

INTRODUCTION

Do not operate this crane until you have read and thoroughly understand this manual, the accompanying Association of Equipment Manufacturers “**SAFETY MANUAL FOR OPERATING AND MAINTENANCE PERSONNEL**”, all decals on the crane and you have been properly trained by an experienced, qualified crane operator. The information in these manuals is a guide to assist qualified personnel in safe operation and maintenance of this crane and is not a substitute for training, experience and common sense.

If there is a question on application and/or operation, contact the Product Safety and Reliability Department at Elliott Equipment Company. If an Elliott Crane is involved in a personal injury or property damage incident notify the Product Safety and Reliability Department as soon as possible. Have the model and serial number and details of the incident recorded prior to the factory.

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Always refer to ANSI/ASME B30.5 standards for safe operation, inspection and maintenance of this crane. Federal, state and local laws, rules and regulations along with safety codes and insurance requirements take precedence over any information in this manual.

See the CIMA manual for correct, safe operation near power lines and hand signals.

 **DANGER**
READ, UNDERSTAND AND FOLLOW
ALL SAFETY LABELS
BEWARE OF OVERHEAD POWER
LINES
UNDERSTAND AND NEVER
ATTEMPT EXCEEDING CRANE LOAD
CHARTS
NEVER EXCEED OPTIONAL
PLATFORM CAPACITY AND AREAS
OF OPERATION

This manual must be retained with this boom truck for use by subsequent operating personnel.

ELLIOTT EQUIPMENT COMPANY**WARRANTY**

Subject to the terms and conditions of this Warranty, Elliott Equipment Company ("**Elliott**") hereby warrants all equipment manufactured by Elliott to be free from defects in material and workmanship at the time of shipment from Elliott. Elliott will repair or replace any equipment found by Elliott to have been defective at the time of original shipment which is returned to Elliott or an authorized distributor of Elliott within twelve (12) months after delivery from Elliott. For clarity, this Warranty is limited to the original purchaser of equipment from Elliott or from an authorized Elliott distributor only and is not transferable to any other person or entity. There are no express or implied warranties, including the warranty of merchantability and fitness for a particular purpose, covering component parts or accessories manufactured or modifications made by someone other than Elliott. This Warranty is void if any modifications whatsoever are made to the equipment.

The following structural components shall have a five-year parts only warranty after date of shipment from Elliott: Subframe, Turrets and Structural Components of all steel beams. This five (5) year parts only warranty requires an annual service inspection by an authorized Elliott distributor and all replacement parts to be original equipment parts from Elliott. The above-listed components shall have a three (3) year parts only warranty if the annual service inspection is performed by an approved entity other than an authorized Elliott distributor. All replacement parts are original equipment parts from Elliott. This five (5) year parts only warranty specifically excludes any other parts or components, including without limitation seals, gaskets, hydraulic components and exterior coatings.

This Warranty shall not apply with respect to any claimed defect which in Elliott's sole judgment has arisen from repair, alteration, damage during shipment, accident, negligence, overloading or misuse, including without limitation, operator's failure to follow the instructions issued with the equipment.

LIMITATION OF LIABILITY: ELLIOTT'S LIABILITY FOR ANY LOSSES AND DAMAGES RESULTING FROM ANY CAUSE WHATSOEVER, INCLUDING WITHOUT LIMITATION, ELLIOTT'S NEGLIGENCE OR FROM DAMAGED OR DEFECTIVE EQUIPMENT, IRRESPECTIVE OF WHETHER SUCH DEFECTS ARE DISCOVERABLE OR LATENT, SHALL IN NO EVENT EXCEED THE PURCHASE PRICE OF THE PARTICULAR EQUIPMENT TO WHICH LOSSES OR DAMAGES ARE CLAIMED, OR AT THE ELECTION OF ELLIOTT, THE REPAIR OR REPLACEMENT OF THE DEFECTIVE EQUIPMENT. IN NO EVENT SHALL ELLIOTT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES INCLUDING WITHOUT LIMITATION COMMERCIAL LOSSES, LOSS PROFITS OR COSTS OF ANY KIND OR FOR ANY DAMAGES FOR WHICH BUYER MAY BE LIABLE TO OTHER PERSONS.

Elliott reserves the right to make changes in design or construction of its equipment at any time without obligating itself to make such changes on equipment previously manufactured.

DISCLAIMER: THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AND IS ALSO IN LIEU OF ANY OTHER OBLIGATIONS ON THE PART OF ELLIOTT. No agent, employee or representative of Elliott may bind Elliott to any other warranty. In the event any provision of the warranty is for any reason held ineffective, the remaining provisions shall remain full and intact.

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SAFETY AND OPERATION

1.1 SAFETY RESPONSIBILITIES

Safety is more than reading and following proper operating instructions or procedures. Safety is achieved by having the appropriate state of mind at all times while operating or working around this equipment. Having a positive attitude towards safety is the most important factor in accident and equipment failure prevention.

Any individual who will operate, supervise, rig loads, service, or work near this boom truck shall read and understand this manual prior to operation. Failure to read this manual is a misuse of this boom truck. Death or serious injury can result from the misuse or improper maintenance of this boom truck.

It is your responsibility to read and understand this safety manual before operating this machine. Remember that **YOU** are the key to safety. Good safety practices not only protect you, but also protect the people around you. Study this manual and make it a working part of your safety program. Keep in mind that this manual is written only for this specific type of machine. Practice all other usual and customary safe working precautions, and above all:

REMEMBER – SAFETY IS UP TO YOU

YOU CAN PREVENT SERIOUS INJURY OR DEATH

Why is **SAFETY** important to **YOU**?

3 BIG REASONS

- Accidents **DISABLE** and **KILL**
- Accidents **COST**
- Accidents **CAN BE AVOIDED**

Your safety, along with the safety of all personnel involved with this boom truck, is of utmost concern to Elliott Equipment Company during the design and manufacture of this boom truck. This manual has been developed with the safety of all personnel that work around, with, or operated this equipment as our primary goal.

It is your responsibility to know and understand this specific requirements and hazards that exist. It is also your responsibility to know and understand all government regulations that apply to the work being performed with this boom truck. You shall make these items known to all personnel working with this equipment or in the area, so that everyone can take the necessary and required safety precautions. Failure to heed these instructions can result in death or serious injury.

It is your responsibility to operate and maintain your boom truck with skill, good judgement, and caution. Following recognized safety procedures will help you avoid accidents. Modifications to any part of this boom truck can create a safety hazard and therefore shall not be made without written approval from Elliott Equipment Company. Use only Elliott factory approved parts to maintain this equipment. If this boom truck is rebuilt or remounted, mounting procedures, re-testing, and re-certification are required in accordance to instructions provided by Elliott Equipment Company.

Safety is dependent on all people associated with this boom truck. The overall condition of the equipment, maintenance and inspection procedures are just as important as safe operating procedures and a positive attitude

towards safety. All of these procedures properly applied will significantly reduce the likelihood of an accident or equipment failure.

1.1.1 Management/Supervisory Responsibilities

As an owner or employer, it is your responsibility to establish a safe working environment for your operator and other employees or people working in within proximity of your equipment. It is your responsibility to instruct or provide instruction to the operator in safe operation of your equipment. It is also your responsibility to provide the operator with properly maintained equipment and qualified crewmembers. Verify that operators are properly trained, competent, physically fit, and if required by local regulations or project requirements, licensed. Good vision, good judgement, coordination, and mental ability are required. Any individual that lacks any of these qualities should not be allowed to operate a boom truck.

Signal personnel must also have good vision and sound judgement, know standard crane signals and be able to clearly give signals. They must have sufficient experience to recognize hazards and signal the operator to avoid them.

Riggers must have the ability to determine weights and distances. Riggers must also demonstrate the ability to select and properly use lifting tackle. It is the responsibility of the management and supervisor to see that riggers are properly trained.

Crewmembers must be given specific safety responsibilities and potential hazards. Crewmembers not required for

the lifting operation shall be instructed to stay clear of the lift. Crewmembers must also be instructed to report any unsafe conditions to the operator, supervisor or management.

1.1.2 Operator's Responsibilities

Safety must be the operator's most important concern. He must refuse to operate the boom truck when knowing it is unsafe and should always consult his/her supervisor if there is any doubt regarding safety. The operator must read and understand the Owner's manual and verify that the equipment is in proper working order and properly set up before operating. The operator must be alert, physically fit, and free from the influence of alcohol, drugs, or medications that might affect his/her eyesight, hearing, reactions, or judgement.

The operator must see that unnecessary people; equipment and material are kept out of the work area. The area around the machine shall be kept in order and properly barricaded.

The operator must understand and be able to accurately interpret the load chart on the boom truck. It is the operator's responsibility to determine that the machine can safely lift and maneuver the load though the range of the lift prior to attempting to lift it.

If any portion of the lift creates a condition of blocked eyesight for the operator, or when operating in or around hazardous areas, a signal person must be used. Because the operator is not in the best position to judge distances and may not be able to see all areas of the work area, a signal person may be necessary at other times. The operator must understand standard crane signals

and take signals from only one designated signal person. The operator, however, shall take a stop signal from anyone.

1.1.3 Signal Person's Responsibilities

The Signal Person must have good vision and sound judgement. The signal person must know the standard crane signals and be able to give these signals clearly and quickly. The signal person must also have appropriate experience to be able to recognize hazards and be able to signal the operator to avoid them. The signal person's primary duty is to assist the operator in safe and efficient operation. The operator's must depend on the signal person to direct load movements without endangering people or property. The signal person must also have a clear understanding of the work being done, and how all steps of the operation fit together. This will allow the signal person to safely coordinate the job with the operator and all other crewmembers. The signal person must position himself or herself so that they can be clearly seen by the operator and clearly observe the entire operation. Standard crane signals must be used unless operator and signal person agree upon an alternative method of communication.

1.1.4 Rigger's Responsibilities

Riggers must be able to accurately determine weights and distances, and be able to select and properly use lifting tackle for the requirements of the lift. Riggers are also required to understand and abide by crewmember's responsibilities.

1.1.5 Crewmember's Responsibilities

It is the responsibility of all crewmembers to report any unsafe condition or practice that is recognized to the job supervisor. Everyone who works around cranes or boom trucks, must obey all warning signs and watch out for his or her own safety and the safety of others. Crewmembers setting up equipment or handling loads are expected to know proper machine erection and rigging procedures. Crewmembers must watch for hazards during operations and alert the operator and signal person of any dangers such as power lines, unexpected presence of people, other equipment or unstable ground conditions.

1.2 OPERATOR QUALIFICATIONS

Operators shall be required to successfully meet the qualifications for operating Elliott manufactured Boom Trucks.

- A) Operator and operator trainees shall meet the following physical qualifications unless it can be shown that failure to meet the qualifications will not affect the operation of the crane. In such cases, specialized clinical or medical judgments and tests may be required.
- 1) vision of at least 20/30 Snellen in one eye and 20/50 in the other, with or without corrective lenses;
 - 2) ability to distinguish colors, regardless of position, if color differentiation is required;
 - 3) adequate hearing, to meet operational demands, with or without hearing aid;
 - 4) sufficient strength, endurance, agility, coordination and speed of

- reaction to meet the operation demands;
- 5) operators and operator trainees shall have normal depth perception, field of vision, reaction time, manual dexterity, coordination and no tendencies to dizziness or similar undesirable characteristics;
 - 6) each operator or operator trainee shall successfully pass with a negative result a substance abuse test. The level of testing will be determined by the standard practice for the industry where the crane is employed and this test shall be confirmed by a recognized laboratory service;
 - 7) no evidence of physical defects or emotional instability that could render a hazard to the operator or others, or that in the opinion of the examiner could interfere with the operator's performance. If evidence of this nature is found, it may be sufficient cause for disqualification; and
 - 8) evidence that an operator is subject to seizures or loss of physical control shall be sufficient reason for disqualification. Specialized medical tests may be required to determine these conditions.
- B) Operator requirements shall include, but not be limited to, the following:
- 1) evidence of successfully passing a physical examination as defined above.
 - 2) satisfactory completion of a written examination covering operational characteristics, controls and emergency control skills such as response to: fire, power line contact, loss of stability, or control malfunction, as well as characteristic and performance questions
- appropriate to the crane type for which qualification is sought;
- 3) operators shall demonstrate their ability to read, write, comprehend and exhibit arithmetic skills and load/capacity chart usage, in the language of the crane manufacturer's operation and maintenance instruction materials;
 - 4) satisfactory completion of a combination written and verbal test on load/capacity chart usage that covers a selection of the configurations (the crane may be equipped to handle) for the type crane for which qualification is being sought;
 - 5) completing an operation test demonstrating proficiency in handling the specific type crane, including both pre-start and post-start inspection, maneuvering skills, shutdown and securing procedures; and
 - 6) operators shall demonstrate understanding of the applicable sections of the B30 Standard and federal, state and local requirements.
- C) Operators who have successfully qualified for a specific type crane shall be required to be re-qualified if supervision deems it necessary. Re-qualification shall include, but not be limited to, the following:
- 1) evidence of successfully passing a current physical examination as defined above.
 - 2) satisfactory completion of a written examination covering operational characteristics, controls and emergency control skills such as response to: fire, power line contact, loss of stability or control malfunctions, as well as characteristic performance stability questions

- appropriate to the crane type for which they are being re-qualified;
- 3) operators shall demonstrate their ability to read, write, comprehend and exhibit arithmetic skills and load/capacity chart usage, in the language of the crane manufacturer's operation and maintenance instruction materials;
 - 4) satisfactory completion of a combination written and verbal test on load/capacity chart usage that covers a selection of the configurations (the crane may be equipped to handle) for the type of crane for which the operator is being re-qualified;
 - 5) completing an operations test demonstrating proficiency in handling the specific type crane on which they are being re-qualified, including both pre-start and post-start inspections, maneuvering skills, shutdown and securing procedures; and
 - 6) operators shall demonstrate understanding of the applicable sections of the ASME/ANSI B30 Standard and federal, state and local safety requirements.
- D) Trainee qualification requirements shall include, but not be limited to, the following;
- 1) evidence of successfully passing a physical examination as defined in above.
 - 2) satisfactory completion of a written examination covering safety, operational characteristics and limitations and controls of the type crane for which they are being qualified;
 - 3) operator trainees shall demonstrate their ability to read, write, comprehend and exhibit arithmetic skills and load/capacity chart usage, in the language of the crane manufacturer's

- operations and maintenance instruction materials; and
- 4) satisfactory completion of a combination written and verbal test on load/capacity chart usage covering various crane configurations.
- E) Trainee qualification, operator qualification and operator re-qualification shall be performed by a designated person who, by experience and training, etc., fulfills the requirements of a qualified person.
- F) Operator physical examinations shall be required every three years as defined above, or more frequently if supervision deems it necessary.

1.3 CONDUCT OF OPERATORS

- A) The operator shall not engage in any practice that will divert his attention while actually engaged in operating the crane.
- B) When physically or mentally unfit, an operator shall not engage in the operation of equipment.
- C) The operator shall respond to signals from the person who is directing the lift or an appointed signal person. When a signal person or a crane follower is not required as part of the crane operation, the operator is then responsible for the lifts. However, the operator shall obey a stop signal at all times, no matter who gives it.
- D) Each operator shall be held responsible for those operations under the operator's direct control. Whenever there is any doubt as to safety, the operator shall consult with the supervisor before handling the loads.
- E) Before leaving the crane unattended, the operator shall:
 - 1) land any load, bucket, lifting magnet or other device;
 - 2) disengage the master clutch;

- 3) set travel, swing, boom brakes, and other locking devices;
 - 4) put controls in the off or neutral position;
 - 5) secure the crane against accidental travel; and
 - 6) stop the engine.
 - 7) An exception to (6) above may exist when crane operation is frequently interrupted during a shift and the operator must leave the crane. Under these circumstances, the engine may remain running and the following conditions (including those in paragraphs E.1 through E.5 above) shall apply:
 - a) the operator shall be situated where unauthorized entry of the crane can be observed; and
 - b) the crane shall be located within an area protected from unauthorized entry.
 - 8) Before closing the switch or starting the engine, the operator shall see that all controls are in the off or neutral position and that all personnel are in the clear.
- F) If there is a warning sign on the switch or engine starting controls, the operator shall not close the switch or start the engine until the warning sign has been removed by an appointed person.
- G) Before closing the switch or starting the engine, the operator shall see that all controls are in the off or neutral position and that all personnel are in the clear.
- H) If power fails during operations, the operator shall:
 - 1) set all brakes and locking devices;
 - 2) move all clutches or other power controls to the off or neutral position; and
 - 3) if practical, land the suspended load under brake control.
- I) The operator shall be familiar with the equipment and its proper care. If adjustments or repairs are necessary, the operator shall promptly report this to the appointed person and shall also notify the next operator.
- J) All controls shall be tested by the operator at the start of a new shift. If any controls fail to operate properly, they shall be adjusted or repaired before operations are begun.
- K) The manufacturer's boom assembly and disassembly procedures should be followed. Any deviation from the manufacturer's procedure shall require blocking of the boom or boom sections to prevent inadvertent dropping of the boom.
- L) When removing pins or bolts from a boom, workers should stay out from under the boom.
- M) Outrigger shall be visible to the operator or to a signal person during extension or setting.

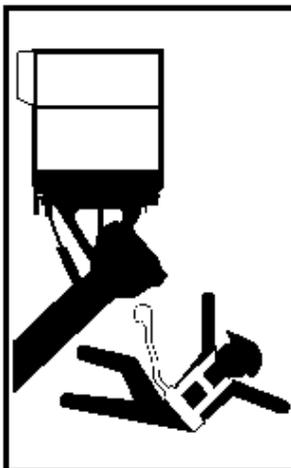
1.4 PLATFORM SAFETY

! DANGER

FAILURE TO OBEY FOLLOWING WILL RESULT IN DEATH OR SERIOUS INJURY

- TRUCK MUST BE SECURELY PARKED WITH PARKING BRAKE APPLIED, TRANSMISSION IN NEUTRAL AND AERIAL DEVICE PROPERLY STABILIZED PRIOR TO OPERATION.
- TO AVOID TIP-OVER, OUTRIGGERS (WHEN SO EQUIPPED) MUST BE PROPERLY EXTENDED ON A SOLID LEVEL SURFACE, USE GROUND BOARDS IF NOT ON SOLID SURFACE.
- OPERATE ALL CONTROLS SLOWLY FOR A SMOOTH PLATFORM MOTION TO MAKE SURE CONTROLS RETURNED TO NEUTRAL AFTER DESIRED OPERATION.
- CREW MUST USE PROPER PERSONAL AND OTHER PROTECTIVE EQUIPMENT.
- NEVER LOAD BEYOND RATED CAPACITY.
- NEVER OPERATE AERIAL DEVICE WITH PERSONNEL UNDER BOOM OR LOAD.
- KEEP AT LEAST (3) WRAPS OF LOADLINE ON WINCH DRUM WHEN SO EQUIPPED.
- NEVER MOVE THE TRUCK UNTIL THE BOOMS, OUTRIGGERS AND WHEN SO EQUIPPED AUGER AND WINCH LINE ARE IN A PROPERLY STOWED POSITION AND SECURED.
- REFER TO THE OPERATIONS MANUAL FOR COMPLETE INSTRUCTIONS. IF MISSING, REPLACE MANUALS.

DO NOT PAINT OVER ANY LABELS 100050 111183

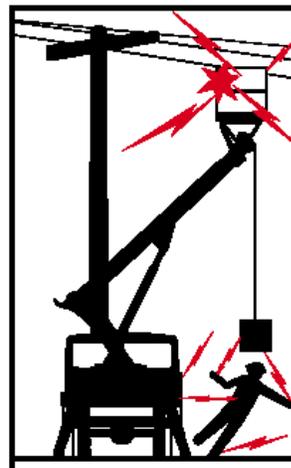


! DANGER

FALLING FROM PLATFORM WILL RESULT IN DEATH OR SERIOUS INJURY

PLATFORM PERSONNEL MUST WEAR BODY HARNESS WITH A LANYARD ATTACHED TO ANCHOR PROVIDED. PLATFORM DOOR, OR OPENING CHAIN, MUST BE SECURELY LATCHED.

DO NOT PAINT OVER ANY LABELS 1002910 011397



! DANGER

ELECTROCUTION HAZARD THIS MACHINE IS NOT INSULATED DEATH OR SERIOUS INJURY WILL RESULT FROM CONTACT WITH OR INADEQUATE CLEARANCE TO ELECTRICAL POWER LINES AND APPARATUS

- MAINTAIN SAFE CLEARANCE FROM ELECTRICAL POWER LINES IN ACCORDANCE WITH APPLICABLE GOVERNMENT REGULATIONS. ALLOW FOR BOOM, ELECTRICAL LINE AND LOADLINE SWAY.
- THIS MACHINE DOES NOT PROVIDE PROTECTION FROM CONTACT WITH OR PROXIMITY TO AN ELECTRICALLY CHARGED POWER LINE.

DO NOT PAINT OVER ANY LABELS 1001470 081792

! DANGER

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 HAVE READ, UNDERSTAND AND FOLLOW THE SAFETY AND OPERATING RECOMMENDATIONS CONTAINED IN THE MACHINE MANUFACTURERS 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 MANUFACTURERS MANUALS.
- YOU ARE SURE THAT ALL SAFETY SIGNS, GUARDS, AND OTHER SAFETY FEATURES ARE IN PLACE AND IN PROPER CONDITION.

DO NOT PAINT OVER ANY LABELS 1001130 040794



Boom truck cranes are designed and intended to be used for handling material, not personnel. Boom mounted personnel platforms can be used as long as guidelines are followed. Guidance on the use of personnel platforms is from ASME B30.5 (latest) and ASME B30.23 (latest). Additionally, federal standards such as OSHA 29 C.F.R. 1962.550, must also be followed.

1.4.1 Personnel Platform Usage

Guidelines:

- 1) The crane shall not be used for other lifting operations while handling personnel. Downhaul weight or load-block must be removed from loadline. Loadline must be stowed on top of main boom. Anti-two-block switch must be overridden.
- 2) Lift controls and platform shall be tested and inspected daily prior to use.
- 3) Only authorized persons shall operate the crane or personnel platform. Operator shall remain at controls when personnel platform is occupied. Operator, platform personnel and ground signalperson shall be in constant communication.

- 4) Boom and platform load ratings or work areas shall not be exceeded. The combined weight of the personnel platform, any attached devices, personnel to be lifted, and tools or other equipment shall not exceed 50% of the load ratings listed on the capacity chart.
- 5) Personnel in the platform shall wear a body harness (fall protection device) that is securely attached to the boom or platform at all times. They shall always stand firmly on the floor of the platform and not climb or sit on the rails of the platform. Nor should personnel use planks, ladders or any other materials for work positions.
- 6) Belting off to structures other than the boom or the platform shall not be permitted.
- 7) The crane that the personnel platform is mounted onto shall not be moved when the boom is elevated. The crane shall be supported by a firm surface. Blocking may be required to ensure that the load-bearing surface can support the weight of crane operations. Provided outriggers shall be properly extended and no lifting of personnel is allowed when the crane is supported by tires.
- 8) The personnel platform and crane are not insulated. Do not operate near power lines or electrical hazards. Recommended minimum working distances are to be maintained when working near power lines or electrical hazards. Distances are based on voltages of electrical hazards.

MINIMUM CLEARANCE REQUIREMENTS

Nominal Voltage kV (Phase to Phase)	Minimum Distance Required
Up to 50	10 feet
Over 50 to 200	15 feet
Over 200 to 350	20 feet
Over 350 to 500	25 feet
Over 500 to 750	35 feet
Over 750 to 1000	45 feet

If electrical voltage is unknown, assume maximum voltage and maintain the maximum clearance of at least 45 feet. You must use a signalperson on the ground to guide the operator.

- 9) Do not allow lifts in the personnel platform in winds in excess of 20 miles per hour (32 km/hr) at the working height of the platform. Cease all personnel lifting activities if hazardous conditions such as electrical storms, snow, ice, sleet or any other adverse conditions occur.
- 10) Modification of the structural integrity of the personnel platform shall not be done without written approval of the manufacturer.
- 11) Personnel platforms are to be used only for personnel, their tools, and sufficient materials for the workers to accomplish their job. Platforms shall not be used to transport bulk materials.
- 12) Properly stow the personnel platform, jib, boom, and outriggers prior to road travel.

1.4.2 SPECIAL WORK CONSIDERATIONS:

Special precautions to be taken for some but not all-special work situations.

- 1) When welding from the personnel platform electrode holders shall be protected from contact with the metal

components of the personnel platform.

- 2) When personnel lifts occur over water, personal flotation devices shall be provided' and required to be worn. Platform personnel shall wear a body (fall protection device) that is securely attached to the platform or booms tip, while over land and detached while over water.
- 3) A boat with rescue personnel shall be available during a personnel lift over water.
- 4) Special personnel protective equipment shall be provided and required to be worn around toxic, flammable or hazardous materials or fumes.

1.4.3 PRE-LIFT REQUIREMENTS AND PLANNING:

Special procedures are to be followed when it is determined that personnel need to be lifted in a platform to perform needed work or gain access to certain areas.

- 1) The person specifically responsible for the work to be performed shall determine that there is no other practical method of performing the required work. This person can authorize the use of personnel lifting. Additionally, this person must evaluate the safety issues associated with the proposed personnel lift and verify the platform and hoisting are suitable for use.
- 2) For each personnel-lifting event, the person responsible for the work shall issue a statement describing the procedure to be used. This statement is to be retained at the jobsite.
- 3) Crane and personnel platform shall be inspected daily prior to any lifting

events. An inspection record is to be maintained.

- 4) Personnel lifting activities shall be made under controlled conditions with the aid of an appointed signalperson.
- 5) A pre-lift meeting shall be held daily to plan and review personnel lifting procedures. This meeting is to be attended by the crane operator, signalperson, platform occupants, and person responsible for the work to be performed. The person responsible for the work to be performed shall instruct the personnel who will occupy the platform during the lifting procedure. Instructions are to include procedures for entering and exiting the platform and when the personnel can enter or exit the platform.

Pre-Lift Meeting Shall Cover These Items as a Minimum:

1. Proper use of all equipment.
2. Assignment and responsibilities of each person involved in the lift.
3. The procedures to be followed.
4. Guidance on general and specific safety precautions.
5. Special signals for the operation.
6. Unique considerations of the lift.
7. Work to be accomplished during the lift.
8. If applicable, the responsibilities and assignments of a signalperson when operating near electrical hazards, including power lines.

If there is a change of personnel during a lifting operation, those people should also be briefed on the lifting operations and safety requirements.

- 6) The operator and signalperson shall perform a test lift. This test lift is to be 125% of rated load. Test weights are to be attached to an empty platform for this test. The test is to verify that the machine is operating on a firm bearing surface and that

the structural integrity of the personnel platform is adequate for the planned lift operation.

1.4.4 PERSONNEL RESPONSIBILITIES and QUALIFICATIONS:

MANAGEMENT

- 1) Shall require that all people associated with a lift operation are familiar with the requirements of applicable manuals, relevant local, state, and federal standards, and consensus standards, ASME B30.5 (latest) and ASME B30.23 (latest) and that these standards are followed during personnel lift operations.
- 2) Shall designate qualified persons to perform duties of "Personnel Lift Authorizer".

Personnel Lift Authorizer shall:

- a. Verify need for personnel lift.
- b. Verify equipment to be used meets standards.
- c. Authorize the personnel lift operation.
- d. Require lift personnel to follow guidelines of standards.

- 3) Shall designate person to perform duties of "Personnel Lift Supervisor".

Personnel Lift Supervisor shall:

- a. Hold pre-lift meeting.
- b. Verify required inspections have been performed.
- c. Verify qualified are assigned to perform functions of ground crew, signalperson, operator, and platform occupants.
- d. Supervise lift operations.
- e. Maintain safety of lifting operations.

EQUIPMENT OPERATOR

- 1) Shall be qualified to operate the equipment being used in the personnel lift.

- 2) Successfully meet the physical qualifications established in the applicable hoisting equipment volumes of ASME B30 (latest). Additionally, the operator shall have been tested for substance abuse. Testing shall be in accordance with applicable government regulations and policies of the employer.
- 3) Successfully meet training and qualification criteria outlined in hoisting equipment volumes of ASME B30 (latest).
- 4) Shall be responsible for complying with the requirements of the standards as they relate to:
 - a. Hoisting equipment capability.
 - b. Rated load constraints.
 - c. Operational limitations.
 - d. Confirming that all hoisting equipment inspections have been completed and are satisfactory, prior to starting the lift.
 - e. Operating the hoisting equipment in compliance with specified procedures.
- 5) Shall not engage in a personnel lift when physically or mentally unfit. The operator has the right to refuse any personnel lift under the following circumstances:
 - a. The operator does not feel physically or mentally fit to perform the operation.
 - b. The operator has been working for more than ten hours prior to the start of the lift or the lift will not be completed before the operator has been working for twelve hours.
 - c. The operator did not have at least eight hours off immediately prior to the work shift containing the personnel lift operation.
- 6) The operator shall not engage in any activity that will divert his attention while engaged in operating the hoisting equipment.
- 7) The operator shall respond only to signals from the Personnel Lift Supervisor of signalperson. The operator shall obey a stop signal at any time, no matter who gives the signal.
- 8) When safety is in doubt, the operator shall consult with the Personnel Lifting Supervisor before commencing or continuing a lift.
- 9) Shall remain at the controls when operating a machine with a boom mounted platform that does not have controls for the duration of the lifting event.
- 10) When performing a lift when the boom mounted platform has upper controls, the operator shall be free to not remain at the hoisting equipment controls.
- 11) The operator shall refer to manufacturers instructional material regarding operation requirements of the hoisting machine and attachments.
- 12) The operator shall inspect the hoist equipment setup area before the personnel lift and report observations to the Personnel Lifting Supervisor. The operator shall inspect the lifting area for potential hazards such as, but not limited to:
 - a. Excessive load and/or radius.
 - b. Overhead obstructions and electrical transmission lines.
 - c. Hazardous locations.
 - d. Inadequate surface and support to withstand all forces imposed.
 - e. Wind, weather, and unstable conditions.
 - f. Any potentially hazardous conditions.
- 13) The operator shall inspect the hoist equipment immediately prior to starting a personnel lift operation. This is a Frequent Inspection and the inspection criteria in ASME B30 shall be used.

- 14) Hoisting equipment shall be operated with outriggers and stabilizers fully deployed and properly set.
- 15) The operator shall verify that the hoisting equipment is set up and maintained within one percent of level (0.56°) during a personnel lift.
- 16) For hoisting equipment with a boom-attached platform, verify that the platform is attached as outlined in the installation section.
- 17) The operator shall not allow the weight of the lifted load including rigging, platform, personnel, tools and materials to exceed 50% of the hoisting equipment's rated load, under planned conditions of operation (except during testing as required by the appropriate volume of ASME B30).
- 18) Not allow the platform's rating or the hoisting equipment's reduced rated load to be exceeded when loads are transferred to the hoisted platform.
- 19) The operator shall perform a trial lift prior to lifting personnel with the platform on each shift and after any change of setup location, hoist equipment configuration, or operator. These lifts shall be used to ascertain that hoist equipment setup and configuration is correct, load capacities are adequate, that no hazardous interferences exist, and to further demonstrate the operator's competence.
- 20) Verify during the trial lift, the platform is loaded to at least the weight expected during the actual lift.
- 21) Not knowingly allow the platform load to exceed the platform rating, except during proof testing.
- 22) Not travel the hoisting equipment with personnel in the personnel platform.
- 23) The operator shall perform all movements if the platform in a slow, controlled manner to minimize sudden movements of the platform.
- 24) Remain at the hoisting equipment controls at all times the personnel platform is occupied.
- 25) Set all brakes and locks on the hoisting equipment after positioning of the personnel platform and before any personnel platform work.
- 26) Move the platform under controlled conditions and under the direction of a designated signalperson.
- 27) The operator shall not move the platform over, under, or in the vicinity of power lines or electrical hazards unless the requirements of the minimum clearance table is met.
- 28) Not lift any other loads, on any other load lines, while conducting a personnel lift. When the hoisting equipment has a boom attached platform without controls it shall not be used for other lifting service.
- 29) Not disable, or allow to be disabled, any hoist equipment safety device during a personnel lift.
- 30) Not operate a platform with motion controls without the platform operation manual available in the platform.
- 31) The operator should avoid the simultaneous operation of more than one of the hoisting equipment motion controls, unless such practice increases the safety of the lift operations.

GROUND CREW

- 1) Visually inspect the platform prior to each lift to verify all attachments and the platform structure are secure.
- 2) Observe the weight test and report any deformation or hazardous conditions to the personnel Lift Supervisor. Items noted during the test weight shall be verified as safe by a qualified person prior to commencing the personnel lift.

- 3) Inspect and attach the platform to the hoisting equipment as specified by the platform manufacturer.
- 4) Verify the platform is evenly loaded, material secured, and the total platform weight does not exceed the platform rating or the reduced hoisting equipment lift capacity.
- 5) Not allow an occupied platform over, under, or in the vicinity of power lines or electrical hazards unless minimum clearance requirements are met.

PERSONNEL PLATFORM OCCUPANTS

- 1) Remain in continuous sight or in communication with the operator and the signalperson.
- 2) Maintain a stable and even loading of the platform.
- 3) Use protective equipment such as hard hats, safety glasses, hearing protection, and gloves in conditions where a hazard of injury exists.
- 4) Wear personnel fall protection devices with lanyards attached to provided anchorage points at all times, while occupying the platform, unless special circumstance work requirements dictate otherwise.
- 5) Be familiar with hand signals posted in the platform. All occupants shall know the emergency stop signal.
- 6) Limit their number commensurate with the work being performed, platform design, and hoisting equipment limitations.
- 7) Have materials and equipment evenly distributed and secured while the platform is lifted.
- 8) Not stand, sit on, or work from the top rail, intermediate rail, toe board, or use any device to enhance their vertical height working capability.
- 9) Not pull the platform out of plumb with the hoisting equipment.
- 10) Not enter or exit a suspended platform while it is raised unless the platform has an installed gate and

the platform is physically secured to the structure to which the occupants are entering or leaving.

- 11) The platform occupant should keep all parts of their body inside the platform during raising, lowering, or positioning unless they are performing the duties of a designated signalperson.

1.4.5 COMMUNICATIONS:

- 1) Signals to the operator shall be in accordance with the hoisting equipment ASME B30 volume, unless voice communication (telephone, radio, or equivalent) is utilized.
- 2) Signals shall be discernible or audible to the operator.
- 3) Hand signals shall be posted as specified:
 - a. As required by the hoisting equipment ASME B30 volume.
 - b. Inside the personnel platform.
 - c. At any platform motion control station.
- 4) Some operations may require additions to, or modifications of standard signals.
 - a. Any special signal shall be agreed upon and understood by the signalperson and the hoisting equipment operator.
 - b. Special signals shall not conflict with the hoisting equipment standard signals.
- 5) If communications between the operator and platform occupants are disrupted, all operations shall be stopped until communication is reestablished.
- 6) If radios or other electrical means of communication are used, they should be operated on a secure channel.
- 7) Proper performance of communications shall be verified prior to each lift if radios or other

electrical communication devices are used.

1.4.6 LIFTING PERSONNEL NEAR ELECTRICAL POWER LINES:

Lifting personnel near electrical power lines is not allowed unless there is no less hazardous way to do the job. Lifting personnel where the hoisting equipment or platform can be electrified from electric power lines is an extremely hazardous practice. It is advisable to perform the lift so there is no possibility of the hoisting equipment, load line, or personnel platform becoming a conductive path. This hoisting equipment shall not be used to lift personnel under, beside, or over electric power lines if any combination of boom, personnel platform, load line, and machine component will enter the prohibited zone as specified in the MINIMUM CLEARANCE REQUIREMENTS table or the clearances as dictated by applicable governmental regulations.

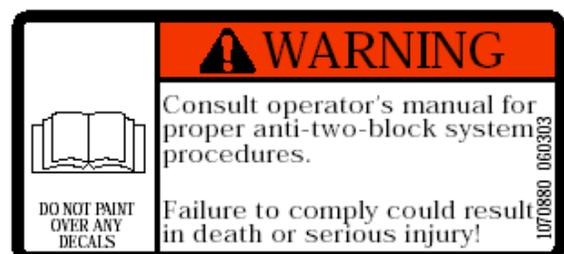
1.4.7 INSPECTION:

The platform shall be inspected by a qualified person prior to initial use at each new job site according to items listed in the "Personnel Platform Pre-Lift Inspection" form in this section. The platform shall then be inspected at least once each day, before use, by a designated person to identify conditions that could create a hazardous operating condition. Any hazardous condition found shall be corrected before personnel are lifted. Dated records of the platform inspections shall be kept with the crane and be available for review. At each new job site, prior to lifting people in the personnel platform, the platform shall be proof tested to 125% of the platform's rating. With the proof test load evenly distributed in the platform. The platform shall be lifted and

held in a raised position for not less than five minutes. After the proof testing the platform shall be inspected by a qualified person. Any damage revealed by the inspection shall be corrected and another proof test conducted. The most recent record of proof testing shall be maintained at the job site.

1.4.8 PLATFORM INSTALLATION:

- 1) Position the truck and crane for use as outlined in the Owner's Manual.
- 2) If the platform has been transported to the job site on the truck, attach the loadline hook to the platform and set the platform on the ground at a radius that will allow the platform to be pinned onto the boom or jib, whichever is to be used.
- 3) Remove loadline from boom sheave case, remove anti-two-block-downhaul weight from loadline and stow loadline on the block provided on top of the main boom section.
- 4) Attach anti-two-block override flag onto the anti-two-block switch.
- 5) If the platform is to be used on the jib tip, deploy the jib and extend the second jib section if required. Consult load chart to verify that the basket and personnel combined weights fall within the allowable load rating of the crane.
- 6) Position the platform and pin the platform bracket to the sheave head of the boom or jib. Attach the two j-hooks to the sheave case.
- 7) When reinstalling the loadline, make sure the anti-two-block switch override flag is removed and the anti-two-block system tested for proper operation prior to hoisting loads on the crane loadline.



To remove the platform, reverse the above procedure. Inspect the platform and replace any damaged parts or labels prior to the next use of the platform.

1.4.9 OPERATION:

- 1) When setting up at a job site, make sure all outriggers and stabilizers are extended to level the truck and the ground is capable of supporting the imposed loads.
- 2) Attach the personnel platform as previously described.
- 3) If using remote controls, turn the power switch on at the control console. Operate all crane functions using the remote control transmitter before performing any lift operations with the personnel platform occupied.
- 4) Referring to the load chart, plan the platform lift operation and review where the load chart will allow the loaded personnel platform to travel.
- 5) Make sure deductions are taken the jib, if stowed along the main boom, and any other boom mounted options.
- 6) Where no capacities are shown on the load-rating chart, operation is allowed with the boom fully retracted.
- 7) Have platform personnel put on the body harnesses with the attached safety lanyard and attach the safety lanyards to the designated anchorage points.

- 8) Elevate the boom with the personnel platform to the approximate angle before extending the boom and moving the personnel platform to the working position. When the boom is near full extension or elevated close to 80°, controls must be applied very gently to avoid dangerous sudden movements at the platform when the telescope or lift cylinders reach full extension.

When the platform has been elevated to the working position, the platform can be rotated to move the platform personnel closer to the work. To rotate the platform to the desired position, first make sure all crane functions are in neutral. With the left hand, grasp the rotation crank and with the right hand, lift the locking lever. With the locking lever raised, the platform can be rotated into position. Release the locking lever and make sure it aligns with one of the cogs in the locked position.



PERSONNEL PLATFORM LIFT
PLANNING AND AUTHORIZATION FORM

- 1. Location _____ Date _____
2. Purpose of Lift _____
3. Hoisting Equipment. Mfg _____ Model # _____ Serial # _____
4. Expected Radius _____ (MAX): _____ (At work Location)
5. A) Rated Load at Radius _____ B) Maximum lift load (50% of 5A) _____
6. Platform ID _____ Platform Rating _____
7. Platform Weight _____
8. A) Number of platform occupants _____ B) Approx. WT. (with equip.) _____
9. Total lift weight _____ (7 + 8B, no more than 5B above)
10. Personnel lift supervisor _____
11. What are the alternatives to this personnel lift? _____
12. Why are they not being used? _____
13. Pre lift briefing held ___/___/___/___ AM/PM
Attendees: _____
14. Anticipated hazards: (wind, weather, visibility, power lines) _____
15. Lift accomplished date _____ Time _____
16. Remarks- _____

Name

Signature

Date

PERSONNEL LIFT PLATFORM PRE-LIFT INSPECTION

Inspector _____ Date _____
Platform ID _____

1. Markings

SAT UNSAT

Platform decals and placards (all information legible)..... _____
Suspension system decals and placards _____

2. Structure

Load supporting welds/bolts _____
Load supporting members _____
Barrier from toe board to intermediate rail _____
Hand rail _____
Fall protection device anchorage points _____
Gate locking mechanisms _____
Platform flooring _____
Suspension attachment points _____

3. Attachment mechanisms

Pins/Ears/Bolt-ups/Eyes (circle) _____
Basket mounting bracket _____
Basket pivot bearings _____

4. Special purpose items

Hand brake operation _____
Safety harness and lanyards _____
Floor cleanliness _____

5. General comments

Name

Signature

Date

1.5 JIB SAFETY

When Deploying or stowing the jib on this boom truck, always follow the instructions instruction found in this manual. The proper procedures can be found in Sections 1.12.1 for jib deployment and 1.12.2 for stowing of the jib. Read and follow these safety guidelines when using the jib.

- A) The anti-two-block switch weight and cord must be attached to the jib when deployed.
- B) Do not lift load with the boom tip when the jib is pinned on the boom tip.
- C) Load Chart Interpretation with boom at full extension
 - 1) Operate with jib by radius when main boom is fully extended. If necessary, increase boom angle to maintain loaded radius.
 - 2) When radius is between points listed on capacity chart, the load shown at the next longer radius shall be used.
- D) Load Chart Interpretation with boom not at full extension.
 - 1) Operate with jib by boom angle when main boom is not fully extended. Do not exceed rated jib capacities at any reduced boom lengths.
 - 2) When angle is between points listed on capacity chart, the load shown at next lower boom angle shall be used.
- E) Ensure jib is stowed correctly.
 - 1) **Removal of swing-around pins, 'C' without proper installation of stow pin 'A' and jib-swing pin 'B', may allow jib to fall.**
 - b. Extending boom with jib stowed and failure to remove swing pins 'C', will damage boom and/or jib.
- F) Only attempt to swing jib to working or stowed position when boom is horizontal, stow pin 'A' and jib-swing pin 'B' are removed and swing pins 'C' are in place. Jib could swing uncontrollably if boom is not horizontal.
- G) Crane shall be fully set up according to proper set-up procedures outlined previously when stowing or unstowing jib.
- H) Operate boom and turn functions very slowly and carefully when using jib since jibs can increase boom length by 50%.
- I) Area where jib swings around must be clear of obstructions and power lines when stowing and unstowing jib.
- J) Use safety glasses when pounding pins with hammer.
- K) Do not extend/retract boom unless boom is horizontal when stow pin 'A' and jib-swing pin 'B' are removed during stowing or unstowing procedures.
- L) Always put spring clips in pins to ensure that they will stay in place.
- M) When the jib is stowed, the boom can not be fully retracted if a boom tip attachment option is installed.
- N) For manually extendable jib options:
 - 1) Extension retaining pin 'E' must always be installed before operation.
 - 2) All swing around (stow and unstowing) operations shall be done with jib retracted and pinned.
 - 3) Extendable section may slide out of 1st section jib when pin 'E' is removed. Keep personnel clear of area.

⚠ DANGER

Visually inspect all pin positions to assure jib is fully retracted into side stow brackets, jib stow attachment is secure, and all pins and spring clips are in their proper locations. Failure to properly secure the jib during stowing and erecting may allow the jib to fall. Serious personal injury or death could result.

Always have at least one, if not both of the following in place at all times:

- **Side stow bracket completely engaged into stow hook with stow pin 'A' properly in place.**
- **Both pins 'C1' in upper and lower jib holes properly in place through mating holes in boom tip.**

1.6 ROAD TRANSPORT

- 1) Make sure outriggers/stabilizers are retracted and removable pads stowed-if applicable. Always retract optional front bumper stabilizer before retracting outriggers and stabilizers.
- 2) Secure the loadline, headache ball or hook block to travel attach point.
- 3) Boom must be in boom rest and turret locked for optional turret locks.
- 4) Secure all items on the truck bed.
- 5) Make sure jib-if supplied-is stowed properly and pinned to boom.
- 6) Disengage the PTO.
- 7) Inflate tires to proper pressure.
- 8) Release park brake.
- 9) Know the weight of the vehicle and items transported on deck. Do not exceed axle limits and bridge load limits.

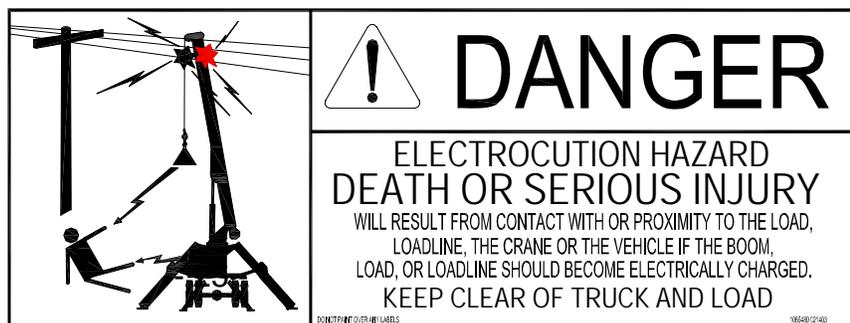
Know overall height and make sure there is clearance before entering

underpasses and other overhead obstructions.

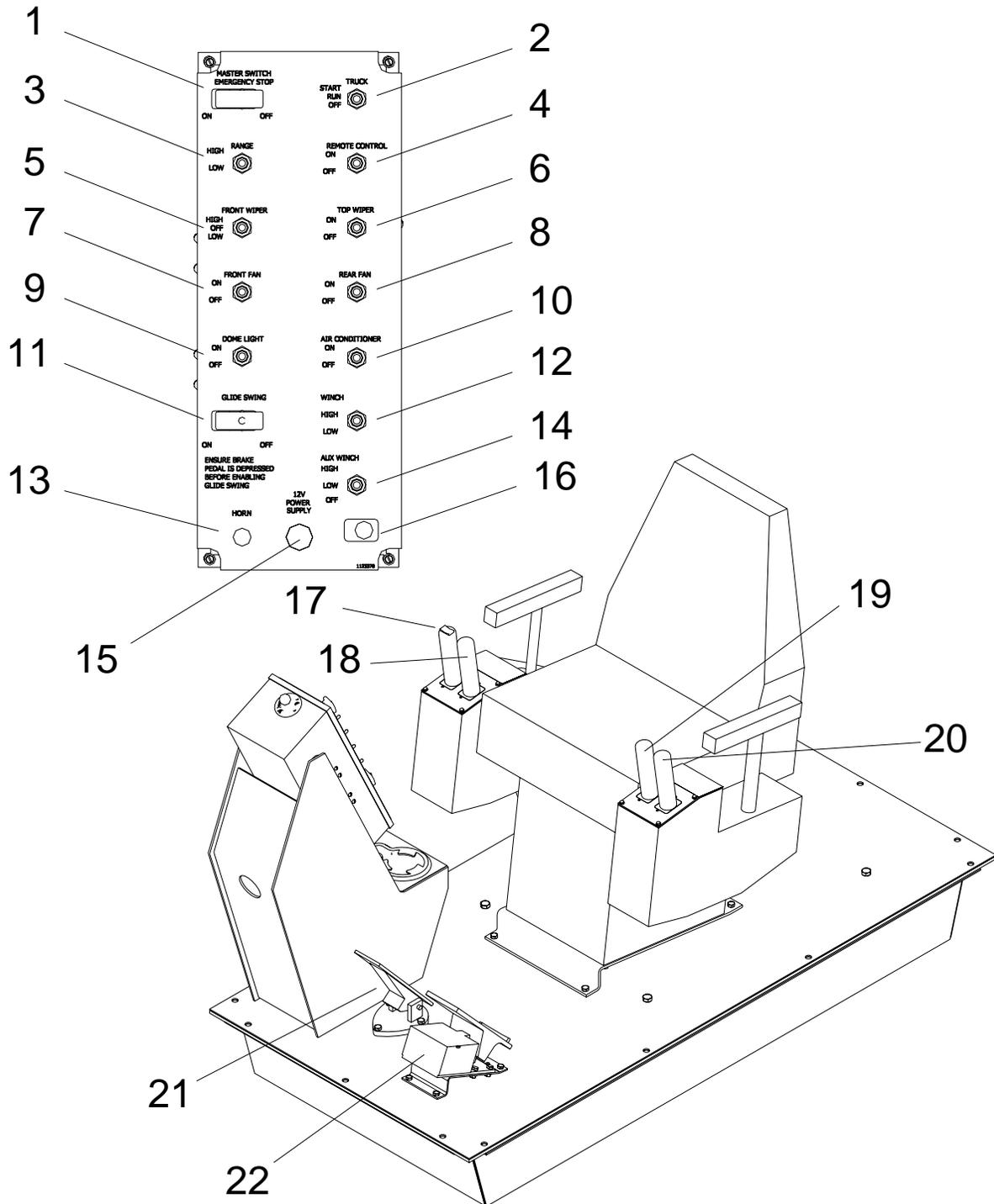
1.7 ON-SITE SETUP

- 1) Position the vehicle in an area free of overhead restrictions. Check capacity chart for picks required and position the crane in the proper place to complete the task safely.
- 2) Maintain a clearance of at least 10 feet (3.05M) between any part of the crane, loadline or load and any electrical line carrying up to 50,000 volts. One additional foot (.30M) clearance is required for every additional 30,000 volts or less. Set ground markers in place to be used as a reference to assist in making sure the crane and load maintain minimum clearances required. Power lines and loadlines deflect in wind and additional clearance must be provided. If the electrical line voltage is unknown, contact the utility and obtain the voltage prior to operation. All overhead wires must be considered energized until the electrical utility representative verifies that they are not and the wires are visibly grounded.
- 3) A qualified signal person shall be assigned to monitor the distance from the crane and load to energized power lines, and warn when approaching the minimum safe distance. Use non-conductive tag lines.
- 4) The crane must be set up on a firm, level surface with adequate support for outrigger/stabilizer loads. Thin concrete, hot asphalt and partially frozen ground may not support outrigger loads. Use cribbing to assist in distributing loads.
- 5) Always set the park brake and disengage the transmission.

- 6) Use a signal person to set the outriggers safely if not visible and avoid a crushing hazard.
- 7) Extend outriggers first so crane is level from side to side and raise vehicle front tires clear of the ground. Level crane using the bubble levels on the console. Then extend stabilizers so crane is level from front to rear and rear tires are off ground. After the crane is level side-to-side and front-to-back, extend the front stabilizer (if equipped with option) until firm contact is made with the ground. Operating out of level will drastically reduce stability.
- 8) Run all controls and safety devices, including the anti-two block system, through a cycle prior to lifting loads.
- 9) Operate control levers and engine speed smoothly to avoid sudden starts and stops, which could cause loads to swing.
- 10) Do not side load the boom. Side loading can result in sudden structural failure or tipping.
- 11) Side loading occurs when rapidly starting and stopping swing operations, operating out of level, dragging or pulling loads sideways or operating in high winds.
- 12) Always position the boom head and loadline directly over the load before lifting and lift slowly to avoid swinging the load. Never drag a load or push down with the boom. When at or near maximum rated load tighten the loadline with the winch and then boom the load off the ground to keep the load from swinging to an increased radius due to boom deflection.
- 13) Always remember the load lifted includes the load weight, the hook block/headache ball weight, slings, and applicable options on the boom. When operating between boom lengths or radii on the load rating chart, use the next lower rated capacity.
- 14) Keep the load as close to the ground as possible.
- 15) Do not lift loads if wind can create a hazard. Winds aloft can be much stronger than at the ground.
- 16) Use multi-part rope reeving when required. Keep at least three full wraps of rope on the winch drum at all times. In some multi-parted cases, the hook block cannot be lowered to the ground if the boom tip is too high before all rope is unspooled from the winch.
- 17) Always keep space between the hook block and boom head when winching up or extending the boom to avoid two-blocking. **Do not rely on the two block system to eliminate two blocking.**
- 18) Do not allow anyone to ride the loadline, hook or load.
- 19) Only use Elliott approved personnel baskets attached to the boom or jib for lifting personnel.
- 20) Do not exceed 80% of the crane rating when using a clam bucket.
- 21) Do not operate the crane if the anti-two block safety system is inoperative.
- 22) Do not operate the crane if the Load Moment Limiter/Load Moment Indicator System installed on the crane is inoperative.



1.8 OPERATING CONTROLS



1.8.1 Boom Controls

Power Take-Off (PTO)

Located in the truck cab. Refer to truck manuals for operating instructions. PTO must be engaged to provide power to crane functions. Located in the truck cab. Refer to truck manuals for operating instructions.

CAUTION: *Driving truck with PTO engaged may damage hydraulic pump.*

1) Master Switch – Emergency Stop Switch

To switch Master Switch on “ON” position, red Emergency Stop Switch Cover must be opened and toggle switch set to the on position. Any time the red Emergency Stop Switch Cover is closed, master switch will move to the off position and crane functions will be disabled.

2) Truck Start/Stop Switch

This is a momentary switch used to start or stop the truck engine. Holding the switch in the start position, activates the starter. Release the switch as soon as the engine starts. Activate and hold the switch in the Stop direction to shut the truck off. Once the engine stops completely stops running, release the switch. If this switch is released while engine is still turning over, the truck will restart.

3) Range – High/Low Switch

With this switch set on High, full activation of the joystick will move the valve spool to its maximum flow position. This is for all boom function except for swing. Swing is set independantly using switch on Swing Control Joystick. Setting this switch at Low, full movement of the joystick

will move the control valve spool approximately 50% of the spool travel. Setting this switch at Low does not necessarily provide half speed of the function. The operator can toggle back and forth between these options based on load or proximity of the crane to other objects.

4) Remote Control Switch

To operate remote controls, toggle this switch to ON. Truck engine may shut off. If so, the truck will need to be restarted using the remote controls. Follow instructions in 1.8.3 to operate remotes. Joysticks in crane cab will be disabled when remote switch is in on position.

5) Front Wiper Switch

This switch operates the front windshield wiper. Set switch to “HIGH” for high speed wipers, Set switch to “OFF” to stop wiper movement, Set switch to “LOW” for low speed wipers.

6) Top Wiper Switch

This switch operates the top skylight wiper. Set switch to “ON” to activate wipers, Set switch to “OFF” to stop wiper movement.

7) Front Fan Switch

This switch operates the fan mounted above the control console. Set the switch to “OFF” to stop the fan, Set the switch to “ON” to operate fan.

8) Rear Fan Switch

This switch operates the fan mounted behind the operator’s seat. Set the switch to “OFF” to stop the fan, Set the switch to “ON” to operate fan.

9) Dome Light Switch

This switch operates cab mounted dome light. Set the switch to "OFF" to when light is not required, Set the switch to "ON" to illuminate dome light.

10) Air Conditioner Switch

On units equipped with optional Air Conditioning, this switch operates the air conditioning. Set the switch to "ON" to start air conditioning. Set switch to "OFF" to shut off Air Conditioning.

11) Glide Swing Switch

This unit is equipped with Glide Swing. In order to rotate the boom, glide swing must be switched on. To switch Glide Swing on, red Emergency Stop Switch Cover must be opened and toggle switch set to the on position.

⚠ DANGER

When glide swing toggle switch is in the "ON" position, swing system is not locked and can swing freely. To apply brake with glide swing in "ON" position, apply brake by applying pressure to brake pedal (Item 19). . Any time the red Emergency Stop Switch Cover is closed, Glide Swing switch will move to the "OFF" position and swing brake will be applied. Brake pedal should be depressed when this switch is moved from one position to the other.

12) Winch Range Switch

This unit is equipped with a two speed winch motor. This switch selects either High or Low speed winch operation for the primary boom winch. Full line pull is only available when switch is in "LOW"

position. See Specifications (2.1) for performance data.

13) Horn Button

Press momentary button to sound horn

14) Aux. Winch Range Switch

If equipped with optional Aux winch, the winch has a two speed winch motor. This switch selects either High or Low speed winch operation for the aux. boom winch. Full line pull is only available when switch is in "LOW" position. See Specifications (2.1) for performance data. To disable Aux winch, toggle switch to the "OFF" position.

15) 12 Volt Power Supply**16) Cab Heater Control**

Push Heat button to turn heater on. Red light will come on, and heat will begin within approximately 30 seconds. Fan Button will control the heater fan speed, and temperature can be adjusted using the dial. To turn heater off, press the "OFF" button.

17) Boom Control Lever

Push Forward - "DOWN" position – Lowers boom.
Pull Back – "UP" position – Raises boom.

A. Truck Throttle Control Switch

This switch can be used to control the truck engine throttle. To increase truck engine speed press and hold switch to the left. The engine speed will increase incrementally to the maximum speed setting to operate hydraulic pump at maximum flow. This speed varies due to differences in truck transmissions and engine sizes. To decrease engine speed, press and hold the switch to the right. The engine speed will decrease incrementally to idle. To set the engine

speed at an intermediate setting, release the switch while the engine speed is either increasing or decreasing.

18) Primary Winch Control Lever

Push forward -“DOWN” position – Winch pays out cable lowers load.
Pull back - “UP” position – Winch winds up cable, raises load.
Optional Winch Drum Rotation Indicator Thumper is located in top of joystick handle on units equipped with winch drum rotation indicator.
Thumper pulsates with rotation of winch drum.

19) Swing Control Joystick

Push forward - “RIGHT” position- Turret swings right - Clockwise
Pull back - “LEFT” position – Turret swings left – Counterclockwise.

A. Swing Control Range can be toggled between High & Low by pressing button on end of the joystick. Range will default to Low Range anytime the Master Switch is toggled on. If the swing control was on High Range when Master Switch is turned off, the switch needs to be toggled twice to get back into High Range.

NOTE: *This unit is equipped with Glide Swing, which must be activated prior to operation of Swing System. See operation of Glide Swing Switch (#11) and Swing Brake (#20).*

20) Aux. Winch Control Lever

Push forward -“DOWN” position – Winch pays out cable lowers load.
Pull back - “UP” position – Winch winds up cable, raises load.
Optional Winch Drum Rotation Indicator Thumper is located in top of joystick handle on units equipped with winch drum rotation indicator.
Thumper pulsates with rotation of winch drum. If not equipped with aux. winch, boom telescope control will be at this location.

21) Glide Swing Brake

This pedal activates swing drive brake. When Glide Swing Switch (#11) in “ON” position, the swing system does not have any brakes applied unless this pedal is depressed. To stop rotation, apply pressure to pedal.

22) Boom Telescope Control Pedal

Push forward -“OUT” position – Extends Boom Sections
Pull back - “IN” position – Retracts Boom Sections.

If equipped with only one winch, this pedal will not be present, and boom telescope will be controlled with joystick located at item 18.

NOTE: *Due to wear pad friction, some loads on the chart cannot be telescoped. However, it is safe to attempt to telescope all loads within the chart limits.*

Hyd. System Pressure Gauge

Located inside control valve enclosure. Indicates Maximum pressure (0-3000 PSI) in the Winch and Function circuits. Does not display pressure in the swing circuit.

Bubble Level

Master Level located on subbase top plate, adjustable levels located at each outrigger control station. Once a week, operator shall verify that bubble located at control stations match the master level. Adjust levels in control stations if necessary. Use to level crane

Boom Angle Indicators

Located on either side of base boom- indicates the angle of the boom (in degrees) above or below horizontal.

NOTE: *For main boom, do not exceed the operating radius for the rated loads on the chart.*

Boom Length Indicators

Located on either side of the first moving boom section. The letters correspond with the letters on the load chart.

LMI (Load Moment Indicator) & Anti-Two Block Control

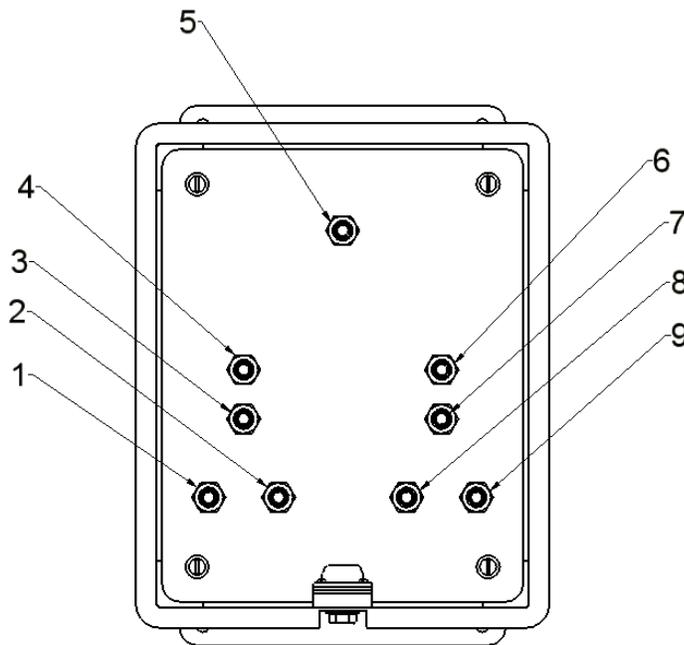
See LMI Manufacturer manual for set-up and operation information. Set for proper boom/jib configuration prior to operation. LMI manufacturer manual is included with this manual. See table of contents for page number.

Anti-Two block and LMI alarm

If a two block or overload condition exists, the alarm horn will sound; telescope out, winch up and boom down will be disabled.

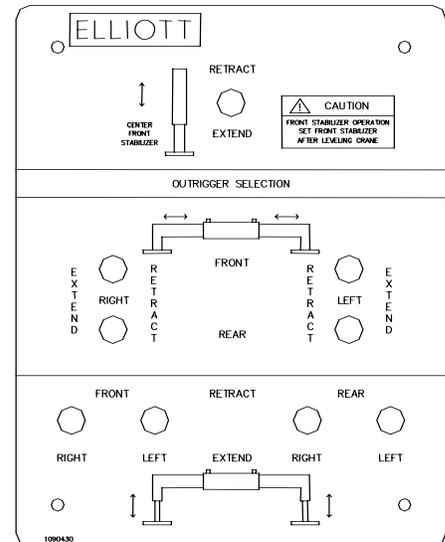
Immediately correct this condition to prevent tipping or structural damage. Lowering the load to ground and/or retracting the boom will resolve the problem.

1.8.2 Outrigger Controls



NOTE: When deploying outriggers, always set the beams to either full or mid-span prior to lowering outrigger jacks. Always be sure to use correct load chart based on outrigger span. When stowing/raising outriggers, always raise outrigger jacks prior to retracting beams. Always set center front stabilizer last and retract first when stowing.

- 1) **Right Front Outrigger Jack Switch** – Activate switch up or down to raise or lower right front outrigger jack.
- 2) **Left Front Outrigger Jack Switch** – Activate switch up or down to raise or lower left front outrigger jack.
- 3) **Right Rear Outrigger Beam Switch** – Activate switch left or right to extend or retract right rear outrigger beam.
- 4) **Right Front Outrigger Beam Switch** – Activate switch left or right to extend or retract right front outrigger beam.
- 5) **Center Front Stabilizer Switch** – Activate switch up or down to raise



or lower center front stabilizer. This stabilizer should always be lowered last and raised first.

- 6) **Left Front Outrigger Beam Switch** – Activate switch left or right to retract or extend left front outrigger beam.
- 7) **Left Rear Outrigger Beam Switch** – Activate switch left or right to retract or extend left rear outrigger beam
- 8) **Right Rear Outrigger Jack Switch** – Activate switch up or down to raise or lower right rear outrigger jack.
- 9) **Left Rear Outrigger Jack Switch** – Activate switch up or down to raise or lower left rear outrigger jack.

NOTE: Left and right are based on operator's left and right as he stands at outrigger control box facing the front of the truck.

1.8.3 Optional Remote Controls

Safety



DANGER ELECTROCUTION HAZARD

This crane is not insulated. This remote control provides no protection against electrocution hazards. Do not operate near live electrical power lines. All warnings in the Safety & Operation Section of this manual and on the crane relative to operating and safety procedures and power line clearances must be observed when using the crane remote controls.

In order to maintain a safe machine, a regular function check of the radio remote control system is necessary. This check shall include verifying all safety features are operational before using this system.

Never allow anyone to operate the system until the operator has read all instructions and has become completely familiar with the total remote control system. In the event any unexplained, unpredicted, or incorrect operation occurs, immediately shut down the complete system and investigate. This includes shutting down all electronics, hydraulics, PTO's and engines. Never resume operation until the problem has been corrected.

When not using the remote controls, switch the transmitter off by pressing the Emergency Stop Button. Verify that the button locks itself down, and then make sure the remote control power switch is switched to the off position. This will prevent inadvertent operation of the crane by activation of the transmitter joysticks.

Operation

If the truck is running when the remotes

are switched on, the truck engine will shut off and the truck will need to be restarted using the remote controls.

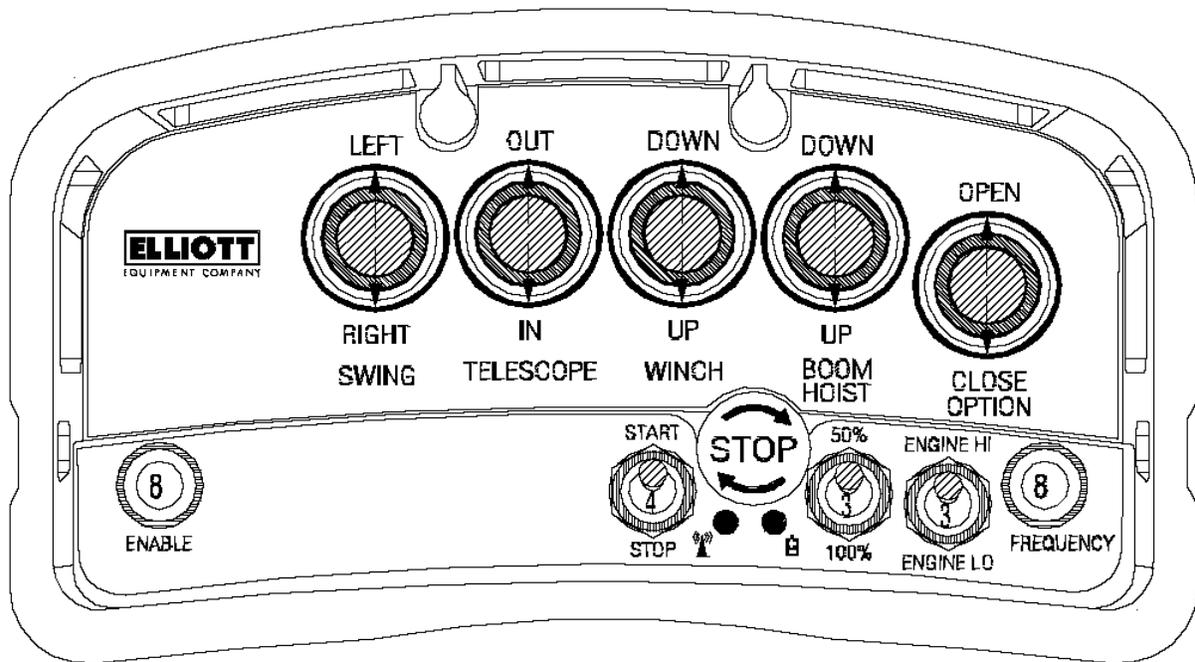
This can be done by following the instructions found later in this section. This remote control system is designed for use either single or multiple functions at once and is fully proportional. See joystick and switch designations found in the transmitter section of this text for specifics on operation of each joystick and switch.

Transmitter

The transmitter enclosure has an exposure rating of IP65. The IP65 rating allows for exposure to normal environmental conditions. Never expose the transmitter to high pressure washing jets.

Crane and Option Function

Joysticks: This transmitter is equipped with either four (standard) or five (optional – shown below) single axis joysticks for the four main crane functions (lift, turn telescope, winch) and one option function. When the joystick is in the center position, the function is inactive. Moving the joystick from the center position initiates function movement. The speed of the function is increased proportionally with the movement of the joystick farther from the center position. The speed of the function is also decreased proportionally with the movement of the joystick back towards the center position. For smooth crane operation slowly meter the joystick away from the center position. Multiple functions can be operated simultaneously with this system. The layout of the joysticks and switches on the transmitter are shown in the drawing below. Refer to the drawing and the descriptions of each joystick/switch below the drawing.



Enable Button

This pushbutton switch needs to be momentarily depressed before operating any of the joysticks. The horn will sound when the button is pushed to alert personnel in the working area that crane movement is about to begin. This Elliott Equipment radio remote is specifically equipped to deactivate if the transmitter is inactive for more than 5 seconds. Any time the transmitter is inactive for more than 5 seconds, this switch needs to be activated again. If a function is activated less than 5 seconds after releasing a function or while operating a function, this switch does not need to be activated.

Start/Stop Switch

This is a momentary switch used to start or stop the truck engine. Holding the switch in the start position, within 5 seconds of pressing the enable button, activates the starter. Release the switch as soon as the engine starts. Activate and hold the switch in the Stop direction to shut the truck off. Once the engine stops completely, release the switch. If this switch is released

while engine is still turning over, the truck will restart.

Emergency Stop Button (Red pushbutton in center of transmitter)
Press this button down to kill the truck engine. When the emergency stop button is pushed down completely, it locks itself in the depressed state. To release the emergency stop button, turn the button clockwise and the button will pop back up allowing the transmitter to operate again. If this button is depressed, the transmitter will not function. The key can be removed when depressed to restrict operation of the remote control system. Once the key is removed, the system is disabled until the switch is reinserted and the button released.

50%/100% Switch

With this switch set at 100%, full activation of the joystick will move the valve spool to its maximum flow position. Setting this switch at 50%, full movement of the joystick will move the control valve spool 50% of the spool travel. Setting this switch at 50% does not necessarily provide half speed of the

function. The operator can toggle back and forth between these options based on load or proximity of the crane to other objects.

Engine Hi/Engine Lo Switch

This switch switches the truck engine throttle back and forth from idle to maximum engine speed for crane operation. Setting this switch to Engine Hi sets the engine throttle to the correct setting for maximum rated pump flow. Setting this switch to Engine Lo sets the engine throttle to the trucks idle setting.

Frequency Change Button

This button is used to change the frequency at which the receiver and transmitter are operating. The radio system will automatically shut off if the receiver does not continually receive a clean signal from the transmitter. Change the frequency if the system is shutting off on it's own. To change frequency, press and hold enable, then press the frequency change button. If the receiver locks into a new frequency, a horn signal is given. After doing this, check the lights on the receiver (see description in receiver section of this text) to verify that there isn't any interference present. If there is (red light still present) repeat this procedure until a clean signal is found.

Operating Status Indicator

This light (green) will be flashing regularly during fault free operation. If this light is not flashing regularly, the HF channel is likely at fault and a new channel needs to be selected.

Battery Life Indicator

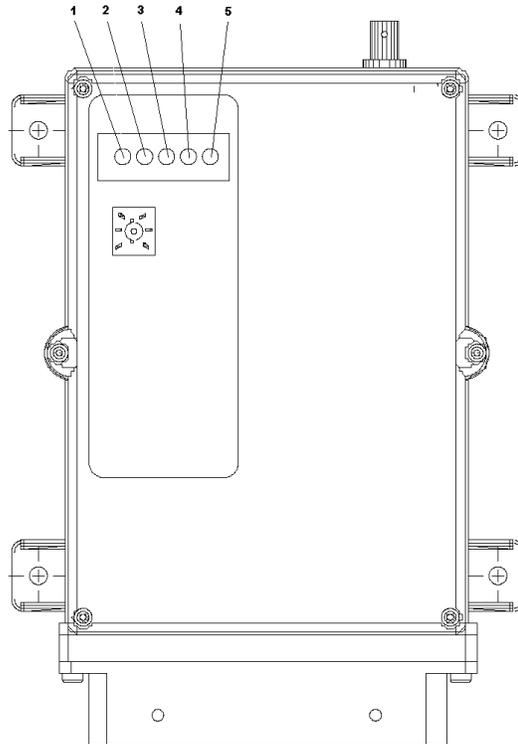
This display is used to indicate the condition of the battery. If there is no

light, the battery has sufficient charge. If the indicator light is on and red, the battery is nearing complete discharge and needs to be recharged or replaced. Elliott Equipment Company provides 2 batteries and a 12V-battery charger with the remote control systems. Keep one battery in the charger and change batteries out at the beginning of each work shift to prevent having a discharged battery in the middle of the shift.

Receiver

The receiver enclosure has an exposure rating of IP65. The IP65 rating allows for exposure to normal environmental conditions. Never expose the transmitter to high pressure washing jets.

Disconnect the receiver from its power supply prior to performing any welding on the truck, crane or anything attached to either. Otherwise there is a risk of damage to the receiver's electronic system. This can be accomplished by disconnecting the wiring harness at the junction on the bottom of the receiver. The receiver has four LED's located on the upper left-hand corner of the front panel. These four LED's are used to indicate the operating condition of the receiver, whether the receiver is properly powered up, and if it is communicating with the transmitter. The location of these LED's shown below is the typical arrangement. The position and direction of these LED's may differ on particular units.



LED 1 (Green): When this LED is on, power is being supplied to the receiver.

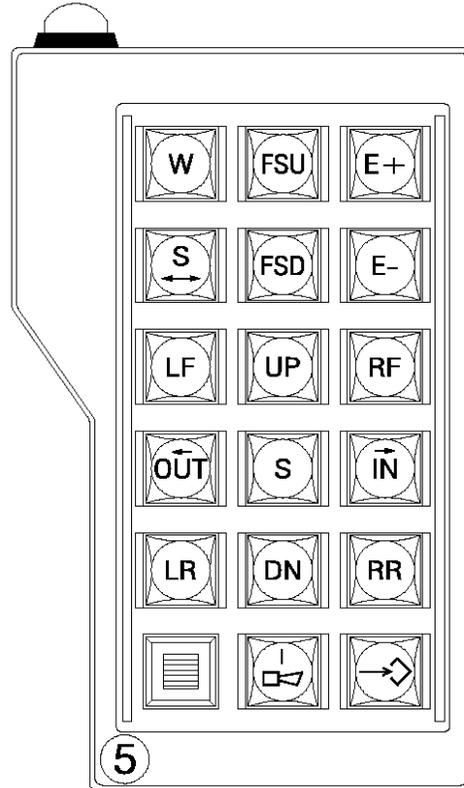
LED 2 (Amber): When the assigned transmitter is turned on and the high frequency (HF) signal is present this LED light is steady. When the assigned transmitter is not present or not turned on this light will flash irregularly.

LED3 (Green): This LED flashes evenly during fault-free operation. Irregular flashing means that the HF channel is probably at fault and another frequency should be selected (See frequency change procedures).

LED 4 (Red): When this LED is on, the HF channel is at fault (See frequency change procedures). After changing frequencies, check this light to verify a clean frequency has been found.

LED 5 Not used by Elliott Equipment.

1.8.4 Optional Outrigger Controls



Remote Control Operating Instructions -Outriggers and Boom Creep Control

Activate Transmitter – Hold red button for 5 sec (green light in lower left corner will start blinking)

After activating transmitter, the Enable (Horn) button needs to be pressed prior to use of any functions. Once this is pressed, functions will be active until the transmitter is cleared (E-)

Enable – Press Horn button (Horn will sound)

Disable (Clear) – Press E-

Selections will automatically clear if an incorrect sequence of selections is performed, this will be accompanied by a horn signal

Engine functions are operated by pressing the appropriate buttons.

Engine Throttle Up – Select E+

Engine Throttle Down – Select E- (This also clears any other selections made)

Engine Start – Press S

Boom functions are operated by first pressing the appropriate button to select function then pressing and holding the appropriate direction (Up, Down, In or Out). Boom functions will operate very slow.

Winch Up – Select W then Press and hold Up

Winch Down – Select W then Press and hold DN

Telescope In – Select IN then Press and hold IN

Telescope Out – Select OUT then Press and hold OUT

Boom Up – Select UP then Press and hold UP

Boom Down – Select DN then Press and hold DN

Swing Left – Select S ←→ then Press and hold ← (OUT)

Swing Right – Select S ←→ then Press and hold → (IN)

Outrigger functions are operated the same as the boom functions, but multiple functions can be selected at the same time to multifunction. For example any 2, 3 or all 4 outriggers can be extended, retracted, raised or lowered simultaneously. All functions selected have to be operated in same direction when multi-functioning.

Left Front Outrigger – Select LF then press and hold IN, OUT, UP or DN

Right Front Outrigger – Select RF then press and hold IN, OUT, UP or DN

Left Rear Outrigger – Select LR then press and hold IN, OUT, UP or DN

Right Rear Outrigger – Select RR then press and hold IN, OUT, UP or DN

Front Stabilizer (Should not be selected along with any outrigger functions)

Front Stabilizer Up – Press and hold FSU

Front Stabilizer Down – Press and hold FSD

1.9 LIFT CAPACITIES

DANGER

Overloading this crane or disregarding Lift Capacity Chart directions can result in structural failure, tipping or injury to personnel. Read and understand all instructions before operating the crane.

DANGER

Do not lift any load without determining the total load lifted. The lifted load must always include the headache ball/hook block and any chains, slings, spreader bars etc. used to pick the load.

CAUTION

For the main boom, the boom length and load radius shall determine the capacity. Boom angle should only be used as a guide. Always measure the load radius. For the jib, the boom angle shall determine the capacity on the jib.

Main boom and jib load ratings above the heavy line on the Capacity Chart are based on structural strength and not stability. The main boom and jib load ratings below the heavy line are based on stability and do not exceed 85 percent of tipping.

Before lifting any load, make sure that:

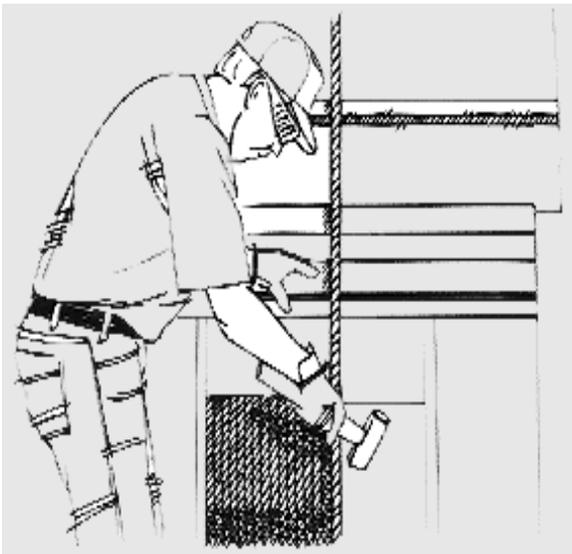
- 1) Outriggers and stabilizers are extended on a firm, uniformly supporting surface.
- 2) Crane is level.
- 3) The exact weight lifted is known.
- 4) The weight of the stored jib, hook block/headache ball, slings, chains and all other load handling devices are deducted from the load ratings on the Capacity Chart.
- 5) Do not exceed the area of operation on the capacity chart.
- 6) Reduce load ratings to compensate for wind, ground conditions and the dynamic effects of swinging, hoisting, and lowering the load.

Note: If the crane owner mounts the crane, he must perform a stability test in compliance with instructions furnished by Elliott.

1.10 WIRE ROPE ANCHORING

Cutting Wire Rope: When cutting wire rope, it must be tightly seized on both sides of the point where the rope will be cut. Seize the wire rope with seizing wire or annealed wire. The seizing prevents the wire rope strands from unraveling and prevents distortion of the rope ends from the pressure applied during cutting.

Anchoring Wire Rope to Winch Drum: See the Tulsa Winch Service Manual. If the end of the rope is welded, seize the rope and cut the weld off before assembling. Weld will not allow strands of wire rope to adjust around the wedge resulting in high strands and wavy rope that can seriously weaken the rope.



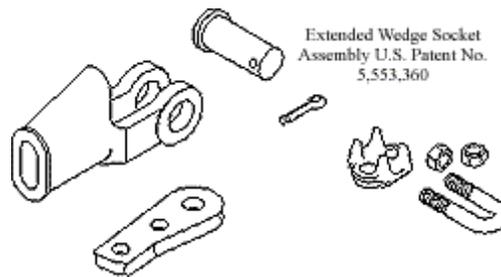
Winding Wire Rope Onto Winch

Drum: Inspect the drum and sheaves for defects that might cut the rope or cause excessive wear. Apply tension to the wire rope and slowly wind it onto the drum. The first layer must be spooled with wraps tight and close together since this layer forms the foundation for succeeding layers. Tap the adjacent wraps against each other with a rubber, lead or brass mallet. Do not use a steel mallet. Make sure all wraps are tight against each other and the drum. Voids in the first layer will permit movement and wedging action with subsequent layers. Wedging will result in crushing and abrasion of the rope. Never allow wire rope to cross wind.

Breaking In Wire Rope: After installing a new wire rope, break it in by operating it several times under light load and at reduced speed. This allows the rope to form its natural lay and seat properly. The dead wraps of the wire rope on the winch drum can become slack during operation due to the normal stretch that occurs in a rope under tension. When slack is noted, the dead wraps of wire rope must be rewound on the drum. Left uncorrected, a wedging action will occur and the resultant abrasion will cause broken wires in the dead wraps.

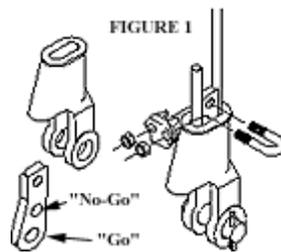
1.11 WEDGE SOCKET

WARNINGS AND APPLICATION INSTRUCTIONS



S-421T / US-422T "TERMINATOR"™

NOTE: Existing Crosby S-421 Wedge Sockets can be retrofitted with the New Terminator Wedge.



<http://catalog.thecrosbygroup.com/qc.htm>

New **QUIC CHECK**® "Go" and "No-Go" features cast into wedge. The proper size wire rope is determined when the following criteria are met: 1. The wire rope shall pass through the "Go" hole in the wedge. 2. The wire rope shall NOT pass through the "No-Go" hole in the wedge.

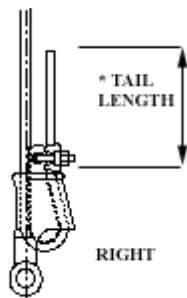
Important Safety Information - Read and Follow

1.11.1 Inspection/Maintenance Safety

- Always inspect socket, wedge and pin before using.
- Do not use part showing cracks.
- Do not use modified or substitute parts.
- Repair minor nicks or gouges to socket or pin by lightly grinding until surfaces are smooth. Do not reduce original dimension more than 10%. Do not repair by welding.
- Inspect permanent assemblies annually, or more often in severe operating conditions.
- Do not mix and match wedges or pins between models or sizes.
- Always select the proper wedge and socket for the wire rope size.

1.11.2 Assembly Safety

- Use only with standard 6 to 8 strand wire rope of designated size. For intermediate size rope, use next larger size socket. For example: When using 9/16" diameter wire rope use a 5/8" size Wedge Socket Assembly. Welding of the tail on standard wire rope is not recommended. The tail length of the dead end should be a minimum of 6 rope diameters but not less than 6" (See Figure 1).
- To use with Rotation Resistant wire rope (special wire rope constructions with 8 or more outer strands) ensure that the dead end is welded, brazed or seized before inserting the wire rope into the wedge socket to prevent core slippage or loss of rope lay. The tail length of the dead end should be a minimum of 20 rope diameters but not less than 6" (See Figure 1).
- Properly match socket, wedge and clip (See Table 1) to wire rope size.
- Align live end of rope, with center line of pin.
(See Figure 1)
- Secure dead end section of rope. (See Figure 1)
- Tighten nuts on clip to recommended torque. (Table 1)
- Do not attach dead end to live end or install wedge backwards. (See Figure 2)
- Use a hammer to seat Wedge and Rope as deep into socket as possible before applying first load.



Standard 6 to 8 strand wire rope:

A minimum of 6 rope diameters, but not less than 6"

Rotation Resistant Wire Rope

A minimum of 20 rope diameters, but not less than 6".

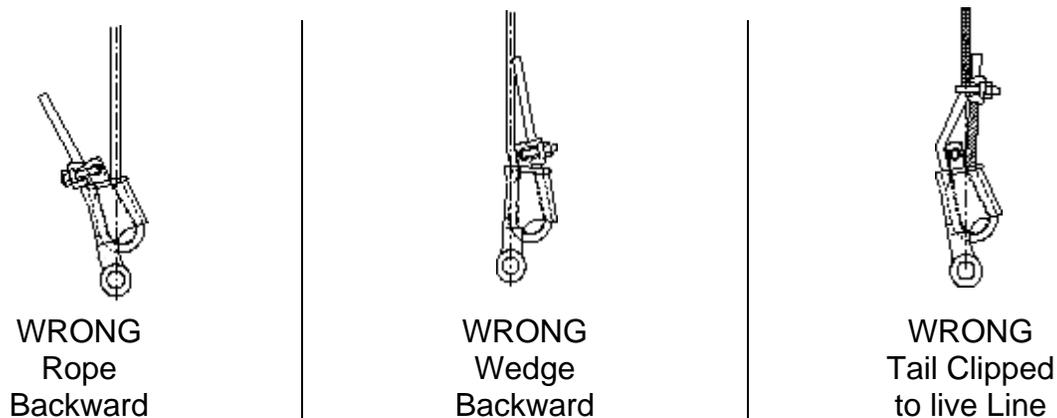
WARNING

- Loads may slip or fall if the Wedge Socket is not properly installed.
- A falling load can seriously injure or kill.
- Read and understand these instructions before installing the Wedge Socket.
- Do not side load the Wedge Socket.
- Apply first load to fully seat the Wedge and Wire Rope in the socket. This load should be of equal or greater weight than loads expected in use.
- Do not interchange wedges between S-421T and US-422T or between sizes.

TABLE 1

Rope Size	Clip Size	*Torque Ft./lbs.
3/8	3/8	45
1/2	1/2	65
5/8	5/8	95
3/4	3/4	130
7/8	7/8	225
1	1	225
1 1/8	1 1/8	225

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

FIGURE 2

1.11.3 Operating Safety

- Apply first load to fully seat the wedge and Wire Rope in the socket. This load should be of equal or greater weight than loads expected in use.
- Efficiency rating of the Wedge Socket termination is based upon the catalog breaking strength of Wire Rope. The efficiency of a properly assembled Wedge Socket is 80%.

During use, do not strike the dead end section with any other elements of the rigging (Called two blocking)

1.12 MULTI-PART REEVING

Reeve rope per diagram show below. Refer to the crane Capacity Chart to determine the parts of line required for each load lifted. **Note:** The type of rope used on the crane must be known in order to pick the correct capacities.

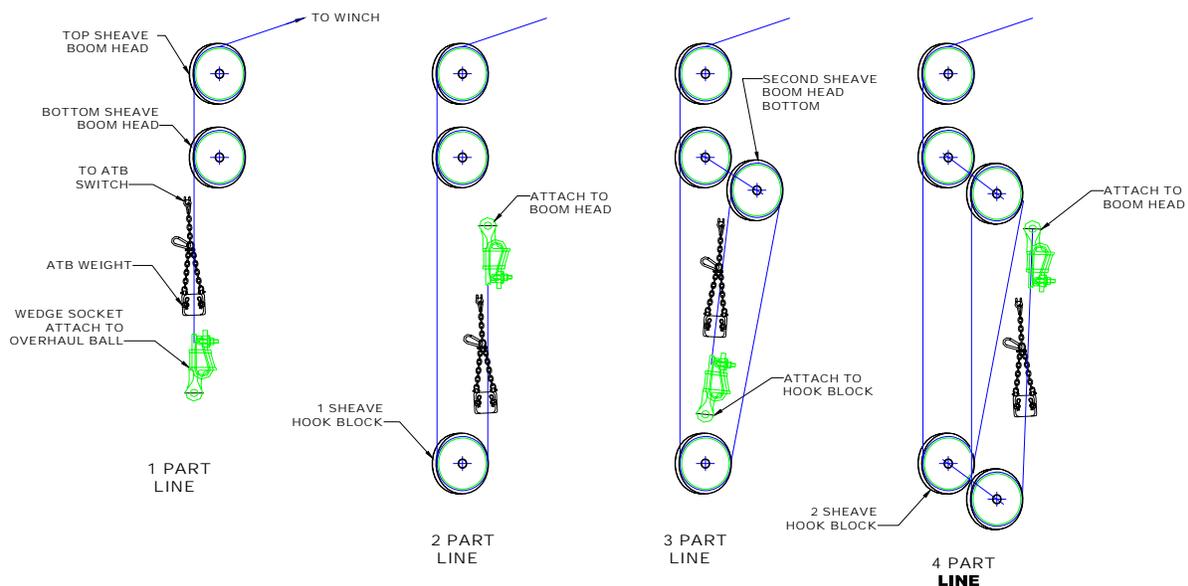
Make sure the rope is properly reeved and travels through all guides on the boom and jib, if erected, prior to picking the load.

Check the operation of the Anti-Two –Block (ATB) as outlined below:

- 4) Install the ATB transmitted on the main boom head or jib head, if jib is erected.
- 5) Connect the ATB counterweight to the Transmitter. **Do not shorten the length of chain-a shortened chain may result in a two-block condition.** Make sure the counterweight is on the correct line part.
- 6) Test the ATB switch by raising the overhaul ball or hook block until there is slack in the counterweight chain. A warning horn should sound and Winch Up and Telescope Out functions should be disabled.

Refer to the Radio ATB “Operator Manual” for detailed testing, maintenance, etc. on the ATB system.

THREE SHEAVE BOOM HEAD REEVING



1.13 JIB OPERATION

The anti-two-block switch weight and cord must be attached to the jib when deployed.

Do not lift load with the boom tip when the jib is pinned on the boom tip.

a. Operate with jib by radius when main boom is fully extended. If necessary, increase boom angle to maintain loaded radius.

b. When radius is between points listed on capacity chart, the load shown at the next longer radius shall be used.

a. Operate with jib by boom angle when main boom is not fully extended. Do not exceed rated jib capacities at any reduced boom lengths.

b. When angle is between points listed on capacity chart, the load shown at next lower boom angle shall be used. Ensure jib is stowed correctly.

a. Removal of swing-around pins, 'C' without proper installation of stow pin 'A' and jib-swing pin 'B', may allow jib to fall.

b. Extending boom with jib stowed and failure to remove swing pins 'C', will damage boom and/or jib.

Only attempt to swing jib to working or stowed position when boom is horizontal, stow pin 'A' and jib-swing pin 'B' are removed and swing pins 'C' are in place. Jib could swing uncontrollably if boom is not horizontal.

Crane shall be fully set up according to proper set-up procedures outlined previously when stowing or unstowing jib.

Operate boom and turn functions very slowly and carefully when using jib since jibs can increase boom length by 50%. Area where jib swings around must be clear of obstructions and power lines when stowing and unstowing jib.

Use safety glasses when pounding pins with hammer.

Do not extend/retract boom unless boom is horizontal when stow pin 'A'

and jib-swing pin 'B' are removed during stowing or unstowing procedures.

Always put spring clips in pins to ensure that they will stay in place.

When the jib is stowed, the boom can not be fully retracted if a boom tip attachment option is installed.

For manually extendable jib options: Extension retaining pin 'E' must always be installed before operation.

All swing around (stow and unstowing) operations shall be done with jib retracted and pinned.

Extendable section may slide out of 1st section jib when pin 'E' is removed.

Keep personnel clear of area.

1.13.1 Deployment Procedure

Using boom telescope function, fully retract boom.

Using lift function, lower boom to allow for easier access to jib deployment pins 'C1' and 'C2'.

Install pins 'C1' in upper and lower jib ears. Install retainer spring clips. These pins will be used as a pivot point to swing jib into the deployed position.

Locate the stowed position of pins 'C2'.

If in jib attachment holes or boom sheave case jib holes, remove pins from storage location.

Remove jib-swing pin 'B' from top ear of jib.

Remove stow pin 'A' from ramp/side stow bracket assembly on jib.

Attach tag line to sheave case end of jib.

Using lift function, raise boom to a horizontal position.

Using telescope function, slowly extend boom approximately one foot. This will pull the jib out of the stow bracket.

 CAUTION

Use Caution during this step. The jib is free to swing away from the boom upon boom extension.

Using tag line, swing jib into deployed position.

Remove cable keeper pins from boom sheave case and jib. Remove hook block. Pivot jib slightly to allow for loadline to be removed from boom sheave case. Remove loadline from boom sheave case and place in an area to minimize possible damage.

Pivot jib into place, visually aligning the upper 'C2' pin holes. Install upper 'C2' pin and spring clip. A slight hammer strike may be necessary to install pins. Always use proper eye protection during this step.

Install lower 'C2' pin and spring clip. A slight hammer strike may be necessary to install pins. Always use proper eye protection during this step.

Using winch function, unspool enough loadline to reeve loadline over jib sheave case. Keep slight tension on loadline to avoid bird caging of loadline on winch drum.

Route loadline over jib sheave and install keeper. Install line block to end of loadline.

Remove anti-two-block weight/chain assembly from boom tip switch and install on jib top switch. Be certain to use keeper provided with switch.

Install jib swing pin 'B' and spring clip into jib ears.

Remove tag line from jib sheave case. For manually extendable jibs, pull extension retention pin 'E', and extend second section out by pulling on sheave case. The second section jib, as it extends, will hit a mechanical stop that allows for extension pin 'E' installation. Install pin and spring clip.

1.13.2 Stowing Procedure

Using lift function, lower boom so that jib tip is close to the ground.

For manually extendable jibs, pull extension retention pin and fully retract extendable 2nd section jib into the 1st section.

Reinstall extension retention pin through the 1st and 2nd section jib assembly and install spring clip.

Remove loadline from jib sheave case. Place loadline in area to avoid possible damage from stow procedure.

Move anti-two-block weight assembly to boom tip switch.

Attach tag line to sheave case end of jib. Remove spring clips from pins 'C2' on both upper and lower jib ears.

Remove pins 'C2' from upper and lower jib ears. Do not remove 'C1' pins at this time. 'C1' pins will be used as a pivot point to swing jib into stowed position. A slight hammer strike may be necessary to remove pins. Always use proper eye protection during this step.

Using lift function, raise boom to a horizontal position.

Using telescope function, extend boom approximately 1 foot.

Using tag line, slowly swing jib into stow position (parallel with 1st section boom). Pins 'C1' are the jib pivot points during this operation.

⚠ CAUTION

Use Caution when swinging jib to avoid unnecessary impact with 1st section.

Install jib-swing pin 'B' with spring clip through jib ear and boom sheave case holes. This pin will keep the jib assembly in line (parallel) with the 1st section boom. Jib swing pin 'B' does not retain the jib in its stowed position on the 1st section boom.

Using boom telescope function, slowly retract boom. The ramp/side stow bracket assembly on the side of the 1st section jib will engage the hook on the side of the 1st section boom, first lifting the jib and then engaging the jib side stow bracket and the boom hook completely upon full retraction of the boom.

Install stow pin 'A' with spring clip into the ramp/side stow bracket assembly on the jib. Complete engagement of stow brackets and proper installation of pin 'A' is critical for secure jib stow attachment.

Remove pins 'C1' from upper and lower jib ears. A slight hammer strike may be necessary to remove pins. Always use proper eye protection during this step. Reinstall loadline over boom sheave case.

⚠ DANGER

Visually inspect all pin positions to assure jib is fully retracted into side stow brackets, jib stow attachment is secure, and all pins and spring clips are in their proper locations. Failure

to properly secure the jib during stowing and erecting may allow the jib to fall. Serious personal injury or death could result.

Always have at least one, if not both of the following in place at all times:

**Side stow bracket completely engaged into stow hook with stow pin 'A' properly in place.
Both pins 'C1' in upper and lower jib holes properly in place through mating holes in boom tip.**

1.13.3 Jib Maintenance

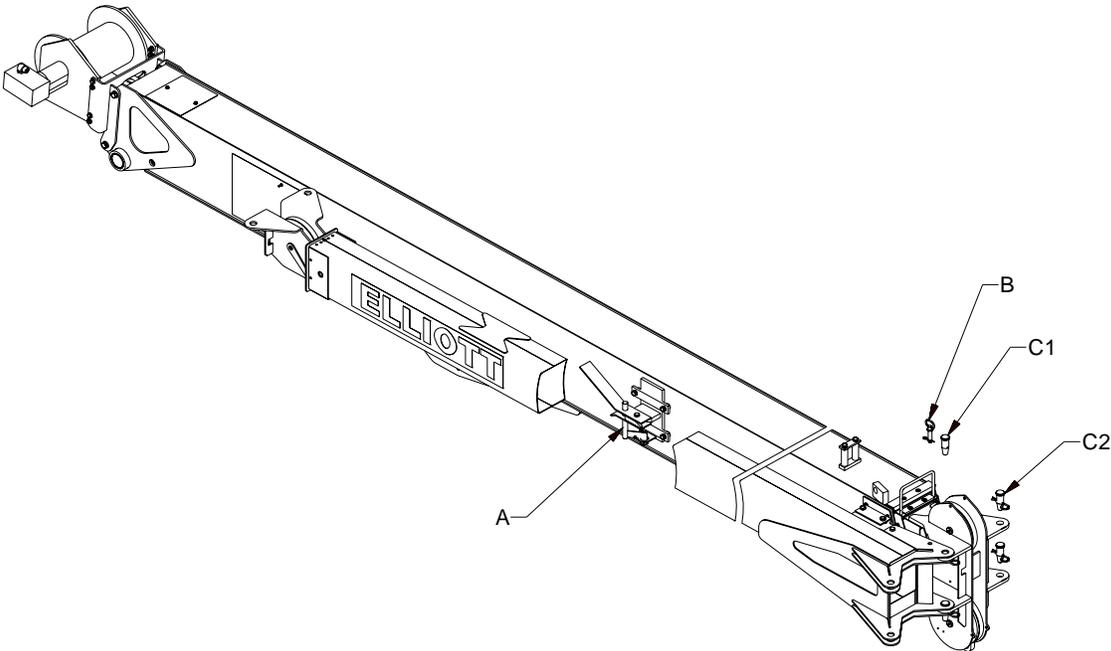
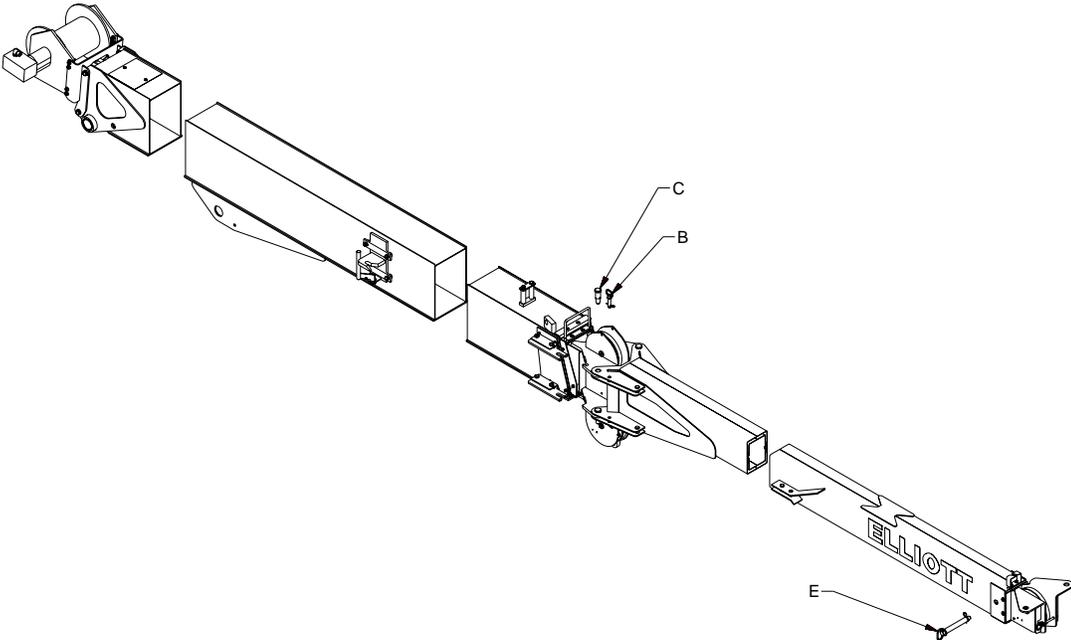
Lubricate sheave pin on jib with grease gun containing chassis grease weekly. Check for free rotation of jib sheave daily when using jib.

Lubricate jib sheave case pivot pin with grease gun containing chassis grease monthly.

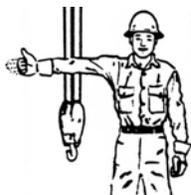
1.13.4 Jib removal

Should jib removal from the boom become necessary, proceed as follows: Unstow and swing jib into position on the boom tip according to steps 1-10 in the preceding jib deployment section. Support and raise the jib at its balance point and remove the two swing around pins. Jib is now free of boom.

To install, proceed in reverse order of removal.



1.14 HAND SIGNALS

Standard Hand Signals for Crane Operators				
ASME B30.5-1998				
				
		<p>HOIST. With forearm vertical, and forefinger pointing up, move hand in small horizontal circle.</p>	<p>LOWER. With arm extended downward, forefinger pointing down, move hand in a small horizontal circle.</p>	
				
<p>USE MAIN HOIST. Tap fist on head; then use regular signals.</p>	<p>USE WHIPLINE. (Auxiliary Hoist) Tap elbow with one hand; then use regular signals.</p>	<p>RAISE BOOM. Arm extended, fingers closed, thumb pointing upward.</p>	<p>LOWER BOOM. Arm extended, fingers closed, thumb pointing downward.</p>	<p>MOVE SLOWLY. Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. <i>(Hoist Slowly shown as example)</i></p>
				
<p>RAISE THE BOOM AND LOWER THE LOAD. With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired.</p>	<p>LOWER THE BOOM AND RAISE THE LOAD. With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.</p>	<p>SWING. Arm extended, point with finger in direction of swing of boom.</p>	<p>STOP. Arm extended, palm down, move arm back and forth horizontally.</p>	<p>EMERGENCY STOP. Both arms extended, palms down, move arms back and forth horizontally.</p>
				
<p>DOG EVERYTHING. Clasp hands in front of body.</p>	<p>EXTEND BOOM. (Telescoping Booms). One Hand Signal. One fist in front of chest with thumb tapping chest.</p>	<p>RETRACT BOOM. (Telescoping Booms). One Hand Signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.</p>	<p>RETRACT BOOM. (Telescoping Booms). Both fists in front of body with thumbs pointing toward each other.</p>	<p>EXTEND BOOM. (Telescoping Booms). Both fists in front of body with thumbs pointing outward.</p>

1.15 REQUIRED INSPECTIONS

Government regulations and Elliott Equipment Company require the following inspections. It is the responsibility of the operator to not operate this boom truck until the appropriate inspections have been performed, documented, and any necessary repairs are made. Failure to perform and record these inspections shall be considered misuse of the equipment and could void warranty consideration. It is the responsibility of the operator or employer to maintain accurate inspection records for the periodic inspections. The owner shall maintain a record of the results of the inspections for each boom truck and its optional equipment. These records shall be kept in a location accessible to the operator.

CAUTION

Be sure the unit is in an area free of overhead obstructions and power lines.

1.15.1 Daily Inspection

- 1) Perform all items required in a standard walk around vehicle inspection in accordance with US DOT Commercial vehicle requirements. Perform daily inspection of truck per manufacturer's recommendations. Verify that the loaded vehicle does not exceed the Gross Vehicle Weight Rating, Gross Axle Weight Ratings or exceed state law ratings.
- 2) Inspect the unit's underside for structural damage and hydraulic leaks.
- 3) Check all hydraulic hoses, particularly those that flex in normal operation for any scuffing, cuts or wear marks.
- 4) Check the turret, pedestal and boom for cracked welds, loose or broken bolts and damaged or missing parts. Verify all guards and covers are in place.
- 5) Perform the daily lubrication per the "Lube Chart".
- 6) Check that oil level is at proper level
- 7) Check oil filter condition by reading dirty filter gaugeon filter housing. This needs to be checked while engine is running and PTO is engaged.
- 8) Inspect the wire rope for wear and damage, check for corrosion, kinking, crushing, cuts, and slippage of clamps at wedge socket.
- 9) Check for proper wire rope spooling on the winch drum and proper reeving. Make sure all sheaves turn freely.
- 10) Make sure the load line is correctly fastened to the hook block/headache ball.
- 11) Make sure the hook block/headache ball latch works properly.
- 12) Check slings, chains, etc. for damage or wear.
- 13) Check that the Lift Capacity Charts and all other decals are in place and readable.
- 14) Check proper operation of all crane functions.
- 15) Check boom proportioning. Verify all sections start and stop simultaneously.
- 16) Check all control mechanisms for maladjustment that could interfere with proper operation.
- 17) Verify that all control mechanisms when released to the neutral position all functions stop.

- 18) Make sure all control mechanisms are free of excessive wear and are not contaminated by lubricants or other foreign matter.
- 19) Check the hook block/headache ball for excessive wear and overload. Check for cracks, spread side plates, elongated holes, bent tie bolts etc.
- 20) Test the ATB system. With the engine running and PTO engaged, raise the ATB weight and make sure the alarm sounds and the winch up, telescope out, and lift down functions are disabled. Refer to the ATB manufacturer's operator manual for additional daily inspection procedures.
- 21) Test the Load Moment Indicator (LMI) by picking a known weight load and slowly move it toward an overload condition per the Capacity Chart. When the overload position is reached, the alarm should sound and the telescope out, lift down, and winch up functions should be disabled. All other functions should operate.
- 22) Check proper operation of horn, start/stop switch, etc.
- 23) If supplied, clean oil cooler core for proper heat transfer.
- 3) Check the winch drum and sheaves for cracks, wear and damage.
- 4) Make sure the boom angle indicator is working.
- 5) Check boom lift and outrigger holding valves for proper operation.
- 6) Verify winch brake stops and holds load. Check at rated line capacity.
- 7) Verify owner's manual is with unit. If manual is not present and cannot be located, either print new manual from CD provided, or provide serial number to Elliott Dealer to order replacement manual immediately.

⚠ CAUTION

Be sure the unit is in an area free of overhead obstructions and power lines.

1.15.3 Monthly Inspection

- 1) Perform the daily, weekly and monthly lube services.
- 2) Perform the "Daily Check List" and "Weekly Check List".
- 3) Check the boom and all structural components-especially welds-for deformation, cracks, corrosion and other forms of damage.
- 4) Inspect full length of wire rope for damage and excessive wear. See wire rope maintenance section for details.

⚠ CAUTION

Be sure the unit is in an area free of overhead obstructions and power lines.

1.15.2 Weekly Inspection

- 1) Perform the daily and weekly lubrication per the "Lube Chart".
- 2) Perform the "Daily Check List".

⚠ CAUTION

Hook must be replaced if throat opening is 15 percent more than when new or if bent/twisted more than 10 percent from original configuration.

- 5) Check the wire rope attachment at the wedge socket for damage and/or loose parts.
 - 6) Check wiring for damage, dirt accumulation, loose connections etc.
 - 7) Check hydraulic hoses for wear on outside surfaces and leakage at connections.
 - 8) Check hydraulic pump for loose bolts, leaks, noise and vibration.
 - 9) Check the hydraulic valves for leaking.
 - 10) Check the hydraulic cylinders for drifting due to holding valve failure, rod seal leakage, weld joint leaks, visual damage.
 - 11) Check foot throttle engine speed.
 - 12) Check all pins for proper installation and retention.
 - 13) Check boom wear pad retention bolts.
 - 14) Adjust the tension on the extend and retract cables in the boom.
- 3) Check all fasteners and retighten. Check torque of all bolts on "Bolt Torque" chart.
 - 4) Check the relief valve settings per the hydraulic schematic.
 - 5) Check for worn, cracked, or distorted parts such as pins, bearings, shafts, gears, rollers and locking devices.
 - 6) Test lift and outrigger cylinders for drift from possible internal leakage.
 - 7) Check PTO drive line or direct mounted pump for proper alignment, lubrication, and tightness.
 - 8) Check Rotation bearing and gearbox mounting bolts for proper torque. See "Bolt Torque" chart for appropriate torque values.
 - 9) Check mounting bolts, except "huck-bolts" for proper torque. See "Bolt Torque" chart for appropriate torque values.
 - 10) Check all "huck-bolts" for damage and tightness.
 - 11) Inspect all electrical wires and connections for wear, cuts, deterioration, etc. Replace as required.
 - 12) Check condition of extend and retract cables for wear or damage.
 - 13) Re-shim the boom wear pads as required. Replace worn or damaged wear pads as required.
 - 14) Check boom angle and boom length indicators for accuracy throughout entire operating range.
 - 15) Check LMI system for inaccuracies. Perform this check by lifting load of known weight and measuring boom angle and radius.

CAUTION

Be sure the unit is in an area free of overhead obstructions and power lines.

The items listed below should be inspected on a periodic basis, with the interval to be determined by the amount and severity of the operation of the unit. This inspection should be performed at least once every twelve months and shall be performed by a competent individual or a government or private agency recognized by the U.S. Department of Labor.

1.15.4 Periodic Inspection

- 1) Perform all lube services.
- 2) Perform the "Daily", "Weekly", "Monthly", and "Semiannual Checklist".

1.16 WIRE ROPE INSPECTION

All wire ropes should be thoroughly inspected at regular intervals. The longer it has been in service or the more severe the service, the more thoroughly and frequently it should be inspected. Be sure to maintain records of each inspection. A person who has learned through training or practical experience what to look for and who knows how to judge the importance of any abnormal conditions discovered should carry out inspections.

1.16.1 Typical Evidence of Wear and Abuse



A "birdcage" is caused by sudden release of tension and the resulting rebound of rope. These strands and wires will not be returned to their original positions. The rope should be replaced immediately.



This is localized wear over an equalized sheave. The danger here is that it's invisible during the rope's operation, and that's why you need to inspect this portion of an operating rope regularly. The rope should be pulled off the sheave during inspection and bent to check for broken wires.



This is a wire rope with a high strand -- a condition in which one or more strands are worn before adjoining strands. This is caused by improper socketing or seizing, kinks or dog-legs. It reoccurs every 6th strand in a 6 strand rope.



A kinked wire rope is shown here. It's caused by pulling down a loop in a slack line during handling, installation or operation. Note the distortion of the strands and individual wires. This rope must be replaced.



Here's a wire rope that has jumped a sheave. The rope "curled" as it went over the edge of the sheave. There are two types of breaks here: tensile "cup and cone" breaks and shear breaks that appear to have been cut on an angle.



Drum crushing is caused by small drums, high loads and multiple winding condition.

1.16.2 Replacement Criteria

- 1) No precise rules can be given for determining when to replace a wire rope. Replacement depends upon good judgment of a qualified inspector and comparison of data recorded on previous inspection reports. Any deterioration resulting in an appreciable loss of rope strength is sufficient cause for removal of the wire rope. Guidelines for replacement are listed below:
 - 2) Six randomly distributed broken outer wires in one rope lay length or three broken outside wires in one strand of one rope lay length. Note: One rope lay length is the distance measured along a rope in which one strand makes one complete revolution around the rope core.
 - 3) One broken outside wire at the point the wire contacts the core. The broken wire will have worked its way out of the rope structure and either protrude or loop out from the rope structure. Inspect this area of the wire rope for core damage.
 - 4) Wear on one-third the original diameter of outside wires.
 - 5) Kinking, crushing, bird caging, core protrusion or any other damage resulting in distortion of the rope structure.
 - 6) Evidence of heat damage.
 - 7) Severe Corrosion.
 - 8) Reduction from the nominal diameter of more than the following limits.
 - a) 1/64 inch for rope diameters through 5/16 inch
 - b) 1/32 inch for rope diameters 3/8 through 1/2 inch
 - c) 3/64 inch for rope diameters 9/16 through 3/4 inch
 - 9) Core failure. This type of damage is usually indicated by a reduction in the nominal diameter or an increase in rope lay length. If these conditions are noted, open up the wire rope and inspect the core. Replace the rope if the core is broken. See fig. 3 for a recommended method of opening the core

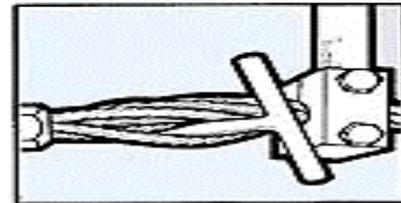
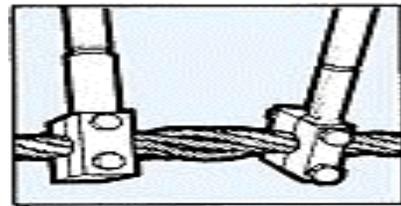
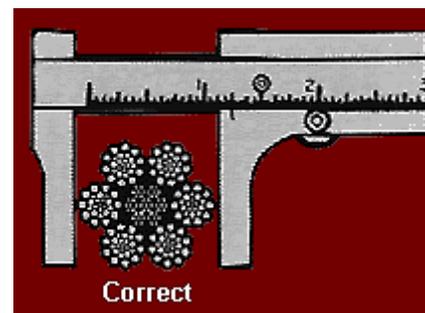
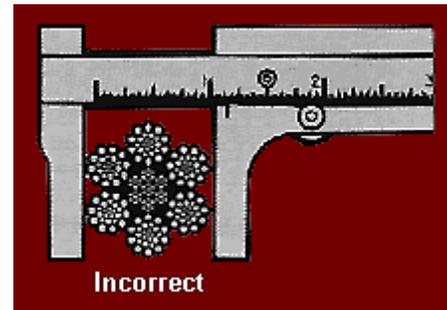


fig 3



1.16.3 Lubrication

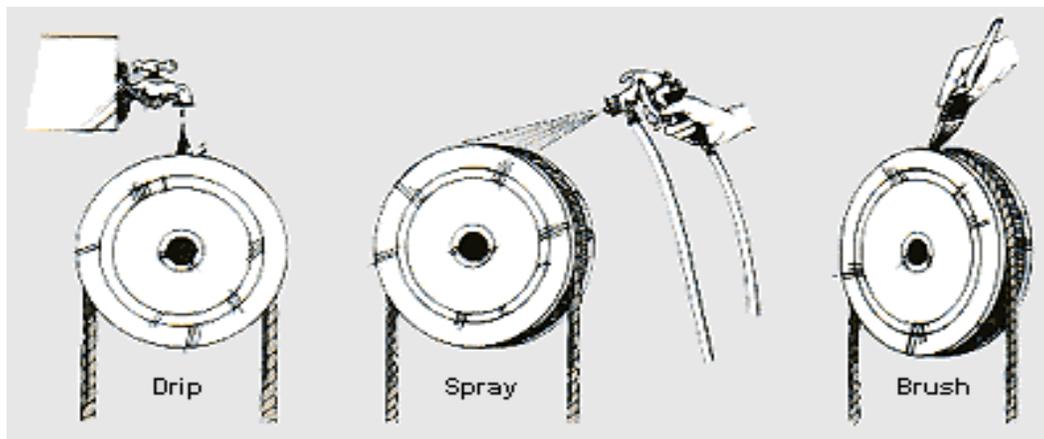
Wire rope is lubricated during manufacture so that the strands -- as well as the individual wires in the strands -- may move and adjust as the rope moves and bends. But no wire rope can be lubricated sufficiently during manufacture to last its entire life. That's why it's important to lubricate periodically throughout the life of the rope.

The surface of some ropes may become covered with dirt, rock dust or other material during their operation. This can prevent field-applied lubricants from properly penetrating into the rope, so it's a good practice to clean these ropes before lubricating.

The lubricant you apply should be light-bodied enough to penetrate to the rope's core. You can normally apply lubricant by using one of three methods: drip it on

rope, spray it on or brush it on. In all cases, you should apply it at a place where the rope is bending such as around a sheave. Apply it at the top of the bend because that's where the rope's strands are spread by bending and more easily penetrated. In addition, there are pressure lubricators available commercially. Your rope's service life will be directly proportional to the effectiveness of the method used and the amount of lubricant that reaches the rope's working parts.

A proper lubricant must reduce friction, protect against corrosion and adhere to every wire. It should also be pliable and not crack or separate when cold yet not drip when warm. Never apply heavy grease to the rope because it can trap excessive grit, which can damage the rope. Nor should you apply used "engine oil" because it contains materials that can damage the rope.



SERVICE & MAINTENANCE**2.1 SPECIFICATIONS**

Hydraulic System	Max		PRESSURE	PRESSURE
	FLOW	FLOW		
	GPM	L/min.	psi	MPa
Piston Pump 131cc	70	265	4200	29.0
			Standby 325	2.2

Pump Flows listed are at free flow condition (100 psi)

Functions	Relief Setting psi	Relief Setting MPa	FLOW GPM	FLOW L/min.	Operating Time seconds	Operating Speed fpm
Lift Up	4200	29.0	30	114	45 +/- 5	
Lift Down	4200	29.0	11	42	40 +/- 5	
Boom Extend	2700	18.8	34	129	150 +/- 10	
Boom Retract	2000	13.8	12	45	120 +/- 10	
Winch Up	4200	29.0	35	132		See Below
Winch Down	4200	29.0	35	132		
Swing Left	2500	17.2	16	61	30 +/- 5	
Swing Right	2500	17.2	16	61	30 +/- 5	
Aux. Winch Up	4200	29.0	35	132		
Aux. Winch Down	4200	29.0	35	132		
Outriggers In/Out	2500	17.2				
Outriggers Up/Down	2500	17.2				
Front Stabilizer	2500	17.2				

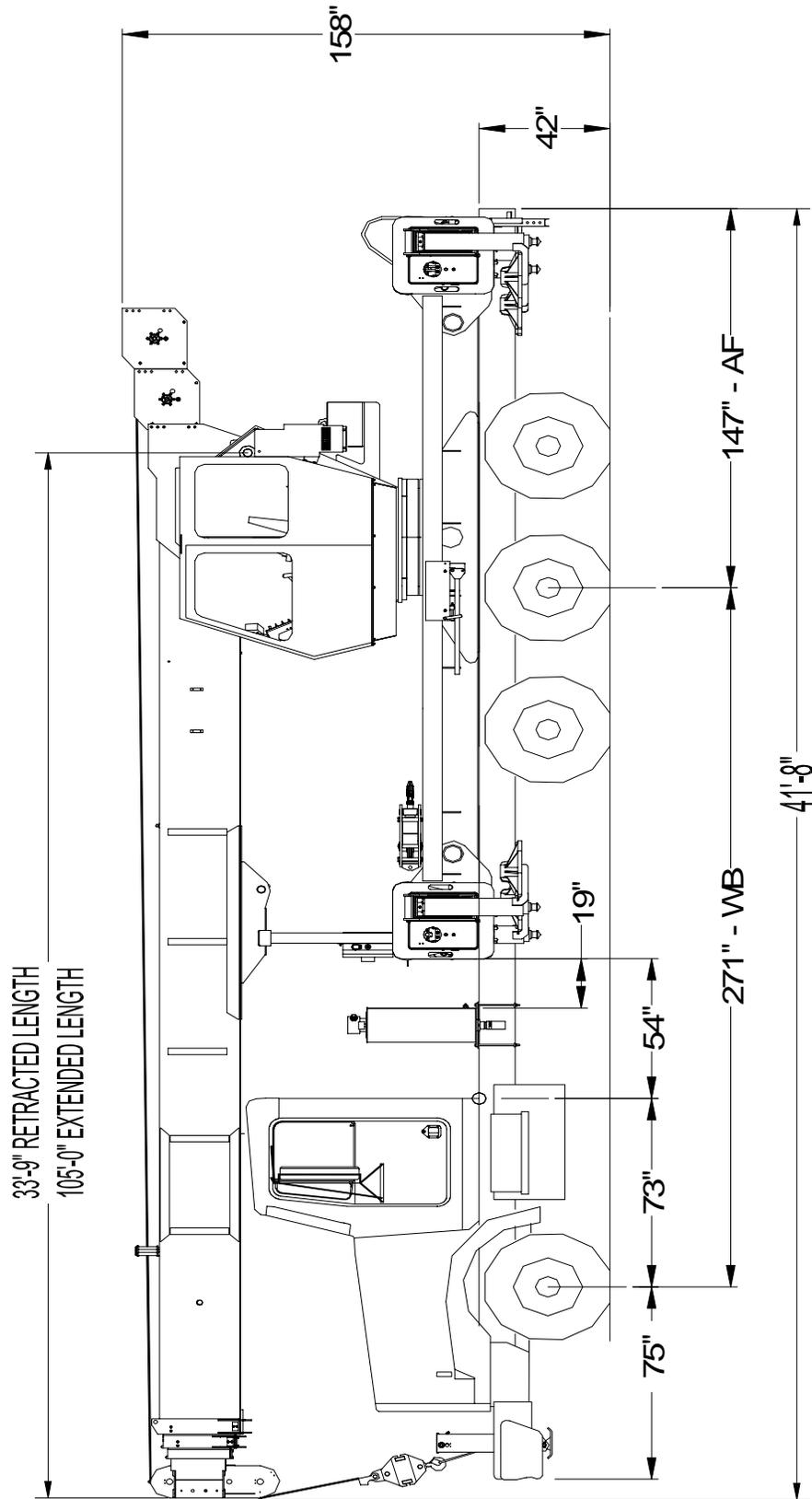
Reservoir Capacity	120 Gallon
Filtration (Pressure)	5 Micron
Filtration (Return)	10 Micron

Winch System Performance

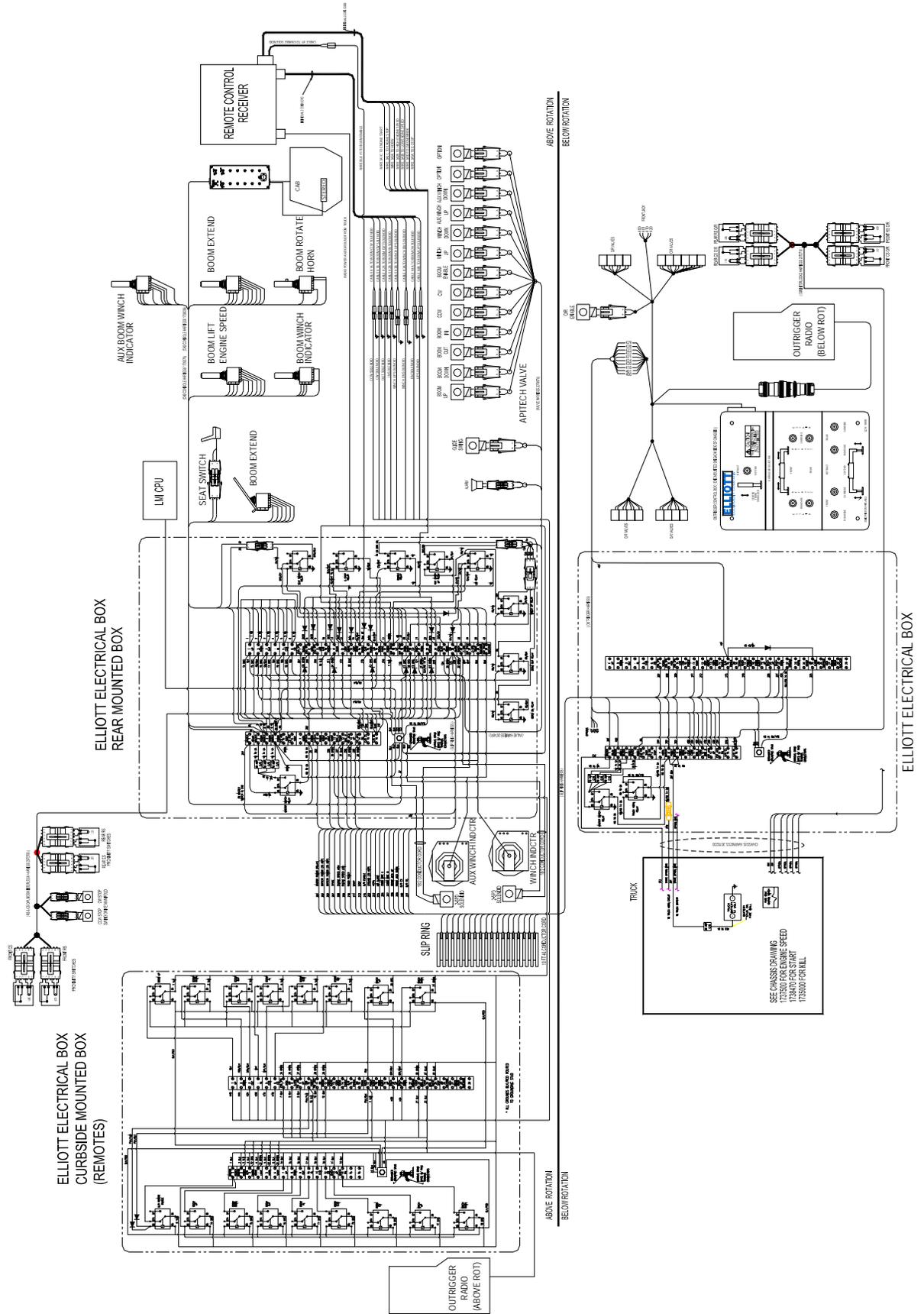
	Standard
Line Pull	10,000 lb.
Wire Rope	5/8" Spin Resistant
Breaking Strength	56,420 lb.
Cable Length	430 ft.

Total Drum Capacity (5/8") Cable		Low Speed				High Speed			
(ft)	Layer	Winch Line Pull lb.	(kg)	Line Speed fpm	(mpm)	Winch Line Pull lb.	(kg)	Line Speed fpm	(mpm)
65	1	15,079	(6840)	122	(37)	7,539	(3420)	244	(74)
137	2	13,571	(6158)	135	(41)	6,785	(3078)	271	(83)
216	3	12,377	(5614)	149	(45)	6,168	(2798)	298	(91)
302	4	11,309	(5130)	162	(49)	5,654	(2565)	325	(99)
398	5	10,439	(4735)	178	(54)	5,219	(2367)	352	(107)
497	6	9,604	(4397)	190	(58)	4,850	(2200)	380	(116)

2.2 PRESENTATION DRAWING



2.3 ELECTRICAL SCHEMATIC (.PDF FILE ON CD)



2.5 MAINTENANCE SAFETY

Perform the following safety steps whenever possible before maintaining or repairing the crane:

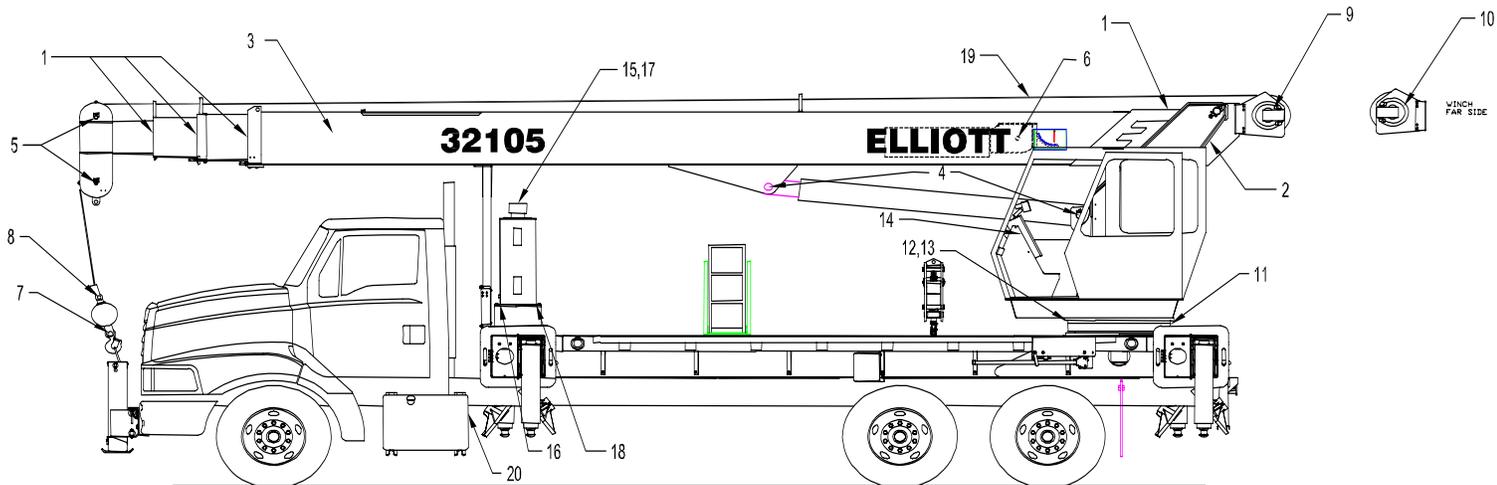
- 1) Apply the Parking brake.
- 2) Lower all loads to ground and disconnect.
- 3) Stow boom on rest if possible.
- 4) Move all controls to off position.
- 5) Disengage PTO and turn engine off.
- 6) Tag start controls warning personnel that crane is being serviced and must not be started.
- 7) Do not place hands or tools in openings in boom sections while engine is running or boom sections are moving.
- 8) Read and thoroughly understand all applicable instructions.
- 9) Pressurized oil can penetrate human skin causing serious injury. Do not use bare hands to check for hydraulic leaks.
- 10) Hydraulic oil is flammable. Keep open flames away.
- 11) Do not alter specified relief settings for hydraulic pressure.
- 12) Make sure boom, outriggers, etc. are securely blocked or resting on the ground before removing cylinders.
- 13) Know the weight of heavy objects and do not attempt to lift them.
- 14) Replace all guards and covers prior to returning the crane to service.
- 15) Never climb on turret, winch, or top of boom. Use ladder and/or manlift to obtain access to these areas.

2.6 CLEANLINESS

Long life of a crane's hydraulic components is dependent on keeping dirt out of the system. Whenever hydraulic lines are disconnected, clean the adjacent area as well as the point of disconnection. Immediately cap or plug openings to prevent entry of dirt. Clean all parts and cover to keep clean.

If evidence of foreign particles is found in the hydraulic system, flush the system. Inspect all sealing elements when disassembling and assembling hydraulic systems. Always install new O-rings on ORFS fittings when removing and reinstalling. Hoses should be installed so any bending is with natural curvature

.2.7 LUBRICATION



Description	Lubricant	Procedure	Interval	Notes
1. Boom Wear Pads	Grease	Brush/Roller	Monthly	1
2. Boom Retract Sheaves	Grease	Gun	Weekly	2
3. Boom Extend Sheaves	Grease	Gun	Weekly	3
4. Boom & Lift Cylinder Pivot Pins	Grease	Gun	Weekly	4
5. Boom Head Sheaves	Grease	Gun	Weekly	
6. Jib Head Sheave	Grease	Gun	Weekly	
7. Hook Block/Headache Ball Swivel	Grease	Gun	Weekly	
8. Hook Block Sheave	Grease	Gun	Weekly	
9. Winch Brake	SAE 20W-20 Motor Oil	Check Level	Monthly	5
10. Winch Gearbox	SAE 90EP Gear Lube	Check Level	Monthly	5
11. Swing Bearing Grease Fitting	Grease	Gun	Monthly	6
12. Swing Bearing Gear Teeth	Grease	Brush	Monthly	7
13. Swing Reducer Gearbox	SAE90EP Gear Lube	Check Level	Semi-annually	8
14. Control Linkage	Engine Oil	Oil Can	Monthly	9
15. Hydraulic Oil Tank Fill	See Notes	Check Level	Daily	10
16. Hydraulic Oil Filter			Daily	11
17. Hydraulic Tank Breather			Semi-annually	12
18. Suction Strainer			At Oil Change	
19. Wire Rope	See Section 2.6.3			
20. Pump Drive U-Joint or Pump Drive Spline Shaft	Grease Coupling Lube Spline Lubricant	Remove Pump and Apply to Shaft		

2.7.1 Lubrication notes

- 1) Fully extend boom and apply a light coat of grease to sides and bottom of moving boom sections in area of wear pads.
- 2) Fully retract boom. Remove cover on top, rear of base boom and coat wear pads with grease. On 4 section booms-slightly extend as necessary to expose all pads to grease. Replace cover.

CAUTION

Do not place hands or tools into opening when truck engine is running and/or boom sections are moving.

Retract sheaves on 1st moving section are accessible through holes in base boom when boom is fully retracted.

CAUTION

Do not place hands or tools into opening when truck engine is running and/or boom sections are moving.

- 3) Fitting is located on end of extend sheave pin on outboard end of telescope cylinder in boom. Extend boom to align holes in sides of mid and fly booms. Caution: Do not place hands or tools into opening when truck engine is running and/or boom sections are moving.
- 4) Grease fittings for the hoist cylinder pivots are on the middle of the cylinder end mounts. Boom pivot grease fittings are on the base boom pivot bushings and are accessible from the back of the boom.
- 5) See "Tulsa Winch Service Manual" for complete lubrication checking and oil changing directions.
- 6) The swing bearing race is lubricated from a remote grease fitting located on the top of the operator's console on the driver's side. Apply three or four pumps of grease, rotate 90 degrees and apply three of four more shots of grease. Repeat procedure through 360 degrees of operation.
- 7) Brush or spray grease on each gear tooth. Note: Swing cover must be removed.
- 8) Apply approx. 3 pumps of grease.
- 9) See "Tulsa Winch Swing Drive Service Manual" for complete lubrication and oil changing directions.
- 10) Remove doors to expose linkage and replace after oiling.
- 11) Fittings are on outrigger cylinders. Apply approx. 3 pumps of grease to each fitting on wear pad. Note: There are 4 fittings per side-two on the top, front of tube and two on the bottom, rear of tube.
- 12) When checking the level on the hydraulic tank, the boom must be retracted and stowed and all outriggers and stabilizers must be fully retracted. Add hydraulic oil as required to keep the level on the sight gauge between the high and low marks. Use high quality ISO Grade 32 hydraulic fluid with a viscosity index greater than 100.
- 13) Check daily and periodically throughout day. Replace the element when the gauge reading reaches 25 PSI with warm oil and the engine at high RPM. Note: The filter has a bypass that opens when the pressure exceeds 25 PSI. Operating the crane when the filter is bypassing may damage the pump, valves and hydraulic system.
- 14) Replace at earlier intervals if required. Do not clean and reuse
- 15).

2.8 BOLT TORQUE

The torque values for fasteners are listed below. Make sure each fastener is the correct size and grade prior to torquing. Always use grade 8 nuts with grade 8 fasteners. Use hardened washers under screw heads and beneath nuts that are torqued. Make sure threads are clean and free of burrs. Semiannually check items #1-8. Use a calibrated torque wrench and recalibrate on a regular basis

Coarse Threaded Fasteners				Fine Threaded Fasteners			
UNC Size	TPI	Grade	Grade	UNF Size	TPI	Grade	Grade
		5 ft-lb.	8 ft-lb.			5 ft-lb.	8 ft-lb.
1/4	20	8	12	1/4	20	10	14
5/16	18	17	25	5/16	18	19	25
3/8	16	30	45	3/8	16	35	50
7/16	14	50	70	7/16	14	55	80
1/2	13	75	110	1/2	13	90	120
9/16	12	110	150	9/16	12	120	170
5/8	11	150	220	5/8	11	180	240
3/4	10	260	380	3/4	10	300	420
7/8	9	400	600	7/8	9	440	660
1	8	580	900	1	8	640	1000
1 1/8	7	800	1280	1 1/8	7	880	1440
1 1/4	7	1120	1820	1 1/4	7	1240	2000
1 3/8	6	1460	2380	1 3/8	6	1680	2720
1 1/2	6	1940	3160	1 1/2	6	2200	3560

* Tolerance on Torque Values +/- 10%



GRADE 5 BOLT
OR SCREW



GRADE 8 BOLT
OR SCREW



GRADE 8 NUT

GRADE MARKINGS

2.9 CHANGING HYDRAULIC OIL

Drain and refill the hydraulic system every six months unless an alternate interval has been established by oil analysis.

- 1) Bring the oil to operating temperature by running the crane functions.
- 2) With all controls in neutral position, turn the truck engine off.
- 3) Remove the drain plug from the tank bottom. If the oil is extremely dirty or contaminated, crack open fittings at high points on the system to vent the lines. Be sure to retighten the fittings prior to starting the truck engine.
- 4) Thoroughly clean dirt from the access cover on the top of the tank and remove the cover.
- 5) Clean out any sediment inside the tank.
- 6) Remove the suction strainer. Soak in solvent and blow off with compressed air before reinstalling.

2.10 BUBBLE LEVEL ADJUSTMENT

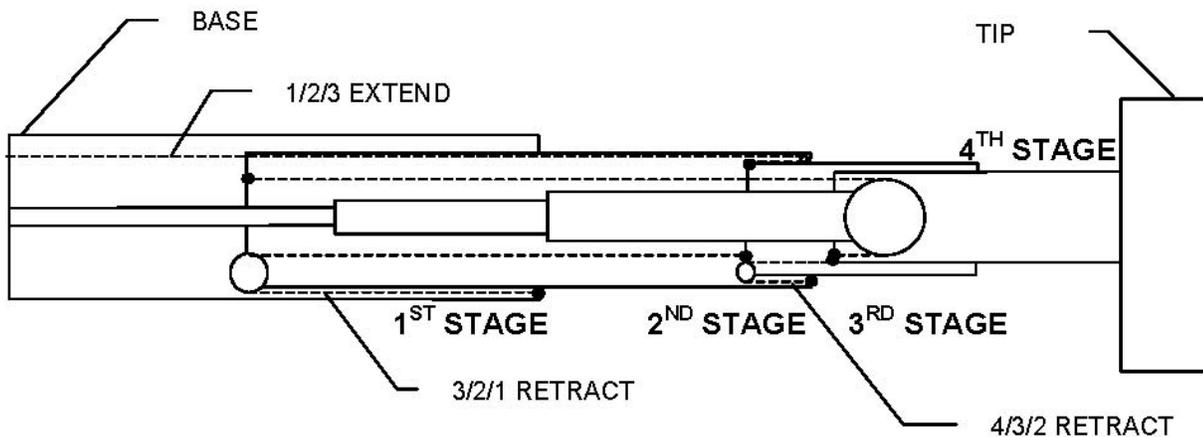
Check the adjustment of the bubble levels on the control consoles monthly:

- 1) Extend outriggers and stabilizers and level the crane with the bubble level.
- 2) Raise the fully retracted boom to 80 degrees.
- 3) Place an accurate carpenter's level on either side of the turret top plate.
- 4) Adjust the outriggers and stabilizers so the crane is level from front to rear according to the carpenter's level.

- 7) Reinstall the cover on the tank top, replace gasket as required.
 - 8) Replace the filter element.
 - 9) Replace the breather.
 - 10) Clean metal particles from the drain plug and reinstall.
 - 11) Fill the hydraulic tank to the proper level with approved, filtered hydraulic oil-use 10 micron filter.
 - 12) Make sure the suction line shut off valve is open before starting the engine; otherwise the pump will cavitate and destroy itself.
 - 13) Start the engine, engage the PTO and let the pump run a couple minutes with no load at low RPM.
 - 14) Gradually increase speed and operate all functions. Operation may be sluggish or erratic as air is purged.
 - 15) Once the functions are operating smoothly, stow the boom and outriggers and then stop the engine.
 - 16) Fill the hydraulic tank to the full level on the sight gauge.
-
- 5) Swing the boom 90 degrees over either side of the truck and adjust the outriggers and stabilizers so the crane is level according to the carpenter's level.
 - 6) Repeat this procedure until the crane is level and needs no further adjustment. Note: Tires must be off the ground.
 - 7) Check the bubble level at each console. Shim under the level base with washers at mounting screws as required until the bubble is centered in the circle. Retighten mounting screws.

2.11 FOUR SECTION BOOM OPERATION

THE BOOM SERVICE AND MAINTENANCE SECTION OF THIS MANUAL INCLUDES BOTH THE FOUR AND FIVE SECTION BOOM INFORMATION. USE APPROPRIATE INFORMATION FOR YOUR PARTICULAR BOOM LENGTH.



A rod-fed, two-stage double-acting cylinder, attached to the 1st, 2nd and 3rd boom sections, supports and propels the 2nd and 3rd boom sections. The extend cables attach to the base end of the 2nd boom section, are reeved around sheaves attached to the cylinder and attach to the base end of the 4th boom section, therefore providing support and extension of the 4th boom section. The 3rd section retract cables attach to the tip end of the 1st boom section, are reeved around sheaves attached to the 2nd boom section and attach to the base end of the 3rd boom section, therefore providing retraction of the 3rd boom section. The 4th section retract cables attach to the tip end of the 2nd boom section, are reeved around sheaves attached to the 3rd boom section, and attach to the base end of the 4th boom section, therefore providing retraction of the 4th boom section. A proportioning cable attached to the rear of the 1st section, reeved around a sheave at the tip of the 2nd section and anchored to the rear of the 3rd section maintain proper cylinder extension proportion, therefore maintaining equal boom section proportion. Detailed service and maintenance is required to insure smooth and proper operation.

Do not, under any circumstances, work at an elevated height without using proper fall protection as required by local, state or federal regulations

2.11.1 INTERNAL CABLE SHEAVE LUBRICATION

NOTE: Observation through the sheave case for the extend sheaves and the winch mount for retract sheaves will visually determine the amount of grease necessary for proper lubrication. A slight amount of grease extrusion around the pin joint is adequate for proper lubrication.

Lubrication of the extend cable sheaves located on the boom tip end of the extend cylinder and the retract cable sheaves located on the inside rear of the 2nd and 3rd section and the extend cable sheave attached to the bottom of the top plate of the second section at the sheave case end of the boom are accomplished with the boom fully retracted. A grease zerk is located on each lubrication point.

2.11.2 FOUR SECTION CABLE

TENSIONING

After boom reassembly or from time to time if interior proportioning cables appear loose, cable tensioning may be required. Tensioning must be done with the boom horizontal

1. Slightly tighten all cables. Then cycle the boom approx. 4 feet (120cm) out and in a few times to equalize the extend and retract cable/boom section sequence positioning.
2. Fully retract boom. Do not induce and hold hydraulic pressure. At full retraction, observing through the winch mount end of the boom, the second section should be bottomed on the extend cylinder butt plate, the third section should be bottomed on the thick vertical side plates welded to the inside of the second section, the fourth section should be bottomed on the thick vertical side plates welded to the inside of the third section.
3. It is important to achieve these boom section positions before torquing. If the boom sections do not bottom out as specified (boom is out of sequence), adjust cables to achieve proper section positioning. After proper section position has been established, a scribe mark on all the sections at the boom tip end to identify proper sections at the boom tip end to identify proper section position relative to each other may be helpful during the tensioning process.
4. Torque 4/3/2 retract cables to 7 ft-lb (9.5 N.m). Cable adjustment point is located at the sheave case end of the boom on the bottom of the 2nd section. Use the flats at the front of the cable ends to keep the cables from turning while torquing retainer nuts.

5. Torque large extend cables to 22 ft-lb (12.2 N.m). Cable adjustment point is located at the rear of the boom on the cable anchor located in the rear of the 2nd section.
6. Torque 3/2/1 retract cables to 9 ft-lb (12.2 N.m). Cable adjustment point is located at the sheave case end of the boom, on the bottom of the 1st section. Use the flats at the front of the cable ends to keep the cables from turning while torquing retainer nuts.
7. Torque 1/2/3 extend cable to 9 ft-lb (12.2N.m). Cable adjustment point is located at rear of boom on the winch crossbar spanning the 1st section.
8. Repeat steps 4,5,6 and 7, torquing the 4/3/2 retract cables to 14 ft-lb (19 N.m). Torque the large extend cables to 45 ft-lb (61 N.m). The 3/2/3 retract cables to 18 ft-lb (24 N.m) and the 1/2/3 extend cable to 18 ft-lb (24 N.m).
9. Cycle the boom fully, check that all the cables are torqued properly and that all sections are retracted completely, utilizing scribe marks or bottoming position of boom sections then add jam nuts to all cables. All threaded cable ends must be equipped with retainer nuts and jam nuts.

2.11.3 BOOM REMOVAL

Boom length

40105

32'/49' jib

Boom weight

14,350 lb (6510 kg)

1950 lb (885 kg)

1. Extend and set machine outriggers. Boom must be completely retracted and stowed in the boom rest.
2. If equipped, remove swing around jib according to procedures outlined in the "Safety & Operation" section.

3. Remove hook block or downhaul weight, wind up rope on winch drum and stow wedge socket on pegs provided on 1st section. Shut down truck engine.
4. Attach a lifting device to rod end of lift cylinder, remove boom lift cylinder pin keeper and pin from bottom of the 1st section boom. Lower lift cylinder to a suitable support.
5. Tag and disconnect extend cylinder lines and winch hydraulic lines. Cap all open lines and ports.
6. Attach a lifting device to provide even weight distribution and raise the boom until weight is removed from the boom pivot pin. Remove boom pivot pin keeper and boom pivot pin. Lift boom free of turret.

2.11.4 BOOM DISASSEMBLY

For reference, the front of the boom refers to the sheave case end, the rear of the boom is the winch mount end. Left and right are viewed from rear to front.

If the boom is to be unpinned from the turret of the crane structure, please refer to the Boom Removal Procedure section in this book. If the required service procedure is to be performed on the boom while still pinned to the turret, please follow these directions.

Do not, under any circumstances, work at an elevated height without using proper fall protection as required by local, state or federal regulations.

1. Extend and set all outriggers and SFO.
2. Fully retract the boom and place in a horizontal position.
3. Winch removal optional.

2.11.4a Boom Disassembly Alternative

1. Gaining access through rear of boom, loosen capscrews retaining

the keeper plates holding the extend cable anchor and retract cables in the rear of the 3rd section, remove keeper plates.

2. Extend boom 24 inches (60 cm). Loosen and remove the nuts which secure the extend cables to the cable anchor plate. Tag and disconnect hydraulic lines to the extend cylinder.
3. Drape extend cables inside boom and slide cable anchor plate out of the side of the winch mount if winch has been removed from boom.
4. Loosen and remove two capscrews, lockwashers and spacers which anchor the extend cylinder rod butt plate to the rear of the 1st section.
5. Loosen and remove two capscrews and lockwashers securing spacer bar to the inside top of the front of the 1st section. Remove spacer bar.
6. Loosen and remove four capscrews securing wear pads to the bottom of the 1st section. Removal of side wear pads is optional. Adequate clearance exists between adjoining section side pads for boom disassembly. If side pad removal is required, tag all pads, shims and corresponding locations for proper reassembly.
7. Support 2nd-3rd-4th assembly at the front with an appropriate lifting method. Raise the 2nd-3rd-4th assembly inside the 1st section to allow for front bottom pad removal. Remove bottom wear pads.
8. With the 2nd-3rd-4th assembly supported, slide assembly out of the 1st. Relocation of the sling point on the 2nd-3rd-4th assembly will be necessary for proper balancing of the assembly as it slides out of the 1st section. Keep tension on retract cables as the assembly is pulled out of the 1st to minimize the chance of retract cable damage.
9. Place 2nd-3rd-4th assembly on a suitable horizontal surface. Take

- care not to pinch or crush retract cables while lifting or supporting assembly.
10. Remove top rear wear pads on the 2nd section. They will lift off the cam plates easily. Do not remove or loosen the capscrews holding the cam plates to the section. This will affect side clearance during re-assembly.
 11. Loosen and remove four capscrews securing the rear bottom wear pads on the 2nd section. This pad serves as a bottom and side pad as well as the retract cable keeper under the retract sheaves. Removal of this pad will allow the retract cables to uncoil off the retract sheaves. Place retract cable ends in a location to minimize the possibility of damage.
 12. Loosen and remove six capscrews securing retract sheave pin and retract sheaves to 2nd section. Remove sheaves and pins.
 13. Loosen and remove two capscrews functioning as upper retract cable keepers. Remove retract cables.
 14. Loosen and remove two capscrews securing lock bar to the extend cylinder collar. This bar constrains the vertical movement of the extend cylinder. Remove bar.
 15. Loosen capscrews retaining extend cable anchor to back of the 4th section. Total removal of the capscrews will allow the cable anchor to be completely disassembled, backing capscrews out approximately .50 inch (12mm) will allow the anchor assembly to slide rearward out of the section as the extend cylinder is removed.
 16. Support extend cylinder with an appropriate lifting device and pull the extend cylinder out of the boom while keeping the extend cables tensioned slightly by hand to minimize the possibility of damage to the cables. Pull cylinder to within 3 feet (91mm) of complete removal from the boom sections.
 17. Reach into the rear of the 4th section and pull the extend cable anchor out from its retaining pocket on the bottom of the 4th section. A slight angle applied to the anchor as it is being pulled to the rear will permit easier removal through the 2nd and 3rd sections.
 18. Remove the extend cylinder from the boom. Do not allow the sheaves to fall off the pin on the end of the extend cylinder. Remove extend cables. Place cylinder and cables in suitable area to prevent possible damage.
 19. Loosen and remove two capscrews, cable guide, wear pad and spacer bar from the front top of the second section.
 20. Loosen and remove four capscrews attaching the bottom pad plate to the second section. Slightly lift third section and remove pad plate.
 21. Slide 3rd section out of 2nd section. Removal of side pads is optional, as the side pads have adequate clearance for boom disassembly. If removal of side pads is required, tag all shims, pads and corresponding locations for proper re-assembly.
 22. Loosen and remove two capscrews, cable guide wear pad and spacer bar from the front top of the third section.
 23. Loosen and remove four capscrews attaching the bottom pad plate to the third section. Slightly lift 4th section and remove pad plate.
 24. Slide 4th section out of 3rd section. Removal of side pads is optional, as the side pads have adequate clearance for the boom disassembly. If removal of the side pads is required. Tag all shims, pads and corresponding locations for proper reassembly.

25. Loosen and remove all remaining capscrews and wear pads from sections.

2.11.5 ADDITIONAL MAINTENANCE, DISASSEMBLED BOOM

1. Clean all boom sections and inspect for wear, dents, bent or crooked boom sections, gouged metal, broken welds or any abnormal conditions. Repair or replace as required.
2. Inspect all sheaves for excessive groove wear or abnormal rim wear. Replace as required.
3. Inspect all sheave bearings for excessive wear or cut inner liner material. If installed bearing diameter is .015 inch (.38 mm) larger than pin diameter, bearing must be replaced. Any cut or gouge which causes the bearing liner to lose strands is cause for bearing replacement.
4. Clean and inspect all cable assemblies according to wire rope inspection procedures in this section. Pay particular attention to any wire breakage at the end connections. Replace cable assemblies as required. Lubricate all cable assemblies as required. Lubricate all cable assemblies before reinstalling them in boom.
5. Inspect all sheave pins for nicks, gouges or pitting due to rust in the bearing surface area. Replace if any damage is evident.
6. Inspect all zerks and grease paths in pins to ensure proper grease flow. Clean and replace as required.
7. Replace all lubricating plugs in all wear pads.

2.11.6 FOUR SECTION BOOM ASSEMBLY

Note: Do not use Loctite on any cable threaded ends. Always use the locknut and nut provided.

When initially assembling threaded ends of cables, thread the first on past the flat in the cables so adjustment can be made later.

1. Assemble sheaves into 4th section sheave case. Top sheave is to be installed to the left hand side of the boom with the spacer to the right hand side.
2. Attach rear wear pads on bottom of 4th section. Using Loctite 242 blue, Loctite all wear pad mounting capscrews.
3. Install 4th boom section into 3rd section. Slide together approximately 5 feet (150cm).
4. Assemble bottom front wear pads for 3rd section. Attach pads to pad plate.
5. Using appropriate lifting device, lift 4th section to allow for wear pad/pad plate installation in front of 3rd. Install wear pad/pad plate assembly. Slide sections together within 12 inches (30cm) of full retraction.
6. Install cable guide and upper spacer to front of 3rd section.
7. Install front side wear pads with appropriate shims, between 4th and 3rd sections. If boom has been disassembled and no sections have been replaced, use same shim quantity and location as was previously used. If locations are in question, refer to shim calibration section in this book. Slide boom sections completely together.
8. Assemble top rear wear pads to the top of the 4th boom section with the cam plates and install through the winch mount end of the boom. Install capscrew through holes in outer boom sections.

- The wear pads on each side at the top/rear of the boom can be adjusted over a range of 3/16 inch (4.8mm) by rotating, end for end, the wear pad and plate or the wear pads and plate independently. This is possible because the holes in these parts are offset from the center. The holes are .06 inch (1.5mm) off center in the plate and .03 inch (.8mm) off center in the wear pad. Various combinations of rotation of these parts allow the adjustment.
9. Uncoil 4/3/2 retract cable assemblies and insert button end into anchors in back of the 4th section. Place uncoiled cable in area that will minimize the potential for damage.
 10. Uncoil 3/2/1 retract cable assemblies and insert button end into cable anchor pockets in back of the 3rd section. Place uncoiled cable in area that will minimize the potential for damage. Assemble retract sheaves and retract sheaves and retract sheave pins in rear of 3rd section. Coat surfaces of bearings and keeper plates with grease before assembly.
 11. Place retract cables anchored to 4th over the top of the retract sheaves on the 3rd. Install keeper capscrew above sheave to hold retract cables in place.
 12. Reeve cables over retract sheave and install keeper/wear pad to bottom rear of 3rd section. This pad acts as a side pad, bottom pad and a cable retainer. Loctite rear wear pad hardware on bottom of 3rd with Loctite 242 blue. Loctite all wear pad mounting capscrews.
 13. Loop the 1/2/3 extend cable in half and place it on the top of the 3rd section with the loop end towards the sheave case end and the threaded and button end towards the rear of the section.
 14. Install clamp plate and capscrews with the button end of the cable installed in the anchor slot on the rear top of the 3rd section.
 15. Place sheave pin and sheave for the 1/2/3 extend cable in position on the sheave case end of the boom, inside the loop of cable.
 16. Install 3rd and 4th section boom assembly into 2nd section. Slide together approximately 5 feet (150 cm). Use caution as retract cables and upper extend cable attached to the 4th-3rd section assembly slide into the 2nd section to prevent damage or crossing of cables.
 17. Assemble bottom front wear pads for 2nd section. Attach pads to pad plate.
 18. Using appropriate lifting device, lift 3rd and 4th section assembly to allow for wear pad/pad plate installation in front of 2nd. Install wear pad/pad plate assembly. Slide sections together within 12 inches (30cm) of full retraction.
 19. Install cable guide and spacer to top of 2nd section.
 20. Install front side wear pads with appropriate shims between 3rd and 2nd sections. If boom has been disassembled and no sections have been replaced, use same shim quantity and location as was previously used. If locations are in question, refer to shim calibration section in this book. Slide sections fully together.
 21. Assemble top rear wear pads to the top of the 3rd boom section with the cam plates and install through the winch mount end of the boom. Install capscrew through holes in outer boom sections.
The wear pads on each side at the top/rear of the boom can be adjusted over a range of 3/16 inch (4.8mm) by rotating, end for end, the wear pad and plate or the wear pads and plate independently. This

- is possible because the holes in these parts are offset from the center. The hole are .06 inch (1.5mm) off center in the plate and .03 inch (.8mm) off center in the wear pad. Various combinations of rotation of these parts allow the adjustment. Plates function as rear side clearance adjustment.
22. Position sheave and sheave pin located in cable loop on top of 3rd to allow capscrew installation through top plate of 2nd. Install capscrews and torque to specification, clamping sheave pin and sheave to the bottom of the 2nd section.
 23. Assemble retract sheaves, retract sheave pins and cable keeper plates in rear of 2nd section. Coat surfaces of bearings with grease and assemble extend sheaves on sheave pin.
 24. Place retract cables anchored to 3rd over top of retract sheaves attached to rear of 2nd. Install keeper capscrew above sheave to hold retract cables in place.
 25. Reeve cables over retract sheave and install keeper/wear pad to bottom rear of 2nd section. This pad acts as a side pad, bottom pad and a cable retainer.
 26. Assemble exterior extend cylinder components. Install and center sheave pin case end of extend cylinder. Install bearings into extend cable sheaves. Coat surface of bearings with grease and assemble extend sheaves on sheave pin.
 27. Wrap approximately 10 feet (300cm) of each diameter 2/3/4 extend cable around extend sheaves and install 4th section extend cable anchor around cables at button end. Do not tighten capscrews clamping anchor together completely. These capscrews if tightened completely will not allow cable anchor to install into 4th section.
 28. Install wear pad over extend cylinder sheave side plates. This serves as a wear pad to keep the end of the extend cylinder centered in the boom, as well as an extend cable retainer.
 29. Slide extend cylinder/extend cables into 2nd-3rd-4th boom assembly enough to assemble extend cable anchor into bottom rear of 4th section. Be aware of extend cable location when inserting cylinder into boom sections, inadvertent crushing or other damage to cables will warrant replacement.
 30. Tighten capscrews clamping extend cable anchor together. This will also lock anchor in place in the anchor cutouts in the 4th section.
 31. Visually verify that the extend cables are properly routed on their sheaves and continue to slide with the extend cylinder and cables into the boom sections. Keep extend cables supported and slightly tensioned during insertion of cylinder to maintain proper cable placement.
 32. As the extend cylinder nears complete insertion into the 2nd-3rd-4th section assembly, adjust the height of the cylinder to allow the cylinder anchor collars to access the cylinder keeper cutouts in the doubler plates on the sides of the 2nd and 3rd sections.
 33. Drop the cylinder down into the vertical cutouts in the doubler plates on the sides of the 2nd and 3rd sections. Cylinder length or boom section placement may have to be adjusted to allow cylinder collars to drop into their proper position.
 34. Install lock bar and capscrews to the extend cylinder collar in the 3rd section.
 35. Install large extend cable anchor into anchor cutouts in the doubler plates in the rear of the 2nd by routing extending cables through the anchor and the small cable over the

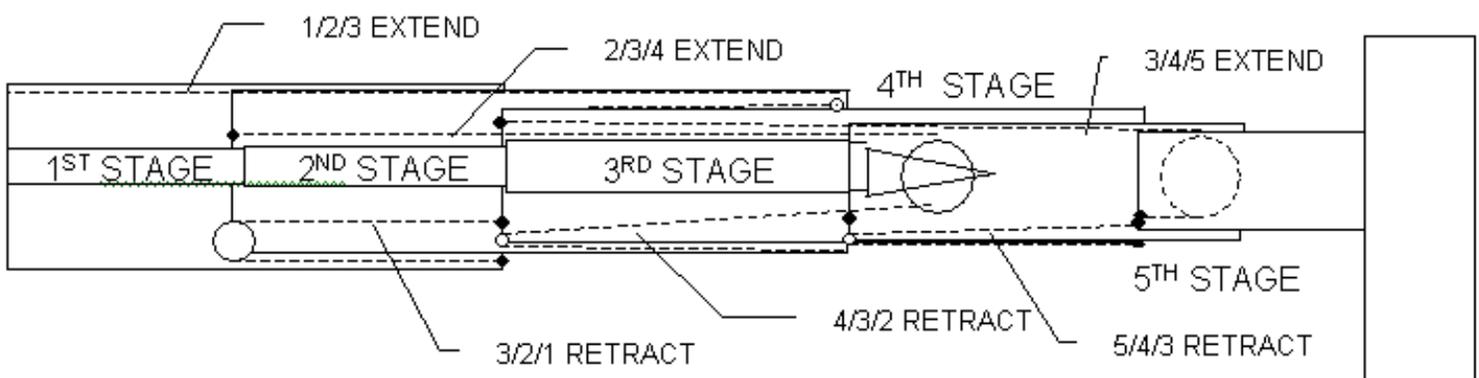
- anchor. Slide anchor fully into cutout.
36. Install keeper plates and hardware. This keeper plate retains both the horizontal movement of the extend anchor and the vertical movement of the extend cylinder.
 37. Install 2nd-3rd-4th section boom assembly into 1st section boom, use caution when sliding sections together, 3rd retract cables must maintain their position to prevent damage, do not let boom rest on cables. Damage will result.
 38. Assemble bottom front wear pads for 1st section.
 39. Using appropriate lifting device, lift 2nd-3rd-4th section assembly to allow for wear pad installation in front of 1st. Install wear pads. Slide sections together within 12 inches (30cm) of full retraction.
 40. Install upper spacer to front of 1st section.
 41. Install front side wear pads with appropriate shims between 2nd and 1st sections. If boom has been disassembled and no sections have been replaced, use same shim quantity and location as was previously used. If locations are in question, refer to shim calibration section in this book.
 42. Push boom together until extend cylinder butt plate makes contact with the rear cylinder anchor plates in the rear of the 1st section. Install spacers, washers and capscrews, attaching cylinder to 1st section boom. If cylinder is misaligned with anchor points, cylinder butt plate can be rotated to achieve proper alignment (holding valve up, parallel with boom top plate).
 43. Assemble top rear wear pads to the top of the 2nd boom section with the cam plates and install through the winch mount end of the boom. Install capscrew through holes in out boom sections.

The wear pads on each side at the top/rear of the boom can be adjusted over a range of 3/16 inch (4.8mm) by rotating, end for end, the wear pad and plate or the wear pads and plate independently. This is possible because the holes in these parts are offset from the center. The hole are .06 inch (1.5mm) off center in the plate and .03 inch (.8mm) off center in the wear pad. Various combinations of rotation of these parts allow the adjustment.
 44. Install thick winch attachment bar into the mount. This bar anchors the extend cable.
 45. Install the threaded ends of the small extend cables through hole in center of the winch mount attachment assembly.
 46. Slightly tighten all cables. Cycle boom slowly to assure proper operation before torquing cables. Refer to the "Four Section Cable Tensioning" section to properly torque the cables in the extend system. Cables must be torqued to proper specifications for proper boom operation.
 47. Install winch and anti-two block system.

2.12 FIVE SECTION BOOM OPERATION

A two-stage, rod fed, double-acting cylinder is attached to and supports the 1st, 2nd and 3rd stage boom sections. The 3/4/5 extend cables attach to the base of the 3rd stage boom, are reeved around sheaves at the tip of the 4th stage boom and attach to the base and support the 5th stage boom. The 5/4/3 retract cables are attached to the base of the 5th stage boom, are reeved around sheaves at the base of the 4th stage boom and attach to the tip of the 3rd stage boom. The 2/3/4 extend cables attach to the base of the 2nd stage boom, are reeved around sheaves at the tip of the 3rd stage cylinder and attach to the base and support the 4th stage boom. The 4/3/2 retract cables are attached to the base of the 4th stage boom, are reeved around sheaves at the base of the 3rd stage. Boom and attach to the tip of the 2nd stage boom.

The 1/2/3 extend cables attach to the base of the 1st stage boom, are reeved around sheaves at the tip of the 2nd stage boom and attach to the base of the 3rd stage boom. The 3/2/1 retract cables attach to the base of the 3rd stage boom, are reeved around sheaves at the base of the 2nd stage boom and attach to the tip of the 1st stage boom. The 3/2/1 retract cables directly oppose the 1/2/3 extend cables to ensure that the 2nd and 3rd stage booms extend and retract equally at all times. The 4/3/2 retract cables directly oppose the 2/3/4 extend cables to ensure that the 3rd and 4th stage booms extend and retract equally at all times. The 5/4/3 retract cables directly oppose the 3/4/5 extend cables to ensure that the 4th and 5th stage booms extend and retract equally at all times.



2.12.1 FIVE SECTION BOOM SERVICE2.12.2 Boom RemovalLengthBoom Weight*

1. Extend and set machine outriggers and front stabilizer. Boom must be completely retracted and stowed in boom rest over front of truck.
2. If equipped, remove swing around jib according to procedures outlined in the "Safety and Operation" section.
3. Remove hook block or downhaul weight, wind up rope on winch drum and stow wedge socket becket on pegs provided on 1st section. Shut down truck engine.
4. Attach a lifting device to rod end of lift cylinder, remove boom lift cylinder pin keeper and pin from bottom of 1st section boom. Lower lift cylinder rod end to the deck.
5. Tag and disconnect extend cylinder lines and winch hydraulic and electric lines. Cap all openings.

Attach a lifting device to provide even weight distribution and raise the boom until weight is removed from the boom pivot pin. Remove boom pivot pin keeper and boom pivot pin. Lift boom free of turret.

2.12.3 FIVE SECTION BOOM
MAINTAINANCE

Do not, under circumstances, work at an elevated height without using proper fall protection as required by local, state or federal regulations.

INTERNAL CABLE SHEAVE
LUBRICATION

NOTE: Observation through the sheave case for the extend sheaves and the

winch mount for retract sheaves will visually determine the amount of grease necessary for proper lubrication. A slight amount of grease extrusion around the pin joint is adequate for proper lubrication.

Lubrication of the extend cable sheaves located on the boom tip end of the extend cylinder and the retract cable sheaves located on the inside rear of the 2nd, 3rd and 4th section and the extend cable sheave attached to the bottom of the top plate of the 2nd section at the sheave case end of the boom, are accomplished with the boom in its fully retracted position. A grease zerk is located on each lubrication end.

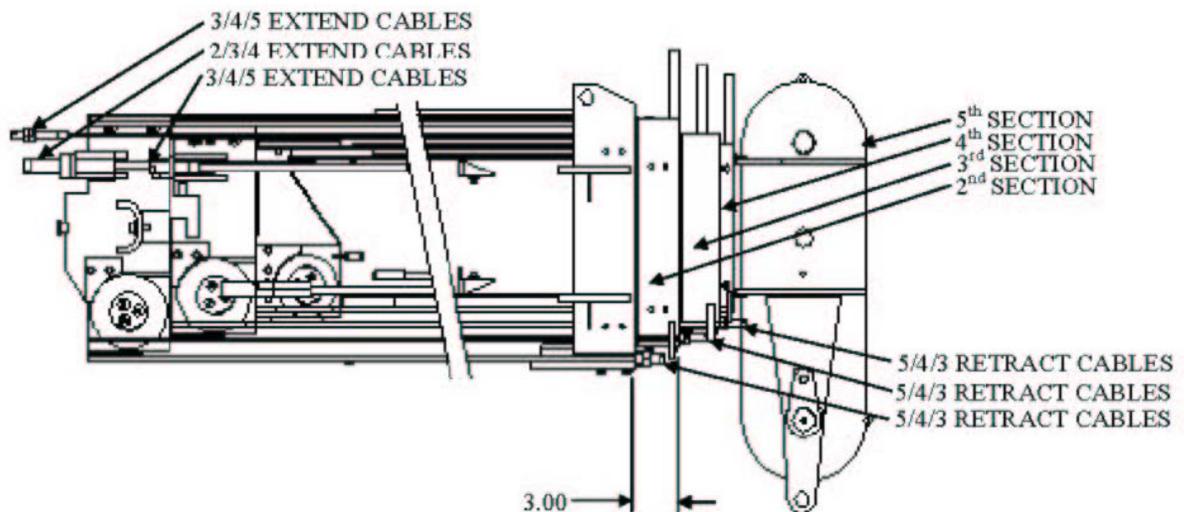
2.12.4 FIVE SECTION CABLE TENSIONING

After boom reassembly or from time to time if interior proportioning cables appear loose, cable tensioning may be required. Tensioning must be done with boom horizontal. Proceed as follows:

- 1) Cycle boom approximately 8 ft (243cm) out and in a few times (2 feet (60cm) per section).
- 2) Fully retract boom. At full retraction the base of the 2nd boom bottoms out in the base of the 1st section boom, the base of the 3rd section bottoms out in the base of the 2nd bottom, the base of the 4th section boom bottoms out in the base of the 3rd section boom and the base of the 5th section boom bottoms out in the base of the 4th section boom. Marks should be scribed on the side plates along the front edge of each upper wear pad indicating where each section

bottoms out. This will aid the mechanic during the cable tensioning procedure. When the cables are torqued (tensioned) properly, the boom sections should extend/retract proportionally and bottom out at the same time during retract.

- 3) Tighten the 5/4/3 retract, 3/4/5 extend, 4/3/2 retract, 2/3/4 extend, 3/2/1 retract and 1/2/3 extend cables (in order listed) to remove slack from the cables and to achieve proper sequencing of bottoming out base of booms. To reach the 3/4/5 extend cables boom must be extended out approximately 18 inches (45cm), 4.50 inches (11.43cm) per stage and tightened through openings in the 1st and 2nd section booms.



- 4) Torque the 5/4/3 retract cables to ft-lb (8.13 N.m) each. Use the flats at the front of the cable ends to keep the cables from rotating while torquing. These cables are located at the bottom tip of the 3rd section boom.
- 5) Torque the 3/4/5 extend cables to 15 ft-lb (20.37 N.m) each. These cables are located at the top base of the 3rd stage boom. (Reference Step #3 for access to the 3/4/5 extend cables.)
- 6) Torque the 4/3/2 retract cables to 7 ft-lb (9.5 N.m). Use the flats at the front of the cable ends to keep the cables from rotating while torquing. These cables are located at the bottom tip of the 2nd section boom.
- 7) Torque the 2/3/4 extend cables to 20 ft-lb (27 N.m) each. These cables are located at the top base of the 2nd section boom. (Reference step #3 for access to the 2/3/4 extend cables).
- 8) Torque the 3/2/1 retract cables to the 9ft-lb (12 N.m). Use the flats at the front of the cable ends to keep the cables from rotating while torquing. These cables are located at the bottom tip of the 1st section boom.
- 9) Torque the 1/2/3 extend cables to 7 ft-lb (9.5 N.m) each. These cables are located at the top of the 1st section boom winch bar.
- 10) Check to ensure that boom sections are all bottoming out simultaneously as in Step 2. If not, proceed as follows:
 - a) If the second section is bottoming out first, equally loosen the 1/2/3 extend cables and tighten the 3/2/1 retract cables. This will cause the second section boom to bottom later but will also cause the 3rd, 4th and 5th sections to bottom out sooner.
 - b) If the 3rd section is bottoming out first, equally loosen the 3/2/1 retract cables and tighten the 1/2/3 extend cables. This will cause the 3rd, 4th and 5th sections to bottom later and the 2nd section boom to bottom sooner.
 - c) If the 4th section is bottoming out first, equally loosen the 4/3/2 retract cables and tighten 2/3/4 extend cables. This will cause the 4th and 5th sections to bottom out later and the 2nd and 3rd sections to bottom out sooner.
 - d) If the 5th section is bottoming out first, equally loosen the 5/4/3 retract cables and tighten the 3/4/5 extend cables. This will cause the 5th section to bottom out later and the 2nd, 3rd and 4th sections to bottom out sooner.
- 11) Cycle the boom a few feet out and in. Check to ensure that all sections are bottoming out simultaneously. Repeat step 10 as required.
- 12) Repeat Steps 4 through 9. Torque the 5/4/3 retract cables to 12 ft-lb (16.26 N.m). Torque the 3/4/5 extend cables to 30 ft-lb (40 N.m). Torque the 4/3/2 retract cables to 14 ft-lb (19 N.m). Torque the 2/3/4 extend cables to 45 ft-lb (61 N.m). Torque the 3/2/1 retract cables to 18 ft-lb (24 N.m) Torque the 1/2/3 extend cables to 14 ft-lb (19 N.m).
- 13) Cycle boom fully, check that all cables are torqued properly and that all sections are bottoming out simultaneously. Repeat Step 10 as required then add locknuts to all cables. Each threaded cable end must have two nuts locked together.

2.12.5 FIVE SECTION BOOM DISASSEMBLY

For reference, front is sheave case end, rear (base) is winch mount end, left and right are viewed from rear to front. Do not, under any circumstances, work at an elevated height without using proper fall protection as required by local, state and federal regulations.

Steps 1 through 3 apply to a boom that is to be disassembled with the 1st section and jib (if equipped) left on crane.

- 1) Extend and set all outriggers and SFO.
- 2) Fully retract boom and place it in a horizontal position.
- 3) Tag and disconnect the hydraulic lines to the telescope cylinder. Cap all lines and fittings.
- 4) Loosen and remove the fasteners attaching the extend cylinder butt plate to the base of the 1st section boom.
- 5) Mark the location of the hex nuts which secure the 1/2/3 extend cables to the cable anchor. Remove hex nuts and washers from 1/2/3 extend cables. Leave the cable ends draped inside the boom.
- 6) Attach a sling or chain to the front of the 2nd section boom, pull the 2nd, 3rd, 4th and 5th assembly out of the 1st section approximately 12 inches (30cm). Remove front upper spacer bar from 1st section. Remove the tag the four side wear pads and shims from the front of the 1st section. Suspend 2nd, 3rd, 4th and 5th assembly off of bottom pads.
- 7) Remove 4 capscrews which retain the lower front pad plate to the 1st section. Remove pad plate. Remove upper back wear pads and cam plates from 2nd section. Pull the retract cables out and keep retract cables taut while pulling the 2nd, 3rd, 4th and 5th assembly out of the 1st section. Support the base end of the 2nd as it exits the 1st stage boom.
- 8) Place 2nd-3rd-4th-5th on a suitable horizontal surface. Take care not to damage the retract cables while lifting or supporting the 2nd-3rd-4th-5th assembly.
- 9) Remove lower L-pads, retract cables and retract cable retaining capscrews from rear of 2nd section. Remove retract cable retaining

plates from the rear of the 3rd section. Remove 3/2/1 retract cables from anchor pocket in 3rd section.

- 10) Remove retaining capscrews from cylinder anchor channels in the rear of the 2nd section. Remove upper top wear pads and cam plates from upper rear of the 3rd section.
- 11) Remove cable guide and upper spacer bar/cable retainers from the front top of the 2nd section. Attach a sling or chain to the tip of the 3rd section boom and pull the 3rd-4th-5th assembly out of the 2nd approximately 12 inches (30cm). Suspend the 3rd section off of the lower wear pads.
- 12) Remove capscrews retaining 1/2/3 extend sheaves to the top plate of the 2nd section, this will allow the sheaves, pins and extend cables to lay on the top plate of the 3rd section.
- 13) Remove 4 capscrews which retain the lower front pad plate to the 2nd section. Remove pad plate. Remove and tag four side wear pads with shims from front of 2nd section. Pull the retract cables out and keep retract cables taut while pulling the 3rd-4th-5th assembly out of the 2nd section. Support the base end of the 3rd as it exits the 2nd section boom.
- 14) Place 3rd-4th-5th assembly on a suitable horizontal surface. Take care not to damage the retract cables while lifting or supporting the 3rd-4th-5th assembly. Remove 1/2/3 extend cables from the top of the 3rd section by removing the anchor plates and capscrews at the rear of the section, place cables in a area to avoid damage.
- 15) Remove lower L-pads, retract cables and retract cable retaining capscrews from rear of 3rd section. Remove retract cable retaining plates from the rear of the 4th section. Remove 4/3/2 retract cables from the anchor pocket in the 4th section.

- 16) Remove lock bar and hardware from extend cylinder collar anchor pocket in the 3rd section. Lifting the butt plate end of the cylinder up will disengage the cylinder from its anchor pockets in the 3rd section. Slowly pull cylinder out of the 3/4/5 assembly. Keep 2/3/4 extend cables taut and in position to avoid damage as cylinder exits boom assembly. Remove 2/3/4 extend cable anchor in the 4th section as the end of the cylinder nears the anchor position.
- 17) Place cylinder assembly on suitable horizontal surface. Take care not to damage the extend cables while lifting or supporting the cylinder assembly. The cables can be disassembled from the cylinder at this time by removing the tapered wear pads on the front of the cylinder assembly and routing the cables through the access opening made by removing the pad. After tapered pads are removed use caution as the sheave pin and sheaves can move forward from the lock position into the assembly position, allowing pin and sheaves
- 18) Remove cable guide and upper spacer bar from the front top of the 3rd section. Loosen and remove hex nuts from threaded ends of 5/4/3 extend cables at rear of 3rd section. Remove top rear wear pads and cam plates from top of 4th section.
- 19) Attach a sling or chain to front of the 4th section boom and pull the 4th-5th assembly out of the 3rd approximately 12 inches (30cm). Suspend the 4th section off of the lower wear pads.
- 20) Remove 4 capscrews which retain the lower front pad plate to the 3rd section. Remove pad plate. Remove and tag four side wear pads with shims from the front of the 3rd section. Pull the retract cables out and keep retract cables taut while pulling the 4th-5th assembly out of the 3rd section. Support the base end of the 4th as it exits the 3rd section boom.
- 21) Place 4th-5th assembly on a suitable horizontal surface. Take care not to damage the retract cables while lifting or supporting the 4/5 assembly.
- 22) Remove lower L-pads, retract cables and retract cable keeper from rear of 4th section, coil 5/4/3 retract cables inside of 5th section. Remove upper top wear pads and cam plates from upper rear of 5th section.
- 23) Remove cable guide and upper spacer bar from the front of the 4th section. Remove side wear/cable retainer pads from front of 4th section, leave 3/4/5 extend sheaves and 3/4/5 extend cables in place.
- 24) Attach sling or chain to the front of the 5th section boom and pull the 5th section out of the 4th until there is approximately 36 inches (90cm) of the 5th still inserted in the 4th, use caution to keep 3/4/5 extend cables from damage as boom sections slide apart, if possible keep tension on 3/4/5 extend cables from the base end of the 4th boom section during this procedure.
- 25) Lift 5th section off the lower pads and remove pads and hardware. Remove 3/4/5 extend sheaves and hardware.
- 26) Slide 5th section completely out of 4th. Support the base end of the 5th as it exits the 4th section boom. Place 5th section boom on a suitable horizontal surface.
- 27) Remove cable retainers and hardware from side anchor locations on the 5th section. Remove 3/4/5 extend and 5/4/3 retract cables from anchor points in the side of the 5th section, place in suitable area to avoid damage.
- 28) Remove loadline sheaves by removing retainers and lightly tapping on sheave pin while removing sheaves and spacers until

- 29) all sheaves are removed from boom sheave case.

2.12.6 ADDITIONAL MAINTENANCE, DISASSEMBLED BOOM

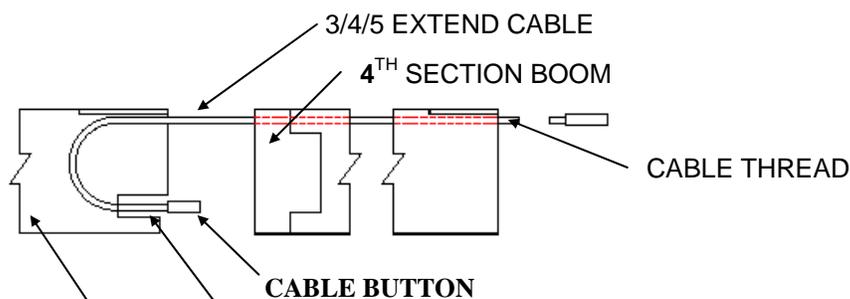
- 1) Clean all boom sections and inspect for wear, dents, bent or crooked boom sections, gouged metal, broken welds or any abnormal conditions. Repair or replace as required.
- 2) Inspect all sheaves for excessive groove wear or abnormal rim wear. Replace as required.
- 3) Inspect all sheave bearings for excessive wear or cut inner liner material. If installed bearing diameter is .015 inch (.38mm) larger than pin diameter, bearing must be replaced. Any cut or gouge which causes the bearing liner to lose strands is cause for bearing replacement.
- 4) Clean and inspect all cable assemblies according to wire rope inspection procedures in this section. Pay particular attention to any wire breakage at the end connections. Replace cable assemblies as required. Lubricate all cable assemblies as required. Lubricate all cable assemblies before reinstalling them in boom.
- 5) Inspect all sheave pins for nicks, gouges or pitting due to rust in the

bearing surface area. Replace if any damage is evident.

- 6) Inspect all zerks and grease paths in pins to ensure proper grease flow. Clean and replace as required.

2.12.7 FIVE SECTION BOOM ASSEMBLY

- 1) Assemble sheaves into 5th section sheavecase. Top sheave is to be installed to the left hand side of the boom with the spacer to the right hand side.
- 2) Attach rear wear pads to the bottom of the 5th section. Using Loctite 242 blue, Loctite all wear pad mounting capscrews.
- 3) Position 5th section boom in front of the 4th section boom ready to slide together. Route 3/4/5 extend cables through 4th section boom with the threaded end of the cable at the rear of the 4th section and the button end out the front, loop the front button end of the 3/4/5 cable beyond its anchor point on the 5th section and install button end into 5th section boom.
- 4) Install 5/4/3 retract cable button end into anchor point in 5th section and install keeper plate and capscrews, keeper plate will lock both the extend and retract cables in place. Coil 5/4/3 retract cables temporarily into 5th section.



- 5) Install 5th section into 4th section approximately 5 feet (100cm). Take care not to damage 3/4/5 extend

cables. They should be laying on the extended lip of the bottom plate of the 5th section.

- 6) Install 3/4/5 extend sheave pins and bearings into the 3/4/5 extend sheaves. Install wear plugs into the holes on each side of the extend sheaves. Loop 3/4/5 extend cables around the 3/4/5 extend sheaves and slide the sheaves between the 4th and 5th boom sections, make certain the grease hole in the pin is orientated correctly before attaching pin to 4th section. Install countersunk capscrews attaching 3/4/5 extend sheave pins to 4th section.
- 7) Raise the 5th section against the top of the 4th and install the bottom wear pads between the 4th and 5th, lower 5th section onto pads.
- 8) Install side wear pads with appropriate shims on front side inside of the 4th section boom. Install upper spacer bar and cable guide with wear pad and related hardware on the top of the 4th section. Shim according to calibration instructions or as pads were originally removed and tagged.
- 9) Push the 5th section completely inside the 4th section until it bottoms out on the doubler plates in the rear of the 4th, keep 3/4/5 extend cables tight when installing section. A scribe mark on the 5th at full retraction will aid in cable tensioning for proper boom sequence later.
- 10) Uncoil 5/4/3 retract cables out of the 5th section, assemble 4th section retract sheaves and pins into the inside of the 4th section rear, using proper hardware and Loctite 242, reeve cable over sheave installing upper keeper capscrew and lower rear pad, this pad serves as a cable keeper, lower pad and side pad for the rear of the section.
- 11) Install 4/3/2 retract cable button end into anchor point in 4th section and install keeper plate and capscrews. This keeper plate is installed temporarily to keep the button ends in place during this phase of the assembly, it will need to come back out during cylinder and 2/3/4 extend cable installation. Coil 4/3/2 retract cables temporarily into 5th section.
- 12) Assemble top rear wear pads with the cam plates to the top of the 5th section. The wear pad on each side of the top/rear of the boom can be adjusted over a range of 3/16 inch (4.8mm) by rotating, end for end, the wear pad and plate or the wear pads and plate independently. This is possible because the holes in these parts are offset from the center. The holes are .06 inch (1.5mm) off center in the plate and .03 inch (.8mm) off center in the wear pad. Various combinations of rotation of these parts allow this adjustment.
- 13) Pull threaded ends of 5/4/3 retract cable, now under the 4th section, towards front of boom.
- 14) Position 4th-5th section in front of 3rd section, ready for assembly. Route 5/4/3 retract cables to allow easy cable movement as the sections slide together.
- 15) Slide 4th-5th section into 3rd boom section approximately 36 inches (90cm) keep 4th-5th sections suspended to avoid damage to 5/4/3 retract cables.
- 16) Assemble bottom wear pads on 3rd section pad plate, raise 4th-5th section high enough in 3rd to allow plate with pads to slide between the sections, place retract cables in the grooves in the bottom pad plate, as boom sections are slid together, retract cables will pull through these grooves, use appropriate hardware and fasten pad plate to the bottom plate of the 3rd section.
- 17) Install a nut on the threaded ends of the 5/4/3 retract cables, to keep the cable ends from pulling through the anchor as the sections are pushed together.

- 18) Push the 4th-5th section inside the 3rd section, until it is within 36 inches (90cm) of full insertion.
- 19) Install side wear pads with appropriate shims on front inside of the 3rd section boom. Install upper spacer bar and cable guide with wear pad and related hardware on the top to the 3rd section. Shim according to calibration instructions, or as pads were originally removed and tagged.
- 20) Slide 4th-5th section inside 3rd until the end of the 4th section hits against the doubler bars in the 3rd section. Use caution as the 5/4/3 retract cable threaded end gets close to the grooves in the lower front pad plate, adjust as necessary to allow proper placement. A scribe mark on the 4th section at full retraction will aid in cable tensioning for proper boom sequence later.
- 21) Assemble top rear wear pads with the cam plates to the top of the 4th section. See step #11 for pad installation detail.
- 22) Uncoil 4/3/2 retract cables out of the 5th section, assemble 3rd section retract sheaves and pins into the inside of the 3rd section rear, using proper hardware and Loctite 242, reeve cable over sheave installing upper keeper capscrew and lower rear pad, this pad serves as a cable keeper, lower pad and side pad for the rear of the section.
- 23) Pull threaded end of 4/3/2 retract cables, now under the 3rd section, toward front of boom.
- 24) Assembly step #22 completes the 5/4/3 boom section stage, at this point the hydraulic extension cylinder and related cables and components are inserted into the 3rd-4th-5th section assembly starting with step #24.
- 25) Support extension cylinder in a workable location and install the 3 extend sheaves in the sheave case end of the cylinder, orientate the pin so that the bearing grease holes are on the unloaded side of the pin (towards cylinder butt plate).
- 26) Install 3 - 2/3/4 extend cables over sheaves by placing button end through opening between the sheave and the front double tapered plate on the cylinder. After the cables are in place, install the plastic tapered cylinder pads on the top bottom shelves of the cylinder sheavecase, these pads when secured in place act as cable retainers as well as wear pads, again apply Loctite and jam nuts in these locations.
- 27) Pull the 3 button ends through the extend cylinder sheavecase until there is enough slack to install the 2/3/4 extend cable anchor, install cable anchor on extend cables, keep capscrews clamping on the two halves of the anchor together just tight enough to not let the cables escape from their positions, this will allow easier assembly into the 4th section anchor point.
- 28) Drape 2/3/4 extend cables that come off top of the sheaves in an area to avoid damage, preferably on the top of the top of the extend cylinder, this will put them in their approximate location as the cylinder is installed into the 5th/4th/3rd boom assembly.
- 29) Slide extend cylinder into the 3rd-4th-5th boom assembly approximately 36 inches (90cm). Raise cylinder up at an angle slightly to allow easier access to the 2/3/4 extend cable anchor in the rear of the 4th section. Install 2/3/4 extend cable anchor and cable ends into the anchor point. Install keeper plates over the retract cable ends these keepers are shaped to retain the 2/3/4 anchor as well as the retract cable ends. Tighten capscrews holding the two halves of the 2/3/4 anchor assembly together.

- 30) Lower extend cylinder to a position parallel with the 3rd/4th/5th boom assembly and slowly push the cylinder into the 3rd/4th/5th boom assembly until the cylinder collar makes contact with the 3rd section rear vertical doubler plates. Monitor 2/3/4 extend cable location as cylinder slides into boom sections to avoid damaging cables.
- 31) Raise extend cylinder up to allow cylinder collar to slide through and align with the anchor pocket on the back of the 3rd, lower cylinder, collar will move down into cylinder anchor pocket, if properly positioned over pocket. Assemble lock bar and proper hardware to the cylinder collar, this will retain the cylinder into the anchor pocket.
- 32) Attach button end of 1/2/3 small extend cables into anchor point on the rear top plate of the 3rd section, a thin plate on the bottom and a thicker anchor plate on the top of the 3rd section top are required for proper cable retention, assemble with proper hardware and Loctite 242.
- 33) Lay 1/2/3 extend cables on the top of the 3rd section with the proper sheaves and pins that eventually will attach to the top plate of the 2nd section. Arrange cables per illustration (see figure 1).
- 34) The 3rd/4th/5th and cylinder assembly is now ready to assemble into the 2nd section boom.
- 35) Slide 3rd/4th/5th and cylinder assembly is now ready to assemble into the 2nd section boom approximately 36 inches (90cm) keep the 3rd/4th/5th and cylinder assembly suspended to avoid damage to the 4/3/2 retract cables.

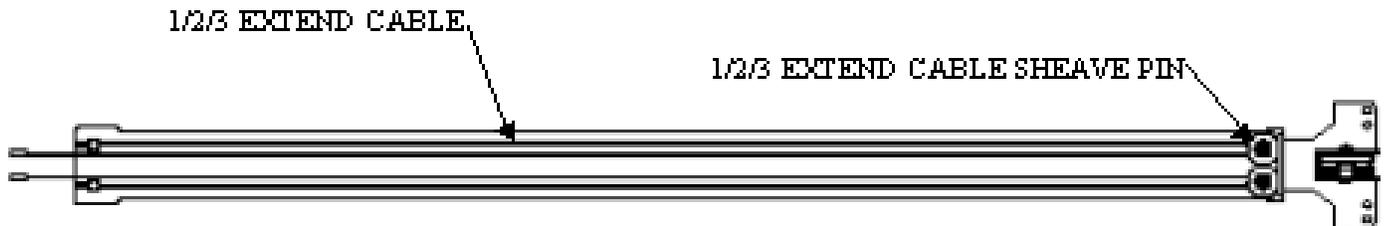
TOP VIEW OF 3RD SECTION

FIGURE 1

- 36) Assemble bottom wear pads on 2nd section pad plate, raise 3rd/4th/5th and cylinder assembly high enough in the 2nd to allow pad plate with pads to slide between the sections, place retract cables in the grooves in the bottom pad plate, as the boom sections are slid together, retract cables will pull through these grooves, use appropriate hardware and fasten the pad plate to the bottom of the 2nd section.
- 37) Install nuts on the threaded ends of the 4/3/2 retract cables, to keep the cable ends from pulling through the anchor as the sections are pushed together.
- 38) Push the 3rd/4th/5th and cylinder assembly inside the 2nd section, until it is within 36 inches (90cm) of full insertion.
- 39) Install side wear pads with appropriate shims on the front inside of the 2nd section, shim according to calibration instructions, or as pads were originally removed and tagged. Assemble 1/2/3 extend cable sheaves and pins with the appropriate hardware to the 2nd section top plate, assemble cable keeper/spacer bar plates to 2nd section, install cable guide and wear pad to the top of the 2nd section.
- 40) Slide the 3rd/4th/5th and cylinder assembly into the 2nd section until the extend cylinder collar bottoms out in its anchor pocket in the rear of the 2nd section or the 3rd section side plates bottom out on the doubler plates on the rear of the 2nd section. Use caution as the 4/3/2 retract cable threaded ends get close to the grooves in the lower front pad plate, adjust as necessary to allow proper placement.
- 41) Cylinder length adjustment may be necessary to properly position cylinder collar in the anchor pocket with the 3rd section side plates bottoming out on the doublers in the rear of the 2nd. A hydraulic power source may have to be utilized to adjust the cylinder length. Install appropriate hardware fastening the extend cylinder collar to the cylinder mounting channels in the rear of the 2nd section boom. A scribe mark on the 3rd section at full retraction will aid in cable tensioning for proper boom sequence later.
- 42) Assemble top rear wear pads with the cam plates to the top of the 3rd section. See step #11 for pad installation detail.
- 43) Assemble 3/2/1 retract cable button ends into anchor points in the rear of the 3rd section. Install keeper plates and capscrews. Assemble with Loctite 242.
- 44) Assemble 2nd section retract sheaves and pins into the inside of the 2nd section using proper hardware and Loctite 242, reeve 3/2/1 retract cables, anchored to 3rd, over sheaves attached to 2nd section and install upper keeper capscrew and lower rear pad, this pad serves as a cable keeper, lower pad and side pad for the rear of the section.
- 45) Pull threaded ends of 3/2/1 retract cables, now under the 2nd section, towards the front of the boom.
- 46) Suspend assembled boom sections, position of extend cylinder butt plate is holding valve down, rotate rod assembly to achieve proper orientation, place retract cables to avoid damage, and slide assembled boom sections into the 1st section approximately 36 inches (90cm). Keep boom assembly suspended to avoid damage to the retract cable.
- 47) Assemble bottom wear pads on the 2nd section pad plate, raise the 2nd/3rd/4th/5th and cylinder assembly high enough in 1st to allow plate with pads to slide between the sections, place retract cables in the grooves in

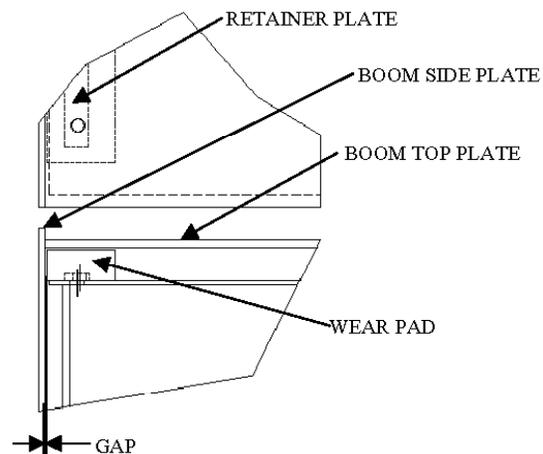
the bottom pad plate, as the boom sections are slid together, retract cables will pull through these grooves, use appropriate hardware and fasten pad plate to the bottom plate of the 1st section.

- 48) Install nuts on the threaded ends of the 3/2/1 retract cables, to keep the cable ends from pulling through the anchor as the sections are pushed together.
- 49) Push the 2nd/3rd/4th/5th and cylinder assembly inside the 1st section, until it is within 36 inches (90cm) of full insertion.
- 50) Install the side wear pads with the appropriate shims on the front inside of the 1st section. Install upper spacer bar with appropriate hardware to the inside top of the 1st. Shim according to calibration instructions, or as pads were originally removed and tagged.
- 51) Slide the 2nd/3rd/4th/5th and cylinder assembly into the 1st section until the extend cylinder butt plate contacts the back plate of the winch mount. Use caution as the holding valve nears the winch mount back plate, the holding valve nears the winch mount back plate, the holding valve to back plate clearance requires the butt plate to be level, with the holding valve down. Use caution as the 3/2/1 retract cable threaded ends get close to the grooves in the lower front pad plate, adjust as necessary to allow proper placement.
- 52) Install proper hardware retaining extend cylinder butt plate to the 1st section winch mount.
- 53) Assemble top rear wear pads with the cam plates to the top of the 2nd section. See step #11 for pad installation detail.
- 54) Install cable guides, angle pendulum, winch and anti-two block system, see anti-two block system description and installation instructions.

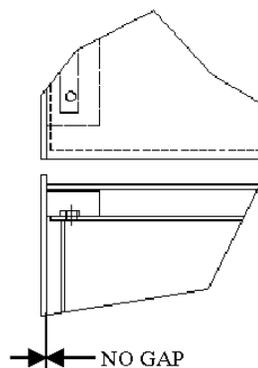
2.12.8 TOP WEAR PAD ADJUSTMENT

- 1) With the boom fully retracted, located the inner boom section horizontally in the outer boom section its riding in, a pry bar used to manipulate the side to side position of the section can be used. It is often difficult to pry the verymost inner sections over.
- 2) Extended boom straightness is critical in proper boom operation. The extended boom straightness required is a deviation of .50 inch (13mm) or less from the theoretical centerline of the boom. A stringline from the center of the winch to the middle of the sheavecase on the last section will provide a theoretical centerline. The top rear pads should be adjusted accordingly to provide proper clearances to achieve a straight extended boom.
- 3) Assemble the top/rear wear pads and plates. The top/rear wear pads on this boom are adjustable to account for lateral tolerances that occur during the manufacturing process of the boom sections.
- 4) The wear pad on each side at the top/rear of the boom can be adjusted over a range of 3/16 inch (4.8mm) by rotating, end for end, the wear pad and plate or the wear pads and plate independently. This is possible because the holes in these parts are offset from the center. The holes are .06 inch (1.6mm) off center in the plate and .03 inch (.8mm) off center in the wear pad. Various combinations of rotation of these parts allow the adjustment.
- 5) Once the boom is located, the wear pad and plate combinations can be inserted into the space between the boom sections and aligned over the holes in the sections. If the holes in the plate are not centered over the holes in the sections, the wear pads

and plates have to be removed and adjusted either towards or away from the side plate of the next larger section until the holes will align. When properly aligned the wear pad should be tight against the side plate of the out boom section and the extended boom should be straight to previously mentioned specifications.



Needs adjustment. The capscrews can not be installed and there is a gap between the wear pad and side plate of the larger boom section



Properly aligned and adjusted wear pad. The holes in the retainer plate are concentric with the threaded holes in the smaller boom section and the wear pad is tight against the side plate of the larger boom section. When wear pads are properly aligned and adjusted, install capscrew and torque to 75 ft-lb (100N.m)

FOUR AND FIVE SECTION
TOP/BOTTOM PAD
REPLACEMENT – ASSEMBLED
BOOM

Inspect top and bottom wear pads periodically for signs of abrasion or excessive wear. Excessive is defined as 3/16 of an inch (4.8mm) from the original pad thickness, top rear pad thickness .75 inch (19mm), bottom front 1st section 1 inch (25mm), bottom front 2nd and 3rd section .44 inch (13mm). Uneven pad wear of 3/32 inch (2mm) from side to side on the wear pad would be considered excessive as well. If any of these conditions exist, the top and bottom pads can be replaced without complete disassembly of the boom.

2.12.9 TOP PAD REPLACEMENT

Pad maintenance on the four or five section can be made easier by removal of the winch. Additional clearance can be achieved on the four section by loosening the large extend cables and removing the extend cable anchor located in the 2nd section.

- 1) Retract boom completely.
- 2) Remove capscrews through access holes on top rear of sections.
- 3) Remove wear pads, shims and cam plates from the rear of the boom through open winch mount end.
- 4) Note all pad locations and tags accordingly.
- 5) Inspect pads for wear using previously mentioned inspection criteria.
- 6) Install new pads through winch mount end of boom. See top pad

adjustment procedure for proper pad and section position.

- 7) Torque retainer capscrews to 75 lb-ft (100 N.m). Failure to properly torque capscrews will cause loss of preload, allowing pad cam to rotate and cause excessive side clearance between sections.

2.12.10 FRONT BOTTOM PAD REPLACEMENT

- 1) Extend boom approximately 4 feet (120cm) out.
- 2) Remove cable guides and upper spacer bars from front of boom sections.
- 3) Loosen and remove hex nuts on retract cables on the front of the 1st and 2nd sections.
- 4) Using an appropriate lifting device, sling around the 4th and 5th depending on configuration section boom and lift it up until weight is removed from the bottom pads in the front of the interior sections.
- 5) Loosen and remove the capscrews holding the pad doubler plates in the front of the sections. Remove plates. Remove pads from these plates. Note all pad locations and tag accordingly.
- 6) Inspect pads for wear using previously mentioned inspection criteria.
- 7) Install new pads on plates or boom sections. Reassemble plates in boom in proper locations.

2.13 TROUBLESHOOTING**1) BOOM EXTENDS DURING TRANSPORTATION:**

Check for oil leaks. Clean or replace holding valve and check setting. Rebuild cylinder and replace seals.

2) BOOM CREEPS BACK AFTER BEING EXTENDED:

As hydraulic oil cools it is normal for it to retract in the telescope cylinder and let the boom creep in slightly. If the creep continues, check for leaks first. Then clean and/or replace the holding valve and check the setting. Finally, remove the telescope cylinder and rebuild it replacing the seals.

3) BOOM TELE OUT, WINCH UP AND BOOM DOWN ARE NOT WORKING:

If these are the only functions not working, check to see if the boom head is two blocked. Next check the load per the Capacity Chart to make sure it is not an overload. Then refer to the LML and Anti-Two Block operator's manual for trouble shooting this system. Also check the wiring from the system to the solenoid valves and the operation of the valves to make sure they are not jammed.

4) BOOM DEFLECTS EXCESSIVELY-UP/DOWN OR SIDE TO SIDE-WHEN PICKING LOAD:

Wear pads are not shimmed properly. Re-shim wear pads per section in manual.

5) BOOM OPERATING SLOWLY OR NOT PICKING LOAD:

Check for leaks and damaged hose. Check relief valve settings. Reset as required. Check flow from pump. Replace as required.

6) BOOM CHATTERS WHEN EXTENDING OR RETRACTING:

Lubricate the boom sections and sheaves per the lubrication directions. Check wear pads for proper adjustment and wear.

7) BOOM DOES NOT SEQUENCE PROPERLY:

Adjust the Extend/Retract boom cables per the manual.

8) WINCH LIFTS LOAD, BUT HAS NO CONTROL ON LOWERING OR HOLDING THE LOAD:**Excessive back pressure on the brake causing it to partially release:**

Back pressure must not exceed 150 PSI. Check the pressure on the return line and remove any restrictions if pressure is too high.

Brake return springs broken or brake discs worn or damaged: Disassemble the brake and replace worn parts in brake.

Clutch slipping: Improper oil can cause the clutch to slip. Drain the winch and refill with oil per the vendor's specifications. Also, the clutch may be damaged or worn. Disassemble the winch and replace faulty parts.

9) WINCH WILL NOT RAISE LOAD:

Check Capacity Chart to make sure load is not an overload. Check LML/Anti-two block system to make sure it is functioning properly and not locking out the system. Check system pressure relief and reset as required. Check pump flow and repair/replace pump as required.

10) WINCH WILL NOT LOWER LOAD OR LOWERS ERRATICALLY:

The winch brake should fully release between 340-400 PSI. Clean and replace the hose as required.

Disassemble the winch and replace faulty parts as required.

11) SWING INOPERATIVE OR ERRATIC:

- Swing park brake should fully release at 400 PSI. Replace hose and rebuild as required. Erratic behavior may be caused by improper backlash between the gears.

- Check for loose swing drive gear box and readjust the backlash as required.
- Check for worn or damaged teeth on the gears or wear in slew ring bearings. Rebuild swing box and replace slew bearing as required.

12) SWING BRAKE DOES NOT HOLD:

Brake return springs probably broken or brake discs worn or damaged.

Disassemble the brake and replace faulty parts.

13) OUTRIGGER/STABILIZER BEAM WILL NOT EXTEND OR MAKES EXCESSIVE NOISE WHEN EXTENDING:

- On outriggers-first grease pads.
- check for worn pads allowing mounting bolts to bind.
- Check system relief pressure.
- Check cylinder for leaks and worn seals.
- Check pump for flow.

14) OUTRIGGER/STABILIZER CREEPS IN UNDER LOAD:

Clean holding valve and check relief setting. Replace as required.

15) OIL CONTAMINATION PROBLEMS:

- Water in oil (milky)
- Filter plugged (dirty)
- Metal particles (mechanical failure)
- Oil discolored or has burned odor (overheating)
- Oil foaming due to low oil, water in oil, air leak in suction, kinked hose or worn pump shaft seal

16) PUMPING PROBLEMS:

- Suction line plugged-clean and check.
- Ball valve closed-open valve
- Air leak in pump suction-replace suction line
- Dirt in pump-flush system & rebuild pump
- Worn pump-repair or replace
- Relief valves not properly adjusted-check and adjust valves

- Dirty or collapsing hoses-replace
- Worn cylinders or motors-rebuild/replace.

17) SYSTEM OPERATES SLOWLY OR ERRATICALLY:

- Air in system-check suction line for leaks and oil level in tank
- Cold oil-run system and make sure oil is warm.
- Pump damaged-repair
- Dirt in relief valve-clean/replace
- Restriction in suction line-clean and replace
- Ball valve closed-open valve
- Oil viscosity too high-replace with proper oil
- Low oil supply
- Valve plugged-clean valve orifices
- Oil leak-tighten fitting/replace hoses as required

18) PUMP MAKES NOISE:

- Low oil
- Oil viscosity too high
- Pump speed too fast
- Suction plugged
- Ball valve closed
- Dirt in pump
- Tank breather plugged
- Air in oil
- Worn pump bearings
- Broken Pump parts

19) OIL OVERHEATING:

- Operator holds control lever in position too long-oil dumps over relief valve generating excess heat
- Using incorrect oil
- Low oil
- Dirty oil
- Engine running too fast
- Incorrect relief valve settings
- Internal oil leakage in valves, cylinders, motors
- Restriction in pump suction line
- Ball valve closed
- Control valve stuck partially open
- Heat not radiating properly from hydraulic tank, oil lines and cooler
- Excessive operation of winch

COMPONENT SERVICE MANUALS

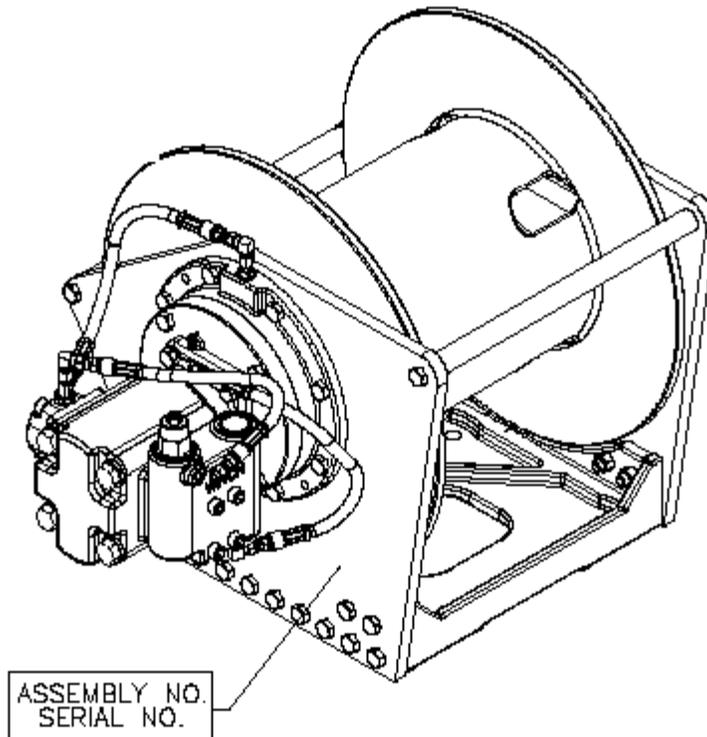
4.1 Winch Service Manual – Tulsa 1500W



Model 1500W Service Manual

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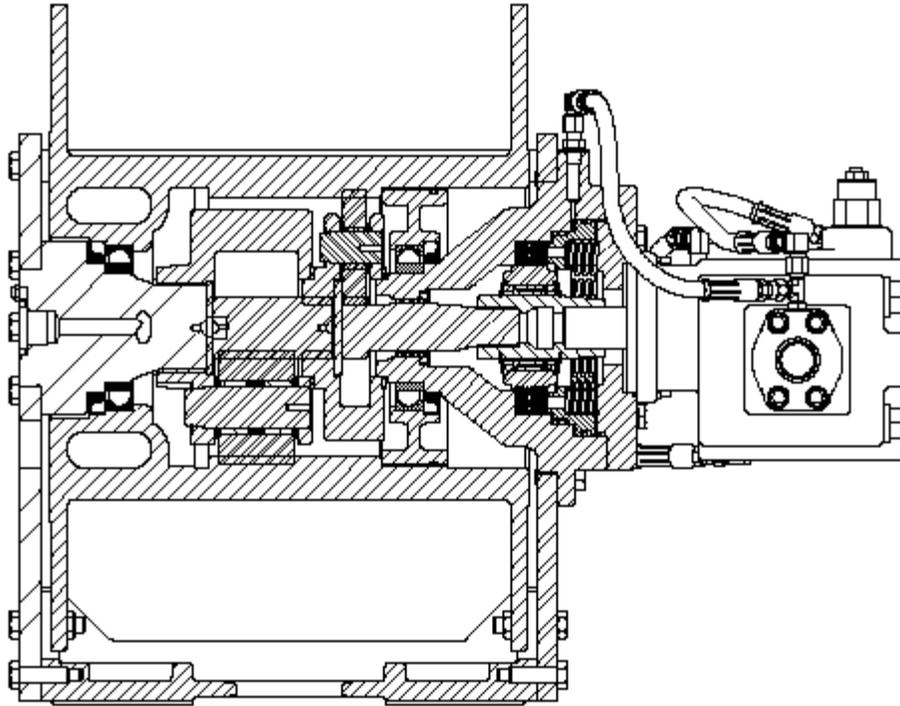


WARNING

**FAILURE TO HEED THE FOLLOWING WARNINGS MAY
RESULT IN SERIOUS INJURY OR DEATH!**

- Operators must be trained in the proper, safe operation of the hoist.
- Hoists are **not** to be used to lift, raise, or move people. If your task involves lifting or moving people, you **must** use the proper equipment, not this hoist.
- Cable anchors on hoists are not designed to hold the rated load of the hoist. You must keep at least five (5) wraps of cable on the drum to ensure that the cable doesn't come loose.
- Stay clear of suspended loads and of cable under tension. A broken cable or dropped load can cause serious injury or death.
- Avoid shock loads. This type of load imposes a strain on the hoist many times the actual weight of the load and can cause failure of the cable or the hoist.
- Make sure that all equipment, including the hoist and cable, are maintained properly.

INTRODUCTION AND THEORY OF OPERATION

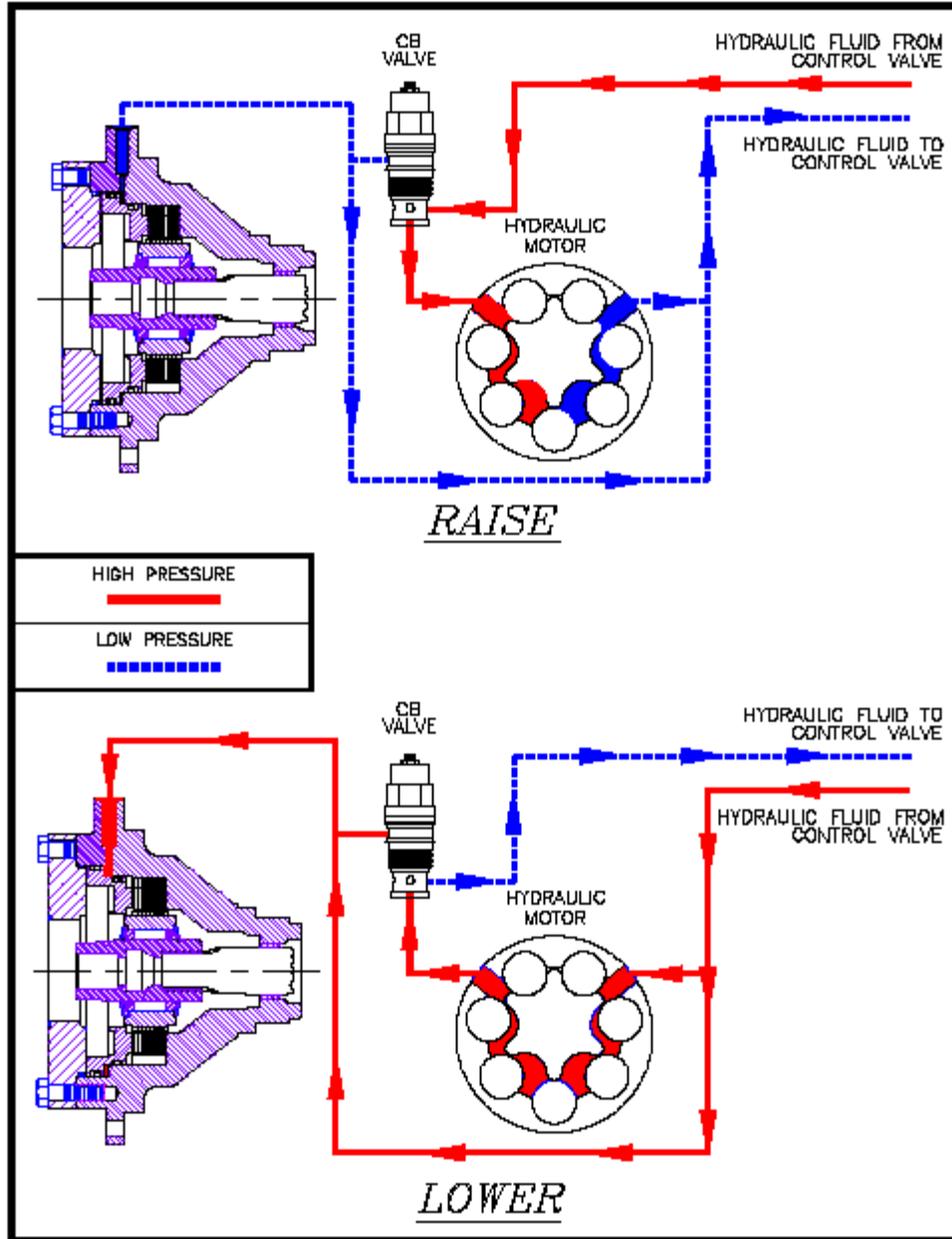


The planetary hoist is designed to utilize a geroler, gear, or piston motor, driving through a multiple-disc oil brake, through a pair of planetary gearsets to the cable drum.

The multiple-disc oil brake is spring applied and hydraulically released through a port in the brake housing. During inhaul, the brake is not released, since the load is driven through a one-way cam clutch, bypassing the brake. When the load comes to a stop, the cam clutch locks up and the brake prevents the load from moving.

During payout, a brake valve is used to prevent the load from moving faster than desired. This brake valve partially blocks the main line from the motor back to the directional control valve, allowing only a limited amount of hydraulic fluid through the motor. The brake valve is then modulated by sensing pressure on the other main line, the line from the directional control valve to the motor. Additionally, any time there is sufficient pressure (225 PSI \pm 10%) to modulate the brake valve; this same pressure releases the brake.

HYDRAULIC SCHEMATIC



MAINTENANCE AND SERVICE

For safe and consistent operation of TULSA WINCH hoists, swing drives, and winches, a regular program of preventive maintenance is strongly recommended. Regular oil changes with the correct oil for the ambient temperature conditions and an annual inspection of the wear components will help ensure a long life for your planetary geared products.

Maintenance Scheduling

The owner is to ensure proper inspection intervals, in compliance with the API RP 2D Section 4 requirements or the ANSI B30.5, 5-2.3, and will review hoist usage categories on a periodic basis. A Qualified Inspector should perform all maintenance and inspections.

- For hoists in occasional use, less than 10 hours per month, API RP 2D recommends a pre-use inspection and an annual 12-month inspection based on average use over a quarter.
- For hoists in moderate use, more than 10 but less than 50 hours per month, API RP 2D recommends a pre-use inspection, quarterly inspection, and an annual 12-month inspection based on average use over a quarter.
- For hoists in heavy use, more than 50 hours per month, API RP 2D recommends a pre-use inspection, monthly inspection, quarterly inspection, and an annual 12-month inspection.

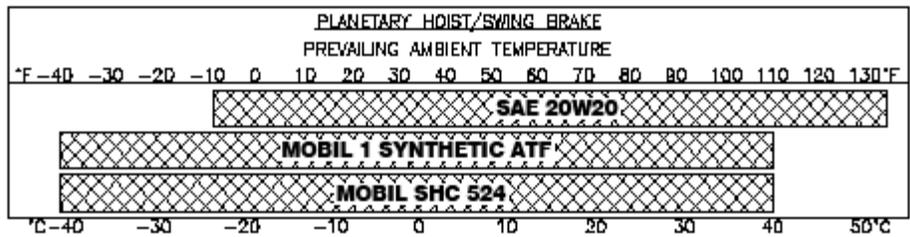
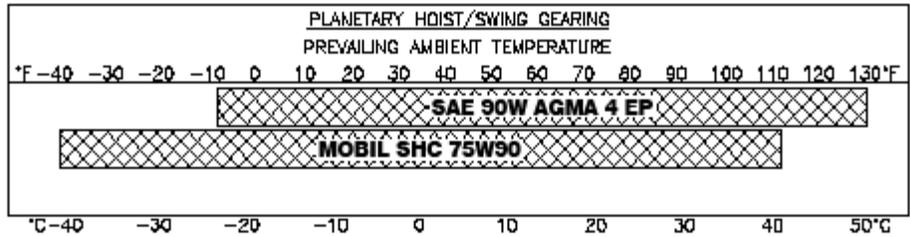
Oil Level Maintenance

Tulsa Winch recommends that the oil level in the gearbox and brake housing be checked and adjusted as part of the pre-use inspection. If the oil level drops frequently or oil leakage is detected during an inspection, maintenance should be performed to correct any problems.

Oil Change Interval

The oil in the gearbox and brake sections should be changed every **1000 hrs** or **6 months** of usage.

RECOMMENDED OIL



All oils must meet MIL-PRF2105E. Substitution from a reputable manufacturer is allowed as long as type and grade are maintained.

OIL CAPACITY	
GEARBOX	1.00 QT
BRAKE	.25 QTS

WARNING

Do not use EP type gear lubes in the brake section of this winch. EP lubes may prevent the clutch from locking up, which, in turn causes the load to fall, resulting in property damage, personal injury, or death.

The hydraulic system should use only high quality hydraulic fluid from reputable suppliers. These oils should contain additives to prevent foaming and oxidation in the system. All hoist hydraulic systems should be equipped with a return line filter capable of filtering 10 micron particles from the system.

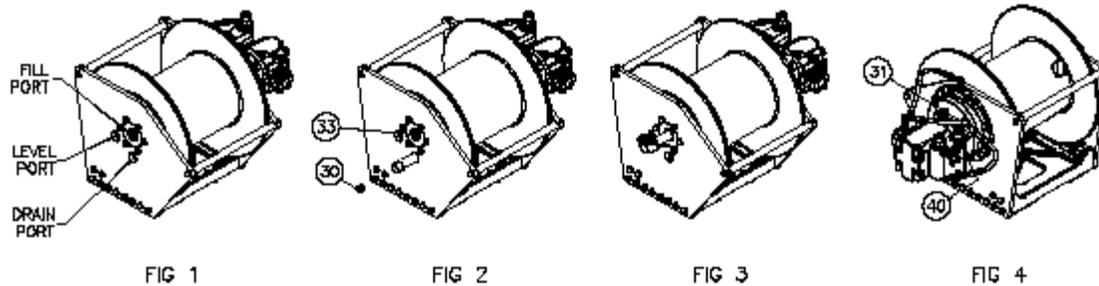
Hoists are shipped from the factory with SAE 90 Extreme Pressure (EP) gear lube in the gearbox and lightweight non-EP oil in the brake section. This oil and gear lube should be satisfactory for operation in ambient temperatures from -10° F (-23° C) to +130° F (+55° C).

OIL CHANGE

Gearbox oil is drained by first removing the drain plug (*Item 33*) by rotating the drum so that the plug is visible through the lower hole in the side plate (*Item 50*) (*See Fig 1*). Screw in a piece of 1" pipe to allow the oil to drain, and then with a hex wrench remove the drain plug located inside of the 1" pipe (*See Fig. 2*). Examine the used oil for signs of significant metal deposits and then dispose of it in a proper manner. Remove the 1" pipe.

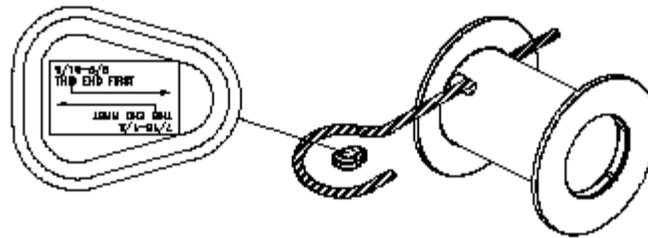
Rotate the drum so that the port is visible through the upper hole in the side plate. With a hex wrench, remove the fill plug (*Item 33*) located in the center of the output shaft (*Item 32*). Install a 1" pipe with elbow through the hole in the output shaft. Fill the gearbox with 1.00 quart of EP-90 oil. Remove the pipe and elbow then replace the plugs (*Items 31 & 33*). *See the Oil Chart on page 6 of this manual for the recommended oil type and grade for your application.*

Drain the brake section by removing the drain plug (*Item 40*) under the motor along with the vent (*Item 30*) above the motor (*See Fig. 4*). Inspect the oil for signs of metallic particles and/or burning and reinstall the drain plug. Fill with $\frac{1}{4}$ quart of non-EP oil and reinstall the vent (*Item 30*). *See Oil Chart Pg. 6 this manual for recommended oil type and grade for your application.*



WIRE ROPE

Wire rope should be installed as shown in the drawing below. Note that the wedge will satisfy cable diameters from 7/16" to 5/8", depending on how it is installed in the cable drum.



7

DISASSEMBLY

1. Drain the oil from the gearbox and brake sections using the instructions on page 7.
2. Stand the hoist on its end with the motor pointing up.
3. Disconnect the tubing or hose connected to the brake housing (*Item 21*). Remove the motor and counterbalance valve assembly from the hoist by removing the capscrews (*Item 51*) and washers (*Item 52*). See Service The Motor section on page 10 for motor and counterbalance valve disassembly.
4. Remove the brake subassembly from the hoist by removing eight capscrews (*Item 9*) holding the brake housing to the side plate (*Item 1*). Reinstall two of these capscrews into the two extra tapped holes and tighten them evenly until the brake housing comes loose from the side plate. See Service The Brake section on page 11 for brake repair.
5. Remove the side plate (*Item 1*) by removing twelve capscrews (*Item 2 & 60*) and two nuts (*Item 61*).
6. Lift the bearing carrier (*Item 26*) out of the drum (*Item 5*). Inspect the bearing (*Item 28*) for signs of pitting or spalling and if necessary, replace the bearing and seal (*Item 7-5*).
7. Remove the thrust washer (*Item 6*) and input sun gear (*Item 8*) from the input planet gearset (*Item 36*). Inspect for damage and replace if needed.
8. Remove the input planet gearset (*Item 36*) from the drum. Inspect the gearset for wear and repair as needed. See Service The Planetary Set section on page 13 for disassembly and repair.
9. Remove the thrust washer (*Item 6*) and output sun gear (*Item 16*). Inspect for damage and replace if needed.
10. Remove the output planet gearset (*Item 4*) from the cable drum. Inspect the gearset for wear and repair as needed. See Service The Planetary Set section on page 13 for disassembly and repair.
11. Remove the drum (*Item 5*) by lifting straight up and off of the output shaft (*Item 32*). Inspect the gear teeth for excessive wear and replace if necessary. Inspect the bearing (*Item 28*) for signs of spalling or pitting and, if necessary, replace the bearing and seal (*Item 7-5*).
12. Inspect the retaining ring (*Item 3*) on the output shaft to ensure that it is still in the groove and is not bent, and replace if necessary.
13. Inspect the shaft (*Item 32*) for wear or damage and, if necessary, remove it from the side plate (*Item 50*) by removing six capscrews (*Item 9*).

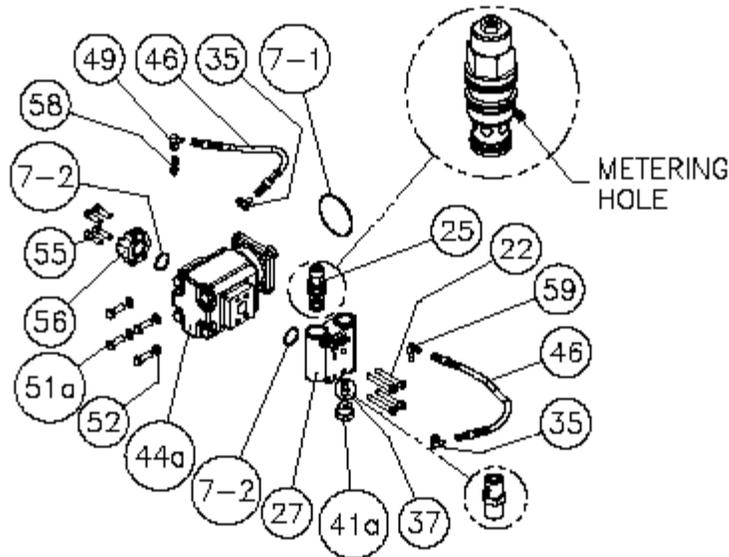
ASSEMBLY

1. Thoroughly clean all parts. Replace those that show wear or damage.
2. Inspect the drum (*Item 5*) for structural integrity and the gear teeth for excessive wear, then replace if necessary.
3. Attach the output shaft (*Item 32*) to the side plate (*Item 50*) with six capscrews (*Item 9*), making sure the vent (*Item 30*) is oriented properly, then torque them to specification (see *Torque Specifications Chart on page 15 of this manual*).
4. Install the retaining ring (*Item 3*) onto the shaft (*Item 32*).
5. Attach the base (*Item 12*) and rods (*Item 43*) to the side plate (*Item 50*) with twelve capscrews (*Items 2 & 60*) and two nuts (*Item 61*). Torque to specification (see *Torque Specifications Chart on page 15 of this manual*).
6. If necessary, install a new bearing (*Item 28*) and oil seal (*Item 7-5*) into the drum.
7. Lay the unit down so that the rods (*Item 43*) and base (*Item 12*) are pointing up. Set the drum (*Item 5*) onto the shaft (*Item 32*) being careful not to damage the seal (*Item 7-5*), seating the drum on the bearing (*Item 28*).
8. Install the output planet gearset (*Item 4*) into the drum (*Item 5*), making sure it's installed correctly onto the output shaft (*Item 32*).
9. Put a light coating of grease on the thrust washer (*Item 6*) to keep it in place. Install the thrust washer into the output gearset (*Item 4*), and then insert the output sun gear (*Item 16*). The slot in the sun gear must be installed facing the output shaft.
10. Install the input planet gearset (*Item 36*) into the drum (*Item 5*), making sure it's installed correctly onto the output sun gear (*Item 16*).
11. Put a light coating of grease on the thrust washer (*Item 6*) to keep it in place. Install the thrust washer into the input gearset (*Item 36*), and then insert the input sun gear (*Item 8*).
12. Install a new o-ring (*Item 7-10*) and, if necessary, a new bearing (*Item 28*) and seal (*Item 7-5*) into the bearing carrier (*Item 26*). Grease the o-ring and seal and install the bearing carrier into the drum.
13. Position the side plate (*Item 1*) on top of the base (*Item 12*) and rods (*Item 43*). Attach the side plate with twelve capscrews (*Items 2 & 60*) and two nuts (*Item 61*). Torque to specification (see *Torque Specifications Chart on page 15 of this manual*).
14. Install the brake subassembly into the side plate (*Item 1*), making sure that the pilot of the brake housing aligns with the bearing (*Item 28*) and seal (*Item 7-5*) in the bearing carrier (*Item 26*) and that the holes for the motor are in the correct orientation. Also, make sure that the level and vent plugs in the cover are properly oriented. Install eight capscrews (*Item 9*) and torque them to specification (see *Torque Specifications Chart on page 15 of this manual*).

15. Install a new o-ring (*Item 7-1*) on the face of the motor and re-install the motor/counterbalance valve assembly. Install the capscrews (*Item 51*) and washers (*Item 52*) and torque them to specification (see *Torque Specifications Chart* on page 15 of this manual).
16. Reconnect the tubing or hose to the brake housing (*Item 21*).
17. Fill both the gearbox and the brake section with the proper amount and type of lubricants as instructed in the *Recommended Oil* section on page 6 of this manual.

SERVICING THE MOTOR

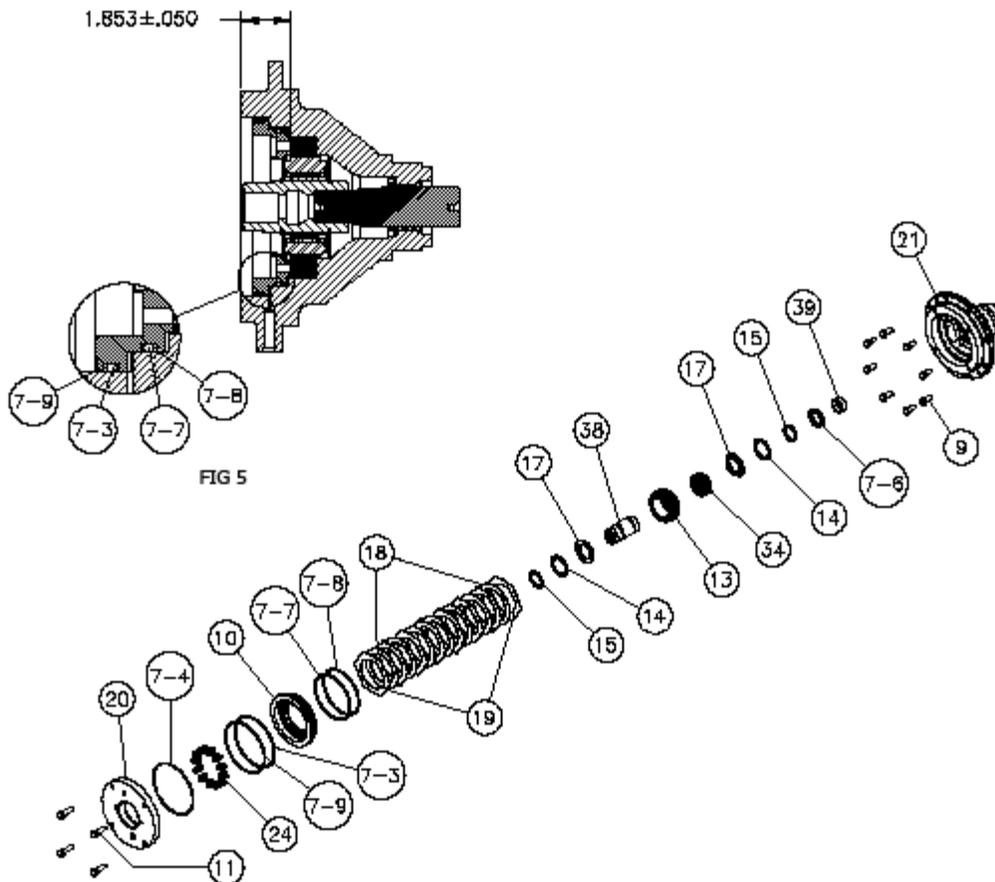
1. Tag tubing or hoses for proper re-installation and remove them from the motor assembly.
2. Remove the counterbalance block (*Item 27*) from the motor.
3. Remove the counterbalance valve (*Item 25*) from the block and inspect the small metering hole located on the side of the valve to make sure it is not obstructed. Also, inspect the o-rings (*Item 7-2*) for damage and replace if necessary.
4. Remove the fitting (*Item 41*) and inspect the check valve (*Item 37*) to make sure it is working properly. The check valve should be installed as shown, with the arrow facing into the block.
5. Motors and counterbalance valves are not serviceable in the field. Return them to an authorized dealer for service.



SERVICING THE BRAKE

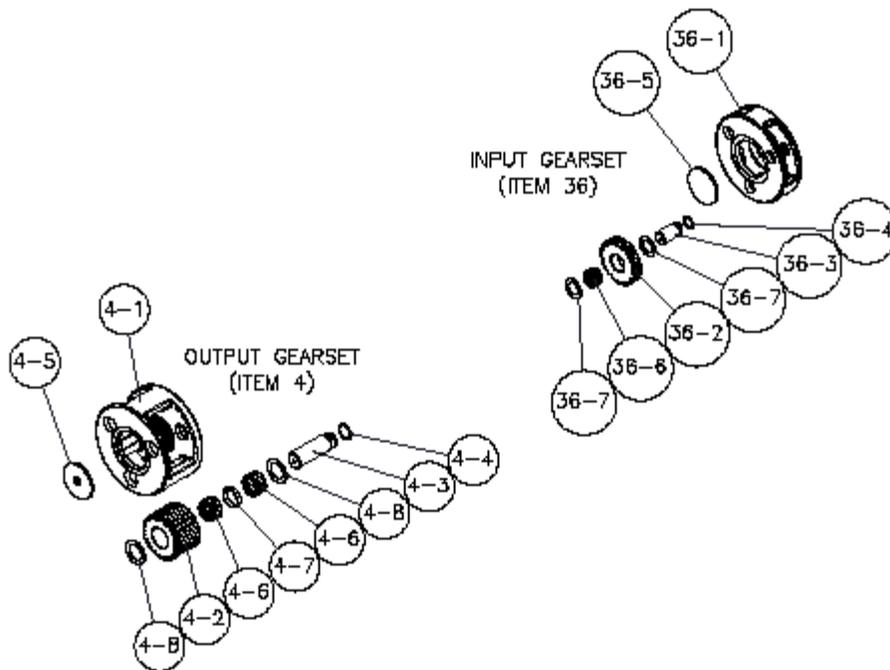
1. Evenly remove the four capscrews (*Item 11*) holding the brake cover (*Item 20*) in place. Spring pressure will raise the cover as the capscrews are loosened. Remove the cover from the brake housing.
2. Remove the springs (*Item 24*) from the piston and check the free height. Each spring should measure at least 1.200 inches with no force on them.
3. Remove the brake piston (*Item 10*) by installing two pieces of 3/8"-16NC all-thread in the bottom of two spring pockets. Using jam nuts, screw the all-thread pieces in evenly until the piston is clear of the housing. An alternate way of removing the piston is to use a portable power unit or shop air to slowly pressurize the brake cavity until the piston is out of the bore.
4. Remove the brake driver/clutch assembly (*Items 13, 14, 15, 17, 34, and 38*) from the brake housing (*Item 21*).
5. Remove the stator plates (*Item 19*) and friction discs (*Item 18*) from the brake housing and check them for excessive wear, then replace if necessary. Additionally, check the top stator plate for scoring caused by the removal tools and polish if necessary. Friction discs should measure no less than 0.055 inches thick and stator plates should measure no less than 0.064 inches thick.
6. If necessary, with a hook wire or pry bar, remove the seal (*Item 7-5*) from the brake housing.
7. Examine the bushing (*Item 39*) in the brake housing for wear and, if worn, replace it.
8. If the brake housing (*Item 21*) is removed from the hoist, examine the journal on the brake housing where the seal (*Item 7-5*) runs for wear. If severely worn, replace the brake housing.
9. Carefully disassemble the brake driver/clutch and note the side in which the markings on the clutch (*Item 34*) are facing. The clutch assembly must be re-assembled with the markings facing the proper direction in order for the hoist to function properly. Inspect the surface on the input and brake drivers (*Items 13 & 38*) where the clutch (*Item 34*) runs. If there is any pitting or spalling on the drivers then both it and the clutch must be replaced.
10. Re-assemble the driver/clutch assembly, making sure that the clutch is installed properly.
11. Install a new seal (*Item 7-6*) into the brake housing. If the brake housing is removed from the hoist, temporarily install the input sun gear (*Item 38*) into the brake housing and slide the driver/clutch assembly onto the sun gear spline.
12. Install the stator plates (*Item 19*) and friction discs (*Item 18*) into the brake housing starting with a stator and alternating friction discs and stator plates. There is one more stator plate than friction disc so you will finish with a stator plate.
13. After installation, check the brake stack-up to make sure that the dimensions are within the tolerance shown in Fig 5. If your measurement is greater than shown, either some friction discs and stator plates have been left out, or the friction discs are worn beyond acceptable tolerances. If your measurement is less than shown, too many plates or discs have been inserted or they are not seated properly.

14. Coat the new o-rings and backup rings (Items 7-3, 7-7, 7-8, & 7-9) with light oil and install onto the piston (Item 10). See Fig. 5 for proper o-ring/backup ring installation.
15. Carefully install the piston (Item 10) into the brake housing (Item 21) and gently tap it down until it is seated.
16. Install the springs (Item 24) into the spring pockets of the piston. If working in a horizontal position, coat the bottom of each spring with chassis lube to keep it in position.
17. Coat the new o-ring (Item 7-4) with light oil and install it into the groove on the brake cover (Item 20).
18. Install the cover (Item 20) onto the brake housing (Item 21) and draw it down evenly, alternating between opposite capscrews. Make sure that the cover is aligned properly with the brake housing in order to correctly orient the motor and vent/drain plugs.
19. Check the brake release with a portable hydraulic pump. Full release should be obtained at 225 PSI $\pm 10\%$.



SERVICING THE PLANETARY SETS

1. Remove the retaining rings from the planet pins.
2. Remove the pins from the carrier by carefully tapping them out.
3. Remove the planet gears, washers and bearings from the carrier.
4. Inspect the pins, bearings, and gear bores for evidence of wear and replace if necessary.
5. On output planet gearsets, note that two bearings with a spacer between them are used.
6. Before reassembly, be sure to insert the thrust plate into the carrier.
7. To reassemble, be careful to line up the planet pins with the thrust washers and bearings then press the knurled part of the pin into the carrier. If the pins are not lined up properly, the washers can be shattered during the pressing operation.
8. Replace the retaining rings onto the planet pins.



TROUBLESHOOTING

Hoist won't hold load

Possible Solutions:

1. There is excessive back pressure in the hydraulic system. Check the system for line restrictions and reduce the back pressure.
2. The brake discs are worn. Replace the brake discs. Friction discs should measure no less than 0.055 inches thick and the stator plates should measure at least 0.068 inches thick.
3. The brake clutch is slipping due to wear of either driver and/or clutch. Inspect the driver components for wear and replace if necessary.

Hoist unable to lift load

Possible Solutions:

1. The relief valve setting may be too low to allow proper lifting. Increase the relief pressure setting.
2. The load being lifted may be more than the winches rating. Verify weight and reduce the load or re-rig it to increase mechanical advantage.

Hoist unable to lower load

Possible Solutions:

1. The hoses or tubes have been installed incorrectly. Check hose routing and correct any errors (*see page 4 for hydraulic schematic*).
2. The counterbalance valve cartridge may have a plugged metering hole (*see page 10 for location of metering hole*). Remove the cartridge and clean it.

Oil leaks from motor-side vent

Possible Solutions:

1. The motor shaft seal may have failed. Replace the seal and reduce the back pressure if that was a cause of the seal failure.
2. The brake pistons o-ring seals may have failed. Service the brake section and replace any worn parts found.

TORQUE SPECIFICATIONS CHART

Nominal	Size	Dry	Plated	Lubricated	Dry	Plated	Lubricated
		SAE Grade 5 Torque *(Ft-Lbs)	SAE Grade 5 Torque *(Ft-Lbs)	SAE Grade 5 Torque *(Ft-Lbs)	SAE Grade 8 Torque *(Ft-Lbs)	SAE Grade 8 Torque *(Ft-Lbs)	SAE Grade 8 Torque *(Ft-Lbs)
1/4	20	8	6	5	12	9	7
1/4	28	10	7	6	14	10	8
5/16	18	17	13	10	25	18	15
5/16	24	19	14	11	27	20	16
3/8	16	31	23	19	44	33	26
3/8	24	35	26	21	49	37	30
7/16	14	49	37	30	70	53	42
7/16	20	55	41	33	78	58	47
1/2	13	76	57	45	106	80	64
1/2	20	85	64	51	120	90	72
9/16	12	109	82	65	153	115	92
9/16	18	122	91	73	172	129	103
5/8	11	150	113	90	212	159	127
5/8	18	170	128	102	240	180	144
3/4	10	266	200	160	376	282	226
3/4	16	297	223	178	420	315	252
7/8	9	430	322	258	606	454	364
7/8	14	474	355	284	668	501	401
1	8	644	483	386	909	682	545
1	14	721	541	433	1019	764	611
1-1/8	7	794	596	475	1288	966	772
1-1/8	12	890	668	534	1444	1083	866
1-1/4	7	1120	840	672	1817	1363	1090
1-1/4	12	1241	930	745	2012	1509	1207

T = BOLT TORQUE (LB. FT.)

T = (KWD) / 12

K = TORQUE COEFFICIENT (K = 0.20 DRY K = 0.15 PLATED K = 0.12 LUBRICATED)

W = PRELOAD TENSION

D = NOMINAL BOLT SIZE (IN.)

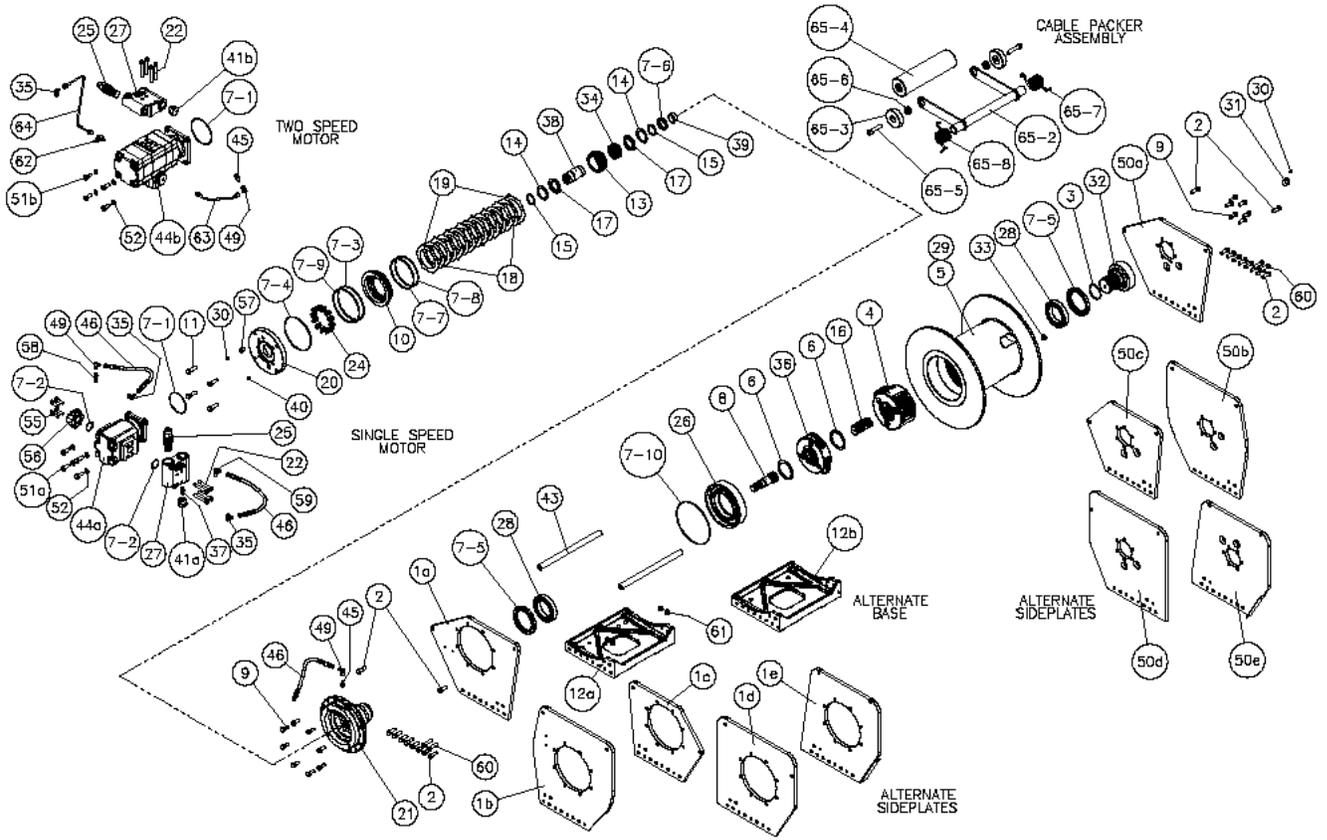
* ALL TORQUE VALUE TOLERANCES ARE ± 5%

BILL OF MATERIAL

SEQ	QTY	P/N	DESCRIPTION	NOTES
1a	1	42489	SIDE PLATE	BRAKE SIDE (SEE PICTORAL FOR IDENTIFICATION) CONTACT FACTORY IF SIDE PLATE ISN'T SHOWN
1b	1	42767	SIDE PLATE	
1c	1	42536	SIDE PLATE	
1d	1	43301	SIDE PLATE	
1e	1	4263	SIDE PLATE	
2	20	29792	CAPSCREW	
3	1	29973	RETAINING RING	
4	1	4370	OUTPUT GEARSET	
4-1	1	42248	CARRIER	
4-2	3	42244	PLANET GEAR	
4-3	3	41747	PLANET PIN	
4-4	3	41716	RETAINING RING	
4-5	1	44067	THRUST PLATE	
4-6	6	41717	BEARING	
4-7	3	41739	SPACER	
4-8	6	939249	WASHER	
5a	1	42251	DRUM	
5b	1	42260	DRUM	
5c	1	42455	DRUM	
6	2	41722	THRUST WASHER	
7a	1	4321	SEAL KIT	FOR SINGLE SPEED MOTOR
7b	1	4339	SEAL KIT	FOR 81525001 ASSEMBLY (NO MOTOR)
7c	1	4372	SEAL KIT	FOR TWO SPEED MOTOR
8	1	42250	INPUT SUN GEAR	
9	14	20524	CAPSCREW	
10	1	42942	BRAKE PISTON	
11	4	10381	CAPSCREW	
12a	1	42488	BASE	FOUR MOUNTING HOLES
12b	1	43023	BASE	TWO MOUNTING HOLES
13	1	43453	BRAKE DRIVER	
14	2	41723	RACE	
15	2	26980	RETAINING RING	
16	1	44066	OUTPUT SUN GEAR	
17	2	41743	BUSHING	
18	7	32765	FRICTION DISC	
19	8	42148	STATOR PLATE	
20a	1	42015	BRAKE COVER	SAE 4-BOLT "B" MOTOR MOUNT
20b	1	42456	BRAKE COVER	SAE 2-BOLT "C" MOTOR MOUNT
20c	1	43419	BRAKE COVER	SAE 4-BOLT "C" MOTOR MOUNT
21	1	43423	BRAKE HOUSING	
22	4	42263	CAPSCREW	
24	12	42230	BRAKE SPRING	
25	1	41867	COUNTERBALANCE VALVE	
26	1	42289	BEARING CARRIER	
27	1	42029	COUNTERBALANCE BLOCK	
28	2	34550	BEARING	
29	1	41756	CABLE THIMBLE	
30	2	13050	BREATHER	
31	1	41879	O-RING PLUG	
32	1	43424	SHAFT	
33	1	41719	O-RING PLUG	
34	1	41759	CLUTCH	
35	2	42089	90 DEGREE ADAPTER	
36	1	4185	INPUT GEARSET	
36-1	1	42528	CARRIER	
36-2	3	42245	PLANET GEAR	

SEQ	QTY	P/N	DESCRIPTION	NOTES
36-3	3	41760	PLANET PIN	
36-4	3	41715	RETAINING RING	
36-5	1	41769	THRUST PLATE	
36-6	3	30484	BEARING	
36-7	6	28771	WASHER	
37	1	42223	CHECK VALVE	
38	1	44852	INPUT DRIVER	
39	1	32445	BUSHING	
40	1	41307	O-RING PLUG	
41	1	42225	O-RING PLUG	
43	2	42134	SUPPORT ROD	
44a	1	42022	SINGLE SPEED MOTOR	
44b	1	43624	TWO SPEED MOTOR	
45	1	41838	STRAIGHT ADAPTER	
46	3	42030	HOSE ASSEMBLY	
49	2	41873	SWIVEL ADAPTER	
50a	1	44542	SIDE PLATE	OUTPUT SHAFT SIDE (SEE PICTORAL FOR IDENTIFICATION) CONTACT FACTORY IF SIDE PLATE ISN'T SHOWN
50b	1	44843	SIDE PLATE	
50c	1	44840	SIDE PLATE	
50d	1	44860	SIDE PLATE	
50e	1	4514	SIDE PLATE	
51	4	28060	CAPSCREW	
52	4	20518	LOCKWASHER	
55	4	40546	CAPSCREW	
56	1	42211	FLANGE	
57	1	12208	BUSHING	
58	1	42209	FITTING TEE	
59	1	42259	ELBOW	
60	4	20311	CAPSCREW	
61	4	20267	NUT	
62	1	42438	BRANCH TEE	
63	1	43400	TUBING	
64	1	42256	TUBING	
65	1	4183	CABLE PACKER	
65-1	2	42515	BEARING	
65-2	1	42485	PACKER ARM	
65-3	2	42418	ROLLER	
65-4	1	42421	ROLLER	
65-5	2	42517	CAPSCREW	
65-6	2	42516	BEARING	
65-7	1	42425	LEFT SPRING	
65-8	1	42533	RIGHT SPRING	

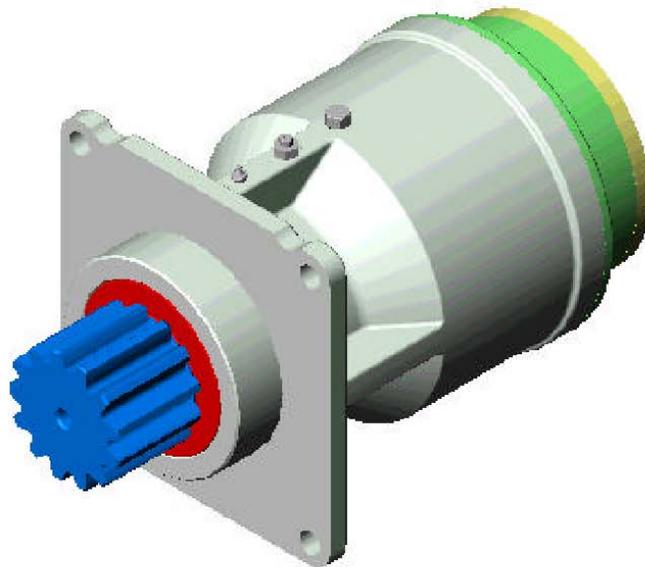
EXPLODED ISOMETRIC ASSEMBLY DRAWING



4.2 Swing Drive Service Manual – Tulsa 6036S



**5200 SERIES
6000 SERIES
SWING DRIVE
SERVICE MANUAL**



G:\SERVICE LITERATURE\52-60 SWING SERVICE LIT\Sel-0007.DOC
Rev-1

This manual will primarily assist in disassembly and assembly procedures of major components for all 52 & 60 series Swing Drives. Item numbers, indicated in parentheses throughout this manual, refer to the Tulsa Winch Model 52 and 60 series exploded assembly drawing located in the back of this manual.

LUBRICATION AND MAINTENANCE

Manufacturer recommends changing oil after first 50 hours of operation. Oil should be changed at 500-hour intervals thereafter. All gearboxes require GL-5 grade EP 80/90 gear oil for lubrication. Some units may be equipped with a grease fitting for lubrication of the output shaft bearings (pinion up applications). The shaft bearings should be greased sparingly at every 50 operating hours with a lithium or GP bearing lube. In pinion down applications, gearbox oil will lubricate Shaft bearings.

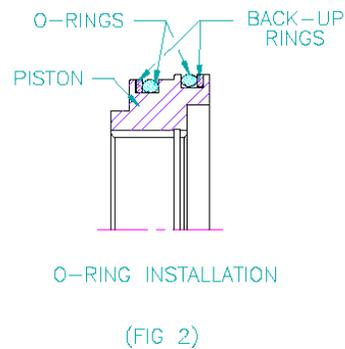
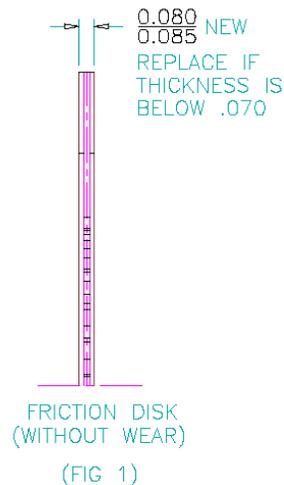
OIL CAPACITIES:

	52	60
Pinion up:	70 Ounces	128 Ounces
Pinion down:	88 Ounces	100 Ounces

DISASSEMBLY PROCEDURE FOR 52 & 60 SERIES SWING DRIVES

1. Remove drive from vehicle and drain gearbox lubricant by removing the drain plug (31).
2. Remove the motor from the motor adapter (30).
3. Remove the brake assembly from the gear housing assembly (7) by removing eight hexhead capscrews (18). NOTE: Notice the position of the brake port in conjunction with the drain and fill holes in the housing for reassembly.
4. Inspect the brake housing o-ring (14) for damage. Replace if necessary.
5. Separate the motor adapter (30) from the brake housing (15) by removing eight capscrews (32). NOTE: Notice the position of the motor mounting hole in relation to the brake release port for re-assembly. CAUTION: The motor adapter is spring-loaded and the capscrews should be loosened in a sequence that will allow an even load distribution on the motor adapter.
6. Inspect the motor adapter o-ring (29) for damage. Replace if necessary.
7. Remove the six springs (33), piston (25), and brake driver (27) from brake housing (15). NOTE: On 52 series swingdrives notice the position of the dowel-pin hole in piston with respect to the brake release port for re-assembly. NOTE: A port-a-power can be used to assist in the removal of piston by slowly pressurizing the brake release port until piston clears the top of housing (15). Remove stator plates (19) and friction discs (20) from the brake housing (15). Inspect stator plates for excessive grooving or burn spots. Also, inspect friction discs for wear. Replace as required. (Ref. Fig. 1)
8. Inspect the piston o-rings (22 & 23) and the back-up rings (21 & 24) for damage, replace if necessary. (Ref. Fig. 2)
9. If applicable remove 2nd piston (36) from the brake housing (15), inspect o-rings

- (37 & 38) and back-up rings (39 & 40) for damage, replace if necessary. (Ref. Fig. 2) On 52 series swingdrive inspect bearing (41) & seal (42) in brake housing (15) replace if necessary.
10. Remove race (12) from input planet set (13).
 11. Remove input planet set (13) from gear housing (7) by pulling straight up and out of the housing.
 12. Remove retaining ring (13.4), press out the planet pins (13.3), remove the planet gear (13.2), and needle bearings (13.5), inspect for unusual wear. Replace as required.
 13. Remove race (12) from output planet set (10).
 14. Remove the output sun gear (11), from the output planet carrier (10.). Lift the output planet set out of the housing (7).
 15. Remove the retaining ring (10.4). Press out the planet pins (10.3); remove the planet gear (10.2) and needle bearings (10.5). Inspect for unusual wear. Replace as required.
 16. Remove bearing lock nut (35) and lock washer (34).
 17. Remove the pinion shaft (1) from the housing (7) inspect the pinion shaft, seal, and bearing for wear and replace if necessary. Remove the inboard bearing (9) and inspect for wear.
 18. Remove outboard seal (2) and bearing (3) Inspect for wear and replace if necessary.



ASSEMBLY PROCEDURE

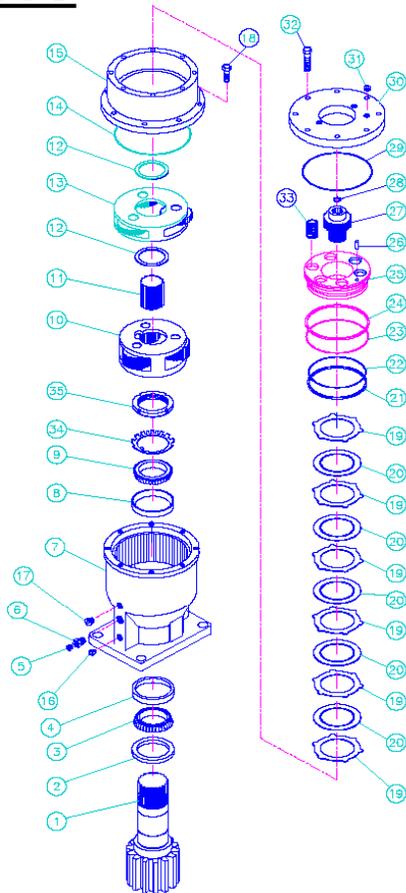
FOR 5200 & 6000 SERIES SWING DRIVES

1. Press the inboard and outboard bearing cup (4 & 8) into the gear housing (7) if replaced.
2. Grease pack the bearing cones (9 & 3) with EP-2 before installation.
3. Install the outboard cone (3) into the outboard cup (4). Press the seal (2) into the gear housing (7) from the outboard side.
4. Slide the output pinion (1) into the housing (7) from the outside.
5. Install the inboard bearing cone (9).
6. Apply Loc-Tite to pinion shaft and locknut.
7. Install the bearing lockwasher (34) then the bearing locknut (35). Torque locknut to 100 Ft. Lbs. Loosen and rotate pinion 90 degrees, re-torque locknut to 100 Ft. Lbs. (repeat this process 4 times) then re-tighten locknut to 100 Ft. Lbs. If the locknut is between tabs on the lockwasher always tighten until tabs align with slots in locknut. Secure locknut by bending tabs on lockwasher so that it engages locknut to prevent locknut from backing off. NOTE: Install a 5/8-11 bolt into the end of the pinion shaft on the outboard side and check the rolling torque. Preload of the bearing torque should be 75-85 In. Lbs.
8. Install the output carrier (10) into the gear housing (7). Install sun gear (11) and then the race (12) into output carrier (10).
9. Install the input carrier section (13) with race (12).
10. Assemble the brake section by first installing the o-ring (14) on the brake housing (15). Install eight capscrews (18) to the brake housing (15) and torque to 10 ft. lbs. NOTE: Notice the position of the brake port in conjunction with the drain and fill holes in the housing.
11. If applicable install piston (36) into brake housing (15). NOTE: Apply a slight film of oil on the o-rings and back-up rings before installation.
12. Insert the brake driver (27) into the assembled brake housing (15).
13. Install the stator plates (19) and friction disks (20) starting with one stator plate and alternating between friction disk and stator plate until six stator plates and five friction disks are used. NOTE: Soak friction disk in EP-90 oil before installation.
14. Carefully press the assembled piston (25) into the brake housing (15), taking care not to damage the o-rings. NOTE: Notice the position of the dowel pin hole in piston with the brake release port for correct assembly.
15. Install six springs (33) into the holes in the piston (25).
16. Mount the motor adapter (30) to the brake housing (15) with eight capscrews (32) checking to make sure the roll pin (26) is in line with the dowel hole in piston (25). NOTE: Notice the position of the motor mounting hole in relation to the brake release port for correct re-assembly.
17. Mount the motor to the adapter (30).
18. Fill the gearbox to desired level with EP-90 gear lube.

5200S

1	1	43379	SHAFT, OUTPUT, PINION
2	1	43382	SEAL, OIL
3	1	34773	CONE, BEARING
4	1	34772	CUP, BEARING
5	1	13050	BREATHER
6	1	42752	ADAPTER
7	1	43378	HOUSING, GEAR
8	1	43381	CUP, BEARING
9	1	43380	CONE, BEARING
10	1	4171	GEAR SET, OUTPUT
11	1	42303	GEAR, SUN, OUTPUT
12	2	41722	RACE
13	1	4170	GEAR SET, INPUT
14	1	939452	O-RING
15	1	42680	HOUSING, BRAKE
16	1	21128	FITTING, GREASE ZERK
17	1	939487	PLUG, O-RING
18	8	20522	CAPSCREW
19	6	42111	PLATE, STATOR
20	5	33564	DISC, FRICTION
21	1	42675	RING, BACK-UP
22	1	42672	O-RING
23	1	32186	O-RING
24	1	42337	RING, BACK-UP
25	1	42897	PISTON, BRAKE
26	1	27590	PIN
27	1	42683	DRIVER, BRAKE
28	1	41994	RING, RETAINING
29	1	33094	O-RING
30	1	42682	COVER, BRAKE
31	1	42392	PLUG, O-RING
32	8	939261	CAPSCREW
33	6	41718	SPRING, BRAKE
34	1	42333	LOCKWASHER, BEARING
35	1	42332	LOCKNUT, BEARING

PART NO. TAKEN FROM 81631

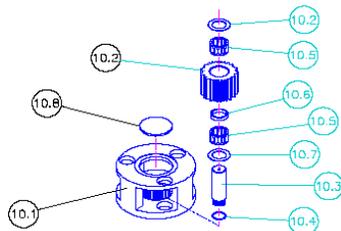
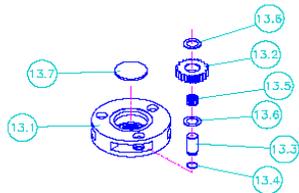


GEAR SET (ITEM 13 ABOVE)

13.1	1	42323	CARRIER, INPUT
13.2	3	42304	GEAR, PLANET, INPUT
13.3	3	41760	PIN, PLANET
13.4	3	41715	RING, RETAINING
13.5	3	30484	BEARING, NEEDLE
13.6	6	28771	RACE
13.7	1	41769	PLATE

GEAR SET (ITEM 10 ABOVE)

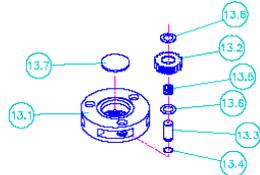
10.1	1	42324	CARRIER, OUTPUT
10.2	3	42306	GEAR, PLANET
10.3	3	41747	PIN, PLANET
10.4	3	41716	RING, RETAINING
10.5	6	41717	BEARING
10.6	3	41739	SPACER
10.7	6	939249	RACE
10.8	1	41769	PLATE



6000S

1	1	42796	SHAFT, OUTPUT, PINION
2	1	42330	SEAL, OIL
3	1	42329	CONE, BEARING
4	1	34771	CUP, BEARING
5	2	13050	BREATHER
6	2	12208	BUSHING, PIPE
7	1	42857	HOUSING, GEAR
8	1	33115	CUP, BEARING
9	1	42331	CONE, BEARING
10	1	4171	GEAR SET, OUTPUT
11	1	42303	GEAR, SUN, OUTPUT
12	2	41722	RACE
13	1	4170	GEAR SET, INPUT
14	1	939452	O-RING
15	1	42897	HOUSING, BRAKE
16	1	42305	GEAR, SUN, INPUT
17	0	OMIT	OMIT
18	8	939261	CAPSCREW
19	6	42148	PLATE, STATDR
20	4	32765	DISC, FRICTION
21	1	42336	RING, BACK-UP
22	1	42335	O-RING
23	1	32186	O-RING
24	1	42337	RING, BACK-UP
25	1	42307	PISTON, BRAKE
26	1	28043	RING, RETAINING
27	1	42327	DRIVER, BRAKE
28	1	41984	RING, RETAINING
29	1	33094	O-RING
30	1	42712	COVER, BRAKE
31	2	939487	PLUG, D-RING
32	8	30076	CAPSCREW
33	6	41718	SPRING, BRAKE
34	1	42333	LOCKWASHER, BEARING
35	1	42332	LOCKNUT, BEARING
36	1	42896	PISTON, BRAKE
37	0	OMIT	OMIT
38	0	OMIT	OMIT
39	0	OMIT	OMIT
40	0	OMIT	OMIT
41	1	42632	BEARING
42	1	11637	SEAL, OIL

PART NO. TAKEN FROM B1459

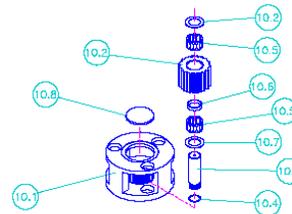
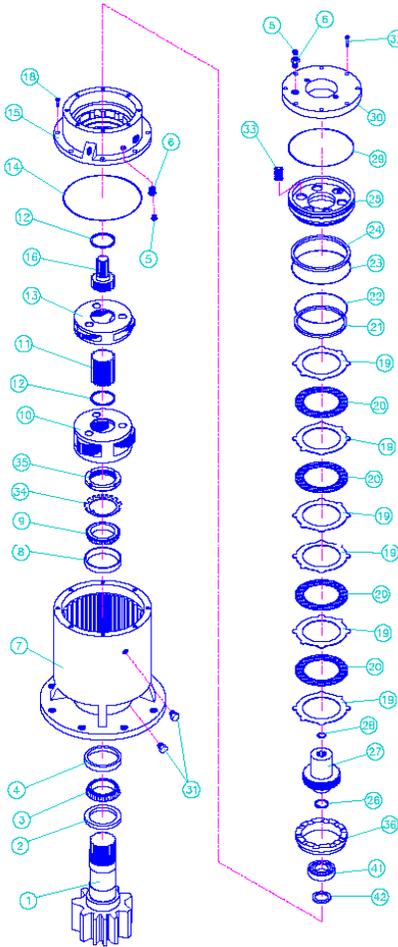


GEAR SET (ITEM 13 ABOVE)

13.1	1	42323	CARRIER, INPUT
13.2	3	42304	GEAR, PLANET, INPUT
13.3	3	41760	PIN, PLANET
13.4	3	41715	RING, RETAINING
13.5	3	30484	BEARING, NEEDLE
13.6	6	28771	RACE
13.7	1	41769	PLATE

GEAR SET (ITEM 10 ABOVE)

10.1	1	42324	CARRIER, OUTPUT
10.2	3	42306	GEAR, PLANET
10.3	3	41747	PIN, PLANET
10.4	3	41716	RING, RETAINING
10.5	6	41717	BEARING
10.6	3	41738	SPACER
10.7	6	939249	RACE
10.8	1	41769	PLATE



4.3 LMI Setup and Operator's Manual – Greer MicroGuard 586

GREER COMPANY

Crane Systems

MicroGuard® 586

Rated Capacity Indicator/Limiter System



Operation/Setup Manual

GREER Company
1918 East Glenwood Place
Santa Ana CA 92705

MicroGuard® 586 Operation/Setup Manual
W458200 REV C 10/29/02

Overview

The MicroGuard[®] 586 Rated Capacity Indicator/Limiter System is an electronic system used in the operation of small cranes and boom trucks. The system is designed to provide the crane operator with information to aid in ensuring safe crane operation. The MicroGuard[®] 586 System is simple to operate. This manual describes the system and its operation.

PROVIDING THE CONTENTS AND INSTRUCTIONS CONTAINED WITHIN THIS MANUAL ARE CAREFULLY READ, UNDERSTOOD, AND FOLLOWED, THE OPERATOR WILL HAVE A CLEAR INDICATION OF RATED CAPACITY, APPROACH TO OVERLOAD, AND TWO-BLOCK CONDITIONS; HOWEVER, IMPROPER INSTALLATION OF THIS SYSTEM CAN RESULT IN SYSTEM MALFUNCTION!



The MicroGuard[®] 586 System is designed for use as an aid to crane operation. Do not use this system as a substitute for the experienced crane operator who has been trained in crane operation and related safety guidelines, or for crane capacity information and guidelines supplied by the crane manufacturer.

MicroGuard® 586
Rated Capacity Indicator/Limiter System
Operation/Setup Manual

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System Description

The MicroGuard[®] 586 Rated Capacity Indicator/Limiter System is a visual and audible alert system used in the operation of industrial cranes. The System, which includes a computer, an operator's display console, an extension reel, and various types of cables and sensors, is designed to measure and display load weight, calculate and display maximum capacity and percent rated capacity, display code configuration numbers, and warn of an approaching overload or two-block condition for each crane configuration.

Please refer to pages 6 and 7 of this manual. The **computer (L)** provides all of the functions necessary to read the System sensors, work out computations, and control the disconnect functions. In order to reliably calculate crane parameters, such as load and rated capacity, and interpret the crane capacity chart and code configuration numbers, information defining the physical characteristics of the crane has been loaded during factory setup.

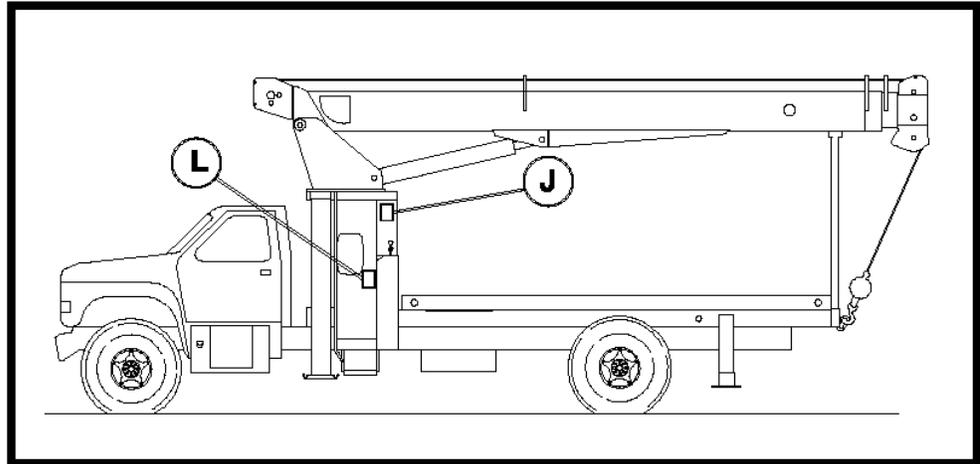
Two **hydraulic pressure sensors**, housed in the computer, measure the pressure in both sides of the boom hoist cylinder. Other System sensors, mounted elsewhere on the crane, are connected to the computer via electrical cables.

The **extension reel (P)** measures the extended length of the telescoping sections of the boom and enables calculation of crane radius, load weight, and percent rated capacity. The **reel-off cable (M)** provides a path, from the boom head to the computer via the **extension reel computer cable (R)**. This path is used to signal a possible two-block condition. The **boom angle sensor (N)** measures the angle of the boom.

The **operator's display console (J)** translates data received from the computer and displays the actual load weight and percent of rated capacity in the **display console** windows. Visual and audible warnings and alarms activate when capacity limits are approached or exceeded, or when a two-block condition is encountered.

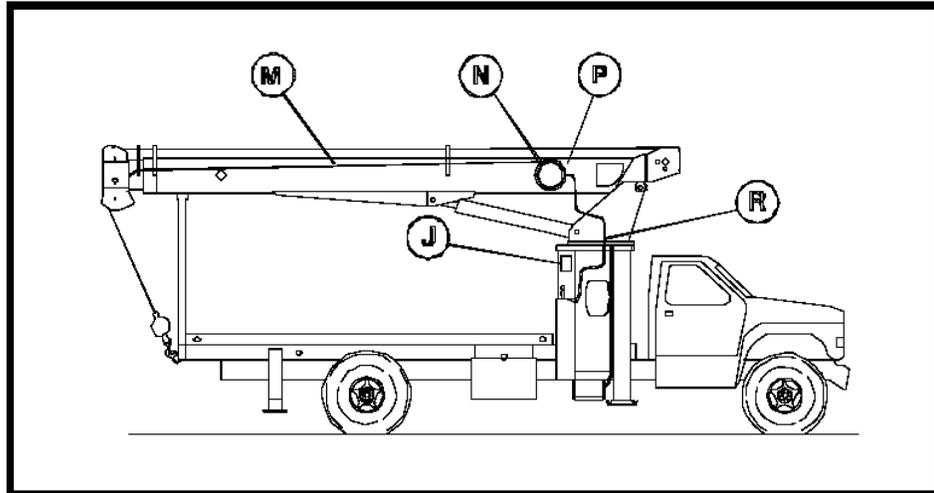
This manual describes the system components and the operation of the System; it also includes maintenance recommendations.

**The MicroGuard[®] 586
Rated Capacity Indicator/ Limiter System**



L Computer with Hydraulic Pressure Sensors inside **J** Operator's Display Console

**The MicroGuard® 586
Rated Capacity Indicator/Limiter System**



J Operator's Display Console
(standard location)

M Reel-Off Cable to Boom Head

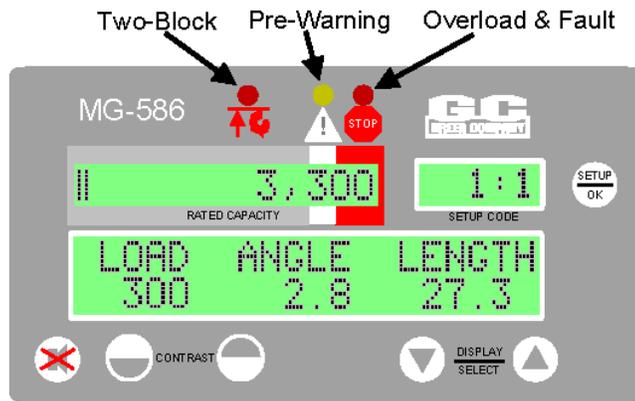
N Boom Angle Sensor (inside reel)

P Extension Reel

R Extension Reel Cable to
Computer

Operator's Display Console - Overview

Warning/Alarm Indications

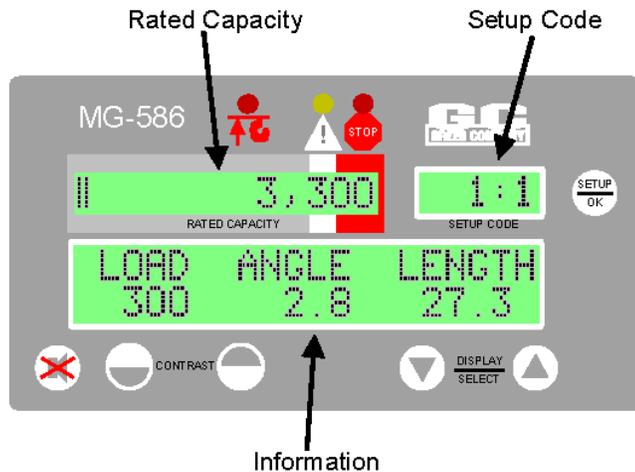


The red two-block indicator will light up when a two-block condition occurs.

The yellow pre-warning light will illuminate at a 90% approach to overload.

The red overload warning lamp will illuminate when the load reaches or exceeds 100% of the allowed capacity.

Display Windows



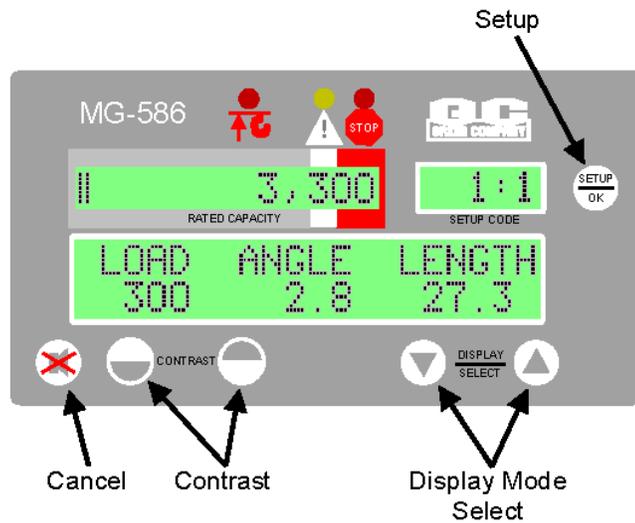
The current rated capacity for the crane in the given configuration will be displayed in this window along with the current percentage of rated capacity shown as a bar graph.

The system needs to be configured to match the current setup of the crane.

The setup codes are shown in this window, along with the parts-of-line and the stowed jib option (if available).

The information window shows crane specific information regarding boom length, boom angle, and working radius, along with the load on hook. In addition, information regarding any warnings or alarms will be flashed in this display area.

Push Buttons



The **setup button** allows the operator to configure the system to match the actual setup of the crane.

Codes are present for:

- stowed jib attachments.
If no stowed options are available, this code will not appear.
- crane configuration.
- number of parts-of-line.

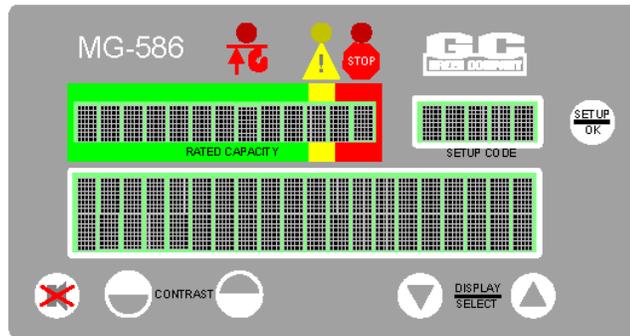
The **cancel key** is used to cancel the audible warning and to override the function kickout during alarm conditions.

The **contrast keys** are used to adjust the contrast of the display area.

The **display mode keys** are used to switch to different display formats showing various combinations of boom angle, boom length, and radius.

System Operation

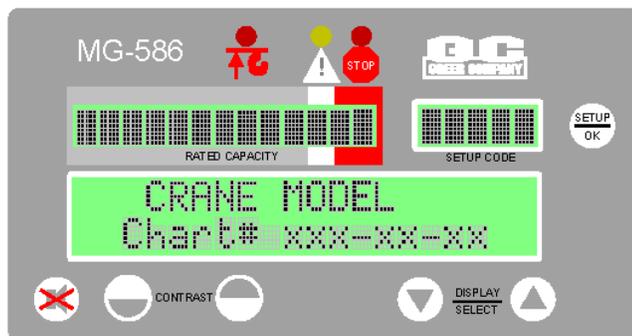
System Self-Test



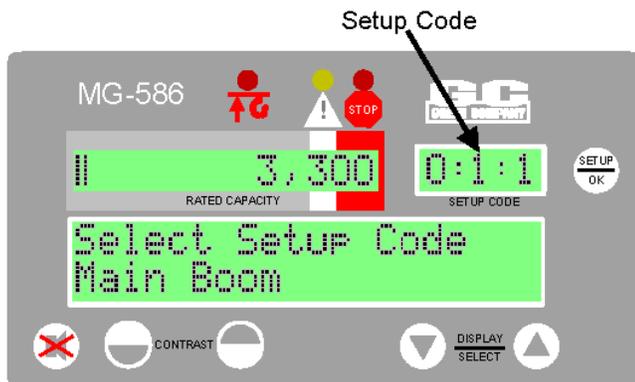
When the System is turned on, it briefly goes through a self-testing process.

The display should look like the illustration to the left.

All three alarm indicators will light up, all display windows will appear black, and the audible alarm will sound.



The information display will now show the crane model and capacity chart number for the System configured.

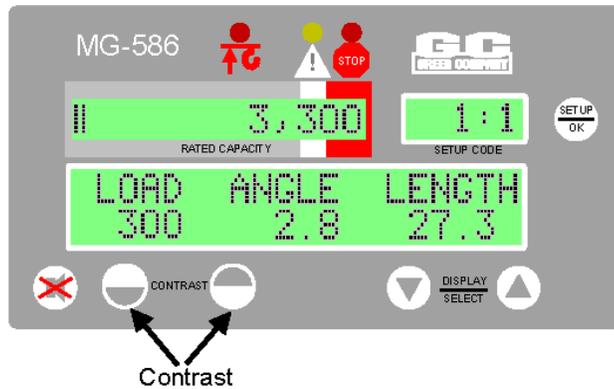


Following self-test, the System will go into the setup mode. The setup code window will display the same setup code used when the system was last powered off.

Check that the correct setup code is displayed before operating the crane.

See the Configuration Selection section for code setup instructions.

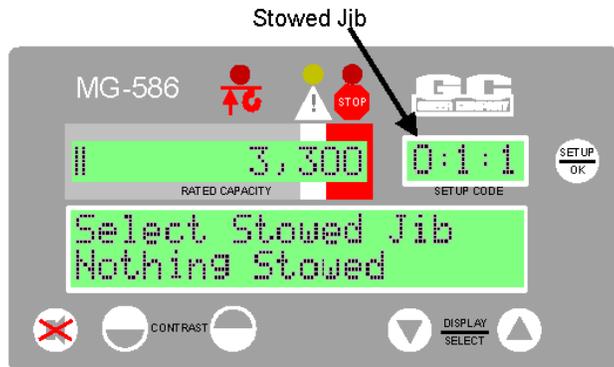
Adjusting Display Contrast



Changes in temperature and lighting conditions may require adjustment of the display contrast buttons.

Use the contrast adjustment keys to make the display area lighter or darker, as desired.

Configuration Selection



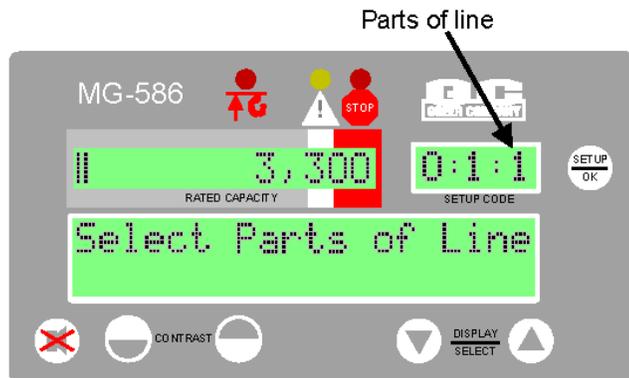
Configuration selection is required upon system power up; however, it can also be entered by pressing the setup key.

- The first phase allows selection of the stowed jib code.
 - Note:** If no stowed jib options are available, this selection option is skipped.
- The current stowed jib code will be flashing. The description of the jib is displayed on the bottom of the display.
- To select a different stowed jib, use the display select arrow keys to display the desired option.
- Press the setup key to move to the next stage.

The current configuration appears at the bottom of the display.

The configuration code will flash.

- To change the configuration code, use the display select arrows to show the desired option.
- Press the setup key to select and move on to the next stage.



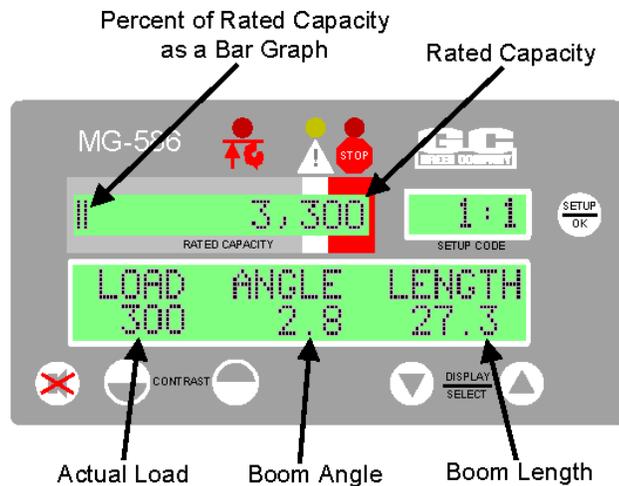
- The current number of parts-of-line is now flashing.
- To change the parts-of-line, use the display select arrow keys to display the desired number.
- To move to the next stage, press the setup key.

Note: Some configurations allow only single part-of-line operation.

In these cases, the whole parts-of-line selection phase will be skipped and the parts-of-line will be set to 1.

Once the correct parts-of-line are entered, the system will exit the configuration mode and return to the normal working screen.

Normal Operation



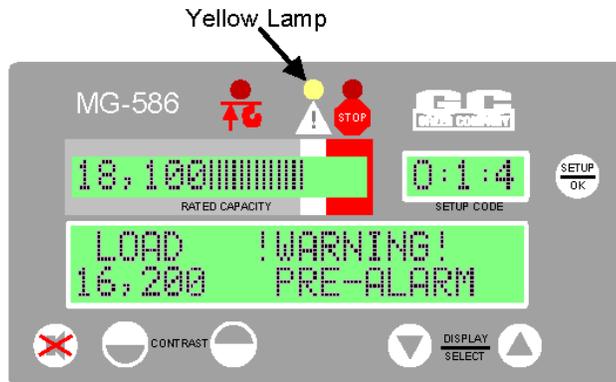
- **"Rated Capacity"** is the heaviest load that the crane can lift in the current crane position and configuration. **Note:** This value may be limited by the number of parts-of-line selected.
- **"Percent of Rated Capacity"** indicates how near the operation is to full capacity and overload.
- The **Percent of Rated Capacity** is shown as a **bar graph**. This Bar Graph progresses to the right as the percentage increases.
- As long as the bar graph remains within the green-bordered normal zone, the Percent of Rated Capacity is within normal operating limits.

- The **weight** of the **"actual load"** appears in the display console window underneath the "LOAD" logo. The Actual Load includes the weight of the load plus the weight of everything hanging below the boom (hook block, etc.).
- Next to the "LOAD" logo is the "ANGLE" or "RADIUS" logo; this logo will switch **automatically** to match the current configuration (whether angle or radius related). The corresponding angle or radius value is displayed underneath on the bottom line.
- The final display logo will show "ANGLE", "RADIUS" or "LENGTH" by default. When operating, this display area will display "LENGTH". However, the display select arrow keys can be used to toggle this display area to show "ANGLE" (for a radius related configuration) or "RADIUS" (for an angle related configuration).
- If the system has any internal faults, it will display a fault message (see section on faults). These fault messages can be viewed by using the display select arrow keys to move to the fault message display. **Note:** If there are no faults, no fault messages will appear.

Note: Both the bar graph and capacity share the same display window. The displayed capacity will move to the left of the bar graph when the bars value exceeds 60%.

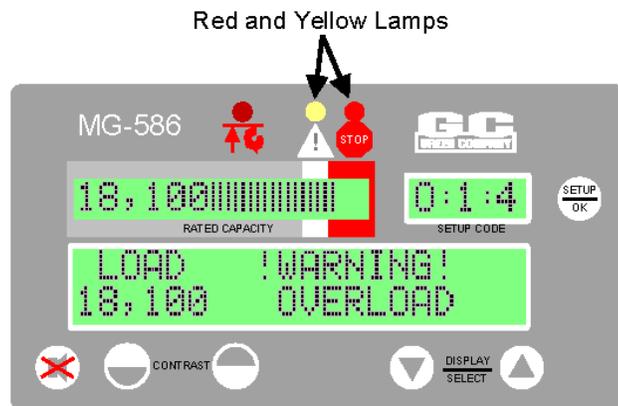
Warning: The operator **must** select the correct crane configuration code number for each setup configuration change. Inaccurate or non-selection of the appropriate Code Number will result in incorrect calculations and readings of the **actual load weight** and **Percent of Rated Capacity**. Refer to Configuration Selection, page 12.

Approaching Overload



- The System monitors the weight of the load suspended below the boom head. The System compares this information with rated capacity data stored within the computer.
- When the rated capacity of the configuration reaches 90%, the **bar graph** in the window of the display console progresses from the normal (green-bordered) zone into the caution (yellow-bordered) zone.
- A **yellow light** above the caution zone of the bar graph lights up and an alarm beeps continuously.
- The message **“WARNING! – PRE-ALARM”** will flash in the information portion of the screen.

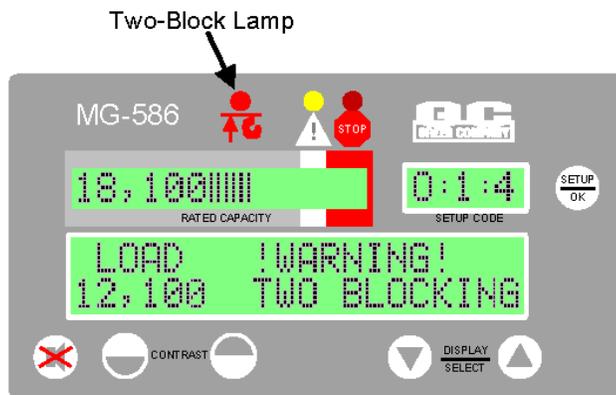
Maximum Capacity and Overload



- When the rated capacity of the crane reaches 100%, the **bar graph** in the window of the display console moves from the caution (yellow-bordered) zone into the warning red zone.
- A **red light** above the alarm zone of the bar graph lights up and an alarm sounds continuously.
- **Crane motions** (boom extend, boom down, and winch up) are cut in order to prevent damage to the crane and the endangerment of persons near the lifting area.
- As the **bar graph** moves into the overload (red-bordered) zone, crane motions remain cut.

The message, “**WARNING! – OVERLOAD**” will flash in the information portion of the screen.

Two-Block Warning



- A **red light** appears and an alarm sounds continuously when the hook block is on a collision course with the head machinery at the end of the boom.
- Crane motions (boom extend, boom down, and winch up) are cut in order to prevent damage to the crane and the endangerment of persons near the lifting area.

The message, **"WARNING! TWO BLOCKING"** will appear in the information area of the display.

Alarm Override



Cancel

The **alarm override button** is used to temporarily silence the **current** audible alarms and to disable the automatic motion cutout operation built into the System for protection.

The audible alarm will sound following any new occurrence of alarm. Overriding the audible alarm only cancels the audible warning for current alarms.

To deactivate the audible alarms, press the override button. Continue to hold the button down for 5 seconds to cancel any existing motion cuts. The override button must be held down to continue overriding the motion cut.



The alarm override button should be used with caution. Automatic audible alarms warning against overload, two-block dangers, and hazardous tipping conditions are temporarily silenced when this option is activated. Motion cutout may also be discontinued.

Other Displayed Warnings

Other warning messages that may flash on the display are shown below. If more than one warning is present at any one time, the system will display them in a strict rotation.

"MAX LOAD ROPE LIMITED"

This message can only accompany an overload or a pre-alarm warning. For example, such a message will be displayed if the maximum operational capacity of the crane is being limited by the number of parts-of-line.

"OPERATING OUTSIDE CHART"

On certain capacity charts stored within the system, additional capacities may have been provided in order to allow crane movements in areas outside of the published capacity charts supplied with the crane. These capacities are determined by the manufacturer of the crane to be sufficient to allow movements during rigging, erection, and setup of the machine prior or subsequent to lifting operations. In such areas, the system displays a warning message, a yellow pre-warning light.

System Care

We recommend that the System checks (1 -9) be carried out when using the MicroGuard® 586 Rated Capacity Indicator/Limiter System.

1 Routine Checks and Maintenance

Items to Check before Each Shift or Crane Operation

- Crane configuration and System setup
- Extension reel – reel-off cable to boom tip – Extension reel cable to computer
- Hydraulic connections
- The anti-two-block weight
- The anti-two-block switch
- Checking the two-block warning signals and cutout of machine motions

MINIMUM MONTHLY CHECKS

- Load test

2 Routine Checks and Maintenance

Crane Configuration and System Setup

The **crane configuration** defines the physical setup of the crane. The **system setup** defines the load parameters for each configuration. The data for these calculations are loaded in the **capacity chart** and installed in the crane's computer prior to factory shipment.



ENSURE THAT THE **CONFIGURATION CODE NUMBER** IN THE DISPLAY CONSOLE WINDOW IDENTIFIES THE **CRANE'S CONFIGURATION** FOR THE CURRENT OPERATION. IF IN DOUBT, SELECT THE CODE NUMBER AGAIN FOLLOWING THE STEPS OUTLINED IN THE SECTION ON **CRANE OPTIONS AND SETUP CODES**.

CHECK THE ABOVE OPERATIONS BEFORE EACH SHIFT OR CRANE OPERATION

3 Routine Checks and Maintenance

Extension Reel

The extension reel houses the reel-off cable to the boom tip, a cable from the extension reel to the computer, and the boom angle sensor. The extension reel **provides the following signals** that are sent directly to the computer via the extension reel computer cable.

- **Boom Extension Signal** – generated within the extension reel, and controlled by the reel-off cable, as the boom is extended or retracted. The extension reel measures the boom extension and provides a signal, which enables the computer to calculate the operating radius of the crane, the weight of the actual load, and the percent of rated capacity.
- **Two-Block Signal** – transmitted from the boom head, through the reel-off cable, to the extension reel and the extension reel cable to the computer. This signal becomes active when the anti-two-block switch opens, indicating a two-block condition. When this signal reaches the computer, it causes an immediate display of a flashing light and an audible alarm on the operator's display console, and the motion cutouts are activated.
- **Boom Angle Signal** – is generated within the extension reel, and designed to measure the angle of the boom relative to the horizon.

4 Routine Checks and Maintenance

Reel-Off Cable

The reel-off cable (extension cable) extends from the extension reel to the boom tip. The reel-off cable provides an electrical path for passage of the two-block warning signal from the boom tip to the computer cable in the extension reel.

Check Points:

- Carefully examine the reel-off cable for damage.
- Fully telescope the boom in and out. As you extend or retract the boom, ensure that the reel-off cable is smoothly fed on and off the extension reel without drooping along the boom or jumping, especially as the boom is telescoped in.



The extension reel extension setting is factory preset. If the reel-off cable has been broken, call your Service Representative. Do not attempt to repair a break in the reel-off cable without consulting with your Service Representative.

Computer Cable

The extension reel cable to the computer acts as a channel for passage of signals to the System computer.

Check Points:

- Ensure that the cable exiting from the extension reel and running down the boom and around its pivot to the computer is free from damage. If this cable has been **damaged in any way**, it should be carefully tested and may need to be replaced to ensure accurate transmission of signals.

CHECK THE ABOVE OPERATIONS BEFORE EACH SHIFT OR CRANE OPERATION

5 Routine Checks and Maintenance

Hydraulic Connections

The two hydraulic pressure sensors, mounted in the computer, measure the pressure within each side of the boom hoist cylinder. The pressure sensors are connected to the boom hoist cylinder valve block by two flexible hoses. Both hoses are subject to the full hydraulic pressure contained within the upper and lower sides of the boom hoist cylinder.

Check Point:

- Ensure that there are no hydraulic leaks at either connection end of both hoses. Check for signs of wear or damage along the length of each hose.

6 Routine Checks and Maintenance

The Anti-Two-Block Weight

Check Points:

- Ensure that the anti-two-block weight and its parts are undamaged, in proper position, and correctly connected.
- Check the chain on the anti-two-block weight for damage and stress, ensuring that there are no open links in the chain.
- Ensure that the chain is securely attached with screw pin and shackle to the narrow vertical connector projecting from the base of the anti-two-block switch.
- Ensure that the anti-two-block weight has been installed around one part of the load line.

7 Routine Checks and Maintenance

The Anti-Two-Block Switch

Checkpoints:

- Ensure that the anti-two-block switch is secure on its mounting post with safety pin inserted through the end of the mounting post and locked into position.
- Ensure that the switch cable is secured to the strain relief thimble and that the thimble is on the mounting post **behind** the switch.
- Ensure that all electrical cables and connectors are free from damage and correctly connected.
See anti-two-block switch installation.

CHECK THE ABOVE OPERATIONS BEFORE EACH SHIFT OR CRANE OPERATION

8 Routine Checks and Maintenance

Checking the Two-Block Warning Signals and Cutout of Machine Motions

The following test activates the anti-two-block warning signals and the valve controlling cut out of crane motions to ensure proper operation. **No other pre-existing alarm conditions may be active when performing this test.**



1. Before performing this test, turn the crane power off and then on again to ensure that an existing two-block warning and/or motion cut has not been overridden.
2. During this test, **do not** use the cancel alarm button to clear audible warnings or motion cuts.
3. During this test, **do not** winch the hook block into the boom tip, in case the System does not cut the crane motions.

TEST FOR OPERATION OF TWO-BLOCK WARNINGS AND CUTOUT OF CRANE MOTIONS

1. Slowly raise the hook block until it lifts the anti-two-block weight and deactivates the anti-two-block switch.
NOTE: This action should cut out the *winch up* motion as well as the *boom down*, and *boom extend* motions. Audible and visual alarms on the operator's display console should become active.
2. Lower the hook block by winching down.
NOTE: This action should disable the audible and visual alarms on the operator's display console and activate the boom motions.



CHECK THE ABOVE OPERATIONS BEFORE EACH SHIFT OR CRANE OPERATION.

9 Routine Checks and Maintenance

Load Test

The best way to identify a possible problem in the System is to do a **load test**. The accuracy of the **load test** is dependent upon accurate operation of all of the sensors in the System and the correct **code number** setting for the configuration of the crane.

If no stowed deduct configuration is provided by the system, perform this test with stowed attachments removed.

It is recommended that a load test be performed monthly.



Ensure that the **configuration code number** in the display console window identifies the **crane configuration** for the current operation. If in doubt, select the Code Number again following the steps outlined in the **CRANE OPTIONS AND SETUP CODES**.

Load Test Steps

1. Select a known weight of at least 20% of maximum rated capacity.
2. Calculate the weight of the total load, including the slings and hook block.
3. Lift the weight, and record the load weight displayed on the MicroGuard[®] 586 operator's display console. The load weight on the console should be between 0 to 10% higher than the load that was lifted.

EXAMPLE:

When lifting 5000 lbs., the display console window should read between 5000 and 5500 lbs.



A load reading on the MicroGuard[®] 586 Operator's Display Console that falls outside of a 10% range may indicate a sensor problem. Call your Service Representative.

MINIMUM SIX MONTHLY CHECK

Faults

System Fault Messages

When the MicroGuard® 586 System detects a fault, the red warning lamp will illuminate and the message, "WARNING: SYSTEM FAULT" will flash on the display. When a more serious fault is detected, the message, "WARNING: SYSTEM OUT OF SERVICE" may flash.

To determine the nature of the problem, press the UP or DOWN arrow key once or twice, which will change the display mode and exhibit the related fault message. This message will appear for up to 20 seconds before the display returns to the normal display mode. If the UP or DOWN arrow key is pressed before the 20 seconds have elapsed, the display will also automatically return to the normal display mode.

Fault messages that can appear on the display and the required corrective action follow:

1. Reselect Crane Setup

This message indicates that there is an error in the CRANE SETUP selection, or there is an internal computer fault. Reselect the correct Crane Setup Code; the error should correct itself.

If not, replace the computer, as described in *Replace the Computer* on the next page.

2. Check Extension

This message indicates a problem with the boom extension sensor.

- a. Inspect/check cabling and connections from computer to extension reel on the side of the boom.
- b. Inspect/check the extension reel-off cable for damage.
- c. Follow *Boom Extension Sensor Zero* and *Boom Length Trim* sections (pages 38 and 39) of this manual.
- d. Remove the extension reel cover and use the *Extension Reel Voltage Checks* section (page 29) in this manual to verify operation of the extension reel.

3. Check Angle

This message indicates a problem with the boom angle sensor.

- a. Inspect/check cabling and connections from computer to extension reel on the side of the boom.
- b. Follow the *Boom Angle Sensor Zero* section (page 37) in this manual.
- c. Remove the extension reel cover and use the *Extension Reel Voltage Checks* section (page 29) in this manual to verify operation of the extension reel.

4. Check ATB Wiring

This message indicates an Anti Two-Block wiring problem usually due to an electrical short to the boom or a damaged cable.

- a. Inspect/check cabling and connections from computer to extension reel on the side of the boom.
- b. Inspect/check reel-off cable from extension reel to boom tip and Anti Two-Block switch connections.
- c. Refer to the *Extension Reel Voltage Checks* section (page 29) to verify electrical signals for the Two-Block drive and signal within the extension reel.

5. Check FKO

This message indicates a Function Kick-Out wiring problem that is usually caused by a fuse or crane circuit breaker failure. Remove the computer unit lid and check the 10A fuse.

6. Replace System Chip

This message indicates a problem with the System chip fitted inside the computer.

- a. Remove the computer lid and replace the System chip.

Note: Use only proper chip insertion and removal tools to perform this operation.

Never use a screwdriver.

7. Replace the Computer

This message indicates an internal fault in the computer. In some cases, it may not be necessary to replace the computer unit.

- a. Remove the computer unit lid and check the Internal LED status indicators located on the computer circuit board.
- b. Review the *Computer Internal Status Indicators* section (page 30) in this manual.

To replace the computer unit:

- *Place the boom in its rest.*
- *Turn off electrical power.*
- *Disconnect all electrical connectors from/to the computer.*
- *Disconnect hydraulic hose connections from/to the computer.*
- *Remove computer from mounting.*

Note: The hydraulic hoses connect directly to the boom hoist cylinder. Do not operate the crane unless the computer has been properly replaced or the hydraulic connections are properly capped.

To fit a new computer unit:

- Mount the computer unit.
- Ensure that a new system chip has been supplied with the computer.
Note: Do not use the system chip from the original computer unit.
- Ensure that all electrical power is turned off.
- Connect all electrical connectors to the computer unit.
- Connect hydraulic hoses to the computer pressure ports.
(*Green* is base-side and *red* is rod-side of the boom hoist cylinder.)
- Follow the System setup instructions in this manual.

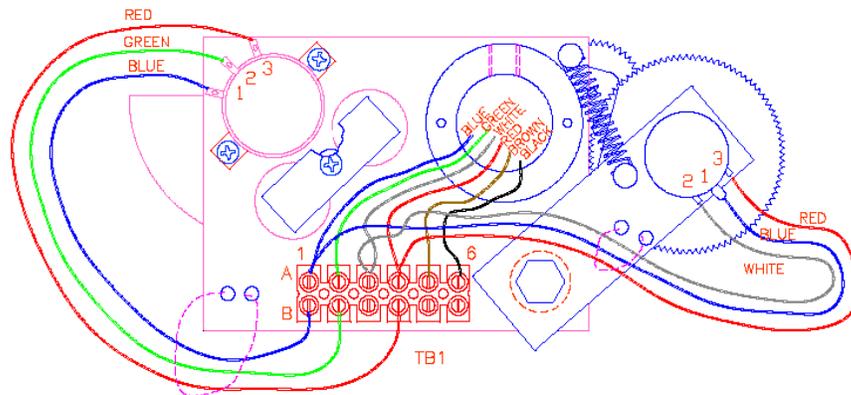
Note: If more than one fault is present, the most serious fault will appear first and must be resolved first. When the first fault is corrected, other existing faults will be displayed and must be resolved one at a time until no further fault codes are listed.

Fault messages should be reported to the Service Representative along with any noticeable damage done during System installation or routine checks. Please refer to Routine Checks and Maintenance in this manual.

Extension Reel Voltage Checks

If problems occur with the Two-Block alarm operation, Angle, or Extension sensor, the following chart details voltage checks that may be made within the extension reel. Follow the action column before measuring voltages at the specified points in the voltmeter connection columns.

SIGNAL	BOOM POSITION / ACTION	VOLTAGE		VOLTMETER CONNECTION	
		MIN	MAX	RED (+)	BLACK (-)
SENSOR DRIVE	-	+4.7V	+5.3V	TB1/4 - RED	TB1/1 - BLUE
ANGLE SENSOR OUTPUT	0 Degrees	0.4V	0.6V	TB1/2 - GREEN	TB1/1 - BLUE
EXT'N SENSOR OUTPUT	0ft (0m) FULLY RETRACTED	0.15V	0.35V	TB1/3 - WHITE	TB1/1 - BLUE
TWO-BLOCK DRIVE	A2B WEIGHT DOWN	5.5V	7.5V	TB1/6 - BLACK	TB1/1 - BLUE
	A2B WEIGHT UP	9.5V	10.5V	TB1/6 - BLACK	TB1/1 - BLUE
TWO-BLOCK SIGNAL	A2B WEIGHT DOWN	5.5V	7.5V	TB1/5 - BROWN	TB1/1 - BLUE
	A2B WEIGHT UP	0V	2V	TB1/5 - BROWN	TB1/1 - BLUE



Notes:

- ANGLE SENSOR OUTPUT IS SET TO 10% (1/10th) OF SENSOR DRIVE VOLTAGE WITH BOOM AT ZERO DEGREES.
- EXTENSION SENSOR IS SET TO 5% (1/20th) OF SENSOR DRIVE VOLTAGE WITH BOOM FULLY RETRACTED.
- MEASURE ALL VOLTAGES WITH A DIGITAL VOLTMETER SET TO DC VOLTS RANGE.

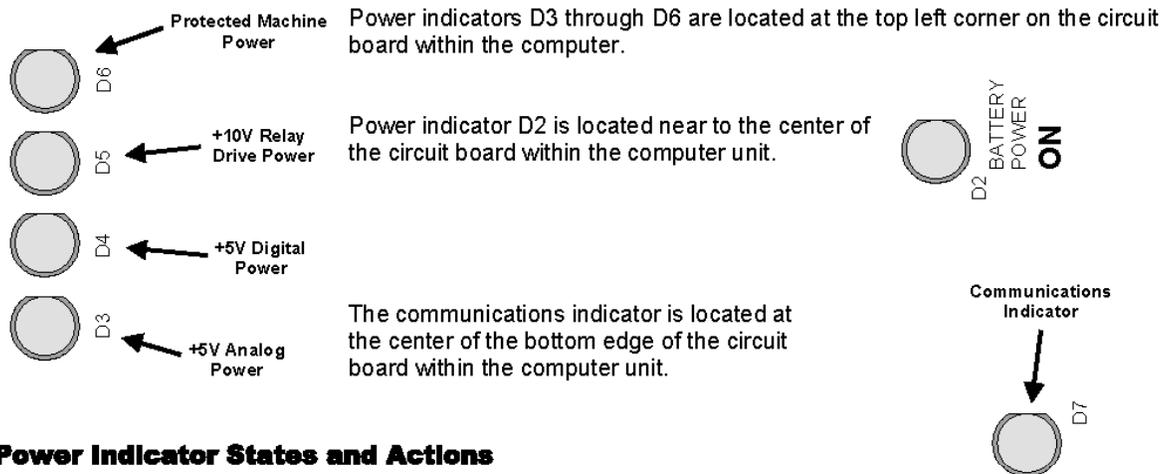
Computer Internal Status Indicators

The computer unit contains six LED indicators that provide an aid to checking presence of power supply voltages and communications between the computer and display console.

All Indicators are bright green light emitting diodes. There are five power indicators (D2 through D6) and one communications indicator (D7).

With the exception of the communications indicator, all indicators should be illuminated at the same brightness level with the system power on.

A missing or dimly lit indicator indicates a power supply problem.



Power Indicator States and Actions

- **All indicators OFF**
Check power and ensure that PTO switch is properly engaged.
- **D2 ON but all other indicators OFF**
Check display console cable and connection.
- **D5 OFF but all other indicators ON**
Replace computer
- **D3, D4 and D7 OFF but all other indicators ON**
Replace computer
- **D3 OFF but all other indicators ON**
Check extension reel signal cable and internal voltages within extension reel.

Communication Indicator

The Communication Indicator provides an indication of the success or otherwise of communication with the display console, and of the running state of the computer program.

Carefully observe the Communication indicator and the display console at power on and through self-test, and then use the following chart to help decide the course of action.

COMMUNICATION INDICATOR Indications at power ON	ACTION
From the moment the system power is applied, the COMM indicator does not illuminate. During and after the self-test period of eight seconds, the COMM indicator remains off.	The computer is not running. Check status indicators (D2 through D6). Try to reset the system by powering off and on again. Listen to the computer for the relays to click. If they do not click, replace the System Chip - If not successful, replace the computer. If the relays do click, replace Communication chips IC1, 2.
From the moment the system power is applied, the COMM indicator does not illuminate. The display console, which never goes to normal, continually reads: "No Communication with MicroGuard."	Communication with the display has not been made. Is the display console connected? Check connector and cabling to the display console.
At the moment power is applied, the COMM indicator flashes briefly, then switches off. After a few seconds, the COMM indicator starts to flash at a fast rate and never stops.	This is the normal operation of the communication between the computer and display console.

Troubleshooting

Start-up Problems

- Display unit lights and alarms are flashing; the computer unit sounds as if it is buzzing.
 - Make sure the PTO is fully engaged.
- During system setup, it is not possible to adjust the angle sensor. The display shows "--".
 - Make sure the extension reel is installed the correct way up.
 - Make sure the extension reel signal cable is correctly connected to the computer unit.
 - Check the extension reel voltages according to the chart on the following page.
- A few seconds after power up, the display shows "No communications with MicroGuard®" in the load display window.
 - Computer is possibly not running.
 - Check that the computer unit has a system program chip fitted.
 - Check that the system program chip is correctly inserted.
 - Check that all LEDs within the computer are lit and that the communications LED (D6) is flashing
 - If not replace system chip.
 - Check the display cable for damage.

System Setup

The MG[®]-586 system contains a setup mode that operates through the system display console. The setup mode provides a means of ensuring that the system sensors are correctly positioned and adjusted following system installation or parts replacement.

This procedure assumes that installation of system components, cabling, and hydraulic connections have been successfully completed and checked.

The setup procedure involves only the sensors mounted within the extension reel on the side of the boom.

It is important that each step of this procedure is properly followed for the system to accurately provide load, rated capacity, warnings, and kickout functions.



At all times, observe safe practices.

Make sure that crane capacity limitations are understood, and that the crane capacity plate is followed. Do not exceed manufacturer's specified lifting limitations.

Required Tools

For Setup:

Phillips Screwdrivers

Bubble Level – Accurate to 0.1° at level

For Testing:

Inclinometer – accurate to 0.2°

Measuring tape (100 ft) – fiber-type with tenths of feet

Crane Configuration

Before starting the system setup, position the crane on firm and level ground with the outriggers properly extended and set.

It is recommended that the crane be configured with no stowed or erected jib (bare boom) and reeved with a single part-of-line.

Accessing the Extension Reel Sensors

Remove the cover from the extension reel by loosening and removing the 12 screws around the perimeter of the cover.

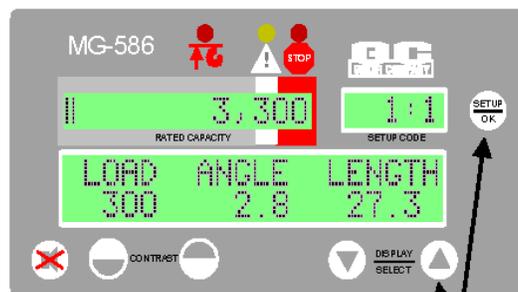
Entering Setup Mode

The display will step through each setup operation, as required by the user. During the setup procedure, the display console should be placed in a position that allows easy viewing while adjustments are being made within the boom extension reel, and allows for operation of the display buttons.

The setup mode is activated by the following procedure:

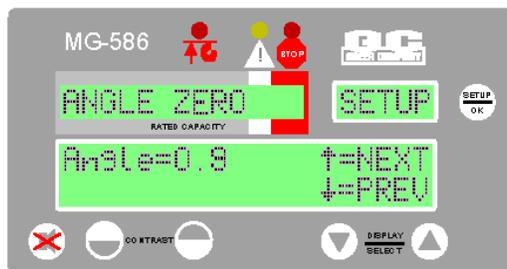


1. Make sure machine power is OFF.
2. Turn ON machine power.
3. During self-test, check that the correct machine model and capacity chart number is displayed on the console.



4. Hold down "Setup" and "up arrow" on the display for 5 seconds at any time to start the self-test.

Setup Mode
Entry



5. Release the buttons.
6. If the display does not indicate SETUP in the SETUP CODE window, check that the System is in the NORMAL-working mode (NOT the configuration mode) with no error codes.

Extension Cable Guides

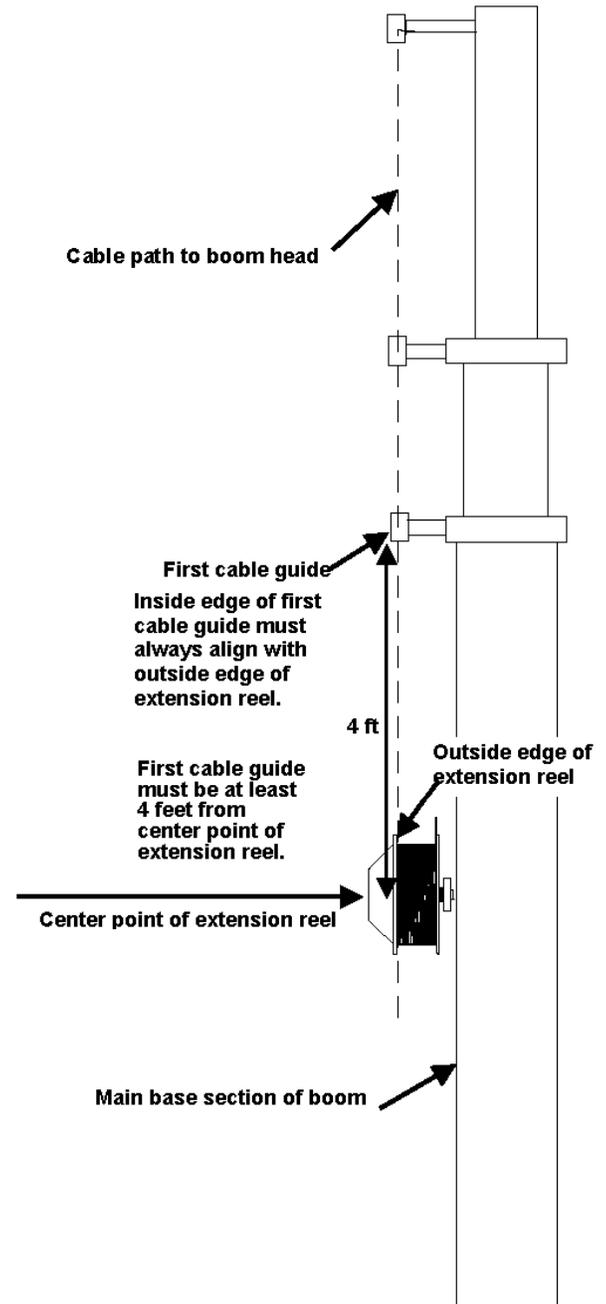
Cable Guides must be used to achieve proper placement of the first roller guide.

Cable Guides maintain the position of the cable, ensuring a controlled path to the boom head.

The distance between the **first** Cable Guide and the Center Point of the Extension Reel must be a **minimum of 4 feet**.

The **inside edge** of the **first** Cable Guide must always align with the **outside edge** of the Extension Reel.

Passage of the cable from the Extension Reel through the Cable Guides to the Tie-Off Post on the boom head may form a straight line parallel to the boom, as shown, or may curve toward the boom depending on the placement of the Cable Guides in the **latter** segments of the crane.



Installing the Reel-Off Cable

Warning: The Reel-Off Cable must be properly pre-tensioned. This procedure keeps the cable taut at all times, with controlled, steady exit from the Extension Reel. Follow the steps below.

Pre-Tension Steps

- 1) Fully retract the boom.
- 2) Slowly rotate the Extension Reel clockwise until a "click" is heard, indicating that the clutch inside the Reel is engaged.
- 3) Turn the Extension Reel counterclockwise for 5 complete rotations.

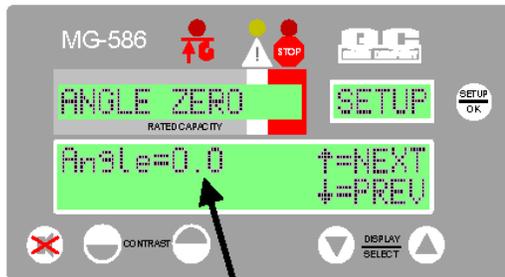
Note: A temporary marker placed on the Extension Reel can facilitate the rotation count.

Pre-Tension is complete.

Boom Angle Sensor Zero

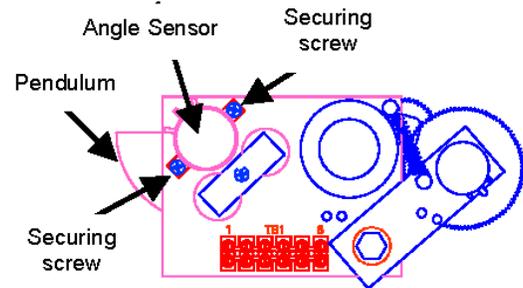
The Boom Angle Sensor is located within the Extension Reel. Remove the extension reel cover by removing all twelve screws in the lid.

The Angle Sensor is factory pre-calibrated and requires no adjustment other than the following mechanical zero setting.



Make sure the boom is perfectly level, then adjust the Angle Sensor inside the Extension Reel to set this reading to "0.0".

1. Fully retract the main boom and use an inclinometer or accurate bubble level to set the boom perfectly level. Make sure that the inclinometer reading is made on the top flat surface of the boom. Take several readings in different places to verify true zero degrees.
2. The console displays the boom angle sensed by the angle sensor inside the extension reel. If the display reads "0.0°," the angle sensor is correctly adjusted. If the display does not read 0.0°, angle sensor adjustment is necessary.



3. To adjust the angle sensor, loosen the two securing screws on either side of the sensor just enough to allow the sensor to be turned by hand. Do not remove the screws and do not put pressure on the terminals exiting the sensor.

Note

Rotating the sensor counterclockwise will increase the angle displayed. Rotating clockwise will reduce the angle displayed. Only fine adjustments are required.

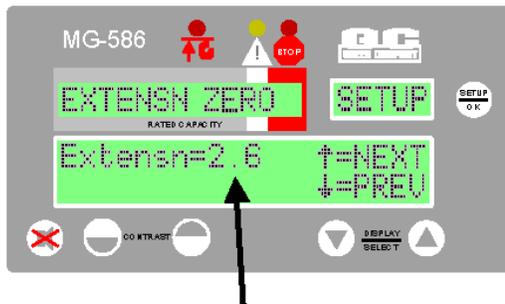
Do not touch the pendulum hanging behind the sensor assembly during adjustment.

4. When 0.0° is showing on the display, carefully tighten the two screws and check that the display still reads 0.0°.
5. Before continuing, it is recommended that the angle be checked against an accurate inclinometer. Boom up to a high angle, and using an inclinometer, check that the displayed angle matches the inclinometer reading within 0.2°.
6. When finished, press ▲ to continue to the next setup step.

Boom Extension Sensor Zero

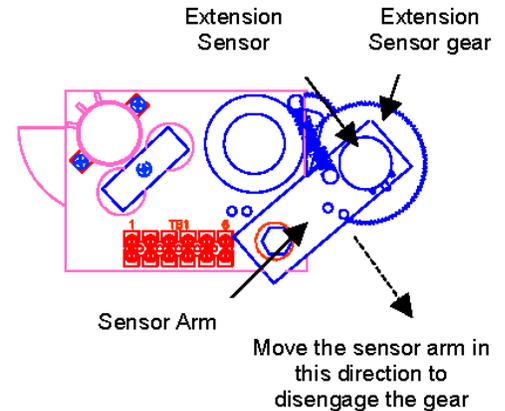
Warning: The EXTENSION SENSOR CLUTCH MUST BE ENGAGED PRIOR TO EXTENSION ZERO ADJUSTMENT (see page 36).

The Extension Sensor must be mechanically adjusted for zero setting. The Boom Extension Sensor is located within the Extension Reel.



Make sure the boom is fully retracted, then adjust the Extension Sensor inside the Extension Reel to set this reading to "0.0".

1. Fully retract the main boom and check that all boom sections are properly retracted.
2. The console displays the boom extension sensed by the extension sensor inside the extension reel. If the display reads "0.0," the extension sensor is correctly adjusted. If the display does not read 0.0°, extension sensor adjustment is necessary.
3. Mechanically adjust the extension sensor clutch until the display reads zero (0.0). To do this, disengage the main gear wheel connected to the extension sensor by pulling the sensor arm in the direction shown.



4. Rotate the gear clockwise until the sensors clutch detent starts to click. At the next click, stop rotating the gear.
5. Rotate the gear back (counterclockwise) about half a turn to set the display to exactly 0.0, then carefully release the sensor arm ensuring the display stays at 0.0 as the gears re-engage.
6. Press ▲ to continue to next setup step.

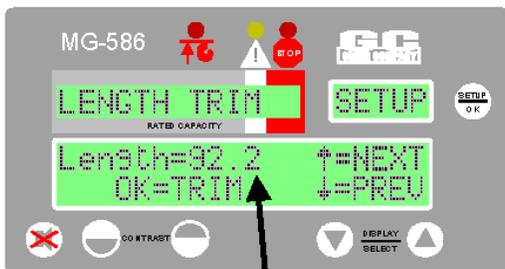
Boom Length Trim

The system is factory pre-calibrated for Extension and Length. A trim function is provided to allow for mechanical tolerances of the Extension Reel drum.

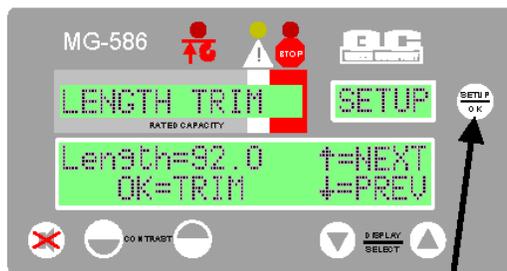
With the boom still fully retracted, check that the displayed length is the same as the specified retracted length for the crane.



With the boom fully retracted, the displayed length should be the same as the specified retracted length for the crane.



With the boom fully extended, the displayed length should be the same as the specified fully extended length for the crane.



To make the length match the specified maximum length of the crane, press OK.

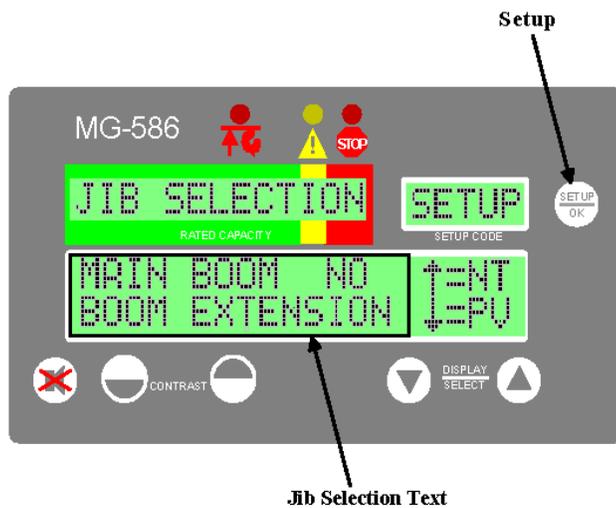
1. Boom up to 60 degrees and then telescope the boom out to fully extended. Make sure that the boom goes out all of the way to fully extended.
2. Check that the displayed length is the same as the specified maximum boom length for the crane.
3. If the displayed length does not match the maximum boom length specified for the crane, press the **SETUP/OK** button. The system will automatically correct the length.
4. If the displayed length does not match the maximum boom length specified for the crane, press the **SETUP/OK** button. The system will automatically correct the length.

Jib Selection Setup (Interlock)

The displayed selection text differs for each model of crane; therefore, the displayed text may not exactly match the text in the images below. For clarification or for more details, please contact the Greer Company.



1. Go to the JIB SELECTION screen.



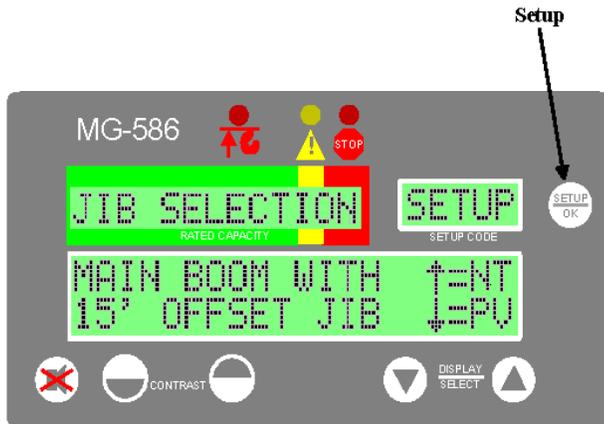
2. Press the SETUP button to activate the Jib Selection Mode. Current jib selection text will flash or blink on the display.

Jib Selection Setup (Interlock) continued



Up and Down Arrow Buttons

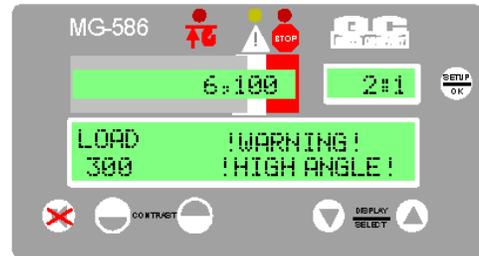
3. Use the UP and DOWN ARROW buttons to scroll through the available jib selections. Stop at the desired jib selection.



4. Press the SETUP button to select and lock-in the new jib selection. As soon as the selection is locked in, the selection text will stop flashing.

Boom Angle Alarm Settings:

The MG586 display is designed to allow for the setting of a Maximum and Minimum boom operating range. This system does not supply function cut out at these alarm points, but instead will warn the operator with a pulsating alarm, and a !WARNING! !HIGH ANGLE! on the screen as in the picture at the right.



The MG586 display must be in the Setup Mode in order to set these alarms. Once in the Setup Mode, you may use the Up Arrow Key to scroll through the menus to get to the High/Low Angle limit screens. When the desired screen is reached, you may enter the adjust mode by pressing the Set Up Button once, and the Limit = "XX" will start blinking slowly and you may change the current setting with the Up/Down arrow keys on the display.

When the desired setting is reached, press the setup button and the limit will be set. To move to the next settable limit, use the Up/Down arrow keys to scroll between the next limit. After setting the next limit, pressing the Up Arrow Key will return the display to the normal operate mode.

Completion

1. *When Setup is complete, press the UP ARROW button to exit the Setup Mode.*
2. *Replace the boom extension reel cover, ensuring that all 12 screws are fitted and evenly tightened.*



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