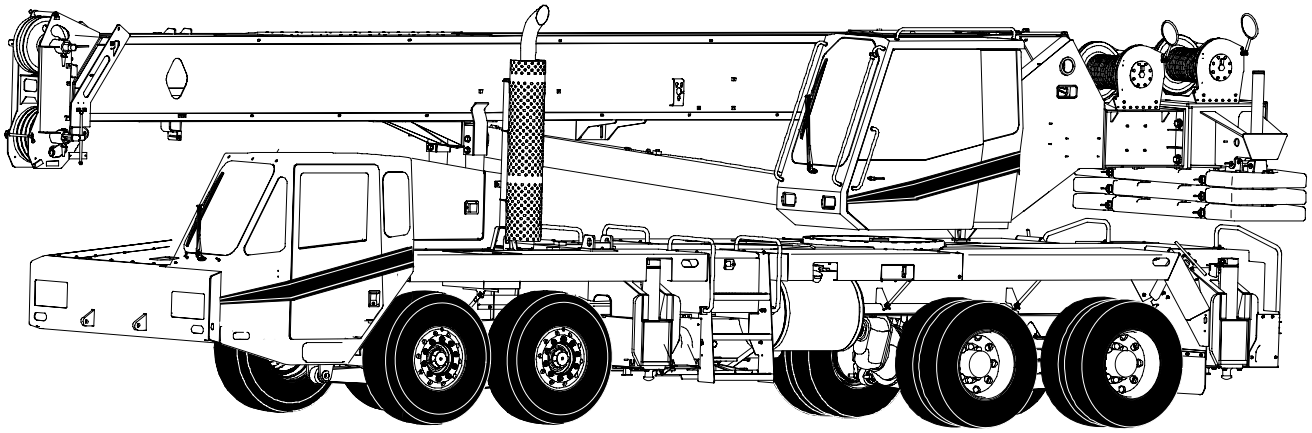


Crane Serial Number

The crane serial number is written on the Crane Rating Manual located in the lower right interior of the upper cab. The sereial number and a Vehicle Identification Number (VIN) is also stamped on a plate located on the front center of the carrier cab dash. The crane serial number should always be furnished when ordering parts for the crane, or when corresponding with the distributor or factory regarding the crane. The serial number is the only method the distributor or factory has of ensuring that the correct parts will be furnished.

In the event the serial number cannot be found, a number is stamped on top of the bumper on the right side of the carrier and on the right side of the upper frame just above the boom hoist cylinder lug. This number can then be used to identify the crane.

Operator's Manual

⚠ WARNING

CONSTRUCTION EQUIPMENT CAN BE DANGEROUS IF IMPROPERLY OPERATED OR MAINTAINED. THIS CRANE SHOULD BE OPERATED AND MAINTAINED ONLY BY TRAINED AND EXPERIENCED PEOPLE WHO HAVE READ, UNDERSTOOD, AND COMPLY WITH THE OPERATOR'S & MAINTENANCE MANUAL.

The productive life of construction equipment depends largely on the care and consideration given to it. This especially holds true for hydraulic cranes. This Operator's & Maintenance Manual was compiled to explain the procedures and adjustments necessary for proper operation of this crane.

A study of this manual will acquaint the operator and service personnel with the construction of this crane. It will enable them to identify and remedy most problems that may occur. Any questions pertaining to the care and upkeep of this crane which are not covered in this manual should be directed to your nearest distributor.

In addition to this Operator's & Maintenance Manual, a Parts Manual, Crane Rating Manual, and Safety Manual are supplied with the crane. Read and understand all safety guidelines before operating the crane. Additional copies of all manuals are available through your distributor.

CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents, and certain vehicle components contain or emit chemicals known to the State of California to cause cancer, birth defects, and other reproductive harm.

Throughout this manual, reference is made to the left, right, front, and rear pertaining to direction and locations. These reference directions are relative to the operator, sitting in the operator's seat of the carrier cab with the upper directly over the front of the carrier, unless otherwise stated.

Danger, warning, and caution captions as well as special notes are used throughout this manual and on the crane to emphasize important and critical instructions. Labels, plates, decals, etc. should be periodically inspected and cleaned as necessary to maintain good legibility for safe viewing. **If any instruction, caution, warning, or danger labels, decals, or plates become lost, damaged, or unreadable, they must be replaced.** Information contained on such labels, decals, and plates is important and failure to follow the information they contain could result in an accident. Replacement labels, decals, and plates can be ordered through your distributor. For the purpose of this manual, and the labels which are placed on the crane, danger, warning, and caution captions and notes are defined as follows:

DANGER

An operating procedure, practice, etc. which, if not correctly followed, will result in severe personal injury, dismemberment, or loss of life.

WARNING

An operating procedure, practice, etc. which, if not correctly followed, may result in personal injury.

CAUTION

An operating procedure, practice, etc. which, if not correctly followed, may result in damage to or destruction of equipment or property.

NOTE

Note: An operating procedure step, condition, etc. which is essential in order for the process to be completed properly.

Operator's Manual

General Index

A detailed table of contents for each section of this manual is included at the beginning of each section. The following is a description of each section:

Section 1 includes the necessary information for safe, productive crane operation. It includes the nomenclature and operation of all control switches, levers, pedals, and instrumentation of the crane.

Section 2 includes the necessary information for proper lubrication and preventive maintenance for daily operations. It includes the check/change intervals and procedures for maximizing the service life of the crane under normal working conditions. It also includes lubrication types and specifications approved for use in the crane.

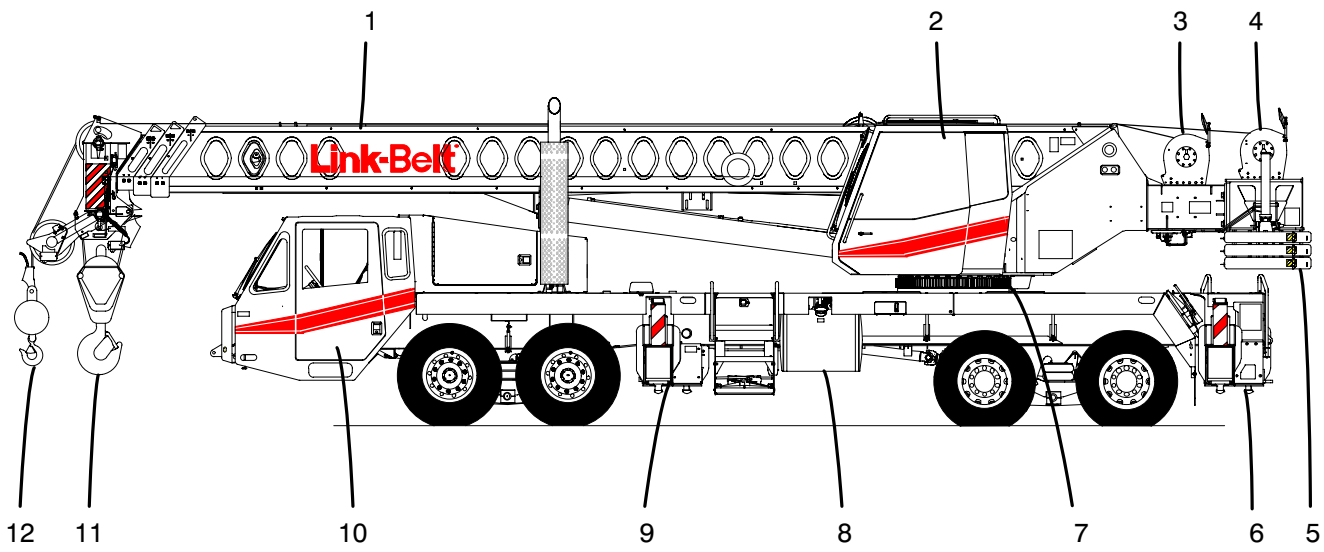
Section 3 includes the adjustments which must be made periodically to keep the crane in proper, safe working order. It includes the procedures and necessary information for adjusting the brakes, mechanical linkages, and hydraulic pressures on the crane.

Section 4 includes the use and operation of the crane attachments. It includes the necessary information for installation, erection, storage, and removal of the auxiliary lifting sheave and offset lattice fly sections.

Section 5 includes general information on the Crane Rating Manual and serial number as well as wire rope specifications, inspection, replacement, connections, and reeving. General specifications for the crane are also included.

Section 6 includes a list of terms which are used to refer to crane functions, assembly, operation, and maintenance. These terms are defined as to how they are used in this manual.

Table Of Contents



1. Four Section Boom
2. Upper Operator's Cab
3. Front Winch
4. Rear Winch
5. Counterweights
6. Rear Outrigger
7. Turntable Bearing
8. Fuel Tank
9. Front Outrigger
10. Carrier Cab
11. Hook Block
12. Hook Ball

Figure 1–1
Crane Nomenclature

On Delivery

When a new crane is delivered, follow the instructions outlined in the latest version of Technical Bulletin General Series #213. A copy of this bulletin can be obtained from your Distributor.

Operating Safety

Remember SAFETY every day. Someone's LIFE may depend on it, MAYBE YOUR OWN.

Safe operations of a hydraulic crane requires a well trained, qualified operator. Crane operation is more involved than it may appear, and operation by a careless or unqualified person can result in a serious accident.

When a hydraulic crane is maintained and used properly it can be a safe, highly productive piece of equipment, but if not used properly, it can be dangerous.

Think Safety – You, the operator, are in charge of an important piece of equipment. It is very important that you know what it can do. It is also important that you know what it should not do. No set of instructions can anticipate all of the situations you will encounter. The rules given here cover the general usage, and some of the more common specific cases. If conditions arise not covered by these rules, consult your nearest Distributor. A phone call could save someone's life.

Figure 1–2
Read and understand all points covered in the Operator's Manual before operating the crane.

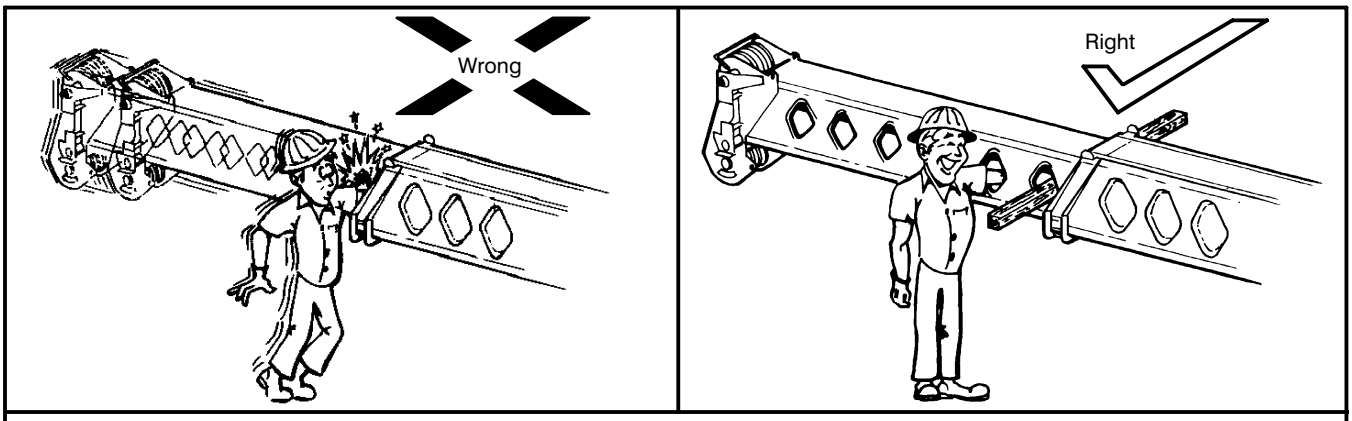


Figure 1–3
Shutdown the engine, ensure that the operator has vacated the upper operator's cab, and insert blocking through the diamond shaped hole closest to the base section of the boom before putting hands or tools inside a boom section.

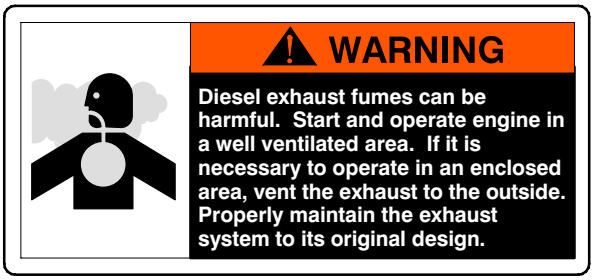


Figure 1–4
Diesel exhaust fumes can be harmful.

Figure 1–5
Keep hands and tools clear of moving parts.

General Safety Rules

The following is a list of safety rules which should be followed during all crane operations.

Operator Awareness

1. Read and understand this Operator's Manual, all safety manuals, and the Crane Rating Manual and heed them. These manuals contain important information.
2. An operator must not eat, read, or otherwise divert his attention while operating a crane. Remember–operating is a full time job.
3. Don't smoke when fueling, or fuel up near an open flame. Keep the nozzle in contact with the filler neck to prevent static electric sparks. Shutdown the engine when fueling.
4. Start and operate the engine in a well ventilated area. Diesel exhaust fumes can be harmful. If it is necessary to operate in an enclosed area, vent the exhaust to the outside. Properly maintain the exhaust system to its original design.
5. Keep your shoes clean. Before entering the operator's cab, wipe clean any mud, gravel, moisture or grease from your shoes. Slippery shoes could cause momentary loss of control of crucial foot operated controls.
6. Keep all non-skid materials on walking surfaces of the crane clean. Non-skid materials placed on the crane assist operators and service personnel with safe access/egress to/from the crane and to/from adjustment and inspection areas. Do not allow non-skid materials to become contaminated with mud, oil, paint, wax, etc. Any contamination can cause the non-skid materials to become slick, reducing their effectiveness for safety while walking on the crane. If any non-skid materials becomes ineffective due to wear, age, or destroyed in any way, they must be replaced.
7. Keep fingers, feet, and clothing away from sheaves, drums, and ropes unless the crane is shutdown and everyone knows what you are doing. Do not place a hand on wire ropes when climbing on the crane. A sudden movement could pull them into the drums or sheaves.
8. Shutdown the engine, ensure that the operator has vacated the upper operator's cab, and insert blocking through the diamond shaped hole closest to the boom base section, to prevent movement of the individual sections, before putting your hands or tools inside the boom. Unsuspected movement of the boom section could sever fingers, hands, arms, etc.

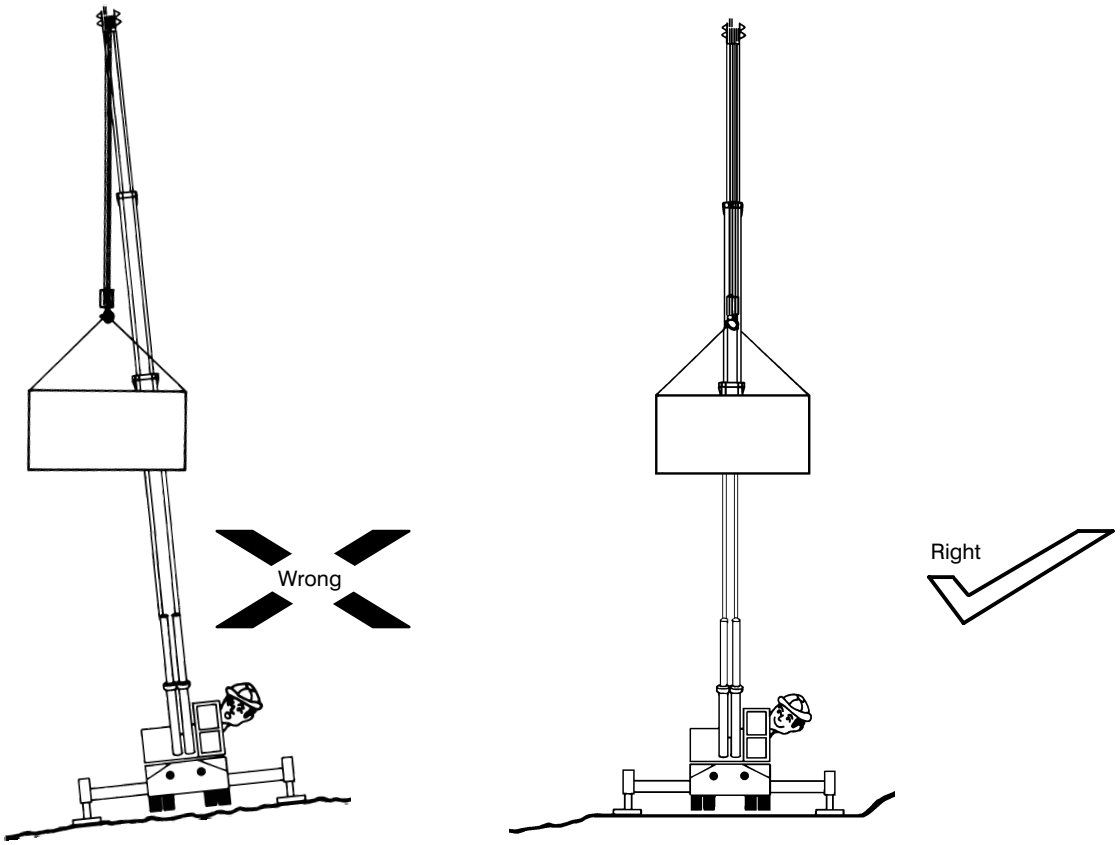


Figure 1—6
Level the crane.

9. The operator, supervisor, or person in charge of the load must observe the following rules:
   a. Loads must be well secured before lifting. Be sure that the rigging cannot slip off or pull away from the load, or get out of position on the load. Be sure the load is rigged so it will not turn over.
   b. Chains and slings must be of adequate size, in good condition, and not twisted around each other.
   c. The load must not catch on an obstruction when lifting or swinging. Be sure the load, fall lines, or any other parts of the crane do not snag or strike any obstruction.
   d. Do not allow the load to rotate out of control. Personal injury to ground personnel, load damage, crane damage, or damage to anti—two block system may occur.
   e. When hoisting with single part line, especially in long falls applications, the design of wire rope and hook ball is crucial to minimize the potential for uncontrolled rope and/or load rotation. Rotation-resistant wire rope is recommended for single part of line applications. See Wire Rope Capacity Chart in the Crane Rating Manual for the specific types of rotation resistant wire rope recommended for the crane.
   f. Avoid sudden starts and stops. Lift carefully, swing gently, brake smoothly, lower and set loads carefully. Jerking the load, swinging and engaging swing brake roughly, and lowering the load rapidly and slamming on brakes, will put shock loadings and possible side loadings on the boom. Unnecessary abuse labels the operator as a beginner. Be a professional.
   g. Do not wrap the winch rope around the load. Do not use discarded, worn, or damaged wire ropes for slings. They may break and drop the load.
   h. The crane must be level before making a lift. Use the bubble level, to level the crane. Check its accuracy frequently with a carpenter's level. Remember, a three degree side tilt can reduce capacities by 50% or more.

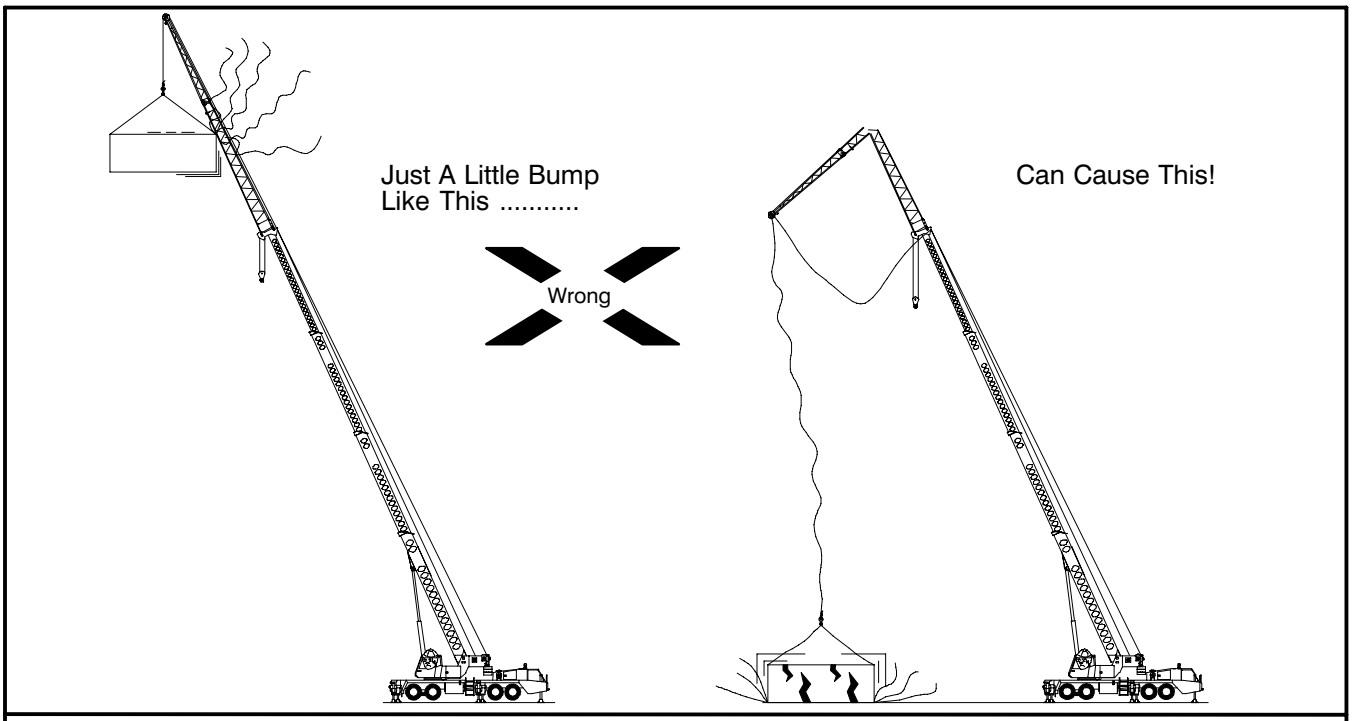


Figure 1—7
Do not let the load hit the boom or fly.

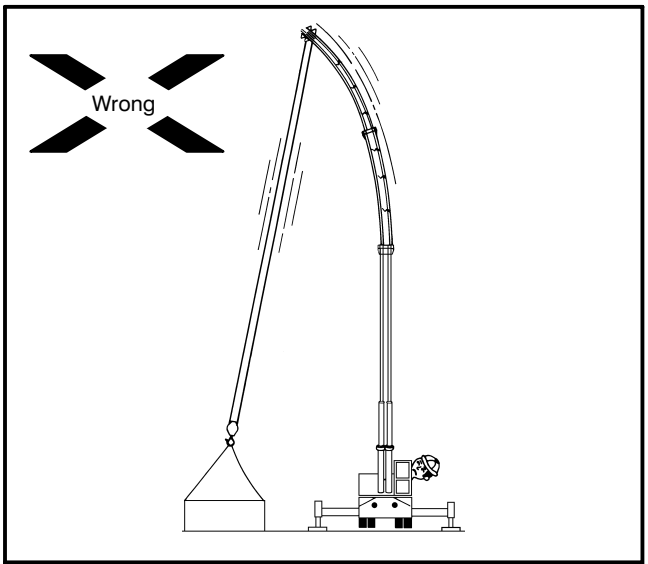


Figure 1—8
Do not use the boom to pull sideways.

10. Don't let the load or bucket hit the boom or fly. Don't let the boom or attachment rest, or hit, a building or any other object. A dent or other damage could result, which will weaken the boom or attachment. If the damage is major, the attachment could collapse. If a lattice or diagonal bracing member on the fly is broken, cracked, or bent, contact your local distributor for repair procedures. If the boom or fly is struck, or damaged by anything, STOP. The loading on a boom or attachments increases as they are lowered, therefore their suspension systems could collapse during lowering. Use another crane to lower a damaged boom or attachment.
11. Don't pull sideways on the boom, not even a little. Lift straight up on every load. Moving trucks, rail cars, barges, or anything else pulling sideways on the winch rope could buckle the boom. It could also damage the swing mechanism. Pulling sideways on a boom can overturn the crane.
12. Do not "two block" (pulling the hook block or ball into the head machinery), as this can cause winch rope and sheave breakage resulting in an accident.
13. Watch the load or signalman at all times. A suspended load must have your undivided attention.
14. Operate crane from the operator's seat only. Operating the crane from any other position, such as reaching in a window, constitutes a safety hazard.
15. After slack winch rope operation, make sure the winch rope is properly seated in sheaves and on drums before continuing to operate. Use a stick or mallet to set the winch rope, not your hands.
16. Do not lower the load beyond the point where less than three full wraps of winch rope are left on the drum. This condition could occur when lowering a load beyond ground level. If all the winch rope runs off the drum, the load will jerk which could break the winch rope.

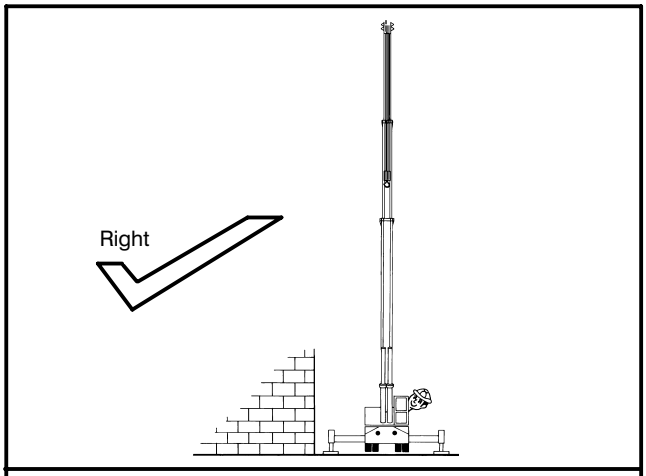


Figure 1—9
Crane level, all beams extended equally (all fully extended, all intermediately extended, or fully retracted), and tires clear of the ground.

17. Make sure there is a safety latch on the hook, and that it works properly. Without a latch, it is possible for slings or chains to come off the hook, allowing the load to fall.
18. Don't alter any part of the crane. Additions to, or changes in, any part of the equipment can create loadings for which the crane was not designed. Such changes may seriously affect the usable capacities and make the entire Crane Rating Manual invalid. Such changes can dangerously overload or weaken critical parts and may cause disastrous failure.
19. Do not exceed the rated capacities of the crane under any circumstances. While a crane has more stability when lifting over a corner (as compared to straight over the side), the crane capacity is not increased. Anytime the load exceeds the rated capacities listed in the Crane Rating Manual, the crane is overloaded. Overloads can damage the crane and such damage could cause failure and accidents.
20. When operating on outriggers, all beams must be extended equally; all fully extended, all intermediately extended, or all fully retracted. All jacks must be extended so all tires are clear of the ground, and the crane must be level. Be sure that blocking or pontoons are set on a firm surface, adequate to support the blocking, pontoon, crane, and load without settling, slipping, or collapsing. Blocking or matting under pontoons must form a smooth, level surface under the entire pontoon. Do not block under outrigger beams inside the pontoons as this reduces stability. Blocking must be under pontoons only. Remember—there are tremendous loadings on pontoons and blocking — the weight of the entire crane plus any load.

    When blocking or matting under pontoons, be sure that each pontoon is supported fully — no unsupported pontoon area is permissible. Be sure pontoons are on a smooth surface. Rough surfaces, rocks, etc., under pontoons will cause unequal loadings, and can puncture them, causing them to collapse.

    Capacities are based on outriggers equally extended; all fully extended, all intermediately extended, or all fully retracted. Working on outriggers that are not equally extended will reduce capacities and crane stability considerably and could cause an accident. Do not make any lifts while on outriggers without the outrigger beams equally extended.

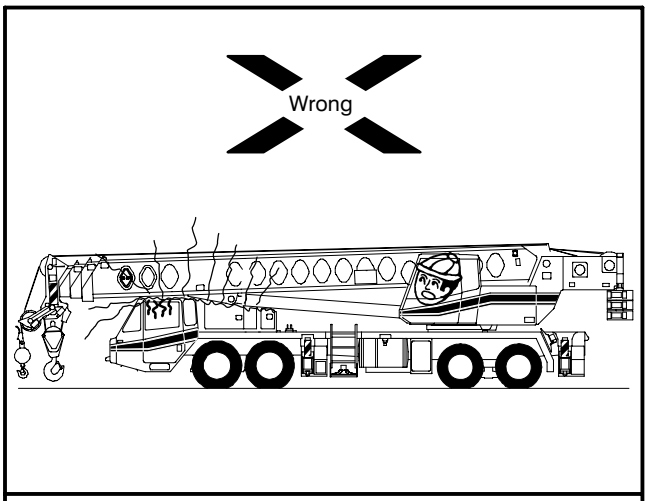
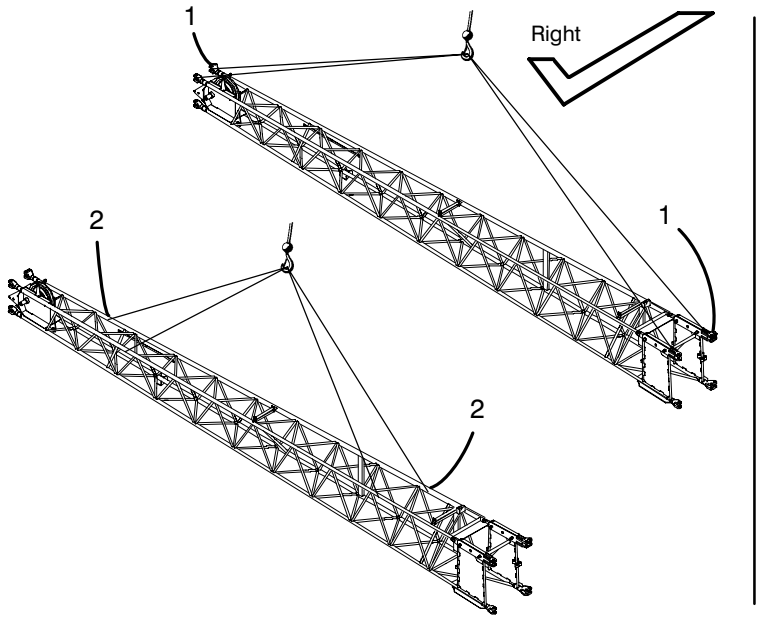


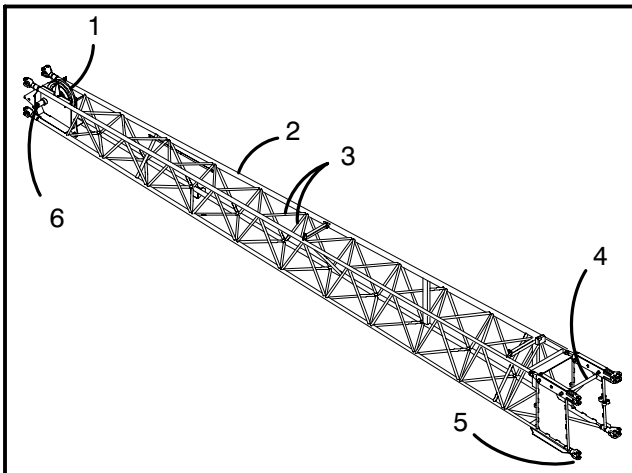
Figure 1—10
Watch that carrier cab!

21. Before attempting to move the carrier, make sure there is enough air pressure to operate the brakes. Always check the brake operation before traveling the crane.
22. Brake firmly in one application. Avoid fanning the brakes. This could exhaust air pressure so fast that the compressor may not supply enough air.
23. Do not coast downhill with the transmission in neutral. It makes control of the crane more difficult and dangerous.
24. Shift the transmission to neutral before operating the crane. Crane operation can cause movement which can damage the transmission or drive line. When parking, shift to neutral and engage the park brake. Block wheels if on an unlevel surface.
25. When operating over the front, use care not to hit the carrier cab or front of the crane with the load or boom.



1. Use The Connecting Lugs Or Main Chords As Lifting Points.
2. Use The Main Chords As Lifting Points With Nylon Straps Only
3. Do Not Attach Slings To Lattices, They Will Bend.

Figure 1–11
Handling The Fly Section.



1. Head Sheave
2. Main Chord
3. Lattices
4. Picture Frame
5. Connecting Lugs
6. Head Machinery Cross Shaft

Figure 1–12
Fly Section Nomenclature

26. Use care handling the fly when loading, transporting, and unloading. Damage that occurs during these operations can go undetected and could result in failure of the attachment, once subjected to loading. Do not attach slings to the lattices, when lifting the fly, as they will bend. It is recommended that the connecting lugs and/or head machinery cross shaft be used as the lifting points. However, it is permissible to attach nylon straps around all four main chords.
27. Block under and between the fly when loading them on a transport vehicle. When securing the fly to a transport vehicle, it is best to use synthetic webs or slings. If using wire rope slings, pad the fly to protect it from damage. Do not overtighten the tie downs or the fly may be damaged. Do not use chain ties downs, as they may dent and damage the sections.
28. Thoroughly inspect all the elements of each fly before installing it on the crane. Check each main chord, picture frame, diagonal, lattice, and connecting lug for bends, dents, and cracked or corroded welds. Picture frames must be square. Do not use any fly that is even slightly damaged. Consult your local distributor for the proper repair procedures.

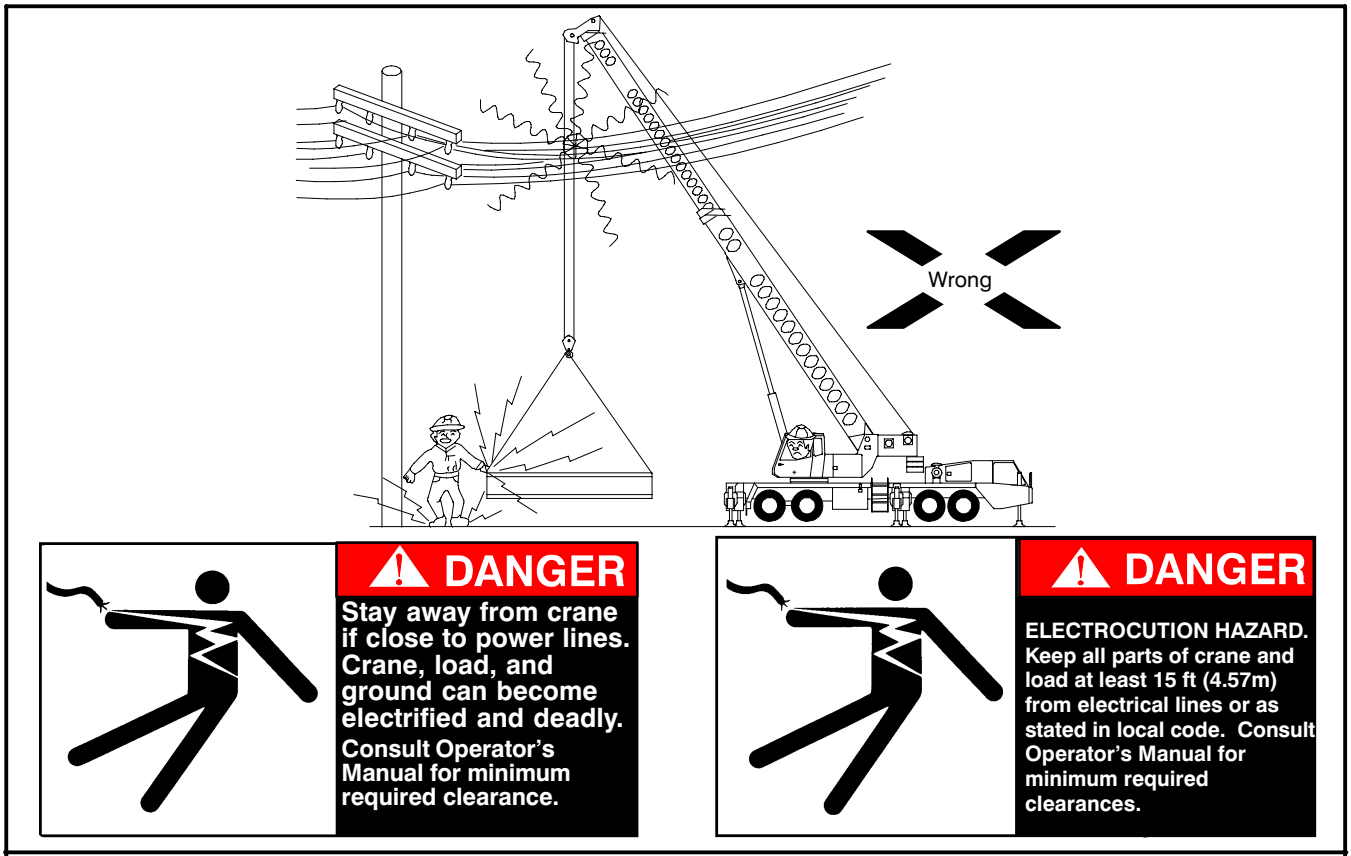


Figure 1–13
Stay away from power lines.

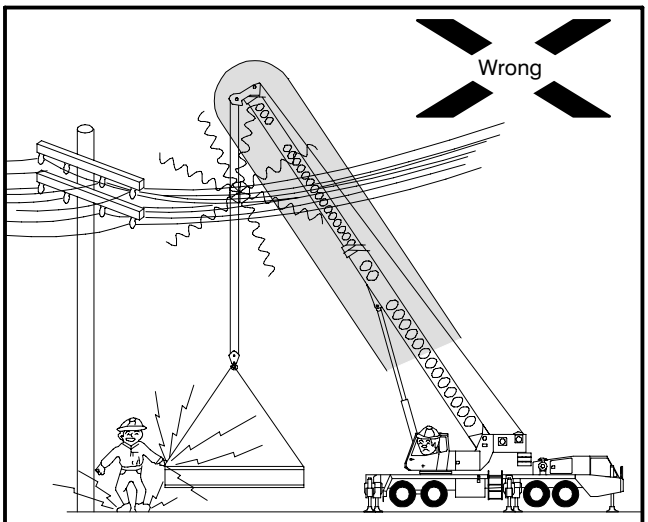
Electrical Dangers

1. All electrical power lines are dangerous. Contact with them, whether insulated or not, can cause death or injury. When operating near power lines, the best rule is to have the power company turn off the power and ground the lines. However, in some cases, the operator may be unable to have the power turned off. Follow these rules whether the power is turned off or not.
   a. Be alert. You are working around conditions which can cause death.
   b. Keep all parts of the crane, fall lines, hook block, hook ball, and load at least 15 ft (*4.57m*) from electrical lines or as specified in the "High Voltage Power Line Clearance Chart" or other distances specified by applicable codes. Slow down crane operation.
   c. Assume that every line is "Hot".
   d. Appoint a reliable person equipped with a loud signal (whistle or horn) to warn the operator when any part of the crane is working around the power line. This person should have no other duties while the crane is working around the power line.

Minimum Required Clearance For Normal Voltage In Operation Near High Voltage Power Lines And Operation In Transit With No Load And Boom Or Mast Lowered.

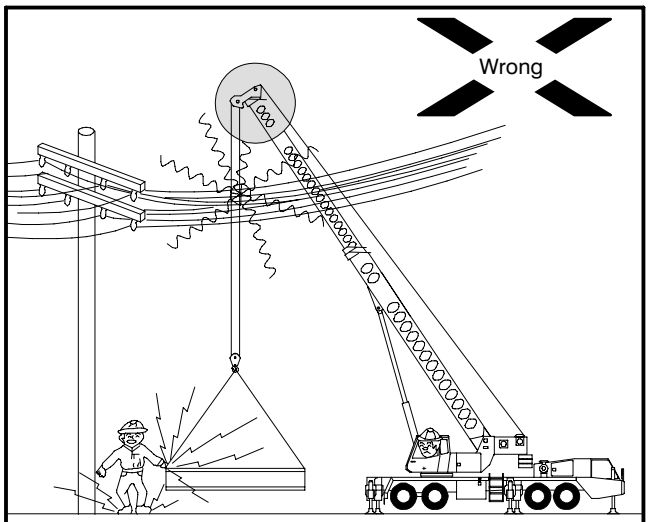
Normal Voltage, kV (Phase to Phase)	Minimum Required Clearance, ft (*m*) See Note 1
Operation Near High Voltage Power Lines	
To 200	15 (*4.57*)
Over 200 To 350	20 (*6.10*)
Over 350 To 500	25 (*7.62*)
Over 500 To 750	35 (*10.67*)
Over 750 To 1000	45 (*13.72*)
Operation in Transit with no Load and Boom or Mast Lowered	
To 345	15 (*4.57*)
Over 345 To 750	16 (*4.87*)
Over 750 To 1000	20 (*6.10*)
Note 1: Environmental conditions such as fog, smoke, or precipitation may require increased clearances.	

High Voltage Power Line Clearance Chart



Shaded area shows "sensitivity zone" with full boom length sensor used, and adjusted for 15 ft (*4.57m*) clearance. Contact can be made outside this zone by the fall lines, winch rope, cab, etc. In such cases, the alarm will not sound, but the crane will be electrified and deadly.

Figure 1—14
Crane Equipped With Proximity Warning Device On The Entire Boom



Shaded area shows "sensitivity zone" with the probe near the boom peak and adjusted for 15 ft (*4.57m*) clearance. Contact can be made outside this zone by the fall lines, winch rope, cab, etc. In such cases, the alarm will not sound, but the crane will be electrified and deadly.

Figure 1—15
Crane Equipped With Proximity Warning Device On The Boom Tip

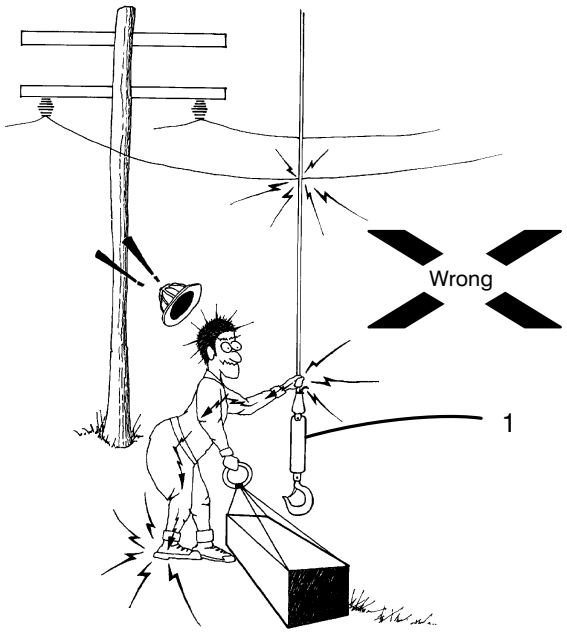
e. Warn all personnel of the potential danger. Don't allow unnecessary persons in the area. Don't allow anyone to lean against or touch the crane. Don't allow ground workers to hold load lines, or rigging gear unless absolutely necessary. In these cases use dry plastic ropes as tether lines. Make certain everyone stays at least 15 ft (*4.57m*) away from the load, or a distance specified in the "High Voltage Power Line Clearance Chart", or such distance as required by applicable codes.

f. The use of boom point guards, proximity devices, insulated hooks, or swing limit stops do not assure safety. Even if codes or regulations require the use of such devices, you must follow rules listed here. If you do not follow them, the result could be serious injury or death.

g. Grounding the crane can increase the danger. Poor grounding, such as a pipe driven into the ground, will give little or no protection. In addition, a grounded crane may strike an arc so heavy that a live line may be burned down. This could cause the crane and the area around it to be electrified.

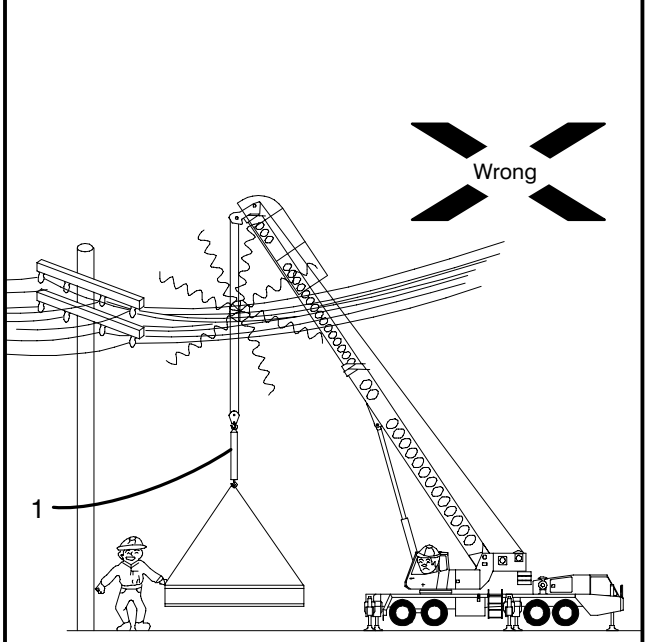
h. When operating near radio or television transmitting stations, high voltage can be induced in metal parts of the crane or in the load. This can occur even if the crane is some distance from the transmitter or antenna. Painful, dangerous shocks could occur. Consult trained electronic personnel before operating the crane to determine how to avoid electrical hazards.

2. **What do you do if a power line is touched by a crane or load?**
   a. Remain calm — think — a mistake can kill someone.
   b. Warn all personnel to keep clear.
   c. If crane will still operate, try to move it away from contact. You, the operator are reasonably safe in the cab unless the crane is on fire or an arc is cutting through the cab.
   d. Move away from contact in the reverse direction to that which caused the contact. Example: If you swing left to the wire, swing to the right to break contact. Remember — once an arc has been struck, it will stretch out much farther than you think before it breaks. Keep moving until the arc has been broken.
   e. When the arc breaks, continue moving away until you are at least 15 ft (*4.57m*) away (or a distance specified in the "High Voltage Power Line Clearance Chart" or as specified by local codes). Stop the crane. Make a thorough inspection for crane damage before further use.



1. Insulated Link

Figure 1—16
Crane Equipped With Insulated Link



1. Insulated Link

Figure 1—17
Crane Equipped With Insulated Link And Boom Point Guard

f. If you can not disengage from the electrical line and the crane is not on fire or no arc is cutting through the cab, stay in your seat until the power line can be turned off.
g. If you must leave the crane, don't step off. Leap from the crane as far as you can, landing with feet together, then hop away from the crane with feet together, or shuffle feet to keep them close together. This could help prevent personal injury.

3. When using a magnet:
   a. Lifting magnet generators produce voltage in excess of 200 volts and present an electrical shock hazard. Only trained personnel should work on the magnet, controller, or wiring. Don't open the controller door with the generator running.
   b. Do not let workmen touch magnet or load.
   c. Do not let workmen get between magnet and a metal object.
   d. If necessary to position a load, use a dry, wooden stick.
   e. Open magnet disconnect switch at magnet control panel before connecting or disconnecting leads.

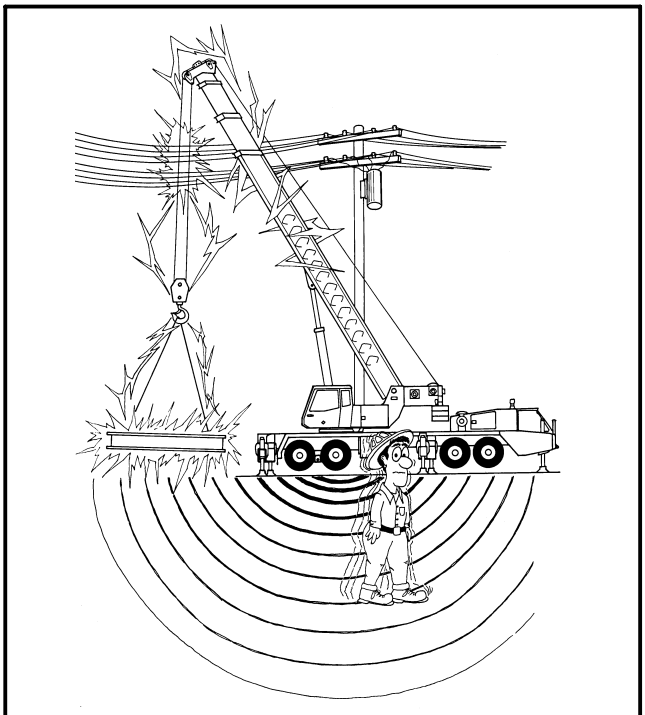


Figure 1—18
If you must leave the crane, do not step off. Leap as far as you can with feet together and hop or shuffle away from the crane.

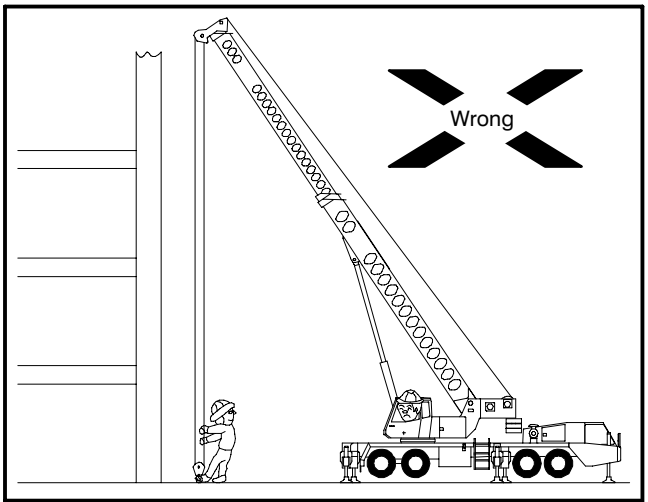


Figure 1—19
No hook riders!

Protective Equipment

1. Always replace protective guards and panels before operating the crane.
2. Always wear hard hats, safety glasses, steel toe shoes, hearing protection, and any other safety equipment required by local job conditions, OSHA, or regulations.
3. Always wear safety glasses when drilling, grinding, or hammering. Flying chips could injure the eyes.
4. Keep a dry chemical or carbon dioxide fire extinguisher of 5BC rating or larger in the cab or in the immediate area of the crane at all times. Instruct all operating and maintenance personnel in proper use of the extinguisher. Check periodically to make sure it is fully charged and in working order.
5. Do not tamper with safety devices. Keep them in good repair and properly adjusted. They were put on the crane for your protection.
6. When operating a crane equipped with any form of load indicating mechanism, overload warning system, or any automatic safety device, remember that such devices cannot replace the skill and judgment of a good operator. For instance, such devices cannot tell when a crane is located on a supporting surface that will give away, that too few parts of line are being used to lift a load, cannot correct for the effects of wind, warn that the device may be improperly adjusted, correct for side pulls on the boom, or for many conditions which could occur and create hazards. It requires all the skill, experience, judgment, and safety consciousness that a good operator can develop to attain safe operation. Many safety devices can assist the operator in performing his duties, but he should not rely on them to keep him out of trouble.

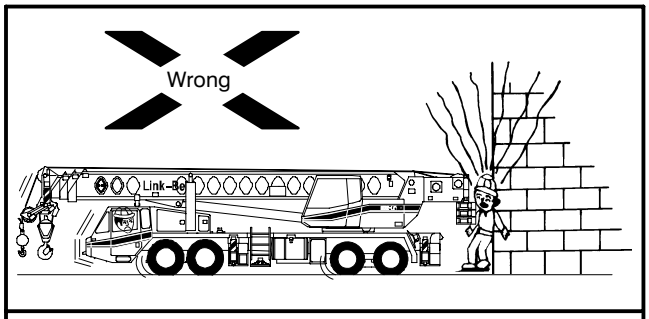


Figure 1—20
Use a signalman, back safely.

Signalmen And Bystanders

1. Don't allow crane boom or load to pass over people or endanger their safety. Remove all loose objects from load. All unnecessary personnel should leave the immediate area when crane is operating.
2. Do not allow anyone to ride on the hook ball, hook block, or any part of the load or attachment for construction work or recreational activities. (This applies to recreational activities such as "bungee jumping" or "bungee cord jumping"). Cranes are intended to lift objects, not people. They are not elevators.
3. Do not carry passengers! There is only one seat and it is for the operator. A fall from the crane can cause death or serious injury.
4. Always look before you back up, or better yet, post a signalman to guide you. If crane is equipped with a back up alarm, make sure it is working properly. Use the horn as a signal. Use a code such as one beep — stop, two beeps — forward, and three beeps — backward. Make sure everyone on the job site knows the code.
5. Do not make a lift which is not in plain sight without a signalman. This can lead to an accident or crane damage.

Crane Inspections And Adjustments

1. Inspect crane daily. Do not operate a damaged or poorly maintained crane. Pay particular attention to the clutches, brakes, attachments, and wire ropes. If a component is worn or damaged, replace it before operating.
2. Labels, plates, decals, etc. should be periodically inspected and cleaned as necessary to maintain good legibility for safe viewing. If any instruction, caution, warning, or danger labels, decals, or plates become lost, damaged, or unreadable, they must be replaced.
3. When performing repetitive lift applications, especially at or near maximum strength limited capacities, an inspection of the major structural areas of the crane, for cracks or other damage, should be conducted on a regular basis. (A non—destructive

test such as magnetic particle or dye penetrant may even be considered.) Along with inspection for cracks and damage, frequently check the critically loaded fasteners, such as the turntable bearing mounting capscrews, to ensure they have not been stretched. Not only does frequent inspection promote safety, but it is also much easier and less expensive to perform a repair when a crack is small, before it has a chance to traverse through a structural member. Any sign of cracks or damage must be repaired before continuing operations. Consult your distributor for repairs.

4. When performing maintenance on the crane, do the following:
   a. Fully retract the boom. Lower the boom to the limit of the boom hoist cylinder or on to the boom rest.
   b. Shutdown engine, disengage the main pump, and work all control levers back and forth to relieve pressure and relax the attachment.
   c. If the above instructions cannot be followed, block securely under the attachment so it cannot move.
   d. Bleed any precharge off the hydraulic reservoir before opening it or disconnecting a line.
   e. Hydraulic oil becomes hot during operation. In some cases it becomes hot enough to cause severe burns. Be careful not to let hydraulic oil come in contact with skin.
   f. Post warning signs in cab so no one will try to start the engine. Never adjust, maintain, or repair a crane while it is in operation.
5. Always reduce pressure in hydraulic system to zero before working on any part of the system. Pin sized and smaller streams of hydraulic oil under pressure can penetrate the skin and result in serious infection. Do not use your hand to check for leaks. If hydraulic oil does penetrate the skin, seek medical treatment immediately.
6. Always reduce pressure in air system to zero before working on any part of the system. Pin sized and smaller streams of air under pressure can penetrate the skin and result in serious infection. Do not use your hand to check for leaks. If air does penetrate the skin, seek medical treatment immediately.
7. Use extreme care when working with circuits with accumulators. Check that hydraulic pressure is relieved before opening the circuit for repairs.
8. When setting pressures, never exceed the manufacturer's ratings. Always follow instructions exactly. Over pressurization can cause hydraulic component damage or failure of mechanical parts on the crane. Either of the above can lead to an accident.

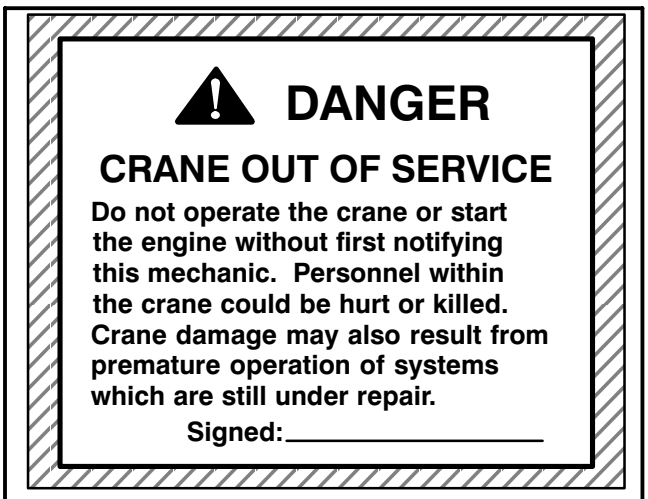


Figure 1–21
Remove the keys from the ignition and post a sign to make others aware of repair activity.

9. When making repairs, which require welding, use proper welding procedures. Also make note of the following:
   a. All paint in the area should be removed to prevent burning the paint. The smoke and fumes from the burning paint can be very hazardous.
   b. Turn the battery disconnect switches to the "OFF" position to protect any electronic equipment on the crane which may be effected by electric arc welding. Contact the distributor or factory for proper procedures.
   c. The welding ground cable should be attached to the portion of the crane being welded. If welding on the upper, ground on the upper. If welding on the carrier, ground on the carrier. Failure to take this precaution may result in electrical arcs in the turntable bearing.
   d. The welding ground cable should always be connected, as close as possible, to the area being welded. This minimizes the distance that electricity must travel.
   e. Disconnect computers and other electronic equipment (such as rated capacity limiters and engine computers) to prevent damage. Contact the distributor or for proper procedures.
   f. Remove all flammables from the proximity of the welding area.

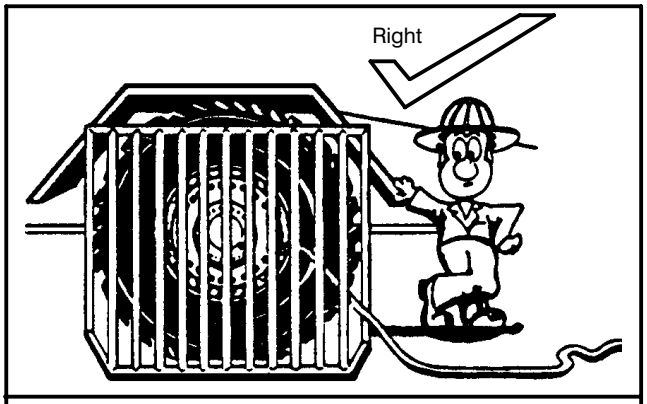


Figure 1–22
Use a guard when inflating tires.

Figure 1–23
Allow engine to cool before removing the radiator cap.

10. Keep the crane clean, in good repair, and in proper adjustment. Oil or grease on the decks may cause falls. Improper adjustments can lead to crane damage, load dropping, or other malfunctions.
11. Keep all non-skid materials on walking surfaces of the crane clean. Non-skid materials placed on the crane assist operators and service personnel with safe access/egress to/from the crane and to/from adjustment and inspection areas. Do not allow non-skid materials to become contaminated with mud, oil, paint, wax, etc. Any contamination can cause the non-skid materials to become slick, reducing their effectiveness for safety while walking on the crane. If any non-skid materials becomes ineffective due to wear, age, or destroyed in any way, they must be replaced.

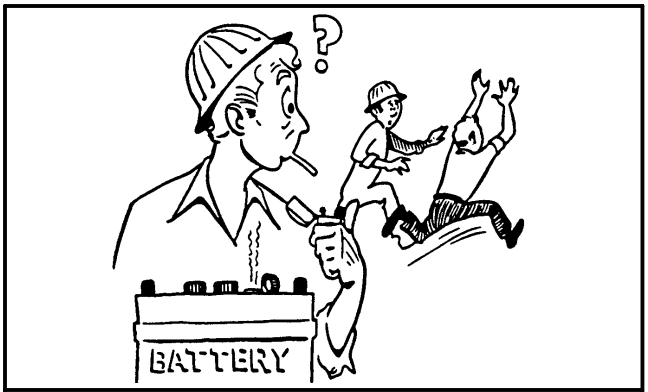


Figure 1–24
Do not use an open flame near the battery.

12. Use extreme caution when removing radiator caps, hydraulic pressure caps, etc. They can fly off and hit you, or you could be burned by hot oil, water, or steam.
13. Check tires daily for correct pressure. Do not stand in front of a tire when inflating it. The lock ring can fly off and injure you. Use a clip-on inflator, and stand aside. Use a guard in front of the tire.

WARNING

Battery posts, terminals, and related accessories contain lead and lead compounds. Wash hands after handling.

14. When checking battery fluid level, use a flashlight, not an open flame. If the battery explodes, you can get acid in your eyes, which could cause blindness. Don't check battery charge by shorting across posts. The resulting spark could cause the battery to explode. Check with a tester or hydrometer. Don't smoke near batteries.
15. When using jumper cables to start an engine, be sure to connect negative post to negative post, and positive post to positive post. Always connect the two positive posts first. Any spark could cause the battery to explode. Refer to "Jump Starting the Crane" found later in this Section of this Operator's Manual for the proper procedure.
16. Test the automatic winch brake by raising the load a few inches and holding. It should hold without slipping. It takes more braking power to hold a load in the air when the drum is full of rope than when it is a few inches above the ground with only a few wraps on the drum.

Wire Rope

1. Inspect all wire rope thoroughly. OSHA (Occupational Safety And Health Act) regulations state "a thorough inspection of all ropes shall be made once a month and a full written, dated, and signed report of the rope condition be kept on file where readily available." Replace any worn or damaged rope. Pay particular attention to winch ropes. Check end connections (pins, sockets, wedges, etc.) for wear or damage.
2. Use at least the number or parts of winch line specified on the Wire Rope Strength Chart located ing the Crane Rating Manual to handle the load. Local codes may require more parts of line than is shown. Check code requirements and use them where applicable.
3. Non-rotating, rotation-resistant, or spin-resistant wire ropes are recommended for single part of line applications. This is of utmost importance for long fall hoist line applications. Only if certain criteria are met may a swivel hook ball be used with rotation resistant rope. Refer to "Single Part Line Hoisting' and "Hook Ball Usage With Rotation Resistant Rope" found in Section 5 of this Operator's Manual.
4. Do not handle wire rope with bare hands. Always use gloves to prevent possible injury from frayed or damaged spots in the rope.
5. Inspect head machinery and hook block often, as damaged or deteriorating sheaves can cause undo wear of the wire rope.
6. When reeving wire rope on the crane, do not stand, walk, or climb on the boom or attachment. Use a ladder or similar device to reach necessary areas.

Crane And Area Clearance

1. Know your job site conditions. Familiarize yourself with work site obstructions and other potential hazards in the area which might lead to mishaps. Make any necessary arrangements to eliminate any potential hazards, if possible.
2. Erect barricades around the immediate work area to prevent unauthorized personnel from wandering onto the job site.

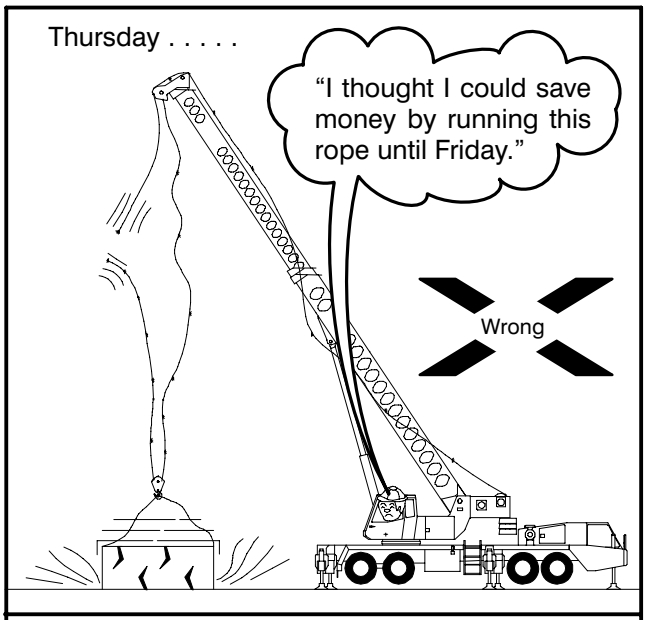


Figure 1–25
Do not operate the crane with worn or damaged wire rope.

3. Be sure the work area is clear. Make sure to have proper clearance for the crane, boom, and load. Don't swing, travel, lift, or lower loads, raise or lower jacks, without first making sure no one is in the way. If your vision is obscured, locate a signalman so you can see him, and he can see all areas you can't. Follow his signals. Be sure you and the signalman understand each other's signals. See the Hand Signal Chart, Figure 1–93. Use the horn to signal or warn. Make sure everyone on the job site understands signals before starting operations.
4. When working inside a building, check overhead clearance to avoid a collision. Check load limits on floors or ramps so as not to crash through.
5. Don't operate close to an overhang or deep ditch. Avoid falling rocks, slides, etc. Don't park crane where a bank can fall on it, or it can fall in an excavation. Don't park where rain can wash out footing.
6. Watch the tail swing of the upper revolving frame and counterweight. Even though the original setup may have been clear, situations change.
7. Do not store material under or near electrical power sources. Make material handlers aware of the dangers involved with storing material under power lines or in the vicinity of any other hazards.

SAFETY INSTRUCTIONS

Operation under conditions which exceed listed capacities may result in overturning.

Swinging, extending or lowering boom to radii where no capacities are listed may result in overturning even without a load.

Figure 1–26
Safety Instruction Label

Weights, Lengths, And Radii

1. Know your load. Don't try to guess or estimate the load. Use a scale or a load indicating system to determine exact weight. Remember the weight you are lifting includes the weight of any lifting slings or gear, the hook block, and any other weight on the hook. If lifting off the boom with the fly installed, the weight of the fly and rigging must also be considered as part of the load. The total load weight must never exceed the rated capacity of the crane, as listed in the Crane Rating Manual, for the position, boom length, load radius, and condition of operation being used. Remember – capacity chart ratings in the Crane Rating Manual are based on ideal conditions:

   a. Standing on firm, level surface
   b. Calm wind
   c. No side loads or out swing of load
   d. Good visibility
   e. Crane in top condition and equipped as when leaving the factory

   When such conditions cannot be attained, loads being handled must be reduced to compensate. The amount loads are reduced depends upon how good or how poor, the actual operating conditions are. It is a matter of judgment and experience. Some factors which may require reduction of capacities are:

   a. Soft or unpredictable supporting surfaces
   b. Wind
   c. Hazardous surroundings
   d. Inexperienced personnel
   e. Poor visibility
   f. Fragile loads
   g. Crane in poor condition
   h. Condition and inflation of tires

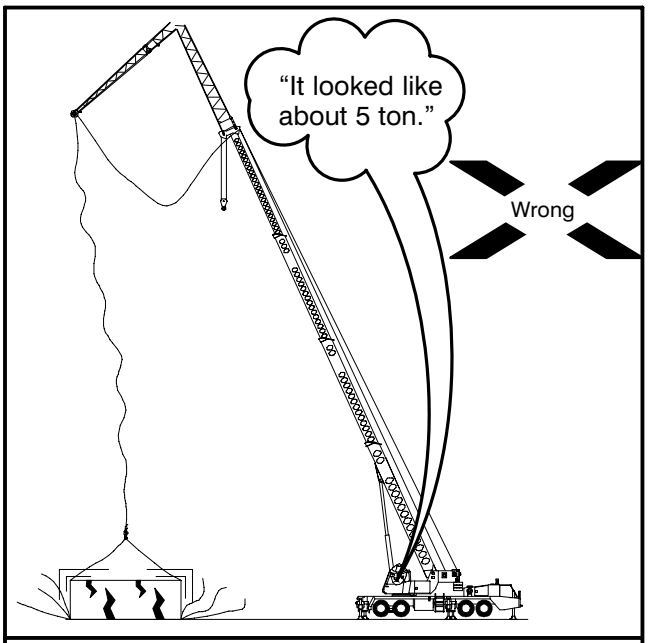


Figure 1–27
Know your load.

   When in doubt, do not take a chance. Reduce ratings more than you think you need. Avoid working a crane in high winds. If you must work in a wind, reduce capacities considerably below those shown in the Crane Rating Manual. Wind blowing against the load and the boom produces a side load on the boom and reduces its capacity.

   When lifting loads in a wind which have large surface areas, such as building panels, the movement of the load may pose a danger to workmen or building structures. Out swing of a load will increase the load radius, and may overload the crane. This could lead to boom failure or the crane tipping.

2. When operating off the main boom with the fly erected, or the fly stored on the boom, deductions must be made for its weight. The weight of the fly, pendants, etc., must be subtracted to obtain a "NET" capacity. Failure to do so could result in an overload condition and cause boom failure. Refer to the Crane Rating Manual for amounts to be deducted.
3. When operating off the main boom with the auxiliary lifting sheave installed, the weight of the auxiliary lifting sheave must be deducted. Refer to the Crane Rating Manual for amount to be deducted.

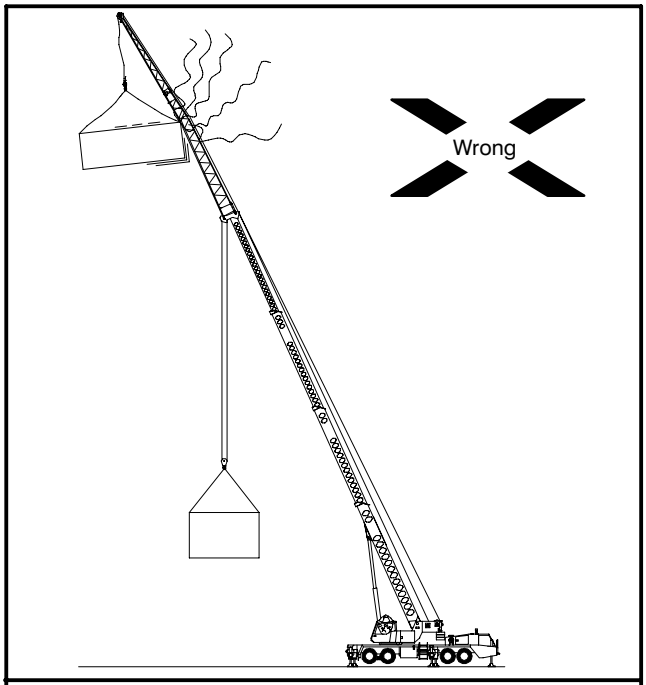


Figure 1—28
Do not lift two loads at the same time.

4. Do not lift two loads at the same time, even if the total load weight is within crane capacity. Loads on the boom and fly at the same time, stress the boom and drastically reduce its ability to handle loads. Your full attention cannot be given to both loads, creating a dangerous situation.
5. Some capacities on hydraulic cranes are based on strength of materials. In these cases, overloads will cause something on the crane to break, before it will tip. Do not use signs of tipping as a warning of overload.
6. Don't lash a crane down. Lashing a crane down encourages overloading. Crane damage or injury could result.
7. Do not shock load and/or overload the crane at anytime. Shock loading or overloading the crane will reduce the fatigue life of crane components and could result in component failure.

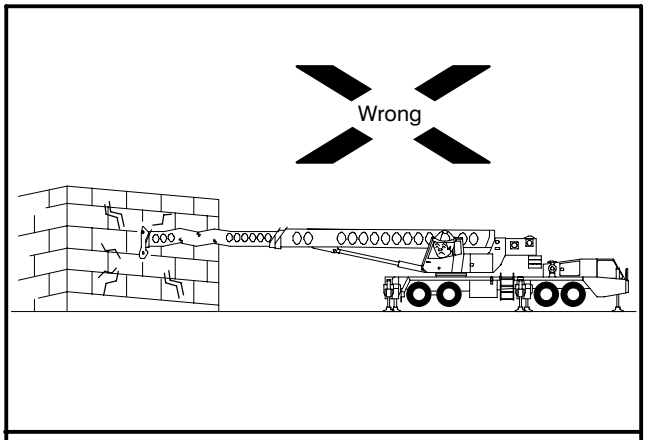


Figure 1—29
Do not push with the boom.

8. When performing repetitive lift applications, especially at or near maximum strength limited capacities, be aware that these applications may reduce component life. These applications include repeated lifting (or lifting and swinging) of near 100% strength limited capacities and repeated lifting maximum moment loads. These applications may fatigue the major structural portions of the crane. Although the crane may not break during these applications, they can reduce the fatigue life and shorten the service life of the crane. To improve the service life, while performing repetitive lift applications, consider reducing the capacities to 70% of maximum strength limited capacities to reduce fatigue cracking. Frequently perform a thorough inspection of all the structural areas of the crane. Any sign of cracks or damage must be repaired before continuing operations. Consult your distributor for repairs.
9. Always refer to the Crane Rating Manual after changing the arrangement of the attachments for the correct lifting capacities.
10. The boom must be extended in the correct manner before making a lift. The capacities listed in the Crane Rating Manual for this crane are based on the boom sections being extended in accordance with boom mode "A" or "B".
11. Do not use the boom to push or pull. It is not designed for this purpose. Such action can damage the boom and lead to an accident.
12. Know the load radius. Don't guess at it. Determine the load radius by using the boom angle indicator, the boom length indicator, and the Crane Rating Manual, or measure it with a steel tape. Remember — Radius is the horizontal distance from the centerline of rotation of the upper to the center of gravity of the load, when the load is hanging free.

Figure 1–30
Pinch Point Label

13. Do not operate a hydraulic crane at radii or boom lengths where the Crane Rating Manual shows no capacity. Do not use a fly not designed for this crane. Either of the above can tip the crane over or cause attachment failure. In some cases, the crane can tip over with no load on the hook, forward or backward! Also, if the boom is fully extended at a low angle, the crane may tip until the boom touches the ground. In any of these cases, injury or crane damage could result.
14. When lifting a load with any crane, the load may swing out, or sideways. The load radius will increase. Due to the design of hydraulic crane booms, (cantilever boom, supported by cylinders and overlapping sections) this increase is much more pronounced. The increase or out swing of the load can overload the boom, and lead to boom failure or tipping. Also, movement of the load can cause it to hit something. Make sure the load being lifted will remain within capacity as it is lifted and the boom deflects.
15. When extending or lowering a boom with a load, the load radius increases. As the load radius increases, capacity decreases. If capacity is exceeded, the boom may bend, or the crane may tip over. Sometimes at low angles, a hydraulic crane boom can be extended with a load, but cannot be retracted. This is because more power is available in the boom telescope cylinders to extend than to retract. If an operator extends the boom under load, he may not be able to retract the boom and may get into a dangerous situation.
16. Know the boom length. Don't guess. Use of an incorrect boom length can cause an accident.
17. When lowering or retracting the boom, the load will lower. To compensate for this, the operator must hoist up on the winch rope. Otherwise, movement of the load may cause an accident. When extending the boom, the load will raise. the operator must hoist down the winch rope to keep the load in place. Extending the boom without winching down, can lead to "two blocking". This is when the hook block or the hook ball contacts the head machinery. Two blocking can lead to sheave or rope damage.
18. The winch rope must be vertical when starting to lift. If not, the load will swing in, out, or sideways when lifted from the ground. The crane will lean toward the load when lifting heavy loads. This is caused by elasticity of the crane and the boom. This lean will increase operating radius so the load will swing outward when it clears the ground. This out swing is dangerous to anything in the path of the load, and because of the increase in load radius may overload the crane. To overcome this out swing, boom up as the load is lifted so winch ropes remain vertical. When setting the load on the ground, lower boom after the load touches down to avoid hook block swing when it is unhooked from load.
19. Pinch points, which result from relative motion between mechanical parts, can cause injury. Keep clear of the rotating upper or moving parts.

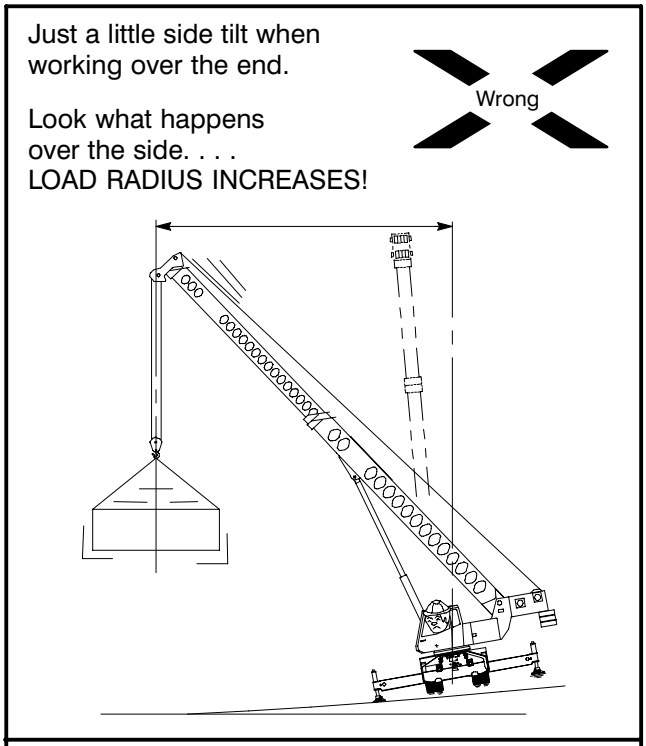


Figure 1—31
Watch that side tilt!

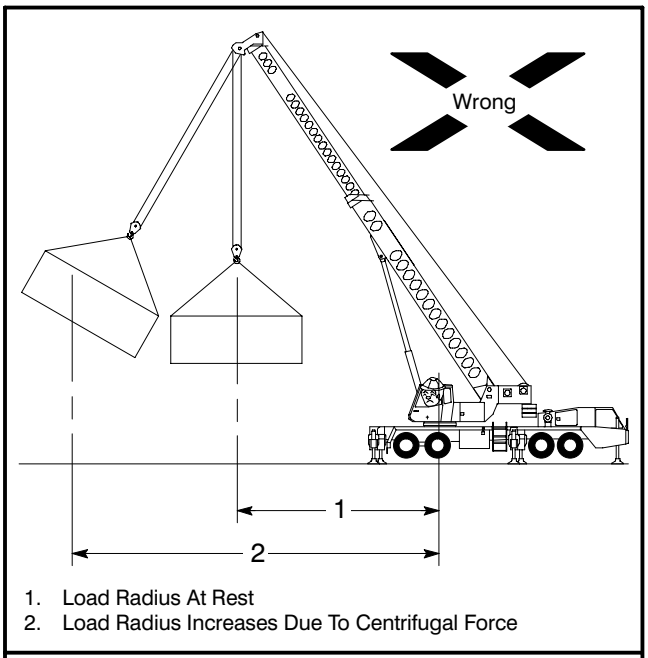


Figure 1—32
Watch that centrifugal force!

20. Lifting heavy loads can cause the crane to tilt or lean toward the load. When swinging a load from over the end to over the side, the tilt of the crane will increase. Since tilt acts to increase load radius, it must be compensated for when swinging the load. Swing slowly. Change boom angle (raise or lower boom) while swinging, to maintain a constant radius, and prevent in swing or out swing of load. If not, a dangerous condition could result.
21. Watch out for centrifugal force when swinging a load. Swing gently. Centrifugal force tends to increase load radius. This increase in radius could overload the crane and cause crane damage or tipping. When stopping the swing, over swing of the load can side load the boom.
22. Keep the winch ropes as short as possible to prevent excessive swinging. Always use the shortest boom length which will do the job. Remember — the shorter the boom, the better the capacity.
23. Do not move a crane away from the load while handling near capacity loads. Due to load inertia (weight) the load will tend to stay in position when the crane starts to move, and then will swing in towards the crane. The inertia effect will tend to increase load radius and decrease stability. This could lead to boom failure or crane tipping.
24. Don't increase the maximum allowable counterweight. Don't add anything to the crane that will act as additional counterweight. Remember that anything which has weight, if carried behind the crane's center of gravity, acts as counterweight. Adding counterweight affects backward stability of the crane, particularly when working over the side. It also encourages overloading of the crane.
25. Working areas for cranes are defined per the Working Areas Chart located in the Crane Rating Manual. Permissible loads, per the Crane Rating Manual, will vary from lifting quadrant to lifting quadrant. The operator must make sure capacity ratings are not exceeded regardless of which quadrant he is operating in, or when swinging from one quadrant to another.
26. When making lifts on tires, the tires must be inflated to pressures shown on the Tire Inflation label located on the carrier or in the Crane Rating Manual.

Traveling

1. Traveling with a suspended load should be avoided if possible. It is especially hazardous when terrain is rough or irregular, on a side slope, or in a hilly area. When traveling with a load, observe the following rules:
   a. Use a hand line to control the load and reduce load swing.
   b. Travel by the smoothest, most level route. If a smooth, level route is not available, don't travel with a suspended load. Grade the route to provide a smooth, level path. If it is not possible to grade the route, move the load by stepping. Level the crane on outriggers, lift the load and set it down ahead of the crane. Travel the unloaded crane beyond the load, level the crane on outriggers, lift the load, swing and set it down farther along the route. Continue this procedure until the load is at its destination.
   c. Carry loads as close to the ground as possible.
   d. Do not allow side swing of the load.
   e. Don't attempt to carry loads which exceed the crane's rating. Refer to On Tires and Pick And Carry capacities shown in the Crane Rating Manual.
   f. Don't travel with a load on soft ground. If the crane sinks into ground, stability can be affected to the point of tipping the crane.
   g. Keep all personnel clear of crane and load. Be prepared to set load down quickly at anytime.
   h. Fully extend outrigger beams. Extend or retract jacks until pontoons just clear the ground.
   i. Check clearance for the extra width of the crane with the outriggers extended. Outrigger beams or pontoons must not hang on any obstruction.
   j. Inflate tires as shown on the Tire Inflation label located on the carrier or in the Crane Rating Manual when making lifts on tires.
   k. See "Pick And Carry Operation" found later in this section of this Operator's Manual.
2. Do not exceed the maximum axle load ratings as listed on the Gross Axle Weight Rating plate.
3. Road the crane safely. Watch for narrow bridges and low clearances. Check load limits, heights, width, and length restrictions in the area you are traveling. Make sure your crane complies with all regulations.
4. Do not allow anyone to ride in the upper operator's cab during any highway travel. Highway travel is considered to be any travel of the crane over 5.0 mph (*8.0km/h*). Refer to "Highway Travel" found later in this Section of this Operator's Manual for more details.
5. When roading the crane, note the following:
   a. Operate with lights on. Use proper warning signs, flags, and other devices. Use an escort service if required.
   b. Engage travel swing lock. Release the 360° swing lock.
   c. Lash down or otherwise restrain the hook block and/or hook ball.
   d. Check for maximum allowable travel speed, and any other travel limitations. Don't exceed these maximums. Crane damage or an accident could result.
   e. When traveling, outriggers must be fully retracted.
   f. Remove all pontoons from the outrigger jacks and store them properly.
   g. See "Traveling the Crane" found later in this Section of this Operator's Manual for more details.
6. If the crane must be towed, shift the transmission to neutral and move slowly. Slowly take up slack in the rope or chain. Don't jerk, the chain or rope may break. Keep the chain or rope tight while towing. See "Towing the Crane" found later in this Section of this Operator's Manual for more details.

Leaving The Station

1. Do not get on or off a crane in motion. Use both hands when climbing on or off of the crane. If a ladder is provided, use it. Remain in three point contact with the crane at all times (two hands and one foot or two feet and one hand)
2. Whenever an operator leaves the control station for any reason, the following must be done:
   a. Lower the load to the ground.
   b. Engage swing lock. Engage the park brake. Shutdown the engine and remove the keys.
   c. Do not depend on a brake to suspend a load unless the operator is at the controls, alert and ready to handle the load. Brake slippage, vandalism or mechanical malfunctions could cause the load to drop.
3. Do not leave crane unattended with engine running.
4. When changing work shifts be sure to notify the next operator of any changes or problems with the crane.

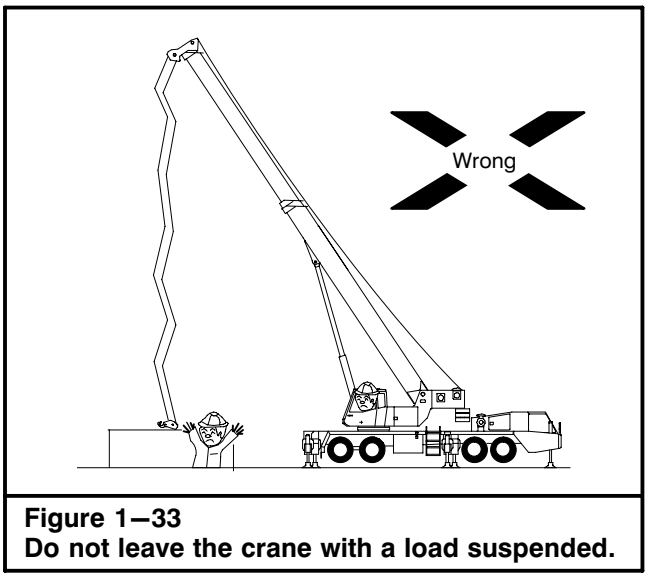


Figure 1–33
Do not leave the crane with a load suspended.

Personnel Handling Guidelines

Introduction

The following information is intended to provide Link-Belt's recommended minimum requirements that must be followed when handling personnel with a personnel basket or work platform (hereafter referred to as a work platform) suspended by wire rope from the boom of Link-Belt cranes. These requirements are based upon several sources and are put forth in recognition of current industry practices. However, safety, when handling personnel, remains the full responsibility of job site management and is dependent upon the responsible action of every person on the job involved in the related work.

This information is intended to supplement and not to supersede or replace any more restrictive federal, state, or local regulations, safety codes, or insurance requirements. It is intended to serve users of personnel work platforms in achieving the following objectives.

1. Reduce risk of personal injuries to users and the public.
2. Inform users of their respective responsibilities.
3. Provide standards of equipment requirements.
4. Provide standards for tests and inspections.
5. Provide standards of operation to promote safety.

Link-Belt cranes are designed and intended for handling material. They are not normally equipped with secondary systems or other devices required by personnel lift or elevator standards and are not intended for handling personnel for construction or amusement purposes. Use of cranes for these purposes is hazardous and is not recommended by Link-Belt. However, Link-Belt understands that circumstances may occur (in construction work) when lifting or lowering personnel on a materials handling crane load line is the only or the least hazardous method available to position personnel. In fact, Occupational Safety and Health Administration (OSHA) Part 29 CFR 1926.550(g) states "The use of a crane or derrick to hoist employees on a personnel work platform is prohibited, except when the erection, use, and dismantling of conventional means of reaching the work site, such as personnel hoist, ladder, stairway, aerial lift, elevating work platform, or scaffold would be more hazardous or is not possible because of structural design or work site conditions."

Much corollary and supplementary information is contained within the following resource documents pertaining to both cranes and personnel work platforms. Job site management must ensure all requirements listed in these resource documents are followed for all personnel handling operations.

- American National Standards Institute Reference — ANSI Standards A10.28, A92.2, A92.3, B30.5, and B30.23.
- Power Crane and Shovel Association (PCSA) Bureau of the Association of Equipment Manufacturers (AEM) Reference — PCSA Standard No. 4.
- American Petroleum Institute (A.P.I.) Specification 2C.
- OSHA Part 29, CFR 1926.550 Cranes and Derricks.

Authorization

Authorized use of a work platform may be permitted only after the following on-site procedures have been performed:

1. A competent person on the job site (job site manager) specifically responsible for the overall work function to be performed has determined that there is no practical alternative means to perform the needed work and has authorized a personnel lifting operation.
2. For each instance of such lifting, a competent person responsible for the task has attested to the need for the operation by issuing a written statement describing the operation and its time frame and itemizing that each of the on—site authorization requirements has been met. The written statement, after being approved by a qualified person, shall be retained at the job site. (Refer to *Personnel Handling Pre—Lift Check List For Link-Belt Cranes* found later in this Section for a sample check list.)
3. Review of crane inspection records has been conducted to ensure the crane being used meets applicable provisions in ANSI B30.5 and B30.23.
4. Review of the work platform inspection records and specifications has been conducted to ensure it meets applicable design standards (refer to ANSI A10—28).
5. Review of the personnel lifting operation practices specified in these instructions have been conducted with job site managers and crane operator(s), foreman, designated signal person, personnel to be lifted, safety supervisor, and any other person(s) who has jurisdiction over the operation to ensure that they are aware of the hazards of the operation and they are aware of provisions of these instructions that must be adhered to before and during the personnel lifting operation.

Equipment

1. The crane system shall be equipped with the following:
   a. A fully functional working operational aid such as a Rated Capacity Limiter (RCL) system – A system consisting of devices that sense crane loading, boom length (extendable booms only), boom angle, and also automatically provide an audible/visual signal when the loading conditions approach, reach, and/or exceed the rated capacity values. When the Actual Load exceeds the Rated Capacity, the system supplies a signal to a function cutout system. The operational aid shall be equipped with these additional devices:
      1. Anti–two block device to prevent damage to the hoist rope, other crane components, or attachments, and subsequent endangerment of personnel.
         - It is required that the anti–two block device warn both audibly and visually as well as have the capability to cutout the controls/functions that may cause a two block condition.
      2. Boom angle indicator.
         - Cranes with extendable booms must utilize a boom angle indicator having "high and low" set points and audible/visual alarm(s) capable of activating function cutouts.
   b. Boom hoist and load line shall have power lowering and raising and shall have an automatic brake which is applied when the applicable control is in neutral, or when the anti–two block device is actuated.
   c. If the crane is equipped with a "free-fall" hoist, steps shall be taken to ensure its use is not possible during the use of the work platform. (Note: A.P.I. applications do not permit the crane to be equipped with free-fall.)
   d. Each crane shall have a mechanical swing park brake or swing lock capable of being set at any swing position, and shall have a variable swing brake or swing controls capable of stopping the upper swing motion smoothly. The swing brake must be properly maintained at all times to ensure its holding capability.

   Note: All operational aids and equipment must be maintained in operable condition.

2. The work platform shall be designed by a qualified engineer competent in structural design. Its maintenance, and its attachment to the crane load line, is the responsibility of the job site management. Their arrangement shall comply with the following as a minimum:
   a. The work platform harness must be of sufficient length to prevent any portion of the work platform or the harness from coming in contact with the boom at any working boom angle.
   b. Audible and visual alert systems shall be provided to the personnel in the work platform to signal for assistance in the event of an emergency.
   c. Hooks on hook ball assemblies, hook block assemblies, or other assemblies, shall be of a type that can be closed and locked, (with a working safety latch) eliminating the hook throat opening, and shall be full load–bearing, and contain a manual trigger release.
3. No unauthorized alterations or modifications shall be made to the basic crane.

Maintenance, Lubrication, And Adjustments

1. The crane operator must have a complete understanding of the crane's maintenance, lubrication, and adjustment instructions as outlined in the Operator's Manual.
2. The crane shall be maintained, lubricated, and adjusted, by a designated person, as specified in the Operator's Manual.
3. The crane and work platform decals must be understood and maintained.
4. All decal precautions and instructions shall be strictly observed.

Inspection And Rigging

1. The lift crane and work platform shall be inspected immediately prior to commencement of operation. (Refer to the Crane Operator's Manual and ANSI B30.5, Section 5, Section 5–2.1.2 and 5.2.4, and ANSI B30.23 for the required inspection procedures for the crane. Refer to ANSI A10–28 for inspection procedures required for the work platform.)
2. The inspection shall be performed once daily when the crane is being used in work platform service or each time the crane is converted from material lifting to personnel handling operation. In the event the operator is replaced, a new inspection is required. Written documentation of all inspections must be kept on the job site during personnel handling operations.
3. Inspect the crane and work platform for any loose, damaged, or missing components.
4. Any structural or functional defect which adversely affects the safe operation of the lift crane shall be corrected before any operation utilizing a work platform begins or continues.

5. The hoist drum shall have at least three wraps of wire rope remaining on the drum at all times when using a work platform.
6. Minimum load hoist and boom hoist wire rope safety factors for the combined weight of the lift attachments, work platform personnel, and tools shall be 7:1 for manufacturer's specified construction wire rope and 10:1 for rotation resistant wire rope. (Note: A.P.I. applications require 10:1 for all rope construction.)
7. Telescopic Boom Cranes — The work platform shall be suspended from the main boom head sheaves only. Lattice Boom Cranes — The work platform shall be suspended from the main boom head sheaves only, or on a luffing attachment, the luffing jib head sheaves only. Do not suspend a work platform from any other lifting sheave(s) on any attachment.
8. Inspect the wire ropes, hoist drum brakes, boom, and other mechanical and rigging equipment vital to the safe operation of the crane. A written record of this inspection must be maintained on the job site.
9. In addition to other regular inspections, visual inspection of the crane and work platform shall be conducted immediately after testing and prior to lifting personnel. The following inspections shall be conducted on extendable booms prior to lifting personnel:
    a. Full power style booms:
        1. Inspection of all extension wire ropes at the access points in the boom where the end connections are visible — Refer to the Operator's Manual for inspection and adjustment procedures.
    b. Pinning and latching style booms:
        1. Inspection of the latching mechanism, sensors, and hydraulic/electrical circuit at the access points.
        2. Inspection of all pins and pinning locations in the individual boom sections and at the fully retracted position.
        3. Verification of the accuracy of the boom length indicator. Refer to the Operator's Manual for the procedures.
10. The following inspections shall be conducted on fixed length style booms prior to lifting personnel:
    a. Inspection of all pendants, pendant links, pendant spreader bars, and dead end lugs and links, etc.
    b. Inspection of all mechanical linkages, shafts, drums, etc.
    c. Inspection of all chord and lattice members of all boom sections, luffing jib sections, and live mast, as equipped.

Crane Test Procedures

The test procedures listed below shall be conducted at the following intervals:

- Daily
- When an operator is replaced
- When, in the judgement of responsible job site management, there has been a significant change in the conditions of the personnel lifting operation.

Note: No personnel shall ride the work platform during any of the tests recommended in this Section.

1. The work platform shall be loaded with ballast at two times the intended load. This load shall not exceed the rated capacity of the work platform. Do not exceed the rated lifting capacity of the applicable lift crane capacity chart. (Refer to ANSI A10.28 for suspended work platform testing and inspection.)
    a. This test load shall be tested for stability.
        - The operator and signal person shall conduct this test.
        - This test shall include movement of the work platform through its entire intended range of motion, simulating the specific operation to be undertaken.
        - A successful stability test must not produce instability of the crane or cause permanent deformation of any component.
    b. This test load shall be raised and lowered at maximum power controlled line speed (NOT FREE-FALL). The acceleration must be smooth and the deceleration capability of the control/braking system shall be confirmed by bringing the work platform to a smooth stop. (This experience is intended to sharpen the skill of the operator in handling the work platform and to give the operator an opportunity to evaluate the crane's performance.) The work platform shall then be inspected for any evident sign of damage or defect.
2. All limiting and warning devices shall be tested by activation of each appropriate control function.
3. With pinning and latching style extendable booms, a visual inspection shall be conducted to verify that the boom extend pins are properly set in the extended boom sections.

Operation And Safety

1. The Operator's Manual for the crane shall be read and fully understood by operating personnel. It shall be available to them at all times.
2. Safety when handling personnel remains the full responsibility of job site management and is dependent upon the responsible action of every person on the job involved in the related work.
3. Mobile lift cranes shall be erected to obtain maximum crane stability. The crane must be level and on firm ground with the outriggers fully extended and the tires clear of the ground before beginning any operation.
4. The operator shall not leave the operator's station when the work platform is occupied. The operator shall remain alert in a position of readiness at the work station with the engine running and the master clutch engaged, if crane is so equipped.
5. Unauthorized personnel shall not be in the operator's cab on the lift crane, or near the lift crane while a work platform is suspended from the load line.
6. Any operation in which a work platform is to be suspended from the load line shall be carefully planned by the operator, supervisory personnel, designated signal person, and personnel to be lifted prior to commencement of such operation. They are to be advised:
   a. That the crane does not have safety devices normally used on personnel handling equipment.
   b. That the safety of the operation depends on the skill and judgment of the crane operator and others present.
   c. Of procedures to enter and leave the work platform and other safety procedures.
7. After positioning of the work platform:
   a. All brakes and locks on the lift crane shall be set before personnel perform any work.
   b. With pinning and latching style extendable booms, a visual inspection shall be conducted to verify that the boom extend pins are properly set in the extended boom sections.
8. Telescope operation is not recommended with any extendable boom with personnel in the work platform.
9. A work platform attached to load line of lift cranes shall not be used for working on any energized electric power line, or any energized device or facility used for electric power generation or transmission. Minimum working clearance shall be at least twice that recommended for material handling operations in ANSI B30.5b section 503.4.5 and ANSI B30.23.
10. The combined weight of the work platform, any attachment device, personnel, tools, and other equipment shall not exceed 50% of the lifting capacity of the applicable lift crane capacity chart. (Note: A.P.I. applications require 25% of lifting capacity as the limit.)
11. The following actions and operations are strictly prohibited when working with personnel suspended in a work platform:
    a. Cranes shall not travel while personnel are in the work platform.
    b. No lifts shall be made on another of the crane's load lines with personnel suspended in a work platform.
    c. No external load shall be lifted by attaching it to the work platform.
    d. Work platform lifts shall be a single crane operation. A work platform shall not be lifted using two cranes.
    e. Hoisting of personnel shall be discontinued upon indication of any dangerous weather conditions, wind, or other impending danger.
    f. The emergency manual mode operation of pinning and latching style extendable booms shall not be utilized.
    g. Free—Fall (if equipped) shall not be used.
12. Movement of the work platform with personnel shall be done in a slow, controlled, cautious manner with no sudden movements of the crane or work platform.
13. Clear, unobstructed visibility between personnel on the work platform and the crane operator shall be maintained at all times except where a designated signal person has been assigned and positioned such that he is visible to both. Such designated signal person shall have no other duties to perform when personnel are in the work platform.
14. Voice communication between work platform personnel, the crane operator, and designated signal person, if assigned, shall be maintained.
15. If other cranes or equipment may interfere with the lifting of personnel, signals or other means of communication between all crane or equipment operators shall be maintained to avoid interference with individual operations.
16. If the work platform is not landed, it shall be tied to a structure before personnel mount or dismount the work platform.
17. Personnel in the work platform shall wear personal fall arrest systems. Anchors used for attachment of personal fall arrest equipment shall be independent of any anchors being used to support or suspend work platforms. Personnel shall keep all parts of body, tools, and equipment inside work platform during raising, lowering, and positioning.

18. Personnel shall always stand firmly on the floor of the work platform and shall not sit or climb on the edge of the work platform or use planks, ladders, or other devices for attaining a work position. (This does not apply to offshore personnel transfer baskets. Personnel must ride on the exterior of this type of personnel handling device to assure greater safety of the operation.)
19. When welding is done by personnel in the work platform, the electrode holders shall be protected from contact with metal components of the work platform. If electrically connected electrode holders contact work platform, work platform could be dropped due to burning/melting of wire ropes suspending the work platform.

Additional Requirements For Offshore Cranes

1. Link-Belt offshore cranes are designed to handle materials. However, due to the special conditions commonly existing offshore, the use of cranes to transfer personnel between vessels or from a vessel to a work platform is an established practice. The safety of the personnel, if a materials handling crane is used in transferring personnel, depends upon the skill and judgment of the crane operator and alertness of the personnel being transferred. Sea and weather conditions may create additional hazards beyond the skill of persons involved.

   This operation is approved by the American Petroleum Institute (A.P.I.). By adopting procedures for this operation, the institute has determined that the transfer of personnel may be performed safely under certain offshore conditions. Therefore, whenever an offshore crane is used to transfer personnel, all persons involved in the operation must know and implement the A.P.I. procedures and verify that sea and weather conditions are within safe limits for the transfer.

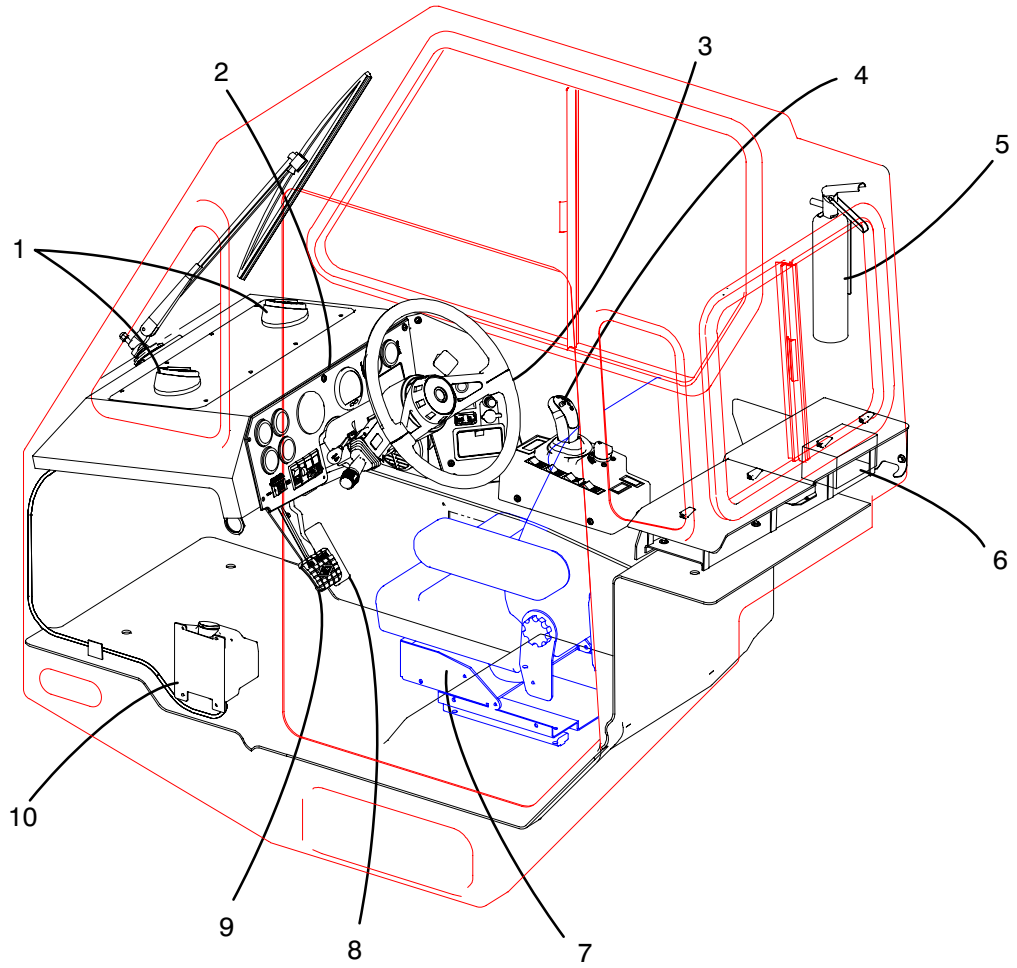
   In addition to all previous requirements in these Instructions, A.P.I. 2C requires the following:

   - Boom and load hoists used shall be approved by the hoist manufacturer for personnel handling and shall be so indicated on their name plate.
   - Refer to A.P.I. 2C Section 6 for further details and procedures.

Personnel Handling
Pre-Lift Check List for Link-Belt Cranes

1	I am the designated person responsible for verifying that all safety requirements are met for this personnel handling operation; Name: _____ Title: _____ Signature: _____ Date: _____/_____/_____	Initials
2	I have verified that there are no better alternative means to handle personnel for this operation.	
3	I have a written statement authorizing personnel handling from a competent person on the job who accepts full responsibility, or I accept full responsibility for the operation.	
4	The Crane Operator acknowledges that he has read and fully understands the Crane Operator's Manual and Crane Rating Manual. All personnel involved have been informed and understand the tasks required to complete the personnel lifting operation.	
5	The crane has been maintained, lubricated, and adjusted by a designated person, as specified in the Crane Operator's Manual.	
6	The lift crane is equipped, and all devices operate properly as follows:	
	• Anti–two block device with hydraulic cutouts • Power load raising and lowering with automatic brakes and function cutouts – Free–Fall (if equipped) shall not be used • Boom angle indicator with high and low set points and function cutouts • Boom length indicator (telescopic booms only) and function cutouts • Rated Capacity System • A variable swing brake or swing controls capable of stopping upper swing motion smoothly • A mechanical swing park brake or swing lock to hold the upper in position while personnel are working from the work platform • Hook block or hook ball being used can be closed and locked with a safety latch	
7	A working audible and visual alert system is provided to the personnel in the work platform.	
8	A mechanical and structural crane inspection has been completed by a designated person.	
9	Test has been completed with twice the total load in the work platform that is expected for the total load during the personnel handling operation.	
10	Lifting personnel is allowed from:	
	• Telescopic Boom Cranes – Main boom head sheaves only • Lattice Boom Cranes – Main boom head sheaves only or on a luffing attachment, the luffing jib head sheaves only	
11	Crane travel is not allowed with personnel in the work platform.	
12	Telescoping the boom is not recommended with personnel in the work platform.	
13	When handling personnel with pinning and latching style booms, it is recommended that the boom be kept in a pinned position. Inspections must be done to ensure that all boom extend pins are set.	
14	Voice communications between the Crane Operator and the personnel in the work platform are present and operational.	
15	Fall arrest systems are present and in use by personnel in the work platform.	
16	Weather and wind conditions are acceptable to safely perform the lift.	

Note: This checklist is to be used as a supplement to (not a substitute for) the information and procedures supplied for personnel handling operations.



1. Defroster Fans
2. Carrier Cab Dash
3. Steering Wheel
4. Transmission Shifter
5. Fire Extinguisher
6. Fuse Box
7. Carrier Cab Seat
8. Throttle Pedal
9. Service Brake Pedal
10. Windshield Washer Reservoir

Figure 1—34
Carrier Cab Layout

Carrier Cab

The carrier cab contains various controls needed to drive the crane. Figure 1—34 illustrates the general location of the these controls.

WARNING

This manual must be thoroughly read and understood by the operator before driving the crane. Crane damage or personal injury could result from improper operating procedures.

Fire Extinguisher

A fire extinguisher is located directly behind the driver's seat in the carrier cab. Refer Figure 1—34. It is an A B C type fire extinguisher, meaning it is capable of extinguishing most types of fires. The operator should be familiar with its location, the clamp mechanism used to secure it in place, and foremost the operation of the device. Specific instructions, regarding operation, are given on the label attached on the fire extinguisher. A charge indicator on the fire extinguisher monitors the pressure within the tank. Check the indicator daily to ensure the fire extinguisher is adequately charged and ready for use.

Carrier Cab Fuse Box

The carrier cab fuse box is located behind the driver's seat. Remove the access panel to gain access to the fuse box. Located on the back of the box cover is a label which designates the carrier electrical circuit protected by each fuse. Refer to Figure 1−35. Use the fuse puller provided when replacing a fuse.

Windshield Washer Reservoir

Check the windshield washer reservoir daily. The reservoir for washer fluid is located in the lower left of the cab. Refer to Figure 1−34. Visual inspection can determine if the washer fluid is adequate. Do not operate the washer when the reservoir is empty. Use specially formulated windshield washer fluid rather than water because specialty washer fluids contain additives that dissolve road grime.

Dash Panel

Located directly in front of the operator, the dash panel contains the following controls and is shown in Figure 1−36.

Note: When the key is turned on, the gauges will go through an initialization sequence to allow the operator to verify correct operation of the gauges and indicator lights. The gauge needle will move counterclockwise to just below minimum scale for a 1/2 second, then clockwise to maximum scale and the indicator light within each gauge will flash. When initialization sequence is complete, all indicator lights will extinguish, gauge needles will indicate actual readings, and the odometer will display in the speedometer gauge.

If a gauge is not monitoring its respective function: (1) the indicator light will flash slowly and the gauge needle will stay at minimum scale. This indicates the gauge is not receiving data from the data bus. (2) the indicator light will flash rapidly and the gauge needle will go to full or minimum scale. This indicates the gauge has received invalid or out-of-range data. (3) the indicator light will flash slowly (about once per second) and the gauge needle will go to full or minimum scale. This indicates the gauge is not receiving any data from the system control unit (SCU). Repair the problem before driving crane.

1. Fuel Gauge

This gauge registers the level of fuel in the fuel tank. The fuel tank capacity is 95 gal (*359.6L*). Refer to the engine manufacturer's manual for the correct grade of diesel fuel.

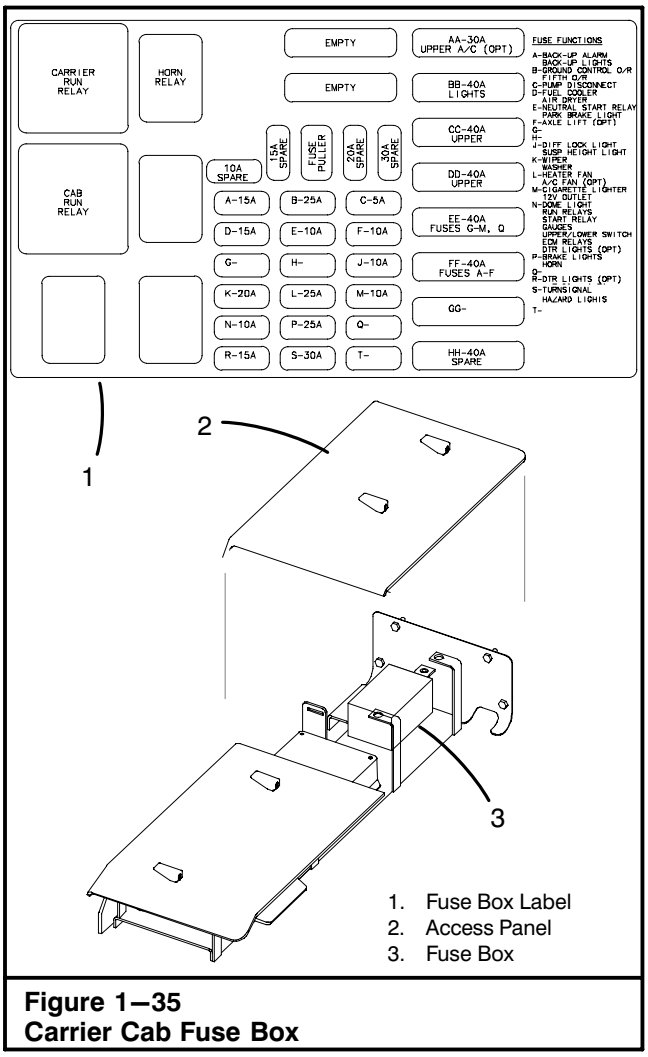
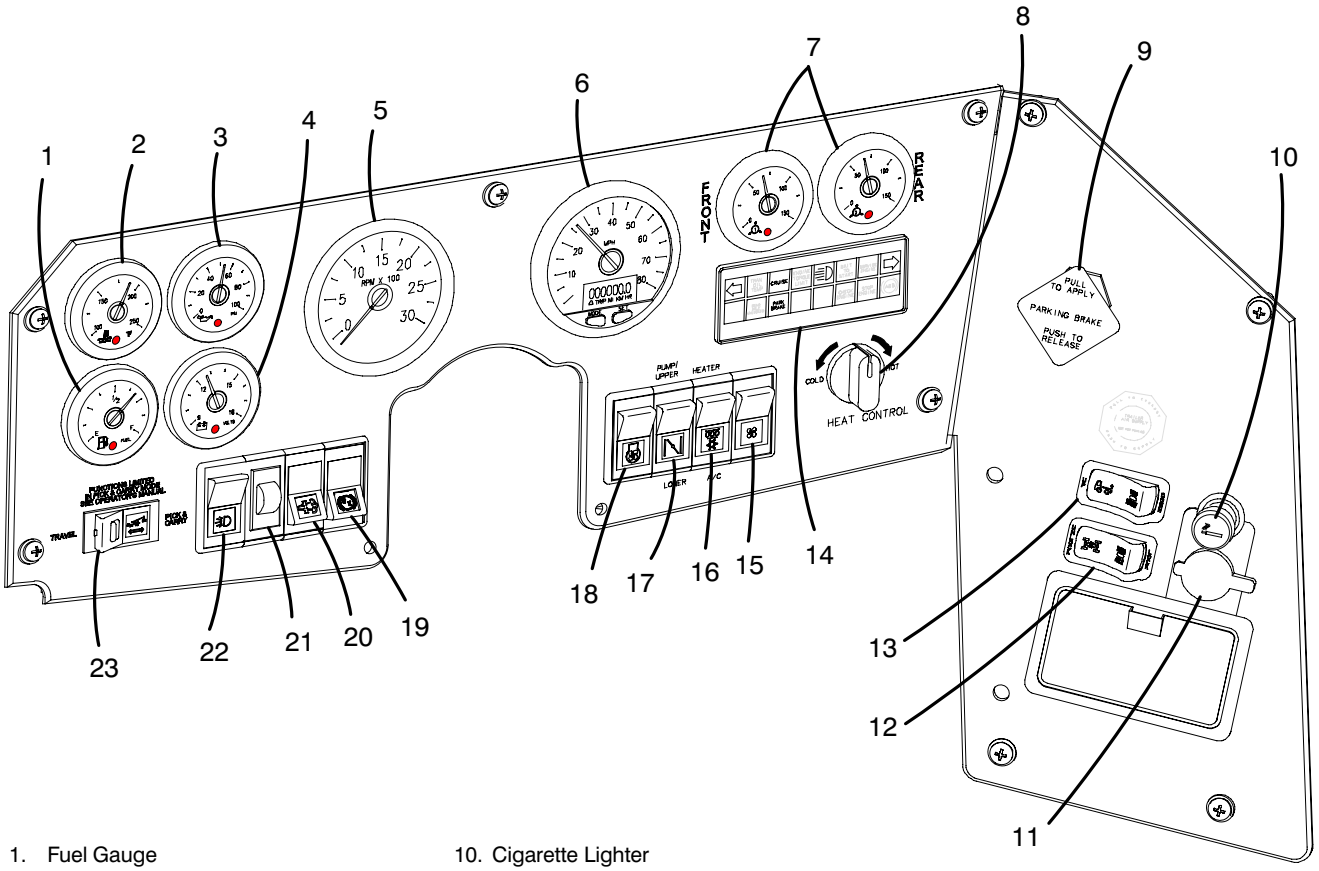


Figure 1−35
Carrier Cab Fuse Box

When the fuel level reaches an eighth of a tank, an indicator light within the gauge will illuminate and the message "LOFUEL" will appear in the LCD area of the speedometer/odometer message center.

2. Coolant Temperature Gauge

This gauge registers engine cooling system temperature. For proper cooling system operating temperature range, refer to the engine manufacturer's manual. If cooling system overheats, reduce engine speed or shift to a lower gear, or both, until the temperature returns to normal operating range. If engine temperature does not return to normal temperature, refer to engine manufacturer's manual. When coolant temperature exceeds normal operating range an indicator light within the gauge will illuminate, an alarm buzzer will sound, the stop engine light will illuminate, and the message "H20 TEMP" will appear in the LCD area of the speedometer/odometer message center.



1. Fuel Gauge
2. Coolant Temperature Gauge
3. Engine Oil Pressure Gauge
4. Battery Gauge
5. Tachometer
6. Speedometer/Odometer Message Center
7. Air System Pressure Gauges
8. Heat Control Switch
9. Park Brake Control Knob
10. Cigarette Lighter
11. 12V DC Accessory Outlet
12. Differential Lock Switch
13. Air Ride Suspension Switch (If Equipped)
14. Indicator Light Cluster
15. Defroster Fan Switch
16. Climate Control Switch
17. Pump Engagement/Throttle Selector Switch
18. Fan Control Override Switch
19. ABS Diagnostic Request Switch
20. Diesel Particulate Filter Regeneration Switch
21. Dash Lights Dimmer Switch
22. Headlight Switch
23. Pick And Carry Switch

Figure 1–36
Carrier Cab Dash Panel

3. Engine Oil Pressure Gauge

This gauge registers the engine oil pressure. For proper oil pressure operating range, refer to the engine manufacturer's manual. If there is no engine oil pressure after 10–15 seconds of running time, shutdown the engine immediately and repair the problem to avoid engine damage. When the oil pressure is not within normal operating range, an indicator light within the gauge will illuminate, an alarm buzzer will sound, the stop engine light will illuminate, and the message "OILPSI" will appear in the LCD area of the speedometer/odometer message center.

4. Battery Gauge

This gauge registers the charge in the battery and the output of the alternator through the regulator. It should read 12 volts with the key on, and 12.5 to 14 volts with the engine running. When the charge or the voltage in the battery is not within normal operating range an indicator light within the gauge will illuminate and the message "VOLTS" will appear in the LCD area of the speedometer/odometer message center.

5. Tachometer

RPM X 100

The tachometer registers engine speed in revolutions per minute (rpm). Refer to the engine manufacturer's manual for suggested operating speeds.

6. Speedometer/Odometer Message Center

The speedometer registers crane travel speed in miles per hour (mph) or kilometers per hour (km/h) The Message Center portion of the gauge is used most often to display the odometer. The Message Center display disappears when the ignition is turned off. To view the display when the ignition is off, press the Mode button in the bottom portion of the gauge. It remains activated for ten seconds after the button is last pushed.

To view a different function, press and release the Mode button until one of the following functions appears:

- Odometer — reads in miles and tenths (for example, 123456.7). The odometer is not resettable.
- Trip 1 Odometer — reads in miles and tenths, preceded by a 1 (for example, 1 123456.7 TRIP MI).
- Trip 2 Odometer — reads in miles and tenths, preceded by a 2 (for example, 2 123456.7 TRIP MI).
- Hour meter — reads in hours, followed by the letters HR (for example, 123456_{HR}).

If a warning alarm is triggered, a warning message will override all other Message Center displays until the alarm condition is corrected. The warning message may be temporarily overridden for twenty seconds as described in "Warning Alarms" found later.

Setting and Resetting Functions in the Message Center

Trip Odometers

To Display The Trip 1 Or Trip 2 Odometer

Press and release the Mode button until the desired trip odometer is displayed.

To Reset A Trip Odometer To Zero

1. Display odometer to be reset (Trip 1 or Trip 2).
2. Press and hold the Set button until the mileage is reset to zero (about three seconds).

Warning Alarms

If a condition that requires attention develops during operation, a warning will be displayed in one of three ways:

- A warning message can appear in the Speedometer Message Center display.
- The red warning light in the associated gauge will turn on.
- An audible warning tone will sound (for select functions only).

Once a warning alarm is triggered, it will continue until the condition that caused it is corrected. At that time, the visual and audible alarms will stop and the Speedometer Message Center will display a Reset message for twenty seconds. Pressing the Set button clears the Reset message sooner.

Temporarily Overriding a Warning Message

1. Press the Set button.
2. Press the Mode button to display another function. After twenty seconds, the warning message will reappear.

The red warning light in the gauge and the warning tone cannot be overridden and will continue until the condition is corrected.

The following identifies the possible warning messages and the conditions that cause them.

Function	Message	Alarm
Low Fuel Warning	LO FUEL	No
Engine Oil Temp Warning	OIL TEMP	Yes
Coolant Temp Alarm	H2O TEMP	Yes
Hydraulic Oil Temp Alarm	HYD TEMP	Yes
Front Air Pressure Alarm	LO AIR1	Yes
Rear Air Pressure Alarm	LO AIR2	Yes
Battery Voltage Warning	VOLTS	No

System Diagnostic Test Mode

To access the System Diagnostic Test mode, turn the ignition on and press the Mode button until "DIAGTST" appears in the display. Then press the Set button to enter the System Diagnostics Test mode. "AUTO" will be displayed.

Note: The System Diagnostics Test mode is only enabled when the ignition is on.

The System Diagnostic Test has three functions available:

- Auto — A fully automatic test of all modules, displays, and indicators.
- Manual — Manual selection of individual modules and telltales to test.
- Fault Display — Recalls up to 128 device faults.

Auto Test Sequence

Pressing the Set button while "AUTO" is displayed starts the Auto Test sequence. During the Auto Test, the system control unit (SCU) generates its own gauge needle positioning data and warning LED data. The sequence begins with all gauge needles at zero scale and a blank Message Center Display. The SCU moves the gauge needle in unison to mid-scale, full scale, back to mid-scale, back to zero, and then exits to the Normal Operation mode.

Pressing the Mode or Set button during the sequence halts the sequence and returns the display to "AUTO".

If the instrumentation passes the Auto Test, it is a good indication that the entire instrumentation system is functioning properly.

Manual Test Function

Pressing the Mode button while "AUTO" is displayed activates the Manual Test function and causes "MANUAL" to be displayed. The Manual Test is the same as the Auto Test except that the user can select which modules to test.

a. Use the Set button while MANUAL is displayed to select the module to be tested. The module's name will appear in the display, starting with SCU.
b. Press the Set button to start the test, or press the Mode button to select a different module.
c. To end the test and display the module name, press the Mode button at any time during the sequence. The Manual Test sequence is identical to the Auto Test sequence except that the user must press the Set button to move from one phase to the next.

Fault Codes

When a device (or ECU) attached to the crane data bus detects a fault, it can place an active fault code on the data bus. The active fault code describes a specific type of failure (for example, low oil pressure). Each fault code includes a device fault code that identifies the device which detected the fault. Pressing the Set button when "FAULTS" is displayed tells the SCU to send a request over the crane data bus for all devices to send their active fault codes. During this time the SCU displays "POLLING". After all the active fault codes have been received, the SCU displays the device fault codes one-at-a-time in 3-second intervals. Up to 128 device fault codes can be displayed. Pressing the Mode or Set button during this time exits the Fault mode.

Note: A device fault code does not contain actual failure data, only the identification of the device that detected the fault.

7. Air System Pressure Gauges

These gauges register the air pressure in the front and rear systems. The front gauge registers the pressure of the front brake system. The rear gauge registers the pressure of the rear brake system. Normal operating range on both systems is 100–120 psi (*690–827kPa*). If they do not register within this range, correct the problem before operating. When the air pressure is not within the normal operating range, an indicator light within the gauge will illuminate, an alarm buzzer will sound, and the message "LO AIR1" or "LO AIR2" will appear in the LCD area of the speedometer/odometer message center.

8. Heater Control Switch

This switch controls the temperature of the carrier cab heater. Rotate the switch clockwise to increase the temperature; counterclockwise to decrease the temperature.

9. Park Brake Control Knob

This knob controls engaging and releasing the park brake.

WARNING

Avoid using the park brake to stop the crane in motion (as a service brake) except in cases of extreme emergency. Brake wear will not be distributed evenly and application cannot be controlled.

To Engage Park Brake

a. Bring the crane to a full stop.
b. Shift the transmission to neutral.
c. Pull the knob out.

To Release Park Brake

a. Apply the service brakes.
b. Push the knob in.

Note: If the park brake knob will not stay in the released position, check the air system pressure. It must be at least 60 psi (*414kPa*) before the brake will release. The emergency park brake will also begin to apply, and will fully engage if pressure decreases below 40 psi (*276kPa*).

10. Cigarette Lighter

Push knob in to heat element. The knob will pop-up when the element is hot.

11. 12V DC Accessory Outlet

Use this outlet for electrical accessories.

CAUTION

Do not connect an accessory to any part of the crane other than the accessory outlets or cigarette lighter. Damage to the crane's electrical system may result. If it is necessary to do so, contact your Link-Belt distributor.

12. Differential Lock Switch

This switch is used to increase rear wheel traction on slippery roads or soft ground. Under normal driving conditions the differential lock switch should remain in the "UNLOCK" position. This will provide differential action between the front-rear and rear-rear axles. To provide maximum pulling power when wheels are likely to slip, use the "LOCK" position to limit slipping.

To Engage The Differential

a. Maintain a constant crane speed.
b. Move the Differential Lock switch to the "LOCK" position.
c. Let up on the throttle pedal momentarily to allow the differential lock to engage.
d. Proceed with caution.

CAUTION

Do not actuate the differential lock when the wheels are slipping or spinning without traction. Do not allow wheels to spin with differential lock in the "UNLOCKED" position. Either situation can damage the differential gears.

To Disengage The Differential Lock

a. Maintain a constant crane speed.
b. Move the Differential Lock switch to the "UNLOCK" position.
c. Let up on the throttle pedal momentarily to allow the differential lock to disengage.
d. Proceed with caution.

13. Air Ride Suspension Switch (If Equipped)

This crane is equipped with an air ride suspension which utilizes air bags to absorb shock. This switch is available when the crane is equipped with the optional axle lift system. This control is used to adjust the crane's suspension depending on operating conditions. Under normal conditions, this switch should be in the "UP" (inflated) position. Use the "DOWN" (deflated) position before raising the crane on outriggers only if the crane is equipped with the axle lift system.

14. Indicator Light Cluster

Multiple indicator lights are contained in this one location. Refer to "Indicator Light Cluster" found later in this Operator's Manual for a description of each indicator light.

15. Defroster Fan Switch

This switch controls the defroster fans. to defrost the windows, press the switch to operate the defroster fans, turn climate control switch to A/C position, and turn the heat control switch to the full HOT position.

16. Climate Control Switch

This control is used to operate the cab heater and air conditioner (if equipped). Once the desired system is selected, use the heat control switch to regulate the temperature inside the cab.

17. Pump Engagement/Throttle Selector Switch

This switch is used to select from which cab the throttle pedal will function. When driving from the carrier cab, this switch must be in the "Lower" position. When performing crane operations, this switch must be in the "Pump/Upper" position. Transmission selector must be in the "Neutral" position before switching throttle locations.

Note: Switching the throttle selector switch to the "Pump/Upper" position also engages the main pump.

When operating from the upper cab and the pump engagement/throttle selector switch is in the "Pump/Upper" position, maximum engine rpm is reduced to 1600. This is a precaution to prevent over speeding of the pumps.

18. Fan Control Override Switch

The fan control override switch is used to help control engine temperature. With the switch in the off position (top part of switch), the fan will automatically come on when the temperature reaches 195˚F (*90˚C*) and will shut off at 178˚F (*81˚C*). With the switch in the "On" position (bottom part of switch), the fan will run continuously. Normally the switch should remain in the "Off" position except for example when climbing a grade. Before climbing a long grade, turn the switch to the "On" position to prevent an unexpected power reduction of the engine if the fan comes on.

19. ABS Diagnostic Request Switch

This switch is used to activate the ABS indicator light to flash active and inactive engine fault codes. Refer to "Anti-lock Brake System (ABS)" found later in this Section of the Operator's Manual for additional information.

20. Diesel Particulate Filter Regeneration Switch

This switch is used to start a manual regeneration to purge the accumulated soot from the diesel particulate filter (DPF). During normal highway travel, the accumulated soot in the DPF will be purged by the automatic regeneration cycle. Use this switch only when the DPF Regeneration Indicator Light illuminates or flashes.

Note: The crane must remain stationary for approximately 45 minutes to complete a manual regeneration.

1. Park the crane in a safe location, shift the transmission to neutral, and engage the park brake.
2. Press and hold the DPF regeneration switch for at least two seconds and release to initiate a manual regeneration cycle.

   Note: Do not press the throttle or brake pedal during a manual regeneration cycle. Pressing these pedals will deactivate the regeneration cycle and the engine will return to idle. The manual regeneration cycle must be restarted.

3. Engine must be at minimum operating temperature of 140˚F (60˚C).

The engine ECM will perform a system check for approximately 30 seconds before starting the manual regeneration cycle; also, the engine speed will increase to 1200—1400 rpm. When the cycle begins, the DPF Regeneration Indicator Light goes out. When regeneration is complete, the engine will return to idle. Consult the engine manufacturer's manual for additional information on the regeneration process and procedures.

⚠ DANGER

The temperature of the exhaust gas and the exhaust system components can reach up to 1,200˚F (650˚C) during regeneration. An unexpected failure of the engine or regeneration system may increase exhaust gas temperature at the particulate exhaust filter to as high as 1,650˚F (900˚C). This may result in fire, burn, or explosion hazards, which may result in personal injury or death. Do not expose flammable material or explosive atmospheres to exhaust gas or to exhaust system components during regeneration.

21. Dash Lights Dimmer Switch

This switch is used to dim the dash lights. Rotate the switch down to dim the lights and rotate up to brighten dash lights.

22. Headlight Switch

Press the bottom half of this switch to turn headlights, park lights, and instrument panel lights on. Press the top half to turn them off.

23. Pick And Carry Switch

Use this switch to select between normal travel and pick and carry travel. When switch is in the pick and carry position, limited hoist and telescope functions are enabled even though the transmission PTO/main pumps are disengaged. Also the transmission will not automatically shift out of first gear. If crane is equipped with the maneuver mode switch located on the transmission shift console, the transmission will not shift beyond 3rd gear.

Note: In case of air pressure loss, this switch can be used to re-establish hydraulic functions of winch and boom hoist when in the pick and carry position.

Indicator Light Cluster

1. Turn Signal Indicator Light

This light will blink to indicate that a turn signal is on or the hazard lights are flashing.

2. Cruise Enabled Indicator Light

This indicator light will illuminate to alert the operator that the cruise control system is enabled.

3. High Beam Indicator Light

This indicator light will illuminate to indicate when the headlights are on high beam.

4. Anti-lock Brake System (ABS) Warning Light

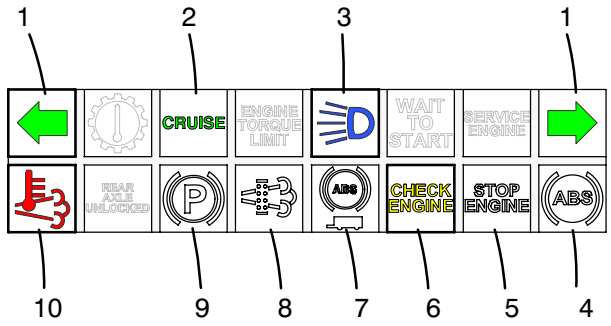
This indicator light will illuminate to alert the operator that a malfunction in the ABS has occurred and the system is disabled. Normal braking should not be affected, however, the ABS should be serviced immediately. Refer to Anti-lock Brake System (ABS) found later in this Operator's Manual.

5. Stop Engine Indicator Light

This red indicator light will illuminate along with an alarm buzzer to make the operator aware of major engine problems. When this light illuminates, stop operations immediately and shutdown the engine. Consult the engine manufacturer's manual and correct the problem before any further operation of the engine.

The stop engine indicator light will also illuminate in conjunction with the check engine light and a flashing DPF regeneration light. This condition alerts the operator that the soot loading in the DPF has reached a critical level. If a regeneration cycle is not started, the stop engine light will begin to flash and the engine will shutdown in 30 seconds. The engine may be restarted and a regeneration cycle must be initiated. If engine operations continue without regeneration, the engine will shutdown a second time. After a second shutdown, regeneration may not be initiated and the engine will run for only 60 seconds at a time.

Note: The stop engine light will illuminate momentarily when the ignition is turned on as a means of testing the indicator light. The light should go out after a short period of time.



1. Turn Signal Indicator Light
2. Cruise Enabled Indicator Light
3. High Beam Indicator Light
4. Anti-lock Brake System (ABS) Warning Light
5. Stop Engine Indicator Light
6. Check Engine Indicator Light
7. Boom Trailer Anti-lock Brake System (ABS) Warning Light
8. Diesel Particulate Filter Regeneration Indicator Light
9. Park Brake Indicator Light
10. High Exhaust System Temperature Indicator Light

Figure 1—37
Indicator Light Cluster

6. Check Engine Indicator Light

This amber indicator light will illuminate along with an alarm buzzer to make the operator aware of minor engine problems. When this light illuminates engine operation may continue. However, consult the engine manufacturer's manual and correct the problem as soon as possible to avoid prolonged operation of the malfunctioning engine which could develop into a major problem.

The check engine indicator light will flash to alert the operator that the engine idle shutdown system will shutdown the engine in 30 seconds. Refer to "Engine Idle Shutdown System" found later in this Operator's Manual.

This light will also illuminate in conjunction with a flashing DPF regeneration light. This condition alerts the operator that the soot loading in the DPF has reached a level where a regeneration, either automatic or manual must be performed as soon as safely possible. If regeneration cannot be achieved, contact your Link-Belt distributor and/or engine dealer. If engine operations continue without regeneration, the engine progressively derates to a reduced horsepower level.

Note: The check engine light will illuminate momentarily when the ignition is turned on as a means of testing the indicator light. The light should go out after a short period of time.

7. Boom Trailer Anti-lock Brake System (ABS) Warning Light (If Equipped)

If the crane is equipped with boom trailer and anti-lock brakes, this amber indicator light will illuminate to alert the operator that a malfunction in the trailer ABS has occurred and the system is disabled. Normal braking should not be affected, however, the ABS should be serviced immediately. Refer to Anti-lock Brake System (ABS) found later in this Operator's Manual.

8. Diesel Particulate Filter Regeneration Indicator Light

This indicator light will illuminate to alert the operator that an active regeneration of the diesel particulate filter is required but cannot occur. When this light illuminates, use the DPF regeneration switch to initiate a manual regeneration cycle as soon as safely possible. Refer to the Diesel Particulate Filter Regeneration Switch description found earlier in this Operator's Manual and the engine manufacturer's manual for the proper filter regeneration procedures.

Note: The diesel particulate filter regeneration indicator light will illuminate momentarily when the ignition is turned on as a means of testing the indicator light. The light should go out after a short period of time.

9. Park Brake Indicator Light

This light will illuminate anytime the park brake is engaged and the ignition is on.

Note: When the park brake control knob is pushed in (released), the park brake remains engaged until the indicator light goes off.

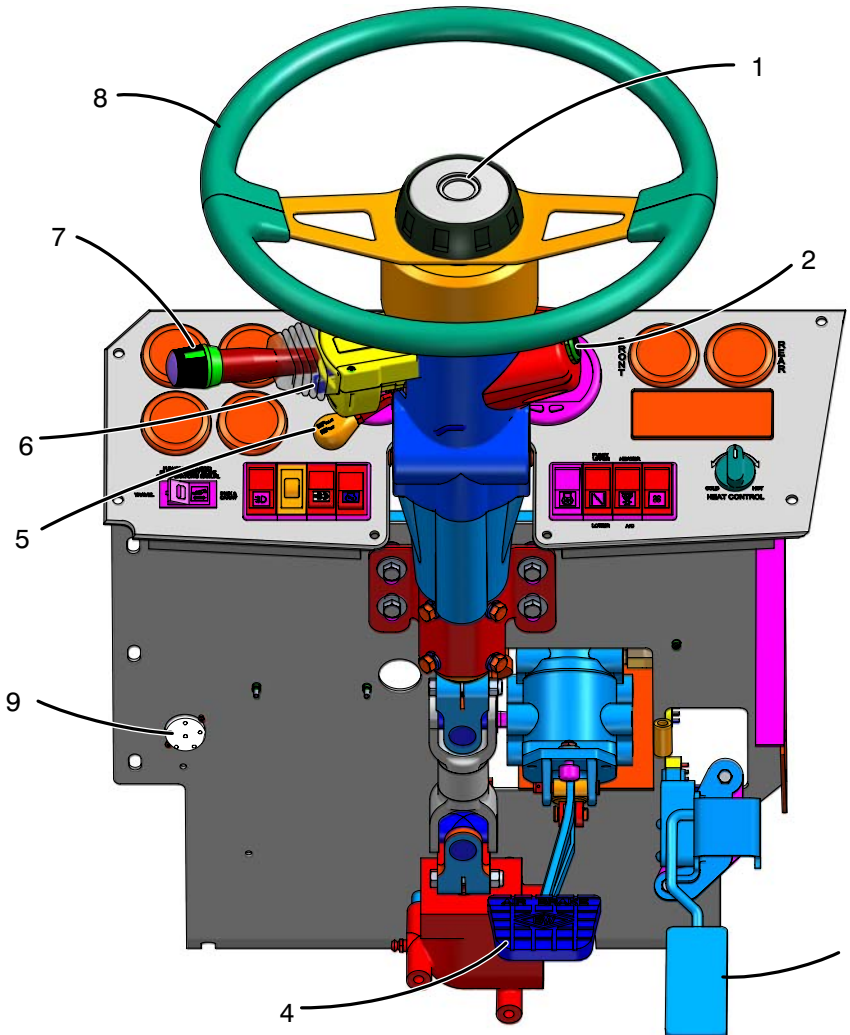
10. High Exhaust System Temperature Indicator Light

This indicator light will illuminate to alert the operator that the outlet temperature in the DPF is above 840˚F (450˚C) if the crane is traveling less than 5 mph (*8km/h*). This condition can occur under normal operation. No action is required.

DANGER

The temperature of the exhaust gas and the exhaust system components can reach up to 1200˚F (650˚C) during regeneration. An unexpected failure of the engine or regeneration system may increase exhaust gas temperature at the particulate exhaust filter to as high as 1650˚F (900˚C). This may result in fire, burn, or explosion hazards, which may result in personal injury or death. Do not expose flammable material or explosive atmospheres to exhaust gas or to exhaust system components during regeneration.

Note: The high exhaust system temperature indicator light will illuminate momentarily when the ignition is turned on as a means of testing the indicator light. The light should go out after a short period of time.



1. Horn
2. Ignition Switch
3. Throttle Pedal
4. Service Brake Pedal
5. Tilt/Telescope Lever
6. Hazard Flasher Switch
7. Turn Signal Lever
8. Steering Wheel
9. Engine Diagnostic Connector

Figure 1—38
Steering Column And Wheel

Steering Column And Wheel And Foot Operated Controls

The steering column and wheel are the conventional automotive type equipped with a tilt function. The following is a description of the switches and controls on the steering column, along with an explanation of their function and/or operation. Refer to Figure 1—38.

1. Horn

The button in the center of the steering wheel activates the horn. Press the button to sound the horn.

2. Ignition Switch

The ignition switch is the key operated, conventional, automotive type. It controls engine off/run/start and energizes the instrument panel gauges in the carrier cab.

3. Throttle Pedal

Engine speed is controlled by the throttle pedal. Press down on the throttle pedal to increase engine speed. Release the throttle pedal to decrease engine speed.

4. Service Brake Pedal

   The air brakes are controlled by the brake pedal. Press the pedal down to apply the brakes. Release the pedal to release the brakes.

   Air Brake Operation

   The distance the service brake pedal is moved regulates the amount of air delivered to the brake chamber, which determines the braking force.

   The smoothest stop results when the brake application is as hard at first as crane speed and road conditions will permit. Then gradually release the pedal as crane speed decreases. As the crane stop is completed, the brake application should only be enough to hold the crane stationary. A rough stop will occur if the application is light at first and increased as crane speed decreases.

   Do not fan the service brake pedal. This wastes compressed air and increases stopping distance. Depress the pedal fully only in cases of emergency as this makes control of the crane difficult.

   If the air system pressure drops below the normal operating range of 100—120 psi (*690—827kPa*), stop the crane and repair the problem. As the air system pressure decreases below 60 psi (*414kPa*), the park brake will automatically begin to apply.

5. Tilt/Telescope Lever

   This lever controls the tilt (angle) and telescope function of the steering wheel. To change steering wheel tilt and/or telescope:

   a. Bring the crane to a complete stop.
   b. Engage the park brake and shift the transmission to neutral.
   c. To change the steering wheel angle, pull the tilt/telescope control lever toward the steering wheel and hold. Position the steering wheel at the desired angle and release the lever.
   d. To change the steering column length, push the tilt/telescope control lever away from the steering wheel and hold. Position the steering column at the desired length and release the lever.
   e. Check all steering wheel functions before continuing operation.

6. Hazard Flasher Switch

   This switch controls the hazard warning flashers. Press the switch to turn the flashers on. Push the switch again to turn the flashers off.

7. Turn Signal Lever

   The turn signal lever controls the following functions:

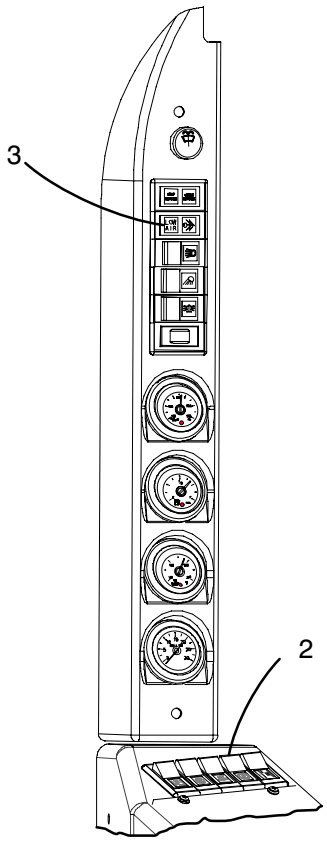
   a. Turn Signals: Push the lever down for left turn signal, pull the lever up for right turn signal.
   b. Headlight Beam Control: Pull the lever toward the steering wheel to change to high beam headlights. Pull the lever toward the steering wheel again to return to low beam headlights.
   c. Windshield Wiper: Rotate the turn signal lever counterclockwise to activate the windshield wiper. Rotate the lever counterclockwise to the first through fifth detent for intermittent wipers and to the sixth detent for low speed wiper, to the seventh detent for high speed wiper. Rotate fully clockwise to turn wiper off.
   d. Windshield Washer: Push in on the end of the lever to spray washer fluid onto the windshield.

8. Steering Wheel

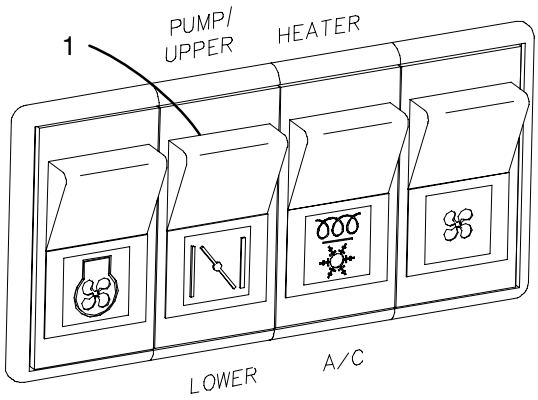
   Turn the steering wheel clockwise for right turns and counterclockwise for left turns.

Engine Diagnostic Connector

The engine diagnostic connector is located under the carrier cab dash to the left of the steering column. Refer to Figure 1—38. The connector allows engine service technicians to attach a laptop computer for diagnosing engine problems. When the check or stop engine light illuminates, contact the engine service technician to retrieve the fault codes and repair the engine.



Upper Operator's Cab Control Panel



Carrier Cab Dash

1. Pump Engagement/Throttle Selector Switch
2. Pump Enable Switch
3. Low Air Indicator Light

Figure 1—39
Main Pump Controls

Main Pump Controls

The main pump is used to supply hydraulic power to the upper. Engage the main pump before performing crane operations. Refer to Figure 1—39.

To Engage The Main Pump

1. Properly start the engine. Allow air pressure to build to normal operating range of 100—120 psi (*690—827kPa*).

WARNING

Stay clear of rotating pump drive shaft. Sufficient air pressure must be attained before the main pump will engage.

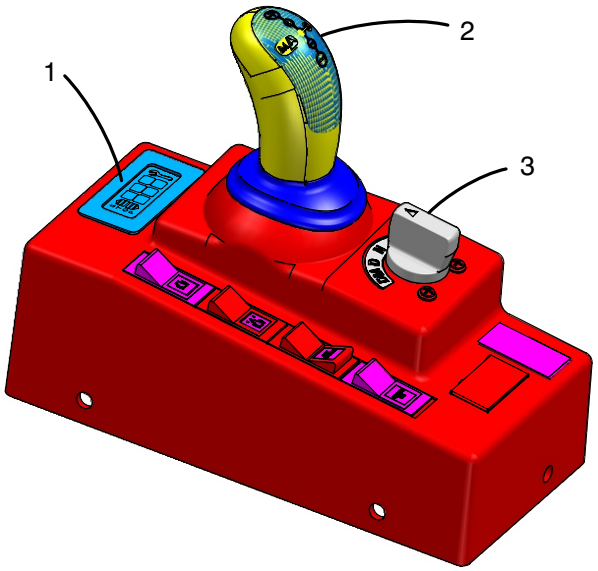
2. Move the pump engagement/throttle selector switch in the carrier cab to the "Pump/Upper" position.

Note: If the pump engagement/throttle selector switch in the carrier cab is moved to the "Pump/Upper" position before sufficient air pressure is attained, the low air indicator light on the control panel in the upper cab will illuminate and an audible alarm will sound in the upper cab. When the light and alarm extinguish, there is sufficient air pressure to engage the pump. At this point, press the bottom part of the pump enable switch and release (this is a momentary switch). This will engage the main pump.

When operating from the upper cab and the pump engagement/throttle selector switch is in the "Pump/Upper" position, maximum engine rpm is reduced to 1600. This is a precaution to prevent over speeding of the pumps.

To Disengage The Main Pump

1. Move the pump engagement/throttle selector switch in the carrier cab to the "Lower" position.



1. Transmission Display
2. Transmission Joystick
3. Transmission Gear Selector

Figure 1—40
Transmission Shift Console

Transmission Controls

The transmission controls are located on the shift console to the right of the operator. Refer to Figure 1—40. It controls all functions of the fully-automated manual transmission. The transmission contains 12 forward speeds and 2 reverse speeds. The transmission can be selected to operate in automatic or manual mode. See "Traveling The Crane" found later in this Section of the Operator's Manual for necessary preparations before traveling the crane.

CAUTION

This crane is equipped with a fully-automated manual transmission. In other words, it has all the components of a typical manual transmission (including a clutch) but the transmission controls clutch actuation and can control gear shifting. Do not attempt to operate this transmission any different than a typical manual transmission. Clutch damage may occur.

1. Transmission Display

The transmission panel display illuminates to provide the following operating information:

- System and shift status.
- Visual and audio alerts if a system malfunction has occurred.

2. Transmission Joystick

The transmission joystick has multiple functions. It can be used to select the desired mode of operation (automatic or manual). While in manual mode, it is used to upshift and downshift the transmission and activate search function mode.

- M/A — Manual/Automatic Mode Toggle
- S — Search Function Mode
- \+ — Cumulative Upshift
- \+ — Upshift
- − — Downshift
- − — Cumulative Downshift

3. Transmission Gear Selector

Use the switch to select the gear:

D—Drive (Forward) DM—Drive (Forward) Maneuver

N—Neutral,

R—Reverse RM—Reverse Maneuver

System Malfunction Warning

If a system malfunction occurs, the transmission display will alert the operator that the shift controls are not operable. The instrument panel display illuminates "SM" for system malfunction. The shift module emits a single beep.

If a system malfunction occurs, apply the brakes to slow the crane. Move the crane to a safe location. Stop the crane and apply the parking brake. Contact your distributor for assistance.

⚠ WARNING

If a system malfunction occurs, the transmission display Illuminates "SM" for system malfunction, and the shift module emits a single beep. When this warning occurs, it may not be possible to shift the transmission. Do not continue to operate the crane. Serious personal injury and damage to components can result. Move the crane to a safe location and contact your distributor for assistance.

System Self-Check

"CH" will appear on the transmission display while the TCU performs a system self-check. Refer to

Figure 1−41. A self-check is performed when the ignition is turned ON. Typically, the self-check continues until the engine is started, but can last longer if the TCU is being powered-up for the first time.

Note: If the system self-check continues for an excessive amount of time after the engine is started, contact your distributor for assistance.

System Air Pressure Is Low Warning

"AL" will appear on the transmission display if the TCU determines that system air pressure is low. Shift into neutral and idle the engine to allow air pressure to build-up. Do not drive the crane with "AL" on the display. Do not turn the ignition OFF with "AL" on the display. The engine may shut down in gear and not start until air pressure is built-up again.

WARNING

Do not operate the crane with "AL" displayed in the transmission display. Serious personal injury and damage to components can result. Allow system air pressure to reach normal operating range before continuing operations.

Clutch Overload Warning

"CL" will appear on the transmission display if the TCU determines that the clutch is operating at a higher temperature than is desirable. Refer to Figure 1−41. This will occur if operating conditions require the clutch to slip excessively. Shift into Neutral and idle the engine to allow the clutch to cool. Limit the amount of time that the crane is operated with this warning displayed to a minimum. Drive the crane in the lowest gear possible when doing slow speed maneuvering to minimize the amount of clutch slippage required. Manipulate the foot throttle setting to achieve slow travel speed by using low engine RPM rather than slipping the clutch. If crane is equipped with the maneuver mode switch and traveling long distances on the job site at low speed is desired, put Maneuver switch in Launch Mode and achieve slow travel speed by using low engine RPM rather than operating in Maneuver Mode with higher engine RPM and slipping the clutch to achieve slow travel speed.

WARNING

Operating the crane for extended periods of time with "CL" displayed in the transmission display can damage the clutch and reduce its service life.

Display	Status
CH	System is performing self check
N	Transmission is in Neutral
▲ 12 ▼	Automatic mode (12th gear)
12	Manual mode (12th gear)
RL	Reverse low is engaged
RH	Reverse high is engaged
▲ PN	PTO 1 is activated (pump engaged). The transmission is in Neutral.
	System Warning
AL	System air pressure is low
FP	Remove foot from pedal
CL	Clutch overload occurred
CW	Clutch wear indicator (replace clutch)
EE	The display line between the main transmission control unit (TCU) and the transmission electronic controller (TEC) is faulty.
	System Malfunction
🔧	System Error. Travel can continue with restrictions.
STOP 🔧	System Error. Stop!
53	Error Code. Example Error Code:53
53	Error Code. Example Error Code:153 Four bars displayed in addition to the figure shown indicates error no. + 100.
▲ 27 ▼	Error Code. Example Error Code:227 Four bars and tow arrows displayed in addition to the figure shown indicates error no. + 200.
−−	NO DATA (the SAE J1587 info is absent.
SM	System Malfunction − Emits a single beep.

Figure 1−41
Transmission Display

Clutch Wear Warning

"CW" will display on the instrument panel if the TCU determines that the clutch is worn beyond safe operation. Replace the clutch. Do not drive the crane with an excessively worn clutch.

WARNING

Do not drive the crane if "CW" displays in the transmission display indicating a worn clutch beyond safe operation. Serious personal injury and damage to components can result. Replace the clutch.

Automatic Mode Operation

1. Properly start the engine. Allow system pressures to reach normal operating range.
2. Apply and hold the carrier service brake pedal.
3. Check that the transmission is in automatic mode. If required, move the transmission selector to Neutral, tap the transmission joystick to the left (M/A) position to select automatic mode.

   Note: Automatic mode is the default starting mode.

4. Move the transmission selector switch to the desired gear ("D", "DM" or "R", "RM").
5. Release the carrier park brake.

⚠ WARNING

This crane is equipped with a fully-automated manual transmission. The crane can roll backward when stopped on a hill or grade, or when the crane is starting from a stop on a hill or grade. Coordinate the use of the carrier brake and throttle pedal as required to control movement of the crane. Serious personal injury and damage to components can result.

6. Remove foot from the carrier service brake pedal and depress the throttle pedal. The transmission automatically shifts gears as required.

⚠ WARNING

Do not let the crane coast in neutral. Loss of control and major transmission damage could occur. Do not allow the crane to roll backwards when the transmission is in a forward gear or forward when it is in a reverse gear. If this is allowed, the transmission controls will repeatedly engage and disengage the clutch slightly to warn the driver that this is happening.

7. Tap the transmission joystick to the left (M/A) position to return to manual mode if desired.

Manual Mode Operation

1. Properly start the engine. Allow system pressures to reach normal operating range.
2. Apply and hold the carrier service brake pedal.
3. Release the carrier park brake.
4. With the transmission selector to Neutral, tap the transmission joystick left (M/A) position to select manual mode.
5. Move the transmission selector switch to the desired gear ("D", "DM" or "R", "RM").

⚠ WARNING

This crane is equipped with a fully-automated manual transmission. The crane can roll backward when stopped on a hill or grade, or when the crane is starting from a stop on a hill or grade. Coordinate the use of the carrier brake and throttle pedal as required to control movement of the crane. Serious personal injury and damage to components can result.

6. Remove foot from the carrier service brake pedal and depress the throttle pedal. Move the transmission joystick forward to upshift through the gears as required. Move the transmission joystick backward to downshift.

⚠ WARNING

Do not let the crane coast in neutral. Loss of control and major transmission damage could occur. Do not allow the crane to roll backwards when the transmission is in a forward gear or forward when it is in a reverse gear. If this is allowed, the transmission controls will repeatedly engage and disengage the clutch slightly to warn the driver that this is happening.

7. Tap the transmission joystick to the left (M/A) position to return to automatic mode if desired.

Search Function Mode

The transmission is equipped with a "search function" mode. Select this mode by tapping the transmission joystick to the right (S) position while operating in manual mode.

If search function mode is selected with the engine brake not activated and in a low gear, the transmission will upshift to an ECO gear decreasing engine speed. This is done automatically to increase fuel efficiency.

If the search function is selected with the engine brake activated, the transmission down shifts to a POWER gear increasing engine speed. This is done automatically to improve engine braking.

Maneuver Mode

The transmission is equipped with a maneuver mode system that allows more precise control of travel speed. The system is activated by moving the gear selector switch on the shift console to DM—Drive (Forward) Maneuver or RM—Reverse Maneuver.

When driving in first gear in forward (DM) or reverse (RM), maneuver mode occurs between 1 and 70% of full throttle position. In this mode, the throttle pedal position controls the amount of torque transmitted to the clutch. The transmission adjusts the engine speed to the level necessary for the maneuvering operation. The clutch does not transmit the entire output produced by the engine, but only as much as necessary to overcome resistance to crane travel. This allows slow, precise maneuvering forward or backward using the throttle pedal.

CAUTION

Clutch may become hot during maneuvering operations. Observe all precautions as stated in "Clutch Overload Warning" section outlined earlier in this Operator's Manual.

Transmission Diagnostics

The transmission control unit (TCU) uses a series of alpha-numeric characters that enable the technician to identify, locate, and repair malfunctions that have occurred in the system. These characters are called fault codes and are listed in the transmission display. The TCU stores these fault codes into memory until the malfunction is repaired and cleared. After retrieving a fault code and identifying the fault, use a volt-ohm meter (VOM) to test the area where the fault code indicates that the malfunction has occurred. Contact your Distributor and request a transmission specialist to repair the fault. Use the instructions and charts on the following pages to identify the fault and the appropriate action to repair the malfunction.

Active Fault Codes

An active fault is a malfunction that currently exists in the transmission or system components. The TCU detects the malfunction during operation and stores it into memory as an active fault.

Note: All active fault codes will steadily display for approximately 1-1/2 seconds each. Ignore fault codes that flash. When the TCU has listed all active fault codes, the list will repeat.

Inactive Fault Codes

An inactive fault results when a system malfunction (an active fault) was repaired but not cleared from TCU memory. The fault exists in TCU memory as inactive until it is cleared.

Note: All inactive fault codes will steadily display for approximately 1-1/2 seconds each. Ignore fault codes that flash. When the TCU has listed all inactive fault codes, the list will repeat.

Retrieving Fault Codes

1. Park the crane and apply the park brake. Turn the engine OFF, but leave the ignition ON. Prepare to record the fault codes before beginning to retrieve them from the transmission display.
2. To retrieve active fault codes, push the transmission joystick forward. The TCU will begin to list the active fault codes on the transmission display.

   Note: The error codes can be two or three digits. If there is a series of bars on the left of the display then add 100 to the code. If there is a series of bars and two arrows on the left of the display then add 200 to the code. For example, if a 53 shows on the display without the bars on the left, then the code is a 53. If a 53 shows with the bars, then the code is 153. If a 53 shows with the bars and arrows, then the code is 253.

3. To retrieve inactive fault codes, move the transmission joystick forward and press the service brake pedal at the same time. The TCU will begin to list the inactive fault codes on the transmission display.
4. Record the fault codes.
5. When finished retrieving fault codes, turn the ignition OFF.

Fault Code Identification		
Display Fault Code	**Fault Description**	**Repair Instructions**
2	Short circuit to ground at the output stage to the splitter direct solenoid (Y2)	Contact your Distributor and request a transmission specialist.
3	Short circuit to ground at the output stage to the splitter indirect solenoid (Y3)	Contact your Distributor and request a transmission specialist.
4	Short circuit to ground at the output stage to the rail select #1 solenoid (Y4)	Contact your Distributor and request a transmission specialist.
5	Short circuit to ground at the output stage to the rail select #2 solenoid (Y5)	Contact your Distributor and request a transmission specialist.
6	Short circuit to ground at the output stage to the gear engage #1 solenoid (Y6)	Contact your Distributor and request a transmission specialist.
7	Short circuit to ground at the output stage to the gear engage #2 solenoid (Y7)	Contact your Distributor and request a transmission specialist.
8	Short circuit to ground at the output stage to the low range solenoid (Y8)	Contact your Distributor and request a transmission specialist.
9	Short circuit to ground at the output stage to the high range solenoid (Y9)	Contact your Distributor and request a transmission specialist.
10	Short circuit to ground at the output stage to the main solenoid (Y10)	Contact your Distributor and request a transmission specialist.
11	Short circuit to ground at the output stage to the warning buzzer (E-Module)	
12	Short circuit to ground at the output stage to the reverse light relay (E-Module)	
13	Short circuit to ground at the output stage to PTO1	
17	Short circuit to ground at the output stage to the inertia brake solenoid (Y1)	Contact your Distributor and request a transmission specialist.
18	Short circuit to ground at the output stage to small disengagement clutch valve (Y17)	Remove the transmission wiring harness and check for continuity (0.0 to 0.5 ohms) from pin 9 of the main TCU connector and pin E of the clutch actuator connector. Check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.
19	Short circuit to ground at the output stage to small engagement clutch valve (Y15)	Remove the transmission wiring harness and check for continuity (0.0 to 0.5 ohms) from pin 7 of the main TCU connector and pin A of the clutch actuator connector. Check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.
20	Short circuit to ground at the output stage to large disengagement clutch valve (Y16)	Remove the transmission wiring harness and check for continuity (0.0 to 0.5 ohms) from pin 12 of the main TCU connector and pin D of the clutch actuator connector. Check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.
21	Short circuit to ground at the output stage to large engagement clutch valve (Y14)	Remove the transmission wiring harness and check for continuity (0.0 to 0.5 ohms) from pin 8 of the main TCU connector and pin B of the clutch actuator connector. Check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.

Fault Code Identification		
Display Fault Code	**Fault Description**	**Repair Instructions**
22	Short circuit to ground at the output ADVP (wakeup control signal for E-Module, voltage supply to display, warning buzzer, warning light, and output speed sensor #1)	Remove and troubleshoot the transmission wiring harness. Pin 11 of the TCU connector, pin 10 of the voltage doubler, pin 1 of the lower output shaft speed sensor (sensor #1), and pin A2 of the E-Module should all have continuity (resistance of 0.0 to 0.5 ohms) and not be shorted to ground. If a short is found, repair or replace the wiring harness as required. If not, repair or replace the lower speed sensor (sensor #1) as required.
23	Short circuit to ground at the output stage to warning light (E-Module)	
25	Short circuit to ground at output SD to display NOTE: The display will flash "EE"	Troubleshoot the transmission wiring harness. Pin 9 of the TCU connector and pin F2 of the E-Module should all have continuity (resistance of 0.0 to 0.5 ohms) and not be shorted to any other circuit. If a short or open circuit is found, repair or replace the wiring harness as required. If not repair or replace the E-Module as required.
26	The main TCU has not received expected communications from the engine (CAN engine configuration timeout)	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
27	The main TCU has not received expected communications from the engine (error on engine configuration message (engine configuration))	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
31	The main TCU has not received expected communications from the engine (error on actual engine retarder–percent torque message ERC1_ER)	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
32	The main TCU has not received expected communications from the engine (error on engine retarder configuration message (engine retarder configuration))	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
33	The main TCU has not received expected communications from the engine (CAN engine retarder configuration timeout)	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
34	Open circuit at the output stage to the splitter direct solenoid (Y2)	Contact your Distributor and request a transmission specialist.
35	Open circuit at the output stage to the splitter indirect solenoid (Y3)	Contact your Distributor and request a transmission specialist.
36	Open circuit at the output stage to the rail select #1 solenoid (Y4)	Contact your Distributor and request a transmission specialist.
37	Open circuit at the output stage to the rail select #2 solenoid (Y5)	Contact your Distributor and request a transmission specialist.
38	Open circuit at the output stage to the gear engage #1 solenoid (Y6)	Contact your Distributor and request a transmission specialist.
39	Open circuit at the output stage to the gear engage #2 solenoid (Y7)	Contact your Distributor and request a transmission specialist.
40	Open circuit at the output stage to the low range solenoid (Y8)	Contact your Distributor and request a transmission specialist.
41	Open circuit at the output stage to the high range solenoid (Y9)	Contact your Distributor and request a transmission specialist.
42	Open circuit at the output stage to the main solenoid (Y10)	Contact your Distributor and request a transmission specialist.
45	Open circuit at the output stage to PTO 1	Contact your Distributor and request a transmission specialist.

Fault Code Identification		
Display Fault Code	**Fault Description**	**Repair Instructions**
49	Open circuit at the output stage to the inertia brake solenoid (Y1)	Contact your Distributor and request a transmission specialist.
50	Open circuit at output stage to small disengagement clutch valve (Y17)	Remove the transmission wiring harness and check for continuity (0.0 to 0.5 ohms) from pin 9 of the main TCU connector and pin E of the clutch actuator connector and check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.
51	Open circuit at output stage to small engagement clutch valve (Y15)	Remove the transmission wiring harness and check for continuity (0.0 to 0.5 ohms) from pin 7 of the main TCU connector and pin A of the clutch actuator connector and check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.
52	Open circuit at output stage to small disengagement clutch valve (Y16)	Remove the transmission wiring harness and check for continuity (0.0 to 0.5 ohms) from pin 12 of the main TCU connector and pin D of the clutch actuator connector and check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.
53	Open circuit at output stage to small engagement clutch valve (Y14)	Remove the transmission wiring harness and check for continuity (0.0 to 0.5 ohms) from pin 8 of the main TCU connector and pin B of the clutch actuator connector and check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.
54	Open circuit at the output ADVP (wakeup control signal for E-Module, voltage supply to display, warning light, warning buzzer, and output speed sensor #2)	Remove and troubleshoot the transmission wiring harness. Pin 11 of the TCU connector, pin 10 of the voltage doubler, pin 1 of the lower output shaft speed sensor (sensor #2), and pin A2 of the E-Module should all have continuity (resistance of 0.0 to 0.5 ohms). If an open circuit is found, repair or replace the wiring harness as required. If not, repair or replace the lower speed sensor (sensor #2) as required.
55	Open circuit of the warning lamp	Contact your Distributor and request a transmission specialist.
59	Acknowledge fault of PTO 1 NOTE: The PTO is active but the TCU hasn't requested it.	Check the wiring harness for short and open circuits. Verify that the PTO pressure switch is operating correctly.
61	PTO 1 disengagement fault NOTE: The TCU has requested that the PTO turn OFF and it has not.	Check the wiring harness for short and open circuits. Verify that the PTO pressure switch is operating correctly.
63	PTO 1 engagement fault NOTE: The TCU has requested that the PTO turn ON and it has not.	Check the wiring harness for short and open circuits. Verify that the PTO pressure switch is operating correctly.
66	Short circuit to positive at the output stage to the splitter direct solenoid (Y2)	Contact your Distributor and request a transmission specialist.
67	Short circuit to positive at the output stage to the splitter indirect solenoid (Y3)	Contact your Distributor and request a transmission specialist.
68	Short circuit to positive at the output stage to the rail select #1 solenoid (Y4)	Contact your Distributor and request a transmission specialist.
69	Short circuit to positive at the output stage to the rail select #2 solenoid (Y5)	Contact your Distributor and request a transmission specialist.
70	Short circuit to positive at the output stage to the gear engage #1 solenoid (Y6)	Contact your Distributor and request a transmission specialist.
71	Short circuit to positive at the output stage to the gear engage #2 solenoid (Y7)	Contact your Distributor and request a transmission specialist.

Fault Code Identification		
Display Fault Code	**Fault Description**	**Repair Instructions**
72	Short circuit to positive at the output stage to the low range solenoid (Y8)	Contact your Distributor and request a transmission specialist.
73	Short circuit to positive at the output stage to the high range solenoid (Y9)	Contact your Distributor and request a transmission specialist.
74	Short circuit to positive at the output stage to the main solenoid (Y10)	Contact your Distributor and request a transmission specialist.
75	Short circuit to positive at output stage to warning buzzer (E-Module)	
76	Short circuit to positive at output stage to reverse light relay (E-Module)	
77	Short circuit to positive of the PTO 1	Contact your Distributor and request a transmission specialist.
78	Short circuit to positive of the PTO 2	Contact your Distributor and request a transmission specialist.
81	Short circuit to positive at the output stage to the inertia brake solenoid (Y1)	Contact your Distributor and request a transmission specialist.
82	Short circuit to positive at output stage to small disengagement clutch valve (Y17)	Remove the transmission wiring harness and check for continuity (0.0 to 0.5 ohms) from pin 9 of the main TCU connector and pin E of the clutch actuator connector and check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.
83	Short circuit to positive at output stage to small engagement clutch valve (Y15)	Remove the transmission wiring harness and check for continuity (0.0 to 0.5 ohms) from pin 7 of the main TCU connector and pin A of the clutch actuator connector and check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.
84	Short circuit to positive at output stage to large disengagement clutch valve (Y16)	Remove the transmission wiring harness and check for continuity (0.0 to 0.5 ohms) from pin 12 of the main TCU connector and pin D of the clutch actuator connector and check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.
85	Short circuit to positive at output stage to large engagement clutch valve (Y14)	Remove the transmission wiring harness and check for continuity (0.0 to 0.5 ohms) from pin 8 of the main TCU connector and pin B of the clutch actuator connector and check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.
86	Short circuit to positive of the output ADVP (wakeup control signal for E-Module, voltage supply to display, warning light, warning buzzer, and output speed sensor #2)	Remove and troubleshoot the crane wiring harness. Pin 11 of the TCU connector, pin 10 of the voltage doubler, pin 1 of the lower output shaft speed sensor (sensor #1), and pin A2 of the E-Module should all have continuity (resistance of 0.0 to 0.5 ohms) and not be shorted to positive. If a short is found, repair or replace the wiring harness as required. If not, repair or replace the lower speed sensor (sensor #1) as required.
87	Short circuit to positive of the warning lamp	Contact your Distributor and request a transmission specialist.
89	Short circuit to positive at output SD to display NOTE: The display will flash "EE"	Troubleshoot the transmission wiring harness. Pin 9 of the TCU connector and pin F2 of the E-Module should all have continuity (resistance of 0.0 to 0.5 ohms) and not be shorted to any other circuit. If a short or open circuit is found, repair or replace the wiring harness as required. If not, repair or replace the E-Module as required.

Fault Code Identification		
Display Fault Code	**Fault Description**	**Repair Instructions**
90	Communication error between TCU 1 and TCU 2: ECU failure	Contact your Distributor and request a transmission specialist.
91	The main TCU has not received communication from the engine. Timeout error: CAN EBC1	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
92	The main TCU has not received communication from the ABS. ABS active message error: EBC1	Check that the ABS controller is SAE J1939 ready (not SAE J1922). Check that the ABS is correctly connected into the SAE J1939 backbone.
93	The main TCU has not received communication from the ABS. ASR engine control active message error: EBC1	Check that the ABS controller is SAE J1939 ready (not SAE J1922). Check that the ABS is correctly connected into the SAE J1939 backbone.
94	The main TCU has not received communication from the ABS. ASR brake control active message error: EBC1	Check that the ABS controller is SAE J1939 ready (not SAE J1922). Check that the ABS is correctly connected into the SAE J1939 backbone.
95	The main TCU has not received communication from the engine. Cruise control active message error: CCVS	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
96	The main TCU has not received communication from the engine. Cruise control set speed message error: CCVS	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
97	The main TCU has not received communication from the engine. Engine speed message error: EEC1	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
98	Input shaft speed sensor fault	Contact your Distributor and request a transmission specialist.
99	Output shaft speed sensor #1 (the upper one). NOTE: Output shaft speed sensor #1 plugs into the transmission wiring harness on the left side of the transmission. Automated shifting is restricted but manual shifting of all gears is still possible.	Remove and troubleshoot the transmission wiring harness. Pin 11 of the TCU connector and pin 4 of the upper output shaft speed sensor (sensor #1) should have continuity (resistance of 0.0 to 0.5 ohms) and not be shorted to any other circuit. If a short or open circuit is found, repair or replace the wiring harness as required. If not, repair or replace the upper speed sensor as required.
100	Error on output speed sensor #2 (the lower one). NOTE: Output shaft speed sensor #2 plugs into the Link-Belt wiring harness on the right side of the transmission. No functional restrictions as long as speed sensor #1 signal is still available.	Remove and troubleshoot the Link-Belt wiring harness. Pin 7 of the TCU connector and pin 4 of the lower output shaft speed sensor (sensor #2) should all have continuity (resistance of 0.0 to 0.5 ohms) and not be shorted to any other circuit. If a short or open circuit is found, repair or replace the wiring harness as required. If not, repair or replace the lower speed sensor as required.
101	Error on both output speed signals	Refer to each of the output shaft speed sensor repair instructions.
102	Plausibility error between transmission input speed and output speed NOTE: The actual speeds registered by the input shaft and output shaft speed sensors do not match the expected ratios.	Check the main TCU for programming errors. Check the transmission wiring harness for short circuits or open circuits. If circuits operate correctly, repair or replace both output shaft speed sensors as required.
103	The main TCU has not received communication from the engine. Wheel-based crane speed message error: CCVS	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
104	High voltage (electrical system voltage too high)	Check that the batteries are supplying 12 VDC to the transmission by measuring the voltage across pins G and E and across pins B and D of the LBCE wiring harness that connects to the transmission wiring harness. Verify that the voltage doubler is supplying 24 VDC to the transmission by unplugging the main TCU and measuring the voltage across pins 4 and 16 and across pins 5 and 17. Repair or replace the voltage doubler as required if battery-supplied power is acceptable and the voltage doubler power is unacceptable.

Fault Code Identification		
Display Fault Code	**Fault Description**	**Repair Instructions**
105	Low voltage (electrical system voltage too low)	Check that the batteries are supplying 12 VDC to the transmission by measuring the voltage across pins G and E and across pins B and D of the LBCE wiring harness that connects to the transmission wiring harness. Verify that the voltage doubler is supplying 24 VDC to the transmission by unplugging the main TCU and measuring the voltage across pins 4 and 16 and across pins 5 and 17. Repair or replace the voltage doubler as required if battery-supplied power is acceptable and the voltage doubler power is unacceptable.
107	Clutch actuator position sensor voltage supply out of valid range	With the transmission wiring harness still connected to the main TCU, check the voltage across pins 15 and 20 of the clutch actuator assembly connector (specification is 4.75 to 5.25 VDC). If the voltage is within the specified range, repair or replace the clutch actuator assembly as required. If not, remove the transmission wiring harness from the transmission. Check for shorts. If the wiring harness has a short circuit, repair or replace it as required. If not, contact your Distributor and request a transmission specialist.
108	Shift lever error	Check for continuity (0.0 to 0.5 ohms) between pins 1 and 8 of the shift lever and pin G3 of the E-Module. Check for continuity between pin 3 of the shift lever and ground. Check for continuity between pin 7 of the shift lever and pin F1 of the E-Module. Check for continuity between pin 9 of the shift lever and pin E3 of the E-Module. If these resistances are correct, repair or replace the shift lever assembly as required.
109	Error in selector lever in upper cab	
110	ZF CAN timeout	Unplug the E-Module only. Check for 58.0 to 62.0 ohms resistance across pins D1 and D2. Unplug the transmission wiring harness. Check for continuity (0.0 to 0.5 ohms) between pin 3 of the main TCU connector, pin D1 of the E-Module connector, and pin A of the CAN terminator. Check for continuity between pin 6 of the main TCU, pin D2 of the E-Module connector, and pin B of the CAN terminator. If any of these tests indicate issues with the wiring harness, repair or replace the wiring harness as required. If not, check for continuity (0.0 to 0.5 ohms) between pins 1 and 8 of the shift lever and pin G3 of the E-Module. Check for continuity between pin 3 of the shift lever and ground. Check for continuity between pin 7 of the shift lever and pin F1 of the E-Module. Check for continuity between pin 9 of the shift lever and pin E3 of the E-Module. If these resistances are correct, repair or replace the shift lever assembly as required. If not, contact your Distributor and request a transmission specialist.
114	Clutch engage unintentionally at standstill, gear engaged.	
115	Failure at steering column switch	
117	Error in clutch self-adjustment process NOTE: The clutch is unable to cycle.	Check the air supply for a pinched line. Check the clutch for failure to stroke. Check the release fork for failure to stroke.
118	Clutch does not disengage	Check the system air pressure for 120 psi. Check the clutch actuator, release fork, push rod, and clutch assembly for damage. Repair or replace as required.
119	Clutch does not engage/does not transmit engine torque or slipping closed clutch	Check the system air pressure for 120 psi. Check the clutch actuator, release fork, push rod, and clutch assembly for damage. Repair or replace as required.
120	Mechanical failure of small clutch disengagement solenoid	Repair or replace the clutch actuator assembly as required.

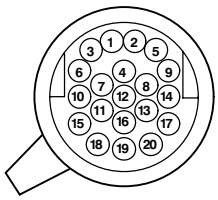
Fault Code Identification		
Display Fault Code	**Fault Description**	**Repair Instructions**
121	Mechanical failure of large clutch disengagement solenoid	Repair or replace the clutch actuator assembly as required.
122	Mechanical failure of small clutch engagement solenoid	Repair or replace the clutch actuator assembly as required.
123	Mechanical failure of large clutch engagement solenoid	Repair or replace the clutch actuator assembly as required.
124	Error on clutch actuator position sensor signal	Verify that the release bearing is correctly engaged to the clutch. If it is, remove the transmission wiring harness. Check for continuity (0.0 to 0.5 ohms) from pin 15 of the main TCU connector and the pin I of the clutch actuator connector. Check for shorts to the other circuits. If an issue is found with the wiring harness, repair or replace it as required. If not, repair or replace the clutch actuator assembly as required.
125	Pressure reduction valve fault	Contact your Distributor and request a transmission specialist.
126	Pressure sensor signal fault	Contact your Distributor and request a transmission specialist.
127	TCU temperature sensor signal fault	Contact your Distributor and request a transmission specialist.
128	Oil temperature sensor fault	Contact your Distributor and request a transmission specialist.
129	Short circuit to positive of the gear engage position sensor signal	Contact your Distributor and request a transmission specialist.
130	Short circuit to ground of the gear engage position sensor signal	Contact your Distributor and request a transmission specialist.
131	Open circuit of the gear engage position sensor signal	Contact your Distributor and request a transmission specialist.
132	Self adjustment error of gear engage position sensor NOTE: The gear engage position sensor is unable to cycle.	Check the air supply for 120 psi. If the air supply is correct, repair or replace the TCU as required.
133	Short circuit to positive of the rail select position sensor	Contact your Distributor and request a transmission specialist.
134	Short circuit to ground of the rail select position sensor	Contact your Distributor and request a transmission specialist.
135	Open circuit of the rail select position sensor	Contact your Distributor and request a transmission specialist.
136	Gate select sensor self-adjustment error	Contact your Distributor and request a transmission specialist.
137	No range change group sensor signal (short circuit to positive)	Contact your Distributor and request a transmission specialist.
138	No range change group sensor signal (short circuit to ground)	Contact your Distributor and request a transmission specialist.
139	No range change group sensor signal (open circuit)	Contact your Distributor and request a transmission specialist.
140	Self-adjustment fault of range position sensor	Contact your Distributor and request a transmission specialist.
141	Short circuit to positive of the splitter position sensor signal	Contact your Distributor and request a transmission specialist.
142	Short circuit to ground of the splitter position sensor signal	Contact your Distributor and request a transmission specialist.
143	Open circuit of the splitter position sensor signal	Contact your Distributor and request a transmission specialist.
144	Splitter position sensor self-adjustment fault NOTE: The gear engage position sensor is unable to cycle.	Verify that the air supply is 120 psi. If the air supply is correct, repair or replace the TCU as required.

Fault Code Identification		
Display Fault Code	**Fault Description**	**Repair Instructions**
145	Range shift disengagement error	Test drive the crane to verify that the transmission does not range shift correctly. Contact your Distributor and request a transmission specialist.
146	Range shift changeover error	Test drive the crane to verify that the transmission does not range shift correctly. If it does not, repair or replace the transmission as required. If the transmission performs a range shift correctly, but the TCU registers a fault: Disregard the fault and clear it from TCU memory.
147	Range shift engagement error	Test drive the crane to verify that the transmission does not range shift correctly. Contact your Distributor and request a transmission specialist.
148	Splitter selection fault; splitter cylinder does not disengage	Test drive the crane to verify that the transmission does not shift correctly. Contact your Distributor and request a transmission specialist.
149	Splitter selection fault during the splitter selection procedure	Test drive the crane to verify that the transmission does not shift correctly. Contact your Distributor and request a transmission specialist.
150	Splitter selection fault; splitter cylinder does not engage	Test drive the crane to verify that the transmission does not shift correctly. Contact your Distributor and request a transmission specialist.
151	Rail select cylinder does not disengage	Test drive the crane to verify that the transmission does not shift correctly. Contact your Distributor and request a transmission specialist.
152	Rail selection fault during the rail selection procedure	Test drive the crane to verify that the transmission does not shift correctly. Contact your Distributor and request a transmission specialist.
153	Rail selection fault; rail select cylinder does not engage	Test drive the crane to verify that the transmission does not shift correctly. Contact your Distributor and request a transmission specialist.
154	Main transmission gear does not disengage	Test drive the crane to verify that the transmission does not shift correctly. Contact your Distributor and request a transmission specialist.
155	Main transmission gear does not engage	Test drive the crane to verify that the transmission does not shift correctly. Contact your Distributor and request a transmission specialist.
156	Wrong gear shifting	Contact your Distributor and request a transmission specialist.
157	Selector sensor signal leaves engaged position	
158	Gear engage position sensor signal leaves engaged position during driving	Test drive the crane to verify that the transmission shifts to Neutral without request. Contact your Distributor and request a transmission specialist.
159	Range position sensor signal leaves engaged position during driving	Test drive the crane to verify that the transmission shifts to Neutral without request. Contact your Distributor and request a transmission specialist.
160	Splitter position sensor signal leaves engaged position during driving	Test drive the crane to verify that the transmission shifts to Neutral without request. If so, repair or replace the transmission as required. If the fault occurs without the transmission shifting into Neutral, repair or replace the TCU as required.
163	Engine does not react to torque intervention	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
164	The main TCU has not received communication from the engine. Error on driver's demand engine percent torque message: EEC1	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.

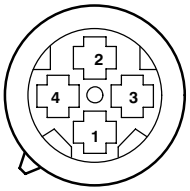
Fault Code Identification		
Display Fault Code	**Fault Description**	**Repair Instructions**
165	The main TCU has not received communication from the engine. Error on accelerator pedal position message: EEC2	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
166	Permanent idle signal NOTE: The idle switch is built into the accelerator pedal and is wired into the engine controller, not the transmission controller or main TCU. The TCU receives the status of the idle switch over the SAE J1939 bus. The transmission is receiving contradictory messages indicating that the idle switch is open (engine is idling) and the accelerator pedal is pressed (engine is not idling).	Check the idle switch and the status of the pedal.
167	The main TCU has not received expected communications from the engine (error on percent load at current speed message EEC2)	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
168	No idle signal or error on idle validation switch signal (EEC2) NOTE: The idle switch is built into the accelerator pedal and is wired into the engine controller, not the transmission controller, or main TCU. The main TCU receives the status of the idle switch over the SAE J1939 bus. The transmission is receiving contradictory messages indicating that the idle switch is closed (engine is not idling) and the accelerator pedal is not pressed (engine is idling).	Check the idle switch and the status of the pedal.
169	Cut-off relay in ECU does not switch off	Contact your Distributor and request a transmission specialist.
170	No voltage supply at pin 30 or cut-off relay in ECU does not switch on	Check that the batteries are supplying 12 VDC to the transmission by measuring the voltage across pins G and E and across pins B and D of the OEM-supplied wiring harness that connects to the transmission wiring harness. Verify that the voltage doubler is supplying 24 VDC to the transmission by unplugging the main TCU and measuring the voltage across pins 4 and 16 and across pins 5 and 17. Repair or replace the voltage doubler as required if the supplied power is acceptable and the voltage doubler-supplied power is unacceptable. If all power circuits operate correctly, contact your Distributor and request a transmission specialist.
171	The main TCU has not received communication from the engine. Error on actual engine percent torque message: EEC1	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
173	The main TCU has not received communication from the engine. Error on brake switch message: CCVS	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
175	Error on "Ignition lock" signal (terminal 15)	Remove and troubleshoot the transmission wiring harness. Pin 11 of the TCU connector, pin 10 of the voltage doubler, pin 1 of the lower output shaft speed sensor (sensor #1), and pin A2 of the E-Module should all have continuity (resistance of 0.0 to 0.5 ohms) and not be shorted to any other circuit. If a short or open circuit is found, repair or replace the wiring harness as required. If not, repair or replace as required the lower speed sensor (sensor #1).
177	The main TCU has not received communication from the engine. Error: system CAN bus off	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.

Fault Code Identification		
Display Fault Code	**Fault Description**	**Repair Instructions**
178	CAN error warning. The main TCU has identified CAN error frames not severe enough to cause a bus off situation	Verify that the backbone is correctly terminated with no short circuits or open circuits.
179	CAN queue overrun. The SAE J1939 bus is not functioning correctly NOTE: The backbone of the SAE J1939 bus is terminated at each end with a 120 ohm resistor. Each component communicating over the bus must connect into the backbone.	Verify that the backbone is correctly terminated with no short circuits or open circuits. NOTE: The resistance across pins C and D of the 9 pin diagnostic connector will be about 60 ohms if both terminating resistors are in place (120 ohms if only one is installed).
180	The main TCU has not received communication from the engine (CAN EEC1 timeout)	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
181	The main TCU has not received communication from the engine (CAN EEC2 timeout)	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
182	The main TCU has not received communication from the engine (CAN CCVS timeout)	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
183	The main TCU has not received communication from the engine (CAN ERC1_ER timeout)	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
188	ECU fault – wrong interrupt	Contact your Distributor and request a transmission specialist.
189	ECU fault – stack watch	Contact your Distributor and request a transmission specialist.
190	EOL EEPROM parameter out of valid range	Contact your Distributor and request a transmission specialist.
191	EOL EEPROM parameter checksum error	Contact your Distributor and request a transmission specialist.
193	ECU temperature too high	Check for obstructions within the transmission cooler, cooler lines, and by-pass valve. Check the oil level (both low and high oil levels may lead to overheating).
194	Both sources for front axle speed not available	Check that the SAE J1939 is activated within the ECM. Check that the ECM is correctly connected into the SAE J1939 backbone.
197	The main TCU has not received communication from the ABS. Error on front axle speed message: WSI	Check that the ABS controller is SAE J1939 ready (not SAE J1922). Check that the ABS is correctly connected into the SAE J1939 backbone.
198	The main TCU has not received communication from the ABS. Error on relative wheel speeds message: WSI	Check that the ABS controller is SAE J1939 ready (not SAE J1922). Check that the ABS is correctly connected into the SAE J1939 backbone.
199	The main TCU has not received communication from the ABS (CAN WSI timeout)	Check that the ABS controller is SAE J1939 ready (not SAE J1922). Check that the ABS is correctly connected into the SAE J1939 backbone.
227	Application–Error database for CAN–communication	Contact your Distributor and request a transmission specialist.
228	Plausibility failure activation of lower/upper cab	Contact your Distributor and request a transmission specialist.
250	Internal shifter error detected	Contact your Distributor and request a transmission specialist.
251	Internal error in the e-module detected	Contact your Distributor and request a transmission specialist.
Not supported	Error on ISO 14230 communications line	Remove and troubleshoot the transmission wiring harness. Pin 2 of the TCU connector and pin F3 of the E-Module (sensor #2) should have continuity (resistance of 0.0 to 0.5 ohms) and not be shorted to any other circuit. If a short or open circuit is found, repair or replace the wiring harness as required. If not, replace the E-Module.

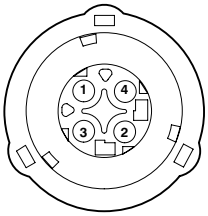
Connector Pin Assignments



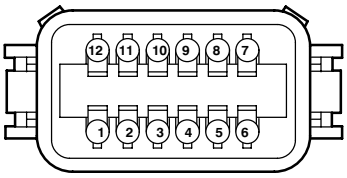
Main TCU Connector (Both Harnesses)



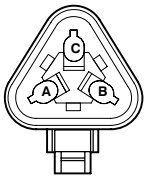
Output Shaft Speed Sensor Connector (Both Harnesses)



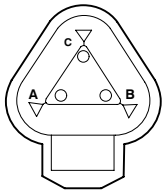
Neutral Switch Connector



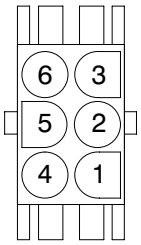
Voltage Doubler Connector



SAE J1939 Connector



Private CAN Connector



Pin 1 (+)
Pin 2 K
Pin 3 (–)
Pin 4 L
Pin 5 Pog
Pin 6

Transmission Diagnostic Connector

Resistance Specifications

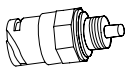
Component		Resistance (Measured Across Pins 1 and 2)	
		In Neutral	Not in Neutral
Neutral Switch		0.0–0.5 ohms	open circuit

Figure 1–42
Connector Pin Assignments

Engine Brake

The engine brake is a device which uses the engine to aid in slowing down and controlling the carrier speed. When activated, the engine brake alters the operation of the engine's exhaust valves so the engine works as a power-absorbing air compressor. This provides a retarding action to the wheels.

WARNING

The engine brake is a crane slowing device. It is not a substitute for the service braking system. The carrier's service brakes must be used to bring the crane to a complete stop.

Engine Brake Controls

The engine brake control switch is located on the transmission shift console. Refer to Figure 1–43. The switch has three retarding levels to regulate the amount of braking force made available: 1 (Low), 2 (Med), and 3 (High). Refer to Figure 1–43.

Engine Brake Operation

Once the engine brake switch is moved to the "ON" position, operation of the engine brake is fully automatic. Since the engine brake depends on the free flow of engine oil for operation, be sure to let the engine warm up before switching it on. The engine brake can be left on whenever driving, providing the weather and road conditions are favorable.

To activate the engine brake, simply remove your foot from the throttle pedal. Note that the engine brake remains activated even after the brake pedal has been depressed, giving the combined power of both the engine and service brakes. The engine brake alone will slow the carrier. However, it is essential that the service brakes be used to bring the carrier to a complete stop.

To deactivate the engine brake, reapply the throttle pedal or move the control switch to the "OFF" position. Always be sure to turn the engine brake switch off before the engine is shutdown.

Descending A Grade

An explanation of "control speed" is helpful in understanding how to use the engine brake while descending a grade. Control speed is the constant speed at which the forces pushing the carrier forward on a grade are equal to the forces holding it back, without using the service brakes. For example, it may be safe to descend a grade at 10 mph (*16km/h*), without an engine brake. With the engine brake, it might be safe to descend that same grade at 25 mph (*40km/h*), and still remain under control.

Under some circumstances, descending a grade at a faster rate than the control speed may be desired. This can be done by selecting a higher gear, or the "1" position on the engine brake switch. However, it may require applying the service brakes intermittently to prevent over-speeding the engine and to keep the crane at a safe speed.

WARNING

Frequent use of the service brakes, while descending a grade, will cause them to heat up and reduce their stopping ability. The result can be dangerous "brake fade". Use engine brake and service brake as required to control crane speed.

Since the engine brake is most effective at rated engine speeds, gear selection is very important. Maximum retarding power is obtained by using the lowest possible gear without exceeding the recommended engine speed. Refer to the engine manufacturer's manual for rated engine speeds.

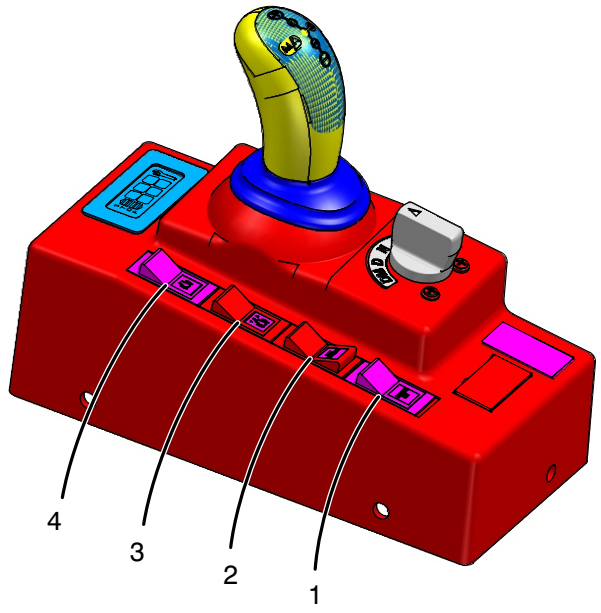
There are other circumstances when descending a grade at a rate slower than the control speed may be desired. This is done by selecting a lower gear, one that will not over-speed the engine. Apply the service brake to obtain the desired lower speed.

As a general rule for maintaining control speed, estimate the gear used to climb the grade. Usually this is the same gear that can be used for a controlled descent with an engine brake.

It's always a good idea to determine if the engine brake is operational before beginning a long steep descent. This can be done by briefly lifting your foot off the throttle. You should feel the engine brake going into action.

Slippery Pavement

If the engine brake operation is unfamiliar, it is recommended that it not be used on slick roads until you gain some experience with it on dry pavement.



1. Cruise ON/OFF Switch
2. Cruise SET/RESUME Switch
3. Engine Brake "Retard" Level Switch
4. Engine Brake ON/OFF Switch

Figure 1–43
Transmission Shift Console

Since the operation of any vehicle under slippery conditions is unpredictable, be sure to have plenty of distance when testing service brakes or engine brake.

When driving on wet or icy pavement, start with the engine brake switch in the "OFF" position and use the same gear you would normally use under these conditions.

Before activating the engine brake be sure that the crane is maintaining traction and stability using the natural retarding of the engine alone.

If the crane is maintaining traction, activate the engine brake by moving the switch to the "1" position. If the drive wheels begin to lock or there is a "fishtail" motion, immediately turn off the engine brake switch. Don't turn the engine brake on until road conditions improve.

If there was no tendency for the drive wheels to lose traction and greater slowing power is desired, move the control switch to the "2" position. If the drive wheels tend to lock, immediately switch the engine brake switch into the number "1" position. Do not attempt to use the "2" or "3" position until road conditions improve.

In changing weather conditions, check the proper positioning of the control switch often. Remember: do not skip a step when operating the engine brake switch. Always go from the "1" position, then to the "2" position, and then to the "3" position.

Cruise Controls

The crane is equipped with cruise control that allows the crane to maintain a constant speed at or above 30 mph (*48km/h*). The controls are located on the transmission shift console. Refer to Figure 1−43.

WARNING

Do not use the cruise control in heavy traffic or on roads that are winding, slippery, or unpaved.

Note: The cruise controls will not function until the engine computor detects a change of state. Activate the cruise control functions upon every ignition cycle by pressing and releasing the brake pedal and cycling the cruise switch off and then on.

To Set The Cruise Control

1. Press and release the "On" switch.
2. Accelerate to the desired speed above 30 mph (*48km/h*) using the accelerator pedal.
3. Press and release the "Set" switch. This will set the speed. Holding the "Set" switch will allow the crane speed to decrease. Release of the switch sets cruise to the lower speed.
4. Remove your foot from the accelerator. The crane should maintain the set speed.

   Note: Pressing the accelerator pedal will allow the crane speed to increase. Taking your foot off the accelerator pedal allows the crane to return to the set speed.

Resetting The Cruise Control

To reset the cruise control to a lower speed, do any of the following:

- Press and hold the "Set" switch. Let the crane slow down to the desired speed and release the "Set" switch. The speed is now set at the lower speed.
- "Tap down" − this allows the current speed to decrease in increments of 1 mph (*1.6km/h*) by a momentary tap of the "Set" switch. Multiple taps of the "Set" switch will decrease the speed 1 mph (*1.6km/h*) for each tap.

To reset the cruise control to a higher speed, do any of the following:

- Accelerate to the desired speed, then press and release the "Set" switch.
- Press and hold the "Res" switch, allow the crane to accelerate and release the switch.
- "Tap up" − this allows the current speed to increase in increments of 1 mph (*1.6km/h*) by a momentary tap of the "Res" switch. Multiple taps of the "Res" switch will increase the speed 1 mph (*1.6km/h*) for each tap.

Suspending And Resuming A Set Speed

To suspend the cruise control, do any of the following:

- Press the "Pause" switch or depress the brake. The cruise controls are suspended, but can be reset by pressing the "Set" switch or return to the previous set speed with the "Res" switch.
- The engine speed drops below the set point (1,000 rpm) or the crane speed drops below the mph set point (30 mph *[48km/h]*). The cruise controls are suspended, but can be reset by pressing the "Set" switch or return to the previous set speed with the "Res" switch.

Turning The Cruise Control Off

To deactivate cruise controls, do any of the following:

- Press the "Off" switch. All cruise control switches are off. To resume cruise control, press the "On" switch and reset the speed control by pressing the "Set" switch.
- The cruise control switches are also turned off each time the crane's engine is turned off.

WARNING

Always wear the seat belt while driving the crane. The seat belt must be snug and low across the hips.

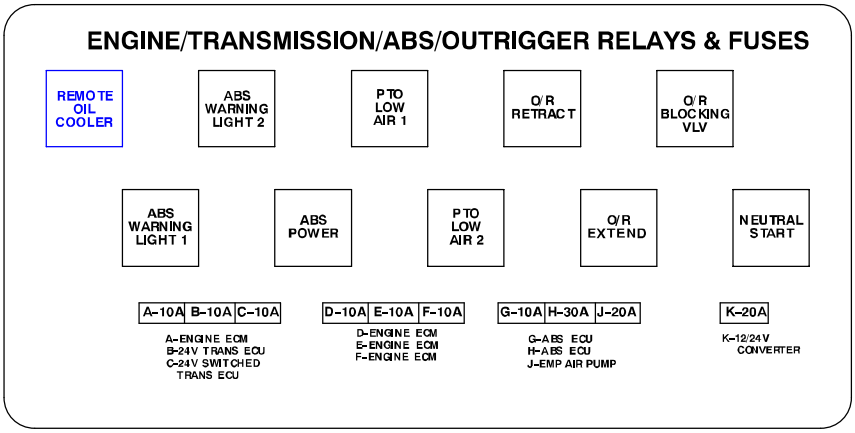


Figure 1—44
Carrier Fuse Label

Battery Disconnect Switches

The battery disconnect switches are located behind the left engine access door. Refer to Figure 1—45. Move the disconnect switches to the "Off" position any time welding is being done on the crane to protect the cranes electronic components from damage due to an electric arc type welder.

Note: If the batteries are disconnected, the start-up time for on-board computer systems will be longer than normal.

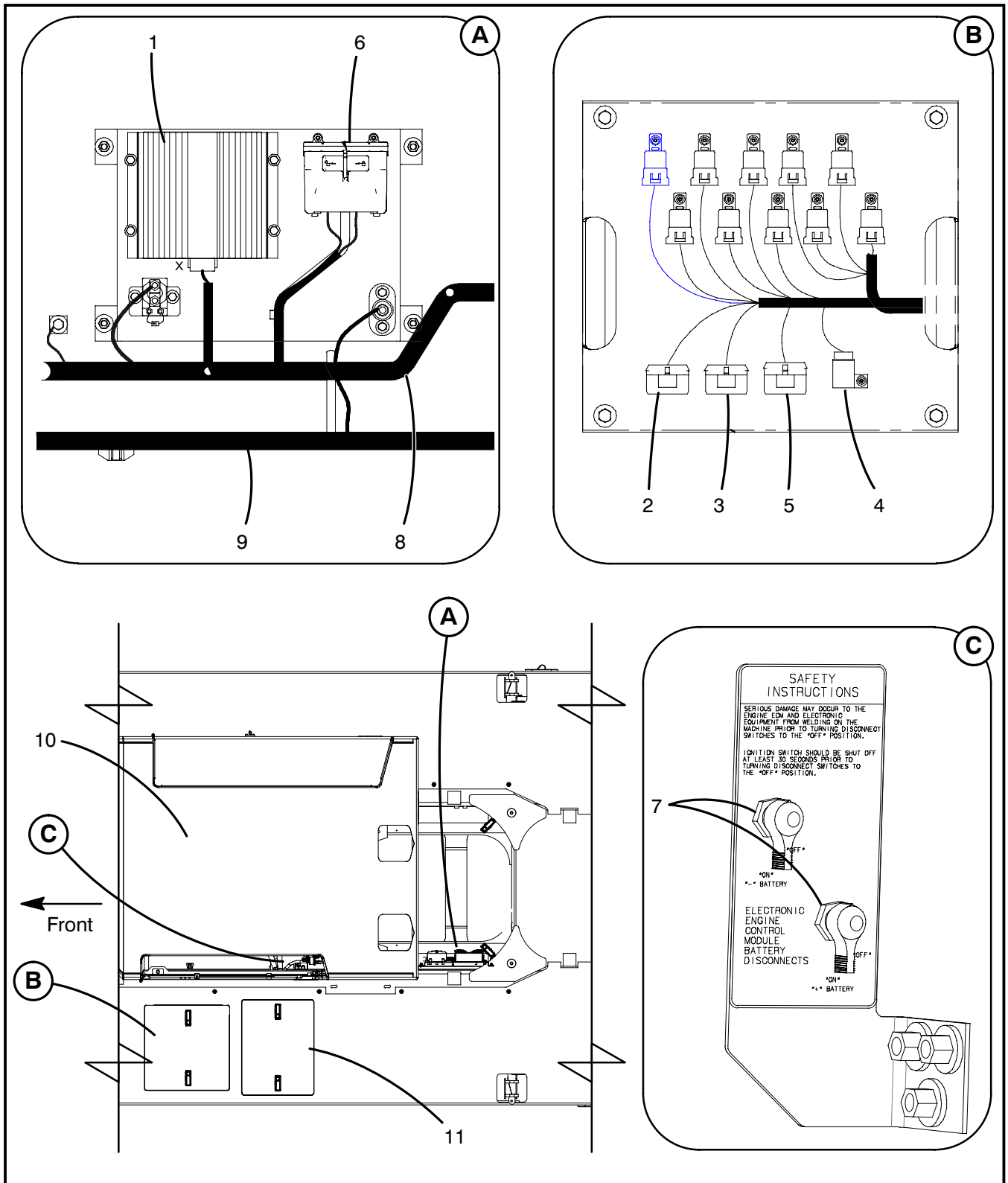
CAUTION

Major damage may occur to the electronic equipment from welding on the crane prior to turning disconnect switches to the "OFF" position.

Ignition switch should be shut off at least 30 seconds prior to turning disconnect switches to the "OFF" position.

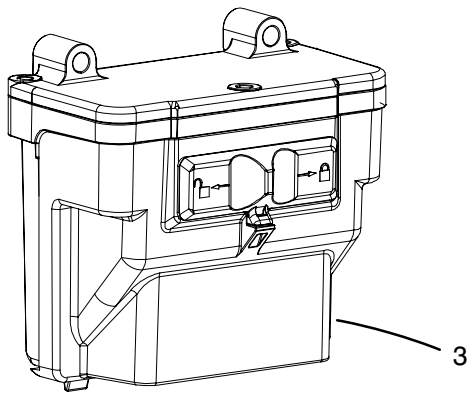
Carrier Power Panel

Located on the power panel are fuses that protect the transmission and engine control units main power. Also located on the panel is a label which designates the carrier electrical circuit protected by each fuse. Refer to Figure 1—44. If the transmission control unit (TCU), engine control module (ECM), or anti-lock brake system (ABS) controller is not functioning, check these fuses and replace if required. The power panel is located on the inside of the left frame rail. Remove the deck plate behind the engine hood to access the power panel. Refer to Figure 1—45.



1. 12V To 24V Convertor
2. Engine/Transmission Fuses
3. Engine ECM Fuses
4. 12V To 24V Convertor Fuse
5. ABS Fuses
6. ABS Controller
7. Battery Disconnect Switches
8. Engine Wire Harness
9. Carrier Wire Harness
10. Engine Hood
11. Battery Box Cover

Figure 1–45
Power Panel And Battery Disconnect Switches



1. ABS Warning Light
2. ABS Diagnostic Request Switch
3. ABS Controller

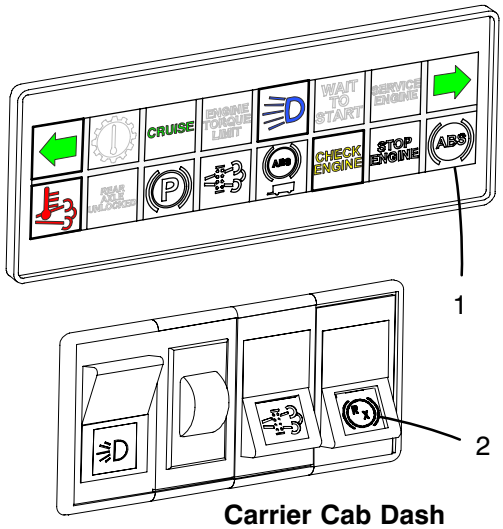


Figure 1—46
ABS Controller

Anti-lock Brake System (ABS)

This crane is equipped with an anti-lock braking system. This system helps the driver maintain control by preventing wheel lockup during hard braking.

The system operates with a computer that optimizes crane control during braking on varying tire and road conditions by modulating the brake pressure at each wheel. During an anti-lock stop, the modulating pressure will not allow the wheels to lock-up. This is an indication that the ABS is working correctly.

CAUTION

The ABS may not assist the crane in stopping quickly on wet or icy surfaces. Heavy braking combined with poor road conditions could cause loss of steering control.

ABS Controller

When a system malfunction has occurred, a warning light on the carrier cab dash will illuminate. When this light illuminates, a malfunction has been detected with the ABS system. Depending on which component has malfunctioned, the ABS may be fully or partially disabled. To determine the malfunction, the ABS diagnostic request switch is used to place the controller (ECU) in diagnostic blink code mode where the ABS warning light will display a sequence of flashes. When the ABS warning light illuminates, the controller should be serviced as soon as possible.

ECU Diagnostics

The controller contains self-testing diagnostic circuitry that continuously checks for the normal operation of internal components and circuitry, as well as external ABS components and wiring.

Active Diagnostic Trouble Codes

When an erroneous system condition is detected, the controller:

1. Illuminates the appropriate indicator light(s) and disengages part or all of the ABS and automatic traction control (ATC) functions.
2. Places the appropriate trouble code information in the ECU memory.
3. Communicates the appropriate trouble code information over the serial communications diagnostic link as required. Hand-held or PC-based diagnostic tools attach to the diagnostic connector located under the carrier cab dash.

Blink Codes

Blink codes allow a technician to troubleshoot ABS problems without using a hand-held or PC-based diagnostic tool. Instead, information about the ABS system is communicated by the ECU using the ABS warning light to display sequences of blinks.

Note: The ECU will not enter the diagnostic blink code mode if the wheel speed sensors show that the vehicle is in motion. If the ECU is in the diagnostic blink code mode and then detects vehicle motion, it will exit the blink code mode.

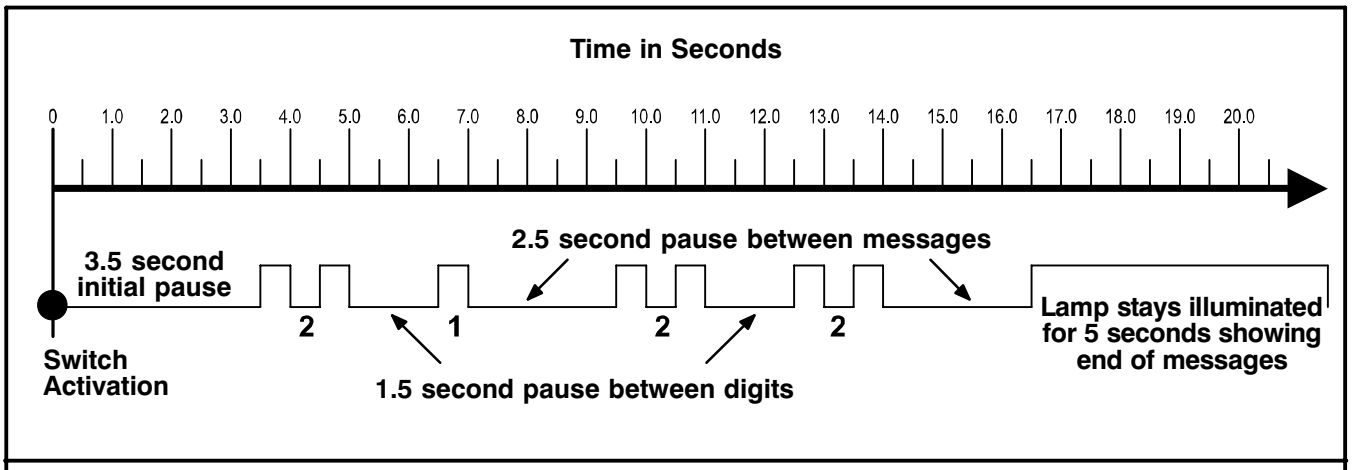


Figure 1—47
Blink Code Message Example

In addition, by operating the diagnostic request switch as described below, one of several diagnostic modes can be entered. Refer to "Diagnostic Modes" found later in this Section of the Operator's Manual.

Blink Code Activation

Activate blink codes with the diagnostic request switch:

1. Wait at least two seconds after ignition on. (Except when entering Reconfiguration Mode — refer to Reconfiguration Mode found later in this Section of the Operator's Manual.
2. For the ECU to recognize that the switch is activated "on", the technician must press it for at least 0.1 seconds, but less than 5 seconds. (If the switch is held for more than 5 seconds, the ECU will register a malfunctioning switch.)
3. Pauses between pressing the switch when a sequence is required, (e.g. when changing mode) must not be longer than 2 seconds.
4. After a pause of 3.5 seconds, the ECU will begin responding with output information blinks. Refer Figure 1—47 for an example.

Blink Code Timing

The ECU responds with a sequence of blink codes. The overall blink code response from the ECU is called a "message". Each message includes, depending on the mode selected, a sequence of one or more groups of blinks. Simply record the number of blinks for each sequence and then use the "Blink Code Identification" chart to identify the active or inactive trouble codes.

1. Sequences of blinks illuminate the ABS warning light for half a second, with half-second pauses between them.
2. Pauses between blink code digits are 1.5 seconds.
3. Pauses between blink code messages are 2.5 seconds.
4. The light remains on for 5 seconds at the end of messages.

Once the ABS warning light begins displaying a sequence of codes, it continues until all blink code messages have been displayed and then returns to the normal operating mode. During this time, the ECU will ignore any additional diagnostic switch activation.

All trouble codes, with the exception of voltage and J1939 trouble codes, will remain in an active state for the remainder of the power cycle. Voltage trouble codes will clear automatically when the voltage returns within the required limits. All ABS functions will be re-engaged.

J1939 trouble codes will clear automatically when communications are re-established.

Diagnostic Modes

In order to communicate with the ECU, the controller has several modes that can be selected, allowing information to be retrieved or other ECU functions to be accessed.

To enter the various diagnostic modes, refer to the "Diagnostic Mode Activation" chart below.

Diagnostic Mode Activation

No. of Times to Press the Diagnostic Request Switch	System Mode Entered
1	Active diagnostic trouble code retrieval
2	Inactive diagnostic trouble code retrieval
3	Clear active diagnostic trouble codes
4	System configuration check
5	Dynamometer Test Mode
7*	Reconfigure ECU

* To enter the Reconfiguration Mode, the switch must be held in before the application of ignition power. Once the power is supplied, the switch is released and then pressed seven times.

Active Diagnostic Trouble Code Mode

For troubleshooting, typically the Active and Inactive Diagnostic Trouble Retrieval Modes are used. Pressing the diagnostic request switch once and the ABS warning light blinks the first group of two codes, and if there are more trouble codes recorded, this is followed by a second set of codes, etc. (refer to "Blink Code Identification" chart to identify the codes). All active trouble codes may also be retrieved using a hand-held or PC-based diagnostic tool.

To clear active diagnostic trouble codes (as problems are fixed), simply clear by removing and re-applying ignition power. The only exception is for wheel speed sensor trouble codes, which clear when power is removed, re-applied, and the ECU detects valid wheel speed from all wheel speed sensors. Alternately, codes may be cleared by pressing the diagnostic request switch 3 times (to enter the Clear Active Diagnostic Trouble Code Mode) or by using a hand-held or PC-based diagnostic tool. Handheld or PC-based diagnostic tools are able to clear wheel speed sensor trouble codes without the vehicle being driven.

Inactive Diagnostic Trouble Code Mode

The ECU stores past trouble codes and comments (such as configuration changes) in its memory. This record is commonly referred to as "event history". When an active trouble code is cleared, the ECU stores it in the event history memory as an inactive trouble code.

Using blink codes, the technician may review all inactive trouble codes stored on the ECU. The ABS warning light will display inactive diagnostic blink codes when the diagnostic request switch is pressed and released two times.

Inactive trouble codes, and event history, may be retrieved and cleared by using a hand-held or PC-based diagnostic tool.

Clearing Active Diagnostic Trouble Codes

The ECU will clear active trouble codes when the diagnostic request switch is depressed and released three times.

System Configuration Check Mode

The ABS warning light will display system configuration information when the diagnostic request switch is depressed and released four times. The light will blink out configuration information codes using the patterns shown in the "System Configuration Check" chart. In this mode the ECU tells the technician, by means of a series of six blink codes, the type of ABS system that the ECU has been set up to expect. For example, if the fourth blink code is a three, the technician knows that a 6S/5M sensor/modulator configuration has been set.

Dynamometer Test Mode

The Dynamometer Test Mode is used to disable automatic traction control (ATC) when needed (e.g. when performing any vehicle maintenance where the wheels are lifted off the ground and moving, including dyno testing). This mode is not reset by power off, power on, cycling. Instead a hand-held or PC-based diagnostic tool must be used to change the setting. Alternatively, pressing and releasing the diagnostic request switch three times will cause the ECU to exit the blink code mode.

Reconfiguration Mode

Reconfiguration is carried out by using the Reconfigure ECU Mode. To enter the Reconfiguration Mode, the blink code switch must be held in before the application of ignition power. Once the power is supplied, the switch is released and then pressed seven times.

Note: During the reconfiguration process, and independently from any reconfiguration being carried out by the technician, the ECU automatically checks the J1939 serial link and communicates with other control modules. In particular, if the serial link shows that the crane has a retarder device present, the ECU will configure itself to communicate with the retarder device for improved ABS performance. For example, if the ECU detects the presence of a retarder disable relay during a reconfiguration, it will configure itself to control the relay to disable the retarding device as needed.

System Configuration Check	
1st Number	**System Power**
1	12 Volts
2	24 Volts
2nd Number	**Wheel Speed Sensors**
4	4 Sensors
6	6 Sensors
3rd Number	**Pressure Modulator Valves**
4	4 Modulators
5	5 Modulators
6	6 Modulators
4th Number	**ABS Configuration**
1	4S/4M or 6S/6M
2	6S/4M
3	6S/5M
5th Number	**Traction Control Configuration**
2	No ATC
3	ATC Engine Control Only
4	ATC Brake Control Only
5	Full ATC (Engine Control & Brake Control)
6th Number	**Retarder Configuration**
1	No Retarder
2	J1939 Retarder
3	Retarder Relay
4	J1939 Retarder, Retarder Relay

Blink Code Identification		
1st Digit Blink Code	2nd Digit Blink Code	Description
2	1	Left Steer Axle Wheel Speed Sensor Excessive Air Gap
2	2	Left Steer Axle Wheel Speed Sensor Output Low @ Drive-Off
2	3	Left Steer Axle Wheel Speed Sensor Open or Shorted
2	4	Left Steer Axle Wheel Speed Sensor Loss of Sensor Signal
2	5	Left Steer Axle Wheel Speed Sensor Wheel End
2	6	Left Steer Axle Wheel Speed Sensor Erratic Sensor Signal
2	7	Left Steer Axle Wheel Speed Sensor Tire Size Calibration
2	8	Left Steer Axle Wheel Speed Sensor Configuration Error
3	1	Right Steer Axle Wheel Speed Sensor Excessive Air Gap
3	2	Right Steer Axle Wheel Speed Sensor Output Low @ Drive-Off
3	3	Right Steer Axle Wheel Speed Sensor Open or Shorted
3	4	Right Steer Axle Wheel Speed Sensor Loss of Sensor Signal
3	5	Right Steer Axle Wheel Speed Sensor Wheel End
3	6	Right Steer Axle Wheel Speed Sensor Erratic Sensor Signal
3	7	Right Steer Axle Wheel Speed Sensor Tire Size Calibration
3	8	Right Steer Axle Wheel Speed Sensor Configuration Error
4	1	Left Drive Axle Wheel Speed Sensor Excessive Air Gap
4	2	Left Drive Axle Wheel Speed Sensor Output Low @ Drive-Off
4	3	Left Drive Axle Wheel Speed Sensor Open or Shorted
4	4	Left Drive Axle Wheel Speed Sensor Loss of Sensor Signal
4	5	Left Drive Axle Wheel Speed Sensor Wheel End
4	6	Left Drive Axle Wheel Speed Sensor Erratic Sensor Signal
4	7	Left Drive Axle Wheel Speed Sensor Tire Size Calibration
4	8	Left Drive Axle Wheel Speed Sensor Configuration Error
5	1	Right Drive Axle Wheel Speed Sensor Excessive Air Gap
5	2	Right Drive Axle Wheel Speed Sensor Output Low @ Drive-Off
5	3	Right Drive Axle Wheel Speed Sensor Open or Shorted
5	4	Right Drive Axle Wheel Speed Sensor Loss of Sensor Signal
5	5	Right Drive Axle Wheel Speed Sensor Wheel End
5	6	Right Drive Axle Wheel Speed Sensor Erratic Sensor Signal
5	7	Right Drive Axle Wheel Speed Sensor Tire Size Calibration
5	8	Right Drive Axle Wheel Speed Sensor Configuration Error
6	1	Battery Voltage Too Low
6	2	Battery Voltage Too High
6	3	Battery Voltage Too Low During ABS
6	4	Battery Voltage Input Open Circuit

Blink Code Identification		
1st Digit Blink Code	2nd Digit Blink Code	Description
6	5	Ignition Voltage Too Low
6	6	Ignition Voltage Too High
6	7	Ignition Voltage Too Low During ABS
6	8	Input Voltage Has Excessive Noise (Temporary)
6	9	Input Voltage Has Excessive Noise
7	1	Left Steer Axle Pressure Modulator Valve Release Solenoid Shorted to Ground
7	2	Left Steer Axle Pressure Modulator Valve Release Solenoid Shorted to Voltage
7	3	Left Steer Axle Pressure Modulator Valve Release Solenoid Open Circuit
7	4	Left Steer Axle Pressure Modulator Valve Hold Solenoid Shorted to Ground
7	5	Left Steer Axle Pressure Modulator Valve Hold Solenoid Shorted to Voltage
7	6	Left Steer Axle Pressure Modulator Valve Hold Solenoid Open Circuit
7	7	Left Steer Axle Pressure Modulator Valve CMN Open Circuit
7	8	Left Steer Axle Pressure Modulator Valve Configuration Error
8	1	Right Steer Axle Pressure Modulator Valve Release Solenoid Shorted to Ground
8	2	Right Steer Axle Pressure Modulator Valve Release Solenoid Shorted to Voltage
8	3	Right Steer Axle Pressure Modulator Valve Release Solenoid Open Circuit
8	4	Right Steer Axle Pressure Modulator Valve Hold Solenoid Shorted to Ground
8	5	Right Steer Axle Pressure Modulator Valve Hold Solenoid Shorted to Voltage
8	6	Right Steer Axle Pressure Modulator Valve Hold Solenoid Open Circuit
8	7	Right Steer Axle Pressure Modulator Valve CMN Open Circuit
8	8	Right Steer Axle Pressure Modulator Valve Configuration Error
9	1	Left Drive Axle Pressure Modulator Valve Release Solenoid Shorted to Ground
9	2	Left Drive Axle Pressure Modulator Valve Release Solenoid Shorted to Voltage
9	3	Left Drive Axle Pressure Modulator Valve Release Solenoid Open Circuit
9	4	Left Drive Axle Pressure Modulator Valve Hold Solenoid Shorted to Ground
9	5	Left Drive Axle Pressure Modulator Valve Hold Solenoid Shorted to Voltage
9	6	Left Drive Axle Pressure Modulator Valve Hold Solenoid Open Circuit
9	7	Left Drive Axle Pressure Modulator Valve CMN Open Circuit
9	8	Left Drive Axle Pressure Modulator Valve Configuration Error
10	1	Right Drive Axle Pressure Modulator Valve Release Solenoid Shorted to Ground
10	2	Right Drive Axle Pressure Modulator Valve Release Solenoid Shorted to Voltage
10	3	Right Drive Axle Pressure Modulator Valve Release Solenoid Open Circuit
10	4	Right Drive Axle Pressure Modulator Valve Hold Solenoid Shorted to Ground
10	5	Right Drive Axle Pressure Modulator Valve Hold Solenoid Shorted to Voltage
10	6	Right Drive Axle Pressure Modulator Valve Hold Solenoid Open Circuit
10	7	Right Drive Axle Pressure Modulator Valve CMN Open Circuit

Blink Code Identification		
1st Digit Blink Code	2nd Digit Blink Code	Description
10	8	Right Drive Axle Pressure Modulator Valve Configuration Error
11	1	J1939 Serial Link
11	2	J1939 Retarder
11	3	J1939 Engine Communications
12	1	Stop Lamp Switch Not Detected
12	2	Stop Lamp Switch Defective
12	3	Dynamometer Test Mode
12	4	Retarder Relay Open Circuit or Shorted to Ground
12	5	Retarder Relay Circuit Shorted to Voltage
12	6	ABS Warning Lamp Circuit Fault
12	7	Pressure Modulator Valve/Traction Control Valve/Diff Lock Common Shorted to Ground
12	8	Pressure Modulator Valve/Traction Control Valve/Diff Lock Common Shorted to Voltage
12	9	ATC Disabled to Prevent Brake Fade
12	10	Tire Size Out of Range (Front to Rear)
12	11	Wheel Speed Sensors Reversed on an Axle
12	12	Diff Lock Solenoid Shorted to Ground or Open Circuit
12	13	Diff Lock Solenoid Shorted to Voltage
13	2	ECU (10)
13	3	ECU (11)
13	4	ECU (12)
13	5	ECU (13)
13	6	ECU (14)
13	7	ECU (15)
13	8	ECU (16)
13	9	ECU (17)
13	10	ECU (18)
13	11	ECU (1A)
13	12	ECU (1B)
13	13	ECU (80)
14	1	Left Additional Axle Wheel Speed Sensor Excessive Air Gap
14	2	Left Additional Axle Wheel Speed Sensor Output Low @ Drive-Off
14	3	Left Additional Axle Wheel Speed Sensor Open or Shorted
14	4	Left Additional Axle Wheel Speed Sensor Loss of Sensor Signal
14	5	Left Additional Axle Wheel Speed Sensor Wheel End
14	6	Left Additional Axle Wheel Speed Sensor Erratic Sensor Signal
14	7	Left Additional Axle Wheel Speed Sensor Tire Size Calibration

Blink Code Identification		
1st Digit Blink Code	2nd Digit Blink Code	Description
14	8	Left Additional Axle Wheel Speed Sensor Configuration Error
15	1	Right Additional Axle Wheel Speed Sensor Excessive Air Gap
15	2	Right Additional Axle Wheel Speed Sensor Output Low @ Drive-Off
15	3	Right Additional Axle Wheel Speed Sensor Open or Shorted
15	4	Right Additional Axle Wheel Speed Sensor Loss of Sensor Signal
15	5	Right Additional Axle Wheel Speed Sensor Wheel End
15	6	Right Additional Axle Wheel Speed Sensor Erratic Sensor Signal
15	7	Right Additional Axle Wheel Speed Sensor Tire Size Calibration
15	8	Right Additional Axle Wheel Speed Sensor Configuration Error
16	1	Left Additional Axle Pressure Modulator Valve Release Solenoid Shorted to Ground
16	2	Left Additional Axle Pressure Modulator Valve Release Solenoid Shorted to Voltage
16	3	Left Additional Axle Pressure Modulator Valve Release Solenoid Open Circuit
16	4	Left Additional Axle Pressure Modulator Valve Hold Solenoid Shorted to Ground
16	5	Left Additional Axle Pressure Modulator Valve Hold Solenoid Shorted to Voltage
16	6	Left Additional Axle Pressure Modulator Valve Hold Solenoid Open Circuit
16	7	Left Additional Axle Pressure Modulator Valve CMN Open Circuit
16	8	Left Additional Axle Pressure Modulator Valve Configuration Error
17	1	Right Additional Axle Pressure Modulator Valve Release Solenoid Shorted to Ground
17	2	Right Additional Axle Pressure Modulator Valve Release Solenoid Shorted to Voltage
17	3	Right Additional Axle Pressure Modulator Valve Release Solenoid Open Circuit
17	4	Right Additional Axle Pressure Modulator Valve Hold Solenoid Shorted to Ground
17	5	Right Additional Axle Pressure Modulator Valve Hold Solenoid Shorted to Voltage
17	6	Right Additional Axle Pressure Modulator Valve Hold Solenoid Open Circuit
17	7	Right Additional Axle Pressure Modulator Valve CMN Open Circuit
17	8	Right Additional Axle Pressure Modulator Valve Configuration Error
18	1	Traction Control Valve Solenoid Shorted to Ground
18	2	Traction Control Valve Solenoid Shorted to Voltage
18	3	Traction Control Valve Solenoid Open Circuit
18	4	Traction Control Valve Configuration Error

Carrier Cab Seat

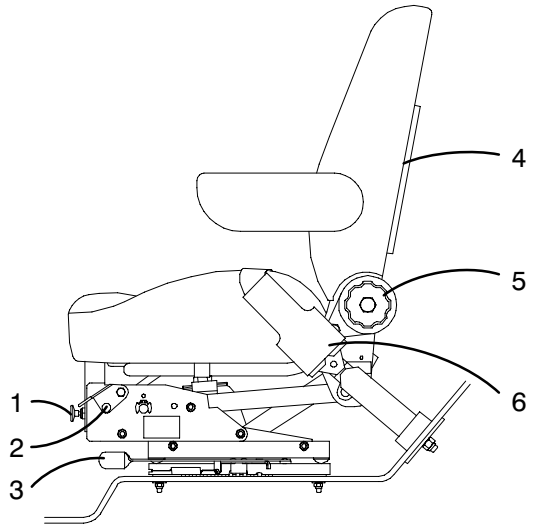
The operator's seat in the carrier cab is fully adjustable. For average conditions, the seat cushion surface should be level while the operator is seated. The seat should ride freely up and down, without bottoming out, during normal crane movement.

Seat back angle and the forward and backward position of the seat should be adjusted to provide operator comfort. The seat is adjusted by manual controls. Refer to Figure 1−48.

Note: For optimum comfort and proper seat adjustment, the operator should "sit back in the seat" and sit erect while making any adjustment.

WARNING

Do not make seat adjustments while crane is in motion. Properly park crane before making seat adjustments.



1. Air Control Valve
2. Height Adjustment Latch
3. Seat Release Lever
4. Operator's Manual Holder
5. Seat Back Adjustment Knob
6. Seat Belt

Figure 1−48
Carrier Cab Seat

1. Air Control Valve

The air control valve is used to adjust the cushion angle and weight resistance for maximum driver comfort. Increase the cushion angle and weight resistance for a heavier operator or bumpy road conditions; decrease for lighter operator or smooth road conditions. Push the valve in to increase the resistance; pull out to decrease the resistance.

2. Height Adjustment Latch

To Raise The Seat:

a. Pull out on the air control valve to exhaust all the air.
b. While holding the height adjustment latch in the released position, push the air control valve in to raise the seat to the desired height.
c. Once the desired height is reached, release the air control valve and the height adjustment latch.
d. Adjust the air pressure as needed using the air control valve to obtain the desired ride.

To Lower The Seat:

a. Firmly pull up on the height adjustment latch while pulling out on the air control valve, exhausting air until the latch releases.
b. Once the desired height is reached, release the air control valve and the height adjustment latch.
c. Adjust the air pressure as needed using the air control valve to obtain the desired ride.

3. Seat Release Lever

To move the seat forward or backward, pull the seat release lever outward and hold. Position the seat as desired and release the lever to lock the seat in place.

4. Operator's Manual Holder

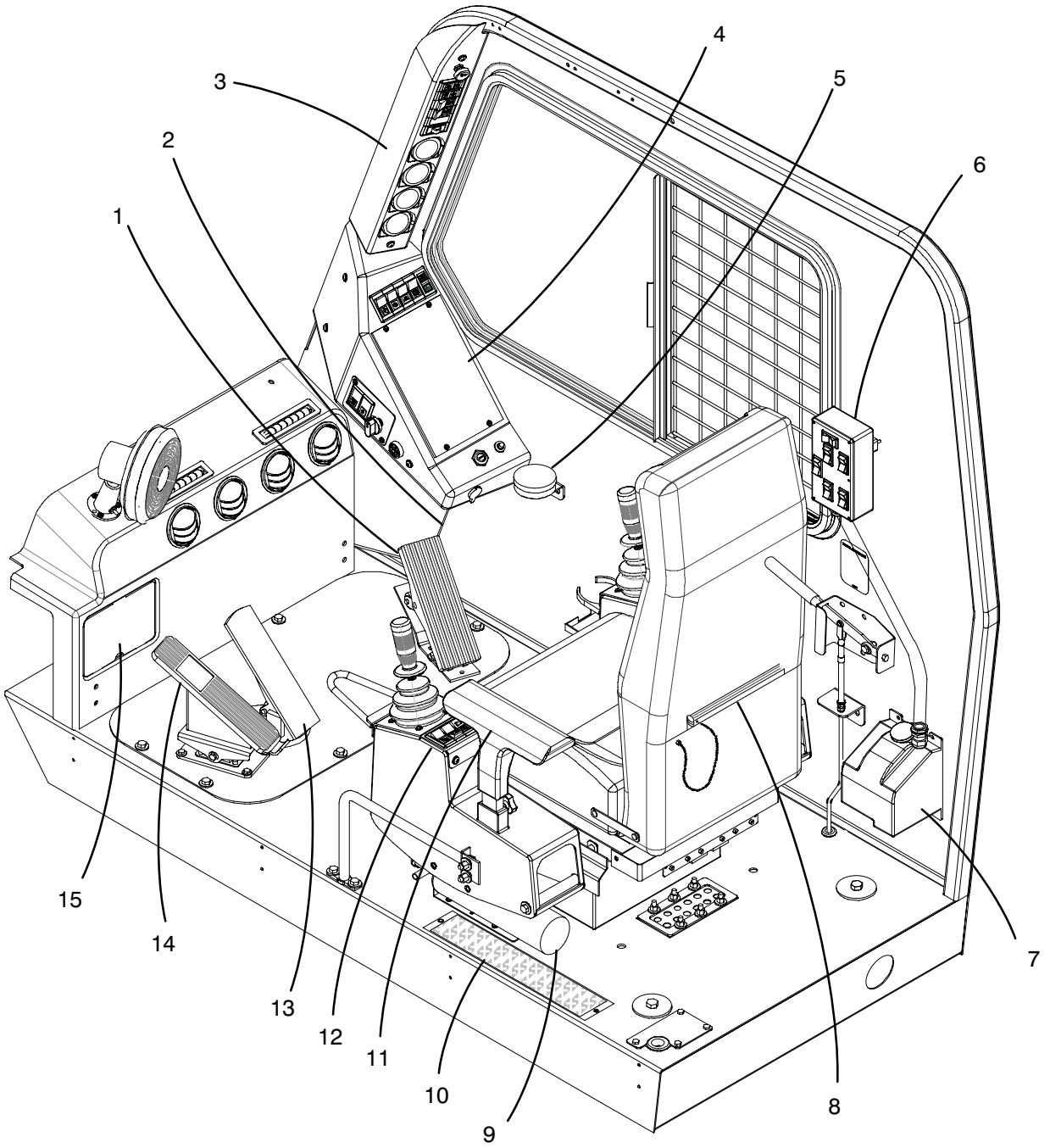
The Operator's Manual is stored in the pocket on the rear of the seat. The manual should remain in the cab at all times. If the manual is not in the cab, order a replacement from your distributor.

5. Seat Back Adjustment Knob

To recline the seat back, turn the seat back adjustment knob clockwise. To bring the seat back forward, turn the knob counterclockwise.

6. Seat Belt

A seat belt is provided for operator safety while driving the crane. The seat belt must be used at all times while driving the crane.

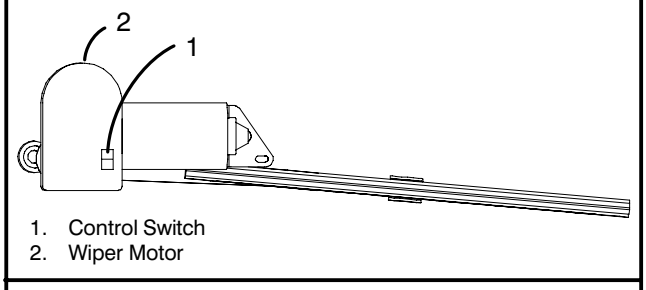


1. Throttle Pedal
2. Crane Rating Manual Holder
3. Gauge And Control Panel
4. Rated Capacity Limiter Display
5. Bubble Level
6. Outrigger Control Box
7. Windshield Washer Reservoir
8. Operator's Manual Holder
9. Fire Extinguisher
10. Air Conditioning Filter (If Equipped)
11. Seat And Console Assembly
12. Console Control Switches
13. Swing Brake Pedal
14. Boom Telescope Pedal
15. Fuse Panel

Figure 1—49
Upper Operator's Cab

Upper Operator's Cab

Located throughout the upper operator's cab are several panels which contain the controls, switches and gauges to operate and monitor crane operations. Refer to Figure 1—49. The following is a description of each gauge, switch, or control in each panel, along with an explanation of their function and/or operation.



1. Control Switch
2. Wiper Motor

Figure 1–50
Top Hatch Wiper

Fire Extinguisher

A fire extinguisher is located in the operator's cab below the left console. Raise the left console to gain access to the extinguisher. It is an A B C type fire extinguisher, meaning it is capable of extinguishing most types of fires. The operator should be familiar with its location, the clamp mechanism used to secure it in place, and foremost the operation of the device. Specific instructions, regarding operation, are given on the label attached on the fire extinguisher. A charge indicator on the fire extinguisher monitors the pressure within the tank. Check the indicator daily to ensure the fire extinguisher is adequately charged and ready for use.

Top Hatch Wiper

The top hatch wiper is located in the top right corner of the cab roof. The switch for the top hatch wiper is located on the wiper motor. Move the switch to the "ON" or "OFF" position as desired. Refer to Figure 1–50.

Upper Operator's Cab Fuse Panel

The fuse panel is located in the lower left front corner of the upper operator's cab. Refer to Figure 1–49. Located behind the fuse panel cover is a label which designates the electrical circuit protected by each fuse. Refer to Figure 1–51. Each fuse has a letter designation which corresponds to the upper electrical system as shown on the fuse identification label.

Windshield Washer Reservoir

Check the windshield washer reservoir daily. The reservoir for washer fluid is located in the lower right rear of the cab. Refer to Figure 1–49. Visual inspection can determine if the washer fluid is adequate. Do not operate the washer when the reservoir is empty. Use specially formulated windshield washer fluid rather than water because specialty washer fluids contain additives that dissolve road grime.

Gauge And Control Panel

Located to the right front corner of the operator's cab is

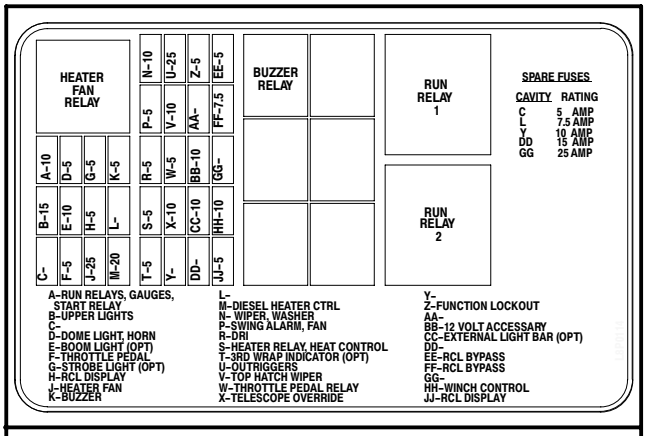


Figure 1–51
Fuse Panel Label

a panel that contains the following controls, gauges, and indicators and is shown in Figure 1–52.

1. Windshield Wiper/Washer Switch

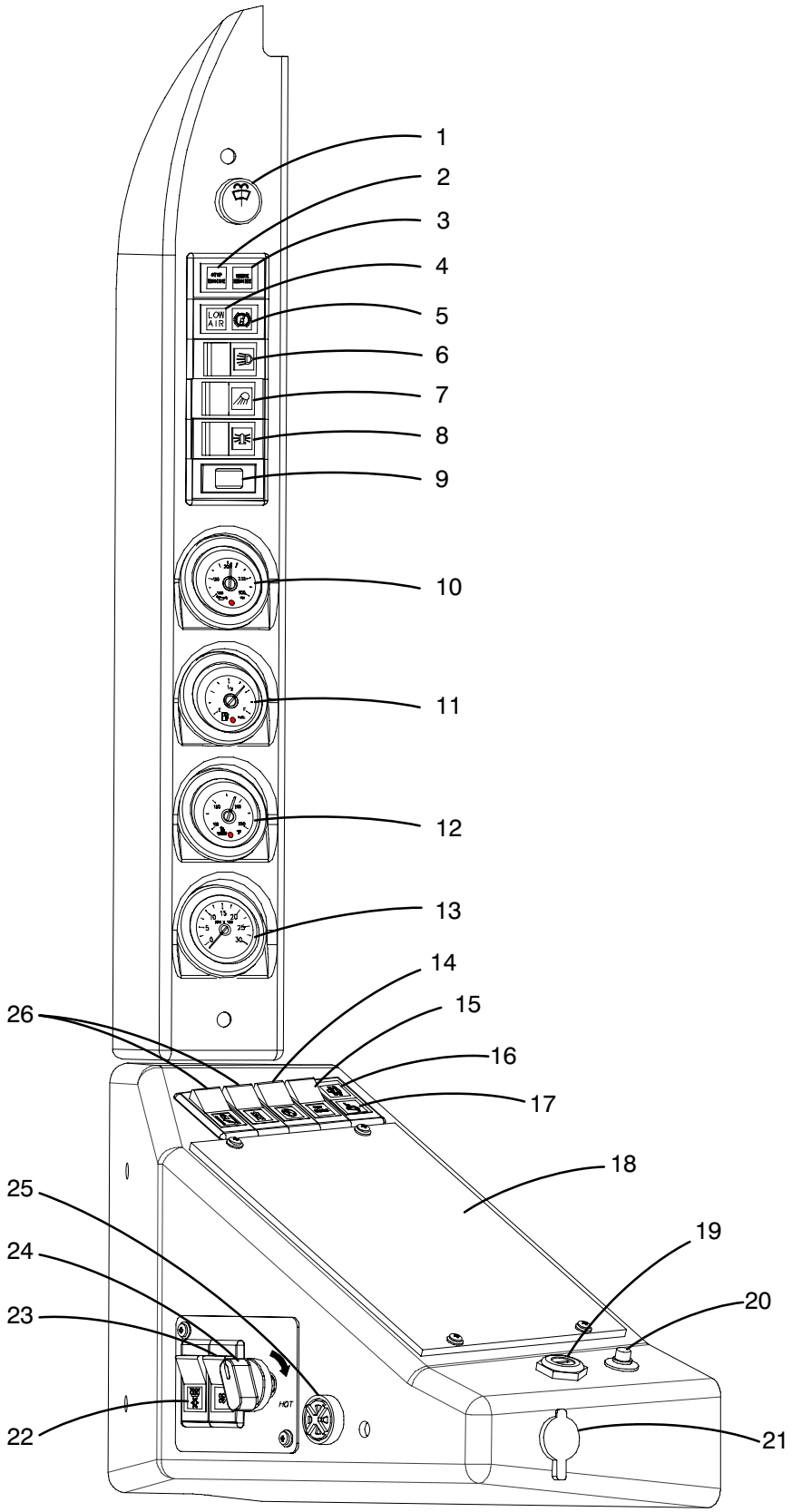
Rotate the wiper/washer knob clockwise to activate the windshield wiper. Rotate the knob to the first detent for low speed wiper and to the second detent for high speed wiper. Pushing the wiper/washer knob sprays washer fluid on the windshield to clean the window.

2. Stop Engine Indicator Light

This red indicator light will illuminate along with an alarm buzzer to make the operator aware of major engine problems. When this light illuminates, stop operations immediately and shutdown the engine. Consult the engine manufacturer's manual and correct the problem before any further operation of the engine.

The stop engine indicator light will also illuminate in conjunction with the check engine light and a flashing DPF regeneration light. This condition alerts the operator that the soot loading in the DPF has reached a critical level. If a regeneration cycle is not started, the stop engine light will begin to flash and the engine will shutdown in 30 seconds. The engine may be restarted and a regeneration cycle must be initiated. If engine operations continue without regeneration, the engine will shutdown a second time. After a second shutdown, regeneration may not be initiated and the engine will run for only 60 seconds at a time.

Note: The stop engine light will illuminate momentarily when the ignition is turned on as a means of testing the indicator light. The light should go out after a short period of time.



1. Windshield Wiper/Washer Switch
2. Stop Engine Indicator Light
3. Check Engine Indicator Light
4. Low Air Indicator Light
5. Swing Park Brake Indicator Light
6. Upper Light Switch
7. Boom Floodlight Switch
8. Rotating Beacon or Strobe Light Switch
9. Gauge Lights Dimmer Switch
10. Hydraulic Oil Temperature Gauge
11. Fuel Level Gauge
12. Coolant Temperature Gauge
13. Tachometer
14. Function Lockout Switch
15. Pump Enable Switch
16. Diesel Particulate Filter Regeneration Light
17. High Exhaust Temperature Indicator Light
18. RCL Display
19. Ignition Switch
20. Horn Button
21. 12V DC Accessory Outlet
22. Heater/Air Conditioner Selector Switch
23. Heater or Fan Speed Switch
24. Climate Control Knob
25. Check Gauges Audible Alarm
26. Throttle Lock Switches

Figure 1–52
Gauge And Control Panel

3. Check Engine Indicator Light

This amber indicator light will illuminate along with an alarm buzzer to make the operator aware of minor engine problems. When this light illuminates engine operation may continue. However, consult the engine manufacturer's manual and correct the problem as soon as possible to avoid prolonged operation of the malfunctioning engine which could develop into a major problem.

The check engine indicator light will flash to alert the operator that the engine idle shutdown system will shutdown the engine in 30 seconds. Refer to "Engine Idle Shutdown System" found later in this Operator's Manual.

This light will also illuminate in conjunction with a flashing DPF regeneration light. This condition alerts the operator that the soot loading in the DPF has reached a level where a regeneration, either automatic or manual must be performed as soon as safely possible. If regeneration cannot be achieved, contact your Link-Belt distributor and/or engine dealer. If engine operations continue without regeneration, the engine progressively derates to a reduced horsepower level.

Note: The check engine light will illuminate momentarily when the ignition is turned on as a means of testing the indicator light. The light should go out after a short period of time.

4. Low Air Indicator Light

This light will illuminate and an audible alarm will sound to alert the operator that there is insufficient air pressure to engage the main pumps. When the light and alarm extinguish there is sufficient air pressure for the pumps to engage. For more information refer to "Main Pump Controls" found earlier in this Operator's Manual.

5. Swing Park Brake Indicator Light

This light will illuminate anytime the swing park brake is applied and the ignition is on.

6. Upper Lights Switch

This switch operates upper floodlights. Push the left side of the switch to turn floodlights on, right side to turn them off.

7. Boom Floodlight Switch

This switch operates the boom floodlight. Push the left side of the switch to turn floodlight on, right side to turn it off.

8. Rotating Beacon or Strobe Light Switch (If Equipped)

This switch controls the cab rotating beacon or strobe light. Push the left side of the switch to turn it on, right side to turn it off.

9. Gauge Lights Dimmer Switch

This switch is used to control the dash lights. Rotate the switch down to dim the lights and rotate up to brighten dash lights.

Note: When the key is turned on, the gauge needle on the coolant temperature, hydraulic oil temperature, tachometer, and fuel gauges will go to the 12 o'clock position and an indicator light within each gauge will flash as a means of testing the gauge. The needle will return to the normal operating position and the light should go out after a short period of time. If the gauge is not monitoring its respective function, the indicator light will illuminate and the needle will sweep back and forth then move and remain at the 10 o'clock position. Repair the problem before operating the crane.

10. Hydraulic Oil Temperature Gauge

This gauge registers the hydraulic oil temperature in the main return line. Normal operating ranges vary with the oils used in different climates. Refer to Section 2 of this Operator's Manual for proper oil viscosities and operating temperature ranges. If the hydraulic oil exceeds the maximum operating temperature, an indicator light within the gauge will illuminate and an alarm buzzer will sound. Shutdown the crane immediately and correct the problem.

11. Fuel Level Gauge

This gauge registers the level of fuel in the fuel tank. The fuel tank capacity is 95 gal (*359.6L*). Refer to the engine manufacturer's manual for the correct grade of diesel fuel. When the fuel level reaches an eighth of a tank, an indicator light within the gauge will illuminate.

12. Coolant Temperature Gauge

This gauge registers the engine cooling system temperature. For proper cooling system operating temperature range, refer to the engine manufacturer's manual. If the cooling system overheats, reduce engine speed or shift to a lower gear, or both, until the temperature returns to normal operating range. If engine temperature does not return to normal temperature, refer to engine manufacturer's manual. When the coolant temperature exceeds normal operating range an indicator light within the gauge will illuminate, an alarm buzzer will sound, and the stop engine light will illuminate.

13. Tachometer

The tachometer registers engine speed in revolutions per minute (rpm). Refer to the engine manufacturer's manual for suggested operating speeds.

14. Function Lockout Switch

This switch is used to disable hydraulic functions which are operated by the control levers and boom telescope foot pedal. Press the top part of the switch to disable hydraulic functions and to prevent inadvertent operation of these controls. To allow normal operation of the control levers and boom telescope foot pedal, press the bottom part of the function lockout switch. The bottom part of the switch will illuminate to indicate switch is in the ON position.

15. Pump Enable Switch

This switch enables the main pump to be engaged. With the pump engagement/ throttle selector switch located in the carrier cab in the "Pump/Upper" position and the low air indicator light off, push the bottom part of the switch to engage the main pump. Refer to "Main Pump Controls" found earlier in this Section of the Operator's Manual.

16. Diesel Particulate Filter Regeneration Indicator Light

This indicator light will illuminate to alert the operator that an active regeneration of the diesel particulate filter is required but cannot occur. When this light illuminates, use the DPF regeneration switch to initiate a manual regeneration cycle as soon as safely possible. Refer to the Diesel Particulate Filter Regeneration Switch description found earlier in this Operator's Manual and the engine manufacturer's manual for the proper filter regeneration procedures.

Note: The diesel particulate filter regeneration indicator light will illuminate momentarily when the ignition is turned on as a means of testing the indicator light. The light should go out after a short period of time.

17. High Exhaust Temperature Indicator Light

This indicator light will illuminate to alert the operator that the outlet temperature in the DPF is above 840˚F (450˚C) if the crane is traveling less than 5 mph (*8km/h*). This condition can occur under normal operation. No action is required.

DANGER

The temperature of the exhaust gas and the exhaust system components can reach up to 1200˚F (650˚C) during regeneration. An unexpected failure of the engine or regeneration system may increase exhaust gas temperature at the particulate exhaust filter to as high as 1650˚F (900˚C). This may result in fire, burn, or explosion hazards, which may result in personal injury or death. Do not expose flammable material or explosive atmospheres to exhaust gas or to exhaust system components during regeneration.

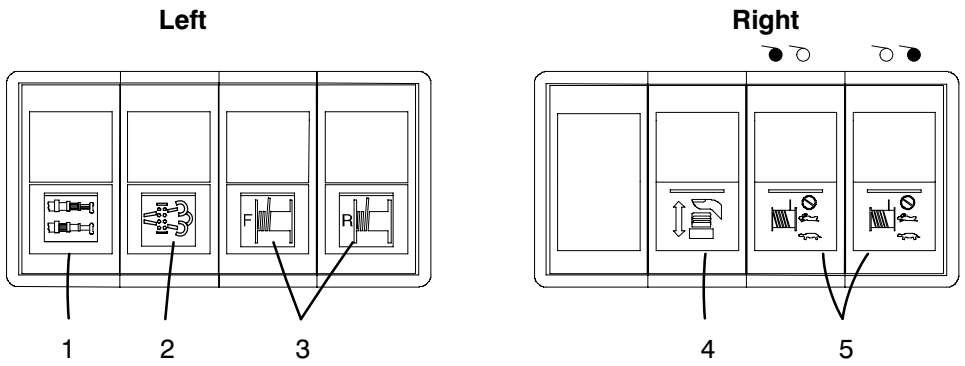
Note: The high exhaust system temperature indicator light will illuminate momentarily when the ignition is turned on as a means of testing the indicator light. The light should go out after a short period of time.

18. Rated Capacity Limiter Display

This displays the boom length, boom angle, load weight, etc. See "Crane Monitoring System" found later in this Section of the Operator's Manual for complete operating instructions.

19. Ignition Switch

The ignition switch is the conventional, key operated, automotive type. It controls engine off/on/start, accessories, and energizes the instrument panel in the upper operator's cab.



1. Boom Telescope Override Switch
2. Diesel Particulate Filter Regeneration Switch
3. Third Wrap Indicator Switches
4. Drum Rotation Indicator Switch
5. Winch Control Switches

Figure 1—53
Console Control Switches

20. Horn Button

Press this button to sound the horn. Before starting the engine, it is recommended to sound the horn twice in succession, wait 10—15 seconds while making a visual check to verify that there are no persons under or in close proximity to the crane. There also is a horn button located on the right hydraulic control lever.

21. 12V DC Accessory Outlet

Use this outlet for electrical accessories.

CAUTION

Do not connect an accessory to any part of the crane other than the accessory outlets or cigarette lighter. Damage to the crane's electrical system may result. If it is necessary to do so, contact your Link-Belt distributor.

22. Heater/Air Conditioner Selector Switch

If cab is equipped with air conditioning, this switch selects which system to operate. Press the top part of the switch to turn the heater on, bottom part to turn the air conditioning on.

23. Heater or Fan Speed Switch

This switch controls the cab heater if cab is not equipped with air conditioning. Press the top part of the switch to turn the unit on, bottom part to turn it off. If cab is equipped with air conditioning, this switch controls the fan speed.

24. Climate Control Knob

Turn the climate control knob to adjust the temperature in the cab.

25. Check Gauges Audible Alarm

This buzzer alarm will sound to alert the operator that a gauge is detecting an abnormal operating range. The check engine or stop engine light will also illuminate where applicable. The problem should be repaired before operating the crane.

26. Throttle Lock Switches

These switches are used to hold the engine at a constant speed. This provides the operator with more flexibility for certain job requirements. Refer to "Throttle Lock System" found later in this Operator's Manual.

Seat Console Control Switches

Control switches are located on the left and right consoles. Refer to Figure 1—49 and Figure 1—53.

1. Boom Telescope Override Switch

This switch is provided to manually override the telescope system when the boom is not extending/retracting proportionally. Use this switch for that purpose only. While in boom mode "B", the switch will stop one of the boom sections so the boom can be extended/retracted proportionally.

2. Diesel Particulate Filter Regeneration Switch

This switch is used to start a manual regeneration to purge the accumulated soot from the diesel particulate filter (DPF). During normal highway travel, the accumulated soot in the DPF will be purged by the automatic regeneration cycle. Use this switch only when the DPF Regeneration Indicator Light illuminates or flashes.

Note: The crane must remain stationary for approximately 45 minutes to complete a manual regeneration.

1. Normal crane operations can continue however, the engine must see a minimum of 1,000 rpm to initiate and maintain a regeneration cycle. The throttle lock can be used to maintain the minimum speed but the engine may be operated above 1000 rpm during regeneration.
2. Press and hold the DPF regeneration switch for at least two seconds and release to initiate a manual regeneration cycle.

   Note: If any of the above conditions change, manual regeneration deactivates. Either an automatic or manual regeneration cycle must be restarted.

3. Engine must be at minimum operating temperature of 140˚F (60˚C).

The engine ECM will perform a system check for approximately 30 seconds before starting the manual regeneration cycle. When the cycle begins, the DPF Regeneration Indicator Light goes out. When regeneration is complete, the high exhaust system temperature indicator light will go out and the engine speed can be lowered below 1,000 rpm if desired. Consult the engine manufacturer's manual for additional information on the regeneration process and procedures.

⚠ DANGER

The temperature of the exhaust gas and the exhaust system components can reach up to 1,200˚F (650˚C) during regeneration. An unexpected failure of the engine or regeneration system may increase exhaust gas temperature at the particulate exhaust filter to as high as 1,650˚F (900˚C). This may result in fire, burn, or explosion hazards, which may result in personal injury or death. Do not expose flammable material or explosive atmospheres to exhaust gas or to exhaust system components during regeneration.

3. Third Wrap Indicator Switches (If Equipped)

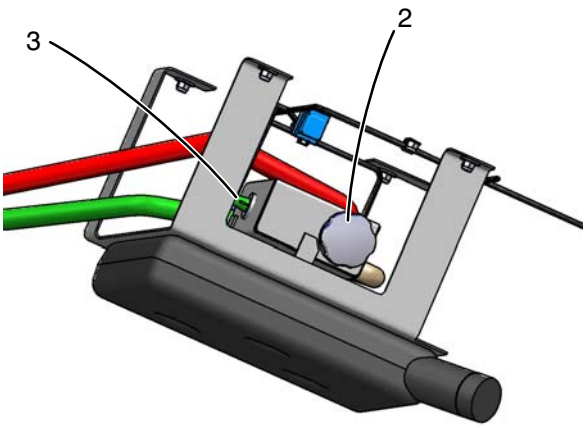
These switches operate the third wrap indicator system for the winch drum(s). When this switch is in the "ON" position, a red warning light will illuminate and a buzzer will sound to alert the operator when the wire rope is down to the third wrap on the winch drum. Press the switch marked "F" to monitor the front drum and "R" for rear drum. Press both switches to monitor the front and rear drums.

4. Drum Rotation Indicator Switch

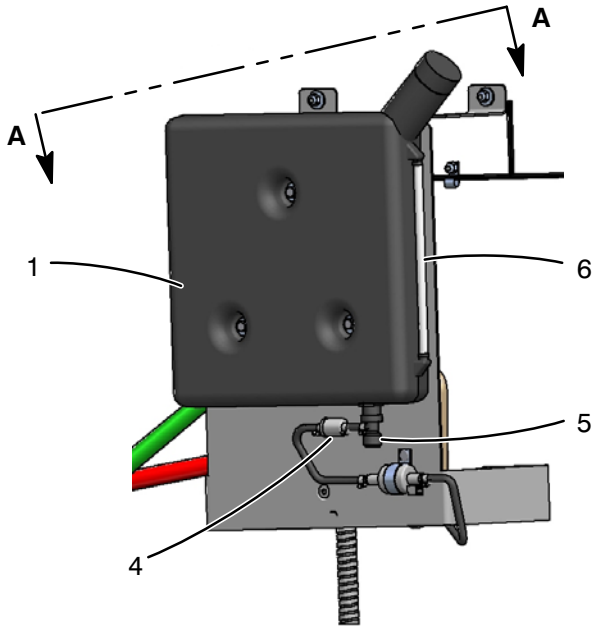
This switch is used to activate the drum rotation indicator system. To activate the system, press the bottom part of the switch. Press the top part of the switch to deactivate the system. The bottom part of the switch will illuminate to indicate switch is in the ON position. Refer to "Drum Rotation Indicators" found later in this Section of the Operator's Manual for complete operating procedures.

5. Winch Control Switches

These switches are used to control engaging/disengaging the high speed hoist and disabling the front and/or rear winch. Refer to "Wire Rope Winch System" found later in this Section of the Operator's Manual for complete operating procedures.



VIEW A—A



1. Diesel Fuel Tank
2. Coolant Reservoir
3. Coolant Reservoir Sight Gauge
4. Diesel Fuel Filter
5. Diesel Fuel Shutoff Valve
6. Diesel Fuel Tank Sight Tube

Figure 1—54
Diesel Fired Warm-water Cab Heater

Cab Heater Operation

This crane may be equipped with a diesel fired warm-water cab heater or an optional engine dependant warm-water cab heater. Refer to the following instructions to operate the cab heater that is used on the crane.

Diesel Fired Warm-water Cab Heater

This cab heater uses anti-freeze circulating through the unit to provide heat. Anti-freeze is stored in a reservoir located on the left side of the upper revolving frame. This anti-freeze is heated by a diesel fired heater/pump and circulated through the heat exchanger in the cab. The diesel fuel tank, for the system, is mounted on the left side of the upper revolving frame. Refer to Figure 1—54. Diesel fuel should be #1, #2, or arctic. The fuel system is equipped with an inline filter and should be changed every 2,000 hours of operation or annually, whichever occurs first. The anti-freeze used should be the same type used in the crane's engine. Refer to engine manufacturer's manual for proper anti-freeze selection.

Note: Operate the heater at least once a month for 10 minutes.

WARNING

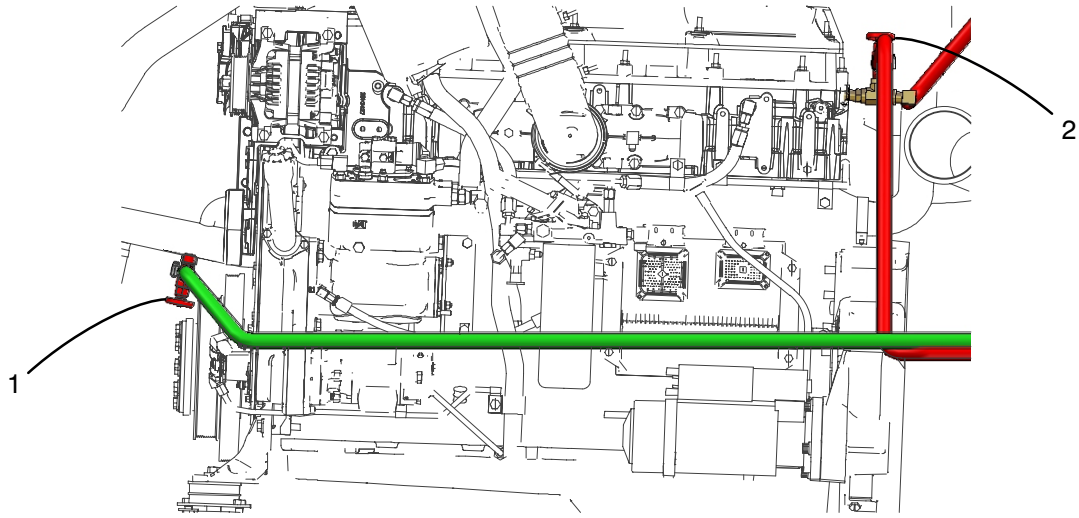
Diesel exhaust fumes can be harmful. Start and operate diesel cab heater in a well ventilated area. If it is necessary to operate in an enclosed area, vent the exhaust to the outside.

To Start The Diesel Fired Warm-water Cab Heater

1. Before activating the heater, ensure that the diesel fuel tank and the coolant reservoir are full.
2. With the engine running, press the heater switch or if crane is equipped with air conditioning, press the top part of the heater/air conditioner selector switch to turn the heater on. Refer to Figure 1—52.
3. Turn the temperature control knob to the desired setting.
4. If cab is equipped with air conditioning, use the fan speed switch to control the air flow into the cab. If cab is not equipped with air conditioning, use the heater/fan speed switch to control the air flow into the cab.

To Stop The Diesel Fired Warm-water Cab Heater

1. Press the heater switch to the off position.
2. During warm weather conditions or if the heater is not going to be used for an extended period of time, rotate the temperature control knob to the coolest setting.



1. Shutoff Valve – Heater Return
2. Shutoff Valve – Heater Supply

Figure 1–55
Engine Dependant Warm-water Cab Heater Shutoff

Engine Dependant Warm-water Cab Heater (If Equipped)

This cab heater uses engine coolant circulating through the unit to provide heat. Normally the engine coolant circulates through the heater in the cab regardless of whether the heater switch is turned on or not. During warm weather conditions, the operator may wish to shutoff the flow of hot engine coolant to the heater to reduce the temperature in the cab. Shutoff valves are located on the engine to perform this function. Refer to Figure 1–55.

To Start The Cab Heater

1. With the engine running, press the heater switch or if crane is equipped with air conditioning, press the top part of the heater/air conditioner selector switch to turn the heater on. Refer to Figure 1–52.
2. Turn the temperature control knob to the desired setting.
3. If cab is equipped with air conditioning, use the fan speed switch to control the air flow into the cab. If cab is not equipped with air conditioning, use the heater/fan speed switch to control the air flow into the cab.

To Stop The Cab Heater

1. Press the heater switch to the off position.
2. During warm weather conditions or if the heater is not going to be used for an extended period of time, rotate the temperature control knob to the coolest setting.

Cab Heater Shutoff (If Equipped)

WARNING

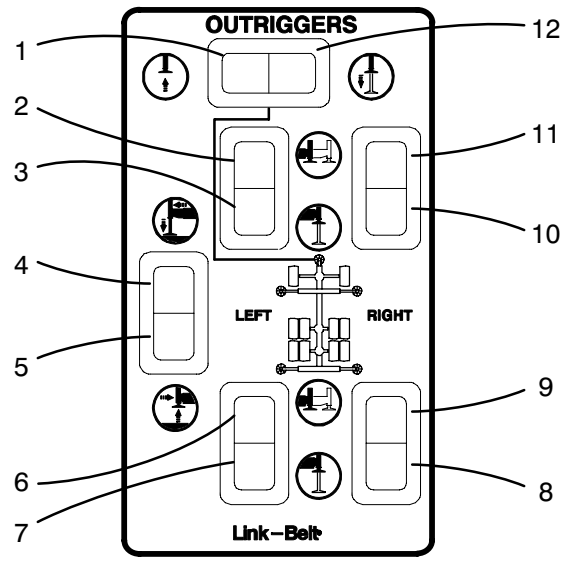
Shutdown the engine and allow it to cool before operating the heater shutoff valves. The valves may be hot and could cause serious burns.

1. Shutdown the engine and rotate the handles on the shutoff valves clockwise to stop the flow of engine coolant to the heater; Counterclockwise to restore it. Refer to Figure 1–55.

Air Conditioning (If Equipped)

The operator's cab may be equipped with an air conditioning unit. Use the following instructions to operate the unit. Refer to Figure 1–52.

1. Start the engine and allow all operating temperatures and pressures to reach their normal range.
2. Press the bottom part of the heater/air conditioner selector switch to activate the air conditioning unit.
3. Press the fan speed switch to control the amount of air blown into the cab.
4. Turn the temperature control knob to the desired setting.
5. To turn the unit off, press the heater/air conditioner selector switch to the off position.



1. Bumper Outrigger — Retract
2. Beam — Left Front
3. Jack — Left Front
4. Extend Mode — Beam/Jack
5. Retract Mode — Beam/Jack
6. Beam — Left Rear
7. Jack — Left Rear
8. Jack — Right Rear
9. Beam — Right Rear
10. Jack — Right Front
11. Beam — Right Front
12. Bumper Outrigger — Extend

Figure 1—56
Outrigger Switches — Hand Held Control Box

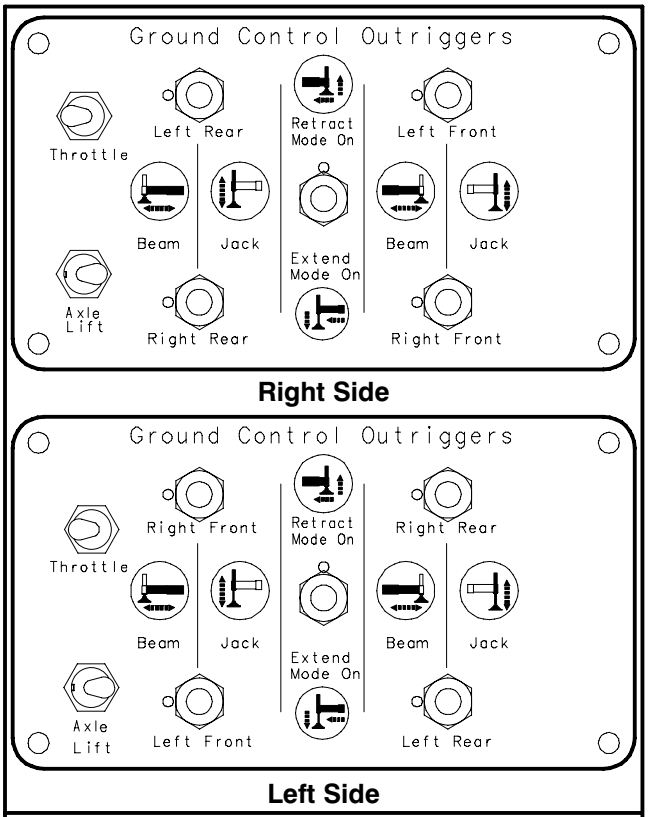


Figure 1—57
Outrigger Switches — Ground Controlled

Main Outrigger Operation

The outriggers can be used in any one of three positions; fully retracted, intermediate, or fully extended. The outriggers are controlled by switches from the hand held, tethered control box in the upper operator's cab or one of two ground control stations located at the rear outriggers, and the extend position pin located at each outrigger station.

The outrigger switches, at each station, control both outrigger functions. Each individual outrigger switch controls all functions of that outrigger beam and jack cylinder. The mode switch controls outrigger direction, extend/retract. Refer to Figure 1—56 and Figure 1—57. Each extend position pin controls the extend length of the beam. When the pin is installed, it allows the beam to be extended to its intermediate position or the fully retracted position. Refer to Figure 1—59.

All of the outrigger pontoons must set on a smooth, solid surface flush with the ground with no hills or valleys under them or they may be damaged or destroyed. If there is any doubt as to the ground conditions, use mats under the pontoons. Check pontoons before and during operations. If they are allowed to settle, they may lose their effectiveness, and make continued operations unsafe.

A bubble level is provided on the side panel in the upper operator's cab and at each ground control station to assist in determining when crane is level.

Included in the ground control outrigger stations is a throttle switch which can be used to increase engine speed during outrigger operation and, if equipped, an axle lift switch that can be used to raise the rear axles while on outriggers.

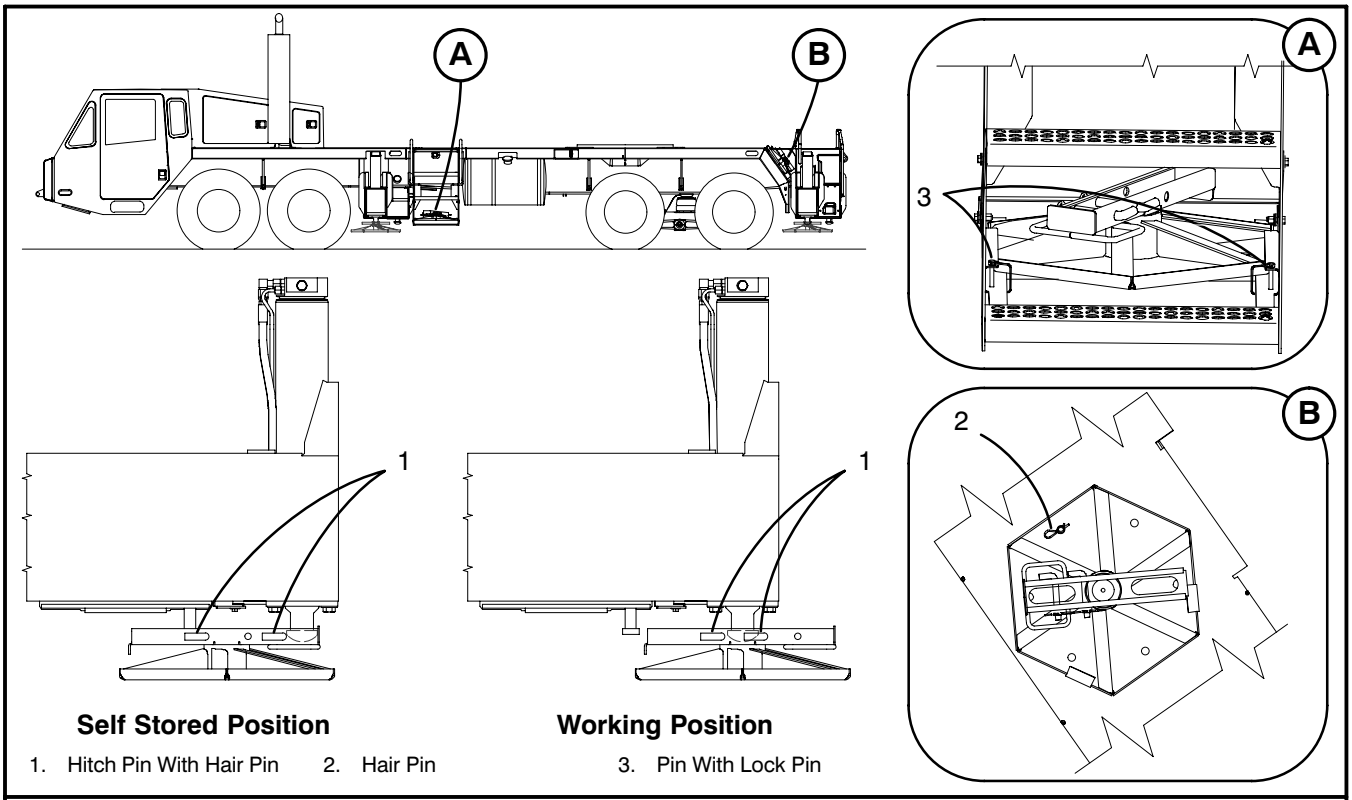


Figure 1–58
Pontoon Storage

To Extend Outrigger Beams

1. Park the crane in the desired location. Engage park brake, shift transmission to neutral and shut-down engine. Engage the main hydraulic pump.
2. If the pontoons are stored on the crane, remove them from storage and attach one to each outrigger jack in the working position. If the pontoons are in the self stored position, move them to the working position. Install all hitch pins in their proper position and secure with hair pins. Refer to Figure 1–58.

⚠ WARNING

Pontoons must be attached to outrigger jacks before crane is set on outriggers. If the pontoons should settle, the jacks could disengage from the pontoons, causing a loss of stability.

3. Determine the outrigger position desired. Install the extend position pins, as required. Refer to Figure 1–59.

⚠ WARNING

When making lifts on outriggers, all outrigger beams must be equally extended; all fully retracted, all intermediate extended, or all fully extended. Failure to do so will cause a loss of stability and possible crane damage and/or personal injury.

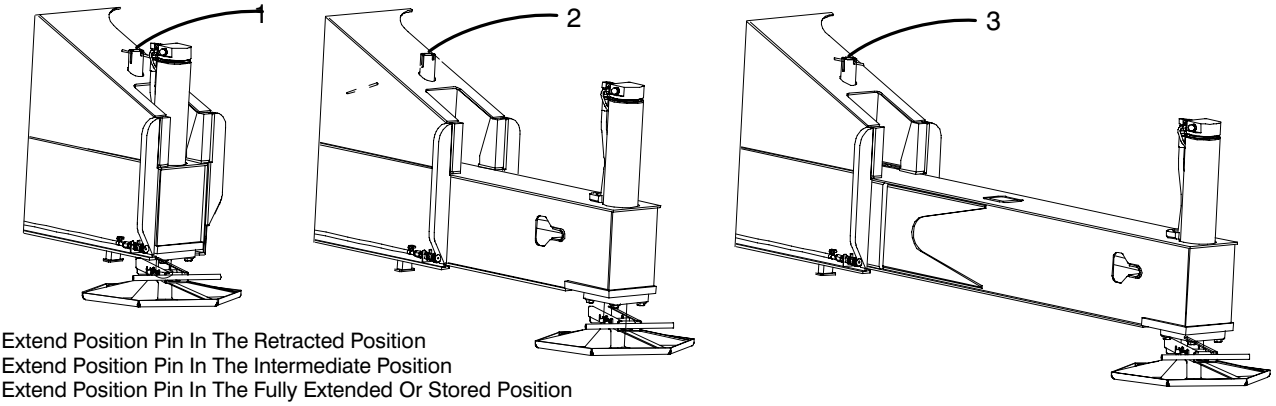
4. Start the engine.

   Note: To operate the outriggers from the hand held control box in the upper operator's cab, the upper operator's cab ignition switch must be in the "ON" position.

⚠ WARNING

Do not extend or retract an outrigger beam or jack unless it is in full view of the operator or signalman. Make sure all personnel and obstructions are clear from the path of the machinery. Unsuspected movement may occur.

5. Push an individual outrigger switch to the "BEAM" position and hold. Push the center mode switch to "EXTEND MODE ON" position and hold until the beam is fully extended.



1. Extend Position Pin In The Retracted Position
2. Extend Position Pin In The Intermediate Position
3. Extend Position Pin In The Fully Extended Or Stored Position

Figure 1—59
Outrigger Extend Positions

6. When the beam reaches the selected position, release both switches.
7. Repeat Steps 5—6, for each outrigger beam, until all the beams are in the selected position.

   Note: As conditions warrant, a proficient crane operator may operate multiple beams such as one end or side at the same time.

8. If the intermediate beam position is to be used, visually check that all beams are properly positioned in the intermediate position by observing the decals on the side of the beams. All beams must be extended until the hydraulic system goes over relief.
9. Set the Rated Capacity Limiter to the proper setting to match the position of the outrigger beams.

WARNING

When making lifts with the crane on outriggers, all outrigger beams must be equally extended; fully retracted, intermediately extended, or fully extended.

When making lifts with the outrigger beams in the intermediate position, the extend position pins must be installed in the beams. Visually check that all beams are properly positioned in the intermediate position by observing the decals on the side of the beams. All beams must be extended until the hydraulic system goes over relief before beginning operations.

Check that the Rated Capacity Limiter is set to the correct outrigger position before beginning operation.

Failure to perform any of the above may cause crane damage and/or serious personal injury.

To Extend Outrigger Jacks — Raise The Crane

1. If crane is equipped with the axle lift system, ensure the air ride suspension switch in the carrier cab is in the "DOWN" (deflated) position.

CAUTION

When the hoist line is tied off to the crane or any solid object, the winch system can be overloaded causing major winch, wire rope, or crane damage. Do not extend boom, raise or lower the boom, or raise the crane on outriggers unless wire rope is spooled off the drum to prevent tension on the wire rope.

2. With the beams extended to the selected position (fully extended, intermediate extended, or fully retracted), push an individual outrigger switch to the "JACK" position and hold.

WARNING

Do not extend or retract an outrigger beam or jack unless it is in full view of the operator or signalman. Make sure all personnel and obstructions are clear from the path of the machinery. Unsuspected movement may occur.

3. Push center mode switch to "EXTEND MODE ON" and hold until the jack cylinder is fully extended.

   Note: As conditions warrant, a proficient crane operator may operate multiple jack cylinders such as one end or side at the same time.

4. Release both switches.
5. Repeat Steps 2—4 for each outrigger jack.
6. Raise or lower jacks as required to level the crane.

   Note: A bubble level is provided on the side panel, in the operator's cab and at each ground control station to assist in determining when the crane is level.

7. Check that all tires are clear of the ground and pontoons are not settling.

WARNING

All capacities listed on the capacity charts in the Crane Rating Manual, when on outriggers, are based on all tires clear of the ground, all outrigger beams equally extended (fully retracted, intermediate extended, or fully extended), using the proper chart for the outrigger beam position and the crane setting on all pontoons on a firm, level solid surface. Major reductions in the crane lifting capacity and unsafe operating conditions can result if these conditions are not met.

8. Properly extend the front bumper outrigger. Refer to "Bumper Outrigger" found later in this Section of this Operator's Manual.

To Retract Outrigger Jacks — Lower The Crane

If the crane is equipped with air ride suspension, it is recommended that lowering the crane be done from the ground control stations.

1. Retract boom fully. Swing the upper over the front of the carrier and engage the travel swing lock.
2. Boom down and set boom on boom rest.
3. Engage the park brake.

WARNING

If the rear air suspension is allowed to hang in its fully extended (lowered) position, the action of the suspension compressing will cause the crane to move slightly forward as the weight transfers from the outriggers to the tires. The suspension lift system will minimize this if the axles are lifted to the highest possible position before lowering the crane onto the tires.

4. If crane is equipped with the axle lift system, ensure the air ride suspension switch in the carrier cab is in the "DOWN" (deflated) position and that the rear axles are lifted to their highest position with the axle lift switch.

WARNING

Do not extend or retract an outrigger beam or jack unless it is in full view of the operator or signalman. Make sure all personnel and obstructions are clear from the path of the machinery. Unsuspected movement may occur.

5. Properly retract the front bumper outrigger. Refer to "Bumper Outrigger" found later in this Section of this Operator's Manual.
6. Push an individual outrigger switch to the "JACK" position and hold.
7. Push the center mode switch to "RETRACT MODE ON" position and hold until the jack cylinder is fully retracted.
8. Release both switches.
9. Repeat Steps 6—8 for each outrigger jack.

   Note: As conditions warrant, a proficient crane operator may operate multiple jack cylinders such as one end or side at the same time.

10. If the crane is equipped with the axle lift system, move the air ride suspension switch to the "UP" position.

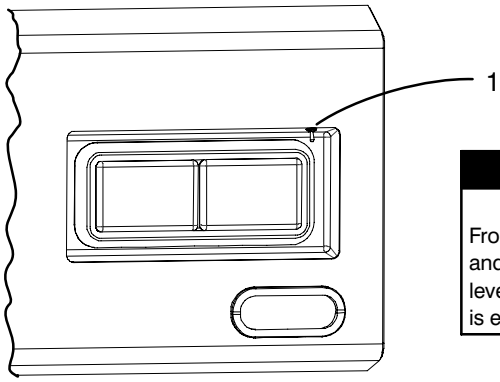
To Retract Outrigger Beams

1. Push an individual outrigger switch to the "BEAM" position and hold.

WARNING

Do not extend or retract an outrigger beam or jack unless it is in full view of the operator or signalman. Make sure all personnel and obstructions are clear from the path of the machinery. Unsuspected movement may occur.

2. Push the center mode switch to the "RETRACT MODE ON" position and hold until the beam is fully retracted.
3. Release both switches.
4. Repeat Steps 1—3 for each beam.
5. Store all pontoons in the brackets provided on the crane or move to the self stored position. Refer to Figure 1—58. Install all hitch pins in their proper position and secure with hair pins.
6. Store the extend position pins as required.



INFORMATION

Front Bumper Jack Control

Front bumper jack must be last jack extended and first jack retracted. Crane must be leveled with other four jacks before front jack is extended.

1. Bumper Outrigger Switch

Left Headlight

Figure 1—60
Bumper Outrigger Switch

Bumper Outrigger

The bumper outrigger is provided to permit the same lifting capacities over the front as over the side when it is used with the main outriggers. Refer to the Crane Rating Manual for specific capacities.

Bumper Outrigger Control Switch

The bumper outrigger is controlled from the ground control switch (toggle type) located on the front bumper, just above the left headlight or from the hand held, tethered control box in the upper operator's cab.

To Extend Bumper Outrigger

1. Level the crane on the main outriggers.

CAUTION

Always level the crane on the main outriggers before extending the bumper outrigger. Failure to do so could result in structural damage to the crane as the bumper outrigger alone will not properly support the weight of the crane.

2. Push the bumper outrigger switch located near the left headlight to the right to extend the cylinder or push the switch on the hand held control box to the position to extend the cylinder. Hold the switch until the pontoon rests firmly on a solid surface and the hydraulic system goes over relief.

WARNING

Always stand in clear view of the outrigger jack when operating it. Be sure nothing is in the path of it to avoid personal injury or damage to the crane. Unsuspected movement may occur.

3. Release the switch.

To Retract Bumper Outrigger

1. Push the bumper outrigger switch located near the left headlight to the left and hold until cylinder is fully retracted or push the switch on the hand held control box to the position until cylinder is fully retracted.

CAUTION

The bumper outrigger must be retracted before the main outriggers. It alone will not properly support the weight of the crane.

Crane System Controls

The following pages, along with Figure 1−61, give detailed instructions of individual controls related to crane operation. It is essential that the operator knows the function of each control and its duty in the overall operation of the crane.

WARNING

Read and understand all "Operating Safety" procedures as well as all other operating instructions in this Operator's Manual before attempting to operate the crane. Operation of the crane by unqualified personnel may result in an accident.

Horn Button

The horn button is located on the right control lever. Refer to Figure 1−61. To sound the horn, press the switch.

Engine Throttle Controls

A foot throttle is located on the cab floor. Refer to Figure 1−61. Before operating the throttle, ensure that the pump engagement/throttle selector switch in the carrier cab is in the "Upper" position. To operate the foot throttle, press down to increase engine speed; release to decrease engine speed.

Note: Switching the pump engagement/throttle selector switch to the "Upper" position also engages the main pumps.

Throttle Lock System

The throttle lock system gives the operator the ability to set and hold a specific engine speed. Refer to Figure 1−52. This provides the operator with more flexibility for certain job requirements.

To lock the throttle, press the throttle pedal until the desired engine speed is reached and press and release the adjustment switch to the "SET/ACCEL" side. The engine should continue to run at a constant speed when the throttle pedal is released.

To increase throttle lock setting, either press and hold the adjustment switch to the "SET/ACCEL" side until desired engine speed is reached and release switch, or press the throttle pedal until the desired engine speed is reached and press and release the adjustment switch to the "SET/ACCEL" side. The throttle lock setting can also be increased incrementally by pressing and releasing (tap up) the "SET/ACCEL" side.

To decrease throttle lock setting, press and hold the adjustment switch to the "RESUME/DECEL" side until desired engine speed is reached and release switch. The throttle lock setting can also be decreased incrementally by pressing and releasing (tap down) the "RESUME/DECEL" side.

To return to idle, press and release the bottom part of the disengage switch.

To resume a previous throttle lock setting, press and release the adjustment switch to the "RESUME/DECEL" side.

Swing System

Rotation of the upper, over the carrier, is controlled by the swing system. Use the following controls to operate the swing function of the crane:

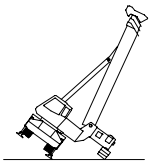
Swing Brake Pedal

The swing brake pedal is used to stop rotation of the upper over the carrier. To apply the swing brake, push down on the swing brake foot pedal. To release the swing brake, release the swing brake foot pedal.

Swing Control Lever

The control lever, on the left side of the operator's seat, is used to operate the swing function of the upper. Move the control lever to the appropriate position to swing the upper.

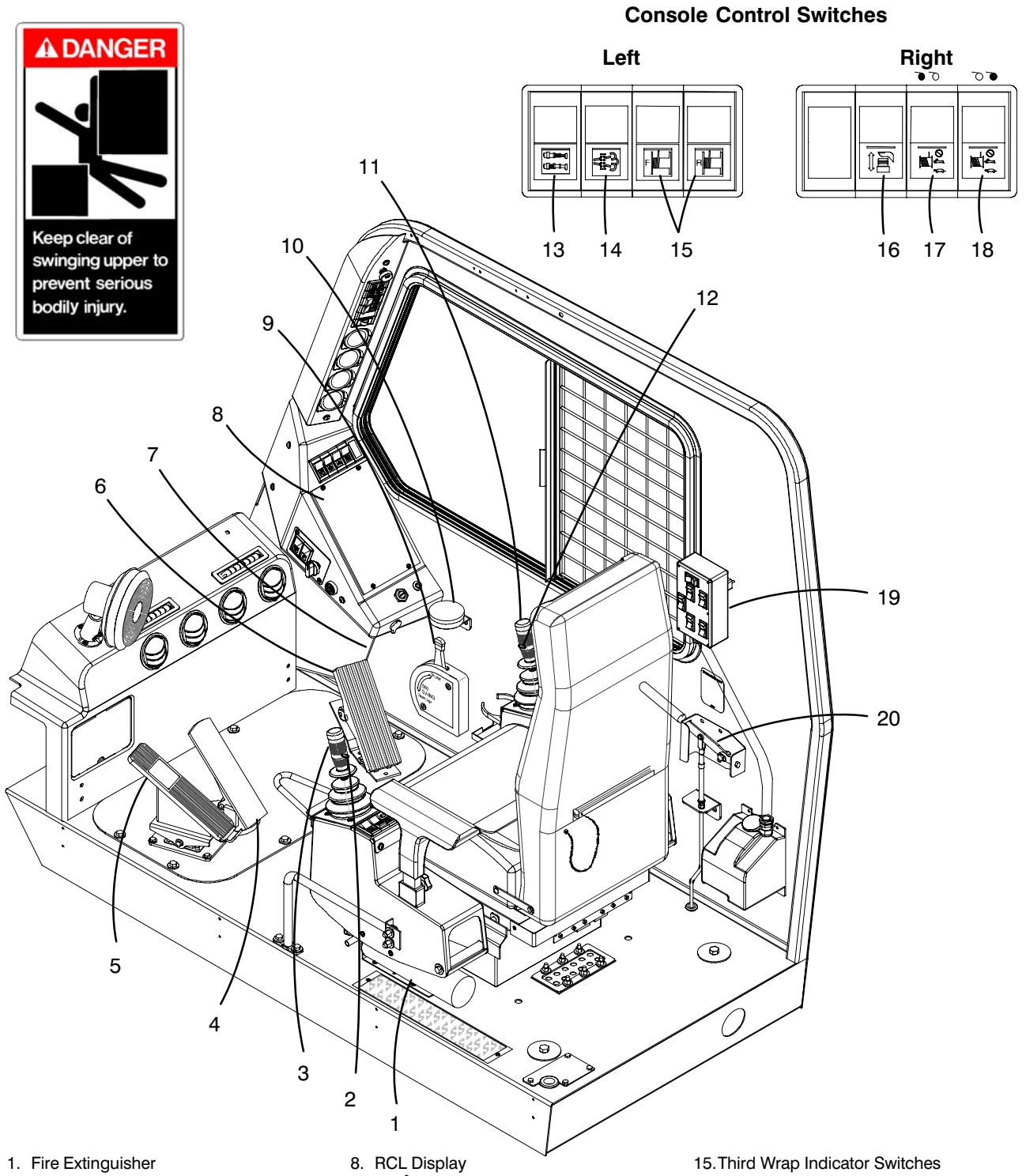
WARNING



Do not exceed maximum boom angles listed below. Crane can tip over backwards when on tires or retracted outriggers.

Maximum Boom Angles

Counterweight		On Tires	On Retracted Outriggers
lb	*kg*		
15,100	*6 849*	59˚	71˚
11,500	*5 216*	67˚	78˚
7,900	*3 583*	74˚	78˚
4,300	*1 950*	78˚	78˚



1. Fire Extinguisher
2. Swing Park Brake Switch
3. Hydraulic Control Lever (Swing, Front Winch)
4. Swing Brake Pedal
5. Boom Telescope Pedal
6. Throttle Pedal
7. Crane Rating Manual Holder
8. RCL Display
9. 360˚ Swing Lock (If Equipped)
10. Bubble Level
11. Hydraulic Control Lever (Boom Hoist, Rear Winch)
12. Horn Button
13. Boom Telescope Override Switch
14. Diesel Particulate Filter Regeneration Switch
15. Third Wrap Indicator Switches
16. Drum Rotation Indicator Switch
17. Front Winch Control Switch
18. Rear Winch Control Switch
19. Outrigger Remote Control Box
20. Travel Swing Lock

Figure 1–61
Crane Controls

To Swing The Upper
1. Compare the boom configuration and length to the capacity chart in the Crane Rating Manual. Position the boom safely within the limits specified on the capacity chart.
2. Fully apply the swing brake pedal and release the swing park brake and/or swing lock(s).
3. Release the swing brake pedal as you begin to engage the swing control lever.

DANGER

Swing slowly and cautiously. Watch for centrifugal force. Out swing of a load increases the load radius and thus decreases capacity. Load out swing may result in tipping or damaging the crane.

All personnel and equipment must be out of the path of the rotating upper. Failure to do so could result in severe personnel injury or equipment damage.

To Stop Upper Swing
1. Ease swing control lever into the neutral position.
2. Apply the swing brake to bring the upper to a complete stop.
3. Engage the swing park brake as required.
4. Check engagement of the swing park brake by trying to swing right, then left. The upper should not swing.

Travel Swing Lock

Use the travel swing lock to lock the upper directly over either the front or rear of the carrier. The travel swing lock will engage in these two positions only. Use of the travel swing lock is mandatory when traveling or transporting the crane and during pick and carry operations.

To Release The Travel Swing Lock
1. Fully apply the swing brake pedal.
2. Press the button in the center of the travel swing lock knob and pull the knob up.
3. Release the button and knob. The knob should remain in the released position.

To Engage The Travel Swing Lock
1. Position the upper directly over either the front or rear of the carrier. Fully apply swing brake pedal.
2. Press the button in the center of the travel swing lock knob and push the knob down.

   Note: In order to engage the travel swing lock, it may be necessary to swing the upper slightly to align the swing lock pin and retaining ring on the carrier deck.
3. Check the engagement of the travel swing lock by trying to swing the upper right, then left. The upper should not swing.

Swing Park Brake

The swing park brake is a multiple disc type brake and is used for holding the upper, in any position, over the carrier during normal, stationary crane operations. Engage the travel swing lock and release the swing park brake anytime the crane is traveled or transported. An indicator light on the gauge and control panel will illuminate when the swing park brake is applied.

CAUTION

Do not leave the swing park brake applied during pick and carry operations or when traveling or transporting the crane. Use the travel swing lock. Failure to release the swing park brake during these operations may result in damage to the swing mechanism.

To Release The Swing Park Brake
1. Fully apply the swing brake pedal.
2. Push the swing park brake switch on the left control lever. The indicator light will go out.

To Apply The Swing Park Brake
1. Rotate the upper to the desired position over the carrier. Apply the swing brake pedal to bring the upper to a complete stop.
2. Push the swing park brake switch on the left control lever. Indicator light will illuminate.

CAUTION

Do not attempt to apply swing park brake with the upper in motion. This practice will result in damage to the swing mechanism. Use the swing brake pedal to stop rotation of upper.

3. Check engagement of swing park brake by trying to swing upper right, then left. Upper should not swing.

360˚ Swing Lock

The 360˚ swing lock, if equipped, is a positive lock against rotation of the upper over the carrier. The upper is mechanically locked by a manually operated pawl that engages the gear teeth in the turntable bearing. Use this swing lock during normal, stationary crane operations. Engage the travel swing lock and release the 360˚swing lock anytime the crane is traveled or transported.

CAUTION

Do not leave the 360˚ swing lock engaged during pick and carry operations or when traveling or transporting the crane. Use the travel swing lock. Failure to release the 360˚ swing lock during these operations may result in damage to the swing mechanism.

To Release The 360˚Swing Lock:

1. Fully apply the swing brake pedal.
2. Move the 360˚ swing lock lever to the "Disengage" position. Refer to Figure 1−61 for location.

To Engage The 360˚ Swing Lock:

1. Rotate the upper to the desired position over the carrier. Apply the swing brake pedal to bring the upper to a complete stop.

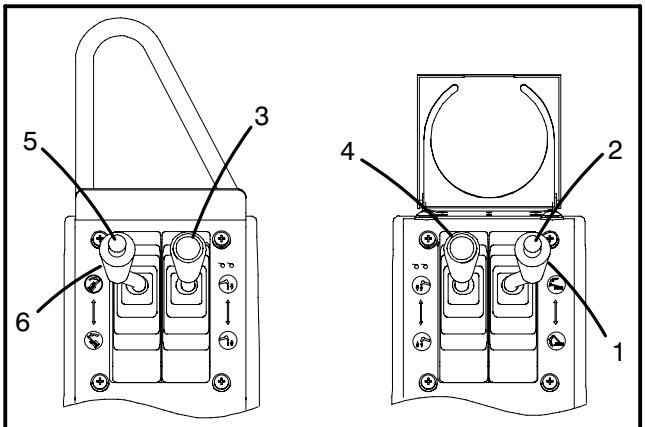
CAUTION

Do not attempt to engage 360˚swing lock with the upper in motion. This practice will result in damage to the swing mechanism. Use swing brake pedal to stop rotation of the upper.

2. Move the 360˚swing lock lever to the "Engage" position.

   Note: In order to engage the 360˚ swing lock, it may be necessary to swing the upper slightly to allow the swing lock pawl to engage in the turntable gear teeth

3. Check engagement of 360˚swing lock by trying to swing upper right, then left. The upper should not swing.



Left **Right**

1. Hydraulic Control Lever (Boom Hoist)
2. Horn Button
3. Hydraulic Control Lever (Front Winch)
4. Hydraulic Control Lever (Rear Winch)
5. Swing Park Brake Switch
6. Hydraulic Control Lever (Swing)

Figure 1−62
Single Axis Controls (If Equipped)

Wire Rope Winch System

This system controls raising and lowering the winch lines. The system is equipped with a two speed motor that, when activated, will approximately double winch line speed. The controls for the system are shown in Figure 1−61. Review the following for control descriptions and brief summary of operation.

WARNING

Cold weather operation of the winch requires a warm-up procedure. Failure to properly warm-up the winch may result in brake slippage. Warm-up the winch before beginning crane operations.

Warm-Up Procedure

A warm-up procedure is recommended at each start-up and is essential at ambient temperatures below 40˚F (*4˚C*). Allow the engine to run at idle speed, with the main hydraulic pump engaged and the winch control lever(s) in neutral, for several minutes. Once the hydraulic oil begins to warm, operate the winch at low speed, with no load, lifting and lowering only the hook-block until warm oil circulates throughout the winch.

⚠ WARNING

The weight of the load must be known before making a lift. Compare the load weight to the appropriate capacity chart in the Crane Rating Manual to ensure compliance with capacity ratings. Compare the load weight to the wire rope strength chart in the Crane Rating Manual to determine the number of parts of line required to lift the load. Rig and set up the crane to ensure compliance with both the appropriate crane capacity chart and wire rope capacity chart in the Crane Rating Manual. Properly set the Rated Capacity Limiter to the correct crane configuration.

Do not lift a load to the point where the hook block contacts the head machinery. "Two blocking" could damage the hook block and/or the head machinery. Always keep load and hook block a safe distance from the boom.

Front Winch Control Lever (If Equipped)

This lever controls the front winch drum. Pull this control lever back, toward the operator to lift the load. Push this control lever forward, away from the operator to lower the load. Refer to "Winch Operation" for more specific instructions.

Rear Winch Control Lever

This lever controls the rear winch drum. Pull this control lever back, toward the operator to lift the load. Push this control lever forward, away from the operator to lower the load. Refer to "Winch Operation" for more specific instructions.

Winch Operation

The following is a brief description of the basic procedure for operating the wire rope winch. Crane operations are to be performed only by a qualified operator who has read and fully understands the entire content of this manual.

To Lift A Load: Attach the hook block or ball to the load. Position head machinery directly above the load, pull the control lever back, toward the operator.

Note: When both winch levers are activated simultaneously, the winch line requiring the most line pull may not function.

To Hold A Load: Return the control lever to the neutral position. The automatic brake in the winch system will hold the load in position.

To Lower A Load: Push the control lever forward. Return the control lever to neutral to stop the load.

Winch Control Switch

This switch is used to control engaging/disengaging the high/low speed hoist and disabling the front or rear winch.

High Speed Hoist Or Lower

Press the winch control switch to the high speed () position. Move the control lever to the "UP" or "DOWN" position. The high speed hoist will activate after engaging the control lever. Refer to Figure 1−61.

Note: Using the high speed hoist reduces the maximum line pull by approximately half. The high speed hoist button can be activated at anytime during either winch mode. Switching the high speed hoist button before engaging the winch control lever will make the system work smoother.

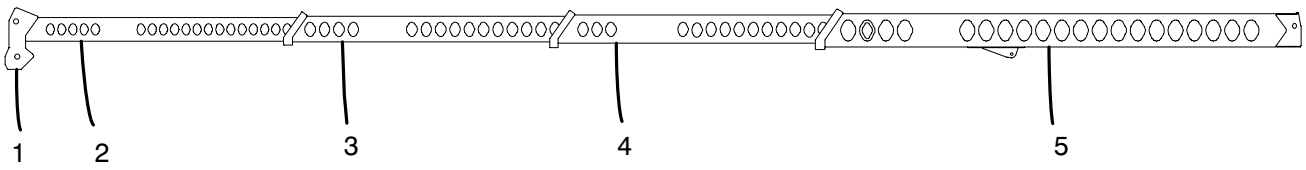
To Return To Standard Winch Mode: Press winch control switch to the low speed () position. Winch will immediately return to standard speed.

Winch Disable

Press the winch control switch(es) to the disable (⃠) position to disable the winch(es) to prevent inadvertent operation of the winch(es) while using the control levers to perform other operations.

Drum Rotation Indicators

This system is used to monitor winch drum speeds through the use of a mechanical signaling device mounted inside each of the winch control levers. To activate the system, move the drum rotation indicator switch, on the control console (Figure 1−52), to the "ON" position. Place your thumb over the end of the control lever being used. As the winch drum rotates, a mechanical signal will be felt with your thumb. The pulse rate of the mechanical signal is a direct indication of the winch drum speed. However, when the pulse rate reaches 20 per second, the signal will stop increasing. Move drum rotation switch to the "OFF" position to deactivate system.



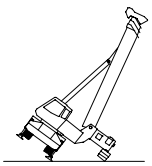
1. Boom Head Machinery
2. Tip Section
3. Outer Mid Section
4. Inner Mid Section
5. Base Section

Figure 1—63
Boom Nomenclature

Boom Hoist System

Raising and lowering the boom is controlled by the boom hoist control lever located on the right arm rest. Refer to Figure 1—61.

WARNING



Do not exceed maximum boom angles listed below. Crane can tip over backwards when on tires or retracted outriggers.

Maximum Boom Angles			
Counterweight		On Tires	On Retracted Outriggers
lb	*kg*		
15,100	*6 849*	59˚	71˚
11,500	*5 216*	67˚	78˚
7,900	*3 583*	74˚	78˚
4,300	*1 950*	78˚	78˚

To Raise The Boom (Boom Up): Move the right control lever to the "Boom Up" position.

CAUTION

When the hoist line is tied off to the crane or any solid object, the winch system can be overloaded causing major winch, wire rope, or crane damage. Do not extend boom, raise or lower the boom, or raise the crane on outriggers unless wire rope is spooled off the drum to prevent tension on the wire rope.

To Lower The Boom (Boom Down): Move the right control lever to the "Boom Down" position.

CAUTION

Wire rope must be spooled off the winch drum as the boom is lowered. Failure to do so may cause two blocking.

To Stop The Boom: Ease the right control lever into the neutral position.

Boom Telescope System

The crane is equipped with a four section full power boom. The four section boom consists of a base section, inner mid section, outer mid section, and a tip section. Refer to Figure 1—63.

The telescoping feature, of the boom sections, is operated through the use of two hydraulic cylinders and a cable/sheave mechanism which are an integral part of the boom assembly. The boom can be extended or retracted to any desired length using the control pedal in the operator's cab. The telescope feature has two modes of operation. Refer to Figure 1—64.

Boom Mode "A": When using boom mode "A" only the inner mid boom section extends/retracts. This mode offers increased strength capacities. Select this mode through the Rated Capacity Limiter system.

Boom Mode "B": When using boom mode "B" all boom sections extend/retract simultaneously. This mode offers increased stability capacities. Select this mode through the Rated Capacity Limiter system.

Note: Boom must be fully retracted before changing boom modes.

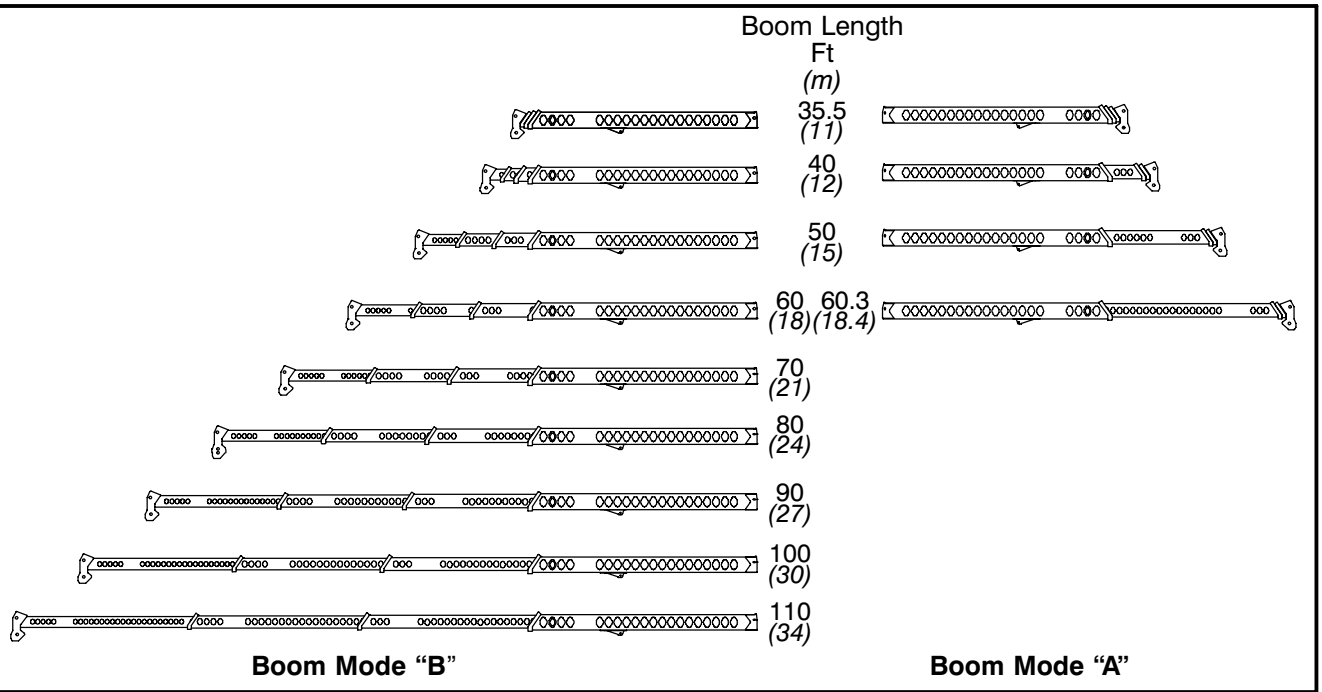


Figure 1—64
Boom Telescope Mode

Boom Telescope Control Pedal

Figure 1—61 shows the location of the telescope control pedal in the operator's cab. Depress the toe of the telescope control pedal to extend the boom. Depress the heel of the telescope control pedal to retract the boom. Use the telescope mode in conjunction with the telescope control pedal to extend the boom sections to the desired length.

Boom Telescope Override Switch

This switch is provided to manually override the telescope system when the boom is not extending/retracting proportionally. Use this switch for that purpose only. While in boom mode "B", the switch will stop one of the boom sections so the boom can be extended/retracted proportionally. Refer to Figure 1—61 for switch location in the upper operator's cab.

To Extend The Boom Sections

1. Park the crane on a firm level surface, engage the park brake, and shift the transmission to neutral.
2. Review the appropriate capacity chart in the Crane Rating Manual to establish boom length, angle and load limitations.
3. Set the Rated Capacity Limiter to the desired telescope mode.

CAUTION

When the hoist line is tied off to the crane or any solid object, the winch system can be overloaded causing major winch, wire rope, or crane damage. Do not extend boom, raise or lower the boom, or raise the crane on outriggers unless wire rope is spooled off the drum to prevent tension on the wire rope.

4. Depress the toe of the telescope control pedal.

CAUTION

Wire rope must be spooled off the winch drum(s) as the boom is extended. Failure to do so may cause two blocking.

5. Stop the boom sections by releasing the telescope control pedal.

   Note: The telescope control pedal is spring loaded and will return to the neutral position when released.

To Retract The Boom Sections

1. Depress the heel of the telescope control pedal.

   Note: As the boom is retracted, the hook block or ball will lower. Winch up as required to position hook block or ball in the desired position.

2. Stop the boom sections by releasing the telescope control pedal.

Operator's Seat

This 6-way adjustable seat is controlled by manual controls. Refer to Figure 1−65.

WARNING

Do not make seat or console adjustments while operating the crane or while crane is in motion. Discontinue operations and properly park crane before making adjustments.

1. Seat & Console Release Lever

Move the seat & console release lever to the left and hold. Position the seat as desired and release the lever to lock the seat in place.

2. Seat Release Lever

Move the seat release lever to the left and hold. Position the seat as desired and release the lever to lock the seat in place.

3. Seat Height Adjustment Lever

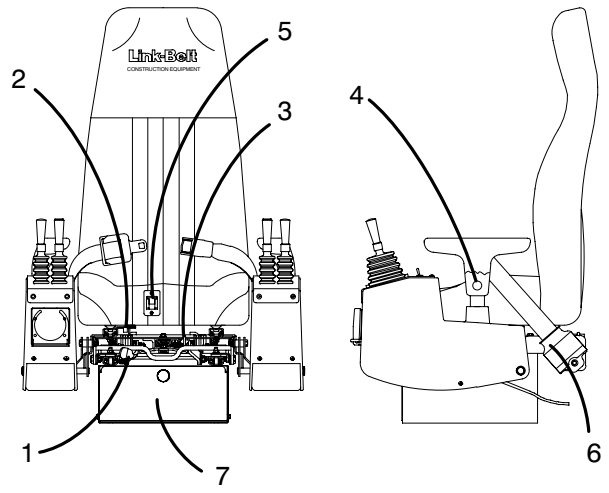
Move the height adjustment lever to the left and hold. Position the seat as desired and release the lever to lock the seat in place.

4. Arm Rest Adjustment Knob

Loosen the knob on the inside of the arm rest. Position the arm rest as desired and tighten knob screw.

5. Seat Back Adjustment Lever

Raise the lever and lean back in the seat to adjust the seat back to the desired position.



1. Seat & Console Release Lever
2. Seat Release Lever
3. Seat Height Adjustment Lever
4. Arm Rest Height Adjustment Knob
5. Seat Back Adjustment Lever
6. Seat Belt
7. Tool Box

Figure 1−65
Upper Operator's Seat

6. Seat Belt

A seat belt is provided and must be worn during all operations. To fasten the seat belt pull the belt out of the retractor and insert the tongue into the buckle until you hear a snap and feel the latch engage. Be sure the belt is not twisted and is fitting snugly around the hips, not around the waist.

WARNING

Always wear the seat belt while operating the crane. The seat belt must be snug and low across the hips.

7. Tool Box

A tool box is provided under the operator's seat to store tools and other crane accessories.

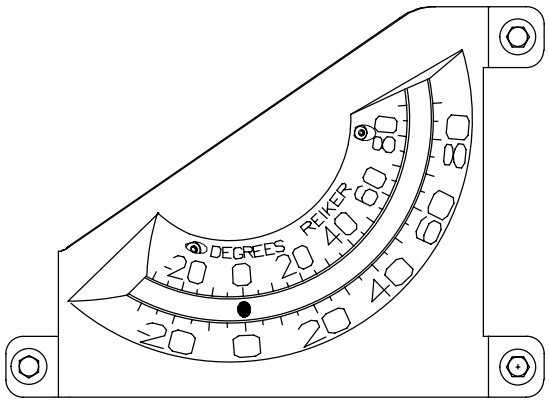


Figure 1—66
Boom Angle Indicator

Crane Monitoring System

Crane monitoring systems are available for monitoring boom length, boom angle, load weight, and two block condition.

Boom Angle Indicator

A mechanical type boom angle indicator is mounted to the right of the operator's cab on the base section of the boom. Refer to Figure 1—66. It must be adjusted properly and the crane must be level for the unit to accurately indicate boom angles. Even under these conditions its readings are only approximate. When making near capacity lifts, measure the load radius to determine crane capacity. Check the adjustment of the boom angle indicator daily to ensure its accuracy. Refer to "Boom Angle Indicator Adjustment" found in Section 3 of this Operator's Manual.

Anti-Two Block Warning System

Integrated into the Rated Capacity Limiter System is an anti-two block warning system. An anti-two block warning system is an electromechanical system designed to alert the operator before the hook block or hook ball contacts the head machinery of the main boom, auxiliary lifting sheave, or fly. When a two block situation is imminent, an audio/visual alarm is activated to alert the operator of the pending danger. When the alarm activates it is essential that the operator discontinue operations immediately, and correct the two-block situation.

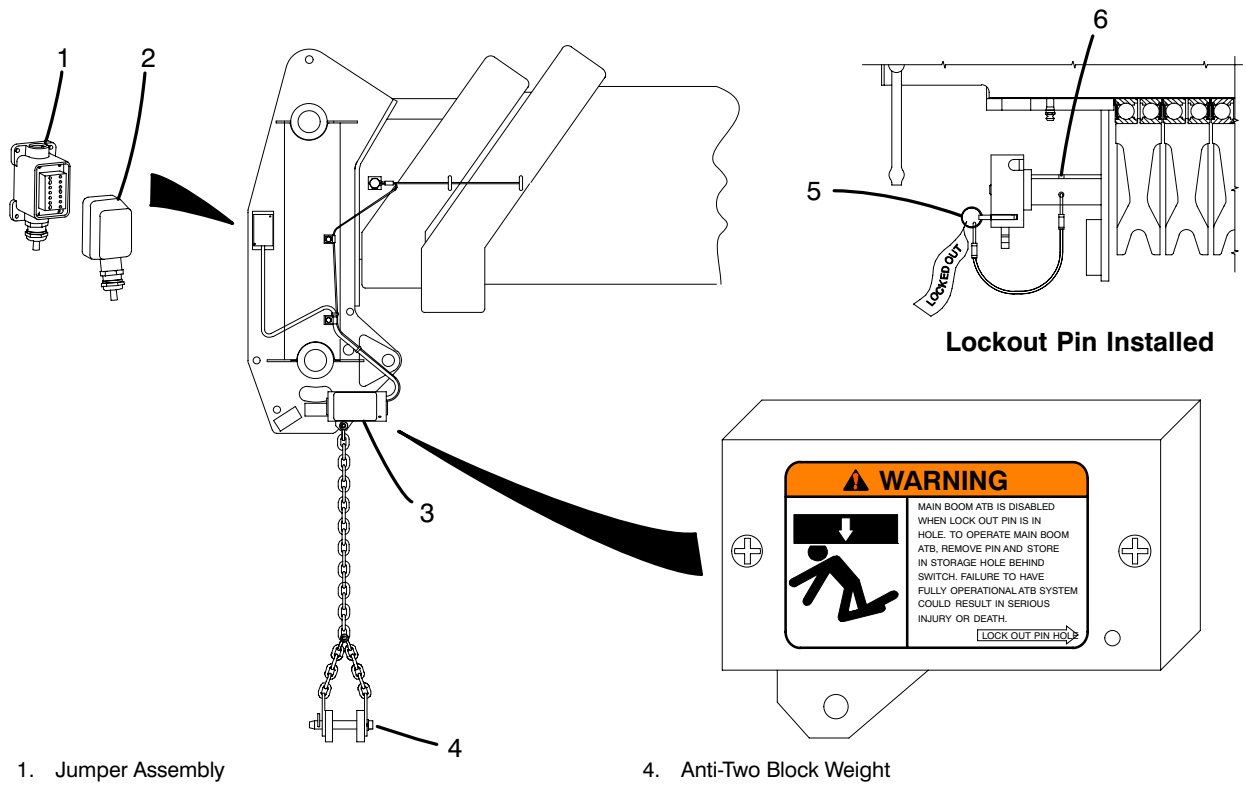
Three basic components are used to make up the anti-two block system. The anti-two block weight, anti-two block switch with lockout pin, and the display unit in the operator's cab. Refer to Figure 1—67 and Figure 1—68.

An anti-two block weight is suspended from the head machinery switch where lifts are to be made and is used to hold the switch in the "working" position. When the anti-two block weight is lifted by the hook block, it allows the switch to activate the audio/visual alarm on the display unit in the operator's cab. In addition to the audio/visual alarm, function limiters will be activated.

CAUTION

Do not allow the load to spin out of control when hoisting. The anti-two block weight may become entangled with the wire rope and could damage the anti-two block system, wire rope, or boom. Use rotation resistant rope during single part line hoisting applications, especially when long fall lifts are involved.

The added feature of hydraulic function limiters, prevents the operator from continuing crane functions which will cause a two block situation to occur. The crane functions of winch up, boom down, and boom extend are disabled when the anti-two block weight is lifted. These functions will remain disabled until the two block situation is corrected or the "cancel alarm" switch on the display unit is utilized.



1. Jumper Assembly
2. Plug Assembly
3. Anti-Two Block Switch
4. Anti-Two Block Weight
5. Lockout Pin & Flag
6. Lockout Pin Storage Hole

Figure 1—67
Anti-Two Block Weights And Switches

The main boom head must always have an anti-two block switch. Each of the added attachments used on the crane must employ a similar head machinery switch as well, in order for that particular attachment to be monitored by the system.

The plug assembly is connected to the jumper assembly on the boom head when operating from the main boom. It is connected to the jumper assembly on the attachment when operating from that attachment.

Check that all the harness connections between the attachments are properly joined and test the system before beginning operations.

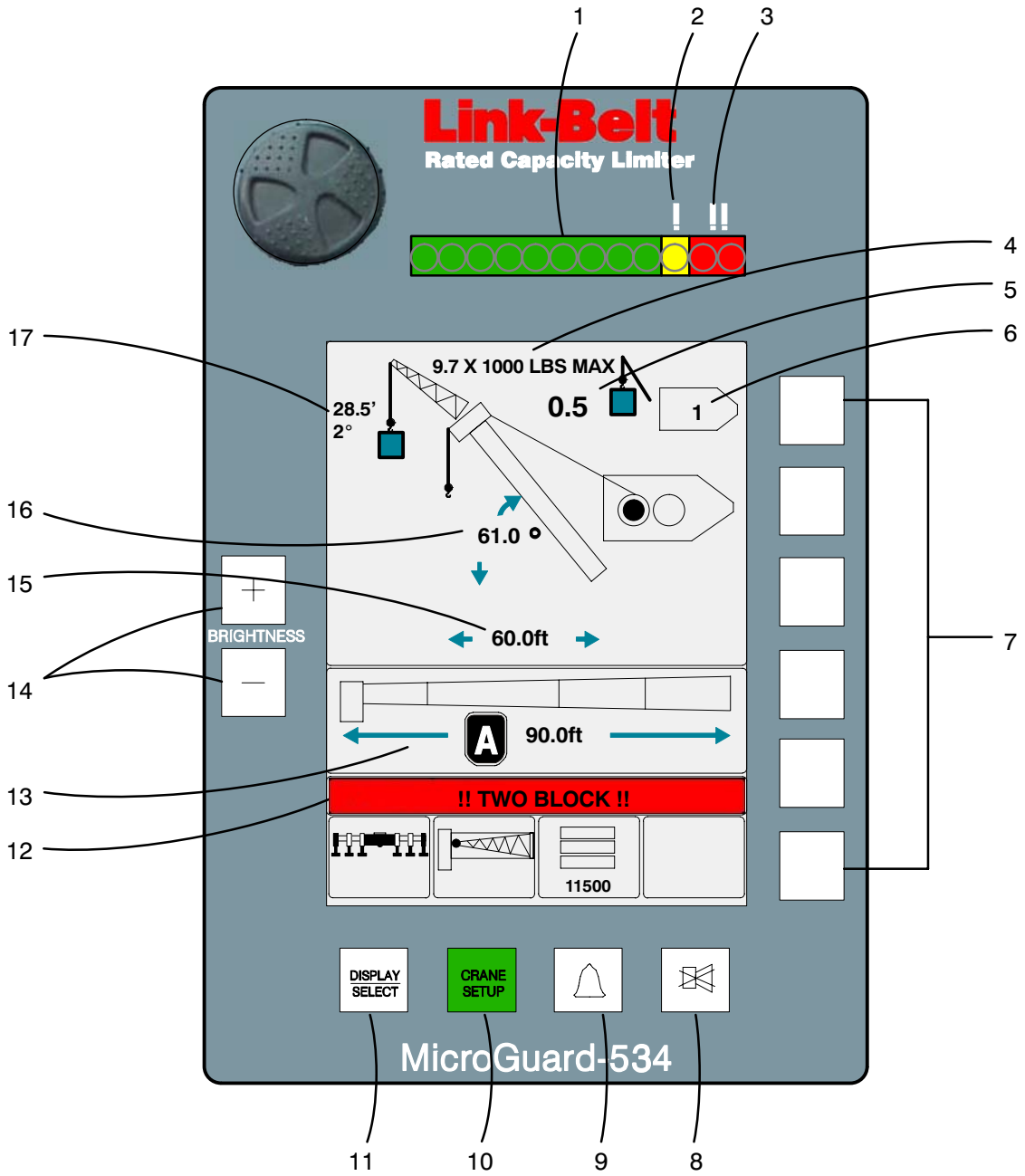
Lockout Pin And Flag

The lockout pin is used to hold the main boom anti-two block switch in the "working" position, the same as having a two block weight suspended from the switch.

When operating from the main boom the lockout pin and flag must be in the stored position. When operating from an attachment only, the lockout pin must be installed in the main boom head anti-two block switch.

When both main boom and attachment are reeved for operation, lockout pin and flag must be removed from switch and properly stored.

Note: When using main boom and attachment, anti-two block weights must be suspended from each anti-two block switch.



1. Bar-Graph
2. Pre-Alarm Indicator
3. Overload Indicator
4. Maximum Rated Capacity Display
5. Actual Load Display
6. Parts-of-Line Display
7. Configuration Selection Buttons
8. Cancel Alarm Button
9. Operator Alarms Button
10. Crane Setup Button
11. Display/Select Button
12. Warning Message Area
13. Boom Length Display
14. Brightness Buttons
15. Load Radius Display
16. Boom Angle Display
17. Erected Attachment Display

Figure 1–68
Microguard 534 Rated Capacity Limiter

MicroGuard 534 Rated Capacity Limiter

The following describes the function and operation of the Microguard 534 Rated Capacity Limiter. The system is intended to aid the operator in the efficient operation of the crane by continually monitoring the load and warning of an approach to an overload or unsafe condition.

WARNING

Although the system will alert the operator of an approaching overload or unsafe condition, it remains the responsibility of the operator to operate the crane safely at all times.

This system must never be substituted for the good judgment of the crane operator using safe operating procedures. The operator is solely responsible for safe operation of the crane.

!!THIS SYSTEM IS AN OPERATOR'S AID — NOT A SAFETY DEVICE!!

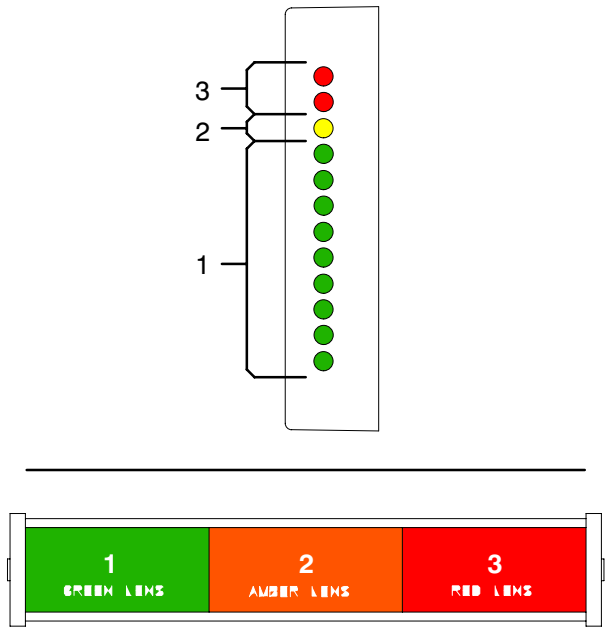
System Description

The system monitors crane functions by means of high accuracy sensors and continuously compares the load with a copy of the crane capacity chart which is stored in the computer memory. If an overload is approached, the system warns by means of audible and visual alarms and is configured to cause function limitation.

The MicroGuard 534 Rated Capacity Limiter provides the operator with a continuous display of:

- Rated Capacity
- Actual Load
- Percentage of Rated Capacity
- Radius of the Load
- Angle of the Main Boom
- Crane Configuration
- Length of the Main Boom

An additional feature of the system is the provision of operator settable alarms. These alarms, when properly set, provide a method of obstacle avoidance. This is achieved by means of maximum boom angle, maximum load radius, maximum boom head height, left and right swing, and defined area alarms. These alarms can be programmed for each job site and set rapidly for the prevailing site conditions thereby aiding the operator in safe operation of the crane.



1. Green Lights — Percentage of Rated Load
2. Amber Lights — Approaching Overload
3. Red Lights — Overload

Figure 1—69
Overhead Bar Graph And External Light Bar (If Equipped)

Display Unit

The following is a description of the control buttons, indicators, and windows on the display unit. Use them along with Figure 1—68.

1. Bar-Graph

The Bar-Graph is a series of twelve colored lights which gives a visual indication of how much of the crane's capacity is being used and the rate at which an overload is being approached. Each green light represents 10% of the crane's rated capacity is being used. Yellow indicates 90—99.9%, and the red lights indicate an overload.

Note: System may be equipped with an overhead bar graph or an external light bar which operates similar to the bar graph on the display. Refer to Figure 1—69.

2. Pre-Alarm indicator

The Pre-Alarm (yellow) Indicator illuminates at a preset value of 90% of Maximum Rated Capacity and provides a visual indication of an approach to an overload.

3. Overload Indicator

The Overload Indicator (red) illuminates at a pre-set value of 100% of Maximum Rated Capacity and provides a visual indication of Maximum Allowed Load. It will also illuminate whenever a wire rope limit is exceeded. Function limiters will occur simultaneously for an Overload, Wire Rope Limit or a Two-Block condition, but function limiters will not occur when exceeding an operator settable alarm. An audible alarm will sound and a message will appear in the warning message area for all 4 conditions.

4. Maximum Rated Capacity Display

The Maximum Rated Capacity is a digital display of the maximum permitted capacity. It is derived from a copy of the crane's capacity chart which is stored in the computer memory and is the reference capacity for any lifting operation. It is dependent on the configuration currently selected, which is shown in the crane setup screen, and which determines the section of the capacity chart to be used as the rated capacity reference.

5. Actual Load Display

The Actual Load Display is a digital display which shows total load suspended below the boom or fly head. It includes the load, any slings, pins, or tackle used to secure the load and the hook block or ball.

6. Parts-of-Line Display

Parts-of-Line displays the parts of line currently selected for the winch in use.

7. Configuration Selection Buttons

These buttons are used during the crane configuration selection routine. Refer to "Configuration Selection" found later in this Section of the Operator's Manual.

8. Cancel Alarm Button

This button is used to silence the audible alarm when the alarm has occurred as a result of either an Overload, Wire Rope Limit, a Two Block, or an Operator Settable alarm. It is also used to reset the function limit relay when it is necessary to by-pass function limit which has occurred as a result of either an Overload, Wire Rope Limit, or a Two Block alarm.

9. Operator Alarms Button

This button is used to start the operator settable alarms routines. Refer to "Operator Settable Alarms" found later in this Operator's Manual.

10. Crane Setup Button

This button is used to start the configuration selection routine. Refer to "Configuration Selection" found later in this Section of the Operator's Manual.

11. Display/Select Button

This button is used to access the Calibration And Diagnostic Screen. Refer to "System Fault Codes" and "Calibration" found later in this Section of the Operator's Manual.

12. Warning Message Area

The Warning Message Area displays text messages of various alarms which may occur during normal operation of the system. When an alarm occurs, the rectangular area fills in red.

13. Boom Length Display

The Boom Length Display gives a continuous indication of the boom length in feet (*m*). It is the distance from the centerline of the boom foot pin to the center line of the boom head machinery.

14. Brightness Buttons

These buttons are used to adjust the display brightness.

15. Load Radius Display

The Load Radius Display gives a continuous indication of the radius of the load in feet. It is the horizontal distance from the centerline of rotation to the centerline of the hook.

16. Boom Angle Display

The Boom Angle Display gives a continuous indication of the angle of the main boom relative to horizontal.

17. Erected Attachment Display

The Erected Attachment Display gives a continuous display of the erected attachment with the top number indicating the actual fly length and the bottom number indicating the offset angle if applicable.

System Operation

The following is a list of procedures which are used to operate the multiple features of the Rated Capacity Limiter. Use these procedures in conjunction with the previous display unit control descriptions.

System Self-Test

At start-up the system automatically performs a self test after which all lamps, audible alarms, and digital displays will be functionally tested and all memory areas checked for accuracy. If faults in the system are detected during a test, the warning message area will show the words SYSTEM FAULT. If the words SYSTEM FAULT occur, press the Display/Select button to display the Calibration And Diagnostic screen. Through the Calibration And Diagnostic screen information can be accessed about the fault condition by means of an error code. Contact your local distributor for details of the fault codes.

Note: If the batteries are disconnected interrupting power to the computer, the start-up time for on-board computer systems will be longer than normal.

System Bypass

In emergency situations, the Rated Capacity Limiter computer can be bypassed. The computer is located on the back of the operator's cab. Refer to Figure 1−70. There is a RCL Status keyswitch adjacent to the computer to bypass the system. Move the key to the "Bypass" position to bypass the system. For emergency use while the system is bypassed, refer to "System Inoperative or Malfunctioning" found in this Operator's Manual.

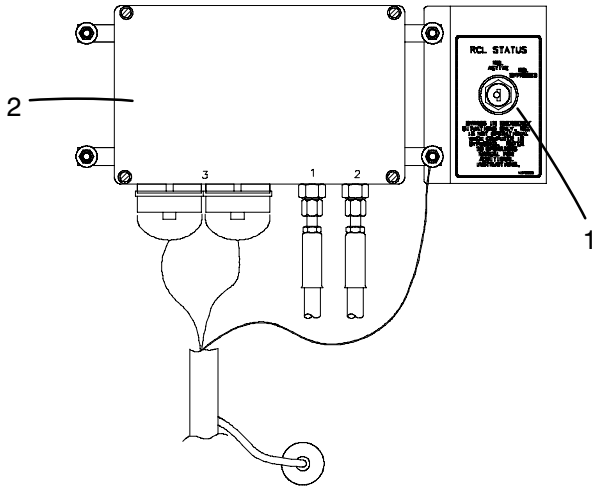
⚠ WARNING

The Microguard 534 is not operational when the computer is bypassed. Bypass the system in emergency situations only.

System Inoperative Or Malfunctioning

When operational aids are inoperative or malfunctioning, the following recommendations for continued use of the crane should be followed or the crane should be shutdown.

1. Steps shall be taken to schedule repairs and recalibration immediately. The operational aids shall be put back into service as soon as replacement parts, if required, are available and the repairs and recalibration can be carried out. Every reasonable effort must be made to expedite the repairs and recalibration.



1. RCL Status Keyswitch 2. Computer

Figure 1−70
Rated Capacity Limiter Computer

2. When the rated capacity limiter is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures for determining load weights and shall ascertain that the weight of the load does not exceed the crane ratings at the radius where the load is to be handled.
3. When a boom angle or radius indicator is inoperative or malfunctioning, the radius or boom angle shall be determined by measurement.
4. When the anti-two block warning device is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures, such as assigning an additional signal person, to furnish equivalent protection. This does not apply when lifting personnel in load line supported baskets. Personnel shall not be lifted in load line supported baskets when the anti-two block devices are not functioning properly.
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 markings on the boom.
6. When a level indicator is inoperative or malfunctioning, other means shall be used to level the crane.
7. In situations where inconsistency exists, verified weights, measured radii, boom lengths, and authorized crane capacities must always take precedence over indicator readings.

Configuration Selection

In the normal operational mode the system is programmed to remember the last configuration selected. Each time the system is powered up it will automatically default to that configuration. Only when the crane is rigged differently must a new configuration be selected. Use the following procedure to select the crane configuration.

Note: When selecting configurations allowed on outriggers, all beams must be equally extended; all fully retracted, intermediate extended, or fully extended.

Depending on how the crane is equipped or which selections have been made, some screens shown may not appear or may not appear as illustrated. The system cannot be programmed for configurations not allowed by the capacity charts listed in the Crane Rating Manual.

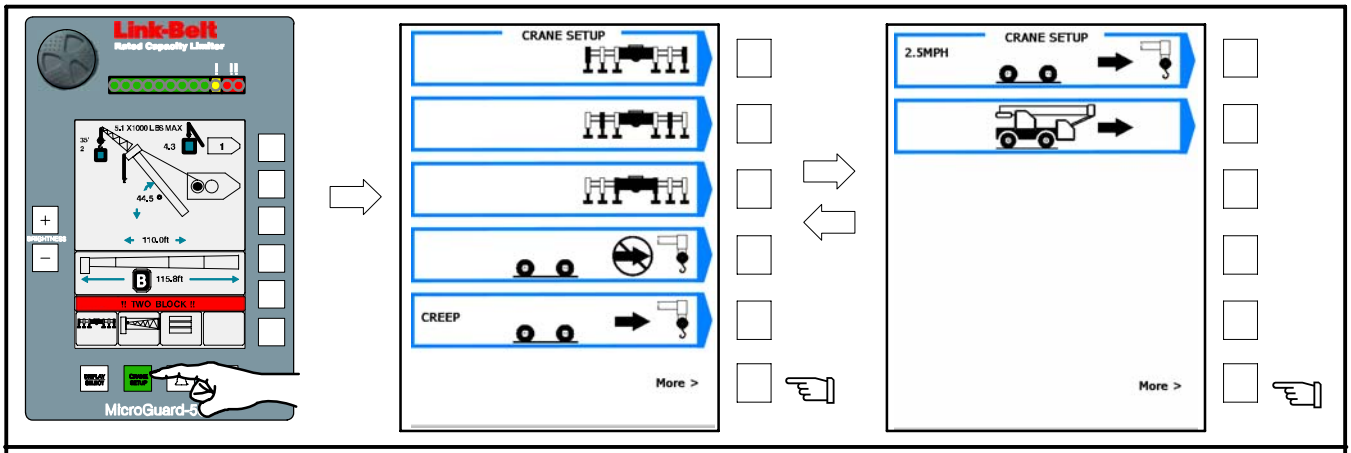


Figure 1–71
Carrier Selection

1. From the normal working screen press the CRANE SETUP button. The normal working screen will change and graphically display the carrier options. Press the corresponding configuration selection button to select the desired carrier configuration. Press the "More" button to display additional selections. Press the "More" button again to return to the first carrier selection screen. If rigging is desired, refer to "To Select Rigging/Travel Mode" found later in this Section of the Operator's Manual.

WARNING

The Microguard 534 is not operational when in the RIGGING/TRAVEL Mode. Return the Microguard 540 to normal operation before operating the crane.

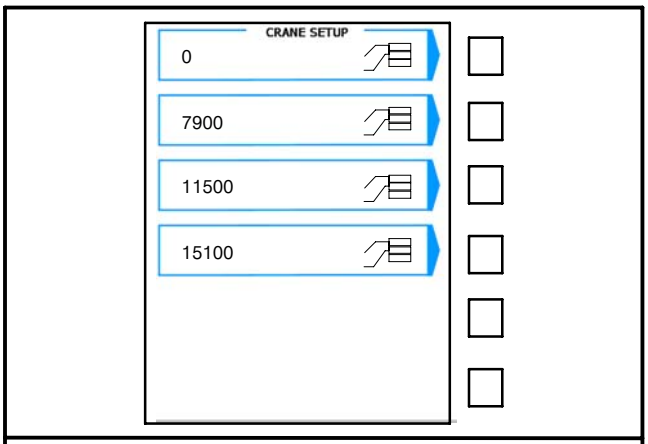


Figure 1–72
Counterweight Selection

2. The carrier selection screen will change and graphically display the counterweight options. Press the corresponding configuration selection button to select the installed counterweight.

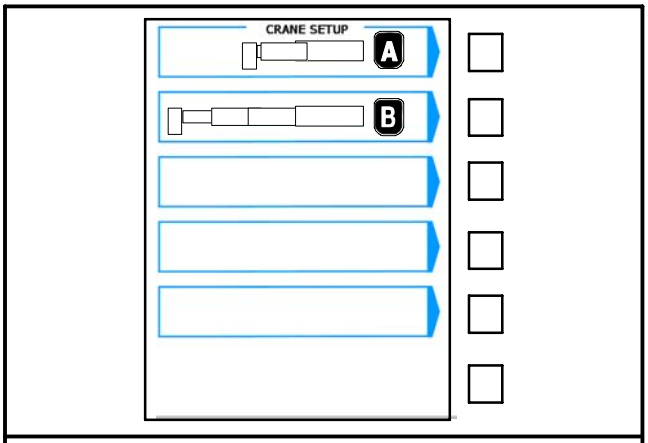


Figure 1–73
Boom Extend Mode Selection

3. The counterweight selection screen will change and graphically display the boom mode options. Press the corresponding configuration selection button to select the desired boom mode.

   Note: Consult the Crane Rating Manual to determine the best boom mode to maximize lift capacity at radius. Boom mode options will only be displayed when the boom is fully retracted.

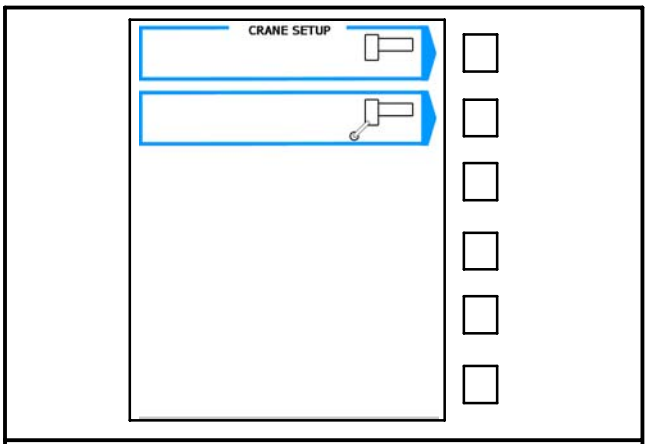


Figure 1–74
Auxiliary Head Selection

4. The boom mode selection screen will change and graphically display the auxiliary lifting sheave fitted or not fitted. Press the corresponding configuration selection button to select the desired auxiliary lifting sheave configuration.

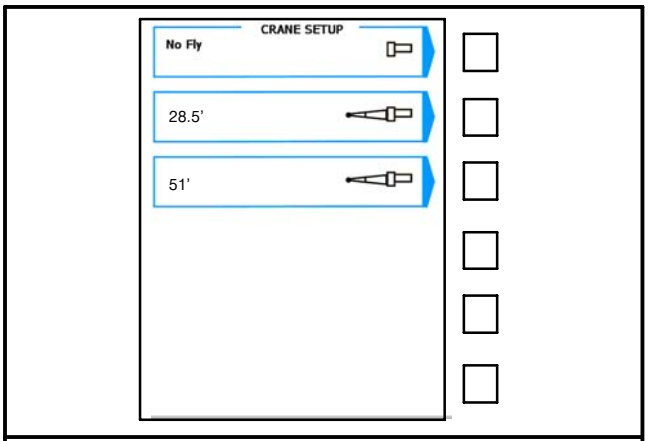


Figure 1–75
Erected Attachment Selection

5. If the crane is equipped with a fly, the auxiliary sheave selection screen will change and graphically display an erected attachment. Press the corresponding configuration selection button to select the intalled erected attachment if required.

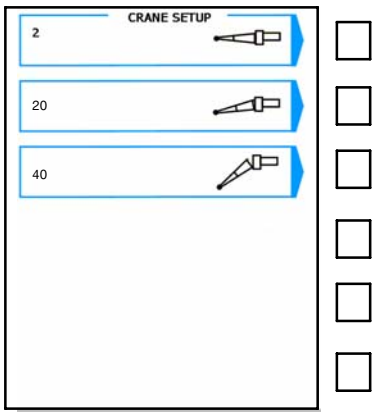


Figure 1–76
Erected Attachment Offset Selection

6. If an offset fly was previously selected, the erected attachment selection screen will change and graphically display the available offset angles. Press the corresponding configuration selection button to select the actual offset angle if required.

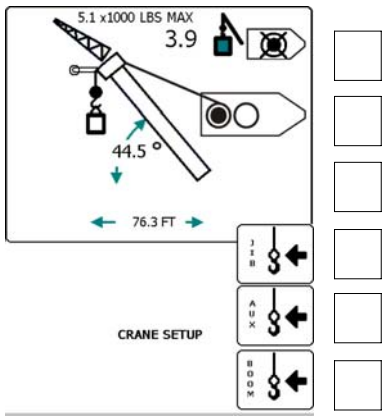


Figure 1–78
Front Winch Lifting Point Selection

8. If the crane is equipped with a front winch, the rear winch lifting point screen will change and graphically display the front winch lifting point. Press the corresponding configuration selection button to select the desired front winch lifting point. Or press the corresponding configuration selection button to select the front winch not in use.

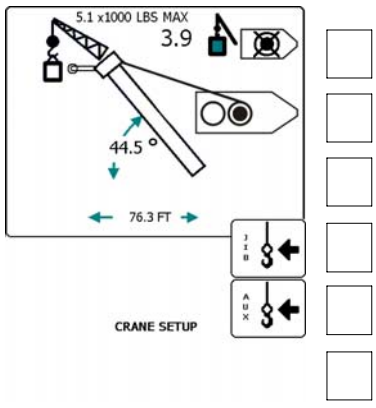


Figure 1–77
Rear Winch Lifting Point Selection

7. The erected attachment or erected attachment offset selection screen will change and graphically display the rear winch lifting point. Press the corresponding configuration selection button to select the desired rear winch lifting point. Or press the corresponding configuration selection button to select the rear winch not in use.

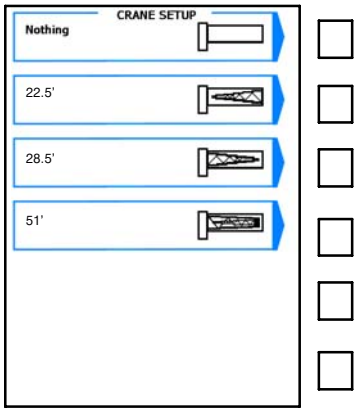


Figure 1–79
Stowed Attachment Selection

9. If the crane is equipped with a fly and was not selected as an erected attachment, the winch lifting point screen will change and graphically display the stowed deduct. Press the corresponding configuration selection button to select the actual stowed deduct if required.

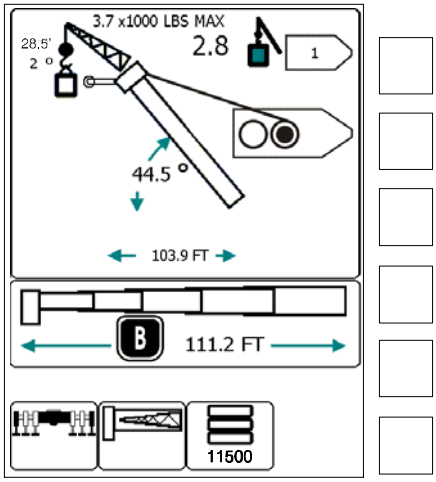


Figure 1—80
Rear Winch Parts Of Line Selection

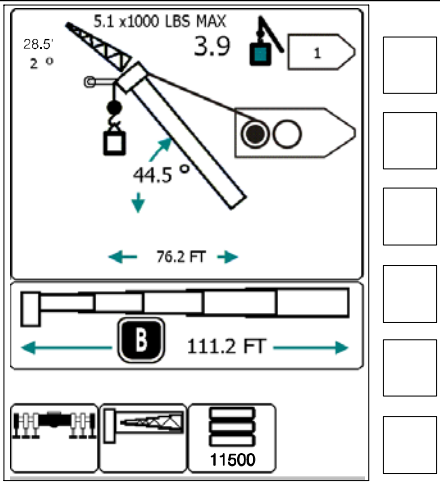


Figure 1—81
Front Winch Parts Of Line Selection

10. The crane setup screen will change to the normal working screen and graphically display the crane configuration as previously selected. Press the corresponding configuration selection button to select the actual parts of line for the rear winch.

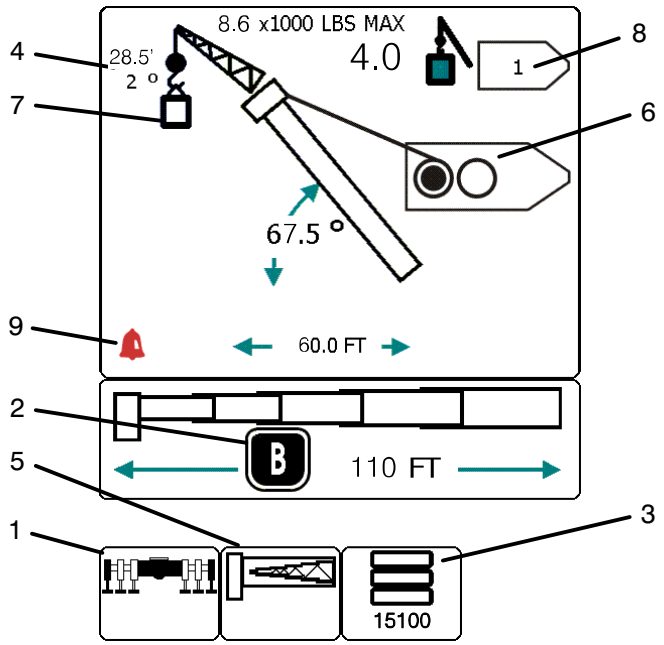
11. If the crane is equipped with a front winch and it was selected, press the corresponding configuration selection button to select the front winch. Press the corresponding configuration selection button to select the actual parts of line for the front winch.

    Note: From the normal working screen, after crane setup has been established, only two selection buttons are active; the winch select button and the parts of line button.

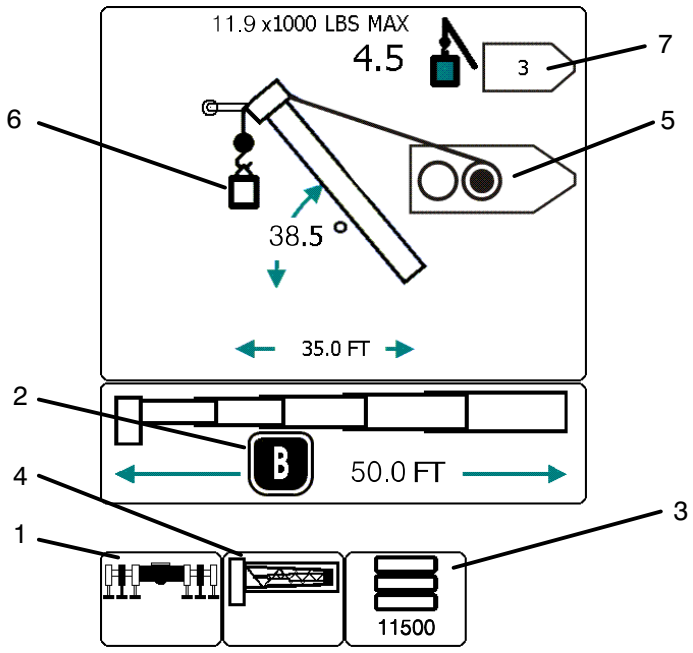
    To change winches, push the winch select button to toggle between winches. The winch lifting points cannot be changed without going through the crane setup routine.

    The parts of line can be changed for the selected winch by pressing the parts of line button to scroll through the available options for that winch.

    Refer to Figure 1—82 and Figure 1—83 for examples of some normal working screens.

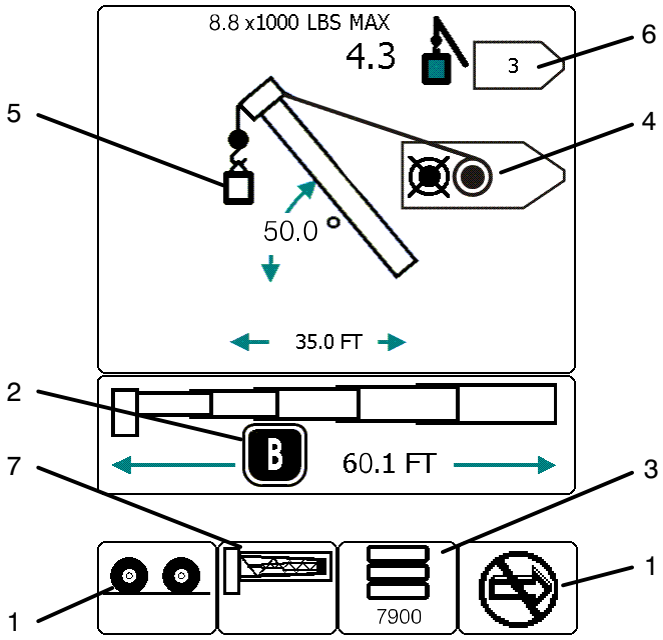


In this example the crane is setup on fully extended outriggers (1), boom mode B (2), 15,100 lb counterweight (3), 28.5' fly base erected at 2 degree offset (4), fly tip stowed (5), the rear winch available with the main boom head and the front winch selected (6), with the winch rope reeved over the fly base (7), with one part of line (8), and an operator settable alarm enabled (9).

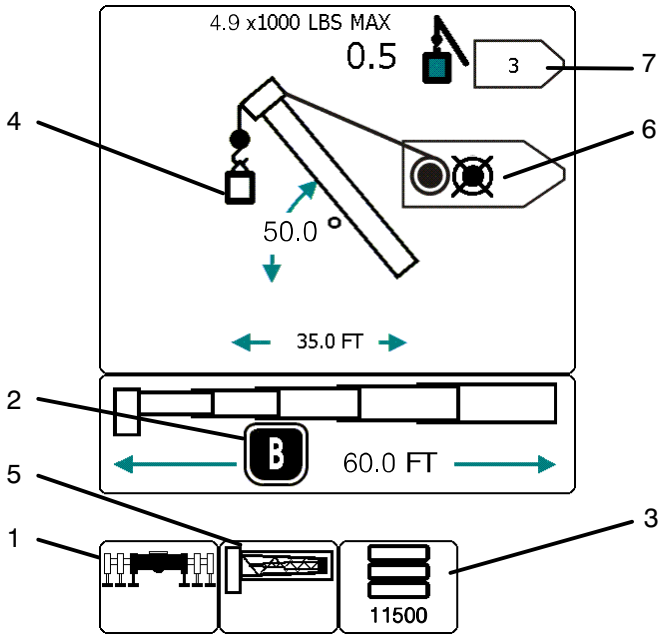


In this example the crane is setup on intermediate extended outriggers (1), boom mode B (2), 11,500 lb counterweight (3) 51' fly stowed (4), the front winch available with the auxiliary head and the rear winch selected (5), with the winch rope reeved over the main boom head (6) with three parts of line (7).

Figure 1–82
Normal Working Screen Examples



In this example the crane is setup for stationary on tires (1), boom mode B (2), 7,900 lb of counterweight (3), front winch not in use and the rear winch selected (4), winch rope reeved over the main boom (5), with three parts of line (6), and the 51' fly stowed (7).



In this example the crane is setup on fully retracted outriggers (1), boom mode B (2), 11,500 lb of counterweight (3), winch rope reeved over the main boom (4), 51' fly stowed (5), rear winch not in use and the front winch selected (6), with three parts of line (7).

Figure 1–83
Normal Working Screen Examples

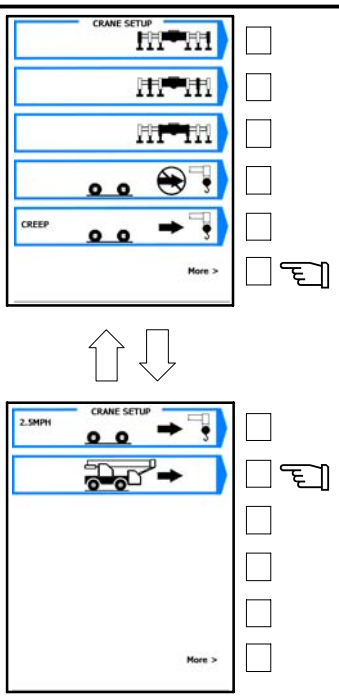


Figure 1—84
Rigging/Travel Mode Screen

To Select Rigging/Travel Mode

The CRANE SETUP push button is also used to select RIGGING/TRAVEL MODE. This mode is used to facilitate rigging and travel of the crane by inhibiting function limiters and the audible alarm while selected. To resume crane operation, select proper outrigger or tire configuration per the proper procedure.

WARNING

The Microguard 534 is not operational when in the RIGGING/TRAVEL Mode. Return the Microguard 534 to normal operation before operating the crane.

1. From the normal working screen press the CRANE SETUP button. The crane setup screen will change and graphically display the carrier options.
2. Press the More button on the carrier options screen to display RIGGING and TRAVEL mode selection screen. Refer to Figure 1—84.
3. Select for stationary rigging or when traveling the crane.

   Note: Boom must be fully retracted to enter rigging/travel mode.

Cancel Audible Alarm And Reset Function Limiters

The CANCEL ALARM button is used to cancel the audible alarm when the alarm has occurred as a result of either an Overload, a Two Block alarm, or an Operator settable alarm. The audible alarm may be canceled by pressing and releasing the CANCEL ALARM button. The audible alarm remains canceled until the condition which caused the alarm has been removed. For example, if the audible alarm was canceled because of an overload condition, it will remain canceled until the overload condition is removed. However, if a different alarm, e.g. two block condition, was to occur when the audible alarm was still canceled for an earlier overload condition, the new alarm condition would cause the audible alarm to be re-started.

WARNING

Once the function limiters have been by-passed, the crane is no longer protected against the condition that initially caused the function limiters to occur.

Note: The CANCEL ALARM feature is a temporary function. The audible alarm or function limit is automatically reset when the condition which caused the alarm is no longer present.

The CANCEL ALARM is also used to reset the function limiters when it is necessary to by-pass the function limiters which has occurred as a result of either an overload, a two block alarm, or a rope limit. Function limiters are reset by first canceling the audible alarm (as described above) and then pressing and holding the CANCEL ALARM button for about 3 seconds, after which the function limiters will be reset to allow normal operation. However, should another different alarm condition occur when the function limiters had previously been over-ridden, then the newly occurring alarm condition would cause the function limiters to activate again.

Operator Settable Alarms

Some alarms occur automatically as a result of limitations imposed by the capacity chart. The operator has control over additional alarms which can be set to operate within the normal chart limitations which are in addition to, those already set by the chart.

Operator settable alarms will be stored in the computer memory, even if the crane is shutdown, until they are cleared. Refer to Figure 1—85.

Alarms available for operator use are:

Minimum Boom Angle	Maximum Boom Length
Maximum Boom Angle	Left and Right Swing
Maximum Tip Height	Operator Defined Area

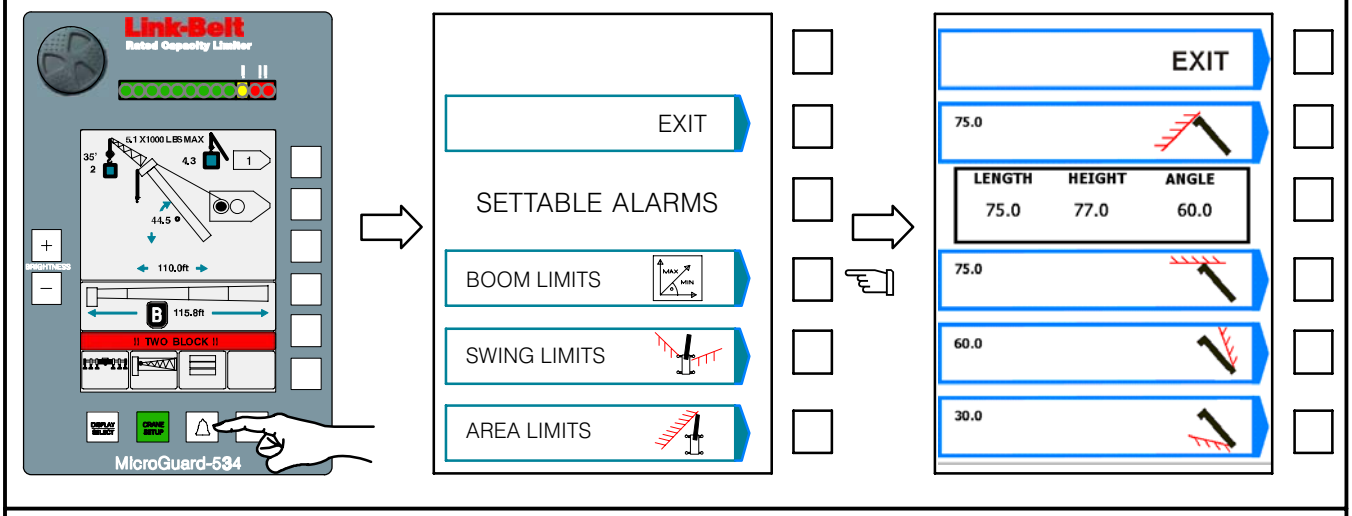


Figure 1—85
Boom Limit Alarms

WARNING

The operator settable alarms are a warning device. All functions remain operational when entering the operator defined bad area. For safe operation, adequate distance must be maintained to allow for operator reaction time to avoid entering the bad area. It is the responsibility of the operator to set points which ensure that the crane's boom, attachment, load, rigging, etc. maintains a safe working distance and complies with local safety regulations.

Angle, Length, And Height Operator Settable Alarms

1. From the normal working screen press OPERATOR ALARM button to access the Settable Alarms screen.
2. Press the corresponding button for Boom Limits.

WARNING

Avoid positioning the boom, attachment, load, rigging, etc. into the bad area when setting the alarm values.

When selecting the alarm values, ensure that the load will maintain a safe distance from the obstacle.

3. Position the boom in the desired position depending upon the alarm to be set. The numerical value displayed will be the current position of the boom.
4. Press the corresponding selection button to set the desired alarm value as defined below. Press the button again to turn alarm off.

	Maximum Boom Length
	Maximum Tip Height
	Maximum Boom Angle
	Minimum Boom Angle

5. When all alarm values are set, press the EXIT button to return to the alarm screen. At the Settable Alarm screen, press the EXIT button again to return to the normal working screen.
6. Test the alarm, with no load, to ensure the alarm points have been properly set. When approaching the alarm set point, the audible will sound intermittently and a warning message will appear in the warning message area. When exceeding the alarm set point, the audible alarm will sound continuously and a warning message will appear in warning message area.

Note: An alarm icon will appear on the normal working screen to alert the operator that an operator alarm has been set.

WARNING

If crane or obstacle is moved or if a different size load is lifted, the alarm(s) must be reset.

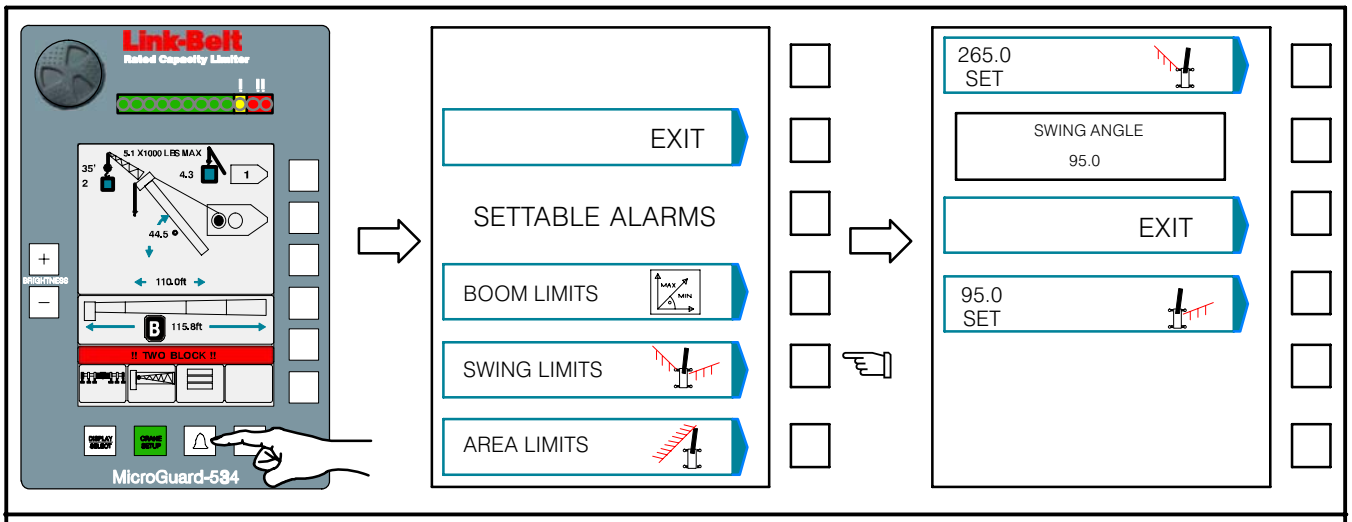


Figure 1—86
Swing Alarm

Swing Operator Settable Alarm

To have an alarm whenever the left swing and right swing exceed pre-determined alarm points, use the following procedure:

1. From the normal working screen press OPERATOR ALARM button to access the Settable Alarms screen.
2. Press the corresponding button for Swing Limits .
3. Swing the boom to the left alarm point .
4. Press the corresponding button for Left Swing to enter the left alarm point. The displayed value will be the left alarm setting.
5. Swing the boom to the right alarm point.
6. Press the corresponding button for Right Swing to enter the right alarm point. The displayed value will be the right alarm setting.
7. Press the EXIT button to return to the settable alarm screen. Press the EXIT button on the settable alarms screen to return to the normal working screen.
8. Test the alarm, with no load, to ensure the alarm points have been properly set. When approaching the set alarm point, the audible alarm will sound intermittently and "Swing Alarm" will appear in the warning message area. The audible alarm will activate whenever the swing exceeds the alarm points and "Swing Alarm" will appear in warning message area.

Note: Both the left and right swing alarms must be set for the system to determine the operator set working area.

Note: An alarm icon will appear on the normal working screen to alert the operator that an operator alarm has been set.

Operator Defined Area Alarm

The operator defined area alarm, when set, will define an imaginary vertical plane between two set points to optimize the working area. When approaching the plane, the audible alarm will sound intermittently, and the message "Bad Working Area" will appear in the warning message area. When passing the plane, the audible alarm will sound continuously and the message "Bad Working Area" will appear on the warning message area. Use the following procedure, Figure 1—87, and Figure 1—88 to set the operator defined area alarm.

WARNING

The operator defined area alarm is a warning device. All functions remain operational when entering the operator defined bad area. For safe operation, adequate distance must be maintained to allow for operator reaction time to avoid entering the bad area. It is the responsibility of the operator to set points which ensure that the crane's boom, attachment, load, rigging, etc. maintains a safe working distance and complies with local safety regulations.

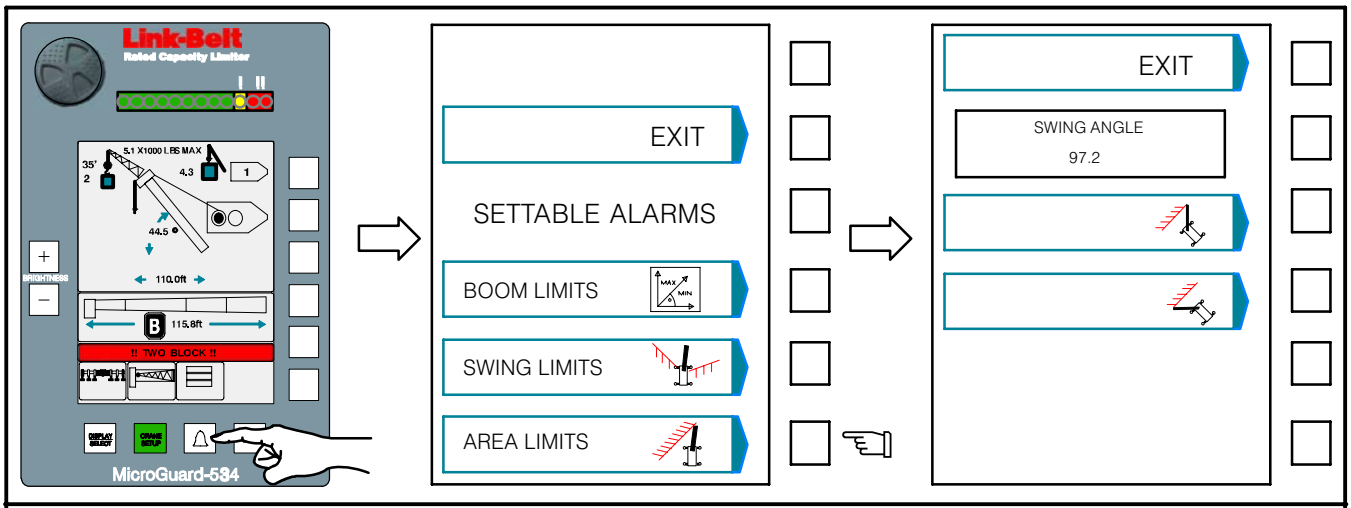


Figure 1—87
Operator Defined Area Alarm

Setting Operator Defined Area Alarm

1. From the normal working screen press OPERATOR ALARM button to access the Settable Alarms screen.
2. Disable any previously set left and right swing alarms if required.

   Note: The left and right swing alarms must be cleared prior to setting the defined area alarm.

3. Press the corresponding button for Area Limit.

WARNING

Avoid positioning the boom, attachment, load, rigging, etc. into the bad area when setting the left or right alarm points.

When selecting the left and right alarm points, ensure that the load will maintain a safe distance from the obstacle. Also ensure that the two points are set so that the tailswing of the crane will not enter the bad area.

4. Position the boom, attachment, load, rigging, etc. to the right alarm point and press the corresponding button to enter the right alarm point. The displayed value will be the right alarm setting.
5. Position the boom, attachment, load, rigging, etc. to the left alarm point and press the corresponding button to enter the left alarm point. The displayed value will be the left alarm setting.

   Note: For best results, the two points should be separated by a minimum of 10 ft (*3m*) or 30 degrees.

6. When both alarm points are set, press the EXIT button to return to the settable alarms screen. Press the EXIT button on the settable alarms to return to the normal working screen.
7. Test the alarm, with no load, to ensure the alarm points have been properly set. When approaching the plane, the audible alarm will sound intermittently and the message "Bad Working Area" will appear on the warning message area. When passing the plane, the audible alarm will sound continuously and the message "Bad Working Area" will appear on the warning message area.

WARNING

If crane or obstacle is moved or if a different size load is lifted, the area alarm must be reset.

Note: An alarm icon will appear on the normal working screen to alert the operator that an operator alarm has been set.

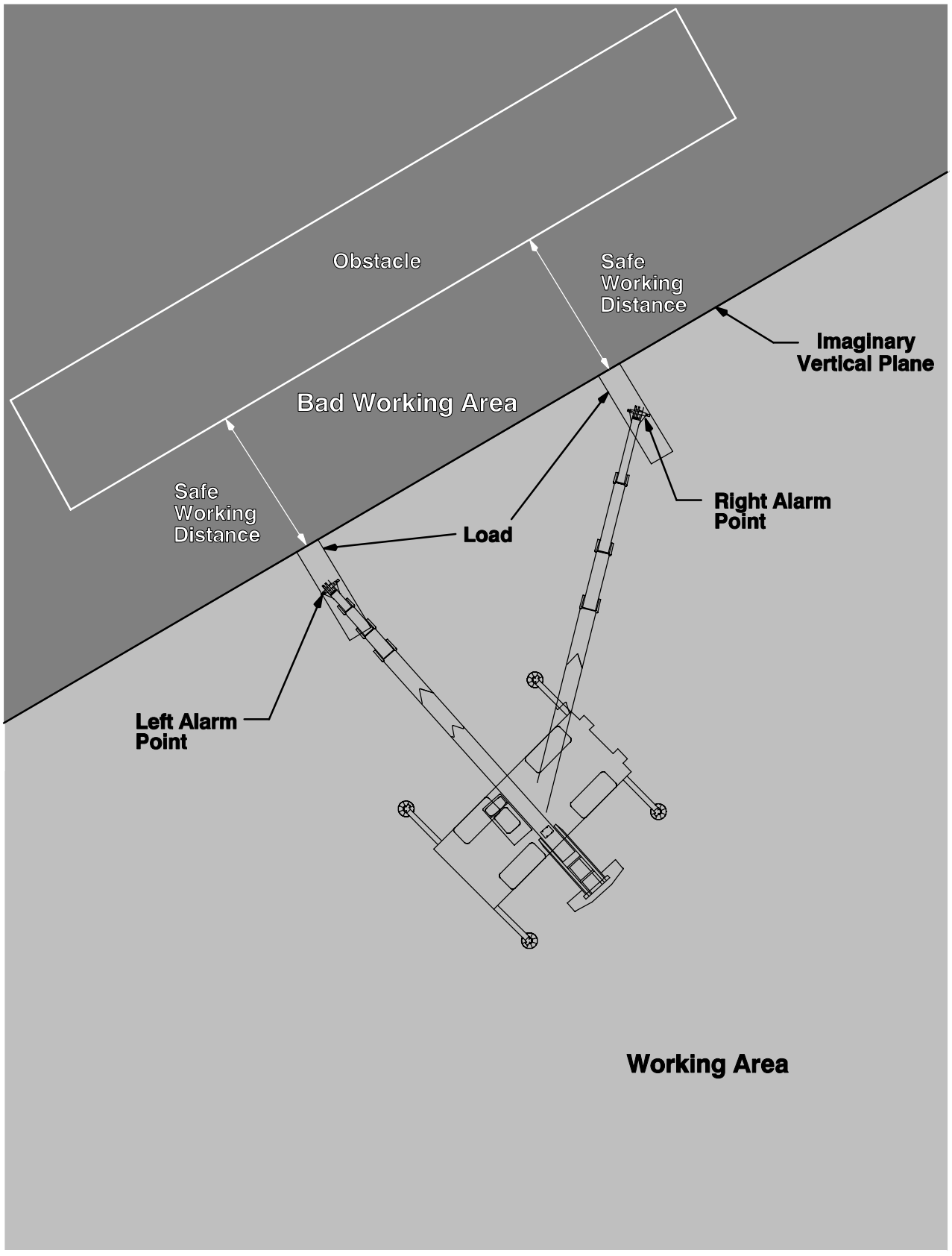


Figure 1–88
Operator Defined Area Alarm

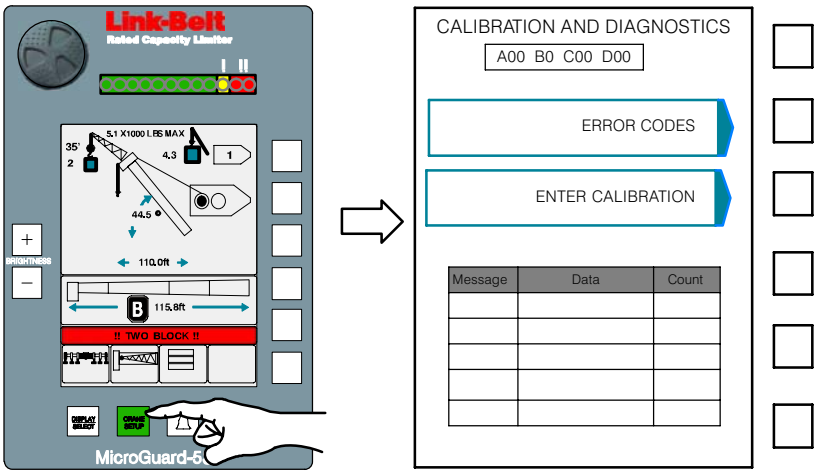


Figure 1—89
Calibration And Diagnostic Screen

System Fault Codes

If faults in the system are detected during a test, the warning message area will show the words SYSTEM FAULT. If the words SYSTEM FAULT occur, press the Display/Select button to display the Calibration And Diagnostic screen. On the Calibration And Diagnostic screen, press the Error Code button to display error codes in the box at the top of the screen. This information can then be used to assist the service technician in determining the fault. Contact your distributor for assistance with the fault codes.

Calibration

If the system requires calibration, contact you distributor for assistance. Calibration must be done by a qualified technician. Press the Display/Select button to display the Calibration And Diagnostic screen. On the Calibration And Diagnostic screen, press the Enter Calibration button. The calibration screen will be displayed and prompt a calibration key sequence to begin the calibration routine.

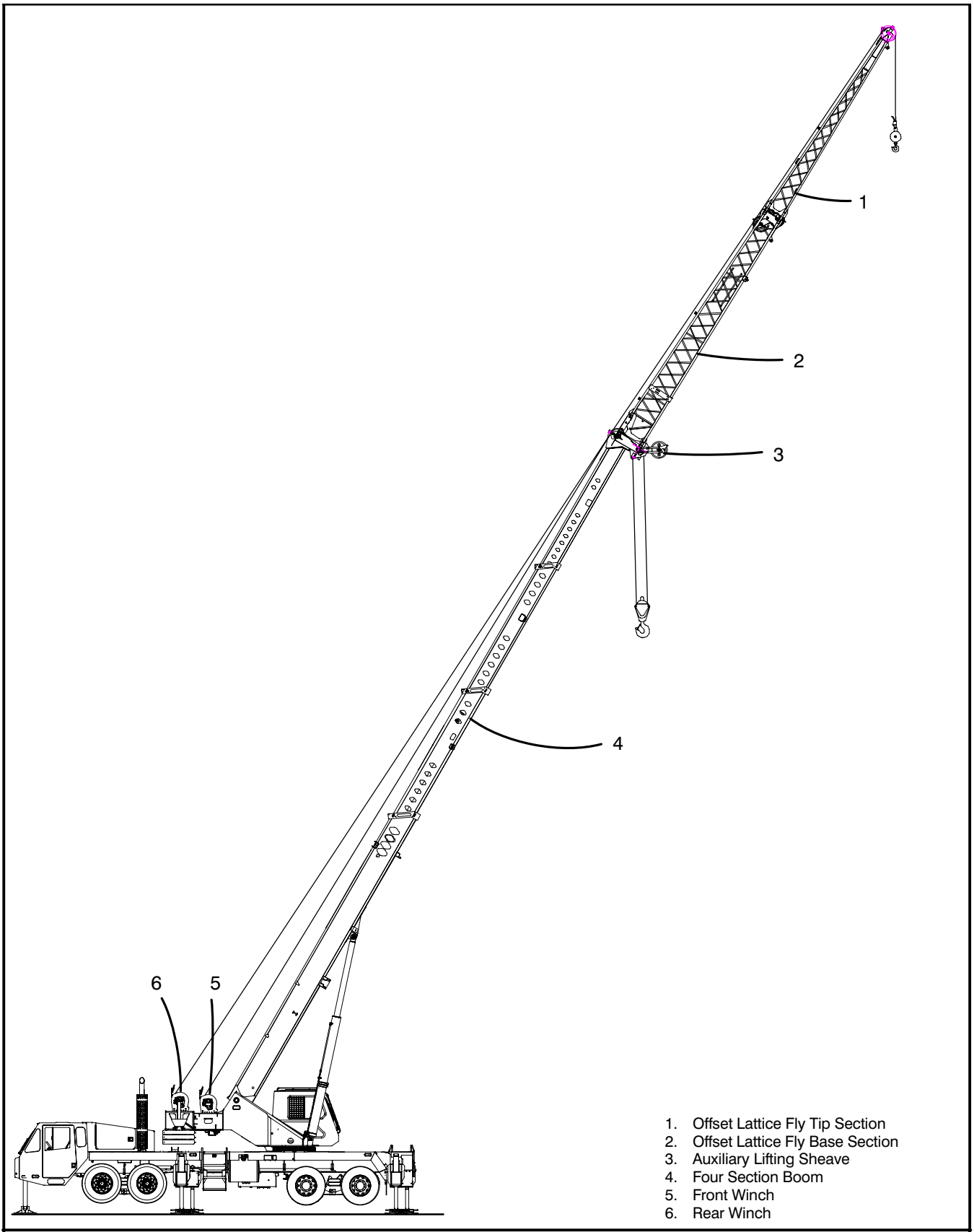


Figure 1–90
Typical Crane Attachment Setup (Provided for correct identification of attachments)

Entering And Exiting The Upper Cab

Entering or leaving the upper cab could be hazardous if certain aspects are not taken into consideration. The elevation of the carrier deck and upper cab alone could cause serious injury if someone was to fall. For this reason a ladder is mounted on each side of the carrier to provide easy access to the carrier deck and upper cab. Numerous hand grips are also attached to the upper cab as well as textured tread areas on the surface of the carrier deck, to provide safe entry to the cab . Use these features to make climbing on the crane as safe as possible. Remain in three point contact with the crane at all times (two hands and one foot or two feet and one hand).

Inside the cab, two separate features are provided to prevent accidental operation of the hydraulic controls while entering or leaving the operator's seat.

1. Function Lockout Switch

   This switch is used to disable the hydraulic functions which are operated by the control levers and boom telescope foot pedal. Move the switch to the "DISABLE" position to prevent inadvertent operation of these controls. To allow normal operation of the swing, winch, boom hoist, and telescope functions, move the function lockout switch to the "OPERATE" position. This switch must always be moved to the "DISABLE" position before entering or leaving the operator's seat.

2. Movable Left Hand Side Console

   The left hand side console is hinged at the rear to allow the operator to pivot the console up, out of the way while entering or exiting the upper cab. A counterbalance spring holds the console securely in position during normal operation and makes movement of it as effortless as possible.

⚠ WARNING

To prevent personal injury do not attempt to enter the operator's cab prior to raising the left console stand.

   Lifting the left arm rest enables the console to pivot up, out of the way for ease of entry and exit. It also performs the same duty as the function lockout switch, described above, disabling all hydraulic functions related to the control levers and boom telescope foot pedal. Make sure the side console is rotated up, out of the way before attempting to enter or exit the upper cab.

   One more feature which is available to ease entry and exit of the upper cab, is the adjustable operator's seat. Lift the left hand arm rest up out of the way and move the seat and/or console back as required to allow safe entry. This feature also provides operator comfort during crane operation as well. Refer to "Operator's Seat" found earlier in this Section of the Operator's Manual for complete seat operating instructions.

Break-In Period

Operate a new crane at half throttle for the first twenty (20) hours of operation. A break-in period under moderate loads will assist in providing long, trouble-free performance.

Before Starting Operations

Before starting daily operations, make the following checks and inspections.

Engine

Check fuel, oil, and cooling systems for proper fluid levels. Check for leaks. Repair or fill as required. Refer to engine manufacturer's manual for additional details.

Gear Cases

Visually inspect all gear cases for leaks or damage. If leaks or damage exist, repair and fill case to proper lubrication level.

Hydraulic System

Check all hoses for chafing, bulging, or other damage. Replace as necessary. Inspect hydraulic system for external leaks. Repair as needed. Check hydraulic reservoir oil level. Add oil if necessary. Refer to Section 2 of this Operator's Manual for additional information.

Lubrication

Lubricate the crane as outlined in Section 2 of this Operator's Manual.

Note: Operators may have nothing to do with lubrication or maintenance of the crane, but it could be advantageous for them to be familiar with it. Knowledge of preventive maintenance makes the operator more aware of malfunctions in the crane so repairs can be made with a minimum of downtime.

Tires And Wheels

Check tire inflation. Inflate to pressures per the Gross Axle Weight Rating plate for highway travel, or per the Crane Rating Manual for pick and carry operations. Check wheel lug nut torque, each day, for the first five (5) days of operation, and periodically thereafter. Refer

to Section 3 of this Operator's Manual for additional information.

Wire Rope And Sheaves

Inspect all wire rope and sheaves for damage or deterioration. Replace as necessary. Refer to Section 5 of this Operator's Manual for additional information.

General Inspection

Visually inspect the entire crane for loose or missing cotter pins or bolts, or damaged fly chords or lattices. Check for oil or fluid leaks. Make repairs as needed.

Electrical System

Check the operation of all lights, windshield wipers, horns, turn signals, etc. Repair as needed.

Brakes

Start the engine and allow the air system pressure to reach its normal operating range, 100—120 psi (*690—827kPa*). Check park brake and service brake operations. Adjust or repair as needed.

Controls

Check all controls for proper operation and adjustment. Repair as needed.

⚠ WARNING

This Operator's Manual must be thoroughly read and understood by the operator before starting the engine. Crane damage or personal injury could result from improper operating procedures.

Engine Starting Procedure

⚠ WARNING

Diesel exhaust fumes can be harmful. Start and operate engine in a well ventilated area. If it is necessary to operate in an enclosed area, vent the exhaust to the outside. Properly maintain the exhaust system to its original design.

Before attempting to start the engine, the operator should carefully read and understand the engine starting instructions in the engine manufacturer's manual and this Operator's Manual. Attempting to start or run the engine before studying these instructions may result in engine damage. The operator should learn and obey all applicable "Rules of the Road" and if not already a competent driver, obtain instructions to attain these necessary skills. With the crane fully serviced and the operator familiar with all gauges, switches, controls, and having read and fully understood this entire manual, start the engine using one of the following procedures:

To Start The Engine From The Carrier Cab

1. Walk around the crane to verify that there are no persons under, or in close proximity to the crane.
2. Engage the park brake.
3. Shift the transmission to neutral. (The engine will not start unless the transmission is in neutral.)
4. Move pump engagement/throttle selector switch to "Lower" position.
5. Sound the horn twice in succession, wait 10—15 seconds while making a visual check to verify that there are no persons under, or in close proximity to the crane.
6. Turn the ignition switch to the "On" position to energize the engine electrical system and allow the gauges to go through their self test routine.
7. Turn the ignition switch to the "Start" position. Release the ignition switch immediately after the engine starts. If engine fails to start in 30 seconds, release the ignition switch and allow the starter motor to cool a few minutes before trying to start again. If engine fails to start after four attempts, refer to engine manufacturer's manual for instructions.
8. Warm Up — Run the engine at low throttle with no load while engine is warming up. Observe the following instruments for proper indications.
   a. Engine Oil Pressure — If there is no engine oil pressure after 10—15 seconds of running time, shutdown the engine immediately and repair the problem to avoid major engine damage. Refer to engine manufacturer's manual for proper oil pressure operating range.
   b. Battery Gauge — Observe indicator to ensure battery and electrical system is working properly. The gauge should indicate 12.5 to 14.0 volts while engine is running. (It should read 12.0 volts when the key is on, without the engine running.)
   c. Air Pressure Warning Light — Normal operating range is 100—120 psi (*690—827 kPa*). When air pressure is sufficient for safe carrier operations, the low air pressure warning light and alarm will turn off. Do not attempt to operate crane until air pressure warning light and alarm are off.

9. When the engine has thoroughly warmed up, after all pressures and temperatures are within operating ranges, and all daily checks have been made, the crane is ready for operation.

To Start The Engine From The Upper Cab

1. Walk around the crane to verify that there are no persons under, or in close proximity to the crane.
2. Check the carrier cab to ensure that the transmission is in neutral, the park brake is engaged, and the ignition switch is in the "LOCK" position.
3. Check that the pump engagement/throttle selector switch in the carrier cab is in "Pump/Upper" position.
4. Sound the horn twice in succession, wait 10—15 seconds while making a visual check to verify that there are no persons under, or in close proximity to the crane.
5. In the upper cab, turn the ignition switch to the "On" position to energize the engine electrical system and allow the gauges to go through their self test routine.
6. Turn the ignition switch to the "Start" position. Release the ignition switch when the engine starts. If the engine fails to start in 30 seconds, release the ignition switch and allow the starter motor to cool a few minutes before trying to start the engine again. If the engine fails to start after four attempts, refer to the engine manufacturer's manual for instructions.
7. Warm Up — Run the engine at low throttle with no load while the engine is warming up. Observe the engine oil pressure gauge for proper indications. If there is no engine oil pressure after 10—15 seconds of running time, shutdown the engine immediately and repair the problem to avoid major engine damage. Refer to engine manufacturer's manual for proper oil pressure operating range.
8. When the engine has thoroughly warmed up, after all pressures and temperatures are within operating ranges, all daily checks have been made, the crane is ready for operation.

   Note: If air pressure was sufficient at initial start-up (light and alarm in upper cab is off), pump will engage. If air pressure was not sufficient at initial start-up, wait for the low air indicator light and audible alarm to cease. Then press the pump enable switch to engage the main pump.

⚠ WARNING

Stay clear of rotating pump drive shaft. Sufficient air pressure must be attained before the main pump will engage.

9. After the main pump is engaged, the crane is ready for operation.

Engine Shutdown Procedure From The Carrier Cab

1. Throttle the engine back to idle. Engage the park brake and shift the transmission to neutral.
2. Allow the engine to idle 3 to 5 minutes to allow the engine to cool gradually and uniformly.
3. Turn the ignition switch to the "Off" position.

   Note: If the ignition switch is in the "On" position in the upper cab, it must be moved to the "Off" position before the engine will shutdown.

4. Remove the ignition keys from both cabs and lock the doors if the crane is to be left unattended.

Engine Shutdown Procedure From The Upper Cab

1. Lower any load to the ground and secure it properly.
2. Engage the travel swing lock.
3. Throttle the engine back to idle.
4. Allow the engine to idle 3 to 5 minutes to allow the engine to cool gradually and uniformly.
5. Turn the ignition switch to the "Off" position.

   Note: If the ignition switch is in the "On" position in the carrier cab, it must also be turned to the "Off" position before the engine will shutdown.

6. Remove the ignition keys from both cabs and lock the doors if the crane is to be left unattended.

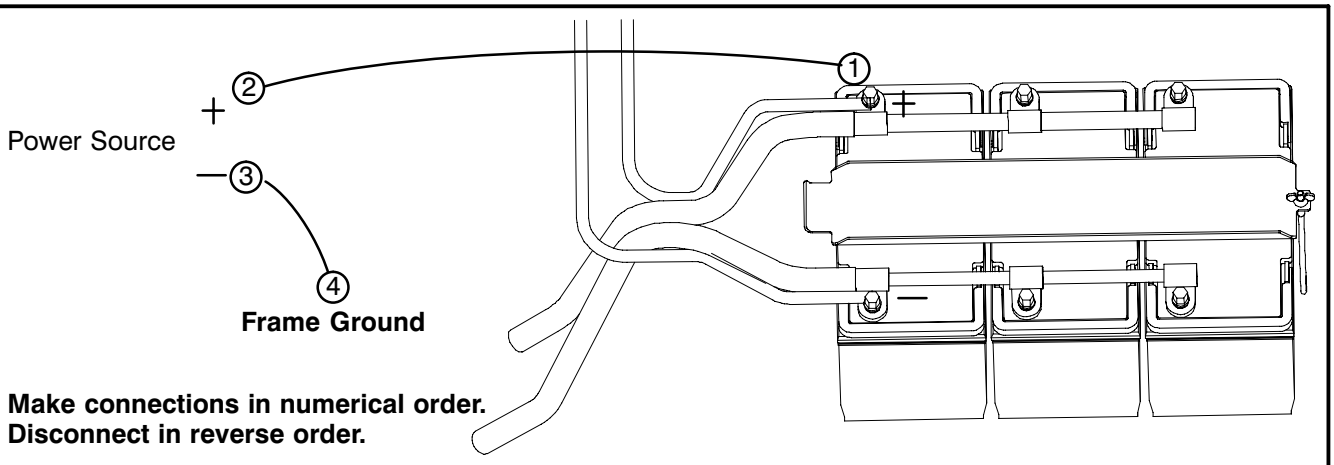


Figure 1—91
Battery Cable Connections

Jump Starting The Crane

The crane has three (3) 12V batteries. The batteries are located on the left side of the crane next to the fuel tank.

⚠ WARNING

To avoid serious personal injury and/or equipment damage, follow these procedures in the order they are given.

Wear protective clothing and shield your face and eyes when working around batteries. Batteries contain sulfuric acid which burns skin, eyes, and clothing.

Do not jump start a damaged battery. Be sure vent caps are tight and level. If another vehicle is used, be sure booster vehicle and crane are not touching.

The gases around the battery can explode if exposed to open flames or sparks. An explosion could result in serious personal injury and/or equipment damage.

Battery posts, terminals, and related accessories contain lead and lead compounds. Wash hands after handling.

1. Check all battery terminals and remove any corrosion before attaching jumper cables.
2. Connect one end of the first jumper cable to the 12V positive (+) terminal of the discharged battery.
3. Connect the other end of the first cable to the 12V positive (+) terminal of the 12V power source or booster battery.

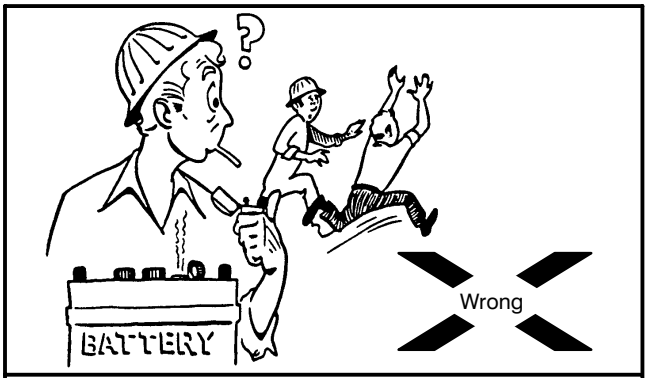


Figure 1—92
Do not use an open flame near the battery.

4. Connect one end of the second jumper cable to the negative (—) terminal of the 12V power source or booster battery.
5. Connect the other end of the second cable to a good metallic surface on the carrier frame.
6. If another vehicle is used to jump start the crane, start the booster vehicle. Run the booster vehicle's engine at a moderate speed.
7. Turn on the key switch to allow discharged batteries to charge for a few minutes prior to attempting to start the disabled crane.
8. Start the disabled crane. After the crane is started, remove jumper cables in reverse order.
9. Let the crane's engine run for a few minutes to charge the discharged batteries.
10. Check the battery gauge in the operator's cab. The gauge reading should be increasing toward 14 volts.

Note: If the batteries are severely discharged, voltage may increase slowly.

Crane Operation

Cranes are used primarily for making heavy lifts. In order to do this properly, certain procedures must be followed. The following is a suggested procedure for making typical lifts:

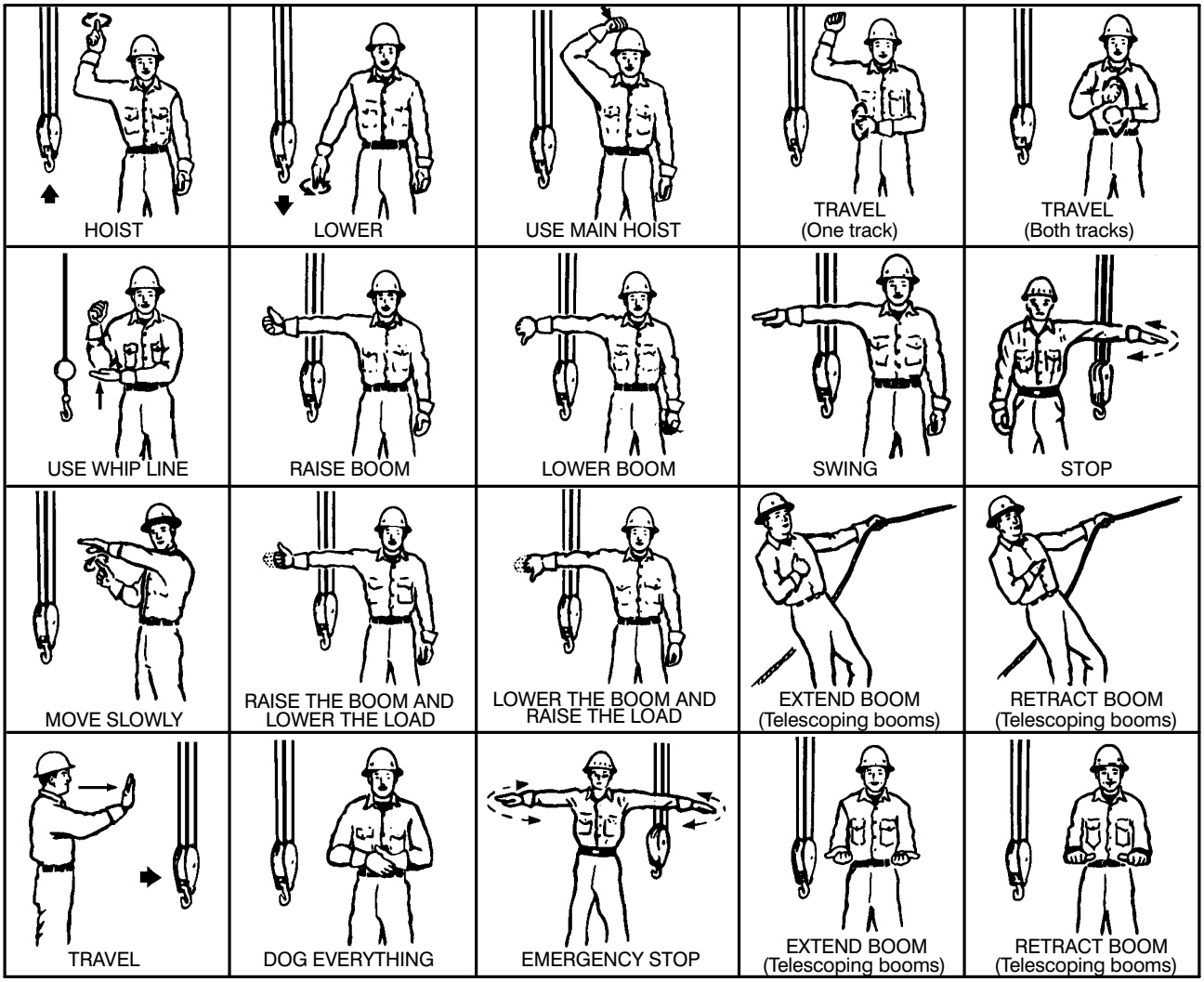
1. Determine weight to be lifted. Be sure to add the weight of the hook block, slings, rigging, fly, etc. Determine height to which the load must be lifted.
2. Consult the proper capacity, working areas, and working range chart located in the Crane Rating Manual. Find the shortest boom length and load radius that will accomplish the job.
3. Do not swing upper while on tires, use outriggers. Position crane so a minimum swing is necessary.
4. The crane must be supported by a firm, solid level surface before starting to lift. All capacities in the Crane Rating Manual are based on the crane being level in all directions. If the crane is not level, out swing or side swing of the load will greatly reduce lifting capacities and could cause crane damage or an accident. If the ground is soft, use mats.
5. If outriggers are used, the following points must be observed:
   a. The outrigger beams must all be equally extended (all fully extended, intermediately extended or fully retracted) to lift the loads shown in the Crane Rating Manual. Serious reductions in lifting capacity will result if all beams are not in the same position and this could lead to serious crane damage or an accident.
   b. The bumper outrigger must be properly set.
   c. Outrigger pontoons must be on solid, smooth footing, flush with the ground (no hills, or valleys under pontoons), otherwise pontoons may be damaged or destroyed. If there is any doubt, use mats.
   d. All capacities listed for the crane on outriggers are based on the outrigger jacks being used to raise the crane so that all tires are clear of the ground and the crane level. A bubble level is provided in the upper cab to assist the operator in leveling the crane. (If crane is equipped with ground control outriggers, a bubble is also provided at each of these stations).
6. When making lifts on tires, all tires must be inflated to pressures as listed in the Crane Rating Manual. Do not make lifts which exceed Crane Rating Manual specifications.
7. Raise the boom and swing over the load. Extend the boom to the desired length. Make sure power boom sections are properly extended.
8. Lower the hook block and fasten it onto the load. The following points must be observed:
   a. The boom peak must be directly above the load. Booms are made to lift, and should never be used to drag a load sideways.
   b. Always use chains, wire ropes or slings of ample size, and make periodic checks of their condition.
   c. Always use sufficient parts of line. Consult Wire Rope Capacity chart located in the Crane Rating Manual for the number of parts of line needed for a given lift.
   d. When lifting loads, care should be taken to prevent sudden loading or unloading of the winch rope. Ease into the load. Lift load a few inches off the ground and hold to check the winch brakes.
9. Lift the load to the desired height. Boom to the desired angle. Be careful when booming down or swinging the load, as these increase the load radius and result in a decrease in capacity. Make sure the load being lifted remains within the lifting capacity of the crane at the boom length and radius being used.
10. Control the load at all times. Use hand lines to guide the load. Do not guide loads into place with your hands. Swing slowly and smoothly. Avoid jerks when starting or stopping swings.

During Operation

The operator must remain alert to possible malfunctioning of the crane while operating. If the crane does malfunction, lower the load, and shutdown the crane until the problem is found and corrected. During operation, the operator must:

1. Remain alert to any noise or loss of power, or bad response to control of the crane. Watch the engine oil pressure and water temperature gauges for proper operating ranges.
2. Watch the hydraulic system oil temperature gauge. If the temperature exceeds maximum temperature, shutdown the crane until the problem is corrected. (Refer to "Hi Performance Hydraulic Oil" chart in Section 2 of this Operator's Manual for the maximum temperature for each viscosity of hydraulic oil.)
3. Listen for any unusual noises in the hydraulic system, power train, or the speed reducers. If any, correct problem.
4. Watch for oil leaks or any loss of control. If any develop, correct before continuing operation.
5. Make sure all controls work freely and easily, with no sticking or binding. Lubricate or adjust as necessary.

Standard Hand Signals For Controlling Crane Operations



Extracted from the American National Standard, Crawler, Locomotive and Truck Cranes, ANSI B30.5b–1985, with the permission of the Publisher the American Society of Mechanical Engineers, 345 E. 47th Street, New York, New York 10017.

Figure 1–93
Hand Signals

6. If working on outriggers, periodically check the outriggers to make sure the crane is level and stable. If working without outriggers, make sure the tires are inflated to the proper pressure and the boom is positioned directly over the rear of the carrier with the travel swing lock engaged. (Refer to Crane Rating Manual for proper tire pressure.)
7. Heed all warning and caution labels. Observe good safety practices at all times.

Hand Signals

Hand Signals are important for communications between the designated signalman and the operator. A hand signal chart is shown Figure 1–93. A copy is also located on the right hand side of the carrier, on the hydraulic reservoir.

These signals should be used at all times unless voice instructions with a radio or telephone are being used. One person should be designated as a signalman and their signals obeyed by the operator. Obey a stop signal from anyone.

Pick And Carry Operation

Travel during pick and carry operations is restricted to "creep" speeds of 1.0 mph (*1.6km/h*) or less on a firm, level surface. During creep operations crane movement must not exceed 200 ft. in a 30 minute period.

Lifts are to be made off the main boom only, with the crane prepared as follows:

WARNING

Do not travel above the maximum speeds listed. Crane damage, property damage, and/or personal injury may result.

1. Inflate the tires to the pressure listed in the Crane Rating Manual for "creep" speed. Refer to Section 3 of this Operator's Manual for correct procedure.
2. If the crane is equipped with the axle lift system, ensure that the air ride suspension switch in the carrier cab is in the "DOWN" position.
3. Level the crane on fully extended outriggers with the tires clear of the ground.
4. Position the upper over the rear of the carrier and engage the travel swing lock.

CAUTION

Do not leave swing park brake applied during pick and carry operations. Failure to release these devices during this operation may result in damage to the swing speed reducer.

5. Properly store the fly.
6. Move the pick and carry switch to the "Pick and Carry" position.

   Note: When pick and carry is selected, the transmission is automatically put into first gear and cannot be upshifted. Also swing and telescope functions are disabled and boom hoist and winch functions operate at reduced speeds in pick and carry mode.

7. Retract all outrigger jacks just clear of the ground but leave the outrigger beams fully extended.
8. Attach as many hand lines as necessary to prevent the load from swinging during travel.
9. Carefully attach the load to the winch rope and lift it only as high as necessary.
10. Carefully travel at creep speed. Take extra care due to the increased overall width caused by the extended outrigger beams. The outriggers or pontoons must not be allowed to hit any obstructions. Maintain a safe distance from all personnel, obstructions, structures, and power lines. Travel only on a firm, level surface.
11. Once the desired destination is reached, shift the transmission to neutral and apply the park brake.

Traveling The Crane

Truck cranes are designed for highway and job site travel. Certain conditions must be met for safe travel. Refer to the following outlined procedures before traveling the crane.

WARNING

Do not travel above the maximum speeds listed. Crane damage, property damage, and/or personal injury may result.

Job Site Travel

Job site travel is limited to speeds less than 5.0 mph (*8.0km/h*) on a firm, smooth, and level surface. The crane may be traveled on the job site with no load per the following procedure:

1. Inflate the tires to pressure listed on the Gross Axle Weight Rating (GAWR) plate for 5.0 mph (*4.0km/h*) maximum speed. Refer to Section 3 of this Operator's Manual for correct procedure.
2. If the crane is equipped with the axle lift system, ensure that the air ride suspension switch in the carrier cab is in the "DOWN" position.
3. Level the crane on fully extended outriggers.
4. Position the upper and attachments in one of the following arrangements:
   a. The upper over the front or rear. The boom sections fully retracted and the fly stored.
   b. The upper over the rear. The boom sections fully retracted. The fly base erected and the fly tip stored or the fly base and tip erected.

      Note: The fly must be in the 2˚ offset position.

   c. The upper over the front. Boom fully retracted. Fly base erected with fly tip stored, or fly base and tip erected.
5. Boom down fully. Engage the travel swing lock.

CAUTION

Do not leave the swing park brake applied when traveling the crane. Failure to release these devices during this operation may result in damage to the swing speed reducer.

6. Move the pick and carry switch to the "Travel" position.
7. Move the pump engagement/throttle selector switch to the "Lower" position.
8. Retract all outrigger jacks just clear of the ground but leave the beams fully extended.
9. Carefully travel at no more than 5.0 mph (*8.0km/h*). Take extra care due to the increased overall width caused by the extended outriggers. The outriggers or pontoons must not be allowed to hit any obstructions. Maintain a safe distance from all personnel, obstructions, structures, and power lines.

Highway Travel

Highway travel is considered to be any travel of the crane over 5.0 mph (*8.0km/h*). The following conditions and precautions must be met for any highway travel.

Note: If road weight or axle load limitations are a factor, the crane may be equipped with removable counterweights. Use this system as necessary to meet road weight or axle load limitations. Refer to the Gross Axle Weight Rating (GAWR) plate for axle load limits, tire pressures, and maximum speed.

1. If equipped, the fly must be secured in the stored position on boom.
2. Inflate the tires to pressure listed on the Gross Axle Weight Rating (GAWR) plate for speeds over 5.0 mph (*8.0km/h*). Refer to Section 3 of this Operator's Manual for correct procedure.
3. If the crane is equipped with the axle lift system, ensure that the air ride suspension switch in the carrier cab is in the "UP" position.
4. Move the pick and carry switch to the "Travel" position.
5. The boom must be fully retracted, over the front of the crane, and in the boom rest, (unless a boom dolly is being used), with the travel swing lock engaged.

CAUTION

Do not leave the swing park brake applied when traveling the crane. Failure to release this device during this operation may result in damage to the swing speed reducer.

6. Secure hook block to prevent excessive swinging.

CAUTION

When the hoist line is tied off to the crane or any solid object, do not extend the boom, raise or lower the boom, or raise the crane on outriggers. The winch system could be overloaded causing major winch or crane damage.

7. All outriggers must be fully retracted (jacks and beams) with all outrigger position pins in the retracted position. All main outrigger pontoons must be in the self stored position or removed from jacks and properly stored on the crane.
8. All upper control levers must be in the neutral position. The upper ignition key must be turned off, key removed, and all doors and windows locked.
9. Move the pump engagement/throttle selector switch to the "Lower" position.
10. Obey all "Rules of the Road" and travel carefully.

Counterweight Removal

Access to certain job sites may require the crane to travel on roads with strict vehicle load limitations. In order to meet such limitations the crane is designed so the counterweights can be lowered onto and pinned to the carrier deck to balance axle loadings, or removed and transported separately. The crane may be equipped with up to three counterweight slabs. Each counterweight weighs approximately 3,600 lb (*1 633kg*). Therefore, removing the counterweights can reduce the weight of the crane by as much as 10,800 lb (*4 899kg*). Refer to the Crane Rating Manual for the exact weight of the counterweight.

To Remove The Counterweights

1. Park the crane on a firm level surface, engage the park brake, and shift the transmission to neutral.
2. Properly level the crane on outriggers with the tires clear of the ground.
3. Fully retract all boom sections. If equipped, properly store the fly on the boom.
4. Swing the upper over the rear of the carrier. Engage the travel swing lock and boom up to 30°.

5. Remove the connecting pins which secure the counterweights to the upper frame. Refer to Figure 1−94.

   Note: Counterweights may have to be raised (cylinders retracted) to relieve pressure on the lock pins to ease removal.

6. Pull the counterweight cylinder control lever to lower (extend cylinders) the counterweights to the storage lugs on the carrier deck.

WARNING

To avoid personal injury, do not stand under counterweights during lowering or raising of the counterweights.

7. Remove the connecting pin which secures the counterweights to the counterweight removal cylinder.

   Note: If all counterweights are not going to be removed, remove only the two counterweight connecting pins above the counterweights to be removed.

8. Pull the counterweight cylinder control lever to retract (raise) the cylinders away from the counterweights.
9. Install the connecting pins to secure the counterweights to the counterweight storage lugs on the carrier deck. Install the pin keepers.
10. If required, remove the counterweights from the carrier deck. The boom may be used to lift the counterweights onto a transport vehicle. Refer to the Crane Rating Manual for lifting loads with no counterweight.

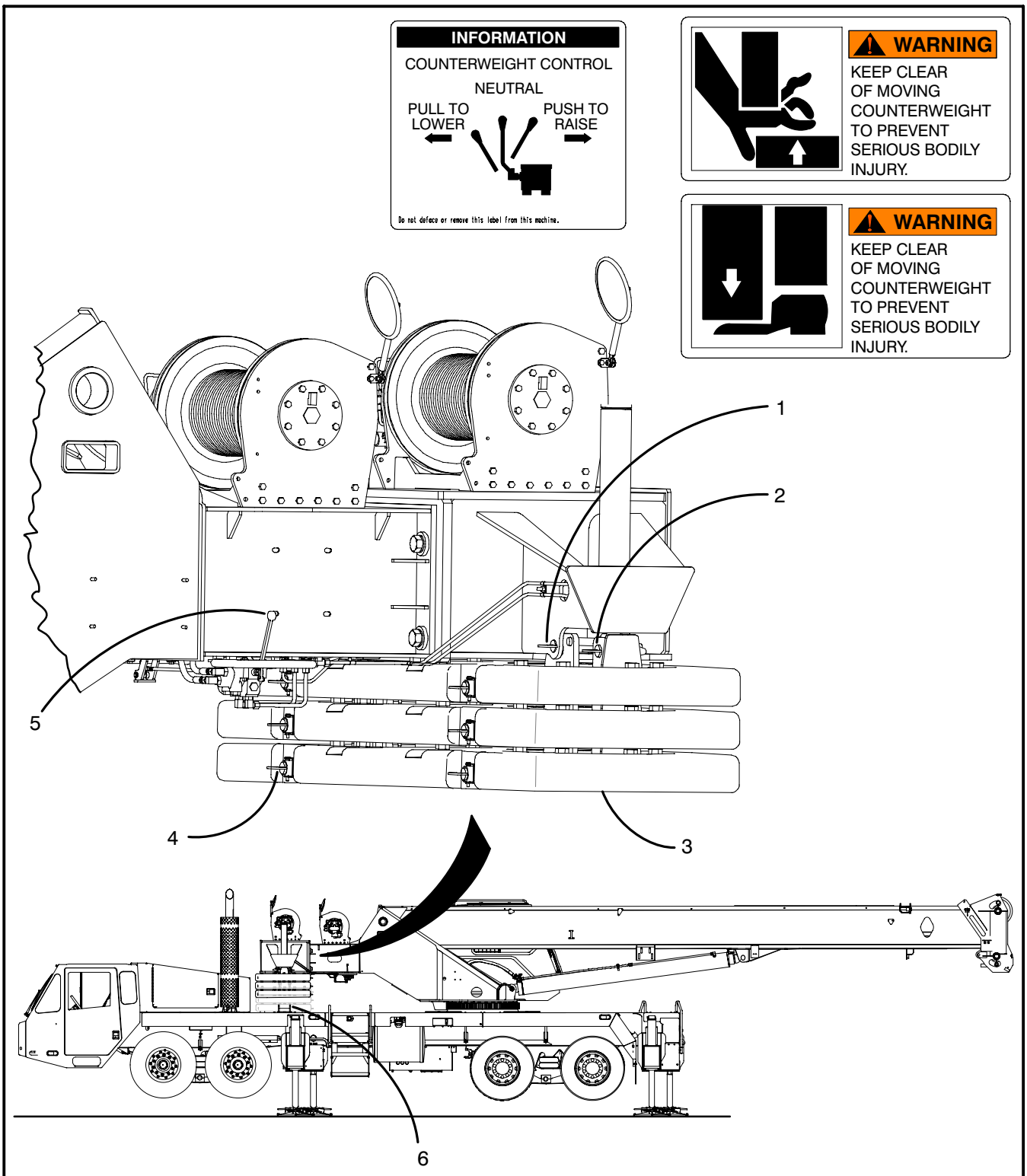
To Install The Counterweights

1. Park the crane on a firm level surface, engage the park brake, and shift the transmission to neutral.
2. Properly level the crane on outriggers with all tires clear of the ground.
3. If required, install the counterweights onto the carrier deck. The boom may be used to lift the counterweights onto carrier deck. Refer to the Crane Rating Manual for lifting loads with no counterweight.
4. Swing the upper over the rear of the carrier. Engage the travel swing lock and boom up to 30°.
5. Pull the counterweight cylinder control lever to extend (lower) the counterweight removal cylinders to align connecting lugs on the top counterweight.
6. Install the connecting pins and keeper pins to secure the counterweights to the counterweight removal cylinder.
7. Remove the connecting pins which secure the counterweights to the storage lugs on the carrier deck.
8. Push the counterweight cylinder control lever to retract (raise) the cylinders and lift the counterweights.

WARNING

To avoid personal injury, do not stand under counterweights during lowering or raising of the counterweights.

9. Continue to lift the counterweights until the lugs on the top counterweight align with the lugs on the upper frame.
10. Install the connecting pins and keepers which secure the counterweights to the upper frame.
11. Lower counterweights (extend cylinders) slightly to transfer the weight of the counterweights from the cylinders to the upper frame.



1. Connecting Pins With Keepers – Counterweights to Upper Frame (2 Required)
2. Connecting Pin With Keepers – Counterweight to Counterweight Removal Cylinder (2 Required)
3. Counterweights Installed
4. Connecting Pin With Keepers – Counterweight to Counterweight (2 Required Per Counterweight)
5. Counterweight Removal Cylinder Control Lever
6. Carrier Deck Storage Lugs

Figure 1–94
Counterweight Removal System

Lifting The Crane

The entire crane can be lifted or the components may be removed from the crane and lifted individually. Refer to Figure 1−95 for the centers of gravity and weights for the entire crane and the individual components. The following conditions and precautions must be met before lifting the crane or removing any component.

1. The crane must be parked on a firm level surface with the travel swing lock engaged, and boom in the boom rest.
2. Use lifting equipment, shackles, slings, etc., of suitable size and strength. All lifting equipment must be inspected before lifting the crane. The inspection must be recorded and dated in accordance with current OSHA regulations.
3. The weights and locations of all centers of gravity include all possible options (heaviest crane) except the fly base and fly tip. Use the centers of gravity as a starting point. Center hoist line on the center of gravity, lift a few inches, and adjust the hoist line to keep the crane/components level at all times.
4. Removal of any components from the crane will shift the center of gravity of the entire crane. Adjust hoist line to account for the removal of any component.
5. The hook block and ball are assumed to be tied off to the front of the crane.
6. When lifting the entire crane, extend outriggers beams to the intermediate position and install slings around the beams. Protect slings from any sharps edges.
7. Do not reeve load lines through the fly when lifting the entire crane or damage may result
8. Use only nylon straps to lift fly base or fly tip to prevent damage to them. Protect the straps from sharp edges. Use the connecting lugs, at each end of the sections, as the lifting points.
9. Do not allow the hoist lines to contact boom while lifting crane. Damage to the boom may result.

Towing The Crane

Always use good judgment and reliable equipment when towing the crane. Use extra caution when towing the crane on the highway and in traffic. When making connections between the crane and towing vehicle, be sure none of the connections will cause damage to either vehicle. Pay particular attention to tie rods, brake lines, steering cylinders, and steering lines.

Always exercise safety and follow all local codes when towing the crane. Prepare the crane as follows before towing it.

1. If equipped, store the fly on the boom.
2. The boom must be fully retracted and over the front of the crane in the boom rest with the travel swing lock engaged. Release the 360˚ swing lock.

CAUTION

Do not leave the 360˚ swing lock engaged when towing the crane. Failure to release the 360 degree swing lock during this operation may result in damage to the swing speed reducer.

3. Secure the hook block or ball to prevent excessive swinging.

CAUTION

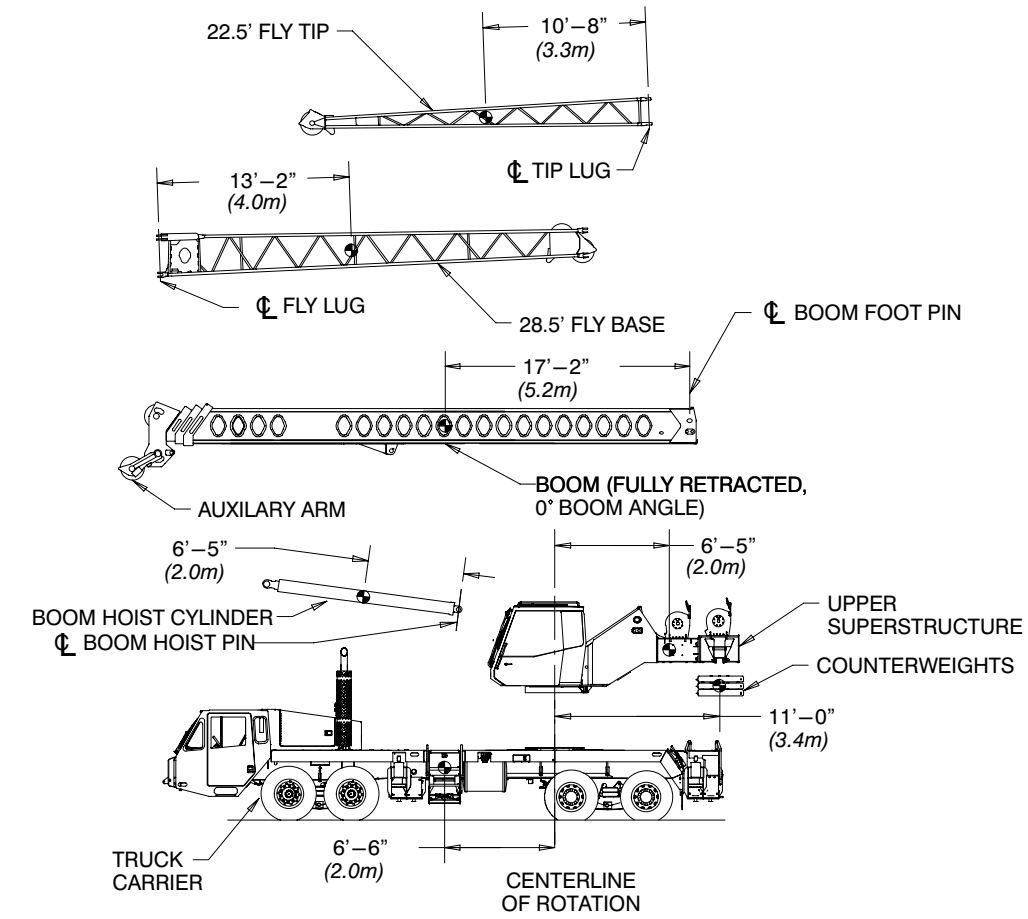
When the hoist line is tied off to the crane or any solid object, do not extend the boom, raise or lower the boom, or raise the crane on outriggers. The winch system could be overloaded causing major winch or crane damage.

4. All outriggers must be fully retracted (jacks and beams) with all pontoons removed from jacks and stored properly.
5. All control levers in the upper cab must be in the neutral position.
6. Shift the transmission to neutral.
7. Remove the drive tube between the transmission and axle.

CAUTION

Failure to disconnect the drive tube, or lift the driving wheels, before pushing or towing the crane can cause major transmission damage.

8. Unlock the steering column by turning the ignition switch to the "On" position. Turn on the hazard flashers.
9. Release the park brake when the crane is attached to the towing vehicle and ready to be towed.



DESCRIPTION	WEIGHT
CARRIER	37,500 lb (*17 000kg*)
UPPER	14,500 lb (*6 580kg*)
BOOM HOIST CYLINDER	1,900 lb (*860kg*)
BOOM w/ FOOT PIN	15,120 lb (*6 860kg*)
COUNTERWEIGHT (3)	10,800 lb (*4 900kg*)
AUXILIARY ARM	100 lb (*45kg*)
FLY BASE	1,240 lb (*565kg*)
FLY TIP	590 lb (*270kg*)
TOTAL CRANE	81,750 lb (*37 080kg*)

Figure 1–95
Lifting The Crane

Transporting the Crane

When transporting the crane, precautions should be taken in securing the crane to the trailer, barge, or other means of conveyance. The towing shackles are the recommended tie down points. If the crane is not equipped with towing shackles, chains may be looped around the outrigger boxes or the axle housings and used to secure the crane down.

CAUTION

If chains are wrapped around the axle housing, be certain the chains will not damage the tie rods, brake lines, steering cylinders, or steering lines.

If chains are wrapped around the outrigger box collar, be certain the chains will not damage the hydraulic lines and fittings. The chains should be wrapped around the outrigger box, not the outrigger beam.

Always exercise safety and follow all local codes when loading, unloading, or transporting the crane.

WARNING

Do not use the towing shackles as a means of lifting the crane. These shackles are not intended to be used to lift the crane and may break if subjected to the entire weight of the crane. Severe personal injury or extensive equipment damage may result from this practice.

Prepare the crane as follows before transporting it:

1. If equipped, store the fly on boom.
2. The boom must be fully retracted and over the front of the crane with the travel swing lock engaged. Release the 360˚ swing lock.

CAUTION

Do not leave the 360˚ swing lock engaged when transporting the crane. Failure to release the 360˚ swing lock during this operation may result in damage to the swing mechanism.

3. Secure the hook block to prevent excessive swinging.

CAUTION

When the hoist line is tied off to the crane or any solid object, do not extend the boom, raise or lower the boom, or raise the crane on outriggers. The winch system could be overloaded causing major winch or crane damage.

4. All outriggers must be fully retracted (jacks and beams) with all pontoons removed from jacks and stored properly.
5. Engage the park brake and shift the transmission to neutral.
6. All control levers in the upper cab must be in the neutral position.
7. Lock all windows and doors. Remove the keys from the crane.
8. Depending on the specific situations, further preparations may be needed to protect the crane from the environment or vandalism. See "Crane Storage" for further suggestions.

Crane Storage

Anytime the crane is going to be left unattended, it should be prepared so that it will not be damaged by the elements, be an attraction to vandals, or a plaything for children.

Short Term Storage

1. Do not leave the crane where it will be a traffic hazard.
2. Lower all loads to the ground.
3. The travel swing lock must be engaged.
4. Fully retract the boom. Boom down to 0 degrees. The fly may be erected if the crane is on outriggers.
5. Tie off the hook block to the towing shackles. Winch lines should be snug.
6. All control levers must be in the neutral position.
7. Shift the transmission to neutral, engage the park brake, and shutdown the engine. Block the wheels to prevent the crane from rolling if on tires.
8. If the crane is on outriggers, the outriggers must be properly set and supported so the crane will remain level.
9. In cold weather, locate the crane where it will not freeze to the ground.
10. Lock all windows and doors. Remove the keys from the crane.

Long Term Storage

1. Store the crane inside a building if possible.
2. Thoroughly clean the crane.
3. Touch up any spots where paint has chipped. This will prevent rusting.
4. Lubricate the entire crane as per the Lubrication Chart. Make sure all gear cases are full of oil.
5. Inflate tires to pressures shown on the Gross Axle Weight Rating plate. Check tire pressures periodically during storage to make sure they do not go flat. Refer to Section 3 for correct procedure. If possible block the crane up so the tires are clear of the ground. Make sure the blocking is placed so the crane cannot fall off it. If this is not possible, set the crane on planks so the tires will not sink in the ground. Block the tires to prevent the crane from rolling.
6. Fully retract all hydraulic cylinders if possible. If equipped, store the fly. Cover all cylinder rods and machined and unpainted surfaces with a coat of grease.
7. Leave all control levers in neutral.
8. Engage the park brake and shift the transmission to neutral.
9. Prepare the engine as per the engine manufacturers manual. Make sure antifreeze protection is sufficient to prevent the engine from freezing. If antifreeze protection is not adequate, completely drain the engine block.
10. Cover all open areas around the engine, cab, etc. to prevent entry of water. Cover the entire engine area with a tarp if possible.
11. If in a location where vandalism may occur, lock the cab doors. Cover all cab glass with plywood or boards to prevent glass breakage. Provide a means of locking the engine access doors, fuel tank, and hydraulic reservoir.
12. Drain all moisture from the air reservoirs to prevent rust and deterioration.
13. Store the crane so it does not provide a plaything for children. Such a unit can be an "attractive nuisance" for children to play on. If they fall off it or get entangled, serious injury may result.
14. While in storage, the crane should be "exercised" every 60 days to ensure the working condition of the crane. Uncover all closed-up areas and remove any tarp/cover from the engine. Start the engine and operate all switches, control cables, and hydraulic functions several times to circulate lubricants and to keep all mechanisms and linkages operative.

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General Lubrication Information

The crane should be regularly and systematically lubricated in accordance with the Lubrication Chart shown on the following pages. Refer to Figure 2−1 and Figure 2−2. Another copy of the chart is located on the the carrier. The time intervals shown on the Lubrication Chart are intended as a guide only. Under unusual working conditions, such as working in dry, dusty conditions, in water or mud, or around a corrosive atmosphere, more frequent lubrication could be necessary. In these cases, the oiler must use his best judgment and work out his own lubrication schedule.

In addition to the points on the Lubrication Chart, all movable linkages and control cables should be periodically lubricated to resist wear.

There are some very practical reasons for lubricating and lubricant changes. Lubricants serve more than one purpose. They not only lubricate, but they transport chemically reactive additives, wash away minute wear particles, serve as a corrosion inhibitor, and act as a heat transfer medium. Draining and refilling any gear unit with a fresh supply of oil also assists in eliminating wear particles not trapped by magnetic plugs.

⚠ WARNING

Shutdown engine before fueling or lubricating crane. To avoid a fire hazard, do not smoke or handle fuel around an open flame. To avoid crane damage and to prevent serious injury, do not lubricate gears or any assemblies while they are in motion.

The following procedures are important for proper lubrication of the crane:

1. Clean the grease gun nozzle and grease fitting before lubricating. This will help keep dirt and grit from entering the bushing or bearing.
2. Keep all grease and oil cans and containers clean. Always replace the lid on containers when finished to prevent entry of foreign materials. Wipe off oil can covers before using.
3. Drain oil cases when hot to drain off accumulated sludge.
4. Watch for signs of incorrect lubrication such as failure of clean grease to purge the old grease.
5. Bleed off hydraulic pressure before opening or removing a line or fitting.
6. Replace all guards before starting crane.
7. Use a clean funnel equipped with a strainer for pouring lubricants.
8. Clean the area around check and fill plugs before removing them to prevent entry of foreign particles.

Note: See specific instructions later in this section for lubrication check and change procedures on all gear compartments.

Keep grease, oil, containers, and guns clean. Wipe all fittings before lubrication. Raise the crane on outriggers or block the wheels and shutdown the engine before working on the crane. Replace all guards or panels before operating the crane.

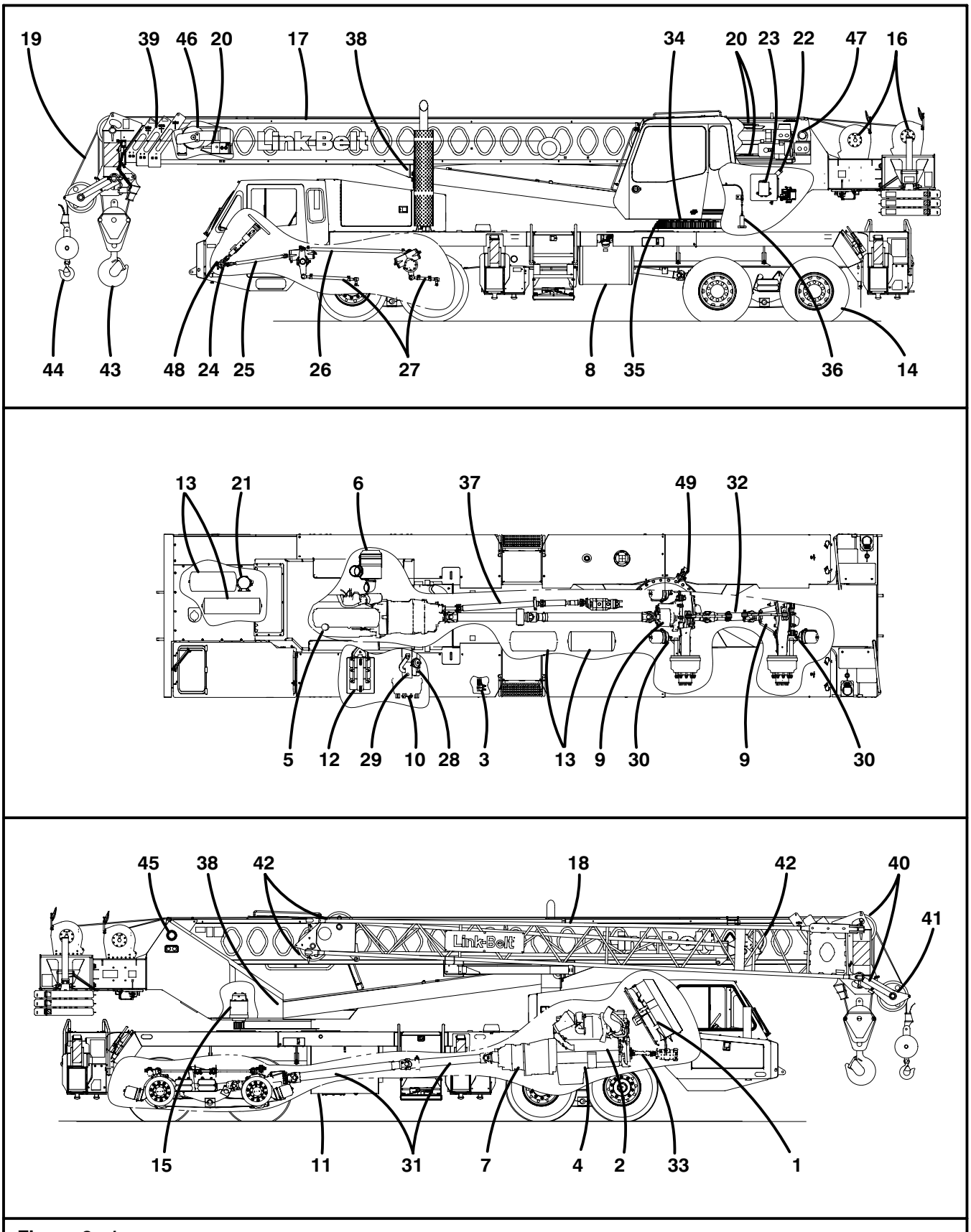


Figure 2–1
Lubrication Chart

CAPACITY

Location	Gallons	Liters	Lube Code Above −10˚F	Lube Code Below −10˚F
Engine Oil	10.50	39.70	Key 2	Key 2
Engine Coolant	9.90	37.50	Key 2	Key 2
Transmission	3.00	11.36	PP	PP
Front-Rear Axle Differential	4.90	18.55	E	LL
Rear-Rear Axle Differential	4.63	17.53	E	LL
Front Axle Wheel Bearings (each)	0.50	1.90	E	E
Fuel Tank	75.00	283.90	Key 2	Key 2
Hydraulic System	200.00	757.08	Key 3	Key 3
Hydraulic Reservoir	144.00	545.10	Key 3	Key 3
Swing Speed Reducer	1.06	4.01	HH	QQ
Winch Drum (Each)	2.25	8.52	HH	QQ
Diesel Heater Coolant Reservoir	0.79	3.00	Key 3	Key 3
Diesel Heater Fuel Tank	3.20	12.11	Key 3	Key 3

KEY

1. SYMBOLS:
   - * Check fluid level and fill as required.
   - 0 Inspect, lubricate, adjust, repair or replace as required.
   - + Change oil (and filter if applicable).
   - # Change filter only.
   - X Clean fins if needed.
   - $ Drain water.
   - N/A Not applicable.

   A,B,C,D, etc. are lubrication codes. Refer to the Lubrication Code Identification on this chart. Link-Belt recommends the lubrication codes on this chart, however if an equivalent is to be used refer to the Operator's Manual for detailed specifications to ensure a correct equivalent is used.
2. Refer to engine manufacturer's manual for proper maintenance, lubrication, fuel or coolant grade and additional information.
3. Refer to the Operator's Manual for additional information.
4. Lubricate the turntable bearing through the grease fittings on the front of the upper frame. Use a low pressure handgun and pump grease until clean grease comes out. Rotate the upper a few degrees and pump grease until clean grease comes out again. Repeat throughout the 360° cycle.

LUBRICATION CODE IDENTIFICATION

Lube Code	Recommended Type
A	Bearing Grease NLGI Grade No. 2
C	SAE 10W/30 Detergent Engine Oil
E	80W/90 Extreme Pressure Gear Lubricant
H	Open Gear Grease (Summer Grade)
V	Molybdenum Disulfide Compound Lubricant
HH	Gear Lubricant
KK	Arctic Bearing Grease NLGI Grade No.1
LL	SAE 75W/90 Extreme Pressure Gear Oil
PP	Synthetic Transmission Oil CD SAE 50
QQ	Synthetic Gear Oil

LUBRICATION

Location	Reference Number	Number Of Points	Lube Interval (Hours)	Lube Code Above −10˚F	Lube Code Below −10˚F
Miter Gear Boxes (Each Box)	24	1	250	A	KK
Steering Drive Shafts/U-joints	25	6	250	A	KK
Steering Idler Guide	26	2	250	A	KK
Steering Drag Links	27	4	250	A	KK
Tie Rod Ends	28	4	250	A	KK
King Pins (Each Front Wheel)	29	2	250	A	KK
Brake Slack Adjusters (Each Wheel)	30	2	250	A	KK
Transmission Drive Tubes/U-joints	31	3	250	A	KK
Axle Drive Tube/U-joints	32	2	250	A	KK
Front Pump Drive Tube/U-joints	33	3	50	A	KK
Turntable Bearing	34	2,Key 4	50	A	KK
Turntable Gear Teeth	35	All	50	H	H
Travel Swing Lock	36	1	250	A	KK
Main Pump Drive Tube/U-Joints	37	4	50	A	KK
Boom Hoist Cylinder Pins	38	2	10	A	KK
Boom Sliding Surfaces	39	All	Key 3	V,H	V,H
Boom Head Machinery	40	All	50	A	KK
Auxiliary Lifting Sheave	41	1	50	A	KK
Fly Head Sheaves (Base & Tip)	42	3	50	A	KK
Hook Block & Sheaves	43	All	Key 3	A	KK
Hook Ball	44	1	Key 3	A	KK
Boom Foot Pin	45	2	10	A	KK
Boom Extend Sheaves	46	2	50	A	KK
Boom Retract Sheaves	47	2	50	A	KK
Steering Column U-joint	48	1	250	A	KK
360 Degree Swing Lock	49	4	50	A	KK

MAINTENANCE

Location	Reference Number	Service Interval (Hours)	Operation	Key	Lube Code Above −10˚F	Lube Code Below −10˚F
Radiator/Surge Tank	1	10	*,X	1,2	Key 2	Key 2
Engine	2	10	*	1,2	Key 2	Key 2
Engine Fuel Filters	3	Key 3	0,$	1,2,3	Key 2	Key 2
Engine Oil Filter	4	Key 2	0,+	1,2,3	Key 2	Key 2
Engine OVC Filter	5	Key 2	#	1,2	N/A	N/A
Engine Air Cleaner	6	10	0	1,3	N/A	N/A
Transmission	7	Key 3	*,+	1,3	PP	PP
Fuel Tank	8	10	*	1,2	Key 2	Key 2
Rear Axle Differentials	9	Key 3	*,+	1,3	E	LL
Front Wheel Bearings (Each Wheel)	10	Key 3	*,+	1,3	E	LL
Hydraulic Reservoir	11	10	*,$	1,3	Key 3	Key 3
		500	#	1,3	Key 3	Key 3
		2000	+	1,3	Key 3	Key 3
Batteries	12	50	0	1	N/A	N/A
Air Reservoirs (4)	13	10	$	1	N/A	N/A
Tires	14	10	0	1,3	N/A	N/A
Swing Speed Reducer	15	50	*	1,3	HH	QQ
		1000	+	1,3	HH	QQ
Winch Drum(s)	16	50	*	1,3	HH	QQ
		1000	+	1,3	HH	QQ
Boom	17	10	0	1,3	V,H	V,H
Fly	18	10	0	1,3	N/A	N/A
Wire Rope	19	10	0	1,3	C	C
Boom Extend & Retract Wire Rope Anchors	20	50	0	1,3	N/A	N/A
Air Dryer	21	500	0	1,3	N/A	N/A
		2000	#	1,3	N/A	N/A
Diesel Heater Fuel Tank	22	10	*	1,3	N/A	N/A
Diesel Heater Coolant Reservoir	23	10	*	1,3	N/A	N/A

Figure 2–2
Lubrication Chart

Lubrication Specifications

The following specifications are approved for use in Link-Belt cranes. The specifications are identified by a code letter. When a code letter appears on the lubrication or maintenance chart, it is referring to one of the lubricants as described on the following pages. These lubricants are listed by specifications and by one brand name. Most reputable oil companies can provide a lubricant to match a particular specification. It may then be used in the crane no matter what the brand name. When using other brand names, the user assumes all responsibility for product and patent liability. It is recommended that types and brands of oil not be intermixed because of possible incompatibility.

Type A

Bearing Grease
NLGI Grade No. 2

This grease shall be a homogeneous combination of refined mineral oil and lithium soap. This grease shall not contain any fillers which adversely affect the lubricating qualities of the product. It may have additives that give a high degree of protection against corrosion of metals and oxidation of the grease. Also contains lead soap and extreme pressure additives.

The mineral oil shall meet the following specifications:

Viscosity at 100°F (*38 °C*) SUS	1086
Viscosity at 210°F (*99 °C*) SUS	82.5
Viscosity at Index (Minimum)	65
Timken Test Lever Load (Minimum)	40 lb
Pour Point (°F) Maximum	15
(*°C*) Maximum	*−9.44*

The grease shall have the following physical and chemical properties:

Penetration, Worked at 77°F (*25 °C*) (60 Strokes) Units	280
Penetration, Unworked at 77°F (*25 °C*) (60 Strokes) Units	295
Penetration Change After 10,000 Strokes (%) Maximum	15
Dropping Point (°F)	365
(*°C*)	*185*
Lithium Soap (%)	6.0
Lead Soap (%)	1.1
Recommended Maximum Temperature (°F)	250
(*°C*)	*121*
Recommended Minimum Temperature (°F)	−20
(*°C*)	*−28.8*
Water (%) Maximum	0.10

Texaco Marfak — All Purpose or Equivalent.

Type E

80W/90 Extreme Pressure Gear Lubricant

An extreme pressure gear lubricant containing antifoam protection, oxidation stability, anti-rust, and anti-corrosion qualities. Contains sulfur and phosphorus additive materials but no zinc in compliance with Eaton, General Motors and International Harvester truck driving axle requirements.

Must meet or exceed military specifications MIL−L−2104C, and are suitable for API service designations GL3, GL4 and GL5, with a rating of 10 as determined in the shock load test CRC−L−42.

Physical Properties:

Gravity, °API	25.1
Flash, COC (°F)	400
(*°C*)	*204*
Pour Point (°F)	−30
(*°C*)	*−34*
Viscosity at 100°F (*38 °C*) SUS	829
Viscosity at 210°F (*99 °C*) SUS	79.9
Viscosity Index	97
Sulfur	2.37
Ash (%)	None
CU Corr 3 Hours 250°F (*121 °C*)	1 b
Channel Point (°F) Maximum	0
(*°C*) Maximum	*−17.7*
Timken Test Lever Load (Minimum)	50 lb
Phosphorus (%)	12

Texaco Code 2316 Multigear 80W/90 or Equivalent.

Type H

Open Gear Grease

For open gear applications. Satisfactory down to −40°F (*−40 °C*) on dry gears. Good adhesiveness on open gears at 73°F (*22.7 °C*) and good retention. The grease with use will become tacky and will resist leaking. Used on cast tooth gears and ring gear teeth. Extremely resistant to water washing.

Physical Properties:

Mineral Oil Component:

Viscosity at 100°F (*38 °C*) SUS	4104
Viscosity at 210°F (*99 °C*) SUS	180
Load Wear Index	53
Penetration, Worked at 77°F (*25 °C*) (60 Strokes) Units	270
Penetration, Unworked at 77°F (*25 °C*)	242
Dropping Point (°F) Minimum	222
(*°C*) Minimum	*105*
Soap Base — Calcium (%)	8.0
With 22% graphite and 3% Molybdenum Disulfide	
Water (%)	0.6
Recommended Maximum Temperature (°F)	175
(*°C*)	*79.4*
Consistency	Buttery Grease

Texaco Texclad #2 or Equivalent.

Type V

Molybdenum Disulfide Compound Lubricant

Recommended use for grease on cut tooth gears.

A grease consistency mixture containing purified molybdenum disulfide powder M_0S_2. Powder to meet or exceed specification MIL−L−7866 (AER) with max particle size of 40 microns.

Compound to have mineral oil base not to exceed 50% by volume containing not less than 40% M_0S_2.

Non-melting molybdenum disulfide compound. It is impervious to water and is not affected by most acids or alkalis. Helps prevent galling and seizing at bearing pressures well over 100,000 pounds per square inch. Has excellent lubricating qualities at sub-zero temperatures and elevated temperatures up to 750°F (*398 °C*) under certain conditions. Has a high film strength, low coefficient of friction and tenacious adherence to metal surfaces. Will prevent corrosion. Excellent lubrication on parts exposed to water.

Physical Properties:

M_0S_2 (%)	.40
Drop Point	None
Mineral Oil (%)	42
Viscosity, Base Oil @ 100°F (*38 °C*)	2690
Corrosion	.NIL
Water (%)	0
Alkali (%)	0
Fillers (%)	0
Consistency	Medium
Jelling Agent	Pyrogenic Silicone

Bel-Ray Co. Molylube Anti-seize or Equivalent.

Type HH

Gear Lubricant

This gear lubricant is suitable for use in a wide variety of mobile equipment gear and brake applications. Has good oxidation and thermal stability, is non-corrosive to most gear and bearing materials, is inhibited to provide good foam resistance and water separation characteristics. Has moderate concentration of EP additives.

Must Meet performance requirements of AGMA Specification 250.04 for extreme pressure lubricants. Is suitable for API service designations of GL2 and GL3.

Physical Properties:

Gravity, °API	26.7
Viscosity cSt @ 104°F (*40 °C*)	144.0
Viscosity cSt @ 212°F (*100 °C*)	14.7
Viscosity SUS @ 100°F (*38 °C*)	754.0
Viscosity SUS @ 210°F (*99 °C*)	78.0
Viscosity Index	101
Flash COC	420°F (*215.5 °C*)
Pour Point	−20°F (*−28.8 °C*)
Sulfur, %	0.66
Phosphorous, %	0.03
Timken Test Lever Load (Minimum)	60 lb
AGMA No. EP	4
Appearance	Dark Red

Texaco Code No. 2320, Meropa 150 or Equivalent.

Type KK

Arctic Bearing Grease
NLGI Grade No. 1

Low temperature, extreme pressure, all purpose grease made from a low pour point hydrocarbon lubricant, thickened with a modified bentonite clay. The grease is fortified with an extreme pressure additive and a rust inhibitor to provide even better equipment protection.

A multi-purpose grease that can be pumped from normal grease dispensing equipment at temperatures down to a −65°F (*−54 °C*). Good for heavy duty operation.

Recommended for use in centralized lube systems, wheel bearings. chassis bearings, universal joints and all other applications requiring a grease of this type. This grease offers full protection regardless of the season. Pumpable at −65°F (*−54 °C*), even in a hand grease gun. Excellent anti-wear and load carrying ability, stays in place better than lighter greases, waterproof to resist washout, good shear stability. Assures good high temperature performances. Compatibility of this grease with ordinary greases presents no problems below an operating temperature of 200°F (93.3°C). Above this temperature, its compatibility is like any other bentone thickened grease.

Physical Properties:

Thickener	Bentone
Penetration worked @ 77°F (*25 °C*) (ASTM D217)	
60 stroke units	340
10,000 units	368
Roll Stability (ASTM D1831)	
Penetration Change	28
Oil Separation, WT.% (ASTM D1742)	12.6
Dropping Point (°F) (ASTM D2265)	500
(*°C*)	*262*
Viscosity @ -30°F (*-34 °C*) cSt (ASTM D446)	6750
Wheel Bearing Leakage Wt.% (D1263)	2.83
Water Washout Wt.% 77°F (*25 °C*) (D1264)	1.2
Rust Properties (ASTM D1743)	1
Falex Test (ASTM D2670)	
Teeth Wear	28
Seizure, PSI	3175
Four Ball, EP (ASTM D2596)	
Wear, mm	0.5
Weld, kg	240
LWI	40
No Seizure, kg	80
Color	Natural Tan

Continental Oil Co. (CONOCO) DN600 Grease or Equivalent.

Type LL

SAE 75W/90 Extreme Pressure Gear Oil

A synthetic, extreme pressure gear oil designed for cold weather operation in hypoid, spiral bevel and planetary gear axles. Must meet the requirements of Military Specification MIL−PRF−2105E. Meets API GL−5 and MT−1 performance ratings

Physical Properties:

Gravity, °API . . . . . 25.2 to 33.3
(ASTM D−1298)

Kinematic Viscosity
@ 212°F (100°C), cST . . . . . 15.5 Min
@ 104°F (40°C) . . . . . 126 Max
(ASTM D−443)

Apparent Viscosity @ −40°F (−40°C), ml
(Brookfield) (ASTM 2983) . . . . . 150,000 max.

Flash Point (ASTM D−92) (°C) . . . . . 204 Min.

Pour Point (ASTM D−97) (°C) . . . . −45 Max.

Viscosity Index (ASTM D−2270) . 140 to 151

Copper Corrosion,
3 hrs. @ 250°F (121°C) (ASTM D−130) 3 Max.

Foaming Characteristics (ASTM D−892)
(Foaming readings taken immediately after 5 minutes aeration)
@ 75°F (24°C), ml . . . . . 20 Max.
@ 200°F (94°C), ml . . . . . 50 Max.

Storage Stability, %
(FTMS 791B Method 3440) . . . . . 0.25 Max.

Compatibility
(FTMS 791B Method 3430) . . . . . Note 1

The latest revision of all referenced specifications and test methods shall be used.

FTMS= Federal Test Method Standard.

Note 1: Use approved per Eaton PS−163 and Mack GO−J Plus.

Mobil Oil Molilube SHC 75W/90, Code No. 51100-6 or Equivalent.

Type PP

Synthetic Transmission Fluid — CD SAE 50

A specially formulated synthetic lubricant designed for extended drain and severe service in heavy duty manual transmissions which require a straight mineral oil (non EP) MIL−L−2104D or MIL−L−46152B engine lubricant.

This lubricant is formulated from a synthetic basestock having a high viscosity index, low pour point, and sub-zero fluid flow. It also contains an anti-wear additive as well as rust, oxidation and corrosion inhibitors.

CD SAE 50 synthetic lubricant provides:

- all-climate, year round performance
- improved component protection
- easier cold weather shifting
- potential for fuel economy

Physical Properties:

SAE Grade (J306−B) 50
Viscosity, cSt (ASTM D−445)
212°F (*100°C*) 18.0
104°F (*40°C*) 138.2
Viscosity, SUS (ASTM D−2161)
210°F (*99°C*) 92.2
100°F (*38°C*) 685
Viscosity, cP (ASTM 2983)
32°F (*0°C*) 1,250
14°F (*−10°C*) 3,850
−4°F (*−20°C*) 11,650
−15°F (*−26°C*) 24,250
−22°F (*−30°C*) 45,250
−40°F (*−40°C*) 270,000
Viscosity Index (ASTM D−2270) 154
Pour Point °F (*°C*) (ASTM D−97) . . <−40 (*−40*)
Flash Point °F(*°C*) (ASTM D−92) 455(*235*)
Foam (ASTM D−892)
Sequence I . . . . . Pass
Sequence II . . . . . Pass
Sequence III . . . . . Pass
Gravity, °API 23.0
Density, lbs./gal 7.63
Copper Strip Corrosion (ASTM D−130)
3 hrs. @ 212°F (*100°C*) . . . . . Pass
3 hrs. @ 250°F (*121°C*) . . . . . Pass

Texaco Syn-Star TL50 or Equivalent.

Type QQ

Synthetic Gear Oil

A specially formulated lubricant for applications where service conditions are severe because of high operating and bulk oil temperatures. Typical applications are spur, helical, herringbone, bevel, and planetary gears. This lubricant is derived from synthetic based oils that are more resistant to thermal and oxidation degradation. It can offer advantages of extension of lubricant life and reduced risk of damage to machine elements.

Physical Properties:

AGMA Grade No. . . . . 4 EP
Gravity, °API 25.4–34.4
ISO Viscosity Grade 150
Viscosity @ 100°F (*38 °C*), Cst 140.0
Viscosity @ 212°F (*100 °C*), Cst 14.0
Viscosity @ 100°F (*38 °C*), SUS 737
Viscosity @ 210°F (*99 °C*), SUS 75–100
Viscosity Index 96–150
Flash COC . . . . . 460°F (*238 °C*)
Pour Point . . . . . –10°F (*–23 °C*)
Rust Test, Distilled Water . . . . . Pass
Copper Corrosion Test
24 hr. –30 hr. @ 212°F (*100 °C*) . . . . . 1 b
Timken Extreme Pressure Test
Pass Value . . . . . 60 lb
FZG Test, Stages, Pass 12
Phosphorus, Wt. % 005–.03

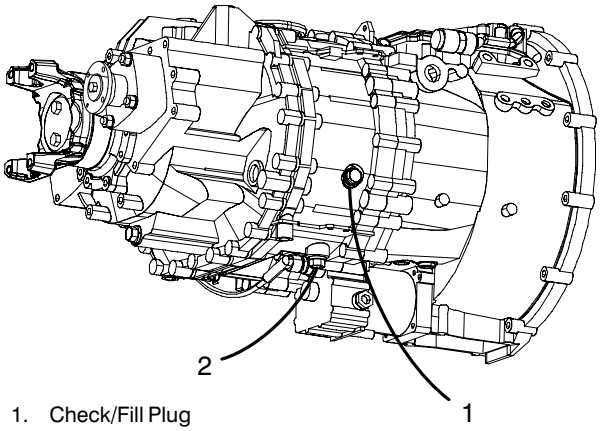
Mobil SHC 629 or Equivalent.

Hi Performance Hydraulic Oil Chart

Important

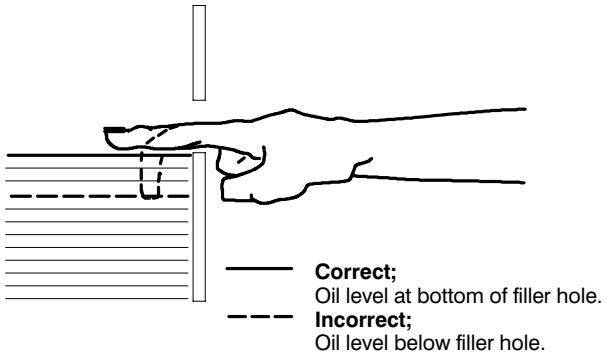
Use only pre-filtered hydraulic oil. Warranty is void if incorrect oil is used. Incorrect oil may result in damage to hydraulic components. Hi Performance Hydraulic Oil is available through your distributor in the following grades and quantities.

Oil Grades	Temperature Range		Container Capacity		Link-Belt Part Number
	Ambient Temperature Use	Maximum Hydraulic System Temperature	Gallons	*Liters*	
Grade 22	–45°F to 80°F *–43 °C to 27 °C*	150°F *65 °C*	5 55	*18.9* *208.0*	830666001 830666002
Grade 46	10°F to 100°F *–12 °C to 38 °C*	200°F *93 °C*	5 55	*18.9* *208.0*	830663001 830663002



1. Check/Fill Plug
2. Drain Plug

Figure 2–3
Transmission Lubrication



Note: Oil level close enough to the hole to be seen or touched is not sufficient. It must be level with the bottom of the hole.

Figure 2–4
Checking The Oil Level

Transmission Lubrication

The transmission is designed so that internal parts operate in a bath of oil circulated by the motion of gears and shafts. Some internal parts are equipped with built in channels to ensure that the bearings and shafts are properly lubricated.

On new or rebuilt transmissions, change transmission oil after the initial 3,000 miles (*4 800km*). Change the oil every 50,000 miles (*80 450km*) or two years thereafter. The oil level should be checked every 10,000 miles (*16 090km*) or monthly, whichever occurs first.

Transmission Oil Level Check

1. Park the crane on a firm, level surface. Engage the park brake, shift the transmission to neutral, and shutdown the engine.
2. From the underside of the carrier, locate the check/fill plug on the right side of the transmission housing. Refer to Figure 2–3.
3. Clean the transmission housing around the check/fill plug to prevent entry of foreign material into the transmission.
4. Remove the check/fill plug. The oil must be level with the bottom of the hole. Refer to Figure 2–4.
5. Add oil as required through the check/fill hole to bring the oil to the proper level. Install the check/fill plug. Refer to the Lubrication Chart for the correct grade of oil.

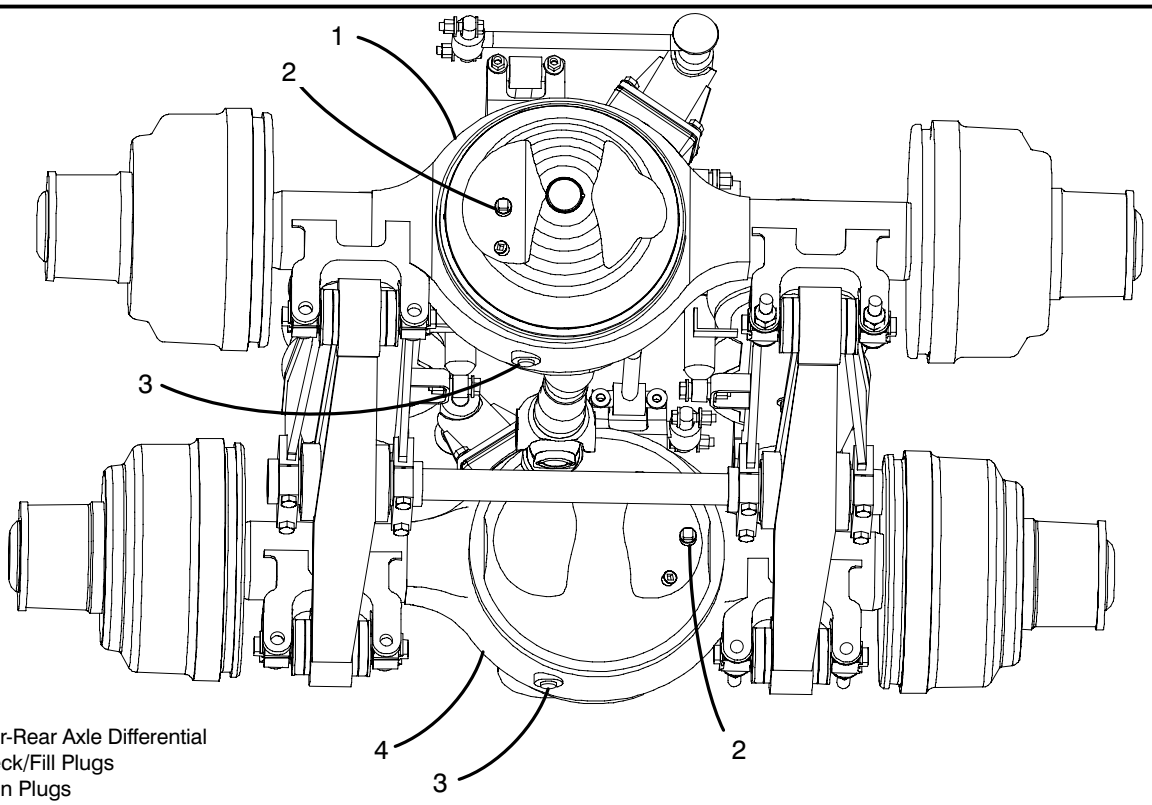
   Note: Do not overfill. Overfilling the transmission will cause oil to be forced out of the case through the main shaft opening.

   Note: The transmission manufacturer recommends that types and brands of oil not be intermixed because of possible incompatibility.

Transmission Oil Change

The best time to change transmission oil is just after the crane has been road driven. The oil will be warm and any foreign particles will be suspended in the oil. This is especially desirable in cold weather situations.

1. Park the crane on a firm, level surface. Engage the park brake, shift the transmission to neutral, and shutdown the engine.
2. From the underside of the carrier, locate the check/fill plug on the right side of the transmission housing. Refer to Figure 2–3. Locate the drain plug on the bottom of the transmission.
3. Clean the transmission housing around the drain and check/fill plugs. Remove the drain plug and check/fill plug. Allow the oil to drain into a suitable container. The drain plug is magnetic and should be inspected for large quantities of metal particles. After the initial oil change, these are signs of damage or extreme wear in the transmission and inspection of the entire unit may be necessary.
4. After the transmission has thoroughly drained, install the drain plug and fill the transmission with light flushing oil or kerosene.
5. Remove drain plug and drain flushing oil or kerosene from transmission into a suitable container.
6. Clean and install the drain plug. Add oil through the check/fill hole until it is level with the bottom of the hole. Refer to Figure 2–4.
7. Clean and install the check/fill plug. Properly dispose of the used oil and flushing solution.



1. Rear-Rear Axle Differential
2. Check/Fill Plugs
3. Drain Plugs
4. Front-Rear Axle Differential

Figure 2–5
Rear Axle Differentials

Axle Differential Lubrication

For troublefree operation, over a period of years, the differentials must be properly lubricated. Check the oil level in each rear axle differential every 1,000 miles (*1 600km*). The oil in a new or rebuilt axle should be changed after the first 1,000 miles (*1 600km*) but no later than the first 3,000 miles (*4 800km*). Change the oil every 30,000 miles (*48 000km*) or semiannually thereafter, whichever occurs first.

Axle Differentials Oil Level Check

1. Park the crane on a firm, level surface, engage the park brake, shift the transmission to neutral, and shutdown the engine.
2. From the underside of the carrier, locate the check/fill plug of the differential. Refer to Figure 2–5.

CAUTION

Do not tamper with the pinion drive gear backlash adjusting screw located on the opposite side of the axle from the check/fill plug. Tampering with this screw may result in differential damage.

3. Clean the area around the check/fill plug.
4. Remove the check/fill plug and check the oil level. Oil must be level with the bottom of the check/fill hole. Refer to Figure 2–4.
5. Add oil, as required, until it begins to flow from the check/fill hole. Refer to Lubrication Chart for correct grade of oil.

   Note: The axle manufacturer recommends that types and brands of oil not be intermixed because of possible incompatibility.

   Note: When checking oil levels of the axle differentials, also check and clean axle housing breathers, located on the top of the axle housings.

6. Clean and install the check/fill plug.

Axle Differentials Oil Change

The best time to change oil in the differentials is immediately after the crane has been driven. At this time, the lubricant will be warm and easily drained. This procedure is especially desirable in cold weather conditions.

1. Park the crane on a firm, level surface, engage the park brake, shift the transmission to neutral, and shutdown the engine.

2. From the underside of the carrier, locate the drain plug in the bottom of the differential. Refer to Figure 2−5.
3. Clean the area around the drain plug, before removing it.
4. Remove the drain plug and allow the oil to drain into a suitable container. The drain plug is magnetic and should be inspected for large quantities of metal particles. After the initial oil change, this is a sign of damage or extreme wear within the unit, and a complete internal inspection may be necessary. Clean the drain plug and install it after the oil has thoroughly drained.
5. Locate and remove the check/fill plug. Refer to Figure 2−5.

CAUTION

Do not tamper with the pinion drive gear backlash adjusting screw located on the opposite side of the axle from the check/fill plug. Tampering with this screw may result in differential damage.

6. Fill the differential with oil until it is level with the bottom of the check/fill hole. Refer to Figure 2−4. Refer to the Lubrication Chart for correct quantity and grade of oil.

   Note: The axle manufacturer recommends that types and brands of oil not be intermixed because of possible incompatibility.

   Note: When changing the oil of the axle differentials, also check and clean the axle housing breathers located on the top of the axle housing.

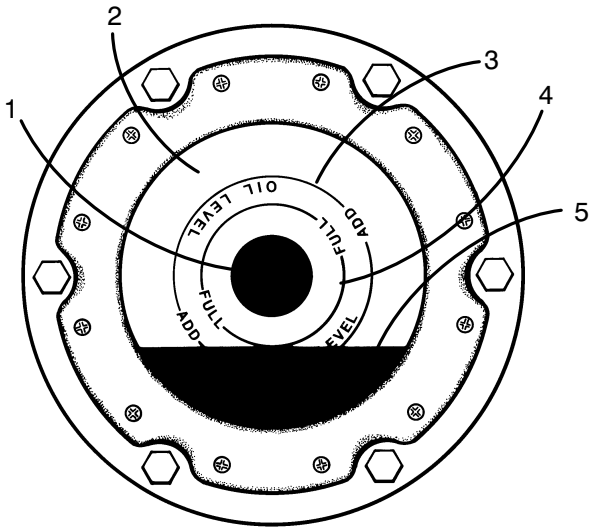
7. Clean and install check/fill plug. Properly dispose of the used oil.

Wheel Bearing Lubrication

Rear Axle Wheel Bearings

Under normal operating conditions, the rear axle wheel bearings are protected by oil carried into the wheel ends by the motion of axle shafts and gearing. Oil becomes trapped in the cavities of the wheel end and remains there, ensuring that oil is instantly available when the crane is in motion.

In short, as long as the rear axle differentials are operating with the proper oil levels and using the correct grade oil, the rear wheel bearings are automatically lubricated.



1. Fill Plug
2. Transparent Hub Cap
3. Add Line
4. Full Line
5. Correct Oil Level

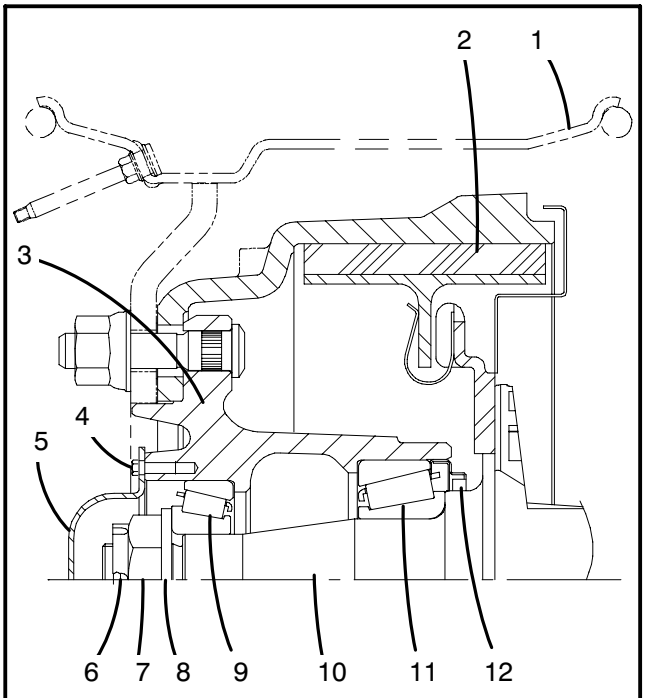
Figure 2−6
Front Axle Wheel End

Front Axle Wheel Bearings

The wheel bearings of the front axles are oil lubricated. A transparent hub cap is used on each of the front axle wheel ends, to simplify filling and checking the oil level. Check the oil level, in each front wheel end, every 1,000 miles (*1 600km*). Change the oil every 30,000 miles (*48 000km*) or semiannually, whichever occurs first.

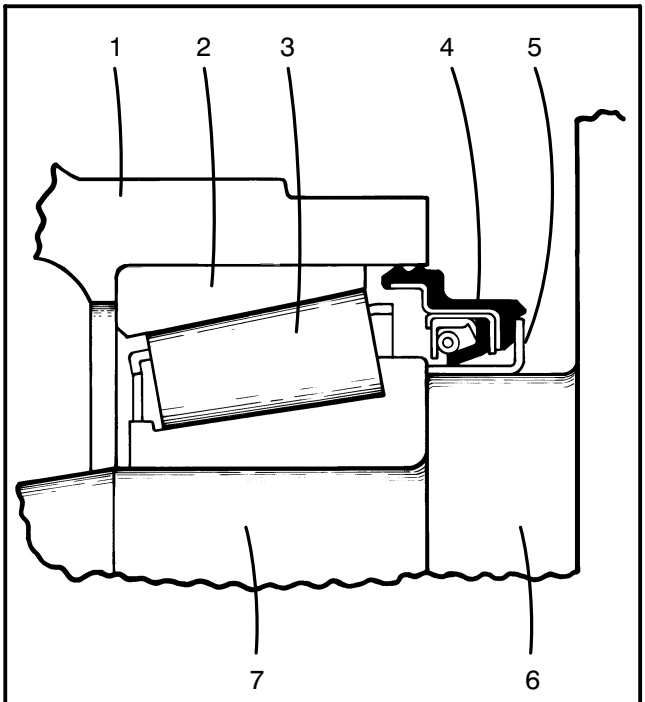
Front Axle Wheel End Oil Level Check

1. Park the crane on a firm, level surface, engage the park brake, shift the transmission to neutral, and shutdown the engine.
2. View the oil level in each axle wheel end, through the transparent hub cap. Refer to Figure 2−6.
3. Check to see that the oil level is above the "ADD" line on the hub cap.
4. If the oil level is on or below the "ADD" line, thoroughly clean the exterior surface of the hub cap and remove the fill plug. Add oil as required to bring the oil level to the "FULL" line. Refer to the Lubrication Chart for the correct grade of oil. Do not overfill.
5. Clean and install the fill plug.



1. Rim Assembly
2. Brake Shoe
3. Hub
4. Capscrew
5. Hub Cap
6. Cotter Pin
7. Adjusting Nut
8. Thrust Washer
9. Outer Bearing
10. Spindle
11. Inner Bearing
12. Oil Seal

Figure 2–7
Front Wheel Assembly



1. Hub
2. Inner Bearing Cap
3. Inner Bearing Cone
4. Oil Seal
5. Deflector Ring
6. Spindle Shoulder
7. Spindle

Figure 2–8
Oil Seal Installation

Front Axle Wheel End Oil Change

1. Park the crane on a firm, level surface, engage the park brake, and shift the transmission to neutral. Level the crane on outriggers and shutdown the engine.
2. Carefully remove the tire and rim assembly from the wheel. Refer to Section 3 of this Operator's Manual for the correct procedure.
3. Place a suitable container under the wheel assembly to catch the oil which will be drained from the hub. Remove the capscrews securing the hub cap to the hub. Refer to Figure 2–7.
4. Break the seal between the hub cap and hub, and remove the hub cap.
5. After the oil has thoroughly drained from the hub, remove the cotter pin, adjusting nut, and thrust washer from the spindle.
6. Adequately support the wheel assembly with an appropriate lifting device. Slowly remove the wheel assembly, using care not to damage the bearings, hub, or spindle.
7. Remove the oil seal and bearings from the hub. Use care not to damage the oil seal, if it is to be reused.
8. If the oil seal is to be replaced, remove the deflector ring from the spindle and discard. Refer to Figure 2–8.
9. Thoroughly clean all components with kerosene. Be sure to remove all foreign material from bearings and interior cavity of the hub. Remove any old gasket material from the spindle.
10. Thoroughly inspect all parts for damage, wear, and corrosion. Replace any defective parts as required. When replacing a bearing cone, install a new bearing cup also. Remove any burrs on the spindle with an emery cloth. It is recommended that the oil seal be replaced, however, the old oil seal may be reused if it is properly inspected for damage or wear before installation.
11. Install the oil seal on the spindle as follows:

    To Install A New Oil Seal

    a. Apply a light coat of Permatex No. 2, or equivalent, to the O.D. of the spindle shoulder. Refer to Figure 2–8.
    b. Place the oil seal and deflector ring assembly on the spindle so the words "OIL BEARING SIDE" can be read. A slight step in the I.D. of the deflector ring, will allow it to be placed by hand, approximately .12 inch (*3mm*) onto the

shoulder of the spindle. Do not install the oil seal into the bore of the hub.

c. Using the proper size seal installation tool, install the oil seal and deflector ring assembly on the shoulder of the spindle, so it is square and flush with the face of the shoulder.

To Reuse The Same Oil Seal

a. Inspect the old oil seal and deflector ring to be sure they are clean and suitable for reuse. Refer to Figure 2−8.

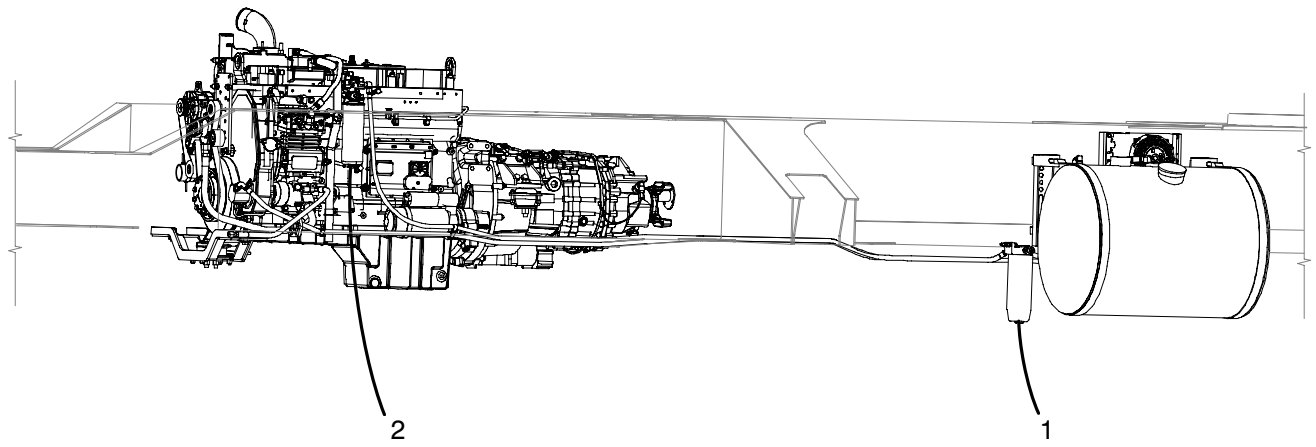
b. Lightly lubricate the oil seal and place it on the deflector ring so the words "OIL BEARING SIDE" can be read.

c. Rotate the oil seal back and forth to ensure it is properly seated on the deflector ring.

12. Dip the inner bearing in oil and place it on the spindle. Use care not to get oil on the brake linings. Refer to the Lubrication Chart for the correct grade of oil to use.
13. Carefully place the wheel assembly on the spindle and slide it back until it just contacts the oil seal. Do not push the wheel onto the seal by hand. The wheel will be pushed onto the seal when the adjusting nut is tightened.
14. Dip the outer bearing in oil and place it on the spindle. Install the thrust washer and adjusting nut.
15. Tighten the adjusting nut to 50 ft lb (*68 Nm*) while rotating the wheel back and forth.
16. Back off the adjusting nut 1/16 to 1/4 turn, to allow the wheel to turn freely and install the cotter pin.
17. Install the hub cap, using a new gasket and tighten the capscrews evenly.
18. Remove the fill plug in the hub cap. Fill the hub with oil until the oil level reaches the "FULL" line on the transparent cover. Refer to the Lubrication Chart for the correct quantity and grade of oil. Do not overfill. Refer to Figure 2−6.

    Note: Allow sufficient time for the oil to seep through the bearings and reach its actual level before reading the oil level indicated on the transparent cover.

19. Install the fill plug in the hub cap.
20. Install tire and rim assembly. Refer to Section 3 of this Operator's Manual for the correct procedure.
21. Repeat procedure for each front axle wheel end. Properly dispose of the used oil.



1. Primary Fuel Filter
2. Secondary Fuel Filter

Figure 2–9
Fuel Filters

Fuel Filters

Two spin-on type filter are used, a primary filter/water separator and a secondary fuel filter. The function of the filters is to remove water and contaminants from the fuel before they enter the engine fuel system. Providing clean, dry fuel is important for troublefree operation and long life of the fuel system. Water should be drained daily before start-up. Change the fuel filters every 500 hours of operation. The primary filter is located next to the fuel tank. The secondary filter is located on the left side of the engine. Refer to Figure 2–9.

⚠ WARNING

Do not service the fuel filter until the fuel has cooled. When the temperature of diesel fuel is elevated, as occurs when the fuel is circulated through an operating engine, it may pose the following hazards which should be guarded against.

Heated liquid fuel may cause scalding if allowed to come in contact with the skin.

Heated diesel fuel can form combustible vapor mixtures in the area around the fuel source.

The following precautions should be taken to minimize the possibility of injuries from heated diesel fuel:

1. **Whenever possible, the engine and fuel should be given an opportunity to cool down to ambient temperature before performing service operations that could result in the spillage of fuel from the engine or fuel system. When this is not possible, protective clothing (face shield, insulated gloves, apron, etc.) should be worn when performing these operations.**
2. **Keep open flames, sparks, or other potential ignition sources away and do not smoke during refueling and service operations which could result in the escape of liquid or vaporized diesel fuel.**
3. **Fuel system service operations should be performed in a well ventilated area.**

Primary Fuel Filter Water Drain

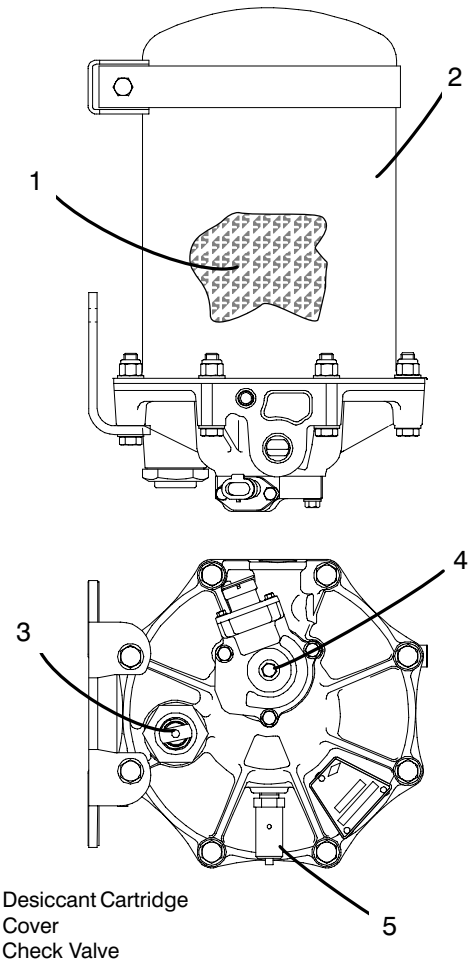
1. Park crane on a firm, level surface, shift transmission to neutral, engage park brake, and shutdown the engine.
2. Place a suitable container under the drain valve. Open the filter vent and drain valve.
3. Continue draining until clean fuel is visible.
4. Close the drain valve and filter vent.
5. Open the bleed plug located by the secondary filter. Start the engine and check for leaks. Let the engine run for a few minutes to purge any air that may be trapped in the system. Close the bleed plug.
6. Properly dispose of contaminated fuel.

Primary Fuel Filter Change

1. Park crane on a firm, level surface, shift transmission to neutral, engage park brake, and shutdown the engine.
2. Clean the area around the filter head.
3. Place a suitable container under the drain valve. Open the filter vent and drain valve. Drain all fuel from the filter.
4. Remove the filter from the filter head.
5. Fill the new filter with clean fuel.
6. Lubricate the new filter seal with clean engine oil. Install the new filter onto the filter head by hand.
7. Open the bleed plug located by the secondary filter. Start the engine and check for leaks. Let the engine run for a few minutes to purge any air that may be trapped in the system. Close the bleed plug.
8. Properly dispose of contaminated fuel and filter.

Secondary Fuel Filter Change

1. Park crane on a firm, level surface, shift transmission to neutral, engage park brake, and shutdown the engine.
2. Clean the area around the filter head.
3. Place a suitable container under the filter to catch any fuel that may be spilled during filter removal.
4. Remove the filter from the filter head.
5. Fill the new filter with clean fuel.
6. Lubricate the new filter seal with clean engine oil. Install the new filter onto the filter head by hand.
7. Open the bleed plug. Start the engine and check for leaks. Let the engine run for a few minutes to purge any air that may be trapped in the system. Close the bleed plug.
8. Properly dispose of contaminated fuel and filter.



1. Desiccant Cartridge
2. Cover
3. Check Valve
4. Purge Valve
5. Safety Valve

Figure 2–10
Air Dryer

Carrier Air System

The air system is equipped with an air dryer which removes water, oil, and dirt from the system. The air dryer provides clean, dry air to the air system components. Every 500 hours or 3 months, whichever occurs first, ensure the air dryer is functioning properly. Open the air reservoir drain valves and check for moisture in the system. If moisture is present, the desiccant cartridge may require replacement; however, the following conditions can also cause water accumulation and should be considered before replacing the desiccant cartridge:

1. An outside air source has been used to charge the system. This air did not pass through the air dryer.
2. In areas where more than a 30 degree range of temperature occurs in one day, small amounts of water can accumulate in the system due to condensation.
3. Air usage is high. Check the entire system for leaks. Check for leakage at the air dryer's exhaust port purge valve and the delivery port check valve. Refer to Figure 2–10. Check the operation of the safety valve by pulling the exposed stem while the compressor is loaded (compressing air). There must be an exhaust of air while the stem is held and the valve should reseat when the stem is released.

Air Dryer Desiccant Cartridge Change

The air dryer contains of a desiccant cartridge which must be changed every 2,000 hours or annually, whichever occurs first. Refer to Figure 2–10.

1. Park the crane on a firm, level surface, shift the transmission to neutral, and engage the park brake.
2. Engage the travel swing lock and shutdown the engine.

⚠ WARNING

Air lines may contain high pressure. Opening lines and fittings before relieving air pressure may result in serious injury. Shutdown the engine and drain the air system reservoirs before opening any line or fitting.

3. Open the drain valves on the air system reservoirs to relieve the air system pressure.
4. When pressure is fully relieved, close the drain valves on the air system reservoirs.
5. Label for assembly purposes and disconnect the air lines. Cap the air lines to prevent contamination.
6. Disconnect the electrical connector.
7. Remove the capscrews from the mounting bracket and remove the unit from crane.
8. Remove the cover from the base.
9. Remove the desiccant cartridge from the base and properly discard the o-rings and used cartridge.
10. Install the new cartridge and o-rings.
11. Remove and replace the safety valve and the exhaust cover.
12. Install unit on crane.

Figure 2–11
Allow engine to cool before removing the fill cap.

Engine Cooling System

The coolant in the engine cooling system must be maintained at the proper level and proper concentration levels to adequately keep the engine operating at safe temperatures.

Anti-freeze must be used in all climates for both freezing and boiling protection. It broadens the operating temperature range by lowering the coolant freezing point and by raising its boiling point. Refer to engine manufacturer's manual for proper coolant selection.

WARNING

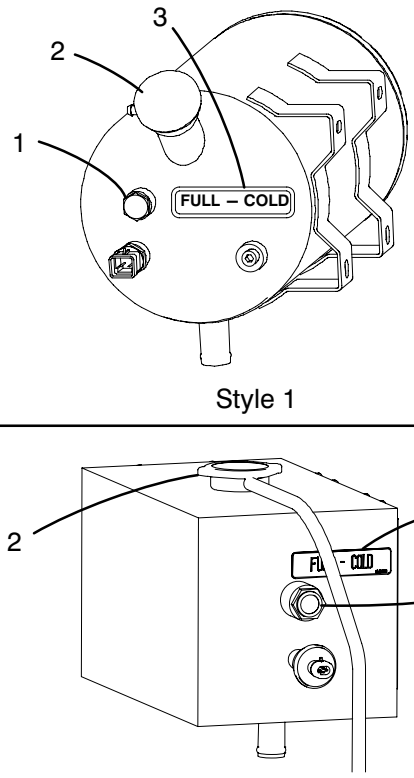
Avoid prolonged and repeated skin contact with antifreeze. Such prolonged, repeated contact can cause skin disorders or other bodily injury. Keep out of reach of children.

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

Cooling System Test

Check the glycol (antifreeze) concentration and the freezing point protection as outlined in the engine manufacturer's manual.

Testing the engine coolant is important to ensure that the engine is protected from internal cavitation and from corrosion. Refer to engine manufacturer's manual for additional information on coolant system analysis.



1. Sight Gauge
2. Fill Cap
3. Coolant Level Label

Figure 2–12
Engine Coolant Surge Tank

Cooling System Level Check

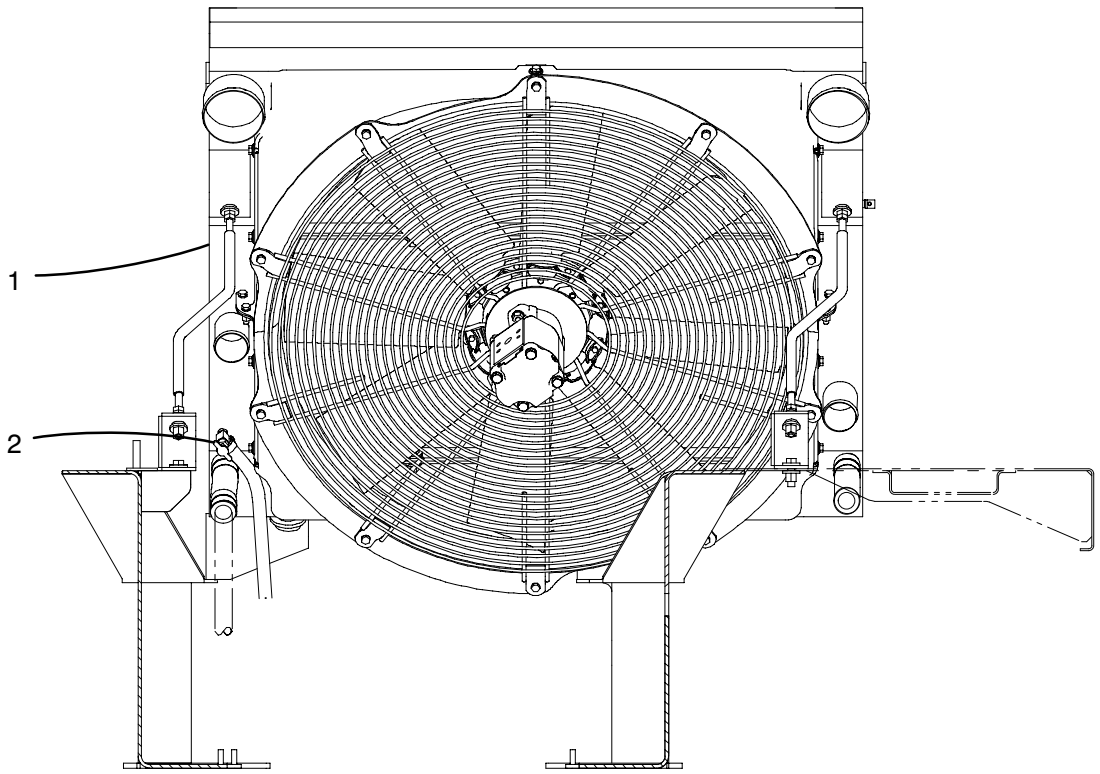
Check the coolant level in surge tank every 10 hours of operation.

1. Park the crane on a firm, level surface, shift the transmission to neutral, apply the park brake, and shutdown the engine.
2. Check that the coolant level in the surge tank is at least up to the "Full–Cold" level on the side of the tank. Refer to Figure 2–12.

WARNING

Engine cooling system is pressurized. Do not remove vent cap from a hot engine. Heated coolant spray or steam can cause personal injury. Wait until the engine has cooled before slowly removing fill cap.

3. If coolant must be added, allow engine to cool until the the coolant temperature is below 122˚F (*50˚C*).



1. Radiator Assy
2. Drain Valve

Figure 2–13
Engine Cooling System

CAUTION

Do not add cold coolant to a hot engine. Engine castings can be damaged. Allow the engine to cool until the coolant temperature is below 122˚F (*50˚C*) before adding coolant.

Never use a sealing additive to stop leaks in the cooling system. This can result in cooling system plugging and inadequate coolant flow, causing the engine to overheat.

If additional coolant must be added, it must be pre-mixed before being added to the system. Since the ability of antifreeze to remove heat from the engine is not as good as water, pouring antifreeze into the system first could contribute to an overheated condition before the liquids are completely mixed.

4. Slowly remove the fill cap. Add coolant, as required, to completely fill the tank. Use a pre-mixed solution per the engine manufacturer's specification. Refer to engine manufacturer's manual for proper coolant selection.
5. Replace fill cap. Start the engine and let it run until it reaches normal operating temperature. Shutdown the engine and repeat Step 2.

Cooling System Coolant Change

Drain, flush, and fill the engine cooling system at the intervals outlined in the engine manufacturer's manual. Use a pre-mixed solution per the engine manufacturer's specification. Refer to engine manufacturer's manual for proper coolant selection.

CAUTION

Protect the environment: Handling and disposing of used anti-freeze is subject to federal, state, and local regulations. Use authorized waste disposal facilities, including civic amenity sites and garages providing authorized facilities for the receipt of used anti-freeze. If in doubt, contact your local authorities or the EPA for guidance as to proper handling of used anti-freeze.

1. Park the crane on a firm, level surface, shift the transmission to neutral, apply the park brake, and shutdown the engine.
2. Allow the engine to cool until the coolant temperature is below 122˚F (*50˚C*).

WARNING

Engine coolant may be hot and could cause burns. Avoid prolonged and repeated skin contact with antifreeze. Such prolonged, repeated contact can cause skin disorders or other bodily injury. Keep out of reach of children.

Coolant is toxic. Keep away from children and pets. If not reused, dispose of in accordance with local environmental regulations.

3. Drain the cooling system by opening the drain valve on the radiator and engine block. Allow the coolant to drain into a suitable container. Properly dispose of used anti-freeze. Refer to Figure 2−13.
4. Check for damaged hoses and hose clamps. Hoses must be firm to the feel. If they are soft and spongy they must be replaced. Replace as required. Check the radiator for leaks, damage, and build up of dirt. Clean and replace as required.
5. Close the drain valve on the radiator and engine block.

CAUTION

During filling, air must be vented from the engine coolant passages. Wait 2 to 3 minutes to allow air to be vented. Air trapped in the system may cause damage to the engine.

6. Remove the fill cap from the surge tank.
7. Flush the system as outlined in the engine manufacturer's manual. If the engine is warm, fill slowly to prevent the rapid cooling and distortion of the metal castings.
8. Flush the system as many times as required until the water is clean.
9. Add coolant, as required, to completely fill the tank. Use a pre-mixed solution per the engine manufacturer's specification. Refer to engine manufacturer's manual for proper coolant selection. Do not install the filler cap.
10. Start the engine and let it run at low idle. Increase engine rpm to 1,500. Run the engine at high idle for approximately 1 minute to purge trapped air from the system. Shutdown the engine.
11. Check the coolant level to make sure that the coolant level has risen to the "Full−Cold" level on the side of the tank. Refer to "Coolant System Level Check" found earlier in this Section of this Operator's Manual.
12. Install the fill cap on the surge tank.

WARNING

Engine cooling system is pressurized. Do not remove vent cap from a hot engine. Heated coolant spray or steam can cause personal injury. Wait until the engine has cooled before slowly removing fill cap.

13. Start the engine. Check System for leaks and for proper operating temperature.

Hydraulic Reservoir

The hydraulic reservoir is used to supply and store hydraulic oil needed to operate all hydraulic functions of the crane. The hydraulic reservoir, as shown in Figure 2−14, is equipped with a sight gauge for checking the oil level.

A filter housing is mounted on the top of the tank. It has a contamination indicator which signals when the filter is being bypassed. Drain any water from the hydraulic reservoir, check the oil level, and inspect the contamination indicator daily. Operating the crane with the oil level below the full mark or with the filter element bypassed can lead to hydraulic component failure. Refer to the following procedures when servicing the hydraulic reservoir.

Water Drain

Drain the water from the hydraulic reservoir daily before start-up. Contaminated oil will damage the systems hydraulic components.

1. Relieve any trapped hydraulic system pressure by working the control levers back and forth in the operator's cab.

WARNING

All trapped hydraulic pressure must be exhausted from the system before removing any plug or cover. A sudden release of hot oil could cause burns or other serious injury.

2. Loosen the water drain plug and allow the water to drain into a suitable container. The water drain plug is slotted and does not need to be completely removed to drain the water.
3. When a clean flow of hydraulic oil begins to drain from the water drain plug, tighten the plug.
4. Check the oil level in the hydraulic reservoir before beginning operation of the crane. Add oil if necessary. Refer to "Adding Oil to The Hydraulic Reservoir" found later in this Operator's Manual. Properly dispose of the contaminated oil.

Hydraulic Reservoir Oil Level Check

Check the oil level in the hydraulic reservoir daily before start-up. Operating the crane with the oil level below the full mark can lead to hydraulic component failure.

1. With all hydraulic cylinders fully retracted and the boom in the boom rest, park the crane on a firm level surface. Engage the park brake, shift the transmission to neutral, and shutdown the engine.
2. With the hydraulic oil cold (approximately 62°F 17°C), check its level through the sight gauge located on the front of the hydraulic reservoir. Refer to Figure 2−14. The proper level must be maintained at all times. Add hydraulic oil as necessary to bring the oil level between the "HIGH" and "LOW" marks. Use only Hi Performance Hydraulic Oil or an approved substitute. Do Not Overfill.

Adding Oil To The Hydraulic Reservoir

1. Park the crane on a firm, level surface. Engage the park brake, shift the transmission to neutral, and shutdown the engine.
2. Relieve any trapped hydraulic system pressure by working the control levers back and forth in the operator's cab.

WARNING

All trapped hydraulic pressure must be exhausted from the system before removing any plug or cover. A sudden release of hot oil could cause burns or other serious injury.

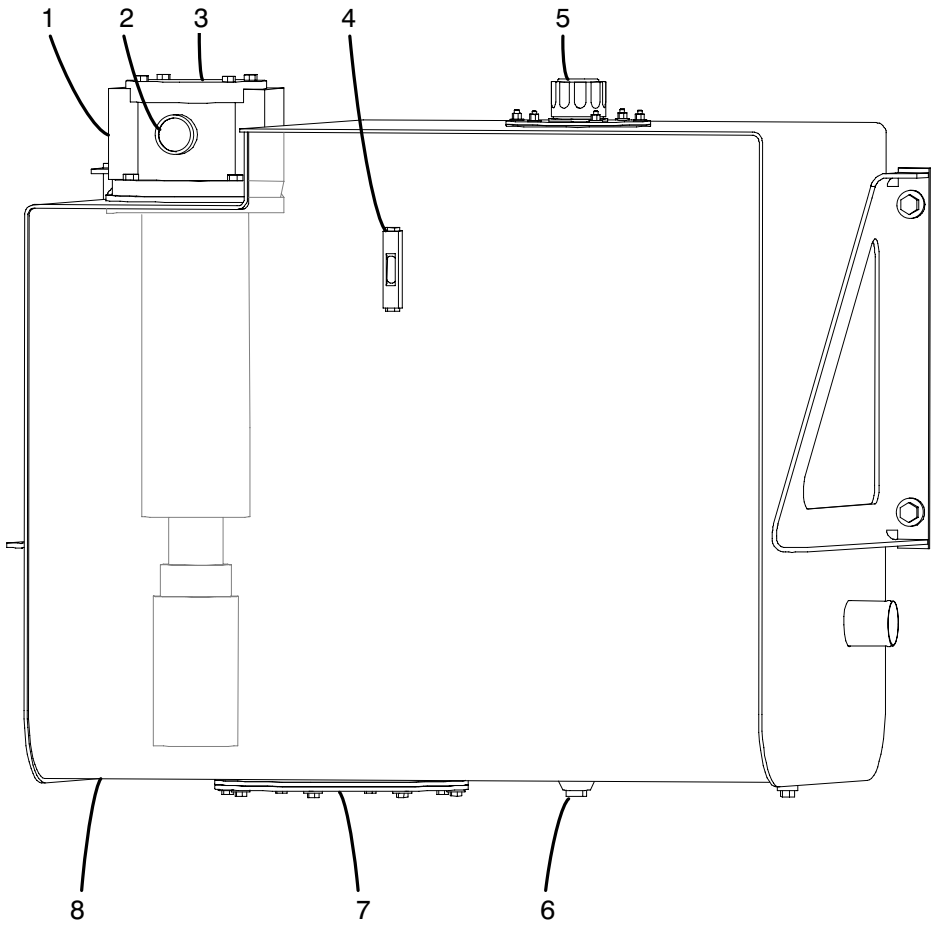
3. Clean the top of the hydraulic reservoir, the breather/filler cap, and breather/filler cover to prevent foreign material from entering the hydraulic system.
4. Remove the breather/filler cap.
5. Add oil as required to bring the oil level to the "FULL" mark.
6. Install filler/breather cap.

TO CHECK OIL LEVEL

Check level when oil is cold (approx. 62°F 17°C), engine off, machine level, and all cylinders fully retracted.

INFORMATION

Oil level must be maintained between"HIGH"and"LOW"marks at all times. Operation of machine with oil level below"LOW"will contribute to pump failure. Do not overfill.



1. Filter Housing
2. Contamination Indicator
3. Filter Housing Cover
4. Sight Gauge
5. Breather/Filler Cap
6. Water Drain Plug
7. Access Panel
8. Hydraulic Reservoir

Figure 2–14
Hydraulic Reservoir

Hydraulic Reservoir Oil Change

The hydraulic reservoir oil should be changed every 2,000 hours of operation or seasonally, whichever occurs first. Change the hydraulic reservoir oil at the end of a working day when any foreign particles will be suspended in the warm oil. If this is not possible, cycle the crane until the oil is warm and proceed as follows:

1. With all hydraulic cylinders fully retracted, park the crane on a firm, level surface. Engage the park brake, shift the transmission to neutral, and shutdown the engine.
2. Relieve any trapped hydraulic system pressure by working the control levers back and forth in the operator's cab.

⚠ WARNING

All trapped hydraulic pressure must be exhausted from the system before removing any plug or cover. A sudden release of hot oil could cause burns or other serious injury.

3. Thoroughly clean the exterior surface of the hydraulic reservoir to prevent foreign materials from entering the system, once the access panels and filter housing are opened.
4. Remove the filler/breather cover and pump the hydraulic oil into suitable containers. Refer to the Lubrication Chart to determine the volume of oil to be removed.

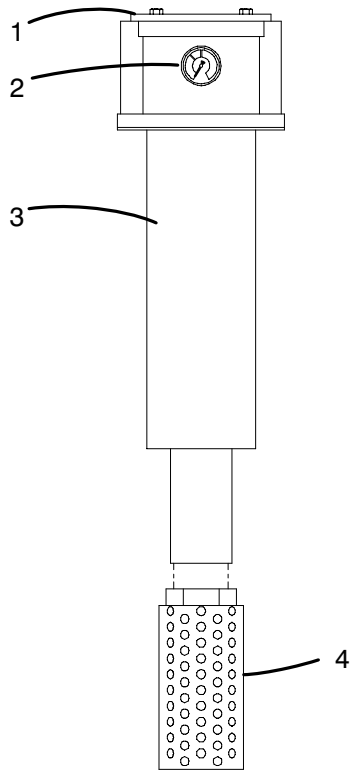
   Note: If a pump is not available to remove the oil from the reservoir, place a suitable container under the water drain plug. Open the plug and drain one container full at a time, until the oil has thoroughly drained from the reservoir. Do not remove bottom access panel to drain reservoir.

⚠ WARNING

Do not remove the bottom access panel before the hydraulic reservoir has completely drained. A large volume of hot oil may suddenly be released resulting in personal injury and/or property damage. Drain the oil from the hydraulic reservoir before removing the bottom access panel.

5. Remove the bottom access panel, filter housing cover, and the filter element. Properly dispose of the filter element.
6. Clean any old gasket material off the access panels and hydraulic reservoir.
7. Remove and clean the oil diffuser in the bottom of the filter housing.
8. Clean the interior of the hydraulic reservoir with clean diesel fuel or kerosene.
9. Allow the diesel fuel or kerosene to drain into a suitable container until the hydraulic reservoir is thoroughly drained. Inspect the interior of the hydraulic reservoir for foreign material and wipe clean.
10. Clean and install the water drain plug.
11. Clean the filter housing. Install oil diffuser in the bottom of filter housing. Install a new filter element.
12. Install the access panels, using new gaskets.
13. Using clean, uncontaminated oil, fill the reservoir through the filter element until it reaches the full mark in the sight gauge.
14. Install the filter housing cover.
15. Remove the breather/filler cap from he breather/filler cover. Clean or replace the sponge filter inside the breather/filler cap.
16. Install the breather/filler cover to the reservoir.
17. Start the engine and engage the main pump. Allow the engine to idle several minutes to ensure oil is being cycled properly. Check for any leaks.
18. Check the oil level in the hydraulic reservoir for proper level. Add oil if necessary. Properly dispose of the used oil.

    Note: In case of hydraulic system component failure, a more thorough oil change procedure is required. Consult your distributor for this procedure.



1. Filter Housing Cover
2. Contamination Indicator
3. Element
4. Oil Diffuser

Figure 2—15
Filter Assembly

Hydraulic Reservoir Filter Change

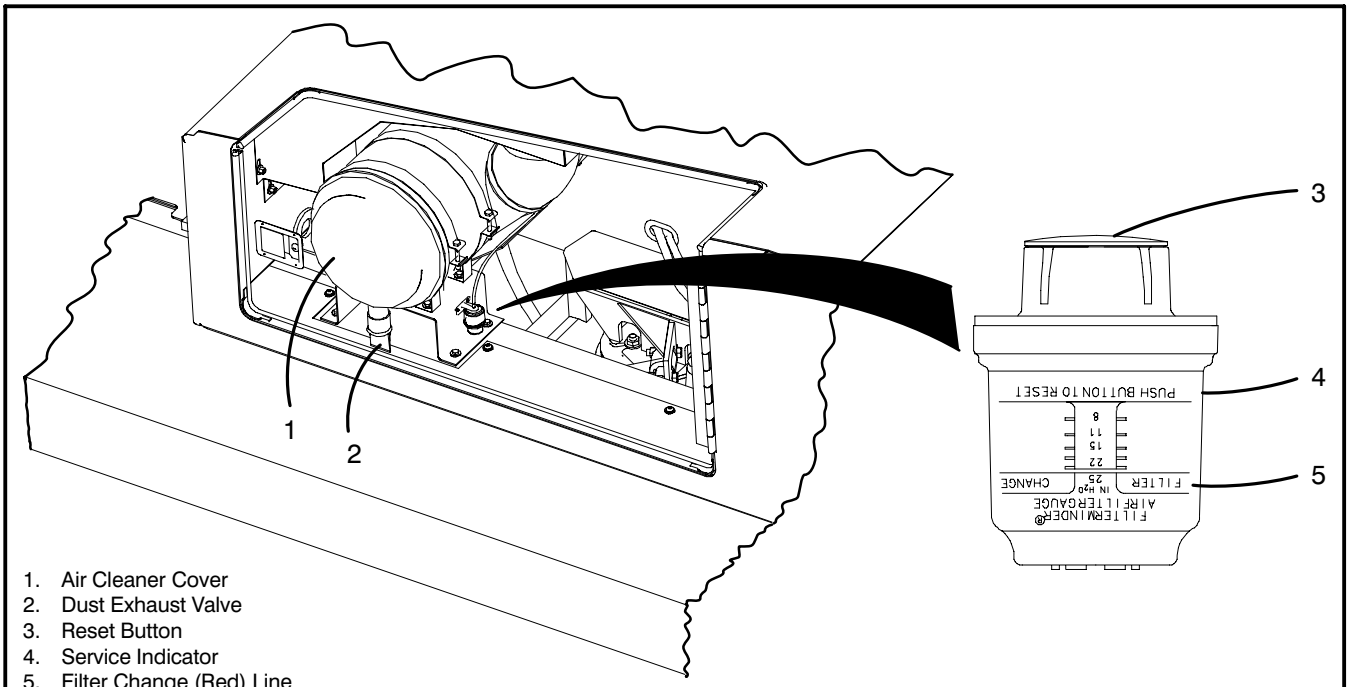
Change hydraulic reservoir filter element after the initial 50 hours of operation and every 500 hours of operation thereafter. Change the filter element immediately if the contamination indicator is in the "Change" position after the oil has reached operating temperature.

1. Park the crane on a firm, level surface. Engage park brake, shift the transmission to neutral, and shutdown the engine.
2. Relieve any trapped hydraulic system pressure by working the control levers in the operator's cab back and forth.

WARNING

All trapped hydraulic pressure must be exhausted from the system before removing any plug or cover. A sudden release of hot oil could cause burns or other serious injury.

3. Clean the top the the hydraulic reservoir, the filter housing, and filter housing cover to prevent foreign material from entering the hydraulic system.
4. Remove the filter housing cover.
5. Remove the filter element and inspect it for contamination. Any dirt or foreign particles on the filter element may indicate excessive system contamination or imminent system component failure. Once the filter has been thoroughly inspected, dispose of it properly.
6. Install new filter element and filter housing cover.
7. Start engine and check the filter housing for leaks.
8. Check the hydraulic reservoir oil level. Add oil if necessary.. Refer to "Adding Oil to The Hydraulic Reservoir" found later in this Operator's Manual.



1. Air Cleaner Cover
2. Dust Exhaust Valve
3. Reset Button
4. Service Indicator
5. Filter Change (Red) Line

Figure 2–16
Engine Air Cleaner

Engine Air System Inspection

In addition to servicing the air cleaner, it is also recommended that the engine air system be inspected every 250 hours or 6 months. Inspect the air system pipes, hoses, air compressor, and turbocharger systems, as equipped. (Be sure to inspect all the pipes and hoses associated with the air compressor, turbocharger, air cleaner, and air intake.) Check for any cracks, corrosion, loose clamps, wear points, leaks or punctures which can allow contaminants to enter the system and damage air system components and/or the engine. All hoses should be kept free of oil contaminants, both internally and externally. Disassemble and clean as required. Tighten or replace parts as necessary to ensure that the air system does not leak.

Engine Air Cleaner

Variations in job site conditions prevent establishing a set interval for air cleaner servicing. For this reason a vacuum operated service indicator is mounted on the air cleaner to assist in determining the condition of the air cleaner element. Refer to Figure 2–16. Anytime the yellow indicator reaches the red line, service the air cleaner immediately. Clean or replace the air cleaner element as often as required. Replace the air cleaner element after the sixth cleaning or annually, whichever occurs first. Service the engine air cleaner as follows:

Changing The Air Cleaner Element

1. Park the crane on a firm level surface. Shift the transmission to neutral, engage the park brake, and shutdown the engine.
2. Inspect the service indicator to see if the yellow indicator has reached the filter change (red) line. If the yellow indicator has reached the filter change (red) line, proceed with the following steps. If it has not reached the red line, there is no reason to service the air cleaner. Over servicing the air cleaner will shorten the life of the element and unnecessarily increase downtime.
3. Remove the cover from the air cleaner body.
4. Remove element from the air cleaner body.
5. Remove the dust exhaust valve and inspect it for damage or wear. Replace it if required.
6. Wipe the inside of the air cleaner body clean using a damp cloth. Install the dust exhaust valve.
7. Clean or replace the element as required.
8. Slide the element into the air cleaner body.
9. Install the cover to the air cleaner body.
10. Reset the service indicator by pressing the button on top of it.

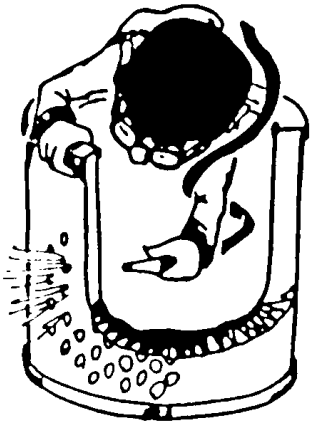


Figure 2–17
Cleaning The Primary Air Cleaner Element With Compressed Air

Figure 2–18
Cleaning The Primary Air Cleaner Element By Soaking

Cleaning The Air Cleaner Element

The primary air cleaner element can be cleaned by washing or using compressed air. Compressed air is recommended when the element is to be reused immediately. A washed element must dry before reuse, however the washing method does a better job and must be used when exhaust soot has lodged in the fine pores of the filter media. Use one of the following procedures to clean the primary air cleaner element.

Compressed Air

Hold an air hose nozzle at least 1 in (*25mm*) away from the primary air cleaner element. Spray air through the element in the direction opposite to normal air flow. Move the nozzle up and down while rotating the element. Use air pressure of less than 100 psi (*690kPa*) to prevent damage to the filter paper within the element. Thoroughly inspect the element after cleaning. Refer to Figure 2–17.

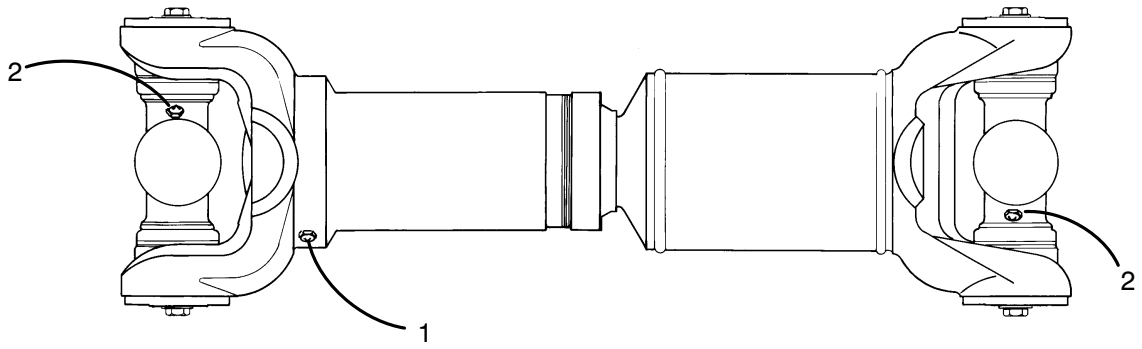
Washing

Soak the primary air cleaner element for 15 minutes or more, in a solution of water and Donaldson D–1400 detergent, or equivalent. Refer to Figure 2–18. Thoroughly rinse the element by spraying it with a hose in the direction opposite the air flow. Use water pressure of less than 40 psi (*276kPa*) to prevent damage to the filter paper within the element. Rinse until the water is clear; air dry. Do not attempt to dry the element using compressed air or light bulbs. This may ruin the element. Thoroughly inspect the element after cleaning.

Figure 2–19
Inspecting The Air Cleaner Element

Inspecting The Air Cleaner Element

Place a bright light inside the air cleaner element and rotate the element. Inspect the element from the outside looking for ruptures, tears, and holes. If any damage is discovered, replace the element. Refer to Figure 2–19.



1. Slip Yoke Fitting
2. U-joint Fitting (Each End)

Figure 2—20
Drive Tube And U-joint Lubrication

Drive Tube And U-Joint Lubrication

Drive tubes and u-joints are used to transmit torque from one drive line component to another. They also help absorb shock loadings. Because they are so critical to crane operation, thorough lubrication is necessary.

Lubrication Procedure For Drive Tubes/U-Joints

1. Park the crane on a firm, level surface. Engage the park brake, shift the transmission to neutral, and shutdown the engine. Follow Steps 2—7 on each drive tube.
2. Check the slip yoke for looseness or side play.
3. Apply grease through the fitting at the slip yoke until all the old grease is purged from the slip yoke. Refer to Figure 2—20 for illustration of grease fitting locations.
4. Check each u-joint for looseness.
5. Apply grease through the fitting on each u-joint until all the old grease is purged. Purging should occur at all four seals on each u-joint. Refer to Figure 2—20 for grease fitting locations.
6. If grease does not purge from each seal, manipulate the u-joint until purging occurs.
7. If the above is not successful, remove the u-joint and inspect it. If the grease is rusty, gritty, or burnt, replace the u-joint.

Swing Speed Reducer Lubrication

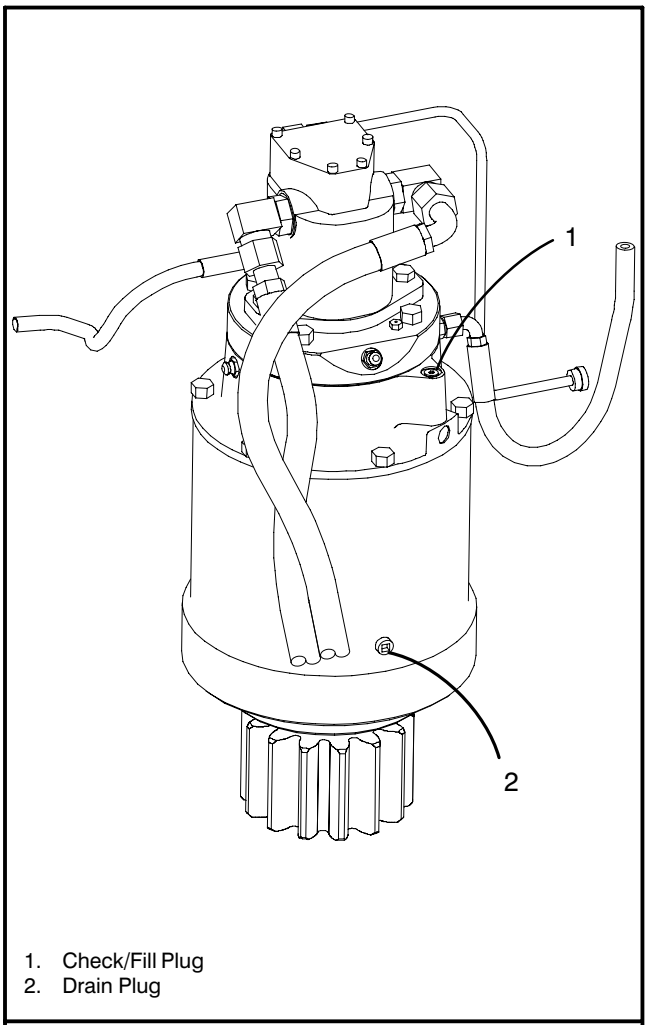
Check the oil level in the swing speed reducer after every 50 hours of operation. The oil in a new or rebuilt swing speed reducer should be changed after the initial 200 hours of operation. Thereafter, change the oil with each 1,000 hours of operation or seasonally, whichever occurs first.

Swing Speed Reducer Oil Level Check

1. Park the crane on a firm, level surface. Shift the transmission to neutral, and engage the park brake.
2. Engage the travel swing lock and shutdown the engine. Refer to Figure 2−21.
3. Clean the speed reducer around the check/fill plug to prevent contamination from entering the system. Remove the check/plug.
4. Oil should be within 0.25 in (*6mm*) of the bottom of the threads. Add oil as required to bring the oil to the proper level. Refer to the Lubrication Chart for the correct grade of oil.
5. Clean and install the check/fill plug.

Swing Speed Reducer Oil Change

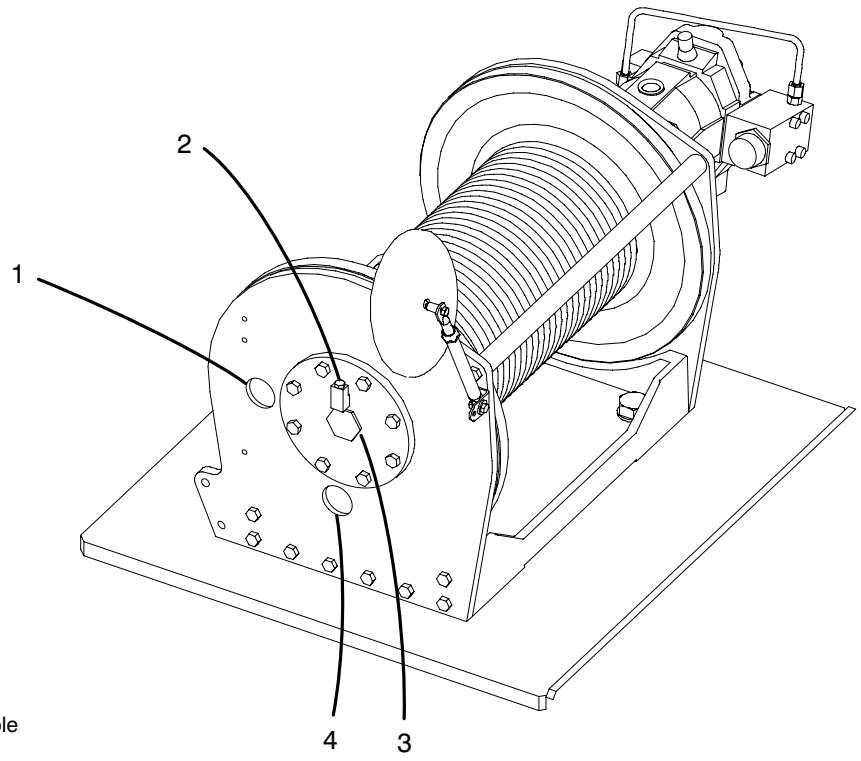
1. Park crane on a firm, level surface, shift the transmission to neutral, and engage the park brake.
2. Level the crane on fully extended outriggers and swing the upper for several minutes, to agitate and warm the oil within the swing speed reducer.
3. Engage the travel swing lock, fully lower the boom, and shutdown the engine.
4. Thoroughly clean the exterior surface of the swing speed reducer around the check/fill and drain plugs to prevent contamination from entering the unit. Refer to Figure 2−21.
5. Remove the check/fill and drain plugs and allow the oil to drain into a suitable container. The drain plug is magnetic and should be inspected for large quantities of metal particles. After the initial oil change, this is a sign of damage or extreme wear within the unit, and a complete internal inspection may be necessary.



1. Check/Fill Plug
2. Drain Plug

Figure 2−21
Swing Speed Reducer

6. After the oil has thoroughly drained, clean and install the drain plug.
7. Fill the unit with oil through the check/fill hole, until the oil is within 0.25 in (*6mm*) of the bottom of the hole. For the correct grade and quantity of oil, refer to the Lubrication Chart.
8. Clean and install the check/fill plug. Properly dispose of the used oil.



1. Fill Alignment Hole
2. Vent Plug
3. Sight Gauge
4. Drain Alignment Hole

Figure 2–22
Winch Drum Lubrication

Winch Drum Lubrication

For maximum operating efficiency and service life of the winch drum, check oil level after every 50 hours of operation. The oil, in a new or rebuilt winch drum, should be changed after the initial 100 hours of operation. Thereafter, change oil with each 1,000 hours of operation or seasonally, whichever occurs first. It is also recommended that every 2,000 hours of operation, the winch should be disassembled and thoroughly inspected for damaged or worn parts. Replace damaged or worn parts as required.

Winch Drum Oil Level Check

1. Park the crane on a firm, level surface, shift the transmission to neutral, engage the park brake, and shutdown the engine.
2. Observe the oil level within the sight gauge. Oil should be visible within the sight gauge. Refer to Figure 2–22.

Winch Drum Oil Change

1. Park the crane of a firm, level surface, shift the transmission to neutral, and engage the park brake.
2. Cycle the winch for several minutes, without a load to agitate and warm the oil within the winch drum.
3. Engage the travel swing lock and shutdown the engine.
4. Rotate winch drum until the plug is aligned with the drain alignment hole in the side support. Refer to Figure 2–22.
5. Thoroughly clean the exterior surface of the winch around the vent and drain plugs to prevent contamination from entering the unit.
6. Install a short piece of pipe one inch in diameter in the larger threads of the drain hole.
7. Remove the vent plug.
8. Remove drain plug through the pipe and allow the oil to drain in a suitable container
9. After the oil has thoroughly drained, remove the drain pipe and rotate the drum until the hole is aligned with the fill alignment hole in the side support.
10. Fill the unit with oil through the fill hole, until oil is visible within the sight gauge. For the correct grade and quantity of oil, refer the Lubrication Chart.
11. Clean and install the vent and fill plugs. Properly dispose of the used oil.

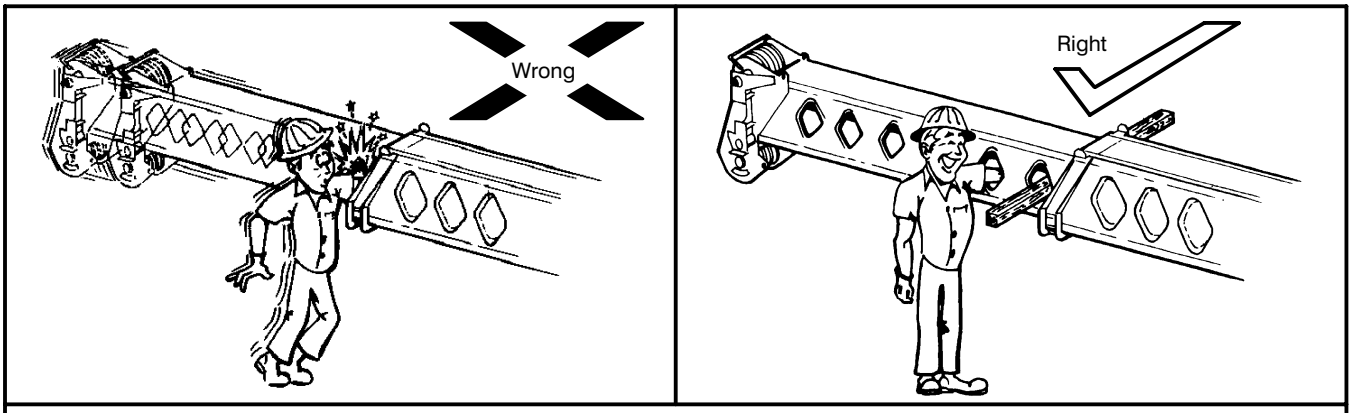


Figure 2–23
Shutdown the engine, ensure that the operator has vacated the upper operator's cab, and insert blocking through the diamond shaped hole closest to the base section of the boom before putting hands or tools inside a boom section.

⚠ WARNING

To avoid personal injury, do not climb, stand, or walk on the boom or fly. Use a ladder or similar device to reach necessary areas.

Shutdown the engine, ensure that the operator has vacated the upper operator's cab, and insert blocking through the diamond shaped hole closest to the base section of the boom before putting hands or tools inside a boom section. Movement of the boom could cause serious injury.

Do not use a crane that has a damaged boom. The structural integrity of the boom is lost and could collapse with any load. Use the crane only after the boom has passed a thorough inspection. Contact your distributor for the proper inspection procedures.

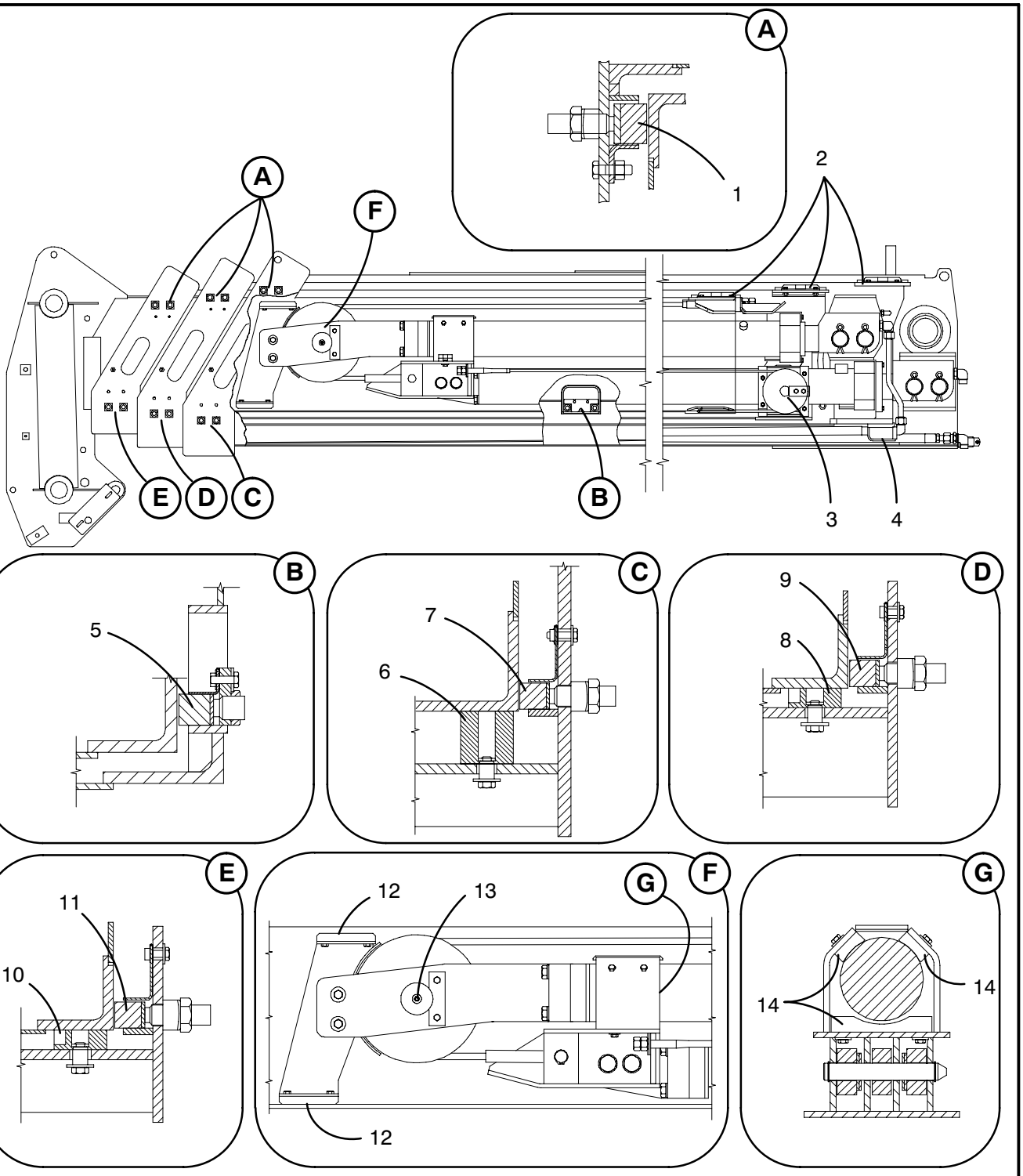
Figure 2–24
Do not climb on boom or attachments.

Boom Lubrication And Inspection

Boom lubrication is important to extend wear shoe life and to aid in smooth performance of the boom. Lubrication involves covering all boom sliding surfaces with a film of grease. This is accomplished by applying grease directly to boom surfaces and the wear shoes that slide on the boom and telescope cylinder surfaces. Refer to Figure 2–25 for wear shoe locations.

Inspect the boom daily for adequate lubrication and grease it as necessary. Visually inspect all boom sections daily for damaged or cracked members or welds. If any dents, bends, cracked welds, etc. are found, do not use the crane. Contact your nearest distributor for repair procedures. Also check for damaged or leaking hoses, fittings, valves, cylinders etc. Repair as necessary. At 250 hour intervals, check all boom wear shoes for proper adjustment. See "Boom Wear Shoe Adjustment" in Section 3 of this Operator's Manual for further details.

Grease boom extend and retract sheaves at 50 hour intervals. It is also recommended that every 4,000 hours of operation the boom should be disassembled and the extend and retract wire ropes inspected, lubricated, and/or replaced as required. See "Wire Rope Lubrication" found later in this Section and "Wire Rope Inspection And Replacement Recommendations" in Section 5 of this Operator's Manual.



1. Side Wear Shoe – Top (6 Places)
2. Top Rear Wear Shoe – (6 Places)
3. Grease Fitting – Retract Sheave (2 Places)
4. Bottom Wear Shoe – Inner Mid (2 Places)
5. Side Wear Shoe – Bottom (4 Places)
6. Bottom Wear Shoe – Base (2 Places)
7. Side Wear Shoe – Base (2 Places)
8. Bottom Wear Shoe – Inner Mid (2 Places)
9. Side Wear Shoe – Inner Mid (2 Places)
10. Bottom Wear Shoe – Outer Mid (2 Places)
11. Side Wear Shoe – Outer Mid (2 Places)
12. Telescope Cylinder Slider Bracket Wear Shoes (4 Places)
13. Grease Fitting – Extend Sheaves (2 Places)
14. Telescope Cylinder Wear Shoes (3 Places)

Figure 2–25
Boom Lubrication And Inspection

Wire Rope Lubrication

Wire rope is like a machine. Each time a wire rope bends over a sheave or straightens from a slack position many wires move against each other. Lubrication is necessary to help prevent wear caused by this movement. Lubrication also helps prevent deterioration of wire rope due to rust and corrosion.

⚠ WARNING

Rusty wire rope is dangerous since there is no way to determine its remaining strength.

Most wire ropes are lubricated during manufacture, but the lubricant does not last the life of the rope. The lubricant is squeezed out of the rope as it runs over sheaves under tension, or washed off by rain.

For the above reasons, wire rope MUST BE periodically lubricated. Crude or used oils and grease should not be used as lubricants because they may be grit or acid laden. Either of these conditions can cause damage to the rope.

No set rule can be given for lubrication frequency. This will depend on the type of conditions under which the rope is used.

A rope used in wet conditions would need to be lubricated more often than one used in dry conditions, to prevent rust and corrosion.

Lubricants used for wire rope lubrication should have the following properties:

1. They must have enough adhesive strength to stay on the rope.
2. They must be able to penetrate between the wires and strands.
3. They must have high film strength.
4. They must resist oxidation.
5. They must remain soft and pliable.

Application Of Wire Rope Lubricant

Wire ropes that have been in service should be cleaned before re-lubricating them. Use a wire brush and compressed air to clean the rope. All possible foreign material and old lubricant should be removed from the rope before re-lubricating it. Use one of the following methods to apply the lubricant.

1. Continuous Bath

   Run the rope through a container filled with lubricant. A sheave mounted in the center of the container will hold the rope submerged as it passes through the container. Use swabbing to remove excess lubricant as the rope leaves the container.

2. Dripping

   Place a container above a sheave so a spigot can be opened to drip oil on the wire rope as it passes through the sheave groove.

3. Swabbing And Painting

   Two fast methods are swabbing the lubricant on with rags or painting it on with a brush.

4. Spraying

   Light lubricants may be applied with a spray gun. Aerosol cans of lubricant are also available.

Fly Inspection & Lubrication

Inspect all parts of the fly daily. Lubricate head machinery as required. Pay particular attention to the chords and lattice. If any dents, bends, cracked welds, etc. are found, do not use the fly. Contact your nearest distributor for repair procedures.

⚠ WARNING

Do not use a fly which has been damaged. The structural integrity of the fly is lost and the attachment could collapse with any load. Use the fly only after it has passed a thorough inspection.

Hook Block, Ball, And Swivel Inspection And Maintenance

1. All nuts, setscrews, pins, bolts, and retainers should be checked for tightness every 14 to 30 days, depending on the operating conditions and the product involved.
2. Inspect the components carefully at least once a month.

   Swivels: Check for excessive gap distance between the rotating parts. Check threaded parts that are installed together to see that they are secure and tight. Check all setscrews to see that they are tight and staked.

   Hook Blocks: Check all pins and bolts for tightness, spreading of side plates, weld cracks, sheave wear, bearing wear, spreading of hook, and that setscrews are tight and staked. Check that hook latch is operative.

   Hook Balls: Check pin, nut, and washer to ensure ball halves are held securely together. Check locating pin for excessive wear. Inspect swivel parts as specified previously. Check that hook latch is operative.
3. If a swivel is constantly overloaded, it will cause damage to the unit. The first sign of damage is often bearing brinelling (dimpling of the bearing races). This condition is determined by spinning the swivel by hand. If the motion is rough or has a ratchet-like effect, the bearing has been damaged and should be replaced.
4. The distance between the swivel barrel and shank or rotating members are pre-set with a factory clearance of 0.020—0.050 in (*0.5—1.2mm*). If this distance increases more than 0.060 in (*1.5mm*) over the above distance, it is a good indication of bearing fatigue and the unit should be removed from service.

Item	Under Intermittent Operating Conditions	Under Continuous Operating Conditions
Swivels, Swivel Overhaul Balls, Swivel Balls	14 days	24 hours
Blocks with Bronze Bushed Sheaves	14 days	8 hours
Blocks with Roller Bearing Sheaves	14 days	24 hours

Chart A — Hook Block, Ball, & Swivel Lubrication Frequency

Item	Frequency	What to Check For	Appropriate Action
Swivels	14 days under continuous operation 30 days under intermittent operation	End play or gap of more than 0.06 in (*1.5mm*) along the axis.	Remove from service immediately.
		Rough turning.	Defective bearing. Remove from service immediately.
		Elongated eye holes, bent clevis pins.	Indicates overload. Remove for repairs.
Sheaves	14 days under continuous operation 30 days under intermittent operation	Misalignment, as evidenced by wobble or uneven groove flange wear.	Indicates severe bearing wear. Remove from service. Check for wear in bronze spacers where used.
		Striations or corrugations in sheave groove.	Result of rope wear. If serious, replace.
Hook Latch	When Used	Missing, off center, bent, broken spring, or defective.	Replace immediately
Hooks	Daily or When Used	Permanent deformation or stretching.	An indication of overload. If serious, replace.
			Any suspicion of fractures calls for an immediate investigation and, if necessary, replacement of part.
		Crack or other defects.	Hooks should be tested at least once a year by magnafluxing, x-ray, or other qualified method. Intermittent tests can be conducted by a less accurate oil stain method.

Chart B — Hook Block, Ball, & Swivel Inspection Frequency

Turntable Bearing Capscrew Torque

Maintaining the proper torque on turntable bearing mounting capscrews is critical. If the bearing has been replaced or the crane undecked for any reason, capscrews should be replaced. Reuse of turntable bearing mounting capscrews is not recommended.

CAUTION

All turntable bearing capscrews use Loctite® 571 Pipe Sealant, or equivalent, with exception given to capscrews coated with Xylan®. The sealant or coating is used to protect the threads of the capscrews from rust and corrosion. Unprotected capscrews will not maintain the proper torque. Always use sealant or coating when installing turntable bearing capscrews.

Turntable Bearing Capscrew Inspection Schedule

Capscrews should be inspected and/or torqued after the initial 250 hours of operation of any new crane or if the crane has been undecked for any reason. Inspect and/or torque capscrews per the Turntable Bearing Capscrew Torque Inspection Schedule, thereafter. Torque capscrews to 1,500−1,650 ft lb (*2 034−2 237Nm*).

Turntable Bearing Capscrew Torque Inspection Schedule

Schedule	Interval	Requirements
A	500 Hrs	• Perform an initial torque of the capscrews after the first 250 hours of operation of a new crane, or if the crane has been undecked for any reason, to establish capscrew torque baseline. **Note: Use the minimum applicable torque value when checking.**
		• After the next 500 hours of operation, if any of the capscrew torques have degraded, tighten capscrews to the proper torque. **Note: Use the minimum applicable torque value when checking.**
		• If the crane is utilized for duty cycle work, Schedule A must be continuously maintained during duty cycle applications.
		• Inspection Schedule A must be maintained until such a time that no capscrews require tightening after 500 hours of operation. Schedule B can then be followed.
		• The minimum applicable torque value is acceptable for the turntable bearing capscrew torque inspection.
B	Annually	• If the capscrew torque has degraded at any annual check, Torque Inspection Schedule A must be followed until such time that no loss of capscrew torque is observed.
		• The minimum applicable torque value is acceptable for the turntable bearing capscrew torque inspection.

Figure 2–26
Display Cleaning

Crane Monitoring System

Maintenance of the Microguard Rated Capacity Limiter System consists of the following daily inspection prior to the first operation:

WARNING

Any unusual or erratic system operation must be investigated and corrected immediately. If any problem is found with any of the above inspection steps, the problem must be corrected/repaired as soon as possible. If necessary to continue crane operations, refer to "System Inoperative Or Malfunctioning" in Section 1 of this Operator's Manual.

1. Check that the system is operating normally as described in Section 1 of this Operator's Manual.
2. Check the electrical cables connecting the various parts of the system.
3. Check insulation on the boom reeling drum cable.
4. Check boom reeling drum cable for proper tension.
5. Check all anti-two block switches for freedom of movement.
6. Check that the anti-two block weights are installed and working properly with the anti-two block switches.
7. Inspect the pressure transducers at the boom hoist cylinders and the connecting hoses for oil leaks.
8. Test that the function limiters activate properly by two-blocking the crane. (Do this by manually lifting the ATB weight.)
9. Check for erratic readings on the boom angle, the boom length, and the operating radius displays. Check the boom angle, boom length, and the operating radius for accuracy every 30 days.
10. If a known test weight is available, check that the displayed weight agrees with the test load. The displayed load includes the hook block and any lifting equipment such as slings, pins, shackles, etc.
11. If crane capacities are rated for specific areas e.g. side, front, rear, check the system by swinging the boom into the permitted areas and checking that the rated capacity reading agrees with the crane capacities as listed in the Crane Rating Manual.

Display Cleaning

The Rated Capacity Limiter display is not field serviceable and should not be disassembled by anyone other than an authorized service repair facility. However, the screen can be sufficiently cleaned without unit disassembly.

Compressed air used for cleaning electronic equipment can be obtained at any major electronic or office supply store. Do not use compressed air from an air compressor. Kensington Dust Blaster has been used with good results.

After removing the display from the crane console, locate the rectangular ventilation hole on the side of the display. This is the area of access for cleaning the display.

Insert the nozzle of the compressed air just to the edge of the LCD display at the air gap, and angled toward the display screen cover. Activate the air container and slide from end to end of the display. Only a few seconds of application should be required to sufficiently clean the display unit. If the unit cannot be adequately cleaned using this process, it must be returned to a factory authorized repair facility.

Paint Maintenance

Knowledgeable equipment owners realize the value of periodic preventative maintenance and responsible care. A regular surface care program should be followed to protect the equipment's paint finish and maintain a like-new appearance. There is no one correct/ultimate procedure since the uniqueness of every crane's operating environment and owner/operator maintenance habits differ. However, it is important to remove surface contaminants before they have time to bond or etch into the paint finish.

The crane has non-skid materials located in certain areas to assist operators and service personnel with safe access/egress to/from the crane. Do not paint or wax non skid materials. Paint or wax will cause the non-skid materials to become slick, reducing their effectiveness for safety while walking on the crane. If any non-skid materials becomes ineffective due to wear, age, or destroyed in any way, it must be replaced.

⚠ WARNING

Do not apply paint or wax over non-skid materials. Keep all non-skid materials clean and free of all contaminants. All walking surfaces on the crane should be cleaned to eliminate any contaminants. Paint, wax, or other contaminants will reduce the effectiveness of the materials. Ineffective materials can create unsafe access/egress to/from the crane leading to serious personal injury. Mask off and/or cover non-skid materials prior to painting or waxing areas around any non-skid material(s). Contact your distributor for information regarding the replacement or repair of any non-skid material(s).

Regular Preventative Maintenance

1. Regular washing is the best way to remove surface contaminants.
2. Always use mild cleaners and soaps, and rinse thoroughly after washing. Do not use harsh detergents, such as household laundry detergents, or cleaners that contain phosphates, as they will "burn" the paint, strip off protective coating, diminish the gloss and accelerate the contamination process.
3. Periodic waxing will enhance the luster and protect the paint surface.

If environmental damage to the paint finish is detected (loss of some of its luster due to lack of or inability to maintain as recommended) the paint finish can be restored to near-new appearance by following a simple polishing and waxing procedure.

Polishing And Waxing Procedure

1. Clean surface thoroughly by hand washing or power washing with a mild detergent. Rinse thoroughly with water before buffing.
2. Apply a polishing compound, such as Meguiar's M8432, or equivalent, to a surface area approximately two feet by two feet at a time. Make sure the cleaner is applied liberally to entire area and work on only that area with the buffing wheel.
3. Buff surface with an electric or air buffer at 1,000 rpm using a 3M Superbuff polishing pad, or equivalent, with light to medium pressure until a uniform high gloss is obtained. Hand wipe with a clean cloth.
4. After surface has been buffed, apply a quality automotive wax such a Meguiar's M−26 Hi−Tech Yellow Wax, or equivalent, and hand buff until the cloth moves freely. The original luster of coating should be restored.

Cab Dash Cleaning

Care should be taken when cleaning the cab dash, especially the new polycarbonate dashes. If the incorrect cleaning agent is used, the finish of the material could be destroyed. It is recommended by the dash manufacturer that only the following materials be used for cleaning:

1. Soap and water
2. Denatured alcohol
3. Joy and Palmolive dishwashing liquids
4. Windex with Ammonia D
5. Formula 409, Fantastik, Mr. Clean

Notes:

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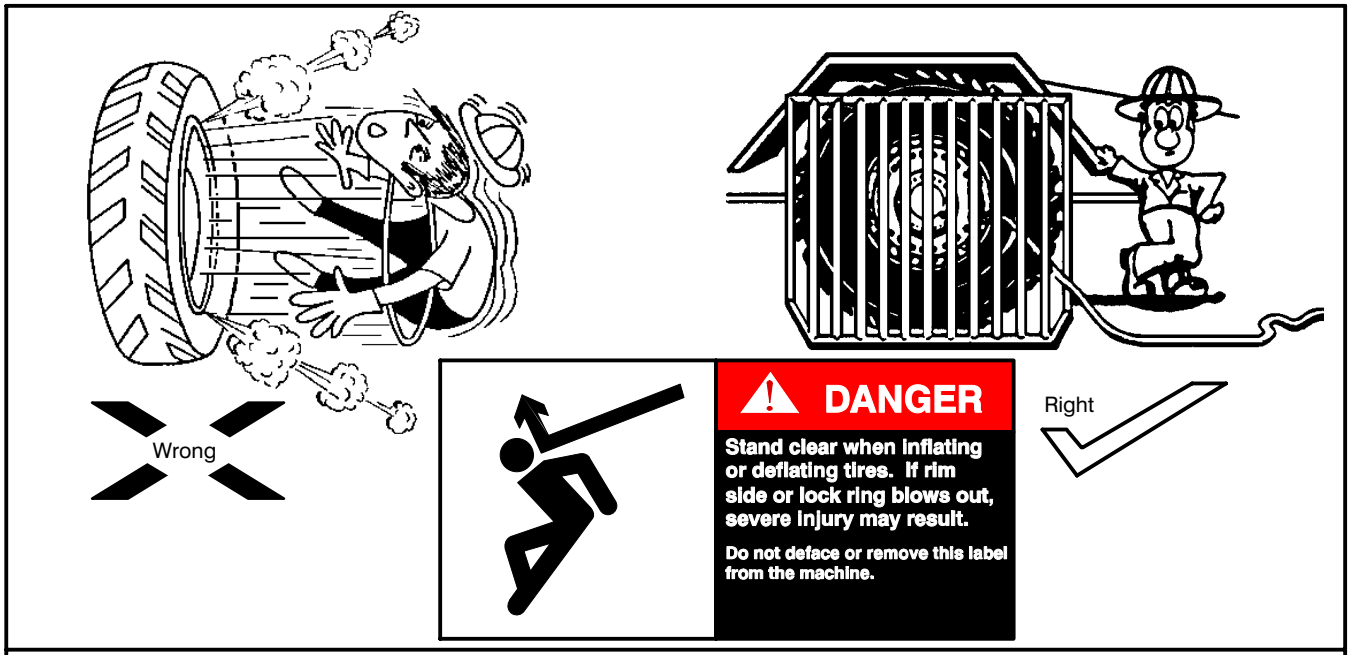


Figure 3–1
Tire Inflation Warning

Tire Inspection

Inspect the tire treads daily and remove any debris that may be wedged in the tire grooves. Check for nails, screws, glass, or anything that may penetrate the tire and permit air to leak from the tires. Check the side walls and treads for cuts, bulges, and other damage. Check and remove any debris that may be wedged between the tires in dual tire applications. If internal damage to any tire is suspected, have it demounted and checked. Make all necessary repairs or replace as required.

Replace any tire that shows any wear indicator. Because tires may wear unevenly, it may be necessary to replace them before the wear indicator appears across the entire tread. When replacing tires, all tires should be of the same manufacturer, size, type, load rating, and construction. Do not mix bias-belted and radial tires. Refer to the tire manufacturer and follow all recommendations regarding tire inspection and replacement.

Tire Inflation

Check the tire inflation pressures daily when the tires are cold. The tire inflation pressures for normal highway travel are listed on the gross weight rating plate. The tire inflation pressures for pick and carry operations are listed in the Crane Rating Manual.

Note: The crane should not be road driven with the tires inflated to pick and carry pressures. Travel on tires inflated to pick and carry pressures is limited to 1.0 mph (*1.6km/h*) maximum.

Dual wheels and tires must be installed so the valve stem of the inner tire is 180˚ opposite the valve stem of the outer tire. All tires of the same weight and size are interchangeable. Inspect the wheel rims, nuts, studs, etc., on a weekly basis. If any damage is apparent, repair or replace before operating the crane.

A rim cage should be used when deflating or inflating tires to protect against personal injury. Refer to Figure 3–1.

DANGER

A damaged or improperly assembled tire and rim assembly may explode while inflating or deflating tires. Severe personal injury may result if tire and rim assembly explodes. Always use a rim cage and stand clear of the tire while inflating or deflating it.

DANGER

Servicing the tire and rim assemblies can be extremely dangerous. For your protection, read and understand all safety instructions before removing or installing a tire and rim assembly.

Tire And Rim Safety Instructions

1. Always remove the valve cores, and exhaust all air pressure from the tire, prior to removing any rim or wheel components, (Both tires on a dual tire and rim assembly).
2. Use a rim cage and stand clear when deflating and inflating tires. A damaged rim may burst. The operator should stand well away from the potentially explosive force. Refer to Figure 3−1.
3. After deflating the tire, check the valve stem by running a piece of wire through the stem, to ensure it is not clogged and the tire is completely deflated. Ice may form as the air leaves the tire, or foreign material may clog the stem.
4. Do not inflate a tire that has been run flat or extremely under inflated. Demount the tire and inspect it, rim, and wheel assembly for damage. These components may have been damaged or dislocated during the time the tire was under inflated.
5. Exercise caution when removing the lug nuts.
6. When assembling the tire and rim assembly, use only parts of the same type, manufacturer and correct size. Mismatched parts may appear to fit but when the tire is inflated they may fly apart with explosive force.
7. Always double check to be sure rim components are properly installed before inflating the tire. Improperly assembled parts could fly off during inflation.
8. Clean and inspect all parts prior to assembly. Do not use bent, worn, damaged or rusted parts.
9. When inflating a tire, use an air hose with a clip-on chuck and in-line pressure gauge. Be sure the air hose is long enough, to permit the person inflating the tire, to stand clear of the rim cage.
10. Inflate the tire to 10 psi (*68 kPa*), and check the rim components for proper fit, before completely inflating. If the assembly is not correct, completely deflate the tire and correct the problem. Do not hammer on an inflated tire and rim assembly. Properly matched and assembled rim components will seat without tapping.
11. Do not run the crane on one tire of a dual assembly. The excessive overload can cause damage to the tire and rim assembly.
12. Always check rims and wheels for damage during normal tire inspection. Early detection of potential component failure may prevent serious injury.
13. Do not attempt to rework, weld, heat, or braze any damaged rim components. Heating may weaken the part and result in complete failure of the component and possible injury.

Tire And Rim Removal And Installation

Carefully read and understand the safety instructions given earlier in this Section of the Operator's Manual. Then, choose one of the following procedures for tire and rim removal.

Dual Rear Tire And Rim Removal

1. Properly park the crane and engage the park brake. Level the crane on outriggers and shutdown the engine.
2. Position a rim cage in front of the tire and rim assembly, before deflating the tire.

DANGER

Exhaust all air pressure from both tires before removing any wheel or rim component. Use a rim cage and stand clear when deflating the tires. Rim components are under extreme pressure and may fly off. Failure to exhaust air pressure, or use a rim cage, could result in a fatal accident.

3. Remove the core from the valve stem (3) on the inner rim (4) and outer rim (1). Allow all air pressure to exhaust from both tires. Refer to Figure 3−2.
4. Check each valve stem (3), by running a piece of wire through the stems, to make sure they are not plugged and the tires are completely deflated. Remove the rim cage.
5. Adequately support the outer rim (1) and tire assembly with an appropriate lifting device.
6. Remove the lug nuts (7) from the studs (2).
7. Remove the outer rim (1), and inner rim (4) from the wheel (6).

Dual Rear Tire And Rim Installation

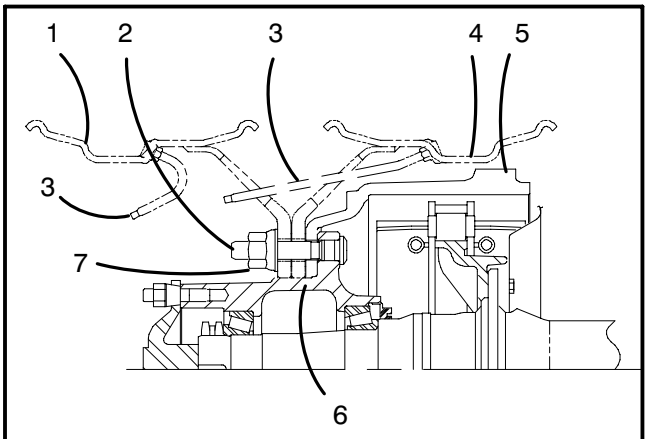
The correct installation, and tightening of the lug nuts, on a tire and rim assembly is one of the most important operations in wheel maintenance. When tire, rim, or wheel problems occur, incorrect installation and tightening procedures are usually found to be the cause of the problem. The following procedures must be carefully followed to ensure safe and dependable service.

1. Check the tires to ensure that they are deflated. Inspect all parts for damage and proper assembly. Refer to Figure 3–2.

⚠ DANGER

All air pressure must be exhausted from the tires before installing them. An inflated tire may cause improperly assembled rim components to fly off. Failure to deflate the tires could result in a fatal accident.

2. Using a wire brush, thoroughly clean the mounting surfaces of the inner and outer rims (4, 1), and wheel (6). Surfaces should be free of rust, dirt, and excess paint.
3. Using an appropriate lifting device, slide the inner rim (4) over the wheel (6) and push it into position against the mounting surface. Be sure that the valve stem (3) points outward.
4. Slide the outer rim (1) on the wheel (6). Be sure the valve stem (3) points outward.
5. Push the assembly into position, so the inner rim (4) fits snugly against the mounting surfaces of the wheel (6).
6. Install the lug nuts (7) on each stud (2). Tighten the lug nuts until the face of each is flush with the studs.
7. Rotate the wheel (6) one half turn to allow the parts to seat naturally.
8. Tighten the lug nuts (7), one turn at a time, following the criss-cross sequence shown in Figure 3–3. Always rotate the lug nut to be tightened to the top spoke position to ensure even tightening and proper alignment of inner and outer rims (4,1). Tighten the lug nuts in this manner until all lug nuts are torqued to 450–500 ft lb (*610.2–678Nm*).
9. Check the alignment of the inner and outer rims by placing an object on the floor beside the outer tire and rotating the wheel. Note any variation in the distance between the tire and the object. Refer to Figure 3–4. If the variation in distance exceeds .25 inch (*6.3mm*), the rims are misaligned.
10. Misalignment is due to defective or damage parts. Inspect components for damage and replace as required.



1. Outer Rim
2. Stud
3. Valve Stem*
4. Inner Rim
5. Brake Drum
6. Wheel
7. Lug Nut

* Valve Stem Position May Vary

Figure 3–2
Dual Tire And Rim Assembly

11. Repeat Steps 9 and 10 until the proper alignment is obtained. Check the lug nuts to be sure each is torqued to the specified amount.

CAUTION

Improper torque can cause damage to components, rim slippage, or alignment problems. Tighten the lug nuts to the specified torque only.

12. Properly position a rim cage in front of the tire and rim assembly. Figure 3–1.

⚠ DANGER

Use a rim cage and stand clear when inflating the tires. Rim components are under extreme pressure and may fly off. Failure to use a rim cage could result in a fatal accident.

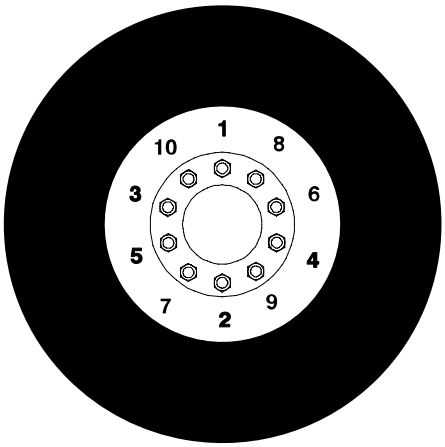
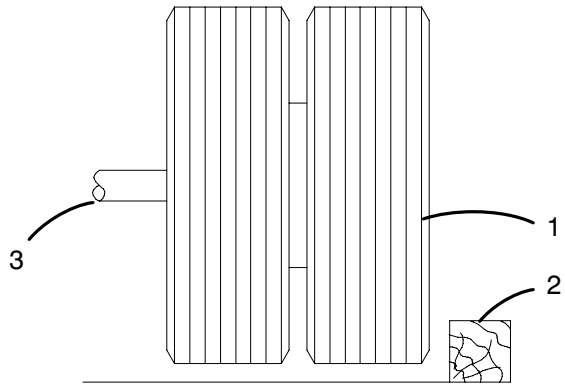


Figure 3–3
Lug Nut Torquing Sequence



1. Tire
2. Stationary Object
3. Axle

Figure 3–4
Tire And Rim Alignment

13. Install the cores in the valve stems (3). Using an air hose equipped with a clip-on chuck and in-line pressure gauge, inflate the tires to 10 psi (*68kPa*). Inspect all parts to see that they are properly seated. Figure 3–2.

    Note: The air system of the crane is equipped with a tire inflation service port which may be used to supply air pressure to inflate tires. The ports are located on either side of the carrier on top of the front outrigger boxes and are capable of supplying 150 psi (*1 034kPa*) of air pressure. Refer to Figure 3–5.

14. If parts are not properly seated, completely deflate the tires and correct the problem.
15. If parts are properly seated, inflate the tire until the tire bead is fully seated.
16. Inflate the tires to the pressure listed in the "Tire Inflation" chart located in the Crane Rating Manual or on the Gross Axle Weight Rating plate located on the hydraulic reservoir.
17. Start the engine, fully retract the outrigger jacks and beams, and drive the crane approximately 1 mile (*1.6km*). Tighten the lug nuts again using the proper torquing sequence (Figure 3–3) and recommended torque value.

    Note: Lug nut torque values should be checked every 10 hours, for the first 50 hours of operation, after any tire and rim assembly is installed. Tighten any lug nuts, as required, to the recommended torque value. Check the lug nut torque every 50 hours of operation thereafter.

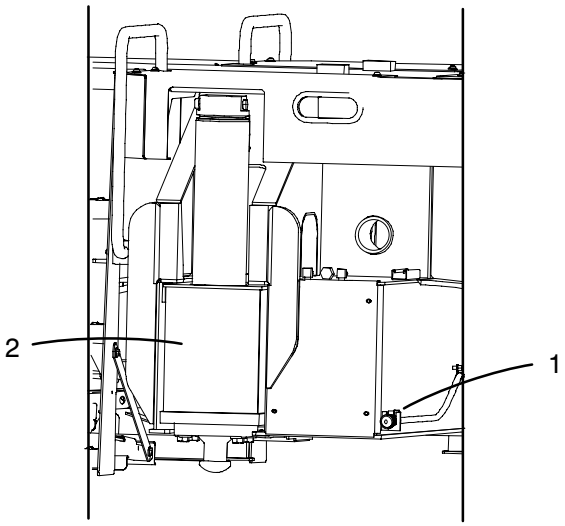
Front Tire And Rim Removal

1. Properly park the crane, shift the transmission to neutral, and engage the park brake.
2. Loosen each of the lug nuts (3) one half turn. Refer to Figure 3–6.
3. Level the crane on outriggers and shutdown the engine.
4. Adequately support the tire and rim assembly (5) with an appropriate lifting device.
5. Remove the lug nuts (3) from the studs (2).
6. Carefully remove the tire and rim assembly (5) from the wheel (1).

Front Tire And Rim Installation

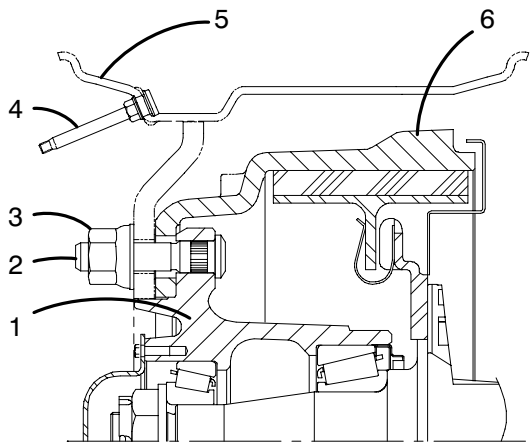
The correct installation and tightening of the tire and rim assembly is one of the most important operations in wheel maintenance. When tire, rim, or wheel problems occur, incorrect installation and tightening procedures are usually found to be the cause of the problem. The following procedures must be carefully followed to ensure safe and dependable service.

1. Using a wire brush, thoroughly clean the mounting surfaces of the wheel (1), and tire and rim assembly (1). Surfaces should be free of rust, dirt, and excess paint. Refer to Figure 3–6.
2. Slide the tire and rim assembly (1) over the wheel (1), and push it into position against the mounting surfaces of the wheel.
3. Install the lug nuts (3) on each stud (2). Tighten the lug nuts until the face of each is flush with the studs.
4. Rotate the wheel (1) one half turn to allow the parts to seat naturally.



1. Tire Inflation Service Port 2. Front Outrigger

Figure 3—5
Tire Inflation Service Port



1. Wheel
2. Stud
3. Lug Nut
4. Valve Stem
5. Tire And Rim
6. Brake Drum

Figure 3—6
Front Tire And Rim Assembly

5. Tighten the lug nuts (3), one turn at a time, following the criss-cross sequence shown in Figure 3—3. Always rotate the lug nut to be tightened to the top position. This will ensure even tightening and proper alignment of the tire and rim assembly (5). Tighten the lug nuts in this manner until all lug nuts are torqued to 450—500 ft lb (*610.2—678Nm*).
6. Check the alignment of the tire and rim assembly by placing an object on the floor beside the tire, and rotating the wheel. Note any variation in the distance between the tire and the object. Refer to Figure 3—7. If the variation in distance exceeds .19 inch (*4.8mm*), the tire and rim assembly is misaligned.
7. Misalignment is due to defective or damage parts. Inspect components for damage and replace as required.
8. Repeat Steps 6 and 7 until the proper alignment is obtained. Check the lug nuts to be sure each is torqued to the specified amount.

CAUTION

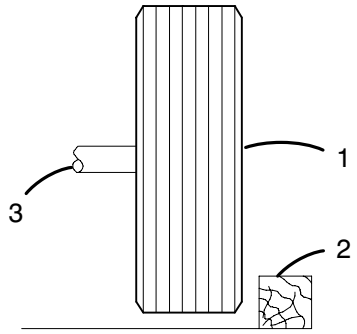
Improper torque can cause damage to components, rim slippage, or alignment problems. Tighten the lug nuts to the specified torque only.

9. Check the tire and rim assembly to be sure the tire is properly inflated. Correct tire pressures are listed in the Crane Rating Manual, located in the operator's cab and on the Gross Axle Weight Rating plate located on the hydraulic reservoir.

   Note: The air system of the crane is equipped with a tire inflation service port which may be used to supply air pressure to inflate tires. The ports are located on either side of the carrier on the front lower portion of the front outrigger boxes and are capable of supplying 150 psi (*1 034kPa*) of air pressure. Refer to Figure 3—5.

10. Start the engine, fully retract the outrigger jacks and beams, and drive the crane approximately 1 mile (*1.6km*). Tighten the lug nuts again using the proper torquing sequence (Figure 3—3) and recommended torque value.

    Note: Lug nut torque values should be checked every 10 hours, for the first 50 hours of operation, after any tire and rim assembly is installed. Tighten any lug nuts, as required, to the recommended torque value. Check the lug nut torque every 50 hours of operation thereafter.



1. Tire
2. Stationary Object
3. Axle

Figure 3–7
Tire And Rim Alignment

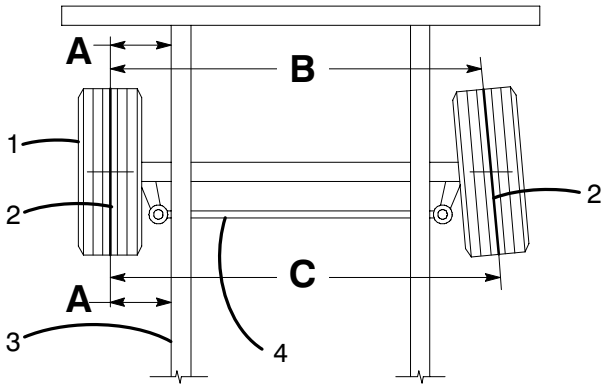
Front Wheel Alignment

The wheel alignment should be checked seasonally. The best way to determine proper alignment is by evaluating tire wear. If the tires are wearing correctly, the alignment should be correct. If the tires are not wearing correctly, the following procedure can be used to give an approximately correct alignment. Professional laser type alignment equipment should be used to achieve the best accuracy. If assistance is needed in finding service facilities capable of doing this alignment, please consult the factory.

1. Park crane on a firm, level surface, shift the transmission to neutral, and engage the park brake.
2. Raise the crane on outriggers to get the tires off the ground. Release the park brake.
3. Scribe a line on the approximate center of each tire by bringing a pointed, stationary object into contact with the tread while rotating the wheel. Refer to Figure 3–8. The line must begin and end at the same point on the tread.
4. Apply park brake and retract outriggers to allow the entire weight of the crane to rest on the tires.
5. Turn the wheels to align the left wheel parallel with the carrier frame. This can be done by equalizing the distances at "A". Refer to Figure 3–8.

⚠ DANGER

Use extreme caution when operating the steering with someone under the carrier. The hydraulic force behind the steering components is capable of severely injuring anyone caught in the steering linkage or trapped behind a tire. Post a signalman to watch carefully to ensure the safety of the person under the carrier.



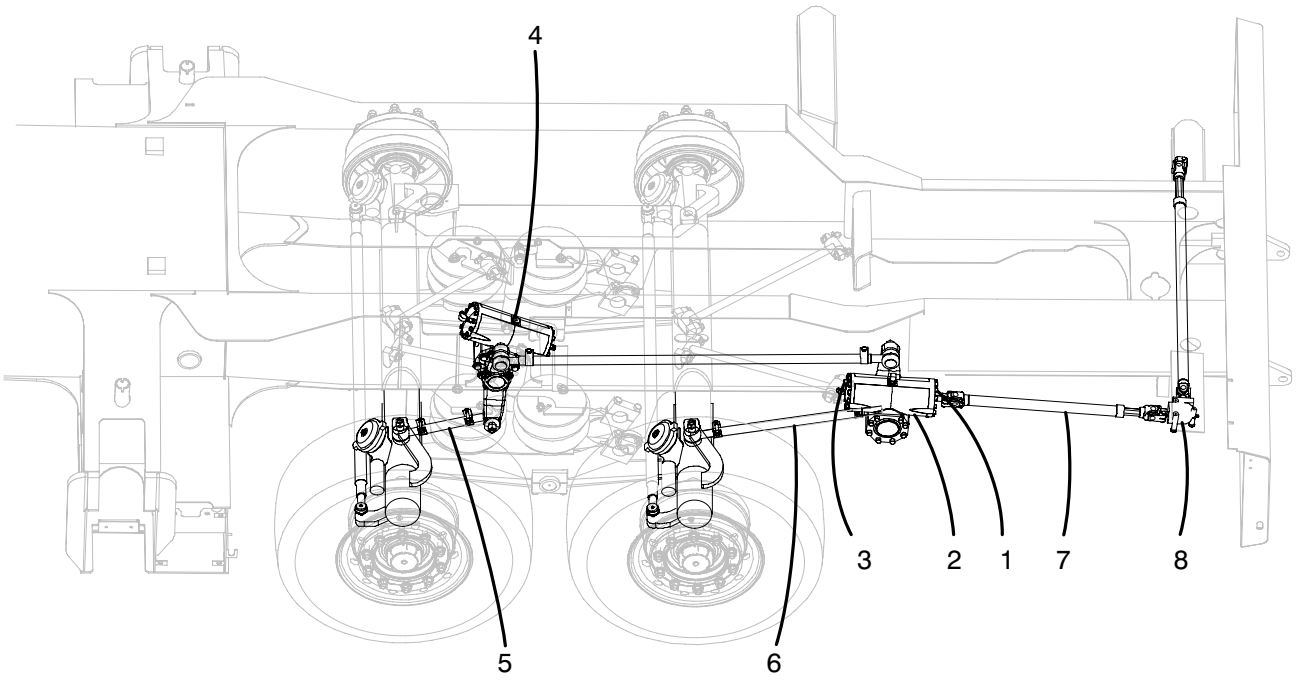
1. Tire
2. Scribed Lines
3. Carrier Frame
4. Tie Rod

Figure 3–8
Front Wheel Alignment

6. Shutdown the engine. Make sure distance "A" has not changed after engine was shutdown.
7. Measure the distances from the scribed line of one tire to the scribed line of the other, at the front and rear of the tire, "B" and "C". Refer to Figure 3–8.

   Note: Measurement must be made with the weight of the crane on the axle.

8. Proper toe-in requires the distance at the rear "C" be 0.06–0.25 in (*1.5–6.4mm*) greater than at the front "B".
9. If adjustment is required, loosen the clamps on each end of the tie rod and adjust the length of the tie rod to obtain the proper "B" and "C" dimensions. Tighten the clamps.
10. Roll the crane forward at least 50 ft (*15m*) and repeat Steps 2–8 to check the adjustment.
11. Repeat Steps 2–10 for the second axle. The toe-in is now properly adjusted on both axles.
12. With the distances at "A" equal on the first axle, check the the distances at "A" on the second axle. If the distances at "A" are equal proceed with Step 13. If the distances at "A" are not equal proceed with the following:
    a. Loosen the clamps on each end of the right drag link on the second axle. Refer to Figure 3–9.
    b. Adjust the length of the drag link to equalize the distances at "A". Tighten the clamps.
13. Turn the wheels full left and full right and check all clearances of the wheels, linkages, and other crane components.
14. Adjust the axle stop bolts on the steering knuckle as required to prevent any interference between the wheels, linkages, and other crane components.



1. Left Relief Plunger — Max Left Turn Angle
2. Front Steering Gear
3. Right Relief Plunger — Max Right Turn Angle
4. Rear Steering Gear
5. Right Rear Drag Link
6. Right Front Drag Link
7. Steering Drive Shaft
8. Miter Box

Figure 3—9
Steering Linkage

15. With the entire weight of the crane on the tires, turn the wheels full left and full right and check that the steering gears go over relief just before the wheels contact the axle stop bolts.

    Note: The steering gear will make a hissing sound when it is going over relief.

16. If steering gears go over relief just before the wheels contact the axle stop bolts, go to Step 17. If the steering gears do not go over relief just before the wheels contact the axle stop bolts, proceed with the following:

⚠ WARNING

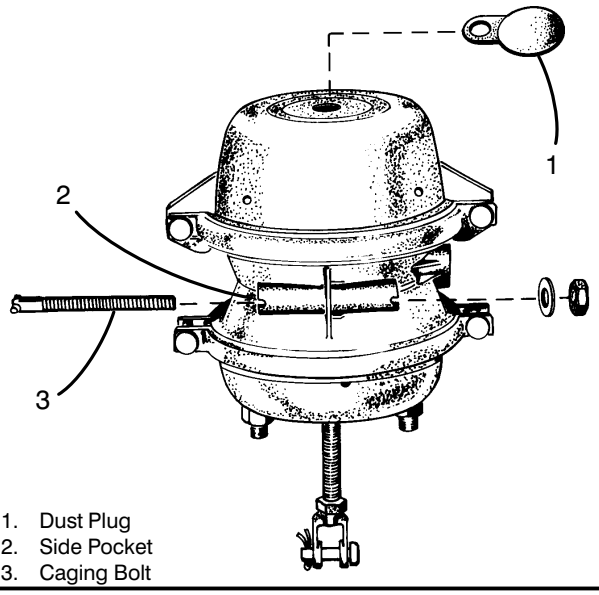
Do not loosen the relief plungers beyond flush with the end cap. The relief plunger could eject from the end cap causing a sudden release of hot oil which could cause burns or other serious injury.

    a. Turn the wheels full right. On the right side of the crane adjust the right relief plunger on the front steer gear until the steering gears go over relief just before the wheels contact the axle stop bolts. Refer to Figure 3—9.

       Note: Turn relief plunger in to reduce maximum turn angle, turn out to increase angle.

    b. Turn the wheels full left. On the right side of the crane adjust the left relief plunger on the front steer gear until the steering gears go over relief just before the wheels contact the axle stop bolts.

17. Check that the steering wheel is centered when the wheels are positioned straight. If the steering wheel is centered when the wheels are positioned straight, go to Step 18. If the steering wheel is not centered when the wheels are positioned straight, proceed with the following:
    a. Position the wheels so they are straight ahead.
    b. Disconnect the steering drive shaft from the miter box and center the steering wheel.
    c. Reassemble the steering drive shaft and torque the drive shaft capscrew.
18. Test all steering functions before placing the crane in service.



1. Dust Plug
2. Side Pocket
3. Caging Bolt

Figure 3—10
Air Brake Chamber

Carrier Brakes

WARNING

Removal of the bands holding dual air brake chambers together before caging the power spring will result in the chamber and its internal parts being rapidly and forcefully ejected. This may result in severe personal injury. Always cage the power spring before attempting any brake or air chamber repair. If any doubt exists as to whether a potential safety hazard exists, contact your nearest distributor before repairs are attempted.

Caging Dual Air Brake Chamber

A dual air brake chamber is a brake system component that uses two internal air chambers to control the functions of the service and park brakes. This particular crane only uses dual air brake chambers on the rear brakes.

The chamber closest to the push rod controls the service brake. The other chamber controls application of the park brake. The park brake chamber contains a large high force (power) spring that will cause the unit to literally "explode" if it is not caged prior to disassembly. Caging compresses and restrains the power spring. Use the following procedure to cage the power spring.

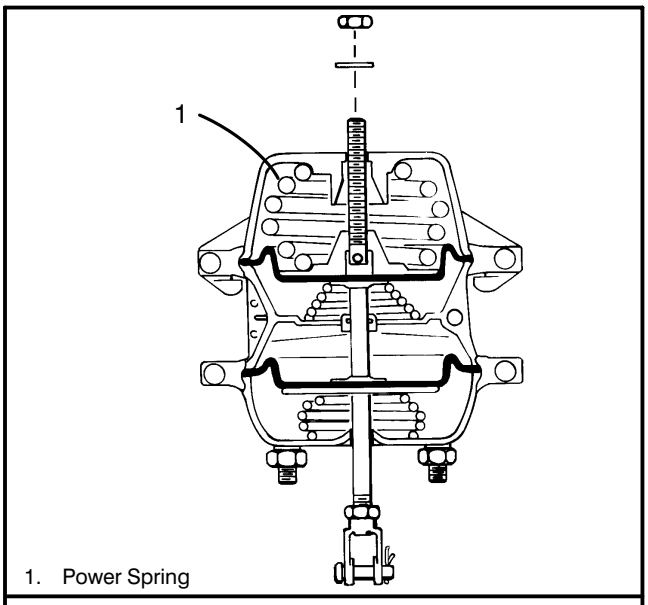
1. Park the crane on a firm, level surface. Engage the park brake and shift the transmission to neutral.
2. Level the crane on fully extended outriggers, release the park brake and shutdown the engine.

   Note: If leveling the crane on outriggers is not practical, the wheels must be blocked so that the park brake can be released.

3. Remove the dust plug from the end of the air brake chamber. Refer to Figure 3—10.
4. Locate and remove the caging bolt assembly which is stored in the side pocket of the air brake chamber.
5. Insert the caging bolt into the end of the air brake chamber as far as possible. Refer to Figure 3—11.
6. Rotate the caging bolt 1/4 turn to lock it in place. Install the lockwasher and nut on the caging bolt.
7. Note the position of the push rod and clevis as the caging bolt nut is tightened . It should be retracting into the brake chamber as the nut is tightened. Refer to Figure 3—12.
8. Continue to tighten the caging bolt nut until the power spring is fully caged. Do not over tighten, 50 ft lb (*67Nm*) maximum.

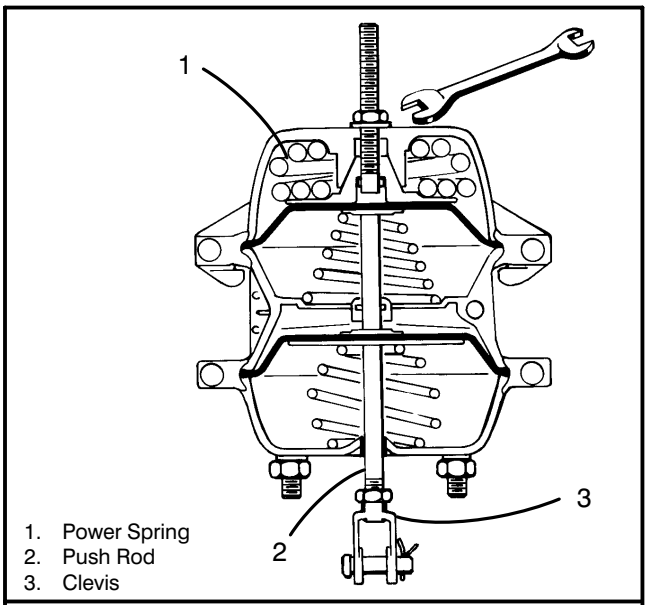
   Note: If the cranes air system is inoperative and the park brake is engaged, turning the caging bolt nut will be more difficult than if the park brake is released.

9. The power spring has now been caged Continue with any necessary repair. Repeat the above procedure for each brake serviced.



1. Power Spring

Figure 3–11
Air Brake Chamber – Power Spring Free



1. Power Spring
2. Push Rod
3. Clevis

Figure 3–12
Air Brake Chamber – Power Spring Caged

Releasing A Caged Dual Air Brake Chamber

The park brake chamber contains a large high force (power) spring that will cause the unit to literally "explode" if it is not caged prior to disassembly. Caging compresses and restrains the power spring. After installing the air brake chamber on the crane, the power spring must then be released in order for the park brake feature of the brake chamber to function. Use the following procedure to release the caged power spring once the unit is installed on the crane.

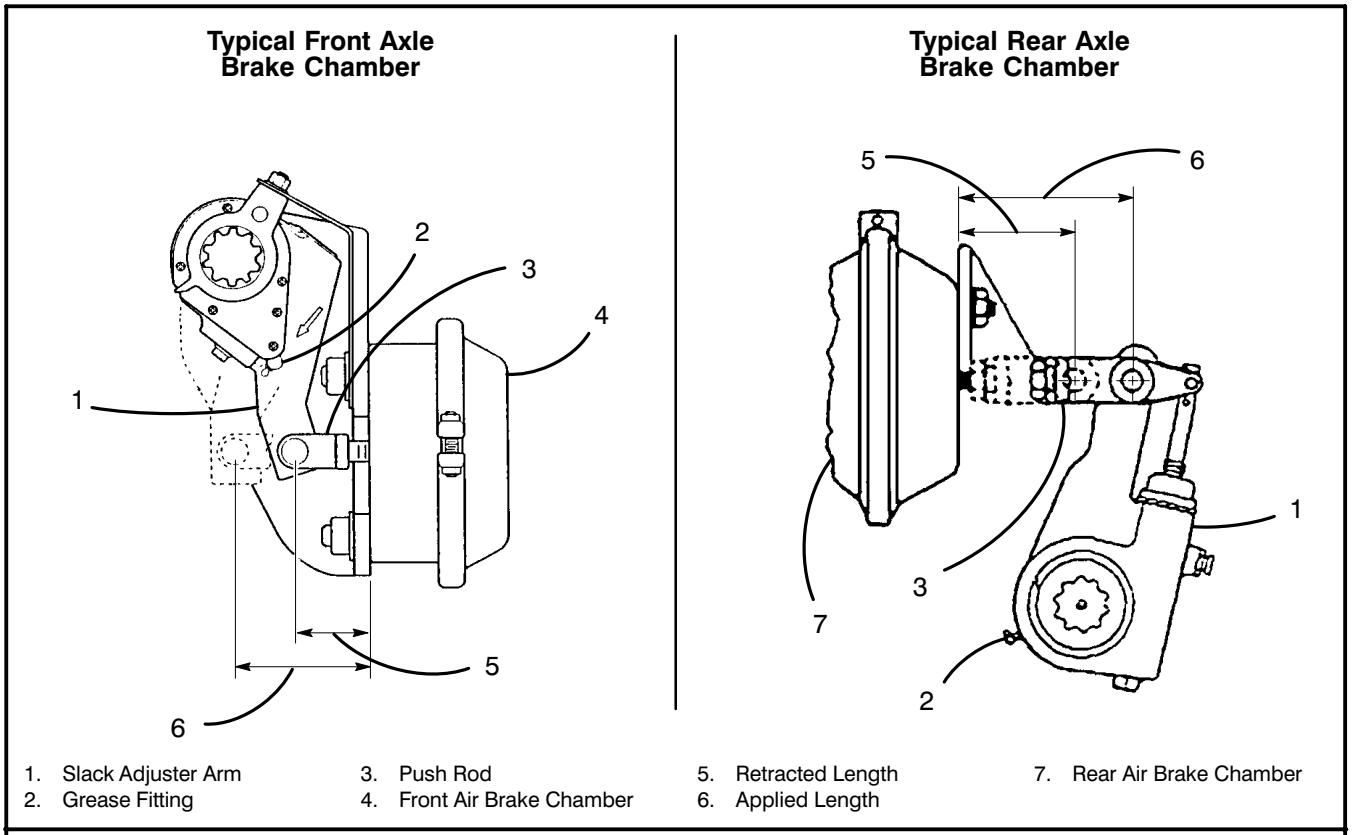
1. Park the crane on a firm, level surface. Engage the park brake and shift the transmission to neutral.
2. Level the crane on fully extended outriggers, release the park brake, and shutdown the engine.

   Note: If leveling the crane on outriggers is not practical, the wheels must be blocked so that the park brake can be released.

3. Slowly loosen the caging bolt to release the power spring by turning it counterclockwise.

   Note: If the cranes air system is inoperative and the park brake is engaged, turning the caging bolt will be more difficult than if the park brake is released.

4. Note the position of the push rod and clevis while loosening the caging bolt. It should begin to extend out of brake chamber as the nut is loosened.
5. When the power spring is fully released the caging bolt and stop washer can be removed from the chamber.
6. Store the caging bolt in the side pocket of the air brake chamber and install the washer and locknut. Refer to Figure 3–10.
7. Install the dust plug on the end of the air brake chamber. Refer to Figure 3–10.



1. Slack Adjuster Arm
2. Grease Fitting
3. Push Rod
4. Front Air Brake Chamber
5. Retracted Length
6. Applied Length
7. Rear Air Brake Chamber

Figure 3–13
Front And Rear Brake Chambers

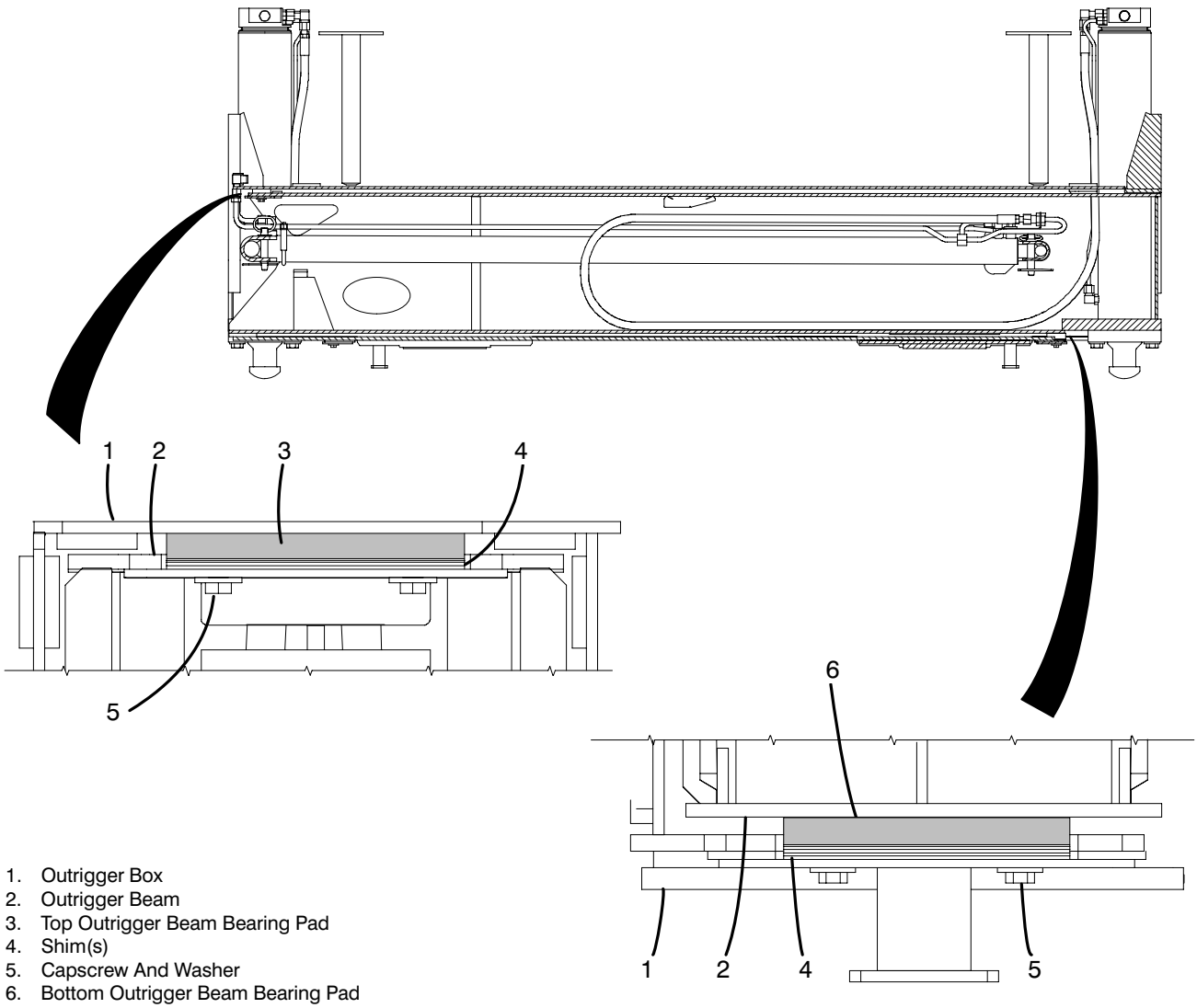
Brake Inspection

The front and rear brakes are equipped with automatic slack adjusters to compensate for brake lining wear. They should be checked periodically to ensure that they are operating properly. Refer to Figure 3–13.

1. Park the crane on a firm, level surface. Shift the transmission to neutral and engage the park brake.
2. Level the crane on fully extended outriggers with all tires clear of the ground. Shutdown the engine.
3. Measure the pushrod length (distance from the face of air chamber to the centerline of the pushrod clevis pin) when fully retracted. Refer to Figure 3–13.
4. Make an 80–90 psi (*552–620kPa*) brake application. Measure the pushrod length again.

   Note: To obtain an 80–90 psi (*552–620kPa*) brake application, start the engine and build system pressure to 100 psi (689*kPa*). Shutdown the engine. Make and hold a full brake application. This will give 80–90 psi (*552–620kPa*) in the air chamber.

5. Subtract the retracted length from the applied length. The difference is the "applied stroke".
6. The applied stroke should be 2 in (*5cm*) or less.
7. If the automatic slack adjuster does not maintain specified applied stroke, further service is required.



1. Outrigger Box
2. Outrigger Beam
3. Top Outrigger Beam Bearing Pad
4. Shim(s)
5. Capscrew And Washer
6. Bottom Outrigger Beam Bearing Pad

Figure 3—14
Outrigger Beam Bearing Pads

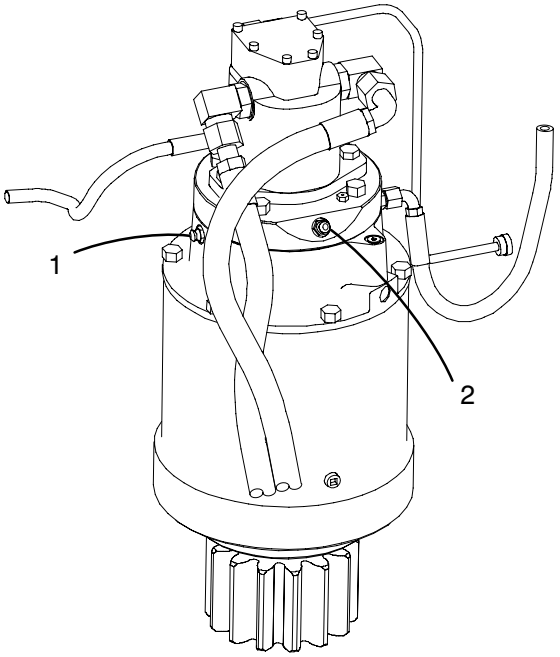
Outrigger Beam Bearing Pad Adjustment

Bearing pads are provided on the outrigger beams as a means of keeping the outrigger beams working smoothly. They must be adjusted periodically to prevent excessive deflection of the beams. Refer to Figure 3—14.

1. Park crane on a firm, level surface. Extend the outrigger beams approximately 4 in (*10.1cm*).
2. Place a 0.25 in (*6.35mm*) shim on top of the inner outrigger beam and between the beam and outrigger box. Refer to Figure 3—14. Do this on all four outrigger beams.
3. Extend the outrigger jacks until the beams contact the shims. Do not raise the crane off the ground.
4. Remove all outrigger box covers. Remove capscrews and washers. Shim, as required, to maintain 0.25 in (*1.5mm*) clearance. Install capscrews and washers.

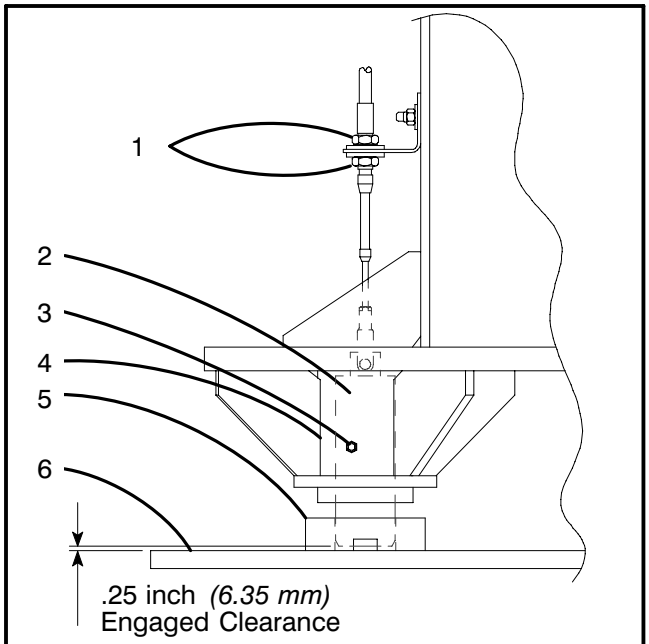
   Note: If clearance can not be obtained due to bearing pad wear, replace the bearing pads as required.

5. Fully retract the outrigger jacks.
6. Remove shims from the top of the beams.
7. Fully extend outrigger beams and check that there is 0.06 in (*1.5mm*) maximum clearance between the top of the inner outrigger beam and outrigger box



1. Park Brake Bleeder Plug
2. Service Brake Bleeder Plug

Figure 3—15
Swing Unit



1. Cable Adjusting Nuts
2. Swing Lock Pin
3. Grease Fitting
4. Pin Guide Tube
5. Retainer Ring
6. Carrier Deck

Figure 3—16
Travel Swing Lock Adjustment

Swing Brake Bleeding

Bleed the swing brake whenever a hydraulic line is removed from the swing unit to remove any air that may have been trapped in the circuit. Use the following procedure to bleed the swing brake.

1. Park the crane on a firm, level surface. Shift the transmission to neutral and engage the park brake.
2. Engage travel swing lock and shutdown engine.
3. Position a suitable container under bleeder plugs.
4. Loosen the park brake bleeder plug. Refer to Figure 3—15. Turn the key switch to the "ON" position but do not start the engine.
5. Operate the swing park brake control switch located on the overhead control panel. Allow the fluid to discharge into the container until no air is present. Tighten the park brake bleeder plug.
6. Turn the key switch to the "OFF" position.
7. Loosen the service brake bleeder plug. Push the swing brake pedal and allow the fluid to discharge into the container until no air is present. Tighten the service brake bleeder plug.
8. Check the hydraulic oil level. Refer to "Hydraulic Reservoir Oil Level Check" found in Section 2 of this Operator's Manual.
9. Test all swing brake functions before operating the crane.
10. Properly dispose of used oil.

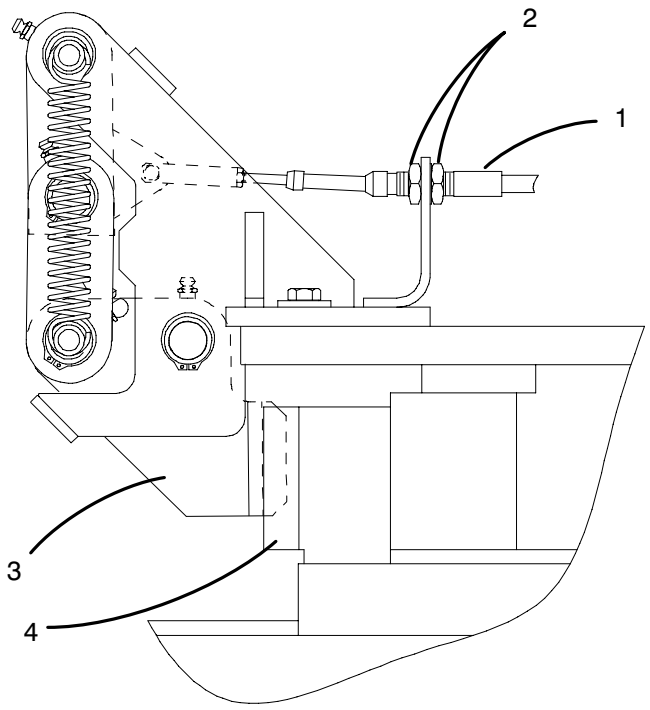
Travel Swing Lock Adjustment

The travel swing lock is a two position, positive lock of the upper over the carrier to prevent swinging of the upper. The travel swing lock must be kept adjusted.

1. Park the crane on a firm, level surface. Shift transmission to neutral and engage the park brake. Level the crane on outriggers.
2. Check that the travel swing lock is engaged and shutdown engine. Refer to Figure 3—16.

   Note: The travel swing lock control cable should only operate after the release button in the center of the control knob is depressed. Replace the control cable if the release button does not operate properly.

3. Check the engagement of the swing lock pin in the retainer ring on the carrier deck. The pin should extend in the retainer plate to within 0.25 in (*6.35mm*) of the carrier deck.
4. Adjust the stroke of the swing lock as required by using the cable adjusting nuts.
5. Test the swing lock in each working position before operating the crane.



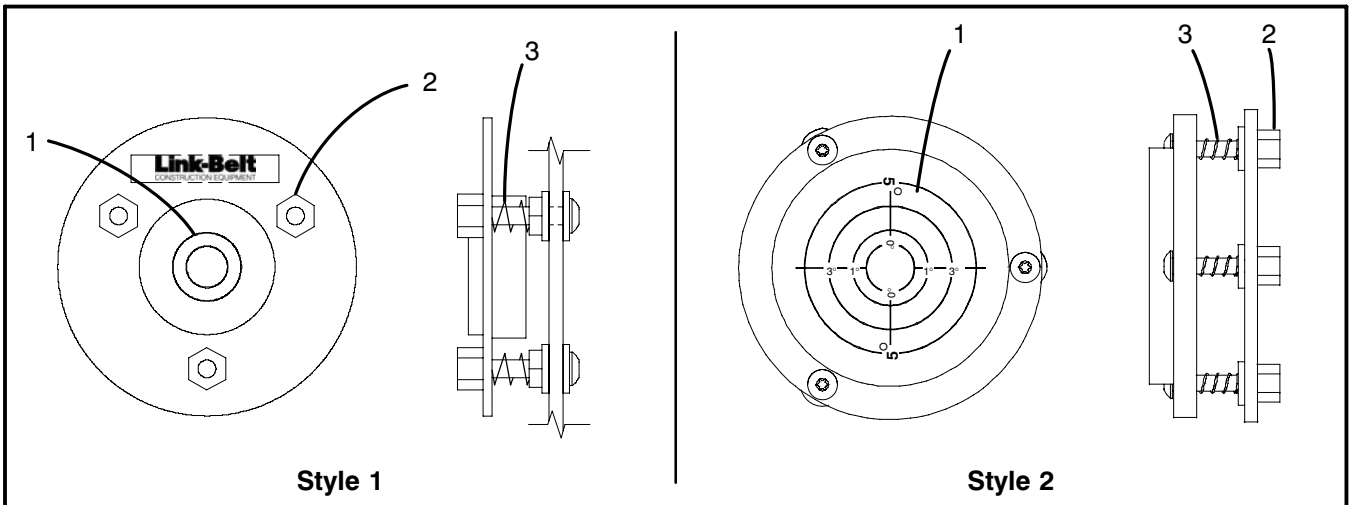
1. Control Cable
2. Adjusting Nuts
3. Swing Lock Pawl
4. Turntable Bearing Gear Teeth

Figure 3–17
360˚ Swing Lock Adjustment

360˚ Swing Lock System Inspection And Adjustment

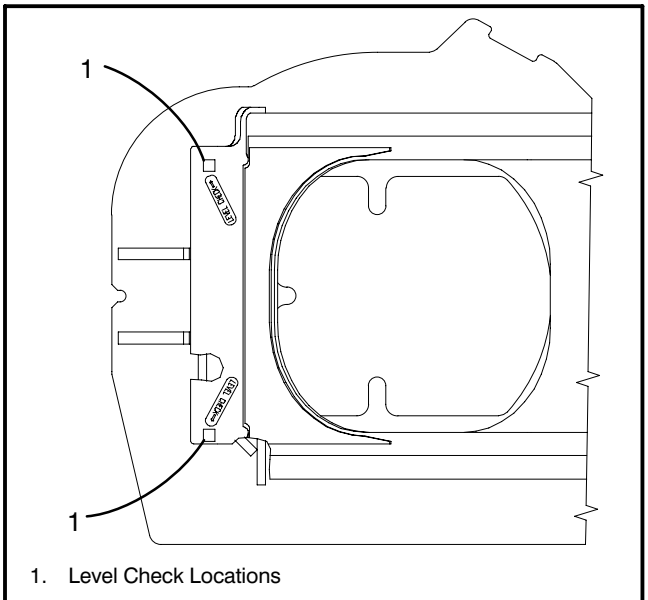
The 360˚ swing lock system, if equipped, functions to prevent rotation of the upper over the carrier. The 360˚ swing lock functions by engaging a pawl in the external turntable bearing gear teeth. The swing lock must be correctly adjusted in order to operate properly. Use the following procedures to properly inspect and adjust the 360˚swing lock.

1. Park the crane on a firm, level surface, shift the transmission to neutral, and engage the park brake. Level the crane on outriggers.
2. Engage the travel and 360˚ swing locks. Shutdown the engine.
3. Visually inspect the 360˚ swing lock pawl. The pawl should be fully engaged with the linkage just over center. Refer to Figure 3–17.
4. If the pawl is not fully engaged and the linkage is not just over center, use the cable adjusting nuts to correctly position it.
5. Tighten the adjusting nuts and test the 360˚ swing lock before operating the crane.



1. Glass Vial
2. Adjusting Nut
3. Spring

Figure 3—18
Bubble Level Adjustment



1. Level Check Locations

Figure 3—19
Level Check Locations

Bubble Level Adjustment

A bubble level, for leveling the crane on outriggers, is mounted in the upper operator's cab on the right side wall, and at each of the remote outrigger stations on the carrier. They should be checked periodically to ensure proper adjustment.

1. Park the crane on a firm, level surface. Engage the park brake and shift the transmission to neutral.
2. Level the crane on fully extended outriggers. Position the upper over the rear of the carrier and engage the travel swing lock. Fully retract the power sections of the boom. Boom down to 0° angle.
3. Verify the crane is level by placing a carpenter's level across the level check locations on the front of the upper frame. Refer to . Check levelness with the upper over the rear and over the side of the crane. Adjust the outriggers as necessary.
4. Rotate the adjustment nuts as required until the bubble is centered within the vial. Refer to Figure 3—18.

   Note: Do not flatten out the springs under the bubble level. Loosen rather that overtighten the adjustment nuts to gain the necessary adjustment.

Crane Monitoring System

A properly calibrated Rated Capacity Limiter is critical for safe crane operation. The boom angle and length are crucial factors in determining crane capacities. The Rated Capacity Limiter must be checked for accuracy on a daily basis and calibrated as needed.

The Rated Capacity Limiter should be calibrated by a qualified technician only. Contact your local distributor to arrange for a qualified technician to perform the calibration procedures.

Hydraulic System Relief Valve Adjustment

The following instructions pertain to checking and setting all relief valve pressures in the hydraulic system. All cranes are tested and properly adjusted before leaving the factory and should not need checking when first put into operation. Each 250 hours of operation, the relief valve pressure settings should be checked. A drop in relief valve pressure setting may be noticed the first time checked. This is normal and is probably due to lessening of spring tension or stress relief in relief valve parts.

If a new or rebuilt pump is installed, all relief valve pressures must be backed off and reset, as outlined in this Section before putting the crane in operation. The purpose of this is to avoid the possibility of damaging the new pump from over pressurization, if relief valves are set incorrectly. Do not operate the crane over relief pressures for extended periods of time to avoid overheating of hydraulic oil.

CAUTION

Relief valves are provided to protect the hydraulic system. Do not increase relief valve pressures above specifications or hydraulic system damage may occur.

Preparing The Crane For Checking Relief Pressures

1. Park the crane on firm, level surface. Shift the transmission to neutral and engage the park brake.
2. Level the crane on outriggers and operate the hydraulic functions, as required, to bring the hydraulic oil temperature to its normal operating range. Refer to "Hi Performance Hydraulic Oil" chart located in Section 2 of this Operator's Manual for oil operating temperature ranges.
3. Engage the travel swing lock with the upper directly over the front of the carrier.
4. Fully retract and lower the boom. Shutdown the engine.

   Note: Checking relief valve pressures is simplified by using two persons, one in the upper operator's cab to operate the controls and one to check and adjust the relief valves.

Relief Valve Pressure Checking Instructions

Refer To Figure 3−21 thru Figure 3−22 for relief valve and quick disconnect fitting locations.

1. Use a gauge of known accuracy. Have the gauge calibrated if necessary. Use a snubber or gate valve to reduce shock loading in the gauge.
2. Release the hydraulic system precharge pressure and work the control, for the circuit being checked, back and forth to relieve any trapped hydraulic pressure.

   Note: For functions which are operated by a toggle switch, the ignition switch must be in the "ON" position but do not start the engine.

⚠ WARNING

All trapped hydraulic pressure must be exhausted from the system before installing a gauge in any quick disconnect. A sudden release of hot oil could cause burns or other serious injury.

3. Install the pressure gauge on the quick disconnect fitting.
4. Refer to "Hydraulic Pressure Settings", Figure 3−20, to determine the correct pressure setting for the circuit being checked. Also, review the procedure for checking that particular circuit outlined in the chart.
5. Start the engine.
6. If applicable, fully engage the control for the circuit being checked and hold it in that position.
7. With the engine running at the speed specified in the "Hydraulic Pressure Settings", Figure 3−20, check the gauge for the correct reading, adjust as required.

   Note: Obtain each final pressure by bringing the pressure up to the proper setting, not by backing down to it.

8. Allow the engine to return to idle before shutting it down.
9. Release the hydraulic system precharge pressure and work the control back and forth to relieve any hydraulic pressure before removing pressure gauge from the quick disconnect fitting.

Hydraulic Pressure Settings

Relief Valve	Hydraulic Circuit	Quick Disconnect & Adjustment Location	Relief Valve Setting	Procedure For Setting The Relief Valve
1	Outrigger	Figure 3–21 A & B	3,000 psi (*20 685kPa*)	Fully retract an outrigger beam and hold. Engine at full throttle.
2	Bumper Outrigger	Figure 3–21 C & D	650 psi –0 +50 psi (*4 481kPa*) (*+0 –344kPa*)	Level crane on main outriggers. Fully extend bumper outrigger and hold. Engine at idle.
3	Steering	Figure 3–21 E & F	2,000 psi (*13 790kPa*)	Crane on tires, boom fully retracted, travel swing lock engaged with boom over front. Retract bumper outrigger jack and hold. Engine at idle.
4	Axle Lift (If Equipped)	Figure 3–21 G & H	1,500 psi (*10 342kPa*)	Engage axle lift control and hold. Adjust with engine at idle.
5	Pilot Control	Figure 3–22 I & J	500 psi (*3 448kPa*)	Adjust with engine at idle.
6	Swing			Engage travel swing lock. Engine at idle.
	Left	Figure 3–22 K & L	2,000 psi (*13 790kPa*)	Swing left and hold. Check pressure.
	Right	Figure 3–22 K & M		Swing right and hold. Check pressure.
	Telescope 1	Figure 3–22 K & N	3,000 psi (*20 685kPa*)	Crane on fully extended outriggers, travel swing lock engaged with boom over rear. Engine at full throttle. Fully retract telescope cylinder and hold.
	Telescope 2	Figure 3–22 O & P		Crane on fully extended outriggers, travel swing lock engaged with boom over rear. Engine at full throttle. Swing either direction and hold. Fully retract telescope cylinder and hold.
7	Boom Hoist	Figure 3–22 Q & R	3,500 psi (*22 408kPa*)	Crane on fully extended outriggers, travel swing lock engaged, boom fully retracted and over rear. Fully boom up and hold. Engine at full throttle.
		Figure 3–22 Q & S	2,000 psi (*13 790kPa*)	Crane on fully extended outriggers, travel swing lock engaged, boom fully retracted and over rear. Fully boom down and hold. Engine at full throttle.
8	Front And Rear Winch	Figure 3–22 T & U	3,400 psi (*23 443kPa*)	Travel swing lock engaged with boom over rear. Remove and plug line to winch brake. Engage winch down and hold. Engine at full throttle.

Note:
1. **Adjust all pressures to within ±50 psi (*344kPa*) except where noted.**

Figure 3–20
Relief Valves Pressure And Adjusting Procedures

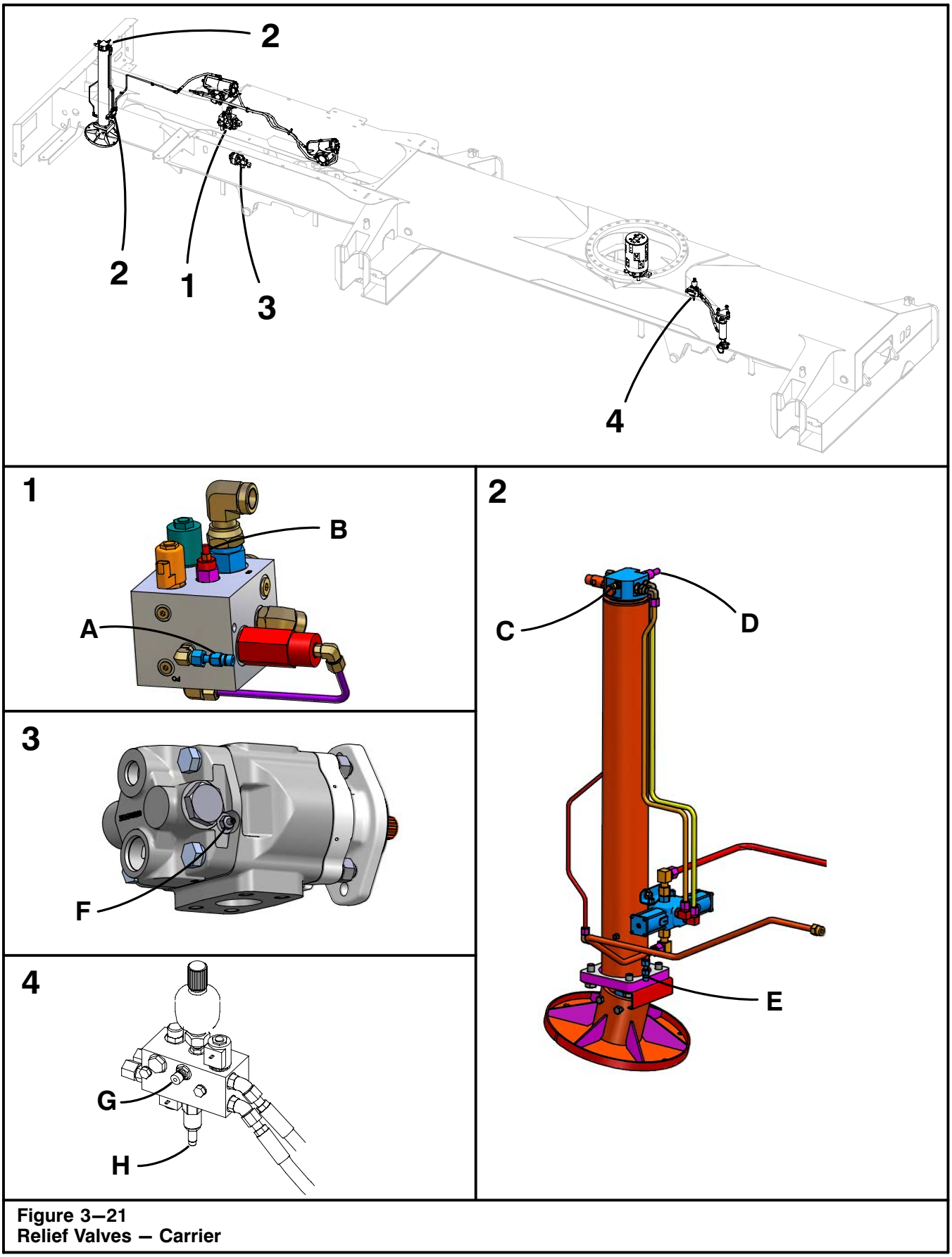


Figure 3–21
Relief Valves – Carrier

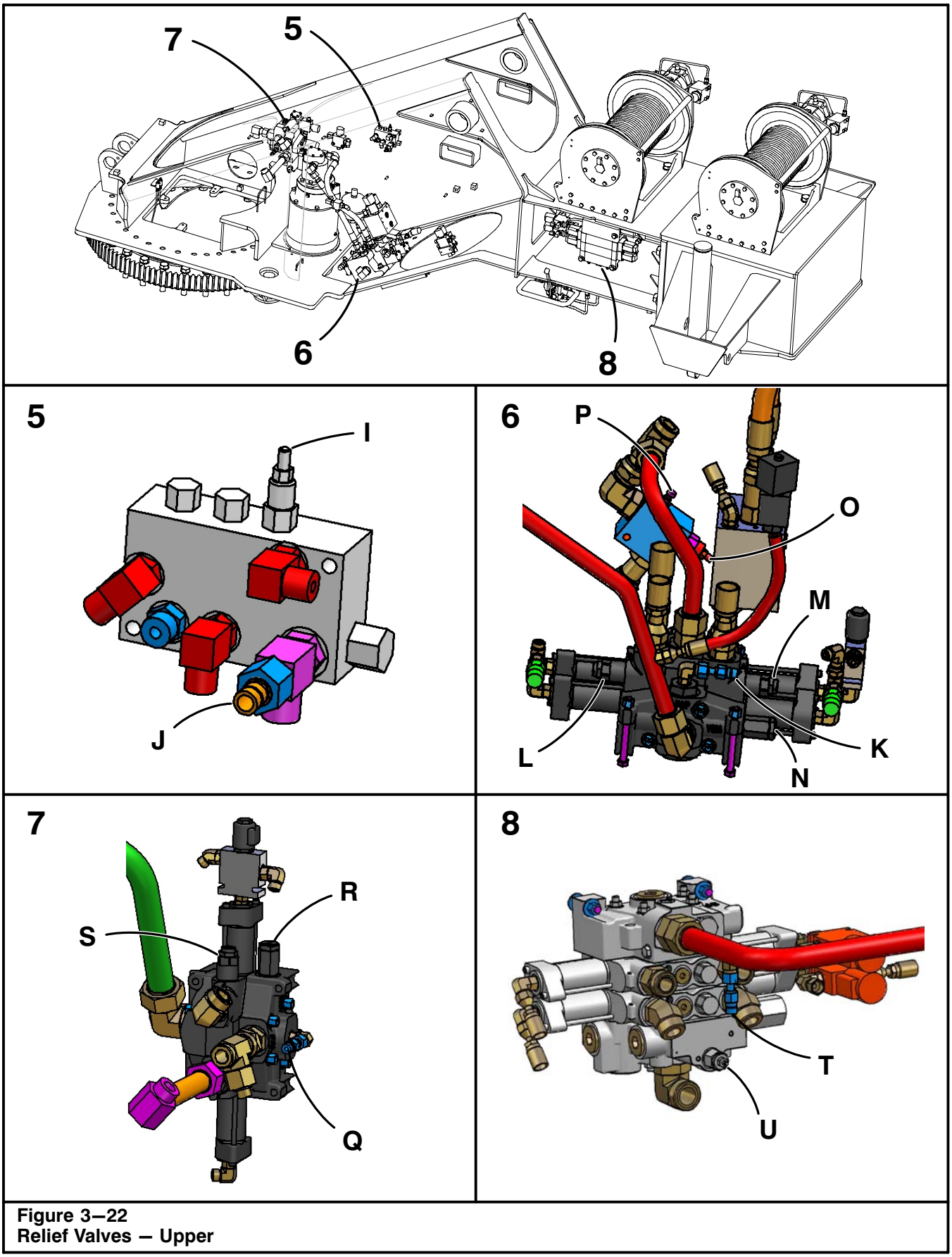


Figure 3–22
Relief Valves – Upper

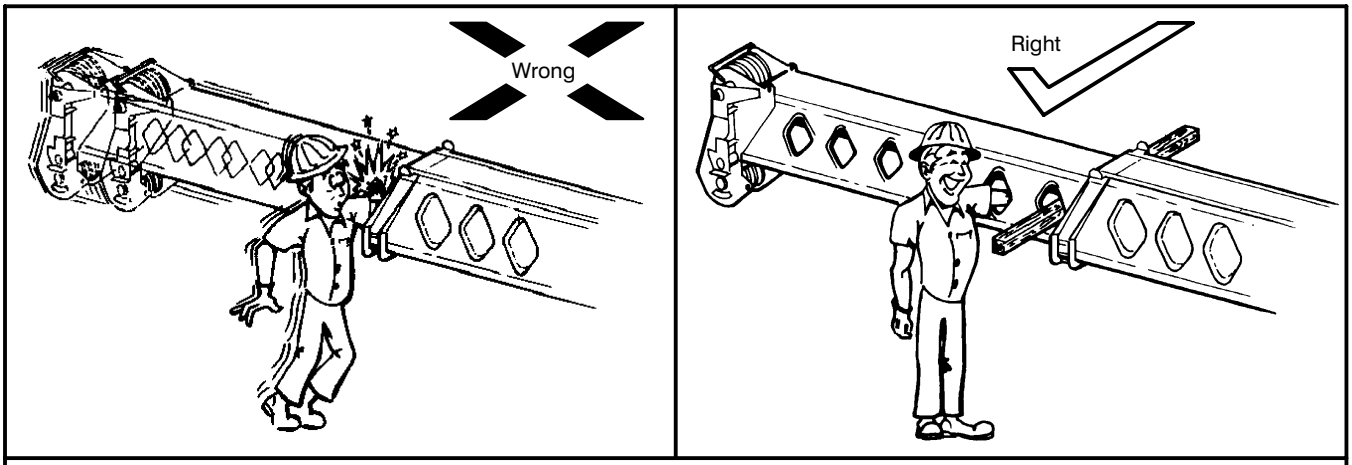


Figure 3–23
Shutdown the engine, ensure that the operator has vacated the operators cab, and insert blocking through the diamond shaped hole closest to the base section of the boom before putting hands or tools inside a boom section.

Boom Wear Shoe Adjustment

Boom wear shoes are provided as a means of keeping the boom working smoothly. They must be adjusted periodically to prevent excessive deflection of the boom sections. Refer to Figure 3–25.

1. Level the crane on fully extended outriggers with all tires clear of the ground. Swing the upper over the front of the carrier and engage the travel swing lock. Lower the boom and extend each boom section as required to gain access to each wear shoe.
2. Center each boom section within the next and adjust the top side wear shoes (item 1) to maintain a 0.09 in. (*2.3mm*) maximum clearance. Adjust the bottom side wear shoes (items 4, 5, 7, 9, & 11) to maintain a 0.03 in. (*0.8mm*) maximum clearance.

WARNING

To avoid personal injury, do not climb, stand or walk on the boom. Use a ladder or similar device to reach necessary areas.

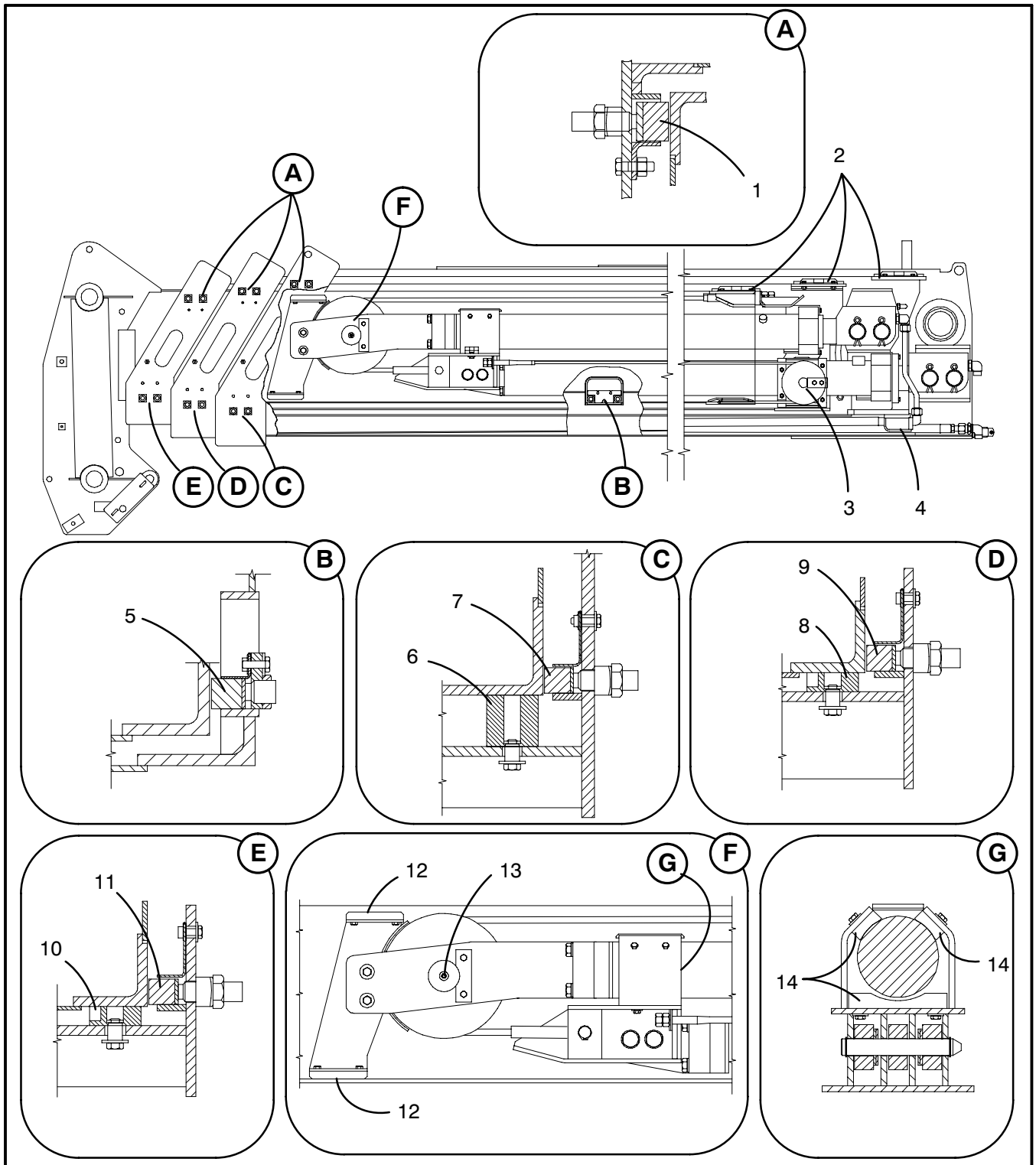
To prevent movement of individual boom sections, shutdown the engine, ensure that the operator has vacated the operators cab, and insert blocking through the diamond shaped hole closest to the base section before putting hands or tools inside the boom.

3. Check the thickness of all the wear shoes. Refer to the chart below for the minimum allowable thickness of each wear shoe. Replace the shoes in pairs as required.

Figure 3–24
Do not climb on boom or attachments.

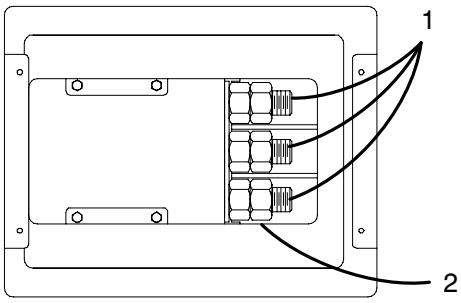
4. After adjusting the boom wear shoe clearances, boom up to a 60˚ angle and fully extend the boom. Make sure that the boom is straight and the sections are centered within each other. Thoroughly lubricate all boom wear shoes and their sliding surfaces as outlined in Section 2 of this Operator's Manual.

Minimum Wear Shoe Thickness			
Item	**Wear Shoe**	**Inches**	**mm**
2	Top Wear Shoes	0.5	*12.7*
6	Bottom Wear Shoes – Base	1.75	*44.45*
8 & 10	Bottom Wear Shoes – Inner mid, Outer Mid	0.5	*12.7*
12	Slider Bracket Wear Shoes	0.5	*12.7*
14	Cylinder Wear Shoes	.38	*9.7*

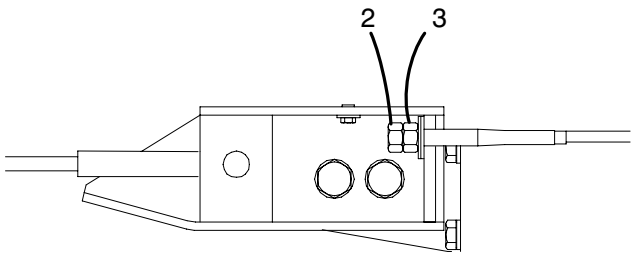


1. Side Wear Shoe – Top (6 Places)
2. Top Rear Wear Shoe – (6 Places)
3. Grease Fitting – Retract Sheave (2 Places)
4. Bottom Rear Wear Shoe – Inner Mid (2 Places)
5. Side Wear Shoe – Bottom (4 Places)
6. Bottom Wear Shoe – Base (2 Places)
7. Side Wear Shoe – Base (2 Places)
8. Bottom Wear Shoe – Inner Mid (2 Places)
9. Side Wear Shoe – Inner Mid (2 Places)
10. Bottom Wear Shoe – Outer Mid (2 Places)
11. Side Wear Shoe – Outer Mid (2 Places)
12. Telescope Cylinder Slider Bracket Wear Shoes (4 Places)
13. Grease Fitting – Extend Sheaves (2 Places)
14. Telescope Cylinder Wear Shoes (3 Places)

Figure 3–25
Boom Lubrication And Inspection



Boom Extend Wire Rope Anchors



Boom Retract Wire Rope Anchor

1. Extend Rope Anchors
2. Jam Nut
3. Retract Rope Anchor (Both Sides)

Figure 3–26
Boom Extend And Retract Wire Rope Anchors

Boom Extend And Retract Wire Rope Inspection And Adjustment

The boom extend and retract wire ropes must be inspected and the rope anchors torqued periodically to compensate for stretching of the wire rope. Refer to Figure 3–26.

WARNING

To avoid personal injury, do not climb, stand or walk on the boom. Use a ladder or similar device to reach necessary areas.

Extend/Retract Wire Rope Inspection

1. Level the crane on fully extended outriggers with all tires clear of the ground. Swing the upper over the front of the carrier and engage travel swing lock.
2. Using the boom telescope override switch, fully extend the outer mid and tip sections at 0˚ angle. Retract the sections 0.5–1 ft (*152–304mm*) to remove the load from the extend wire ropes and allow them to sag.
3. Visually inspect the ropes through the diamond shaped cutouts of the outer mid boom section. If one or more of the extend wire ropes sag to less than 3.5 in (*89mm)* from the bottom of the outer mid section or if there is a difference of more than 1 in. (*25.4mm*) between any of them, wire ropes must be adjusted. Refer to "Extend And Retract Wire Rope Adjustment".
4. Inspect extend/retract wire rope for wear. Refer to "Wire Rope Inspection And Replacement Recommendations" in Section 5 of this Operator's Manual.
5. Lubricate the extend/retract wire ropes. Refer to "Wire Rope Lubrication" in Section 2 of this Operator's Manual.

Extend/Retract Wire Rope Adjustment

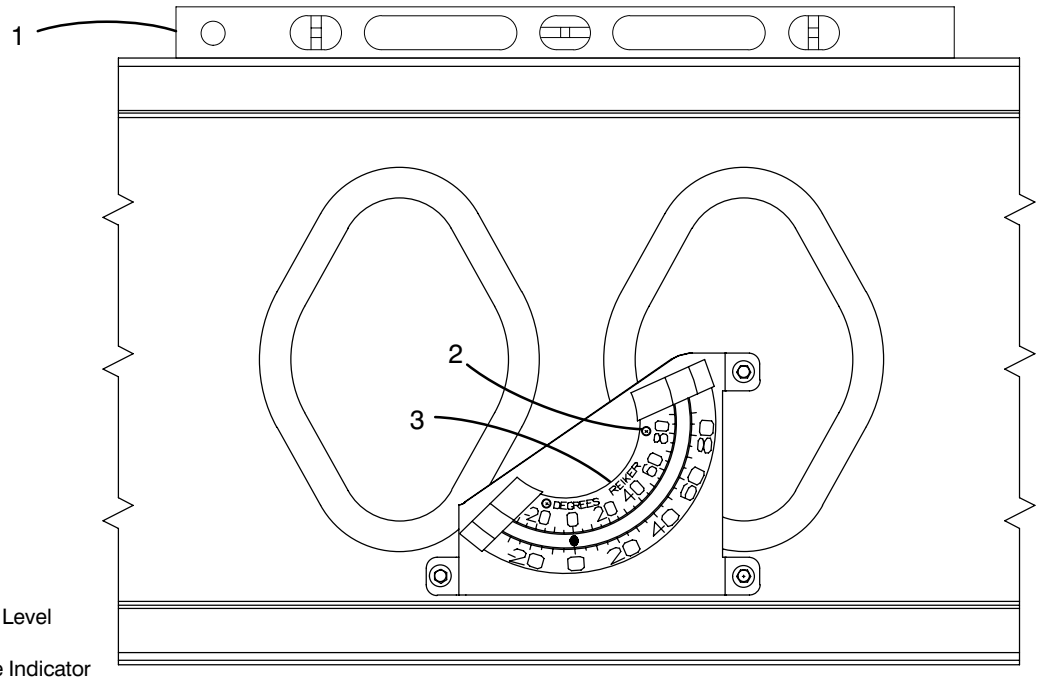
1. Level the crane of fully extended outriggers with all tires clear of the ground. Swing the upper over the front of the carrier and engage travel swing lock.
2. Fully retract the boom sections. With the boom in mode "A", extend the boom 6–8 ft (*1.8–2.4m*). The tip, outer mid, and inner mid section must remain in contact. Boom down to 0˚ angle.

   Note: If the tip section does not contact the outer mid section, loosen the extend wire ropes and tighten the retract wire rope until the tip section contacts the outer mid section.

3. Access the retract wire rope through the cutout on each side of the boom.
4. Loosen the jam nut and torque retract wire rope anchor to 20.4 ft lb (*27.6Nm*). Refer to Figure 3–26. Tighten the jam nut.
5. Fully retract the boom.
6. Remove access cover on the top rear of the boom.
7. Torque each of the three extend wire rope anchors to 25 ft lb (*33.9Nm*). Repeat the torque until all anchors are torqued to 25 ft lb (*33.9Nm)*.

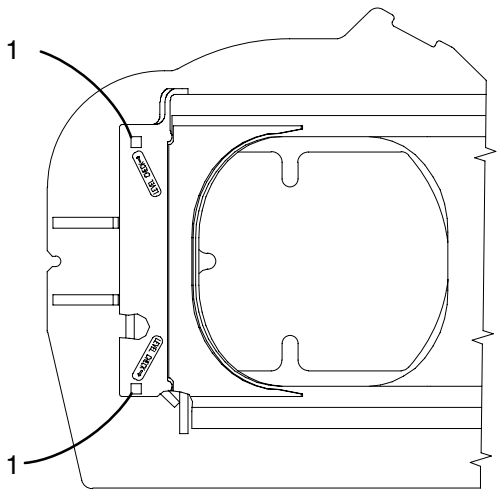
   Note: A 2 inch (*50.8mm*) "crows foot" is provided to aid in this adjustment.

   Extend wire rope should measure 4.5 in (*114.6mm*) from the bottom of the outer mid section when properly adjusted.



1. Carpenter's Level
2. Screw
3. Boom Angle Indicator

Figure 3–27
Boom Angle Indicator



Front of Upper Frame

1. Level Check Location

Figure 3–28
Level Check Location

Boom Angle Indicator

A mechanical type boom angle indicator is mounted to the right of the operator's cab on the base section of the boom. Refer to Figure 3–27. It must be adjusted properly and the crane must be level for the unit to accurately indicate boom angles. Check the adjustment of the boom angle indicator daily to ensure its accuracy.

Boom Angle Indicator Adjustment

1. Park the crane on a firm level surface, shift the transmission to neutral, and engage the park brake.
2. Level the crane on fully extended outriggers. Position the upper over the front of the carrier and engage the travel swing lock. Fully retract the power sections of the boom. Boom down to 0° angle.
3. Verify the crane is level by placing a carpenter's level across the level check locations on the front of upper frame. Refer to Figure 3–28. Check levelness with the upper over the front and over the side of the crane. Adjust the outriggers as necessary.
4. Once the crane is level, verify that the boom is at 0 degrees by placing carpenter's level on top of the boom. Refer to Figure 3–27. Adjust the boom as necessary.
5. If necessary, loosen the screw and adjust the angle indicator until the bubble within the vial is located under the 0 mark. Tighten screw.

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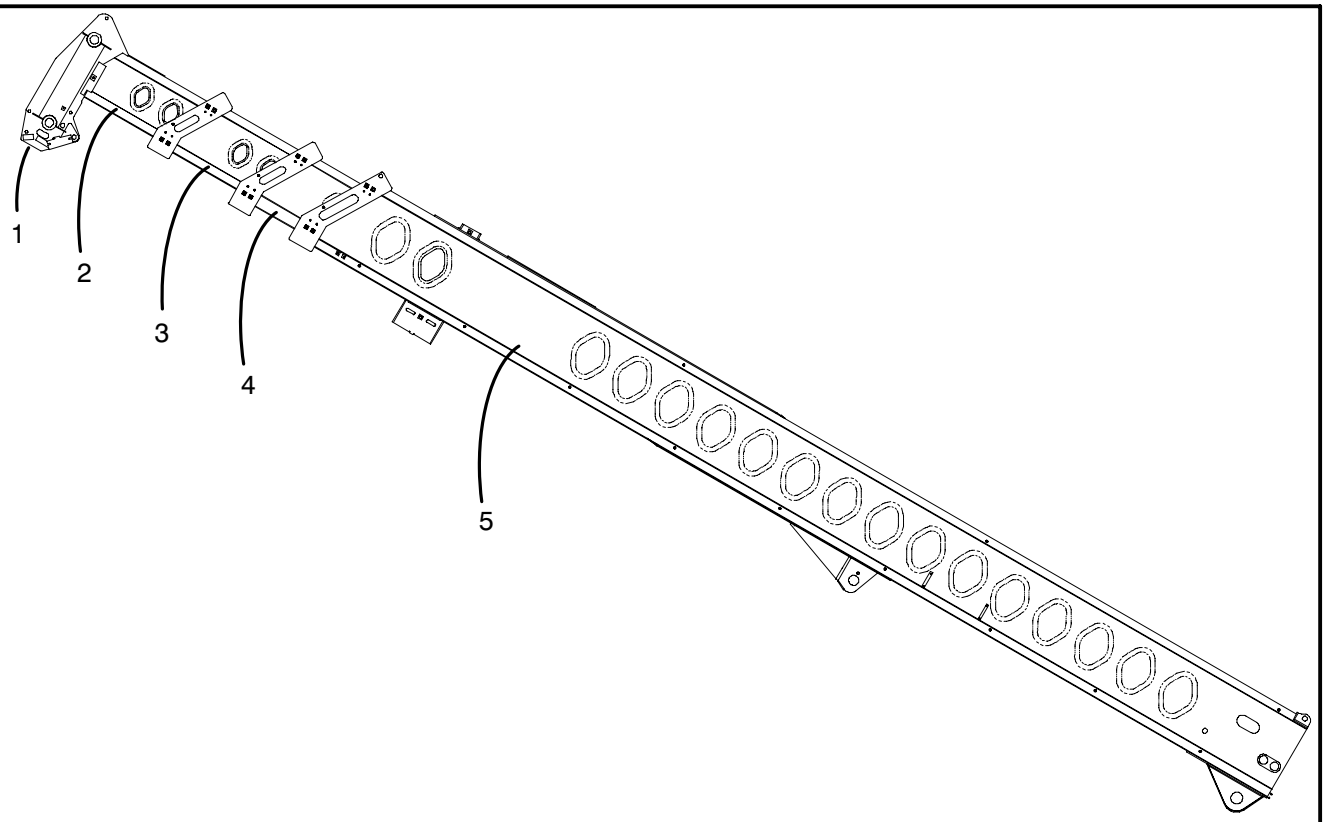
Notes:



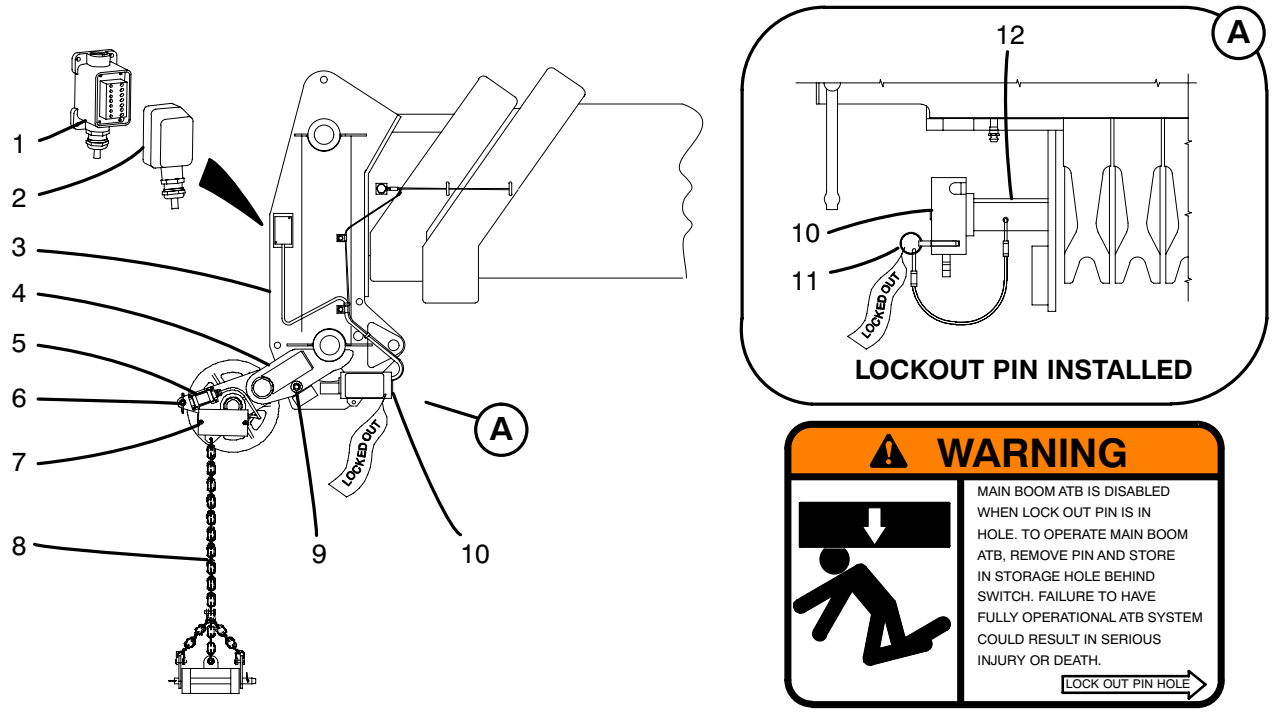
1. Boom Head Machinery
2. Tip Section
3. Outer Mid Section
4. Inner Mid Section
5. Base Section

Figure 4—1
Boom Nomenclature

Boom

The crane is equipped with a four section boom. Refer to Figure 4—1. It consists of four basic parts: a base section, an inner mid section, an outer mid section and a tip section. The base section is connected to the upper revolving frame. It is raised and lowered by the boom hoist cylinder.

The telescoping feature of the boom sections, is operated through the use of two hydraulic cylinders and a cable sheave mechanism which are an integral part of the boom assembly. The inner mid, outer mid, and tip sections of the boom are "power sections". Power sections can be extended or retracted to any desired length using the boom telescope control in the operator's cab. Refer to Section 1 of the Operator's Manual for complete operating instructions.



1. Jumper Assembly
2. Plug Assembly
3. Main Boom Head
4. Auxiliary Lifting Sheave
5. Auxiliary Arm Connector
6. Auxiliary Lifting Sheave Rope Guard
7. Auxiliary Lifting Sheave Anti-Two Block Switch
8. Anti-Two Block Weight
9. Capscrew, Locknut, & Washer
10. Main Boom Anti-Two Block Switch
11. Lockout Pin & Flag (Installed)
12. Lockout Pin Storage Hole

Figure 4–2
Auxiliary Lifting Sheave

Auxiliary Lifting Sheave

The auxiliary lifting sheave connects to the boom head machinery. It is used for reeving winch rope for the second winch drum. Once installed, it may be left in place without interfering with installation, erection, or storage of other boom attachments.

WARNING

The auxiliary lifting sheave adds weight to the boom which must be considered in lifting capacities. When making lifts from the main boom or fly, refer to Crane Rating Manual for the appropriate deductions to lifting capacities.

Installation Of Auxiliary Lifting Sheave

1. Park crane on a firm level surface. Shift transmission to neutral and engage the park brake.
2. Fully retract the boom and position the upper over the rear of the carrier. Engage the travel swing lock.
3. Boom down and/or extend the boom as required, to ease access to the head machinery.
4. Adequately support the auxiliary lifting sheave with an appropriate lifting device. It weighs approximately 95 lb (*43kg*). Position the auxiliary lifting sheave frame under the boom head cross shaft. Align the holes in the auxiliary lifting sheave frame with the lugs in the main boom and install capscrews, locknuts and washers. Refer to Figure 4–2.

WARNING

To avoid personal injury, do not climb, stand or walk on the boom. Use a ladder or similar device as required to reach necessary areas.

5. Remove the rope guard from the auxiliary lifting sheave. Reeve the winch rope on the boom deflector sheave, then over the sheave on the auxiliary lifting sheave. Install the rope guard.

CAUTION

All rope guards must be in proper position during operation.

6. Disconnect plug assembly from jumper assembly on the main boom head and connect it to the auxiliary arm connector.
7. Install the anti-two block weight to the auxiliary lifting sheave anti-two block switch.
8. Properly install lockout pin and flag in main boom anti-two block switch.

   Note: When lockout pin and flag is installed, the anti-two block switch is inactive. The flag is there as visual verification of an inactive switch.

   When both main boom and auxiliary sheave are reeved for operation, the lockout pin and flag must be removed and properly stored and an anti-two block weight must be suspended from each anti-two block switch.

9. Properly set the Rated Capacity Limiter to the correct crane configuration. Refer to Section 1 of this Operator's Manual.
10. Check Crane Rating Manual in the operator's cab for necessary deductions with the auxiliary lifting sheave installed before continuing operations.

Removal Of Auxiliary Lifting Sheave

1. Park crane on a firm level surface. Shift the transmission to neutral and engage the park brake.
2. Fully retract the boom and position the upper over the rear of the carrier. Engage travel swing lock.
3. Boom down and/or extend the boom as required to ease access to the head machinery.

WARNING

To avoid personal injury, do not climb, stand or walk on the boom. Use a ladder or similar device to reach necessary areas.

4. Disconnect the plug assembly from the auxiliary lifting sheave and connect it to the jumper assembly on the main boom head.
5. Remove, and properly store, the lockout pin and flag from the main boom head anti-two block switch.
6. Remove the anti-two block weight from the auxiliary lifting sheave and install it on the main boom anti-two block switch.
7. Remove the rope guard from the auxiliary lifting sheave. Remove the winch rope and install the rope guard for storage.
8. Adequately support the auxiliary lifting sheave. It weighs 95 lb (*43kg*). Remove the capscrews, locknuts and washers. Remove the auxiliary lifting sheave. Refer to Figure 4–2.
9. Properly store the auxiliary lifting sheave, the capscrews, locknuts and washers and the winch rope which was used on the auxiliary lifting sheave.

Offset Lattice Fly

The crane may be equipped with either a one or two piece offset lattice fly. The offset lattice fly sections, as seen in Figure 4−3, connect to the main boom head. It can be mounted in one of three offset positions: 2°, 20° or 40°. The fly sections extend the boom length for greater heights. The tip section of the fly extends its overall length from 28.5ft (*8.7m*) to 51 ft (*15.5m*). Once installed, the offset lattice fly sections can be stored on the right side of the boom base section.

Installation Of The Offset Lattice Fly Sections

1. Park the crane on a firm level surface, shift the transmission to neutral, and engage the park brake.
2. Level the crane on fully extended outriggers with all tires clear of the ground.
3. Position the upper directly over the rear of the carrier and engage the travel swing lock.

WARNING

Install the offset fly with the crane level on fully or intermediate extended outriggers, all tires clear of the ground, the upper directly over the rear of the carrier and the travel swing lock engaged.

The fly adaptor lug and offset connecting pins must be in the 2˚ offset position to remove, install, store, or erect the offset fly.

Refer to the Crane Rating Manual for the maximum boom length the fly can be raised/lowered to/from the ground.

Failure to do the above could result in personal injury and/or the crane tipping.

4. Check that the fly adaptor lug and offset connecting pins are installed in the 2˚ offset position. Refer to Figure 4−5.

   Note: Fly base section may be installed by itself if desired.

5. Pin the fly base and tip together on secure blocking. The base fly section weighs 1,238 lb (*562kg*) and the tip fly section weighs 591 lb (*268kg*). Refer to Figure 4−4.
6. Remove the winch rope from the main boom head machinery or the auxiliary lifting sheave, whichever is to be used on the fly, and lay it aside to prevent damage to it during installation of the fly.

WARNING

To avoid personal injury, do not climb, stand or walk on the boom or fly. Use a ladder or similar device to reach necessary areas.

7. Lower the boom and extend it to the fly. Slowly raise or lower the boom to engage the fly lugs with the head machinery cross shafts.
8. Remove the four fly connecting pins from the storage rings at the rear of the fly base section. Refer to Figure 4−3. Install all four pins to connect the fly lugs to the head machinery cross shafts on the right side of the boom. (Install the pins with the head on top and keeper on the bottom.) Install the pin keepers.
9. Remove the two fly connecting pins from the boom head machinery cross shaft on the left side of the boom head. Refer to Figure 4−3. Install the top pin to connect the fly lug to the head machinery cross shaft on the left side of the boom head. Turn the t-handle to push and align the bottom left fly lug and the bottom boom head cross shaft. Install the bottom left fly connecting pin. (Install the pins with the head on top and keeper on the bottom.) Install the pin keepers.

WARNING

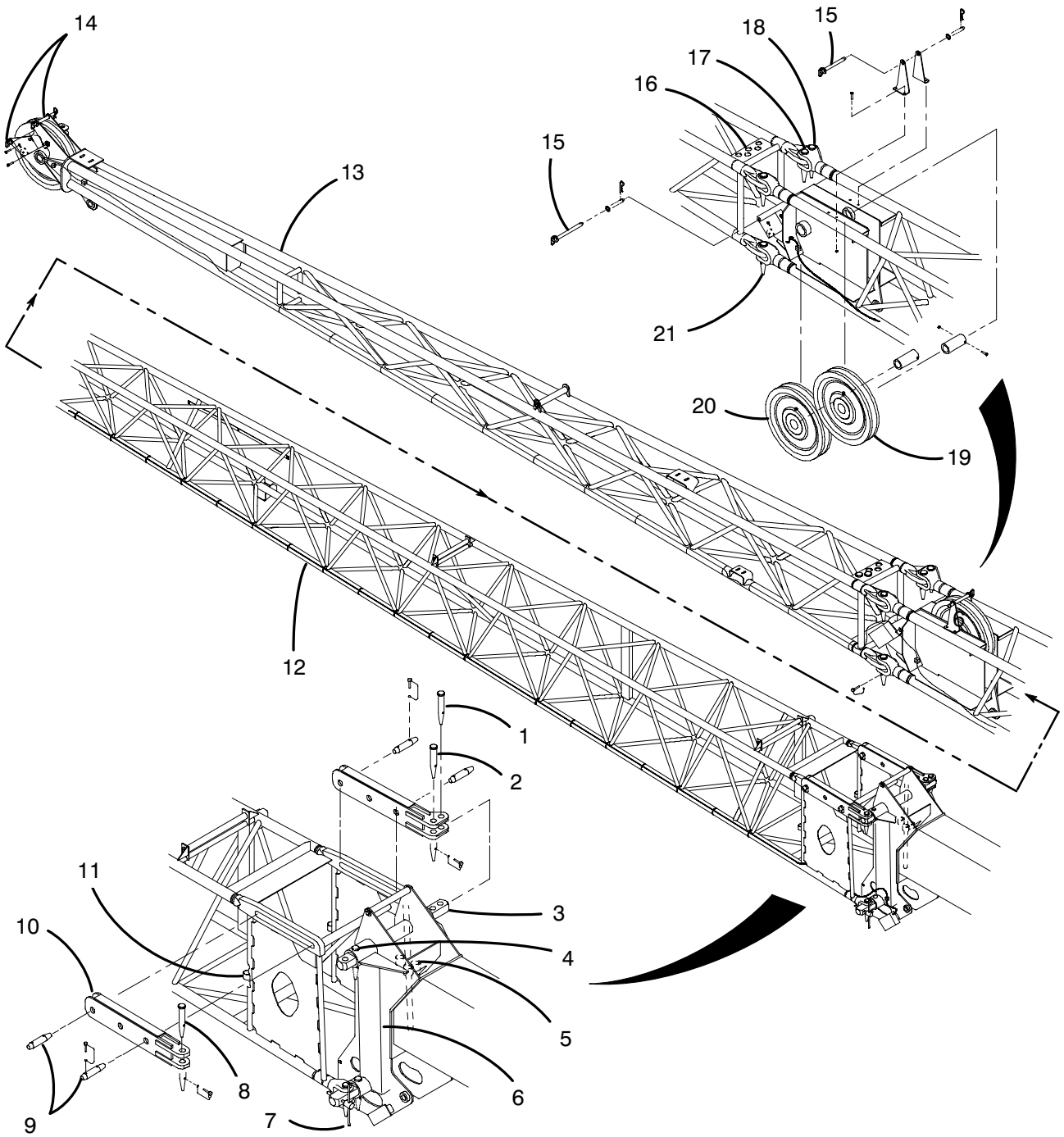
All fly tip and base connecting pins must be properly installed before operating the crane with the fly erected. Damage could occur to the fly if all connecting pins are not properly installed.

10. Remove the rope guards from the fly base and boom head deflector sheaves. Reeve the winch rope over the boom deflector sheave, then on the fly base deflector sheave.
11. Remove the rope guards from either the fly base or fly tip head sheaves, whichever is to be used. Reeve the winch rope over the appropriate head sheave and install the rope guards.

CAUTION

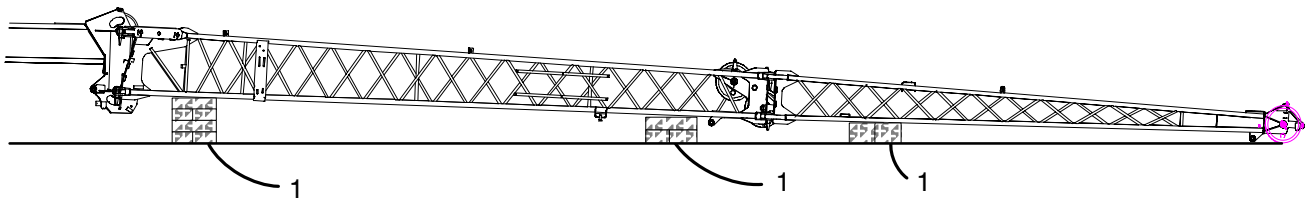
All rope guards must be in proper position during operation.

12. Disconnect plug assembly from jumper assembly on the main boom head and connect it to the offset lattice fly section connector.
13. Install the anti-two block weight on the offset lattice fly anti-two block switch.



1. Right Side Fly Base Connecting Pin (Pivot Pin)
2. Right Side Fly Base Connecting Pin
3. Boom Head Machinery Cross Shaft
4. Left Side Fly Base Connecting Pin (Fly Stored Position)
5. Fly Connecting Pin Storage Rings
6. Boom Head
7. T-Handle
8. Left Side Fly Base Connecting Pin (Fly Erected Position)
9. Offset Connecting Pins (2˚ Position Shown)
10. Fly Adaptor Lug
11. Offset Connecting Pin Storage Ring
12. Fly Base Section
13. Fly Tip Section
14. Fly Tip Rope Guards
15. Fly Base Rope Guard
16. Fly Tip Connecting Pin Storage Location
17. Right Side Fly Tip Connecting Pin
18. Right Side Fly Tip Connecting Pin (Pivot Pin)
19. Fly Base Deflector Sheave
20. Fly Base Head Sheave
21. Left Side Fly Tip Connecting Pin

Figure 4—3
Offset Lattice Fly Sections



1. Blocking

Figure 4—4
Installation And Removal Of The Fly

14. Install lockout pin and flag in anti-two block switch on the main boom head.

    Note: When lockout pin and flag is installed, the anti-two block switch is inactive. The flag is there as visual verification of an inactive switch.

    When both main boom and fly are reeved for operation, the lockout pin and flag must be removed and properly stored and an anti-two block weight must be suspended from each anti-two block switch.

15. Properly set the Rated Capacity Limiter to the correct crane configuration. Refer to Section 1 of this Operator's Manual.
16. Check the Crane Rating Manual, in the operator's cab, for deductions to the lifting capacities with the fly installed before continuing operations.

WARNING

The fly adds weight to the boom which must be considered in lifting capacities when the fly is erected. When making lifts from the main boom or auxiliary lifting sheave with the fly erected, refer to the Crane Rating Manual for the appropriate deductions from lifting capacities. Do not use the offset lattice fly while on tires or fully retracted outriggers, level the crane on fully or intermediate extended outriggers.

Removal Of The Offset Lattice Fly Sections

1. Park the crane on a firm level surface. Shift transmission to neutral and engage the park brake.
2. Level the crane on fully extended outriggers with all tires clear of the ground.
3. Position the upper directly over the rear of the carrier and engage the travel swing lock.

WARNING

Remove the offset fly with the crane level on fully or intermediate extended outriggers, all tires clear of the ground, the upper directly over the rear of the carrier and the travel swing lock engaged.

The fly adaptor lug and offset connecting pins must be in the 2˚ offset position to remove, install, store, or erect the offset fly.

Refer to the Crane Rating Manual for the maximum boom length the fly can be raised/lowered to/from the ground.

Failure to do the above could result in personal injury and/or the crane tipping.

4. If the fly is not in the erected position, erect it per "Erection Of The Fly Base & Tip Sections From The Stored Position" found later in this Section.
5. Check that the fly adaptor lug and offset connecting pins are installed in the 2˚ offset position. Refer to Figure 4—5. If necessary change the fly offset to the 2˚ position. Refer to "Changing The Fly Offset" found later in this Section for detailed instructions.
6. Remove all fly base and tip rope guards. Remove boom head and deflector sheave rope guards and lay the winch rope aside.

WARNING

To avoid personal injury, do not climb, stand or walk on the boom or fly. Use a ladder or similar device to reach necessary areas.

7. Install all fly base and tip rope guards at the deflector and head sheaves. Install the boom head and deflector sheave rope guards.
8. Extend the boom until the fly tip sheave rests on the ground.
9. Securely block up the fly sections to support it. Refer to Figure 4—4. The base fly section weighs

1,238 lb (*562kg*) and the tip fly section weighs 591 lb (*268kg*).

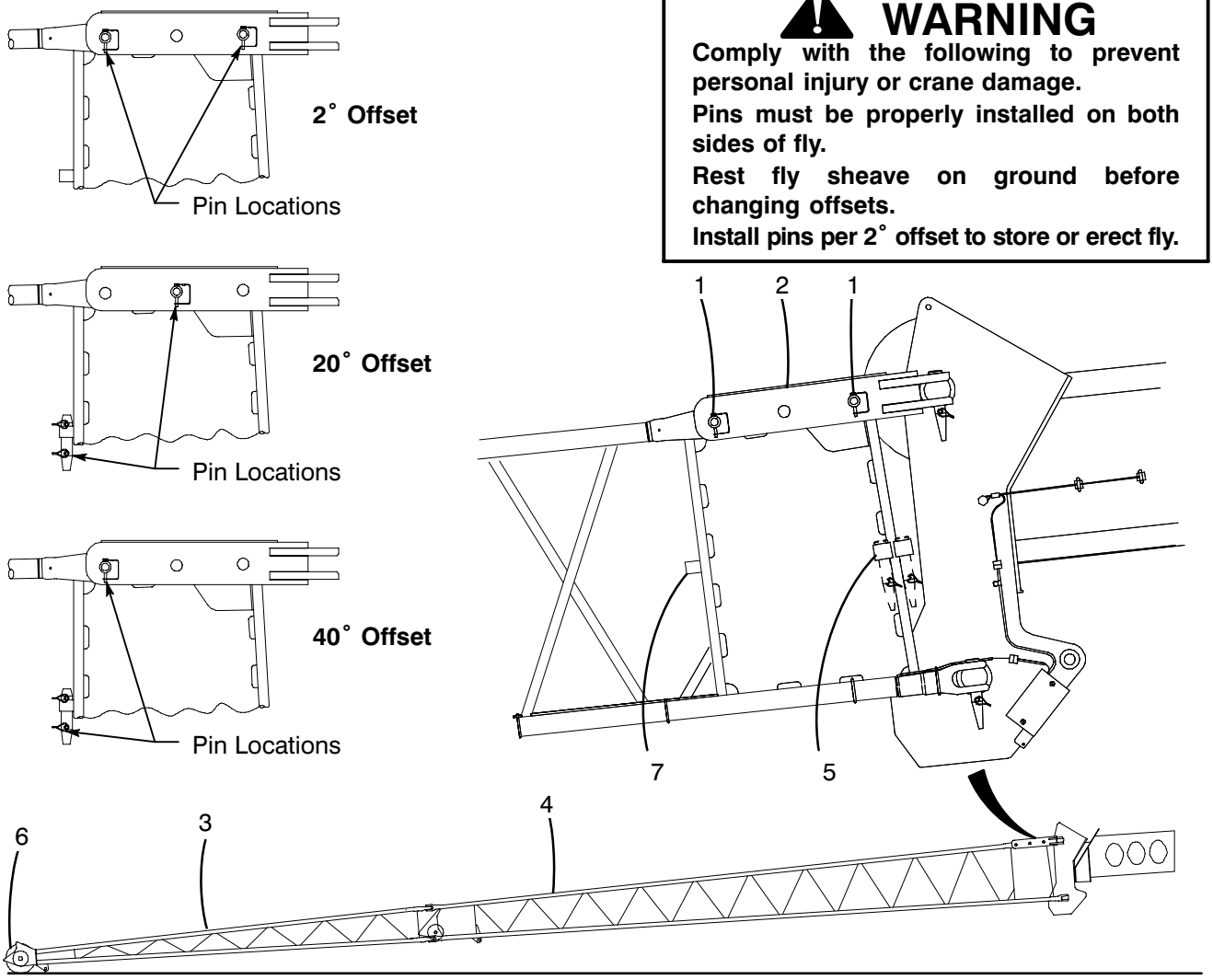
WARNING

Use extreme care when removing the tapered fly connecting pins. They could pop out suddenly and cause personal injury.

10. Remove the six fly connecting pins and store four of the pins and keepers in the storage rings at the rear of the fly. Install the remaining two pins and keepers in the storage holes on the left side of the boom head machinery cross shafts to prevent the shaft from rotating. Refer to Figure 4−3

    Note: If only the fly tip section is to be removed, remove the connecting pins from the fly tip lugs.

11. Remove the plug assembly from the offset lattice fly and connect it to the jumper assembly on the main boom head.
12. Retract the boom away from the fly.
13. Properly reeve or secure the winch rope which was used on the fly.
14. Remove, and properly store, the lockout pin and flag on main boom head. Refer to Figure 4−2.
15. Remove the anti-two block weight from the offset lattice fly and install it on the main boom head anti-two block switch.
16. Properly set the Rated Capacity Limiter to the correct crane configuration. Refer to Section 1 of this Operator's Manual.
17. Properly store fly section to prevent damage to it.



WARNING

Comply with the following to prevent personal injury or crane damage.

Pins must be properly installed on both sides of fly.

Rest fly sheave on ground before changing offsets.

Install pins per 2˚ offset to store or erect fly.

1. Offset Connecting Pin (2˚ Position Shown)
2. Fly Adaptor Lug
3. Offset Lattice Fly Tip Section
4. Offset Lattice Fly Base Section
5. Fly Connecting Pin Storage Ring
6. Fly Tip Head Sheave
7. Offset Connecting Pin Storage Location

Figure 4–5
Changing The Fly Offset Angle

Changing The Fly Offset Angle

1. Park the crane on a firm level surface. Shift the transmission to neutral and engage the park brake.
2. Level the crane on fully or intermediate extended outriggers with all tires clear of the ground.
3. Position the upper directly over the rear of the carrier and engage the travel swing lock.

WARNING

Change the fly offset angle with the crane level on fully or intermediate extended outriggers with all tires clear of the ground, the upper directly over the rear of the carrier and the travel swing lock engaged.

Refer to the Crane Rating Manual for the maximum boom length the fly can be raised/lowered to/from the ground.

Failure to do the above could result in the crane tipping.

4. If the offset lattice fly section is not in the erected position, erect it per "Erection Of The Fly From The Stored Position" found later in this Section.
5. Carefully extend and/or lower the boom until the fly tip head sheave is resting on the ground. Use a signalman to alert the operator when the sheave is resting on the ground.

   Note: If the crane is not equipped with the fly tip section or the fly tip section is not erected, lower the fly base section until the fly base head sheave is resting on the ground.

CAUTION

Do not extend the boom or boom down to the point of over stressing the offset lattice fly section. Structural damage to the fly could occur if care is not taken. Use a signalman to aid the operator in lowering the fly head sheave to the ground.

6. Use one of the following procedures and the information label, located on the offset lattice fly section, to determine the correct offset connecting pin locations for the desired offset angle of the fly. Refer to Figure 4–5.

   If the existing offset angle is 2˚:
   a. Remove one of the offset connecting pins from each side of the fly and place it in the storage ring provided.
   b. Locate the other offset connecting pin in the correct location for the desired offset angle.
   c. Make sure to properly locate the offset connecting pins on both sides of the fly and ensure that the keeper pins are securely installed.
   d. Slowly boom up to allow the fly section to adjust itself to the desired offset angle.

   If the existing offset angle is 20˚ and a 2˚ offset is desired:
   a. Carefully extend and/or lower the boom until the 2˚ angle is reached.
   b. Remove the offset connecting pin from the storage ring on the fly and install it through the fly adaptor lug, in one of the 2˚ offset holes.
   c. Relocate the other offset connecting pin from the 20˚ offset position to the 2˚ offset position.
   d. Make sure to properly locate the offset connecting pins on both sides of the fly and ensure that the keeper pins are securely installed.
   e. Slowly boom up to allow the fly section to adjust itself to the desired offset angle.

   If the existing offset angle is 20˚ and a 40˚ offset is desired:
   a. Carefully extend and/or lower the boom until the 2˚ angle is reached.
   b. Relocate the offset connecting pin from the 20˚ offset position to the 40˚ offset position.
   c. Make sure to properly locate the offset connecting pins on both sides of the fly and ensure that the keeper pins are securely installed.
   d. Slowly boom up to allow the fly section to adjust itself to the desired offset angle.

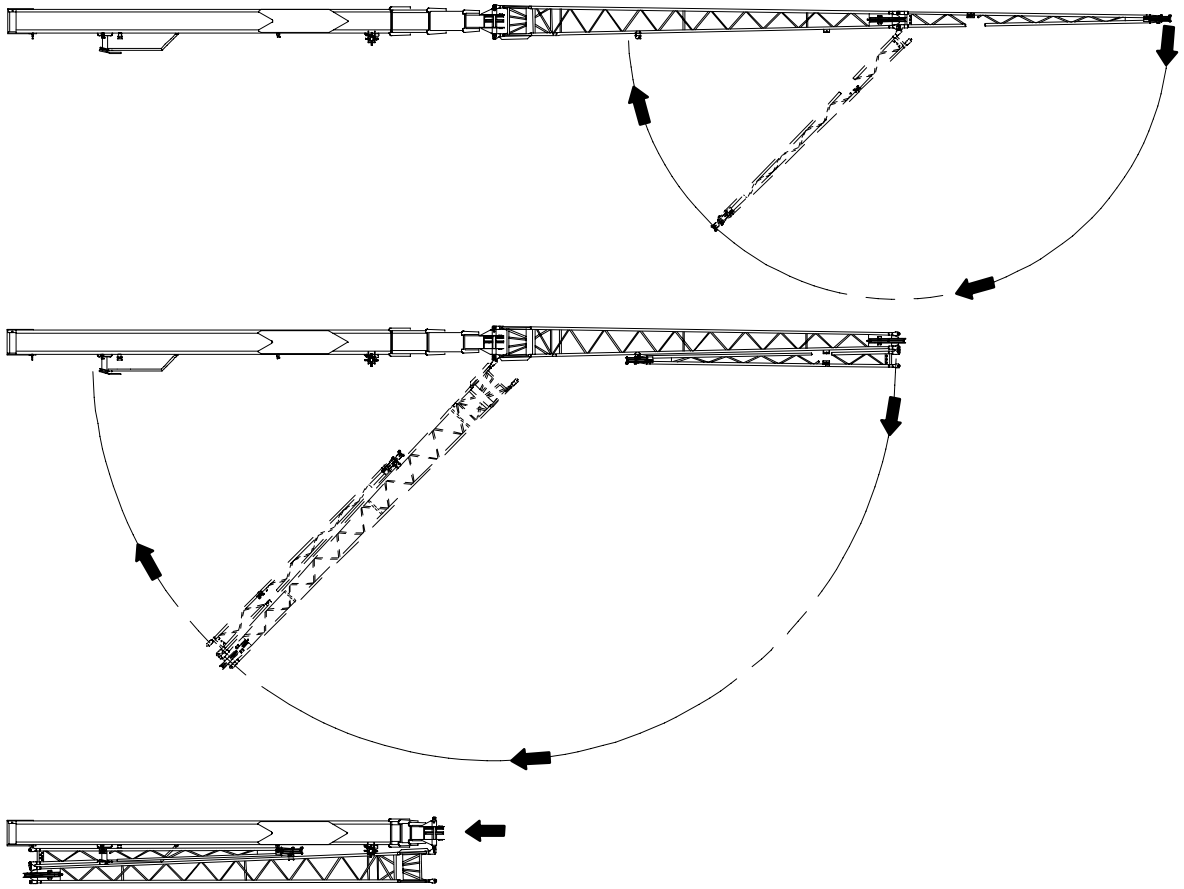
   If the existing offset angle is 40˚ and a 2˚ offset is desired:
   a. Carefully extend and/or lower the boom until the 2˚ angle is reached.
   b. Remove the offset connecting pin from the storage ring on the fly and install it through the fly adaptor lug, in the front 2˚ offset hole.
   c. Make sure to properly locate the offset connecting pins on both sides of the fly and ensure that the keeper pins are securely installed.
   d. Slowly boom up to allow the fly section to adjust itself to the desired offset angle.

   If the existing offset angle is 40˚ and a 20˚ offset is desired:
   a. Carefully extend and/or lower the boom until the 2˚ angle is reached.
   b. Relocate the offset connecting pin from the 40˚ offset position to the 20˚ offset position.
   c. Make sure to properly locate the offset connecting pins on both sides of the fly and ensure that the keeper pins are securely installed.
   d. Slowly boom up to allow the fly section to adjust itself to the desired offset angle.
7. Properly set the Rated Capacity Limiter to the correct crane configuration before continuing operations. Refer to Section 1 of this Operator's Manual.
8. Check the Crane Rating Manual, in the operator's cab, for deductions to the lifting capacities with the fly installed before continuing operations.

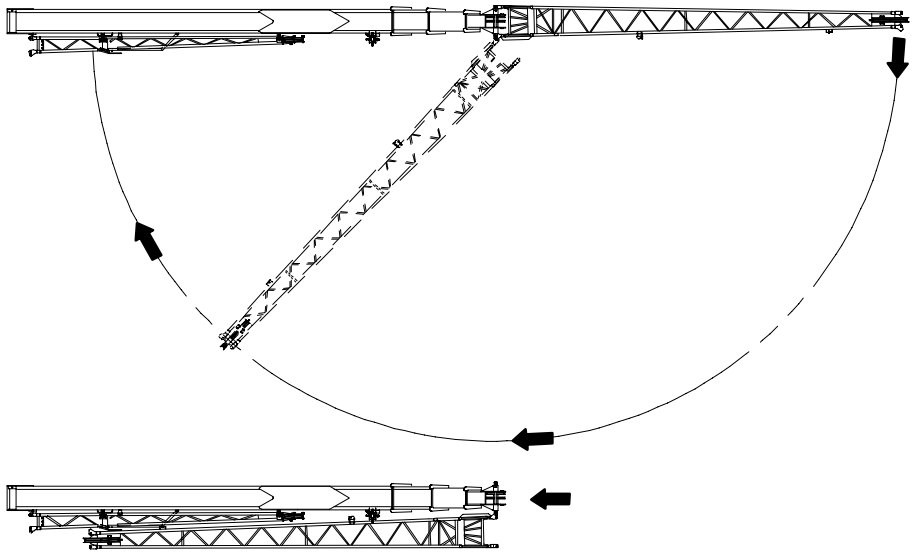
⚠ WARNING

The fly adds weight to the boom which must be considered in lifting capacities when the fly is erected. When making lifts from the main boom or auxiliary lifting sheave with the fly erected, refer to the Crane Rating Manual for the appropriate deductions from lifting capacities. Do not use the offset lattice fly while on tires or fully retracted outriggers, level the crane on fully extended or intermediate extended outriggers.

Top View



Swinging The Fly Base & Tip Sections



Swinging The Fly Base Section

Figure 4–6
Swinging The Fly

Storage Of The Fly Base Section From The Erected Position

1. Park crane on a firm level surface. Shift the transmission to neutral and engage the park brake.
2. Level the crane on fully or intermediate extended outriggers with all tires clear of the ground.
3. Position the upper directly over the rear of the carrier and engage the travel swing lock.

WARNING

Store the fly with the crane level on fully or intermediate extended outriggers with all tires clear of the ground, the upper directly over the rear of the carrier and the travel swing lock engaged.

The fly adaptor lug and offset connecting pins must be in the 2˚ offset position to remove, install, store, or erect the offset fly.

Refer to the Crane Rating Manual for the maximum boom length the fly can be raised/lowered to/from the ground.

Failure to do the above could result in personal injury and/or the crane tipping.

4. Check that the offset connecting pins (1) are installed in the 2˚ offset position. Refer to Figure 4−5. If necessary change the fly offset to the 2˚ position. Refer to "Changing The Fly Offset Angle" found earlier in this Section for detailed instructions.

CAUTION

Do not extend the boom beyond the recommended 2−5 ft (*0.61−1.5m*) length. Extending the boom beyond the 2−5 ft (*0.61−1.5m*) length may cause boom damage.

5. Position the boom at a 0˚ angle and a boom length of 2−5 ft (*0.61−1.5m*) longer than fully retracted.
6. Disconnect plug assembly from fly and connect it to the jumper assembly on the main boom head.
7. Remove lockout pin and flag from main boom head anti-two block switch. Properly store lockout pin and flag.

   Note: When lockout pin and flag is installed, the anti-two block switch is inactive. The flag is there as visual verification of an inactive switch.

8. Remove the anti-two block weight from the fly base section and install it on the main boom anti-two block switch.

WARNING

To avoid personal injury, do not climb, stand or walk on the boom or fly. Use a ladder or similar device to reach necessary areas.

9. Remove rope guards from fly base head sheave, fly base deflector sheave, the boom head sheave and boom deflector sheave. Refer to Figure 4−3. Remove the winch rope and lay it aside. Install rope guards at all sheaves for storage.
10. Properly store winch rope which was used on fly. Attach a hand line to the tip of the fly base.
11. Remove the two fly base connecting pins (8) on the left side of the fly and store them in the storage holes (4) on the boom head machinery cross shafts (3) located on the left side of the boom.

WARNING

Do not remove the fly connecting pivot pins on the right side of the boom until the fly is pinned to the storage brackets. The fly could fall.

Use extreme care when removing the tapered fly connecting pins. They could pop out suddenly causing personal injury.

12. Remove the two fly base connecting pins (2) on the right side of the fly. Refer to Figure 4−3. Store the two pins and keepers in the storage rings (5) on the rear picture frame of the fly base section (12).

WARNING

Use a hand line to control fly swing. Fly could swing around the boom rapidly. Keep all personnel clear of swing path to avoid injury.

13. Slowly swing the fly base section around to the right side of the boom while slowly booming up to 20˚. Refer to Figure 4−6.
14. Align the lug on the front storage bracket with the mounting hole on the rear of the fly base. Refer to Figure 4−9.
15. Slowly retract the boom to slide the storage lug on the front of the fly base into the slot on the rear storage bracket (10). Refer to Figure 4−9. (At the same time the lug on the front storage bracket (15) should engage through the hole on the rear of the fly base.
16. Boom down to 0˚. Pull and rotate retaining pin (16). Release retaining pin to engage the pin through the lug on the front storage bracket (25).

WARNING

Do not remove the fly connecting pivot pins on the right side of the boom until the fly is pinned to the storage brackets. The fly could fall causing crane damage and/or personal injury.

17. Remove two fly base connecting pivot pins (1) from the right side of the boom. Refer to Figure 4−3. Store pins and keepers in storage rings (5) on the rear picture frame of the fly base section (12).

CAUTION

Before operating or traveling the crane ensure the right side fly connecting pins are properly stored in their storage rings, and the left side connecting pins are stored in their storage holes in the boom head cross shafts. Damage could result to the fly and/or boom if fly connecting pins are not properly stored.

18. Properly set the Rated Capacity Limiter to the correct crane configuration. Refer to Section 1 of this Operator's Manual.
19. Check the Crane Rating Manual for lifting capacities with the fly in the stored position before continuing operations.

WARNING

The fly adds weight to the boom which must be considered in lifting capacities when the fly is erected. When making lifts from the main boom or auxiliary lifting sheave with the fly erected, refer to the Crane Rating Manual for the appropriate deductions from lifting capacities.

Storage Of The Fly Base And Tip Sections From The Erected Position

1. Park crane on a firm level surface. Shift the transmission to neutral and engage the park brake.
2. Level the crane on fully or intermediate extended outriggers with all tires clear of the ground.
3. Position the upper directly over the rear of the carrier and engage the travel swing lock.

WARNING

Store the fly with the crane level on fully or intermediate extended outriggers with all tires clear of the ground, the upper directly over the rear of the carrier and the travel swing lock engaged.

The fly adaptor lug and offset connecting pins must be in the 2˚ offset position to remove, install, store, or erect the offset fly.

Refer to the Crane Rating Manual for the maximum boom length the fly can be raised/lowered to/from the ground.

Failure to do the above could result in personal injury and/or the crane tipping.

4. Check that the offset connecting pins (1) are installed in the 2˚ offset position. Refer to Figure 4−5. If necessary change the fly offset to the 2˚ position. Refer to "Changing The Fly Offset Angle" found earlier in this Section for detailed instructions.

CAUTION

Do not extend the boom beyond the recommended 2−5 ft (*0.61−1.5m*) length. Extending the boom beyond the 2−5 ft (*0.61−1.5m*) length may cause boom damage.

5. Position the boom at a 0˚ angle and a boom length length of 2−5 ft (*0.61−1.5m*) longer than fully retracted.
6. Disconnect plug assembly from fly and connect it to the jumper assembly on the main boom head.
7. Remove lockout pin and flag from main boom head anti-two block switch. Properly store lockout pin and flag.
8. Remove the anti-two block weight from the fly section and install it on the main boom anti-two block switch.

WARNING

To avoid personal injury, do not climb, stand or walk on the boom or fly. Use a ladder or similar device to reach necessary areas.

9. Remove rope guards from fly base head sheave, fly base deflector sheave, the boom head sheave and boom deflector sheave. Refer to Figure 4−3. Remove the winch rope and lay it aside. Install rope guards at all sheaves for storage.

10. Properly store winch rope which was used on fly. Attach a hand line to the tip of the fly tip section.

WARNING

Do not remove fly tip connecting pivot pins on the right side of the fly until the fly is pinned to the storage brackets. Fly tip could fall causing crane damage and/or personal injury.

Use extreme care when removing the tapered fly connecting pins. They could pop out suddenly causing personal injury.

11. Remove the two fly tip connecting pins (21) on the left side of the fly tip section (13). Refer to Figure 4–3. Store pins and keepers in the storage holes (16) on the rear of the fly tip section.
12. Remove the two fly tip connecting pins (17) on the right side of the fly tip section (13). Refer to Figure 4–3. Store pins and keepers in the storage holes (16) on the rear of the fly tip section.

WARNING

Use a hand line to control fly swing. Fly tip could swing around fly base rapidly. Keep all personnel clear of swing path to avoid injury.

13. Using the hand line attached to the fly tip section, slowly swing the fly tip section around to the right side of the fly base section. Refer to Figure 4–6.
14. Align the storage bracket on the fly tip section with the storage bracket on the fly base section. Refer to Figure 4–9. Install the hitch pin (12) through the storage brackets and secure the hitch pin.
15. Remove the two fly base connecting pins (8) on the left side of the fly base section and store them in the storage holes (4) on the boom head machinery cross shafts (3) located on the left side of the boom. Refer to Figure 4–3.

WARNING

Do not remove fly base connecting pivot pins on the right side of the boom until the fly is pinned to the storage brackets. Fly could fall causing crane damage and/or personal injury.

16. Remove the two fly base connecting pins (2) on the right side of the fly. Refer to Figure 4–3. Store the two pins and keepers in the storage rings (5) on the rear picture frame of the fly base section (12).

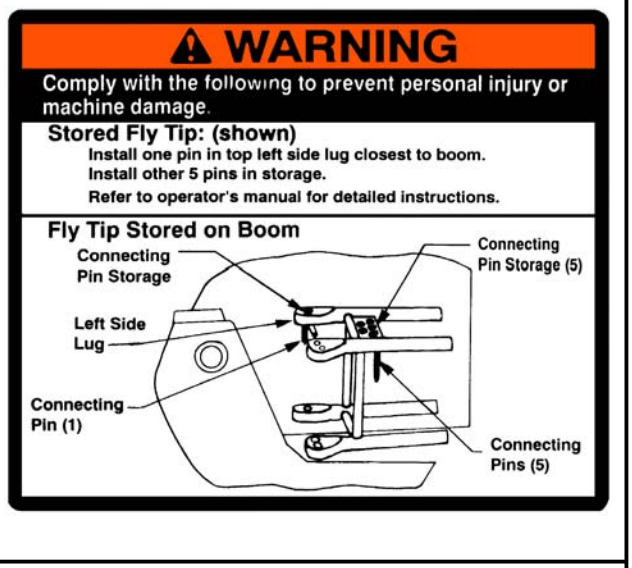


Figure 4–7
Fly Tip Storage Label

WARNING

Use a hand line to control fly swing. Fly could swing around the boom rapidly. Keep all personnel clear of swing path to avoid injury.

17. Attach a hand line to the tip of the fly base section. Slowly swing the fly base section around to the right side of the boom while slowly booming up to 20˚. Refer to Figure 4–6.
18. Align the lug on the front storage bracket with the mounting hole on the rear of the fly base. Refer to Figure 4–9.
19. Slowly retract the boom to slide the storage lug on the front of the fly base into the slot on the rear storage bracket (10). (At the same time the lug on the front storage bracket (15) should engage through the hole on the rear of the fly base.
20. Boom down to 0˚. Pull and rotate retaining pin (16). Release retaining pin to engage the pin through the lug on the front storage bracket (25).

WARNING

Do not remove the fly base connecting pivot pins on the right side of the boom until the fly is pinned to the storage brackets. The fly could fall causing crane damage and/or personal injury.

21. Remove two fly base connecting pivot pins (1) from the right side of the boom. Refer to Figure 4—3. Store pins and keepers in storage rings (5) on the rear picture frame of the fly base section (12).

CAUTION

Before operating or traveling the crane ensure the right side fly connecting pins are properly stored in their storage rings, and the left side connecting pins are stored in their storage holes in the boom head cross shafts. Damage could result to the fly and/or boom if fly connecting pins are not properly stored.

22. Remove the two fly tip connecting pivot pins (3) on the right side of the fly tip section. Refer to Figure 4—9. Store one pin and keeper in the storage hole (2) on the rear of the fly tip section and one pin and keeper in the top fly tip connecting lug (1) on the left side of the fly tip section.

WARNING

A connecting pin and keeper must be installed in the top fly tip connecting lug on the left side of the fly tip section when the fly tip is in the stored position. The fly tip could fall causing crane damage and/or personal injury.

23. Properly set the Rated Capacity Limiter to the correct crane configuration. Refer to Section 1 of this Operator's Manual.
24. Check the Crane Rating Manual for lifting capacities with the fly in the stored position before continuing operations.

WARNING

The fly adds weight to the boom which must be considered in lifting capacities when the fly is erected. When making lifts from the main boom or auxiliary lifting sheave with the fly erected, refer to the Crane Rating Manual for the appropriate deductions to lifting capacities.

Erection Of The Fly Base Section From The Stored Position

1. Park crane on a firm level surface. Shift the transmission to neutral and engage the park brake.
2. Level the crane on fully or intermediate extended outriggers with all tires clear of the ground.
3. Position the upper directly over the rear of the carrier and engage the travel swing lock.

WARNING

Erect the fly with the crane level on fully or intermediate extended outriggers with all tires clear of the ground, the upper directly over the rear of the carrier and the travel swing lock engaged.

The fly adaptor lug and offset connecting pins must be in the 2° offset position to remove, install, store, or erect the offset fly.

Refer to the Crane Rating Manual for the maximum boom length the fly can be raised/lowered to/from the ground.

Failure to do the above could result in personal injury and/or the the crane tipping.

4. Check that the fly tip connecting pins are in the stored position.
5. Check that the offset connecting pins (1) are installed in the 2° offset position. Refer to Figure 4—5. If necessary change the fly offset to the 2° position. Refer to "Changing The Fly Offset Angle" found earlier in this Section for detailed instructions.
6. Retract the boom to engage the fly lugs with the head machinery cross shafts on the right side of the boom. Fully lower the boom.
7. Remove two fly connecting pins from the storage rings (11) on the rear fly picture frame on the fly base section. Install them through the fly pivot lugs (18) on the right side of the boom. Refer to Figure 4—9. (Install the pins with the head on top and the keeper on the bottom.) Install the pin keepers.

WARNING

To avoid personal injury, do not climb, stand or walk on the boom or fly. Use a ladder or similar device to reach necessary areas.

8. Remove the winch rope from the head machinery or the auxiliary lifting sheave whichever is to be used on the fly and lay it aside to prevent damage to it during erection of the fly.

WARNING

Check that the fly base connecting pins are installed on the right side of the boom in the pivot holes before disconnecting the fly from the storage brackets. The fly could fall.

9. Pull the retaining pin (16) to disengage the pin from the lug on the front storage bracket. Rotate and release the retaining pin to lock it in the disengaged position.

CAUTION

Do not extend the boom beyond the recommended 2–5 ft (*0.61–1.5m*) length. Extending the boom beyond the 2–5 ft (*0.61–1.5m*) length may cause boom damage.

10. Attach a hand line to the tip of the fly base and boom up to 20˚. Slowly extend the boom approximately 2–5 ft (*0.61–1.5m*) to slide the fly off the storage brackets.
11. Slowly lower the boom to 0˚ angle to swing the fly base around the boom head until the fly lugs engage with the head machinery cross shafts on the left side of the boom. Refer to Figure 4–6.

WARNING

Use a hand line to control fly swing. The fly could swing around the boom rapidly. Keep all personnel clear of the swing path to avoid injury.

12. Remove the two connecting pins from the storage rings (11) on the rear fly picture frame on the fly base section and install them in the cross shafts (23) on the right side of the boom. (Install the pins with the head on top and the keeper on the bottom.) Install the pin keepers.
13. Remove the two fly connecting pins from the storage location (24) on the boom head machinery cross shaft on the left side of the boom. Refer to Figure 4–9. Install one pin through the top fly lug (21) on the left side of the boom. Turn the t-handle to push and align the bottom left fly lug and the bottom boom head cross shaft. Install the bottom left fly connecting pin. (Install the pins with the head on top and the keeper on the bottom.) Install the pin keepers.

WARNING

All six fly base connecting pins must be properly installed before operating the crane with the fly base erected. Damage could occur to the fly base if all connecting pins are not properly installed.

14. Remove the rope guard from the fly base head and deflector sheaves. Refer to Figure 4–3. Reeve the winch rope on the boom deflector sheave then over the fly deflector and head sheaves. Install all rope guards.

CAUTION

All rope guards must be in proper position during operation.

15. Disconnect the plug assembly from the jumper assembly on main boom head and connect it to the fly base section.
16. Install the anti-two block weight. Refer to Section 1 of this Operator's Manual.
17. Properly install lockout pin and flag in main boom head anti-two block switch.

    Note: When lockout pin and flag is installed, the anti-two block switch is inactive. The flag is there as visual verification of an inactive switch.

    When both main boom and fly are reeved for operation, the lockout pin and flag must be removed and properly stored and an anti-two block weight must be suspended from each anti-two block switch.

18. Properly set the Rated Capacity Limiter to the correct crane configuration. Refer to Section 1 of this Operator's Manual.
19. Check the Crane Rating Manual for lifting capacities with the fly installed before continuing operations.

WARNING

The fly adds weight to the boom which must be considered in lifting capacities when the fly is erected. When making lifts from the main boom or auxiliary lifting sheave with the fly erected, refer to the Crane Rating Manual for the appropriate deductions from lifting capacities. Do not use the fly while on tires, level the crane on outriggers.

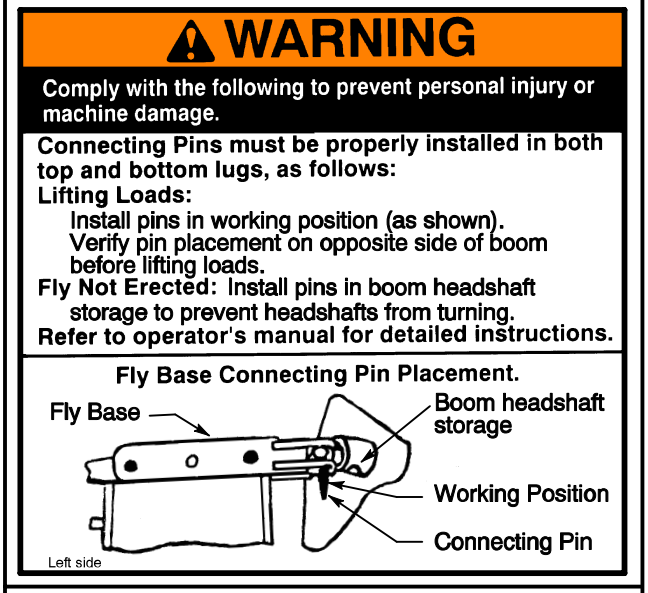


Figure 4–8
Left Side Fly Base Connecting Pin Label

Erection Of The Fly Base And Tip Sections From The Stored Position

1. Park crane on a firm level surface. Shift the transmission to neutral and engage the park brake.
2. Level the crane on fully or intermediate extended outriggers with all tires clear of the ground.

WARNING

Erect the fly with the crane level on fully or intermediate extended outriggers with all tires clear of the ground, the upper directly over the rear of the carrier and the travel swing lock engaged.

The fly adaptor lug and offset connecting pins must be in the 2˚ offset position to remove, install, store, or erect the offset fly.

Refer to the Crane Rating Manual for the maximum boom length the fly can be raised/lowered to/from the ground.

Failure to do the above could result in personal injury and/or the the the crane tipping.

3. Position the upper directly over the rear of the carrier and engage the travel swing lock.
4. Fully lower the boom. Retract the boom to engage the fly lugs with the head machinery cross shafts on the right side of the boom.
5. Remove two fly connecting pins from the storage rings (11) on the rear fly picture frame on the fly base section. Install them through the fly base pivot lugs (18) on the right side of the boom. Refer to Figure 4–9. (Install the pins with the head on top and the keeper on the bottom.) Install the pin keepers.
6. Check that the offset connecting pins (1) are installed in the 2˚ offset position. Refer to Figure 4–5. If necessary change the fly offset to the 2˚ position. Refer to "Changing The Fly Offset Angle" found earlier in this Section for detailed instructions.
7. Remove the connecting pin and keeper from the top fly tip connecting lug (1) on the left side of the fly tip section. Remove another fly tip connecting pin from the storage hole (2) on the rear of the fly tip section. Refer to Figure 4–9. Install them through the fly tip pivot lugs (3). (Install the pins with the head on top and the keeper on the bottom.) Install the pin keepers.

WARNING

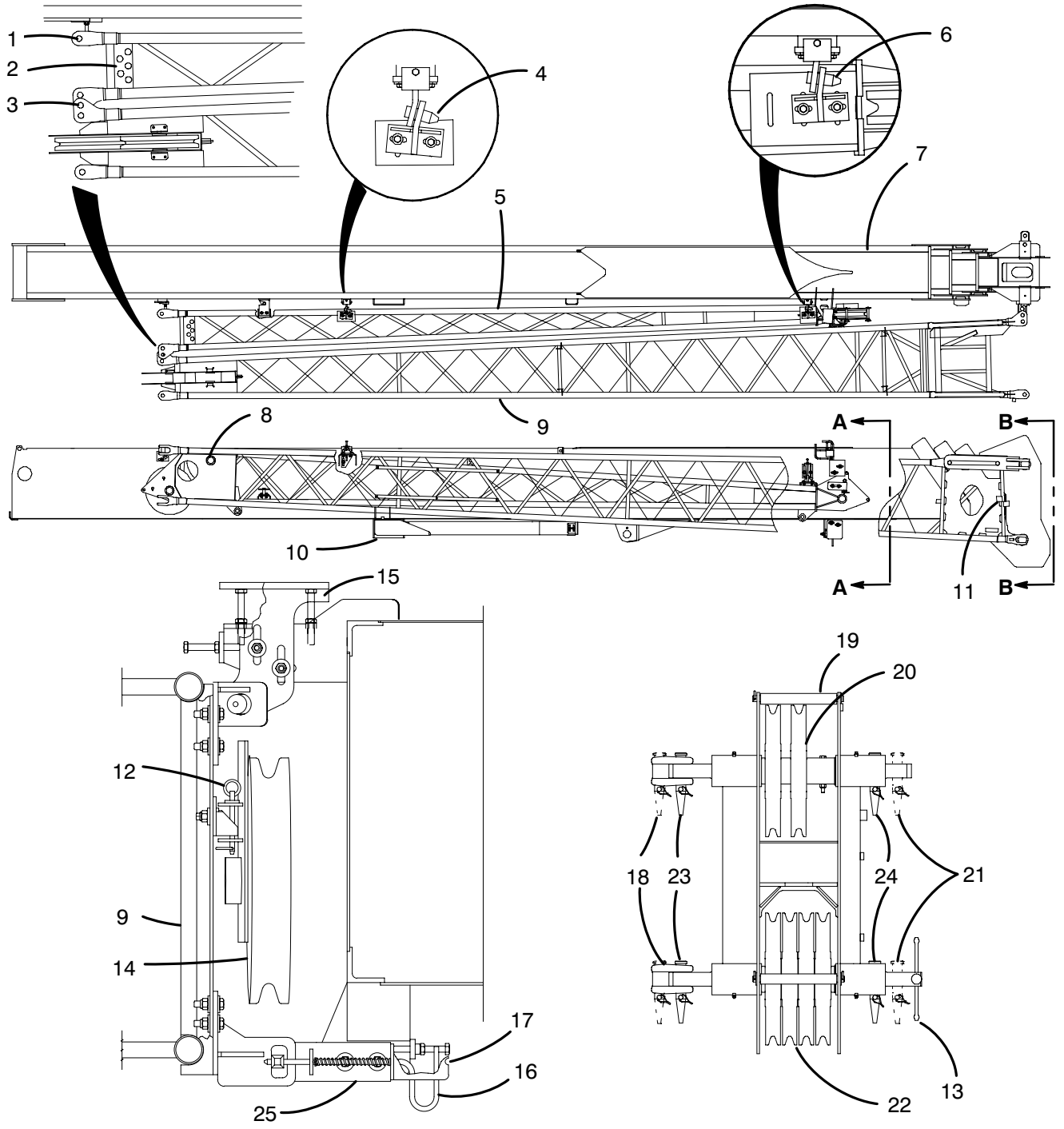
To avoid personal injury, do not climb, stand or walk on the boom or fly. Use a ladder or similar device to reach necessary areas.

8. Remove the winch rope from the head machinery or the auxiliary lifting sheave whichever is to be used on the fly and lay it aside to prevent damage to it during erection of the fly.
9. Check that the hitch pin is installed through the lugs on the fly tip and base sections.

WARNING

Check that the fly base and tip connecting pins are installed in the pivot holes before disconnecting the fly from the storage brackets. Also check that the hitch pin is installed through the lugs on the fly tip and base sections. The fly could fall causing crane damage and/or personal injury.

10. Pull the retaining pin (16) to disengage the pin from the lug on the front storage bracket. Refer to Figure 4–9. Rotate and release the retaining pin to lock it in the disengaged position.



VIEW A—A

VIEW B—B

1. Left Side Fly Tip Connecting Pin Storage Location
2. Fly Tip Connecting Pin Storage Holes
3. Fly Tip Pivot Hole
4. Rear Fly Tip Storage Lug
5. Offset Lattice Fly Tip Section
6. Front Fly Tip Storage Lug
7. Boom
8. Fly Base Deflector Sheave
9. Offset Lattice Fly Base Section
10. Rear Fly Storage Bracket
11. Fly Base Connecting Pin Storage Location
12. Hitch Pin
13. T-Handle
14. Fly Tip Head Sheave
15. Front Top Fly Storage Bracket
16. Retaining Pin in Engaged Position
17. Retaining Pin in Disengaged Position
18. Fly Base Pivot Pins
19. Boom Deflector Sheave Rope Guard
20. Boom Deflector Sheave
21. Left Side Fly Base Connecting Pin
22. Boom Head Sheave
23. Right Side Fly Base Connecting Pin
24. Fly Base Connecting Pin Storage Location
25. Front Bottom Fly Storage Bracket

Figure 4—9
Fly Erection And Storage

⚠ WARNING

Comply with the following to prevent personal injury or machine damage.

Connecting Pins must be properly installed in both top and bottom lugs, as follows:
Lifting Loads:
Install 2 pins in each right side lug (total of 4 pins on right side).
Fly Not Erected:
Install pins in storage tubes on fly.
Refer to operator's manual for detailed instructions.

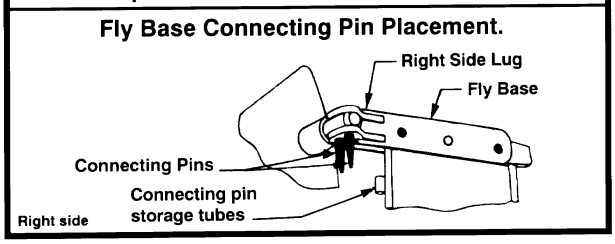


Figure 4–10
Right Side Fly Base Connecting Pin Label

CAUTION

Do not extend the boom beyond the recommended 2–5 ft (*0.61–1.5m*) length. Extending the boom beyond the 2–5 ft (*0.61–1.5m*) length may cause boom damage.

11. Attach a hand line to the tip of the fly base and boom up to 20˚. Slowly extend the boom approximately 2–5 ft (*0.61–1.5m*) to slide the fly base off the storage brackets.

⚠ WARNING

Use a hand line to control fly swing. The fly could swing around the boom rapidly. Keep all personnel clear of the swing path to avoid injury.

12. Slowly lower the boom to 0˚ angle to swing the fly base and tip around the boom head until the fly lugs engage with the head machinery cross shafts on the left side of the boom. Refer to Figure 4–6.
13. Remove the two connecting pins from the storage rings (11) on the rear fly picture frame on the fly base section and install them in the cross shafts (23) on the right side of the boom. (Install the pins with the head on top and the keeper on the bottom.) Install the pin keepers.
14. Remove the two fly connecting pins from the storage location (24) on the boom head machinery cross shaft on the left side of the boom. Refer to Figure 4–9. Install one pin through the top fly lug (21) on the left side of the boom. Turn the t-handle to push and align the bottom left fly lug and the bottom boom head cross shaft. Install the bottom left fly connecting pin. (Install the pins with the head on top and the keeper on the bottom.) Install the pin keepers.

⚠ WARNING

All six fly base connecting pins must be properly installed before operating the crane with the fly base erected. Damage to the fly base may occur if all connecting pins are not properly installed.

15. Attach a hand line to the tip of the fly tip section. Remove the hitch pin which connects the fly tip section to the fly base section. Refer to Figure 4–9. Store the hitch pin back in the lug on the fly tip section once it is erected.
16. Swing the fly tip section around the fly base section until the fly tip lugs engage with the fly base lugs on the left side of the fly.
17. Remove the fly tip connecting pins from the storage holes on the rear of the fly tip section. Install them through the fly tip connecting lugs on both sides of the fly. (Install the pins with the head on top and the keeper on the bottom.) Install the pin keepers.

⚠ WARNING

All six fly tip connecting pins must be properly installed before operating the crane with the fly tip erected. Damage could occur to the fly tip if all connecting pins are not properly installed.

18. Remove the rope guards from the fly base head, deflector and fly tip head sheaves. Refer to Figure 4–3. Reeve the winch rope on the boom deflector sheave then over the fly deflector, head and fly tip head sheaves. Install all rope guards.

CAUTION

All rope guards must be in proper position during operation.

19. Disconnect the plug assembly from the jumper assembly on the main boom head and connect it to the connector assembly on the fly.

20. Install the anti-two block weight on fly. Refer to Section 1 of this Operator's Manual.
21. Properly install lockout pin and flag in anti-two block switch on main boom head.

    Note: When lockout pin and flag is installed, the anti-two block switch is inactive. The flag is there as visual verification of an inactive switch.

    When both main boom and fly are reeved for operation, the lockout pin and flag must be removed and properly stored and an anti-two block weight must be suspended from each anti-two block switch.

22. Properly set the Rated Capacity Limiter to the correct crane configuration. Refer to Section 1 of this Operator's Manual.
23. Check the Crane Rating Manual for lifting capacities with the fly installed before continuing operations.

WARNING

The fly adds weight to the boom which must be considered in lifting capacities when the fly is erected. When making lifts from the main boom or auxiliary lifting sheave with the fly erected, refer to the Crane Rating Manual for the appropriate deductions to lifting capacities. Do not use the fly while on tires, level the crane on outriggers.

Notes:

Table Of Contents

Crane Rating Manual And Serial Number

The Crane Rating Manual is located in the lower right interior of the upper operator's cab. This manual has the crane serial number on it. The serial number and a Vehicle Identification Number (VIN) is also stamped on a plate located on the front center of the carrier cab dash. The serial number is also stamped on the top of the bumper on the right side of the carrier and on the right side of the upper frame just above the boom hoist cylinder lug. The serial number must be used with any correspondence with the factory concerning parts or warranty. This manual also lists the maximum allowable lifting capacities for the crane. The manual should be checked for the proper lifting capacities before making any lifts.

If the Crane Rating Manual becomes lost, damaged, or unreadable, it must be replaced before operating the crane. Information contained in the Crane Rating Manual is important and failure to follow the information it contains could result in an accident. A replacement manual can be ordered through your distributor.

WARNING

The Crane Rating Manual in the crane is the only authorized listing of lifting capacities for the crane. It supercedes any other printed literature which lists lifting capacities. It alone is to be used for determining crane capacities.

Wire Rope Capacity Chart

The Wire Rope Capacity chart gives the maximum lifting capacities based on wire rope strength. A typical example is shown Figure 5−1. The actual chart is located in the Crane Rating Manual. It lists the maximum load that should be lifted with different sizes and types of wire rope. The weights shown are based on wire rope strength alone. Exceeding these load weights may result in rope damage or failure.

Before making a lift, compare the weight being lifted (remember to add the weight of the hook block, hook ball slings, and riggings to the actual load weight) with the Wire Rope Capacity Chart located in the Crane Rating Manual. Check the chart for the number of parts of line required to make the lift. Use at least that number of parts of line to make the lift. When making a lift with more parts of line that is needed to make the lift, remember to add weight for each one (1) foot (*0.3m*) of extra rope required to reeve the extra parts of line, to the actual load weight. The extra parts of line act as additional load weight.

WARNING

Do not exceed the capacities listed for wire rope strength or crane capacity, whichever is less, when making a lift. Serious personal injury or crane damage may result.

Wire Rope Specifications

The specifications for the wire rope used on this crane are on the Wire Rope Capacity chart located in the Crane Rating Manual. Refer to Figure 5−1 for a typical example. Always refer to the Wire Rope Capacity chart in the Crane Rating Manual when ordering replacement wire rope.

Wire Rope Diameter

In standard practice, the nominal diameter of wire rope is the minimum acceptable diameter. It is always made larger, not smaller, than the nominal diameter according to the allowable tolerances shown in the following chart:

Nominal Rope Diameter	Allowable Limits	
Thru 1/8" (*3.2mm*)	−0	+8%
Over 1/8" (*3.2mm*) thru 3/16" (*4.8mm*)	−0	+7%
Over 3/16" (*4.8mm*) thru 5/16" (*8.0mm*)	−0	+6%
Over 5/16" (*8.0mm*) and larger	−0	+5%

Wear and stress tend to reduce the diameter. It should be measured periodically and replaced if the size is below the nominal size of the wire rope being used as shown in the chart on page 5−4. It should always be measured across the largest diameter that will fit inside a true circle. Refer to Figure 5−2.

Wire Rope Capacity

Maximum Lifting Capacities Based On Wire Rope Strength

Parts of Line	5/8" Type DB	5/8" Type RB	Notes
1	11,770	9,080	Capacities shown are in pounds and working loads must not exceed the ratings on the capacity charts in the Crane Rating Manual.
2	23,540	18,160	
3	35,310	27,240	Capacity deducts for auxiliary lifting devices do not apply for wire rope strength capacities.
4	47,080	36,320	
5	58,850	45,400	Study Operator's Manual for wire rope inspection procedures and single part of line applications.
6	70,620	54,480	
7	82,390	63,560	
8	94,160	72,640	
9	105,930	81,720	

LBCE TYPE	DESCRIPTION
RB	18 X 19 Rotation Resistant – Compacted Strand – High Strength – Preformed, Right Regular Lay
DB	6 X 26 (6 X 19 Class) - Warrington Seale - Extra Improved Plow Steel - Preformed - Right Regular Lay - I.W.R.C.

Note: The Wire Rope Capacity chart depicted above is shown as an example only. Use the official Wire Rope Capacity chart located in the Crane Rating Manual. Use it to determine the correct parts of line required for the given wire rope type and diameter.

Note: Always refer to the crane's Parts Manual when ordering wire rope.

Figure 5–1
Typical Wire Rope Capacity Chart (Example Only)

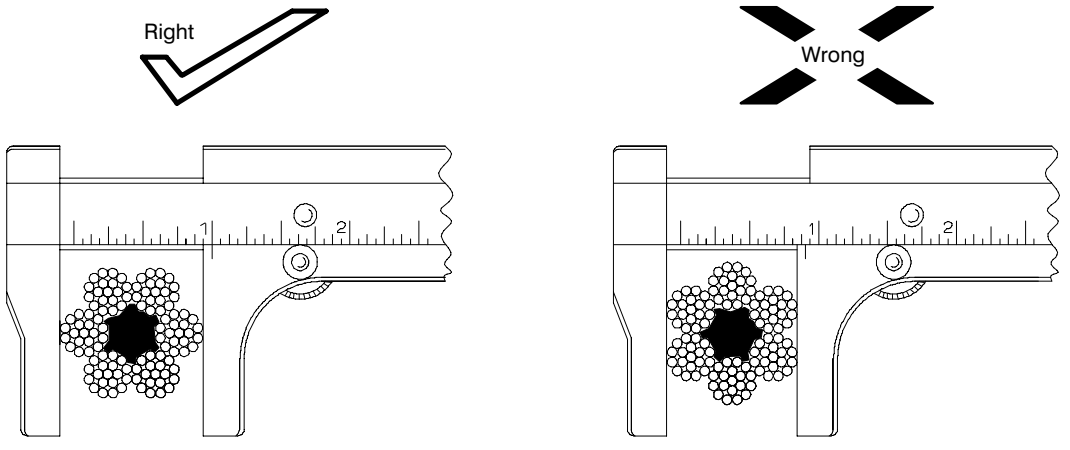


Figure 5–2
Measuring Wire Rope Diameter

WIRE ROPE INSPECTION REPORT

Machine _____ Owned By _____ Machine Location _____

Date of Inspection _____ Rope Application _____ Rope Description _____

Manufacturer's Ident. No. _____ Applicable Standards _____

Criteria for Removal				1/3 of outside wire dia.	1							
Location on Rope	Measured Diameter	Broken Wires: In 1 Rope Lay	Broken Wires: In 1 strand of 1 Lay	Excessive Wear	End Attachments: Broken Wires	End Attachments: Corrosion of Rope	End Attachments: Fitting Condition	Rope Damage	Sheave Condition	Drum Condition		Rope Lay Measurement

Signature: _____

Figure 5–3
Typical Wire Rope Inspection Report

Wire Rope Inspection And Replacement Recommendations

The three basic reasons for deterioration of wire rope are abrasion, corrosion, and damage, caused by fatigue bending, crushing, kinking, and forces or abuse acting against the rope during normal usage.

When wire rope is replaced, use the type specified on the Wire Rope Capacity chart located in the Crane Rating Manual. Cranes are designed to use a specific type and size of rope. Using ropes other than those recommended, may result in short life or even failure of the rope.

According to ASME standards, all wire ropes in active service MUST BE visually inspected daily. A qualified, trained person should be appointed to conduct the inspection. Also on a monthly basis, that person is required to inspect all wire ropes and keep a dated, written record noting any damage and recording when ropes are replaced.

These inspections should be done to determine the degree of deterioration of the rope at any given section (refer to the following on rope replacement). This will determine the suitability of the rope for continued service. A sample inspection report is shown in Figure 5–3. (It can be reproduced and used if desired).

Wire Rope Inspection

Any of the following are reasons to question rope safety:

1. More than one broken wire in any one strand should be cause for caution. Breaks that occur on the worn crowns of the outside wires usually indicate normal deterioration. Breaks that occur in the valleys between strands can indicate an abnormal condition, possibly fatigue and breakage of other wires that are not readily visible. One or more valley breaks should be cause for replacement.
2. Wire breaks generally occur in those portions of wire rope which pass over sheaves, wind onto drums, or receive mechanical abuse. Breaks that occur near attached fittings are apt to result from fatiguing stresses concentrated in these localized sections. Breaks of the latter type should be cause for replacement of the rope or renewal of the attachment to eliminate the locally fatigued area. When running ropes over nylon sheaves, inspect the wire rope where it travels over the sheaves. Inspect for a loss of diameter and then bend the rope to inspect the internal wires for breaks and wear.
3. Heavy wear, or broken wires, may occur in sections under equalizer sheaves or other sheaves where rope travel is limited, or in contact with saddles. Particular care should be taken to inspect rope at these points. If wire rope wear is detected at these locations, these wear points can be shifted by removing the rope from the drum and cutting a 20 ft (*6.1m*) section off at the drum end. This may assist in extending the wire rope life.
4. Rope stretch is generally greatest during initial stages of operation when the strands are becoming adjusted and seated. This is accompanied by some reduction in rope diameter.
5. Time for rope replacement is indicated by the extent of abrasion, scrubbing, and peening on the outside wires, broken wires, evidence of pitting or severe corrosion, kink damage, or other mechanical abuse resulting in distortion of the rope structure.
6. Sheaves, guards, guides, drums, flanges, and other surfaces contacted by wire rope during operation should be examined at the time of inspections. Any condition harmful to the rope in use at the time should be corrected. The same equipment and particularly sheave and drum grooves should be inspected and placed in proper condition before a new rope is installed.

Wire Rope Replacement

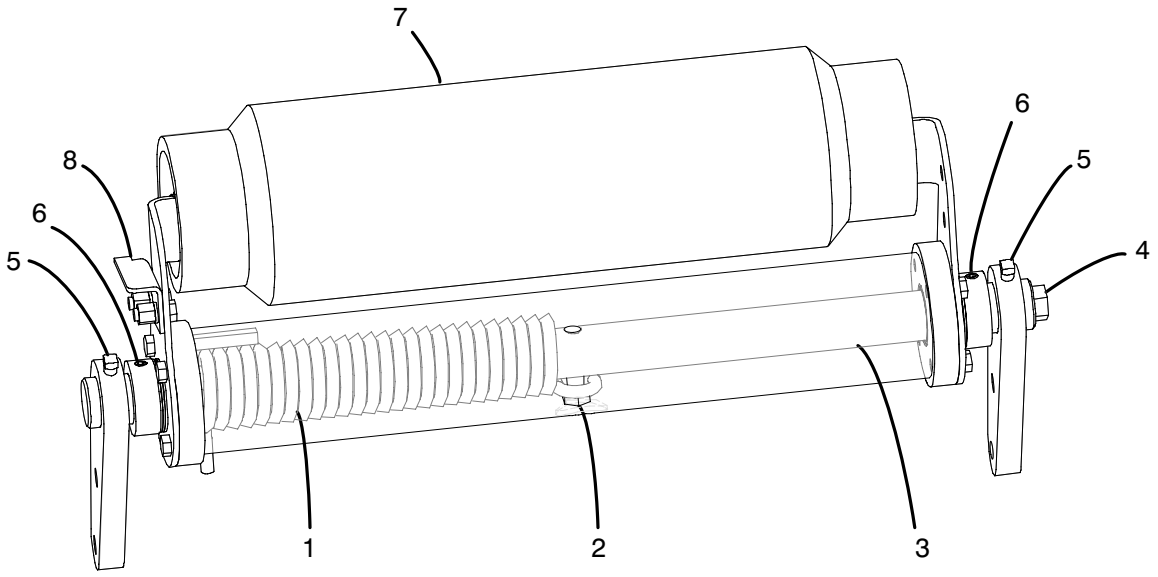
Any of the following are reasons for rope replacement:

1. In running ropes, six randomly distributed broken wires in one rope lay, or three broken wires in one strand in one rope lay.

   For rotation resistant ropes, two randomly distributed broken wires in six rope diameters, or four randomly distributed broken wires in thirty rope diameters.
2. In pendants or standing ropes, evidence of more than two broken wires in one lay in sections beyond end connections or more than one broken wire in one rope lay at end connection.
3. One outer wire broken at the contact point with the core of the rope which has worked its way out of the rope structure and protrudes or loops out from the rope structure.
4. Abrasion, scrubbing, or peening causing loss of more than 1/3 the original diameter of individual wires.
5. Evidence of rope deterioration from corrosion.
6. Kinking, crushing, "bird caging", or other damage resulting in distortion of the rope structure.
7. Evidence of any heat damage.
8. Marked reduction in diameter indicates deterioration of the core resulting in lack of proper support for the load carrying strands. Excessive rope stretch or elongation may also be an indication of internal deterioration. Reduction from nominal diameter or more than:

Reduction of	Nominal Rope Diameters
1/64" (*.4mm*)	up to and including 5/16" (*8mm*)
1/32" (*.79mm*)	over 5/16" (*9.5mm*) to 1/2" (*13mm*)
3/64" (*1.2mm*)	over 1/2" (*13 mm*) to 3/4" (*19mm*)
1/16" (*1.6mm*)	over 3/4" (*19mm*) to 1—1/8" (*29mm*)
3/32" (*2.4mm*)	over 1—1/8" (*29mm*)

9. Noticeable rusting or development of broken wires in the area of connections.



1. Spring
2. Bolt
3. Torque Shaft
4. Capscrew
5. Setscrew
6. Setscrew
7. Roller
8. Roller Stop

Figure 5–4
Winch Roller Adjustment

Wire Rope Installation

When installing wire rope, the primary concern is getting the rope onto the drum without trapping any twist that may have been induced during handling. Use the following procedure to install the rope on the crane.

Winch Roller Adjustment

Before installing wire rope on the drum, adjust the drum roller. Refer to Figure 5–4.

1. Check that the roller (7) is centered between the drum flanges. If not, loosen setscrews (6), center roller, and tighten setscrews.

⚠ WARNING

Do not attempt to service winch roller before properly relieving torsion spring tension. If proper directions are not followed, the torsion spring could rapidly and forcefully uncoil. This may result in serious personal injury and component damage. Always release tension on torsion spring before attempting any winch roller repair.

2. Properly release torsion spring (1) tension as follows. This procedure is greatly simplified by using two service technicians. (One to hold the breaker bar/wrench, the other to loosen and tighten setscrews.)
   a. Ensure capscrew (4) is tightened securely in torque shaft (3).
   b. Using a breaker bar or long handle wrench, hold tension on torsion spring (1) while loosening the setscrews (5) on both ends of torque shaft (3).
   c. Allow torque shaft (3) to rotate counterclockwise, as far as possible while maintaining control of the torque shaft, then securely tighten setscrews (5).
   d. Reposition breaker bar or wrench on capscrew (4).
   e. Repeat steps b thru d until tension is fully relieved from torsion spring (1).

CAUTION

Do not overtighten the spring. Damage to the wire rope may occur.

3. Turn the capscrew (4), which will rotate the torque shaft (3), until the bolt (2) through the torque shaft contacts the spring (1).
4. With the roller stop (8) resting against the winch frame and the bolt (2) through the torque shaft (3) just contacting the spring (1), rotate the torque shaft 290° to preload the spring. The torque required to turn the shaft 290° is approximately 72 ft lb (*97Nm*).
5. Tighten setscrews (5). The roller should roll freely when the drum rotates.

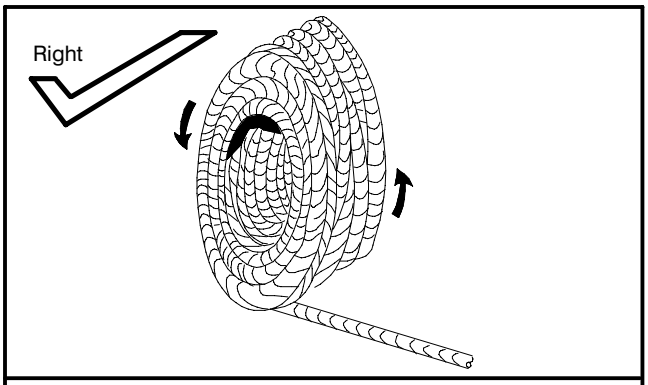


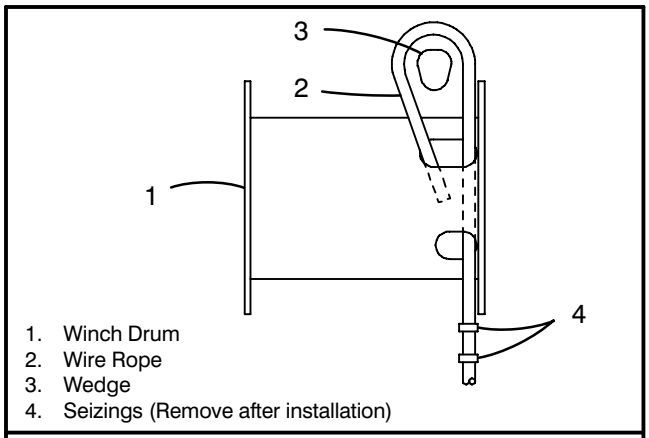
Figure 5–5 CD00326
Uncoiling Wire Rope

Uncoiling Wire Rope

1. To avoid twists, unreel the entire rope on the ground in line with the boom deflector sheave and drum. Set the reel up horizontally so it can rotate as the rope is reeled off. Refer to Figure 5–5. Reel the rope off slowly, so the reel won't tend to "throw" the rope off. If the new rope cannot be laid out on the ground, further steps are necessary:
   a. Mount the reel on a shaft through flange holes and on jack stands, making sure the reel is set to be unreeled over the top. Do not allow the reel to "free–wheel". Brake the reel by applying pressure to a flange. Do not apply braking pressure to the rope on the reel or pass rope between blocks of wood or other material.
2. Reeve the rope over the boom deflector sheave and anchor it to the drum.

   Note: When replacing wire rope, the sheaves and grooves in drums should be checked for wear or damage and replaced if necessary. Damaged, worn, or undersized sheaves will damage the rope. On older equipment, remember that new rope is usually larger in diameter than the worn rope it replaces. The sheave grooves may be worn to the smaller diameter of the old rope.

   A new rope should be broken in by running it slowly through its working cycle for a short period under a light load. Refer to "Rope Break–In" found later in this Section of the Operator's Manual.



1. Winch Drum
2. Wire Rope
3. Wedge
4. Seizings (Remove after installation)

Figure 5–6
Anchoring Wire Rope to Drum

Anchoring Wire Rope to Drum

Attach two seizings (hose clamps are an effective and efficient alternative if traditional seizings are not available) about 24 in (*609.6mm*) from the end with a 3 in (*76.2mm*) space between them. Refer to Figure 5–6. The seizings will prevent any looseness of the outer strands from traveling up the rope during installation. Insert the free end of the rope into the small opening of the anchor pocket. Loop the rope and push the free end about 3/4 of the way back through the pocket. Install the wedge, then pull the slack out of the rope. Remove the seizings after the rope is secured in the drum. Keep tension on the rope to prevent the rope from becoming slack and forming loops or kinks and also to allow uniform winding on the drum. It is important that original rope lay is maintained at all times.

Winding Rope on Drum

Proper winding of the first layer of rope on a multiple wrap drum is important. If the first layer is properly wound, succeeding layers will be easier to control.

This is especially important on ungrooved drums. When starting new wire rope on such drums, drive each wrap of the first layer lightly, with a wooden mallet, so each wrap barely contacts the preceding one. Keep tension on the rope to prevent the rope from becoming slack and forming loops or kinks and also to allow uniform winding on the drum. It is important that original rope lay is maintained at all times.

It's important to apply a tensioning load while spooling the rope on the drum. (If not, the lower layers may be loose enough that the upper layers become wedged into the lower layers under load, which can seriously damage the rope.) The tensioning load should range from 1 to 2% of the rope's nominal strength.

Wire Rope Reeving

Hook blocks should be reeved correctly so they hang straight and do not cause excessive wear on the rope and sheaves. Refer to Figure 5–7.

WARNING

To avoid personal injury, do not climb, stand, or walk on the boom or fly. Use a ladder or similar device to reach necessary areas when reeving the crane.

Only if certain criteria are met may a swivel hook ball be used with rotation resistant rope. Refer to "Hook Ball Usage With Rotation Resistant Rope" found in this Operator's Manual.

The crane can use multiple parts of line when reeving the main winch, depending on the lift being made, and the number of sheaves available. When reeving the main winch, odd parts of line dead end at the hook block and even parts dead end at the boom head. The auxiliary lifting sheave may be reeved with either one or two parts of line. The fly section may be reeved with two parts of line for better line control. Figure 5–8 gives the proper reeving for various parts of line. The reeving patterns illustrated must be used at all times. To determine how many parts of line to use for a particular lift, check the Wire Rope Capacity chart and the Winch Performance chart located in the Crane Rating Manual.

Note: Rope guards must always be used during operations. They must be pinned in place to prevent wire rope from jumping off the sheaves.

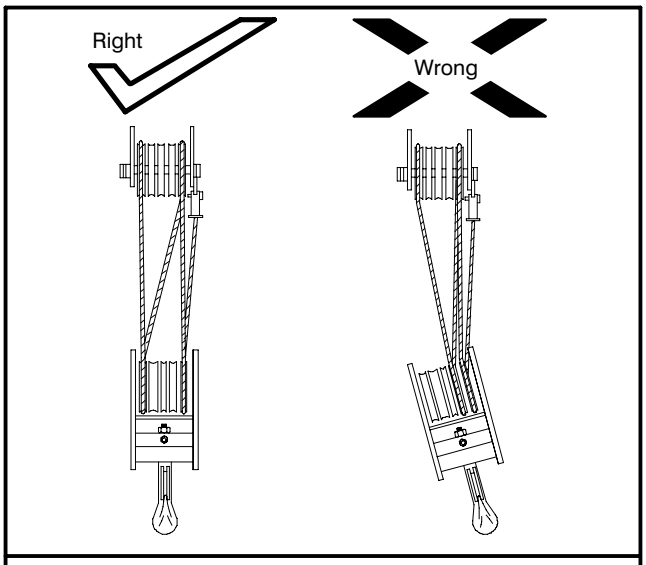
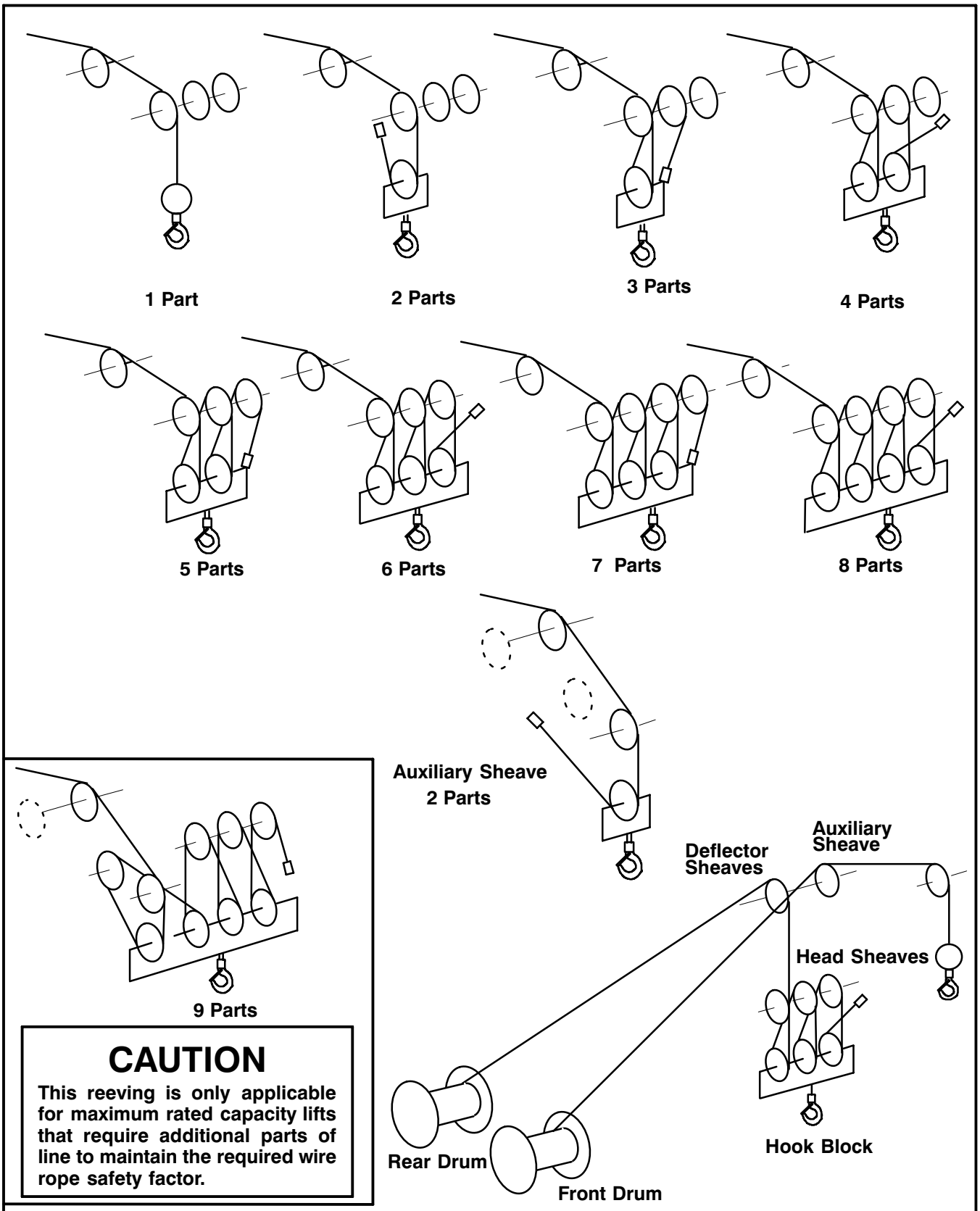
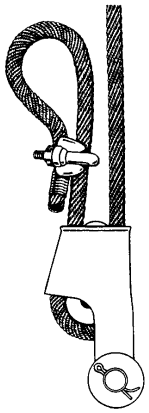


Figure 5–7
Hook Block Reeving

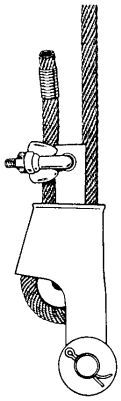


Note: Reeving shown is typical. Either drum may be reeved over head sheaves or auxiliary sheave.

Figure 5–8
Wire Rope Reeving Diagrams



Socket And Wedge
<u>Without</u> Extended Wedge
Refer to page 5–10



Socket And Wedge
<u>With</u> Extended Wedge
Refer to page 5–11

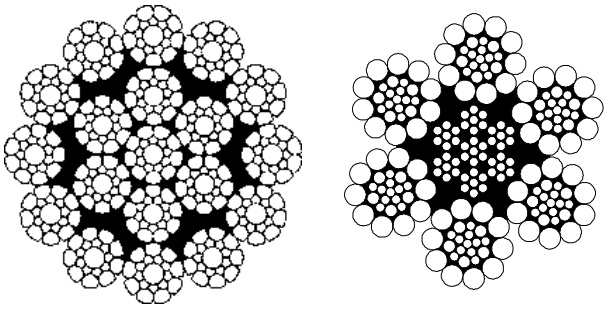
Figure 5–9
Sockets And Wedges

Sockets And Wedges

This crane may be equipped with either of two styles of sockets and wedges. One style socket uses a "terminator" extended wedge and the other does not. The wedges for each style are installed differently. Refer to Figure 5–9 to determine which style your crane has and where to find the appropriate information for use and installation.

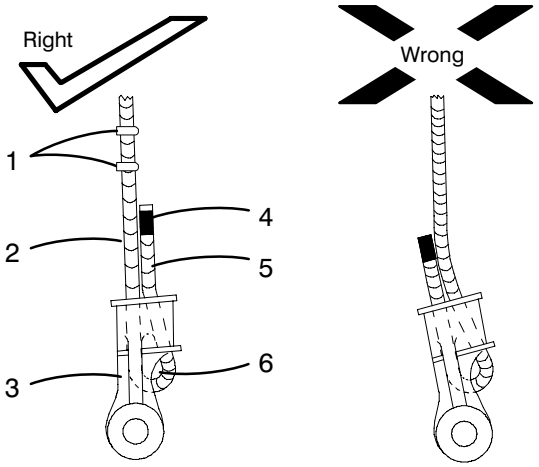
WARNING

Do not interchange sockets and wedges. Loads may slip or fall if socket and wedge are not properly matched. Use a "terminator" wedge with a utility socket for a "terminator" wedge and a non-"terminator" wedge with a non-"terminator" ready socket.



Type RB **Type DB**

Figure 5–10
Wire Rope Identification



1. Seizings (Remove after installation)
2. Wire Rope Live End
3. Socket
4. Dead End Seizing
5. 20 Rope Diameters Minimum Tail Length
6. Wedge

Figure 5—11
Socket & Wedge Connections

Socket And Wedge Connections — Without Extended Wedge

WARNING

Use the proper size wedge with a wire rope socket or lagging. The use of an off—size wedge in a socket or lagging is dangerous as it may not hold. Wedges and sockets shipped from the factory are stamped with size and type identification. A lagging or socket may be stamped for two or more sizes of rope and a wedge for one or two. The size on the lagging, socket, and wedge must correspond with the size of rope being used.

The correct and incorrect methods of attaching a socket and wedge to wire rope are shown in Figure 5—11. The dead end of the wire rope must always be on the sloped portion of the socket. The load line must be in a straight line pull with the eye of the socket. If the rope is installed wrong, as shown in Figure 5—11, a permanent set will develop at the point where the rope enters the socket.

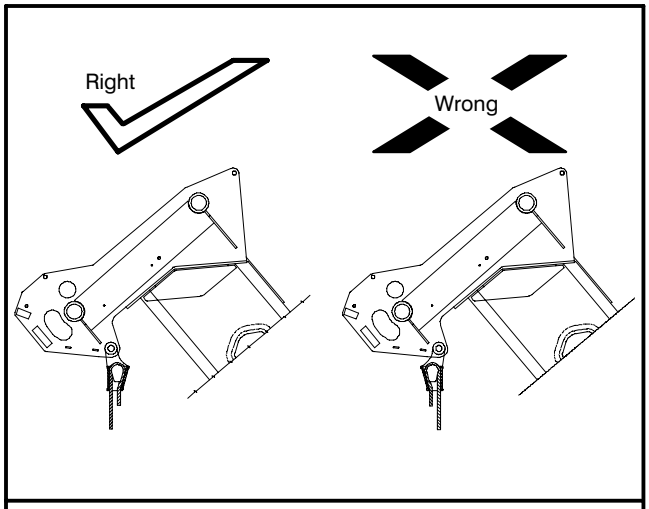


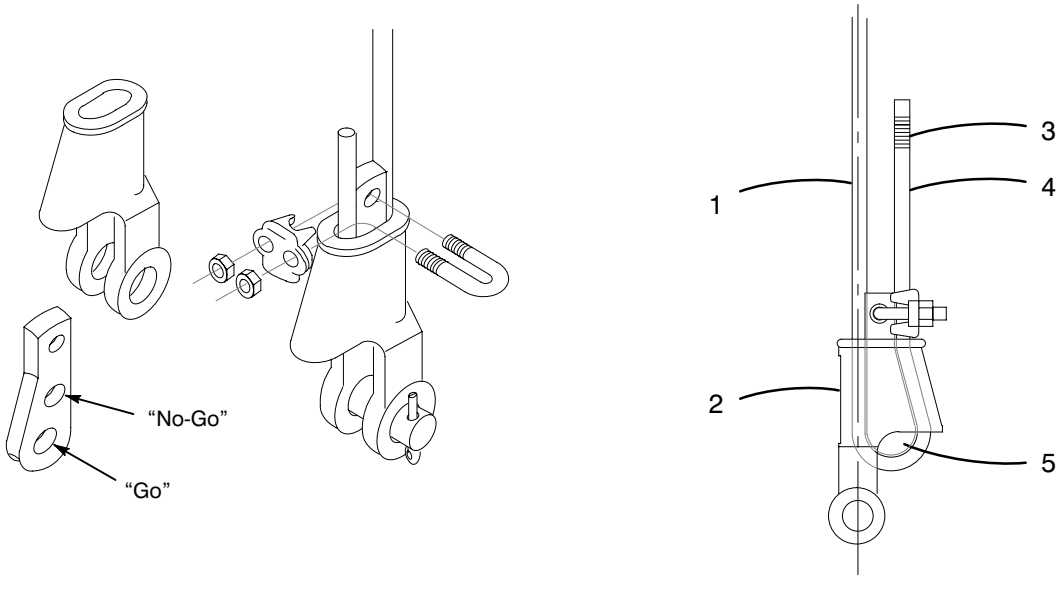
Figure 5—12
Socket & Wedge Installation

Before installing wire rope into a socket or wedge, attach two seizings (hose clamps are an effective and efficient alternative if traditional clips are not available) approximately 3—4 ft (*0.9—1.2m*) from the end with a 3 in (*76.2mm*) space between them. Refer to Figure 5—11.

The dead end must also be seized and a minimum tail length of 20 rope diameters (15 in (*0.38m*) for 3/4 in rope) is required. The seizings will help prevent core slippage and any looseness of the outer strands from traveling up the rope during installation while still allowing the rope strands to be free to adjust. Remove seizings from the live end after rope is securely installed into the socket.

When anchoring the socket to the boom head, make sure the flat face is facing out, as shown in Figure 5—12. If socket is not installed correctly, structural damage to the boom head may occur.

It is recommended that the wire rope socket and wedge connection be re-established on an annual basis. This can be accomplished by cutting the rope 6" (*.15m*) above the socket and wedge connection. (See "Cutting Wire Rope" found in this section of this Operator's Manual). Install the socket and wedge connection as shown in Figure 5—11.



1. Wire Rope Live End
2. Socket
3. Dead End Seizing
4. Tail Length – 20 Rope Diameters Minimum for Rotation Resistant Ropes, 6 Rope Diameters Minimum for 6 to 8 Strand Rope
5. Extended Wedge

Figure 5–13
Socket & Wedge Assembly – With Extended Wedge

Socket And Wedge Assembly – With Extended Wedge

WARNING

Use the proper size wedge with a wire rope socket or drum. The use of an incorrect size, type, or brand of wedge in a socket or drum is dangerous as it may not hold. Wedges and sockets shipped from the factory are stamped with size and type identification. A drum or socket may be stamped for two or more sizes of rope and a wedge for one or two. The size on the drum, socket, and wedge must correspond with the size of rope being used.

WARNING

Do not interchange sockets and wedges. Loads may slip or fall if socket and wedge are not properly matched. Use a "terminator" wedge with a utility socket for a "terminator" wedge and a non-"terminator" wedge with a non-"terminator" ready socket.

The correct and incorrect methods of attaching a wedge and socket to wire rope are shown in Figure 5–13 and Figure 5–14. The dead end of the wire rope must always be on the sloped portion of the socket. The load line must be in a straight line pull with the eye of the socket. If the rope is installed wrong as shown in Figure 5–14, a permanent set will develop at the point where the rope enters the socket. This permanent set will weaken the rope and accelerate wear at this point.

Wedges and sockets shipped from the factory are stamped with size and type or pair identification. A socket or wedge may be stamped for two or more sizes of rope. The size on the socket, and wedge must correspond with the size of rope being used. The wedge also has a "go"/"no-go" feature cast into the wedge to assist in determining the proper size wire rope that can be used with that particular socket and wedge. Refer to Figure 5–13. The proper size wire rope is determined when: 1) the wire rope passes through the "go" hole in the wedge, and 2) the wire rope does not pass through the "no-go" hole in the wedge. The part number may also be stamped on the socket and wedge. Consult the Parts Manual for confirmation. If there is any doubt as to the mating of the socket and wedge, consult your Distributor.

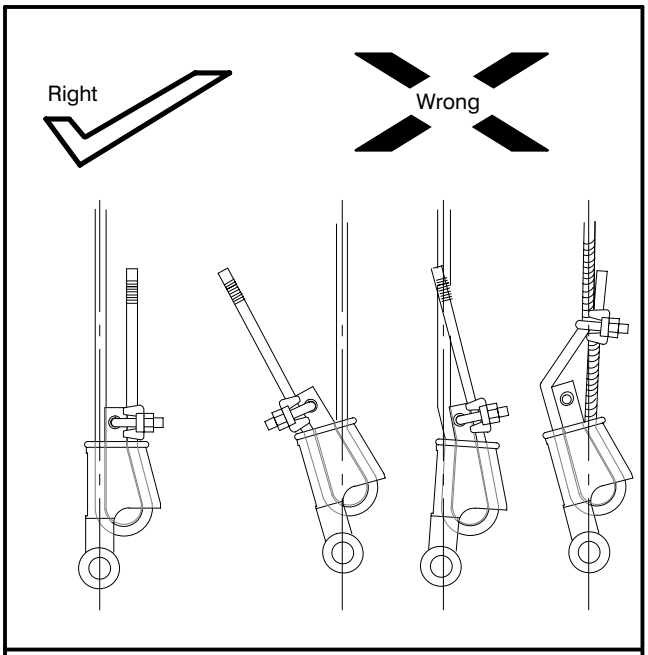


Figure 5—14
Socket & Wedge Connections

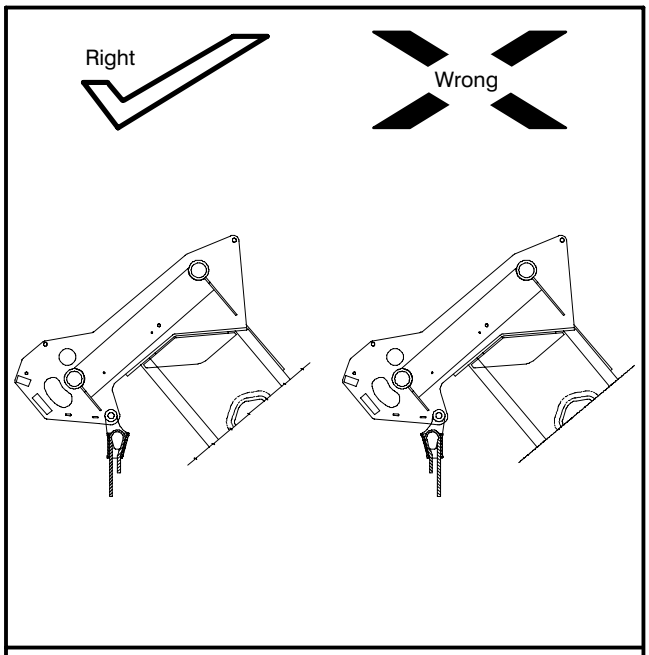


Figure 5—15
Socket & Wedge Installation

The dead end must also be seized and a minimum tail length of 20 rope diameters (15 inches for 3/4 inch rope) for rotation resistant ropes and 6 rope diameters minimum for 6 to 8 strand rope is required. Refer to Figure 5—13.

Note: Refer to Figure 5—10 to identify which type of rope is installed on the crane.

Use a hammer to seat the wedge and rope into the socket before applying first load. Lift the first load a few inches from the ground to fully seat the wedge and wire rope in the socket. This load should be of equal or greater weight than loads expected in use.

Secure the dead end section of the rope by installing the clip through the wedge as shown in Figure 5—13. Tighten the nuts on the clip to the recommended torque as shown on the table in Figure 5—17.

When anchoring the socket to the heavy duty boom head, make sure the flat face is facing in as shown in Figure 5—15. If socket is not installed correctly, damage to the boom head may occur.

It is recommended that annually, the socket and wedge connection be removed, that portion of wire rope be removed, and a new connection be installed.

Rope Break—In

After the rope has been installed and the ends secured in the correct manner, the new rope must be run through a break—in period. This allows the component parts of the new rope to gradually adjust itself to actual operating conditions.

1. Level the crane on fully extended outriggers with all tires clear of the ground. Swing the upper over the rear of the carrier and engage the travel swing lock.
2. Fully raise and fully extend the boom. Attach a light load at the hook and raise it a few inches off the ground. Allow to stand for several minutes.
3. Run the rope through a cycle of operation at very slow speeds. During this trial operation, a very close watch should be kept on all working parts—sheaves, drums, roller, etc. to make certain that the rope runs freely, and without any possible obstructions as it makes its way through the system.

   Note: Run these loads with reeving that places the loads on the block with all rope off the drum except the last three wraps. If this is not possible, alternate methods must be used to assure proper tensioning of the rope on the drum.

4. If no problems appear in running the rope, repeat procedure with an increased load.

Single Part Line Hoisting

Non-rotating, rotation-resistant, or spin-resistant wire ropes are recommended for single part of line applications. This is of utmost importance for long fall hoist line applications. Link-Belt type "P", "RB", and "ZB" are examples of ropes recommended for single part hoisting. See the Wire Rope Capacity Chart in the Crane Rating Manual for the specific types of rotation resistant wire rope recommended for your crane.

The use of non-rotation resistant rope is **not** recommended for long falls of single part of line hoisting since the rope and load may spin. If the crane operator allows either the load or the rope to rotate, the crane or rope can be damaged. The anti-two block weight may also become entangled with the wire rope and could damage the anti-two block system, wire rope, and/or head machinery.

Hook Ball Usage With Rotation Resistant Rope

The rotation resistant characteristic is achieved by laying the outer strands around an independent wire rope that is wound in the opposite direction. When the rope has tension on it, opposing rotational forces are created between the core and outer strands. If a swivel hook ball is utilized with rotation resistant rope, the rope is allowed to twist. The outer strands unwind and get longer while the inner core is forced to rotate in the same direction and shortens in length. As a result of this treatment, the inner core sees a disproportionately greater load, and core damage may occur due to shock loading or overloading. A rotating load on an unrestrained, non—swivel hook ball without a tagline, affects the internal loading of the rope in this manner. This practice, or any other which allows the rope to rotate while in service, leads to unbalanced loading between the inner and outer layer of strands, which may result in core failure. Wire rope manufacturer's testing has shown that rotation resistant rope utilized with a swivel hook ball has reduced the breaking strength by as much as 50% if excessive rotation occurs.

Non—Swivel Usage

A non—swivel hook ball in conjunction with a tagline or other device to control load spin should be used when the crane is equipped with rotation resistant wire rope. This is to avoid unrestrained rotation of the wire rope.

Swivel Usage

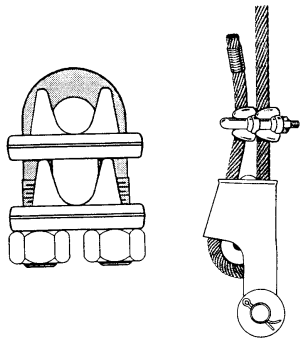
A swivel hook ball can be used with rotation resistant rope if:

1. The wire rope is not shock loaded or overloaded.
2. Wire rope working strength is reduced to maintain original design factors.
3. The wire rope is inspected frequently as outlined below.

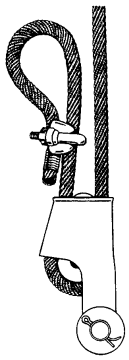
Rope Inspection

Marked reduction in diameter indicates deterioration of the core resulting in lack of proper support for the load carrying strands. Excessive rope stretch or elongation may also be an indication of internal deterioration. Major concerns and replacement recommendations include:

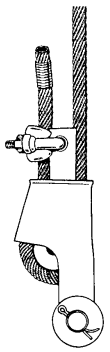
1. Loss of rope diameter (in excess of those listed in the table in the "Wire Rope Replacement" section found earlier in this Operator's Manual), abnormal lengthening of rope lay, or protrusion of wires between the outer strands.
2. 2 randomly distributed broken wires in 6 rope diameters, or 4 randomly distributed broken wires in 30 rope diameters.



The Double—Saddle—Clip Method



The Loop Back Method



The Extended Wedge Method

Figure 5—16
Wire Rope Socket With Clip

Wire Rope Sockets With Clips

Some codes require the use of a wire rope clip in conjunction with a socket and wedge connection. Figure 5—16 illustrates some typical methods of clip installation with sockets. In some cases, particularly in wrecking ball work, there is a chance that the wedge can loosen, releasing the socket from the rope. This could be caused by the banging action and alternate loading and unloading of the rope that occurs during this type work.

⚠ WARNING

Regularly inspect the integrity of the wire rope at the point of exit at the dead end side. High velocity spin of wire rope when loading and unloading can cause the rope to flip—flop, fatigue, and finally break off.

The use of wire rope clips with a socket and wedge connection can weaken the connection if done improperly. Do not attach the dead end of the rope to the live side with the clip as this will seriously weaken the connection. The clip may ultimately take the load and may deform or break the rope.

If using the loop back method, the loop formed must not be allowed to enter the wedge, or the connection will be weakened. The tail length of the dead end must be a minimum of 20 rope diameters [15 in (*0.38m*) for 3/4 inch rope].

Wire Rope Clip Installation

The correct method of installing wire rope clips is shown in Figure 5—18. The u—bolt must always be over the short end of the wire rope and the base must always contact the long end.

Clips should NOT be staggered, that is u—bolt of one clip over short end and u—bolt of next clip over long end. This practice will not only distort the wire rope excessively, but will prevent maximum strength of this type fastening. Placing all clips with the u—bolt over the long end of the wire rope will damage strands and result in an unsafe condition.

The distance between clips should be not less than six times the wire rope diameter. In relation to size of wire rope, the minimum number of clips recommended for safe connections is given in Figure 5—17.

CAUTION

Apply the initial load and retighten nuts to the recommended torque. Rope can stretch and reduce in diameter when loads are applied. Inspect periodically and retighten as required.

Clip Size		Minimum No. of Clips	Amount OF Rope To Turn Back*		Torque	
Inches	*mm*	Quantity	Inches	*mm*	ft lb	*Nm*
1/4	*3.2*	2	3-1/4	*82.5*	–––	–––
3/16	*4.7*	2	3-3/4	*95.2*	–––	–––
1/4	*6.3*	2	4-3/4	*120.6*	15	*20.0*
5/16	*7.9*	2	5-1/4	*133.3*	30	*40.7*
3/8	*9.5*	2	6-1/2	*165.1*	45	*60.1*
7/16	*11.1*	2	7	*177.8*	65	*86.8*
1/2	*12.7*	3	11-1/2	*292.1*	65	*86.8*
9/16	*14.3*	3	12	*304.8*	95	*126.9*
5/8	*15.9*	3	12	*304.8*	95	*126.9*
3/4	*19.0*	4	18	*457.2*	130	*173.6*

* If a greater number of clips are used than shown in this table, the amount of rope turnback should be increased proportionally.

Figure 5–17
Wire Rope Clip Application Recommendation

Cutting Wire Rope

When wire rope is to be cut, seizings should be placed on each side of the point where the rope is to be cut, to keep the strands in place. On preformed rope such as type RB, one seizing on each side of the cut is enough. On non–preformed rope less than 7/8 in (*23mm*) diameter such as type ZB, two seizings are recommended. On non–preformed rope over 7/8 in (*23mm*) diameter, three seizings are recommended. Original rope lay must be maintained at all times.

Two Basic methods of cutting wire rope are recommended:

1. Abrasive cutting tools.
2. Shearing tools. (Wire cutters on small rope, a wire rope cutter and hammer for larger ropes.)
3. Oxy/acetylene fuel torch (non–preformed ropes only).

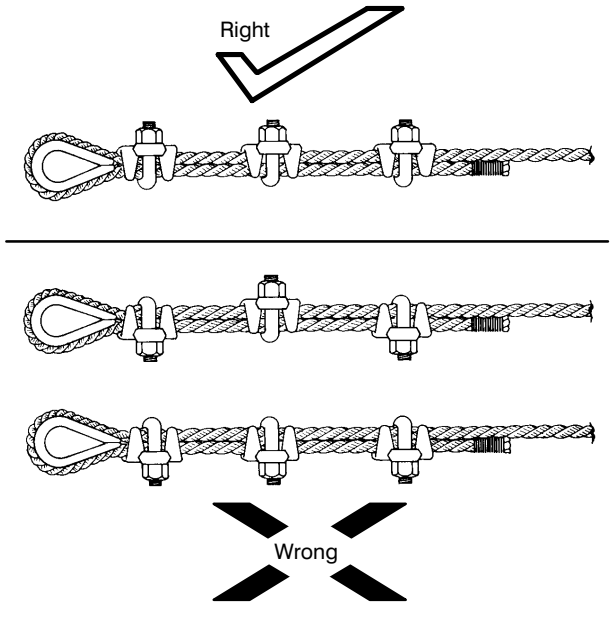
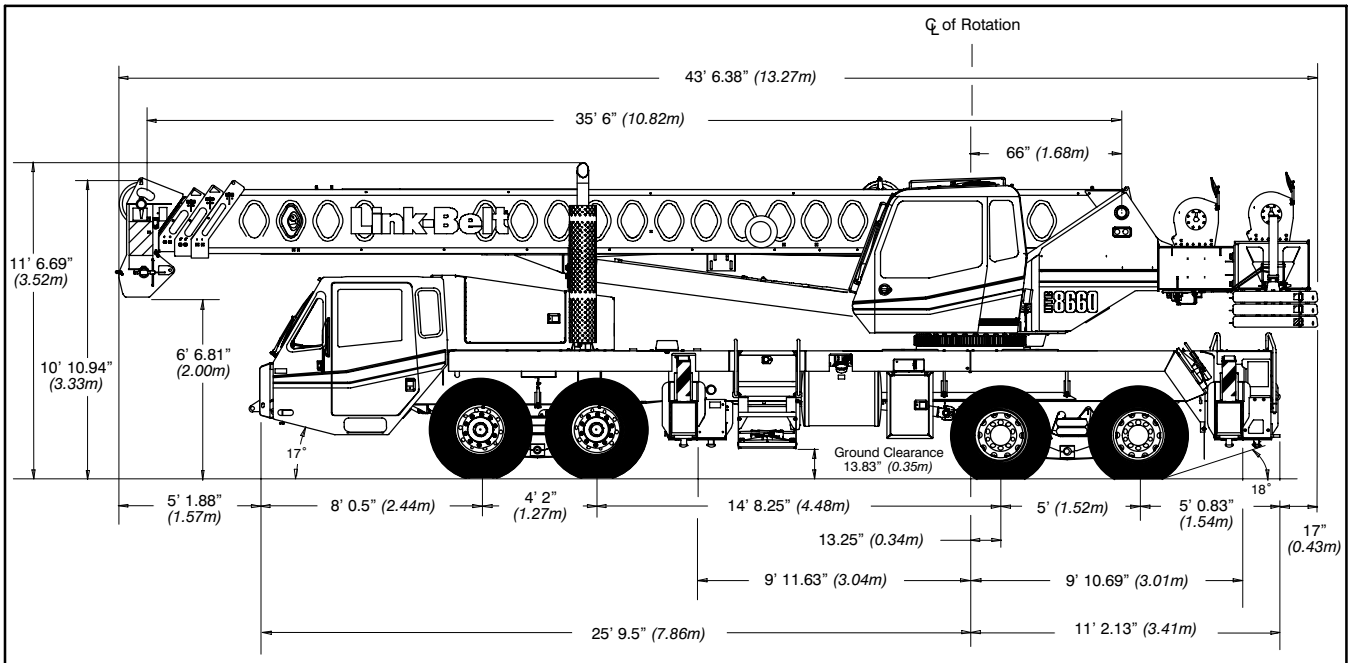
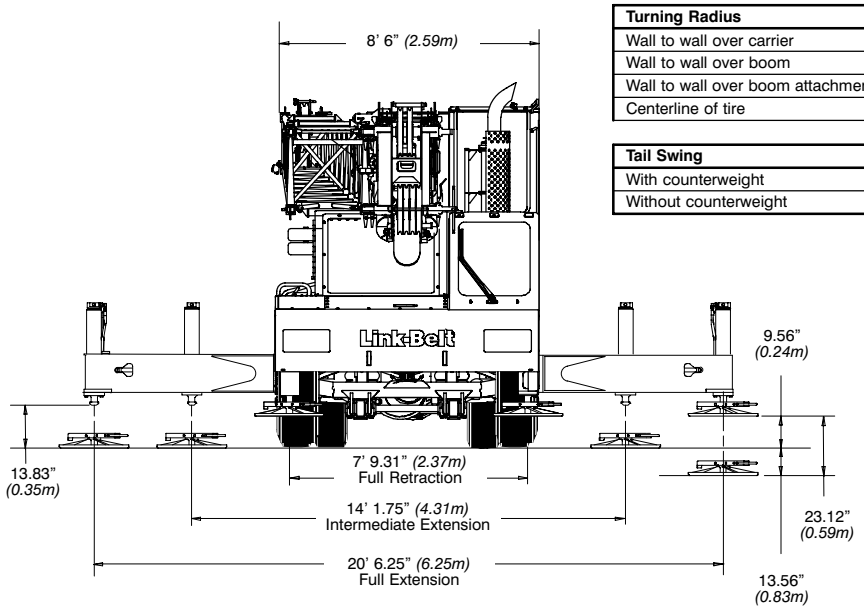


Figure 5–18
Wire Rope Clip Installation

Crane Specifications

The information in Figure 5—19 and the following instructions is general in nature and is used for reference purposes only. Depending upon the vintage of the crane, some features may no longer be available. Standard and optional features may vary from crane to crane. Consult the factory to verify the specific information if required.





Turning Radius	English	*Metric*
Wall to wall over carrier	44' 1"	*13.4m*
Wall to wall over boom	45' 6"	*13.9m*
Wall to wall over boom attachment	46' 11"	*14.3m*
Centerline of tire	38' 7"	*11.8m*

Tail Swing	English	*Metric*
With counterweight	12' 8.5"	*3.9m*
Without counterweight	12' 5.25"	*3.8m*

Figure 5—19
Crane Dimensions

Boom, Attachments, and Upper Structure

■ Boom

Design – Four section, box type construction of high tensile steel consisting of one base section and three telescoping sections. The vertical side plates have diamond shaped impression for superior strength to weight ratio. The first telescoping section extends independently by means of one double–acting, single stage hydraulic cylinder with integrated holding valves. The second and third telescoping sections extend proportionally by means of one double–acting, single stage cylinder with integrated holding valves and cables.

Boom

- 35.5–110 ft *(10.8–33.5m)* four–section full power boom
- Two mode boom extension: A–max mode provides superior capacities by extending the first telescope section to 60.3 ft *(18.4m)*. Standard mode synchronizes all the telescoping sections proportionally to 110 ft *(33.5m)*. Controlled from operator's cab.
- Mechanical boom angle indicator
- Maximum tip height for A–max mode is 68.8 ft *(21.0m)* and standard mode is 117.4 ft *(35.8m).*

Boom Head

- Four 16.5 in *(41.9cm)* root diameter nylon sheaves to handle up to eight parts of line
- Easily removable wire rope guards
- Rope dead end lugs on each side of the boom head
- Boom head is designed for quick–reeve of the hook block

Boom Elevation

- One double acting hydraulic cylinder with integral holding valve
- Boom elevation: –3˚ to 78˚

Auxiliary Lifting Sheave – Optional

- Single 16.5 in (*41.9m*) root diameter nylon sheave
- Easily removable wire rope guards
- Does not affect erection of the fly or use of the main head sheaves

Hook Blocks and Balls – Optional

- 25 ton (*22.7mt*) 3 sheave quick–reeve hook block with safety latch
- 40 ton (*36.3mt*) 4 sheave quick–reeve hook block with safety latch
- 50 ton (*45.4mt*) 5 sheave quick–reeve hook block with safety latch
- 8.5 ton (*7.7mt*) swivel and non–swivel hook balls with safety latch

Fly – Optional

- 28.5 ft *(8.7m)* one piece lattice fly, stowable, offsettable to 2°, 20°, and 40°. Maximum tip height is 144.8 ft *(44.1m)*.
- 28.5–51 ft *(8.7–15.5m)* two piece bi–fold lattice fly, stowable, offsettable to 2°, 20° and 40°. Maximum tip height is 166.9 ft *(50.9m).*

■ Upper Operator's Cab and Controls

Environmental Cab – Fully enclosed, one person cab of galvaneal steel structure with acoustical insulation. Equipped with:

- Tinted and tempered glass windows
- Extra–large fixed front window with windshield wiper and washer
- Swing up roof window with windshield wiper
- Sliding left side door with large fixed window
- Sliding rear and right side windows for ventilation
- Six way adjustable, cushioned seat with seat belt and storage compartment
- Engine dependent warm–water heater with air ducts for front windshield defroster and cab floor
- Defroster fan for the front window
- Bubble level
- Circulating fan
- Adjustable sun visor
- Dome light
- Cup holder
- Fire extinguisher
- Left side viewing mirror
- Pull–out cabwalk
- Two position travel swing lock

Air Conditioning – Optional – Integral with cab heating system utilizing the same ventilation outlets

Armrest Controls – Two dual axis hydraulic joystick controllers or optional single axis hydraulic controllers for:

- Swing with integrated swing park brake switch
- Boom hoist with integrated warning horn button
- Main rear winch
- Auxiliary front winch – optional
- Drum rotation indication
- Drum rotation indicator activation switch
- Winch high/low speed and disable switch(es)
- Third wrap selector switch – optional
- Telescopic override switch
- Diesel particulate filter regneration switch

Outrigger Controls – Hand held control box with umbilical cord gives the operator the freedom to view operation while setting the outriggers.

Drive and Steer Controls – Optional – Hand held control box with umbilical cord gives the operator the ability to drive and steer the crane at low speed from the operator's cab.

Foot Controls

- Boom telescope
- Swing brake
- Engine throttle
- Carrier service brake – optional

Right Front Console — Controls and indicators for:

- Engine ignition
- Engine throttle lock
- Pump enable
- Function disable
- Front windshield wiper and washer
- Cab floodlights
- Warning horn
- Heating controls
- Two position house lock
- Bubble level
- 12 volt power connection
- Carrier park brake — optional
- Air conditioning — optional
- Boom floodlight — optional
- Console dimmer switch

Cab Instrumentation — Ergonomically positioned, analog instrumentation for crane operation including:

- Check and stop engine indicators
- Engine coolant temperature with warning indicator
- Hydraulic oil temperature with warning indicator
- Low air pressure warning indicator
- Fuel level
- Tachometer
- Swing park brake indicator
- Diesel particulate filter regeneration indicator
- High exhaust temperature indicator

Rated Capacity Limiter — Microguard graphic audio—visual warning system integrated into the dash with anti—two block and function limiter. Operating data available includes:

- Crane configuration
- Boom length and angle
- Boom head height
- Allowed load and % of allowed load
- Boom angle
- Radius of load
- Actual load
- Operator settable alarms (include):
  - Maximum and minimum boom angles
  - Maximum and minimum tip height
  - Maximum boom length
  - Left/right swing positions
  - Operator defined area (imaginary plane)

Internal RCL Light Bar — Optional — Visually informs the operator when crane is approaching maximum load capacity with a series of green, yellow, and red lights.

External RCL Light Bar — Optional — Visually informs the ground crew when crane is approaching maximum load capacity with a series of green, yellow, and red lights.

■ Swing

Motor/Planetary — Bi—directional hydraulic swing motor mounted to a planetary reducer for 360˚ continuous smooth swing at 2.5 rpm.

Swing Park Brake — 360˚, electric over hydraulic, (spring applied/hydraulic released) multi—disc brake mounted on the speed reducer. Operated by a switch from the operator's cab.

Swing Brake — 360˚, foot operated, hydraulic applied disc brake mounted to the speed reducer.

Swing Lock — Two—position swing lock (boom over front or rear) operated from the operator's cab.

360˚ Positive Swing Lock — Optional — Meets New York City requirement.

■ Electrical

Swing Alarm — Audio warning device signals when the upper is swinging.

Lights

- Two working lights on front of the cab
- One rotating amber beacon on top of the cab — optional
- One amber strobe beacon on top of the cab — optional
- Boom floodlight — optional

■ Load Hoist System

Load Hoist Performance

Main (Rear) and Auxiliary (Front) Winches — 5/8 in (*16mm*) Rope										
	Maximum Line Pull		Normal Line Speed		High Line Speed		Layer		Total	
Layer	lb	*kg*	ft/min	*m/min*	ft/min	*m/min*	ft	*m*	ft	*m*
1	15,871	*7 199*	166	*50.5*	329	*100.2*	97	*29.6*	97	*29.6*
2	14,356	*6 512*	183	*55.8*	364	*110.8*	108	*32.6*	205	*62.5*
3	13,104	*5 944*	201	*61.2*	398	*121.4*	117	*36.0*	322	*98.1*
4	12,054	*5 468*	218	*66.5*	433	*132.0*	128	*39.0*	450	*137.2*
5	11,159	*5 062*	236	*71.8*	468	*142.6*	139	*42.1*	589	*179.5*
6	10,388	*4 712*	253	*77.2*	502	*153.2*	148	*45.1*	737	*224.6*

Wire Rope Application		Diameter		Type
		in	*mm*	
Main (Rear) Winch	Standard	5/8	*16*	Type DB
	Optional	5/8	*16*	Type RB
Auxiliary (Front) Winch	Standard	5/8	*16*	Type DB
	Optional	5/8	*16*	Type RB

2M Main and Optional Auxiliary Winches

- Axial piston, full and half displacement (2—speed) motors driven through planetary reduction unit for positive control under all load conditions.
- Grooved lagging
- Power up/down mode of operation
- Hoist drum cable follower — optional
- Drum rotation indicator
- Drum diameter: 10.63 in (*27.0cm*)
- Rope length:
  - Main: 550 ft (*167.6m*)
  - Auxiliary: 450 ft (*137.2m*) or 550 ft (*167.6m*)
- Terminator style socket and wedge

Third wrap indicator — optional — Visually and audibly warns the operator when the wire rope is on the first/bottom layer and when the wire rope is down to the last three wraps.

■ Hydraulic System

Counterbalance Valves — All hoist motors, boom extend cylinders, and boom hoist cylinder are equipped with counterbalance valves to provide load lowering and to prevent accidental load drop if hydraulic power is suddenly reduced.

Hydraulic Oil Cooler — Carrier mounted cooler removes heat from the hydraulic oil. Cooler is integral to the engine radiator/charge air cooler.

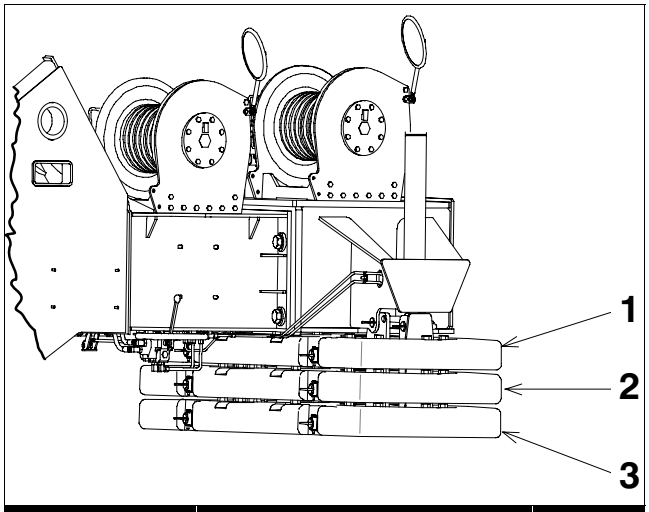
Boom Hoist Float Valves (Optional) — For transporting the boom over the rear of the crane with a boom dolly. Allows hydraulic oil within the boom hoist cylinder to flow between piston side and rod side, allowing the boom to float while on the boom dolly.

Swing Brake Release — For transporting the boom over the rear of the crane with a boom dolly. Holds the 360° swing park brake in the released position allowing free rotation of the upper structure.

■ Counterweight

Standard — 11,500 lb *(5 216kg)* total counterweight consisting of two, hydraulically removable 3,600 lb *(1 633kg)* counterweights with capacities for 4,300 lb *(1 950kg)* and 7,900 lb *(3,583kg)* counterweight configurations. Assembled and disassembled by hydraulic cylinders controlled from both sides of the upper structure.

Optional — 3,600 lb *(1 633kg)* in addition to standard counterweight for a total of 15,100 lb *(6 849kg)*.



Counterweight Usage Combinations	Standard			Optional
	4,300 lb *(1 950kg)*	7,900 lb *(3 583kg)*	11,500 lb *(5 216kg)*	15,100 lb *(6 849kg)*
1		X	X	X
2			X	X
3				X

Carrier

■ General

- 8 ft 6 in (2.6 m) wide
- 23 ft 10 in (*7.26m*) wheelbase (centerline of first axle to centerline of fourth axle)
- **Frame** – Box–type, torsion resistant, welded construction made of high tensile steel. Equipped with front and rear towing and tie–down lugs, tow connections, and access ladders.

■ Outriggers

Boxes – Two double box, front and rear welded to the carrier frame

Beams and Jacks – Four single stage beams with Confined Area Lifting Capacities (CALC) provide selectable outrigger extensions of full, intermediate, and retracted positions. Jacks with integral check valve, hydraulically controlled from the operator's cab and on both sides of carrier. A fifth front bumper outrigger with integral check valve is hydraulically controlled from the operator's cab and at the front bumper of carrier.

Pontoons – Four lightweight, stow'n go, 23.5" x 27.25" (*59.7 x 69.2cm*) hexagonal steel pontoons with a contact area of 485 in^2 (*3 129cm^2*) can be stored for road travel in either the storage racks on the carrier or under the outrigger boxes.

Main Jack Reaction – 76,000 lb (*34 473.0kg*) force and 157 psi (*1 082.5kPa*) ground bearing pressure

■ Steering and Axles

- Sheppard full integral master gear/slave gear steering system provides hydraulic assisted steering with mechanical link between steering wheel and wheels
- **Drive** – 8 x 4 for on/off–highway travel
- **Axle 1 & 2** – Tandem steered, non–driven
- **Axle 3 & 4** – Tandem non–steered, driven with reduction: 5.38 to 1
- **Inter–Axle Differential Lock** – Traction adding device that locks axle 3 with axle 4. Operated by a switch from the carrier cab.

■ Suspension

Front – Raydan Air Link walking beam air suspension

Rear – Raydan Air Link walking beam air suspension

- **Axle Lift System – Optional** – Improves rear tire ground clearance when the crane is up on outriggers. The rear air suspension can be raised or lowered with a switch in the carrier cab. The axle lift system can be controlled with a switch on both sides of the carrier.

■ Tires and Wheels

Front – Four (single) 425/65R22.5 tires on aluminum disc wheels

Rear – Eight (dual) 11R22.5 tires on aluminum outer/steel inner disc wheels

- Spare tires and wheels – optional
- Tire inflation kit – optional

■ Brakes

Service – Full air anti–lock (ABS) brakes on all wheel ends. Dual circuit compressed air system with air dryer.

Parking/Emergency – Spring loaded type, acting on 3rd and 4th axles automatically apply when air pressure drops below 40 psi (*275.8kPa*) in both circuits.

■ Electrical

Battery – Three batteries provide 12 volt starting and operation

Lights

- Front lighting includes two main headlights, two high beam lights, two parking/directional indicators, and three cab marker lights.
- Side lighting includes three parking/directional indicators per side.
- Rear lighting includes two parking/directional indicators, two parking/brake lights, two reverse lights, three marker lights, and a license plate light.
- Other equipment includes hazard/warning system, cab light, instrument panel light, and signal horn.
- One amber strobe beacon on top of the cab – optional
- Daytime running lights – optional

■ Engine

Specification	CAT C13
Numbers of cylinders	6
Cycle	4
Bore and Stroke: inch (*mm*)	5.12 x 6.18 (*130x157*)
Piston Displacement: in^3 (*L*)	763 (*12.5*)
Max. Brake Horsepower: hp (*kW*)	365 (*272.2*) @ 1,800 rpm 350 (*261.0*) @ 2,100 rpm
Peak Torque: ft lb (*Nm*)	1,350 (*1 830.4*) @ 1,200 rpm
Alternator: volts – amps	12 – 135
Crankcase Capacity: qt (*L*)	42.4 (*40.1*)

- Cruise control
- Three–stage engine compression brake
- Thermostatically controlled, hydraulically driven radiator fan
- 120 volt engine block heater
- Ether injection system – optional

■ Transmission

Automated – ZF AS–TRONIC (no clutch pedal) manual transmission with 12 forward gears and 2 reverse gears.

■ Carrier Speeds and Gradeability

ZF Astronic		Governed Speed		Gradeability (@ Peak Torque Except Creep @ Idle)
Gear	**Ratio**	**mph**	***km/h***	**% Grade**
12th	0.78	60.69	*97.65*	2.49
11th	1.00	47.22	*75.97*	3.72
10th	1.27	37.27	*59.96*	5.10
9th	1.63	28.99	*46.64*	6.89
8th	2.10	22.47	*36.16*	9.17
7th	2.70	17.49	*28.14*	12.04
6th	3.55	13.29	*21.39*	16.09
5th	4.57	10.34	*16.64*	20.89
4th	5.78	8.16	*13.14*	26.65
3rd	7.44	6.35	*10.22*	34.45
2nd	9.59	4.92	*7.92*	44.63
1st	12.33	3.83	*6.16*	57.55
Reverse 1	11.41	4.14	*6.66*	53.24
Reverse 2	8.88	5.32	*8.56*	41.28
Creep @ idle **2nd**	9.59	1.64	*2.64*	27.78
Creep @ idle **1st**	12.33	1.27	*2.04*	35.89
Creep @ idle **Reverse 1**	11.41	1.38	*2.22*	33.18
Creep @ idle **Reverse 2**	8.88	1.77	*2.85*	25.68
Based on a gross vehicle weight of 78,000 lb (*35 380kg*)				

■ Fuel Tank

One 75 gal (*283.9L*) capacity tank

■ Hydraulic System

All functions are hydraulically powered allowing positive, precise control with independent or simultaneous operation of all functions.

Main Pumps

- Four fixed displacement gear pumps with automatic disconnect for the main and auxiliary winches, swing, boom hoist, control circuit, and telescope for use when crane is in travel mode
- One fixed displacement gear pump for steering and the front bumper outrigger
- Two fixed displacement gear pumps for engine cooling fan and main outriggers. These pumps also provide flow to the winches and boom hoist for "pick & carry" mode. Operated by a switch in the carrier cab.
- Combined pump capacity of 190 gpm (*719.2Lpm*)

Hydraulic Reservoir – 144 gal (*545.1L*) capacity equipped with sight level gauge. Diffusers built in for deaeration.

Filtration – One 10 micron, full flow, return line filter. All oil is filtered prior to return to reservoir. Accessible for easy filter replacement.

■ Pump Drive

All pumps are mechanically driven by the diesel engine. Main and auxiliary winches, swing, boom hoist, control circuit, and telescope pumps are mounted to an automatic pump disconnect on the rear of the transmission to aid in cold weather starting as well as to reduce pump wear while traveling.

■ Lower Cab and Controls

Environmental Cab – Fully enclosed, one person cab of composite structure with acoustical insulation. Equipped with:
- Tinted and tempered glass windows
- Roll down left side window for ventilation
- Sliding rear and right side windows for ventilation
- Windshield wiper and washer
- Six way adjustable and air suspended driver's seat with seat belt
- Two adjustable rear view mirrors
- Engine dependent warm–water heater with air ducts for windshield defroster and cab floor
- Adjustable sun visor
- Dome light
- 12 volt connection
- Fire extinguisher

Air Conditioning – Optional – Integral with cab heating system utilizing the same ventilation outlets

Cab Instrumentation – Ergonomically positioned analog instrumentation for driving including:
- Speedometer with odometer, hourmeter, trip odometer, and clock
- Front and rear air pressure with warning indicator
- Engine coolant temperature with warning indicator
- Engine oil pressure with warning indicator
- Voltage indicator with warning indicator
- Fuel level
- Tachometer

Right Side Console – Controls and indicators for:
- Transmission gear shifting
- Transmission digital readout
- Cruise controls
- Engine compression brake controls

Dash Mounted Controls For:
- Windshield wiper and washer
- Carrier lights
- Carrier/upper throttle control
- Engine cooling fan override
- Cab heater/air conditioning
- Console dimmer switch
- ABS diagnostic switch
- Diesel particulate filter regneration switch
- Park brake
- Engine ignition

Dash Mounted Indicator For:
- Check, stop, and service engine
- Turn signal indication
- Park brake
- Cruise activation
- Transmission oil
- High beam headlights
- Anti–lock brake activation
- Diesel particulate filter regeneration indication
- High exhaust temperature indication

Foot Controls For:
- Carrier service brakes
- Engine throttle

■ Additional Equipment

Standard:
- Aluminum full deck fenders with mud flaps
- Left and right bubble levels
- Air hose connection ports
- Clearance flags

Optional:
- Pneumatic and electrical quick disconnect connectors mounted on the rear for trailer or boom dolly brakes and lights
- Left side aluminum storage box
- Rear mounted pintle hook

Axle Loads

Base crane with full tank of fuel and 4,300 lb (*1 950.4kg*) counterweight	Gross Vehicle Weight ([1])		Front Axles		Rear Axles	
	lb	*kg*	lb	*kg*	lb	*kg*
	65,605	*29 758*	29,803	*13 518*	35,802	*16 240*
Driver in carrier cab	250	*113*	328	*149*	−78	*−35*
Rear pintle hook	34	*15*	−13	*−6*	47	*21*
Pneumatic and electrical connectors for trailer or boom dolly	11	*5*	−4	*−2*	15	*7*
Carrier aluminum storage box	66	*30*	20	*9*	46	*21*
Air ride lift system − rear axles	52	*24*	7	*3*	45	*20*
Ether injection	7	*3*	7	*3*	0	*0*
Air conditioning − carrier	58	*26*	83	*38*	−25	*−11*
Hoist drum follower − main	75	*34*	−27	*−13*	102	*47*
Auxiliary winch with 450 ft (*137.2m*) of 5/8" (*16mm*) type "DB" rope	351	*159*	−83	*−38*	434	*197*
Hoist drum follower − auxiliary	75	*34*	−16	*−8*	91	*42*
Substitute type "DB" rope with "RB" rope − main	77	*35*	−29	*−13*	106	*48*
Substitute type "DB" rope with "RB" rope − auxiliary	63	*29*	−15	*−7*	78	*35*
Substitute 450 ft (*137.2m*) with 550 ft (*167.6m*) rope − auxiliary	72	*33*	−17	*−8*	89	*40*
Remove 550 ft (*167.6m*) of rope from rear (main) winch	−405	*−184*	154	*70*	−559	*−254*
Remove 450 ft (*137.2m*) of rope from front (auxiliary) winch	−333	*−151*	80	*36*	−413	*−187*
Air conditioner − operator's cab	179	*81*	3	*1*	176	*80*
360˚ mechanical swing lock	60	*27*	6	*3*	54	*24*
Remote steer	120	*54*	42	*19*	78	*35*
One slab of counterweight on upper	3,582	*1 625*	−1,375	*−624*	4,957	*2 248*
Two slabs of counterweight on upper	7,164	*3 250*	−2,750	*−1 247*	9,914	*4 497*
Three slabs counterweight on upper	10,746	*4 874*	−4,125	*−1 871*	14,871	*6 745*
Floodlight to the front of boom base section	10	*5*	15	*7*	−5	*−2*
Fly mounting brackets to boom base section for fly options	99	*45*	87	*39*	12	*5*
28.5 ft (*8.7m*) offsettable, one−piece lattice fly − stowed	1,238	*562*	1,312	*595*	−74	*−34*
28.5−51 ft (*8.7−15.5m*) offsettable, two−piece (bi−fold) lattice fly − stowed	1,830	*830*	1,810	*821*	20	*9*
Auxiliary lifting sheave	91	*41*	165	*75*	−74	*−34*
25 ton (*22.7mt*) 3−sheave hook block at boom head	670	*304*	1,169	*530*	−499	*−226*
40 ton (*36.3mt*) 4−sheave hook block at boom head	780	*354*	1,360	*617*	−580	*−263*
50 ton (*45.4mt*) 5−sheave hook block at boom head	1,090	*494*	1,901	*862*	−811	*−368*
60 ton (*54.4mt*) 5−sheave hook block at boom head	1,122	*509*	1,957	*888*	−835	*−379*
8.5 ton (*7.7mt*) hook ball at boom head	360	*163*	641	*291*	−281	*−127*
Hook block/ball storage box	375	*170*	−143	*−65*	518	*235*
25 ton (*22.7mt*) 3−sheave hook block in storage box	670	*304*	−256	*−116*	926	*420*
40 ton (*36.3mt*) 4−sheave hook block in storage box	780	*354*	−298	*−135*	1,078	*489*
50 ton (*45.4mt*) 5−sheave hook block in storage box	1,090	*494*	−417	*−189*	1,507	*684*
60 ton (*54.4mt*) 5−sheave hook block in storage box	1,122	*509*	−429	*−195*	1,551	*704*
8.5 ton (*7.7mt*) hook ball in storage box	360	*163*	−138	*−63*	498	*226*

Counterweight Load Transfer	Front Axles		Rear Axles	
	lb	*kg*	lb	*kg*
Transfer one 3,600lb (*1 632.9kg*) slab of counterweight to carrier deck	4,091	*1 856*	−4,091	*−1 856*
Transfer two 3,600lb (*1 632.9kg*) slabs of counterweight to carrier deck	8,182	*3 711*	−8,182	*−3 711*
Transfer three 3,600lb (*1 632.9kg*) slabs of counterweight to carrier deck	12,273	*5 567*	−12,273	*−5 567*

Axle	Maximum Load @ 65 mph (*105km/h*)
Front	45,400 lb (*20 593kg*) − aluminum disc wheels with 425/65R22.5 tires
Rear	47,250 lb (*21 432kg*) − aluminum disc wheels with 11R22.5 tires

([1]) Adjust gross vehicle weight and axle loading according to component weight. All weights are ±3%.

Axle Loads with 2—Axle Boom Dolly

Base crane with full tank of fuel and 4,300 lb (*1 950.4kg*) counterweight	Gross Vehicle Weight ([1])		Front Axles		Rear Axles		Dolly Axles	
	lb	*kg*	lb	*kg*	lb	*kg*	lb	*kg*
	65,605	*29 758*	27,790	*12 605*	27,082	*12 285*	10,733	*4 868*
Nelson 2—axle boom dolly	6,000	*2 722*	0	*0*	0	*0*	6,000	*2 722*
Driver in carrier cab	250	*113*	328	*149*	—78	*—35*	0	*0*
Rear pintle hook	34	*15*	—13	*—6*	47	*21*	0	*0*
Pneumatic and electrical connectors for trailer or boom dolly	11	*5*	—4	*—2*	15	*7*	0	*0*
Carrier aluminum storage box	66	*30*	20	*9*	46	*21*	0	*0*
Air ride lift system — rear axles	52	*24*	7	*3*	45	*20*	0	*0*
Ether injection	7	*3*	7	*3*	0	*0*	0	*0*
Air conditioning — carrier	58	*26*	83	*38*	—25	*—11*	0	*0*
Hoist drum follower — main	75	*34*	55	*25*	21	*10*	0	*0*
Auxiliary winch with 450 ft (*137.2m*) of 5/8" (*16mm*) type "DB" rope	351	*159*	215	*98*	136	*62*	0	*0*
Hoist drum follower — auxiliary	75	*34*	44	*20*	32	*14*	0	*0*
Substitute type "DB" rope with "RB" rope — main	77	*35*	58	*26*	19	*9*	0	*0*
Substitute type "DB" rope with "RB" rope — auxiliary	63	*29*	39	*18*	24	*11*	0	*0*
Substitute 450 ft (*137.2m*) with 550 ft (*167.6m*) rope — auxiliary	72	*33*	44	*20*	28	*13*	0	*0*
Remove 550 ft (*167.6m*) of rope from rear (main) winch	—405	*—184*	—305	*—138*	—100	*—45*	0	*0*
Remove 450 ft (*137.2m*) of rope from front (auxiliary) winch	—333	*—151*	—204	*—93*	—129	*—59*	0	*0*
Air conditioner — operator's cab	179	*81*	64	*29*	115	*52*	0	*0*
360˚ mechanical swing lock	60	*27*	16	*7*	44	*20*	0	*0*
Remote steer	120	*54*	50	*23*	70	*32*	0	*0*
One slab of counterweight on upper	3,582	*1 625*	2,716	*1 323*	866	*393*	0	*0*
Two slabs of counterweight on upper	7,164	*3 250*	5,432	*2 464*	1,732	*786*	0	*0*
Three slabs counterweight on upper	10,746	*4 874*	8,148	*3 696*	2,598	*1 178*	0	*0*
Floodlight to the front of boom base section	10	*5*	—1	*—0.5*	—1	*—0.5*	12	*5*
Fly mounting brackets to boom base section for fly options	99	*45*	12	*5*	14	*6*	72	*33*
28.5 ft (*8.7m*) offsettable, one—piece lattice fly — stowed	1,238	*562*	80	*36*	89	*40*	1,069	*485*
28.5—51 ft (*8.7—15.5m*) offsettable, two—piece (bi—fold) lattice fly — stowed	1,830	*830*	163	*74*	182	*83*	1,484	*673*
Auxiliary lifting sheave	91	*41*	—18	*—8*	—20	*—9*	130	*59*
40 ton (*36.3mt*) 4—sheave hook block at boom head	780	*354*	—138	*—63*	—154	*—70*	1,072	*486*
50 ton (*45.4mt*) 5—sheave hook block at boom head	1,090	*494*	—193	*—88*	—215	*—98*	1,498	*679*
60 ton (*54.4mt*) 5—sheave hook block at boom head	1,122	*509*	—198	*—90*	—221	*—100*	1,542	*699*
8.5 ton (*7.7mt*) hook ball at boom head	360	*163*	—68	*—31*	—76	*—34*	504	*229*

Counterweight Load Transfer	Front Axles		Rear Axles		Dolly Axles	
	lb	*kg*	lb	*kg*	lb	*kg*
Transfer one 3,600lb (*1 632.9kg*) slab of counterweight to boom dolly	—2,716	*—1 232*	—866	*—393*	3,582	*1 625*
Transfer two 3,600lb (*1 632.9kg*) slabs of counterweight to boom dolly	—5,432	*—2 464*	—1,732	*—786*	7,164	*3 250*
Transfer three 3,600lb (*1 632.9kg*) slabs of counterweight to boom dolly	—8,148	*—3 696*	—2,598	*—1 178*	10,746	*4 874*

Axle	Maximum Load @ 65 mph (*105km/h*)
Front	45,400 lb (*20 593kg*) — aluminum disc wheels with 425/65R22.5 tires
Rear	47,250 lb (*21 432kg*) — aluminum disc wheels with 11R22.5 tires

([1]) Adjust gross vehicle weight and axle loading according to component weight. All weights are ±3%.

Table Of Contents

Notes:

Fundamental Terms

Many terms are used which refer to crane function, assembly, operation and maintenance. The following list gives a brief definition as to how the terms are used in this Operator's Manual and how they fit this particular crane.

Accumulator: A container in which fluid is stored under pressure as a source of hydraulic energy.

Aeration: The condition when air is present in the hydraulic fluid. This causes the fluid to appear milky and components to operate erratically because of the compressibility of air trapped in the fluid.

Annually: Once a year.

Anti-Two Block System: A system of electromechanical devices used to alert or prevent the crane operator from two blocking the crane. See Two Block.

Attachment: The boom assembly, offset fly section(s), or auxiliary lifting sheave.

Audio/Visual Warning System: 1. Alarm device that signals the operator of low engine oil pressure, high engine coolant temperature, and high hydraulic oil and transmission oil temperature. 2. Device utilizing buzzer and/or lights as a signal of approaching two block and/or overload condition. See Rated Capacity Indicator.

Automatic Brake: Drum brake system that is applied automatically any time the drum control lever is in neutral.

Auxiliary Lifting Sheave: A unit which connects to the boom head machinery and is used for reeving winch rope for a second (auxiliary) winch drum.

Backward Stability: Resistance to overturning of the crane in rearward direction.

Base Section: The segment of the boom which attaches to the upper frame by the boom foot pin.

Boom: The assembly of the base, inner mid, outer mid and tip sections used as the telescoping extension.

Boom Angle: The angle above or below horizontal of the longitudinal axis of the boom.

Boom Angle Indicator: An accessory which measures the angle of the boom relative to horizontal.

Boom Foot: Base of boom where it attaches to the upper revolving frame.

Boom Hoist: The hydraulic method of raising and lowering the boom to different boom angles.

Boom Length: The straight line through the centerline of the boom foot pin to the centerline of the boom head sheave shaft, measured along the longitudinal axis of the boom.

Boom Section: The base, inner mid, outer mid and manual segments which are used as the telescoping extension.

Bumper (5th) Outrigger: An outrigger located on the front of the carrier that provides additional stability for "On Outrigger" capacities when deployed.

By-Pass: A secondary passage of fluid flow, in addition to the main flow path.

Capacity Chart: The chart(s) in the Crane Rating Manual in the crane which gives rated lifting capacities for the crane under different load conditions.

Carrier: The portion of the crane located below the turntable bearing.

Carrier Cab: A housing which covers the driver's station on the carrier of a truck crane.

Carrier Frame: The main structure of the carrier section of the crane.

Cavitation: A condition where air is induced into a cavity, line, or chamber normally filled with oil. This condition can cause damage to pumps, cylinder walls, etc.

Check Valve: A valve which permits flow in one direction only.

Circuit: A complete or partial path over which current or fluid may flow.

Closed Center Circuit: The condition where the fluid only flows through the main control valves when a control valve spool is actuated. This can be done two different ways: (1) using a pressure compensated pump, or (2) using a fixed displacement pump, unloading valve, and an accumulator.

Collector Ring (Slip Ring): A device used to transmit the electrical power from the carrier to the upper utilizing a rotating disk to allow rotation of the upper and maintain connectivity.

Compressibility: The change in volume of fluid when it is subjected to a unit change in pressure.

Counterbalance Valve (Holding Valve): A valve which regulated fluid flow by maintaining resistance in one direction, but allows free flow in the other direction.

Counterweight: Weight used to supplement the weight of the crane in providing stability for lifting loads.

Cracking Pressure: The pressure at which a pressure actuated valve begins to open to allow flow.

Crane Configuration: The relative position and arrangement of the parts or elements of the crane e.g. amount of counterweight, attachment position, etc.

Crane Rated Capacity: The maximum weight allowed to be lifted with the crane setup in a particular crane configuration.

Crane Rating Manual: A compilation of the necessary information needed to plan a safe lift with the crane. It includes instructions such as the allowable lifting capacity charts, Working Range Diagrams, Working Areas chart, etc.

Crane Set Up: The act or instance of preparing the crane for operation which entails the positioning of the crane and its elements. It concerns details or items such as finding a suitable location to perform the lift, setting the outrigger position, leveling, cribbing or blocking of the crane, etc.

Cylinder: A device which converts fluid power into mechanical force and motion. It usually consists of a moveable element such as a piston and piston rod, which operates within a cylindrical bore.

Delivery: The volume of fluid discharge by a pump in a given time, usually expressed in gallons per minute (gpm) or liters per minute (*L/min*).

Displacement: The quantity of fluid which can pass through a pump, motor, or cylinder in a single revolution or stroke.

Double Acting Cylinder: A cylinder in which fluid force can be applied in either direction.

Drum Lagging: See Winch Drum.

Drum Rotation Indicator: A device that is used to indicate winch drum motion and can also be used to monitor speed.

Filter: A device which functions to remove insoluble contaminants from a fluid by a porous media.

Flow Divider: A valve which divides a flow of oil into two streams.

Fly Base Section: Boom tip extension supported only at its base.

Force: Any cause which tends to produce or modify motion. In hydraulics, total force is expressed by the product of pressure (P) and the area of the surface (A) on which the pressure acts. (Formula – F = P X A)

Frame: Structure on which either upper or carrier machinery is attached.

Friction: The property which tends to resist the relative motion of one surface in contact with another surface. It always exerts a "Drag" in the direction opposite of the motion, thus consumes power.

Full Flow: In a filter, the condition where all the fluid must pass through the filter element.

Full Load Speed: The speed at which an engine runs when it is delivering its full rated horsepower.

Function Limiter (Function Lockout, Hydraulic Cutouts, Hydraulic Kickouts): Devices incorporated into the anti-two block system or rated capacity indicator system which will disable the crane function of winch up, telescope out, and/or boom down (as applicable) as two block or overload situations approach.

Gradablity: The slope which a crane can climb expressed as a percentage. (45˚ equals 100% slope.)

Ground Pressure: Weight of crane divided by the area of the surface directly supporting the crane.

Head Machinery: An arrangement of sheaves on the end of an attachment used to reeve wire rope.

High Idle: Governed engine speed at full throttle and no load.

Hoist: Function of lifting and lowering loads.

Hoist Drum: See Winch Drum.

Hoist Rope: The wire rope used to reeve the winch and the attachments for lifting loads.

Holding Valve (Counterbalance Valve): A valve which regulates fluid flow by maintaining resistance in one direction, but allows free flow in the other direction.

Hook Ball: Ball with hook attached used in lifting service. It is used with one part of line only.

Hook Block: Block with hook attached used in lifting service. It may have a single sheave for two or three part line, or multiple sheaves for four or more parts of line.

HTC: Hydraulic highway truck crane.

Hydraulic Reservoir: The storage tank for hydraulic fluid.

Inner Mid Section: The segment of the boom which is attached to the base and outer mid sections.

Instability: A "tipping condition" in which the moments acting to overturn a crane exceed the moments acting to resist overturning.

Lifting Capacity: The rated load for any given load radius and boom angle under specified operating conditions.

Line Pull: The rope pull generated off a rope drum or lagging at a specified pitch diameter.

Line Speed: The rope velocity at a rope drum or lagging at a specified pitch diameter.

Load Radius: The horizontal distance from the centerline of rotation of the upper to the center of gravity of a suspended load.

Mat: Support, usually of timber or wire construction, for supporting the pontoons on soft surfaces where the pontoon areas are not large enough to support the load without settling.

Motor (Hydraulic): A rotary motion device which changes hydraulic energy into mechanical energy, a rotary actuator.

Offset Fly: A fly section that is capable of being pinned at different angles.

Oil Cooler: A heat exchanger used to remove heat from the hydraulic or transmission fluid.

Open Center Circuit: A circuit where the pump continuously circulates fluid through the control valves when they are in a neutral position.

Operational Aid: An accessory that provides information to facilitate operation of a crane or that takes control of particular crane functions without action of the operator when a limiting condition is sensed.

Operator's Cab (Upper Cab): A housing which covers the operator's station.

Outer Mid Section: The segment of the boom which is attached to the inner mid and tip sections.

Outrigger: An extendable supporting device used to level the crane and increase stability.

Outrigger Beam: The part of the outrigger which extends horizontally and acts as the support for the outrigger jack.

Outrigger Jack: The hydraulic cylinder on the outrigger beam which extends vertically to raise and lower the crane.

Pick And Carry: The crane operation of lifting a load and traveling with it suspended.

Pilot Pressure: Auxiliary pressure used to actuate or control hydraulic components.

Pinion: The small gear in a gear train which drives the other gears.

Pitch Diameter: Root diameter of drum, lagging, or sheave, plus the diameter of the rope.

Planetary: A set of gears used to either speed up or slow down the input vs the output to gain speed or power, whichever is applicable.

Platform: A device (basket, work platform, bucket, cage, etc.) designed and fabricated with its intended use being to position personnel.

Pontoon: The support which attaches to the outrigger jack to increase the supporting area.

Poppet: A disc, ball, or cone shaped part of certain valves, which when closed against a seat prevents flow.

Port: The open end of a passage. May be within or at the surface of a hydraulic component housing or body.

Pressure: Force per unit of area usually expressed in pounds per square inch (psi) or Kilopascals (*kPa*).

Pressure Drop: The reduction in pressure between two points in a line or passage due to the energy lost in maintaining flow.

Pressure Reducing Valve: A valve which limits the maximum pressure at its outlet regardless of the inlet pressure.

Pump Disconnect: Device which engages and dlsengages the main hydraulic pump. Disengaging the pump aids in engine start-up by reducing cranking resistance.

Pump (Hydraulic): A device which converts mechanical force and motion into hydraulic fluid power.

Radius Of Load: The horizontal distance from the centerline of rotation of the crane to the center of gravity of the suspended load.

Rated Capacity Indicator (RCI): A device that automatically monitors radius, load weight, and load rating and warns the crane operator of an overload condition.

Rated Capacity Limiter (RCL): A device that automatically monitors radius, load weight, and load rating and prevents movements of the crane that would result in an overload condition.

Reeving: Passing of ropes over pulleys or sheaves.

Relief Valve: A pressure operated valve which bypasses pump delivery to the reservoir, limiting system pressure to a predetermined maximum valve.

Reservoir: A container for storage of fluid in a fluid power system.

Restriction: A reduced cross-sectional area in a line which produces a pressure drop.

Rigging Switch (System Override Switch): A switch which can be used to override any or all of the function limiters (cutouts) which have been activated on the crane during crane rigging/set up.

Rope: Refers to wire rope unless otherwise specified. See "Wire Rope".

Rotating Joint: Component which transfers fluid between a stationary and a rotating member.

Schematic: A diagram or representation of a system showing everything in a simple way. No attempt is made to show the various devices in their actual relative positions. A schematic points out the operation of a circuit for troubleshooting purposes.

Seasonally: Four times per year.

Semiannually: Twice per year.

Service Brake: A foot operated brake which regulates the amount of air or fluid delivered to the brake chamber, which determines the braking force.

Shall: The word shall is to be understood as mandatory.

Should: The word should is to be understood as advisory.

Side Loading: A load applied at an angle to the vertical plane of the boom.

Single Acting Cylinder: A cylinder in which fluid power can only be used in one direction. Another force must be used to return the cylinder.

Spool: Term applied to almost any moving cylindrically shaped part of a hydraulic component which moves to direct flow through the component.

Strainer: A filtering device for the removal of coarse solids from a fluid.

Stroke: The length of travel of a piston or spool.

Suction Line: The hydraulic line connecting the pump inlet port to the hydraulic reservoir.

Sump Tank: See Hydraulic Reservoir.

Surge: A very sudden rise in hydraulic pressure in a circuit.

Swing: The rotation of the upper with the carrier remaining stationary.

Swing Brake: A brake which is used to resist the rotation of the upper during normal, stationary crane operations.

Swing Motor: Hydraulic device which uses a planetary to rotate the upper on the carrier.

Swing Park Brake: A self contained brake used for holding the upper, in any position, during normal, stationary crane operations.

Tailswing: The swing radius from the centerline of rotation of the upper frame to the extreme rear edge of the counterweight.

Tip Section: The outer most live segment of a telescopic boom. It is attached to an outer mid section and contains the head machinery of the attachment.

Torque: Turning or twisting force usually measured in foot pounds (ft lb) or Newton meters (*Nm*).

Travel Swing Lock (2 Position Swing Lock): A mechanical lock that engages with the upper directly over either the front or the rear of the carrier only. Use of the travel swing lock is mandatory when traveling or transporting the crane and during pick and carry operations.

Turntable Bearing: A large bearing which attaches the upper to the carrier allowing the upper to rotate on the carrier.

Two Block: The condition when the crane's hook block, ball, any other load attachment means, or the load itself, comes into contact with any of the attachment's load sheaves or other physical entity on the attachment.

Two Block Warning System: A system of electromechanical devices used to warn the crane operator of impending two block condition.

Unloading Valve: A valve which by-passes flow to tank when a set pressure is maintained on its pilot port.

Upper: The portion of the crane located above the turntable bearing.

Upper Revolving Frame: The main structure of the upper section of the crane which serves as mounts for other components in the upper section.

Valve: A device for controlling flow rate, flow direction, or pressure of a fluid.

Viscosity: The resistance to flow. High viscosity indicates a high resistance, low viscosity, a low resistance.

Winch: Function of lifting and lowering loads.

Winch Drum: A rotating cylindrical spool with side flanges used to wrap the winch rope during the raising and lowering with the winch.

Winch Rope: The wire rope used to reeve the winch and the attachments for lifting loads.

Wire Rope: A flexible, multiwired member usually consisting of a core member around which a number of multiwired strands are helically wrapped.

Wiring Diagram: A diagram that includes all the devices in an electrical system and shows their functional relationships to each other. Such a diagram gives the necessary information for actual wiring or physically tracing circuits when troubleshooting is necessary.

Working Weight: Weight of crane with full radiator, half full fuel tank, and attachments installed.

360˚ Swing Lock: A positive mechanical lock against rotation of the upper over the carrier during normal, stationary crane operations.