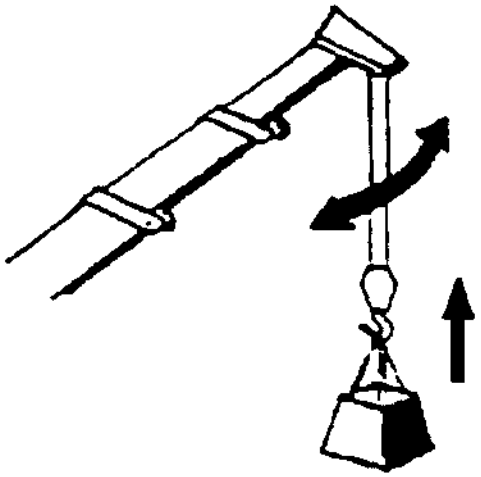
The crane is equipped with an anti two-block system which includes a warning light, audible alarm, and control disconnects. When the hook block or ball activate a

correctly installed and maintained anti two-block 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 anti two block 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 result in damage to boom head and sheaves or the cable may be broken 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.

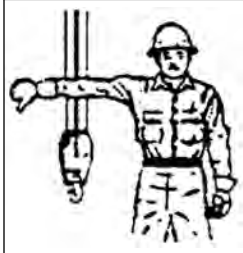
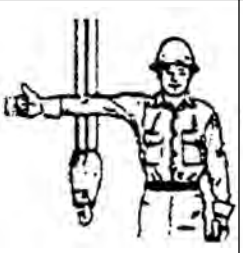
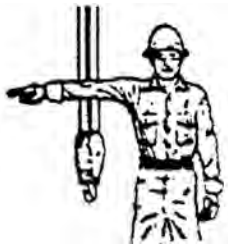
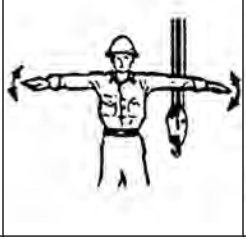
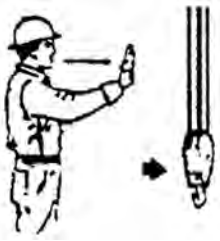
When operating a hydraulic crane, the operator should realize that hydraulic and structural competence, NOT TIPPING LOAD, is often the determinant of lifting capacity.

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.

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.
				

TEREX

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.

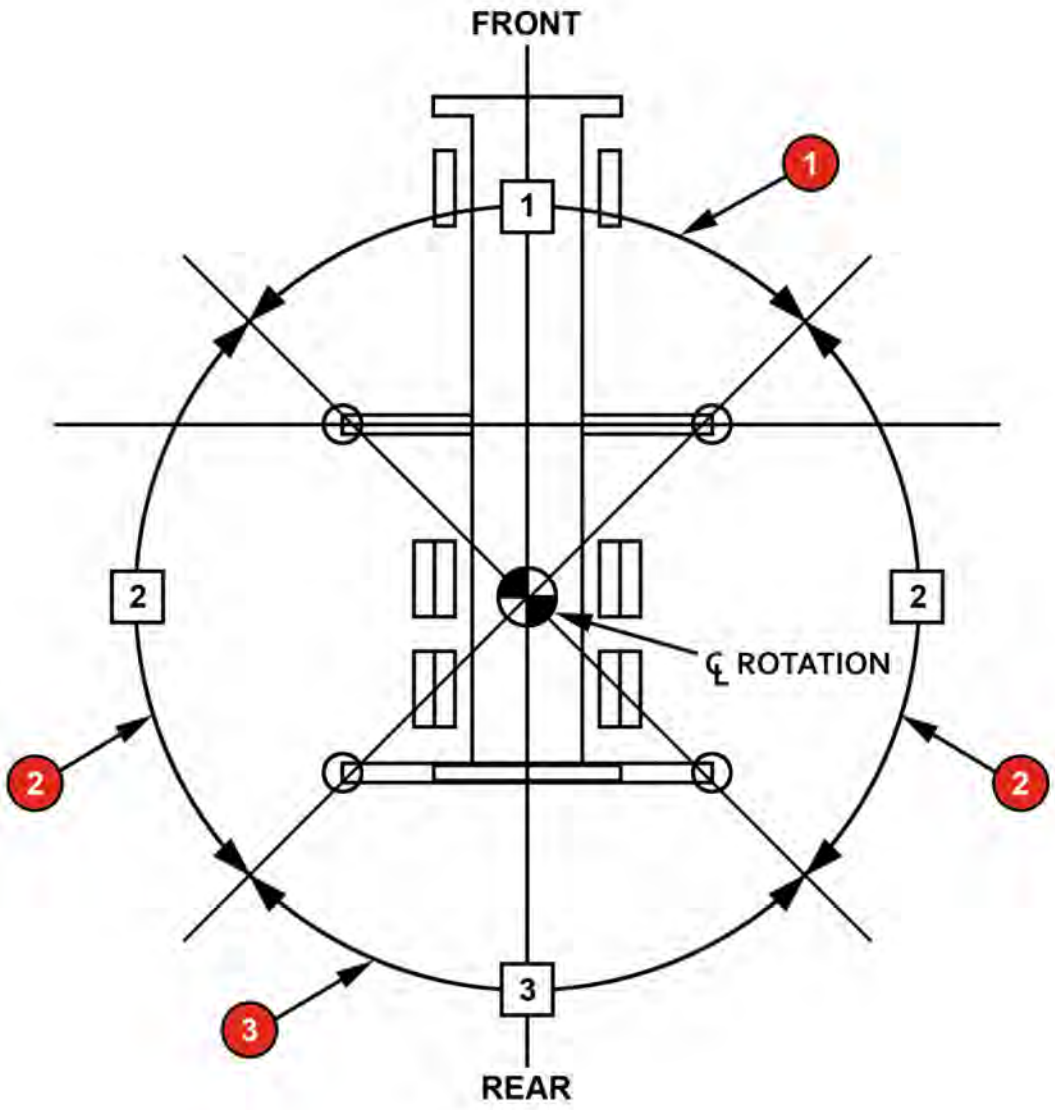
360° capacities apply only to machines equipped with a front outrigger jack and all five(5) outrigger jacks properly set. If the front (5th) outrigger jack is not properly set, the work

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.

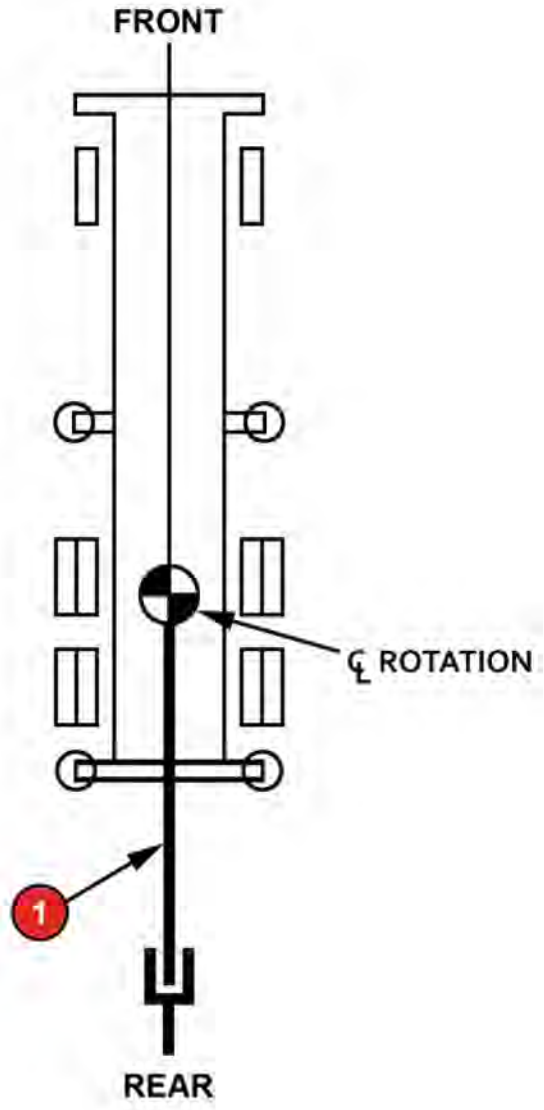
1. Boom over front working area
2. Boom over side working area
3. Boom over rear working area

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 over rear working area



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.

Rated Load On Outriggers											
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:

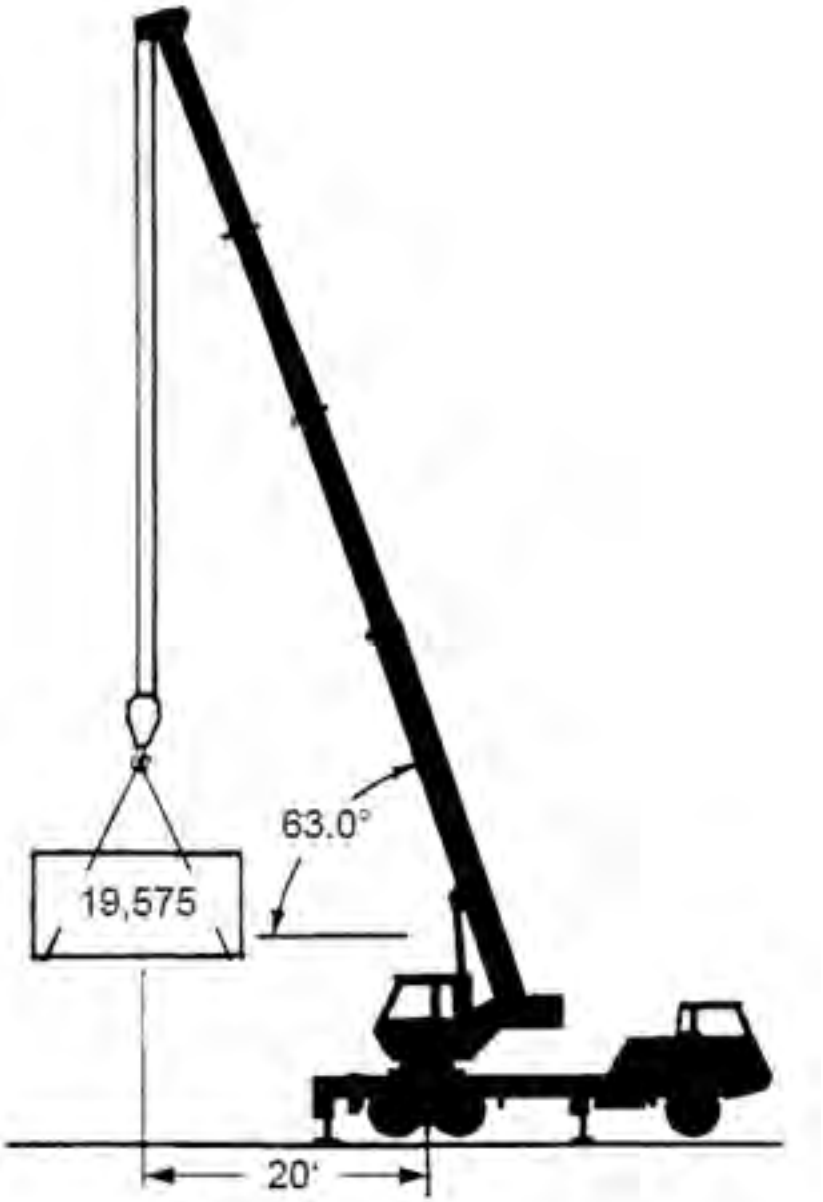
1. Determine the weight of the load to be lifted.
2. Determine the weight of slings, rigging hardware and hook block.
3. Calculate weight of lifted load.
4. Determine load radius, boom angle, and boom length.
5. Determine which load chart to use for your lift. Individual load charts exist for the following 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. If equipped with rear air suspension, the rear air 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 crane to tip and/ or result in damage to tires and 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.

On-Tires Load Rating Chart

ON TIRES		
RADIUS (FT)	MAX BOOM LENGTH (FT)	BOOM STRAIGHT OVER REAR 0 TO 2 1/2 MPH
10	30	13,900
12	30	12,600
15	39	10,600
20	39	7,400
25	50	5,100
30	50	3,300
35	50	1,900
40	50	1,000

Air-Ride Suspension

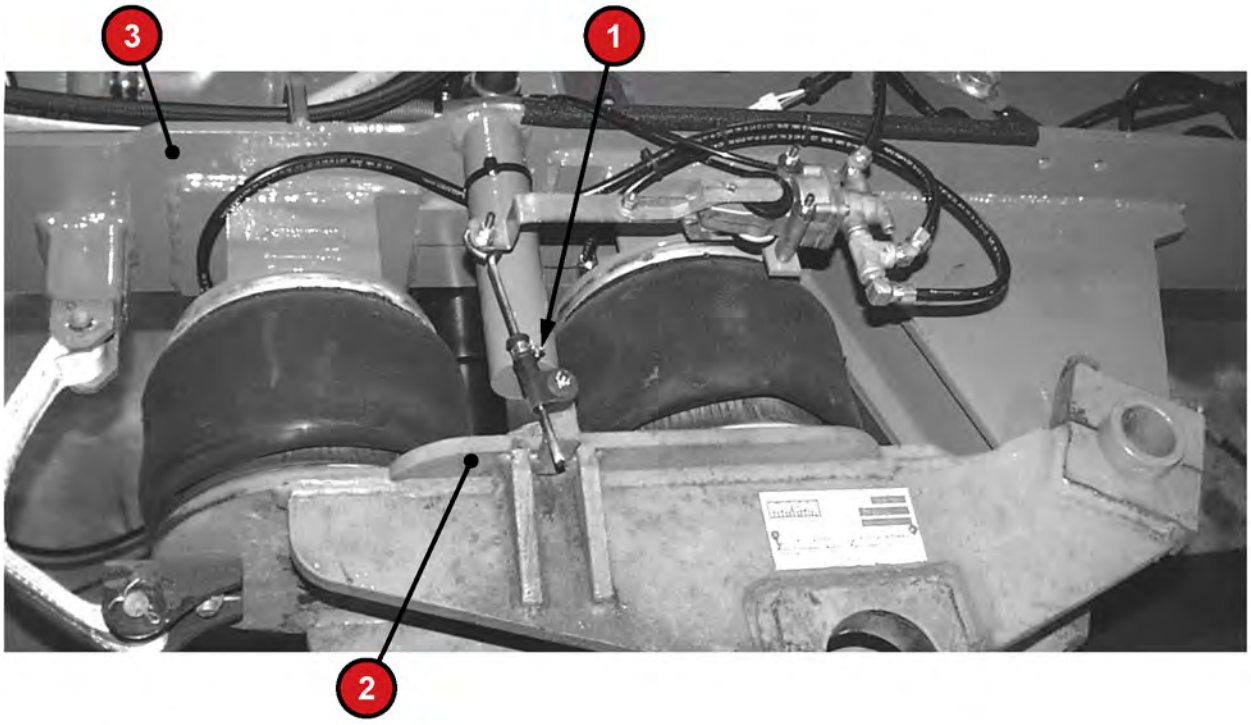
This machine is equipped with an air suspension on both the front & rear axles. Operation of the suspension is very simple. As explained in Group 2, air is added or released from the air bags by depressing the switch in the carrier cab.

T300-1-Dumps air only on rear axles.

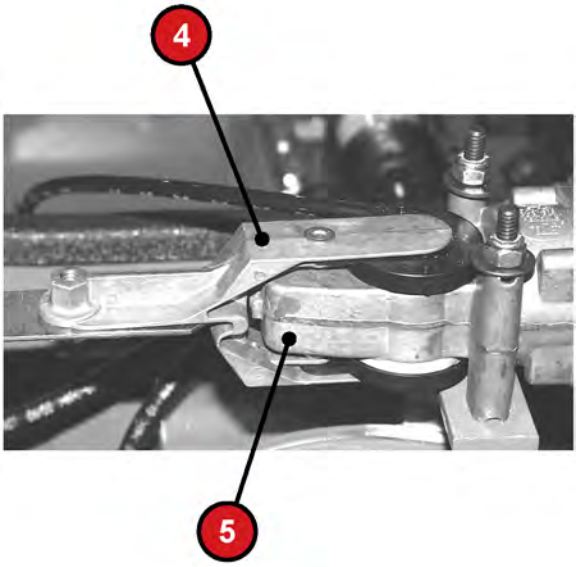
T500-1 & T780-Dumps air on both front & rear axles.

RIDE HEIGHT ADJUSTMENT

To adjust the ride height, begin by loosening clamp (1). This will allow the bar to slide so that the trailing arm can be rotated relative to the frame. Adjust the suspension member so that its surface (2) is parallel to the frame surface (3). Pass a small rod through the holes in the air yoke (4) and the switch (5). The rod should pass through both outside holes and between the two small bosses on the switch. Tighten the clamp (1). Remove the small rod, by moving arm (4) up to add air, pushing the trailing arm away from the frame, or down to bring it closer.



1	Clamp	3	Frame Surface
2	Suspension Member Surface		



4	Air Yoke	5	Switch

Remote Carrier Operation

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

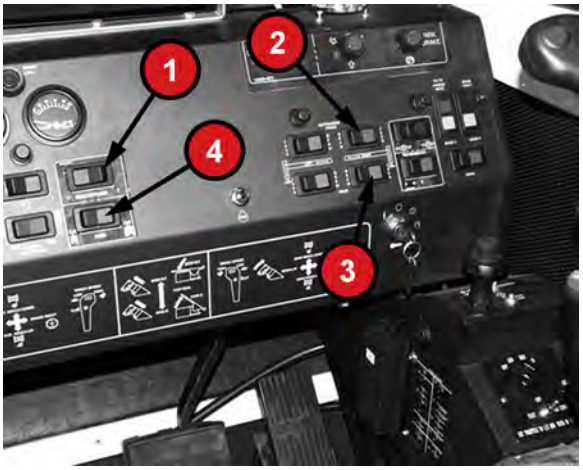
1. Move to the upper (crane) cab.
2. Start the crane engine. If the red (Low Air) light is "ON", run the crane engine for a few minutes to allow air pressure to build up before moving the carrier.
3. Turn "ON" the "Remote Power" switch item (1) as shown in photo below.
4. Apply the service brakes by 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 dash mounted switch item (3) as shown in photo below located on the dash panel. "F"=(forward), "N"= (neutral), "R"=(reverse), as applicable.
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 returnto the straight-ahead position automatically) you must actuate the switch in the opposite direstion 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".



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

Moving the Unit

Removable Counterweight (T500-1 & T780)

INSTALLATION

NOTE: *The counterweight slabs are an integral part of this crane. When the crane is to be traveled at highway speeds, a portion of these slabs are intended to be moved to and carried on the counterweight supports on the deck of the crane in order to equalize the axle loading.*

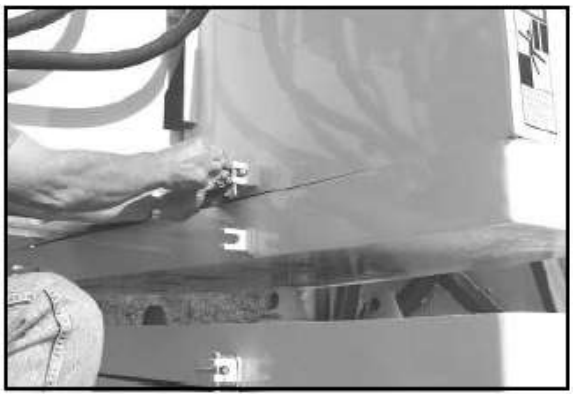
1. Lower the outrigger jacks to support the weight of the crane

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 drive the slabs down after they have seated.

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-Cummins EPA 2013

Use as a guide for Cummins On-Highway Heavy-Duty Engines with Aftertreatment.

This covers engine, aftertreatment and emissions-related indicator lamps found on the vehicle's instrument panel and explains what they mean and the actions drivers need to take when they illuminate. Important information about fuel, oil, Diesel Exhaust Fluid (DEF) and operating tips is also listed.

General Engine Indicator Lamps

Check Engine Lamp or Amber Warning Lamp

The Check Engine Lamp (which may also be referred to as the Amber Warning Lamp) illuminates when the engine needs to be serviced at the first available opportunity.

Stop Engine Lamp

The red Stop Engine Lamp indicates, when illuminated, that the vehicle needs to be stopped as soon as it is safe to do so.

On-Board Diagnostics

In 2013, all on-highway engines will include On-Board Diagnostics as a part of the emissions regulation requirement. On-Board Diagnostics monitors all emissions-related engine systems during operation. If the system detects any emissions-related malfunctions, it will alert the operator to these detected malfunctions through a dash lamp know as the Malfunction Indicator Lamp (MIL).

Malfunction Indicator Lamp (MIL)

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 then be taken to an authorized Cummins location for repair.

Diesel Exhaust Fluid For Selective Catalytic Reduction (SCR) Aftertreatment

Every 2010 and newer vehicle has an on-frame storage tank for Diesel Exhaust Fluid (DEF) and a dash lamp that indicates low DEF levels. Refilling this tank with DEF is critical in

order for your vehicle to comply with U.S. Environmental Protection Agency (EPA) emissions regulations.

Diesel Exhaust Fluid (DEF) Lamp

Illuminated

An illuminated DEF Lamp is an indication that the DEF level is low. This can be corrected by refilling the DEF tank with Diesel Exhaust Fluid.

Flashing

A flashing DEF Lamp indicates that the DEF level has fallen below a critical level. This can be corrected by refilling the DEF tank.

Flashing DEF Lamp With Check Engine Lamp / Amber Warning Lamp
A flashing DEF Lamp combined with an illuminated Check Engine Lamp / Amber Warning Lamp indicates that the DEF level is critically low and you will experience a power loss. Normal engine power will be restored after refilling the DEF tank.

Flashing DEF Lamp With Check Engine Lamp / Amber Warning Lamp and Stop Engine Lamp
When your DEF gauge reads zero and the engine has been shut down, has idled for one hour after the DEF tank has been run dry or if the vehicle's diesel fuel tank is refilled without refilling the DEF tank, the Stop Engine Lamp will also be illuminated, along with the flashing DEF Lamp and the illuminated Check Engine Lamp / Amber Warning Lamp. Engine power will continue to be reduced automatically. The vehicle will also be limited to a speed of 5 miles (8 km) per hour. Normal engine power and vehicle speed will be restored after refilling the DEF tank.

Diesel Particulate Filter (DPF)

The DPF is an integral component of the aftertreatment system on every 2007 and newer vehicle. It captures Particulate Matter (PM) in a wall-flow ceramic filter. The exhaust system periodically undergoes regeneration, raising temperatures to oxidize captured PM and clean the system. Lamps alert the driver when a regeneration is needed.

High Exhaust System Temperature (HEST) Lamp

The HEST Lamp illuminates to indicate that high exhaust temperatures may exist due to aftermarket regeneration. This is normal and does not signify the need for any kind of vehicle service or engine service. When this lamp is illuminated, ensure that the exhaust pipe outlet is not directed at any combustible surface or material. Reference your Cummins Owners Manual for complete instructions.

Aftertreatment Diesel Particulate Filter (DPF) Lamp

Illuminated

The Aftertreatment DPF Lamp indicates, when illuminated or flashing, that the Aftertreatment DPF requires regeneration. This is accomplished by the following:

1. If the vehicle is equipped with a Regeneration Inhibit Switch, ensure that the switch is not in the Inhibit position.
2. Perform a DPF regeneration by one of the following methods:
   a. Change to a more challenging duty cycle - such as highway driving - for at least 20 minutes to increase exhaust temperatures - OR
   b. Perform a parked regeneration.

Flashing

If a regeneration is not performed in a timely manner after the DPF Lamp is illuminated, the DPF Lamp will begin to flash. This indicates a higher level of PM in the DPF. In addition, engine power may be reduced automatically.

Flashing With Check Engine Lamp / Amber Warning Lamp

If flashing DPF Lamp combined with an illuminated Check Engine Lamp / Amber Warning Lamp indicates that the aftertreatment DPF needs regeneration immediately. Engine power will be reduced automatically. A parked regeneration is required.

Stop Engine Lamp

If a parked regeneration is not performed, the red Stop Engine Lamp will illuminate. As soon as it is safe to do so, the vehicle should be stopped. It should then be taken to an authorized Cummins location for repair.

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. Cummins 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.

CARRIER BREAK-IN Refer to special break in requirements for new cranes on page 287.

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

1. Stow the boom in the boom rack.
2. Lock the upper structure swing brake and engage the mechanical swing lock.
3. Secure hoist block to the bumper loop. If this is impractical, pull the anti-two block system counterweight up to within approximately 1” of the load sheaves, or until block lightly contacts boom head.

Use the anti two block 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).

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 swing brake.
7. Apply the swing lock.
8. Apply the Service Brake.
9. Release the Parking Brake.
10. Push in the clutch (if equipped with a manual transmission).
11. 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-T300-1 & T500-1	DUALS	SINGLES-FRONT
Tire Size	11R22.5 14PR XDE	425/65R22.5, 20PR
Ply Rating	14	18
Pressure (PSI)	95	110
Pressure (kPa)	655	758

TIRE DATA-T780	DUALS	SINGLES-FRONT
Tire Size	315/80R22.5 MICHELIN TREAD XDY 3 (40302)	315/80R22.5 MICHELIN TREAD XDY 3 (40302)
Ply Rating	20	20
Pressure (PSI)	120 max.	120 max.
Pressure (kPa)	830	830

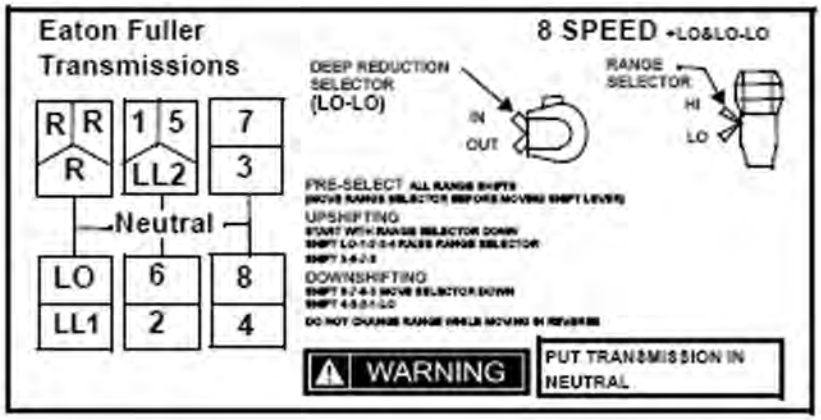
Before stopping the engine, put the transmission in neutral, engage the parking brake and reduce engine speed.

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 Fuller Manual



The transmission provides eight highway ratios, plus a LO gear and a LL1 and LL2 gear for extra pulling power. There are three reverse ratios.

The transmission has a five speed front section and a three speed auxiliary section which has an extra deep reduction gear. The LO ratio in the front section is used only as a starting gear. The other four ratios are used once in Low Range and one again in High Range.

Always preselect the range shift. After preselection and moving the shift lever, the transmission will automatically make the synchronized range shift as the lever passes through neutral.

LL1 is selected by the Deep Reduction Button mounted on the shift lever. When operation in ratios from LO to 8th the Deep Reduction Button should be in the REARWARD position. Move the Deep Reduction Button into the FORWARD position to select LL1. This shift should only be made with the transmission in Low Range and the shift lever in the LO speed gear position.

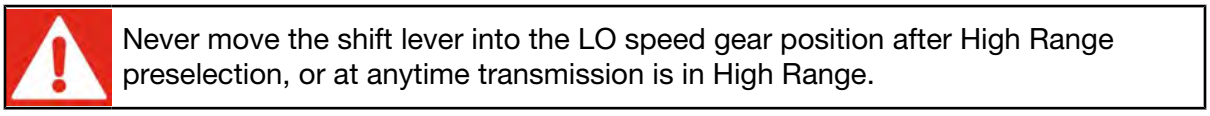
DOUBLE - CLUTCHING – Always double-clutch when making lever shifts. Use the following double - clutching procedure when upshifting and downshifting:

1. Depress pedal to disengage clutch.
2. Move gear shift lever to neutral.
3. Release pedal to engage clutch.
   A. Upshifts - decelerate engine until engine RPM and road speed match.
   B. Downshifts - accelerate engine until engine RPM and road speed match.
4. Quickly depress pedal to disengage clutch and move gear shift lever to next gear speed position.
5. Release pedal to engage clutch.

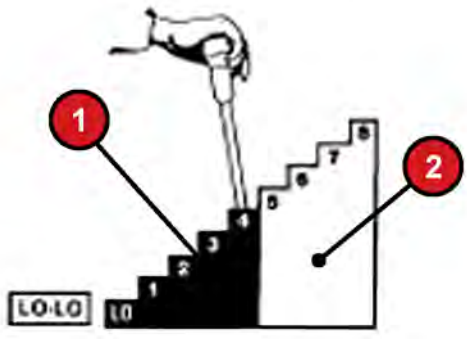
NOTE: *By engaging the clutch with the gear shift lever in the neutral position, the operator is able to control the RPM of the main shaft gears since they are regulated by engine RPM. This procedure enables the operator to match the RPM of the main shaft gears with those of the main shaft driven by the cranes rear wheels.*

UPSHIFTING:

1. Move the gear shift lever into neutral.
2. Start the engine and wait for the vehicle's air system to reach normal line pressure.
3. Make sure the Range Selector Lever is DOWN in the Low Range position.
4. Make sure the Deep Reduction Button is in the REARWARD position. Or, in the FORWARD position if you want to start in LL1 under adverse conditions.
5. With clutch disengaged, move the gear shift lever to the LO speed gear position. Release clutch pedal to start moving. If Deep Reduction was selected, the crane will be moving in LL1.
6. To upshift from LL1 to LO in the same gear shift lever position, move the Deep Reduction Button to the REARWARD position and IMMEDIATELY release accelerator. Depress the clutch pedal ONCE to break torque and reengage the clutch. The transmission will shift from /Deep Reduction to Low Range when synchronous is reached. Then accelerate.
7. To upshift form LO upshift from LO through 1st, 2nd and 3rd to 4th while in Low Range.
8. While in 4th and ready for the next upshift, PULL UP the Range Preselection Lever and move the shift lever to the 5th speed gear position. As the shift lever passes through neutral, the transmission will automatically shift from Low Range to High Range.



Never move the shift lever into the LO speed gear position after High Range preselection, or at anytime transmission is in High Range.



DOWNSHIFTING:

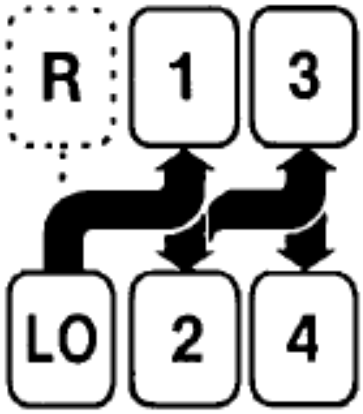
1. Move the gear shift lever, from 8th through 7th and 6th to 5th while in High Range.

2. While in 5th and ready for the next downshift, PUSH DOWN the Range Preselection Lever and move the shift lever to the 4th speed gear position. As the shift lever passes through neutral, the transmission will automatically shift from High Range to Low Range.
3. Continue downshifting from 4th through 3rd, 2nd, and 1st to LO while in Low Range.
4. DO NOT down shift into LL1 from LO unless operating conditions make it necessary. LL1 can be obtained with the transmission in Low Range and the shift lever in the LO speed gear position by moving the Deep Reduction Button to the FORWARD position. Then IMMEDIATELY release accelerator, depress clutch pedal ONCE to break torque, reengage clutch and accelerate. The transmission will shift from LO to LL1 when synchronous is reached.

DOWN HILL DRIVING - The engine provides most efficient braking when run at or near top RPM in the operating range - but remember, the governor has no control over the engine speed when it its being pushed by a load.

When the engine speed exceeds the rated governed speed, while descending a grade or downshifting at the high end of the operating range, the engine over-speeds and can result in serious damage. On grades, use the vehicle brakes and gears in combination to keep the vehicle speed under control and engine RPM below rated governed RPM.

In going down a steep or dangerous hill, close the throttle and allow the engine to assist the brakes in retarding the descent of the carrier. In going down exceptionally steep hills, it is advisable to change to 3rd or 2nd gear, or even low to obtain greater braking action from the engine. Always leave the ignition switch ON. In all cases, the brakes must be the main factor in retarding the descent of the vehicle. Never allow the engine to operate in excess of the governor speed.

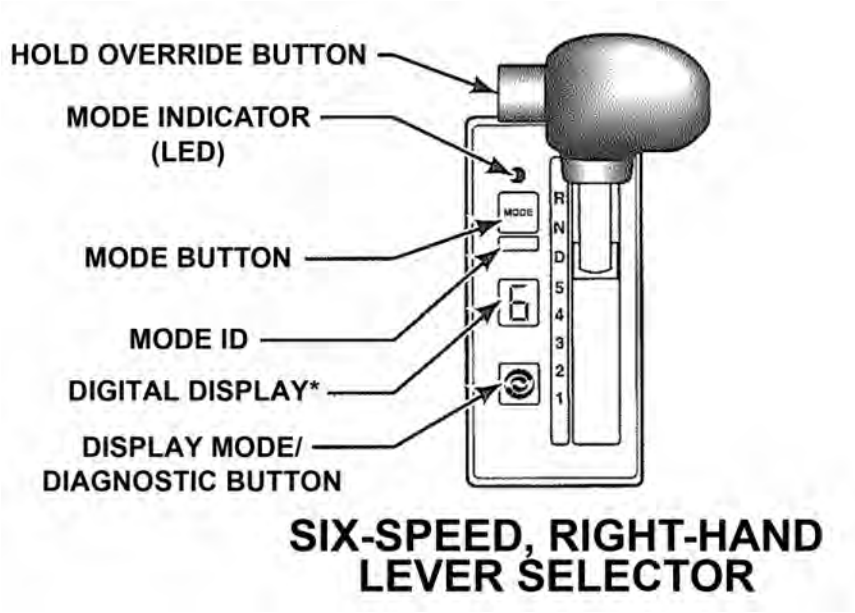


NOTE: *When properly adjusted the parking brake will hold this machine on a 30% grade, if the tires have adequate traction. It is recommended that when parked on a grade that the wheels be chocked.*

Allison Automatic (WTEC III Controls)

Shift Selector

With an Allison-equipped truck crane, it is not necessary to select the right moment to upshift or downshift during changing road and traffic conditions. The Allison MD, HD or B Series does it for you. However, knowledge of the shift selector positions, ranges available, and when to select them, will make vehicle control and your job even easier. It is recommended to select lower ranges when descending long grades to reduce wear on service brakes. Be sure to read RANGE SELECTION in the Allison Operator's Manual-OM2995EN which is included in the Manual Packet of your crane.



SIX-SPEED, RIGHT-HAND LEVER SELECTOR

Turning off the Vehicle

Always select N (Neutral) prior to turning off the vehicle engine.

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.

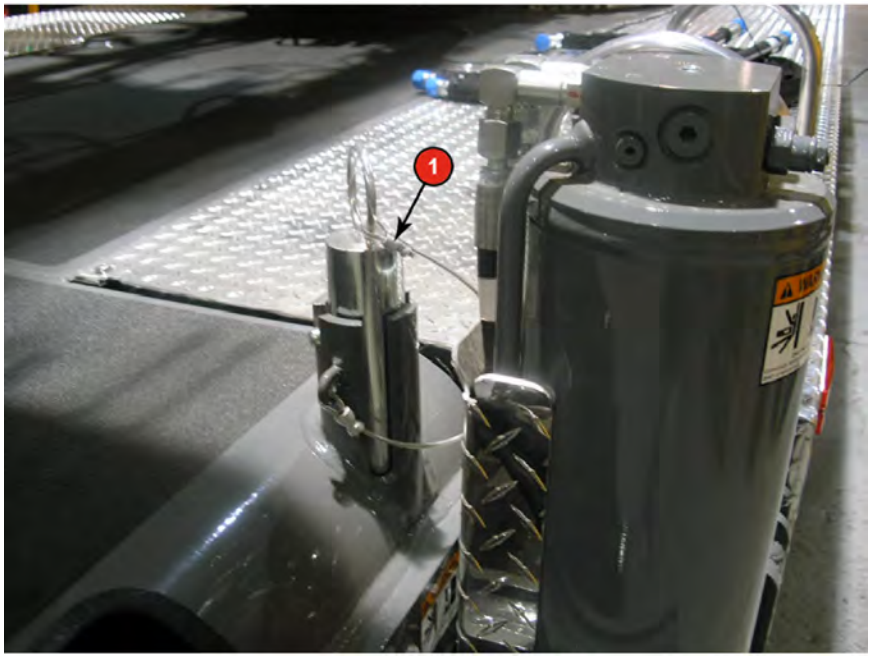
NOTE: *See the "ON TIRES LIFT" instructions found in the Operating Instructions section for Information on moving the crane with a load.*

- Carry the boom over the front only.

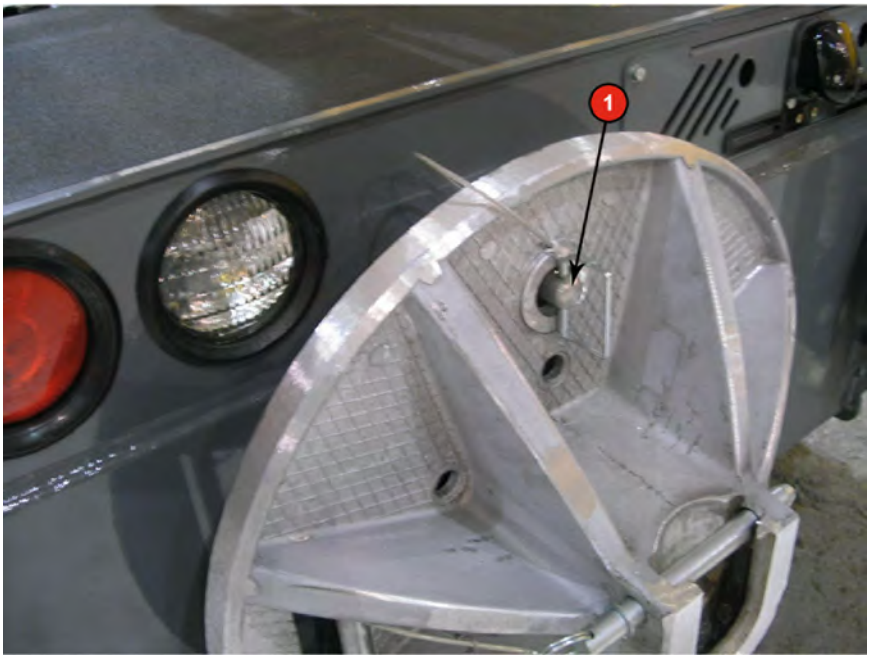
- Lock the swing brake and swing lock.

- 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.

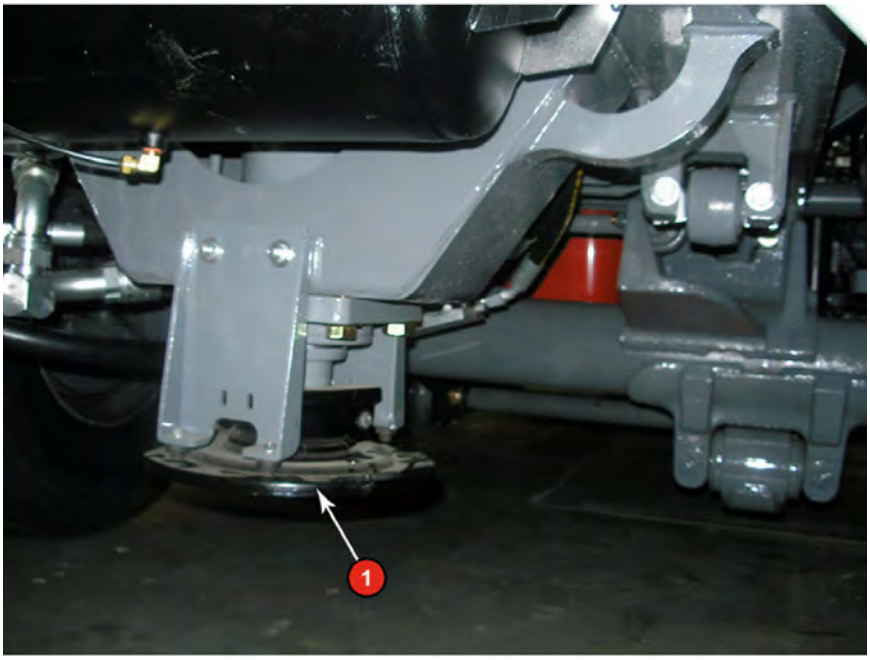
- Make sure all outriggers are completely retracted before moving the crane.



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.

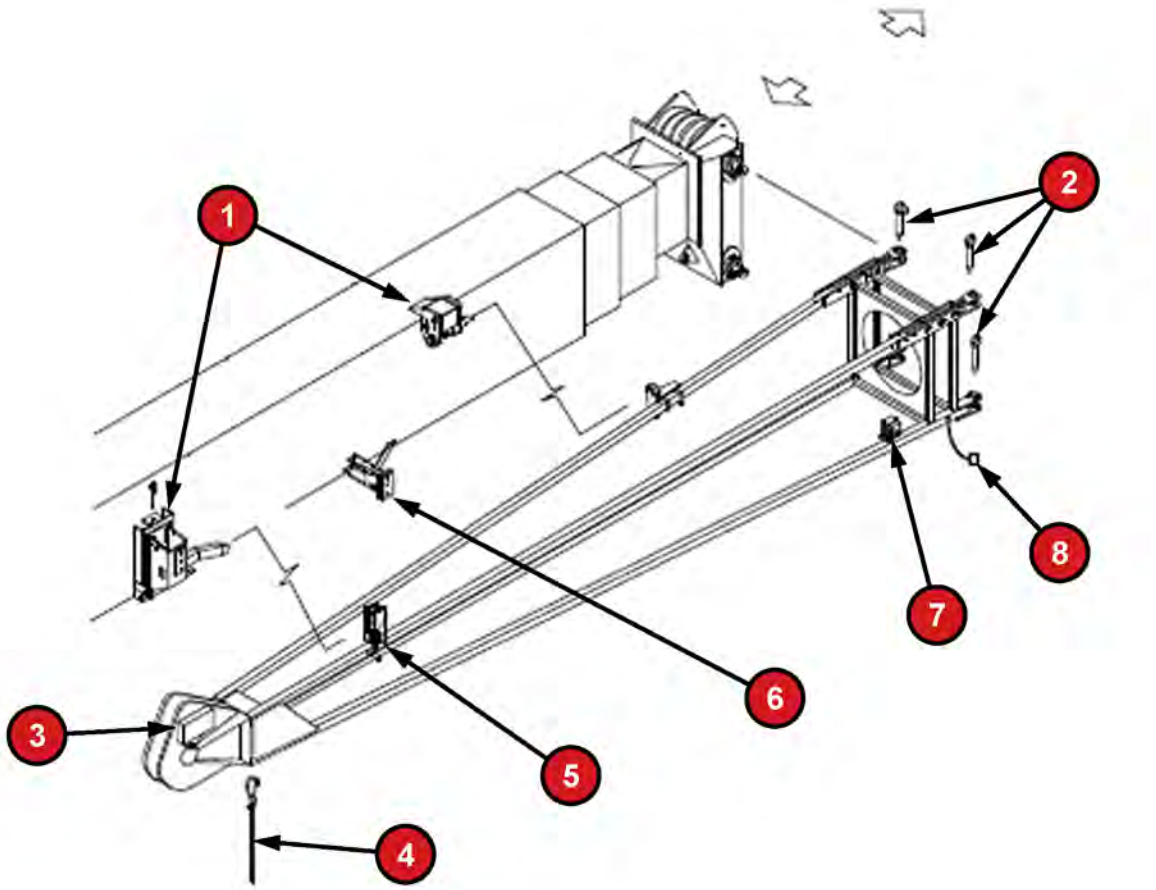
- The operator must be very careful on steep side slopes to avoid tipping the crane.

NOTE: *This machine can travel on 15° side slopes which have a firm level prepared surface. Due to variations in 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.

Stowing the Jib

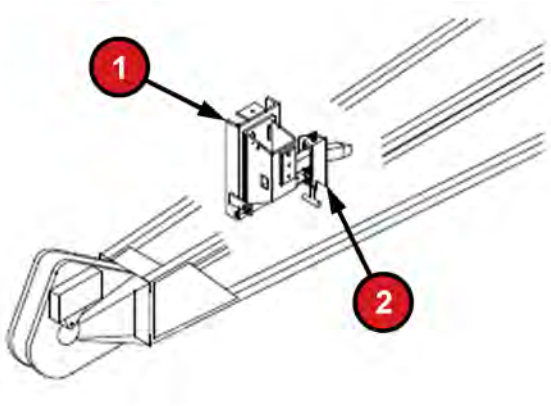


1	Jib Storage Brackets	5	T - Handle
2	Jib Mounting Pins (4)	6	Wear Pad
3	Anti Two-block Switch	7	Anti Two-block Socket
4	Guide Rope	8	Anti Two-block Plug

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

1. Extend and set the outriggers.
2. Rotate the upper structure to the “over rear” position.
3. Make sure the stinger is in the stowed position and the jib offset is at 0° offset.
4. Boom down to minimum boom angle.
5. Remove the hoist line from jib sheave and lay to left side.
6. Disconnect the anti two-block plug from the boom head and plug it in to the jib anti two-block socket. Move the dummy plug from the jib anti two-block socket to the boom head anti two-block socket.

7. Extend the boom to 2-3 feet (.6-1 m).
8. Attach the guide rope to the eye on the bottom tip of the jib.
9. Remove the left upper and lower jib mounting pins. With guide rope, pull left jib ears out of left boom head ears.
10. With the engine at idle, slowly boom up while a second operator holds the guide rope to control the rotating speed of the jib.
11. 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.
12. With the engine at idle, slowly retract the boom completely. The jib will engage the jib storage brackets as the boom is retracted.
13. Remove the guide rope from the tip of the jib.



1	Bracket mounted to boom	2	Bracket mounted to jib

14. 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.
15. Rotate and release the T- handle to lock the jib to the storage brackets.
16. Remove the right upper and lower jib mounting pins.
17. Test the anti two-block system at the boom head by lifting the anti two-block weight. The light and audible alarms should be actuated in the cab and the boom down, boom extend, and winch up controls should disconnect.

Transportation

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 of machine as described in Pre-Start Inspection on page 139 .

STARTING THE ENGINE

At ambient temperatures over 32° F on Cummins 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 on page 218 .

SECURE EQUIPMENT

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

UNLOADING EQUIPMENT

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 on page 218 .

PRE-START INSPECTION

Complete Pre-Start Inspection of machine as described in Pre-Start Inspection on page 139 .

STARTING THE ENGINE

At ambient temperatures over 32° F on Cummins 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.**(T300-1 ONLY)**
4. Turn the ignition switch to the “START” position to start the engine.

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

Engine Data-Tier 3 Export & EPA 2013

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.

T340-07 EXPORT (2007)	DESCRIPTION
TRANSMISSION	MANUAL
ENGINE MODEL	QSC8.3 Tier 3
TEREX ENGINE NUMBER	714 1688
HP & RPM	275 @ 2200
MAX RPM	2200
PEAK TORQUE (Lb-Ft)	895
CONTROL MODULE	CM850
CYLINDERS	6

T340-07 EXPORT (2007)	DESCRIPTION
TRANSMISSION	AUTO
ENGINE MODEL	QSC8.3 Tier 3
TEREX ENGINE NUMBER	T122717
HP & RPM	275 @ 2200
MAX RPM	2200
PEAK TORQUE (Lb-Ft)	895
CONTROL MODULE	CM850
CYLINDERS	6

T340-2013	DESCRIPTION
TRANSMISSION	MANUAL
ENGINE MODEL	ISL8.3 2013
TEREX ENGINE NUMBER	T124885
HP & RPM	300 @ 2000
MAX RPM	2200
PEAK TORQUE	860
CONTROL MODULE	CM2350
CYLINDERS	6

T340-2013	DESCRIPTION
TRANSMISSION	AUTO
ENGINE MODEL	ISL8.3 2013
TEREX ENGINE NUMBER	T124884

HP & RPM	300 @ 2000
MAX RPM	2200
PEAK TORQUE (Lb-Ft)	860
CONTROL MODULE	CM2350
CYLINDERS	6

T560-EXPORT	DESCRIPTION
TRANSMISSION	MANUAL
ENGINE MODEL	DD Series 60 14L
TEREX ENGINE NUMBER	T122718
HP & RPM	445@ 1800
MAX RPM	2175
PEAK TORQUE (Lb-Ft)	1450
CONTROL MODULE	NA
CYLINDERS	6

T560-EXPORT	DESCRIPTION
TRANSMISSION	AUTO
ENGINE MODEL	DD Series 60 14L
TEREX ENGINE NUMBER	717 1278
HP & RPM	455 @ 1800
MAX RPM	2175
PEAK TORQUE (Lb-Ft)	1550
CONTROL MODULE	NA
CYLINDERS	6

T560-2013	DESCRIPTION
TRANSMISSION	MANUAL
ENGINE MODEL	ISX 2013
TEREX ENGINE NUMBER	T125439
HP & RPM	455 @1800
MAX RPM	2100
PEAK TORQUE (Lb-Ft)	1650
CONTROL MODULE	CM2350
CYLINDERS	6

T560-2013	DESCRIPTION
TRANSMISSION	AUTO

TEREX

ENGINE MODEL	ISX 2013
TEREX ENGINE NUMBER	T125438
HP & RPM	455 @1800
MAX RPM	2100
PEAK TORQUE (Lb-Ft)	1650
CONTROL MODULE	CM2350
CYLINDERS	6

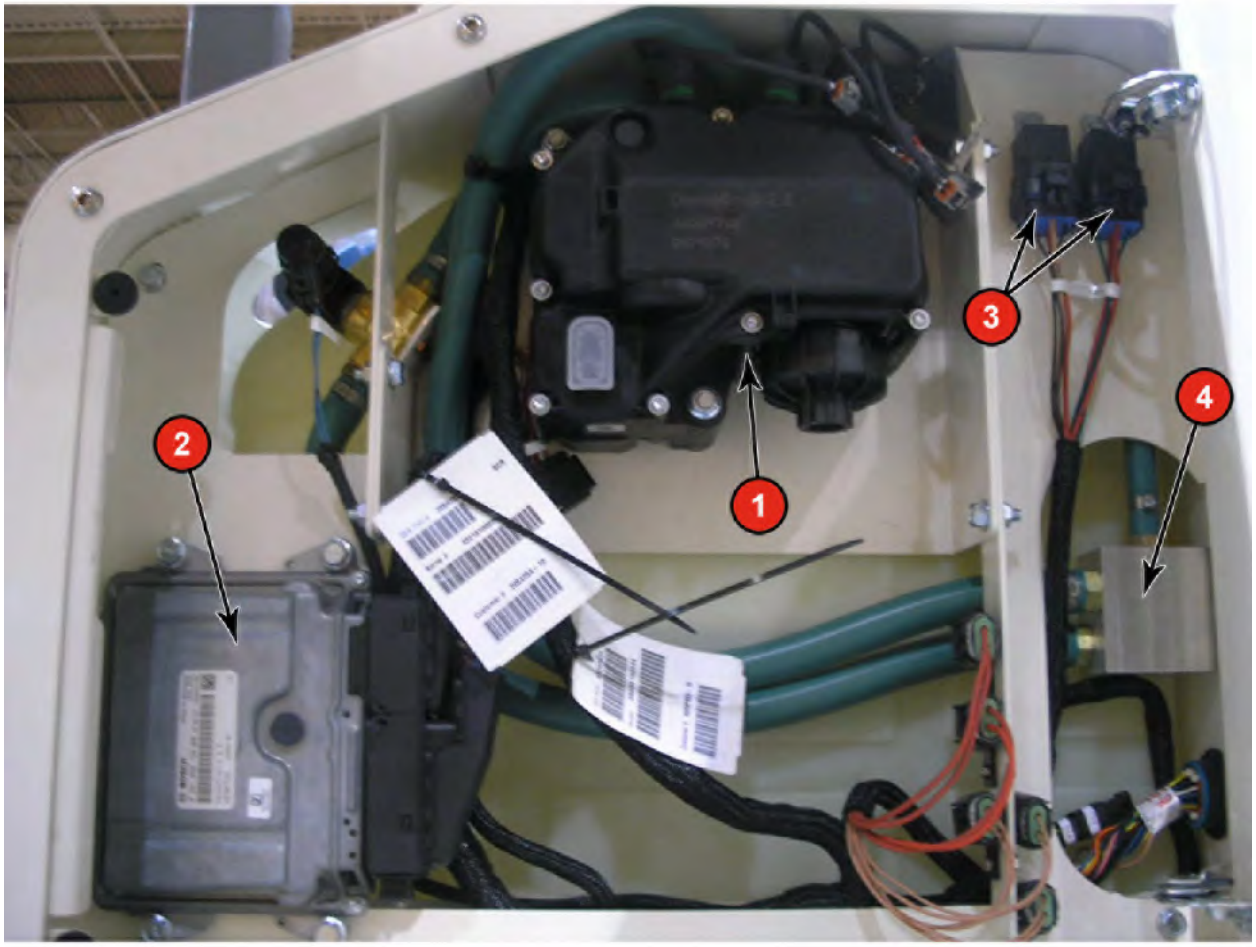
T780-EXPORT	DESCRIPTION
TRANSMISSION	MANUAL
ENGINE MODEL	DD Series 60
TEREX ENGINE NUMBER	T122719
HP & RPM	515 @ 1800
MAX RPM	2175
PEAK TORQUE (Lb-Ft)	1650
CONTROL MODULE	NA
CYLINDERS	6

T780-EXPORT	DESCRIPTION
TRANSMISSION	AUTO
ENGINE MODEL	DD Series 60
TEREX ENGINE NUMBER	T122719
HP & RPM	515 @ 1800
MAX RPM	2175
PEAK TORQUE (Lb-Ft)	1650
CONTROL MODULE	NA
CYLINDERS	6

T780-2013	DESCRIPTION
TRANSMISSION	MANUAL
ENGINE MODEL	ISX 2013
TEREX ENGINE NUMBER	T125439
HP & RPM	455 @1800
MAX RPM	2100
PEAK TORQUE (Lb-Ft)	1650
CONTROL MODULE	CM2350
CYLINDERS	6

T780-2013	DESCRIPTION
TRANSMISSION	AUTO
ENGINE MODEL	ISX 2013
TEREX ENGINE NUMBER	T125882
HP & RPM	500 @1800
MAX RPM	2100
PEAK TORQUE (Lb-Ft)	1650
CONTROL MODULE	CM2350
CYLINDERS	6

T300-1, T500-1, T780 Engine DEF Control Unit



DESCRIPTION	TEREX PART NO.
1. DEF SUPPLY MODULE	222725
2. Dosing Control Unit - Not Used for 2013 Engine	NA
3. RELAY-40A	222727
4. COOLANT MANIFOLD	222728

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.

Crane Maintenence & Specification

Acronyms and Abbreviations

204-009 Acronyms and Abbreviations

General Information

The following list contains some of the acronyms and abbreviations used in this manual.

API	American Petroleum Institute
ASTM	American Society of Testing and Materials
BTU	British Thermal Unit
BTDC	Before Top Dead Center
°C	Celsius
CO	Carbon Monoxide
CCA	Cold Cranking Amperes
CARB	California Air Resources Board
C.I.B.	Customer Interface Box
C.I.D.	Cubic Inch Displacement
CNG	Compressed Natural Gas
CPL	Control Parts List
cSt	Centistokes
DEF	Diesel Exhaust Fluid
DOC	Diesel Oxidation Catalyst
DPF	Diesel Particulate Filter
ECM	Electronic Control Module
EGR	Exhaust Gas Recirculation
EPA	Environmental Protection Agency
°F	Fahrenheit
ft-lb	Foot-Pound Force
FMI	Failure Mode Indentifier
GVW	Gross Vehicle Weight
Hg	Mercury
hp	Horsepower
H_2O	Water
inHg	Inches of Mercury
in H_20	Inches of Water
ICM	Ignition Control Module

km/l	Kilometers per Liter
kPa	Kilopascal
LNG	Liquid Natural Gas
LPG	Liquified Petroleum Gas
LTA	Low Temperature Aftercooling
MIL	Malfunction Indicator Lamp
MPa	Megapascal
mph	Miles Per Hour
mpq	Miles Per Quart
N•m	Newton-meter
NOx	Mono-Nitrogen Oxides
NG	Natural Gas
O2	Oxygen
OBD	On-Board Diagnostics
OEM	Original Equipment Manufacturer
PID	Parameter Identification Descriptions
ppm	Parts Per Million
psi	Pounds Per Square Inch
PTO	Power Takeoff
REPTO	Rear Power Take Off
RGT	Rear Gear Train
rpm	Revolutions Per Minute
SAE	Society of Automotive Engineers
SCA	Supplemental Coolant Additive
SCR	Selective Catalytic Reduction
STC	Step Timing Control
SID	Subsystem Identification Descriptions
VDC	Volts of Direct Current
VS	Variable Speed
VSS	Vehicle Speed Sensor

Last Modified: 02-Jul-2010

204-006 General Safety Instructions

Important Safety Notice

⚠ WARNING ⚠

Improper practices, carelessness, or ignoring the warnings can cause burns, cuts, mutilation, asphyxiation or other personal injury or death.

Read and understand all of the safety precautions and warnings before performing any repair. This list contains the general safety precautions that **must** be followed to provide personal safety. Special safety precautions are included in the procedures when they apply.

- Work in an area surrounding the product that is dry, well lit, ventilated, free from clutter, loose tools, parts, ignition sources and hazardous substances. Be aware of hazardous conditions that can exist.
- **Always** wear protective glasses and protective shoes when working.
- Rotating parts can cause cuts, mutilation or strangulation.
- Do **not** wear loose-fitting or torn clothing. Remove all jewelry when working.
- Disconnect the battery (negative [-] cable first) and discharge any capacitors before beginning any repair work. Disconnect the air starting motor if equipped to prevent accidental engine starting. Put a "Do **Not** Operate" tag in the operator's compartment or on the controls.
- Use ONLY the proper engine barring techniques for manually rotating the engine. Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. This practice can cause serious personal injury, property damage, or damage to the fan blade(s) causing premature fan failure.
- If an engine has been operating and the coolant is hot, allow the engine to cool before slowly loosening the filler cap to relieve the pressure from the cooling system.
- **Always** use blocks or proper stands to support the product before performing any service work. Do **not** work on anything that is supported ONLY by lifting jacks or a hoist.
- Relieve all pressure in the air, oil, fuel, and cooling systems before any lines, fittings, or related items are removed or disconnected. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure. Do **not** check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
- To reduce the possibility of suffocation and frostbite, wear protective clothing and ONLY disconnect liquid refrigerant (Freon) lines in a well ventilated area. To protect the environment, liquid refrigerant systems **must** be properly emptied and filled using equipment that prevents the release of refrigerant gas (fluorocarbons) into the atmosphere. Federal law requires capturing and recycling refrigerant.
- To reduce the possibility of personal injury, use a hoist or get assistance when lifting components that weigh 23 kg [50 lb] or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly. **Always** use a spreader bar when necessary. The lifting hooks **must not** be side-loaded.
- Corrosion inhibitor, a component of SCA and lubricating oil, contains alkali. Do **not** get the substance in eyes. Avoid prolonged or repeated contact with skin. Do **not** swallow internally. In case of contact, immediately wash skin with soap and water. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. IMMEDIATELY CALL A PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.
- Naptha and Methyl Ethyl Ketone (MEK) are flammable materials and **must** be used with caution.

Follow the manufacturer's instructions to provide complete safety when using these materials. KEEP OUT OF REACH OF CHILDREN.

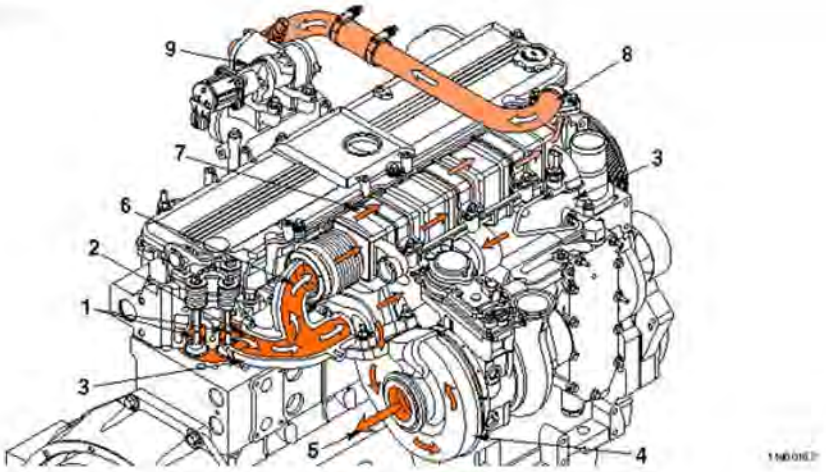
- To reduce the possibility of burns, be alert for hot parts on products that have just been turned off, exhaust gas flow, and hot fluids in lines, tubes, and compartments.
- **Always** use tools that are in good condition. Make sure you understand how to use the tools before performing any service work. Use ONLY genuine Cummins® or Cummins ReCon® replacement parts.
- **Always** use the same fastener part number (or equivalent) when replacing fasteners. Do **not** use a fastener of lesser quality if replacements are necessary.
- When necessary, the removal and replacement of any guards covering rotating components, drives, and/or belts should only be carried out be a trained technician. Before removing any guards the engine **must** be turned off and any starting mechanisms **must** be isolated. All fasteners **must** be replaced on re-fitting the guards.
- Do **not** perform any repair when fatigued or after consuming alcohol or drugs that can impair your functioning.
- Some state and federal agencies in the United States of America have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil.
- Do **not** connect the jumper starting or battery charging cables to any ignition or governor control wiring. This can cause electrical damage to the ignition or governor.
- **Always** torque fasteners and fuel connections to the required specifications. Overtightening or undertightening can allow leakage. This is critical to the natural gas and liquefied petroleum gas fuel and air systems.
- **Always** test for fuel leaks as instructed, as odorant can fade.
- Close the manual fuel valves prior to performing maintenance and repairs, and when storing the vehicle inside.
- Coolant is toxic. If **not** reused, dispose of in accordance with local environmental regulations.
- The catalyst reagent contains urea . Do **not** get the substance in your eyes. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. Avoid prolonged contact with skin. In case of contact, immediately wash skin with soap and water. Do **not** swallow internally. In the event the catalyst reagent is ingested, contact a physician immediately.
- The catalyst substrate contains Vanadium Pentoxide. Vanadium Pentoxide has been determined by the State of California to cause cancer. Always wear protective gloves and eye protection when handling the catalyst assembly. Do not get the catalyst material in your eyes. In Case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. Avoid prolonged contact with skin. In case of contact, immediately wash skin with soap and water.
- The Catalyst substrate contains Vanadium Pentoxide. Vanadium Pentoxide has been determined by the State of California to cause cancer. In the event the catalyst is being replaced, dispose of in accordance with local regulations.
- 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.

Last Modified: 25-Jan-2010

Flow Diagram-Exhaust System

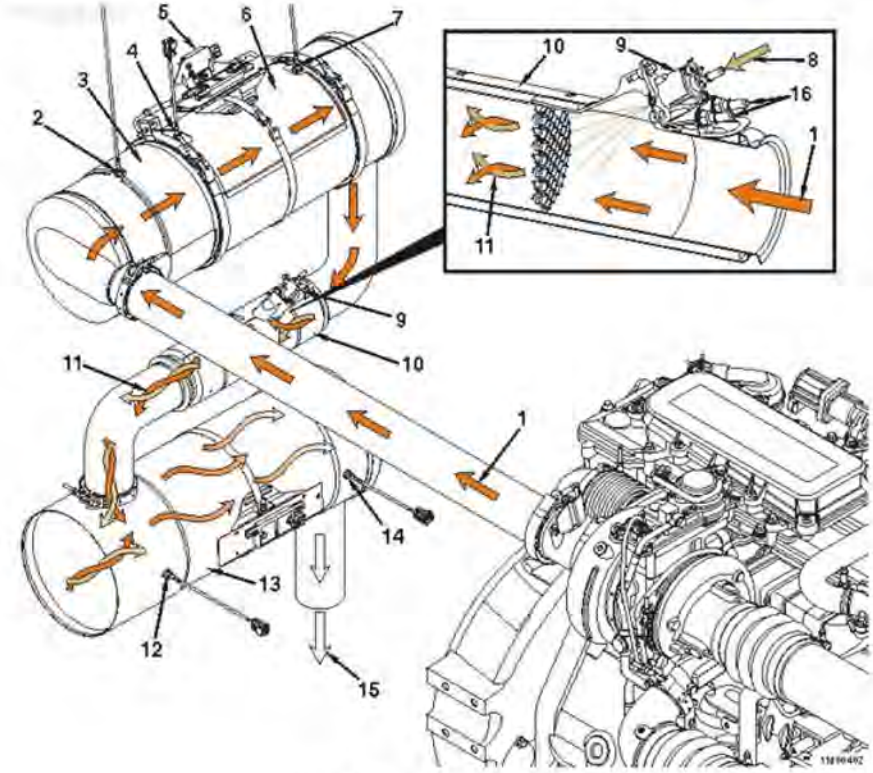
200-005 Flow Diagram, Exhaust System

General Information



Exhaust Flow

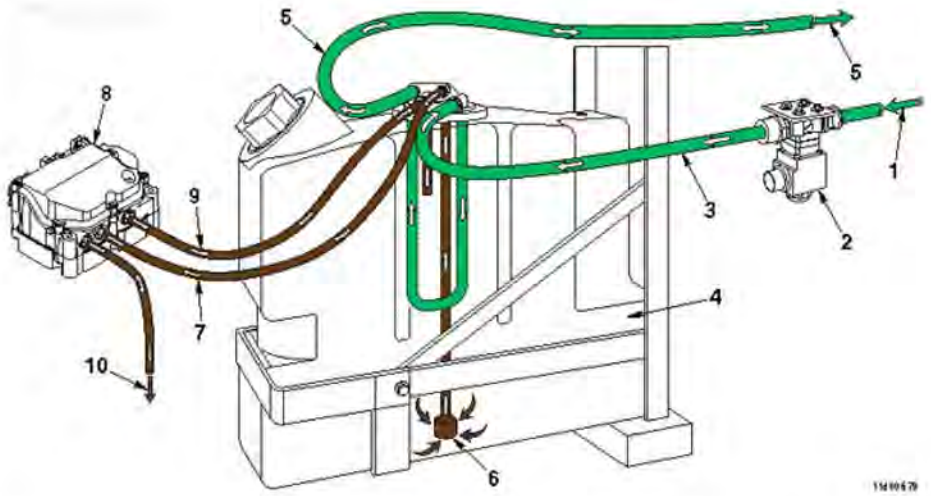
1. Exhaust valves
2. Exhaust port
3. Exhaust manifold
4. Turbocharger turbine housing
5. Turbocharger exhaust outlet
6. EGR cooler gas inlet
7. EGR cooler
8. EGR cooler gas outlet
9. EGR valve.



ISC8.3 and ISL9 CM2250

1. Exhaust from turbocharger
2. Aftertreatment diesel oxidation catalyst intake temperature sensor
3. Aftertreatment diesel oxidation catalyst (DOC)
4. Aftertreatment diesel particulate filter intake temperature sensor
5. Aftertreatment diesel particulate filter pressure sensor
6. Aftertreatment diesel particulate filter (DPF)
7. Aftertreatment diesel particulate filter outlet temperature sensor
8. Diesel Exhaust Fluid (DEF) supply to aftertreatment DEF dosing valve
9. Aftertreatment DEF dosing valve
10. Decomposition reactor
11. Exhaust and DEF mixture
12. Aftertreatment selective cataylist reduction (SCR) intake temperature sensor
13. Aftertreatment SCR cataylst
14. Aftertreatment SCR outlet temperature sensor
15. Exhaust flow exiting aftertreatment system
16. Aftertreatment DEF dosing valve coolant fittings.

6.-Aftertreatment Diesel Particulate Filter (DPF)
10.-Decomposition Reactor
13.-Aftertreatment SCR Catalyst



1. Coolant flow from engine to aftertreatment diesel exhaust fluid (DEF)
2. Aftertreatment DEF tank coolant valve
3. Coolant flow to aftertreatment DEF tank (**Only** when aftertreatment DEF tank coolant valve is open)
4. Aftertreatment DEF tank
5. Coolant return to engine
6. Aftertreatment DEF supply from aftertreatment DEF tank
7. Aftertreatment DEF flow to aftertreatment DEF dosing unit
8. Aftertreatment DEF dosing control valve
9. Aftertreatment DEF return to aftertreatment DEF tank
10. Aftertreatment DEF flow to the aftertreatment DEF dosing valve.

NOTE: For additional information regarding the diesel exhaust fluid tank or coolant valve, refer to the OEM service manual.

Last Modified: 19-Jul-2010

Engine & Cooling System Maintenence Schedule

102-002 Maintenance Schedule

Maintenance Check

ISC Engines

Perform maintenance at whichever interval occurs first.

At each scheduled maintenance interval, perform all previous maintenance checks that are due for scheduled maintenance.

Maintenance Procedures at Daily Interval (Section3)

- Air Intake Piping - Check
- Fan, Cooling - Check
- Crankcase Breather Tube - Check
- Air Tanks and Reservoirs - Check
- Coolant Level - Check
- Fuel-Water Separator - Drain
- Lubricating Oil Level - Check
- Aftertreatment Exhaust Piping - Check
- Aftertreatment Diesel Exhaust Fluid (DEF) Level - Check

Maintenance Procedures at 12,000 Kilometers [7500 Miles], 250 Hours, or 3 Months (Section4)

- Air Cleaner Restriction - Check
- Charge-Air Piping - Check
- Charge-Air Cooler - Check

Maintenance Procedures at 24,000 Kilometers [15,000 Miles], 500 Hours, or 6 Months (Section6)

- Fuel Filter (Spin-On Type) - Change[7]
- Lubricating Oil System - Drain[1]
- Lubricating Oil Filter (Spin-On) - Change[1]
- Supplemental Coolant Additive (SCA) and Antifreeze Concentration - Check[2]
- Coolant Filter - Change
- Batteries - Check[4]
- Battery Cables and Connections - Check[4]
- Radiator Pressure Cap - Check

Maintenance Procedures at 48,000 Kilometers [30,000 Miles], 1000 Hours, or 1 Year (Section8)

- Fuel Filter (Spin-On Type) - Change[8]
- Drive Belt, Cooling Fan - Check
- Belt Tensioner, Automatic (Water Pump) - Check

Maintenance Procedures at 96,000 Kilometers [60,000 Miles] or 2000 Hours (Section10)

- Crankcase Breather Element - Change

Maintenance Procedures at 96,000 Kilometers [60,000 Miles], 2000 Hours, or 2 Years (Section11)

- Cooling System - Change
- Vibration Damper, Rubber - Check
- Vibration Damper, Viscous - Check[3]
- Engine Steam Cleaning - Clean
- Radiator Hoses - Check
- Air Compressor Discharge Lines - Clean

Maintenance Procedures at 241,500 Kilometers [150,000 Miles], 5000 Hours, or 4 Years (Section13)

- Overhead Set - Adjust[5]
- Engine Brake Assembly - Adjust[4]

Maintenance Procedures at 321,500 Kilometers [200,000 Miles] or 6500 Hours (Section14)

- Aftertreatment Diesel Particulate Filter - Clean[6]
- Aftertreatment Diesel Exhaust Fluid Dosing Unit Filter - Change

1. The lubricating oil and lubricating oil filter interval can be adjusted based on application, fuel consumption, gross vehicle weight, and idle time. See the Oil Drain Intervals table in this procedure.
2. Service interval is every oil change or 24,000 Kilometers [15,000 Miles], 500 hours, or 6 months, whichever occurs first. A heavy-duty year-round antifreeze that meets the chemical composition of ASTM D6210**must** be used. The change interval is 2 years or 385,000 Kilometers [240,000 Miles], whichever occurs first. Antifreeze is essential for freeze, overheat, and corrosion protection. SCA is essential for liner pitting and scaling protection.
3. Service interval is 2 years or 385,000 Kilometers [240,000 Miles], whichever occurs first.
4. Follow the manufacturers' recommended maintenance procedures for the starter, alternator, batteries, electrical components, engine brake, exhaust brake, charge-air cooler, radiator, air compressor, air cleaner, refrigerant compressor, and fan clutch.
5. Reset valve lash, if needed, to nominal specifications. Refer to Procedure 018-015 in Section V
6. The aftertreatment diesel particulate filter clean/replace interval is based on the use of lubricating oils that meet the Cummins® Engineering Standard (C.E.S.) 20081 oil specification. If a non-low ash lubricating oil meeting the American Petroleum Institute (API) performance classification CI-4/SL and/or C.E.S. 20078 is used, the service intervals for the aftertreatment systems will be reduced to 241,000 Kilometers [150,000 Miles] or 5000 hours.
7. Replace the primary (or suction side) fuel filter at every oil change.
8. Replace the secondary (or pressure side) fuel filter at every other oil change.

All low emission EPA 07, EPA 10, EPA Tier 4 Interim/European Union Stage IIIB 2011(174 -751 hp) engine systems equipped with exhaust aftertreatment **must** operate on ultra-low sulfur diesel (ULSD) with a maximum sulfur content of 15 ppm in the United States and 10 ppm in the European Union. Failure to do so can permanently damage engine and aftertreatment systems within a short period of time. This damage could cause the engine to become inoperable and affect the warranty coverage on the engine system.

ISL Engines

Perform maintenance at whichever interval occurs first.

At each scheduled maintenance interval, perform all previous maintenance checks that are due for scheduled maintenance.

Maintenance Procedures at Daily Interval (Section3)

- Air Intake Piping - Check
- Fan, Cooling - Check
- Crankcase Breather Tube - Check
- Air Tanks and Reservoirs - Check
- Coolant Level - Check
- Fuel-Water Separator - Drain
- Lubricating Oil Level - Check
- Aftertreatment Exhaust Piping - Check
- Diesel Exhaust Fluid (DEF) Level - Check

Maintenance Procedures at 16,000 Kilometers [10,000 Miles], 250 Hours, or 3 Months (Section5)

- Air Cleaner Restriction - Check
- Charge-Air Piping - Check
- Charge-Air Cooler - Check

Maintenance Procedures at 32,000 Kilometers [20,000 Miles], 500 Hours, or 6 Months (Section7)

- Fuel Filter (Spin-On Type) - Change[7]
- Lubricating Oil System - Drain[1]
- Lubricating Oil Filter (Spin-On) - Change[1]
- Supplemental Coolant Additive (SCA) and Antifreeze Concentration - Check[2]
- Coolant Filter - Change
- Batteries - Check[4]
- Battery Cables and Connections - Check[4]
- Radiator Pressure Cap - Check

Maintenance Procedures at 64,000 Kilometers [40,000 Miles], 1000 Hours, or 1 Year (Section9)

- Fuel Filter (Spin-On Type) - Change[8]
- Drive Belt, Cooling Fan - Check
- Belt Tensioner, Automatic (Water Pump) - Check

Maintenance Procedures at 96,000 Kilometers [60,000 Miles] or 2000 Hours (Section10)

- Crankcase Breather Element - Change

Maintenance Procedures at 128,000 Kilometers [80,000 Miles], 2000 Hours, or 2 Years (Section12)

- Cooling System - Change
- Vibration Damper, Rubber - Check
- Vibration Damper, Viscous - Check[3]
- Engine Steam Cleaning - Clean
- Radiator Hoses - Check
- Air Compressor Discharge Lines - Clean

Maintenance Procedures at 241,500 Kilometers [150,000 Miles], 5000 Hours, or 4 Years (Section13)

- Overhead Set - Adjust[5]
- Engine Brake Assembly - Adjust[4]

Maintenance Procedures at 321,500 Kilometers [200,000 Miles] or 6500 Hours (Section14)

- Aftertreatment Diesel Particulate Filter - Clean[6]
- Aftertreatment Diesel Exhaust Fluid Dosing Unit Filter - Change

1. The lubricating oil and lubricating oil filter interval can be adjusted based on application, fuel consumption, gross vehicle weight, and idle time. See the Oil Drain Intervals table in this procedure.
2. Service interval is every oil change or 24,000 Kilometers [15,000 Miles], 500 hours, or 6 months, whichever occurs first. A heavy-duty year-round antifreeze that meets the chemical composition of ASTM D6210**must** be used. The change interval is 2 years or 385,000 Kilometers [240,000 Miles], whichever occurs first. Antifreeze is essential for freeze, overheat, and corrosion protection. SCA is essential for liner pitting and scaling protection.
3. Service interval is 2 years or 385,000 Kilometers [240,000 Miles], whichever occurs first.
4. Follow the manufacturers' recommended maintenance procedures for the starter, alternator, batteries, electrical components, engine brake, exhaust brake, charge-air cooler, radiator, air compressor, air cleaner, refrigerant compressor, and fan clutch.
5. Reset valve lash, if needed, to nominal specifications. Refer to Procedure 018-015 in Section V.
6. The aftertreatment diesel particulate filter clean/replace interval is based on the use of lubricating oils that meet the Cummins® Engineering Standard (C.E.S.) 20081 oil specification. If a non-low ash lubricating oil meeting the American Petroleum Institute (API) performance classification CI-4/SL and/or C.E.S. 20078 is used, the service intervals for the aftertreatment systems will be reduced to 241,000 Kilometers [150,000 Miles] or 5000 hours.
7. Replace the primary (or suction side) fuel filter at every oil change.
8. Replace the secondary (or pressure side) fuel filter at every other oil change.

All low emission' EPA 07, EPA 10, EPA Tier 4 Interim/European Union Stage IIIB 2011(174 -751 hp) engine systems equipped with exhaust aftertreatment **must** operate on ultra-low sulfur diesel (ULSD) with a maximum sulfur content of 15 ppm in the United States and 10 ppm in the European Union. Failure to do so can permanently damage engine and aftertreatment systems within a short period of time. This damage could cause the engine to become inoperable and affect the warranty coverage on the engine system.

Table 1, Oil Drain Intervals

Vehicle or Equipment	Kilometers	Miles	Hours	Months
Truck Crane	14,500	9000	500	6

Cummins Inc. bases its oil drain specifications on duty cycle and oil contamination. This contamination occurs in all engines at varying rates regardless of design.

Maintaining the correct oil and filter change interval is a vital factor in preserving the integrity of an engine. Filters **must** be changed when the oil is changed.

011-060 Aftertreatment Diesel Exhaust Fluid Dosing Unit Filter

General Information

The diesel exhaust fluid dosing unit filter is a 10-micron filter designed to prevent foreign objects, that may be suspended in the diesel exhaust fluid, from entering the dosing system.

Debris can cause permanent damage and premature failure to either the aftertreatment diesel exhaust fluid dosing unit or the aftertreatment diesel exhaust fluid dosing valve. The aftertreatment diesel exhaust fluid dosing unit filter is a maintenance item.

For handling incorrect or contaminated diesel exhaust fluid, contact a Cummins® Authorized Repair Location.

The aftertreatment diesel exhaust fluid dosing unit filter consists of the following components:

1. Aftertreatment Diesel Exhaust Fluid Dosing Unit Filter Cap
2. Aftertreatment Diesel Exhaust Fluid Dosing Unit Filter Equalizing Element
3. Aftertreatment Diesel Exhaust Fluid Dosing Unit Filter Element.

Initial Check

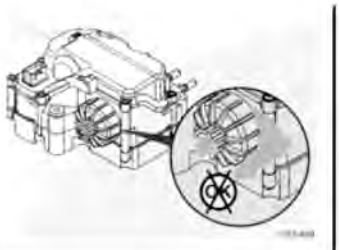
Locate the aftertreatment diesel exhaust fluid dosing unit on the vehicle and notice the dome-shaped filter cap.

NOTE: The location of the aftertreatment diesel exhaust fluid dosing unit varies on vehicles. Locate the diesel exhaust fluid tank and follow the diesel exhaust fluid lines to the the aftertreatment diesel

exhaust fluid unit.

Inspect the area around the seal and vent of theaftertreatment diesel exhaust fluid dosing unit filter cap forsigns of leakage.

Diesel exhaust fluid leaks leave a white deposit. If deposits are found, see the Clean and Inspect for Reuse section in this procedure.



Preparatory Steps

WARNING

Diesel exhaust fluid (diesel exhaust fluid) contains urea . Do not get thesubstance in your eyes. In case of contact, immediatelyflush eyes with large amounts of water for a minimum of15 minutes. Do not swallow. In the event the diesel exhaustfluid is ingested, contact a physician immediately.Reference the Materials Safety Data Sheet (MSDS) foradditional information.

WARNING

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

WARNING

The diesel exhaust fluid line connecting the aftertreatment diesel exhaust fluid dosing unit to the aftertreatment diesel exhaust fluid dosing valve is under low pressure and should not be disconnected while the engine is running or before the system has completed the purge process after engine shutdown.

Disconnecting the diesel exhaust fluid line while under low pressure could cause diesel exhaust fluid to spray.

WARNING

Wear appropriate eye and face protection when using compressed air. Flying debris and dirt can cause personal injury.

NOTE: Do not disconnect the vehicle batteries until the diesel exhaust fluid dosing system has completed the purge cycle. Before beginning to remove and/or disconnect any components, wait at least five minutes after the keyswitch is turned OFF for the aftertreatment diesel exhaust fluid dosing system to purge the diesel exhaust fluid from the system. The purge cycle is an automatic process and does not require intervention to occur. The aftertreatment diesel exhaust fluid dosing unit will create an audible pumping noise during the purging process

NOTE: Do not power wash or steam clean this unit. Use compressed air to remove any loose debris.

- Disconnect the batteries. Refer to the OEM service manual.

Remove

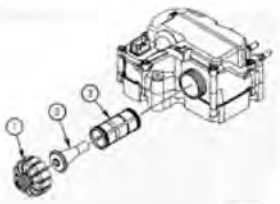
NOTE: There may be residual diesel exhaust fluid in the filter housing. A collection container placed below the diesel exhaust fluid filter cap is recommended.

Unscrew the diesel exhaust fluid filter cap (1).

Remove the aftertreatment diesel exhaust fluid filter equalizing element (2).

Remove the old aftertreatment diesel exhaust fluid dosing unit filter element (3).

NOTE: If removing the aftertreatment diesel exhaust fluid dosing unit filter as part of a maintenance



interval, discard the equalizer element and filter.		

Clean and Inspect for Reuse

Inspect the aftertreatment diesel exhaust fluid dosing unit filter cap for cracks or holes that could create a diesel exhaust fluid leak path. Check the condition of the threads on the aftertreatment diesel exhaust fluid dosing unit cap. If the threads are damaged, replace the aftertreatment diesel exhaust fluid dosing unit filter cap. Inspect the aftertreatment diesel exhaust fluid dosing unit threads. This is especially important if the aftertreatment diesel exhaust fluid dosing unit cap was damaged. If the aftertreatment diesel exhaust fluid dosing unit threads are damaged, replace the entire aftertreatment diesel exhaust fluid dosing unit.		
NOTE: Never operate the vehicle with the diesel exhaust fluid cap removed. Clean the aftertreatment diesel exhaust fluid dosing unit cap with warm water and a clean cloth.		

Install

NOTE: Lubrication of the diesel exhaust fluid filter o-rings is not required.

Slide the diesel exhaust fluid filter equalizing element (2) into the diesel exhaust fluid filter cartridge (3).

Insert the assembly into the aftertreatement diesel exhaust fluid dosing unit.

Install and tighten the cap (1).

Torque Value: 20 n.m [177 in-lb]

Finishing Steps

⚠ WARNING ⚠

Batteries can emit explosive gases. To reduce the possibility of personal injury, always ventilate the compartment before servicing the batteries. To reduce the possibility of arcing, remove the negative (-) battery cable first and attach the negative (-) battery cable last.

NOTE: The aftertreatment diesel exhaust fluid dosing system will not prime until the correct SCR temperatures are reached. To verify that there are no diesel exhaust fluid leaks, test drive the vehicle for a minimum of 15 minutes to get the SCR system up to temperature.

- Connect the batteries. Refer to the OEM service manual.
- Operate the engine and check for leaks.

Last Modified: 17-Nov-2009

Engine Indicator Lamps

101-048 Engine Indicator Lamps

General Information

The following engine indicator lamps cover **only** the lamps controlled by the engine ECM. The equipment manufacturer can provide additional indicator lamps. Please refer to the equipment owners manual for additional lamp information.

Wait to Start Lamp

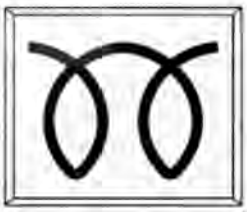
The WAIT TO START lamp illuminates when the intake air heater needs to warm the intake air prior to starting the engine.

The WAIT TO START lamp on time will vary, depending on the ambient air temperature. See Normal Starting Procedure in Section 1. Refer to Procedure 101-014 in Section 1.

For vehicles equipped with an engine starting motor protection feature, another function of the WAIT TO START lamp is to flash for two minutes if the starting motor is engaged for 30 seconds or more.

The WAIT TO START lamp can look like:

- The words WAIT TO START spelled out
- A symbol similar to the graphic illustrated
- The color of the symbol or words can vary, based on the manufacturer of the vehicle, but will typically be red or amber.



Check Engine Lamp

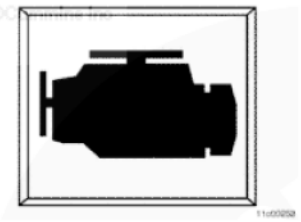
The CHECK ENGINE lamp illuminates when the engine needs to be serviced at the first available opportunity.

The CHECK ENGINE lamp is amber, and can look like:

- The words WARNING or CHECK ENGINE spelled out
- A symbol of an engine, similar to the graphic illustrated.

Another function of the CHECK ENGINE lamp is to flash for 30 seconds at key ON when one of the following occurs. This flashing function is referred to as the MAINTENANCE lamp. The MAINTENANCE lamp could flash for any of the following reasons:

- Maintenance required (if the Maintenance Monitor is enabled)
- Water-in-fuel is detected
- Coolant level is low.



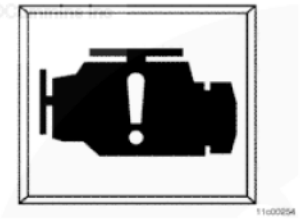
Stop Engine Lamp

The STOP ENGINE lamp indicates, when illuminated, the need to stop the engine as soon as it can be safely done. The engine **must** remain shut down until the engine can be repaired.

For engines with the Engine Protection Shutdown feature enabled, if the STOP ENGINE lamp begins to flash, the engine will automatically shut down after 30 seconds. The flashing STOP engine lamp alerts the operator to the impending shutdown.

The STOP ENGINE lamp is red in color, and can look like:

- The words STOP or STOP ENGINE spelled out
- A symbol of an engine with an exclamation point in the center, similar to the graphic illustrated.

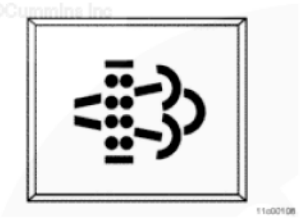


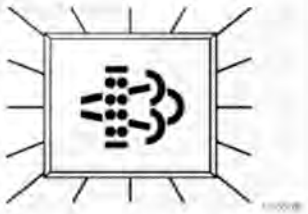
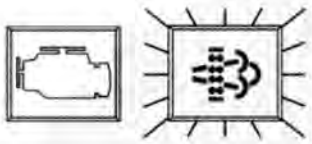
Aftertreatment Diesel Particulate Filter Lamp

The AFTERTREATMENT DIESEL PARTICULATE FILTER lamp indicates, when illuminated or flashing, that the aftertreatment diesel particulate filter requires regeneration.

An illuminated AFTERTREATMENT DIESEL PARTICULATE FILTER lamp indicates that the aftertreatment diesel particulate filter needs to be regenerated at the next changing opportunity. This can be accomplished by:

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



2. Performing a stationary regeneration. Follow the instructions in Unique Operating Characteristics of an Engine with Aftertreatment, in Section 1. **NOTE: Stationary regeneration is considered a normal maintenance practice and is not covered by Cummins Inc. warranty.**		
A flashing AFTERTREATMENT DIESEL PARTICULATE FILTER lamp indicates that the aftertreatment diesel particulate filter needs to be regenerated at the next possible opportunity. Engine power may be reduced automatically. When this lamp is flashing, the operator should: 1. Change to a more challenging duty cycle, such as highway driving, for at least 20 minutes 2. Performing a stationary regeneration. Follow the instructions in Unique Operating Characteristics of an Engine with Aftertreatment, in Section 1.		
A flashing AFTERTREATMENT DIESEL PARTICULATE FILTER lamp combined with an illuminated WARNING or CHECK ENGINE lamp indicates that the aftertreatment diesel particulate filter needs be regenerated immediately. Engine power will be reduced automatically. When these lamps are illuminated, a stationary regeneration is required. Follow the instructions in Unique Operating Characteristics of an Engine with Aftertreatment, in Section 1. **NOTE: If a stationary regeneration is not performed, the STOP ENGINE lamp will illuminate and the vehicle will need to be taken to a Cummins® Authorized Repair Location.**		

High Exhaust System Temperature Lamp

The HIGH EXHAUST SYSTEM TEMPERATURE lamp indicates, when illuminated, that exhaust temperatures are high due to regeneration of the aftertreatment diesel particulate filter. The lamp could illuminate during normal engine operation or during regeneration. **NOTE: The OEM determines whether or not the HIGH EXHAUST SYSTEM TEMPERATURE lamp is installed on the vehicle. The OEM also specifies the temperatures, vehicle speeds, and other conditions at**		

which the lamp illuminates. Refer to the OEM service manual for additional information regarding this lamp.

When this lamp is illuminated, be sure the exhaust pipe outlet is **not** directed at any surface or material that can melt, burn, or explode.

⚠ WARNING ⚠

When this lamp is illuminated, the exhaust gas temperature could reach 800°C [1500°F], which is hot enough to ignite or melt common materials, and to burn people.

- Keep the exhaust outlet away from people and anything that can burn, melt, or explode.
- Nothing within 0.6 m [2 ft] of the exhaust outlet.
- Nothing that can burn, melt, or explode within 1.5 m [5 ft] (such as gasoline, wood, paper, plastics, fabric, compressed gas containers, or hydraulic lines).
- In an emergency, turn the engine off to stop the flow of exhaust.

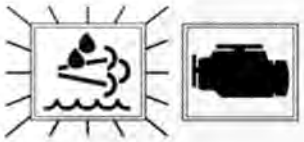
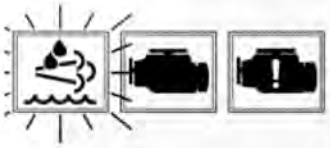
NOTE: The HIGH EXHAUST SYSTEM TEMPERATURE lamp does not signify the need for any kind of vehicle or engine service; It merely alerts the vehicle operator to high exhaust temperatures. It will be common for the HIGH EXHAUST SYSTEM TEMPERATURE lamp to illuminate on and off during normal vehicle operation as the engine completes regeneration.

Aftertreatment Diesel Exhaust Fluid Lamp

The AFTERTREATMENT DIESEL EXHAUST FLUID lamp indicates, when illuminated or flashing, that the diesel exhaust fluid level is low.

An illuminated AFTERTREATMENT DIESEL EXHAUST FLUID lamp indicates that the diesel exhaust fluid level has fallen below the initial warning level.This can be corrected by filling the diesel exhaust fluid tank with diesel exhaust fluid.

NOTE: It is recommended that the diesel exhaust fluid tank be filled completely full of diesel exhaust fluid in order to correct any fault conditions.

A flashing AFTERTREATMENT DIESEL EXHAUST FLUID lamp indicates that the diesel exhaust fluid level has fallen below the critical warning level. This can be corrected by filling the diesel exhaust fluid tank with diesel exhaust fluid. **NOTE: It is recommended that the diesel exhaust fluid tank be filled completely full of diesel exhaust fluid in order to correct any fault conditions.**	
A flashing AFTERTREATMENT DIESEL EXHAUST FLUID lamp combined with an illuminated WARNING or CHECK ENGINE lamp indicates that the diesel exhaust fluid level has fallen below the initial derate level. The engine power will be limited automatically. This can be corrected by filling the diesel exhaust fluid tank with diesel exhaust fluid. **NOTE: It is recommended that the diesel exhaust fluid tank be filled completely full of diesel exhaust fluid in order to correct any fault conditions.**	
If the engine has been shut down or has idled for 20 hours after the diesel exhaust fluid tank has been emptied, the STOP ENGINE lamp will also be illuminated along with the flashing AFTERTREATMENT DIESEL EXHAUST FLUID lamp and illuminated CHECK ENGINE lamp. The engine power will continue to be limited automatically. The vehicle speed will also be limited to 5 mph. **NOTE: In order to remove the 5 mph speed limit, the diesel exhaust fluid tank must be filled to at least 10 percent volume of the tank.** **NOTE: It is recommended that the diesel exhaust fluid tank be filled completely full of diesel exhaust fluid in order to correct any fault conditions.**	

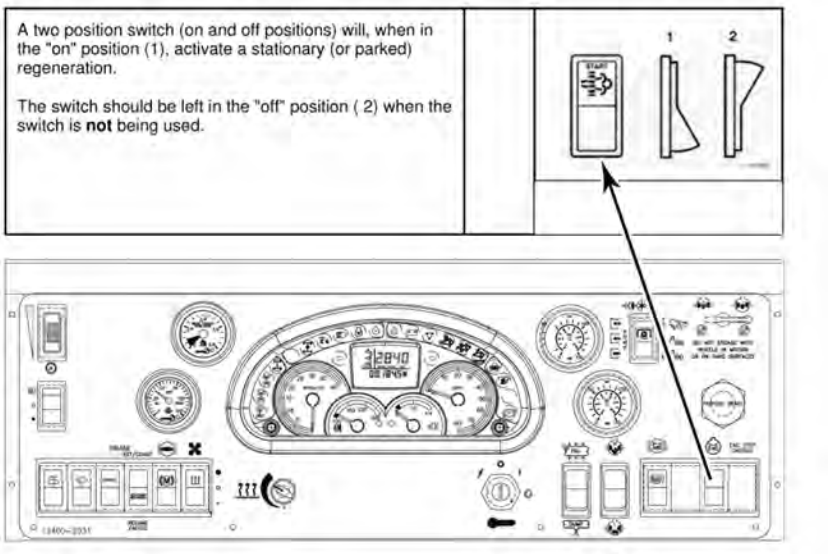
Last Modified: 22-Jul-2010

TEREX®

TEREX DEF LEVEL DRIVER NOTIFICATION AND INDUCEMENT SOFTWARE SETTINGS		NOTES
100%	= DEF tank full	
10%	= DEF tank low	DEF lamp will come on
5%	= DEF tank warning	DEF lamp will begin to flash
2.50%	= DEF tank derate	DEF lamp flashing, engine warning lamp flashing, engine power derate
0%	= DEF tank empty	DEF lamp flashing, engine stop lamp flashing, engine power derate, vehicle speed restricted to 5mph

Aftertreatment Switch

The stationary (parked) regeneration switch used to initiate regeneration with the aftertreatment system.

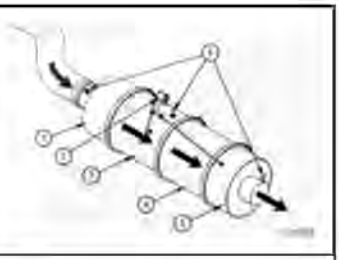


101-047 Unique Operating Characteristics of an Engine with Aftertreatment Diesel Particulate Filter

General Information

The aftertreatment system is used to reduce particulate emissions, and is composed of six main components:

- Aftertreatment inlet
- Aftertreatment diesel particulate filter differential pressure sensor
- Aftertreatment diesel oxidation catalyst
- Aftertreatment diesel particulate filter
- Aftertreatment outlet
- Aftertreatment exhaust gas temperature sensors.



The components of the aftertreatment system perform the following functions:

The aftertreatment inlet and outlet adapt the vehicle exhaust piping to the aftertreatment system, and also provide a mounting location for the aftertreatment gas temperature sensors.

The aftertreatment diesel particulate filter differential pressure sensor measures the restriction across the aftertreatment diesel particulate filter.

The aftertreatment diesel particulate filter captures the soot and ash from the engine exhaust

The aftertreatment diesel oxidation catalyst is used to oxidize fuel in the exhaust in order to create heat for the regeneration process.

The aftertreatment exhaust gas temperature sensors are used to measure the exhaust gas temperatures at various points in the aftertreatment system.

Soot is composed of the partially burned particles of fuel that occur during normal engine operation (black smoke).

Ash is composed of the partially burned particles of engine oil that occur during normal engine operation.

Over time, both soot and ash accumulate in the aftertreatment diesel particulate filter and **must** be removed. Soot is removed by a process called regeneration. Ash is removed by removing the aftertreatment diesel particulate filter and cleaning it at specified intervals.

A vehicle with an aftertreatment system has up to two additional indicator lamps on the dashboard. The two additional lamps, along with the check engine lamp, alert the operator of the status of the aftertreatment diesel particulate filter.

NOTE: See Section 1 of the Owner's Manual or the Operation and Maintenance Manual of the

engine being serviced for additional information on the engine indicator lamps.

Ultra low sulfur diesel fuel is required for an engine equipped with an aftertreatment diesel particulate filter. If ultra low sulfur diesel is **not** used, the engine might **not** meet emissions regulations, and the aftertreatment diesel particulate filter or aftertreatment diesel oxidation catalyst can be damaged.

To maximize the maintenance intervals of the aftertreatment diesel particulate filter, Cummins Inc. recommends the use of a lubricating engine oil meeting Cummins Engineering Standard 20081. The use of oil meeting CES 20081 also requires the use of ultra low sulfur diesel fuel to maintain the specified oil drain interval without risk of engine damage.

NOTE: See Section V of the Owner's or Operation and Maintenance Manual of the engine being serviced for details on the recommended oil and fuel.

NOTE: See Section 2 of the Owner's or Operation and Maintenance Manual of the engine being serviced for Maintenance Schedule, which provides the aftertreatment diesel particulate filter cleaning intervals.

Regeneration

Regeneration is the process of converting the soot collected in the aftertreatment diesel particulate filter into carbon dioxide.

The regeneration process requires heat to occur, and can be classified into two different types: passive regeneration and active regeneration.

Passive Regeneration

Passive regeneration occurs when the exhaust temperatures are naturally high enough to oxidize the soot collected in the aftertreatment diesel particulate filter faster than the soot is collected.

Passive regeneration typically occurs when the vehicle is driven at high speeds (ie, highway speeds) and/or under heavy loads.

Active Regeneration

Active regeneration occurs when the exhaust temperatures are **not** naturally high enough to oxidize the soot collected in the aftertreatment diesel particulate filter faster than it is collected.

Active regeneration requires assistance from the engine in order to increase the exhaust temperature. This is typically accomplished by the engine injecting a small amount of diesel fuel into the exhaust stream, which is then oxidized by the aftertreatment diesel oxidation catalyst, which creates the heat needed to regenerate the aftertreatment diesel particulate filter.

Active regeneration will occur more frequently in vehicles with low speed, low load, or stop and go duty cycles

Active regeneration only occurs if the engine ECM has detected that the aftertreatment diesel particulate filter restriction has reached a specified limit, and may only occur if the vehicle is moving

above a speed threshold. The engine ECM will activate and de-activate active regeneration as needed.

The speed threshold for active regeneration to occur is dictated by the vehicle manufacturer, and can be set at vehicle speeds from 5 MPH to 25 MPH.

For all ISX engines, and ISM non-transit bus applications, active regeneration can occur at any time the vehicle speed is above the speed threshold.

For ISM transit bus applications, the vehicle speed must reach 40 MPH for active regeneration to begin, regardless of the set speed. The active regeneration event will then continue until the vehicle speed drops below the speed threshold.

Refer to the vehicle owner's manual for information for the speed threshold for active regeneration used for a specific vehicle.

Active regeneration is largely transparent to the vehicle operator. The vehicle operator may notice an increase in turbocharger noise during an active regeneration event, and may notice that the high exhaust temperature lamp is illuminated, if the vehicle is so equipped.

During active regeneration, the exhaust temperature can be hotter than when the engine is operating at full load. The exhaust temperature during a normal active regeneration event could reach 1100°F, and possibly 1500°F under certain conditions.

NOTE: See Section 1 of the Owner's Manual or the Operation and Maintenance Manual of the engine being service for additional information on the engine indicator lamps.

⚠ WARNING ⚠

If the vehicle is not equipped with a High Exhaust System Temperature Lamp, follow these precautions for active regeneration whenever the vehicle is running and the vehicle slows or comes to a stop. Active regeneration can occur any time the vehicle is moving, and the exhaust temperature can remain hot after the vehicle has stopped moving. The exhaust temperature could reach 1500°F, which hot enough to ignite or melt common materials, or to burn people.

Stationary (Parked) Regeneration

Under some operating conditions, such as low speed, low load, or stop and go duty cycles, the engine may **not** have enough opportunity to regenerate the aftertreatment diesel particulate filter during normal vehicle operation. When this occurs, the engine will illuminate the aftertreatment diesel particulate filter lamp to inform the vehicle operator that assistance is required, typically in the form of a stationary (parked) regeneration.

Stationary (parked) regeneration is a form of active regeneration that is initiated by the vehicle operator when the vehicle is **not** moving.

Stationary (parked) regeneration requires an elevated engine speed of approximately 1000 to 1400 RPM. The length of a stationary (parked) regeneration will vary depending on how full the aftertreatment diesel particulate filter is, but will typically take anywhere from 45 minutes to 1.5 hours to complete.

A stationary (parked) regeneration can be initiated one of two ways:

- A vehicle mounted stationary (parked) regeneration switch. Refer to the vehicle owners manual for the location and operation of this switch, if so equipped (this switch may also be called a "parked

regeneration" switch or "start" switch). The vehicle mounted stationary (parked) regeneration switch will only initiate a stationary (parked) regeneration when the aftertreatment diesel particulate filter lamp is illuminated.
- The INSITE™ electronic service tool can initiate a stationary (parked) regeneration by starting the "Aftertreatment Diesel Particulate Filter Regeneration Test".

⚠ WARNING ⚠

During regeneration, exhaust gas temperature could reach 1500°F, and exhaust system surface temperature could exceed 1300°F, which is hot enough to ignite or melt common materials, and to burn people. Engine speed will increase and could possibly reach between 1000 to 1500 RPM. Follow these instructions to avoid the risk of fire, property damage, burns, or other serious personal injury.

To perform a stationary (parked) regeneration, follow the steps listed:

- Select an appropriate location to park the vehicle.
  - Preferably on a surface that will **not** burn or melt under high exhaust temperatures (such as clean concrete or gravel, **not** grass or asphalt).
- Park the vehicle away from anything that can burn, melt or explode.
  - Ensure there are no items within 2 feet of the exhaust outlet.
  - Items that can burn, melt or explode **must** be kept at least 5 feet from the exhaust outlet (such as gasoline, paper, plastics, fabrics, compressed gas containers, hydraulic lines).
  - Ensure that there are no gases or vapors nearby that could burn, explode or contribute to a fire (such as LP gas, gasoline vapors, oxygen, nitrous oxide).
- Park the vehicle securely. Place the transmission in park, if provided, otherwise in neutral. Set wheel chocks at front and rear of at least one tire.
- Set up a safe exhaust area. If bystanders might enter the area, set up barriers to keep people at least 5 ft from the exhaust outlet during the stationary (parked) regeneration. When indoors, attach an exhaust discharge pipe rated for at least 1500°F.
- Keep a fire extinguisher nearby.
- Check the exhaust system surfaces. Confirm that nothing is on or near the exhaust system surfaces (such as tools, rags, grease, or debris).
- Verify the following conditions are met in the vehicle:
  - The clutch pedal is released.
  - The brake pedal is released.
  - The transmission is in neutral or park.
  - PTO or Remote PTO is off.
  - The vehicle speed is 0 MPH.
  - The throttle pedal is released.
- Initiate the stationary (parked) regeneration by toggling the vehicle mounted stationary (parked) regeneration switch or by using the INSITE™ electronic service tool.
  - Once the stationary (parked) regeneration is initiated, the engine speed will increase, and turbocharger noise will increase.
  - The High Exhaust System Temperature Lamp (if equipped) may illuminate during the stationary (parked) regeneration as the exhaust temperatures increase.
  - When the engine ECM detects that the aftertreatment diesel particulate filter has been regenerated, the engine will automatically return to normal idle speed.
- Monitor the vehicle and surrounding area during the stationary (parked) regeneration. If any unsafe condition occurs, shut off the engine immediately.

To stop a stationary (parked) regeneration before it has completed, depress the clutch, brake, or throttle pedal, or turn off the engine.

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

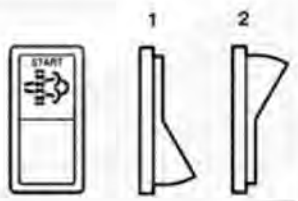
NOTE: If a stationary (parked) regeneration is attempted, and the engine speed does not increase, contact a Cummins authorized repair facility for assistance.

Aftertreatment Switches

- A stationary (parked) regeneration switch (can also be called a "start" switch or "parked regeneration" switch).
- The stationary (parked) regeneration switch is used to initiate a stationary (or parked) regeneration.
- A two position switch that is used to activate stationary (parked) regeneration.

A two position switch (on and off positions) will, when in the "on" position (1), activate a stationary (or parked) regeneration.

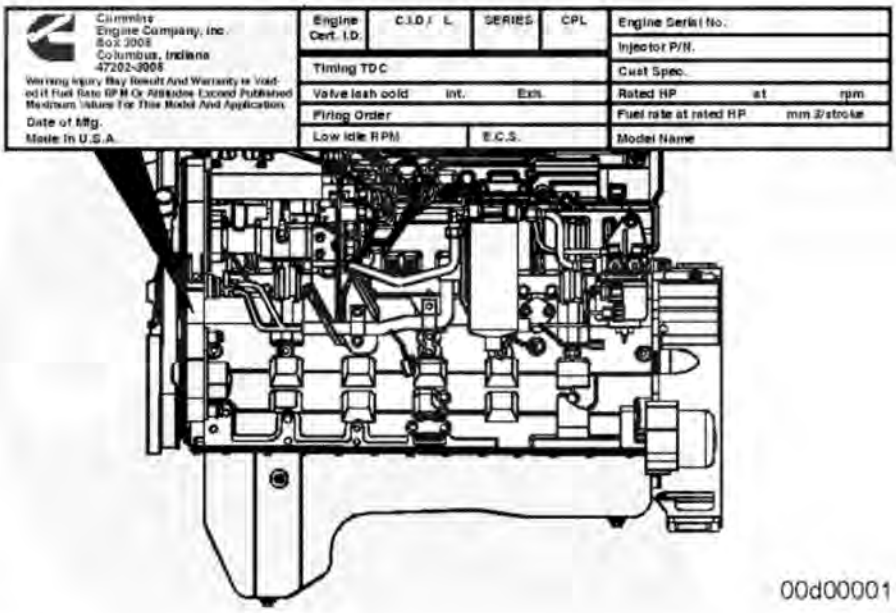
The switch should be left in the "off" position (2) when the switch is **not** being used.



Engine Indentification

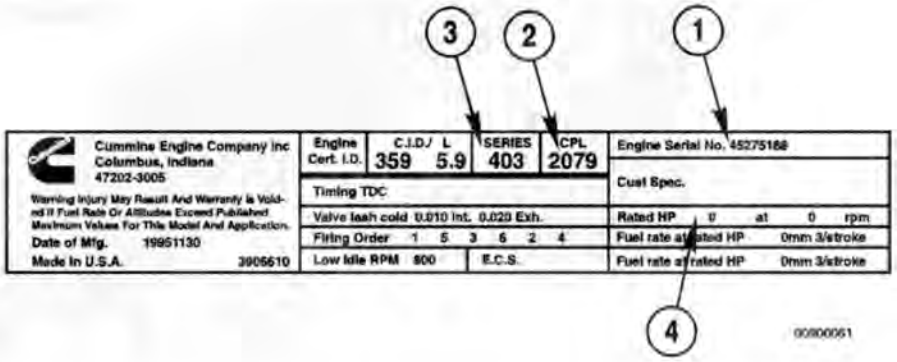
100-001 Engine Identification

Engine Dataplate



The engine dataplate provides important facts about the engine. The engine serial number (ESN) and control parts list (CPL) provide information for service and ordering parts. The engine dataplate **must not** be changed unless approved by Cummins Inc.

The engine dataplate **must not** be changed unless approved by Cummins Inc. Have the following engine data available when communicating with a Cummins® Authorized Repair Location. The information on the dataplate is **mandatory** when sourcing service parts.

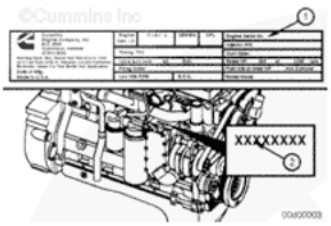


The dataplate is located on the top side of the gear housing.

Have the following engine data available when communicating with a Cummins® Authorized Repair Location:

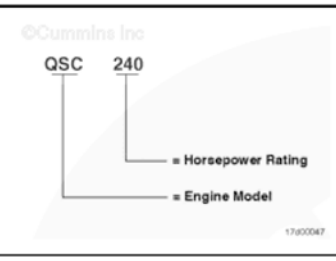
1. Engine serial number (ESN)
2. Control parts list (CPL)
3. Model
4. Horsepower and rpm rating.

If the engine dataplate (1) is **not** legible, the engine serial number (ESN) (2) can be found on the engine block on top of the lubricating oil cooler housing. Additional engine information is on the ECM dataplate.



Cummins® Engine Nomenclature

The Cummins® engine nomenclature provides the engine model and horsepower rating.

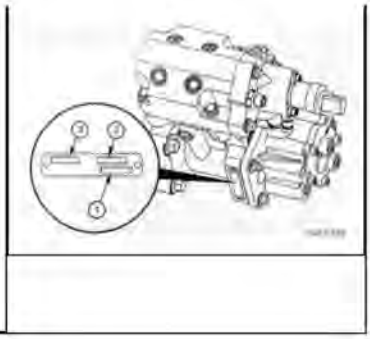


Fuel Pump Dataplate

The fuel pump dataplate is located on the side of the

high-pressure pump. The dataplate contains the following information:

1. Cummins® part number
2. Pump serial number
3. Factory code.

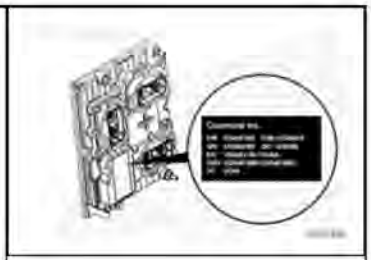


ECM Dataplate

The ECM dataplate is located on the front of the ECM.

The following information is found on the ECM dataplate:

- ECM part number (PN)
- ECM serial number (SN)
- ECM date code (DC)
- Engine serial number (ESN)
- ECM code (identifies the software in the ECM).

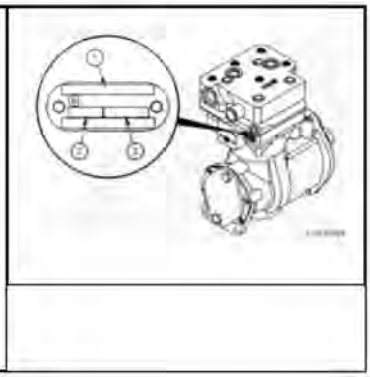


Air Compressor

The Cummins Inc branded air compressor dataplate, identified by the Cummins Inc. logo on the dataplate, is typically located on the rear side of the air compressor. The dataplate contains the following information that assists in service or replacement.

NOTE: Not all engines are equipped with an air compressor.

1. Cummins® part number
2. Date code
3. Serial number.



Variable Geometry Turbocharger

The Holset® variable geometry turbocharger (VGT) dataplate is located on the turbocharger inlet compressor housing. The dataplate contains the following information which will assist in service or replacement.

- Cummins® assembly part number
- Serial number
- Customer number
- Model number.

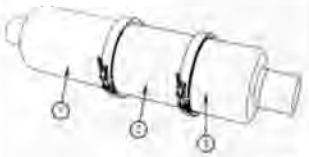
NOTE: The electronic actuator on the VGT is a serviceable component and has a separate dataplate that assists in service or replacement.

Exhaust System

The diesel particulate aftertreatment assembly has important information for service and replacement stamped into the canister.

There are three important stamping locations on the aftertreatment assembly:

1. Aftertreatment diesel oxidation inlet/catalyst part number and serial number. Located on the inlet/catalyst section
2. Aftertreatment diesel particulate filter part number and serial number. Located on the filter section.
3. Aftertreatment assembly outlet section part number. Located on the outlet of the aftertreatment system.

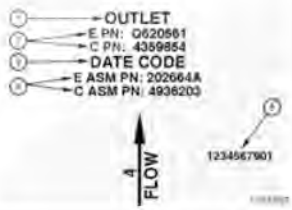


A typical aftertreatment information stamping can provide the following:

1. Section name
2. Part number

3. Date code
4. Assembly number (**only** located on the outlet section)
5. Serial number.

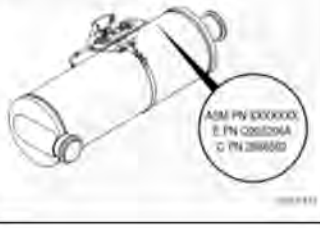
NOTE: Some aftertreatment components could possibly only have the Cummins® Emission Solution (CES) part number. for cross referencing and part number identification, reference to QuickServe™ Online.



Dosing Control Unit Dataplate

The aftertreatment SCR catalyst identification is located on the side of the part and contains the following information to assist in service or replacement:

- Assembly part number
- Cummins Emission Solutions™ (CES) part number
- Cummins® part number.



The aftertreatment decomposition tube identification is located on the side of the part and contains the following information to assist in service or replacement:

- Cummins Emission Solutions™ (CES) part number
- Cummins® part number.

The aftertreament DEF dosing valve identification is located on the side of the part and contains the following information to assist in service or replacement:

- Cummins® part number
- Cummins Emission Solutions™ (CES) part number

- Bosch™ part number
- Bosch™ production data (date code and serial number).

Example:

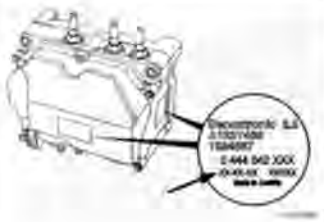
- 2866485 is the Cummins® part number
- 12345-67890-12345 is the Cummins Emission Solutions™ (CES) part number
- B 444 606 XXX is the Bosch™ part number
- XXXXX is the date code
- XXX is the serial number.

The aftertreament DEF dosing unit identification is located on the side of the part and contains the following information to assist in servicing or replacement:

- Cummins Emission Solutions™ (CES) part number
- Cummins® part number
- Bosch™ part number
- Bosch™ production data (date code and serial number).

Example:

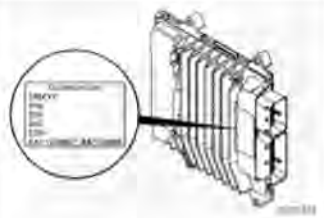
- A123Y456 is the Cummins Emission Solutions™ (CES) part number
- 123456 is the Cummins® part number
- 0 444 042 XXX is the Bosch™ part number
- XXXXX is the date code
- XXX is the serial number.



The aftertreatment DEF controller dataplate is located on the side of the part and contains the following information to assist the service or replacement:

Example

- A030F523 is the Cummins Emission Solutions™ (CES) part number
- 2888101 is the Cummins® part number
- 1375 0283 is the serial number
- 0281020 150 is the Bosch™ part number
- 10-2-13 is the Day Code.



Last Modified: 30-Jul-2010

Diesel Exhaust Fluid Specification

018-026 Diesel Exhaust Fluid Recommendations and Specifications

General Information

⚠ WARNING ⚠

It is unlawful to tamper with or remove any component of the aftertreatment system. It is also unlawful to use a Diesel Exhaust Fluid (DEF) that does not meet the specifications provided or to operate the vehicle/equipment with no Diesel Exhaust Fluid (DEF).

⚠ WARNING ⚠

Diesel Exhaust Fluid (DEF) contains urea. Do not get the substance in your eyes. In case of contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Do not swallow internally. In the event the diesel exhaust fluid is ingested, contact a physician immediately. Reference the Materials Safety Data Sheet (MSDS) for additional information.

△ CAUTION △

Never attempt to create Diesel Exhaust Fluid by mixing agricultural grade urea with water. Agricultural grade urea does not meet the necessary specifications required and the aftertreatment system may be damaged.

Cummins Inc. requires the use of Diesel Exhaust Fluid meeting ISO 22241-1. There is NO acceptable substitute.

NOTE: Some locations may reference the DIN 70070 standard. Diesel Exhaust Fluid specification limits of this standard are identical to ISO 22241-1.

Cummins Inc. is not responsible for failures or damage resulting from what Cummins Inc. determines to be abuse or neglect, including but not limited to: operation without correctly specified Diesel Exhaust Fluid; lack of maintenance of aftertreatment; improper storage, or shutdown practices; unauthorized modifications of the engine and aftertreatment. Cummins is also not responsible for failures caused by incorrect Diesel Exhaust Fluid or by water, dirt or other contaminants in the Diesel Exhaust Fluid

For further details and discussion of Diesel Exhaust Fluid (DEF) for Cummins® engines. Refer to the Diesel Exhaust Fluid Specifications for Cummins® Selective Catalytic Reduction Systems, Service Bulletin Number 4021566.

For engines using SCR operating in the United States and Canada, it is also strongly recommended that the Diesel Exhaust Fluid (DEF) used be certified by the		

American Petroleum Institute (API). This would be indicated by a symbol on the container/dispensing system as shown.		API AMERICAN PETROLEUM INSTITUTE CERTIFIED DIESEL EXHAUST FLUID
To ensure the correct Diesel Exhaust Fluid (DEF) is used, Cummins Inc. recommends the use of Fleetguard® Diesel Exhaust Fluid. Fleetguard® carries different quantity options from small to bulk containers. For customers located in the United States and Canada, for assistance locating Diesel Exhaust Fluid (DEF), contact the Cummins Customer Assistance Center: 1-800 DIESELS (1-800-343-7357). For customers outside of the United States and Canada, contact you local Cummins authorized repair location for assistance in locating Diesel Exhaust Fluid (DEF).		

The following are other common names used for Diesel Exhaust Fluid (DEF):

- Urea
- AUS 32 (Aqueous Urea Solution 32)
- AdBlue
- NOx Reduction Agent
- Catalyst Solution
- DEF

Regardless of what the Diesel Exhaust Fluid is called, the Diesel Exhaust Fluid must meet the specifications as outlined in the General Information section of this procedure.

Storage

NOTE: The following information is for reference and is to be used as a guideline only. There are many factors that determine Diesel Exhaust Fluid (DEF) shelf life, with temperature and duration being two of the major determining contributors. If in doubt, check the concentration of the Diesel Exhaust Fluid (DEF), refer to the Test step of this procedure, or replace the fluid with known quality Diesel Exhaust Fluid.

Diesel Exhaust Fluid has a limited shelf life, both in the vehicle's diesel exhaust fluid tank and in

storage/bulk/transportation containers.

The following conditions are ideal for maintaining DEF quality and shelf life during prolonged transportation and storage:

- Storage temperature between 23 °F and 77 °F (-5 °C and 25 °C)
- Store in sealed containers to avoid contamination
- Avoid direct sunlight

In these conditions, DEF has a minimum expected shelf life of 18 months. If stored at higher temperatures for extended periods of time, the shelf life will be reduced by approximately 6 months for every 5 °C [9 °F] above the highest storage temperature listed above.

Long term storage in a vehicle (in excess of 6 months) is not recommended. If long term storage is necessary, periodic testing of the Diesel Exhaust Fluid is recommended to be performed to ensure the concentration does not fall out of specification. Follow the Test step of this procedure.

NOTE: To assist in preventing Diesel Exhaust Fluid from deteriorating when stored in the vehicles DEF tank, locate and plug the tanks venting to seal the tank exposure to the atmosphere.

Handling

Diesel Exhaust Fluid is not harmful to handle, but can be corrosive to certain materials over time. Such as carbon steels, iron, zinc, nickel, copper, aluminum and magnesium.

- Make sure to only use approved containers to transport and store Diesel Exhaust Fluid. Containers made of polyethylene and polypropylene are recommended.
- If Diesel Exhaust Fluid is spilled, rinse and clean immediately with water.
- Avoid prolonged contact with skin. In case of contact, wash with immediately with soap and water. If not washed immediately, when the diesel exhaust fluid dries, a white film will be left that can be more difficult to wash off.

NOTE: Spilled Diesel Exhaust Fluid if left to dry or wiped away with a cloth only will leave a white residue. Failure to clean the spilled Diesel Exhaust Fluid may result in an incorrectly diagnosed leak of the Diesel Exhaust Fluid Dosing system.

Before using containers, funnels, etc. that will be used to dispense, handle or store Diesel Exhaust Fluid, make sure to wash thoroughly to remove any contaminants and then rinse with distilled water.

NOTE: Do not use tap water to rinse components that will be used to deliver diesel exhaust fluid. Tap water will contaminate the Diesel Exhaust Fluid. If distilled water is not available, rinse with tap water and then rinse with Diesel Exhaust Fluid.

Disposal

If disposing of Diesel Exhaust Fluid (DEF), always check with the local authority regulations on proper disposing process and requirements.

Test

Having the correct concentration of Diesel Exhaust Fluid is critical to the engine and aftertreatment system performing correctly.

To test the concentration of the Diesel Exhaust Fluid, use the Cummins Diesel Exhaust Fluid Refractometer, service tool part number 4919554. Follow the instructions provided with the service tool.

Percent Urea Concentration: 32.5 +/- 1.5%

The specification listed above takes into consideration the refractometer tool tolerances, varibility, and calibration when measuring Diesel Exhaust Fluid concentration.

If the Diesel Exhaust Fluid concentration is found to be outside of this specification, drain the Diesel Exhaust Fluid tank, flush with distilled water and fill with new and/or known good Diesel Exhaust Fluid. Recheck the Diesel Exhaust Fluid concentration.

Concentration of the Diesel Exhaust Fluid should be checked when:

- The vehicle has been stored for an extended period of time.
- It is suspected that water has been added to the Diesel Exhaust Fluid tank

Contamination/Incorrect Fluid

CAUTION

Never add water or any other fluid besides what is specified to the Diesel Exhaust Fluid (DEF) tank. The aftertreatment system may be damaged.

In the event that the incorrect fluid is added to the Diesel Exhaust Fluid tank, such as, but not limited to:

- Water
- Diesel Fuel
- Hydraulic Fluid
- Coolant
- Windshield Washer Fluid

Contact a local Cummins Authorized Repair location to determine the appropriate repair direction.

If only water has been added to the Diesel Exhaust Fluid (DEF) tank, drain the Diesel Exhaust Fluid (DEF) tank, flush with distilled water and refill with new and/or known good Diesel Exhaust Fluid (DEF). Check the Diesel Exhaust Fluid (DEF) concentration after completing the refill, follow to the Test step of this procedure.

Freezing

CAUTION

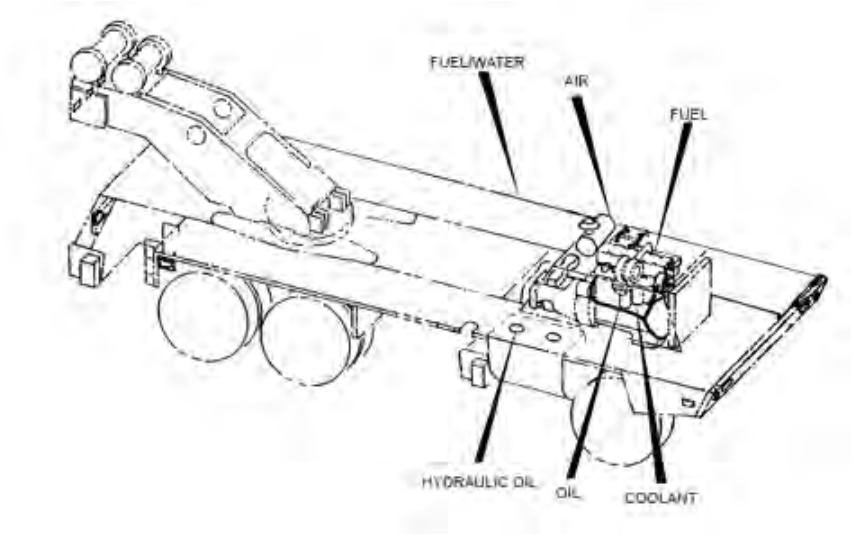
Do **NOT** add any chemicals/additives to the Diesel Exhaust Fluid in an effort to prevent freezing. If chemicals/additives are added to the Diesel Exhaust Fluid, the aftertreatment system may be damaged.

Diesel Exhaust Fluid will freeze around -11°C [12°F]. The diesel exhaust fluid system on the vehicle is designed to accommodate this and does not require any intervention by the vehicle operator.

The Operating the Engine (101-015) procedure in Section 1 of the Owners and Operation and Maintenance Manual will provide information on proper cold weather set up for your engine/vehicle.

Last Modified: 01-Jul-2010

Filter Specification



FILTER SERVICE NO.S - CUMMINS ENGINES						
CRANE MODEL	TRANSMISSION TYPE	OIL	FUEL (Primary)	FUEL (Secondary Suction Side)	CRANKCASE BREATHER	AFTERTREATMENT DEF DOSING UNIT
T340-2013	MANUAL	218027	219903	219902	222678	222679
T340-2013	AUTO	218027	219903	219902	222678	222679
T340-2013 ROW	MANUAL	222644	222645	222646	222647	222648
T560-2013	MANUAL	222680	222681	NA	222682	222679
T560-2013	AUTO	222680	222681	NA	222682	222679
T780-2013	MANUAL	222680	222681	NA	222682	222679
T780-2013	AUTO	222680	222681	NA	222682	222679

NOTE: *ROW = Rest of World (Export only)*

2013 = EPA 2013 Automotive

2013 ROW = EPA Tier 3 Industrial - Export / Military Only

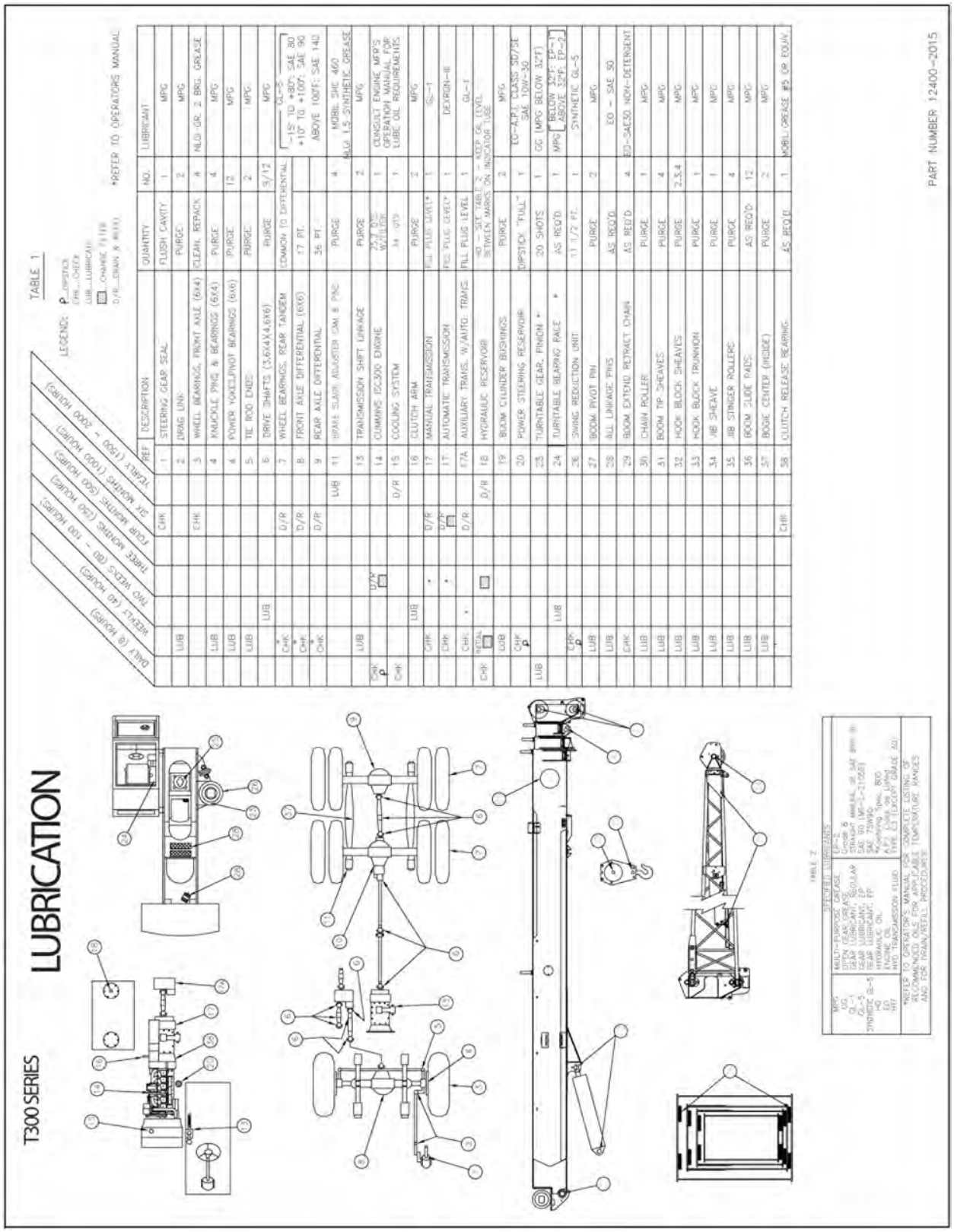
FILTER SERVICE NO.S - DETROIT DIESEL EPA07 SERIES 60 ENGINE DOMESTIC & EXPORT						
CRANE MODEL	TRANSMISSION TYPE	OIL	FUEL (Primary)	FUEL (Secondary Suction Side)	CRANKCASE BREATHER	FILTER KIT (Includes Fuel, Oil, Air, Trans)
T560-Pre-2010	MANUAL	218624	219949	219317	NA	216699
T560-Pre-2010	AUTO 219905 (Oil Filter)	218624	219949	219317	NA	216699
T780-Pre-2010	MANUAL	218624	219949	219317	NA	216699
T780-Pre-2010	AUTO	218624	219949	219317	NA	216699

NOTE: *A. Change air cleaner element according to restriction indicator - check restriction indicator min 250 hrs or 3 months.*

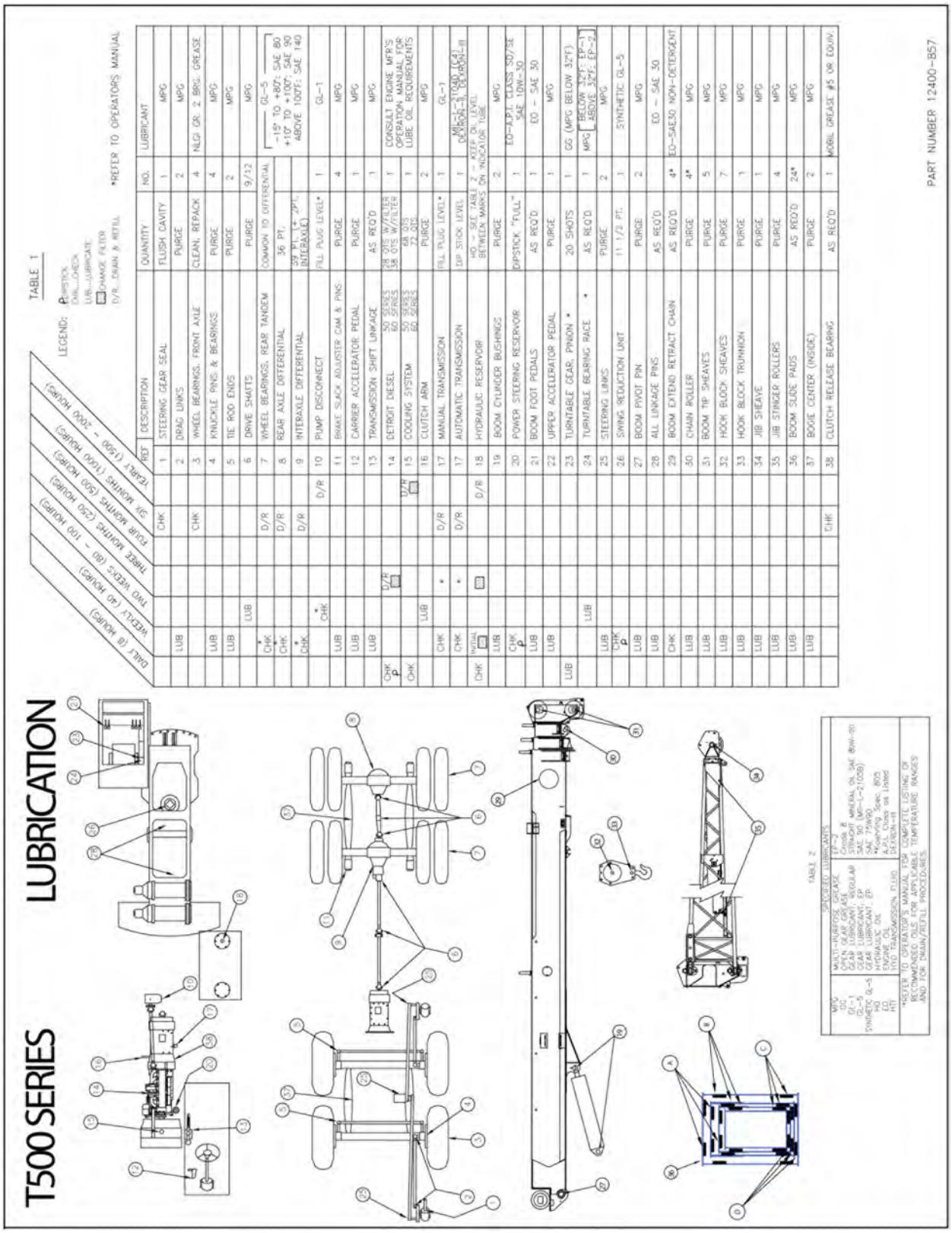
B. Correct coolant filter pn# is determined by testing coolant at maintenance interval. See Maintenance section of manual.

TEREX

Lubrication Charts



T300-1_T500-1_T780
Maintenance



TEREX

T700 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	CHK	LUB	D/R	NO.	LUBRICANT
							1	STEERING GEAR SEAL	FLUSH CAVITY		LUB		1	MPG
							2	DRAG LINKS	PURGE		LUB		2	MPG
							3	WHEEL BEARINGS, FRONT AXLE	CLEAN, REPACK	CHK			4	NLGI GR. 2 BRG. GREASE
							4	KNUCKLE PINS & BEARINGS	PURGE		LUB		4	MPG
							5	TIE ROD ENDS	PURGE		LUB		2	MPG
							6	DRIVE SHAFTS	PURGE		LUB		9/12	MPG
							7	WHEEL BEARINGS, REAR TANDEM	COMMON TO DIFFERENTIAL	D/R	CHK		1	GL-5 -15° TO +80°: SAE 80 +10° TO +100°: SAE 90 ABOVE 100°F: SAE 140
							8	REAR AXLE DIFFERENTIAL	36 PT.	D/R	CHK		1	CONSULT ENGINE MFR'S OPERATION MANUAL FOR LUBE OIL REQUIREMENTS
							9	INTERAXLE DIFFERENTIAL	39 PT. (+ 2PT. INTERAXLE)	D/R	CHK			
							10	BRAKE SLACK ADJUSTER CAM & PINS	PURGE		LUB		4	MPG
							11	CARRIER ACCELERATOR PEDAL	PURGE		LUB		1	MPG
							12	DETROIT DIESEL	58 QTS W/FILTER	CHK P		D/R	1	
							13	COOLING SYSTEM	43 QTS	CHK		D/R	1	DEXRON-III
							14	AUTOMATIC TRANSMISSION	DIP STICK LEVEL	CHK	*	D/R	1	
							15	HYDRAULIC RESERVOIR	NO — SEE TABLE 2 — KEEP OIL LEVEL BETWEEN MARKS ON INDICATOR TUBE	CHK		D/R		
							16	BOOM CYLINDER BUSHINGS	PURGE		LUB		2	MPG
							17	UPPER ACCELERATOR PEDAL	PURGE		LUB		1	MPG
							18	TURNTABLE GEAR, PINION *	20 SHOTS			LUB	1	GG (MPG BELOW 32°F)
							19	TURNTABLE BEARING RACE *	AS REQ'D			LUB	1	MPG BELOW 32°F: EP-1 ABOVE 32°F: EP-2
							20	STEERING LINKS	PURGE		LUB		2	MPG
							21	SWING REDUCTION UNIT	11 1/2 PT.	CHK O			1	SYNTHETIC GL-5
							22	BOOM PIVOT PIN	PURGE		LUB		2	MPG
							23	BOOM EXTEND RETRACT CHAIN	AS REQ'D	CHK			4*	EO-SAE30 NON-DETERGENT
							24	CHAIN ROLLER	PURGE		LUB		4*	MPG
							25	BOOM TIP SHEAVES	PURGE		LUB		5	MPG
							26	HOOK BLOCK SHEAVES	PURGE		LUB		7	MPG
							27	HOOK BLOCK TRUNNION	PURGE		LUB		1	MPG
							28	JIB SHEAVE	PURGE		LUB		1	MPG
							29	JIB STINGER ROLLERS	PURGE		LUB		4	MPG
							30	BOOM SLIDE PADS	AS REQ'D		LUB		24*	MPG
							31	BOGIE CENTER (INSIDE)	PURGE		LUB		2	MPG

PART NUMBER 12400-943

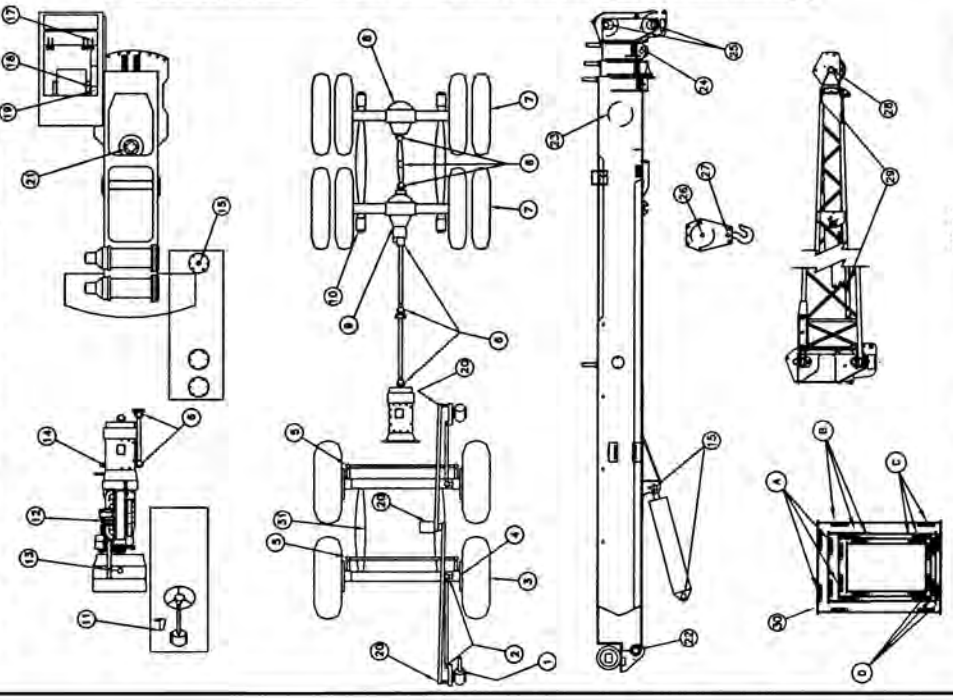


TABLE 2

SPECIFIED LUBRICANTS	
MPG	MULTI-PURPOSE GREASE
GG	GEAR GREASE
GL-1	GEAR LUBRICANT, REGULAR
GL-5	GEAR LUBRICANT, EP
SYNTHETIC GL-5	GEAR LUBRICANT, EP
EO	ENGINE OIL
ETF	SYNTHETIC OIL
HTF	HYD TRANSMISSION FLUID

*REFER TO OPERATOR'S MANUAL FOR COMPLETE LISTING OF RECOMMENDED OILS FOR APPLICABLE TEMPERATURE RANGES AND FOR DRAIN/REFILL PROCEDURES.

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 400-500ft. lbs.
- 30 HOURS - After thirty hours of travel, drain and refill the transmission with new fluid. Replace filter and strainer.
- 40 HOURS - Retorque the swing bearing bolts to a torque of 725ft. lbs on T300-1 & T500-1 and 980 ft. lbs on T775. 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 Cummins and Detroit 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.

Machine Maintenance Checklist

DAILY CHECK (8 HOURS)

___ Perform Daily Lubrication
___ Check Hydraulic Reservoir Fluid Level
___ Fill Fuel Tank
___ Check Engine Oil Level
___ Check Coolant Level
___ Check Hydraulic Cylinder Mounting Bushings And Pins
___ Check Hydraulic Components & Hoses (See Hydraulic Hose topic in Maintenance section)
___ Check Transmission Oil Level
___ Check Boom Chains And Ends
___ Drain Fuel Filters or Water Separator
___Check DEF (Urea) Fluid Level in Reservoir
___ Check Boom Front Slider Pads
___ 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 Anti-Two Block System
___ Check Engine Manufacturer's Manual For Additional Maintenance Requirements
___ Ensure Swing Brake Is Able To Hold Against Full Torque of Swing Motor
___Drain Water from Air Tanks

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 (100 - 200 HOURS)

___ Perform Daily And Weekly Checks
___ Perform Monthly Lubrication
___ Check Engine Belts
___ Check All Slider Pads
___ Have Hydraulic Oil Sample Analyzed
___ Clean Radiator & Oil Cooler Exterior

___ Check Hydraulic Reservoir For Moisture

___See Engine Maintenence Section

___ Check Engine Manufacturer's Manual For Additional Maintenance Requirements

___See Transmission Maintenence Section

QUARTERLY CHECK (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

___See Engine Maintenence Section

___ Change Hydraulic Return Line Filters

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

___ Check Engine Manufacturer's Manual For Additional Maintenance Requirements

___ Lubricate Valve Disconnects

___ Clean And Wax All Exterior Painted Surfaces

___See Transmission Maintenence Section

SEMI - ANNUAL CHECK (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

___See Transmission Maintenence Section

___ Change Power Steering Filter Element-(T300-1 only)

___ Check Hydraulic Relief Valve Pressure Settings

___ Torque Swing Bearing Bolts T300-1 & T500-1 (725 ft. lbs.) , T780 (980 ft. lbs.) according to tightening sequence.

___ 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

___See Engine Maintenence Section

ANNUAL CHECK (1500 - 2000 HOURS)

___ Perform Daily,Weekly, Monthly, Quarterly and Semi-annual Checks

___ Perform Annual Lubrication

___ Disassemble Winch And Inspect.

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

___ Drain and Refill The Winch Lubricant

___ Change Axle Oil

___ Drain And Clean Hydraulic Reservoir

___See Engine Maintenence Section

___See Transmission Maintenence Section

___ Hydraulic Hoses (See Hydraulic Hose topic in Maintenance section)

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.

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.

Hydraulic Oil Requirements

The hydraulic system is filled with KOEHRING SPEC 805 hydraulic oil to give the unit the highest performance as a hydraulic machine and to provide proper lubrication for the hydraulic components. To ensure the longest life for this piece of equipment, particular attention must be paid to maintain oil at the proper level with an approved hydraulic oil and to keep the circuit system clean.

The oil for the hydraulic system performs the dual function of lubrication and transmission of power. Oil must, therefore, be selected with care and with the assistance of a reputable supplier. To guide in the selection of this oil, the general requirements are specified below. Good oils are economical in the long run. Check with the oil manufacturer prior to the use of his product.

Oils which conform to Koehring Specification 805 are recommended for most conditions. Under certain climate and operating conditions, it may be advisable to use a fluid of heavier or lighter viscosity in order to maintain a viscosity less than 7500 SSU at start-up and more than 50 SSU during operation. These machines should not be operated with hydraulic reservoir temperatures in excess of 200×F (87×C) due to possible excessive damage to the hydraulic oil and rubber components (hoses, seals, shaft seals, motor seals etc.). If overheating occurs, discontinue operation and:

1. Check the hydraulic fluid level.
2. Check the oil cooler for cleanliness.
3. Check the oil viscosity versus the recommended Ambient Temperature - may require an oil change.
4. Check the hydraulic system efficiency - a pump may be failing or a relief valve set low.
5. Reduce the duty cycle of the machine.
6. Consult an authorized distributor.

ENGINE OILS

Engine oils that meet Mil Spec 2104 and have the antiwear additive zinc dithiophosphate can be used as hydraulic oils. DO NOT USE C.D. rated engine oil, some of which will not protect against wear in hydraulic pumps and motors.

Not all motor oils have zinc dithiophosphate. Those that do not have this heavy duty additive can cause immediate failure of pumps.

Engine oils tend to form sludge in the presence of water. This sludge can plug the filters so they will require frequent changing. This is not detrimental to the machine unless the filters are allowed to plug so badly that they by-pass oil.

Never use multi-viscosity grades of engine oil because of the shear and thin out characteristics of this type of oil.

TRANSMISSION FLUIDS

DO NOT use transmission fluids. These fluids have been designed to work in automatic transmissions and they will not necessarily work in hydraulic systems.

MIXING:

Mixing different brands of oil is not recommended. Various companies use different additive packages, which when mixed together, may cause problems in a hydraulic system. This type of problem is rare but can cause sludge which can plug the filters or acid which will etch the pump plates. In either case, the warranty would be voided. If, knowing all this, you still choose to add oil different from the initial fill, stay with a single brand as this will minimize the likelihood of problems occurring. Then at the first complete oil change you may switch to the brand you prefer to use.

PRE-FILTER:

Oil should be filtered through a 10 micron nominal filter before it enters the hydraulic system. New hydraulic fluid as received by the user is generally not in a satisfactory cleanliness condition for long component life.

OIL MAINTENANCE:

Optimum life from hydraulic equipment can only be obtained with proper hydraulic oil maintenance. This includes checking the oil every three to six months. An oil should be checked for viscosity, oxidation, water content, contamination and copper particles. A record should be kept of each check to detect signs of progressive deterioration. Oil samples should be taken with the system running at normal operating temperature. It is important to use good technique in obtaining an oil sample. The exact same procedure should be followed each time an oil sample is taken. Most fluid suppliers will provide assistance in analyzing your oil sample. The following are some guidelines to use in this analysis.

Viscosity- Many hydraulic fluids will shear or thin out with use. The viscosity at each check should be compared to the viscosity when new. At no time should the viscosity be less than 45 SSU at 210° F. If viscosity is less than 45 SSU at 210° F, the oil must be replaced immediately.

Oxidation- Oil oxidation will occur with age and use and is evidenced by a change in color and/or odor, increased acidity, and possible formation of sludge, gum or varnish in the system. The rate of oxidation increases significantly with operations at temperatures over 140° F (60°C). The oil should be checked more often if operation is a high temperature. The oxidation process increases the acidity of the fluid and is measured by a neutralization number. The oxidation process is typically slow at first and then increases sharply in the final stages of complete oxidation. A sharp increase (by factor of 2 - 3) in a neutralization number is a good indication that the fluid is reaching the limit of its oxidation life and should be replaced.

Water Contamination- All hydraulic oils in the following charts will readily separate water which will settle to the bottom of the reservoir. This water should be drained off. The water

that is measured in the oil sample will be dissolved water. This should be less than .05%. If it is greater than .05%, the oil in the system should be drained and replaced.

Particle Contamination- Excess contamination in a hydraulic system will greatly shorten the life of pumps and motors. Your oil sample analysis will show the number of particles per milliliter greater than a given micron size. The number of particles in your sample should be less than the following:

Particle Size	No. of Particles/Milliliter
10 micron or larger	3,000
20 micron or larger	300
30 micron or larger	100
40 micron or larger	30
50 micron or larger	10
100 micron or larger	1

If your oil sample shows numbers greater than in the chart, your hydraulic system is contaminated. The system should be checked for broken or torn filters, plugged filters, stuck filter bypass valves and so forth. Continued operation with particle counts greater than those shown in the chart will result in short pump and motor life.

Copper Particle Counts- The oil sample analysis should include a copper particle count in parts/million. This number should normally be less than 100. A high copper particle count indicates that a gear pump or motor is rapidly deteriorating. A count of 200 or more would be cause for concern. The most important thing to look for is a sudden increase in the copper particle count. This indicates that a gear pump or motor has suddenly begun deteriorating and a catastrophic failure can be expected shortly.

VISCOSITY:

Oils are available in various grades (viscosities). The ISO (International Organization for Standardization) viscosity classification system is currently being adopted. The ISO grade applies strictly to viscosity and does NOT imply type of oil. (engine, anti-wear, hydraulic, gear.etc.). A viscosity grade should be selected that will meet the minimum start up temperature requirement and the maximum operating hydraulic oil temperature.

This machine is factory filled with Koehring spec 805 hydraulic fluid that is acceptable for start-up at ambient temperatures of 20°F and should not be operated above a hydraulic reservoir temperature of 200°F. If these limits are exceeded damage can result. For operation outside these ranges, select the proper hydraulic fluid from the charts on this and the following pages or from a reputable supplier.

Koehring Spec 805 Data

PHYSICAL PROPERTIES	TEST METHOD	REQUIREMENT	
A. A.P.I. Gravity	ASTM D287	28 Min.	
B. Flash Point	ASTM D92	380× F Min.	
C. Viscosity Index 100×F 210×F	 ASTM D445 ASTM D445	 200-220 SSU 46 SSU MIn.	
D. Viscosity Index	ASTM D2270	95 Min.	
E. Pour Point	ASTM D97	-25× F Max.	
F. Oxidation Test to 2.0 Neut. No.	ASTM D943	2500 Hours Min.	
G. Rust Test	ASTM D665 Procedure A	Pass	
H. Foam Test	ASTM D892 Sequence I Sequence II Sequence III	Foam Tendency 25 ml Max. 50 ml Max. 25 ml Max.	Foam Stability Nil 10 ml Max. Nil
I. Demulsibility	ASTM D1401 to 40-37-3 point	30 Min. Max.	
J. Aniline Point	ASTM D611	200-230× F	
K. Pump Wear	Dennison HFO or Vickers M2905 (100 Hrs.@150× F)	Satisfactory	
L. % Zn	ASTM D1549	.07 Min.	
M. Filterability		Fluid shall show no additive loss when filtered through 5.0 micron filter.	
N. Cleanliness		Fluid shall appear bright and clear and shall be free of visible contaminates or sludge.	

Grade Selection Chart

Maximum life of pumps, motors, hoses, and seals will be obtained by selecting an oil as far down the chart as possible.

Viscosity Grade		Minimum Start-UP Temp. *	Ideal Cont. Operating Hyd. Oil Temp.	Maximum Operating Hyd. Oil Temp.	Selection Guide Lines
I.S.O. (New)	A.S.L.E. (Old)				
Synthetic		-30×F (-8×C)	160×F (71×C)	195×F (91×C)	Extreme cold start can be used year round in most machines in temperature climates
Multi. Viscosity		0×F (-17.8×C)	130×F (54×C)	190×F (88×C)	Cold Climate Year Round. Must Be Changed More Frequently Than Straight Grades
22		0× F (-17.8×C)	105×F (41×C)	160×F (71×C)	Winter Oil For Ambient Temperatures Up TO 60×F (16×C)
	150	5×F (-15×C)	120×F (49×C)	180×F (82×C)	For Ambient Temperatures Up To 80×F (27×C)
32		10×F (-12.2×C)	120×F (49×C)	180×F (82×C)	
	215	15×F (-9.4×C)	140×F (60×C)	200×F (93×C)	Can Be Used Year Round In Most Machines In Temperate Climates
46		20×F (-6.7×C)	145×F (63×C)	200×F (93×C)	

	315	25×F (-3.9×C)	155×F (68×C)	200×F (93×C)	Well Suited For Most Machines In Southern U.S. And As Summer Oil For Heavily Loaded Machines In Central And Northern U.S.
68		30×F (-1.1×C)	160×F (71×C)	200×F (93×C)	
100		35×F (-1.1×C)	175×F (80×C)	200×F (93×C)	Especially Suited For Regions With Ambient Temp. Range From 100×F To 120×F

* Minimum temperature for starting without extended warm-up. For lower temperatures, follow warm up procedure in the operators manual.

Premium Grade Anti-Wear Hydraulic Oils

OIL COMPANY	ISO	BRAND NAME
Amalie Refining Co. (USA)	32	Ama-Oil R & O 100 AW
	46	Ama-Oil R & O 200 AW
	68	Ama-Oil R & O 300 AW
	100	Ama-Oil R & O 500 AW
Amoco Oil Co. (USA)	32	Amoco AW 32
	46	Amoco AW 46
	68	Amoco AW 68
Arco	32	Duro AW 32
	46	Duro AW 46
	68	Duro AW 68
	100	Duro AW 100
Conoco		Conoco DN 600 (Artic) Conoco Super Hyd. 5W-20 (Multi Viscosity)
	32	Conoco Super Hyd. 32
	46	Conoco Super Hyd. 46
	68	Conoco Super Hyd. 68
	100	Conoco Super Hyd. 100
D-A Lubricant Co. Inc (USA)	32	D-A Hydra Shield 32
	46	D-A Hydra Shield 46
	68	D-A Hydra Shield 68
	100	D-A Hydra Shield 100
Dryden Oil Co. (USA)	32	Paradene Anti-Wear 32 AW
	46	Paradene Anti-Wear 46 AW
	68	Paradene Anti-Wear 68 AW
	100	Paradene Anti-Wear 100 AW

OIL COMPANY	ISO	BRAND NAME
Exxon Co. (USA)	32	Nuto-H 32
	46	Nuto-H 46
	68	Nuto-H 68
	100	Nuto-H 100
Gulf Oil Co. (USA)	32	Gulf Harmony AW 32
	46	Gulf Harmony AW 46
	68	Gulf Harmony AW 68
	100	Gulf Harmony AW 100
Imperial Oil Limited (Canada)	32	Nuto H 32
	46	Nuto H 46
	68	Nuto H 68
	80	Nuto H 80
	100	Nuto H 100
Kendll Refining Co. (USA)	32	Kenoil R&O AW 32
	46	Kenoil R&O AW 46
	68	Kenoil R&O AW 68
	100	Kenoil R&O AW 100
Mobil Oil Corp.	32	DTE 24/DTE-13M
	46	DTE 25/DTE-15M
	68	DTE 26/DTE-16M
Northland Products (USA)	32	Talamar 150
	46	Talamar 215 *
	68	Talamar 315
	100	Talamar 465

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OIL COMPANY	ISO	BRAND NAME
Pennzoil Products Co. (USA)		AWX Multi-Viscosity
	32	AW 32 Hyd. Fluids
	46	AW 46 Hyd. Fluids
	68	AW 68 Hyd. Fluids
	100	AW 100 Hyd. Fluids
Shell Co. (Canada)	37	Tellus T37 (Multigrade
Shell Co. (USA)	23	Tellus 23
	32	Tellus 32
	46	Tellus 46 (XSL 9101)
	68	Tellus 68
	100	Tellus 100
Sun Oil Co. (USA)	32	Sunvis 816 WR
	46	Sunvis 821 WR
	68	Sunvis 831 WR
	100	Sunvis 851 WR
Texaco Inc. (USA)		Rando Oil HD A2 (5w-20)
	32	Rando Oil HD 32
	46	Rando Oil HD 46
	68	Rando Oil HD 68

*** Factory filled with Northland Talamar 215 or equivalent.**

KOEHRING SPEC 805 IS EQUIVALENT TO HYDRAULIC OILS SHOWN ABOVE

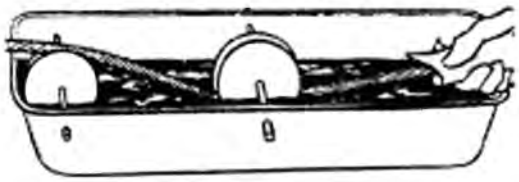
Cable Lubrication Methods

GENERAL

We are covering the more commonly used methods of lubricating cable (wire rope). For special cable lubrication problems consult the cable manufacturer.

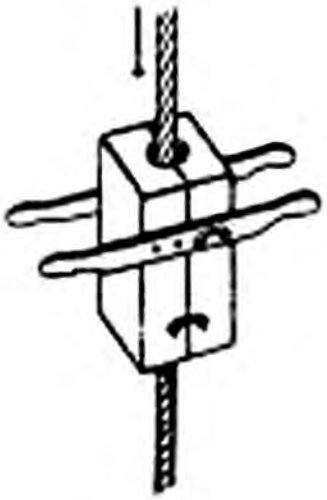
HOT APPLICATION

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

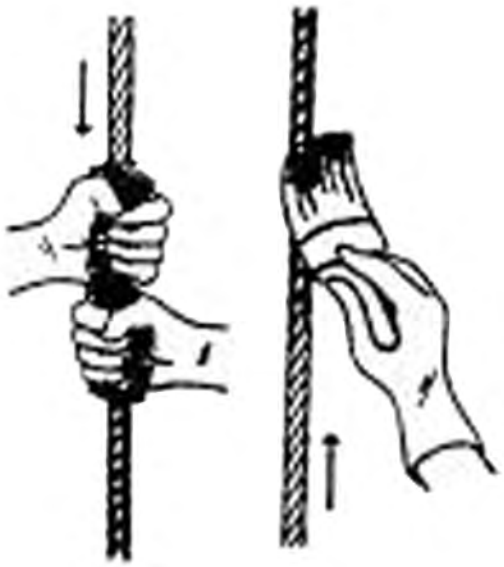
A container can be placed above the sheave, so that the rope can be lubricated by opening a spigot. Sheaves are the best location for lubricating operating wire ropes, because the wires and strands open somewhat as they bend along the groove.

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.



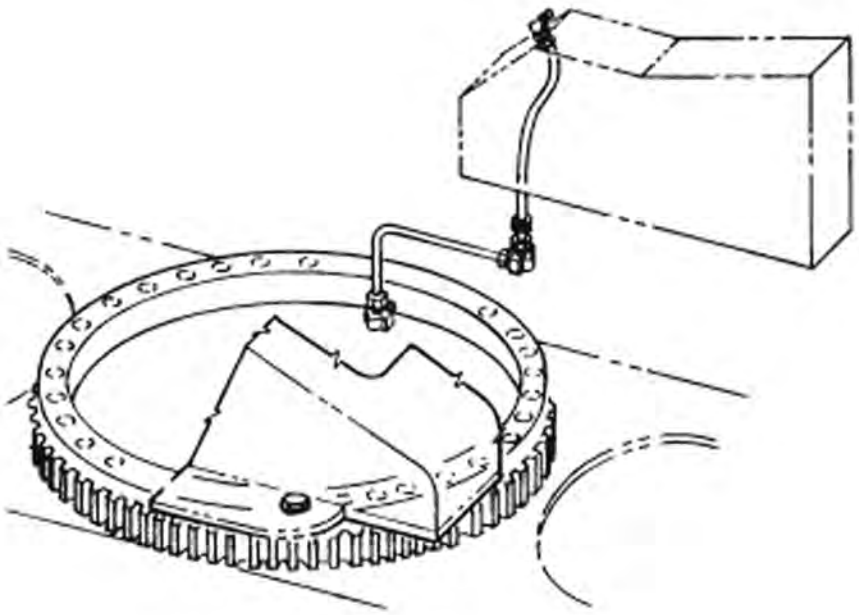
SPRAYING

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 by the manufacturer are:

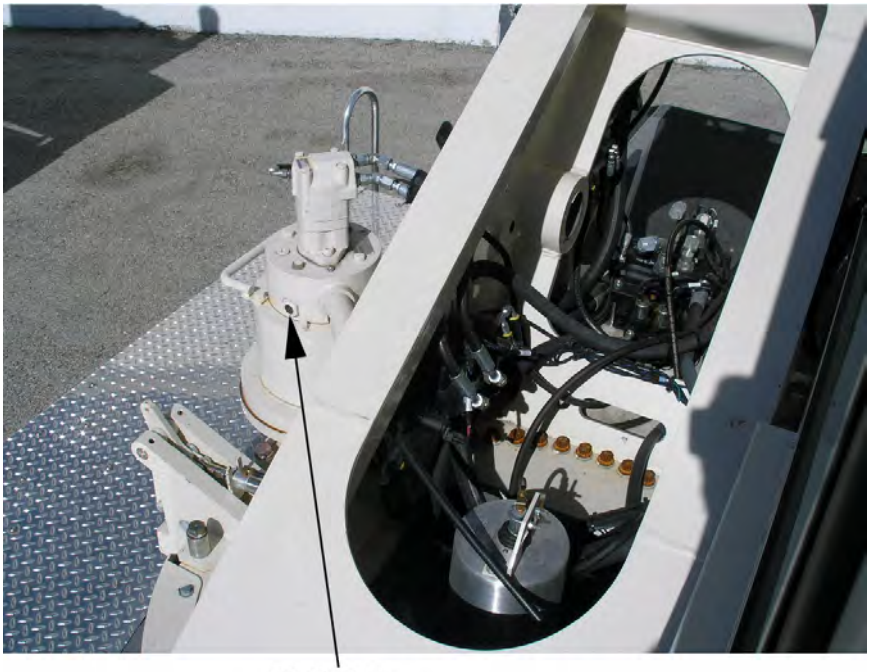
	MOBIL	TEXACO	SUNOCO	AMOCO	EXON
RACE	Mobilux EP1	Mutifak EP1	Prestige 742EP	Amolith EP1	Beacon EP1
GEAR	Mobiltac 375NC	Crater 2X	407 Compound B	Amovis 8-X	Surett Fluid 4k

NOTE: Refer to Kaydon Installation & Maintenence Catalog #390 supplied with crane.

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. Recommended lubricant is AGMA #4EP Gear Oil or equivalent.
2. All swing drive gearboxes from Terex 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, Terex recommends the same amount of ethylene glycol is added to prevent freeze up of unit due to internal condensation.



TEREX®

STATIC BRAKE SERVICE

Disassembly

1. Remove the four capscrews and sealing washers (items 9 & 8). Turn the assembly over and remove the housing adapter (item 15). Remove and discard the O-Ring (item 2).

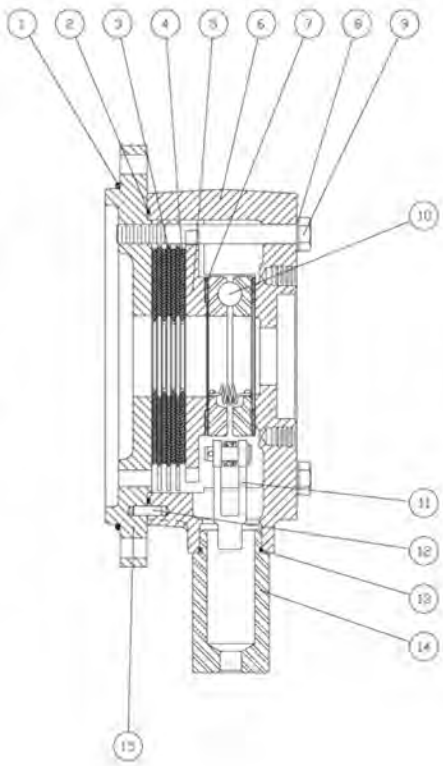
2. Remove the friction and steel brake discs (items 4 & 3). Remove the pressure plate (item 5).

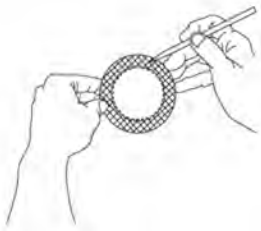
3. Remove the brake actuating assembly and clevis (items 10 & 11) and the two thrust bearings (item 7).

! WARNING !

DO NOT CLEAN BRAKE FRICTION DISCS IN SOLVENT. SOLVENT MAY CAUSE DAMAGE TO FRICTION MATERIAL WHICH MAY RESULT IN BRAKE FAILURE AND LOSS OF LOAD CONTROL.

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 3/32 in. when new. If worn to less than 1/16 in. thickness, they should be replaced.





Place each friction disc 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.

ITEM	DESCRIPTION	PART NO.	QTY.
1	O-RING	216064	2
2	O-RING	216091	1
3	BRAKE PLATE	216094	3
4	FRICTION DISK	216093	4
5	PISTON	216095	1
6	HOUSING	216090	1
7	THRUST BEARING	216096	2
8	WASHER, SEALING	216099	4
9	CAPSCREW	216098	4
10	ACTUATING ASSEMBLY	216097	1
11	YOKE END	216100	1
12	DOWEL PIN	216092	1
13	O-RING	216104	1
14	CABLE ADAPTER	216103	1
15	HOUSING ADAPTER	216086	1

Power Steering Maintenance

LUBRICATION - STEERING GEARS The lubricant used in the power steering system is the medium by which hydraulic pressures are applied and relieved, under control, to effect steering assist.

In addition the lubricant also lubricates moving parts and dissipates heat which reduces efficiency and accelerates wear. It is of the utmost importance to use a lubricant specified and approved by R.H. Sheppard Co., Inc. in the Sheppard Steering Gear.

The Sheppard Gear requires the use of 10W-30 Motor Oil. Highway vehicles should have the oil changed twice a year or every 50,000 miles. Off highway vehicles will require more frequent change intervals.

The power steering pump reservoir must be kept filled to the proper indicator level and free of air. When filling the reservoir, start the engine and turn the steering wheel from left to right and continue filling until proper level is maintained. (See final adjustments section for system bleeding procedures).

A replaceable type filter element is located in the reservoir. Carefully clean any build-up of dirt and grease form the reservoir cover. Remove the reservoir cover and filter element. Clean inside of reservoir with a lint free cloth. Install a new filter element refill with oil and replace cover.

LUBRICATION - BEARING CAPS To lubricate the dirt and salt seals in the bearing cap, and flush out any contaminants that have passed these seals, chassis grease should be added with low pressure per the lube chart.

1. Steering Orbitrol

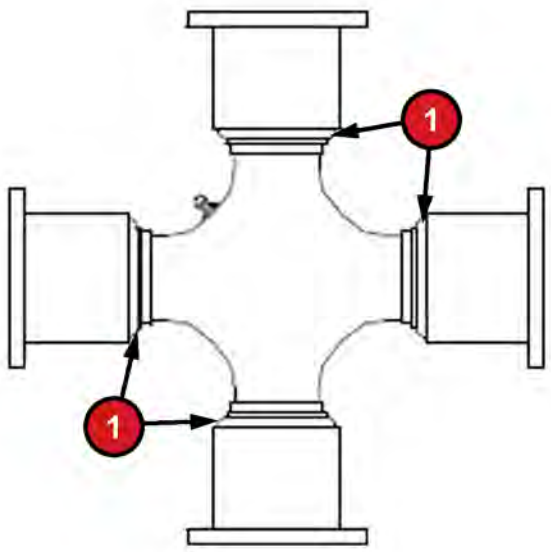
Drive Shaft Maintenance

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.

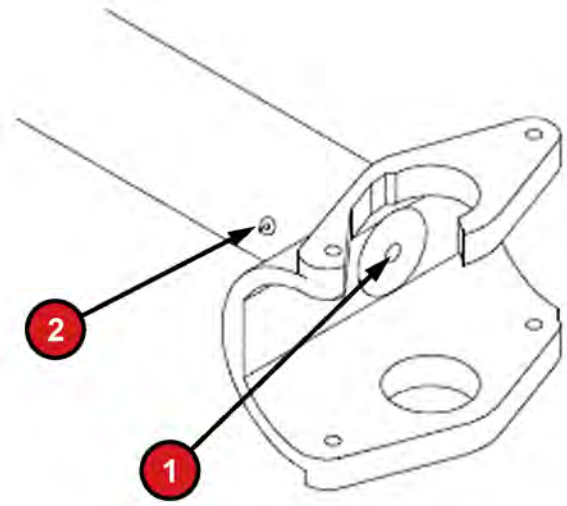
It is recommended that all universal joints be relubed after installation of the drive shaft prior to putting a vehicle in service.

JOURNAL AND BEARING KITS

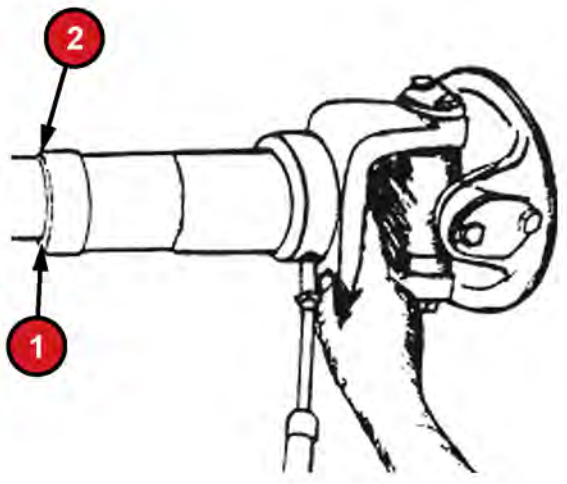
It is necessary to completely lubricate each replacement kit prior to assembly into the drive shaft yokes. Each journal cross lube reservoir should be fully packed with a recommended grease and each bearing assembly should also be wiped with the same grease; filling all the cavities between the rollers 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.

Brake System Maintenance

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.

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-PRF2105E 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.

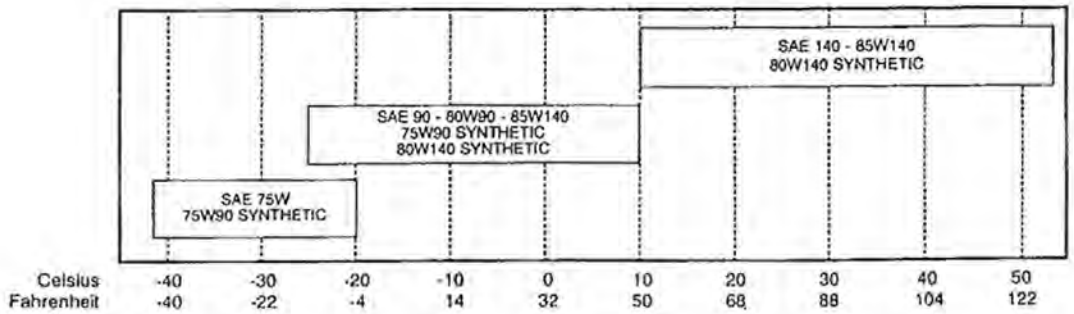
In general, synthetic oils have a lower pressure viscosity response than mineral oil lubricants. As the contact pressure between the gears increases, this produces a thickening of the mineral oil at the contact interface. This increase in viscosity helps to maintain lubricant film thickness reducing the possibility of surface and spalling fatigue. 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.

Viscosity Grade Based on Prevailing Ambient Temperature



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 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 is also recommended that the desiccant cartridge be replaced if the compressor has been rebuilt.

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 in Section 4. 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. There are five (5) tanks in the air system, all having drain cocks on the bottom of the tank. The accessory tank is located at the front of the machine, behind the front outrigger. The wet tank is located just inside of the fuel tank with the rear tank immediately behind it. The front tank is located just inside of the hydraulic tank. The park brake tank is located at the rear of the machine in the center just ahead of the rear outriggers.

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.

TIRES

MAINTENANCE CHECK

As a part of the WEEKLY MAINTENANCE CHECK inspect the tires and rims for damage. Cuts, 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.

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 pressures. In such circumstances, NEVER BLEED THE TIRES. Instead, slow down or stop until the tires cool.

The energy stored in a tire and rim assembly under pressure makes changing truck and off-road tires hazardous. Special procedures must be followed and special tools must be used if tires are to be changed safely. Whenever possible, let your tire 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. Instead, use an extension hose long enough to permit you to stand behind the tire tread. Always use a tire cage or equivalent protection when adding air.

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.

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 chance 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.

TIRE MATCHING

Unmatched tires on tandem drive units will cause tire wear and scuffing and possible damage to the drive units. Consequently, we recommend the tires be matched to within 1/8” of the same rolling radius; 3/4” of the same rolling circumference.

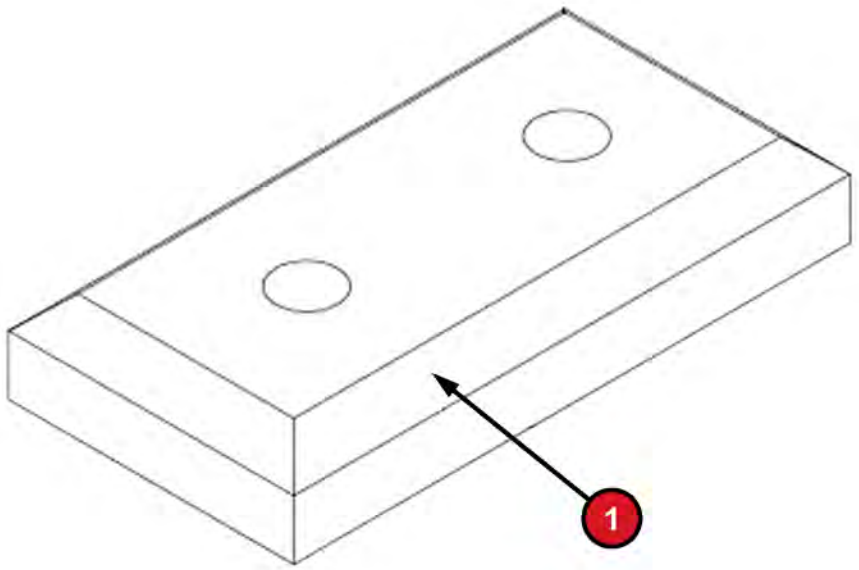
Tandem units-IMPORTANT:

The four largest tires should never be installed on one driving axle or the four smallest tires on the other driving axle. Such tire mounting will cause an inter-axle “fight”, unusually high axle lubricant breakdown, and possible costly axle service.

In addition to matching individual tire rolling radius or rolling circumference, we recommend matching, as nearly as possible, the total tire circumference of one driving axle to the total circumference of the other driving axle. This will usually result in satisfactory tandem axle lubricant temperatures that lengthen drive unit service with higher tire mileage.

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 (94')STANDARD & XL(105')

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.

1. 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.

1. 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.

1. 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.
2. 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.

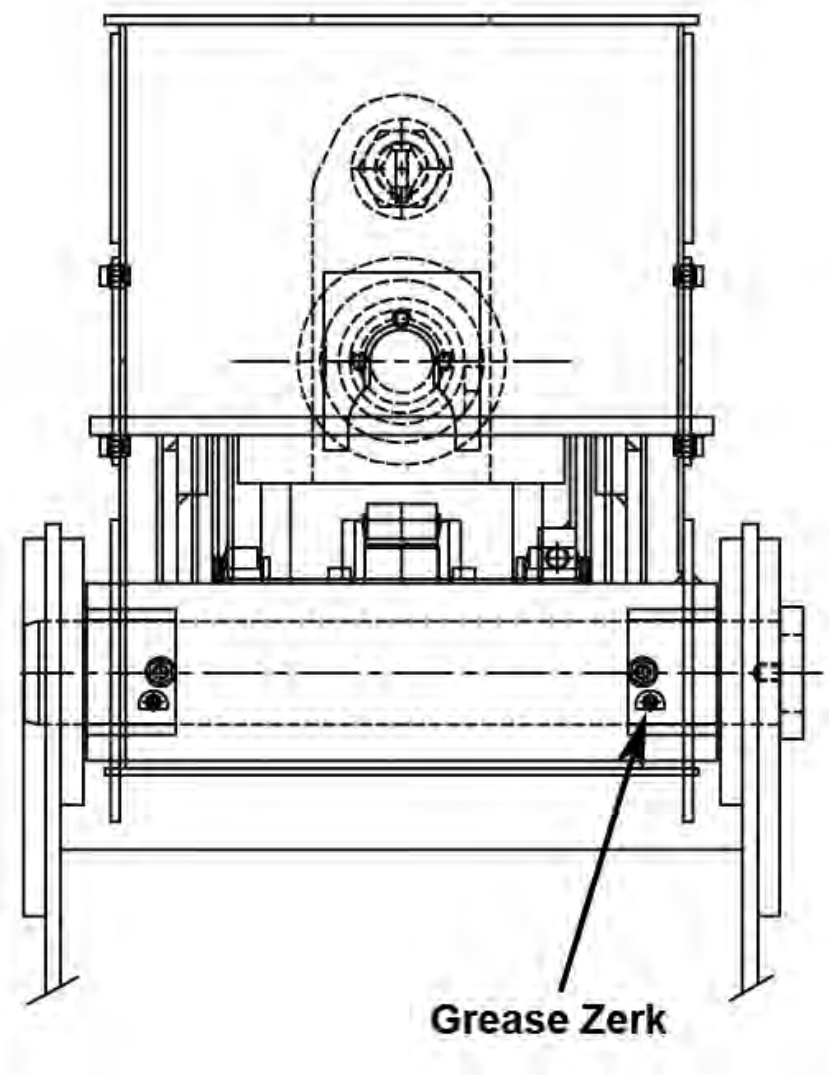
1. Fully extend the boom sections 3 & 4 to obtain access to the internal wear pad contact areas thru the large circular openings in the side plates of each section.
2. **WARNING-ENGINE MUST BE SHUT DOWN**-When performing lubrication internal to the boom sections.

1.

1. 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.
2. Use a 3" to 4" wide roller to apply the grease to the wear pad contact areas top and bottom. See photo below
3. Apply grease to approximately the center 12" of the floor of the 3rd section as shown in photo below.

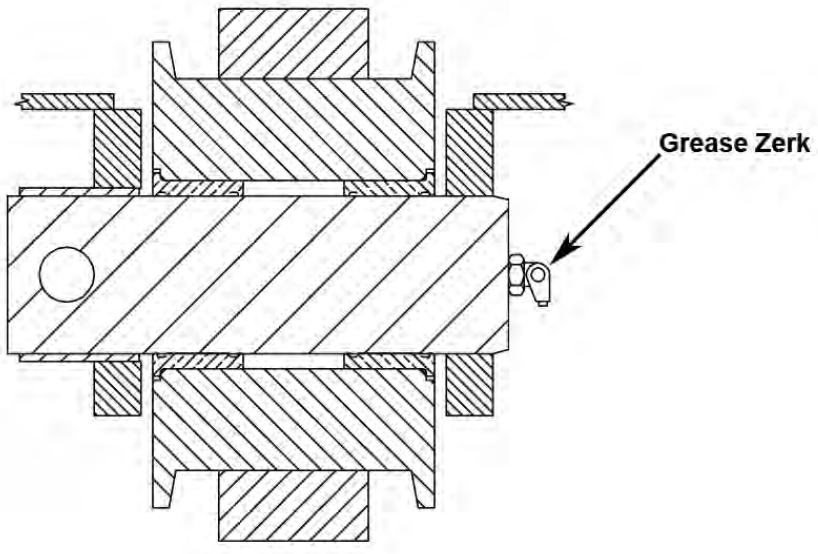
1. Apply multi-purpose grease along the entire length of the section to the outer 5" of both sides of the top plate of Section 3. This area can be accessed through the holes in the #3 section.
2. Apply a fist sized portion of grease in the center of the bottom plate on the inside through each of the holes in the boom on the path where the cylinder slides.
3. 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.

1. Boom Hoist Cylinder Pin lubrication, lubricate with MPG until grease starts to protrude from bearing sides.
2. 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).



3. 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.

4. 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.



1. Boom Head Sheaves lubrication-With outriggers set , boom retracted, boom lowered, and hook block on the ground then **SHUTDOWN ENGINE.**
2. 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

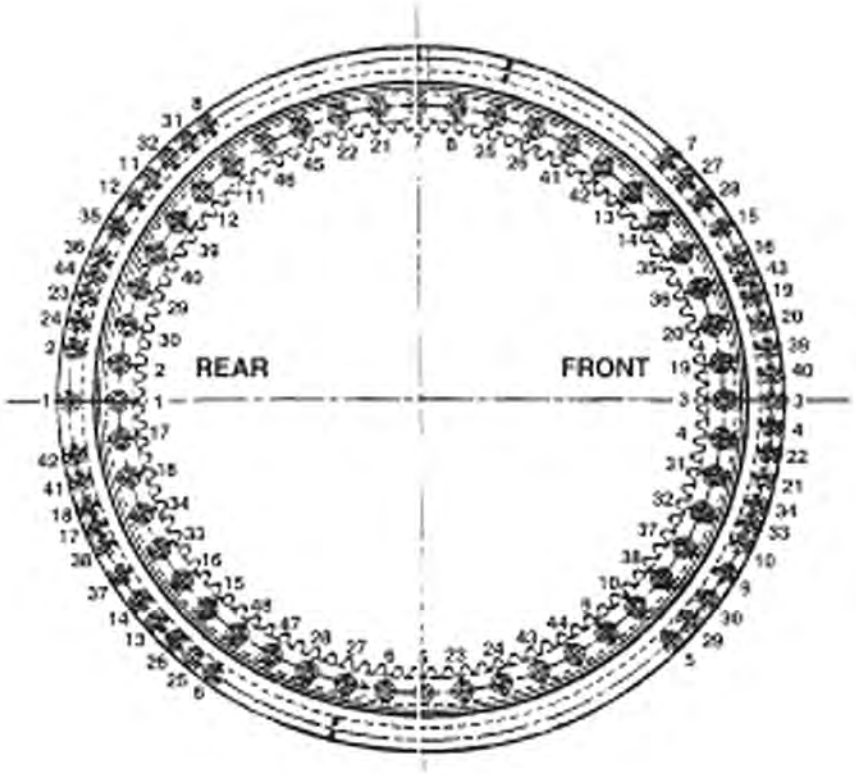
MAINTENANCE CHECK

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.

MODEL	4:1 TORQUE MULTIPIER	NO TORQUE MULTIPLIER
T300-1	DRY: 181 FT. LBS. (245 NM)	DRY: 725 FT. LBS. (983 NM)
T500-1	DRY: 180 FT. LBS. (244 NM)	DRY: 725 FT. LBS (976 NM)
T775	DRY: 245 FT. LBS. (332 NM)	DRY: 980 FT. LBS. (1329 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-(T300-1, T500-1, T780 shown below).



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 sixtyfour (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.

Engine Radiator Maintenance

DAILY:

COOLANT LEVEL

Check the engine radiator coolant level and add coolant if necessary. A solution of 50% ethylene glycol by volume is the recommended yearround coolant. Replenish the corrosion inhibitor according to engine manufacturer's recommendation.

In warm climates a coolant based on water with corrosion inhibitors is approved for use. Water only systems need to be treated with the proper dosage of corrosion inhibitors.

Inadequate concentration of the coolant additive can result in major corrosive damage to cooling system components. Over concentration can cause formation of "gel" that can cause restriction, plugging of coolant passages, and overheating.

MONTHLY:

RADIATOR EXTERIOR

Clean any foreign matter from the radiator cooling fins and through-core cooling passages by directing compressed air and flushing water over the entire area of the core in the reverse direction of normal air flow.

QUARTERLY

CORROSION INHIBITOR FILTER

Replenish the cooling system corrosion inhibitor filter every 250hours of operation.

Never use a chromate base corrosion inhibitor when the coolant contains ethylene glycol. Use only non-chromate base inhibitors. 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.

SEMI ANNUALLY

COOLING SYSTEM

Clean the cooling system every 2,000 hours or 2 years whichever comes first. Use a radiator cleaning compound, following the instructions on the container. Flush the system thoroughly and refill with an ethylene glycol solution of 50% by volume.

Refer to the topic, "Corrosion Inhibitor," above, when cleaning the cooling system and be certain the inhibitor used is compatible with the coolant.

Clean any foreign matter from the radiator cooling fins and through core cooling passages by directing compressed air and flushing water over the total area of the core in the reverse direction of normal flow.

Transmission Maintenance

Manual Transmission (EATON-FULLER)

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 Fuller Manual Transmission)

First locate the oil level plug holes by facing the rear of the 32000 series manual 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 within dipstick marks for the corresponding oil temperature. Oil should be checked at idle speed in the neutral position using the corresponding temperature band. Cold checks can be performed when the oil temperature is 60-120°F. The oil level should be within the dipstick "cold" band. Additional checks can be made with the transmission at operating temperature by using the "hot" band on the opposite side of the dipstick. The "hot" band temperature range is 180-220°F.

2.Draining Oil

Drain transmission while oil is at ambient temperature (65°F + 20). To drain oil, remove the main case drain plug and the converter housing oil pan drain plug. Clean the drain plugs 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.

3.Refilling-(Allison Auto)

The operational level should always be within the limit marks on the dipstick. The exact amount of oil depends on the transmission inclination and model. Insufficient oil damages the pump and other components, and can affect the function and reduce the life of the transmission.

DO NOT OVERFILL!

This causes overheating and loss of fuel economy. When adding oil, types and brands of oil should not be mixed because of possible incompatibility. When changing oil viscosity to Arctic oil or alternate viscosity ranges, follow the recommended transmission oil flush procedure. Use clean oil and clean containers when filling transmission. Containers that have been used for anti-freeze or water should not be used for transmission oil.

1. Remove the dipstick and slowly add seven (7) gallons of the prescribed oil through the fill tube.
2. Place the transmission in the neutral position and apply the parking brakes. Start the engine and let it idle for 5 minutes, (this allows oil to fill the converter, main case, and cooling system), add oil as needed to obtain a level at the proper temperature range, (cold band under 120°F, hot band between 180 and 220°F). Total oil quantity needed at this time should be approximately 10 gallons this varies depending on the cooling system.
3. Increase the engine idle slowly to 1500 RPM for two (2) minutes. Now recheck the oil level at normal idle speed in neutral, again adding oil to obtain a level at the proper temperature range (cold band under 100°F, hot band between 180 and 220°F).
4. Replace the dipstick and tighten securely.

4. Flush Procedure

1. Disconnect the transmission cooler supply line between the transmission outlet and the oil cooler, (not between the cooler and the transmission oil pan).
2. With clean dry air from a hose and nozzle (20 psi), use a rubber stopper or clean rag to seal the air hose to the converter outlet hose.
3. Apply air to the converter outlet for approximately 2 minutes to backflush oil into the transmission oil pan
4. Connect the hose between the transmission and cooler. Tighten to vehicle manufacturers specifications.
5. Install the transmission converter housing oil pan drain plug, tighten to 14-20 Lb, ft of torque.
6. Install the transmission main case drain plug (rear bottom), tighten I to 45-50 Lb, ft of torque.
7. Remove the transmission dipstick and slowly pour 7 gallons of the appropriate oil into the transmission.

8. Apply the vehicle parking brakes and place the transmission lever in neutral. Start the engine and let it idle for 5 minutes. Check the dipstick periodically while the engine is idling, adding oil as needed to obtain a level that is in the Cold Band on the dipstick. Total quantity added at this time should be approximately 10 gallons.
9. With the transmission still in neutral, increase the engine idle speed t 1500 rpm and retain at this speed for 5 minutes. Now recheck the oil level at normal engine idle speed in neutral, again adding oil as requite on the dipstick. Total oil quantity added at this time should be 11 gallons.

Transmission Temperature (°F)	
180 to 220	Oil level between the add-hot and full-hot marks.
Below 120	Oil level at the cold fill mark.

5. Maintenance Interval Chart-(EATON FULLER Only)

Lubrication Change and Inspection	
HIGHWAY USE	
First 1,000 to 1,500 miles	Change transmission oil, filter, and strainer on new units.
Every 2,500 miles	Inspect lubrication level. Check for leaks.
Every 50,000 miles or 1 year	Change transmission lubricant and filter. Check the strainer for dirt.
OFF-HIGHWAY USE	
First 30 hours	Change transmission oil, filter, and strainer on new units.
Every 40 hours	Inspect lubrication level. Check for leaks.
Every 500 hours	Change transmission lubricant and filter where severe dirt conditions exist.
Every 1,000 hours	Change transmission lubricant and filter. (Normal off-highway use.)

Automatic Transmission (Allison Auto)

No Longer Approved Fluids

DEXTRON and Allison C4 Transmission Fluids are no longer approved for new commercial On-Highway products.

Approved Fluids

Proper Fluid Level

Because the transmission fluid cools, lubricates, and transmits hydraulic power, it is important that the proper fluid level be maintained at all times. If the fluid level is too low, the converter and clutches do not receive an adequiate supply of fluid. If the fluid level is too high, the fluid will aerate. Aerated fluid can cause the transmission to shift erratically or overheat. The MD, HD and B Series have an optional oil level (OLS) sensor that allows the operator to obtain an indication of fluid level from the shifter selector.

IMPORTANCE OF PROPER FLUID LEVEL

It is important that the proper fluid level be maintained at all times because the transmission fluid cools, lubricates, and transmits hydraulic power. If the fluid level is too low, the converter and clutches do not receive an adequate supply of fluid. If fluid level is too high, the fluid can aerate. Aerated fluid can cause the transmission to shift erratically or overheat.

Oil level sensor (OLS) allows the operator to obtain an indication of the fluid level from the full-function shift selector.

Frequently look for the presence of oil level diagnostics if the transmission is known to contain an OLS. If an OLS is not detected during a fixed number of engine starts, the TCM/ECU concludes that no OLS is present. If an OLS is known to be present, but has not been detected, then troubleshooting of the OLS circuit is required. After the OLS circuit is repaired, reset "autodetect" or manually select the OLS function using Allison DOC™ For PC–Service Tool. For detailed troubleshooting procedures refer to the Troubleshooting Manual. Refer to the SERVICE LITERATURE section for specific publication numbers.

NOTE: To correctly determine the transmission fluid level using the dipstick, the transmission fluid must be at operating temperature. The oil level sensor method of determining the fluid level compensates for transmission fluid temperature between 60°C–104°C (140°F–220°F). Any temperature below 60°C (140°F) or above 104°C (220°F) will result in an **Invalid for Display** condition.

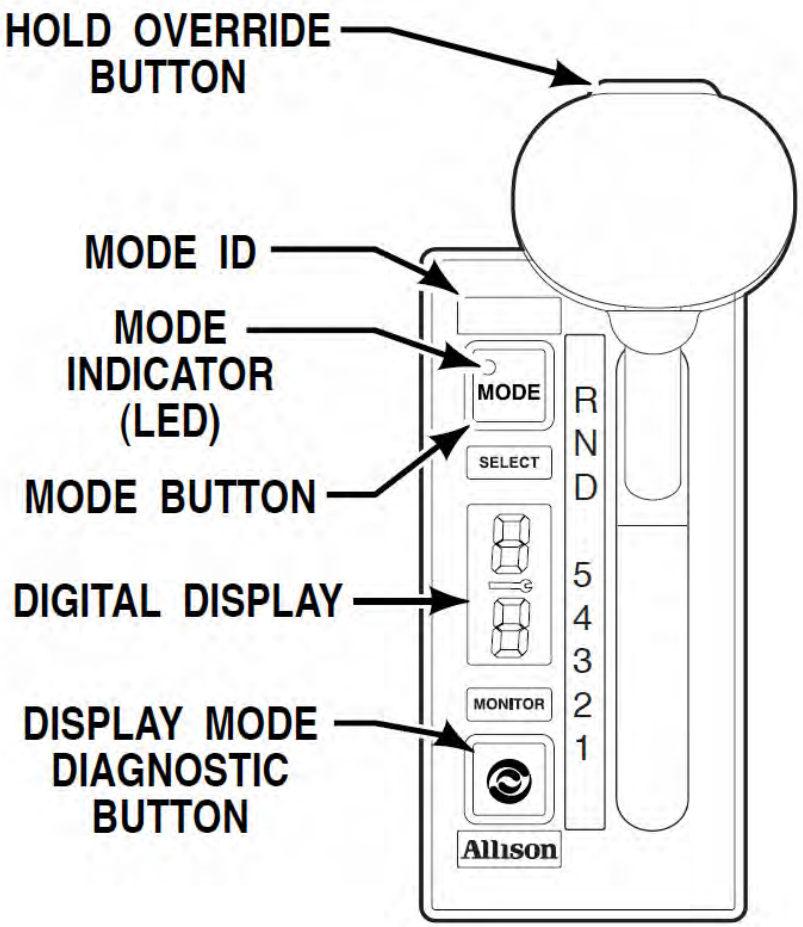
Fluid Level Check

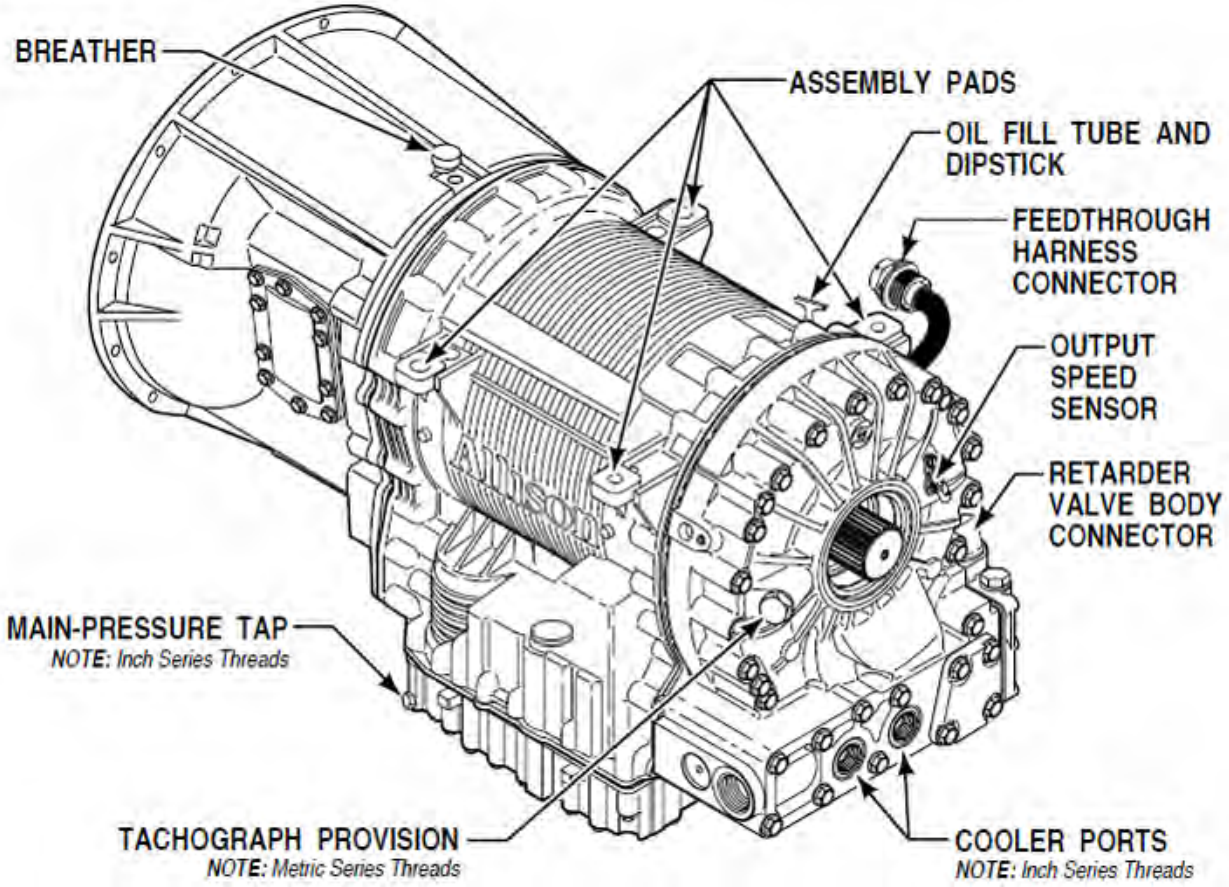
Fluid level check by using the Lever Shift Selector and perform the following steps:

1. Park the vehicle on a level surface, shift to N (Neutral), and apply the parking brake.
2. Engine at idle, fluid temperature is above 60 degrees C (140F) and below 104 degrees C (220F) and transmission output shaft is stopped. The fluid temperature may be delayed until the temperature range is met.
3. The vehicle has been stationary for approximately two minutes to allow the fluid to settle.
4. Lever Shift Selector-Press the Display Mode/Diagnostic button once.
5. The delayed fluid level check is indicated by a "-" in each of the digital displays (SELECT and MONITOR) followed by a numerical countdown. The countdown, from 8 to 1, indicates the time remaining in the two minute waiting period. The following is an explaination of what will appear in the SELECT and MONITOR digital displays.

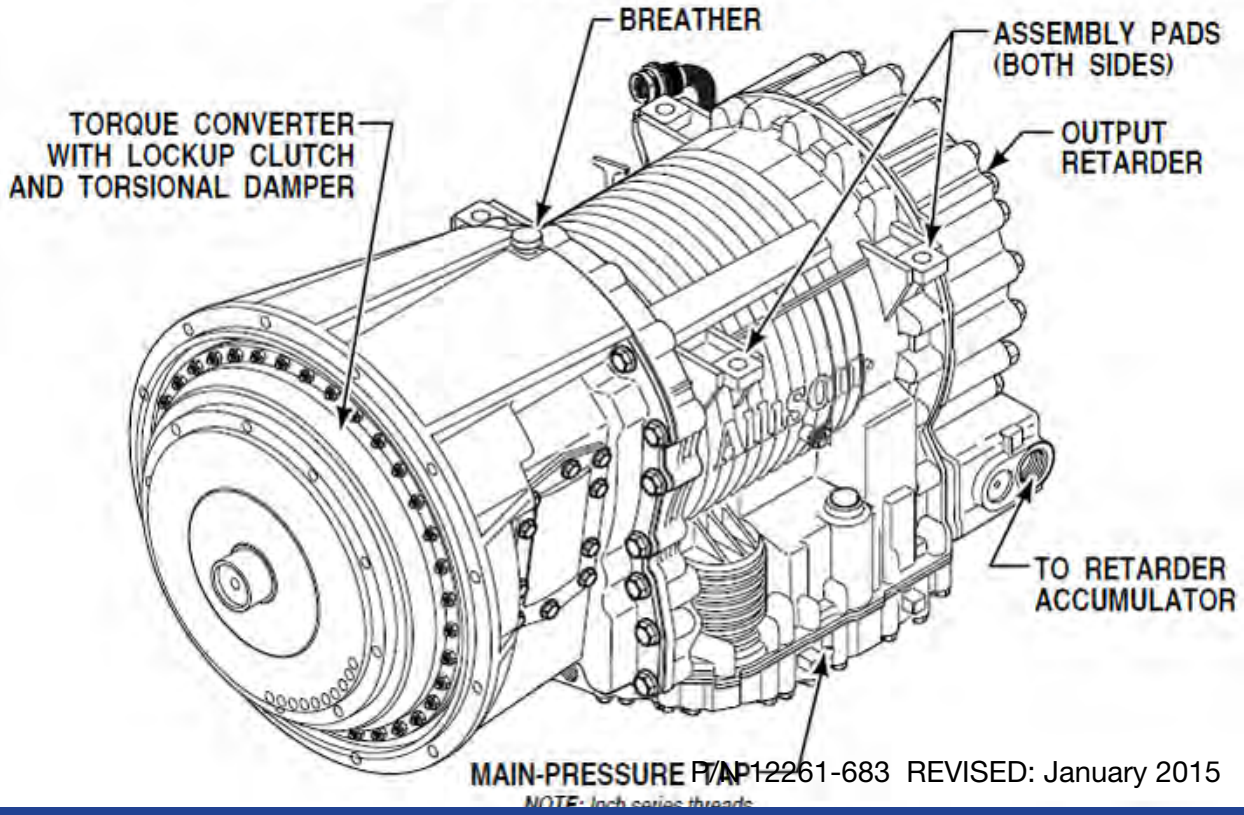
Correct Fluid Level

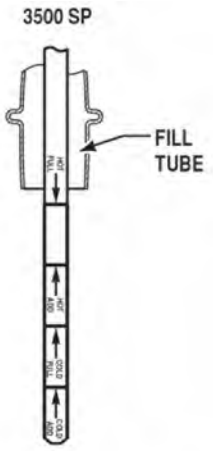
SELECT	MONITOR	Description
"o"	"L"	Represents Fluid (oil) Level Check Mode
"o"	"K"	Fluid level is within the correct fluid level zone.





LEFT-REAR VIEW





OIL SUMP	TRANSMISSION/SUMP DESCRIPTION
4.00 in.	3200/3500 SP

Allison Transmission Filters

3000 Series High Capacity Filter Kit (4 inch)-For Replacement or Service Order: **Terex No. 222661**

Kit contains the following items listed below:

ITEM NO.	Allison PART NO.	QTY.	DESCRIPTION
1.	29545778	1	Instruction Sheet #322
2.	23019664	1	O-Ring-Packing-(drain plug)
3.	29524449	2	Gasket, Filter Cover
4.	29548953	2	O-Ring, Low Temp (Rd. edge) See note A) below
5.	29501469	2	Seal, Ring (Sq. cut)
6.	29507437	2	O-Ring, Packing
7.	29545780	2	Filter

NOTE: *A) Only one style of item 4 & 5 is used. The kit is supplied with both old style cut o-ring and new style round edge o-ring. If the filter cover is the old style it will be machined for the square cut o-ring, if not, then you disgard the square cut and use the new round edge or visa versa.*

High Fluid Temperature

The transmission is considered to be overheated when any of the following termperatures are exceeded:

Sump fluid	121 C (250 F)
Fluid to cooler	149 C (300F)
Retarder out fluid	165 C (330 F)

If the transmission overheats during normal operation, check the fluid level in the transmission. If the engine temperature guage indicates high temperature, then the transmission is probably overheated. Stop the vehicle and check the cooling system. If it appears to be functioning properly, run the engine at 1200-1500 rpm with the transmission in N (Neutral). This should reduce the transmission and engine temperatures to normal operating levels in 2 to 3 minutes. If temperatures do not decrease, reduce the engine rpm.

Transmission Fluid Temperature-CAUTION

The engine should never be operated for more than 30 seconds at full throttle with the transmission in range and the output stalled. Prolonged operation of this type will cause the transmission fluid temperature to become excessively high and will result in servere overheat damage to the transmission.

Minimum Operating Temperature

Transmission Fluid Minimum Operating Temperature Requirements

Fluid Type	Minimum Operating Temperature	
	Celsius	Fahrenheit
TES 295	–35	–31

TEREX®

Recommeded Fluid/Filter Change Intervals

Recommended Fluid/Filter Change Intervals for 3000 Product Family Transmission with High Capacity Filter

filters at or before recommended mileage, months, or hours have elapsed, whichever occurs first.

, severity of operation or duty cycle may require more or less frequent fluid change intervals that differ commended fluid change intervals of Allison Transmission. Allison Transmission recommends that the alysis as the primary method for determining fluid change intervals. In the absence of a fluid analysis e intervals listed in the chart should be used.

SEVERE VOCATION*			GENERAL VOCATION**			
	Filters			Filters		
Main	Internal	Lube/ Auxiliary	Fluid	Main	Internal	Lube/ Auxiliary
Schedule 2—TES 295 Fluid***						
000 Miles 0 000 km) Months 00 Hours	Overhaul	75,000 Miles (120 000 km) 36 Months 3000 Hours	300,000 Miles (480 000 km) 48 Months 6000 Hours	75,000 Miles (120 000 km) 36 Months 3000 Hours	Overhaul	75,000 Miles (120 000 km) 36 Months 3000 Hours

Schedule 2 are based on the transmission containing 100 percent TES 295 fluid and Allison Transmission Gold Series filters.

Recommended Fluid/Filter Change Intervals for MY09 Prognostics Enabled 3000 and 4000 Product Families Transmissions

C: This schedule is to be used with Prognostics "ON" beginning with the serial numbers listed in Service Tips #1099. Go w.allisontransmission.com and click SERVICE, Fluids, then Service Tips for the current revision.

C: 100 percent concentration of TES 295 Allison approved fluids and Allison High Capacity Filters is REQUIRED. Less 00 percent concentration of TES 295 Allison approved fluids are considered a mixture and shall not be used with MY09 ostics or this change schedule. Utilization of previous Non-TES 295 Fluid/Filter Change Intervals tables is required.

C: Fluid fill capacity is dependent on vehicle configuration. Final fluid capacity must be determined by dipstick level to Mechanic's Tips, MT3004EN, Refill Transmission Section 2–8c, or Operator's Manual, CARE AND MAINTENANCE n).

General or Severe Vocation		
Fluids–Prognostics ON*		**Filters–Prognostics ON***
ange fluid when indicated by controller or months (five years) whichever occurs first. Also change filters with fluid	**Main and Lube**	Change filters when indicated by controller between fluid changes or 60 months (five years) whichever occurs first.
	Internal	Overhaul only

ognostics is turned OFF or not calibrated in the TCM after the serial numbers listed in Service Tips #1099, utilization of Table 7 or Table 8 fluid ge intervals is required.

Transmission Fluid Capacity

REFILL TRANSMISSION

The amount of refill fluid is less than the amount used for the initial fill. Fluid remains in the external circuits and transmission cavities after draining the transmission.

After refill, determine that the fluid level is correct using the FLUID LEVEL CHECK USING LEVER SHIFT SELECTOR section of this manual.

NOTE: Quantities listed are approximations and do not include external lines and cooler hose.

Transmission Fluid Capacity

Transmission	Sump	Initial Fill		Refill	
		Liters	Quarts	Liters	Quarts
3000 Product Family	4 inch	27	29	18	19
4000 Product Family	4 inch	48	51	40	42

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 and/or emergency brakes.

Operating Temperatures with Oil Coolers

An external oil cooler is required on the automatic transmission in order to maintain proper operating temperatures*. Transmission oil temperature is sensed as ~from the torque converter outlet port before the oil enters the cooler. Normal operating temperature, when sensed from the torque converter outlet port, should be below 250°F; however, intermittent operating temperatures to 300°F do not harm the transmission. On vehicles equipped with two transmission oil temperature gauges, one gauge (required) senses torque converter oil as mentioned above, while the other gauge (optional) reads oil temperature from the transmission sump. The sump temperature represents oil that has circulated through the cooler. This temperature is normally below 225°F; however, intermittent sump temperatures to 250°F do not harm the transmission. When the average temperature of the transmission oil exceeds the temperature limits as stated above, more frequent oil changes may be needed. The following conditions in any combination can cause the recommended transmission oil temperatures to be exceeded: (1) operating the transmission in a "stall" condition; i.e., extended operation while in gear with the vehicle stopped or slowly moving, (2) high density of starts and stops at slow operating speed, (3) minimal cooler capacity and/or restricted air flow to the transmission oil cooler, (4) exhaust system too close to the transmission, (5) improper oil level/incorrect oil.

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.

3. Dipstick

   Remove dipstick and check level of lubricant at specified intervals. Check oil in neutral at engine idle.

4. Drain Plugs

   Tighten the drain plugs securely. Tighten the main case drain plug to 45-50 Lbf.ft of torque. Tighten oil pan plugs to 14-20 Lbf.ft of torque.

5. 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 Companison 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.

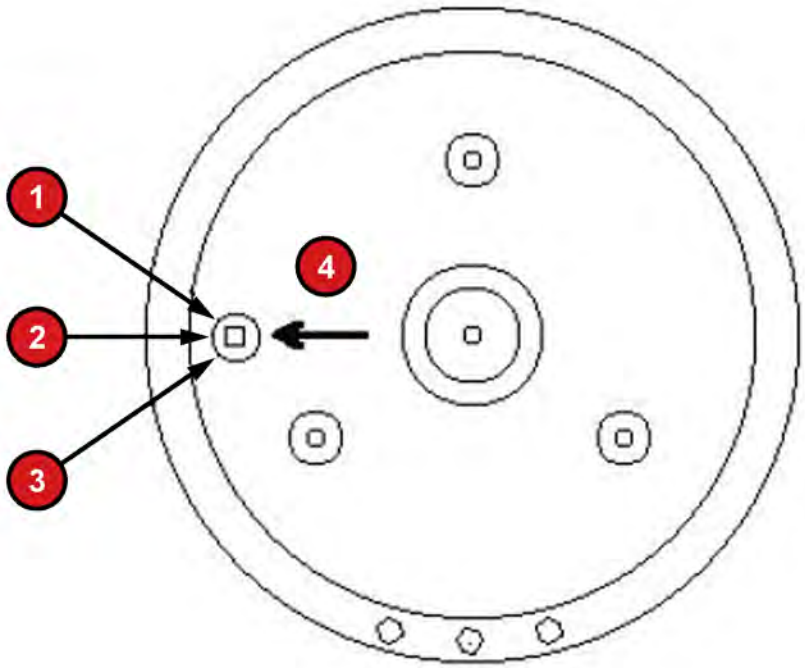
9. Mainshaft Rear Bearing Cover

   Check oil seal for wear.

Axle Maintenance

MAINTENANCE CHECK

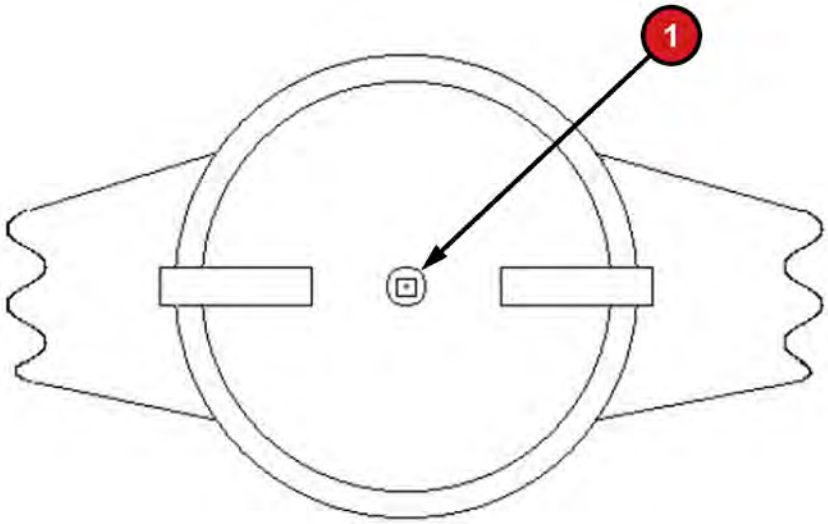
As a part of the MONTHLY MAINTENANCE CHECK, inspect the axle and differential levels. When checking the AXLE OIL LEVEL, rotate each wheel until the planet cover is positioned as shown in the illustration below. the arrow on the planet cover points horizontal when the cover is properly positioned for checking the oil.



1	Lubricant Level	3	Drain Plug (Rotates to Bottom)
2	Check Plug	4	Horizontal Oil Fill Level

Remove the oil level plug in the planet cover and add oil as necessary to bring the oil level to the bottom of the fill and check hole See the lubrication chart.

Check the DIFFERENTIAL OIL LEVEL by removing the fill and check plug (1) indicated in the illustration . Add oil as necessary to bring the oil level to the bottom of the hole. See lubrication chart.



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.

TEREX®

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-PRF2105E 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.

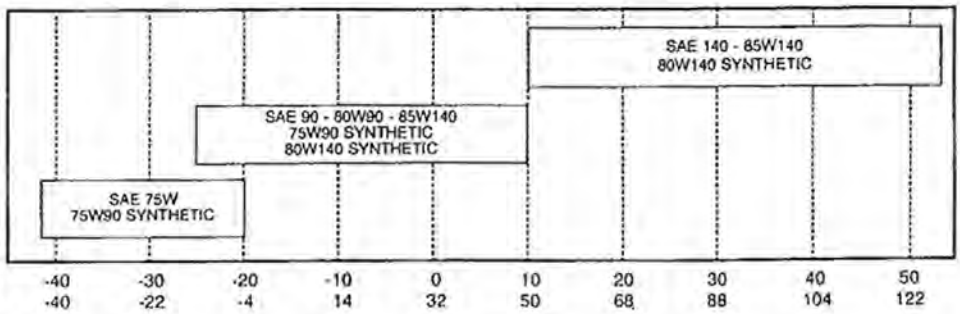
In general, synthetic oils have a lower pressure viscosity response than mineral oil lubricants. As the contact pressure between the gears increases, this produces a thickening of the mineral oil at the contact interface. This increase in viscosity helps to maintain lubricant film thickness reducing the possibility of surface and spalling fatigue. 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.

Viscosity Grade Based on Prevailing Ambient Temperature



Drain the oil from hubs removing the fill and check plug by rotating the hub until the hole is at the extreme low position. After draining, rotate the hub until the hole is at the check position. Refill the hub with the lubricant specified on the lubrication chart. Refill to the level of the bottom of the check plug.

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 400-500 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.

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

1. Deflate tires completely prior to demounting by removing the valve core.
2. Replace bent, cracked,worn, corroded, or damaged parts.
3. Inflate tires in a safety cage.
4. Inspect wheel nuts periodically for excessive wear, corrosion, proper centering and nut torque.

DON'T

1. Do not use loads or inflation pressures exceeding the manufacturer's recommendations.
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.

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

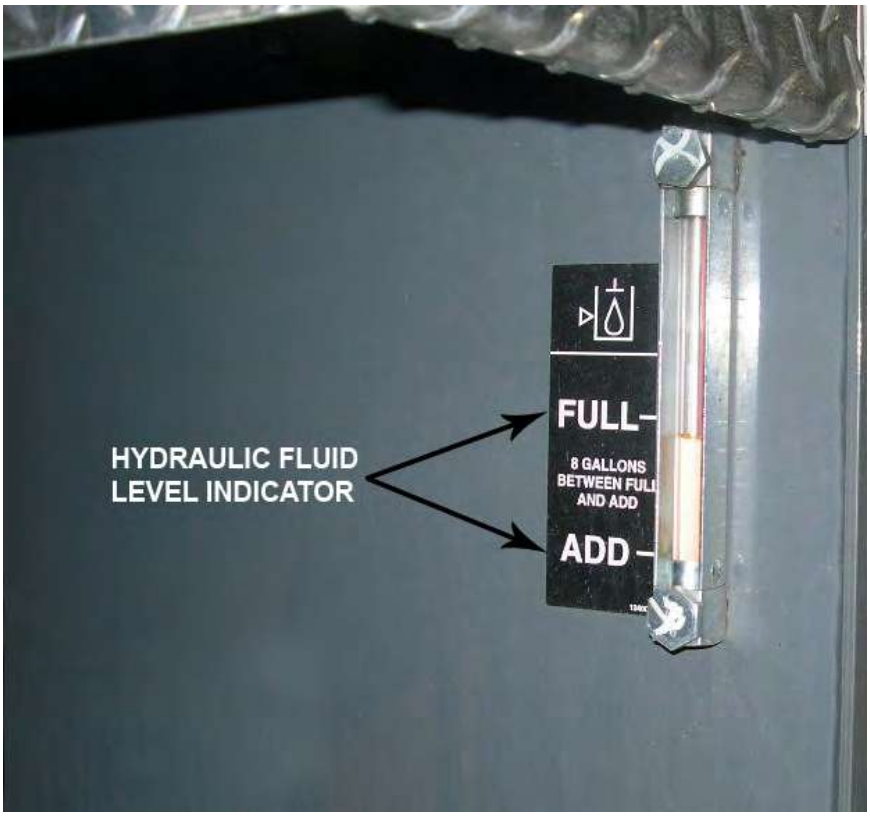
MAINTENANCE CHECKS

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
T300-1	70 GAL. (265 Liters)
T500-1	117 GAL. (443 Liters)
T780	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.

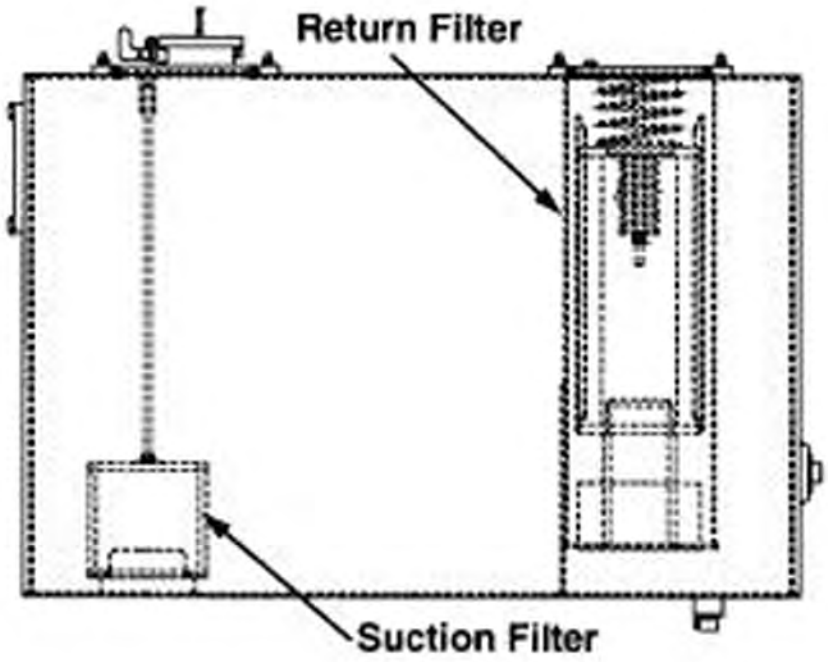
Change the oil whenever testing and/or inspection reveals the oil to be unsuitable for safe and efficient operation or yearly.

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 Terex 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

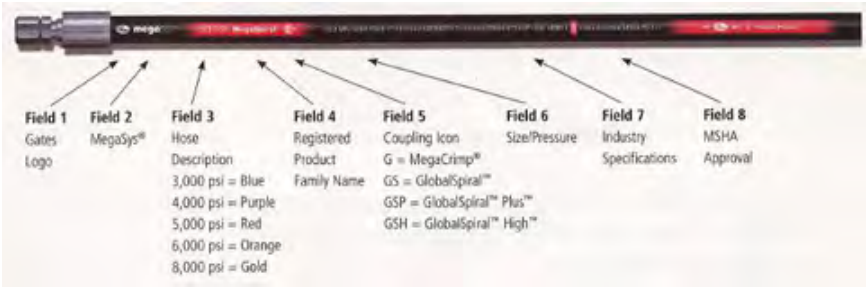
Recommendations for the replacement of hydraulic hose assemblies:

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:

T300-1_T500-1_T780
Maintenance

P/N 12261-683 REVISED: January 2015

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 152 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 302 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

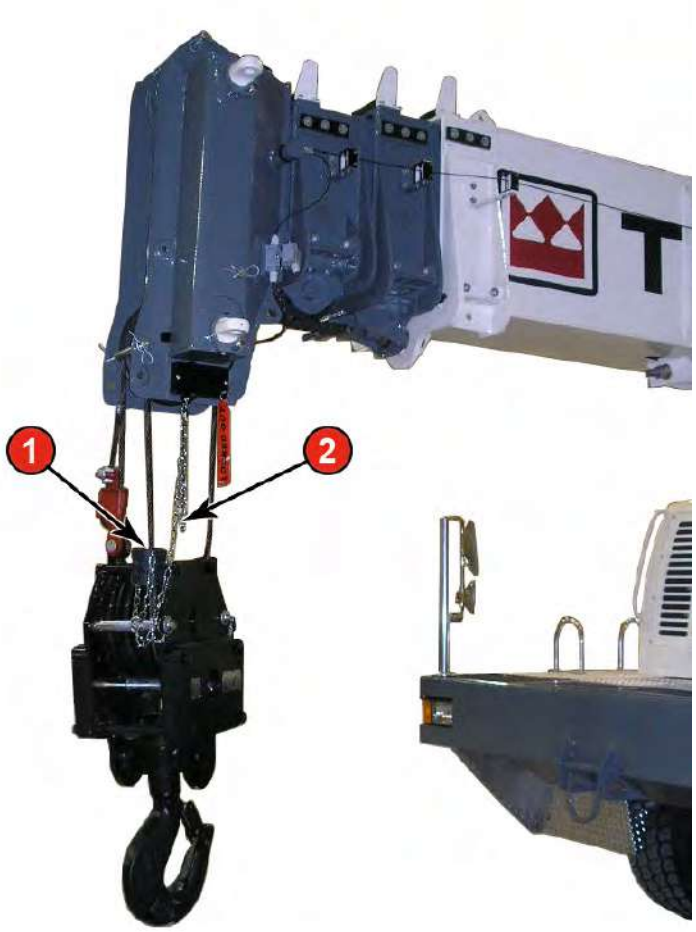
NOTE: IF A SOCKET IS CHANGED OR REPLACED, OR IF YOU ARE CHANGING HOOK BLOCK WEIGHTS; IT IS IMPORTANT TO USE THE CORRECT SOCKET

Anti-Two Block System

MAINTENANCE

This crane is equipped with an anti-two block 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. If equipped with control disconnects, it will also disengage the hydraulic functions. Verify that the two-blocking system is functioning properly by performing the following procedure.

Check anti-two block 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 (and shut-off, if so equipped) by manually lifting chain hung counterweight(s). A warning light should come on, horn in “on” position should sound, and (if so equipped) 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. If the crane is equipped with control linkage disconnect, perform the following checks, also.



1. With the engine ignition key in the "off" position, check that free action (no self-centering) occurs on the boom lowering pedal, the boom telescope lever- extended direction, and the winch lever (S) - raising direction.
2. With the engine ignition key in the "on" position, check to be sure that these controls latch (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.*

The throttle control consists of cables and clevis ends. Adjustment is dependent on cable travel and the adjusted length of the clevis rods. Adjustment is not required as long as the full range of engine rpm is available in response to control input.

No adjustments are possible. In the event of malfunction, check for electrical continuity and air supply.

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 engine 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. Drain the raw water system and leave the drain cocks open.
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. Refer to Cummins 018-026 Diesel Exhaust Fluid Recommendations and Specifications document.
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 NEW UNITS

New units contain preservative oil when shipped for Funk and can be safely stored for 6 weeks without further treatment. Refer to the Funk Transmission manual for additional information.

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, Chicage, 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. See chart below

TRANSMISSION TYPE	RECOMMENDED FLUID
1. ALLISON 3000 & 4000 Series Auto	TES 295
2. EATON-FULLER MANUAL	SAE 40 or SAE 50 (must meet CAT TO-4 requirement)

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 SPECIFICATION-T300-1, T500-1 & T780

Main Winch-T300-1 & T500-1

STD.-5/8" dia. 6X19 OR 6X37 CLASS

IWRC REG. LAY WIRE ROPE

MINIMUM BREAKING STRENGTH-17.9 TONS

OPT.- 5/8" ROTATION RESISTANT

COMPACTED STRAND 18X19 OR 19X19

MINIMUM BREAKING STRENGTH 22.7 TONS

Auxilary Winch-T300-1 & T500-1

STD.-5/8" dia. 6X19 OR 6X37 CLASS

IWRC REG. LAY WIRE ROPE

MINIMUM BREAKING STRENGTH-17.9 TONS

OPT.- 5/8" ROTATION RESISTANT

COMPACTED STRAND 18X19 OR 19X19

MINIMUM BREAKING STRENGTH 22.7 TONS

Main Winch-T780

STD.-3/4" dia. 6X19 OR 6X25 CLASS

IWRC REG. LAY WIRE ROPE

MINIMUM BREAKING STRENGTH-25.6 TONS

OPT.- 3/4" ROTATION RESISTANT

ROTATION RESISTANT COMPACTED STRAND BRIDON-DYFORM 34LR 1960

MINIMUM BREAKING STRENGTH 34.51 TONS

Auxilary Winch-T780

STD.-3/4" dia. 6X19 OR 6X25 CLASS

IWRC REG. LAY WIRE ROPE

MINIMUM BREAKING STRENGTH-25.6 TONS

OPT.- 3/4" ROTATION RESISTANT

P/N 12261-683 REVISED: January 2015

T300-1_T500-1_T780
Specifications

ROTATION RESISTANT COMPACTED STRAND BRIDON-DYFORM 34LR 1960

MINIMUM BREAKING STRENGTH 34.51 TONS

P/N 12261-683 REVISED: January 2015

Troubleshooting

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.

On the T300-1 and T500-1 the diverter valve should be checked by using a test gauge on the test port and activating the outrigger controls. If pressure (2500 psi) is indicated, the spool is shifting. The T775 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.

If the spools shift, see page 5-26, “Outrigger Circuit”.

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.

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

HEAVILY WORN STEERING ARM BALL STUD

CAUSE	REMEDY
Inadequate or improper lubrication	Consult lubrication chart for proper lubricant, lubrication intervals and procedures
Spring and seat in drag link worn	Replace spring and seat, replace ball stud

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
Clogged oil filter in reservoir (high back pressure)	Replace filter. Increase change frequency
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 or install larger steering gear
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
Pitman arm ball worn “egg-shaped”	Replace pitman arm assembly where riveted ball is used or only where bolted ball is used (vertical socket)
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

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

Engine Clutch

CLUTCH SLIPPAGE

CAUSE	REMEDY
Insufficient clutch pedal free play	Adjust release bearing position, then adjust linkage if necessary
Damaged cable	Replace cable
Linkage blocked from complete return	Remove blockage
Linkage needs lubrication	Lubricate linkage
Release bearing locknut loose	Adjust release bearing length and tighten locknut
Worn clutch disc facings	Replace clutch disc
Worn or damaged flywheel	Resurface or replace flywheel
Worn or damaged clutch pressure plate	Replace pressure plate and cover assembly
Grease or oil contamination on facings	Clean facings and repair cause of contamination. If contaminant cannot be removed, replace clutch disc.
New clutch installation needs break-in	Perform clutch break-in procedure

CLUTCH DRAG/HARD SHIFTING

CAUSE	REMEDY
Linkage blocked from full travel	Remove blockage
Linkage incorrectly adjusted	Adjust clutch linkage
Linkage worn/damaged	Replace faulty linkage components
Clutch damaged - damaged clutch disc hub splines - bent clutch disc - bent drive straps - broken/warped pressure plate	Replace damaged component
Contamination/grease in release bearing bore	Clean release bearing bore and transmission input shaft
Excessive side loading on release bearing	Eliminate source of excessive side loading (worn/damaged cross shaft bushings, worn/damaged cross shaft, worn/damaged or bent release yoke tips, worn/damaged or uneven release bearing yoke contact wear pads, excessive release bearing travel during disengagement, worn/damaged pilot bearing, excessive flywheel runout, excessive engine to transmission misalignment, etc.).

Failed pilot bearing	Replace pilot bearing and input shaft if damaged.
Transmission input shaft splines worn/ damaged	Replace input shaft.
Tight or contaminated clutch disc splines	Clean clutch disc and input shaft splines or replace clutch disc as necessary
Flywheel housing to clutch housing excessive misalignment	Replace faulty housing
Grease or oil contamination on facings	Clean facings and repair cause of contamination. If contaminant cannot be removed, replace clutch disc.

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

Swng 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”

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
Steer pump worn or damaged	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. With engine shut off, hold or tie the telescope foot pedal in the full "extend" position for approximately 15 minutes.
4. 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.

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 anti-two block 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.)

ANTI-TWO BLOCK 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.

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.

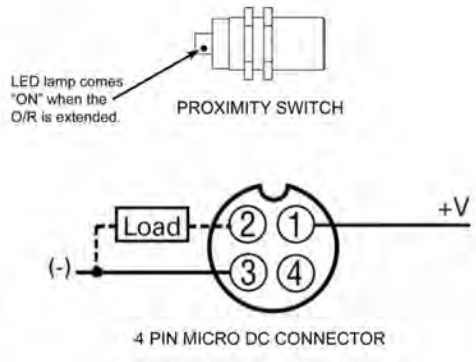
Keep parts in order when large components are disassembled, particularly so when it has a great number of similar parts. Loosely reassemble assemblies whenever possible to prevent small parts from being lost. Keep subassembly parts together, but be careful not to get right and left hand parts mixed up.

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.

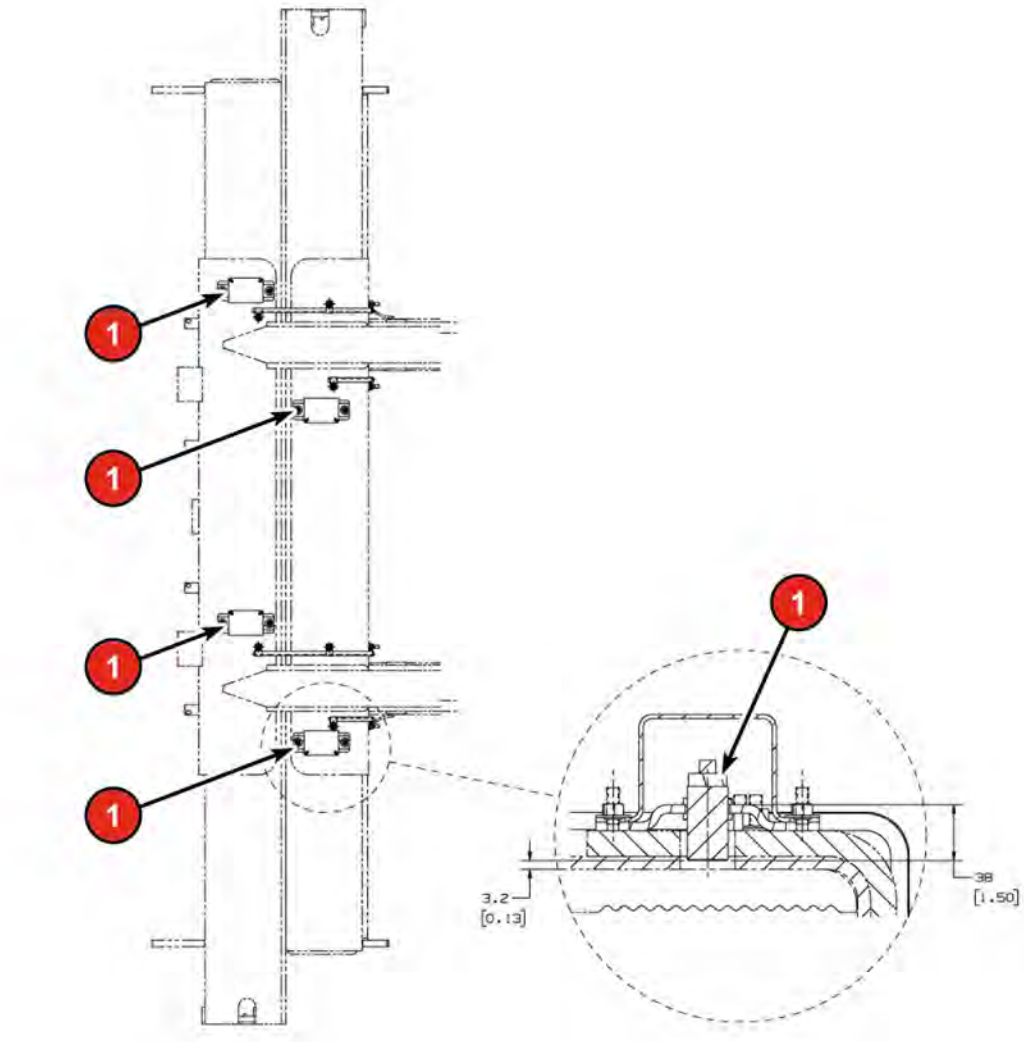
Bolts and nuts should be placed into their respective holes when removing guards, cases, etc. so that proper bolt will be on hand when reassembling these parts.

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.



SENSOR CHARACTERISTICS & SETTING	
OUTPUT TYPE	NORMALLY CLOSED
SENSING RANGE	15 MM
MINIMUM OPERATING VOLTAGE	6 VDC
MAXIMUM OPERATING VOLTAGE	48 VOLTS
MINIMUM OPERATING TEMPERATURE	-40C
MAXIMUM OPERATING TEMPERATURE	+70C
MINIMUM LOAD CURRENT	200 MA
AIR GAP SETTING	0.12" (3.2 mm)



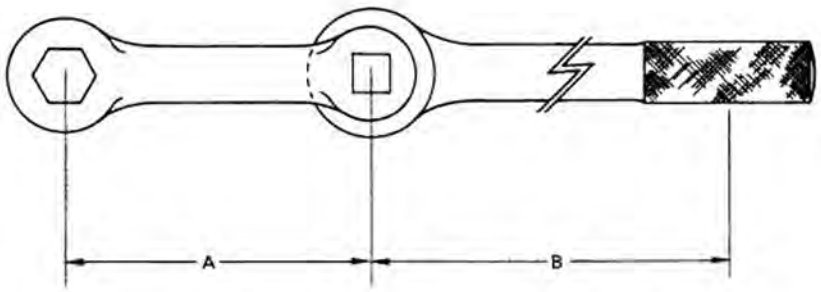
1. Proximity Sensor-Outrigger Position

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")

$$\text{TWS} = \frac{\text{(600 ft.lb.) X 43"}}{\text{43" + 10.25"}} =$$

$$\frac{25,800}{53.25} =$$

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 ANSI/AWS D14.3 when welding on load sustaining members (ANSI/ASME B30.5). Refer to ISO 2553 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.

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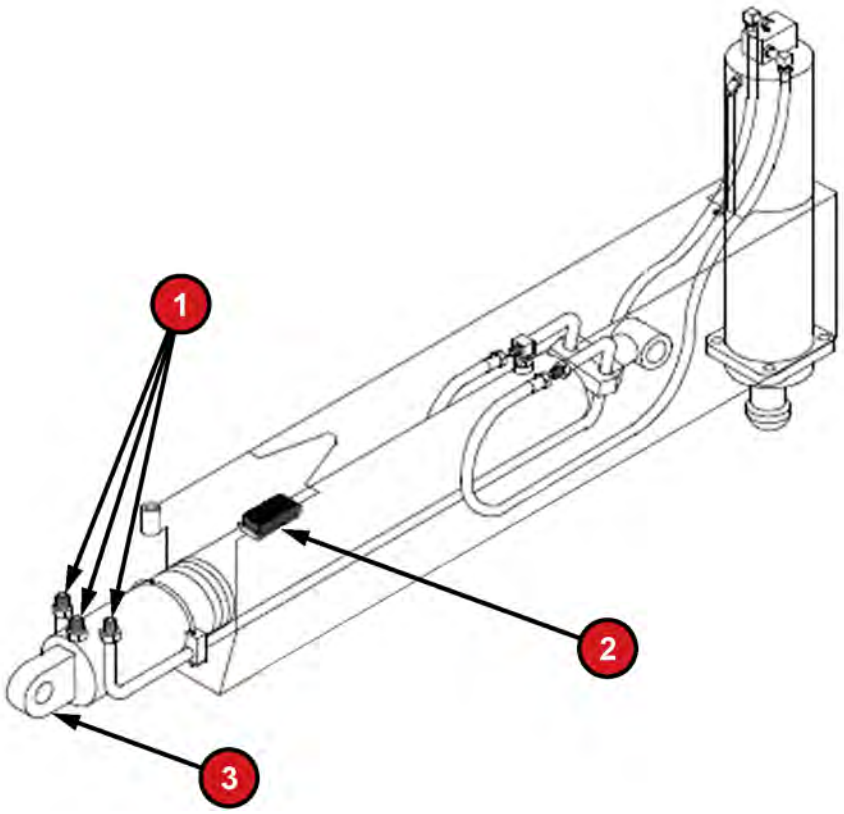
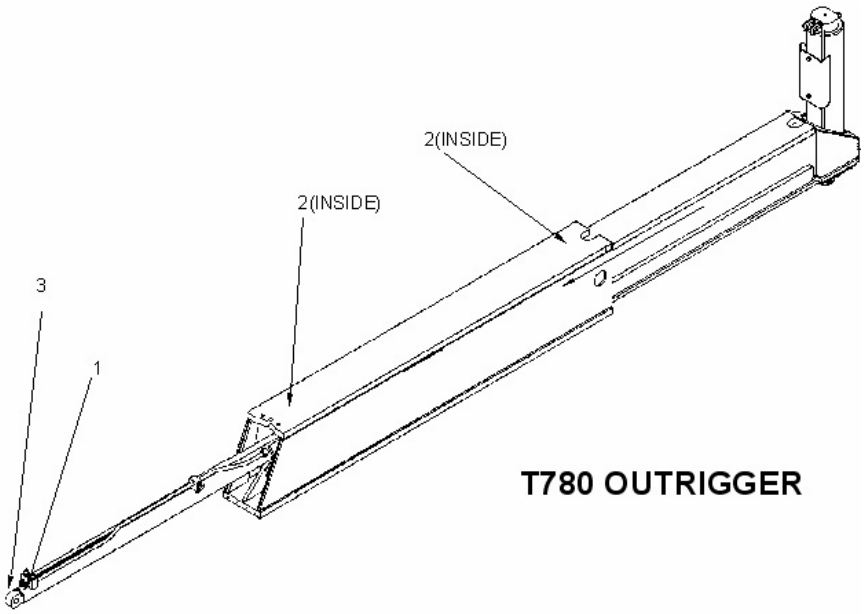
Outriggers

T300-1 & T500-1 -Use single beam outriggers as shown below.



1. Hose Disconnects
2. Wear Pad
3. Outrigger Extend Cylinder Deadend

T780-Use a double beam outrigger as shown below.



T780 OUTRIGGER

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)

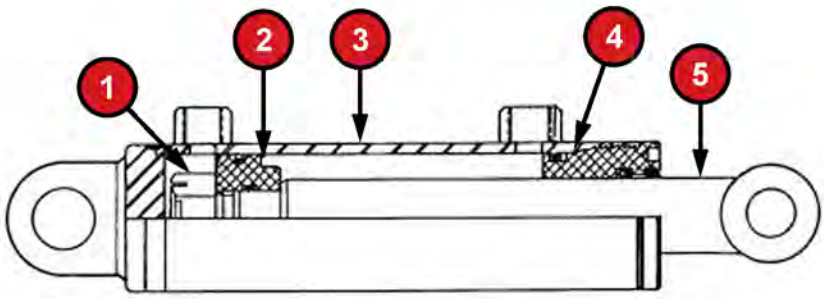
A wear pad (2) is mounted on the back end of each outrigger beam to prevent the beam from gouging the outrigger box when extending or retracting the outrigger beams. The wear pad (2) can be reached when the outrigger beam is fully retracted. The wear pad (2) can be replaced by removing one bolt.

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.

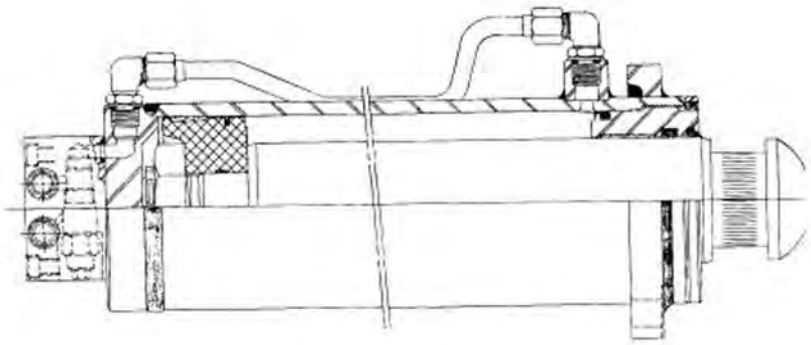
4. Remove the piston retaining nut (1) and slide the piston (2) and head gland (4) off the rod (5).

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.*

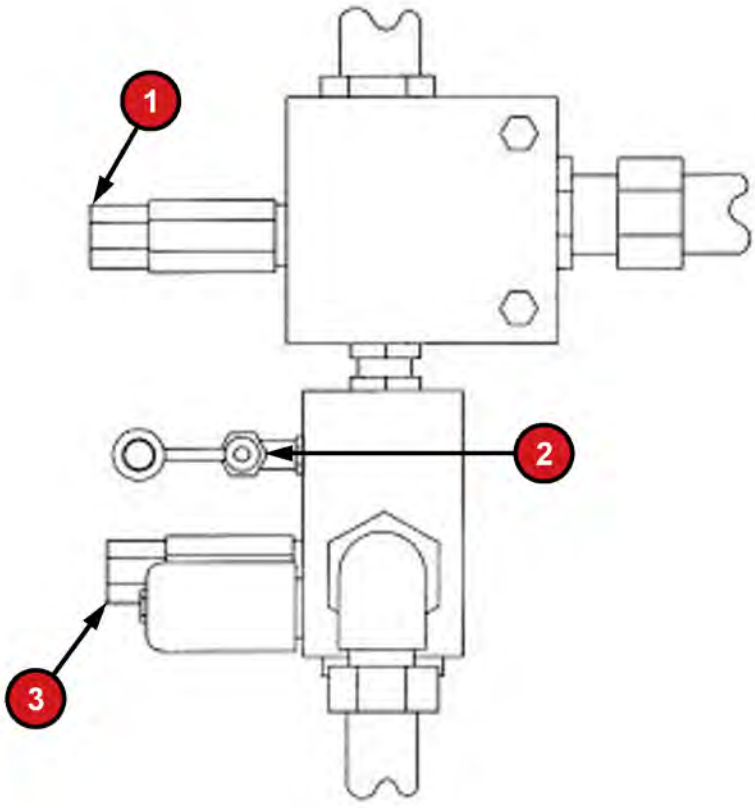
Replace O-rings, wear rings, seals or other components as required.

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. T300-1 & T500-1 Outrigger Relief Valve
2. Test Port
3. Bottom This Relief Valve

T300-1 & T500-1 DIVERTER VALVE ADJUSTMENT

The diverter valve regulates the flow of hydraulic oil to the outrigger control and should maintain a pressure setting at 2500 psi. Check the diverter valve relief pressure using the following procedure:

1. Operate the boom over relief to warm the oil if necessary.
2. Attach a calibrated pressure gauge in the test port (2).

   NOTE: *The test port (2) is located on the outrigger diverter valve which is mounted on the inside of the left frame rail just ahead of the swing bearing.*

3. Stall an outrigger function over relief by retracting either a beam or jack and continuing to hold the function at full engine RPM. The relief setting should be 2500 psi ±50 psi. If necessary, adjust the relief valve (1).

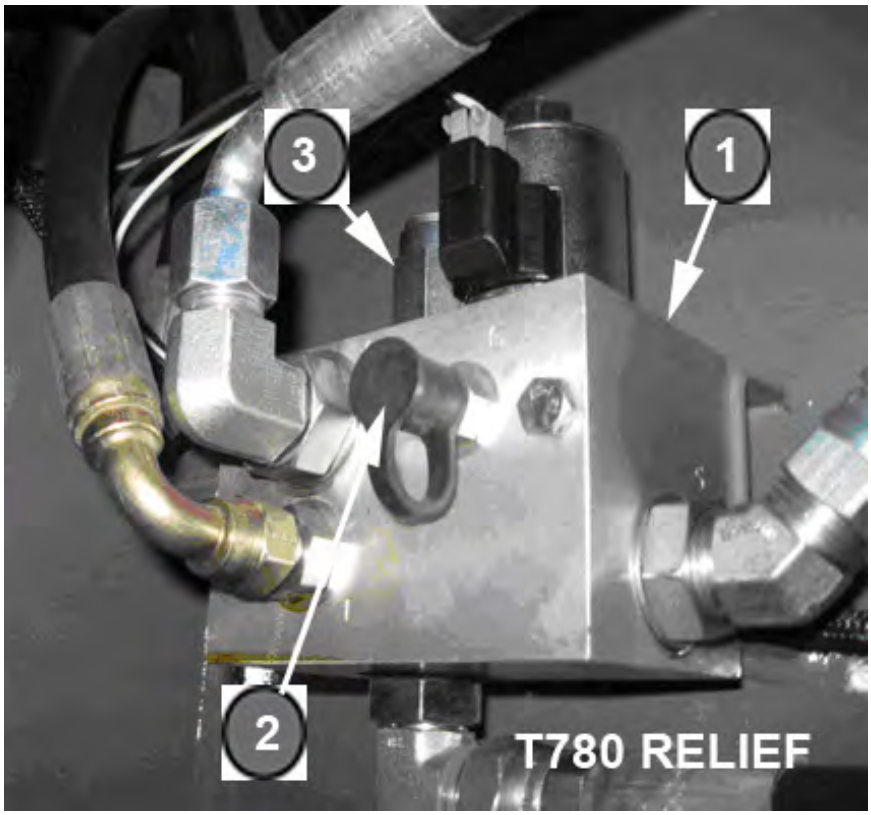
T300-1 & T500-1 OUTRIGGER RELIEF VALVE ADJUSTMENT

Adjust this relief using the following procedure:

NOTE: *There are two relief valves shown in the illustration. The relief valve in the lower valve section (3) is not used and should be deactivated by turning it in until it bottoms out. This should be checked prior to setting the outrigger relief valve.*

Loosen the jam nut on the relief valve. Adjust the relief with the adjusting screw while fully retracting and continuing to hold an outrigger jack or beam with the engine at full RPM. Screw in the adjustment to increase the pressure and out to decrease it. Set the pressure at 2500 psi ± 50 psi.

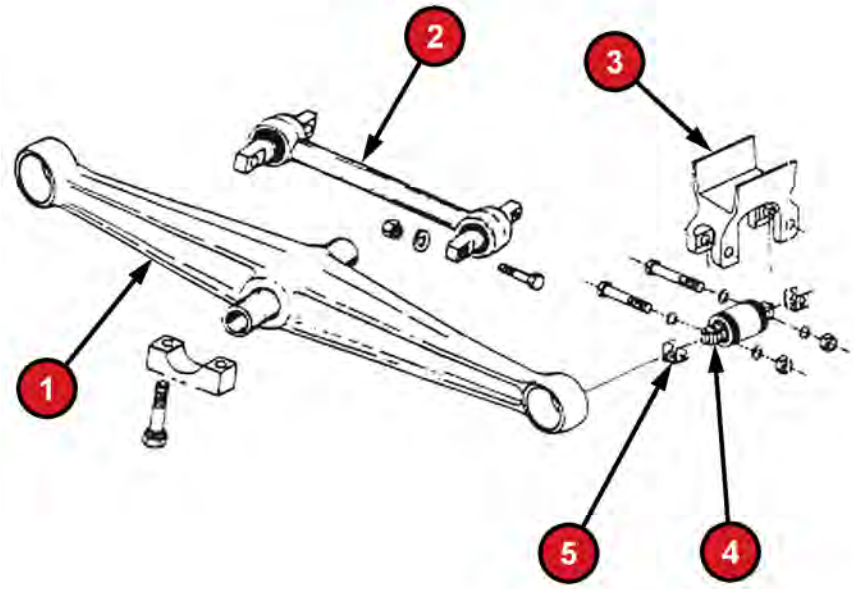
Recheck the pressure setting after tightening the jam nut as the pressure may change due to tighten the nut.



1. T780 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 ISTALLATION

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.

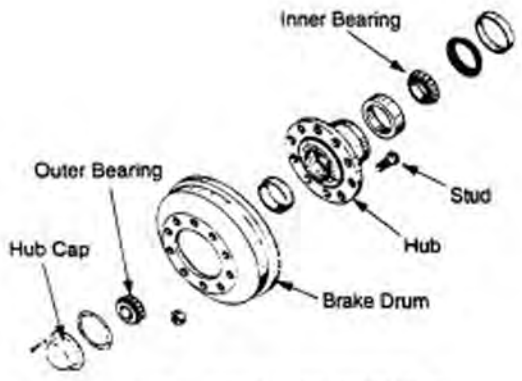
Torque the adjusting nut to 50 ft. lbs. while rotating the wheel in both directions to ensure that all bearing surfaces are in contact. Then, back off the adjusting nut 1/ 8 to 1/6 turn and cotter pin the nut.

End play must be within the limits of .001” to .010” loose.

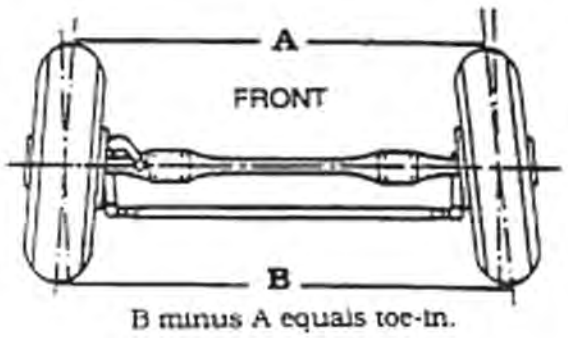
TOE-IN ADJUSTMENT

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.

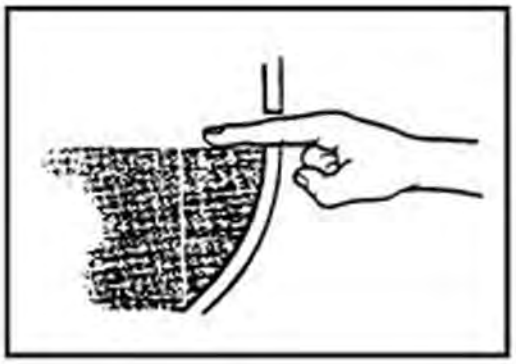
5. Position trammel bar at rear of tires and adjust pointers to line up with scribe lines and lock in place. (Repeat for front of tires.)
6. Read toe-in (or toe-out) from scale. The recommended loaded toe-in is 1/32” - 1/16”.

NOTE: *Set radial tires from 0 to 1/32”.*

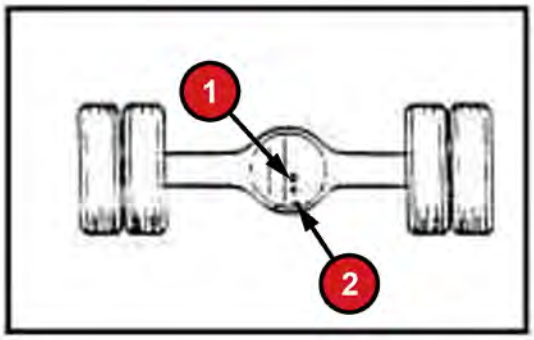
Rear Axle

MAINTENANCE CHECK

As a part of MONTHLY MAINTENANCE CHECK, inspect the differential oil level by removing the fill-and-check plug in the rear cover of each differential housing. The oil should be level with the bottom of the hole. 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. The five minute interval allows the oil to settle to the proper levels in the power divider case and axle housing. It is not necessary to check the oil level in the power divider. If the oil level is up to the bottom of the rear filler hole, 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 is level with the bottom of the filler hole in the rear cover. Next, add two (2) more pints through the forward filler hole located slightly offset to the right in the top portion of the differential carrier. Never use the rear hole at the top of the differential as an oil filler hole. Fill the rear driving axle through the rear filler hole until oil flows from the bottom of the hole. After filling, be sure all plugs are reinstalled.

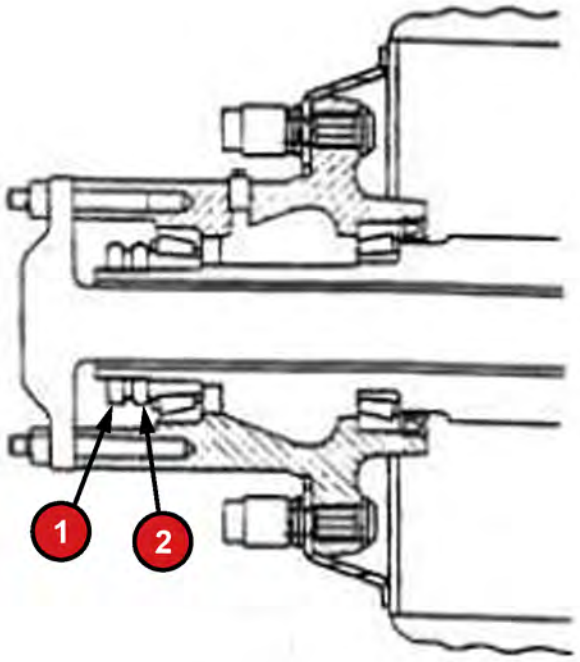


1. Fill Hole	2. Temperature Sensor Mounting Hole

As part of the SEMI-ANNUAL MAINTENANCE CHECK, completely drain the oil from the rear axle by removing the plug at the bottom of the differential and the plug at the bottom of the power divider. Replace the plugs and fill differential through rear filler hole. Add two (2) pints of oil through the forward filler hole at the right top portion of the differential carrier. Refer to Section 9 for the recommended lubricant.

WHEEL BEARING ADJUSTMENT

Remove the lock nut (1) from the hub spindle prior to adjustment. Tighten the inner nut (2) while turning the wheel in both directions to ensure that all bearing surfaces are in contact. Tighten until there is a slight bind, then, back off inner nut (2) 1/6 turn (wheel should rotate freely). Install and tighten lock nut (1). End play should be within .001” to .005”.



REAR BEARING ARRANGEMENT

1. Lock Nut	2. Adjusting Nut

Propellor Shaft & Universal Joints

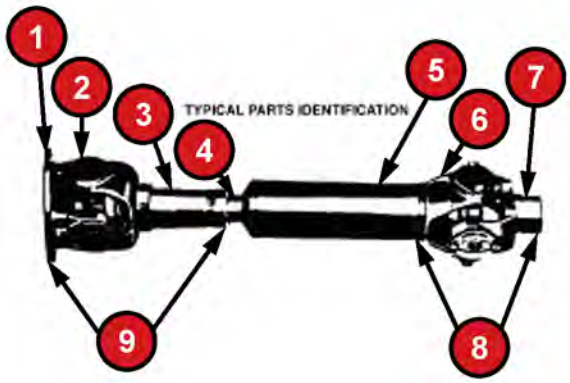
The drive train on this machine incorporates three drive shafts and five universal joints:

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

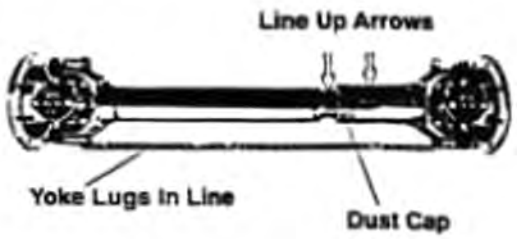
Remove the capscrews and bearing caps from the intermediate axle end yoke. Remove capscrews, lock plates, and bearing caps from rear end yoke of front shaft. Remove the second shaft with journal crosses and remaining bearings as a unit. Intermediate axle end yoke remains on machine.

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.

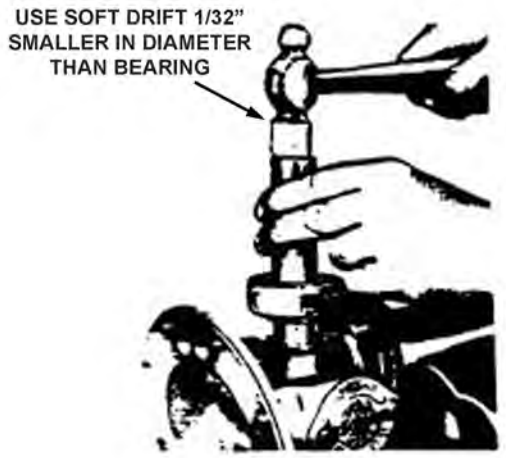
UNIVERSAL JOINT DISASSEMBLY

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

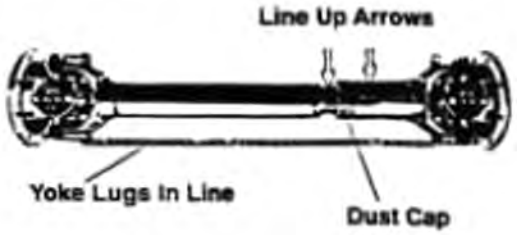
The installation of the drive shaft into the carrier does not present any unusual mechanical difficulties. Before actual installation, the drive shaft should be checked for the following items:

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.

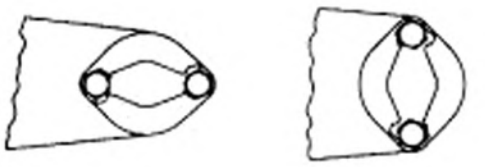
SLIP JOINT ASSEMBLY

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.

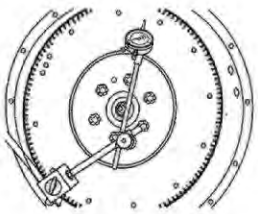
Engine Clutch Adjustment & Repair

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:

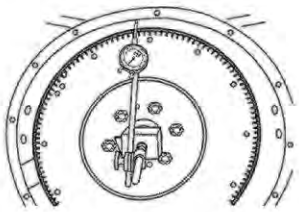
Flywheel Face Runout

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).



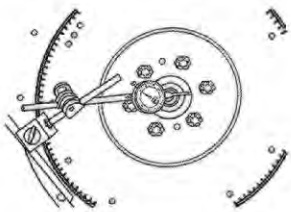
Flywheel Housing I.D. Runout

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).



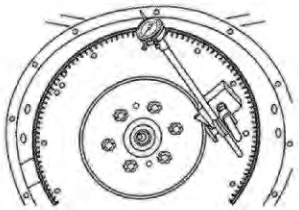
Pilot Bearing Bore Runout

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

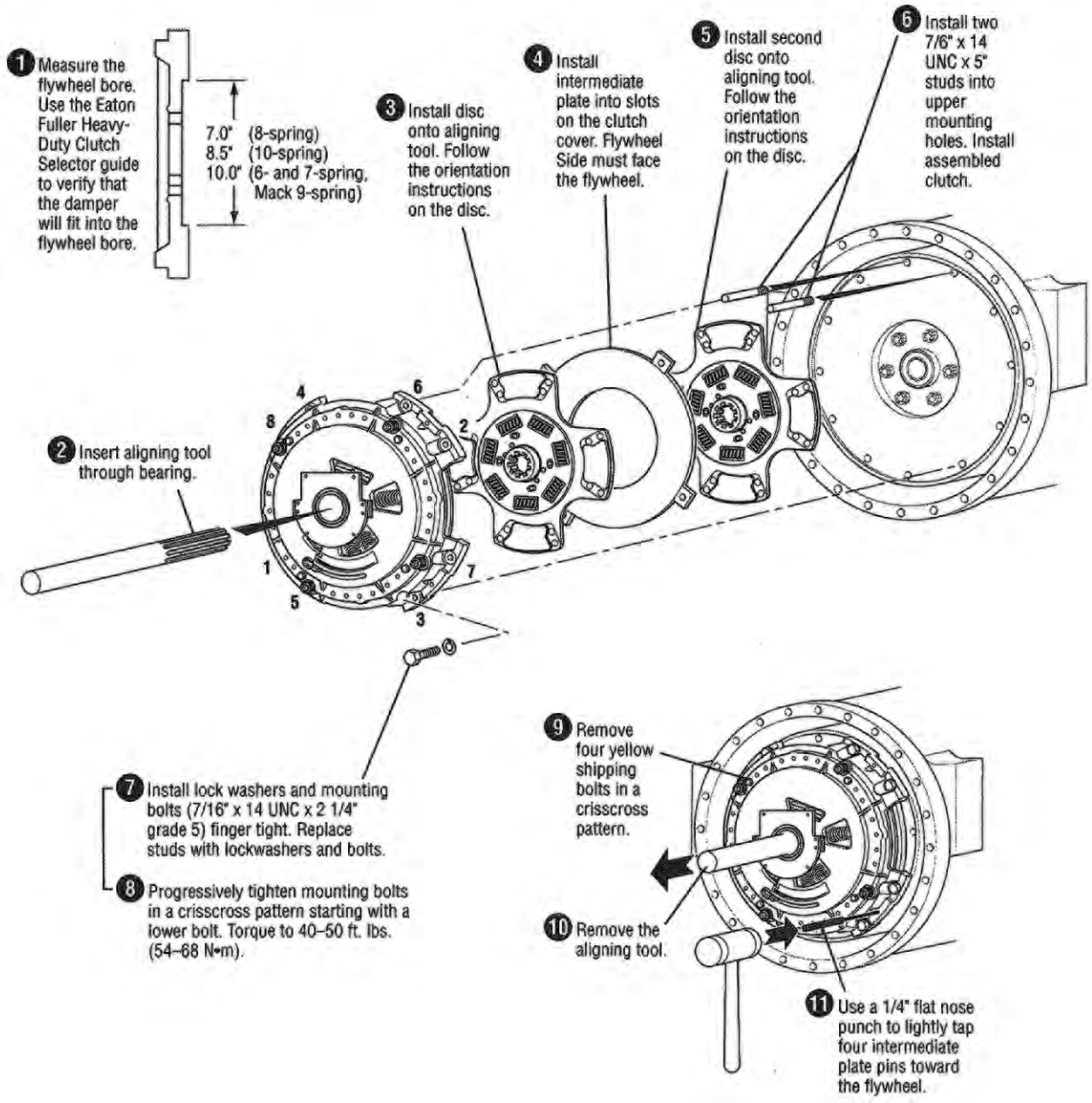
Secure dial indicator base to flywheel near the outer edge. Put gauge finger in contact with face of flywheel housing. Rotate flywheel one revolution. Maximum runout is .008" (.20 mm).



TEREX®

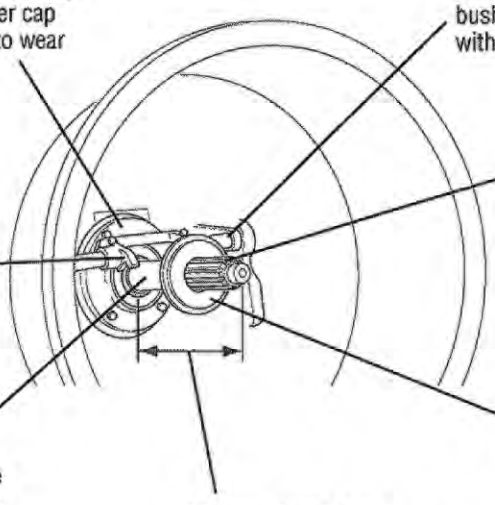
IMPORTANT: Use the Eaton Fuller Heavy-Duty Clutch Selector guide (CLSL-1299) to make sure you have the right clutch!

CAUTION: An assembled clutch weighs about 150 lbs. (68 kg). Avoid the risk of injury. Use proper equipment when lifting a clutch.



T300-1_T500-1_T780
Service / Parts

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.

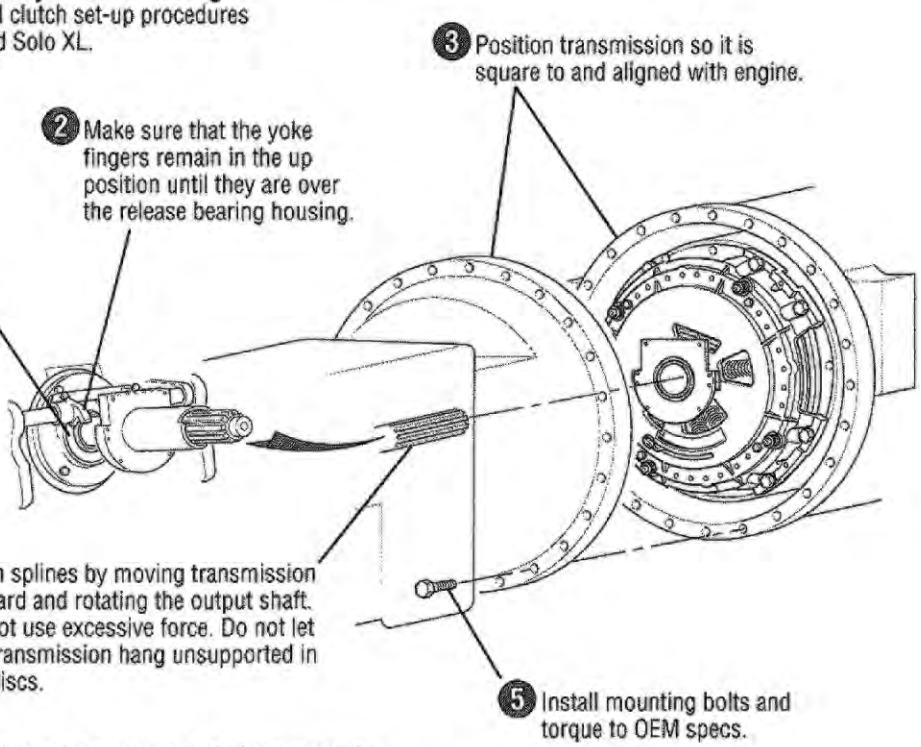
Input Shaft Splines
Any wear on the splines will prevent the driven discs from sliding freely, causing poor clutch release (clutch drag). Slide discs full length of shaft to check for twisted shaft splines.

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.

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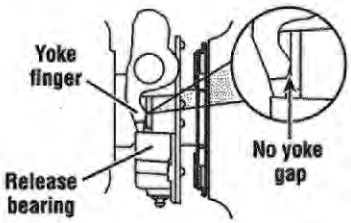
TEREX®

Adjust Clutch Linkage

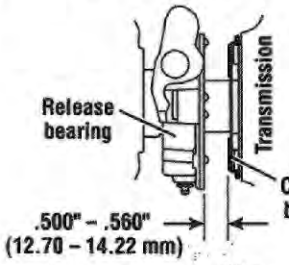
NOTE: Clutch set-up procedures are the same for the Solo and Solo XL.

1. Adjust the clutch linkage until the yoke fingers contact the release bearing (zero free-play in the cab).



2. Fully press the pedal up to 5 times to move the release bearing slightly closer to the transmission and gain free-play in the cab.

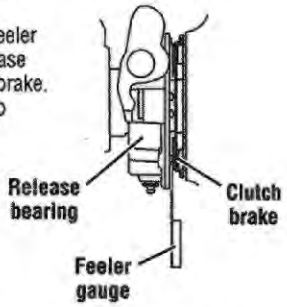
3. Measure the distance between the release bearing and the clutch brake. The correct distance should be .500" – .560" (12.70 – 14.22 mm)



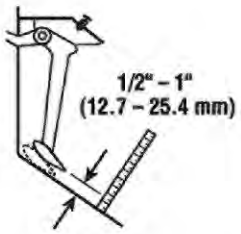
- If the distance is more than .560" (14.22 mm) return to **Step 1** and readjust the clutch linkage.
- If the distance is less than .500" (12.70 mm) consult Solo Troubleshooting Guide (CLTS-1295).

Verify Clutch Brake Squeeze

4. Insert .010" (.25 mm) feeler gauge between the release bearing and the clutch brake. Press the pedal down to clamp the gauge.
   - If the gauge does not clamp, return to **Step 1** and readjust the clutch linkage.

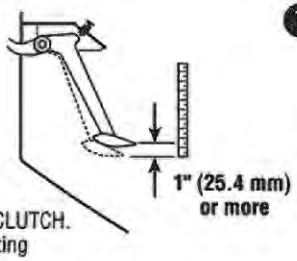


5. Slowly let up on the pedal and check the pedal position at the moment the gauge can be removed.
   - If the pedal is less than 1/2" (12.7 mm) or more than 1" (25.4 mm) from the floor when the gauge can be removed, readjust the clutch linkage. (Repeat steps 4 and 5.)



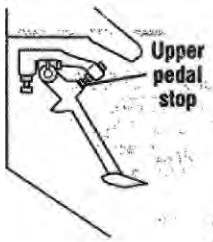
Verify Free-Play

6. Measure the free-play in the cab. The distance must be 1" (25.4 mm) or more.
   - If the free-play distance is not 1" (25.4 mm) or more, go to **Step 7** and change the free-play.



IMPORTANT: DO NOT RESET THE CLUTCH. Do not change free-play by readjusting the clutch linkage.

7. To change the free-play, adjust the upper pedal stop to raise or lower the pedal in the cab.



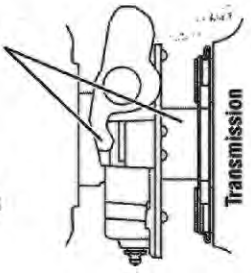
Lubricate

NOTE: All others use a lithium soap base E.P. (Extreme Pressure) grease with a minimum of 325°F (163°C) operating range meeting N.L.G.I. grade #2 or #3 specs.

NOTE: Apply ample grease that visibly exits the opening and contacts the transmission shaft. This will lube the clutch brake when pedal is pressed.

8. Apply grease to the input shaft and yoke fingers.

9. Apply grease to the cross shaft bushings and linkage pivot points.



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.

Excessive clutch pedal lash or free travel may prevent complete clutch disengagement, while insufficient clutch pedal lash or free travel will cause slippage and short clutch life

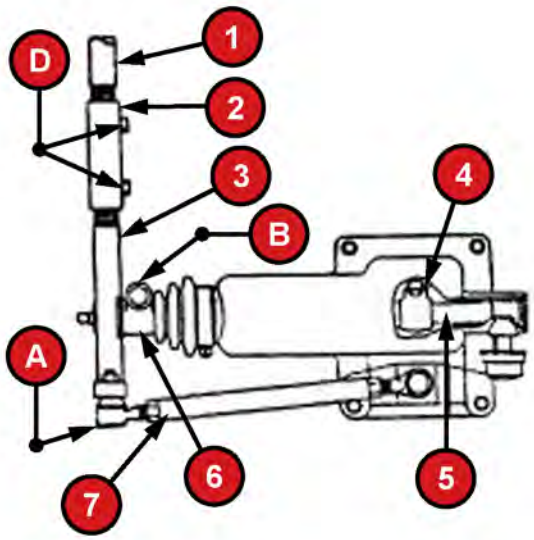
Shift Control Adjustment

Proper adjustment of the L.R.C. is necessary for smooth shift linkage operation. Use the procedure listed below to insure correct adjustment. The steps should be followed as listed to avoid confusion and prevent mistakes.

MOVE THE INNER SHIFT FINGER TO THE NEUTRAL POSITION

Move gear shift lever forward or backward to the neutral position.

Move the gear shift lever sideways, toward reverse, until you feel resistance from the reverse plunger spring. DO NOT overcome the spring tension and shift to reverse. The shift finger must remain in this position while you are making all the adjustments.



1. REACH ROD	2. TURNBUCKLE
3. SELECTION LEVER	4.INNER SHIFT FINGER
5. INNER SHIFT SHAFT	6. SHIFT ARM
7. PIVOT LINK ASSEMBLY	

ADJUST THE SLAVE UNIT

Remove the cotter pin, castle nut, and ball joint A from the selection lever. Do not remove the ball joint from the pivot link.

Loosen capscrew B and remove shift arm from inner shaft. Do not disconnect the selection lever from the shift arm.

Turn the shift arm until it is at a right angle (90°) to the selection lever as viewed from the side.

NOTE: *Ideally, the shift arm should be adjusted 90° to the selection lever as described, but in some chassis configurations, it may be necessary to index the shift arm in the vertical position. This is done to prevent a shift lever jump out complaint. This type of adjustment will cause an unequal amount of gear shift lever travel between neutral and a forward lever position as compared to neutral and a rearward lever position.*

Re-install the shift arm on the splines of the inner shift shaft. You may have to move the shift arm 4 or 5 degrees to align the splines of the two parts. Disregard any movement of the gear shift lever at this point. You will adjust the gear shift lever later.

Tighten capscrew B

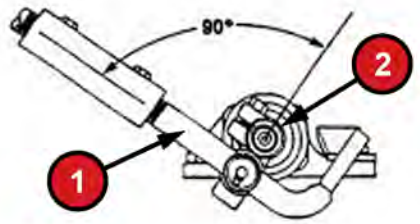
Re-connect pivot link assembly ball joint to selection lever. Secure with castle nut and cotter pin.

Loosen jam nuts C on pivot link.

Check to be sure the inner shift finger is still in place as described above.

Rotate pivot link until curved end of selection lever is parallel with the shift arm as viewed from the rear.

Tighten pivot link jam nuts C.



1. SELECTION LEVER	2. SHIFT ARM

ADJUST GEAR SHIFT LEVER NEUTRAL POSITION

Loosen both capscrews on turnbuckle D

Check to be sure inner shift finger is still in place as described above.

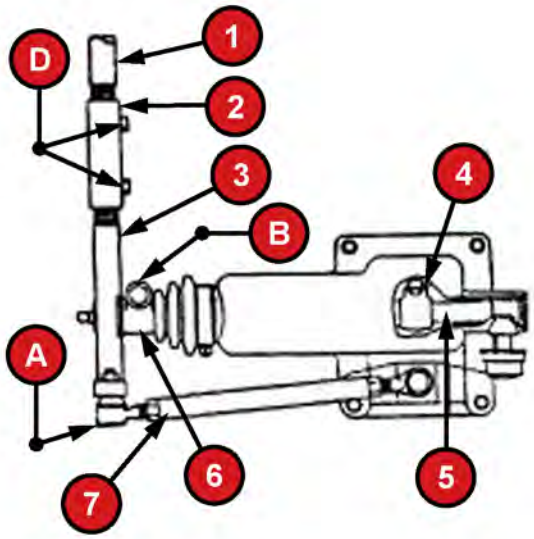
Rotate turnbuckle to obtain proper forward-backward neutral position of the gear shift lever in the cab.

Tighten one turnbuckle capscrew D

Move gear shift lever to desired left-right neutral position.

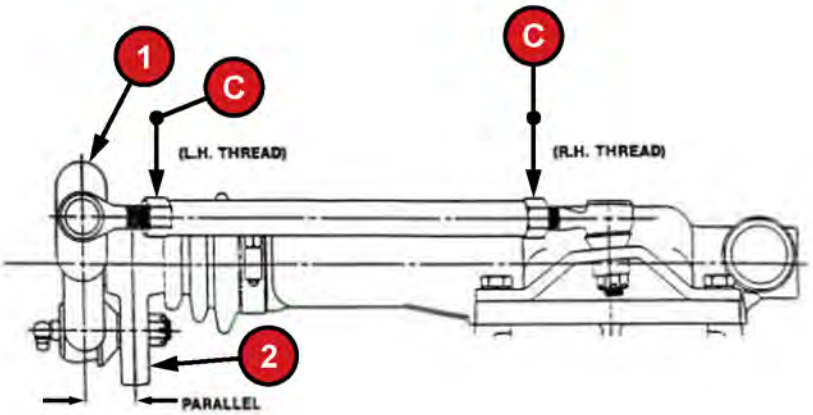
Tighten second turnbuckle capscrew D

Check for linkage obstructions in all gear positions.



1. REACH ROD	2. TURNBUCKLE
3. SELECTION LEVER	4.INNER SHIFT FINGER
5. INNER SHIFT SHAFT	6. SHIFT ARM
7. PIVOT LINK ASSEMBLY	

T300-1_T500-1_T780
Service / Parts



1. SELECTION LEVER	2. SHIFT ARM

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Steering and Power Steering

STEERING STOP ADJUSTMENT

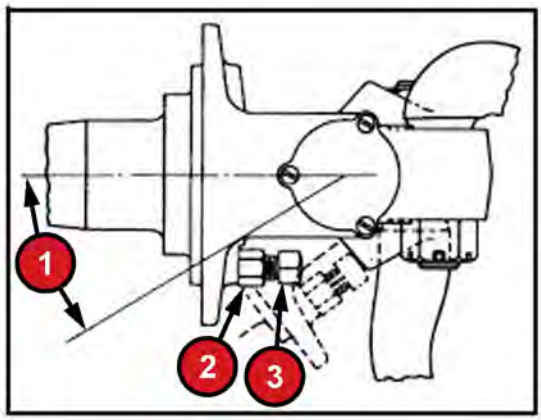
An initial stopscrew (3) adjustment is made on all steering axles to obtain maximum turning angle (1). However, because a power steering unit has been added, the stop screw (3) should be reexamined to assure that the adjustment is such that the power steering unit will not override the axle stop.

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	

POWER STEERING MAINTENANCE CHECK-(T300-1 ONLY)

On a SEMI-ANNUAL basis, remove the reservoir cover and filter element. Clean the inside of the reservoir with a lint-free cloth. Install a new filter element, refill with oil and replace the cover.

When filling, start the engine. With the engine running, turn the steering wheel from left to right and continue filling until proper level is maintained. Refer to Section 4 for other lubrication recommendations.

Swing Reducer

MAINTENANCE CHECK

On a WEEKLY basis, check the swing reducer oil level. See section 4 for the type of oil recommended.

DISASSEMBLY

1. Remove the upper cover along with the brakes and motor. Examine the ring gear bolted to the cover and the seal located in brake housing.
2. Lift out the upper planet carrier and examine gears, roller bearings, and bronze thrust bushings for wear. Replace if necessary
3. Replace the thrust bushing located between the planet carriers if necessary.
4. Examine lower planet carrier gears, roller bearings, and bronze thrust bushings for wear. Replace if necessary.
5. Examine thrust bushings located between input gear and lower planet drive gear. Replace if necessary.
6. The lower planet carrier is splines to the output shaft. Remove the cap and shims to disassemble the carrier, shaft, and lower case. Place shims aside for use in reassembly. Examine the roller bearings and lower seal. Replace if necessary.
7. The only adjustment necessary is to shim below the shaft retainer cap for proper bearing adjustment. Use the original shims (see step 6)

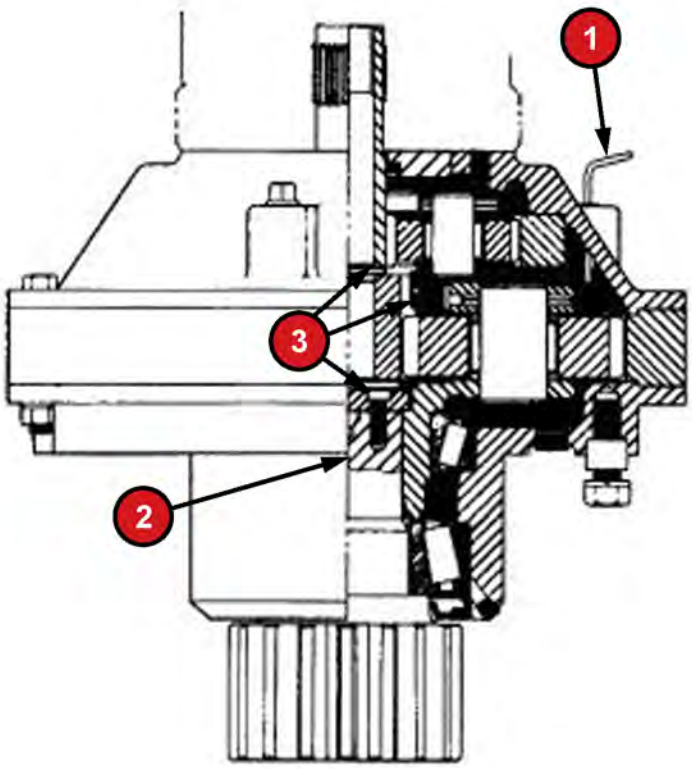
REASSEMBLY

After shimming as required, reassemble the unit by reversing the steps in the disassembly sequence.

Refer to Section 4 for quantity and type of lubricant.

BRAKE

Remove the motor and upper cover of brake housing to inspect or replace brake discs.



1. Swing Reducer Dipstick	2. Shim
3. Thrust Bushings	

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. Check the plug positions below for proper direction of rotation.

For P330 only - plug 5 required in position A and position B.

For P365: Plug in position B gives clockwise rotation. Plug in position A gives counter-clockwise rotation.

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. Be sure the correct engine speed is used, as 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:

T300-1	BOOM HOIST	SET TO:3500 psi
T500-1	BOOM HOIST	SET TO:3500 psi
T780	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.

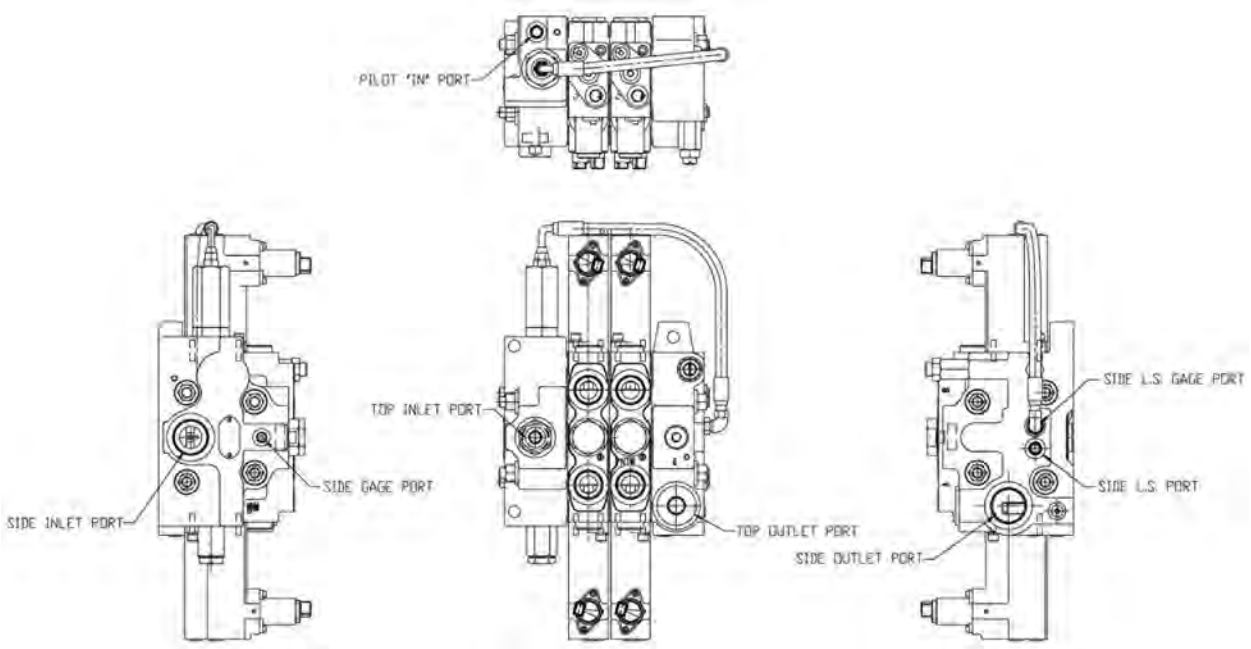
Set extend/retract by the following procedure:

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.

T300-1	MAIN & AUX WINCH	SET TO:3500 psi
T500-1	MAIN & AUX WINCH	SET TO:3500 psi
T780	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 T780 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.

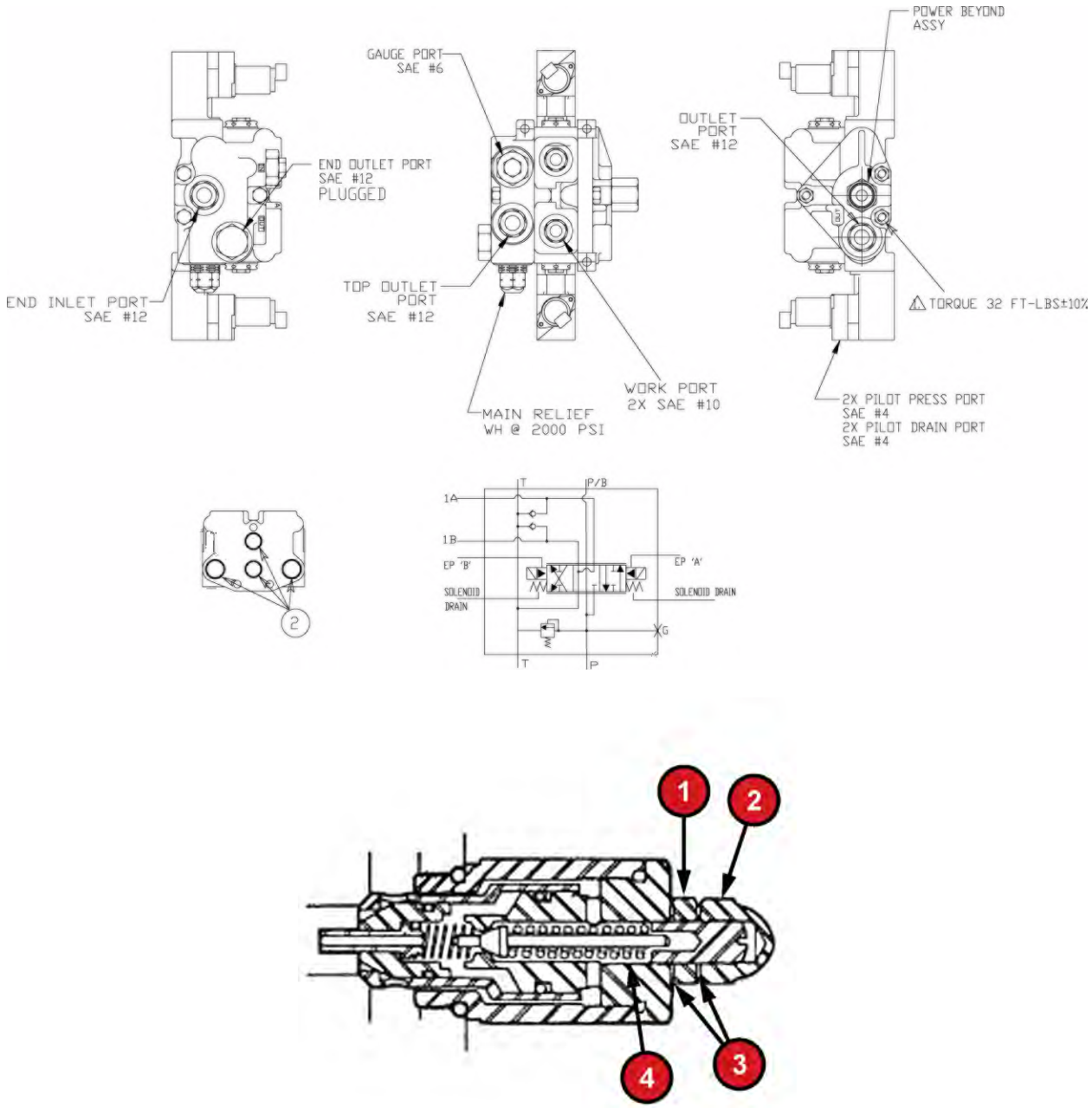
T300-1	SWING	SET TO:2000 psi
T500-1	SWING	SET TO:2500 psi
T780	SWING/AC/C'WT	SET TO: 3500 psi
T780	OUTRIGGERS	SET TO: 2500 psi

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.

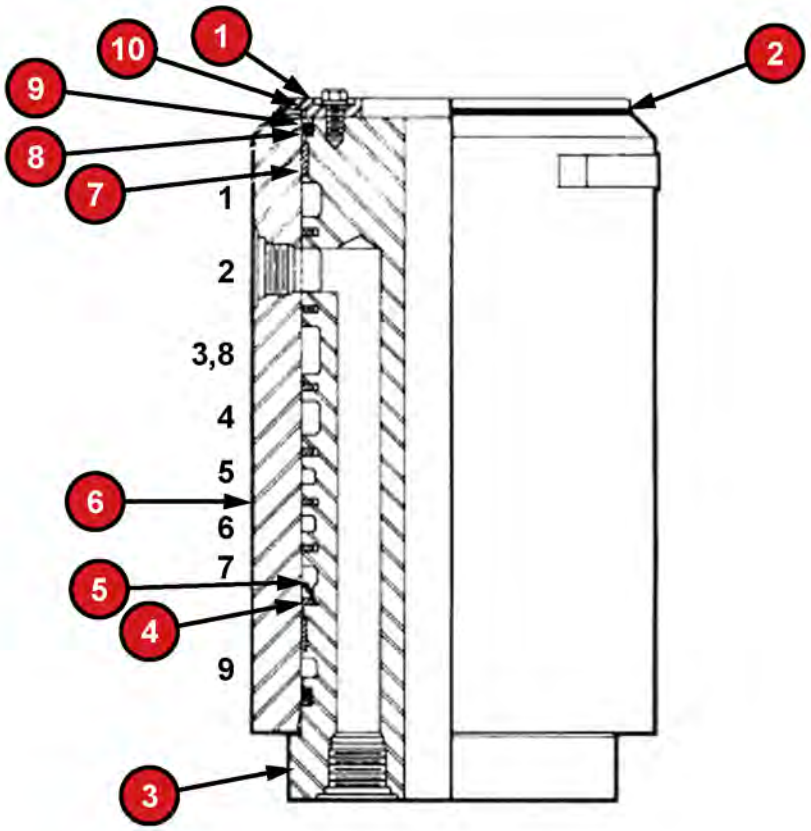
3. Set the outrigger extend/retract switch to the retract position and read the gauge. The relief is located above the outrigger diverter valve. Adjust to proper setting as listed in chart below:

T300-1	OUTRIGGERS	SET TO:2500 psi
T500-1	OUTRIGGERS	SET TO:2500 psi
T780	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

The cable and mechanical controls used on this machine are designed to require little or no adjustment. The use of standardized cable-mechanical linkage means that one adjustment procedure may be applied to several control functions. Should adjustment become necessary, refer to Group 28 of the Parts Book when making them.

The cables used on this machine are sealed. Never adjust a cable to the point that the threads on the rod end are pulled into the seal.

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.

SWING, WINCH, BOOM TELESCOPE, BOOM HOIST, VALVE CONTROL

The swing, winch, boom telescope, and boom hoist valve control linkages are all electro-proportional in operation. No adjustments should be required to the coil of each valve spool. The coil or electrical connection of the coil may need to be replaced if the valve fails to function. Check continuity of signal to the valve coils and that electrical contacts are clean and free of dirt and not having bent or misaligned terminals.

SHIFT CONTROL

No adjustments are possible. In the event of malfunction, check for electrical continuity.

THROTTLE CONTROL

The throttle control is electronic, see Cummins 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
TXCR-325 & 326	Kenway AC/HYD. Heater Manual-PRE 2010 Models
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 left-hand side of machine for the T300-1 and on the right-hand side for the T500-1 & T780. 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.

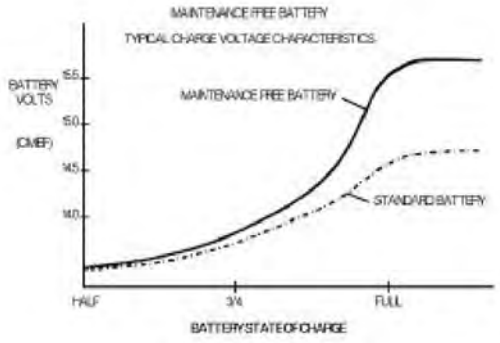
CHARGING MAINTENANCE-FREE BATTERIES

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.

It must be realized the maintenance-free batteries cannot be charged at ampere rates or periods of time greater than specified in the “12 Volt Maintenance-free Battery Charging Guide”. If the battery is charged more than specified, it loses water which cannot be replaced in some constructions so the life of the battery is shortened.

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.

COLLECTOR RING-49 CIRCUIT IDENTIFICATION CHART (2013 EPA ENGINE)

CIRCUIT #	COLOR	WIRE TAG #	FUNCTION		CIRCUIT #	COLOR	WIRE TAG #	FUNCTION
1	YEL	000AA	BATT		25	RED	024EA	PARK SWITCH

CIRCUIT #	COLOR	WIRE TAG #	FUNCTION		CIRCUIT #	COLOR	WIRE TAG #	FUNCTION
2	YEL	000AB	BATT (ACC)		26	YELLOW	025EA	STEER SWITCH
3	YEL	000AC	BATT		27	GREEN	026EA	STEER SWITCH
4	BLACK	016AA	GROUND		28	BLACK	203AB	WARN SWITCH
5	WHITE	015AA	START		29	YELLOW	063AJ	CLEARANCE LIGHTS
6	RED	017AB	IGNITION SUPPLY		30	YELLOW	091AA	FRONT JACK EXT.
7	BLUE	067AG	RCL POWER		31	BROWN	204AA	REGEN LAMP.
8	REDW	153AE	RCL POWER		32	BROWN	206AA	ENGINE STOP
9	WHITE	001AA	O.R. EXTEND		33	RED	211AA	WTS
10	BLACK	002AA	O.R. RETRACT		34	RED	129AA	THROTTLE
11	RED	003AA	RIGHT REAR JACK		35	BLACK	130AA	THROTTLE +5V
12	YELLOW	004AA	LEFT REAR JACK		36	WHITE	131AA	THROTTLE SIGNAL
13	GREEN	005AA	RIGHT FRONT JACK		37	YELLOW	J1939AG	J1939 +
14	BLUE	006AA	LEFT FRONT JACK		38	GREEN	J1939AG	J1939 -
15	BROWN	007AA	REAR RIGHT BEAM		39	-	J1939AG	SHIELD
16	WHITE	008AA	LEFT REAR BEAM		40	GREEN	191BA	SHIFT
17	BLACK	009AA	RIGHT FRONT BEAM		41	YELLOW	102BA	SPARE
18	RED	010AA	LEFT FRONT BEAM		42	BLACK	103BA	SPARE

CIRCUIT #	COLOR	WIRE TAG #	FUNCTION		CIRCUIT #	COLOR	WIRE TAG #	FUNCTION
19	YELLOW	011AA	FRONT JACK PROX.		43	YELLOW	176	SPARE
20	BLUE	013AA	FRONT JACK RET.		44	GRAY	143BK	SHIFT COM
21	BLACK	016AB	GROUND		45	BLUE	192BA	REVERSE
22	BLUE	020AA	E-STOP		46	TAN	194BA	FORWARD
23	BROWN	021AA	E-STOP		47	GREEN	315BA	SHIFT LT
24	BLACK	023EA	SPARE		48	WHITE	500AA	OR POSITION
					49	WHITE	501AA	OR POSITION

COLLECTOR RING-48 CIRCUIT IDENTIFICATION CHART (ROW - EXPORT ENGINE)

CIRCUIT #	COLOR	WIRE TAG #	FUNCTION		CIRCUIT #	COLOR	WIRE TAG #	FUNCTION
1	RED	0A	HOT		25	RED	24	REMOTE STEER
2	RED	0B	HOT		26	YELLOW	25	REMOTE STEER
3	RED	0C	HOT		27	GREEN	26	REMOTE STEER
4	BLACK	16A	GROUND		28	BLUE	55	FUEL GAUGE
5	WHITE	15	START		29	YELLOW	63	CLEARANCE LIGHTS
6	RED	17	IGNITION		30	BROWN	64	SPARE
7	BLUE	67	LMI POWER		31	RED	91	FRONT O.R.
8	YELLOW	153	CONTROL POWER		32	GREEN	201	ENGINE STOP
9	WHITE	1	O.R. RETRACT		33	BLUE	206	ENGINE WARNING
10	BLACK 2	2	O.R. EXTEND		34	BLUE	211	WAIT TO START
11	RED	3	RIGHT REAR JACK		35	BLACK	129	THROTTLE +5V

CIRCUIT #	COLOR	WIRE TAG #	FUNCTION		CIRCUIT #	COLOR	WIRE TAG #	FUNCTION
12	YELLOW	4	LEFT REAR JACK		36	RED	130	THROTTLE SIGNAL
13	GREEN	5	RIGHT FRONT JACK		37	GREEN	131	THROTTLE RETURN
14	BLUE	6	LEFT FRONT JACK		38	BLACK	J1939+	ENGINE COMMUNICATION
15	BROWN	7	REAR RIGHT BEAM		39	WHITE	J1939 -	ENGINE COMMUNICATION
16	WHITE	8	LEFT REAR BEAM		40	SHIELD	SHIELD	SHIFT
17	BLACK	9	RIGHT FRONT BEAM		41	RED	191	TRANS SHIFT
18	RED	10	LEFT FRONT BEAM		42	YELLOW	102	SPARE
19	YELLOW	11	FRONT JACK		43	GREEN	103	SPARE
20	BLUE	13	FRONT JACK		44	YELLOW	176	TRANS SHIFT
21	BLACK	16B	GROUND		45	BLACK	143	TRANS SHIFT
22	BLUE	20	E-STOP		46	VIOLET	192	TRANS SHIFT
23	BROWN	21	E-STOP		47	YELLOW	194	TRANS SHIFT
24	BLACK	23	SPARE		48	BLUE	315	SHIFT LIGHT

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 Terex 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.

T300-1_T500-1_T780
Service / Parts

P/N 12261-683 REVISED: January 2015

Hydraulic Cylinder Maintenance

HYDRAULIC CYLINDER DISASSEMBLY

GENERAL

Refer to pages 5-37 and 5-38 for removal of cylinders from the boom. 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 serious 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 Group 39 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: *When installing the piston ring nut on the piston rod, torque to 2500 ft. lbs. and then secure with setscrew lock. 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.*

On cylinders P/N 706 8584 and 706 8585 preset nylon plug with a 25 ft. lb. torque, using a Grade 8 capscrew, and install setscrew and torque to 15 ft. lbs., three (3) places.

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.

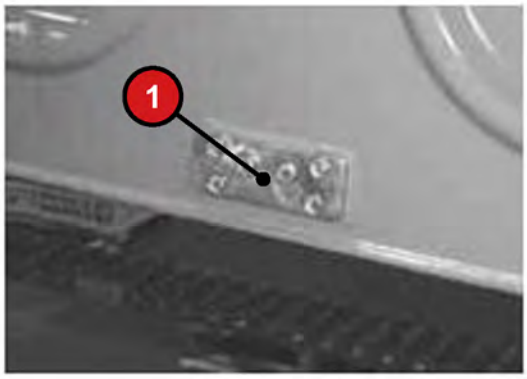
   Before attempting to turn one of the adjustment nuts, extend or retract the boom slightly to relieve the tension on that nut. After extending the boom, adjustment C will be under tension and D will be free. After retracting the boom, adjustment D will be under tension and C will be free.

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

5 SECTION BOOM (138')

On both sides of every boom section (except 5) there are wear pads (1) located near the bottom of the section, approximately 10' from the tip end. These pads are used to adjust each 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, 3, and 4.

Setting Proximity Sensors

5 SECTION BOOM (138')

Section 2 Proximity Sensor:

The Section 2 proximity sensor determines if Section 2 is fully extended. To install and set, begin by fully extending the external cylinder.

Measure the distance from the sensor block to the outside of the mounting plate

Set the distance from the face of the proximity switch to the inside of the plate to 3/8" less than the measured distance. (Indicator light should be lit.)

Install proximity switch plate (Indicator light faces down.)

Repairs-Adjustments-Remarks Log

ITEM	REQUIREMENT	DATE

Appendix

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

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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

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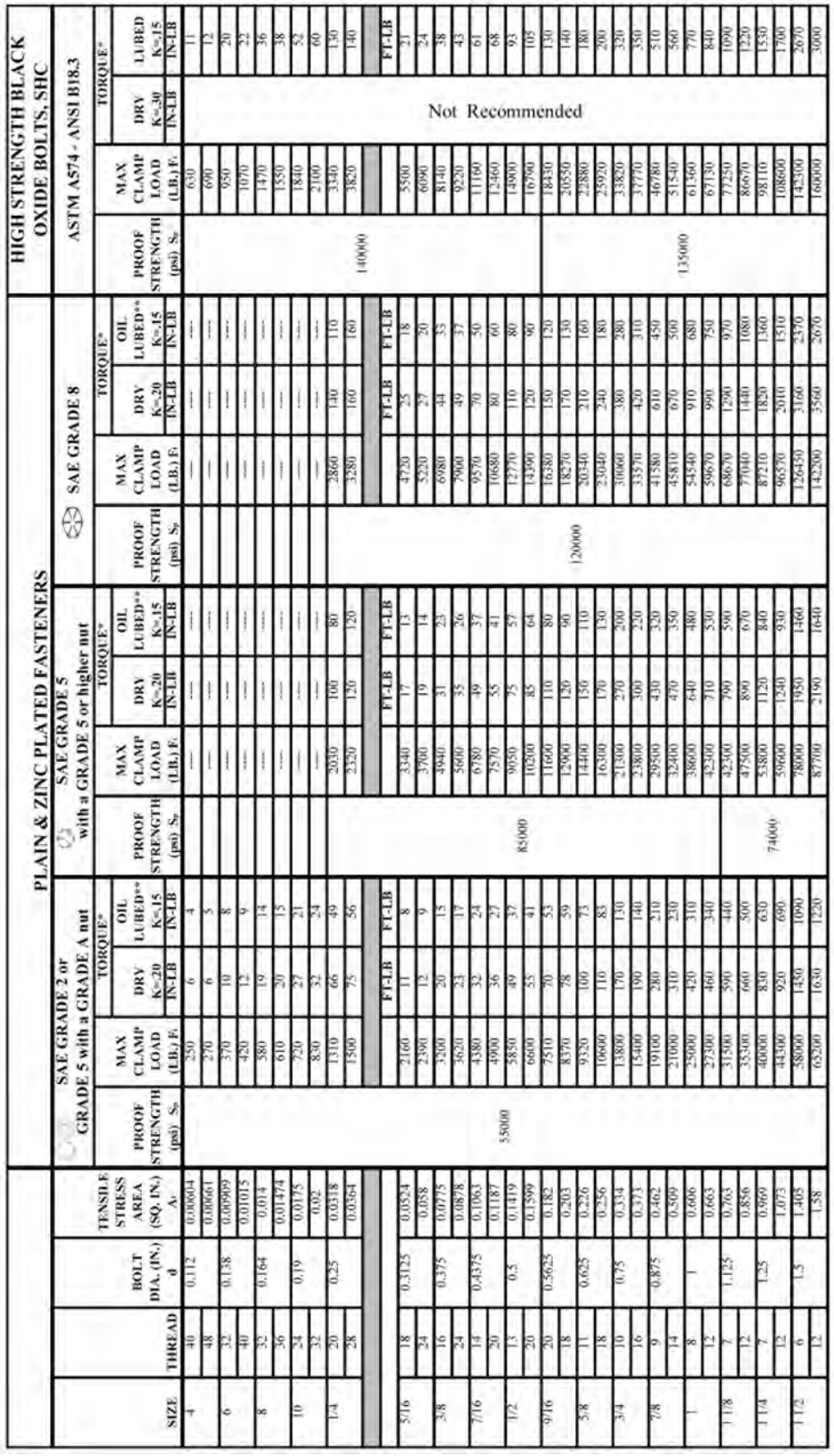
TEREX

Torque Specs -SAE & Metric



PLAIN & ZINC PLATED FASTENERS																HIGH STRENGTH BLACK OXIDE BOLTS, SHC					
				SAE GRADE 2 or GRADE 5 with a GRADE A nut				SAE GRADE 5 with a GRADE 5 or higher nut				SAE GRADE 8				ASTM A574 - ANSI B18.3					
						TORQUE*				TORQUE*				TORQUE*				TORQUE*	
SIZE	THREAD	BOLT DIA. (IN.) d	TENSILE STRESS AREA (SQ. IN.) A_s	PROOF STRENGTH (psi) S_p	MAX CLAMP LOAD (LB.) F_i	DRY K=.20	OIL LUBED** K=.15	PROOF STRENGTH (psi) S_p	MAX CLAMP LOAD (LB.) F_i	DRY K=.20	OIL LUBED** K=.15	PROOF STRENGTH (psi) S_p	MAX CLAMP LOAD (LB.) F_i	DRY K=.20	OIL LUBED** K=.15	PROOF STRENGTH (psi) S_p	MAX CLAMP LOAD (LB.) F_i	DRY K=.30	LUBED K=.15
						IN-LB	IN-LB			IN-LB	IN-LB			IN-LB	IN-LB			IN-LB	IN-LB
4	40	0.112	0.00604	55000	250	6	4	85000	---	---	---	120000	---	---	---	140000	630	Not Recommended	
	48		0.00661		270	6	5		---	---	---		---	---	---		690		
6	32	0.138	0.00909		370	10	8		---	---	---		---	---	---		950		
	40		0.01015		420	12	9		---	---	---		---	---	---		1070		
8	32	0.164	0.014		580	19	14		---	---	---		---	---	---		1470		
	36		0.01474		610	20	15		---	---	---		---	---	---		1550		
10	24	0.19	0.0175		720	27	21		---	---	---		---	---	---		1840		
	32		0.02		830	32	24		---	---	---		---	---	---		2100		
1/4	20	0.25	0.0318		1310	66	49		2030	100	80		2860	140	110		3340		
	28		0.0364		1560	75	56		2320	120	120		3280	160	160		3820		
					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		11660	110	80		16380	150	120		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		42500	710	530		59670	990	750		67130	840	
1 1/8	7	1.125	0.763		31500	590	440		42500	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		142350	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.

T300-1_T500-1_T780
Appendix

Table 2. Metric Size Bolt Torque

			PLAIN & ZINC PLATED FASTENERS																	
			CLASS 4.6 per ISO 898/1				CLASS 8.8 per ISO 898/1				CLASS 10.9 per ISO 898/1				CLASS 12.9 per ISO 898/1			
					TORQUE*				TORQUE*				TORQUE*				TORQUE*	
SIZE	BOLT DIA. (mm) d	TENSILE STRESS AREA (SQ. mm) At	PROOF STRENGTH (Mpa) Sp	MAX CLAMP LOAD (N) Fi	DRY K=.20 N-m	OIL LUBED** K=.15 N-m	PROOF STRENGTH (MPa) Sp	MAX CLAMP LOAD (N) Fi	DRY K=.20 N-m	OIL LUBED** K=.15 N-m	PROOF STRENGTH (MPa) Sp	MAX CLAMP LOAD (N) Fi	DRY K=.20 N-m	OIL LUBED** K=.15 N-m	PROOF STRENGTH (MPa) Sp	MAX CLAMP LOAD (N) Fi	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		15921	25.5	19.1		22784	36.5	27.3		26626	42.6	32
M10-1.5	10	58		9787	19.6	14.7	580	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	830	97032	313	235		114218	365	274
M18-2.5	18	192	225	32400	117	87.5		86400	311	233		119520	430	323		139680	503	377
M20-2.5	20	245		41345	165	124		110250	441	330		152513	610	458		178238	715	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.

Lead Warning - State of California

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

Battery posts, terminals, and related accesories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.

TEREX

EPA / NHTSA Greenhouse Gas Standards Information - (T300 & T500 only)

Terex is an EPA certified manufacturer of heavy duty highway vocational vehicles including Concrete Mixers and Truck Cranes. All new Terex Concrete Mixers and Truck Cranes use low rolling resistance tires on both the steering axle and drive axles in order to fully comply with the applicable EPA Green House Gas (GHG) Emissions standards.

A repair shop or person of the owner's choosing may maintain, replace, or repair emission control devices and systems (tires). Any replacement tires should have a rolling resistance of equal or lesser value to that of the original tires. Rolling resistance values can be found at tire manufacturer websites.

Tire Maintenance Instructions:

For full tire maintenance instructions, please see the tire manufacturer's online information:

- **Goodyear** Radial Truck Tire & Retread Service Manual:

http://www.goodyeartrucktires.com/resources/service-manual.aspx

- **Michelin** Truck Tire Service Manual:

http://www.michelintruck.com/michelintruck/toolbox/reference-material.jsp

- **Bridgestone** Tire Warranty, Maintenance, and Safety Manual:

http://www.trucktires.com/bridgestone/us eng/load/general pdf/bridgestone limited warranty.pdf

- **Continental** Tire Maintenance Manual:

http://www.continental-truck.com

EMMISSION CONTROL WARRANTY STATEMENT

YOUR WARRANTY RIGHTS AND OBLIGATIONS

The United States Environmental Protection Agency and Terex Corporation are pleased to explain the emission control system warranty on your 2015 model year vocational vehicle.

New vocational vehicles must be designated and built to conform to applicable Federal Green House Gas Emissions (GHG) requirements at the time of sale. Terex Corporation must warrant the tires on your vehicle as they are part of the emissions control system.

MANUFACTURER'S WARRANTY COVERAGE:

Terex Corporation must warrant the tires on your vehicle for the periods of time of 2 years or 24,000 miles. Tires are warranted against defect for this period (not tread wear). Where a warrantable condition exists, Terex Corporation will repair your vehicle at no cost to you including diagnosis, parts and labor.

P/N 12261-683 REVISED: January 2015

OWNER'S WARRANTY RESPONSIBILITIES:

As the vehicle owner, your are responsible for the performance of the required maintenance listed in your owner's manual.

As the vehicle owner, you should however be aware that Terex Corporation may deny you warranty coverage if your vehicle has failed due to abuse, neglect, improper maintenance or unapproved modifications.

You are responsible for initiating the warranty process. Terex Corporation recommends presenting your vehicle as soon as a problem exists. The warranty repairs should be completed by the dealer as expeditiously as possible.

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

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