

Operator's Manual

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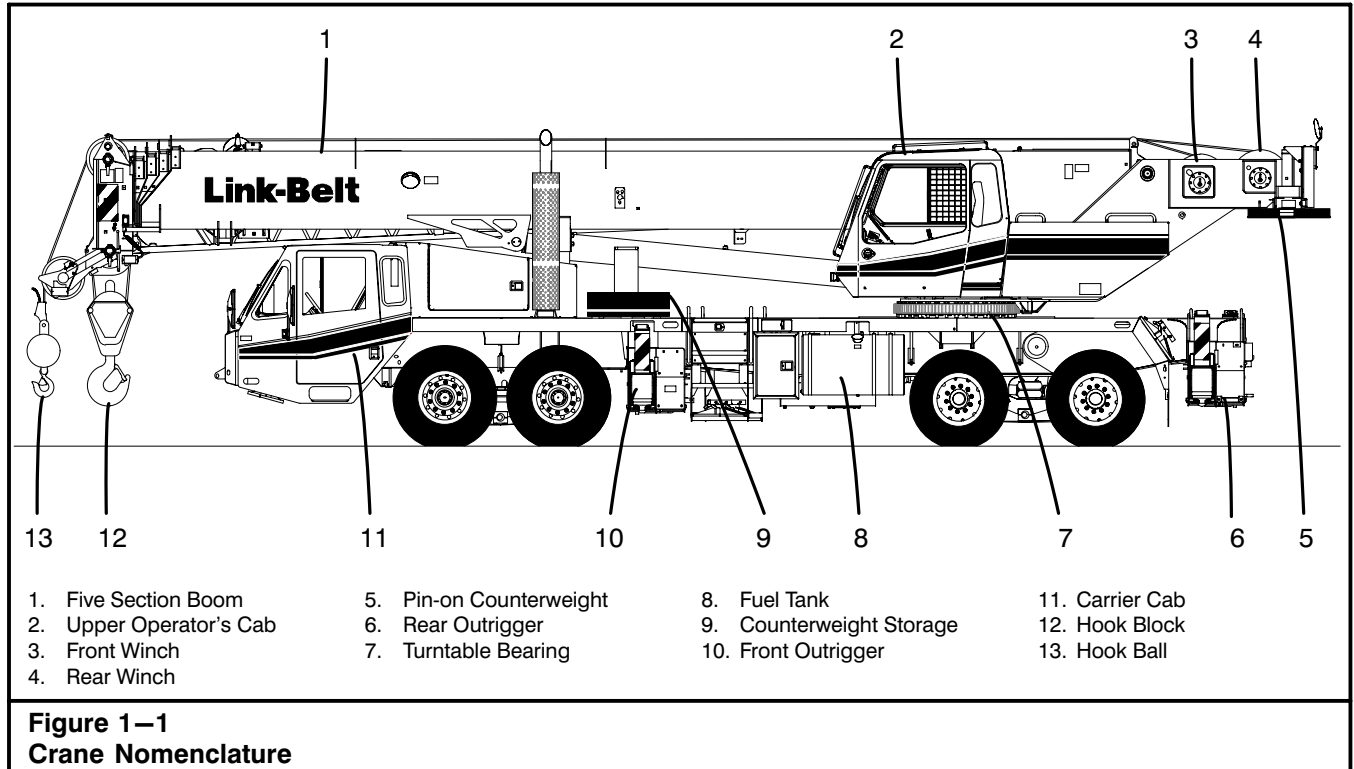
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On Delivery

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.



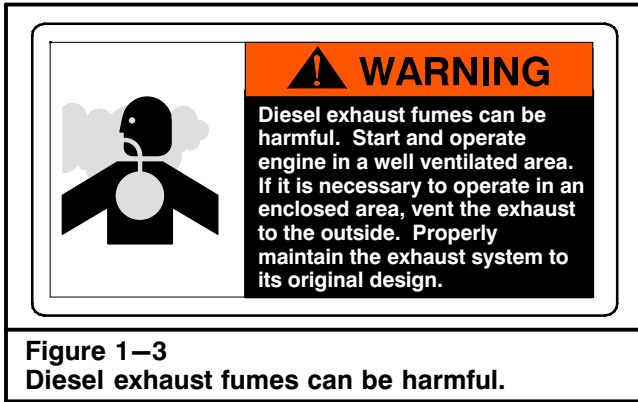
WARNING
Do not lift, suspend, swing or lower loads or attachments over anyone. Do not allow anyone to ride on any part of load or attachment.

SAFETY INSTRUCTIONS
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 complied with the Operator's Manual. Before leaving operator's position, lower load to the ground. Do not use swing brake for swing lock. When facing over rear some functions will be reversed relative to operator. Raise the crane on outriggers, or block the wheels before working on the crane. Replace all guards or panels before operating the crane. With the boom removed from upper, do not swing over side on tires or on retracted outriggers.

Do not deface or remove this label from the crane.

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

Operator's Manual



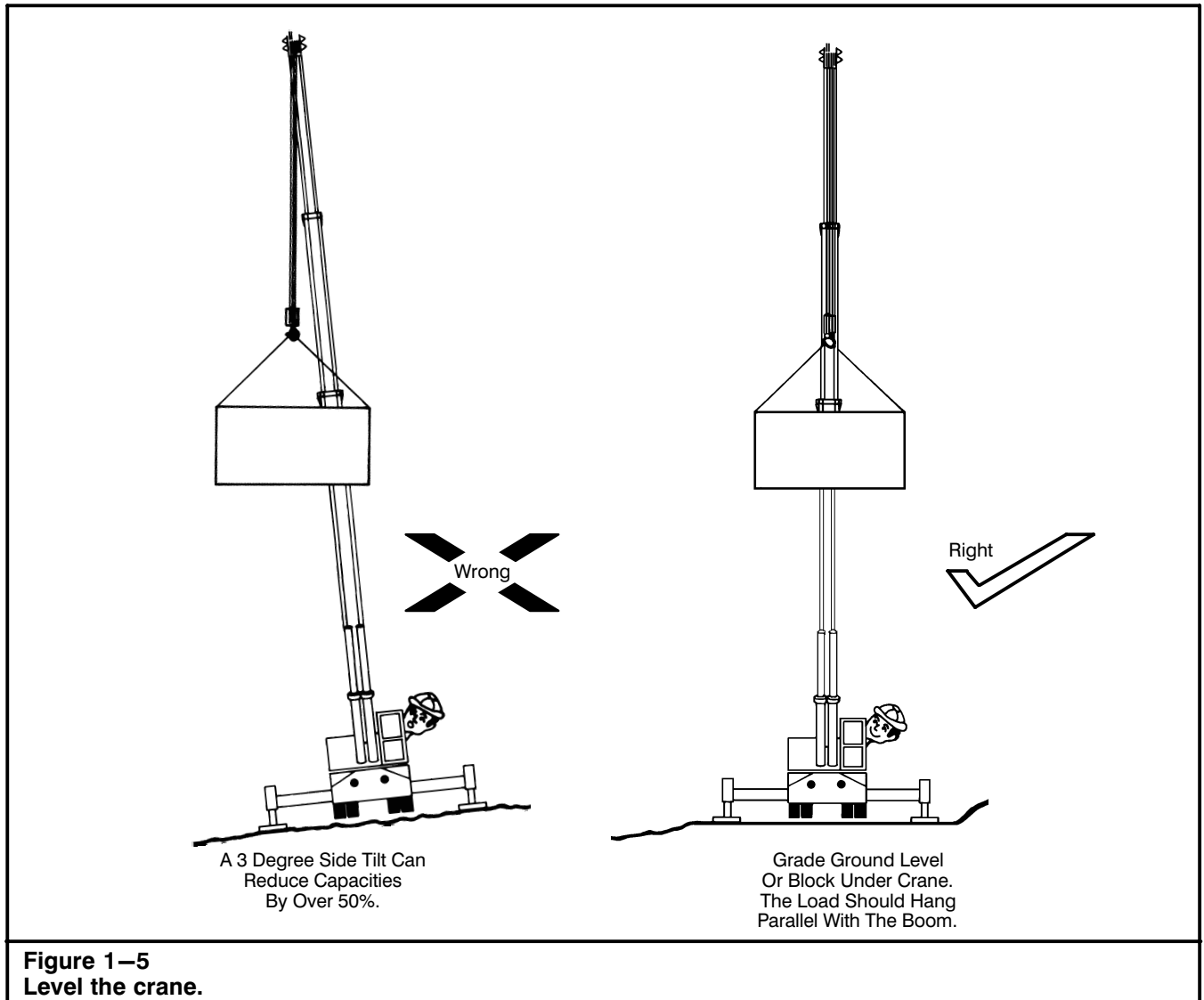
General Safety Rules

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

Operator Awareness

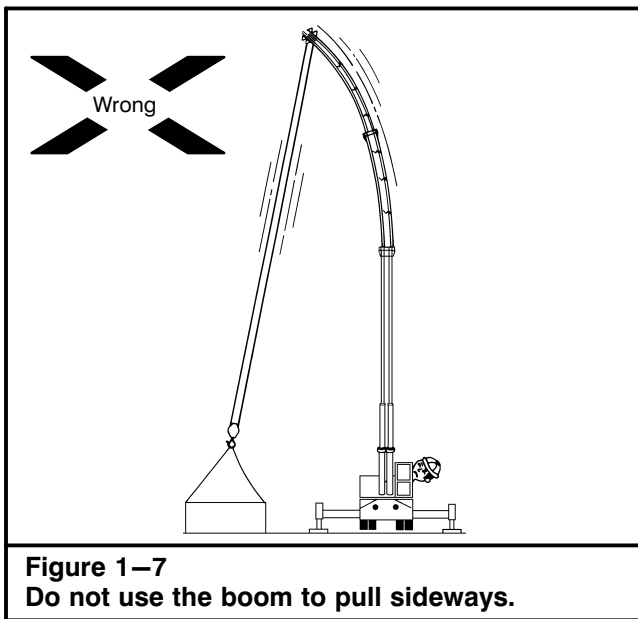
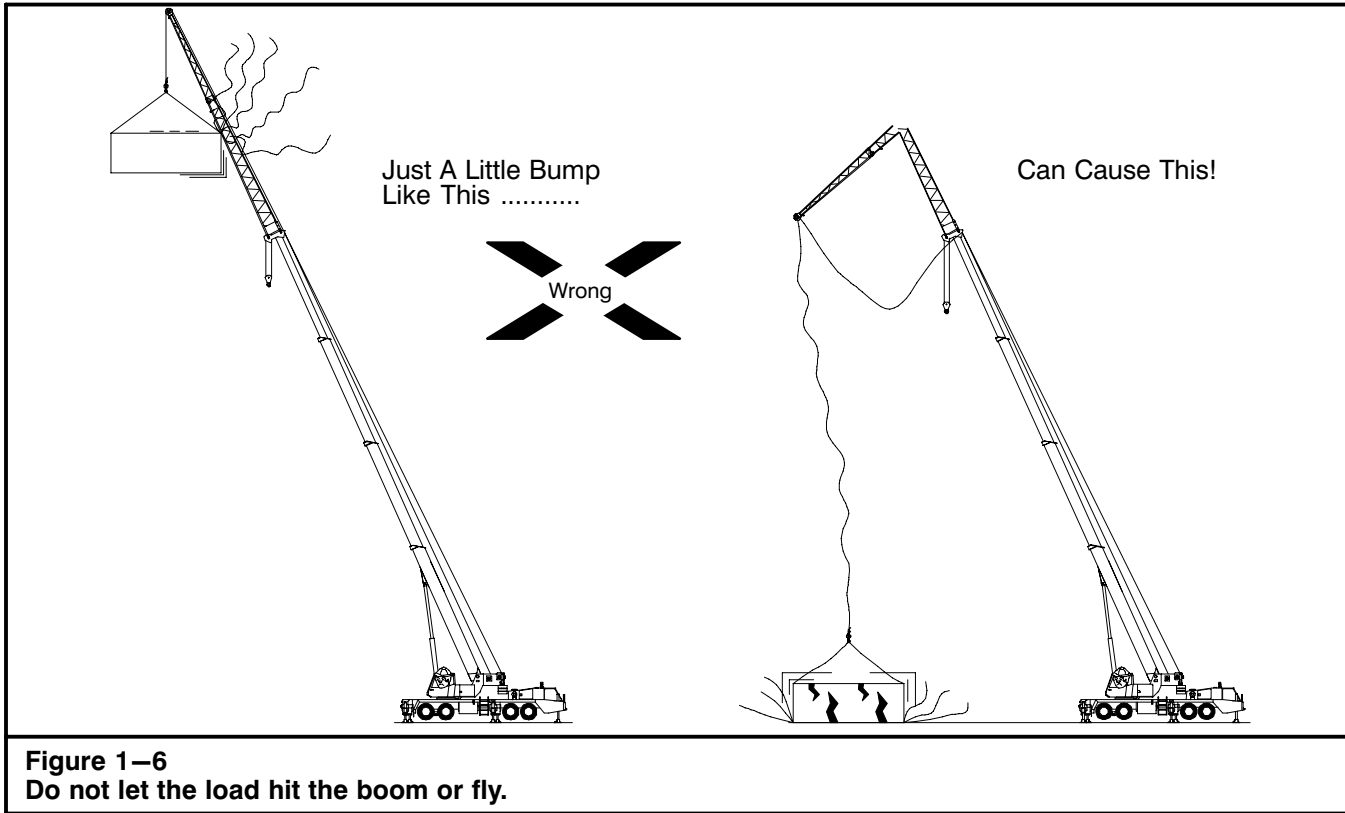
1. Read and understand this Operator's Manual, all safety manuals, and the Crane Rating Manual and heed them. These manuals contain important information.
2. An operator must not eat, read, or otherwise divert his attention while operating a crane. Remember—operating is a full-time job.
3. Don't smoke 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, 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. To prevent movement of the individual boom sections, shutdown the engine and ensure that the operator has vacated the operator's cab before putting your hands or tools inside the boom. Unsuspected movement of the boom section could sever fingers, hands, arms, etc.
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.

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- 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.

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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. 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.
14. 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.
15. 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.

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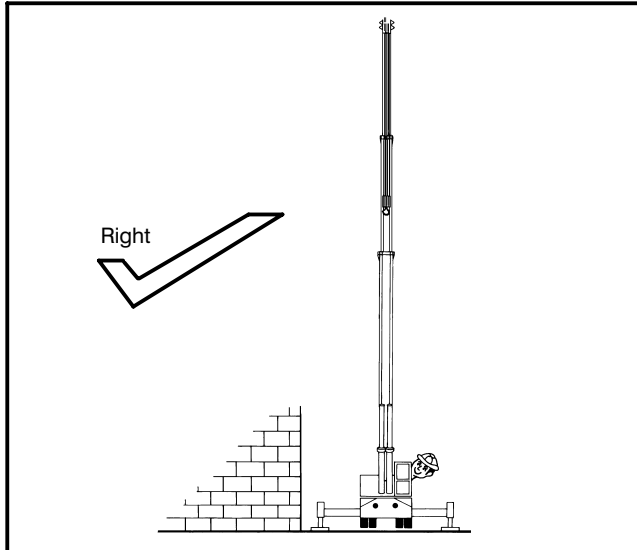


Figure 1-8
Crane level, all beams extended equally (all fully extended, all intermediately extended, or fully retracted), and tires clear of the ground.

16. 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.
17. 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.
18. 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.

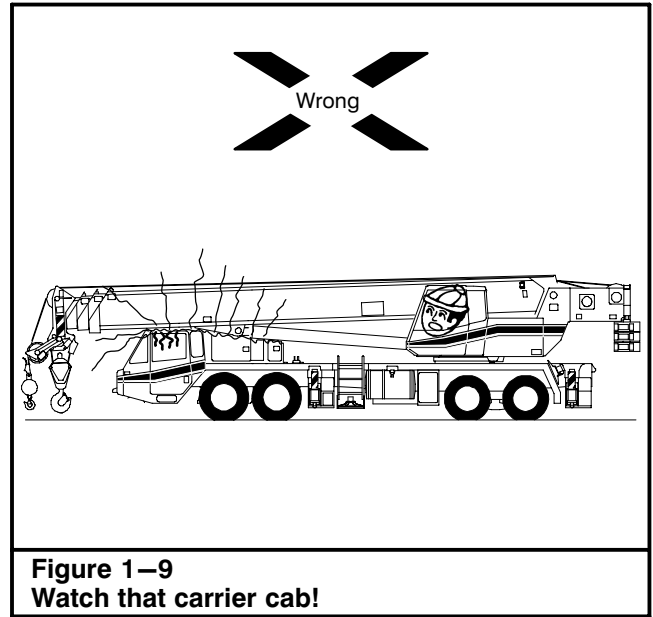


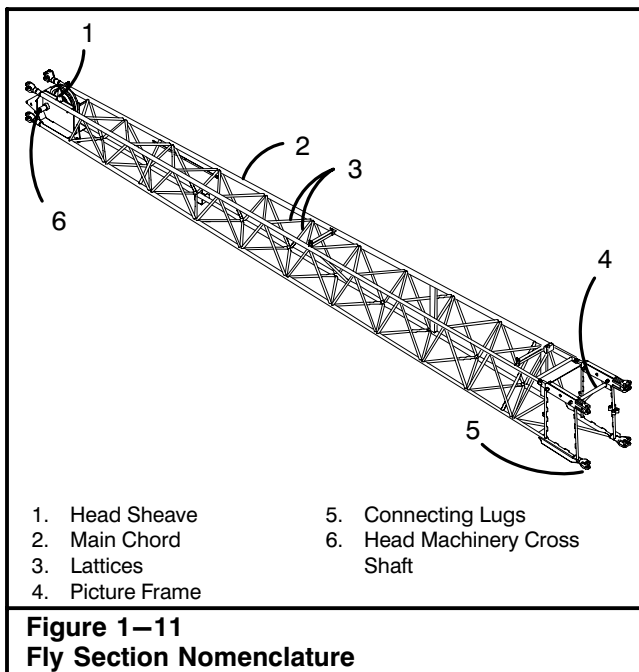
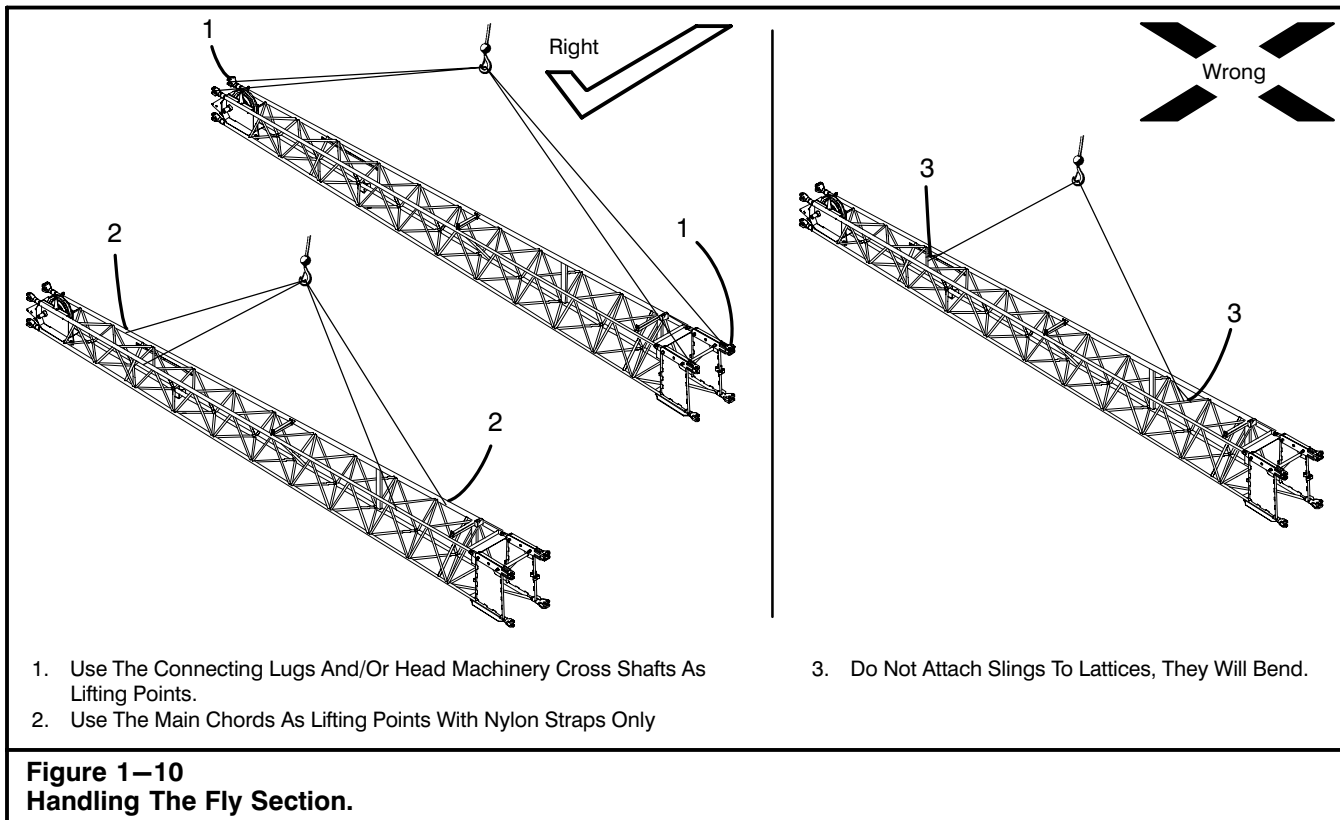
Figure 1-9
Watch that carrier cab!

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 surface, 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.

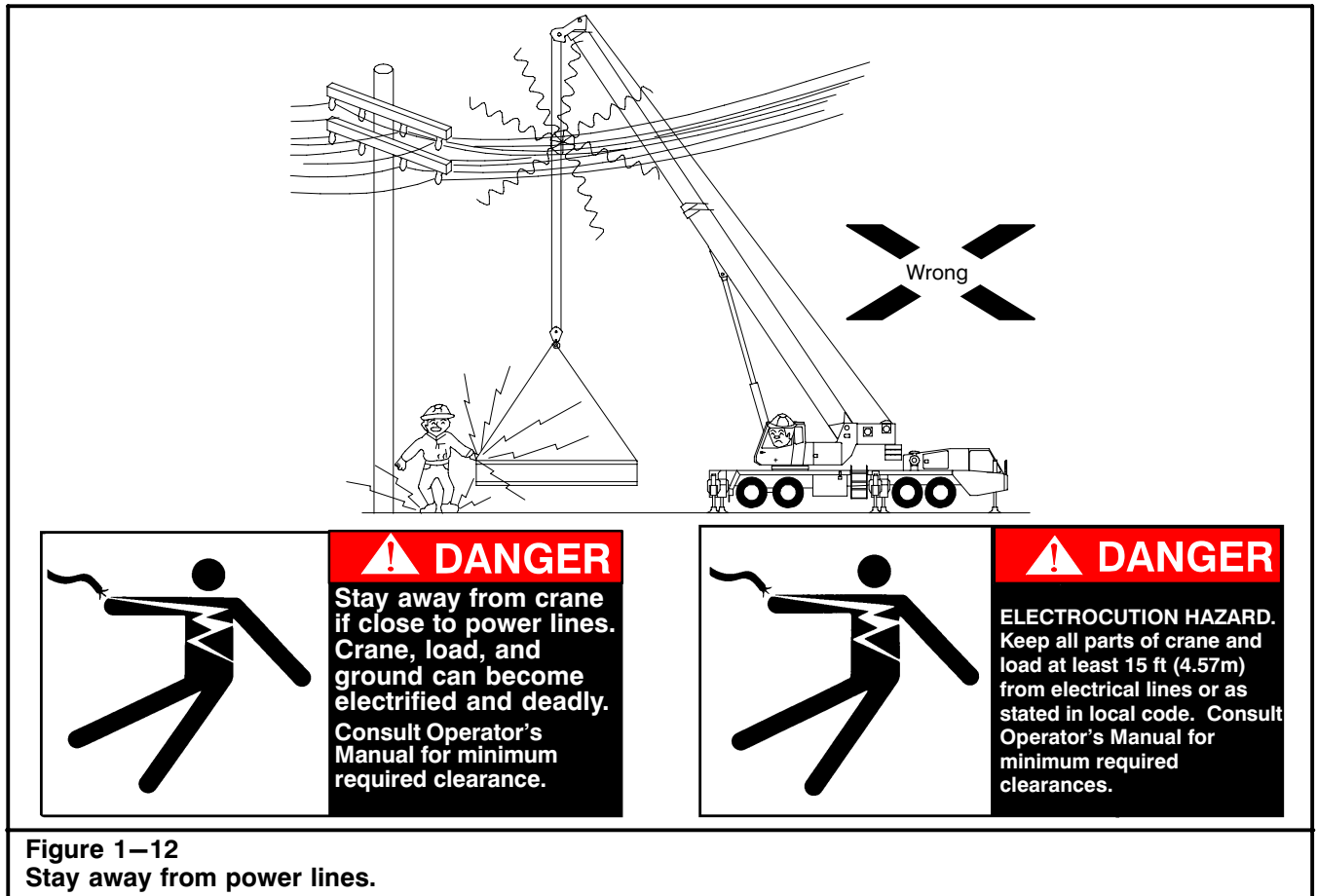
19. Before attempting to move the carrier, make sure there is enough air pressure to operate the brakes. Always check the brake operation before traveling the crane.
20. Brake firmly in one application. Avoid fanning the brakes. This could exhaust air pressure so fast that the compressor may not supply enough air.
21. Do not coast downhill with the transmission in neutral. It makes control of the crane more difficult and dangerous.
22. 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.
23. When operating over the front, use care not to hit the carrier cab or front of the crane with the load or boom.

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24. 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.
25. 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 tie downs, as they may dent and damage the sections.
26. 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.

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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 or 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.

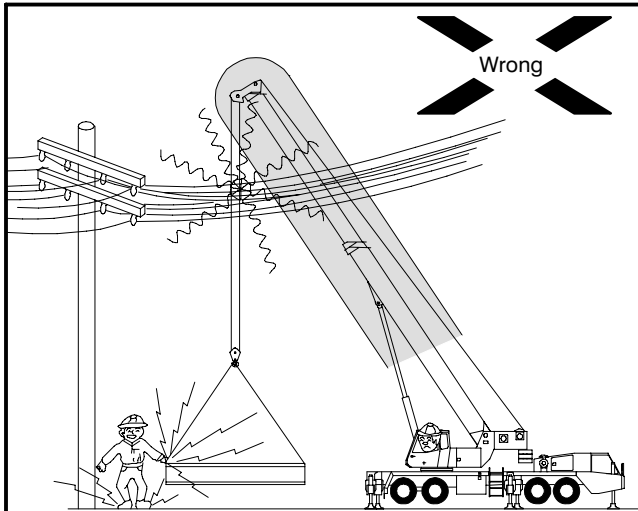
Minimum Required Clearance For Normal Voltage In Operation Near High Voltage Power Lines And Operation In Transit With No Load And Boom Or Mast Lowered.

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.

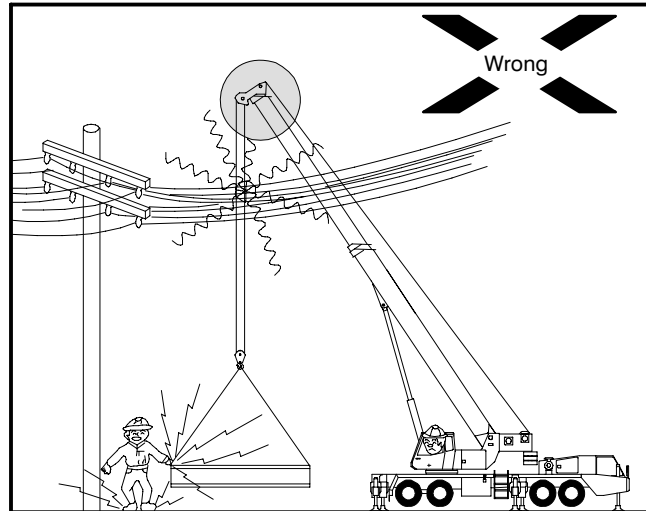
High Voltage Power Line Clearance Chart

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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 1-13
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.

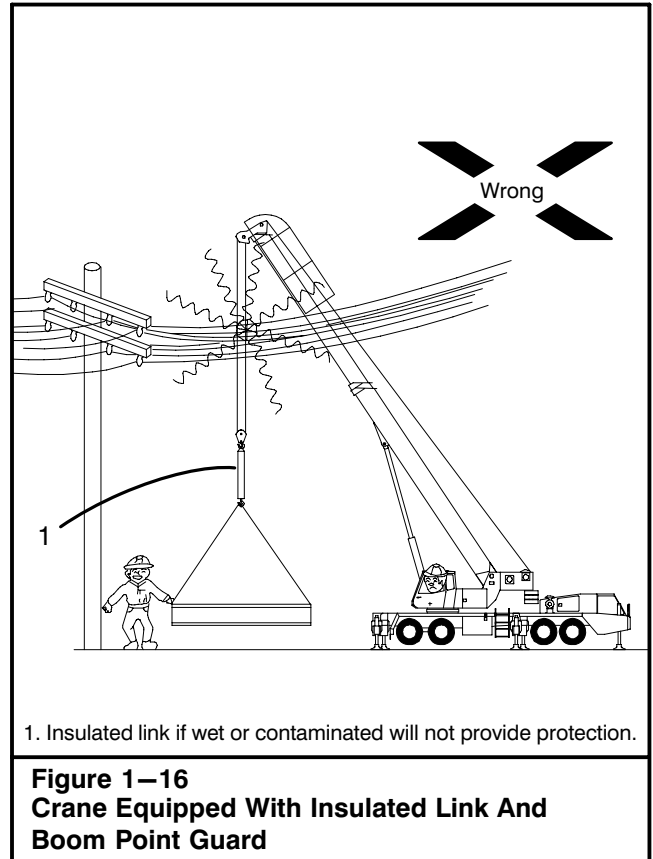
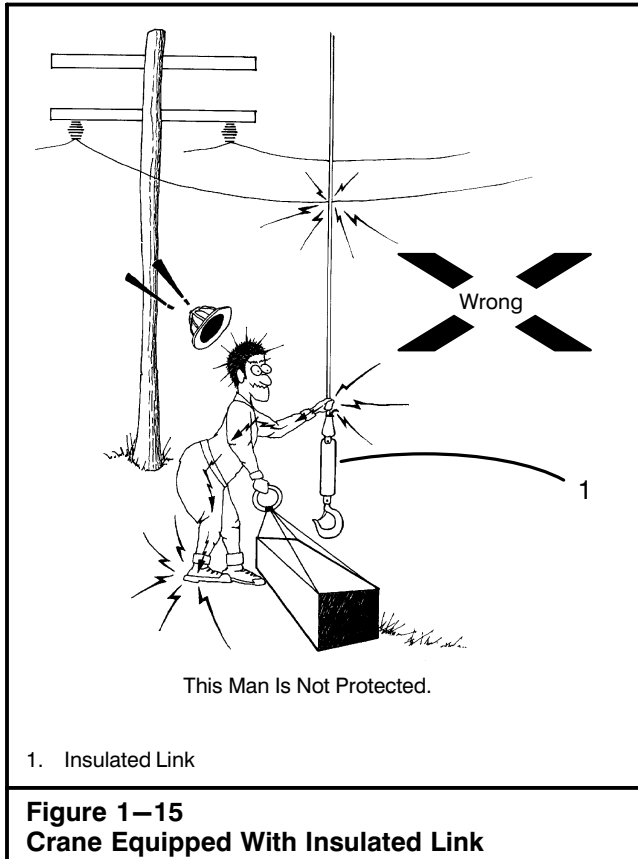
Figure 1-14
Crane Equipped With Proximity Warning Device On The Boom Tip

- 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 T.V. 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

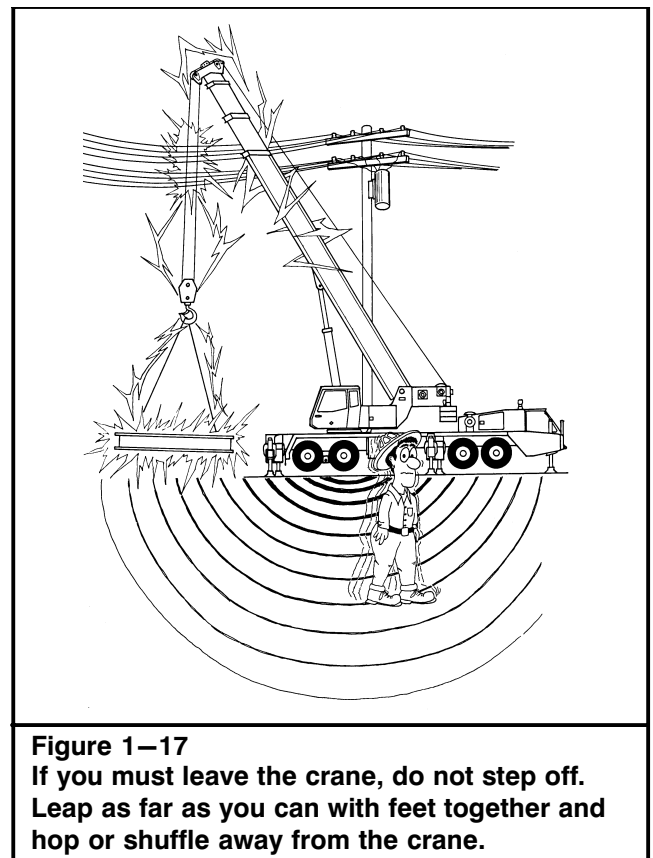
transmitter or antenna. Painful, dangerous shocks could occur. Consult trained electronic personnel before operating the crane to determine how to avoid electrical hazards.

- 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.

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- 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.



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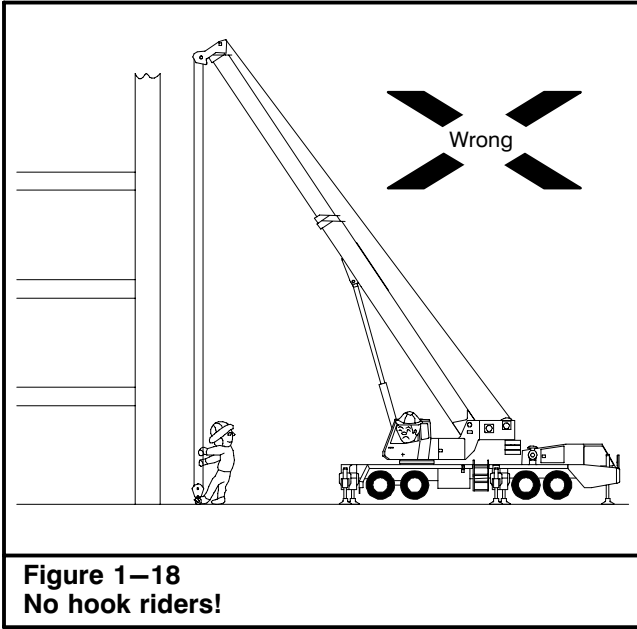


Figure 1-18
No hook riders!

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.

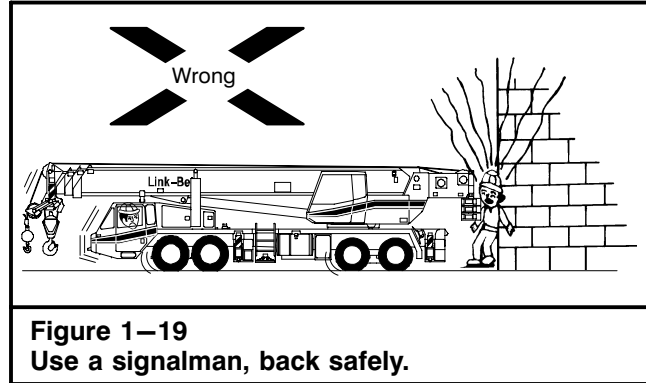


Figure 1-19
Use a signalman, back safely.

Signalmen And Bystanders

1. Don't allow crane boom or loads 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.

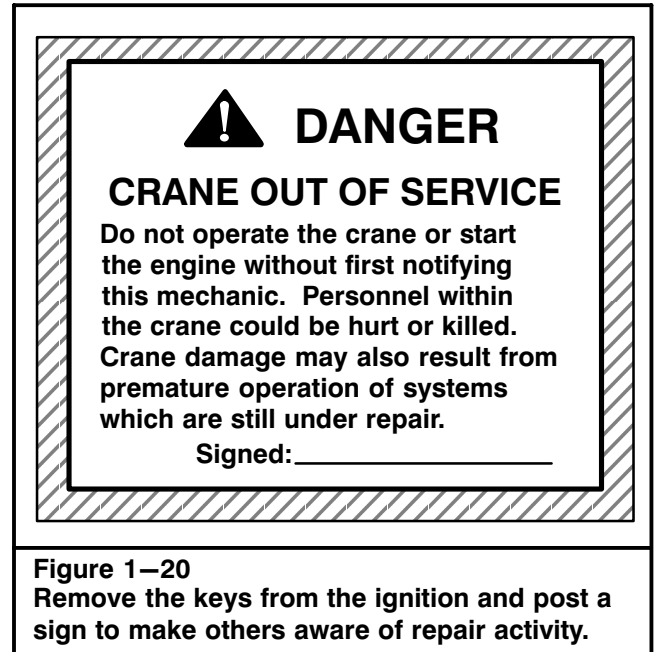
Crane Inspections And Adjustments

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

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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.



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.

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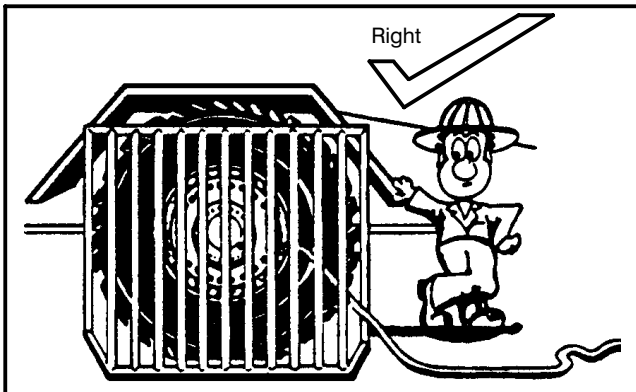


Figure 1-21
Use a guard when inflating tires.



Figure 1-22
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.
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.

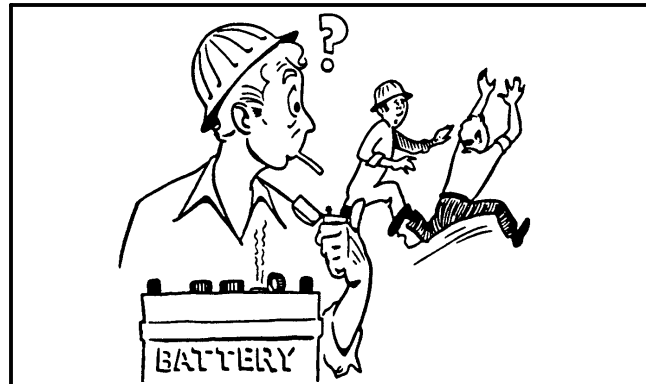



Figure 1-23
Do not use an open flame near the battery.

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.

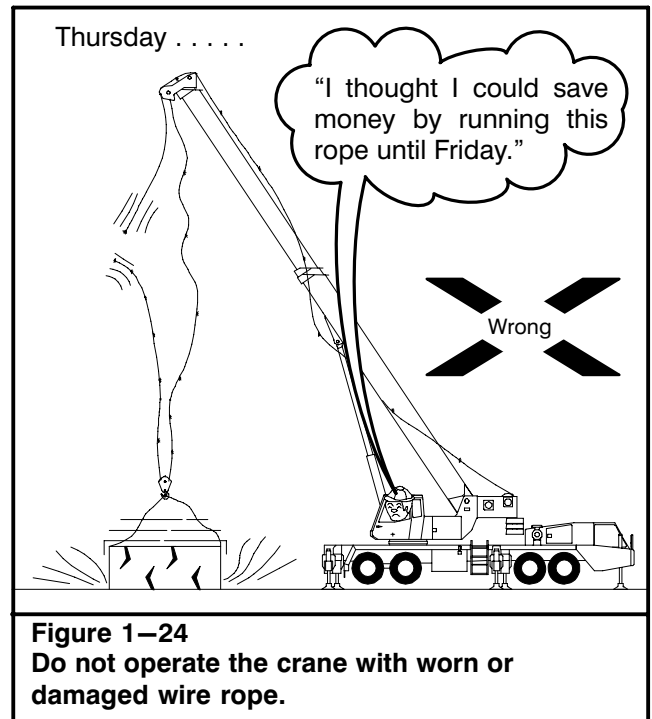
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Wire Rope

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 Capacity Chart located in 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 unnecessary 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.



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, or 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 hand signal chart found later in this Operator's Manual or the label located on the crane. 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 set-up 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.

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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 1–25
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

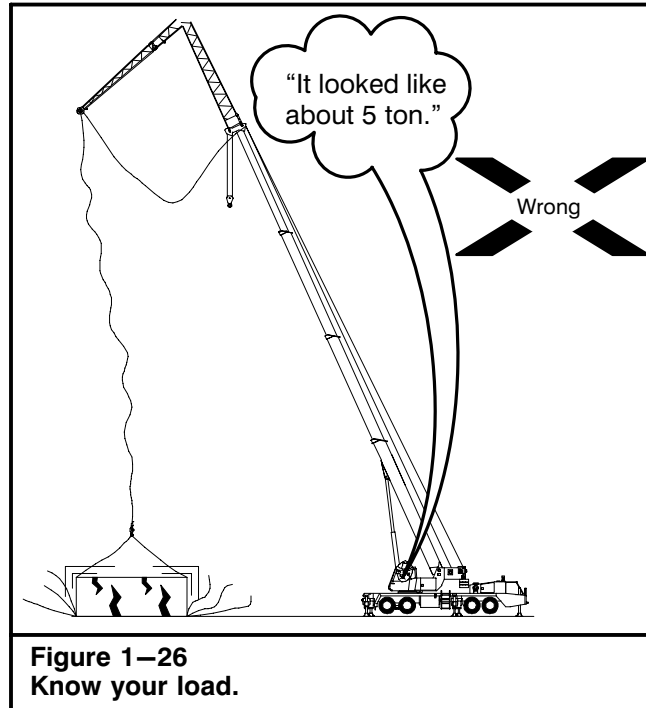


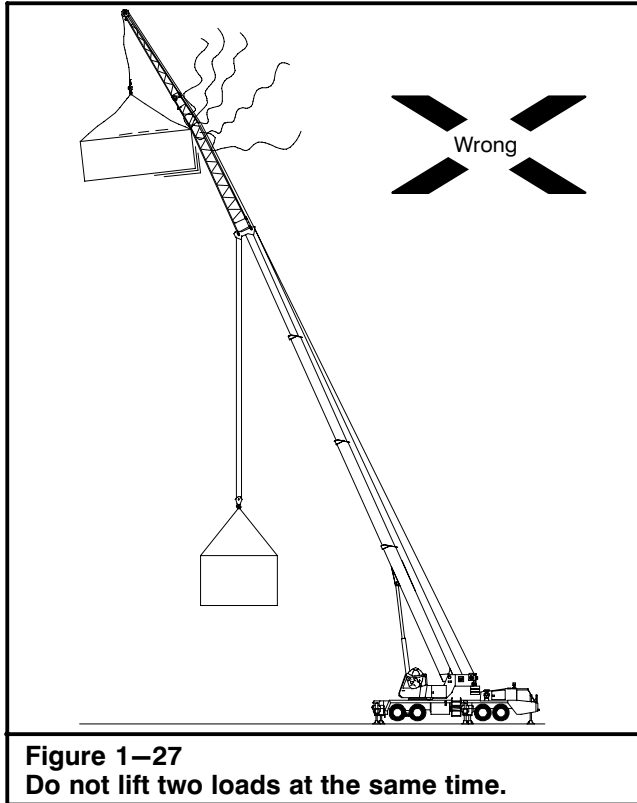
Figure 1–26
Know your load.

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.

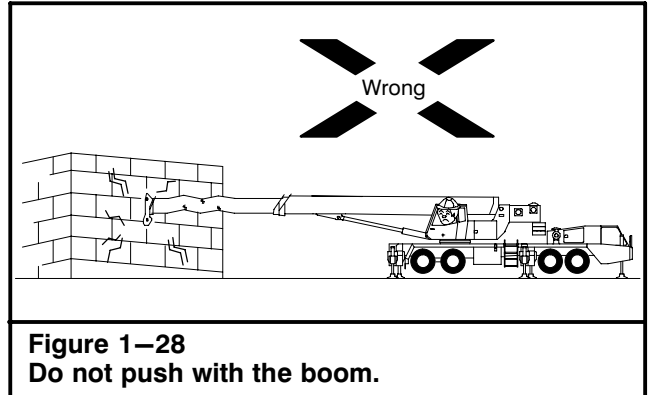
When lifting loads in a wind which have large surface areas, such as building panels, the movement of the load may pose a danger to workmen or building structures. Out swing of a load will increase the load radius, and may overload the crane. This could lead to boom failure or the crane tipping.

2. When operating off the main boom with the fly erected, 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.

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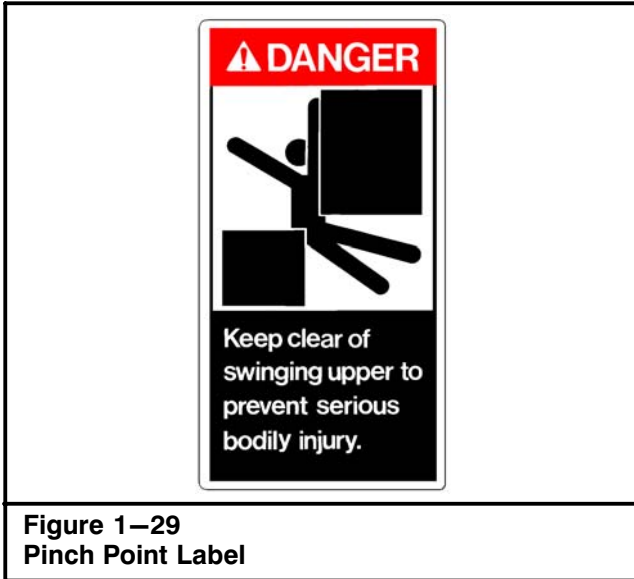


4. Do not lift two loads at the same time, even if the total load weight is within crane capacity. Loads on the boom and fly at the same time, stress the boom and drastically reduce its ability to handle loads. Your full attention cannot be given to both loads, creating a dangerous situation.
5. Some capacities on hydraulic cranes are based on strength of materials. In these cases, overloads may 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.

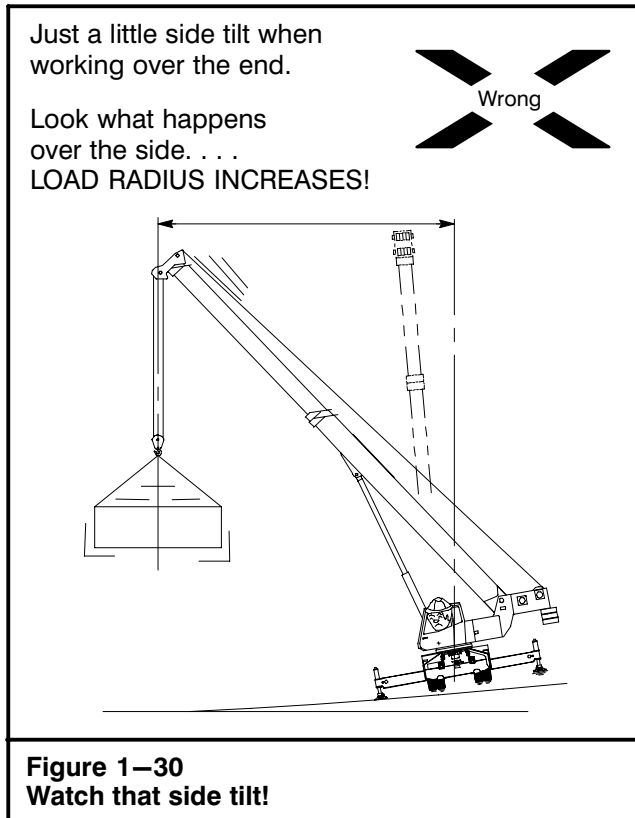


8. When performing repetitive lift applications, especially at or near maximum strength limited capacities, be aware that these applications may reduce component life. These applications include repeated lifting (or lifting and swinging) of near 100% strength limited capacities and repeated lifting maximum 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 the boom modes as selected through the RCL system.
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 center-line of rotation of the upper to the center of gravity of the load, when the load is hanging free.

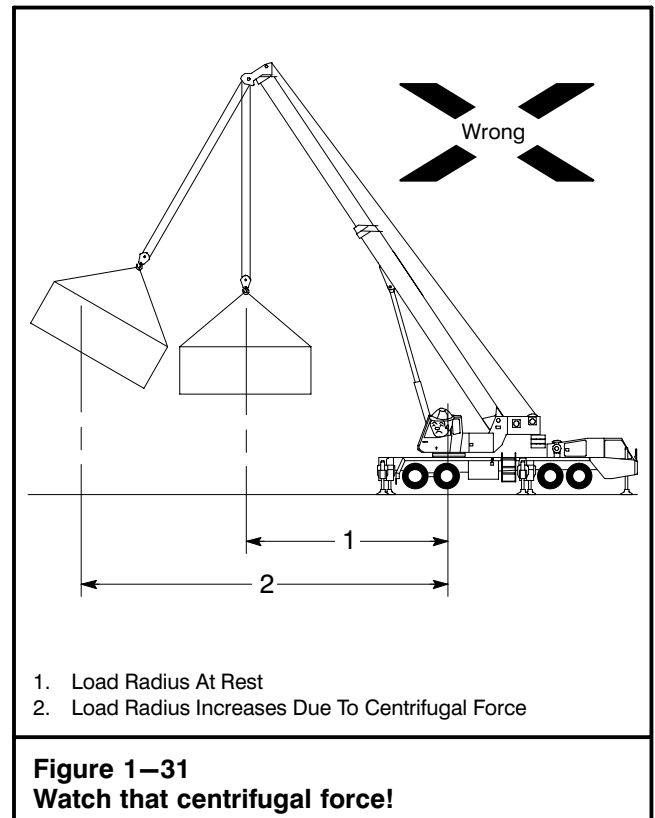
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13. Do not operate a hydraulic crane at radii or boom lengths where the Crane Rating Manual shows no capacity. Do not use a fly not designed for this crane. Either of the above can tip the crane over or cause attachment failure. In some cases, the 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.



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.

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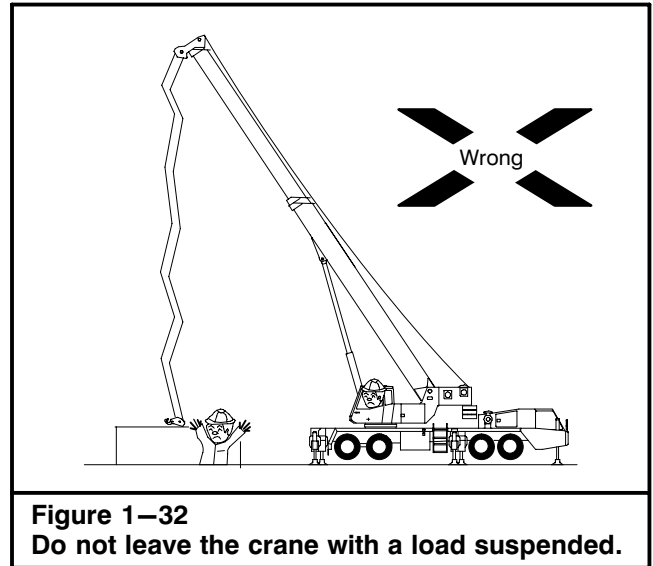
Traveling

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 for more details.
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.

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Leaving The Station

1. Do not get on or off a crane in motion. Use the grab handles and ladders when climbing on or off the crane. 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 the swing lock. Engage the park brake. Shutdown engine and remove 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 the engine running.
4. When changing work shifts be sure to notify the next operator of any changes or problems with the crane.



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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.

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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.

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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.

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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.

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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.

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Personnel Handling Pre-Lift Check List for Link-Belt Cranes		
1	<p>I am the designated person responsible for verifying that all safety requirements are met for this personnel handling operation;</p> <p>Name: _____ Title: _____</p> <p>Signature: _____ Date: ____/____/____ Initials _____</p>	
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	<p>The lift crane is equipped, and all devices operate properly as follows:</p> <ul style="list-style-type: none"> • 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	<p>Lifting personnel is allowed from:</p> <ul style="list-style-type: none"> • 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.

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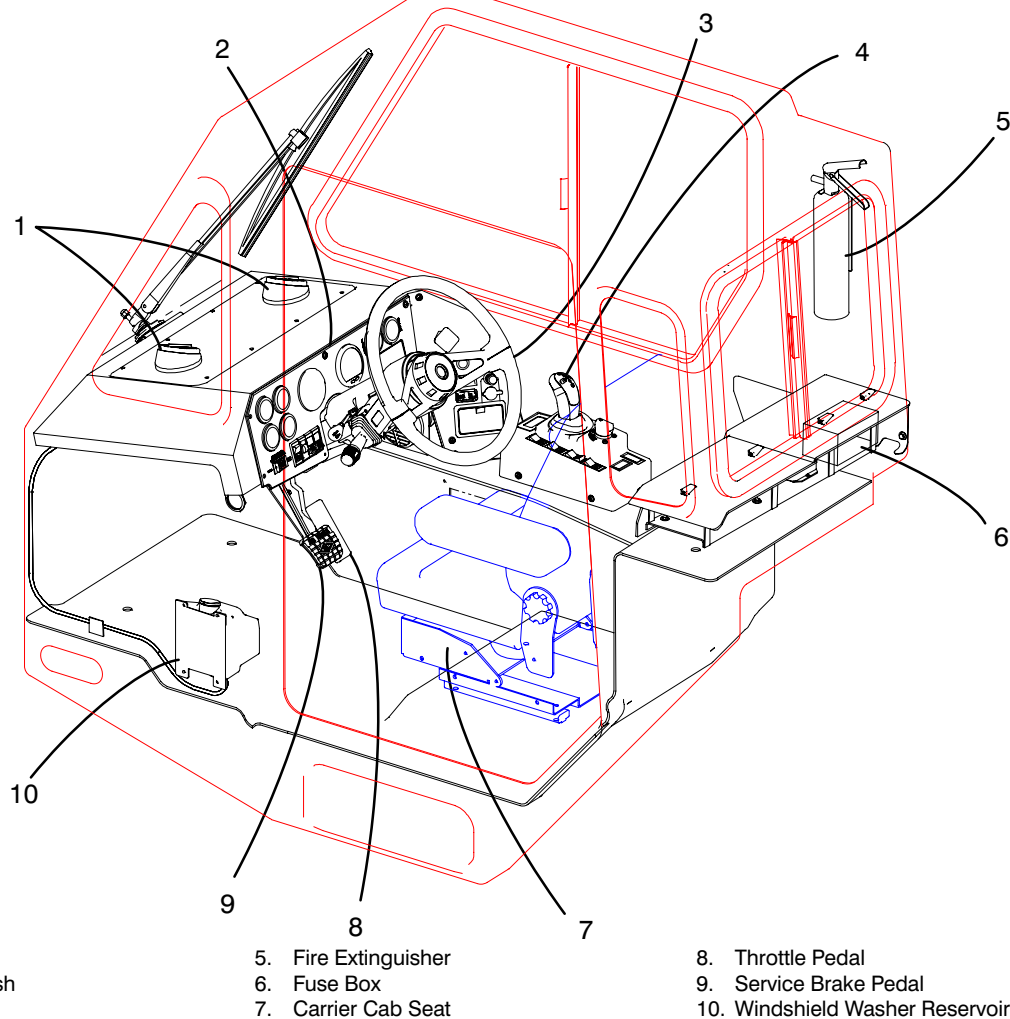


Figure 1–33
Carrier Cab Layout

Carrier Cab

The carrier cab contains various controls needed to drive the crane. Figure 1–33 illustrates the general location of 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 1–33. It is an ABC 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 1–34. 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 1–33. 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 1–35.

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 counter-clockwise 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.

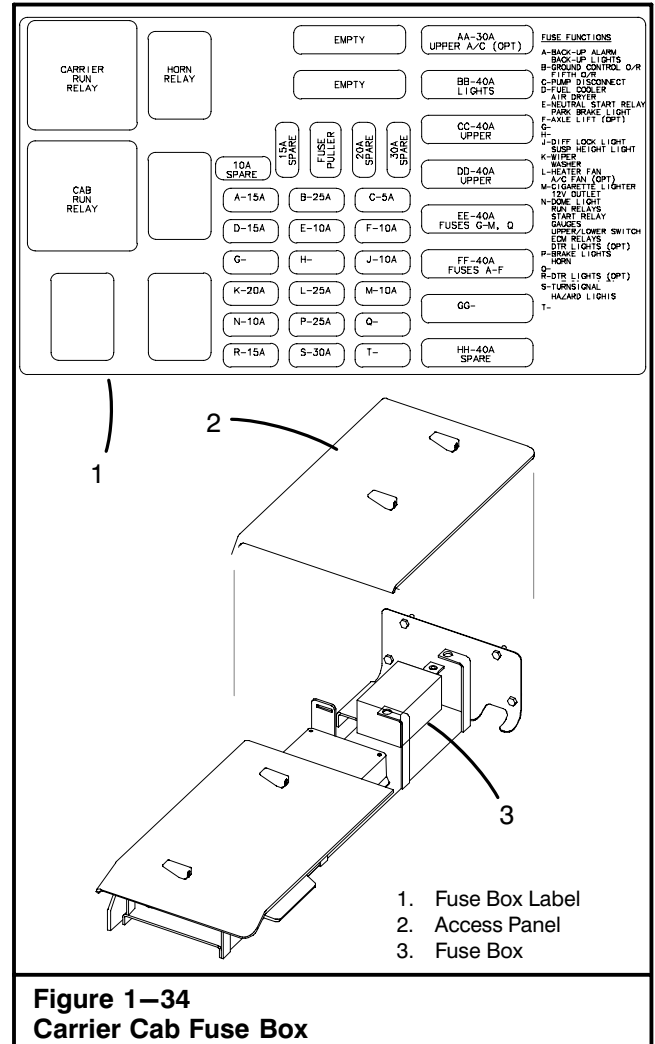


Figure 1–34
Carrier Cab Fuse Box

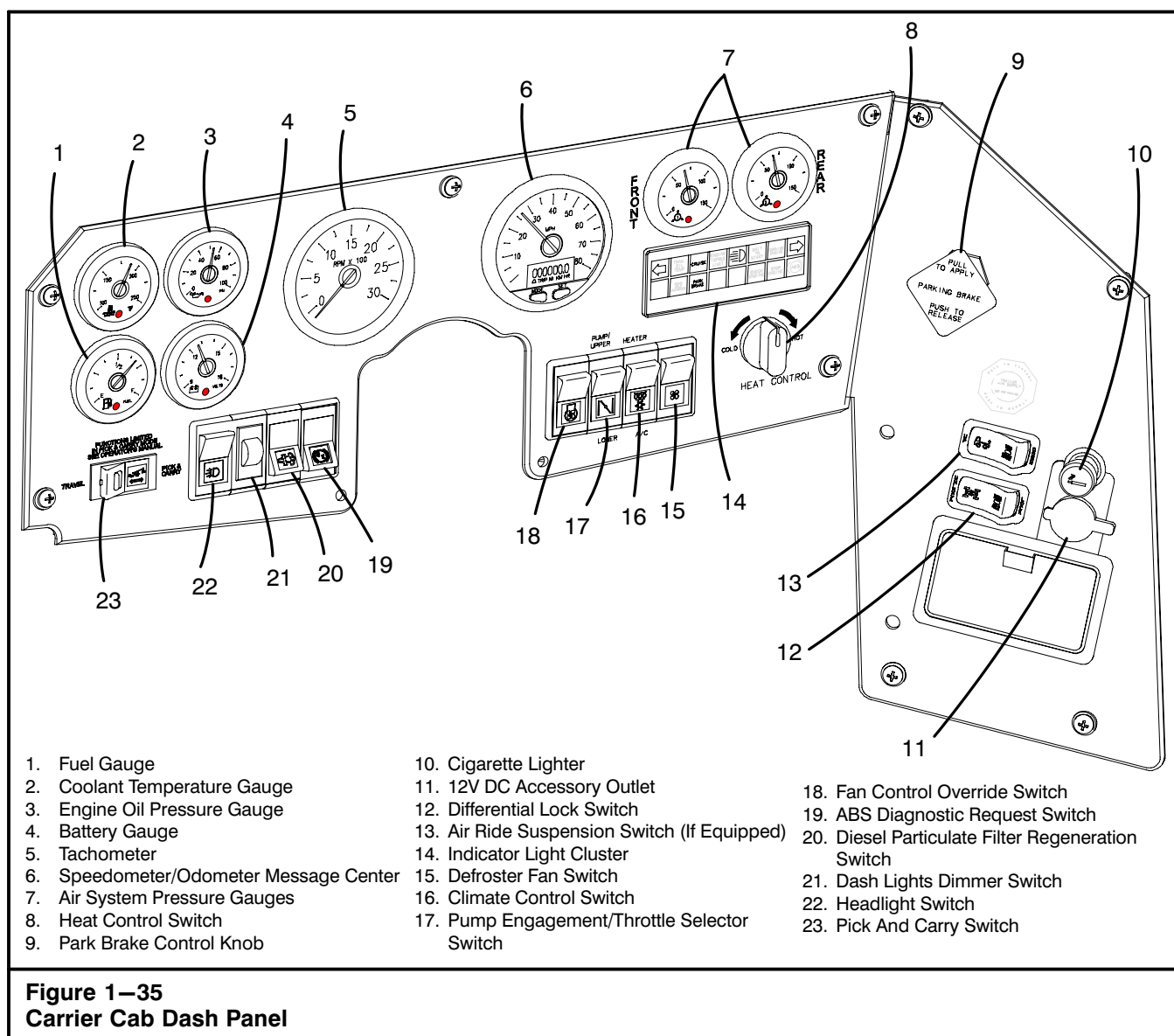
When the fuel level reaches an eighth of a tank, an indicator light within the gauge will illuminate and the message "LOFUEL" will appear in the LCD area of the speedometer/odometer message center.

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 "H2O TEMP" will appear in the LCD area of the speedometer/odometer message center.

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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



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.

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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.

- 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.
- Press the Set button to start the test, or press the Mode button to select a different module.
- 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; counter-clockwise 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

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

To Release Park Brake

- Apply the service brakes.
- 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).

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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

- Maintain a constant crane speed.
- Move the Differential Lock switch to the "LOCK" position.
- Let up on the throttle pedal momentarily to allow the differential lock to engage.
- 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

- Maintain a constant crane speed.
- Move the Differential Lock switch to the "UNLOCK" position.
- Let up on the throttle pedal momentarily to allow the differential lock to disengage.
- 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.

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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.

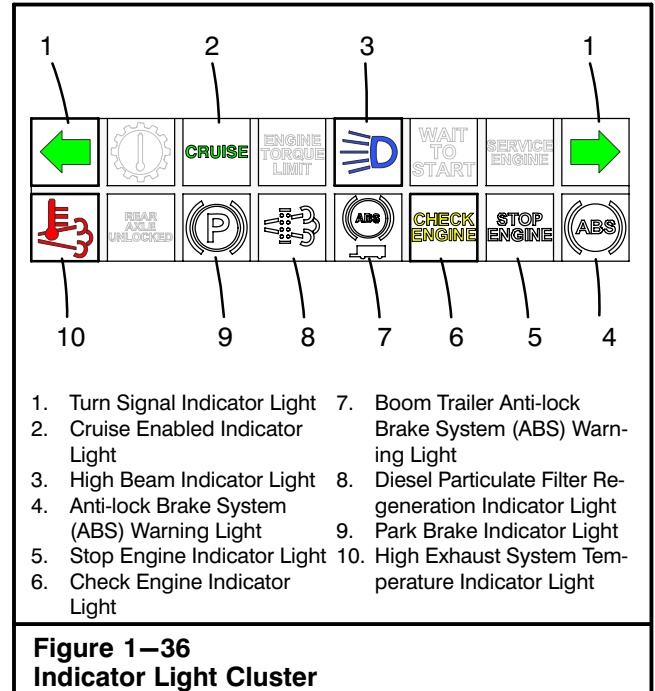
5. Stop Engine Indicator Light



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.



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 de-rates 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.

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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



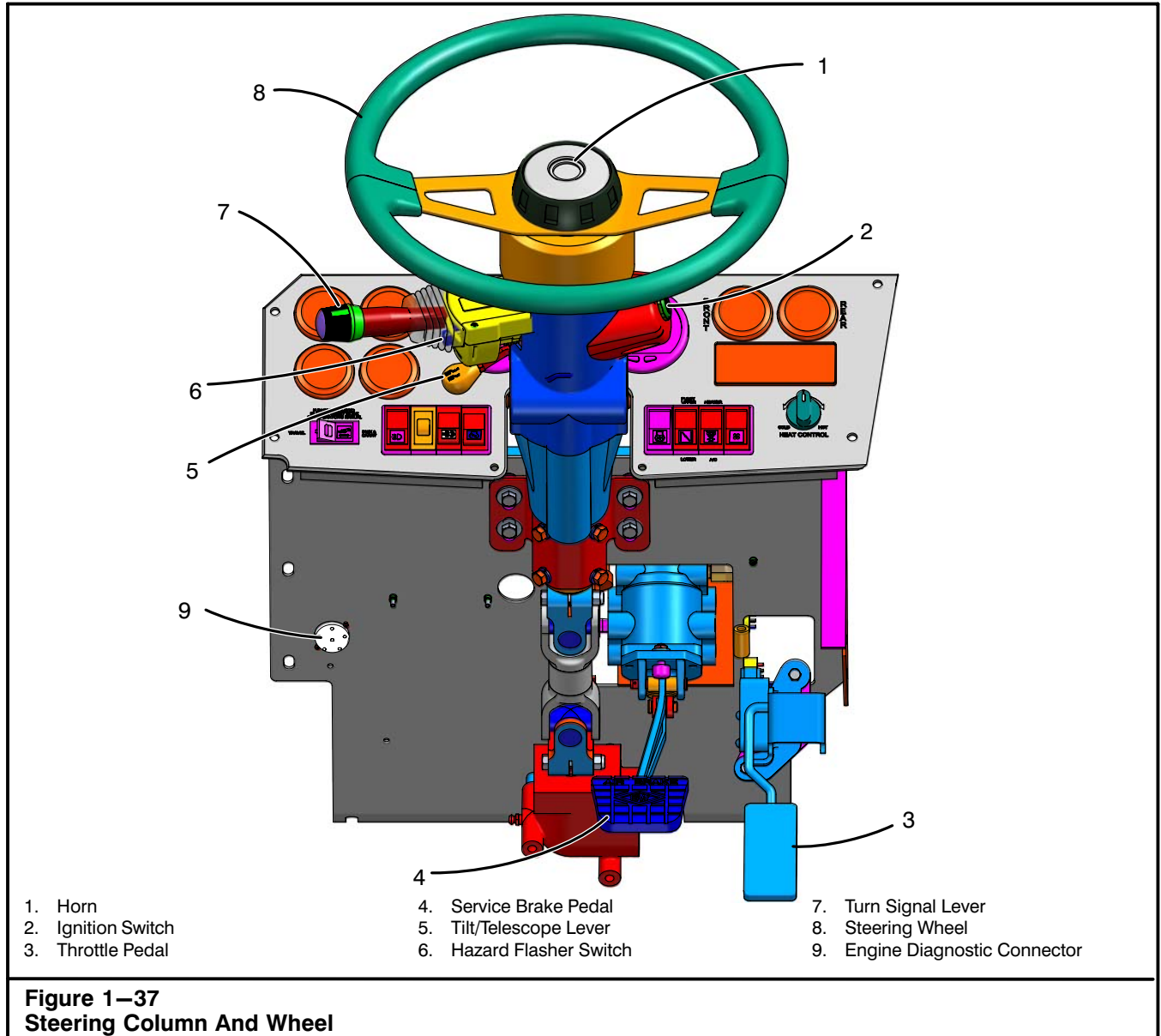
This indicator light will illuminate to alert the operator that the outlet temperature in the DPF is above 840°F (450°C) if the crane is traveling less than 5 mph (8km/h). This condition can occur under normal operation. No action is required.



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.



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 1–37.

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.

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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:

- Bring the crane to a complete stop.
- Engage the park brake and shift the transmission to neutral.
- 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.
- 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.
- 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:

- Turn Signals: Push the lever down for left turn signal, pull the lever up for right turn signal.
- 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.
- 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.
- 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

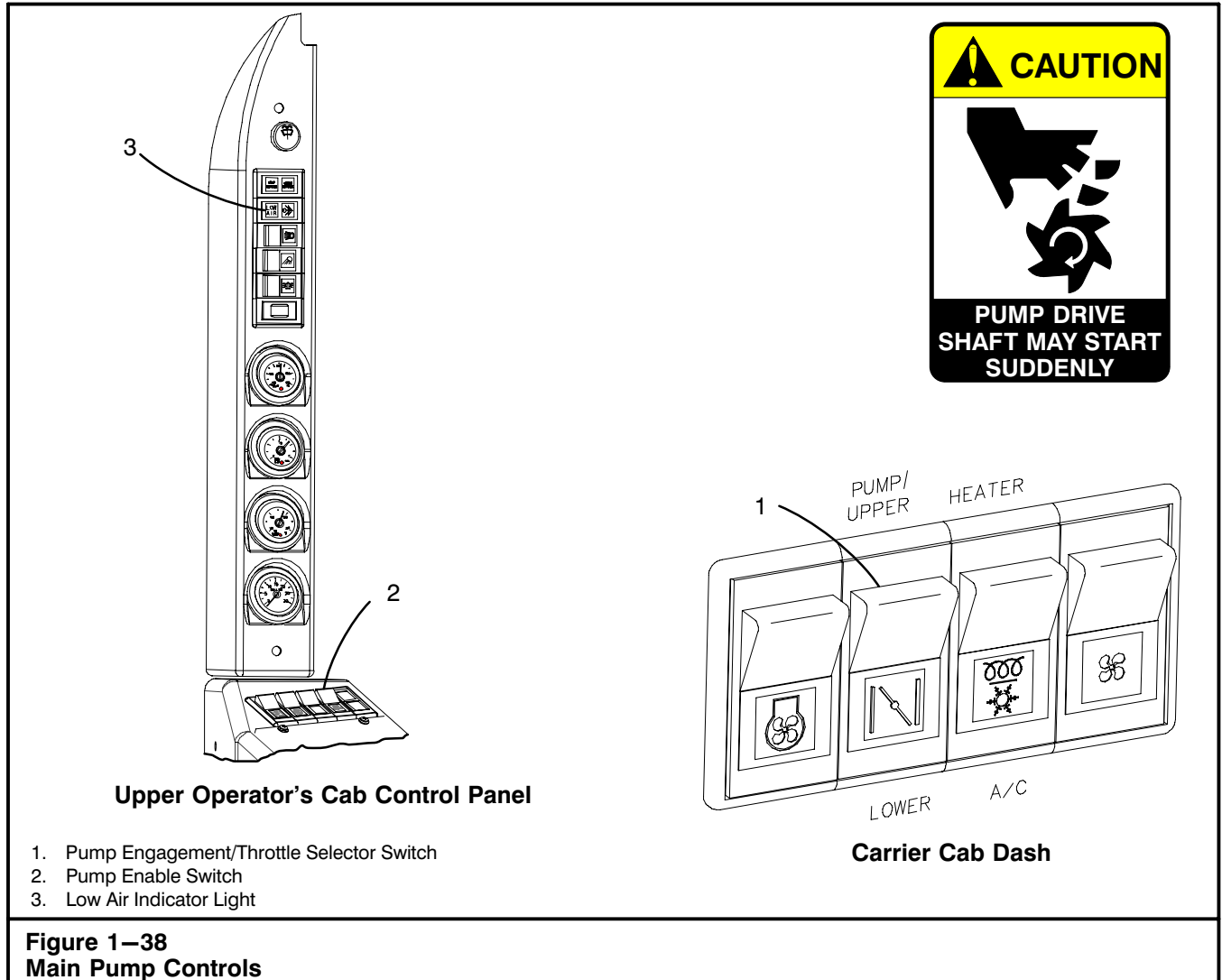
The engine diagnostic connector is located under the carrier cab dash to the left of the steering column. Refer to Figure 1–37. The connector allows engine service technicians to attach a laptop computer for diagnosing engine problems. When the check or stop engine light illuminates, contact the engine service technician to retrieve the fault codes and repair the engine.

Engine Idle Shutdown System

To meet State and Federal Laws required to reduce emissions and conserve fuel, the engine control system is programmed to automatically shutdown the engine under non-crane operating conditions. When conditions are correct, the engine will automatically shutdown when idling for periods longer than five minutes. The system does not shut off electrical power.

When the Pump Engagement/Throttle Selector switch is in the “Lower” position, the engine idling with transmission in neutral, and the engine water temperature at 60° or above, the Check Engine light will begin to flash in 4.5 minutes to alert the operator that the engine will shutdown in 30 seconds. To reset the timer and prevent the engine from shutting down, the operator can press the brake or throttle pedal. When this action is taken, the Check Engine light will stop flashing and the 5 minute timer will begin again.

When performing crane operations, the Pump Engagement/Throttle Selector switch must be in the “Pump/Upper” position. In this position the engine idle shutdown system is disabled.



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 1-38.

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.

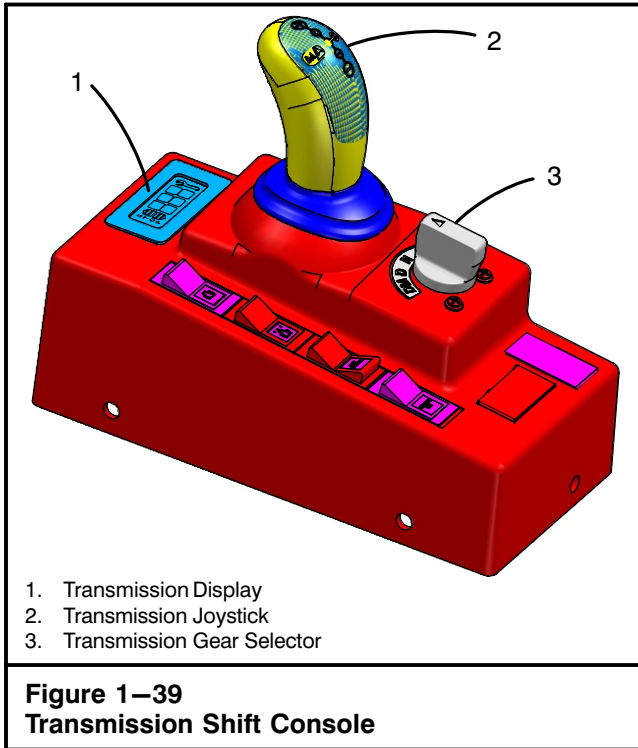
Note: If the pump engagement/throttle selector switch in the carrier cab is moved to the "Pump/Upper" position before sufficient air pressure is attained, the low air indicator light on the control panel in the upper cab will illuminate and an audible alarm will sound in the upper cab. When the light 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.

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Transmission Controls

The transmission controls are located on the shift console to the right of the operator. Refer to Figure 1-39. 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** 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 1-40. A self-check is performed when the igni-

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tion 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 1–40. 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.
	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 1–40 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.

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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  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  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  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  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  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.

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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.

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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.

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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.

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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.

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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.

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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 1 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.

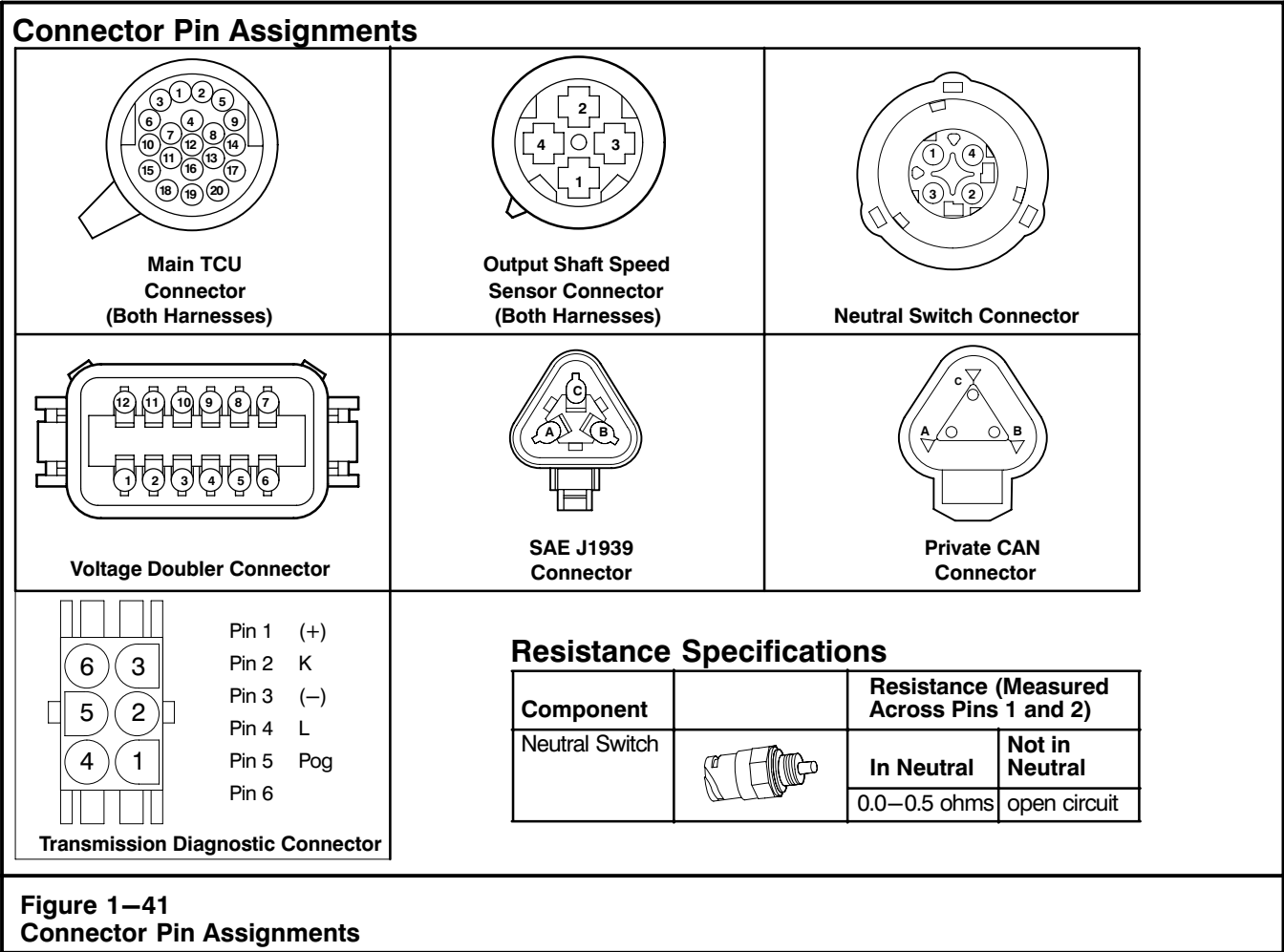
Fault Code Identification		
Display Fault Code	Fault Description	Repair Instructions
145	Range shift disengagement error	Test drive the crane to verify that the transmission does not range shift correctly. Contact your Distributor and request a transmission specialist.
146	Range shift changeover error	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.

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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.

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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.

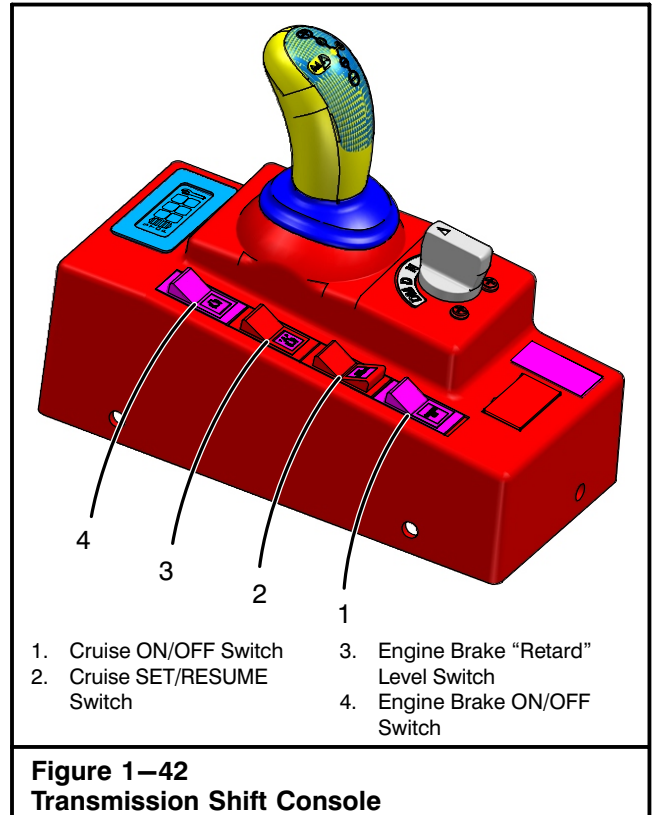
There are other circumstances when descending a grade at a rate slower than the control speed may be desired. This is done by selecting a lower gear, one that will not over-speed the engine. Apply the service brake to obtain the desired lower speed.

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.



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.

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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—42.



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 computer 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 mo-

mentary 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

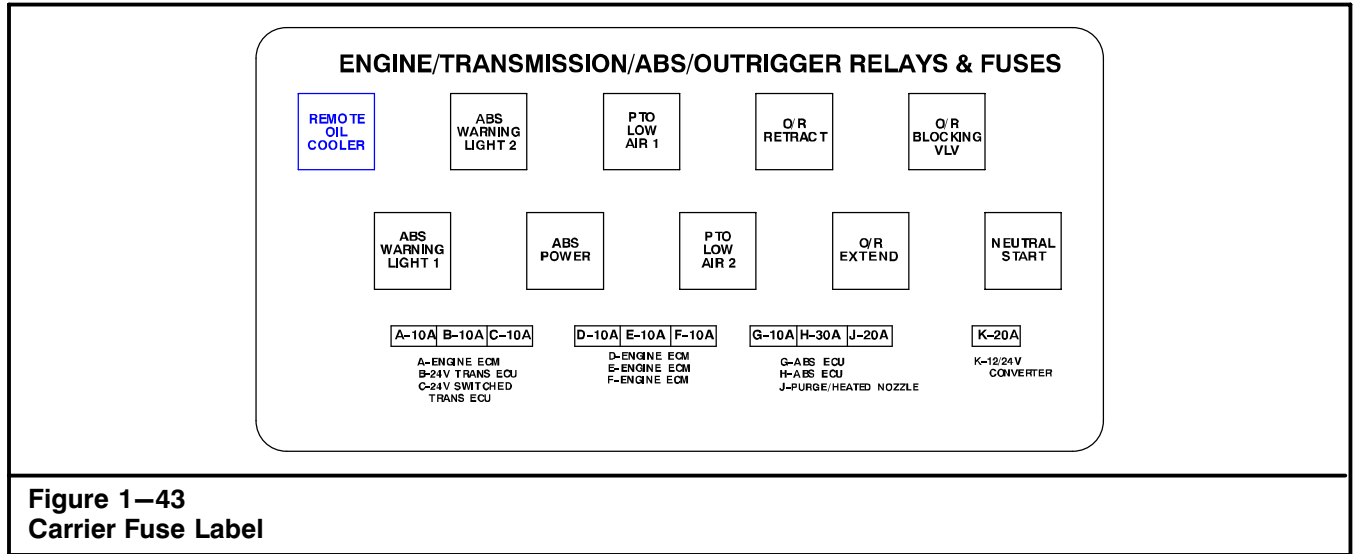
To deactivate cruise controls, do any of the following:

- 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.



Battery Disconnect Switches

The battery disconnect switches are located behind the left engine access door. Refer to Figure 1—44. 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—43. 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—44.

Operator's Manual

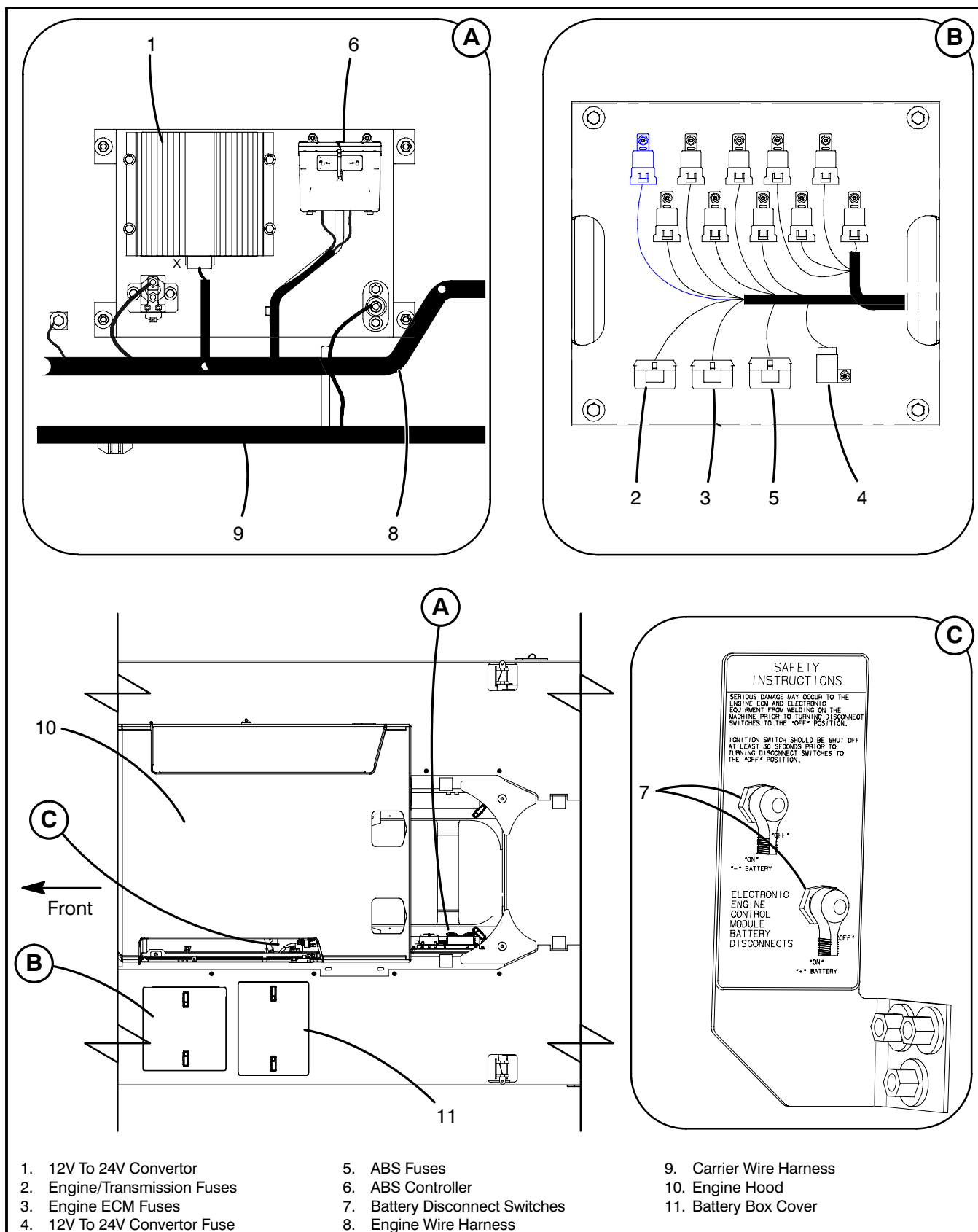
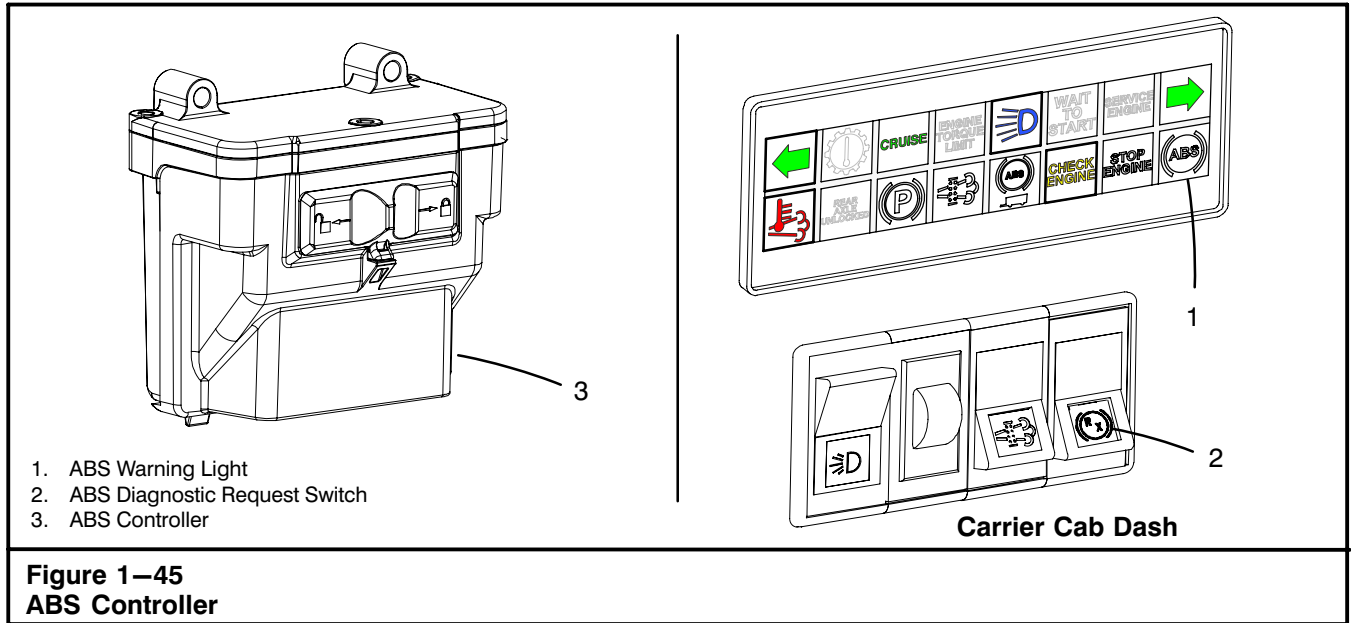


Figure 1-44
Power Panel And Battery Disconnect Switches



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.

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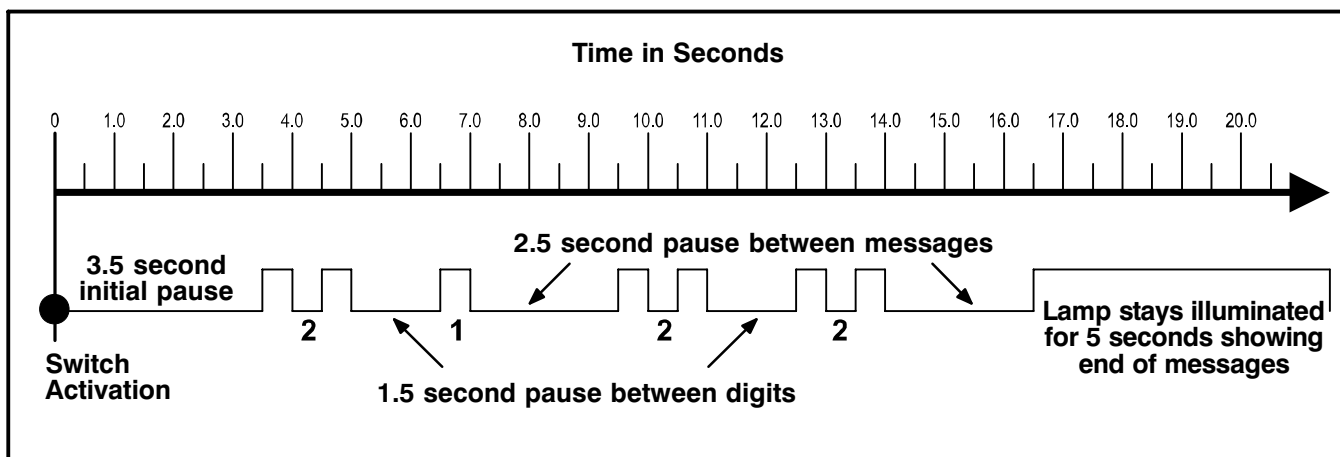


Figure 1-46
Blink Code Message Example

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 1-46 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.

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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 Diagnos-

tic 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.

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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

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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

Operator's Manual

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

Operator's Manual

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

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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.

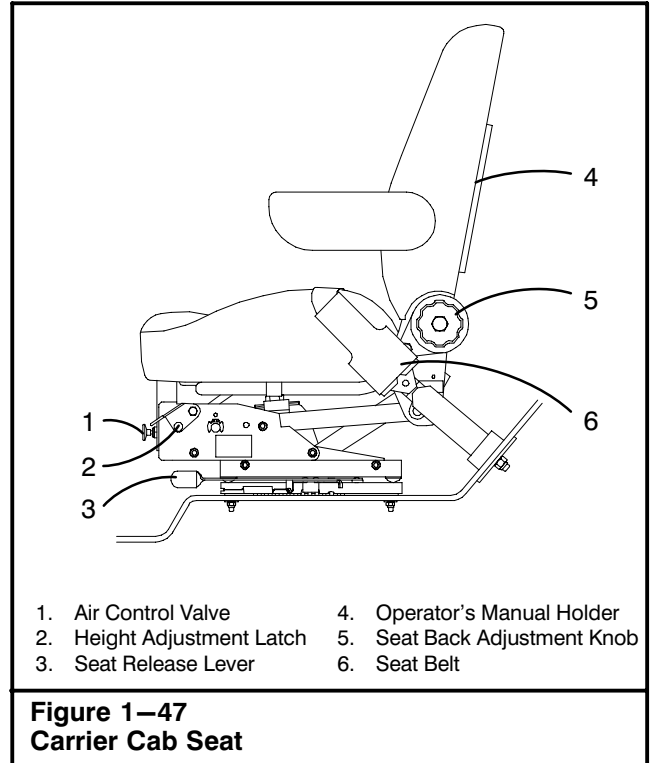
Seat back angle and the forward and backward position of the seat should be adjusted to provide operator comfort. The seat is adjusted by manual controls. Refer to Figure 1–47.

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.



**Figure 1–47
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:

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

To Lower The Seat:

- Firmly pull up on the height adjustment latch while pulling out on the air control valve, exhausting air until the latch releases.
- Once the desired height is reached, release the air control valve and the height adjustment latch.
- 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.

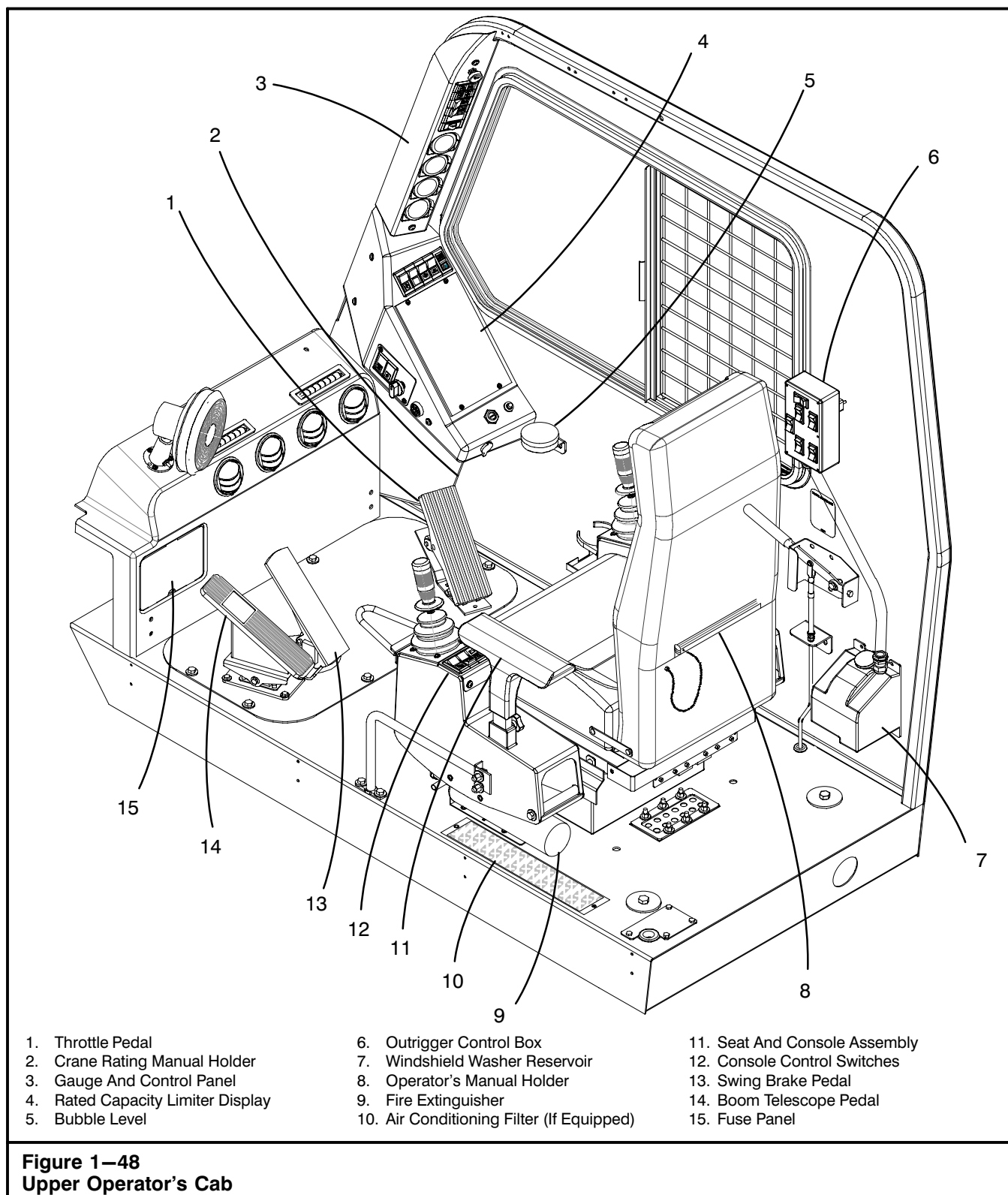
5. Seat Back Adjustment Knob

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.

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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 1-48. The following is a description of each gauge, switch, or control in each panel, along with an explanation of their function and/or operation.

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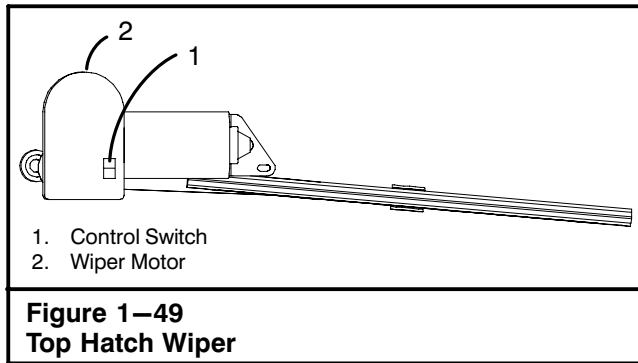


Figure 1-49
Top Hatch Wiper

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 1-49.

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 1-48. Located behind the fuse panel cover is a label which designates the electrical circuit protected by each fuse. Refer to Figure 1-50. 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 1-48. 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 a panel that contains the following controls, gauges, and indicators and is shown in Figure 1-51.

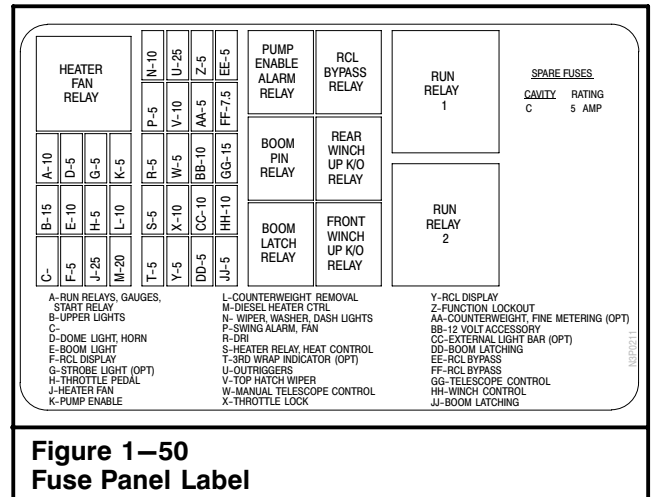


Figure 1-50
Fuse Panel Label

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.

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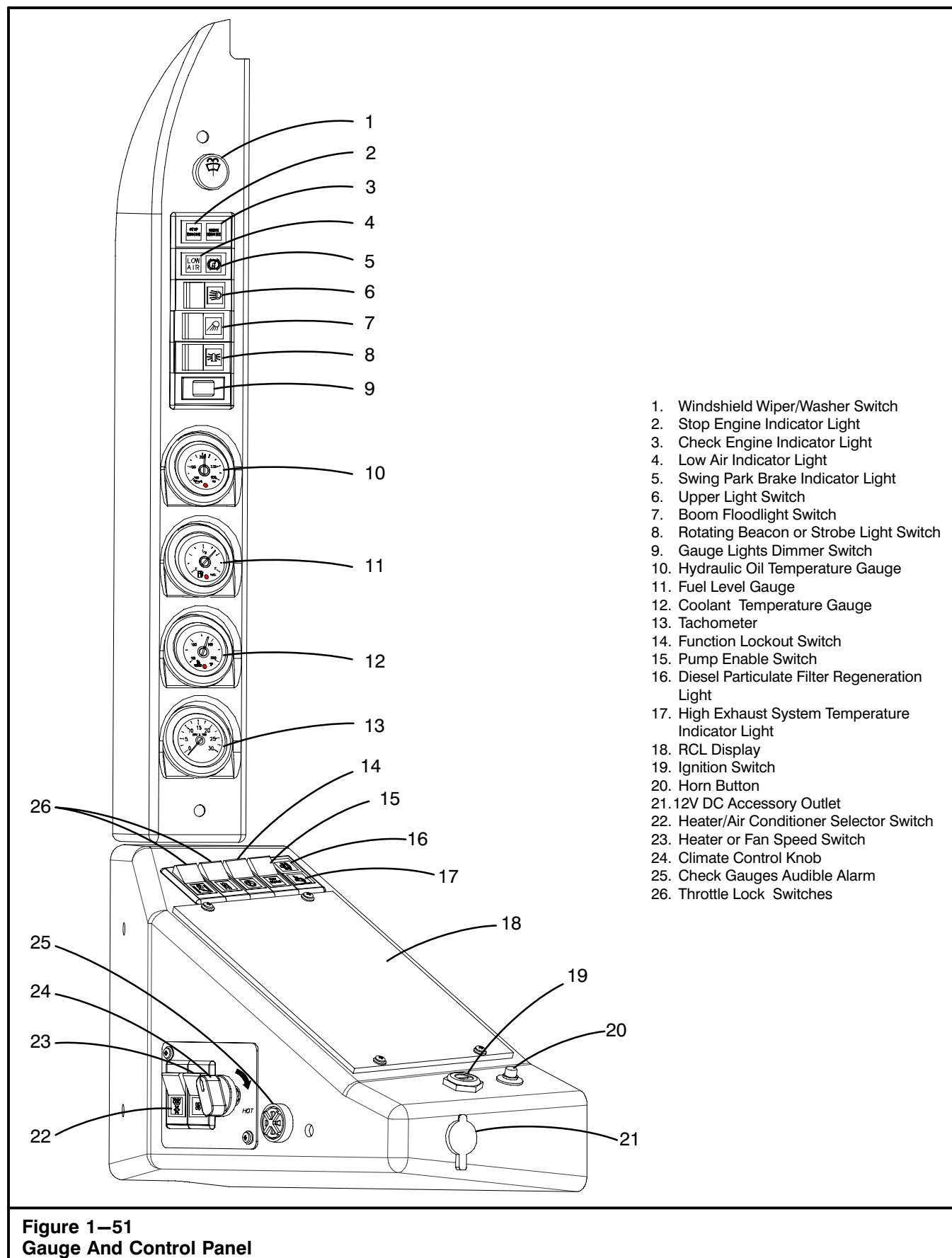


Figure 1–51
Gauge And Control Panel

Operator's Manual

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 degrades 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.

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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 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.

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.

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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 of the operator's seat. Refer to Figure 1–48 and Figure 1–52.

1. Third Wrap/First Layer Indicator Switch (If Equipped)



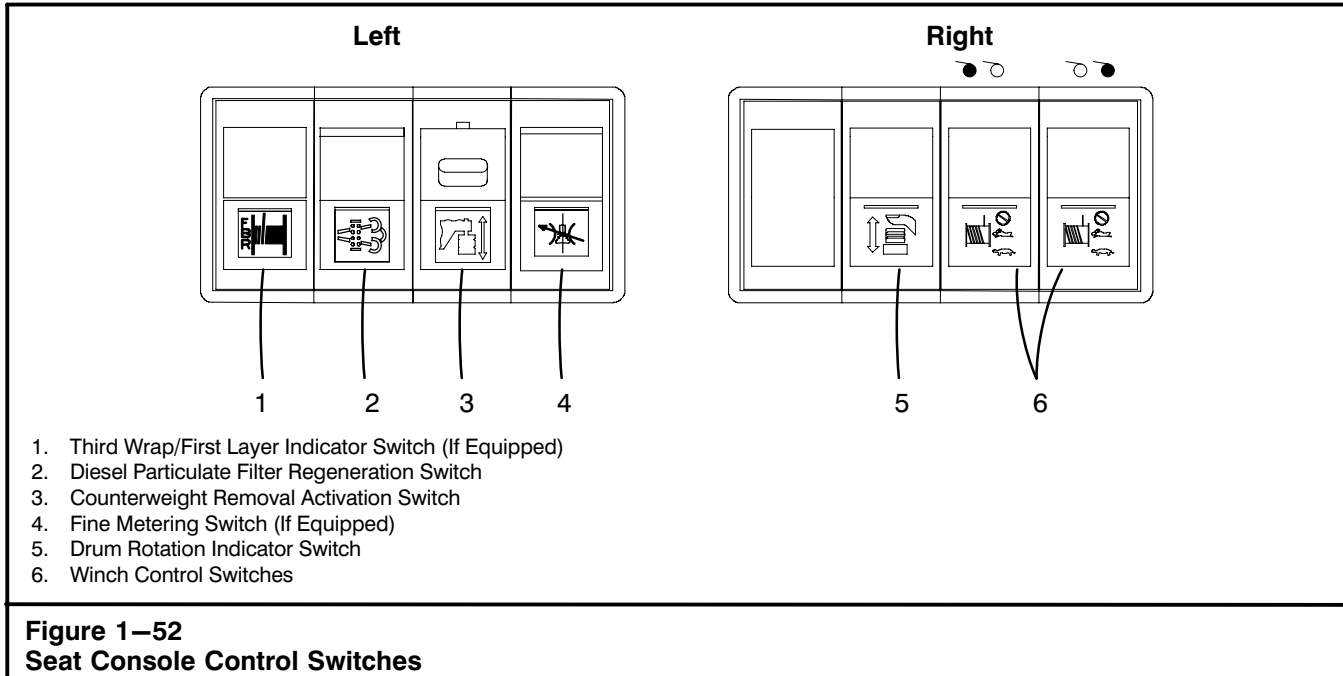
Once the third wrap indicator system is enabled, this switch allows the operator to select which winch drum(s) to monitor. Enable the system through the RCL system using the operator settable alarm feature. Refer to "MicroGuard 540 Rated Capacity Limiter" found in this Section of the Operator's Manual. Press the switch to the "F" (Front), "B" (Both), or "R" (Rear) position as desired. When the system is enabled, the audible alarm will sound intermittently, and "First Layer" will appear in the warning message area to alert the operator when the wire rope is down the the first layer on the winch drum(s). The audible alarm will sound continuously and "Third Wrap" will appear in warning message area to alert the operator when the wire rope is down to the third wrap on the winch drum(s).



WARNING

Three (3) full wraps of wire rope must be maintained on the winch drum at all times during operation. Rope failure may occur.

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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 1,000 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.

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3. Counterweight Removal Activation Switch

Pressing this switch changes the function of the left joystick (or single axis controller, if equipped) from operating the swing/front winch functions to operating the counterweight lock—unlock/counterweight raise—lower functions. Pull the control lever back, toward the operator to raise the counterweight. Push the control lever forward, away from the operator to lower the counterweight. Move the control lever to the left to lock the counterweight and to the right to unlock.

Also the RCL display changes screens to display the location of the counterweight lift cylinder rods to alert the operator of counterweight status. An alarm on the RCL screen will be displayed if the counterweights are not fully raised (retracted) against the upper. If no counterweights are installed, the alarm will sound if the counterweight cylinders are not fully retracted. Refer to “Counterweight Removal” found later in this Section of the Operator's Manual.

4. Fine Metering Switch (If Equipped)

This switch is used to activate the fine metering system. Refer to “Fine Metering System” found later in this Section of the Operator's Manual.

5. Drum Rotation Indicator Switch



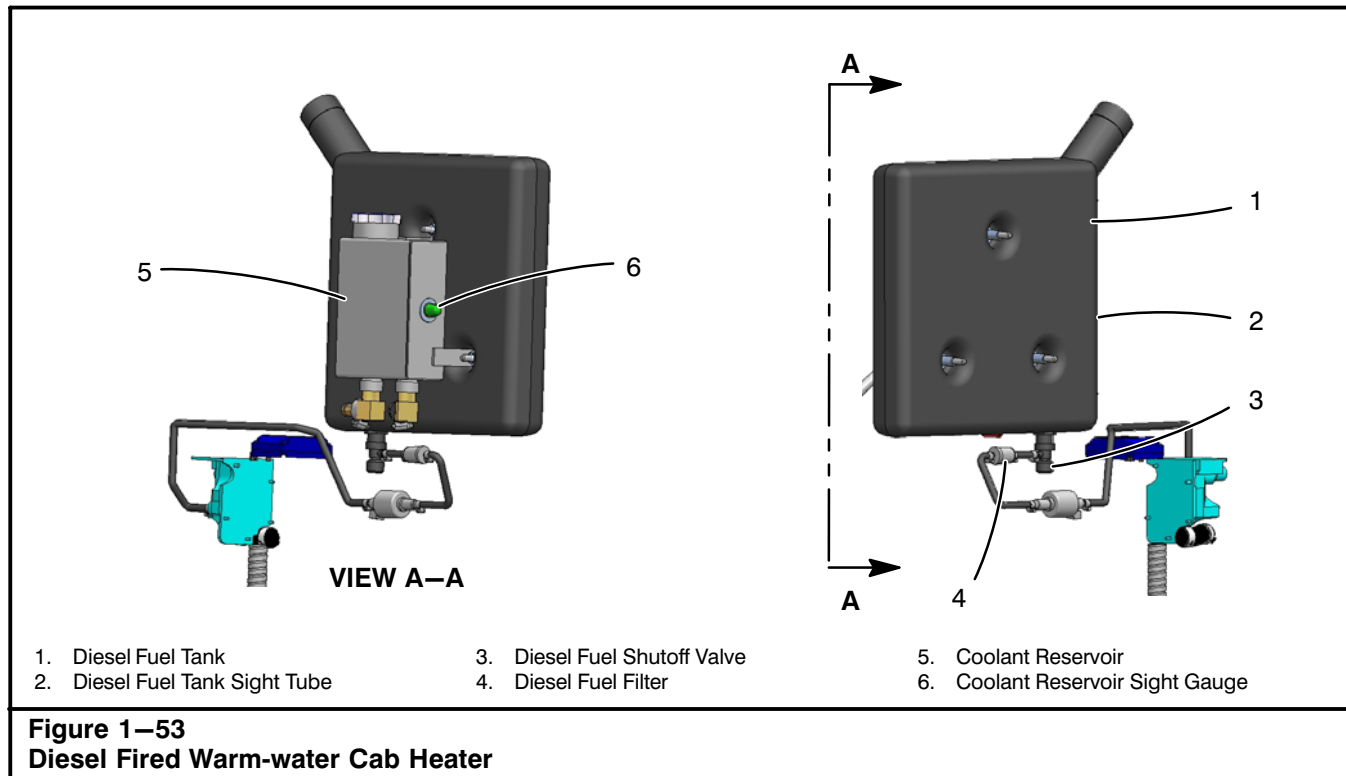
This switch is used to activate the drum rotation indicator system. To activate the system, press the bottom part of the switch. Press the top part of the switch to deactivate the system. The bottom part of the switch will illuminate to indicate switch is in the ON position. Refer to “Drum Rotation Indicators”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

6. 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.

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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 1-53. 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

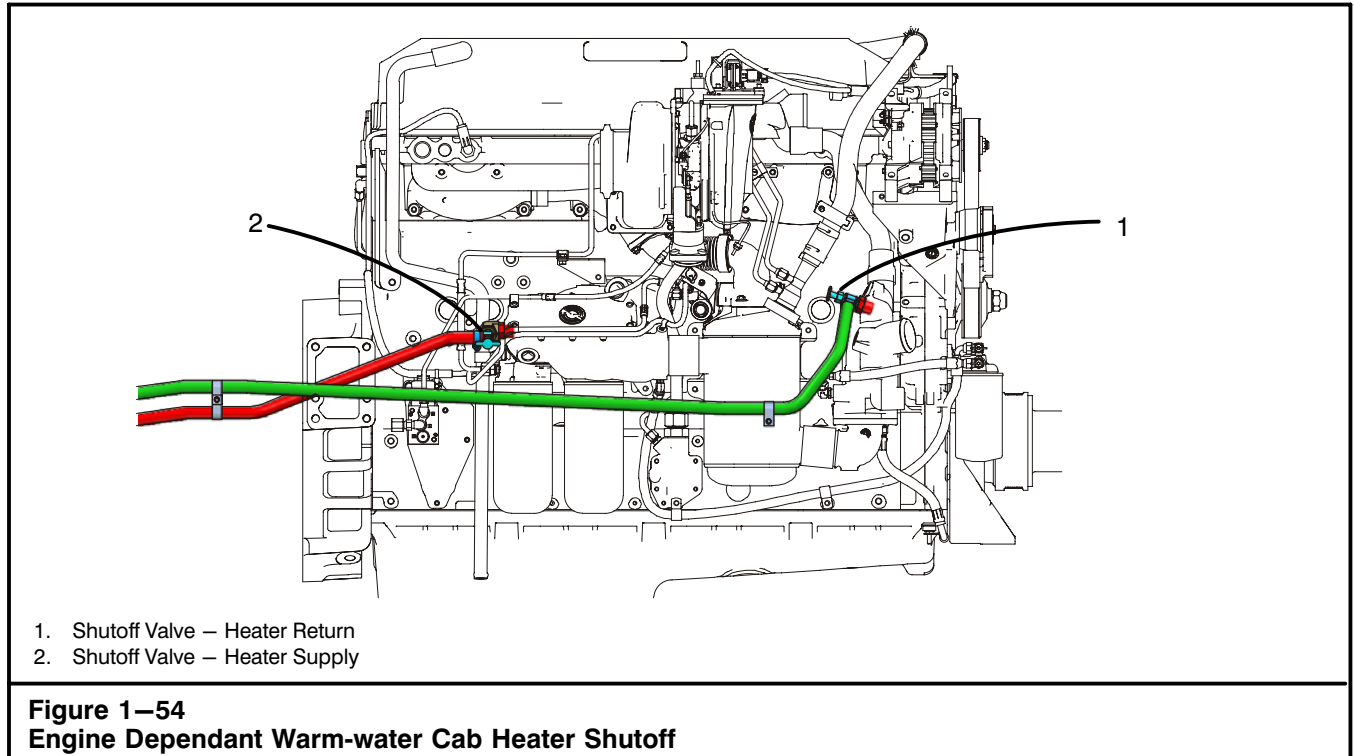
Diesel exhaust fumes can be harmful. Start and operate diesel cab heater in a well ventilated area. If it is necessary to operate in an enclosed area, vent the exhaust to the outside.

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 1-51.
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.



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 1–54.

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 1–51.
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.

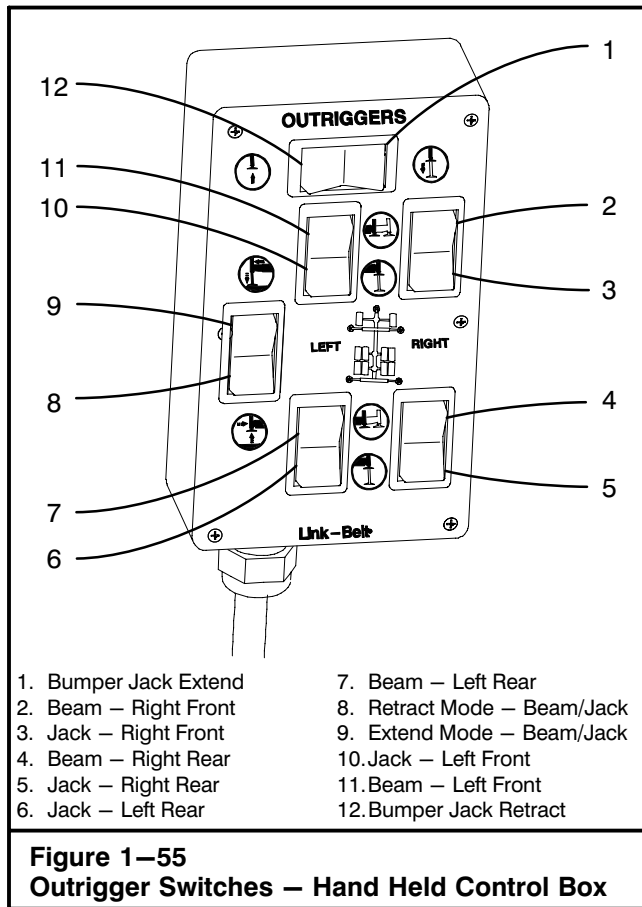
1. Shutdown the engine and rotate the handles on the shutoff valves clockwise to stop the flow of engine coolant to the heater; Counterclockwise to restore it. Refer to Figure 1–54.

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 1–51.

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.

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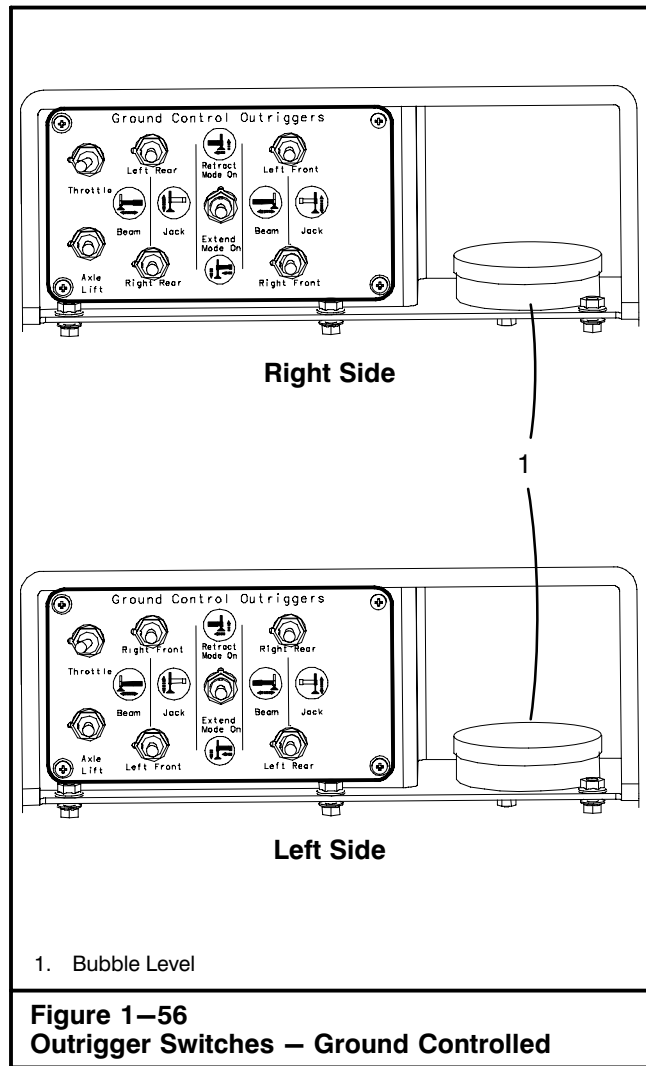


Main Outrigger Operation

The outriggers can be used in any one of three positions; fully retracted, intermediate, or fully extended. The outriggers are controlled from the hand held control box, located 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.

Note: The throttle lock switch located in the upper cab must be in the OFF position to activate the ground control stations.

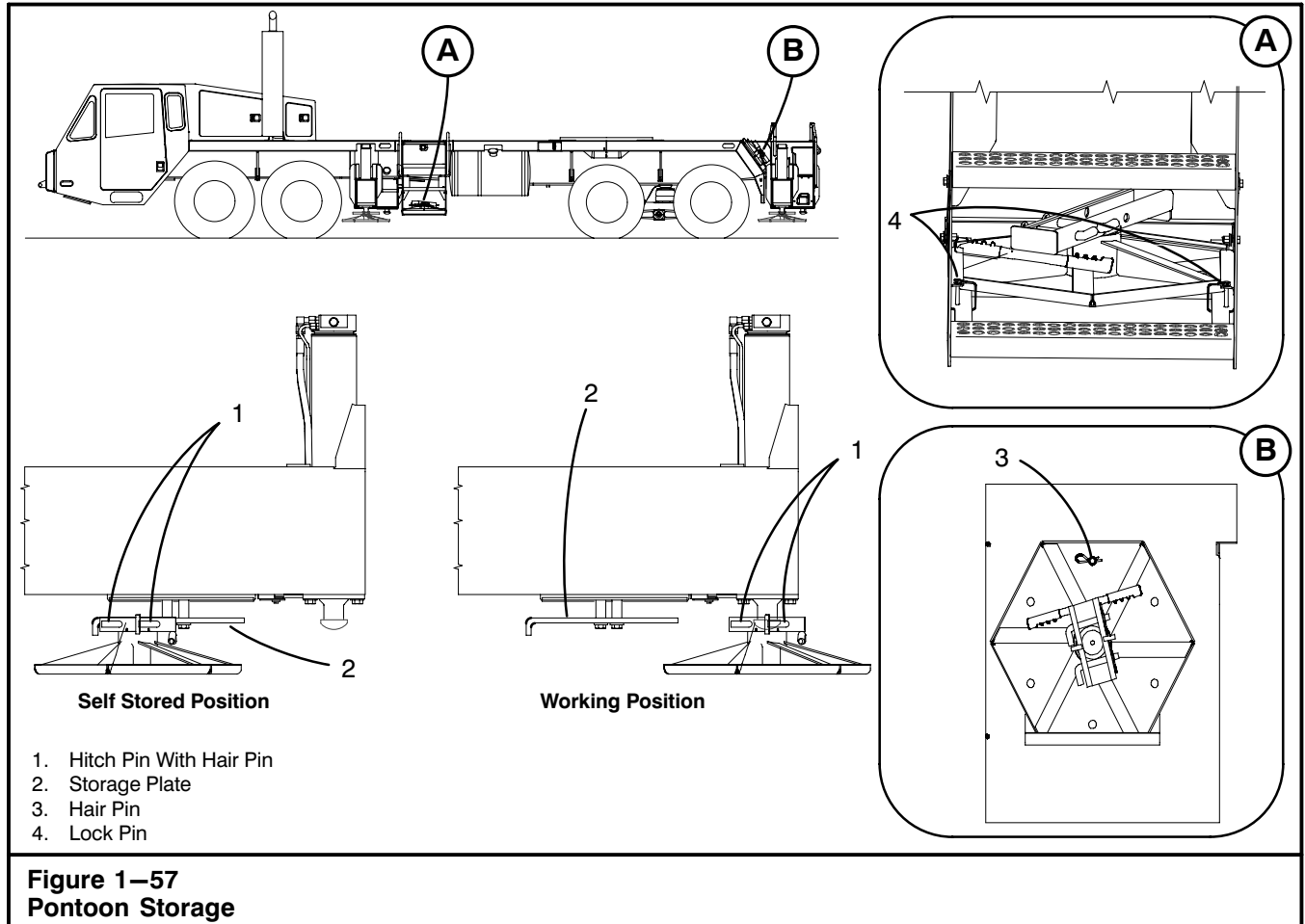
The outrigger switches, at each station, control both outrigger functions. Each individual outrigger switch controls all functions of that outrigger beam and jack cylinder. The mode switch controls outrigger direction, extend/retract. Refer to Figure 1–55, Figure 1–56, and Figure 1–58. Each extend position 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.



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 right side wall of 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 an axle lift switch that can be used to raise the rear axles while on outriggers.



To Extend Outrigger Beams

1. Park the crane in the desired location. Engage park brake and shift transmission to neutral.
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 1-57.



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 1-58.



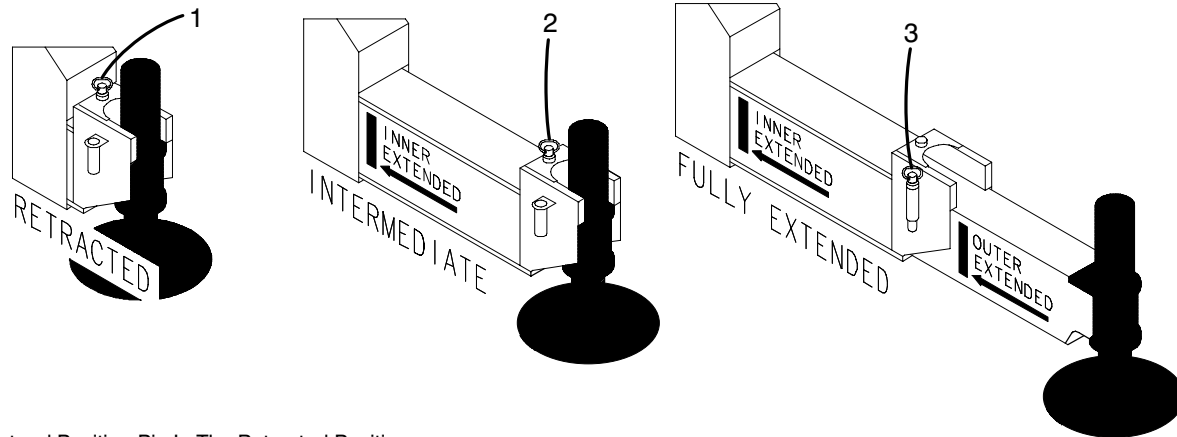
WARNING

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.

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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 1–58
Outrigger Extend Positions



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.
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 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.

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.


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To Extend Outrigger Jacks — Raise The Crane

1. If the crane is equipped with the axle lift system, ensure the air ride suspension switch in the carrier cab is in the "DOWN" 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"  position and hold until the pontoon just contacts the ground.
4. Release both switches.
5. Repeat Steps 2–4 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.

6. Extend the jack cylinders until all tires are clear of the ground.

Note: 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 the crane is level.

7. Raise or lower jacks as required to level the crane.
8. 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, and the front bumper outrigger properly extended. Major reductions in the crane lifting capacity and unsafe operating conditions can result if these conditions are not met.

9. 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

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 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 and that the rear axles are lifted to their highest position with the axle lift switch.

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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. Carefully retract jack until the pontoon just clears the ground.
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. Fully retract all jacks.
11. If the crane is equipped with the axle lift system, move the air ride suspension switch to the "UP" position.

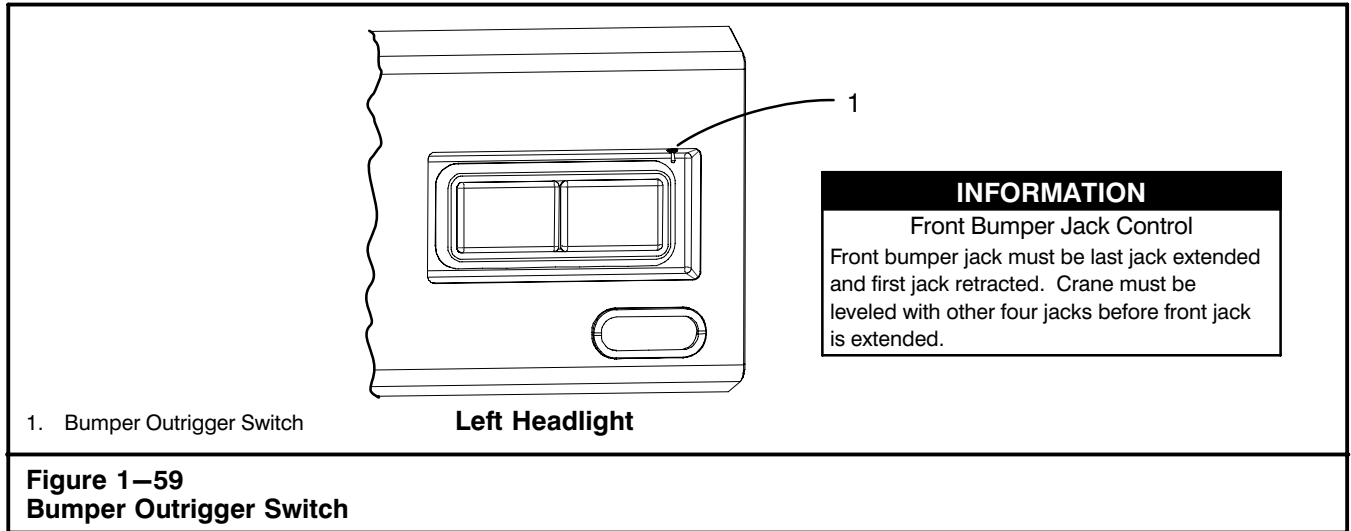
To Retract Outrigger Beams



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.

1. Push an individual outrigger switch to the "BEAM"  position and hold.
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.
6. Store the extend position pins, as required.



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

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. The bumper outrigger pontoon must set on a smooth, solid surface flush with the ground with no hills or valleys under it or it may be damaged or destroyed. If there is any doubt as to the ground conditions, use a mat under the pontoon. Check pontoon before and during operations. If it is allowed to settle, it may lose its effectiveness and make continued operations unsafe.
3. Push the bumper outrigger switch down (or the right side of the switch on the hand held control box) to extend the cylinder. Hold the switch until

the pontoon rests firmly on a solid surface and the hydraulic system goes over relief.



WARNING

Do not extend or retract an outrigger 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.

4. Release the switch.

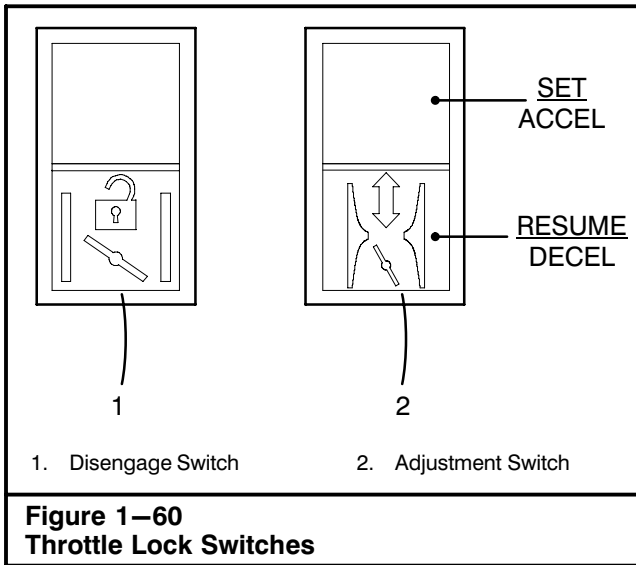
To Retract Bumper Outrigger

1. Push the bumper outrigger switch up (or the left side of the switch on the hand held control box) and hold 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.

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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.

Fire Extinguisher

A fire extinguisher is located under the left seat console. Refer Figure 1-61. 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.

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 1-51. 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. Refer to Figure 1-60. 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.

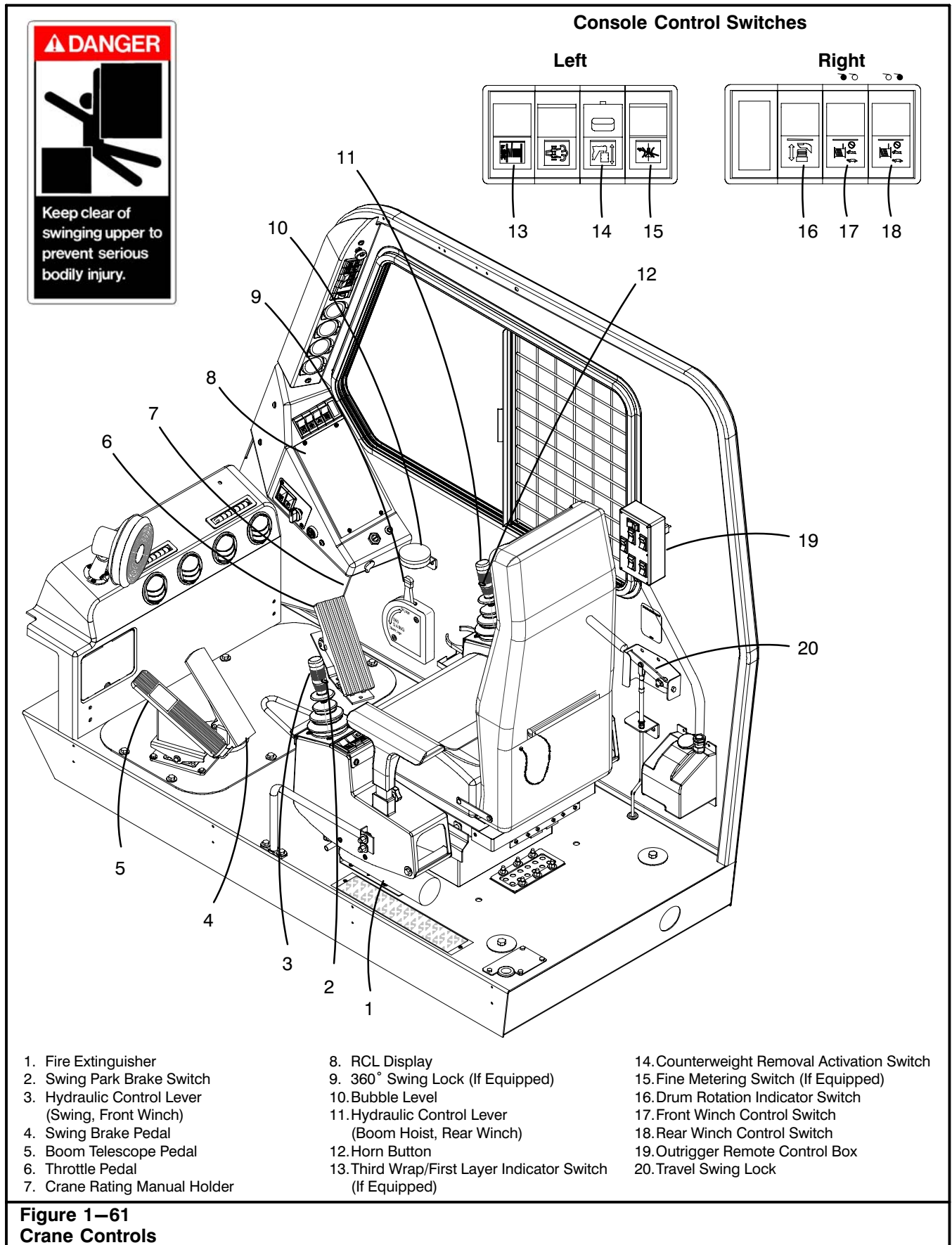
To decrease throttle lock setting, press and hold the adjustment switch to the “RESUME/DECEL” side until desired engine speed is reached and release switch. The throttle lock setting can also be decreased incrementally by pressing and releasing (tap down) the “RESUME/DECEL” side.

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.

Note: The throttle lock system is deactivated anytime the ignition switch is turned off.

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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  position to swing left; move it to the  position to swing right.



WARNING

When on tires or retracted outriggers, with counterweight combinations of 20,500 lb or less, maintain 40° boom angle with fully retracted boom before swinging to over side position. Do not swing to over side position with counterweight combinations over 20,500 lb unless boom angle is less than maximum boom angle shown on Backward Stability chart located in the Crane Rating Manual. When on tires, do not swing to over side position with 32,500 and 39,500 lb counterweight combinations. Crane can tip forward or backward causing crane damage and/or personal injury.

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. Pull the travel swing lock lever up.

Note: In order to disengage the travel swing lock, it may be necessary to swing the upper slightly to relieve the pressure on the swing lock pin.

3. Move the lever to the right and release. The lever 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. Pull the travel swing lock lever up and to the left. Then push the lever down to the locked  position.

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.

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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. Refer to Figure 1–61 for switch location.

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. Refer to Figure 1–61 for switch location.

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.

Note: In order to disengage the 360° swing lock, it may be necessary to swing the upper slightly to allow the swing lock pawl to disengage from the turntable gear teeth

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

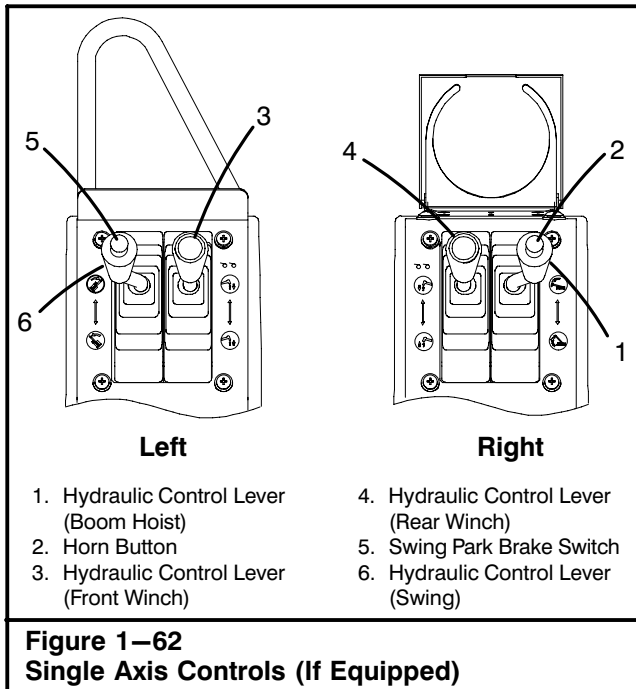
Do not attempt to engage 360° swing lock with the upper in motion. This practice will result in damage to the swing mechanism. Use swing brake pedal to stop rotation of the upper.

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.

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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.

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 or Figure 1-62 if equipped single axis controllers. 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 hookblock until warm oil circulates throughout the winch.

Front Winch Control Lever (If Equipped)

This lever controls the front winch drum. Pull this control lever back to the  position to lift the load. Push this control lever forward to the  position 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 to the  position to lift the load. Push this control lever forward to the  position 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: Position head machinery directly above the load. Attach the hook block or ball to 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.

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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  or  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, push the bottom part of the drum rota-

tion indicator switch , on the right seat console (Figure 1–61), to the “ON” position (indicator within switch will illuminate). 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. Push the top part of the drum rotation switch to deactivate system.

Third Wrap/First Layer Indicator (If Equipped)

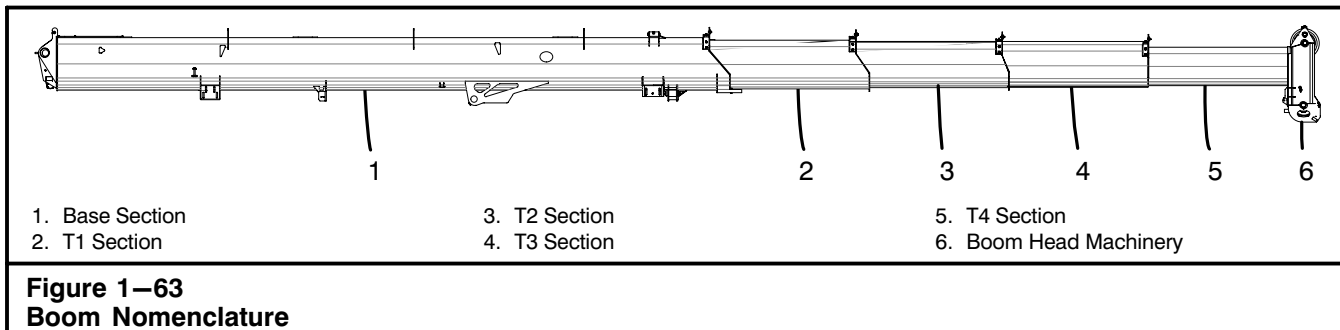
The crane may be equipped with a third wrap/first layer indicator system. This system allows the operator to monitor the wire rope windings on the drum(s). Enable the system through the RCL system using the operator settable alarm feature. Refer to “MicroGuard 540 Rated Capacity Limiter” found in this Section of the Operator's Manual. Once the third wrap/first layer indicator system is enabled, press the third wrap/first layer switch to the “F” (Front) position to monitor the front drum only, “B” (Both) to monitor both drums, or “R” (Rear) to monitor the rear drum only. When the system is enabled, the audible alarm will sound intermittently, and “First Layer” will appear in the warning message area of the RCL display to alert the operator when the wire rope is down the the first layer on the winch drum(s). The audible alarm will sound continuously and “Third Wrap” will appear in warning message area to alert the operator when the wire rope is down to the third wrap on the winch drum(s).



WARNING

Three (3) full wraps of wire rope must be maintained on the winch drum at all times during operation. Rope failure may occur.

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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 or Figure 1–62.



WARNING

When on tires or retracted outriggers, with counterweight combinations of 20,500 lb or less, maintain 40° boom angle with fully retracted boom before swinging to over side position. Do not swing to over side position with counterweight combinations over 20,500 lb unless boom angle is less than maximum boom angle shown on Backward Stability chart located in the Crane Rating Manual. When on tires, do not swing to over side position with 32,500 and 39,500 lb counterweight combinations. Crane can tip forward or backward causing crane damage and/or personal injury.

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 five section boom. The five section boom consists of a base, T1, T2, T3, and a T4 section. Refer to Figure 1–63.

One telescope cylinder and one pin/latch cylinder are used to sequentially telescope one section at a time and pin that section to the next adjacent section in one of 3 positions: 0%, 50%, or 100% extension for each section. The operation of these cylinders is a combination of computer control and operator input. The computer controls which section is being extended or retracted, all pinning and unpinning operations, direction, and in some cases the speed of the telescope cylinder. The operator controls whether to extend or retract the boom and the speed at which to extend or retract the boom.

The telescope feature has five modes of operation and one travel mode:

- EM1 extends all sections 100% for a max boom length of 140 ft (42.7m).
- EM2 extends the T4 section 50% and all other sections 100% for a max boom length of 127.3 ft (38.8m).
- EM3 extends only the T1, T2, and T3 to 100% for a max boom length of 115.8 ft (35.3m). T4 section remains fully retracted.
- EM4 extends the T2, T3, and T4 50% and the T1 100% for a max boom length of 102 ft (31.1m).
- EM5 extends T1, T2, and T3 to 50% for a max boom length of 76.5 ft (23.3m). The T4 section remains fully retracted. Capacities are only available when all the sections are pinned together.

Note: When utilizing the EM5 boom mode, ensure the boom sections are pinned together and the telescope cylinder is unlatched before lifting the allowable capacities. Utilize the boom pinning information on the RCL boom telescope screen to confirm a “Pinned” and “Not Latched” condition.

There is a 10,000 lb (4 536kg) allowable capacity given for telescoping the boom in EM5 boom mode. The 10,000 lb (4 536kg) capacity allows for telescoping the boom with rigging to the appropriate lengths for pinning the section(s) only. Do not attempt to extend or retract the boom with more than 10,000 lb (4 536kg) of rigging when utilizing EM5 boom mode.

- Travel Mode extends only the T1 section from 0–100%. This mode is for use only when the boom needs to be telescoped to transfer axle loading for travel. (An example would be to extend the boom to transfer the boom weight on a boom dolly.) No capacities are available in this mode.

Boom Telescope Mode Selection

The boom modes can be changed only when the boom is fully retracted. If a boom mode change is attempted before boom is fully retracted, the message “Retract Boom” will be displayed and the boom mode will not change. When a boom mode is selected, the telescope controller's first command will be one of the following:

- With software version 56 or lower, the controller will automatically move the telescope cylinder into alignment with the first boom section that is to be extended for the boom mode selected.
- With software version 57 or higher, the controller requires the telescope pedal to be pressed and held to move the telescope cylinder into alignment with the first boom section that is to be extended for the boom mode selected.

Note: To determine which software version is installed on the crane, press the Display/Select button on the RCL display to access Boom Telescope screen. The software version will be located in the General Diagnostic Message Area of the display as “Telescope Latching Controller vXX”. Refer to RCL Boom Telescope Screen and Figure 1–64.

The automatic movement of the telescope cylinder must be allowed to continue to completion before any other telescope function can happen. This movement is most noticeable when the Travel Mode is selected because the cylinder has to travel from either the T4 or T3 section to the T1 section, therefore taking more time to complete. Be patient and allow the system to complete these functions before attempting other functions.

Note: When changing from Travel Mode to Rigging mode, an outrigger selection and boom mode selection must be made prior to selecting rigging mode.

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Boom Extend Modes

BOOM LENGTH (FT)	BOOM TELESCOPE LENGTH (Ft)				
	T4	T3	T2	T1	
50	12.0				<div>EM 1</div>
60	22.0				
70	24.2	7.8			
80	24.2	17.8			
90	24.2	25.1	2.7		
100	24.2	25.1	12.7		
110	24.2	25.1	22.7		
120	24.2	25.1	25.9	6.8	
130	24.2	25.1	25.9	16.8	
140	24.2	25.1	25.9	26.8	
BOOM LENGTH (FT)	BOOM TELESCOPE LENGTH (Ft)				
	T4	T3	T2	T1	
50	11.5	0.5			<div>EM 2</div>
60	11.5	10.5			
70	11.5	20.5			
80	11.5	25.1	5.4		
90	11.5	25.1	15.4		
100	11.5	25.1	25.4		
110	11.5	25.1	25.9	9.5	
120	11.5	25.1	25.9	19.5	
127.3	11.5	25.1	25.9	26.8	
BOOM LENGTH (FT)	BOOM TELESCOPE LENGTH (Ft)				
	T4	T3	T2	T1	
50		12.0			<div>EM 3</div>
60		22.0			
70		25.1	6.9		
80		25.1	16.9		
90		25.1	25.9	1.0	
100		25.1	25.9	11.0	
115.8		25.1	25.9	26.8	
BOOM LENGTH (FT)	BOOM TELESCOPE LENGTH (Ft)				
	T4	T3	T2	T1	
50	11.5	0.5			<div>EM 4</div>
60	11.5	10.5			
70	11.5	12.7	7.8		
80	11.5	12.7	13.0	4.8	
90	11.5	12.7	13.0	14.8	
102	11.5	12.7	13.0	26.8	
BOOM LENGTH (FT)	BOOM FIXED LENGTH (Ft)				
	T4	T3	T2	T1	
50.7		12.7			<div>EM 5</div>
63.7		12.7	13.0		
76.5		12.7	13.0	12.8	

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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.

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. Refer to "MicroGuard 540 Rated Capacity Limiter" found later in this Section of the Operator's Manual

Note: Mode changes can only be made when the boom is fully retracted. When a mode change is made with software version 56 or less, the computer automatically moves the telescope cylinder to line up with the first section to be extended; with software version 57 or higher, the computer requires the telescope pedal to be pressed and held to move the telescope cylinder to line up with the first section to be extended. Allow this operation to finish before continuing. If a boom mode change is attempted before boom is fully retracted, the message "Retract Boom" will be displayed in the Telescope Operation Mode display on the RCL Boom Telescope screen and the boom mode will not change.

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.

CAUTION

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

4. Depress the toe of the telescope control pedal to extend the boom. Allow time for the telescope cyl-

inder to latch to the correct section and pull the pin between sections. The computer will then accelerate the boom section up to a speed proportional to the amount the telescope pedal is depressed. Removing your foot from the pedal will stop telescope operation.

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

Note: In very cold weather, the latch and pin cylinder will not function as fast as normal due to the change in the viscosity of the hydraulic oil. Allow extra time for this function in very cold weather.

5. Depressing the toe of the pedal will begin telescoping. When the section nears the point where the section will be pinned to the adjacent section, the computer automatically slows down the speed of the telescope cylinder. It is not necessary to remove your foot from the pedal or reduce the amount the pedal is depressed, this is done automatically. The section will actually be extended slightly past the pinning point and then slowly reverse direction to gently load up the pin and unload the latches that attach the telescope cylinder to the section being extended.

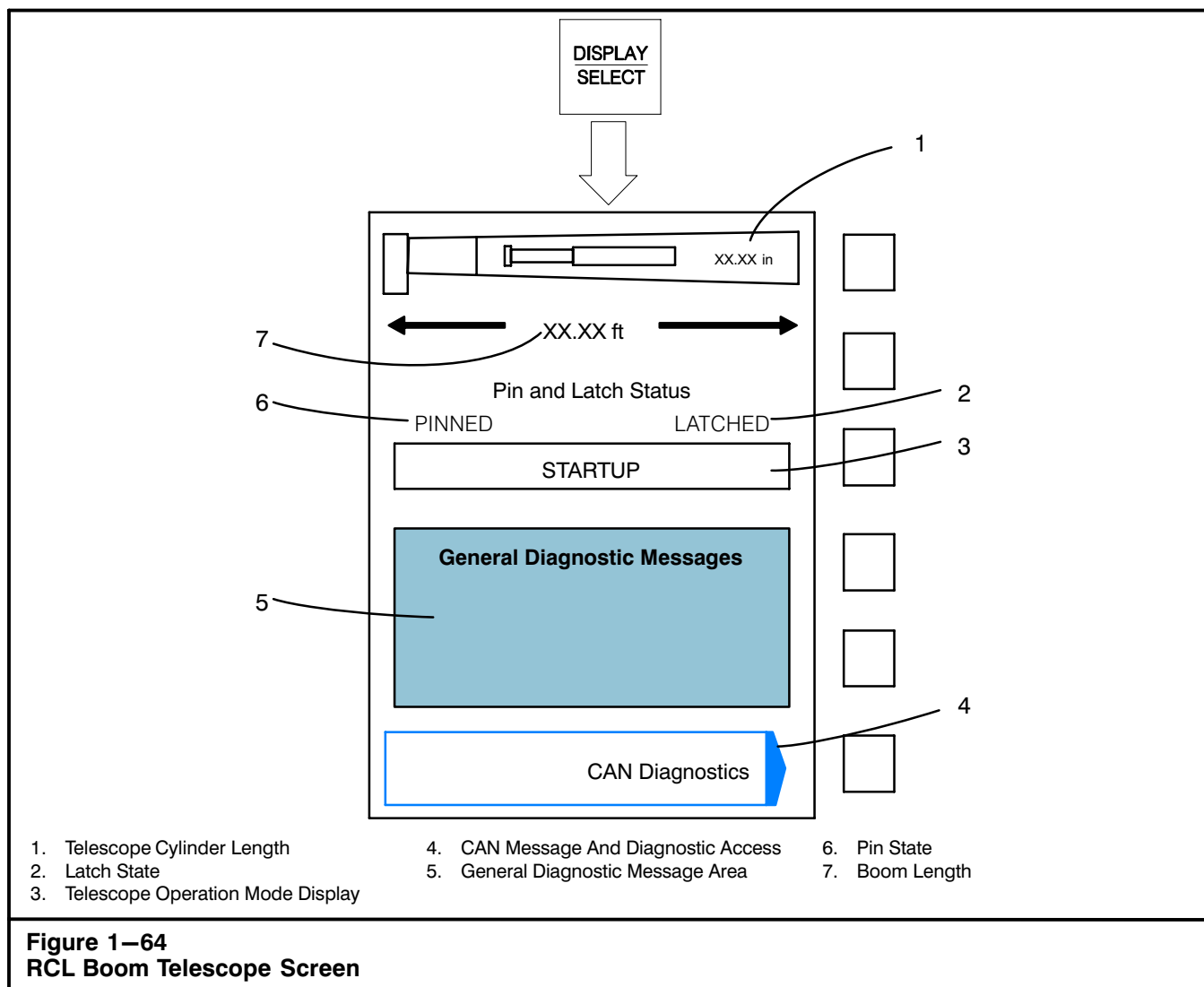
Note: The RCL system is equipped with an alternate screen for visual feedback about what is occurring while telescoping. Press the Display/Select button on the RCL display to access this screen. Refer to RCL Boom Telescope Screen and Figure 1—64.

CAUTION

If a load is suspended while telescoping, the load will lower slightly during the pinning operation. This is more noticeable with a single part of line.

6. Continue to depress the toe of the telescope control pedal until the desired boom length is achieved. When the desired boom length is achieved remove your foot from the telescope control pedal. The last section extended can be telescoped until the cylinder is pinned and not latched to eliminate boom length changes due to thermal changes in the hydraulic oil in the cylinder or leakage in the extend system valves.

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To Retract The Boom Sections

1. Depress the heel of the telescope control pedal.

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

Note: In very cold weather, the latch and pin cylinder will not function as fast as normal due to the change in the viscosity of the hydraulic oil. Allow extra time for this function in very cold weather.

RCL Boom Telescope Screen

The RCL system is equipped with an alternate screen for visual feedback about what is occurring while telescoping the boom. Press the Display/Select button on the RCL display to access this screen. Refer to Figure 1–64. The screen will display a graphic representation of the boom at the top of the screen and will display the boom length in feet and the telescope cylinder location in inches. Just below the boom graphic the pin and the latch status and the telescope operation mode will be displayed. Below this is an area that displays the various CAN BUS information and error messages. Display of this screen is a personal preference as the boom can be telescoped with the main working screen displayed.

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Boom Operating and Error Messages

The following charts list the operation and error messages displayed in the Telescope Operation Mode Display.

Normal Operation Messages		
Message	Meaning	What Is Happening
E_Ret	Extend – Cylinder Retract Telescope cylinder is retracting at maximum speed to line up with the next section to be extended.	Boom is pinned and not latched. Telescope cylinder moves at maximum speed regardless of pedal position within retract range. Boom will not enter this condition unless pin/latch state is Pinned and Not Latched.
E_SRB	Extend – Slow Retract Bottom Extending boom at slow speed near the 0% pin location. Telescope cylinder is retracting.	Telescope cylinder is latching into the next section to extend and is unpinning it at the 0% pin location.
E_SEB	Extend – Slow Extend Bottom Extending boom at slow speed near the 0% pin location. Telescope cylinder is extending.	Telescope cylinder is latching into the next section to extend and is unpinning it at the 0% pin location.
E_Ext	Extend – Boom Extend Extending boom at speed proportional to extend pedal input.	Section is latched to telescope cylinder and not pinned. Boom will not enter this condition unless pin/latch state is Not Pinned and Latched.
E_SRT	Extend – Slow Retract Top Extending boom at slow speed near the 50% or 100% pin location. Telescope cylinder is retracting.	Pin is being engaged in the hole and the telescope cylinder is retracting to gently load up the pin and unload the latches.
E_SET	Extend – Slow Extend Top Extending boom at slow speed near the 50% or 100% pin location. Telescope cylinder is extending.	Pin should be fully engaged in the hole and the telescope cylinder is extending out slightly so the latches can disengage from the section.
StopExt	Boom Stop Extend	Boom has finished extending. No further action is required.
R_Ret	Retract – Cylinder Retract Telescope cylinder is extending at maximum speed to line up with the next section to be retracted.	Boom is pinned and not latched. Telescope Cylinder moves at maximum speed regardless of pedal position within retract range. Boom will not enter this condition unless pin/latch state is Pinned and Not Latched.
R_SET	Retract – Slow Extend Top Retracting boom at slow speed near the 50% or 100% pin location. Telescope cylinder is retracting.	Telescope cylinder is latching into boom section to be retracted. Cylinder is retracting at slow speed.
R_SRT	Retract – Slow Retract Top Retracting boom at slow speed near the 50% or 100% pin location. Telescope cylinder is extending.	Telescope cylinder is latched into boom section and pulling the pin. Cylinder is extending at slow speed to gently unload the pin so it can be pulled.
R_Ext	Retract – Boom Extend Retracting boom at speed proportional to retract pedal input.	Boom section is latched to telescope cylinder and not pinned. Boom will not enter this condition unless pin/latch state is Not Pinned and Latched.

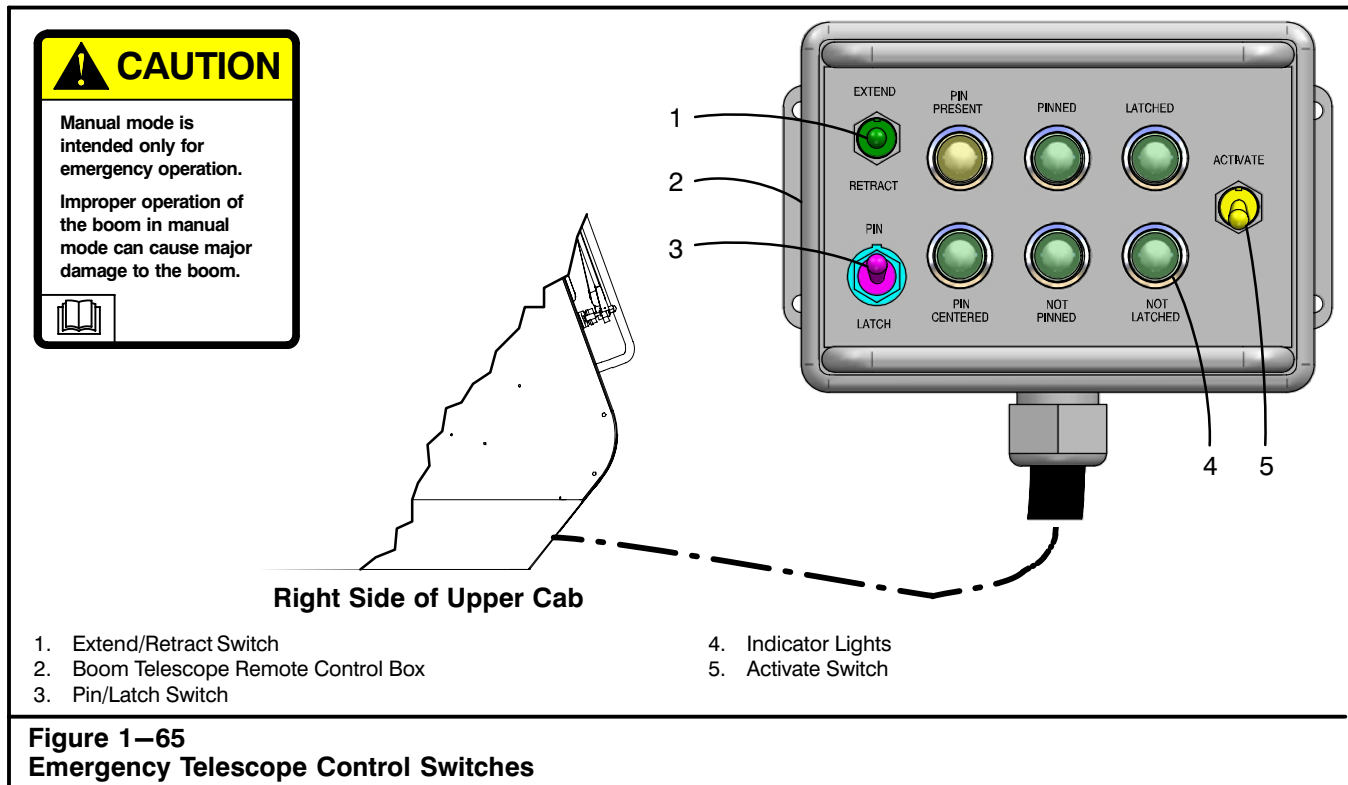
Operator's Manual

Normal Operation Messages		
Message	Meaning	What Is Happening
R_SEB	Retract – Slow Extend Bottom Retracting boom at slow speed near the 0% pin location. Telescope cylinder is retracting.	Telescope cylinder is easing the boom section to a stop at the 0% pinning location for that section.
R_SRB	Retract – Slow Retract Bottom Retracting boom at slow speed near the 0% pin location. Telescope cylinder is extending.	Boom section has been pinned at 0% location and the telescope cylinder is slowly extending back out to unload the latches and allow them time to fully disengage from the section.
StopRet	Boom Stop Retract	Boom has finished retracting. No further action is required.
Neutral	Telescope pedal is centered.	No input from the operator is being sensed by the controller.
Release	Pin and unlatch from incorrect section	Telescope cylinder is not lined up with correct section to be moved. Controller is automatically pinning and unlatching from the incorrect section and moving to line up with correct section.
ExtSlow	Cylinder is extending slowly	Telescope cylinder is moving slowly to allow pin/latch state to reach a valid state.
		<p>CAUTION</p> <p>Do not shut the crane power off with this message displayed if the cylinder length is between these values:</p> <p>170.2 to 171.3 if T4 is being extended. 174.9 to 176 if T3 is being extended. 167.4 to 168.5 if T2 is being extended. 154.6 to 155.7 if T1 is being extended.</p> <p>Shutting the crane power off and restarting it between these cylinder lengths could potentially shear the bolts in the base section cover plate.</p>
RetSlow	Cylinder is retracting slowly.	Telescope cylinder is moving slowly to allow pin/latch state to reach a valid state.
		<p>CAUTION</p> <p>Do not shut the crane power off with this message displayed if the cylinder length is between these values:</p> <p>170.2 to 171.3 if T4 is being extended. 174.9 to 176 if T3 is being extended. 167.4 to 168.5 if T2 is being extended. 154.6 to 155.7 if T1 is being extended.</p> <p>Shutting the crane power off and restarting it between these cylinder lengths could potentially shear the bolts in the base section cover plate.</p>

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Error Messages		
Message	Meaning	How To Clear Message
Cur1Err	Telescope valve section 1 current error. Controller is not detecting the correct current.	Check all wires and connectors between the telescope controller and the telescope valve solenoids. Error may occur during manual boom operation. Shutdown and restart crane to clear.
Cur2Err	Telescope valve section 2 current error. Controller is not seeing the correct current.	Check wires and connectors between telescope controller and telescope valve solenoids.
OvrLoad	RCL system has detected an overload condition while operator is trying to extend boom.	Decrease radius or reduce load.
CylErr	Invalid Cylinder Position (Cylinder position was not received by the controller or position reported is outside of the valid range.)	Check all wires and connectors to the Cylinder Position Encoder. Using the remote control box, fully retract the boom, pin the boom, and unlatch the telescope cylinder. Using the remote control box, fully retract the telescope cylinder until it bottoms out. Request to Zero Telescope Cylinder Position.
PdIErr	Invalid Pedal Input Signal. (Anytime arm rest is in the up position, PdIErr will be displayed).	<p>Check all wires and connectors to the pedal. Do not press the pedal to it's maximum stroke in the direction that gives the error.</p> <p>CAUTION</p> <p>The boom section may start moving as soon as the pedal is moved from maximum stroke.</p>
Int_Err	Internally Detected Error	Something is wrong internally in the telescope valve controller. Controller must be repaired or replaced by a qualified technician.
LtchErr	Pin Pulled and Latch Pulled inputs both active at the same time or Latch Pulled signal expected but not received.	Continue holding down extend/retract pedal for at least 30 seconds to ensure error does not correct itself. Check pin/latch relays first. Check all wiring in the pin and latch switch circuits. Check pin and latch switches.
PdICtr?	Telescope pedal was not centered upon starting the crane.	Center the pedal.
Sw_Err	Switch Error – invalid or unexpected combination of switch inputs.	Shutdown crane and restart to see if error corrects itself. Check all switches for proper operation and that switch inputs are getting to the telescope valve controller.
Rezero	Telescope cylinder needs to be rezeroed. Occurs when a "Sw_Err" message appears when operating the boom with the boom telescope remote control box.	Using the remote control box, fully retract the boom, pin the boom, and unlatch the telescope cylinder. Using the remote control box, fully retract the telescope cylinder until it bottoms out. Request to Zero Telescope Cylinder Position.

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Emergency Telescope Operation

WARNING

Manual mode is intended for emergency operation only. Improper operation of the boom in manual mode can damage internal components of the boom. This can lead to crane damage, property damage, or possibly personal injury.

The crane has been designed with the ability to telescope the boom manually. This is intended only for emergency operation. Note the following restrictions:

- Do not telescope the boom in manual mode with a load on the hook. Set the load down before telescoping.
- Use the holes provided in the side of each boom section to visually check to ensure that pins and latches are fully engaged or disengaged before moving boom sections or the telescope cylinder.
- Clear all unauthorized personnel from the area surrounding the crane. Ensure that all authorized personnel are well out of the way of all moving parts.

The emergency telescope control switches are located on a remote control box stored in the tool box under the operator's seat. To enable the switches, connect the cord to the electrical connector on the lower right corner of the operator's cab. To enable the extend/retract and pin/latch switches, move and hold the activate switch to the "ACTIVATE" position. Refer to Figure 1–65.

WARNING

When the emergency telescope control box is connected to the upper, the RCL system automatically changes to rigging mode. The RCL system is not operational when in the rigging Mode. Disconnect the remote control box, turn the ignition switch to the "OFF" position, and return the RCL system to normal operation before operating the crane.

When the emergency telescope control box is connected to the upper, the RCL system automatically changes to the rigging mode. All function limiters except anti-two block are disabled when the RCL is in the rigging mode.

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To Manually Retract A Boom Section



WARNING

Manual mode is intended for emergency operation only. Improper operation of the boom in manual mode can damage internal components of the boom. This can lead to crane damage, property damage, or possibly personal injury.

1. If the telescope cylinder is not already latched to the section to be retracted, move the pin/latch switch to the "PIN" position (up) and visually check to ensure that the telescope cylinder is not latched to a section. NOT LATCHED indicator light should illuminate.
2. Using the Extend/Retract switch, telescope the cylinder out until the latches align with the holes in the rear of the section to be retracted. The center roller that pulls the pin down should be near the center of the pin. The PIN CENTERED indicator light will illuminate when the cylinder is centered with the pin. Refer to the following chart for telescope cylinder positions.

Extend Mode	Boom Length	Telescope Cylinder Length
	±0.25 ft	±0.25 in
EM1	140.0	322.9
	113.2	322.9
	87.3	322.9
	62.2	322.9
EM2	127.3	322.9
	100.5	322.9
	74.6	322.9
	49.5	170.6
EM3	115.8	322.9
	89.0	322.9
	63.1	322.9
EM4	102.0	322.9
	75.2	167.7
	62.2	175.3
	49.5	170.6
EM5	76.5	155.0
	63.7	167.7
	50.7	175.3

3. Move the Pin/Latch switch to the LATCH position and visually check to ensure that the latches have fully engaged the section. LATCHED indicator light should illuminate.
4. Use the Extend/Retract switch to telescope the cylinder in or out slightly as needed to allow the latches to fully engage the section.
5. When the latches are fully engaged (LATCHED indicator light illuminated), telescope the cylinder out slightly to unload the pin. The pin will pull when it is unloaded. NOT PINNED indicator light should illuminate.
6. When the pin is pulled, the section can be retracted. Be sure to winch up while retracting the section to maintain tension on the wire rope so it will spool correctly.
7. When the section is fully retracted, move the Pin/Latch switch to the PIN position. PINNED indicator light should illuminate.
8. Extend the cylinder slightly to unload the latches and allow them to disengage from the section. Visually check to ensure that the latches are fully disengaged from the section before retracting another section. NOT LATCHED indicator light should illuminate.
9. Repeat this operation until boom is fully retracted.
10. Disconnect remote control box, turn the ignition switch to the "OFF" position, and return the RCL system to normal operation before operating crane.

Operator's Manual

To Manually Extend A Boom Section



WARNING

Manual mode is intended for emergency operation only. Improper operation of the boom in manual mode can damage internal components of the boom. This can lead to crane damage, property damage, or possibly personal injury.

1. If the telescope cylinder is not already latched to the section to be extended, move the Pin/Latch switch to the PIN position and visually check to ensure that the telescope cylinder is not latched to a section. NOT LATCHED indicator light should illuminate.
2. Press the Extend/Retract switch to telescope the cylinder until the latches align with the holes in the rear of the section to be extended. The center roller that pulls the pin down should be near the center of the pin. The PIN CENTERED indicator light will illuminate when the cylinder is centered with the pin. Refer to the following chart for telescope cylinder positions.

Extend Mode	Boom Length	Telescope Cylinder Length
	±0.25 ft	±0.25 in
EM1	38.0	33.0
	62.2	22.0
	87.3	11.7
	113.2	1.0
EM2	38.0	33.0
	49.5	22.0
	74.6	11.7
	100.5	1.0
EM3	38.0	22.0
	63.1	11.7
	89.0	1.0
EM4	38.0	33.0
	49.5	22.0
	62.2	11.7
	75.2	1.0
EM5	38.0	22.0
	50.7	11.7
	63.7	1.0

3. Press the Pin/Latch switch to the LATCH position and visually check to ensure that the latches have fully engaged the section.
4. Telescope the cylinder in or out slightly as needed to allow the latches to fully engage the section.
5. When the latches are fully engaged (LATCHED indicator light illuminated), telescope the cylinder out slightly to unload the pin. The pin will pull when it is unloaded. NOT PINNED indicator light should illuminate.

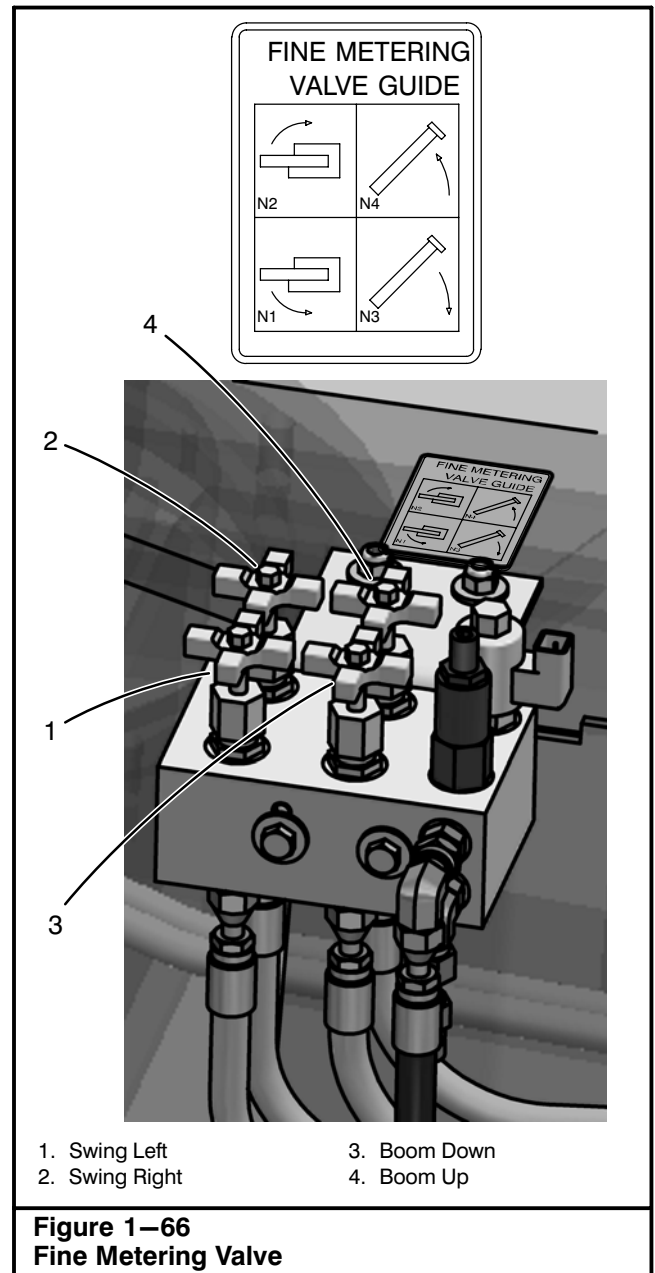
CAUTION

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

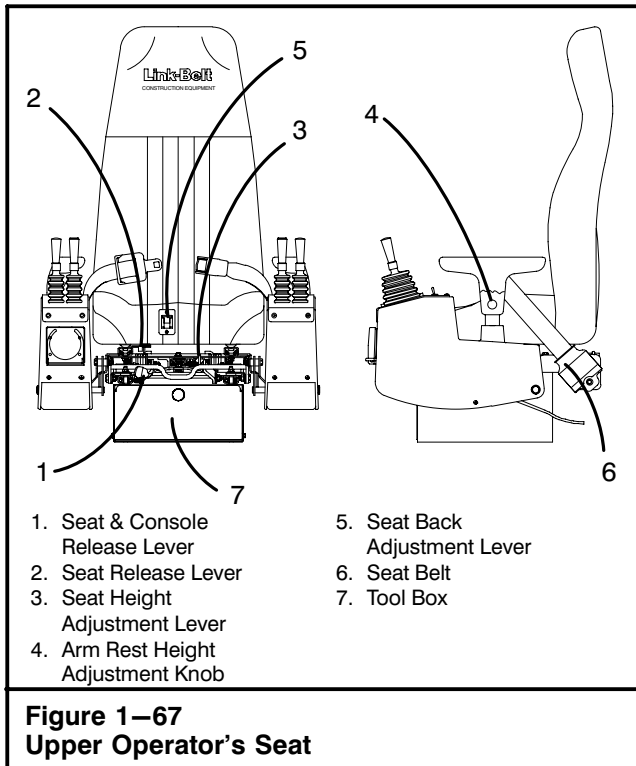
6. When the pin is pulled the section can be extended. Be sure to winch down while extending the section to avoid two blocking.
7. When pin is lined up with the hole it is to be pinned into, move the Pin/Latch switch to the PIN position.
8. Visually check to verify that the pin has fully engaged the pin hole. If it has not engaged the pin hole, press the Pin/Latch switch to the LATCH position and telescope the cylinder in the direction required to align the pin with the hole. Repeat Step 7.
9. Retract the cylinder to load up the pin. If this is done at a high boom angle further retraction of the cylinder will unload the latches and allow them to disengage from the section. If this is done at a low boom angle, the cylinder must be extended slightly to unload the latches and allow them to disengage from the section.
10. When the cylinder is disengaged from the section, it can be retracted to align with the next section to be extended and the process can be repeated to extend other boom sections as required.

Fine Metering System

This crane may be equipped with a fine metering system is used to adjust the crane's hydraulic functions to certain job functions or for settings that are comfortable to the operator. The system is for precise controlled operation and heavy lift capacity with slower speed. Use for jobs where accurate positioning is more important than speed. The system is activated by the fine metering switch located on the gauge and control panel. Refer to Figure 1–51 for switch location. The control valve is located behind the operator's cab.



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Operator's Seat

This 6-way adjustable seat is controlled by manual controls. Refer to Figure 1–67.



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.



WARNING

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

1. Seat And Console Release Lever

Move the seat and 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.

5. Seat Back Adjustment Lever

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

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.

7. Tool Box

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

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 1–68. 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 1–69 and Figure 1–71.

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 or hook ball, 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.

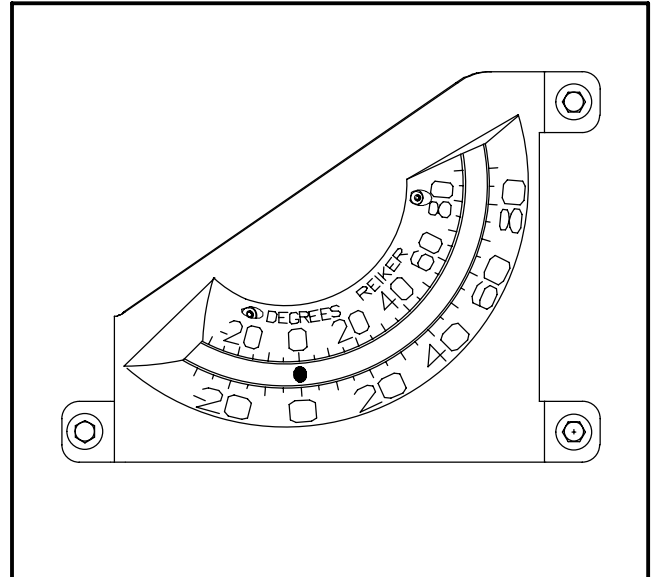


Figure 1–68
Boom Angle Indicator

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.

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.

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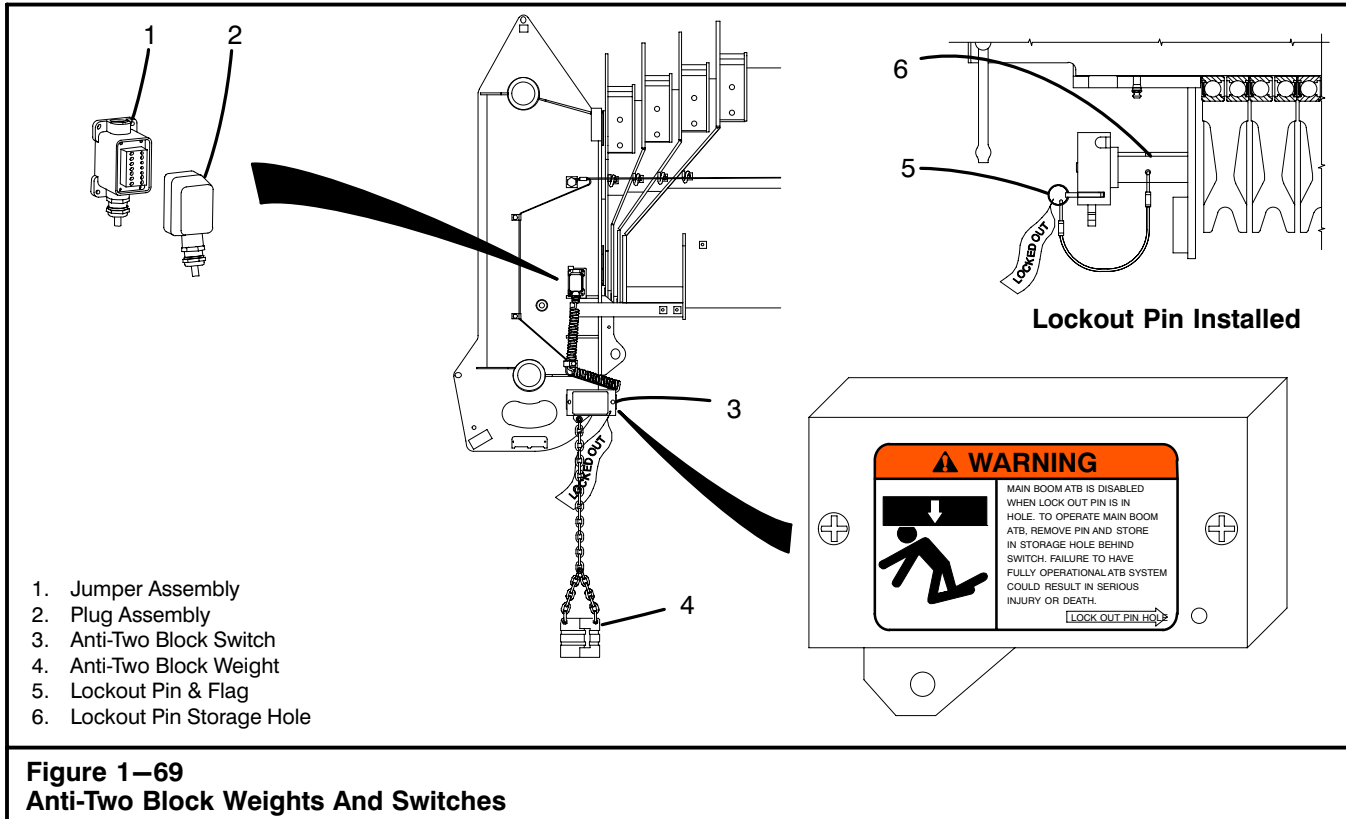


Figure 1-69
Anti-Two Block Weights And Switches

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 the anti-two block switch on each attachment.

Operator's Manual

MicroGuard 540 Rated Capacity Limiter

The following describes the function and operation of the Microguard 540 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!!

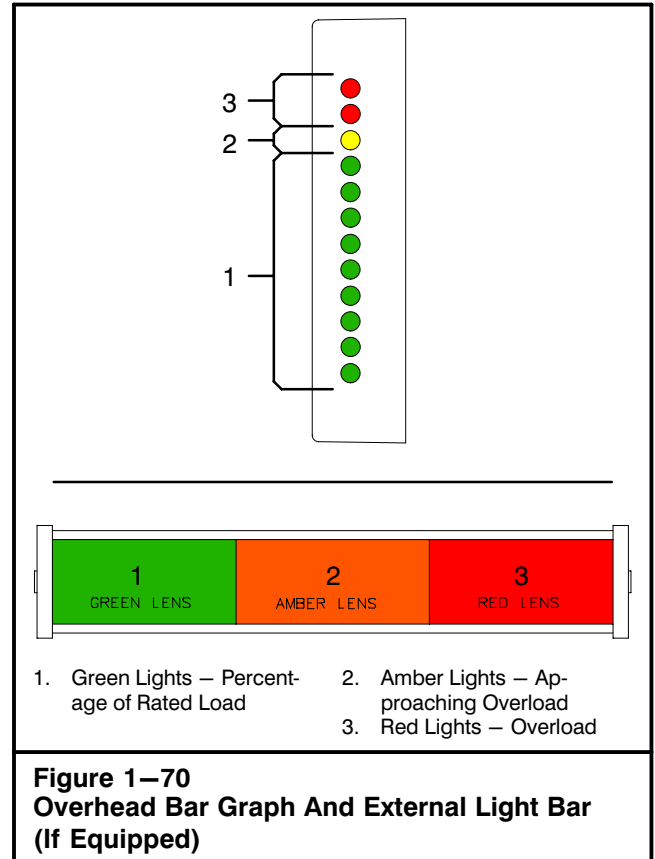
System Description

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 540 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
- Height of the Main Boom Head

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.



Display Unit

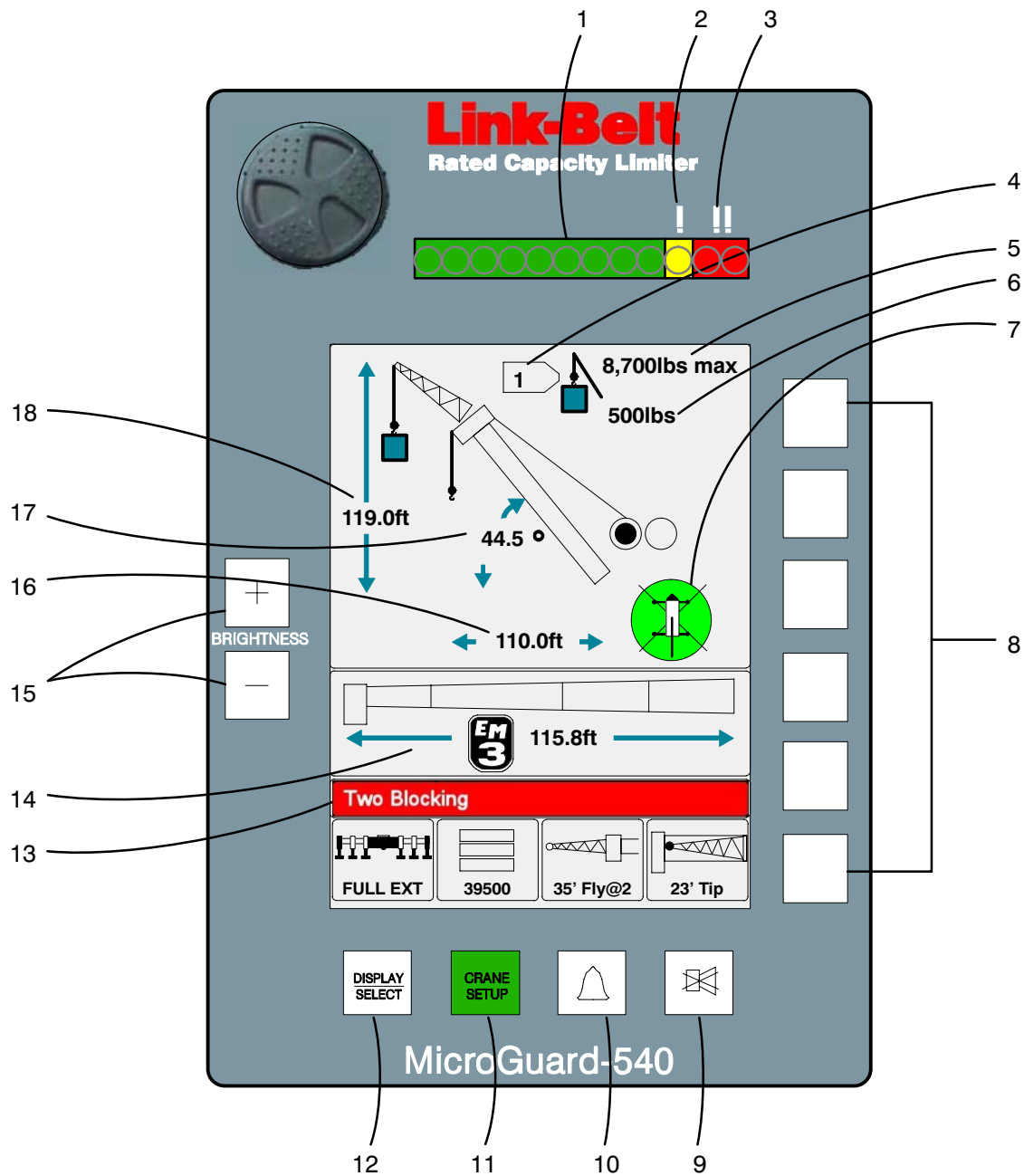
The following is a description of the control buttons, indicators, and windows on the display unit. Use them along with Figure 1-71.

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 1-70.

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- | | | |
|-----------------------------------|------------------------------------|------------------------------|
| 1. Bar-Graph | 7. Working Area Display | 13. Warning Message Area |
| 2. Pre-Alarm Indicator | 8. Configuration Selection Buttons | 14. Boom Length Display |
| 3. Overload Indicator | 9. Cancel Alarm | 15. Brightness Buttons |
| 4. Parts-of-Line Display | 10. Operator Alarms Button | 16. Load Radius Display |
| 5. Maximum Rated Capacity Display | 11. Crane Setup Button | 17. Boom Angle Display |
| 6. Actual Load Display | 12. Display/Select Button | 18. Boom Head Height Display |

Figure 1–71
Microguard 540 Rated Capacity Limiter

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2. Pre-Alarm indicator

The Pre-Alarm (yellow) Indicator illuminates at a pre-set 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. Parts-of-Line Display

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

5. 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.

6. 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.

7. Working Area Display

This area displays a graphical representation of the allowable lifting quadrant(s) based on the selected configuration. A quadrant not allowed will be filled red, an allowable quadrant will be filled green.

8. 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.

9. Cancel Alarm Button

This button is used to silence the audible alarm when the alarm has occurred as a result of either an Overload, 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 or a Two Block alarm.

10. 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.

11. 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.

12. Display/Select Button

This button is used to access the boom telescope screen for visual feedback about what is occurring while telescoping. Refer to "Boom Telescope System" found earlier in this Section of the Operator's Manual.

13. 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.

14. 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 centerline of the boom head machinery.

15. Brightness Buttons

These buttons are used to adjust the display brightness.

16. 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.

17. Boom Angle Display

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

18. Boom Head Height Display

The Boom Head Height Display gives a continuous display of the height of the boom head shaft or attachment head shaft above ground level, that is the vertical distance from the ground to the working head shaft.

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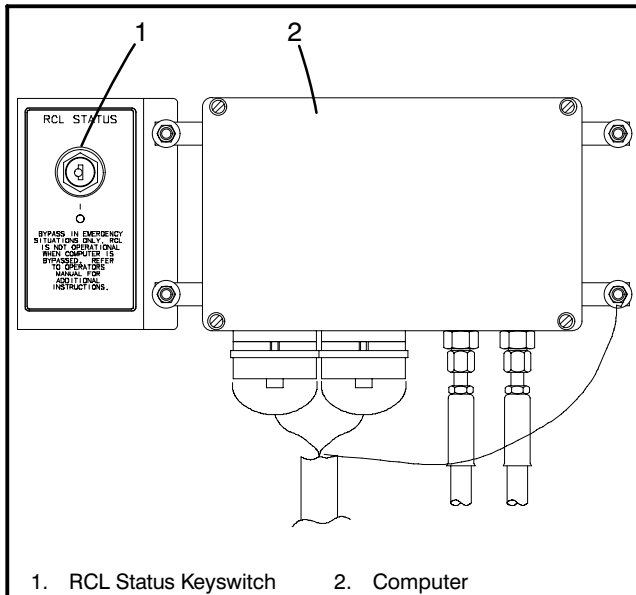


Figure 1–72
Rated Capacity Limiter Computer

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 diagnostic screen. The diagnostic screen lists information 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, 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. 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 540 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.
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 marking 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.

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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.

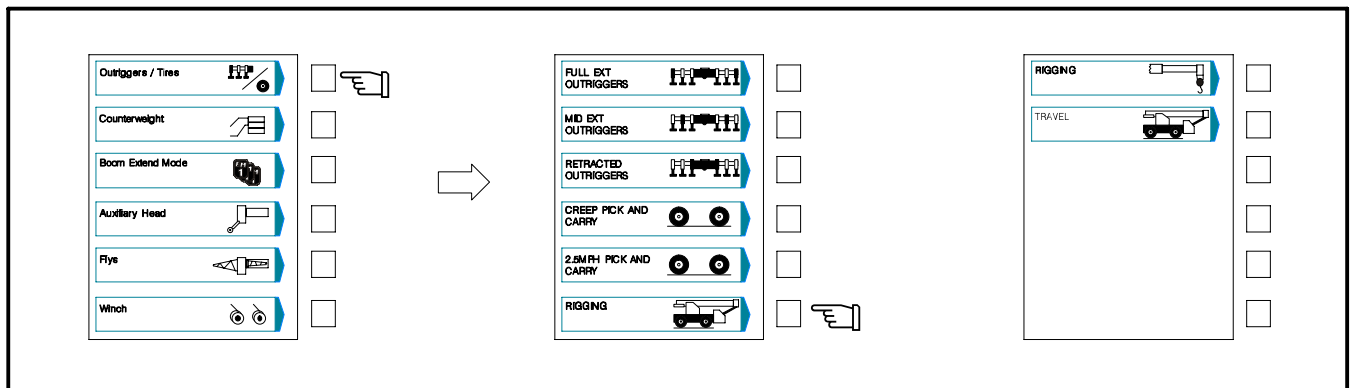


Figure 1–73
Carrier Selection

1. From the normal working screen press the CRANE SETUP button. The normal working screen will change and graphically display the crane configurations that can be selected from the crane set up screen. Press the corresponding configuration selection button to select the carrier configuration.
2. The crane setup screen will change and graphically display the carrier options. Press the corresponding configuration selection button to select the desired carrier configuration. If rigging is desired, refer to “To Select Rigging/Travel Mode” found later in this Section of the Operator’s Manual.



WARNING

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

3. Press the CRANE SETUP button to return to the crane setup screen.

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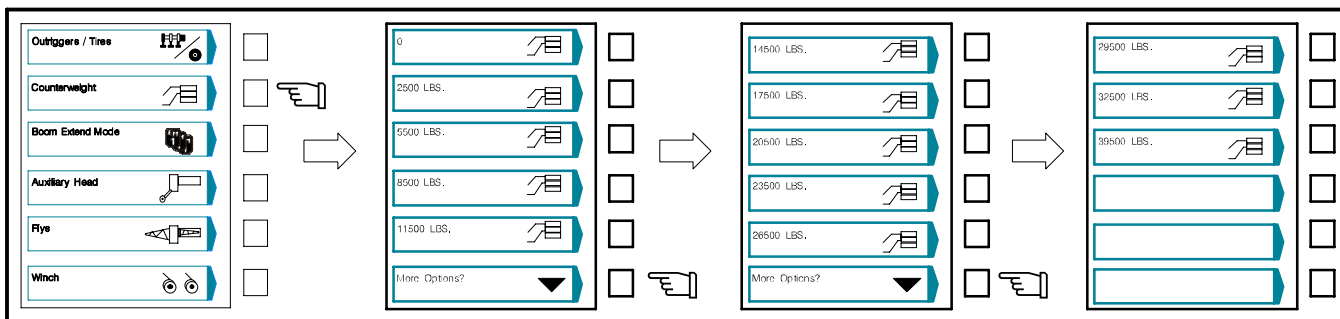


Figure 1-74
Counterweight Selection

4. On the crane set up screen, press the corresponding configuration selection button to select the counterweight options. Press the corresponding configuration selection button to select the desired counterweight.
5. Press the CRANE SETUP button to return to the crane setup screen.

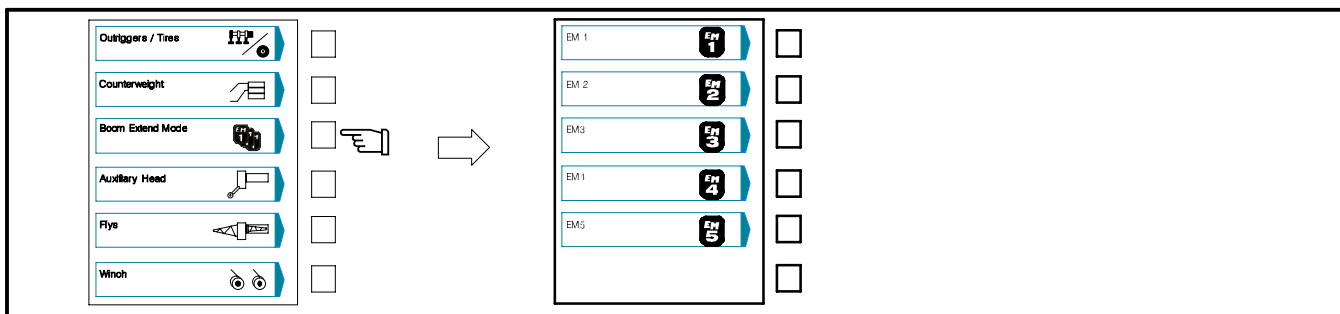


Figure 1-75
Boom Extend Mode Selection

6. On the crane set up screen, press the corresponding configuration selection button to select 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 and the telescope cylinder unlatched from all boom sections.

7. Press the CRANE SETUP button to return to the crane setup screen.

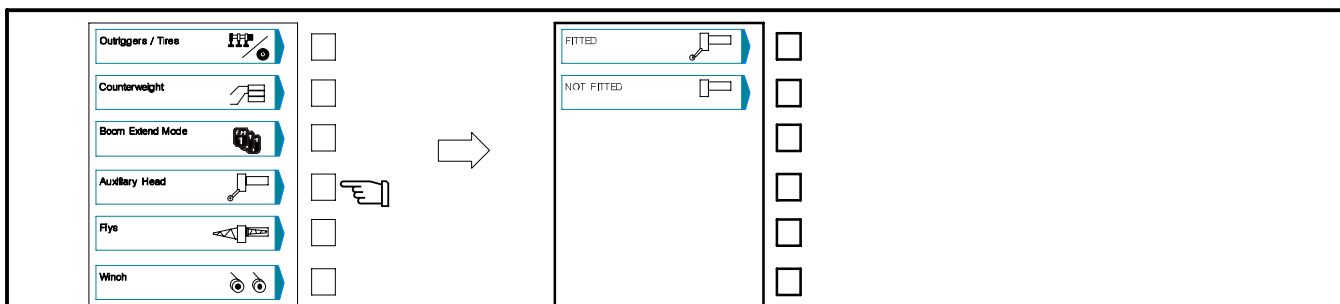


Figure 1-76
Auxiliary Head Selection

8. On the crane set up screen, press the corresponding configuration selection button to display the auxiliary lifting sheave fitted or not fitted. Press the corresponding configuration selection button to select the desired auxiliary lifting sheave.
9. Press the CRANE SETUP button to return to the crane setup screen.

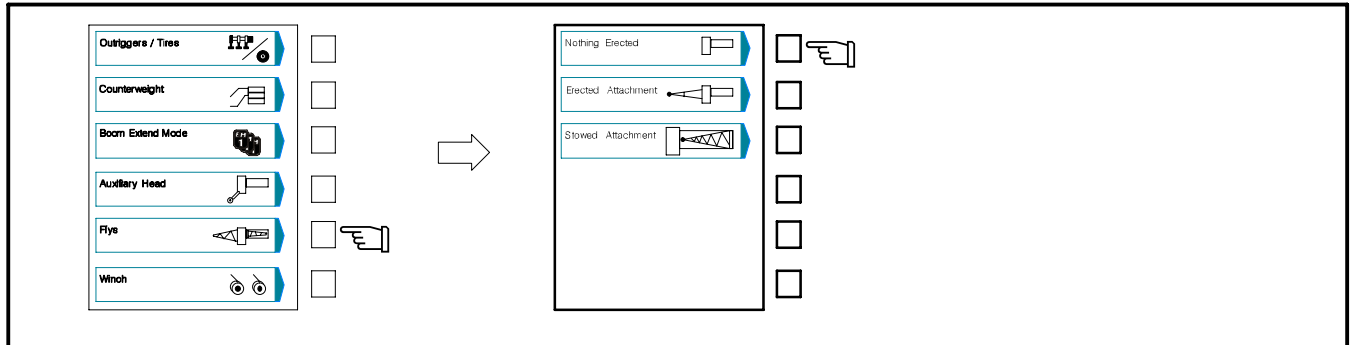


Figure 1–77
Nothing Erected Selection

10. On the crane set up screen, press the corresponding configuration selection button to display the fly options. Press the corresponding configuration selection button to select the desired erected fly, if required.
 - a. If nothing erected is selected, the attachment screen will return to the crane setup screen.

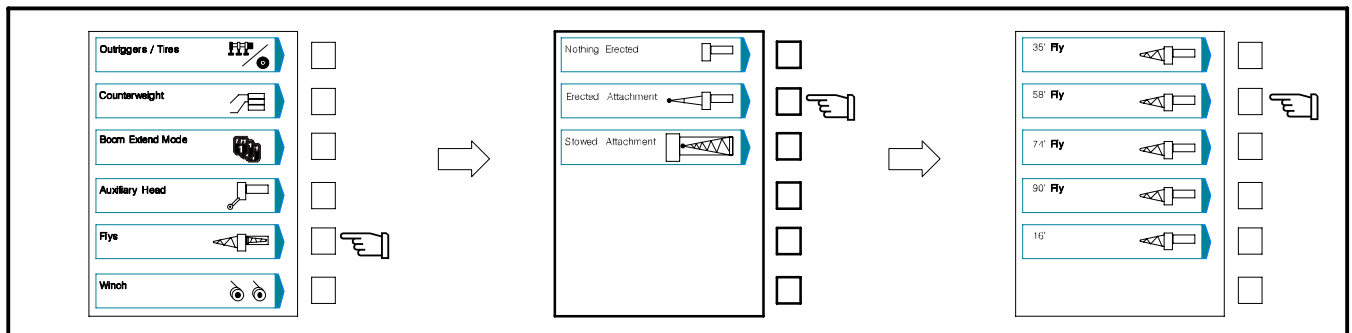


Figure 1–78
Erected Attachment Selection

- b. If erected attachment is selected, the attachment screen will change and graphically display the available attachments as required.

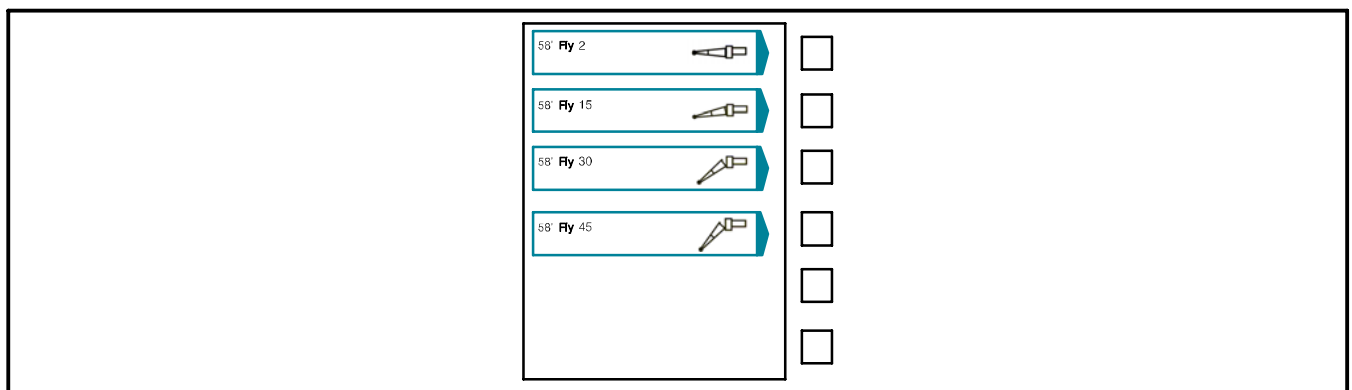


Figure 1–79
Erected Attachment Offset Selection

- c. If erected attachment is selected, the attachment screen will change and graphically display the available offsets as required.
 - d. Press the corresponding configuration selection button to select the desired offset angle.
 - e. Press the CRANE SETUP button to return to the crane setup screen.

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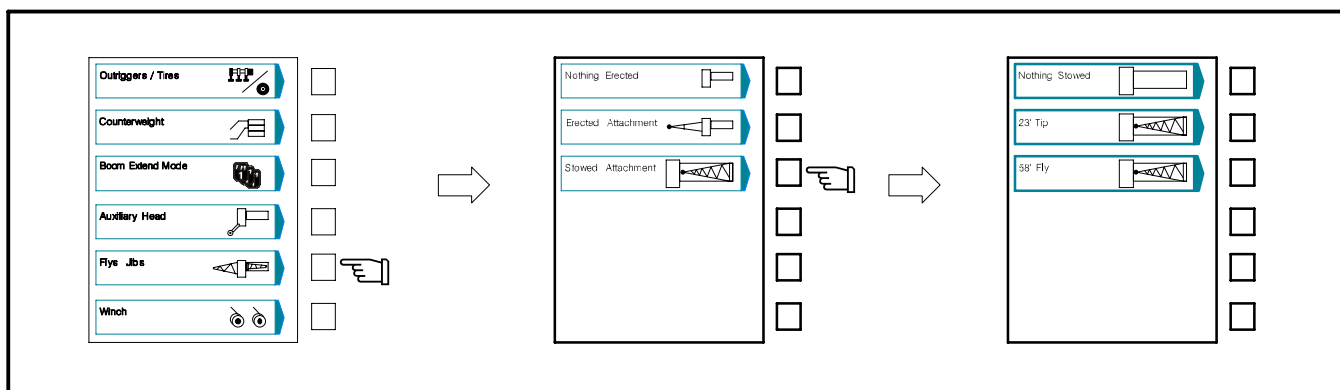


Figure 1-80
Stowed Attachment Selection

11. If the crane is equipped with a fly and was not selected as an erected attachment, press the corresponding configuration selection button to select Fly Jib. Press the corresponding configuration selection button to select Stowed Attachment. Press the corresponding configuration selection button to select the desired stowed deduct if required.
12. Press the CRANE SETUP button to return to the crane setup screen.

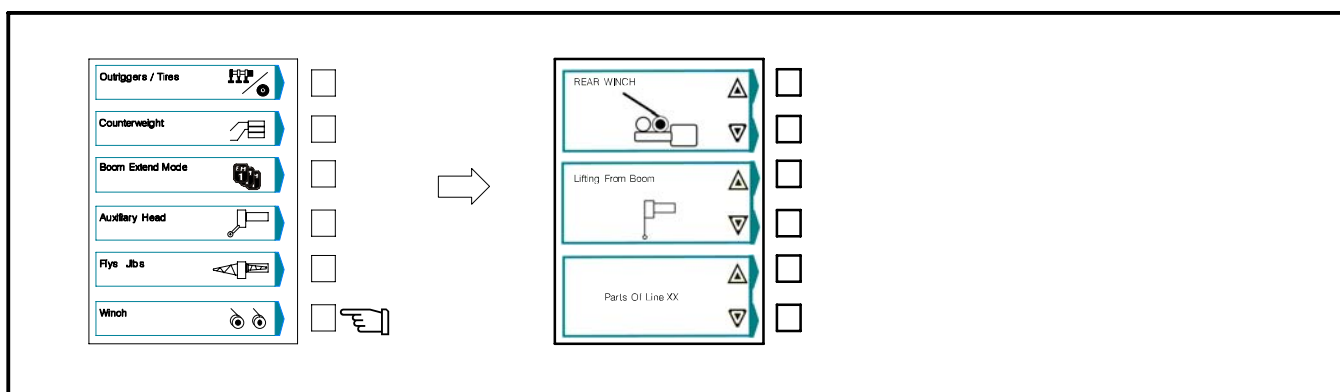


Figure 1-81
Winch Configuration

13. Press the corresponding configuration selection button to select the winch configuration.

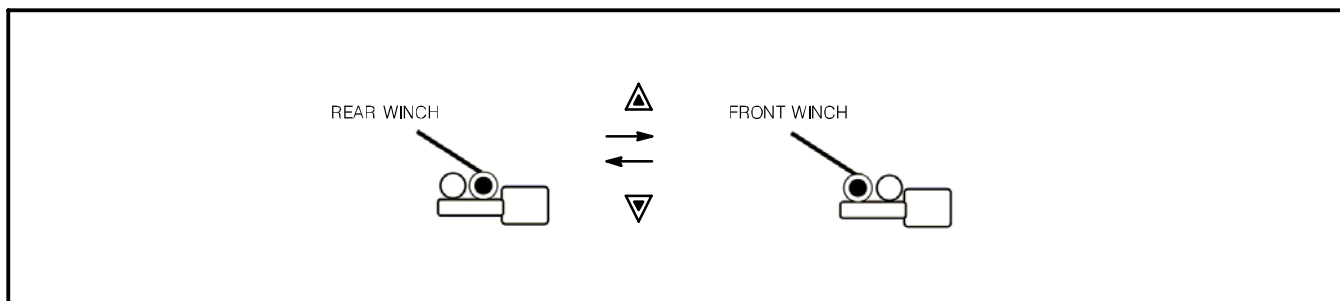
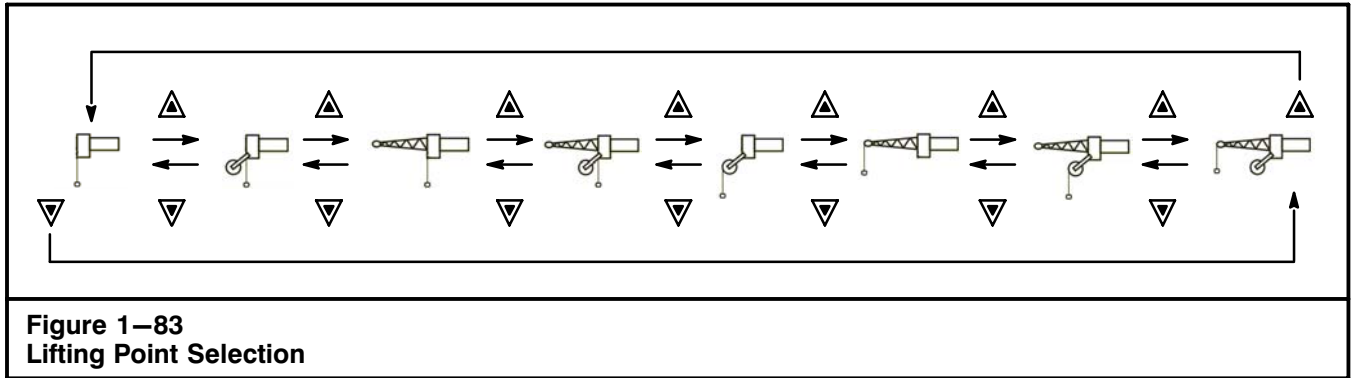
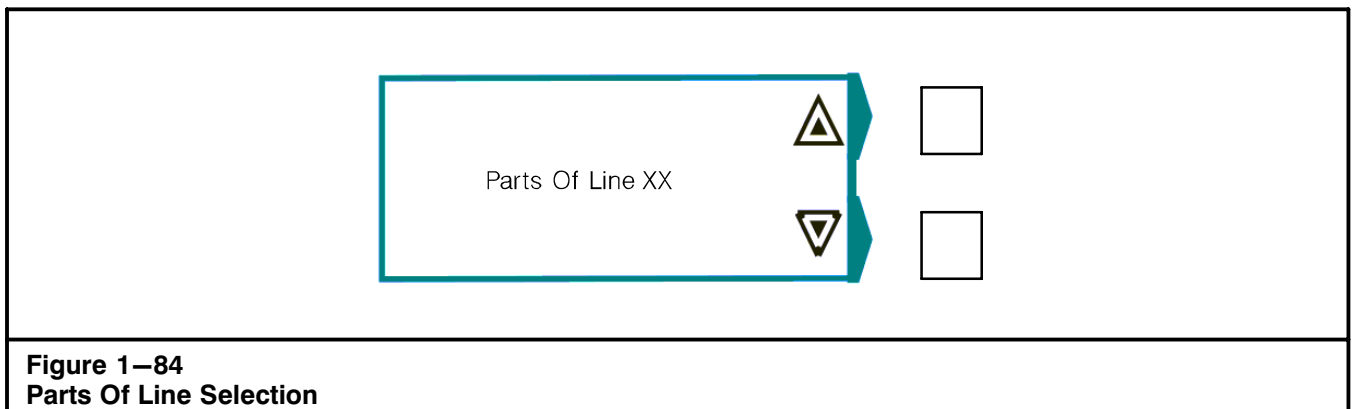


Figure 1-82
Winch Selection

- a. Press the corresponding configuration selection button to toggle between the front and rear winch until the desired winch is displayed.



- b. Press the corresponding configuration selection button to scroll through the available lifting points until the desired lifting point, for the winch selected, is displayed.

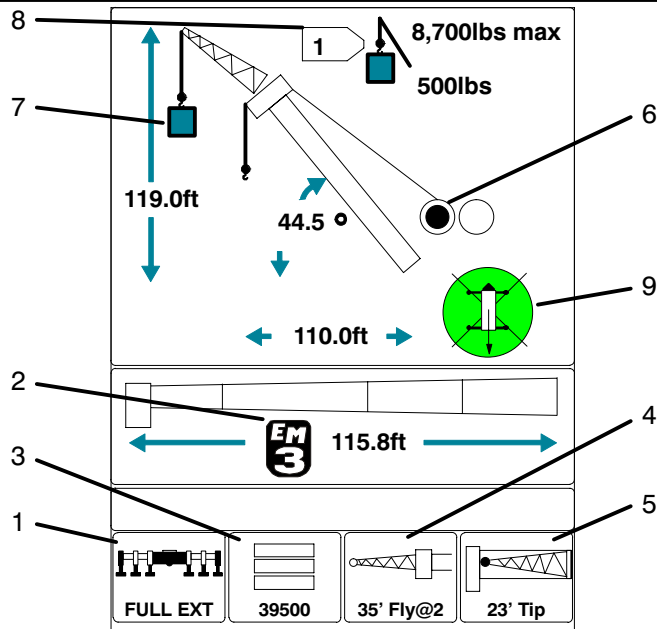


- c. Press the corresponding configuration selection button to scroll through the available parts of line until the desired parts of line, for the winch selected, is displayed.
- d. Repeat Steps a thru c for the other winch, if required.
14. Press the CRANE SETUP button to return to the crane setup screen.

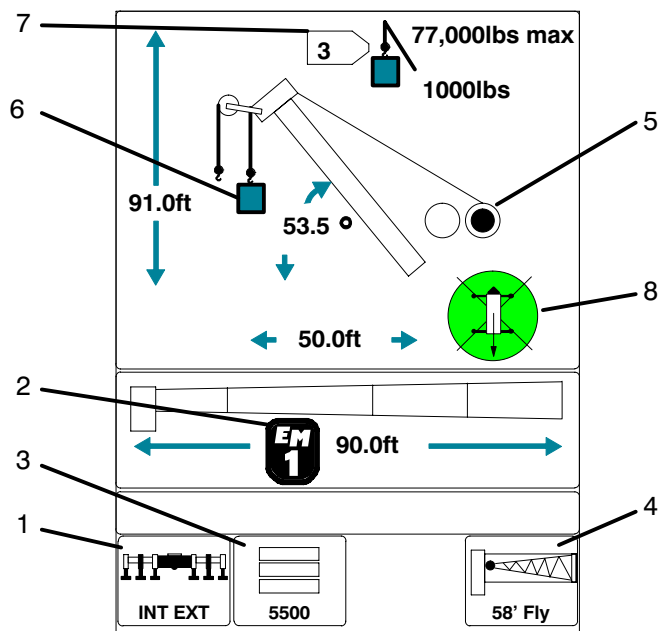
Note: A change to any selection can be made at anytime during the configuration routine. When at the crane set up screen, simply press the desired configuration button to go directly to that sub-routine.

15. Press the CRANE SETUP button to return to the normal working screen and graphically display the crane configuration as previously selected.

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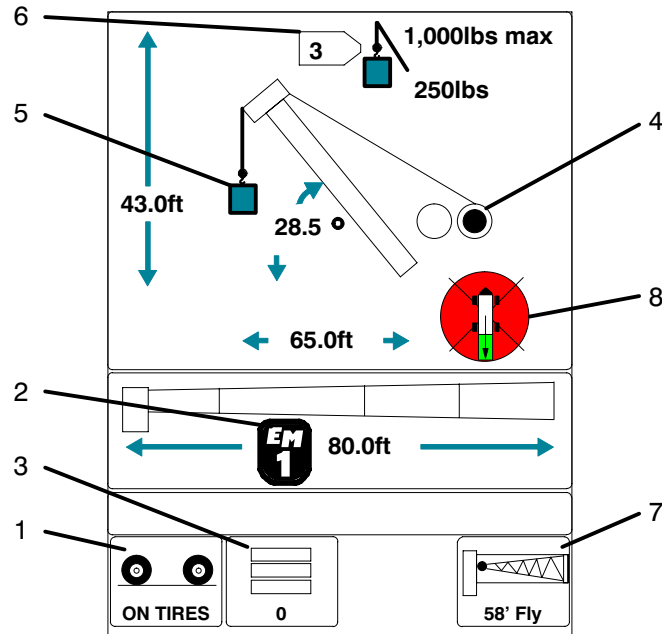


In this example the crane is setup on fully extended outriggers (1), boom mode EM3 (2), 39,500 lb counterweight (3), fly base erected at 2 degree offset (4), fly tip stowed (5), the rear winch available with the main boom head and the front winch selected (6), with the winch rope reeved over the fly base (7), with one part of line (8), and 360 degree capacities with the boom currently positioned over the rear (9).

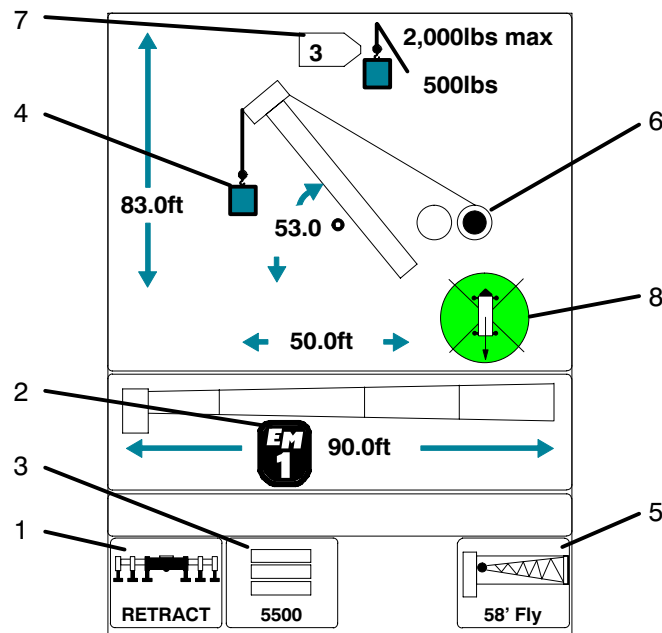


In this example the crane is setup on intermediate extended outriggers (1), boom mode EM1 (2), 5,500 lb counterweight (3) 58' fly stowed (4), the front winch available with the auxiliary head and the rear winch selected (5), with the winch rope reeved over the main boom head (6), with three parts of line (7) and 360 degree capacities with the boom currently positioned over the rear (8).

Figure 1–85
Normal Working Screen Examples



In this example the crane is setup for stationary on tires (1), boom mode EM1 (2), no 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), the 58' fly stowed (7) and directly over the rear capacities with the boom currently positioned over the rear (8).



In this example the crane is setup on fully retracted outriggers (1), boom mode EM1 (2), 5,500 lb of counterweight (3), winch rope reeved over the main boom (4), 58' fly stowed (5), front winch not in use and the rear winch selected (6), with three parts of line (7), and 360 degree capacities with the boom currently positioned over the rear (8).

Figure 1–86
Normal Working Screen Examples

Operator's Manual

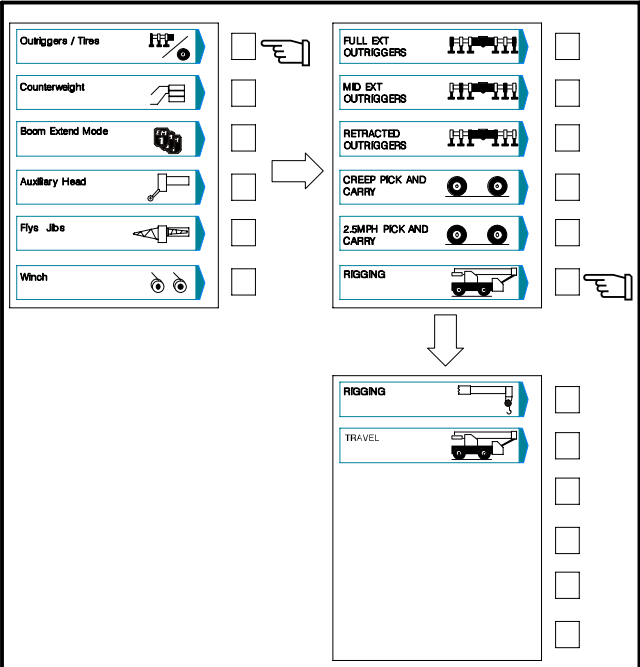


Figure 1-87
Rigging/Travel Mode Screen



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 540 is not operational when in the RIGGING/TRAVEL Mode. Return the Microguard 540 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 corresponding configuration selection button to select RIGGING mode. Refer to Figure 1-87.
3. The crane setup screen will change and graphically display the RIGGING and TRAVEL mode icons.
4. Select  when traveling the crane. Select  for stationary rigging of the crane.

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

When changing from Travel Mode to Rigging mode, an outrigger selection and boom mode selection must be made prior to selecting rigging 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 occur 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 and 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 1-88.

Nine alarms are available for operator use.

Minimum Angle	Maximum Load Radius	Left and Right Swing
Maximum Angle	Maximum Boom Length	First Layer Warning
Maximum Height	Operator Defined Area	Third Wrap Warning

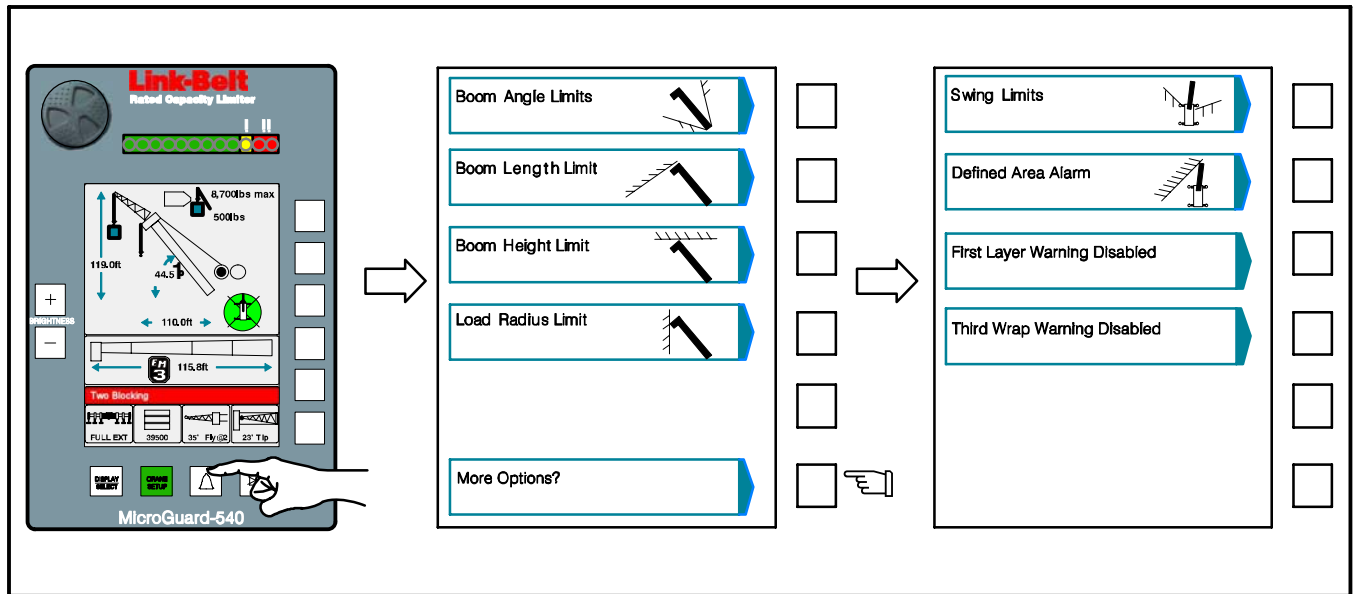



Figure 1-88
Operator Settable Alarms



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.

Setting Angle, Length, Height, Radius, And Swing Operator Alarms

1. From the normal working screen press OPERATOR ALARM  button to access the Operator Settable Alarm screen.
2. Press the corresponding selection button to select the desired alarm to be set.







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. Place the crane in the desired position depending upon the alarm to be set. The numerical value displayed will be the current position of the crane.

Note: If an alarm had been previously set, the numerical value displayed will be the previously set alarm value and indicated by the  icon. The previous alarm must first be disabled, then set the new alarm. Alarms which are disabled are indicated by the  icon.

4. Press the corresponding selection button to set the alarm value.
5. When all alarm values are set, press the OPERATOR ALARM  button to return to the alarm screen.
6. Press the corresponding selection button to set another alarm if desired. If you do not want to set another alarm, press the OPERATOR ALARM  button to return the normal working screen.
7. Test the alarm, with no load, to ensure the alarm points have been properly set. When approaching the alarm set point, the audio 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.

8. Use the following examples to understand the use of the procedure.

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Boom Angle Limits 	<input type="checkbox"/>	Set Min Angle at 30.0° 	<input type="checkbox"/>	Min Angle Set at 30.0° 	<input type="checkbox"/>
Boom Length Limit 	<input type="checkbox"/>	Set Max Angle at 60.0° 	<input type="checkbox"/>	Max Angle Set at 60.0° 	<input type="checkbox"/>
Boom Height Limit 	<input type="checkbox"/>	Current Angle = 60.0°	<input type="checkbox"/>	Current Angle = 60.0°	<input type="checkbox"/>
Load Radius Limit 	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
More Options?	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>

Figure 1–89
Boom Angle Alarm



WARNING

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








WARNING

Check the crane's current configuration, capacity chart, and Working Areas chart in the Crane Rating Manual to ensure safe, stable operation under conditions described in the following examples.

To Set Minimum Angle Alarm






Example: To have an alarm whenever the boom is below a 30 degree angle, use the following procedure:

1. From the normal working screen, Press the OPERATOR ALARM  button to access the alarm screen.
2. Press the corresponding button for Boom Angle Limits .
3. Move the boom to a 30 degree angle.
4. Press the corresponding button for "Set Min Angle at" to enter the alarm. The displayed value will be the alarm setting. The  will appear to indicate that the alarm is set.
5. Press the OPERATOR ALARM  button to return to the alarm screen. Press the OPERATOR ALARM  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

30 degree boom angle, the audio will sound intermittently and "Minimum Angle" will appear in the warning message area. The audible alarm will sound continuously and "Minimum Angle" will appear in warning message area whenever the boom is lowered below 30 degrees.

To Set Maximum Angle Alarm

Example: To have an alarm whenever the boom is above a 60 degree angle use the following procedure:

1. From the normal working screen press the OPERATOR ALARM  button to access the alarm screen.
2. Press the corresponding button for Boom Angle Limits .
3. Move the boom to a 60 degree angle.
4. Press the corresponding button for "Set Max Angle at" to enter the alarm. The displayed value will be the alarm setting. The  will appear to indicate that the alarm is set.
5. Press the OPERATOR ALARM  button to return to the alarm screen. Press the OPERATOR ALARM  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 60 degree boom angle, the audio will sound intermittently and "Maximum Angle" will appear in the warning message area. The audible alarm will sound continuously whenever the boom is raised above 60 degrees and "Maximum Angle" will appear in warning message area.

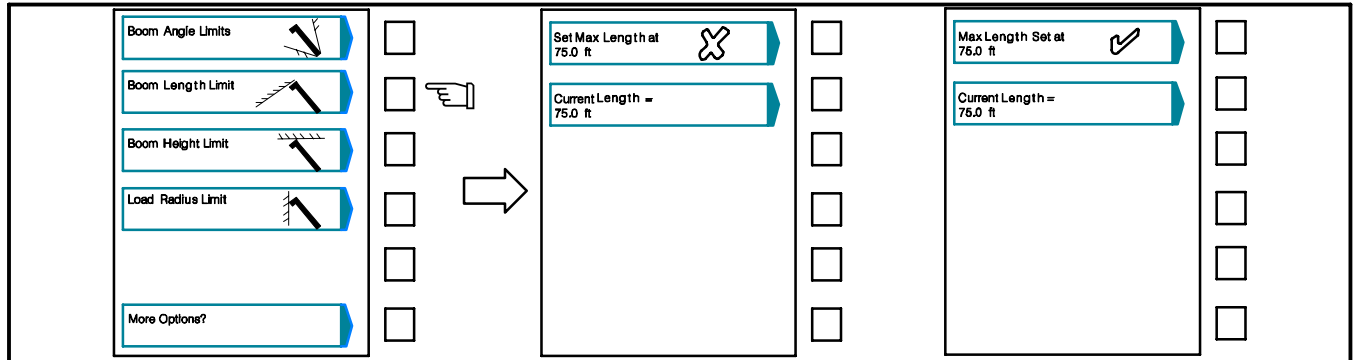


Figure 1-90
Boom Length Alarm

To Set Maximum Length Alarm

Example: To have an alarm whenever the boom length exceeds 75 feet, use the following procedure:

1. Press the OPERATOR ALARM button to access the alarm screen.
2. Press the corresponding button for Boom Length Limit.
3. Extend the boom so that the length is 75 feet.
4. Press the corresponding button for "Set Max Length at" to enter the alarm. The displayed value will be the alarm setting. The checkmark will appear to indicate that the alarm is set.
5. Press the OPERATOR ALARM button to return to the alarm screen. Press the OPERATOR ALARM 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 75 foot boom length, the audio alarm will sound intermittently and "Maximum Length" will appear in the warning message area. The audible alarm will sound continuously whenever the boom length exceeds 75 feet and "Maximum Length" will appear in the warning message area.

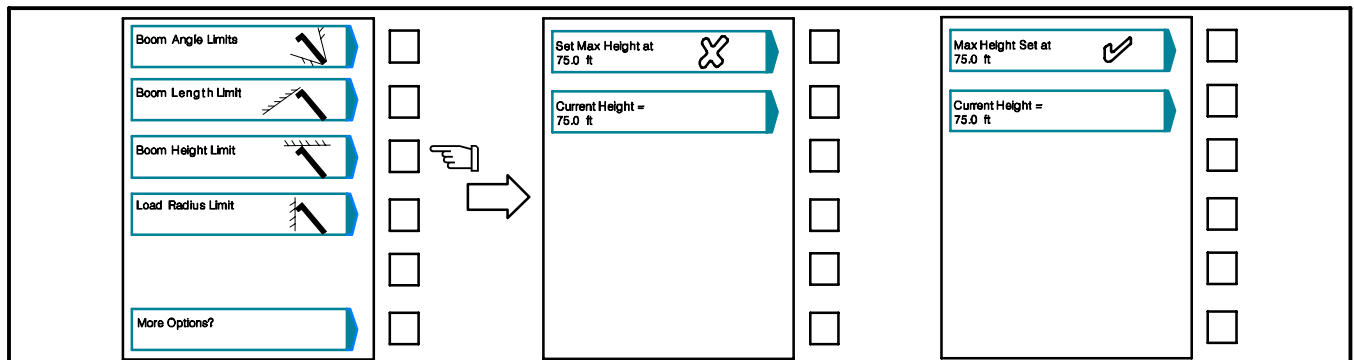


Figure 1-91
Boom Height Alarm

To Set Maximum Height Alarm

Example: To have an alarm whenever the boom tip height exceeds 75 feet, use the following procedure:

1. Press the OPERATOR ALARM button to access the alarm screen.
2. Press the corresponding button for Boom Height Limit.
3. Extend the boom and/or adjust the boom angle so that the tip height is 75 feet.
4. Press the corresponding button for "Set Max Height at" to enter the alarm. The displayed value will be the alarm setting. The checkmark will appear to indicate that the alarm is set.
5. Press the OPERATOR ALARM button to return to the alarm screen. Press the OPERATOR ALARM 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 75 foot boom tip height, the audio alarm will sound intermittently and "Maximum Height" will appear in the warning message area. The audible alarm will sound continuously whenever the boom tip height exceeds 75 feet and "Maximum Height" will appear in the warning message area.

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









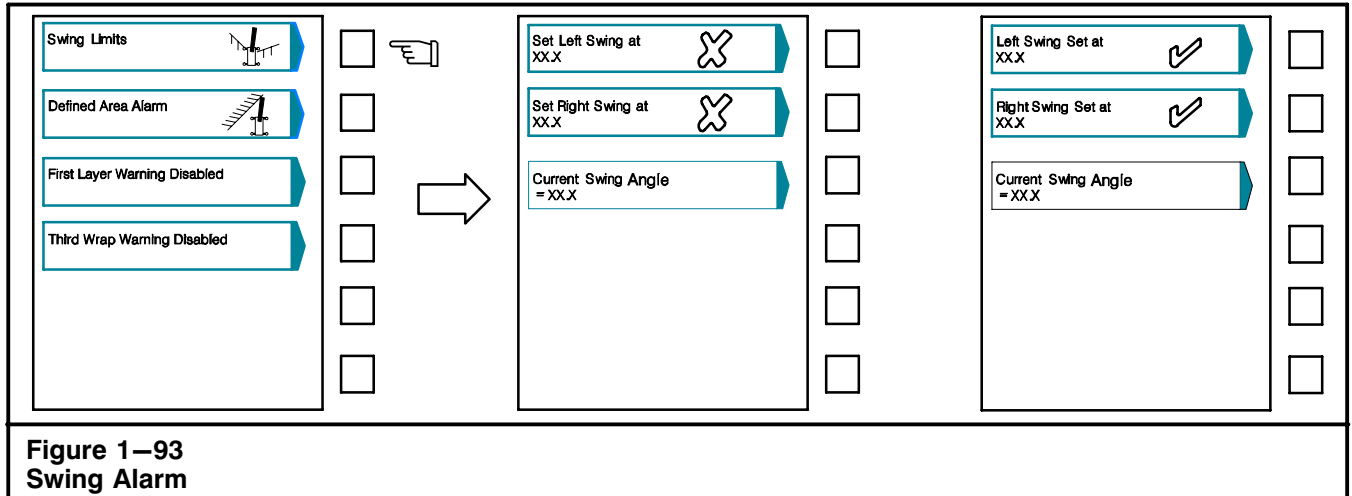
<div>Boom Angle Limits </div> <div>Boom Length Limit </div> <div>Boom Height Limit </div> <div>Load Radius Limit </div> <div>More Options? </div>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>  <input type="checkbox"/> <input type="checkbox"/>	<div>Set Load Radius Limit at 95.0 </div> <div>Current Radius = 95.0 </div>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<div>Load Radius Limit Set at 95.0 </div> <div>Current Radius = 95.0 </div>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
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Figure 1–92
Load Radius Alarm

To Set Maximum Radius Alarm

Example: To have an alarm whenever the boom radius exceeds 95 feet, use the following procedure:

1. Press the OPERATOR ALARM  button to access the alarm screen.
2. Press the corresponding button for Load Radius Limit .
3. Extend the boom and/or adjust the boom angle so that the radius is 95 feet.
4. Press the corresponding button for “Set Max Radius at” to enter the alarm. The displayed value will be the alarm setting. The  will appear to indicate that the alarm is set.
5. Press the OPERATOR ALARM  button to return to the alarm screen. Press the OPERATOR ALARM  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 95 foot boom radius, the audio will sound intermittently and “Maximum Radius” will appear in the warning message area. The audible alarm will sound continuously whenever the boom radius exceeds 95 feet and “Maximum Radius” will appear in warning message area.



To Set Left And Right Swing Alarms

Example: To have an alarm whenever the LEFT SWING AND RIGHT SWING exceed pre-determined alarm points, use the following procedure:

1. Press the OPERATOR ALARM button to access the alarm screen.
2. Press the corresponding button for Swing Limits .
3. Swing the boom to the left alarm point.
4. Press the corresponding button for “Set Left Swing at” to enter the left alarm point. The displayed value will be the left alarm setting. The will appear to indicate that the alarm is set.
5. Swing the boom to the right alarm point.
6. Press the corresponding button for “Set Right Swing at” to enter the right alarm point. The dis-

played value will be the right alarm setting. The will appear to indicate that the alarm is set.

7. Press the OPERATOR ALARM button to return to the alarm screen. Press the OPERATOR ALARM button again 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 audio 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.

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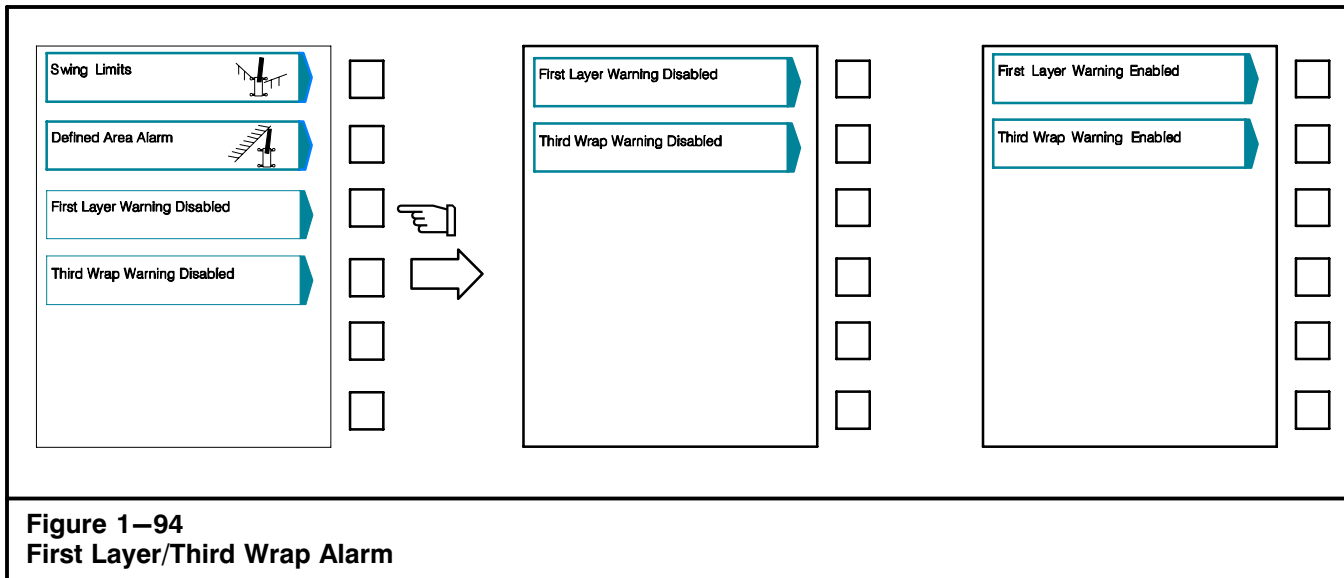


Figure 1–94
First Layer/Third Wrap Alarm



First Layer/Third Wrap Alarm (If Equipped)

The crane may be equipped with a first layer/third wrap alarm indicator system for the winch drum(s). When the system is enabled, the audible alarm will sound intermittently, and “First Layer” will appear in the warning message area to alert the operator when the wire rope is down the the first layer on the winch drum(s). The audible alarm will sound continuously and “Third Wrap” will appear in warning message area to alert the operator when the wire rope is down to the third wrap on the winch drum(s).



WARNING

Three (3) full wraps of wire rope must be maintained on the winch drum at all times during operation. Rope failure may occur.

1. Press the OPERATOR ALARM button to access the alarm screen.
2. Press the corresponding button for Options.
3. Press the corresponding button for First Layer or Third Wrap until the word “Enabled” appears.
4. Press the OPERATOR ALARM  button to return to the alarm screen. Press the OPERATOR ALARM  button again to return to the normal working screen.
5. Select the winch drum to monitor by using the winch drum selector switch located on the gauge and control panel. Refer to Figure 1–51

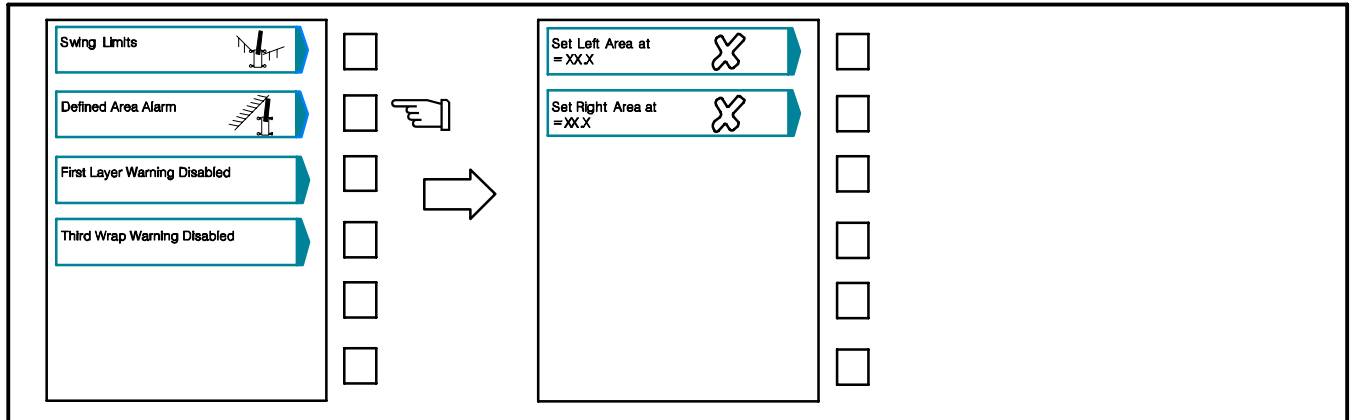


Figure 1–95
Operator Defined Area Alarm

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 audio alarm will sound intermittently, and the message “Bad Working Area” will appear in the warning message area. When passing the plane, the audio alarm will sound continuously and the message “Bad Working Area” will appear on the warning message area. Use the following procedure, Figure 1–95, and Figure 1–96 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.

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Setting Operator Defined Area Alarm

1. From the normal working screen press the OPERATOR ALARM button to access the Operator Alarm screen.
2. Disable any previously set left and right swing alarms if required. Refer to "To Disable Operator Settable Alarms" found later in this Section of the Operator's Manual.

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


3. Press the corresponding button for Range 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 left alarm point and press the corresponding button for "Set Left Range Limit at" to enter the left alarm point. The displayed value will be the left alarm setting. The  will appear to indicate that the left alarm point is set.
5. Position the boom, attachment, load, rigging, etc. to the right alarm point and press the corresponding button for "Set Right Range Limit at" to enter the right alarm point. The displayed value will be

the right alarm setting. The  will appear to indicate that the right alarm point is set.

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


6. When both alarm points are set, press the OPERATOR ALARM  button to return to the alarm screen. Press the OPERATOR ALARM  button again 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 audio alarm will sound intermittently and the message "Bad Working Area" will appear on the warning message area. When passing the plane, the audio 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.

To Disable Operator Settable Alarms

1. From the normal working screen press the OPERATOR ALARM button to access the Operator Alarm screen.
2. Press the corresponding selection button to select the desired alarm to be disabled.
3. Press the corresponding button for each alarm. The  icon indicates the alarm has been cleared.
4. When all alarms are disabled press the DISPLAY/SELECT button to return to the alarm screen.

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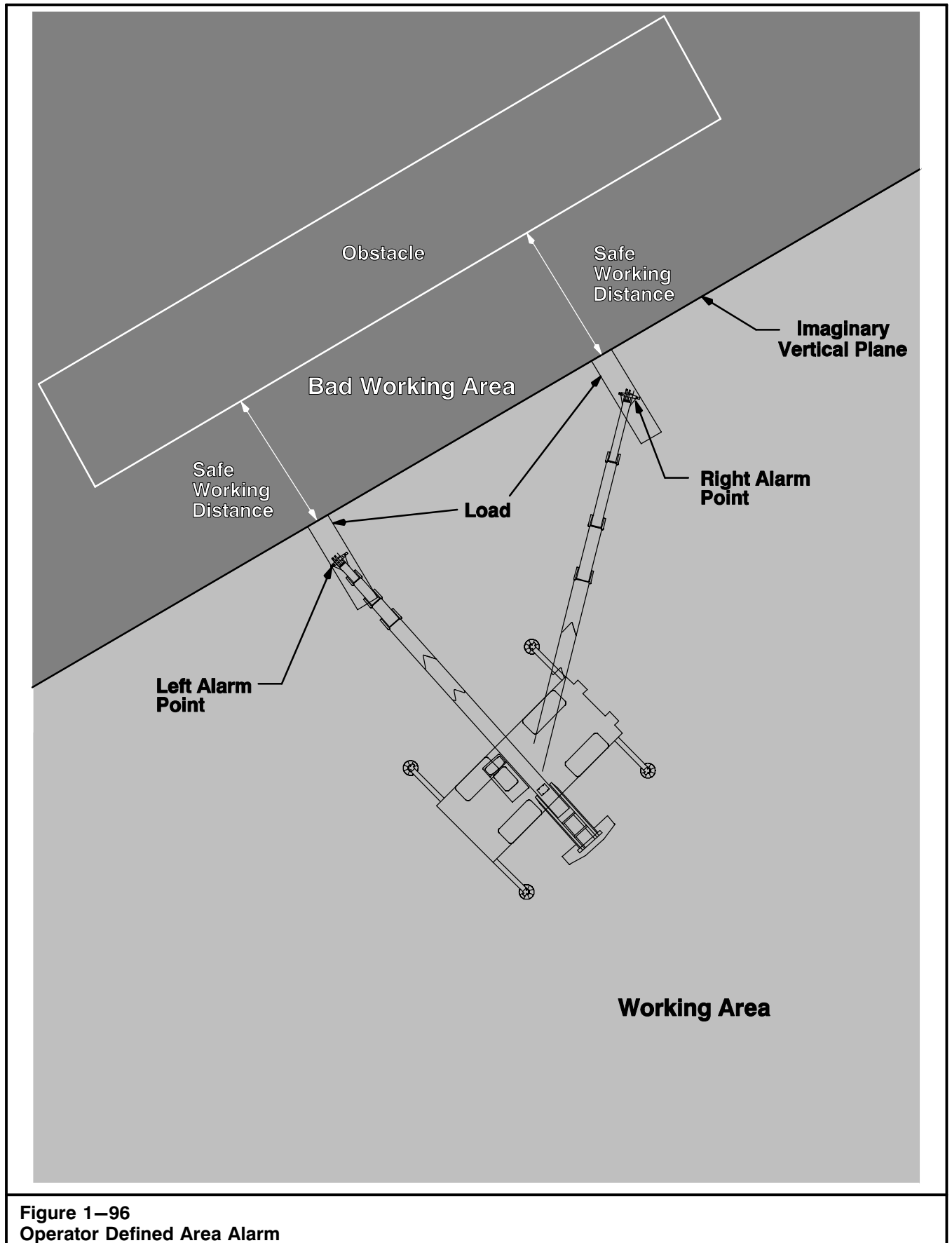
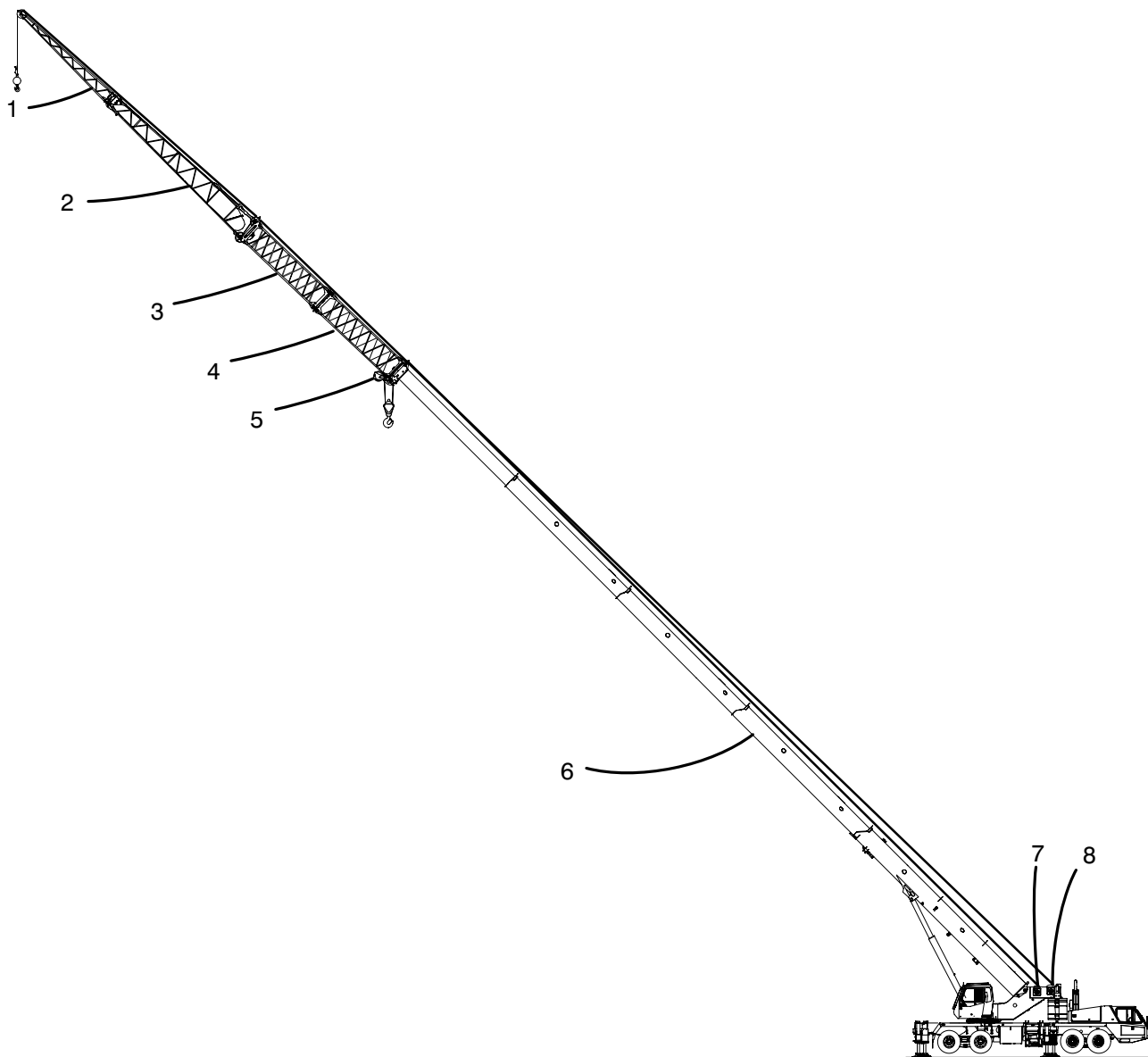


Figure 1–96
Operator Defined Area Alarm

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1. Offset Lattice Fly Tip Section
2. Offset Lattice Fly Base Section
3. Fly Extension With Sheave
4. Fly Extension Without Sheave
5. Auxiliary Lifting Sheave
6. Five Section Boom
7. Front Winch
8. Rear Winch

Figure 1–97
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.

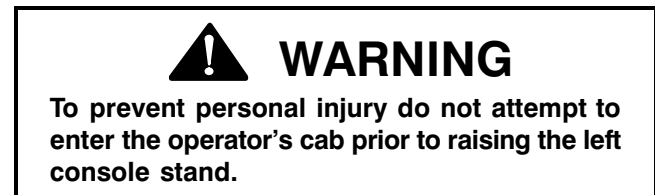
1. Function Lockout Switch

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.



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 previously, 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.

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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

	<p>! WARNING</p> <p>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.</p>
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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.

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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.

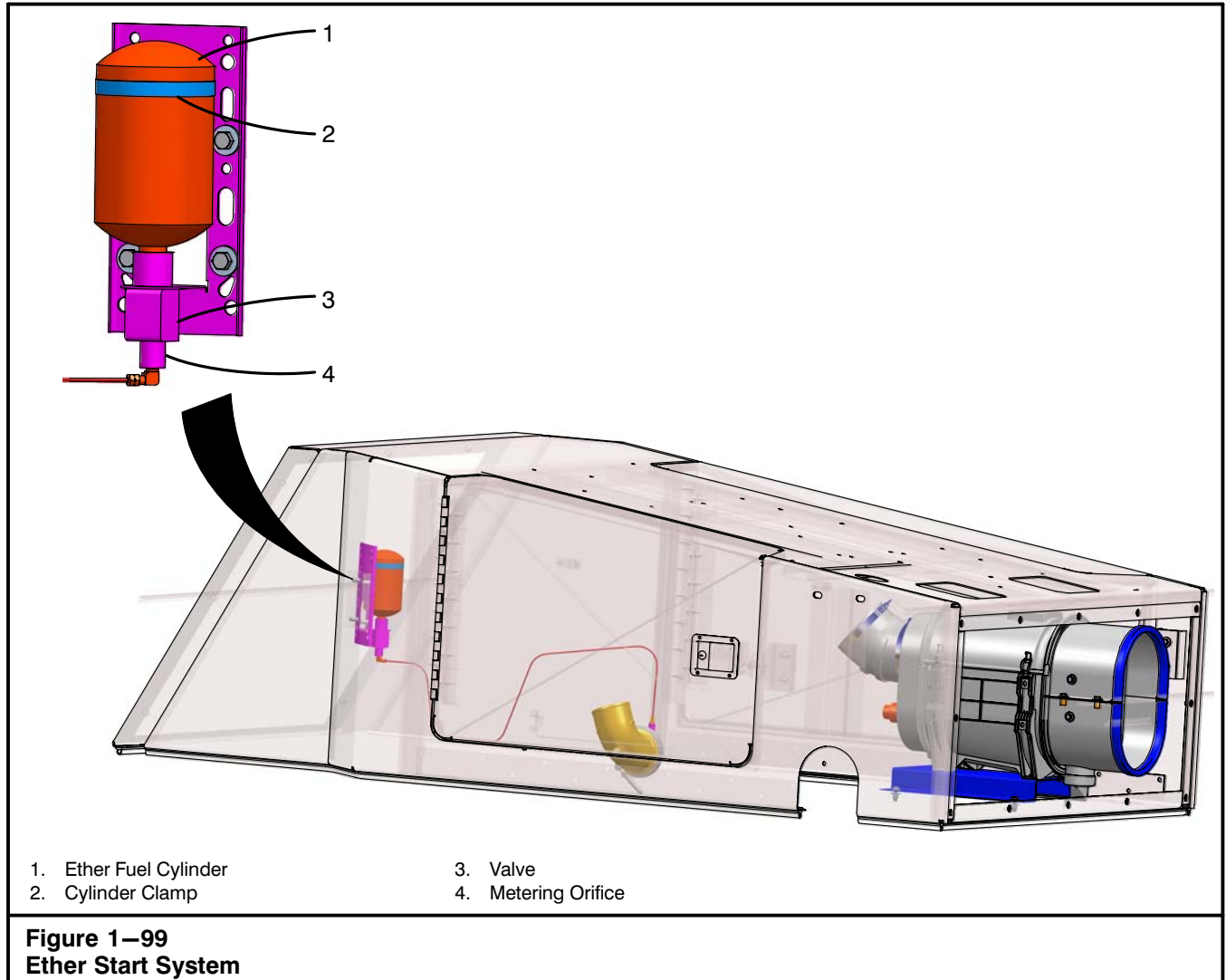
4. Remove the ignition keys from both cabs and lock the doors if the crane is to be left unattended.

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.



Ether Start System (If Equipped)

The ether start system is a fully-automatic engine starting fluid system designed to spray a controlled amount of ether into the engine intake system during and immediately after cranking. The engine control module (ECM) determines when the system should function. Whenever the engine does not start within a normal period of cranking the ether fuel cylinder may be empty. Replace the cylinder as required. The ether fuel cylinder is located just inside the engine access door on the left side of the crane. Refer to Figure 1—99.



WARNING

When maintaining or troubleshooting ether start system, always make sure the area is well ventilated and away from heat, open flames, or sparks. Wear goggles to avoid eye injury. When opening ether fuel line or disconnecting atomizer, make sure it is pointed away from you. The ethyl ether fuel used in this system is extremely flammable, toxic, harmful, and can be fatal.

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Changing The Ether Fuel Cylinder

1. Park crane on a firm level surface, engage the park brake, shift the transmission to neutral, and shut-down the engine.
2. Clean all dirt from the neck of the fuel cylinder and top of the valve. Refer to Figure 1–99.
3. Loosen the cylinder clamp.
4. Turn the fuel cylinder counterclockwise to remove the cylinder from the valve. Remove the old gasket from the valve and properly discard.
5. Install the protective cap to protect the top of the valve from dirt after removal.
6. Find the new gasket from the inside of the thread protective white cap on the new fuel cylinder.
7. Install the new gasket into the valve.

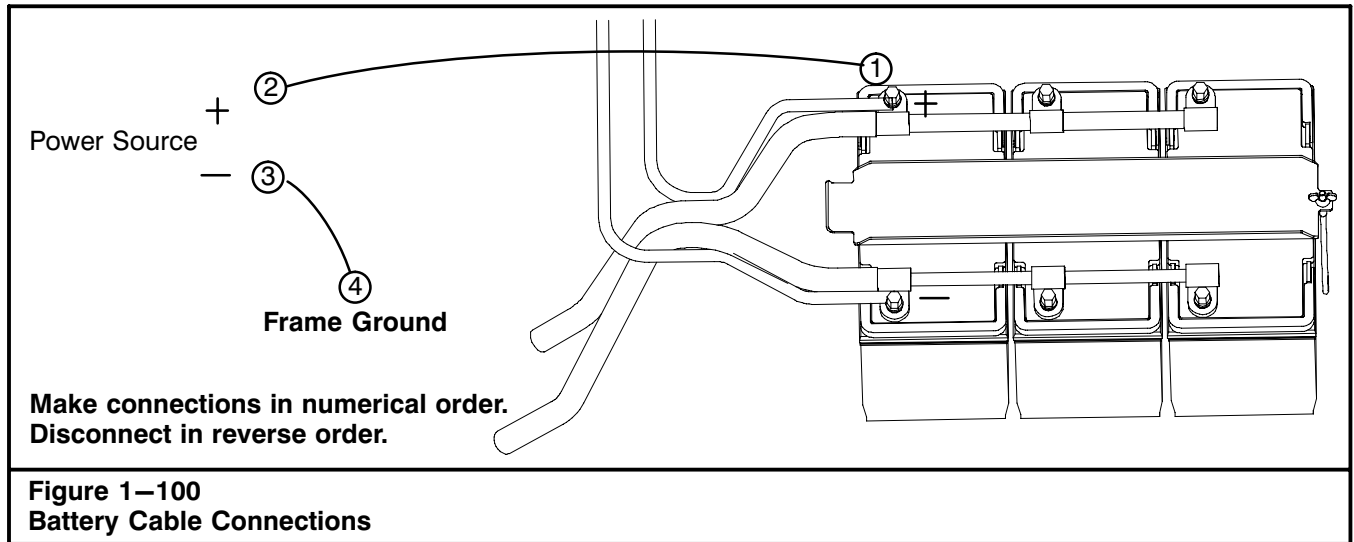
Note: Replace gasket inside valve each time a cylinder is replaced. Read the entire cylinder label for additional information on cylinder and valve gasket installation.

8. Coat the new cylinder's threads with clean engine oil.
9. Install the cylinder by turning the cylinder clockwise until the cylinder dirt and moisture seal o-ring contacts the valve.
10. Tighten an additional 1–1/2 turns. Do not overtighten.

CAUTION

Do not overtighten the cylinder. Over-tightening may damage the valve or the cylinder.

11. Tighten the cylinder clamp.



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.
4. Connect one end of the second jumper cable to the negative (–) terminal of the 12V power source or booster battery.

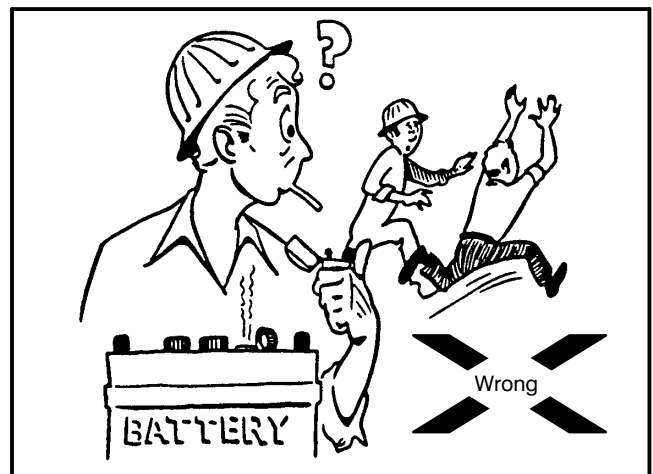


Figure 1–101

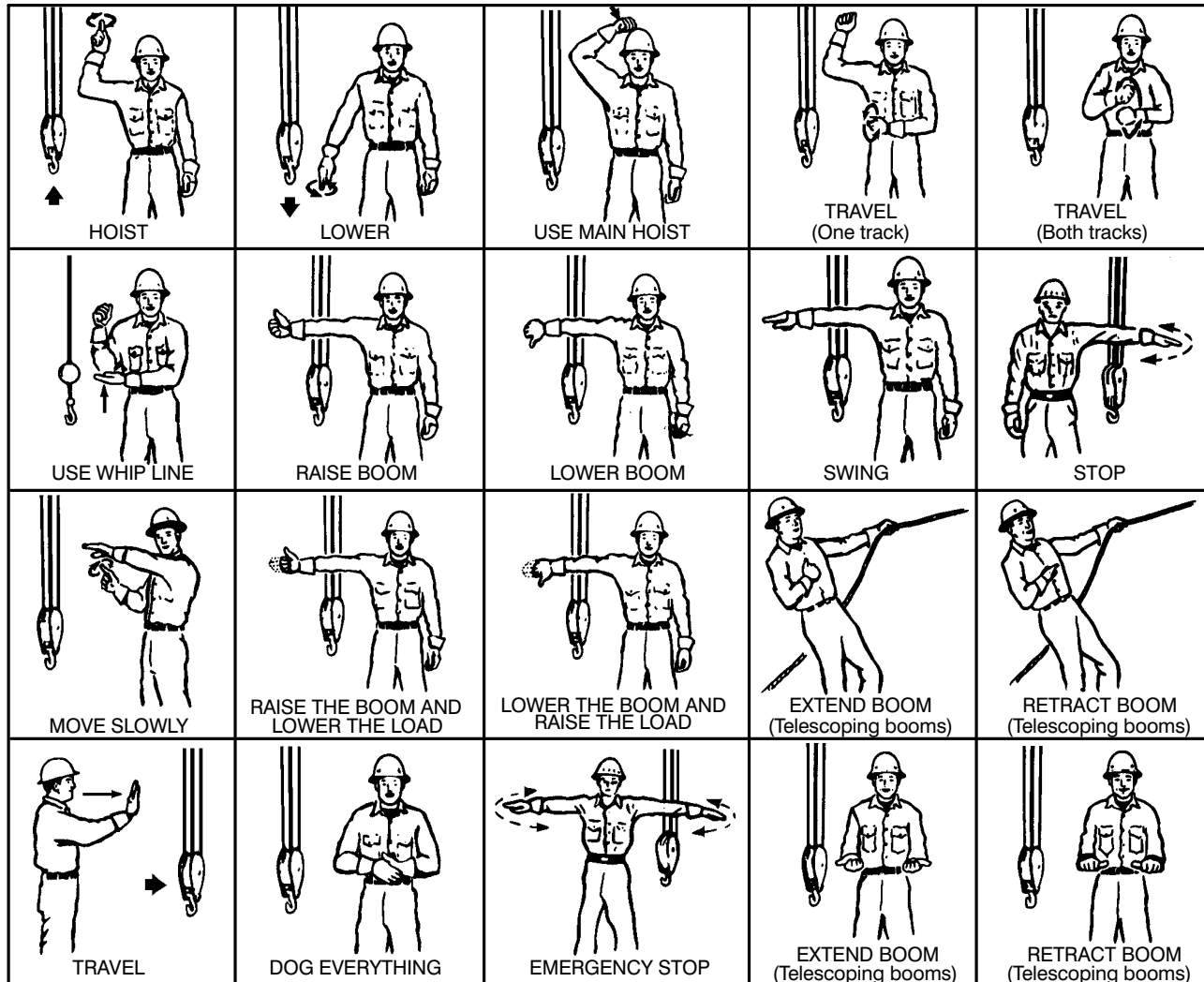
Do not use an open flame near the battery.

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 as given in Steps 2–5.
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.

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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 1-102
Hand Signals

Hand Signals

Hand Signals are important for communications between the designated signalman and the operator. A hand signal chart is shown Figure 1-102. 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.

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, hook ball, slings, rigging, fly, etc. Determine height to which the load must be lifted.
2. Consult the proper capacity, Working Areas, and Working Range diagram located in the Crane Rat-

Operator's Manual

- ing 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, intermediate 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 pinned to the jacks and 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 and at each ground control outrigger station to assist the operator in leveling the crane.
 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.
 8. Lower the hook block or ball 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.
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.

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Pick And Carry Operation

Travel during pick and carry operations is restricted to speeds of 1.0 mph (1.6km/h) or less on a firm, level surface. 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 1.0 mph (1.6km/h) 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 "UP" 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. Release the 360° swing lock, if equipped.

CAUTION

Do not leave swing park brake applied or the 360° swing lock engaged 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, 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.

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 1.0 mph (1.6km/h). Take extra care due to the increased overall width caused by the extended outrigger beams. Use extreme care that the outriggers or pontoons are not 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.

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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.

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. Release the 360° swing lock, if equipped.
6. Secure hook block or hook ball to prevent excessive swinging.

CAUTION

Do not leave swing park brake applied or the 360° swing lock engaged during highway travel. Failure to release these devices during highway travel may result in damage to the swing speed reducer.

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.

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.

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Job Site Travel

Job site travel is limited to speeds of 5.0 mph (8.0km/h) or less 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 the pressure listed on the Gross Axle Weight Rating (GAWR) plate or the Tire Inflation chart located in the Crane Rating Manual. 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 "UP" position.
3. Level the crane on fully extended outriggers.
4. Position the upper and attachments according to one of the "Job Site Travel" charts found later in this Section of the Operator's Manual
5. Engage the travel swing lock. Release the 360° swing lock, if equipped.

CAUTION

Do not leave swing park brake applied or the 360° swing lock engaged while traveling the crane. Failure to release these devices during while traveling 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.
9. Carefully travel at no more than the specified speed in accordance with the applicable "Job Site Travel" chart. Maintain a safe distance from all personnel, obstructions, structures, and power lines.

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Jobsite Travel, No Load Upper Over the Rear, Boom Retracted 5 MPH (8.0km/h) Maximum

Counterweight (lb) Installed on Upper	Maximum Boom Angle (°)			
	Block and Ball Permissible	Ball Only Permissible		N/A
	35–58 Ft Fly Stored	35 Ft Fly Erected (2° Offset)	58 Ft Fly Erected (2° Offset)	74–90 Ft Fly Erected (2° Offset)
0–20,500	30	15	10	PROHIBITED
23,500–32,500	30	15	PROHIBITED	PROHIBITED
39,500	PROHIBITED	PROHIBITED	PROHIBITED	PROHIBITED

Jobsite Travel, No Load Upper Over the Front Boom Retracted 5 MPH (8.0km/h) Maximum

Counterweight (lb) Installed on Upper	Maximum Boom Angle (°)			
	Block and Ball Permissible			N/A
	35–58 Ft Fly Stored	35 Ft Fly Erected (2° Offset)	58 Ft Fly Erected (2° Offset)	74–90 Ft Fly Erected (2° Offset)
0–20,500	30	15	10	PROHIBITED
23,500–39,500	PROHIBITED	PROHIBITED	PROHIBITED	PROHIBITED

Jobsite Travel, No Load Upper Over the Rear Boom Retracted 1 MPH (1.6km/h) Maximum

Counterweight (lb) Installed on Upper	Maximum Boom Angle (°)			
	Block and Ball Permissible			N/A
	35–58 Ft Fly Stored	35 Ft Fly Erected (2° Offset)	58 Ft Fly Erected (2° Offset)	74–90 Ft Fly Erected (2° Offset)
0–39,500	30	15	10	PROHIBITED

Jobsite Travel, No Load Upper Over the Front, Boom Retracted 1 MPH (1.6km/h) Maximum

Counterweight (lb) Installed on Upper	Maximum Boom Angle (°)			
	Block and Ball Permissible			N/A
	35–58 Ft Fly Stored	35 Ft Fly Erected (2° Offset)	58 Ft Fly Erected (2° Offset)	74–90 Ft Fly Erected (2° Offset)
0–29,500	30	15	10	PROHIBITED
32,500–39,500	PROHIBITED	PROHIBITED	PROHIBITED	PROHIBITED

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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 can be configured with up to thirteen counterweight options. Therefore, removing the counterweights can reduce the weight of the crane by as much as 39,500 lb (17 917kg).

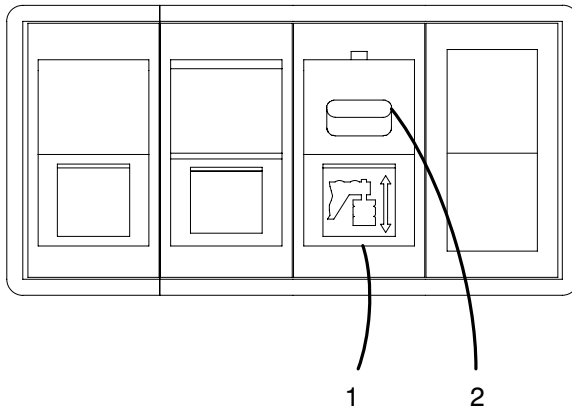
The left joystick is used as the counterweight removal controls. Actuating a switch on the left control changes the function of the left joystick (or single axis controller, if equipped) from operating the swing/

front winch functions to operating the counterweight lock—unlock/counterweight raise—lower functions. Pull the control lever back, toward the operator to raise the counterweight. Push the control lever forward, away from the operator to lower the counterweight. Move the control lever to the left to lock the counterweight and to the right to unlock the counterweight. Refer to Figure 1—103.

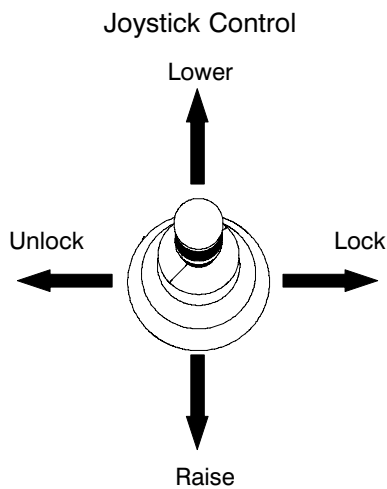
Also the RCL display changes screens to display the location of the counterweight lift cylinder rods to alert the operator of counterweight status. An alarm on the RCL screen will be displayed if the counterweights are not fully raised (retracted) against the upper. If no counterweights are installed, the alarm will sound if the counterweight cylinders are not fully retracted. Refer to Figure 1—104.

Allowable Counterweight								
Counterweight Packages		11,500 lb (5 216kg) – Standard						
		26,500 (12 020kg) – Optional						
		32,500 (14 742kg) – Optional						
		39,500 (17 917kg) – Optional						
Counterweight Modules		2,500 lb (1 134kg) Tray	6,000 lb (2 722kg) Piece	3,000 lb (1 361kg) Pin-on	3,000 lb (1 361kg) Piece	12,000 lb (5 443kg) Piece	6,000 lb (2 722kg) Piece	7,000 lb (3 175kg) 2-Pieces
Counterweight Configurations	0 lb (0kg)							
	2,500 lb (1 134kg)	X						
	5,500 lb (2 495kg)	X		X				
	8,500 lb (3 855kg)	X	X					
	11,500 lb (5 216kg)	X	X	X				
	14,500 lb (6 577kg)	X	X	X	X			
	17,500 (7 938kg)	X	X	X			X	
	20,500 lb (9 299kg)	X	X	X	X		X	
	23,500 lb (10 660kg)	X	X	X		X		
	26,500 (12 020kg)	X	X	X	X	X		
	29,500 lb (13 381kg)	X	X	X		X	X	
	32,500 (14 742kg)	X	X	X	X	X	X	
	39,500 (17 917kg)	X	X	X	X	X	X	X

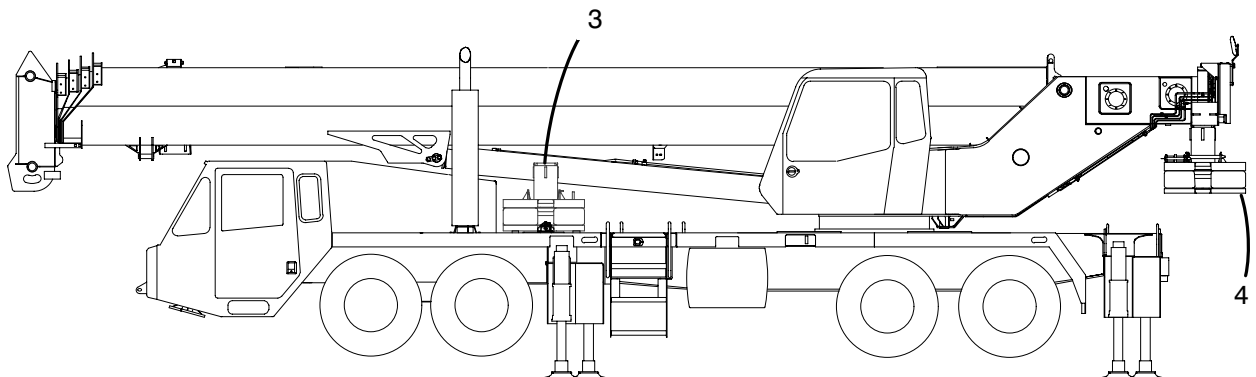
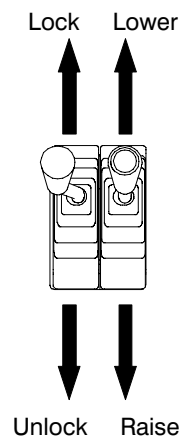
Left Seat Console Controls



Left Hydraulic Controls



Single Axis Controls

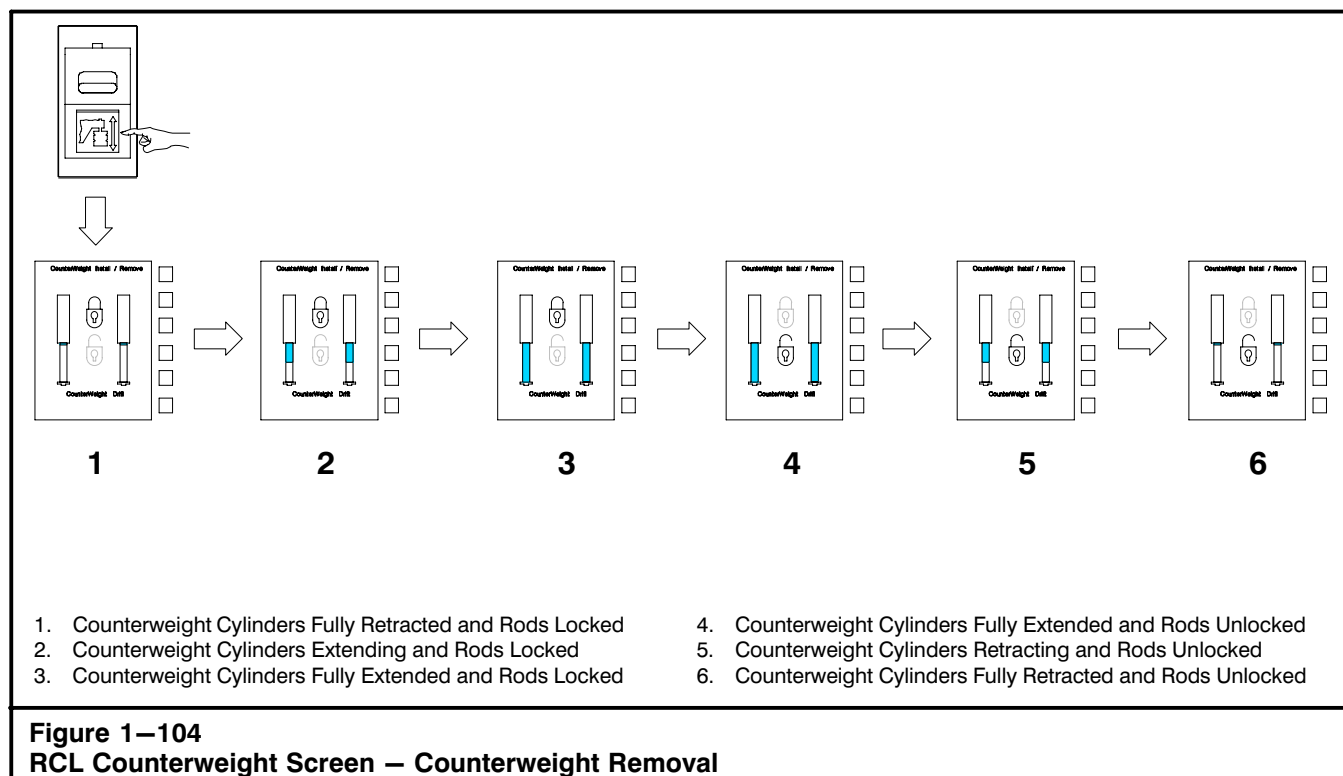


1. Counterweight Removal Cylinder Control Switch
2. Counterweight Locking Tab

3. Counterweights Stored On Carrier Deck
4. Counterweights Installed

Figure 1–103
Counterweight Removal System

Operator's Manual



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°.



WARNING

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

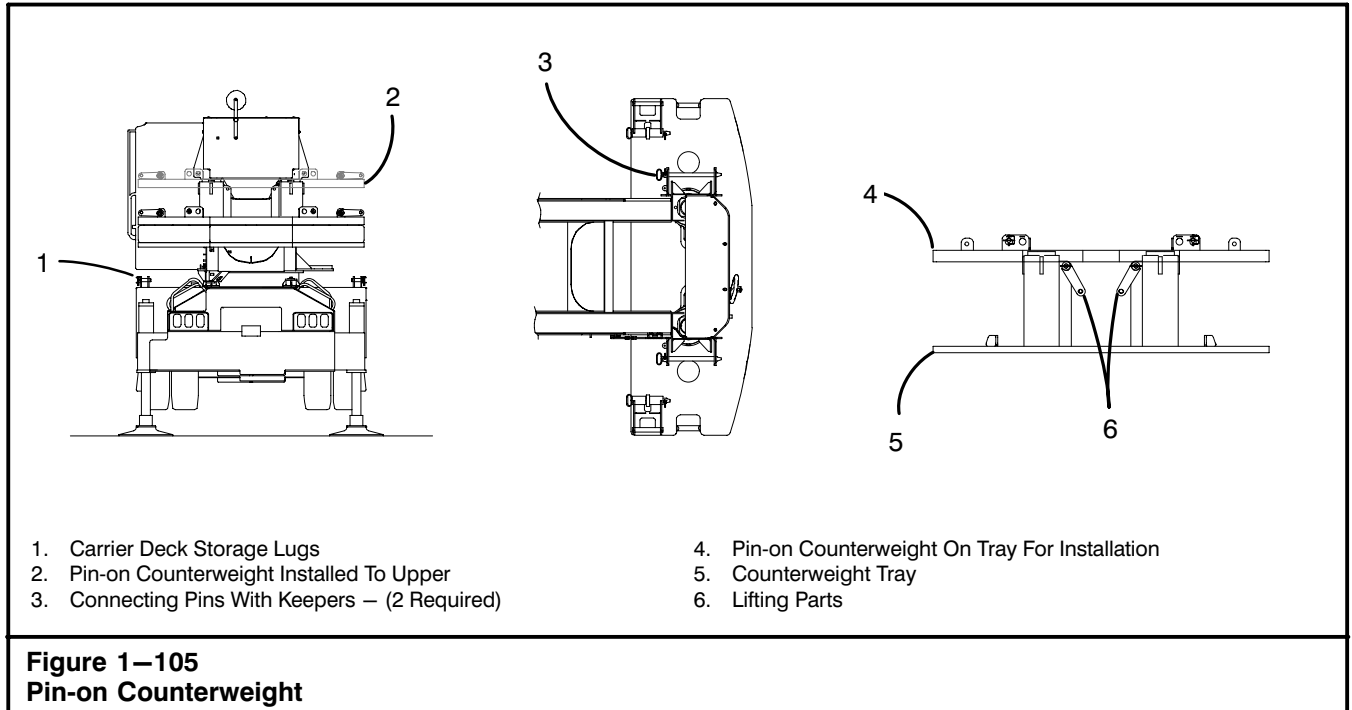
5. If removing the pin-on counterweight, remove the connecting pins which secure the counterweight to the upper frame. Refer to Figure 1–103.

Note: Pin-on counterweight may have to be raised (cylinders retracted) to relieve pressure on the connecting pins to ease removal.

6. On the counterweight removal switch, slide and hold the locking tab, then push the counterweight

switch to activate the left control lever to be used as counterweight controls. Move the control lever forward to the lower position to extend the counterweight removal cylinders to lower the counterweights to the storage lugs on the carrier deck.

7. Move the control lever to the “Unlock” position to rotate the cylinder rods to the unlocked position to disengage the cylinders from the counterweight tray.
8. Move the control lever to the “Raise” position to retract (raise) the cylinders until they are fully retracted.
9. Push the top part of the counterweight switch and select the appropriate counterweight configuration.
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 “0 lb CTWT” capacities.
11. Install the connecting pins to secure any remaining counterweights to the counterweight storage lugs on the carrier deck. Install the pin keepers.



Pin-on Counterweight

The pin-on counterweight can be transported and/or used for operation with it pinned to the upper. During transport it can be pinned to the upper or stored on the carrier deck. During crane operation it can be pinned to the upper or left on the counterweight stack. Refer to the Crane Rating Manual for lifting loads with the pin-on counterweight installed on the upper. Refer to Figure 1-105.

If the 11,500 lb (5 216kg) counterweight is used, the lifting parts are required to connect the pin-on counterweight to the upper. If there is enough counterweights in the stack, the lifting parts are not required to install the counterweight to the upper. Use the following procedure to install the pin-on counterweight to the upper when using the 11,500 lb (5 216kg) lb counterweight:

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 counterweight tray and 6,000 lb (2 722kg) slab onto the carrier deck. The boom may be used to lift the counterweights onto the carrier deck. Refer to the Crane Rating Manual for "0 lb CTWT" capacities.
4. Install lifting parts to counterweight tray.
5. Install the pin-on counterweight on the counterweight tray and lifting parts.
6. Swing the upper over the rear of the carrier. Engage the travel swing lock and boom up to 30°.

7. On the counterweight removal switch, slide and hold the locking tab, then push the counterweight switch to activate the left control lever(s) to be used as counterweight controls. Move the control lever to the "Lower" position to extend (lower) the counterweight removal cylinders until the cylinder rods enter the slots on the top counterweight tray.
8. Move the control lever to the "Lock" position to rotate the cylinder rods to the locked position to connect the cylinders to the counterweight tray.
9. Remove the connecting pins which secure the counterweights to the storage lugs on the carrier deck.

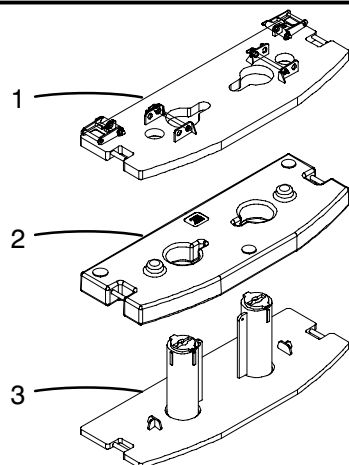


WARNING

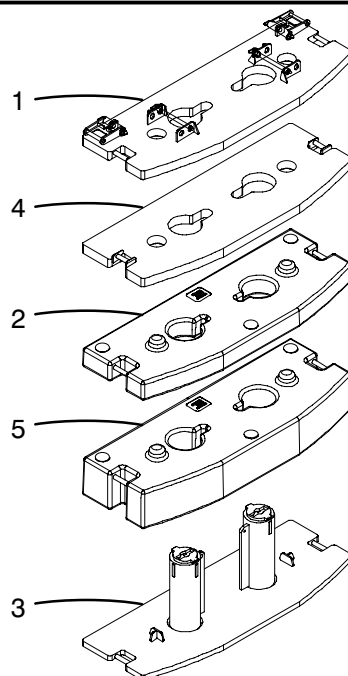
To avoid personal injury, do not stand under counterweights during lowering or raising of the counterweights.

10. Move the left control lever to the "Raise" position to retract (raise) the cylinders and lift the counterweights.
11. Continue to lift the counterweights until the counterweight cylinders are fully retracted.
12. Connect the pin-on counterweight to the upper by installing the connecting pins and keepers to secure the pin-on counterweight to the upper frame.
13. Lower the counterweight tray to the carrier deck. Install the connecting pins to secure the counterweights to the counterweight storage lugs on the carrier deck. Install the pin keepers.

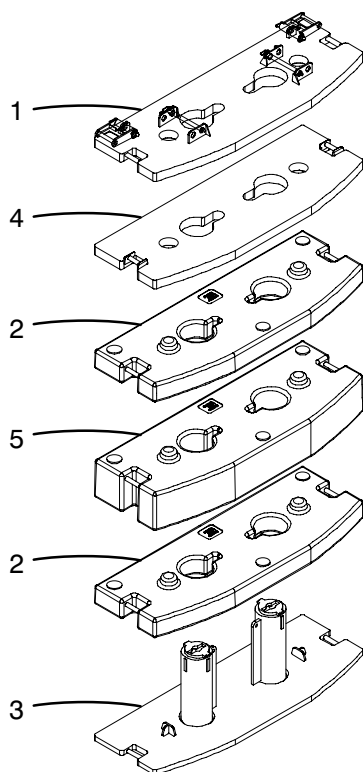
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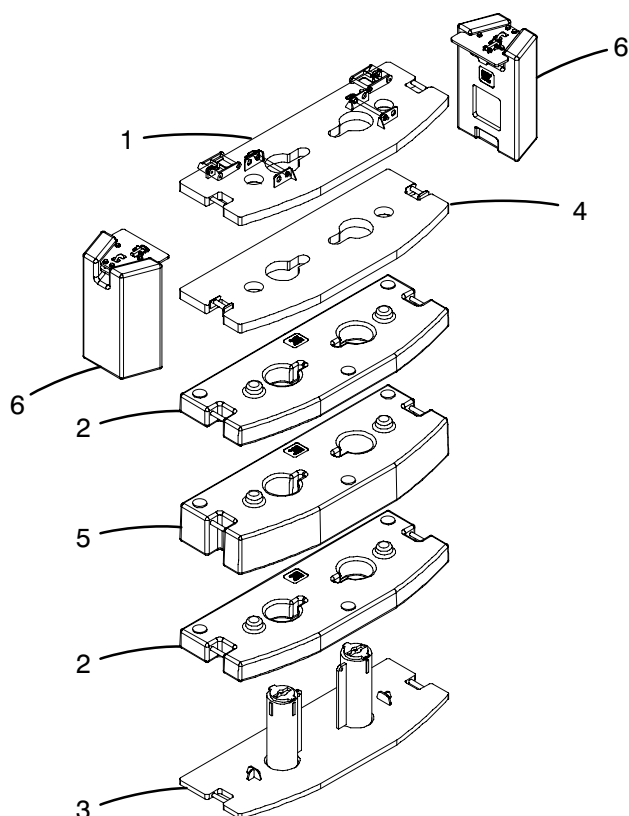
11,500 lb (5 216kg)



26,500 lb (12 020kg)



32,500 lb (14 742kg)



39,500 lb (17 917kg)

- 1. Pin-on Counterweight – 3,000 lb (1 361kg)
- 2. Slab Counterweight – 6,000 lb (2 722kg)
- 3. Counterweight Tray – 2,500 lb (1 134kg)

- 4. Top Plate– 3,000 lb (1 361kg)
- 5. Slab Counterweight – 12,000 lb (5443kg)
- 6. Side Counterweights – 3,500 lb (1 588kg) Each

Figure 1–106
Counterweight Packages

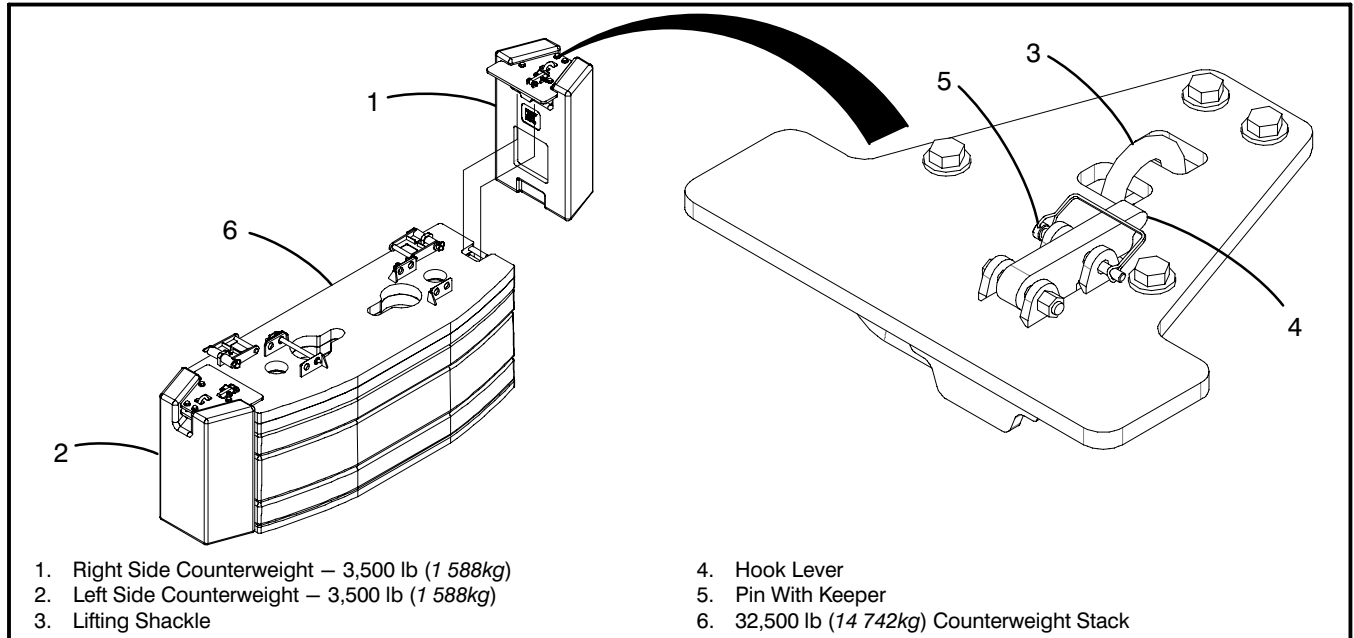


Figure 1–107
Side Counterweights

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. Stack the counterweights in the desired combination. The counterweight tray must always be on the bottom and the top plate and pin-on counterweight must always be on the top. Refer to the Crane Rating Manual for "0 lb CTWT" capacities.
4. Swing the upper over the rear of the carrier. Engage the travel swing lock and boom up to 30°.
5. On the counterweight removal switch, slide and hold the locking tab, then push the counterweight switch to activate the left control lever(s) to be used as counterweight controls. Move the control lever to the "Lower" position to extend (lower) the counterweight removal cylinders until the cylinder rods enter the slots on the top counterweight tray.
6. Move the control lever to the "Lock" position to rotate the cylinder rods to the locked position to connect the cylinders to the counterweight tray.
7. Remove the connecting pins which secure 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.

8. Move the left control lever to the "Raise" position to retract (raise) the cylinders and lift the counterweights.
9. Continue to lift the counterweights until the counterweight cylinders are fully retracted.
10. If required, connect the pin-on counterweight to the upper by installing the connecting pins and keepers to secure the pin-on counterweight to the upper frame.
11. If required, install the 3,500 lb (1 588kg) side counterweights. Refer to Figure 1–107.
 - a. Attach sling to the lifting shackle on top of the counterweight.
 - b. Remove the pin from the hook lever and pull the lever up.
 - c. With a auxiliary lifting device of sufficient size, lift the counterweight.
 - d. Place the counterweight on the side of the pin-on counterweight so the tab engages behind the bar on the pin-on counterweight.
 - e. Push the hook lever down and install the pin and keeper pin.
12. Push the top part of the counterweight switch and select the appropriate counterweight configuration.

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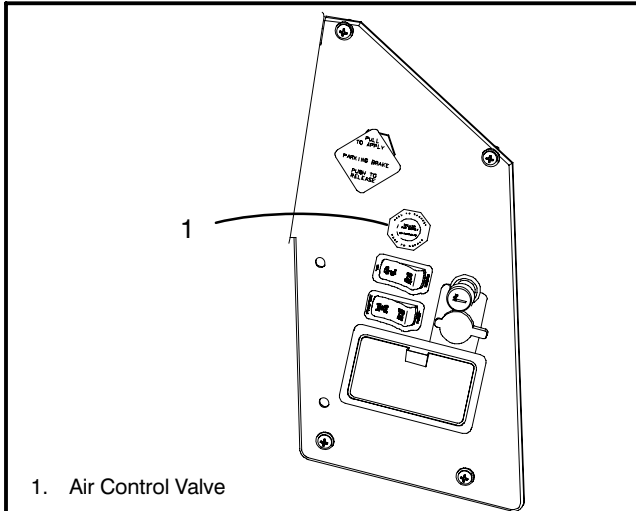


Figure 1–108
Dolly/Trailer Air Supply Control

Boom Dolly/Trailer

A boom dolly/trailer can be used to reduce the weight on each of the carrier axles by supporting a portion of the weight of the boom during highway travel, if highway codes allow the use of this equipment. The fly will also be partially supported by the dolly/trailer if it is properly stored on the boom. The crane must be equipped with the boom dolly/trailer kit to provide the necessary hydraulic plumbing required to allow the boom to float freely on the dolly/trailer. The boom dolly/trailer is for highway use only.



WARNING

When initiating a turn with the boom dolly/trailer, the tip of the boom may swing outside the turning radius of the dolly/trailer axles. In some cases the tip of the boom will move into the line of traffic. The tip of the boom must be properly flagged before roading the crane. Allow ample time to complete a turn before oncoming traffic approaches.

The dolly/trailer must be equipped with an air brake system. Pressurized air for this system is supplied to the dolly/trailer through outlets on the rear of the carrier. Push in on the boom dolly/trailer air control valve knob, on the carrier cab dash, to pressurize the outlets. Pull it out to shutoff the air supply to the dolly/trailer. Refer to Figure 1–108. Electrical hook-ups for lights are also available on the rear of the carrier.



WARNING

The counterweights must be removed from the upper when traveling the crane with a boom dolly/trailer. Crane may tip over when initiating a turn when the counterweights are left installed on the upper. The counterweights may be transported on the carrier deck or on the boom dolly/trailer. If the counterweights are transported on the boom dolly/trailer, consult the dolly/trailer manufacturer to ensure that the counterweights are properly stored and secured.

Boom Dolly/Trailer Installation

1. Remove counterweights from the upper.
2. Properly prepare the crane for highway travel. See "Traveling the Crane", in this section for instructions.
3. If installing a boom trailer:
 - a. Open the pintle hook latch on the rear of crane.
 - b. Using a signalman, back up the crane to the trailer and engage the tongue of the trailer with the pintle hook.
 - c. Latch the pintle hook, and lock it closed with the cotter pin.
 - d. Hook the safety chain to the ring on the rear of the crane. Be sure the latch on the hook is closed.
4. Hook up the air lines and plug in the electrical cable. Refer to Figure 1–109.
5. Push the boom trailer air control valve on the carrier dash, in to supply air to the trailer. Refer to Figure 1–108.
6. Make necessary preparations on the boom and dolly/trailer to allow the connection.
7. Position the fully retracted boom at a 40° angle. Swing the boom over the dolly/trailer as required. Lower the boom onto the dolly/trailer.

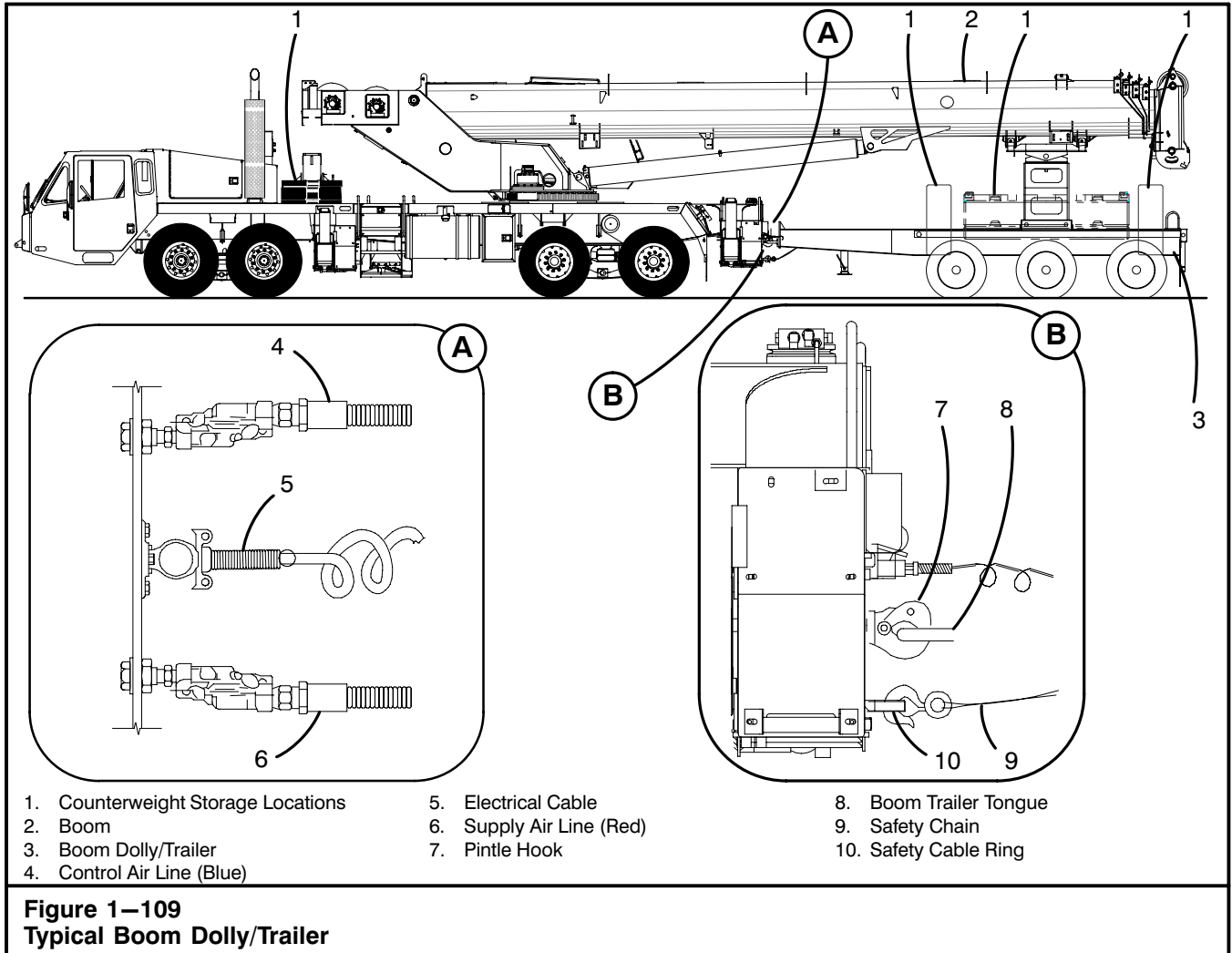


WARNING

When swinging over the side on tires with no counterweight maintain 40° boom angle. Crane may tip over causing personal injury and/or crane damage.

8. Make all necessary boom connections to the dolly/trailer. Consult the dolly/trailer manufacturer for instructions.
9. Secure or remove hook block and/or hook ball.
10. Set the RCL system to rigging mode.

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CAUTION

Do not leave any swing lock device in the engaged position when traveling the crane with a boom dolly/trailer. Failure to release these devices during this operation may result in damage to the swing speed reducer.

11. Disengage the travel swing lock and release the swing lock. Also disengage the 360 degree swing lock, if equipped.
12. Shutdown the engine and disengage the main pump.



WARNING

Check that the boom is properly supported by the dolly/trailer before opening the needle valves. The boom could drop suddenly causing damage or injury.

All needle valves must be fully open before traveling the crane with a boom dolly/trailer. Crane damage could result.

13. Turn all float valves at the boom hoist cylinders, counterclockwise as far as possible to open the valves and allow the boom to float freely on the trailer. Refer to Figure 1-110.
14. Flag the end of the boom before roading the crane.

Note: If the boom trailer air system is not already pressurized, allow ample time for the system to charge before attempting to move the trailer. The system must have sufficient air pressure before the trailer's park brake will release.

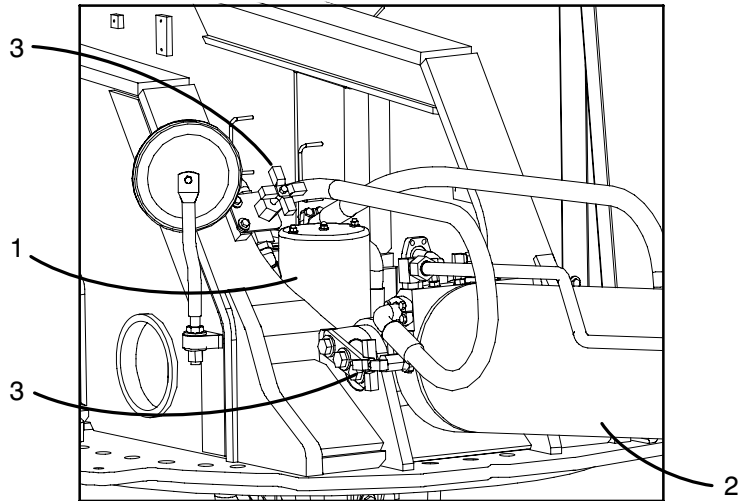
Operator's Manual

SAFETY INSTRUCTIONS

All needle valves must be fully closed before operating boom hoist cylinders.

Open valves only if boom is supported by boom dolly.

All valves must be fully open if boom is to float on boom dolly.



1. Rotating Joint
2. Boom Hoist Cylinder
3. Float Valves

Figure 1–110
Boom Hoist Float Valves

Boom Dolly/Trailer Removal

1. Park the boom dolly/trailer where desired and apply the park brake. Shutdown the engine. Block the wheels of the dolly/trailer so that trailer is restrained in both directions.
2. Turn all float valves, at the boom hoist cylinder, clockwise as far as possible to close the valves and allow normal operation of the boom hoist function. Refer to Figure 1–110.



WARNING

All of the valves on the boom hoist lines must be fully closed before operating boom hoist system. The boom could fall causing damage or injury.

3. Start the engine. Pull the boom dolly/trailer air control valve on the carrier cab dash, out to cut the air supply to the trailer. Refer to Figure 1–108.
4. Disconnect the boom from the dolly/trailer
5. Raise the boom off the dolly/trailer and to a 40° angle. Fully retract the boom, swing the upper directly over the front, and place it on the boom rest. Engage the travel swing lock.
6. Disconnect the electrical cable and air lines from the rear of the carrier. Cap the outlets and the air hoses using the storage hardware and brackets provided.
7. If required, unhook the safety chain from the rear of the carrier. Remove the cotter pin from the pintle hook and open the pintle hook.
8. Carefully pull the crane away from the dolly/trailer.

Boom Trailer Park Brake

The trailer is equipped with a spring applied air released park brake. When the trailer is installed on the crane the same control knob used to operate the carrier park brake, also controls the trailer park brake simultaneously.

When the trailer is not connected to the carrier air system, an air control valve on the front of the trailer is used to control the park brake. The blue and red air lines to the carrier must be disconnected before the trailer park brake control will operate independently from the carrier park brake control.



WARNING

Block the wheels of the trailer before releasing the trailer park brake. Trailer will roll if not restrained by some means. Use blocking of adequate size and place it so that trailer is restrained in both directions.

Push the dolly/trailer park brake control knob in to release the brake. Pull it out to apply the brake.

Note: The trailer air system must have sufficient pressure to release the park brake. A fully charged air tank will allow you to release the brake approximately twelve times.

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Lifting The Crane

The entire crane can be lifted or the components may be removed from the crane and lifted individually. Refer to Figure 1–111 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, fly tip, and counterweights. 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/or hook 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 sharp 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, or main chords 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 and brake.

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 and/or hook ball to prevent excessive swinging.

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 released from the drum.

4. 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.
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.

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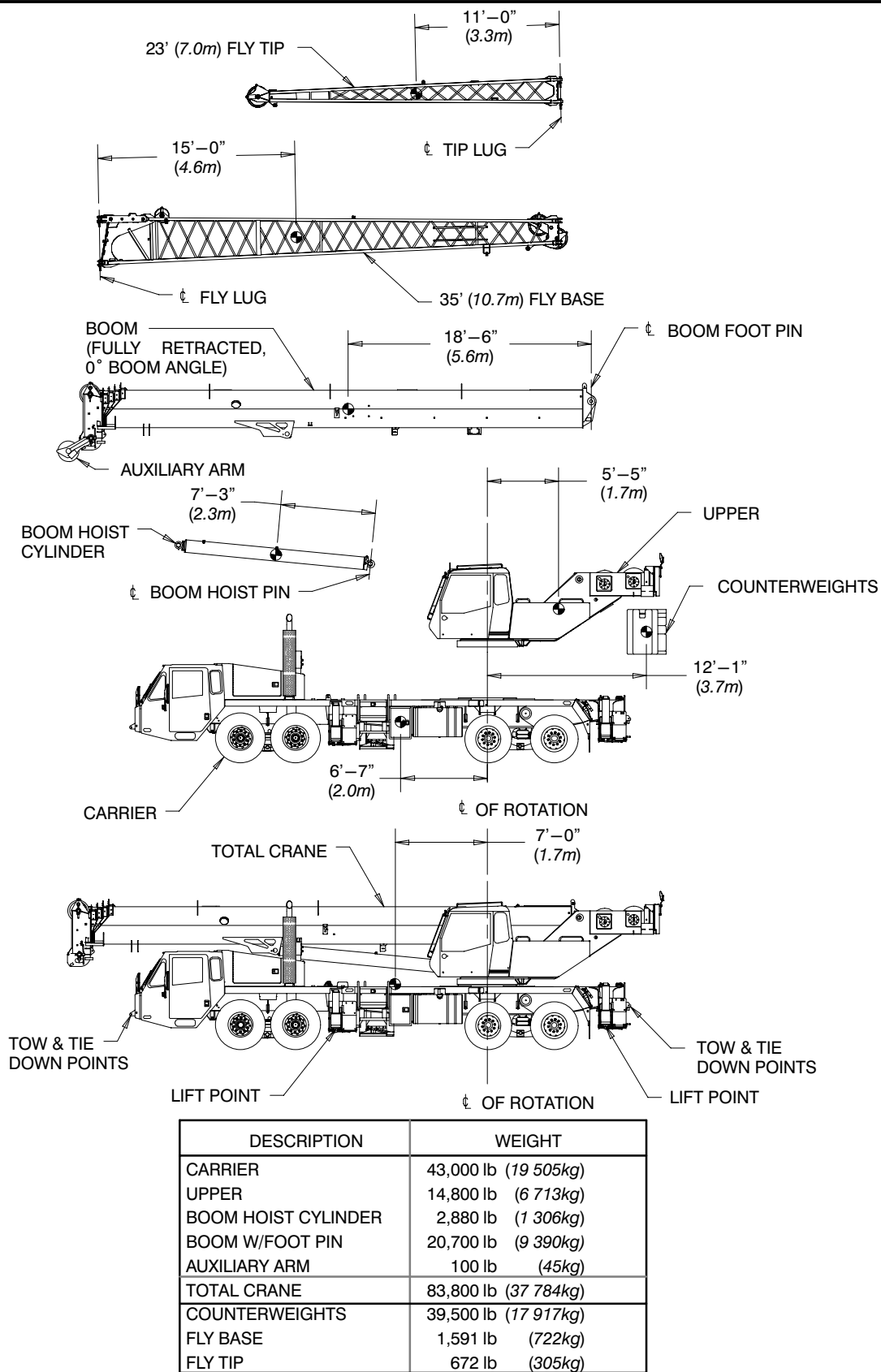


Figure 1-111
Lifting The Crane

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 and/or hook ball to prevent excessive swinging.

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 released from the drum.

4. 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.
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.

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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 and/or hook ball 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. To preserve battery life, move the battery disconnect switches to the off position.
11. 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. Cover all open areas around the engine, cab, etc. to prevent entry of water. Cover the entire engine area with a tarp if possible.
10. 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.
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. To preserve battery life, move the battery disconnect switches to the off position.
14. 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.
15. 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.