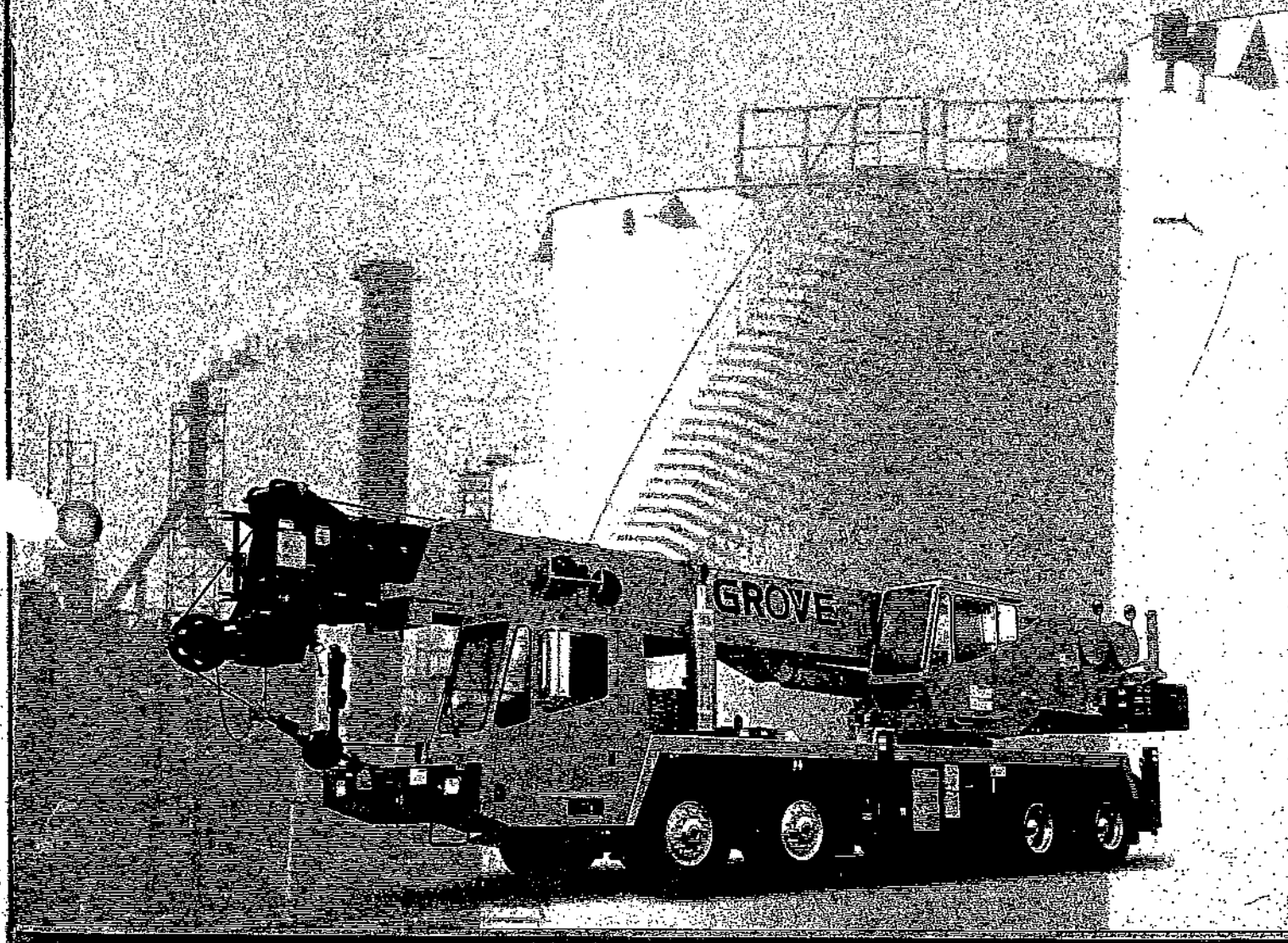
GROVE

TMS875C



TRUCK MOUNTED HYDRAULIC CRANE

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SECTION 1
INTRODUCTION

This handbook provides information for the operator of the TMS875C Grove Crane.

The mobile crane carrier incorporates an all welded steel frame. The 8 x 4 x 4 carrier utilizes two drive axles and two steer axles. Axle steering is provided by a power steering pump and power steering gear. The engine is mounted in the front of the carrier and provides power through a 10 (Early Models) or 11(Later Models) speed forward and 3 speed reverse manual transmission.

Hydraulic, two-stage double box telescopic beam with inverted stabilizer (jack) cylinder outriggers are integral with the carrier frame. The outriggers are utilized in three positions; fully extended, intermediate (50%) extended, and fully retracted. The carrier is also equipped with a center front stabilizer with a permanently stowed pad.

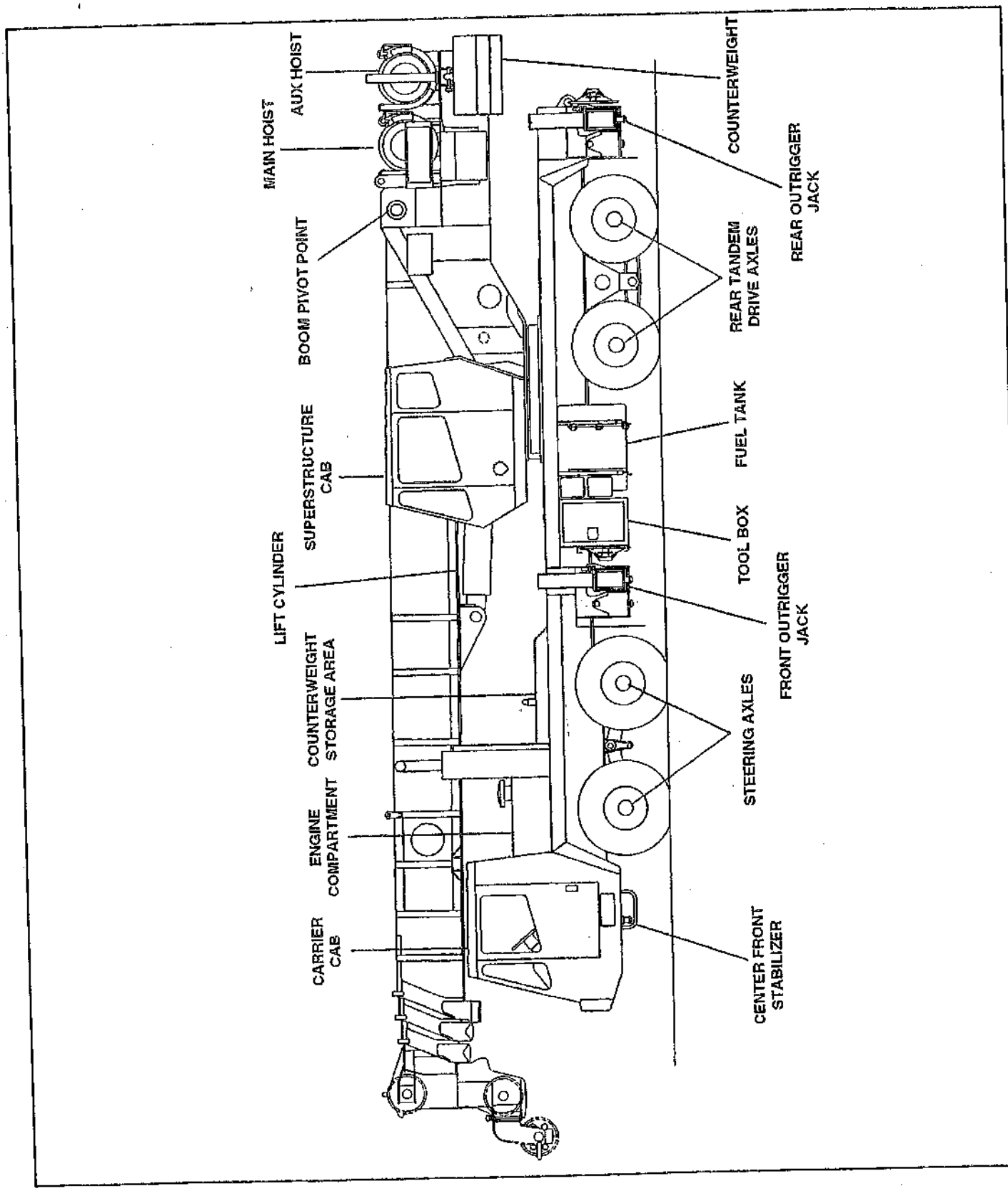
The superstructure is capable of 360° rotation in either direction. All crane functions, with the exception of counterweight removal, are controlled from the fully enclosed cab. The crane is equipped with one of three booms:

- 10.6 to 33.5 m (35 to 110 ft) four section boom.
- 12.2 to 38.1 m (40 to 125 ft) four section boom.
- 10.8 to 42.0 m (35 to 136 ft) five section boom.

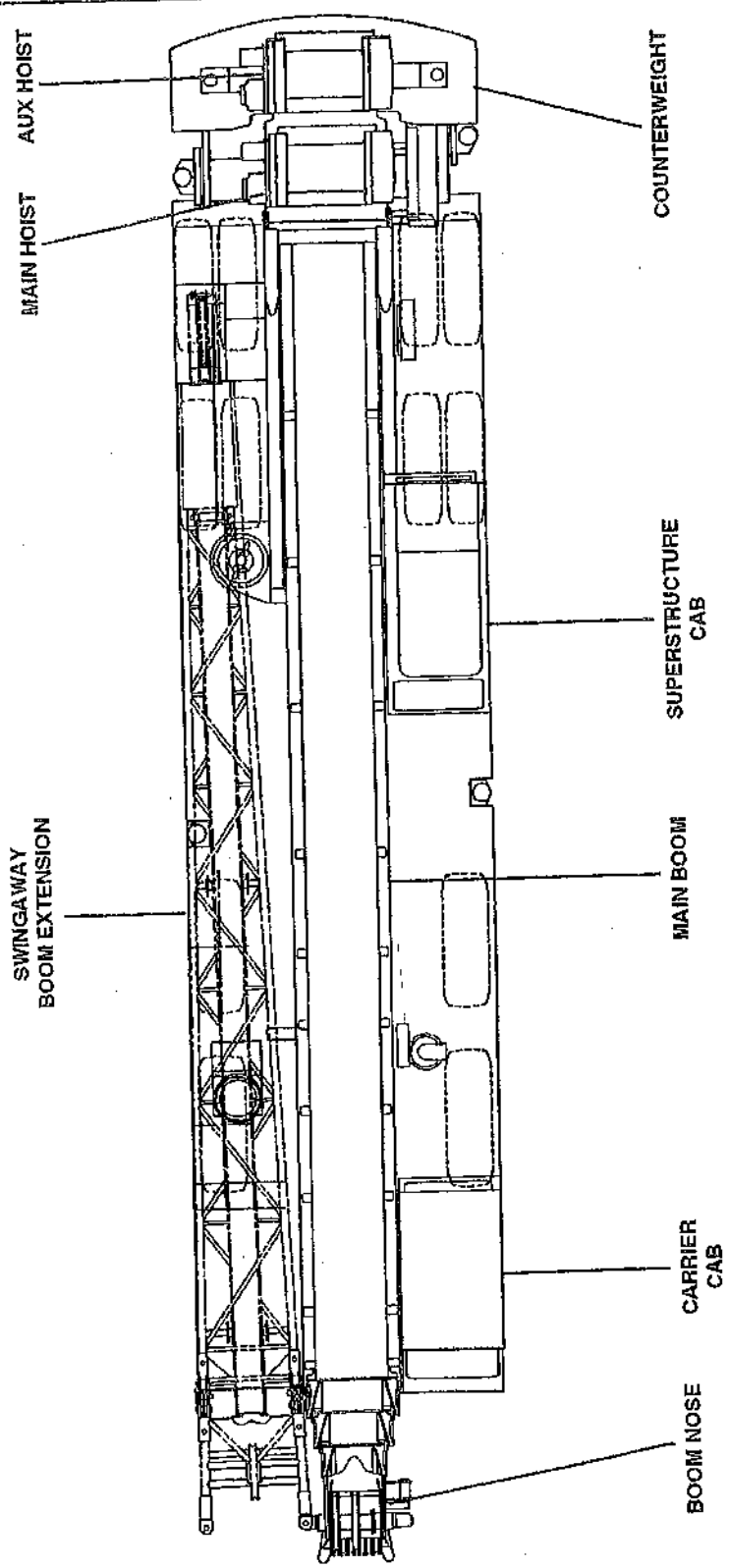
Lifting on all three booms is provided by a main and optional auxiliary hoist. A boom extensions are available.

NOTE

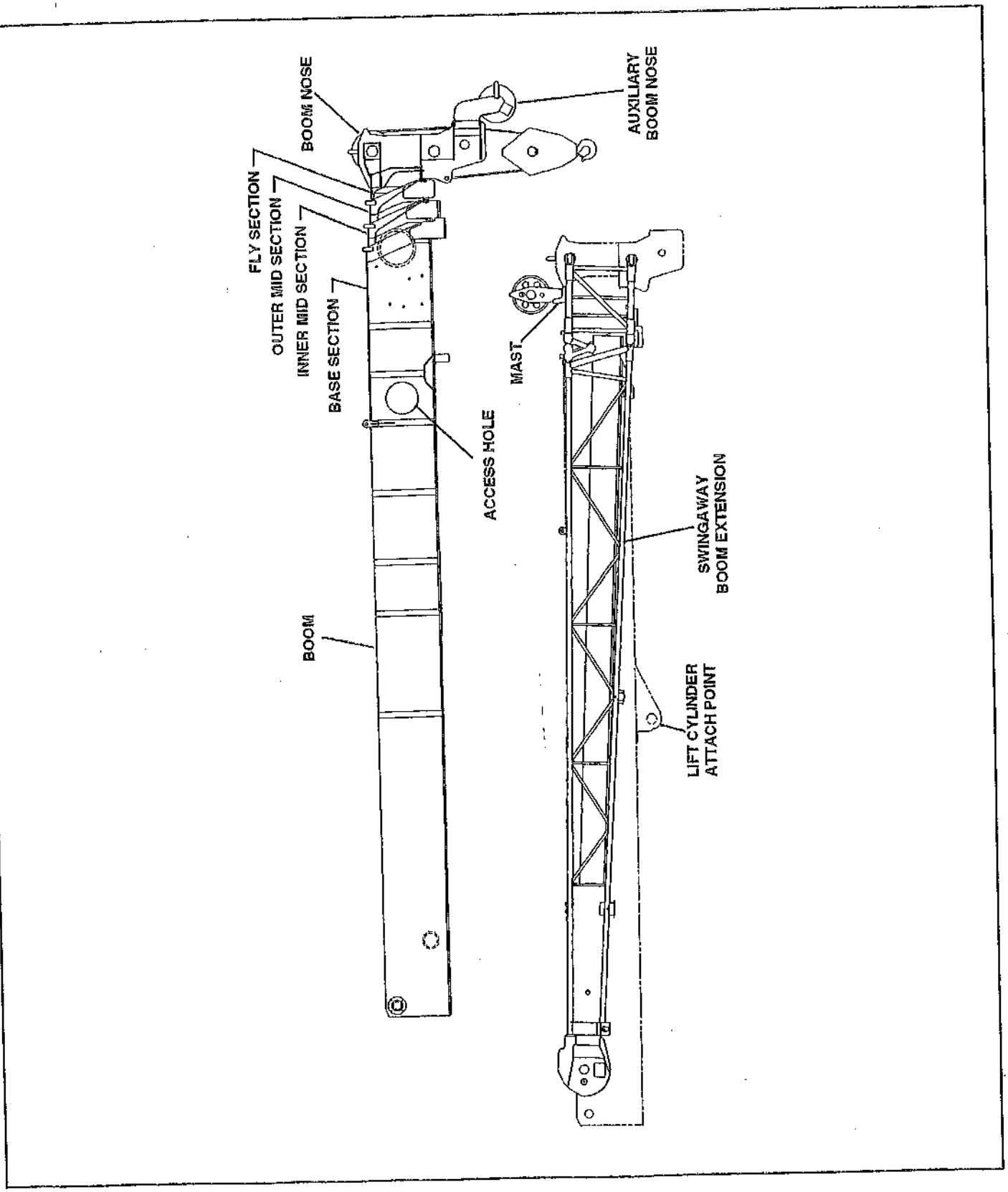
Throughout this manual, reference is made to left, right, front, and rear when describing locations. These reference locations are to be considered as those viewed from the operator's seat with the superstructure facing forward over the front of the carrier frame.



Basic Nomenclature (Sheet 1 of 3)



Basic Nomenclature (Sheet 2 of 3)



Basic Nomenclature (Sheet 3 of 3)

SECTION 2
SAFETY PRECAUTIONS

GENERAL

NOTE

Illustrations have been included in this section to emphasize certain proper and improper points; READ AND FOLLOW PRINTED INSTRUCTIONS.

It is impossible to compile a list of safety precautions covering all situations. However, there are basic principles that MUST be followed during your daily routine. Safety is YOUR PRIMARY RESPONSIBILITY, since any piece of equipment is only as safe AS THE PERSON AT THE CONTROLS.

With this thought in mind, this information has been provided to assist you, the operator, in promoting a safe working atmosphere for yourself and those around you. It is not meant to cover every conceivable circumstance which could arise. It is intended to present basic safety precautions that should be followed in daily operation.

Because you, the operator, are the only part of the crane that can think and reason, your responsibility is not lessened by the addition of operational aids or warning devices. Indeed, you must guard against acquiring a false sense of security when using them. They are there to assist, not direct the operation. Operational aids or warning devices can be mechanical, electrical, electronic, or a combination thereof. They are subject to failure or misuse and should not be relied upon in place of good operating practices.

You, the operator, are the only one who can be relied upon to assure the safety of yourself and those around you. Be a PROFESSIONAL and follow the RULES of SAFETY.

REMEMBER, failure to follow just one safety precaution could cause an accident that results in death or serious injury to personnel or damage to equipment.

You are responsible for the safety of yourself and those around you.

IMMEDIATELY report all accidents, malfunctions, and equipment damages to your local Grove distributor. Following any accident or damage to equipment the local Grove distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Should the distributor not be immediately available, contact should be made directly with Grove Worldwide Product Support. The crane must not be returned to service until it is thoroughly inspected for any evidence of damage. All damaged parts must be repaired or replaced as authorized by your local Grove Worldwide distributor and/or Grove Worldwide.

OPERATOR'S INFORMATION

You must READ and UNDERSTAND the Operator's and Safety Handbook and the Load Chart before operating the crane. You must also VIEW and UNDERSTAND the safety video titled "The Real Key to Crane Safety" supplied with your new Grove product. The handbook and Load Chart must be readily available to the operator at all times and must remain in the cab while the crane is in use.

Ensure that all personnel working around the crane are thoroughly familiar with safe operating practices. You must be thoroughly familiar with the location and content of all placards and decals on the crane. Decals provide important instructions and warnings and must be read prior to any operational or maintenance function.

You must be familiar with the regulations and standards governing cranes and their operation. Work practice requirements may vary slightly between government regulations, industry standards, and employer policies so a thorough knowledge of all such relevant work rules is necessary.

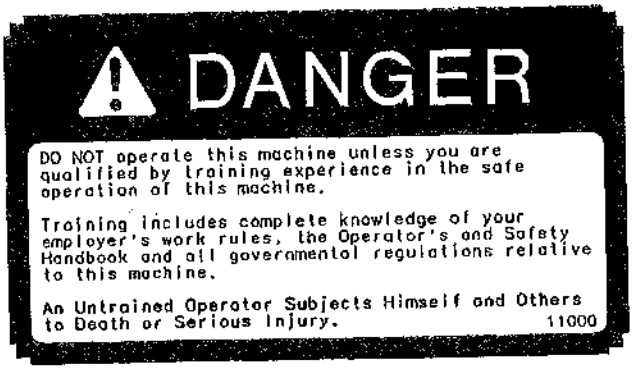
DO NOT REMOVE the load chart, this Operator's and Safety Handbook, or any decal from this crane.

Inspect the crane every day (before the start of each shift). Ensure that routine maintenance and lubrication are being dutifully performed. Don't operate a damaged

or poorly maintained crane. You risk lives when operating faulty machinery, including your own.

Allow No One other than the operator to be on the crane while the crane is functioning or moving, unless they are seated in a two-man cab.

OPERATOR'S QUALIFICATIONS



An untrained operator subjects himself and others to death or serious injury.

YOU MUST NOT OPERATE THIS MACHINE UNLESS:

- You have been trained in the safe operation of this machine.
- You read, understand, and follow the safety and operating recommendations contained in the manufacturer's manuals, your employer's work rules, and applicable government regulations.
- You are sure the machine is operating properly and has been inspected and maintained in accordance with the manufacturer's manuals.
- You are sure that all safety signs, guards, and other safety features are in place and in proper condition.

Do not attempt to operate the crane unless you are trained and thoroughly familiar with all operational functions. Controls and design may vary from crane to crane, therefore, it is important that you have specific training on the particular crane you will be operating.

Training is ESSENTIAL for proper crane operation. Never jeopardize your own well-being or that of others by attempting to operate a crane on which you have not been trained.

You must be mentally and physically fit to operate a crane. Never attempt to operate a crane while under the influence of medication, narcotics or alcohol. Any type of drug could impair physical, visual and mental reactions and capabilities.

CRANE STABILITY/STRUCTURAL STRENGTH

To avoid death or serious injury, ensure that the crane is on a firm surface with load and crane's configuration within capacity as shown on the crane's load rating chart and notes.

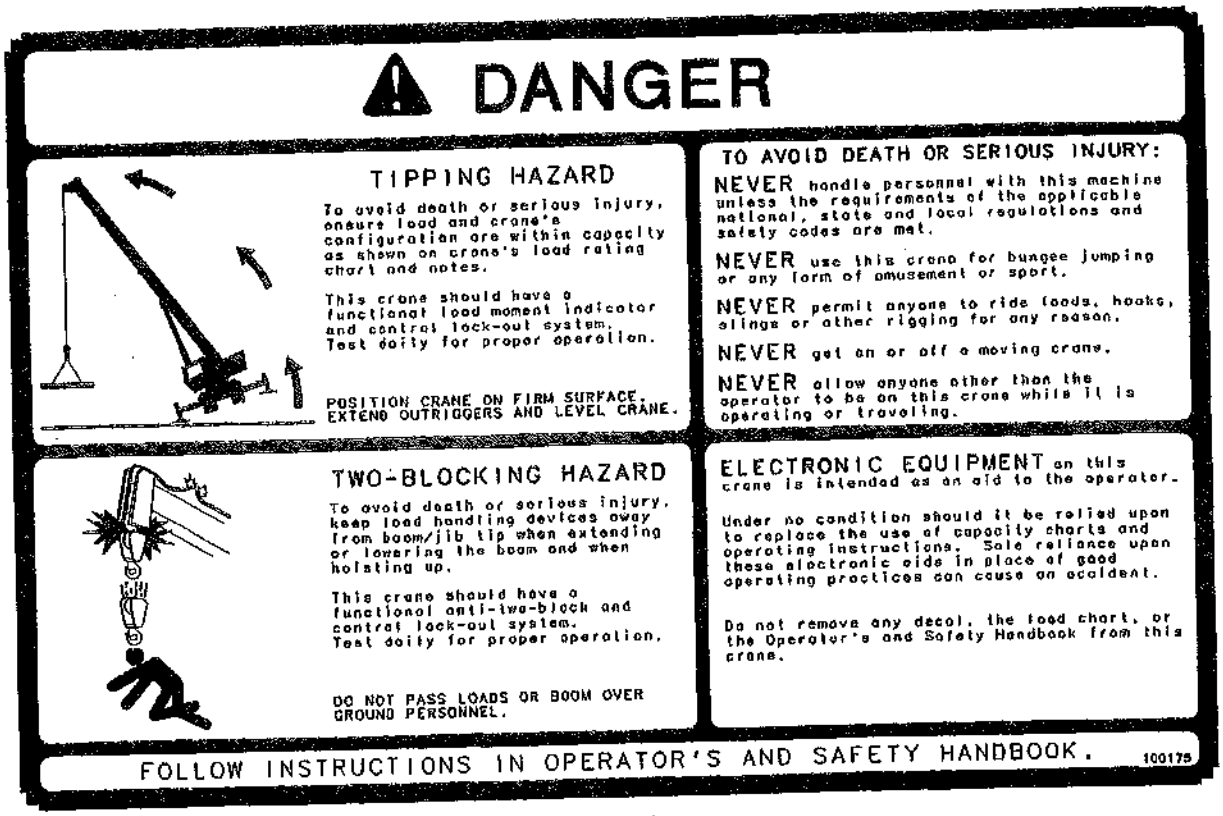
Do not lift loads unless the outriggers are properly extended and the crane leveled. On models equipped with outriggers that can be pinned at the mid-extend position, the outriggers must also be pinned when operating from the mid-extend position.

This crane should have a functional load moment indicator and control lock-out system. Test daily for proper operation. Never interfere with the proper functioning of operational aids or warning devices.

Before swinging the superstructure over the side when the outriggers are retracted, check the load chart for backwards stability.

Long cantilever booms can create a tipping condition when in an extended and lowered position. Retract the boom proportionally with reference to the capacity of the applicable load chart.

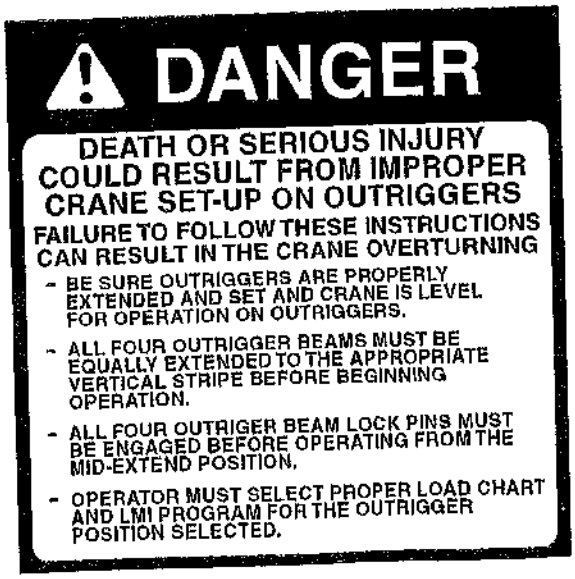
Check crane stability before lifting loads. Ensure the outriggers (or tires if lifting on rubber) are firmly positioned on solid surfaces. Ensure the crane is level, brakes are set, and the load is properly rigged and attached to the hook. Check the load chart against the weight of the load. Lift the load slightly off the ground and recheck the stability before proceeding with the lift. Determine the weight of the load before you attempt the lift.



Ensure all pins and floats are properly installed and outrigger beams are properly extended before lifting on outriggers.

Unless lifting within On Rubber capacities, outrigger beams must be properly extended, jack cylinders extended and set, to provide maximum leveling of the crane. On models equipped with outriggers that can be pinned at the mid-extend position, the outriggers must also be pinned when operating from the mid-extend position. Tires must be clear of the ground before lifting on outriggers. Remove all weight from tires before lifting on outriggers.

Use adequate cribbing under outrigger floats to distribute weight over a greater area. Check frequently for settling.



Carefully follow the procedures in this handbook when extending or retracting the outriggers. Death or serious injury could result from improper crane set-up on outriggers.

Be sure the outriggers are properly extended and set and the crane is level for operation on outriggers.

All four outrigger beams must be equally extended to the appropriate vertical stripe before beginning operation.

All four outrigger beam lock pins must be engaged before operating from the mid-extend position.

The operator must select the proper load chart and LMI program for the outrigger position selected.

KEEP THE BOOM SHORT. Swinging loads with a long line can create an unstable condition and possible structural failure of the boom.

LOAD CHARTS

Load charts represent the absolute maximum allowable loads, which are based on either tipping or structural limitations of the crane under specific conditions. Knowing the precise load radius, boom length, and boom angle should be a part of your routine planning and operation. Actual loads, including necessary allowances, should be kept below the capacity shown on the applicable load chart.

You must use the appropriate load chart when determining the capability of the crane in the configuration required to perform the lift.

Maximum lifting capacity is available at the shortest radius, minimum boom length, and highest boom angle.

Do not remove the load charts from the crane.

WORK SITE

Prior to any operation, you must inspect the ENTIRE work-site, including ground conditions, where the crane will travel and operate. Be sure that the surfaces will support a load greater than the crane's weight and maximum capacity.

Barricade the area where the crane is working and keep all unnecessary personnel out of that area.

Be aware of all conditions that could adversely affect the stability of the crane.

Use caution when operating in the vicinity of overhanging banks and edges.

Wind can have a significant affect on loads that may be lifted by a crane. Wind forces act differently on a crane depending upon the direction from which the wind is blowing (e.g., wind on the rear of the boom can result in decreased forward stability, wind on the underside of the boom can result in decreased backward stability, wind on the side of the boom can result in structural damages, etc.). To assist you in determining prevailing wind conditions, refer to the "WIND VELOCITY CHART" on page 2-5.

LIFTING OPERATIONS

If the boom extension, jib, or auxiliary boom nose is to be used, ensure the electrical cable and the weight for the antitwo-block switch are properly installed and the LMI is programmed for the crane configuration. Refer to the LMI handbook supplied with the crane.

Before lifting, position the crane on a firm surface, properly extend and set the outriggers, and level the crane.

If the boom extension or auxiliary boom nose is to be used, you must ensure that the cable for the LMI system is properly connected at the junction box located on the boom nose.

Depending on the nature of the supporting surface, adequate cribbing may be required to obtain a larger bearing surface.

DO NOT OVERLOAD THE CRANE by exceeding the capacities shown on the appropriate load chart. Death or serious injury could result from the crane tipping over or failing structurally from overload.

Do not rely on the crane's tipping to determine your lifting capacity.

If you should encounter a tipping condition, immediately lower the load with the hoist line and retract or elevate the boom to decrease the load radius. Never lower or extend the boom, this will aggravate the condition.

Be sure the load is properly rigged and attached. Always determine the weight of the load before you attempt to lift it and remember that all rigging (slings, etc.) and lift-

g devices (hook block, jib, etc.) must be considered part the load.

Measure the load radius before making a lift and stay within approved lifting areas based on the range diagrams and working area diagrams on the crane's load chart.

Verify the crane's capacity by checking the load chart against the weight of the load then lift the load slightly at first to ensure stability before proceeding with the lift.

Always keep the load as near to the crane and as close to the ground as possible.

The crane can tip over or fail structurally if:

- the load and crane's configuration is not within the capacity as shown on the applicable load rating chart and notes.
- the ground is soft and/or the surface conditions are poor.
- outriggers are not properly extended and set. On models equipped with outriggers that can be pinned at the mid-extend position, the outriggers must also be pinned when operating from the mid-extend position.
- cribbing under the outrigger pads is inadequate.
- the crane is improperly operated.

Wind forces can exert extreme dynamic loads. **Grove recommends that a lift not be made if the wind can cause a loss of control in handling the load.** Grove recommends if the wind speed (velocity) is between 32 km/h (20 mph) to 48 km/h (30 mph), that the load capacities shall be reduced to account for the size and shape of the load and the wind direction in relation to the machine for all boom, boom extension, and jib lengths. Further, operation of the crane in wind velocities over 48 km/h (30 mph) is not recommended. To assist you in determining prevailing wind conditions, refer to the "WIND VELOCITY CHART" below.

Wind Velocity Chart

Wind Force		Wind Velocity km/h (mph)	Visible Indicator Effects of wind as observed on land
Beauford Scale	**Designation**		
Zero (0)	Calm	<2 (<1)	No wind: smoke rises vertically
1	Light Air	2-5 (1-3)	Wind direction seen by smoke but not by wind vanes
2	Light Breeze	6-11 (4-7)	Wind felt on face: leaves rustle: wind vane moves slightly
3	Gentle Breeze	13-19 (8-12)	Leaves/small twigs in constant motion: wind extends flag
4	Moderate Breeze	21-29 (13-18)	Raises dust & loose paper: moves small branches
Reduce crane load ratings and operating parameters at 32 km/h (20 mph)			
5	Fresh Breeze	31-39 (19-24)	Small trees in leaf begin to sway: on ponds, crested wavelets form
6	Strong Breeze	40-50 (25-31)	Large branches in motion: telegraph wires whistle: umbrellas used with difficulty
Cease all craning operations at 48 km/h (30 mph); lower & retract boom			
7	Moderate Gale	52-61 (32-38)	Whole trees in motion: walking against wind is inconvenient

The crane cab is equipped with a sight level bubble that should be used to determine whether the crane is level. The load line can also be used to estimate the levelness of the crane by checking to be sure it is in-line with the center of the boom at all points on the swing circle.

Use tag lines whenever possible to help control the movement of the load.

When lifting loads, the crane will lean toward the boom and the load will swing out, increasing the load radius. Ensure the load capacity chart is not exceeded when this occurs.

Be sure the hoist line is vertical before lifting. Do not subject the crane to side loading. A side load can tip the crane or cause it to fail structurally.

Do not strike any obstruction with the boom. If the boom should accidentally contact an object; stop immediately. Inspect the boom. Remove the crane from service if the boom is damaged.

Never push or pull with the crane boom.

Avoid sudden starts and stops when moving the load. The inertia and an increased load radius could tip the crane over or cause it to fail structurally.

Load Chart capacities are based on freely suspended loads. Do not pull posts, pilings, or submerged articles. Be sure the load is not frozen or otherwise attached to the ground before lifting.

Use only one hoist at a time when lifting loads.

Always use enough parts-of-line to accommodate the load to be lifted. Lifting with too few parts-of-line can result in failure of the wire rope.

Never operate the crane with less than two wraps of wire rope on the hoist drum.

COUNTERWEIGHT

On cranes equipped with removable counterweights, ensure the appropriate counterweight sections are properly installed for the lift being considered.

To reduce the crushing hazard and to prevent death or serious injury, always clear all personnel from the counterweight area before moving the counterweight.

Federal law prohibits modification or additions which affect the capacity or safe operation of the equipment without the manufacturer's written approval. [29CFR 1926.550]

Do not add material to the counterweight to increase capacity.

MULTIPLE CRANE LIFTS

Multiple crane lifts are not recommended.

Any lift that requires more that one crane must be precisely planed and coordinated by a qualified engineer.

If it is necessary to perform a multi-crane lift, the operator shall be responsible for assuring that the following minimum safety precautions are taken.

1. Secure the services of a qualified engineer to direct the operation.
2. Use one qualified signal person.
3. Coordinate lifting plans with the operator, engineer and signal person prior to beginning the lift.
4. Communication between all parties must be maintained throughout the entire operation. If possible, provide approved radio equipment for voice communication between all parties engaged in the lift.
5. Use cranes and rigging of equal capabilities and use the same boom length.
6. Use outriggers on cranes so equipped.
7. Be certain cranes are of adequate lifting capacity.
8. Calculate the amount of weight to be lifted by each crane and attach slings at the correct points for proper weight distribution.
9. Ensure the load lines are directly over the attach points to avoid side loading and transfer of loading from one crane to the other.
10. **DO NO TRAVEL.** Lift only from a stationary position

LOAD MOMENT INDICATING SYSTEMS

Electronic equipment on this crane is intended as an aid to the operator.

Under NO CONDITION should it be relied upon to replace the use of capacity charts and operating instructions. Sole reliance upon these electronic aids in place of good operating practices can cause an accident.

Know the weight of all loads and always check the capacity of the crane as shown on the load chart before making any lifts.

NEVER exceed the rated capacity shown on the load chart. Always check the load chart to ensure the load to

ve lifted at the desired radius is within the rated capacity of the crane.

Never interfere with the proper functioning of operational aids or warning devices.

For detailed information concerning the operation and maintenance of the load moment indicating system installed on the crane see the manufacturer's manual supplied with the crane.

TWO-BLOCKING

Two-blocking occurs whenever the load block (hook block, headache ball, rigging, etc.) comes into physical contact with the boom (boom nose, sheaves, jib, etc.). Two-blocking can cause hoist lines (wire rope) rigging, reeving, and other components to become highly stressed and overloaded in which case the wire rope may fail allowing the load, block, etc. to free fall.

Two-blocking is more likely to occur when both the main and auxiliary hoist lines are reeved over the main boom nose and boom extension/jib nose respectively. An operator, concentrating on the specific line being used, may telescope or lower the boom allowing the other hoist line attachment to contact the boom or boom extension/jib nose, thus causing damage to the sheaves, or causing the wire rope to fail, dropping the lifting device to the ground and possibly injuring personnel working below.

Caution must be used when lowering or extending the boom. Let out load line(s) simultaneously to prevent two-blocking the boom tip(s) and the hook block, etc. The closer the load is carried to the boom nose the more important it becomes to simultaneously let out wire rope as the boom is lowered. Keep load handling devices a minimum of 107 cm (42 in.) below the boom nose at all times.

Two-blocking can be prevented. Operator awareness of the hazards of two-blocking is the most important factor in preventing this condition. An anti two-block system is intended to assist the operator in preventing dangerous two-block conditions. It is not a replacement for operator awareness and competence.

To avoid death or serious injury, keep load handling devices away from boom/jib tip when extending or lowering the boom and when hoisting up.

This crane should have a functional ANTI-TWO BLOCK and CONTROL LOCK- OUT system. Test daily for proper operation.

Do not pass loads or boom over ground personnel.

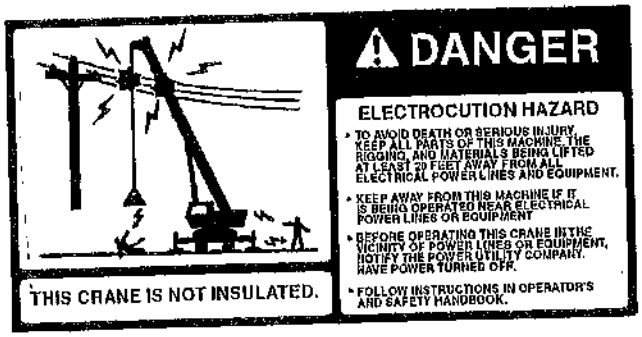
Barricade the area where the crane is working and keep all unnecessary personnel out of that area. DO NOT allow personnel to be under the load or boom.

Never pass loads, load handling devices, or the crane boom over people on the ground.

Never operate the crane with less than two wraps of wire rope on the hoist drum.

Never interfere with the proper functioning of operational aids or warning devices.

ELECTROCUTION HAZARD



To avoid death or serious injury, keep all parts of this machine, the rigging, and materials being lifted at least 6 m (20 ft.) away from all electrical power lines and equipment.

Keep all personnel away from this machine if it is being operated near electrical power lines or equipment.

Before operating this crane in the vicinity of electrical power lines or equipment, notify the power utility company. Obtain positive and absolute assurance that the power has been turned off.

This machine is NOT INSULATED. Always consider all parts of the load and the crane, including the wire rope, hoist cable, pendant cables and tag lines, as conductors.

Most overhead power lines ARE NOT insulated. Treat all overhead power lines as being energized unless you have reliable information to the contrary from the utility company or owner.

The rules in this handbook must be followed at all times, even if the electrical power lines or equipment have been de-energized.

Crane operation is dangerous when close to an energized electrical power source. Exercise extreme caution and prudent judgement. Operate slowly and cautiously when in the vicinity of power lines.

If the load, wire rope, crane boom or any portion of the crane contacts or comes too close to an electrical power source, everyone in, on, and around the crane can be seriously injured or killed.

The safest way to avoid electrocution is to stay away from electrical power lines and electrical power sources.

You, the operator, are responsible for alerting all personnel of dangers associated with electrical power lines and equipment. The crane is not insulated. Do not allow unnecessary personnel in the vicinity of the crane while operating. Permit no one to lean against or touch the crane. Permit no one including riggers and load handlers to hold the load, load lines, tag lines or rigging gear.

Even if the crane operator is not affected by an electrical contact, others in the area may become seriously injured or killed.

It is not always necessary to contact a power line or power source to become electrocuted. Electricity, depending on magnitude, can arc or jump to any part of the load, load line or crane boom if it comes too close to an electrical power source. Low voltages can also be dangerous.

Thoroughly read, understand, and abide by all applicable federal, state and local regulations.

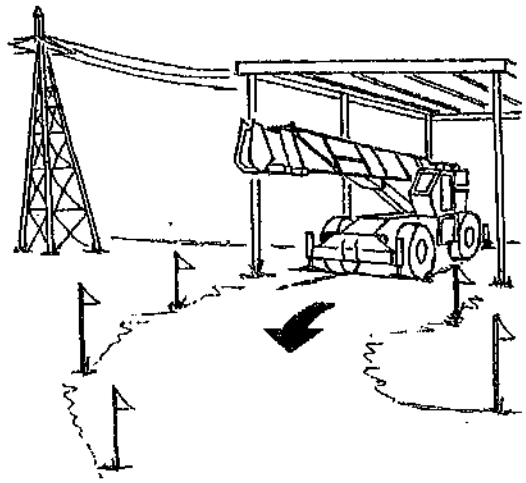
Federal law prohibits the use of cranes closer than 3 m (10 ft.) to power sources up to 50,000 volts and greater distances for higher voltages. [29CFR1910.180 and 29CFR1926.550] Grove recommends keeping cranes twice the minimum distance (e.g., 6 m (20 ft.)) as specified by US Department of Labor - Occupational Safety and Health Administration (OSHA) standards.

SET-UP AND OPERATION

During crane use, assume that every line is energized ("hot" or "live") and take the necessary precautions.

Set-up the crane in a position such that the load, boom or any part of the crane and its attachments cannot be moved to within 6 m (20 ft.) of electrical power lines or equipment. This includes the crane boom (fully extended to maximum height, radius and length) and all attachments (jibs, boom extensions, rigging, loads, etc.). Overhead lines tend to blow in the wind so allow for lines' movement when determining safe operating distance.

A suitable barricade should be erected to physically restrain the crane and all attachments (including the load) from entering into an unsafe distance from electrical power lines or equipment.



Plan ahead and always plan a safe route before traveling under power lines. Rider poles should be erected on each side of a crossing to assure sufficient clearance is maintained.

Appoint a reliable and qualified signal person, equipped with a loud signal whistle or horn and voice communication equipment, to warn the operator when any part of the crane or load moves near a power source. This person should have no other duties while the crane is working.

Tag lines should always be made of non-conductive materials. Any tag line that is wet or dirty can conduct electricity.

DO NOT store materials under power lines or close to electrical power sources.

ELECTROCUTION HAZARD DEVICES

The use of insulated links, insulated boom cages/guards, proximity warning devices, or mechanical limit stops does not assure that electrical contact will not occur. Even if codes or regulations require the use of such devices, failure to follow the rules listed here may result in serious injury or death. You should be aware that such devices have limitations and you should follow the rules and precautions outlined in this handbook at all times even if the crane is equipped with these devices.

Insulating links installed into the load line afford limited protection from electrocution hazards. Links are limited in their lifting abilities, insulating properties, and other properties that affect their performance. Moisture, dust, dirt, oils, and other contaminants can cause a link to conduct electricity. Due to their capacity ratings, some links are not effective for large cranes and/or high voltages/currents.

The only protection that may be afforded by an insulated link is below the link (electrically downstream), provided the link has been kept clean, free of contamination, has not been scratched or damaged, and is periodically tested (just before use) for its dielectric integrity.

Boom cages and boom guards afford limited protection from electrocution hazards. They are designed to cover only the boom nose and a small portion of the boom. Performance of boom cages and boom guards is limited by their physical size, insulating characteristics, and operating environment (e.g. dust, dirt, moisture, etc.). The insulating characteristics of these devices can be compromised if not kept clean, free of contamination, and undamaged.

Proximity sensing and warning devices are available in different types. Some use boom nose (localized) sensors and others use full boom length sensors. No warning may be given for components, cables, loads, and other attachments located outside of the sensing area. Much reliance is placed upon you, the operator, in selecting and properly setting the sensitivity of these devices.

Never rely solely on a device to protect you and your fellow workers from danger.

Some variables you must know and understand are:

- Proximity devices are supposed to detect the existence of electricity and not its quantity or magnitude.
- Some proximity devices will detect only alternating current (AC) and not direct current (DC).
- Some proximity devices detect radio frequency (RF) energy and others do not.
- Most proximity devices simply provide a signal (audible, visual or both) for the operator and this signal must not be ignored.
- Sometimes the sensing portion of the proximity devices becomes confused by complex or differing arrays of power lines and power sources.

DO NOT depend on grounding. Grounding of a crane affords little or no protection from electrical hazards. The effectiveness of grounding is limited by the size of the (wire) conductor used, the condition of the ground, the magnitude of the voltage and current present, and numerous other factors.

ELECTRICAL CONTACT

If the crane should come in contact with an energized power source, you must:

1. Stay in the crane cab. DON'T PANIC.
2. Immediately warn personnel in the vicinity to stay away.
3. Attempt to move the crane away from the contacted power source using the crane's controls which are likely to remain functional.
4. Stay in the crane until the power company has been contacted and the power source has been de-energized. NO ONE must attempt to come close to the crane or load until the power has been turned-off.

Only as a last resort should an operator attempt to leave the crane upon contacting a power source. If it is absolutely necessary to leave the operator station, JUMP COMPLETELY CLEAR OF THE CRANE. DO NOT STEP OFF. Hop away with both feet together. DO NOT walk or run.

Following any contact with an energized electrical source the local, authorized Grove Worldwide distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Thoroughly inspect the wire rope and all points of contact on the crane. Should the distributor not be immediately available, contact Grove Worldwide Product Support. The crane must not be returned to service until it is thoroughly inspected for any evidence of damage and all damaged parts are repaired or replaced as authorized by Grove Worldwide or your local Grove Worldwide distributor.

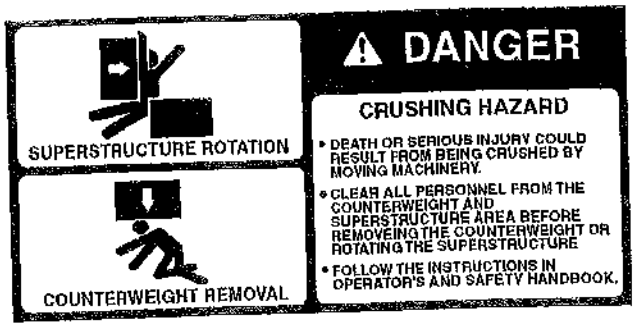
SPECIAL OPERATING CONDITIONS AND EQUIPMENT

Never operate the crane during an electrical thunderstorm.

Working in the vicinity of radio frequency transmission towers and other transmission sources may cause a crane to become "electrically charged".

When operating cranes equipped with electromagnets you must take additional precautions. Permit no one to touch the magnet or load. Alert personnel by sounding a warning signal when moving a load. Do not allow the cover of the electromagnet power supply to be open during operation or at any time the electrical system is activated. Shut down the crane completely and open the magnet controls switch prior to connecting or disconnecting magnet leads. Use only a non-conductive device when positioning a load. Lower the magnet to the stowing area and shut off power before leaving the operator's cab.

CRUSHING HAZARDS



Death or serious injury could result from being crushed by moving machinery.

Clear all personnel from the counterweight and superstructure area before removing the counterweight or rotating the superstructure.

Barricade the entire area where the crane is working and keep all unnecessary personnel out of the work area.

Never allow anyone to stand or work on or near the superstructure while the crane is in operation.

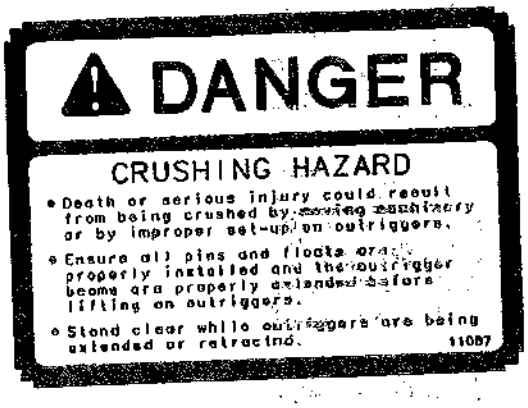
Always barricade the tail-swing of the rotating superstructure.

Before actuating swing or any other crane function, sound the horn and verify that all personnel are clear of rotating and moving parts.

Watch the path of the boom and load when swinging. Avoid lowering or swinging the boom and load into ground personnel, equipment or other objects.

Always be aware of your working environment during operation of the crane. Avoid contacting any part of the crane with external objects.

You must always be aware of everything around the crane while lifting or traveling. If you are unable to clearly see in the direction of motion, you must post a look-out or signal person before moving the crane or making a lift. Sound the horn to warn personnel.



Clear all personnel from the outrigger area before extending or retracting the outriggers.

Carefully follow the procedures in this handbook when extending or retracting the outriggers. Death or serious injury could result from improper crane set up on outriggers.

Be sure the outriggers are properly extended, set and the crane is level for operation on outriggers.

All four outrigger beams must be equally extended to the appropriate vertical stripe before beginning operation.

All four outrigger beam lock pins must be engaged before operating from the mid-extend position.

The operator must select the proper Load Chart and LMI System program for the outrigger position selected.

Only the crane operator shall occupy the crane when traveling or in operation.

PERSONNEL HANDLING

The American Society of Mechanical Engineers issued a new American National Standard entitled, Personnel Lifting Systems, ASME B30.23-1998. This standard provides, "lifting and lowering of personnel using ASME B30 Standard hoisting equipment shall be undertaken only in circumstances when it is not possible to accomplish the task by less hazardous means. Unless all of the applicable requirements of this volume are met, the lifting or lowering of personnel using ASME B30 Standard equipment is prohibited." This new standard is consistent with the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) regulations for Construction that state, in 29CFRI926.550(g)(2): "General requirements. The use of a crane or derrick to hoist employees on a personnel platform is prohibited, except when the erection, use, and dismantling of conventional means of reaching the work site, such as a personnel hoist, ladder, stairway, aerial lift, elevating work platform or scaffold, would be more hazardous or is not possible because of structural design or work site conditions." Additional requirements for crane operations are stated in ASME B30.5, Mobile And Locomotive Cranes, and in OSHA regulations 29CFRI910.180 for General Industry and 29CFRI926.550 for Construction.

Use of a Grove crane to handle personnel is acceptable provided:

- The requirements of the applicable national, state and local regulations and safety codes are met.
- A determination has been made that use of a crane to handle personnel is the least hazardous means to perform the work.
- The crane operator shall be qualified to operate the specific type of hoisting equipment used in the personnel lift.
- The crane operator and occupants have been instructed in the recognized hazards of personnel platform lifts.
- The crane is in proper working order.
- The crane is equipped with a functional anti-two block device.
- The crane's load capacity chart is affixed inside the crane's cab, readily accessible to the Operator. The total weight of the loaded personnel platform and related rigging shall not exceed 50 percent of the rated capacity for the radius and configuration of the crane.
- The crane is uniformly level within one percent of level grade and located on a firm footing. Cranes with outriggers shall have them all fully deployed following manufacturer's specifications.

- The crane's Operator's And Safety Handbook and other operating manuals are inside the crane's cab, readily accessible to the Operator.
- The platform meets the requirements as prescribed by applicable standards and regulations.
- For wire rope suspended platforms, the crane is equipped with a hook that can be closed and locked, eliminating the throat opening.
- The platform is properly attached and secure.

To avoid death or serious injury:

NEVER use this crane for bungee jumping or any form of amusement or sport.

NEVER permit anyone to ride loads, hooks, slings or other rigging for any reason.

NEVER get on or off a moving crane.

NEVER allow anyone other than the operator to be on this crane while the machine is operating or traveling.

Grove Worldwide continues to recommend that cranes be properly maintained, regularly inspected and repaired as necessary. Grove reminds crane owners to ensure that all safety decals are in place and legible. Grove continues to urge Grove crane owners to upgrade their cranes with load moment indicator (LMI) and control lever lockout systems for all lifting operations.

The following standards and regulations are available by mail at the following addresses:

- ASME (formerly ANSI) B30 Series American National Safety Standards For Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, And Slings; ASME B30.5, Mobile And Locomotive Cranes, and ASME B30.23, Personnel Lifting Systems, are available by mail from the ASME, 22 Law Drive, Fairfield, New Jersey, 0700-2900.
- US DOL/OSHA Rules and Regulations are available by mail from the Superintendent of Documents, PO Box 371954, Pittsburgh, PA, 15250-7954.

TRAVEL OPERATION

- Before travel, fully retract and lower the boom into the boom rest and engage the turntable pin swing lock.
- Secure the hook block and other items before moving the crane.
- Follow the instructions in this handbook and in the Carrier Handbook when preparing the crane for highway travel.
- If using a boom dolly/trailer, thoroughly read and understand all the steps and safety precautions in the handbook for setup and travel and in the Carrier Handbook.
- Watch overhead and side clearances and avoid running into obstructions along the travel route.
- When moving in a tight quarters, post a signal person to help guard against collisions or bumping structures.
- Never back up without the aid of a signal person to verify that the area behind the crane is clear of all personnel and obstructions.
- Check load limits of bridges on the travel route and ensure they are greater than the crane's weight.
- Always drive the crane carefully, obeying speed limits and highway regulations.
- Keep lights on, use traffic warning flags and signs, and use front and rear flag vehicles when necessary. Check state and local restrictions and regulations.
- When parking on a grade, apply parking brake and chock the wheels.

'AINTENANCE

The crane must be inspected prior to use on each work shift. The owner, user and operator must ensure that routine maintenance and lubrication are being dutifully performed. NEVER operate a damaged or poorly maintained crane.

Keep the crane properly maintained and adjusted at all times. Shut down the crane while making repairs or adjustments.

Always perform a function check after repairs have been made to ensure proper operation. Load tests should be performed when structural or lifting members are involved.

Follow all applicable safety precautions in this handbook when performing crane maintenance as well as crane operations.

Before crane use:

- Conduct a visual inspection for cracked welds, damaged components, loose pin/bolt, and wire connections. Any item or component that is found to be loose or damaged (broken, chipped, cracked, worn-through, etc.) must be repaired or replaced.
- Check for proper functioning of all controls and operator aids (e.g. LMI).
- Check all braking (e.g. wheel, hoist, and swing brakes) and holding devices before operation.

Keep the crane clean at all times, free of mud, dirt, and grease. Dirty equipment introduces hazards, wears-out faster, and makes proper maintenance difficult. Cleaning solutions used should be appropriate for the job and non-flammable/toxic.

ROUTINE MAINTENANCE and INSPECTION of this crane must be performed by a qualified person(s) according to the recommendations in the Grove Worldwide Crane Maintenance and Inspection Manual. Any questions regarding procedures and specifications should be directed to the your local, authorized Grove Worldwide Distributor.

SERVICE AND REPAIRS

Service and repairs to the crane must only be performed by a qualified person. All service and repairs must be performed in accordance with manufacturer's recommendations, this handbook, and the Service Manual for this machine. All replacement parts must be approved by Grove Worldwide.

Any modification, alteration, or change to a crane which affects its original design and is not authorized and approved by Grove Worldwide is STRICTLY PROHIBITED. Such action invalidates all warranties and makes the owner/user liable for any resultant accidents.

Before performing any maintenance, service or repairs on the crane:

- The boom should be fully retracted and lowered and the load placed on the ground.
- Stop the engine and disconnect the battery.
- Controls should be properly tagged. Never operate the crane if it is TAGGED-OUT nor attempt to do so until it is restored to proper operating condition and all tags have been removed by the person(s) who installed them.

Recognize and avoid pinch-points while performing maintenance. Stay clear of sheave wheels, holes, and lattice work in crane booms.

After maintenance or repairs:

- Replace all guards and covers that had been removed.
- Remove all tags, connect the battery, and perform a function check of all operating controls.
- Load tests must be performed when a structural or lifting member is involved in a repair.

LUBRICATION

The crane must be lubricated according to the factory recommendations for lubrication points, time intervals, and types. Lubricate at more frequent intervals when working under severe conditions.

Exercise care when servicing the hydraulic system of the crane, as pressurized hydraulic oil can cause serious injury. The following precautions must be taken when servicing the hydraulic system:

1. Follow the manufacturer's recommendations when adding oil to the system. Mixing the wrong fluids could destroy seals, causing machine failure.

2. Be certain all lines, components and fittings are tight before resuming operation.

3. When checking for suspected leaks, use a piece of wood or cardboard and wear appropriate personal protective equipment.

4. Never exceed the manufacturers recommended relief valve settings.

TIRES

Inspect the tires for nicks, cuts, embedded material, and abnormal wear.

Ensure all lug nuts are properly torqued.

Ensure pneumatic tires are inflated to the proper pressure (Refer to the Tire Inflation Chart in the Load Chart Binder). When inflating tires, use a tire gauge, clip-on inflator, and extension hose which will permit standing clear of the tire while inflating.

WIRE ROPE

Use ONLY the wire rope specified by Grove as indicated on the crane's load capacity chart. Substitution of an alternate wire rope may require the use of a different permissible line pull and, therefore, require different reeving.

Always make daily inspections of the wire rope, keeping in mind that all wire rope will eventually deteriorate to a point where it is no longer usable. Wire rope shall be taken out of service when any of the following conditions exist:

1. For rotation resistant running ropes - more than two (2) broken wires in a length of rope equal to six(6) times the rope diameter, or more than four (4) broken wires in a length of rope equal to thirty (30) times the rope diameter.

2. For running ropes other than rotation resistant - six (6) broken wires in one rope lay or three (3) broken wires in one strand.

3. One valley break where the wire fractures between strands in a running rope is cause for removal.

4. Abrasion of the rope resulting in wear of the individual outside wires of 1/3 of the original wire diameter.

5. Any kinking, bird caging, crushing, corrosion, or other damage resulting in distortion of the rope structure.

6. Rope that has been in contact with a live power line or been used as a ground in an electric circuit (eg. welding) may have wires that are fused or annealed and must be removed from service.

7. In standing ropes, more than three (3) breaks in one rope lay in sections beyond the end connection or more than two (2) broken wires at an end connection.

8. Core deterioration is usually observed as a rapid reduction in rope diameter and is cause for immediate removal of the rope.

Refuse to work with worn or damaged wire rope.

When installing and inspecting wire ropes and attachments keep all parts of your body and clothing away from rotating hoist drums and all rotating sheaves.

Never handle the wire rope with bare hands.

Periodic rope inspection records are required by law. Make sure these records have been reviewed and are up to date.

When installing a new rope :

- Follow proper instructions for removing rope from a reel.
- Apply back tension to the storage/payoff reel of the new rope to insure tight, even spooling onto

the hoist drum.

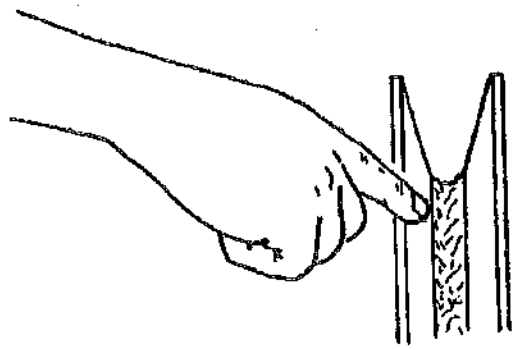
- Operate the new rope, first through several cycles at light load and then through several cycles at intermediate load to allow the rope to adjust to operating conditions.

When using a wedge socket :

- Always inspect socket, wedge, and pin for correct size and condition.
- Do not use parts that are damaged, cracked, or modified.
- Assemble the wedge socket with live end of rope aligned with the centerline of pin and assure proper length of tail (dead end) protrudes beyond the socket.

Never overload or shock load a wire rope.

Lubricate the wire rope periodically as the lubricant becomes depleted.



Inspect the boom nose and hook block sheaves for wear. Damaged sheaves cause rapid deterioration of wire rope.

To attain maximum wire rope life and minimize hook block rotation, it is recommended that even numbers of parts-of-line be used in multiple-part reevings whenever possible.

If applicable to your crane, the use of nylon (nylatron) sheaves, as compared with metallic sheaves, may change the replacement criteria of rotation resistant wire rope.

NOTE

If applicable to your crane, the use of cast nylon (nylatron) sheaves, as compared with steel sheaves, will substantially increase the service life of wire rope. However, conventional rope retirement criteria based only upon visible wire breaks may prove inadequate in predicting rope failure. The user of cast nylon sheaves is therefore cautioned that a retirement criteria should be established based upon the user's experience and the demands of his application.

BATTERIES

Battery electrolyte must not be allowed to contact the skin or eyes. If this occurs, flush the contacted area with water and consult a doctor immediately.

When checking and maintaining batteries exercise the following procedures and precautions:

- Disconnect the batteries.
- Wear safety glasses when servicing batteries.
- Do not short across the battery posts to check charge. Short circuit, spark, or flame could cause battery explosion.
- Maintain battery electrolyte at the proper level. Check the electrolyte with a flashlight.
- Check battery test indicator on maintenance-free batteries.
- Do not break a live circuit at the battery terminal. Disconnect the ground battery cable first when removing a battery and connect it last when installing a battery.
- Check battery condition only with proper test equipment. Batteries shall not be charged except in an open, well ventilated area free of flame, smoking, sparks, and fire.

ENGINE

Be careful when checking the engine coolant level. The fluid may be hot and under pressure. Shut down the engine and allow the radiator time to cool before removing the radiator cap.

Shut down the engine and disconnect the battery before performing maintenance. If unable to do so for the task required, keep hands clear of the engine fan and other moving parts while performing maintenance.

Be careful of hot surfaces and hot fluids when performing maintenance on or around the engine.

WORK PRACTICES

CRANE ACCESS

You must take every precaution to ensure you do not slip and/or fall off the crane. Falling from any elevation could result in serious injury or death.

Never exit or enter the crane cab or deck by any other means than the access system(s) provided (i.e., steps and grab handles).

If necessary, use a ladder or aerial work platform to access the boom nose.

Do not step on surfaces on the crane that are not approved or suitable for walking and working. All walking and working surfaces on the crane should be clean, dry, slip-resistant, and have adequate supporting capacity. Do not walk on a surface if slip-resistant material is missing or excessively worn.

Do not use the top of the boom as a walkway.

Do not step on the outrigger beams or outrigger pads (floats) to enter or exit the crane.

Wear shoes with a highly slip-resistant sole material. Clean any mud or debris from shoes before entering the crane cab or climbing onto the crane superstructure. Excessive dirt and debris on the hand-holds, access steps or walking/working surfaces could cause a slipping accident. A shoe that is not clean might slip off a control pedal during operation.

Do not make modifications or additions to the crane's access system that have not been evaluated and approved by Grove Worldwide.

JOB PREPARATION

You must inspect the crane prior to your work shift - checking for cracked welds, damaged components, and evidence of improper maintenance (consult Maintenance-Inspection and Service manuals).

You must ensure that the crane is properly equipped, including access steps, covers, doors, guards, and controls.

You must ensure that the outriggers are properly extended and set before performing any lifting operations. On models equipped with outriggers that can be pinned at the mid-extend position, the outriggers must also be pinned when operating from the mid-extend position.

Wear appropriate clothing and personal protective equipment whether or not required by local or job regulations. Be prepared for the work day.

Before entering the cab, you must be THOROUGHLY familiar with the planned route of travel and area of operation, including surface conditions and the presence of overhead obstructions and power lines.

Always keep the crane clean, free of dirt, debris, and grease.

Fuel the crane ONLY with the engine turned off. Do not smoke while fueling the crane. Do not store flammable materials on the crane or in the operator's cab.

Follow standard safety precautions when refueling. FUEL IT SAFELY.

Be familiar with the location and use of the nearest fire extinguisher.

Cold weather requires special starting procedures, use of built-in starting aids, if provided, and ample time for hydraulic oil to warm-up. Keep the crane free of ice and snow.

WORKING

Never operate the crane when darkness, fog or other visibility restrictions make operation unsafe. Never operate a crane in thunderstorms or high winds.

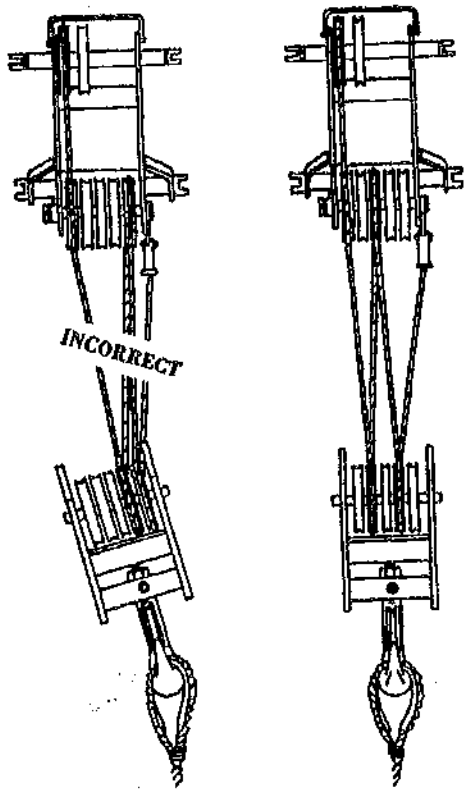
Keep unauthorized personnel clear of the working area during operation.

Operate the crane only from the operator's seat. Do not reach in a window or door to operate any controls.

Operate the crane slowly and cautiously, looking carefully in the direction of movement.

"Stunt" driving and "horse-play" is strictly prohibited. Never allow anyone to hitch a ride or get on or off a moving crane.

A good practice is to make a "dry run" without a load before making the first lift. Become familiar with all factors peculiar to the job site.



Ensure the wire rope is properly routed on the hook block and boom nose and that all rope guards are in place.

USE ENOUGH PARTS OF LINE FOR HEAVY LIFTS AND CHECK ALL LINES, SLINGS, AND CHAINS FOR CORRECT ATTACHMENT. To obtain maximum lifting capacities the hook block must be set up with enough parts of line. NO LESS THAN TWO WRAPS of wire rope should remain on the hoist drum.When slings, ties, hooks, etc., are used, make certain they are correctly positioned and secured before raising or lowering the loads.

Be sure the rigging is adequate before lifting and use tag lines when possible to position and restrain loads. Personnel using tag lines should be on the ground.

Be sure good rigging practices are being used. Refuse to use any poorly maintained or damaged equipment. Never wrap the hoist cable around a load.

LIFTING

Operate the crane at or near governed RPM during all lifting operations.

Check the hoist brake by raising the load a few inches, stopping the hoist and holding the load. Be sure the hoist brake is working correctly before continuing the lift.

When lowering a load always slow down the load's descent before stopping the hoist. Do not attempt to change speeds on multiple speed hoists while the hoist is in motion.

LIFT ONE LOAD AT A TIME. Do not lift two or more separately rigged loads at one time, even if the loads are within the crane's rated capacity.

Never leave the crane with a load suspended. Should it become necessary to leave the crane, lower the load to the ground and stop the engine before leaving the cab.

Remember - all rigging equipment must be considered as part of the load. Lifting capacities vary with working areas. Permissible working areas are posted in the crane cab. When swinging from one working area to another, ensure load chart capacities are not exceeded. Know your crane!

Never swing or lower the boom into the carrier cab.

Stop the hook block from swinging when unhooking a load.

Swinging rapidly can cause the load to swing out and increase the load radius. Swing the load slowly. Swing with caution and keep the load lines vertical.

Look before swinging your crane. Even though the original set-up may have been checked, situations do change.

Keep everyone away from suspended loads. Allow no one to walk under a load. Ensure that all slings, ties, and hooks are correctly placed and secured before raising or lowering the load.

Use tag lines, as appropriate, for positioning and restraining loads. Check the load slings before lifting.

Be sure everyone is clear of the crane and work area before making any lifts.

Never swing over personnel, regardless of whether load is suspended from or attached to the boom.

Be sure the load is well secured and attached to the hook with rigging of proper size and in good condition.

Use only slings or other rigging devices rated for the job and use them properly. Never wrap the hoist cable around a load.

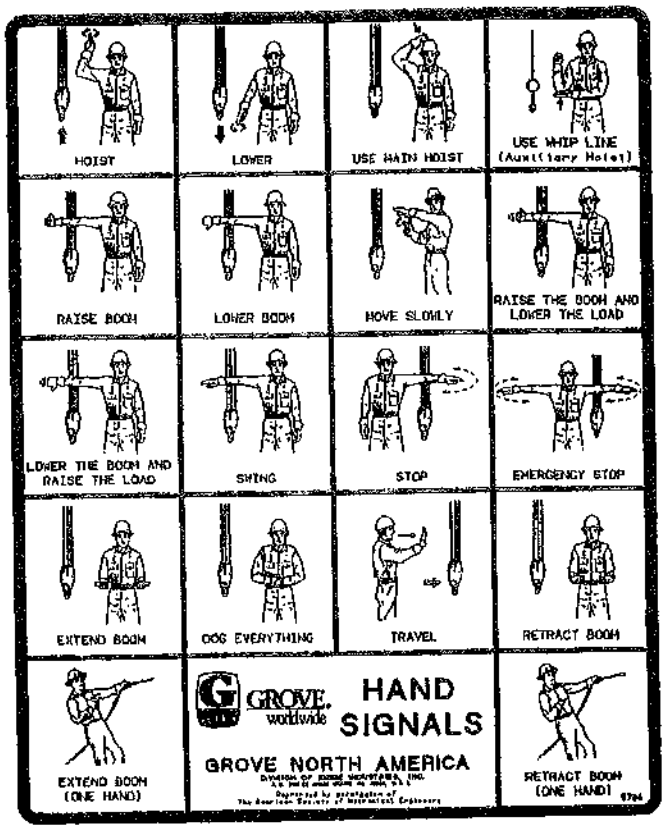
Check all tackle, hardware, and slings before use. Refuse to use faulty equipment.

Never work the crane when darkness, fog, or other visibility restrictions make such operations unsafe.

HAND SIGNALS

A qualified signal person shall be used at all times when:

- working in the vicinity of power lines.
- the crane operator cannot clearly see the load at all times.
- moving the crane in an area or direction in which the operator cannot clearly see the path of travel.



At all times use standardized hand signals previously agreed upon and completely understood by the operator and signal person.

If communication with the signal person is lost, crane movement must be stopped until communications are restored.

Keep your attention focused on the crane's operation. If for some reason you must look in another direction, stop all crane movement first.

When vision is obscured, use and follow the directions of a single qualified signal person.

Obey a signal to stop from anyone.

SHUT-DOWN

Never leave the crane with a load suspended. Lower the load to the ground before shutting down the crane.

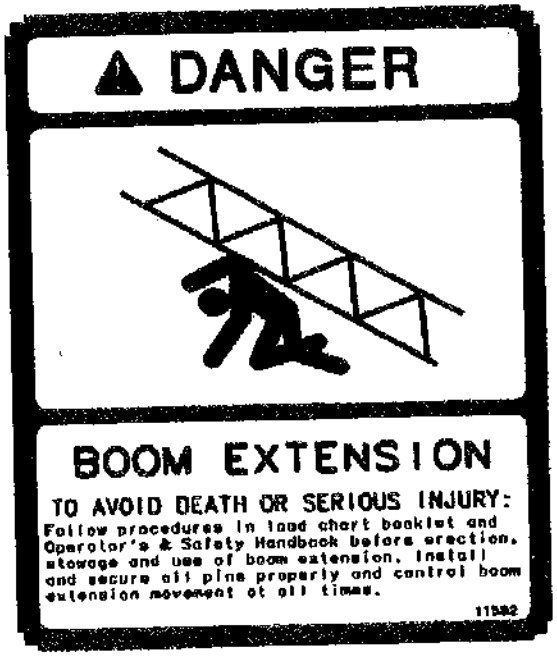
Use the following steps when shutting down the crane:

- Engage the parking brake.

- Fully retract and lower the boom.
- Engage the pin swing lock or 360° swing lock.
- Place controls in neutral position.
- Shut down the engine and remove the ignition key.
- Chock the wheels.
- Lock the operator's cab and install vandal guards, if used.

In cold weather, never park the crane where the tires can become frozen to the ground.

BOOM EXTENSION/JIB



To avoid death or serious injury, follow proper procedures during erection, stowage, and use of the boom extension/jib.

Install and secure all pins properly.

Control movement of boom extension/jib at all times.

Do not remove right side boom nose pins unless boom extension is properly pinned and secured on front and/or rear stowage brackets.

Do not remove all the pins from both front and rear stowage brackets unless the boom extension is pinned to the right side of the boom nose.

Sling jib sections from the main chords or the end fittings.

NOTE

The following are applicable only if crane is equipped with Jib Sections.

When assembling and disassembling jib sections, use blocking to adequately support each section and to provide proper alignment.

Stay outside of jib sections and lattice work.

Watch for falling or flying pins when they are being removed.

COLD WEATHER OPERATION

Cold weather operation requires additional caution on the part of the operator.

Check operating procedures for cold weather starting.

Don't touch metal surfaces that could freeze you to them.

Clean the crane of all ice and snow.

Allow ample time for hydraulic oil to warm up.

In freezing weather, park the crane in an area where it cannot become frozen to the ground. The drive line can be damaged when attempting to free a frozen crane.

If applicable to your crane, frequently check all air tanks for water in freezing weather.

If applicable to your crane, always handle propane tanks according to the supplier's instructions.

Never store flammable materials on the crane.

If cold weather starting aids are provided on your crane, use them. The use of aerosol spray or other types of starting fluids containing ether/volatiles can cause explosions or fire.

SECTION 3
CAB CONTROLS AND INDICATORS

Because there is only one engine on this crane, it can be controlled from both the superstructure and carrier cabs. Each ignition switch, when positioned to the acc or on position, supplies voltage through the electrical swivel to certain gauges and indicators in the other cab. The engine oil pressure gauges, water temperature gauges, and tachometer are connected in parallel with one sender unit. Two separate senders (one for the carrier gauge and one for the superstructure gauge) are utilized for the fuel level gauges.

NOTE

The following paragraphs describe the controls and indicators located in the superstructure cab. The numbers in parentheses ( ) represent the index number from the figure titled Cab Controls and Indicators. Some optional controls shown in the illustrations may not appear in all cabs.

ENGINE CONTROLS AND INDICATORS

HAND THROTTLE CONTROL

The THROTTLE control (32) is located on the right console. The control is electronically connected to the engine throttle and provides the operator with a means of maintaining specified engine rpm for crane operation by hand.

THROTTLE MODE SWITCH

The THROTTLE mode switch (38) is located on the right console. The switch is a three-position rocker switch with three placarded positions; HAND, FOOT, and CARRIER. The switch provides the operator with a means of selecting the control used to control the engine throttle. The HAND position is for selecting the hand throttle control on the right console. The FOOT position is for selecting the foot throttle pedal in the superstructure cab. The CARRIER position is for selecting the foot throttle pedal in the carrier cab.

IGNITION SWITCH

The ignition switch (39) is located on the right console. It is a key-operated switch with four positions; acc (3), off (0), run (1), and start (2). The switch is spring-returned from start to run. With the switch in the off position, all electrical power in the carrier is off. Positioning the switch to the accessory position energizes all electrical components except the engine fuel solenoid valve. Placing the switch in the on position is the same as acc except the engine fuel solenoid valve becomes energized. Placing the switch in the start position energizes the cranking motor solenoid and cranks the engine for starting. Releasing the switch will allow it to spring return to the run position. To shut down the engine, place the switch in the off position.

TACHOMETER

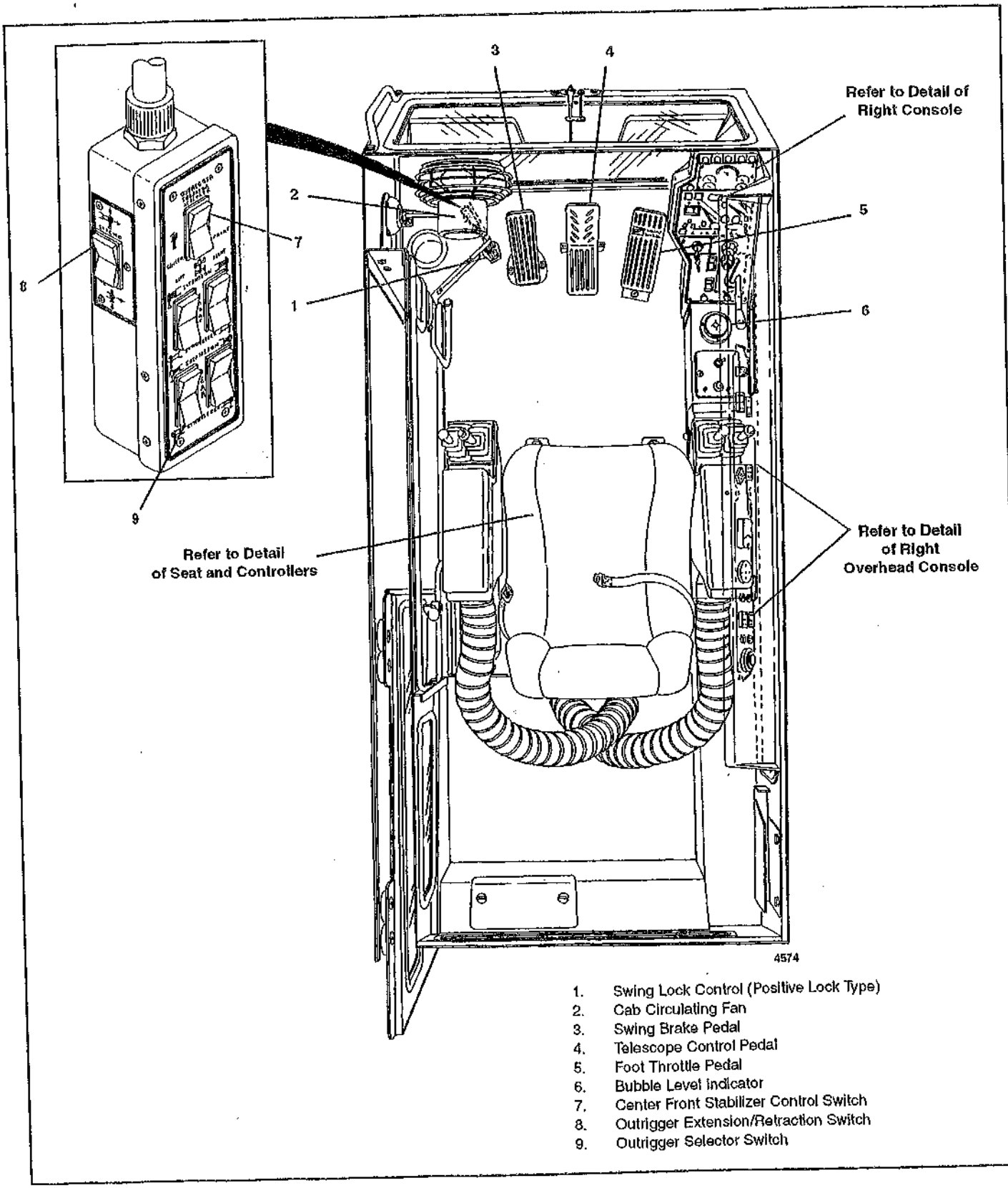
The tachometer (28) (TACH) is located at the top of the gauge cluster on the right console. The tachometer registers engine rpm and is calibrated in rpm x 100 with a range of zero (0) to 35. It receives a signal from a sending unit on the engine and does not utilize the machine's electrical system.

ENGINE OIL PRESSURE GAUGE

The engine oil pressure (OIL PRESS) gauge (29) is located on the right side of the gauge cluster at the top of the right console. The gauge indicates the engine oil pressure on the dual scale calibrated from zero (0) to 100 psi (zero to 6 bar). It receives a signal from an oil pressure sending unit on the engine.

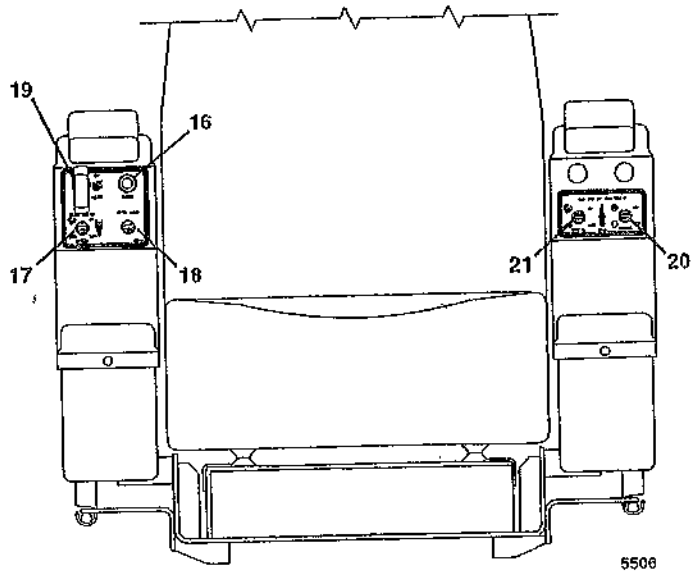
VOLTMETER

The voltmeter (30) (BATTERY) is located on the gauge cluster on the right console. With the ignition switch in the on position and before starting the engine, the voltmeter indicates the condition of the batteries. With the engine running, the voltmeter indicates output voltage of the alternator. The voltmeter indicates voltage on a scale from 20 to 32 volts.

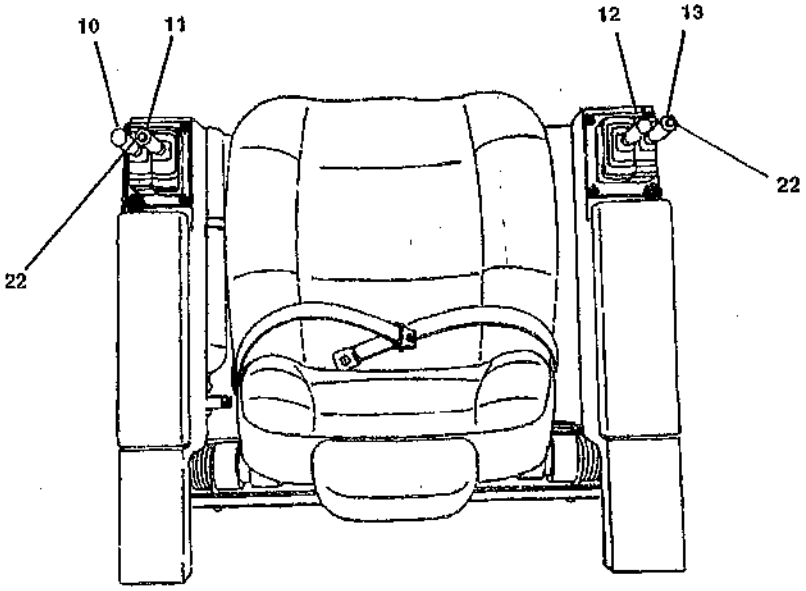


1. Swing Lock Control (Positive Lock Type)
2. Cab Circulating Fan
3. Swing Brake Pedal
4. Telescope Control Pedal
5. Foot Throttle Pedal
6. Bubble Level Indicator
7. Center Front Stabilizer Control Switch
8. Outrigger Extension/Retraction Switch
9. Outrigger Selector Switch

Cab Controls and Indicators (Sheet 1 of 4)



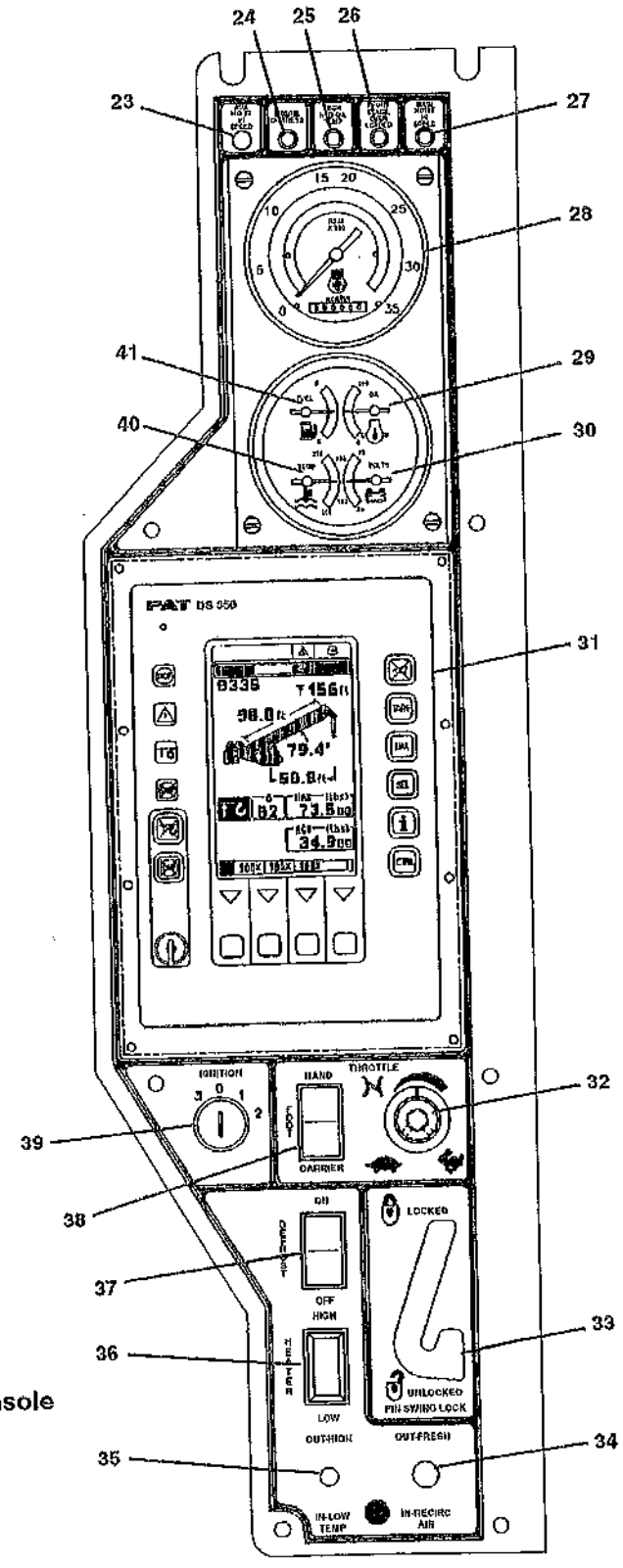
Front View of Seat



10. Swing Control Lever
11. Telescope or Auxiliary Hoist Control Lever
12. Boom Lift Control Lever
13. Main Hoist Control Lever
14. Not Used
15. Not Used
16. Swing Horn Button
17. Main Hoist Speed Selector Switch
18. Turntable Greaser Switch
19. Luffing Boom Extension Offset Switch
20. Aux Hoist On Off Switch
21. Auxiliary Hoist Speed Selector Switch
22. Hoist Rotation Indicator

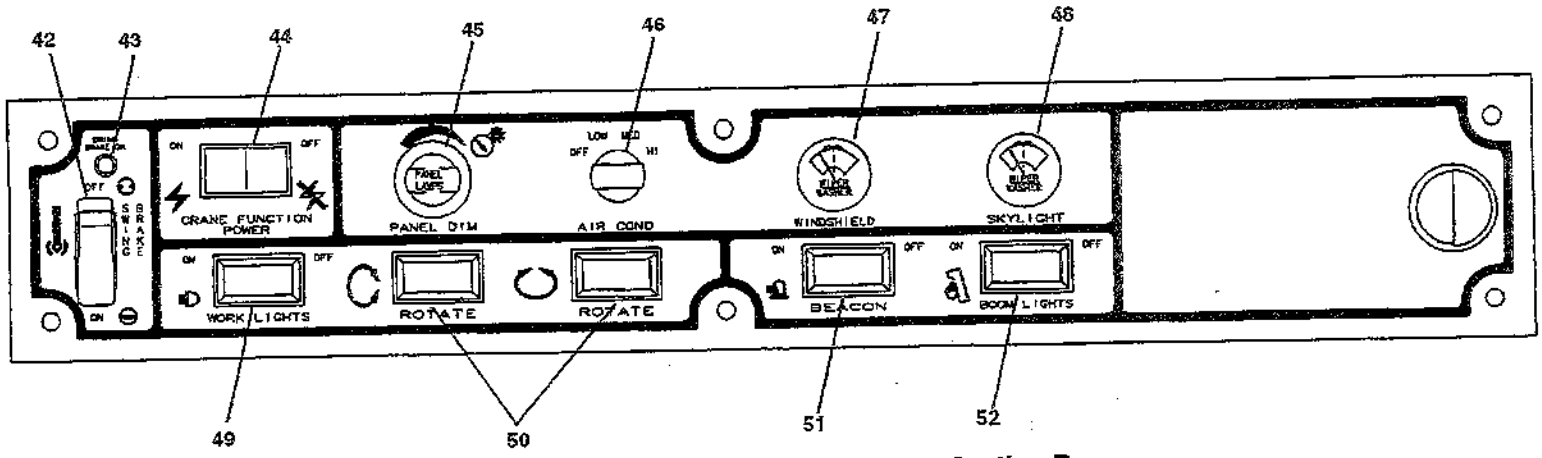
Cab Controls and Indicators (Sheet 2 of 4)

23. Auxiliary Hoist Hi Speed Indicator Light
24. Engine Distress Indicator Light
25. High Hydraulic Oil Temperature Indicator Light
26. Front Stabilizer Overloaded Indicator Light
27. Main Hoist Hi Speed Indicator Light
28. Tachometer
29. Engine Oil Pressure Gauge
30. Voltmeter
31. LMI Panel
32. Hand Throttle Lock Control
33. Swing Lock Control (Pin Type)
34. Air Circulation Control
35. Temperature Control
36. Heater Control Switch
37. Defroster Control Switch
38. Throttle Mode Switch
39. Ignition Switch
40. Engine Temperature Gauge
41. Fuel Gauge

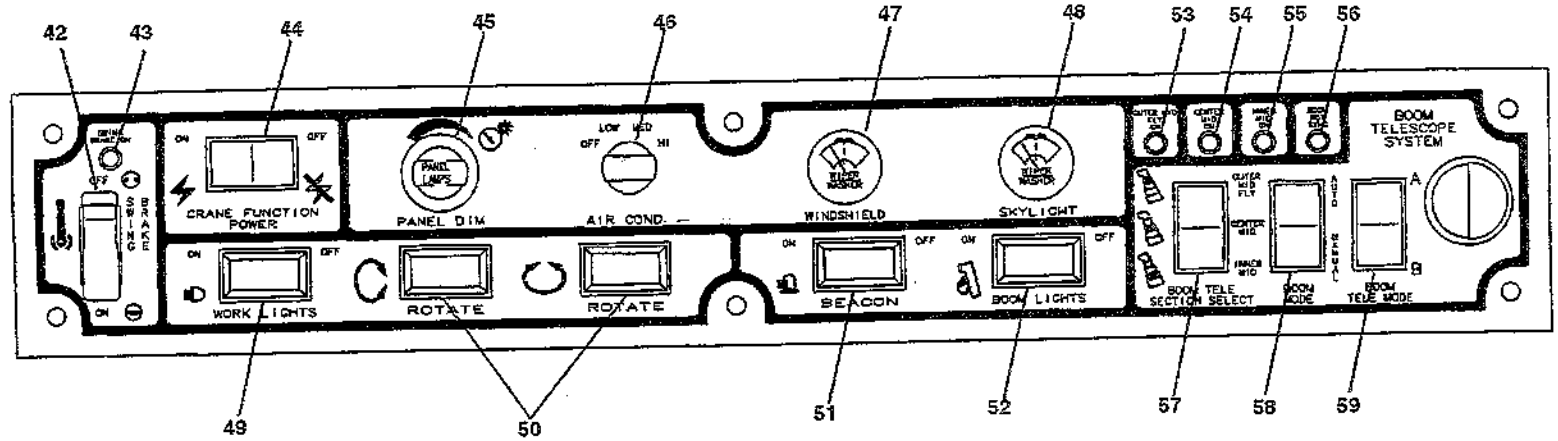


Right Console

Cab Controls and Indicators (Sheet 3 of 4)



Right Overhead Console – Four Section Boom



Right Overhead Console – Five Section Boom

42. Swing Brake Control Switch
43. Swing Brake On Indicator
44. Crane Function Power Switch
45. Panel Light Control
46. Air Conditioning Control Switch
47. Windshield Wiper Switch
48. Skylight Wiper Switch
49. Work Lights Switch
50. Rotation Switch
51. Beacon Light Switch
52. Boom Lights Switch
53. Outer Mid Fly On Indicator
54. Center Mid On Indicator
55. Inner Mid On Indicator
56. Boom Not Synchronized Indicator
57. Boom Tele Section Select Switch
58. Boom Mode Control Switch
59. Boom Tele Mode Select Switch

ENGINE TEMPERATURE GAUGE

The engine temperature (ENGINE TEMP) gauge (40) at the bottom of the gauge cluster on the right console. The gauge receives it's signal from a sending unit in the engine's cylinder head and indicates the engine temperature on a scale calibrated from 40 to 140° C (100 to 280° F).

FUEL GAUGE

The fuel (FUEL) gauge (41) is located on the right side of the gauge cluster at the top of the right console. The gauge indicates the quantity of fuel in the fuel tank and has a scale calibrated from empty (E) to full (F). The fuel quantity gauge receives a signal from a sending unit in the fuel tank.

ENGINE DISTRESS INDICATOR

The ENGINE DISTRESS indicator (24) is located on the LED alert panel at the top of the right console panel. It is a red light that illuminates when engine temperature is too high or engine oil pressure is too low. When the light illuminates a buzzer also sounds.

HIGH HYDRAULIC OIL TEMPERATURE INDICATOR

The HIGH HYD OIL TEMP indicator (25) is located on the LED alert panel at the top of the right console panel. It is a red light that illuminates when the hydraulic oil temperature is too high. When the light illuminates a buzzer also sounds.

FOOT THROTTLE PEDAL

The foot throttle pedal (5) is located on the right side of the cab floor. The pedal sends an electronic signal to control the engine throttle.

CRANE CONTROLS AND INDICATORS

SWING CONTROL LEVER

The SWING control lever (10) is located on the end of the left armrest. The lever controls the swing functions. The lever, when positioned forward or back actuates a control valve through hydraulic pilot pressure to provide 360° continuous rotation in the desired direction.

TELESCOPE OR AUXILIARY HOIST CONTROL LEVER

The telescope or auxiliary hoist (TELE or AUX) control lever (11) is located on the end of the left armrest. The lever controls the telescope functions when the crane is not equipped with an auxiliary hoist. When equipped with an auxiliary hoist, the lever controls auxiliary hoist functions and telescope functions are controlled through a foot pedal. Positioning the lever forward actuates the control valve to telescope the boom out and pulling the lever back actuates the boom to telescope in. If equipped with an auxiliary hoist, positioning the lever forward actuates the control valve to let out hoist cable and pulling the lever back reels the cable in.

BOOM LIFT CONTROL LEVER

The boom LIFT control lever (12) is located on the right armrest. The lever, when positioned forward or back, actuates the control valve through hydraulic pilot pressure to raise or lower the boom.

MAIN HOIST CONTROL LEVER

The MAIN hoist control lever (13) is located on the right armrest. Pushing the lever forward will let out the hoist cable and pulling the lever back reels the cable in.

TELESCOPE CONTROL PEDAL

The telescope control pedal (4) is located on the middle of the cab floor. The telescope control pedal is normally used when the crane is equipped with an auxiliary hoist. Pushing forward on the top of the pedal actuates a control valve through hydraulic pilot pressure to telescope the boom out. Pushing down on the bottom of the pedal will telescope the boom in.

SWING HORN BUTTON

The swing horn button (16) is located on the right armrest. The swing horn is used by the operator to provide a warning that the superstructure is rotating.

MAIN HOIST SPEED SELECTOR SWITCH

The MAIN HOIST SPEED selector switch (17) is located on the right seat armrest. It is a two-position toggle switch placarded HI and LOW. The switch operates a solenoid controlled valve on the main hoist which in turn

etermines the flow of the hydraulic oil to the hoist otors.

AUXILIARY HOIST ON-OFF SWITCH

The AUXILIARY HOIST on-off switch (20) is located on the left seat armrest. It is a two-position toggle switch placarded ON and OFF. The switch is used to turn off the auxiliary hoist control lever to prevent the control from being inadvertently activated during other crane functions.

AUXILIARY HOIST SPEED SELECTOR SWITCH

The AUXILIARY HOIST SPEED selector switch (21) is located on the left seat armrest. It is a two-position toggle switch placarded HI and LOW. The switch operates a solenoid controlled valve on the auxiliary hoist which determines the flow of hydraulic oil to the hoist motors.

LUFFING BOOM EXTENSION OFFSET SWITCH

The luffing boom extension offset switch (19) is a three-position toggle switch on the right seat armrest. The switch operates a solenoid control valve which sends oil o the cylinders to change the offset of the luffing boom extension. Activate the switch in the desired direction to change the offset of the boom extension.

MAIN HOIST HI SPEED INDICATOR LIGHT

The MAIN HOIST HI SPEED indicator light (27) is located on the LED alert panel at the top of the right console panel. It is an amber light that illuminates when the MAIN HOIST SPEED selector switch is positioned to HIGH.

AUXILIARY HOIST HI SPEED INDICATOR LIGHT

The AUXILIARY HOIST HI SPEED indicator light (23) is located on the LED alert panel at the top of the right console panel. It is an amber light that illuminates when the AUXILIARY HOIST SPEED selector switch is positioned to HIGH.

HOIST ROTATION INDICATORS

The hoist rotation indicators (22) are located on the top of each hoist control lever. The indicators are electronically driven by a signal from an electronic transmitter attached to each hoist frame. A pulsating signal is sensed by the operator's thumb during operation.

CRANE FUNCTION POWER SWITCH

The CRANE FUNCTION POWER switch (44) is located on the right overhead console. The switch has two placarded positions; ON and OFF. Positioning the switch to off removes power from the crane functions controlled by the hydraulic remote controllers on the armrests. This prevents inadvertent operation of functions due to bumping of the controllers while roading or other operations.

BOOM TELE MODE SELECT (FIVE SECTION BOOM ONLY)

The BOOM TELE MODE select switch (59) is located on the right overhead console. It is a two-position switch which is used to select the different operating modes of boom telescoping as described below. Modes A and B are normally selected with the boom fully retracted.

Mode A (Five Section Boom Operation - Main Boom Capacities Selected On The L.M.I.)

NOTE

In Mode A the inner Mid boom section is not in use until the mid, outer mid, and fly sections are fully extended.

When Mode A is selected, on selection of the telescoping control, the MID, OUTER MID and FLY boom sections will extend in the proper sequence. Refer to the figure titled Boom Extension Configurations. The MID section extends to full extension first, followed by the OUTER MID and FLY sections synchronized. At this point, the load moment indicator monitors the position of the INNER MID section and will prevent telescoping of the boom if it detects the INNER MID section has extended, it will then be necessary to remove any load from the hook and switch the BOOM MODE control switch to MANUAL to correct the error. When the mid, outer mid, and fly sections are fully extended, the inner mid section will then extend. Retracting of the boom is the reverse order of extending.

Mode B (Five Section Boom Operation - Main Boom Capacities Selected On The L.M.I.)

When Mode B is selected, select the appropriate code on the load moment indicator. On selection of the telescoping control the INNER MID, MID, OUTER MID and FLY boom sections will extend in the proper sequence. Refer to the figure titled Boom Extension Configurations. The INNER MID and MID sections extend in the proper sequence then to full extension followed by the OUTER MID and FLY sections synchronized. The load moment indicator constantly monitors the telescoping of the INNER MID and MID sections and will prevent further telescoping if an error occurs in the telescoping sequence, it will then be necessary to remove any load from the hook and switch the BOOM MODE control switch to MANUAL to correct the error. Retracting of the boom is the reverse order of extending.

BOOM MODE CONTROL SWITCH (FIVE SECTION BOOM ONLY)

The BOOM MODE control switch (58) is located on the right overhead console. The switch is a two-position rocker switch placarded AUTO and MANUAL.

When the switch is in the AUTO mode, the boom sections extend in a predetermined sequence when telescoping the boom; refer to the figure titled Boom Extension Configurations. The sections retract in the same manner in reverse order.

When in the MANUAL mode, the BOOM TELE SECTION SELECT switch is positioned to either the OUTER MID FLY or CENTER MID or INNER MID position in order to extend or retract the selected section until it is returned to the proper position for normal boom synchronization to occur.

BOOM TELE SECTION SELECT CONTROL SWITCH (FIVE SECTION BOOM ONLY)

The BOOM TELE SECTION SELECT switch (57) is located on the right overhead console. The switch is a three-position rocker switch placarded OUTER MID FLY, CENTER MID, and INNER MID. The switch is used in conjunction with the BOOM MODE control switch. When the BOOM MODE control switch is positioned to MANUAL, the BOOM TELE SECTION SELECT switch is positioned to either the OUTER MID FLY or CENTER MID or INNER MID position in order to extend or retract the selected section until it is returned to the proper position for normal boom synchronization to occur.

BOOM NOT SYNCHRONIZED INDICATOR (FIVE SECTION BOOM ONLY)

The boom not synchronized (BOOM NOT SYNC) indicator (56) is located on the right overhead console. The indicator is a red light that illuminates when the boom sections are no longer telescoping in the correct synchronization. The BOOM MODE and BOOM TELE SECTION SELECT switches must then be used to correct the synchronization.

OUTER MID FLY ON INDICATOR (FIVE SECTION BOOM ONLY)

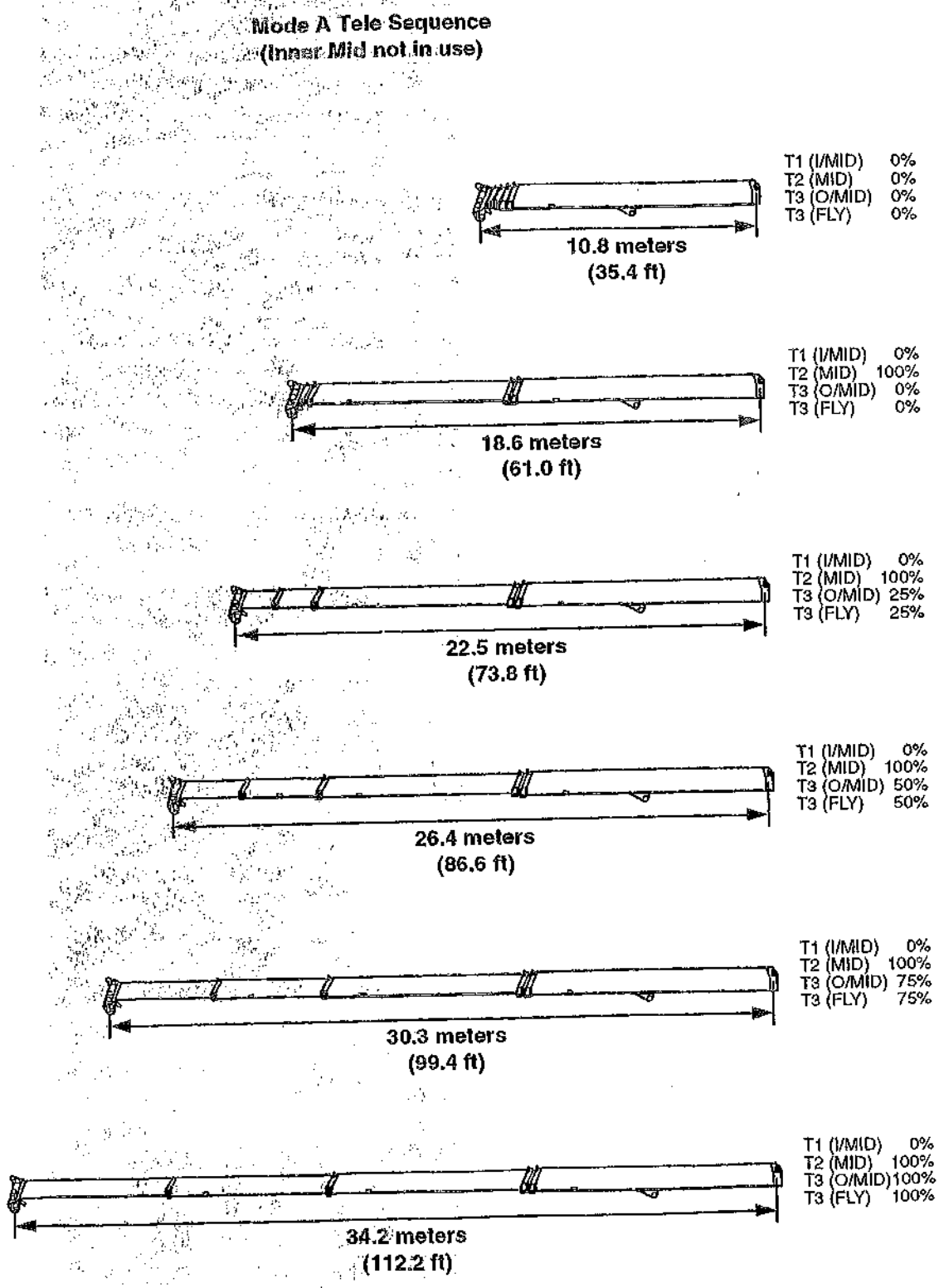
The OUTER MID FLY ON indicator (53) is located on the right overhead console. The indicator is an amber light that illuminates to signify that the BOOM TELE SECTION SELECT switch is in the OUTER MID FLY position for the purpose of synchronizing the extension of the outer mid and fly sections.

CENTER MID ON INDICATOR (FIVE SECTION BOOM ONLY)

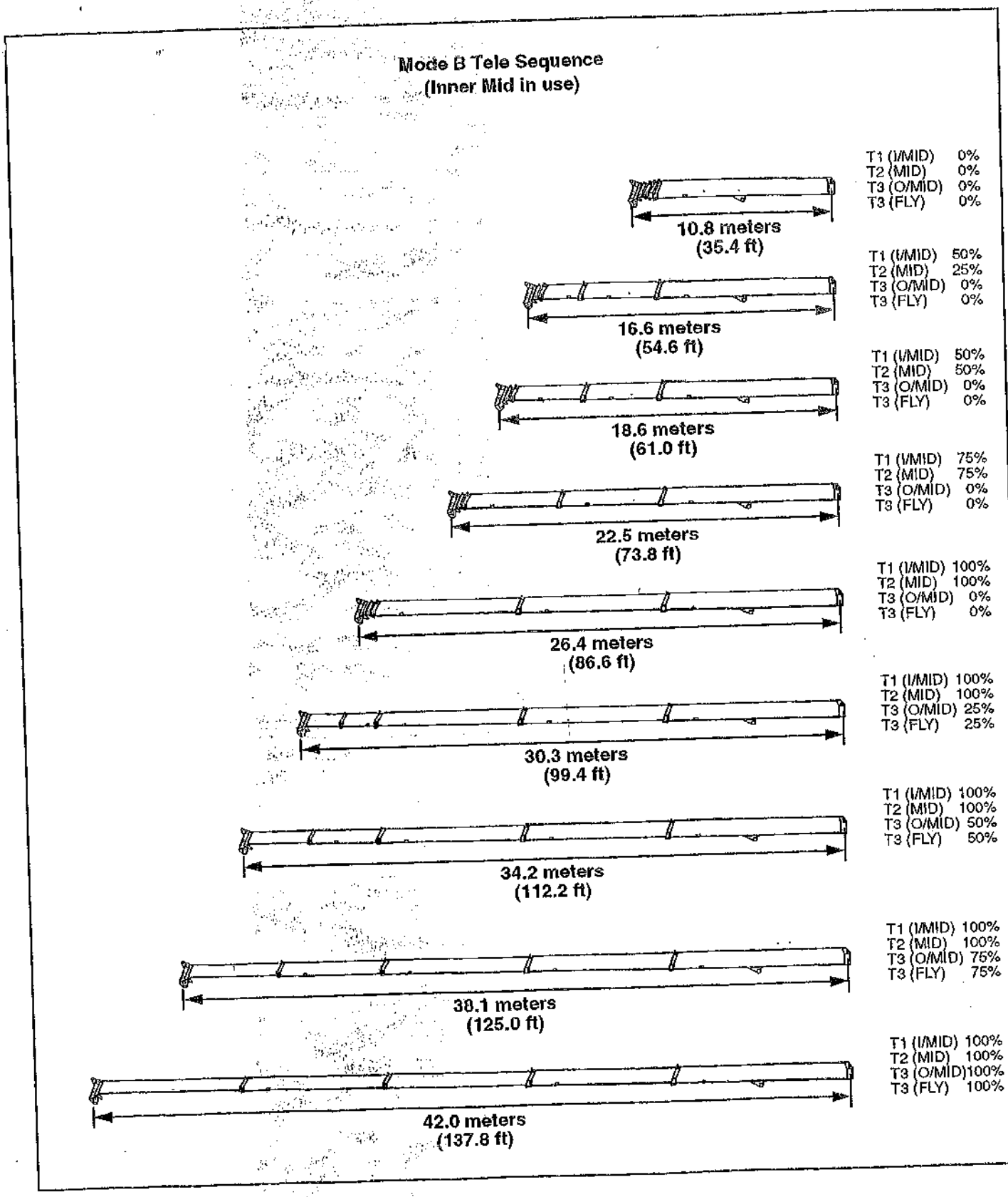
The CENTER MID ON indicator (54) is located on the right overhead console. The indicator is an amber light that illuminates to signify that the BOOM TELE SECTION SELECT switch is in the MID position for the purpose of synchronizing the extension of the center mid section.

INNER MID ON INDICATOR (FIVE SECTION BOOM ONLY)

The INNER MID ON indicator (55) is located on the right overhead console. The indicator is an amber light that illuminates to signify that the BOOM TELE SECTION SELECT switch is in the INNER MID position for the purpose of synchronizing the extension of the inner mid section.



Boom Extension Configurations (Sheet 1 of 2)



Boom Extension Configurations (Sheet 2 of 2)

OUTRIGGER CONTROL BOX

Outrigger Selector Panel

The OUTRIGGER SELECTOR panel (9) is located on the front of the outrigger control box on the left side of the cab. There are five two-position, spring-centered to off rocker switches on the panel. These switches, in conjunction with the outrigger extension/retraction switch on the side of the box, provide control of all four outrigger extension and stabilizer cylinders and the center front stabilizer. Positioning any one of the rocker switches energizes a solenoid valve for the appropriate component to be operated. Positioning the outrigger extension/retraction switch energizes the control solenoid to allow hydraulic fluid to flow through the control solenoid valve and move the selected component in the desired direction.

Outrigger Extension/Retraction Switch

The outrigger extension/retraction switch (8) is located on the side of the outrigger control box. It has two placarded positions, EXTEND and RETRACT. It must be used in conjunction with the switches on the OUTRIGGER SELECTOR panel to control the operation of the stabilizer and extension cylinders. After positioning the switch on the OUTRIGGER SELECTOR panel, positioning the outrigger extension/retraction switch energizes the control solenoid to allow hydraulic fluid to flow through the control solenoid valve and the individual solenoid valve and move the selected component in the desired direction. The switch is also used for the control of the center front stabilizer.

Center Front Stabilizer Control Switch

The CENTER FRONT STABILIZER control switch (7) is located on the front of the outrigger control box on the left side of the cab. It has two placarded positions, ACTIVATE and OFF. Positioning the outrigger extension/retraction switch energizes the control solenoid to allow hydraulic fluid to flow through the control solenoid valve and move the center front stabilizer in the desired direction. Any time any of the main jack cylinders are retracted, the front stabilizer will also retract automatically and therefore must be reset if continued use is desired.

FRONT STABILIZER OVERLOADED INDICATOR

The front stabilizer overloaded (FRONT STABIL OVER LOADED) indicator (26) is located on the LED alert panel at the top of right console. The indicator is a red light that will illuminate when the pressure switch in the front stabilizer circuit senses overpressurization indicating an overload condition. In addition to the indicator light, a buzzer will sound.

BUBBLE LEVEL INDICATOR

The bubble level indicator (6) is located on the right side console. The indicator provides the operator with a visual indication for determining the levelness of the machine.

SWING BRAKE CONTROL SWITCH

The SWING BRAKE control switch (42) is located on the right overhead console. The switch has two positions; ON and OFF. It is used to control a hydraulic valve that directs a regulated flow of pressure to or from the swing brake.

SWING BRAKE PEDAL

The swing brake pedal (3) is located on the left side of the cab floor. The brake pedal is used to actuate the swing brake to slow or stop motion. Braking is proportional to pedal depression. With the pedal not depressed and the swing brake control valve disengaged, hydraulic pressure is applied to the brake, thereby, overcoming spring pressure and releasing the brake. Depressing the pedal actuates a swing power brake valve to apply pressure to the brake assembly. This pressure aids the spring pressure to overcome the hydraulic pressure being applied to the brake release circuit and applies the spring brake according to the pressure from the spring power brake valve.

SWING BRAKE ON INDICATOR

The SWING BRAKE ON indicator (43) is located on the right overhead console above the SWING BRAKE control switch. The indicator is a red light that will illuminate when the swing brake is on.

SWING LOCK CONTROL (PIN TYPE)

The swing lock control handle (33) is located on the right console. The purpose of the swing lock is to secure the

superstructure in position. When the control handle is pushed down, the swing lock is disengaged and swing can be accomplished. When the control handle is lifted up and the superstructure is directly over the front, the swing lock pin is engaged in the socket in the turntable, thus preventing swing.

SWING LOCK CONTROL (POSITIVE LOCK TYPE)

The swing lock control pedal (1) is located on the left side of the cab floor. The purpose of the swing lock is to secure the superstructure in position. When the control pedal is up, the swing lock is disengaged and swing can be accomplished. Pushing down on the control pedal engages the lock.

ACCESSORY CONTROLS AND INDICATORS

TURNTABLE GREASER SWITCH

The turntable bearing greaser switch (18) is located on the right armrest. Pushing the switch activates the bearing greaser pump to pump grease to the turntable bearing.

PANEL LIGHT CONTROL

The panel light (PANEL DIM) control (45) is located on the right overhead console. When the switch is pulled out to the on position, rotating the control knob controls the brightness of the panel lights.

WORK LIGHTS SWITCH

The WORK LIGHTS switch (49) is a two-position rocker switch, on and off. It is located on the right overhead console. The switch controls the crane's work light. When the remote control light is supplied, two rotation (ROTATE) switches (50) are also included to control the movement of the light.

BOOM LIGHTS SWITCH

The BOOM LIGHTS switch (52) is a two-position rocker switch, placarded ON and OFF. It is located on the right overhead console. The switch controls the flood lights located on the boom base section.

CAB CIRCULATING FAN

The cab circulating fan (2) is located on a mounting bracket above the window frame. A swivel allows the fan to be rotated. The fan is controlled by a switch on the base.

CAB DOME LIGHT (NOT SHOWN)

The cab dome light is located on the right rear corner of the cab roof and provides illumination of the cab. The light is controlled by a switch on the light itself.

FIRE EXTINGUISHER (NOT SHOWN)

The fire extinguisher is located at the left side of the cab below the armrest. The fire extinguisher is a BC rated dry type fire extinguisher for emergency use.

WINDSHIELD WIPER SWITCH

The windshield wiper (WIPER/WASHER) switch (47) is located on the right overhead console. The switch has four positions; off, low, and high plus a variable speed (intermittent) setting. In addition, pushing the switch energizes the motor on the windshield washer pump assembly. Positioning the switch to low energizes the wiper motor in low speed and positioning it to high energizes the motor for high speed. Positioning the switch to off stops the motor and causes the automatic park function of the wiper motor to return the wiper blade to the parked position.

SKYLIGHT WIPER SWITCH

The skylight wiper (WIPER/WASHER) switch (48) is located on the right overhead console. The switch has three positions; off, low, and high. In addition, pushing the switch energizes the motor on the windshield washer pump assembly. Positioning the switch to low energizes the wiper motor in low speed and positioning it to high energizes the motor for high speed. Positioning the switch to off stops the motor and causes the automatic park function of the wiper motor to return the wiper blade to the parked position.

HEATER CONTROL SWITCH

The HEATER CONTROL switch (36) is located on the right console. Positioning the switch to high energizes the heater fan to run on high speed, and positioning the switch to low energizes the heater fan to run on low speed.

TEMPERATURE CONTROL

The TEMPERATURE CONTROL (35) is located on the right console. It is a push-pull cable control that positions the temperature control on the hot water heater. Push in on the knob for low temperature and pull out on the knob for high temperature.

AIR CIRCULATION CONTROL

The AIR CIRCULATION CONTROL (34) is located on the right console. It is a push-pull cable control that moves an air duct to control the operation of the heater to pull outside air into the cab to be heated or to recirculate the air already in the cab for heating. Push in on the knob for recirculating air and pull out on the knob for fresh air from outside.

DEFROSTER CONTROL SWITCH

The DEFROSTER CONTROL switch (37) is located on the right console. Positioning the switch to on energizes the defroster fan to circulate air to the windshield.

AIR CONDITIONING CONTROL SWITCH

The air conditioner (AIR COND) switch (46) is located on the right overhead console. The switch has four positions; off, low, medium and high. The switch controls the operation of the air conditioning system and the fan speed.

SECTION 4
OPERATING PROCEDURES

PRE-STARTING CHECKS

A complete walk-around visual inspection of the crane should always be made with special attention to structural damage, loose equipment, leaks, or other conditions that would require immediate correction for safety of operation. The following checklist items are suggested specifically for the operator's benefit to make certain his crane is prepared for starting the days work.

FUEL SUPPLY

Ensure the fuel tank is full and the cap is on tight.

ENGINE OIL

CAUTION

DO NOT OVER FILL.

Check oil level in the crankcase; fill to FULL mark on the dipstick. Do not over fill.

ENGINE COOLANT

Check coolant level in the radiator; fill to proper level. Do not over fill. Check radiator cap for security.

BATTERIES

If the machine is equipped with a standard or low maintenance battery, check each cell for the correct electrolyte level. Add only clean distilled water. Do not over fill. If equipped with a maintenance free battery, check the state of charge indicator if applicable. On all batteries ensure the cables and clamps are tight and not corroded.

DAILY LUBRICATION

Make certain that all components requiring daily lubrication have been serviced. (Refer to Section 5 - Lubrication.)

HYDRAULIC RESERVOIR AND FILTER

Check hydraulic fluid quantity level gauge and check filter condition indicator. Hydraulic fluid should be at normal operating temperature and the boom and outriggers in a retracted position.

Check breather for cleanliness and security.

WIRE ROPE

Inspect wire rope in accordance with applicable Federal Regulations.

Sheaves, guards, guides, drums, flanges, and any other surfaces that come in contact with the rope should be inspected for any condition that could cause possible damage to the rope.

HOOK BLOCK

Visually inspect for nicks, gouges, cracks, and evidence of any other damage. Replace a hook containing cracks or showing evidence of excessive deformation of the hook opening (including twist). Be sure the safety latch is free and aligned.

SWINGAWAY EXTENSION

DANGER

BOOM EXTENSION STOP MUST BE ENGAGED TO KEEP SWINGAWAY ANCHOR LUGS FROM CONTACTING BOOM NOSE ANCHOR FITTINGS DURING FULL BOOM RETRACTION. FAILURE TO DO THIS COULD RESULT IN DAMAGE TO THE CRANE AND POSSIBLE SERIOUS INJURY OR DEATH TO PERSONNEL.

Check to ensure the boom extension stop is engaged, preventing the swingaway extension anchor lugs from contacting the boom nose anchor fittings when the boom is fully retracted and the swingaway is properly stowed.

COLD WEATHER OPERATION

The following recommendations are for operating Grove cranes in very low (i.e. sub-zero) temperatures.

Use particular care to ensure that cranes being operated in very cold temperatures are operated and maintained in accordance with the procedures as provided by Grove Worldwide. Cranes should have appropriate hydraulic oil, lubricants, and other auxiliary items required for operation in sub-zero temperatures. Individual crane functions should be operated to ensure they are sufficiently warmed prior to performing a lift.

Operation of cranes at full rated capacities in temperatures between 0° and -40° C (-40° F) or lower shall be accomplished only by competent operators who possess the skill, experience, and dexterity to ensure smooth operation. Shock loading shall be avoided. For crane operation below -40° C, capacities shall be derated 3.67 percent of the rated load shown on the capacity charts for each degree (1° C) below -40° C. For crane operation below -40° F, capacities shall be derated 2 percent of the rated load shown on the capacity charts for each degree (1° F) below -40° F.

ENGINE OPERATION

Starting and shutdown procedures for most diesel engines generally follow the same pattern. Therefore, the following procedures can be applied, except where specific differences are noted. (Refer to the applicable engine manufacturer's manual for detailed procedures.)

STARTING PROCEDURE

DANGER

BEFORE STARTING THE ENGINE, ENSURE THE TRANSMISSION IS IN NEUTRAL, PARKING BRAKE IS APPLIED, AND SWING LOCK IS ENGAGED.

CAUTION

NEVER CRANK THE ENGINE FOR MORE THAN 30 SECONDS DURING AN ATTEMPTED START. IF THE ENGINE FAILS TO START AFTER 30 SECONDS, ALLOW THE STARTER MOTOR TO COOL FOR APPROXIMATELY TWO MINUTES BEFORE ATTEMPTING ANOTHER START.

CAUTION

IF THE ENGINE FAILS TO START AFTER FOUR ATTEMPTS, CORRECT THE MALFUNCTION BEFORE ATTEMPTING ANY FURTHER STARTS.

NOTE

When starting a cold engine, ensure the hydraulic pumps are disengaged.

1. Turn the ignition switch to the start position (2) and release immediately when the engine starts.
2. When the start has been accomplished, check the engine instruments for proper indications.

DANGER

ENSURE BOTH AIR SYSTEM PRESSURES ARE IN THE NORMAL OPERATING RANGE PRIOR TO DISENGAGING THE PARK BRAKE.

CAUTION

IF OIL PRESSURE AND/OR TEMPERATURE INDICATOR(S) DO NOT DISPLAY THE PROPER READINGS, SHUT DOWN THE ENGINE AND CORRECT THE MALFUNCTION BEFORE RESUMING OPERATION.

3. Allow the engine to warm up at least five minutes before applying a load. Do not race the engine for a faster warm up.

COLD WEATHER STARTING

The correct grade of oil for the prevailing temperature should be used in the crankcase to prevent hard cranking. Diesel fuel should have a pour point of 6° C (10° F) less than the lowest expected temperature. In case of an emergency, white kerosene may be added to the fuel to bring the pour point down to the required temperature to prevent clogging of filters and small passages by wax crystals. The addition of kerosene is NOT recommended for general use. If low temperatures are ONLY expected at start-up, it is advisable to use starting aids such as preheating, starting aid compound metering equipment, or starting aid spray application into the air cleaner intake.

CAUTION

THE ENGINE IS EQUIPPED WITH AN AUTOMATIC ETHER INJECTION SYSTEM. IF THE ENGINE DOES NOT START IMMEDIATELY, AVOID OVERLOADING THE AIR BOX WITH HIGH VOLATILE FLUID WHICH COULD RESULT IN A MINOR EXPLOSION.

To start the engine, position the ignition switch to the start position (2). If the engine does not start within 30 seconds, allow the starter to cool at least two minutes and repeat the procedure.

IDLING THE ENGINE

Idling the engine unnecessarily for long periods of time wastes fuel and fouls injector nozzles. Unburned fuel causes carbon formation; oil dilution; formation of lacquer or gummy deposits on the valves, pistons, and rings; and rapid accumulation of sludge in the engine.

NOTE

When prolonged engine idling is necessary, maintain at least 800 rpm.

RACING THE ENGINE

NEVER race the engine during the warm-up period. NEVER operate the engine beyond governed speed (as might occur in down hill operation or downshifting). Engine bearings, pistons, and valves may be damaged if these precautions are not taken.

SHUTDOWN PROCEDURE

1. Allow the engine to operate at fast idle speed for approximately five minutes to avoid high internal heat rise and allow for heat dissipation.

2. Position the ignition switch to the off position (0).

CAUTION

CORRECT THE PROBLEM THAT CAUSED THE EMERGENCY SHUTDOWN BEFORE ATTEMPTING RESTART OF THE ENGINE.

CONTROL LEVER OPERATION

The control lever operation for crane functions is standard, i.e., the closer the lever is to neutral (center), the slower the system responds. This applies to forward, rear, or side movement of the applicable lever. The control lever should be returned to neutral to hold the load. Never feather the hoist control to hold the load.

NOTE

Always operate the control levers with slow, even pressure.

PRELOAD CHECK

After the crane has been readied for service, an operational check of all crane functions (with no load applied) should be performed. Accomplish the Preload Check as follows.

CAUTION

OPERATE THE ENGINE AT OR NEAR THE GOVERNED RPM DURING PERFORMANCE OF ALL CRANE FUNCTIONS.

NOTE

Carefully read and become familiar with all crane operating instructions before attempting a Preload Check and operating the crane under load.

1. Extend and set the outriggers.

2. Raise, lower, and swing the boom right and left a minimum of 45°.

3. Telescope the boom in and out, ensuring all sections extend and retract properly.

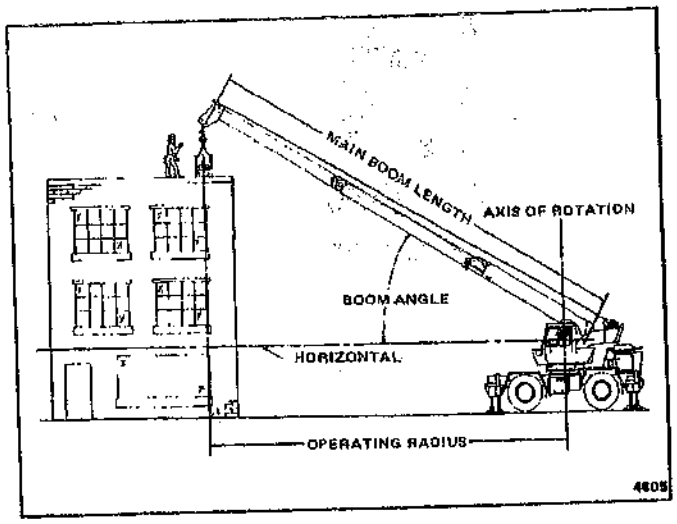
4. Raise and lower the cable a few times at various boom lengths. Ensure there is no kinking.

USING YOUR LOAD CHART

NOTE

One of the most important tools of every Grove crane is the load chart found in the crane operator's cab.

The load charts contain a large amount of information, which must be thoroughly understood by the operator. Load charts are based on boom configuration, outrigger position, and counterweight configuration.



Terms To Know

The capacity charts are divided into capacities limited by structural strength and capacities limited by stability. This is shown by the bold line across the chart. Capacities above the line are limited by structural strength and capacities below the line are limited by machine stability.

The chart shows the radius of the load in a column at the left. The radius is the distance between the center line of rotation of the crane and the center of gravity of the load. Various boom lengths are listed across the top, ranging from fully retracted to fully extended and with the swing-away extension in use. The boom angle (in degrees) required for the given lift is shown in parenthesis below the maximum total weight which can be lifted. Note that the boom lengths in between the increments shown should always be treated as if the boom was extended to the next longer length. For example, if the load chart has capacities for 48 foot and 54 foot boom lengths and the actual length of the boom in use is 50 feet, then the maximum capacity will be listed under the 54 foot boom length because the boom is beyond 48 feet in length.

Another important section of the load chart is the range diagram. The range diagram illustrates the tip height which can be achieved at each boom length, angle, and radius. If the operator knows the radius required for a specific lift and the tip height necessary, he can calculate the required boom length and angle needed for the lift. He then checks the capacity chart for the specific boom length and radius to find out if the crane is capable of performing the lift safely. Or, on the other hand, if the boom length and angle are known, the radius can be determined from the range diagram.

A lifting area diagram is included as part of the load chart to describe over side, over rear, and over front lifting areas. An examination of the lifting area diagram shows that the locations of the outrigger stabilizer cylinders in the fully extended position are used to mark the boundaries of the lifting areas.

A boom extension capacity chart and notes are also included as part of the load chart to list the capacities for the degree of offset and boom angle.

The last major portion of the load chart is the section concerning notes to lifting capacities. Be sure to read all notes carefully so you understand what each one means. The load chart also gives weight reductions for Grove load handling devices such as hook blocks, headache balls, boom extension sections, etc., which must be taken into consideration as part of the load. Remember, any other load handling devices, such as chains, slings, or spreader bars must also be considered, and the weight of these devices must be added to the weight of the load.

Special Note:

Regardless of counterweight and outrigger spread configurations, no deduct is required from the main boom charts for a stowed boom extension. However, the LMI System still monitors the effect of the stowed boom extension and will display a load value which will vary with changes in boom length and boom angle. To achieve maximum main boom capacities, the boom extension must be removed from the crane.

CRANE FUNCTIONS

DANGER

THE OUTRIGGERS AND THE CENTER FRONT STABILIZER MUST BE PROPERLY EXTENDED AND SET BEFORE ANY OTHER OPERATION OF THE CRANE IS ATTEMPTED UNLESS PERFORMING ON-RUBBER LIFTING.

DANGER

THE CENTER FRONT STABILIZER WILL RETRACT WHEN THE MAIN OUTRIGGER CONTROL IS SHIFTED TO THE RETRACT POSITION. AFTER OPERATING THE MAIN OUTRIGGER CONTROL, THE CENTER FRONT STABILIZER MUST BE RESET BEFORE OPERATING THE CRANE.

SETTING THE OUTRIGGERS

NOTE

On cranes equipped with air suspension, the air suspension system must be deflated when on outriggers.

1. Position the outrigger floats directly out from each outrigger to where the outriggers will be properly extended.

CAUTION

ALWAYS POSITION A SWITCH ON THE OUTRIGGER SELECTOR PANEL BEFORE POSITIONING THE OUTRIGGER EXTENSION/RETRACTION SWITCH TO EXTEND OR RETRACT. FAILURE TO DO THIS MAY CAUSE A HYDRAULIC LOCK AGAINST THE INDIVIDUAL SOLENOID VALVES, PREVENTING THEM FROM OPENING.

2. Position the appropriate outrigger selector switch FRONT EXTENSION or REAR EXTENSION and position the outrigger extension/retraction switch to EXTEND. The appropriate outrigger should begin to extend. Refer to Engaging the Mid-Extend Lock Pin if the crane is to be operated at the mid-extend position.

DANGER

ALL FOUR OUTRIGGER BEAMS MUST BE EQUALLY EXTENDED TO THE APPROPRIATE VERTICAL STRIPE BEFORE BEGINNING OPERATION.

NOTE

More than one outrigger may be extended at one time. However, to ensure that each outrigger is fully extended, each outrigger selector switch should be depressed individually and the outrigger extension/retraction switch momentarily positioned to EXTEND after multi-outrigger extension.

3. After all four outrigger beams have been fully extended, position the appropriate outrigger selector switch to FRONT STABILIZER or REAR STABILIZER and position the outrigger extension/retraction switch to EXTEND.

4. Extend each stabilizer, positioning the float as necessary, until the locking levers of the float engage the stabilizer cylinder rod.

NOTE

More than one stabilizer may be extended at one time.

5. With each stabilizer float firmly touching the ground, position the front outrigger selector switches to FRONT STABILIZER and position the extension/retraction switch to EXTEND. Extend the front stabilizers approximately 76 to 102 mm (3 to 4 in).

6. Position the rear outrigger selector switches to REAR STABILIZER switches and position the extension/retraction switch to EXTEND. Extend the rear stabilizers approximately 76 to 102 mm (3 to 4 in).

DANGER

ALL FOUR OUTRIGGER BEAM LOCK PINS MUST BE ENGAGED BEFORE OPERATING FROM THE MID-EXTEND POSITION.

DANGER

THE OPERATOR MUST SELECT THE PROPER LOAD CHART AND LMI PROGRAM FOR THE OUTRIGGER POSITION SELECTED.

7. Repeat the procedures in steps 5 and 6 until all wheels are clear of the ground and the crane is level, as indicated by the bubble level indicator located on the front console. If suspected that the bubble level indicator is out of adjustment, verify and adjust it as follows.

   a. Locate the crane on a firm, level surface.

   b. Extend and set the outriggers. Level the crane, as indicated by the bubble level indicator, using the outriggers.

   c. Place a miracle pointer, carpenter level, or similar type device on a machined surface such as the turntable bearing or bearing mounting surfaces.

   d. Using the outriggers, level the crane as indicated on the device used in step c.

   e. Using the mounting screws, adjust the bubble level indicator to show level.

Engaging the Mid Extension Lock Pin

NOTE

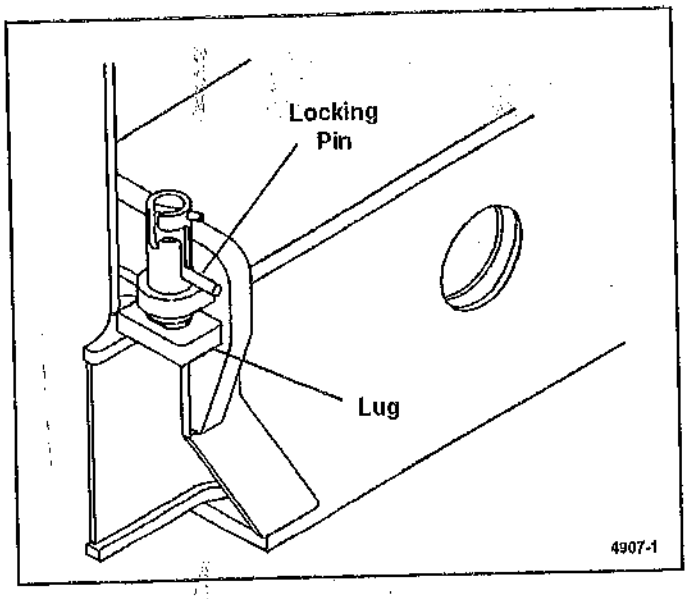
It may be necessary to jog the outrigger extension/retraction switch slightly to ensure proper pin engagement.

With the outriggers fully retracted, turn the locking pin 90° from its stowed position and allow the pin to slip into the lug on the jack beam. If the pin will not slip into the lug, slowly extend or retract the outrigger beam, allowing the locking pin to drop into the lug.

STOWING THE OUTRIGGERS

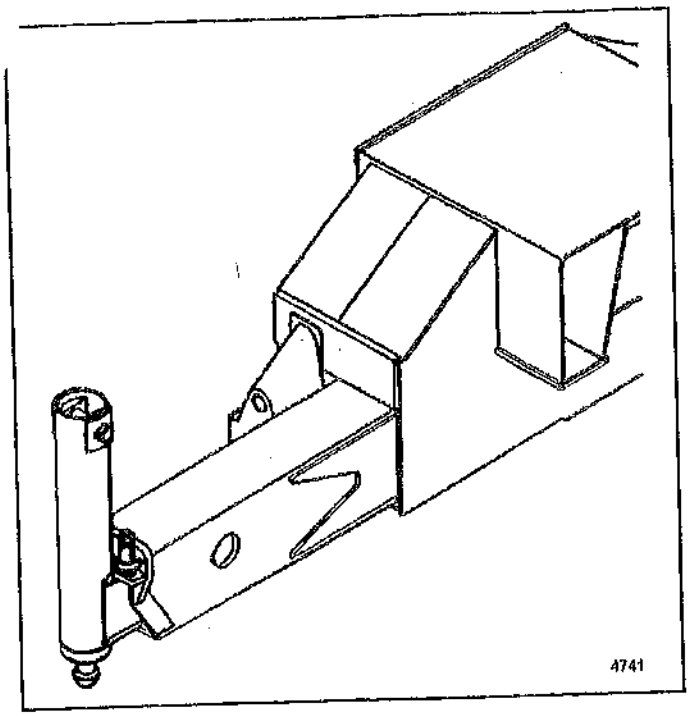
1. Position the rear outrigger selector switches to REAR STABILIZER and position the extension/retraction switch to RETRACT until the rear stabilizers have retracted several inches.

2. Position the front outrigger selector switches to FRONT STABILIZER and position the extension/retraction switch to RETRACT until the front stabilizers have retracted several inches.



Outrigger Locking Pin Down

3. Repeat steps 1 and 2 until the crane is resting on all wheels and the stabilizer floats are several inches off the ground.



Outrigger Beam Pinned in Mid Extension Position

DANGER

KEEP FEET AND HANDS CLEAR OF THE FLOATS WHEN UNLOCKING THEM FROM THE STABILIZERS.

4. Release the locking levers and allow the floats to drop to the ground.

5. Continue to retract the stabilizers until they are fully retracted.

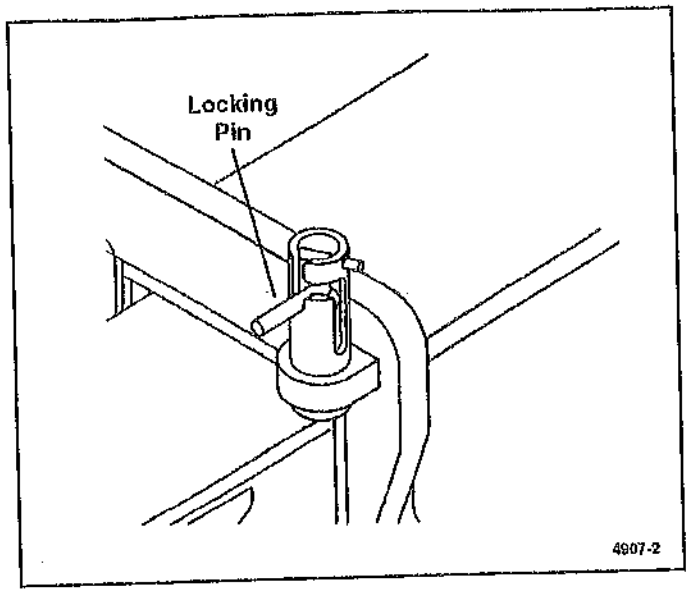
6. Position the appropriate outrigger selector switches to FRONT EXTENSION or REAR EXTENSION and position the extension/retraction switch to RETRACT to retract each outrigger. Refer to Stowing the Mid-Extend Lock Pin if the crane was operated at the mid-extend position.

NOTE

More than one outrigger may be retracted at a time.

7. Stow the outrigger floats.

Stowing the Mid Extension Lock Pin



Outrigger Locking Pin Raised

NOTE

If the lock pin is wedged in the hole in the outrigger beam, it may be necessary to jog the outrigger extension/retraction switch slightly while pulling upward on the pin.

Fully retract the outrigger beams. Lift the lock pin and turn it 90° to its stowed position.

SETTING THE CENTER FRONT STABILIZER

CAUTION

NEVER OPERATE THE CENTER FRONT STABILIZER UNLESS THE BOOM IS RETRACTED AND IN THE BOOM REST POSITION. NEVER EXTEND THE CENTER FRONT STABILIZER UNLESS THE MAIN OUTRIGGERS AND STABILIZERS ARE EXTENDED AND SET. ALWAYS RETRACT THE CENTER FRONT STABILIZER BEFORE RETRACTING THE MAIN STABILIZERS AND OUTRIGGERS.

1. Position the CENTER FRONT STABILIZER control switch to ACTIVATE and position the outrigger extension/retraction switch to EXTEND.

CAUTION

DO NOT TRY TO LIFT OR LEVEL THE CRANE WITH THE CENTER FRONT STABILIZER.

2. Continue to extend the stabilizer until the float is firmly set on the ground.

STOWING THE CENTER FRONT STABILIZER

CAUTION

NEVER OPERATE THE CENTER FRONT STABILIZER UNLESS THE BOOM IS RETRACTED AND IN THE BOOM REST POSITION. NEVER EXTEND THE CENTER FRONT STABILIZER UNLESS THE MAIN OUTRIGGERS AND STABILIZERS ARE EXTENDED AND SET. ALWAYS RETRACT THE CENTER FRONT STABILIZER BEFORE RETRACTING THE MAIN STABILIZERS AND OUTRIGGERS.

DANGER

THE CENTER FRONT STABILIZER WILL RETRACT WHEN THE MAIN OUTRIGGER CONTROL IS SHIFTED TO THE RETRACT POSITION. AFTER OPERATING THE MAIN OUTRIGGER CONTROL, THE CENTER FRONT STABILIZER MUST BE RESET BEFORE OPERATING THE CRANE.

1. Position the CENTER FRONT STABILIZER control switch to ACTIVATE and position the outrigger extension/retraction switch to RETRACT.

DANGER

KEEP FEET AND HANDS CLEAR OF THE FLOAT WHEN UNLOCKING IT FROM THE STABILIZER.

2. Retract the center front stabilizer until the stabilizer is fully retracted.

SWINGING THE BOOM

DANGER

THE CRANE MUST ALWAYS BE SET UP ON OUTRIGGERS PRIOR TO SWINGING OVER-THE-SIDE.

DANGER

BEFORE INITIATING ANY SWING OPERATIONS, ENSURE THE AREA IN THE SWING PATH OF THE HOOK AND/OR LOAD, AS WELL AS THE TAIL SWING AREA, IS CLEAR OF ALL OBSTRUCTIONS AND PERSONNEL.

DANGER

DEATH OR SERIOUS INJURY COULD RESULT FROM BEING CRUSHED BY MOVING MACHINERY. BEFORE ACTUATING THE SWING FUNCTION, SOUND THE SWING HORN AND VERIFY THAT ALL PERSONNEL ARE CLEAR OF ROTATING AND MOVING PARTS.

DANGER

WHEN SWINGING THE LOAD FROM OVER-THE-FRONT TO OVER-THE-SIDE OF THE CRANE, REFER TO THE OVER-THE-SIDE LOAD CHART TO MAKE CERTAIN THE APPLICABLE CAPACITY IS NOT EXCEEDED. TRAVELING WITH ANY LOAD OVER-THE-SIDE IS PROHIBITED.

CAUTION

ENSURE THE POSITIVE SWING LOCK IS DISENGAGED AND THE SWING BRAKE SWITCH IS IN THE DISENGAGE POSITION BEFORE ATTEMPTING TO SWING.

CAUTION

NEVER PUSH OR PULL THE SWING CONTROL LEVER THROUGH NEUTRAL TO THE OPPOSITE DIRECTION TO STOP SWING MOTION.

To swing the boom, the SWING control lever is pushed to the right for right swing and pushed to the left for left swing. Always operate the control lever with a slow, even pressure. With non-free swing, returning the lever to neu-

'al stops rotation. With free swing, rotation is stopped tilizing the swing brake foot pedal. When rotation is stopped, put the SWING BRAKE switch in the engage position to prevent further rotation.

ELEVATING AND LOWERING THE BOOM

Elevating The Boom

DANGER

BEFORE ELEVATING THE BOOM, ENSURE THE AREA ABOVE AND BENEATH THE BOOM IS CLEAR OF ALL OBSTRUCTIONS AND PERSONNEL.

To elevate the boom, the BOOM control lever is pushed to the left, and held until the boom reaches the desired elevation angle.

Lowering The Boom

DANGER

BEFORE LOWERING THE BOOM, MAKE CERTAIN THE AREA BENEATH THE BOOM IS CLEAR OF ALL OBSTRUCTIONS AND PERSONNEL.

DANGER

LONG CANTILEVER BOOMS CAN CREATE A TIPPING CONDITION EVEN WHEN UNLOADED AND IN AN EXTENDED AND LOWERED POSITION.

DANGER

WHEN LOWERING THE BOOM, LET OUT THE CABLE SIMULTANEOUSLY TO PREVENT TWO-BLOCKING THE BOOM NOSE AND THE HOOK BLOCK.

DANGER

THE CLOSER THE LOAD IS CARRIED TO THE BOOM NOSE, THE MORE IMPORTANT IT BECOMES TO SIMULTANEOUSLY LET OUT CABLE AS THE BOOM IS LOWERED.

To lower the boom, the BOOM control lever is pushed to the right and held until the boom is lowered to the desired position.

TELESCOPING THE BOOM

NOTE

When the crane is equipped with an auxiliary hoist the telescope function is controlled by a foot pedal.

Extending The Four Section Boom

DANGER

WHEN EXTENDING THE BOOM, LET OUT CABLE SIMULTANEOUSLY TO PREVENT TWO-BLOCKING THE BOOM NOSE AND HOOK BLOCK.

DANGER

CHECK THE LOAD CHART FOR MAXIMUM LOAD AT GIVEN RADIUS, BOOM ANGLE, AND LENGTH BEFORE EXTENDING BOOM WITH A LOAD.

To extend the boom, the TELESCOPE control lever is pushed forward away from the operator, to the OUT position and held until the boom extends to the desired length. The inner mid will fully extend and then the synchronized outer mid and fly sections will extend.

Retracting The Four Section Boom

DANGER

WHEN RETRACTING THE BOOM, THE LOAD WILL LOWER UNLESS THE CABLE IS TAKEN IN SIMULTANEOUSLY.

To retract the boom, the TELESCOPE control lever is pulled back, toward the operator, to the IN position and held until the boom retracts to the desired length. The synchronized outer mid and fly sections will retract and then the inner mid will retract.

Extending The Five Section Boom In Manual Mode

DANGER

WHEN EXTENDING THE BOOM, LET OUT CABLE SIMULTANEOUSLY TO PREVENT TWO-BLOCKING THE BOOM NOSE AND HOOK BLOCK.

DANGER

CHECK THE LOAD CHART FOR MAXIMUM LOAD AT GIVEN RADIUS, BOOM ANGLE, AND LENGTH BEFORE EXTENDING BOOM WITH A LOAD.

The MANUAL mode of operation should not be used for lifting operations because the LMI System is programmed to provide a lesser load chart for manual operation. MANUAL mode should be used for rigging operation only.

1. Position the BOOM MODE switch to MANUAL.
2. Using the BOOM TELE SECTION SELECT switch, select which boom section (INNER MID, CENTER MID or OUTER MID FLY) is to be extended. The appropriate amber indicator light will illuminate, indicating the section selected.

NOTE

The outer mid and fly sections are always synchronized and are operated as a unit.

3. The TELESCOPE control lever is pushed forward away from the operator, to the OUT position and held until the boom section selected extends to the desired length.

Retracting The Five Section Boom In Manual Mode

DANGER

WHEN RETRACTING THE BOOM, THE LOAD WILL LOWER UNLESS THE CABLE IS TAKEN IN SIMULTANEOUSLY.

1. Position the BOOM MODE switch to MANUAL.
2. Using the BOOM TELE SECTION SELECT switch, select which boom section (INNER MID, CENTER MID or OUTER MID FLY) is to be extended.The appropriate amber indicator light will illuminate indicating the section selected.

NOTE

The outer mid and fly sections are always synchronized and are operated as a unit.

3. The TELESCOPE control lever is pulled back, toward the operator, to the IN position and held until the boom section selected retracts to the desired length.

Extending The Five Section Boom In Mode A

DANGER

WHEN EXTENDING THE BOOM, LET OUT CABLE SIMULTANEOUSLY TO PREVENT TWO-BLOCKING THE BOOM NOSE AND HOOK BLOCK.

DANGER

CHECK THE LOAD CHART FOR MAXIMUM LOAD AT GIVEN RADIUS, BOOM ANGLE, AND LENGTH BEFORE EXTENDING BOOM WITH A LOAD.

NOTE

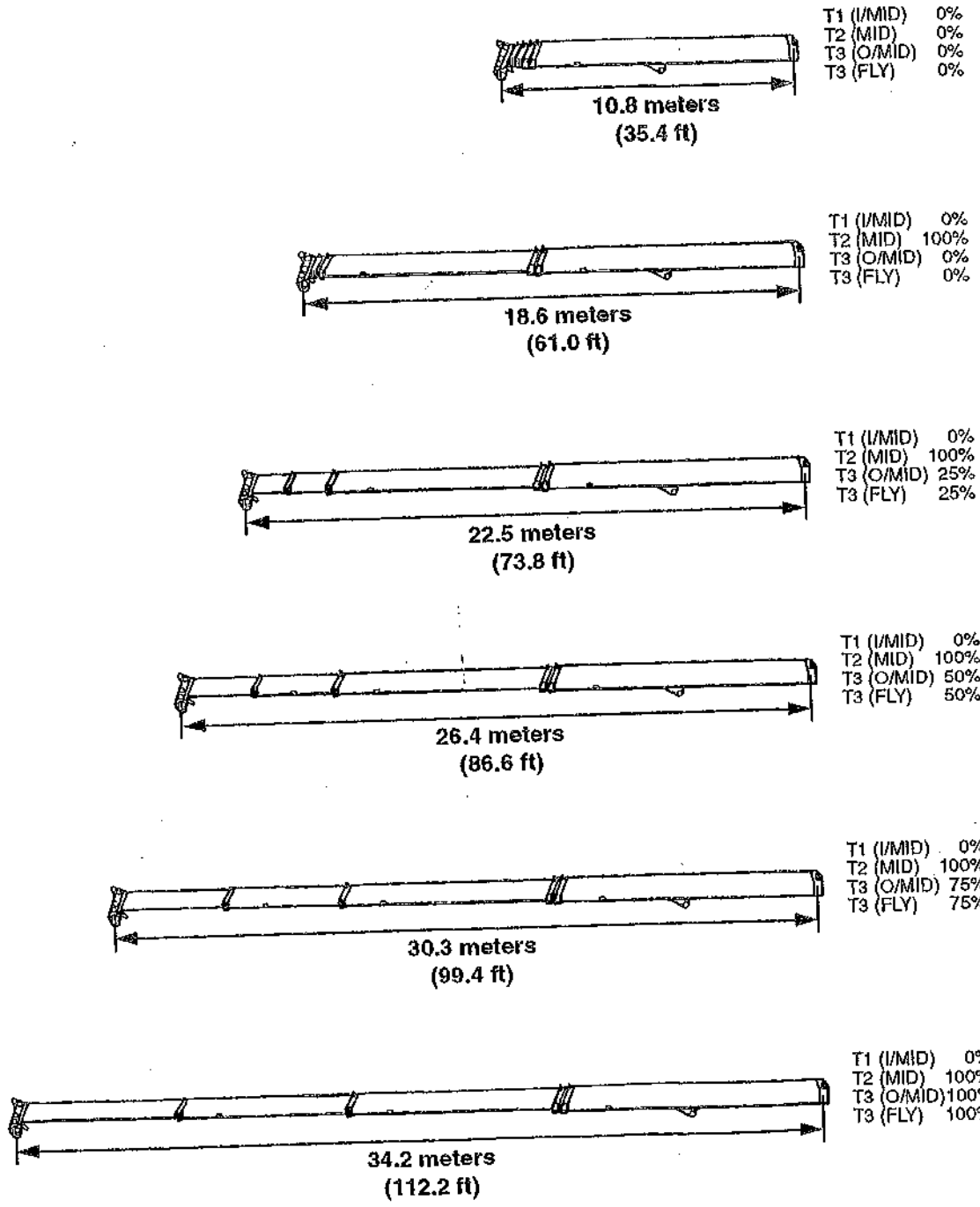
In the AUTO Mode, the operation of the five section boom's telescope system is electronically controlled by the LMI system.

NOTE

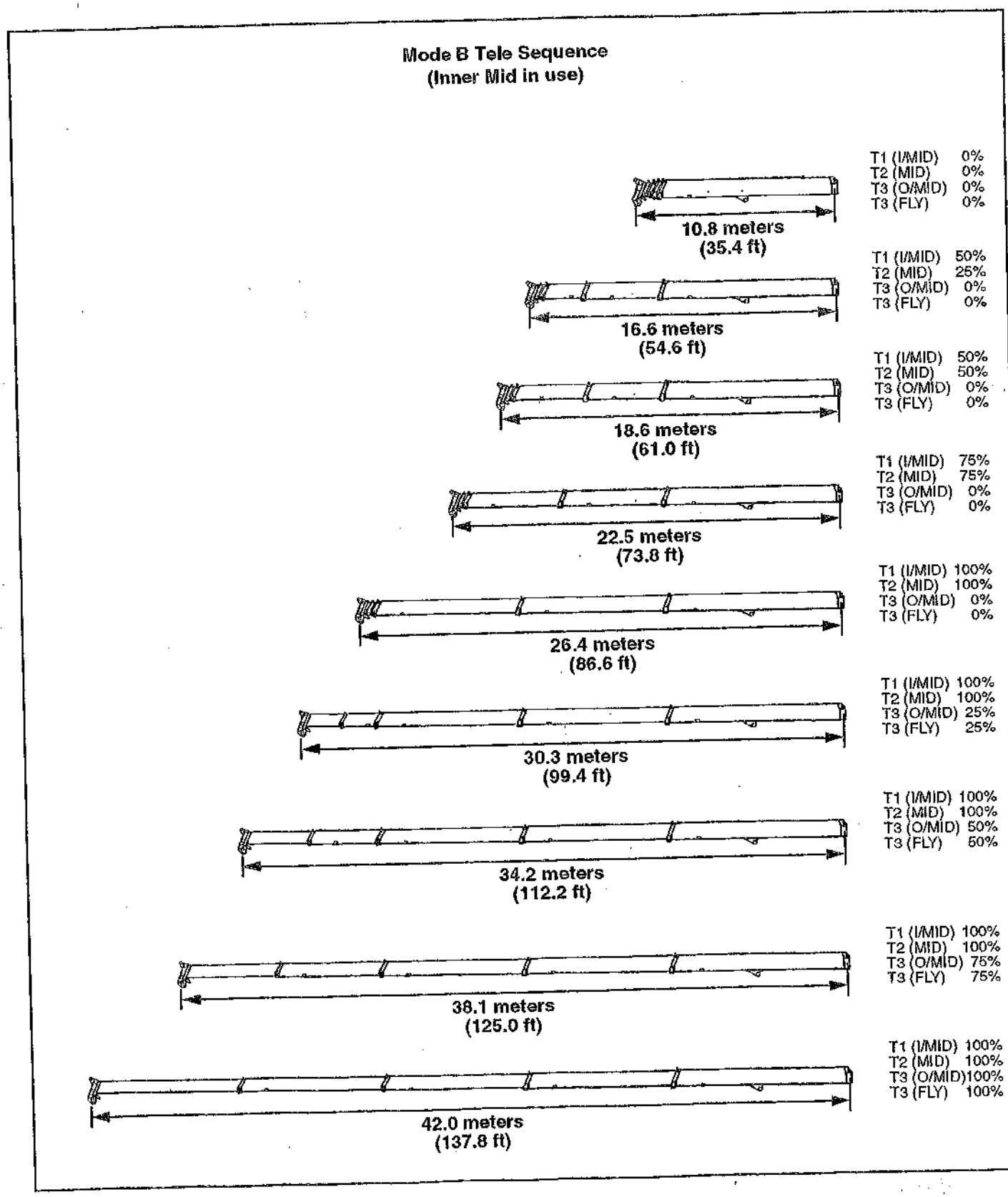
In Mode A the Inner Mid boom section is not in use until the mid, outer mid, and fly sections are fully extended.

1. Position the BOOM MODE switch to AUTO.
2. Position the BOOM TELE MODE switch to A.
3. The TELESCOPE control lever is pushed forward away from the operator, to the OUT position and held. The center mid, outer mid and fly sections will extend in the proper sequence determined by the LMI system. Refer to the figure titled Boom Extension Configurations.
4. If the boom sequence malfunctions, and the red BOOM NOT SYNC light illuminates, stop telescoping the boom and refer to manual boom operation to get the boom back into synchronization or fully retract the boom and start over again. Percentage of boom section extension can be obtained from the LMI panel.

Mode A Tele Sequence
(Inner Mid not in use)



Boom Extension Configurations (Sheet 1 of 2)



Boom Extension Configurations (Sheet 2 of 2)

Retracting The Five Section Boom In Mode A

DANGER

WHEN RETRACTING THE BOOM, THE LOAD WILL LOWER UNLESS THE CABLE IS TAKEN IN SIMULTANEOUSLY.

NOTE

In the AUTO Mode, the operation of the five section boom's telescope system is electronically controlled by the LMI system.

1. Position the BOOM MODE switch to AUTO.
2. Position the BOOM TELE MODE switch to A.
3. The TELESCOPE control lever is pulled toward the operator, to the IN position and held. The outer mid and fly sections and then the center mid section will retract in the proper sequence determined by the LMI system. Refer to the figure titled Boom Extension Configurations.
4. If the boom sequence malfunctions, and the red BOOM NOT SYNC light illuminates, stop telescoping the boom and refer to manual boom operation to get the boom back into synchronization or fully retract the boom and start over again.Percentage of boom section extension can be obtained from the LMI panel.

CAUTION

WHEN SWITCHING FROM ONE MODE TO THE OTHER MODE (A OR B) THE BOOM SHOULD EITHER BE FULLY RETRACTED OR FULLY EXTENDED.

Extending The Five Section Boom In Mode B

DANGER

WHEN EXTENDING THE BOOM, LET OUT CABLE SIMULTANEOUSLY TO PREVENT TWO-BLOCKING THE BOOM NOSE AND HOOK BLOCK.

DANGER

CHECK THE LOAD CHART FOR MAXIMUM LOAD AT GIVEN RADIUS, BOOM ANGLE, AND LENGTH BEFORE EXTENDING BOOM WITH A LOAD.

NOTE

In the AUTO Mode, the operation of the five section boom's telescope system is electronically controlled by the LMI system.

1. Position the BOOM MODE switch to AUTO.
2. Position the BOOM TELE MODE switch to B.
3. The TELESCOPE control lever is pushed forward away from the operator, to the OUT position and held. The inner mid, center mid, outer mid and fly sections will extend in the proper sequence determined by the LMI system. Refer to the figure titled Boom Extension Configurations.
4. If the boom sequence malfunctions, and the red BOOM NOT SYNC light illuminates, stop telescoping the boom and refer to manual boom operation to get the boom back into synchronization or fully retract the boom and start over again. Percentage of boom section extension can be obtained from the LMI panel.

Retracting The Five Section Boom In Mode B

DANGER

WHEN RETRACTING THE BOOM, THE LOAD WILL LOWER UNLESS THE CABLE IS TAKEN IN SIMULTANEOUSLY.

NOTE

In the AUTO Mode, the operation of the five section boom's telescope system is electronically controlled by the LMI system.

1. Position the BOOM MODE switch to AUTO.
2. Position the BOOM TELE MODE switch to B
3. The TELESCOPE control lever is pulled toward the operator, to the IN position and held. The outer mid and fly sections and then the center mid and inner mid sections will retract in the proper sequence

determined by the LMI system. Refer to the figure titled Boom Extension Configurations.

4. If the boom sequence malfunctions, and the red BOOM NOT SYNC light illuminates, stop telescoping the boom and refer to manual boom operation to get the boom back into synchronization or fully retract the boom and start over again. Percentage of boom section extension can be obtained from the LMI panel.

LOWERING AND RAISING THE CABLE

DANGER

BEFORE LOWERING OR RAISING THE CABLE (LOAD), ENSURE THE AREA BENEATH THE LOAD IS CLEAR OF ALL OBSTRUCTIONS AND PERSONNEL.

DANGER

WHEN STARTING OR STOPPING THE HOIST, DO NOT JERK THE CONTROL LEVER. JERKING THE LEVER CAUSES THE LOAD TO BOUNCE, WHICH COULD RESULT IN POSSIBLE DAMAGE TO THE CRANE.

NOTE

When the load is stopped at the desired height, the automatic brake will engage and hold the load as long as the control lever remains in neutral.

Lowering The Cable

To lower the cable, the MAIN hoist or AUX hoist control lever is pushed forward, away from the operator, to the down position and held until the hook or load is lowered to the desired height.

Raising The Cable

To raise the cable, the MAIN hoist or AUX hoist control lever is pulled back, toward the operator, to the up position and held until the hook or load is raised to the desired height.

STOWING AND PARKING

DANGER

NEVER PARK THE CRANE NEAR HOLES, OR ON ROCKY OR EXTREMELY SOFT SURFACES. THIS MAY CAUSE THE CRANE TO OVERTURN, RESULTING IN INJURY TO PERSONNEL.

After the crane is parked, complete the following.

1. Remove the load from the hook.
2. Remove or stow boom extensions if so equipped.
3. Fully retract all boom sections.
4. Lower the boom to normal travel position.
5. Engage the swing brake and/or swing lock.
6. Retract all stabilizer cylinders and outrigger beams.
7. Park the crane on a stable surface.
8. Apply the parking brakes and chock wheels.
9. Ensure all operating controls are in neutral position.
10. Shut down engine following proper procedures specified in this Handbook and the applicable engine manual.
11. Remove the keys.
12. Close and lock, if applicable, all windows, covers, and doors.

RECOMMENDED CRANE SHUTDOWN PROCEDURES

The following procedure will extend serviceable life of various crane components, reduce vandalism and accidents during crane shutdown periods or anytime the crane is left unattended.

1. Lower any load to the proper surface.
2. Remove or stow all jibs or boom extensions.
3. Fully retract the boom and lower to the travel position.

4. Engage the swing brake and/or swing lock.

5. Retract all stabilizer cylinders and outrigger beams.

6. Ensure all craning and accessory controls are in neutral and/or off.

7. Shut down the engine using the proper procedures as specified by this handbook and the applicable engine manual.

8. Perform any other specified procedures required at the end of the working day, i.e. drain water from the fuel filter-water separator, refueling, etc.

9. Close and lock all windows and the sky light.

10. Remove the keys from the crane.

11. Lock up the crane and install vandal guards, if used.

DANGER

STEP 12 DOES NOT TAKE THE PLACE OF THE PRESTARTING CHECKS WHICH MUST BE PERFORMED JUST PRIOR TO USING THE CRANE AT THE NEXT WORKING DAY.

12. Make a thorough walk-around inspection to ensure that all cylinders that can be retracted are fully retracted. The only exceptions are those cylinders which cannot be fully retracted. Also, look for anything that could hinder or prevent starting the next day's work.

TRAVELING WITH BOOM EXTENSION ERECTED

Four Section Boom With Telescoping Boom Extension

Traveling with the telescoping boom extension erected is permissible if the following conditions are adhered with:

1. Jobsite travel must be on firm, level surface only.

2. Boom must be fully retracted with the boom extension at minimum offset.

3. Main boom angle must be 10° minimum, 30° maximum.

4. Maximum travel speed must not exceed 4 kmh (2.5 mph).

5. Superstructure must be pinned over the front with up to 8165 kg (18,000 lb) of counterweight or pinned over the rear with 3865 to 8615 kg (8500 to 18,000 lb) of counterweight.

6. Hook block may be reeved over main boom nose and hanging no more than 92 cm (3 ft) below lower boom nose sheaves.

7. Headache ball may be reeved over boom extension and hanging no more than 92 cm (3 ft) below extension sheave.

Four or Five Section Boom With Folding Boom Extension

Traveling with the folding boom extension erected is permissible if the following conditions are adhered with:

1. Jobsite travel must be on firm, level surface only.

2. Boom must be fully retracted with the boom extension at minimum offset.

3. Main boom angle must be 60° minimum, 70° maximum with stinger erected or 20° minimum, 70° maximum with stinger stowed on main boom base.

4. Maximum travel speed must not exceed 4 kmh (2.5 mph).

5. Superstructure must be pinned over the front with 3865 to 8615 kg (8500 to 18,000 lb) of counterweight on carrier.

6. Hook block may be reeved over main boom nose and hanging no more than 92 cm (3 ft) below lower boom nose sheaves.

7. Headache ball may be reeved over boom extension and hanging no more than 92 cm (3 ft) below extension sheave.

OPERATIONAL AIDS

GENERAL

This section provides a brief description of optional operational aids available on the crane.

LOAD MOMENT INDICATING SYSTEM

The load moment indicating system is an electromechanical sensing system designed to alert the operator of impending capacity lifts when the system has been properly preset by the crane operator. The control panel is mounted in the cab. When an overload condition is sensed, the system provides the operator with a visual and audible warning and locks out the control levers to prevent lowering the boom, extending the boom, or raising the main or auxiliary hoist cables. Antitwo-block devices are also incorporated into the system to prevent the hook block from coming into contact with the boom nose or jib. This condition will also cause a lockout of the above mentioned control functions. Boom angle indication is provided on the control panel.

CONTROL LEVER LOCKOUT SYSTEM

The control lever lockout system consists of hydraulic solenoid valves placed in-line between the hydraulic remote control valves in the cab and the pilot-operated directional control valves. When the valves are actuated, they prevent pilot flow between the hydraulic remote control valve in the cab and the appropriate directional control valve. The valves are activated in such a manner as to prevent worsening the condition, i.e. boom down, telescope out, or hoist up. The control lever lockout system is used with the antitwo-block system or the load moment indicating system.

SECTION 5
LUBRICATION

GENERAL

Following the designated lubrication procedures is important in ensuring maximum crane lifetime and utilization. The procedures and lubrication charts in this section include information on the types of lubricants used, the location of the lubrication points, the frequency of lubrication, and other information.

The service intervals specified are for normal operation where moderate temperature, humidity, and atmospheric conditions prevail. In areas of extreme conditions, the service periods and lubrication specifications should be altered to meet existing conditions. For information on extreme condition lubrication, contact your local service representative or Grove Product Support, Chambersburg, Pennsylvania.

LUBRICANTS AND SPECIFICATIONS

CAUTION

CHASSIS GREASE LUBRICANTS MUST NOT BE APPLIED WITH AIR PRESSURE DEVICES AS THIS LUBRICANT IS USED ON SEALED FITTINGS.

CAUTION

THE MULTIPURPOSE GREASE INSTALLED DURING MANUFACTURE IS OF A LITHIUM BASE. USE OF A NON-COMPATIBLE GREASE COULD RESULT IN DAMAGE TO EQUIPMENT.

Specific recommendations of brand and grade of lubricants are not made here due to regional availability, operating conditions, and the continual development of improved products. Where questions arise, refer to the component manufacturer's manual and a reliable supplier.

EP-MPG (EXTREME PRESSURE MULTIPURPOSE GREASE).

Reference Specifications.

Citgo ..... Extra Range Grease
Exxon ..... Beacon Q2 Grease
Esso ..... Beacon Q2 Grease (U.K.)
Kendall ..... L-424 Grease

Scope.

This specification is intended to provide the minimum requirements for multipurpose extreme pressure lithium soap base grease with molybdenum disulfide filler.

Application.

This material is intended for use as a general purpose lubricant in slow plain bearings and sliding surface applications on mobile crane chassis and telescoping booms.

Typical Properties.

NLGI No.2
Molybdenum Disulfide Content .. 1% Minimum
Minimum Dropping Point ..... 177°C (350°F)
Water Resistance, ASTM-D1264 ..... 10% Max Loss
Timkin OK Load ..... 15.87 kg (35 lbs), Minimum

Qualified Products.

Citgo ..... Extra Range Grease
Exxon ..... Beacon Q2
Kendall ..... L-424 Grease

Grove Lube Symbol.

EP-MPG

AFC (ANTIFREEZE/COOLANT)

Reference Specifications.

SAE J1034. . . . . .Engine Coolant Concentrate Ethylene-Glycol Type
Cummins Engine 85T8-2 . . . . . Low Silicate Requirement
Federal Specification O-A-548 . . . . . Antifreeze Coolant, Ethylene Glycol, Inhibited, Concentrated

Scope.

This specification is intended to provide the minimum performance requirements for ethylene-glycol, low silicate, engine antifreeze/coolant concentrate for use in initial fill of liquid cooled internal combustion engines. It does not relieve the supplier of responsibilities associated with brand name products.

Application.

This material is intended to provide protection for a minimum of one (1) year in a properly maintained cooling system.

Physical and Chemical Properties.

Glycol content, weight %	94 min.
Water content weight%	5
Freezing point °C (°F), 50% Vb	-37 (-34)
Flash point °C (°F), COC	121 (250)
Silicate content weight %	0.1
Reserve alkalinity ml	10.0 min.
pH 33% Vb	9.9-10.5
50% Vb	10.0-11.0
Ash content, weight %	5.0

a. Single values are maximum unless otherwise indicated.

b. Concentration of antifreeze by volume in a water solution.

c. As anhydrous sodium silicate.

Qualified Products.

Oliver Oil Company . . . . . Full Force Antifreeze Coolant
Shell Oil Company . . . . . .Shellzone Antifreeze Coolant
Houghton Chemical Corporation . . . . . Pan-nol Formula U900 Antifreeze Coolant
Texaco Lubricants Company . . . . . .Code 2055 Startex Antifreeze Coolant

Grove Lube Symbol.

AFC

EO (ENGINE OIL).

Scope.

This specification is intended to provide the minimum requirements for engine oil purchased for initial fill of naturally aspirated and turbo charged diesel engines and gasoline engines in accordance with the engine manufacturer's recommendations.

Application.

This material is intended to provide proper crankcase lubrication in both gasoline and diesel engines.

Physical Properties.

API Service Classification	CH
Viscosity rating SAE	15W-40
Flash point, °C (°F), COC	225 (435)
Pour point, °C (°F)	-30 (-22)
Sulfated ash, weight % max.	1.0
Viscosity, cP @ -15°C (CCS)	3000
Viscosity index	133
Viscosity	
cST @ 40°C	124
cST @ 100°C	15.6
SUS @ 100°F	640
SUS @ 210°F	82.3

a. Values are typical except where ranges or limits are shown.

Qualified Products.

Citgo Citgard 500 . . . . . Grade 15W-40

Grove Lube Symbol.

EO

ATF (AUTOMATIC TRANSMISSION FLUID).

Reference Specifications.

Citgo . . . . . .Multipurpose Automatic Transmission Fluid, Dexron - III E, Mercon
Exxon . . . . . Superflo ATF Automatic Transmission Fluid Identification
Esso . . . . . .Esso Automatic Transmission Fluid Identification

Scope.

This specification is intended to provide the minimum requirements for automatic transmissions in accordance with the transmission manufacturer's recommendations.

Application.

This material is intended to provide proper lubrication when used in automatic transmissions, powershift transmissions, and torque converters at operating temperatures above -26°C (-15°F).

Typical Properties.

Fluid Type . . . . . GM Dexron III E Allison Div. C-4, Ford Mercon
Color . . . . . Red

NOTE

Automatic transmissions manufactured by Allison require the addition of a fungal growth inhibitor to the transmission fluid if the transmission is expected to be inactive for a year or more.

Qualified Products.

Citgo . . . . . Automatic Transmission Fluid (Dexron III E, Mercon)
Exxon . . . . . Automatic Transmission Fluid (Superflo ATF)
Esso . . . . . Automatic Transmission Fluid (Esso ATF)

Grove Lube Symbol.

ATF

WPG (WATER PUMP GREASE).

Scope.

This specification is intended to provide the minimum requirements for multi-purpose high pressure lithium grease.

Application.

This lithium grease is recommended for the lubrication of wheel bearings, water pumps, and universal joints.

Typical Properties.

NLGI Grade . . . . . #2
Soap Type . . . . . Lithium
Penetration, Worked . . . . . 270 - 290
Dropping Point, °F Min. 340
Water Resistance, ASTM D126 . . . . . 5% Max.

Qualified Products.

Citgo . . . . . Premium Lithium Grease
Sunoco . . . . . Sunfleet HP Grease
Gulf . . . . . Gulfcrown E.P. Grease

Grove Lube Symbol.

WPG

SSGL-5 (SEMI-SYNTHETIC GEAR LUBRICANT).

Scope.

This specification is intended to provide the minimum requirements for a semi-synthetic hypoid gear lubricant. It must have good thermal stability, sludge and deposit control, and seal compatibility.

Application.

This material is intended for axle applications when specifications when specifically called for by the equipment manufacturer.

Typical Properties.

API Service Classification	GL-5
SAE Grade	80W-90
API Gravity	28.8
Viscosity	
cST @ 40°C (100°F)	125
cST @ 100°C (210°F)	14.1
SUS @100°C (210°F)	76
SUS @ 38°C (100°F)	650
cP @ -26°C (-15°F)	45,000
Viscosity index	114
Flash point, °C (°F), COC	355 (180)
Pour point, °C (°F)	-40 (-40)
Timken OK Load	60

Qualified Products.

Century Unigear Semi-synthetic ..... SAE 80W-90 Gear Lubricant, Product Code No. 324094

Grove Lube Symbol.

SSGL-5

SYNTHETIC GEAR LUBRICANT.

Scope.

This lubricant provides improved start-up, easier shifting, and less gear wear in colder operations. Less friction, less drag and improved oxidation resistance combine to provide potential fuel economy benefits and longer fluid drain intervals. This product does contain antiwear, rust, oxidation, foam and corrosion inhibitors to protect bearings and synchronizers and to promote longer transmission life.

Application.

For heavy duty service in manual transmissions where the transmission manufacturer normally recommends either engine oils or non-EP type lubricants. Not recommended for hypoid gears where API Service Classification GL-5H is required.

Typical Properties.

API Service Classification	GL-5H
SAE Grade	50
API Gravity	23
Viscosity	
cST @ 40°C (100°F)	138
cST @ 100°C (210°F)	18
cP @ 0°C (32°F)	1 (250)
cP @ -26°C (-15°F)	24 (250)
cP @ -30°C (-22°F)	45 (250)
cP @ -40°C (-40°F)	270 (000)
Viscosity index	154
Flash point, °C (°F)	235 (455)
Pour point, °C (°F)	-40 (-40)

Qualified Products.

Citgo	Synthetic Gear Lubricant SAE 50
Eaton	Roadranger CD Synthetic Lubricant
Mobil	Mobiltrans SHC 50
Shell	Dentrax S
Sunoco	Duratrans SAE 50

HYDO (HYDRAULIC OIL).

Scope.

This specification provides requirements for a factory fill hydraulic fluid.

Application.

This fluid is for use in hydraulic systems of lifting equipment manufactured by Grove Worldwide. It must provide quiet, chatter free performance of sprag clutches, wet brakes, and hydraulic cylinders. It must protect against wear, fluid oxidation, rust and corrosion, and foaming. It must not form sludge or varnish in pumps or motors. It must provide lubrication for spur gearing and anti-friction bearings. It must maintain these characteristics when used outdoors in vented reservoirs for a wide temperature range and with some condensed water. It must be filterable under these conditions, not forming compounds that blind filter media. This fluid is also acceptable for use in powershift transmissions and torque converters at operating temperatures above -12°C (10°F).

Required Properties.

1. This fluid must be certified to meet John Deere Standard JDM J20C Specification for Anti-Brake Chatter Transmission/Hydraulic Fluids.
2. This fluid must meet or exceed a cleanliness level matching ISO #4406 level 16/13.

Typical Viscometrics of Some Qualified Products.

SAE Grade	Hyken 052 10W-20	Exxon Torque Fluid 56 10 W -20	Esso Torque Fluid 56 10W-20	BP-Eldoran UTH & Trak-Tran 9 10W-20	BP-BLend 7367 10W-20
Viscosity					
SUS @ 100°F	230	297	255.2*	261	290
SUS @ 210°F	55.5	57.3	55.9*	54.5	57
SUS @ 0°F	7500	12,000	8,200	10,500	10,800
cST to 100°C	8.95	9.3	8*	9.2	9.2
Viscosity Index	152	142	135	142	133
cST @ 40°C	52.1	57.8	55*	55.7	56
Pour Point, °F	-43	-31	-50	-30	-39
Zinc, wt.%	0.10	- - -	0.17	0.14	0.14

*Converted from kinematic values.

Grove Lube Symbol.

HYDO

SYNTHETIC AXLE LUBRICANT.

Scope.

This specification is intended to provide the minimum requirements for a synthetic hypoid gear lubricant. It must have good thermal stability, sludge and deposit control, and seal compatibility.

Application.

This material is intended for axle applications when specifically called for by the equipment manufacturer.

Typical Properties.

API Service Classification GL-5
SAE Grade 75W-90
API Gravity 24.3
Viscosity
cST @ 100°F (40°C) 136.5
cST @ 210°F (100°C) 17.5
SUS @ 210°F (100°C) 90
SUS @ 100°F (38°C) 653
Viscosity index 150
Flash point, °F (°C), COC 405 (207)
Pour point, °F (°C) ..... -50 (-45)
Timken OK Load 50

Qualified Products.

Citgo ..... Synthetic Gear Lubricant, 75W-90
Eaton ..... Roadranger EP75W-90
Mobil ..... Mobilube SHC 75W-90
Shell ..... Spirax S 75W-90
Sunoco ..... Duragear EP75W-90

HYDRAULIC OIL RECOMMENDATIONS.

New cranes come from the factory with a type of hydraulic fluid commonly known as Tractor Hydraulic Fluids. Tractor Hydraulic Fluids are intended to provide chatter-free lubrication of wet brakes and wet clutches in addition to good gear lubrication and hydraulic performance.

Factory fill oil meets the optimum viscosity requirements through a temperature range from -21 to 99° C (-5 to 210° F). When replenishment of the oil becomes necessary, or when replacement of the oil is required as a result of contamination or operation outside the recommended temperature range for the factory fill oil, the following types of oil are suitable under most operating conditions:

- Tractor Hydraulic Fluids of suitable viscosity.
- Good quality anti-wear hydraulic oils of suitable viscosity and specifically formulated to provide chatter-free operation of wet brakes.

The most important factors in selecting an oil for hydraulic service are:

- Viscosity.
- #Anti-wear additives.

VISCOSITY.

The oil must have proper viscosity to provide a lubricating film at system operating temperature.

Oil viscosity is important because it has a direct bearing on efficient transmission of power. An oil must flow readily through the system with a minimum of pressure and flow loss. Positive lubrication depends on viscosity. The oil must be sufficiently light to get between the components machined surfaces, and maintain a lubricating film at system operating temperatures. Cold weather start-up procedures should allow for a gradual warm-up until the oil reaches a reasonably fluid state.

Oil that is too light may cause the following conditions in the system:

- Excessive leakage.
- Lower volumetric efficiency of the pump.
- Increased component wear.
- Loss of system pressure.
- Lack of positive hydraulic control.
- Lower overall efficiency.

Oil that is too heavy may cause the following conditions in the system:

- System pressure drop.
- Increases system temperature.
- Sluggish system operation.
- Low mechanical efficiency.
- Higher power consumption.

The following oil viscosity characteristics are recommended:

- 80 to 180 SUS optimum at system operating temperature.
- 60 SUS minimum at system operating temperature 7500 SUS maximum at starting temperature.
- 90 Viscosity Index (VI), minimum.
- Pour point at least 11°C (20°F) below start-up temperature.

The following grades will usually meet the above viscosity requirements:

SAE VISCOSITY DESIGNATION	TEMPERATURE °C(°F)
5W-20	-10 to 180 (-23 to 82)
10W	+10 to 180 (-12 to 82)
10W-30	+10 to 210 (-12 to 99)

Arctic Conditions Below -18°C (0°F).

In general, petroleum based fluids developed especially for low temperature service may be used with satisfactory results. However, certain fluids, such as halogenated

ydrocarbons, nitro hydrocarbons, and phosphate ester ydraulic fluids, might not be compatible with hydraulic system seals and wear bands.If you are in doubt about the suitability of a specific fluid, check with your authorized Grove Worldwide distributor or Grove Worldwide Product Support.

Regardless of temperature and oil viscosity, always use suitable start-up procedures to ensure adequate lubrication during system warm-up.

Antiwear Additives.

Excessive wear in the system may cause a loss in volumetric efficiency and may cause shutdowns for maintenance. An efficient antiwear oil protects the components against rusting; resists oxidation, and helps prevent wear.

LUBRICATION POINTS

A regular frequency of lubrication must be established for all lubrication points. Normally, this is based on component operating time. The most efficient method of keeping track of lube requirements is to maintain a job log indicating crane usage. The log must use the engine hour meter to ensure coverage of lube points that will receive attention based on their readings. Other lubrication requirements must be made on a time basis, i.e. weekly, monthly, etc.

All oil levels are to be checked with the crane parked on a level surface in transport position, and while the oil is cold, unless otherwise specified.

On plug type check points, the oil levels are to be at the bottom edge of the check port.

On all hoists with a check plug in the drum, the fill plug shall be directly on top of the hoist, and the check plug level.

All grease fittings are SAE STANDARD unless otherwise indicated. Grease non-sealed fittings until grease is seen extruding from the fitting. 0.28 kg (1 oz) of EP-MPG equals one pump on a standard 0.45 kg (1 lb) grease gun.

Over lubrication on non-sealed fittings will not harm the fittings or components, but under lubrication will definitely lead to a shorter lifetime.

On sealed U-joints, care must be exercised to prevent rupturing seals. Fill only until expansion of the seals first becomes visible.

Unless otherwise indicated, items not equipped with grease fittings, such as linkages, pins, levers, etc., should be lubricated with oil once a week. Motor oil, applied sparingly, will provide the necessary lubrication and help prevent the formation of rust. An anti-seize compound may be used if rust has not formed, otherwise the component must be cleaned first.

Grease fittings that are worn and will not hold the grease gun, or those that have a stuck check ball, must be replaced.

Where wear pads are used, cycle the components and relubricate to ensure complete lubrication of the entire wear area.

The following describe the lubrication points and gives the lube type, lube interval, lube amount, and application of each. Each lubrication point is numbered, and this number corresponds to the index number shown on the Lubrication Diagram.

CAUTION

THE FOLLOWING LUBE INTERVALS ARE TO BE USED AS A GUIDELINE ONLY. ACTUAL LUBE INTERVALS SHOULD BE FORMULATED BY THE OPERATOR TO CORRESPOND ACCORDINGLY TO CONDITIONS SUCH AS CONTINUOUS DUTY CYCLES AND/OR HAZARDOUS ENVIRONMENTS.

CAUTION

COMPONENTS UTILIZING SYNTHETIC LUBRICANTS SHOULD ALWAYS BE SERVICED WITH SYNTHETIC LUBRICANTS. THE SUBSTITUTION OR ADDITION OF PETROLEUM BASED LUBRICANTS IN THESE COMPONENTS COULD CAUSE THE SEALS TO LEAK.

1. **Telescope Cylinder Hydraulic Swivel Fittings.**

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Until grease extrudes
Application - 2 grease fittings (4-section booms only)

2. **Boom Pivot Shaft.**

NOTE

When greasing the lift cylinder and boom pivot shafts, better distribution of grease within the shafts is obtained if the weight of the boom is removed from the shafts.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Until grease extrudes
Application - 2 grease fittings - 1 each side

3. **Top Telescope Cylinder Upper Wear Pad.**

NOTE

The boom sections must be extended to gain entry through the access holes in the boom.

Lube Type - EP-MPG
Lube Interval - 125 hours or every 3 months
Lube Amount - Thoroughly coat the area on the tele cylinders the wear pad moves on.
Application - By brush; extend the boom as required to align the holes in the side of the boom sections.

4. **Bottom Telescope Cylinder Side Guide Pads.**

NOTE

The boom sections must be extended to gain entry through the access holes in the boom.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Thoroughly coat the area on the tele cylinders the wear pad moves on.
Application - By brush; extend the boom in the manual mode as required to align the holes in the side of the boom sections (4-section booms only).

5. **Retraction and Extend Cable Sheave.**

NOTE

The boom sections must be extended to gain entry through the access holes in the boom.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Until grease extrudes
Application - 3 (4-section boom), 2 (5-section boom) grease fittings; extend the boom as required to align the holes in the side of the boom sections.

6. **Boom Section Side Guide Wear Pads.**

NOTE

The boom sections must be extended to gain entry through the access holes in the boom.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Thoroughly coat the area the wear pad moves on.
Application - By brush. Spread grease on the inside of the boom sections in the area of the wear pad.

7. **Boom Section Adjustable Wear Pads.**

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Thoroughly coat the area the wear pad moves on.
Application - By brush. Spread grease on bottom rails, adjustable wear pads, and cam plates.

8. **Top Telescope Cylinder Lower Wear Pad.**

NOTE

The boom sections must be extended to gain entry through the access holes in the boom.

Lube Type - EP-MPG
Lube Interval - 125 hours or every 3 months
Lube Amount - Thoroughly coat the area on the tele cylinders the wear pad moves on.
Application - By brush; extend the boom as required to align the holes in the side of the boom sections (4-section booms only).

9. **Telescope Cylinder Structure Side Guide Wear Pad.**

NOTE

The boom sections must be extended to gain entry through the access holes in the boom.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Thoroughly coat the area the wear pad moves on.
Application - By brush. Spread grease on the inside of the boom sections in the area of the wear pad (4-section booms only).

10. **Telescope Cylinder Structure Upper Wear Pad.**

NOTE

The boom sections must be extended to gain entry through the access holes in the boom.

Lube Type - EP-MPG
Lube Interval - 125 hours or every 3 months
Lube Amount - Thoroughly coat the area the wear pad moves on.
Application - By brush. Spread grease on the inside of the boom sections in the area of the wear pad (4-section booms only).

11. **Boom Section Lower Wear Pads.**

NOTE

The boom sections must be extended to gain entry through the access holes in the boom.

Lube Type - EP-MPG
Lube Interval - 50 hours or weekly
Lube Amount - Thoroughly coat the area the wear pad moves on.
Application - By brush; Extend the boom sections and thoroughly brush grease on the entire length of the bottom rails.

12. **Upper Boom Nose Sheaves.**

Lube Type - N/A
Lube Amount - Sheaves are permanently lubricated, no lubrication required. Inspect every 500 hours or 6 months per Service Manual.

13. **Boom Section Upper Rear Wear Pads.**

Lube Type - EP-MPG
Lube Interval - 50 hours or weekly
Lube Amount - Until grease is visible on boom section.
Application - Use fittings located at bottom front of boom sections while telescoping the boom in and out.

NOTE

Lube interval may be more frequent if environmental or operating conditions dictate.

14. **Boom Extension Alignment Device.**

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Until grease extrudes
Application - 1 grease fitting

15. **Lower Boom Nose Sheaves.**

Lube Type - N/A
Lube Amount - Sheaves are permanently lubricated, no lubrication required. Inspect every 500 hours or 6 months per Service Manual.

16. **Aux Boom Nose Sheave.**

Lube Type - N/A
Lube Amount - Sheaves are permanently lubricated, no lubrication required. Inspect every 500 hours or 6 months per Service Manual.

17. **Hook Block Sheaves.**

Lube Type - N/A
Lube Amount - Sheaves are permanently lubricated, no lubrication required. Inspect every 500 hours or 6 months per Service Manual.

18 **Hook Block Swivel Bearing.**

Lube Type - EP-MPG
Lube Interval - 500 hours or every 6 months
Lube Amount - Until grease extrudes
Application - 3 grease fittings

19. **Hook Shank and Hex Nut.**

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Apply a liberal coating to the hook shank threads and the top of the nut to prevent dust, water, etc. from entering the threads.
Application - By brush or hand

20. Telescope Cylinder Structure Lower Wear Pad.

NOTE

The boom sections must be extended to gain entry through the access holes in the boom.

Lube Type - EP-MPG
Lube Interval - 125 hours or every 3 months
Lube Amount - Thoroughly coat the area the wear pad moves on.
Application - By brush. Spread grease on the inside of the boom sections in the area of the wear pad.

21. Base Section Area of Inner Skid Plate.

NOTE

The boom sections must be extended to gain entry through the access holes in the boom.

Lube Type - EP-MPG
Interval - 50 hours or weekly
Lube Amount - Thoroughly coat the area the wear pad moves on.
Application - Pump grease into 38 mm (1.5 inch) hole in base section in the area of the rear inner mid skid plates on both sides (4-section booms only).

22. Swingaway Rollers.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Thoroughly coat all sliding contact surfaces.
Application - 1 fitting on each roller, 5 rollers.

23. Mast Sheave.

Lube Type - N/A
Lube Amount - Sheaves are permanently lubricated, no lubrication required. Inspect every 500 hours or 6 months per Service Manual.

24. Boom Extension Sheave.

Lube Type - N/A
Lube Amount - Sheaves are permanently lubricated, no lubrication required. Inspect every 500 hours or 6 months per Service Manual.

25. A2B Switch Mounting Brackets.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Until grease extrudes
Application - 1 grease fitting per bracket

26. Luffing Boom Extension Pivot Points

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Until grease extrudes
Application - 2 grease fittings per cylinder

27. Hoist.

CAUTION

USE OF NON-SEMI-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

Lube Type - SSGL-5
Lube Interval - Check and fill every 500 hours or every 12 months.
Lube Amount - 11.6 L (3 gal)
Application - With the crane level, position the drum so the fill plug is directly on top and can be accessed to add oil. Rotate the drum 90°. Oil should just run out of the plug with the drum in this position.

28. Cable Follower and Idler Assembly.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Until grease extrudes
Application - 2 fittings on idler, 1 fitting on follower

29. Swivel.

Lube Type - WPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Approx. 28 grams (1 oz) per fitting
Application - 4 fittings

30. Swing Brake.

Lube Type - HYDO
Lube Interval - Check every 50 hours. Drain and refill twice a year.
Lube Amount - Approximately 0.47 L (0.5 pt)
Application - Fill until oil runs out oil level plug.

31. Swing Gearbox.

CAUTION

USE OF NON-SEMI-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

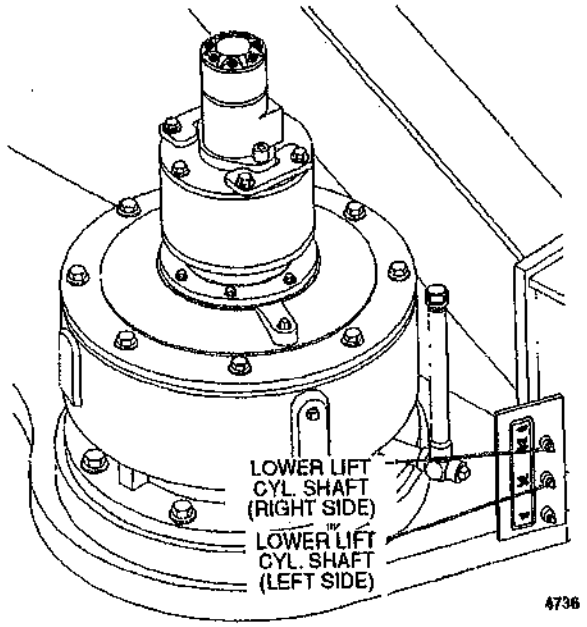
Lube Type - SSGL-5

CAUTION

WHEN CHECKING THE SWING GEARBOX OIL LEVEL, PLACE THE DIPSTICK INTO THE SLEEVE UNTIL THE CAP IS FLUSH WITH THE END OF THE SLEEVE. DO NOT SCREW THE CAP ONTO THE SLEEVE TO CHECK THE LEVEL.

Lube Interval - Check every 50 hours. Drain 1st time after 250 hours and every 500 hours or 12 months thereafter.
Lube Amount - Capacity 14.2 L (15 qt)
Application - Fill to mark on dipstick.

32. Lower Lift Cylinder Pivot Shaft.



NOTE

When greasing the lift cylinder pivot shafts, better distribution of grease within the shafts is obtained if the weight of the boom is removed from the shafts. If this is not possible, slowly elevate and lower the boom while pumping grease into the fitting.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Until grease extrudes
Application - 1 fitting per side

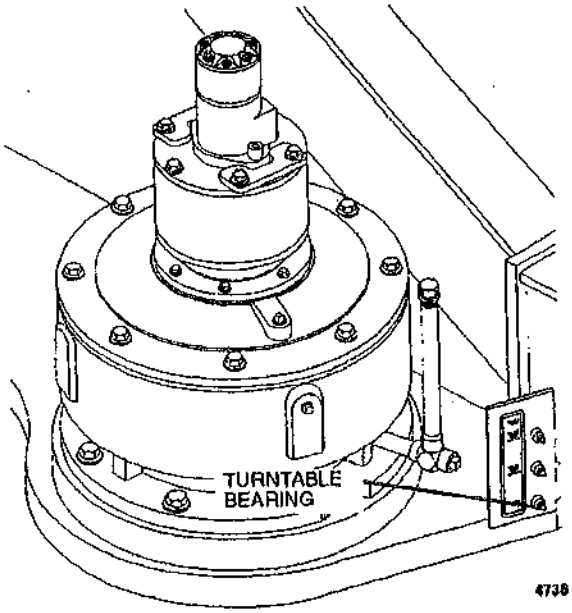
33. Upper Lift Cylinder Pivot Shaft.

NOTE

When greasing the lift cylinder pivot shafts, better distribution of grease within the shafts is obtained if the weight of the boom is removed from the shafts. If this is not possible, slowly elevate and lower the boom while pumping grease into the fitting.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Until grease extrudes
Application - 3 grease fittings

34. Swing Bearing.



Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Until grease extrudes from the whole circumference of bearing.

Application -
On units without an automatic bearing greaser:
There is 1 grease fitting at the front of the turntable. Apply grease and swing the superstructure in 10° increments for one complete revolution. Repeat the procedure until grease can be seen the whole way around the seal.

On units equipped with an automatic bearing greaser:
Depress the control switch on the armrest and swing the superstructure through 2 complete revolutions after every 100 hours of use. Inspect the pump reservoir and fill as required.

35. Pinion Gear Bearing.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Until grease extrudes
Application - 1 grease fitting

36. Swing Gear and Pinion.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 12 months
Lube Amount - Coat all teeth
Application - By brush

NOTE

Items 37 thru 63 apply to cranes without air suspension.

37. Jack Cylinder Support Tubes.

Lube Type - EP-MPG
Lube Interval - 500 hours or every 6 months
Lube Amount - Thoroughly coat the area the cylinder rides on.
Application - By brush

38. Pump Drive.

CAUTION

USE OF NON-SEMI-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

Lube Type - SSGL-5
Lube Interval - Check 100 hours or monthly. Do not overfill. Change every 500 hours.
Lube Amount - Approx. 2.3 L (2.5 qt)
Application - Remove the plug marked check plug. The oil should be at the edge of the port opening.

39. Pump Drive Drive Shaft.

Lube Type - EP-MPG
Lube Interval - 250 hours for U-joints, 500 hours for shaft splines.
Lube Amount - Until grease extrudes
Application - 2 fittings on U-joints, 1 fitting on shaft splines.

40. Transmission Shift U-Joints.

Lube Type - EP-MPG
Lube Interval - 500 hours
Lube Amount - Until grease extrudes
Application - 1 fitting each end of linkage

41. Engine Crankcase.

Lube Type - EO
Lube Interval - Check daily. Drain per Engine Service Manual or 250 hours.
Lube Amount -34 L (9 gal)
Application - Refer to Engine Service Manual. Idle engine after filling with oil, shut down engine and recheck level.

42. Engine Coolant System.

Lube Type - AFC
Lube Interval - Check daily; replace or renew per Engine Service Manual
Lube Amount - 38 L(10 gal)
Application - Refer to Engine Service Manual. Idle engine after filling, shut down engine and recheck level.

43. Headache Ball Tie Down.

Lube Type - EP-MPG
Lube Interval - 500 hours or 6 months
Lube Amount - Until grease extrudes
Application - 1 fitting

44. Clutch Linkage.

Lube Type - EP-MPG
Lube Interval - 500 hours
Lube Amount - Until grease extrudes
Application - 5 fittings

45. Steering Gearbox.

Lube Type - EP-MPG
Lube Interval - 1000 hours

46. Cylinder Barrels.

Lube Type - EP-MPG
Lube Interval - 500 hours or 6 months
Lube Amount - Fully extend the outriggers and apply undercoat to the cylinder barrels.
Application - By brush

47. Steering Relay Arms.

Lube Type - EP-MPG
Lube Interval - 250 hours
Lube Amount - Until grease extrudes
Application - 2 fittings

48. Front Axle King Pins.

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 1 fitting at each end (total of 8)

49. Front Axle Tie Rods.

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 1 fitting each end of the rod (total of 4)

50. Front Axle Hubs.

CAUTION

USE OF NON-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

Lube Type - Synthetic Axle Lubricant
Lube Interval - Check and fill every 250 hours. Change lubricant with every brake job.
Lube Amount - 0.9 L (1 qt) Fill to full mark on hub.
Application - 1 fill plug on each hub

51. Throw-Out Bearing.

Lube Type - EP-MPG
Lube Interval - 250 hours
Lube Amount - Until grease extrudes; Engine shall be running during lubrication to ensure equal distribution of grease.
Application - 1 fitting

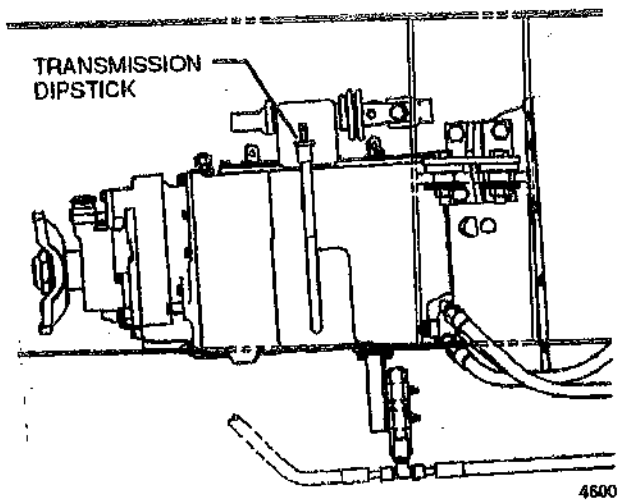
52. Transmission.

CAUTION

USE OF NON-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

Lube Type - Synthetic Gear Lubricant
Lube Interval -
1. 100 hours or monthly. Inspect oil level. Check for leaks.
2. Every 2 years or 80,450 km (50,000 miles). Change transmission oil.

Lube Amount - 19 L (20.0 qt)
Application - To the oil level mark on the dipstick.



53. Front Axle Brake Slack Adjuster.

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 4 fittings

54. Front Axle Brake Camshaft.

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 4 fittings

55. Outrigger Beams.

Lube Type - EP-MPG
Lube Interval - 500 hours or 6 months
Lube Amount - Thoroughly coat the area the beam moves on.
Application - By brush

56. Hydraulic Reservoir.

Lube Type - HYDO
Lube Interval - Check daily. Drain as necessary.
Lube Amount - Capacity 643.5 L (170 gal)
Application - Fill through the cap on top of the tank. Hydraulic oil shall meet or exceed the cleanliness level shown below.

TARGET CONTAMINATION TO ISO S.C.CODE		SUGGESTED MAXIMUM PARTICLE LEVEL	
5µm	15µm	5µm	15µm
16	13	64,000	8,000

57. Rear Rear Axle Diff Lock.

Lube Type - ATF
Lube Interval -
1. Check every 500 hours or 6 months
2. Drain and fill every 32,180 km (20,000 miles) or every year.

Lube Amount - 0.47 L (1 pt)
Application - Check/fill plug in housing

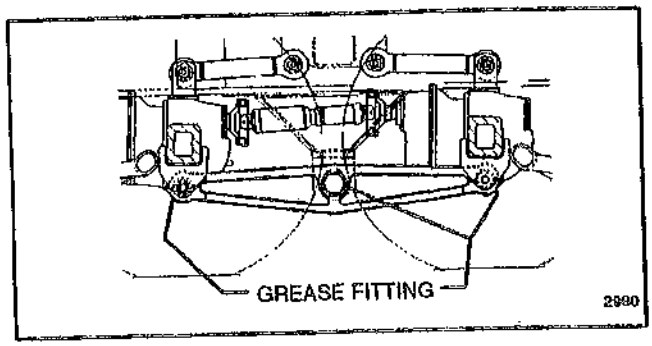
58. Rear Axle Brake Slack Adjuster.

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 4 fittings

59. Rear Axle Brake Camshaft.

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 4 fittings

60. Equalizer Beam.



Lube Type - EP-MPG
Lube Interval - 250 hours
Lube Amount - Until grease extrudes
Application - 3 fittings per beam

61. Front Rear Axle Differential.

CAUTION

USE OF NON-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

Lube Type - Synthetic Axle Lubricant
Lube Interval -
1. Check every 250 hours
2. Drain and fill every 80,450 km (50,000 miles) or every 2 years.

Lube Amount - 19.7 L (42 pt)
Application - Check/fill plug in housing

62. Rear Rear Axle Differential.

CAUTION

USE OF NON-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

Lube Type - Synthetic Axle Lubricant
Lube Interval -
1. Check every 250 hours
2. Drain and fill every 80,450 km (50,000 miles) or every 2 years.

Lube Amount - 18.3 L (39 pt)
Application - Check/fill plug in housing. Change filter when changing oil and clean magnetic plug.

63. **Front Rear Axle.**

CAUTION

USE OF NON-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

Lube Type - Synthetic Axle Lubricant
Lube Interval - N.A.
Lube Amount - 0.96 L (2 pt)
Application - Fill point at top of diff carrier requires service at initial fill only or after rebuild. Periodic service not required.

NOTE

Items 64 thru 85 apply to cranes with air suspension.

64. **Pump Drive.**

CAUTION

USE OF NON-SEMI-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

Lube Type - SSGL-5
Lube Interval - Check 100 hours or monthly. Do not overfill. Change every 500 hours.
Lube Amount - Approx. 2.3 L (2.5 qt)
Application - Remove the plug marked check plug. The oil should be at the edge of the port opening.

65. **Pump Drive Drive Shaft.**

Lube Type - EP-MPG
Lube Interval - 250 hours for U-joints, 500 hours for shaft splines.
Lube Amount - Until grease extrudes
Application - 2 fittings on U-joints, 1 fitting on shaft splines.

66. **Transmission Shift U-Joints.**

Lube Type - EP-MPG
Lube Interval - 500 hours
Lube Amount - Until grease extrudes
Application - 3 fittings

67. **Engine Crankcase.**

Lube Type - EO
Lube Interval - Check daily. Drain per Engine Service Manual or 250 hours.
Lube Amount -34 L (9 gal)
Application - Refer to Engine Service Manual. Idle engine after filling with oil, shut down engine and recheck level.

68. **Engine Coolant System.**

Lube Type - AFC
Lube Interval - Check daily; replace or renew per Engine Service Manual
Lube Amount - 38 L(10 gal)
Application - Refer to Engine Service Manual. Idle engine after filling, shut down engine and recheck level.

69. **Clutch Linkage.**

Lube Type - EP-MPG
Lube Interval - 500 hours
Lube Amount - Until grease extrudes
Application - 5 fittings

70. **Steering Gearbox.**

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 1 fitting

71. **Cylinder Barrels.**

Lube Type - EP-MPG
Lube Interval - 500 hours or 6 months
Lube Amount - Fully extend the outriggers and apply to the cylinder barrels.
Application - By brush

72. **Steering Relay Arms.**

Lube Type - EP-MPG
Lube Interval - 250 hours
Lube Amount - Until grease extrudes
Application - 2 fittings

73. **Front Axle King Pins.**

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 1 fitting at each end (total of 8)

74. **Front Axle Tie Rods.**

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 1 fitting each end of the rod (total of 4)

75. Front Axle Hubs.

CAUTION

USE OF NON-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

Lube Type - SSGL-5
Lube Interval - Check and fill every 250 hours. Change lubricant with every brake job.
Lube Amount - 0.9 L (1 qt) Fill to full mark on hub.
Application - 1 fill plug on each hub

76. Throw-Out Bearing.

Lube Type - EP-MPG
Lube Interval - 250 hours
Lube Amount - Until grease extrudes; Engine shall be running during lubrication to ensure equal distribution of grease.
Application - 1 fitting

77. Transmission.

CAUTION

USE OF NON-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

Lube Type - Synthetic Gear Lubricant
Lube Interval -
1. 100 hours or monthly. Inspect oil level. Check for leaks.
2. Every 2 years or 80,450 km (50,000 miles). Change transmission oil.

Lube Amount - 19 L (20.0 qt)
Application - To the oil level mark on the dipstick.

78. Front Axle Brake Slack Adjuster.

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 4 fittings

79. Front Axle Brake Camshaft.

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 4 fittings

80. Outrigger Beams.

Lube Type - EP-MPG
Lube Interval - 500 hours or 6 months
Lube Amount - Thoroughly coat the area the beam moves on.
Application - By brush

81. Hydraulic Reservoir.

Lube Type - HYDO
Lube Interval - Check daily. Drain as necessary.
Lube Amount - Capacity 643.5 L (170 gal)
Application - Fill through the cap on top of the tank. Hydraulic oil shall meet or exceed the cleanliness level shown below.

TARGET CONTAMINATION TO ISO S.C.CODE		SUGGESTED MAXIMUM PARTICLE LEVEL	
5µm	15µm	5µm	15µm
16	13	64,000	8,000

82. Rear Axle Brake Slack Adjuster.

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 4 fittings

83. Rear Axle Brake Camshaft.

Lube Type - EP-MPG
Lube Interval - 1000 hours
Lube Amount - Until grease extrudes
Application - 4 fittings

84. Front Rear Axle Differential.

CAUTION

USE OF NON-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

Lube Type - SSGL-5
Lube Interval -
1. Check every 250 hours
2. Drain and fill every 80,450 km (50,000 miles) or every 2 years.

Lube Amount - 27 L (57 pt)
Application - Check/fill plug in housing

35. **Rear Rear Axle Differential.**

CAUTION

USE OF NON-SYNTHETIC LUBRICANT WILL DAMAGE COMPONENTS AND INVALIDATE PUBLISHED LUBRICATION INTERVALS.

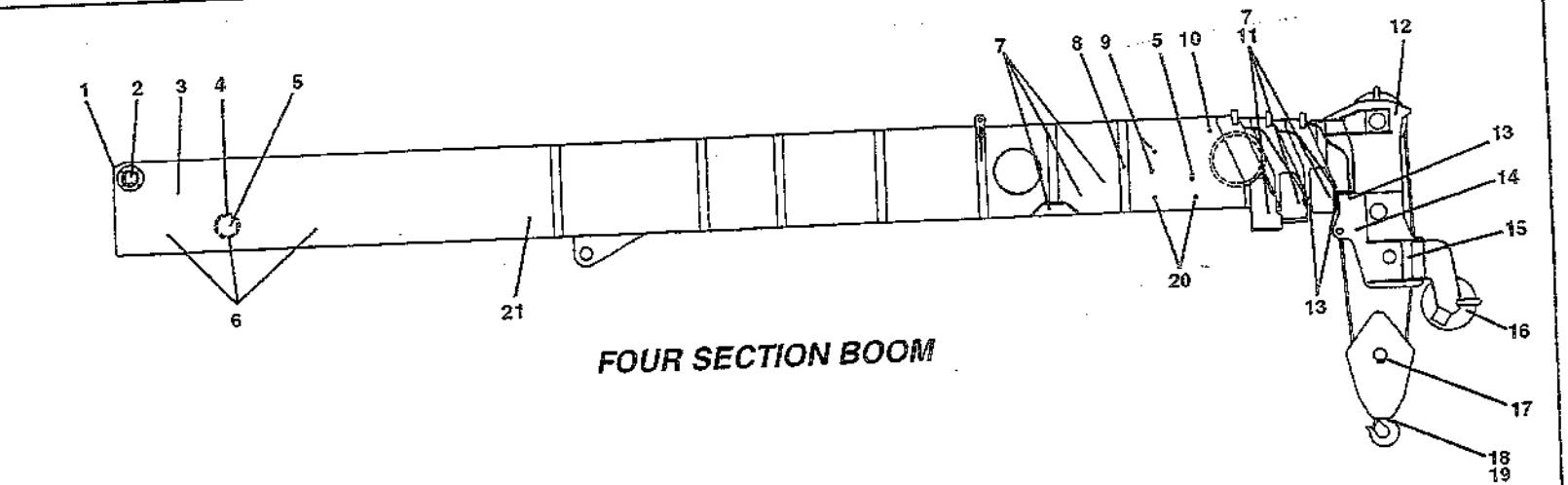
Lube Type - SSGL-5
Lube Interval -
1. Check every 250 hours
2. Drain and fill every 80,450 km (50,000 miles) or every 2 years.

Lube Amount - 17.5 L (37 pt)

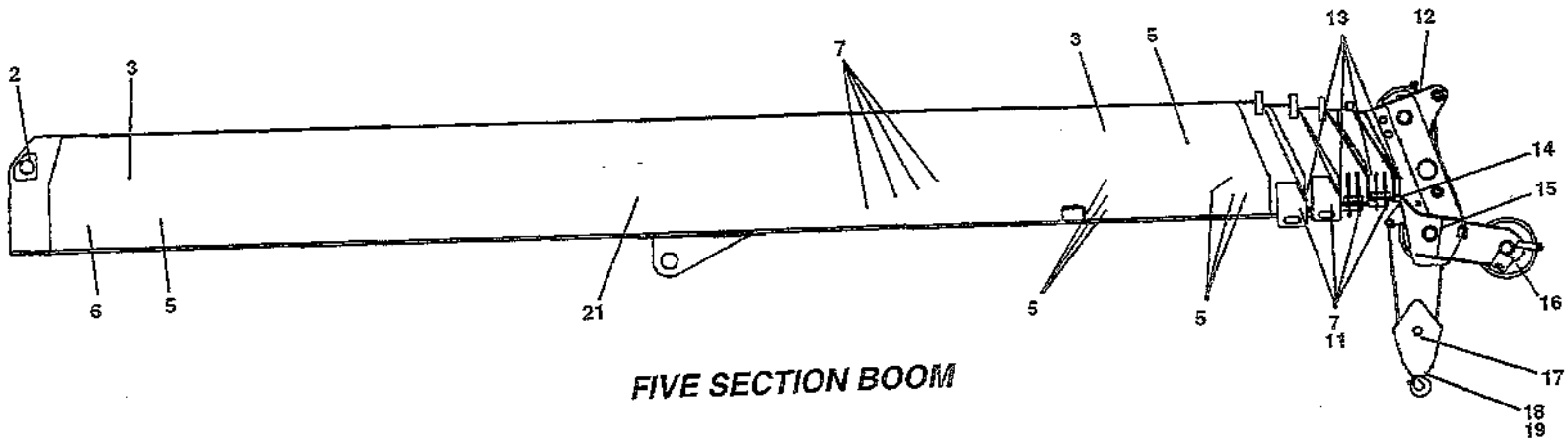
Application - Check/fill plug in housing. Change filter when changing oil and clean magnetic plug.

WIRE ROPE LUBRICATION

Wire rope is lubricated during manufacturing so the strands, and individual wires in strands, may move and adjust as the rope moves and bends. A wire rope cannot be lubricated sufficiently during manufacture to last its entire life. Therefore, new lubricant must be added periodically throughout the life of a rope to replace factory lubricant which is used or lost. For more detailed information concerning the lubrication and inspection of wire rope, refer to WIRE ROPE in Chapter 1, Section 2 - GENERAL MAINTENANCE in the Service Manual.

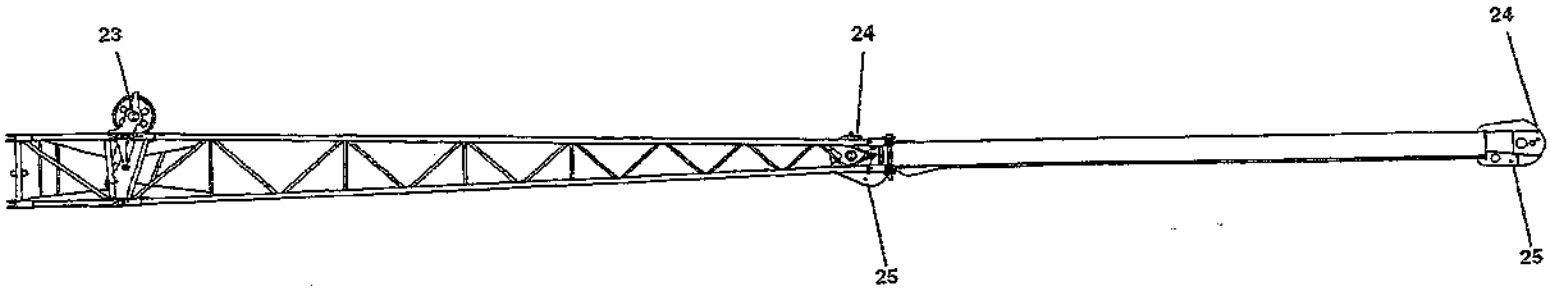


FOUR SECTION BOOM

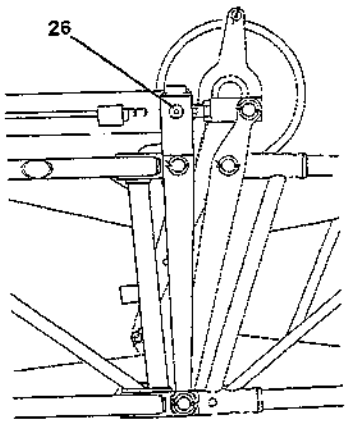


FIVE SECTION BOOM

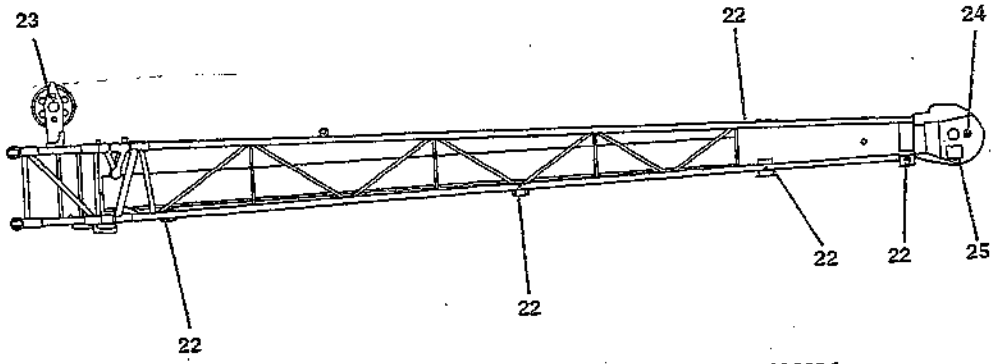
1. Telescope Cylinder Hydraulic Swivel Fittings
2. Boom Pivot Shaft
3. Top Telescope Cylinder Upper Wear Pad
4. Bottom Telescope Cylinder Side Guide Pads
5. Retract and Extend Cable Sheave
6. Boom Section Side Guide Wear Pads
7. Boom Section Adjustable Wear Pads
8. Top Telescope Cylinder Lower Wear Pad
9. Telescope Cylinder Structure Side Guide Wear Pad
10. Telescope Cylinder Structure Upper Wear Pad
11. Boom Section Lower Wear Pads
12. Upper Boom Nose Sheaves
13. Boom Section Upper Rear Wear Pads
14. Boom Extension Alignment Device
15. Lower Boom Nose Sheaves
16. Aux Boom Nose Sheave
17. Hood Block Sheaves
18. Hood Block Swivel Bearing
19. Hook Shank and Hex Nut
20. Telescope Cylinder Structure Lower Wear Pad
21. Base Section Area of Inner Skid Plate



FOLDING SWINGAWAY

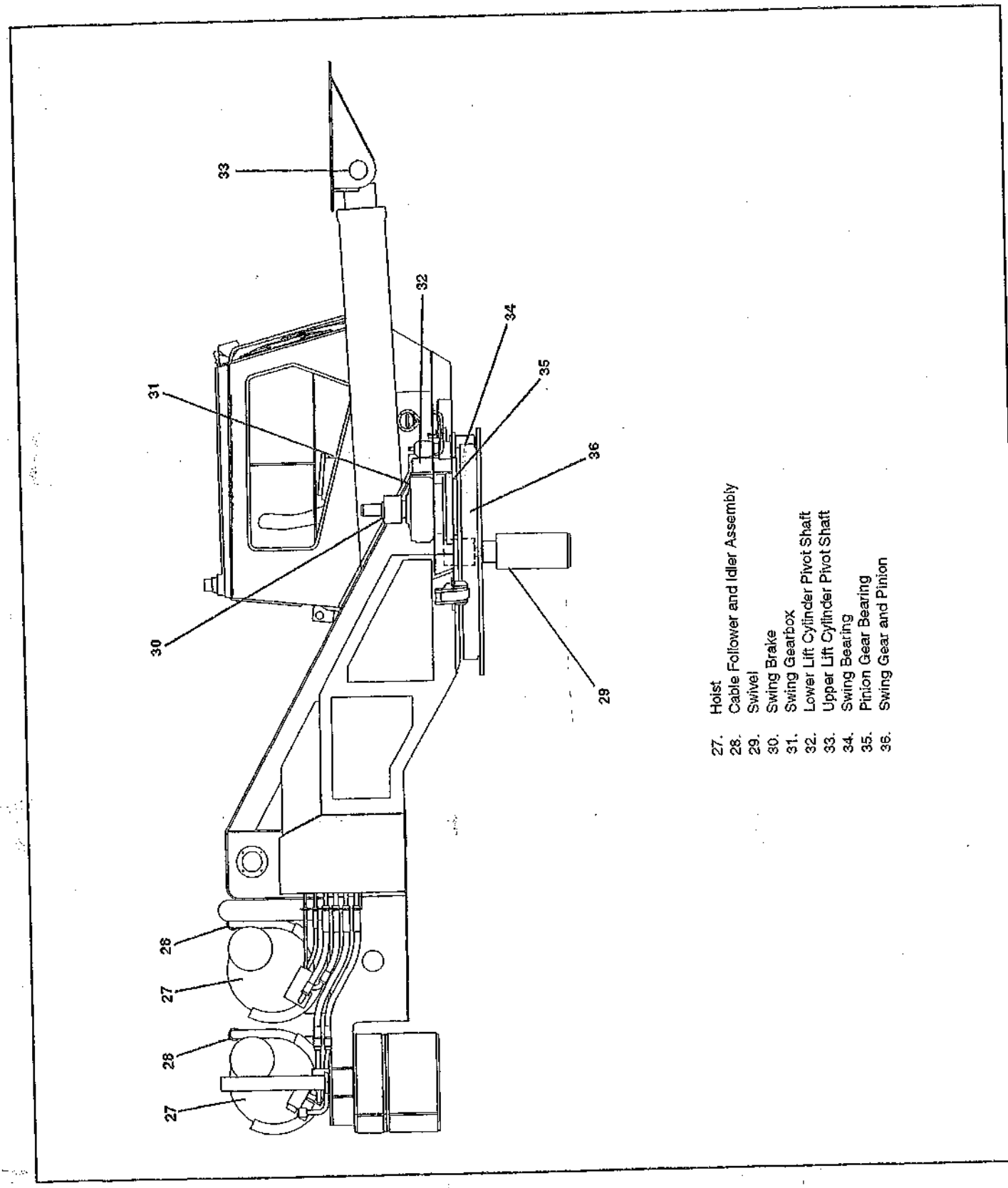


LUFFING SWINGAWAY



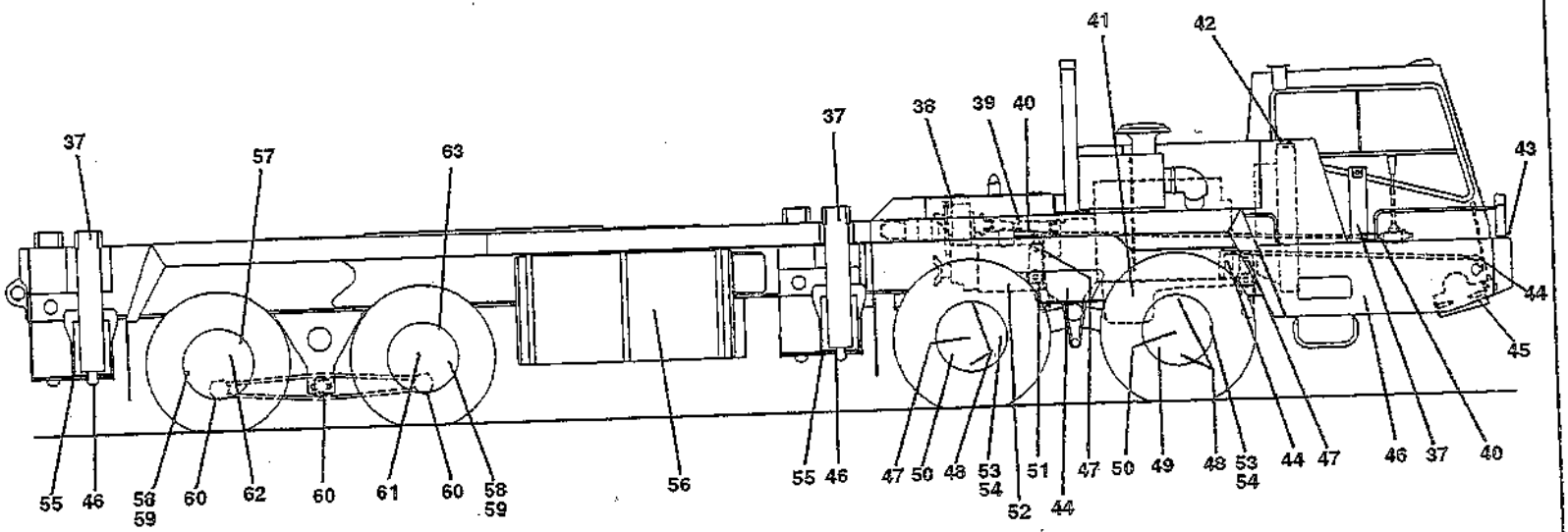
TELESCOPING SWINGAWAY

22. Swingaway Rollers
23. Mast Sheave
24. Swingaway Sheave
25. A2B Switch Mounting Brackets
26. Luffing Boom Extension Cylinder Pivots



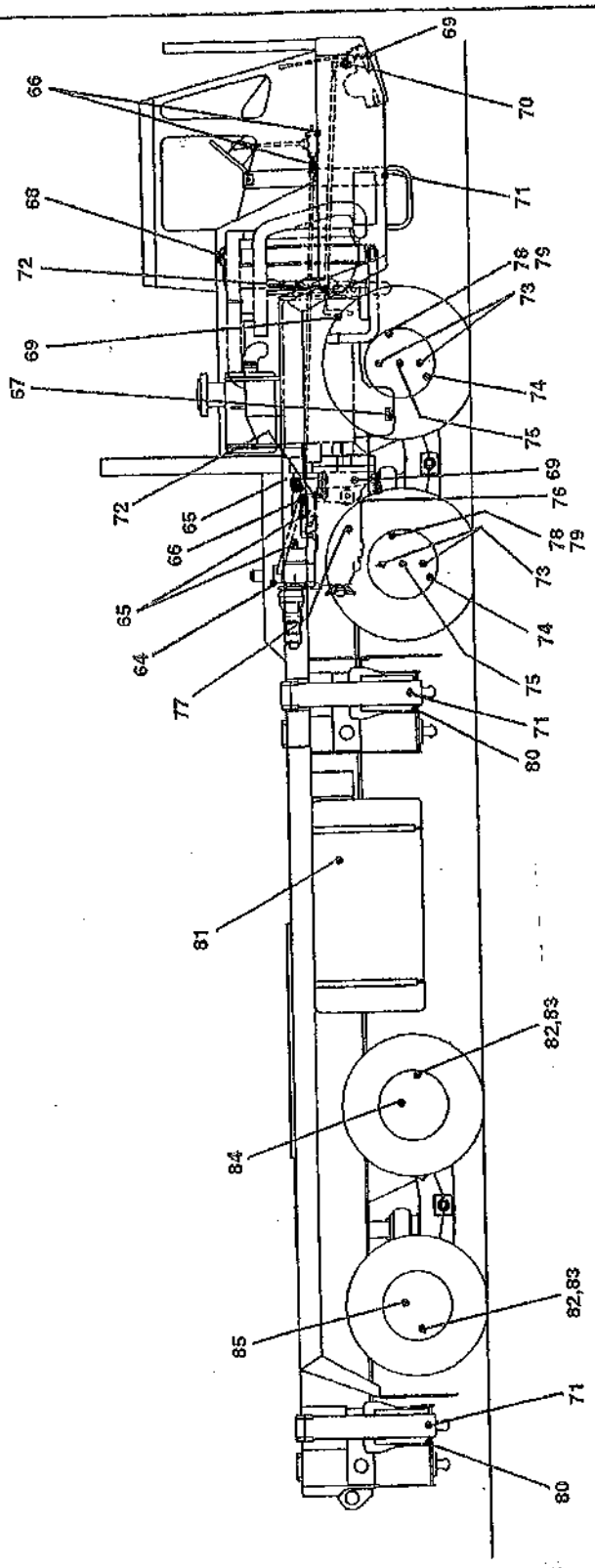
Lubrication Diagram (Sheet 3 of 5)

CARRIER WITHOUT AIR SUPENSION



37. Jack Cylinder Support Tubes
38. Pump Drive
39. Pump Drive Shaft
40. Transmission Shift U-Joints
41. Engine Crankcase
42. Engine Coolant System
43. Headache Ball Tie-Down
44. Clutch Linkage
45. Steering Gearbox
46. Cylinder Barrels
47. Steering Relay Arms
48. Front Axle King Pins
49. Front Axle Tie Rods
50. Front Axle Hubs
51. Clutch Throw-Out Bearing
52. Transmission
53. Front Axle Brake Slack Adjuster
54. Front Axle Brake Camshaft
55. Outrigger Beams
56. Hydraulic Reservoir
57. Rear Rear Axle Diff Lock
58. Rear Axle Brake Slack Adjuster
59. Rear Axle Brake Camshaft
60. Equalizer Beam
61. Front Rear Axle Differential
62. Rear Rear Axle Differential
63. Front Rear Axle

CARRIER WITH AIR SUPENSION



64. Pump Drive
65. Pump Drive Shaft
66. Transmission Shift U-Joints
67. Engine Crankcase
68. Engine Coolant System
69. Clutch Linkage
70. Steering Gearbox
71. Cylinder Barrels
72. Steering Relay Arms
73. Front Axle King Pins
74. Front Axle Tie Rods
75. Front Axle Hubs
76. Clutch Throw-Out Bearing
77. Transmission
78. Front Axle Brake Slack Adjuster
79. Front Axle Brake Camshaft
80. Outrigger Beams
81. Hydraulic Reservoir
82. Rear Axle Brake Slack Adjuster
83. Rear Axle Brake Camshaft
84. Front Rear Axle Differential
85. Rear Rear Axle Differential

Lubrication Diagram (Sheet 5 of 5)

SECTION 6
SET UP AND INSTALLATION PROCEDURES

GENERAL

This section provides procedures for installing the hoist cable on the hoist drum, cable reeving, and erecting and stowing the swingaway boom extension.

INSTALLING CABLE ON THE HOIST

CAUTION

IF CABLE IS WOUND FROM THE STORAGE DRUM, THE REEL SHOULD BE ROTATED IN THE SAME DIRECTION AS THE HOIST.

NOTE

The cable should preferably be straightened before installation on the hoist drum.

Install cable on the hoist drum in accordance with the following procedure.

1. Position the cable over the boom nose sheave and route to the hoist drum.
2. Position the hoist drum with the cable anchor slot on top.
3. Insert the cable through the slot and position around the anchor wedge.

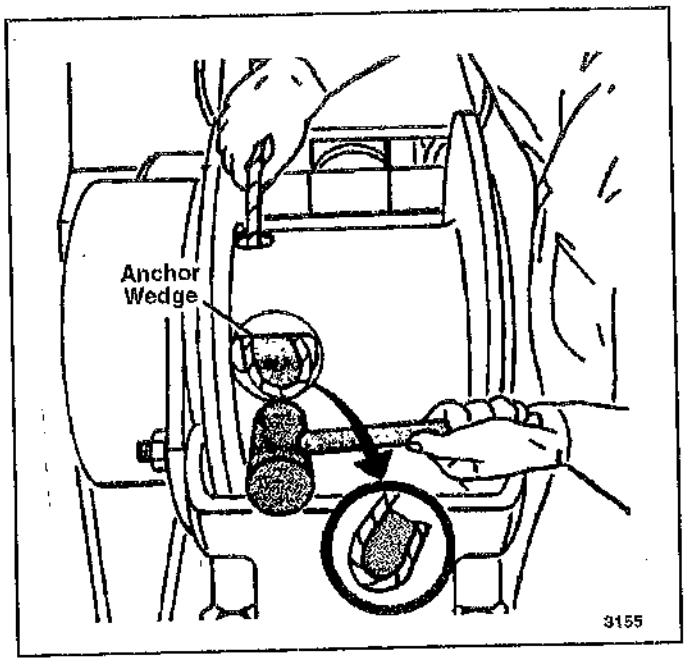
NOTE

The end of the cable should be even with the bottom of the anchor wedge.

4. Position the anchor wedge in the drum slot; pull firmly on the free end of the cable to secure the wedge.

NOTE

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

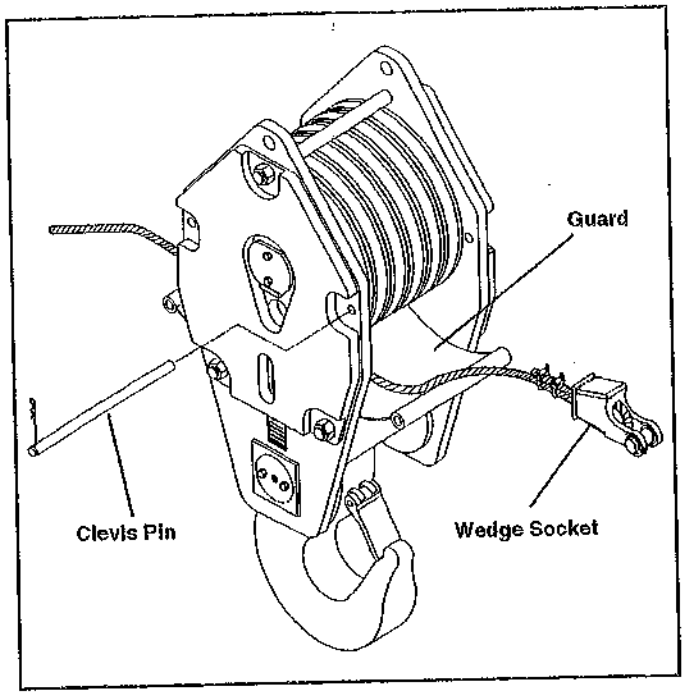


Installing Cable Anchor Wedge

5. Slowly rotate the drum, ensuring the first layer of cable is evenly wound onto the drum.
6. Install the remainder of the cable, as applicable.

CABLE REEVING

Within the limits of the load and range charts and permissible line pull, multi-part lines allow the operator to raise a greater load than can be raised with a single part line. Various cable reeving (part line) is possible with the boom nose and hook block. This reeving should be accomplished by a qualified rigger using standard rigging procedures.



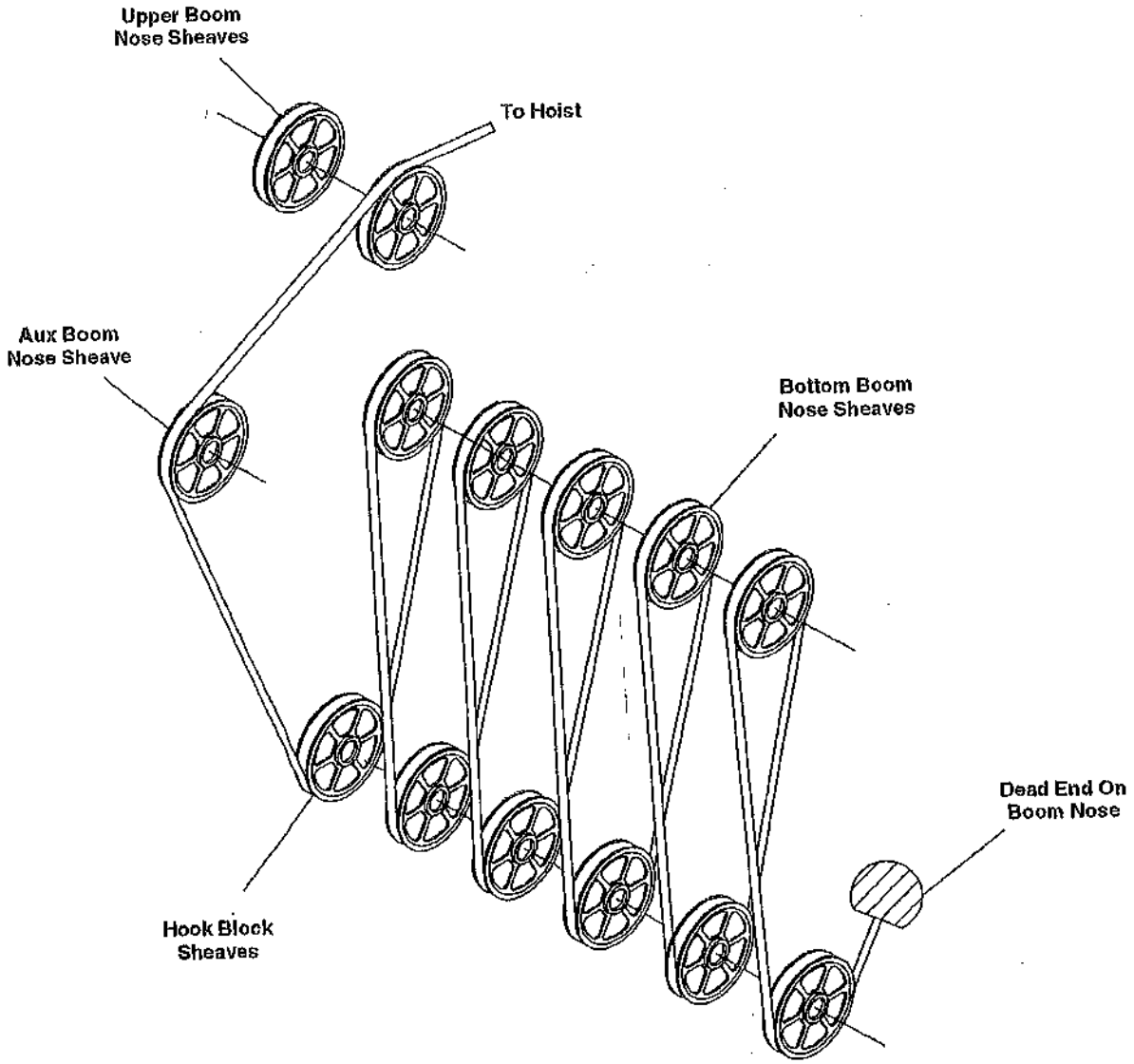
Quick Reeving Hook Block

CAUTION

TO ATTAIN MAXIMUM WIRE ROPE LIFE AND MINIMIZE HOOK BLOCK ROTATION, IT IS RECOMMENDED THAT EVEN NUMBERS OF PARTS-OF-LINE BE USED IN MULTIPLE-PART REEVINGS, WHENEVER POSSIBLE.

Utilizing the auxiliary boom nose sheave, boom nose sheaves, and the hook block sheaves, maximum parts of line can be accomplished. Refer to the figure titled Reeving For 12 Parts Line.

In order to quick reeve the hook block without removing the wedge socket on the end of the cable, refer to the figure titled Quick Reeving Hook Block.



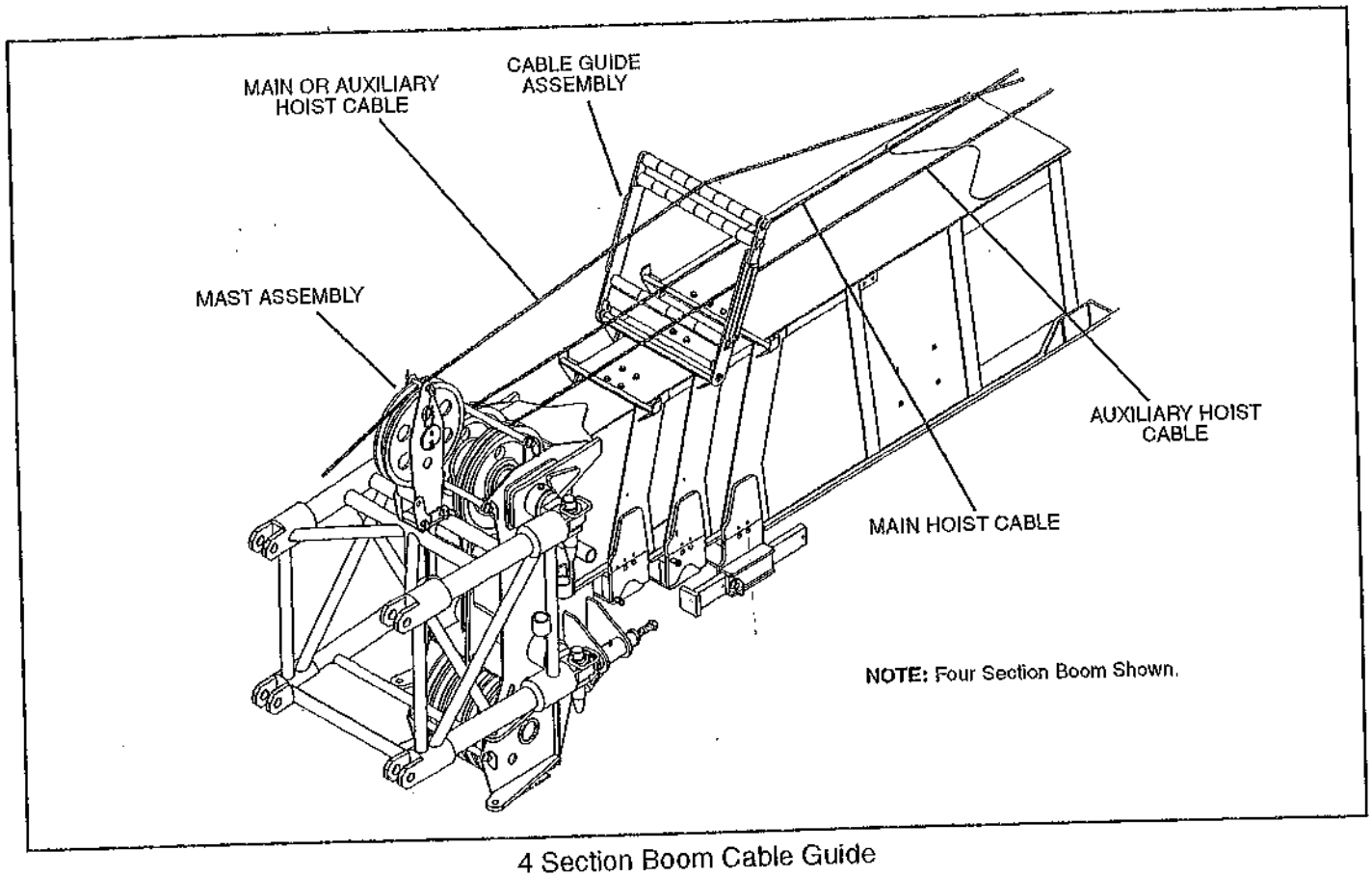
Reeving For 12 Parts Line

4 SECTION BOOM CABLE GUIDE

A cable guide assembly is provided on the top of the 4 section booms to prevent the cable(s) from falling off the side of the boom when it becomes slack. It is installed on the inner mid section. It is free to raise and lower as well as telescope up and down as the cable angle changes.

Reeving

When reeving the main and/or auxiliary hoist cable over the main boom nose, route to cable(s) through the cable guide (between the bottom roller and the two top rollers). When either the main hoist or auxiliary hoist cable is used over the boom extension, route the cable over the top roller on the cable guide to the mast assembly on the boom extension.



4 Section Boom Cable Guide

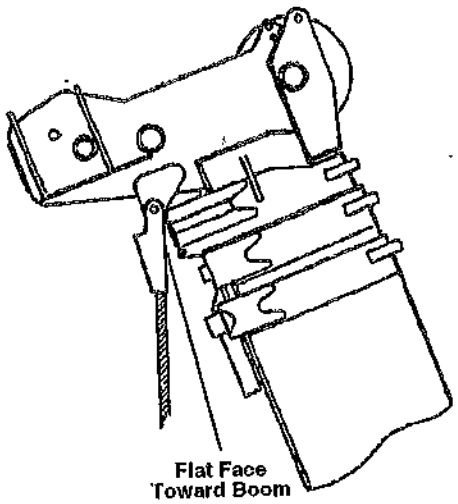
DEAD-END RIGGING/WEDGE SOCKETS

The wedge socket is a very popular cable end attachment and is easily installed and dismantled, but it must be installed correctly as stated in the following procedure. If variations are made to suit special conditions, they should be carefully evaluated before proceeding. Since state and local laws may vary, alternate attachment methods may be necessary depending upon work conditions. If alternate methods are selected, the user is responsible and should proceed in compliance with the regulations in force. If there are any questions, contact your local Grove Distributor or Grove Product Support.

It is essential to use only a wedge and socket of the correct size for the rope fitted. Failure to do so may result in the rope pulling through the fitting.

Do not mix components from different manufacturers. The fitting of the wedge (with rope) in the socket should always be checked at the time of assembly.

When assembly is complete, the boom should be raised to a working position and a load suspended to firmly seat the wedge and rope into the socket before the crane is used operationally.



CAUTION

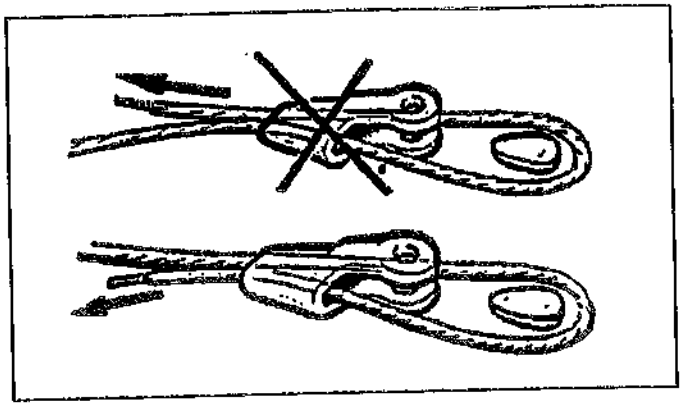
IF THE SOCKET IS NOT POSITIONED WITH THE FLAT FACE TOWARDS THE BOOM SECTIONS, STRUCTURAL DAMAGE WILL OCCUR.

When anchoring the socket to the boom, ensure the flat face of the socket is in position as shown towards the boom sections.

INSTALLING THE WEDGE AND SOCKET

1. Inspect the wedge and socket; remove any rough edges and burrs.

2. If the end of the rope is welded, the welded end should be cut off. This will allow the distortion of the rope strands, caused by the bend around the wedge, to adjust themselves at the end of the line.

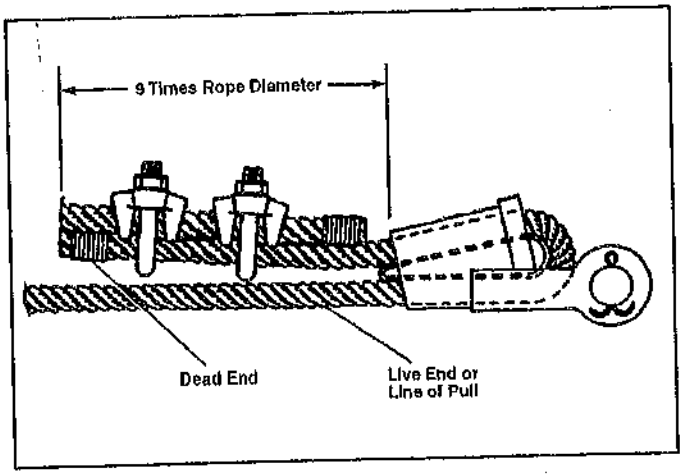


Proper Wedge Socket Routing

3. Ensure the live-loaded-side of the rope is in line with the ears of the socket. If the rope is loaded into the socket incorrectly, under a load the rope will bend as it leaves the socket and the edge of the socket will wear into the rope causing damage to the rope and eventual failure.

4. The dead end of the rope should extend from the socket for a distance approximately nine times the rope diameter, [a minimum of 15.2 cm (6 in.)].

5. Place the wedge in the socket.



Dead-End Rigging/Wedge Socket

6. Place a wire rope clip around the dead end by clamping a short extra piece of rope to the dead end. DO NOT CLAMP THE LIVE END. The U-bolt should bear against the dead end. The saddle of the clip should bear against the short extra piece. Torque

the U-bolts according to the figures listed in the chart titled Wire Rope Clip Torque Values.

7. Secure the ears of the socket to a sturdy support. Pull the wedge and rope into position with tension on the live side of the rope sufficiently tight enough to hold them in place.

8. After final pin connections are made, increase the loads gradually until the wedge is properly seated.

WIRE ROPE CLIP TORQUE VALUES			
Clip Sizes		*Torque	
mm	inches	N•m	lb-ft
3.18	1/8	4	3
4.76	3/16	6	4.5
6.35	1/4	20	15
7.94	5/16	20	15
13.28	3/8	40	30
11.11	7/16	54	40
12.70	1/2	60	45
14.29	9/16	70	50
15.88	5/8	100	75
19.05	3/4	100	75
22.23	7/8	175	130
25.40	1	175	130
28.58	1-1/8	270	200
31.75	1-1/4	270	200
38.68	1-3/8	490	360
38.10	1-1/2	490	360

* The tightening torque values shown are based upon the threads being clean, dry, and free of lubrication.

ERECTING AND STOWING THE TELESCOPING SWINGAWAY BOOM EXTENSION

DANGER

BEFORE ATTEMPTING TO ERECT OR STOW THE SWINGAWAY, READ AND STRICTLY ADHERE TO ALL DANGER DECALS INSTALLED ON THE SWINGAWAY AND STOWAGE BRACKETS.

ERECTING

1. Fully extend and set the outriggers.

2. Position the boom over the rear.

3. If extended, fully retract all the boom sections and lower to minimum elevation to permit ease of installation of pins and access to the boom nose.

NOTE

The auxiliary boom nose (rooster sheave) does not have to be removed.

4. Remove the pin and clip pin securing the boom extension alignment device in the stowed position. Pull the alignment device out to the working position and secure it in place with the pin and clip pin.

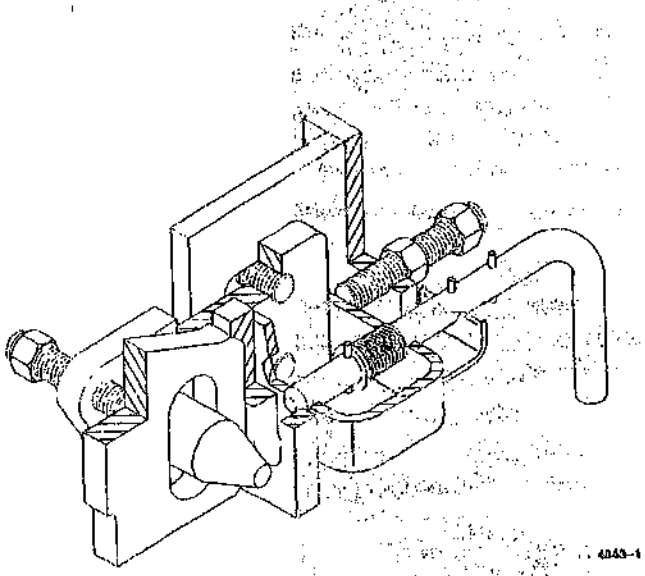
5. Rig either the main hoist or optional auxiliary hoist cable for single part line with nothing but the becket on the end of the cable.

6. Extend the boom enough to disengage the spring loaded boom extension stop block.

7. Disengage the spring-loaded boom extension stop block and fully retract the boom.

8. Remove the retainer clips from the attach pins stowed in the base of the swingaway and insert the attach pins through the attach and anchor fittings on the right side of the boom nose. Install the retainer clips in the attach pins.

9. Pull the pin securing the swingaway to the front stowage bracket. Ensure the pin is pulled out to the second roll pin and turned as shown above.



10. Attach a length of rope to the swingaway tip to aid in swinging the swingaway into place ahead of the boom nose.

11. Raise the boom to horizontal and extend the boom just enough to clear the swingaway stowage lugs from the guide ramps and stowage pins on the front and rear stowage brackets.

DANGER

WHEN ERECTING THE SWINGAWAY, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE KEPT CLEAR OF THE SWING PATH.

12. Slightly raise and/or lower the boom to help control the swingaway. Using the rope attached to the tip of the swingaway, swing the swingaway into place ahead of the boom nose, engaging the anchor fittings with the attach fittings on the left side of the boom nose.

DANGER

DO NOT MODIFY THE ATTACH POINTS TO PERMIT THE INSTALLATION OF THE ATTACH PINS.

13. Install the attach pin and retainer clip into the upper anchor and attach fittings on the left side of the boom nose.

NOTE

If the boom extension alignment device does not properly align the anchor and attach fittings to allow installation of the attach pin and retainer clip, refer to the service manual and adjust the boom extension alignment device.

14. Fully retract the boom until the bottom swingaway anchor fitting is against the boom extension alignment device and install the attach pin and retainer clip in the lower anchor and attach fittings on the left side of the boom nose.

15. Lower the boom and remove the rope from the tip of the swingaway.

NOTE

Refer to SETTING THE TELESCOPING SWINGAWAY OFFSET in this section to obtain a 30° offset with the swingaway.

NOTE

Refer to SETTING THE TELESCOPING EXTENSION LENGTH in this section for extending or retracting the telescoping extension section.

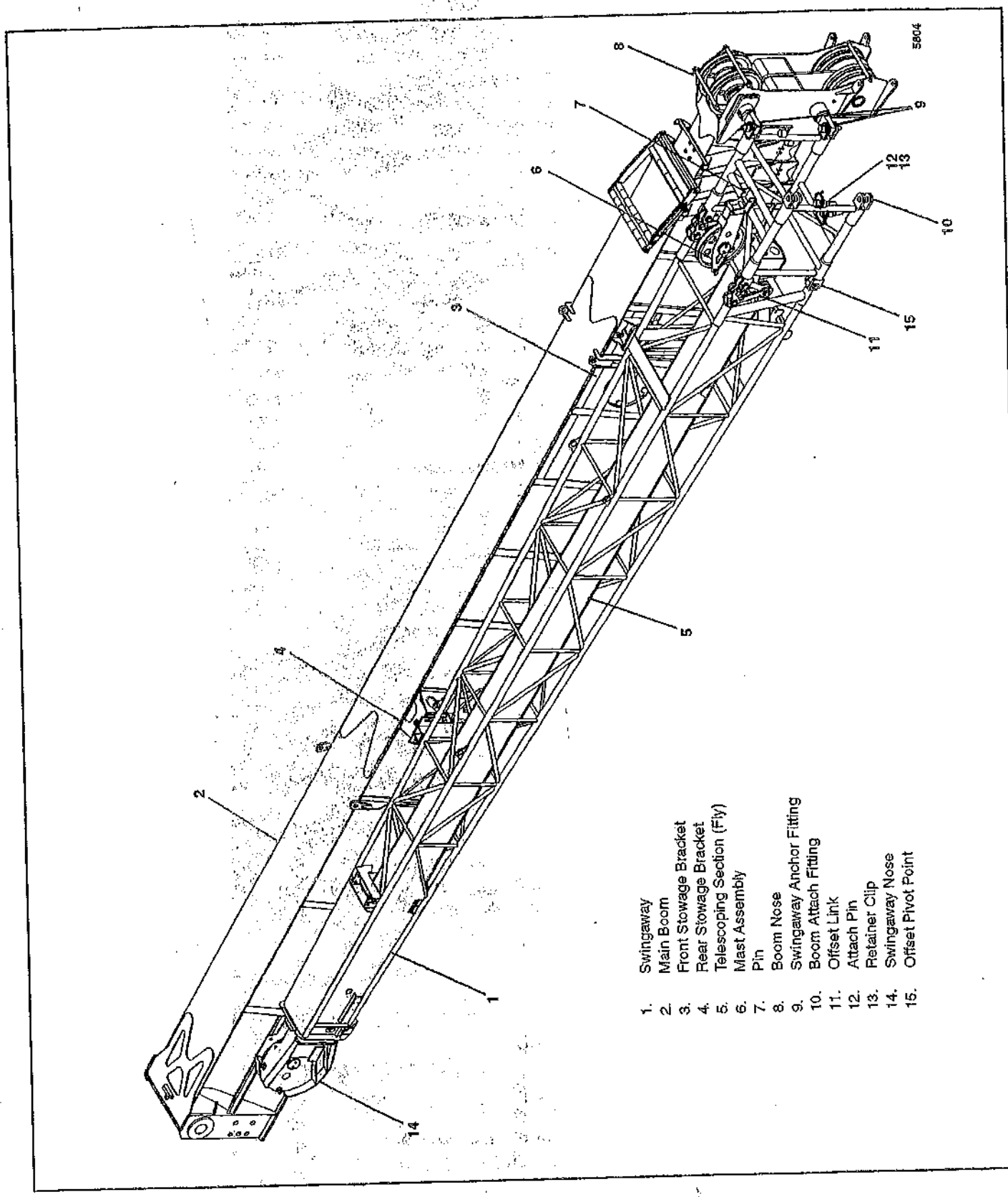
16. Remove the pin and clip pin securing the boom extension alignment device in the working position. Push the alignment device back to the stowed position and secure it in place with the pin and clip pin.

17. Lower the boom to minimum elevation and remove the cable retainer pins and clip pins from the tip of the swingaway.

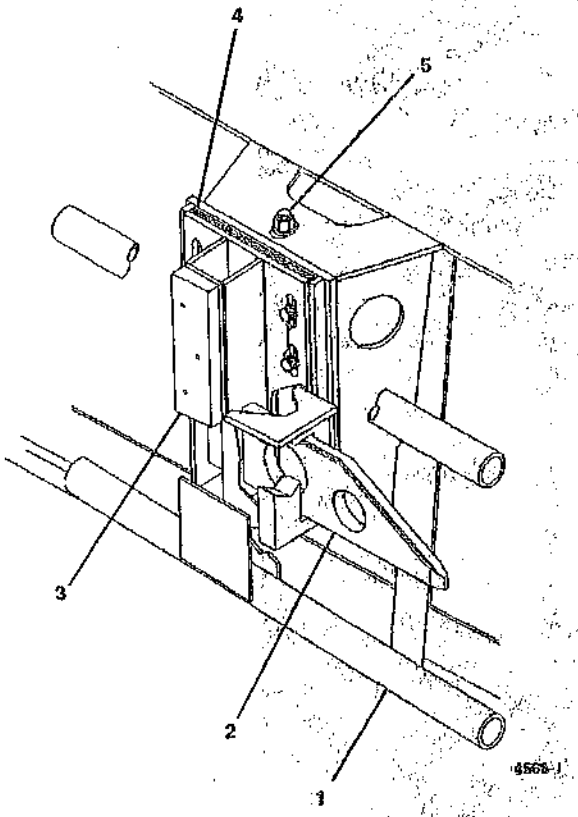
18. Remove the mast assembly clip pin and pin from the stowed position on the swingaway and raise the mast assembly to an upright position. Install the pin and clip pin. Remove the cable retainer pin and clip pin from the mast.

19. Route the hoist cable over the mast sheave and the sheave on the swingaway tip. Install the cable retainer pins and clip pins.

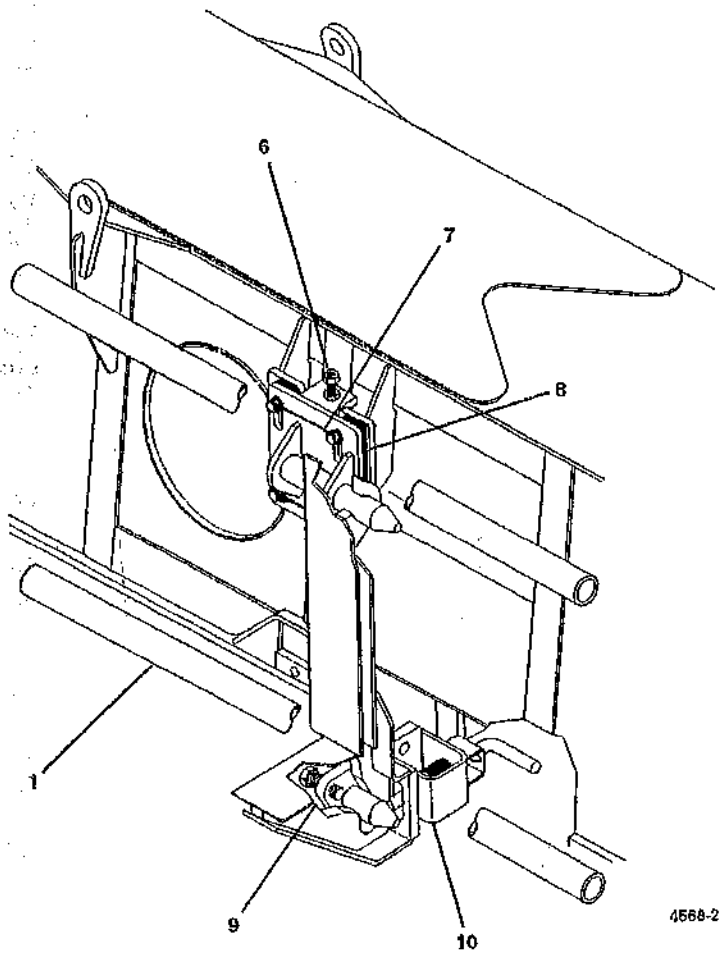
20. Rig the hoist cable.



Erecting and Stowing the Telescoping Swingaway Boom Extension (Sheet 1 of 4)



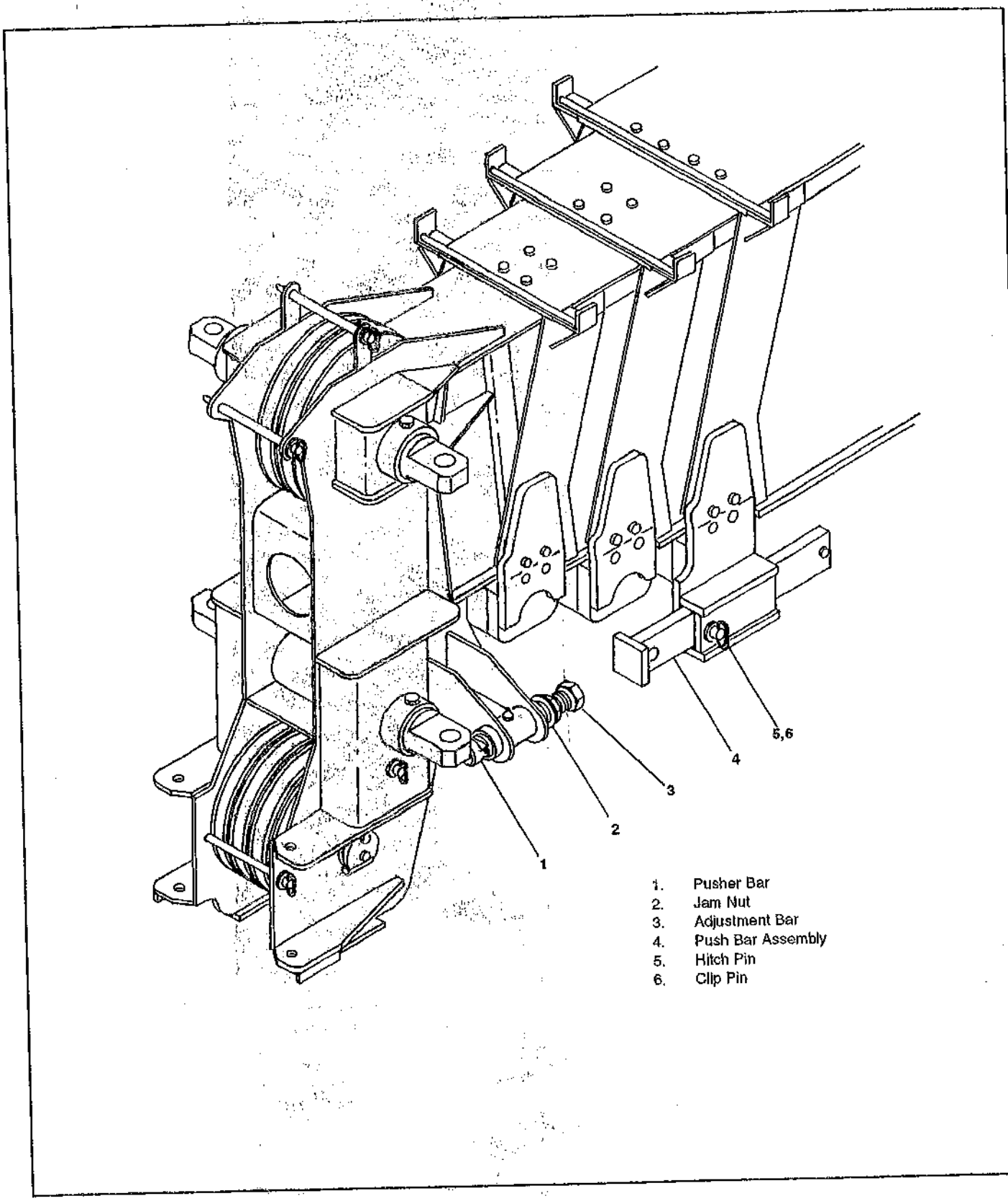
Rear Stowage Bracket



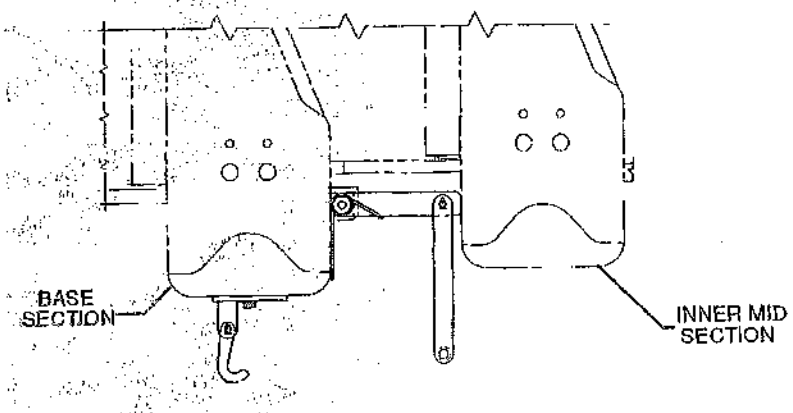
Front Stowage Bracket

1. Swingaway
2. Slider
3. Wear Pad
4. Shims
5. Adjustment Screw
6. Adjustment Screw
7. Hanger
8. Shims
9. Pin Plate
10. Front Support

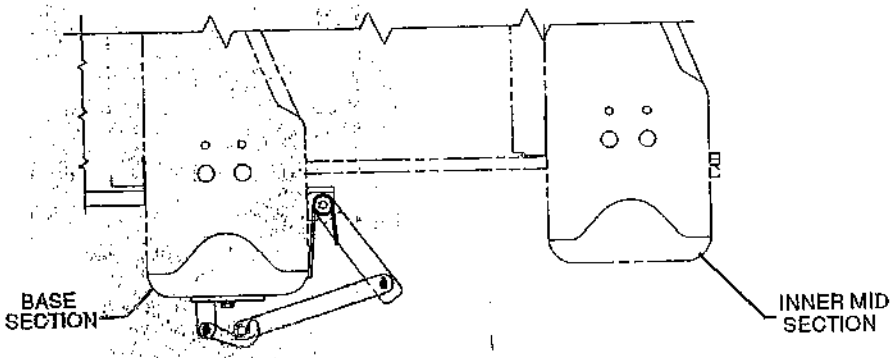
Erecting and Stowing the Telescoping Swingaway Boom Extension (Sheet 2 of 4)



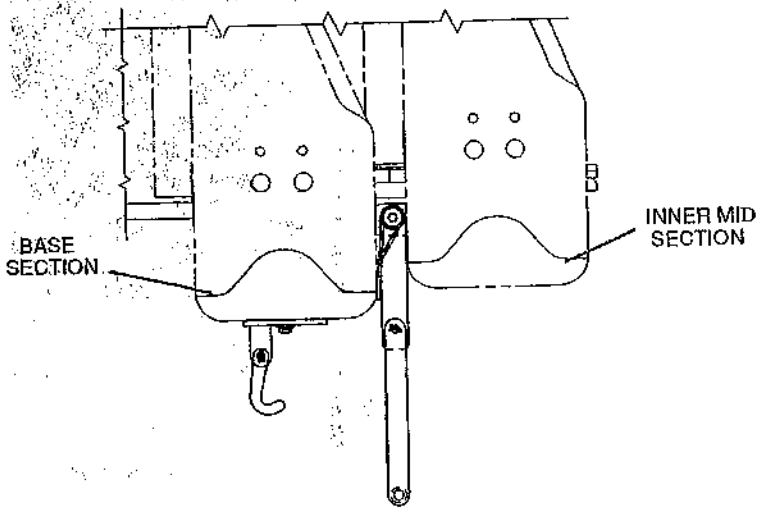
Erecting and Stowing the Telescoping Swingaway Boom Extension (Sheet 3 of 4)



BOOM EXTENSION STOP IN NORMAL POSITION



BOOM EXTENSION STOP IN LATCHED POSITION



FULLY RETRACTED POSITION USED WHEN INSTALLING BOOM EXTENSION

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Erecting and Stowing the Telescoping Swingaway Boom Extension (Sheet 4 of 4)

STOWING

NOTE

The swingaway boom extension must be set at the minimum offset and, if so equipped, the telescoping section must be fully retracted. Refer to SETTING THE TELESCOPING SWINGAWAY OFFSET and/or SETTING THE TELESCOPING EXTENSION LENGTH in this section.

1. Remove the pin and clip pin securing the boom extension alignment device in the stowed position. Pull the alignment device out to the working position and secure it in place with the pin and clip pin.
2. Fully retract the boom and swing to over the rear.
3. Lower the boom to minimum elevation.
4. Remove the cable retainer pins and clip pins from the swingaway tip and mast assembly. Remove the hoist cable from the swingaway sheave and mast. Install the cable retainer pins and clip pins.
5. Remove the mast assembly pin and clip pin securing the mast in the upright position. Lay the mast over to the stowed position and install the mast assembly pin and clip pin.
6. Attach a length of rope to the swingaway tip.
7. Raise the boom to horizontal.
8. Remove the retainer clips and attach pins from the anchor and attach fittings on the left side of the boom nose and stow them in the base of the swingaway.
9. Extend the boom enough so that the swingaway stowage lugs will line up in front of the guide ramps and pins on the stowage brackets when the swingaway is positioned to the side of the boom.

DANGER

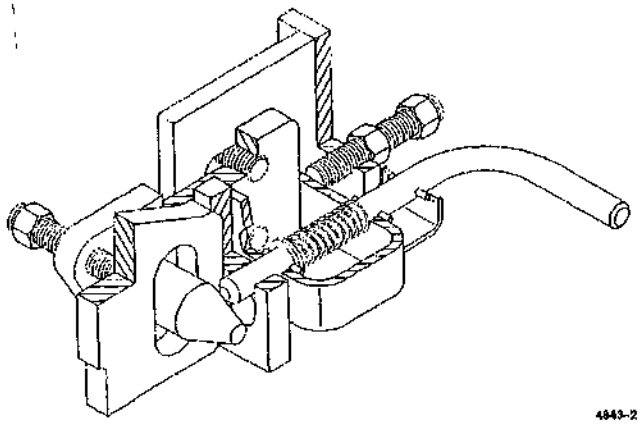
WHEN STOWING THE SWINGAWAY, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE KEPT CLEAR OF THE SWING PATH.

10. Raise and/or lower the boom to help control the swingaway and using the rope attached to the tip of the swingaway, swing the swingaway to the side of the boom.
11. Elevate the boom and push in on the swingaway to align the stowage lugs on the swingaway with the guide ramps and pins on the stowage brackets and fully retract the boom.

DANGER

DURING DISENGAGEMENT OF THE STOP BLOCK, EXTEND THE BOOM ONLY ENOUGH TO FREE THE BLOCK. EXTENDING THE BOOM TOO FAR WILL CAUSE THE SWINGAWAY TO SLIDE OFF THE GUIDE RAMPS AND ALLOW THE SWINGAWAY TO SWING.

12. Lower the boom and extend the boom only enough to disengage the spring-loaded boom extension stop block.
13. Disengage the stop block and fully retract the boom.
14. Install the hitch pin and pin securing the swingaway to the rear stowage bracket.



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15. Install the pin securing the swingaway to the front stowage bracket. Ensure the pin is pushed the whole way in as shown above.
16. Remove the attach pins and retainer clips from the anchor and attach fittings on the right side of the

boom nose and stow them in the base of the swingaway.

17. Remove the clip pin and pin securing the boom extension alignment device. Place the boom extension alignment device in the stowed position and secure it in place with the pin and clip pin.

DANGER

FAILURE TO MAINTAIN THE PROPER CLEARANCE BETWEEN THE SWINGAWAY ANCHOR FITTINGS AND THE BOOM NOSE ATTACH FITTINGS COULD CAUSE THESE FITTINGS TO CONTACT EACH OTHER DURING OPERATION OF THE BOOM.

18. Extend the boom enough to engage the boom stop block.

19. Rig the boom nose and hoist cable as desired and operate the crane using normal operating procedures.

SETTING THE TELESCOPING SWINGAWAY OFFSET

DANGER

ENSURE ANY BLOCKING MATERIAL USED IS ADEQUATE TO SUPPORT THE WEIGHT OF THE SWINGAWAY WITHOUT TIPPING OR FALLING.

1. Extend and set the outriggers and swing the boom to over the rear. Position the boom to above horizontal.

2. Block up under the tip of the swingaway base section.

3. To set the offset from 2 to 30° perform the following procedures.

CAUTION

DO NOT OVERLOAD THE SWINGAWAY ANCHOR FITTINGS OR THE SWINGAWAY BASE SECTION WHEN LOWERING THE BOOM.

a. Slowly lower the boom until the pressure is relieved on the offset pin.

b. Remove the offset pin securing the offset links in the 2° offset position and store it in the stowage lug.

c. Slowly elevate and telescope the boom at the same time so that the swingaway does not move off of the blocking until the offset links take the full weight of the swingaway.

d. Reeve the hoist cable over the mast sheave.

4. To set the offset from 30° back to 2°, perform the following procedures.

CAUTION

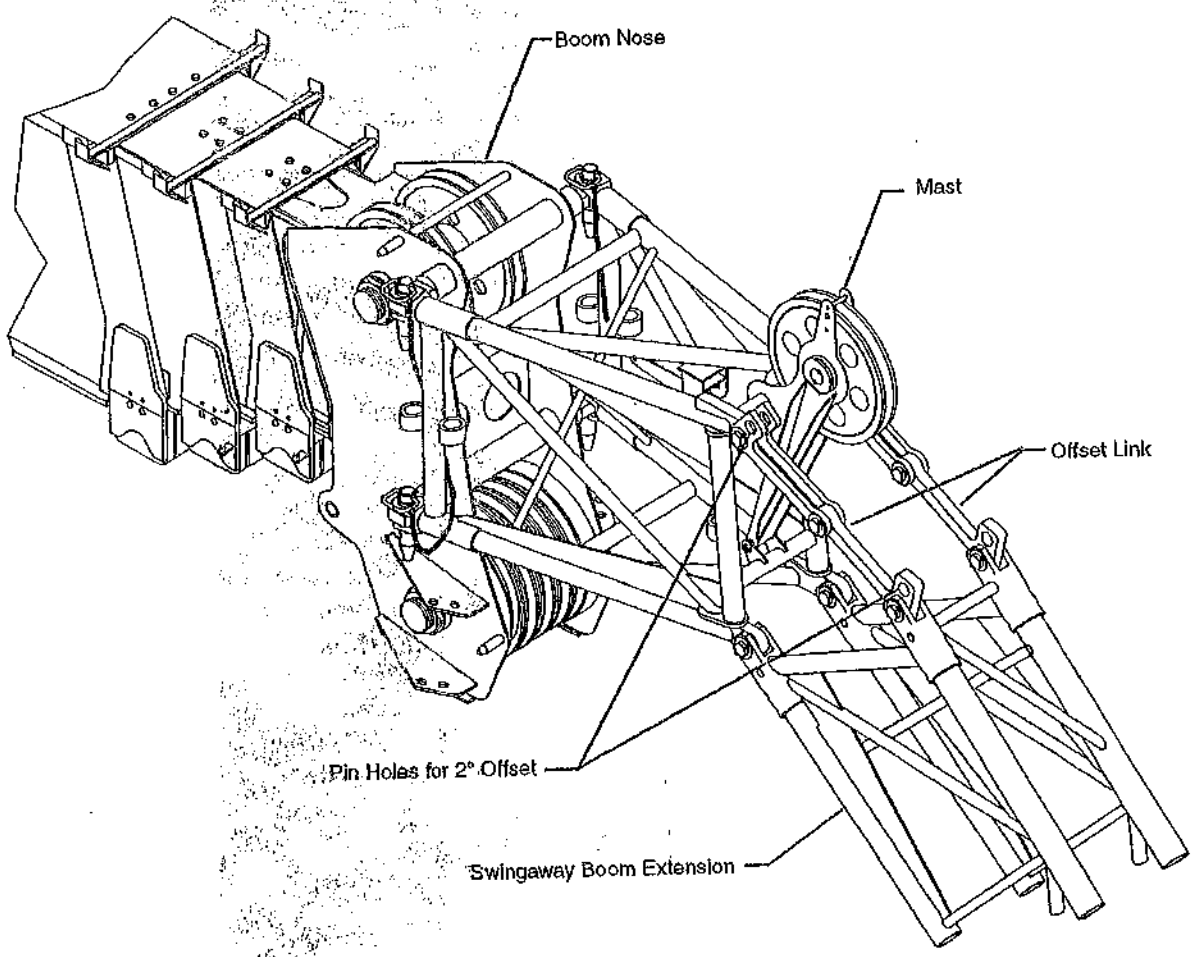
DO NOT OVERLOAD THE SWINGAWAY ANCHOR FITTINGS OR THE SWINGAWAY BASE SECTION WHEN LOWERING THE BOOM.

a. Slowly lower the boom until the pressure is relieved from the offset links (30° offset).

b. Remove the offset pin and lower the boom until the holes for the 2° offset position align with the offset links. Install the offset pin.

c. Slowly elevate and telescope the boom at the same time so that the swingaway does not move off of the blocking until the offset links take the full weight of the swingaway.

d. Reeve the hoist cable as outlined in step 3d.



Shown at 30° Offset

Telescoping Swingaway Offset

SETTING THE TELESCOPING EXTENSION LENGTH

Extending

1. Extend and set the outriggers and swing the boom to over the rear.

NOTE

Depending upon how well the swingaway is lubricated, it might be possible to pull the telescoping section to the desired length without setting the offset. If so, skip step 2 and continue with step 4. It is not desirable to change the offset, perform step 3.

2. Set the swingaway to maximum offset according to the procedures in SETTING THE TELESCOPING SWINGAWAY OFFSET in this section.

3. Loosen the side wear pads on the swingaway until the telescoping section is free.

4. Within the limits of the load chart, extend the boom to at least the length of telescoping swingaway to be extended, and lower the boom until the swingaway sheave touches the ground or is as low as it will go.

DANGER

BEFORE REMOVING THE HITCH PIN AND PIN SECURING THE TELESCOPING SECTION INSIDE THE BASE SECTION, ENSURE THE TELESCOPING SECTION CANNOT SLIDE COMPLETELY OUT OF THE BASE SECTION.

NOTE

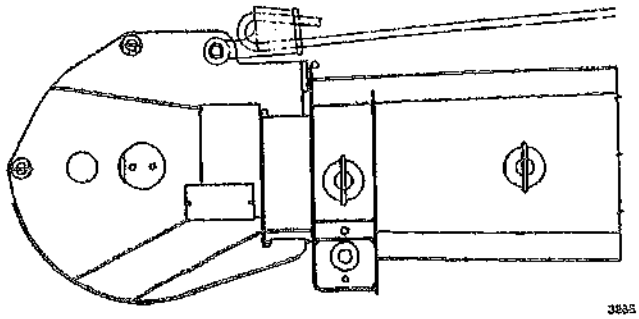
Use the hoist cable to control the extension of the telescoping swingaway.

5. Remove the pin and hitch pin securing the telescoping section to the base section.

6. While controlling the extension of the telescoping swingaway section with the hoist cable, raise and/or retract the boom allowing the section to slide out of the base to the desired length.

7. Install the pin and hitch pin.

8. If the wear pads were loosened, retighten the wear pads to ensure the telescoping section is straight with the base section.



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Retracting

1. Attach the hoist cable to the dead end lug at the front of the swingaway.

2. Remove the pin and hitch pin.

DANGER

WHEN USING THE HOIST CABLE TO PULL THE TELESCOPING SECTION INTO THE SWINGAWAY BASE, DO NOT DAMAGE THE HOIST CABLE OR SWINGAWAY BY PULLING THE SECTION PAST ITS FULLY STOWED POSITION.

CAUTION

IF A BINDING CONDITION OCCURS DURING RETRACTION STOP IMMEDIATELY. RESOLVE THE PROBLEM BEFORE CONTINUING THE RETRACTION OF THE TELESCOPING SECTION.

3. Slowly reel in the hoist cable pulling the section into the swingaway base until the hitch pin can be installed.

ERECTING AND STOWING THE FOLDING SWINGAWAY BOOM EXTENSION

DANGER

BEFORE ATTEMPTING TO ERECT OR STOW THE SWINGAWAY, READ AND STRICTLY ADHERE TO ALL DANGER DECALS INSTALLED ON THE SWINGAWAY AND STOWAGE BRACKETS.

ERECTING

1. Fully extend and set the outriggers.
2. Position the boom over the rear.
3. If extended, fully retract all the boom sections and lower to minimum elevation to permit ease of installation of pins and access to the boom nose.
4. Remove the pin and clip pin securing the boom extension alignment device in the stowed position. Pull the alignment device out to the working position and secure it in place with the pin and clip pin.

NOTE

The auxiliary boom nose (rooster sheave) does not have to be removed.

5. Rig either the main hoist or optional auxiliary hoist cable for single part line with nothing but the becket on the end of the cable.
6. Extend the boom enough to disengage the spring-loaded boom extension stop block.
7. Disengage the spring-loaded boom extension stop block and fully retract the boom.
8. Remove the retainer clips from the attach pins stowed in the base of the swingaway and insert the attach pins through the attach and anchor fittings on the right side of the boom nose. Install the retainer clips in the attach pins.

CAUTION

IF SWINGAWAY FLY SECTION (STINGER) IS NOT TO BE ERECTED, IT SHOULD REMAIN ON THE STOWAGE BRACKETS ON THE SIDE OF THE BOOM.

NOTE

If not erecting the swingaway fly section (stinger) perform steps 9 and 10.

9. Remove retainer clip from attach pin and remove attach pin from base section to fly section attach fittings.
10. Insert attach pin removed in step 9 through lugs on fly section and base end stowage bracket (see detail C). Install retainer clip in attach pin.
11. Remove safety hitch pin and pull down on the latch pin securing the swingaway base to the front stowage bracket (see detail B). Reinstall safety hitch pin to maintain latch pin in down position.
12. Attach a length of rope to the swingaway tip to aid in swinging the swingaway into place ahead of the boom nose.

CAUTION

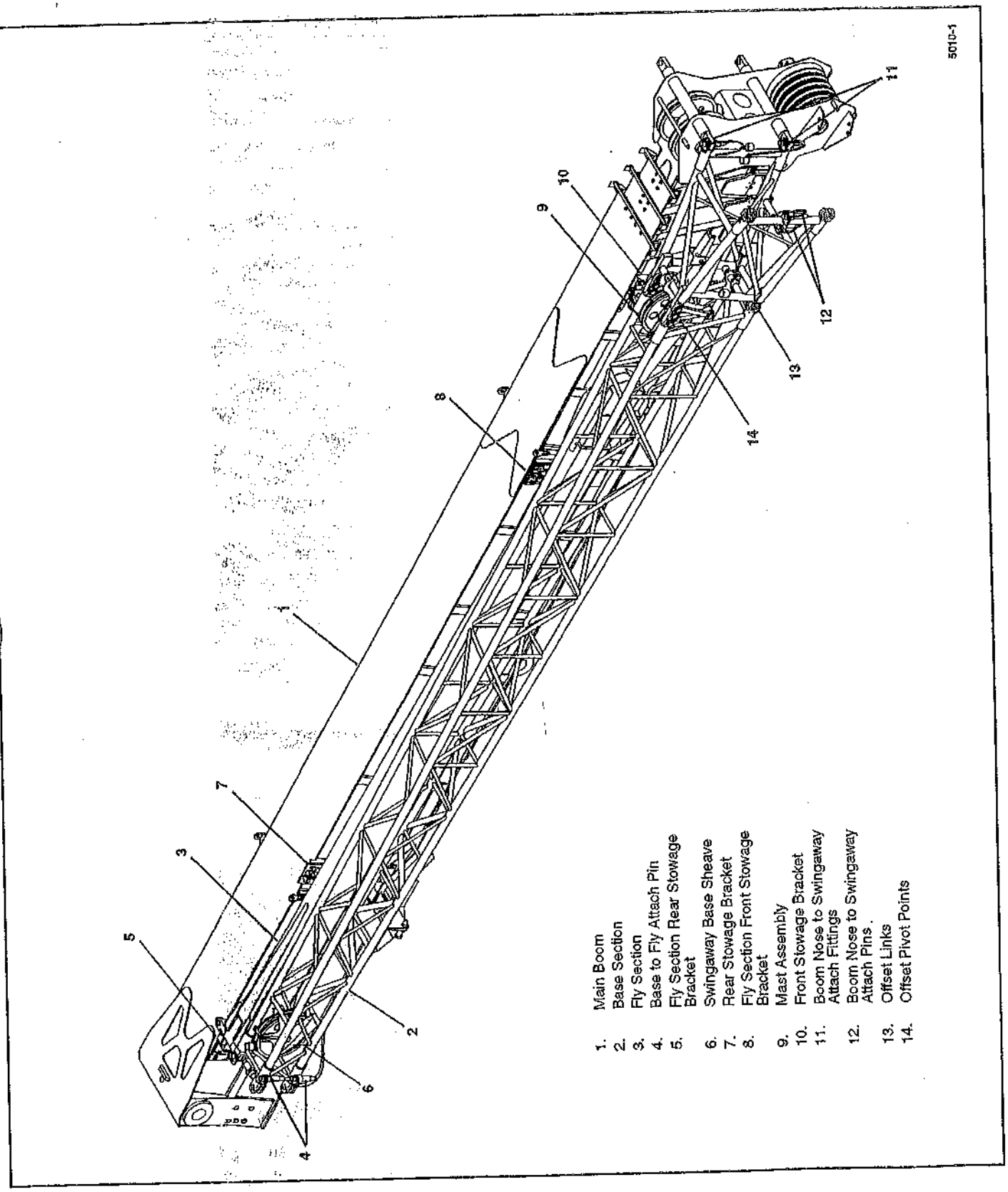
IF THE FLY SECTION REMAINS ON THE SWINGAWAY BASE, DO NOT EXTEND THE SWINGAWAY TOO FAR AS THE NOSE OF THE FLY SECTION COULD CONTACT THE FRONT STOWAGE BRACKET AND CAUSE DAMAGE.

13. Raise the boom to horizontal and extend the boom approximately 46 cm (18 in) so the wear pad will clear the ramp (see detail A).

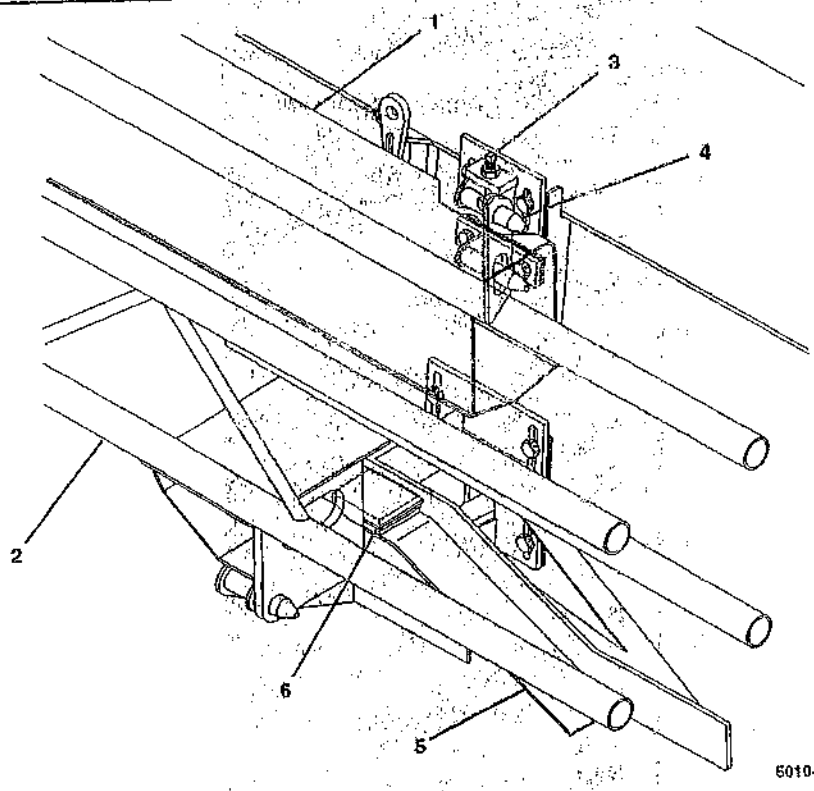
DANGER

WHEN ERECTING THE SWINGAWAY, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE KEPT CLEAR OF THE SWING PATH.

14. Slightly raise and/or lower the boom to help control the swingaway. Using the rope attached to the tip of the swingaway, swing the swingaway into place ahead of the boom nose, engaging the anchor fittings with the attach fittings on the left side of the boom nose.



Erecting and Stowing the Folding Swingaway Boom Extension (Sheet 1 of 9)

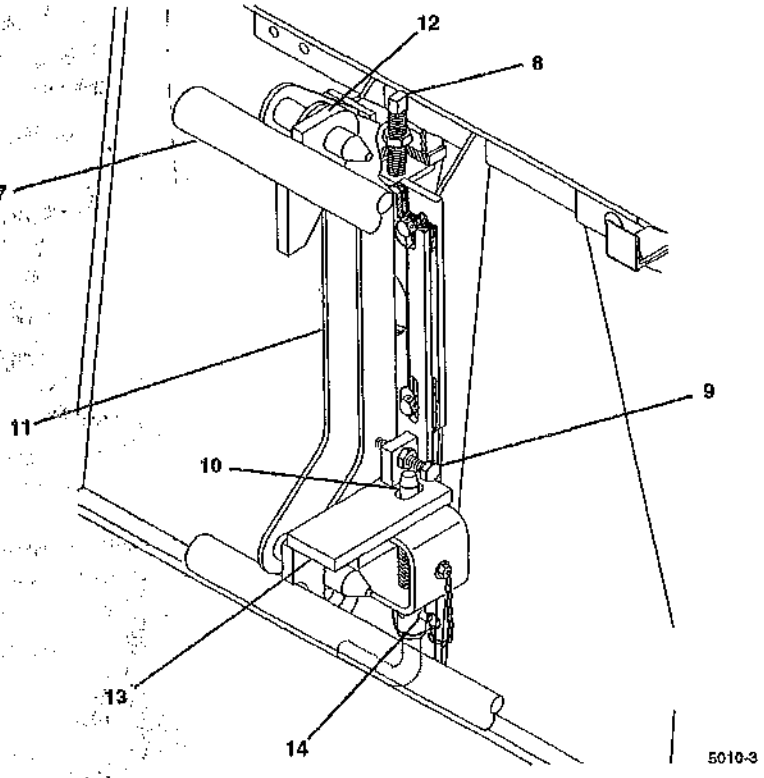


Rear Stowage Bracket

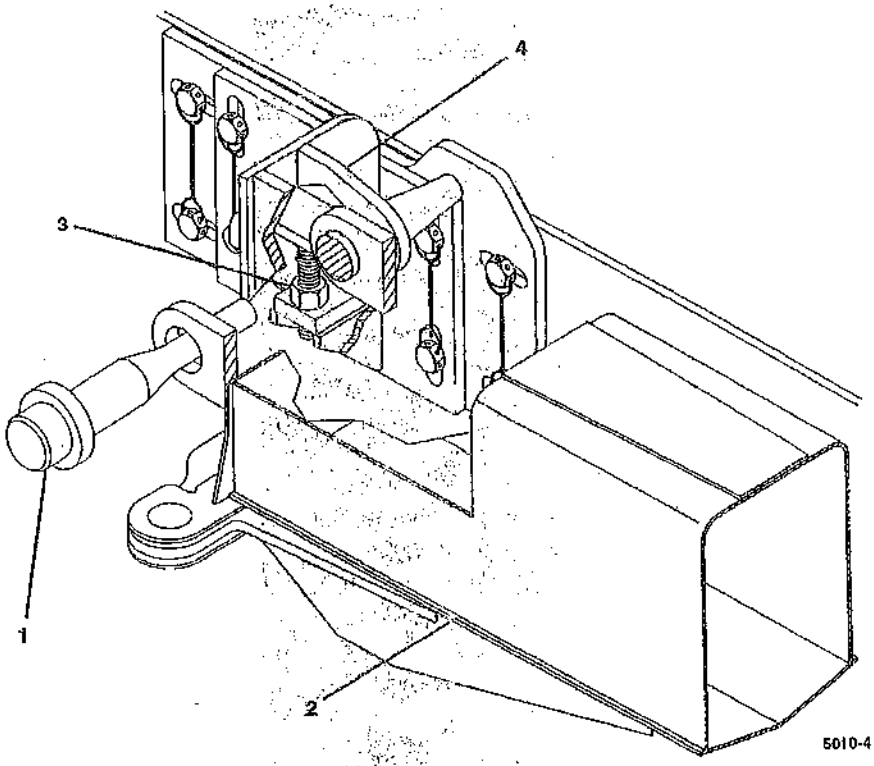
1. Fly Section
2. Base Section
3. Adjusting Screw
4. Pin
5. Ramp
6. Wear Pad

Front Stowage Bracket

7. Base Section
8. Adjusting Screw
9. Adjusting Bolt
10. Spring Loaded Latch Pin
11. Front Hanger
12. Support Plate
13. Support
14. Hitch Pin

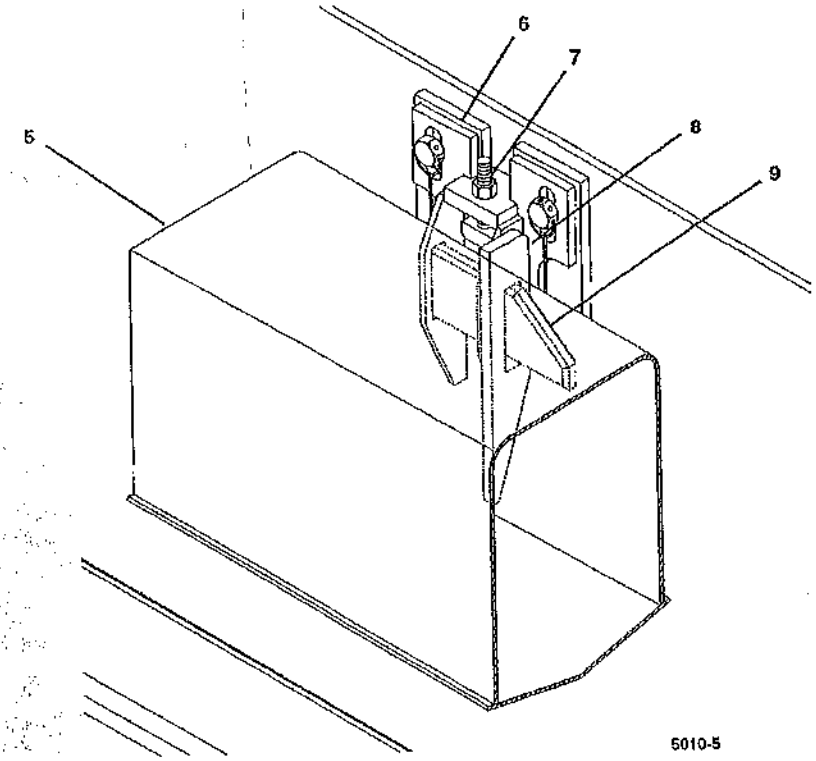


Erecting and Stowing the Folding Swingaway Boom Extension (Sheet 2 of 9)



Fly Section Rear Stowage Bracket

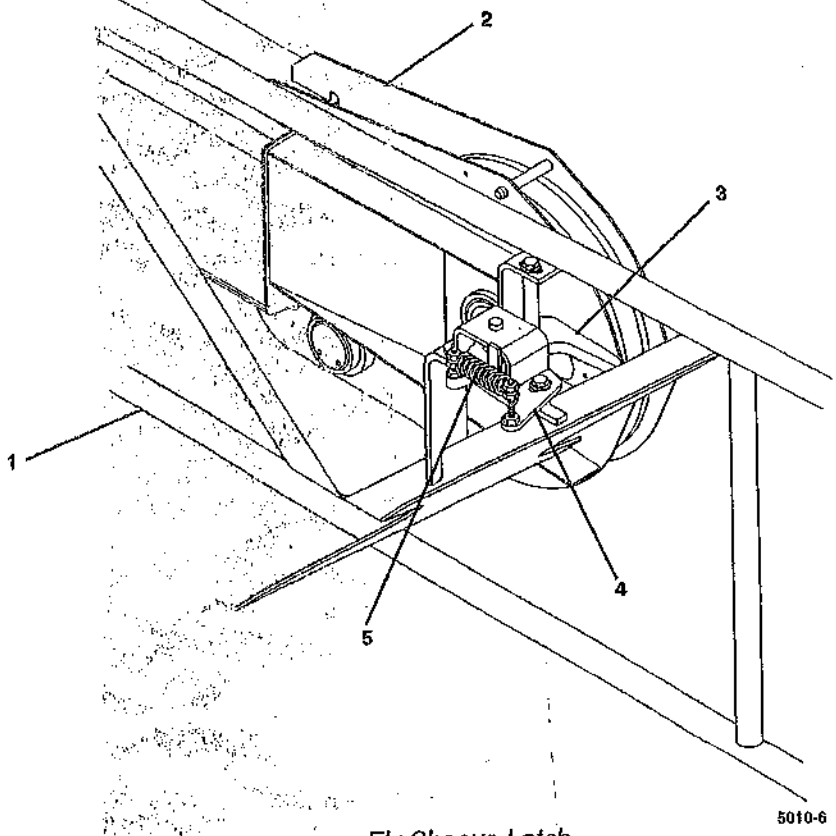
1. Fly to Base Attach Pin
2. Fly Section
3. Adjusting Bolt
4. Stowage Bracket



Fly Section Front Stowage Bracket

5. Fly Section
6. Stowage Bracket
7. Adjusting Screw
8. Hanger
9. Slider

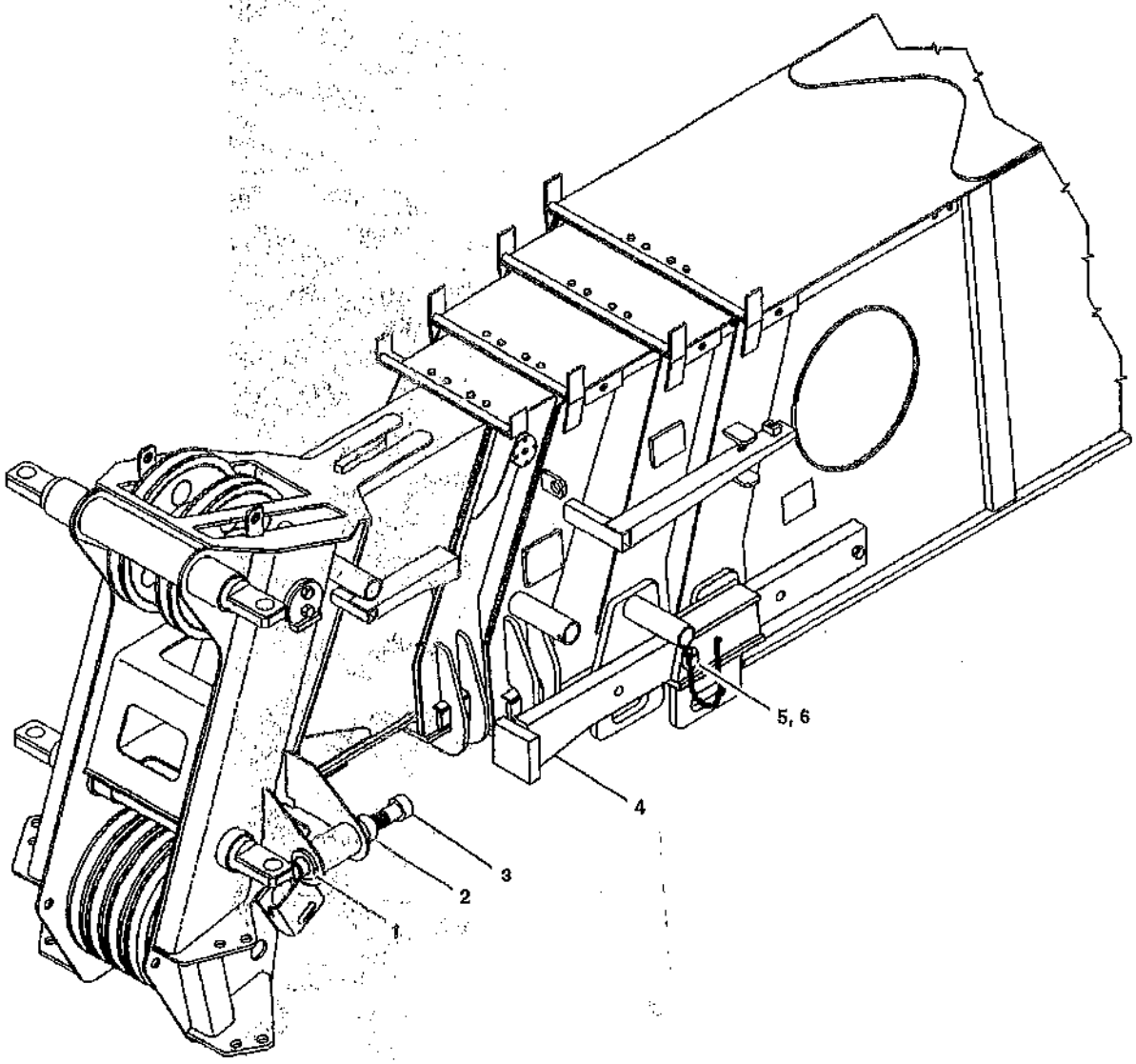
Erecting and Stowing the Folding Swingaway Boom Extension (Sheet 3 of 9)



Fly Sheave Latch

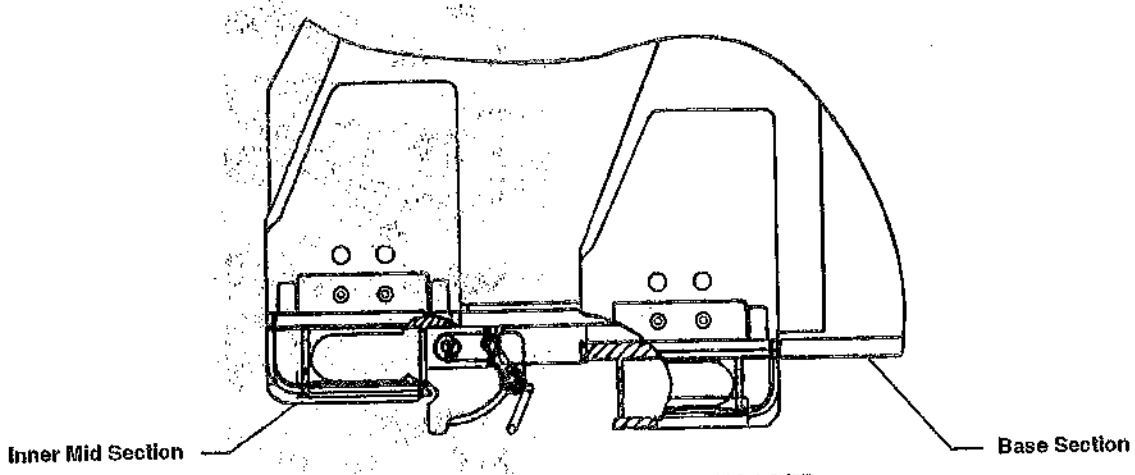
1. Base Section
2. Fly Section
3. Latch Hook
4. Latch Housing
5. Spring

Erecting and Stowing the Folding Swingaway Boom Extension (Sheet 4 of 9)

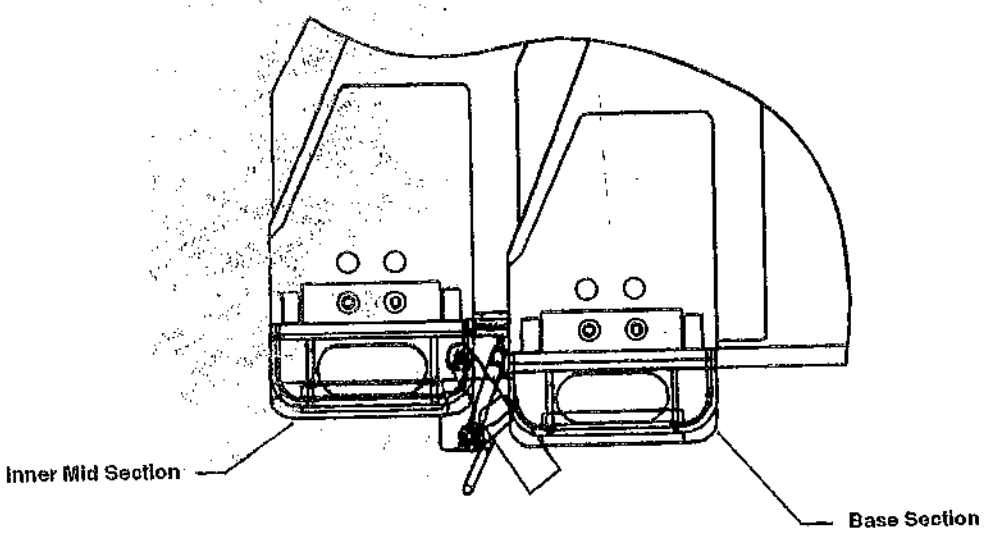


1. Pusher Bar
2. Clamp
3. Adjustment Bar
4. Push Bar Assembly
5. Hitch Pin
6. Clip Pin

Erecting and Stowing the Folding Swingaway Boom Extension (Sheet 5 of 9)



BOOM EXTENSION STOP ENGAGED



BOOM EXTENSION STOP DISENGAGED

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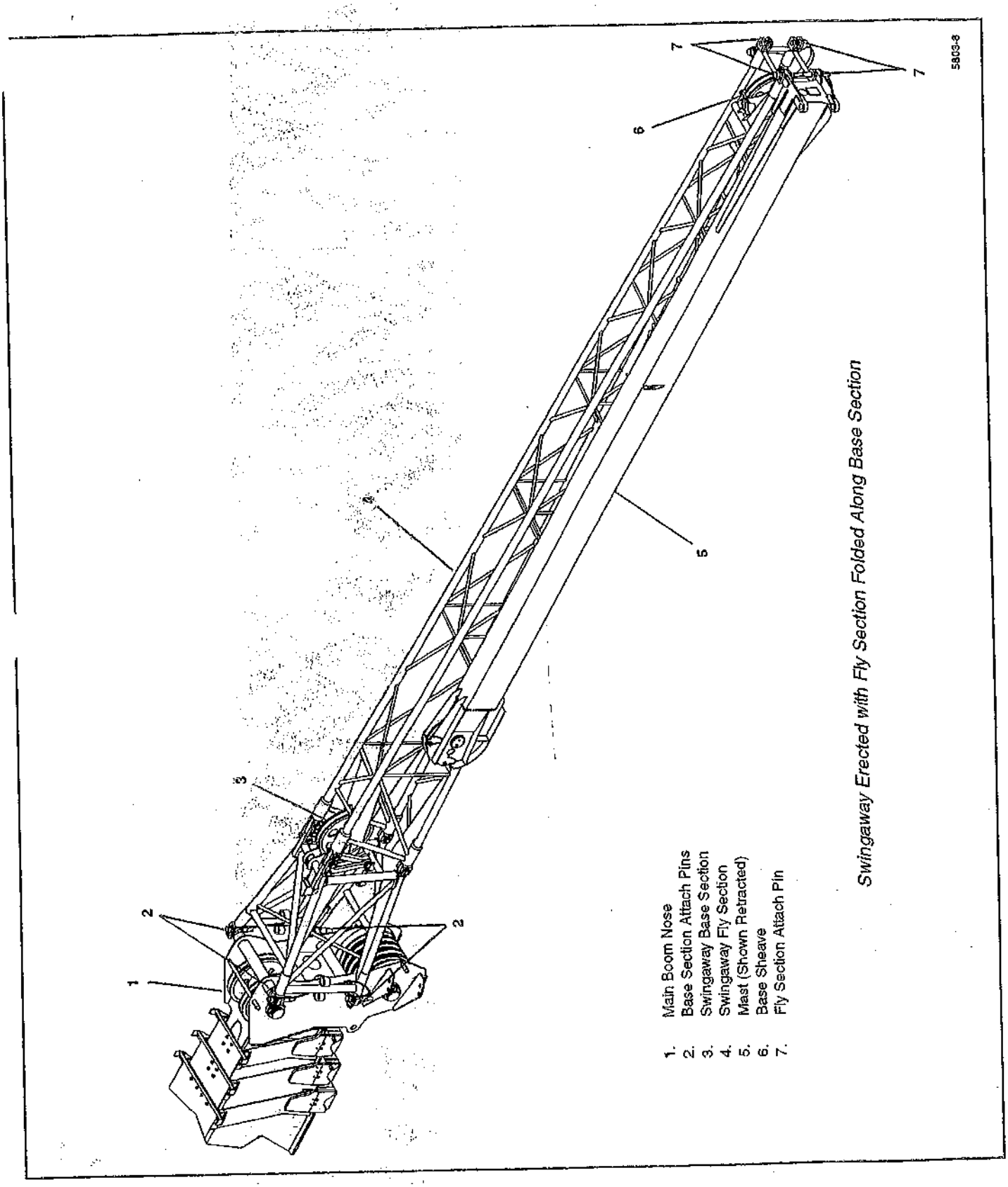
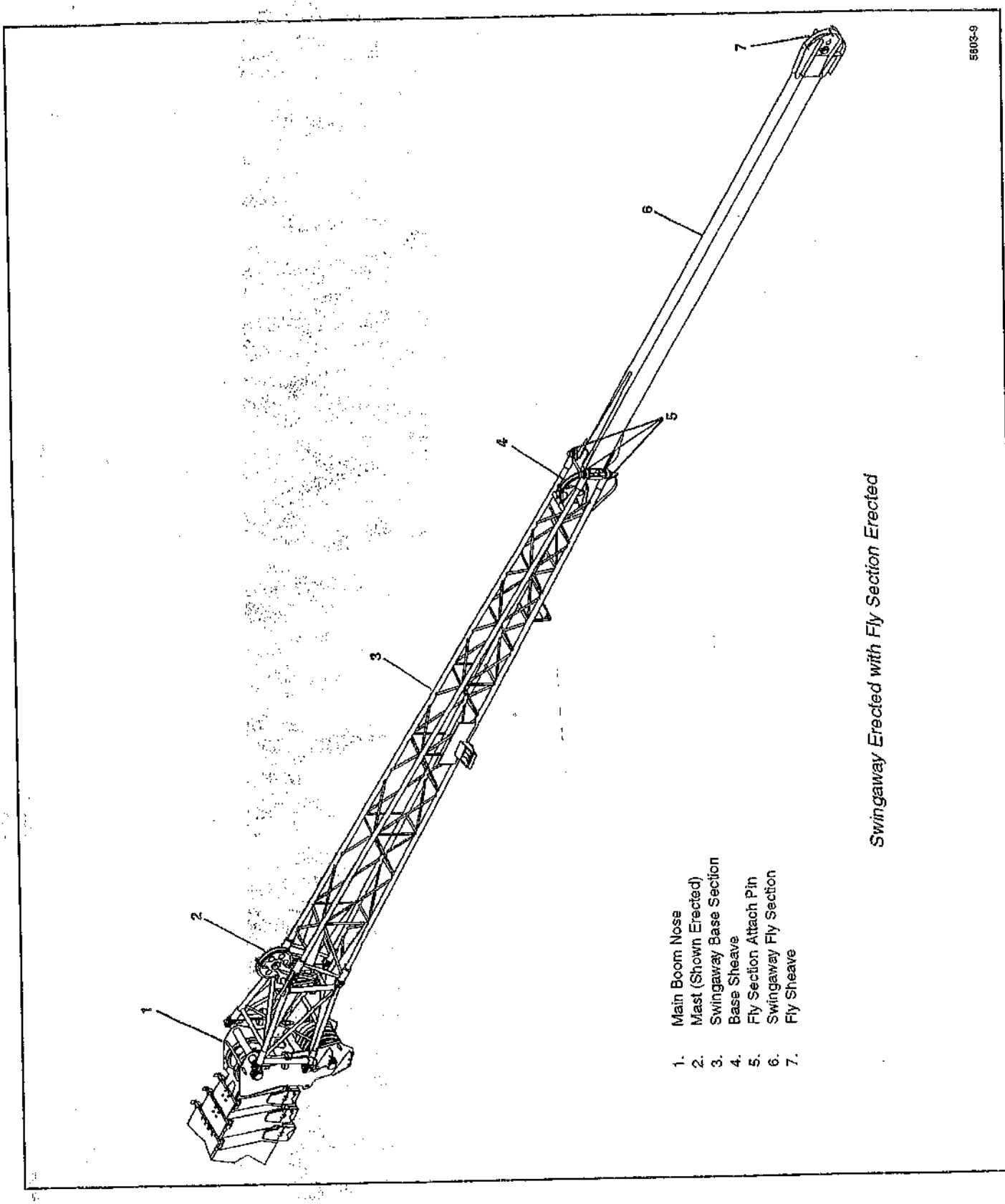
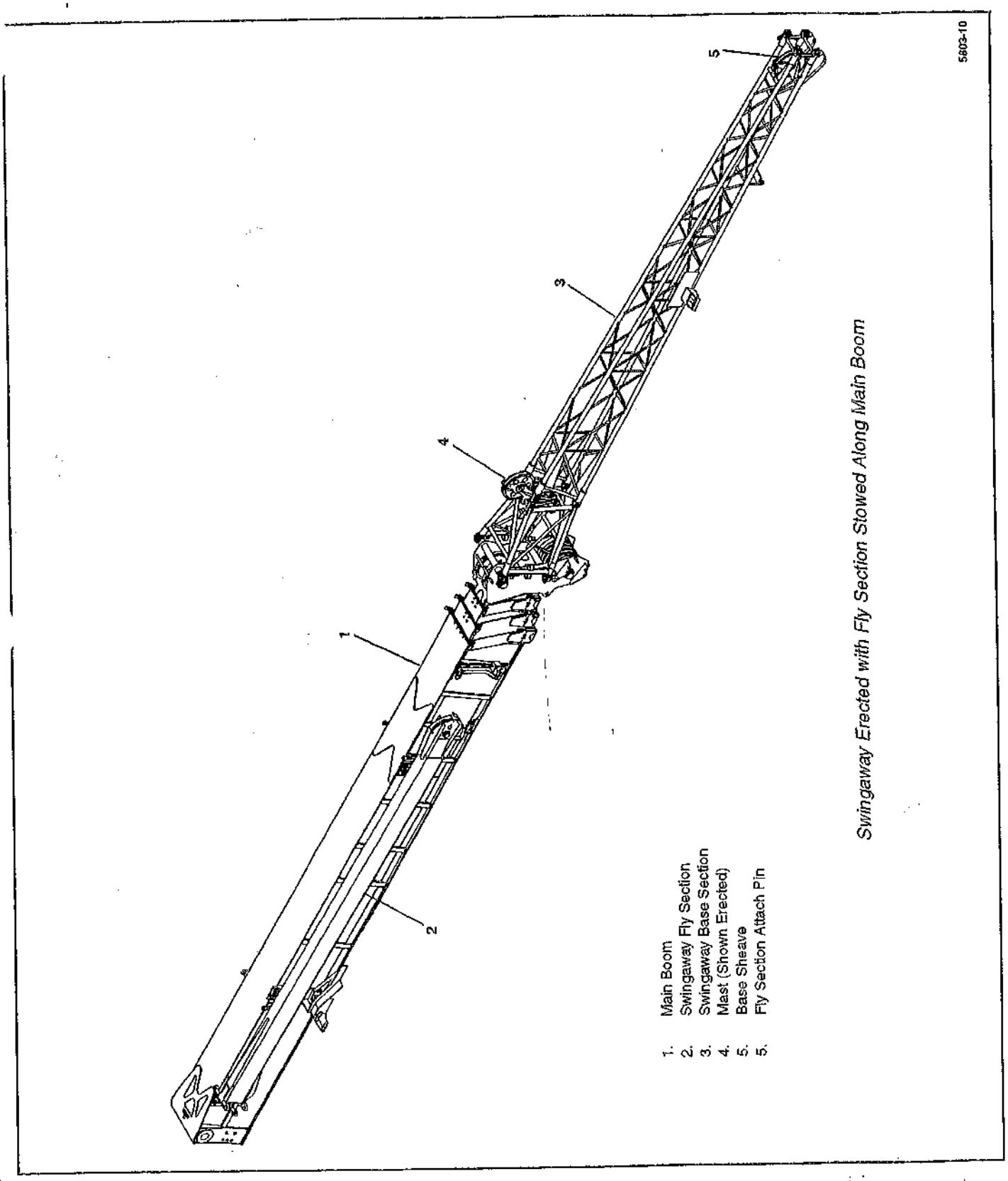
Erecting and Stowing the Folding Swingaway Boom Extension (Sheet 6 of 9)



Erecting and Stowing the Folding Swingaway Boom Extension (Sheet 7 of 9)



Erecting and Stowing the Folding Swingaway Boom Extension (Sheet 8 of 9)



Erecting and Stowing the Folding Swingaway Boom Extension (Sheet 9 of 9)

DANGER

DO NOT MODIFY THE ATTACH POINTS TO PERMIT THE INSTALLATION OF THE ATTACH PINS.

15. Install the attach pin into the upper anchor and attach fitting on the left side of the boom nose. Install retainer clip in attach pin.

NOTE

If the boom extension alignment device does not properly align the anchor and attach fittings to allow installation of the attach pin, refer to the Service Manual and adjust the boom extension alignment device.

16. Fully retract the boom until the bottom swingaway anchor fitting is against the boom extension alignment device. Install the attach pin in the lower anchor and attach fittings on the left side of the boom nose. Install the retainer clip in the attach pin.

17. Lower the boom and remove the rope from the tip of the swingaway base.

18. Remove the pin and clip pin securing the boom extension alignment device in the working position. Push the alignment device back to the stowed position and secure it in place with the pin and clip pin.

DANGER

DO NOT ATTEMPT TO ERECT THE FLY SECTION UNLESS IT WAS ATTACHED TO THE BASE SECTION DURING THE INITIAL ERECTION PROCEDURE.

19. Erect the swingaway fly section as follows:

    a. Attach a length of rope to the tip of the swingaway fly section to aid in swinging the fly into place ahead of the base section.

    b. Raise the boom to horizontal.

    c. At the fly section stowage bracket on the swingaway base section (see detail D) push in on the spring-loaded latch hook to release the fly section.

DANGER

WHEN ERECTING THE SWINGAWAY FLY SECTION, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE KEPT CLEAR OF THE SWING PATH.

    d. Slightly raise and/or lower the boom to help control the swingaway fly. Using the rope attached to the tip of the fly section, swing the fly into place ahead of the swingaway base, engaging the anchor fittings with the attach fittings on the left side of the base section.

    e. Install the attach pin into the anchor and attach fittings on the left side of the base section.

    f. Lower the boom and remove the rope from the tip of the swingaway.

NOTE

Refer to SETTING THE FOLDING SWINGAWAY OFFSET in this section to obtain a 25 or 45° offset with the swingaway.

20. Remove the cable retainer pins and clip pins from the tip of the swingaway.

21. Remove the mast assembly clip pin and pin from the stowed position on the swingaway and raise the mast assembly to an upright position. Install the pin and clip pin. Remove the cable retainer pin and clip pin from the mast.

22. Route the hoist cable over the mast sheave and the sheave on the swingaway tip. Install the cable retainer pins and clip pins.

23. Rig the hoist cable.

TOWING

NOTE

The swingaway boom extension must be set at the minimum offset. Refer to SETTING THE FOLDING SWINGAWAY OFFSET in this section.

NOTE

If so equipped, the folding fly section must be stowed on the side of the base section.

1. Fully retract the boom and swing to over the rear.
2. Lower the boom to minimum elevation.
3. Remove the cable retainer pins and clip pins from the swingaway tip and mast assembly. Remove the hoist cable from the swingaway sheave and mast. Install the cable retainer pins and clip pins.
4. Remove the mast assembly pin and clip pin securing the mast in the upright position. Lay the mast over to the stowed position and install the mast assembly pin and clip pin.
5. If erected, stow the swingaway fly section as follows:
   a. Attach a length of rope to the swingaway tip.
   b. Raise the boom to horizontal.
   c. Remove the retainer clip and attach pin from the anchor and attach fittings on the left side of the base section and stow in the base section.

DANGER

WHEN STOWING THE SWINGAWAY FLY, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE KEPT CLEAR OF THE SWING PATH.

   d. Slightly raise and/or lower the boom to help control the swingaway fly. Using the rope attached to the tip of the fly section, swing the fly to the side of the base section.
   e. Elevate the boom and push in on the fly section to engage the spring-loaded latch (see detail D) on the base section. Ensure the latch is properly engaged.
   f. Lower the boom and remove the rope from the fly section.
6. Remove the pin and clip pin securing the boom extension alignment device in the stowed position. Pull the alignment device out to the working position and secure it in place with the pin and clip pin.
7. Lower the boom to minimum elevation.
8. Attach a length of rope to the swingaway tip.
9. Raise the boom to horizontal.
10. Remove the retainer clips and attach pins from the anchor and attach fittings on the left side of the boom nose and stow them in the base of the swingaway.
11. Extend the boom approximately 46 cm (18 in) so that the swingaway base and fly stowage lugs will line up in front of the guide ramps and pins on the stowage brackets when the swingaway is positioned to the side of the boom.

DANGER

WHEN STOWING THE SWINGAWAY, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE KEPT CLEAR OF THE SWING PATH.

12. Raise and/or lower the boom to help control the swingaway and using the rope attached to the tip of the swingaway, swing the swingaway to the side of the boom.
13. Elevate the boom and push in on the swingaway to align the stowage lugs on the swingaway with the guide ramps and pins on the stowage brackets and fully retract the boom.

DANGER

DURING DISENGAGEMENT OF THE STOP BLOCK, EXTEND THE BOOM ONLY ENOUGH TO FREE THE BLOCK.

EXTENDING THE BOOM TOO FAR WILL CAUSE THE SWINGAWAY TO SLIDE OFF THE GUIDE RAMPS AND ALLOW THE SWINGAWAY TO SWING.

14. Lower the boom and extend the boom only enough to disengage the spring-loaded boom extension stop block.

15. Disengage the stop block and fully retract the boom.

16. Ensure that all the stowage lugs on the base and fly are fully engaged with the pins on the stowage brackets.

17. Install the latch pin securing the swingaway base to the front stowage bracket (see detail B). Ensure the pin is pushed all the way up in the locked position. Insert the safety hitch pin.

NOTE

If the swingaway fly section remained on the boom stowage brackets, perform steps 18 and 19.

18. Remove retainer clip and attach pin from lugs on fly section and base end stowage bracket (see detail C).

19. Insert the attach pin into the base section to fly section attach fittings and install the retainer pin.

20. Remove the retainer clips and attach pins from the anchor and attach fittings on the right side of the boom nose and stow them in the base of the swingaway.

21. Remove the clip pin and pin securing the boom extension alignment device. Place the boom extension alignment device in the stowed position and secure it in place with the pin and clip pin.

DANGER

FAILURE TO MAINTAIN THE PROPER CLEARANCE BETWEEN THE SWINGAWAY ANCHOR FITTINGS AND THE BOOM NOSE ATTACH FITTINGS COULD CAUSE THESE FITTINGS TO CONTACT EACH OTHER DURING OPERATION OF THE BOOM.

22. Extend the boom enough to engage the boom stop block.

23. Rig the boom nose and hoist cable as desired and operate the crane using normal operating procedures.

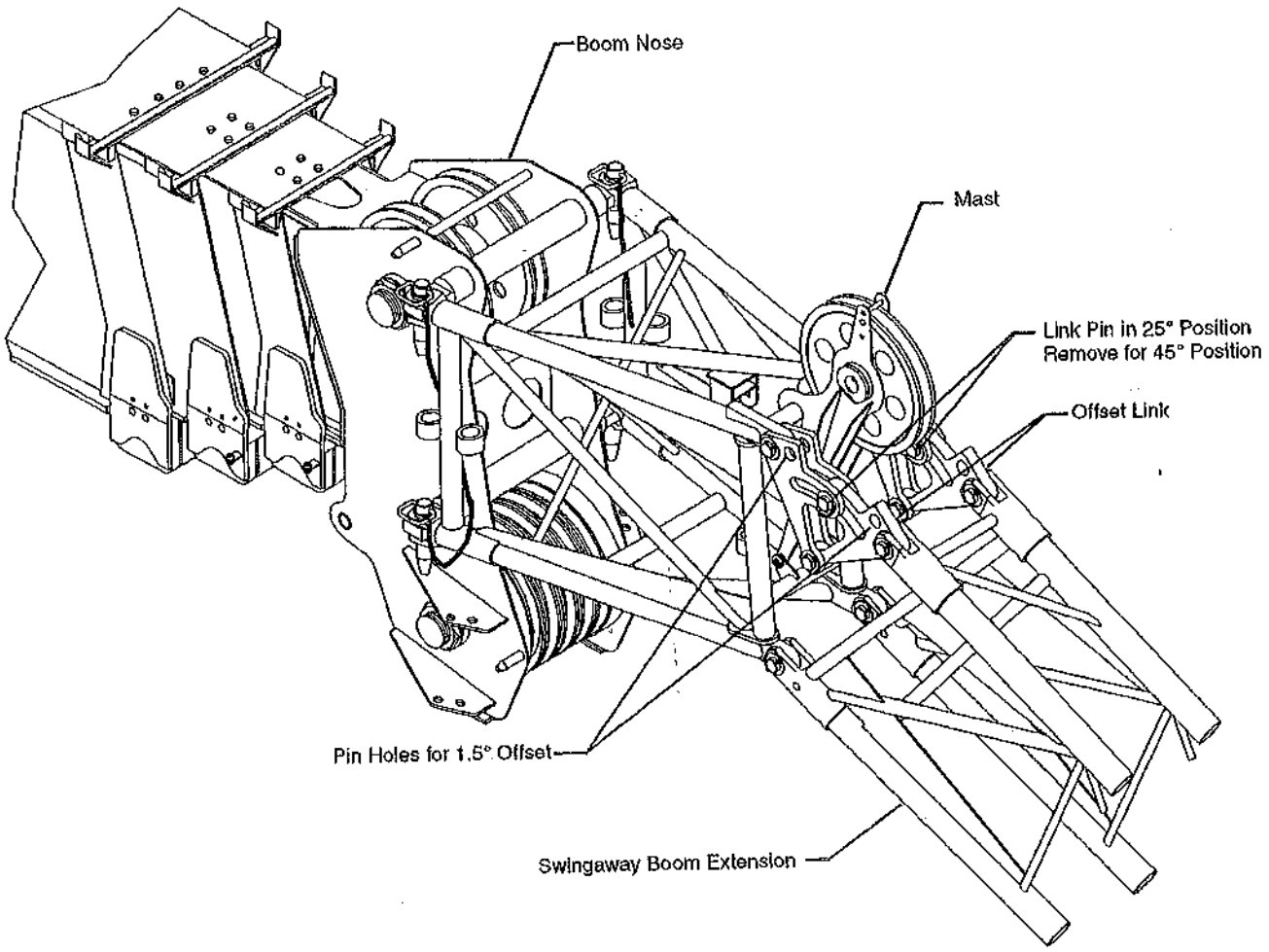
SETTING THE FOLDING SWINGAWAY OFFSET.

DANGER

ENSURE ANY BLOCKING MATERIAL USED IS ADEQUATE TO SUPPORT THE WEIGHT OF THE SWINGAWAY WITHOUT TIPPING OR FALLING.

1. Extend and set the outriggers and swing the boom to over the rear. Position the boom to above horizontal.

2. Block up under the tip of the swingaway base section.



Shown at 25° Offset

Folding Swingaway Offset Positions

3. To set the offset from a lesser degree to higher degree perform the following procedures.

CAUTION

DO NOT OVERLOAD THE SWINGAWAY ANCHOR FITTINGS OR THE SWINGAWAY BASE SECTION WHEN LOWERING THE BOOM.

a. Slowly lower the boom until the pressure is relieved on the offset link pins.

b. Remove the offset link clip pins and attach pins securing the offset links in the lesser degree offset position. If going to maximum offset stow them in the stowage lugs. If going to the intermediate (25°) offset install them in the offset links for that degree of offset.

c. Slowly elevate and telescope the boom at the same time so that the swingaway does not move off of the blocking until the offset links take the full weight of the swingaway.

d. Reeve the hoist cable as described under normal erecting procedures.

4. To set the offset from higher degree to lesser degree, perform the following procedures.

CAUTION

DO NOT OVERLOAD THE SWINGAWAY ANCHOR FITTINGS OR THE SWINGAWAY BASE SECTION WHEN LOWERING THE BOOM.

a. Slowly lower the boom until the pressure is relieved from the offset links.

b. Remove the offset link clip pins and attach pins and lower the boom until the holes for the lesser degree offset position align in the offset links. Install the offset pins and clip pins.

c. Slowly elevate and telescope the boom at the same time so that the swingaway does not move off of the blocking until the offset links take the full weight of the swingaway.

d. Reeve the hoist cable as described under normal erecting procedures.

ERECTING AND STOWING THE SWING-AWAY LUFFING BOOM EXTENSION

DANGER

BEFORE ATTEMPTING TO ERECT OR STOW THE SWINGAWAY, READ AND STRICTLY ADHERE TO ALL DANGER DECALS INSTALLED ON THE SWINGAWAY AND STOWAGE BRACKETS.

ERECTING

1. Fully extend and set the outriggers.

NOTE

Refer to ERECTING AND STOWING THE FOLDING SWINGAWAY BOOM EXTENSION in this section to position the swing-away luffing boom extension.

NOTE

The auxiliary boom nose (rooster sheave) does not have to be removed.

2. Attach the swingaway luffing boom extension to the end of the main boom.

3. Connect the hydraulic lines from the luffing boom extension to the quick couplers on the boom nose.

STOWING

NOTE

The swingaway boom extension must be set at the minimum offset. Refer to SETTING THE LUFFING BOOM EXTENSION OFFSET in this section.

NOTE

If so equipped, the folding fly section must be stowed on the side of the base section.

1. Disconnect the hydraulic lines at the boom nose. Install the caps and plugs on the hydraulic lines.

NOTE

Refer to ERECTING AND STOWING THE FOLDING SWINGAWAY BOOM EXTENSION in this section to position the swingaway luffing boom extension.

2. Stow the luffing boom extension.

SETTING THE LUFFING BOOM EXTENSION OFFSET

DANGER

NEVER ATTEMPT TO CHANGE THE LUFFING BOOM EXTENSION OFFSET WITH A LOAD ATTACHED TO THE LINE.

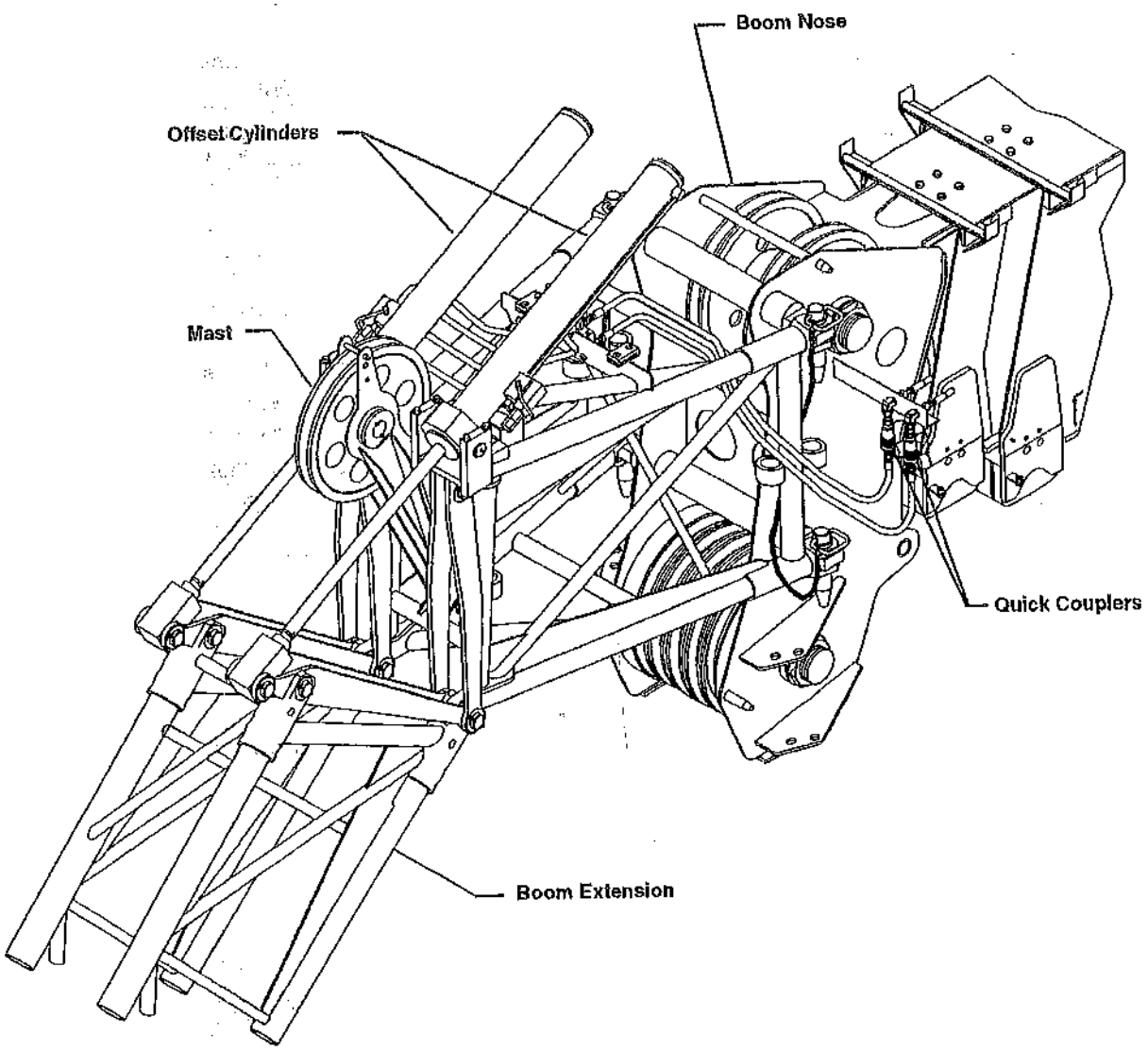
1. Remove any load attached to the load line.

DANGER

WHEN ERECTING THE SWINGAWAY FLY SECTION, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE KEPT CLEAR OF THE SWING PATH.

2. Raise the boom above horizontal sufficiently to allow the nose of the boom extension to be lowered without contacting the ground.

3. Move the luffing boom extension offset switch, located on the right side of the seat, down or up to increase or decrease the offset to the desired position. The luffing boom extension may be adjusted to any position between 0 and 45° offset.



Luffing Boom Extension Offset

REMOVABLE COUNTERWEIGHT

NOTE

The removable counterweight consists of up to three major pieces [1361 kg (3000 lb), 2495 kg (5500 lb), and 4309 kg (9500 lb)]. The following procedures are applicable for removal and installation of any or all pieces.

MOUNTING THE COUNTERWEIGHT

1. Fully extend and set the outriggers.
2. Rotate and align the rear of the superstructure above the removable counterweight stowed on the carrier deck. Engaging the pin type turntable lock will aid alignment.
3. Using the counterweight removal controls located on the left side of the turntable, lower the counterweight cylinders. Pin the cylinders to the counterweight using the clevis pins in the cylinders. Insert the retaining pins in the clevis pins.
4. Remove the long pins from the counterweight and carrier frame lugs.
5. Using the controls, raise the counterweight up under the superstructure frame.

NOTE

It may be necessary to jog the control switch to install the upper clevis pins.

6. Remove the clevis pins and lock pins from the stowage bushings and install them into the upper counterweight and superstructure frame lugs.
7. Insert the lock pins through the lugs to lock the clevis pins in place. Insert the retaining pins through the lock pins.
8. Insert long pins into the bottom of the counterweight.
9. Insert the lock pins through the lugs to lock the long pins in place. Insert the retaining pins through the lock pins.
10. The crane is now ready for operation with the counterweight installed.

STOWING THE COUNTERWEIGHT

1. Fully extend and set the outriggers.
2. Rotate the superstructure to align the counterweight with the stowage area. Engaging the pin type turntable lock will aid alignment.

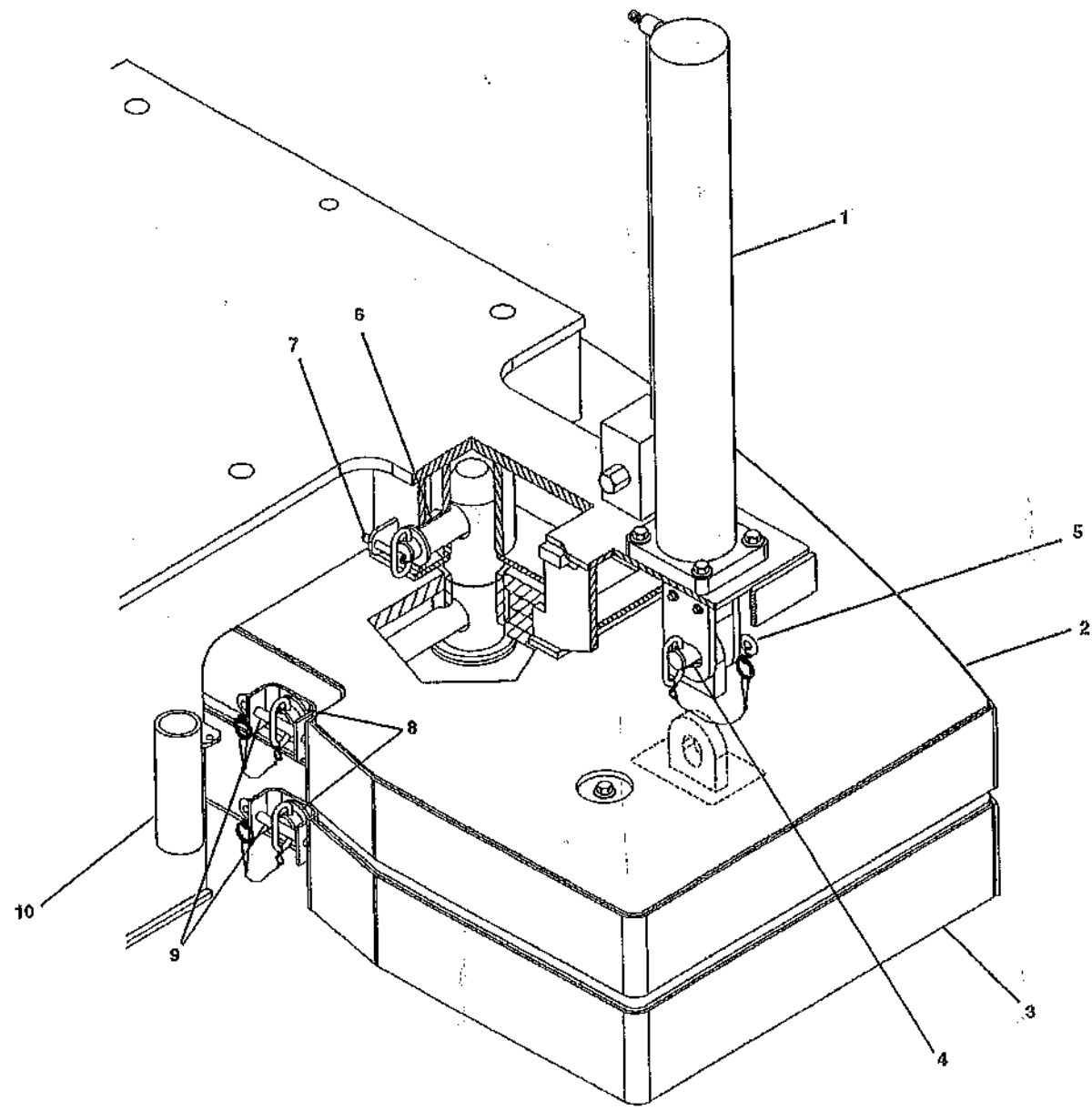
DANGER

ENSURE THAT ALL MOUNTING PINS ARE PROPERLY INSTALLED AND LOCKED WITH CLIP PINS BEFORE, DURING, AND AFTER OPERATING THE COUNTERWEIGHT REMOVAL SYSTEM.

NOTE

It may be necessary to jog the counterweight removal control to remove the weight of the counterweight from the upper clevis pins.

3. Using the counterweight removal control, raise the counterweight cylinders to relieve weight on the upper clevis pins and remove the lock pins and upper clevis pins from the superstructure frame lugs and the counterweight
4. Stow the upper clevis pins in the bushings on the side of the superstructure.
5. Remove the lock pins and long pins from the bottom of the counterweight.
6. Using the removal control, slowly lower the counterweight onto the carrier stowage area.
7. Insert the long pins through the carrier lugs and counterweight.
8. Insert the lock pins through the lugs to lock the long pins into place and install the retaining pins through the lock pins.
9. Remove the clevis pin from the counterweight lugs and cylinder ends. Raise the cylinders and stow the clevis pins in cylinder and insert retainer clip pins.
10. The carrier is now ready for highway travel with the counterweight stowed.



8500 lb. Configuration Shown

1. Removal Cylinder
2. 3000 lb. Counterweight
3. 5500 lb. Counterweight
4. Cylinder Clevis Pin
5. Retaining Pin
6. Upper Clevis Pin
7. Locking Pin
8. Long Pin
9. Locking Pin
10. Storage Bushing for Items 6 & 7

5813

Removable Counterweight

GROVE

OPERATOR'S, AND SAFETY HANDBOOK SUPPLEMENT

S/N 222789

PUBLISHED: AUGUST, 2001

This Supplement must be added to all Crane Operator's and Safety Handbooks and Service Manuals. If the Service Manual has a section on Temperature Effects on Hydraulic Cylinders in the Hydraulic System section (2-8), this supplement will be replace it.

TEMPERATURE EFFECTS ON HYDRAULIC CYLINDERS

Hydraulic oil expands when heated and contracts when cooled. This is a natural phenomena that happens to all liquids. The coefficient of expansion for API Group 1 hydraulic oil is approximately 0.00043 cubic inches per cubic inch of volume for 1°F of temperature change. **Thermal contraction will allow a cylinder to retract as the hydraulic fluid which is trapped in the cylinder cools.** The change in the length of a cylinder is proportional to the extended length of the cylinder and to the change in temperature of the oil in the cylinder. For example, a cylinder extended 25 feet in which the oil cools 60°F would retract approximately 7 3/4 inches (see chart below). A cylinder extended 5 feet in which the oil cools 60°F would only retract approximately 1 1/2 inches. The rate at which the oil cools depends on many factors and will be more noticeable with a larger difference in oil temperature verses the ambient temperature.

Thermal contraction coupled with improper lubrication or improper wear pad adjustments may, under certain conditions, cause a "stick-slip" condition in the boom. This "stick-slip" condition could result in the load not moving smoothly. Proper boom lubrication and wear pad adjustment is important to permit the boom sections to slide freely. Slow movement, of the boom may be undetected by the operator unless a load is suspended for a long period of time.

If a load and the boom is allowed to remain stationary for a period of time and the ambient temperature is cooler than the trapped oil temperature, the trapped oil in the cylinders will cool. The load will lower as the telescope cylinder(s) retracts allowing the boom to come in. Also, the boom angle will decrease as the lift cylinder(s) retracts causing an increase in radius and a decrease in load height.

This situation will also occur in reverse. If a crane is set up in the morning with cool oil and the daytime ambient temperature heats the oil, the cylinders will extend in similar proportions.

The chart below has been prepared to assist you in determining the approximate amount of retraction/extension that may be expected from a hydraulic cylinder as a result of change in the temperature of the hydraulic oil inside the cylinder. The chart is for dry rod cylinders. If the cylinder rod is filled with hydraulic oil, the contraction rate is somewhat greater.

NOTE

Operators and service personnel must be aware that load movement, as a result of this phenomena, can be easily mistaken as leaking cylinder seals or faulty holding valves. If leaking seals or faulty holding valves are suspected to be the problem, refer to Service Bulletin 98-036 dealing with testing telescope cylinders.

BOOM DRIFT CHART (Cylinder length change in inches)

Coeff. = 0.00043 ($in^3/in^3/°F$)

STROKE (FT.)	Temperature Change (°F)									
	10	20	30	40	50	60	70	80	90	100
5	0.26	0.52	0.77	1.03	1.29	1.55	1.81	2.06	2.32	2.58
10	0.52	1.03	1.55	2.06	2.58	3.10	3.61	4.13	4.64	5.16
15	0.77	1.55	2.32	3.10	3.87	4.64	5.42	6.19	6.97	7.74
20	1.03	2.06	3.10	4.13	5.16	6.19	7.22	8.26	9.29	10.32
25	1.29	2.58	3.87	5.16	6.45	7.74	9.03	10.32	11.61	12.90
30	1.55	3.10	4.64	6.19	7.74	9.29	10.84	12.38	13.93	15.48
35	1.81	3.61	5.42	7.22	9.03	10.84	12.64	14.45	16.25	18.06
40	2.06	4.13	6.19	8.26	10.32	12.38	14.45	16.51	18.58	20.64
45	2.32	4.64	6.97	9.29	11.61	13.93	16.25	18.58	20.90	23.22
50	2.58	5.16	7.74	10.32	12.90	15.48	18.06	20.64	23.22	25.80
55	2.84	5.68	8.51	11.35	14.19	17.03	19.87	22.70	25.54	28.38
60	3.10	6.19	9.29	12.38	15.48	18.58	21.67	24.77	27.86	30.96

Length change in inches = Stroke (Ft.) X Temperature Change (°F) X Coeff. ($in^3/in^3/°F$) X 12 in/ft

⚠ WARNING

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

CALIFORNIA
Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

⚠ WARNING

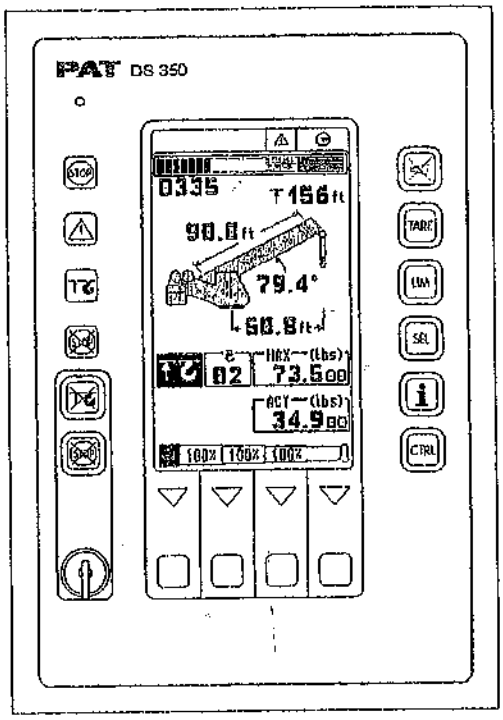
The battery posts, terminals, and related accessories contains chemical lead and lead compounds, chemicals known to the State of California to cause cancer, birth defects or other reproductive harm. Wash hands after handling.

CALIFORNIA
Proposition 65 Warning

Battery posts, terminals, and related accessories contain chemical lead and lead compounds, chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.
Wash hands after handling.

PAT

LOAD MOMENT INDICATOR



DS 350 / 1319 GRAPHIC

OPERATOR'S HANDBOOK

NOTICE

The information in this document is subject to change without notice.
PAT makes no warranty of any kind with regard to this material, including, but not limited to the implied warranties of merchantability and fitness for a particular purpose.
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Sixth Edition 2000-19-12 / csh. (con: KOGW V 4.9) 50\350\19_1319f.DOC

TABLE OF CONTENTS

1 GENERAL INFORMATION

The PAT Load Moment Indicator[1] (LMI) DS 350 has been designed to provide the crane operator with the essential information required to operate the machine within its design parameters.

Using different sensing devices, the Load Moment Indicator monitors various crane functions and provides the operator with a continuous reading of the crane's capacity. The readings continuously change as the crane moves through the motions needed to make the lift.

The LMI provides the operator with information regarding the length and angle of the boom, working radius, rated load and the total calculated weight being lifted by the crane.

If non permitted conditions are approached, the DS 350 Load Moment Indicator will warn the operator by sounding an audible alarm, lighting a warning light and locking out those functions that may aggravate the crane's condition.

2 WARNINGS

The LMI is an operational aid that warns a crane operator of approaching overload conditions and of overhoist conditions that could cause damage to equipment and personnel.

The device is not, and shall not, be a substitute for good operator judgment, experience and use of accepted safe crane operating procedures.

The responsibility for the safe crane operation shall remain with the crane operator who shall ensure that all warnings and instructions supplied are fully understood and observed.

Prior to operating the crane, the operator must carefully and thoroughly read and understand the information in this manual to ensure that he knows the operation and limitations of indicator and crane.

Proper functioning depends upon proper daily inspection and observance of the operating instructions set forth in this manual. Refer to Section 6. *Pre-Operation Inspection and Calibration Verification* of this handbook.

⚠ WARNING

The LMI can only work correctly, if all adjustments have been properly set. For correct adjustment, the operator has to answer thoroughly and correctly all questions asked during the setup procedure in accordance with the real rigging state of the crane. To prevent material damage and serious or even fatal accidents, the correct adjustment of the LMI has to be ensured before starting the crane operation.

[1] LOAD MOMENT: generally the product of a force and its moment arm; specifically, the product of the load and the load-radius. Used in the determination of the lifting capacity of a crane

3 SYSTEM DESCRIPTION

The PAT Load Moment Indicator DS 350 consists of a central micro processor unit, operating console, length/angle sensor, pressure transducers, and anti-two block switches.

The system operates on the principle of reference/real comparison. The real value, resulting from the pressure measurement is compared with the reference data, stored in the central processor memory and evaluated in the micro processor. When limits are reached, an overload warning signal is generated at the operator's console. At the same time, the aggravating crane movements, such as hoist up, telescope out and boom down, will be stopped.

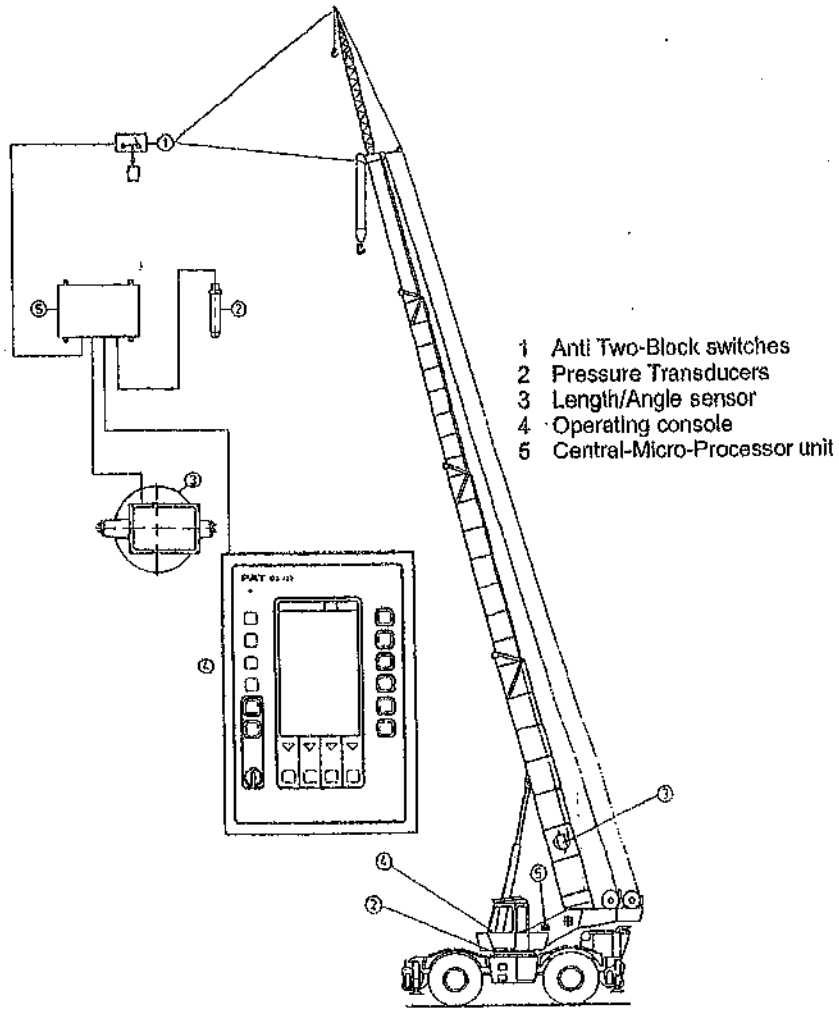
The fixed data regarding the crane, such as capacity charts, boom weights, centers of gravity and dimensions are stored in memory chips in the central processor unit. This data is the reference information used to calculate the operating conditions.

Boom length and boom angle are registered by the length/angle sensor, mounted inside the cable reel which is mounted on the boom. The boom length is measured by the cable reel cable which also serves as an electrical conductor for the anti two-block switches.

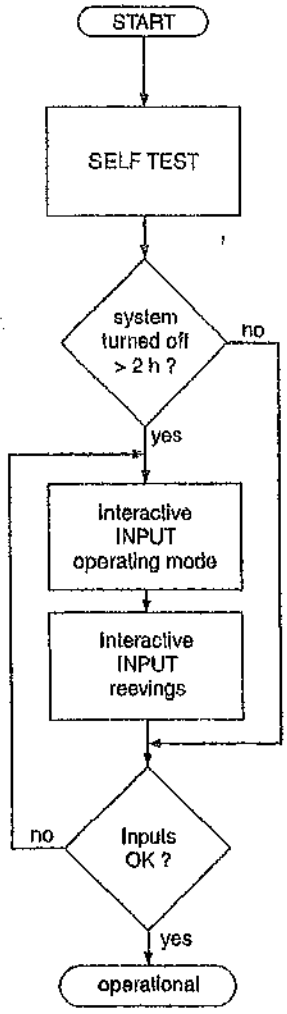
The crane load is measured by pressure transducers attached to the piston and rod side of the hoist cylinders.

The interactive user guidance considerably simplifies the input of operating modes as well as the setting of geometry limit values.

Fig. 1: *Components of the LMI system PAT DS 350*



3.1 System Function



Upon switching on, the system starts with an automatic test of the LMI system, of lamps and audible alarm. During the test, the LC display shows the initial logo.

If the system was turned off for more than two hours, the setup configuration has to be entered after the system test. (⇒ chapter 4)

First, the operating mode is determined by an interactive step-by-step interrogation of the rigging states.

Next is the interactive input of the reeving.

Now the LC display shows in symbols all inputs and awaits acknowledgment or cancelling.

Upon acknowledgment of the inputs the system is ready for operation.

3.2 Operating Console

The console has 3 functions:

- inputs by the crane operator (operating mode, reeving)
- input of geometry limit values and signalization of exceeded limit values
- display of important data and information

The operator's console is mounted in the crane's cab in the operator's field of vision. For a better identification of displays and operating elements, they are continuously backlit during operation.

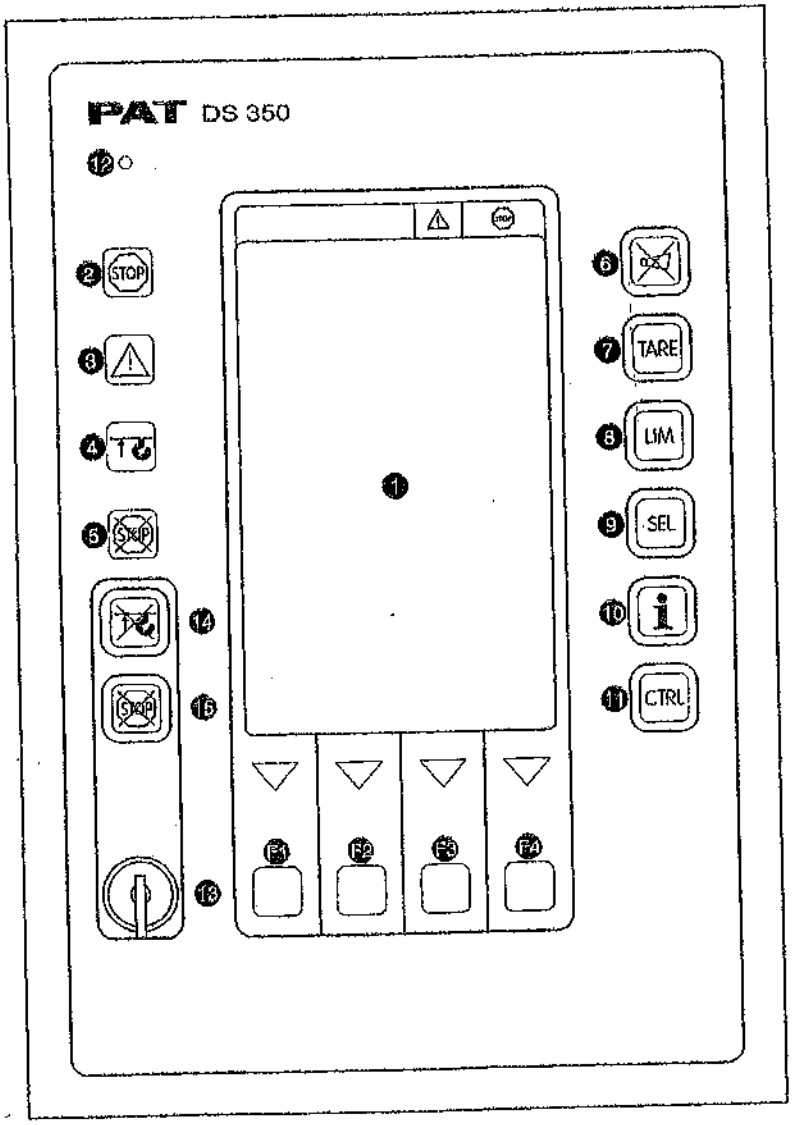
3.3 Control Identification

This unit contains a display and different controls which are described as follows:

Legend to **Fig 2:**

1 LC Display Area
2 Load Moment Limit Light
3 Load Moment Prewarning Light
4 Alarm Light "Anti-Two-Block"
5 Override Key Warning Light
6 Button "Alarm Stop"
7 Button and Control Light "TARE"
8 Button and Control Light "LIMITS"
9 Button and Control Light "SELECT OPERATION MODE"
10 Button and Control Light "INFO"
11 Button and Control Light "CONTROL"
12 Audible Alarm
13 By-Pass Key Switch
14 Button and Control Light "By-Pass Anti-Two-Block"
15 Button and Control Light "By-Pass LMI shut-off function"
F1 Button "Function 1"
F2 Button "Function 2"
F3 Button "Function 3"
F4 Button "Function 4"

Fig. 2: *Operating Console*



❶ LC-Display

The LC display visualizes graphical symbols, texts and numerical values. Depending on the selected operating mode (setup, limit mode or LMI representation), the corresponding information is indicated on the display.
Please refer to the description of the different operating modes for the signification of the individual elements.

❷ Load Moment Limit Light

The red LOAD MOMENT LIMIT LIGHT (2) warns the operator that a rated load condition has been reached. It lights up when the load on the crane reaches the crane load capacity. The audible alarm also sounds when this condition has been reached.
The following crane movements will be stopped concurrently:

- hoist up
- telescope out
- boom down

❸ Load Moment Prewarning Light

The yellow LOAD MOMENT PRE-WARNING LIGHT (3) will light up when the load on the crane reaches the defined prewarning area, thus indicating that an overload condition is approaching.
This means for the operator to continue his crane operation with extreme caution.

❹ Alarm Light "Anti-2-Block"

The red "Anti Two-Block Alarm Light" (4) lights up when the anti-two-block limit switch contacts open, indicating that a two-blocking condition is approaching. At the same time the audible alarm will sound.
The following crane movements will be stopped subsequently: hoist up, telescope out, boom down.

❺ Override Key Warning Light

The red OVERRIDE KEY WARNING LIGHT (5) flashes to indicate that the cut-off function of the A2B / LMI system is deactivated.

❻ Button and Control Light "Alarm Stop"

This ALARM STOP BUTTON (6) allows the audible alarm to be silenced for approximately 15 seconds by pressing this button. Reference ⇒ "Audible Alarm" (12).

⑦ Button and Control Light "Tare"

The button "TARE" (7) is used to indicate the "Net load" on the LC Display (1). Net load is the present load, less lifting tackle and hook block. The Tare Button (7) has to be activated *before* lifting.

After pushing the "Tare Button" (7) the load display is set to zero (taring) and the control light lights up. After lifting a load the display shows the *net load* (pay load).
The *net load* display will change to the actual load display when the boom radius is changed (either by angle or length).

⑧ Button "LIMITS"

Button to start the function "program limit values".
For the proceeding please refer to ⇒ chapter 5.1.

⑨ Button "SELECT"

Button to start the function "set operating mode".
For the proceeding please refer to ⇒ chapter 4.1.

⚠ WARNING

The correct setting is of utmost importance for the proper function of the system and the crane. Therefore only operators who are thoroughly familiar with use and operation of the system shall set this button.

⑩ Button "INFO"

Button to start the function "information crane configuration"
Please refer to ⇒ chapter 5.2.

⑪ Button "CONTROL"

Button to start additional functions.
Please refer to ⇒ chapter 5.3.

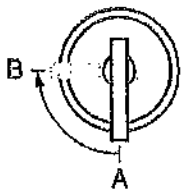
⑫ Audible Alarm

The AUDIBLE ALARM (12), sounds during the following conditions:

- overload condition
- approaching two-block condition
- preset limits reached
- malfunction of the LMI system
- operating error

The alarm can be temporarily silenced by pushing the button "Alarm Stop" (6).

⑬ Key Switch



- The **anti-two-block** switch cut-off function is deactivated when the KEY SWITCH (13) is turned to position "B" **and** the "By-pass A2B" button (14) is pushed.

or

- The **LMI** cut-off function is deactivated when the KEY SWITCH (13) is turned to position "B" **and** the "By-pass LMI" button (15) is pushed.

KEY SWITCH (13) can be operated only by using the matching key.

⚠ WARNING

Since button (14) and (15) deactivate the cut-off function of the LMI system / the anti two-block system, the following instructions must be obeyed:

- **The by-pass function shall be used with discretion, as unwarranted use of it to override the control lever lockout system can result in harm to the crane and danger to property and persons.**
- **Never use the by-pass function to either overload or operate the crane in a non permissible range.**

⑭ Button "By-pass A2B"

This button can be operated only if key switch (13) is turned to position B.
After pushing this button, the cut-off function of the anti-two-block switch is deactivated.
The Override Key Warning Light (5) flashes to indicate that the cut-off function is deactivated.

⑮ Button "By-pass LMI"

This button can be operated only if key switch (13) is turned to position B.
After pushing this button, the control lever lockout function of the LMI is deactivated.
The Override Key Warning Light (5) flashes to indicate that the cut-off function is deactivated.

4 CONFIGURATION SETUP

The LMI setup prucedure allows the operator to input the crane configuration using interactive displays. The operator must complete the setup procedure for the Load Moment Indicator system if the system has been turned off for more than two hours or the crane operation configuration has been changed.

4.1 LMI Setup Procedure

...starts:

- *automatically*, if the system was turned off for more than two hours.
- *manually* at each modification of the crane configuration by pressing key (9) "SEL"

...is operated:

- by answering the different questions using functional keys F1...F4 in accordance with the actual configuration of the crane.

...is cancelled:

- any time by pressing again key (9) "SEL". The system, however, is only ready for operation, if the procedure has been completed and the inputs have been confirmed.

If the system is turned off, for example during short breaks (less than 2 hours), all adjustments remain stored. When turning on again the system these adjustments can be acknowledged by merely pressing one key (provided that the crane configuration has not been modified!).

During the programming procedure the Load Moment Prewarning Light (3) and the Load Moment Limit Light (2) will light up and the aggravating crane movements will be interrupted.

Note:
If a configuration is selected which is not available, the display will indicate error code E04. In this case, the procedure has to be repeated with valid values!

⚠ CAUTION

The correct setting is of utmost importance for the proper functioning of the system and the crane. Therefore, only operators who are thoroughly familiar with the crane and the operation of the system should execute the setting of the system according the operating configuration of the crane.

The LMI programming procedure consists of the following steps:

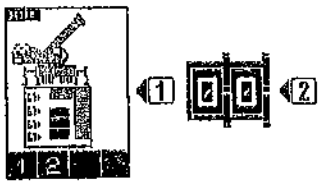
- setting the boom configuration
- setting the counterweight configuration (where applicable)
- setting the hoist configuration
- setting the outrigger configuration
- setting the reevings
- confirmation of the programming procedure

For easy operation, the computer guides the operator through the procedure step by step. (interactive operation)

Definition of the Displayed Symbols:

The following illustrations define the symbols appearing on the display during the setup procedure. Not all symbols will be shown, depending on the crane type and the answers to the questions.

- **Select interactive configuration setup / special mode setup**

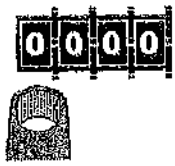


1 interactive configuration setup

2 special mode setup

Note: Refer to manufacturer load chart for special LMI operating code

- **(if selected special mode setup only)**

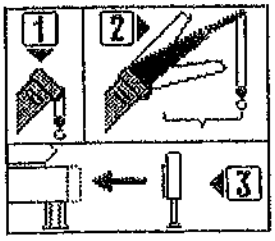


\+ increase selected numeral

\- decrease selected numeral

\> select next numeral
confirm selected operating code

- **Setting the boom configuration**

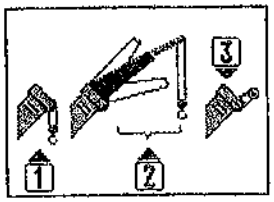


1 main boom / aux. boom nose operation

2 operation with boom extensions

3 rigging mode operation*
** for cranes with rigging mode for outrigger box installation only*

or



1 main boom

2 operation with boom extensions

3 aux. boom nose operation

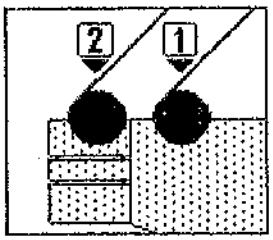
main boom | *aux. boom nose* | *A-frame boom ext.* | *fixed ext.* | *fixed, offsettable extension* | *tele-offsettable extension* | *fixed jib*

For detailed symbol explanation of extensions, please refer to Appendix A in this manual.

- **Setting the counterweight configuration**

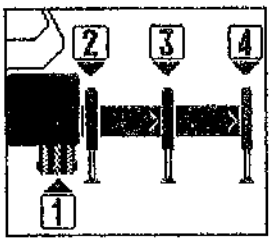
If your crane is equipped with counterweight options, please refer to Appendix B in this manual for detailed symbol explanation of counterweight.

- **Setting the hoist configuration**



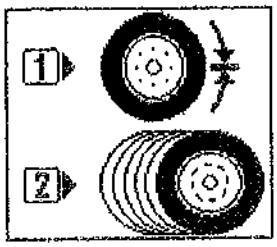
1 Front Hoist
2 Rear Hoist

- **Setting the outrigger configuration**



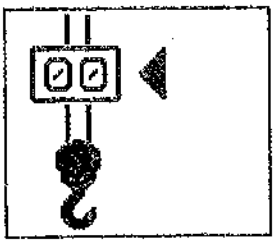
1 on rubber
2 outrigger position 0%
3 outrigger position 50%
4 outrigger position 100%

- **(if selected on rubber mode only)**



1 static
2 pick & carry

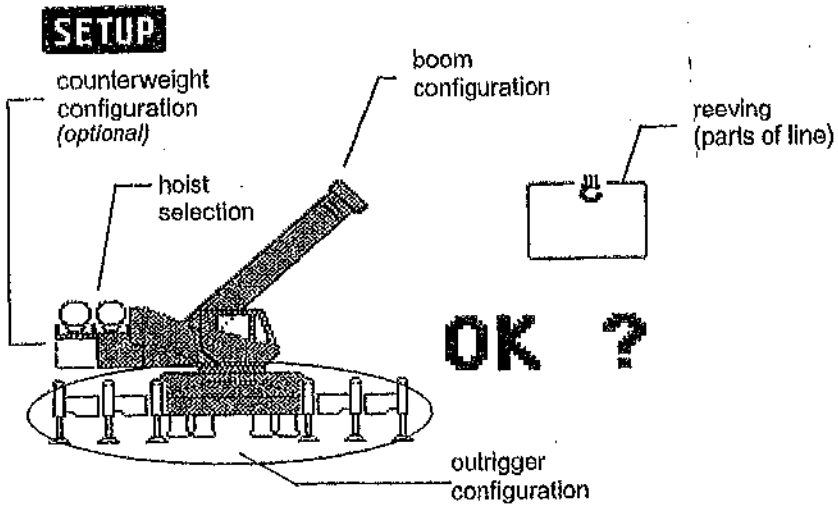
- **Setting the reeving (parts of line)**



\+ increase reeving.
\- decrease reeving

OK confirm reeving

- **Confirmation of the programming procedure**



At the end of the procedure all inputs are represented once again in symbolic forms. If inputs have been made, the corresponding symbols are filled black.

quick setting the reeving (⇒ chapter 4.3)

quick hoist line selection (⇒ chapter 4.2)

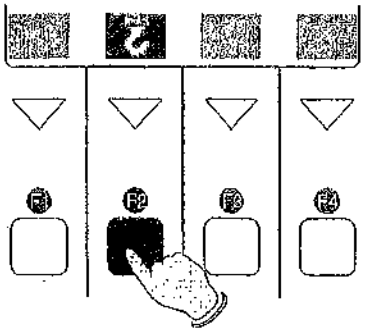
DEL cancel procedure

OK confirm inputs

4.2 Quick Setting of the Reeving

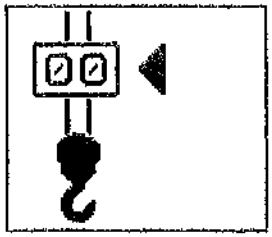
If, during the crane operation, the number of reeving is modified, the LMI system has to be adjusted to this modification. The input of the reeving can be carried out directly without having to go through the whole LMI programming procedure again:

Call LMI Programming Procedure.



Directly call function "Quick Setting of the Reevings".

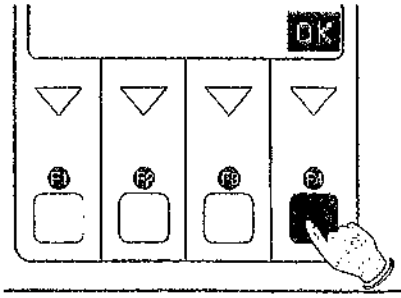
Note:
The direct call is impossible, if the system has been turned off for more than 2 hours.



input of reeving:

+	increase reeving
−	decrease reeving
OK	confirm reeving

Confirm modification.



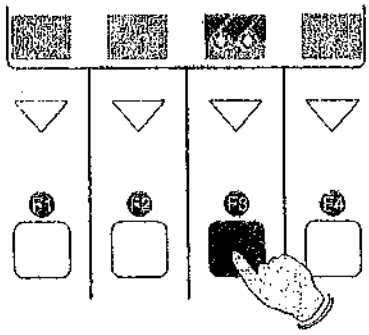
(select again the function upon faulty input)

Note:
If a configuration is selected which is not available on the present crane, the system will not accept the selection and the display will indicate the error code E04.

4.3 Quick Hoist Line Selection

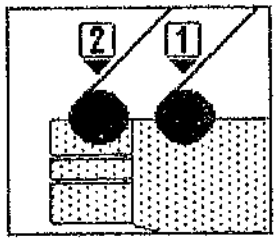
If, during the crane operation, the crane is switched over from front to rear hoist, the LMI system has to be adjusted to this modification. This modification can be entered without having to go through the whole LMI setup procedure again:

Call LMI setup procedure.



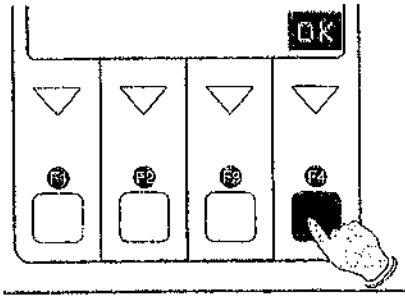
Directly call function "Hoist Line Selection".

Note:
The direct call is not possible, if the system has been turned off for more than 2 hours.



Select hoist:

1 Front Hoist
2 Rear Hoist



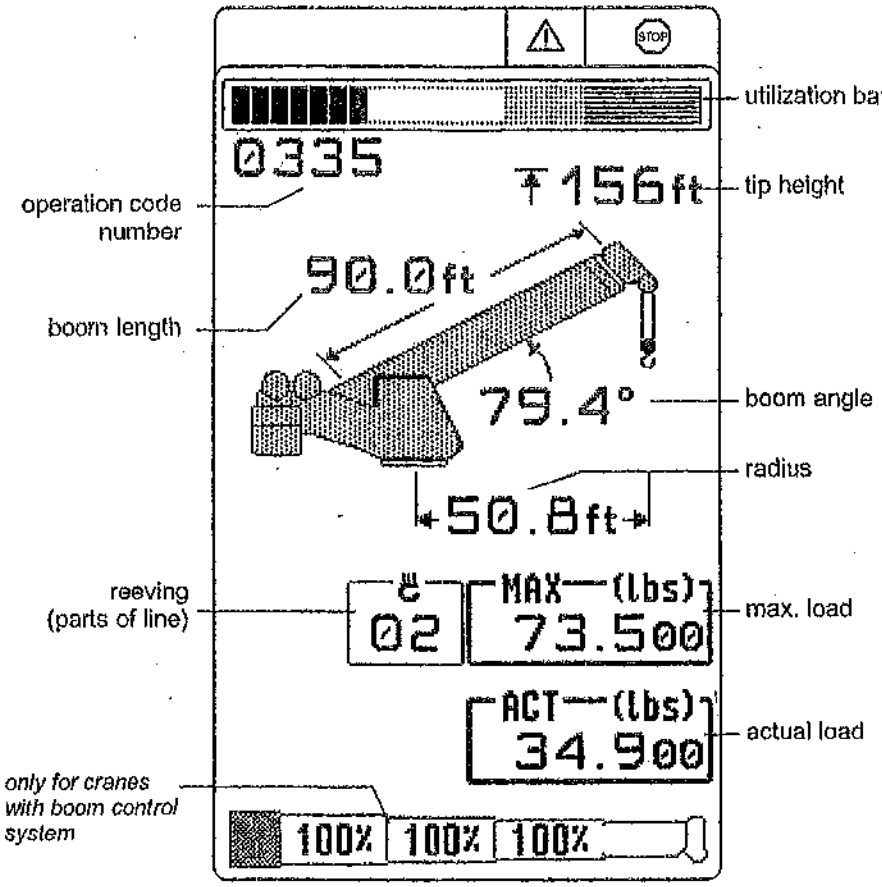
Confirm modification.

(call up the function again if you have selected the wrong whinch by mistake)

Note:
If a configuration is selected which is not available on the crane, the system will not accept the selection and the display will indicate the error code E04.

5 OPERATION

After having set the LMI to the actual crane configuration, the system is ready for operation. The display shows the LMI screen (example for value representation).



Upon request, further symbols can be shown on the display:

	Symbol **Anti Two-Block Alarm** • visible when the anti-two-block limit switch contacts open, indicating that a two-blocking condition is approaching.
	Symbol **slewing angle limitation**: • continuously visible: *slewing angle limitation active* • blinking: *slewing angle limits exceeded* (⇒ see chapter 5.1.1.a)
	Symbol **work area definition**: • continuously visible: *work area definition active* • blinking: *work area limits exceeded* (⇒ see chapter 5.1.1.b)
	Symbol **height limitation**: • continuously visible: *height limitation active* • blinking: *height limit exceeded* (⇒ see chapter 5.1.2)
	Symbol **boom angle limitation**: • continuously visible: *boom angle limitation active* • blinking: *angle limits exceeded* (⇒ see chapter 5.1.3)
	Symbol **radius limitation** • continuously visible: *radius limitation active* • blinking: *range limits exceeded* (⇒ see chapter 5.1.4)
E#####	**Error code** No. #### (⇒ see chapter 8 "Troubleshooting")

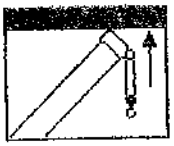
5.1 LIMIT Setting

The LMI system has been equipped with programmable limits for the crane's operation range.

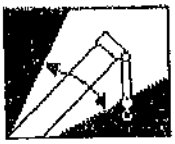
- Easy programming due to interactive, step-by-step user guidance
- Functions can be used individually or in combinations.
- Exceeding a programmed limit triggers an audible and visual alarm.
- Depending on the crane type not all functions listed below are available.

Overview limits:

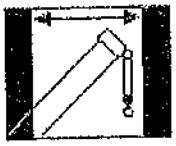
Slewing Angle Limitation / Work Area Definition
(⇒ chapter 5.1.1)



Tip Height Limitation
(⇒ chapter 5.1.2)



Boom Angle Limitation
(⇒ chapter 5.1.3)

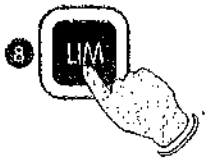


Radius Limitation
(⇒ chapter 5.1.4)

5.1.1 Slewing Angle Limitation / Work Area Definition

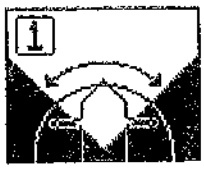
Programmable function for the limitation of the left and/or right slewing angle or working area definition.

- **Call function:**



Call LIMIT Setting.

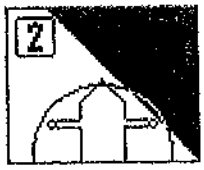
Enter the corresponding figure to call the function:



1 Slewing angle limitation

(maximum/minimum slewing angle)

(⇒ chapter 5.1.1.A)



2 Work Area Definition

(Virtual wall setup. A wall is defined by a straight line between two set points.)

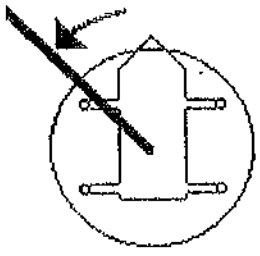
(⇒ chapter 5.1.1.B)

5.1.1.A Slewing Angle Limitation

- **set / delete left slewing angle:**

Select limit:

Select left limit



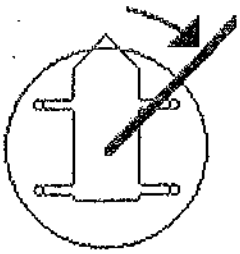
set:	delete:
Position boom to required left limit value.	DEL delete left angle limit
SET program present slewing angle as left limit	

OK quit function

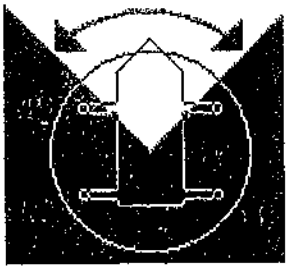
- **set / delete right slewing angle**

Select limit:

select right limit



set:	delete:
Position boom to the required right limit value.	DEL delete right angle limit
SET set present slewing angle as right limit	



Display shows symbols and angle values of the programmed slewing angle limit

Display shows symbols without angle values

DK quit function

5.1.1.B Work Area Definition

The *work area definition system* helps the operator to define the crane's working area. This is done by creating vertical wall(s) that can represent obstacles (i.e. buildings, towers, poles, etc.) in the crane's working range. The wall(s) are set by defining points with the boom tip along the outer limits of the operator's work area, see setup procedure below. Because these walls are defined by the operator and are not "actual real" walls, we refer to them as *"virtual"* walls. **When setting the walls, always keep a safe working distance to any obstacles. Never work outside a safe working area as outlined by common practice, standards, and manuals.**

A *virtual wall* is set by defining two points. To prevent inaccuracies when defining the two points for the virtual wall, use the following to rules:

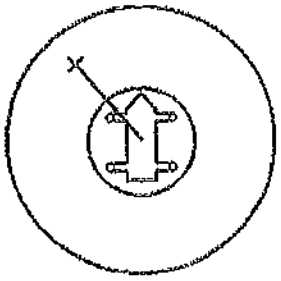
1. *The two points should be the same distance form the obstacle.*
2. *Set the two points at the maximum distance apart, which can be safely reached by the boom tip.*

The operator can setup up to 5 virtual walls, the first wall is defined by a straight line between two set points. The second through fifth walls are created by one new point and the previously selected point. After the walls have been set, the system alerts the operator when the boom approaches them. This is done both visual and audible. The console will warn the operator by an audible, beeping alarm which increases in frequency as the boom approaches the wall. At the same times, the control light *"Alarm Stop"* (refer to no. 6, chapter 3.3 of the operator's manual) will come on and the button *"LIM"* (refer to no. 8, chapter 3.3 of the operator's manual) will be lit. Similarly, the *"virtual wall"* symbol in the main screen blinks. If the boom crosses the wall the audible alarm becomes continuous. See the Pre-warning System Section for information on how the pre-warning system is defined.

⚠ WARNING

THERE ARE NO CUTOUTS ASSOCIATED WITH THE WORK AREA DEFINITION FEATURE.

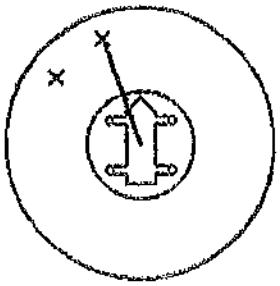
- **set / delete work area:**



On entering the work area definition function, the crane working area is displayed. A blinking X indicates that a point may be set to define a wall. Move the boom tip to one end of the virtual wall you want to set.

SET — Sets a point in the working area to start a wall

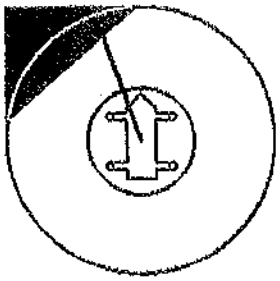
DEL — Exits the screen



Having pressed SET, the X is displayed (without blinking) at this point.
A blinking X at the boom tip indicates that the second point may be set to define the wall.
Move the boom tip to other end of the virtual wall you want to set.

SET Sets the second point to create a wall

DEL Exits the screen and deletes all virtual wall settings

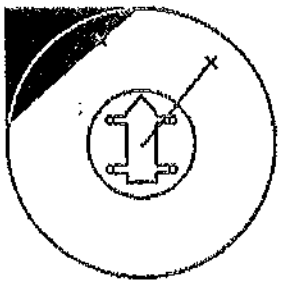


After pressing SET, an infinite virtual wall is defined. Now, three soft keys are available:

OK Accepts the defined wall and exits

SET Allows for further walls to be added

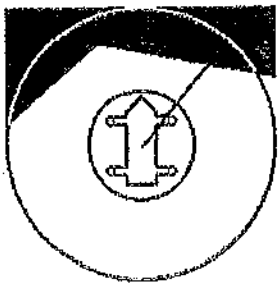
DEL Exits the screen and deletes all virtual wall settings



After pressing SET, an X appears where the last point had been set, and a new wall may thus be added. Move the boom tip to the other end of the additional virtual wall you want to set.

SET Sets the third point to create a second wall

DEL Exits the screen and deletes all virtual wall settings



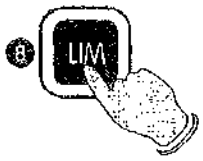
Upon pressing SET, the second wall is created.

OK	Accepts the defined walls and exits
SET	Allows for further walls to be added
DEL	Exits the screen and deletes all virtual wall settings

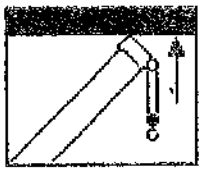
5.1.2 Tip Height Limitation

Programmable function for the limitation of the tip height

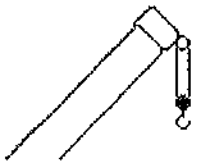
- **Set tip height / delete height limitation:**



Call LIMIT Setting.

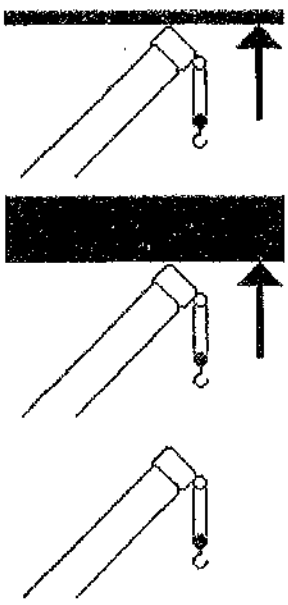


Press the corresponding figure to select function "tip height limitation".



Press key

set:	delete:
Move the tip to the required upper limit.	DEL delete tip height limitation
SET set present tip height as upper limit	
Display shows symbol and value of the programmed height limit	
	Display shows symbol without values

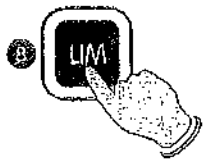


OK quit function

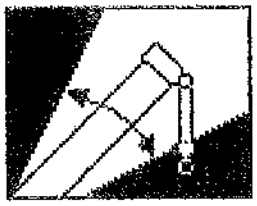
5.1.3 Boom Angle Limitation

Programmable function for the limitation of the upper and/or lower boom angle.

- **Call function:**

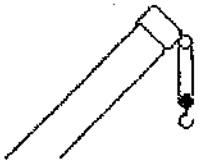


Call LIMIT Setting.



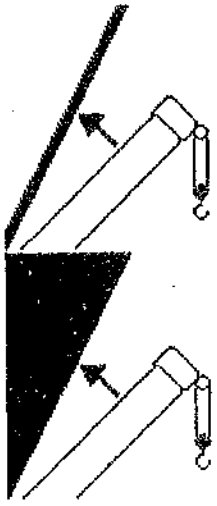
Enter the corresponding figure to call function "boom angle limitation".

- **set / delete upper limit value:**



Select limit:

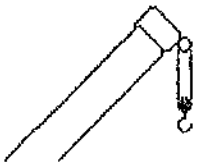
selection upper boom angle limit



set:	delete:
Luff up the boom the requested limit value.	DEL delete upper angle limit
SET set present boom angle as upper limit	
Display shows symbol with value of the upper angle limit	Display shows symbol without value of the upper angle limit

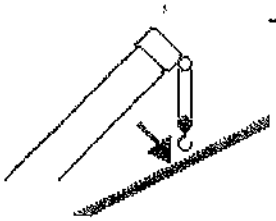
OK quit function

- **set / delete lower limit angle**

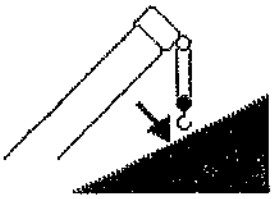


Select limit:

 selection lower boom angle limit



set:	delete:
Luff down boom to the required limit value.	DEL delete lower angle limit
SET set present boom angle as lower limit	
Display shows symbol with lower angle limit	Display shows symbol without value of lower limit angle

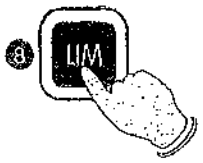


OK quit function

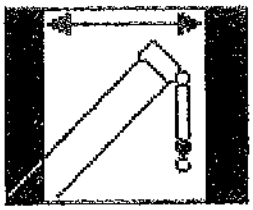
5.1.4 Radius Limitation

Programmable function for the limitation of the minimum and/or maximum working radius.

- **Call function:**

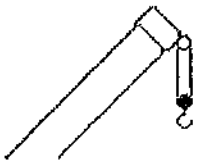


Call LIMIT Setting



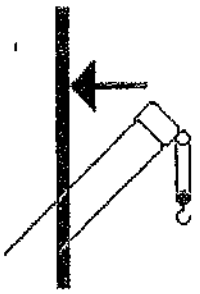
Select the corresponding figure to call the function "radius limitation".

- **set / delete minimum radius:**

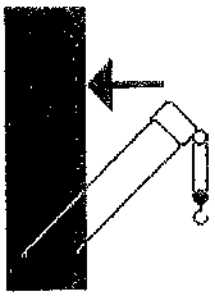


Select limits:

select minimum radius limit



set:	delete:
position boom at the required minimum radius value.	DEL delete minimum radius limit
SET set present boom radius as minimum radius	

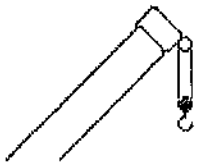


display shows symbol with radius value of minimum limit

display shows symbol without value of minimum radius

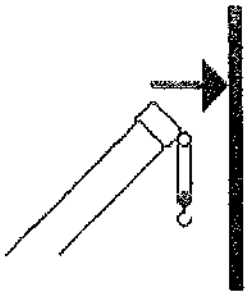
OK quit function

- **set / delete maximum radius**

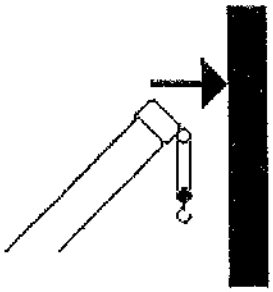


Select limit:

→ selection maximum radius limit



set:	delete:
position boom to the required maximum radius value.	DEL delete maximum radius limit
SET set present boom radius as maximum radius	



display shows symbol with radius value of max. limit

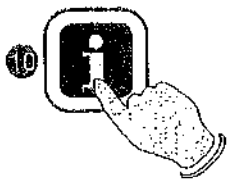
display shows symbol without value of max. radius

OK quit function

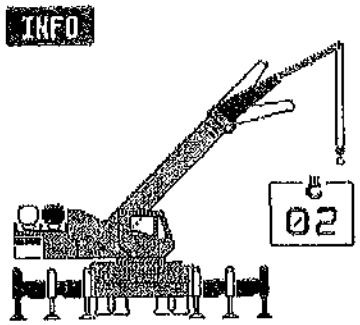
5.2 INFO crane configuration

With the system being ready for operation, this function serves to display the system configuration

- **Call function**

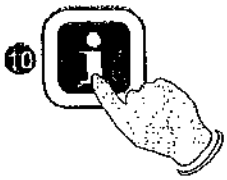


Press key "INFO".



The display shows the crane symbol representing the adjusted configuration (marked black), the extended operating code number and the reeving number (parts of line).

- **End function**

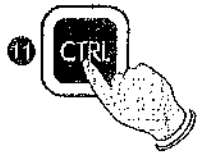


Press again key "INFO".

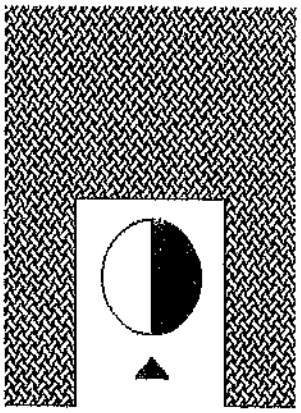
5.3 Display Contrast Control

This function serves for the contrast adjustment of the LC display. The last adjustment is stored and does not have to be repeated at every system start.

- **Contrast adjustment**



Press "CTRL".



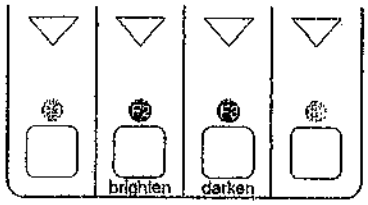
A pattern is shown by means of which the display can be adjusted to the optimum contrast. Use the functional keys to modify the contrast upon request:

darken display

brighten display

confirm setting

Press key "OK" to store the momentarily adjusted contrast value and to quit the function.



During normal LMI operation the display contrast can be adjusted too by pressing button:

F2 (brighten display) or
F3 (darken display).

6 Pre-Operation Inspection and Calibration Verification

Before operating the crane, the following electrical connections must be checked to ensure that the system is properly connected for the crane configuration.

Machines with only a Main Hoist

If the crane works only with the boom and without boom extension, no additional connections are necessary. However, be sure the weight of the anti two-block switch is properly installed on the main hoist load line. With even parts of hoisting line, the weight shall be attached to the dead-end line. With odd parts of hoisting line, the weight shall be attached to the line of lowest speed.

If the crane works with boom extension, the connecting cable shall be installed between the junction box on the boom extension and the boom junction box. The weight attached to the main hoist anti two-block switch shall be removed. In that case the anti two-block switch has to be locked with the red Anti Two-Block Retainer, which is fixed with a red lanyard at the anti two-block switch (described on pages 40 and 41). Then the weight shall be reattached to the boom extension anti two-block switch.

⚠ WARNING

Failure to re-position the anti two-block switch weight will prevent the overhoist system from functioning properly. No weight shall be on the main hoist anti two-block switch when the boom extension is being used.

Machines with Main and Auxiliary Hoists

If the boom extension is not in the operating position, the by-pass plug shall be installed in the main boom junction box. The weight of the main hoist anti two-block switch shall be installed.
If the boom extension is in the operating position, the connecting cable shall be installed between the junction boxes on the boom extension and the main boom. Weights shall also be attached to the anti two-block switches on both the main boom and boom extension.

If the boom extension is in the operating position and no load line is being used on main boom, to prevent injury or damage to equipment, the weight shall be removed from main boom switch. In that case the anti two-block switch has to be locked with the red Anti Two-Block Retainer, which is fixed with a red lanyard (not shown) at the anti two-block switch.

Installation of Anti Two-Block Retainer in Locking Position

Procedure (see Fig. 1 and 2):

1. Pull the cable out of the switch and bend back parallel to the boom and hold (1).
2. Slide the retainer from left side with its slot over the cable between the crimped stop and the switch (2). Push it firmly straight onto the cable guide of the Anti Two-Block switch (3).

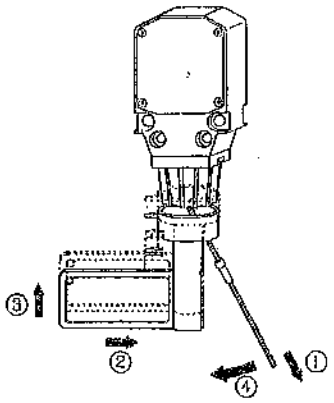


Fig. 1: *Setting of Anti Two-Block Retainer in Locking Position*

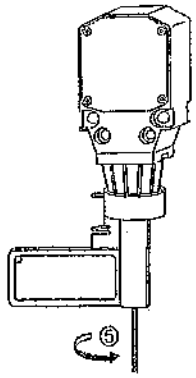


Fig. 2: *Retainer in Locking Position*

3. Straighten the cable completely into the slot and release the cable (4).
4. Turn the flag of the retainer for best visibility for the operator (5).

Removal and Storage of the Anti Two-Block Retainer

Procedure (see Fig. 3 and 4):

1. Pull the cable out of the switch (1) and bend back parallel to the boom and hold (2).
2. Move the retainer down (3) and then left (4) to remove it from the Anti Two-Block switch. Release the cable.
3. For storage slide the retainer from right side (5) over the Anti Two-Block switch until the clips (A) lock into the holes (B).

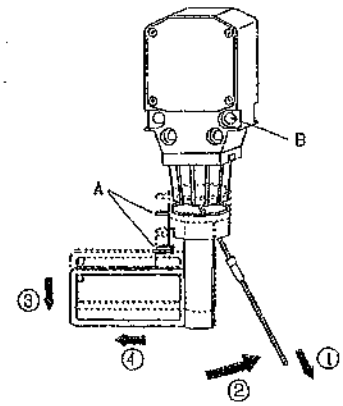


Fig. 3: *Removal of the Anti Two-Block Retainer*

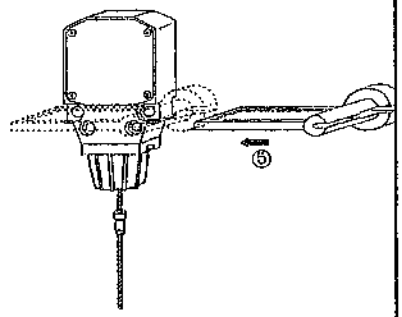


Fig. 4: *Retainer in Storage Position*

Pre-Operation Inspection and Calibration Verification

After the electrical connections have been checked to insure that the system is properly connected for the crane configuration, the following checks shall be made:

1. Check the electrical wiring connecting the various parts of the system for physical damage.
2. Check the anti two-block switches and weights for free movement.
3. Check the spring-loaded cable reel to be sure it is free to rotate, has tension and the cable is reeled properly.

⚠ WARNING

The following tests shall be performed with care to prevent damage to the machine or injury to personnel. Proper functioning of the system requires successful completion of these tests before operating the machine.

If the operator cannot see the load handling device approaching the boom nose, he shall have an assistant (signal person) watch the load handling device. The operator shall be prepared to stop the machine immediately should the LMI system not function properly as indicated by lighting the red warning light (4), sounding the audible alarm (12) and locking the crane movements, hoist up, telescope out and boom down.

4. Check the anti two-block alarm light (4) and the audible alarm (12) by performing one of the following tests:
   a) By manually lifting the weight attached to the anti two-block switches. When the weight is lifted, the audible alarm (12) should sound, the anti two-block alarm light (4) should light.
   b) Slowly raise the main boom load handling device to create a potential two-block condition. When the load handling device lifts the weight, the audible alarm (12) should sound, the anti two-block alarm light (4) should light and the motion of the load handling device should be stopped. Lower the load handling device slightly to eliminate this condition.
   c) Slowly lower the boom to create a potential two-block condition. When the load handling device lifts the weight, the audible alarm (17) should sound, the anti two-block alarm light (24) should light and the boom lowering function should be stopped. Lower the load handling device slightly to eliminate this condition.
   d) Slowly extend (telescope) the boom to create a potential two-block condition. When the load handling device lifts the weight, the audible alarm (17) should sound, the anti two-block alarm light (24) should light and the boom telescope out function should be stopped. Lower the load handling device slightly to eliminate this condition.

⚠ WARNING

If the light and audible alarm do not function as described and the crane movements are not stopped, the system is not working properly. The malfunction shall be corrected before operating the crane.

5. If the crane is equipped with a boom extension, repeat the test procedure for the boom extension anti two-block switch. Check that the display of the main boom length agrees with the actual boom length.
6. Check that the display of the main boom angle agrees with the actual boom angles.
7. Check that the display of the operating radius of the crane agrees with the actual radius.
8. Check the load display by lifting a load of known weight.

Operation

Upon correct inspection the LMI is operational. The operator shall be thoroughly familiar with all controls of the LMI before operating the crane. The proper function of the system shall be checked by lifting a load of known weight and comparing the load to the information displayed on the LMI.
Rated loads include the weight of the hook block, slings, and auxiliary load handling devices. Their combined weights shall be subtracted from the listed load capacities as stated on the load capacity chart to obtain the net load to be lifted.

⚠ WARNING

If any of the displays reflects a deviation between displayed and actual values, an authorized PAT service representative shall be called for repair of the system or reverification of the crane's LMI calibration.

⚠ WARNING

Any structural modifications or changes to the crane shall require reverification of the crane's LMI calibration.

7 SERVICE AND MAINTENANCE

Daily maintenance of the load moment indicator consists of inspecting:

1. The electrical wiring connecting the various parts of the system.
   If electrical wiring is damaged, it shall be replaced immediately.

2. If the insulation is worn on the length sensor cable or cable guides are damaged, these parts shall be replaced.

3. Check the anti two-block limit switches for freedom of movement.

4. The cable reel shall be under tension to operate properly.

5. Check the pressure transducers at the hoist cylinder(s) and the connecting hoses for oil leakage.

Other than correcting the problems identified in the Malfunctions Table and replacing faulty mechanical parts and cables, no other repairs shall be performed by non expert personnel.

8 TROUBLESHOOTING

General

In case of a malfunction of the system, the display (1) will indicate a code that identifies the system malfunction.
The error codes listed in the Malfunction Table will identify various faults that can occur with the LMI. Following the Malfunction Table are pages which explain each fault and describe the action which shall be taken to correct the fault.
Faults within the electronic microprocessor shall be repaired by factory trained service personnel. When these faults occur, the competent service organization shall be contacted.

Malfunction Table

Error Code	Error
E01	Fallen below the radius or above angle range
E02	Radius range exceeded or fallen below angle range
E03	Boom position is out of the permissible working area
E04	Operating mode not existing
E05	Prohibited length range
E18	Front outrigger overloaded
E83	Center Mid not fully extended
flashing %	Telescope out of permissible sequence

NOTE:
If there is any Error Code displayed on the console which is not listed in the Malfunctions Table you shall call the Local Distributor.

Operating Errors

Malfunctions in the system which are caused by range exceeding or operating errors by the crane operator himself are indicated on the display together with an explanation. These error codes are E01, E02, E03, E04, E05, E18 and E83 and they can normally be eliminated by the crane operator himself.

Error Code	Cause	Elimination
E01	Fallen below the minimum radius or above the angle given in the load capacity chart due to luffing up the boom too far.	Luff down boom to a radius or angle given in the load capacity chart.
E02	The maximum radius or minimum angle given in the load capacity chart was exceeded due to luffing down the boom too far.	Luff up boom to a radius or angle given in the load capacity chart.
E03	Boom position is out of the permissible working area (over front).	Move boom back to the permissible working area. See lifting diagram in the load capacity charts.
E04	Operating mode switch in the console incorrectly set.	Correctly set operating mode switch to the code assigned to the operating mode of the crane.
	Operating mode is not permissible with the actual crane configuration, boom position or area definition.	Be sure crane is set up according to proper operating configurations.
E05	Boom was telescoped too far or not far enough, you may only operate up to a certain maximum or minimum boom length or with load curves for boom extension where you have to telescope the main boom to a certain length.	Telescope boom to correct length, given in the load capacity chart.
	Length sensor adjustment changed i.e. length sensor cable slid off the length sensor drum.	For elimination refer to service manual.

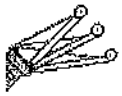
Error Code	Cause	Elimination
E18	Front outrigger overloaded	Refer to load capacity charts.
E83	The Center Mid is not on its fully extended position while the OM/Fly is not completly retracted.	• Extend the Center Mid • Retract the OM/Fly • Check the OM/Fly switch (dig. input 4)
flashing tele %	Telescope is out of the permissible sequence.	• Fully retract telescope

Appendix A:
Detailed symbol explanation of boom extensions

main boom

auxiliary boom nose

A-frame boom extension

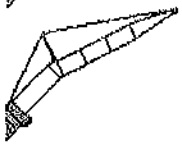


offsetable A-frame

fixed extension

tele-offsettable extension

fixed, offsettable extension



fixed jib

swingaway/ bifold with fly stowed on main boom

swingaway with fly/tele

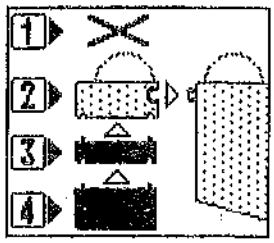
swingaway/ bifold without fly stowed on main boom

swingaway/ bifold without fly

fly stowed on main boom

bifold with fly stowed on main boom

Appendix B:
Detailed symbol explanation of counterweight options

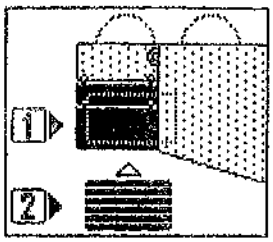


1 without auxiliary hoist structure

2 with mounted auxiliary hoist structure

3 with counterweight *A*

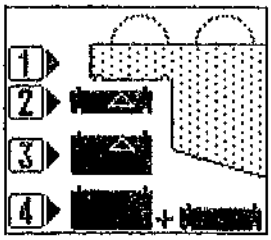
4 with counterweight *B*



only for cranes with auxiliary counterweight:

1 without auxiliary counterweight

2 with auxiliary counterweight

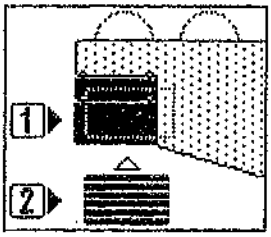


1 without counterweight

2 with counterweight *A*

3 with counterweight *B*

4 with counterweight *A* + *B*



only for cranes with auxiliary counterweight:

1 without auxiliary counterweight

2 with auxiliary counterweight

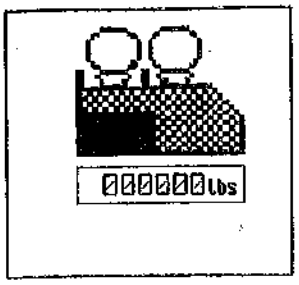
Operating Errors

Malfunctions in the system which are caused by range exceeding or operating errors by the crane operator himself are indicated on the display together with an explanation. These error codes are E01, E02, E03, E04, E05, E18 and E83 and they can normally be eliminated by the crane operator himself.

Error Code	Cause	Elimination
E01	Fallen below the minimum radius or above the angle given in the load capacity chart due to luffing up the boom too far.	Luff down boom to a radius or angle given in the load capacity chart.
E02	The maximum radius or minimum angle given in the load capacity chart was exceeded due to luffing down the boom too far.	Luff up boom to a radius or angle given in the load capacity chart.
E03	Boom position is out of the permissible working area (over front).	Move boom back to the permissible working area. See lifting diagram in the load capacity charts.
E04	Operating mode switch in the console incorrectly set.	Correctly set operating mode switch to the code assigned to the operating mode of the crane.
	Operating mode is not permissible with the actual crane configuration, boom position or area definition.	Be sure crane is set up according to proper operating configurations.
E05	Boom was telescoped too far or not far enough, you may only operate up to a certain maximum or minimum boom length or with load curves for boom extension where you have to telescope the main boom to a certain length.	Telescope boom to correct length, given in the load capacity chart.
	Length sensor adjustment changed i.e. length sensor cable slid off the length sensor drum.	For elimination refer to service manual.

Error Code	Cause	Elimination
E18	Front outrigger overloaded	Refer to load capacity charts.
E83	The Center Mid is not on its fully extended position while the OM/Fly is not completly retracted.	• Extend the Center Mid • Retract the OM/Fly • Check the OM/Fly switch (dig. input 4)
flashing tele %	Telescope is out of the permissible sequence.	• Fully retract telescope

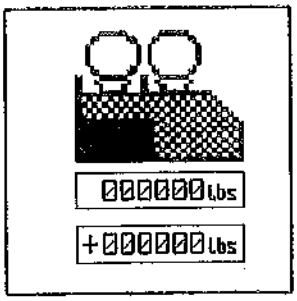
Appendix B:
Detailed symbol explanation of counterweight options



+ scroll up to the next pre-programmed counterweight configuration

− scroll down to the next pre-programmed counterweight configuration

OK press the O.K. button to confirm and to proceed with console programming



only for cranes with superstructure counterweight and front bumper counterweight configuration:

+ scroll up to the next pre-programmed counterweight configuration

− scroll down to the next pre-programmed counterweight configuration

OK press the O.K. button to confirm and to proceed with console programming