Link-Belt®
CONSTRUCTION EQUIPMENT

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CRANE OPERATING SAFETY & PERSONNEL HANDLING GUIDELINES

Book No. 1021D
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Link-Belt CRANES

General

Read this everyday – someone's life may depend on it, maybe your own.

When a crane is maintained and used properly, it can be a safe, highly useful piece of equipment, but as with many commonly used things such as a lawn mower, a motor boat, or even a kitchen knife, 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 the situations you will run into. The rules given here cover general usage, and some of the more specific cases. If conditions arise that are not covered by these rules, contact the manufacturer. A phone call may save someone's life, maybe your own. Link-Belt Construction Equipment Company has Distributors worldwide that can answer questions.

This Safety Manual is intended to cover operating practices on both hydraulic and non-hydraulic cranes. Correct operating practices for both types are similar, but different problems will arise on each type of crane. For this reason, there is a Section in this Safety Manual on Hydraulic Crane Safety. The other Sections, for the most part, apply to both types of cranes.

Reference Material

Additional material on safe operation is available from several sources. Link-Belt Construction Equipment Company strongly recommends that crane users obtain this information:

1. Society of Automotive Engineers, Inc. (SAE) 400 Commonwealth Drive, Warrendale, Pa. 15096, publishes a list called "Safety Considerations For The Operator," SAE J153, in their "Recommended Practices Manual."
2. Power Crane and Shovel (PCSA), Bureau of Association of Equipment Manufacturers (AEM), 111 E. Wisconsin Avenue, Milwaukee, WI. 53202, Standard No. 4, "Mobile Power Crane and Excavator and Hydraulic Crane Standards," contains information on safety. Safety Manuals on crane operating safety are also available from PCSA.
3. The Department of Labor, Occupational Safety and Health Administration (OSHA), publishes safety and health regulations and standards under authority of the Occupational Safety and Health Act. Its address is Occupational Safety and Health Administration, U.S. Dept. of Labor, Washington, D.C., 20210.
4. American National Standards Institute, (ANSI) C/O The American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017 includes standards for safe operation, inspection, and maintenance in their ANSI B30.5.

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

Link-Belt CRANES

1	I am the designated person responsible for verifying that all safety requirements are met for this personnel handling operation; Name: _____ Title: _____ Signature: _____ Date: ____/____/____	Initials
2	I have verified that there are no conventional means to handle personnel for this operation.	
3	I have a written statement authorizing personnel handling from a competent person on the job who accepts full responsibility, or I accept full responsibility for the operation.	
4	The Crane Operator acknowledges that he has read and fully understands the Crane Operator's Manual and Crane Rating Manual. All personnel involved have been informed and understand the tasks required to complete the personnel lifting operation.	
5	The crane has been maintained, lubricated, and adjusted by a designated person, as specified in the Crane Operator's Manual.	
6	The lift crane is equipped, and all devices operate properly as follows:	
	• Anti-two block device with hydraulic cutouts • Power load raising and lowering with automatic brakes and function cutouts – Free-fall (if equipped) shall not be used • Boom angle indicator with high and low set points and function cutouts • Boom length indicator (telescopic booms only) and function cutouts • Load Indicating System or Rated Capacity Limiter 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	The wire rope used to lift the work platform is reeved from an allowed lifting sheave.	
10	Crane travel is not allowed with personnel in the work platform.	
11	Telescoping the boom is not recommended with personnel in a suspended work platform.	
12	When handling personnel with pinning and latching style booms, it is recommended boom be kept in a pinned position. Inspections must be made to ensure all boom extend pins are set.	
13	All wire rope sockets and dead end lugs are properly installed and are in good working condition. All wire rope guards are properly installed and adjusted to hold all ropes on the appropriate sheaves.	
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.	
17	A Proof-Test/Trial Lift was completed with 125 % of the work platform's rated capacity.	
18	The total load being lifted will not exceed 50% of the standard lift crane capacity charts.	
19	Cranes with outriggers have them equally extended with tires clear of the ground.	
20	A Pre-Lift meeting was held with all appropriate personnel to review all aspects of 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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Note: Refer to the crane Operator's Manual for possible language translations of this form.

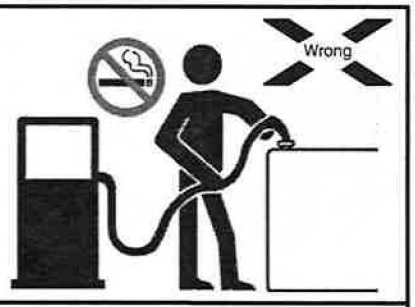


Figure 3
Do not smoke when fueling, or fuel up near an open flame.

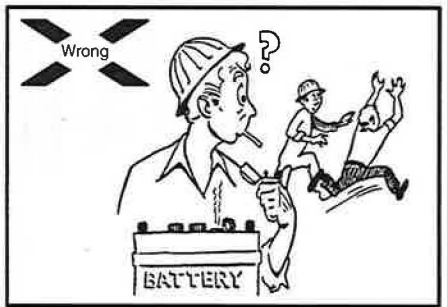


Figure 4
Do not use an open flame near the battery.

8. **Keep the crane clean, in good repair, and in proper adjustment.** Oil, grease, or tools left on the decks may cause falls. Improper adjustments can lead to crane damage, load dropping, or other malfunctions. After working on the crane, remove all oil, grease, and tools before resuming operation.
9. **Keep your shoes clean.** Before entering the operator's cab, wipe your feet clean of an mud, gravel, snow, ice, moisture, grease, etc. Slippery shoes could cause momentary loss of control of crucial foot operated controls.
10. **Keep all walking surfaces (steps, ladders, platforms, etc.) on the crane clean.** These are to assist operators and service personnel with safe access/egress to/from the crane and to/from adjustment and inspection areas. Do not allow walking surfaces to become contaminated with mud, snow, ice, oil, paint, wax, etc. Any contamination can cause the walking surfaces to become slick, reducing their effectiveness for safety while walking on the crane.
11. **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(s) when fueling.
12. **Use care when working with any brake and/or clutch linings.** The material in older brake and clutch linings may contain asbestos fibers, a cancer and lung disease hazard. Brake and clutch linings manufactured today contain non-asbestos fibers, whose long-term effects to health are unknown. Use caution when handling either asbestos or non-asbestos materials used in brake and/or clutch linings. Refer to OSHA regulations for proper handling of these materials. Material Safety Data Sheets (MSDS) regarding brake and clutch lining materials can be obtained from a Link-Belt Distributor.
13. **When checking battery fluid level, use a flashlight– not an open flame.** Battery gas is explosive. If the battery explodes you may get acid in your eyes, which may 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, especially when they are being charged.

    Battery posts, terminals, and related accessories contain lead and lead compounds. Eating or smoking with lead residue on hands may cause lead poisoning. Wash hands after handling lead products.
14. **When using jumper cables to start an engine, always connect negative post to negative post, and positive post to positive post.** Always connect the two positive posts together first, and the two negative posts last to minimize sparks when the cables are connected. These sparks could cause the battery to explode.

8. Telescope operation is not recommended with any extendable boom with personnel in a suspended 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 as listed on the crane capacity chart. (Note: A.P.I. applications require 25% of lifting capacity as the limit.)
11. Use caution when utilizing pendant supported lattice jibs on tubular or angle booms as the jib can drift backwards into the jib backstops under certain conditions. This is most likely with short jib lengths with minimum jib offset and maximum boom angle. Pay special attention to detect the possibility of jib drift during the work platform test lift. An additional test lift is recommended with an empty work platform when operation at or near these conditions.
12. 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 is allowed to 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.
13. 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. Do not use high speed functions, if equipped.
14. Do not use multi-function crane operation. If load hoist, boom hoist, and swing functions must be used to position the work platform, perform each function individually.
15. 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.
16. Voice communication between work platform personnel, the crane operator, and designated signal person, if assigned, shall be maintained.
17. 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.
18. If the work platform is not landed, it shall be tied to a structure before personnel mount or dismount the work platform.

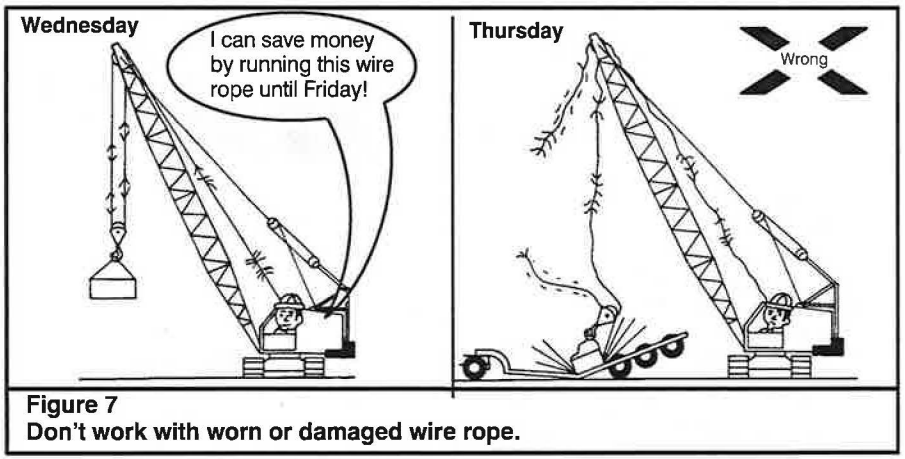


Figure 7
Don't work with worn or damaged wire rope.

Occupational Safety and Health Act (OSHA) regulations state, "a thorough inspection of all wire ropes shall be made once a month and a full written, dated, and signed report of wire rope condition kept on file where readily available". Replace any worn or damaged wire rope. Pay particular attention to boom hoist wire ropes and pendants. Check end connections (pins, sockets, wedges, etc.) for wear and/or damage.

19. **Visually inspect all hose assemblies in service daily.** Replace any damaged hose assemblies, hose and mating fittings, and seals as required.
20. **Use caution when disconnecting the dead end of wire ropes.** Reeved wire rope can become twisted on the sheaves. When the dead end pin or socket is removed, the wire rope may spin.
21. **If the boom, mast, gantry, etc. is struck or damaged by anything, stop.** The loading on a boom increases as the boom is lowered; therefore a damaged boom or boom suspension system may collapse during lowering. Use a helper crane to assist in lowering a damaged boom.
22. **Ensure the boom hoist pawl is always engaged except when lowering the boom.** Don't rely on the boom hoist brake alone to hold the boom. Wear, improper adjustment, water or oil on linings, and other factors may reduce the ability of the brake to hold the boom.
23. **Always replace protective guards and panels before operating crane.** The machinery house also serves as a machinery guard. No one should be inside the machinery house when the engine is running and the master clutch is engaged.
24. **Do not get on or off a crane in motion.** Remain in three point contact with the crane at all times (two hands and one foot or two feet and one hand) when climbing on or off a crane. If a ladder is provided, use it. Be careful when walking on track shoes. They may be slippery and cause a fall.
25. **Do not tamper with safety devices.** Keep them in good repair and properly adjusted. They were put on the crane for your protection.
26. **Before performing repairs or adjustments, lower attachment to the ground, or onto blocking.** Don't walk on a boom, fly, or jib unless a walkway is provided. Use ladder, planking, or lift work platform to prevent falls. Lock the starter, or remove battery cables so crane can't be started. Remove ignition key. Post warning signs in operator's cab so no one will try to start the engine. Do not adjust, maintain, or repair a crane while it is operating.

b. Pinning and latching style booms:
   i. Inspection of the latching mechanism, sensors, and hydraulic/electrical circuit at the access points.
   ii. Inspection of all pins and pinning locations in the individual boom sections and at the fully retracted position.
   iii. Verification of the accuracy of the boom length indicator. Refer to the Operator's Manual for the procedures.

13. 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, links, etc.
    b. Inspection of all mechanical linkages, shafts, drums, etc.
14. A written record of all the above inspections must be maintained on the job site.

Crane Test Procedures

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

- Daily,
- At each job site before hoisting employees,
- After any repairs or modifications to the equipment,
- When an operator is replaced, and
- When, in the judgement of responsible job site management, or controlling entity, there has been a significant change in the conditions of the personnel lifting operation.

Note: No personnel are allowed to ride the work platform during any of the tests required in this Section.

1. The work platform and rigging shall be proof tested to 125 percent of the work platform's rated capacity. (The proof test may be done concurrently with the trial lift by completing the following test procedures.) Do not exceed the rated lifting capacity of the applicable lift crane as listed on the crane capacity charts. (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. The work platform shall be held in a suspended position for a minimum of five minutes with the test load evenly distributed on the work platform. (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.

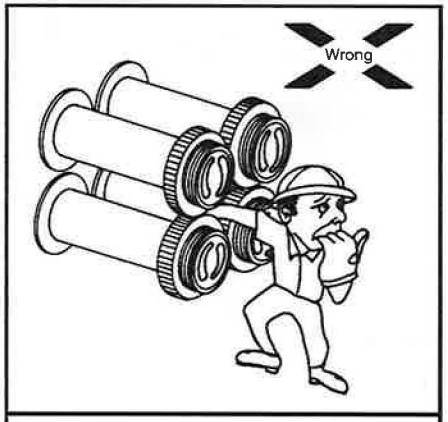


Figure 10
Don't get near moving gears.

Figure 11
Avoid pinch points - rotating parts.

37. **When working inside a building, check clearance to avoid a collision.** Check load limits on floors or ramps to prevent crashing through them. Always check work areas for dangerous features. Don't operate close to an overhang or deep ditch. Avoid caving edges, falling rocks, slides, etc. Do not 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.
38. **Keep clear of swinging upper and other moving/rotating parts.** Pinch points, which result from relative motion between moving/rotating parts can cause injury.
39. **Use extreme caution when removing radiator/surge tank caps, drain plugs, grease fittings, hydraulic pressure caps, etc.** They may fly off and hit you, or you may be burned by hot oil, water, or steam.
40. **Do not lubricate open gears while they are turning.** You may injure your fingers, hands, or other parts of your body. Disengage master clutch and shutdown engine(s) before lubricating. **If it is required to operate the crane during maintenance and/or adjustments,** use extreme caution as service personnel may have to work near and/or under moving machinery. Serious personal injury and/or death may result. Always remain in visual and/or verbal contact to ensure the safety of service personnel. Use a signal person if necessary.
41. **Ensure all labels, plates, decals, etc. are in place and legible.** Labels, plates, decals, etc. should be periodically inspected and cleaned as necessary to maintain good legibility for safe viewing. If any are missing, damaged, unreadable, or painted over, obtain new ones and install them on the crane.
42. **When making repairs which require welding, disconnect any electronic equipment (such as Rated Capacity Indicators/Limiters and engine computers) to prevent damage to them.** Connect the ground to the carrier if welding on the carrier or to the upper if welding on the upper. Electrical current through the turntable bearing could cause an arc which could damage it. (All paint and acoustical material in the area being welded should be removed to prevent burning them. The smoke and fumes from the burning paint and/or acoustical material can be very hazardous.) Also remove any flammable materials from the immediate area.

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. Alternative measures are not permitted.

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 block assemblies, hook ball 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 are allowed to 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 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.

Minimum Clearance When Operating Near High Voltage Power Lines Or During Crane Assembly/Disassembly.	
Normal Voltage, kV (Phase to Phase)	Minimum Required Clearance, ft (*m*) See Note 1
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*)
Over 1000	As established by the power line owner/ operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution.
Minimum Clearance When Traveling With No Load	
To 345	15 (*4.57*)
Over 345 To 750	16 (*4.87*)
Over 750 To 1000	20 (*6.10*)
Over 1000	As established by the power line owner/ operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution.
Note 1: Maintain 50 ft (15.2*m*) minimum clearance from power lines if voltage is unknown. If unknown but yet known to be less than 350 kV, maintain 20 ft *(6.1m)* minimum clearance.	
Note 2: Environmental conditions such as wind, fog, smoke, or precipitation may require increased clearances.	
High Voltage Power Line Clearance Chart	

Working Near Power Lines

1. **All electrical power lines are dangerous. Contact with them, whether insulated or not, can cause injury or death.** 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, you may be unable to have the power turned off. Follow these rules whether the power is turned off or not. Follow all requirements per OSHA regulations 1926.1407 through 1926.1411 as applicable while assembling, disassembling, operating, or traveling the crane in the vicinity of any power lines.
   a. **Be alert** – you are working around conditions which can cause death.
   b. Keep all parts of the crane – fall lines, hook block, hook ball, and load – at least the distance from the power line as specified in the "High Voltage Power Line Clearance Chart", or such distance as required by any other state of local requirements.
   c. **Assume that every power line is "hot".**

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 1926.1431 states "The use of equipment to hoist employees is prohibited except where the employer demonstrates that the erection, use, and dismantling of conventional means of reaching the work area, such as personnel hoist, ladder, stairway, aerial lift, elevating work platform, or scaffold, would be more hazardous, or is not possible because of the project's structural design or worksite 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 1926.1431 Cranes and Derricks.

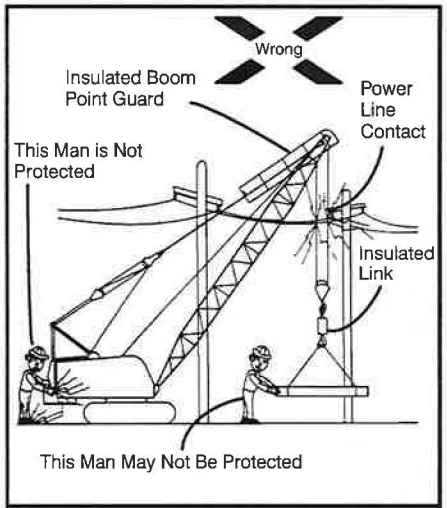
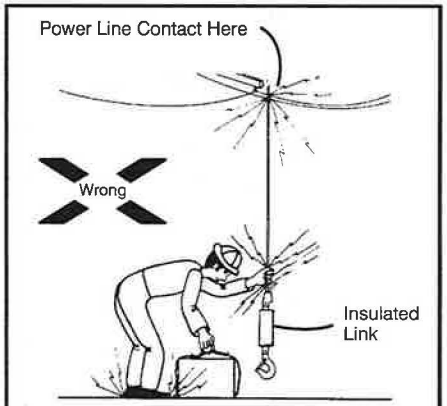


Figure 14
Crane equipped with both an insulated link and insulated boom point guard.



Even though the crane is equipped with an insulated link and boom point guard, in the above situation the man is not protected.

Figure 15
Crane equipped with insulated link.

i. The use of boom point guards, proximity devices, insulated links or blocks, 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 may be serious personal injury or death. Figure 14 through Figure 17 portrays some of the limitations of these devices.

j. When operating near radio or TV transmitting stations, or power plants, high voltage can be induced in metal parts of cranes or in their loads. This can occur even if the crane is some distance from the transmitter or antenna. Painful, dangerous shocks may occur. Contact trained electronic personnel before crane operation is started to determine how to avoid hazards.

2. **What should you do if a power line is touched by 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(s) unless the crane is on fire or an arc is cutting through the cab near you.
   d. Move away from contact in reverse to that which caused the contact. Example: If you swing left into the wire, swing to the right to break contact. Remember – once an arc has been struck, it may stretch out much further than you think before it breaks. Keep moving away from the line until arc breaks.
   e. When the arc breaks, continue moving until you are at least the minimum distance away as specified in the "High Voltage Power Line Clearance Chart", or such distance as required by any other state or local requirements. Stop the crane. Thoroughly inspect crane for damage. Repair any damage before further use.

Traveling With A Load On A Luffing Attachment

Traveling with a load suspended on a luffing attachment is only allowed under certain conditions (reduced load and reduced boom length). Refer to the specific luffing attachment Crane Rating Manual to determine if travel capacities are listed. If travel capacities are listed, these capacities must be used. Do not exceed these listed capacities. If travel capacities are not listed in the luffing attachment Crane Rating Manual, contact the factory to request approval before traveling with any load on a luffing attachment. Traveling with a load can create shock loads and side loads which may result in loss of stability and/or structural failure of the crane and/or luffing attachment.

Luffing Attachment Repair

Inspect all sections of the luffing attachment daily to ensure that they have not been damaged. Look closely at all lattice to chord welds. Even the smallest crack in a lattice, chord, or weld can greatly reduce the strength of the overall luffing attachment. If a luffing boom, luffing jib, or fixed jib section is damaged, it must be repaired before further use. Damaged lattice can be replaced. If a main chord on a section is bent or damaged, the luffing boom section, luffing jib section, or fixed jib section must be replaced. Do not try to repair main chord members. Refer to the latest version of the Link-Belt "Boom Inspection And Repair" Manual for more information on inspection and lattice replacement on luffing boom, luffing jib, and fixed jib sections.

Load Monitoring System

Ensure that the load monitoring system is properly calibrated, set to the correct crane configuration, and is fully operational. Check the system before each shift and repair problems as soon as possible. In an emergency situation, if these systems are not operational, follow the procedures "System Inoperative Or Malfunctioning" in the Operator's Manual.

Duty Cycle Applications

The use of luffing attachments for duty cycle applications (drag line, clamshell, and/or magnet) is prohibited.

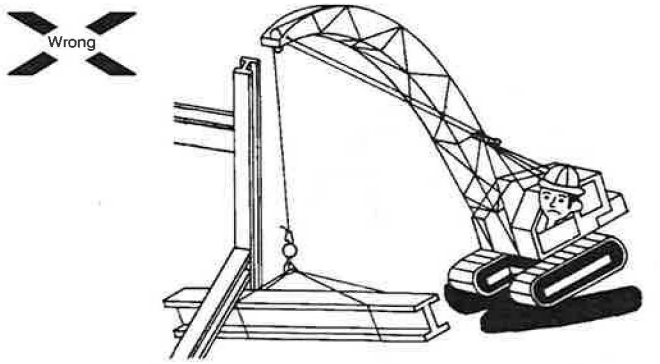


Figure 18
Ensure load doesn't get caught.

Crane Safety

1. **The operator, supervisor, or person in charge of the load must observe the following rules.**
   a. Loads must be well secured before lifting. Ensure that the rigging can't slip off or pull away from the load, or get out of position on the load. Use a three-point sling if necessary to prevent the load from rolling or turning over.
   b. Chains and slings must be of adequate size, in good condition, and not twisted around each other.
   c. Do not allow the boom or loads to pass over personnel.
   d. The load must not catch on an obstruction when lifting or swinging. Ensure the load, fall lines, or any other part of crane does not snag or strike an obstruction.
   e. Avoid sudden starts and stops. Lift carefully, swing gently, brake smoothly, lower and set loads carefully. Jerking the load, sporadic swing motion, lowering the load rapidly, and slamming on the brakes, will put shock loadings and possible side loadings on the boom. Unnecessary abuse labels the operator as a beginner. Be a professional.
   f. Do not wrap the hoist line around the load. Do not use discarded, worn, or damaged wire rope for slings. They may break and drop the load.
   g. The crane must be level before making a lift. Use levels if the crane is so equipped. If not use a good carpenter's level placed on a smooth horizontal surface on the upper or lower frame. Remember – a 3 degree side tilt can reduce capacities by 50% or more.

   The hook block or hook ball and fall lines can be used as a "plumb bob" to level a crane, Figure 19. Pick up a small compact load, well within the crane's capacity, a few inches *(centimeters)* above the ground. If crane is level, fall lines will hang directly between the boom foot, as you face the boom. Now swing over the side. The fall lines should still hang directly between the boom foot. Don't use this method on a windy day.

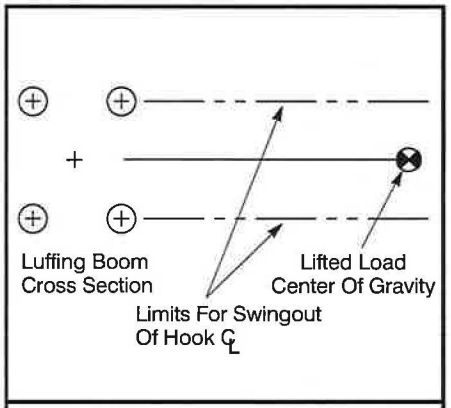


Figure 52
Load Swing

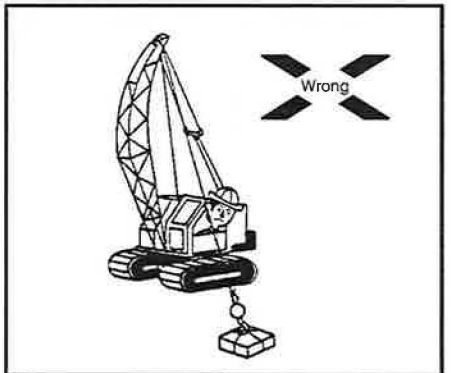


Figure 53
Do not use the boom or the luffing attachment to pull sideways.

Swinging The Luffing Attachment

When operating a luffing attachment, the swing movement must always be slow and smooth to prevent torque (twist) forces on the luffing attachment. The crane operator must ensure that the hook block or hook ball and load are kept directly under the luffing jib, fixed jib, or auxiliary lifting sheaves lifting point at all times. The load must remain freely suspended and must never be allowed to swing outside imaginary lines drawn through the centerline of the luffing boom chords as shown in Figure 52.

Luffing Attachment Side Load

Applications where the crane boom is used to pull sideways on loads are prohibited as indicated in the crane Operator's Manual. Side loading can create loads that exceed the design limits of the crane boom. This can be especially damaging when using luffing attachments.

Link-Belt cranes are designed to lift and position freely suspended loads where the weight and working radius do not exceed the capacities shown in the Crane Rating Manual for each specific crane. Link-Belt cranes are not designed to drag or pull loads in any direction. This type of operation can induce high side loads and can cause major boom damage or failure. The center of gravity of the load must be positioned directly below the attachment lifting point before attempting to lift any load, and must remain within the limits as shown in Figure 52, during all operations.

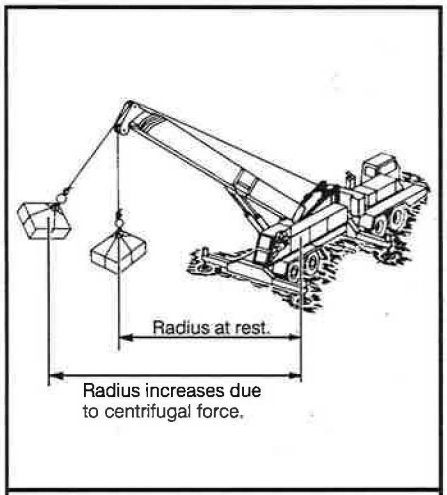


Figure 22
Watch out for centrifugal force.

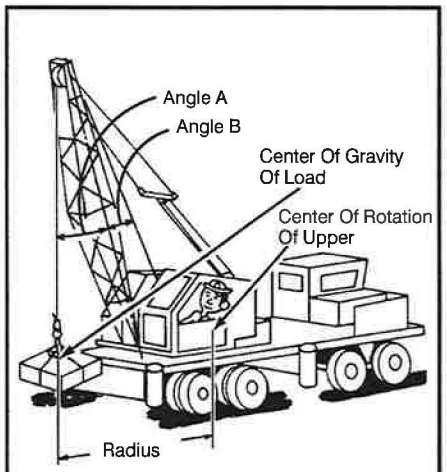


Figure 23
Watch while lifting at short load radius.

7. **Keep the load lines as short as possible to prevent excessive swinging.** Always use the shortest boom length that will do the job. Remember, the shorter the boom, the stronger it is.
8. **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 and/or tipping. When stopping the swing, overswing of the load can side load the boom. The use of a tagline is recommended to control this force.
9. **Use at least the number of parts of hoist line as specified in the Wire Rope Capacity Chart for the specific crane to handle the load.** (Do not exceed the maximum capacity for the number of parts of line being used or the maximum capacity on the Capacity Chart or Crane Rating Manual for the specific crane and its working setup, whichever is less.) Local codes may require more parts of line than shown. Check code requirements and use them where applicable.

   Use special care when handling loads on single part line with boom at a short radius. This is especially important when hoist line is off rear drum. The boom may be whipped back over crane. In single part line operation, ensure Angle A is always greater than Angle B, as shown in Figure 23.
10. **Know the boom length. Don't guess.** Use of an incorrect boom length can cause an accident.
11. **Know the load radius.** Don't guess at it. Determine radius by using the boom angle indicator, the boom length indicator, and the Capacity Chart or Crane Rating Manual for the specific crane, or measure it with a tape measure. Remember – radius is the horizontal distance from the centerline of rotation of the upper to the center of gravity of the load when the load is hanging free.

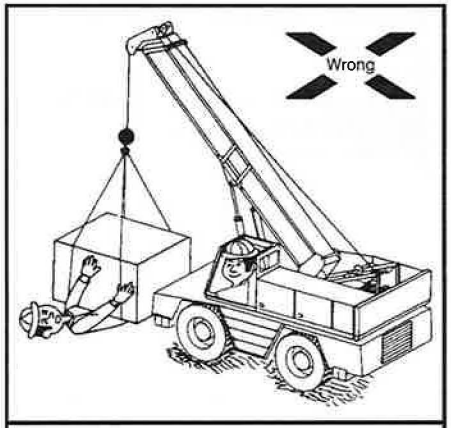


Figure 49
When boom retracts, load will lower.

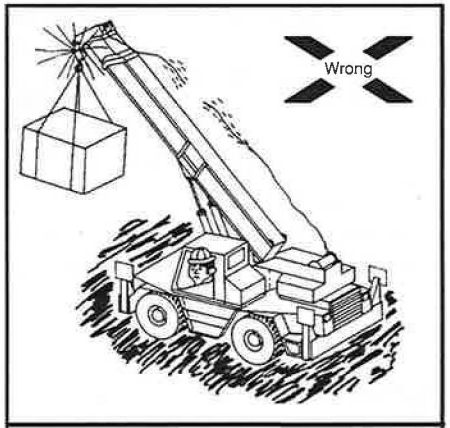


Figure 50
Avoid two blocking.

6. **When picking a load with any crane, the load radius will increase.** Due to the design of hydraulic crane booms (cantilever boom, supported by cylinders with overlapping sections) this increase is much more pronounced. The increase or outswing 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. Ensure the load being lifted will remain within capacity as it is lifted and the boom deflects.
7. **Do not use a hydraulic crane boom to push or pull.** It is not designed for this purpose. Such action can damage the boom and lead to an accident.
8. **Do not operate a hydraulic crane at radii or boom lengths where the Capacity Chart or Crane Rating Manual, for the specific crane, shows no capacity.** In some cases the crane can tip over with no load on the hook. This is particularly true over the side when on tires, where these cranes are the least stable. Also, if the boom is fully extended at a low angle, the crane may tip until the boom touches the ground. In any case, serious personal injury and/or major crane damage may result.
9. **When lowering or retracting the boom, the load will lower.** To compensate for this, the operator must take up on the hoist wire rope. Otherwise, movement of the load may cause an accident.

   When extending the boom, the load will raise. The operator must let off the hoist wire rope to keep the load in place. Extending the boom without letting off on the wire rope can lead to "two blocking". This is when the hook block, hook ball, or load contacts the head sheaves. Two blocking can lead to sheave damage, wire rope breakage, and/or load dropping.
10. **When extending or lowering a boom with a load, load radius increases.** As radius increases, capacity decreases. If capacity is exceeded, the boom may bend, as the safety factor in the boom hoist cylinders may exceed the strength of the boom, 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 cylinders to extend than to retract. If an operator extends the boom under load, thinking he can retract it if he gets into a precarious condition, it may cause an accident.

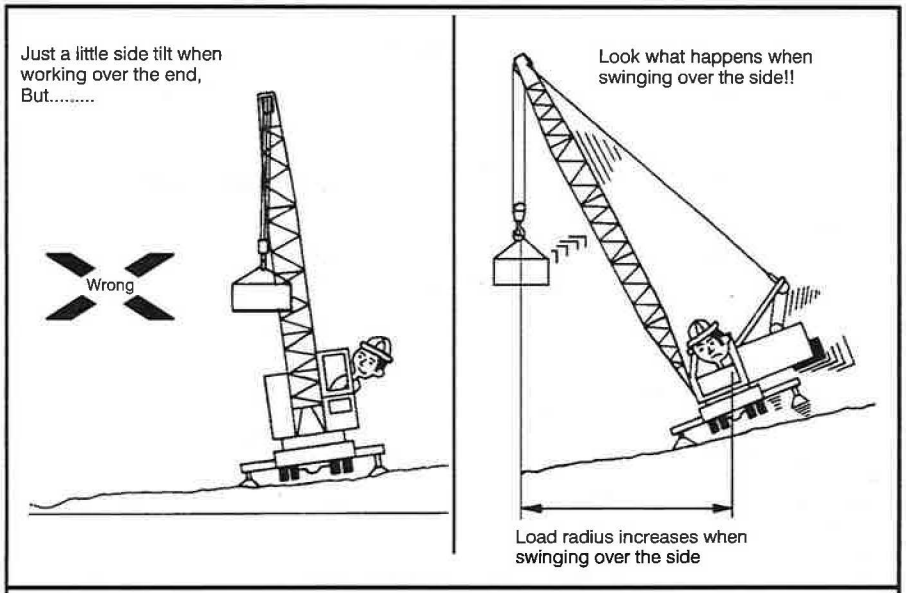


Figure 20
Effect of side tilt.

4. **When swinging a load from over end to over side, the lean described previously will increase.** This is especially noticeable when operating on tires. 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 inswing or outswing of load. If not, a dangerous condition may result.
5. **Know the load weight. Don't try to guess or estimate the load.** Use a scale weight, carefully calculated weight, a hook scale, or a Load Indicating System. Remember – the weight being lifted includes the weight of any lifting slings, or gear, the hook block, and any hook ball weights. If picking off the boom with the fly and/or jib installed, the weight of the fly and/or jib and rigging must also be considered part of the load. The total load weight must not exceed the rated capacity of the crane, as listed on the Capacity Chart or Crane Rating Manual for the specific crane, and Wire Rope Capacity Chart, for the position, boom length, load radius, number of parts of line, and condition of operation being used.

Remember – capacity ratings are based on ideal conditions:

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

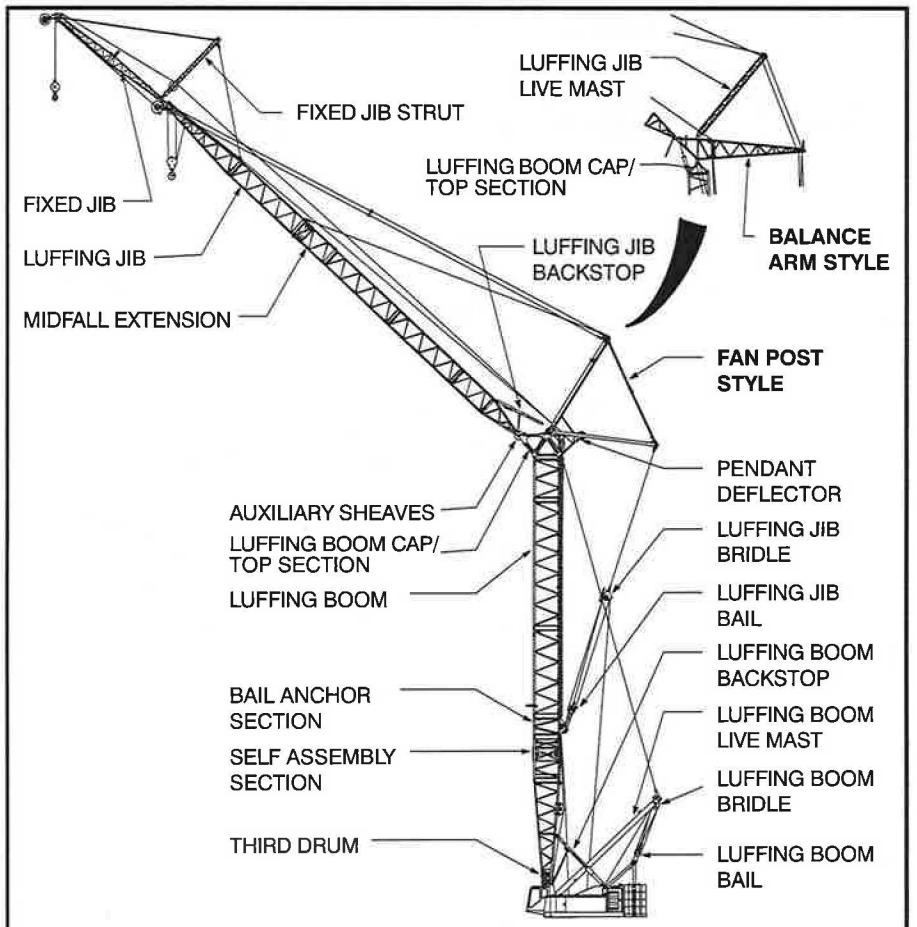


Figure 51
Typical Luffing Attachment Nomenclature

Luffing Attachment Operation

Introduction

Modern lattice boom luffing attachments are very specialized attachments specifically designed for applications requiring extra "up and over" reach capabilities. Both the luffing boom and the luffing jib angles can be controlled from the crane operator's station greatly expanding the crane's reach and capability. These added features increase the complexity of operation and therefore require specially trained operators and vigilant attention to crane safety by the entire work crew.

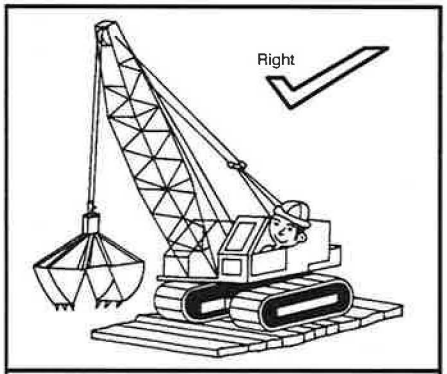


Figure 26
Use matting on soft ground.

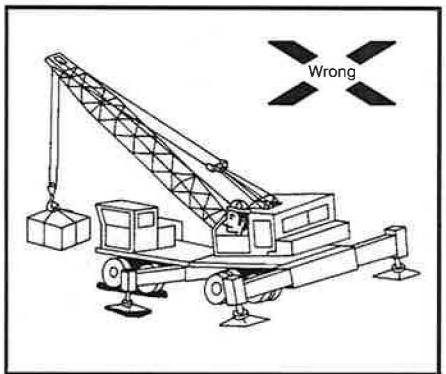


Figure 27
Working over front can cause accidents.

Jacks must be extended so all tires are clear of all supporting surfaces, and the crane must be level. Ensure that 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 outriggers beams inside the pontoons as this reduces stability. Blocking must be under pontoons only. Remember—there are tremendous loadings on pontoons and blocking – the weight of the entire crane plus any load.

When blocking or matting under pontoons, ensure that each pontoon is supported fully – no unsupported pontoon area is permissible. Ensure that the 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 all outriggers being equally extended to the desired approved position; all fully retracted, all half/intermediately extended, all fully extended, etc. 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.

Avoid working with only the front or the rear outriggers extended. If swinging over the side, the crane may tip over, or boom may be damaged from side loadings because the crane is not level.

When working a crane with mechanical (non-hydraulic) outriggers, ensure the beams are pinned in place, otherwise they can "creep in" while operating, causing an unstable condition and possibly tipping the crane over.

16. **When using a boom length where retractable gantry or live mast is required, ensure it is fully extended and pinned in place.**

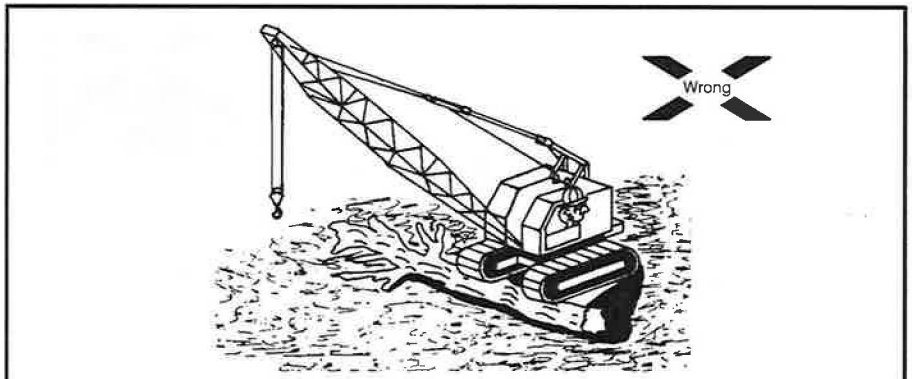


Figure 46
If possible, go around obstacles.

Crawler Operation

1. **Travel safely.** Watch for narrow bridges or openings, low clearances, etc. When maneuvering in tight places, post a signal person on the ground to guide you. Check load limits, and know the crane weight. When transporting the crane on a trailer, ensure it is securely tied down. Engage the travel swing lock. Use proper warning signs, flags, etc. Check local regulations before transporting, and follow them.
2. **When towing cranes, move slowly.** Take up slack in chain or wire rope. Don't jerk, it may break chain or wire rope. Keep chain or wire rope tight while towing. Disengage traction brakes on tracks before towing.
3. **In cold weather, park where crane won't freeze to the ground.** Powertrain failure can result when trying to move a crane that is frozen to the ground.
4. **Avoid traveling over obstacles (rough terrain, rocks, logs, curbs, ditches, etc.), if at all possible.** The size and type of obstacle that can be safely crossed will depend on many factors, including good judgment. When obstructions must be crossed, do so with extreme caution, at an angle if possible, and at slow speed. Ease up to the break over point, balance on the obstruction, and then ease down to minimize jolt of contact on the other side.
5. **Cross a gully or deep ditch at an angle and very slowly.** Carry boom at a low angle for increased stability.
6. **Avoid sidehill travel whenever possible.** Travel up or down the slope. Shift crane to lowest travel speed when starting up or down the slope. Keep the upper facing downhill. If necessary to face uphill, keep the attachment close to ground. If the crane starts slipping sideways on a grade, immediately turn the crane downgrade.
7. **One worker on the job site should be designated as a signal person, and the operator should obey signals from that worker only.** However, a signal to stop should be obeyed no matter who gives it. (Refer to the Hand Signals Chart at the end of this Safety Manual.)

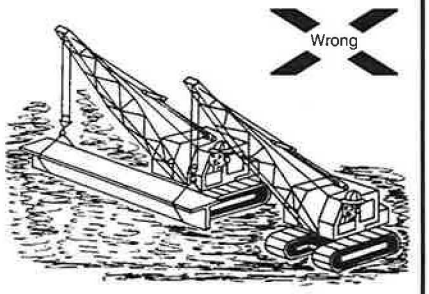


Figure 30
Avoid using multiple cranes on a lift.

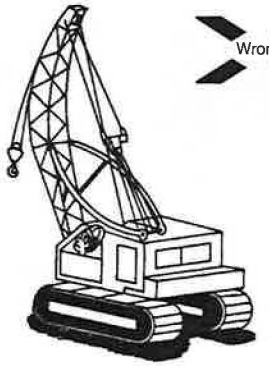


Figure 31
Use caution when booming to minimum radius.

22. **Don't exceed the rated capacities of the crane under any circumstances.** While a crane may have more stability when lifting over a corner (as compared to straight over the side) the crane capacity is not increased. Any time the rated capacities, as listed on the Capacity Chart or Crane Rating Manual for the specific crane are exceeded, the crane is overloaded. Overloads can damage the crane and such damage may cause major failures and/or serious accidents.
23. **Don't work with jib angles which are not listed on the Capacity Chart or in the Crane Rating Manual.** The greater the angle, the less capacity the jib has. Working with unapproved jib angles may cause jib or suspension failure, and may cause dangerous twisting forces in the boom.
24. **Do not use a fly, jib, or boom which is not approved for the crane.** Tipping may result. Use only the attachments which are specifically designed for the crane. Do not exceed maximum boom length as specified on the Capacity Chart or in the Crane Rating Manual.
25. **Know how much counterweight is on the crane.** Ensure that you know how the crane is equipped before attempting to read the Capacity Chart or Crane Rating Manual for the specific crane. Some cranes have different capacities based on the amount of counterweight installed on the crane.
26. **Be aware of backward stability.** Certain boom length and counterweight combinations can cause the crane to tip over backwards. Refer to the Capacity Chart or Crane Rating Manual and the Operator's Manual for conditions that must be met to avoid a backward tipping condition.
27. **Use caution when booming up to minimum radius.** Be prepared to stop boom travel. If the boom limit device malfunctions, the boom and backstops may be damaged, or someone may be hurt. Do not boom into boom limit device in normal operation.
28. **Unless the Crane Rating Manual lists specific capacities and the Operator's Manual gives specific instructions to follow, do not lift more than one separately rigged load at a time, (more than one load line and hook block or hook ball on separately operated drums), even if both loads combined don't exceed the crane's capacity.** Your full attention cannot be given to both loads, creating a dangerous situation.

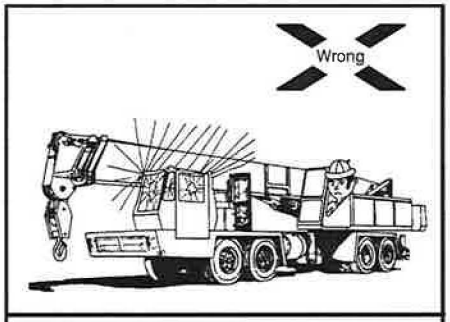


Figure 44
Watch the carrier cab!

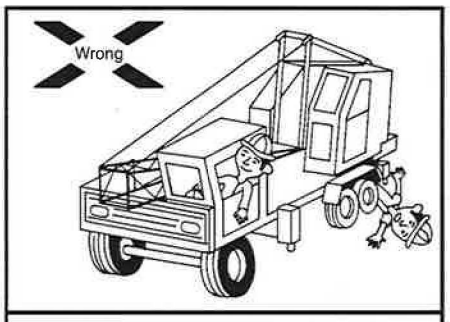


Figure 45
Back the crane safely.

7. **When swinging upper, watch the carrier cab.** Swinging into the carrier cab will damage it, and probably the boom too.
8. **If the carrier is equipped with a safety belt or shoulder harness, use them.** They are there for your protection.
9. **Brake firmly in one application.** Avoid fanning the brakes. This may exhaust air pressure, needed to apply the brakes, so fast the compressor can't keep up.
10. **If a crane must be towed, move slowly.** Take up slack in chain or wire rope. Don't jerk, it may break the chain or wire rope. Keep chain or wire rope tight while towing.
11. **Before attempting to move the carrier, ensure there is enough air pressure to operate the brakes.** Always check brake operation before driving the crane.
12. **Always look before you back up, or better yet, post a signal person to guide you.** If the crane is equipped with a back up alarm, ensure it is working properly if not, use the horn as a signal. Use a code such as one beep - stop, two beeps — forward, three beeps — backward. Ensure everyone on the job site knows the code.
13. **When moving crane around the job site with boom in the air, observe the following precautions:**
    a. Position boom and attachments per the Operator's Manual. Engage the travel swing lock.
    b. Shift carrier transmission into the lowest possible gear. Do not move faster than speed listed on the Capacity Chart or in the Crane Rating Manual for the specific crane.
    c. The terrain must be smooth and solid. If not, grade area before moving crane.
    d. Tie down the hook block and/or hook ball to prevent them from swinging. If hooked to the carrier, use care not to raise boom, telescope out, or hoist up without first unhooking the hook block and/or hook ball from the carrier to prevent crane damage.
    e. On cranes equipped with outriggers, fully extend outrigger beams. Extend or retract jacks until pontoons just clear the ground. (Use extreme care due to the added width with extended beams. Watch to avoid any obstructions.)
    f. Inflate tires to pressure given on the Capacity Chart or in the Crane Rating Manual for making lifts on tires, before attempting to move the crane. This pressure is usually higher than normal, and will provide better crane stability. If required, adjust pressures to those shown for highway travel before driving on the highway.

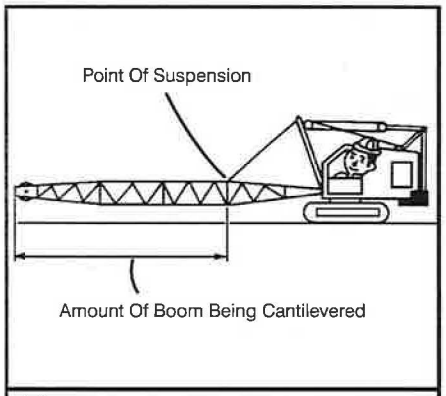


Figure 32
Cantilevering the boom.

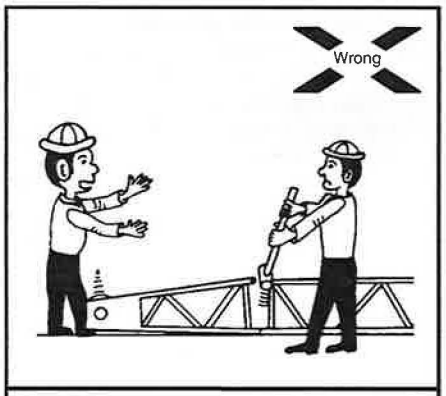


Figure 33
Block under top section before unpinning.

31. **When operating near minimum radius, be ready to boom down as the load is set down to compensate for the tendency of the boom to move back against the backstops when the load is released.** This action occurs because of the elasticity in the boom and boom hoist system. Major bending of the boom can occur if it is allowed to push against the backstops too heavily.
32. **Watch out for "two blocking" (pulling hook block, hook ball, or load into boom sheaves or other attachment sheaves).** This can cause wire rope breakage, sheave damage, or can pull the boom back over the operator's cab, resulting in an accident.
33. **Know the maximum amount of boom that can be cantilevered, (projected beyond point of suspension) during boom assembly and disassembly.** Exceeding this amount can cause boom or boom suspension failure.
34. **Block under the boom top section before unpinning from extensions.** Since the top section is tapered, it will fall to the ground when unpinned, possibly resulting in an accident or damage to the top section.
35. **When disassembling bolted boom, block securely under each end of each section before unbolting them.** Otherwise boom may fall and seriously injure or kill someone. Do not get under a boom, or walk on the boom, especially when assembling or disassembling it.

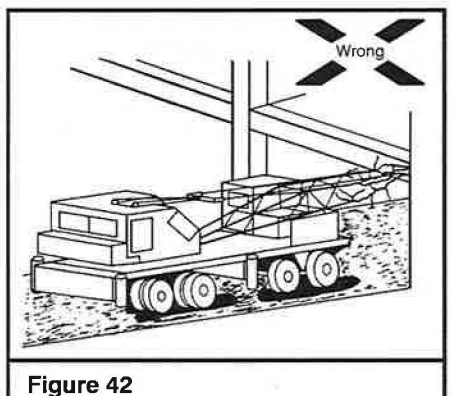


Figure 42
Travel safely.

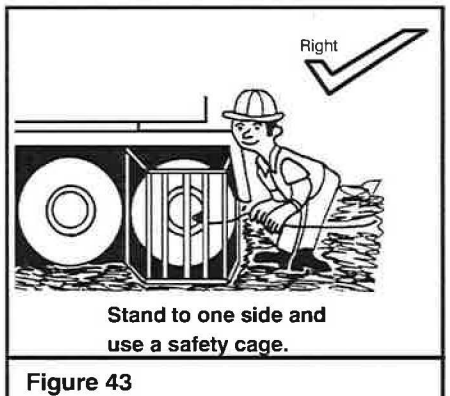


Figure 43
Be careful when inflating tires.

Carrier Operation

1. **Road the crane safely.** Watch for narrow bridges and low clearances. When maneuvering in tight places, post a signal person on the ground to guide you. Check load limits, height, width, and length restrictions in the area you are traveling. Ensure your crane complies with all regulations.
2. **When roading a carrier mounted crane, note the following:**
   a. Operate with lights on. Use proper warning signs, flags, and other such devices. Use an escort service if required.
   b. Engage the travel swing lock in upper (if equipped with both a travel and a 360° swing lock, engage the travel swing lock and release the 360° swing lock) unless the crane is being traveled with the boom installed and it is necessary to swing the upper for clearance, or if boom is on a boom dolly/trailer.
   c. Tie down or otherwise restrain hook block and/or hook ball. If hooked to the carrier, use care not to raise boom, telescope out, or hoist up without first unhooking the hook block and/or hook ball from the carrier to prevent crane damage.
   d. Check the Operator's Manual for maximum allowable travel speed, maximum amount of boom that can be transported, and any other travel limitations. Don't exceed these maximums. Major crane damage and/or an accident may result.
   e. When traveling with outriggers retracted, secure them in retracted position. If they should accidentally extend while the crane is traveling, a serious accident may result.
   f. When roading a crane, store pontoons in storage areas provided, and fasten them securely. If a pontoon should fall off the crane, it could cause a serious accident.
   g. If a tire loses air, do not slam on the brakes. Continue corrective steering and slowly bring the crane to a smooth stop.

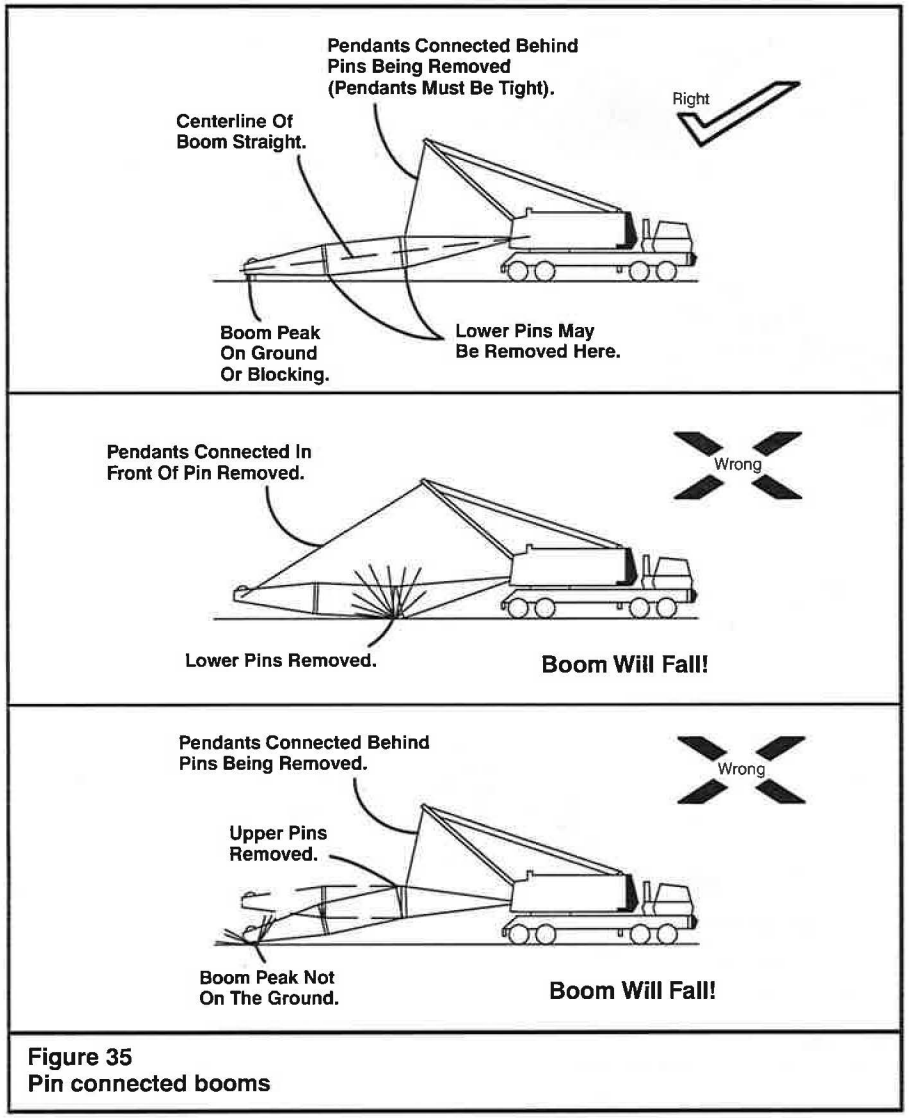


Figure 35
Pin connected booms

37. **Disassembly of any pin connected boom can be hazardous.** Removing the boom pins without reconnecting pendants behind the pins being removed can cause the boom to fall to the ground. If you are under the boom when it falls, you may be killed. Do not remove boom pins unless boom peak is resting on the ground or blocking, and pendants are reconnected properly as shown in Figure 35. If there is any doubt regarding boom disassembly procedure, block tightly under the boom before removing the pins, or contact a Link-Belt Distributor or the factory regarding procedures.

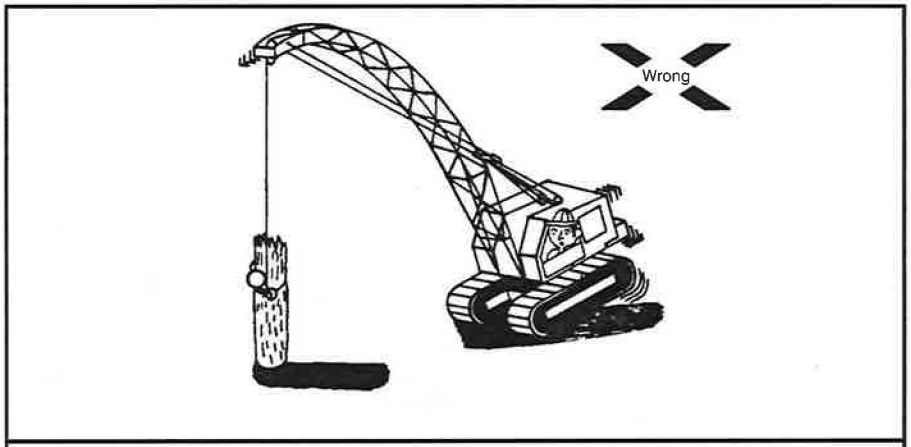


Figure 40
Use caution when extracting pilings, casings, etc.

51. **Don't extract pilings, casings, or other such loads by jerking on them.** The practice of pulling on the load until the crane has tipped, then releasing the hoist line, allowing the crane to drop back and catching the hoist line on a clutch or brake may damage the boom or other parts of the crane. If a piling or casing won't pull out with a smooth, steady pull, use an extractor, pulling frame, or some similar rigging intended for this purpose. Pulling on a load that is not free to be lifted can develop loadings in the crane far in excess of the normal weight of the load. Imposing such loads on a crane can damage the crane and may cause disastrous failure. When using a pile extractor, use a shock or vibration insulator unit.
52. **Operation with auxiliary equipment such as pile driver leads, pile hammers, or caisson boring attachments imposes additional loading on the crane.** This causes major reductions in lifting capacities of the crane. Changes in augers and kelly bar lengths with drilling attachments and in pile hammer attachments, further complicate the manner in which lifting capacities are reduced. The weight of each piece of auxiliary equipment is to be considered a part of the live load acting at the radius of the center of gravity of the piece.
53. **Keep holding line tight when hoisting a clamshell.** Don't permit it to overhaul the closing line, otherwise bucket will open to "dribble" the load. Release closing line gently to avoid shock to holding line and boom when opening bucket.

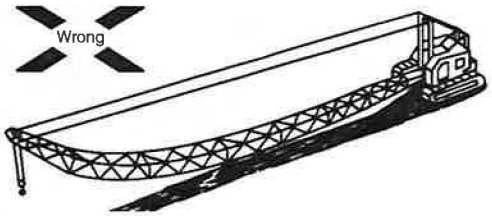


Figure 37
Use midpoint suspension as required.

b. When the Rated Capacity Indicator/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.

c. When a boom angle or radius indicator is inoperative or malfunctioning, the radius or boom angle shall be determined by measurement.

d. 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.

e. When a boom length indicator is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish the boom length at which the lift will be made by actual measurement or markings on the boom.

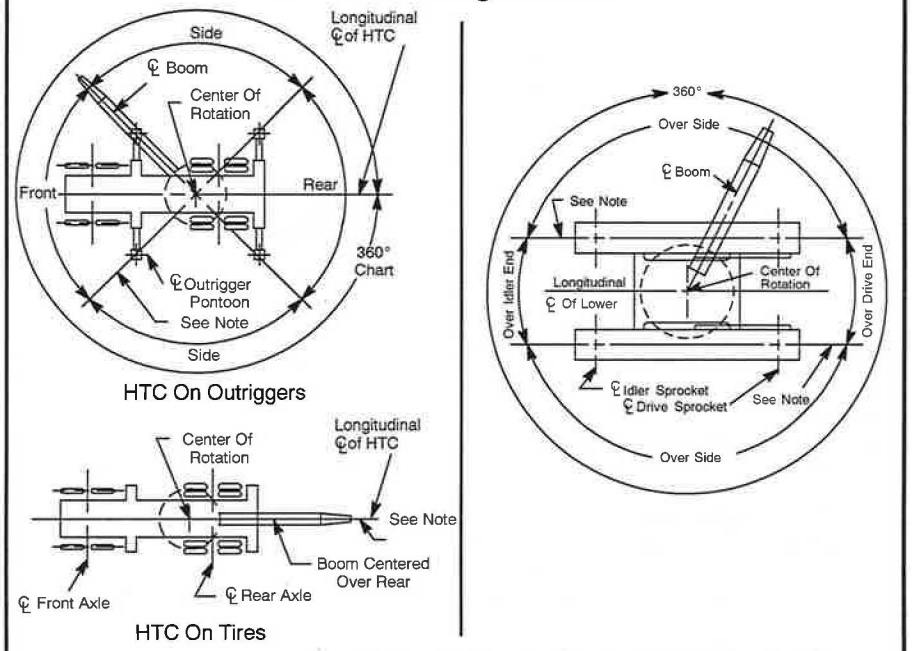
f. When a level indicator is inoperative or malfunctioning, other means shall be used to level the crane.

g. In situations where inconsistency exists, verified weights, measured radii, boom lengths, and authorized crane capacities must always take precedence over indicator readings.

41. **Some cranes are equipped with bar pendants.** Extreme care must be taken to prevent damage to the bar pendants. Refer to the Operator's Manual for the proper handling and inspection procedures.

42. **If the boom length is such that midpoint or intermediate suspension is required, ensure it is installed and properly adjusted.** Long booms may buckle in the middle from their own weight without this suspension.

43. **Don't tie a crane down unless an operable load indicating system is being used, or the weight of every load is known.** Tying a crane down encourages overloading, and, if the crane can't tip, it can be extremely overloaded with no indication of it. Serious personal injuries and/or major crane damage may result.



Note: These charts are examples only. Use charts on the crane and/or in the Crane Rating Manual for the crane.

Figure 38
Working Areas Charts

44. **Working areas for cranes are defined on the Working Areas Chart in the operator's cab or in the Crane Rating Manual.** Figure 38 shows examples of these charts. (Use the chart in the crane or Crane Rating Manual rather than these shown here.) Permissible loads, per the Capacity Chart or Crane Rating Manual of the specific crane, may vary from lifting quadrant to lifting quadrant. The operator must ensure capacity ratings are not exceeded no matter what quadrant he is operating within, or when swinging from one quadrant to another.

45. **After slack wire rope operation, ensure wire rope is properly seated in sheaves and on drums before continuing to operate.** Use a smooth stick or mallet to seat the wire rope, not your hands, when spooling wire rope onto a drum. Use extreme caution and wear heavy leather gloves while handling wire rope.

46. **Do not lower the boom or load beyond the point where three full wraps of wire rope are left on the drum.** This condition could occur when lowering a load below ground level. If all the wire rope runs off the drum, the load will jerk which could break the wire rope and drop the load.

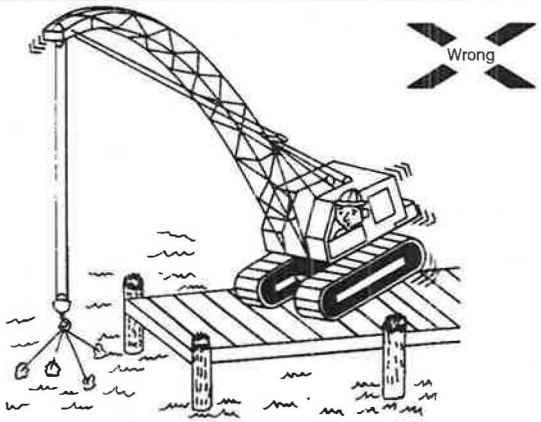


Figure 39
Use caution when lifting submerged loads.

47. **On some cranes equipped with live mast, it is permissible to connect live mast to boom lower section with links for transportation purposes, and in some cases for boom make-up.** Be extremely cautious about raising boom above horizontal with the links connected. If the boom is raised too far, the live mast legs and boom throat will hit together and damage the mast and boom.
48. **When operating a crane equipped with torque convertor or fluid coupling, remember to speed up the engine before engaging boom hoist or load hoist clutch.** If the engine isn't running fast enough, the boom or load may go down instead of up. Keep your foot on the brake until engine speed is fast enough to raise the load. The boom hoist pawl should be engaged at all times except when lowering the boom.
49. **Ensure there is a latch on the hook, and that it works properly.** Without a latch, it is possible for slings or chains to come off the hook and allow the load to fall.
50. **When lifting submerged loads, the suction caused by the load resting on the bottom acts to increase the weight of the load in some cases to many times the actual load weight.** This same effect can occur on land, for example, when a load is embedded in mud. To break a load loose from suction, don't pull sideways or a boom may collapse. If possible, rig the load so it is lifted from one end. Don't jerk on the load. A steady pull, maintained for a period of time will often free the load without overloading the equipment.

    When a submerged load reaches the surface, don't attempt to lift it out of the water all at once. It may be saturated with water and weigh many times what is expected. Raise the load slowly to allow it to drain. Be patient, since draining may take a long time. A load, when removed from the water, even when fully drained, will have a greater effective weight than it will when submerged, because of buoyancy.

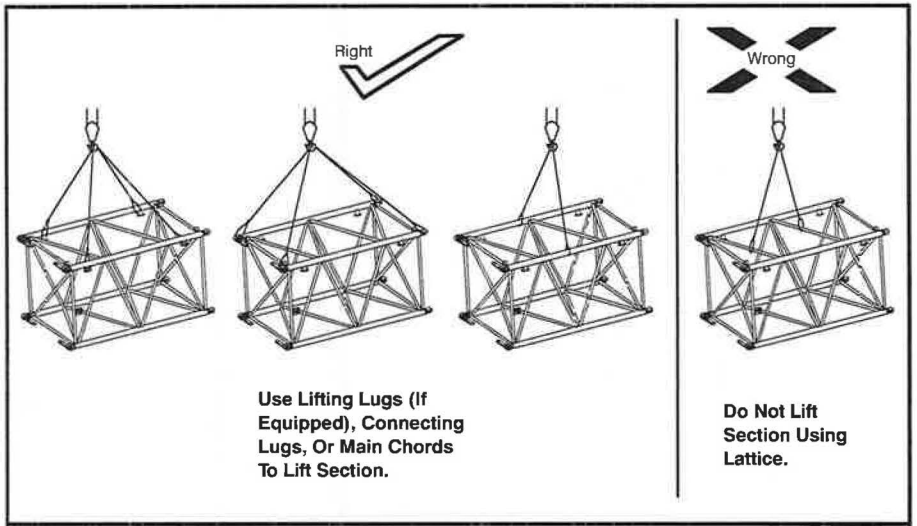


Figure 36
Handling Lattice Sections

38. **Use the lifting lugs (if applicable), connecting lugs, head machinery cross shafts (if applicable), or main chords on lattice boom, fly, and jib sections when lifting them.** Connecting rigging to lattice, diagonals, or picture frame elements may damage the structure and weaken the section. Lifting from the lifting lugs (if applicable), connecting lugs, head machinery cross shafts (if applicable), and pendant connecting lugs is recommended. Using the main chord members when attaching rigging to lattice sections is also allowable. Use only soft nylon straps, minimum 3 inches (*7.62cm*) in width, and of sufficient strength to handle the sections.
39. **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 way, or that too few parts of line are being used to hoist a load, or correct for the effects of wind, or warn that the device may be improperly adjusted, or correct for side pulls on the boom, or for many conditions which may occur and which may 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 operators in performing their duties, but they should not depend on them to keep out of trouble. Remember also that these devices must be inspected and tested for accuracy at the start of each work period to assure their accuracy.
40. **When operational aids are inoperative or malfunctioning, the following recommendations should be followed or the crane should be shutdown.**
    a. 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.

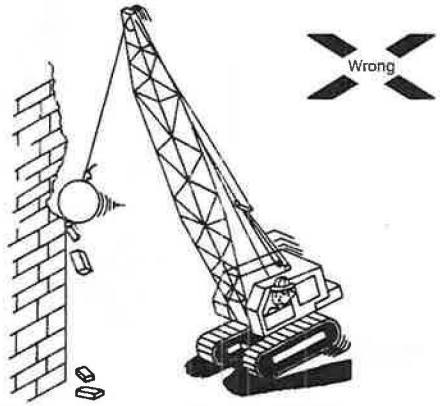


Figure 41
Use caution when using a demolition ball.

Demolition Work

1. **Demolition work can be particularly hazardous.** Major shock loadings and side loadings can be caused by demolition ball and clamshell bucket work. The repetitive nature of such work imposes heavy demands on all parts of the crane. Restrict demolition ball weights to not exceed 50% of crane capacity (on tire capacities for truck cranes) at maximum radius at which you handle the ball, with the boom length being used. In no case however, should the ball weight exceed 50% of the available line pull. Do not use the jib for demolition, drop ball, drag line, or any other type of duty cycle application.

   When using demolition ball, avoid sudden clutch and brake applications. Work steadily and smoothly. Don't try to knock the whole structure down with one blow. Use good aim. If the ball misses its target, out swing could cause crane tipping or overload. When swinging back, ball may hit the boom and damage it.

   When using a clamshell bucket on demolition work, and taking a bite on a piece of unknown weight, be ready to release the closing line as more weight than can be handled may break loose. Be prepared to drop the load.

   When using a clamshell bucket, always stay within the boom length and load limitations shown for lifting capacities on the Capacity Chart or Crane Rating Manual for the specific crane. Failure to do so may create fatigue which can lead to eventual failure.

2. **When dismantling a structure where a portion is being cut loose while suspended by a crane, ensure the weight of the portion being cut loose is known, and the crane pull on the load is equal to the weight.** The point of attachment must be directly above the center of gravity of the load. The fall lines must be vertical. This is an extremely hazardous operation. The services of a professional engineer should be used to plan and supervise such lifts.

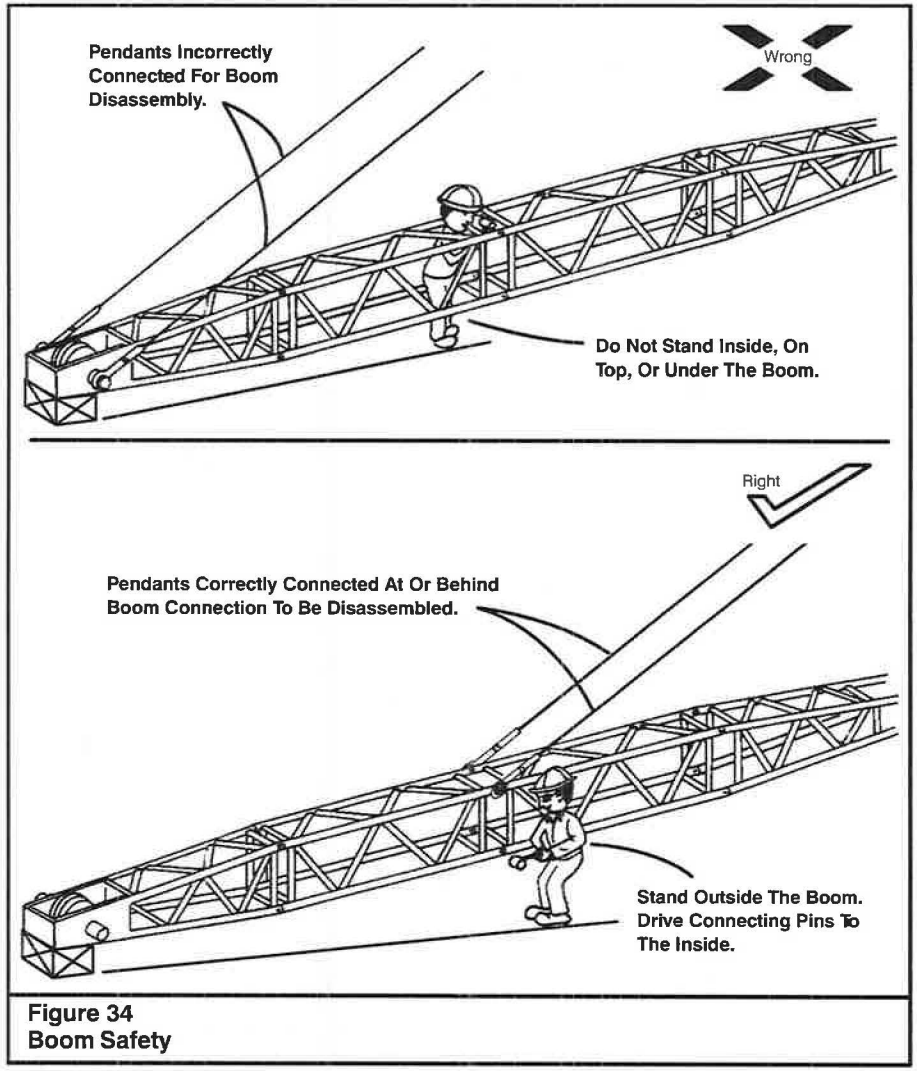


Figure 34
Boom Safety

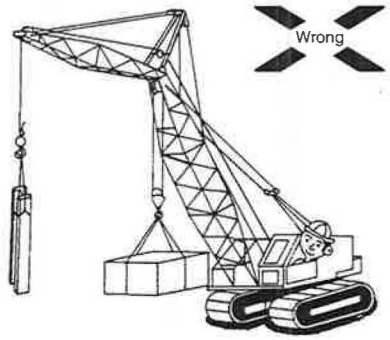
36. **When removing or installing the boom, jib, or fly section connecting pins, properly block under the top section and drive the pins from outside the attachment toward the inside.** Always stand outside the attachment and drive the pins toward the inside.

3. **Inspect tire treads and remove any debris that may be wedged in the grooves.** Check for nails, screws, glass, or anything that may penetrate the tire and permit air to leak from the tires. Check the side walls and treads for cuts, bulges, and other damage. Check and remove any debris that may be wedged between the tires in dual tire applications. If internal damage to any tire is suspected, have it demounted and checked. Make all necessary repairs or replace as required.
4. **Check tires daily for correct pressure.** Do not stand or let anyone stand, in front of a tire while inflating it. The lock or side ring may fly off and cause serious personal injury or death.
   a. Always use a rim cage (safety cage) and "clip-on" air chuck with a remote valve to change tire inflation pressures with tires mounted on a crane.
   b. Do not attempt to inflate a flat tire on the crane. Remove the flat tire and repair/inflate it in a rim cage or use a spare tire.
   c. Always deflate tires completely before removing wheel lock or side rings.
   d. Always inspect and clean all wheel parts before reassembling. Keep paint on all external parts to prevent rust.
   e. Do not mix parts from different manufacturers, types or sizes (unless approved by the manufacturer).
   f. Do not use cracked, bent, or badly rusted parts or any parts with any other apparent damage.
   g. Do not add air to any tire until the lock or side ring is fully seated.
   h. Do not weld on or apply any source of heat to the tire or rim parts. Major damage and/or serious personal injury could result.
   i. Always use a rim cage to inflate a flat or badly under-inflated tire.
5. **When lifting on tires, they must be inflated to pressures given for "on tire" capacities.**
6. **Shift carrier transmission to neutral before operating upper.** Crane rocking may damage transmission or drive line. Apply operating or digging brakes if working on tires. If necessary, leave engine(s) running to maintain air pressure. When parking a wheeled crane, shift to neutral and apply park brake. Block wheels if on a hill.

29. **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 hilly areas. When traveling with a load, observe the following rules:
   a. Tether the load to reduce load swing. Don't tether to boom structure.
   b. Travel by the smoothest, most level route. If a smooth level route is not available, don't travel with a suspended load unless the route to be taken is graded to provide a smooth level path. If it's not possible to grade the route, move the load by stepping. Pick the load and set it down along side the travel route. Travel unloaded crane beyond load, pick load, swing, and set down farther along route. Continue procedure until load is at its destination.
   c. Carry load as close to the ground as possible.
   d. Avoid side swing of load. If tethering won't hold load directly below boom point, swing until boom points directly down hill. While this may reduce stability of the crane, it will reduce boom side loadings. Carrying the load near the ground will reduce the danger of overturning.
   e. Don't attempt to carry loads which approach the crane's rated capacity.
   f. Don't travel with a load on soft ground. If crane sinks into ground, stability can be affected to the point of tipping the crane over.
   g. Keep all personnel clear of crane and load. Be prepared to set load down quickly at any time.
   h. When traveling up or down slopes, keep the upper facing downhill to reduce the tendency for the boom to fall backward. If necessary to face uphill, keep the boom down.
   i. On cranes equipped with outriggers, fully extend outrigger beams. Extend or retract jacks until pontoons just clear the ground. (Use extreme care due to the added width with extended beams. Watch to avoid hitting any obstructions.)
   j. Properly inflate tires, per the Capacity Chart or Crane Rating Manual, for pick and carry (on tires) operations.
   k. Use a signal person to warn of any danger or obstruction along the route being traveled.
30. **Lifts where two or more cranes work together can be hazardous and should be avoided.** Such lifts should be made only under the direction of a qualified engineer. If a multiple crane lift is unavoidable observe the following rules:
   a. Cranes must be level and located on firm surfaces.
   b. Cranes should be the same size and capacity, use the same boom length, and be reeved similarly.
   c. Cranes equipped with outriggers must be completely supported on fully extended outrigger beams.
   d. Cranes must be positioned so that each boom point is directly over its load attaching point. Fall lines must be vertical during all phases of the lift.
   e. Rigging must be placed so each crane lifts its share of the load well within the crane's capacity.
   f. During handling, ensure that more load is not transferred to either one of the cranes than it can handle.
   g. Don't attempt to travel when making multiple crane lifts.
   h. Coordinate plans with the other operator before beginning to lift.
   i. Use only one signal person.
   j. Use of an operable load and angle indicating system is desirable.

g. Lower the boom to the lowest possible angle for better crane stability and to avoid overhead obstructions before moving.
h. Engage clutch smoothly. Keep a steady foot on the accelerator. Don't jerk the crane.
i. Position a signal person to guide you.
j. Avoid traveling on a grade, particularly a side slope. If you must travel up a slope, go straight up, or better yet back up the grade for maximum crane stability and minimum side loadings.

14. **Do not coast down hill with clutch disengaged or transmission in neutral.** Either practice makes control of the vehicle more difficult, and less safe.
15. **Do not leave a crane unattended with its engine(s) running.**



Don't pick loads on main boom and fly or jib at the same time.

Figure 28
Don't pick two loads at once.

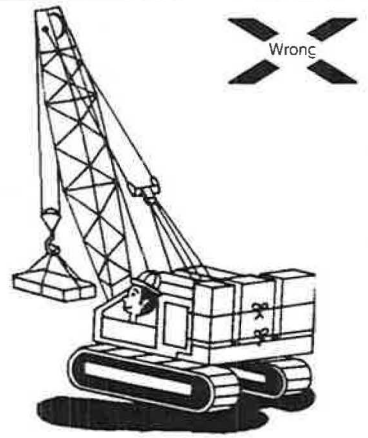


Figure 29
Don't add extra counterweight.

17. **When operating a track driven crane, where the tracks sink into the soil any noticeable amount, use matting.** Timbers used for matting should be at least as long as the total width of the lower and should be heavy enough to withstand loadings without damage. Timbers should be close together to form a solid work platform.

    When lifting over lower ends, block under track ends so full support is provided where track leaves the ground.

18. **Don't alter any part of the crane.** Additions to or changes in any part of the equipment can create loadings for which the crane was not designed. Such changes may have a major affect on the useable capacities and make the entire Capacity Chart invalid. Such changes can dangerously overload or weaken critical parts and may cause major failures.
19. **Don't increase the counterweight above that specified.** Don't add anything to the crane that will act as additional counterweight. Remember that anything which has weight, if carried behind crane's tipping point, acts as counterweight. Adding counterweight affects backward stability of the crane, particularly when working over the side. It also encourages overloading of the crane which can cause a disastrous accident.
20. **Don't operate over the front of a truck crane, either on tires or on outriggers, unless the crane being used is rated for over the front.** Lifting loads over the front can cause damage to the carrier. Also the operator's vision may be obscurec by the front of the carrier. If it is absolutely necessary to work over the front, contact the factory for special instructions and load ratings.
21. **Don't pick loads on main boom, fly, jib, or auxiliary sheave at the same time, even if total load weight is within crane capacity.** Loads on the fly or jib stress the boom and drastically reduce its ability to handle loads.

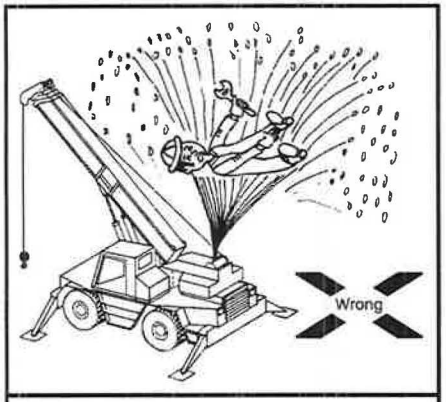


Figure 47
Use caution when working on hydraulic systems.

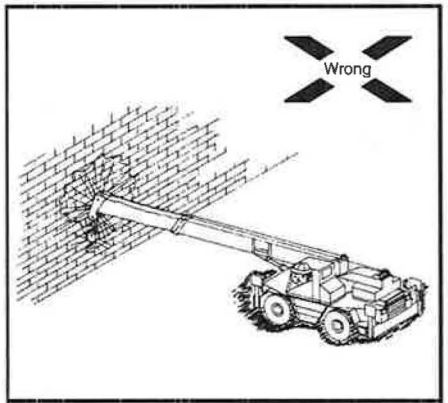


Figure 48
Do not use the boom to push or pull.

Hydraulic Crane Operation

1. **Safe operation of hydraulic cranes requires qualified operators.** Operation by unqualified operators can cause accidents.
2. **Do not work on a hydraulic crane without doing the following:**
   a. Fully retract the boom. Lower boom to the limit of the boom hoist cylinder(s) or into the boom rest.
   b. Disengage the master clutch. Shutdown the engine(s). Work all control levers back and forth to relieve pressure and relax the attachment.
   c. If the above instructions cannot be followed, securely block under the attachment so it cannot move.
   d. Hydraulic oil becomes hot during operation. In some cases it becomes hot enough to cause severe burns. Be careful not to let hot hydraulic oil contact the skin.
   e. On cranes equipped with a pressurized or precharged hydraulic reservoir, relieve the pressure before working on the hydraulic system. (Also, use extreme care when working on circuits which contain an accumulator.) This pressure can push oil out of a connection, drain plug, etc. as it is loosened. This could cause an injury.
3. **When setting relief pressures, Do not exceed manufacturer's rating.** Always follow instructions. Over pressurization can cause hydraulic component damage or failure. Over pressurization in hydraulic circuits can also lead to damage or failure of mechanical parts on a crane. Any of the above can lead to an accident.
4. **Do not put any part of your body into a hole in a telescopic hydraulic boom.** A sudden movement of the boom could cut it off.
5. **Do not make a lift which is not in plain sight without a signal person.** This is particularly true on some hydraulic yard cranes where the operator does not swing with the boom. This can lead to an accident and/or crane damage.

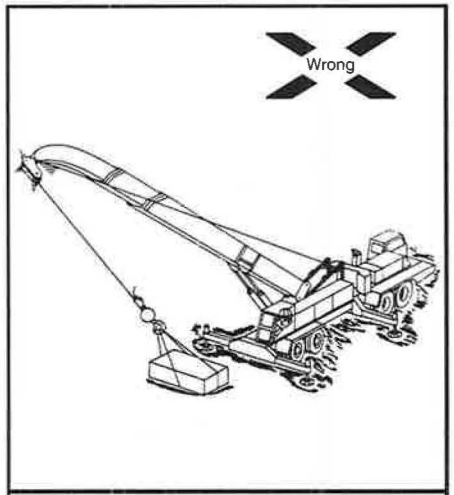


Figure 24
Do not use boom to pull sideways.

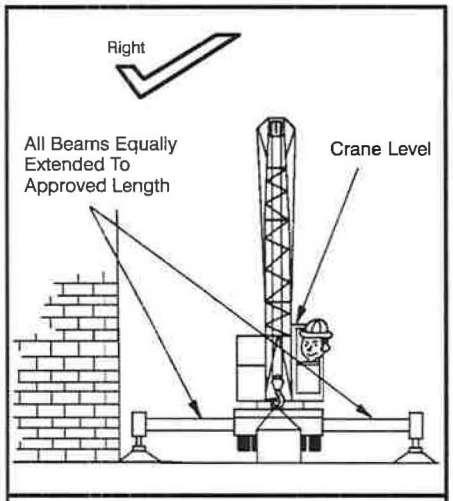


Figure 25
Use of outriggers.

12. **Test the hoist brake by raising the load a few inches *(centimeters)* and holding.** It should hold easily. It takes more brake to hold a load in the air when the drum is full of wire rope, than a few inches *(centimeters)* above the ground with only a few layers of wire rope on the drum.
13. **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 with the hoist line may buckle the boom. It may also damage the swing mechanism. Pulling sideways on a boom positioned at a high angle can turn the crane over sideways.
14. **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 toward the crane. The inertia effect will tend to increase load radius and decrease stability This could lead to boom failure or crane tipping.
15. **When operating on outriggers, all beams must be equally extended to the desired approved position; all fully retracted, all half/intermediately extended, all fully extended, etc. with all tires free of supporting surface.**

    Note: Some cranes require fully extended outrigger beams for all on outrigger lifts. Other cranes are approved for making lifts with outrigger beams at other positions. Always refer to the Operator's Manual and the Capacity Chart or Crane Rating Manual for the specific crane to determine the approved outrigger position(s) and lift capacities.

11. **Most 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 warning of overload.
12. **When operating off the boom with the fly and/ or jib installed, deductions from the Capacity Chart or Crane Rating Manual must be made.** The weight of the fly and/or jib, backstops, stays, etc. must be subtracted from the rated capacity to obtain a "net" capacity. Failure to do so will result in an overload condition which can cause boom failure or crane tipping.
13. **The boom must be extended in the correct manner before making a lift.** Variation in booms, controls, etc. make operation of the telescoping feature different from crane to crane. However, rated lifting capacities are based on proper and correct operation of this feature as described in the Operator's Manual. If the telescoping feature of the boom is not performed correctly, lifting capacities must be greatly reduced.
14. **Hydraulic cylinders, left unattended under load, often times have a tendency to drift in (retract) due to internal fluid passage in the cylinders and/or control valves.** Do not shutdown the crane and leave it unattended for extended periods of time, i.e. overnight, with the boom positioned over anything or the crane itself that the boom could damage if it should lower.
15. **Boom distortion due to thermal effects of the sun.** The heat from the sun may have a thermal effect on the sides of telescopic booms causing the sides of the boom to expand (lengthen). The sides of the boom may not expand equally if the boom is extended for long periods of time with only one side of the boom exposed to the sun. The unequal expansion may cause boom distortion (the boom may "deflect" to one side). This is more noticeable with long boom lengths and/or long booms with long lattice flys attached to the boom. Prior to lifting any loads, inspect the boom or boom and fly combination to ensure they are straight. If the boom or boom and fly combination is not straight, ensure that all the boom wear pads are properly adjusted. If the boom is distorted due to temperature differential on the sides of the boom, reposition the boom to allow the thermal effects from the sun to equalize the temperatures of the side walls of the boom to eliminate the distortion before lifting a load.
16. **Know the load radius.** This is particularly important on hydraulic cranes. Any two of three variables (1) boom length, (2) boom angle, or (3) load radius, must be known to properly figure what load can be lifted. On hydraulic cranes, it is difficult to figure the boom length. This fact makes it imperative that load radius and boom angle be known. Measure the radius with a tape measure. Find the boom angle by reading the boom angle indicator.
17. **Be careful when swinging a long load.** While this applies to all cranes, it is particularly important on some hydraulic yard cranes where the operator sits in an operator's cab on the carrier and does not swing with the upper. If one end of the load catches on an obstruction, the other end may hit the crane.

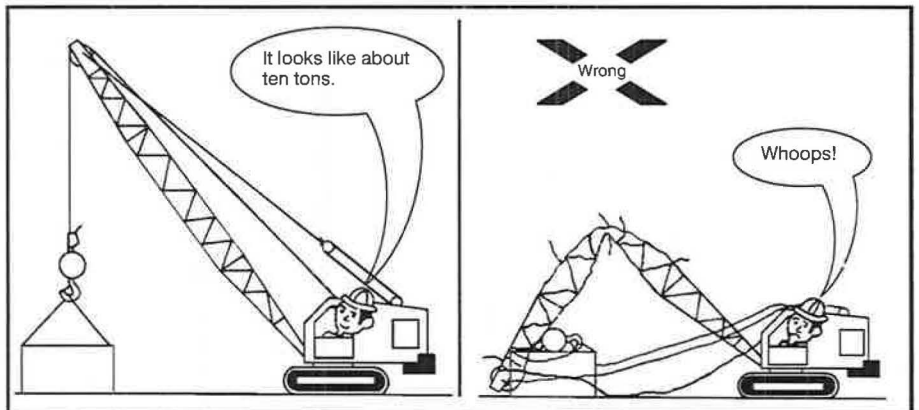


Figure 21
Know the load weight.

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 will require reduction of loads below listed ratings 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

When in doubt, don't take a chance. Reduce ratings more than you think you need to.

Avoid working a crane in high winds and when there is a likelihood of lightning. If there is a likelihood of lightning, immediately stop lifting operations, ground the load, and fully retract and lower the boom. If you must work in a wind, reduce capacities considerably below those shown on the Capacity Chart or Crane Rating Manual for the specific crane. (In many cases a "Wind Speed Chart" or "Wind Restrictions Guide" is included in the Crane Rating Manual that can be used.) Wind blowing against the load and the boom produces a side load on the boom and reduces its capacity.

When lifting large loads such as building panels in a wind, the movement of the load may pose a danger to workers or building structures. Outswing of a load will increase load radius, and may overload the crane. This could lead to boom failure or crane tipping.

6. **Don't operate at radii and boom lengths where the Capacity Chart or Crane Rating Manual lists no capacity. Don't use longer booms, flys, or jibs than what are approved.** Any of the above can tip crane over, or cause boom, fly, or jib failure.

Luffing Attachment Operator's Manual

Each Link-Belt luffing attachment comes with its own serial number and an Operator's Manual, separate from the standard crane Operator's Manual. The luffing attachment Operator's Manual is designed specifically for the use of the luffing attachment portion of the crane. Prior to the installation or operation of the luffing attachment, thoroughly read and understand both the complete crane and luffing attachment Operator's Manuals.

Luffing Attachment Crane Rating Manual

Each Link-Belt luffing attachment comes with its own Crane Rating Manual designed specifically for listing the allowable lifting capacities for the luffing attachment. This Crane Rating Manual is separate from the Crane Rating Manual for the conventional boom on the crane. The luffing attachment Crane Rating Manual must contain the serial number of the specific luffing attachment as well as the specific serial number(s) of the crane(s) for which the luffing attachment and Crane Rating Manual are approved for use. If a luffing attachment is to be installed on a crane with a serial number for which the luffing attachment Crane Rating Manual does not list that crane serial number, factory approval must be obtained before installing the luffing attachment. Prior to the installation or operation of the luffing attachment, thoroughly read and understand both the complete crane and luffing attachment Crane Rating Manuals.

Before making any lifts, refer to the luffing attachment Crane Rating Manual in the operator's cab. Ensure that the load being lifted and the load radius are within the rated capacity of the crane and luffing attachment under the existing crane configuration and operating conditions.

Luffing Attachment Erection Procedures

Special erection and lowering procedures are included in the luffing attachment Operator's Manual that pertain to the luffing attachment. It is critical that these special erection and lowering procedures are followed each and every time the luffing attachment is raised or lowered. Failure to follow these procedures can result in overturning of the crane and/or structural failure of the crane and/or luffing attachment. These procedures may vary depending upon total luffing attachment length. For example, if the luffing attachment Operator's Manual specifies a 70 degree luffing boom angle for raising and lowering the luffing jib, or luffing jib and fixed jib, do not vary from this requirement. Follow all instructions exactly as specified.

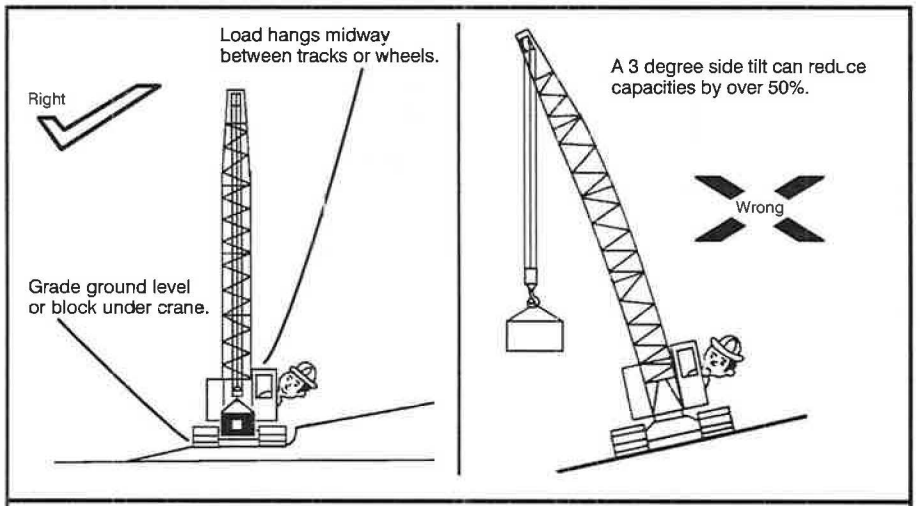


Figure 19
Level the crane.

2. **The hoist line must be vertical when starting to lift.** If not, load will swing in, out, or sideways when lifted from the ground.
3. **When picking a heavy load, crane will lean toward the boom.** This is caused by elasticity of the crane and boom. The lean is more noticeable when picking over the side on tires. The lean will increase operating radius so the load will swing outward when it clears the ground. This outswing 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 outswing, boom up as the load is lifted so fall lines remain vertical. When setting the load on the ground, lower boom after load touches down to avoid hook block or hook ball swing, or the boom from contacting the boom backstops, when the hook is unhooked from the load.

Electrical Power Line And Obstacle Avoidance

Luffing attachments are specially designed for extra height and reach capabilities. This makes it very important that extreme care is used around all electrical power lines and/or other obstacles. Follow all the procedures and guidelines and keep a safe distance from all electrical power lines as listed in the "High Voltage Power Line Clearance Chart" listed in the Operator's Manual or any such distance as required by any other state or local requirements. A copy of this chart is also included in the Section "Working Near Power Lines" in this Safety Manual.

Wind Speed Restrictions

Wind speed restrictions for proper operation are listed in the luffing attachment Crane Rating and Operator's Manuals. Failure to follow these wind speed restrictions may result in structural failure of the crane and/or luffing attachment, or loss of stability, which could cause property damage and/or personal injury. Take special note of the following.

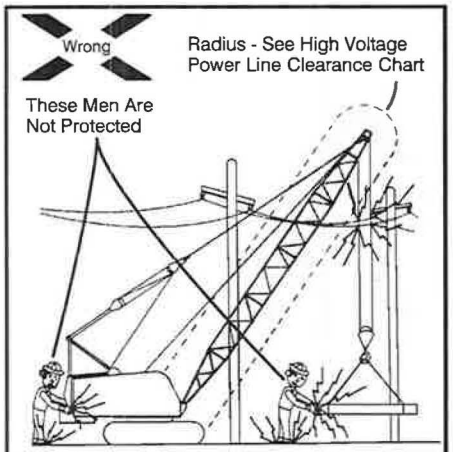
1. It is the responsibility of the operator to take into account the effects of the wind force on the hook load. When hoisting any load in wincy conditions, the load wind sail area and load controllability must be considered for safe crane operation.
2. Wind speed is to be determined at the luffing boom cap (or higher). Wind velocity increases with height and may be much higher at the luffing boom cap than on the ground.
3. Wind velocity limitations are based on maximum allowable wind gusts (instantaneous wind velocity). When in doubt, use the capacities listed for the next higher wind velocity range.

General Safety

Link-Belt does not recommend lifting personnel on the wire rope hoist lines of any conventional boom or luffing attachment. However, some applications may arise where exceptions are made. In these cases refer to "Lifting Sheaves For Personnel Handling With Suspended Work Platforms" chart in the "Inspection And Rigging" Section of the "Personnel Handling Guidelines" Section of this Safety Manual to determine the allowed lift points/sheave(s). Refer to the "Personnel Handling Guidelines" Section of the Operator's Manual or in this Safety Manual for all other procedures.

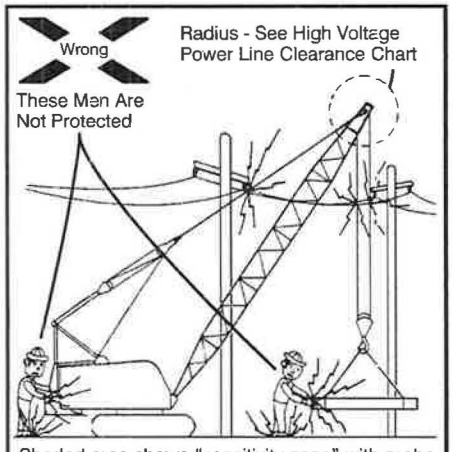
Calibration and adjustment of all computer equipment, luffing boom limit switches, luffing boom backstops, luffing jib limit switches, luffing jib backstops, etc. are extremely important for safe luffing attachment operation. Refer to the crane and luffing attachment Operator's Manuals for all such procedures.

Proper inspection and maintenance of all wire ropes and pendants are critical to safe operation of any crane. Refer to the Operator's Manual for these procedures.



Shaded area shows "sensitivity zone" with full boom length sensor used. Contact can be made outside this zone by the fall lines, hoist wire ropes, gantry, operator's cab, etc. In such cases the warning will not sound until contact is made, and the crane is electrified and deadly.

Figure 16
Crane equipped with proximity device on full boom.



Shaded area shows "sensitivity zone" with probe near boom peak. Contact can be made outside this zone by the fall lines, hoist wire ropes, gantry, operator's cab, etc. In such cases the warning will not sound until contact is made, and the crane is electrified and deadly.

Figure 17
Crane equipped with proximity device at boom tip.

   f. If you cannot disengage from the line, and crane is not on fire or no arc is cutting through the cab(s), stay in your seat until 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. Land with your feet together, then hop or shuffle, keeping your feet close together, until you are a safe distance away.

3. **When using a magnet:**
   a. Lifting magnet generators produce voltages in excess of 200 volts and present an electrical shock hazard. Only trained personnel should work on the magnet, controller, or wiring. Do not open the controller door with the generator running.
   b. Do not let workers touch magnet or load.
   c. Do not let workers 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.

Radio Frequency Or Electro Magnetic Interference

Certain areas may contain high Radio Frequency Or Electro Magnetic Interference (RFI or EMI). In these areas the boom can act like an antenna and produce an electrical current that may cause electrical shocks and/or the crane to malfunction. If operating in an area where these conditions may exist, test the crane or have the area tested for the magnitude of this interference before operating the crane. Operation may not be possible or boom length may be limited. Comply with all local, state, and federal laws when operating in high RFI/EMI areas.

Repetitive Lift Applications

There are many applications that impose high repetitive loadings into the structure of the crane and luffing attachment, and therefore warrant frequent attention to the condition of the crane and luffing attachment. These "Repetitive Lift" applications include, but are not limited to the following.

1. Drop ball applications
2. Concrete bucket applications
3. Loading or unloading ships or barges
4. Loading or unloading rail cars (such as in a tunneling application)
5. Any other applications that involve repetitive lifts at or near the maximum strength rated lifting capacity of the crane or luffing attachment under the existing operating conditions

Link-Belt requires the capacities of the luffing attachment to be reduced to 70% of the standard strength limited luffing attachment capacities when performing repetitive lift applications as listed above. In these applications, the possibility of structural failure exists due to the repetitive nature of the loadings. Under repetitive loadings at or near the maximum strength rated lifting capacity of the crane and/or luffing attachment, some structural components can eventually fail due to fatigue. This will normally show up in the form of a fatigue crack. Usually a fatigue crack occurs in a tension member and starts at a notch, stress concentration, or change in section. If a crane and/or luffing attachment have been used in repetitive lift applications, at or near maximum strength limited capacities, the possibility of small fatigue cracks exists. Regularly and carefully make systematic inspections of all structural members to ensure they are completely "crack free".

For all stability limited capacities for a luffing attachment used in repetitive lift applications listed above, contact Link-Belt for approval before performing the the repetitive lifts. Calculations must be performed to determine the capacity for each specific type application.

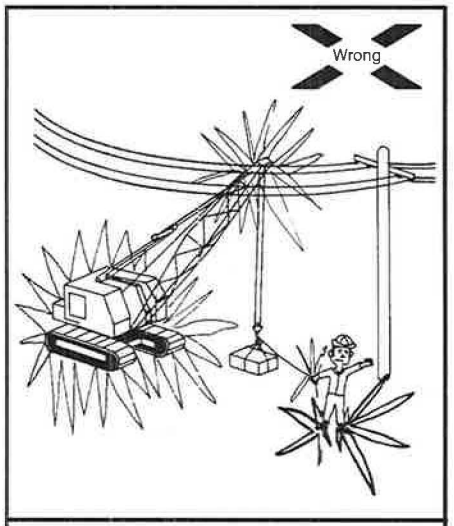
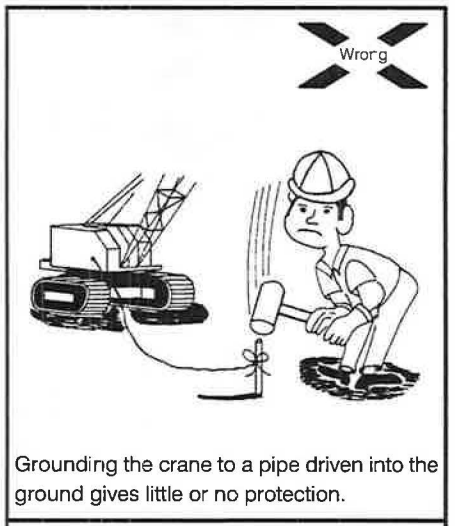


Figure 12
Stay away from power lines.



Grounding the crane to a pipe driven into the ground gives little or no protection.

Figure 13
Grounding the crane.

d. Appoint a reliable person equipped with a loud signal (whistle or horn) to warn the operator when any part of the crane or load moves near the power line. This person should have no other duties while the crane is working around the power line.
e. Do not perform any crane assembly/disassembly under any energized power line.
f. Warn all personnel of the potential danger. Don't allow unnecessary person(s) in the area. Don't allow anyone to lean against or touch the crane. Don't allow workers or load handlers to hold load, load lines, or rigging gear unless absolutely necessary. Use dry hemp or dry plastic ropes as tether lines. Make certain everyone stays a minimum distance away from the load as specified in the "High Voltage Power Line Clearance Chart", or such distance as required by any other state or local requirements.
g. **Grounding the crane may increase the danger.** Poor grounding such as a pipe driven into the ground, gives little or no protection (Refer to Figure 13). 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. Overhead lines can move when the wind blows against them. Allow for this when determining safe operating distances.

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* in this Safety Manual for a sample check list.)
3. Review of crane inspection records has been conducted to ensure the crane being used meets applicable provisions in ANSI B30.5 and B30.23.
4. Review of the work platform inspection records and specifications has been conducted to ensure it meets applicable design standards (refer to ANSI A10–28).
5. Review of the personnel lifting operation practices specified in these instructions have been conducted with job site managers and crane operator(s), foreman, designated signal person, personnel to be lifted, safety supervisor, and any other person(s) who has jurisdiction over the operation to ensure that they are aware of the hazards of the operation and they are aware of provisions of these instructions that must be adhered to before and during the personnel lifting operation.

Equipment

1. The crane system shall be equipped with the following:
   a. A fully functional working operational aid such as a Rated Capacity Limiter (RCL) System – A system consisting of devices that sense crane loading, boom length (extendable booms only), boom angle, and also automatically provide an audible/visual signal when the loading conditions approach, reach, and/or exceed the rated capacity values. When the Actual Load exceeds the Rated Capacity, the system supplies a signal to a function cutout system. The operational aid shall be equipped with these additional devices:
      i. Anti-two block device to prevent damage to the hoist wire 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.
      ii. 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.

43. **When performing repetitive lift applications on some cranes, especially at or near maximum strength limited capacities, periodic inspections of the major structural areas of the crane are required.** Refer to the Operator's Manual for specific instructions.
44. **Combustion fumes from diesel engines, cab heaters, engine preheaters, and some of their constituents are known to cause cancer, birth defects, and other reproductive harm.** Start and operate these devices in a well ventilated area only. If it is necessary to operate in an enclosed area, vent the exhaust to the outside. Properly maintain exhaust systems to their original design. Avoid harmful fumes.
45. **Cold weather operation requires some special attention by the operator to allow for changes in everyday routines:**
   a. Clean all snow and ice from all steps, ladders, platforms, etc. to eliminate slippery walking surfaces.
   b. Clean the crane, especially the boom, of accumulated amounts of ice or snow. Operating the crane with an ice or snow covered boom is dangerous. The added weight of the ice or snow can drastically reduce the capacity of the crane. Also, falling ice may pose danger for ground personnel.
   c. If cold weather starting aids are provided on the crane, use them with caution. The use of aerosol starting sprays can be dangerous if the manufacturer's directions are not closely followed.
   d. Use caution when lifting any load during freezing weather, as it may be frozen to the ground or the supporting surface. The added tension, to break the load free, could cause an unexpected overload situation. Also, when the load does finally break loose it could create an erratic motion causing injury and/or damage.
   e. At the end of the work shift, park the crane where it will not freeze to the ground. Major damage to the drive train could occur while trying to free the crane from a frozen surface.
46. **Use proper fall protection** such as a fall arrest system as required by any applicable codes when working at elevated heights. Falls can lead to severe personal injuries and/or death.

Telescopic Booms	Main Boom Head Sheaves	Auxiliary Head Sheaves	Fixed Fly Sheave
	Allowed	Allowed	Allowed
	Offset Fly Sheave	Offset Fly With Extension(s) Sheave	A-Frame Jib Sheave
	Allowed	Allowed	Not Recommended
Conventional Lattice Tubular or Angle Booms	Main Boom Head Sheaves	Tip Extension Sheaves	Jib Head Sheave
	Allowed	Allowed	Allowed

Luffing Attachments	Luffing Boom Auxiliary Head Sheaves	Midfall Sheaves	Luffing Jib Head Sheaves	Fixed Jib Head Sheave
	Not Recommended	Allowed	Allowed	Not Recommended

Lifting Sheaves For Personnel Handling With Suspended Work Platforms

4. Any structural or functional defect which adversely affects the safe operation of the lift crane shall be corrected before any operation utilizing a work platform begins or continues.
5. The hoist drum shall have at least three full 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 design factors for the combined weight of the lift attachments, work platform personnel, and tools shall be 10:1 for "Non-Rotating" and "Rotation Resistant" wire ropes. All other wire rope types require a 7:1 design factor. (Note: A.P.I. applications require 10:1 design factor for all wire rope construction.)
7. The work platform shall be suspended from a wire rope that is reeved from an allowed lifting sheave. Refer to "Lifting Sheaves For Personnel Handling With Suspended Work Platforms" chart to determine the allowed sheave(s).
8. Inspect the wire ropes, sheaves, hoist drum brakes, and other mechanical and rigging equipment vital to the safe operation of the crane.
9. Ensure that all wire rope sockets and dead end lugs are properly installed and are in good working condition.
10. Ensure that all wire rope guards are in good working order and that they are properly installed and adjusted to prevent wire rope from jumping off sheaves.
11. Inspect all structural members of all boom/luffing boom sections, fly sections, jib/luffing jib sections, and live mast, as equipped.
12. 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:
        i. 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.

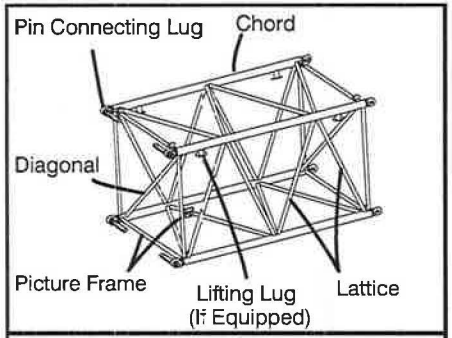


Figure 8
Boom/Jib Section Nomenclature

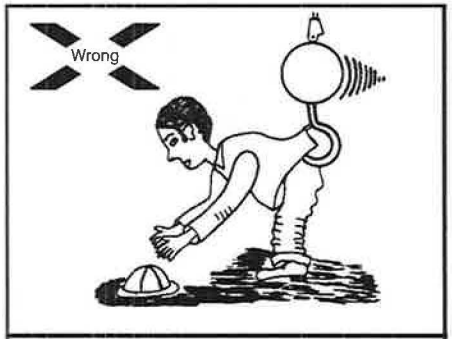


Figure 9
Dress properly for the job.

27. **Always wear hard hats, safety glasses, steel toe shoes, and any other safety equipment required by job conditions and/or local applicable regulations.**
28. **Always wear safety glasses when drilling, grinding, or hammering.** If you do not wear safety glasses, flying chips may cause eye injuries.
29. **Always wear a mask to prevent breathing any dust, smoke, fumes, etc. while cleaning, drilling, welding, grinding, sanding, etc. on any part of the crane.** Breathing dust, smoke, fumes, etc. can be very hazardous.
30. **Keep a dry chemical or carbon dioxide fire extinguisher of 5BC rating or larger in the cab(s) or in the immediate vicinity of the crane at all times.** Instruct all operating and maintenance personnel in proper use of the extinguisher. Check periodically to ensure it is fully charged and is in working order.
31. **Always provide adequate lighting** when working at night to ensure the operator and all other workers can see all movements of the crane, attachment, and load.
32. **Always reduce pressure in hydraulic system to zero before working on any part of the system.** (Use extreme care when working with circuits which contain an accumulator.) Work control levers back and forth with engine(s) shutdown to reduce the pressure to zero.
33. **Keep fingers, feet, and clothing away from sheaves, drums, and wire ropes unless the crane is shutdown and everyone knows what you are doing.** Do not place a hand on wire ropes when climbing to the top of the crane. A sudden movement may pull them into the drum or sheaves.
34. **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.
35. **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 wire rope and/or load rotation**. Rotation resistant wire rope is recommended for single part of line applications. Refer to the Wire Rope Capacity Chart in the Crane Rating Manual or the Operator's Manual and Parts Manual for the specific types of rotation resistant wire rope recommended for the crane.
36. **Tie down the hook block and/or hook ball** when leaving the area. Do not leave them or any rigging where the wind could swing them to cause damage to the attachment and/or nearby objects.

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.
4. At the beginning of each lift, the work platform must be hoisted a few inches *(centimeters)* with the personnel and materials/tools on board and inspected by a competent person to ensure:
   - The work platform is secure and properly balanced,
   - All wire ropes are free of deficiencies such as kinking, crushing, corrosion, etc.,
   - Any multiple part lines are not twisted,
   - The primary attachment is centered over the work platform, and
   - If any load wire rope is slack, it must be inspected to ensure that all wire ropes are properly seated on the drum and in the sheaves.
5. Any condition found during any of these tests/inspections that fails to meet requirements or may create a safety hazard, must be corrected before hoisting personnel.

Operation And Safety

1. The Operator's Manual for the crane shall be read and fully understood by operating personnel. The Operator's Manual 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. It is recommended that the outriggers be fully extended and the tires must be 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(s) 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.

Figure 5
Watch all clearances.

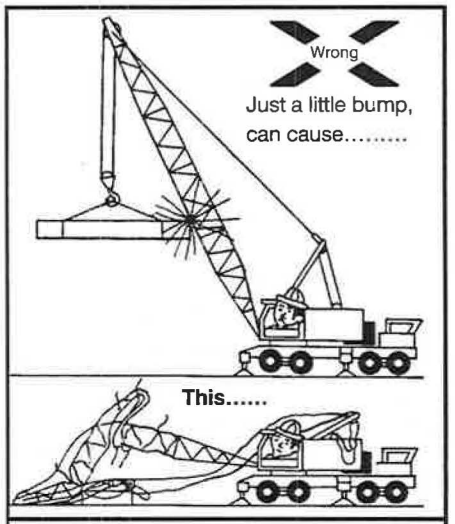


Figure 6
Don't let the load hit the boom.

15. **Ensure the work area is clear.** Ensure proper clearance for crane boom or load. Don't swing, travel, hoist, or lower load, raise or lower boom, extend or retract outrigger beams, raise or lower jacks, without first making sure no one is in the way. If your vision is obscured, locate a signal person so you can see them, and they can see all areas you can't. Follow their signals. Ensure that you and the signal person both understand all signals. (Refer to the Hand Signals Chart at the end of this Safety Manual.) Use the horn to signal or warn. Ensure everyone on the job site understands all signals before starting work.
16. **When operating over the front or rear, use care not to hit the lower with the load or attachment.**
17. **Don't let the load or bucket hit the boom, fly, or jib. Don't let the boom, fly, or jib rest on or hit against a building or any other object.** A dented or damaged boom, fly, and/or jib may result, which will weaken them. If the damage is major, the boom, fly, and/or jib may collapse. If a lattice or diagonal bracing member is broken or cracked, replace it. If bent, straighten it.
18. **Inspect the crane daily. Don't operate a damaged or poorly maintained crane.** Pay particular attention to the clutches, brakes, attachment (boom, fly, jib), and wire ropes. If a component is worn or damaged, replace it before operating.

    Ensure clutch and brake surfaces are clean and dry. A small amount of hoist clutch or brake slippage may help to dry out wet linings. Avoid excessive heating; it shortens lining life. If oil or grease gets on linings, clean them immediately with a nonflammable, low toxicity solvent. If linings are saturated, replace them.

    Important – Detailed information on boom inspection and repair is available from a Link-Belt Distributor. Some of the steel used in booms, flys, and jibs is a special type which can be damaged by incorrect repair procedures. If a chord is damaged or bent, even a small amount, don't use it. Don't try to repair it. Chords are so vital to the strength of the boom, fly, and/or jib that it is not practical to attempt repairs.

19. 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 of the platform.
20. 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.)
21. 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.
22. A pre-lift meeting must be conducted with the crane operator, signal person, employee(s) to be hoisted, person responsible for the task to be performed, and anyone else that is directly involved with the lift (as applicable) to review all the requirements and procedures that must be followed to complete the lift.
23. Follow all procedures for determining the rated capacity and perform all testing as outlined in the Operator's Manual, the Crane Rating Manual, and this Safety Manual.

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.

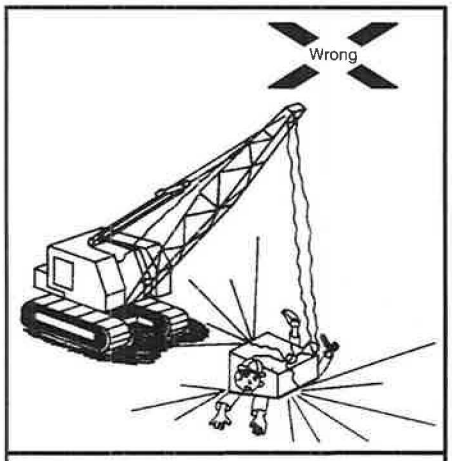


Figure 1
Do not leave a load in the air. It may fall.

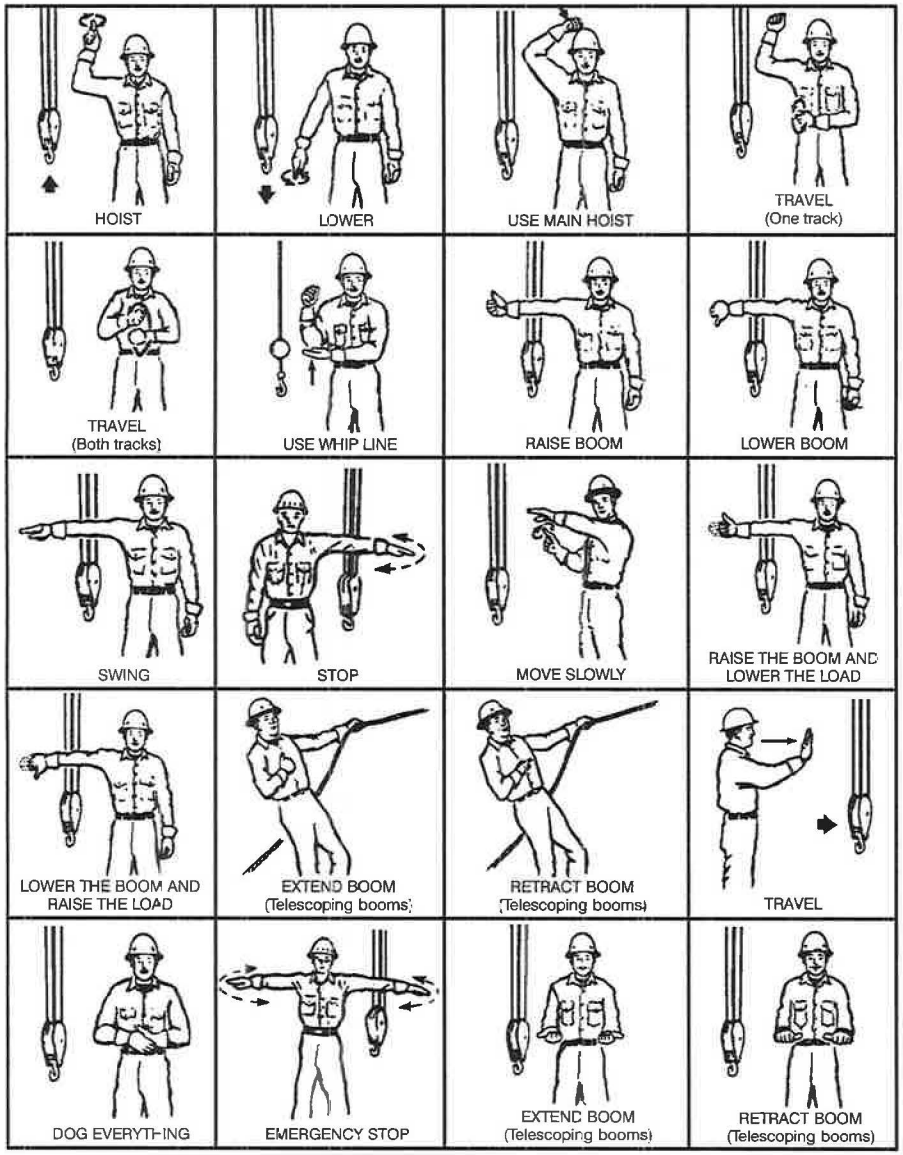
Figure 2
Don't let anyone hitch a ride.

General Safety Rules

1. **Read the Operator's Manual and heed it.** The Operator's Manual contains important information.
2. **When an operator leaves the cab for any reason, the following must be done:**
   a. Lower the bucket, grapple, load, etc. to the ground.
   b. Engage the travel swing lock. Disengage the master clutch. Shutdown the engine(s). Engage the park brake (tire mounted) or travel brakes (crawler mounted).
   c. Do not depend upon a hoist 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 if left in the air unattended.
   d. Tie down the hook block and/or hook ball when leaving the area. Do not leave them or any rigging where the wind could swing them to cause damage to the attachment and/or nearby objects.

   Note: The hoist brake pedal locks are intended to allow the operator to rest his legs when suspending a load for a short period of time, but the operator must remain in his seat with his feet on the pedals. Failure to follow these instructions could lead to an accident.
3. **When changing work shifts always notify the next operator of any changes or problems with the crane.**
4. **An operator must not eat, read, or otherwise divert his attention while operating a crane.** Remember – operating is a full time job. Operate the crane from the operator's seat only. Do not operate a crane from outside the operator's cab by reaching in.
5. **Do not carry passengers!** The one seat in the crane is for the operator.
6. **Don't allow crane loads, bucket, grapple, etc. to pass over people, or endanger their safety.** Remove all loose objects from load. All non-operating personnel should leave the immediate area when crane is operating.
7. **Don't let anyone ride the hook block, hook ball, bucket, grapple, etc.** These cranes are intended to lift objects – not people. They are not elevators.

Standard Hand Signals For Controlling Crane Operations



Crane Operating Safety

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